MITSUBISHI ELECTRIC

Changes for the Better

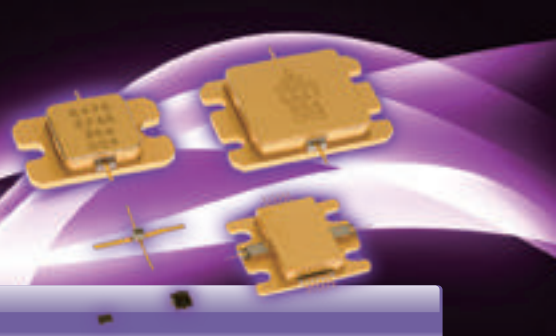
for a greener tomorrow

HIGH FREQUENCY DEVICES

High Frequency Devices

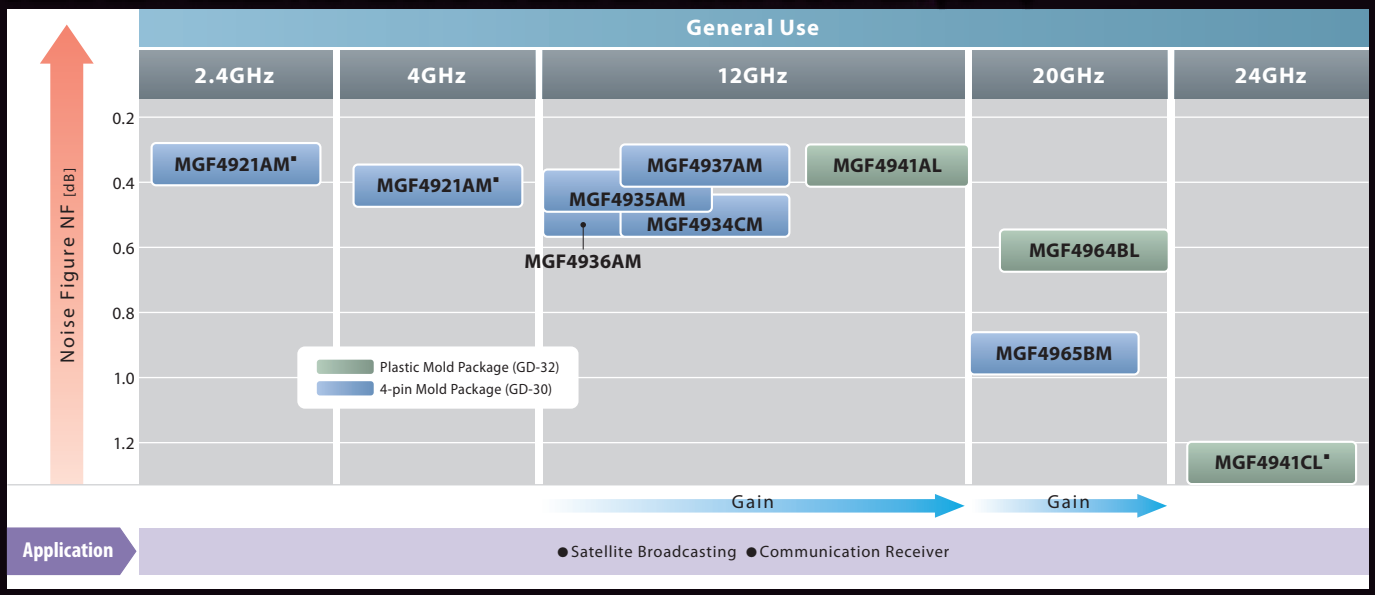
The Best Solution for Realizing the Information and Communication Era

Communication networks, such as high speed Internet, and high-speed data communication, are developing rapidly. We are ready to offer the best solution to the systems for realizing the infomation and communication era by providing of the GaN/GaAs products.



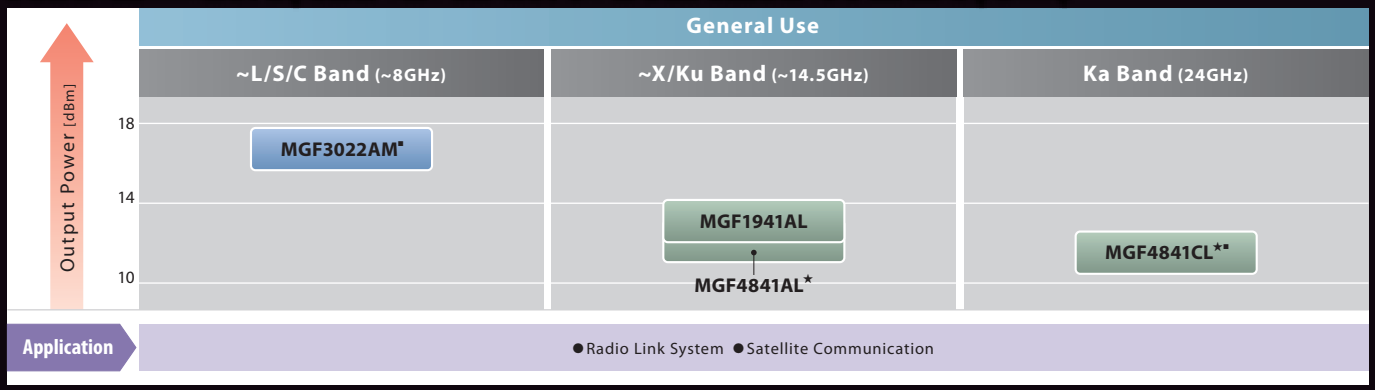
SELECTION MAP

GaAs HEMT SERIES FOR MICROWAVE-BAND LOW-NOISE AMPLIFIERS (Discrete)



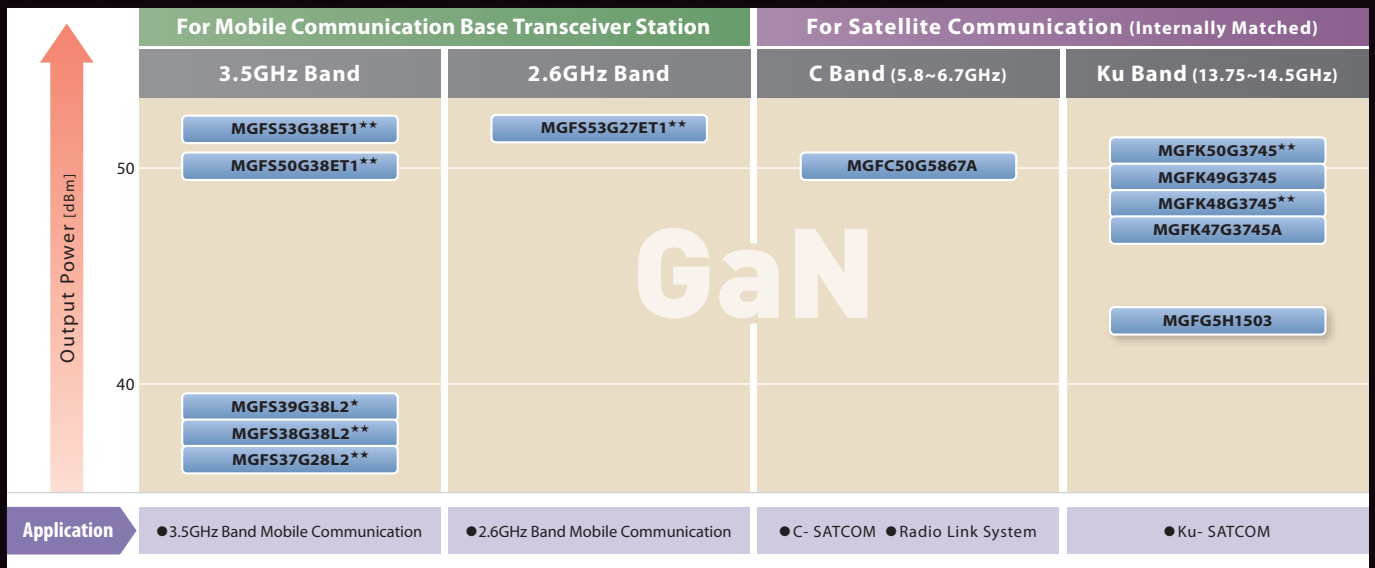
■: AEC-Q101 qualified FET: Field Effect Transistor HEMT: High Electron Mobility Transistor HBT: Heterojunction Bipolar Transistor

GaAs HEMT/MES FET, InGaP HBT SERIES FOR SMALL SIGNAL AMPLIFIERS (Discrete)



★: New Product ■: AEC-Q101 qualified

GaN HEMT SERIES FOR MICROWAVE-BAND HIGH POWER AMPLIFIERS



★: New Product ★★: Under Development

Partially supported by Japan's New Energy and Industrial Technology Development Organization(NEDO).

PRODUCT LIST

GaAs HEMT SERIES FOR MICROWAVE-BAND LOW-NOISE AMPLIFIERS (Discrete)

Type Number	Noise Figure [dB]		Associated Gain [dB]		Frequency [GHz]	Drain-Source Voltage [V]	Drain Current [mA]	Package Outline
	Typ.	Max.	Min.	Typ.				
MGF4921AM■	0.35	0.55	11.5	13.0	4	2	10	GD-30
MGF4934CM	0.50	0.75	11.5	13.0	12	2	10	GD-30
MGF4935AM	0.45	0.65	11.0	12.0	12	2	10	GD-30
MGF4936AM	0.50	0.70	11.0	12.0	12	2	10	GD-30
MGF4937AM	0.35	0.50	11.5	13.0	12	2	10	GD-30
MGF4941AL	0.35	0.50	12.0	13.5	12	2	10	GD-32
MGF4964BL	0.65	0.90	11.5	13.5	20	2	10	GD-32
MGF4965BM	0.95	1.25	9.5	11.5	20	2	10	GD-30
MGF4941CL■	2.40	3.80	7.5	10.0	24	1.5	Idss	GD-32

Ta=25°C ■: AEC-Q101 qualified

GaAs HEMT/MES FET, InGaP HBT SERIES FOR SMALL SIGNAL AMPLIFIERS (Discrete)

Type Number	Output Power at 1dB Gain Compression [dBm]		Output Power [dBm]	Linear Power Gain [dB]	3rd Order IM Distortion [dBc]		Power Added Efficiency [%]	Frequency [GHz]	Drain-Source Voltage [V]	Drain Current [A]	Thermal Resistance [°C/W]		Package Outline
	Min.	Typ.			Min.	Typ.					Typ.	Max.	
MGF1941AL	11.0	15.0	–	10.0	–	–	–	12	3	0.03	–	–	GD-32
MGF4841AL★	11.5	14.5	–	12.0	–	–	–	12	2.5	0.025	–	–	GD-32
MGF4841CL★■	–	11.5	–	8.5	–	–	–	24	1.5	Idss	–	–	GD-32
MGF3022AM■	14.0	16.5	–	18.0	–	–	–	2.4	3	0.033	–	–	GD-30

Ta=25°C ★: New Product ■: AEC-Q101 qualified

GaN HEMT SERIES FOR MOBILE COMMUNICATION BASE TRANSCEIVER STATION

Type Number	Output Power [dBm]	Linear Power Gain [dB]	Power Added Efficiency [%]	Frequency [GHz]	Drain-Source Voltage [V]	Thermal Resistance [°C/W]		Package Outline
						Typ.	Max.	
MGFS53G38ET1★★	53	17	70	3.4~3.8	50	1.1	–	Flange-less NI400✱
MGFS50G38ET1★★	50	17	74	3.4~3.8	50	2.0	–	Flange-less NI400✱
MGFS39G38L2★	39	20	67	3.4~3.8	50	–	10.2	GF-67
MGFS38G38L2★★	38	20	67	3.4~3.8	50	–	11.7	GF-67
MGFS37G38L2★★	37	20	67	3.4~3.8	50	–	13.5	GF-67
MGFS53G27ET1★★	53	18	74	2.5~2.7	50	T.B.D.	–	Flange-less NI400✱

Ta=25°C ★: New Product ★★: Under Development ✱: T.B.D.

GaN HEMT SERIES FOR SATELLITE COMMUNICATION (Internally Matched)

Type Number	Output Power [dBm]	Linear Power Gain [dB]	3rd Order IM Distortion [dBc]		Power Added Efficiency [%]	Frequency [GHz]	Drain-Source Voltage [V]	Drain Current [A]	Thermal Resistance [°C/W]		Package Outline
			Min.	Typ.					Typ.	Max.	
MGFC50G5867A	50	10	-25	–	40	5.8~6.7	40	1.92	0.6	0.8	GF-38
MGFK50G3745★★	50	10	-25	–	30	13.75~14.5	24	2.4	T.B.D.	T.B.D.	GF-38
MGFK49G3745	49	7.5	-25	–	28	13.75~14.5	24	2.1	0.4	0.6	GF-38
MGFK48G3745★★	48.3	9.3	-25	–	33	13.75~14.5	24	1.44	0.8	1.0	GF-8
MGFK47G3745A	47	9	-25	–	30	13.75~14.5	24	1.05	1.1	1.4	GF-8
MGFG5H1503	43	20	-25	–	12	13.75~14.5	24	2.7	1.2	1.5	GF-65

Ta=25°C ★★: Under Development

TYPE NAME DEFINITION OF HIGH FREQUENCY DEVICES

Discrete

MGF **49** **41** **A** **L**
A B C D

- A Device Structure — **1x**:MES FET (Small Signal) **3x**:HBT **4x**:HEMT
- B Chip Type
- C Series Number
- D Auxiliary Symbol

For Mobile Communication Base Transceiver Station

MGF **S** **53** **G** **38** **ET** **1**
A B C D E F

- A Freq. Band — **S**
- B Output Power in dBm — ex.**53**=53dBm
- C Device Structure — **G**:GaN HEMT
- D Freq. Band in GHz — ex.**38**=~3.8GHz
- E Package — **ET**:Flange-less NI400 **L**:QFN
- F Input / Output Pair — ex.**1**=Input / Output 1 Pair

For Satellite Communication (Internally Matched)

MGF **C** **50** **G** **5867** **A**
A B C D E

- A Freq. Band — **C, Ku**
- B Output Power in dBm — ex.**50**=50dBm=100W(typ.)
- C Device Structure — **G**:GaN HEMT
- D Freq. Band in GHz — ex.**5867**=5.8GHz~6.7GHz
- E Series Number

High Frequency devices are compliant with the RoHS (2011/65/EU).

RoHS: Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

Please visit our website for further details.

www.MitsubishiElectric.com

eco Changes **for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

MITSUBISHI ELECTRIC CORPORATION

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www.MitsubishiElectric.com

New publication effective Sep. 2016.
Specifications subject to change without notice.

H-CX587-V KI-1609 Printed in Japan (TOT)

MITSUBISHI ELECTRIC

Changes for the Better

OPTICAL DEVICES

for a greener tomorrow eco Changes

Optical Devices

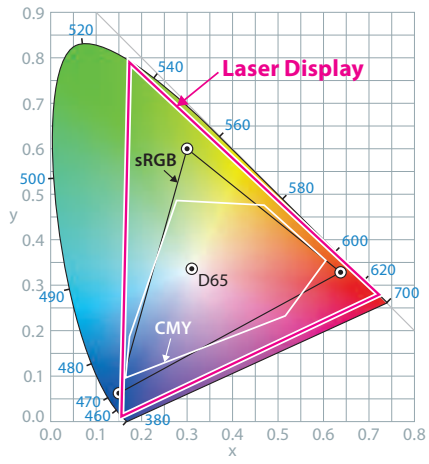
2016

Mitsubishi Electric Optical Devices:
The Key to Connecting Information Networks in the Future.

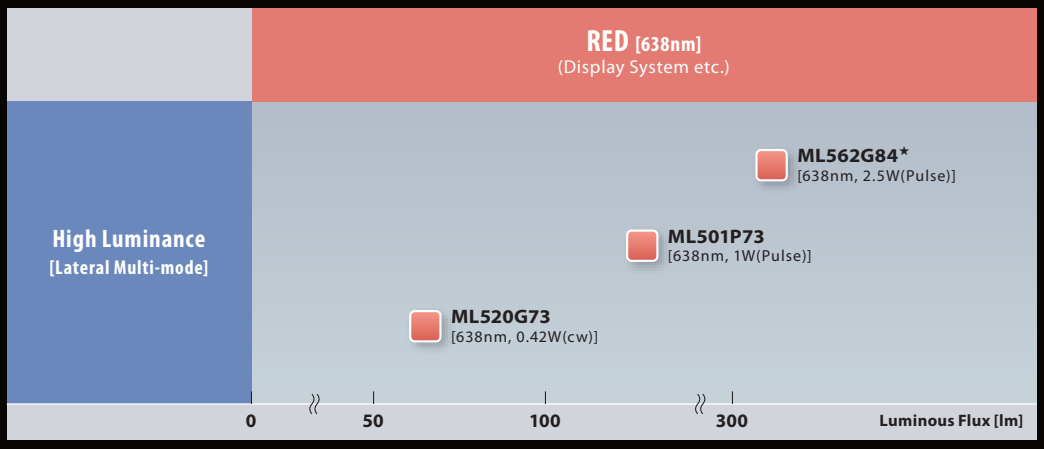
LASER DIODES FOR INDUSTRY & DISPLAY

638nm High-output Laser Diode for Industry and Displays

Compared to LEDs, semiconductor lasers have lower power consumption, higher output and can be used with optical systems having a higher maximum aperture. These considerable advantages mean that they can be used for projectors that do not require focal adjustment. Mitsubishi Electric has a range of lasers available, including a multi-mode semiconductor laser with a 638nm wavelength and 2.5W output (when pulse-driven) that provides highly visible, vibrant red colors for color projectors.



Selection map of Red Laser Diodes



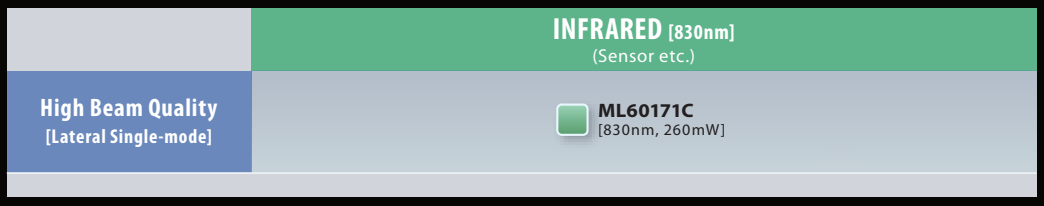
ML562G84

ML501P73

ML520G73

★: New Product

Selection map of High Power Short Wavelength Laser Diodes (Except Red LD)



ML60171C

Line-up of Laser Diodes

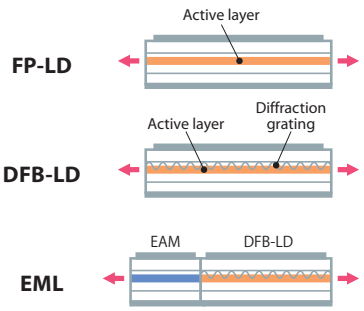
Type Number	Application	Wavelength [nm]	Output Power @CW [mW]	Output Power @Pulse [mW]	Case Temperature [°C]	Package
ML562G84*	Display	638	–	2500	45	ϕ9mm TO-CAN
ML501P73	Display	638	500	1000	40	ϕ5.6mm Capless
ML520G73	Display	638	420	–	35	ϕ5.6mm TO-CAN
ML60171C	Sensor, Printing	830	260	–	60	ϕ5.6mm TO-CAN

★: New Product

OPTICAL DEVICES FOR OPTICAL COMMUNICATION SYSTEMS

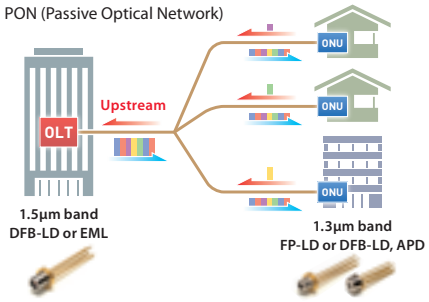
DFB-LD: Distributed Feedback Laser Diode

DFB-LDs are semiconductor lasers that enable further and faster signal transmission than conventional FP-LDs through maintaining the oscillation spectrum in a single longitudinal mode (a single wavelength component). This is achieved by installing a minute periodic structure (diffraction grating) within the internal elements of the laser diode.
EMLs are also available, featuring an electro-absorption modulator (EAM) integrated in front of the DFB-LD, for even further transmission.



Laser Diodes and Photo Diodes for Fiber to the Home (FTTH)

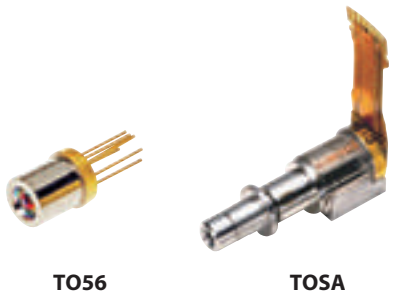
Faster PON technology has led to the development of B-PON, G-PON and GE-PON in response to demands for increased speed and capacity in optical communication systems. Backed by the leading photo diode for FTTH in the B-PON field, DFB-LDs and APDs are designed for different types of access network optical fiber grids, providing a flexible approach to changes in customer specifications and packages. These parts are used extensively in G-PON, which has rapidly become increasingly popular around the world.



CAN EML Device for 10Gbps Transmission

Mitsubishi Electric has developed an electro-absorption modulation (EML) device with superior performance at high temperature and integrated it into a Peltier cooler, realizing a smaller package and lower power consumption. The TO56 chassis—known for its excellent mass-production characteristics—is adopted.
In addition to a lineup including the industry-standard XMD-MSA TOSA and TO56 CAN appropriate for BiDi* modules, these devices contribute to the energy-saving operation of optical transmission equipment and various other needs.

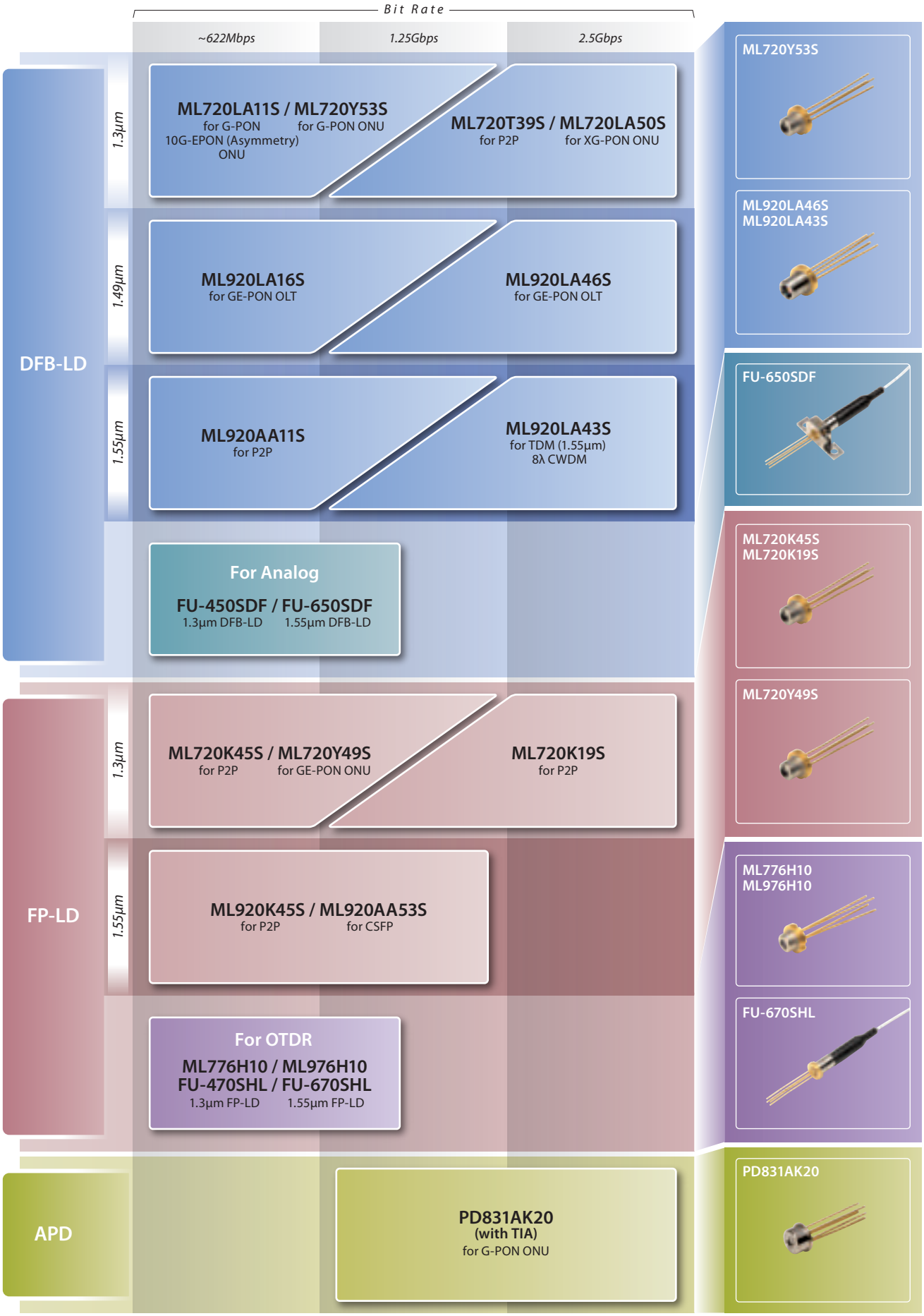
*BiDi : Bidirectional



Terminology

- **APC** ····· Angled Physical Contact
- **APD** ····· Avalanche Photo Diode
- **APD TIA** ····· Avalanche Photo Diode Trans Impedance Amplifier
- **B-PON** ····· Broadband Passive Optical Network
- **CPRI** ····· Common Public Radio Interface
- **CWDM** ····· Coarse Wavelength Division Multiplexing
- **DFB-LD** ····· Distributed FeedBack Laser Diode
- **DWDM** ····· Dense Wavelength Division Multiplexing
- **EAM** ····· Electro Absorption Modulator
- **EML** ····· Electro absorption Modulator integrated Laser diode
- **ER** ····· Extended Reach
- **FP-LD** ····· Fabry-Perot Laser Diode
- **FR** ····· Fiber Reach
- **FTTH** ····· Fiber To The Home
- **G-PON** ····· Gigabit Passive Optical Network
- **GE-PON** ····· Gigabit Ethernet Passive Optical Network
- **LC** ····· Lucent Connector
- **LED** ····· Light Emitting Diode
- **LR** ····· Long Reach
- **LRM** ····· Long Reach Multimode
- **OLT** ····· Optical Line Terminal
- **ONU** ····· Optical Network Unit
- **OTDR** ····· Optical Time Domain Reflectometer
- **P2P** ····· Peer to Peer
- **PC** ····· Physical Contact
- **PD-TIA** ····· Photo Diode with Trans-Impedance Amplifier
- **RoF** ····· Radio over Fiber
- **ROSA** ····· Receiver Optical Sub-Assembly
- **SC** ····· Single fiber Connector
- **SDH** ····· Synchronous Digital Hierarchy
- **SFP+** ····· Small Form-factor Pluggable Plus
- **SONET** ····· Synchronous Optical NETwork
- **TOSA** ····· Transmitter Optical Sub-Assembly
- **VSR** ····· Very Short Reach
- **X2** ····· 2nd Generation XENPAK
- **XENPAK** ····· 10 Gigabit Ethernet Transceiver Package
- **XFP** ····· 10 Gigabit small Form-factor Pluggable
- **10G-EPON** ····· 10 Gigabit Ethernet Passive Optical Network
- **XG-PON** ····· 10 Gigabit Passive Optical Network
- **XLMD-MSA** ····· 40 Gbps Miniature Device Multi Source Agreement
- **XMD-MSA** ····· 10 Gbps Miniature Device Multi Source Agreement

Selection Map of OPTICAL DEVICES [**Under 2.5Gbps**]



Selection Map of OPTICAL DEVICES [**Over 10Gbps**]

Bit Rate

		10Gbps	25Gbps	100Gbps
EML	1.3μm		**FU-411REA**** for 10km TDM	**FU-402REA**** (28Gbps x 4λ) for 100Gbps 10/40km
EML	1.55μm	**FU-613REA** for 40km TDM **FU-614REA**** for 80km TDM **FU-615REA*** for 25km DWDM **ML958D56** for 40km TDM		
EML	1.577μm	**ML958K55** for 10G-EPON OLT **ML958H55*** for xG-PON OLT		
DFB-LD	1.3μm	**ML768K42T** for 10GBASE-LR **ML768LA42T** for CPRI **ML769T56T*** For 10G-EPON ONU **ML768T42T** for 10G-EPON ONU	**ML764AA58T**** for 2km TDM	**ML7xx58**** for 4λ CWDM
APD		**PD831AP28**** for 80km **PD831AH28**** for 10G EPON ONU & 40km TDM **PD831W24** for 10G EPON ONU		

FU-402REA

FU-411REA

FU-613REA
FU-614REA
FU-615REA

ML958D56
ML958K55
ML958H55

ML768K42T

ML769T56T
ML768T42T

PD831AP28
PD831AH28
PD831W24

★: New Product ★★: Under Development

Line Up of **LD** [**Under 2.5Gbps**]

	Type Number	Chip Type	Package	Wavelength [nm]	Case Temp. [°C]	Features
2.5G	**ML720T39S**	DFB-LD	TO56-CAN	1310	–40~+95	P2P
	ML720LA50S	DFB-LD	TO56-CAN	1270	–40~+95	XG-PON ONU
	ML720K19S	FP-LD	TO56-CAN	1310	–40~+85	P2P
	ML920LA46S	DFB-LD	TO56-CAN	1490	–40~+85	G-PON OLT
	ML920LA43S	DFB-LD	TO56-CAN	1550	–20~+95	P2P
	ML920LA43S	DFB-LD	TO56-CAN	1470~1610 8λ CWDM	–10~+85	8λ CWDM
1.25G/ ~622M	**ML720LA11S**	DFB-LD	TO56-CAN	1310	–40~+85	G-PON ONU, 10G-EPON (Asymmetry) ONU
	ML720Y53S	DFB-LD	TO56-CAN	1310	–40~+85	G-PON ONU
	ML720K45S	FP-LD	TO56-CAN	1310	–40~+85	P2P
	ML720Y49S	FP-LD	TO56-CAN	1310	–40~+85	GE-PON ONU, High coupling efficiency
	ML920LA16S	DFB-LD	TO56-CAN	1490	–40~+85	GE-PON OLT
	ML920AA11S	DFB-LD	TO56-CAN	1550	–40~+85	P2P
	ML920K45S	FP-LD	TO56-CAN	1550	–40~+85	P2P
	ML920AA53S	FP-LD	TO56-CAN	1530	–40~+95	P2P, CSFP
For Analog	**FU-450SDF**	DFB-LD	Coaxial Pigtail	1310	–20~+85	CATV Return Path, RoF
	FU-650SDF	DFB-LD	Coaxial Pigtail	1550	–20~+85	CATV Return Path, RoF
For OTDR	**FU-470SHL**	FP-LD	Coaxial Pigtail	1310	–20~+70	OTDR
	FU-670SHL	FP-LD	Coaxial Pigtail	1550	–20~+70	OTDR
	ML776H10	FP-LD	TO56-CAN	1310	–40~+85	OTDR
	ML996H10	FP-LD	TO56-CAN	1550	–40~+85	OTDR

Line Up of **APD** [**Under 2.5Gbps**]

	Type Number	Chip Type	Package	Wavelength [nm]	Case Temp. [°C]	Features
2.5G	**PD831AK20**	APD	TO46-CAN	1490	–40~+85	Built-in TIA, G-PON ONU

SAFETY CAUTIONS FOR USE OR DISPOSAL OF LISTED PRODUCTS

The warnings below apply to all products listed in this pamphlet.

