

MITSUBISHI IGBT Module

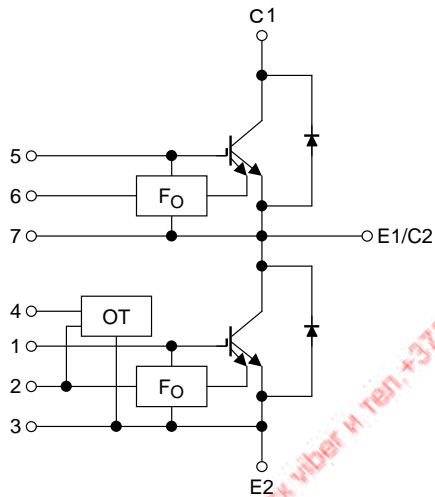
MG400Q2YS60A

High Power Switching Applications

Motor Control Applications

- Integrates a complete half bridge power circuit and fault-signal output circuit in one package.
(short circuit and over temperature)
- The electrodes are isolated from case.
- Low thermal resistance.
- $V_{CE(sat)} = 2.4 \text{ V (typ.)}$

Equivalent Circuit

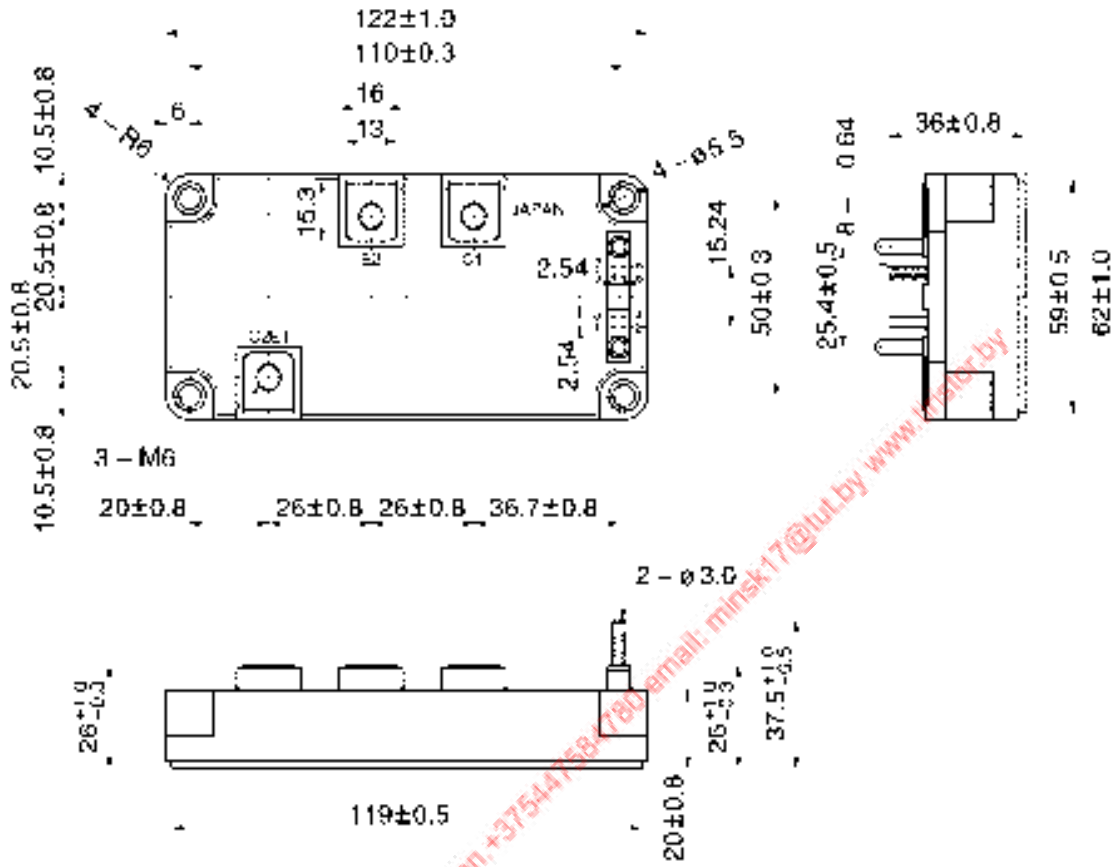


Signal terminal

1.	G (L)	2.	F _O (L)	3.	E (L)	4.	V _D
5.	G (H)	6.	F _O (H)	7.	E (H)	8.	Open

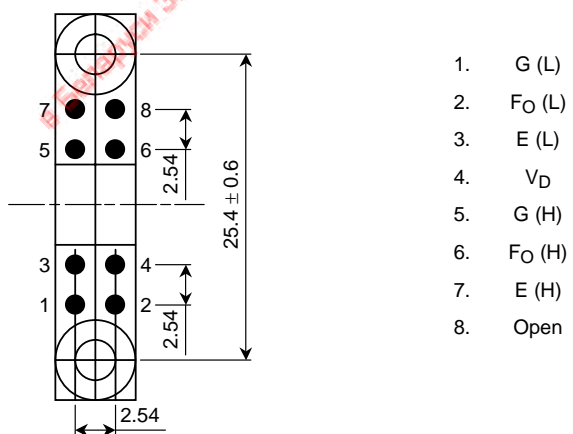
Package Dimensions

Unit: mm



- | | | | | | | | |
|----|-------|----|--------------------|----|-------|----|----------------|
| 1. | G (L) | 2. | F _O (L) | 3. | E (L) | 4. | V _D |
| 5. | G (H) | 6. | F _O (H) | 7. | E (H) | 8. | Open |

Signal Terminal Layout



- | | |
|----|--------------------|
| 1. | G (L) |
| 2. | F _O (L) |
| 3. | E (L) |
| 4. | V _D |
| 5. | G (H) |
| 6. | F _O (H) |
| 7. | E (H) |
| 8. | Open |

Weight: 375 g

Maximum Ratings (Ta = 25°C)

Stage	Characteristics	Symbol	Rating	Unit	
Inverter	Collector-emitter voltage	V_{CES}	1200	V	
	Gate-emitter voltage	V_{GES}	± 20	V	
	Collector current	DC	I_C	400	A
		1 ms	I_{CP}	800	
	Forward current	DC	I_F	400	A
		1 ms	I_{FM}	800	
Collector power dissipation (Tc = 25°C)		P_C	3750	W	
Control	Control voltage (OT)	V_D	20	V	
	Fault input voltage	V_{FO}	20	V	
	Fault input current	I_{FO}	20	mA	
Module	Junction temperature	T_j	150	°C	
	Storage temperature range	T_{stg}	-40~125	°C	
	Operation temperature range	T_{ope}	-20~100	°C	
	Isolation voltage	V_{isol}	2500 (AC 1 min)	V	
	Screw torque	—	3 (M5)	N·m	

