КАТАЛОГ МИНСК

модуль, igbt, модуль диодный

купить, продажа

Technical specifications

SINAMICS GM150 in IGBT version Air cooling, with sine-wave filter (option Y15)		6SL3810-2LN34-6AA1	6SL3810-2LN35-3AA1	6SL3810-2LN36-0AA0	6SL3810-2LN38-8AA1	6SL3810-2LN41-1AA0
Output voltage 3.3 kV						
Type rating	kVA	2350	2600	2900	4750	5350
Shaft output [1]	kW	1850	2100	2450	3650	4500
	hp	2500	2850	3250	5100	6000
Rated output current	A	410	440	510	830	940
Input voltage	kV	2 × 1.7	2 × 1.7	2 × 1.7	2 × (2 × 1.7)	2 × (2 × 1.7)
Rated input current [1]	A	2 × 347	2 × 417	2 × 453	2 × (2 × 355)	2 × (2 × 420)
Power loss [2]	kW	40	42	49	73	86
Efficiency [2]	%	98.1	98.1	98.1	98.2	98.2
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [3]	A	2.5	2.5	2.5	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [4]	A	33	33	33	66	66
Cooling air flow rate	m^3/s	3	3	3	5.8	5.8
Sound pressure level L_{pA} (1 m)	dB	81	81	81	87	87
Measuring surface level L_s (1 m)	dB	18	18	18	19	19
Cable cross-sections, line-side, max. connectable per phase [5] [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [5] [6]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [5]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP22	IP22	IP22	IP22	IP22
Dimensions [7]						
• Width	mm	3640	3640	3640	6660	6660
• Height	mm	2570	2570	2570	2570	2570
• Depth	mm	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	④	④	④	⑥	⑥
Weight [7]	kg	3350	3350	3500	6500	6500

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Without cooling system

3) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

4) Additional 20 A precharging current for 25 s.

5) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

6) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

7) The specified dimensions and weights include doors, panels and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version Air cooling, with sine-wave filter (option Y15)		6SL3810-2LP31-8AA0	6SL3810-2LP32-2AA0	6SL3810-2LP32-6AA0	6SL3810-2LP33-0AA0	6SL3810-2LP33-5AA0	6SL3810-2LP34-0AA0
Output voltage 4.16 kV							
Type rating	kVA	1100	1350	1600	1850	2100	2450
Shaft output 1)	kW	900	1150	1300	1550	1750	2000
	hp	1250	1500	1750	2000	2250	2750
Rated output current	A	150	190	220	260	290	340
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2
Rated input current 1)	A	2 × 133	2 × 163	2 × 195	2 × 225	2 × 262	2 × 304
Power loss 2)	kW	24	25	29	33	38	41
Efficiency 2)	%	97.5	97.9	97.9	98.0	98.0	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 3)	A	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 4)	A	33	33	33	33	33	33
Cooling air flow rate	m^3/s	3	3	3	3	3	3
Sound pressure level L_{pA} (1 m)	dB	79	79	79	81	81	81
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase 5) 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 5) 6)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 5)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP22	IP22	IP22	IP22	IP22	IP22
Dimensions 7)							
• Width	mm	3640	3640	3640	3640	3640	3640
• Height	mm	2570	2570	2570	2570	2570	2570
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	4	4	4	4	4	4
Weight 7)	kg	3300	3300	3300	3350	3350	3350

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Without cooling system

3) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

4) Additional 20 A precharging current for 25 s.

5) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

6) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

7) The specified dimensions and weights include doors, panels and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version Air cooling, with sine-wave filter (option Y15)		6SL3810-2LP34-6AA1	6SL3810-2LP35-3AA1	6SL3810-2LP36-0AA0	6SL3810-2LP38-8AA1	6SL3810-2LP41-1AA0
Output voltage 4.16 kV						
Type rating	kVA	2950	3250	3600	6000	6650
Shaft output [1]	kW	2400	2600	3000	5100	5500
	hp	3250	3600	4000	6800	7500
Rated output current	A	410	480	500	830	920
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × (2 × 2.2)	2 × (2 × 2.2)
Rated input current [1]	A	2 × 355	2 × 417	2 × 449	2 × (2 × 355)	2 × (2 × 413)
Power loss [2]	kW	43	48	61	85	106
Efficiency [2]	%	98.2	98.2	98.1	98.3	98.2
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [3]	A	2.5	2.5	2.5	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [4]	A	33	33	33	66	66
Cooling air flow rate	m^3/s	3	3	3	5.8	5.8
Sound pressure level L_{pA} (1 m)	dB	81	81	81	87	87
Measuring surface level L_s (1 m)	dB	18	18	18	19	19
Cable cross-sections, line-side, max. connectable per phase [5) 6)]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [5) 6)]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [5]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP22	IP22	IP22	IP22	IP22
Dimensions [7]						
• Width	mm	3640	3640	3640	6660	6660
• Height	mm	2570	2570	2570	2570	2570
• Depth	mm	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	4	4	4	6	6
Weight [7]	kg	3450	3450	3450	6500	6600

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Without cooling system

3) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

4) Additional 20 A precharging current for 25 s.

5) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

6) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

7) The specified dimensions and weights include doors, panels and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LM35-0AA0	6SL3815-2LM35-5AA0	6SL3815-2LM36-0AA1	6SL3815-2LM36-6AA1
Output voltage 2.3 kV					
Type rating	kVA	2000	2200	2400	2600
Shaft output 1)	kW	1650	1800	2000	2150
	hp	2250	2500	2750	2950
Rated output current	A	500	550	600	660
Input voltage	kV	2 × 1.2	2 × 1.2	2 × 1.2	2 × 1.2
Rated input current 1)	A	2 × 444	2 × 494	2 × 519	2 × 575
Power loss 2) 3)	kW	28	31	33	34
Efficiency 3)	%	98.4	98.4	98.4	98.4
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 4)	A	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 5)	A	25	25	25	25
Raw water flow rate	l/min	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions 8)					
• Width	mm	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	①	①	①	①
Weight 8)	kg	2600	2650	2650	2650

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

2

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LM37-4AA0	6SL3815-2LM38-0AA0	6SL3815-2LM38-8AA1	6SL3815-2LM41-0AA1
Output voltage 2.3 kV					
Type rating	kVA	2900	3200	3500	4000
Shaft output [1]	kW	2450	2650	2900	3300
	hp	3250	3500	3850	4400
Rated output current	A	740	800	880	1000
Input voltage	kV	2 × 1.2	2 × 1.2	2 × 1.2	2 × 1.2
Rated input current [1]	A	2 × 650	2 × 717	2 × 771	2 × 870
Power loss [2) 3]	kW	38	42	42	44
Efficiency [3]	%	98.5	98.5	98.6	98.7
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	25	25	25	25
Raw water flow rate	l/min	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6) 7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6) 7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [8]					
• Width	mm	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	①	①	①	①
Weight [8]	kg	2700	2700	2700	2700

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

2

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LN33-5AA0	6SL3815-2LN34-0AA0	6SL3815-2LN34-5AA0	6SL3815-2LN35-0AA0	6SL3815-2LN35-5AA0
Output voltage 3.3 kV						
Type rating	kVA	2000	2300	2600	2900	3100
Shaft output 1)	kW	1650	1900	2150	2400	2650
	hp	2250	2500	3000	3250	3500
Rated output current	A	350	400	450	500	550
Input voltage	kV	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7
Rated input current 1)	A	2 × 309	2 × 360	2 × 406	2 × 453	2 × 484
Power loss 2) 3)	kW	28	32	34	38	40
Efficiency 3)	%	98.4	98.4	98.5	98.5	98.6
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 4)	A	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 5)	A	14	14	14	14	14
Raw water flow rate	l/min	183	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43
Dimensions 8)						
• Width	mm	3620	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	①	①	①	①	①
Weight 8)	kg	2750	2800	2800	2800	2850

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LN36-0AA1	6SL3815-2LN36-6AA1	6SL3815-2LN37-4AA0	6SL3815-2LN38-0AA0	6SL3815-2LN38-8AA1	6SL3815-2LN41-0AA1
Output voltage 3.3 kV							
Type rating	kVA	3400	3800	4200	4600	5100	5700
Shaft output 1)	kW	2800	3150	3500	3800	4250	4700
	hp	3800	4200	4500	5000	6000	6150
Rated output current	A	600	660	740	800	880	1000
Input voltage	kV	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7
Rated input current 1)	A	2 × 521	2 × 575	2 × 656	2 × 719	2 × 756	2 × 870
Power loss 2) 3)	kW	42	46	55	60	56	63
Efficiency 3)	%	98.5	98.6	98.5	98.5	98.7	98.7
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 4)	A	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 5)	A	25	25	25	25	25	25
Raw water flow rate	l/min	183	183	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions 8)							
• Width	mm	3620	3620	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	①	①	①	①	①	①
Weight 8)	kg	2850	2850	2850	2850	2850	2850

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

SINAMICS GM150 in IGBT version
Water cooling, without sine-wave filter

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LN41-1AA1	6SL3815-2LN41-2AA1	6SL3815-2LN41-3AA0	6SL3815-2LN41-4AA0	6SL3815-2LN41-6AA1	6SL3815-2LN41-8AA1
Output voltage 3.3 kV							
Type rating	kVA	6300	6800	7400	8000	9100	10300
Shaft output 1)	kW	5300	5600	6200	6700	7600	8600
	hp	7000	7400	8000	9000	10200	11500
Rated output current	A	2 × 550	2 × 600	2 × 650	2 × 700	2 × 800	2 × 900
Input voltage	kV	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)
Rated input current 1)	A	2 × (2 × 492)	2 × (2 × 519)	2 × (2 × 578)	2 × (2 × 625)	2 × (2 × 671)	2 × (2 × 784)
Power loss 2) 3)	kW	80	87	96	104	104	117
Efficiency 3)	%	98.5	98.5	98.5	98.5	98.7	98.7
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 4)	A	4	4	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 5)	A	31	31	31	31	31	31
Raw water flow rate	l/min	283	283	283	283	283	283
Deionized water requirement, approx.	l	100	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	76	76	76	76	76	76
Measuring surface level L_s (1 m)	dB	19	19	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions 8)							
• Width	mm	5420	5420	5420	5420	5420	5420
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	③	③	③	③	③	③
Weight 8)	kg	4200	4200	4200	4200	4200	4200

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815- 2LP32-8AA0	6SL3815- 2LP33-1AA0	6SL3815- 2LP33-5AA0	6SL3815- 2LP34-0AA0	6SL3815- 2LP34-5AA0	6SL3815- 2LP35-0AA0
Output voltage 4.16 kV							
Type rating	kVA	2000	2200	2500	2900	3200	3600
Shaft output [1]	kW	1700	1850	2100	2400	2700	3000
	hp	2250	2500	2750	3000	3500	4000
Rated output current	A	280	310	350	400	450	500
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2
Rated input current [1]	A	2 × 245	2 × 273	2 × 310	2 × 359	2 × 397	2 × 446
Power loss [2] [3]	kW	28	31	33	38	42	47
Efficiency [3]	%	98.4	98.4	98.5	98.5	98.5	98.5
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	25	25	25	25	25	25
Raw water flow rate	l/min	183	183	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions [8]							
• Width	mm	3620	3620	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	①	①	①	①	①	①
Weight [8]	kg	2750	2800	2800	2800	2850	2850

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

2

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LP35-5AA0	6SL3815-2LP36-0AA1	6SL3815-2LP36-6AA1	6SL3815-2LP37-4AA0	6SL3815-2LP38-0AA0	6SL3815-2LP38-8AA1	6SL3815-2LP41-0AA1
Output voltage 4.16 kV								
Type rating	kVA	4000	4300	4800	5300	5800	6400	7200
Shaft output [1]	kW	3300	3600	4000	4500	4800	5300	5900
	hp	4500	4850	5450	6000	6500	7150	8000
Rated output current	A	550	600	660	740	800	880	1000
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2
Rated input current [1]	A	2 × 496	2 × 519	2 × 575	2 × 657	2 × 719	2 × 772	2 × 870
Power loss [2) 3]	kW	52	46	51	69	75	65	74
Efficiency [3]	%	98.5	98.7	98.7	98.5	98.6	98.8	98.8
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	25	25	25	25	25	25	25
Raw water flow rate	l/min	183	183	183	183	183	183	183
Deionized water requirement, approx.	l	90	90	90	90	90	90	90
Sound pressure level L_{pA} (1 m)	dB	73	73	73	73	73	73	73
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6) 7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6) 7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43	IP43
Dimensions [8]								
• Width	mm	3620	3620	3620	3620	3620	3620	3620
• Height	mm	2280	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	1	1	1	1	1	1	1
Weight [8]	kg	2850	2850	2850	2850	2850	2850	2850

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, without sine-wave filter		6SL3815-2LP41-1AA1	6SL3815-2LP41-2AA1	6SL3815-2LP41-3AA0	6SL3815-2LP41-4AA0	6SL3815-2LP41-6AA1	6SL3815-2LP41-8AA1
Output voltage 4.16 kV							
Type rating	kVA	7900	8600	9400	10100	11500	13000
Shaft output [1]	kW	6600	7150	7900	8500	9600	11250
	hp	9000	9500	10000	11000	13000	15300
Rated output current	A	2 × 550	2 × 600	2 × 650	2 × 700	2 × 800	2 × 900
Input voltage	kV	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)
Rated input current [1]	A	2 × (2 × 490)	2 × (2 × 519)	2 × (2 × 583)	2 × (2 × 627)	2 × (2 × 694)	2 × (2 × 785)
Power loss [2) 3)]	kW	86	94	122	131	118	133
Efficiency [3]	%	98.7	98.7	98.5	98.5	98.8	98.8
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	4	4	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	31	31	31	31	31	31
Raw water flow rate	l/min	283	283	283	283	283	283
Deionized water requirement, approx.	l	100	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	76	76	76	76	76	76
Measuring surface level L_s (1 m)	dB	19	19	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase [6) 7)]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6) 7)]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions [8]							
• Width	mm	5420	5420	5420	5420	5420	5420
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/4)	Fig. No.	③	③	③	③	③	③
Weight [8]	kg	4200	4200	4200	4200	4200	4200

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, with sine-wave filter (option Y15)		6SL3815-2LM35-0AA0	6SL3815-2LM35-5AA0	6SL3815-2LM36-0AA1	6SL3815-2LM37-4AA0	6SL3815-2LM36-6AA1	6SL3815-2LM38-0AA0
Output voltage 2.3 kV							
Type rating	kVA	1500	1650	2150	2200	2350	2400
Shaft output [1]	kW	1250	1350	1790	1850	1950	2000
	hp	1500	1750	2400	2500	2550	2750
Rated output current	A	380	410	540	550	590	600
Input voltage	kV	2 × 1.2	2 × 1.2	2 × 1.2	2 × 1.2	2 × 1.2	2 × 1.2
Rated input current [1]	A	2 × 331	2 × 364	2 × 467	2 × 491	2 × 513	2 × 540
Power loss [2] [3]	kW	29	30	31	39	34	41
Efficiency [3]	%	97.8	97.9	98.0	98.0	98.0	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	31	31	31	31	31	31
Raw water flow rate	l/min	183	183	183	183	183	183
Deionized water requirement, approx.	l	100	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	74	74	74	74	74	74
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions [8]							
• Width	mm	4540	4540	4540	4540	4540	4540
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	④	④	④	④	④	④
Weight [8]	kg	3750	3850	3900	3950	3950	3950

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos\varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, with sine-wave filter (option Y15)		6SL3815-2LN33-5AA0	6SL3815-2LN34-0AA0	6SL3815-2LN34-5AA0	6SL3815-2LN35-0AA0	6SL3815-2LN35-5AA0
Output voltage 3.3 kV						
Type rating	kVA	1550	1750	2000	2150	2350
Shaft output [1]	kW	1300	1450	1650	1800	1950
	hp	1750	2000	2250	2500	2750
Rated output current	A	270	310	350	380	410
Input voltage	kV	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7
Rated input current [1]	A	2 × 234	2 × 269	2 × 307	2 × 346	2 × 370
Power loss [2] [3]	kW	29	32	36	40	42
Efficiency [3]	%	97.8	97.9	98.0	98.0	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	31	31	31	31	31
Raw water flow rate	l/min	183	183	183	183	183
Deionized water requirement, approx.	l	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	74	74	74	74	74
Measuring surface level L_s (1 m)	dB	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43
Dimensions [8]						
• Width	mm	4540	4840	4840	4840	4840
• Height	mm	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	④	④	④	④	④
Weight [8]	kg	4000	4200	4200	4200	4300

[1] The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

[2] Approx. 5 % of the power loss is dissipated in the room.

[3] Without cooling system

[4] The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

[5] Additional 20 A precharging current for 25 s.

[6] Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

[7] The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

[8] The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

2

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, with sine-wave filter (option Y15)		6SL3815-2LN36-0AA1	6SL3815-2LN37-4AA0	6SL3815-2LN36-6AA1	6SL3815-2LN38-0AA0
Output voltage 3.3 kV					
Type rating	kVA	3100	3200	3400	3500
Shaft output [1]	kW	2550	2700	2800	2900
	hp	3400	3500	3700	4000
Rated output current	A	540	560	590	610
Input voltage	kV	2 × 1.7	2 × 1.7	2 × 1.7	2 × 1.7
Rated input current [1]	A	2 × 467	2 × 501	2 × 513	2 × 549
Power loss [2] [3]	kW	44	54	49	60
Efficiency [3]	%	98.2	98.1	98.2	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	31	31	31	31
Raw water flow rate	l/min	183	183	183	183
Deionized water requirement, approx.	l	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	74	74	74	74
Measuring surface level L_s (1 m)	dB	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [8]					
• Width	mm	4840	4840	4840	4840
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	4	4	4	4
Weight [8]	kg	4400	4400	4400	4400

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, with sine-wave filter (option Y15)		6SL3815-2LN41-1AA1	6SL3815-2LN41-3AA0	6SL3815-2LN41-4AA0	6SL3815-2LN41-2AA1
Output voltage 3.3 kV					
Type rating	kVA	5500	5600	6050	6100
Shaft output [1]	kW	4550	4700	5100	5100
	hp	6000	6250	6500	7000
Rated output current	A	960	980	1060	1080
Input voltage	kV	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)	2 × (2 × 1.7)
Rated input current [1]	A	2 × (2 × 429)	2 × (2 × 441)	2 × (2 × 477)	2 × (2 × 479)
Power loss [2] [3]	kW	78	90	97	82
Efficiency [3]	%	98.3	98.2	98.2	98.3
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	43	43	43	43
Raw water flow rate	l/min	283	283	283	283
Deionized water requirement, approx.	l	120	120	120	120
Sound pressure level L_{pA} (1 m)	dB	78	78	78	78
Measuring surface level L_s (1 m)	dB	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm² (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm² (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm² (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [8]					
• Width	mm	7860	7860	7860	7860
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	6	6	6	6
Weight [8]	kg	7100	7100	7300	7300

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

2

Technical specifications

SINAMICS GM150 in IGBT version **Water cooling, with sine-wave filter (option Y15)**		6SL3815-2LP32-8AA0	6SL3815-2LP33-1AA0	6SL3815-2LP33-5AA0	6SL3815-2LP34-0AA0	6SL3815-2LP34-5AA0
Output voltage 4.16 kV						
Type rating	kVA	1600	1750	1950	2250	2500
Shaft output [1]	kW	1300	1450	1600	1850	2100
	hp	1750	2000	2250	2500	2750
Rated output current	A	220	240	270	310	350
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2
Rated input current [1]	A	2 × 190	2 × 210	2 × 240	2 × 282	2 × 311
Power loss [2] [3]	kW	30	31	35	41	43
Efficiency [3]	%	97.8	97.9	98.0	98.0	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	31	31	31	31	31
Raw water flow rate	l/min	183	183	183	183	183
Deionized water requirement, approx.	l	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	74	74	74	74	74
Measuring surface level L_s (1 m)	dB	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43
Dimensions [8]						
• Width	mm	4840	4840	4840	4840	4840
• Height	mm	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	④	④	④	④	④
Weight [8]	kg	4200	4250	4250	4250	4300

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

Technical specifications

SINAMICS GM150 in IGBT version **Water cooling, with sine-wave filter (option Y15)**		6SL3815-2LP35-0AA0	6SL3815-2LP35-5AA0	6SL3815-2LP36-0AA1	6SL3815-2LP37-4AA0	6SL3815-2LP36-6AA1	6SL3815-2LP38-0AA0
Output voltage 4.16 kV							
Type rating	kVA	2800	3100	3900	4100	4250	4500
Shaft output 1)	kW	2350	2600	3250	3450	3550	3800
	hp	3000	3500	4450	4500	4750	5000
Rated output current	A	390	430	540	570	590	625
Input voltage	kV	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2	2 × 2.2
Rated input current 1)	A	2 × 350	2 × 388	2 × 471	2 × 514	2 × 513	2 × 562
Power loss 2) 3)	kW	48	53	57	66	59	72
Efficiency 3)	%	98.1	98.1	98.2	98.2	98.3	98.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 4)	A	2.5	2.5	2.5	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 5)	A	31	31	31	31	31	31
Raw water flow rate	l/min	183	183	183	183	183	183
Deionized water requirement, approx.	l	100	100	100	100	100	100
Sound pressure level L_{pA} (1 m)	dB	74	74	74	74	74	74
Measuring surface level L_s (1 m)	dB	18	18	18	18	18	18
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43	IP43
Dimensions 8)							
• Width	mm	4840	4840	4840	4840	4840	5440 9)
• Height	mm	2280	2280	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	④	④	④	④	④	④
Weight 8)	kg	4300	4300	4850	4850	4850	5200

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0.6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

9) For a combination with the power cable connection at the converter output from the top (option **M78**), then the cabinet width decreases by 600 mm.

Technical specifications

SINAMICS GM150 in IGBT version Water cooling, with sine-wave filter (option Y15)		6SL3815-2LP41-1AA1	6SL3815-2LP41-3AA0	6SL3815-2LP41-2AA1	6SL3815-2LP41-4AA0
Output voltage 4.16 kV					
Type rating	kVA	7150	7350	7700	7950
Shaft output [1]	kW	5900	6200	6350	6600
	hp	7950	8000	8600	9000
Rated output current	A	960	1020	1080	1100
Input voltage	kV	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)	2 × (2 × 2.2)
Rated input current [1]	A	2 × (2 × 431)	2 × (2 × 456)	2 × (2 × 464)	2 × (2 × 491)
Power loss [2] [3]	kW	95	117	103	126
Efficiency [3]	%	98.3	98.2	98.3	98.2
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	43	43	43	43
Raw water flow rate	l/min	283	283	283	283
Deionized water requirement, approx.	l	120	120	120	120
Sound pressure level L_{pA} (1 m)	dB	78	78	78	78
Measuring surface level L_s (1 m)	dB	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [8]					
• Width	mm	7860	7860	7860	7860
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 2/5)	Fig. No.	6	6	6	6
Weight [8]	kg	7200	8200	8200	8200

[1] The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

[2] Approx. 5 % of the power loss is dissipated in the room.

[3] Without cooling system

[4] The typical current drawn (rms value; $\cos \varphi_{typ.} = 0.6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

[5] Additional 20 A precharging current for 25 s.

[6] Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 2/5.

[7] The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

[8] The specified dimensions and weights include doors, panels, cooling unit and sine-wave filter (option **Y15**), however no additional options.

SINAMICS GM150 in IGCT version

3

SINAMICS GM150 in IGCT version

Overview

SINAMICS GM150 as IGCT version

The water-cooled SINAMICS GM150 converters in the IGCT version with IGCT Motor Modules represent an expansion of the SINAMICS GM150 converters in the IGBT version in the upper power range up to 21 MVA.

SINAMICS GM150 converters as IGCT version are optimally matched to Siemens motors.

SINAMICS GM150 converters as IGCT version offer economic drive solutions that can be matched to customers' specific requirements by adding from the wide range of available components and options.

IGCT converters are available for the following voltage and outputs:

Rated output voltage	Type rating
3.3 kV	10 MVA to 21 MVA

Global use

SINAMICS GM150 converters as IGCT version are manufactured to international standards and regulations, making them ideally suited for global use. These converters are also available in ship-going form (meeting the requirements of all major classification organizations).

Benefits

- Compact design and high flexibility in configuration ensures easy plant integration
- Easy operation and monitoring on the convenient operator panel
- Easy and reliable operation through integrated maintenance functions: the converter signals early and automatically if maintenance is required or components need to be exchanged
- High robustness and reliability due to the use of IGCT power semiconductors in the high power range and fuseless installation combined with intelligent reaction to external disturbances
- Can be easily integrated into automation solutions due to PROFIBUS interface supplied as standard and various analog and digital interfaces
- High level of service-friendliness through innovative power section design with compact phase modules and easy access to all components

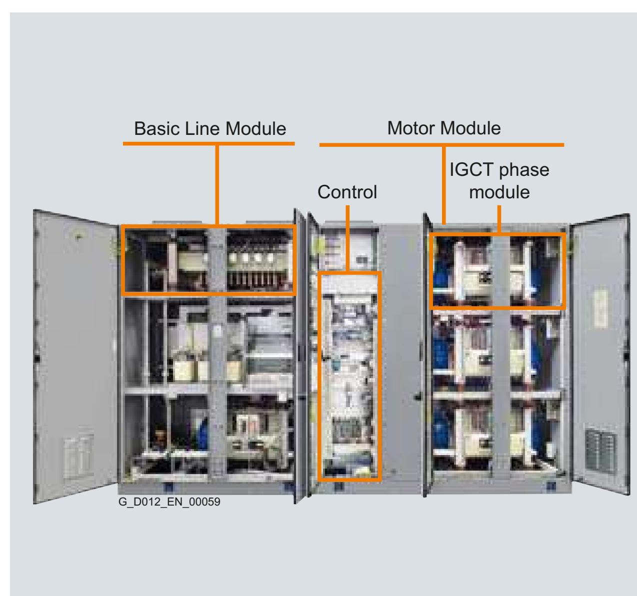
Design

SINAMICS GM150 converters in the IGCT version are available in the basic connection with a 12-pulse or 24-pulse Basic Line Module (option).

For greater output ratings, two or three complete converter units with isolated DC links are operated in parallel.

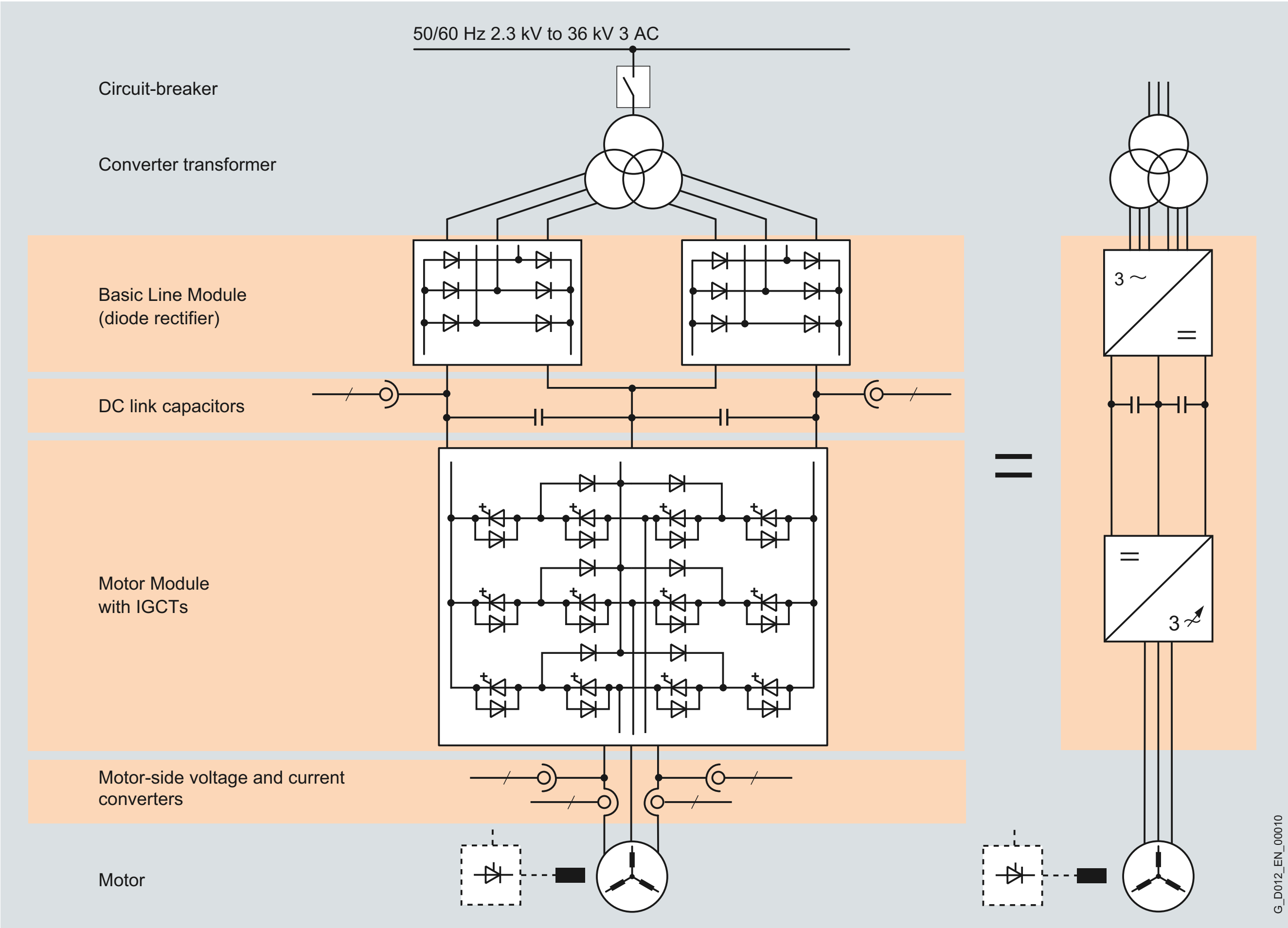
Phase components in which IGCTs, diodes etc. are grouped together in one pressure stack are used in the Motor Modules.

The converter consists of cabinet units for the Basic Line Module and for the Motor Module. One of three phase modules and the control section in the Motor Module cabinet unit are highlighted in the illustration.



SINAMICS GM150 as IGCT version, internal design (without cooling unit)

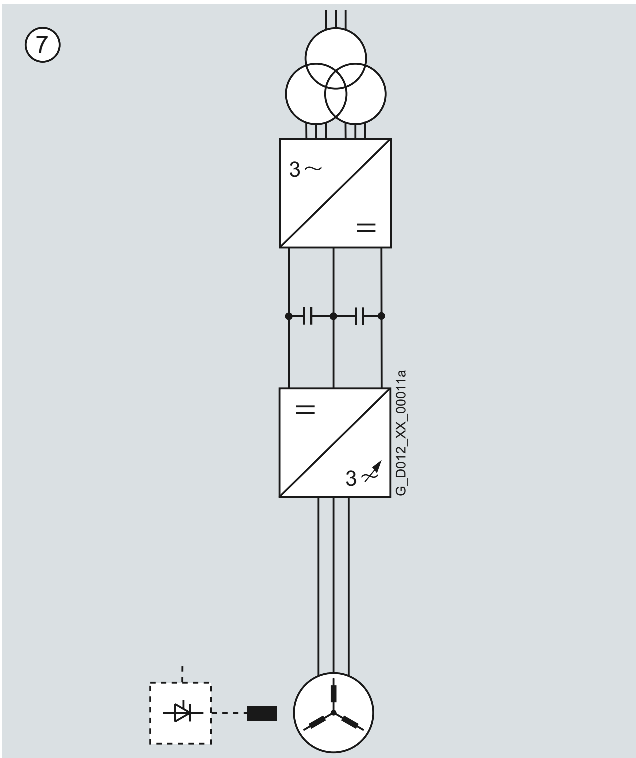
Design



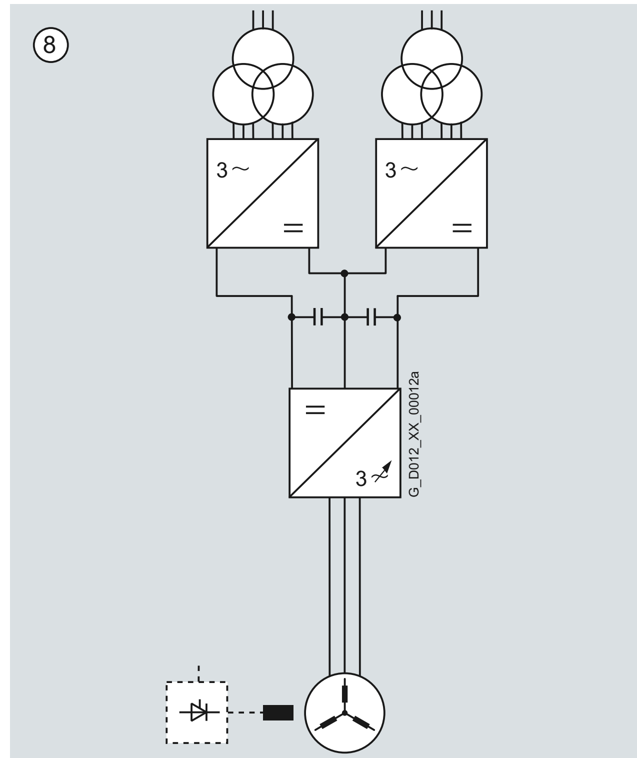
Block diagram

Design

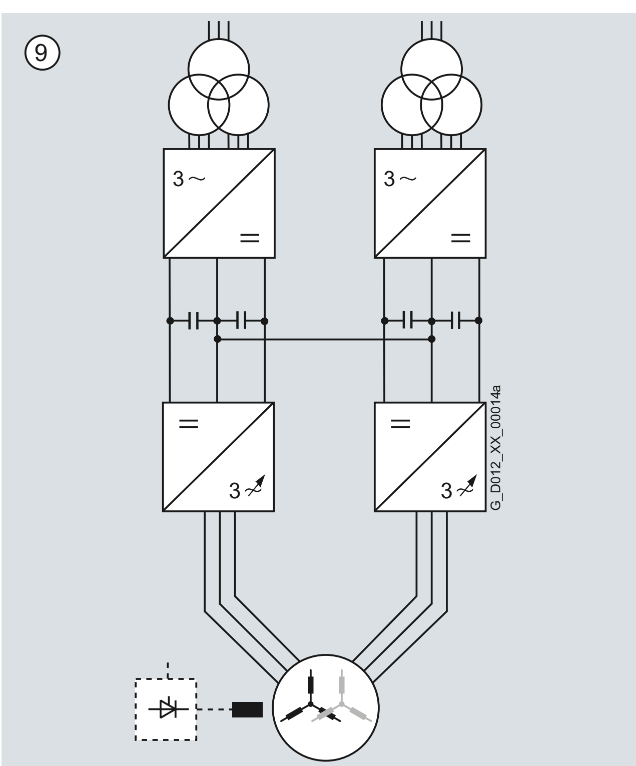
The following wiring versions are available for SINAMICS GM150 as IGCT version.



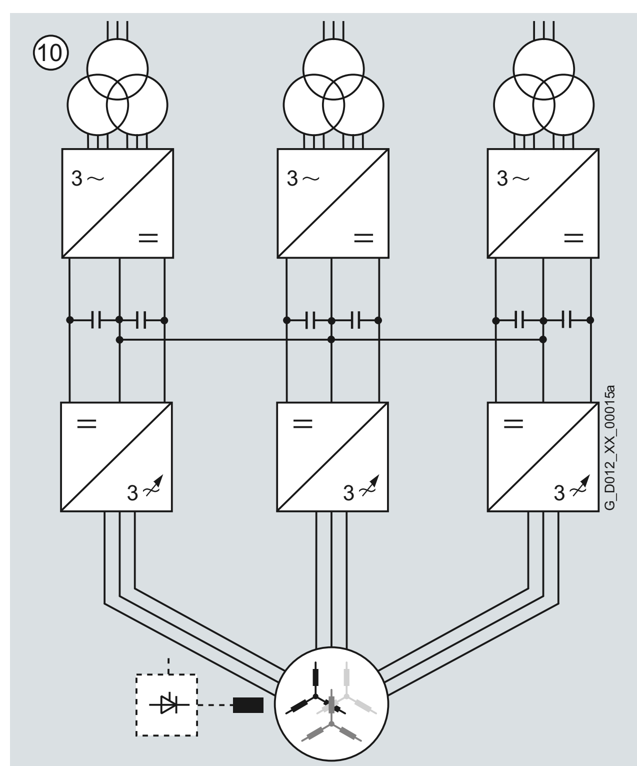
Basic circuit
12-pulse infeed



24-pulse infeed through series connection of two Basic Line Modules: option **N15**



Two converter units operated in parallel in order to increase the output [1)], 24-pulse infeed



Three converter units operated in parallel in order to increase the output [1)], 36-pulse infeed

1) Requires a motor with separate winding systems.

Function

Characteristic features

SINAMICS GM150 as IGCT version		
Line Module (rectifier on mains side)		
Basic Line Module, 12-pulse (two-quadrant operation)	Standard	
Basic Line Module, 24-pulse (two-quadrant operation)	Option Standard for parallel connection	
Basic Line Module, 36-pulse (two-quadrant operation)	Standard for triple parallel connection	
Motor Module (rectifier on motor side)		
Voltage range	3.3 kV	
Power range (typ.)	10 ... 21 MVA	
Cooling method		
• Water cooling	Standard	
Control modes		
• Induction motor	Standard	Standard
• Synchronous motor, separately excited	Option	Option
• Synchronous motor, separately excited, with brushless (RG) excitation system	On request	On request
• Synchronous motor, permanently excited	On request	Option

Software and protection functions

SINAMICS GM150 in the IGCT version	Description
Closed-loop control	The motor-side closed-loop control is realized as a field-oriented closed-loop vector control that can be operated as a speed or torque control as required. The closed-loop vector control achieves the dynamic performance of a DC drive. This is made possible by the fact that the current components forming the torque and flux can be controlled precisely independently of each other. Prescribed torques can thus be observed and limited accurately. In the speed range from 1:10, the field-oriented closed-loop control does not require an actual speed value encoder. An actual speed value encoder is required in the following scenarios: • High dynamics requirements • Torque control/constant torque drives with a control range > 1:10 • Very low speeds • Very high speed accuracy
Setpoint input	The setpoint can be defined internally or externally; internally as a fixed setpoint, motorized potentiometer setpoint or jog setpoint, externally via the PROFIBUS interface or an analog input of the customer's terminal strip. The internal fixed setpoint and the motorized potentiometer setpoint can be switched over or adjusted using control commands via all of the interfaces.
Ramp-function generator	A user-friendly ramp-function generator with separately adjustable ramp-up and ramp-down times, together with variable smoothing times in the lower and upper speed ranges, improves the control response and therefore prevents mechanical overloading of the drive train. The ramp-down ramps can be parameterized separately for emergency stop.
$V_{dc\ max}$ controller	The $V_{dc\ max}$ controller automatically prevents overvoltages in the DC link if the down ramp is too short, for example. This can also extend the set ramp-down time.
Kinetic buffering (KIP)	Power supply failures are bridged to the extent permitted by the kinetic energy of the drive train. The speed drops depending on the moment of inertia and the load torque. The current speed setpoint is resumed when the power supply returns. This function can cause fast load cycles changes which may have a negative effect on the infeed line (in particular on weak lines e.g. on ships).
Automatic restart (option L32)	The automatic restart switches the drive on again when the power is restored after a power failure or a general fault, and ramps up to the current speed setpoint.
Flying restart	The flying restart function permits smooth connection of the converter to a rotating motor.
Diagnostics functions	• Self-diagnosis of control hardware • Non-volatile memory for reliable diagnosis when the power supply fails • Monitoring the IGBTs with individual messages for each mounting location • User-friendly on-site operator panel with plain text messages
Operating hours and switching cycle counter	The switching cycles of the circuit breakers are detected and summed to form the basis for preventive maintenance work.

SINAMICS GM150 in IGCT version

3

Function

SINAMICS GM150 in the IGCT version	Description
Detecting the actual motor speed (option)	The SMC30 encoder module can be used to record the actual motor speed. The signals from the rotary pulse encoder are converted here and made available to the closed-loop control for evaluation via the DRIVE-CLiQ interface.
Operator protection	The cabinet doors of the power units are fitted with electromagnetic locks. This prevents the cabinet doors being opened while hazardous voltages are connected inside the cabinet.
EMERGENCY-OFF button	The converters are equipped as standard with an EMERGENCY-OFF button with protective collar which is fitted in the cabinet door. The contacts of the button are connected in parallel to the terminal strip so they can be integrated in a protection concept on the plant side. EMERGENCY-OFF stop category 0 is set as standard for an uncontrolled shutdown (EN 60204-1/VDE 0113-1 (IEC 60204-1)). The function includes voltage disconnection of the converter output through the circuit breaker. The motor coasts in the process. EMERGENCY-STOP category 1 is optionally available for a controlled shutdown (option **L60**).
Insulation monitoring	The converters feature insulation monitoring of the complete electrical circuit from the secondary side of the transformer to the stator windings of the motor.
Monitoring of the peripherals	An extensive package of options for I/O monitoring (from the transformer and the motor through to the auxiliaries) is available. In addition, it is possible to monitor the temperature with thermocouples or Pt100 resistors.
Thermal overload protection	An alarm message is issued first when the overtemperature threshold is reached. If the temperature rises further, either a shutdown is carried out or automatic influencing of the output current so that a reduction in the thermal load is achieved. Following elimination of the cause of the fault (e.g. improvement in the ventilation), the original operating values are automatically resumed. In the case of water-cooled converters, the water temperature and flow rate are recorded at several points in the cooling circuit and evaluated. An extensive self-diagnosis protects the converter and reports faults.
Grounding switch (option)	If grounding on the infeed or motor side is required for safety and protection reasons, a motorized grounding switch can be ordered. For safety reasons, the converter controller locks these grounding switches against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.

AOP30 operator panel

The AOP30 operator panel is fitted into the cabinet door of the SINAMICS GM150 to enable operation, monitoring and commissioning.

It has the following features and characteristics:

- Graphical LCD display with backlighting for plain-text display and a bar display of process variables
- LEDs for displaying the operational status
- Help function describing causes of and remedies for faults and alarms
- Membrane keyboard with keypad for operational control of a drive
- Local/remote switchover to select the operator control location (priority assigned to operator panel or customer's terminal strip/PROFIBUS)
- Numeric keypad for input of setpoint or parameter values
- Function keys for prompted navigation in the menu
- Two-stage safety strategy to protect against accidental or unauthorized changes to settings. The keyboard lock disables operation of the drive from the operator panel, so that only parameter values and process variables can be displayed. A password can be used to prevent the unauthorized modification of converter parameters.

The operator panel languages – English, German, Spanish and Chinese – are stored on the CompactFlash card of the Control Unit.

Configuration

Standard dimensioning

If the motor data are not precisely known, then the converter should be dimensioned based on the rated output current for typical induction motors. If current derating is required, then the derating factors are applied to this rated output current. The current derating when converter units are operated in parallel has already been taken into account for the values in the selection and ordering data table.

Higher output currents are also possible under certain conditions; refer to the following section.

Detailed dimensioning

If the motor data are more precisely known, then the converters can also be operated with higher output currents. In this case, the rated motor current must lie below the maximum thermal converter output current, and the motor short-circuit current must be less than the maximum permissible motor short-circuit current of the converter.

Note:

The motor short-circuit current is the current that flows in a system in the first 100 ms if all subsystems are short-circuited and the leakage paths are saturated.

For higher rated output currents, the type-specific technical data can differ. Please contact your regional Siemens sales partner if you have any questions on this topic.

During the detailed dimensioning phase, derating factors should be applied to the maximum thermal converter output current. The current derating when converter units are operated in parallel has already been taken into account for the values in the selection and ordering data table.

Selection and ordering data

Type rating	Shaft output		Rated output current for typical induction motors	Max. thermal output current	Max. motor short-circuit current for induction motors	**SINAMICS GM150 in the IGCT version**	Circuit version (Page 3/4)
kVA	kW	hp	A	A	A	Order No.	Fig. No.
Output voltage 3.3 kV							
10000	8000	11000	1750	1750	8700	**6SL3835-2LN41-8AA0**	7
15500	13000	17000	2 × 1360	2 × 1440	7200	**6SL3835-2LN42-8AA0**	9
18000	15000	20000	2 × 1570	2 × 1660	8300	**6SL3835-2LN43-6AA0**	9
21000	17000	23000	3 × 1220	3 × 1630	8100	**6SL3835-2LN44-2AA0**	10

3

Options

When ordering a converter with options, add **"-Z"** to the order number of the converter, followed by the order code(s) for the desired option(s).

Example:

6SL3835-2LN41-8AA0-Z
+N15+L60+...

In the following tables, related options are arranged in groups. Whether the options can be combined or are mutually exclusive is indicated within these groups. A detailed description of the options can be found in Chapter 6.

Input-side options		**N15**	**N13**
24-pulse Basic Line Module [1]	**N15**		–
Circuit breaker at converter input (for 24-pulse Basic Line Module on request)	**N13**	–	

[1] Option **N15** cannot be combined with option **L72** (Braking Module).

Output-side options		**L08**	**L52**	**L72**	**Y73**
Output reactor	**L08**		✓	✓	✓
Circuit breaker at converter output [1]	**L52**	✓		✓	✓
Braking Module [2]	**L72**	✓	✓		✓
Braking resistor	**Y73**	✓	✓	✓	

[1] Option **L52** cannot be combined with option **L51** (disconnector at converter output).
[2] Option **L72** cannot be combined with option **N15** (24-pulse Basic Line Module).

Protective functions		**K80**	**L48**	**L49**	**L51**	**L60**	**M10**
Control of "Safe Torque Off" function (on request)	**K80**		✓	✓	✓	✓	✓
Make-proof grounding switch at converter input (motor-operated)	**L48**	✓		✓	✓	✓	✓
Make-proof grounding switch at converter output (motor-operated)	**L49**	✓	✓		✓	✓	✓
Disconnector at converter output [1]	**L51**	✓	✓	✓		✓	✓
EMERGENCY-STOP, Stop Category 1 for controlled stopping	**L60**	✓	✓	✓	✓		✓
Safety interlocking system	**M10**	✓	✓	✓	✓	✓	

[1] Option **L51** cannot be combined with option **L52** (circuit breaker at converter output).

✓	Options can be combined
–	Options are mutually exclusive

Options

Temperature sensing and evaluation (standard: 3 Pt100 inputs)		L80	L81	L82	L90	L91	L92	L93	L94	L95	L96
2 thermistor motor protection relays for alarm and fault [1]	**L80**		–	–	✓	✓	✓	✓	✓	✓	✓
2 x 2 thermistor protection relays for alarm and fault[1]	**L81**	–		–	✓	✓	✓	✓	✓	✓	✓
3 x 2 thermistor protection relays for alarm and fault[1]	**L82**	–	–		✓	✓	✓	✓	✓	✓	✓
Pt100 evaluation unit with 3 inputs[1]	**L90**	✓	✓	✓		–	–	–	–	–	–
2 Pt100 evaluation units with 3 inputs each[1]	**L91**	✓	✓	✓	–		–	–	–	–	–
3 Pt100 evaluation units with 3 inputs each[1]	**L92**	✓	✓	✓	–	–		–	–	–	–
Pt100 evaluation unit with 6 inputs and 2 analog outputs (outputs for display connected to the control system)[1]	**L93**	✓	✓	✓	–	–	–		–	–	–
2 Pt100 evaluation units each with 6 inputs and 2 analog outputs (outputs for display connected to the control system)[2]	**L94**	✓	✓	✓	–	–	–	–		–	–
Pt100 evaluation unit with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system)[1]	**L95**	✓	✓	✓	–	–	–	–	–		–
2 Pt100 evaluation units each with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system)[2]	**L96**	✓	✓	✓	–	–	–	–	–	–	

[1] Options **L..** cannot be combined with option **G61** (additional TM31 Terminal Module).

[2] Option **L94** and **L96** cannot be combined with options **G61** and **G62** (additional Terminal Modules TM31) as well as with option **E86** (additional analog inputs).

Increased degree of protection of the control cabinets in the water-cooled version (standard: IP43)	
IP54 degree of protection	**M54**

Controlled motor feeder for auxiliaries [1]		N30	N31	N32	N33
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 4/4.8 kW	**N30**		–	–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 7/8 kW	**N31**	–		–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 11/12.7 kW	**N32**	–	–		–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 15/17.5 kW	**N33**	–	–	–	

[1] With the ON command at the converter, the contactor is **closed**, and with the OFF command, the contactor is **opened** (example: external fan on the motor). The supply voltage for the auxiliaries must be provided externally.

Controlled outgoing feeder for auxiliaries [1]		N35	N36	N37	N38
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 1.2/1 kW	**N35**		–	–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 2.2/1.5 kW	**N36**	–		–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 3.5/2.1 kW	**N37**	–	–		–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 4.5/2.8 kW	**N38**	–	–	–	

[1] With the ON command at the converter, the contactor is **opened**, and with the OFF command, the contactor is **closed** (example: heater). The supply voltage for the auxiliaries must be provided externally.

✓	Options can be combined
–	Options are mutually exclusive

3

Options

Connection of signal cables (standard: signal cable connected directly to the terminals of the Terminal Modules)		M32	M33	M36
Customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2	**M32**		–	✓
Customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2	**M33**	–		✓
Cable entry, brass for power cables	**M36**	✓	✓	

Operator control and display instruments in the door of the control cabinet		K20	K21	K22
Indicator lights in the cabinet door	**K20**		–	–
Display instruments in the cabinet door for voltage, current, speed and power as well as indicator lights	**K21**	–		–
Display instruments in the cabinet door for current, speed, power and winding temperature as well as indicator lights	**K22**	–	–	

Interface modules for connection to external bus systems (standard: PROFIBUS (slave))		G20	G21	G22	G23	G24
CAN bus interface (CANopen, on request)	**G20**		–	–	–	–
Modbus Plus interface (on request)	**G21**	–		–	–	–
Modbus RTU slave interface (on request)	**G22**	–	–		–	–
DeviceNet interface (on request)	**G23**	–	–	–		–
PROFINET interface (via CBE20) (on request)	**G24**	–	–	–	–	

Interface modules for additional customer connections and speed encoders		G61	G62	G63	K50
Additional TM31 Terminal Module [1)]	**G61**		✓	✓	✓
Second additional TM31 Terminal Module [1)]	**G62**	✓		✓	✓
Additional TM15 Terminal Module	**G63**	✓	✓		✓
Sensor Module Cabinet-Mounted SMC30	**K50**	✓	✓	✓	

[1)] For the exclusions for options **G61** and **G62** see the description of the options, Page 6/16.

Additional analog inputs/outputs (isolated)		E86	E87
Additional analog inputs (isolated) [1)]	**E86**		✓
Additional analog outputs (isolated) [2)]	**E87**	✓	

[1)] Option **E86** cannot be combined with option **G62** (second additional TM31 Terminal Module) as well as with options **L94** and **L96** (2 Pt100 evaluation units).
[2)] Option **E87** cannot be combined with option **G62** (second additional TM31 Terminal Module).

✓	Options can be combined
–	Options are mutually exclusive

Options

Other interface modules		G66	G70	G71
PADU8 diagnostic module (8 analog and 8 digital signals)	**G66**		✓	✓
Pulse distributor for transferring the speed encoder signal (on request)[1]	**G70**	✓		✓
Optical bus terminal (OBT) for PROFIBUS (on request) [2]	**G71**	✓	✓	

[1] Option **G70** can only be ordered in combination with option **K50** (Sensor Module Cabinet-Mounted SMC30).
[2] Option **G71** cannot be combined with options **G20 to G24** and **G34** (access to other bus systems).

Industry-specific options		B00	M66
NAMUR terminal strip	**B00**		✓
Suitable for marine applications	**M66**	✓	
The following option is included as standard in option **M66** :			
Cabinet anti-condensation heating	**L55**	✓	✓
The following options are required for safety-relevant drives in addition **to option M66** :			
Individual certification of the converter by the relevant certification societies	**E11 to E71**	✓	✓

Individual certification of the converters for use on ships (includes option M66)		E11	E21	E31	E51	E61	E71
Suitable for marine use with individual certificate from Germanische Lloyd (GL)	**E11**		–	–	–	–	–
Suitable for marine use with individual certificate from Lloyds Register (LR)	**E21**	–		–	–	–	–
Suitable for marine use with individual certificate from Bureau Veritas (BV)	**E31**	–	–		–	–	–
Suitable for marine use with individual certificate from Det Norske Veritas (DNV)	**E51**	–	–	–		–	–
Suitable for marine use with individual certificate from the American Bureau of Shipping (ABS)	**E61**	–	–	–	–		–
Suitable for marine use with individual certificate from the Chinese Classification Society (CCS)	**E71**	–	–	–	–	–	

Functional options		E01	E02	E03	L32
Control for separately excited synchronous motors with slipring excitation (on request)	**E01**		–	–	✓
Control for separately excited synchronous motors with brushless excitation system (on request)	**E02**	–		–	✓
Control for permanently-excited synchronous motors [1] (on request) [1]	**E03**	–	–		✓
Automatic restart	**L32**	✓	✓	✓	

[1] Option **E03** can only be ordered in combination with option **L52** (circuit breaker at the converter output).

✓	Options can be combined
–	Options are mutually exclusive

3

Options

Documentation (standard: PDF format in English on CD-ROM)		B43	B44	B45	D02	D15	Y10
Production flowchart: Generated once	B43		–	–	✓	✓	✓
Production flowchart: Updated every two weeks	B44	–		–	✓	✓	✓
Production flowchart: Updated every month	B45	–	–		✓	✓	✓
Circuit diagrams, terminal diagrams and dimension drawings in DXF format [1)]	D02	✓	✓	✓		✓	✓
One set of printed documentation (multiple orders possible)	D15	✓	✓	✓	✓		✓
Circuit diagrams with customer-specific text field (plain text required) [1)]	Y10	✓	✓	✓	✓	✓	

[1)] The equipment-specific documents (circuit diagrams etc.) are only available in English/German.

Documentation in languages (standard: PDF format in English on CD-ROM)		D00	D55	D56	D57	D72	D76	D77	D78	D79	D84
Documentation in German	D00		–	–	–	–	✓	–	–	–	–
Documentation in Polish	D55	–		–	–	–	✓	–	–	–	–
Documentation in Russian	D56	–	–		–	–	✓	–	–	–	–
Documentation in Japanese (on request)	D57	–	–	–		–	✓	–	–	–	–
Documentation in Italian (on request)	D72	–	–	–	–		✓	–	–	–	–
Documentation in English (additional CD-ROM in English, irrespective of the selected language)	D76	✓	✓	✓	✓	✓		✓	✓	✓	✓
Documentation in French	D77	–	–	–	–	–	✓		–	–	–
Documentation in Spanish	D78	–	–	–	–	–	✓	–		–	–
Documentation in Portuguese (Brazil)	D79	–	–	–	–	–	✓	–	–		–
Documentation in Chinese	D84	–	–	–	–	–	✓	–	–	–	

Rating plate language (standard: English/German)		T58	T60	T80	T82	T85	T86	T90	T91
Rating plate in English/French	T58		–	–	–	–	–	–	–
Rating plate in English/Spanish	T60	–		–	–	–	–	–	–
Rating plate in English/Italian	T80	–	–		–	–	–	–	–
Rating plate in English/Portuguese (on request)	T82	–	–	–		–	–	–	–
Rating plate in English/Russian (on request)	T85	–	–	–	–		–	–	–
Rating plate in English/Polish (on request)	T86	–	–	–	–	–		–	–
Rating plate in English/Japanese (on request)	T90	–	–	–	–	–	–		–
Rating plate in English/Chinese (on request)	T91	–	–	–	–	–	–	–	

Auxiliary voltage supply	
Auxiliary voltage other than N/400 V/3 AC	C30 to C55

✓ Options can be combined
– Options are mutually exclusive

Options

Converter acceptance inspections in presence of customer		F03	F73	F77	F79	F97
Visual acceptance of converter	F03		–	–	–	–
Functional acceptance of converter with inductive load	F73	–		✓	✓	–
Acceptance of the converter insulation test [1]	F77	–	✓		✓	–
Test of the interface between the converter and customer equipment (5 hours) [1]	F79	–	✓	✓		–
Customer-specific system acceptance tests (on request)	F97	–	–	–	–	

[1] Options **F77** and **F79** can only be ordered in conjunction with option **F73** .

Cooling unit (standard: Cooling unit with redundant pumps and a stainless steel plate-type heat exchanger)		W02	W11	W12	W14	Y40
Cooling unit with redundant stainless steel plate-type heat exchangers	W02		–	–	–	–
Cooling unit with titanium plate-type heat exchanger	W11	–		–	–	–
Cooling unit with redundant titanium plate-type heat exchangers	W12	–	–		–	–
Converter without cooling unit (provided on the system side)	W14	–	–	–		–
Raw water data that deviates from the technical data (on request) [1]	Y40	–	–	–	–	

[1] Option **Y40** includes a cooling system which is adapted to the raw water data according to the customer's specifications.

Extension of the liability for defects		Q80	Q81	Q82	Q83	Q84	Q85
Extension of the liability for defects period by 12 months to a total of 24 months	Q80		–	–	–	–	–
Extension of the liability for defects period by 18 months to a total of 30 months	Q81	–		–	–	–	–
Extension of the liability for defects period by 24 months to a total of 36 months	Q82	–	–		–	–	–
Extension of the liability for defects period by 30 months to a total of 42 months	Q83	–	–	–		–	–
Extension of the liability for defects period by 36 months to a total of 48 months	Q84	–	–	–	–		–
Extension of the liability for defects period by 48 months to a total of 60 months	Q85	–	–	–	–	–	

Miscellaneous options		L50	L53	L55	Y05	Y09
Cabinet lighting and service socket in the control section	L50		✓	✓	✓	✓
UPS for the power supply of the open-loop and closed-loop control (on request)	L53	✓		✓	✓	✓
Anti-condensation heating for the cabinet	L55	✓	✓		✓	✓
Customer-specific rating plate	Y05	✓	✓	✓		✓
Special paint finish acc. to RAL.... (in a color other than RAL 7035; plain text required)	Y09	✓	✓	✓	✓	

✓	Options can be combined
–	Options are mutually exclusive

Technical specifications

General technical data	
Power components	Diodes, IGCTs
Line-side converter	
• Standard	12-pulse diode rectifier (Basic Line Module)
• Option	24-pulse diode rectifier (Basic Line Module)
Motor-side converter	Inverter (Motor Module)
Closed-loop control	Closed-loop vector control
Drive quadrants	2 (2 directions of rotation, driving)
Electrical isolation, power unit/ open-loop and closed-loop control	Closed-loop vector control, insulating transformer
Auxiliary power supply (for fans, coolant pumps, precharging the DC link capacitors, open-loop and closed-loop control)	230 V 1 AC ±10 %, 50/60 Hz ±3 % and 400 V 3 AC ±10 %, 50/60 Hz ±3 % or another auxiliary voltage (options **C30 to C55**)
Installation altitude	≤ 1000 m above sea level: 100 % load capability >1000 ... 4000 m above sea level: current derating required >2000 ... 4000 m above sea level: voltage derating required in addition
Insulation	According to EN 50178/VDE 0160 (IEC 62103): Pollution degree 2 (without conductive pollution), condensation not permissible
Degree of protection	According to EN 60529/VDE 0470 T1 (IEC 60529): IP43
Protection class	I acc. to EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1)
Shock-hazard protection	EN 50274/VDE 0660 T514 and BGV A3 when used for the intended application
Interference transmission	This drive unit is part of a PDS, Category C4 acc. to EN 61800-3/VDE 0160 T103 (IEC 61800-3). It has not been designed to be connected to the public line supply. EMC disturbances can occur when connected to these line supplies. The essential requirements placed on EMC protection for the drive system should be secured using an EMC plan on the customer side.
Paint finish/color	Indoor requirements/RAL 7035, light gray
Applicable standards and directives	
• Standards	EN 61800-3/VDE 0160 T103 (IEC 61800-3) EN 61800-4/VDE 0160 T104 (IEC 61800-4), however, only if referenced in the standards EN 61800-3 or EN 61800-5-1 EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1) EN 60146-1-1/VDE 0558 T11 (IEC 60146-1-1) EN 50178/VDE 0160 (IEC 62103) EN 60204-11/VDE 0113 T11 (IEC 60204-11), however, structuring principles and reference marking according to EN 61346-1 instead of EN 81346-1
• EU directives	2006/95/EC + amendments (Low Voltage Directive) 2004/108/EC + amendments (Electromagnetic Compatibility)
Water cooling	Water-water cooling unit, internal circuit, deionized water
Permissible coolant temperature (raw water)	
• Inlet	5 ... 35 °C
• Discharge, max.	40 °C

Rated data	
Output voltage	**3.3 kV**
Input voltage	2 × 1.7 kV
Tolerance of input voltage	±10 %
Line frequency	50/60 Hz ± 3 %
Line power factor fundamental mode	> 0.96

Technical specifications

	Operation of induction motors		Operation of separately excited synchronous motors
	Without speed encoder	With speed encoder	With speed encoder
Control properties			
Operating range			
• Lower limit of speed control range (% of rated motor speed)	5 %	0 %	0 %
• Max. permissible output frequency	250 Hz	250 Hz	90 Hz
• Field-shunting range	1:3	1:3	1:4
Stationary operation			
• Speed accuracy (% of rated motor speed)	± 0.2 % (from 5 % of rated speed)	± 0.01 %	± 0.01 %
• Torque accuracy (% of rated torque)	± 5 % (from 5 % of rated speed)	± 5 %	± 2 %
Dynamic operation			
• Torque rise time	5 ms	5 ms	5 ms

	Storage	Transport	Operation
Climatic ambient conditions			
Ambient temperature	-25 ... +70 °C	-25 ... +70 °C	5 ... 45 °C
Relative air humidity	5 ... 95 % (only slight condensation permitted; converter must be completely dry before commissioning)	5 ... 75 %	5 ... 85 % (condensation not permissible)
Other climatic conditions in accordance with Class	1K3 acc. to EN 6072131 (IEC 6072131) (formation of ice not permissible)	2K2 acc. to EN 6072132 (IEC 6072132)	3K3 acc. to EN 6072133 (IEC 6072133)
Degree of pollution	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)
Mechanical ambient conditions			
Dynamic stress			
• Deflection	1.5 mm at 2 ... 9 Hz	3.5 mm at 2 ... 9 Hz	0.3 mm at 2 ... 9 Hz
• Acceleration	5 m/s^2 at 9 ... 200 Hz	10 m/s^2 at 9 ... 200 Hz 15 m/s^2 at 200 ... 500 Hz	1 m/s^2 at 9 ... 200 Hz
Other mechanical conditions in accordance with Class (increased strength for marine duty)	1M2 acc. to EN 6072131 (IEC 60721-3-1)	2M2 acc. to EN 6072132 (IEC 60721-3-2)	3M1 acc. to EN 6072133 (IEC 60721-3-3)
Other ambient conditions			
Biological ambient conditions in accordance with Class	1B1 acc. to EN 6072131 (IEC 6072131)	2B1 acc. to EN 6072132 (IEC 6072132)	3B2 acc. to EN 6072133 (IEC 6072133) (without damaging flora)
Chemically active substances in accordance with Class	1C1 acc. to EN 6072131 (IEC 6072131)	2C1 acc. to EN 6072132 (IEC 6072132)	3C2 acc. to EN 6072133 (IEC 6072133) (no salt mist)
Mechanically active substances in accordance with Class	1S1 acc. to EN 6072131 (IEC 6072131)	2S1 acc. to EN 6072132 (IEC 6072132)	3S1 acc. to EN 6072133 (IEC 6072133)

Note:

The values specified under storage and transport apply to suitably packed converters.

Technical specifications

Derating for special installation conditions

Current derating

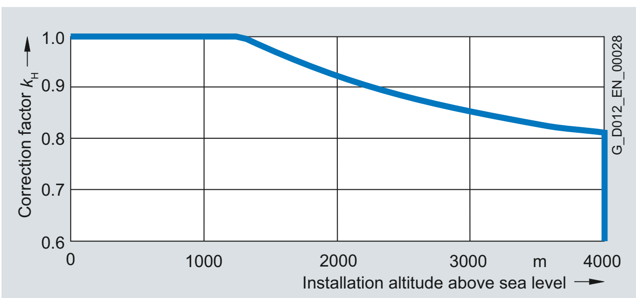
If the converters are operated at installation altitudes above 1000 m above sea level or with intake temperatures in the cooling unit > 35 °, derating factors k_H or k_T must be taken into account for the rated current (DIN 43671). For the permitted continuous current I:

$I \leq I_N \times k_H \times k_T$

I permitted continuous current

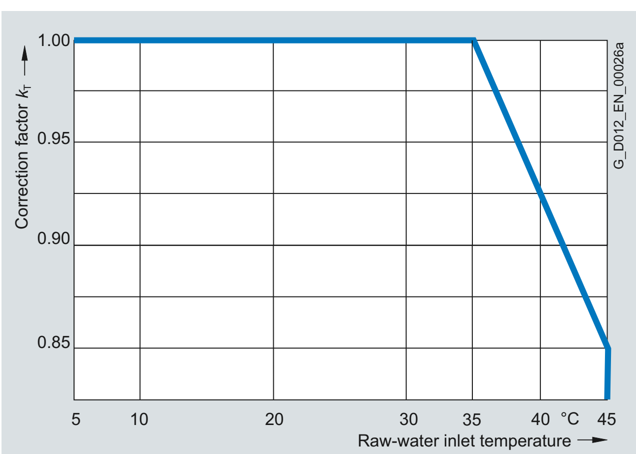
I_N rated current

Current derating as a function of the installation altitude (water cooling)



Derating factor k_H for water cooling

Current derating as a function of the raw water intake temperature

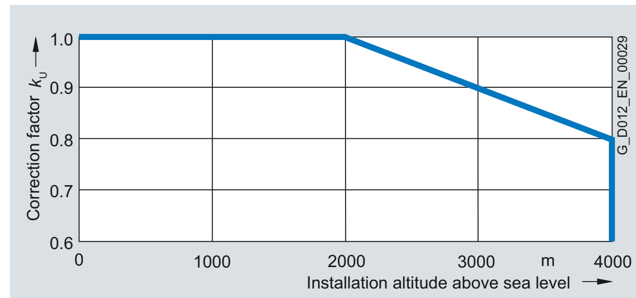


Derating factor k_T (raw water intake temperature)

Voltage derating

For installation altitudes > 2000 m, acc. to EN 60664-1/VDE 0110 (IEC 60664-1) in addition to a current derating, a voltage derating is also required. This depends on the air and creepage distances in the unit.

Voltage derating as a function of installation altitude



Derating factor k_U

Example

Derating data SINAMICS GM150 in IGCT version

Drive unit	6SL3835-2LN43-6AA0
Output voltage	3.3 kV
Input voltage	2 × (2 × 1.7) kV
Type rating	18000 kVA, 2 × 1570 A
Installation altitude	2000 m
Raw water intake temperature	40 °C
k_H (water cooling)	0.925
k_T (raw water intake temperature)	0.925
k_U	1.0

For the current, the following applies:

$I \times I_N \times 0.925 \times 0.925 = I_N \times 0.856$

For the standard version, a current derating of 14.4 % is required.

The maximum available output current is 1344 A for each subsystem.

Technical specifications

SINAMICS GM150 as IGCT version Water cooling		6SL3835-2LN41-8AA0	6SL3835-2LN42-8AA0	6SL3835-2LN43-6AA0	6SL3835-2LN44-2AA0
Output voltage 3.3 kV					
Type rating	kVA	10000	15500	18000	21000
Shaft output [1]	kW	8000	13000	15000	17000
	hp	11000	17000	20000	23000
Rated output current	A	1750	2 × 1360	2 × 1570	3 × 1220
Max. thermal output current	A	1750	2 × 1440	2 × 1660	3 × 1630
Max. motor short-circuit current	A	8700	7200	8300	8100
Input voltage	kV	2 × 1.7	2 × (2 × 1.7)	2 × (2 × 1.7)	3 × (2 × 1.7)
Rated input current [1]	A	2 × 1550	2 × (2 × 1240)	2 × (2 × 1450)	3 × (2 × 1150)
Power loss [2] [3]	kW	80	128	160	192
Efficiency [3]	%	99.1	99.1	99.1	99.1
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	3	6	6	9
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	17	20	20	23
Precharging current demand, briefly for approx. 25 s	A	20	40	40	60
Raw water flow rate	l/min	208	417	417	667
Deionized water requirement, approx.	l	135	170	170	255
Sound pressure level L_{pA} (1 m)	dB	75	77	77	79
Measuring surface level L_s (1 m)	dB	22	23	23	24
Cable cross-sections, line-side, max. connectable per phase [5] [6]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [5] [6]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [5]	mm^2 (DIN VDE)	3 × 120	6 × 120	6 × 120	9 × 120
	AWG/MCM (NEC, CEC)	3 × 250 MCM	6 × 250 MCM	6 × 250 MCM	9 × 250 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [7]					
• Width	mm	5300	9400	9400	14300
• Height	mm	2540	2540	2540	2540
• Depth	mm	1600	1600	1600	1600
Circuit version (Page 3/4)	Fig. No.	7	9	9	10
Weight [7]	kg	5400	9800	9800	15000

Footnotes see next page.

Technical specifications

[1] The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical motor power factor cos φ and motor efficiency. The calculation is based on the rated output current. In this case, the kW and hp values lie in a power range, which is obtained by selecting the following values: Motor power factor between 0.85 and 0.88 and a motor efficiency of 96 %. The rated input current also depends on the line power factor, for which a typical value of between 0.94 and 0.96 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 500. Both approximate values need to be adapted to the motor which is actually used.

[2] Approx. 5 % of the power loss is dissipated in the room.

[3] Without cooling system

[4] The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0,6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

[5] Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Page 3/4.

[6] The maximum permissible cable lengths must be carefully observed (see Power cables, Page 9/13).

[7] The specified dimensions and weights include doors, panels and cooling unit, however no options.

SINAMICS SM150 in IGBT version

4

Overview

SINAMICS SM150 in the IGBT version

SINAMICS SM150 converters in the IGBT version, capable of energy recovery, are available as single-motor drives with IGBT power semiconductors.

IGBT converters are available for the following voltages and power ranges.

Rated output voltage	Type rating with air cooling	Type rating with water cooling
3.3 kV	3.4 and 4.6 MVA	4.6 and 5.7 MVA
4.16 kV	4.3 and 5.8 MVA	5.8 and 7.2 MVA

The rated power in the specific application will depend on the necessary load cycle.

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies) please contact your Siemens partner in sales with the required specifications.

Global use

SINAMICS SM150 converters in the IGBT version are manufactured to international standards and regulations, making them ideally suited for global use.

Benefits

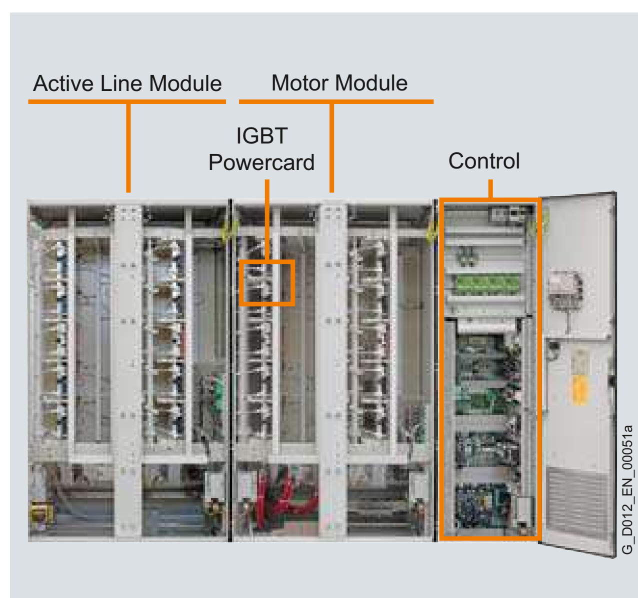
- Compact design and highly flexible configuration ensures easy plant integration
- Simple operator control and monitoring from the user-friendly operator panel
- Simple and reliable operation through integrated maintenance functions: The converter signals early on and automatically if maintenance is required or components need to be replaced
- High degree of ruggedness and reliability by using HV-IGBT technology and a fuseless design combined with intelligent response to external disturbances
- Can be easily integrated into automation solutions as the PROFIBUS interface is supplied as standard along with various analog and digital interfaces
- High level of service-friendliness through innovative power unit design with plug-in Powercards and easy access to all components
- By appropriately engineering the drive system, reactive power can be made available to other drives, therefore helping ensure that the plant or system is cost effective.

Design

Active Line Modules and Motor Modules have an almost identical design. HV-IGBT power semiconductors are used in both – they are mounted on plug-in power cards that are simple to replace.

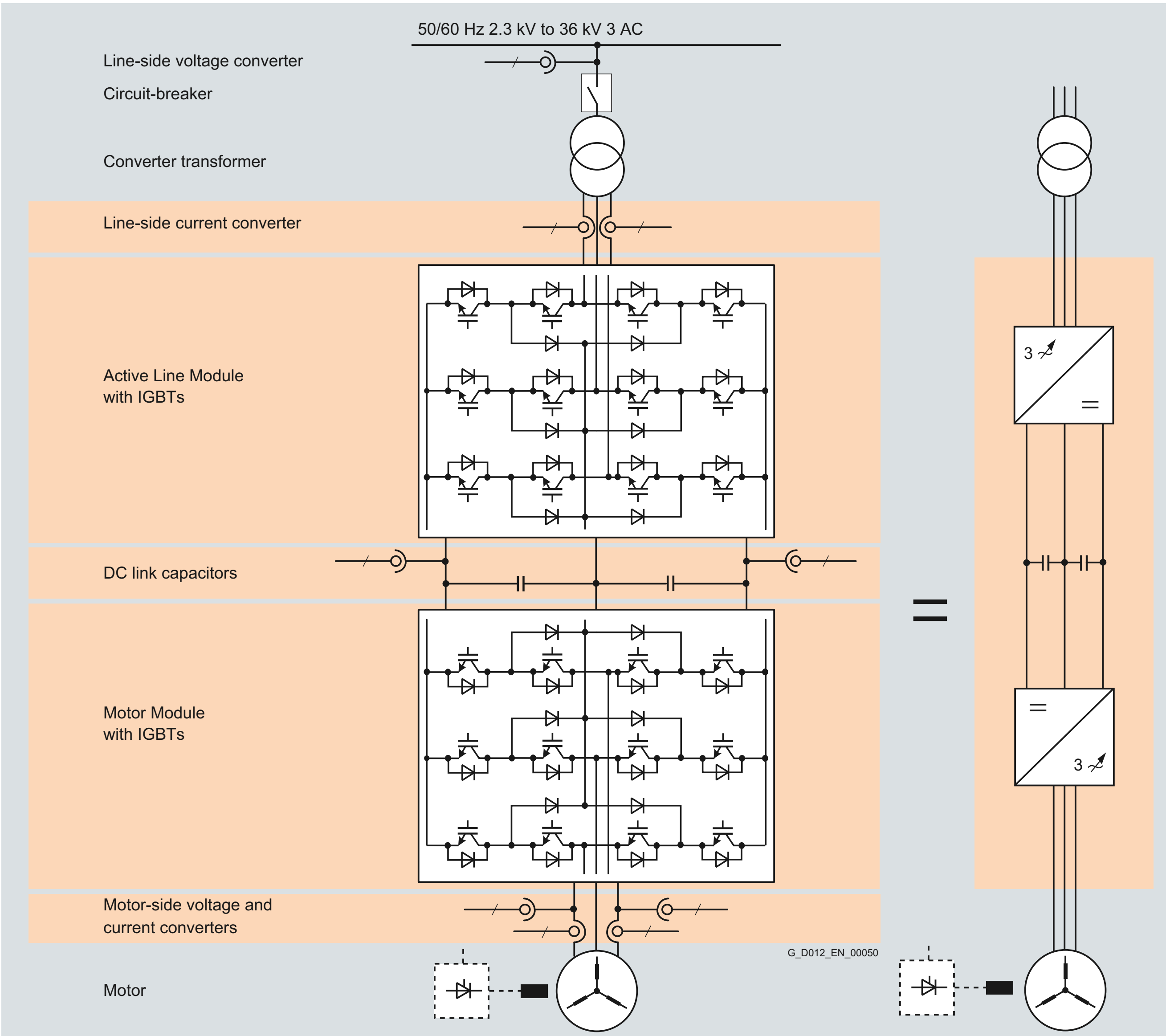
In the basic circuit, one Active Line Module and one Motor Module are interconnected via a DC link.

The converter consists of cabinet units for the Active Line Module and for the Motor Module. In the following diagram, one Powercard and the Control Unit are marked in the Motor Module.



SINAMICS SM150 in the IGBT version, water cooling, internal design without cooling unit

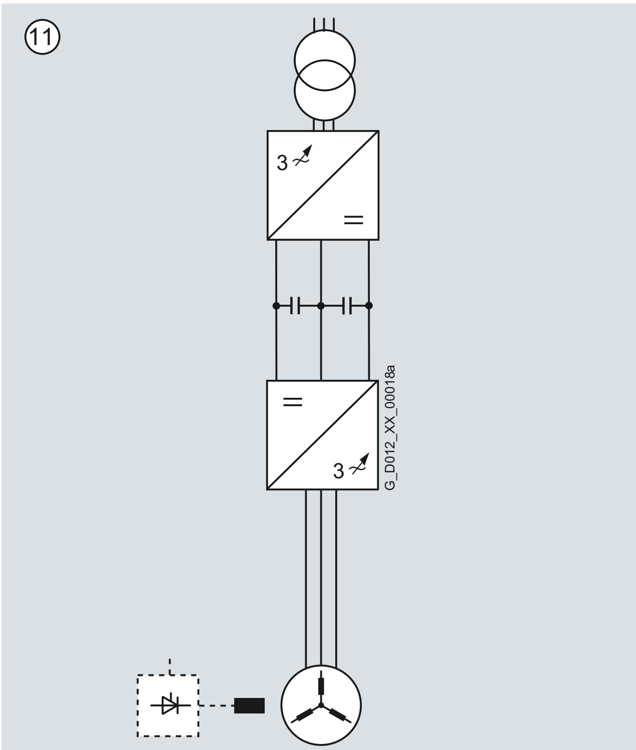
Design



Block diagram

Design

The following circuit is available for SINAMICS SM150 in the IGBT version.



Basic circuit

Function

Characteristic features

SINAMICS SM150 in the IGBT version	
Line Module (rectifier on mains side)	
Active Line Module (four-quadrant operation)	Standard
Motor Module (rectifier on motor side)	
Voltage range	3.3 kV/4.16 kV
Power range, typ.	3.4 ... 7.2 MVA
Cooling method	
• Air cooling	Standard
• Water cooling	Standard
Control modes	Standard: With encoder
• Induction motor	Standard
• Synchronous motor, separately excited	Option
• Synchronous motor, separately excited, with brushless excitation system	On request
• Synchronous motor, permanently excited	On request

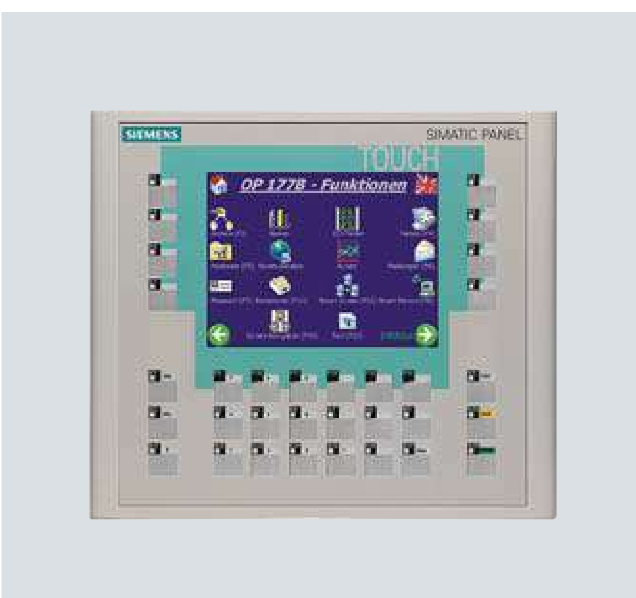
Software and protection functions

SINAMICS SM150 in the IGBT version	Description
Closed-loop control	The motor-side closed-loop control is realized as a field-oriented closed-loop vector control that can be operated as a speed or torque control as required. The closed-loop vector control achieves the dynamic performance of a DC drive. This is made possible by the fact that the current components forming the torque and flux can be controlled precisely independently of each other. Prescribed torques can thus be observed and limited accurately. In the speed range from 1:10, the field-oriented closed-loop control does not require an actual speed value encoder. An actual speed value encoder is required in the following scenarios: • High dynamics requirements • Torque control/constant torque drives with a control range > 1:10 • Very low speeds • Very high speed accuracy
Setpoint input	The setpoint can be defined internally or externally; internally as a fixed setpoint, motorized potentiometer setpoint or jog setpoint, externally via the PROFIBUS interface or an analog input of the customer's terminal strip. The internal fixed setpoint and the motorized potentiometer setpoint can be switched over or adjusted using control commands via all of the interfaces.
Ramp-function generator	A user-friendly ramp-function generator with separately adjustable ramp-up and ramp-down times, together with variable smoothing times in the lower and upper speed ranges, improves the control response and therefore prevents mechanical overloading of the drive train. The ramp-down ramps can be parameterized separately for emergency stop.
$V_{dc\ max}$ controller	The $V_{dc\ max}$ controller automatically prevents overvoltages in the DC link if the down ramp is too short, for example. This can also extend the set ramp-down time.
Kinetic buffering (KIP)	Power supply failures are bridged to the extent permitted by the kinetic energy of the drive train. The speed drops depending on the moment of inertia and the load torque. The current speed setpoint is resumed when the power supply returns.
Automatic restart	The automatic restart switches the drive on again when the power is restored after a power failure or a general fault, and ramps up to the current speed setpoint.
Flying restart	The flying restart function permits smooth connection of the converter to a rotating motor.
Diagnostics functions	• Self-diagnosis of control hardware • Non-volatile memory for reliable diagnosis when the power supply fails • Monitoring of HV-IGBTs with individual messages for each mounting location • User-friendly on-site operator panel with plain text messages
Operating hours and switching cycle counter	The operating hours of the non-redundant fans, which are located on the roof section of the cabinets, are detected and logged so that preventive maintenance can be performed or equipment replaced as a preventive measure. The switching cycles of the circuit breaker are recorded and added together, to form the basis of preventive maintenance work.

Function

SINAMICS SM150 in the IGBT version	Description
Detecting the motor actual speed	The SMC30 encoder module can be used to record the actual motor speed. The signals from the rotary pulse encoder are converted here and made available for evaluation to the closed-loop controller via the DRIVE-CLiQ interface.
Operator protection	The cabinet doors of the power units are fitted with electromagnetic locks. This prevents the cabinet doors being opened while hazardous voltages are connected inside the cabinet.
EMERGENCY-OFF button	The converters are equipped as standard with an EMERGENCY-OFF button with protective collar which is fitted in the cabinet door. The contacts of the button are connected in parallel to the terminal strip so they can be integrated in a protection concept on the plant side. EMERGENCY-OFF stop category 0 is set as standard for an uncontrolled shutdown (EN 60204-1/VDE 0113-1 (IEC 60204-1)). The function includes voltage disconnection of the converter output through the circuit breaker. The motor coasts in the process. The control of the "Safe Torque Off" function is optionally available (option **K80**).
Insulation monitoring	The converters feature insulation monitoring of the complete electrical circuit from the secondary side of the transformer to the stator windings of the motor.
Monitoring of the peripherals	An extensive package of options for I/O monitoring (from the transformer and the motor through to the auxiliaries) is available. In addition it is possible to monitor the temperature with thermocouples or Pt100 resistors.
Thermal overload protection	An alarm message is issued first when the overtemperature threshold is reached. If the temperature rises further, either a shutdown is carried out or automatic influencing of the output current so that a reduction in the thermal load is achieved. Following elimination of the cause of the fault (e.g. improvement in the ventilation), the original operating values are automatically resumed. For instance, for air-cooled converters and when filter mats are used, the amount of pollution of the filter mats is monitored by measuring the differential pressure which is then signaled. In the case of water-cooled converters, the water temperature and flow rate are recorded at several points in the cooling circuit and evaluated. An extensive self-diagnosis protects the converter and reports faults.
Grounding switch (option)	If grounding on the infeed or motor side is required for safety and protection reasons, a motorized grounding switch can be ordered. For safety reasons, the converter controller locks these grounding switches against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.

SIMATIC OP 177B operator panel



The SIMATIC OP 177B operator panel is fitted into the cabinet door of the SINAMICS SM150 to enable operation, monitoring and commissioning.

It has the following features and characteristics:

- 5.7" STN touch display
- Context-dependent operations by touch, permanently available functions can be selected using individual keys
- Non-volatile message buffer, no battery

English and German are available as operator panel languages.

Selection and ordering data

Air cooling

Type rating	Shaft output		Rated output current	**SINAMICS SM150 in the IGBT version, air-cooled**	Circuit version (Page 4/4)
kVA	kW	hp	A	Order No.	Fig. No.
Output voltage 3.3 kV					
3400	2800	3600	600	**6SL3810-7NN36-0AA0**	⑪
4600	3800	4950	800	**6SL3810-7NN38-0AA1**	⑪
Output voltage 4.16 kV					
4300	3600	4700	600	**6SL3810-7NP36-0AA0**	⑪
5800	4800	6500	800	**6SL3810-7NP38-0AA1**	⑪

Water cooling

Type rating	Shaft output		Rated output current	**SINAMICS GM150 in the IGBT version, water-cooled**	Circuit version (Page 4/4)
kVA	kW	hp	A	Order No.	Fig. No.
Output voltage 3.3 kV					
4600	3800	4950	800	**6SL3815-7NN38-0AA0**	⑪
5700	4700	6350	1000	**6SL3815-7NN41-0AA1**	⑪
Output voltage 4.16 kV					
5800	4800	6500	800	**6SL3815-7NP38-0AA0**	⑪
7200	5900	8000	1000	**6SL3815-7NP41-0AA1**	⑪

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies) please contact your Siemens partner in sales indicating the required specifications.

Options

When ordering a converter with options, add **"-Z"** to the order number of the converter, followed by the order code(s) for the desired option(s).

Example:

6SL3810-7NN36-0AA0-Z
+G63+L08+...

In the following tables, related options are arranged in groups. Whether the options can be combined or are mutually exclusive is indicated within these groups. A detailed description of the options can be found in Chapter 6.

Output-side options		**L08**	**L52**	**L72**	**Y73**
Output reactor	**L08**		✓	✓	✓
Circuit breaker at converter output [1]	**L52**	✓		✓	✓
Braking Module (on request)	**L72**	✓	✓		✓
Braking resistor (on request)	**Y73**	✓	✓	✓	

[1] Option **L52** cannot be combined with option **L51** (disconnector at converter output).

Protective functions		**K80**	**L48**	**L49**	**L51**	**M10**
Control of "Safe Torque Off" function	**K80**		✓	✓	✓	✓
Make-proof grounding switch at converter input (motor-operated, on request)	**L48**	✓		✓	✓	✓
Make-proof grounding switch at converter output (motor-operated, on request)	**L49**	✓	✓		✓	✓
Disconnector at converter output [1]	**L51**	✓	✓	✓		✓
Safety interlocking system	**M10**	✓	✓	✓	✓	

[1] Option **L51** cannot be combined with option **L52** (circuit breaker at converter output).

✓	Options can be combined
–	Options are mutually exclusive

4

Options

Temperature sensing and evaluation (standard: 3 Pt100 inputs)		L80	L81	L82	L90	L91	L92	L93	L94	L95	L96
2 thermistor motor protection relays for alarm and fault [1]	**L80**		–	–	✓	✓	✓	✓	✓	✓	✓
2 x 2 thermistor protection relays for alarm and fault [1]	**L81**	–		–	✓	✓	✓	✓	✓	✓	✓
3 x 2 thermistor protection relays for alarm and fault [1]	**L82**	–	–		✓	✓	✓	✓	✓	✓	✓
Pt100 evaluation unit with 3 inputs [1]	**L90**	✓	✓	✓		–	–	–	–	–	–
2 Pt100 evaluation units with 3 inputs each [1]	**L91**	✓	✓	✓	–		–	–	–	–	–
3 Pt100 evaluation units with 3 inputs each [1]	**L92**	✓	✓	✓	–	–		–	–	–	–
Pt100 evaluation unit with 6 inputs and 2 analog outputs (outputs for display connected to the control system) [1]	**L93**	✓	✓	✓	–	–	–		–	–	–
2 Pt100 evaluation units each with 6 inputs and 2 analog outputs (outputs for display connected to the control system) [2]	**L94**	✓	✓	✓	–	–	–	–		–	–
Pt100 evaluation unit with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system) [1]	**L95**	✓	✓	✓	–	–	–	–	–		–
2 Pt100 evaluation units each with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system) [2]	**L96**	✓	✓	✓	–	–	–	–	–	–	

[1] Options **L..** cannot be combined with option **G61** (additional TM31 Terminal Module).

[2] Option **L94** and **L96** cannot be combined with options **G61** and **G62** (additional Terminal Modules TM31) as well as with option **E86** (additional analog inputs).

Controlled motor feeder for auxiliaries [1]		N30	N31	N32	N33
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 4/4.8 kW	**N30**		–	–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 7/8 kW	**N31**	–		–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 11/12.7 kW	**N32**	–	–		–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 15/17.5 kW	**N33**	–	–	–	

[1] With the ON command at the converter, the contactor is **closed**, and with the OFF command, the contactor is **opened** (example: external fan on the motor). The supply voltage for the auxiliaries must be provided externally.

Controlled outgoing feeder for auxiliaries [1]		N35	N36	N37	N38
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 1.2/1 kW	**N35**		–	–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 2.2/1.5 kW	**N36**	–		–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 3.5/2.1 kW	**N37**	–	–		–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 4.5/2.8 kW	**N38**	–	–	–	

[1] With the ON command at the converter, the contactor is **opened**, and with the OFF command, the contactor is **closed** (example: heater). The supply voltage for the auxiliaries must be provided externally.

✓	Options can be combined
–	Options are mutually exclusive

Options

Connection of signal cables (standard: signal cable connected directly to the terminals of the Terminal Modules)		M32	M33
Customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2	**M32**		–
Customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2	**M33**	–	

Operator control and display instruments in the door of the control cabinet		K20	K21	K22
Indicator lights and Start/Stop button in the cabinet door	**K20**		–	–
Display instruments in the cabinet door for voltage, current, speed and power as well as indicator lights and start/stop buttons	**K21**	–		–
Display instruments in the cabinet door for current, speed, power and winding temperature as well as indicator lights and start/stop buttons	**K22**	–	–	

Interface modules for additional customer connections		G61	G62	G63
Additional TM31 Terminal Module 1)	**G61**		✓	✓
Second additional TM31 Terminal Module 1)	**G62**	✓		✓
Additional TM15 Terminal Module	**G63**	✓	✓	

1) For the exclusions for options **G61** and **G62** see the description of the options, Page 6/16.

Additional analog inputs/outputs (isolated)		E86	E87
Additional analog inputs (isolated) 1)	**E86**		✓
Additional analog outputs (isolated) 2)	**E87**	✓	

1) Option **E86** cannot be combined with option **G62** (second additional TM31 Terminal Module) as well as with options **L94** and **L96** (2 Pt100 evaluation units).
2) Option **E87** cannot be combined with option **G62** (second additional TM31 Terminal Module).

Other interface modules		G66	G70	G71
PADU8 diagnostic module (8 analog and 8 digital signals)	**G66**		✓	✓
Pulse distributor to transfer the speed encoder signal	**G70**	✓		✓
Optical bus terminal (OBT) for PROFIBUS	**G71**	✓	✓	

Industry-specific options	
NAMUR terminal strip	**B00**

✓	Options can be combined
–	Options are mutually exclusive

Options

Functional options		E00	E01	E02	E03
Control for separately-excited synchronous motors (static excitation unit is provided on the plant side)	**E00**		–	–	–
Control for separately excited synchronous motors with slipring excitation	**E01**	–		–	–
Control for separately excited synchronous motors with brushless excitation system (on request)	**E02**	–	–		–
Closed-loop control of permanent-magnet synchronous motors (on request) [1]	**E03**	–	–	–	

[1] Option **E03** can only be ordered in combination with option **L52** (circuit breaker at the converter output).

Documentation (standard: PDF format in English on CD-ROM)		D02	D15	Y10
Circuit diagrams, terminal diagrams and dimension drawings in DXF format [1]	**D02**		✓	✓
One set of printed documentation (multiple orders possible)	**D15**	✓		✓
Circuit diagrams with customer-specific text field (plain text required)[1]	**Y10**	✓	✓	

[1] The equipment-specific documents (circuit diagrams etc.) are only available in English/German.

Documentation in languages (standard: PDF format in English on CD-ROM)		D00	D55	D56	D57	D72	D76	D77	D78	D79	D84
Documentation in German	**D00**		–	–	–	–	✓	–	–	–	–
Documentation in Polish	**D55**	–		–	–	–	✓	–	–	–	–
Documentation in Russian	**D56**	–	–		–	–	✓	–	–	–	–
Documentation in Japanese (on request)	**D57**	–	–	–		–	✓	–	–	–	–
Documentation in Italian (on request)	**D72**	–	–	–	–		✓	–	–	–	–
Documentation in English (additional CD-ROM in English, irrespective of the selected language)	**D76**	✓	✓	✓	✓	✓		✓	✓	✓	✓
Documentation in French	**D77**	–	–	–	–	–	✓		–	–	–
Documentation in Spanish	**D78**	–	–	–	–	–	✓	–		–	–
Documentation in Portuguese (Brazil)	**D79**	–	–	–	–	–	✓	–	–		–
Documentation in Chinese	**D84**	–	–	–	–	–	✓	–	–	–	

Auxiliary voltage supply	
Auxiliary voltage other than N/400 V/3 AC	**C30 to C55**

✓	Options can be combined
–	Options are mutually exclusive

Options

Converter acceptance inspections in presence of customer		F03	F29	F73	F77	F79	F97
Visual acceptance of converter	**F03**		–	–	–	–	–
Noise measurement under no-load conditions	**F29**	–		✓	✓	✓	–
Functional acceptance of converter with inductive load	**F73**	–	✓		✓	✓	–
Acceptance of the converter insulation test[1)]	**F77**	–	✓	✓		✓	–
Test of the interface between the converter and customer equipment (5 hours, on request) [1)]	**F79**	–	✓	✓	✓		–
Customer-specific system acceptance tests (on request)	**F97**	–	–	–	–	–	

[1)] Options **F77** and **F79** can only be ordered in conjunction with option **F73** .

Cooling unit (water-cooled converters, standard: Cooling unit with redundant pumps and a		W02	W11	W12	W14
Cooling unit with redundant stainless steel plate-type heat exchangers	**W02**		–	–	–
Cooling unit with titanium plate-type heat exchanger	**W11**	–		–	–
Cooling unit with redundant titanium plate-type heat exchangers	**W12**	–	–		–
Converter without cooling unit (provided on the system side)	**W14**	–	–	–	

Miscellaneous options		L50	L55	Y05	Y09
Cabinet lighting and service socket in the control section	**L50**		✓	✓	✓
Anti-condensation heating for the cabinet	**L55**	✓		✓	✓
Customer-specific rating plate	**Y05**	✓	✓		✓
Special paint finish acc. to RAL.... (in a color other than RAL 7035; plain text required)	**Y09**	✓	✓	✓	

✓	Options can be combined
–	Options are mutually exclusive

Technical specifications

General technical data	
Power components	3.3 kV IGBTs
Line-side converter	Regulated, self-commutating infeed/regenerative unit (Active Line Module)
Motor-side converter	Inverter (Motor Module)
Closed-loop control	Closed-loop vector control
Drive quadrants	4 (driving and braking per 2 directions of rotation)
Electrical isolation, power unit/ open-loop and closed-loop control	Fiber-optic cable, insulating transformer
Auxiliary power supply (for fans, coolant pumps, precharging the DC link capacitors, open-loop and closed-loop control)	230 V 1 AC ±10 %, 50/60 Hz ±3 % and 400 V 3 AC ±10 %, 50/60 Hz ±3 % or another auxiliary voltage (options **C30 to C55**)
Installation altitude	≤ 1000 m above sea level: 100 % load capability >1000 ... 4000 m above sea level: current derating required > 2000 ... 4000 m above sea level: voltage derating required in addition
Insulation	According to EN 50178/VDE 0160 (IEC 62103): Pollution degree 2 (without conductive pollution), condensation not permissible
Degree of protection	According to EN 60529/VDE 0470 T1 (IEC 60529): IP22 (air cooling), IP43 (water cooling)
Protection class	I acc. to EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1)
Shock-hazard protection	EN 50274/VDE 0660 T514 and BGV A3 when used for the intended application
Interference transmission	This drive unit is part of a PDS, Category C4 acc. to EN 61800-3/VDE 0160 T103 (IEC 61800-3). It has not been designed to be connected to the public line supply. EMC disturbances can occur when connected to these line supplies. The essential requirements placed on EMC protection for the drive system should be secured using an EMC plan on the customer side.
Paint finish/color	Indoor requirements/RAL 7035, light gray
Applicable standards and directives	
• Standards	EN 61800-3/VDE 0160 T103 (IEC 61800-3) EN 61800-4/VDE 0160 T104 (IEC 61800-4), however, only if referenced in the standards EN 61800-3 or EN 61800-5-1 EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1) EN 60146-1-1/VDE 0558 T11 (IEC 60146-1-1) EN 50178/VDE 0160 (IEC 62103) EN 60204-11/VDE 0113 T11 (IEC 60204-11), however, structuring principles and reference marking according to EN 61346-1 instead of EN 81346-1
• EU directives	2006/95/EC + amendments (Low Voltage Directive) 2004/108/EC + amendments (Electromagnetic Compatibility)
Air cooling	Forced air cooling with integrated fans
Water cooling	Water-water cooling unit, internal circuit, deionized water
Permissible coolant temperature (raw water)	
• Inlet	+5 ... +35 °C
• Discharge, max.	+40 °C

Rated data		
Output voltage	**3.3 kV**	**4.16 kV**
Input voltage	3.3 kV	4.16 kV
Tolerance of input voltage	±10 %	±10 %
Line frequency	50/60 Hz ± 3 %	50/60 Hz ± 3 %
Line power factor fundamental mode	1	1

Technical specifications

	Operation of induction motors		Operation of separately excited synchronous motors
	Without speed encoder	With speed encoder	With speed encoder
Control properties			
Operating range			
• Lower limit of speed control range (% of rated motor speed)	5 %	0 %	0 %
• Max. permissible output frequency	250 Hz	250 Hz	90 Hz
• Field-shunting range	1:3	1:3	1:4
Stationary operation			
• Speed accuracy (% of rated motor speed)	± 0.2 % (from 5 % of rated speed)	± 0.01 %	± 0.01 %
• Torque accuracy (% of rated torque)	± 5 % (from 5 % of rated speed)	± 5 %	± 2 %
Dynamic operation			
• Torque rise time	5 ms	5 ms	5 ms

	Storage	Transport	Operation
Climatic ambient conditions			
Ambient temperature	-25 ... +70 °C	-25 ... +70 °C	5 ... 40 °C (air cooling) 5 ... 45 °C (water cooling)
Relative air humidity	5 ... 95 % (only slight condensation permitted; converter must be completely dry before commissioning)	5 ... 75 %	5 ... 85 % (condensation not permissible)
Other climatic conditions in accordance with Class	1K3 according to EN 60721-3-1 (IEC 60721-3-1) (icing not permitted)	2K2 according to EN 60721-3-2 (IEC 60721-3-2)	3K3 according to EN 60721-3-3 (IEC 60721-3-3)
Degree of pollution	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)
Mechanical ambient conditions			
Dynamic stress			
• Deflection	1.5 mm at 2 ... 9 Hz	3.5 mm at 2 ... 9 Hz	0.3 mm at 2 ... 9 Hz
• Acceleration	5 m/s^2 at 9 ... 200 Hz	10 m/s^2 at 9 ... 200 Hz 15 m/s^2 at 200 ... 500 Hz	1 m/s^2 at 9 ... 200 Hz
Other mechanical conditions in accordance with Class (increased strength for marine duty)	1M2 according to EN 60721-3-1 (IEC 60721-3-1)	2M2 according to EN 60721-3-2 (IEC 60721-3-2)	3M1 according to EN 60721-3-3 (IEC 60721-3-3)
Other ambient conditions			
Biological ambient conditions in accordance with Class	1B1 according to EN 60721-3-1 (IEC 60721-3-1)	2B1 according to EN 60721-3-2 (IEC 60721-3-2)	3B2 according to EN 60721-3-3 (IEC 60721-3-3) (without harmful flora)
Chemically active substances in accordance with Class	1C1 according to EN 60721-3-1 (IEC 60721-3-1)	2C1 according to EN 60721-3-2 (IEC 60721-3-2)	3C2 according to EN 60721-3-3 (IEC 60721-3-3) (no occurrence of salt mist)
Mechanically active substances in accordance with Class	1S1 according to EN 60721-3-1 (IEC 60721-3-1)	2S1 according to EN 60721-3-2 (IEC 60721-3-2)	3S1 according to EN 60721-3-3 (IEC 60721-3-3)

Note:

The values specified under storage and transport apply to suitably packed converters.