	WARNING
Laser Beam	While the laser diode is on, its gives a laser beam. Even if we can't see a laser beam by its wavelengt, penetration into the eye by a laser beam or its reflected light may cause eye injury. Prevent the irradiating part or its reflected light from entering the eyes.
Injury	Fiber fragments may cause injury. In cases of fiber bending or breakage, never touch the fragment.
GaAs	Gallium arsenide (GaAs) is used in these products. To avoid danger, strictly observe the following cautions. • Never place the products in your mouth. • Never burn or break the products, or use any type of chemical treatment to reduce them to gas or powder. • When disposing of the products, always follow the laws which apply, as well as your own company's internal waste treatment regulations.
Disposal of Flame-Retarded Fiber Core Wire	Flame retardant resin must be disposed of according to law of industrial waste in disposal place. This product is a bromine type flame-retarded resin, containing bromine compounds and antimony trioxide. All disposal operations should be conducted with full consideration of this content.

Line Up of **LD / LD Modules [Over 10Gbps]**

	Type Number	Chip Type	Package	Wavelength [nm]	Case Temp. [°C]	Features
100G	FU-402REA**	EML	TOSA, LC Receptacle	LAN-WDM	–5~+80	28Gbps x 4λ
	ML7xx58**	DFB-LD	TBD	4λ CWDM	+20~+70	25Gbps x 4λ
25G	FU-411REA**	EML	TOSA, LC Receptacle	1310	–5~+80	28Gbps, XLMD-MSA Compliant
	ML764AA58T**	DFB-LD	TO56-CAN	1310	0~+80	25Gbps
10G	FU-613REA	EML	TOSA, LC Receptacle	1550	–5~+95	XFP/SFP+ 40km, XMD-MSA Compliant
	FU-614REA**	EML	TOSA, LC Receptacle	1550	–5~+80	XFP/SFP+ 80km, XMD-MSA Compliant
	FU-615REA*	EML	TOSA, LC Receptacle	1550	–40~+95	25km DWDM, XMD-MSA Compliant
	ML958D56	EML	TO56-CAN	1550	–5~+80	XFP/SFP+ 40km
	ML958K55	EML	TO56-CAN	1577	–5~+80	10G-EPON OLT
	ML958H55*	EML	TO56-CAN	1577	–5~+80	xG-PON OLT
	ML768K42T	DFB-LD	TO56-CAN	1310	–40~+95	10GBASE-LR, SONET/SDH
	ML768LA42T	DFB-LD	TO56-CAN	1270, 1330	–40~+95	CPRI, 10Gbps x 2λ
	ML769T56T*	DFB-LD	TO56-CAN	1270	–40~+95	10G-EPON (Symmetry) ONU
	ML768T42T	DFB-LD	TO56-CAN	1270	–5~+75	10G-EPON (Symmetry) ONU

★: New Product ★★: Under Development

Line Up of **APD / APD Modules [Over 10Gbps]**

	Type Number	Chip Type	Package	Wavelength [nm]	Case Temp. [°C]	Features
10G	PD831AP28**	APD	TO46-CAN	1550	–5~+85	Built-in TIA, SFP+ 80km
	PD831AH28**	APD	TO46-CAN	1310 / 1577	–40~+90	Built-in TIA, 10G-EPON/XG-PON ONU & 40km
	PD831W24	APD	TO46-CAN	1577	–40~+90	Built-in TIA, 10G-EPON/XG-PON ONU

★★: Under Development

Type Name Definition of Optical Devices for Optical Communication Systems

FU- 6 50 S DF- FW1M15

- Optical Module
- LD Module

No.	Wavelength
4	1.3μm
6	1.55μm

- PD/APD Module

No.	Wavelength
3	Long–

- Model of product
- Shows using optical fiber
  S : Single-mode fiber P : Polarization Maintaining fiber none : Multi-mode fiber R : LC receptacle
- Shows kind of LD chip

LD	FP laser diode	PD	Photo diode
DF	DFB laser diode	AP	Avalanche photo diode
HL	High power FP Laser diode	PP	Photo diode with preamp
EA	EAM Laser diode	PA	Avalanche photo diode with preamp

- Shows connector type, pin-connection type, level of optical output, customer code and specification's number, Swavelength cord, etc.

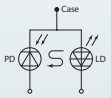
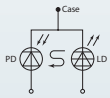
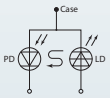
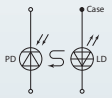
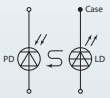
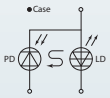
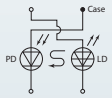
Type Name Definition of Laser and Photo Diodes

ML 7 68K 42 T

- Device Type [ML: Laser Diode PD: Photo Diode]
- Wavelength
- Package*
- Chip Series
- Pin Assignment (Available for Monitor PD Contained Package)

Categories

Device Type	Wavelength	Wavelength Range (nm)
ML	5	500<λ≤700
	6	700<λ≤1000
	7	1250<λ≤1400
	9	1400<λ
PD	7 8	1000<λ≤1600

Type	N	C	R	F	E	S	T
							
LD	Anode Common	Cathode Common	Cathode Common	Anode Common	Cathode Common	Floating	Floating
PD	Cathode Common	Cathode Common	Anode Common	Floating	Floating	Floating	Anode Common

*Please contact our sales office about the selection packages.

Please visit our website for further details.

www.MitsubishiElectric.com

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eco Changes **for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

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New publication effective Mar. 2016.
Specifications subject to change without notice.

H-CX606-U KI-1603 Printed in Japan (TOT)

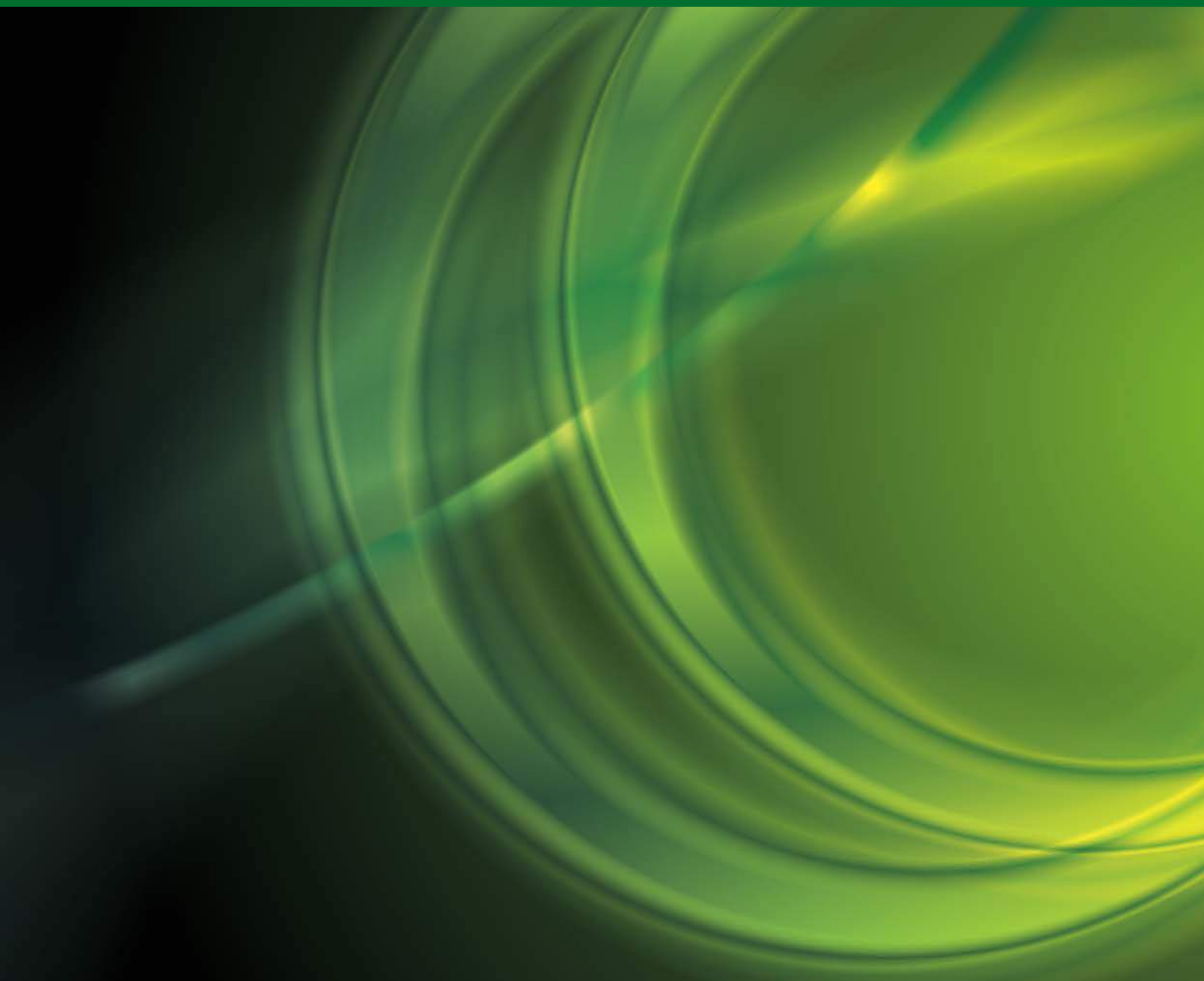
MITSUBISHI ELECTRIC

Changes for the Better

POWER MODULES

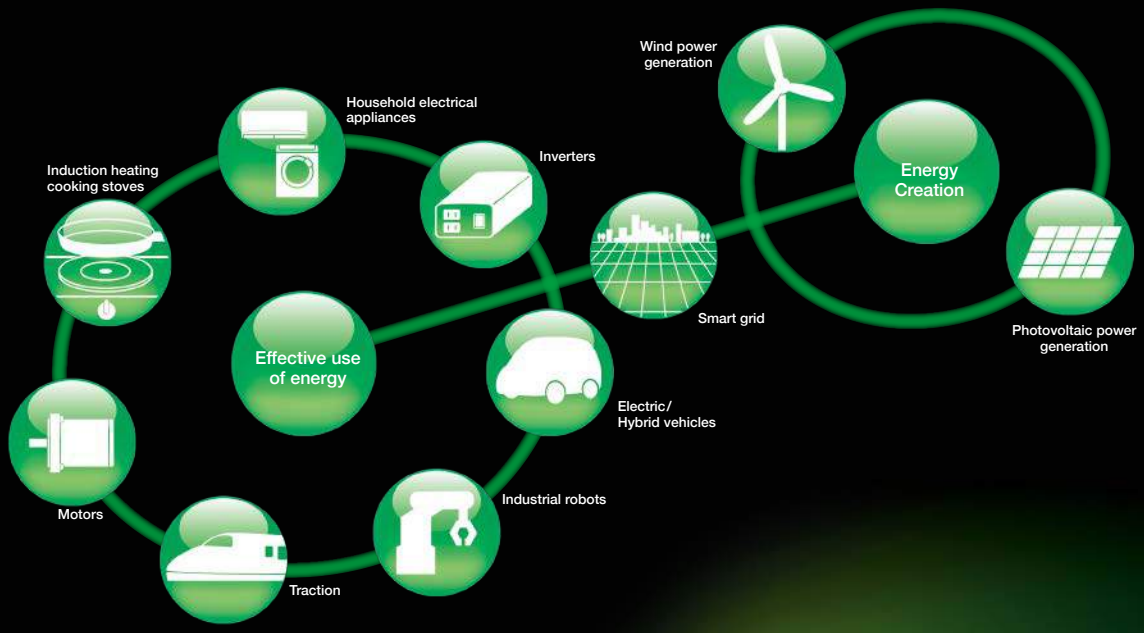
for a greener tomorrow eco Changes

Power Modules



Innovative Power Devices for a Sustainable Future

Mitsubishi Electric power modules are at the forefront of the latest energy innovations that seek to solve global environmental issues while creating a more affluent and comfortable society for all. Some of these innovations are photovoltaic (PV) and wind power generation from renewable energy sources, smart grids realizing efficient supply of power, hybrid/electric vehicles (HVs/EVs) that take the next step in reducing carbon emissions and fuel consumption, and home appliances that achieve ground-breaking energy savings. Whether in appliances, railcars, EVs or industrial systems, our power modules are key elements in changing the way energy is used.



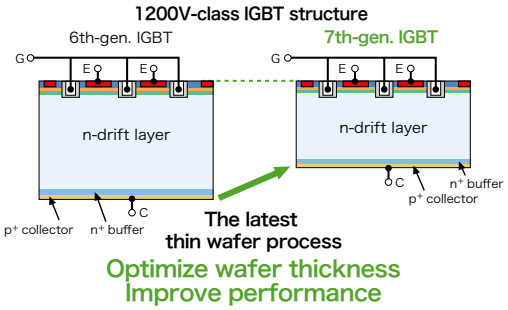
Focus Technology

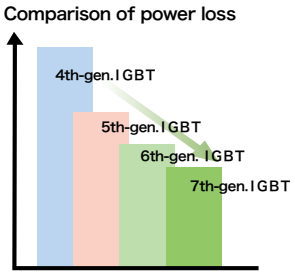
7th-Generation 1,200V-Class IGBT Chip Technology

Cutting-edge technology realizes energy-saving inverter devices

- Latest thin-wafer processing (n-drift layer) achieves thinner wafer than 6th-generation devices
- Performance improved by combining CSTBT™* and light punch-through (LPT) structures
- Inverter system power dissipation minimized using lower V_{CEsat} and Eoff

*CSTBT: Mitsubishi Electric's unique IGBT that makes use of carrier cumulative effect



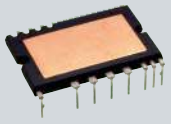


Modules realizing single-control power supply and photocoupler-less systems for household appliances and low-capacity inverters

Key Features

- Transfer-molded structure with insulation sheet having high heat conductivity simultaneously provides heat dissipation and insulation
- High-voltage IC equipped with drive, protection and level-shift circuits for direct control via input signals from a CPU or microcomputer
- Compact board and highly reliable equipment realized through single power-supply and photocoupler-less systems
- Includes built-in bootstrap diode (BSD)

DIPIPM™
Dual-In-Line Package
Intelligent Power Modules



Modules with built-in control and protection circuits for AC servo robots and PV power generation

Key Features

- Built-in protection circuit for short-circuiting, power supply undervoltage and overheating
- Highly compatible package with simplified printed circuit board (PCB) design
- Special intelligent power modules (IPMs) for power conditioners in PV power generation systems

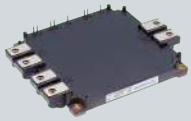
IPM
Intelligent Power Modules

IGBT modules for general-purpose inverters used in various applications

Key Features

- Various low-inductance packages and power chips available
- Compatible with high-frequency, high-voltage (1,700V) applications
- Large-capacity modules available for renewable energy systems

IGBT Modules
Insulated Gate Bipolar
Transistor Modules



Modules meeting the high voltage, current and insulation requirements of inverters for traction

Key Features

- High isolation package (10.2kVrms: AC60Hz 1min) matched to high catenary voltage
- Lightweight modules with aluminum silicon carbide (AlSiC) baseplate available
- Range of HV diode modules enabling highly efficient comprehensive converter design

HVIGBT Modules
High-Voltage Insulated Gate Bipolar
Transistor Modules

Modules realizing high performance and reliability as motor drives in HVs/EVs

Key Features

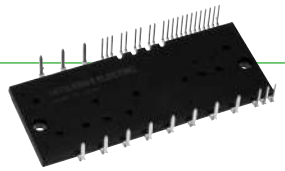
- Built-in temperature analog output function realizing highly reliable motor drive
- High-power/temperature cycle life ensures high reliability
- Compliant with the End-of-life Vehicles Directive, regulations relating to substances of environmental concern
- High traceability in managing materials/components throughout the entire production process for each product

Power Modules for Vehicles
Power Modules for EV/PHEV

*HV: Hybrid Vehicle *EV: Electric Vehicle *PHEV: Plug-in Hybrid Electric Vehicle

Feature Products

All-in-one intelligent power modules equipped with 3-phase converter and brake circuit in addition to inverter circuit

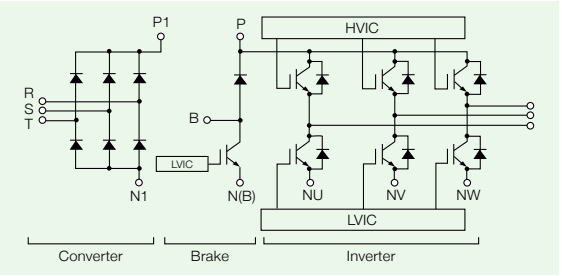


DIPIPM+ PSS05MC1FT, PSS10MC1FT, PSS15MC1FT, PSS25MC1FT, PSS35NC1FT, PSS50MC1F6

<Main Features>
- Encapsulated by transfer molded resin, integrates three-phase converter, inverter, brake and control IC
- Built-in converter and brake enable system size to be reduced and save design cost, contributing to total cost reduction
- Lower PCB inductance pattern reduces noise, thereby reducing design time and countermeasure parts required for noise reduction
- Built-in BSD*1 with 1,200V withstand voltage reduces number of external parts and improves reliability

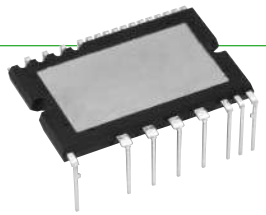
*1 BSD: Bootstrap diode

■ Internal circuit diagram



Feature Products

Contributing to reducing annual Power consumption of high-end air conditioners by incorporating SJ-MOSFET

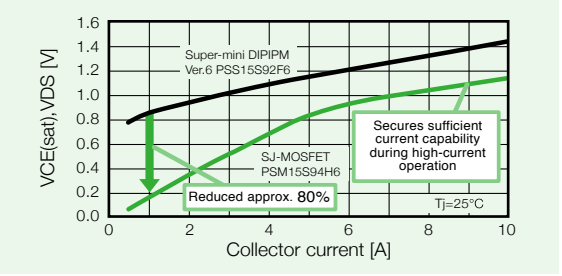


SJ-MOSFET Super-mini DIPIPM™ PSM10S94F6, PSM15S94H6, PSM20S94H6

<Main Features>
- SJ-MOSFET realizes approx. 80% smaller ON voltage during low- current operation compared to IGBT. It contributes to improving efficiency of air conditioner during steady-state operation especially
- Built-in IGBT function secures sufficient current capability during high-load operation
- Current rating lineup expanded to support 2.2-8.0kW class air conditioners
- External size, pin assignment, etc. secure compatibility with our Super-mini package*2 products
- Built-in BSD*3 for power supply to drive the P-side reduces number of external peripheral parts required

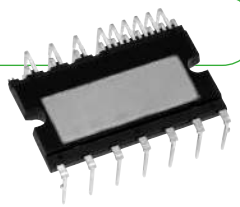
*1 Compared to Super-mini DIPIPM Ver.6 PSS15S92F6 (15A/600V)
*2 Super-mini package such as Super-mini DIPIPM Ver.6 Series, etc.
*3 BSD : Bootstrap diode

■ Output characteristics (Typical)



Feature Products

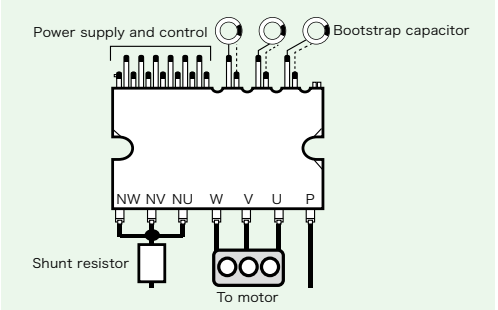
Smaller package size realized by integrating newly designed RC-IGBT Recommended for low-cost inverter and fan controller applications



SLIMDIP™ SLIMDIP-S, SLIMDIP-L

<Main Features>
- RC-IGBT*1 incorporated, reducing package size 30% compared to Super-mini DIPIPM
- Maximum case temperature increased from 100°C to 115°C, raising operating temperature range and leading to easier system design
- Additional terminals for floating supply and built-in bootstrap diodes simplify PCB wiring pattern
- Both VOT*2 and OT*3 functions integrated for temperature protection

*1 RC-IGBT: Reverse conducting IGBT
*2 VOT: Temperature information output function
*3 OT: Over-temperature protection function



Line-up of DIPIPM™

Series Matrix of 600V / 500V DIPIPM™

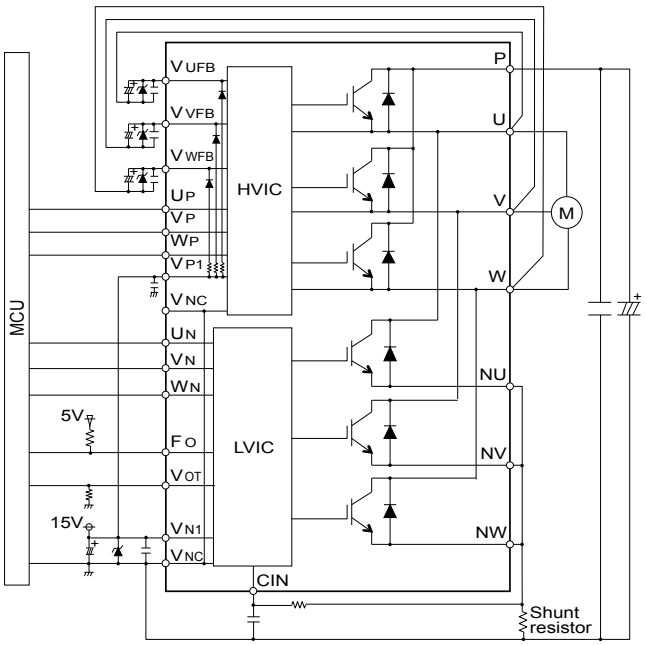
V_{CES} (V)		600V						500V
Series / I_C (A)		SLIMDIP	Ver.6	Industrial use	Ver.4	DIPIPM+	MOSFET	
		SLIM	Super-mini	Mini	Large	CIB	Super-mini	Super-mini
3		SLIMDIP-S★ SLIMDIP-L★						PSM03S93E5-A
5			PSS05S92F6-AG PSS05S92E6-AG	PSS05S51F6 PSS05S51F6-C				PSM05S93E5-A
10			PSS10S92F6-AG PSS10S92E6-AG	PSS10S51F6 PSS10S51F6-C				
15			PSS15S92F6-AG PSS15S92E6-AG	PSS15S51F6 PSS15S51F6-C			PSM15S94H6-A★	
20			PSS20S92F6-AG PSS20S92E6-AG	PSS20S51F6 PSS20S51F6-C PSS20S71F6			PSM20S94H6-A★	
30			PSS30S92F6-AG PSS30S92E6-AG	PSS30S71F6				
35			PSS35S92F6-AG PSS35S92E6-AG					
50				PSS50S71F6	PS21A79	PSS50MC1F6★ PSS50NC1F6*7★		
75					PS21A7A			
Chip	IGBT/MOSFET	RC-IGBT	CSTBT	CSTBT	CSTBT	CSTBT	SJ-MOSFET	MOSFET
	HVIC	×1	×1	×3	×3	×1	×1	×1
	LVIC	×1	×1	×1	×1	×2 *8	×1	×1
	BSD	×3	×3	×3	–	×3	×3	×3
Protective Function	UV	P-side/N-side	P-side/N-side	P-side/N-side	P-side/N-side	P-side/N-side/Brake part	P-side/N-side	P-side/N-side
	SC	N-side	N-side	N-side	N-side with sense	N-side	N-side	N-side
	OT	N-side	N-side*1	–	–	–	–	N-side
	V_{OT}*2	N-side	N-side*1	N-side	N-side	N-side	N-side	–
Specifications	Active input	High(3/5V)	High(3/5V)	High(3/5V)	High(3/5V)	High(5V)	High(3/5V)	High(3/5V)
	Emitter pin of N-side	Open	Open	Open	Open	Open	Open	Open
	Fault output	N-side(UV,SC,OT)	N-side (UV,SC,OT)	N-side (UV,SC)	N-side (UV,SC)	N-side (UV,SC)	N-side (UV,SC)	N-side (UV,SC,OT)
	Insulation voltage	2000Vrms	1500Vrms*3	2500Vrms	2500Vrms	2500Vrms	1500Vrms*3	1500Vrms*3
	Insulation structure	Insulation sheet	Insulation sheet	Molding resin*6/Insulation sheet	Insulation sheet	Insulation sheet	Insulation sheet	Insulation sheet
	RoHS directive	Compliant *5	Compliant *5	Compliant *4,*5	Compliant *5	Compliant *5	Compliant *5	Compliant *5
	Pin type	Control side of zigzag	Long	C: Control side of zigzag None: Short	–	–	Long	Long

★: New Product

[Notes] *1: PSSxxS92E6 has OT function, PSSxxS92F6 has V_{OT} function
*2: Analog temperature output
*3: AC60Hz,1minute.Corresponds to isolation voltage 2500Vrms in the case the convex-shaped heat sink
*4: High melting point solder (Lead Over 85%) is used for chip soldering of PSSxxS51F6 only
*5: Pin plating and chip soldering : Lead-free solder
*6: Molding resin insulation for PSSxxS51F6/-C
*7: PSS50NC1F6 doesn't integrate brake part
*8: LVIC 1pcs in case of PSS50NC1F6

[Term] CIB: Converter inverter brake

Application circuit of built-in BSD super-mini DIPIPM™



Line-up of DIPIPM™

Series Matrix of 1200V DIPIPM™

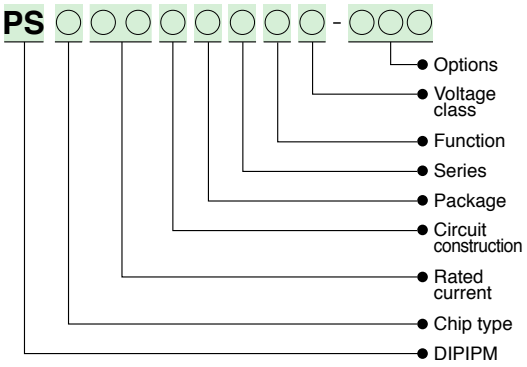
V_{CES} (V)		1200V			
Series / I_C (A)		Mini Type	Ver.6	Ver.4	DIPIPM+
		Mini	Large	Large	CIB
5		PSS05S72FT	PSS05SA2FT	PS22A72	PSS05MC1FT★ PSS05NC1FT★
10		PSS10S72FT	PSS10SA2FT	PS22A73	PSS10MC1FT★ PSS10NC1FT★
15			PSS15SA2FT	PS22A74	PSS15MC1FT★ PSS15NC1FT★
25			PSS25SA2FT	PS22A76	PSS25MC1FT★ PSS25NC1FT★
35			PSS35SA2FT	PS22A78-E	PSS35MC1FT★ PSS35NC1FT★
50			PSS50SA2FT	PS22A79	
Chip	IGBT/MOSFET	CSTBT	CSTBT	CSTBT	CSTBT
	HVIC	×3	×3	×3	×1
	LVIC	×1	×1	×1	×2 *4
	BSD	×3	×3	—	×3
Protective Function	UV	P-side/N-side	P-side/N-side	P-side/N-side	P-side/N-side/Brake
	SC	N-side	N-side	N-side	N-side
	OT	—	—	—	—
	V_{OT}*1	N-side	N-side	N-side	N-side
Specifications	Active input	High(5V)	High(5V)	High(5V)	High(5V)
	Emitter pin of N-side	Open	Open	Open	Open
	Fault output	N-side (UV,SC)	N-side (UV,SC)	N-side (UV,SC)	N-side (UV,SC)
	Insulation voltage	2500Vrms	2500Vrms	2500Vrms	2500Vrms
	Insulation structure	Insulation sheet	Insulation sheet	Insulation sheet	Insulation sheet
	RoHS directive	Compliant *2	Compliant *2	Compliant *2	Compliant *2
	Pin type	—	—	—	—

★: New Product Non-recommended : Please contact to the sales offices.