Electrical Characteristics (Tj = 25°C)**1. Inverter stage**

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit	
Gate leakage current		I_{GES}	$V_{GE} = \pm 20 \text{ V}, V_{CE} = 0$	—	—	+3/-4	mA	
			$V_{GE} = +10 \text{ V}, V_{CE} = 0$	—	—	100	nA	
Collector cut-off current		I_{CES}	$V_{CE} = 1200 \text{ V}, V_{GE} = 0$	—	—	1.0	mA	
Gate-emitter cut-off voltage		$V_{GE} \text{ (off)}$	$V_{CE} = 5 \text{ V}, I_C = 400 \text{ mA}$	6.0	7.0	8.0	V	
Collector-emitter saturation voltage		$V_{CE} \text{ (sat)}$	$V_{GE} = 15 \text{ V}, I_C = 400 \text{ A}$	$T_j = 25^\circ\text{C}$	—	2.4	2.8	V
				$T_j = 125^\circ\text{C}$	—	—	3.2	
Input capacitance		C_{ies}	$V_{CE} = 10 \text{ V}, V_{GE} = 0, f = 1 \text{ MHz}$	—	31000	—	pF	
Switching time	Turn-on delay time	$t_d \text{ (on)}$	$V_{CC} = 600 \text{ V}, I_C = 400 \text{ A}$ $V_{GE} = \pm 15 \text{ V}, R_G = 5.1 \Omega$ (Note 1)	0.10	—	1.00	μs	
	Turn-off time	t_{off}		—	—	2.00		
	Fall time	t_f		—	—	0.50		
Reverse recovery time		t_{rr}	(See page 4)	—	—	0.50		
Forward voltage		V_F	$I_F = 400 \text{ A}$	—	2.4	2.8	V	

Note 1: Switching time test circuit & timing chart

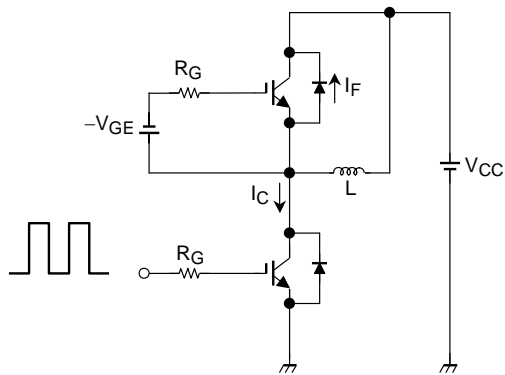
2. Control (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Fault output current	OC	$V_{GE} = 15 \text{ V}$	480	—	—	A
Over temperature	OT	—	100	—	125	°C
Fault output delay time	$t_d \text{ (Fo)}$	$V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$	—	—	8	μs

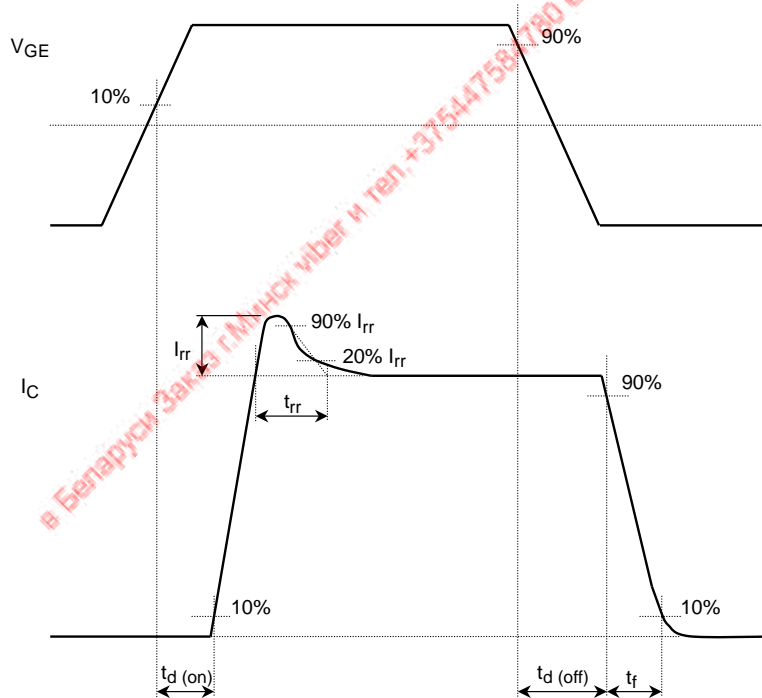
3. Module (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to case thermal resistance	R _{th (j-c)}	Inverter IGBT stage	—	—	0.033	°C/W
		Inverter FRD stage	—	—	0.068	
Case to fin thermal resistance	R _{th (c-f)}	With silicon compound	—	0.013	—	°C/W

Switching Time Test Circuit



Timing Chart



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Remark**<Short circuit capability condition >**

- Short circuit capability is 6 μ s after fault output signal.
Please keep following condition to use fault output signal.
 - $V_{CC} \leq 750$ V
 - 14.8 V $\leq V_{GE} \leq 17.0$ V
 - $R_G \geq 5.1$ Ω
 - $T_j \leq 125^\circ$ C

<Gate voltage >

- To use this product, V_{GE} must be provided higher than 14.8 V
In case V_{GE} is less than 14.8 V, fault signal FO may not be output even under error conditions.