Technical specifications

Derating for special installation conditions

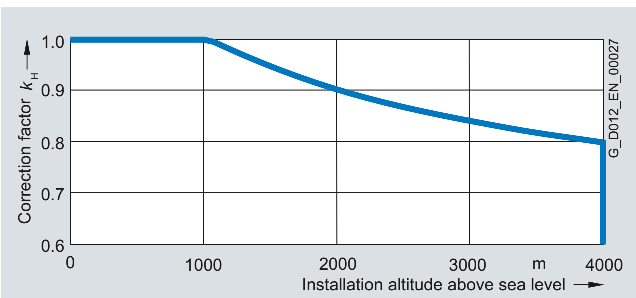
Current derating

If the converters are operated at installation altitudes from 1000 m above sea level or at ambient/coolant temperatures > 40 °C for air cooling or with intake temperatures in the cooling unit > 35 °, derating factors k_H or k_T must be taken into account for the rated current (DIN 43671). For the permitted continuous current *I*:

$I \leq I_N \times k_H \times k_T$

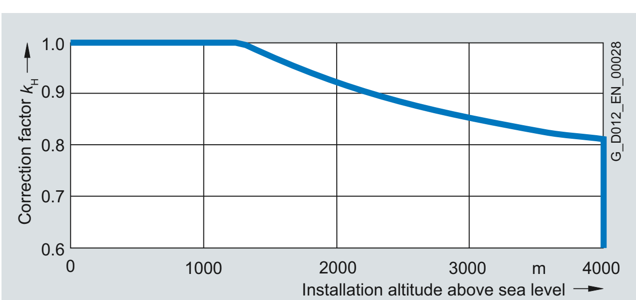
- I permitted continuous current
- I_N rated current

Current derating as a function of the installation altitude (air cooling)



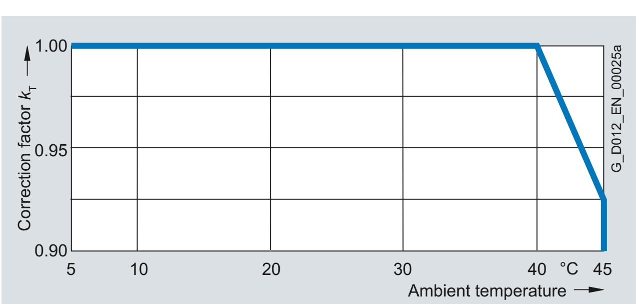
Derating factor k_H for air cooling

Current derating as a function of the installation altitude (water cooling)



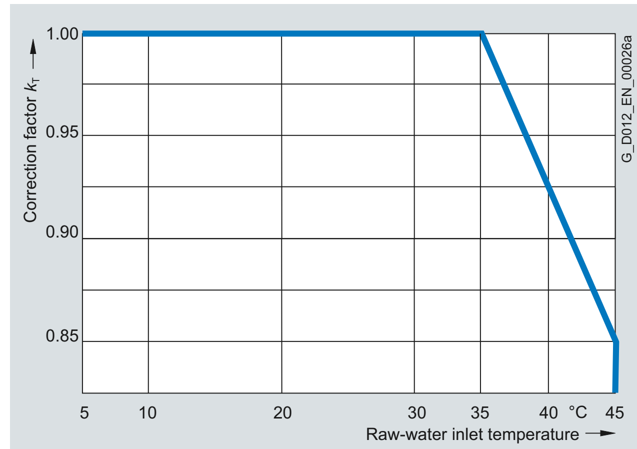
Derating factor k_H for water cooling

Current derating as a function of ambient temperature



Derating factor k_T (ambient temperature)

Current derating as a function of the raw water intake temperature

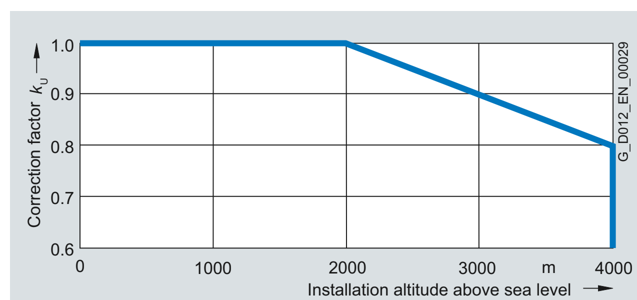


Derating factor k_T (raw water intake temperature)

Voltage derating

For installation altitudes >2000 m, acc. to EN 60664-1/VDE 0110 (IEC 60664-1) in addition to a current derating, a voltage derating is also required. This depends on the air and creepage distances in the unit.

Voltage derating as a function of installation altitude



Derating factor k_U

Example

Derating data SINAMICS SM150 in IGBT version (water-cooled converter)

Drive unit	6SL3815-7NN38-0AA0
Output voltage	3.3 kV
Input voltage	3.3 kV
Type rating	4600 kVA, 800 A
Installation altitude	2000 m
Raw water intake temperature	40 °C
k_H (water cooling)	0.925
k_T (raw water intake temperature)	0.925
k_U	1.0

For the current, the following applies:

$I \leq I_N \times 0.925 \times 0.925 = I_N \times 0.856$

A current derating of 14.4 % is required.

The maximum available output current is 685 A.

Technical specifications

SINAMICS SM150 in the IGBT version Air cooling		6SL3810-7NN36-0AA0	6SL3810-7NN38-0AA1	6SL3810-7NP36-0AA0	6SL3810-7NP38-0AA1
Output voltage	**kV**	**3.3**		**4.16**	
Type rating	kVA	3400	4600	4300	5800
Shaft output 1)	kW	2800	3800	3600	4800
	hp	3600	4950	4700	6500
Rated output current	A	600	800	600	800
Input voltage	kV	3.3	3.3	4.16	4.16
Rated input current 1)	A	616	822	616	822
Power loss 2)	kW	76	94	98	118
Efficiency 2)	%	97.3	97.5	97.3	97.5
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 3)	A	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz 4)	A	43	43	43	43
Cooling air flow rate	m^3/s	4.7	4.7	4.7	4.7
Sound pressure level L_{pA} (1 m)	dB	85	85	85	85
Measuring surface level L_s (1 m)	dB	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase 5) 6)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 5) 6)	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 5)	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP22	IP22	IP22	IP22
Dimensions 7)					
• Width	mm	3020	3020	3020	3020
• Height	mm	2570	2570	2570	2570
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 4/4)	Fig. No.	11	11	11	11
Weight 7)	kg	2850	2850	2850	2850

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with synchronous motors for a power factor cos φ = 1 and a motor efficiency of 96 %. The calculation is based on the rated output current. The rated input current also depends on the line power factor, for which a typical value of 1 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Without cooling system.

3) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0,6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

4) Additional 20 A precharging current for 25 s.

5) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit version, Page 4/4.

6) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

7) The specified dimensions and weights include doors and panels, however no options.

Technical specifications

SINAMICS SM150 in the IGBT version Water cooling		6SL3815-7NN38-0AA0	6SL3815-7NN41-0AA1	6SL3815-7NP38-0AA0	6SL3815-7NP41-0AA1
Output voltage	**kV**	**3.3**		**4.16**	
Type rating	kVA	4600	5700	5800	7200
Shaft output [1]	kW	3800	4700	4800	5900
	hp	4950	6350	6500	8000
Rated output current	A	800	1000	800	1000
Input voltage	kV	3.3	3.3	4.16	4.16
Rated input current [1]	A	822	1027	822	1027
Power loss [2] [3]	kW	102	115	132	145
Efficiency [3]	%	97.3	97.6	97.3	97.6
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [4]	A	4	4	4	4
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz [5]	A	20	20	20	20
Raw water flow rate	l/min	283	283	283	283
Deionized water requirement, approx.	l	95	95	95	95
Sound pressure level L_{pA} (1 m)	dB	76	76	76	76
Measuring surface level L_s (1 m)	dB	19	19	19	19
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	4 × 240	4 × 240	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM	4 × 500 MCM
Degree of protection		IP43	IP43	IP43	IP43
Dimensions [8]					
• Width	mm	4220	4220	4220	4220
• Height	mm	2280	2280	2280	2280
• Depth	mm	1275	1275	1275	1275
Circuit version (Page 4/4)	Fig. No.	11	11	11	11
Weight [8]	kg	3500	3500	3500	3500

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with synchronous motors for a power factor cos φ = 1 and a motor efficiency of 96 %. The calculation is based on the rated output current. The rated input current also depends on the line power factor, for which a typical value of 1 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 50. Both approximate values need to be adapted to the motor which is actually used.

2) Approx. 5 % of the power loss is dissipated in the room.

3) Without cooling system.

4) The typical current drawn (rms value; cos $\varphi_{typ.}$ = 0,6) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

5) Additional 20 A precharging current for 25 s.

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit version, Page 4/4.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

Notes

SINAMICS SM150 in IGCT version

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SINAMICS SM150 in IGCT version

Overview

SINAMICS SM150 in the IGCT version

Water-cooled, regenerative feedback SINAMICS SM150 converters in the IGCT version are available as single or multi-motor drives with the well-proven medium-voltage IGCT power semiconductors. With multi-motor drives, a common DC bus enables the direct exchange of energy in generator and motor applications.

IGCT converters are available for the following voltage and outputs:

Rated output voltage	Max. type rating
3.3 kV	10.5 MVA, 21 MVA, 31.5 MVA (for a single circuit configuration, double or triple parallel circuit configurations)

The rated power in the specific application will depend on the necessary load cycle.

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies, possibly necessary derating for parallel circuit configurations, limits regarding the maximum permissible short-circuit current) please contact your Siemens sales partner indicating the required specifications.

Global use

SINAMICS SM150 converters in the IGCT version are manufactured to international standards and regulations, making them ideally suited for global use. These converters are also available in ship-going form (meeting the requirements of all major classification organizations).

Benefits

- Compact design and highly flexible configuration ensures easy plant integration
- Simple operator control and monitoring from the user-friendly operator panel
- Simple and reliable operation through integrated maintenance functions: The converter signals early on and automatically if maintenance is required or components need to be replaced
- High degree of ruggedness and reliability due to the use of IGCT power semiconductors in the high power range and fuseless design combined with an intelligent response to external disturbances
- Can be easily integrated into automation solutions as the PROFIBUS interface is supplied as standard along with various analog and digital interfaces
- High level of service-friendliness through innovative power unit design with compact phase modules and easy access to all components
- By appropriately engineering the drive system, reactive power can be made available to other drives, therefore helping ensure that the plant or system is cost effective.

Design

Active Line Modules and Motor Modules share an almost identical structure with both the single-motor and the multi-motor drive. Phase modules in which IGCTs, diodes etc. are grouped together in one compact system are used in both.

Single-motor drive

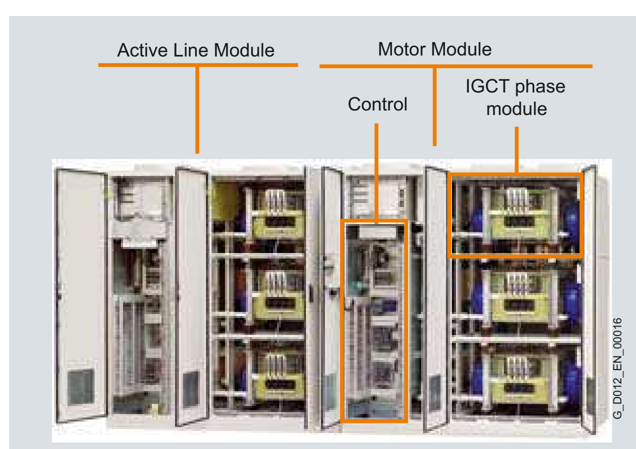
With a single-motor drive in the basic circuit, one Active Line Module and one Motor Module are connected via a DC link.

For greater output ratings, two or three complete converter units with isolated DC links are operated in parallel.

Multi-motor drive

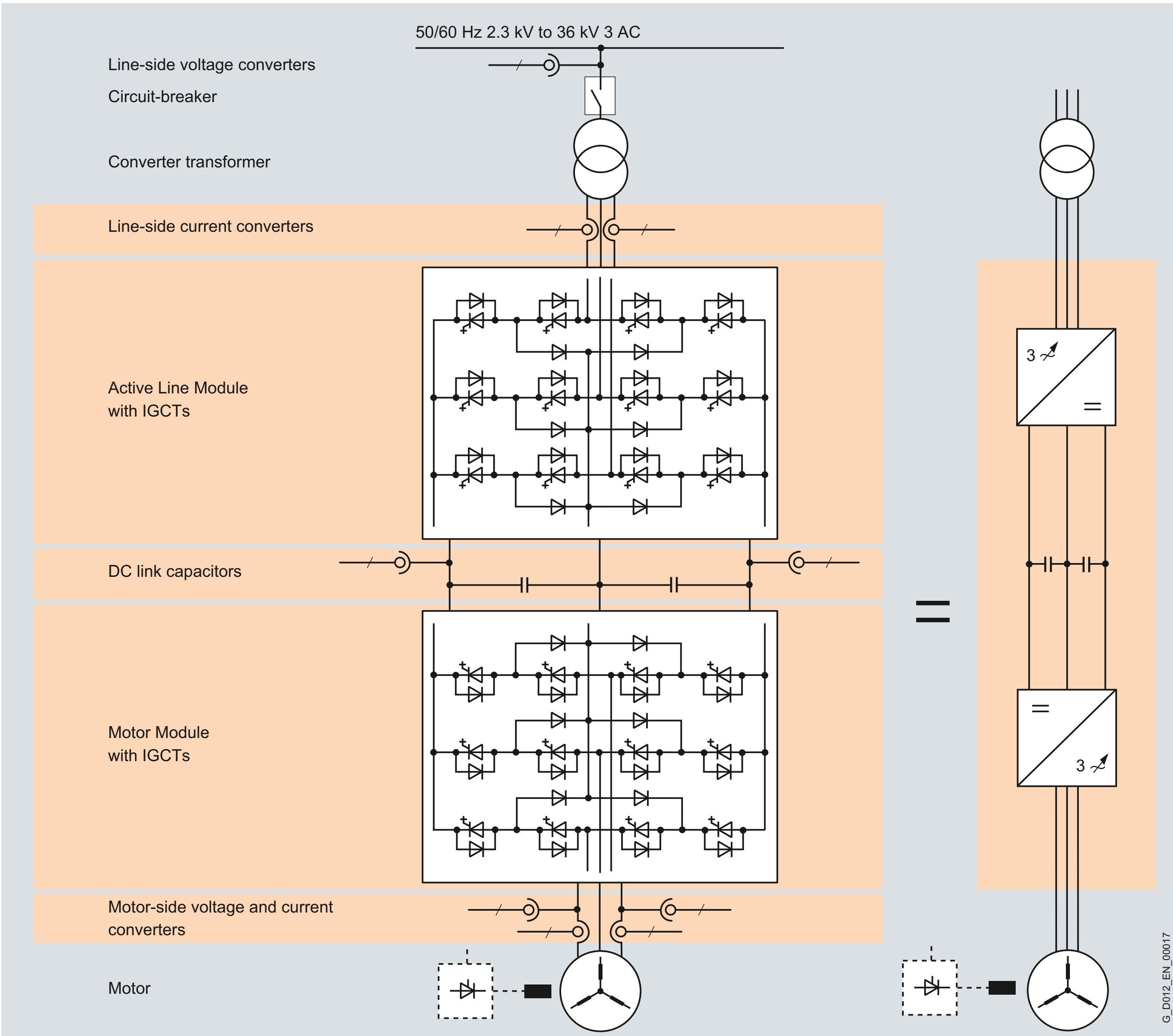
With multi-motor drives, up to six power units are operated on the common DC bus. In addition to the Active Line Module, four Motor Modules with four motors can be operated on the common DC bus where energy can be directly exchanged. In this case, configurations are also possible with two Active Line Modules.

The converter consists of cabinet units for the Active Line Module and for the Motor Module. One of three phase modules and the control section in the Motor Module cabinet unit are highlighted in the illustration.



SINAMICS SM150 in the IGCT version, internal design (without cooling unit)

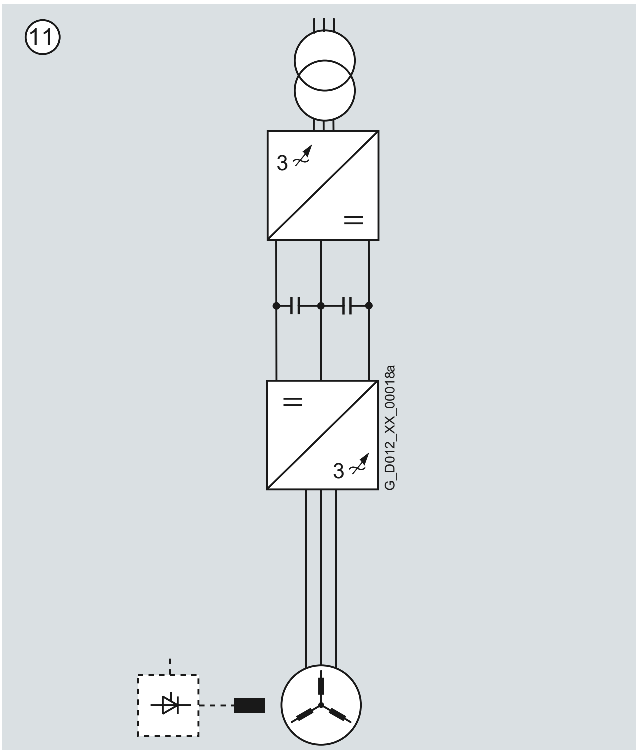
Design



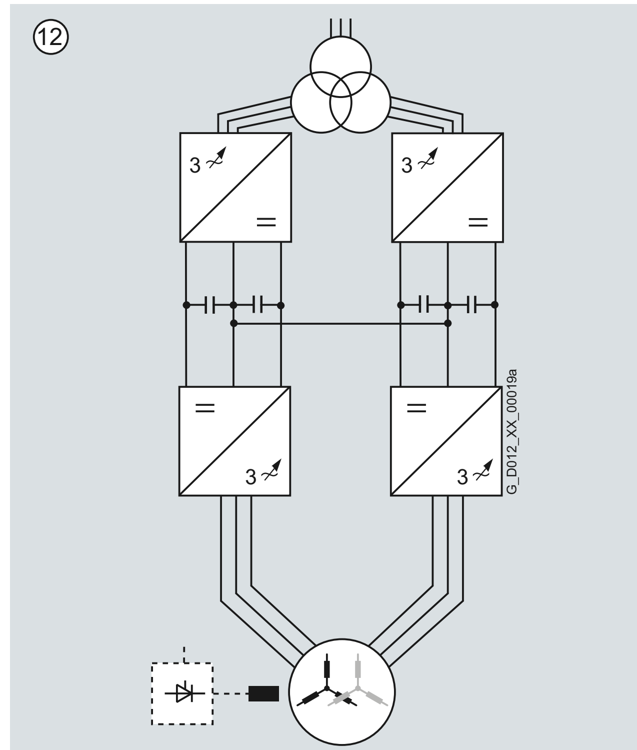
Block diagram

Design

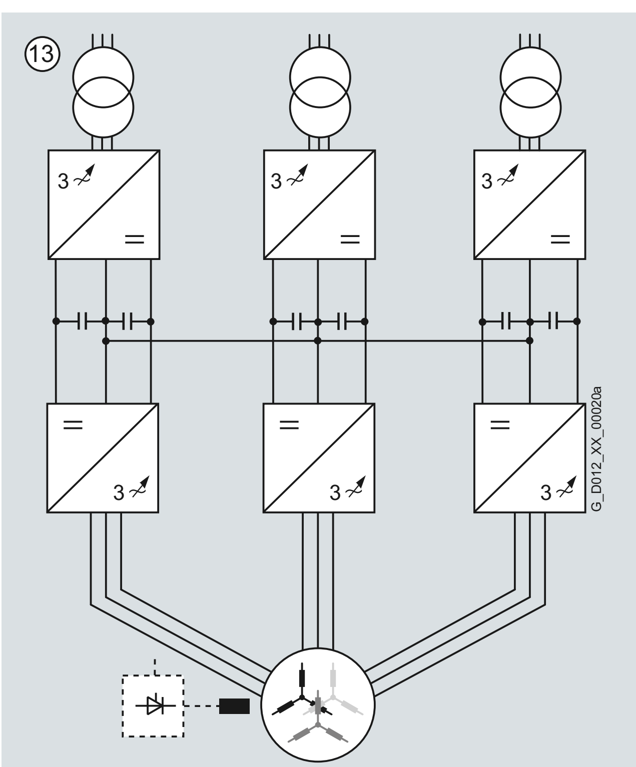
Folgende Schaltungsvarianten stehen für SINAMICS SM150 in IGCT-Ausführung zur Verfügung.



Basic circuit



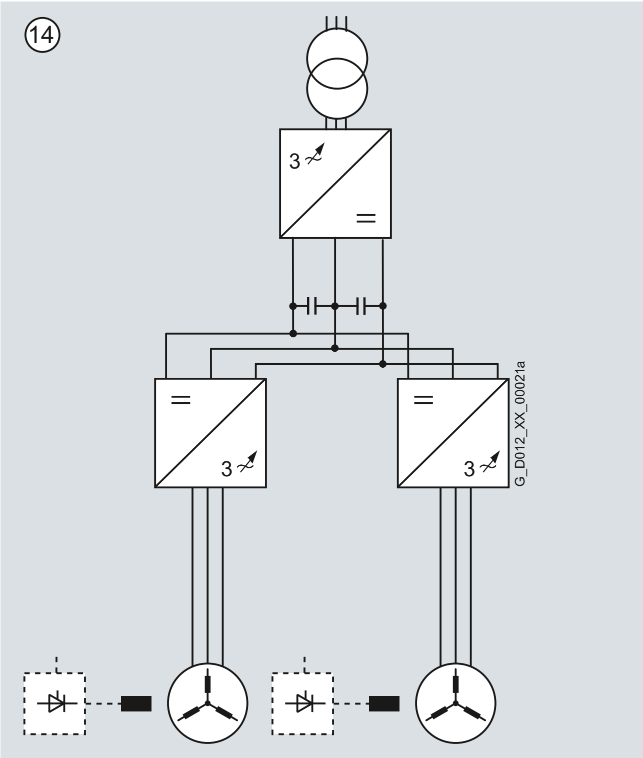
Two converter units operated in parallel in order to increase the output (with reduction of circuit feedbacks in addition) [1)]



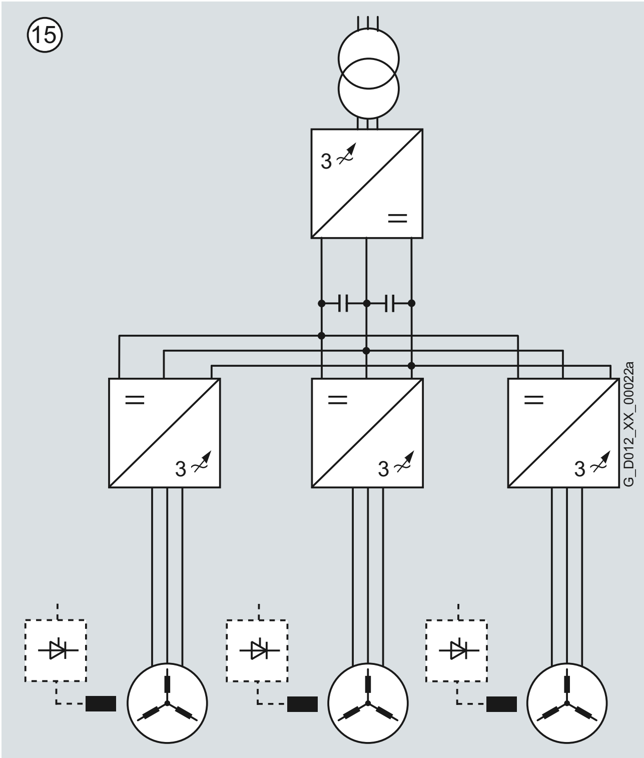
Three converter units operated in parallel in order to increase the output (with reduction of circuit feedbacks in addition) [1)]

[1)] Requires a motor with separate winding systems.

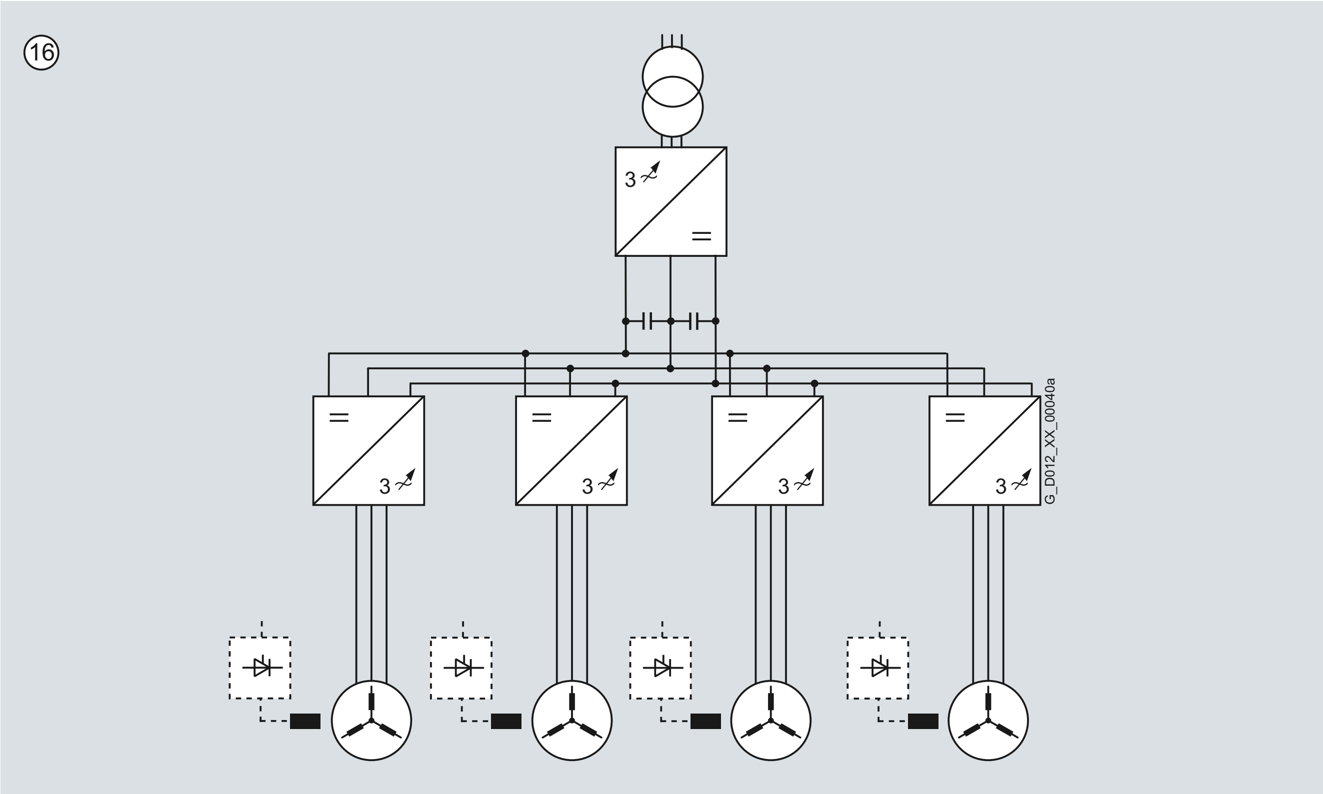
Design



DC bus configuration with two motors on common DC link



DC bus configuration with three motors on common DC link



DC bus configuration with four motors on a common DC link

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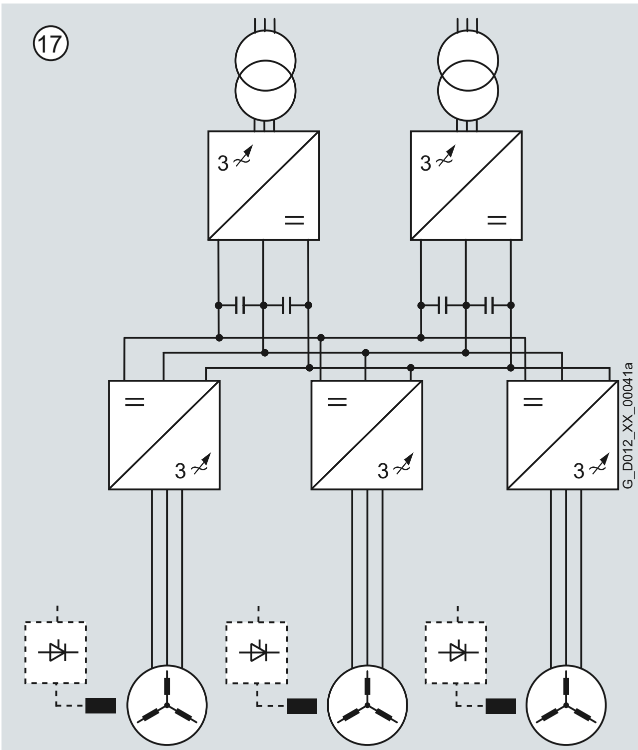
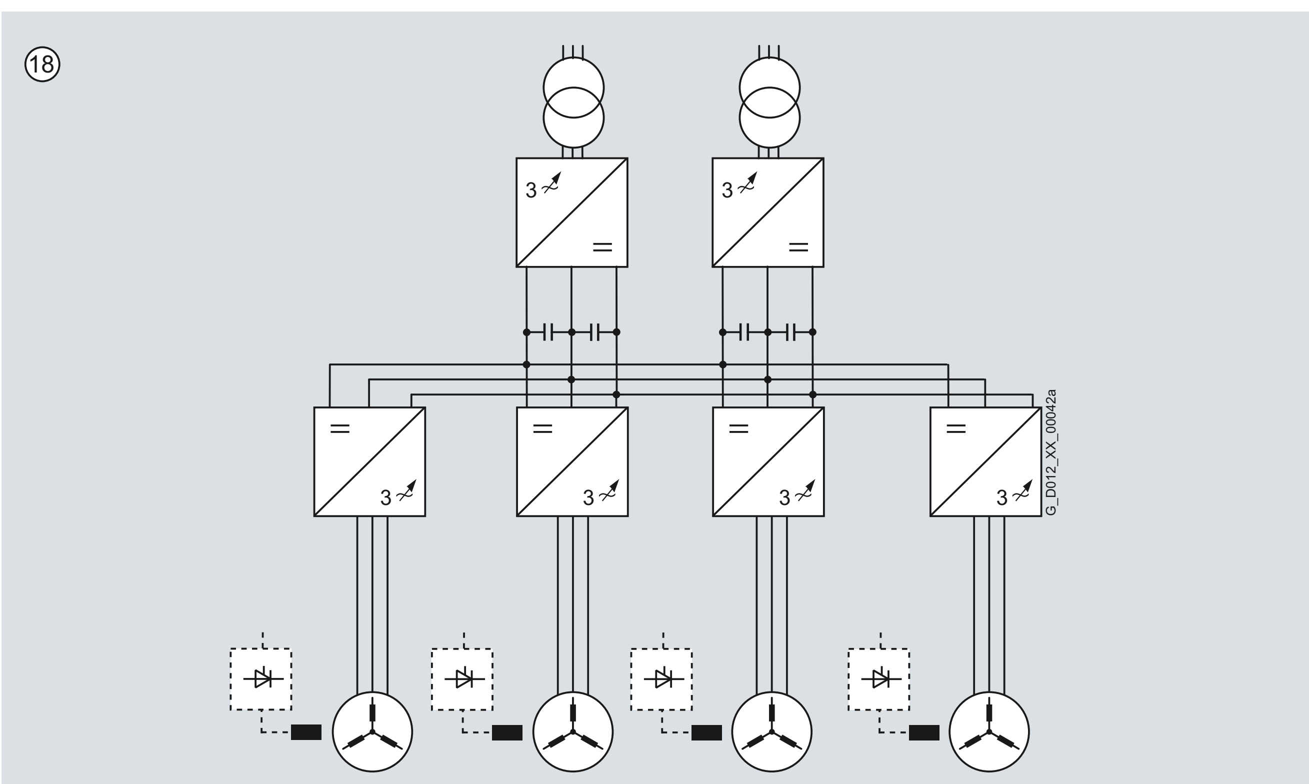
Design

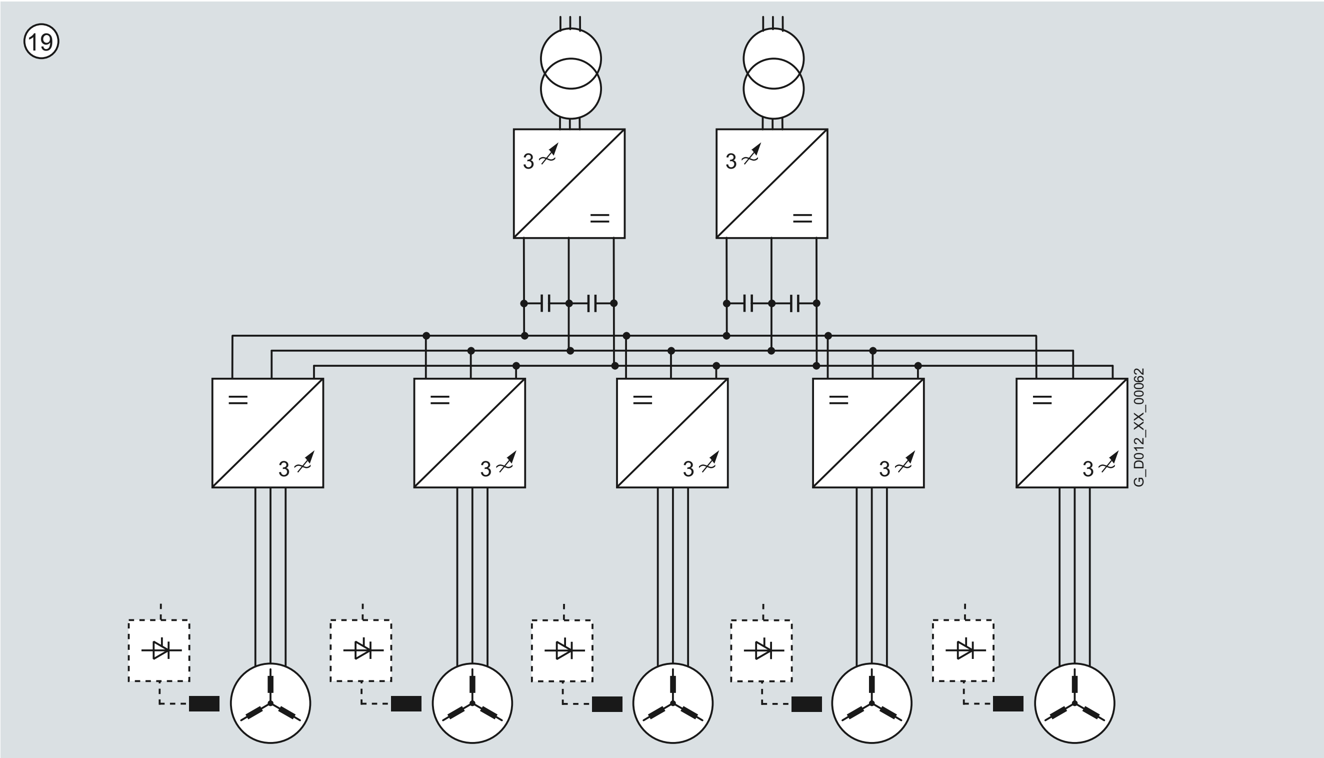


DC bus configuration with two Active Line Modules and three motors on a common DC link

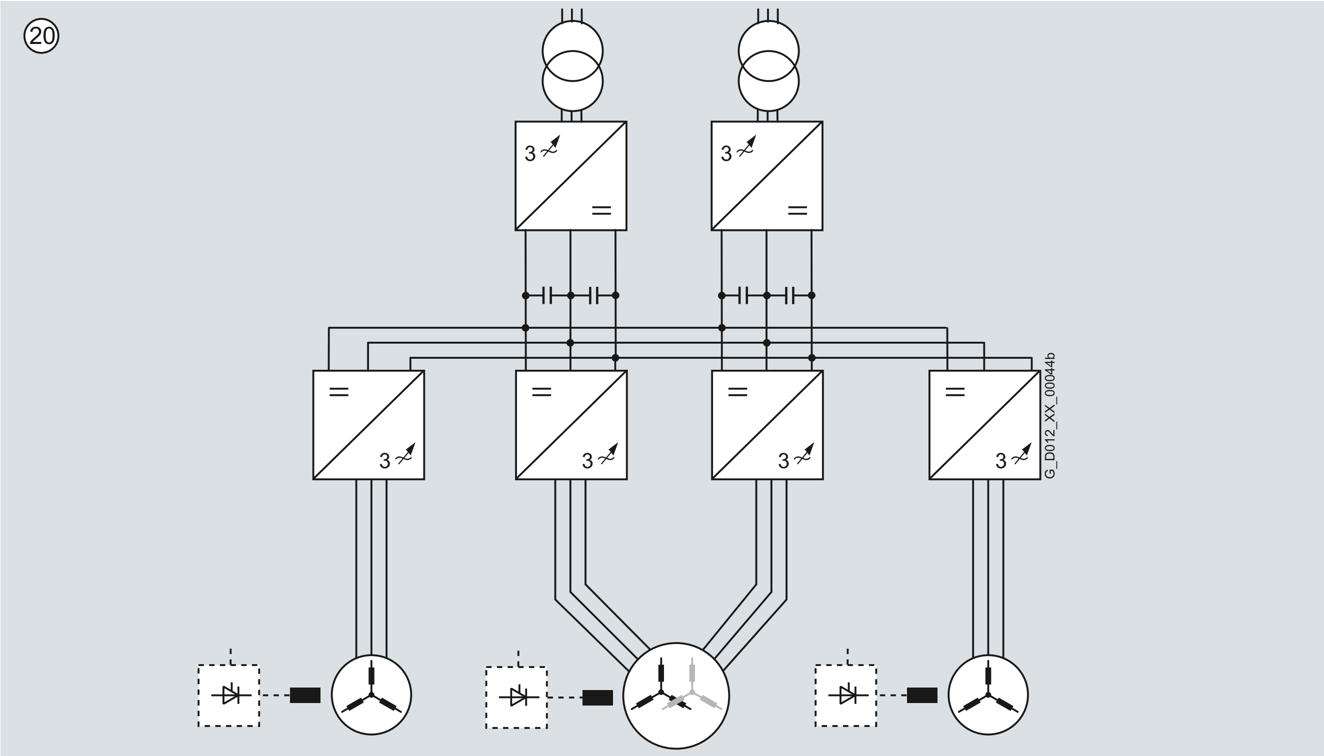


DC bus configuration with two Active Line Modules and four motors on a common DC link

Design



DC bus configuration with two Active Line Modules and five motors on a common DC link



DC bus configuration with two Active Line Modules and three motors on a common DC link (2 × 10 MVA, 1 × 20 MVA)

For the DC bus configurations with two or more motors, energy can be exchanged along the common DC link between drives that are either motoring or regenerating. This results in savings in the Active Line Module, the transformers and the circuit breakers. These configurations are used mainly for single-stand cold rolling mills with a coiler and for transmission test stands.

Function

Characteristic features

SINAMICS SM150 in the IGCT version	
Line Module (rectifier on mains side)	
Active Line Module (four-quadrant operation)	Standard
Motor Module (rectifier on motor side)	
Voltage range	3.3 kV
Power range (typ.)	5 ... 31.5 MVA
Cooling method	
• Water cooling	Standard
Control modes	Standard: With encoder
• Induction motor	Standard
• Synchronous motor, separately excited	Option
• Synchronous motor, separately excited, with brushless excitation system	On request
• Synchronous motor, permanently excited	Option
DC bus configuration with several Motor Modules on one common DC bus	Standard

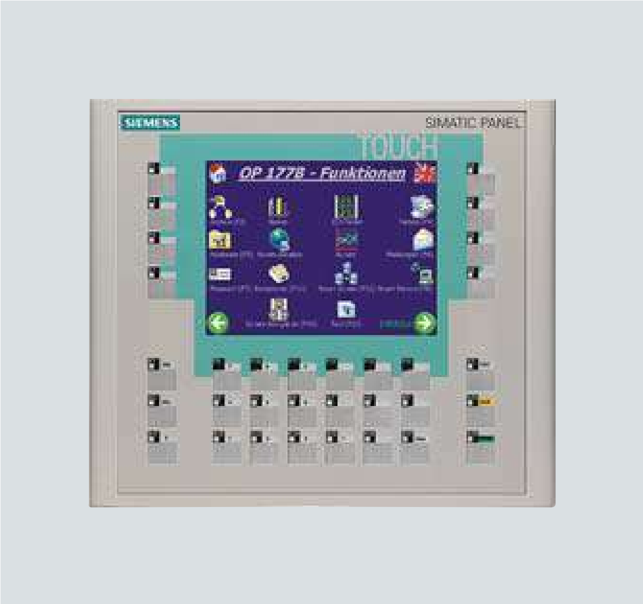
Software and protection functions

SINAMICS SM150 in the IGCT version	Description
Closed-loop control	The motor-side closed-loop control is realized as a field-oriented closed-loop vector control that can be operated as a speed or torque control as required. The closed-loop vector control achieves the dynamic performance of a DC drive. This is made possible by the fact that the current components forming the torque and flux can be controlled precisely independently of each other. Prescribed torques can thus be observed and limited accurately. In the speed range from 1:10, the field-oriented closed-loop control does not require an actual speed value encoder. An actual speed value encoder is required in the following scenarios: • High dynamics requirements • Torque control/constant torque drives with a control range > 1:10 • Very low speeds • Very high speed accuracy
Setpoint input	The setpoint can be defined internally or externally; internally as a fixed setpoint, motorized potentiometer setpoint or jog setpoint, externally via the PROFIBUS interface or an analog input of the customer's terminal strip. The internal fixed setpoint and the motorized potentiometer setpoint can be switched over or adjusted using control commands via all interfaces.
Ramp-function generator	A user-friendly ramp-function generator with separately adjustable ramp-up and ramp-down times, together with variable smoothing times in the lower and upper speed ranges, improves the control response and therefore prevents mechanical overloading of the drive train. The ramp-down ramps can be parameterized separately for emergency stop.
$V_{dc\ max}$ controller	The $V_{dc\ max}$ controller automatically prevents overvoltages in the DC link if the down ramp is too short, for example. This can also extend the set ramp-down time.
Kinetic buffering (KIP)	Power supply failures are bridged to the extent permitted by the kinetic energy of the drive train. The speed drops depending on the moment of inertia and the load torque. The current speed setpoint is resumed when the power supply returns.
Automatic restart	The automatic restart switches the drive on again when the power is restored after a power failure or a general fault, and ramps up to the current speed setpoint.
Flying restart	The flying restart function permits smooth connection of the converter to a rotating motor.
Diagnostics functions	• Self-diagnosis of control hardware • Non-volatile memory for reliable diagnosis when the power supply fails • Monitoring the IGCTs with individual messages for each mounting location • User-friendly on-site operator panel with plain text messages
Operating hours and switching cycle counter	The switching cycles of the circuit breakers are detected and summed to form the basis for preventive maintenance work.
Operator protection	The cabinet doors of the power units are fitted with electromagnetic locks. This prevents the cabinet doors being opened while hazardous voltages are connected inside the cabinet.

Function

SINAMICS SM150 in the IGCT version	Description
EMERGENCY-OFF button	The converters are equipped as standard with an EMERGENCY-OFF button with protective collar which is fitted in the cabinet door. The contacts of the button are connected in parallel to the terminal strip so they can be integrated in a protection concept on the plant side. EMERGENCY-OFF stop category 0 is set as standard for an uncontrolled shutdown (DIN EN 60204-1/VDE 0113-1 (IEC 60204-1)). The function includes voltage disconnection of the converter output through the circuit breaker. The motor coasts in the process. The control of the "Safe Torque Off" function is optionally available (option **K80**).
Insulation monitoring	The converters feature insulation monitoring of the complete electrical circuit from the secondary side of the transformer to the stator windings of the motor.
Monitoring of the peripherals	An extensive package of options for I/O monitoring (from the transformer and the motor through to the auxiliaries) is available. In addition it is possible to monitor the temperature with thermocouples or Pt100 resistors.
Thermal overload protection	An alarm message is issued first when the overtemperature threshold is reached. If the temperature rises further, either a shutdown is carried out or automatic influencing of the output current so that a reduction in the thermal load is achieved. Following elimination of the cause of the fault (e.g. improvement in the ventilation), the original operating values are automatically resumed. In the case of water-cooled converters, the water temperature and flow rate are recorded at several points in the cooling circuit and evaluated. An extensive self-diagnosis protects the converter and reports faults.
Grounding switch (option)	If grounding on the infeed or motor side is required for safety and protection reasons, a motorized grounding switch can be ordered. For safety reasons, the converter controller locks these grounding switches against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.

SIMATIC OP 177B operator panel



The SIMATIC OP 177B operator panel is fitted into the cabinet door of the SINAMICS SM150 to enable operation, monitoring and commissioning.

It has the following features and characteristics:

- 5.7" STN touch display
- Context-dependent operations by touch, permanently available functions can be selected using individual keys
- Non-volatile message buffer, no battery

English and German are available as operator panel languages.

Selection and ordering data

Type rating	Shaft output		Rated output current	SINAMICS SM150 in the IGCT version	Circuit versions (Pages 5/4 to 5/7)
kVA	kW	hp	A	Order No.	Fig. No.
Output voltage 3.3 kV					
10000	9600	13000	1750	**6SL3845-7NN41-8AA0**	⑪
20000	19200	26000	2 × 1750	**6SL3845-7NN43-6AA0**	⑫
30000	28800	39000	3 × 1750	**6SL3845-7NN45-4AA0**	⑬
10000 1)	9600	13000	2 × 1750	**6SL3845-7NN41-8AB0**	⑭
10000 1)	9600	13000	3 × 1750	**6SL3845-7NN41-8AC0**	⑮
10000 1)	9600	13000	4 × 1750	**6SL3845-7NN41-8AD0**	⑯
10000 1)	9600	13000	3 × 1750	**6SL3845-7NN41-8AF0**	⑰
10000 1)	9600	13000	4 × 1750	**6SL3845-7NN41-8AG0**	⑱
10000 1)	9600	13000	5 × 1750	**6SL3845-7NN41-8AK0**	⑲
20000 1)	19200	26000	1 × (2 × 1750) +2 × 1750	**6SL3845-7NN43-6AF0**	⑳
10500	10200	13500	1850	**6SL3845-7NN42-2AA0**	⑪
21000	20400	27000	2 × 1850	**6SL3845-7NN44-5AA0**	⑫
31500	30600	40500	3 × 1850	**6SL3845-7NN46-7AA0**	⑬

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Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies, possibly necessary derating for parallel circuit configurations, limits regarding the maximum permissible short-circuit current) please contact your Siemens sales partner indicating the required specifications.

1) The underlying circuits are based on a drive line-up in which the drives operate both as motor and generator. Energy is exchanged via the DC link. The specified power corresponds to the maximum infeed power. The effective total power of the Motor Modules (taking into account the power flow direction) may not exceed this infeed power.

Options

When ordering a converter with options, add **"-Z"** to the order number of the converter, followed by the order code(s) for the desired option(s).

Example:

6SL3845-1NN41-8AA0-Z
+N06+M10+...

In the following tables, related options are arranged in groups. Whether the options can be combined or are mutually exclusive is indicated within these groups. A detailed description of the options can be found in Chapter 6.

Input-side options	
Circuit breaker at the converter input (on request)	**N13**

Output-side options		**L08**	**L52**	**L72**	**Y73**
Output reactor	**L08**		✓	✓	✓
Circuit breaker at converter output [1)]	**L52**	✓		✓	✓
Braking Module (on request)	**L72**	✓	✓		✓
Braking resistor (on request)	**Y73**	✓	✓	✓	

[1)] Option **L52** cannot be combined with option **L51** (disconnector at converter output).

Capacitor Modules to increase the DC link capacitance		**N06**	**N07**	**N08**
Capacitor Module to increase the DC link capacitance (1 module)	**N06**		–	–
Capacitor Modules to increase the DC link capacitance (2 modules)	**N07**	–		–
Capacitor Modules to increase the DC link capacitance (3 modules)	**N08**	–	–	

Protective functions		**K80**	**L48**	**L49**	**L51**	**M10**
Control of "Safe Torque Off" function	**K80**		✓	✓	✓	✓
Make-proof grounding switch at converter input (motor-operated)	**L48**	✓		✓	✓	✓
Make-proof grounding switch at converter output (motor-operated)	**L49**	✓	✓		✓	✓
Disconnector at converter output [1)]	**L51**	✓	✓	✓		✓
Safety interlocking system	**M10**	✓	✓	✓	✓	

[1)] Option **L51** cannot be combined with option **L52** (circuit breaker at converter output).

✓	Options can be combined
–	Options are mutually exclusive

Options

Temperature sensing and evaluation (standard: 3 Pt100 inputs)		L80	L81	L82	L90	L91	L92	L93	L94	L95	L96
2 thermistor motor protection relays for alarm and fault [1]	**L80**		–	–	✓	✓	✓	✓	✓	✓	✓
2 x 2 thermistor protection relays for alarm and fault[1]	**L81**	–		–	✓	✓	✓	✓	✓	✓	✓
3 x 2 thermistor protection relays for alarm and fault[1]	**L82**	–	–		✓	✓	✓	✓	✓	✓	✓
Pt100 evaluation unit with 3 inputs[1]	**L90**	✓	✓	✓		–	–	–	–	–	–
2 Pt100 evaluation units with 3 inputs each[1]	**L91**	✓	✓	✓	–		–	–	–	–	–
3 Pt100 evaluation units with 3 inputs each[1]	**L92**	✓	✓	✓	–	–		–	–	–	–
Pt100 evaluation unit with 6 inputs and 2 analog outputs (outputs for display connected to the control system)[1]	**L93**	✓	✓	✓	–	–	–		–	–	–
2 Pt100 evaluation units each with 6 inputs and 2 analog outputs (outputs for display connected to the control system)[2]	**L94**	✓	✓	✓	–	–	–	–		–	–
Pt100 evaluation unit with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system)[1]	**L95**	✓	✓	✓	–	–	–	–	–		–
2 Pt100 evaluation units each with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system)[2]	**L96**	✓	✓	✓	–	–	–	–	–	–	

[1] Options **L..** cannot be combined with option **G61** (additional TM31 Terminal Module).

[2] Option **L94** and **L96** cannot be combined with options **G61** and **G62** (additional Terminal Modules TM31) as well as with option **E86** (additional analog inputs).

Increased degree of protection of the control cabinets in the water-cooled version (standard: IP43)	
IP54 degree of protection	**M54**

Controlled motor feeder for auxiliaries [1]		N30	N31	N32	N33
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 4/4.8 kW	**N30**		–	–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 7/8 kW	**N31**	–		–	–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 11/12.7 kW	**N32**	–	–		–
Controlled motor feeder for auxiliaries 440/480 V 3 AC, max. 15/17.5 kW	**N33**	–	–	–	

[1] With the ON command at the converter, the contactor is **closed**, and with the OFF command, the contactor is **opened** (example: external fan on the motor). The supply voltage for the auxiliaries must be provided externally.

✓	Options can be combined
–	Options are mutually exclusive

Options

Controlled outgoing feeder for auxiliaries [1]		N35	N36	N37	N38
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 1.2/1 kW	**N35**		–	–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 2.2/1.5 kW	**N36**	–		–	–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 3.5/2.1 kW	**N37**	–	–		–
Controlled outgoing feeder for auxiliaries 230/120 V 1 AC, max. 4.5/2.8 kW	**N38**	–	–	–	

[1] With the ON command at the converter, the contactor is **opened**, and with the OFF command, the contactor is **closed** (example: heater). The supply voltage for the auxiliaries must be provided externally.

Connection of signal cables (standard: signal cable connected directly to the terminals of the Terminal Modules)		M32	M33	M36
Customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2	**M32**		–	✓
Customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2	**M33**	–		✓
Cable entry, brass for power cables	**M36**	✓	✓	

Operator control and display instruments in the door of the control cabinet		K20	K21	K22
Indicator lights and Start/Stop button in the cabinet door	**K20**		–	–
Display instruments in the cabinet door for voltage, current, speed and power as well as indicator lights and start/stop buttons	**K21**	–		–
Display instruments in the cabinet door for current, speed, power and winding temperature as well as indicator lights and start/stop buttons	**K22**	–	–	

Interface modules for connection to external bus systems (standard: PROFIBUS (Slave))	
PROFINET interface (via CBE30, on request)	**G34**

Interface modules for additional customer connections		G61	G62	G63
Additional TM31 Terminal Module [1]	**G61**		✓	✓
Second additional TM31 Terminal Module [1]	**G62**	✓		✓
Additional TM15 Terminal Module	**G63**	✓	✓	

[1] For the exclusions for options **G61** and **G62** see the description of the options, Page 6/16.

✓	Options can be combined
–	Options are mutually exclusive

Options

Additional analog inputs/outputs (isolated)		E86	E87
Additional analog inputs (isolated) [1]	E86		✓
Additional analog outputs (isolated) [2]	E87	✓	

[1] Option **E86** cannot be combined with option **G62** (second additional TM31 Terminal Module) as well as with options **L94** and **L96** (2 Pt100 evaluation units).
[2] Option **E87** cannot be combined with option **G62** (second additional TM31 Terminal Module).

Other interface modules		G66	G70	G71
PADU8 diagnostic module (8 analog and 8 digital signals)	G66		✓	✓
Pulse distributor to transfer the speed encoder signal	G70	✓		✓
Optical bus terminal (OBT) for PROFIBUS	G71	✓	✓	

5

Industry-specific options	
NAMUR terminal strip	B00

Functional options		E00	E01	E02	E03
Control for separately-excited synchronous motors (static excitation unit is provided on the plant side)	E00		–	–	–
Control for separately excited synchronous motors with slipring excitation	E01	–		–	–
Control for separately excited synchronous motors with brushless excitation system (on request)	E02	–	–		–
Control for permanently-excited synchronous motors [1]	E03	–	–	–	

[1] Option **E03** can only be ordered in combination with option **L52** (circuit breaker at the converter output).

Documentation (standard: PDF format in English on CD-ROM)		B43	B44	B45	D02	D15	Y10
Production flowchart: Generated once	B43		–	–	✓	✓	✓
Production flowchart: Updated every two weeks	B44	–		–	✓	✓	✓
Production flowchart: Updated every month	B45	–	–		✓	✓	✓
Circuit diagrams, terminal diagrams and dimension drawings in DXF format [1]	D02	✓	✓	✓		✓	✓
One set of printed documentation (multiple orders possible)	D15	✓	✓	✓	✓		✓
Circuit diagrams with customer-specific text field (plain text required) [1]	Y10	✓	✓	✓	✓	✓	

[1] The equipment-specific documents (circuit diagrams etc.) are only available in English/German.

✓	Options can be combined
–	Options are mutually exclusive

Options

Documentation in languages (standard: PDF format in English on CD-ROM)		D00	D55	D56	D57	D72	D76	D77	D78	D79	D84
Documentation in German	**D00**		–	–	–	–	✓	–	–	–	–
Documentation in Polish	**D55**	–		–	–	–	✓	–	–	–	–
Documentation in Russian	**D56**	–	–		–	–	✓	–	–	–	–
Documentation in Japanese (on request)	**D57**	–	–	–		–	✓	–	–	–	–
Documentation in Italian (on request)	**D72**	–	–	–	–		✓	–	–	–	–
Documentation in English (additional CD-ROM in English, irrespective of the selected language)	**D76**	✓	✓	✓	✓	✓		✓	✓	✓	✓
Documentation in French	**D77**	–	–	–	–	–	✓		–	–	–
Documentation in Spanish	**D78**	–	–	–	–	–	✓	–		–	–
Documentation in Portuguese (Brazil)	**D79**	–	–	–	–	–	✓	–	–		–
Documentation in Chinese	**D84**	–	–	–	–	–	✓	–	–	–	

Rating plate language (standard: English/German)		T58	T60	T80	T82	T85	T86	T90	T91
Rating plate in English/French	**T58**		–	–	–	–	–	–	–
Rating plate in English/Spanish	**T60**	–		–	–	–	–	–	–
Rating plate in English/Italian	**T80**	–	–		–	–	–	–	–
Rating plate in English/Portuguese (on request)	**T82**	–	–	–		–	–	–	–
Rating plate in English/Russian (on request)	**T85**	–	–	–	–		–	–	–
Rating plate in English/Polish (on request)	**T86**	–	–	–	–	–		–	–
Rating plate in English/Japanese (on request)	**T90**	–	–	–	–	–	–		–
Rating plate in English/Chinese (on request)	**T91**	–	–	–	–	–	–	–	

Converter acceptance inspections in presence of customer		F03	F73	F77	F79	F97
Visual acceptance of converter	**F03**		–	–	–	–
Functional acceptance of converter with inductive load (on request)	**F73**	–		✓	✓	–
Acceptance of the converter insulation test (on request) [1)]	**F77**	–	✓		✓	–
Test of the interface between the converter and customer equipment (5 hours, on request) [1)]	**F79**	–	✓	✓		–
Customer-specific system acceptance tests (on request)	**F97**	–	–	–	–	

[1)] Options **F77** and **F79** can only be ordered in conjunction with option **F73** .

✓ Options can be combined
– Options are mutually exclusive

Options

Cooling unit (standard: Cooling unit with redundant pumps and a		W02	W11	W12	W14	Y40
Cooling unit with redundant stainless steel plate-type heat exchangers	**W02**		–	–	–	–
Cooling unit with titanium plate-type heat exchanger	**W11**	–		–	–	–
Cooling unit with redundant titanium plate-type heat exchangers	**W12**	–	–		–	–
Converter without cooling unit (provided on the system side)	**W14**	–	–	–		–
Raw water data that deviates from the technical data (on request) [1]	**Y40**	–	–	–	–	

[1] Option **Y40** includes a cooling system which is adapted to the raw water data according to the customer's specifications.

Extension of the liability for defects		Q80	Q81	Q82	Q83	Q84	Q85
Extension of the liability for defects period by 12 months to a total of 24 months (2 years) after being delivered	**Q80**		–	–	–	–	–
Extension of the liability for defects period by 18 months to a total of 30 months (2.5 years) after being delivered	**Q81**	–		–	–	–	–
Extension of the liability for defects period by 24 months to a total of 36 months (3 years) after being delivered	**Q82**	–	–		–	–	–
Extension of the liability for defects period by 30 months to a total of 42 months (3.5 years) after being delivered	**Q83**	–	–	–		–	–
Extension of the liability for defects period by 36 months to a total of 48 months (4 years) after being delivered	**Q84**	–	–	–	–		–
Extension of the liability for defects period by 48 months to a total of 60 months (5 years) after being delivered	**Q85**	–	–	–	–	–	

Miscellaneous options		L50	L55	Y05	Y09
Cabinet lighting and service socket in the control section	**L50**		✓	✓	✓
Anti-condensation heating for the cabinet	**L55**	✓		✓	✓
Customer-specific rating plate	**Y05**	✓	✓		✓
Special paint finish acc. to RAL.... (in a color other than RAL 7035; plain text required)	**Y09**	✓	✓	✓	

✓ Options can be combined
– Options are mutually exclusive

Technical specifications

General technical data	
Power components	IGCTs
Line-side converter	Regulated, self-commutating feed/feedback unit (Active Line Module)
Motor-side conveter	Inverter (Motor Module)
Closed-loop control	Closed-loop vector control
Drive quadrants	4 (driving and braking per 2 directions of rotation)
Electrical isolation, power unit/ open-loop and closed-loop control	Fiber-optic cable, isolating transformer
Auxiliary power supply (for fans, coolant pumps, precharging the DC link capacitors, open-loop and closed-loop control)	230 V 1 AC ±10 %, 50/60 Hz ±3 % and 400 V 3 AC ±10 %, 50/60 Hz ±3 %
Installation altitude	≤ 1000 m above sea level: 100 % load capability > 1000 ... 4000 m above sea level: current derating required > 2000 ... 4000 m above sea level: voltage derating required in addition
Insulation	According to EN 50178/VDE 0160 (IEC 62103): Pollution degree 2 (without conductive pollution), condensation not permissible
Degree of protection	According to EN 60529/VDE 0470 T1 (IEC 60529): IP43
Protection class	I acc. to EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1)
Shock-hazard protection	EN 50274/VDE 0660 T514 and BGV A3 when used for the intended application
Interference transmission	This drive unit is part of a PDS, Category C4 acc. to EN 61800-3/VDE 0160 T103 (IEC 61800-3). It has not been designed to be connected to the public line supply. EMC disturbances can occur when connected to these line supplies. The essential requirements placed on EMC protection for the drive system should be secured using an EMC plan on the customer side.
Paint finish/color	Indoor requirements/RAL 7035, light gray
Applicable standards and directives	
• Standards	EN 61800-3/VDE 0160 T103 (IEC 61800-3) EN 61800-4/VDE 0160 T104 (IEC 61800-4), however, only if referenced in the standards EN 61800-3 or EN 61800-5-1 EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1) EN 60146-1-1/VDE 0558 T11 (IEC 60146-1-1) EN 50178/VDE 0160 (IEC 62103) EN 60204-11/VDE 0113 T11 (IEC 60204-11), however, structuring principles and reference marking according to EN 61346-1 instead of EN 81346-1
• EU directives	2006/95/EC + amendments (Low Voltage Directive) 2004/108/EC + amendments (Electromagnetic Compatibility)
Water cooling	Water-water cooling unit, internal circuit, deionized water
Permissible coolant temperature (raw water)	
• Inlet	5 ... 35 °C
• Discharge, max.	40 °C

Rated data	
Output voltage	**3.3 kV**
Input voltage	3.3 kV
Tolerance of input voltage	±10 %
Line frequency	50/60 Hz ± 3 %
Line power factor fundamental mode	1

Technical specifications

	Operation of induction motors		Operation of separately excited synchronous motors
	Without speed encoder	With speed encoder	With speed encoder
Control properties			
Operating range			
• Lower limit of speed control range (% of rated motor speed)	5 %	0 %	0 %
• Max. permissible output frequency	250 Hz	250 Hz	90 Hz
• Field-weakening range	1:3	1:3	1:4
Stationary operation			
• Speed accuracy (% of rated motor speed)	±0.2 % (from 5 % of rated speed)	±0.01 %	±0.01 %
• Torque accuracy (% of rated torque)	±5 % (from 5 % of rated speed)	±5 %	±2 %
Dynamic operation			
• Torque rise time	5 ms	5 ms	5 ms

	Storage	Transport	Operation
Climatic ambient conditions			
Ambient temperature	-25 ... +70 °C	-25 ... +70 °C	5 ... 45 °C
Relative air humidity	5 ... 95 % (only slight condensation permitted; converter must be completely dry before commissioning)	5 ... 75 %	5 ... 85 % (condensation not permissible)
Other climatic conditions in accordance with Class	1K3 according to EN 60721-3-1 (IEC 60721-3-1) (icing not permitted)	2K2 according to EN 60721-3-2 (IEC 60721-3-2)	3K3 according to EN 60721-3-3 (IEC 60721-3-3)
Degree of pollution	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)	2 without conductive pollution according to EN 50178/VDE 0160 (IEC 62103)
Mechanical ambient conditions			
Vibratory load			
• Deflection	1.5 mm at 2 ... 9 Hz	3.5 mm at 2 ... 9 Hz	0.3 mm at 2 ... 9 Hz
• Acceleration	5 m/s^2 at 9 ... 200 Hz	10 m/s^2 at 9 ... 200 Hz 15 m/s^2 at 200 ... 500 Hz	1 m/s^2 at 9 ... 200 Hz
Other mechanical conditions in accordance with Class (increased strength for marine duty)	1M2 acc. to DIN EN 60721-3-1 (IEC 60721-3-1)	2M2 acc. to DIN EN 60721-3-2 (IEC 60721-3-2)	3M1 acc. to DIN EN 60721-3-3 (IEC 60721-3-3)
Other ambient conditions			
Biological ambient conditions in accordance with Class	1B1 according to EN 60721-3-1 (IEC 60721-3-1)	2B1 according to EN 60721-3-2 (IEC 60721-3-2)	3B2 according to EN 60721-3-3 (IEC 60721-3-3) (without harmful flora)
Chemically active substances in accordance with Class	1C1 according to EN 60721-3-1 (IEC 60721-3-1)	2C1 according to EN 60721-3-2 (IEC 60721-3-2)	3C2 according to EN 60721-3-3 (IEC 60721-3-3) (no occurrence of salt mist)
Mechanically active substances in accordance with Class	1S1 according to EN 60721-3-1 (IEC 60721-3-1)	2S1 according to EN 60721-3-2 (IEC 60721-3-2)	3S1 according to EN 60721-3-3 (IEC 60721-3-3)

Note:

The values specified under storage and transport apply to suitably packed converters.

Technical specifications

Derating for special installation conditions

Current derating

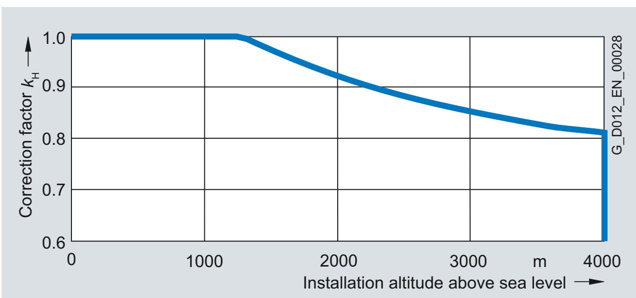
If the converters are operated at installation altitudes above 1000 m above sea level or at deionized water temperatures > 40 °C or raw water temperatures > 35 °, derating factors k_H or k_T must be taken into account for the rated output current (DIN 43671). For the permitted continuous current I:

$I \leq I_N \times k_H \times k_T$

I permitted continuous current

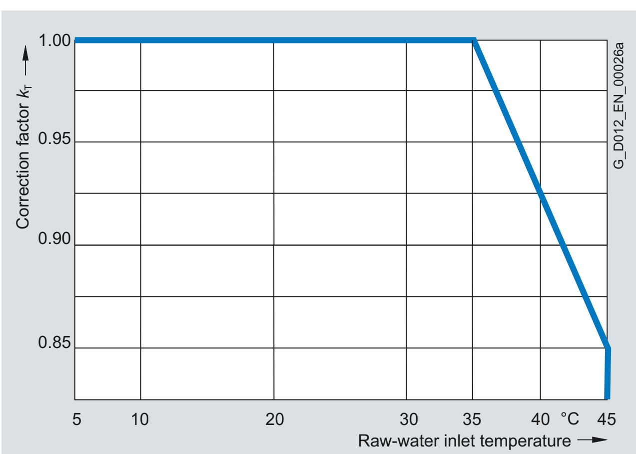
I_N rated current

Current derating as a function of the installation altitude (water cooling)



Derating factor k_H for water cooling

Current derating as a function of the raw water intake temperature

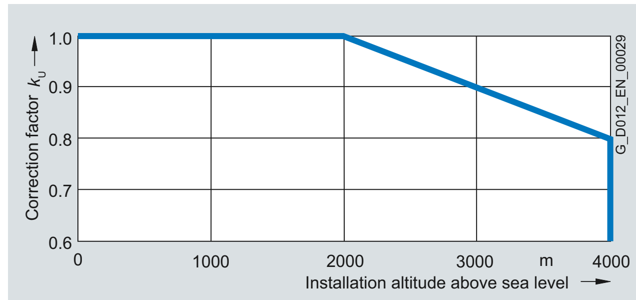


Derating factor k_T (raw water intake temperature)

Voltage derating

For installation altitudes >2000 m, acc. to EN 60664-1/VDE 0110 (IEC 60664-1) in addition to a current derating, a voltage derating is also required. This depends on the air and creepage distances in the unit.

Voltage derating as a function of installation altitude



Derating factor k_U

Example

Derating data SINAMICS SM150 in IGCT version

Drive unit	6SL3845-7NN41-8AA0
Output voltage	3.3 kV
Input voltage	3.3 kV
Type rating	10000 kVA, 1750 A
Installation altitude	2000 m
Raw water intake temperature	40 °C
k_H (water cooling)	0.925
k_T (raw water intake temperature)	0.925
k_U	1.0

For the current, the following applies:

$I \leq I_N \times 0.925 \times 0.925 = I_N \times 0.856$

A current derating of 14.4 % is required.

The maximum available output current is 1497 A.

Technical specifications

SINAMICS SM150 in the IGCT version Water cooling		6SL3845-7NN41-8AA0	6SL3845-7NN43-6AA0	6SL3845-7NN45-4AA0	6SL3845-7NN41-8AB0	6SL3845-7NN41-8AC0
Output voltage 3.3 kV						
Type rating	kVA	10000	20000	30000	10000	10000
Shaft output 1)	kW	9600	19200	28800	9600 2)	9600 2)
	hp	13000	26000	39000	13000 2)	13000 2)
Rated output current	A	1750	2 × 1750	3 × 1750	2 × 1750	3 × 1750
Input voltage	kV	3.3	2 × 3.3	3 × 3.3	3.3	3.3
Rated input current 1)	A	1770	2 × 1770	3 × 1770	1770	1770
Power loss 3) 4)	kW	100	200	300	150	225
Efficiency 4)	%	99.0	99.0	98.9	99.3	99.2
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz 5)	A	6	12	18	9	12
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	17	20	23	19	20
Precharging current demand, briefly for approx. 25 s	A	20	40	60	22	24
Raw water flow rate	l/min	333	667	1000	667	667
Deionized water requirement, approx.	l	150	250	300	225	250
Sound pressure level L_{pA} (1 m)	dB	75	77	79	76	77
Measuring surface level L_s (1 m)	dB	22	23	24	22.5	23
Cable cross-sections, line-side, max. connectable per phase 6) 7)	mm² (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase 6) 7)	mm² (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw 6)	mm² (DIN VDE)	2 × 120	2 × 120	2 × 120	2 × 120	2 × 120
	AWG/MCM (NEC, CEC)	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43
Dimensions 8)						
• Width	mm	5800	10700	15800	8400	10700
• Height 9)	mm	2540	2540	2540	2540	2540
• Depth	mm	1600	1600	1600	1600	1600
Circuit version (Pages 5/4 and 5/5)	Fig. No.	⑪	⑫	⑬	⑭	⑮
Weight 8)	kg	6700	12100	17500	9400	12100

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies, possibly necessary derating for parallel circuit configurations) please contact your Siemens sales partner indicating the required specifications. Additional DC bus configurations are available on request.

Footnotes see page 5/23.

Technical specifications

SINAMICS SM150 in the IGCT version Water cooling		6SL3845-7NN41-8AD0	6SL3845-7NN41-8AF0	6SL3845-7NN41-8AG0	6SL3845-7NN41-8AK0	6SL3845-7NN43-6AF0
Output voltage 3.3 kV						
Type rating	kVA	10000	10000	10000	10000	20000
Shaft output [1]	kW	9600 [2]	9600 [2]	9600 [2]	9600 [2]	19200 [2]
	hp	13000 [2]	13000 [2]	13000 [2]	13000 [2]	26000 [2]
Rated output current	A	4 × 1750	3 × 1750	4 × 1750	5 × 1750	1 × (2 × 1750) +2 × 1750
Input voltage	kV	3.3	2 × 3.3	2 × 3.3	2 × 3.3	2 × 3.3
Rated input current [1]	A	1770	2 × 1770	2 × 1770	2 × 1770	2 × 1770
Power loss [3] [4]	kW	250	250	300	350	300
Efficiency [4]	%	97.5	97.5	97	99	98.4
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [5]	A	15	15	18	21	18
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	22	22	23	24	23
Precharging current demand, briefly for approx. 25 s	A	20	40	40	40	40
Raw water flow rate	l/min	1000	1000	1000	1333	1000
Deionized water requirement, approx.	l	275	275	300	350	300
Sound pressure level L_{pA} (1 m)	dB	78	78	79	79	79
Measuring surface level L_s (1 m)	dB	24	24	24	24	24
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	2 × 120	2 × 120	2 × 120	2 × 120	2 × 120
	AWG/MCM (NEC, CEC)	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM
Degree of protection		IP43	IP43	IP43	IP43	IP43
Dimensions [8]						
• Width	mm	13500	13500	15800	18100	15800
• Height [9]	mm	2540	2540	2540	2540	2540
• Depth	mm	1600	1600	1600	1600	1600
Circuit version (Pages 5/5 to 5/7)	Fig. No.	⑯	⑰	⑱	⑲	⑳
Weight [8]	kg	14800	14800	17500	20200	17500

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies, possibly necessary derating for parallel circuit configurations) please contact your Siemens sales partner indicating the required specifications. Additional DC bus configurations are available on request.

5

Footnotes see page 5/23.

Technical specifications

SINAMICS SM150 in the IGCT version Water cooling		6SL3845-7NN42-2AA0	6SL3845-7NN44-5AA0	6SL3845-7NN46-7AA0
Output voltage 3.3 kV				
Type rating	kVA	10500	21000	31500
Shaft output [1]	kW	10200	20400	30600
	hp	13500	27000	40500
Rated output current	A	1850	2 × 1850	3 × 1850
Input voltage	kV	3.3	2 × 3.3	3 × 3.3
Rated input current [1]	A	1870	2 × 1870	3 × 1870
Power loss [3] [4]	kW	150	300	450
Efficiency [4]	%	98.6	98.6	98.6
Typ. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [5]	A	6	12	18
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	17	20	23
Precharging current demand, briefly for approx. 25 s	A	20	40	60
Raw water flow rate	l/min	333	667	1000
Deionized water requirement, approx.	l	150	250	300
Sound pressure level L_{pA} (1 m)	dB	75	77	79
Measuring surface level L_s (1 m)	dB	22	23	24
Cable cross-sections, line-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase [6] [7]	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
PE connection, max. connection cross-section at the enclosure with M12 screw [6]	mm^2 (DIN VDE)	2 × 120	2 × 120	2 × 120
	AWG/MCM (NEC, CEC)	2 × 250 MCM	2 × 250 MCM	2 × 250 MCM
Degree of protection		IP43	IP43	IP43
Dimensions [8]				
• Width	mm	5800	10700	15800
• Height[9]	mm	2540	2540	2540
• Depth	mm	1600	1600	1600
Circuit version (Page 5/4)	Fig. No.	11	12	13
Weight [8]	kg	6700	12100	17500

Note:

For other technical requirements that have to be taken into consideration (surge loads, operation at low frequencies, possibly necessary derating for parallel circuit configurations) please contact your Siemens sales partner indicating the required specifications. Additional DC bus configurations are available on request.

Footnotes see page 5/23.

Technical specifications

1) The data for the rated input current and the power data in hp and kW are approximate values only; these have been calculated for operation with synchronous motors for a power factor cos phi =1 and a motor efficiency of 96%. The calculation is based on the rated output current. The rated input current also depends on the line power factor, for which a typical value of 1 was assumed.
The hp data are based on the NEC and CEC guidelines for the North American market. The kW values are specified in multiples of 500. Both approximate values need to be adapted to the motor which is actually used.

2) The underlying circuits are based on a drive line-up in which the drives operate both as motor and generator. Energy is exchanged via the DC link. The specified power corresponds to the maximum infeed power. The effective total power of the Motor Modules (taking into account the power flow direction) may not exceed this infeed power.

3) Approx. 5 % of the power loss is dissipated in the room.

4) Without cooling system

5) The typical current drawn (rms value; $\cos \varphi_{typ.} = 0{,}6$) of the supply for the converter open-loop/closed-loop control is specified. The separate supplies for the socket outlets/light or switched auxiliary power feeders (options **N35 to N38**) have not been taken into account. Values for the typical current drawn for special configurations (e.g. for dimensioning an upstream UPS) are available on request.
When using options **L48** (make-proof grounding switch at the converter input), **L49** (make-proof grounding switch at the converter output) or **L51** (disconnector at the converter output), it should further be taken into account that for switching operations, additional peak values of up to 10 A can occur for each make-proof grounding switch or disconnector. This corresponds to the starting current of a motor used to operate a switch, which decays from approx. 10 A to approx. 2 A in 200 ms. A switching operation takes a total time of approx. 2 s. All optionally used make-proof grounding switches or disconnectors are controlled via the manually-actuated make-proof grounding switch for the converter DC link (standard) and therefore switch simultaneously!

6) Data refer to a sub-system; for details about the number of sub-systems to be connected on the line or motor side, see Circuit versions, Pages 5/4 and 5/5.

7) The maximum permissible cable lengths must be observed (see Power cables, Page 9/13).

8) The specified dimensions and weights include doors, panels and cooling unit, however no options.

9) Depending on the pressure equalization tank, the cooling unit can have a maximum cabinet height of 2790 mm.

Notes

Description of options

6

Description of options

Overview

The following tables contain a complete overview of the availability of options for the four converter versions, SINAMICS GM150 and SINAMICS GM150 in the IGBT and IGCT versions.

Information on the possibility of combining various options can be taken from the matrices in Chapters 2, 3, 4 and 5.

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
B00	NAMUR terminal strip	✓	✓	✓	✓
B43	Documentation, production flowchart: Generated once	✓	✓	✓	✓
B44	Documentation, production flowchart: Updated every two weeks	✓	✓	✓	✓
B45	Documentation, production flowchart: Updated every month	✓	✓	✓	✓
C30	Auxiliary voltage 50 Hz 200 V 3 AC	✓	✓	✓	–
C33	Auxiliary voltage 60 Hz 220 V 3 AC	✓	✓	✓	–
C34	Auxiliary voltage 60 Hz 230 V 3 AC	✓	✓	✓	–
C35	Auxiliary voltage 60 Hz 240 V 3 AC	✓	✓	✓	–
C36	Auxiliary voltage 50 Hz 380 V 3 AC	✓	✓	✓	–
C37	Auxiliary voltage 60 Hz 380 V 3 AC	✓	✓	✓	–
C38	Auxiliary voltage 50 Hz 400 V 3 AC	✓	✓	✓	–
C39	Auxiliary voltage 50 Hz 415 V 3 AC	✓	✓	✓	–
C40	Auxiliary voltage 60 Hz 440 V 3 AC	✓	✓	✓	–
C41	Auxiliary voltage 60 Hz 460 V 3 AC	✓	✓	✓	–
C42	Auxiliary voltage 60 Hz 480 V 3 AC	✓	✓	✓	–
C43	Auxiliary voltage 50 Hz 500 V 3 AC	✓	✓	✓	–
C44	Auxiliary voltage 50 Hz 550 V 3 AC	✓	✓	✓	–
C46	Auxiliary voltage 60 Hz 575 V 3 AC	✓	✓	✓	–
C48	Auxiliary voltage 50 Hz 690 V 3 AC	✓	✓	✓	–
C49	Auxiliary voltage 60 Hz 690 V 3 AC	✓	✓	✓	–
C55	Auxiliary voltage 120 V 1 AC for open-loop and closed-loop control	✓	✓	✓	–

✓	Options that can be ordered
–	Options that cannot be ordered

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
D00	Documentation in German	✓	✓	✓	✓
D02	Circuit diagrams, terminal diagrams and dimension drawings in DXF format	✓	✓	✓	✓
D15	One set of printed documentation	✓	✓	✓	✓
D55	Documentation in Polish	✓	✓	✓	✓
D56	Documentation in Russian	✓	✓	✓	✓
D57	Documentation in Japanese	On request	On request	On request	On request
D72	Documentation in Italian	On request	On request	On request	On request
D76	Documentation in English	✓	✓	✓	✓
D77	Documentation in French	✓	✓	✓	✓
D78	Documentation in Spanish	✓	✓	✓	✓
D79	Documentation in Portuguese (Brazil)	✓	✓	✓	✓
D84	Documentation in Chinese	✓	✓	✓	✓
E00	Control for separately-excited synchronous motors	✓	✓	✓	✓
E01	Control for separately excited synchronous motors with slipring excitation	On request	On request	✓	✓
E02	Control for separately excited synchronous motors with brushless reverse field excitation	On request	On request	On request	On request
E03	Control for permanently-excited synchronous motors	On request	On request	On request	✓
E11	Suitable for marine use with individual certificate from Germanische Lloyd (GL)	Only for water cooling	✓	–	–
E21	Suitable for marine use with individual certificate from Lloyds Register (LR)	Only for water cooling	✓	–	–
E31	Suitable for marine use with individual certificate from Bureau Veritas (BV)	Only for water cooling	✓	–	–
E51	Suitable for marine use with individual certificate from Det Norske Veritas (DNV)	Only for water cooling	✓	–	–
E61	Suitable for marine use with individual certificate from the American Bureau of Shipping (ABS)	Only for water cooling	✓	–	–
E71	Suitable for marine use with individual certificate from the Chinese Classification Society (CCS)	Only for water cooling	✓	–	–
E82	Increased frequency (converter for high-speed rotors)	✓	–	–	–
E86	Additional analog inputs	✓	✓	✓	✓
E87	Additional analog outputs	✓	✓	✓	✓

✓	Options that can be ordered
–	Options that cannot be ordered

Description of options

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
F03	Visual acceptance, with the customer present	✓	✓	✓	✓
F28	Noise measurement under no-load conditions, without the customer present	Only for air cooling	–	Only for air cooling	–
F29	Noise measurement under no-load conditions, with the customer present	Only for air cooling	–	Only for air cooling	–
F72	Functional acceptance of converter with inductive load, without the customer present	✓	✓	✓	✓
F73	Functional acceptance of converter with inductive load, with the customer present	✓	✓	✓	✓
F76	Acceptance of the converter insulation test, without the customer present	✓	✓	✓	✓
F77	Acceptance of the converter insulation test, with the customer present	✓	✓	✓	✓
F79	Test of the interface between the converter and customer equipment, with the customer present (5 hours)	✓	✓	✓	✓
F97	Customer-specific system acceptance tests	On request	On request	On request	On request
G20	CAN bus interface	On request	On request	–	–
G21	Modbus Plus interface	On request	On request	–	–
G22	Modbus RTU slave interface	On request	On request	–	–
G23	DeviceNet interface	On request	On request	–	–
G24	PROFINET interface (via CBE20)	On request	On request	–	–
G25	TeleService connection TS Adapter II analog modem	✓	–	–	–
G34	PROFINET interface (via CBE30)	–	–	–	On request
G35	TeleService connection TS Adapter II ISDN modem	✓	–	–	–
G30	PROFIBUS master	Only for static excitation unit	Only for static excitation unit	–	–
G61	Additional TM31 Terminal Module	✓	✓	✓	✓
G62	Second additional TM31 Terminal Module	✓	✓	✓	✓
G63	Additional TM15 Terminal Module	✓	✓	✓	✓
G66	PADU8 diagnostics module	–	✓	✓	✓
G70	Pulse distributor to transfer the speed encoder signal	On request	On request	✓	✓
G71	Optical bus terminal (OBT) for PROFIBUS	On request	On request	✓	✓

✓	Options that can be ordered
–	Options that cannot be ordered

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
K20	Indicator lights in the cabinet door	✓	✓	✓	✓
K21	Display instruments in the cabinet door for voltage, current, speed and power as well as indicator lights	✓	✓	✓	✓
K22	Display instruments in the cabinet door for current, speed, power and winding temperature as well as indicator lights	✓	✓	✓	✓
K50	Sensor Module Cabinet-Mounted SMC30	✓	✓	Included as standard	Included as standard
K80	Control of "Safe Torque Off" function	On request	On request	✓	✓
L08	Output reactor	✓	✓	✓	✓
L21	Overvoltage protection AC	Only for static excitation unit	Only for static excitation unit	–	Only for static excitation unit
L29	Bidirectional synchronized bypass operation	Only with induction motor	–	–	–
L32	Automatic restart	✓	✓	Included as standard (VSM10 and software functionality)	
L48	Make-proof grounding switch at converter input	✓	✓	On request	✓
L49	Make-proof grounding switch at converter output	✓	✓	On request	✓
L50	Cabinet lighting and service socket in the control section	✓	✓	✓	✓
L51	Disconnector at the converter output	✓	✓	✓	✓
L52	Circuit breaker at converter output	✓	✓	✓	✓
L53	UPS for the power supply of the open-loop and closed-loop control	On request	On request	–	–
L55	Anti-condensation heating for the cabinet	✓	✓	✓	✓
L60	EMERGENCY-STOP, Stop Category 1 for controlled stopping	✓	✓	–	–
L72	Braking Module	✓	✓	On request	On request
L80	2 thermistor protection relays for alarm and fault	✓	✓	✓	✓
L81	2 x 2 thermistor protection relays for alarm and fault	✓	✓	✓	✓
L82	3 x 2 thermistor protection relays for alarm and fault	✓	✓	✓	✓
L87	Rotor ground fault monitoring	Only for static excitation unit	Only for static excitation unit	–	Only for static excitation unit

✓	Options that can be ordered
–	Options that cannot be ordered

6

Description of options

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
L90	Pt100 evaluation unit with 3 inputs	✓	✓	✓	✓
L91	2 Pt100 evaluation units, each with 3 inputs	✓	✓	✓	✓
L92	3 Pt100 evaluation units, each with 3 inputs	–	✓	✓	✓
L93	Pt100 evaluation unit with 6 inputs and 2 analog outputs	✓	✓	✓	✓
L94	2 Pt100 evaluation units each with 6 inputs and 2 analog outputs	–	✓	✓	✓
L95	Pt100 evaluation unit with 6 inputs for explosion-protected motors and 2 analog outputs	✓	✓	✓	✓
L96	2 Pt100 evaluation units each with 6 inputs for explosion-protected motors and each with 2 analog outputs	–	✓	✓	✓
M10	Safety interlocking system	✓	✓	✓	✓
M11	Dust protection	Only for air cooling	–	Only for air cooling	Included as standard
M13	Power cable connected at the converter input from the top	✓	–	–	–
M16	Extended dust protection	Only for water cooling	–	–	–
M32	Customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2	✓	✓	✓	✓
M33	Customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2	✓	✓	✓	✓
M34	Auxiliary voltage and signal cables connected from the top	✓	–	–	–
M36	Cable entry, brass for power cables	✓	✓	–	✓
M42	IP42 degree of protection	Only for air cooling	–	–	–
M54	IP54 degree of protection	Only for water cooling	✓	–	✓
M61	Redundant fan in the power unit	✓	–	–	–
M64	Converter prepared for connection to an external air discharge system, with internal cabinet fans	Only for air cooling	–	–	–
M66	Suitable for marine applications	Only for water cooling	✓	–	–
M78	Power cable connected at the converter output from the top	✓	–	–	–

✓	Options that can be ordered
–	Options that cannot be ordered

6

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
N06	Capacitor Module to increase the DC link capacitance (1 module)	–	–	–	✓
N07	Capacitor Modules to increase the DC link capacitance (2 modules)	–	–	–	✓
N08	Capacitor Modules to increase the DC link capacitance (3 modules)	–	–	–	✓
N13	Circuit breaker at the converter input	24-pulse on request only	Not for parallel circuit configuration	–	On request
N15	24-pulse Basic Line Module	✓	✓	–	–
N20	Capacitor tripping device 110 V to 120 V DC	✓	–	–	–
N21	Capacitor tripping device 230 V DC	✓	–	–	–
N22	Input-side switch	Only for static excitation unit	Only for static excitation unit	–	Only for static excitation unit
N30	Controlled motor feeder for auxiliaries 400 V 3 AC/480 V 3 AC, max. 4/4.8 kW	✓	✓	✓	✓
N31	Controlled motor feeder for auxiliaries 400 V 3 AC/480 V 3 AC, max. 7/8 kW	✓	✓	✓	✓
N32	Controlled motor feeder for auxiliaries 400 V 3 AC/480 V 3 AC, max. 11/12.7 kW	✓	✓	✓	✓
N33	Controlled motor feeder for auxiliaries 400 V 3 AC/480 V 3 AC, max. 15/17.5 kW	✓	✓	✓	✓
N35	Controlled outgoing feeder for auxiliaries 230 V 1 AC/120 V 1 AC, max. 1.2/1 kW	✓	✓	✓	✓
N36	Controlled outgoing feeder for auxiliaries 230 V 1 AC/120 V 1 AC, max. 2.2/1.5 kW	✓	✓	✓	✓
N37	Controlled outgoing feeder for auxiliaries 230 V 1 AC/120 V 1 AC, max. 3.5/2.1 kW	✓	✓	✓	✓
N38	Controlled outgoing feeder for auxiliaries 230 V 1 AC/120 V 1 AC, max. 4.5/2.8 kW	✓	✓	✓	✓
Q80	Extension of the liability for defects period by 12 months to a total of 24 months (2 years) after being delivered	✓	✓	✓	✓
Q81	Extension of the liability for defects period by 18 months to a total of 30 months (2.5 years) after being delivered	✓	✓	✓	✓
Q82	Extension of the liability for defects period by 24 months to a total of 36 months (3 years) after being delivered	✓	✓	✓	✓
Q83	Extension of the liability for defects period by 30 months to a total of 42 months (3.5 years) after being delivered	✓	✓	✓	✓
Q84	Extension of the liability for defects period by 36 months to a total of 48 months (4 years) after being delivered	✓	✓	✓	✓
Q85	Extension of the liability for defects period by 48 months to a total of 60 months (5 years) after being delivered	✓	✓	✓	✓

✓	Options that can be ordered
–	Options that cannot be ordered

Description of options

Overview

Order code	Option	SINAMICS GM150		SINAMICS SM150	
		IGBT version	IGCT version	IGBT version	IGCT version
S05	Basic configuration	–	–	✓	✓
T58	Rating plate in English/French	✓	✓	✓	✓
T60	Rating plate in English/Spanish	✓	✓	✓	✓
T80	Rating plate in English/Italian	✓	✓	✓	✓
T8^2	Rating plate in English/Portuguese	On request	On request	On request	On request
T85	Rating plate in English/Russian	On request	On request	On request	On request
T86	Rating plate in English/Polish	On request	On request	On request	On request
T90	Rating plate in English/Japanese	On request	On request	On request	On request
T91	Rating plate in English/Chinese	On request	On request	On request	On request
W02	Cooling unit with redundant stainless steel plate-type heat exchangers	Only for water cooling	✓	Only for water cooling	✓
W11	Cooling unit with titanium plate-type heat exchanger	Only for water cooling	✓	Only for water cooling	✓
W12	Cooling unit with redundant titanium plate-type heat exchangers	Only for water cooling	✓	Only for water cooling	✓
W14	Converter without cooling unit, provided on the plant side	Only for water cooling	✓	Only for water cooling	✓
W20	Raw-water connection from the bottom	Only for water cooling	Included as standard	–	Included as standard
Y05	Customer-specific rating plate	✓	✓	✓	✓
Y09	Special paint finish according to RAL...	✓	✓	✓	✓
Y10	Customer-specific circuit diagrams	✓	✓	✓	✓
Y15	Sine-wave filter	✓	–	On request	–
Y17	Line reactor	Only for static excitation unit	Only for static excitation unit	–	Only for static excitation unit
Y40	Raw-water data that deviates from the catalog data	Only for water cooling, on request	On request	–	On request
Y73	Braking resistor	✓	✓	On request	On request

✓	Options that can be ordered
–	Options that cannot be ordered

Options

To enable the required description to be found more easily, the following option descriptions are sorted alphabetically by order codes. If an option is only available for certain converter configurations, this is indicated in brackets after the option title.

Note:

An option can only be ordered once per converter, if not explicitly specified otherwise.

Note:

The "on request" comment can have the following meanings:

- The price has not been defined and must be determined after an inquiry has been sent to the factory before a quotation can be generated.
- The option requires technical clarification and – depending on secondary technical conditions – may not be able to be realized for all types.

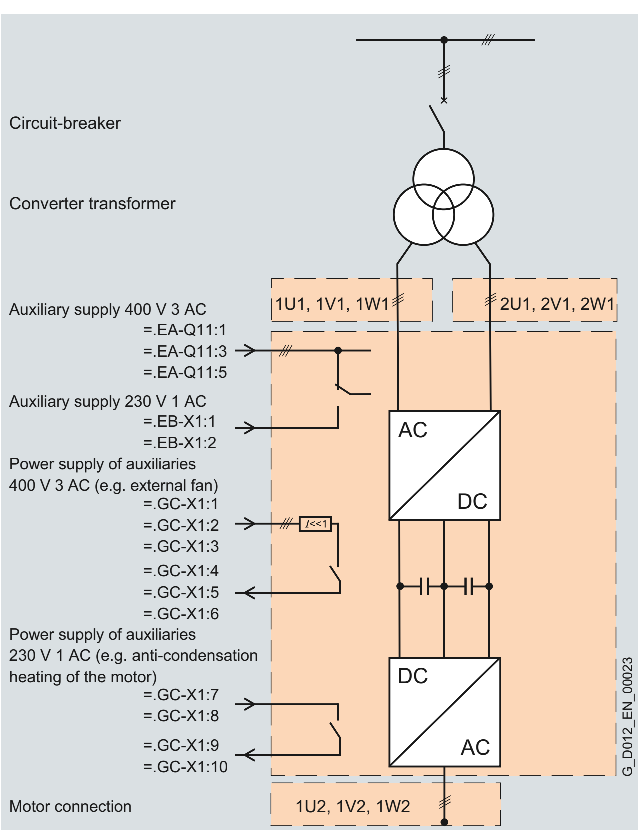
B00

NAMUR terminal strip

The terminal strip has been configured in accordance with the requirements and guidelines of the Standards Working Group for Instrumentation and Control in the Chemical Industry (NAMUR Recommendation NE37), i.e. fixed terminals are assigned to certain functions of the devices. The inputs and outputs assigned to the terminals comply with "Protective extra-low voltage PELV" requirements.

For temperature monitoring of explosion-protected motors, options for PTC thermistors with PTB approval and Pt100 evaluation units for use in hazardous areas are available.

This terminal strip and the associated functions are reduced to the required amount. Contrary to the NAMUR recommendation, no additional terminals are included.



Assignment of the NAMUR terminal strip

Terminal	No.	Type	Preassignment	Comment
For signal lines that must meet "Protective extra-low voltage PELV" requirements				
= LC–X2	1 1.0 1.1	M	Reference conductor to the 24 V DC infeed	–
	3 3.0 3.1	P24	24 V DC infeed	Protected internally with 2 A fuse
	10	DI	ON (dynamic)/ ON/OFF(static)	–
	11	DI	OFF (dynamic)	–
	12	DI	Faster	–
	13	DI	Slower	–
	14	DI	RESET	–
	15	DI	Interlock	Corresponds to OFF3
	16	DI	Counterclockwise	"0" signal for CW phase sequence "1" signal for CCW phase sequence
	17 18		PS disconnection	EMERGENCY STOP sequence
	30 31		Ready to run	Relay output (NO contact)
	32 33		Motor rotates	Relay output (NO contact)
	34	DO (NO)	Fault	Relay output (changeover contact)
	35	DO (COM)		
	36	DO (NC)		
	50 51	AI 0/4 ... 20 mA	Speed setpoint	–
	60 61	AO 0/4 ... 20 mA	Motor frequency	–
	62 63	AO 0/4 ... 20 mA	Motor current	Preassigned with motor current/can be reparameterized for other variables
For connecting the PTC sensor of the motor				
–A1–X3	90/91	AI	Connection of a PTC sensor	Shutdown if limit value is exceeded.

If Pt100 resistance thermometers are integrated into the windings of the motor in order to protect the motor, Pt100 evaluation units for explosion-protected motors are available with options **L95** and **L96**.

If a force-ventilated motor is used due to the application (load torque/control range), controlled outgoing feeders – protected using motor circuit breakers – are available with options **N30 to N33** to supply an external fan. The incoming voltage supply for the external fan must be provided on the plant side.

Options **N35 to N38** include a controlled and fused external voltage outgoing feeder for the anti-condensation heating in the motor.

6

Description of options

Options

B43 to B45

Production flowcharts:

Production flowcharts are provided with options **B43 to B45**. After the order has been clarified, these are sent as dual language (English/German) PDF file by E-Mail.

Option	Description
B43	Documentation, production flowchart: Generated once
B44	Documentation, production flowchart: Updated every two weeks
B45	Documentation, production flowchart: Updated every month

C30 to C49

Auxiliary voltage other than N/400 V/3 AC (SINAMICS GM150, SINAMICS SM150 in IGBT version)

A N/400 V/3 AC auxiliary supply must be provided on the plant side to supply power for the fans, open-loop/closed-loop control, protection and monitoring systems as well as the DC link pre-charging. If the auxiliary supply in the plant differs from this value, you must select one of the options **C30 to C49**. In this case the three-phase infeed supply which differs from the standard version is adapted with three individual transformers to the required voltage level. Tappings from 200 V 3 AC to 690 V 3 AC are available for this purpose. The current required for the auxiliary infeed supply can be determined from the data for the current requirement at 400 V 3 AC (see Technical Specifications, Conversion to Existing Auxiliary Voltage).

Order codes for auxiliary voltages and line frequencies	
C30	50 Hz 200 V 3 AC
C33	60 Hz 220 V 3 AC
C34	60 Hz 230 V 3 AC
C35	60 Hz 240 V 3 AC
C36	50 Hz 380 V 3 AC
C37	60 Hz 380 V 3 AC
C38	50 Hz 400 V 3 AC
C39	50 Hz 415 V 3 AC
C40	60 Hz 440 V 3 AC
C41	60 Hz 460 V 3 AC
C42	60 Hz 480 V 3 AC
C43	50 Hz 500 V 3 AC
C44	50 Hz 550 V 3 AC
C46	60 Hz 575 V 3 AC
C48	50 Hz 690 V 3 AC
C49	60 Hz 690 V 3 AC

Note:

A matching transformer is necessary if 50 Hz 400 V 3 AC is available on the plant side, however, without a neutral conductor connection. In this case, option **C38** should be selected. Exception: A separate 230 V supply can be provided for the closed-loop control on the plant side.

Note:

For isolated systems the maximum supply voltage is 500 V 3 AC.

Note:

Access to the matching transformers is possible only from the rear of the converter.

Auxiliary voltage infeed		Supply voltage for
= EA–Q11:1	L1	Fan, DC link precharging
= EA–Q11:3	L2	
= EA–Q11:5	L3	
= EB–X1:1	L1	Open-loop and closed-loop control, protection and monitoring equipment
= EB–X1:2	N	

Options

C55

Auxiliary voltage 120 V 1 AC for open-loop and closed-loop control (SINAMICS GM150, SINAMICS SM150 in IGBT version)

The open-loop control of the converter can be supplied with 120 V 1 AC with option **C55** .

Note:

The following options are available in conjunction with option **C55** on special request:

- **L48** and **L49** (grounding switch at converter input and output)
- **L51** (disconnector at converter output)
- **L52** (circuit breaker at converter output)
- **N13** (circuit breaker at converter input)

D00 to D84

Documentation

The standard documentation is supplied in English on CD-ROM. The circuit diagrams/terminal diagrams are only available in English/German. Supplementary documentation for the components installed in the converter, which the manufacturers of these components provide, is supplied on the CD-ROM in English/German. For technical reasons, it is not possible to restrict the scope of this supplementary documentation to just the options that the customer has ordered.

Option	Description
D00	**Documentation in German** Use the code **D00** to obtain the documentation in German on CD-ROM.
D02	**Circuit diagrams, terminal diagrams and dimension drawings in DXF format** Documents such as circuit diagrams, terminal diagrams, the arrangement diagram and the dimension drawing with the code **D02** are ordered in DXF format so that they can be processed in AutoCAD systems, for instance.
D15	**One set of printed documentation (multiple orders possible)** If documentation is also required on paper, this must be ordered using the code **D15**.
D55	**Documentation in Polish** With order code **D55** the documentation is supplied in Polish on CD-ROM.
D56	**Documentation in Russian** Use the code **D56** to obtain the documentation in Russian on CD-ROM.
D57	**Documentation in Japanese (on request)** With order code **D57** the documentation is supplied in Japanese on CD-ROM.
D72	**Documentation in Italian (on request)** Use the code **D72** to obtain the documentation in Italian on CD-ROM.
D76	**Documentation in English** If a documentation language other than English is selected using options **D00** or **D55 to D84**, then by specifying order code **D76** , an additional CD-ROM with documentation in English as second documentation language can be ordered. Note: When simultaneously selecting option **D15** (a set of printed documentation) the printed documentation is only supplied in the first documentation language.
D77	**Documentation in French** Use the code **D77** to obtain the documentation in French on CD-ROM.
D78	**Documentation in Spanish** Use the code **D78** to obtain the documentation in Spanish on CD-ROM.
D79	**Documentation in Portuguese (Brazil)** With order code **D79** the documentation is supplied in Portuguese on CD-ROM.
D84	**Documentation in Chinese** Use the code **D84** to obtain the documentation in Chinese on CD-ROM.

Description of options

Options

E00

Closed-loop control for separately-excited synchronous motors (static excitation unit is provided on the plant side)

When option **E00** is selected, the converter is supplied without static excitation unit. The static excitation unit should be provided on the plant side.

E01

Closed-loop control for separately excited synchronous motors with slipring excitation
(for static excitation units, see Accessories, Chapter 7)

If the converter is to be used to control separately excited synchronous motors with slipring excitation, put the code **E01** in the order. For slipring excitation, the exciter cabinet must also be ordered. It has its own order number.

Note:

Converter and exciter cabinet must be ordered together.

Note:

For SINAMICS GM150, option **E01** on request.

E02

Closed-loop control for separately excited synchronous motors with brushless excitation
(on request, for static excitation units, see Accessories, Chapter 7)

If the converter is to be used to control separately excited synchronous motors with brushless excitation, order code **E02** must be specified when ordering. For brushless excitation, the exciter cabinet must also be ordered. It has its own order number.

E03

Control for permanently-excited synchronous motors

If the converter is to be used to control permanently-excited synchronous motors, order code **E03** must be included in the order.

Note:

Option **E03** requires that option **L52** is simultaneously ordered (circuit breaker at converter output).

Note:

For SINAMICS SM150 in IGBT version and SINAMICS GM150, option **E03** on request.

E11 to E71

(SINAMICS GM150, water-cooled)
Individual certification of the converter by the relevant certifying organizations, including the extensions described under option M66

Option	Description
E11	**Suitable for marine use with individual certificate from Germanische Lloyd (GL)** includes option **M66**
E21	**Suitable for marine use with individual certificate from Lloyds Register (LR)** includes option **M66**
E31	**Suitable for marine use with individual certificate from Bureau Veritas (BV)** includes option **M66**
E51	**Suitable for marine use with individual certificate from Det Norske Veritas (DNV)** includes option **M66**
E61	**Suitable for marine use with individual certificate from the American Bureau of Shipping (ABS)** includes option **M66**
E71	**Suitable for marine use with individual certificate from the Chinese Classification Society (CCS)** includes option **M66**

Note:

It is not possible to combine several individual certificates.

Note:

For SINAMICS GM150 in IGBT version, the combination with option **Y15** (sine-wave filter) on request.

E82

Increased frequency
(converter for high-speed rotors, SINAMICS GM150 in IGBT version)

When operated above 66 Hz, the converter should be classified as a converter for high-speed rotors.

E86

Additional analog inputs (isolated)

With option **E86** an additional TM31 Terminal Module is available. Its analog inputs are isolated. Multirange transformers are used (setting range: 0 V to 10 V; 0 mA to 20 mA or 4 mA to 20 mA).

Note:

Option **E86** cannot be combined with options **G62** (second additional TM31 Terminal Module), as well as **L94** and **L96** (2 Pt100 evaluation units).

Options

E87

Additional analog outputs (isolated)

With option **E87** an additional TM31 Terminal Module is available. Its analog outputs are isolated. Multirange transformers are used (setting range: 0 V to 10 V; 0 mA to 20 mA or 4 mA to 20 mA).

Note:

Option **E87** cannot be combined with option **G62** (second additional TM31 Terminal Module).