[Notes] *1: Analog temperature output
*2: Pin plating and chip soldering : Lead-free solder
*3: PSS**NC1FTis not included brake.
*4: LVIC 1pcs in case of PSS**NC1FT

[Term] CSTBT™: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.
BSD: Bootstrap diode, HVIC: High-voltage IC, LVIC: Low-voltage IC,
UV: Supply Under Voltage protection,
SC: Short circuit protection, OT: Over-temperature protection,
RoHS: Restriction of hazardous substances in electrical and electronic equipment
CIB: Converter inverter brake

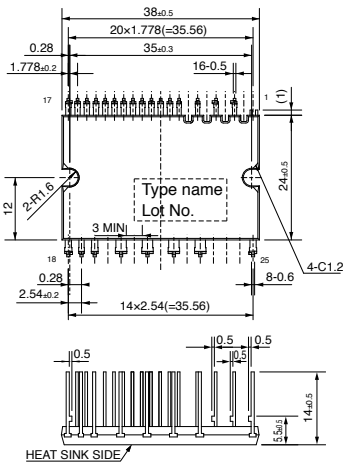
Type Name Definition of DIPIPM™



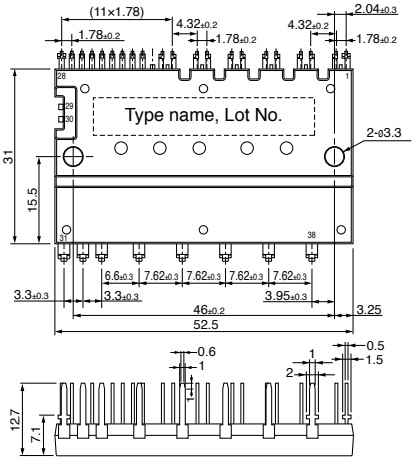
Outline Drawing of DIPIPM™

Unit:mm

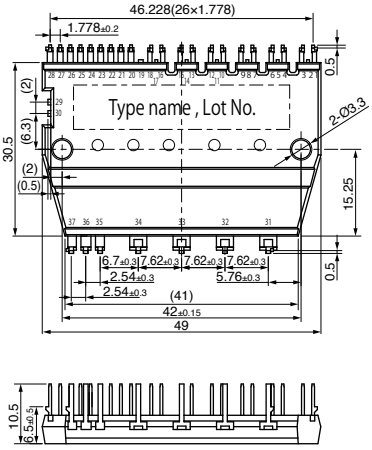
Super-mini DIPIPM Ver.6
MOSFET Super-mini DIPIPM
Super-mini DIPIPM Ver.5
Long (A)



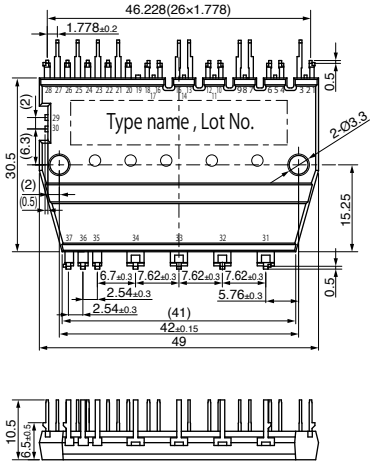
Industrial DIPIPM (PSSxxS71F6)
1200V Mini DIPIPM



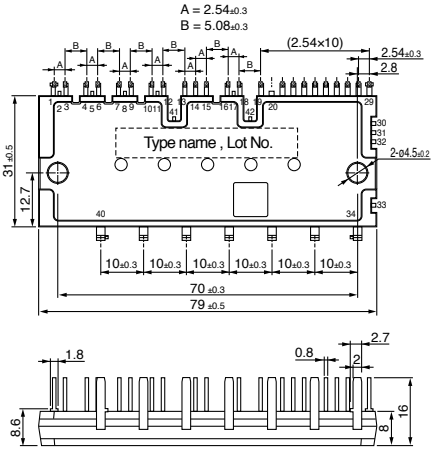
Industrial DIPIPM (PSSxxS51F6)



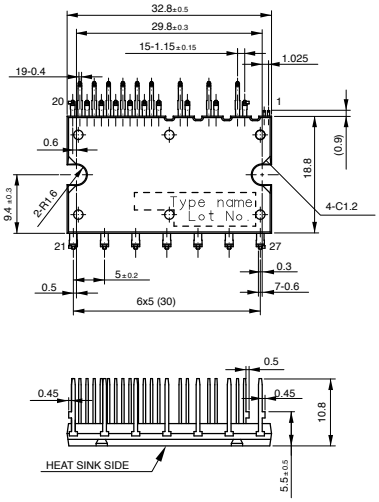
Industrial DIPIPM(PSSxxS51F6-C)
Zigzag(C)



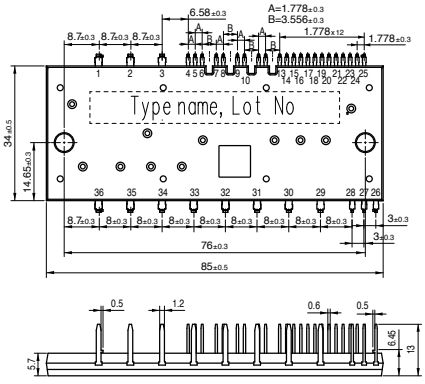
600V Large DIPIPM
1200V Large DIPIPM



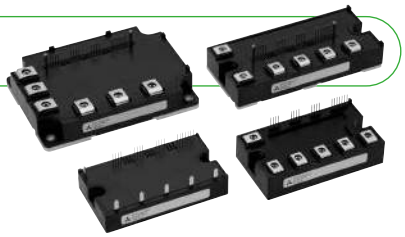
SLIMDIP-S/L



DIPIPM+



New Products



Loaded with built-in functions, contributing to inverters with enhanced energy savings

IPM G1 Series with 7th-generation IGBT

<Main Features>

- Power loss has been reduced with the introduction of the 7th-generation IGBT produced using CSTBT™*1 and a diode incorporating a RFC*2 structure that contributes to reducing the power consumed in inverters.
- The new resin-insulated metal baseplate, the same as that for the 7th-generation IGBT modules introduced, eliminates the solder-attached section, and the thermal cycle lifetime has been increased, which contributes to improving inverter reliability.
- In addition to the built-in functions of the previous product,*3 a low-noise drive, error detection function and bootstrap power source*4 contribute to lowering inverter noise and shortening design time.
- The introduction of press-fit pins and PC-TIM*5 contribute to simplifying the inverter assembly process (optional).

*1 CSTBT™: Mitsubishi Electric's unique IGBT that utilizes the carrier cumulative effect.
*2 RFC: Relaxed field cathode
*3 Conventional product: IPM L1-Series
Built-in functions: Supply Undervoltage lock protection (UV)、Short-circuit protection (SC), Over-temperature protection (OT)
*4 Bootstrap power supply: Optional products include 50A, 75A, 100A/650V, 25A, 50A/1200V
*5 PC-TIM: Phase change-thermal interface material

"A" package main pin shape and layout

For the "A" package 6-in-1 (CG1A) main pin shape, select either solder pin or screw type.
For the pin layout, select either straight or L-shaped.

Main pin shape

Main pin: Solder pin

Main pin: Screw

Main pin layout

Straight

L-shaped

Lineup

V_{CES}(V)	Package	Connection	Ic(A)							
			25	50	75	100	150	200	300	450
650V	A package	C		PM50CG1A065**	PM75CG1A065**	PM100CG1A065**				
		R		PM50RG1A065**	PM75RG1A065**					
	B package	C		PM50CG1B065**	PM75CG1B065**	PM100CG1B065**	PM150CG1B065**	PM200CG1B065**		
		R		PM50RG1B065**	PM75RG1B065**	PM100RG1B065**	PM150RG1B065**	PM200RG1B065**		
	C package	C						PM200CG1C065**	PM300CG1C065**	PM450CG1C065**
		R						PM200RG1C065**	PM300RG1C065**	
1200V	A package	C	PM25CG1A120**	PM50CG1A120**						
		R	PM25RG1A120**							
	B package	C	PM25CG1B120**	PM50CG1B120**	PM75CG1B120**	PM100CG1B120**				
		R	PM25RG1B120**	PM50RG1B120**	PM75RG1B120**	PM100RG1B120**				
	C package	C				PM100CG1C120**	PM150CG1C120**	PM200CG1C120**		
		R				PM100RG1C120**	PM150RG1C120**			

★★: Under Development

Representative reference is "A" package with screw terminal and straight layout (CG1A).

Line-up of IPM

Series Matrix of 600V IPM (No.: Number of outline drawing, see page 10 to 11)

VCES(V) / Series / IC(A)	600V																							
	G Series			L1 Series				S1 Series				V1 Series				Photovoltaic				L Series				
		Connection	No.		Connection	No.			Connection	No.			Connection	No.			Connection	No.			Connection	No.		
50	PM50CGAP060★	C	09	PM50CL1A060	C	01		PM50CS1D060	C	05						PM50B4LA060	B4	01		PM50CLA060	C		
	PM50CGB060★	C	10	PM50CL1B060	C	02										PM50B5LA060	B5	01		PM50CLB060	C		
	PM50RGAP060★	R	09	PM50RL1A060	R	01										PM50B6LA060	B6	01		PM50RLA060	R		
	PM50RGB060★	R	10	PM50RL1B060	R	02										PM50B4LB060	B4	02		PM50RLB060	R		
	PM50CGA060★	C	12	PM50RL1C060	R	03										PM50B5LB060	B5	02					
	PM50CGAL060★	C	12													PM50B6LB060	B6	02					
	PM50CGAPL060★	C	09													PM50B4L1C060	B4	03					
																PM50B5L1C060	B5	03					
	PM50RGA060★	R	12													PM50B6L1C060	B6	03					
75	PM75CGAP060★	C	09	PM75CL1A060	C	01		PM75CS1D060	C	05						PM75B4LA060	B4	01		PM75CLA060	C		
	PM75CGB060★	C	10	PM75CL1B060	C	02										PM75B5LA060	B5	01		PM75CLB060	C		
	PM75RGAP060★	R	09	PM75RL1A060	R	01										PM75B6LA060	B6	01		PM75RLA060	R		
	PM75RGB060★	R	10	PM75RL1B060	R	02										PM75B4LB060	B4	02		PM75RLB060	R		
	PM75CGA060★	C	12													PM75B5LB060	B5	02					
	PM75CGAL060★	C	12													PM75B6LB060	B6	02					
	PM75CGAPL060★	C	09													PM75B4L1C060	B4	03					
																PM75B5L1C060	B5	03					
	PM75RGA060★	R	12													PM75B6L1C060	B6	03					
100	PM100CGAP060★	C	09	PM100CL1A060	C	01		PM100CS1D060	C	05										PM100CLA060	C		
	PM100CGB060★	C	10	PM100CL1B060	C	02														PM100RLA060	R		
	PM100RGB060★	R	10	PM100RL1A060	R	01																	
	PM100CGA060★	C	12	PM100RL1B060	R	02																	
	PM100CGAL060★	C	12																				
	PM100CGAPL060★	C	09																				
150				PM150CL1A060	C	01		PM150CS1D060	C	05										PM150CLA060	C		
	PM150CGB060★	C	10	PM150CL1B060	C	02														PM150RLA060	R		
	PM150RGB060★	R	10	PM150RL1A060	R	01																	
				PM150RL1B060	R	02																	
200	PM200CGBB060★	C	10	PM200CL1A060	C	04		PM200CS1D060	C	05										PM200CLA060	C		
	PM200CGC060★	C	11	PM200RL1A060	R	04														PM200RLA060	R		
	PM200RGC060★	R	11																				
300	PM300CGC060★	C	11	PM300CL1A060	C	04														PM300CLA060	C		
	PM300RGC060★	R	11	PM300RL1A060	R	04														PM300RLA060	R		
400/450	PM450CGC060★	C	11									PM400DV1A060	D	06						PM450CLA060	C	08	
600												PM600DV1A060	D	06						PM600CLA060	C	08	
800												PM800DV1B060	D	07									
IGBT chip	CSTBT*1 Built-in emitter sensor Built-in temperature sensor			CSTBT*1 Built-in emitter sensor Built-in temperature sensor				CSTBT*1 Built-in emitter sensor Built-in temperature sensor				CSTBT*1 Built-in emitter sensor Built-in temperature sensor				CSTBT*1 Built-in emitter sensor Built-in temperature sensor				CSTBT*2 Built-in emitter sensor Built-in temperature sensor			
Fault output UV	P-side/N-side			P-side/N-side				N-side				P-side/N-side				P-side/N-side				P-side/N-side			
Fault output OT	P-side/N-side			P-side/N-side				N-side				P-side/N-side				P-side/N-side				P-side/N-side			
Fault output SC	P-side/N-side			P-side/N-side				N-side				P-side/N-side				P-side/N-side				P-side/N-side			
Fault output OC	—			—				—				—				—				—			
RoHS directive	Compliant			Compliant				Compliant				Compliant				Compliant				Compliant			
Compatibility	—			L Series				S-DASH SERVO				V Series				—				—			
Connection	D			B4				B5				B6				C				R			

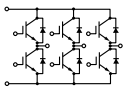
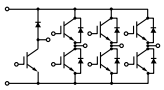
★★: Under Development ★: New Product Non-recommended : Please contact to the sales offices.

[Notes] *1: Full-gate CSTBT™ *2: PCM (Plugged Cell Merged) CSTBT™

[Term] UV: Supply Under Voltage-lock protection, SC: Short-Circuit protection, OT: Over-temperature protection,
OC: Over-current protection, CSTBT™: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect
RoHS: Restriction of hazardous substances in electrical and electronic equipment

Line-up of IPM

Series Matrix of 1200V IPM (No.: Number of outline drawing, see page 10 to 11)

V_{CES}(V)	1200V																	
Series / Ic(A)	G Series			L1 Series			S1 Series			V1 Series			L Series					
		Connection	No.		Connection	No.		Connection	No.		Connection	No.		Connection	No.			
25	PM25CGAP120★ PM25CGB120★ PM25RGAP120★ PM25RGB120★ PM25CGA120★ PM25CGAL120★ PM25CGAPL120★ PM25RGA120★	C C R R C C C R	09 10 09 10 12 12 09 12	PM25CL1A120 PM25CL1B120 PM25RL1A120 PM25RL1B120 PM25RL1C120	C C R R R	01 02 01 02 03	PM25CS1D120	C	05				PM25CLA120 PM25CLB120 PM25RLA120 PM25RLB120	C C R R				
50	PM50CGAP120★ PM50CGB120★ PM50RGB120★ PM50CGA120★ PM50CGAL120★ PM50CGAPL120★	C C R C C C	09 10 10 12 12 09	PM50CL1A120 PM50CL1B120 PM50RL1A120 PM50RL1B120	C C R R	01 02 01 02	PM50CS1D120	C	05				PM50CLA120 PM50CLB120 PM50RLA120 PM50RLB120	C C R R				
75	PM75CGB120★ PM75RGB120★	C R	10 10	PM75CL1A120 PM75CL1B120 PM75RL1A120 PM75RL1B120	C C R R	01 02 01 02	PM75CS1D120	C	05				PM75CLA120 PM75CLB120 PM75RLA120 PM75RLB120	C C R R				
100	PM100CGB120★ PM100CGC120★ PM100RGC120★	C C R	10 11 11	PM100CL1A120 PM100RL1A120	C R	04 04	PM100CS1D120	C	05				PM100CLA120 PM100RLA120	C R				
150	PM150CGC120★ PM150RGC120★	C R	11 11	PM150CL1A120 PM150RL1A120	C R	04 04							PM150CLA120 PM150RLA120	C R				
200	PM200CGC120★	C	11							PM200DV1A120	D	06	PM200CLA120	C	08			
300										PM300DV1A120	D	06	PM300CLA120	C	08			
450										PM450DV1A120	D	06	PM450CLA120	C	08			
IGBT chip	CSTBT*1 Built-in current sensor Built-in temperature sensor			CSTBT*1 Built-in current sensor Built-in temperature sensor			CSTBT*1 Built-in current sensor Built-in temperature sensor			CSTBT*1 Built-in current sensor Built-in temperature sensor			CSTBT*2 Built-in current sensor Built-in temperature sensor					
Fault output UV	P-side/N-side			P-side/N-side			N-side			P-side/N-side			P-side/N-side					
Fault output OT	P-side/N-side			P-side/N-side			N-side			P-side/N-side			P-side/N-side					
Fault output SC	P-side/N-side			P-side/N-side			N-side			P-side/N-side			P-side/N-side					
Fault output OC	—			—			—			—			—					
RoHS directive	Compliant			Compliant			Compliant			Compliant			Compliant					
Compatibility	—			L Series			S-DASH SERVO			V Series			—					
Connection	D  C  R 																	

★★: Under Development ★: New Product Non-recommended : Please contact to the sales offices.

[Notes] *1: Full-gate CSTBT™ *2: PCM (Plugged Cell Merged) CSTBT™

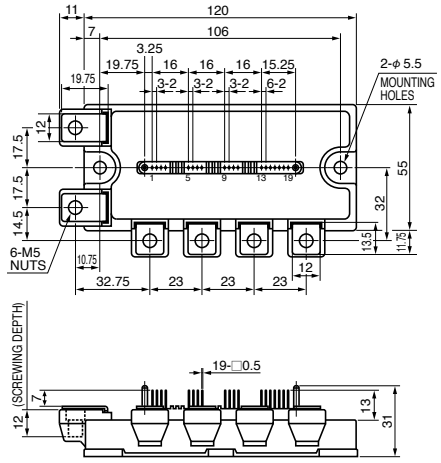
[Term] UV: Supply Under Voltage-lock protection, SC: Short-circuit protection, OT: Over-temperature protection,
OC: Over-current protection, CSTBT™: Carrier stored trench-gate bipolar transistor.
RoHS: Restriction of hazardous substances in electrical and electronic equipment

Outline Drawing of IPM

Unit:mm

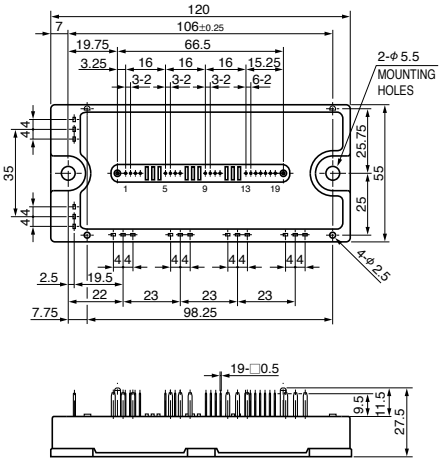
01

PM50,75,100,150CL1A/RL1A060
PM25,50,75CL1A/RL1A120
PM50,75B4/B5/B6LA060



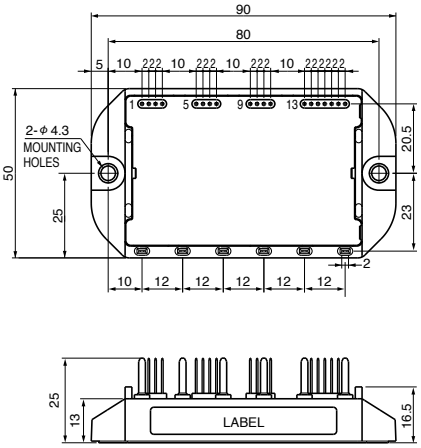
02

PM50,75,100,150CL1B/RL1B060
PM25,50,75CL1B/RL1B120
PM50,75B4/B5/B6LB060



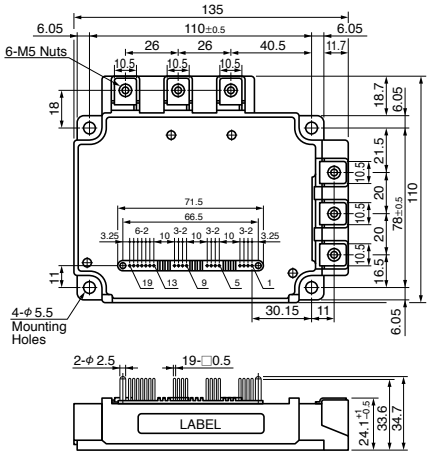
03

PM50RL1C060
PM25RL1C120
PM50,75,B4/B5/B6L1C060



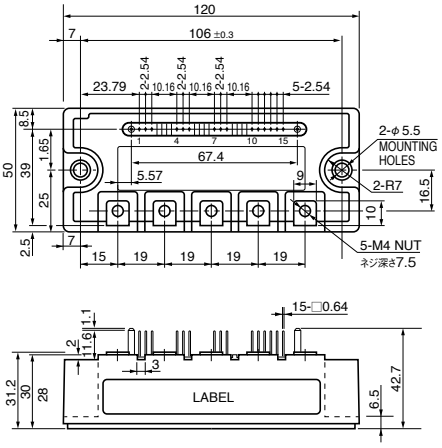
04

PM200,300CL1A/RL1A060
PM100,150CL1A/RL1A120



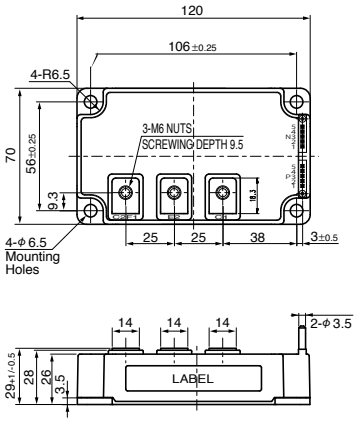
05

PM50,75,100,150,200CS1D060
PM25,50,75,100CS1D120



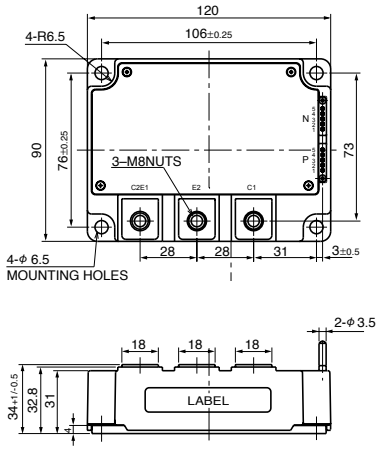
06

PM400,600DV1A060
PM200,300,450DV1A120



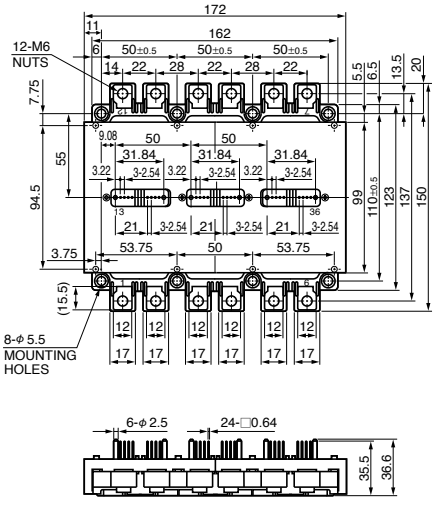
07

PM800DV1B060



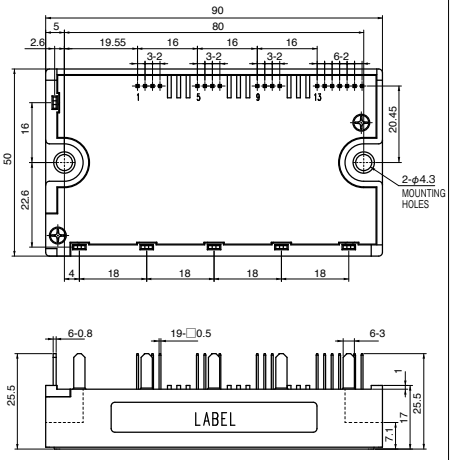
08

PM450,600CLA060
PM200,300,450CLA120



09

PM50,75,100CGAP/CGAPL/
RGAP060
PM25,50CGAP/CGAPL/
RGAP120

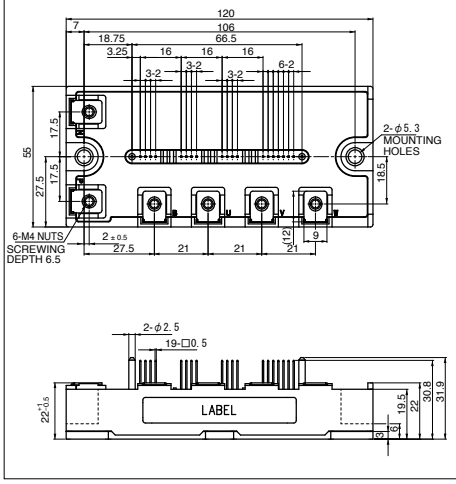


Line-up of IPM

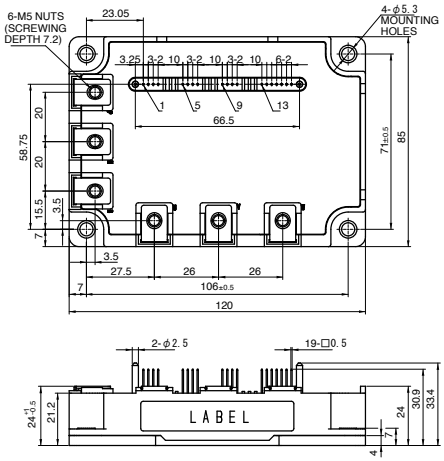
Outline Drawing of IPM

Unit:mm

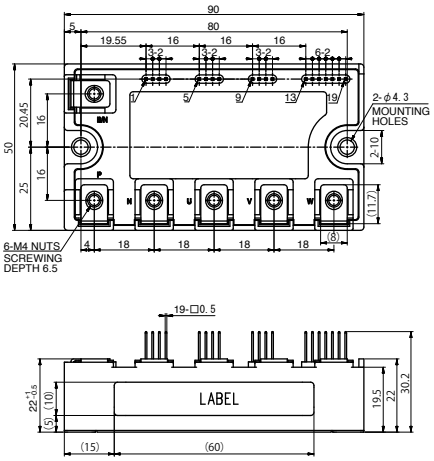
10 PM50,75,100,150CGB/RGB060 PM200CGBB060 PM25,50,75,100CGB/RGB120



11 PM200,300CGC/RGC060 PM100,150,200CGC/RGC120



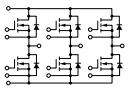
12 PM50,75,100CGA/CGAL060 PM50,75RGA060 PM25,50CGA/CGAL120 PM25RGA120



Line-up of MOSFET Modules

Series Matrix of MOSFET Modules

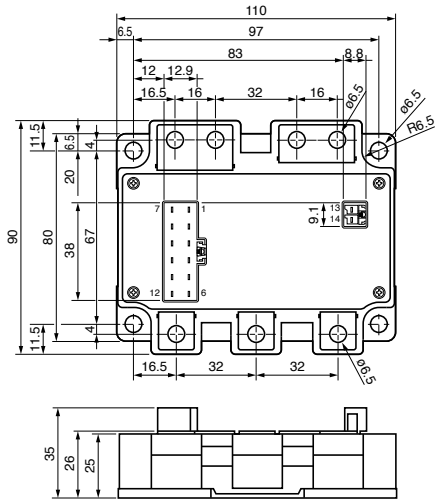
RoHS directive compliant

V_{DSS} / I_D (A)	75V	Connection	100V	Connection	150V	Connection
100	FM200TU-07A	T	FM200TU-2A	T	FM200TU-3A	T
200	FM400TU-07A	T	FM400TU-2A	T	FM400TU-3A	T
300	FM600TU-07A	T	FM600TU-2A	T	FM600TU-3A	T
Connection	T 					

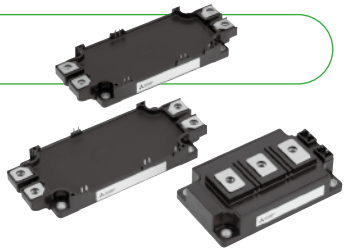
Outline Drawing of MOSFET Modules

Unit : mm

FM200TU-07A, -2A, -3A
FM400TU-07A, -2A, -3A
FM600TU-07A, -2A, -3A



New Products



Contributes to realizing smaller, energy-saving large-capacity inverters

T Series 7th-generation IGBT Module

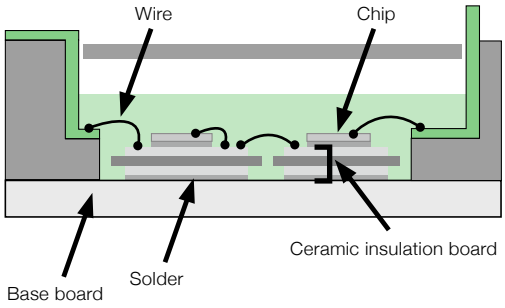
<Main Features>
- Power loss has been reduced with the introduced of the 7th-generation IGBT produced using CSTBT™*2 and a diode incorporating a relaxed field of cathode (RFC) structure, which contributes to reducing the power consumed in inverters.
- The new structure introduced eliminates the solder-attached section, and the thermal cycle lifetime has been increased, which contributes to improving the reliability of inverters.
- The introduction of press-fit pins and PC-TIM*1 contribute to simplifying the assembly process for inverters.

*1 PC-TIM: Phase change - pin interface material
*2 CSTBT™: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.

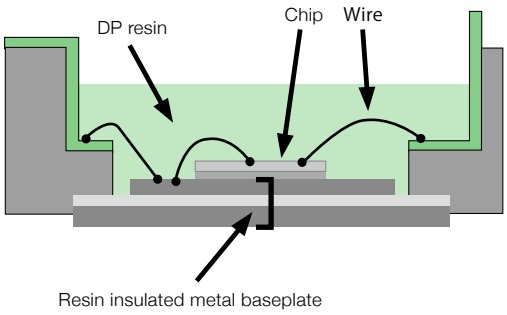
New structure realizes improved reliability (improved thermal cycle lifetime)

NX package structure comparison

6th-generation IGBT



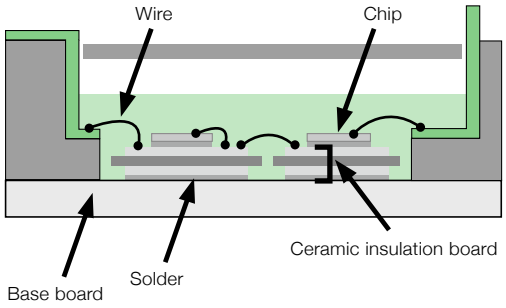
7th-generation IGBT



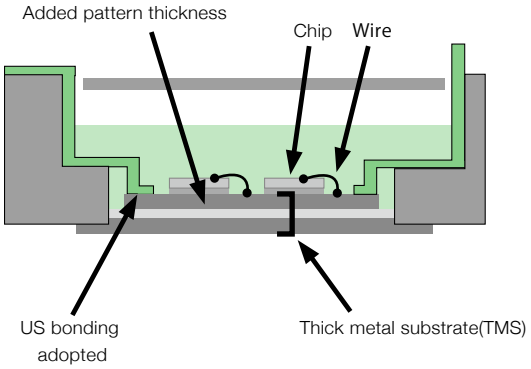
※Adopts SoLid Cover(SLC) Technology

Compared to standard package structure

6th-generation IGBT



7th-generation IGBT

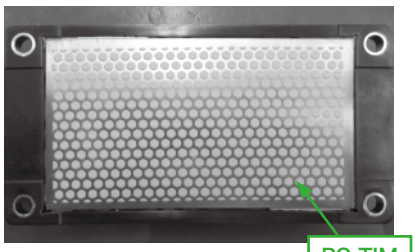


Assembly process simplified

◆ PC-TIM support

- Handling simple using heat dissipation grease
- Heat dissipation application process eliminated
- Contact heat resistance reduced through high thermal conductivity
- High heat resistance improves quality
- Disparity in contact heat resistance reduced by managing thickness

■PC-TIM application



Fixed at room temperature

■After face change

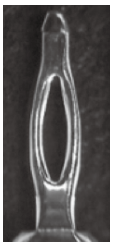
Liquefied and spread like grease

◆ Press-fit terminal support (NX)

- Possible to select the control pin shape (soldered terminals/press-fit terminals)
- Solder attachment process eliminated

■Press-fit pin (under development)

①Main pin



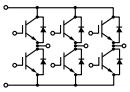
②Signal pin

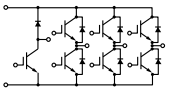
Series atrix of 7th-generation IGBT Modules (No.: Number of outline drawing, see page 22, 23)

V_{CES}(V) / Series / I_C(A)	650V						1200V						1700V					
	NX type	Connection	No.	Std type	Connection	No.	NX type	Connection	No.	Std type	Connection	No.	NX type	Connection	No.	Std type	Connection	No.
75																CM75DY-34T★★	D	—
100	CM100TX-13T★★ CM100TXP-13T★★	T T	34 38	CM100DY-13T★★	D	31	CM100TX-24T★★ CM100TXP-24T★★ CM100RX-24T★★ CM100RXP-24T★★	T T R R	34 38 35 39	CM100DY-24T★★	D	31	CM100TX-34T★★ CM100TXP-34T★★	T T	— —	CM100DY-34T★★	D	—
150	CM150TX-13T★★ CM150TXP-13T★★ CM150RX-13T★★ CM150RXP-13T★★	T T R R	34 38 35 39	CM150DY-13T★★	D	31	CM150TX-24T★★ CM150TXP-24T★★ CM150RX-24T★★ CM150RXP-24T★★	T T R R	34 38 35 39	CM150DY-24T★★	D	31	CM150TX-34T★★ CM150TXP-34T★★	T T	— —	CM150DY-34T★★	D	—
200	CM200TX-13T★★ CM200TXP-13T★★ CM200RX-13T★★ CM200RXP-13T★★	T T R R	34 38 35 39	CM200DY-13T★★	D	31	CM200TX-24T★★ CM200TXP-24T★★	T T	34 38	CM200DY-24T★★	D	32				CM200DY-34T★★	D	—
225							CM225DX-24T★★ CM225DXP-24T★★	D D	29 40				CM225DX-34T★★ CM225DXP-34T★★	D D	— —			
300	CM300DX-13T★ CM300DXP-13T★	D D	29 40	CM300DY-13T★	D	32	CM300DX-24T★ CM300DXP-24T★	D D	29 40	CM300DY-24T★★	D	32	CM300DX-34T★★ CM300DXP-34T★★	D D	— —	CM300DY-34T★★	D	—
400				CM400DY-13T★	D	32												
450	CM450DX-13T★ CM450DXP-13T★	D D	29 40				CM450DX-24T★ CM450DXP-24T★	D D	29 40	CM450DY-24T★	D	33	CM450DX-34T★★ CM450DXP-34T★★	D D	— —			
600	CM600DX-13T★ CM600DXP-13T★	D D	29 40	CM600DY-13T★	D	33	CM600DX-24T★ CM600DXP-24T★	D D	29 40	CM600DY-24T★	D	33	CM600DX-34T★★ CM600DXP-34T★★	D D	— —			
1000							CM1000DX-24T★★ CM1000DXP-24T★★	D D	30 41									

Connection

D 

T 

R 

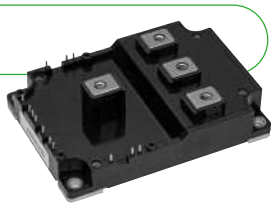
★★: Under Development ★: New Product

Feature Products

Contributes to realizing smaller, energy-saving large-capacity inverters

Power Module for 3-level Inverter

1-in-1 / 2-in-1 type

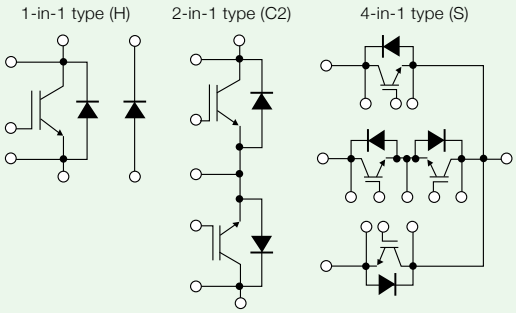


4-in-1 type

<Main Features>
- Compatible with 3-level inverters, reducing power consumption approx. 30%*1
- New package developed*2 contributing to lower inductance and simplified inverter circuit structure
- IGBT specifications optimized*3 with development of new compact, low-inductance package
- 4-in-1*4 and 1-in-1/2-in-1*5 lineup contributes to improved compactness and freedom in inverter design

*1 Comparison between 3-level inverter incorporated in this device and 2-level inverter in conventional device.
*2 1-in-1/2-in-1 type external dimensions of 130x67mm, 4-in-1 type external dimensions of 115x82mm, new package developed with innovative terminal positioning.
*3 IGBT specifications optimized for 3-level inverters, adopting CSTBT™ (Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect).
*4 4-in-1 module with one 3-level inverter arm in one package.
*5 Bidirectional switch model as emitter common connection.