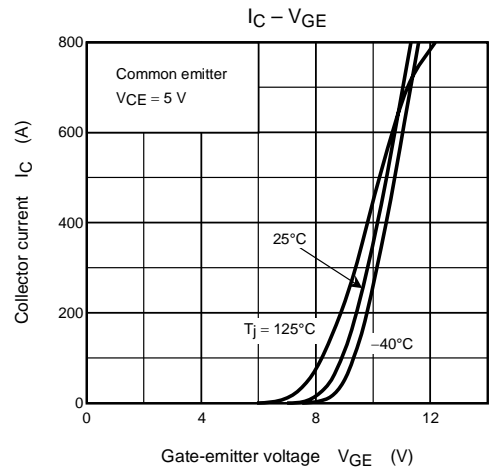
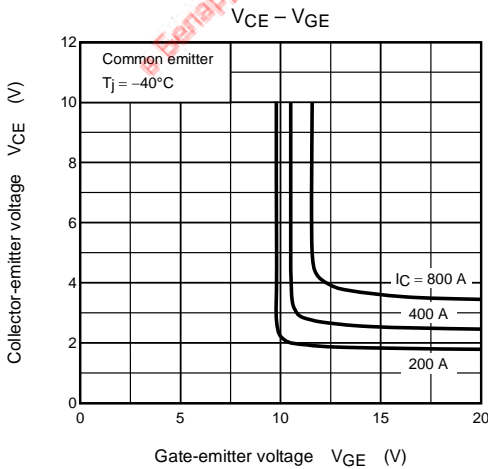
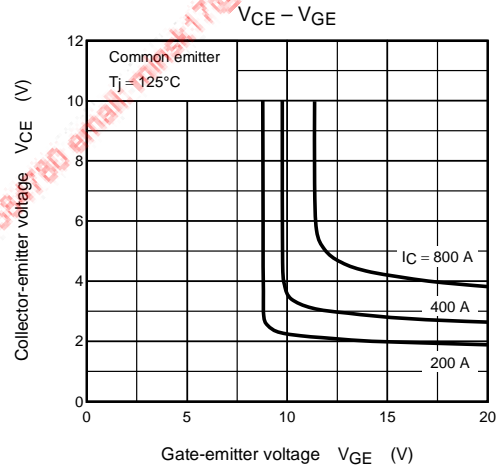
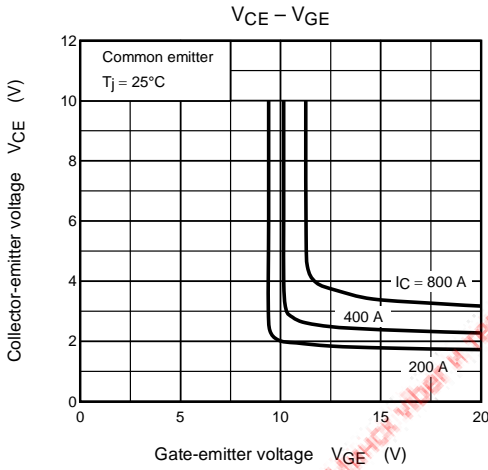
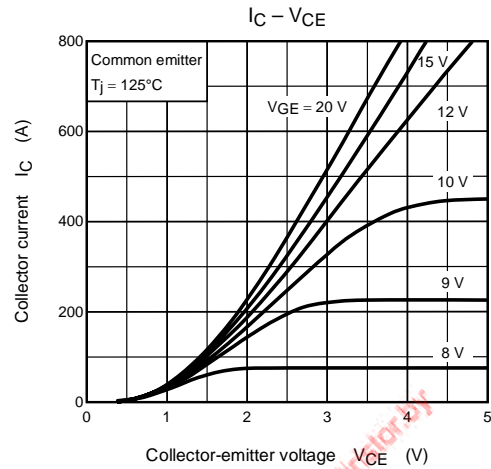
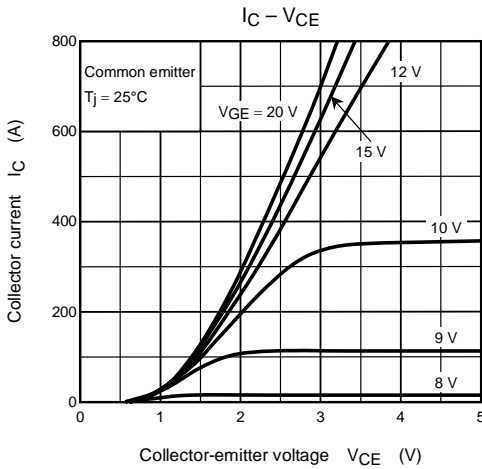
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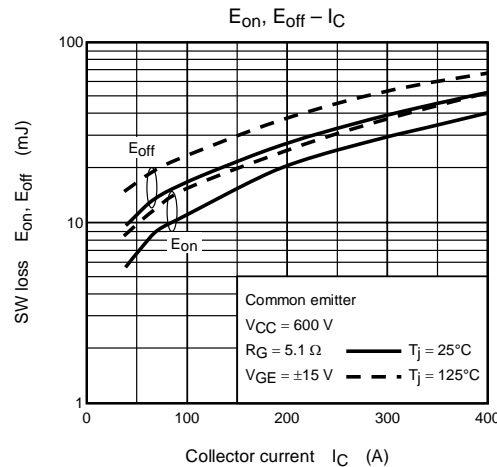
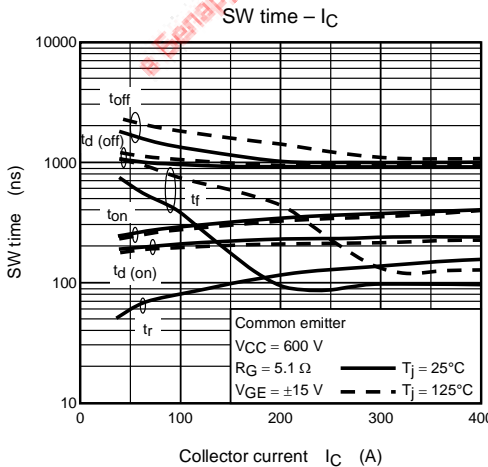
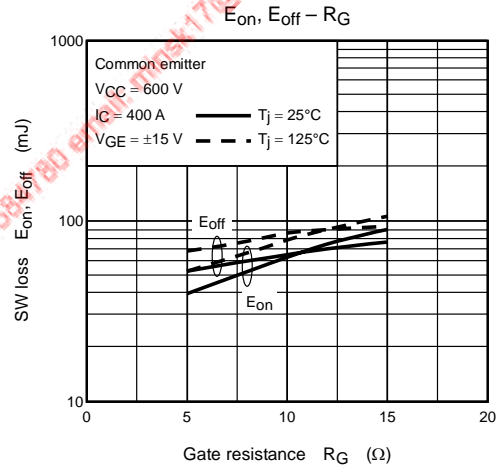
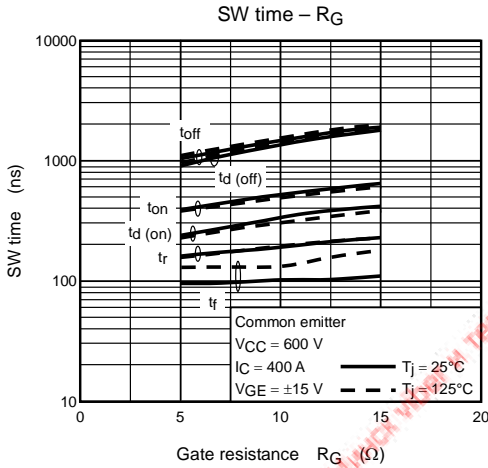
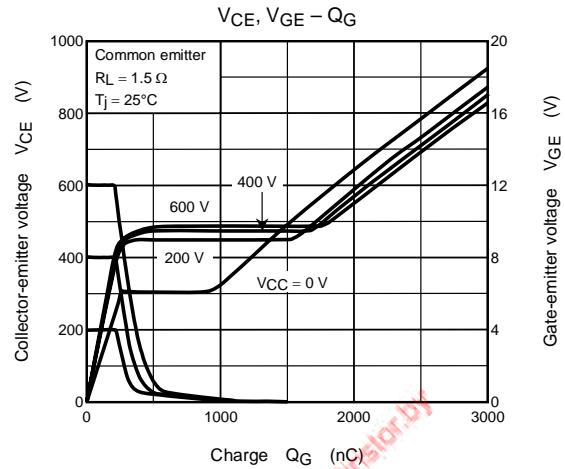
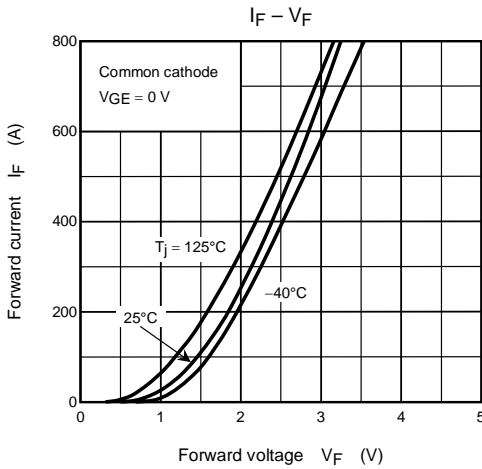
Characteristics	Symbol	Min	Typ.	Max	Unit
P-N power terminal supply voltage	V_{CC}	—	600	750	V
Gate voltage	V_{GE}	14.8	15	17	V
Gate resistance	R_G	5.1	—	—	Ω
Switching frequency	fc	—	—	20	kHz