F03, F29, F73, F77, F79, F97

Converter acceptance inspections in presence of customer

Option	Description
F03	**Visual acceptance** The checks are carried out with the converter deenergized. The following is included in the scope of the acceptance tests: • Check of degree of protection • Check of equipment (components) • Check of equipment identifier • Check of clearance and creepage distances • Check of cables • Check of customer documentation • Submitting the acceptance report
F29	**Noise measurement under no-load conditions (SINAMICS GM150 and SINAMICS SM150 in an air-cooled IGBT version)** With option **F29**, the sound pressure level of the converter is measured under no load conditions with the continuously operating fans switched on.
F73	**Functional acceptance of converter with inductive load** [1)] After the visual inspection with the converter off, the converter is connected to rated voltage. Rated current flows in an inductive load at an output frequency of 5 Hz (without connector motor) on the converter output side. The following is included in the scope of the acceptance tests: • Visual inspection as described for option **F03** • Check of power supply • Check of protective and monitoring devices (simulation) • The fan is checked (for water cooling: cooling circuit elements in the converter) • Precharging test • Functional test with inductive load at rated voltage and rated current • Submitting the acceptance report
F77	**Acceptance of the converter insulation test** [1)] The following is included in the scope of the acceptance tests: • High-voltage test • Measurement of insulation resistance Option **F77** can only be ordered in connection with options **F73**.
F79	**Test of the interface between the converter and customer equipment (5 hours)** [1)] The analog, digital and serial interfaces are tested according to their preassignment described in Chapter 8. For additional test requirements, option **F97** must be selected. Option **F79** can only be ordered in connection with option **F73**.

[1)] As a result of the local situation and the dimensions of the converter, the acceptance is always performed using a basic unit comprising a Line Module and a Motor Module.

Description of options

Options

Option	Description
F97	**Customer-specific system acceptance tests (on request)** For a system acceptance test, transformer (if technically required), converter, cooling system (if technically required) and motor should be set up and commissioned. Converter, cooling system and transformer are mounted directly next to each other, but separately from the motor. Only already pre-tested components (together with a test certificate) are subject to a system test. The tests that can be performed in the System Test Center are listed in the following. For each system acceptance test, the actual test scope must first be coordinated with the Siemens contact person. Temperature-rise test Full load test run or partial load test run of the motor in converter operation until the temperature reaches its steady-state level. The operating point should be preferably selected where the highest temperature increases is expected (M_N, n_N). The resistance method is the basis for determining the temperature rise. During the temperature-rise test, in addition to the motor temperatures, the electrical operating parameters of the complete drive system are also continuously recorded. Load tests • Load points at four different operating points • The system efficiency is determined at the defined load points • Line-side harmonics analysis Additional tests • High-voltage insulation test: The converter and motor have already been tested as part of the routine tests performed during production. Re-testing the converter is time-consuming and is not recommended. It can only be performed as part of a test that is separately performed for options **F73/F77**. • Converter function test: The fault and alarm functions are checked using defined simulation routines (e.g. overtemperature trip, EMERGENCY-STOP, overcurrent, overspeed, undervoltage) • 120 % overspeed test • Noise measurement (motor fed from the converter without load) • Vibration measurement (motor fed from the converter without load) • Visual inspection (converter and motor and where relevant, transformer)

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Note:

An acceptance test of static excitation units according to options **F03**, **F73** and **F77** is only possible together with the converter which must be ordered simultaneously.

In general, a high voltage test of the converter is already performed during the type test. When the test is repeated as part of option **F77**, the test voltage is reduced to 80 % (according to DIN EN 61800-5-1/VDE 0160 T105 (IEC 61800-5-1)).

Excitation units are only accepted as part of option **F97** when this option is simultaneously selected for the converter and excitation unit and is generally performed at another location and at another time.

F28, F72, F76

Converter acceptance tests without the customer present

The acceptance scope of these options corresponds to that of options **F29, F73** or **F77**, however, without the customer being present.

Options

G20 to G24 and G34

Access to other bus systems

In the standard version the SINAMICS GM150 and SINAMICS SM150 are equipped with a PROFIBUS interface (slave). Additional interface modules are optionally available.

Option	Description
For SINAMICS GM150 (on request)	
G20	CAN bus interface (CANopen)
G21	Modbus Plus interface
G22	Modbus RTU slave interface
G23	DeviceNet interface
G24	PROFINET interface (via CBE20)
For SINAMICS SM150in IGCT version (on request)	
G34	PROFINET interface (via CBE30)

The SINAMICS Communication Boards CBC10 or CBE20 (option **G24** for SINAMICS GM150) and CBE30 (option **G34** for SINAMICS SM150) are used to connect to the CANopen bus system (option **G20**) or to PROFINET.

The "Anybus-X-Gateway" from the HMS Industrial Networks company is used to connect to third-party Modbus Plus systems (option **G21**), Modbus RTU (option **G22**) and DeviceNet (option **G23**).

When one of the options **G21 to G23** is ordered, the Anybus-X-Gateway is installed when the equipment is delivered and is connected to the CU320 Control Unit via a PROFIBUS cable. The scope of supply includes a null modem cable to configure the Anybus-X-Gateway. The Anybus-X-Gateway is preconfigured to 20 bytes of I/O data. The data size can be changed via the configuration interface from a PG/PC (standard PC tool "Windows Hyper Terminal").

The "NetTool" supplied by HMS Industrial Networks must be used to configure the PROFIBUS. This is not included in the scope of supply.

Current information, documentation and tools for Anybus-X-Gateway are available at
http://www.anybus.de

G25, G35

TeleService connection TS Adapter II analog modem, ISDN modem
(SINAMICS GM150 in the IGBT version)

Using the TeleService connection, personnel in the central service department can perform all operator functions and settings with the STARTER software and provide support when service is required.

An appropriate modem is required for the TeleService connection. This permits communications to be established between the PROFIBUS inside the drive unit and a telephone cable to a central service department. This modem, with PROFIBUS connection, is integrated in a SIMATIC TS Adapter II, which is available in an analog (option **G25**) and an ISDN version (option **G35**). Under certain circumstances, an appropriate extension cable is required to connect to the telephone line.

Further, a 24 V DC power supply is required locally for the TS Adapter.

Note:

You will find additional information on TeleService in the following Service&Support article on the Internet at
http://support.automation.siemens.com/WW/view/de/20301397

G30

PROFIBUS master
(SINAMICS GM150 with static excitation unit, ***see Accessories, Chapter 7******)***

SINAMICS GM150 converters can communicate as standard only as PROFIBUS slaves. Therefore, in conjunction with a SINAMICS GM150 converter, a SIMATIC S7 controller with PROFIBUS master capability is used in the static excitation unit.

Options

G61

Additional TM31 Terminal Module

One TM31 Terminal Module and two TM15 Terminal Modules for integrating warning and fault messages and drive signals and for communicating with a higher control level are already included in the standard version of the converter. If the number of signals to be monitored is not sufficient, the interface can also be extended by an additional Terminal Module. Additional digital inputs and outputs and two analog inputs and outputs are available with the TM31.

The TM31 Terminal Module has:

- 8 digital inputs
- 4 bidirectional digital inputs and outputs
- 2 relay outputs with changeover contact
- 2 analog inputs
- 2 analog outputs
- 1 temperature sensor (KTY84-130 or PTC)

The following table shows an overview of the exclusions, which must be considered when selecting options **G61** or **G62**.

	G61	G62	E86	E87	L80 to L93, L95	L94, L96
G61		✓	✓	✓	–	–
G62	✓		–	–	✓	–
E86	✓	–		✓	✓	–
E87	✓	–	✓		✓	✓
L80 bis L93, L95	–	✓	✓	✓		✓
L94, L96	–	–	–	✓	✓	

✓	Options can be combined
–	Options are mutually exclusive

Note:

For isolated analog inputs/outputs, options **E86** or **E87** are available.

TM31 Terminal Module	
Digital inputs	
• Voltage	-3 ... +30 V
• Low level (an open digital input is interpreted as "low")	-3 ... +5 V
• High level	15 ... 30 V
• Current consumption at 24 V DC, typ.	10 mA
• Signal propagation times of digital inputs, approx.	
- L → H	50 µs
- H → L	100 µs
• Conductor cross-section, max.	1.5 mm²
Digital outputs (sustained short-circuit strength)	
• Voltage	24 V DC
• Load current per digital output, max.	100 mA
• Total current of digital outputs, max.	400 mA
• Conductor cross-section, max.	1.5 mm²
Analog inputs (a switch is used to toggle between voltage and current input)	
• As voltage input	
- Voltage range	-10 ... +10 V
- Internal resistance R_i	100 kΩ
• As current input	
- Current range	4 ... 20 mA/-20 ... +20 mA, 0 ... 20 mA
- Internal resistance R_i	250 Ω
- Resolution	11 bit + sign
• Conductor cross-section, max.	1.5 mm²
Analog outputs (sustained short-circuit strength)	
• Voltage range	-10 ... +10 V
• Load current, max.	-3 ... +3 mA
• Current range	4 ... 20 mA, -20 ... +20 mA, 0 ... 20 mA
• Load resistance, max.	500 Ω for outputs in the range -20 ... +20 mA
• Resolution	11 bit + sign
• Conductor cross-section, max.	1.5 mm²
Relay outputs (changeover contacts)	
• Load current, max.	8 A
• Operating voltage, max.	250 V AC, 30 V DC
• Switching power at 250 V AC, max.	2000 VA (cos φ = 1) 750 VA (cos φ = 0.4)
• Switching power at 30 V DC, max.	240 W (ohmic load)
• Required minimum current	100 mA
• Conductor cross-section, max.	2.5 mm²

Options

Terminal connection overview for IGBT version

Terminal strip at TM31 (=.HD–A11)				
Terminal	Type		Preassign-ment	Comment
X540:				
1-8	P24	24 V DC supply for inputs DI0 to DI7	–	–
X520:				
1	DI0	Digital input electrically isolated via optocoupler	–	Pre-assigned for options L91, L93 and L96
2	DI1		–	
3	DI2		–	Pre-assigned for options L93 and L95
4	DI3		–	
5	M1	Reference ground for digital inputs DI0 to DI3	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X530:				
1	DI4	Digital input electrically isolated via optocoupler	–	Pre-assigned for options L90 and L91
2	DI5		–	
3	DI6		–	Pre-assigned for options L80 to L82
4	DI7		–	
5	M2	Reference ground for digital inputs DI4 to DI7	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X541:				
1	P24	24 V DC supply for inputs/outputs DI/O8 to DI/DO11	–	–
2	DI/DO8	Digital inputs/ digital outputs non-isolated	–	Pre-assigned for options L81 and L82
3	DI/DO9		–	
4	DI/DO10		–	Pre-assigned for option L82
5	DI/DO11		–	
6	M	Reference ground for P24, ground of digital inputs/ digital outputs	–	–

Terminal strip at TM31 (=.HD–A11)				
Terminal	Type		Preassign-ment	Comment
X521:				
1	AI0+	Analog inputs set up as differential inputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA The voltage input/current input is selected with a switch	–	–
2	AI0-			
3	AI1+		–	–
4	AI1-			
5	P10	Auxiliary voltage ± 10 V (10 mA) to connect a poten-tiometer to enter a setpoint via an ana-log input	–	–
6	M		–	–
7	N10		–	–
8	M		–	–
X522:				
1	AO 0V+	Analog outputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA	–	–
2	AO 0V-			Pre-assigned for options L93 and L95
3	AO0C+			–
4	AO 1V+		–	–
5	AO 1V-			Pre-assigned for options L93 and L95
6	AO 1C+			–
7	KTY+	Temperature sensor KTY84 0 ... 200 °C or PTC (R_{cold} < 1.5 kΩ)	–	The sensor type must be parameter-ized
8	KTY-		–	
X542:				
1	DO 0.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
2	DO 0.COM		–	Basic
3	DO 0.NO		–	NO contact
4	DO 1.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
5	DO 1.COM		–	Basic
6	DO 1.NO		–	NO contact

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Description of options

Options

Terminal connection overview for IGCT version

Terminal strip at TM31 (=.HD–A11)				
Terminal	Type		Preassign-ment	Comment
X540:				
1-8	P24	24 V DC supply for inputs DI0 to DI7	–	–
X520:				
1	DI0	Digital input electrically isolated via optocoupler	–	Pre-assigned for options L91 to L96
2	DI1		–	
3	DI2		–	Pre-assigned for options L92 to L96
4	DI3		–	
5	M1	Reference ground for digital inputs DI0 to DI3	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X530:				
1	DI4	Digital input electrically isolated via optocoupler	–	Pre-assigned for options L90 to L92
2	DI5		–	
3	DI6		–	Pre-assigned for options L80 to L82
4	DI7		–	
5	M2	Reference ground for digital inputs DI4 to DI7	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X541:				
1	P24	24 V DC supply for inputs/outputs DI/O8 to DI/DO11	–	–
2	DI/DO8	Digital inputs/ digital outputs non-isolated	–	Pre-assigned for options L81 and L82
3	DI/DO9		–	
4	DI/DO10		–	Pre-assigned for option L82
5	DI/DO11		–	
6	M	Reference ground for P24, ground of digital inputs/ digital outputs	–	–

Terminal strip at TM31 (=.HD–A11)				
Terminal	Type		Preassign-ment	Comment
X521:				
1	AI0+	Analog inputs set up as differential inputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA The voltage input/ current input is selected with a switch	–	–
2	AI0-			
3	AI1+		–	–
4	AI1-			
5	P10	Auxiliary voltage ± 10 V (10 mA) to connect a poten-tiometer to enter a setpoint via an analog input	–	–
6	M		–	–
7	N10		–	–
8	M		–	–
X522:				
1	AO 0V+	Analog outputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA	–	–
2	AO 0V-			Pre-assigned for options L93 to L96
3	AO0C+			–
4	AO 1V+		–	–
5	AO 1V-			Pre-assigned for options L93 to L96
6	AO 1C+			–
7	KTY+	Temperature sensor KTY84 0 ... 200 °C or PTC (R_{cold} < 1.5 kΩ)	–	The sensor type must be parameter-ized
8	KTY-		–	
X542:				
1	DO 0.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
2	DO 0.COM		–	Basic
3	DO 0.NO		–	NO contact
4	DO 1.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
5	DO 1.COM		–	Basic
6	DO 1.NO		–	NO contact

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Options

G62

Second additional TM31 Terminal Module

With order code **G62** a second TM31 Terminal Module can be ordered (description and exclusions under option **G61**).

Terminal connection overview

Terminal strip at TM31 (=.HD–A31)

Terminal	Type		Preassign-ment	Comment
X540:				
1-8	P24	24 V DC supply for inputs DI0 to DI7	–	–
X520:				
1	DI0	Digital input electrically isolated via optocoupler	–	Pre-assigned for options L94 and L96
2	DI1		–	
3	DI2		–	
4	DI3		–	
5	M1	Reference ground for digital inputs DI0 to DI3	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X530:				
1	DI4	Digital input electrically isolated via optocoupler	–	–
2	DI5		–	
3	DI6		–	–
4	DI7		–	
5	M2	Reference ground for digital inputs DI4 to DI7	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X541:				
1	P24	24 V DC supply for inputs/outputs DI/O8 to DI/DO11	–	–
2	DI/DO8	Digital inputs/ digital outputs non-isolated	–	–
3	DI/DO9		–	
4	DI/DO10		–	–
5	DI/DO11		–	
6	M	Reference ground for P24, ground of digital inputs/ digital outputs	–	–

Terminal strip at TM31 (=.HD–A31)

Terminal	Type		Preassign-ment	Comment
X521:				
1	AI0+	Analog inputs set up as differential inputs for the following ranges: -10 ... +10 V, +4 ... +20 mA, 0 ... +20 mA, -20 ... +20 mA. The voltage input/ current input is selected with a switch	–	–
2	AI0-			
3	AI1+		–	–
4	AI1-			
5	P10	Auxiliary voltage ± 10 V (10 mA) to connect a poten-tiometer to enter a setpoint via an ana-log input	–	–
6	M		–	–
7	N10		–	–
8	M		–	–
X522:				
1	AO 0V+	Analog outputs for the following ranges: -10 ... +10 V, +4 ... +20 mA, 0 ... +20 mA, -20 ... +20 mA	–	–
2	AO 0V-			Pre-assigned for options L94 and L96
3	AO0C+			–
4	AO 1V+		–	–
5	AO 1V-			Pre-assigned for options L94 and L96
6	AO 1C+			–
7	KTY+	Temperature sensor KTY84 0 ... 200 °C or PTC (R_{cold} < 1.5 kΩ)	–	The sensor type must be parameter-ized
8	KTY-		–	
X542:				
1	DO 0.NC	Relay output for changeover contact. Max. switching voltage: 250 V AC, 30 V DC. Max. switching power at 250 V AC: 2000 VA. Max. switching power at 30 V DC: 240 W	–	NC contact
2	DO 0.COM		–	Basic
3	DO 0.NO		–	NO contact
4	DO 1.NC	Relay output for changeover contact. Max. switching voltage: 250 V AC, 30 V DC. Max. switching power at 250 V AC: 2000 VA. Max. switching power at 30 V DC: 240 W	–	NC contact
5	DO 1.COM		–	Basic
6	DO 1.NO		–	NO contact

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Description of options

Options

G63

Additional TM15 Terminal Module

One TM31 Terminal Module and two TM15 Terminal Modules for integrating alarm and fault messages as well as control signals and for communicating with a higher-level control are already included in the standard version of the converter. The number of digital inputs and outputs can be expanded with an additional TM15 Terminal Module. This is recommended if, for instance, external signals are to be read in and processed or external components are to be controlled in addition to the standard customer's terminal strip.

The TM15 Terminal Module has:

- 24 bidirectional digital inputs and outputs (isolation in three groups of eight channels each)
- 24 green status LEDs for indicating the logical signal status of the relevant terminal

TM15 Terminal Module	
Digital inputs	
• Voltage	-30 ... +30 V
• Low level (an open digital input is interpreted as "low")	-30 ... +5 V
• High level	15 ... 30 V
• Current consumption at 24 V DC	5 ... 11 mA
• Signal propagation times of digital inputs, typ.	
- L → H	50 µs
- H → L	100 µs
• Conductor cross-section, max.	1.5 mm^2
Digital outputs (sustained short-circuit strength)	
• Voltage	24 V DC
• Load current per digital output, max.	0.5 A
• Output delay (ohmic load)	
- L → H, typ./max.	50/100 µs
- H → L, typ./max.	150/225 µs
• Total current of digital outputs (per group)	400 mA
- Up to 60 °C	2 A
- Up to 50 °C	3 A
- Up to 40 °C	4 A
• Conductor cross-section, max.	1.5 mm^2

G66

PADU8 diagnostics module (SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version)

The PADU8 diagnostic module reads out up to eight analog signals and up to eight digital signals from the gating and monitoring module of the power unit and makes these available for diagnostic purposes or for further processing. The typical detection cycle of all channels in parallel is 1 ms, enabling rapid signal characteristics to be detected and diagnosed simultaneously. The detected values are transferred to an evaluation system (e.g. notebook) either by optical conductors or by an RJ11 socket. All output data are available in parallel at the optical conductor output and at the RJ11 socket. This means that measurements can be taken in parallel at the RJ11 socket without disrupting the transfer of data at the optical conductor. With the option **G66** a PADU8 diagnostic module is integrated in the control section of each Motor Module.

G70

Pulse distributor for transferring the speed encoder signal (SINAMICS SM150; SINAMICS GM150 on request)

With this pulse distributor it is possible to split the encoder signal. This possibility is used, for example, when speed list values from an HTL incremental encoder are required at various points for measured-value acquisition and processing.

The pulse distributor transfers the HTL incremental encoder signals to two separate RS422 signal outputs. The inputs are electrically isolated from the outputs.

8-pole terminal strips are used for the connection.

Note:

For SINAMICS GM150, option **K50** (Sensor Module Cabinet-Mounted SMC30) should be ordered at the same time.

G71

Optical bus terminal (OBT) for PROFIBUS (SINAMICS SM150; SINAMICS GM150 on request)

PROFIBUS OBT is a network component for use in optical PROFIBUS DP fieldbus networks. The individual bus stations are linked using two-phase plastic optical conductors. These automatically provide isolation and prevent potential differences in large plants from having any impact.

The OBT has three interfaces:
Channel 1 is an electrical RS485 interface which is implemented as a 9-pole Sub D socket connector and establishes the link to the converter control.
Channels 2 and 3 form the optical interface. They are configured as a duplex socket and can be used for connection on the plant side to higher-level systems.

Note:

For SINAMICS GM150, option **G71** cannot be combined with options **G20 to G24** and **G34** (access to other bus systems) as well as with **G25** and **G35** (Teleservice).

Options

K20

Indicator lights in the cabinet door

With option **K20**, five indicator lights that signal the operating status of the converter are provided in the cabinet door of the control section.

- Fault (red)
- Warning (yellow)
- Operation (green)
- Drive ready (white)
- Local operation (white)

K21

Display instruments in the cabinet door for voltage, current, speed and power as well as indicator lights

To enable process variables to be displayed, analog display instruments that show the measurement parameter as a % are located in the cabinet door.

- Motor current (0 to +120 %)
- Motor speed (-120 % ... 0 … +120 %)
- Calculated motor power (0 to +120 %)
- Motor voltage (0 to +120 %).

Note:

Option **K21** includes option **K20**.

K22

Display instruments in the cabinet door for current, speed, power and winding temperature as well as indicator lights

To enable process variables to be displayed, analog display instruments that show the measurement parameter as a % are installed in the cabinet door. The motor winding temperature is displayed as an absolute value in °C.

- Motor current (0 to +120 %)
- Motor speed (-120 % ... 0 … +120 %)
- Calculated motor power (0 to +120 %)
- Motor winding temperature (0 to 200 °C)

Note:

Option **K22** includes option **K20**.

K50

SMC30 Sensor Module Cabinet-Mounted (SINAMICS GM150, standard for SINAMICS SM150)

The SMC30 encoder module can be used to record the actual motor speed. The signals from the rotary pulse encoder are converted here and made available to the closed-loop control for evaluation via the DRIVE-CLiQ interface.

The following encoders are supported by the SMC30:

- TTL encoders
- HTL encoders

The maximum connectable conductor cross-section is 20 mm^2.

Terminal	Significance
-X521:	
1	Track A+
2	Track A-
3	Track B+
4	Track B-
5	Track R+
6	Track R-
-X521:	
1	Power supply 5 V/24 V
2	

K80

Control of "Safe Torque Off" function (SINAMICS SM150; SINAMICS GM150 on request)

The "Safe Torque Off" function is a "mechanism for preventing the drive from unexpectedly starting" according to EN 60204-1/ VDE0113T1 (IEC 60204-1), Section 5.4. In conjunction with external circuitry, the "Safe Torque Off" function has been certified by TÜV-Süd [German Technical Inspectorate] in accordance with EN ISO 13849-1 with Safety Category 3 and Performance Level d as well as EN 61508 (IEC 61508), Parts 1 to 4, SIL 2. However, this certification is only valid if the plant-side circuit breaker is equipped with an undervoltage trip unit.

The switch on the motor side as shutdown path can be eliminated as a result of the "Safe Torque Off" function.

The comparison between options **K80** and **L60** contains additional information. (see the description of option **L60**).

Note:

Option **K80** is only available for SINAMICS GM150 on request. However, option **L60** (EMERGENCY-STOP, Stop Category 1 for controlled stopping) is available for this purpose.

Description of options

Options

L08

Output reactor

The output reactor is used to limit the capacitive charge-reversal currents of motor cables. Data regarding cable lengths when using the output reactor can be obtained for specific systems from your local Siemens sales contact.

Converter	Max. cable lengths			
	Without output reactor (standard)		With output reactor [1) (option **L08**)	
	Shielded	Un-shielded	Shielded	Un-shielded
Output voltage 2.3 kV to 4.16 kV				
SINAMICS GM150 IGBT version and SINAMICS SM150 IGBT version	Up to 2 parallel cables: each 100 m 3 parallel cables: each 80 m >3 parallel cables: not permitted	Not permitted	On request	Not permitted
Output voltage 3.3 kV				
SINAMICS GM150 as IGCT version	Up to 2 parallel cables: each 100 m 3 parallel cables: each 80 m 4 parallel cables: each 80 m	Not permitted	On request	Not permitted
	Mechanically, up to six parallel cables are possible (on request).			
SINAMICS SM150 IGCT version	Up to 4 parallel cables: each 80 m	Not permitted	On request	Not permitted
	Mechanically, up to six parallel cables are possible (on request).			

The output reactor is located in an additional cabinet unit.

Notice:

When using an output reactor, the following values apply for the maximum output frequency:

- SINAMICS GM150 in IGBT version and SINAMICS SM150 in IGBT version: 150 Hz
- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version: 90 Hz

Notice:

With option **L08** the cabinet width is increased as follows:

- SINAMICS GM150 in IGBT version and SINAMICS SM150 in IGBT version:
  - Single circuit configuration: 600 mm
  - Parallel circuit configuration: 2 × 600 mm

When option **M13** or **M78** is simultaneously selected the width does not have to be increased.

- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version: 700 mm per converter unit

When option **L49** or **L51/L52** is simultaneously selected, the width does not have to be increased.

[1) Distance between the converter and the motor depending on the current load for max. 6 three-wire EMC cables connected in parallel.

L21

Overvoltage protection AC *(static excitation unit, see Accessories, Chapter 7)*

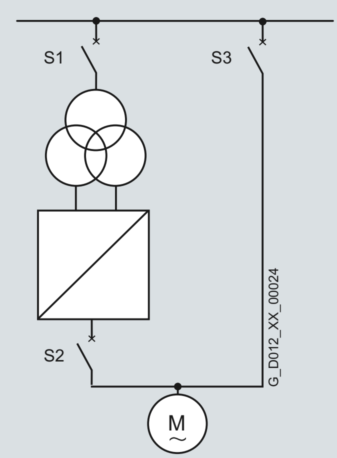
Option **L21** provides type SICROWBAR integrated overvoltage protection on the input side.

L29

Bidirectional synchronized bypass operation (SINAMICS GM150 in the IGBT version with induction motor)

Option **L29** offers synchronization with seamless (commutating) passing of the motor to the line and receiving of the motor from the line.

The converter synchronizes the motor to the existing line (phase relation, frequency and voltage). The motor is subsequently connected in parallel to the line by means of circuit breaker S3 before the output-side circuit breaker S2 opens.



Approx. 100 ms go by according to the response time constants of the two circuit breakers (opening time and closing time). Within this period of time the motor commutates from the converter to the line. This ensures smooth passing of the motor to the line.

If the motor is to be subsequently taken from the line and operated using the converter again, the commutation process is executed in the reverse order. The converter is first run up no-load operation and its output voltage is adapted to the line voltage (= motor voltage) in its phase relation, frequency and amplitude. Then circuit breaker S2 is closed before S3 is opened and the motor is isolated from the line.

This ensures that the motor is received smoothly by the converter so that it can be either operated under variable speed or shut down under control. Speed-controlled operation during running up and shutting down does not produce any high starting and peak transient torques that could damage the mechanical connection or cause transient and pressure fluctuations in the process.

Options

With option **L29** a VSM10 Voltage Sensing Module is integrated into the converter. The VSM10 detects the line supply voltage regarding phase position, frequency and amplitude. A voltage transformer, which should be provided on the primary side of the switch S1 (plant-side) is used for this purpose. It thus supplies the data for synchronization of the motor to the line and from the line to the converter. The converter control prepares the drive signals of the two circuit breakers to be provided on the plant side.

In addition, an output reactor with u_K = 10 % (±2 %) or option **Y15** (sine-wave filter) is required to decouple the converter during commutation.

Note:

A u_K value of 10 % cannot be reached with option **L08** (output reactor).

Circuit breaker S3 should be dimensioned so that it protects the motor against overvoltage and overcurrent during line supply operation. If temperature sensors are fitted in the motor, these must be monitored on the plant side for the case of mains operation.

Notice:

Option **L29** is only possible if the converter output voltage is the same as the line voltage.

L32

Automatic restart (SINAMICS GM150)

Option **L32** enables the converter to be restarted after a power failure once the mains supply has been restored.

If such a restart is required for technical reasons, the conditions set out below must be taken into consideration.

The 400 V 3 AC and 230 V 1 AC auxiliary infeed supplies must not fail; this is so that the voltage supply to the fans and coolant pumps and to the controller and closed-loop control is maintained.

If the main infeed fails, a pulse block is triggered and the DC link is supported through precharging for a short period. It is important to distinguish between two cases here:

Case A:

The circuit breaker on the input side is still switched on.

When the medium voltage supply returns, the DC link voltage rises. This is detected by the closed-loop control and the controller. Operation is resumed when a threshold value is exceeded.

Case B:

The circuit breaker on the input side has responded.

After a fixed time (which can be parameterized), the circuit breaker receives an "ON command". The response of the DC link voltage is then analyzed.

If the DC link voltage falls, the converter is disconnected.

If the DC link voltage rises, operation is resumed when a threshold value is exceeded.

Depending on the down times, load characteristic and moment of inertia, the drive may be "caught" again or the machine may need to be "excited" again first before operation can be resumed.

With option **L32** a VSM10 Voltage Sensing Module is integrated into the converter. The VSM10 detects the line supply voltage regarding phase position, frequency and amplitude. A voltage transformer, which should be provided on the primary side of the switch S1 (plant-side) is used for this purpose. This enables the controller and closed-loop control to detect when the medium voltage returns after a power failure if the circuit breaker on the input side has dropped out.

For safety reasons, a time limit is built in between the power failure and the maximum permitted line restoration time so that the drive cannot start up again uncontrolled.

A signal is issued in addition when restarting and can be used to generate an acoustic warning.

Note:

For SINAMICS SM150 in the IGBT and IGCT versions, the Voltage Sensing Module VSM10 as well as the software functionality is included as standard.

Connections at the VSM10 Voltage Sensing Module

DRIVE-CLiQ interface to connect VSM10		
Pin	Signal name	Comment
–X500:		
1	TXP	Transmit data +
2	TXN	Transmit data -
3	RXP	Receive data +
4	Reserved	–
5	Reserved	–
6	RXN	Receive data -
7	Reserved	–
8	Reserved	–
A	+ (24 V)	Power supply
B	M (0 V)	Electronic ground

Electronics power supply VSM10		
Terminal	Type	Comment
–X524:		
+	Electronics power supply	Voltage: 24 V DC (20.4 ... 28.8 V)
+	Reserved	Current consumption: Max. 0.2 A
M	Electronic ground	
M	Electronic ground	Max. current via the jumper in the connector: 20 A at 55 °C

Analog inputs/temperature sensor input VSM10		
Terminal	Type	Comment
–X520:		
1	AI 0+	Inputs can be parameterized via the software, resolution: 12 bit
2	AI 0-	
3	AI 1+	
4	AI 1-	
5	+Temp	Temperature sensor connection KTY84-1C130/PTC
6	-Temp	

Phase inputs VSM10		
Terminal	Type	Comment
–X522:		
1	Phase voltage U	Phase differential voltages U_{UV} and U_{VW} are sensed.
2	Phase voltage V	
3	Phase voltage W	

Description of options

Options

L48

Make-proof grounding switch at the converter input, motor-operated (SINAMICS SM150 in IGBT version on request only)

If grounding on the infeed side is required for safety and protection reasons, a motorized make-proof grounding switch can be ordered under code **L48**. The number of make-proof grounding switches depends on the particular infeed version (12/24-pulse for SINAMICS GM150 or 6-pulse for SINAMICS SM150).

For safety reasons, the converter controller locks these grounding switches against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.

In the event of maintenance work on the converter, it must be ensured on the plant side that there is no external voltage present, e.g. auxiliary voltage for fans, the cooling system, controller and closed-loop control and any external outputs in the converter.

Notice:

With option **L48** the cabinet width is increased as follows:

- SINAMICS GM150 in IGBT version:
  600 mm
- SINAMICS GM150 in IGCT version:
  2 × 700 mm per converter unit
- SINAMICS SM150 in IGCT version:
  700 mm per converter unit

Note:

Option **L48** in conjunction with option **C55** (auxiliary power supply for open-loop and closed-loop control) on request.

Note:

For SINAMICS GM150 in IGCT version, option **L48** in conjunction with option **N15** (24-pulse Basic Line Module) on request.

L49

Make-proof grounding switch at the converter output, motor-operated (SINAMICS SM150 in IGBT version on request only)

In certain operating modes/versions of the load machine (e.g. drive line-up with gas turbines) and types of drive motor (e.g. PEM), operating statuses may occur in which there is a risk that energy is fed back to the converter by the motor This can lead to dangerous voltages. In these cases a motorized grounding switch for the converter output side can be ordered under code **L49**. Where power units are connected in parallel, the number of circuit breakers will rise accordingly.

For safety reasons, the converter open-loop control locks the grounding switch against activation while voltage is still present. The control is integrated into the protection and monitoring chain of the converter. The grounding switches are inserted automatically when the standard grounding switches of the DC link are inserted.

Notice:

With option **L49** the cabinet width is increased as follows:

- SINAMICS GM150 in IGBT version:
  600 mm

When options **L51** or **L52** are simultaneously selected, the width does not have to be increased.

- SINAMICS GM150 in IGCT version and
  SINAMICS SM150 in IGCT version:
  700 mm per converter unit

When options **L08** and/or **L51/L52** are simultaneously selected, the width does not have to be increased.

Note:

Option **L49** in conjunction with option **C55** (auxiliary power supply for open-loop and closed-loop control) on request.

Options

L50

Cabinet lighting and service socket in the closed-loop control section

If option **L50** is chosen, a universal lamp and a service socket (Schuko version) are installed respectively in the cabinet panels of the control sections for Motor Modules and Active Line Modules.

The power supply for the cabinet lighting and service socket (on terminal strip = EG-X1) is provided externally. The cabinet lighting is switched on manually via a switch or automatically by an integrated motion detector. The mode is switch-selected.

Terminal	Significance
= EG–X1:1	L1 (230 V)
= EG–X1:2	N

L51

Disconnector at the converter output

If isolation between the converter output and the drive motor is required for safety and protection reasons, a motorized isolator at the converter output can be ordered under code **L51**.

Notice:

The cabinet width increases as follows due to the additional cabinet at the converter:

- SINAMICS GM150 in IGBT version and SINAMICS SM150 in IGBT version: 600 mm

When option **L49** is simultaneously selected, the width does not have to be increased.

- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version: 700 mm per converter unit

When option **L08** or **L49** are simultaneously selected, the width does not have to be increased.

Note:

Option **L51** cannot be combined with option **L52** (circuit breaker at the converter output), and can be ordered on request in conjunction with option **C55** (auxiliary power supply for open-loop and closed-loop control).

L52

Circuit breaker at converter output

If isolation between the converter output and the drive motor is required for safety and protection reasons, a circuit breaker at the converter output can be ordered under code **L52**. This circuit breaker is triggered from the converter controller. On an ON command, the circuit breaker on the output side is connected together with the auxiliaries. The circuit breaker is switched off with the OFF command.

Note:

Option **L52** is mandatory in conjunction with permanent-magnet synchronous motors. However, a separate inquiry is required for this option, as several variable secondary conditions must be taken into account.

Note:

Option **L52** cannot be combined with option **L51** (disconnector at the converter output), and can be ordered on request in conjunction with option **C55** (auxiliary power supply for open-loop and closed-loop control).

Notice:

With option **L52** the cabinet width is increased as follows:

- SINAMICS GM150 in IGBT version and SINAMICS SM150 in IGBT version: 600 mm

When option **L49** is simultaneously selected, the width does not have to be increased.

- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version: 700 mm per converter unit

When option **L08** or **L49** are simultaneously selected, the width does not have to be increased.

L53

UPS for the power supply of the open-loop and closed-loop control (SINAMICS GM150 on request)

If there is a danger of voltage dips and brief line supply failures in the plant, then the drive can continue to operate if the closed-loop control is supplied from a UPS. The prerequisite for continued operation is that the DC link voltage does not fall below the $V_{d\ min}$ limit and the medium-voltage switch does not trip due to an undervoltage condition. This means that the drive can tolerate voltage dips up to brief line supply failures; this is especially true if the driven load has a high moment of inertia and the DC link can be kinetically buffered.

In the case of line supply interruptions that cause the power unit to shut down, the downtime is reduced using the automatic restart function (option **L32**). The UPS is configured for a buffer time of up to 10 min.

Note:

Option **L53** limits the temperature range as follows:
continuous operation: 0 to +40 °C
operation <2 h/d: 0 to +45 °C
transport and storage: -15 to +50 °C

Terminal	Significance
= EB–X1:1	L1 (230 V)
= EB–X1:2	N

Description of options

Options

L55

Anti-condensation heating for the cabinet

The anti-condensation heating is recommended at low ambient temperatures and high levels of humidity to prevent condensation. The number of 100 W switch cabinet unit heaters fitted depends on the number of cabinet panels. The anti-condensation heaters are controlled by means of a thermostat. Should the external auxiliary infeed fail, this is monitored and reported by the converter for safety reasons.

The voltage for the anti-condensation heating (110 V to 240 V AC, on terminal block = GB–X1:) must be supplied externally.

Terminal	Significance
= GB–X1:1A	L1 (110 ... 240 V)
= GB–X1:2A	N

L60

EMERGENCY STOP, Stop Category 1 for controlled stopping (SINAMICS GM150)

For uncontrolled stopping, the standard converter is equipped with an EMERGENCY-OFF function, which involves integrating an external safety circuit and a positively opening mushroom pushbutton at the front of the unit. When the mushroom pushbutton is pressed, the line supply voltage is disconnected from the converter through the circuit breaker and the motor then coasts down.

As a supplement, the "EMERGENCY-STOP, Stop Category 1" function is available (acc. to EN 60204-1/VDE 0113 T1 (IEC 60204-1)) with option **L60**. This includes stopping the drive in an open-loop controlled fashion using a fast stop along a down ramp that has to be parameterized by the user. The line supply is then disconnected from the converter – the same as for EMERGENCY-OFF – via the time-delayed contact of the safety relay being used. The duration should be set at the safety relay corresponding to the selected down ramp. The selection and the feedback signal of the "EMERGENCY-STOP, Stop Category 1" function are connected to the customer's terminal strip.

Among others, depending on the safety relay selected (single-channel or two-channel) and the selected fault detection (e.g. using cyclic tests) a maximum of Safety Category 3 according to EN 954-1:1996 or EN ISO 13849-1:2006 can be achieved for the "EMERGENCY-STOP, Stop Category 1" function.

Notice:

The braking process can take considerable time even with an EMERGENCY-STOP, Stop Category 1.

Among other things, this depends on the total moment of inertia of the drive train. It may be necessary to use a Braking Module (option **L72**).

In addition to option **L60**, the "Safe Torque Off (STO)" safety function is available as option **K80** on request. The two options are compared in the following table.

	Option **L60** EMERGENCY-STOP, Stop Category 1 for controlled stopping	Option **K80** Safe Torque Off (STO)
Functionality	When activated, the drive is braked down to zero speed and the energy feed to the converter is then interrupted by opening the circuit breaker. In addition to the software intervention (OFF3), a safety relay also ensures that the circuit breaker reliably opens.	When activated, the drive is braked down to zero speed and then the gating commands of the power semiconductors are safely inhibited. The circuit breaker remains closed so that the converter is still connected to the power supply. The option also fulfills the "EMERGENCY-STOP, Stop Category 1" function as the rotating motion of the connected motor is brought to a standstill by removing the drive energy.
Assured safety feature	The converter is disconnected from the power after the selected delay time of the safety relay has expired	Driving torque is safely switched off according to safety category
Safety category	Up to category 3 acc. to EN 9541:1996 or EN ISO 138491:2006 can be achieved, depending on the circuit arrangement of the safety relay and the fault detection using separate tests.	EN 9411: 1996, Category 3 IEC 61508: 2000, Parts 1 to 4, SIL2
Certification of the option	No; however, the German Statutory Industrial Accident Insurance Association has certified the safety relay	Yes; by TÜV Süd [German Technical Inspectorate]
User's view	**The user is responsible for configuring and implementing the safety function.**	**The complete safety function is certified if the specifications are strictly met.**
Availability	SINAMICS GM150	SINAMICS SM150, SINAMICS GM150 on request

6

Options

L72

Braking Module

In order to permit braking operation for Basic Infeed (SINAMICS GM150) or for Active Infeed (SINAMICS SM150) to be able to brake even if the power fails, a Braking Module with braking resistor can be used. The mechanical design of the Braking Module corresponds to that of a Motor Module; its actual version is adapted to the converter cooling type (air or water cooling).

The following should be ensured when engineering:

- Shielded cables should be used just the same as at the converter output.
- The same maximum cable lengths as for SINAMICS GM150 in the IGBT version apply (without sine-wave filter or output reactor; refer to Power cables, Page 9/13).
- Regarding inductance L, the following requirements apply to the braking resistor and cable routing: The time constant L/R must not exceed 20 µs, i.e. L must be less than $R \times 20$ µs.

Note:

An external load resistor is connected as the braking resistor. This is not included in the scope of supply (option **Y73** see Page 6/42).

Note:

Option **L72** cannot be combined with option **M61** (redundant fan in the power unit).

Note:

For SINAMICS SM150 in IGCT version, option **L72** on request.

Note:

For SINAMICS GM150 in IGCT version, option **L72** cannot be combined with option **N15** (24-pulse Basic Line Module).

Notice:

With option **L72** the cabinet width is increased as follows:

- SINAMICS GM150 in the 12-pulse IGBT version: 600 mm
- SINAMICS SM150 in the IGCT version: 1800 mm

Braking power of the Braking Module with external braking resistor

Converter output voltage	Cooling method	Required braking resistor (± 10 %)	Braking resistor supply voltage	Braking power Braking Module	
				P_{20}	P_{DB}
kV		Ω	kV	kW	kW
SINAMICS GM150 in IGBT version					
2.3	Air	9.5	4.1	1000	333
	Water	7.5	4.1	1250	417
3.3	Air	13.5	5.8	1400	467
	Water	11	5.8	1700	567
4.16	Air	17.5	7.5	1800	600
	Water	14	7.5	2250	750
SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version					
3.3	Water	2 × 2.2	5.8	4000 [1]	4000

Note:

The data in the table above apply for the maximum control of the Braking Module. Different values for braking resistors are available on request.

Power connections, braking resistor

Terminal	Significance
SINAMICS GM150 and SINAMICS SM150 in IGBT version	
1C1	Power cable connection (+)
1D1	Power cable connection (–)
SINAMICS GM150 and SINAMICS SM150 in IGCT version	
1C1	Power cable connection (+)
1D1	Power cable connection (–)
1M1	Power cable connection (0)

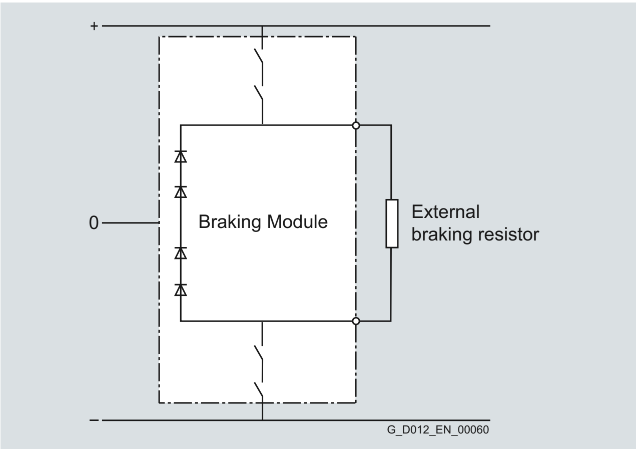
Connections, temperature monitoring for braking resistor

Terminal	Significance
SINAMICS GM150 and SINAMICS SM150 in IGBT version	
=.CG-X11:1	24 V DC power supply
=.CG-X11:2	Braking resistor temperature too high, fault
=.CG-X11:3	Braking resistor temperature too high, alarm
=.CG-X11:5	Air flow switch ON (option **Y73**)
=.EF-X22:8	Reference ground
SINAMICS GM150 and SINAMICS SM150 in IGCT version	
=.CG-X11:1	24 V DC power supply
=.CG-X11:2	Braking resistor temperature too high, fault
=.CG-X11:3	Braking resistor temperature too high, alarm
=.EF-X22:4	Reference ground

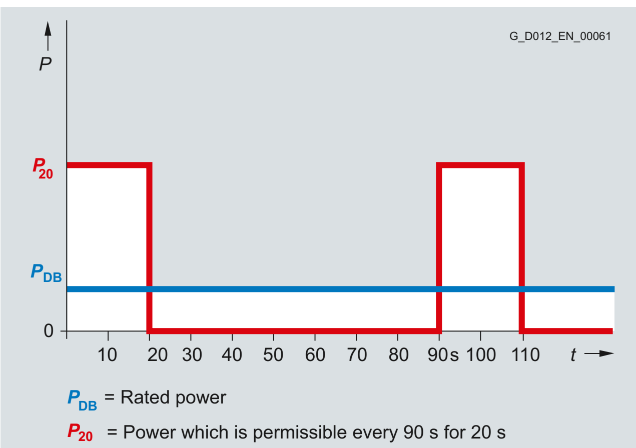
[1] Values can be higher for brief periods (in the range of seconds).

Description of options

Options



Block diagram of the Braking Module with braking resistor



Load diagram

L80

2 thermistor protection relays for alarm and fault

Option **L80** offers two thermistor protection relays (with PTB approval) for PTC thermistors (type A) for warning and disconnection. The power supply for the relay and the evaluation is provided within the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals.

Note:

Option **L80** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Meaning (alarm)
= LF–A11:T1	Sensor circuit connection
= LF–A11:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A12:T1	Sensor circuit connection
= LF–A12:T2	Sensor circuit connection

L81

2 x 2 thermistor protection relays for alarm and fault

Option **L81** offers four thermistor protection relays (with PTB approval) for PTC thermistors (type A) for warning and disconnection. The power supply for the relay and the evaluation is provided within the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals.

Note:

Option **L81** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Meaning (alarm)
= LF–A11:T1	Sensor circuit connection
= LF–A11:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A12:T1	Sensor circuit connection
= LF–A12:T2	Sensor circuit connection

Terminal	Meaning (alarm)
= LF–A21:T1	Sensor circuit connection
= LF–A21:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A22:T1	Sensor circuit connection
= LF–A22:T2	Sensor circuit connection

Options

L82

3 x 2 thermistor protection relays for alarm and fault

Option **L81** offers six thermistor protection relays (with PTB approval) for PTC thermistors (type A) for warning and disconnection. The power supply for the relay and the evaluation is provided within the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals.

Note:

Option **L82** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Meaning (alarm)
= LF–A11:T1	Sensor circuit connection
= LF–A11:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A12:T1	Sensor circuit connection
= LF–A12:T2	Sensor circuit connection

Terminal	Meaning (alarm)
= LF–A21:T1	Sensor circuit connection
= LF–A21:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A22:T1	Sensor circuit connection
= LF–A22:T2	Sensor circuit connection

Terminal	Meaning (alarm)
= LF–A31:T1	Sensor circuit connection
= LF–A31:T2	Sensor circuit connection

Terminal	Meaning (disconnection)
= LF–A32:T1	Sensor circuit connection
= LF–A32:T2	Sensor circuit connection

L87

Rotor ground-fault monitoring
(static excitation unit, see Accessories, Chapter 7)

Option **L87** provides integrated ground-fault monitoring for the rotor circuit.

L90 to L96

Three Pt100 inputs are available in the standard version. As a consequence, together with one of the options **L90 to L96** the following maximum number of Pt100 inputs can be achieved:

- SINAMICS GM150 in the IGBT version: 9 (with **L91**, **L93** or **L95**)
- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version: 15 (with **L94** or **L96**)

L90

Pt100 evaluation unit with 3 inputs

The Pt100 evaluation unit can monitor up to three sensors. For all three sensors, the limits for alarm and disconnection must be set centrally.

The output relays are integrated into the internal fault and shutdown sequence of the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L90** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Significance
= LJ–A11:1T1 to 1T3	Pt100; sensor 1
= LJ–A11:2T1 to 2T3	Pt100; sensor 2
= LJ–A11:3T1 to 3T3	Pt100; sensor 3

The sensors can be connected using a two-wire or three-wire system. In a two-wire system inputs xT1 and xT2 must be assigned and a jumper inserted between terminals xT2 and xT3.

Options

L91

2 Pt100 evaluation units, each with 3 inputs

Each Pt100 evaluation unit can monitor up to three sensors. For all three sensors, the limits for alarm and disconnection must be set centrally.

The output relays are integrated into the internal fault and shutdown sequence of the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L91** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Significance
= LJ–A11:1T1 to 1T3	Pt100; sensor 1
= LJ–A11:2T1 to 2T3	Pt100; sensor 2
= LJ–A11:3T1 to 3T3	Pt100; sensor 3

Terminal	Significance
= LJ–A12:1T1 to 1T3	Pt100; sensor 1
= LJ–A12:2T1 to 2T3	Pt100; sensor 2
= LJ–A12:3T1 to 3T3	Pt100; sensor 3

The sensors can be connected using a two-wire or three-wire system. In a two-wire system inputs xT1 and xT2 must be assigned and a jumper inserted between terminals xT2 and xT3.

L92

3 Pt100 evaluation units each with 3 inputs (SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version)

Each Pt100 evaluation unit can monitor up to three sensors. For all three sensors, the limits for alarm and disconnection must be set centrally.

The output relays are integrated into the internal fault and shutdown sequence of the converter.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L92** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Significance
= LJ–A11:1T1 to 1T3	Pt100; sensor 1
= LJ–A11:2T1 to 2T3	Pt100; sensor 2
= LJ–A11:3T1 to 3T3	Pt100; sensor 3

Terminal	Significance
= LJ–A12:1T1 to 1T3	Pt100; sensor 1
= LJ–A12:2T1 to 2T3	Pt100; sensor 2
= LJ–A12:3T1 to 3T3	Pt100; sensor 3

Terminal	Significance
= LJ–A21:1T1 to 1T3	Pt100; sensor 1
= LJ–A21:2T1 to 2T3	Pt100; sensor 2
= LJ–A21:3T1 to 3T3	Pt100; sensor 3

The sensors can be connected using a two-wire or three-wire system. In a two-wire system inputs xT1 and xT2 must be assigned and a jumper inserted between terminals xT2 and xT3.

Options

L93

Pt100 evaluation unit with 6 inputs and 2 analog outputs (outputs for display connected to the control)

The Pt100 evaluation unit can monitor up to six sensors. The limit values can be programmed by the user for each channel.

In the standard setting, the measuring channels are divided into two groups of three channels each. With motors, for example, this means that three Pt100s in the stator windings and two Pt100s in the motor bearings can be monitored. Channels that are not used can be suppressed using appropriate parameter settings.

The output relays are integrated into the internal fault and shutdown sequence of the converter. Two freely programmable analog outputs (0/4 mA to 20 mA and 0/2 V to 10 V) are also available.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals and analog outputs. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L93** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Significance
= LG–A11:T11 to T13	Pt100; sensor 1; group 1
= LG–A11:T21 to T23	Pt100; sensor 2; group 1
= LG–A11:T31 to T33	Pt100; sensor 3; group 1
= LG–A11:T41 to T43	Pt100; sensor 1; group 2
= LG–A11:T51 to T53	Pt100; sensor 2; group 2
= LG–A11:T61 to T63	Pt100; sensor 3; group 2
The sensors can be connected to the Pt100 evaluation unit using either a two-wire or three-wire system. In a two-wire system inputs Tx1 and Tx3 must be assigned. In a three-wire system, input Tx2 must also be connected (x = 1, 2 , ..., 6).	
= LG–A11:11/12/14	Relay output limit for group 1 reached (alarm); changeover contact
= LG–A11:21/22/24	Relay output limit for group 1 reached (fault); changeover contact
= LG–A11:T1 (OUT 1)	Analog output Out 1; sensor group 1
= LG–A11:I1 (OUT 1)	Analog output Out 1; sensor group 1
= LG–A11:31/32/34	Relay output limit for group 2 reached (alarm); changeover contact
= LG–A11:41/42/44	Relay output limit for group 2 reached (fault); changeover contact
= LG–A11:T2 (OUT 2)	Analog output Out 2; sensor group 2
= LG–A11:I2 (OUT 2)	Analog output Out 2; sensor group 2

L94

2 Pt100 evaluation units each with 6 inputs and 2 analog outputs (outputs for display connected to the control; SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version)

Option **L94** offers two Pt100 evaluation units as described under option **L93**, enabling up to 12 sensors in total to be monitored.

Two additional TM31 Terminal Modules are integrated as interfaces for further processing and to display signals and analog outputs. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L94** cannot be combined with options **G61** and **G62** (additional TM31 Terminal Modules), as well as with option **E86** (additional analog inputs).

Terminal	Significance
= LG–A11:T11 to T13	Pt100; sensor 1; group 1
= LG–A11:T21 to T23	Pt100; sensor 2; group 1
= LG–A11:T31 to T33	Pt100; sensor 3; group 1
= LG–A11:T41 to T43	Pt100; sensor 1; group 2
= LG–A11:T51 to T53	Pt100; sensor 2; group 2
= LG–A11:T61 to T63	Pt100; sensor 3; group 2
The sensors can be connected to the Pt100 evaluation unit using either a two-wire or three-wire system. In a two-wire system inputs Tx1 and Tx3 must be assigned. In a three-wire system, input Tx2 must also be connected (x = 1, 2 , ..., 6).	
= LG–A11:11/12/14	Relay output limit for group 1 reached (alarm); changeover contact
= LG–A11:21/22/24	Relay output limit for group 1 reached (fault); changeover contact
= LG–A11:T1 (OUT 1)	Analog output Out 1; sensor group 1
= LG–A11:I1 (OUT 1)	Analog output Out 1; sensor group 1
= LG–A11:31/32/34	Relay output limit for group 2 reached (alarm); changeover contact
= LG–A11:41/42/44	Relay output limit for group 2 reached (fault); changeover contact
= LG–A11:T2 (OUT 2)	Analog output Out 2; sensor group 2
= LG–A11:I2 (OUT 2)	Analog output Out 2; sensor group 2

Terminal	Significance
= LG–A21:T11 to T13	Pt100; sensor 1; group 3
= LG–A21:T21 to T23	Pt100; sensor 2; group 3
= LG–A21:T31 to T33	Pt100; sensor 3; group 3
= LG–A21:T41 to T43	Pt100; sensor 1; group 4
= LG–A21:T51 to T53	Pt100; sensor 2; group 4
= LG–A21:T61 to T63	Pt100; sensor 3; group 4
The sensors can be connected to the Pt100 evaluation unit using either a two-wire or three-wire system. In a two-wire system inputs Tx1 and Tx3 must be assigned. In a three-wire system, input Tx2 must also be connected (x = 1, 2 , ..., 6).	
= LG–A21:11/12/14	Relay output limit for group 3 reached (alarm); changeover contact
= LG–A21:21/22/24	Relay output limit for group 3 reached (fault); changeover contact
= LG–A21:T1 (OUT 1)	Analog output Out 1; sensor group 3
= LG–A21:I1 (OUT 1)	Analog output Out 1; sensor group 3
= LG–A21:31/32/34	Relay output limit for group 4 reached (alarm); changeover contact
= LG–A21:41/42/44	Relay output limit for group 4 reached (fault); changeover contact
= LG–A21:T2 (OUT 2)	Analog output Out 2; sensor group 4
= LG–A21:I2 (OUT 2)	Analog output Out 2; sensor group 4

Description of options

Options

L95

Pt100 evaluation unit with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control)

Six evaluation units are available for use in hazardous areas Zone 2 and Zone 22 (non-conductive dust) Div. 2 and in safe areas (intrinsically safe input: [Ex ia] IIC). The resistance thermometers (Pt100, Pt500, Pt1000) can be operated in a two-wire, three-wire or four-wire system. The six evaluation units are arranged in two groups of three units each. For each group the warning and disconnect messages are arranged together and integrated into the warning and fault reporting chain of the converter. In each group a temperature reading is also led to an analog input of the converter so that it is available to the converter control for measurement and display purposes.

An additional TM31 Terminal Module is integrated as interface for further processing and to display signals and analog outputs. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L95** cannot be combined with option **G61** (additional TM31 Terminal Module).

Terminal	Significance
= LH–A11:10/11/12/14	Pt100; sensor 1; group 1
= LH–A12:10/11/12/14	Pt100; sensor 2; group 1
= LH–A13:10/11/12/14	Pt100; sensor 3; group 1

Terminal	Significance
= LH–A21:10/11/12/14	Pt100; sensor 1; group 1
= LH–A22:10/11/12/14	Pt100; sensor 2; group 1
= LH–A23:10/11/12/14	Pt100; sensor 3; group 1

The sensors can be connected to the Pt100 evaluation unit in either a two-wire, three-wire or four-wire system.
In a two-wire system the inputs 10 and 12 must be connected, in a three-wire system the inputs 10, 11 and 12 and in a four-wire system the inputs 10, 11, 12 and 14 must be connected.
Parameterization is done using software.

L96

2 Pt100 evaluation units each with 6 inputs for explosion-protected motors and 2 analog outputs (outputs for display connected to the control system; SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version)

Two times six evaluation units are available for use in hazardous areas Zone 2 and Zone 22 (non-conductive dust) Div. 2 and in safe areas (intrinsically safe input: [Ex ia] IIC). The resistance thermometers (Pt100, Pt500, Pt1000) can be operated in a two-wire, three-wire or four-wire system. The evaluation units are arranged in groups of three units each. For each group the warning and disconnect messages are arranged together and integrated into the warning and fault reporting chain of the converter. In each group a temperature reading is also led to an analog input of the converter so that it is available to the converter control for measurement and display purposes.

Two additional TM31 Terminal Modules are integrated as interfaces for further processing and to display signals and analog outputs. The terminals that are assigned for the Pt100 evaluation are listed in the following table.

Note:

Option **L96** cannot be combined with options **G61** and **G62** (additional TM31 Terminal Modules), as well as with option **E86** (additional analog inputs).

Terminal	Significance
= LH–A11:10/11/12/14	Pt100; sensor 1; group 1
= LH–A12:10/11/12/14	Pt100; sensor 2; group 1
= LH–A13:10/11/12/14	Pt100; sensor 3; group 1

Terminal	Significance
= LH–A21:10/11/12/14	Pt100; sensor 1; group 1
= LH–A22:10/11/12/14	Pt100; sensor 2; group 1
= LH–A23:10/11/12/14	Pt100; sensor 3; group 1

Terminal	Significance
= LH–A31:10/11/12/14	Pt100; sensor 1; group 1
= LH–A32:10/11/12/14	Pt100; sensor 2; group 1
= LH–A33:10/11/12/14	Pt100; sensor 3; group 1

Terminal	Significance
= LH–A41:10/11/12/14	Pt100; sensor 1; group 1
= LH–A42:10/11/12/14	Pt100; sensor 2; group 1
= LH–A43:10/11/12/14	Pt100; sensor 3; group 1

The sensors can be connected to the Pt100 evaluation unit in either a two-wire, three-wire or four-wire system.
In a two-wire system the inputs 10 and 12 must be connected, in a three-wire system the inputs 10, 11 and 12 and in a four-wire system the inputs 10, 11, 12 and 14 must be connected.
Parameterization is done using software.

Options

M10

Safety interlocking system

The safety interlocking system is based on the key transfer system developed developed by Castell. It is a supplementary mechanism to the electromagnetic door locking system integrated as standard. To obtain the coded key of the key exchange unit, the medium-voltage circuit breaker must first be opened. The opened medium-voltage circuit breaker releases the keys to the key exchange unit, which in turn releases the keys to the converter cabinet doors of the power unit. This ensures that the converter is isolated from the medium voltage and that the medium voltage is no longer present in the cabinet. As long as the cabinet doors are not closed again and the keys of the converter cabinet doors are not put back into the key exchange unit, the key for the medium voltage circuit breaker will not be released and the medium voltage circuit breaker cannot be reclosed.

M11

Dust protection (air-cooled converters)

With option **M11** the cabinet doors are fitted with additional filter mats to prevent the ingress of dangerous dusts that would otherwise be deposited on the power unit components. The filter mats are fitted to the outside of the cabinet doors, which means that they can be replaced during operation.

A differential pressure technique continually determines the amount of dust in the filter mats. A maintenance request is issued in plenty of time before the filter mats get clogged up.

When replacing the filter mats, it must be ensured that no dust gets into the cabinet unit through the air pulled in by the cabinet fans as they run.

Note:

For SINAMICS SM150 in the IGCT version, the filter mats are already included as standard.

M13

Power cables are connected at the converter input from the top (SINAMICS GM150 in the IGBT version)

Given suitable installation conditions, option **M13** enables the line-side power cable to be introduced into the cabinet unit from the top.

Notice:

Option **M13** increases the width of the cabinet unit by 600 mm. When simultaneously selecting option **L08** (output reactor) or **Y15** (sine-wave filter) the width does not increase. In the case of option **Y15**, the dimensions in the Technical specifications apply.

Note:

Option **M13** is included in option **M78** (power cable connection at the converter output from the top).

M16

Extended dust protection (SINAMICS GM150 in a water-cooled IGBT version)

Opening the cabinet doors before commissioning (e.g. to route connecting cables) can mean, in certain environments, that the converter is polluted, for example as a result of welding operations. Option **M16** involves installing a dust protection cover manufactured out of polycarbonate (Makrolon) inside the converter. This dust protection cover reduces the amount of pollution that can get to the converter components through open doors, therefore minimizing cleaning costs for the converter.

Note:

The commissioning personnel must remove the dust protection cover of the converter prior to commissioning.

M32

Customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2

The signal cable is normally connected directly to the terminals of the TM31 or TM15 Terminal Modules. It must be noted that the maximum connectable cross-section for TM31 and TM15 is limited to 1.5 mm^2.

With option **M32**, the signals are fed to a terminal strip with spring-loaded terminals. In this case connection cross-sections of up to 2.5 mm^2 are permitted.

Note:

In conjunction with options **G61**, **G62** and **L80 to L96**, it is not possible to lead out the signals from the additional Terminal Modules.

M33

Customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2

The signal cable is normally connected directly to the terminals of the TM31 or TM15 Terminal Modules. It must be noted that the maximum connectable cross-section for TM31 and TM15 is limited to 1.5 mm^2.

With option **M33**, the signals are fed out to a terminal strip with screw terminals. In this case connection cross-sections of up to 2.5 mm^2 are permitted.

Note:

In conjunction with options **G61**, **G62** and **L80 to L96**, it is not possible to lead out the signals from the additional Terminal Modules.

Description of options

Options

M34

Connection of auxiliary voltage and signal cables from the top (SINAMICS GM150 in the IGBT version)

Given suitable installation conditions, option **M34** enables the auxiliary infeed and the signal cable to be introduced into the cabinet unit from the top.

Note:

Option **M34** requires that option **M32** (customer's terminal strip with spring-loaded terminals for signal cables up to 2.5 mm^2) or **M33** (customer's terminal strip with screw terminals for signal cables up to 2.5 mm^2) must be simultaneously ordered.

M36

Brass cable entry for power cables (SINAMICS GM150, SINAMICS SM150 in IGCT version)

With option **M36** the converter is supplied with a brass cable entry for the power cables.

For versions with single-core cables, option **M36** is required, so that no circulating currents form in the cable gland.

M42

IP42 degree of protection (SINAMICS GM150 in the air-cooled IGBT version)

With option **M42** , the degree of protection of the air-cooled converters can be enhanced (IP22 is standard). Additional close-meshed grilles where the air comes in and goes out prevent the ingress of solid matter with diameters > 1.0 mm.

M54

IP54 degree of protection (SINAMICS GM150 in the water-cooled version and SINAMICS SM150 in the IGCT version)

With option **M54** , the degree of protection of the water-cooled converters can be enhanced (IP43 is standard).

M61

Redundant fan in the power unit (SINAMICS GM150 in the IGBT version)

To improve system availability, it is possible to equip the converter with an additional redundantly operating fan. If a fan within the converter cabinet unit fails, this is immediately detected by the differential pressure detector in the cabinet and the redundant fan is activated by the converter controller without the converter and hence the drive system failing. This enables production down times or interruptions to be avoided and replacement of the faulty fan to be postponed until the next scheduled shutdown.

Note:

Option **M61** cannot be combined with option **L72** (Braking Module).

Note:

Option **M61** is not available for all converters.

For the following converters, the cabinet width must be increased by 600 mm:

Rated voltage	Converter
2.3 kV	6SL3810-2LM36-0AA0
	6SL3810-2LM37-0AA1
	6SL3810-2LM38-0AA1
3.3 kV	6SL3810-2LN36-0AA0
	6SL3810-2LN37-0AA1
	6SL3810-2LN38-0AA1
4.16 kV	6SL3810-2LP35-3AA1

For the following converters, the cabinet width must be increased by 600 mm and the air intake temperature must be limited to a maximum of +35 °C:

Rated voltage	Converter
4.16 kV	6SL3810-2LP36-0AA0
	6SL3810-2LP37-0AA1
	6SL3810-2LP38-0AA1

The following converters cannot be ordered with option M61:

Rated voltage	Converter
3.3 kV	6SL3810-2LN41-4AA1
4.16 kV	6SL3810-2LP41-1AA0
	6SL3810-2LP41-2AA1
	6SL3810-2LP41-4AA1

Options

M64

Converter prepared for connection to an external air discharge system, with internal cabinet fans (SINAMICS GM150 in the air-cooled IGBT version)

Retaining the fans inside the cabinet unit ensures that the volume of cool air required for cooling can be supplied without any major distribution faults occurring. If the exhaust air is led in a duct system over long sections or even around bends, the pressure drop that arises in this duct system must be compensated by additional fans within the exhaust air system. Suitable "flange connections" for connecting the converter to an external exhaust air system are located in the roof part of the cabinet unit.

M66

Suitable for marine use (SINAMICS GM150, water-cooled)

With option **M66** , the version of the converter meets the requirements of the following classification organizations:

- Lloyds Register
- American Bureau of Shipping
- Germanischer Lloyd
- Bureau Veritas
- Det Norske Veritas
- Chinese Classification Society

Option **M66** includes a seawater-proof paint finish, a strengthened mechanical design of the cabinet, handrails below the operator panel and a mechanical locking system for the cabinet doors. The cabinet has degree of protection IP44, includes anti-condensation heating (option **L55**) and can be welded to the ship's structure to mount the converter.

Note:

For SINAMICS GM150 in the IGBT version, the cabinet has a reinforced base frame. This increases the cabinet height by 100 mm. (The cabinet in the IGCT version is already equipped with an appropriate base frame as standard).

Note:

With option **M66** the following ambient conditions in operation apply that are changed with respect to the standard values:
Ambient temperature: 0 °C to 45 °C
(derating must be taken into account)
Relative air humidity: 5 % to 95 %

Note:

For SINAMICS GM150 in IGBT version, the combination with option **Y15** (sine-wave filter) on request.

Note:

If the converter is used for a safety-relevant drive ("essential service") on the ship, individual certification is additionally required (options **E11 to E71** see Page 6/12).

Terminal connection overview

When selecting option **M66** , an additional TM31 Terminal Module is required, which provides the additional digital and analog inputs/outputs. An overview is shown in the following table.

Terminal strip on TM31 (=.HC–A71)

Terminal	Type		Pre-assignment	Comment
X540:				
1-8	P24	24 V DC supply for inputs DI0 to DI7	–	–
X520:				
1	DI0	Digital input electrically isolated via optocoupler	–	–
2	DI1		–	–
3	DI2		–	–
4	DI3		–	–
5	M1	Reference ground for digital inputs DI0 to DI3	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X530:				
1	DI4	Digital input electrically isolated via optocoupler	–	–
2	DI5		–	–
3	DI6		–	–
4	DI7		–	–
5	M2	Reference ground for digital inputs DI4 to DI7	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X541:				
1	P24	24 V DC supply for inputs/outputs DI/O8 to DI/DO11	–	–
2	DI/DO8	Digital inputs/ digital outputs non-isolated	–	–
3	DI/DO9		–	–
4	DI/DO10		–	–
5	DI/DO11		–	–
6	M	Reference ground for P24, ground of digital inputs/ digital outputs	–	–

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Description of options

Options

Terminal strip on TM31 (=.HC–A71)				
Terminal	Type		Preassign-ment	Comment
X521:				
1	AI0+	Analog inputs set up as differential inputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA The voltage input/current input is selected with a switch	Cooling unit flow measure-ment with 4 ... 20 mA signal	–
2	AI0-			
3	AI1+		–	–
4	AI1-			
5	P10	Auxiliary voltage ± 10 V (10 mA) to connect a poten-tiometer to enter a setpoint via an analog input	–	–
6	M		–	–
7	N10		–	–
8	M		–	–
X522:				
1	AO 0V+	Analog outputs for the following ranges: -10 ... +10 V +4 ... +20 mA 0 ... +20 mA -20 ... +20 mA	–	–
2	AO 0V-			
3	AO0C+			
4	AO 1V+		–	–
5	AO 1V-			
6	AO 1C+			
7	KTY+	Temperature sensor KTY84 0 ... 200 °C or PTC (R_{cold} < 1.5 kΩ)	–	The sensor type must be parameter-ized
8	KTY-		–	
X542:				
1	DO 0.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
2	DO 0.COM		–	Basic
3	DO 0.NO		–	NO contact
4	DO 1.NC	Relay output for changeover contact Max. switching voltage: 250 V AC, 30 V DC Max. switching power at 250 V AC: 2000 VA Max. switching power at 30 V DC: 240 W	–	NC contact
5	DO 1.COM		–	Basic
6	DO 1.NO		–	NO contact

M78

Power cables at the converter output are connected from the top (SINAMICS GM150 in the IGBT version)

Given suitable installation conditions, option **M78** enables the motor-side power cable to be introduced into the cabinet unit from the top.

Option **M78** includes option **M13** (power cable connection at the converter input from the top).

Notice:

Option **M78** increases the cabinet width by 600 mm. When simultaneously selecting option **L08** (output reactor) or **Y15** (sine-wave filter) the width does not increase. In the case of option **Y15**, the dimensions in the Technical specifications apply.

N06 to N08

Capacitor Modules to increase the DC link capacitance (SINAMICS SM150 in IGCT version)

With options **N06 to N08** the converter is shipped with Capacitor Modules to increase the DC link capacitance. The increase for each sub DC link is 6, 12 or 18 mF.

Note:

Options **N06 to N08** are only available for the basic and parallel connections with order numbers 6SL3845-7NN42-2AA0, 6SL3845-7NN44-5AA0 and 6SL3845-7NN46-7AA0. They are not available for DC bus configurations.
With these options, the cabinet width per converter unit is increased (see the following table).

Number of Capacitor Modules	Option	Additional cabinet width per converter unit	DC link capacitance per sub DC link
0	–	–	12 mF
1	**N06**	970 mm	18 mF
2	**N07**	1940 mm	24 mF
3	**N08**	2910 mm	30 mF

Options

N13

Circuit breaker at the converter input (SINAMICS GM150, for 24-pulse Basic Line Module on request; not available for the IGCT version with converter units operated in parallel; SINAMICS SM150 in the IGCT version on request)

Option **N13** provides integrated circuit breakers. Option **N13** is particularly important in the retrofit business where existing circuit breakers do not meet requirements (tripping times, low-voltage coil). The circuit breakers are installed below the Basic Line Module in the converter cabinet and are thus located on the secondary side of the line-side transformer.

Notice:

Option N13 increases the width of the cabinet as follows:

- SINAMICS GM150 in the IGBT version: 600 mm
- SINAMICS GM150 in the IGCT version: 2 × 700 mm

Note:

In conjunction with option **C55** (auxiliary power supply for open-loop and closed-loop control), as well as for converters with 24-pulse Basic Line Module, for option **N13** a special request is required.

N15

24-pulse Basic Line Module (SINAMICS GM150)

For particularly high requirements regarding low line harmonics, the power units of voltage ranges 2.3 kV, 3.3 kV and 4.16 kV can be equipped with a 24-pulse Basic Line Module. (circuit version (2) for IGBT version, circuit version (8) for IGCT version).

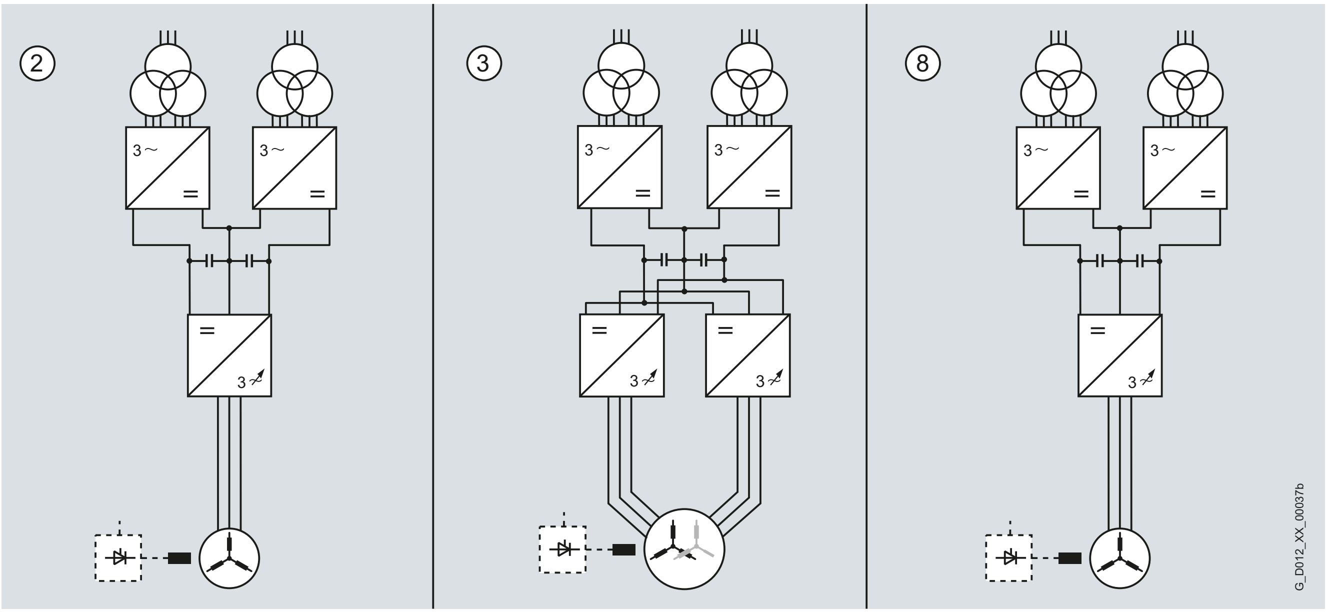
Converters with higher power ratings with power units connected in parallel can also be operated without this 24-pulse option (circuit version (3)). The converter transformer required at the medium-voltage level must be designed as a five-winding transformer, or else two two-tier transformers must be provided. Vector groups and winding offsets must be appropriately engineered.

Notice:

With the option **N15** the width of the converter cabinet for SINAMICS GM150 as IGBT version increases by 600 mm.

Note:

For SINAMICS GM150 in the IGCT version, option **N15** cannot be combined with option **L72** (Braking Module), and a request is required in conjunction with option **L48** (make-proof grounding switch at the converter input).

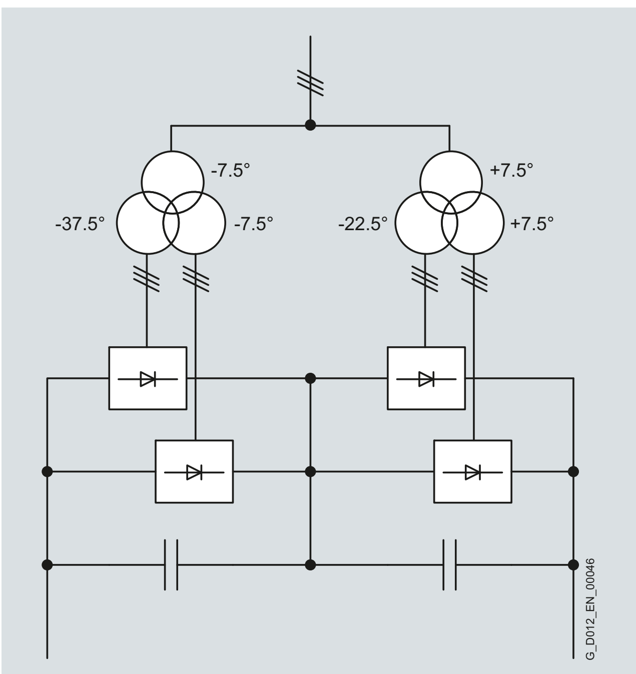


(2) SINAMICS GM150 in IGBT version, basic circuit 2.3 kV to 4.16 kV (Option **N15**)
(3) SINAMICS GM150 in IGBT version, parallel connection 2.3 kV to 4.16 kV (24-pulse infeed as standard)
(8) SINAMICS GM150 in IGCT version (option **N15**)

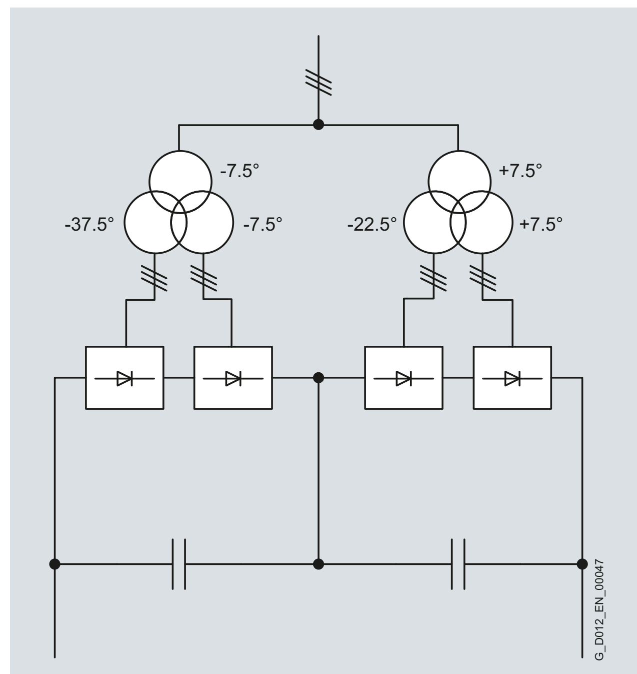
Description of options

Options

The circuit for the 24-pulse infeed is implemented in different ways for SINAMICS GM150 in the IGBT version and in the IGCT version. The two following diagrams should clearly show the principle difference between the parallel connection (for IGBT) and the series connection (for IGCT). The Basic Line Modules (each with two diode rectifiers) are supplied from two 3-winding transformers with ±7.5° shift on the primary side. 12-pulse operation applies as a result of the 30° phase shift between the two rectifiers of a DC link half. For the same load of the halves, 24-pulse operation is achieved as the infeeds of the two DC link halves are phase shifted through 15° with respect to one another. In the case of IGBTs, the deviation of the secondary voltage of a transformer under load conditions may be a maximum of 1 %.



SINAMICS GM150 in the IGBT version, 24-pulse infeed by connecting two Basic Line Modules in parallel (absolute values of the individual phase shift angles as example only)



SINAMICS GM150 in the IGCT version, 24-pulse infeed by connecting two Basic Line Modules in series (absolute values of the individual phase shift angles as example only)

Options

N20

110 V to 120 V DC capacitor tripping device (SINAMICS GM150 in the IGBT version)

The capacitor tripping device is used if the existing circuit breaker has no undervoltage coil and cannot be retrofitted with one.

It is installed in the converter and has the following functions:

- Monitoring of the auxiliary voltage supply of the circuit breaker on the plant side
- Monitoring of the own internal voltage supply
- Locking of the circuit breaker in the open position if there is insufficient voltage

The capacitor tripping device ensures that the circuit breaker on the plant side can still be safely opened even if there is a power failure or the normal OPEN command is not effective, e.g. because of wire breakage.

N21

230 V DC capacitor tripping device (SINAMICS GM150 in the IGBT version)

The capacitor tripping device is used if the existing circuit breaker has no undervoltage coil and cannot be retrofitted with one.

It is installed in the converter and has the following functions:

- Monitoring of the auxiliary voltage supply of the circuit breaker on the plant side
- Monitoring of the own internal voltage supply
- Locking of the circuit breaker in the open position if there is insufficient voltage

The capacitor tripping device ensures that the circuit breaker on the plant side can still be safely tripped even if there is a power failure or the normal OFF command is not effective, e.g. because of a wire break.

N22

Switch on the input side
(static excitation unit, see Accessories, Chapter 7)

When option **N22** is chosen, a circuit breaker which is controlled by the static excitation unit itself is integrated on the input side. On the variants for brushless reverse field excitation this circuit breaker is configured as a contactor, on the variants for slipring excitation as a disconnector.

Note:

If this circuit breaker is not available, an external circuit breaker must be provided.

N30 to N33

Controlled motor feeder for auxiliaries 400 V 3 AC/480 V 3 AC

An outgoing feeder for the operation of external auxiliary equipment, e.g. separate fans on the motor or pumps/oil supplies, is available in the converter. It is controlled and is fused by motor circuit breakers. The voltage supply required for the drive must be provided from an external source.

Depending on the drive output that is required, four different outgoing feeders are available.

The contactor is closed with the **ON** command at the converter and opened with the **OFF** command.

Option	Description
N30	Controlled motor feeder for auxiliaries 50 Hz 400 V 3 AC, max. 4 kW or 60 Hz 480 V 3 AC, max. 4.8 kW (cos φ = 0.8; setting range of the motor circuit breaker from 9 A to 12.5 A)
N31	Controlled motor feeder for auxiliaries 50 Hz 400 V 3 AC, max. 7 kW or 60 Hz 480 V 3 AC, max. 8 kW (cos φ = 0.8; setting range of the motor circuit breaker from 14 A to 20 A)
N32	Controlled motor feeder for auxiliaries 50 Hz 400 V 3 AC, max. 11 kW or 60 Hz 480 V 3 AC, max. 12.7 kW (cos φ = 0.8; setting range of the motor circuit breaker from 18 A to 25 A)
N33	Controlled motor feeder for auxiliaries 50 Hz 400 V 3 AC, max. 15 kW or 60 Hz 480 V 3 AC, max. 17.5 kW (cos φ = 0.8; setting range of the motor circuit breaker from 28 A to 40 A)

Note:

Other voltages are also possible according to the ratings in question.

Note:

It is not possible to combine several options (**N30 to N33**).

Auxiliary voltage infeed	Outgoing feeder for auxiliaries	Protective circuit breaker external power supply ON	
= GC–X1:1 L1	= GC–X1:4 L1	= GC–X2:1	Relay contact, max. 60 V DC
= GC–X1:2 L2	= GC–X1:5 L2	= GC–X2:2	
= GC–X1:3 L3	= GC–X1:6 L3		

Description of options

Options

N35 to N38

Controlled outgoing feeder for auxiliaries 230 V 1 AC/120 V 1 AC

A controlled outgoing feeder protected by miniature circuit breakers is available in the converter for controlling external auxiliaries, e.g. the anti-condensation heating for the motor. The infeed required for the voltage supply, e.g. the anti-condensation heating, must be provided externally.

Depending on the output that is required, four different outgoing feeders are available.

The contactor is opened with the **ON** command at the converter and closed with the **OFF** command.

Option	Description
N35	Controlled outgoing feeder for auxiliaries 50 Hz 230 V 1 AC, max. 1.2 kW or 60 Hz 120 V 1 AC, max. 1 kW
N36	Controlled outgoing feeder for auxiliaries 50 Hz 230 V 1 AC, max. 2.2 kW or 60 Hz 120 V 1 AC, max. 1.5 kW
N37	Controlled outgoing feeder for auxiliaries 50 Hz 230 V 1 AC, max. 3.5 kW or 60 Hz 120 V 1 AC, max. 2.1 kW
N38	Controlled outgoing feeder for auxiliaries 50 Hz 230 V 1 AC, max. 4.5 kW or 60 Hz 120 V 1 AC, max. 2.8 kW

Note:

It is not possible to combine several options (**N35 to N38**).

Auxiliary voltage infeed	Outgoing feeder for auxiliaries	Protective circuit breaker external power supply ON	
= GC–X1:7 L1	= GC–X1:9 L1	= GC–X2:3	Relay contact, max. 60 V DC
= GC–X1:8 N	= GC–X1:10 L2	= GC–X2:4	

Q80 to Q85

Extension of the liability for defects

For a description, refer to services and documentation, Pages 10/12 and 10/13.

S05

Basic configuration (SINAMICS SM150)

Option **S05** provides a system-specific software configuration, which is absolutely necessary for the correct functioning of the SINAMICS SM150 converter system. If option **S05** is not selected, then a system integrator must carry out this basic configuration.

The basic configuration includes:

- Connection of the static excitation unit via PROFIBUS
- Operation of the SIMATIC OP 177B operator panel
- Signal marshaling to connect to the basic automation (e.g. ON/OFF or fault signals from Motor Modules)

T58, T60, T80, T85, T90, T91

Rating plate languages

The rating plate is normally supplied in two languages (English/German). Other languages can be ordered using the codes below.

Option	Description
T58	Rating plate in English/French
T60	Rating plate in English/Spanish
T80	Rating plate in English/Italian
T82	Rating plate in English/Portuguese (on request)
T85	Rating plate in English/Russian (on request)
T86	Rating plate in English/Polish (on request)
T90	Rating plate in English/Japanese (on request)
T91	Rating plate in English/Chinese (on request)

Note:

It is not possible to combine several options (**T58 to T91**).

Options

W02

Cooling unit with redundant stainless steel plate-type heat exchangers (for water cooling)

The cooling unit is used to dissipate the power loss from the converter and consists of two cooling circuits: the internal cooling circuit with deionized water and the external raw water circuit for dissipating the power loss. In the standard version the internal cooling circuit has two redundant circulating pumps and one stainless steel plate-type heat exchanger. With option **W02** , a second stainless steel plate-type heat exchanger is integrated to enable fully redundant operation.

W11

Cooling unit with a titanium plate-type heat exchanger (for water cooling)

If the raw water specified in the Technical specifications is not available for the cooling unit, option **W11** must be selected. This is required in the case of aggressive raw water such as seawater, for instance. With option **W11** , a titanium plate-type heat exchanger is installed instead of the stainless steel plate-type heat exchanger. The three-way valve for preventing condensation and the necessary pipe connections are still made from stainless steel.

Notice:

When option **W11** is chosen, the piping on the raw water side is manufactured of stainless steel and not titanium.

W12

Cooling unit with redundant titanium plate-type heat exchangers (for water cooling)

With option **W12**, two completely redundant titanium plate-type heat exchangers are integrated for the internal cooling circuit (other characteristics as described under option **W11**).

Notice:

When option **W12** is chosen, the piping on the raw water side is manufactured of stainless steel and not titanium.

W14

Converter without cooling unit. This must be provided on the plant side (for water cooling)

When option **W14** is chosen, the water-cooled converter is supplied without a cooling unit. The necessary cooling system must be provided on the plant side.

Note:

Option **W14** reduces the width and weight of the cabinet (data available on request).

W20

Raw-water connection from the bottom (SINAMICS GM150 in the IGBT version)

Option **W20** enables the raw water for the cooling unit to be supplied from the bottom through the cabinet floor with a flange connection. The necessary mating flanges are included as a pack with the cooling unit.

Note:

With water-cooled IGBT converters, the raw water is supplied to the cooling unit through the side panel from the left-hand side. For converters in IGCT technology, the raw water is connected at the cooling unit from the bottom.

Y05

Customer-specific rating plate

With option **Y05** the data on the rating plate can be adapted for the specific plant or system, depending on the ambient conditions such as installation altitude or ambient temperature. This also involves data regarding the rated voltage, rated current and the frequency range at the converter output. The maximum values of the adapted rating plate are defined by the values of the standard rating plate, which correspond to the catalog data.

Y09

Special paint finish according to RAL...

Converters are normally supplied in RAL 7035 (light gray). With option **Y09** a special color can be ordered by specifying plain text.

Note:

For SINAMICS GM150 in the air-cooled version, the following applies: The fans still have the standard RAL 7035 color even when the cabinet has a special paint finish.

Y10

Customer-specific circuit diagrams

The circuit diagrams are given customized headers.

The data for the header must be specified in plain text (up to three lines, with 45 characters per line).

Description of options

Options

Y15

Sine-wave filter (SINAMICS GM150 in the IGBT version and SINAMICS SM150 in the IGBT version on request)

Sine-wave filters are required for the following applications:

- When operating old motors (retrofit)
- When operating third-party motors without taking supplementary measures for converter operation

The sine-wave filters supply the motors with almost sinusoidal motor currents and voltages so that line motors can be operated. The sine-wave filter operates optimally for motors with a rated frequency of 50 Hz or 60 Hz. It should be noted that only driven loads with a square-law load torque may be operated (e.g. pumps, fans). The output frequencies used in operation can lie in the range between 30 Hz and 66 Hz.

A field weakening range of 1:1.1 is permissible (max. 55 Hz for 50 Hz motors and max. 66 Hz for 60 Hz motors).

When sine-wave filters are used, the voltage harmonic distortion at an output frequency of 50 Hz is less than 5 %.

If the sine-wave filter is used, the output of the converter must be reduced (see Technical specifications).

Note:

The rated motor current, the motor current in the operating point and the motor no-load current must be given in plain text when ordering filters.

Converter	Max. cable lengths			
	Without sine-wave filter (standard)		With sine-wave filter [1] (option **Y15**)	
	Shielded	Un-shielded	Shielded	Un-shielded [2]
Output voltage 2.3 kV to 4.16 kV				
SINAMICS GM150 as IGBT version	Up to 2 parallel cables: 100 m 3 parallel cables: 80 m >3 parallel cables: Not permitted	Not permitted	1000 m	1000 m

Notice:

Option **Y15** increases the width of the cabinet unit (for dimensions see Technical specifications).

Y17

Line reactor
(static excitation unit, see Accessories, Chapter 7)

With the option **Y17** a line reactor is integrated to protect against excessive harmonic currents and to limit the circuit feedbacks. The exact values for the reactor must be given in plain text as they are dependent on the supplying network.

Y40

Raw water data deviating from the catalog data (with water cooling, on request)

With option **Y40**, raw water whose data does not conform to the Technical specifications can also be used with water-cooled converters (for specifications, see Cooling unit, Pages 9/8 and 9/9). Deviations from the values indicated in the specification must be clarified in advance.

Y73

Braking resistor
(SINAMICS SM150 on request only)

The braking resistor is connected to the Braking Module (option **L72**) via two connections (SINAMICS GM150 in the IGBT version) or three connections (SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version). For dimensioning, refer to the Table in the description for option **L72**, Page 6/27.

Notice:

The power loss of the braking resistor must be taken into account when dimensioning the room or the area in which the converters is mounted. If required, the braking resistor should be mounted outside the room/area. The braking resistor is equipped with a temperature monitor. This must be connected up so that when it responds, the converter is shut down. Regarding inductance L, the following requirements apply to the braking resistor and cable routing: The time constant L/R must not exceed 20 µs, i.e. L must be less than $R \times 20$ µs.

The signal cables to the temperature monitoring and the power cable are not included in the scope of supply.

Note:

When ordering, the following data must be specified in plain text: max. rated power, braking duration and cycle. The Technical specifications are obtained, based on this data (for example, dimensions, weight), whereby the following basic data apply to all resistors:

- Degree of protection IP20, with perforated sheet steel roof section manufactured out of V2A steel
- Cooling using an internal fan
- Digital feedback signal from the air flow switch and temperature switch
- Mounted outside the converter, in electrical rooms and areas
- Ambient temperature: max. converter ambient temperature
- Enclosure, painted, RAL 7035

[1] Distance between the converter and the motor depending on the current load for max. 6 three-wire EMC cables connected in parallel.

[2] Armored cables are recommended.

Accessories

7

Accessories for grounding and short-circuiting the converter

Overview

Accessories for grounding and short-circuiting the converter for commissioning and maintenance work

For safety reasons, devices for grounding and short-circuiting the converter are required for work on the converter in the de-energized state (EN 61230/VDE 0683-100 (IEC 61230)). They are required for commissioning or service work, for example, as well as for replacing fans or Power cards/phase modules.

As some of this work has to be performed by operator personnel with the relevant training, the specified tools must be available on the equipment. If these devices are not available, the work must not be performed due to the electrical hazards.

In the case of SINAMICS GM150 and SINAMICS SM150, spherical grounding points are fitted on the input and output side in the area of the connecting bar which can be short-circuited and grounded with an appropriate three-pole grounding device (grounding harness).

As a rule, this must be done in the de-energized state for all work (in the case of converters with a power unit connected in parallel at both infeed points or motor feeders).

If appropriate devices are not available on the equipment, the relevant converter accessories must be supplied in the requisite quantity.

Please note in this case that the number of three-pole grounding devices required is dependent on the number of infeeding three-phase current systems. One grounding device per three-phase current system is required.

If there is a risk of power being fed from the motor side back into the converter, one grounding device per three-phase current system must be fitted here as well.

Selection and ordering data

Description	Order No.
Grounding bar 1000 mm, to connect the grounding device	**6SY8101-0AB54**
Three-pole grounding device (grounding harness) for 20 mm spherical grounding points for grounding and short-circuiting the DC link	**6SY8101-0AB55**
Three-pole grounding device (grounding harness) with universal terminals	**6SY8101-0AB58**

Accessories for replacing phase modules

Overview

Accessories for replacing phase modules (SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version)

The phase modules of the converters with IGCT power semiconductors (SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version) can be completely replaced by trained personnel. To replace, the entire phase module must be extracted from the converter using a special lifting tool and transported on a stacker truck.

Selection and ordering data

Description	Order No.
Contact spray	**6SC8476-1DA00-0AA0**
Forklift truck RHM23 standard	**6SC8476-1EA00-0AA0**
Replacement equipment (roller track)	**6SL3986-6YX00-0AA0**

Static excitation units

Overview

The following versions are available as static excitation units for SINAMICS GM150 and SINAMICS SM150:

- Static excitation unit for separately excited synchronous motors with brushless rotating reverse-field excitation
- Static excitation unit for separately excited synchronous motors with slipring excitation

Control with both versions is performed by the converter through a PROFIBUS interface.

A static excitation unit must always be ordered together with the converter but it has its own order number.
Add "-Z" to the order number of the converter and specify the code E01 or E02.
The static excitation unit cannot be ordered on its own.

Note:

The option **G30** (PROFIBUS master) must also be ordered in conjunction with SINAMICS GM150.

7

Selection and ordering data

Rated current A	Comment	**Static excitation unit** Order No.
For supply voltage 500 V 3 AC		
130	–	**6RN7030-1RH31-3AA0**
250	–	**6RN7030-2RH32-5AA0**
250	Can only be ordered together with option **M66** (suitable for marine applications).	**6RN7031-1RH32-5AA0-Z M66**
For supply voltage 690 V 3 AC		
130	–	**6RN7030-1RF31-3AA0**
250	–	**6RN7030-2RF32-5AA0**
250	Can only be ordered together with option **M66** (suitable for marine applications).	**6RN7031-1RF32-5AA0-Z M66**

Accessories

Designation	Order No.
PROFIBUS connecting cable between the basic unit and static excitation unit	
PROFIBUS cable	**6XV1830-0EH10**
Connector for PROFIBUS	
• Without PG/PC connection	**6ES7972-0BA41-0XA0**
• With PG/PC connection	**6ES7972-0BB41-0XA0**

Options

When ordering a device with options, add **"-Z"** to the order number of the device, followed by the order code(s) for the desired option(s).

In the following tables, related options are arranged in groups. Whether the options can be combined or are mutually exclusive is indicated within these groups. A detailed description of the options can be found in Chapter 6.

Input-side options	
Circuit breaker on input side (configured as a contactor)	**N22**

Output-side options	
Disconnector at the output for redundancy [1]	**L51**

[1] Option **L51** can only be ordered in conjunction with option **M66** (suitable for marine applications).

Connection of power and signal cables		**M13**	**M78**	**M34**
Power cable connected at the input from the top (on request) [1]	**M13**		✓	✓
Power cable connected at the output from the top (on request) [1]	**M78**	✓		✓
Auxiliary voltage and signal cables connected from the top	**M34**	✓	✓	

[1] If options **M13** and/or **M78** are selected, then an additional cabinet (width 600 mm × depth 600 mm) is required.

✓	Options can be combined
–	Options are mutually exclusive

7

Static excitation units for brushless rotating reverse-field excitation

Options

PROFIBUS communication (SINAMICS GM150)	
PROFIBUS master	**G30**

Industry-specific options	
Suitable for marine applications [1]	**M66**

[1] Option **M66** is only available for static excitation units 6RN7031-1RH32-5AA0-Z and 6RN7031-1RF32-5AA0-Z.

Documentation (standard: PDF format in English on CD-ROM)		D00	D02	D15	D56	D57	D72	D76	D77	D78	D84	Y10
Documentation in German	**D00**		✓	✓	–	–	–	✓	–	–	–	✓
Circuit diagrams, terminal diagrams and dimension drawings in DXF format [1]	**D02**	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
One set of printed documentation (multiple orders possible)	**D15**	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Documentation in Russian (on request)	**D56**	–	✓	✓		–	–	✓	–	–	–	✓
Documentation in Japanese (on request)	**D57**	–	✓	✓	–		–	✓	–	–	–	✓
Documentation in Italian (on request)	**D72**	–	✓	✓	–	–		✓	–	–	–	✓
Documentation in English (additional CD-ROM in English, irrespective of the selected language)	**D76**	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Documentation in French (on request)	**D77**	–	✓	✓	–	–	–	✓		–	–	✓
Documentation in Spanish (on request)	**D78**	–	✓	✓	–	–	–	✓	–		–	✓
Documentation in Chinese (on request)	**D84**	–	✓	✓	–	–	–	✓	–	–		✓
Circuit diagrams with customer-specific text field (plain text required) [1]	**Y10**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

[1] The equipment-specific documents (circuit diagrams etc.) are only available in English/German.

Rating plate language (standard: English/German)		T58	T60	T80	T82	T85	T86	T90	T91
Rating plate in English/French	**T58**		–	–	–	–	–	–	–
Rating plate in English/Spanish	**T60**	–		–	–	–	–	–	–
Rating plate in English/Italian	**T80**	–	–		–	–	–	–	–
Rating plate in English/Portuguese (on request)	**T85**	–	–	–		–	–	–	–
Rating plate in English/Russian (on request)	**T85**	–	–	–	–		–	–	–
Rating plate in English/Polish (on request)	**T86**	–	–	–	–	–		–	–
Rating plate in English/Japanese (on request)	**T90**	–	–	–	–	–	–		–
Rating plate in English/Chinese (on request)	**T91**	–	–	–	–	–	–	–	

✓	Options can be combined
–	Options are mutually exclusive

7

Options

Auxiliary voltage supply	
Auxiliary voltage other than N/400 V/3 AC (primary voltage must be specified in plain text; available: 110, 220, 240, 380 and 400 V 3 AC)	**Y75**

Device acceptance inspections in presence of customer		**F03**	**F73**	**F77**	**F97**
Visual acceptance	**F03**		–	–	–
Functional acceptance with inductive load	**F73**	–		✓	–
Acceptance of the insulation test [1]	**F77**	–	✓		–
Customer-specific acceptance (on request)	**F97**	–	–	–	

[1] Option **F77** requires that option **F73** is simultaneously ordered.

Miscellaneous options		**L50**	**L55**	**Y09**
Cabinet lighting and service socket outlet	**L50**		✓	✓
Anti-condensation heating for the cabinet	**L55**	✓		✓
Special paint finish to RAL .... (in a color other than RAL 7035; plain text required)	**Y09**	✓	✓	

✓ Options can be combined

– Options are mutually exclusive

Technical specifications

Brushless rotating reverse-field excitation		6RN7030-1RH31-3AA0 6RN7030-1RF31-3AA0	6RN7030-2RH32-5AA0 6RN7030-2RF32-5AA0	6RN7031-1RH32-5AA0-Z M66 6RN7031-1RF32-5AA0-Z M66
Rated current	A	130	250	250
Supply voltage	V	500 V 3 AC or 690 V 3 AC	500 V 3 AC or 690 V 3 AC	500 V 3 AC or 690 V 3 AC
Voltage range		110 V -10 % to 500 V +10 %	110 V -10 % to 500 V +10 %	110 V -10 % to 500 V +10 %
Rated supply frequency	Hz	50/60	50/60	50/60
Frequency range	Hz	45 ... 65	45 ... 65	45 ... 65
Power loss at rated current (SIMOTRAS HD)	kW	1.3	2 × 1.3	1.3
Electronics power supply		400 V 2 AC, 1 A or 230 V 1 AC, 2 A	400 V 2 AC, 1 A or 230 V 1 AC, 2 A	400 V 2 AC, 1 A or 230 V 1 AC, 2 A
Fan power supply		Without fan	Without fan	400 V 3 AC, 50 Hz, 0.24 A 460 V 3 AC, 60 Hz, 0.24 A
Max. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [1]	A	16	16	16
Max. current demand of the auxiliary supply 400 V 3 AC 50/60 Hz	A	–	–	6
Cooling air flow rate	m^3/s	–	–	0.85
Sound pressure level L_{pA} (1 m)	dB	<73	<73	<73
Measuring surface level L_s (1 m)	dB	16	16	16
Cable cross-sections, line-side, max. connectable per phase	mm^2 (DIN VDE)	1 × 70	2 × 70	2 × 70
	AWG/MCM (NEC, CEC)	1 × 3/0 AWG/ 1 × 138 MCM	2 × 3/0 AWG/ 2 × 138 MCM	2 × 3/0 AWG/ 2 × 138 MCM
Cable cross-sections, motor-side, max. connectable per phase	mm^2 (DIN VDE)	1 × 70	2 × 70	2 × 70
	AWG/MCM (NEC, CEC)	1 × 3/0 AWG/ 1 × 138 MCM	2 × 3/0 AWG/ 2 × 138 MCM	2 × 3/0 AWG/ 2 × 138 MCM
PE connection, max. connection cross-section at enclosure with M12 screw	mm^2 (DIN VDE)	1 × 70	1 × 70	1 × 70
	AWG/MCM (NEC, CEC)	1 × 3/0 AWG	1 × 3/0 AWG	1 × 3/0 AWG
Degree of protection		IP42	IP42	IP44
Dimensions (with doors and panels)				
• Width	mm	600	1200	600
• Height	mm	2300	2300	2200
• Depth	mm	600	600	600
Weight	kg	300	400	300

[1] Data without taking options into account.

Selection and ordering data

Rated DC current A	Supply voltage V	Comment	Static excitation unit Order No.
600	400 3 AC	–	**6RN7011-5SE36-0AA0**
400	460 3 AC	Suitable for marine applications	**6RN7011-5SE34-0AA0-Z M66**
1200	460 3 AC	–	**6RN7011-2SE41-2AA0**
1200	460 3 AC	Compact	**6RN7011-3SE41-2AA0**
1900	830 3 AC	–	**6RN7011-0SJ42-0AA0**
2000	690 3 AC	–	**6RN7011-1SH42-0AA0**
2200	950 3 AC	–	**6RN7011-6SK42-2AA0**

Accessories

Designation	Order No.
PROFIBUS connecting cable between the basic unit and static excitation unit	
PROFIBUS cable	**6XV1830-0EH10**
Connector for PROFIBUS	
• Without PG/PC connection	**6ES7972-0BA41-0XA0**
• With PG/PC connection	**6ES7972-0BB41-0XA0**

Note:

The slipring excitation units can be ordered with a SINAMICS DC MASTER power unit on request.

Options

When ordering a device with options, add **"-Z"** to the order number of the device, followed by the order code(s) for the desired option(s).

In the following tables, related options are arranged in groups. Whether the options can be combined or are mutually exclusive is indicated within these groups. A detailed description of the options can be found in Chapter 6.