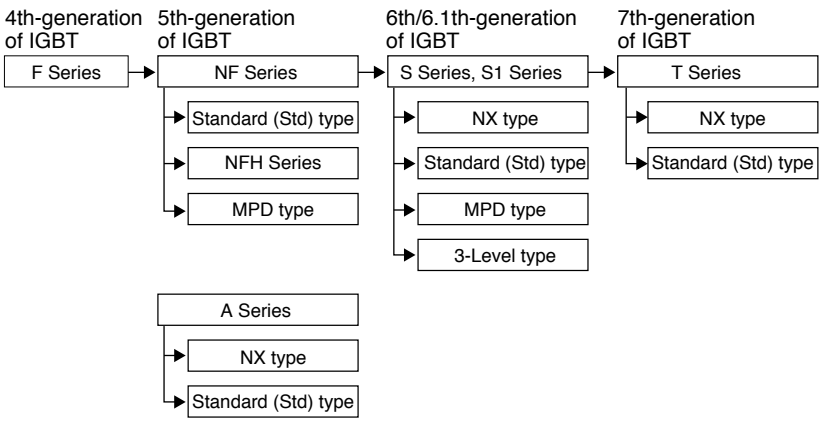
Internal circuit diagram



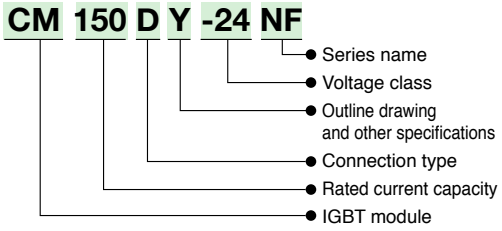
Lineup

Main application	Model	Module type	Rated voltage	Rated current	Circuit structure	External dimensions W×D (mm)
125-500kW inverter	CM400ST-24S1	IGBT	1200V	400A	4-in-1	115×82
500kW - inverter	CM1400HA-24S	IGBT	1200V	1400A	1-in-1	130×67
	RM1400HA-24S	Diode	1200V	1400A	1-in-1	130×67
	CM1000HA-34S	IGBT	1700V	1000A	1-in-1	130×67
	CM500C2Y-24S	IGBT	1200V	500A	2-in-1	130×67

Evolution of IGBT Module Series



Type Name Definition of IGBT Modules



Features of IGBT Module Series

S Series

- Lineup includes various package types
- 6th-generation CSTBT™ delivers low-loss performance
- Thinner package (Height: 17mm) (NX type)
- Suited to large-capacity applications (1200V/2500A, 1700V/1800A) (MPD type)

MPD: Mega power dual

NFH Series

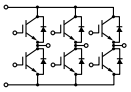
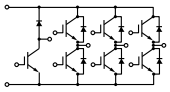
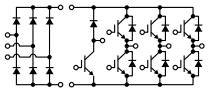
- High-speed CSTBT™ delivers low-loss performance
- Soft switching (resonant) turn-off function (ZVS)
- Enhanced inner wiring (skin effect)

CSTBT™: Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect.

Line-up of IGBT / Diode Modules

Matrix of 600V IGBT Modules (No.: Number of outline drawing, see page 19 to 20)

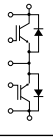
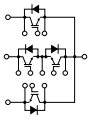
RoHS directive (2011/65/EU) compliant

VCES(V) / Series / IC(A)	600V											
	NX Series	Connection	No.	NF Series	Connection	No.	NFH Series	Connection	No.	F Series	Connection	No.
75	CM75MX-12A	M	01	CM75TL-12NF CM75RL-12NF	T R	07 07				CM75DU-12F CM75TU-12F	D T	
100	CM100MX-12A CM100RX-12A	M R	01 02	CM100TL-12NF CM100RL-12NF	T R	07 07	CM100DUS-12F	D	13	CM100DU-12F CM100TU-12F	D T	
150	CM150RX-12A	R	02	CM150DY-12NF CM150TL-12NF CM150RL-12NF	D T R	08 07 07	CM150DUS-12F	D	13	CM150DU-12F CM150TU-12F	D T	
200	CM200RX-12A	R	02	CM200DY-12NF CM200TL-12NF CM200RL-12NF	D T R	08 09 09	CM200DU-12NFH	D	13	CM200DU-12F CM200TU-12F	D T	
300	CM300DX-12A	D	03	CM300DY-12NF	D	08	CM300DU-12NFH	D	14	CM300DU-12F	D	
400	CM400DX-12A	D	03	CM400DY-12NF	D	10	CM400DU-12NFH	D	14	CM400DU-12F	D	
600				CM600DY-12NF	D	11	CM600DU-12NFH	D	15	CM600HU-12F	H	
Connection	H  D  T  R  M 											

Non-recommended : Please contact to the sales offices.

Matrix of Power Module for 3-level Inverter (No.: Number of outline drawing, see page 22 to 23)

RoHS directive (2011/65/EU) compliant

VCES/VRRM / IC/IF	1200V IGBT Module	Connection	No.	1700V IGBT Module	Connection	No.	1200V Diode Module	Connection	No.
400	CM400ST-24S1★	S	36						
	CM400C1Y-24S	C1	11						
500	CM500C2Y-24S★	C	37						
1000				CM1000HA-34S★	H	37			
1400	CM1400HA-24S★	H	37				RM1400HA-24S★	H	37
Connection	IGBT module C1  C2  H  S 						Diode module H 		

★: New Product ＊Connection H of diode module and IGBT module are different.

Line-up of IGBT Modules

Matrix of 6th/6.1th-generation of IGBT Modules <S Series / S1 Series> 1200V/1700V

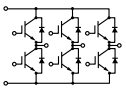
(No.: Number of Outline Drawing, see page 19 to 23)

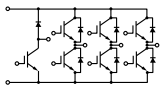
RoHS directive (2011/65/EU) compliant

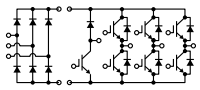
V_{CES}(V)	1200V									1700V					
Series / I_C	NX type	Connection	No.	Std type	Connection	No.	MPD type	Connection	No.	NX type	Connection	No.	MPD type	Connection	No.
35	CM35MXA-24S	M	04												
50	CM50MXA-24S	M	04												
75	CM75MXA-24S CM75TX-24S CM75RX-24S	M T R	04 05 02							CM75MXA-34SA CM75RX-34SA	M R	24 20			
100	CM100MXA-24S CM100TX-24S1 CM100RX-24S1	M T R	04 26 27												
150	CM150DX-24S CM150EXS-24S CM150TX-24S1 CM150RX-24S1	D E T R	03 25 26 27							CM150DX-34SA CM150RXL-34SA	D R	21 22			
200	CM200EXS-24S CM200RXL-24S	E R	25 22							CM200DX-34SA CM200EXS-34SA	D E	21 25			
225	CM225DX-24S1	D	28												
300	CM300DX-24S1 CM300EXS-24S CM300RXL-24S1★	D E R	28 25 22	CM300DY-24S	D	10				CM300DX-34SA	D	21			
450	CM450DX-24S1	D	28	CM450DY-24S	D	11				CM450DXL-34SA	D	23			
600	CM600DX-24S1 CM600DXL-24S	D D	28 06	CM600DY-24S	D	11				CM600DXL-34SA	D	23			
800				CM800DY-24S	D	12									
900							CM900DUC-24S	D	17						
1000	CM1000DXL-24S	D	06										CM1000DUC-34SA	D	17
1400							CM1400DUC-24S	D	17						
1800													CM1800DY-34S	D	19
2500							CM2500DY-24S	D	19						

Connection

D 

T 

R 

M 

E 

★: New Product

Series Matrix of IGBT Modules 1200V/1700V

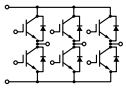
RoHS directive (2011/65/EU) compliant

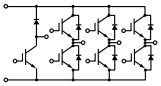
V_{CES}(V)	1200V									1700V					
Series / I_C	Std type	Connection	No.	NFH Series	Connection	No.	F Series	Connection	No.	MPD Series	Connection	No.	Std type	Connection	No.
50	CM50RL-24NF	T	07				CM50DU-24F	D							
	CM50TL-24NF	R	07												
75	CM75RL-24NF	T	07				CM75DU-24F	D					CM75DY-34A	D	08
	CM75TL-24NF	R	07				CM75TU-24F	T							
100	CM100DY-24NF	D	08	CM100DU-24NFH	D	13	CM100DU-24F	D					CM100DY-34A	D	08
	CM100DY-24A	D	08										CM100DU-34KA	D	
	CM100E3Y-24NF	E3	08												
	CM100RL-24NF	R	07												
	CM100TL-24NF	T	07												
150	CM150DY-24NF	D	08	CM150DU-24NFH	D	13	CM150DU-24F	D					CM150DY-34A	D	10
	CM150DY-24A	D	08												
	CM150E3Y-24NF	E3	08												
	CM150TL-24NF	T	09												
	CM150RL-24NF	R	09												
200	CM200DY-24NF	D	10	CM200DU-24NFH	D	14	CM200DU-24F	D					CM200DY-34A	D	10
	CM200DY-24A	D	08												
	CM200TL-24NF	T	09												
	CM200RL-24NF	R	09												
300	CM300DY-24NF	D	11	CM300DU-24NFH	D	14	CM300DU-24F	D					CM300DY-34A	D	11
	CM300DY-24A	D	10												
400	CM400DY-24NF	D	11	CM400DU-24NFH	D	15							CM400DY-34A	D	18
	CM400DY-24A	D	11												
	CM400HA-24A	H	16												
500													CM500HA-34A	H	16
600	CM600DU-24NF	D	12	CM600DU-24NFH	D	15	CM600DU-24F	D							
	CM600DY-24A	D	11												
	CM600HA-24A	H	16												
900	CM900DUC-24NF	D													
1000										CM1000DUC-34NF	D				
1400	CM1400DUC-24NF	D													

Connection

H 

D 

T 

R 

E3 

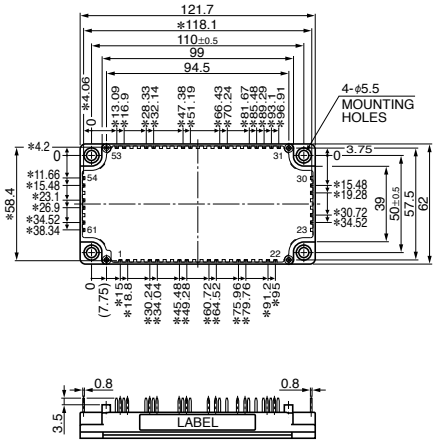
Non-recommended : Please contact to the sales offices.

Line-up of IGBT Modules

Outline Drawing of IGBT Modules

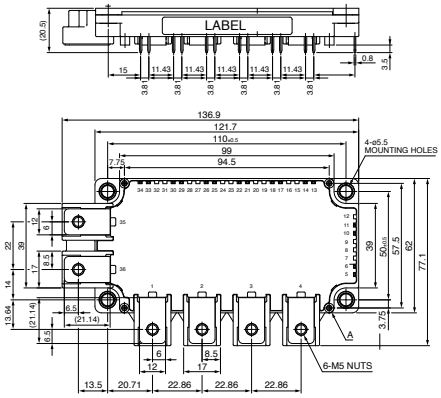
Unit:mm

01 CM75,100MX-12A



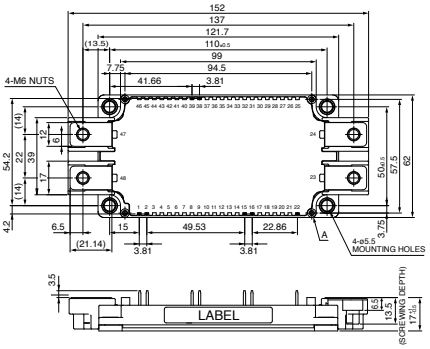
∗All dimensions with a tolerance of ⊕ φ0.5

02 CM100,150,200RX-12A CM75RX-24S



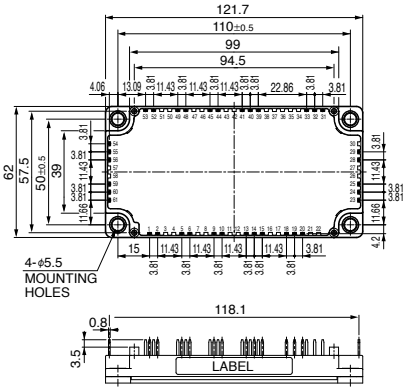
∗All dimensions with a tolerance of ⊕ φ0.5

03 CM300,400DX-12A CM150,200DX-24S

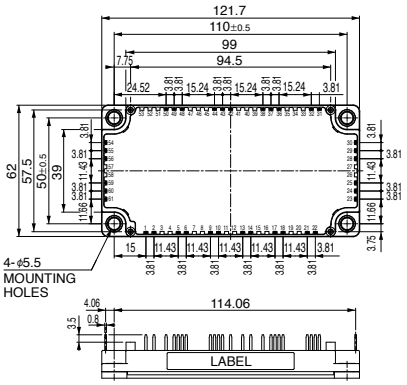


∗All dimensions with a tolerance of ⊕ φ0.5

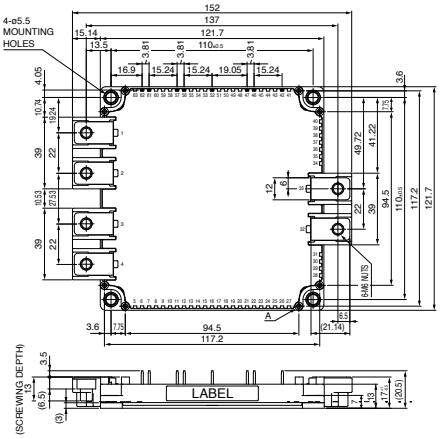
04 CM35,50,75,100MXA-24S



05 CM75TX-24S

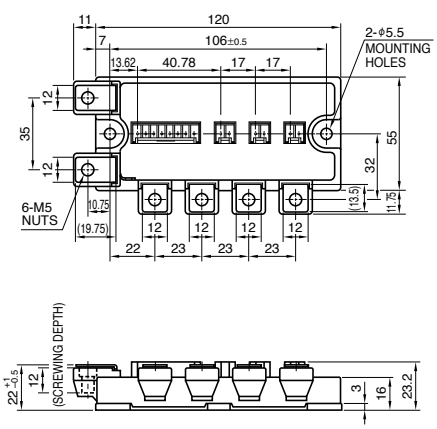


06 CM600,1000DXL-24S

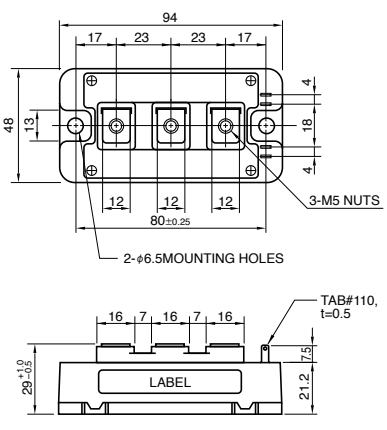


∗All dimensions with a tolerance of ⊕ φ0.5

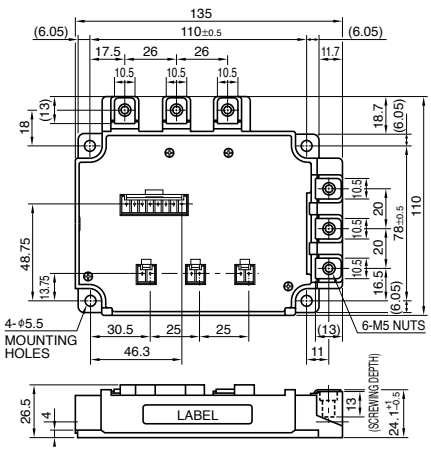
07 CM75,100,150TL/RL-12NF CM50,75,100TL/RL-24NF



08 CM150,200,300DY-12NF CM100,150DY-24NF CM100,150,200DY-24A CM75,100DY-34A CM100,150E3Y-24NF



09 CM200TL/RL-12NF CM150,200TL/RL-24NF

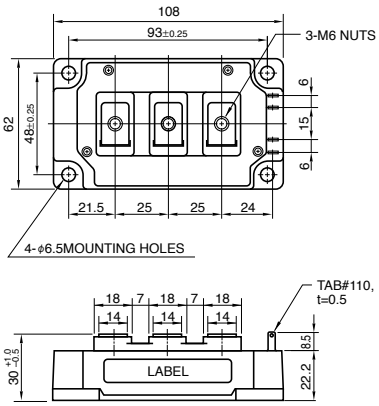


Outline Drawing of IGBT Modules

Unit:mm

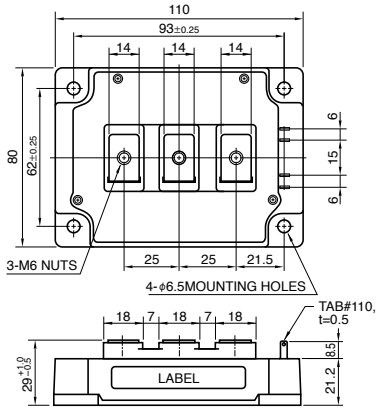
10

CM400DY-12NF
CM200DY-24NF
CM300DY-24A
CM300DY-24S
CM150,200DY-34A



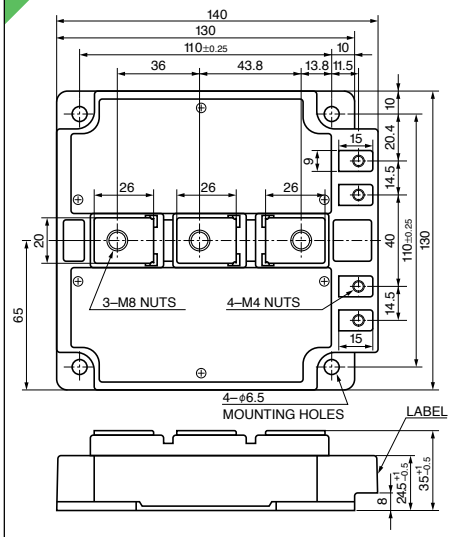
11

CM600DY-12NF
CM400DY-24NF
CM400,600DY-24A
CM300DY-34A
CM400C1Y-24S
CM450DY-24S
CM600DY-24S
CM300DY-24NF



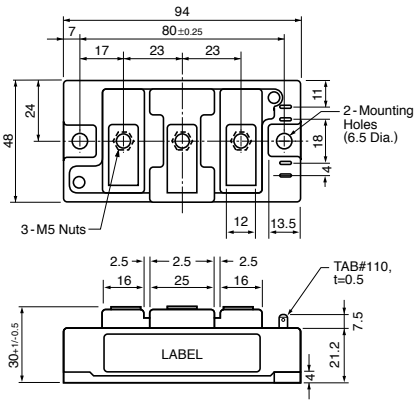
12

CM600DU-24NF
CM800DY-24S



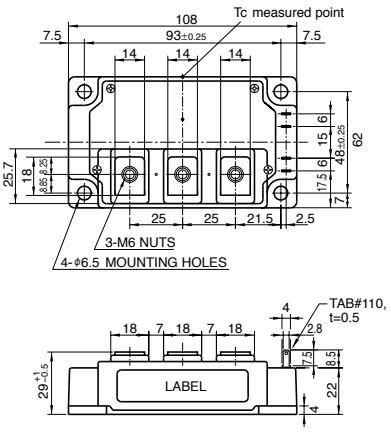
13

CM100,150DUS-12F
CM200DU-12NFH
CM100,150DU-24NFH



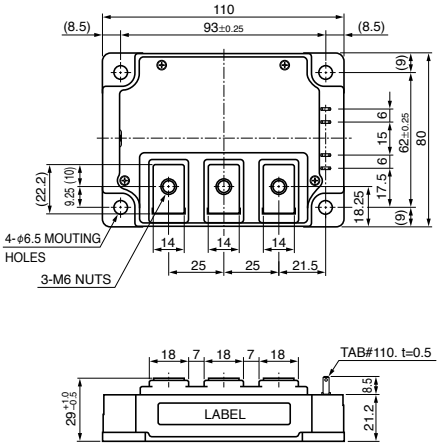
14

CM300,400DU-12NFH
CM200,300DU-24NFH



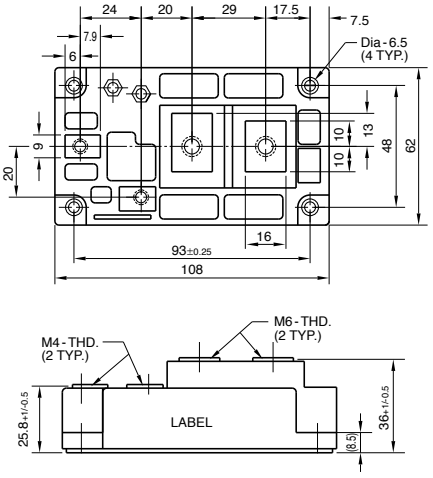
15

CM600DU-12NFH
CM400,600DU-24NFH



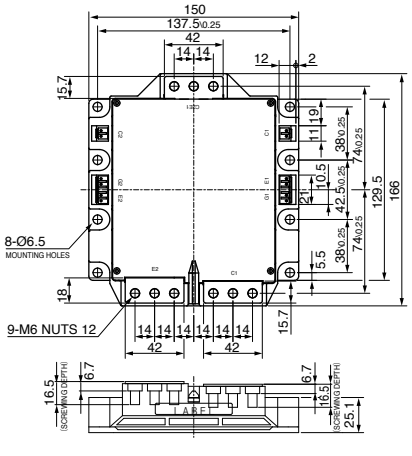
16

CM400,600HA-24A
CM500HA-34A



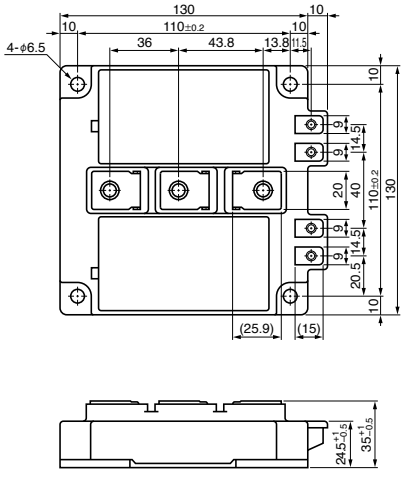
17

CM900,1400DUC-24S
CM1000DUC-34SA



18

CM400DY-34A

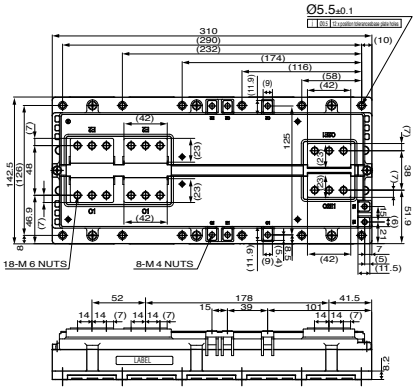


Line-up of IGBT Modules

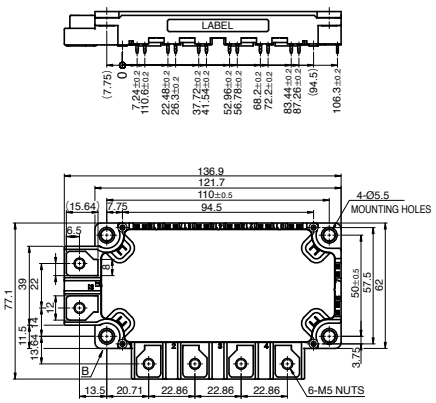
Outline Drawing of IGBT Modules

Unit:mm

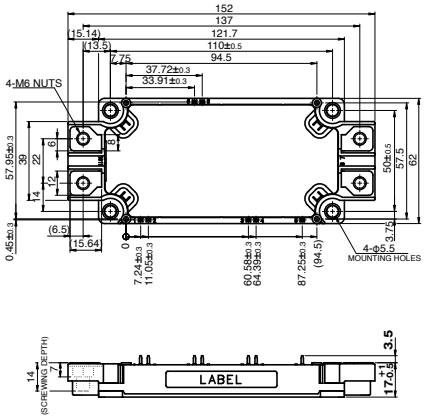
19 CM1800DY-34S CM2500DY-24S



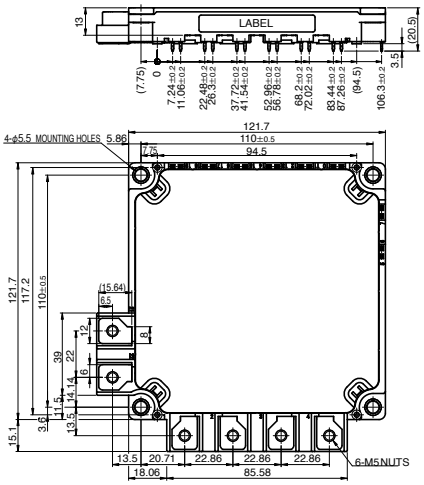
20 CM75RX-34SA



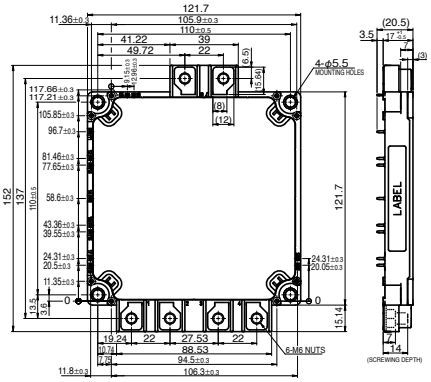
21 CM150DX-34SA CM200DX-34SA CM300DX-34SA



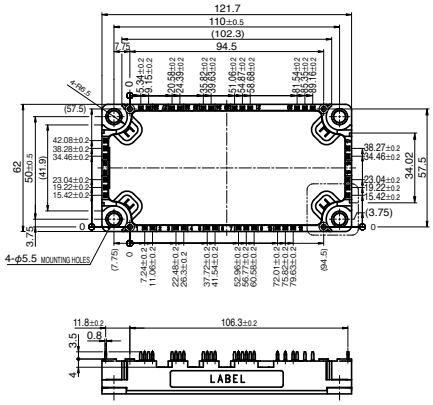
22 CM200RXL-24S CM300RXL-24S1 CM150RXL-34SA



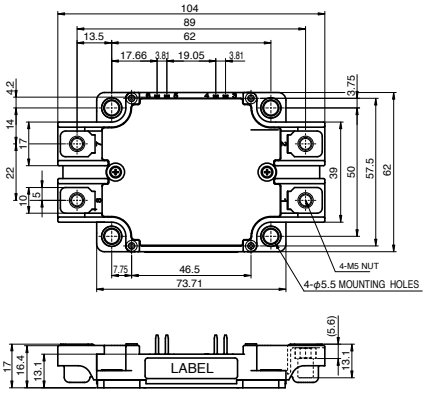
23 CM450DXL-34SA CM600DXL-34SA



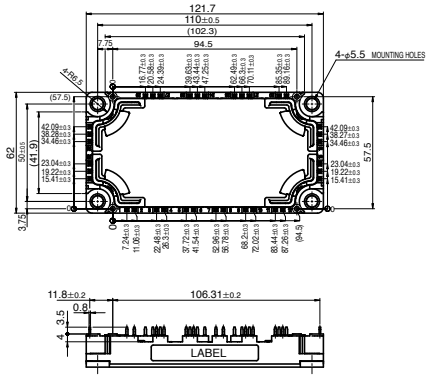
24 CM75MXA-34SA



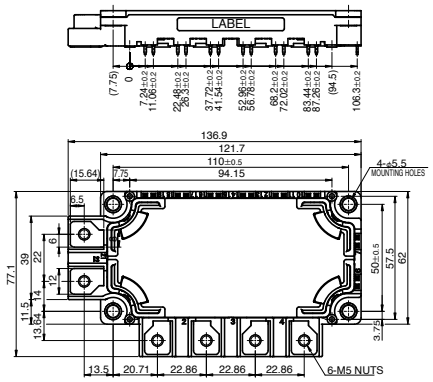
25 CM150EXS-24S CM200EXS-24S CM300EXS-24S CM200EXS-34SA