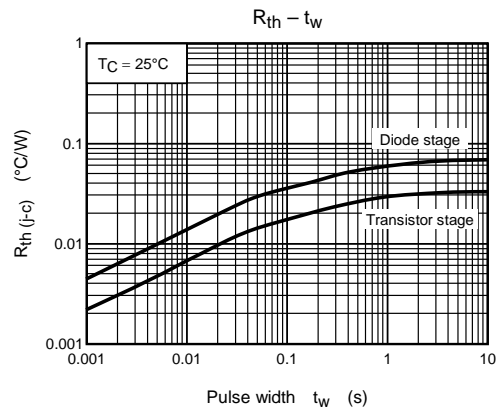
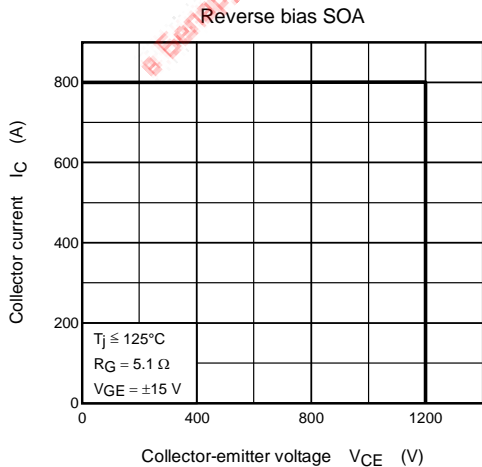
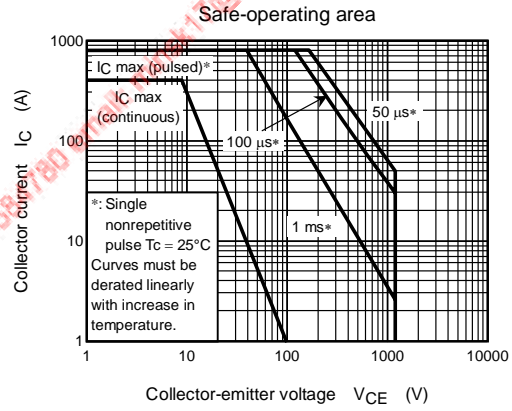
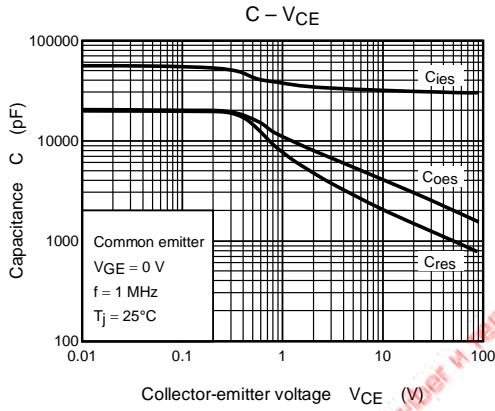
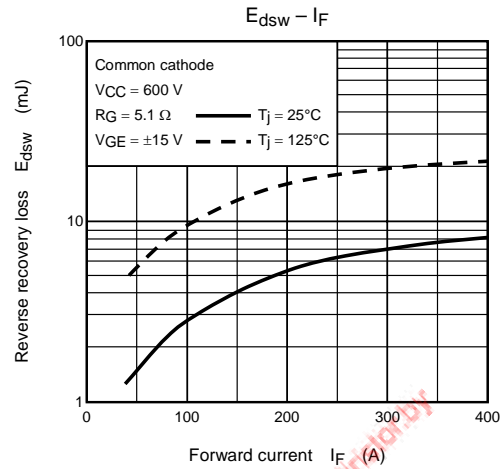
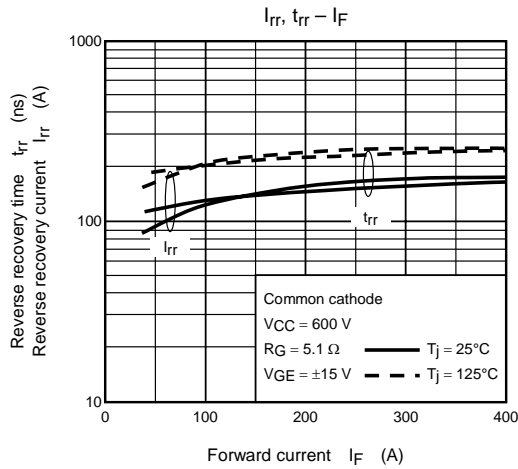
<For parallel use>

- For parallel use of this product, please use the same rank for both $V_{CE(sat)}$ and V_F among IGBT in parallel without fail.

$V_{CE(sat)}$	V_F	Min	Max
24	E	2.1	2.4
26	F	2.3	2.6
28	G	2.5	2.8







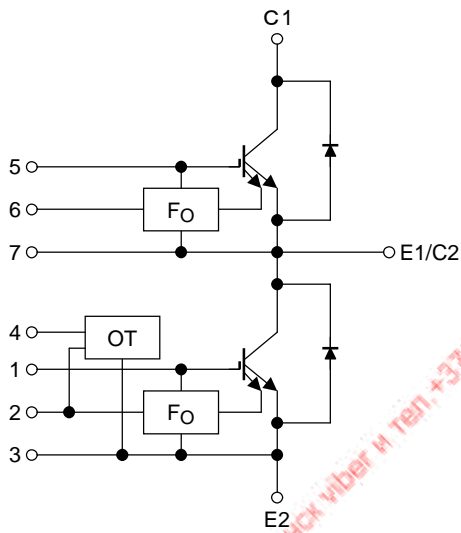
TOSHIBA IGBT Module Silicon N Channel IGBT

MG400Q2YS60A

High Power Switching Applications
 Motor Control Applications

- Integrates a complete half bridge power circuit and fault-signal output circuit in one package.
 (short circuit and over temperature)
- The electrodes are isolated from case.
- Low thermal resistance.
- $V_{CE(sat)} = 2.4\text{ V (typ.)}$

Equivalent Circuit



Signal terminal

1.	G (L)	2.	F _O (L)	3.	E (L)	4.	V _D
5.	G (H)	6.	F _O (H)	7.	E (H)	8.	Open

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Maximum Ratings (Ta = 25°C)

Stage	Characteristics	Symbol	Rating	Unit	
Inverter	Collector-emitter voltage	V_{CES}	1200	V	
	Gate-emitter voltage	V_{GES}	±20	V	
	Collector current	DC	I_C	400	A
		1 ms	I_{CP}	800	
	Forward current	DC	I_F	400	A
		1 ms	I_{FM}	800	
Collector power dissipation (Tc = 25°C)		P_C	3750	W	
Control	Control voltage (OT)	V_D	20	V	
	Fault input voltage	V_{FO}	20	V	
	Fault input current	I_{FO}	20	mA	
Module	Junction temperature	T_j	150	°C	
	Storage temperature range	T_{stg}	-40~125	°C	
	Operation temperature range	T_{ope}	-20~100	°C	
	Isolation voltage	V_{isol}	2500 (AC 1 min)	V	
	Screw torque	—	3 (M5)	N·m	

Electrical Characteristics (Tj = 25°C)