Input-side options		**N22**	**Y17**
Circuit breaker on input side [1] (configured as a disconnector)	**N22**		✓
Line reactor [2] (plain text is required)	**Y17**	✓	

[1] Option **N22** is not available for the compact static excitation unit 6RN7011-3SE41-2AA0. In this case a circuit breaker must be provided on the plant side.

[2] Option **Y17** is not available for the static excitation units 6RN7011-3SE41-2AA0 and 6RN7011-0SJ42-0AA0. With option **Y17**, the cabinet size can vary – depending on the reactor.

✓	Options can be combined
–	Options are mutually exclusive

Options

Protective functions		L21	L87
Overvoltage protection AC [1]	L21		✓
Isolation monitoring device for rotor system	L87	✓	

[1] Option **L21** is not available for the compact static excitation unit 6RN7011-3SE41-2AA0. In this case, AC overvoltage protection must be provided on the plant side. Otherwise a connection voltage of 200 V must not be exceeded.

Enhanced protection for cabinet units		M11	M43
Dust protection	M11		–
IP43 degree of protection	M43	–	

Connection of power and signal cables		M13	M78	M34
Power cable connected at the input from the top [1] (on request)	M13		✓	✓
Power cable connected at the output from the top [1] (on request)	M78	✓		✓
Auxiliary voltage and signal cables connected from the top	M34	✓	✓	

[1] If options **M13** and/or **M78** are selected, then an additional cabinet (width 600 mm × depth 600 mm) is required.

PROFIBUS communication (SINAMICS GM150)	
PROFIBUS master	G30

Industry-specific options	
Suitable for marine applications [1]	M66

[1] Option **M66** is only available for version 6RN7011-5SE34-0AA0-Z.

✓	Options can be combined
–	Options are mutually exclusive

Options

Documentation (standard: PDF format in English on CD-ROM)		D00	D02	D15	D56	D57	D72	D76	D77	D78	D84	Y10
Documentation in German	D00		✓	✓	–	–	–	✓	–	–	–	✓
Circuit diagrams, terminal diagrams and dimension drawings in DXF format [1]	D02	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
One set of printed documentation (multiple orders possible)	D15	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Documentation in Russian (on request)	D56	–	✓	✓		–	–	✓	–	–	–	✓
Documentation in Japanese (on request)	D57	–	✓	✓	–		–	✓	–	–	–	✓
Documentation in Italian (on request)	D72	–	✓	✓	–	–		✓	–	–	–	✓
Documentation in English (additional CD-ROM in English, irrespective of the selected language)	D76	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Documentation in French (on request)	D77	–	✓	✓	–	–	–	✓		–	–	✓
Documentation in Spanish (on request)	D78	–	✓	✓	–	–	–	✓	–		–	✓
Documentation in Chinese (on request)	D84	–	✓	✓	–	–	–	✓	–	–		✓
Circuit diagrams with customer-specific text field (plain text required) [1]	Y10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

[1] The equipment-specific documents (circuit diagrams etc.) are only available in English/German.

Rating plate language (standard: English/German)		T58	T60	T80	T82	T85	T86	T90	T91
Rating plate in English/French	T58		–	–	–	–	–	–	–
Rating plate in English/Spanish	T60	–		–	–	–	–	–	–
Rating plate in English/Italian	T80	–	–		–	–	–	–	–
Rating plate in English/Portuguese (on request)	T82	–	–	–		–	–	–	–
Rating plate in English/Russian (on request)	T85	–	–	–	–		–	–	–
Rating plate in English/Polish (on request)	T86	–	–	–	–	–		–	–
Rating plate in English/Japanese (on request)	T90	–	–	–	–	–	–		–
Rating plate in English/Chinese (on request)	T91	–	–	–	–	–	–	–	

✓ Options can be combined
– Options are mutually exclusive

7

Options

Auxiliary voltage supply	
Auxiliary voltage other than N/400 V/3 AC (primary voltage must be specified in plain text; available: 110, 220, 240, 380 and 400 V 3 AC)	**Y75**

Device acceptance inspections in presence of customer		F03	F73	F77	F97
Visual acceptance	**F03**		–	–	–
Functional acceptance with inductive load	**F73**	–		✓	–
Acceptance of the insulation test [1]	**F77**	–	✓		–
Customer-specific acceptance (on request)	**F97**	–	–	–	

[1] Option **F77** requires that option **F73** is simultaneously ordered.

Miscellaneous options		L50	L55	Y09	M06
Cabinet lighting and service socket outlet	**L50**		✓	✓	✓
Anti-condensation heating for the cabinet	**L55**	✓		✓	✓
Special paint finish acc. to RAL.... (in a color other than RAL 7035; plain text required)	**Y09**	✓	✓		✓
100 mm base (base frame in the cabinet color)	**M06**	✓	✓	✓	

✓ Options can be combined
– Options are mutually exclusive

Technical specifications

Slipring excitation unit		6RN7011-5SE36-0AA0	6RN7011-5SE34-0AA0-Z M66	6RN7011-2SE41-2AA0	6RN7011-3SE41-2AA0
Rated DC current	A	600	400	1200	1200
Supply voltage	V	400 V 3 AC	460 V 3 AC	460 V 3 AC	460 V 3 AC
Voltage range	%	-20 ... +15	-20 ... +15	-20 ... +15	-20 ... +15
Rated supply frequency	Hz	50/60	50/60	50/60	50/60
Frequency range	Hz	45 ... 65	45 ... 65	45 ... 65	45 ... 65
Power loss at rated current (SIMOTRAS HD)	kW	1.8	1.8	4.7	4.7
Electronics power supply		230 V 1 AC, 2 A	400 V 2 AC, 1 A or 230 V 1 AC, 2 A	230 V 1 AC, 2 A	230 V 1 AC, 2 A
Fan power supply		400 V 3 AC, 50 Hz, 0.3 A 460 V 3 AC, 60 Hz, 0.3 A	400 V 3 AC, 50 Hz, 0.55 A 460 V 3 AC, 60 Hz, 0.55 A	230 V 1 AC, 50/60 Hz, 2.6/3.3 A	230 V 1 AC, 50/60 Hz, 2.6/3.3 A
Max. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [1]	A	2.5	16	5.1	5.1
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	Plant-specific, typical 50	6	–	–
Cooling air flow rate	m^3/s	0.16	0.85	0.36	0.36
Sound pressure level L_{pA} (1 m)	dB	<73	<76	<76	<76
Measuring surface level L_s (1 m)	dB	17	17	17	16
Cable cross-sections, line-side, max. connectable per phase	mm^2 (DIN VDE)	2 × 185	1 × 95	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	2 × 350 MCM	1 × 3/0 AWG	4 × 500 MCM	4 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase	mm^2 (DIN VDE)	2 × 240	2 × 95	4 × 240	4 × 240
	AWG/MCM (NEC, CEC)	2 × 500 MCM	2 × 3/0 AWG	4 × 500 MCM	4 × 500 MCM
PE connection, max. connection cross-section at enclosure with M12 screw	mm^2 (DIN VDE)	1 × 185	1 × 50	2 × 240	2 × 240
	AWG/MCM (NEC, CEC)	1 × 350 MCM	1 × 1/0 AWG	2 × 500 MCM	2 × 500 MCM
Degree of protection		IP23	IP44	IP23	IP23
Dimensions (with doors and panels)					
• Width	mm	1200	900	600	600
• Height	mm	2300	2200	2300	2300
• Depth	mm	600	1200	1200	600 (compact)
Weight	kg	550	1100	850	450

[1] Data without taking options into account.

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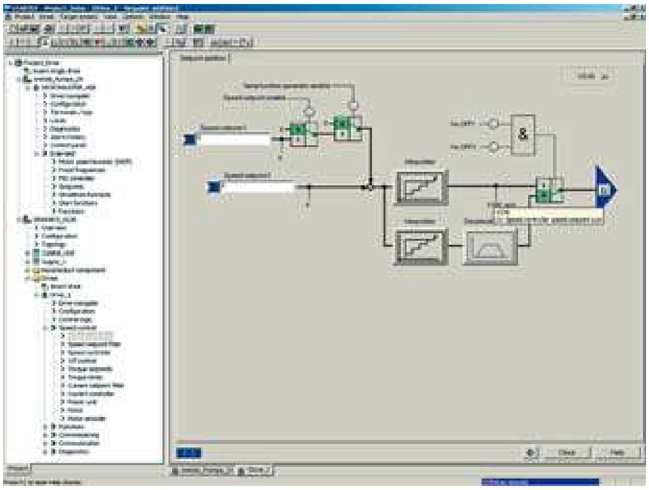
Technical specifications

Slipring excitation unit		6RN7011-0SJ42-0AA0	6RN7011-1SH42-0AA0	6RN7011-6SK42-2AA0
Rated DC current	A	1900	2000	2200
Supply voltage	V	830 V 3 AC	690 V 3 AC	950 V 3 AC
Voltage range	%	-20 ... +10	-20 ... +10	-20 ... +15
Rated supply frequency	Hz	50/60	50/60	50/60
Frequency range	Hz	45 ... 65	45 ... 65	45 ... 65
Power loss at rated current (SIMOTRAS HD)	kW	8.7	8.2	11.4
Electronics power supply		230 V 1 AC, 2 A	230 V 1 AC, 2 A	230 V 1 AC, 2 A
Fan power supply		400 V 3 AC, 50 Hz, 1.0 A 460 V 3 AC, 60 Hz, 1.25 A	400 V 3 AC, 50 Hz, 1.0 A 460 V 3 AC, 60 Hz, 1.25 A	400 V 3 AC, 50 Hz, 1.0 A 460 V 3 AC, 60 Hz, 1.25 A
Max. current demand of the auxiliary supply 230 V 1 AC, 50/60 Hz [1]	A	2.5	2.5	2.5
Max. current demand of the auxiliary supply 400 V 3 AC, 50/60 Hz	A	2	2	2
Cooling air flow rate	m^3/s	0.67	0.67	0.67
Sound pressure level L_{pA} (1 m)	dB	<87	<87	<87
Measuring surface level L_s (1 m)	dB	17	17	17
Cable cross-sections, line-side, max. connectable per phase	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
Cable cross-sections, motor-side, max. connectable per phase	mm^2 (DIN VDE)	6 × 240	6 × 240	6 × 240
	AWG/MCM (NEC, CEC)	6 × 500 MCM	6 × 500 MCM	6 × 500 MCM
PE connection, max. connection cross-section at enclosure with M12 screw	mm^2 (DIN VDE)	3 × 240	3 × 240	3 × 240
	AWG/MCM (NEC, CEC)	3 × 500 MCM	3 × 500 MCM	3 × 500 MCM
Degree of protection		IP23	IP23	IP23
Dimensions (with doors and panels)				
• Width	mm	600	600	600
• Height	mm	2300	2300	2300
• Depth	mm	1200	1200	1200
Weight	kg	900	900	900

[1] Data without taking options into account.

Overview



The user-friendly STARTER commissioning tool can be used for:

- Commissioning
- Optimization
- Diagnostics

This software can be operated either as a standalone PC application, integrated in SIMATIC STEP 7 with TIA compatibility via Drive ES Basic, or it can be integrated into the SCOUT engineering system (for SIMOTION). The basic functions and handling are the same in both cases.

In STARTER, MICROMASTER 4 devices are also supported in addition to the SINAMICS drives.

The project wizards can be used to create the drives within the structure of the project tree.

Beginners are supported by solution-based dialog guidance, whereby a standard graphics-based display maximizes clarity when setting the drive parameters.

First commissioning is guided by a wizard which makes all the basic settings in the drive. Therefore, getting a motor up and running is merely a question of setting a few of the drive parameters as part of the drive configuration process.

The individual settings required are made using graphics-based parameterization screens, which also precisely visualize the principle of operation of the drive.

Examples of individual settings that can be made include:

- How terminals are used
- Bus interface
- Setpoint channel (e.g., fixed setpoints)
- Closed-loop speed control (e.g., ramp-function generator, limits)
- BICO interconnections
- Diagnostics

For experts, the expert list can be used to specifically and quickly access individual parameters at any time. An individual compilation of frequently used parameters can be saved in dedicated user lists and watch tables.

In addition, the following functions are available for optimization purposes:

- Self-optimization of the controller settings (depending on drive unit)
- Trace
  (depending on the drive unit, this is not supported for
  - MICROMASTER 4
  - SINAMICS G110
  - SINAMICS G120 < FW V4.4
  - SINAMICS G110D
  - SINAMICS G120D)

Diagnostics functions provide information about:

- Control/status words
- Parameter status
- Operating conditions
- Communication states

Performance features

- User-friendly: only a small number of settings need to be made for successful first commissioning: the motor starts to rotate
- Solution-oriented dialog-based user guidance simplifies commissioning
- Self-optimization functions reduce manual effort for optimization

Selection and ordering data

Description	Order No.
STARTER commissioning tool for SINAMICS and MICROMASTER DVD-ROM English, French, German, Italian, Spanish	**6SL3072-0AA00-0AG0**

More information

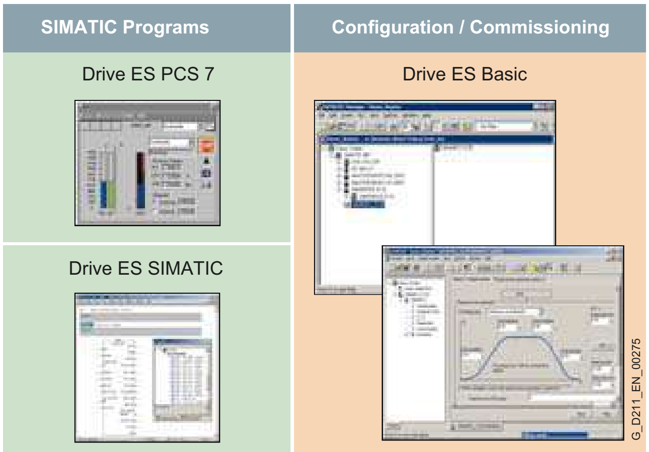
The STARTER commissioning tool is also available for update purposes on the Internet at
www.siemens.com/starter

Note:

The SINAMICS SM150 converters are operated with the SIMOTION SCOUT engineering system. For more information, please refer to page 7/15 et seqq.

Engineering software Drive ES

Overview



Drive ES is the engineering system used to integrate Siemens drive technology into the SIMATIC automation world easily, efficiently and cost-effectively in terms of communication, configuration and data management.

It is based on the operator interface of the STEP 7 Manager, the essential element when it comes to engineering.

Drive ES Basic

Drive ES Basic is for first-time users of the world of Totally Integrated Automation and the basic software for setting the parameters of all drives online and offline in this environment. Drive ES Basic enables both the automation system and the drives to be handled using the SIMATIC Manager software. Drive ES Basic is the starting point for common data archiving for complete projects and for extending the use of the SIMATIC teleservice to drives. Drive ES Basic provides the configuration tools for the new Motion Control functions – slave-to-slave communication, equidistance and isochronous operation with PROFIBUS DP and ensures that drives with PROFINET IO are simply integrated into the SIMATIC environment.

Selection and ordering data

Description	Order No.
Drive ES Basic V5.5 SPx *)	
Configuration software for the integration of drives into TIA (Totally Integrated Automation) Precondition: STEP 7 from V5.3, SP3 and higher	
Supplied as: DVD Languages: Eng, Fr, Ger, It, Sp with electronic documentation	
• Floating license, 1 user	**6SW1700-5JA00-5AA0**
• Floating license (copy license), 60 users	**6SW1700-5JA00-5AA1**
• Update service for single-user license	**6SW1700-0JA00-0AB2**
• Update service for copy license, 60 users	**6SW1700-0JA00-1AB2**
• Upgrade from V5.x to V5.5 SPx *)	**6SW1700-5JA00-5AA4**

More information

More information is available on the Internet at:
http://www.siemens.com/drivesolutions

* Orders are always automatically supplied with the latest SP.

Overview

The SIMOTION SCOUT engineering system provides important new features in version V4.2 and higher. The focus is on an improved connection of the SINAMICS S120 drive system, the completion of the comparison functionality and many usability improvements.

Improved connection to SINAMICS S120

The most important innovation in the SIMOTION SCOUT engineering system is the significantly simplified connection to the SINAMICS S120 drive system. Drives and their components are integrated automatically to the greatest possible extent. The connections to the drive objects are simply interconnected, whereby the required message frame generation is performed automatically by the engineering system.

Uniform display of lists

The display of all lists in the system has now been simplified and adapted to the well-known look and feel of Office applications. The highest possible data security was observed during the implementation. If there are any operation faults (e.g. faulty copy and paste), the system restores the data. In this way, even beginners can become familiar with the engineering software, intuitively, quickly and safely.

System trace across several motion controllers

The so-called system trace feature is available for analysis or system optimization. This enables up to 128 signals from SIMOTION controllers networked via PROFINET to be recorded synchronously.

Trace for technology objects

With the new TO trace, all events affecting a technology object can be recorded in real-time and displayed in detail in a chronological sequence in the engineering system.

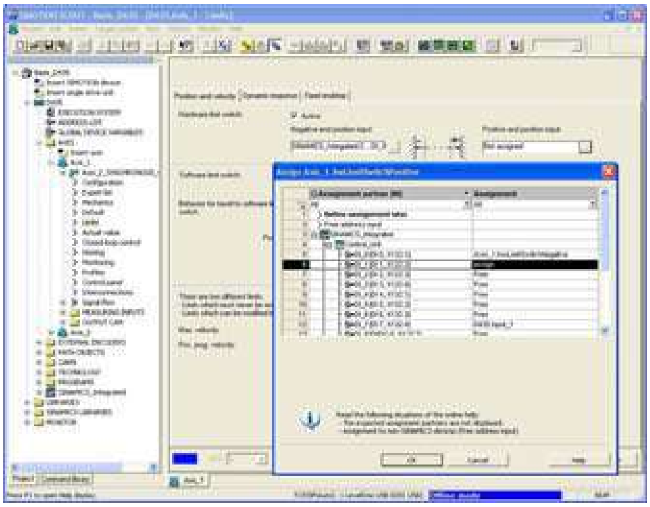
New watch tables

The new watch tables provide extended functions and diagnostic options. They allow different variables of the project (also different devices) to be collected. The watch tables can be clearly displayed and controlled with current values. Stored control value tables can also be used to perform comprehensive test sequences quickly and easily.

Easier to use during programming

Greater clarity is provided in the general programming through small additions such as the display of the variable type, display of the current value when there is an online connection and language-dependent comments which appear when the cursor is moved over the code ("tooltips").

Rollout tips provide the user with information on faulty entries or system information that is still missing when working in tables or entry fields. The system-wide effective automatic completion of user entries ("Auto-Complete") with automatic correction of upper/lower case makes the editing process more efficient and provides an easily readable program code.



Simple interconnection of the drive I/Os

Scope of supply

<u>SIMOTION SCOUT engineering software</u>

- SCOUT with corresponding license
- License key for SCOUT
- Integrated STARTER commissioning tool

<u>Optional packages for SIMOTION SCOUT</u>

- Optional Drive Control Chart (DCC) package without license
  The license must be ordered separately.

<u>Documentation</u>

- Complete SIMOTION documentation on DVD

<u>Other software</u>

- SIMOTION – Utilities & Applications
  Free utilities (e.g. calculation tools, optimization tools, etc.) and application examples (ready-to-apply solutions such as winders, cross cutters or handling) as well as the project generator SIMOTION easyProject
- SIMATIC NET without license
- DriveES Basic with license
- SIMATIC software:
  with SCOUT stand-alone, the necessary components of STEP 7

SIMOTION SCOUT V4.2 software package

Overview

Integrated STARTER commissioning tool

The STARTER commissioning tool is directly integrated in SCOUT. It supports the simple and rapid commissioning, optimization and diagnostics of all new-generation Siemens drives with only one tool.

STARTER supports the drives:

- SINAMICS
- MICROMASTER 420/430/440
- MICROMASTER 411/COMBIMASTER 411
- COMBIMASTER

SIMOTION SCOUT stand-alone software package

If STEP 7 is not installed, the SIMOTION SCOUT stand-alone software package can be used. It also contains the components of STEP 7 that are required for SIMOTION SCOUT as well as the license key for SCOUT stand-alone. It is not possible to operate the SCOUT and SCOUT stand-alone software packages on the same machine.

SIMOTION Kernel updates

SIMOTION Kernel updates for all SIMOTION platforms are supplied on DVD and can then be copied from the PG/PC to the SIMOTION Micro Memory Card (C2xx) or SIMOTION CompactFlash card (SIMOTION D) or installed on the P350-3.

A PC card adapter is needed to write to the SIMOTION MMC (Micro Memory Card) or the SIMOTION CF (CompactFlash card).

Adapters can usually be found in PC shops and at electronics shops.

Benefits

- Time saving and reduction of faulty entries through automatic generation of the PROFIdrive message frames by the engineering.
- Comparison function allows the simple comparison of programs. Existing programs can therefore be simply merged.
- Improved system and error diagnostics through numerous extensions for the test and diagnostic functions within the engineering environment.
- Quicker and simpler program creation through extended editor functions and easier-to-read programs through the retention of upper and lower cases in the system.

Selection and ordering data

Description	Order No.
SIMOTION SCOUT software package	
SIMOTION SCOUT V4.3 SP1 On DVD, including STARTER, runtime software and documentation Languages: English, French, German, Italian	
• Single license	**6AU1810-1BA43-1XA0**
• Upgrade	**6AU1810-1BA43-1XE0**
• Trial license	**6AU1810-1BA42-1XT7**
SIMOTION SCOUT V4.3 SP1 stand-alone On DVD, including STARTER, runtime software and documentation Languages: English, French, German, Italian	
• Single license	**6AU1810-1CA43-1XA0**
• Upgrade	**6AU1810-1CA43-1XE0**
• Trial license	**6AU1810-1CA42-1XT7**
Software update service The latest software version is necessary	
• for SIMOTION SCOUT	**6AU1810-0BA00-0XL0**
• for SIMOTION SCOUT stand-alone	**6AU1810-0CA00-0XL0**
Optional packages for SIMOTION SCOUT	
DCC SIMOTION/SINAMICS V2.2 SP1 for SCOUT V4.3 SP1/ STARTER V4.3 SP1 Graphic programming with Drive Control Chart DCC editor + DCB libraries for use on SIMOTION and SINAMICS S120	
• Single engineering license, with data carrier	**6AU1810-1JA22-1XA0**
• Upgrade, with data carrier	**6AU1810-1JA22-1XE0**

More information

A number of additional software products can be used in conjunction with SIMOTION SCOUT. It must be ensured that the corresponding versions of these software products are compatible. Please consult the "Compatibility table of the software products in the SIMOTION environment".

Additional information is available in the Internet under:
http://support.automation.siemens.com/WW/view/en/18857317

Overview

Please observe the availability of the licenses for SIMOTION technology and communication functions for SINAMICS SM150 listed in the following.

Unlicensed basic functions

The rights of use for these software components are included when the basic unit is purchased:

- SIMOTION Kernel runtime software
  The SIMOTION Kernel is already installed on the unit.
- Motion Control Basic technology functions
  Use of technology functions for speed-controlled axes, single output cams and cam tracks, measuring inputs, and external encoders.
- Technology functions for Drive Control Chart
  By installing the optional SCOUT package Drive Control Chart, the technology functions of Drive Control Chart are made available to the SIMOTION runtime system.
- Supplementary technology functions
  Use of supplementary technology functions, such as adders, formula objects and fixed gears.
- Function libraries for I/O interfacing
- Communication functions
  This includes SIMATIC S7 communication functions on the SIMOTION side (programming device/OP communication to programming devices, for engineering and communication to TPs/OPs/MPs and PCs with SIMATIC HMI, e.g., ProTool/Pro, WinCC flexible or SIMATIC NET OPC), as well as UDP and TCP/IP communication

SIMOTION IT communication functions subject to license

SIMOTION IT enables additional communication functions via Industrial Ethernet (HTML through the Internet browser):

- Diagnostics functions via SIMOTION IT DIAG
- Communication via SIMOTION IT OPC XML DA
- SIMOTION IT Virtual Machine: Creation of Java applications for SIMOTION

Licenses for SIMOTION IT

One license is required for each SIMOTION device for the software options "SIMOTION IT DIAG", "SIMOTION IT OPC XML-DA" and the multiple license "SIMOTION IT".

How can licenses be obtained for runtime software?

Licenses for SIMOTION runtime software are ordered separately, independently of purchase of a SIMOTION controller or a SIMOTION memory card (CompactFlash card). The required software options are assigned to hardware (memory cards) by generating a license key over the Internet at:
www.siemens.com/automation/license

Selection and ordering data

Description	Order No.
CompactFlash Card (CF) 1 Gbyte for SINAMICS SM 150 with SIMOTION D455-2, including the SINAMICS drive software, current firmware version	**6AU1400-2PM22-0AA0**

Notes

Motors
for converter operation

8

H-compact and H-compact PLUS

Overview

The use of variable-speed motors enables savings to be achieved in many applications through higher system efficiencies compared to fixed-speed operation.

H-compact and H-compact PLUS motors have proven themselves many times over in variable-speed applications. For these motor series, special versions have been designed for operation with SINAMICS GM150 and SINAMICS SM150 medium-voltage converters.

These motor versions have, as standard, a reinforced stator winding insulation so that they can be fed from drive converters without requiring a sine-wave filter. Further, both bearings are electrically insulated and the shaft is equipped with a grounding system.

The motor insulation system corresponds to thermal class 155 (F) and they are generally utilized to thermal class 155 (F).

Catalog D 84.1 contains detailed technical data for the following motors.

Air-cooled H-compact 1LA4 motors

Technical specification overview

H-compact 1LA4	
Rated voltage	2.3 ... 6.6 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM V1
Degree of protection	IP55
Cooling method	IC411
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	450 ... 630 mm
Bearings	Roller bearings, sleeve bearings
Cage material	Die-cast aluminum or copper (dependent on the shaft height and number of poles)
Standards	IEC, EN
Frame design	Cast iron with cooling ribs

Air-cooled H-compact 1PQ4 motors

Technical specification overview

H-compact 1PQ4	
Rated voltage	2.3 ... 6.6 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM V1
Degree of protection	IP55
Cooling method	IC416
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	450 ... 630 mm
Bearings	Roller bearings, sleeve bearings
Cage material	Die-cast aluminum or copper (dependent on the shaft height and number of poles)
Standards	IEC, EN
Frame design	Cast iron with cooling ribs

Overview

Air-cooled motors, H-compact PLUS 1RA4, 1RA6, 1RP6

Technical specification overview

H-compact PLUS 1RA4, 1RA6, 1RP6	
Rated voltage	2.3 ... 6.6 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM V1
Degree of protection	IP23
Cooling method	IC01
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	450 ... 630 mm
Bearings	Roller bearings, sleeve bearings
Cage material	Copper
Standards	IEC, EN
Frame design	
• Shaft height 450 ... 560 mm	Frame: Cast iron Cooling enclosure: Steel
• Shaft height 630 mm	Frame: Steel Cooling enclosure: Steel

Air-cooled H-compact PLUS 1RQ4 and 1RQ6 motors

Technical specification overview

H-compact PLUS 1RQ4 and 1RQ6	
Rated voltage	2.3 ... 6.6 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM V1
Degree of protection	IP55
Cooling method	IC611/IC616
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	450 ... 630 mm
Bearings	Roller bearings, sleeve bearings
Cage material	Copper
Standards	IEC, EN
Frame design	
• Shaft height 450 ... 560 mm	Frame: Cast iron Cooling enclosure: Steel
• Shaft height 630 mm	Frame: Steel Cooling enclosure: Steel

H-compact and H-compact PLUS

Overview

Water-cooled H-compact 1LH4 motors

Technical specification overview

H-compact 1LH4	
Rated voltage	2.3 ... 4.16 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM B35 and IM V1
Degree of protection	IP55
Cooling method	IC71W
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	500 mm
Bearings	Roller bearings
Cage material	Copper
Standards	IEC, EN
Frame design	Steel frame with water jacket

Water-cooled H-compact PLUS 1RN4 and 1RN6 motors

Technical specification overview

H-compact PLUS 1RN4 and 1RN6	
Rated voltage	2.3 ... 6.6 kV
Rated frequency	50/60 Hz
Motor type	Induction motor with squirrel-cage rotor
Type of construction	IM B3, IM V1
Degree of protection	IP55
Cooling method	IC81W
Stator winding insulation	Insulation system, thermal class 155 (F), utilized to 155 (F)
Shaft height	450 ... 630 mm
Bearings	Roller bearings, sleeve bearings
Cage material	Copper
Standards	IEC, EN
Frame design	
• Shaft height 450 ... 560 mm	Frame: Cast iron Cooling enclosure: Steel
• Shaft height 630 mm	Frame: Steel Cooling enclosure: Steel

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Engineering information

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SIZER WEB ENGINEERING

Overview

Flexible, customized and user-friendly

With the web-based drive engineering tool you can quickly find the solution for your particular drive application: Menu-prompted workflows specifically guide you when you are selecting and dimensioning products and drive systems – including accessories.

Via an integrated query function, SIZER WEB ENGINEERING can also provide you with customized special solutions for applications that cannot be addressed using "Standard Products", i.e. where the focus is on flexibility and a customized solution

Currently the following product groups are supported:

- High-Voltage motors
- Low-Voltage motors
- Medium-Voltage converters
- Low-Voltage converters
- DC technology

Comprehensive documentation such as data sheets, starting calculations, dimension drawings, quotation documentation – to name just a few – are a fixed component of this tool.

The result: customized solutions for your drive tasks.

For example Starting calculation

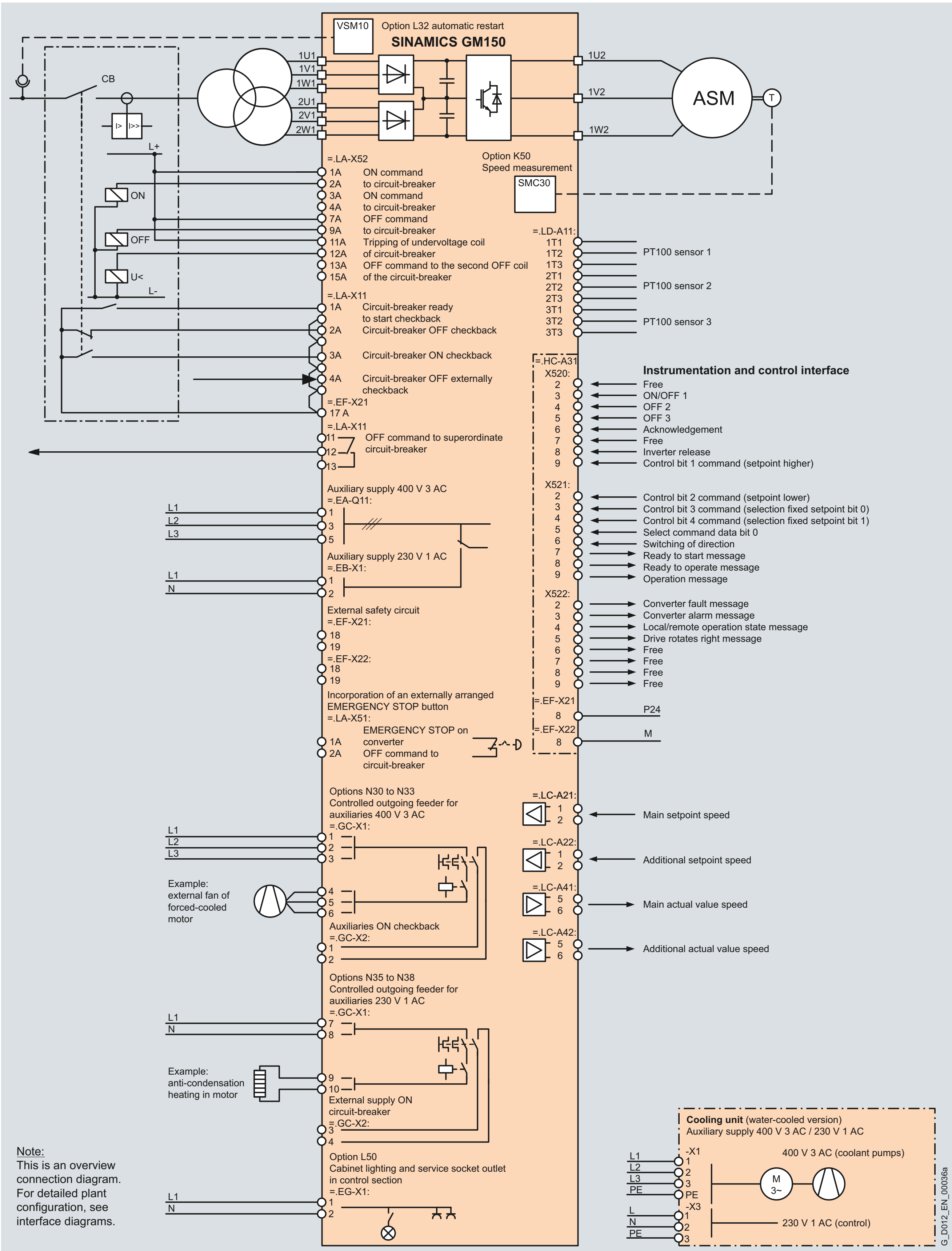
System requirements include Internet access as well as a standard browser (e.g. Internet Explorer from V7.0, Firefox from V3.0).
SIZER WEB ENGINEERING is available for use 24h/365 days after registration and release.

More information

Further information on the SIZER WEB ENGINEERING engineering tool is available at

www.siemens.com/sizer-we

Overview of connections for SINAMICS GM150



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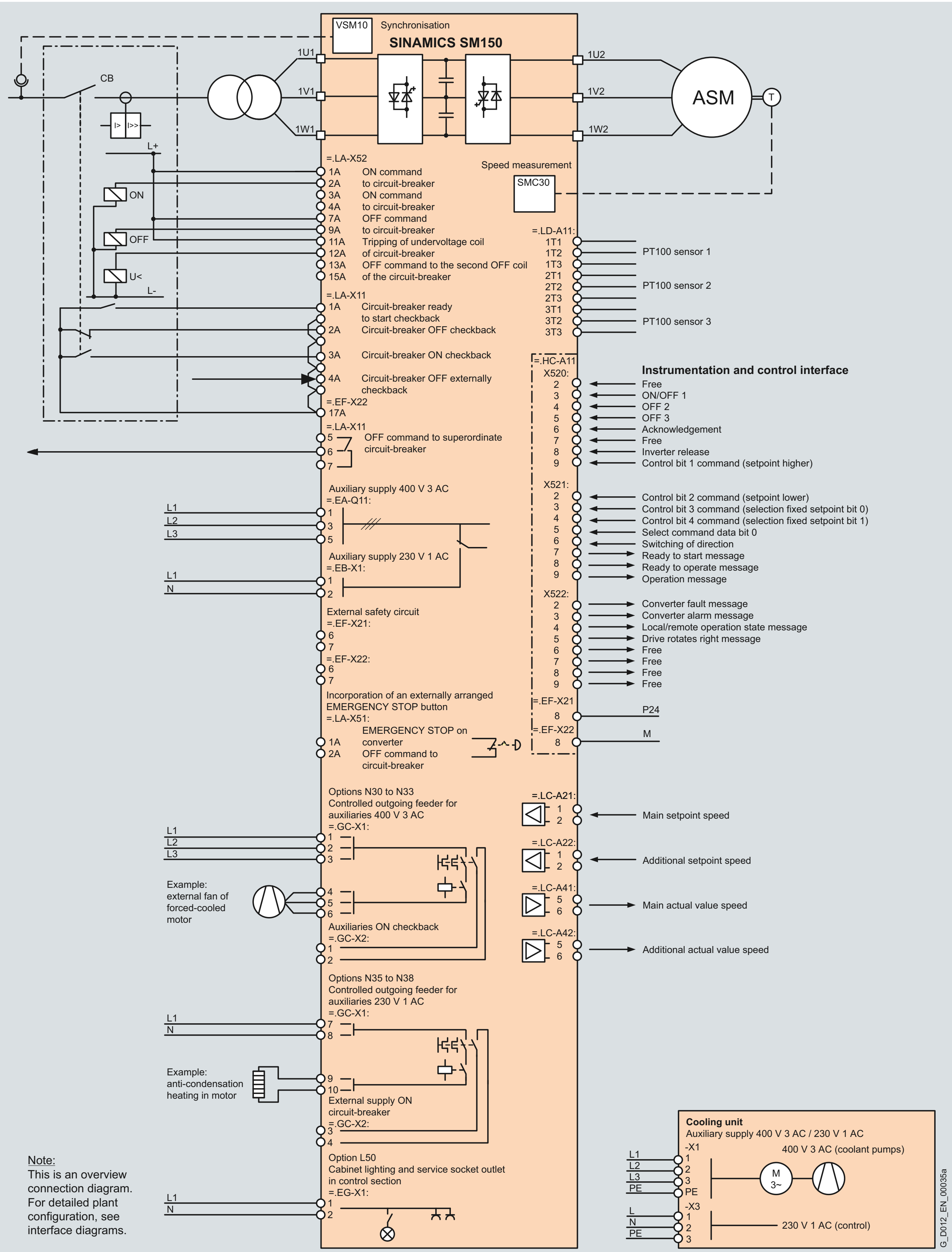
Overview of interfaces

Overview of connections for SINAMICS SM150



Note:
This is an overview connection diagram. For detailed plant configuration, see interface diagrams.

Configuration

The interfaces of the TM31 and TM15 Terminal Modules are available for communication with the higher level. Additional terminal strips can be used to connect the circuit breaker or external protection and monitoring devices. The following tables give an overview of the type and preassignment of the interfaces in the standard version.

Note: For max. conductor cross-section and further technical data on TM31 and TM15 Terminal Modules, see Description of options **G61** and **G63**, Pages 6/16 and 6/20.

Terminal strip on TM31 (=.HC–A51)

Terminal	Type		Preassign-ment	Comment
X540:				
1-8	P24	24 V DC supply for inputs DI0 to DI7	–	–
X520:				
1	DI0	Digital input electrically isolated via optocoupler	Preassigned internally	–
2	DI1		Preassigned internally	–
3	DI2		–	–
4	DI3		–	–
5	M1	Reference ground for digital inputs DI0 to DI3	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X530:				
1	DI4	Digital input electrically isolated via optocoupler	Preassigned internally	–
2	DI5		–	–
3	DI6		–	–
4	DI7		–	–
5	M2	Reference ground for digital inputs DI4 to DI7	–	–
6	M	Reference ground for P24, auxiliary voltage for digital inputs	–	–
X541:				
1	P24	24 V DC supply for inputs/outputs DI/O8 to DI/DO11	–	–
2	DI/DO8	Digital inputs/digital outputs non-isolated	Preassigned internally	–
3	DI/DO9		–	–
4	DI/DO10		–	–
5	DI/DO11		–	–
6	M	Reference ground for P24, ground of digital inputs/ digital outputs	–	–

Terminal strip on TM31 (=.HC–A51)

Terminal	Type		Preassign-ment	Comment
X521:				
1	AI0+	Analog inputs set up as differential inputs for the following ranges: -10 ... +10 V, +4 ... +20 mA, 0 ... +20 mA, -20 ... +20 mA	Main speed setpoint	Isolating amplifiers are used here for electrical isolation (4 ... 20 mA, 0 ... 10 V, 0 ... 20 mA)
2	AI0-			
3	AI1+	The voltage input/ current input is selected with a switch	Additional speed setpoint	Isolating amplifiers are used here for electrical isolation (4 ... 20 mA, 0 ... 10 V, 0 ... 20 mA)
4	AI1-			
5	P10	Auxiliary voltage ± 10 V (10 mA) to connect a potentiometer to enter a setpoint via an analog input	–	–
6	M		–	–
7	N10		–	–
8	M		–	–
X522:				
1	AO 0V+	Analog outputs for the following ranges: -10 ... +10 V, +4 ... +20 mA, 0 ... +20 mA, -20 ... +20 mA	Main actual value (speed)	Isolating amplifiers are used here for electrical isolation (4 ... 20 mA, 0 ... 10 V, 0 ... 20 mA)
2	AO 0V-			
3	AO0C+			
4	AO 1V+		Additional actual value (speed)	Isolating amplifiers are used here for electrical isolation (4 ... 20 mA, 0 ... 10 V, 0 ... 20 mA)
5	AO 1V-			
6	AO 1C+			
7	KTY+	Temperature sensor KTY84 0 ... 200 °C or PTC (R_{cold} < 1.5 kΩ)	–	The sensor type must be parameter-ized
8	KTY-		–	
X542:				
1	DO 0.NC	Relay output for changeover contact. Max. switching voltage: 250 V AC, 30 V DC. Max. switching power at 250 V AC: 2000 VA. Max. switching power at 30 V DC: 240 W	–	NC contact
2	DO 0.COM		–	Basic
3	DO 0.NO		–	NO contact
4	DO 1.NC	Relay output for changeover contact. Max. switching voltage: 250 V AC, 30 V DC. Max. switching power at 250 V AC: 2000 VA. Max. switching power at 30 V DC: 240 W	–	NC contact
5	DO 1.COM		–	Basic
6	DO 1.NO		–	NO contact

Overview of interfaces

Configuration

Terminal strip on TM15 (SINAMICS GM150: =.HC-A31, SINAMICS SM150: =.HC-A11)			
Terminal	Type		Preassignment
X520:			
2	DI/DO0	Bidirectional digital inputs and outputs [1)]	Free
3	DI/DO1		ON / OFF1
4	DI/DO2		OUT2
5	DI/DO3		OUT3
6	DI/DO4		Acknowledgement
7	DI/DO5		Free
8	DI/DO6		Inverter enable
9	DI/DO7		Control bit 1 (increase setpoint)
X521:			
2	DI/DO8	Bidirectional digital inputs and outputs [1)]	Control bit 2 command (decrease setpoint)
3	DI/DO9		Control bit 3 command (select fixed setpoint bit 0)
4	DI/DO10		Control bit 4 command (select fixed setpoint bit 1)
5	DI/DO11		Select command data set bit 0
6	DI/DO12		Switchover of direction of rotation
7	DI/DO13		Ready to start message
8	DI/DO14		Ready to run message
9	DI/DO15		Operating message
X522:			
2	DI/DO16	Bidirectional digital inputs and outputs [1)]	Converter fault message
3	DI/DO17		Converter warning message
4	DI/DO18		Local/remote operating status message
5	DI/DO19		Drive rotates to the right (clockwise)
6	DI/DO20		Free
7	DI/DO21		Free
8	DI/DO22		Free
9	DI/DO23		Free
=.EF–X21:			
8	P24		The jumper must be removed according to the control mode (non-isolated/isolated).
=.EF–X22:			
8	M		The jumper must be removed according to the control mode (non-isolated/isolated).

Terminal strip on isolation amplifier		
Terminal	Preassignment	Comment
=.LC–A21:		
1	Main speed setpoint (4 ... 20 mA)	Signal level adjustable (0 ... 10 V; 0 ... 20 mA; 4 ... 20 mA)
2		
=.LC–A22:		
1	Supplementary speed setpoint (4 ... 20 mA)	Signal level adjustable (0 ... 10 V; 0 ... 20 mA; 4 ... 20 mA)
2		
=.LC–A41:		
1	Main speed actual value (4 ... 20 mA)	Signal level adjustable (0 ... 10 V; 0 ... 20 mA; 4 ... 20 mA)
2		
=.LC–A42:		
1	Supplementary speed actual value (4 ... 20 mA)	Signal level adjustable (0 ... 10 V; 0 ... 20 mA; 4 ... 20 mA)
2		

Temperature monitoring with Pt100 evaluation unit		
Terminal	Type	Comment
=.LD–A11:		
1T1 to 1T3	Pt100	Sensor 1
2T1 to 2T3	Pt100	Sensor 2
3T1 to 3T3	Pt100	Sensor 3

The sensors can be connected to the Pt100 evaluation unit using either a two-wire or three-wire system. In the two-wire system, inputs xT1 and xT2 must be assigned and terminals xT2 and xT3 must be jumpered. The limit values for warning and shutdown must be set centrally for all three sensors.
The output relays are integrated into the internal fault and shutdown sequence of the converter. The signals can also be picked up in the plant side by means of two spare fault signaling relays.

Incorporating an external safety shutdown, SINAMICS GM150		
Terminal	Type	Comment
=.EF–X21:		
18	External safety shutdown	Jumper = EF-X21:18-19 should be removed when incorporating the external safety shutdown.
19		
=.EF–X22:		
18	Reference ground	If the power supply is externally provided, then jumper = EF-X22:18-19 must be removed and the reference ground of the external supply must be connected with = EF-X22:19.
19		

[1)] The digital inputs/outputs can be parameterized individually as inputs or outputs (electrical isolation in three groups of eight channels each). The preassignment as an input or output is identified by underlining.

Configuration

Incorporating an external safety shutdown, SINAMICS SM150

Terminal	Type	Comment
=.EF–X21:		
16	External safety shutdown	Jumper = EF-X21:16-17 should be removed when incorporating the external safety shutdown.
17		
=.EF–X22:		
16	Reference ground	If the power supply is externally provided, then jumper = EF-X22:16-17 must be removed and the reference ground of the external supply must be connected with = EF-X22:17.
17		

Incorporating the EMERGENCY-OFF button in a plant-side EMERGENCY-OFF circuit

Terminal	Type	Comment
=.LA–X51:		
1A	Button (NC contact)	EMERGENCY STOP on converter Permissible contact load DC-13 acc. to DIN EN 60947-5-1/ VDE 0660-200 (IEC 60947-5-1): 24 V/3 A (min. 5 mA)
2A		

Control of circuit breaker on input side

Terminal	Type	Comment
=.LA–X52:		
1A	Isolated contact	ON command to the circuit breaker
2A		
3A	Isolated contact	ON command to the circuit breaker
4A		
7A	Isolated contact	OFF command to the circuit breaker
9A		
11A	Isolated contact	Tripping of low-voltage coil of circuit breaker
12A		
13A	Isolated contact	OFF command to the second OFF coil of the circuit breaker
15A		

Checkbacks from the circuit breaker on the input side

Terminal	Type	Comment
=.LA–X11:		
1A	Digital input	Circuit breaker ready to close checkback
2A	Digital input	Circuit breaker OFF checkback
3A	Digital input	Circuit breaker ON checkback
4A	Digital input	Circuit breaker switched OFF externally message

OFF command to the higher-level circuit breaker, SINAMICS GM150

Terminal	Type	Comment
=.LA–X11:		
11	Relay output for changeover contact Permissible contact load DC-13 acc. to DIN EN 60947-5-1/ VDE 0660-200 (IEC 60947-5-1): 24 V/10 A	Basic
12		NC contact
13		NO contact

OFF command to the higher-level circuit breaker, SINAMICS SM150

Terminal	Type	Comment
=.LA–X11:		
5	Relay output for changeover contact Permissible contact load DC-13 acc. to DIN EN 60947-5-1/ VDE 0660-200 (IEC 60947-5-1): 24 V/10 A	Basic
6		NC contact
7		NO contact

Connection of the auxiliary voltage supply

Connection of the auxiliary voltage 3 AC 50 Hz 400 V or others

Terminal	Type	Comment
=.EA1–Q11:		
1	L1	e.g. fan, DC link precharging
3	L2	
5	L3	

Connection of the auxiliary voltage 1 AC 50 Hz 230 V or 1 AC 60 Hz 120 V

Terminal	Type	Comment
=.EB–X1:		
1	L1	e.g. open-loop and closed-loop control, protection and monitoring units
2	N	

Connecting the cooling unit

Connection of the power supply for the cooling unit 3 AC 400 V

Terminal	Type	Comment
–X1:		
1	L1	Voltage supply for thve coolant pumps
2	L2	
3	L3	
PE	PE	

Connection of the power supply for the cooling unit 1 AC 230 V

Terminal	Type	Comment
–X3:		
1	L	Voltage supply for the internal control system
2	N	
3	PE	

Connections at the VSM10 Voltage Sensing Module

For interfaces, refer to the description of the options (**L32**).

Cooling unit

Overview

The cooling unit is used to dissipate the power loss from the converter. It consists of an inner fresh water circuit and an outer raw water circuit.

Mode of operation

The heated fresh water in the inner circuit of the converter passes through two redundant, maintenance-free circulation pumps into the water/water plate heat exchanger which is made of high-grade steel and connected to the untreated water circuit on the installation side. The fresh water is cooled by the untreated water of the outer circuit and flows back into the converter.

The closed inner fresh water circuit is filled with deionized water and vented by means of a compensating tank. This tank is situated at the highest point of the cooling circuit.

Function

Raw water specifications

The raw water must be chemically neutral, clean and free of solids. Other quality requirements to be met by the raw water are listed in the following table.

Raw water	
Grain size of any entrained parts	< 0.5 mm
pH value	6.5 ... 8.0
Carbonate hardness	< 0.9 mMol/l (5 °dH)
Total hardness	< 1.7 mMol/l (9.5 °dH)
Chlorides	60 mg/l
Sulfates	80 mg/l
Nitrates	10 mg/l
Iron (Fe)	0.2 mg/l
Ammoniac	10 mg/l
Dissolved substances	< 3.4 mMol/l (340 ppm)

In case of deviations it is recommended to carry out an analysis of the water in order to ensure the heat exchanger's endurance strength. In case of aggressive cooling water (including sea water), plate-type heat exchangers made of titanium should be used (options **W11** and **W12**).

Avoiding condensation

To avoid condensation at excessively low raw water temperatures, a three-way valve for controlling the water temperature is installed as standard.

Specifications for the cooling water in the fresh water circuit

Clean water (battery water) should be used to fill and top-up the deionized water circuit

Deionized water	**In accordance with DIN EN 60993 (IEC 60993)**
Specific conductivity when filled in	≤ 30 µS/cm[1)]
Evaporation residue	< 20 mg/l
pH value	5 ... 9
Content of • metals from the hydrogen sulfide group (lead, antimony, tin, bismuth, arsenic, copper, cadmium) • metals from the ammonium sulfide group (iron, cobalt, nickel, chrome, manganese) • sulfur and nitrogen chloride compounds	Not detectable
Content of oxidizable, organic substances	Max. a quantity equivalent to the usage of 30 mg/l potassium permanganate KMnO4

Monitoring units in the fresh water circuit

To guarantee the self-protection of the converter, the deionized water is monitored by the converter:

- Conductivity measurement:
  The conductivity of the cooling water is constantly monitored in order to ensure that the leakage currents in the converter between different potentials and against ground remain small. An ion exchanger (in the cooling unit) holds the conductivity below the permitted maximum value of 1.0 µS/cm. If the conductivity is too high, the ion exchanger filling must be changed. After the first year, an ion exchanger filling must be changed at least every two years as a rule.
- Temperature monitoring
- Flow monitoring
- Leakage water monitoring

Other monitoring operations and the control of the electrical equipment are performed in the cooling unit:

- A compensating tank for the compensation of changes in the volume of cooling water due to evaporation or temperature changes
- Indication of pressure in the converter inlet

The operating status is signaled to the converter.

Piping

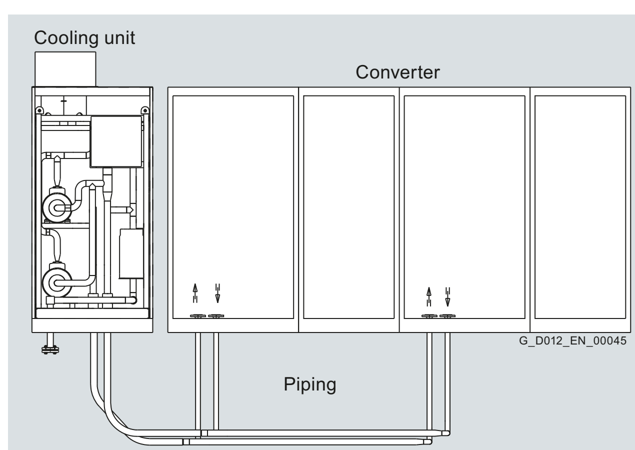
The cooling unit consists of one transport unit and is supplied without deionized water.

For SINAMICS GM150 in the IGBT version and SINAMICS SM150 in the IGBT version, a pipe-connecting element between the cooling unit and converter is included in the scope of delivery. As standard, the water connections are located on the side.

For SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version, the piping between the cooling unit and the basic unit is realized below the units (refer to example shown in following diagram). The necessary pipes and connection pieces are included in the scope of delivery and are supplied loose. Rigid pipes are used (stainless steel). The converter is connected to the stainless steel pipe using a flexible hose. The height of the vertical pipes can be adjusted.

Special installation conditions have not been taken into account and, where applicable, a separate inquiry is necessary (e.g. where the cooling unit is not mounted directly next to the basic unit).

The piping for the raw water supply on the plant side is not included.



Piping for SINAMICS GM150 in the IGCT version and for SINAMICS SM150 in IGCT version

1) After the converter is filled and before the converter is switched on, the conductivity value is reduced to the permitted operating value of < 1.0 µS/cm by the ion exchanger which is integrated in the cooling unit.

Function

Options

Redundancy (options **W02** and **W12**)

On request, the cooling unit can be designed for fully redundant operation, i.e. two plate-type heat exchangers are provided. In this case, defective parts can be exchanged while the system continues to run.

Tube-nest heat exchanger (on request)

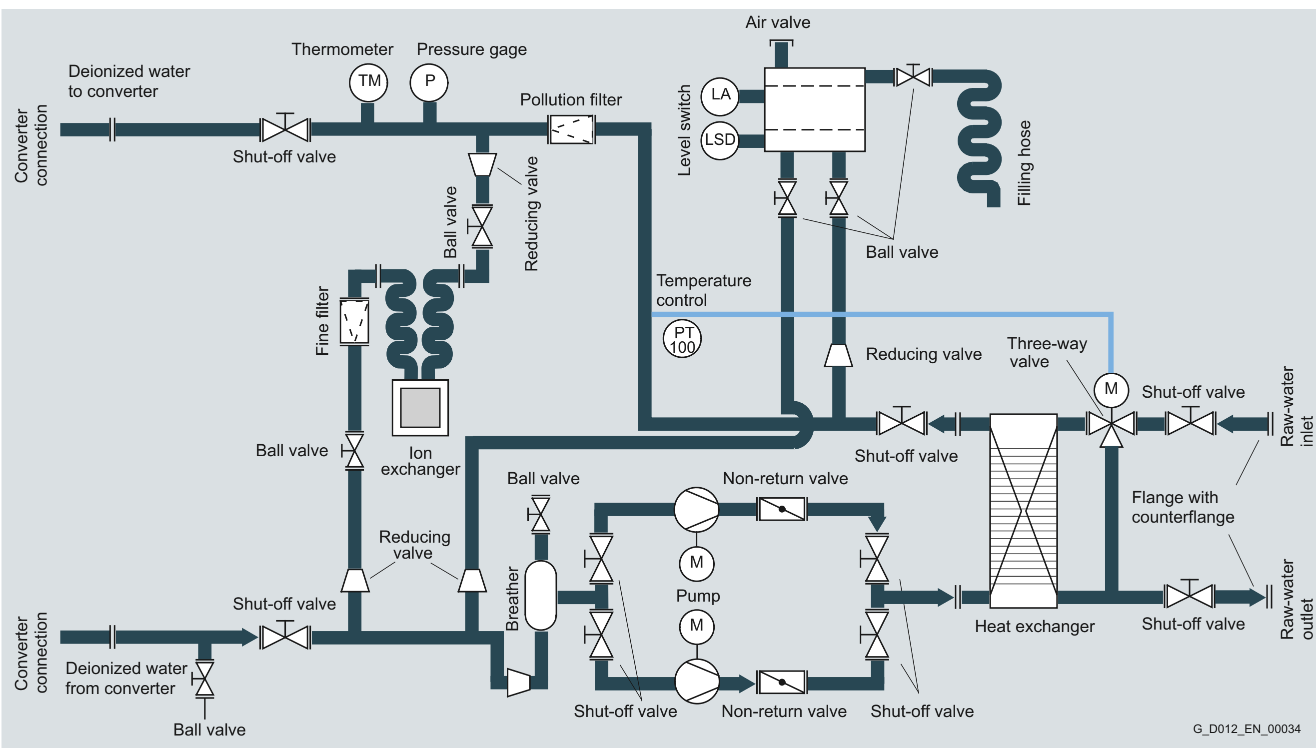
If the raw water quality deviates from the standard values specified above (e.g. the water contains suspended particles), on request, a tube-nest heat exchanger can be used.

Notice: A supplementary cabinet is required if a tube-nest heat exchanger is used.

The following additional options are available on request:

- External air-to-water heat exchanger (on request)
  An external air-to-water heat exchanger can be used on request if there is no process water available on the plant side. In this case, the ambient temperature may be a maximum of 35 °C.
- Chillers (on request)
  If there is no process water on the plant side and if the ambient temperature exceeds 35 °C, then on request, a so-called chiller (incl. compressor) can be used.
- Specification for the cooling unit (on request)
  When selecting option **W14** (converter without cooling unit), specifications of the cooling unit are available on request.

Flowchart of the cooling unit



Technical specifications

Technical specifications of the cooling unit	
Degree of protection	
• Cabinet	IP20
• All internal components	IP54
Supply voltage	3/N/PE/AC 400 V ±10 %, 50/60 Hz ±3 %
Raw water circuit	
• Inlet temperature	5 ... 35 °C (for power derating of the converter max. +40 °C)
• Temperature rise in converter, max.	10 K (for minimum flow)
• Input pressure	2 ... 10 bar
Pressure drop	<1 bar

Circuit breakers

Configuration

The circuit breaker placed on the primary side of the input transformer on the plant side belongs to the safety system of the converter. If a fault occurs inside the converter, the energy that is effective at the fault location must be limited. This is realized as a result of the inductance of the incoming transformer, which limits the rate-of-rise and magnitude of the current and the circuit breaker that trips as quickly as possible.

For the above conditions to be satisfied, the circuit breaker used must have the following characteristics:

- The total opening time of the circuit breaker – from the command to actually opening – must not be more than 80 ms. This means that the opening time, specified in the technical documentation of the circuit breaker manufacturer, must not be longer than 80 ms. The converter monitors the total opening time.
- The converter monitors the TRIP coils (shunt releases) for wire breakage and failure of the control voltage in the switchgear installation.
- The circuit breaker must be fitted with an undervoltage trip unit. The undervoltage trip unit (low-voltage coil) is controlled by way of the tripping chain in which the "undervoltage trip unit" of the converter must also be integrated. The auxiliary voltage from the switchgear (this is a reliable supply) is used as the supply.
- Additional delay times in controlling the circuit breaker must be avoided. All commands from the converter to the circuit breaker must act directly, without recourse to any coupling relays.
- A separate check-back signal must exist for each of the circuit breaker states ON and OFF. The checkbacks must not be delayed, i.e. no coupling relays may be used.
- An additional, independently operating overcurrent protection for the circuit breaker must be provided on the plant side (transformer and cable protection).
- Under no circumstances may the circuit breaker be electrically or mechanically closed externally. A mechanical interlock of the manual ON command on the circuit breaker prevents destruction of the converter by uncoordinated switch-on.

Transformers

Configuration

The SINAMICS GM150 and SINAMICS SM150 converters are always connected to the medium-voltage network through a converter transformer.

By using the transformer the drive (converter and motor) are disconnected from the network and electrically isolated:

- The short-circuit power is limited to a maximum permissible value.
- Converter and motor are operated ground-free.
- The line harmonics and the voltage ripple are limited.

An insulation monitor, integrated in the converter, monitors the insulation state of the transformer secondary winding up to the motor.

Configurations for SINAMICS GM150

For the 12-pulse Basic Line Module of the SINAMICS GM150 converter, a three-winding transformer is required. The secondary windings of the three-winding transformer have a phase shift around 30°el, resulting in a 12-pulse infeed with accordingly lower line harmonic distortions.

For the 24-pulse Basic Line Module, two three-winding transformers are required. Two transformers with primary windings offset through 15° are used.

In this case, it must be ensured that the individual secondary windings have the same voltage, in order to reduce the line harmonics and to ensure a symmetrical current distribution. In this case, a maximum deviation of 1 % is permissible for the two secondary windings connected in parallel.

Instead of the two three-winding transformers a five-winding transformer can also be used in consultation with the transformer manufacturer.

Configurations for SINAMICS SM150

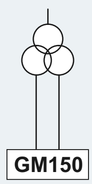
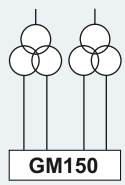
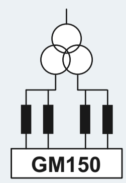
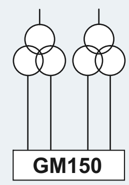
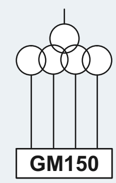
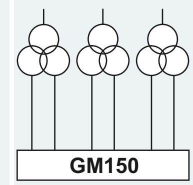
A two-winding transformer is required for each Active Line Module. When two or three complete converter units are operated in parallel, it is also possible to use a three-winding or a four-winding transformer with offset windings to suppress line harmonics.

Configuration

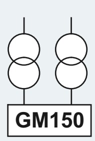
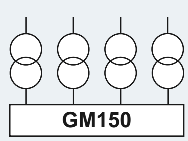
Transformer secondary voltages

SINAMICS GM150

Transformer secondary voltages when using three-winding or five-winding transformers

	SINAMICS GM150 (IGBT) and SINAMICS GM150 (IGCT)					
Circuit	Single connection of Motor Module		Parallel connection of Motor Modules			
Infeed	12-pulse	24-pulse	12-pulse	24-pulse		36-pulse
Circuit version (Fig. No.)	1, 7	2, 8	–	3, 9	–	10
Infeed transformers	1 three-winding transformer 	2 three-winding transformers 	1 three-winding transformer, 4 line reactors 	2 three-winding transformers 	1 five-winding transformer 	3 three-winding transformers 
Offset between the transformer secondary windings	30 °	15 °	30 °	15 °	15 °	10 °
Converter: V_{Nconv} in kV	**Transformer: secondary voltage V_{sec} in kV (no-load voltage)**					
2.3	2 × 1.2	2 × (2 × 1.2) 1)	–	–	–	–
3.3 (IGBT)	2 × 1.7	2 × (2 × 1.7) 1)	2 × 1.7	2 × (2 × 1.7)	4 × 1.7	–
3.3 (IGCT)	2 × 1.7	2 × (2 × 0.85) 1)	–	2 × (2 × 1.7)	–	3 × (2 × 1.7)
4.16	2 × 2.2	2 × (2 × 2.2) 1)	2 × 2.2	2 × (2 × 2.2)	4 × 2.2	–

Transformer secondary voltages when using two-winding transformers

	SINAMICS GM150 (IGBT) and SINAMICS GM150 (IGCT)		
Circuit	Single connection of Motor Module		Parallel connection of Motor Modules
Infeed	12-pulse	24-pulse	
Circuit version (Fig. No.)	–	–	–
Infeed transformers	2 two-winding transformers 	4 two-winding transformers 	
Offset between the transformer secondary windings	30 °	15 °	15 °
Converter: V_{Nconv} in kV	**Transformer: secondary voltage V_{sec} in kV (no-load voltage)**		
2.3	2 × 1.2	4 × 1.2 1)	4 × 1.2
3.3 (IGBT)	2 × 1.7	4 × 1.7 1)	4 × 1.7
3.3 (IGCT)	2 × 1.7	4 × 0.85 1)	4 × 1.7
4.16	2 × 2.2	4 × 2.2 1)	4 × 2.2

1) Single connection with option **N15**.

9

Configuration

SINAMICS SM150

Transformer secondary voltage (phase-to-phase, line to line):

- SINAMICS SM150 in the IGCT version: 3.3 kV
- SINAMICS SM150 in the IGBT version: 3.3 kV or 4.16 kV

If the converter is also to provide capacitive reactive power (a noticeable amount) to compensate for other inductive loads connected to the line supply, then the secondary no-load voltage of the transformer must be dimensioned lower, in order that the converter voltage of 3.3 kV or 4.16 kV is sufficient. As a consequence, the maximum power that can be transferred is reduced. For extremely high surge power levels, the secondary no-load voltage must also be dimensioned somewhat lower.

Transformer leakage reactances

The minimum required protection values for the leakage reactance of the various converter types can be found in the following table. These values include all the inductances between the line supply and converter Line short-circuit inductance, transformer inductance, reactor inductance.

Converter		Transformer	
Version	Rated output voltage	Secondary voltage per winding system V_{sec}	Minimum leakage reactance $X_{S,min}$ [1]
	kV	kV	Ω
SINAMICS GM150			
IGBT	2.3	1.2	0.068
	3.3	1.7	0.101
	4.16	2.2	0.143
IGCT	3.3	1.7	0.058
		0.85 [2]	0.029 [2]
SINAMICS SM150			
IGBT	3.3	3.3	0.314
IGCT	3.3	3.3	0.179

Transformer minimum leakage reactances (short-circuit impedance of the line supply of 1 % taken into account)

Transformer short-circuit voltage

The required relative short-circuit voltage u_K (for each secondary winding) depends on – for the selected leakage reactance X_S (see table) – the rated apparent power of the transformer S_{NTrans} (for each secondary winding) and can be defined using the following formula:

$$u_K = X_S \times S_{NTrans} / (V_{sec})^2$$

X_S in Ω

S_{NTrans} in MVA

V_{sec} in kV

Taps for adjusting the voltage

The winding taps are usually located on the high voltage side of the transformer.

SINAMICS GM150

Recommended taps for the voltage adjustments:
2 × ±2.5 % or ±5 % for operation with a sine-wave filter

SINAMICS SM150

Recommended taps for the voltage adjustment:
2 × ±2.5 %

[1] The corresponding minimum leakage inductances $L_{S,min}$ can be calculated using the following formula: $X_{S,min} = 2\pi \times f_{Nline} \times L_{S,min}$ (with f_{Nline} = line frequency).

[2] Option **N15**.

Configuration

Basic information

The cable selection and cable dimensioning depend on various factors (e.g. temperature, routing type, cable type, EMC requirements, local regulations).

This is the reason that it should be noted that the following data represent recommendations only. The system integrator is responsible for dimensioning the cables.

Motor cables

If the SINAMICS GM150 and SINAMICS SM150 converters are operated without sine-wave filters, higher voltages arise on the motor terminals and hence on the cable due to the switching edges. Suitable cables must be selected, therefore. to meet the EMC and voltage endurance requirements. Different technical characteristics result in differences between the converters with IGBT power units and those with IGCT power units.

The correct cable cross-section depends not only on the motor current but also on the number of cables which are routed in parallel, the routing conditions and the ambient temperature. It must be determined for each individual case. Local installation regulations must be observed in addition.

A finely-stranded cable for equipotential bonding between the motor and converter should be installed parallel to the power cables. Local regulations must be observed in this case, too.

SINAMICS GM150 in the IGBT version and SINAMICS SM150 in the IGBT version (without sine-wave filter)

Shielded three-core medium-voltage cables must be used to connect the converter to the motor. For converters with an output voltage of 2.3 kV, cables for a minimum of 3.6/6 kV are adequate. For converters with output voltages of 3.3 kV and 4.16 kV, cables for a minimum of 6/10 kV are required. Symmetrical cables with individually shielded copper conductors are recommended. An additional common outer shield is an advantage for improving the EMC characteristics. The cable capacitances must not exceed the following values.

Cable cross-section	Cable capacitance
3 × 240 mm^2	0.6 µF/km
3 × 95 ... 185 mm^2	0.5 µF/km
3 × 70 mm^2	0.4 µF/km

Single-core, shielded cables are permissible if three cables are routed in a triangular arrangement without clearance between the cables as cable bundle on the cable tray. The symmetrically arranged cable bundle comprises one cable for every phase (three-phase system). The cable bundles are arranged next to one another on the cable tray. The clearance between them corresponds to twice the outer diameter of a single-core cable. The cable bundles have alternating rotating fields – clockwise and counter-clockwise.

EMC-FC (Frequency Converter) cables should be used for increased requirements regarding EMC. Their EMC-optimized cable design reduces the radio interference radiation and radio interference voltage when compared to standard medium-voltage cables.

SINAMICS GM150 in the IGBT version and SINAMICS SM150 in the IGBT version (with sine-wave filter)

For operation with a sine-wave filter there are no special requirements to be met by the cables from the converter to the motor. When using unshielded medium-voltage cables, some type of cable armor is recommended in order to ensure the mechanical ruggedness of the cables. For a rated motor voltage of 3.3 kV and lower, the rated cable voltage is 3.6/6 kV. For a rated motor voltage above 3.3 kV, the rated cable voltage is 6/10 kV.

SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version

Shielded three-core medium-voltage cables for 6/10 kV must be used to connect the converter to the motor. Symmetrical cables with individually shielded copper conductors are recommended. An additional common outer shield is an advantage for improving the EMC characteristics.

Single-core, shielded cables are permissible if three cables are routed in a triangular arrangement without clearance between the cables as cable bundle on the cable tray. The symmetrically arranged cable bundle comprises one cable for every phase (three-phase system). The cable bundles are arranged next to one another on the cable tray. The clearance between them corresponds to twice the outer diameter of a single-core cable. The cable bundles have alternating rotating fields – clockwise and counter-clockwise.

EMC-FC (Frequency Converter) cables should be used for increased requirements regarding EMC. Their EMC-optimized cable design reduces the radio interference radiation and radio interference voltage when compared to standard medium-voltage cables.

Cables between the transformer and the converter

The same instructions apply as in the case of the motor cables.

Power cables

Configuration

Permissible cable lengths

In the case of long cables between the converter and the motor, reflection phenomena lead to overvoltages and recharging currents on the cables and at the motor terminals and, in turn, to a higher level of stress on the motor insulation. The motor insulation is additionally subject to stress as a result of the voltage rates of rise (voltage gradients).

The increased stress on the cables and motor as a result of reflection phenomena in the case of long cables can be significantly reduced using a sine-wave filter at the converter output (option **Y15**).

The recharging currents in the cables and in the motor can be significantly reduced by using reactors at the converter output (option **L08**).

Maximum cable lengths without and with output reactor

Converter	**Max. cable lengths**			
	Without output reactor (standard)		With output reactor [1] (option **L08**)	
	Shielded	Un-shielded	Shielded	Un-shielded
Output voltage 2.3 kV to 4.16 kV				
SINAMICS GM150 IGBT version and SINAMICS SM150 IGBT version	Up to 2 parallel cables: each 100 m 3 parallel cables: each 80 m >3 parallel cables: Not permitted	Not permitted	On request	Not permitted
Output voltage 3.3 kV				
SINAMICS GM150 as IGCT version	Up to 2 parallel cables: each 100 m 3 parallel cables: each 80 m 4 parallel cables: each 80 m	Not permitted	On request	Not permitted
	Mechanically, up to six parallel cables are possible (on request).			
SINAMICS SM150 IGCT version	Up to 4 parallel cables: each 80 m	Not permitted	On request	Not permitted
	Mechanically, up to six parallel cables are possible (on request).			

Data regarding cable lengths when using option **L08** (output reactor) can be obtained for specific systems from your local Siemens sales contact.

Maximum cable lengths without and with sine-wave filter

Converter	**Max. cable lengths**			
	Without sine-wave filter (standard)		With sine-wave filter [1] (option **Y15**)	
	Shielded	Un-shielded	Shielded	Un-shielded [2]
Output voltage 2.3 kV to 4.16 kV				
SINAMICS GM150 in IGBT version	Up to 2 parallel cables: each 100 m 3 parallel cables: each 80 m >3 parallel cables: Not permitted	Not permitted	1000 m	1000 m

Maximum cable lengths between line-side transformer and converter

Converter	**Max. cable lengths**	
	Shielded	Unshielded
Output voltage 2.3 kV to 4.16 kV		
SINAMICS GM150	300 m	300 m
Output voltage 3.3 kV		
SINAMICS SM150	80 m	Not permitted

[1] Distance between the converter and the motor depending on the current load for max. 6 three-wire EMC cables connected in parallel.

[2] Armored cables recommended.

Configuration

General notes on operating high-voltage motors

High-voltage motors can generate a voltage if they are driven by the load as a result of the inherent plant or system principle. The magnitude of this voltage essentially depends on the speed and the type of excitation of the high-voltage motor. The following must be noted in order to ensure that the converter power unit safely and reliably operates while the high-voltage motor is rotating:

- For permanent-magnet synchronous motors, options **L49** (make-proof grounding switch at the converter output) and **L52** (circuit breaker at the converter output) must be selected.
- For induction motors and separately-excited synchronous motors, if the motor is driven by the load, then options **L49** and **L51/L52** (depending on the particular application) should be selected.

Operation of Siemens high-voltage motors

A sine-wave filter is not required between the Siemens high-voltage motors H-compact, H-compact PLUS, H-modyn and special motors for e.g. marine, rolling mill and high-speed applications and the SINAMICS GM150 and SINAMICS SM150 converters. Reliable operation of the drive is assured by the following measures:

- The MICALASTIC VPI insulation system is optimally suited for the voltage stressing which occurs in converter operation.
- The protection concept for high voltage motors when fed from converters involves two insulating bearings to avoid damaging bearing currents. Further, shaft grounding is absolutely necessary so that no voltage can be established at the motor shaft with respect to ground. The shaft is either grounded using a rotary pulse encoder with integrated grounding track on the non-drive end or using a separate grounding brush on the motor drive end. In the first case, an insulated coupling must be used. This is because as a result of the shaft grounding at the non-drive end, circulating currents can flow through the driven load. In the second case, the rotary pulse encoder must be mounted at the non-drive end so that it is insulated; an insulated coupling is not required (see alongside figures).

Minimum motor rated frequency:

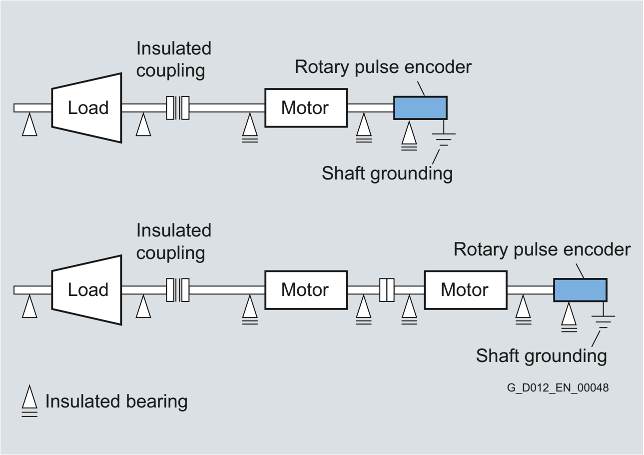
- SINAMICS GM150 in IGBT version and SINAMICS SM150 in IGBT version:
  20 Hz
- SINAMICS GM150 in IGCT version and SINAMICS SM150 in IGCT version:
  - 8.5 Hz for an output voltage of 3.3 kV
  - 5.0 Hz for a reduced voltage of 3.15 kV

Note:

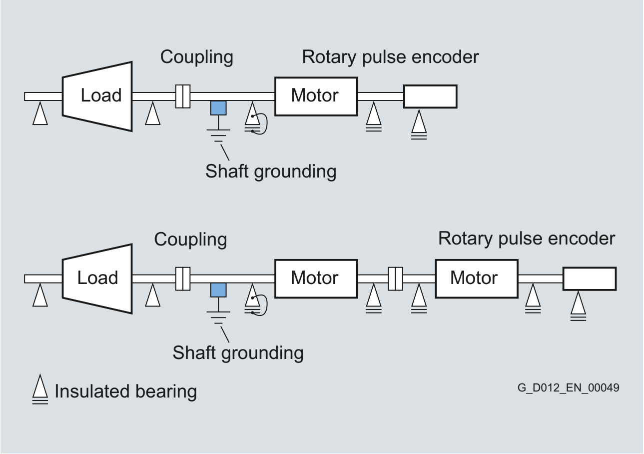
Please contact your regional Siemens sales partner in the case of different data.

Note:

For motors with rated frequency of less than 8.5 Hz, a reduced voltage of 3.15 kV should always be selected.



Shaft grounding at the non-drive end



Shaft grounding at the drive end

Configuration

Operation of motors with several winding systems

To increase the output power of the converters it is possible to operate several power units in parallel. In this way, a maximum power rating of up to 13 MVA with an output voltage of 4.16 kV can be achieved by connecting two SINAMICS GM150 in the IGBT version converters in parallel. Using the same principle, a maximum power rating of 21 MVA or 31.5 MVA is achieved by connecting three SINAMICS GM150, in the IGCT version and SINAMICS SM150 converters in parallel.

To ensure a uniform division of current between the two subsystems, two or three electrically isolated but mutually non-displaced winding systems are required in the motor.

Operation of two-pole motors

High-speed converter drives with 2-pole motors require special measures regarding their mechanical design (limiting and critical speed, bearings, rotor design, foundation design). An inquiry is required for such applications.

In the case of retrofit applications it is necessary to ensure that the motors have no mechanical natural resonance in the provided setting range. Affected speed ranges can be suppressed by the converter if necessary.

Operation of explosion-protected motors

Motors from Siemens are also available in versions for use in areas subject to explosion hazard. Types of protection available for the motors are:

- Pressurized enclosure: Ex pe IIC T3
  acc. to EN 60079-2/VDE 0170/0171 T301 (IEC 60079-2)
- Non-sparking: Ex n AIIC T3
  acc. to EN 60079-15/VDE 0170/0171 T16 (IEC 60079-15)

Apart from the measures required – also for fixed-speed motors – to increase the type of protection, for variable speed motors it is also necessary to have a shaft grounding device with type of protection type Ex d IIC T6 (without rotary pulse encoder) or Ex de IIC T6 (with rotary pulse encoder).

An inquiry is always necessary for motors with increased safety Ex e.

Ex certification

For motors with Ex n type of protection and converter operation it may be necessary to accept the complete system on a case-for-case basis in order to issue an Ex certificate. An inquiry is required for such cases.

An acceptance test of the complete drive system is not required for motors with Ex pe type of protection and converter operation.

Drives for a square-law load torque

Driven loads with a square-law load torque ($M \sim n^2$) such as pumps and fans, require the full torque at rated speed. Increased starting torques or load surges do not usually occur. It is therefore unnecessary to provide an overload capability for the converter.

The following applies when selecting a suitable converter for driven loads with a square-law load torque: The rated current of the converter must be at least as large as the motor current at full torque in the required load point.

Drives for a constant load torque

Self-ventilated motors cannot provide their full rated torque in continuous operation over the complete speed range. The continuous permissible torque decreases as the speed decreases because of the reduced cooling effect. Depending on the speed range, the torque – and thus the power – must be reduced accordingly for self-cooled motors.

For frequencies above the rated frequency f_N, force-ventilated motors are operated in the field-weakening mode. In this case, the torque that can be utilized decreases with approx. f_N/f. The power remains constant. A sufficient interval of ≥ 30 % from the breakdown torque must be observed, which is reduced by $(f_N/f)^2$.

Drives with overload requirements

The rated data of the converters specified in the Technical data provide no reserves for overload capability. The current rating of the converter must always be reduced if the specifications call for an increased overload capability of the converter. The required power reduction differs according to the application, operating mode and converter type. The derating can be determined on request if all of the boundary conditions are specified.

Operating standard line motors (only SINAMICS GM150 in the IGBT version)

In conjunction with the optional sine-wave filter (option **Y15**) the SINAMICS GM150 as IGBT version is ideal for the operation of line motors in applications with a quadratic load torque (e.g. pumps and fans). The near sinusoidal output voltages and currents rule out all loading of the insulating system and bearings. The sine-wave filters supply the motors with almost sinusoidal motor currents and voltages so that line motors can be operated. The sine-wave filter operates optimally for motors with a rated frequency of 50 Hz or 60 Hz. It should be noted that only driven loads with a square-law load torque may be operated (e.g. pumps, fans). The output frequencies used in operation can lie in the range between 30 Hz and 66 Hz.

A field weakening range of 1:1.1 is permissible (max. 55 Hz for 50 Hz motors and max. 66 Hz for 60 Hz motors).

The voltage harmonic distortion at an output frequency of 50 Hz is less than 5 % when using a sine-wave filter.

In order to optimally adapt the sine-wave filter to the motor, the rated motor current, the motor current at the rated point and the motor no-load current must be specified when ordering.

Configuration

The standard scope of delivery of the SINAMICS GM150 and SINAMICS SM150 comprises:

1. Basic unit

The basic unit consists of the converter power unit including closed-loop control, in either an air-cooled or water-cooled version. One or more transport units are supplied depending on the converter type. Exact details are to be found in the dimension drawing for the specific order.

SINAMICS SM150 includes a VSM10 Voltage Sensing Module in the basic unit. The VSM10 detects the line supply voltage regarding phase position, frequency and amplitude. A voltage transformer, which should be provided on the primary side of the circuit breaker (plant-side) is used for this purpose.

2. Cooling unit for water-cooled converters

The cooling unit consists of one transport unit and is supplied without deionized water.

For SINAMICS GM150 in the IGBT version, a pipe-connecting element between the cooling unit and converter is included in the scope of delivery.

For SINAMICS GM150 in the IGCT version and SINAMICS SM150 in the IGCT version, the piping between the cooling unit and the basic unit is routed below the units. The necessary pipes and connection pieces are included in the scope of delivery and are supplied loose.

Special installation conditions have not been taken into account and, where applicable, a separate inquiry is necessary (e.g. where the cooling unit is not mounted directly next to the basic unit).

The piping for the raw water supply on the plant side is not included.

3. Optional components

Optional components, e.g. sine-wave filters or output reactors, are delivered as separate transport units. If necessary, cables for connecting the optional components to the power unit are delivered as well. For the DC bus configurations of SINAMICS SM150, the cabling between the basic unit and the option cabinets is routed below the units. The cables required are not included in the scope of delivery as they have to be selected according to the particular project.

4. Static excitation unit

A static excitation unit is generally included in the scope of delivery for converters to supply synchronous motors. This must be ordered with a separate order number (see Accessories, Chapter 7).

The following items are not included in the standard scope of delivery:

- **Cables between the transformer and the converter**
- **Motor cables**
- **Circuit breakers**
- **Transformer**
- **Motor**
- **Cable ducts**
- **Filter systems**
- **Piping for the raw water circuit of the cooling unit**
- **Voltage transformer for the synchronizing voltage of the VSM10**
- **Basic configuration for SINAMICS SM150**

Basic configuration for SINAMICS SM150

For the SINAMICS SM150 converter system, it is absolutely necessary that the software is configured for the specific plant or system.

This involves:

- connection of the static excitation unit via PROFIBUS
- operation of the SIMATIC OP 177B operator panel
- signal marshaling to connect to the basic automation (e.g. ON/OFF or fault signals from Motor Modules)

Without this basic configuration, the SINAMICS SM150 converter system cannot function. The basic configuration should either be undertaken by a system integrator or option **S05** should be ordered.

Beyond this, in individual cases, application-specific engineering is required, which is not emulated in the product, but can be implemented in coordination with the system integrator.

This includes:

- power pre-control of several Motor Modules on a common infeed
- power monitoring
- control of auxiliaries with temperature/flow/bearings
- communication configuration to the PDA (Process Data Acquisition) via PROFINET
- integration of additional options

Notes

Services and documentation

10

Training

Overview

Faster and more applicable know-how: Hands-on training from the manufacturer

SITRAIN – Siemens Training for Industry – provides you with comprehensive support in solving your tasks.

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Application

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10

Design

Range of training courses for SINAMICS GM150/SM150

Here you will find an overview of the training courses available for SINAMICS GM150 and SINAMICS SM150.

The courses are modular in design and are intended for a variety of target groups as well as individual customer requirements.

The system overview will acquaint decision-makers and sales personnel with the system very quickly.

The configuration course provides all the information you need to configure the drive system.

The basic and follow-up courses are guaranteed to provide all of the technical knowledge service engineers will need for servicing/commissioning motion control applications, communication and cabinet units.

All modules contain as many practical exercises as possible, in order to facilitate intensive and direct training on the drive system and with the tools in small groups.

More information on course contents, dates and prices is available on the Internet at:
www.siemens.com/sitrain

Title	Target group				Duration	Course code
	Project managers, project personnel	Programmers	Commissioning engineers, application engineers	Service personnel, maintenance technicians		
SINAMICS GM150/SM150 engineering	✓	✓			3 days	DR-GMPH-PJ
SINAMICS GM150 commissioning and service			✓	✓	5 days	DR-GM150
SINAMICS SM150 commissioning and service			✓	✓	8 days	DR-SM150

Description

SINAMICS GM150/SM150 engineering (3 days) DR-GMPH-PJ

Description/learning objective

The course addresses design engineers, application engineers and sales personnel who are involved in the application engineering for SINAMICS GM150 or SINAMICS SM150. Training covers the fundamental physical relationships for the design of a drive system. Using the self-explanatory SIZER for Siemens Drives engineering tool, different SINAMICS applications are calculated and consolidated using exercises on PCs. Control functions are explained, and their boundary conditions described. The various options for SINAMICS are also presented to permit derivation of their application.

Target group

Project managers, members of project teams, programmers

Requirements

Knowledge of drive and control technology

Content

- SINAMICS system overview
- Physical fundamentals for drive calculation
- Engineering SINAMICS GM150 and SINAMICS SM150 cabinet components together with background information: Line supplies, EMC, EMERGENCY-STOP, interfaces
- SIZER for Siemens Drives engineering tool with exercises for various applications
- Technical documentation: catalogs, engineering information, operating instructions
- Open-loop and closed-loop control functions
- Simple startup using the AOP30 operator panel
- Transformer/reactor
- Cooling unit
- High-voltage motor
- Medium-voltage cable

Description

SINAMICS GM150 commissioning and service (5 days) DR-GM150

Description/learning objective

This training course provides you with the basics to understand the commissioning steps for the SINAMICS GM150 drive system. You know the closed-loop control structures and communication interfaces. You can diagnose the drive state and analyze fault messages. To do this, you use the AOP30 operator panel and the STARTER commissioning tool.

Target group

Commissioning engineers, application engineers, service engineers, maintenance technicians

Requirements

Basic knowledge of electrical engineering

Content

- Design and function of the SINAMICS GM150 converter components
- Power unit topology: Precharging, rectifier and inverter, actual value sensing
- Identifying the hardware and circuit diagrams
- Drive CLiQ topology, objects and components
- Parameterization, diagnostics and data backup using the AOP30 operator panel and STARTER commissioning tool
- Principle of operation and analysis of the setpoint channel and the closed-loop control
- Analysis of alarm and fault messages
- Configuration and analysis of PROFIBUS communication between SINAMICS GM150 and SIMATIC S7
- Detailed practical exercises for basic commissioning, engineering and analysis of the drive functions using the AOP30 operator panel and STARTER commissioning tool
- Detailed practical exercises to commission the Motor Module:
  - Execution of test and identification routines
  - Operation of the drive
  - Optimization and checking the current and speed controller

SINAMICS SM150 commissioning and service (8 days) DR-SM150

Description/learning objective

This training course provide you with the basics to understand the commissioning steps for the SINAMICS SM150 drive system. You know the closed-loop control structures and communication interfaces. You can diagnose the drive state and analyze fault messages. To do this, you use the SIMOTION SCOUT software package and the STARTER commissioning tool.

Target group

Commissioning engineers, application engineers, service engineers, maintenance technicians

Requirements

Basic knowledge of electrical engineering

Content

- Design and function of the SINAMICS SM150: D445 and CX32 control modules, Power Stack Adapter PSA, line-side and motor-side inverters, DC link, interfaces, circuit diagrams
- Layout and arrangement of the complete drive system: Circuit breaker, transformer, reactor, motor, cooling unit
- Parameterization, diagnostics and data backup using the SIMOTION SCOUT software package with integrated STARTER commissioning tool
- Procedure when commissioning
- Closed-loop control: Setpoint channel, vector control, function diagrams, interface to higher-level technology in SIMOTION
- Communication via PROFIBUS integrated to SIMOTION
- Alarms and fault messages
- Information on replacing components: IGCT phase module, AVT Combi, pre-charging
- Practical exercises using the SIMOTION SCOUT software package with integrated STARTER commissioning tool on training equipment

AOP30 cabinet operator panel training case

Application

This training case is used for training and marketing SINAMICS cabinet units.

When used as a stand-alone unit, it can be used to demonstrate commissioning and usability offline. Online operation is implemented by connecting to a SINAMICS cabinet unit or the SINAMICS S120 training case.

Design

- Cabinet operator panel with line connection
- Internal 24 V DC power supply
- Can be set upright for demonstration purposes
- Offline functions
- Online functions with SINAMICS CU320 Control Unit via RS232 PPI

Technical specifications

AOP30 cabinet operator panel training case	
Degree of protection in accordance with DIN VDE 0470	IP00
Dimensions	
• Width	377 mm
• Height	158 mm
• Depth	277 mm
Weight, approx.	7 kg

Selection and ordering data

Description	Order No.
AOP30 cabinet operator panel training case TG-SN-AOP	**6ZB2480-0CA00**

Documentation

Overview

The documentation is supplied with the converter in PDF format on a CD-ROM as standard.

It consists of the following sections:

- Operating Instructions
- List Manual (parameter lists and function diagrams)
- Equipment-specific documents such as circuit diagrams, dimension drawings, layout diagrams and terminal diagrams
- Additional operating instructions (comprehensive component descriptions)

The documentation is in English. Additional languages can be optionally ordered (see Description of options, Page 6/11).

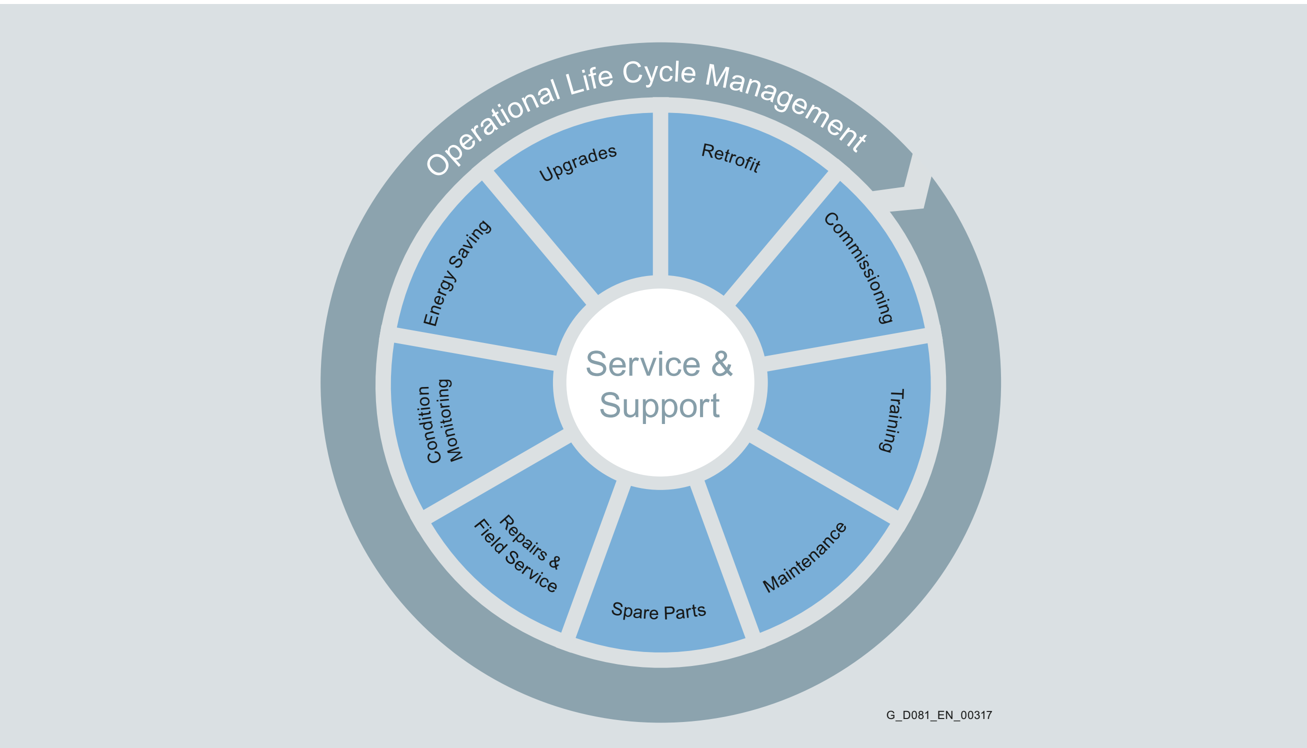
Notice:

Due to US embargo restrictions, the documentation cannot be supplied on CD-ROM to countries such as Iran, Syria, Cuba, Sudan or Libya, as Adobe Acrobat Reader is not permitted in these countries for reading PDF documents. The documentation must be ordered in paper form when exporting converters to these countries (option **D15**).

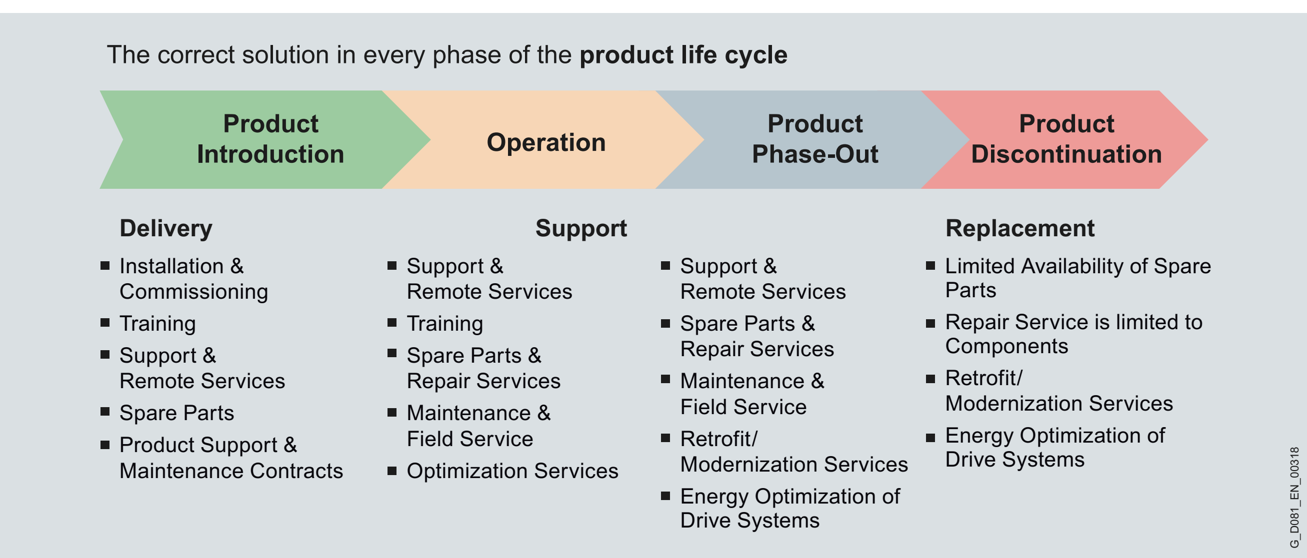
Perfectly setup for global service over the complete lifecycle

Overview

Our service and support is available to you worldwide and supports you over the complete lifecycle of your machines and plants in all areas of Siemens drive technology – locally in over 100 countries and around the clock.



You will find our regional contact partner as well as further information under:
www.siemens.com/automation/partner
www.siemens.com/ld-service



Perfectly setup for global service over the complete lifecycle

Commissioning drive systems

Our services

In addition to commissioning plants and systems, we also provide the associated local service for motors, converters and auxiliary equipment for variable-speed drives in medium-voltage applications up to 60 MW.

We focus on the following sectors and segments:

- Oil and gas
- Chemical industry
- Energy
- Steel
- Paper
- Marine engineering
- Mining
- Cement
- Water and wastewater
- Wind turbines
- Auxiliaries
  - Water cooling systems
  - Oil cooling systems
  - Higher-level control systems
  - Protective equipment
  - Static excitation units/excitation converters
  - Transformer protection

Your advantages at a glance

- High degree of flexibility and cost advantages thanks to a global network of qualified service personnel
- Direct contact between customers and manufacturer, in close collaboration with local service centers
- Short communication paths across all organizational levels
- "Global resource management" for global service calls taking into account legal stipulations and tax regulations
- Cross-area drive know-how for the entire system
- Highly qualified specialists for variable-speed drives

For ordering information on our extensive range of services see Page 9/12.

Customized training courses for drives

Our services

We offer a wide range of individual training courses to expand existing know-how or to provide basic information on specific topics. These training courses can be designed as follows:

- local training courses at the customer's site in the form of a workshop, or
- training in the Siemens factory

The duration of the training course is adapted to the particular training-specific requirements and necessities. It goes without saying that we can support you in implementing individual training requirements and planning.

Your advantages at a glance

- Providing the customer's own maintenance and operating personnel with technical information
- Maintaining and correctly implementing drive-specific maintenance work to reduce internal costs and time
- Fast and competent recording and determination of fault causes (real-time troubleshooting)
- In case of a fault situation, the customer's own maintenance personnel are in a position to quickly and reliably make the correct decisions
- Targeted contact with the Siemens service organization with a competent description of the fault
- Providing information and know-how to correctly select and stock a range of important spare parts to ensure quick replacement and resumption of operation in the case of a plant failure

For ordering information on our extensive range of services see Page 9/12.

Perfectly setup for global service over the complete lifecycle

Maintenance and inspection of drives

Our services

In addition to regular inspections, we also provide the option of entering into specific maintenance contracts. These can be individually tailored to your requirements and specifically expanded by the options that you require.

- Inspection
  - Determining and documenting the actual condition of electric motors and converters
  - Comprehensive plant or system assessment based on checklists that have been specifically developed for this purpose
  - Definition of additional measures required, including reporting
- Maintenance contracts
  - Definition of the required maintenance intervals
  - Remote support and availability of a technical contact person
  - Agreed fixed inspection dates
  - Spare parts, service materials and tools
  - Training the service and plant operating personnel of the customer

Your advantages at a glance

- Inspection
  - Assessment of the actual situation, measurements and diagnostics corresponding to the checklist
  - Determination of the required maintenance work
  - Recommendation for an optimum range of spare parts to be stocked
  - Investigation of the possibilities for improving the operating conditions
- Maintenance
  - Maximizing the drive lifetime
  - Minimizing component wear
  - Avoiding non-scheduled production failures and the associated costs
  - Monitoring the product lifecycle and providing support on alternatives

For ordering information on our extensive range of services see Page 9/12.

Spare parts for drives

Our services

Spare parts/spare part packages on site:

For drives – especially in the medium-voltage range – which generally play an essential role as main drives, in addition to the general service requirements, the availability of spare parts is of crucial significance. In addition to ordering individual spare parts, this is the reason that we now also offer the option of requesting complete packages of spare parts. The essential basis for creating these packages is our extensive experience that we have gained over decades regarding maintenance activities in the drive and component area.

Various spare part packages are available for low and medium-voltage units:

- Basic spare part package
  Spare part package with the most important electronic components, for example for commissioning
- Advanced spare part package
  A spare part package that has been expanded to include additional electronic and power unit components in order to secure spare parts for the first operating years
- Premium spare part package
  Comprehensive spare part package, which includes spare parts to extend the period of usage
  The stock of spare parts can be checked every year as part of annual maintenance and can be individually adapted.

Your advantages at a glance

- Minimization of fault-related downtimes
- In the case of a fault, no additional waiting times for spare parts to be delivered
- Increased availability of the drive unit
- Cost advantages by compiling spare part packages
- Individual package content corresponding to the customer and plant requirements over the complete lifecycle

By specifying the device-specific Siemens order number as well as the associated serial number, you can view our "SparesOnWeb" database to obtain spare parts information for almost all of our current drive products. The recommended spare part packages are displayed here with the corresponding content and ordering data.
www.siemens.com/sow

Spare part package	SINAMICS GM150 Order No.	SINAMICS SM150 Order No.
Basic spare package	**9LD1651-0AA10**	**9LD1652-0AA10**
Advanced spare package	**9LD1651-0AA20**	**9LD1652-0AA20**
Premium spare package	**9LD1651-0AA30**	**9LD1652-0AA30**

10

Perfectly setup for global service over the complete lifecycle

Remote maintenance – expert knowledge close at hand

Our services

Complex drive systems must have a high availability and when required demand competent and fast support. Specialist personnel cannot always be available locally. This is the reason that we offer you the option of remotely monitoring your plants or systems. Such remote maintenance can, for instance, include the following services:

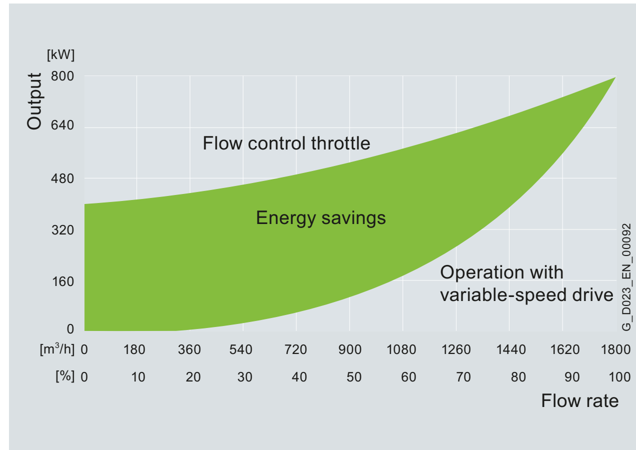
- Online condition monitoring
- Data is stored so that it cannot be lost in the event of a power failure
- Trend analysis, archiving and comparison of the saved data
- When required, expert support from the local service organization
- Video-based support for plant personnel
- Definition of additional measures required, including a report

Your advantages at a glance

- Leading edge technology for highly secure connections with the maximum availability
- High number of supported software applications
- Support service around-the-clock
- Transparency through monitoring and signaling all connections
- Minimizing non-scheduled plant downtimes and avoiding possible subsequent costs
- Increased plant availability
- Basis for condition-oriented maintenance
- Optimization and planning of service and maintenance work
- Careful use of valuable resources by reducing plant visits
- Optimization of the spare part inventory
- Graded, flexible hardware and software concepts can be adapted in a scaled fashion to the appropriate drive system

For ordering information on our extensive range of services see Page 9/12.

Saving energy in drive technology



Our services

Drive technology represents about 2/3 of the industrial energy consumed. As a consequence, the efficient use of energy in the drives field plays a significant role and today represents high cost-saving potential. To optimize the energy usage, we have defined essential measures, which when requested, we can apply in your facility:

- Identification of energy-saving potential
  Determine the actual energy demand and subsequent calculation of the possible energy-saving potential
- Evaluation of the data determined
  By applying various methods, the identified energy-saving potential is evaluated, therefore providing a sound basis for making a decision
- Implementation of measures to optimize energy usage
  Selection of the appropriate products as well as performing specific implementation measures

Your advantages at a glance

- Efficient use of energy by using state-of-the-art, energy-saving drive technology
- Efficient use of energy by changing over to variable-speed drives
- Reduction of the line-side reactive power demand
- Improvement in the starting behavior of motors
- Reduced line harmonics
- Noise reduction by applying state-of-the-art technology
- Optimization of production conditions
- Reduction of wear by adapting the speed

Retrofitting drives

Our services

Retrofitting drives is one of the most important elements in the product lifecycle. You can only ensure that your production runs smoothly if your machines, converters and plants operate safely and reliably.