26 CM100TX-24S1 CM150TX-24S1



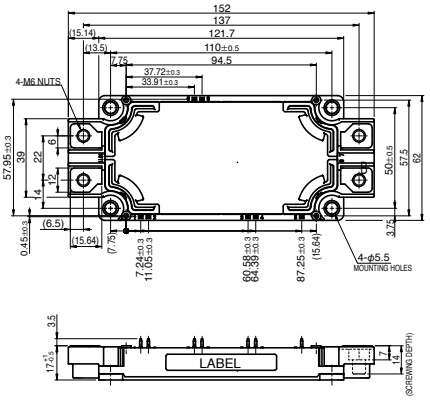
27 CM100RX-24S1 CM150RX-24S1



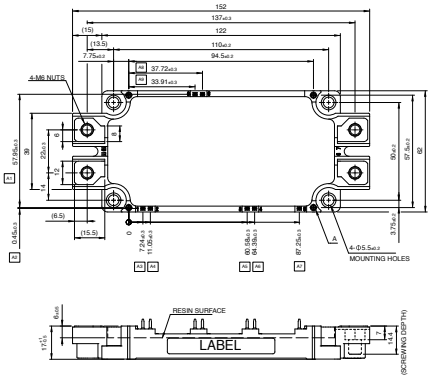
Outline Drawing of IGBT Modules

Unit:mm

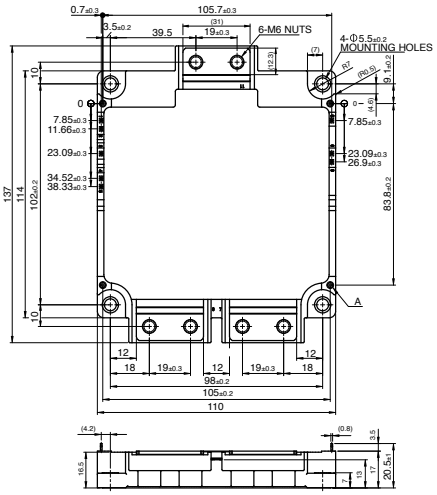
28
CM225DX-24S1
CM300DX-24S1
CM450DX-24S1
CM600DX-24S1



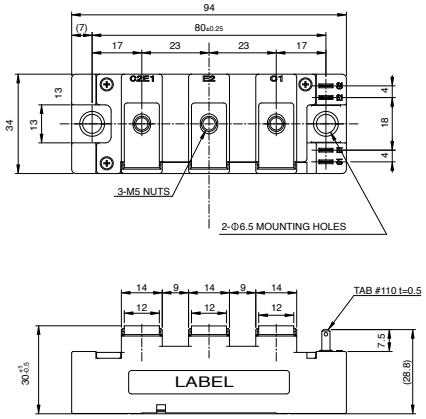
29
CM300,450,600DX-13T
CM225,300,450,600DX-24T



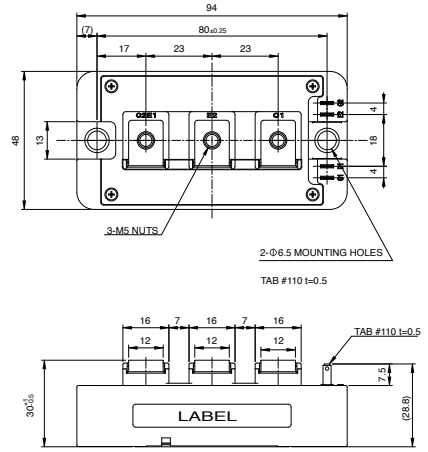
30
CM1000DX-24T



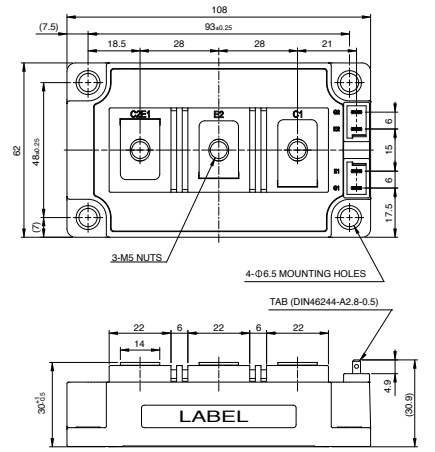
31
CM100,150,200DY-13T
CM100,150DY-24T



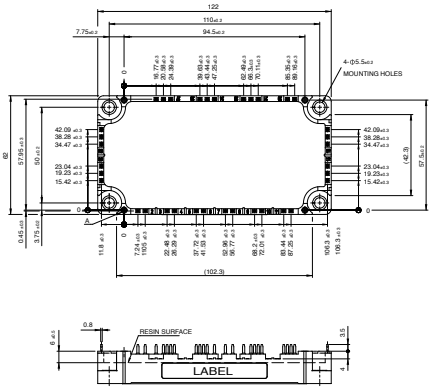
32
CM300,400DY-13T
CM200,300DY-24T



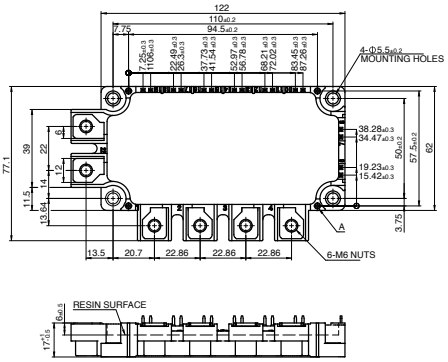
33
CM600DY-13T
CM450,600DY-24T



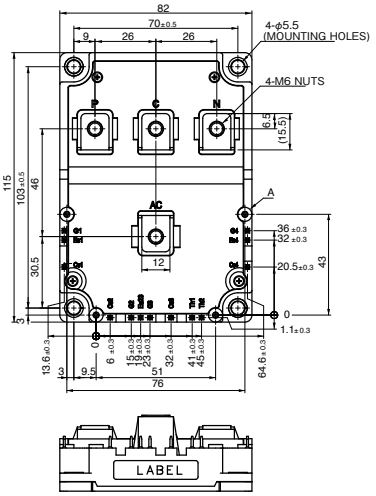
34
CM100,150,200TX-13T
CM100,150,200TX-24T



35
CM150,200RX-13T
CM100,150RX-24T



36
CM400ST-24S1



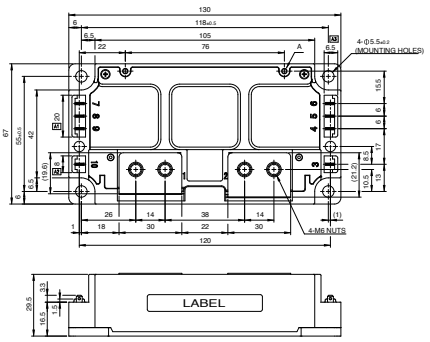
Line-up of IGBT Modules

Outline Drawing of IGBT Modules

Unit:mm

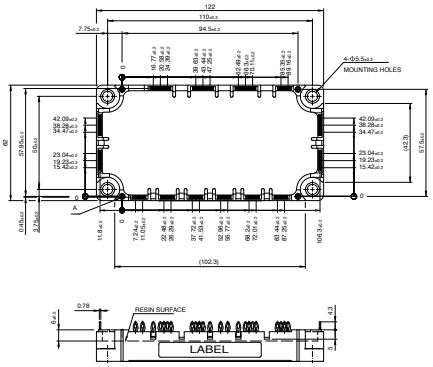
37

CM500C2Y-24S
CM1400HA-24S
CM1000HA-34S
RM1400HA-24S



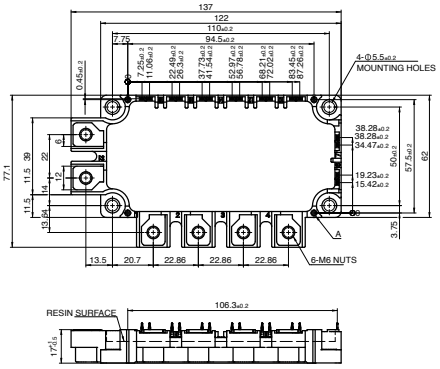
38

CM100,150,200TXP-13T
CM100,150,200TXP-24T



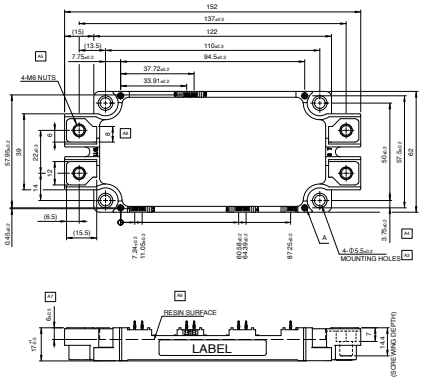
39

CM150,200RXP-13T
CM100,150RXP-24T



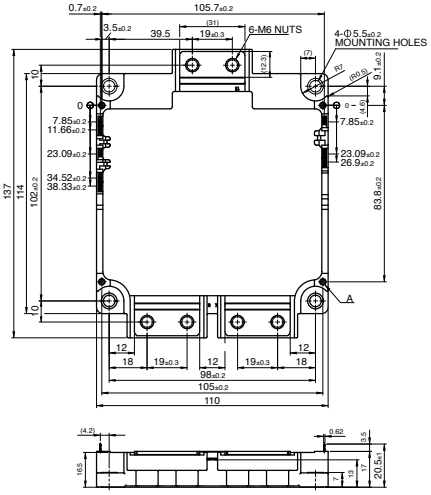
40

CM300,450,600DXP-13T
CM225,300,450,600DXP-24T

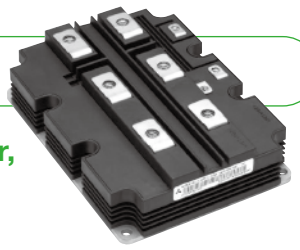


41

CM1000DXP-24T



New Products



Industry-leading power and operating temperature range for smaller, higher-capacity inverter systems

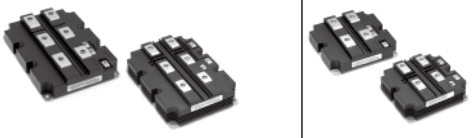
X Series HVIGBT Modules (6,500V/1,000A)

<Main Features>
- Power loss reduced by incorporating 7th-generation IGBT and RFC*1 diode
- Maximum operation temperature of 150 degrees Celsius, a world's first*2 for the 6.5kV class
- High SOA capability, high snap-off tolerance
- Thermal resistance improved approx. 10% compared to using LNFLR structure*3 (CM750HG-130R)
- Replacement is simple using package compatible with IGBT H Series and R Series modules

*1 RFC: Relaxed field of cathode
*2 As of May 2015, based on Mitsubishi Electric research
*3 LNFLR: Linearly-Narrowed Field Limiting Ring

Increased current capacity

(190mm x 140mm) (130mm X 140mm)

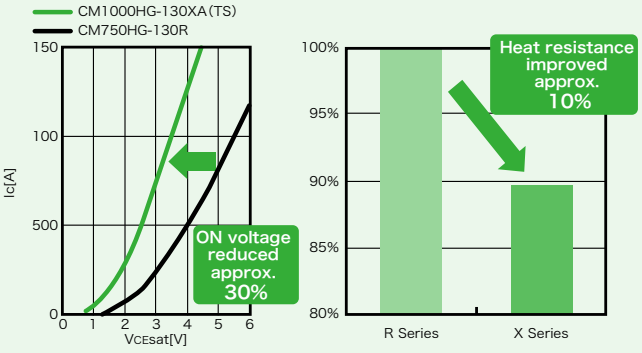


V	H Series (190mm x 140mm)	X Series (190mm x 140mm)	X Series (130mm X 140mm)
3.3kV	1200A (400A/segment)	1800A (600A/segment)	1200A (600A/segment)
4.5kV	900A (300A/segment)	1350A (450A/segment)	900A (450A/segment)
6.5kV	600A (200 A/segment)	900A (300A/segment)	600A (300A/segment)

① Current capability is increased 1.5 times for the same package size.

② Same current capability is realized in smaller package.

Characteristics graph

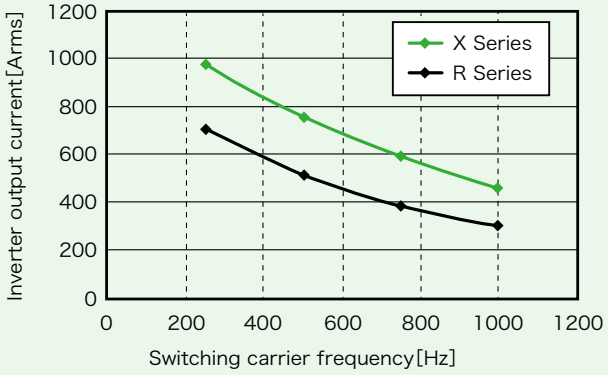


Saturation voltage between collector and emitter (R Series vs X Series)

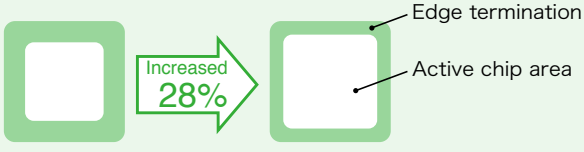
Heat resistance comparison (R Series vs. X Series)

Output current characteristics

Condition: Tj=125°C, Vcc=3600V, P.F=0.85, fo=50Hz, Tf=80°C



LNFLR structure (edge termination optimized)



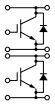
Compared to previous product*, active chip area is increased 28% by optimizing edge termination.

* CM750HG-130R

Line-up of HV Modules

Series Matrix of HVIGBT/HVIPM (No.: Number of outline drawing, see page 26 and 27)

Vces / Ic(A)	1700V	Connection	Type	No.	2500V	Connection	Type	No.	3300V	Connection	Type	No.	4500V	Connection	Type	No.	6500V	Connection	Type	No.
200																	CM200HG-130H	H	HG	07
400					CM400DY-50H	D	HA	15	CM400HG-66H	H	HG	07					CM400HG-130H	H	HG	12
									CM400DY-66H	D	HA	15					CM400E2G-130H	E2	HG	09
																	CM400E4G-130H	E4	HG	09
600	CM600DY-34H	D	HA	01									CM600HG-90H	H	HG	12	CM600HG-130H	H	HG	09
	CM600E2Y-34H	E2	HA	01																
750																	CM750HG-130R	H	HG	11
800	CM800DZB-34N	D	NB	01					CM800HC-66H	H	HC	03								
	CM800DZ-34H	D	HC	01	CM800HB-50H	H	HB	03	CM800E4C-66H	E4	HC	06	CM800HC-90R	H	R	08				
	CM800HA-34H	H	HA	-					CM800E6C-66H	E2	HC	06	CM800HG-90R	H	RG	13				
									CM800HB-66H	H	HB	03								
900													CM900HG-90H	H	HG	13				
													CM900HC-90H	H	HG	09				
													CM900HB-90H	H	HC	06				
													CM900HG-90X★★	H	HB	06				
1000									CM1000HC-66R	H	R	08					CM1000HG-130XA★	H	HG	11
									CM1000E4C-66R	E4	R	10								
1200	CM1200HCB-34N	H	NB	03																
	CM1200DB-34N	D	N	04					CM1200HG-66H	H	HG	09								
	CM1200DC-34N	D	N	04	CM1200HC-50H	H	HC	06	CM1200HC-66H	H	HC	06	CM1200HC-90R	H	R	10				
	CM1200E4C-34N	E4	N	05	CM1200HB-50H	H	HB	06	CM1200HB-66H	H	HB	06	CM1200HC-90RA	H	R	10				
	CM1200HC-34H	H	HC	02					PM1200HCE330-1	H	HC	14	CM1200HG-90R	H	RG	11				
	CM1200DC-34S★	D	S	04																
1500									CM1500HC-66R	H	R	10								
									CM1500HG-66R	H	RG	11								
1600	CM1600HC-34H	H	HC	02																
1800	CM1800HCB-34N	H	NB	06																
	CM1800HC-34N	H	N	05					CM1800HC-66X★★	H	HC	10								
	CM1800HC-34H	H	HC	06																
2400	CM2400HCB-34N	H	NB	06																
	CM2400HC-34N	H	N	05																
	CM2400HC-34H	H	HC	06																

Connection: H  E2/E6  E4  D 

[Type Description] (H Series: Standard) HA: Cu base plate, HB: Cu base plate, HC: AlSiC base plate, HG*: AlSiC base plate
(N Series: CSTBT™) N: AlSiC base plate (CM1200DB-34N: Cu base plate), NB: AlSiC base plate (Outline of H Series)
(R Series: Low-loss) R: AlSiC base plate, RG*: AlSiC base plate
(S Series: CSTBT™ (Ⅲ)) S: AlSiC base plate
*: High-Insulation package (10.2kV, AC 1min.)

Non-recommended : Please contact to the sales offices.
★★: Under Development ★: New Product

Series Matrix of HVDIODE Modules (No.: Number of outline drawing, see page 28)

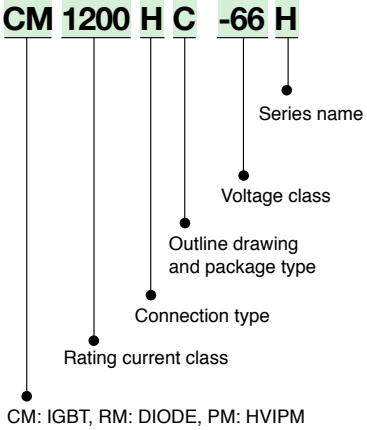
VPRM / IF(A)	1700V	Connection	Type	No.	3300V	Connection	Type	No.	4500V	Connection	Type	No.	6500V	Connection	Type	No.
200													RM200DG-130S	D	SG	18
250													RM250DG-130F	D	FG	18
300									RM300DG-90S	D	SG	18				
400					RM400DG-66S	D	SG	18	RM400DG-90F	D	FG	18				
					RM400DY-66S	D	SD	19								
600					RM600DY-66S	D	SD	19	RM600HE-90S	H	SH	17	RM600DG-130S	D	SG	18
800									RM800DG-90F	D	F6	18				
900									RM900HC-90S	H	SH	21				
									RM900DB-90S	D	SD	21				
1000					RM1000DC-66F	D	F	20								
1200					RM1200DG-66S	D	SG	18								
	RM1200DB-34S	D	SD	16	RM1200HE-66S	H	SH	17	RM1200DG-90F	D	FG	18				
					RM1200DB-66S	D	SD	21								
1500					RM1500DC-66F	D	F	20								
1800	RM1800HE-34S	H	SH	17												

Connection: H  D 

[Type Description] (F Series: Low-loss) F: AlSiC base plate, FG*: AlSiC base plate
(S Series: Standard) SH: AlSiC base plate, SD: Cu base plate, SG*: AlSiC base plate
*: High-Insulation package (10.2kV, AC 1min.)

★★: Under Development ★: New Product

Type Name Definition of IGBT Modules

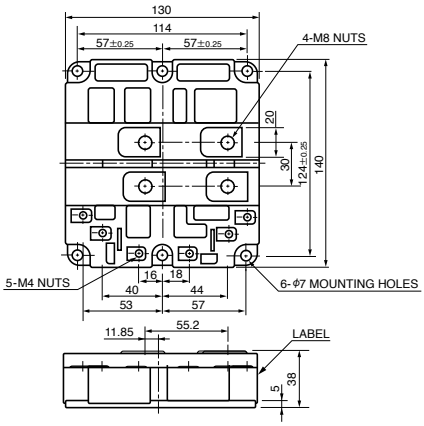


Outline Drawing of HVIGBT Modules

Unit:mm

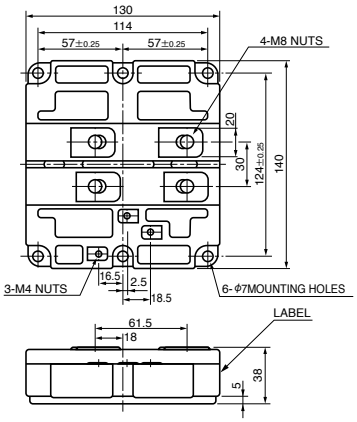
01

CM600DY-34H
CM600E2Y-34H
CM800DZ-34N
CM800DZB-34N



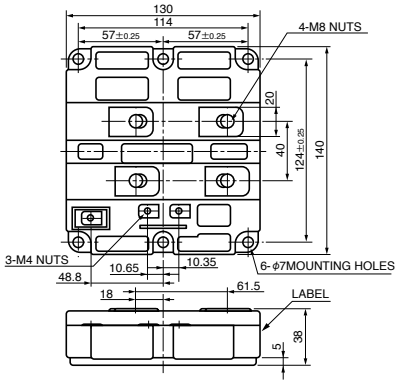
02

CM1200,1600HC-34H



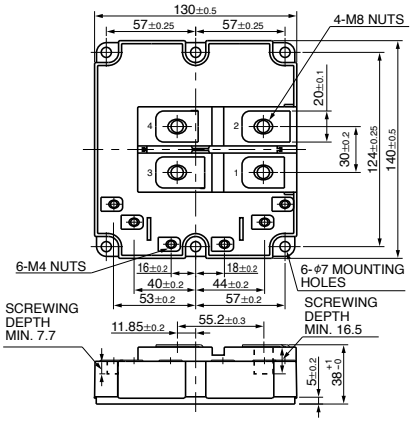
03

CM1200HCB-34N
CM800HB-50H,-66H
CM800HC-66H



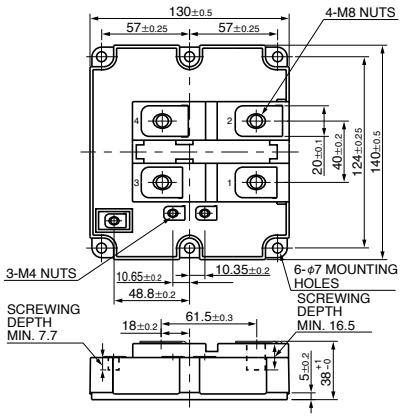
04

CM1200DB/DC-34N
CM1200DC-34S



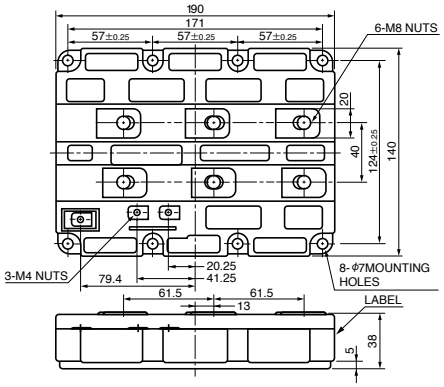
05

CM1200E4C-34N
CM1800,2400HC-34N



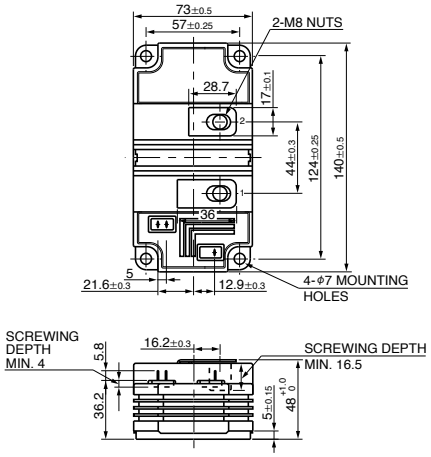
06

CM1800,2400HCB-34N
CM1800,2400HC-34H
CM1200HB/HC-50H,-66H
CM800E4C/E6C-66H
CM900HB/HC-90H



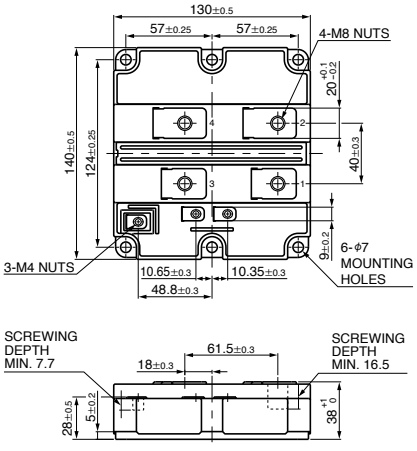
07

CM400HG-66H
CM200HG-130H



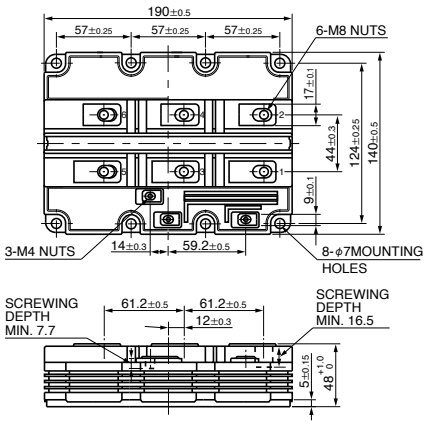
08

CM1000HC-66R
CM800HC-90R



09

CM1200HG-66H
CM900HG-90H
CM400E2G/E4G-130H
CM600HG-130H



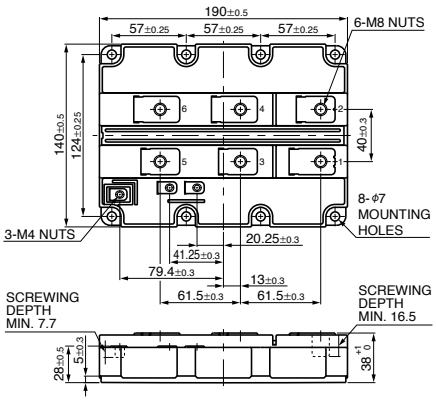
Line-up of HV Modules

Outline Drawing of HVIGBT Modules

Unit:mm

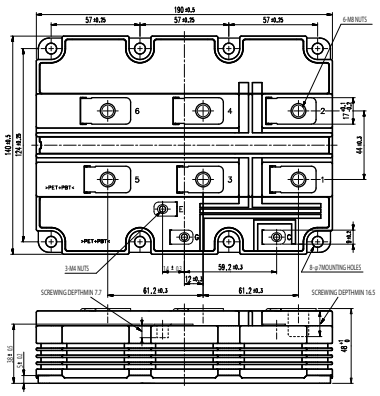
10

CM1000E4C-66R
CM1500HC-66R
CM1800HC-66X
CM1200HC-90R
CM1200HC-90RA



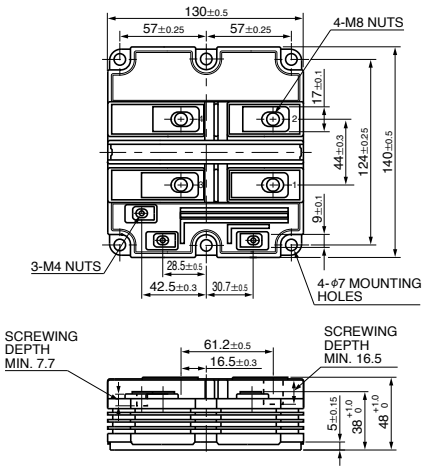
11

CM1500HG-66R
CM1200HG-90R
CM750HG-130R
CM1000HG-130XA



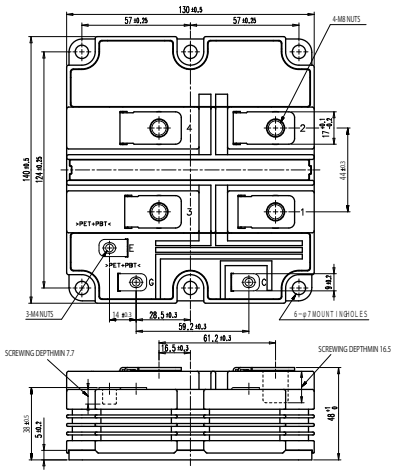
12

CM600HG-90H
CM400HG-130H



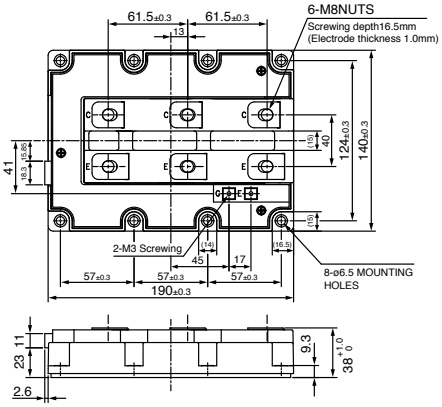
13

CM800HG-90R
CM900HG-90X



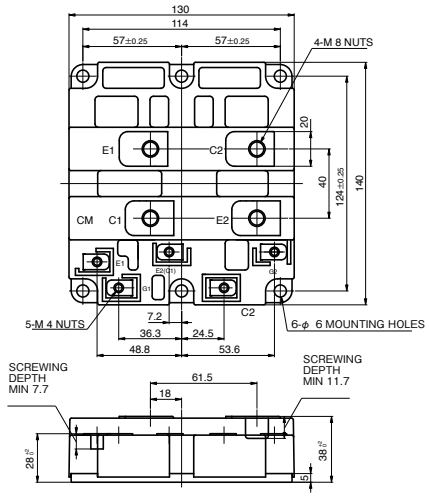
14

PM1200HCE330-1



15

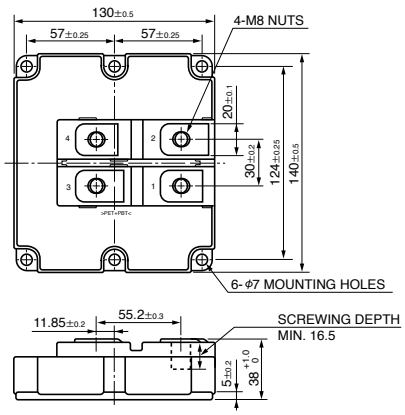
CM400DY-50H/66H



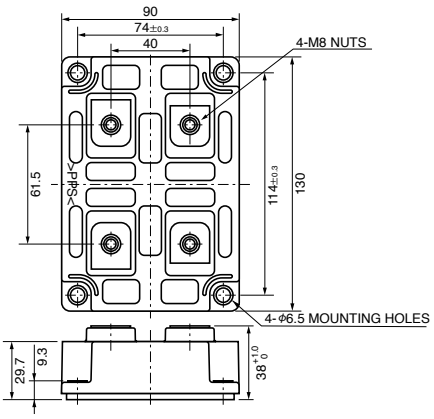
Outline Drawing of HVDIODE Modules

Unit:mm

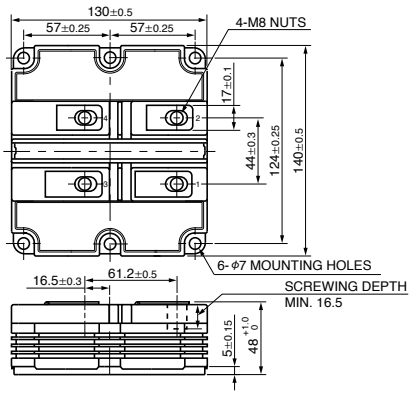
16 RM1200DB-34S



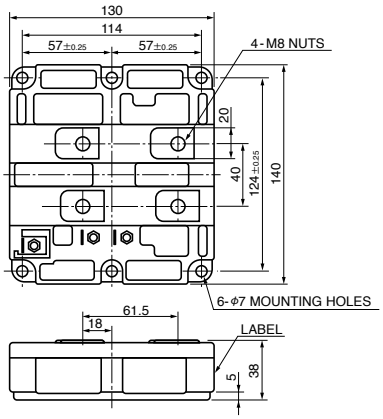
17 RM1800HE-34S RM1200HE-66S RM600HE-90S



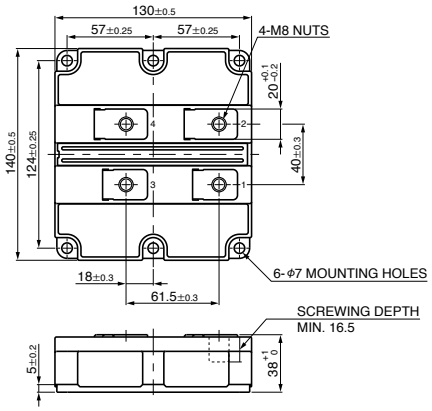
18 RM400,1200DG-66S RM300DG-90S RM400,800,1200DG-90F RM200,600DG-130S RM250DG-130F



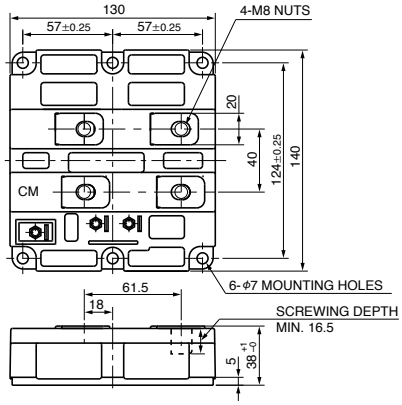
19 RM400,600DY-66S



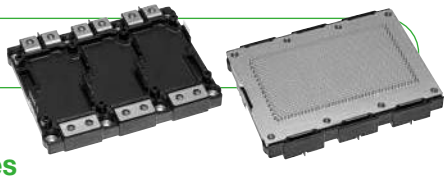
20 RM1000,1500DC-66F



21 RM1200DB-66S RM900DB/HC-90S



New Products



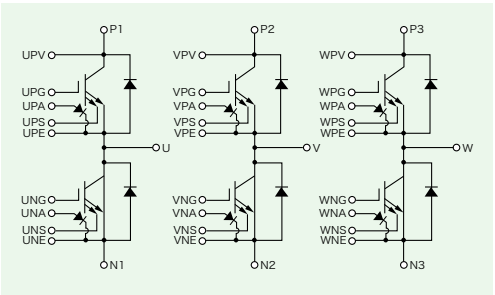
Package with 6-in-1 connection and integrated water-cooled fin contributes to more compact, high-power inverters for automobiles

High Power J1 Series Power Modules for Automobiles CT1000CJ1B060, CT600CJ1B120

<Main Features>
- Integrated direct water-cooling structure with cooling fins and 6-in-1 connection contribute to more compact inverters for automobiles
- Direct lead bonding (DLB) structure ensures high reliability
- Loss further reduced by incorporating 7th-generation IGBT built with a CSTBT™* structure
- Completely lead-free, conforms to RoHS directives (2011/65/EU)
- Suitable for a variety of electric and hybrid vehicle inverters

*CSTBT™: Mitsubishi Electric's unique IGBT that utilizes the carrier cumulative effect.