1. Inverter stage

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	
Gate leakage current	I_{GES}	$V_{GE} = \pm 20 \text{ V}, V_{CE} = 0$	—	—	+3/-4	mA	
		$V_{GE} = +10 \text{ V}, V_{CE} = 0$	—	—	100	nA	
Collector cut-off current	I_{CES}	$V_{CE} = 1200 \text{ V}, V_{GE} = 0$	—	—	1.0	mA	
Gate-emitter cut-off voltage	$V_{GE} \text{ (off)}$	$V_{CE} = 5 \text{ V}, I_C = 400 \text{ mA}$	6.0	7.0	8.0	V	
Collector-emitter saturation voltage	$V_{CE} \text{ (sat)}$	$V_{GE} = 15 \text{ V}, I_C = 400 \text{ A}$	$T_j = 25^\circ\text{C}$	—	2.4	2.8	V
			$T_j = 125^\circ\text{C}$	—	—	3.2	
Input capacitance	C_{ies}	$V_{CE} = 10 \text{ V}, V_{GE} = 0, f = 1 \text{ MHz}$	—	31000	—	pF	
Switching time	Turn-on delay time	$V_{CC} = 600 \text{ V}, I_C = 400 \text{ A}$ $V_{GE} = \pm 15 \text{ V}, R_G = 5.1 \Omega$ (See page 4) (Note 1)	0.10	—	1.00	μs	
	Turn-off time		—	—	2.00		
	Fall time		—	—	0.50		
Reverse recovery time	t_{rr}		—	—	0.50		
Forward voltage	V_F	$I_F = 400 \text{ A}$	—	2.4	2.8	V	

Note 1: Switching time test circuit & timing chart

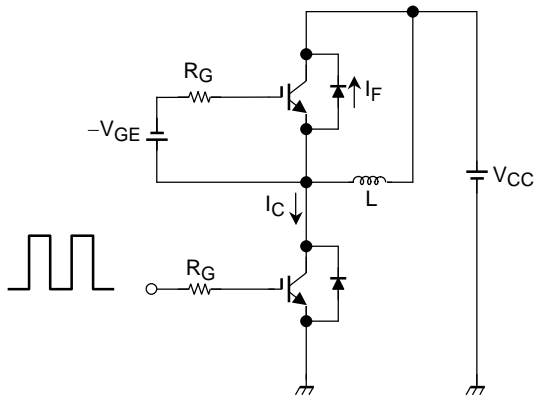
2. Control (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Fault output current	OC	$V_{GE} = 15 \text{ V}$	480	—	—	A
Over temperature	OT	—	100	—	125	°C
Fault output delay time	$t_d \text{ (Fo)}$	$V_{CC} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$	—	—	8	μs

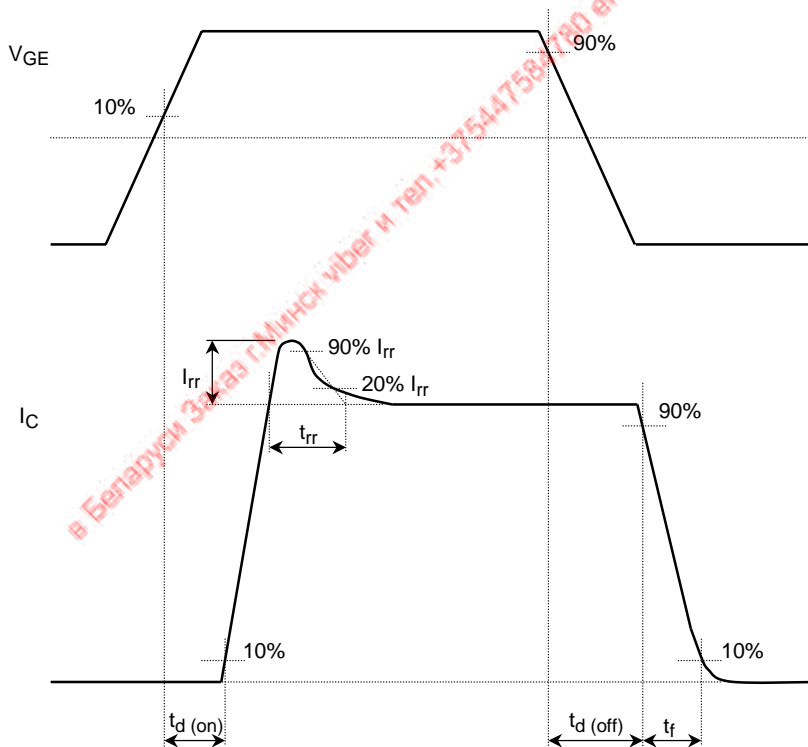
3. Module (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to case thermal resistance	$R_{th(j-c)}$	Inverter IGBT stage	—	—	0.033	°C/W
		Inverter FRD stage	—	—	0.068	
Case to fin thermal resistance	$R_{th(c-f)}$	With silicon compound	—	0.013	—	°C/W

Switching Time Test Circuit



Timing Chart



Remark

<Short circuit capability condition >

- Short circuit capability is 6 μ s after fault output signal.
Please keep following condition to use fault output signal.
 - $V_{CC} \leq 750$ V
 - 14.8 V $\leq V_{GE} \leq 17.0$ V
 - $R_G \geq 5.1$ Ω
 - $T_j \leq 125^\circ$ C

<Gate voltage >

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In case V_{GE} is less than 14.8 V, fault signal FO may not be output even under error conditions.

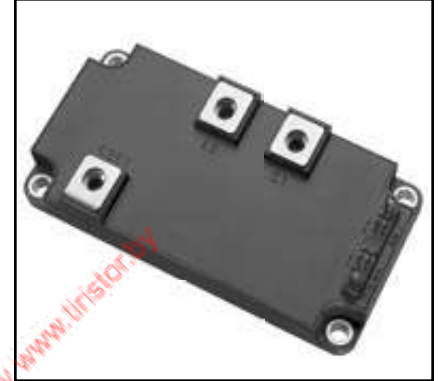
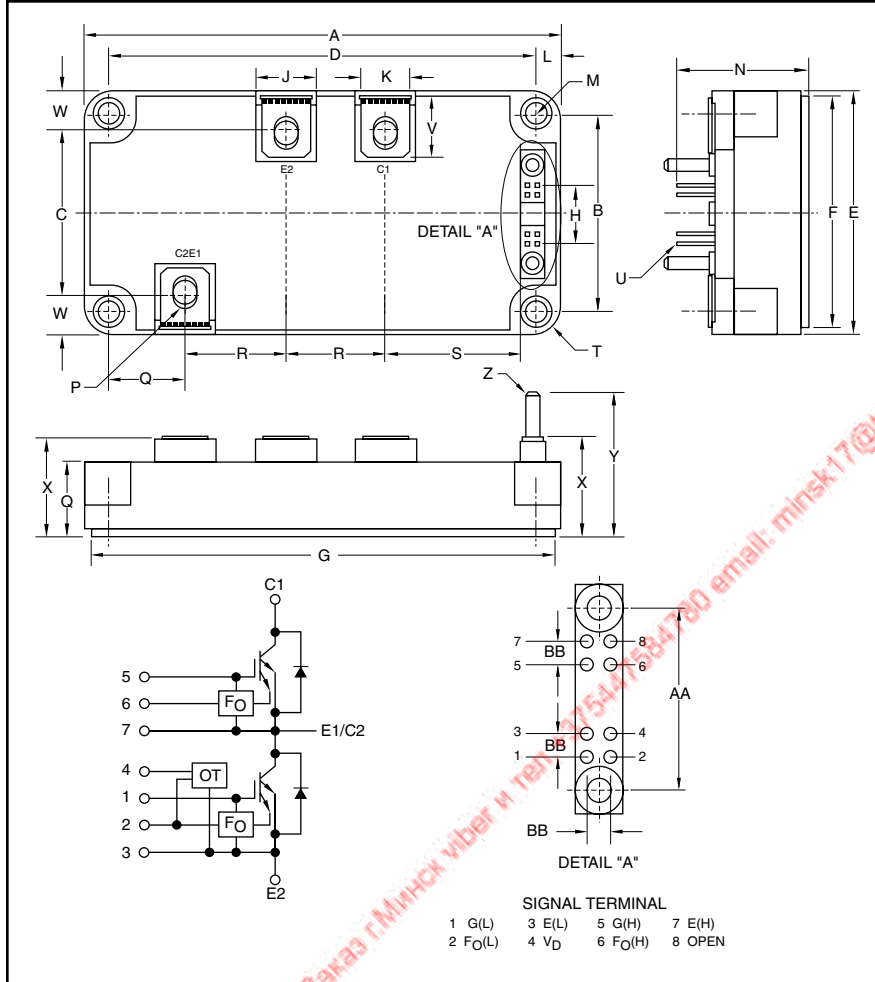
<For parallel use>