To support you here, we can replace old technology by state-of-the-art converters and motors from our current product portfolio. Generally, it is not necessary to expand functions or plants – or to modify the drive concept.

Retrofit measures for drives:

- Replacement of older converters by new state-of-the-art medium-voltage drives
- Service advantages
  - 100 % availability of spare parts
  - Availability of know-how
  - Diagnostic options according to state-of-the-art technology
  - Low maintenance costs
  - Availability of software updates

Your advantages at a glance

- Lower maintenance costs in later lifecycle phases
- Increased efficiency
- Process optimization
- Improved energy efficiency and adaptation to latest environmental legislation
- Reduced risk as a result of faults

For ordering information on our extensive range of services, see the right section.

Service portfolio

The following services for medium-voltage converters can be directly ordered:

- Standard inspection of medium-voltage converters, for one unit:

Description **Standard inspection for**	Duration	Order No.
SINAMICS GM, air-cooled	2 days	**9LD1240-0AA12**
SINAMICS GM, water-cooled plus water-cooled heat exchanger	2 days	**9LD1240-0AA13**
SINAMICS SM, air-cooled	2 days	**9LD1240-0AA14**
SINAMICS SM, water-cooled plus water-cooled heat exchanger	2 days	**9LD1240-0AA15**
SINAMICS SM, air cooled plus excitation rectifier	2 days	**9LD1240-0AA16**
SINAMICS GM, water-cooled plus water-cooled heat exchanger plus excitation rectifier	3 days	**9LD1240-0AA17**

- Service products

Description	Order No.
Repair order	**9LD1040-0AF00**
Product support & maintenance contract	**9LD1360-0AF00**
Field service call for commissioning and troubleshooting	**9LD1140-0AF00**
Retrofit order	**9LD1540-0AF00**

Notes:

All services and service products are invoiced according to the actual costs incurred.

Ordering information and inquiries regarding quotations should be addressed to the responsible Siemens sales contact.

When ordering, the product should be specified with the order number, the associated serial number and the quotation number in the ordering text.

You can find further information at:
www.siemens.com/ld-service

Perfectly setup for global service over the complete lifecycle

Extension of the liability for defects

For the products listed in this catalog, we also provide the option of extending the liability for defects period beyond the normal period. The standard liability for defects period, as listed in our standard conditions for the supply of services and products, is 12 months.

Extension of the liability for defects period when ordering new products

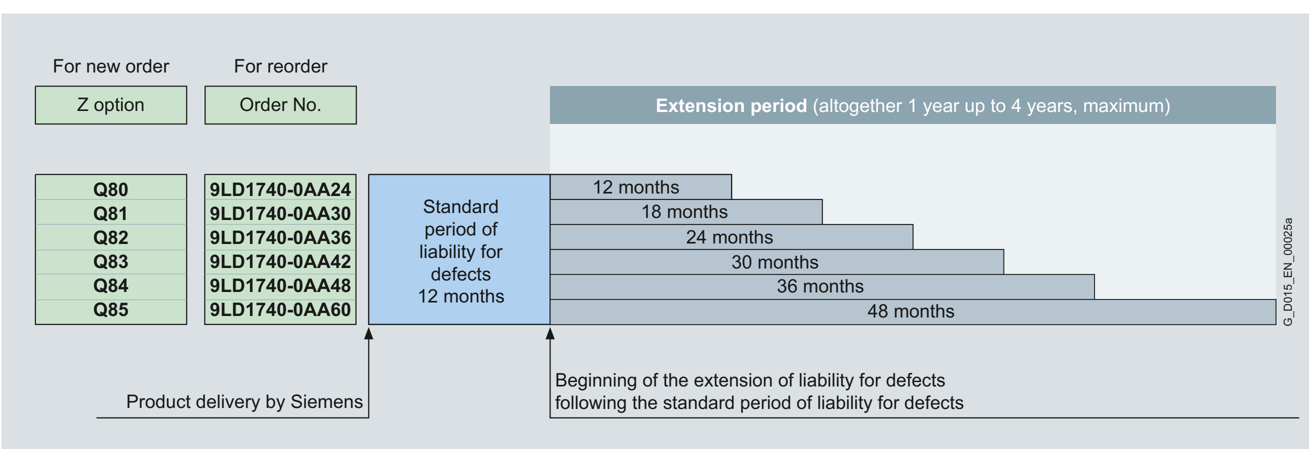
When ordering new products, the standard liability for defects period can be optionally extended for an additional price. Various extension periods can be selected.

Extension of the liability for defects	Order code The suffix "**-Z**" should be added to the converter order number followed by the order code for the required option
Extension of the liability for defects period by 12 months to a total of 24 months (2 years) after being delivered	**Q80**
Extension of the liability for defects period by 18 months to a total of 30 months (2.5 years) after being delivered	**Q81**
Extension of the liability for defects period by 24 months to a total of 36 months (3 years) after being delivered	**Q82**
Extension of the liability for defects period by 30 months to a total of 42 months (3.5 years) after being delivered	**Q83**
Extension of the liability for defects period by 36 months to a total of 48 months (4 years) after being delivered	**Q84**
Extension of the liability for defects period by 48 months to a total of 60 months (5 years) after being delivered	**Q85**

Extension of the liability for defects period after the product has already been delivered

If a product has already been delivered, an extended liability for defects period can be ordered, if the original liability for defects period has still not expired. When ordering, in addition to the order number specified on the type plate, the serial number is also required.

Extension of the liability for defects	Order No.
Extension of the liability for defects period by 12 months to a total of 24 months (2 years) after being delivered	**9LD1740-0AA24**
Extension of the liability for defects period by 18 months to a total of 30 months (2.5 years) after being delivered	**9LD1740-0AA30**
Extension of the liability for defects period by 24 months to a total of 36 months (3 years) after being delivered	**9LD1740-0AA36**
Extension of the liability for defects period by 30 months to a total of 42 months (3.5 years) after being delivered	**9LD1740-0AA42**
Extension of the liability for defects period by 36 months to a total of 48 months (4 years) after being delivered	**9LD1740-0AA48**
Extension of the liability for defects period by 48 months to a total of 60 months (5 years) after being delivered	**9LD1740-0AA60**

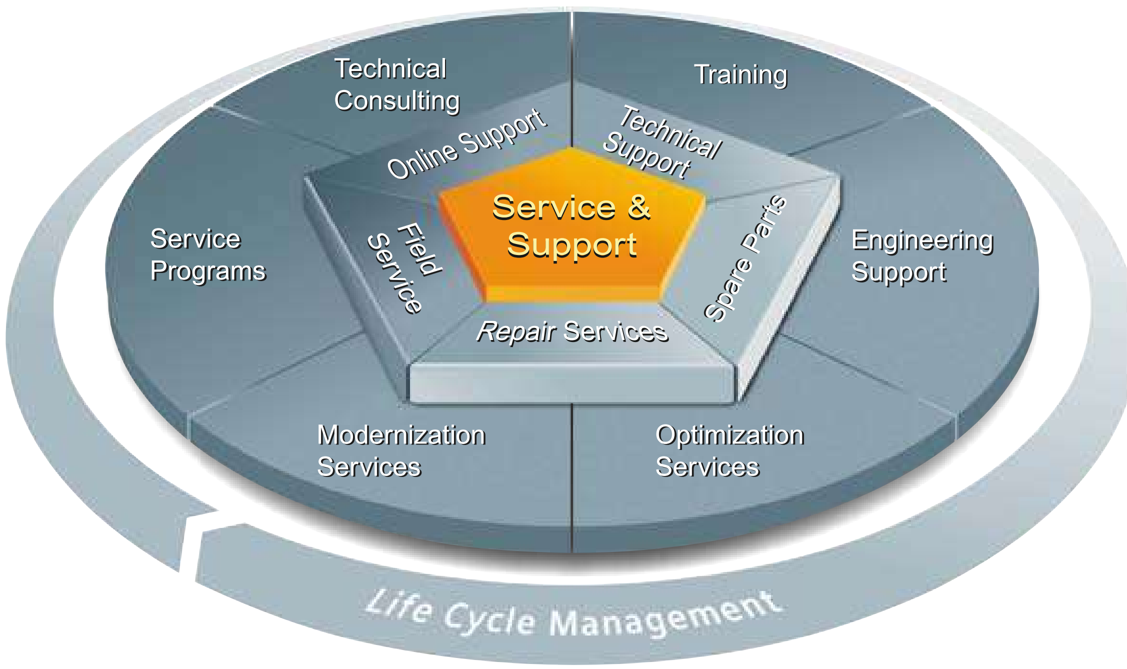


Extension of the liability for defects

Conditions for an extension of the liability for defects:

- For all extension periods of liability for defects, for new and subsequent orders, the final destination of the product must be known.
  The EUNA process is available to obtain this information at www.siemens.com/euna, which must be performed by your local Siemens contact person.
- For all 4 and 5 year extension periods of the liability for defects (Q84/9LD1740-0AA48, Q85/9LD1740-0AA60), this is only possible in conjunction with a corresponding maintenance contract with regular inspections. This maintenance contract must be signed and concluded with the responsible service department.
  This must be documented using the EUNA procedure at www.siemens.com/euna, which must be performed by your local Siemens contact person.
- The general storage conditions described in the operating instructions must be adhered to, especially the specifications for long-term storage.
- Commissioning must be performed by appropriately qualified personnel. When making liability for defect claims, under certain circumstances, it may be necessary to submit the commissioning report to the department making the decision.
- Periodic maintenance must be performed in accordance with the specifications of the operating instructions. When making liability for defect claims, under certain circumstances, it may be necessary to submit the corresponding maintenance documentation and history.
- The operating conditions correspond to the specifications in the operating instructions, the installation instructions or specific conditions laid down in the contract.
- The extended liability for defects excludes wearing parts such as fans or filters. This does not apply if it can be clearly proven that the failure is a premature one.
- Otherwise, the general conditions regarding liability for defects applies as agreed in the delivery contract.

Unmatched complete service for the entire life cycle



For machine constructors, solution providers and plant operators: The service offering from Siemens Industry, Automation and Drive Technologies includes comprehensive services for a wide range of different users in all sectors of the manufacturing and process industry

To accompany our products and systems, we offer integrated and structured services that provide valuable support in every phase of the life cycle of your machine or plant – from planning and implementation through commissioning as far as maintenance and modernization.

Our Service & Support accompanies you worldwide in all matters concerning automation and drives from Siemens. We provide direct on-site support in more than 100 countries through all phases of the life cycle of your machines and plants.

You have an experienced team of specialists at your side to provide active support and bundled know-how. Regular training courses and intensive contact among our employees – even across continents – ensure reliable service in the most diverse areas.

Online Support

The comprehensive online information platform supports you in all aspects of our Service & Support at any time and from any location in the world.

www.siemens.com/automation/service&support

Technical Consulting

Support in planning and designing your project: From detailed actual-state analysis, definition of the goal and consulting on product and system questions right through to the creation of the automation solution.

Technical Support

Expert advice on technical questions with a wide range of demand-optimized services for all our products and systems.

www.siemens.com/automation/support-request

Training

Extend your competitive edge – through practical know-how directly from the manufacturer.

www.siemens.com/sitrain

Contact information is available in the Internet at:
www.siemens.com/automation/partner

Unmatched complete service for the entire life cycle

Engineering Support

Support during project engineering and development with services fine-tuned to your requirements, from configuration through to implementation of an automation project.

Field Service

Our Field Service offers you services for commissioning and maintenance – to ensure that your machines and plants are always available.

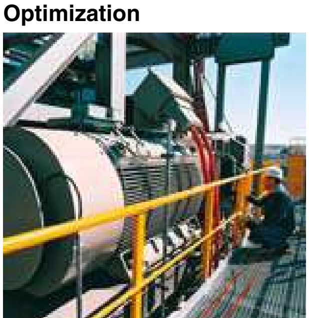
Spare parts

In every sector worldwide, plants and systems are required to operate with constantly increasing reliability. We will provide you with the support you need to prevent a standstill from occurring in the first place: with a worldwide network and optimum logistics chains.

Repairs

Downtimes cause problems in the plant as well as unnecessary costs. We can help you to reduce both to a minimum – with our worldwide repair facilities.

Optimization



During the service life of machines and plants, there is often a great potential for increasing productivity or reducing costs. To help you achieve this potential, we are offering a complete range of optimization services.

Modernization

You can also rely on our support when it comes to modernization – with comprehensive services from the planning phase all the way to commissioning.

Service programs

Our service programs are selected service packages for an automation and drives system or product group. The individual services are coordinated with each over to ensure smooth coverage of the entire life cycle and support optimum use of your products and systems.

The services of a service program can be flexibly adapted at any time and used separately.

Product registration

To ensure high service performance (availability of spare parts, hotline service, availability of personnel), you can register your SINAMICS drive units. We can ensure a timely service response by letting us know the final destination (site location) and nominating a contact partner. You can provide us with this information either using the feedback form (enclosed with each converter) or via Internet:

http://www.siemens.com/reg

Examples of service programs:

- Service contracts
- Plant IT Security Services
- Life Cycle Services for Drive Engineering
- SIMATIC PCS 7 Life Cycle Services
- SINUMERIK Manufacturing Excellence
- SIMATIC Remote Support Services

Advantages at a glance:

- Reduced downtimes for increased productivity
- Optimized maintenance costs due to a tailored scope of services
- Costs that can be calculated and therefore planned
- Service reliability due to guaranteed response times and spare part delivery times
- Customer service personnel will be supported and relieved of additional tasks
- Comprehensive service from a single source, fewer interfaces and greater expertise

Contact information is available in the Internet at:
www.siemens.com/automation/partner

Notes

Appendix

11

Glossary

Overview

Active infeed

Overall functionality of an infeed with → Active Line Module, including the required additional components (filters, switching devices, computing power portion of a → Control Unit, voltage detection, etc.).

For cabinet-mounted units, a → Motor Module can be used instead of the → Active Line Module.

Active Line Module

A controlled, self-commutated infeed/regenerative feedback unit (with IGBTs in infeed/feedback direction) which supplies a constant DC link voltage for the → Motor Modules.

Induction motor

The induction motor is an AC motor, which runs at a speed "lagging behind" the synchronous speed.

Induction motors can be connected to the AC line both directly in a star or delta circuit and via a converter.

When combined with a converter, induction motors form a "variable-speed drive system".

Other commonly used terms: squirrel-cage motor, cage motor.

See also → Synchronous motor.

Output reactor

Reactor (inductance) at the converter or inverter output for reducing the capacitive charge/discharge currents in long power cables.

Basic infeed

Overall functionality of an infeed with → Basic Line Module including the required additional components (filters, switching devices, etc.).

Basic Line Module

Unregulated line infeed unit (diode bridge or thyristor bridge, without feedback) for rectifying the line voltage for the DC link.

CompactFlash Card

Memory card for non-volatile storage of the drive software and corresponding parameters. The memory card can be plugged into the → Control Unit from the outside.

Control Unit

The central control module, in which the open-loop and closed-loop control

functions for one or more SINAMICS → Line Modules and/or → Motor Modules are implemented.

DRIVE-CLiQ

Abbreviation for "Drive Component Link with IQ".

Communication system for connecting the various components of a SINAMICS drive system, e.g. → Control Unit, → Line Modules, → Motor Modules, motors and speed/position encoders.

From a hardware perspective, DRIVE-CLiQ is based on the standard Industrial Ethernet with twisted-pair cables. The DRIVE-CLiQ line provides the transmit and receive signals and also the +24 V power supply.

Field weakening

Field weakening describes the reducing of the magnetizing current of an electric motor in order that the speed can be increased further when the rated voltage is reached.

Non-Siemens motor

A motor is designated as a non-Siemens motor if its motor data is not known to the drive line-up, and it cannot be identified by means of its order number.

The motor data of an external motor is required for commissioning. It must be entered manually in the corresponding parameters.

Kinetic buffering

Kinetic buffering (KIP) is a software function, which can be used to bridge transient line failures (up to approx. 1 s or as long as the drive continues to turn). Kinetic buffering can usually only be used on drives that are primarily motor-driven. It requires a sufficiently large centrifugal mass, i.e., sufficient kinetic energy, on the part of the mechanical transmission element. During the line failure, KIP switches the machine to no-load operation or light regeneration (in order to cover the minor losses from the motor and inverter). Once the line supply has been restored, the machine switches back to standard motor-driven operation.

In order to use kinetic buffering, the technological conditions must be in place to allow the motor to coast or brakes for the duration of the line failure. In some applications with multi-motor drives, the speed ratios between the individual drives have to be maintained during kinetic buffering, in order to prevent the web from tearing or damage. In such cases, kinetic buffering may only be activated on one of the drives (usually the main drive). The reduced speed setpoint values must then be fed into the overall setpoint cascade.

Overview

Line Module

A Line Module is a power component, which creates the DC link voltage for one or several → Motor Modules from a three-phase line supply voltage.

The following types of Line Module are used in the SINAMICS system:

→ Basic Line Module and → Active Line Module.

Motor Module

A Motor Module is a power unit (DC-AC inverter) that provides the power supply for the connected motor.

Power is supplied through the → DC link of the drive line-up.

A Motor Module must be connected to a → Control Unit via → DRIVE-CLiQ. The open-loop and closed-loop control functions of the Motor Module are stored in the Control Unit.

PROFIBUS

Standardized fieldbus according to IEC 61158, Parts 2 to 6.

PROFIdrive

PROFIBUS profile specified for speed and position-controlled drives by the PROFIBUS user organization (German: PNO).

The latest version is the PROFIdrive V3 profile.

Sensor Module

Hardware module for evaluating speed/position encoder signals.

Synchronous motor

Synchronous motors run at the same frequency with which they are operated: They have no slip (which is the case with → induction motors). Synchronous motors require different feed-forward and feedback control concepts depending on their design to ensure that they can be operated with converters.

Synchronous motors are distinguished by the following features:

- permanent-field/separately excited
- with/without damping cage
- with/without position encoder.

Synchronous motors are used for different reasons:

- high drive dynamic response
- high overload capability
- high speed accuracy with exactly specified frequency (SIEMOSYN motors).

Terminal Module

Terminal extension module for snapping onto the installation rail, for installation in the control cabinet.

In SINAMICS, the TM31 Terminal Module is available with analog and digital I/O terminals.

DC link

The component of the converter (or converter system) that connects the input converter (rectifier) and the output converter (one or more inverters).

With voltage source DC link converters like SINAMICS, a constant DC voltage is present in the DC link (rectified line voltage).

Partners at Industry Automation and Drive Technologies

At Siemens Industry Automation and Drive Technologies, more than 85 000 people are resolutely pursuing the same goal: long-term improvement of your competitive ability. We are committed to this goal. Thanks to our commitment, we continue to set new standards in automation and drive technology. In all industries – worldwide.

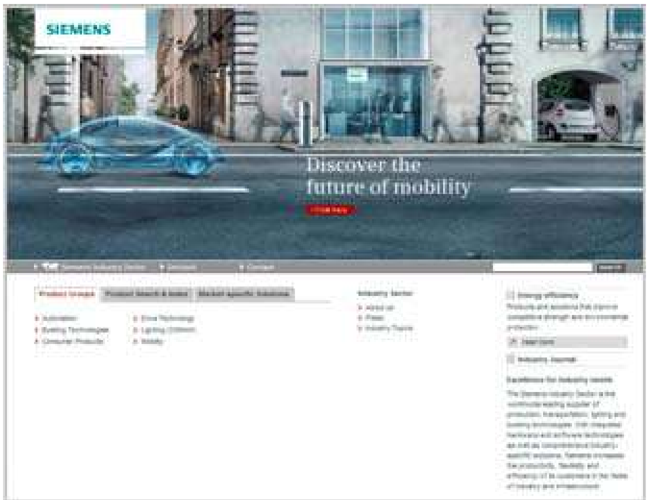
At your service locally, around the globe for consulting, sales, training, service, support, spare parts ... on the entire Industry Automation and Drive Technologies range.

Your personal contact can be found in our Contacts Database at:
www.siemens.com/automation/partner

You start by selecting a

- Product group,
- Country,
- City,
- Service.

Siemens Industry Automation and Drive Technologies in the WWW



A detailed knowledge of the range of products and services available is essential when planning and configuring automation systems. It goes without saying that this information must always be fully up-to-date.

Siemens Industry Automation and Drive Technologies has therefore built up a comprehensive range of information in the World Wide Web, which offers quick and easy access to all data required.

Under the address

www.siemens.com/industry

you will find everything you need to know about products, systems and services.

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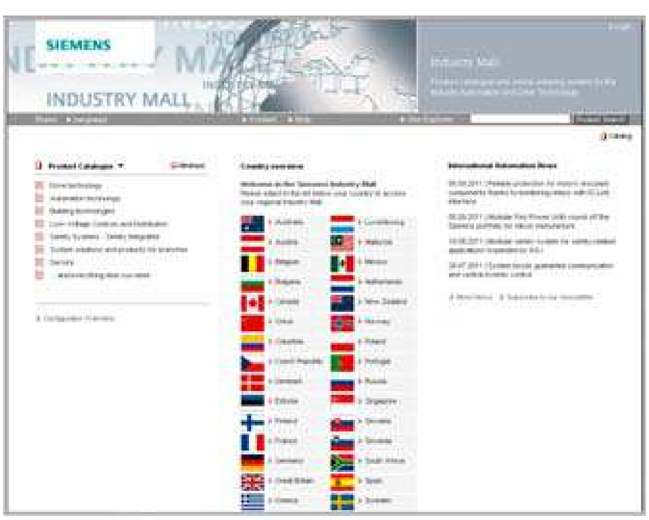

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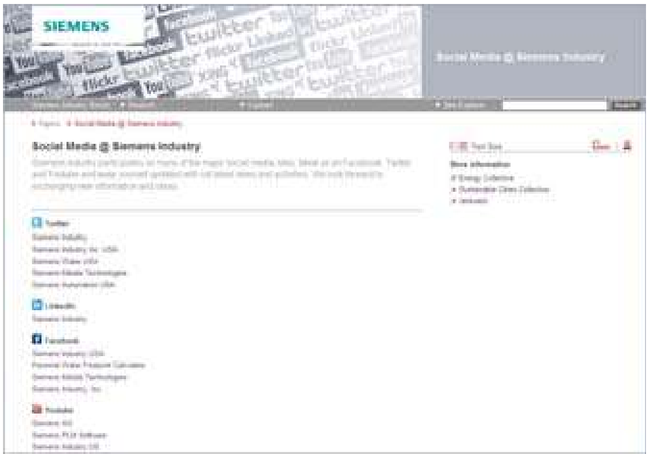

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Subject index

Notes

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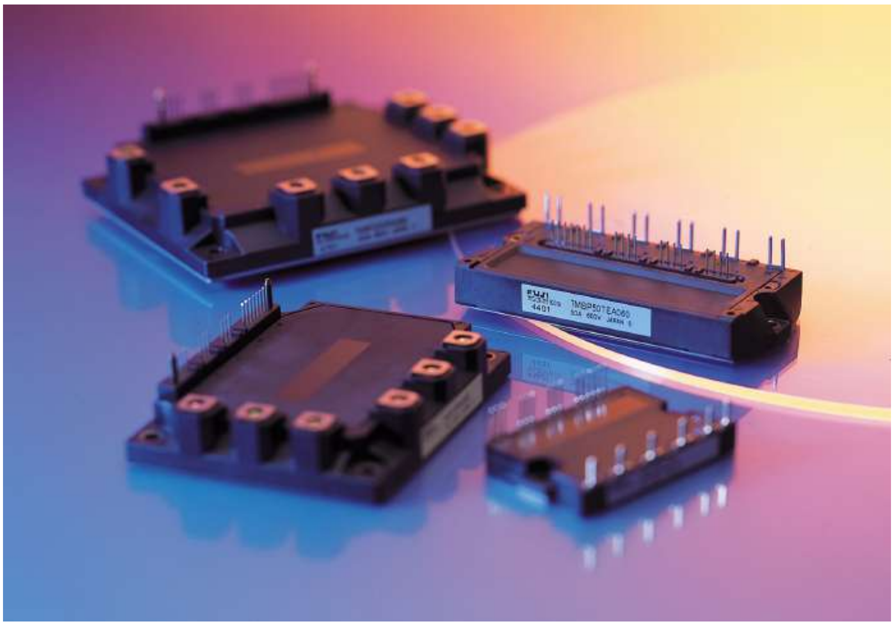

Fuji Electric Device Technology Co., Ltd.

Sep. 2004
REH983a

CONTENTS

Chapter 1

Features

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1 GBT-IPMs Characteristics

An intelligent power module (IPM) has the following characteristics when compared with a combination of IGBT modules and drive circuits.

1.1 Built-in drive circuit

- IGBT gate drives operate under optimal conditions.
- Since the wiring length between the internal drive circuit and IGBT is short and the impedance of the drive circuit is low, no reverse bias DC source is required.
- The R-series IPM (R-IPM) devices require four control power sources, one source on the lower arm side, and three individual sources on the upper arm side with proper circuit isolation.

1.2 Built-in protection circuits

- The following built-in protection circuits are included in the R-IPM devices:

  (OC): Overcurrent protection
  (SC): Short-circuit protection
  (UV): Undervoltage protection for control power source
  (OH): Overheating protection
  (ALM): External alarm output

- The OC and SC protection circuits provide protection against IGBT damage caused by overcurrent or load short-circuits. These circuits monitor the collector current using detection elements incorporated in each IGBT and thus can minimize the possibility of severe damage to the IGBT. They also protect against arm short-circuits.[*1]

- The UV protection circuit is in all of the IGBT drive circuits. This circuit monitors the Vcc supply voltage level against the IGBT drive Vin.

- The OH protection circuit protects the IGBT and FWD from overheating. It also monitors the insulating substrate's temperature with temperature detection elements installed on the insulating substrates inside the IPM.
  (Case temperature overheating protection: TcOH)[*2]

- Additionally, each IGBT chip contains a temperature detection element on the IGBT die, which allows the OH to act rapidly when abnormally high chip temperatures are detected. (Junction temperature overheating protection: TjOH)
- The ALM circuit outputs an alarm signal to outside of the IPM, making it possible to shutdown the system reliably by outputting the alarm signal to the microcontroller which controls IPM when the circuit detects an abnormal condition (specified above). [*2]

[*1] The N-line shunt resistance method is used for overcurrent detection of small-capacity types.

[*2] Refer to Chapter 3 “Description of Functions” for the protective functions of each IPM.

1.3 Built-in brake circuit (7 in 1 IPM)

- For a motor control inverter application, a brake circuit can be built to protect bus overvoltage by just adding a power dissipating resistor.
- The drive circuits and protection circuits are included in the brake IGBT in the same way as inverter IGBTs.

2 IPM Characteristics by Series

2.1 R-IPM, R-IPM3 series

2.1.1 Small-capacity types

A lineup of small-capacity types with 15 to 30 A for 600 V systems and 15 A for 1200 V systems is available. (P617, P619 package)

- P617 package products are a type without a copper base, while P619 package products are a type with a copper base, which further improves the heat radiation ability.
- The control input terminals have a standard pitch of 2.54 mm.
- The shape of the main terminals is the Faston shape, and as the height is the same as that of the control input terminals, connection by the same printed boards is possible with the soldering method as well as with the connector method.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection.

2.1.2 Medium-capacity types (alarm output only for the lower arm)

A lineup of medium-capacity types with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems is available. (P610, P611 package)

- The control input terminals have a standard pitch of 2.54 mm, they are arranged in one line, and connection is possible with one connector for general use. A guide pin makes insertion of the connector for the printed board easy.
- The main power source inputs (P, N), the brake output (B), and the output terminals (U, V, W) are arranged close to each other, and the main wiring is a simple package construction.
- As the main terminals are M5 screws, large currents can be connected securely.
- The screw diameter for connection to the heat sink is M5, the same as for the main terminals.
- As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection.[*3]

  [*3] There is no alarm output from the upper arm side.

2.1.3 Medium-capacity types (with upper arm alarm output function)

A lineup of medium-capacity types with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems is available. (P621 package)

- OC, SC, UV, and TjOH alarm signals can be output from the upper arm. This allows secure protection against trouble from ground faults, etc.[*4]
- As the main terminals are M5 screws, large currents can be connected securely.
- The screw diameter for connection to the heat sink is M5, the same as for the main terminals.

- As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection.

  *4 The TcOH alarm is output only from the lower arm.

2.1.4 Large-capacity types (alarm output only for the lower arm)

A lineup of large-capacity types with 200 to 300 A for 600 V systems and 100 to 150 A for 1200 V systems is available. (P612 package)

- The layout of the control input terminals is the same as for the medium-capacity standard package, and correspondence is possible with one connector type.
- The main power source inputs (P, N), the brake output (B), and the output terminals (U, V, W) are arranged close to each other, and the main wiring is a simple package construction.
- As the main terminals are M5 screws, large currents can be connected securely.
- The screw diameter for connection to the heat sink is M5, the same as for the main terminals.
- As all electrical connections are made by screws or connectors, soldering is not required and removal is easy.
- By improvement of the trade-off between Vce(sat) and switching loss, the total loss has been improved.
- The chip is protected from abnormal heating by IGBT chip overheating protection.[*5]

  *5 There is no alarm output from the upper arm side.

2.2 Econo IPM series

The Econo IPM series is a lineup with 50 to 150 A for 600 V systems and 25 to 75 A for 1200 V systems. (P622 package)

- In comparison with the medium-capacity types, the mounting area has been reduced by approximately 30% and the mass has been reduced by approximately 40%, contributing to reduction of the device size.
- As the height is the same as that of Econo DIMs (Econo Diode Modules), connection is possible with the same printed circuit boards.
- OC, SC, UV, and TjOH alarm signals can be output from the upper arm. This makes secure protection against trouble from ground faults etc. possible.
- The chip is protected from abnormal heating by IGBT chip overheating protection.

3 Definition of Type Name and Lot No.

• Type name

7 MBP 50 RT A 060 -01

- -01: Additional model number (if necessary)
- 060: Voltage rating
  - 060: 600 V
  - 120: 1200 V
- A: Additional number of series
- RT: Series name
  - R: R-IPM
  - RT: R-IPM3
  - TE: Econo IPM
- 50: Inverter IGBT current rating
  - 50: 50 A
- MBP: Indicates IGBT-IPM
- 7: Number of main elements
  - 7-chip circuit with built-in brake
  - 6-chip circuit without dynamic brake

• Lot No.

4 1 01

- 01: Additional number (01 to 99)
- 1: Month of production
  - 1: Jan.
  - 9: Sep.
  - 0: Oct.
  - N: Nov.
  - D: Dec.
- 4: Year of production
  - 4: 2004

4 Lineup

600 V system, 15 to 75 A

	15A	20A	30A	50A	75A
R-IPM	6MBP15RH060	6MBP20RH060	6MBP30RH060	6MBP50RA060 7MBP50RA060	6MBP75RA060 7MBP75RA060
R-IPM3	–	6MBP20RTA060	–	6MBP50RTB060 7MBP50RTB060 6MBP50RTJ060 7MBP50RTJ060	6MBP75RTB060 7MBP75RTB060 6MBP75RTJ060 7MBP75RTJ060
Econo IPM	–	–	–	6MBP50TEA060 7MBP50TEA060	6MBP75TEA060 7MBP75TEA060

600 V system, 100 to 300 A

	100A	150A	200A	300A
R-IPM	6MBP100RA060 7MBP100RA060	6MBP150RA060 7MBP150RA060	6MBP200RA060 7MBP200RA060	6MBP300RA060 7MBP300RA060
R-IPM3	6MBP100RTB060 7MBP100RTB060 6MBP100RTJ060 7MBP100RTJ060	6MBP150RTB060 7MBP150RTB060 6MBP150RTJ060 7MBP150RTJ060	–	–
Econo IPM	6MBP100TEA060 7MBP100TEA060	6MBP150TEA060 7MBP150TEA060	–	–

1200 V system

	15A	25A	50A	75A	100A	150A
R-IPM	6MBP15RA120	6MBP25RA120 7MBP25RA120 6MBP25RJ120 7MBP25RJ120	6MBP50RA120 7MBP50RA120 6MBP50RJ120 7MBP50RJ120	6MBP75RA120 7MBP75RA120 6MBP75RJ120 7MBP75RJ120	6MBP100RA120 7MBP100RA120	6MBP150RA120 7MBP150RA120
Econo IPM	–	6MBP25TEA120 7MBP25TEA120	6MBP50TEA120 7 MBP50TEA120	6MBP75TEA120 7MBP75TEA120	–	–

5 Outline Drawings

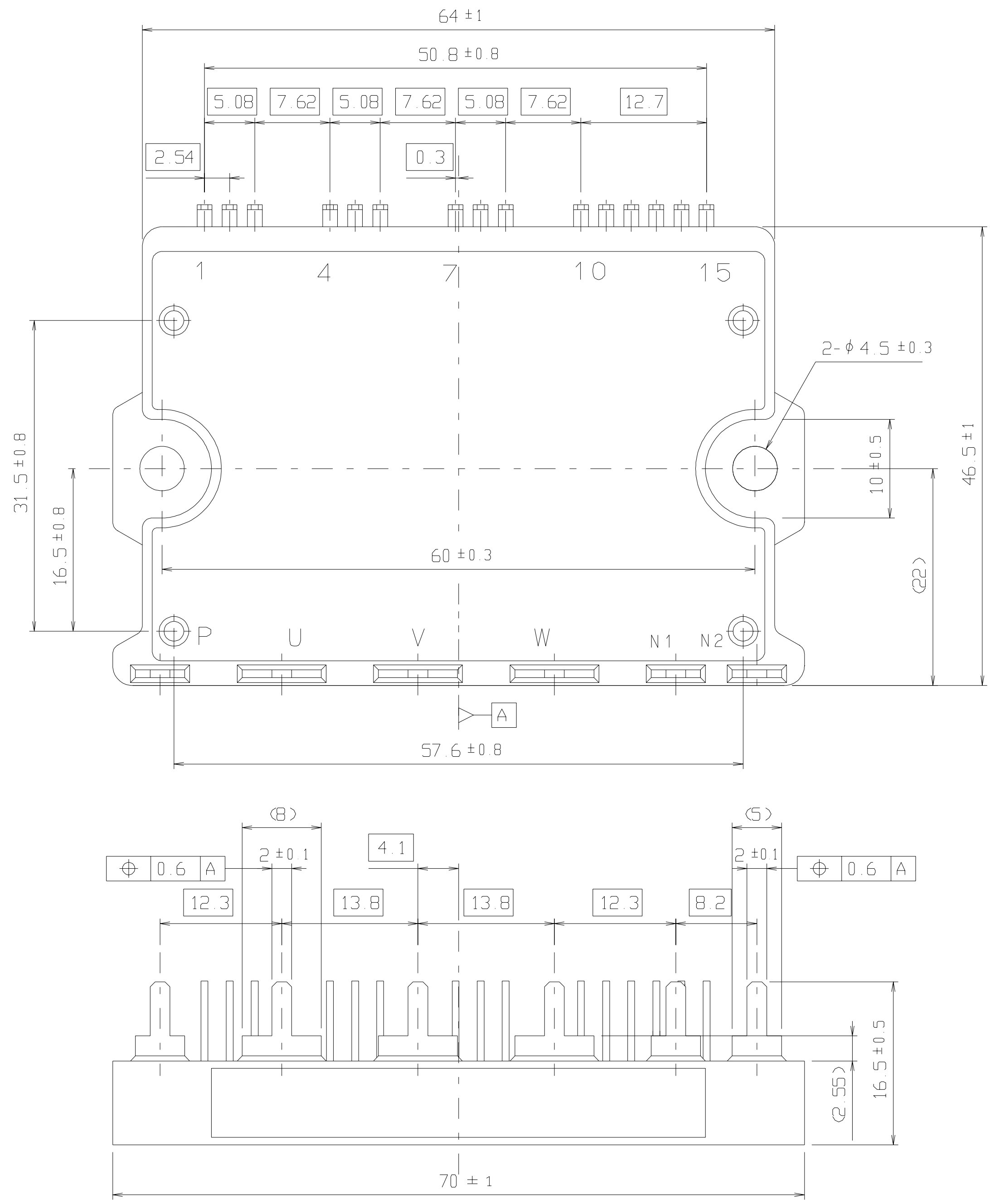

Fig. 1-1 Outline Drawing (P617)

Type name: 6MBP15RH060, 6MBP20RH060, 6MBP30RH060

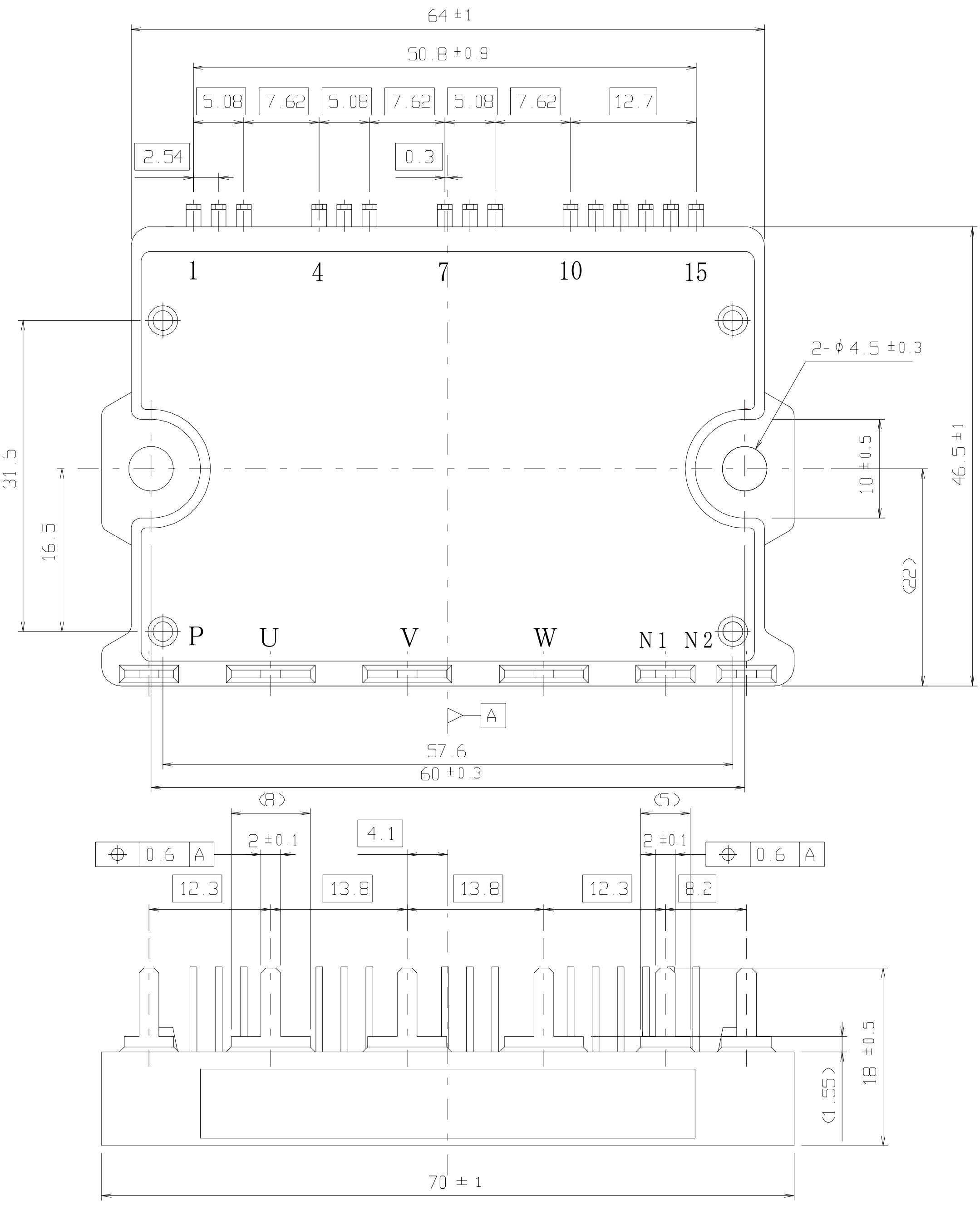

Fig. 1-2 Outline Drawing (P619)

Type name: 6MBP20RTA060, 6MBP15RA120

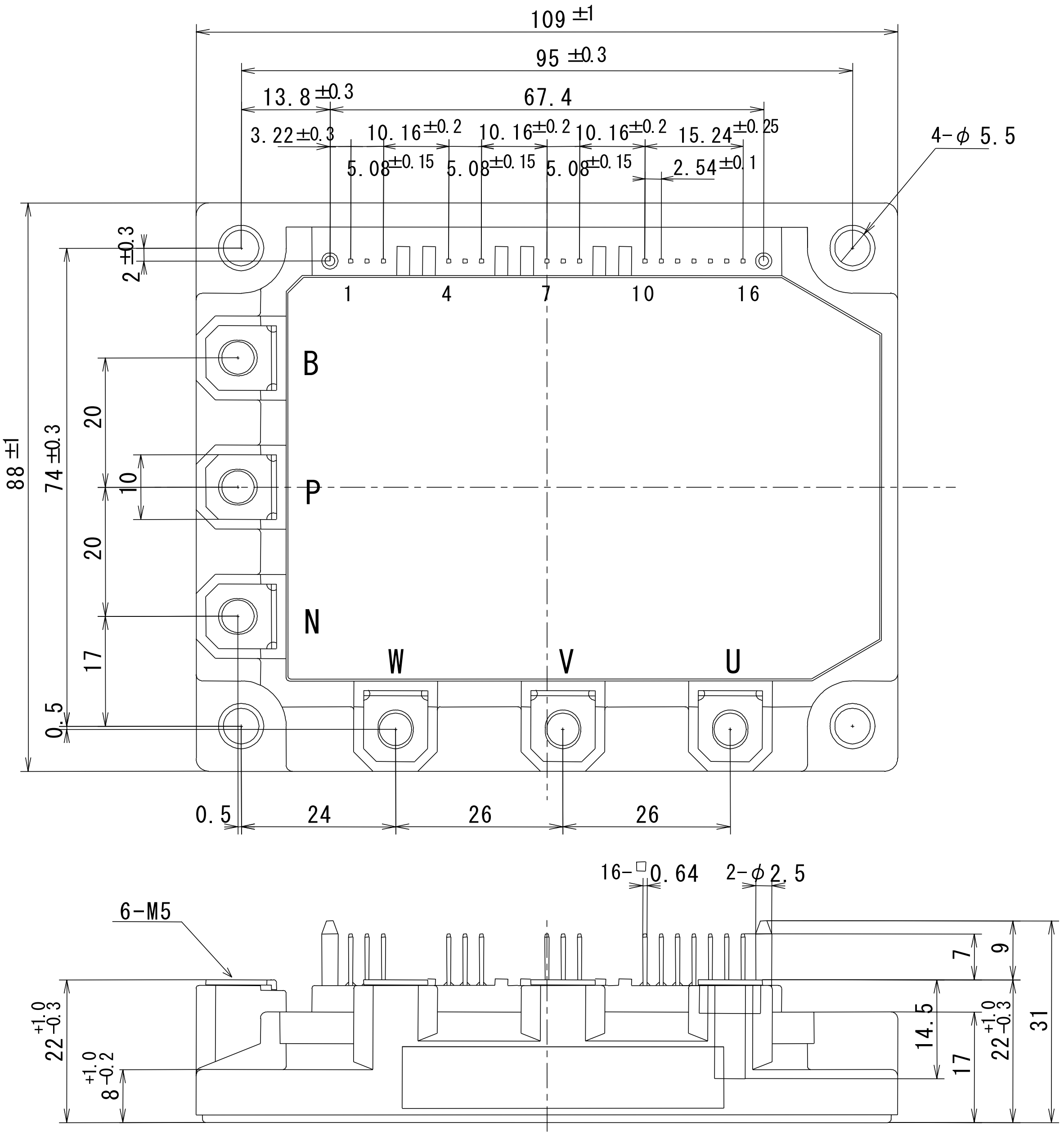

Fig. 1-3 Outline Drawing (P610)

Type name: 6MBP50RA060, 6MBP75RA060, 6MBP50RTB060, 6MBP75RTB060, 6MBP25RA120

7MBP50RA060, 7MBP75RA060, 7MBP50RTB060, 7 MBP75RTB060, 7MBP25RA120

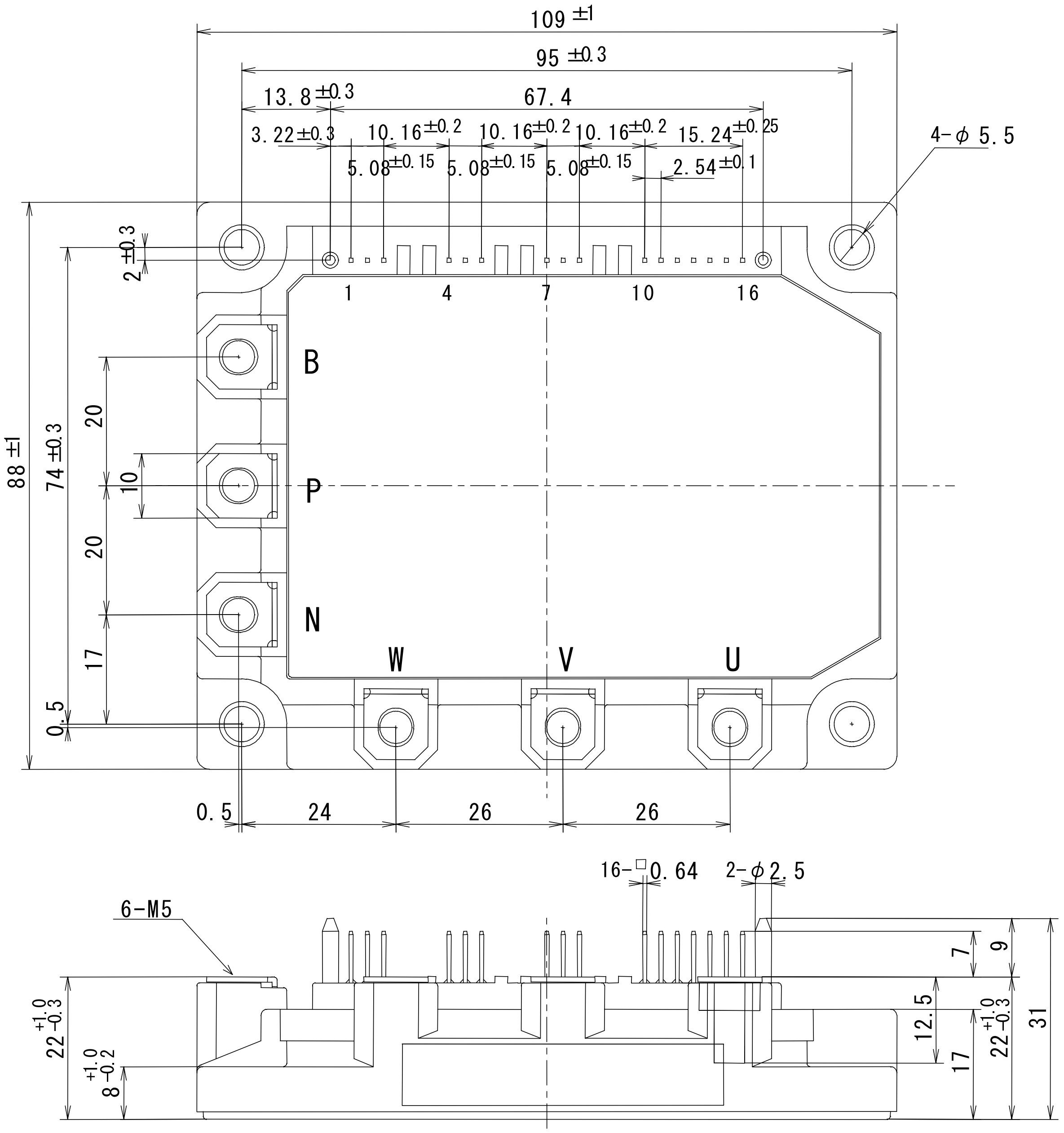

Fig. 1-4 Outline Drawing (P611)

Type name: 6MBP100RA060, 6MBP150RA060, 6MBP100RTB060, 6MBP150RTB060, 6MBP50RA120, 6MBP75RA120
7MBP100RA060, 7MBP150RA060, 7MBP100RTB060, 7MBP150RTB060, 7MBP50RA120, 7MBP75RA120

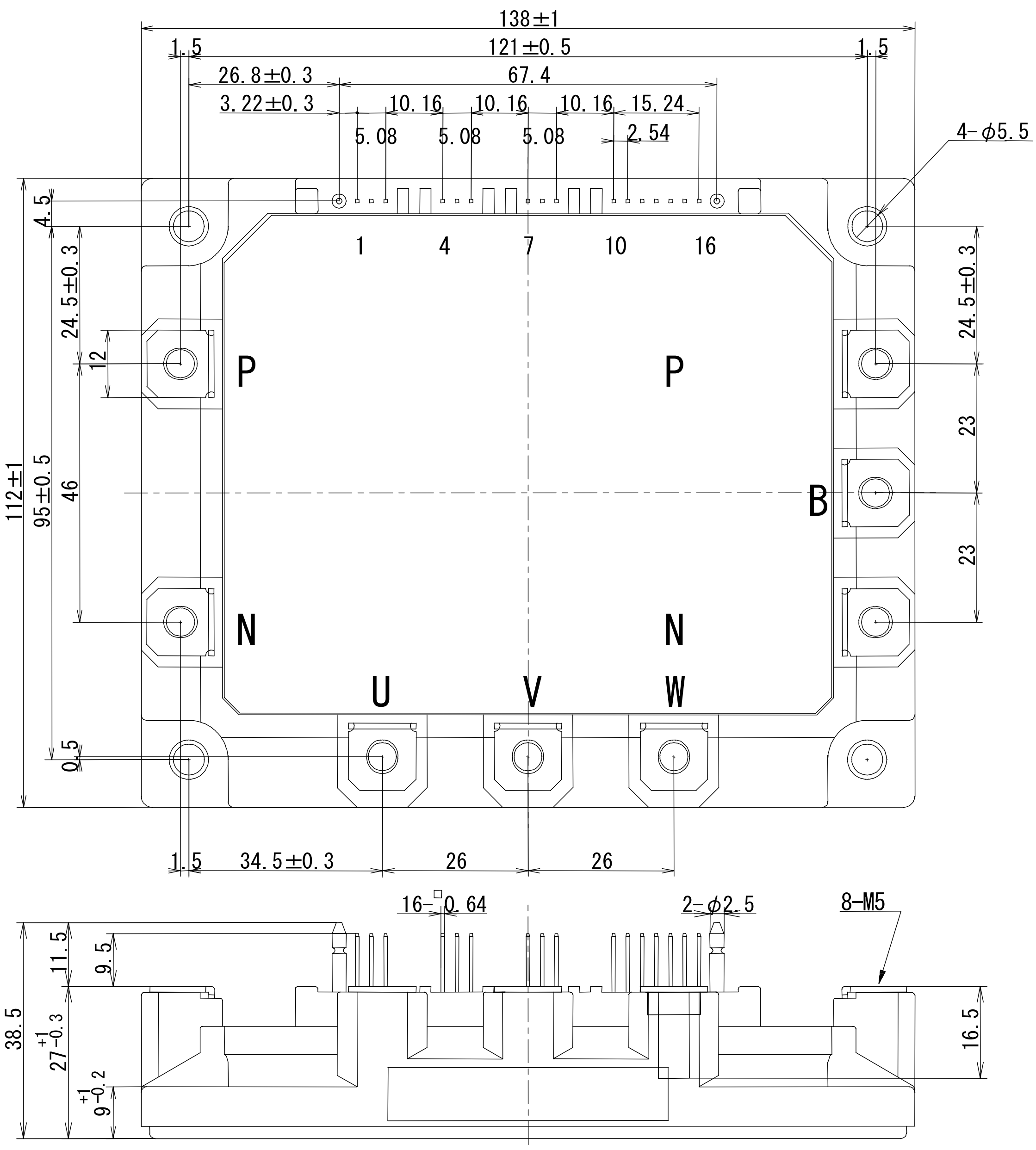

Fig. 1-5 Outline Drawing (P612)

Type name: 6MBP200RA060, 6MBP300RA060, 6MBP100RA120, 6MBP150RA120

7MBP200RA060, 7MBP300RA060, 7MBP100RA120, 7MBP150RA120

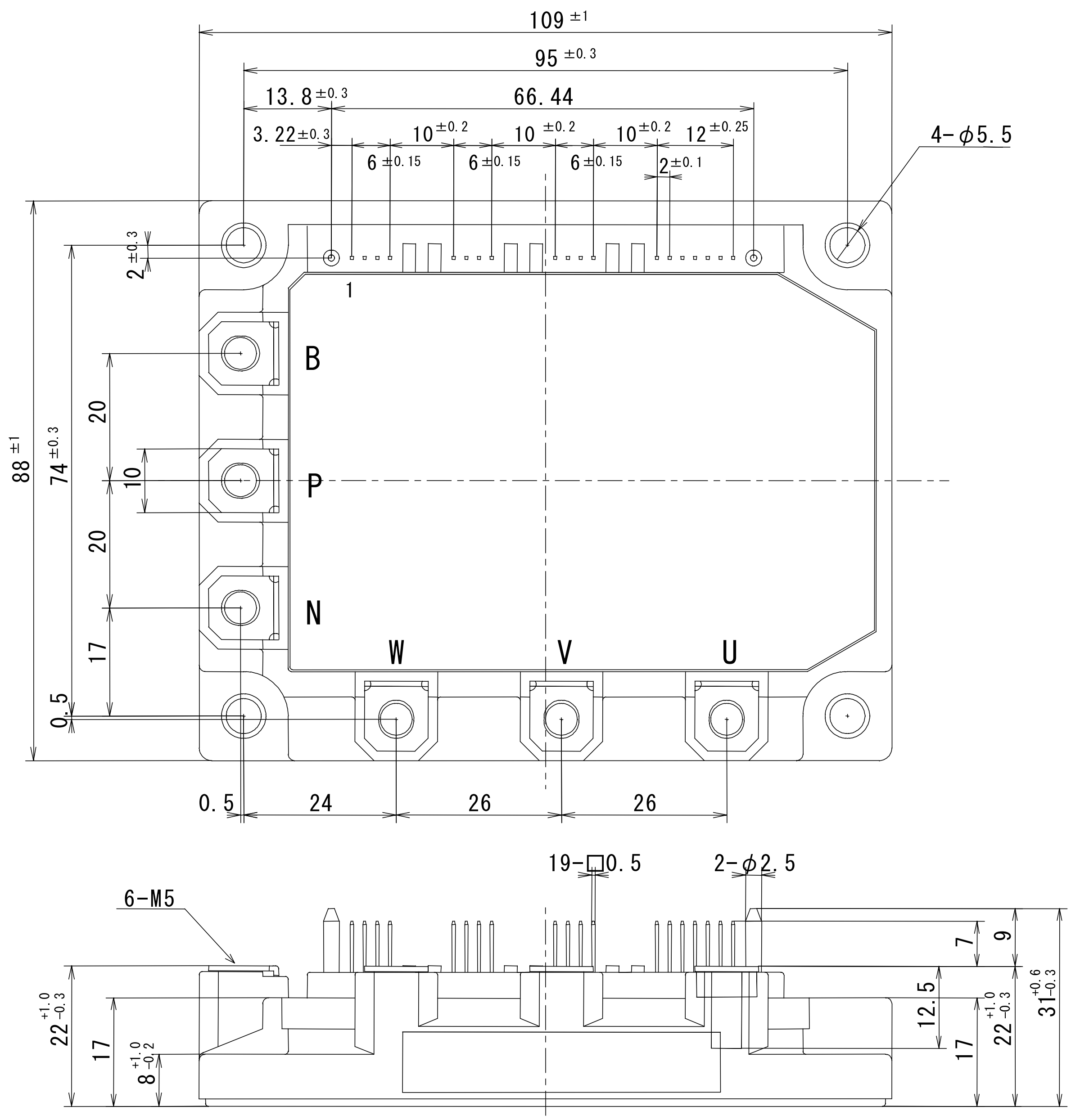

Fig. 1-6 Outline Drawing (P621)

Type name: 6MBP50RTJ060, 6MBP75RTJ060, 6MBP100RTJ060, 6MBP150RTJ060, 6MBP25RJ120, 6MBP50RJ120, 6MBP75RJ120
7MBP50RTJ060, 7MBP75RTJ060, 7MBP100RTJ060, 7MBP150RTJ060, 7MBP25RJ120, 7MBP50RJ120, 7MBP75RJ120

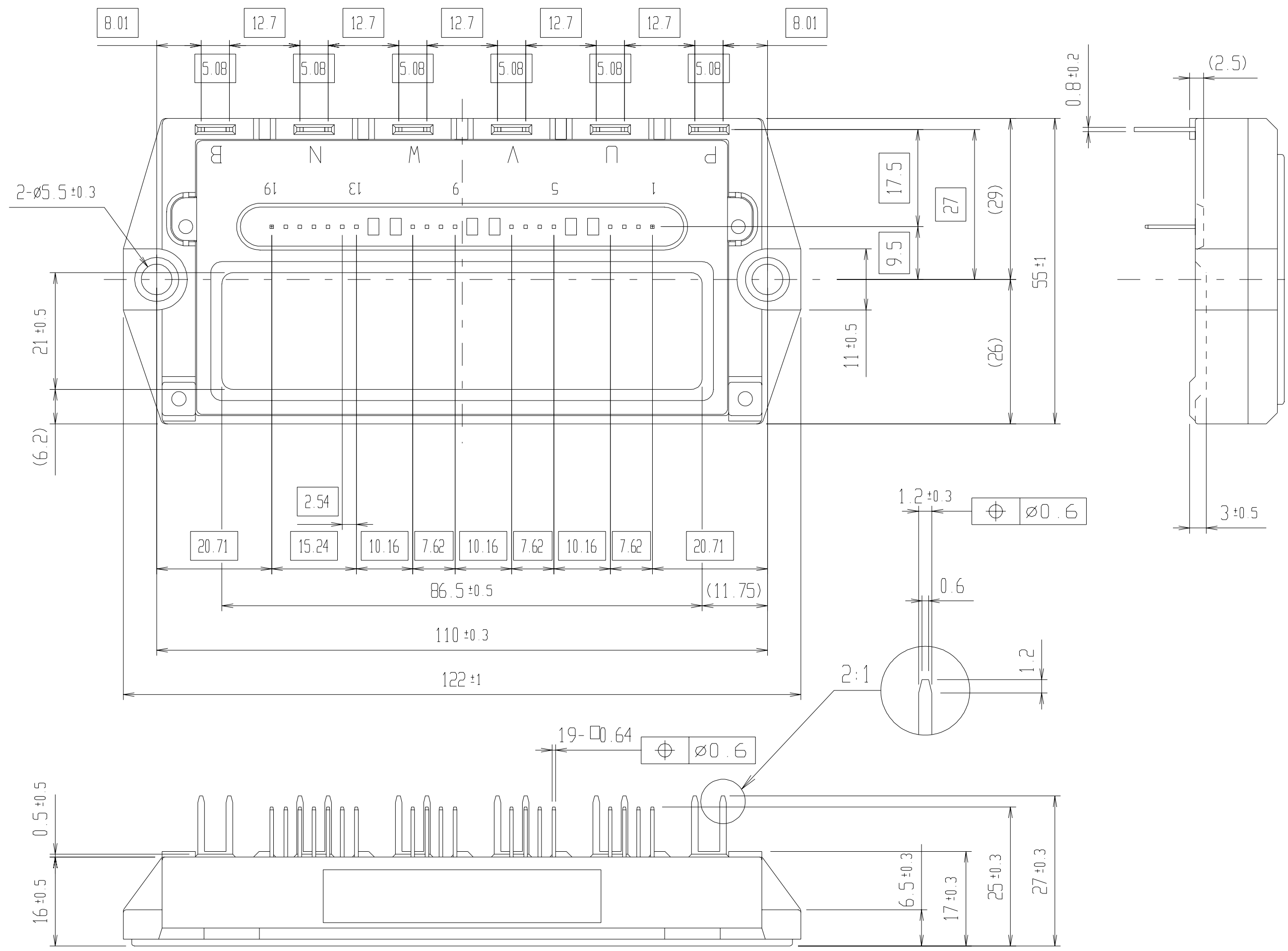

Fig. 1-7 Outline Drawing (P622)

Type name: 6MBP50TEA060, 6MBP75TEA060, 6MBP100TEA060, 6MBP150TEA060
6MBP25TEA120, 6MBP50TEA120, 6MBP75TEA120

7MBP50TEA060, 7MBP75TEA060, 7MBP100TEA060, 7MBP150TEA060
7MBP25TEA120, 7MBP50TEA120, 7MBP75TEA120

Chapter 2

Description of Terminal Symbols and Terminology

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1 Description of Terminal Symbols

Main terminals

Terminal Symbol	Description
P N	Main power source Vd input terminal for the inverter bridge. P: + side, N: – side
B	Brake output terminal: terminal to connect the resistor for regenerative operation declaration
U V W	3-phase inverter output terminal
N2	Main power source Vd "negative(-)" input terminal after rectification converter smoothing of the inverter unit (P617, 619)
N1	Terminal for external connection of resistance when the OC level is to be changed (P617, 619)

Control terminals

Terminal Symbol	P610, P611 P612	P617 P619	P621 P622	Description
GND U Vcc U	<1> <3>	<1> <3>	<1> <4>	Control power source Vcc input in the upper arm U phase Vcc U: + side, GND U: – side
Vin U	<2>	<2>	<3>	Control signal input in the upper arm U phase
ALM U	–	–	<2>	Upper arm U-phase alarm output when the protection circuits are operating
GND V Vcc V	<4> <6>	<4> <6>	<5> <8>	Control power source Vcc input in the upper arm V phase Vcc V: + side, GND V: – side
Vin V	<5>	<5>	<7>	Control signal input in the upper arm V phase
ALM V	–	–	<6>	Upper arm V-phase alarm output when the protection circuits are operating
GND W Vcc W	<7> <9>	<7> <9>	<9> <12>	Control power source Vcc input in the upper arm W phase Vcc W : + side, GND W: – side
Vin W	<8>	<8>	<11>	Control signal input in the upper arm W phase
ALM W	–	–	<10>	Upper arm W-phase alarm output when the protection circuits are operating
GND Vcc	<10> <11>	<10> <11>	<13> <14>	Control power source Vcc input in the lower arm common Vcc: + side, GND: – side
Vin X	<13>	<12>	<16>	Control signal input in the lower arm X phase
Vin Y	<14>	<13>	<17>	Control signal input in the lower arm Y phase
Vin Z	<15>	<14>	<18>	Control signal input in the lower arm Z phase
Vin DB	<12>	–	<15>	Control signal input in the lower arm brake phase
ALM	<16>	<15>	<19>	Lower arm alarm output when the protection circuits are operating

2 Description of Terminology

1. Absolute Maximum Ratings

Term	Symbol	Description
Bus voltage	V_{DC}	DC voltage that can be applied between PN terminals
DC Bus voltage (surge)	V_{DC} (surge)	Peak value of the surge voltage that can be applied between PN terminals in switching
DC Bus voltage (short circuit)	V_{SC}	DC source voltage between PN terminals that can be protected from short circuits/overcurrent
Collector-emitter Voltage	V_{CES}	Maximum collector-emitter voltage of the built-in IGBT chip and repeated peak reverse voltage of the FWD chip (only the IGBT for the brake)
Reverse voltage	V_R	Repeated peak reverse voltage of the FWD chip in the brake section
Collector current	I_C	Maximum DC collector current for the IGBT chip
	I_{CP}	Maximum DC pulse collector current for the IGBT chip
	$-I_C$	Maximum DC forward current for the FWD chip
FRD forward Current	I_F	Maximum DC forward current for the FWD chip in the brake section
Collector power Dissipation	P_C	Maximum power dissipation for one IGBT element Power dissipation for Tj to become 150°C at Tc = 25°C or power dissipated in collector so that Tj becomes 150°C at Tc = 25°C
Control power source voltage	V_{CC}	Voltage that can be applied between GND and each Vcc terminal
Input voltage	Vin	Voltage that can be applied between GND and each Vin terminal
Input current	Iin	Current that flows between GND and each Vin terminal
Alarm signal voltage	V_{ALM}	Voltage that can be applied between GND and ALM terminal
Alarm signal current	I_{ALM}	Current that flows between GND and ALM terminal
Chip junction Temperature	Tj	Maximum junction temperature of the IGBT and FWD chips during continuous operation
Operating case temperature	Topr	Range of case temperature for electrical operation (Fig. 1 shows the measuring point of the case temperature Tc)
Storage temperature	T_{stg}	Range of ambient temperature for storage or transportation, when there is no electrical load
Isolating voltage	Viso	Maximum effective value of the sine-wave voltage between the terminals and the heat sink, when all terminals are shorted simultaneously
Screw torque — Terminal	–	Max. torque for connection of terminal and external wire with the specified screw
Screw torque — Mounting	–	Max. torque when mounting the element to the heat sink with the specified screw

2. Electrical Characteristics

2.1 Main Circuit

Term	Symbol	Description
Collector-emitter cutoff current	I_{CES}	Collector current when a specified voltage is applied between the collector and emitter of an IGBT with all input signals H (= Vz)
Collector-emitter saturation voltage	V_{CE} (sat)	Collector-emitter voltage at a specified collector current when the input signal of only the elements to be measured is L (= 0V) and the inputs of all other elements are H (= Vz)
Diode forward voltage	V_F	Forward voltage at a specified forward current with all input signals H (= Vz)
Turn-on time	ton	The time from the input signal dropping below the threshold value until the collector current becomes 90% of the rating. See Fig. 2-3.
Turn-off time	toff	The time from the input signal rising above the threshold value until the collector current becomes 10% of the rating. See Fig. 2-3.
Fall time	tf	The time from the collector current becoming 90% at the time of IGBT turn-off until the tangent to the decreasing current becomes 10%. See Fig. 2-3.
Reverse recovery time	trr	The time required for the reverse recovery current of the built-in diode to disappear. See Fig. 2-3.

2.2 Control Circuits

Term	Symbol	Description
Control power source consumption current	Iccp	Current flowing between control power source Vcc and GND on the P-side (upper arm side)
	Iccn	Current flowing between control power source Vcc and GND on the N-side (lower arm side)
Input signal threshold voltage	Vinth (on)	Control signal voltage when IGBT changes from OFF to ON
	Vinth (off)	Control signal voltage when IGBT changes from ON to OFF
Input zenor voltage	Vz	Voltage clamped by zener diode connected between GND and each Vin when the control signal is OFF
Signal hold time	t_{ALM}	Period in which an alarm continues to be output (ALM) from the ALM terminal after the N-side protection function is actuated
Limiting resistor for alarm	R_{ALM}	Built-in resistance limiting the primary current of the photocoupler for ALM output
Current detection shunt resistance	R1	Resistance value of the IPM built-in shunt resistor (P617, P619)

2.3 Protection Circuits

Term	Symbol	Description
Overcurrent protective operation current	I_{OC}	IGBT collector current at which the overcurrent protection (OC) works
Overcurrent cut off time	t_{DOC}	Shown in Fig. 2-1
Short-circuit protection delay time	tsc	Shown in Fig. 2-2
Chip overheating protection temperature	TjoH	Tripping temperature at which the IGBT chip junction temperature Tj overheats and IGBT soft shutdown is performed
Chip overheating protection hysteresis	TjH	Drop temperature required for output stop resetting after protection operation
Case overheating protection temperature	TcOH	Tripping temperature at which the IGBT performs soft shutdown when the case temperature Tc shows overheating
Case overheating protection hysteresis	TcH	Drop temperature required for output stop resetting after protection operation
Under voltage protection level	V_{UV}	Tripping voltage at which the IGBT performs soft shutdown when the control power source voltage Vcc drops
Control power source undervoltage protection hysteresis	V_H	Recovery voltage required for output stop resetting after protection operation

3. Thermal Characteristics

Term	Symbol	Description
Chip-case thermal resistance	Rth (j-c)	Chip-case thermal resistance of IGBT or diode
Chip-fin thermal resistance	Rth (c-f)	Thermal resistance between the case and heat sink, when mounted on a heat sink at the recommended torque using the thermal compound
Case temperature	Tc	IPM case temperature (temperature of the copper plate directly under the IGBT or the diode)

4. Noise Tolerance

Term	Symbol	Description
Common mode noise	–	Common mode noise tolerance in our test circuit
Electric surge	–	Electric surge tolerance in our test circuit

5. Other

Term	Symbol	Description
Weight	Wt	Weight of IPM
Switching frequency	fsw	Range of control signal frequencies for input to the control signal input terminal
Reverse recovery current	Irr	Shown in Fig. 2-3
Reverse bias safe operation area	RBSOA	Area of the current and voltage in which IGBT can be cut off under specified conditions during turn-off
Switching loss	Eon	IGBT switching loss during turn-on
	Eoff	IGBT switching loss during turn-off
	Err	FWD switching loss during reverse recovery

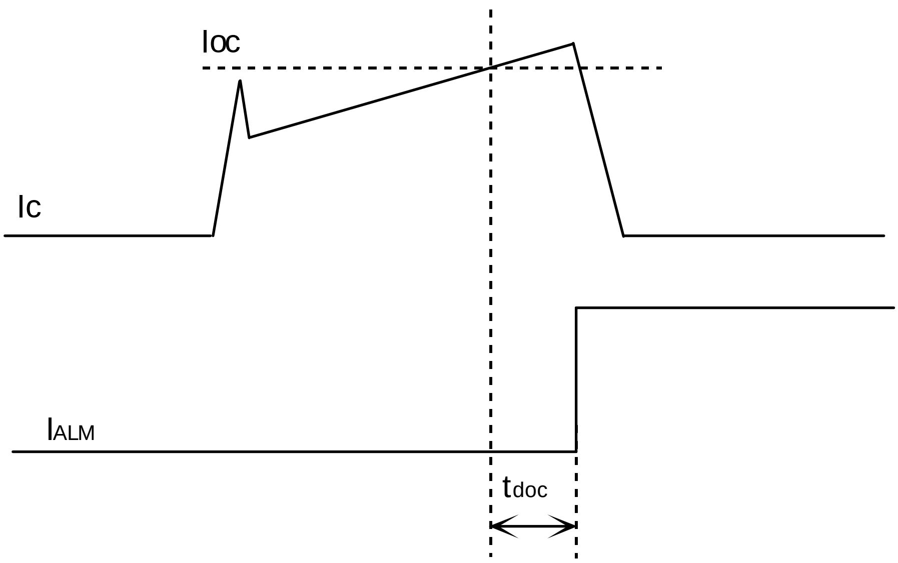

Fig. 2-1 Overcurrent Protection Delay Time (tdoc)

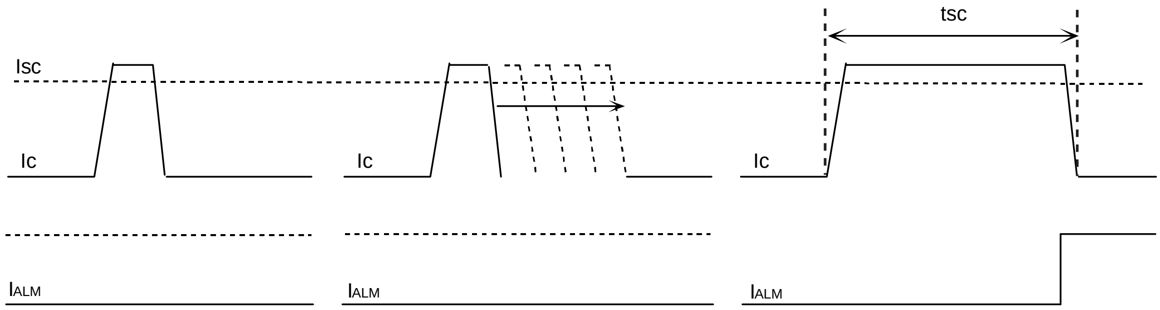

Fig. 2-2　Short-circuit Protection Delay Time (tsc)

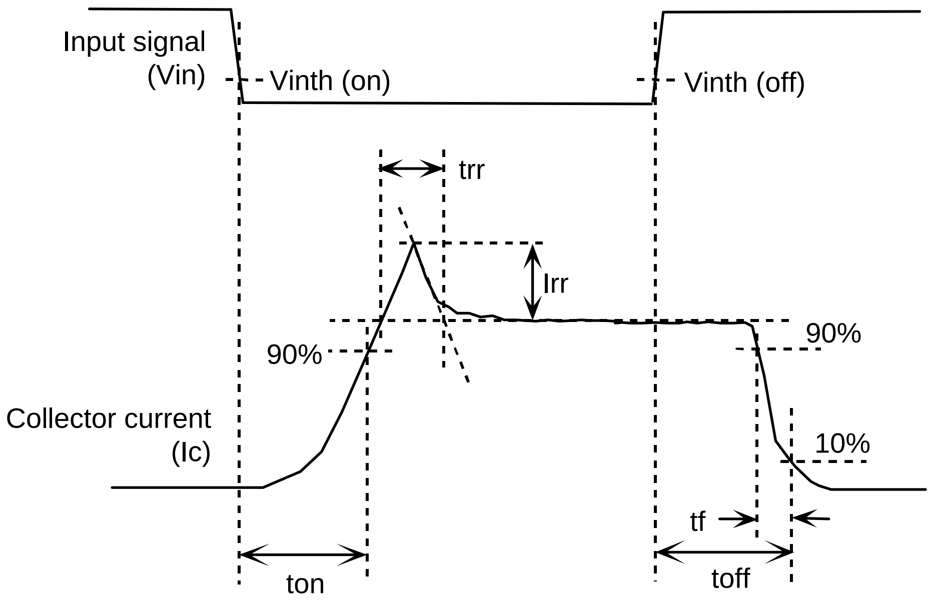

Fig. 2-3　Switching Time

Chapter 3

Description of Functions

Contents Page

1 Function Tables

The functions built into the IPM are shown in Tables 3-1 to 3-3.

Table 3-1 IPM Built-in Functions (R-IPM)

600 V system

Element Number	Model	Built-in Functions								Package
		Common for Upper and Lower Arm			Upper Arm		Lower Arm			
		Dr	UV	TjOH	OC	ALM	OC	ALM	TcOH	
6 in 1	6MBP15RH060	√	√	√	–	–	√	√	–	P617
	6MBP20RH060	√	√	√	–	–	√	√	–	P617
	6MBP30RH060	√	√	√	–	–	√	√	–	P617
	6MBP50RA060	√	√	√	√	–	√	√	√	P610
	6MBP75RA060	√	√	√	√	–	√	√	√	P610
	6MBP100RA060	√	√	√	√	–	√	√	√	P611
	6MBP150RA060	√	√	√	√	–	√	√	√	P611
	6MBP200RA060	√	√	√	√	–	√	√	√	P612
	6MBP300RA060	√	√	√	√	–	√	√	√	P612
7 in 1	7MBP50RA060	√	√	√	√	–	√	√	√	P610
	7MBP75RA060	√	√	√	√	–	√	√	√	P610
	7MBP100RA060	√	√	√	√	–	√	√	√	P611
	7MBP150RA060	√	√	√	√	–	√	√	√	P611
	7MBP200RA060	√	√	√	√	–	√	√	√	P612
	7MBP300RA060	√	√	√	√	–	√	√	√	P612

1200 V system

Element Number	Model	Built-in Functions								Package
		Common for Upper and Lower Arm			Upper Arm		Lower Arm			
		Dr	UV	TjOH	OC	ALM	OC	ALM	TcOH	
6 in 1	6MBP15RA120	√	√	√	–	–	√	√	–	P619
	6MBP25RA120	√	√	√	√	–	√	√	√	P610
	6MBP50RA120	√	√	√	√	–	√	√	√	P611
	6MBP75RA120	√	√	√	√	–	√	√	√	P611
	6MBP100RA120	√	√	√	√	–	√	√	√	P612
	6MBP150RA120	√	√	√	√	–	√	√	√	P612
7 in 1	7MBP25RA120	√	√	√	√	–	√	√	√	P610
	7MBP50RA120	√	√	√	√	–	√	√	√	P611
	7MBP75RA120	√	√	√	√	–	√	√	√	P611
	7MBP100RA120	√	√	√	√	–	√	√	√	P612
	7MBP150RA120	√	√	√	√	–	√	√	√	P612
6 in 1	6MBP25RJ120	√	√	√	√	√	√	√	√	P621
	6MBP50RJ120	√	√	√	√	√	√	√	√	P621
	6MBP75RJ120	√	√	√	√	√	√	√	√	P621
7 in 1	7MBP25RJ120	√	√	√	√	√	√	√	√	P621
	7MBP50RJ120	√	√	√	√	√	√	√	√	P621
	7MBP75RJ120	√	√	√	√	√	√	√	√	P621

Dr: IGBT drive circuit, UV: Control power source undervoltage protection, TjOH: Element overheating protection, OC: Overcurrent protection, ALM: Alarm output, TcOH: Case overheating protection

Table 3-2 IPM Built-in Functions (R-IPM3)

600 V system

Element Number	Model	Built-in Functions								Package
		Common for Upper and Lower Arm			Upper Arm		Lower Arm			
		Dr	UV	TjOH	OC	ALM	OC	ALM	TcOH	
6 in 1	6MBP20RTA060	√	√	√	–	–	√	√	–	P619
	6MBP50RTB060	√	√	√	√	–	√	√	√	P610
	6MBP75RTB060	√	√	√	√	–	√	√	√	P610
	6MBP100RTB060	√	√	√	√	–	√	√	√	P611
	6MBP150RTB060	√	√	√	√	–	√	√	√	P611
7 in 1	7MBP50RTB060	√	√	√	√	–	√	√	√	P610
	7MBP75RTB060	√	√	√	√	–	√	√	√	P610
	7MBP100RTB060	√	√	√	√	–	√	√	√	P611
	7MBP150RTB060	√	√	√	√	–	√	√	√	P611
6 in 1	6MBP50RTJ060	√	√	√	√	√	√	√	√	P621
	6MBP75RTJ060	√	√	√	√	√	√	√	√	P621
	6MBP100RTJ060	√	√	√	√	√	√	√	√	P621
	6MBP150RTJ060	√	√	√	√	√	√	√	√	P621
7 in 1	7MBP50RTJ060	√	√	√	√	√	√	√	√	P621
	7MBP75RTJ060	√	√	√	√	√	√	√	√	P621
	7MBP100RTJ060	√	√	√	√	√	√	√	√	P621
	7MBP150RTJ060	√	√	√	√	√	√	√	√	P621

Dr: IGBT drive circuit, UV: Control power source undervoltage protection, TjOH: Element overheating protection, OC: Overcurrent protection, LM: Alarm output, TcOH: Case overheating protection

Table 3-3 IPM Built-in Functions (Econo IPM)

600 V system

Element Number	Model	Built-in Functions: Common for Upper and Lower Arm: Dr	UV	TjOH	Upper Arm: OC	ALM	Lower Arm: OC	ALM	TcOH	Package
6 in 1	6MBP50TEA060	√	√	√	√	√	√	√	–	P622
	6MBP75TEA060	√	√	√	√	√	√	√	–	P622
	6MBP100TEA060	√	√	√	√	√	√	√	–	P622
	6MBP150TEA060	√	√	√	√	√	√	√	–	P622
7 in 1	7MBP50TEA060	√	√	√	√	√	√	√	–	P622
	7MBP75TEA060	√	√	√	√	√	√	√	–	P622
	7MBP100TEA060	√	√	√	√	√	√	√	–	P622
	7MBP150TEA060	√	√	√	√	√	√	√	–	P622

1200 V system

Element Number	Model	Built-in Functions: Common for Upper and Lower Arm: Dr	UV	TjOH	Upper Arm: OC	ALM	Lower Arm: OC	ALM	TcOH	Package
6 in 1	6MBP25TEA120	√	√	√	√	√	√	√	–	P622
	6MBP50TEA120	√	√	√	√	√	√	√	–	P622
	6MBP75TEA120	√	√	√	√	√	√	√	–	P622
7 in 1	7MBP25TEA120	√	√	√	√	√	√	√	–	P622
	7MBP50TEA120	√	√	√	√	√	√	√	–	P622
	7MBP75TEA120	√	√	√	√	√	√	√	–	P622

Dr: IGBT drive circuit, UV: Control power source undervoltage protection, TjOH: Element overheating protection, OC: Overcurrent protection, ALM: Alarm output, TcOH: Case overheating protection

2 Function Descriptions

2.1 IGBT, FWD for 3-phase inverters

As shown in Fig. 3-1, IGBT and FWD for 3-phase inverters are built in, and a 3-phase bridge circuit is formed inside the IPM. The main circuit is completed by connecting the main power source to the P and N terminals and the 3-phase output lines to the U, V, and W terminals. Connect a snubber circuit to suppress the surge voltages.

2.2 IGBT, FWD for brake

As shown in Fig. 3-1, IGBT and FWD for brake are built in, and an IGBT collector is connected internally to the B terminal. By controlling the brake IGBT through connection of brake resistance between the terminals P and B, the regeneration energy can be dissipated while decelerating to suppress the rise of voltage between the P and N terminals.

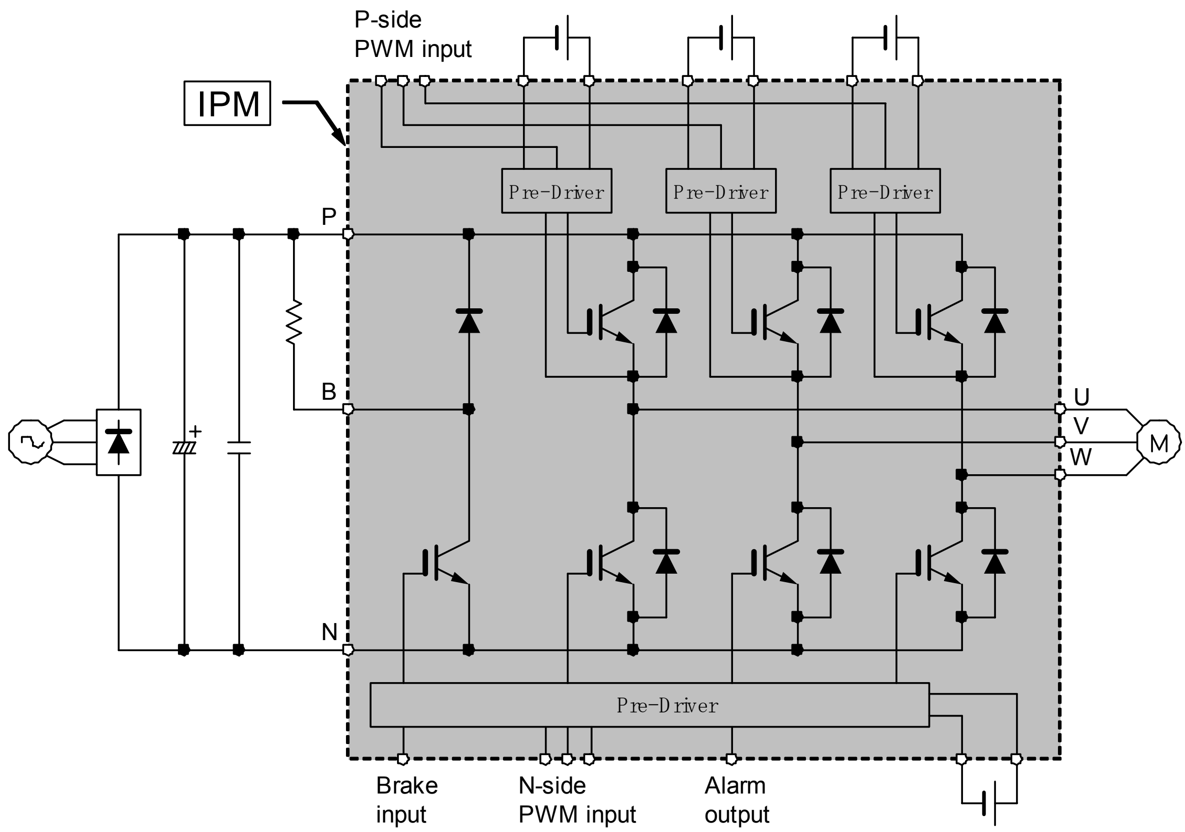

Fig. 3-1 3-Phase Inverter Application Model (in Case of 7MBP150RTB060)

2.3 IGBT drive function

Fig. 3-2 shows the pre-driver block diagram. As the IPM incorporates an IGBT drive function, the IGBT can be driven without designing a gate resistance value by connecting the photocoupler output to the IPM. The features of this drive function are introduced below.

- Independent gate resistance control

  A special turn-on/turn-off Rg not using any exclusive gate resistance Rg is built in. With this, the dv/dt of turn-on and turn-off can be controlled individually, so that the merits of the element are fully demonstrated (Turn on/Normal Shutdown).

- Soft shutdown

  During an overcurrent or other abnormality, the gate voltage is lowered softly and gently to prevent element destruction by surge voltage (Soft Shutdown).

- Errorneous ON prevention

  Since a circuit is set up to ground the gate electrode with low impedance while OFF, erroneous ON caused by the rise of VGE due to noise can be prevented (Off Hold).

- A reverse bias power source is not required.
  As the IPM has a short wiring between the drive circuit and the IGBT, the wiring impedance is small, making driving without reverse bias possible.

- Alarm latch
  Alarms have a latch period of approximately 2 ms, and the IGBT does not operate even when an On-signal enters during the latch period. In addition, as the alarms for each phase, including brake, on the lower arm side are connected mutually, all IGBTs on the lower arm side are stopped for the latch period when a protection operation is performed on the lower arm side.

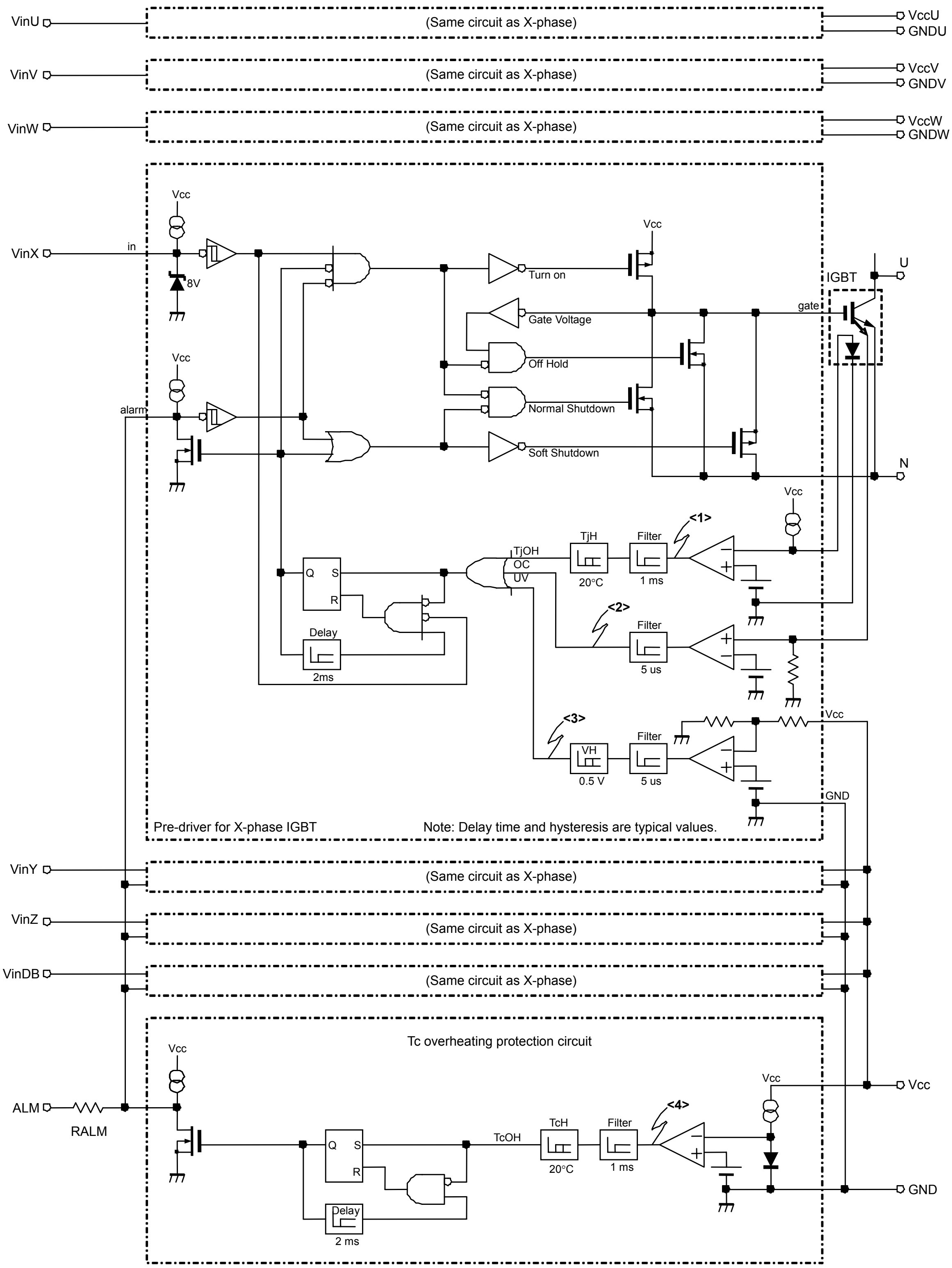

Fig. 3-2 IPM Function Block (Representative Model: 7MBP150RTB060)

2.4 Overcurrent protection function (OC)

Two detection methods are used, the sense IGBT method and the shunt resistance method.

(1) Sense IGBT method

Models: P610/P611/P612/P621/P622

- The main current flowing in the IGBT is detected by taking the sense current flowing in the current sense IGBT inside the IGBT chip into the control circuit. The sense current is extremely small in comparison with the main current, so that the detection loss can be kept minimal in comparison with the shunt resistance method.
- When the overcurrent protection Ioc level is exceeded for a duration of approximately 5 μs (tdoc), the IGBT goes through a soft shutdown. As a detection filter is installed, faulty operations caused by instantaneous overcurrents or noise can be prevented.
- When after approximately 2 ms the level drops below Ioc and the input signal is OFF, the alarm is released.

(2) Shunt resistance method

Models: P617/P619

- Overcurrent protection is performed by detecting the voltage at both ends of the current detection shunt resistance R1, connected to the DC bus bar line N. When the overcurrent detection level Ioc is exceeded for a duration of approximately 5 μs (tdoc), the IGBT goes through a soft shutdown. As a detection filter is installed, faulty operations caused by instantaneous overcurrents or noise can be prevented.
- When after approximately 2 ms the level drops below Ioc and if the input signal is OFF, the alarm is released.

2.5 Short-circuit protection function (SC)

The SC protection function always operates with the OC protection function to suppress the peak current when a load or arm is shorted.

2.6 Undervoltage protection (UV)

- The UV protection function performs soft shutdown of the IGBT when the control source voltage (Vcc) continuously drops below VUV for approximately 5 μs.
- As the hysteresis VH is provided, the alarm is released if Vcc recovers to VUV + VH or more after approximately 2 ms and the input signal is OFF.

2.7 Case temperature overheating protection function (TcOH)

- The TcOH protection function detects the insulating substrate temperature with the temperature detection elements set up on the same ceramic substrate as that on which the power chips (IGBT, FWD) are set up and performs soft shutdown of the IGBT when the detected temperature exceeds the protection level TcOH continuously for approximately 1 ms.
- As the hysteresis TcH is provided, the alarm is released if Tc drops below TcOH-TcH after approximately 2 ms.
- The TcOH detection positions are shown in Fig.3-3 to Fig.3-6.

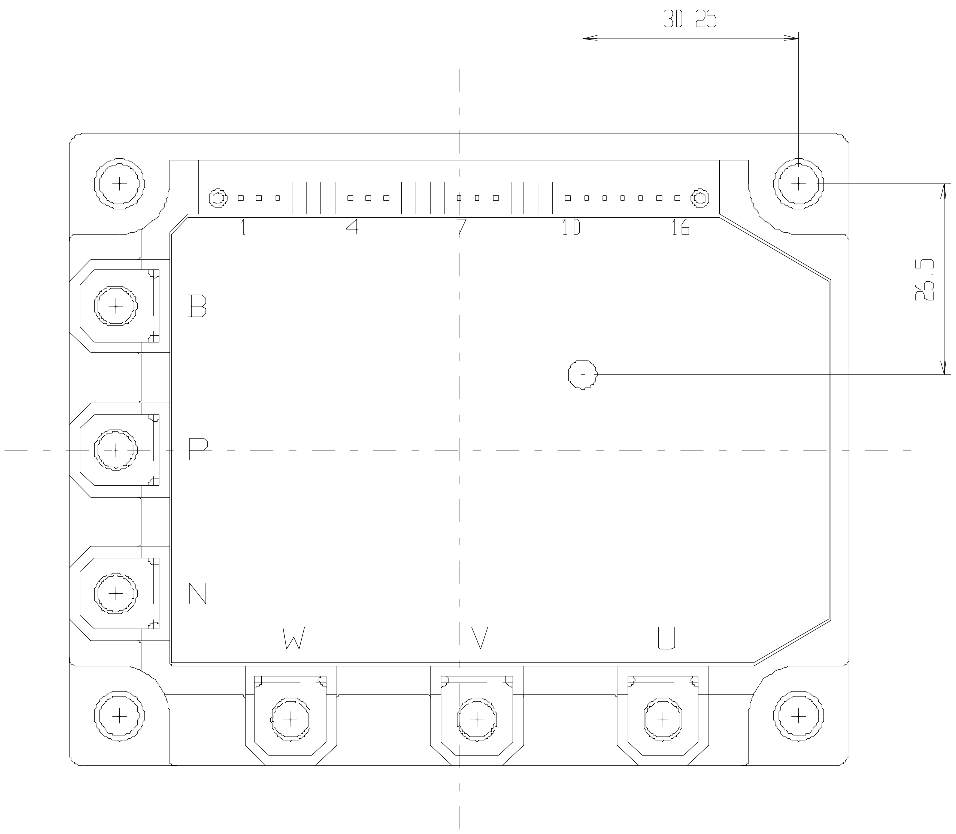

Fig. 3-3 TcOH Detection Position (P610)

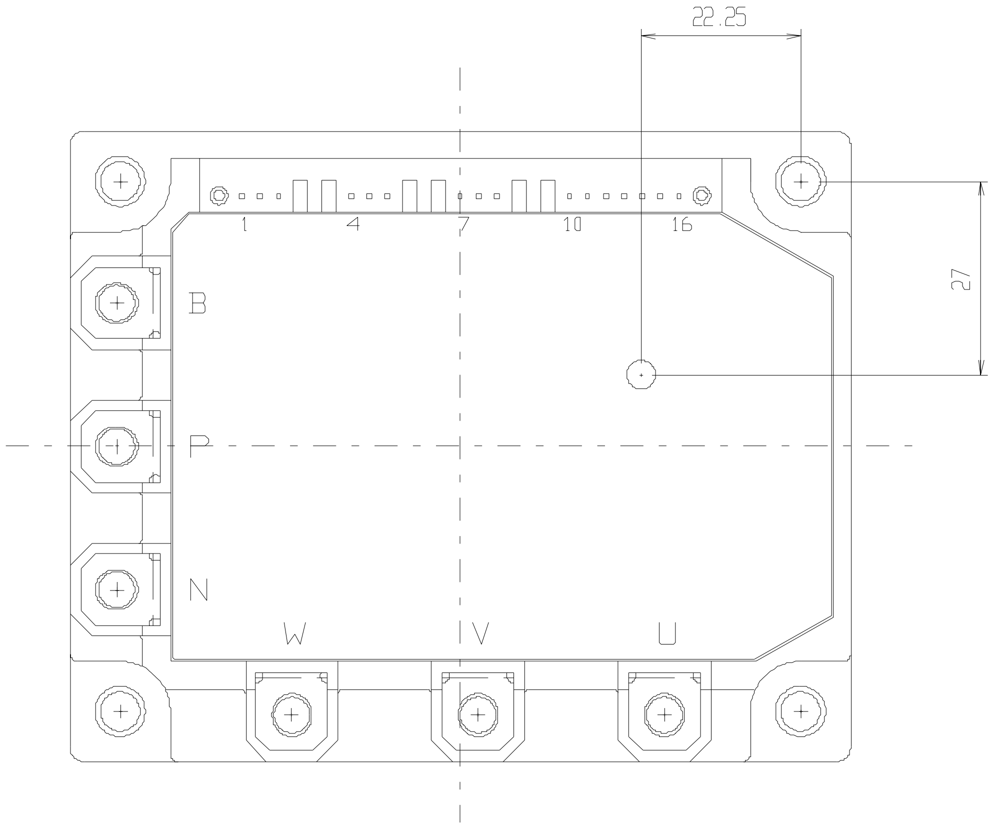

Fig. 3-4 TcOH Detection Position (P611)

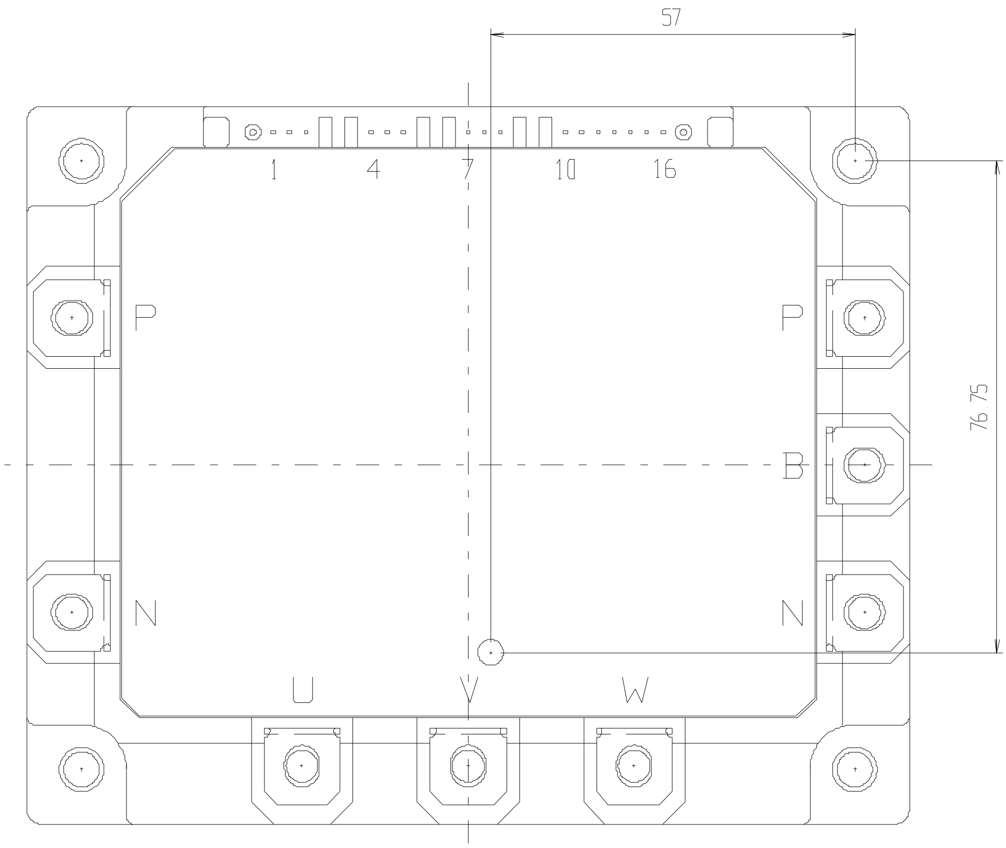

Fig. 3-5 TcOH Detection Position (P612)

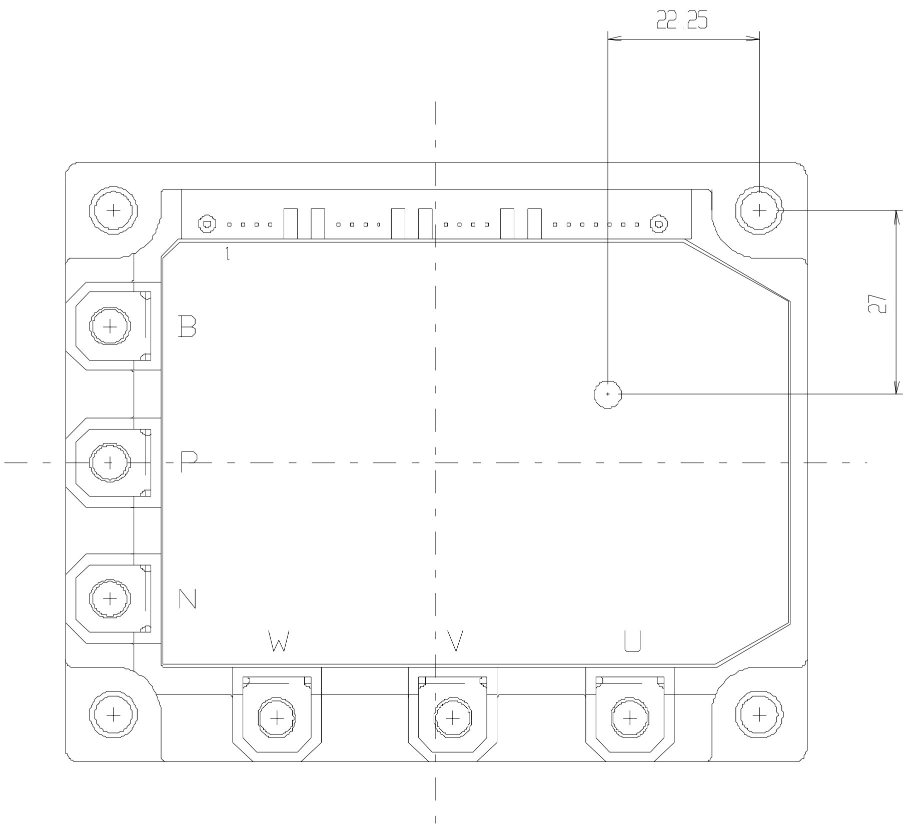

Fig. 3-6 TcOH Detection Position (P621)

2.8 Chip temperature overheating protection function (TjOH)

- The TjOH protection function detects the IGBT chip temperature with the temperature detection elements set up on all IGBT chips and performs soft shutdown of the IGBT when the detected temperature exceeds the protection level (TjOH) continuously for approximately 1 ms or more.
- As the hysteresis TjH is provided, the alarm is released if Tj drops below TjOH-TjH after approximately 2 ms and the input signal is OFF.

2.9 Alarm output function (ALM)

- When a protection function operates, the alarm output terminal becomes conductive against each reference potential GND. With open collector output, a function for direct drive of the photocoupler is provided, and a 1.5 kΩ series resistor is built in.
- When a protection function operates, the alarm signal is output continuously for approximately 2 ms (tALM). The alarm is released when the alarm cause has been removed, tALM has elapsed, and the input signal is OFF. When the cause is TcOH, the alarm is released regardless of the input signal.
- As the alarm terminals of the drive circuit on the lower arm side are connected mutually, all IGBTs on the lower arm side, including the brake, are stopped when any one of the IGBTs outputs an alarm.