Block Diagram



Features

Common

- Long power/temperature cycle life
- High-precision on-chip temperature sensor
- High traceability in managing materials/components for each product throughout the entire production process
- Package structure compliant with the End-of-Life-Vehicles Directive, regulations relating to substances of environmental concern

J Series T-PM (Transfer-molded Power Module)

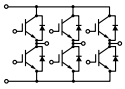
- Structure incorporates transfer modeling and original direct lead bonding (DLB) technique
- DLB structure reduces internal wiring resistance and inductance
- Completely Pb-free (including the pins)

J Series IPM

- Drive circuit and protection circuits for short-circuiting, power supply* undervoltage and overheating
- Built-in isolated switching power supply for IGBT drive and IPM control functions (PM800CJG060G、PM500CJG120G)
- Redundancy function for failsafe design and high system performance, chip temperature analog output function and DC-link voltage analog output function
- Built-in automotive-grade photocouplers and interface connector(s)

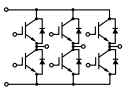
* PM800CJG060G, PM500CJG120G only

Matrix of 650V and 900V Power Modules (No. : Number of outline drawing, please refer to page 30)

VCES(V)	650V									900V		
Series	J1 Series			J Series						J1 Series		
IC(A)	PM with pin fin	Connection	No.	T-PM	Connection	No.	IPM	Connection	No.	PM with pin fin	Connection	No.
300	CT300CJ1A060★★	C	01	CT300DJG060★★	D	02	PM300CJG060G★★	C	04	-	-	-
400	-	-	-	-	-	-	-	-	-	CT400CJ1A090★★	C	01
500	-	-	-	-	-	-	-	-	-	-	-	-
600	CT600CJ1A060★★	C	01	CT600DJH060★★	D	03	PM600CJG060G★★	C	05	-	-	-
800	-	-	-	-	-	-	PM800CJG060G★★	C	06	-	-	-
1000	CT1000CJ1B060★★	C	07	-	-	-	-	-	-	-	-	-
Connection	C  D 											

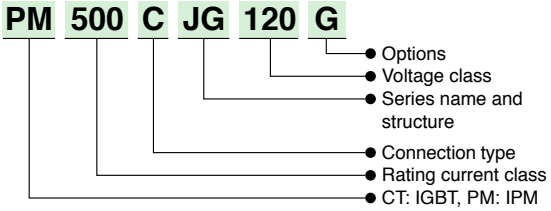
※ PM : Power module, ★★ Under Development

Matrix of 1200V Power Modules (No. : Number of Outline Drawing, please refer to page 30)

VCES(V)	1200V					
Series	J1 Series			J Series		
IC(A)	PM with pin fin	Connection	No.	IPM	Connection	No.
300	CT300CJ1A120★★	C	01	-	-	-
400	-	-	-	-	-	-
500	-	-	-	PM500CJG120G★★	C	06
600	CT600CJ1B120★★	C	07	-	-	-
800	-	-	-	-	-	-
Connection	C  D 					

※ PM : Power module, ★★ Under Development

Type Name Definition of Power Modules for Electric and Hybrid Vehicles

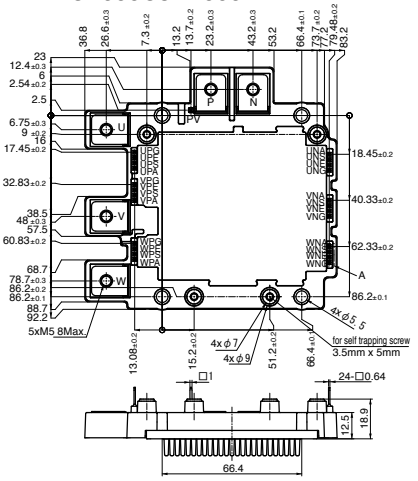


Outline Drawing of Power Modules for Electric and Hybrid Vehicles

Unit:mm

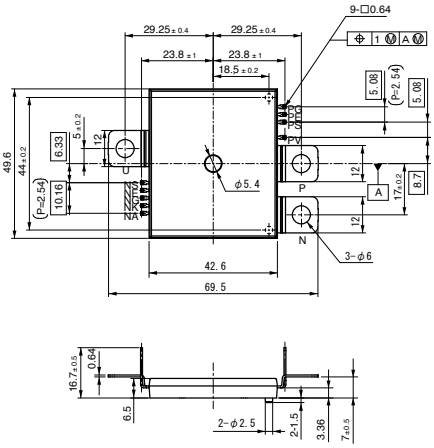
01

CT300CJ1A060
CT300CJ1A120
CT400CJ1A090
CT600CJ1A060



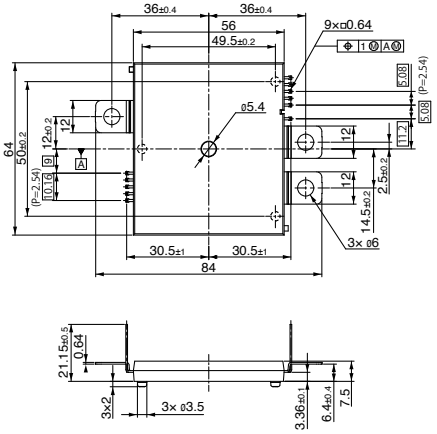
02

CT300DJG060



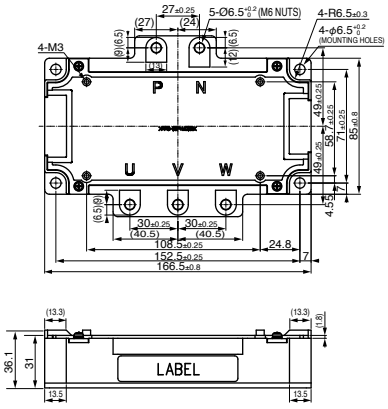
03

CT600DJH060



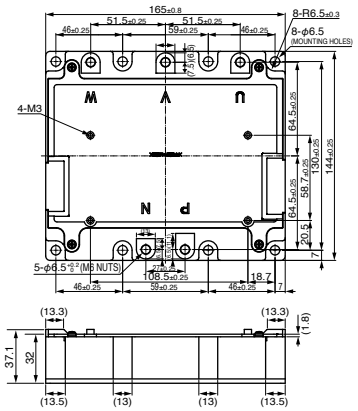
04

PM300CJG060G



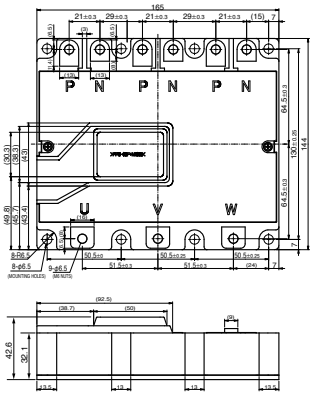
05

PM600CJG060G



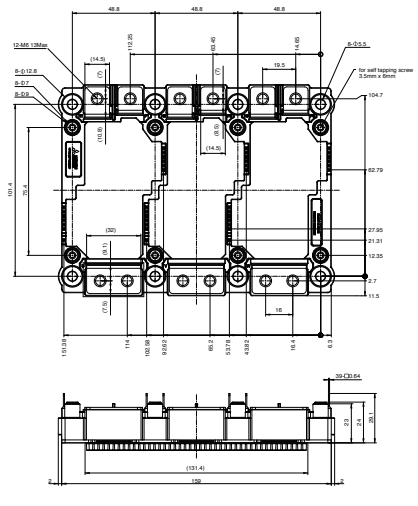
06

PM500CJG120G
PM800CJG060G



07

CT1000CJ1B060
CT600CJ1B120



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Revised publication, effective Apr. 2016.
Superseding publication of H-CT575-W May 2015.
Specifications subject to change without notice.

H-CT575-X FU-1604 Printed in Japan <IP>

MITSUBISHI ELECTRIC

Changes for the Better

for a greener tomorrow

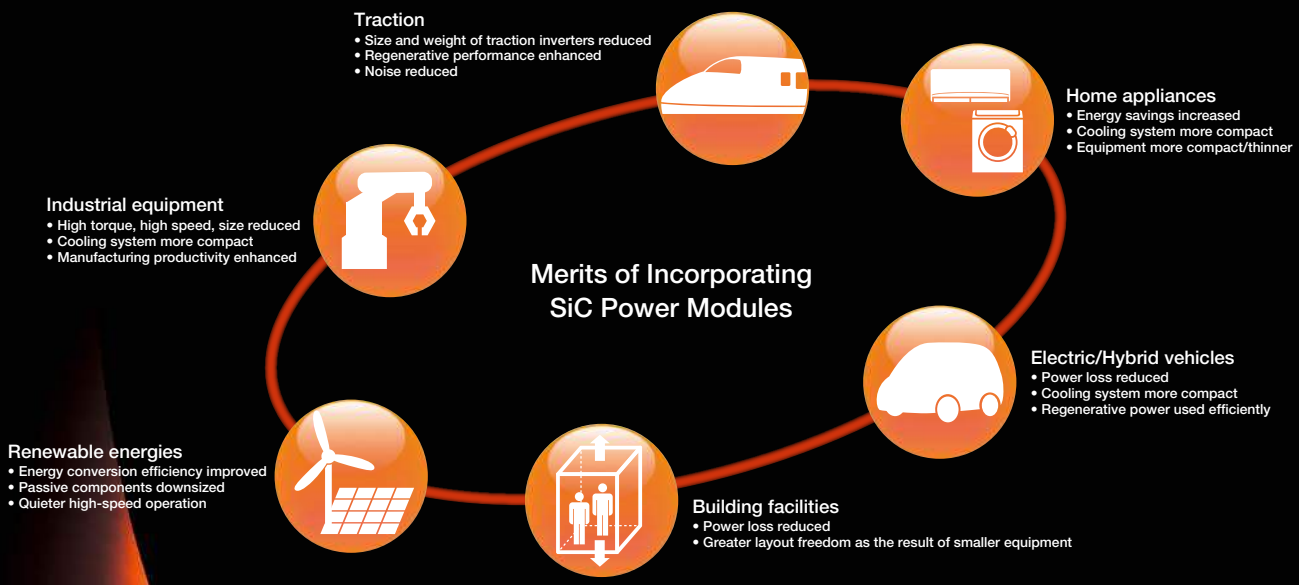
SiC POWER MODULES

SiC Power Modules

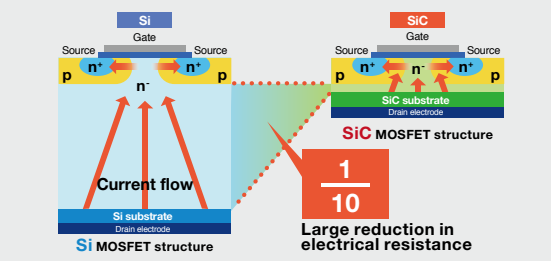
Innovative Power Devices for a Sustainable Future

Traction, industrial equipment, building facilities, electric vehicles, renewable energies, home appliances...
Power devices are a key component in power electronics products for contributing to the realization of a low-carbon society. Attracting attention as the most energy-efficient power device is one made using new material, silicon-carbide (SiC). The material characteristics of SiC have led to a dramatic reduction in power loss and significant energy savings for power electronics devices. Mitsubishi Electric began the development of elemental SiC technologies in the early 1990s and has since introduced them to achieve practical energy-saving effects for products manufactured using SiC. Innovative SiC power modules are contributing to the realization of a low-carbon society and more affluent lifestyles.

※SiC: Silicon Carbide-Compound that fuses silicon and carbon at a ratio of one-to-one.

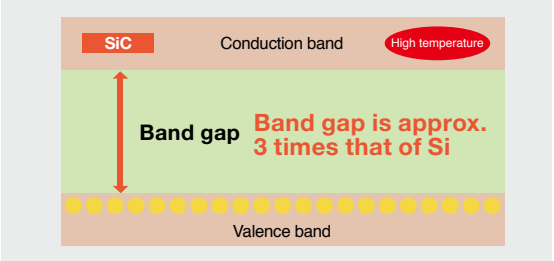


SiC with superior characteristics



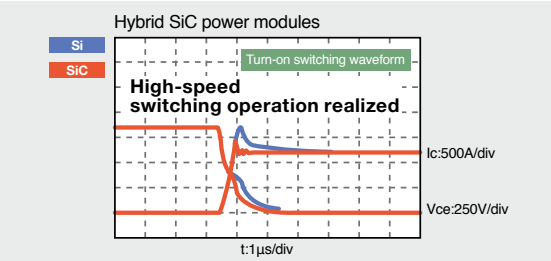
Power loss reduced

SiC has approximately 10 times the critical breakdown strength of silicon. Furthermore, the drift layer that is a main cause of electrical resistance is one-tenth of the thickness. This allows a large reduction in electrical resistance and, in turn, reduces power loss. This SiC characteristic enables dramatic reductions in conductivity loss and switching loss in power devices.



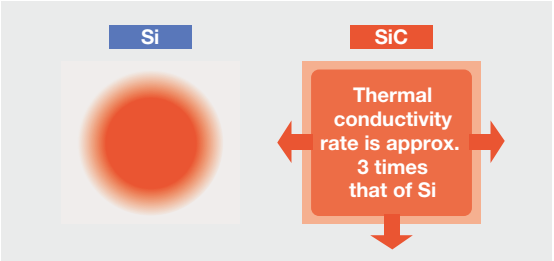
High-temperature operation

When the temperature increases, electrons are exited to the conduction band and the leakage current increases.
At times, this results in abnormal operation.
However, SiC has three times the band gap width of silicon, preventing the flow of leakage current and enabling operation at high temperatures.



High-speed switching operation

With SiC, owing to the high dielectric breakdown, power loss is reduced and high-voltage is easier to achieve, it is possible to use Schottky Barrier Diodes (SBDs), which cannot be used with Si. SBDs can realize high-speed switching motion because they don't have accumulation carriers. As a result, high-speed switching can be realized.



Heat dissipation

SiC has three times the heat conductivity of silicon, which improves heat dissipation.

SiC power modules appropriated by application

Application	Product name	Model	Rating		Connection	States	Insert pages
			Voltages[V]	Current[A]			
Industrial equipment	Hybrid SiC-IPM	PMH200CS1D060	600	200	6 in 1	Commercially available	P3
		PMH75CL1A120	1200	75	6 in 1	Sample available	
	Full SiC-IPM	PMF75CL1A120				Sample available	
	Full SiC-IPM for PV Applications	PMF75B4L1A060	600	75	4 in 1	Sample available	P4
	Full SiC Power Modules	FMF400BX-24A	1200	400	4 in 1	Commercially available	
		FMF800DX-24A	1200	800	2 in 1	Commercially available	
	Hybrid SiC Power Modules for High-frequency Switching Applications	CMH100DY-24NFH	1200	100	2 in 1	Commercially available	P5
		CMH150DY-24NFH		150			
		CMH200DU-24NFH		200			
		CMH300DU-24NFH		300			
		CMH400DU-24NFH		400			
		CMH600DU-24NFH		600			
	Large Hybrid SiC DIPIPM™ for PV Application	PSH50YA2A6	600	50	4 in 1	Commercially available	
Traction	Hybrid SiC Power Modules	CMH1200DC-34S	1700	1200	2 in 1	Commercially available	P6
Home appliances	Super-mini Full SiC DIPIPM™	PSF15S92F6	600	15	6 in 1	Commercially available	
	Super-mini Hybrid SiC DIPPFC™	PSH20L91A6-A	600	20Arms	Interleaved	Commercially available	P7
	Super-mini Full SiC DIPPFC™	PSF20L91A6-A				Commercially available	

Terminology

SiC ····· Silicon Carbide
IPM ····· Intelligent Power Module
DIPIPM ····· Dual-In-Line Package Intelligent Power Module
DIPPFC ····· Dual-In-Line Package Power Factor Correction
SBD ····· Schottky Barrier Diode
MOSFET ····· Metal Oxide Semiconductor Field Effect Transistor
IGBT ····· Insulated Gate Bipolar Transistor
Tr ····· Transistor

FWD-SW ····· Diode switching loss
FWD-DC ····· Diode DC loss
Tr-SW ····· Transistor switching loss
Tr-DC ····· Transistor DC loss
IGBT-SW ····· IGBT switching loss
IGBT-DC ····· IGBT DC loss
PV ····· Photovoltaics
CSTBT ····· Mitsubishi Electric's unique IGBT that makes use of the carrier cumulative effect

600V/200A Hybrid SiC-IPM for Industrial Equipment
PMH200CS1D060 Commercially available

SiC-SBD incorporated in an IPM with a built-in drive circuit and protection functions

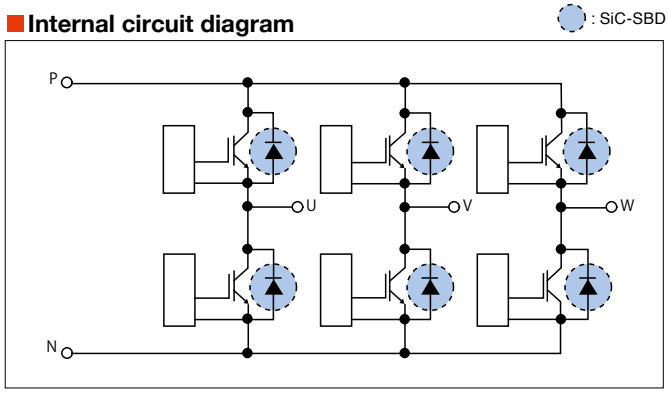
Power loss reduction of approx. 20% contributes to enhancing the performance of industrial machinery

Features

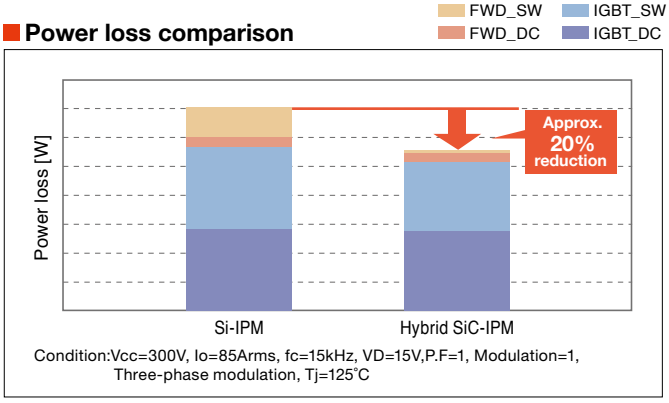
- Hybrid combination of SiC-SBD and IGBT with current and temperature sensors implemented for IPM supplies high functionality and low loss enabling high torque and motor speed
- Recovery loss (Err) reduced by 95% compared to the conventional product*
- Package compatible with the conventional product* making replacement possible

* Conventional product: Mitsubishi Electric S1 Series PM200SC1D060

Internal circuit diagram



Power loss comparison



Condition:Vcc=300V, Io=85Arms, fc=15kHz, VD=15V,P.F=1, Modulation=1, Three-phase modulation, Tj=125°C

1200V/75A Hybrid/Full SiC-IPM for Industrial Equipment
PMH75CL1A120/PMF75CL1A120 Sample available

Built-in drive circuit and protection functions realize high functionality

Features

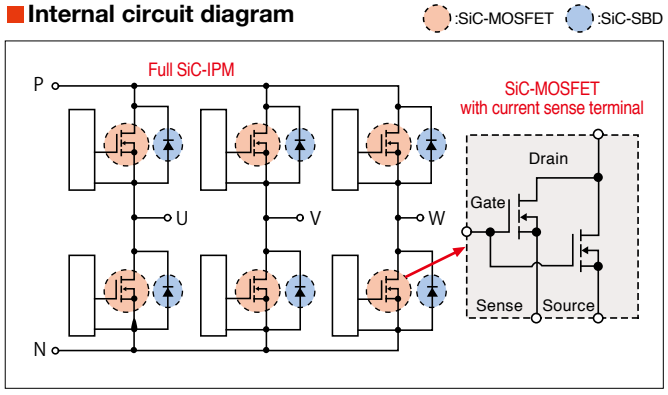
- Incorporates SiC-MOSFET with current sensor and built-in drive circuit and protection functions to deliver high functionality
- Significant reduction in power loss compared to the conventional product*
- Package compatible with the conventional product*

* Conventional product: Mitsubishi Electric IPM L1 Series PM75CL1A120

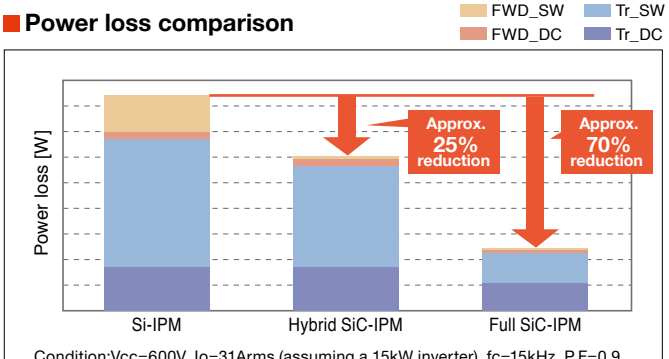
Main specifications

Rating	1200V/75A 6in1
Mounted Functions	• Built-in drive circuit • Under-voltage protection • Short-circuit protection • Over-temperature protection (Monitoring IGBT chip surface)

Internal circuit diagram



Power loss comparison



Condition:Vcc=600V, Io=31Arms (assuming a 15kW inverter), fc=15kHz, P.F=0.9, Modulation=1, Three-phase modulation, Tj=125°C

600V/75A Full SiC-IPM for PV Applications
PMF75B4L1A060 Sample available

Improved power conversion efficiency and high-frequency drive enable reactor size to be reduced

Features

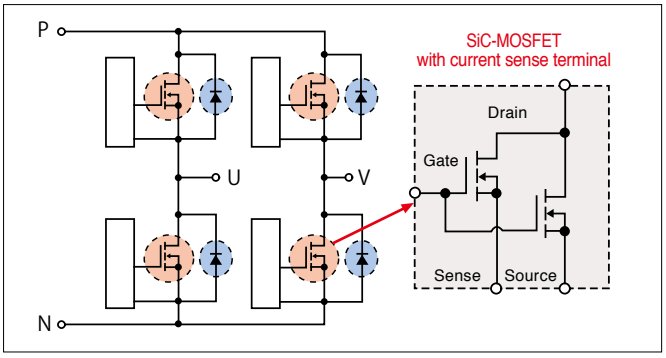
- Incorporates SiC-MOSFET with current sensor, built-in drive circuit and protection functions to deliver higher functionality
- Power loss reduced approx. 50% compared to conventional product*
- Improved power conversion efficiency and high-frequency drive enable reactor size to be reduced
- Package compatible with conventional product*

* Conventional product: Mitsubishi Electric IPM PM75B4LA060

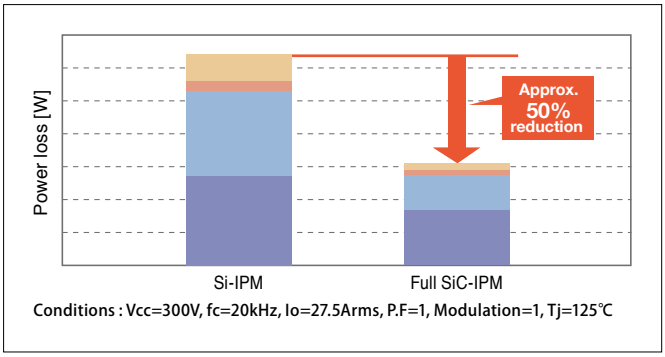
Main specifications

Rating	600V/75A 4-in-1
Functions incorporated	• Built-in drive circuit • Under-voltage protection • Short-circuit protection

Internal circuit diagram



Power loss comparison



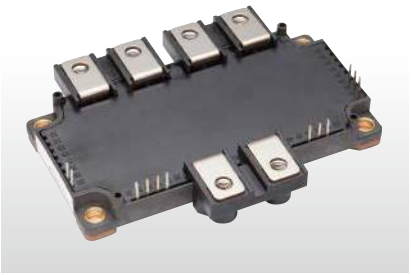
1200V/400A・1200V/800A Full SiC Power Modules for Industrial Equipment
FMF400BX-24A/FMF800DX-24A Commercially available

Contributes to reducing size/weight of industrial-use inverters with the mounting area reduced by approx. 60%

Features

- Power loss reduced approx. 70% compared to the conventional product*
- Low-inductance package adopted to deliver full SiC performance
- Contributes to realizing smaller/lighter inverter equipment by significantly reducing the package size and realizing a mounting area approx. 60% smaller compared to the conventional product*

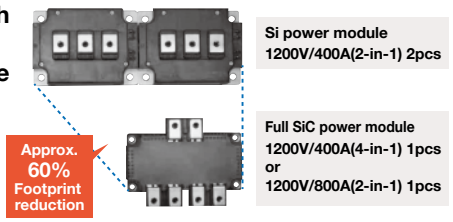
＊Conventional product:Mitsubishi Electric CM400DY-24NF(1200V/400A 2in1) 2pcs



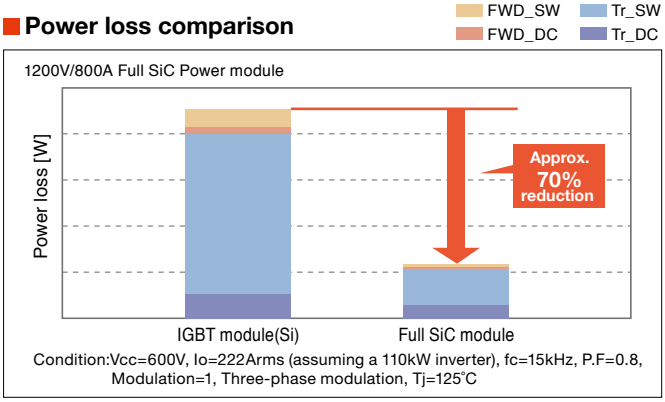
Product lineup

Applications	Rated voltage	Reted current	Circuit configration	Package size (D ×W)
Industrial equipment	1200V	400A	4-in-1	92.3 × 121.7mm
		800A	2-in-1	

Comparison with conventional product package



Power loss comparison



Hybrid SiC Power Modules for High-frequency Switching Applications Commercially available

For optimal operation of power electronics devices that conduct high-frequency switching

Features

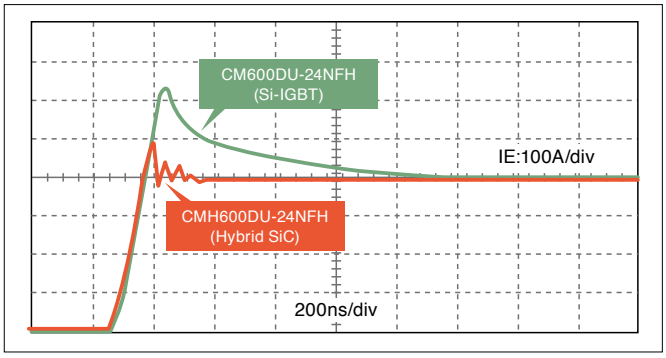
- Power loss reduction of approx. 40% contributes to higher efficiency, smaller size and weight reduction of total system
- Suppresses surge voltage by reducing internal inductance
- Package compatible with the conventional product*