- For parallel use of this product, please use the same rank for both $V_{CE(sat)}$ and V_F among IGBT in parallel without fail.

$V_{CE(sat)}$	V_F	Min	Max
24	E	2.1	2.4
26	F	2.3	2.6
28	G	2.5	2.8

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Dual IGBTMOD™ Compact IGBT Series Module 400 Amperes/1200 Volts



Description:

Powerex Dual IGBTMOD™ Compact IGBT Series Modules are designed for use in switching applications. Each module consists of two IGBT Transistors in a half-bridge configuration, with each transistor having a reverse-connected super-fast recovery free-wheel diode. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

Features:

- Over-Current and Over-Temperature Protection
- Low V_{CE(sat)}
- Isolated Baseplate for Easy Heat Sinking

Applications:

- AC Motor Control
- Motion/Servo Control
- UPS
- Welding Power Supplies
- Laser Power Supplies

Ordering Information:

Example: Select the complete part number from the table below -i.e. MG400Q2YS60A is a 1200V (V_{CES}), 400 Ampere Dual IGBTMOD™ Compact IGBT Series Module.

Type	Current Rating Amperes	V _{CES} Volts (x 20)
MG	400	60

Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	4.80±0.04	122.0±1.0
B	1.97±0.01	50.0±0.3
C	1.61±0.03	41.0±0.8
D	4.33±0.01	110.0±0.3
E	2.44±0.04	62.0±1.0
F	2.32±0.02	59.0±0.5
G	4.69±0.02	119.0±0.5
H	0.60	15.24
J	0.63	16.0
K	0.51	13.0
L	0.24	6.0
M	0.22 Dia.	5.5 Dia.
N	1.42±0.03	36.0±0.8

Dimensions	Inches	Millimeters
P	M6	M6
Q	0.79±0.03	20.0±0.8
R	1.02±0.03	26.0±0.8
S	1.44±0.03	36.7±0.8
T	0.24 Rad.	6.0 Rad.
U	0.02	0.64
V	0.60	15.3
W	0.41±0.03	10.5±0.8
X	1.02 -0.01/+0.04	26.0-0.3/+1.0
Y	1.48 -0.02/+0.04	37.5-0.5/+1.0
Z	0.01 Dia.	3.0 Dia.
AA	1.00±0.023	25.4±0.6
BB	0.10	2.54

MG400Q2YS60A
Dual IGBTMOD™
Compact IGBT Series Module
 400 Amperes/1200 Volts

Absolute Maximum Ratings, $T_j = 25^\circ\text{C}$ unless otherwise specified

Characteristics	Symbol	MG400Q2YS60A	Units
Power Device Junction Temperature	T_j	-20 to 150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to 125	$^\circ\text{C}$
Operating Temperature Range	T_{ope}	-20 ~ 100	$^\circ\text{C}$
Mounting Torque, M5 Mounting Screws	—	31	in-lb
Mounting Torque, M6 Main Terminal Screws	—	40	in-lb
Module Weight (Typical)	—	375	Grams
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal	V_{ISO}	2500	Volts

IGBT Inverter Sector

Collector-Emitter Voltage	V_{CES}	1200	Volts
Gate-Emitter Voltage	V_{GES}	± 20	Volts
Collector Current ($T_C = 25^\circ\text{C}$)	I_C	400	Amperes
Peak Collector Current ($T_C = 25^\circ\text{C}$)	I_{CP}	800	Amperes
Emitter Current ($T_C = 25^\circ\text{C}$)	I_E	400	Amperes
Peak Emitter Current ($T_C = 25^\circ\text{C}$)	I_{EM}	800	Amperes
Collector Dissipation ($T_C = 25^\circ\text{C}$)	P_C	3750	Watts

IGBT Control Sector

Control Voltage (OT)	V_D	20	Volts
Fault Input Voltage	V_{FO}	20	Volts
Fault Input Current	I_{FO}	20	mA

Electrical and Mechanical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Gate Leakage Current	I_{GES}	$V_{\text{GE}} = \pm 20\text{V}, V_{\text{CE}} = 0\text{V}$	—	—	-4 / +3	mA
		$V_{\text{GE}} = 10\text{V}, V_{\text{CE}} = 0\text{V}$	—	—	100	nA
Collector-Emitter Cutoff Current	I_{CES}	$V_{\text{CE}} = 1200\text{V}, V_{\text{GE}} = 0\text{V}$	—	—	1.0	mA
Gate-Emitter Cutoff Voltage	$V_{\text{GE(off)}}$	$V_{\text{CE}} = 5\text{V}, I_C = 400\text{mA}$	6.0	7.0	8.0	Volts
Collector-Emitter Saturation Voltage	$V_{\text{CE(sat)}}$	$V_{\text{GE}} = 15\text{V}, I_C = 400\text{A}, T_j = 25^\circ\text{C}$	—	2.4	2.8	Volts
		$V_{\text{GE}} = 15\text{V}, I_C = 400\text{A}, T_j = 125^\circ\text{C}$	—	—	3.2	Volts
Input Capacitance	C_{ies}	$V_{\text{CE}} = 10\text{V}, V_{\text{GE}} = 0\text{V}, f = 1\text{MHz}$	—	31,000	—	pF
Inductive Load	$t_{\text{d(on)}}$		0.1	—	1.0	μs
Switching	t_{off}	$V_{\text{CC}} = 600\text{V}, I_C = 400\text{A},$	—	—	2.0	μs
Times	t_f	$V_{\text{GE}} = \pm 15\text{V}, R_G = 5.1\Omega$	—	—	0.5	μs
Reverse Recovery Time	t_{rr}		—	—	0.5	μs
Emitter-Collector Voltage	V_{EC}	$I_E = 400\text{A}$	—	2.4	2.8	Volts