3 Truth Tables

The truth tables when a fault occurs are shown in Tables 3-4 to 3-7.

Table 3-4 Truth Table (P617, P619)

	Cause of Fault	IGBT				Alarm Output Low Side
		U-phase	V-phase	W-phase	Low Side	
High side U-phase	UV	OFF	*	*	*	High
	TjOH	OFF	*	*	*	High
High side V-phase	UV	*	OFF	*	*	High
	TjOH	*	OFF	*	*	High
High side W-phase	UV	*	*	OFF	*	High
	TjOH	*	*	OFF	*	High
Low side	OC	*	*	*	OFF	Low
	UV	*	*	*	OFF	Low
	TjOH	*	*	*	OFF	Low

* Depends on input logic

Table 3-5 Truth Table (P610, P611, P612)

	Cause of Fault	IGBT				Alarm Output Low Side
		U-phase	V-phase	W-phase	Low Side	
High side U-phase	OC	OFF	*	*	*	High
	UV	OFF	*	*	*	High
	TjOH	OFF	*	*	*	High
High side V-phase	OC	*	OFF	*	*	High
	UV	*	OFF	*	*	High
	TjOH	*	OFF	*	*	High
High side W-phase	OC	*	*	OFF	*	High
	UV	*	*	OFF	*	High
	TjOH	*	*	OFF	*	High
Low side	OC	*	*	*	OFF	Low
	UV	*	*	*	OFF	Low
	TjOH	*	*	*	OFF	Low
	TcOH	*	*	*	OFF	Low

* Depends on input logic

Table 3-6 Truth Table (P621)

	Cause of Fault	IGBT				Alarm Output			
		U-phase	V-phase	W-phase	Low Side	ALMU	ALMV	ALMW	ALM
High side U-phase	OC	OFF	*	*	*	Low	High	High	High
	UV	OFF	*	*	*	Low	High	High	High
	TjOH	OFF	*	*	*	Low	High	High	High
High side V-phase	OC	*	OFF	*	*	High	Low	High	High
	UV	*	OFF	*	*	High	Low	High	High
	TjOH	*	OFF	*	*	High	Low	High	High
High side W-phase	OC	*	*	OFF	*	High	High	Low	High
	UV	*	*	OFF	*	High	High	Low	High
	TjOH	*	*	OFF	*	High	High	Low	High
Low side	OC	*	*	*	OFF	High	High	High	Low
	UV	*	*	*	OFF	High	High	High	Low
	TjOH	*	*	*	OFF	High	High	High	Low
	TcOH	*	*	*	OFF	High	High	High	Low

* Depends on input logic

Table 3-7 Truth Table (P622)

	Cause of Fault	IGBT				Alarm Output			
		U-phase	V-phase	W-phase	Low Side	ALMU	ALMV	ALMW	ALM
High side U-phase	OC	OFF	*	*	*	Low	High	High	High
	UV	OFF	*	*	*	Low	High	High	High
	TjOH	OFF	*	*	*	Low	High	High	High
High side V-phase	OC	*	OFF	*	*	High	Low	High	High
	UV	*	OFF	*	*	High	Low	High	High
	TjOH	*	OFF	*	*	High	Low	High	High
High side W-phase	OC	*	*	OFF	*	High	High	Low	High
	UV	*	*	OFF	*	High	High	Low	High
	TjOH	*	*	OFF	*	High	High	Low	High
Low side	OC	*	*	*	OFF	High	High	High	Low
	UV	*	*	*	OFF	High	High	High	Low
	TjOH	*	*	*	OFF	High	High	High	Low

* Depends on input logic

4 IPM Block Diagrams

The IPM block diagrams are shown in Fig. 3-7 to Fig. 3-14.

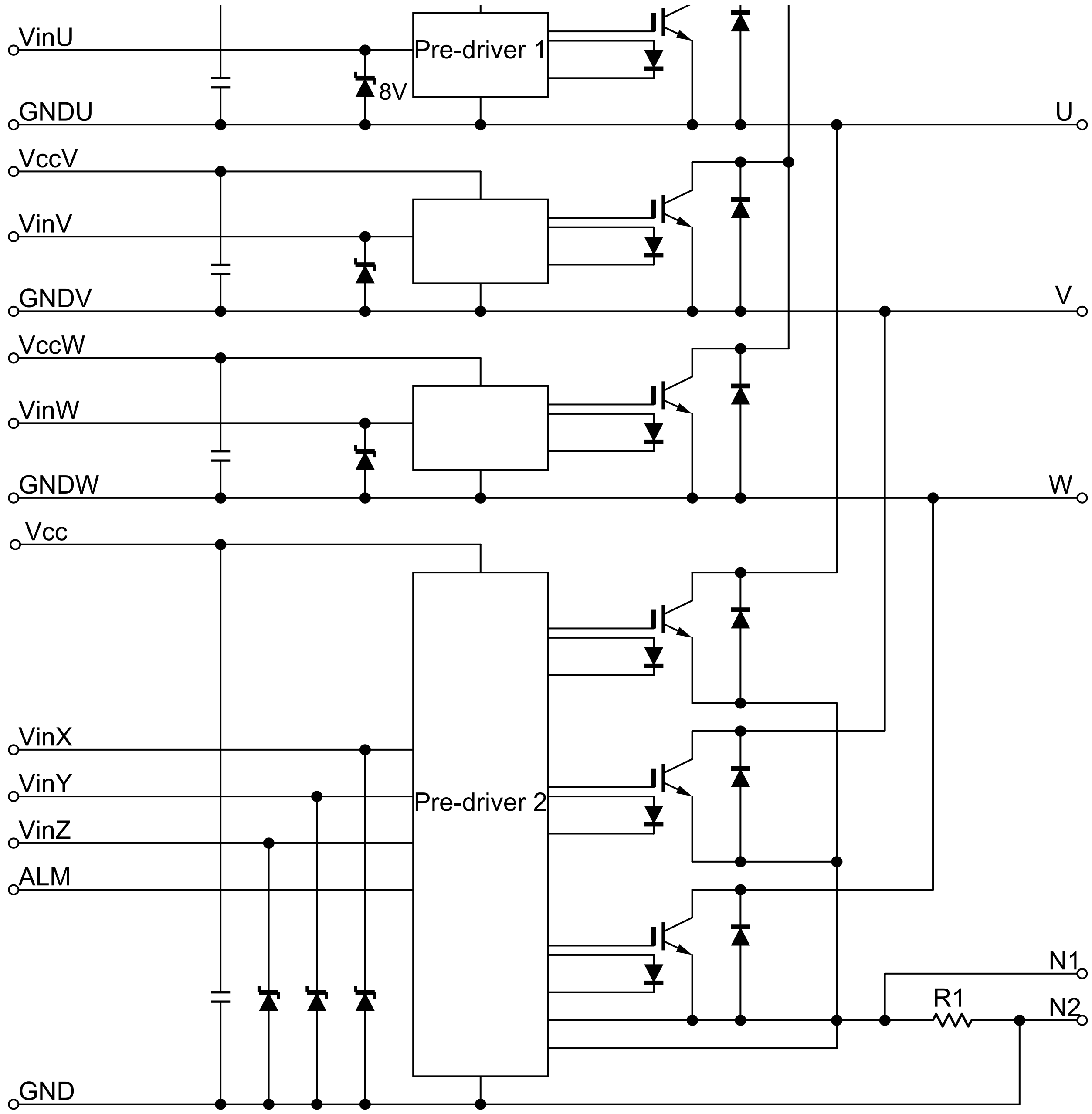

Fig. 3-7 IPM Block Diagram (P617)

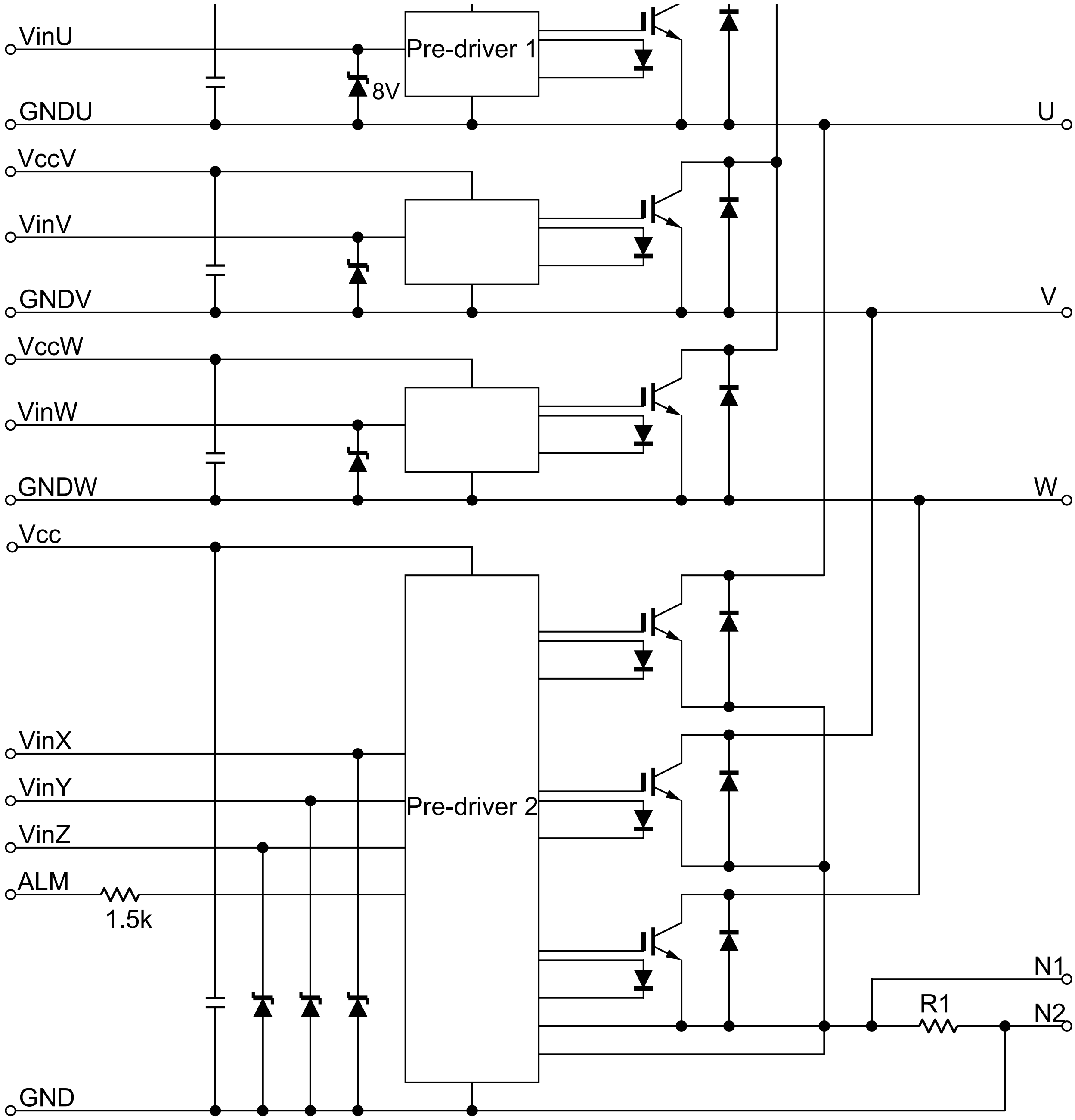

Fig. 3-8 IPM Block Diagram (P619)

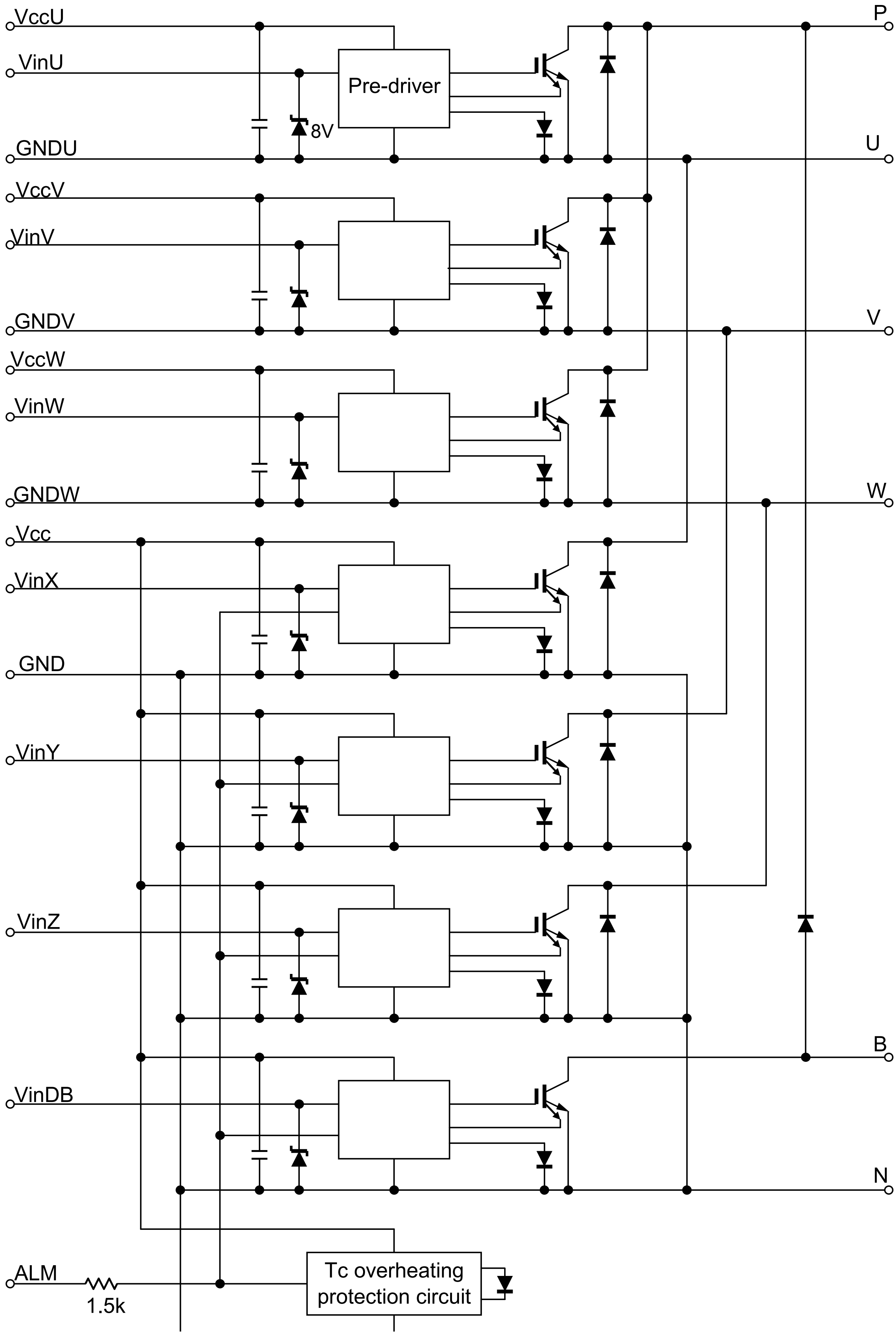

Fig. 3-9 IPM Block Diagram (P610, P611, P612 with Built-in Brake)

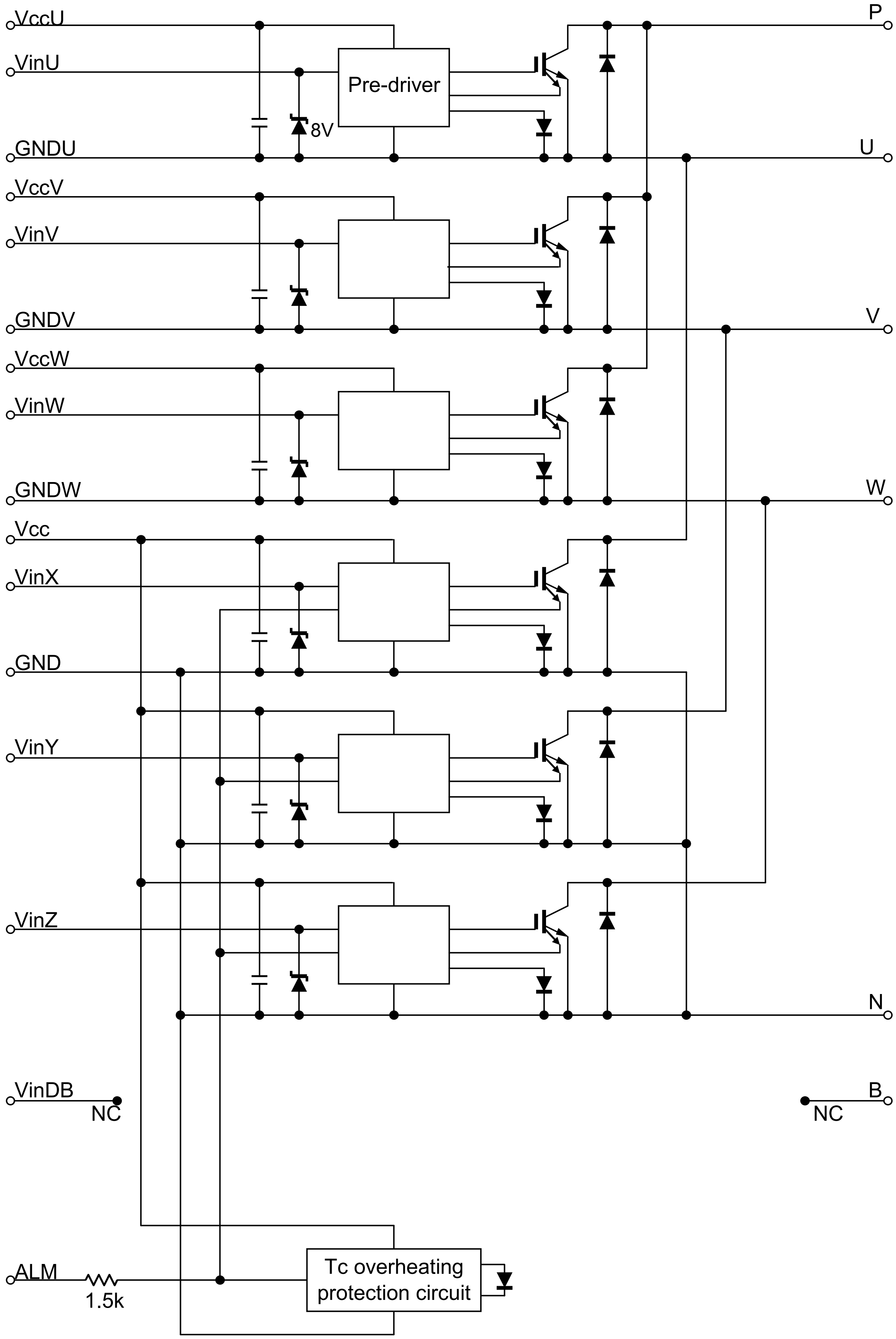

Fig. 3-10 IPM Block Diagram (P610, P611, P612 Without Brake)

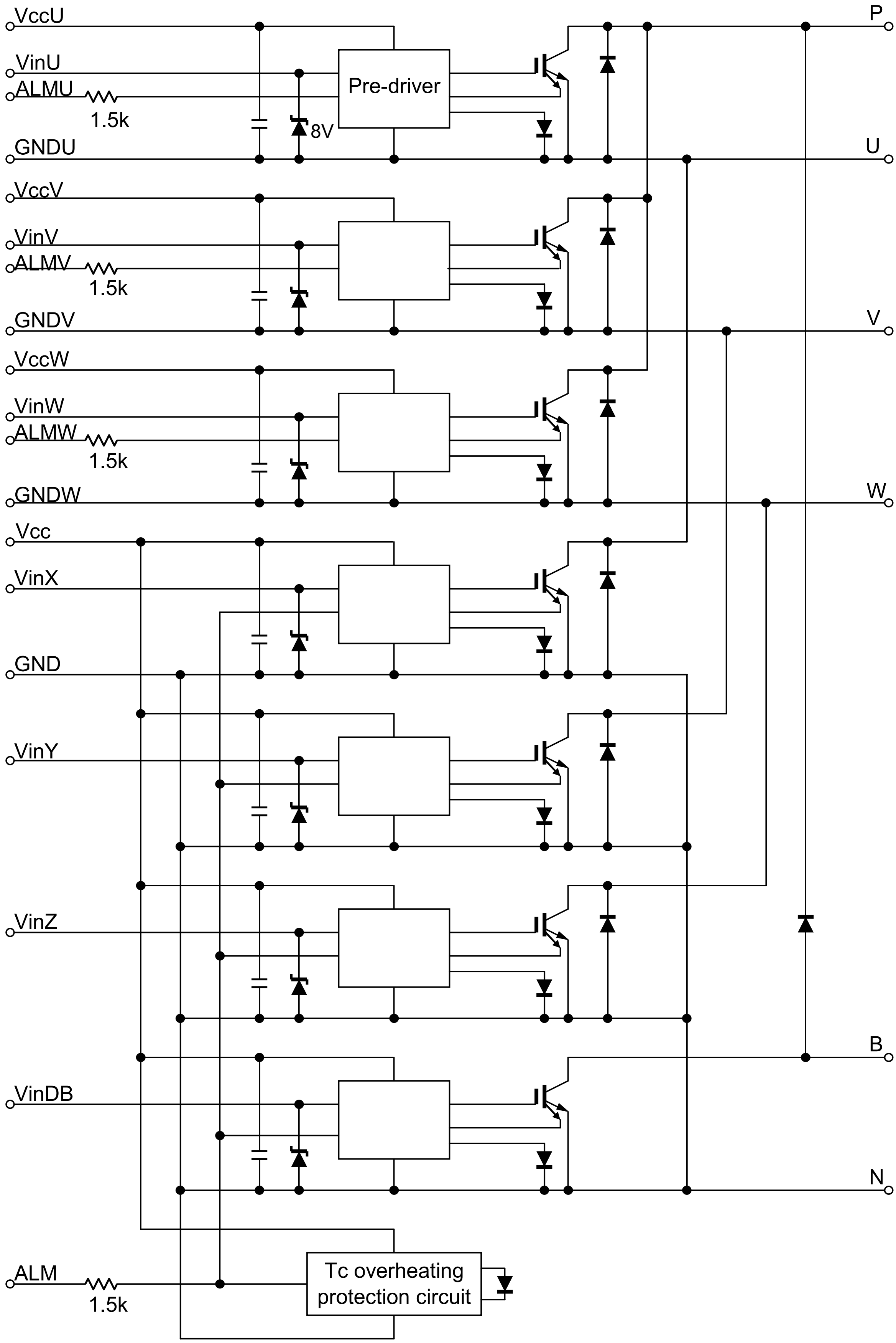

Fig. 3-11 IPM Block Diagram (P621 with Built-in Brake)

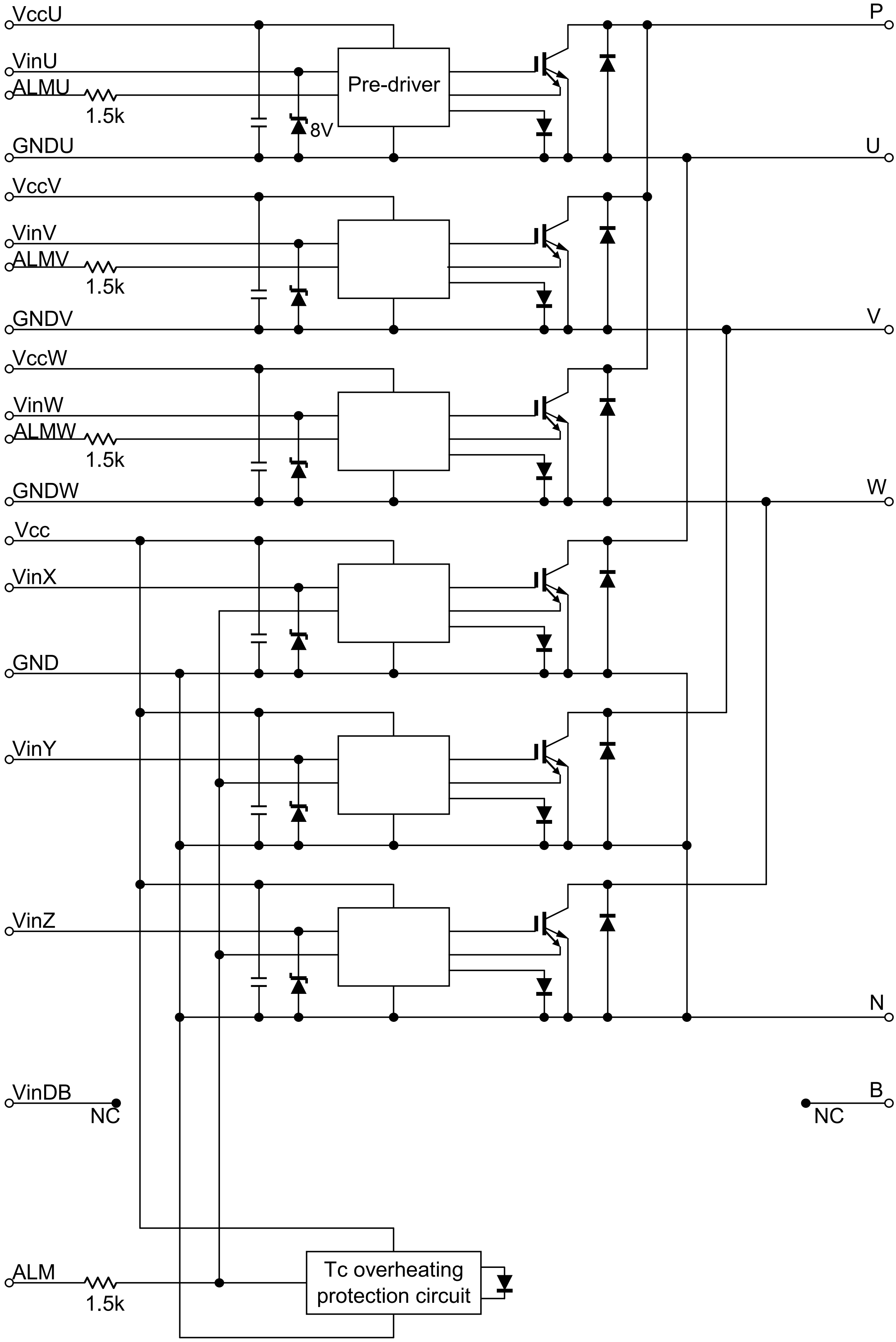

Fig. 3-12 IPM Block Diagram (P621 Without Brake)

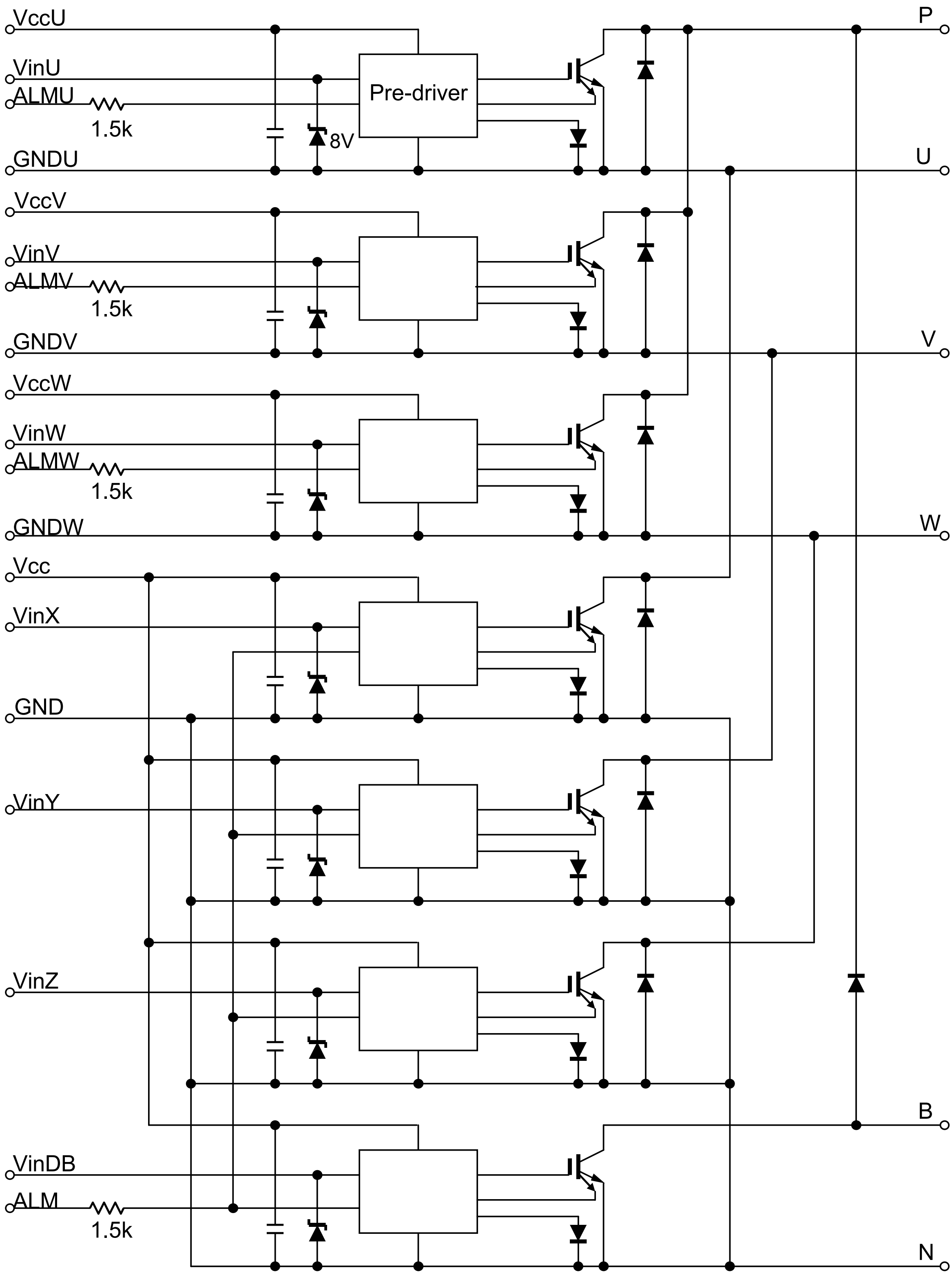

Fig. 3-13 IPM Block Diagram (P622 with Built-in Brake)

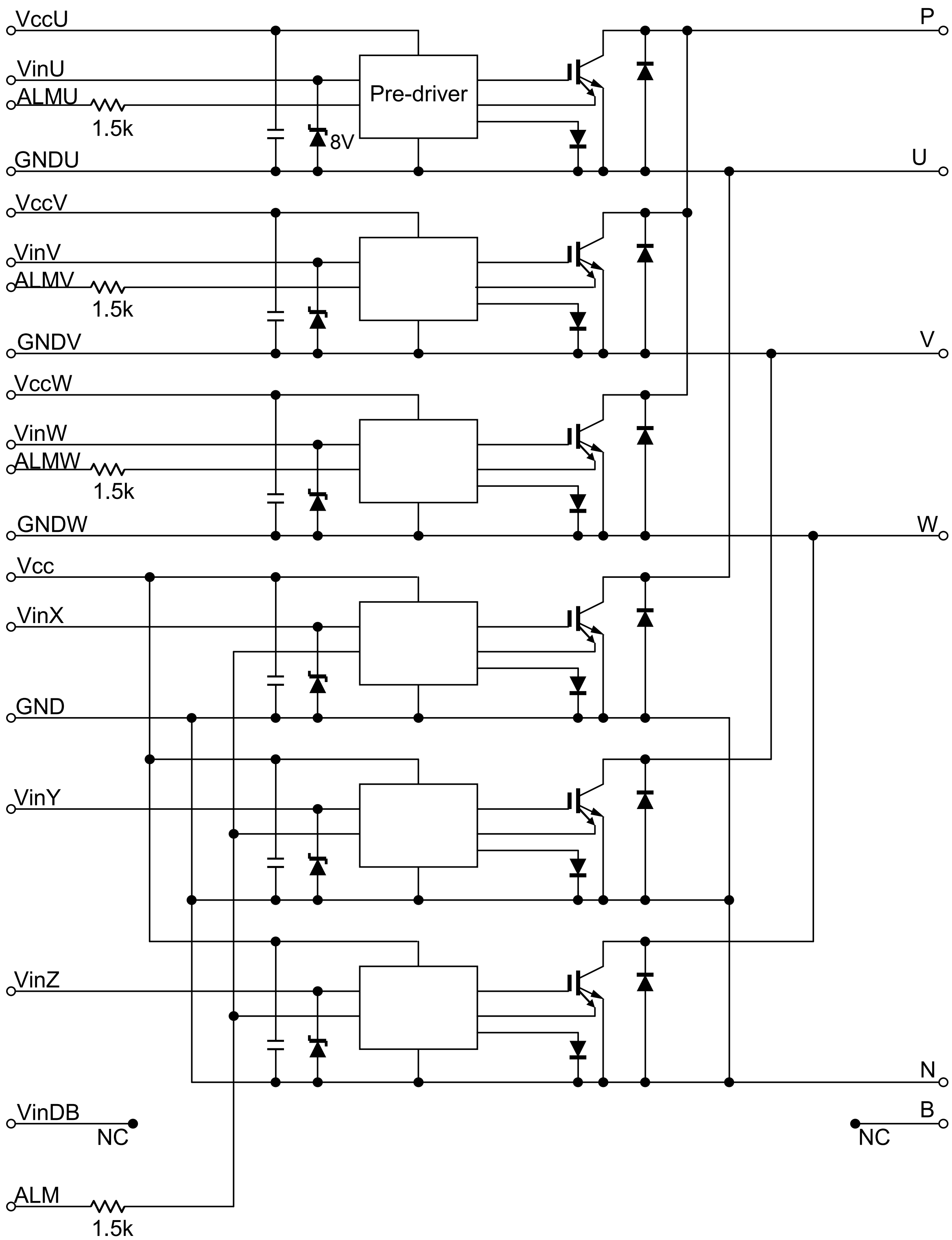

Fig. 3-14 IPM Block Diagram (P622 Without Brake)

5 Timing Charts

The timing charts for the protection functions are shown in Fig. 3-15 to Fig. 3-21.

Undervoltage protection (UV) (1)

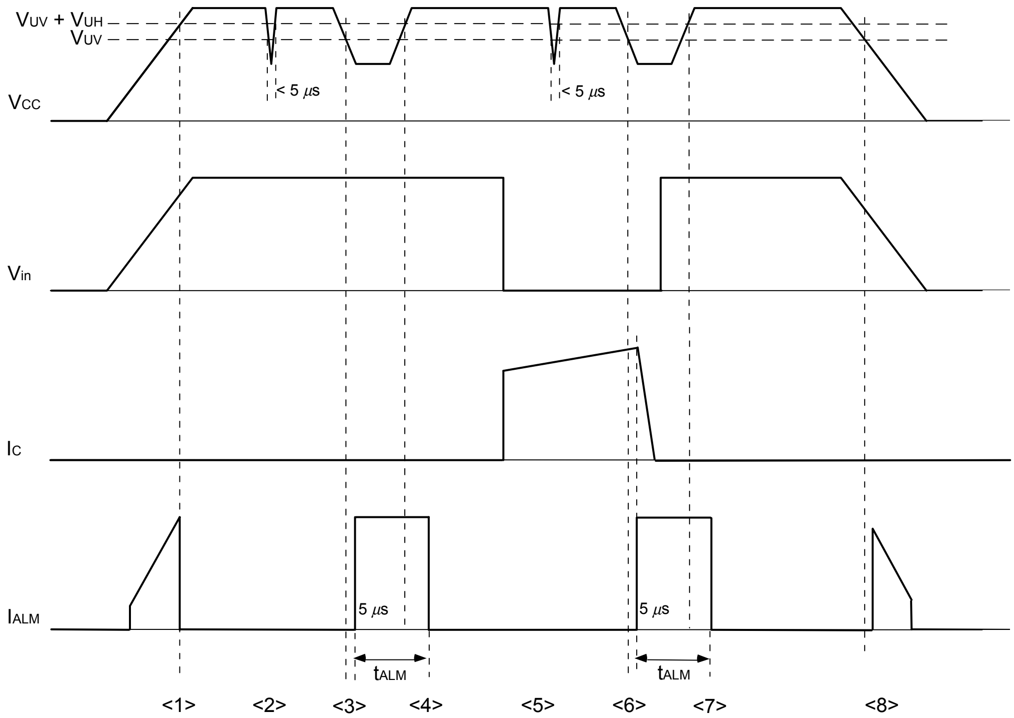

Fig. 3-15 Timing Chart UV (1)

Refer to Fig. 3-2 <3>.

<1> If Vcc is below V_{UV} + V_H while V_{CC} is ON, an alarm is output.

<2> If the period in which V_{CC} falls below V_{UV} is shorter than 5 μs, the protection function does not work (while Vin is OFF).

<3> An alarm is output when a period of about 5 μs elapses after V_{CC} falls below V_{UV} if Vin is OFF, and IGBT remains OFF.

<4> If V_{CC} returns to V_{UV} + V_H after t_{ALM} elapses, UV is reset after t_{ALM} elapses if Vin is OFF and the alarm is also reset simultaneously.

<5> If the period in which V_{CC} falls below V_{UV} is shorter than 5 μs, the protection function does not work (while Vin is ON).

<6> An alarm is output when a period of about 5 μs elapses after V_{CC} falls below V_{UV} if Vin is ON, and a soft IGBT shutdown occurs.

<7> If V_{CC} returns to V_{UV} + V_H after t_{ALM} elapses, UV is reset after t_{ALM} elapses if Vin is OFF and the alarm is also reset simultaneously.

<8> An alarm is output if V_{CC} falls below VUV while V_{CC} c is OFF.

Undervoltage protection (UV) (2)

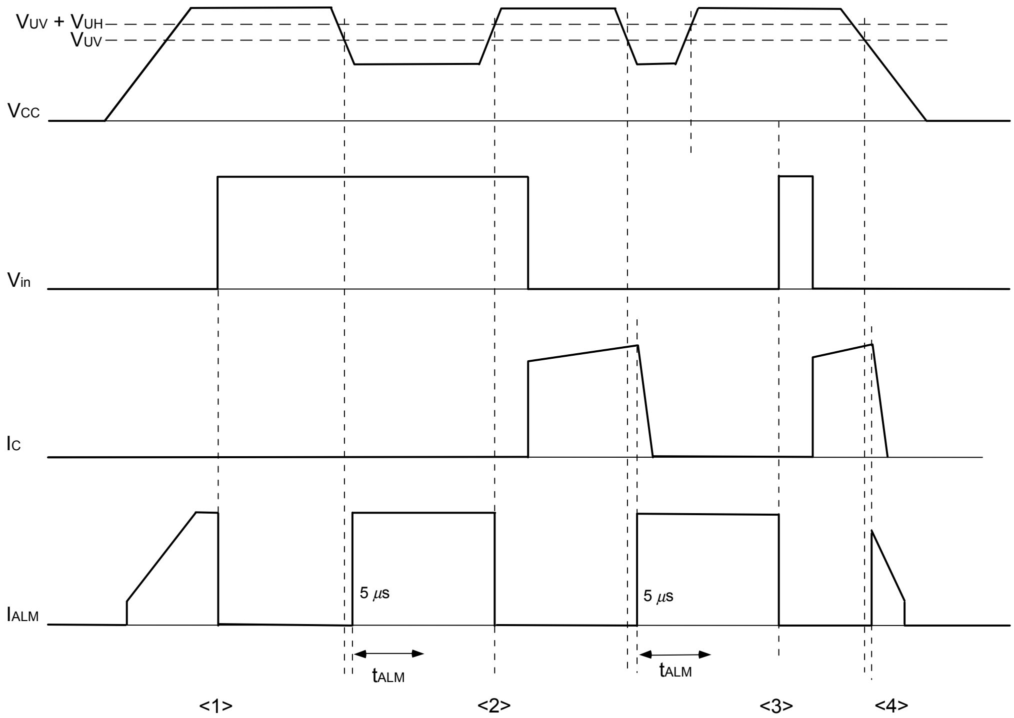

Fig. 3-16 Timing Chart UV (2)

Refer to Fig. 3-2 <3>.

<1> If Vcc is below V_{UV} + V_H while V_{CC} is ON, an alarm is output. (Until Vin changes to OFF)

<2> If Vcc returns to V_{UV} + V_H after t_{ALM} elapses, UV and the alarm are reset simultaneously with the return of V_{UV} + V_H if Vin is OFF.

<3> Even if V_{CC} returns to V_{UV} + V_H after t_{ALM} elapses, UV is not reset after t_{ALM} elapses if Vin is ON. UV and the alarm are reset simultaneously with Vin OFF.

<4> If Vin is ON while V_{CC} is OFF, the alarm is output, and a soft IGBT shutdown is executed while V_{CC} is below V_{UV}.

Overcurrent protection (OC)

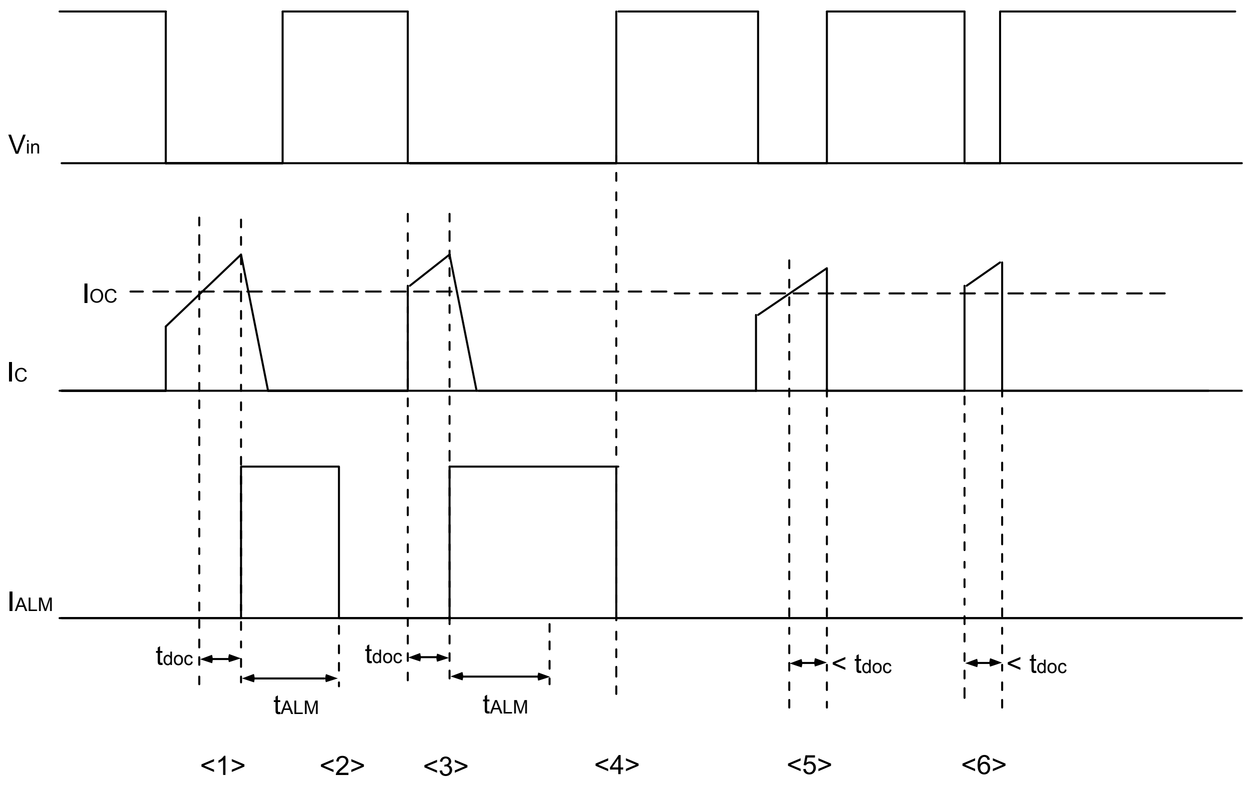

Fig. 3-17 Timing Chart OC

Refer to Fig. 3-2 <3>.

<1> An alarm is output and a soft IGBT shutdown is executed when t_{DOC} elapses after Ic rises above Ioc.

<2> OC and the alarm are reset simultaneously if Vin is OFF when t_{ALM} elapses.

<3> An alarm is output and a soft IGBT shutdown is executed when t_{DOC} elapses after Ic rises above Ioc.

<4> If Vin is ON when t_{ALM} elapses, OC is not reset. OC and the alarm are reset simultaneously when Vin is OFF.

<5> If Vin changes to OFF before t_{DOC} elapses after Ic rises above Ioc, the protection function is not activated and a normal IGBT shutdown is executed.

<6> If Vin changes to OFF before t_{DOC} elapses after Ic rises above Ioc, the protection function is not activated and a normal IGBT shutdown is executed.

Short-circuit protection

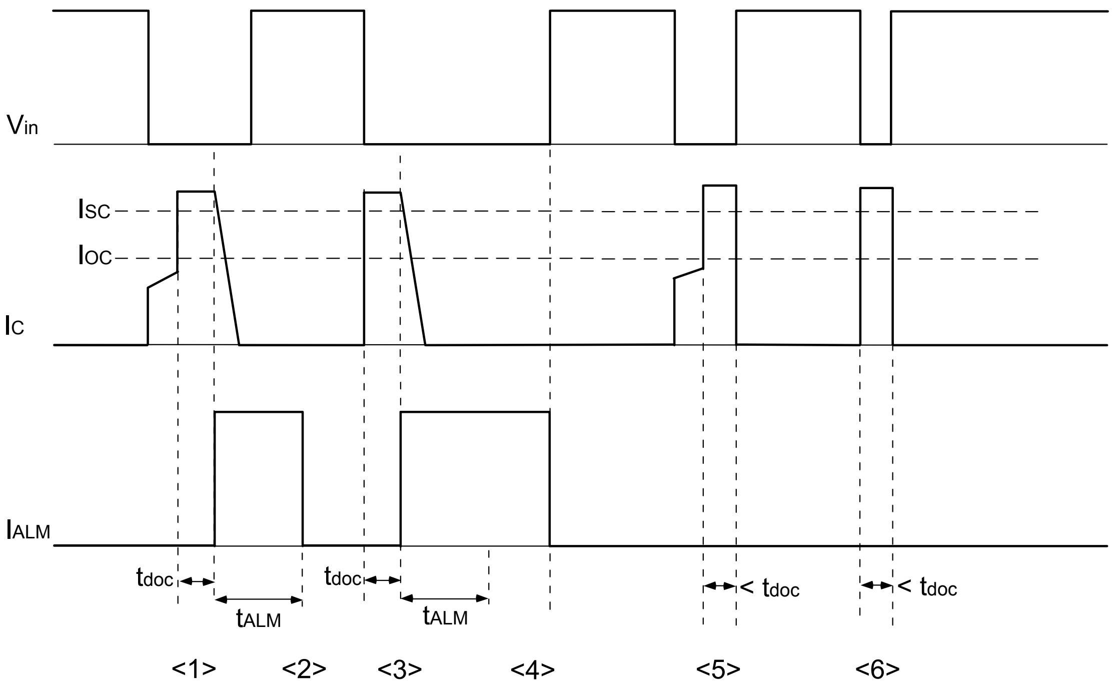

Fig. 3-18 Timing Chart SC

Refer to Fig. 3-2 <2>.

<1> If the load shorts after Ic has started flowing and Ic exceeds Isc, the Ic peak is suppressed instantly. An alarm is output and a soft IGBT shutdown is executed when t_{DOC} elapses.

<2> OC and the alarm are reset simultaneously if Vin is OFF when t_{ALM} elapses.

<3> If the load shorts and Isc is exceeded simultaneously with the start of flow of Ic, the Ic peak is instantly suppressed. An alarm is output and a soft IGBT shutdown is executed after t_{DOC} elapses.

<4> If Vin is ON when t_{ALM} elapses, OC is not reset. OC and the alarm are reset simultaneously when Vin is OFF.

<5> If the load shorts after Ic has started flowing and Ic exceeds Isc, the Ic peak is suppressed instantly. Then, if Vin changes to OFF before t_{DOC} elapses, the protection function is not activated and a normal IGBT shutdown occurs.

<6> If the load shorts simultaneously with the start of flow of Ic and Ic exceeds Isc, the Ic peak is suppressed instantly. Then, if Vin changes to OFF before t_{DOC} elapses, the protection function is not activated and a normal IGBT shutdown is executed.

Case temperature overheating protection (TcOH)

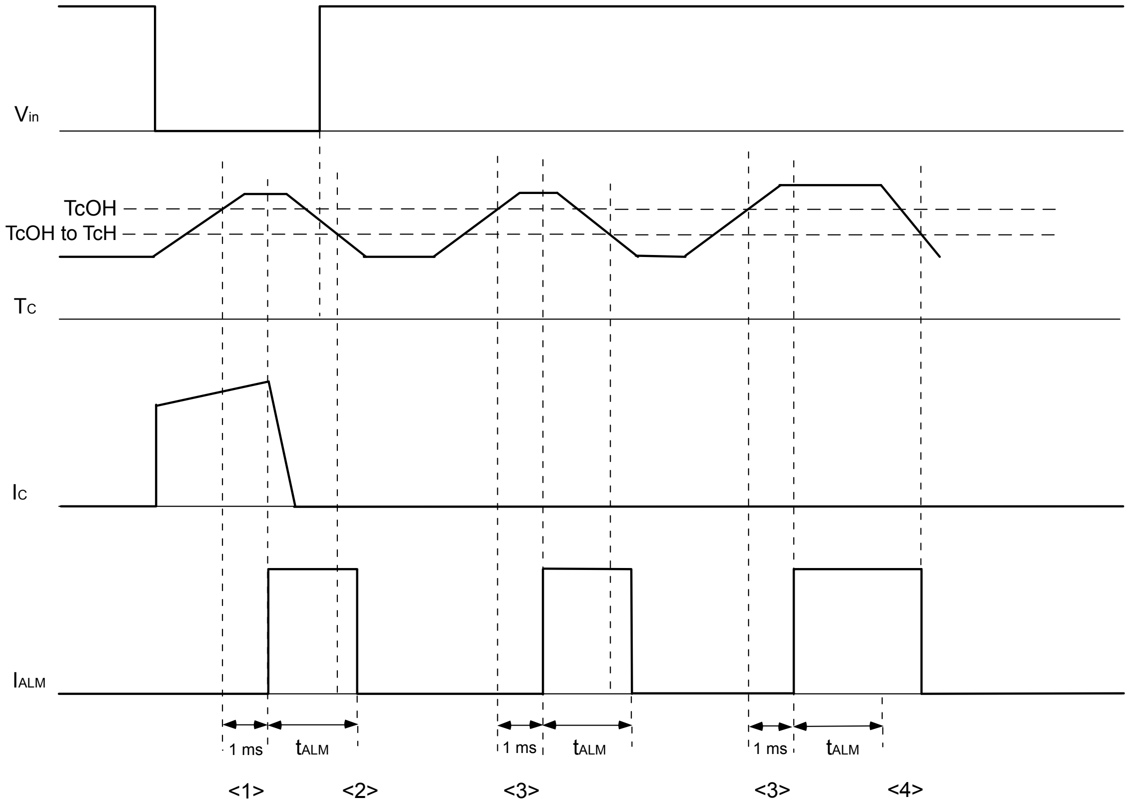

Fig. 3-19 Timing Chart TcOH

Refer to Fig. 3-2 <4>.

<1> An alarm is output if the case temperature Tc continuously exceeds T_{COH} for a period of about 1 ms, and if Vin is ON, a soft shutdown of all IGBTs on the lower arm side is executed.

<2> If Tc falls below T_{COH}-T_{CH} before t_{ALM} elapses, the alarm is reset when t_{ALM} elapses.

<3> If Tc exceeds continuously T_{COH} for a period of about 1 ms, an alarm is output. (While Vin is OFF)

<4> If Tc has not fallen below T_{COH}-T_{CH} when t_{ALM} elapses, the alarm is not reset. When Tc falls below T_{COH}-T_{CH} after t_{ALM} elapses, the alarm is reset.

IGBT chip overheating protection (TjOH) (1)

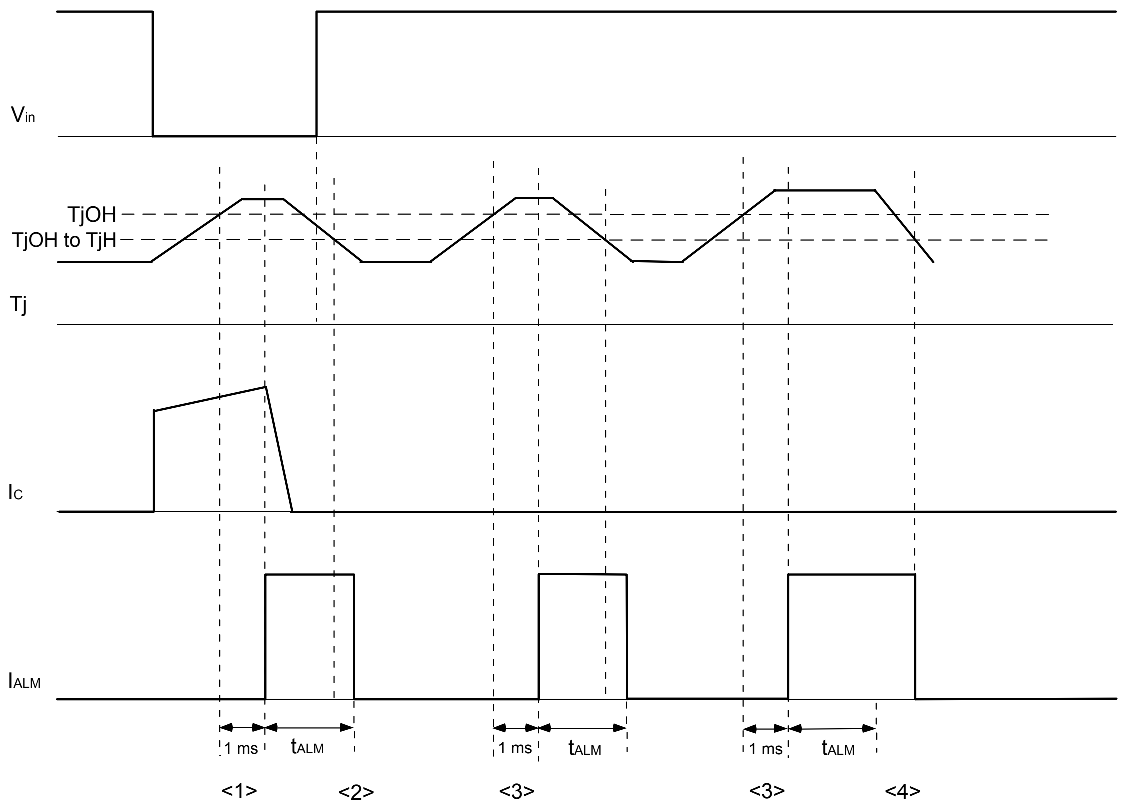

Fig. 3-20 Timing chart TjOH (1)

Refer to Fig. 3-2 <4>.

<1> An alarm is output and a soft IGBT shutdown is executed if the IGBT chip temperature Tj continuously exceeds T_{jOH} for a period of about 1 ms.

<2> If Tj falls below Tj_{OH}-Tj_H before t_{ALM} elapses, OH and the alarm are simultaneously reset if Vin is OFF when t_{ALM} elapses.

<3> An alarm is output if Tj continuously exceeds Tj_{OH} for a period of about 1 ms, and if Vin is OFF, the protection function is not activated.

<4> When Tj falls below Tj_{OH}-Tj_H after t_{ALM} elapses, OH and the alarm are reset simultaneously if Vin is OFF.

IGBT chip overheating protection (TjOH) (2)

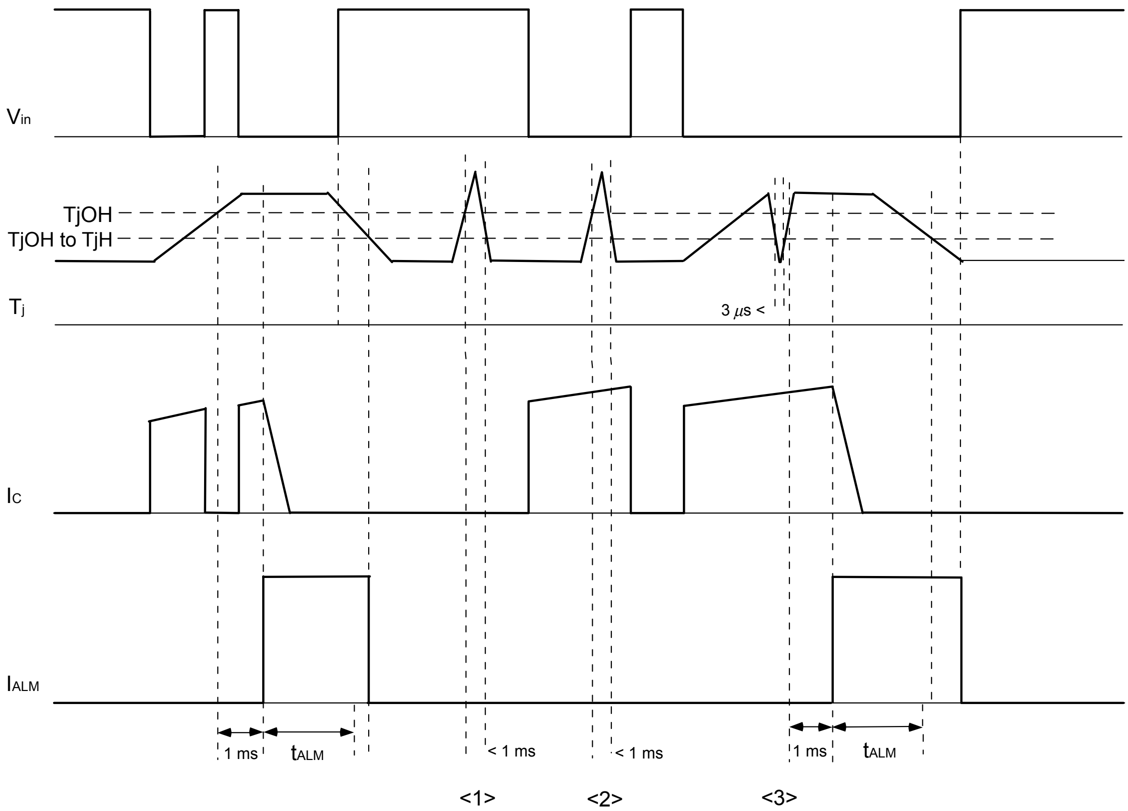

Fig. 3-21 Timing Chart TjOH (2)

Refer to Fig. 3-2.

<1> If Tj exceeds Tj_{OH} and then falls below Tj_{OH} within about 1 ms, OH does not operate regardless of whether Vin is ON or OFF.

<2> If Tj exceeds Tj_{OH} and then falls below Tj_{OH} within about 1 ms, OH does not operate regardless of whether Vin is ON or OFF.

<3> If Tj exceeds Tj_{OH} and then falls below Tj_{OH} for a period of about 3 μs or longer, the 1 ms detection timer is reset.

Chapter 4

Examples of Application Circuits

Contents Page

1 Examples of Application Circuits

Fig. 4-1 shows an example of an application circuit for P610, P611, and P612 (types with built-in brake).

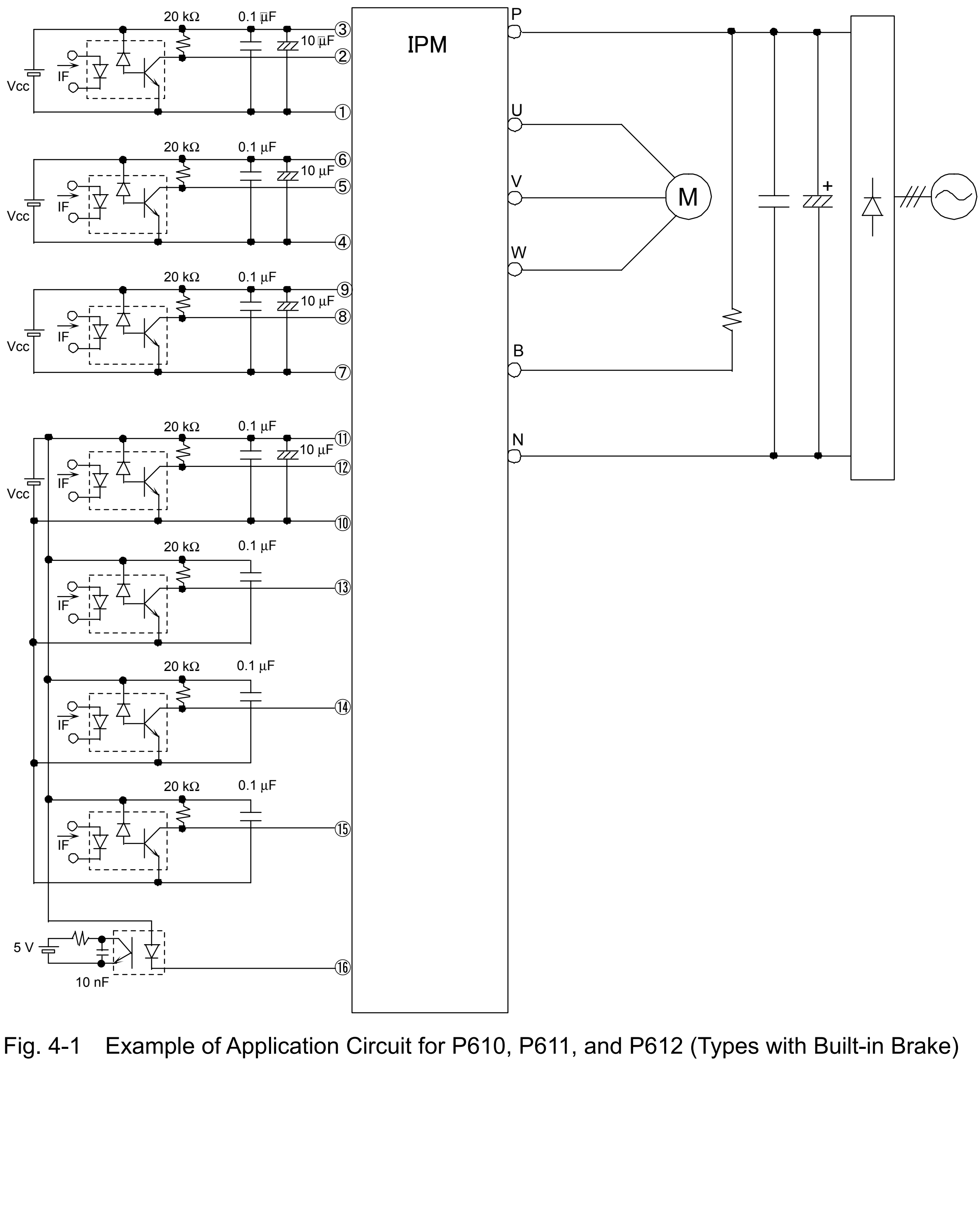

Fig. 4-1 Example of Application Circuit for P610, P611, and P612 (Types with Built-in Brake)

Fig. 4-2 shows an example of an application circuit for P610, P611, and P612 (types without brake).

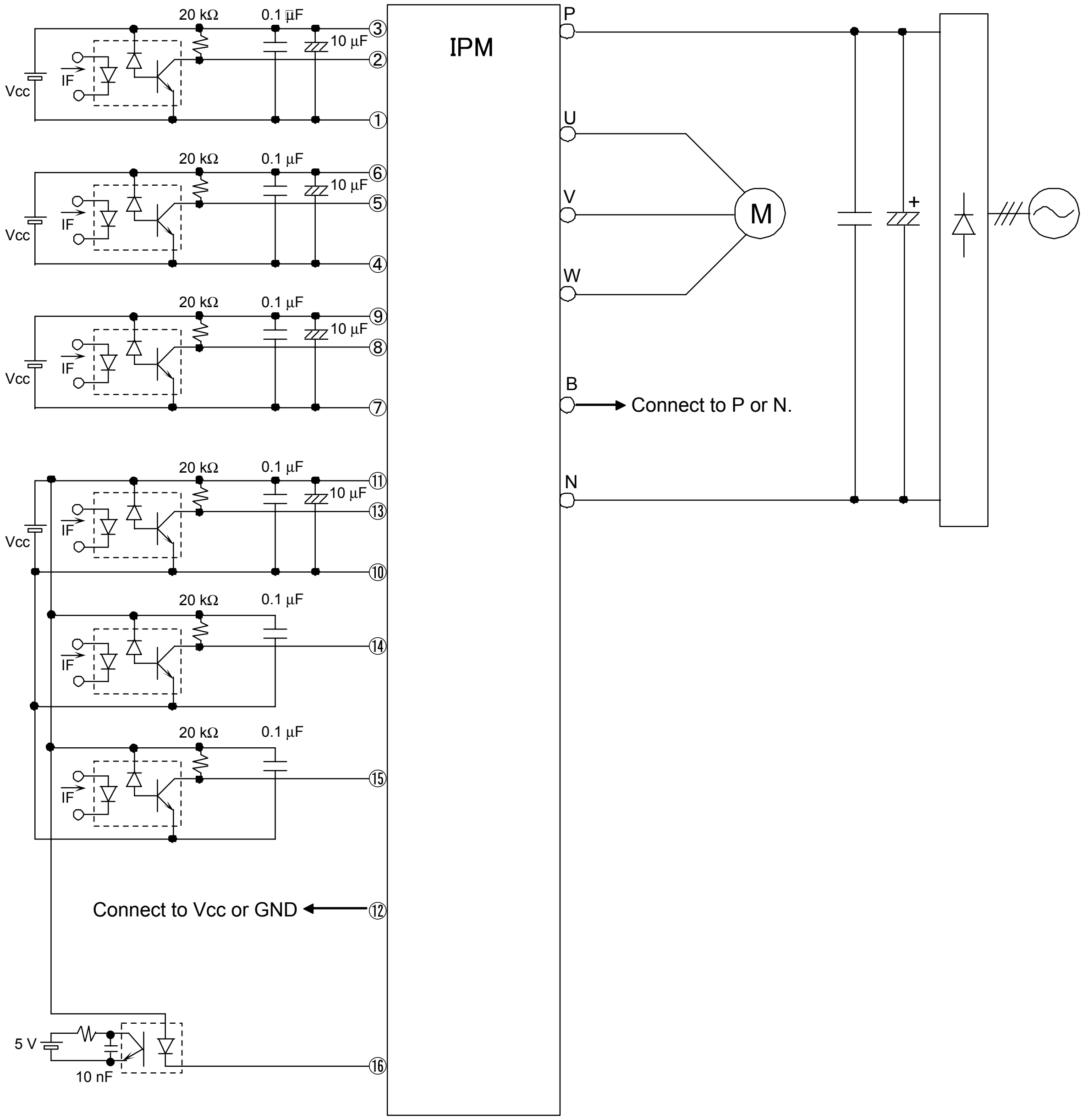

Fig. 4-2 Example of Application Circuit for P610, P611, and P612 (Types Without Brake)

Fig. 4-3 shows an example of an application circuit for P621 and P622 (types with built-in brake).

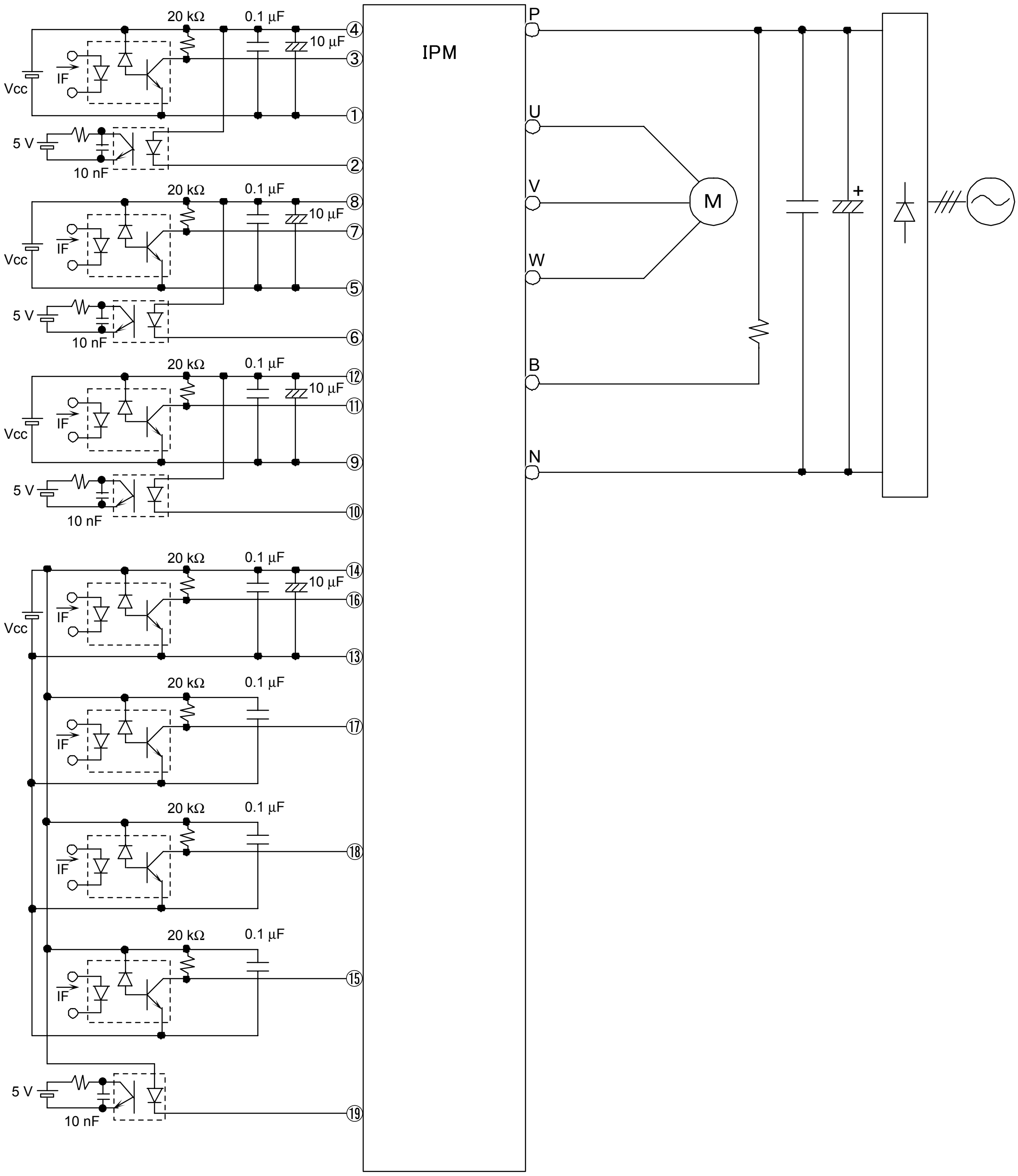

Fig. 4-3 Example of Application Circuit for P621, P622 (with Upper Arm Alarm)
(Types with Built-in Brake)

Fig. 4-4 shows an example of an application circuit for P621 and P622 (types without brake).

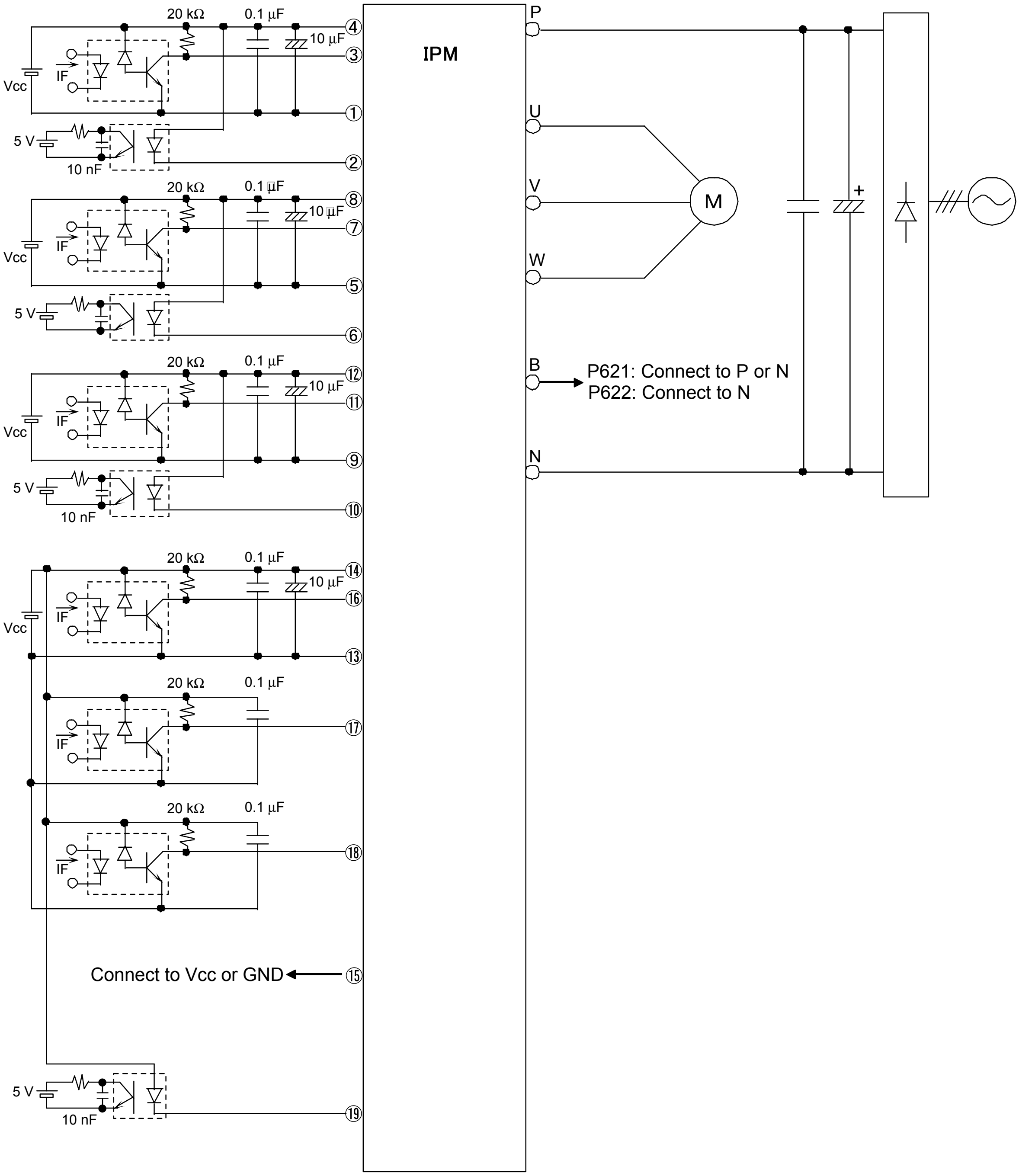

Fig. 4-4 Example of Application Circuit for P621, P622 (with Upper Arm Alarm) (Types Without Brake)

Fig. 4-5 shows an example of an application circuit for P617.

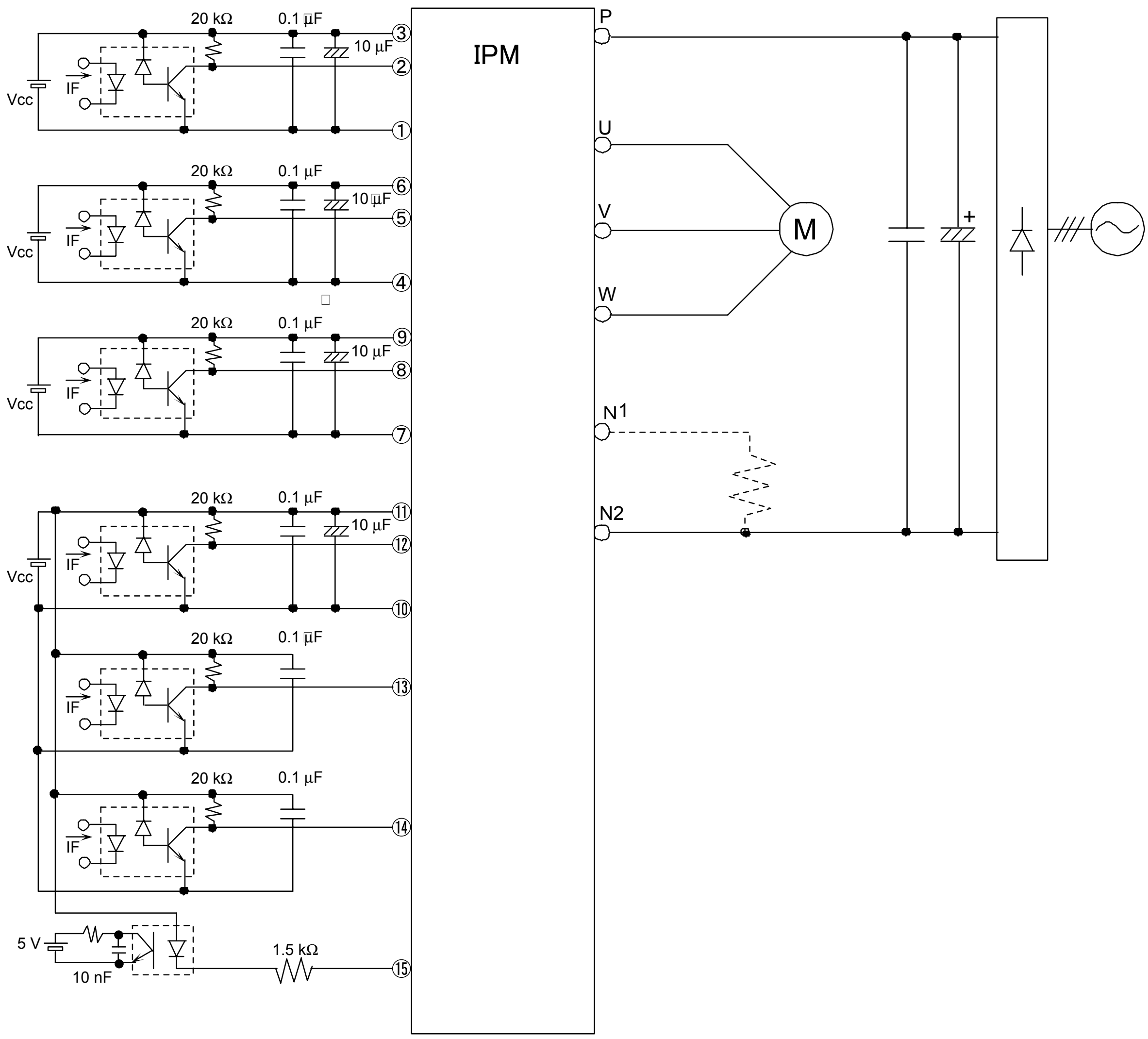

Fig. 4-5 Example of Application Circuit for Small-capacity IPM P617

Fig. 4-6 shows an example of an application circuit for P619.

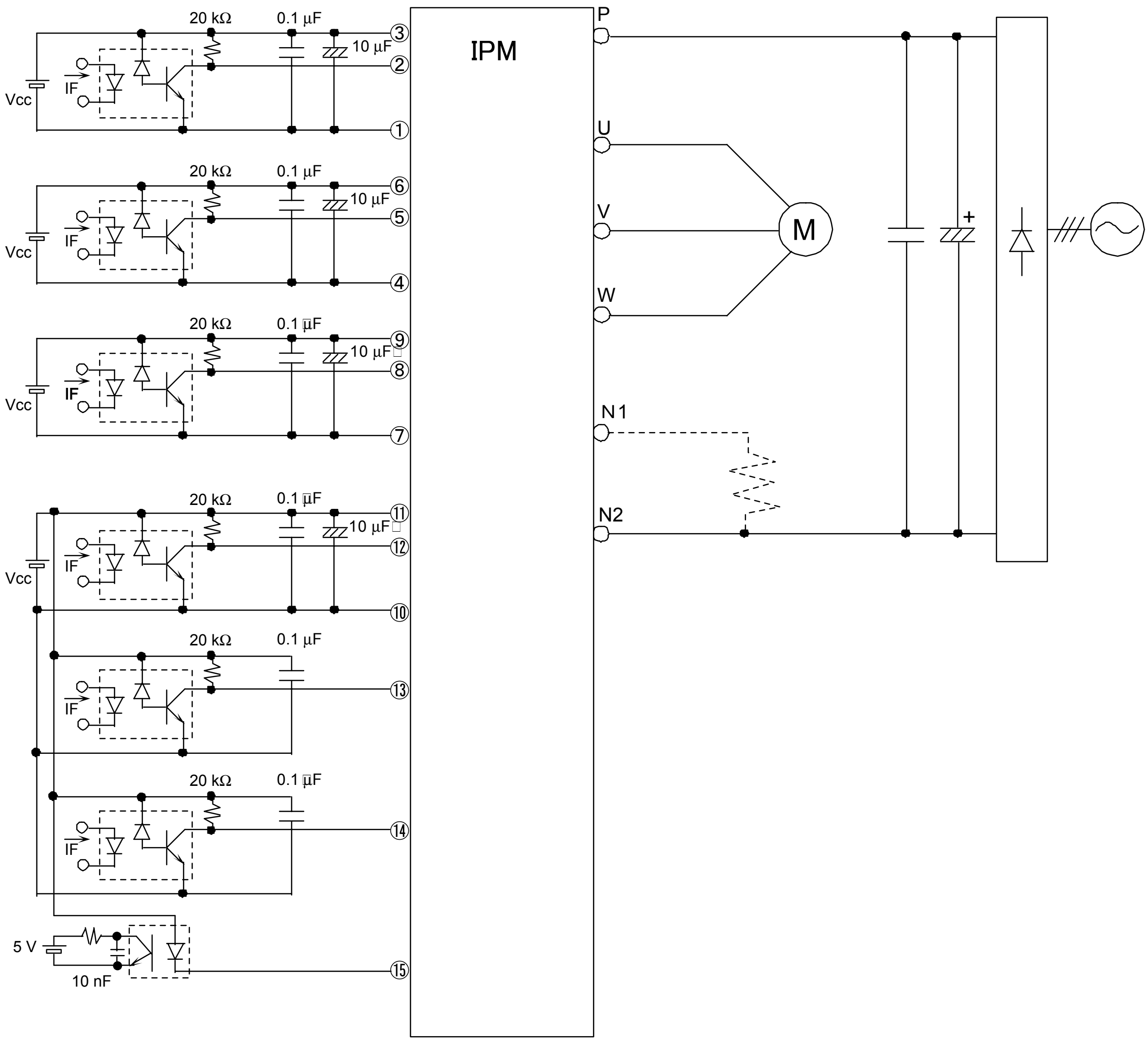

Fig. 4-6 Example of Application Circuit for Small-capacity IPM P619

2 Precautions

2.1 Control power source

As shown in the application circuit examples, a total of four isolation power sources are required for the control power sources, 3 on the upper arm side and 1 on the lower arm side.

If you are using commercial power source units, do not connect the GND terminal on the side of the power source output.

When the GND on the output side is connected to + or -, faulty operation occurs because each power source is connected to the ground on the side of power source input. Stray capacity between each power source and ground should be reduced to a minimum.

2.2 Structural isolation among four power sources (input connectors and PC boards)

Isolation is needed between each of the four power sources and the main power source.

Since a large amount of dv/dt is applied to this isolation during IGBT switching, keep sufficient clearance between the components and the isolation. (2 mm or more is recommended.)

2.3 GND connection

The control power source GND on the lower arm side and the main power source GND are connected inside the IPM. Never connect them outside the IPM. If you connect them outside the IPM, loop currents generated inside and outside the IPM flow to the lower arm due to di/dt and cause malfunctioning of the photocoupler and the IPM. The input circuit of the IPM may also be damaged.

2.4 Control power source capacitor

The 10 μF and 0.1 μF capacitors connected to each control power source as shown in the application circuit examples are not intended for smoothing the control power sources, but for compensating the wiring impedance up to the IPM. Capacitors for smoothing are needed separately.

Since transient variations may be caused in the wiring impedance from the capacitor to the control circuit, connect the capacitor as close to the IPM control terminal and photocoupler pin as possible.

Select capacitors with lower impedance and better frequency characteristics for the electrolytic capacitors. In addition, connect capacitors with better frequency characteristics, such as film capacitors, in parallel.

2.5 Alarm circuits

- The potential on the secondary side of the alarm photocoupler may vary due to dv/dt. It is recommended to stabilize the potential by connecting a capacitor of approximately 10 nF.
- As P617 does not have a built-in alarm resistor, a resistor of 1.5 kΩ must be connected on the outside of the IPM.

2.6 Pull-up of the signal input terminal

Pull up the control signal input terminal to Vcc with a resistor of 20 kΩ. Even if you do not use the brake in the built-in brake IPM, still pull up the DB input terminal. If you do not pull up the terminal, a malfunction may be caused by dv/dt.

2.7 Snubber

Connect the snubber to the PN terminals directly. For the P612 package set up the snubber for each PN terminal on both sides.

2.8 B terminal

In the case of the 6 in 1 package (without brake) type, connecting the B terminal to the N or P terminal as described below is recommended.

P610, P611, P612, P621 ············N or P terminal
P622(Econo-IPM) ························N terminal (connection to the P terminal causes an internal short-circuit)

2.9 Upper arm alarm

When the upper arm alarm of an IPM with upper arm alarm output is not used, connect the alarm terminal to Vcc to stabilize the potential.

2.10 Overcurrent protection for small-capacity IPMs

The limit level for overcurrent protection can be adjusted to a high level by adding a resistor between the N1 and N2 terminals of small-capacity IPMs (P617, 619). The resistor added at that time must be mounted close to the N1 and N2 terminals. A long distance from the N1 and N2 terminals can cause faulty operation of the IPM.

2.11 IPM input circuit

The constant-current circuit shown in Fig. 4-7 is provided in the input section of our IPMs, and outflow from the IPM takes place at the timing shown in the figure. For this reason, the IF on the primary side of the photocoupler must be determined so that a current of IR + 1 mA flows through the pull-up resistor on the secondary side of the photocoupler. If the IF is not sufficient, faulty operation on the secondary side is possible.

Also, the pull-up resistor must be selected so that a current of IR + 1 mA flows on the secondary side of the photocoupler when the photocoupler is ON and that the current flowing into the IPM at the time of OFF does not exceed the Iin MAX listed in the specifications.

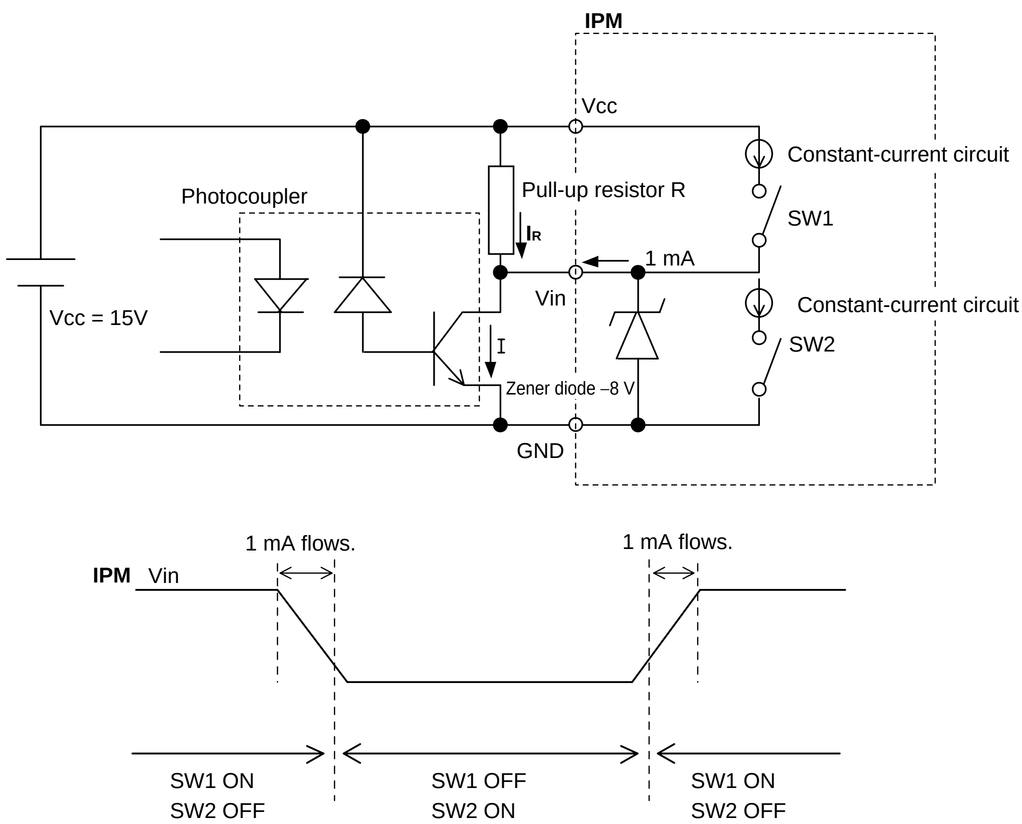

Fig. 4-7 IPM Input Circuit and Rated Current Operation Timing

3 Photocoupler and Peripheral Circuits

3.1 Photocoupler for control input

● Photocoupler rating

Use a photocoupler satisfying the following characteristics.

- CMH = CML > 15 kV/μs or 10 kV/μs
- tpHL = tpLH < 0.8 μs
- tpLH-tpHL = –0.4 to 0.9 μs
- CTR > 15%

Example: Product of Agilent: HCPL-4504
Product of Toshiba: TLP759 (IGM)

Note: Safety standards such as UL and VDE should also be applied.

● Wiring between photocoupler and IPM

Make the wiring between the photocoupler and the IPM as short as possible to reduce the wiring impedance between the photocoupler and the IPM control terminal. Separate each wire between the primary and secondary circuits so that floating capacitance does not become large, since a strong dv/dt is applied between the primary and secondary circuits.

● Light emitting diode driving circuit

The dv/dt withstand capability of the photocoupler is also affected by the input light emitting diode driving circuit. A driving circuit example is shown in Fig. 4-8.

Good example: Totempole output IC
Current limiting resistor on the cathode side of the photo diode

Bad example: Open collector

Good example: Photo diode A-K is shorted by transistors C-E
(example which is particularly fit for photocoupler OFF)

Bad example: Current limiting resistor on the anode side of the photo diode

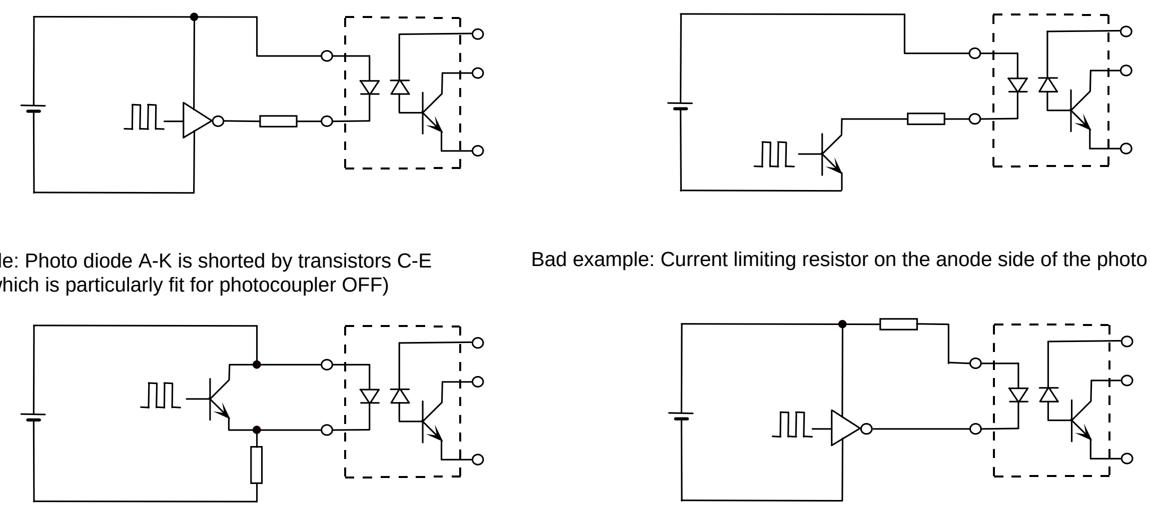

Fig. 4-8 Photocoupler Input Circuits

3.2 Photocoupler for alarm output

● Photocoupler rating

General-purpose photocouplers can be used, but photocouplers satisfying the following characteristics are recommended.

• 100%< CTR< 300%

• Single-element type

Example: TLP521-1-GR rank

Note: Safety standards such as UL and VDE should also be applied.

● Input current limiting resistor

A current limiting resistor for the light emitting diode in the photocoupler input is included in the IPM.

R_{ALM} = 1.5 kΩ and if connected directly to Vcc, about 10 mA of I_F flows with Vcc = 15 V.

Therefore, there is no need to connect any current limiting resistor.

However, if a large amount of current, i.e., Iout > 10 mA, is needed on the photocoupler output, increase the CTR value of the photocoupler to the required value.

● Wiring between the photocoupler and the IPM

Since a large amount of dv/dt is also applied on the photocoupler for the alarm, the same precautions as described in 3.1 should be taken.

4 Connectors

Connectors suitable for the shape of the R-IPM control terminals are commercially available.

16-pin connector for P610, 611, 612: MDF7-25S-2.54DSA made by Hirose Electric

For P621: DF10-31S-2DSA made by Hirose Electric

Please confirm the reliability and the specifications of the above connectors with the manufacturer.

Chapter 5

Cooling Design

Contents Page

1 Cooler (Heat Sink) Selection Method

- To safeguard operation of the IGBT, make sure the junction temperature Tj does not exceed Tjmax. Cooling should be designed in such a way that ensures that Tj is always below Tjmax even in abnormal states such as overload operation as well as under the rated load.
- Operation of IGBT at temperatures higher than Tjmax could result in damage to the chips.
  In the IPM, the TjOH protection function operates when the chip temperature of IGBT exceeds Tjmax. However, if the temperature rises too quickly, the chip may not be protected.
- Likewise, note that the chip temperature of FWD should not exceed Tjmax.
- When selecting the cooler (heat sink), always measure the temperature directly under the center of the chip. The Econo IPM series in particular is designed with operational preconditions for servo applications, etc., in which the temperature increases/decreases in a short time, so care is required in regard to heat accumulation when using under other conditions. As the structure and design place special importance upon compactness, there is a tendency for heat to accumulate in the power chip located at the center. For the chip layout, refer to the IPM internal structure drawing: MT6M5313. For the concrete design, refer to the following document.

  "IGBT MODULE APPLICATION MANUAL REH984"

  Contents: • Power dissipation loss calculation
  • Selecting heat sinks
  • Heat sink mounting precautions
  • Troubleshooting

2 Notes on Heat Sink Selection

How to select heat sinks is described in the manual REH982. Note also the following points.

- Flatness of the heat sink surface
  Flatness between mounting screw pitches: 0 to +100 μm, roughness: 10 μm or less

If the heat sink surface is concave, a gap occurs between the heat sink and the IPM, leading to deterioration of cooling efficiency.

If the flatness is +100 μm or more, the copper base of the IPM is deformed and cracks could occur in the internal isolating substrates.

Chapter 6

Cautions on Use

Contents Page

1 Main Power Source

1.1 Voltage range

1.1.1 600 V system IPMs

- The main power source should not exceed 500 V (= V_{DC}(surge)) between the P and N main terminals. The voltage between the collector and emitter main terminals (= VCES) should not exceed 600 V (= absolute max. rated voltage).
- Surge voltage occurs in the wiring inductance inside the IPM due to di/dt during switching, but the product is designed so that 600 V is not exceeded between the collector and emitter main terminals when the main power source is used at V_{DC}(surge) or lower between the P and N main terminals.
- In order for the maximum surge voltage at the time of switching not to exceed the rated voltage, keep the connecting wires between the IPM and the embedded product short and install a snubber close to the P and N terminals.

1.1.2 1200 V system IPMs

- The main power source should not exceed 1000 V (= V_{DC}(surge)) between the P and N main terminals. The voltage between the collector and emitter main terminals (= VCES) should not exceed 1200 V (= absolute max. rated voltage).
- Surge voltage occurs in the wiring inductance inside the IPM due to di/dt during switching, but the product is designed so that 1200 V is not exceeded close to the chip when the main power source is used at V_{DC}(surge) or lower between the P and N main terminals.
- In order for the maximum surge voltage at the time of switching not to exceed the rated voltage, keep the connecting wires between the IPM and the embedded product short and install a snubber close to the P and N terminals.

1.2 External noise

Countermeasures have been taken against external noise within the IPM, but faulty operation may possibly occur depending on the type and intensity of the noise.

Please take sufficient countermeasures against noise entering the IPM.

1.2.1 Noise from outside the equipment

- Apply a noise filter on the AC line, isolate the ground and so on.
- When required, add capacitors of 100 pF or less between all phase signal inputs and signal GND.
- Install arresters against lightning surges, etc.

1.2.2 Noise from within the equipment

- Outside the rectifier: Implement the same countermeasures as the above.
- Inside the rectifier: Apply snubber circuits on the PN lines.
  (In case of multiple inverters connected to one rectifier converter, etc.)

1.2.3 Noise from the output terminals

- Take external countermeasures so that contactor switching surges and so on do not enter.

2 Control Power Source

2.1 Voltage range

- The drive circuit shows stable operation when the control power source voltage is in the range of 13.5 to 16.5 V.
  Operation with a value as close to 15 V as possible is recommended.
- When the control power source voltage is below 13.5 V, the loss will increase and noise will show a tendency to decrease.
  Also, the protection performance will shift, so that the protection functions may not be sufficient and chip damage may occur.
- When the control power source voltage drops below 13.5 V, dropping down to VUV or lower, the undervoltage protection function (UV) operates.
  When the control power source voltage recovers to VUV + VH, UV is automatically released.
- When the control power source voltage exceeds 16.5 V, the loss decreases and noise shows a tendency to increase.
  Also, the protection performance will shift, so that the protection functions may not be sufficient and chip damage may occur.
- When the control power source voltage is below 0 V (reverse bias) or exceeds 20 V, the drive circuit and/or the main chip may be damaged. Never apply these voltages.

2.2 Voltage ripple

- The recommended voltage range of 13.5 to 16.5 V includes the voltage ripple of Vcc.
  During the manufacture of the control power source, be sure to keep the voltage ripple sufficiently low.
  Also be sure to keep noise superimposed on the power source sufficiently low.
- Design the control power source so as to keep dv/dt at 5 V/μs or lower.

2.3 Power source start-up sequence

- Apply the main power source after confirming that Vcc is in the recommended voltage range.
  If the main power source is applied before the recommended voltage is reached, the chip may be destroyed (worst-case scenario).

2.4 Alarm at the time of power source start-up and shutdown

- At the time of power source start-up, an alarm is output at the UV protection function operation level voltage.
  Recovery is made when the protection release level voltage is reached, but as the alarm will not be released as long as an ON signal is input, appropriate measures must be taken on the drive circuit side.
- As there is also alarm output at the time of power source shutdown, similar measures are required.

2.5 Precautions upon control circuit design

- Design with sufficient margin, taking the current consumption specification (Icc) for the drive circuit into consideration.
- Make the wiring between the input terminals of the IPM and the photocoupler as short as possible, and use a pattern layout with a small stray capacitance for the primary side and the secondary side of the photocoupler.
- Install a capacitor as close as possible between Vcc and GND in the case of a high-speed photocoupler.
- For a high-speed photocoupler, use a high CMR type in which tpHL, tpLH $\leq$ 0.8 μs.
- For the alarm output circuit, use a low-speed photocoupler type in which CTR $\geq$ 100%.
- Use four isolated power sources for the control power source Vcc. Also use a design with suppressed voltage fluctuations.
- When a capacitor is connected between the input terminals and GND, note that the response time in regard to an input signal on the primary side of the photocoupler becomes longer.
- Design the primary-side current of the photocoupler with sufficient margin taking the CTR of the photocoupler being used into consideration.

3 Protection Functions

As the built-in protection functions and the presence or absence of alarm output differ according to the package and the model, confirm the protection functions of your IPM referring to the "List of IPM built-in functions" in chapter 3.

3.1 Protection operations in general

3.1.1 Range of protection

- The protection functions included in the IPM are designed for non-repetitive abnormal phenomena.
- Do not apply constant stress that exceeds the rating.

3.1.2 Countermeasures for alarm output

- If an alarm is output, stop the input signal into the IPM immediately to stop the equipment.
- The IPM protection functions protect against abnormal phenomena, but they cannot remove the causes of the abnormalities. After stopping the equipment, restart it after you have removed the cause of the abnormality.

3.2 Precautions for the protection functions

3.2.1 Overcurrent

- The overcurrent protection function (OC) executes a soft shutdown of the IGBT and outputs an alarm when the overcurrent continues in excess of the insensitive time (tdoc).
  Accordingly, OC does not operate when the overcurrent is removed within the tdoc period.
- In P619, the current is detected on the N-line, so there is no OC for the upper arm.

3.2.2 Starting with load short-circuit

- The OC has an insensitive time (tdoc) of approximately 5 to 10 μs. If the input signal pulse width is shorter than this, the OC does not operate.
- If an input signal pulse width of tdoc or less continues when starting with the load shorted, short circuits occur continuously and the chip temperature of the IGBT rises rapidly.
  In such a case, the rise of the case temperature does not follow the rise of the chip temperature and the case temperature overheating protection function (TcOH) does not operate. Normally the chip temperature overheating protection function (TjOH) operates and provides protection, but as TjOH also has a delay of approximately 1 ms, depending on the state of the chip temperature rise, the protection operation may not occur in time, possibly causing damage to the chip.

3.2.3 Ground short

- If a ground short occurs and an overcurrent flows through the lower arm of the IGBT, overcurrent protection by OC occurs for all IPMs.
- If a ground short occurs and an overcurrent flows through the upper arm of the IGBT, the protection operation differs according to the package and the model.
  P621, P622
    Overcurrent protection is provided by the OC of the upper arm. Alarm output also is provided.
  P610, P611, P612
    Overcurrent protection is provided by the OC of the upper arm, but there is no alarm output.
    For details, refer to the related document MT6M3046 "Protection in R-IPM Earth Fault Mode".
  P619, P617
    As there is no OC for the upper arm, there is no overcurrent protection and no alarm output.

3.3 FWD overcurrent protection

- FWD current is not detected. Accordingly, there is no protection when overcurrent flows only for FWD.

3.4 Case temperature protection

- TcOH is the protection function used when the temperature of the entire insulation substrate rises. Accordingly, the chip temperature protection function (TjOH) operates when the heating is concentrated on one chip.

3.5 Chip temperature protection

- A chip temperature protection function (TjOH) is built into all IGBTs, including the brake part.