* Conventional product: Mitsubishi Electric NFH Series IGBT Modules

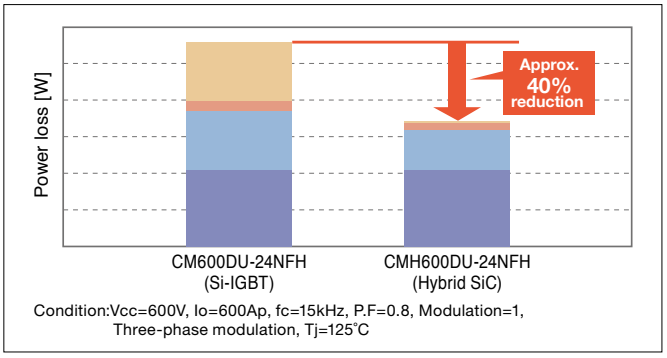
Product lineup

Applications	Model	Rated voltage	Rated current	Circuit configuration	External size (D x W)
Industrial equipment	CMH100DY-24NFH	1200V	100A	2-in-1	48 × 94mm
	CMH150DY-24NFH		150A		48 × 94mm
	CMH200DU-24NFH		200A		62 × 108mm
	CMH300DU-24NFH		300A		62 × 108mm
	CMH400DU-24NFH		400A		80 × 110mm
	CMH600DU-24NFH		600A		80 × 110mm

Recovery waveform (FWD)



Power loss comparison



Condition:Vcc=600V, Io=600Ap, fc=15kHz, P.F=0.8, Modulation=1, Three-phase modulation, Tj=125℃

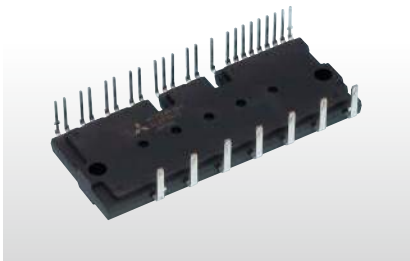
600V/50A Large Hybrid SiC DIPIPM™ for PV Applications PSH50YA2A6 Commercially available

More efficient power modules for PV power conditioner applications

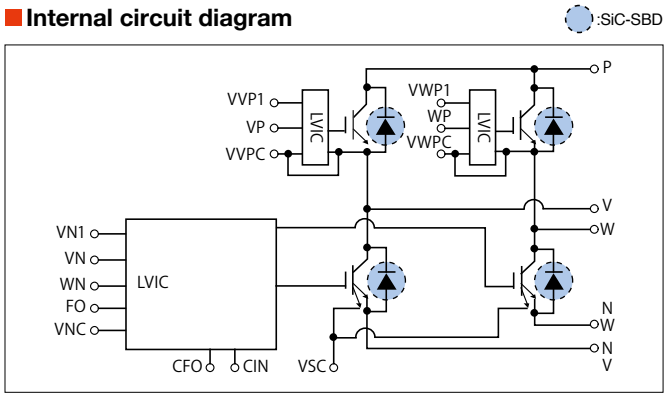
Features

- Hybrid structure achieved with SiC Schottky barrier diode and 7th-generation IGBT chips
- Power loss reduction of approx. 25% compared to the conventional product*
- Helps downsize PV inverter system thanks to modified short-circuit protection scheme

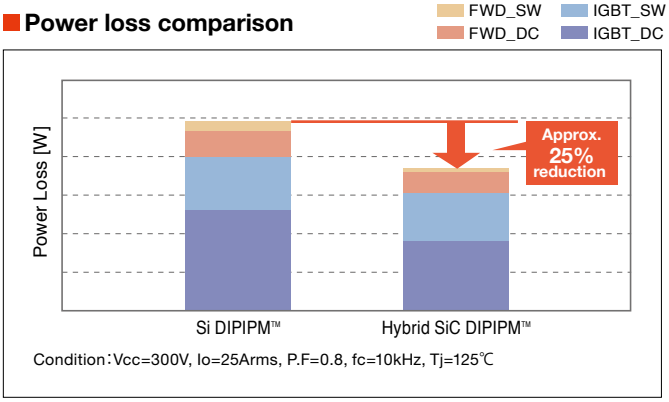
*Conventional product:Mitsubishi Electric Large DIPIPM™ PS61A99



Internal circuit diagram



Power loss comparison



Condition：Vcc=300V, Io=25Arms, P.F=0.8, fc=10kHz, Tj=125℃

1700V/1200A Hybrid SiC Power Modules for Traction Inverters
CMH1200DC-34S Commercially available

High-power/low-loss/highly reliable modules appropriate for use in traction inverters

Features

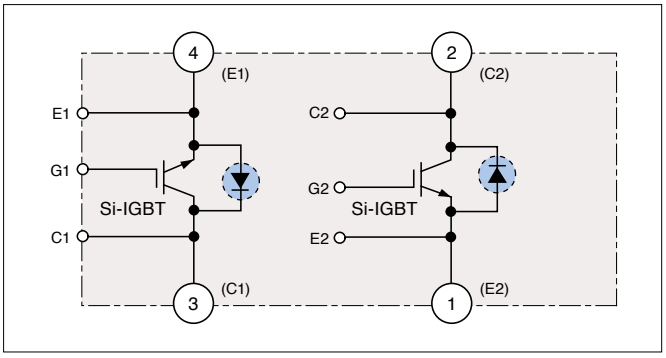
- Power loss reduced approximately 30% compared to the conventional product*
- Highly reliable design appropriate for use in traction
- Package compatible with the conventional product*

* Conventional product: Mitsubishi Electric Power Module CM1200DC-34N

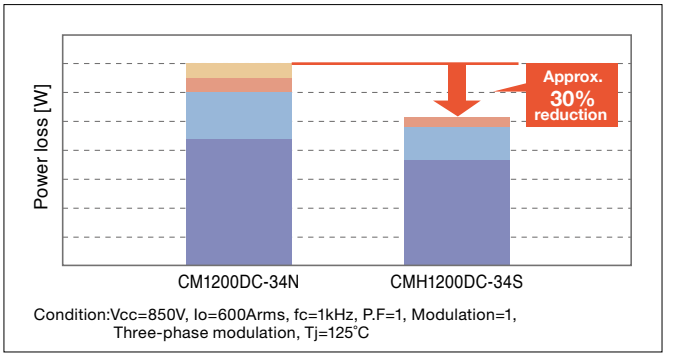
Main specifications

Module	Max.operating temperature		150˚C
	Isolation voltage		4000Vrms
Si-IGBT @150˚C	Collector-emitter saturation voltage		2.3V
	Switching loss 850V/1200V	turn-on	140mJ
		turn-off	390mJ
SiC-SBD @150˚C	Emitter-collector voltage		2.3V
	Capacitive charge		9.0μC

Internal circuit diagram



Power loss comparison



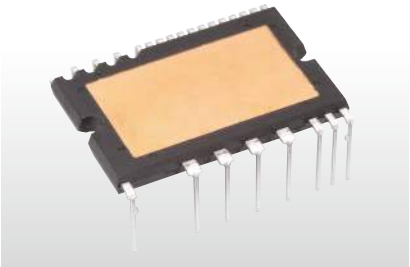
600V/15A Super-mini Full SiC DIPIPM™ for Home Appliances
PSF15S92F6 NEW

Contributes to extremely high power-efficiency in air conditioners, and easily applicable to industrial equipment

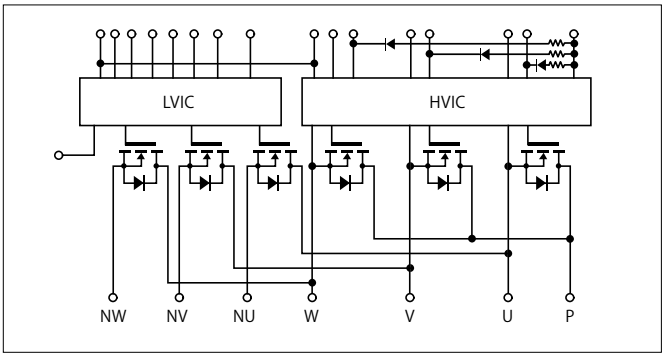
Features

- SiC-MOSFET achieves reduction in ON resistance, power loss reduced approx. 70% compared to conventional product*
- Construct low-noise system by reducing recovery current
- Numerous built-in functions: Bootstrap diode for power supply to drive P-side, temperature information output, etc.
- Unnecessary minus-bias gate drive circuit using original high Vth SiC-MOSFET technology
- As package and pin layout compatibility with conventional products* is ensured, simply replace with this product to improve performance

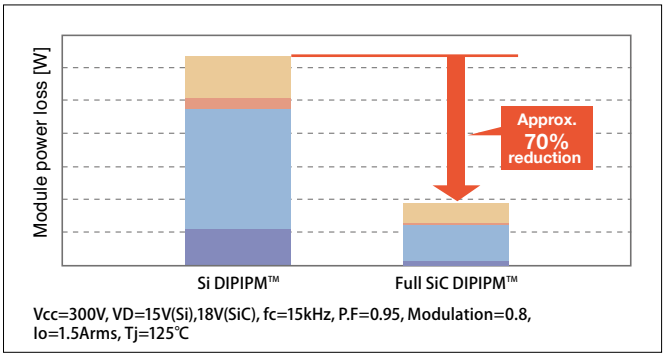
*Conventional product: Mitsubishi Electric Super-mini DIPIPM™ Series



Internal block diagram

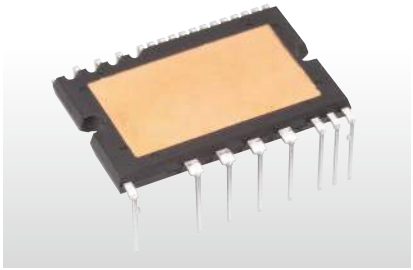


Power loss comparison



Super-mini Hybrid / Full SiC DIPPFC™ for Home Appliances
PSH20L91A6-A / PSF20L91A6-A Commercially available

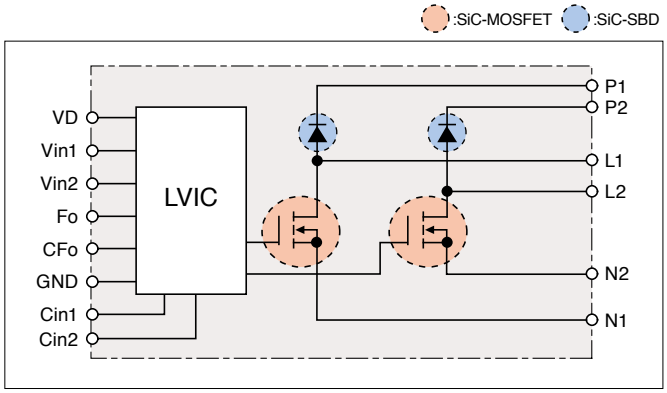
Utilizing SiC enables high-frequency switching and contributes to reducing the size of peripheral components



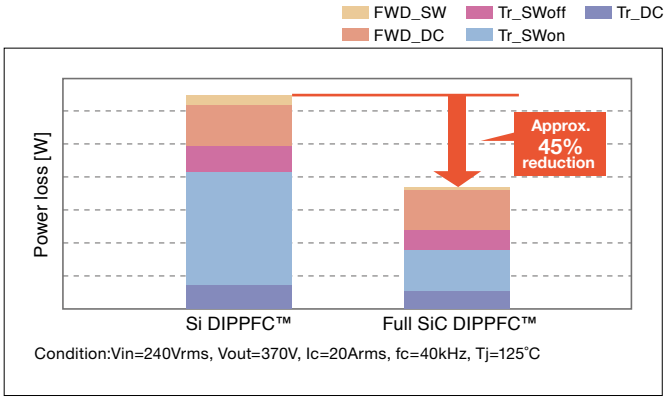
Features

- Incorporating SiC chip in the Super-mini package widely used in home appliances
- The SiC chip allows high-frequency switching (up to 40kHz) and contributes to downsizing the reactor, heat sink and other peripheral components
- Adopts the same package as the Super mini DIPIPM™ to eliminate the need for a spacer between the inverter and heat sink, and to facilitate its implementation

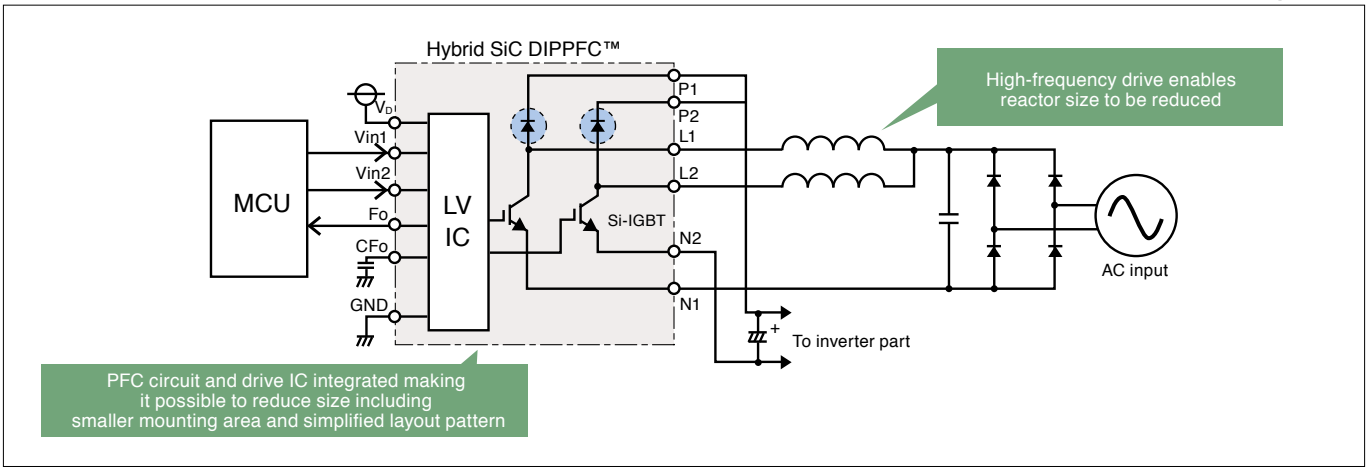
Internal block diagram (Full SiC DIPPFC™)



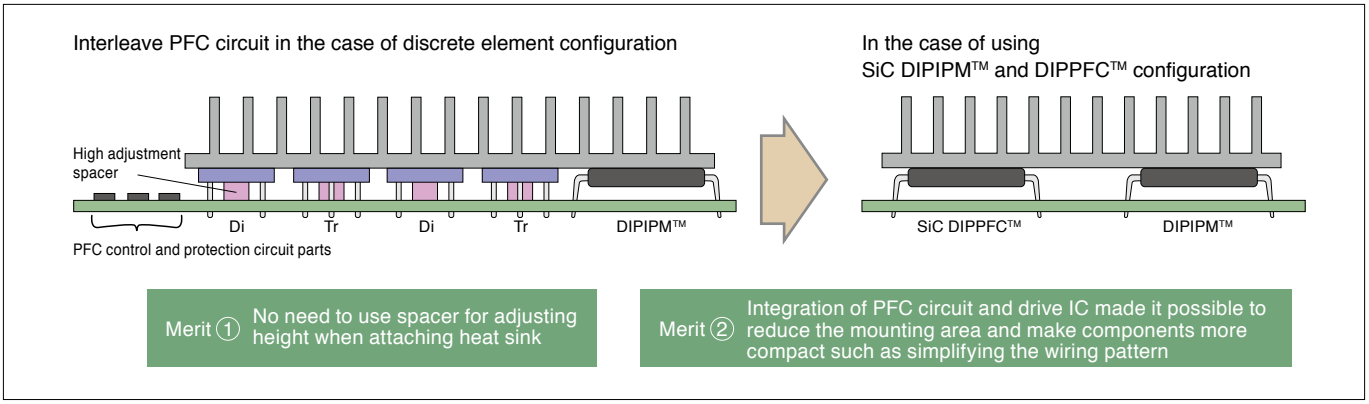
Power loss comparison



Interleaved PFC circuit configuration (for Hybrid SiC DIPPFC™)



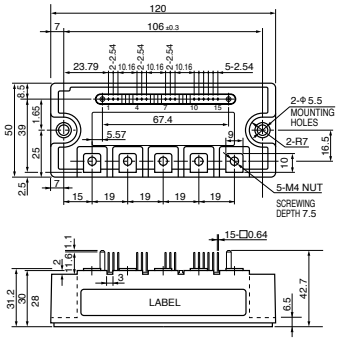
Merits of combined use of SiC DIPIPM™ and DIPPFC™



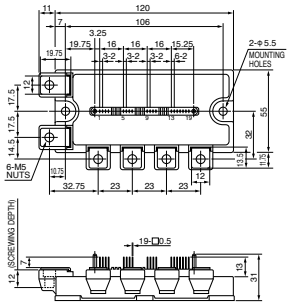
SiC Power Module Lineup

Unit : mm

600V/200A Hybrid SiC-IPM
for Industrial Use
PMH200CS1D060

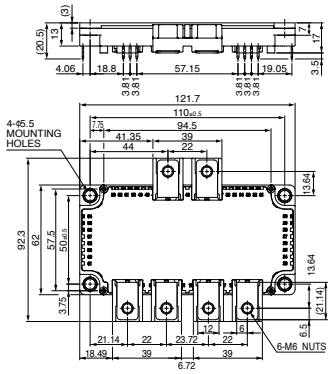


1200V/75A Hybrid/Full SiC-IPM
for Industrial Equipment
PMH75CL1A120/PMF75CL1A120
600V/75A Full SiC-IPM for PV Applications
PMF75B4L1A060

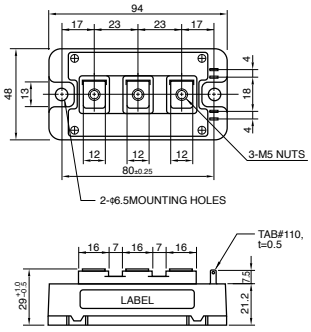


∗Tentative No.

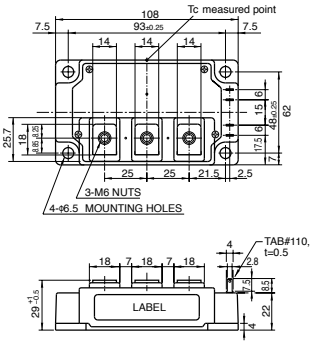
1200V/400A, 1200V/800A
Full SiC Power Modules for Industrial Use
FMF400BX-24A
FMF800DX-24A



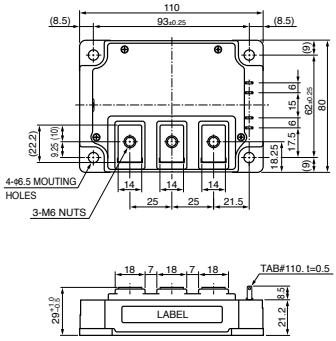
Hybrid SiC Power Modules for
High-frequency Switching Applications
CMH100DY-24NFH
CMH150DY-24NFH



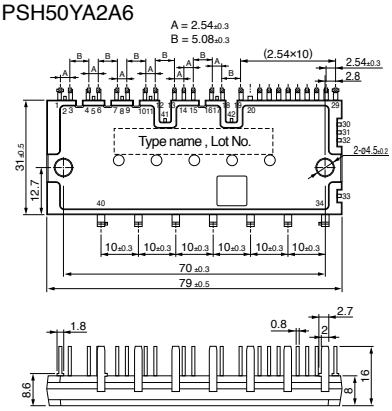
Hybrid SiC Power Modules for
High-frequency Switching Applications
CMH 200DU-24NFH
CMH 300DU-24NFH



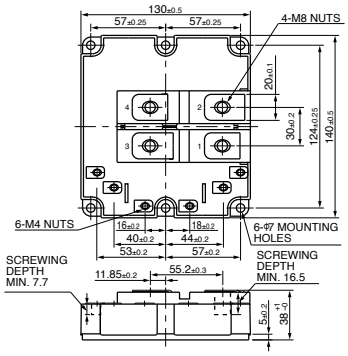
Hybrid SiC Power Modules for
High-frequency Switching Applications
CMH 400DU-24NFH
CMH 600DU-24NFH



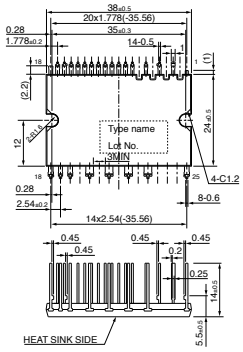
600V/50A Large Hybrid SiC DIPIPM™
for PV Applications
PSH50YA2A6



1700V/1200A Hybrid SiC Power Modules
for Traction Inverters
CMH1200DC-34S



600V/15A Super-mini Full SiC DIPIPM™
PSF15S92F6-A
Super-mini Hybrid / Full SiC DIPPFC™
PSH20L91A6-A / PSF20L91A6-A
Long



Development of Mitsubishi Electric SiC Power Devices and Power Electronics Equipment Incorporating Them

Mitsubishi Electric began developing SiC as a new material in the early 1990s. Pursuing special characteristics, we succeeded in developing various elemental technologies.
In 2010, we commercialized the first air conditioner in the world equipped with a SiC power device.
Furthermore, substantial energy-saving effects have been achieved for traction and FA machinery.
We will continue to provide competitive SiC power modules with advanced development and achievements from now on.

Early 1990s

Developed new material, silicon-carbide (SiC) power semiconductor, maintaining a lead over other companies

2000s

Developed various elemental technologies

2006

January 2006
Successfully developed SiC inverter for driving motor rated at 3.7kW

2009

February 2009
Verified 11kW SiC inverter, world's highest value*1 with approx. 70% reduction in power loss

November 2009
Verified 20kW SiC inverter, world's highest value*1 with approx. 90% reduction in power loss

2010

January 2010
Developed large-capacity power module equipped with SiC diode

October 2010
Launched "Kirigamine" inverter air conditioner

2011

January 2011
Verified highest power conversion efficiency*1 for solar power generation system power conditioner (domestic industry)

October 2011
Commercialized SiC inverter for use in railcars

2012

March 2012
Developed motor system with built-in SiC inverter*2

September 2012
Verified built-in main circuit system for railcars

Development of these modules and applications has been partially supported by Japan's Ministry of Economy, Trade and Industry (METI) and New Energy and Industrial Technology Development Organization (NEDO).

Contributing to the realization of a low-carbon society and more affluent lifestyles

2013

February 2013
Developed SiC for application in elevator control systems*2

February 2013
Developed technologies to increase capacities of SiC power modules*2

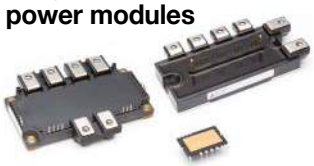
March 2013
Delivered auxiliary power supply systems for railcars

May 2013
Launched SiC power modules

December 2013
Launched railcar traction inverter with full SiC power module

2012

July 2012
Began shipping samples of hybrid SiC power modules



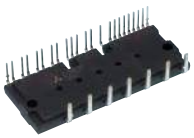
December 2012
Launched CNC drive unit equipped with SiC power module

2014

February 2014
Developed EV motor drive system with built-in SiC inverter*2

May 2014
Began shipping samples of hybrid SiC power modules for high-frequency switching applications

November 2014
Launched Large Hybrid SiC DIPIPM™ for PV Applications



2015

January 2015
Launched power conditioner for PV equipped with full SiC-IPM

June 2015
Railcar traction system with full SiC power modules installed in Shinkansen bullet trains

2016

April 2016
Launched Super-mini Full SiC DIPIPM™

May 2016(Tentative)
Launched package air conditioners with full SiC DIPIPM™ in Japan

＊1 Researched in press releases by Mitsubishi Electric. ＊2 Currently under development, as of April 2016.
* The year and month listed are based on press releases or information released during the product launch month in Japan.

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eco Changes **for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
www.MitsubishiElectric.com

Revised publication, effective Apr. 2016.
Superseding publication of HG-802C May 2015.
Specifications subject to change without notice.

HG-802C FU-1604 Printed in Japan <IP>

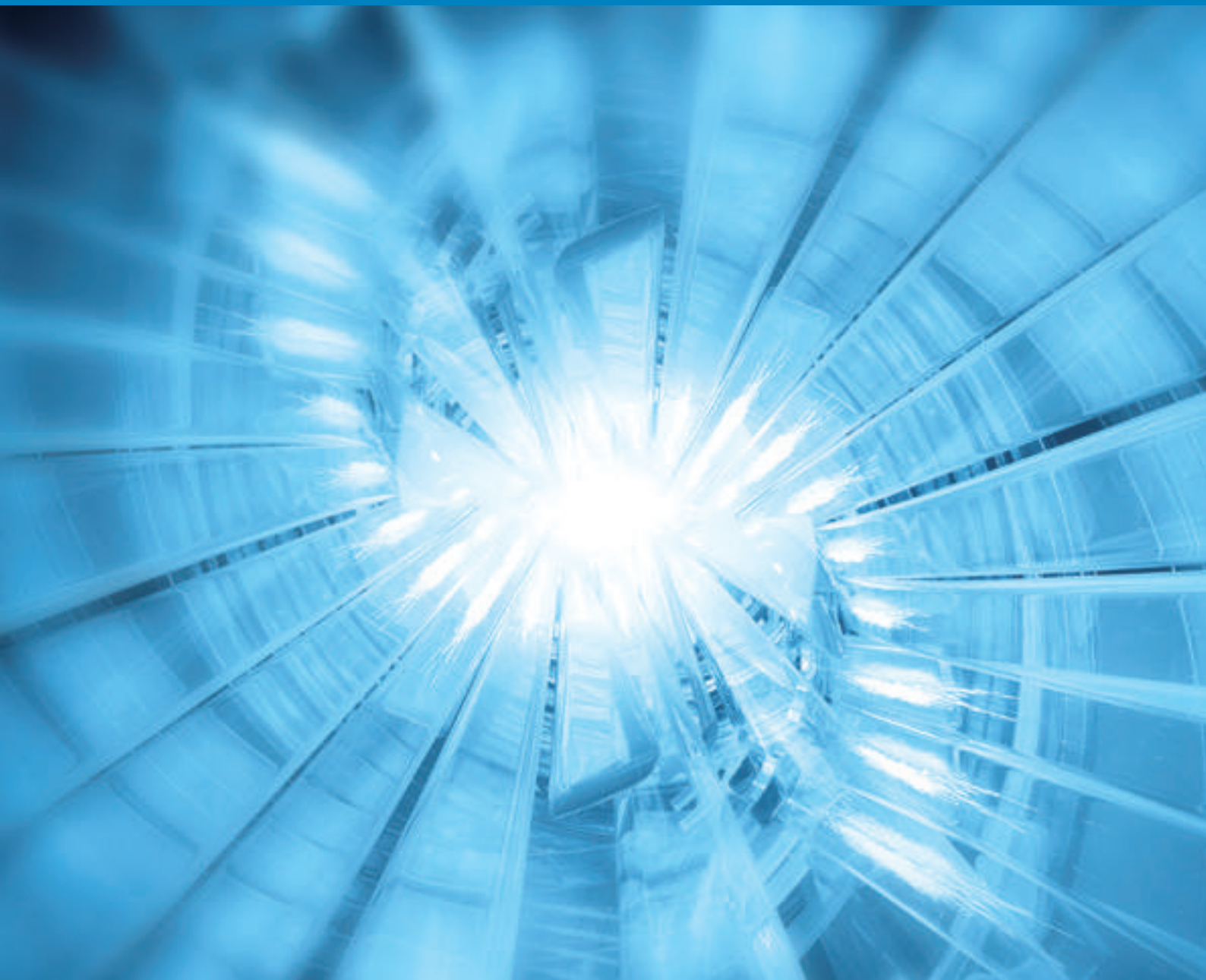
MITSUBISHI ELECTRIC

Changes for the Better

SILICON RF DEVICES

for a greener tomorrow eco Changes

Silicon RF Devices



Better Performance for Radio Communication Network

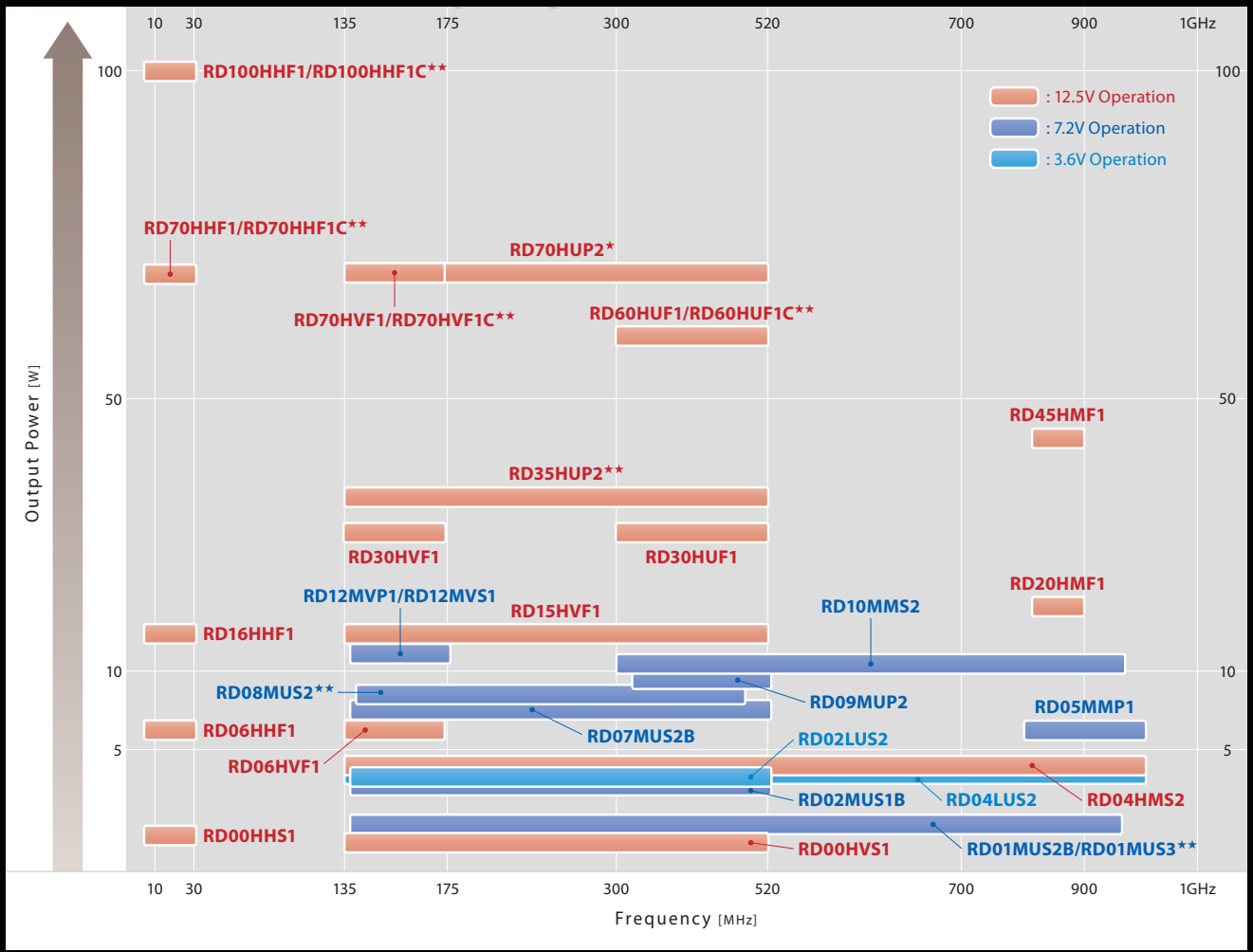
Mitsubishi Electric Silicon RF Devices are Key parts of RF Power Amplifications for various kind of Mobile Radio,
Professional Mobile Radios, Amateur Radios and TELEMATICS for automotive.
Mitsubishi Electric Silicon RF Devices strongly support for Radio communication network.