MG400Q2YS60A
Dual IGBTMOD™
Compact IGBT Series Module
 400 Amperes/1200 Volts

Electrical and Mechanical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

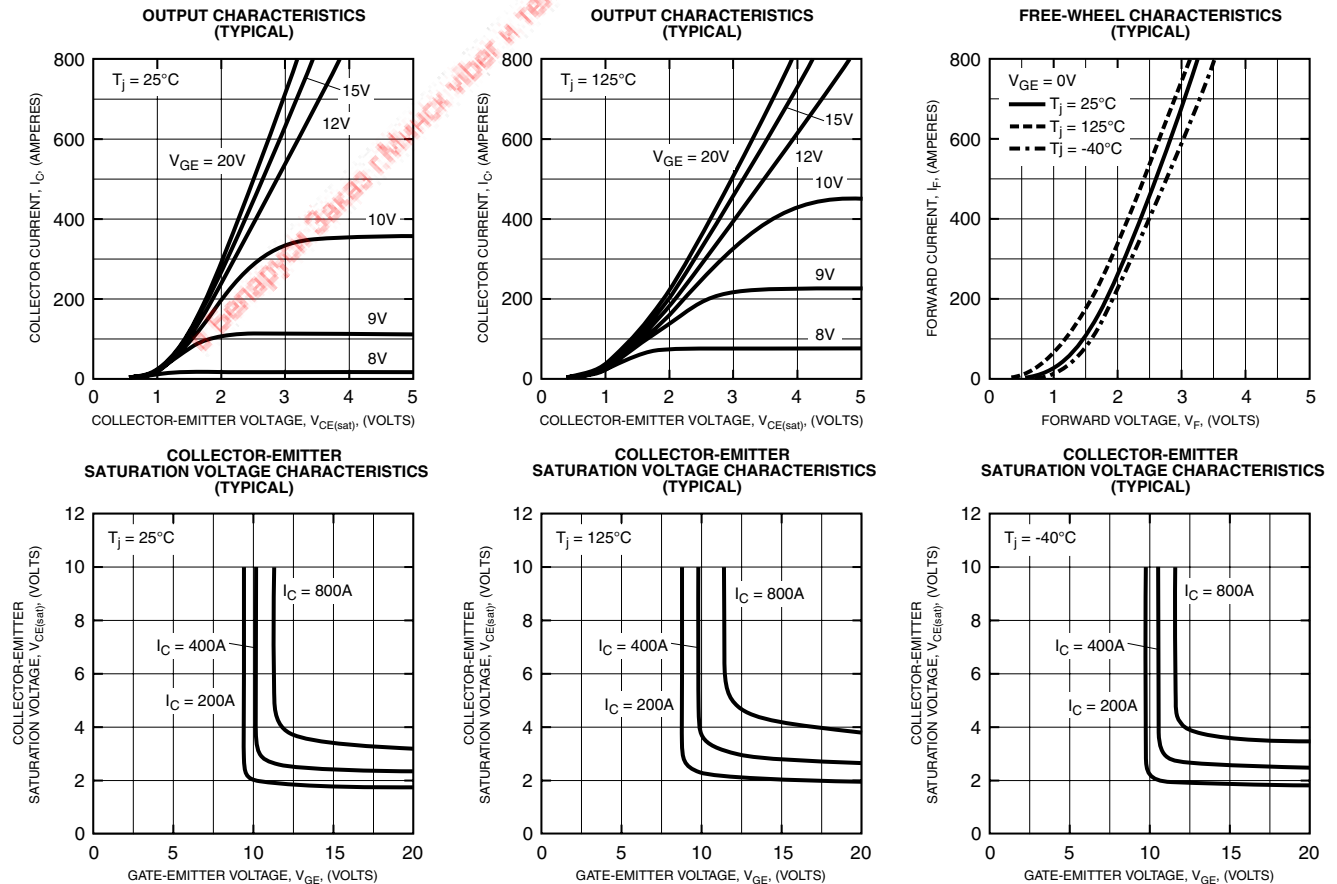
Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Control Sector						
Fault Output Current	O_C	$V_{GE} = 15\text{V}$	480	—	—	A
Over-Temperature	O_T	—	100	—	125	$^\circ\text{C}$
Fault Output Delay Time	$t_d(\text{Fo})$	$V_{CC} = 600\text{V}, V_{GE} = \pm 15\text{V}$	—	—	8	μs

Thermal Characteristics

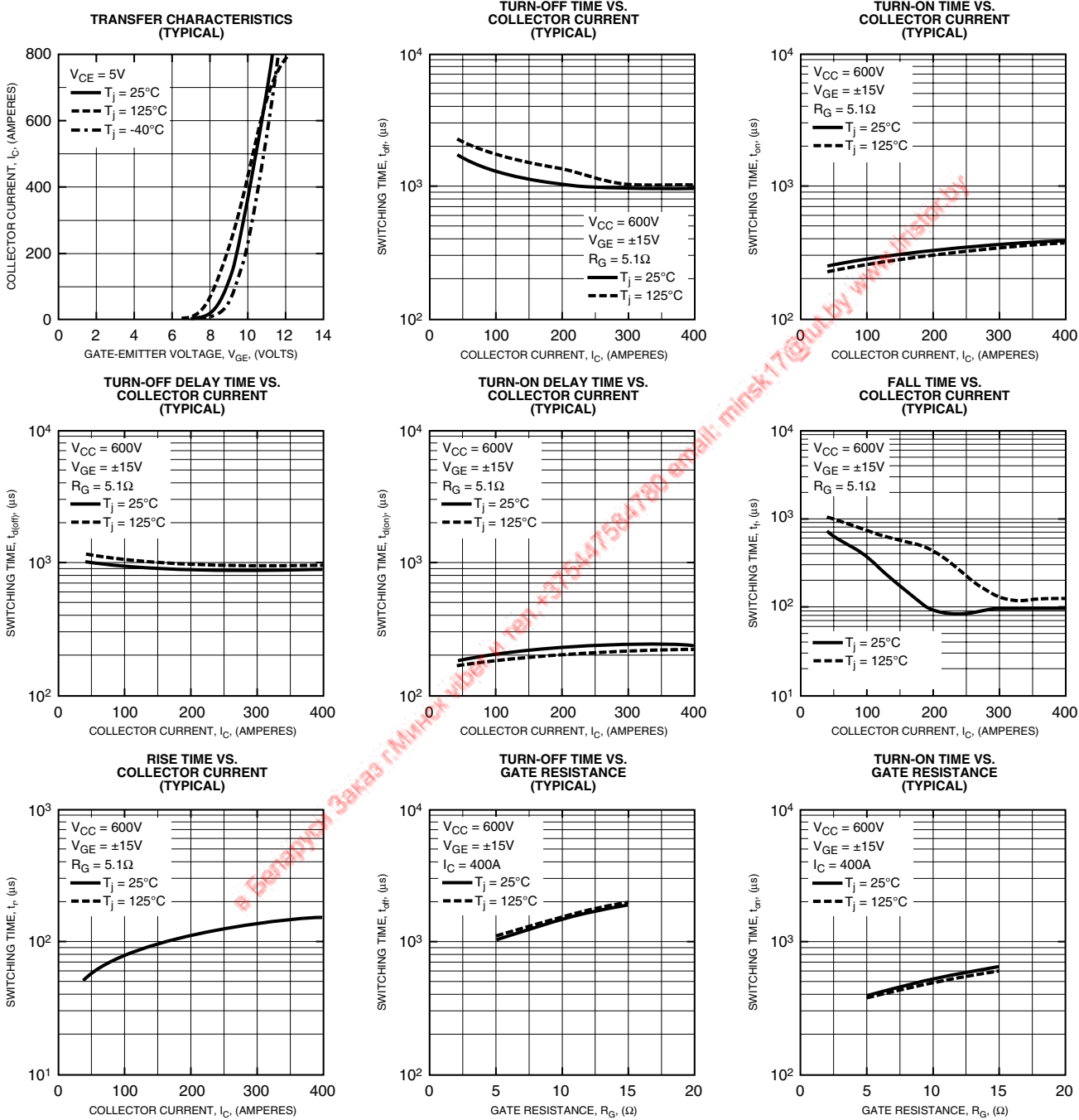
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Case Thermal Resistance	$R_{th(j-c)Q}$	IGBT (Per 1/2 Module)	—	—	0.033	$^\circ\text{C/Watt}$
	$R_{th(j-c)D}$	FWDi (Per 1/2 Module)	—	—	0.068	$^\circ\text{C/Watt}$
Contact Thermal Resistance	$R_{th(c-f)}$	—	—	0.013	—	$^\circ\text{C/Watt}$