4 Power Cycling Capability

The lifetime of semiconductor products is not eternal. Accumulated fatigue by thermal stress resulting from rising and falling temperatures generated within the device may shorten the lifetime of the components. Narrow the range of temperature variations as much as possible.

5 Other

5.1 Precautions for usage and installation into equipment

(1) Also read the IPM delivery specifications for IPM use and installation into the device.

(2) Always prevent secondary damage by installing a fuse or a circuit breaker with a suitable capacity between the commercial power source and this product, keeping in mind the possibility of chip damage caused by unexpected accidents.

(3) When investigating the chip duty at the time of a normal turn-off operation, make sure that the operation track for the turn-off voltage and current is within the RBSOA specifications.
When investigating the chip duty with non-repetitive short-circuit interruption, make sure that it is within the SCSOA specifications.

(4) Use this product upon full understanding of the product usage environment and upon investigation of whether the product reliability life is satisfactory or not. In case of use in excess of the reliability life of the product, the chip may be destroyed before the target life of the device.

(5) Apply a thermal compound or the like between the IPM and the heat sink to make the contact heat resistance as small as possible.

(6) Use the IPM within the range specified in the specifications for the screw torque and the heat sink flatness.
Incorrect handling can cause insulation failure.

(7) Take care so that no load is placed on the IPM. Particularly, the control terminal should not be bent.

(8) Do not perform soldering by reflow on the main terminal and control terminal. Take care to prevent any effect on the IPM by heat, flux, and washing solutions used for soldering other components.

(9) Avoid locations where corrosive gases are generated or dust is present.

(10) Take care to prevent high-voltage static electricity entering the main terminal and control terminal.

(11) When removing and attaching the control circuit and the IPM, first confirm that Vcc is 0 V.

Chapter 7

Trouble Shooting

Contents Page

1 Trouble Shooting

In comparison to standard modules, IPMs have various protection functions (overcurrent, overheating, etc.) built in, so that their devices are not easily destroyed by abnormal conditions. However, destruction may occur depending on the abnormality, so that countermeasures are required once the cause and state of occurrence have been clarified. An analysis diagram indicating the cause of destruction is shown on page 2 and should be used to investigate the causes of destruction.

(For element fault judgment, refer to the Module Application Manual, chapter 4, item 2 "Fault Judgment Method".)

Also, in the case of alarm output from the IPM, use the alarm cause analysis diagrams of Fig. 7-2 to investigate the cause.

2 Fault Analysis Diagrams

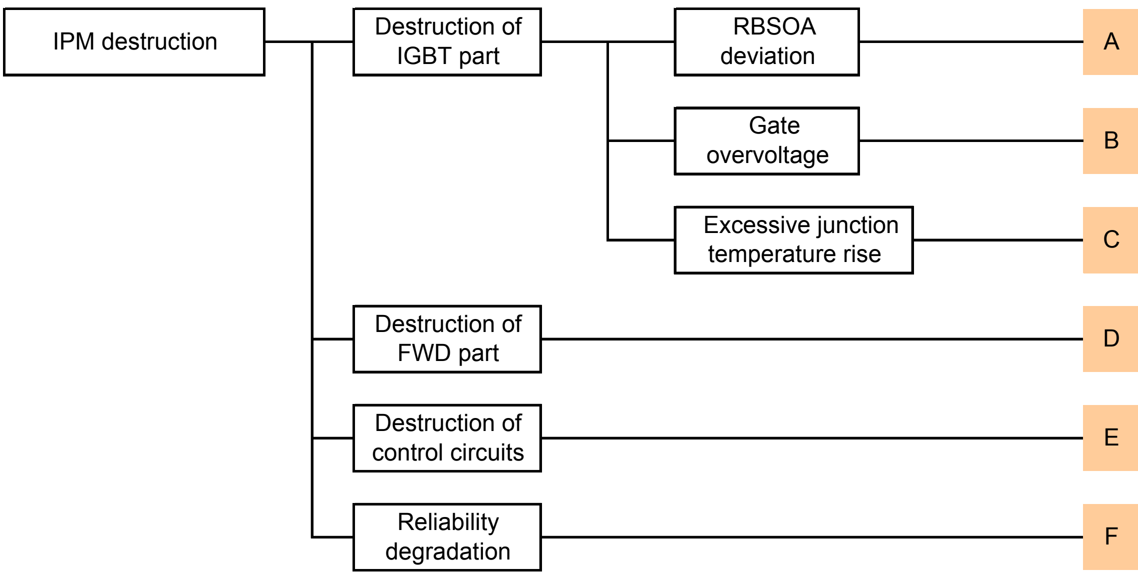

Fig. 7-1 (a.) IPM Fault Analysis Diagram (The letters A to F connect to the following diagrams.)

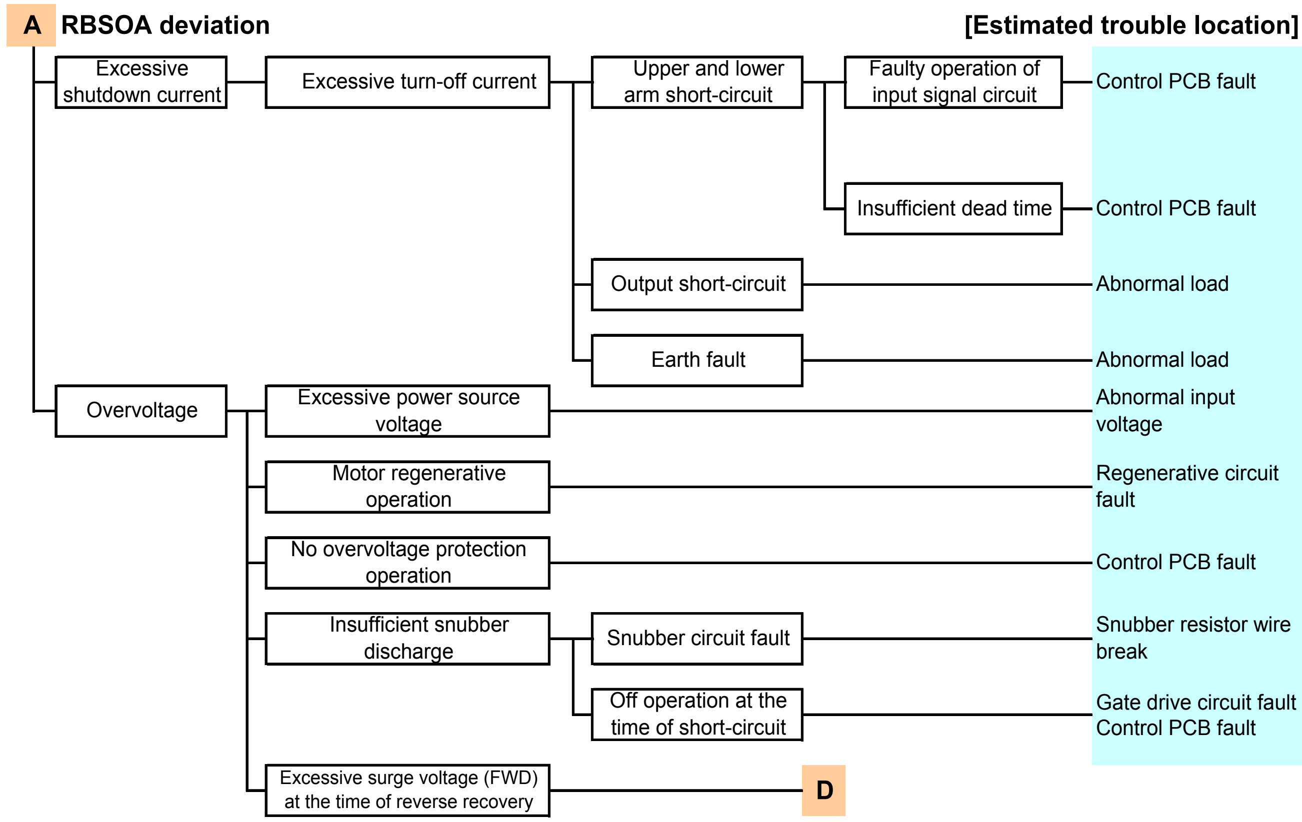

Fig. 7-1 (b) Mode A: RBSOA Deviation

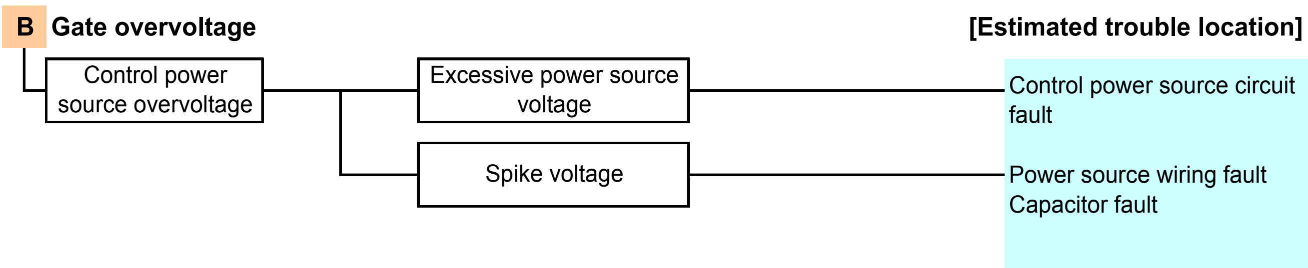

Fig. 7-1 (c) Mode B: Gate Overvoltage

C Excessive junction temperature rise (rapid temperature rise)

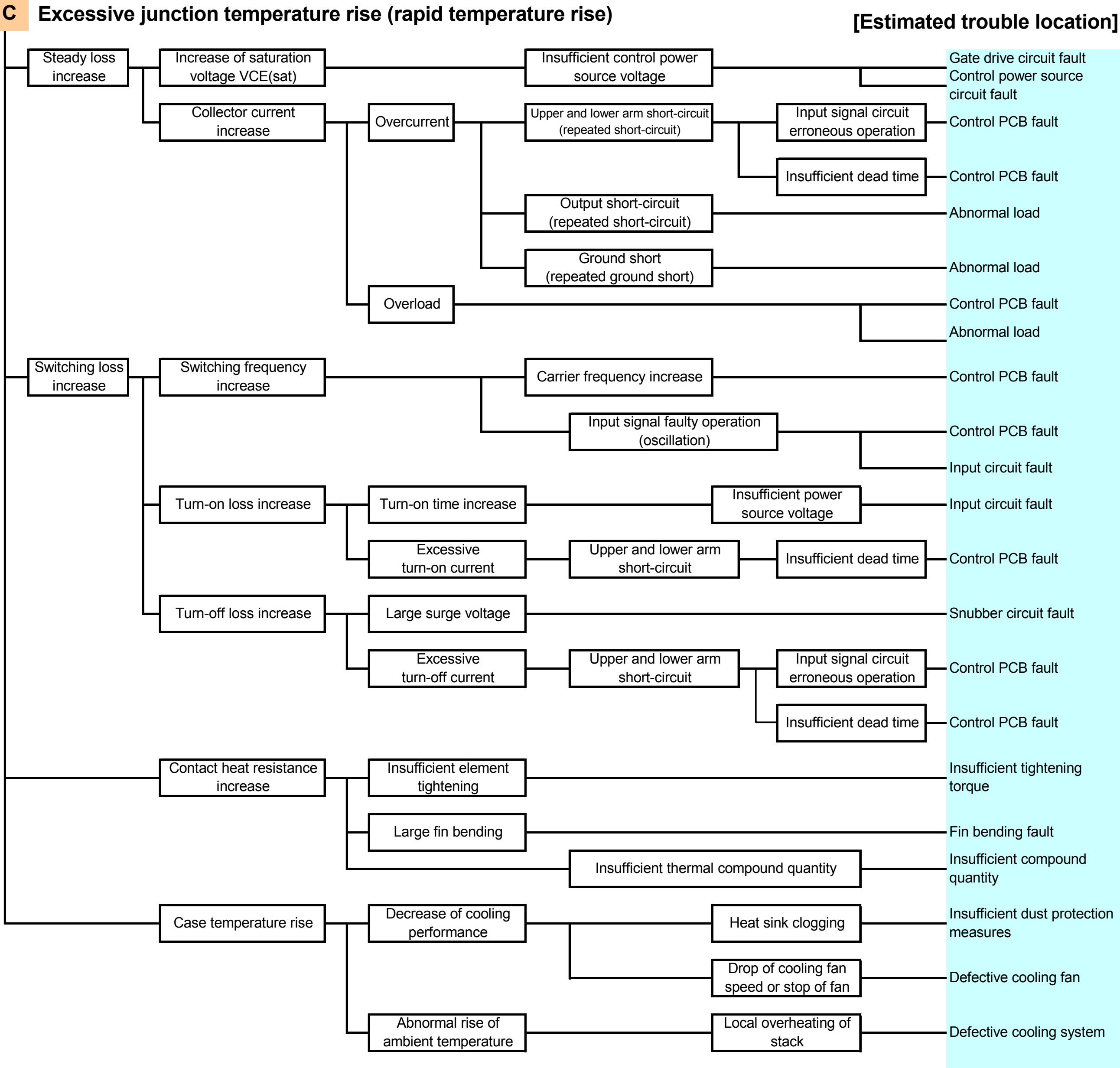

Fig. 7-1 (d) Mode C: Excessive Rise in Junction Temperature

D Destruction of FWD part

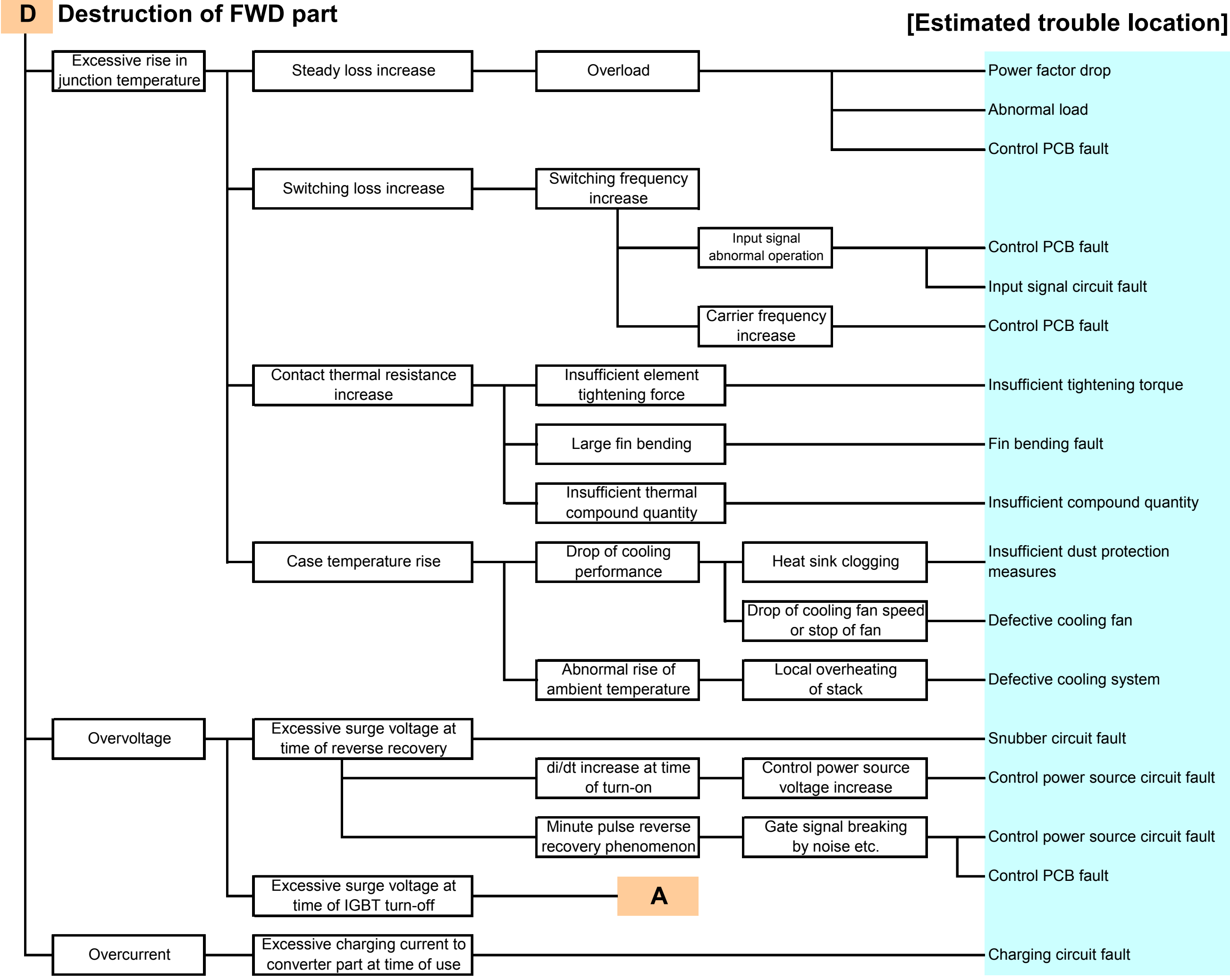

Fig. 7-1 (e) Mode D: Destruction of FWD Part

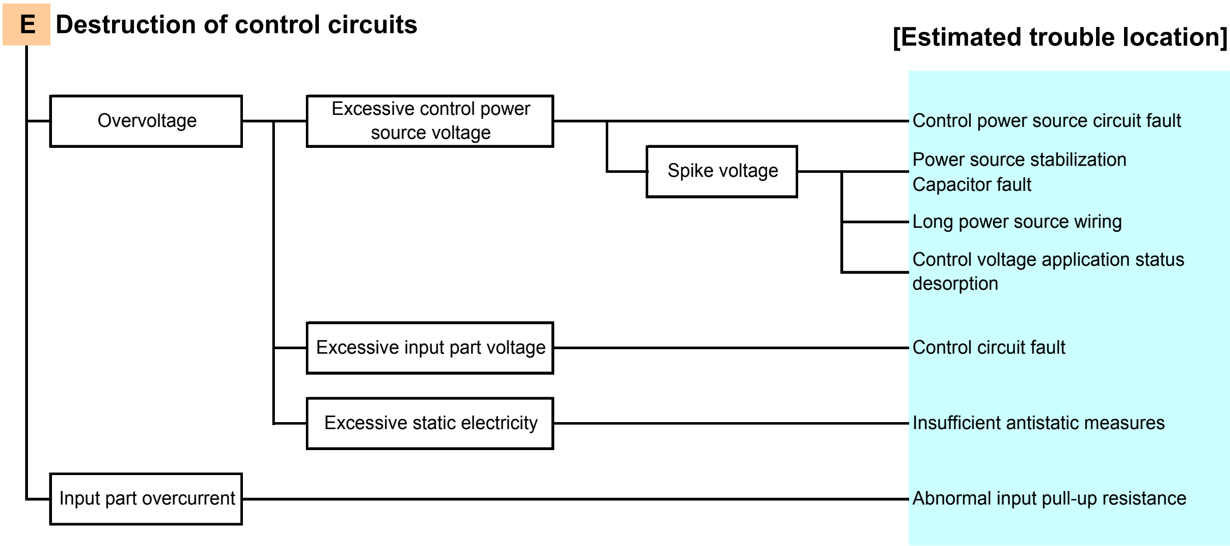

Fig. 7-1 (f) Mode E: Destruction of Control Circuit

F Damage related to reliability and product handling

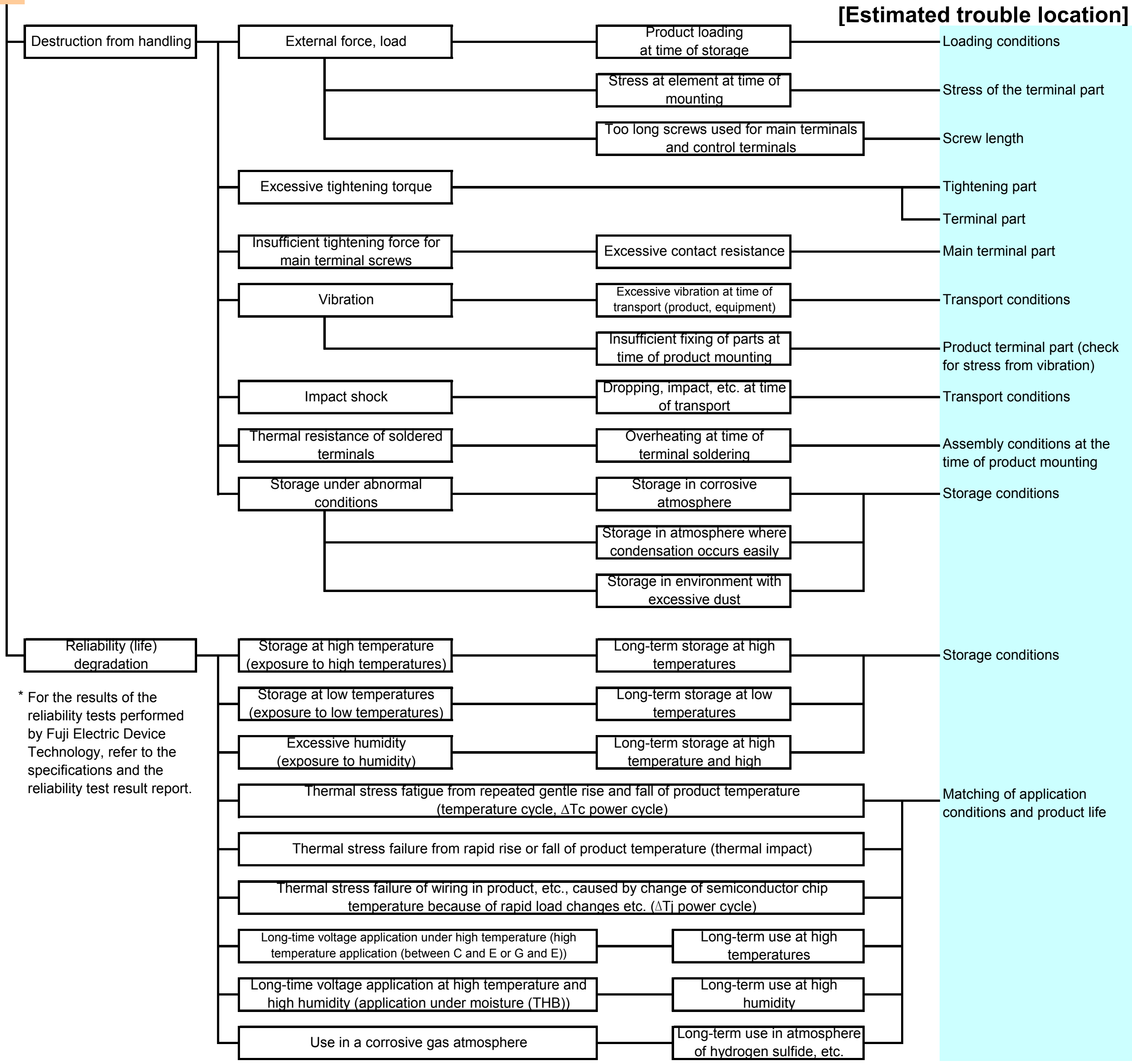

Fig. 7-1 (g) Mode F: Damage Related to Reliability and Product Handling

3 Alarm Cause Analysis Diagram

3.1 Cause analysis in the event an IPM alarm occurs

When an inverter using an IPM comes to an alarm stop, a survey must first be done to find out whether the alarm was output from the IPM or from a device control circuit (other than the IPM).

If the alarm was output by the IPM, determine the cause according to the following cause analysis diagram.

For observation of whether there is an IPM alarm or not via the alarm output voltage, the presence or absence of an alarm output can be confirmed easily by inserting a 1.5 kΩ resistor between the IPM alarm terminal and the cathode of the alarm photodiode and measuring the IPM alarm terminal voltage.

IPM alarm occurrence

Phenomenon		Explanation of alarm cause	How to determine alarm cause
Normal alarm	TjOH	The chip temperature Tj is detected by the temperature detection element (diode) built into all IGBTs. When TjOH exceeds the trip level continuously for 1 ms or longer, the IGBT is switched off for protection.	• Measure the control power source voltage Vcc, the DC input voltage d, the output current Io. • Measure the case temperature Tc directly under the chip, calculate ΔTj-c, and estimate Tj. • Confirm the IPM installation method. (Fin flatness, thermal compound, etc.) • The alarm holding time in many cases is longer than 2 ms.
	OC	The collector current is detected by the current flowing through the current sensing IGBT built into all IGBT chips. When the overcurrent trip level is exceeded continuously for approximately 5 μs or longer, the IGBT is switched off for protection.	• Observe the alarm and the output current (U, V, W) with an oscilloscope. • Observe the alarm and the DC input current (P, N) with an oscilloscope. • Observe the current change 5 μs before alarm output. • Confirm the trip level and the detection location in case of current detection with CT, etc. • The alarm holding time in many cases is 2 ms.
	UV	When the control power source voltage Vcc drops below the undervoltage trip level continuously for 5 μs or longer, the IGBT is switched off for protection.	• Observe the alarm and Vcc with an oscilloscope. • Observe the power source voltage change 5 μs before alarm output • In case of instantaneous voltage drops, the alarm holding time in many cases is 2 ms.
	TcOH	The insulation substrate temperature is detected by the temperature detection element (IC) installed on the same ceramic substrate as the power device. When the TcOH trip level is exceeded continuously for 1 ms or longer, the IGBT is switched off for protection.	• Measure the temperature at the side of the copper base with a thermocouple. • Observe the alarm output period with an oscilloscope. • The possibility that the alarm is TcOH is large when output is made for a longer period than the 2 ms of the alarm holding time.
Faulty alarm		• When the control power source voltage Vcc exceeds the absolute max. rating of 20 V or when an excessive dv/dt or ripple is applied, the drive IC may be damaged or a faulty alarm output. • When noise current flows in the IPM control circuit, the IC voltage may become unstable and a faulty alarm output.	• A short pulse alarm in the order of μs is output. • Observe the Vcc waveform during motor operation with an oscilloscope, preferably in the vicinity of the IPM control terminals. • Vcc < 20 V, dv/dt ≤ 5 V/μs, and Vripple ≤ 2 Vp-p shall apply (all four power supplies). • Confirm that there is no external wiring between IPM control GND and main terminal GND. In case of wiring, noise current flows into the IPM control circuit. • When the drive IC is damaged, there is a high possibility of abnormal increase of Icc. Ex.: If Iccp ≥ 10 mA @Vin = "High", confirm the abnormality of IPM peripheral circuits. Refer to "Cautions for Design and Application" and "Application Circuit Examples" in the delivery specifications.

Fig. 7-2 Alarm Cause Analysis Diagram

WARNING

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of February 2004. The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.

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4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
   - Computers • OA equipment • Communications equipment (terminal devices) • Measurement equipment
   - Machine tools • Audiovisual equipment • Electrical home appliances • Personal equipment • Industrial robots etc.

5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Device Technology Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
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   - Traffic-signal control equipment • Gas leakage detectors with an auto-shut-off feature
   - Emergency equipment for responding to disasters and anti-burglary devices • Safety devices

6. Do not use products in this Catalog for the equipment requiring strict reliability such as (without limitation)
   - Space equipment • Aeronautic equipment • Nuclear control equipment
   - Submarine repeater equipment • Medical equipment

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Table of contents

1 Abstract

The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device. This Application Note is intended to provide an explanation of the parameters and diagrams given in the datasheet of industrial IGBT modules. With the Application Note, the designer of power electronic systems, requiring an IGBT module, is able to use the datasheet in a proper way and will be provided with background information.

2 Introduction

The parameters listed in the datasheet are values that describe the characteristics of the module as detailed as possible.

With this information, the designer should be able to compare devices from different suppliers to each other. Furthermore, the information should be sufficient to figure out the limits of the device.

This document explains the interaction between the parameters and the influence of conditions like temperature. Datasheet values that refer to dynamical characterization tests, e.g. switching losses, are related to a specific test setup with its individual characteristics. Therefore, these values can deviate from a user's application.

The attached diagrams, tables and explanations are referring to the datasheet of a FS200R07N3E4R_B11 rev.2.0 from 2011-04-06 as an example. The values and characteristics shown are not necessarily feasible to be used for design-in activities. For the latest version of datasheets please refer to our website.

Infineon's datasheets of IGBT power modules are structured as listed below:

- Summarized device description on the front page as shown in Figure 1
- Maximum rated electrical values of IGBT-chips
- Recommended electrical operating conditions of IGBT-chips
- Maximum rated electrical values of diode-chips
- Recommended electrical operating conditions of diode-chips
- NTC-Thermistor if applicable
- Parameters concerning the overall module
- Operating characteristics
- Circuit diagram
- Package outline
- Terms and conditions of usage

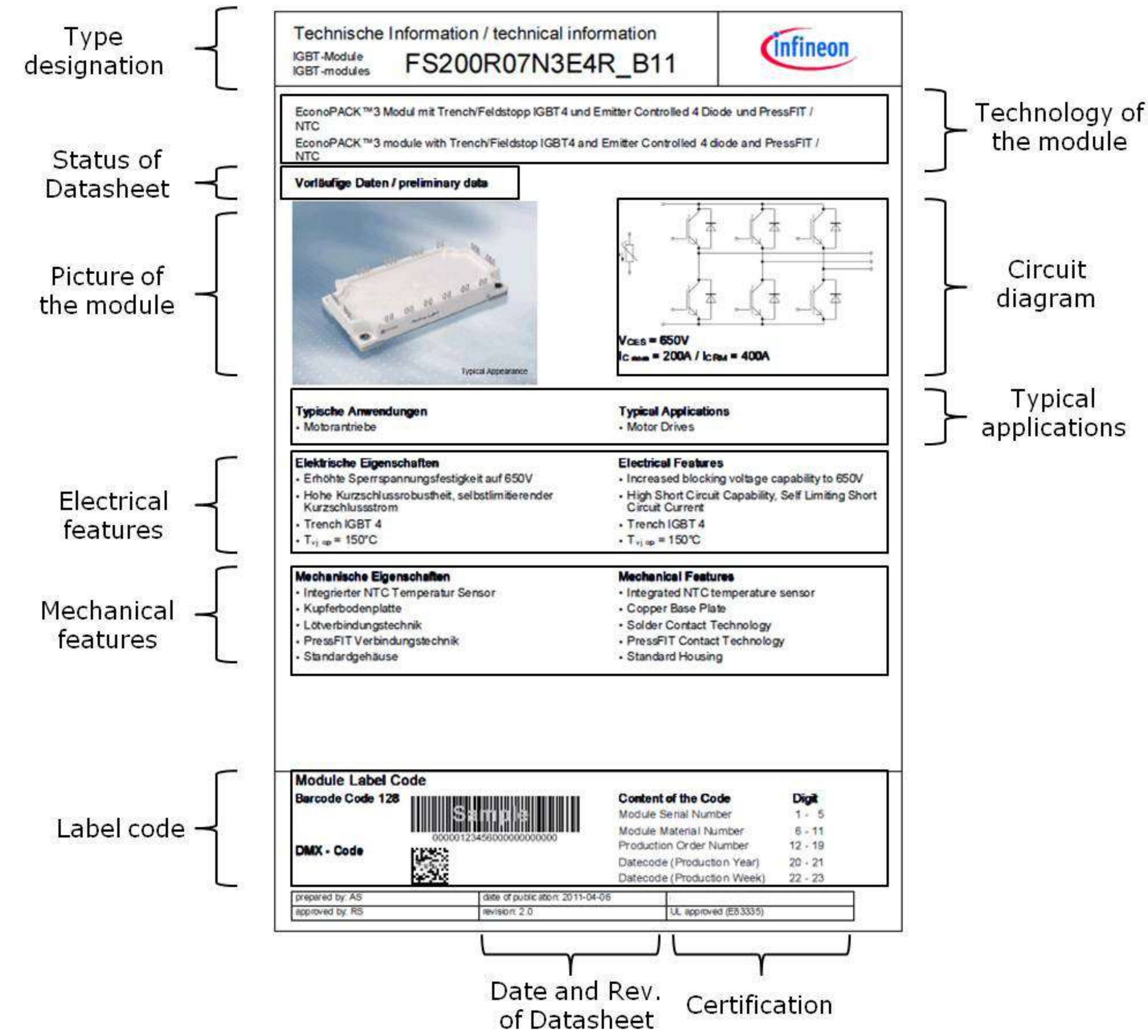


Figure 1: Front page of the datasheet

There are also datasheets for older IGBT modules i.e. BSM100GAL120DLCK, where the front page as shown in Figure 1 does not exist.

2.1 Status of datasheets

Depending on the status of the product development, the relating technical information contains:

- **Target data**

The numbers in these datasheets are target values, which are expected to be achieved. Values from these target datasheets are useful for the initial calculations and approximations. The information and values of a target datasheet cannot be guaranteed for the final product. The dimensioning of an inverter should only be done with values based on a preliminary or final datasheet.

During the development phase, the modules are labeled with their type designation and carry the suffix ENG. Modules with the ENG designation are supplied with a Sample Release Document. Important information can be taken from this additional Sample Release Document, e.g. which values of the module are already fixed and which values can still change during the development phase. ENG module samples are used for preliminary and functional tests during the early stages of a product development phase. Samples marked as ENG are not liable to Product Change Notification (PCN).

- **Preliminary data**

The difference between a preliminary and a final datasheet is, that certain values are still missing, for example the maximum values. These missing values in the preliminary datasheet are marked *to be defined* (t.b.d.).

Modules without ENG on the label reached series production status. All quality requirements are completely fulfilled. If any major change to a module with series production status is necessary, customers must be informed by means of a PCN containing information about the type and extent as well as the time of the changes.

This also applies to modules that have preliminary datasheets.

- **Final data**

The final datasheet is completed with the values which were missing in the preliminary datasheet. Major changes of module characteristics or changes in datasheet values in the series status are accompanied by a PCN.

2.2 Type designation

The first section of the datasheet begins with the type designation of the module as shown in Figure 2.

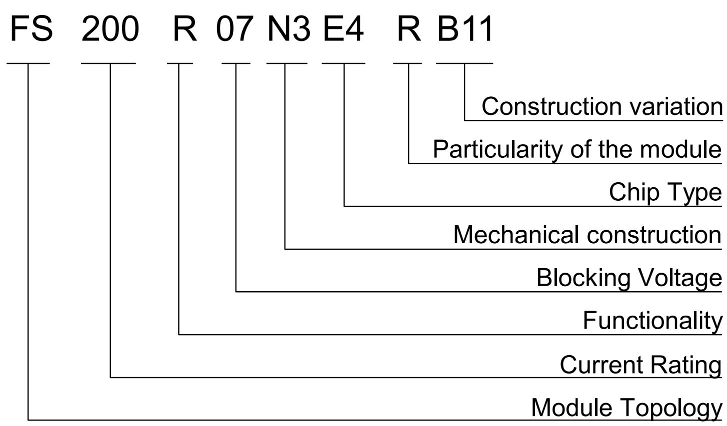


Figure 2: Structure of the type designation

The following tables give a detailed insight to the type designation of Infineon’s industrial IGBT Modules.
As an example the FS200R07N3E4R_B11 is chosen.

FS	200	R	07	N	E	4	R	B11	Explanations
FF									Dual switch
FZ									Single switch
FS									3 phase full bridge
FP									Power integrated module
FB									Power integrated module with single phase input rectifier
FM									Matrix converter module
FR									Switched reluctance module
F4									H bridge
F5									Module with 5 switches
FD/ DF									Chopper configuration
DD									Dual diode (for circuit see outline)
F3L									3-Level one leg IGBT module
FS3L									3-level 3 phase bridge
FT									Tripack
	200								Max. DC-collector current
		R							Reverse conducting
		S							Fast diode
		T							Reverse blocking
			06 07 12 17 33 45 65						Collector-emitter-voltage in 100 V 07 denotes 650V
				K					Mechanical construction: module
				H					Package: IHM / IHV B-Series
				I					Package: PrimePACK™
				M					Econo DUAL™
				N1..3					EconoPACK™1..3
				O					EconoPACK™+
				P					EconoPACK™4
				U1..3					Package: Smart 1..3
				V					Easy 750
				W1.. 3					EasyPACK , EasyPIM™ 1..3
					F				Fast switching IGBT chip
					H				High speed IGBT chip
					J				SiC JFET chip
					L				Low Loss IGBT chip
					S				Fast Short tail IGBT chip
					E				Low Sat & fast IGBT chip
					T				Fast trench IGBT
					P				Soft switching trench IGBT
						1..n			Internal reference numbers
							C		With Emitter Controlled-Diode
							D		Higher diode current
							F		With very fast switching diode
							G		Module in big housing
							I		Integrated cooling
							P		Pre-applied thermal interface material
							R		Reduced numbers of pins
							T		Low temperature type
							-K		Design with common cathode
								B1..n	Construction variation
								S1..n	Electrical selection

BSM100GB120DLx as an Example for the old designation

BSM	**100**	**GB**	**120**	**DLx**	**Explanations**
BSM					Switch with IGBT and FWD
BYM					Diode module
	100				Max. DC-collector current (A)
		GA			Single switch with one IGBT and FWD
		GB			Half bridge
		GD			3 phase full bridge
		GT			3 single switches and FWD
		GP			Power integrated module B6 / Break / Inverter
		GAL			Chopper module (diode on collector side)
		GAR			Chopper module (diode on emitter side)
		A			Single diode
			120		Collector-emitter-voltage in 10V
				DL	Typ with low V_{CEsat}
				DN2	Fast switching type
				DLC	Low loss type with Emitter Controlled-diode
				S	With collector sense
				G	Design variation
				Exx	Special type

Example for MIPAQ module IFS150B12N3T4

Designation of MIPAQ (Module Integrating Power, Application and Quality)									
I	**FS**	**150**	**B**	**12**	**N3**	**T**	**4**		**Explanations**
I									MIPAQ family
	FF								Dual switch
	FZ								Single switch
	FS								3 phase full bridge
	FT								Tripack
	FP								Power Integrated Module
		150							Max. DC-collector current in A
			B						With current sensor
			S						With digital current measurement
			V						With gate driver and temperature measurement
				12					Collector-emitter-voltage in 100 V
					N1..3				Package: EconoPACK™1..3
					P				Package: EconoPACK™4
					U1..3				Package: Smart1..3
						S			Fast Short tail IGBT chip
						E			Low Sat & fast IGBT chip
						T			Thin IGBT
						P			Soft switching IGBT chip
							1..n		Internal reference numbers
								B1..n	Construction variation
								S1..n	Electrical selection

2.3 Module Label Code

To facilitate the handling of the module from logistic's and traceability point of view, all Infineon IGBT modules are considered as unique and labeled as represented in Figure 3. Each module can be identified with its material number, serial number, date code and lot number. All IGBT modules follow similar rules for labeling and identification. Bar code or DMX codes are given on the modules for automated identification. Test data are stored for eleven years.

Module Label Code

Barcode Code 128: Sample 00000123456000000000000

DMX - Code

Content of the Code	Digit
Module Serial Number	1 - 5
Module Material Number	6 - 11
Production Order Number	12 - 19
Datecode (Production Year)	20 - 21
Datecode (Production Week)	22 - 23

Figure 3: Example of Module Label Code

3 Datasheet parameters IGBT

This section explains the electrical properties of the IGBT chip inside the given IGBT module.

If one of these maximum ratings presented in the datasheet is exceeded, it may result in a breakdown of the semiconductor, even if the other ratings are not stressed to their limits. Unless specified to the contrary, the values apply at a temperature of 25°C.

3.1 Collector - emitter voltage V_{CES}

The permissible peak collector - emitter voltage is specified at a junction temperature of 25°C as seen in Figure 4. This value decreases for lower temperatures with a factor of approximately $B_{V_{CES}} \approx 0.1\frac{\%}{K}$.

Kollektor-Emitter-Sperrspannung collector-emitter voltage	T_{vj} = 25°C	V_{CES}	650	V

Figure 4: Collector - emitter voltage of the IGBT

3.2 Total power dissipation P_{tot}

This parameter as shown in Figure 5 describes the maximum feasible power dissipation through the thermal resistance junction to module case R_{thJC}.

Gesamt-Verlustleistung total power dissipation	T_C = 25°C, T_{vj} = 175°C	P_{tot}	600	W

Figure 5: Maximum rating for P_{tot}

The total power dissipation can be calculated in general to be:

$$P_{tot} = \frac{\Delta T}{R_{th}} \tag{1}$$

The considered IGBT module is an EconoPACK™ 3 with a base plate structure. The power dissipation is related to ΔT between junction and case and the thermal resistance R_{thJC} between junction and case as hinted out in equation (2).

$$P_{tot} = \frac{T_{vj} - T_C}{R_{thJC}} \tag{2}$$

At a case temperature of 25°C, the power dissipation is specified as a maximum value of:

$$P_{tot} = \frac{(175 - 25)\,K}{0.25\,\frac{K}{W}} = 600W \tag{3}$$

The power dissipation of the diode chips can be calculated the same way as for the IGBTs, in accordance to equation(2).

3.3 DC Collector Current I_C

Based on the total power dissipation, the maximum permissible collector current rating of a module can be calculated with equation (4). Thus, in order to give a current rating of a module, the corresponding junction and case temperature has to be specified, as shown for example in Figure 6. Please note that current ratings without defined temperature conditions have no technical meaning at all.

$$I_C = \frac{T_{vj} - T_C}{R_{thjc} \cdot V_{CEsat}\left(I_C, T_{vj}\right)} \tag{4}$$

Since I_C is not known in equation (4), V_{CEsat} @ I_C is also not known, but can be found within a few iterations. The ratings of continuous DC-collector current are calculated using maximum values for V_{CEsat} to ensure the specified current rating, taking component tolerances into account.

Kollektor-Dauergleichstrom DC-collector current	T_C = 60°C, T_{vj} = 175°C	$I_{C\,nom}$	200	A

Figure 6: DC collector current

3.4 Repetitive peak collector current I_{CRM}

The nominal current rating can be exceeded in an application for a short time. This is defined as repetitive peak collector current in the datasheet as can be seen in Figure 7 for the specified pulse duration. In theory, this value can be derived from the feasible power dissipation and the transient thermal impedance Z_{th}, if the duration of the over current condition is defined. However, this theoretical value is not taking any limitations of bond wires, bus-bars or power connectors into account.

Therefore, the datasheet value is quite low compared to a calculated value based on theory, but it specifies a safe operation considering all practical limitations of the power module.

Periodischer Kollektor Spitzenstrom repetitive peak collector current	t_P = 1 ms	I_{CRM}	400	A

Figure 7: Repetitive peak collector current

3.5 Reverse bias safe operating area RBSOA

This parameter describes safe operating conditions at turn-off for the IGBT. The chip can be driven within its specified blocking voltage up to twice its nominal current rating, if the maximum temperature under switching conditions is not exceeded. The safe operating area of the power module is limited due to the module's internal stray inductances and specified at the maximum temperature under switching conditions as shown in Figure 8. With increasing currents, the allowed DC-Link voltage is decreased. Furthermore, this derating strongly depends on system related parameters, like stray inductance of the DC-Link and the current commutation slope during the switching transitions. The DC-Link capacitor is assumed to be ideal for this operating area. The current commutation slope is defined via a specified gate resistance and gate driving voltage. In no event the voltage spike must not exceed the specified voltage of the module at the terminals or at chip level to keep the RBSOA limits.

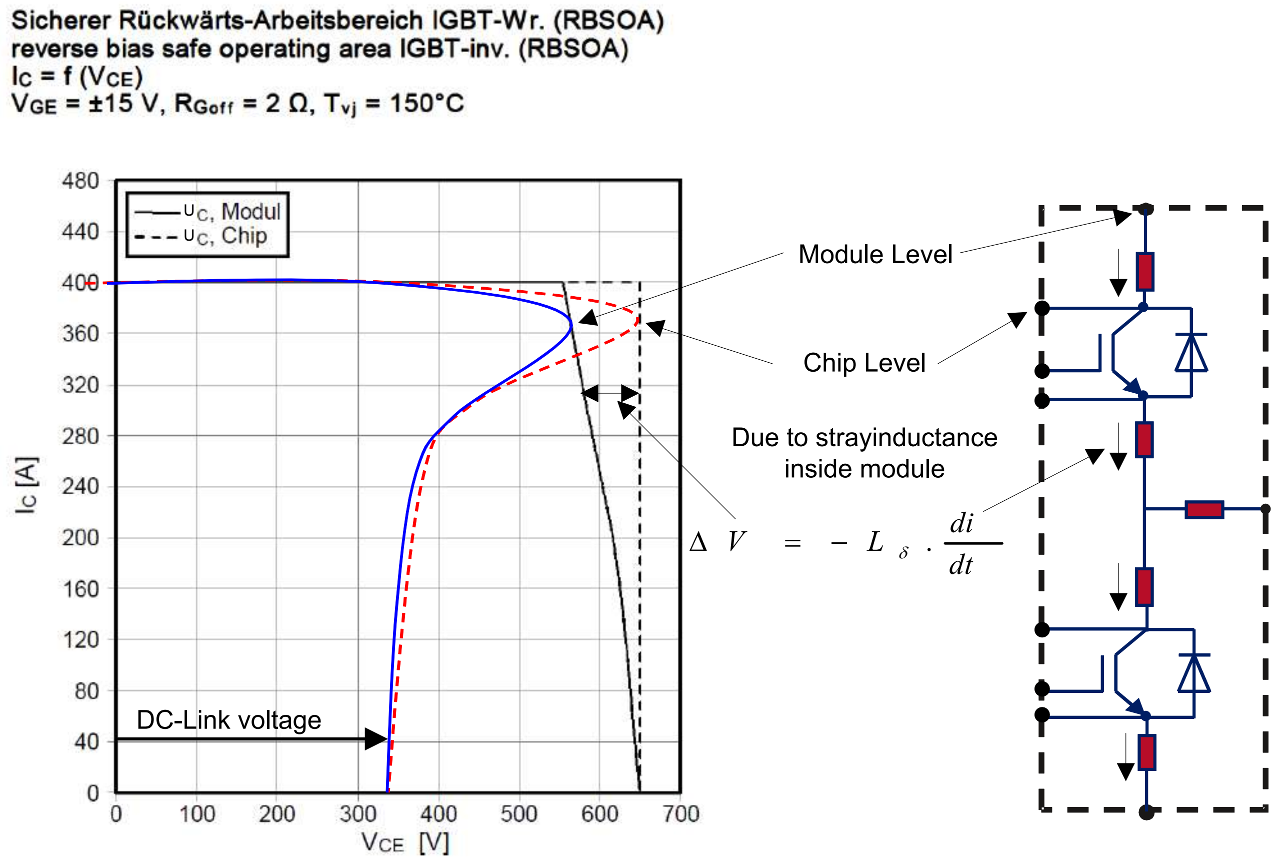


Figure 8: Reverse bias safe operating area

3.6 Typical output and transfer characteristics

This data can be used to calculate conduction losses of the IGBT. In order to contribute to a much better understanding of these parameters, the IGBT device structure as well as it's difference in output characteristic compared to a power MOSFET is discussed briefly. After this, the datasheet parameters of the IGBT module are explained.

Figure 9a shows in detail the structure of a trench-field-stop IGBT with a simplified two-transistor equivalent circuit. The emitter-sided pn-junction of the pnp-transistor resembles the IGBT's collector side. Like a diode it leads to a characteristic voltage drop when the IGBT is conducting current. The intrinsic bipolar transistor of the IGBT is driven by a MOSFET. Therefore, the gate driving characteristic is quite similar to a power MOSFET. The output characteristic is different, which is illustrated in Figure 9b schematically. It shows the characteristic of turned-on devices at two different junction temperatures.

The MOSFET as shown in Figure 9b is reverse conducting for negative drain-source voltages due to its intrinsic body diode. The IGBT has no body diode and thus an anti-parallel diode has to be used, when this operating mode is required. The advantage is, that the external diode can be optimized independently to suit the IGBT's switching characteristics.

In contrast to the MOSFET, that has an on resistance as a dominant parameter, the IGBT has a forward voltage drop. As a result, at very low load, indicated with 1 in Figure 9b, the MOSFET always has lower conduction losses than an IGBT.

Both output characteristics depend on the junction temperature. The $R_{ds(on)}$ of a MOSFET typically increases by a factor of about two, when the junction temperature increases from 25°C to 150°C. The temperature coefficient of an IGBT's forward voltage is much lower. At low load, the conduction losses even decrease with increasing temperature, due to the lower voltage drop at the pn-junction as represented in Figure 9b. At higher currents, the increase of the ohmic resistance is dominant. Due to this, a parallel connection of several IGBTs is possible and is commonly required for high current IGBT power modules.

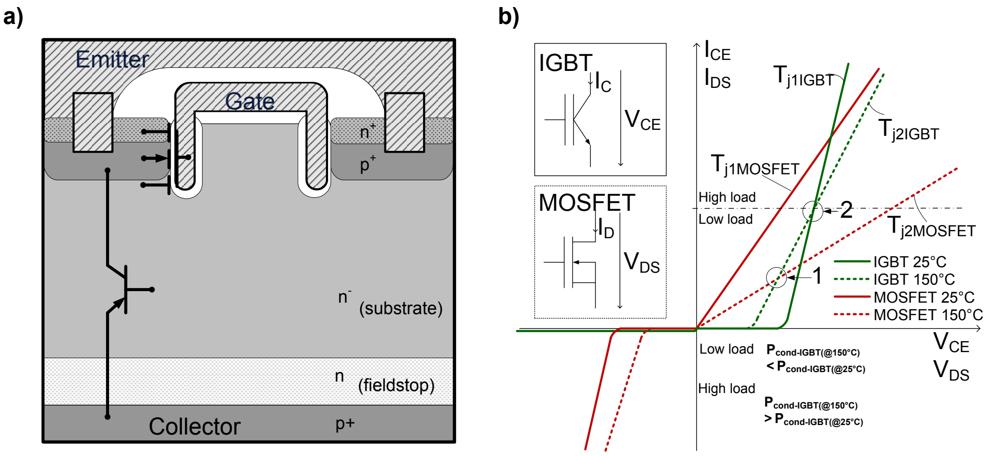


Figure 9: Structure of a Trench-Field-Stop IGBT and two-transistor equivalent circuit (a). Comparison of the output characteristics of power MOSFET and IGBT (b)

The transfer characteristic shows, that the turn-on threshold voltage decreases with increasing junction temperature as seen in Figure 10.

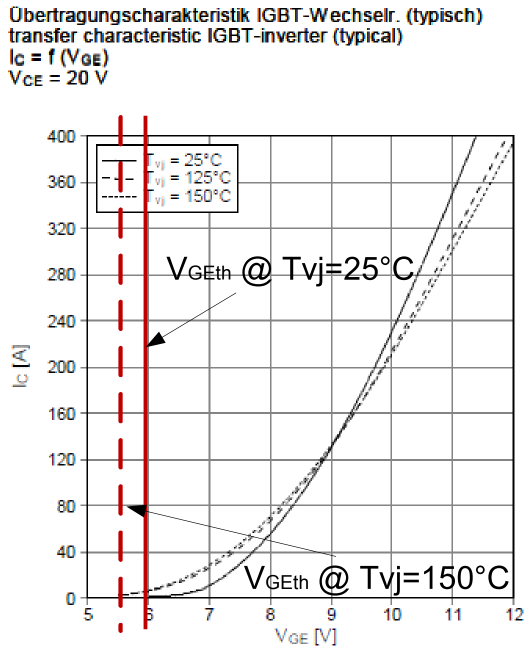


Figure 10: Typical transfer characteristic

As discussed in chapter 3.6, the output characteristic of the IGBT depends on the temperature of the junction. Figure 11a shows the collector current in conducting state as a function of the collector-emitter voltage at different junction temperatures. For currents lower than about 80A, the conduction losses decrease with increasing temperature. For higher currents, the conduction losses increase slightly. In the case considered, an increase in conduction losses of about 6% at nominal current 200A and a temperature increase from 25°C to 150°C can be observed.

a) b)

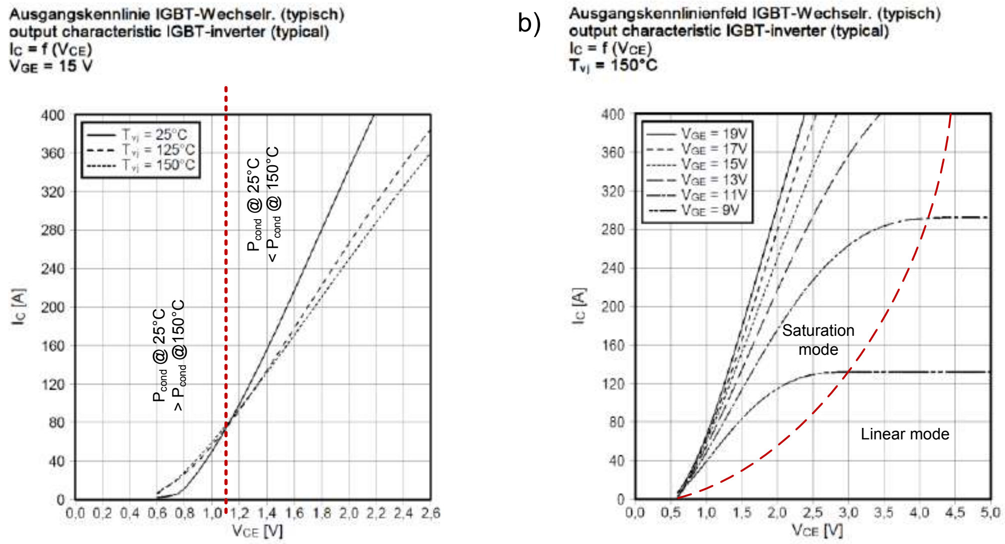


Figure 11: Typical output characteristic as a function of the temperature (a) and gate-emitter voltage variation (b)

Figure 11b shows the typical output characteristic for different gate-emitter voltages. The IGBT should not be operated in linear mode, as this causes excessive conduction losses. If the power dissipation is not limited in magnitude and time, the device might be destroyed. Using 15V as typical gate drive voltage, this linear mode only occurs for short periods at the switching transitions, which is a normal operating condition for the IGBT.

3.7 Parasitic Capacitances

The dynamic characteristics of an IGBT are influenced by several parasitic capacitances. These are inherent parts of the die's internal structure as represented in Figure 12a. A simplified schematic is shown in Figure 12b. The input capacitance C_{ies} and the reverse transfer capacitance C_{res} are the basis for an adequate dimensioning of the gate driver circuit. The output capacitance C_{oss} limits the dV/dt at switching transitions. Losses related to C_{oss} can usually be neglected.

The major parasitic capacitances inside the IGBT die are:

- Input capacitance $C_{ies} = C_{GE} + C_{res}$. C_{GE} includes C_1,C_3,C_4 and C_6.
- Reverse transfer capacitance C_{res} including C_2 and C_5. $C_{res} = C_{CG}$
- Output capacitance C_{ce} represented by C_7. $C_{oss} = C_{CE} + C_{res}$

a) b)

Figure 12: Parasitic capacitances of an IGBT, internal structure a), schematic b)

The values of the parasitic capacitances strongly depend on the operating point of the IGBT. To measure these capacitances with gate- or collector-emitter voltages applied, dedicated measurement circuits according to IEC60747-8 have to be utilized.

Input capacitance C_{ies}

This parameter is determined using the setup in Figure 13. C_{ies} is measured across the gate and emitter connections with collector-emitter connection shorted for AC voltage. The values of the DC voltage across the gate-emitter and collector-emitter connections are specified with the test frequency. Capacitors C_1 and C_2 must form an adequate bypass at the test frequency. The inductor L decouples the DC supply.

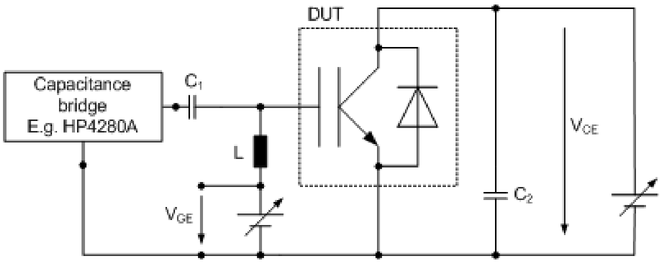


Figure 13: Basic circuit diagram for measuring the input capacitance C_{ies}

Output capacitance C_{oss}

C_{oss} is measured according to the setup in Figure 14. This value is measured across the collector and emitter connections with gate-emitter connections shorted for AC voltage. The values of the DC voltage across the gate-emitter and collector-emitter connections are specified with the test frequency. The capacitors C_1, C_2 and C_3 must form an adequate bypass at the test frequency. The inductor L decouples the DC supply.

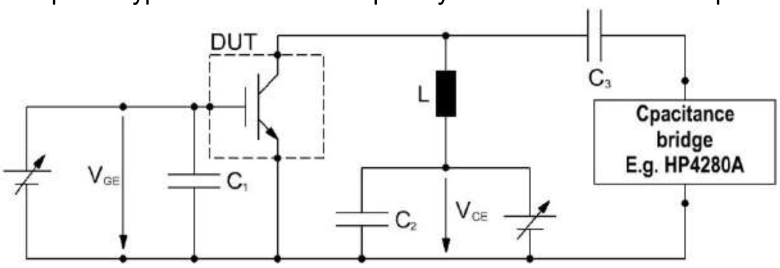


Figure 14: Basic circuit diagram for measuring the output capacitance C_{oss}

Reverse transfer capacitance C_{res}

Figure 15 gives details about the measurement setup for the reverse transfer capacitance. C_{res} is measured across the collector and gate connections, the emitter connection being connected to the protective screen of the bridge. The values of the DC voltage across the gate-emitter connection are specified with the test frequency. Capacitors C_1 and C_2 must form an adequate bypass at the test frequency. The inductors L_1 and L_2 decouple the DC supply.

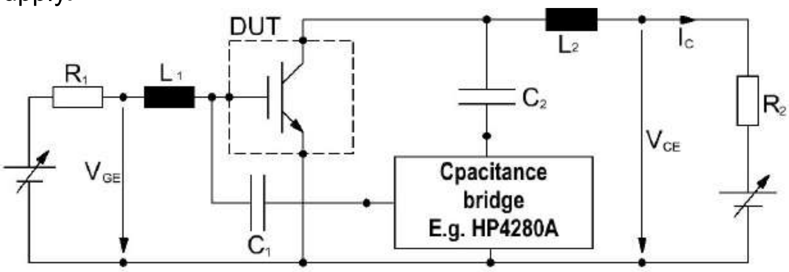


Figure 15: Basic circuit diagram for measuring the reverse transfer capacitance C_{res}

The capacitance meter used for the measurements of C_{ies}, C_{oss} and C_{res} has to be a high resolution capacitance bridge with a sufficient measurement range.

3.8 Gate charge Q_G, gate current, internal and external gate resistor

The value of the gate charge can be used to optimize the design of the gate driver circuit. The average output power that the gate driving circuit has to deliver can be calculated with data of the gate charge, gate driver voltages and switching frequency as given in equation (5).

$$P_{Gdr} = Q_G \cdot \left(V_{GE\,(on)} - V_{GE\,(off)}\right) \cdot f_{sw} \tag{5}$$

Within this formula, Q_G refers to the part of the gate charge that is truly active in the given design. What part is used is depending on the gate driver output voltage; an accurate approximation can be done using the gate charge curve.

The real gate charge Q'_G that has to be taken into account results from the diagram in Figure 16, by choosing the values that correspond to the gate driver's output voltage:

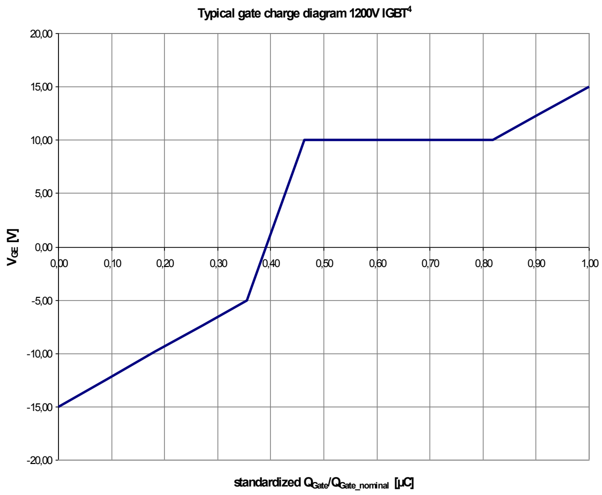


Figure 16: Typical gate charge curve of an 1200V IGBT

Typical values used in industrial applications include designs with a turn-off voltage V_{GE}=0V as well as designs featuring negative supply like V_{GE}=-8V

$Q'_G = 0.62 \cdot Q_G$ for 0V/15V

$Q'_G = 0.75 \cdot Q_G$ for -8V/15V

At a switching frequency of f_{sw}=10 kHz and a driver output voltage of +15/ -8V, the required output power of the gate driving circuit P_{Gdr} can be calculated using the adapted gate charge from Figure 16 and the gate charge as seen in the datasheet Figure 17.

$$P_{Gdr} = 2.15\mu C \cdot 0.75 \cdot (15V + 8V) \cdot 10kHz = 0.37W$$

Gateladung gate charge	V_{GE} = -15 V ... +15 V	Q_G		2,15		µC
Interner Gatewiderstand internal gate resistor	T_{vj} = 25°C	R_{Gint}		2,0		Ω

Figure 17: Gate charge and internal gate resistor

The theoretical gate drive peak current can be calculated according to equation (6), knowing the gate drive voltages and gate resistances. The gate resistor is the sum of external and internal gate drive resistance. Figure 17 shows the value for the internal resistance to be considered.

$$I_{Gdr,peak} = \frac{V_{GE(on)} - V_{GE(off)}}{R_{Gext} + R_{Gint}} \tag{6}$$

In practice, this peak current will not be reached, because it is limited by stray inductances and non-ideal switching transitions of a real gate driving circuit.

The datasheet value given for the internal gate resistor has to be understood as a single resistance and may result from paralleled resistors inside the IGBT module as illustrated in Figure 18. This usually counts for larger modules only, especially medium- and high-power types. These internal resistors lead to improved internal current sharing.

The internal resistance should be considered as one part of total gate resistor to calculate the peak current capability of a driver.

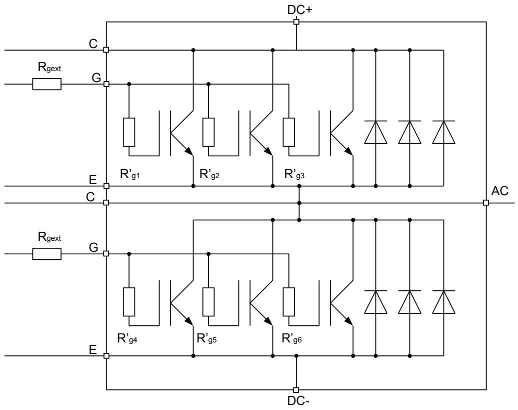


Figure 18: internal gate resistor of the IGBT

The designer can use the external gate resistor to influence the switching performance of the IGBT. Minimum R_{Gon} is limited by turn-on di/dt, minimum R_{Goff} is limited by turn-off dV/dt. Too small gate resistors can cause oscillations and may lead to damage the IGBT or diode. The minimum recommended external gate resistor R_{Gext} is given in the switching losses test conditions as mentioned in Figure 19. The allowed external gate resistor values are shown in the switching loss diagram of Figure 24b.

Einschaltverlustenergie pro Puls turn-on energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 30 nH V_{GE} = ±15 V, di/dt = 5700 A/µs (T_{vj}=150°C) R_{Gon} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		1,10 1,70 2,00		mJ mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 30 nH V_{GE} = ±15 V, du/dt = 4000 V/µs (T_{vj}=150°C) R_{Goff} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		7,90 9,40 9,65		mJ mJ mJ

Figure 19: External gate resistors

3.9 Parasitic turn-on

With the parasitic capacitances of the IGBT, noted in the datasheet as stated in Figure 20, dV/dt induced parasitic turn-on phenomena can occur. The cause of a possible parasitic turn-on is based on the intrinsic capacitive voltage divider between collector-gate and gate-emitter.

In consideration of high voltage transients across collector-emitter, this intrinsic capacitive voltage divider is much faster than an external gate driving circuit that is limited by parasitic inductances. Therefore, even if the gate driver turns off the IGBT with zero gate-emitter voltage, transients of collector-emitter voltage lead to an increase of the gate-emitter voltage. If the gate emitter voltage exceeds the gate threshold voltage V_{GEth}, the

IGBT will turn on. Neglecting the influence of the gate driving circuit, the gate-emitter voltage can be calculated by

$$V_{GE} = \frac{C_{GC}}{C_{GC} + C_{GE}} \cdot \Delta V_{CE} = \frac{C_{res}}{C_{ies}} \cdot \Delta V_{CE} \tag{7}$$

The quotient C_{res}/C_{ies} should be as low as possible. To avoid a parasitic dV/dt induced turn-on, the quotient C_{ies}/C_{res} for the FS200R07N3E4_B11 is about 35. Furthermore, the input capacitance should be as low as possible to avoid gate driving losses; therefore the use of additional gate-emitter capacitance C_{GE} has to be evaluated carefully.

Eingangskapazität input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V	C_{ies}		13,0		nF
Rückwirkungskapazität reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V	C_{res}		0,38		nF

Figure 20: Parasitic capacitances of the IGBT

The parasitic capacitances are determined under the conditions given in Figure 20. The gate-emitter capacitance C_{GE} as shown in Figure 21 can be approximated to be constant over the collector-emitter voltage as shown in equation (8).

$$C_{GE} \approx C_{ies}(25V) - C_{res}(25V) \tag{8}$$

The reverse transfer capacitance C_{res} strongly depends on the collector-emitter voltage and can be estimated according to equation (9).

$$C_{res}(V_{CE}) \approx \frac{C_{res}(25V) \cdot \sqrt{25V}}{\sqrt{V_{CE}}} \tag{9}$$

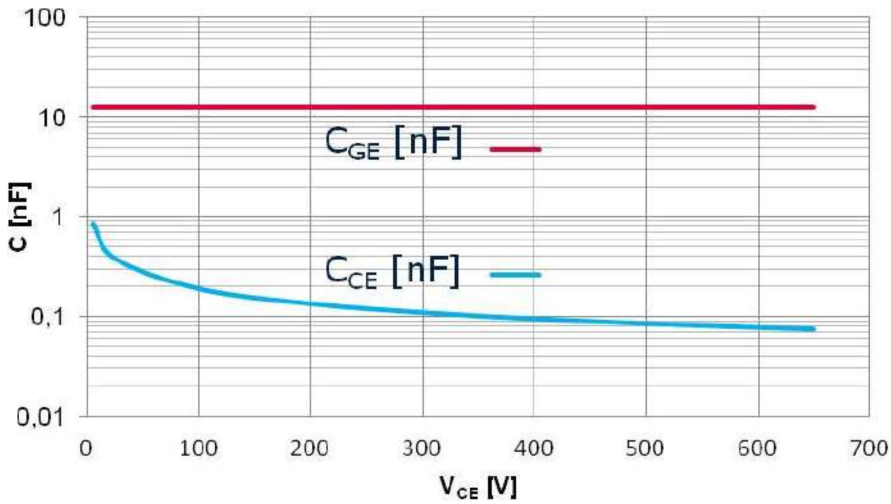


Figure 21: Approximation of C_{GE} and C_{CE} as function of the collector-emitter voltage according to equations (8) and (9)

Consequently, the robustness against dV/dt induced parasitic turn-on increases with the collector-emitter voltage as seen in equation (7).

3.10 Dynamic behavior

The switching characteristic described in the datasheet provides useful information to determine an appropriate dead time between turn-on and turn-off of the complementary devices in a half bridge configuration. For further information about dead time calculation please refer to AN2007-04[1] available at Infineon's website.

- Turn-on delay time t_d on:
  Time it takes from getting the gate-emitter voltage to 10% of the rated value to the moment the collector current reaches 10% of its nominal size
- Rise time t_r:
  Time which the collector current takes to rise from 10% to 90% of its nominal value
- Turn-off delay time $t_{d\ off}$:
  Time necessary from getting the gate-emitter voltage to 90% of the rated value to the moment the collector current reaches 90% of its nominal size
- Fall time t_f:
  Time which the collector current takes to fall from 90% to 10% of his nominal value

The times in the datasheet are defined as detailed in Figure 22:

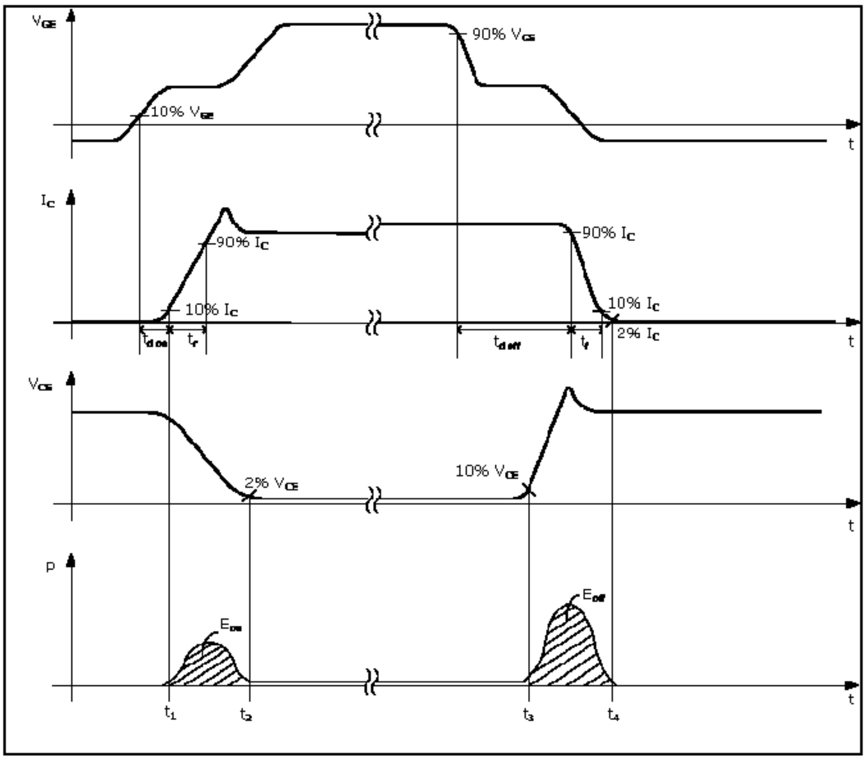


Figure 22: Specification of rise and fall times and conditions to calculate switching losses

[1] Application note 2007-04: How to calculate and minimize the dead time requirement for IGBTs properly.

These times alone will not give reliable information about switching losses, because voltage rise and fall times as well as current tail shape are not specified. Therefore, switching losses per pulse are given separately.

The switching losses per pulse are defined using the integrals:

$$E_{on} = \int_{t_1}^{t_2} U_{CE} \cdot I_C \cdot dt \qquad E_{off} = \int_{t_3}^{t_4} U_{CE} \cdot I_C \cdot dt \qquad (10)$$

The integration limits for the switching losses are given in Figure 22:

- E_{on} as turn-on energy per pulse from t_1 to t_2
- E_{off} as turn-off energy per pulse from t_3 to t_4

Dynamic behavior and thus energy per pulse strongly depend on a variety of application specific operating conditions like gate driving circuit, layout, gate resistance, magnitude of voltages and currents to be switched as well as the junction temperature. Therefore, datasheet values can only give an indication for the switching performance of the power module. For more accurate values, detailed simulations taking application specific parameters into account or experimental investigations are necessary.
Typically, switching transition duration and energy per pulse are characterized at nominal operating conditions for different temperatures as noted in Figure 23.

Einschaltverzögerungszeit (ind. Last) turn-on delay time (inductive load)	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Gon} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ on}$		0,15 0,16 0,17	µs µs µs
Anstiegszeit (induktive Last) rise time (inductive load)	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Gon} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,03 0,04 0,04	µs µs µs
Abschaltverzögerungszeit (ind. Last) turn-off delay time (inductive load)	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Goff} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ off}$		0,34 0,37 0,38	µs µs µs
Fallzeit (induktive Last) fall time (inductive load)	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Goff} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,06 0,07 0,07	µs µs µs
Einschaltverlustenergie pro Puls turn-on energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 30 nH V_{GE} = ±15 V, di/dt = 5700 A/µs (T_{vj}=150°C) R_{Gon} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		1,10 1,70 2,00	mJ mJ mJ
Abschaltverlustenergie pro Puls turn-off energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 30 nH V_{GE} = ±15 V, du/dt = 4000 V/µs (T_{vj}=150°C) R_{Goff} = 2,0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		7,90 9,40 9,65	mJ mJ mJ

Figure 23: Switching times and energies

A first estimation of dynamical losses can be done utilizing Figure 24. The diagram hints out typical losses depending on R_G, I_C and junction temperature T_{vj}. The switching loss diagram Figure 24b and Figure 35b shows also the allowed external gate resistor values. The left end of the curves in Fig 24b and Fig 35b specifies the minimum allowed external gate resistor value. The gate resistors must not be lower because this may lead to a destruction of the device.

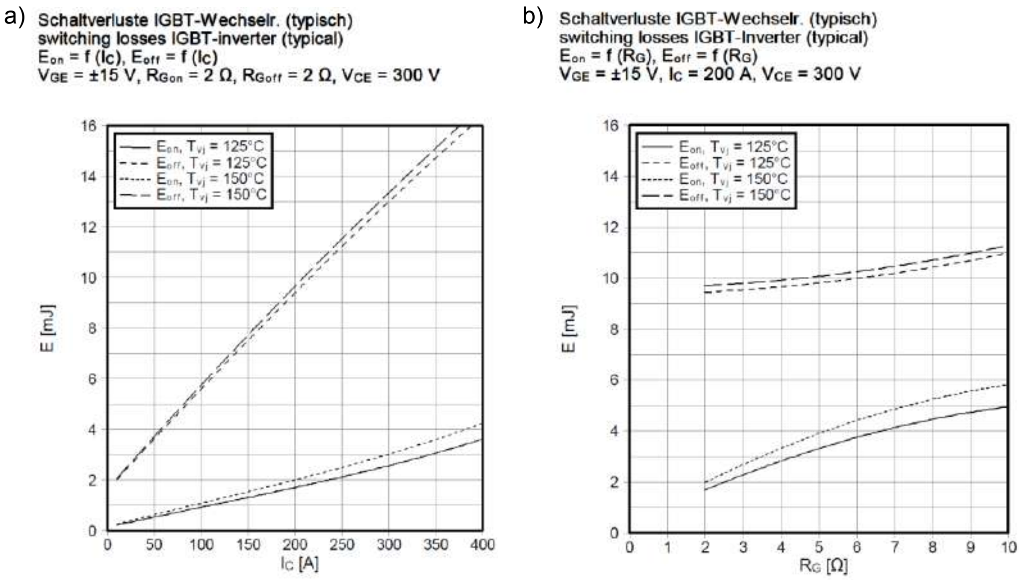


Figure 24: Switching losses per pulse as a function of the collector current and the gate resistance

3.11 Short circuit

The short circuit characteristic strongly depends on application specific parameters like temperature, stray inductances, gate driving circuits and the resistance of the short circuit path. For device characterization, a test setup as drawn in Figure 25a is used. One IGBT is short circuited while the other IGBT is driven with a single pulse. The corresponding typical voltage and current waveforms are illustrated in Figure 25b. The current in the conducting IGBT increases rapidly with a current slope that is depending on parasitic inductances and the DC-Link voltage. Due to desaturation of the IGBT, the current is limited to about 5 times the nominal current in case of IGBT3 and the collector-emitter voltage remains on the high level. The chip temperature increases during this short circuit due to high currents and thus high losses. Because of the increasing chip temperature the current decreases slightly while operating in short circuit condition.
Within a defined short-circuit-withstand time t_{sc} the IGBT has to be switched off to avoid a device failure.

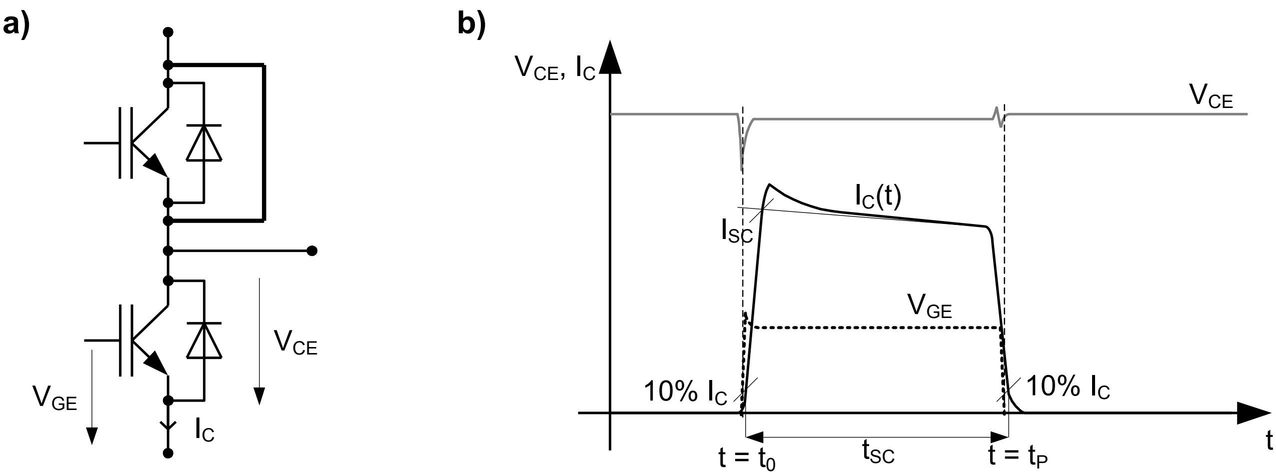


Figure 25: Short circuit test setup (a) and typical voltage/current waveforms during short circuit test (b)

The data of the measured short circuit and the applied parameters are noted in the datasheet as depicted in Figure 26. All of Infineon's IGBT modules are designed to achieve a short circuit-withstand-time of up to 10µs. The IGBT3 600V is an exception as it features a short circuit withstands time of t_p = 6µs

Kurzschlussverhalten SC data	$V_{GE} \le 15$ V, $V_{CC} = 360$ V $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \le 10$ µs, $T_{vj} = 25°C$ $t_P \le 10$ µs, $T_{vj} = 150°C$	I_{SC}		960 760		A A

Figure 26: Short circuit data

3.12 Leakage currents I_{CES} and I_{GES}

Two major types of leakage currents as given in Figure 27 have to be considered:

- The maximum collector-emitter cut-off current describes the leakage current between the collector and emitter, when the IGBT is in blocking mode
- The gate-emitter leakage current gives a hint about the maximum leakage current between gate and emitter, with collector-emitter short circuited and maximum gate-emitter voltage applied.

Kollektor-Emitter Reststrom collector-emitter cut-off current	$V_{CE} = 650$ V, $V_{GE} = 0$ V, $T_{vj} = 25°C$	I_{CES}			1,0	mA
Gate-Emitter Reststrom gate-emitter leakage current	$V_{CE} = 0$ V, $V_{GE} = 20$ V, $T_{vj} = 25°C$	I_{GES}			400	nA

Figure 27: Leakage currents

3.13 Thermal characteristics

The values of power dissipation and current ratings as discussed in chapters 3.2 and 3.3 have no meaning without specification of temperatures as well as thermal resistances. Therefore, in order to compare different devices, it is also necessary to compare thermal characteristics. More information about the thermal equivalent circuit can be found in AN2008-03[2].

When power modules with a base plate or discrete devices are characterized, junction-, case-, and heat sink temperatures are observed. The thermal resistances of junction to case and case to heat sink are specified in the datasheet as given in Figure 28. The datasheet value of the R_{thCH} with a referenced thermal resistance of the thermal interface material is a typical value under the specified conditions.

Innerer Wärmewiderstand thermal resistance, junction to case	pro IGBT / per IGBT	R_{thJC}			0,25	K/W
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro IGBT / per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)	R_{thCH}		0,085		K/W

Figure 28: Thermal resistance IGBT, junction to case and case to heat sink

The thermal resistance characterizes the thermal behavior of the IGBT module at steady state, whereas the thermal impedance characterizes the thermal behavior of the IGBT module at transient conditions like short current pulses. Figure 29a shows the transient thermal impedance Z_{thJC} as a function of the time.

[2]Application note 2008-03: Thermal equivalent circuit model

a) b)

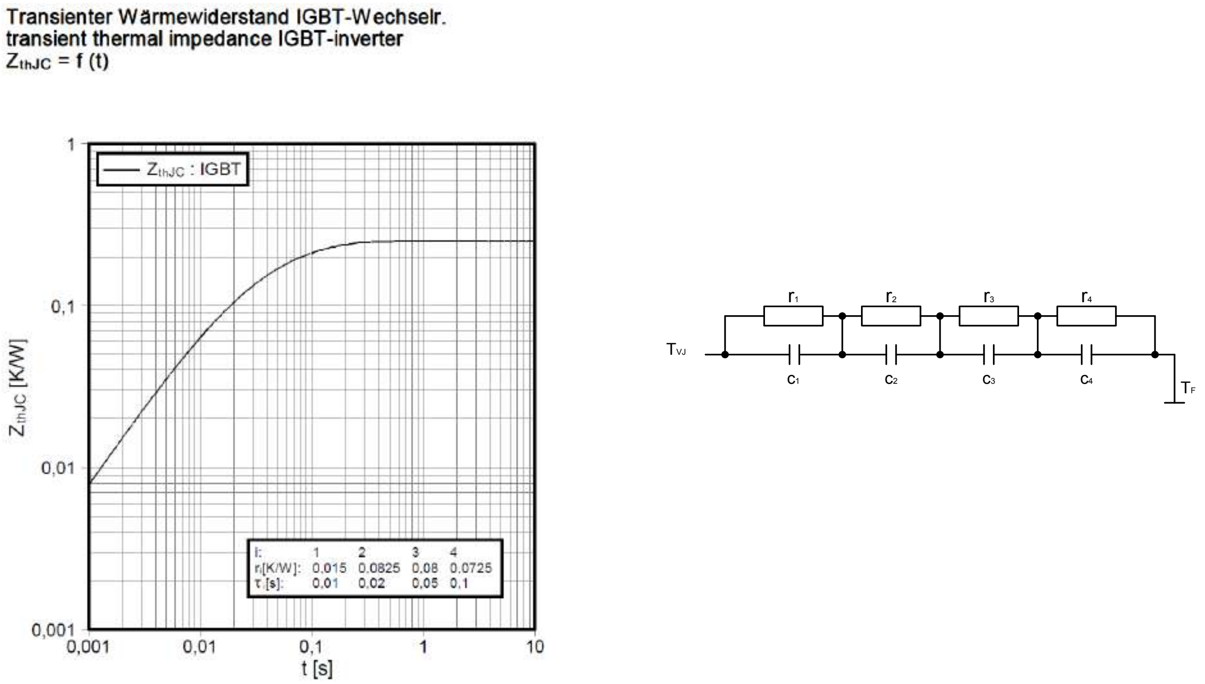


Figure 29: a) Transient thermal impedance junction to case and b) transient thermal model

The main power losses of the IGBT module are dissipated from the silicon die to the heat sink through different materials. Each material within the dissipation path has its own thermal characteristics. As a result, the thermal impedance behavior can be modeled with the appropriate coefficients of the IGBT module and is given as diagram $Z_{thJC}(t)$ as shown in Figure 29a. The separate RC-elements from Figure 29b have no physical meaning. Their values are extracted from the measured heating-up curve of the module by a corresponding analysis tool. The datasheet includes the partial fraction coefficients in tabular form as shown in Figure 29a. The values of the capacitances can be calculated by:

$$c_i = \frac{\tau_i}{r_i} \tag{11}$$

4 Datasheet parameters Diode

This section explains the electrical properties of the diode-chip inside the given IGBT module

4.1 Diode forward characteristic

The maximum permissible diode forward current rating can be calculated with equation (12). To give a current rating of a module, the corresponding junction and case temperature have to be specified, for example in Figure 30. Please note that current ratings without defined temperature conditions have no technical meaning at all. Since I_F is not known in equation (12), V_F @ I_F is also not known, but can be found within a few iterations. The ratings of continuous collector current are calculated with maximum values for V_F to ensure the specified current rating, taking component tolerances into account.

$$I_F = \frac{(\mathrm{T_{vj}} - \mathrm{T_C})}{R_{thJC} \cdot \mathrm{V_F}(\mathrm{I_F}, \mathrm{T_{vj}})} \tag{12}$$

Figure 30 depicts the typical forward characteristic of the implemented diode at different junction temperatures. A negative temperature coefficient of the diode's forward voltage drop can be observed, which is typical for minority-carrier devices. Therefore, the conduction losses of the diode decrease with increasing temperatures.

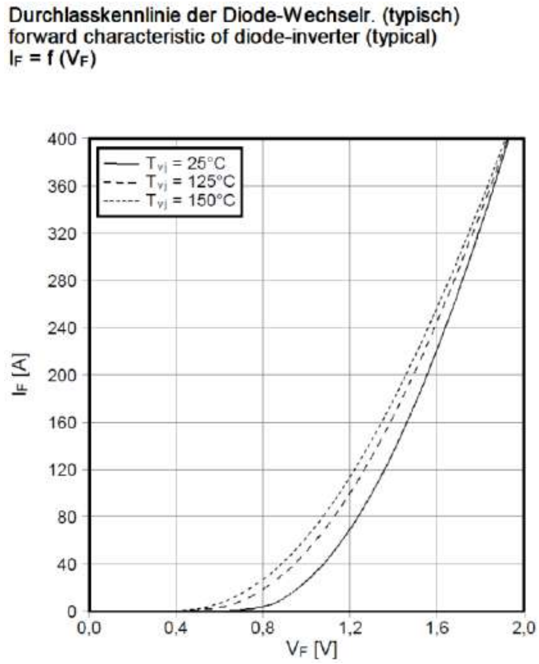


Figure 30: Forward characteristic of diode datasheet

4.2 Repetitive peak forward current

The nominal diode current rating can be exceeded in an application for a short time. This is defined as repetitive peak forward current in the datasheet for the specified pulse duration, for example 1ms as noted in Figure 31. In theory, this value can be derived from the feasible power dissipation and the transient thermal impedance Z_{th}, if the duration of the over current condition is defined. However, this theoretical value is not taking any limitations of bond wires, bus-bars or power connectors into account.

Periodischer Spitzenstrom repetitive peak forward current	t_P = 1 ms	I_{FRM}	400	A

Figure 31: Repetitive peak forward current

4.3 I²t value

This value defines the surge current capability of the diode. The I^2t value applied should be lower than the specified I^2t value and t_p should not exceed 10ms as mentioned in Figure 32.

Grenzlastintegral I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I²t	2850 2700	A²s A²s

Figure 32: Values of the surge capability

4.4 Reverse recovery

To investigate the transient behavior of a diode, the surrounding circuitry as already shown in Figure 8 on page 11 has to be taken into account. To simplify the circuitry, the output current of the half bridge can be assumed to be constant during commutation. The remaining stray inductances formed by the current loop can now be replaced by just one stray inductance between high-side and low-side switch/freewheeling diode.

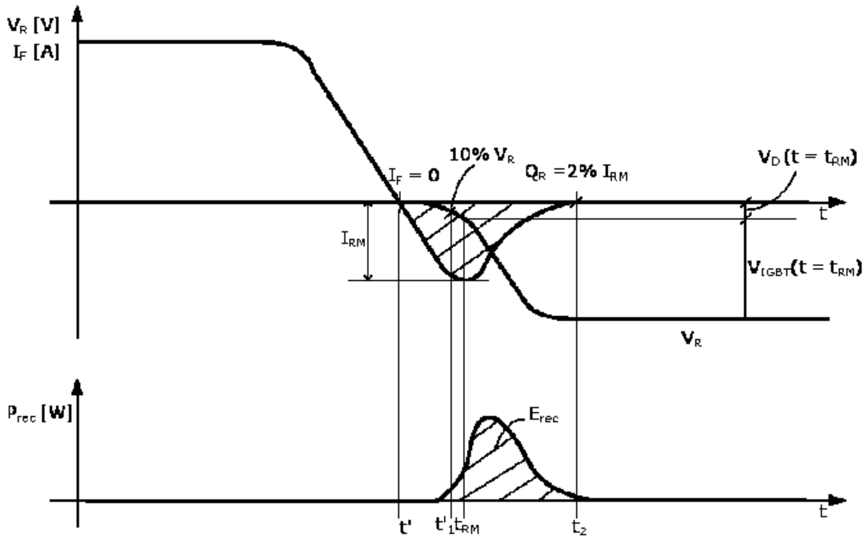


Figure 33: Schematic voltage and current waveform of a soft-recovery diode during turn-off transition

Figure 33 describes the current commutation from a high-side (HS) freewheeling diode to a low-side (LS) IGBT.

The commutation is triggered by turning-on the LS-IGBT which will not reduce the blocking voltage to roughly zero immediately. It will keep a portion of blocking voltage during the commutation. Due to the fact that the HS-diode is still on, the difference $V_L = V_R - V_{IGBT}$ will drop across the stray inductance causing a linear change of current. The diode current will reduce in the same way as the IGBT current increases. As soon as the diode current at t = t' crosses zero, a space charge region within the diode can be formed. Hence the voltage drop across the diode increases as can be seen in Figure 33.

The voltage drop across the stray inductance will be zero if the sum of diode and IGBT voltage is equal to the blocking voltage V_R

$$V_R = V_{IGBT} - V_D \text{ if } di/dt = 0 \quad (13)$$

As a result, the peak reverse recovery current I_{RM} is reached. The current commutation is finished and the reverse recovery current has to be reduced to zero. Any kind of oscillation has to be avoided.

After $t > t_{RM}$, the LS-IGBT which is still not fully turned on will reduce its voltage further and the blocking voltage of the HS-diode will increase to the final V_R. During this last step, the current change from I_{RM} to zero will result in an overvoltage across the diode; however in this case it will be masked by the increasing blocking voltage.

The reverse recovery of the diode will lead to additional turn-off losses as well as additional turn-on losses in the complementary switch. A current and voltage waveform of a soft-recovery emitter controlled diode during turn-off transition can be seen in Figure 33

The characterized peak reverse recovery current I_{RM} given in the datasheet section on Figure 34, is defined as the difference between the maximum negative current peak and zero current. The recovered charge results from:

$$Q_r = \int_{t_1'}^{t_2'} I_F \cdot dt \quad (14)$$

The integration limits are defined as t = t'$_1$ @ I_F =0 and t = t'$_2$ @ $|I_F| \leq 0.02 \cdot I_{RM}$ as marked in Figure 33.
The losses due to reverse recovery can be calculated with the recovered energy per pulse. The energy is determined as defined in equation (15):

$$E_{rec} = \int_{t'_1}^{t_2} V_R \cdot I_F \cdot dt \qquad (15)$$

The integration limits are chosen for the time t'$_1$ corresponding to 10% of the diode reverse voltage V_R and the time t_2 when the reverse recovery current I_{RM} peak attains 2%.
The recovered charge and thus switching losses caused by the reverse recovery of the diode strongly depend on junction temperature as well as current slope.

Rückstromspitze peak reverse recovery current	I_F = 200 A, - di_F/dt = 5700 A/µs (T_{vj}=150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		160 230 240	A A A
Sperrverzögerungsladung recovered charge	I_F = 200 A, - di_F/dt = 5700 A/µs (T_{vj}=150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		10,0 17,0 20,0	µC µC µC
Abschaltenergie pro Puls reverse recovery energy	I_F = 200 A, - di_F/dt = 5700 A/µs (T_{vj}=150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		3,00 5,20 5,80	mJ mJ mJ

Figure 34: Reverse recovery current, charge and reverse recovery energy

To give an indication of application specific switching losses, the losses per diode turn-off pulse as noted in the datasheet are a function of diode forward current and gate resistance of the switching IGBT as represented in Figure 35. The variation in gate resistance is an equivalent to a variation in commutation current slopes.

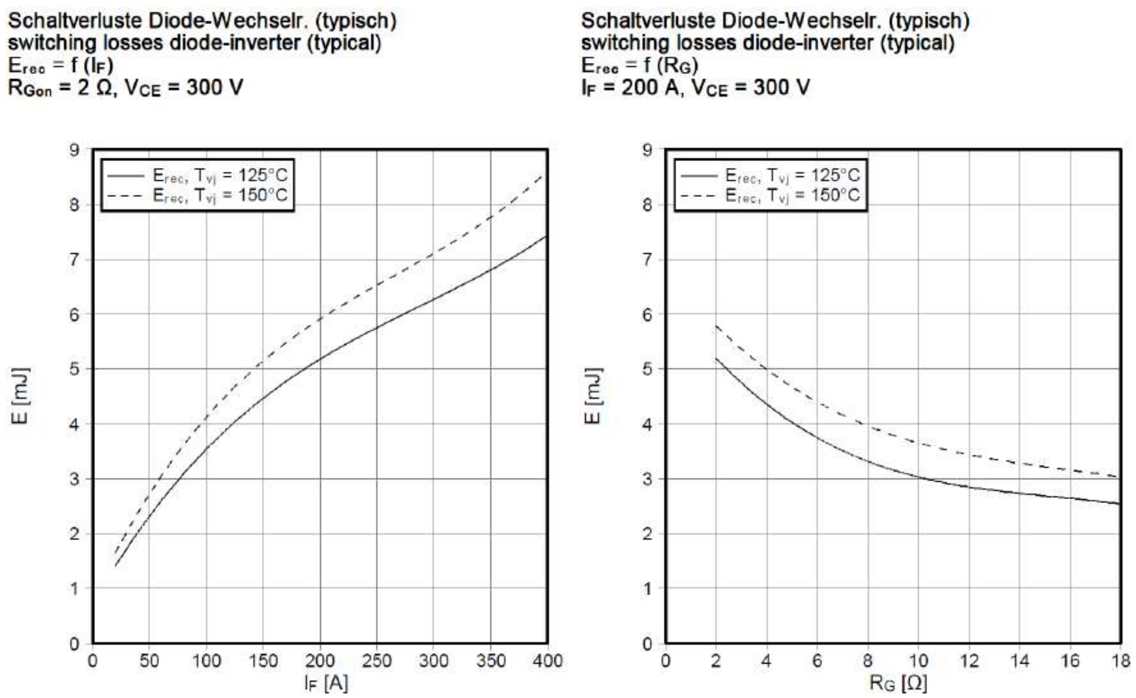


Figure 35: Reverse recovery energy per pulse as a function of
a) diode conducting current and b) gate resistance

5 Datasheet parameters NTC-thermistor

One of the most important parameters in power electronic devices is the chip temperature. The measurement of this temperature during operation is very difficult. One approach to estimate the real chip temperature in steady state is to use the NTC inside the IGBT module. This method is not adequate for measurement of fast variation of the chip temperature.

The temperature of the chips can be calculated using a thermal model and measuring the temperature at the NTC. The resistance of the NTC can be calculated as a function of the NTC temperature T2

$$R_2 = R_{25} \cdot e^{B \cdot \left(\frac{1}{T_2} - \frac{1}{T_1}\right)} \qquad (16)$$

The resistance R25 at temperature $T_1 = 298.15K$ is specified in the datasheet as shown in Figure 36.
With measurement of the actual NTC-resistance R2, the temperature T_2 can be calculated with equation (17).

$$T_2 = \frac{1}{\frac{\ln\left(\frac{R_2}{R_{25}}\right)}{B} + \frac{1}{T1}} \qquad (17)$$

The maximum relative deviation of the resistance is defined at a temperature of 100°C by $\Delta R/R$ from Figure 36. To avoid self heating of the NTC, the power dissipation inside the NTC has to be limited.

To limit the self heating of the NTC up to a maximum value of 1K, the current through the NTC can be calculated according to equation (18). More detailed information how to use the NTC inside the IGBT module is provided in AN2009-10[3]

$$I_{max} = \sqrt{\frac{P_{25}}{R_2}} \qquad (18)$$

NTC-Widerstand / NTC-thermistor

Charakteristische Werte / characteristic values

			min.	typ.	max.	
Nennwiderstand rated resistance	T_C = 25°C	R_{25}		5,00		kΩ
Abweichung von R_{100} deviation of R_{100}	T_C = 100°C, R_{100} = 493 Ω	ΔR/R	-5		5	%
Verlustleistung power dissipation	T_C = 25°C	P_{25}			20,0	mW

Figure 36: Characteristic values of the NTC-thermistor

To calculate the NTC resistance as well as temperature more accurately, B-values are required. The B-value stated in Figure 37 depends on the temperature range considered. Typically a range of 25 to 100°C is of interest and thus $B_{25/100}$ has to be used. In case a lower temperature range is in focus, the B-values $B_{25/80}$ or $B_{25/50}$ can be used, which leads to more accurate calculation of the resistance in these lower ranges.

[3] Application note 2009-10: Using the NTC inside a power electronic module

B-Wert B-value	$R_2 = R_{25}$ exp $[B_{25/50}(1/T_2 - 1/(298{,}15\ K))]$	$B_{25/50}$		3375		K
B-Wert B-value	$R_2 = R_{25}$ exp $[B_{25/80}(1/T_2 - 1/(298{,}15\ K))]$	$B_{25/80}$		3411		K
B-Wert B-value	$R_2 = R_{25}$ exp $[B_{25/100}(1/T_2 - 1/(298{,}15\ K))]$	$B_{25/100}$		3433		K

Figure 37: B-values of the NTC-thermistor

The use of the NTC for temperature measurement is not suitable for short circuit detection or short term overload, but may be used to protect the module from long term overload conditions or malfunction of the cooling system.

6 Datasheet parameters Module

This part covers electrical topics related to the mechanical construction of the IGBT module.

6.1 Insulation voltage

To verify the rated insulation voltage of the IGBT module, all terminals are connected to the high side of a high voltage source. The base plate is connected to the low side of the high voltage source. This high voltage source with high impedance must be able to supply the required voltage V_{iso}. A test voltage is slowly raised to the specified value determined by equation (19) and maintained at that value for the specified time t.

$$U_p = 2 \cdot \frac{U_m}{\sqrt{2}} + 1000V \tag{19}$$

The voltage is then reduced to zero. Infineon's IGBT modules are designed to achieve at least the basic insulation class 1 according to IEC 61140. For IGBT modules with an internal NTC, the functional insulation requirement is fulfilled between the grounded NTC terminals and the remaining control and power terminals connected and powered by the high voltage source.
The appropriate insulation voltage depends on the maximum rated collector-emitter voltage of the IGBT. Most drive applications require an insulation voltage of 2.5kV for IGBT modules up to 1700V blocking voltage. For traction applications, the required insulation voltage is defined to be 4kV for the same IGBT blocking voltage of 1700V. Therefore it is important to focus on the application field during the choice of the IGBT module.

Isolations-Prüfspannung insulation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}	2,5	kV

Figure 38: Insulation test voltage

The insulation test voltage in the datasheet as mentioned in Figure 38 is measured before and after reliability tests of the power module and is furthermore part of failure criteria of such stress tests.
The insulation voltage of the NTC inside the IGBT fulfills a functional isolation requirement only. In case of failures, for example of the gate driving circuit, a conducting path can be formed by moving bond wires that change their position during the failure event or by a plasma path forming as a consequence of arcing during failure. Therefore, if insulation requirements higher than a functional insulation have to be achieved, additional insulating barriers have to be added externally.

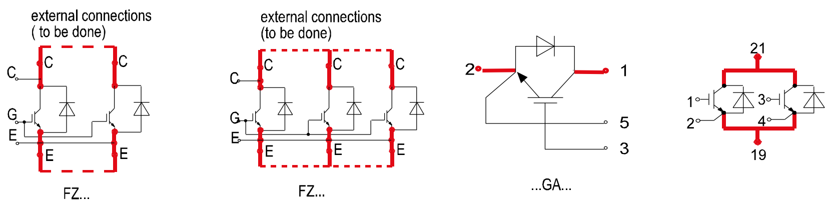
6.2 Stray inductance L_δ

Stray inductances lead to transient over voltages at the switching transients and are a major source of EMI. Furthermore, in combination with parasitic capacitances of the components, they can lead to resonant circuits, which can cause voltage and current ringing at switching transients. The transient voltage due to stray inductances can be calculated with:

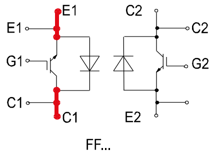
$$\Delta V = -L_\delta \cdot \frac{di_{L_\delta}}{dt} \tag{20}$$

Consequently, the stray inductances have to be minimized in order to reduce voltage overshoot at turn-off transitions. The value of the stray inductance as given in Figure 39, depends on the IGBT topology and would be understood as:

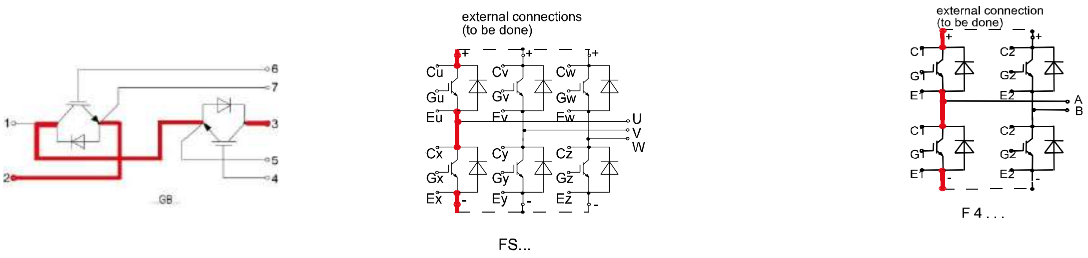
- The inductance of single switch modules



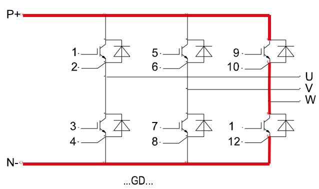
- The inductance of one switch for modules with two switches



- The loop with the highest inductance for half bridge, four- and sixpack modules specifies the inductance of one bridge



- The largest loop from P to N specifies the inductance for PIM modules



Modulinduktivität stray inductance module		L_{sCE}		21		nH

Figure 39: Module stray inductance

6.3 Module resistance $R_{CC'+EE'}$

The lead resistance of the module is a further contributor to voltage drop and power losses. The specified value in the datasheet characterizes the lead resistance between the power terminals of one switch as mentioned in Figure 40. According to the equivalent circuit shown in Figure 41, the module's lead resistance is defined as:

$$R_{CC'+EE'} = R_{CC'} + R_{EE'} + R_{E''E'} \tag{21}$$

Modulleitungswiderstand, Anschlüsse - Chip module lead resistance, terminals - chip	T_C = 25°C, pro Schalter / per switch	$R_{CC'-EE'}$		1,80		mΩ

Figure 40: Module lead resistance

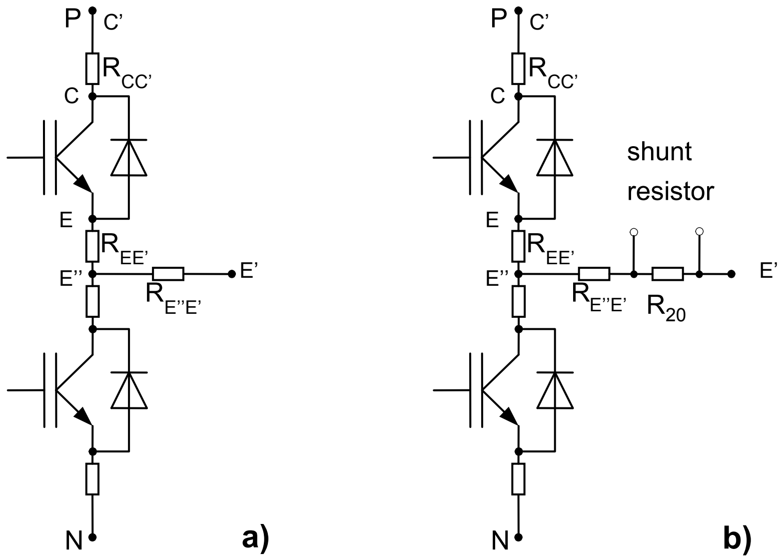


Figure 41: Equivalent circuit of module lead resistance a) without integrated shunt resistor, b) with integrated shunt resistor

If the module is equipped with a shunt resistor at the output terminal, as displayed in Figure 41 b), the resistance of the shunt resistor R_{20} is not included in the module lead resistance $R_{CC'+EE'}$.