Recommended Conditions for Use

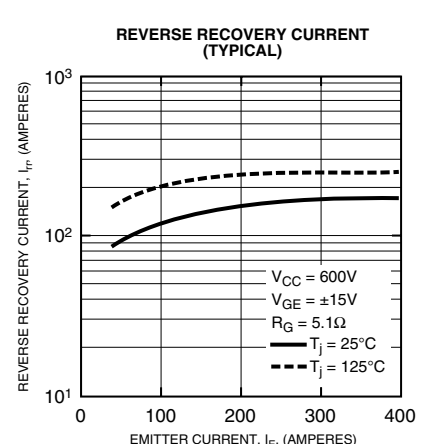
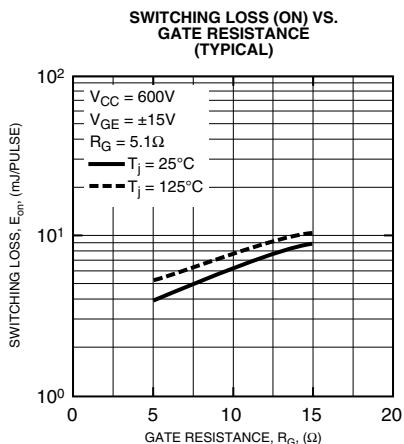
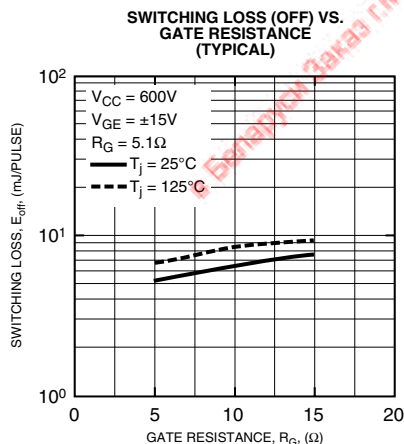
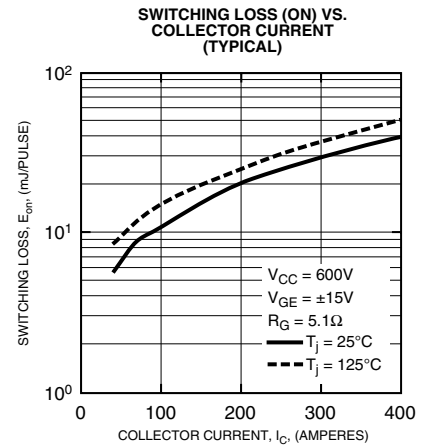
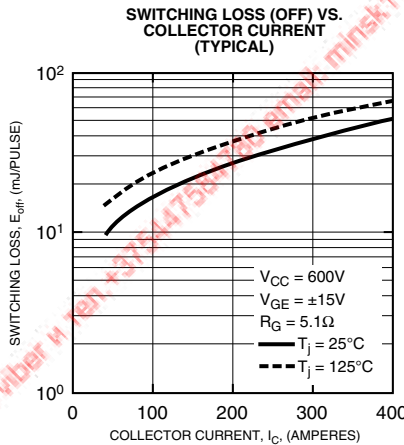
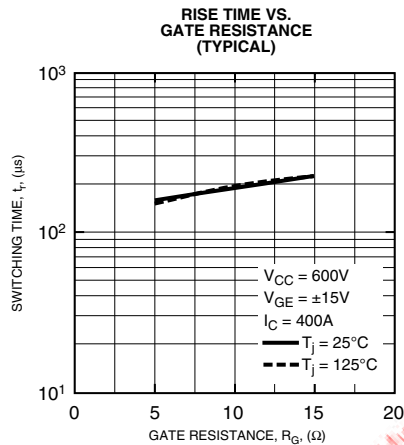
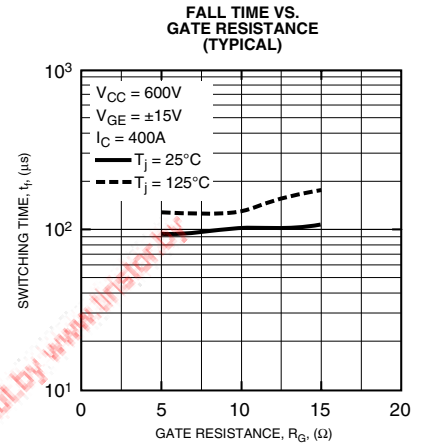
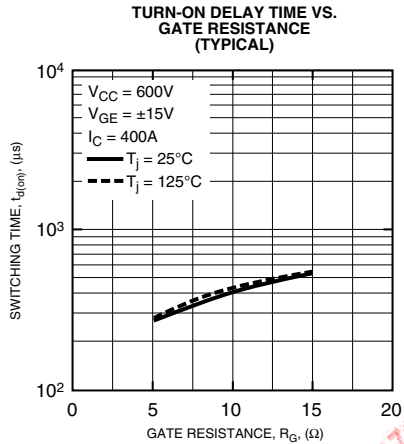
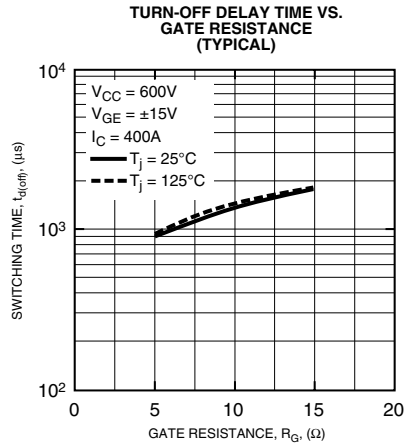
Characteristic	Symbol	Condition	Value	Units
Supply Voltage	V_{CC}	Applied across C1-E2 Terminals	≤ 750	Volts
Gate Voltage	V_{GE}	—	14.8 ~ 17	Volts
Gate Resistance	R_G	—	≥ 10.0	Ω
Switching Frequency	f_C	—	0 ~ 20	kHz



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