6.4 Mounting torque M

The torque for the mechanical mounting of the module is specified in the datasheet as noted in Figure 42. These values are important to ensure the proper clamping force of the module to the heat sink. For modules with screwable power terminals, an additional mounting torque for terminal connection is given in the datasheet to ensure a reliable mechanical and electrical connection of bus-bars.

Anzugsdrehmoment f. mech. Befestigung mounting torque	Schraube M5 - Montage gem. gültiger Applikation Note screw M5 - mounting according to valid application note	M	3,00	-	6,00	Nm

Figure 42: Module mounting torque requirements

7 Symbols and Terms

Symbols and terms used in this document are part of the standards specification as listed below:

Symbols	Terms
A	Anode
C	Capacitance, collector
$C_{o(er)}$	Effective output capacitance, energy related
$C_{o(tr)}$	Effective output capacitance, time related
C_{ies}	Input capacitance
C_{oes}	Output capacitance
C_{res}	Reverse transfer capacitance
C_{th}	Thermal capacitance
C_{DS}	Drain-Source capacitance
C_{GD}	Gate-Drain capacitance
C_{GS}	Gate-Source capacitance
C_{Mi}	Miller capacitance
C_{σ}	Stray capacity
D	Pulse duty factor/duty cycle D = tp/T
di_F/dt	Rate of diode current rise
di/dt	Rate of current rise general
di_{rr} /dt	Peak rate fall of reverse recovery current
dv/dt	Rate of diode voltage rise
E	Energy
E_A	Avalanche energy
E_{AR}	Avalanche energy, repetitive
E_{AS}	Avalanche energy, single pulse
E_{off}	Turn-off loss energy
E_{on}	Turn-on loss energy
F	Frequency
G	Gate
G_{fs}	Transconductance
I	Current
I	Current, instantaneous value
I_{AR}	Avalanche current, repetitive
I_D	DC drain current
I_{Dpuls}	DC drain current, pulsed
I_{DSS}	Drain cutoff current
I_{DSV}	Drain cutoff current with gate voltage applied
I_C	Collector current
I_{CM}	Peak collector current
I_{CES}	Collector cut-off current, gate-emitter short-circuited
I_{CRM}	Repetitive peak collector current
I_{Cpuls}	Collector current, pulsed
I_G	Gate current

Symbols	Terms
I_F	General diode forward current
I_{FSM}	Diode current surge crest value 50 Hz sinusoidal
$I_{c\ nom}$, I_c	Continuous DC collector current
I_{GSS}	Gate-Source leakage current
I_{RM}	Diode peak reverse recovery current
I_{SM}	Inverse diode direct current, pulsed
I_{GES}	Gate leakage current, collector-emitter short-circuited
I_L	Current through inductance
I_{RRM}	Maximum reverse recovery current
K	Cathode
L	Inductance
L_L	Load inductance
L_p	Parasitic inductance (e.g. lines)
L_σ	Leakage inductance
P_{AV}	Avalanche power losses
P_{sw}	Switching power losses
P_{tot}	Total power dissipation
P_{con}	Conducting state power dissipation
Q_G	Gate charge
Q_{GS}	Charge of Gate-Source capacitance
Q_{GD}	Charge of Gate-Drain capacitance
Q_{Gtot}	Total Gate charge
Q_{rr}	Reverse recovery charge
$R_{DS(on)}$	Drain-Source on state resistance
R_G	Gate resistance
$R_{Gint,}$ r_g	Internal gate resistance
R_{GE}	Gate-emitter resistance
R_{Gon}	Gate-turn on resistance
R_{Goff}	Gate-turn off resistance
R_{GS}	Gate-Source resistance
R_i	Internal resistance (pulse generator)
R_L	Load resistance
R_{thCH}	Thermal resistance, case to heat sink
R_{thHA}	Thermal resistance, heat sink to ambient
R_{thJA}	Thermal resistance, junction to ambient
R_{thJC}	Thermal resistance, junction to case
R_{thJS}	Thermal resistance, junction to soldering point
S	Source
T	Cycle time; temperature
T_A	Ambient temperature
T_C	Case temperature

Symbols	Terms
t	Time, general
t_1	Instant time
$t_{d\ off}$	Turn-off delay time
$t_{d\ on}$	Turn-on delay time
t_f	Fall time
T_j	Chip or operating temperature
t_p	Pulse duration time
$T_{vj\ max}$	Maximum junction temperature
$T_{vj\ op}$	Temperature under switching condition
t_{off}	Turn-off time
t_{on}	Turn-on time
t_r	Rise time
t_{rr}	Reverse recovery time
T_{stg}	Storage temperature
T_{sold}	Soldering temperature
V	Voltage, instantaneous value
V_{IN}	Drive voltage
$V_{(BR)CES}$	Collector-emitter breakdown voltage
$V_{(BR)DSS}$	Drain-Source Avalanche breakdown voltage
V_{CC}	Supply voltage
V_{CE}	Collector-emitter voltage
V_{CES}	Collector-emitter voltage, gate-emitter short-circuited
V_{CEsat}	Collector-emitter saturation voltage
V_{CGR}	Collector-Gate voltage
V_{DD}	Supply voltage
V_{DGR}	Drain-Gate voltage
V_{DS}	Drain-Source voltage
V_F	Diode forward voltage
V_{GE}	Gate-emitter voltage
V_{GES}	Gate-emitter voltage, collector-emitter short-circuited
$V_{GE(th)}$	Gate-emitter threshold voltage (IGBT)
V_{GS}	Gate-Source voltage
V_{GSth}	Gate threshold voltage
V_{SD}	Inverse diode forward voltage
$V_{plateau}$	Gate plateau voltage
Z_{thJA}	Transient thermal resistance, chip to ambient
Z_{thJS}	Transient thermal resistance, chip to solder point
Z_{thJC}	Transient thermal resistance, chip to case

8 References

Infineon Technologies AG 'IGBT Modules Technologies, Driver and Application' ISBN978-3-00-032076-7

Type SCD IGBT Snubber Capacitor Modules

High dV/dt Direct Mount IGBT Snubber

Style SCD offers protection against voltage transients in low to medium current IGBT applications where high dV/dt is encountered. Connect these capacitors from C1 to E2 on a dual IGBT module or from P to N on a six-pack module to eliminate severe voltage transients. Parts ending with Z25 fit IGBTs with 23mm, 25mm and 28mm lead spacing. If you have a preferred lead spacing, please specify.

Highlights

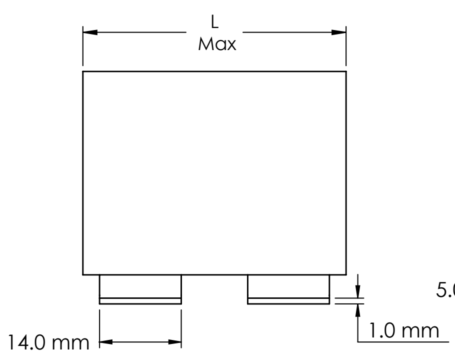
- High peak & RMS current capability
- Mount directly to the IGBT module
- Low inductance <20nH
- Low loss polypropylene dielectric
- Self healing
- Other terminal spacing and capacitance values available.
- We can build to your specs!
- 85 °C ambient temperature

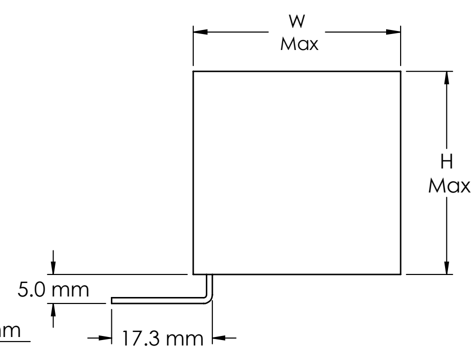
Specifications

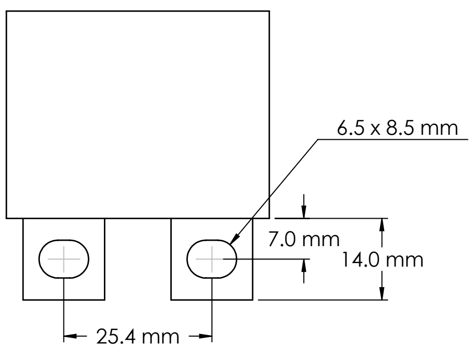
Capacitance Range	0.22 to 4.7 µF
Capacitance Tolerance	±10% (K) standard, ±5% (J) optional
Rated Voltage	600 to 2000 Vdc
Operating Temperature Range with Ripple	-55 ºC to 85 ºC
Maximum rms Current	Check tables for values
Test Voltage between Terminals @ 25ºC	160% rated DC voltage for 60 s
Test Voltage between Terminals & Case @ 25ºC	3 kVac @ 50/60 Hz for 60 s
Life Test	2000 h @ 85 ºC, 125% rated DC voltage
Life Expectancy	60,000 h @ rated Vdc, 70 ºC 30,000 h @ rated Vac, 70 ºC
RoHS Compliant	

Dimensions

Construction Details	
Case Material	Plastic UL94V-0
Resin Material	Dry Resin UL94V-0
Terminal Material	Tin Plated Copper





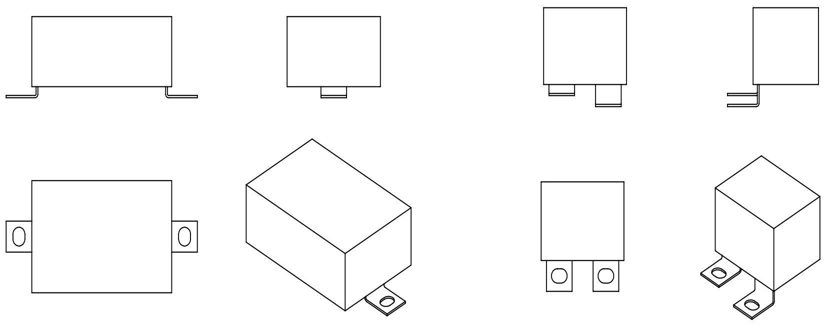


Type SCD IGBT Snubber Capacitor Modules

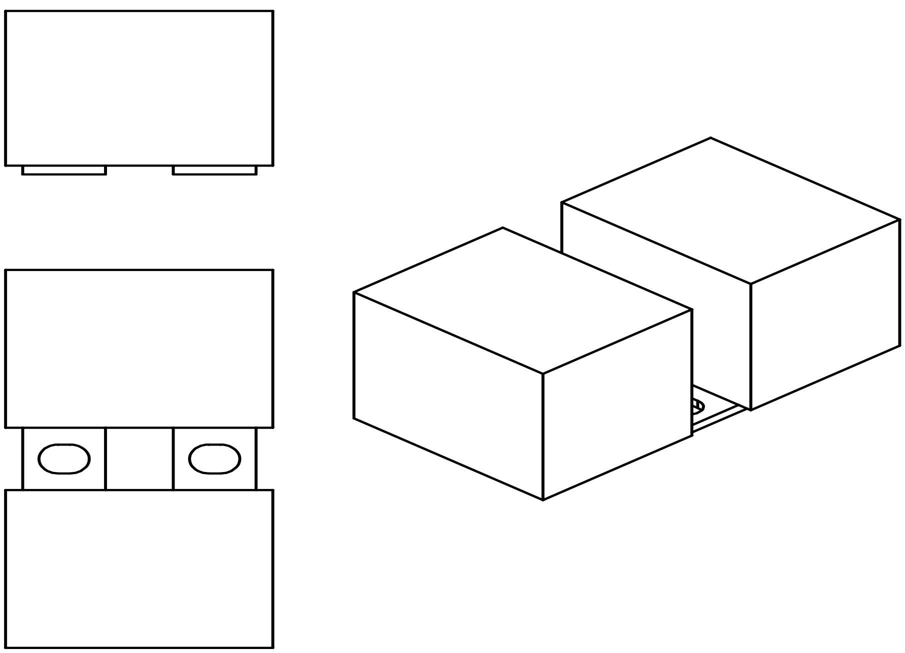
High dV/dt Direct Mount IGBT Snubber

Mounting Across the Bus?

CDE Will Accommodate Your Bus Structure



Dual Snubber Assembly Option



Part Numbering System

SCD	105	K	122	A	3	-	25	–F
Series Type Designation	Capacitance in pF	Tolerance Code	Voltage	Internal Assembly Code	Type of Section to be used	Lug Configuration	Lug Spacing	RoHS Compliant Indicator
	104 = 0.1 µF	J = ±5%	601 = 600 Vdc			Z = Standard	22 = 22 mm	
	105 = 1 µF	K = ±10%	122 = 1200 Vdc			25.4 mm C-C	24 = 24 mm	
	225 = 2.2 µF		202 = 2000 Vdc				25 = 25 mm	
							28 = 28 mm	
							29 = 29 mm	

Type SCD IGBT Snubber Capacitor Modules

High dV/dt Direct Mount IGBT Snubber

Ratings

Note: Other ratings, sizes and performance specification available upon request. Contact us.

Catalog Part Number	Cap. (µF)	Volts (Vdc)	Volts 60 Hz (Vac)	dV/dt (V/µs)	Ipk (A)	ESR (mΩ)	Irms 100 kHz 55 °C (Arms)	W (mm)	L (mm)	H (mm)
600 Vdc										
SCD474K601A3Z25-F	0.47	600	275	250	118	9	9.2	24.6	47.0	24.1
SCD684K601A3Z25-F	0.68	600	275	250	170	7	11.5	29.0	47.0	26.7
SCD105K601A3Z25-F	1.00	600	275	200	200	5	14.0	29.0	47.0	26.7
SCD155K601A3Z25-F	1.50	600	275	150	225	4	17.1	29.0	47.0	26.7
SCD205K601A3Z25-F	2.00	600	275	150	300	3	20.7	32.3	45.1	35.6
SCD335K601D3Z25-F	3.30	600	400	300	825	5	35.0	38.1	52.1	38.1
SCD475K601D3Z25-F	4.70	600	400	250	1175	4	46.2	46.4	56.5	50.2
1000 Vdc										
SCD474K102A3Z25-F	0.47	1000	275	250	118	11	9.2	24.6	47.0	24.1
SCD474K102D3Z25-F	0.47	1000	500	700	329	8	12.1	29.0	47.0	26.7
SCD684K102A3Z25-F	0.68	1000	275	200	136	7	11.5	29.0	47.0	26.7
SCD684K102D3Z25-F	0.68	1000	500	500	340	7	14.4	29.0	47.0	26.7
SCD105K102A3Z25-F	1.00	1000	275	200	200	4	14.0	29.0	47.0	26.7
SCD105K102D3Z25-F	1.00	1000	500	400	400	5	17.5	29.0	47.0	26.7
SCD155K102A3Z25-F	1.50	1000	275	160	240	4	17.9	32.3	45.1	35.6
SCD155K102D3Z25-F	1.50	1000	500	400	600	3	22.4	34.8	45.1	35.6
SCD205K102A3Z25-F	2.00	1000	275	160	320	4	20.9	34.8	45.1	35.6
SCD205K102D3Z25-F	2.00	1000	500	400	800	5	26.2	38.1	52.1	38.1
1200 Vdc										
SCD224K122A3Z25-F	0.22	1200	500	650	143	19	7.9	24.6	47.0	24.1
SCD334K122A3Z25-F	0.33	1200	500	650	215	13	10.0	29.0	47.0	26.7
SCD474K122A3Z25-F	0.47	1200	500	500	235	10	12.0	29.0	47.0	26.7
SCD684K122A3Z25-F	0.68	1200	500	500	340	7	15.1	32.3	45.1	35.6
SCD105K122A3Z25-F	1.00	1200	500	500	500	5	18.5	34.8	45.1	35.6
SCD155K122A3Z25-F	1.50	1200	500	400	600	4	23.9	38.1	52.1	38.1
SCD205K122A3Z25-F	2.00	1200	500	400	800	4	30.1	46.4	56.5	50.2
SCD305K122C3Z25-F	3.00	1200	500	400	1200	5	39.7	76.2	62.9	38.1
1600 Vdc										
SCD224K162A3Z25-F	0.22	1600	500	650	143	19	7.9	24.6	47.0	24.1
SCD334K162A3Z25-F	0.33	1600	500	650	215	12	10.0	29.0	47.0	26.7
SCD474K162A3Z25-F	0.47	1600	500	650	306	10	12.6	32.3	45.1	35.6
SCD684K162A3Z25-F	0.68	1600	500	650	442	7	15.3	34.8	45.1	35.6
SCD105K162A3Z25-F	1.00	1600	500	500	500	6	19.5	38.1	52.1	38.1
SCD155K162A3Z25-F	1.50	1600	500	400	600	5	25.6	41.9	68.6	38.1
SCD205K162A3Z25-F	2.00	1600	500	400	800	5	30.6	44.5	66.7	46.4
2000 Vdc										
SCD224K202A3Z25-F	0.22	2000	500	800	176	19	8.2	24.6	47.0	24.1
SCD334K202A3Z25-F	0.33	2000	500	800	264	13	10.5	32.3	45.1	35.6
SCD474K202A3Z25-F	0.47	2000	500	600	282	10	13.0	34.3	55.9	30.5
SCD684K202A3Z25-F	0.68	2000	500	600	408	8	16.1	38.1	52.1	38.1
SCD105K202A3Z25-F	1.00	2000	500	600	600	6	21.3	46.4	56.5	50.2

Note: Modify Catalog Part Number to specify lead spacing. Example: 44mm spacing would use –44 instead of Z25. Other capacitance values and lead orientations are available. Contact us.

Fuji Electric

Innovating Energy Technology

FUJI Power Semiconductors

IGBT Modules Selection Guide

Standard 1-pack/ 2-pack/chopper Page 5

High Power Module Page 9

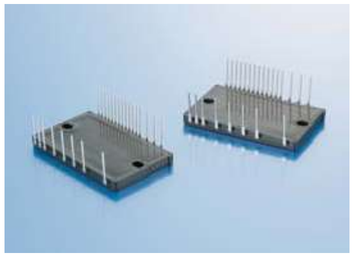
6-pack Page 11

AT-NPC 3 level Module Page 13

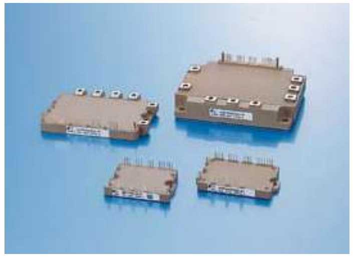
Small PIM Page 14

PIM Page 15

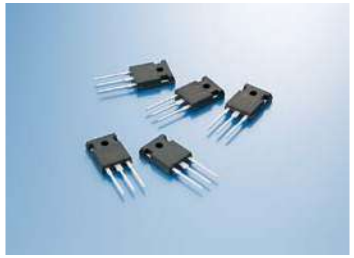
Small IPM Page 17



IPM Page 17



Discrete IGBT Page 20



25A1-E-0003a

IGBT Module Production Number

6 MB I 300 V H - 120 - 50

- 50: Suffix 50 indicates RoHS compliance
- 120: Max V_{CE} : 060⇒600V, 120⇒1200V, 170⇒1700V, 330⇒3300V
- H: Package Type
- V: IGBT Device Technology : V Series / U Series
- 300: Rated current I_C [A]
- I: Internal Configuration : I ⇒Standard Module, R⇒Power Integrated Module, P⇒Intelligent Power Module
- MB: MB indicates IGBT module
- 6: Number of IGBT switches

Number of IGBT Switches	Products Category	Page	Internal Configuration: IGBT Module: Standard Module	Internal Configuration: IGBT Module: Power Integrated Module	Internal Configuration: IGBT Module: Intelligent Power Module	Internal Configuration: Discrete IGBT	Max V_{CE}: 600V	Max V_{CE}: 1200V	Max V_{CE}: 1700V	Max V_{CE}: 3300V	Rated Current: ≤50A	Rated Current: >50A ≤150A	Rated Current: >150A ≤300A	Rated Current: >300A ≤600A	Rated Current: >600A ≤1200A	Rated Current: >1200A
1	Standard 1-pack	5	○					○						○	○	
	Chopper	5	○				○	○			○	○	○			
2	Standard 2-pack	6	○				○	○	○			○	○	○		
		7						○	○				○	○		
1,2	High Speed Module	8	○					○				○	○	○		
	High Power Module	9	○					○	○	○				○	○	○
	Prime PACK™	10	○					○	○					○	○	○
6	6-pack	11	○				○	○	○		○	○	○			
		12						○	○				○	○		
4,12	AT-NPC 3 level	13	Reverse-Blocking IGBTs are integrated.				○	○	○		○	○	○	○	○	
7	PIM	14					○	○			○					
		15		○			○	○			○	○				
		16					○	○			○	○				
6,7	IPM	17					○	○			○	○				
		18			○		○	○			○	○	○	○		
		19					○	○			○	○	○	○		
1	Discrete IGBT	20				○	○	○			○	○				

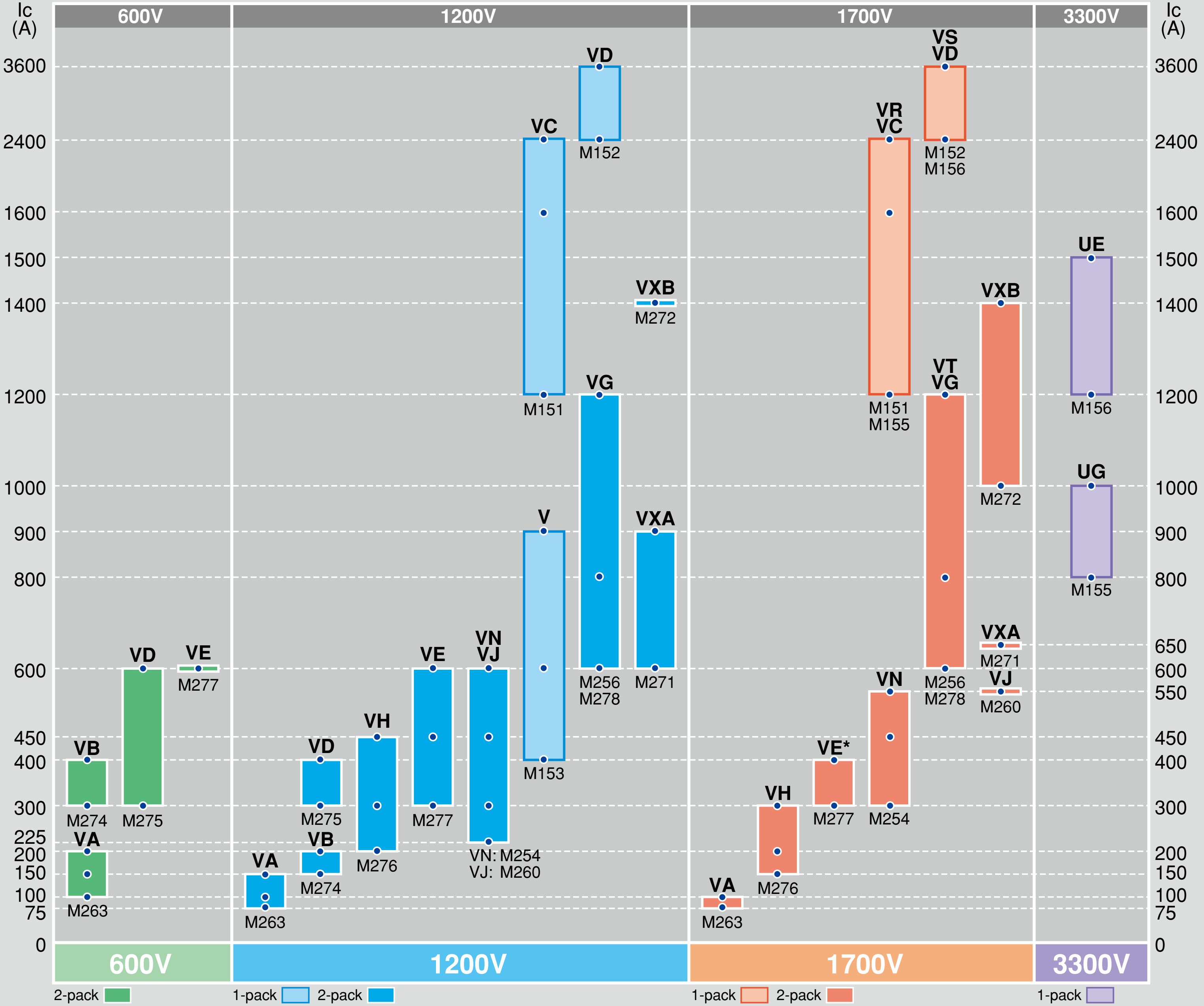
Note: Prime PACK™ is registered trademark Infineon Technology AG, Germany.

Discrete IGBT Production Number

FG W 35 N 60 HD

- HD: Series: H⇒High Speed V w/o FWD, HC and HD⇒High Speed with FWD, VD⇒V Series with FWD
- 60: Max V_{CE} : 60⇒600V, 120⇒1200V
- N: Polarity: N⇒N-ch
- 35: Rated Current Ic [A]
- W: Package Type
- FG: FG indicates Discrete IGBT

1-pack / 2-pack Products Map



1-pack

1MBI Ic [IGBT series & Package type] - Vces

IGBT series & Package type		
V	62×108 mm	Standard Pack
VC, VR, UG	140×130 mm	High Power Module
VD, VS, UE	140×190 mm	

2-pack

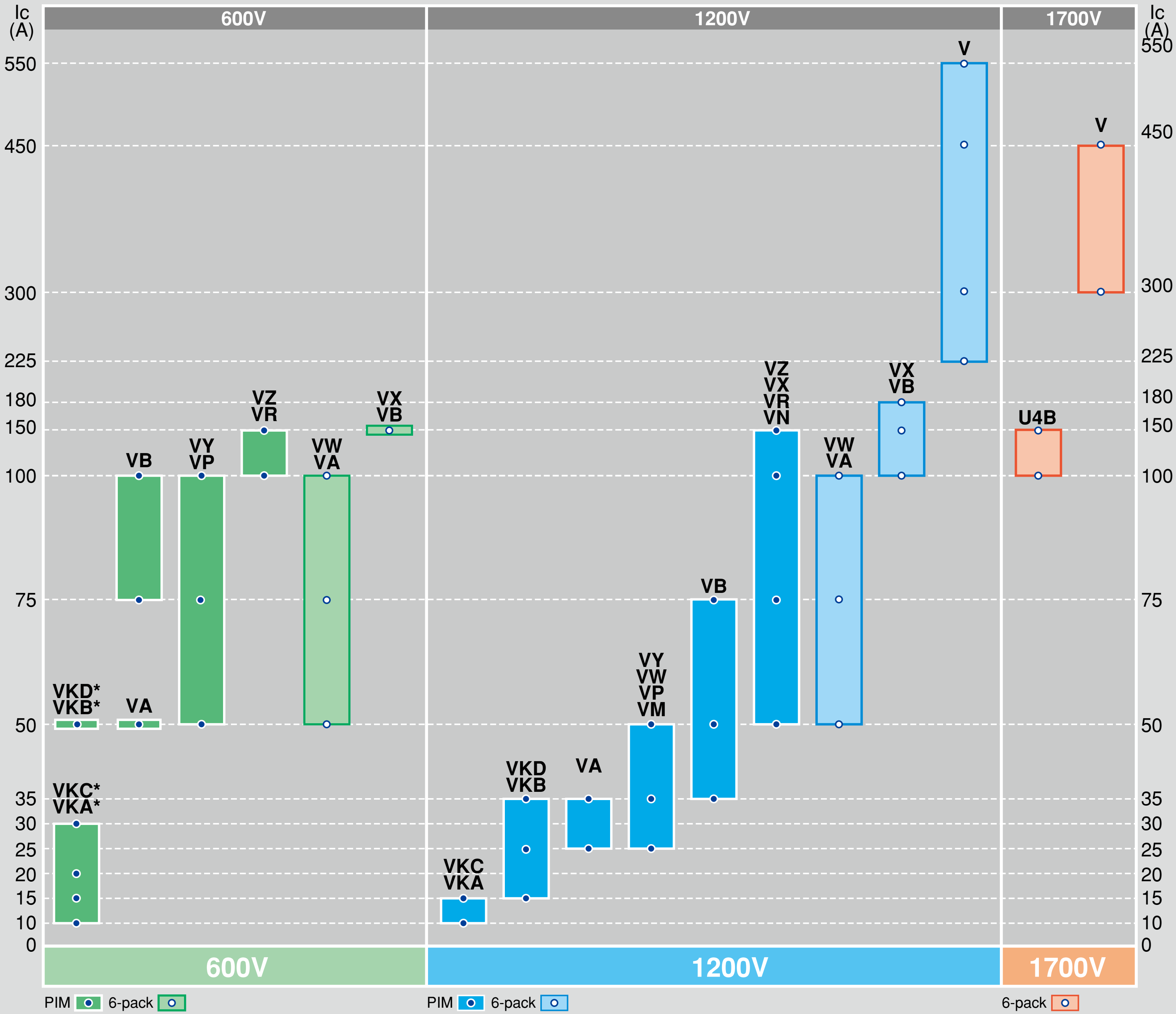
2MBI Ic [IGBT series & Package type] - Vces

IGBT series & Package type		
VA	34× 94 mm	Standard Pack
VB	45× 92 mm	
VD	62×108 mm	
VE*	80×110 mm	
VH	62×108 mm	
VJ, VN	62×150 mm	
VG, VT	140×130 mm	High Power Module
VXA	89×172 mm	Prime PACK™
VXB	89×250 mm	

Prime PACK™ is resistered trademark of Infineon Technology AG, Germany

* Under development

PIM & 6-pack Products Map



Power Integrated Module

7MBR Ic IGBT series & Package type – Vces

IGBT series & Package type	
VKA*, VKC*	33.8 × 62.8 mm
VKB*, VKD*	56.7 × 62.8 mm
VA, VM, VP, VW, VY	45 × 107.5 mm
VB, VN, VR, VX, VZ	62 × 122 mm

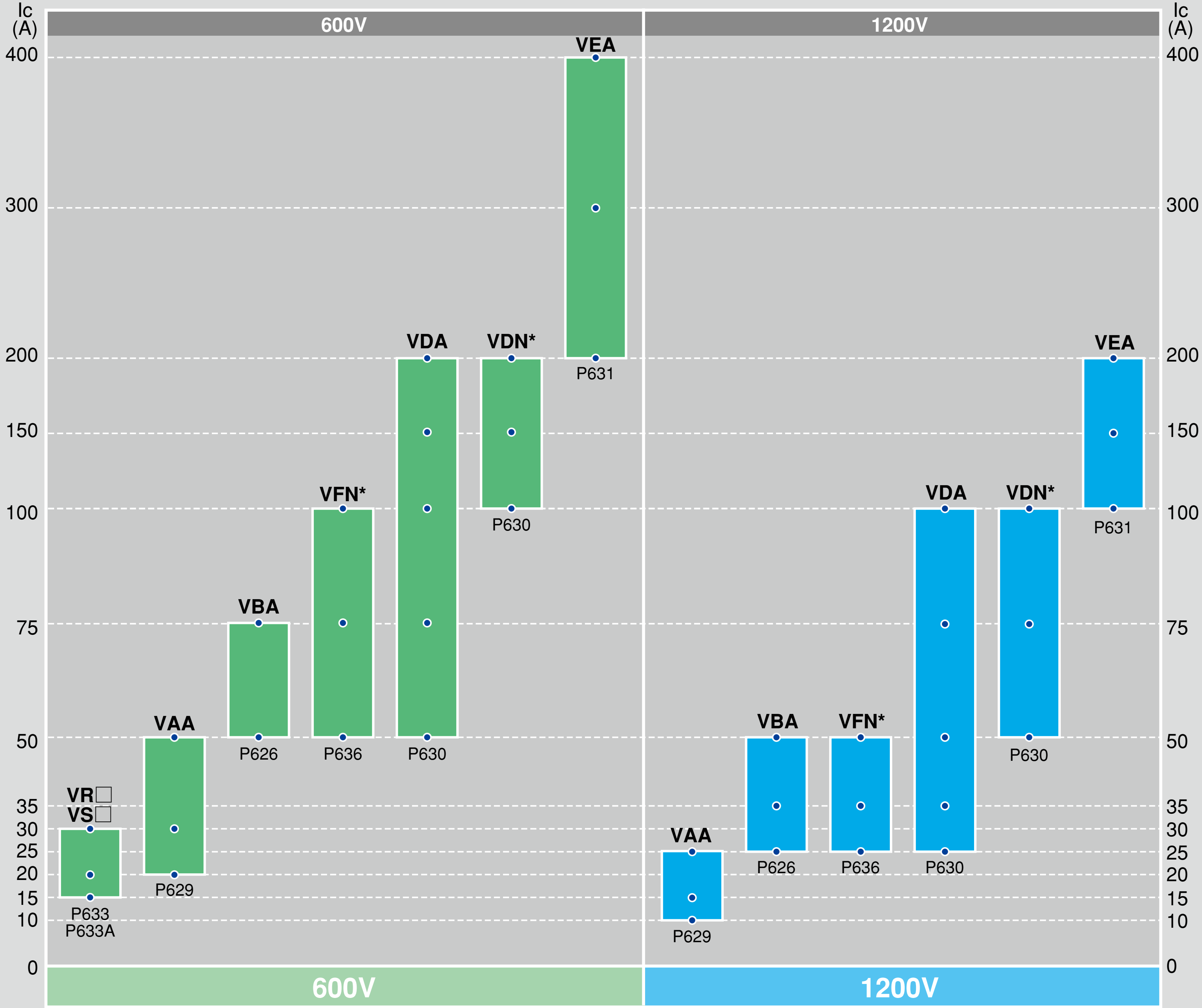
6-pack

6MBI Ic IGBT series & Package type – Vces

IGBT series & Package type	
VA, VW	45 × 107.5 mm
VB, VX, U4B	62 × 122 mm
V	150 × 162 mm

* Under development

Intelligent Power Module Products Map



6/7MBP **Ic** **IGBT series & Package type** – **Vces**

IGBT series & Package type		7 in 1	6 in 1
VR□, VS□	26 × 43 mm	–	○
VAA	49.5 × 70 mm	–	○
VBA	50.2 × 87 mm	–	○
VDA, VDN*	84 × 128.5 mm	○	○
VEA	110 × 142 mm	○	○
VFN*	55 × 90 mm	○	○

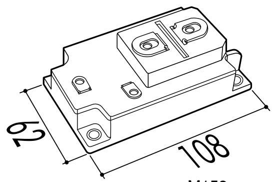
VR□, VS□, type is Small IPM with High Voltage Driver-IC.
Thermal impeadance of VDN type is lower than VDA type.
Thermal impeadance of VFN type is lower than VBA type.

* Under development

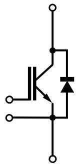
Standard 1-pack

mm

1-pack



M153

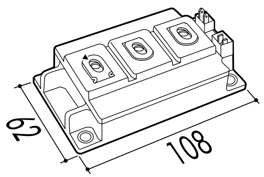


Ic	1200V V Series Trench-FS
400A	1MBI400V-120-50
600A	1MBI600V-120-50
900A	1MBI900V-120-50

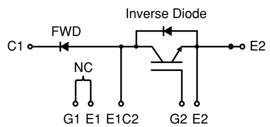
Chopper

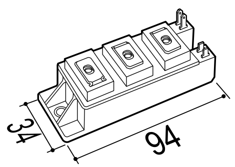
mm

Chopper

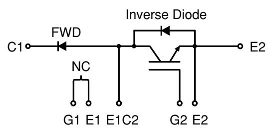


M259





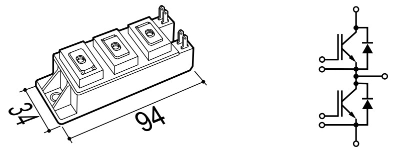
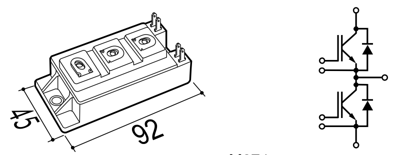
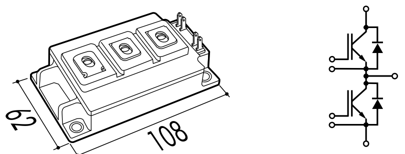
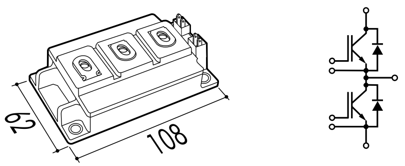
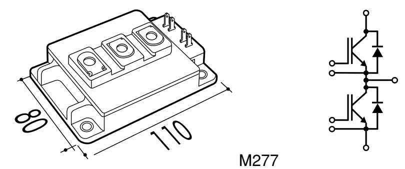
M262



Ic	600V U Series Planar-NPT	1200V U Series Trench-FS	1200V V Series Trench-FS
200A		1MBI200U4H-120L-50	
300A	1MBI300U2H-060L-50		
50A		1MBI50U4F-120L-50	
75A		1MBI75U4F-120L-50	
100A		1MBI100U4F-120L-50	
150A			1MBI150VA-120L-50

Standard 2-pack

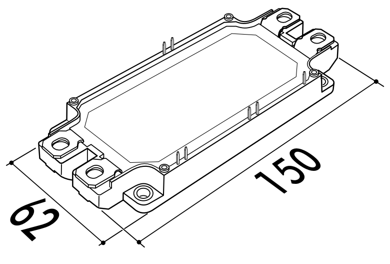
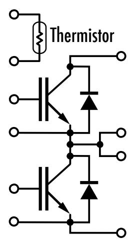
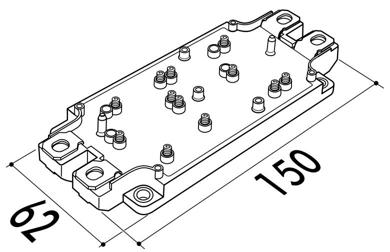
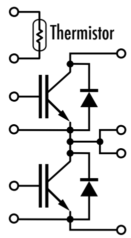
mm

2-pack	Ic	600V V Series Trench-FS	1200V V Series Trench-FS	1700V V Series Trench-FS
 M263	75A		2MBI75VA-120-50	2MBI75VA-170-50
	100A	2MBI100VA-060-50	2MBI100VA-120-50	2MBI100VA-170-50
	150A	2MBI150VA-060-50	2MBI150VA-120-50	
	200A	2MBI200VA-060-50		
 M274	150A		2MBI150VB-120-50	
	200A		2MBI200VB-120-50	
	300A	2MBI300VB-060-50		
	400A	2MBI400VB-060-50		
 M275	300A		2MBI300VD-120-50	
	400A	2MBI400VD-060-50	2MBI400VD-120-50	
	600A	2MBI600VD-060-50		
 M276	150A			2MBI150VH-170-50
	200A		2MBI200VH-120-50	2MBI200VH-170-50
	300A		2MBI300VH-120-50	2MBI300VH-170-50
	450A		2MBI450VH-120-50	
 M277	300A		2MBI300VE-120-50	2MBI300VE-170-50*
	400A			2MBI400VE-170-50*
	450A		2MBI450VE-120-50	
	600A	2MBI600VE-060-50	2MBI600VE-120-50	

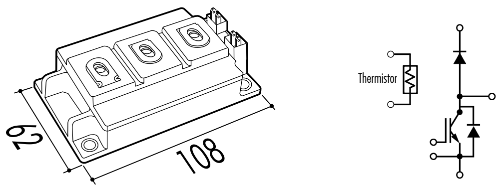
* Under development

Standard 2-pack

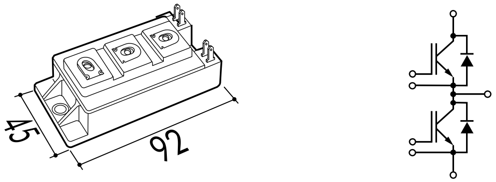
mm

		Ic	1200V V Series Trench-FS	1700V V Series Trench-FS
With NTC, solder pins	  M254	225A	2MBI225VN-120-50	
		300A	2MBI300VN-120-50	2MBI300VN-170-50
		450A	2MBI450VN-120-50	2MBI450VN-170-50
		550A		2MBI550VN-170-50
		600A	2MBI600VN-120-50	
With NTC, spring contacts	  M260	225A	2MBI225VJ-120-50	
		300A	2MBI300VJ-120-50	
		450A	2MBI450VJ-120-50	
		550A		2MBI550VJ-170-50
		600A	2MBI600VJ-120-50	

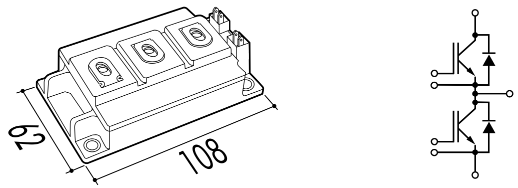
High Speed Module



M249



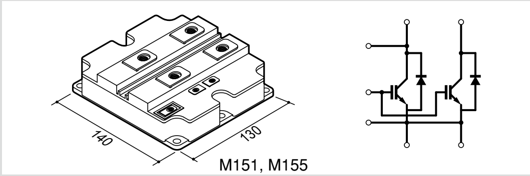
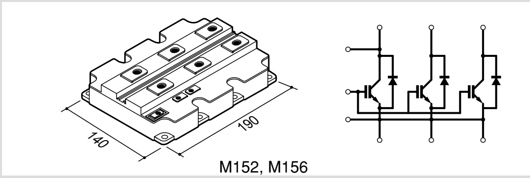
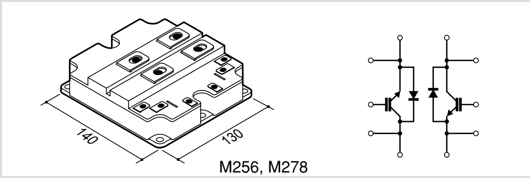
M233



M249

	mm	Ic	1200V High Speed IGBT
Chopper	M249	200A	1MBI200HH-120L-50
		300A	1MBI300HH-120L-50
		400A	1MBI400HH-120L-50
2-pack	M233	100A	2MBI100HB-120-50
	M249	150A	2MBI150HH-120-50
		200A	2MBI200HH-120-50

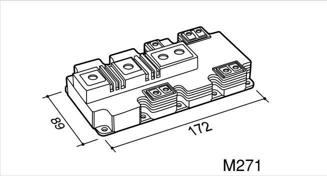
High Power Module

	mm	Ic	1200V V Series Trench-FS Cu-baseplate	1700V V Series Trench-FS Cu-baseplate	1700V V Series Trench-FS AlSiC-baseplate	3300V U Series Trench-FS AlSiC-baseplate
1-pack		800A				1MBI800UG-330
		1000A				1MBI1000UG-330
		1200A	1MBI1200VC-120P	1MBI1200VC-170E	1MBI1200VR-170E	
		1600A	1MBI1600VC-120P	1MBI1600VC-170E	1MBI1600VR-170E	
		2400A	1MBI2400VC-120P	1MBI2400VC-170E	1MBI2400VR-170E	
		1200A				1MBI1200UE-330
		1500A				1MBI1500UE-330
		2400A	1MBI2400VD-120P	1MBI2400VD-170E	1MBI2400VS-170E	
		3600A	1MBI3600VD-120P	1MBI3600VD-170E	1MBI3600VS-170E	
2-pack		600A	2MBI600VG-120P	2MBI600VG-170E	2MBI600VT-170E	
		800A	2MBI800VG-120P	2MBI800VG-170E	2MBI800VT-170E	
		1200A	2MBI1200VG-120P	2MBI1200VG-170E	2MBI1200VT-170E	

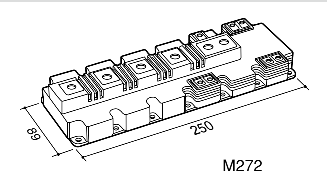
Note: M151, M152, M256: Cu-baseplate   M155, M156, M278: AlSiC-baseplate

Prime PACK™

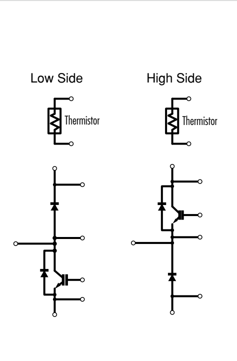
Chopper



M271



M272



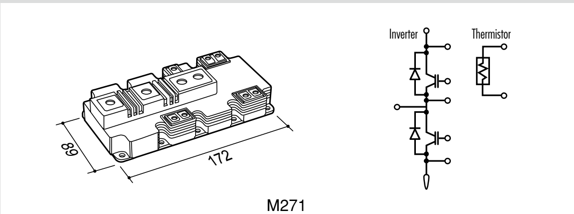
Ic	1200V V Series Trench-FS Soft turn off Low side configuration	1200V V Series Trench-FS Soft turn off High side configuration	1700V V Series Trench-FS Low switching loss Low side configuration	1700V V Series Trench-FS Low switching loss High side configuration
650A			1MBI650VXA-170EL-50 1MBI650VXA-170EL-54	1MBI650VXA-170EH-50 1MBI650VXA-170EH-54
1000A			1MBI1000VXB-170EL-50 1MBI1000VXB-170EL-54	1MBI1000VXB-170EH-50 1MBI1000VXB-170EH-54
1400A	1MBI1400VXB-120PL-54	1MBI1400VXB-120PH-54		

mm

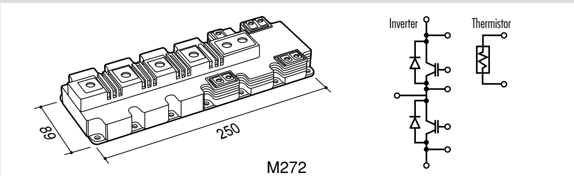
Note: The products with suffix '-54' on this page are labeled to specify the rank of V_{sat} and V_F.
PrimePACK™ is registered trademark of Infineon Technology AG, Germany.

Prime PACK™

2-pack



M271



M272

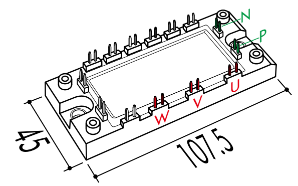
Ic	1200V V Series Trench-FS Low switching loss	1200V V Series Trench-FS Soft turn off	1700V V Series Trench-FS Low switching loss	1700V V Series Trench-FS Soft turn off
600A	2MBI600VXA-120E-50 2MBI600VXA-120E-54			
650A			2MBI650VXA-170E-50 2MBI650VXA-170E-54 2MBI650VXA-170EA-50 2MBI650VXA-170EA-54	
900A	2MBI900VXA-120E-50 2MBI900VXA-120E-54	2MBI900VXA-120P-50 2MBI900VXA-120P-54		
1000A			2MBI1000VXB-170E-50 2MBI1000VXB-170E-54 2MBI1000VXB-170EA-50 2MBI1000VXB-170EA-54	
1400A	2MBI1400VXB-120P-50 2MBI1400VXB-120P-54		2MBI1400VXB-170E-50 2MBI1400VXB-170E-54	2MBI1400VXB-170P-50 2MBI1400VXB-170P-54

mm

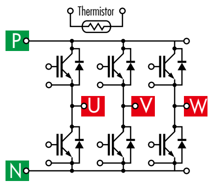
Note: The products with suffix '-54' on this page are labeled to specify the rank of V_{sat} and V_F.
The products with 'EA' on this page have large FWD.
PrimePACK™ is registered trademark of Infineon Technology AG, Germany.

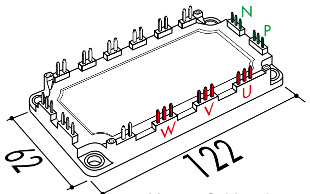
6-pack

mm

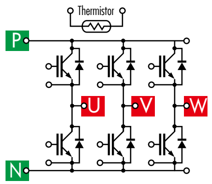


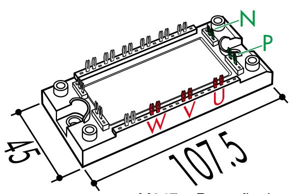
M636 Solder pins



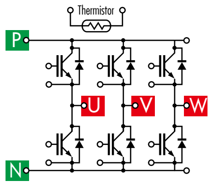


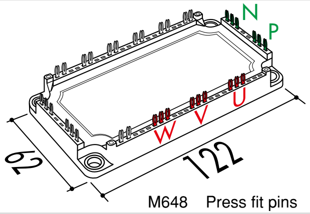
M633 Solder pins

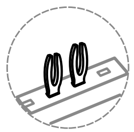




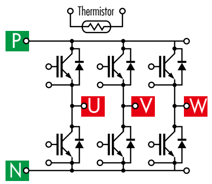
M647 Press fit pins







M648 Press fit pins



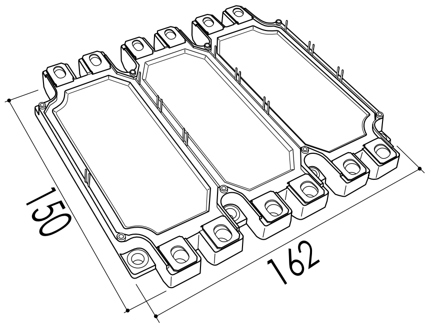
	Package	Ic	600V V Series Trench-FS	1200V V Series Trench-FS	1700V U Series Trench-FS
With NTC, solder pins	M636 Solder pins	50A	6MBI50VA-060-50	6MBI50VA-120-50	
		75A	6MBI75VA-060-50	6MBI75VA-120-50	
		100A	6MBI100VA-060-50	6MBI100VA-120-50	
	M633 Solder pins	100A		6MBI100VB-120-50	6MBI100U4B-170-50
		150A	6MBI150VB-060-50	6MBI150VB-120-50	6MBI150U4B-170-50
		180A		6MBI180VB-120-50	
		180A		6MBI180VB-120-55	
With NTC, press fit pins	M647 Press fit pins	50A	6MBI50VW-060-50	6MBI50VW-120-50	
		75A	6MBI75VW-060-50	6MBI75VW-120-50	
		100A	6MBI100VW-060-50	6MBI100VW-120-50	
	M648 Press fit pins	100A		6MBI100VX-120-50	
		150A	6MBI150VX-060-50	6MBI150VX-120-50	
		180A		6MBI180VX-120-50	
		180A		6MBI180VX-120-55	

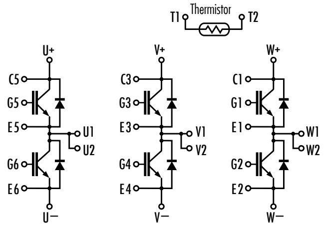
Note: 6MBI180VB-120-55, 6MBI180VX-120-55; Premium type (Low Thermal Impedance Version)
Note: Pin assignment of output terminals changes within the range of colored position depending on output current.

6-pack

With NTC, High power 6-pack

mm





M629

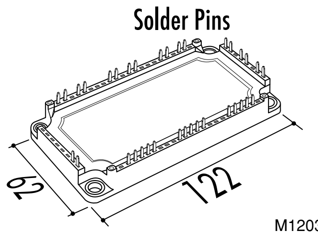
Ic	1200V V Series Trench-FS	1700V V Series Trench-FS
225A	6MBI225V-120-50	
300A	6MBI300V-120-50	6MBI300V-170-50
450A	6MBI450V-120-50	6MBI450V-170-50
550A	6MBI550V-120-50	

AT-NPC 3 level Module

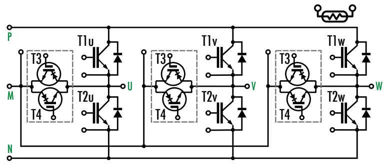
mm

3 Phase With NTC, solder pins

Solder Pins

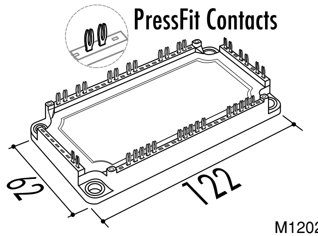


M1203

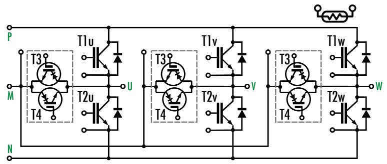


3 Phase With NTC, press fit pins

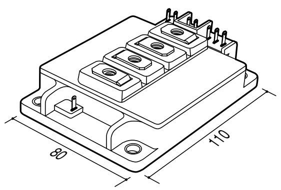
PressFit Contacts



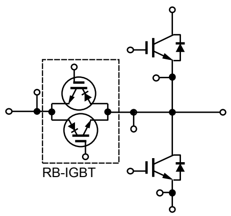
M1202



1 Phase

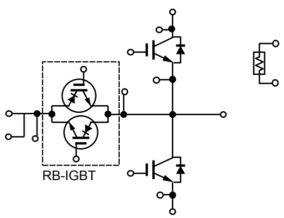


M403



1 Phase

Under Consideration

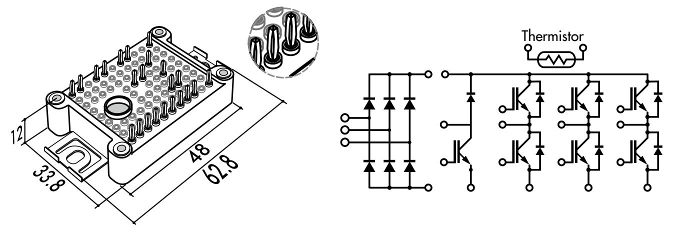
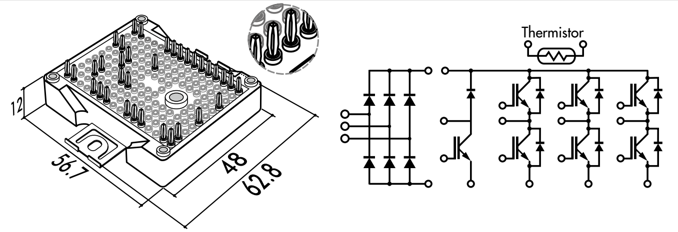
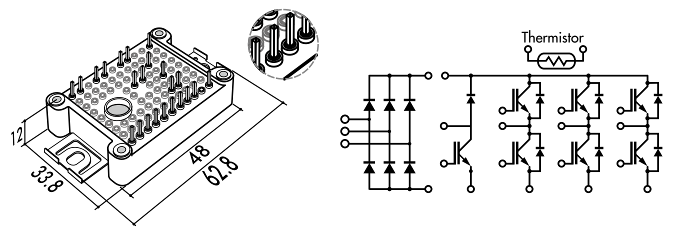
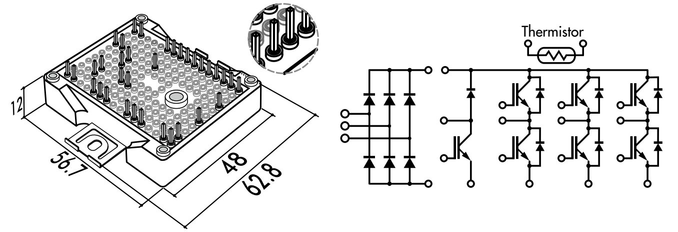


Package	Ic	600V V Series Trench-FS	600V RB-IGBT	1200V V Series Trench-FS	1200V RB-IGBT	1700V V Series Trench-FS	1700V RB-IGBT
3 Phase With NTC, solder pins (M1203)	50A			12MBI50VN-120-50	600V		
	75A			12MBI75VN-120-50	600V		
	100A			12MBI100VN-120-50	600V		
3 Phase With NTC, press fit pins (M1202)	50A			12MBI50VX-120-50	600V		
	75A			12MBI75VX-120-50	600V		
	100A			12MBI100VX-120-50	600V		
1 Phase (M403)	200A					4MBI200VG-170R2-50*	1200V
	300A			4MBI300VG-120R-50	600V		
				4MBI300VG-120R1-50*	900V		
	400A	4MBI400VG-060R-50	600V	4MBI400VG-120R-50*	600V		
	450A						
	650A						
	900A						
1 Phase (Under Consideration)	450A			4MBI450VB-120R1-50*	900V		
	650A			4MBI650VB-120R1-50*	900V		
	900A			4MBI900VB-120R1-50*	900V		

Note: AT-NPC (Advanced T-type Neutral-Point-Clamped) 3 level Module integrates RB-IGBT (Reverse Blocking-IGBT) in addition to ordinary IGBT and FWD in single package.

* Under development

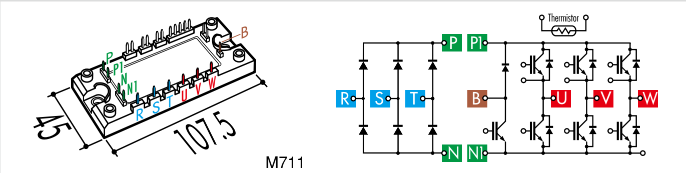
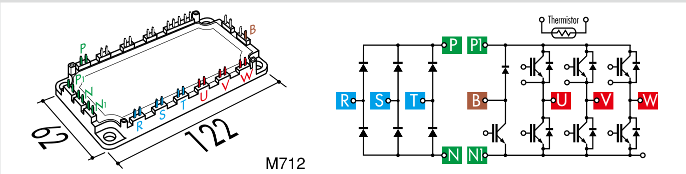
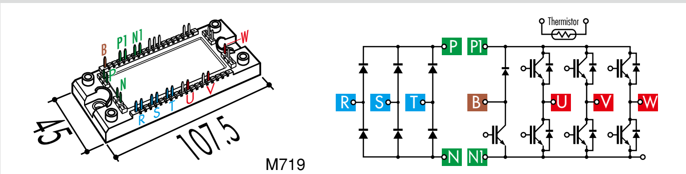
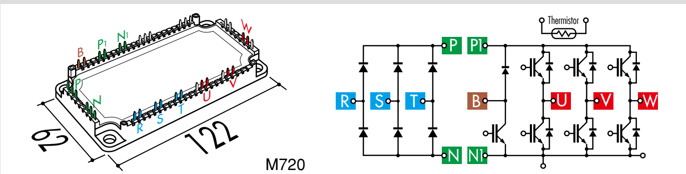
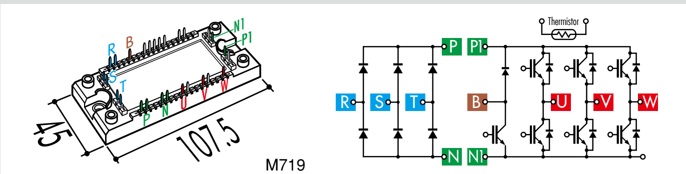
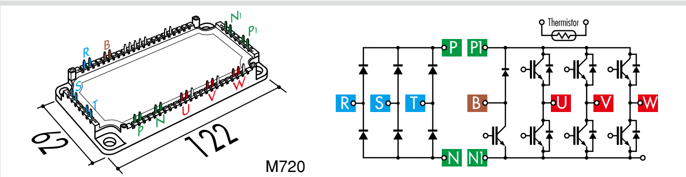
Small PIM (Power Integrated Module) mm

		Ic	600V V Series Trench-FS	1200V V Series Trench-FS
With NTC, press fit pins	 M726 Press fit pins	10A	7MBR10VKA060-50 *	7MBR10VKA120-50
		15A	7MBR15VKA060-50 *	7MBR15VKA120-50
		20A	7MBR20VKA060-50 *	
		30A	7MBR30VKA060-50 *	
	 M727 Press fit pins	15A		7MBR15VKB120-50
		25A		7MBR25VKB120-50
		35A		7MBR35VKB120-50
		50A	7MBR50VKB060-50 *	
With NTC, solder pins	 M728 Solder pins	10A	7MBR10VKC060-50 *	7MBR10VKC120-50
		15A	7MBR15VKC060-50 *	7MBR15VKC120-50
		20A	7MBR20VKC060-50 *	
		30A	7MBR30VKC060-50 *	
	 M729 Solder pins	15A		7MBR15VKD120-50
		25A		7MBR25VKD120-50
		35A		7MBR35VKD120-50
		50A	7MBR50VKD060-50 *	

* Under development

PIM (Power Integrated Module)

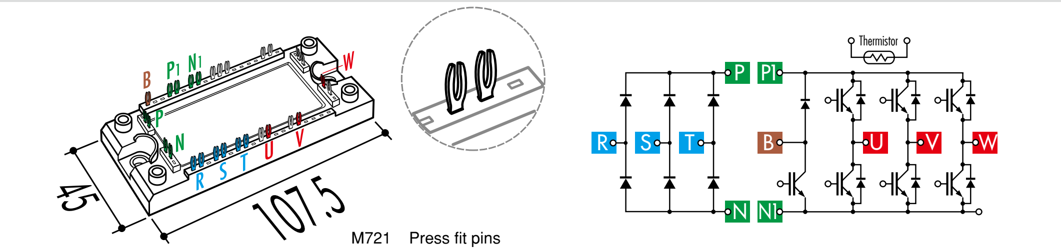
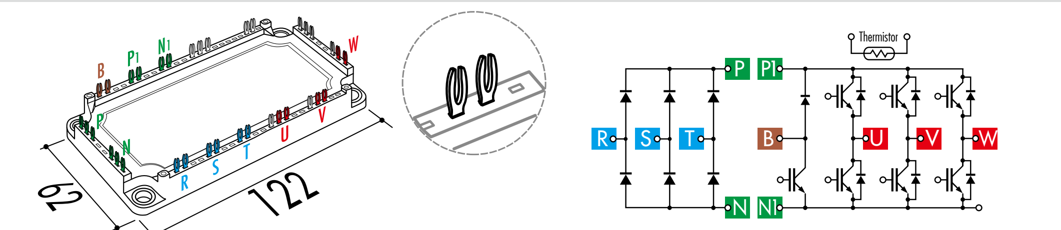
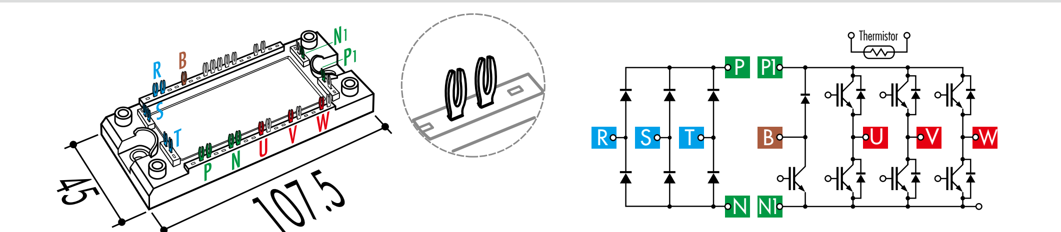
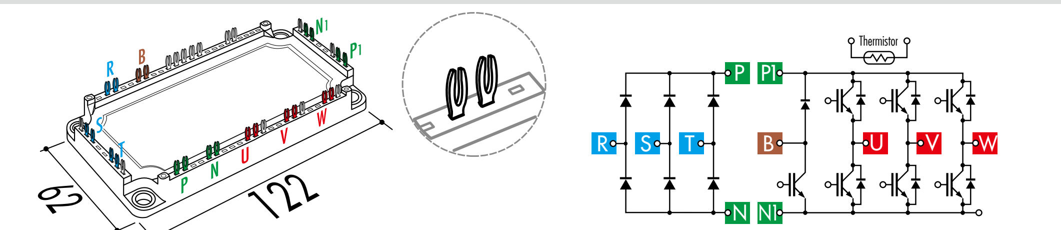
With NTC, solder pins, PIM

Package (mm)	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
 M711	25A		7MBR25VA120-50
	35A		7MBR35VA120-50
	50A	7MBR50VA060-50	
 M712	35A		7MBR35VB120-50
	50A		7MBR50VB120-50
	75A	7MBR75VB060-50	7MBR75VB120-50
	100A	7MBR100VB060-50	
 M719	25A		7MBR25VM120-50
	35A		7MBR35VM120-50
	50A		7MBR50VM120-50
 M720	50A		7MBR50VN120-50
	75A		7MBR75VN120-50
	100A		7MBR100VN120-50
	150A		7MBR150VN120-50
 M719	25A		7MBR25VP120-50
	35A		7MBR35VP120-50
	50A	7MBR50VP060-50	7MBR50VP120-50
	75A	7MBR75VP060-50	
	100A	7MBR100VP060-50	
 M720	50A		7MBR50VR120-50
	75A		7MBR75VR120-50
	100A	7MBR100VR060-50	7MBR100VR120-50
	150A	7MBR150VR060-50	7MBR150VR120-50

Note: Pin assignment of output terminals changes within the range of colored position depending on output current.

PIM (Power Integrated Module)

With NTC, press fit pins. PIM

mm	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
 M721 Press fit pins	25A		7MBR25VW120-50
	35A		7MBR35VW120-50
	50A		7MBR50VW120-50
 M722 Press fit pins	50A		7MBR50VX120-50
	75A		7MBR75VX120-50
	100A		7MBR100VX120-50
	150A		7MBR150VX120-50
 M721 Press fit pins	25A		7MBR25VY120-50
	35A		7MBR35VY120-50
	50A	7MBR50VY060-50	7MBR50VY120-50
	75A	7MBR75VY060-50	
	100A	7MBR100VY060-50	
 M722 Press fit pins	50A		7MBR50VZ120-50
	75A		7MBR75VZ120-50
	100A	7MBR100VZ060-50	7MBR100VZ120-50
	150A	7MBR150VZ060-50	7MBR150VZ120-50

Note: Pin assignment of output terminals changes within the range of colored position depending on output current.

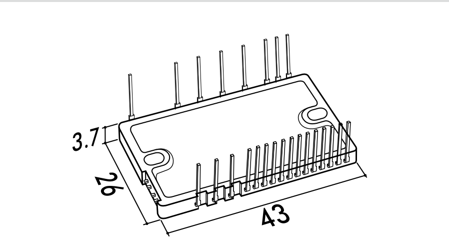
Built-in protection functions

- P-side fault status output (Alarm)
- N-side fault status output (Alarm)
- Under voltage protection (self shutdown)
- Over current protection (self shutdown)
- Overheating protection (self shutdown)
- Temperature sensor output (Vtemp, out)

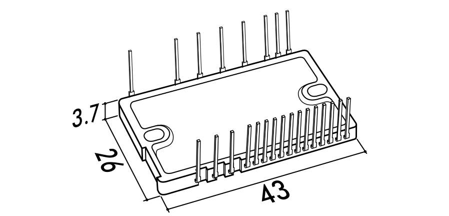
Small IPM (Intelligent Power Module)

mm

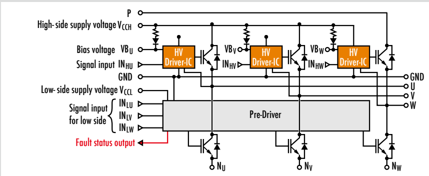
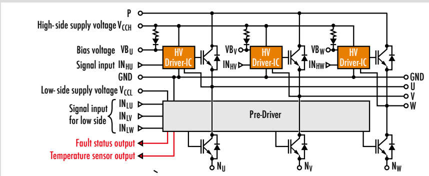
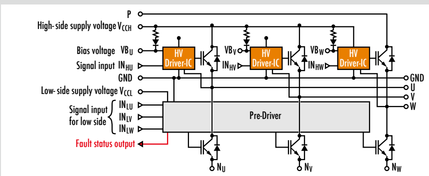
Small IPM with High Voltage Driver-IC without Brake-Chopper



P633 (15A)



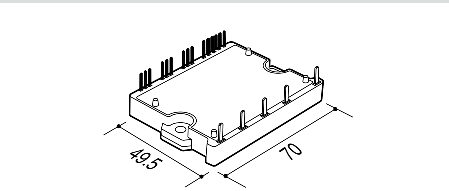
P633A (20A, 30A)

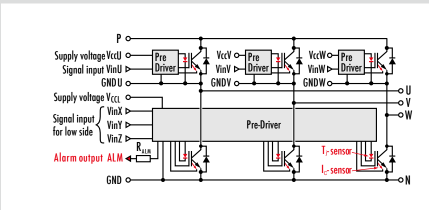
Circuit	Temperature sensor output (Vtemp, out)	Overheating protection (self shutdown)	Over current protection (self shutdown)	Under voltage protection (self shutdown)	N-side fault status output (Alarm)	P-side fault status output (Alarm)	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
1	●	–	●	●	●	–	15A	6MBP15VRA060-50	
							20A	6MBP20VSA060-50	
							30A	6MBP30VSA060-50	
2	–	●	●	●	●	–	15A	6MBP15VRB060-50	
3	●	●	●	●	●	–	15A	6MBP15VRC060-50	
							20A	6MBP20VSC060-50	
							30A	6MBP30VSC060-50	

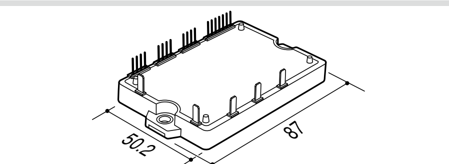
IPM (Intelligent Power Module)

Without Brake-Chopper

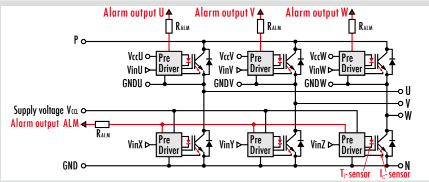


P629





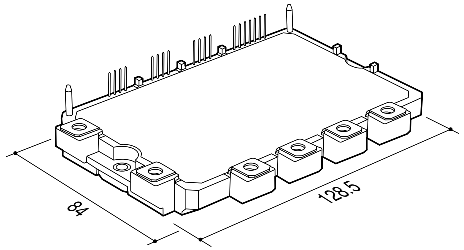
P626



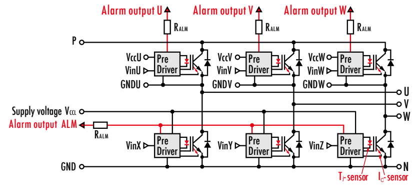
Package	Temperature sensor output (Vtemp, out)	Overheating protection (self shutdown)	Over current protection (self shutdown)	Under voltage protection (self shutdown)	N-side fault status output (Alarm)	P-side fault status output (Alarm)	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
P629	–	●	●	●	●	–	10A		6MBP10VAA120-50
							15A		6MBP15VAA120-50
							20A	6MBP20VAA060-50	
							25A		6MBP25VAA120-50
							30A	6MBP30VAA060-50	
							50A	6MBP50VAA060-50	
P626	–	●	●	●	●	●	25A		6MBP25VBA120-50
							35A		6MBP35VBA120-50
							50A	6MBP50VBA060-50	6MBP50VBA120-50
							75A	6MBP75VBA060-50	

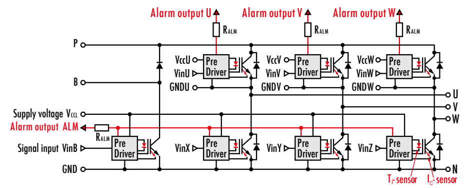
IPM (Intelligent Power Module)

Built-in protection functions:
- P-side fault status output (Alarm)
- N-side fault status output (Alarm)
- Under voltage protection (self shutdown)
- Over current protection (self shutdown)
- Overheating protection (self shutdown)
- Temperature sensor output (Vtemp, out)



P630





	Temperature sensor output (Vtemp, out)	Overheating protection (self shutdown)	Over current protection (self shutdown)	Under voltage protection (self shutdown)	N-side fault status output (Alarm)	P-side fault status output (Alarm)
Without Brake-Chopper	–	●	●	●	●	●
With Brake-Chopper	–	●	●	●	●	●

	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
Without Brake-Chopper	25A		6MBP25VDA120-50
	35A		6MBP35VDA120-50
	50A	6MBP50VDA060-50	6MBP50VDA120-50
			6MBP50VDN120-50*
	75A	6MBP75VDA060-50	6MBP75VDA120-50
			6MBP75VDN120-50*
	100A	6MBP100VDA060-50	6MBP100VDA120-50
		6MBP100VDN060-50*	6MBP100VDN120-50*
	150A	6MBP150VDA060-50	
		6MBP150VDN060-50*	
	200A	6MBP200VDA060-50	
		6MBP200VDN060-50*	
With Brake-Chopper	25A		7MBP25VDA120-50
	35A		7MBP35VDA120-50
	50A	7MBP50VDA060-50	7MBP50VDA120-50
			7MBP50VDN120-50*
	75A	7MBP75VDA060-50	7MBP75VDA120-50
			7MBP75VDN120-50*
	100A	7MBP100VDA060-50	7MBP100VDA120-50
		7MBP100VDN060-50*	7MBP100VDN120-50*
	150A	7MBP150VDA060-50	
		7MBP150VDN060-50*	
	200A	7MBP200VDA060-50	
		7MBP200VDN060-50*	

Note: The products with 'VDN' on this page have high heat dissipation characteristics.

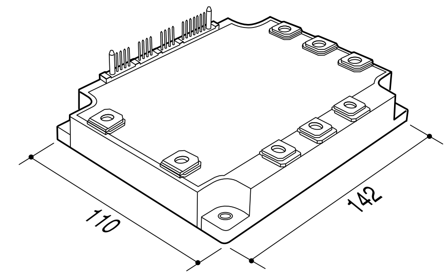
* Under development

Built-in protection functions

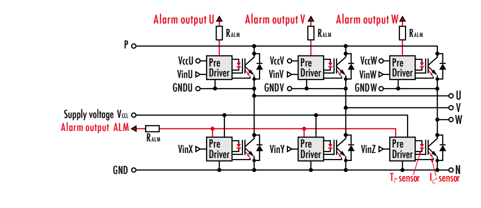
- P-side fault status output (Alarm)
- N-side fault status output (Alarm)
- Under voltage protection (self shutdown)
- Over current protection (self shutdown)
- Overheating protection (self shutdown)
- Temperature sensor output (Vtemp, out)

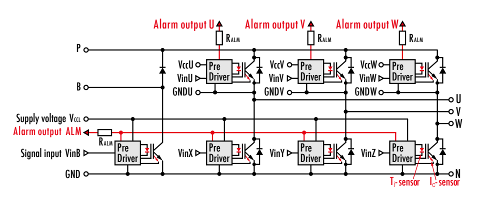
IPM (Intelligent Power Module)

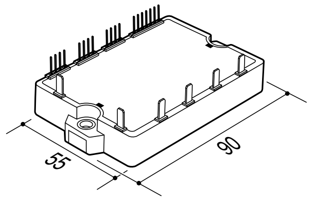
mm



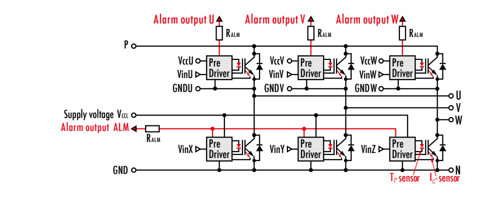
P631

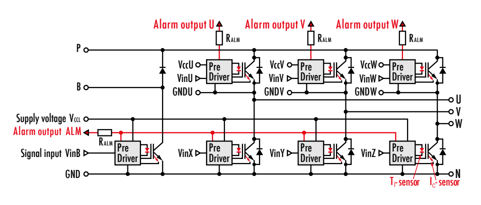






P636





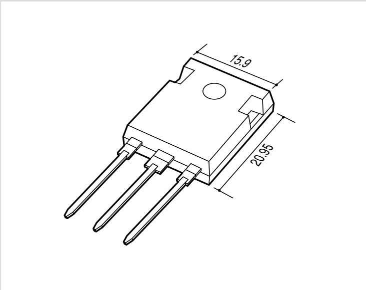
	Temperature sensor output	Overheating protection	Over current protection	Under voltage protection	N-side fault status output	P-side fault status output	Ic	600V V Series Trench-FS	1200V V Series Trench-FS
Without Brake-Chopper (P631)	—	●	●	●	●	●	100A		6MBP100VEA120-50
							150A		6MBP150VEA120-50
							200A	6MBP200VEA060-50	6MBP200VEA120-50
							300A	6MBP300VEA060-50	
							400A	6MBP400VEA060-50	
With Brake-Chopper (P631)	—	●	●	●	●	●	100A		7MBP100VEA120-50
							150A		7MBP150VEA120-50
							200A	7MBP200VEA060-50	7MBP200VEA120-50
							300A	7MBP300VEA060-50	
							400A	7MBP400VEA060-50	
Without Brake-Chopper (P636)	—	●	●	●	●	●	25A		6MBP25VFN120-50*
							35A		6MBP35VFN120-50*
							50A	6MBP50VFN060-50*	6MBP50VFN120-50*
							75A	6MBP75VFN060-50*	
							100A	6MBP100VFN060-50*	
With Brake-Chopper (P636)	—	●	●	●	●	●	25A		7MBP25VFN120-50*
							35A		7MBP35VFN120-50*
							50A	7MBP50VFN060-50*	7MBP50VFN120-50*
							75A	7MBP75VFN060-50*	
							100A	7MBP100VFN060-50*	

* Under development

Discrete IGBT

mm

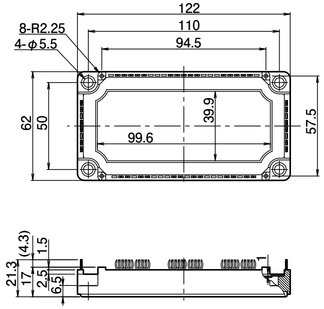
TO-247 -P2



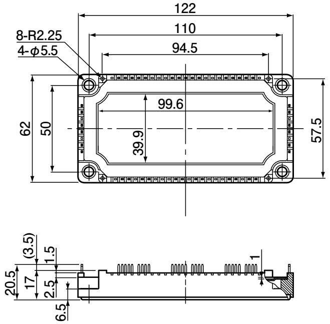
Voltage		600V					1200V		
Series		Reverse Blocking IGBT	Trench-FS V series	Trench-FS High Speed V series			Trench-FS V series	Trench-FS High Speed V series	
IGBT		RB-IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT
Diode		-	Within	Within	Within	Without	Within	Within	Without
Circuit					(If=Ic)				
Ic	15A						FGW15N120VD	FGW15N120HD	FGW15N120H
	25A						FGW25N120VD		
	30A		FGW30N60VD					FGW30N120HD	FGW30N120H
	35A			FGW35N60HD	FGW35N60HC	FGW35N60H			
	40A						FGW40N120VD	FGW40N120HD	FGW40N120H
	50A		FGW50N60VD	FGW50N60HD	FGW50N60HC	FGW50N60H			
	75A			FGW75N60HD		FGW75N60H			
	85A	FGW85N60RB							

Package Outlines, mm

M1202



M1203



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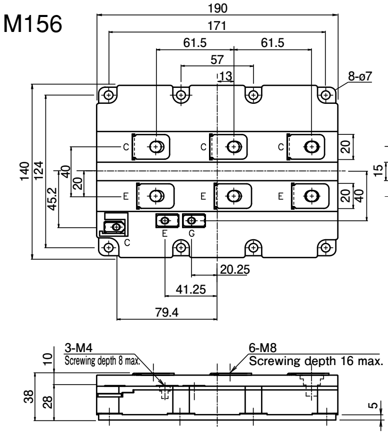

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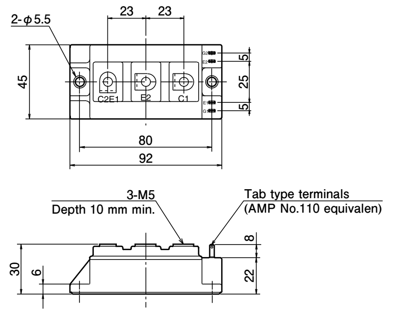

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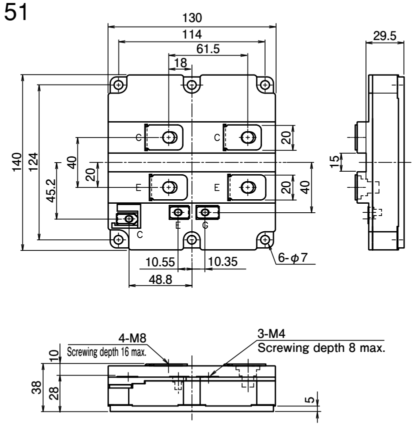
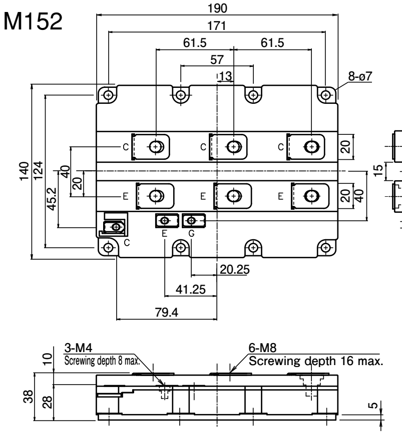


M152



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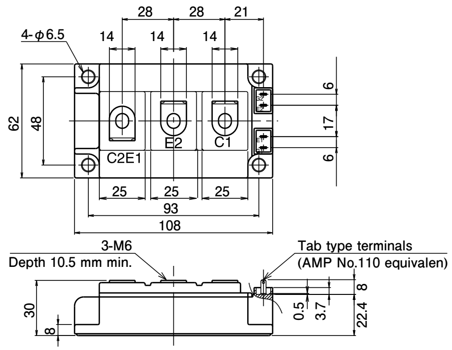

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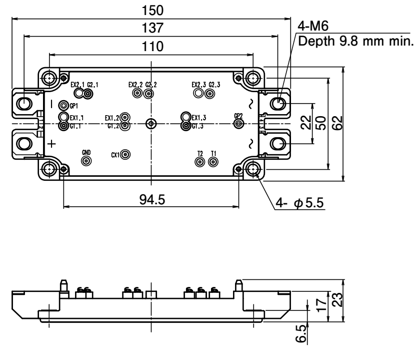
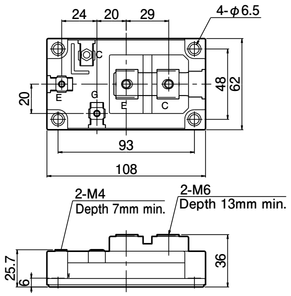


M153



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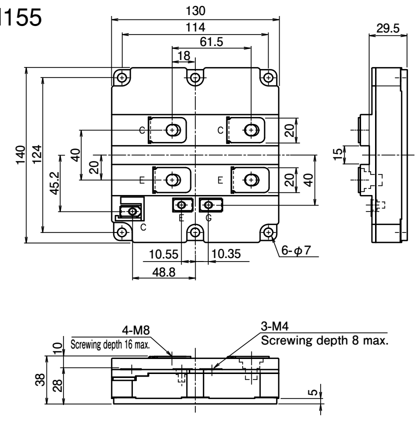

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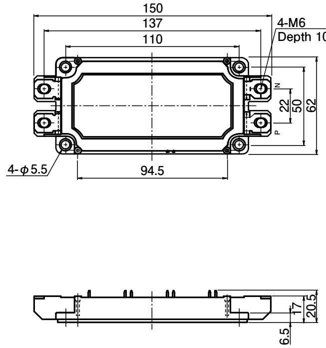

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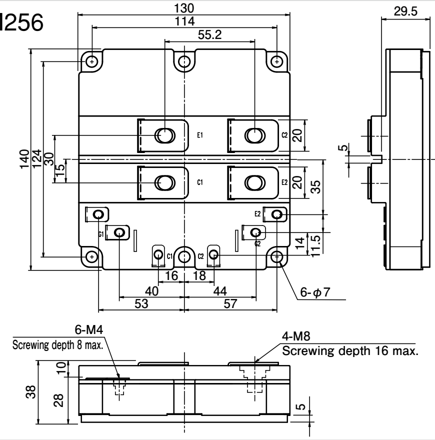
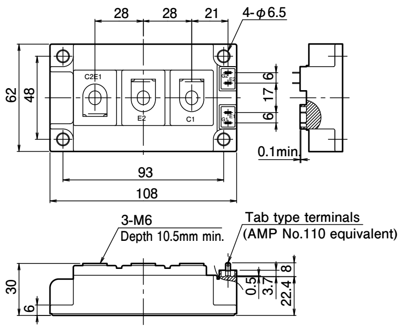
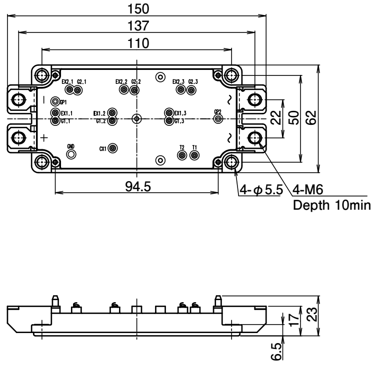


Package Outlines, mm

M259



M260



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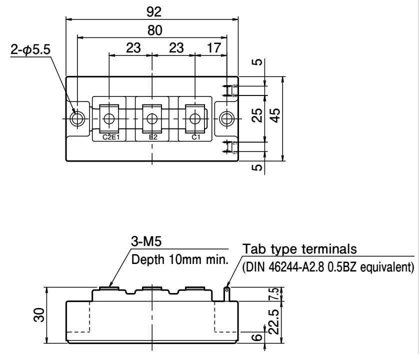
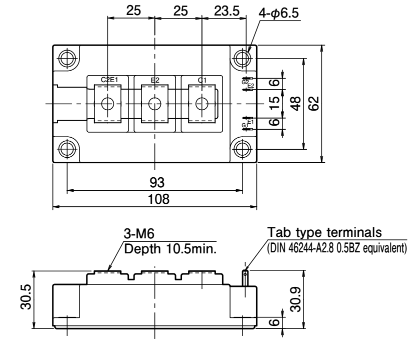
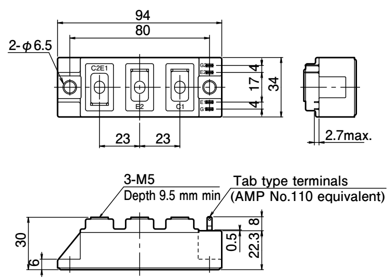


M275



M262



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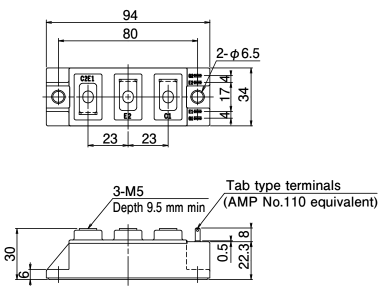

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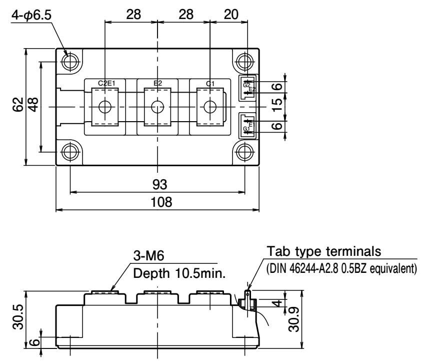

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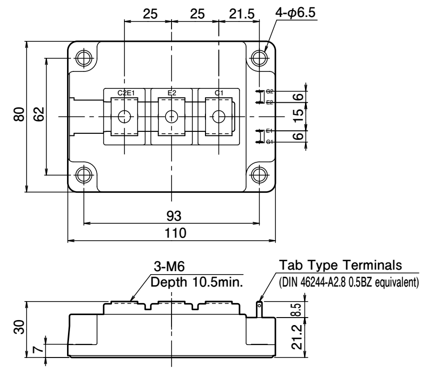

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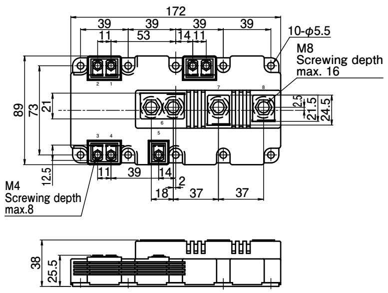

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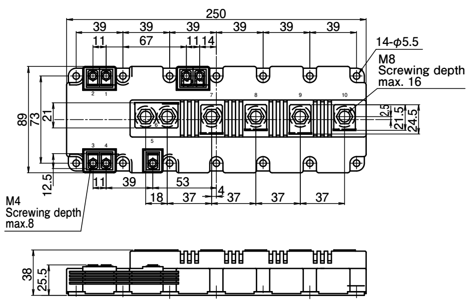

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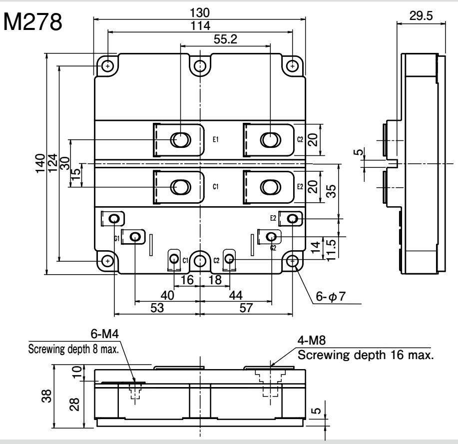

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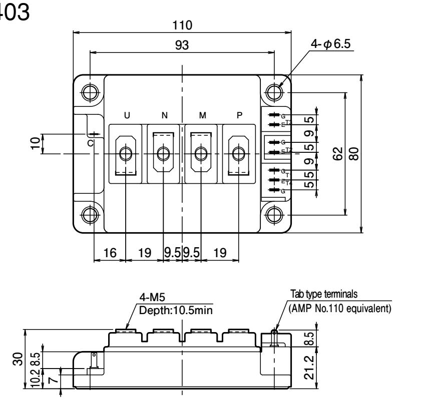
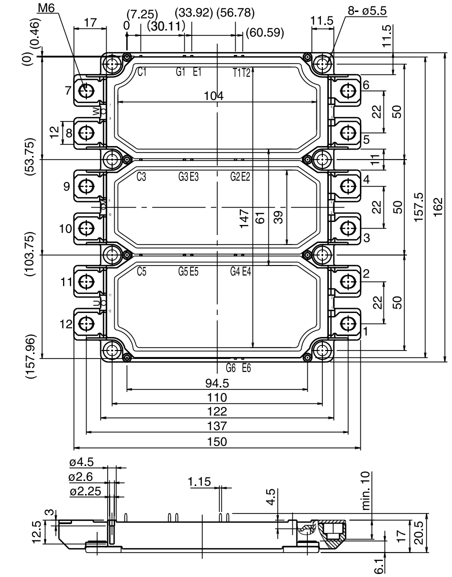


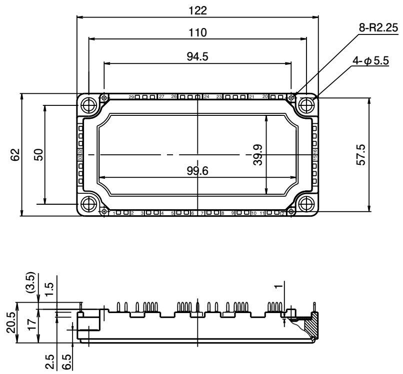
Package Outlines, mm

M629



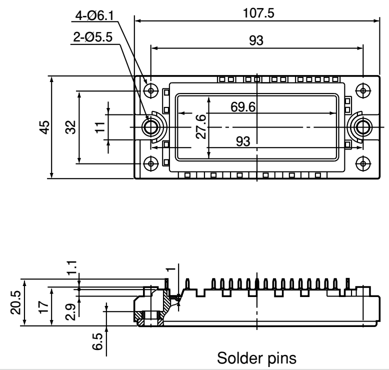
( ) : Theoretical dimensions, tolerance ø0.5

M633



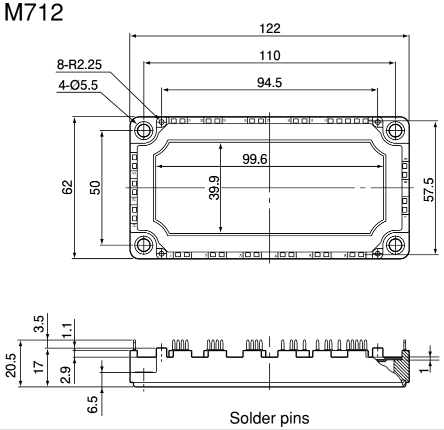
Solder pins

M711



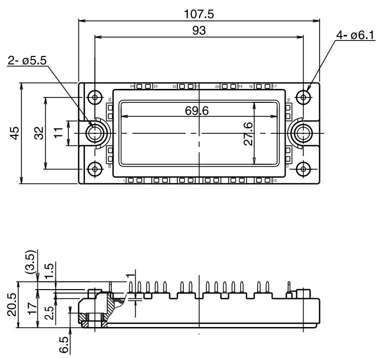
Solder pins

M712



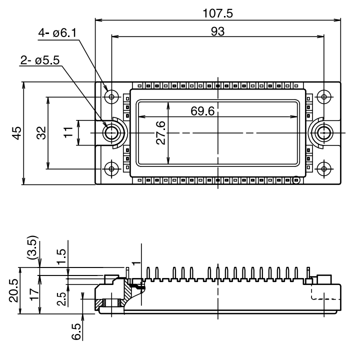
Solder pins

M636



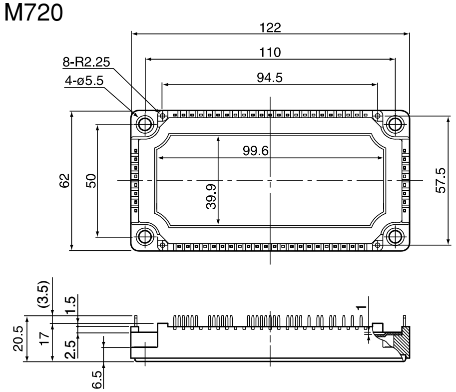
Solder pins

M719



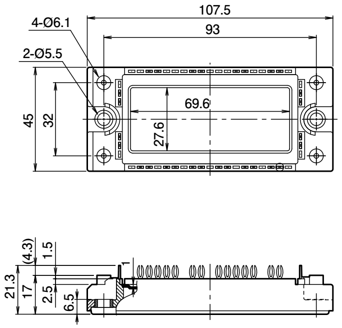
Solder pins

M720



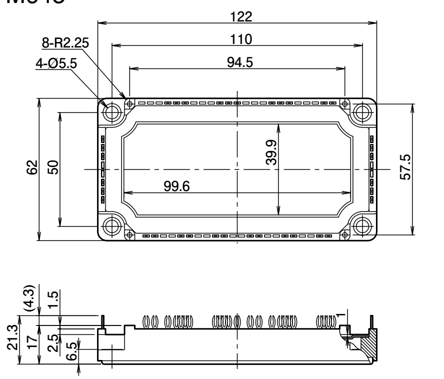
Solder pins

M647



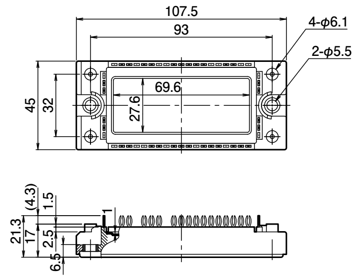
Press fit pins

M648



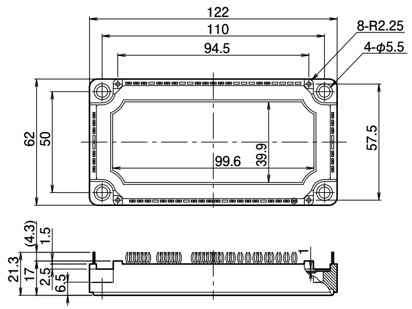
Press fit pins

M721



Press fit pins

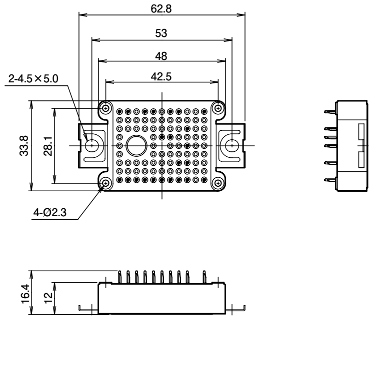
M722



Press fit pins

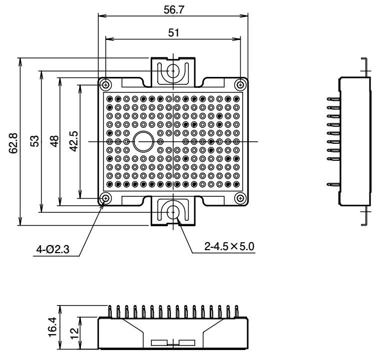
Package Outlines, mm

M726



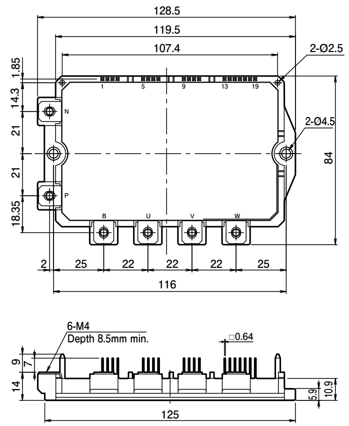
Press fit pins

M727



Press fit pins

P630



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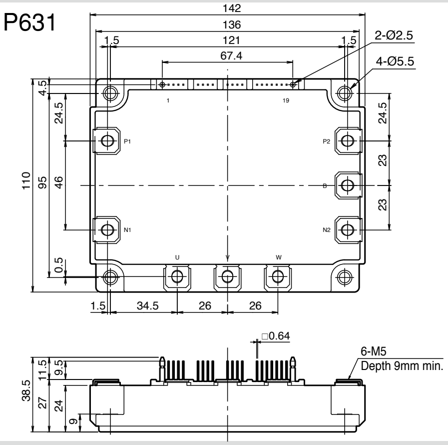

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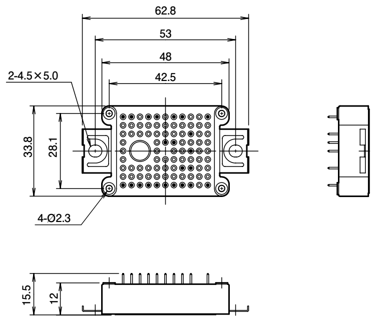
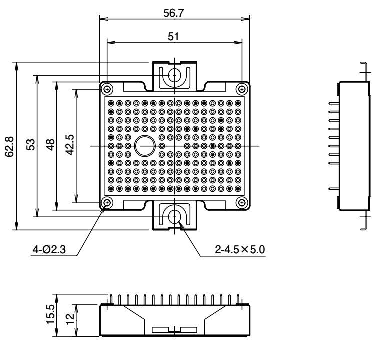


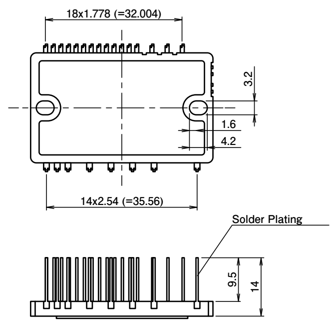
Solder pins

M729

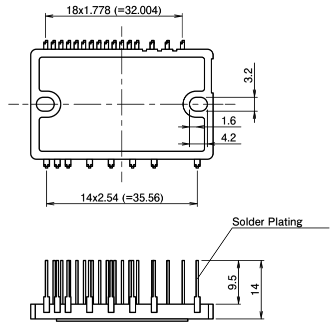


Solder pins

P633



P633A



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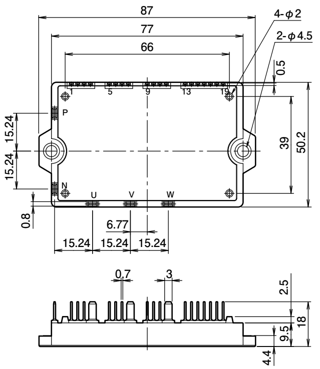

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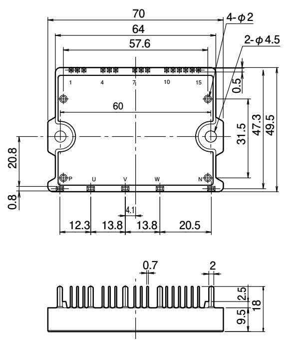
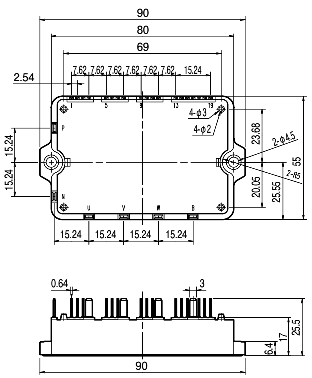
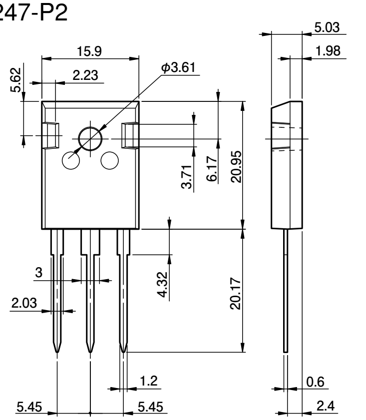


P636



TO-247-P2



Fuji Electric Co., Ltd.

Power Semiconductors Group
http://www.fujielectric.com/products/semiconductor/

Fuji Electric Hong Kong Co., Limited
Unit 227-230, 2nd Floor, No.1 Science Park West Avenue,
Hong Kong Science Park, Shatin, N.T., Hong Kong.
Tel: +852-2664-8699

Fuji Electric Taiwan Co., Ltd.
9F-1, No. 111, Sung Chiang Road, Taipei, TAIWAN
Tel: +886-2-2515-1850

Fuji Electric Asia Pacific Private Ltd.
171 Chin Swee Road,#12-01,San Centre,SINGAPORE 169877
Tel: +65-6533-0014

Fuji Electric (China) Co., Ltd
F27, International Corporate City, No.3000 Zhongshan North Road,
Shanghai 200063 P.R.C., CHINA
Tel: +86-21-5496-1177

Fuji Electric India Private Ltd.
409 &410, Meadows, Sahar Plaza, J.B. Nagar, Andheri-Kurla Road,
Andheri(East), Mumbai - 400 059, India
Tel: +91-22-4010-4870

Fuji Electric Corp. of America
50 Northfield Avenue
Edison, NJ 08837, USA
Tel: +1-732-560-9410

Fuji Electric Europe GmbH
Goethering 58, 63067 Offenbach, am Main, F.R. GERMANY
Tel: +49-69-6690290

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