LINE UP

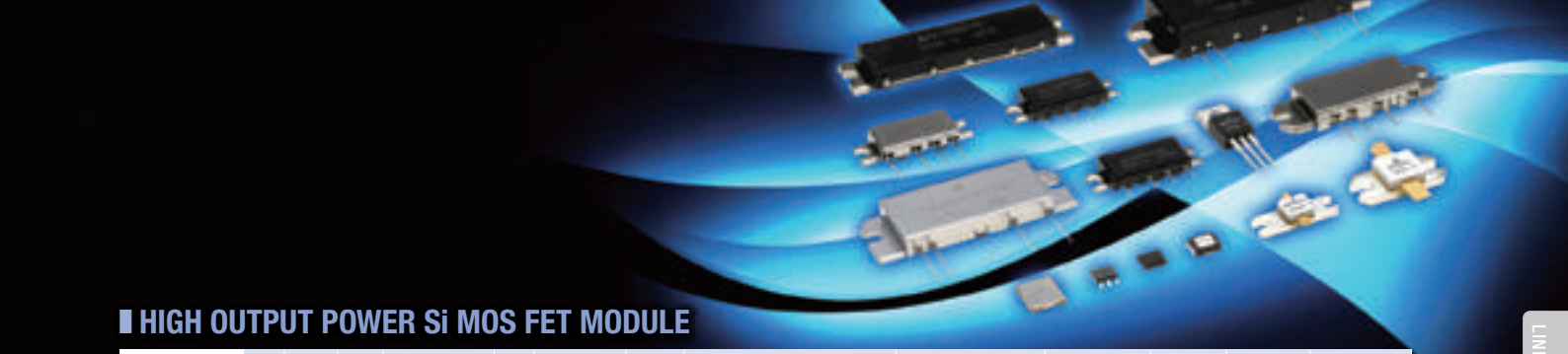
Silicon RF Devices			MAP For SELECTION	PRODUCT LIST
	FET	3.6V Operation High Output Power Si MOS FET (Discrete)	Page 1	Page 3
		7.2v Operation High Output Power Si MOS FET (Discrete)	Page 1	Page 3~4
		12.5v Operation High Output Power Si MOS FET (Discrete)	Page 1	Page 3
	Hybrid IC	7.2v Operation High Output Power Si MOS FET Module	Page 2	Page 5
		9.6v Operation High Output Power Si MOS FET Module	Page 2	Page 5
		12.5v Operation High Output Power Si MOS FET Module	Page 2	Page 5~6

SELECTION MAP

HIGH OUTPUT POWER Si MOS FET (DISCRETE)

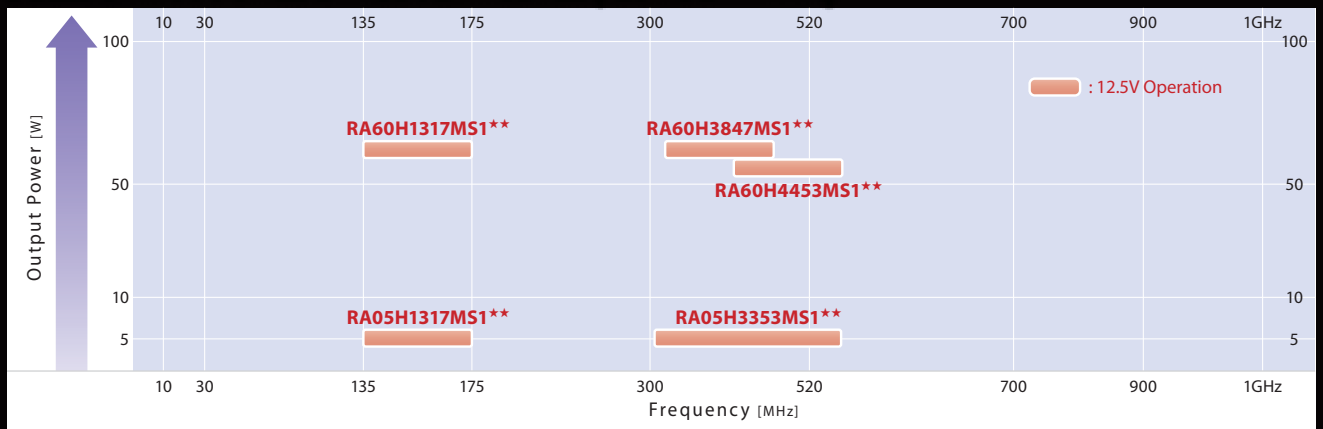


★: New Product ★★: Under Development



HIGH OUTPUT POWER Si MOS FET MODULE

HIGH OUTPUT POWER Si MOS FET MODULE (SERFACE MOUNT TYPE)



★★: Under Development

PRODUCT LIST

3.6V OPERATION HIGH OUTPUT POWER Si MOS FET (DISCRETE)

Type Number	Structure	Max.ratings		Vdd [V]	Frequency Band	Pin [W]	Po (Typ.) [W]	ηd (Typ.) [%]	Package Type
		VDSS [V]	Pch [W]						
RD02LUS2	Si, MOS†	25	15.6	3.6	UHF	0.2	2.3	70	SOT-89
RD04LUS2	Si, MOS†	25	46.3	3.6	UHF	0.4	4.5	65	SLP

Ta=25°C †: Gate Protection Diode

7.2V OPERATION HIGH OUTPUT POWER Si MOS FET (DISCRETE)

Type Number	Structure	Max.ratings		Vdd [V]	Frequency Band	Pin [W]	Po (Typ.) [W]	ηd (Typ.) [%]	Package Type
		VDSS [V]	Pch [W]						
RD01MUS2B	Si, MOS†	25	3.6	7.2	VHF	0.03	1.4	75	SOT-89
					UHF	0.03	1.6	70	
					900	0.03	1.5	65	
RD02MUS1B	Si, MOS	30	21.9	7.2	VHF	0.05	3	65	SLP
					UHF	0.05	3	65	
RA02MUS2**	Si, MOS	40	50	7.2	VHF	0.05	3	65	SLP
					UHF	0.05	3	65	
RD05MMP1	Si, MOS	40	73	7.2	900	0.7	6	46	PMM
RD07MUS2B	Si, MOS†	25	50	7.2	VHF	0.3	7.2	65	SLP
					UHF	0.4	8	63	
					900	0.5	7	58	
RD08MUS2**	Si, MOS†	25	46	7.2	UHF	0.2	8.5	65	SLP
RD09MUP2	Si, MOS†	40	83	7.2	UHF	0.8	9	60	PMM
RD10MMS2	Si, MOS†	40	62	7.2	900	1	12	58	SLP
RD12MVP1	Si, MOS	50	125	7.2	VHF	0.5	12	57	PMM
RD12MVS1	Si, MOS	50	50	7.2	VHF	1	12	57	SLP

Ta=25°C †: Gate Protection Diode ★★: Under Development

12.5V OPERATION HIGH OUTPUT POWER Si MOS FET (DISCRETE)

Type Number	Structure	Max.ratings		Vdd [V]	Frequency Band	Pin [W]	Po (Typ.) [W]	ηd (Typ.) [%]	Package Type
		VDSS [V]	Pch [W]						
RD00HHS1***	Si, MOS	30	3.1	12.5	HF	0.004	0.7	65	SOT-89
RD00HVS1***	Si, MOS	30	3.1	12.5	VHF	0.005	0.8	60	SOT-89
RD04HMS2	Si, MOS†	40	50	12.5	VHF	0.2	5.5	73	SLP
					UHF	0.2	6	62	
					900	0.2	5	58	
RD06HHF1	Si, MOS	50	27.8	12.5	HF	0.15	10	65	TO-220S
RD06HVF1	Si, MOS	50	27.8	12.5	VHF	0.3	10	65	TO-220S
RD15HVF1	Si, MOS	30	48	12.5	VHF	0.6	18	60	TO-220S
					UHF	3	18	55	
RD16HHF1	Si, MOS	50	56.8	12.5	HF	0.4	19	65	TO-220S
RD20HMF1***	Si, MOS	30	71.4	12.5	900	3	25	55	Ceramic (Small)
RD30HVF1***	Si, MOS	30	75	12.5	VHF	1	35	60	Ceramic (Small)
RD30HUF1***	Si, MOS	30	75	12.5	UHF	3	35	55	Ceramic (Small)
RD35HUP2**	Si, MOS†	40	166	12.5	UHF	3	35	55	HPM005
RD45HMF1***	Si, MOS	30	125	12.5	900	15	50	50	Ceramic (Large)
RD60HUF1***	Si, MOS	30	150	12.5	UHF	10	65	55	Ceramic (Large)
RD60HUF1C**	Si, MOS	30	150	12.5	UHF	10	65	55	Ceramic (Large)
RD70HHF1***	Si, MOS	50	150	12.5	HF	3.5	80	60	Ceramic (Large)
RD70HHF1C**	Si, MOS	50	150	12.5	HF	3.5	80	60	Ceramic (Large)
RD70HVF1***	Si, MOS	30	150	12.5	VHF	6	75	60	Ceramic (Large)
					UHF	10	55	55	
RD70HVF1C**	Si, MOS	30	150	12.5	VHF	6	75	60	Ceramic (Large)
					UHF	10	55	55	
RD70HUP2★	Si, MOS†	40	300	12.5	VHF	4	84	74	HPM006
					UHF	5	75	64	
RD100HHF1***	Si, MOS	50	176.5	12.5	HF	7	110	60	Ceramic (Large)
RD100HHF1C**	Si, MOS	50	176.5	12.5	HF	7	110	60	Ceramic (Large)

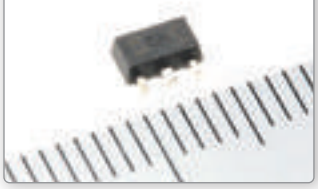
Ta=25°C †: Gate Protection Diode ★: New Product ★★: Under Development ★★★: End of Life in 2017

7.2V OPERATION HIGH OUTPUT POWER Si MOS FET (DUAL FET DISCRETE)

Type Number	Structure	Max.ratings		Vdd [V]	Frequency Band	Pin [W]	Po (Typ.) [W]	ηd (Typ.) [%]	Package Type
		VDSS [V]	Pch [W]						
RD01MUS3**	Si, MOS†	25	6.2	7.2	UHF	0.001	0.15	60	QFN (4mm)
	Si, MOS†	25	8.3	7.2	UHF	0.1	1.8	70	

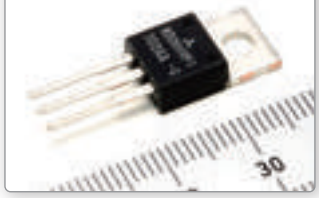
Ta=25°C †: Gate Protection Diode ★★: Under Development

SOT-89

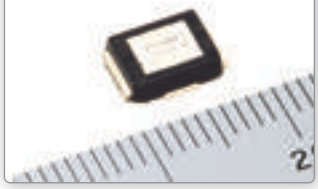


SLP

TO-220S



PMM

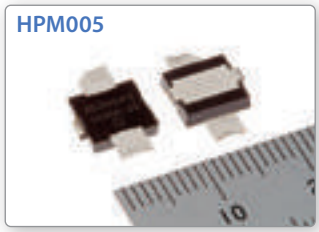


HPM006

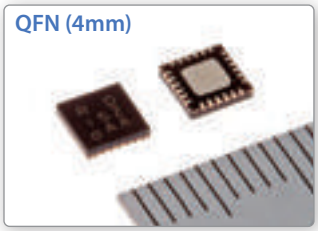
Ceramic (Small)

Ceramic (Large)

HPM005



QFN (4mm)



Type Name Definition of Silicon RF Devices

HIGH OUTPUT POWER Si MOS FET (Discrete Devices)

RD 07 M U S 2B
A B C D E F

A Si MOS FET (Discrete)

B Output Power (W)

C Operation Voltage (V)

Symbol	Voltage
M	7.2V
N	9.6V
H	12.5V

D Frequency Range (MHz)

Symbol	Frequency Range
H	30MHz
V	175MHz
U	520MHz
M	800MHz

E Outline

Symbol	Segment
S	Mold
F	Flange
P	Power Mold Mini

F Serial Number

HIGH OUTPUT POWER Si MOS FET MODULE

RA 07 M 4452 M
A B C D E

A Module

B Output Power (W)

C Operation Voltage (V)

Symbol	Voltage
M	7.2V
N	9.6V
H	12.5V

D Frequency Range (MHz)

Symbol (Example)	Frequency Range (Example)
4452	440~ 520MHz
1317	135~ 175MHz

E Frequency Unit

Symbol	Unit
M	MHz
G	GHz

Note: Type number show the outline of products. For detail specification, Please confirm a formal specification.

PRODUCT LIST

7.2V OPERATION HIGH OUTPUT POWER Si MOS FET MODULE

Type Number	Max.ratings Vdd [V]	f [MHz]		Vdd [V]	Pin [W]	Po (min) [W]	ηT (min) [%]	Package Type
		min	max					
RA02M8087MD***	9.2	806	869	7.2	0.01	1.2	30*1	H54
RA03M3540MD***	9.2	350	400	7.2	0.01	3.2	34*2	H54
RA03M4043MD***	9.2	400	430	7.2	0.01	3.2	34*2	H54
RA03M4547MD***	9.2	450	470	7.2	0.01	3.2	34*2	H54
RA03M8087M	9.2	806	870	7.2	0.05	3.6	32	H46S
RA03M8894M	9.2	889	941	7.2	0.05	3.6	32	H46S
RA07M0608M***	9.2	66	88	7.2	0.03	7	45	H46S
RA07M1317M	9.2	135	175	7.2	0.02	6.5	45	H46S
RA07M2127M	9.2	215	270	7.2	0.02	7	45	H46S
RA07M3340M***	9.2	330	400	7.2	0.05	7	40	H46S
RA07M3843M***	9.2	378	430	7.2	0.05	7	40	H46S
RA07M3847M**	9.2	378	470	7.2	0.05	7	40	H46S
RA07M4047M***	9.2	400	470	7.2	0.05	7	40	H46S
RA07M4452M	9.2	440	520	7.2	0.05	7	40	H46S

Ta=25°C *1: When Po=2.5W *2: When Po=6.3W ★★: Under Development ★★★: End of Life in 2017

9.6V OPERATION HIGH OUTPUT POWER Si MOS FET MODULE

Type Number	Max.ratings Vdd [V]	f [MHz]		Vdd [V]	Pin [W]	Po (min) [W]	ηT (min) [%]	Package Type
		min	max					
RA07N1317M**	12.5	136	174	9.6	0.02	7.5	43	H46S
RA07N3340M***	12.5	330	400	9.6	0.02	7.5	43	H46S
RA07N4047M	12.5	400	470	9.6	0.02	7.5	43	H46S
RA07N4452M	12.5	440	520	9.6	0.02	7.5	43	H46S
RA08N1317M***	12.5	135	175	9.6	0.02	8	50	H46S

Ta=25°C ★★: Under Development ★★★: End of Life in 2017

12.5V OPERATION HIGH OUTPUT POWER Si MOS FET MODULE (SERFACE MOUNT TYPE)

Type Number	Max.ratings Vdd [V]	f [MHz]		Vdd [V]	Pin [W]	Po (min) [W]	ηT (min) [%]	Package Type
		min	max					
RA05H1317MS1★	17	135	175	12.5	0.01	5	45	H61
RA05H3353MS1★	17	330	527	12.5	0.01	5	45	H61
RA60H1317MS1★	17	135	175	12.5	4	60	55	H60
RA60H3847MS1★	17	378	470	12.5	4	60	50	H60
RA60H4453MS1★	17	440	527	12.5	4	60	50	H60

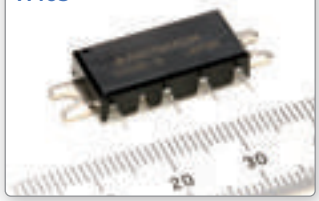
Ta=25°C ★: New Product

H2S

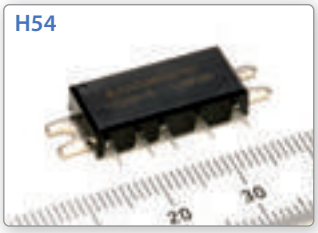
H2M/H2M(A)

H11S

H46S



H54



H57

H60

H61

SiRF devices are compliant with the RoHS (2011/65/EU).

RoHS: Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

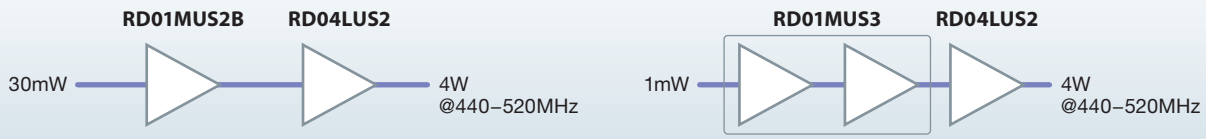
12.5V OPERATION HIGH OUTPUT POWER Si MOS FET MODULE

Type Number	Max.ratings Vdd [V]	f [MHz]		Vdd [V]	Pin [W]	Po (min) [W]	ηT (min) [%]	Package Type
		min	max					
RA07H0608M***	13.2	68	88	12.5	0.03	7	38	H46S
RA07H3340M***	13.2	330	400	12.5	0.02	7	40	H46S
RA07H4047M***	13.2	400	470	12.5	0.02	7	40	H46S
RA07H4452M***	13.2	440	520	12.5	0.02	7	40	H46S
RA08H1317M***	13.2	135	175	12.5	0.02	8	40	H46S
RA08H3843MD***	17	380	430	13.2	1.4m	6.3	15	H2S (6-pins)
RA08H4547MD	18	450	470	12.5	0.3m	7.9	17	H2S (6-pins)
RA13H1317M***	17	135	175	12.5	0.05	13	40	H2S
RA13H3340M***	17	330	400	12.5	0.05	13	40	H2S
RA13H4047M***	17	400	470	12.5	0.05	13	40	H2S
RA13H4452M***	17	440	520	12.5	0.05	13	40	H2S
RA13H8891MA***	17	889	915	12.5	0.2	13	30	H2S
RA13H8891MB***	17	880	915	12.5	0.001	13	35	H11S
RA18H1213G1**	17	1240	1300	12.5	0.2	18	20	H2M
RA20H8087M***	17	806	870	12.5	0.05	20	25	H2S
RA20H8994M***	17	896	941	12.5	0.05	20	25	H2S
RA30H0608M***	17	66	88	12.5	0.05	30	40	H2S
RA30H0608M1**	17	66	88	12.5	0.05	30	40	H2M
RA30H1317M***	17	135	175	12.5	0.05	30	40	H2S
RA30H1317M1	17	135	175	12.5	0.05	30	40	H2M
RA30H1317M1A*	17	136	174	12.5	0.05	30	45	H2M(A)
RA30H1721M***	17	175	215	12.5	0.05	30	40	H2S
RA30H2127M***	17	210	270	12.5	0.05	30	40	H2S
RA30H2127M1**	17	210	275	12.5	0.05	30	40	H2M
RA30H3340M***	17	330	400	12.5	0.05	30	40	H2S
RA30H3340M1**	17	330	400	12.5	0.05	30	40	H2M
RA30H3847M1**	17	378	470	12.5	0.05	30	40	H2M
RA30H3847M1A*	17	378	470	12.5	0.05	30	40	H2M(A)
RA30H4047M***	17	400	470	12.5	0.05	30	40	H2S
RA30H4047M1	17	400	470	12.5	0.05	30	42	H2M
RA30H4452M***	17	440	520	12.5	0.05	30	40	H2S
RA30H4452M1**	17	440	520	12.5	0.05	30	40	H2M
RA30H4452M1A*	17	440	520	12.5	0.05	30	40	H2M(A)
RA30H4552M1***	17	450	520	12.5	0.05	30	42	H2M
RA33H1516M1	17	154	162	12.5	0.01	33	50	H57
RA35H1516M***	17	154	162	12.5	0.05	40	50	H2S
RA45H4045MR***	17	400	450	12.5	0.05	45	35	H2RS
RA45H4047M***	17	400	470	12.5	0.05	45	35	H2S
RA45H4452M***	17	440	520	12.5	0.05	45	35	H2S
RA45H7687M1*	17	763	870	12.8	0.05	45	33	H2M(A)
RA45H8994M1*	17	896	941	12.8	0.05	45	33	H2M(A)
RA55H3340M***	17	330	400	12.5	0.05	55	35	H2S
RA55H3847M***	17	380	470	12.5	0.05	55	38	H2S
RA55H4047M***	17	400	470	12.5	0.05	55	35	H2S
RA55H4452M***	17	440	490	12.5	0.05	55	43	H2S
		490	520			45	35	
RA60H1317M***	17	135	175	12.5	0.05	60	40	H2S
RA60H1317M1A	17	136	174	12.5	0.05	60	45	H2M
RA60H1317M1B*	17	136	174	12.5	0.05	60	45	H2M(A)
RA60H3340M1A***	17	330	400	12.5	0.05	60	40	H2M(A)
RA60H3847M1	17	378	470	12.5	0.05	60	40	H2M
RA60H3847M1A*	17	378	470	12.5	0.05	60	40	H2M(A)
RA60H4047M1***	17	400	470	12.5	0.05	60	40	H2M
RA60H4452M1	17	440	520	12.5	0.05	60	40	H2M
RA60H4452M1A*	17	440	520	12.5	0.05	60	40	H2M(A)
RA80H1415M1	17	144	148	12.5	0.05	80	50	H2M
		136	174			60		

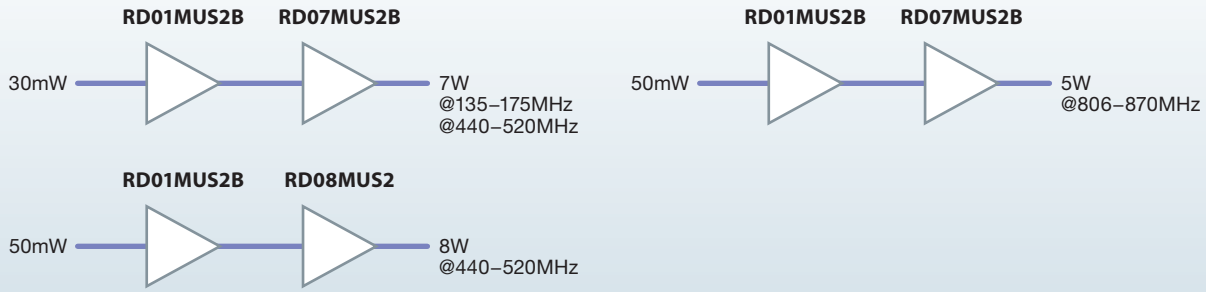
Ta=25°C *: V_{GG1}, V_{GG2} Separation type ★★: Under Development ★★★: End of Life in 2017

APPLICATION

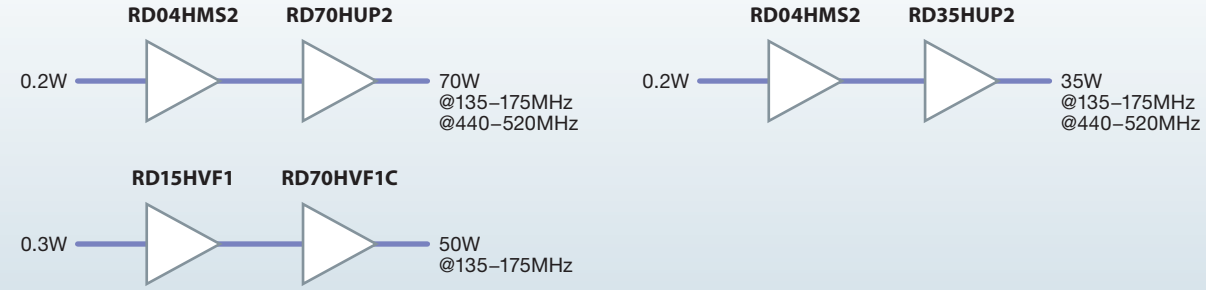
3.6V OPERATION RECOMMENDED LINE UP



7.2V OPERATION RECOMMENDED LINE UP



12.5V OPERATION RECOMMENDED LINE UP



Precautions for the use of Mitsubishi Electric silicon RF power amplifier devices

01.This general catalog do not guarantee the product specifications. Please confirm additional details regarding operation of these products from the formal specification sheet. For copies of the formal specification sheets, please contact one of our sales offices from the list of contact addresses listed on the last page for further information.

02.RA series products (RF power amplifier modules) and RD series products (RF power transistors) are designed for consumer mobile communication terminals and were not specifically designed for use in other applications. In particular, while these products are highly reliable for their designed purpose, they are not manufactured under a quality assurance testing protocol that is sufficient to guarantee the level of reliability typically deemed necessary for critical communications elements. Examples of critical communications elements would include transmitters for base station applications and fixed station applications that operate with long term continuous transmission and a higher on-off frequency during transmitting, especially for systems that may have a high impact to society.

03.RA series and RD series products use MOSFET semiconductor technology. They are sensitive to ESD voltage therefore appropriate ESD precautions are required.

04.In order to maximize reliability of the equipment, it is better to keep the devices temperature low. It is recommended to utilize a sufficient sized heat-sink in conjunction with other cooling methods as needed (fan, etc.) to keep the case temperature for RA series products lower than 60deg/C under standard conditions, and less than 90deg/C under extreme conditions.

05.RA series products are designed to operate into a nominal load impedance of 50 ohms. Under the condition of operating into a severe high load VSWR approaching an open or short, an over load condition could occur. In the worst case there is risk for burn out of the transistors and smoking of other parts including the substrate in the module.

06.The formal specification includes a guarantee against parasitic oscillation under a specified maximum load mismatch condition. The inspection for parasitic oscillation is performed on a sample basis on our manufacturing line. It is recommended that verification of no parasitic oscillation be performed at the completed equipment level also.

07.For specific precautions regarding assembly of these products into the equipment, please refer to the supplementary items in the specification sheet.

08.Warranty for the product is void if the products protective cap (lid) is removed or if the product is modified in any way from it's original form.

09.For additional "Safety first" in your circuit design and notes regarding the materials, please refer the last page of this manual.

10.Please refer to the additional precautions in the formal specification sheet.

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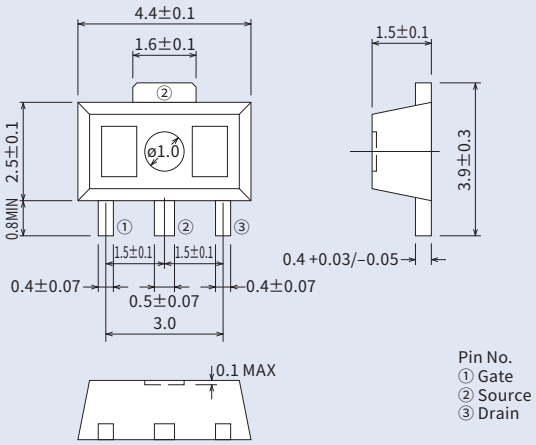
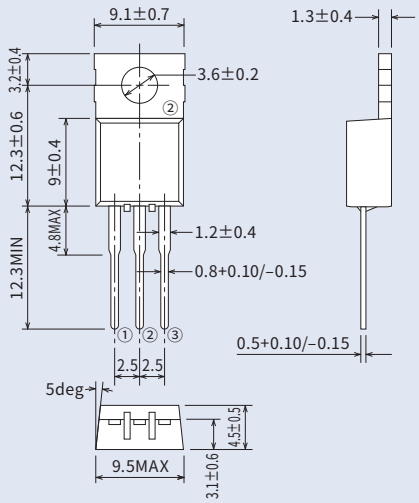
SOT-89



Pin No.
① Gate
② Source
③ Drain

UNIT: mm

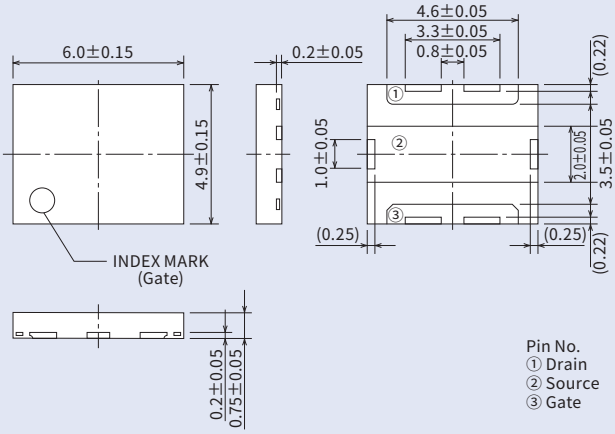
TO-220S



Pin No.
① Gate
② Source
③ Drain

UNIT: mm

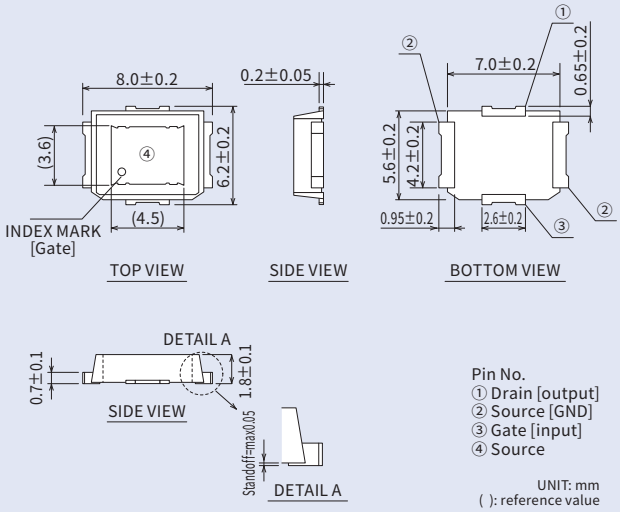
SLP



Pin No.
① Drain
② Source
③ Gate

UNIT: mm
( ): reference value

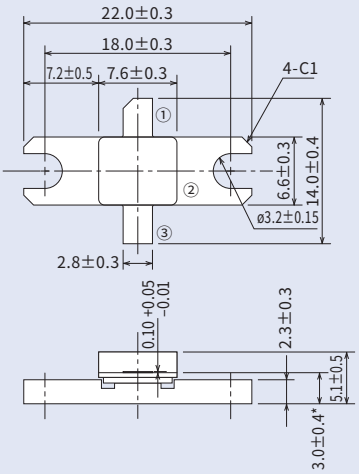
PMM



Pin No.
① Drain [output]
② Source [GND]
③ Gate [input]
④ Source

UNIT: mm
( ): reference value

Ceramic (Small)

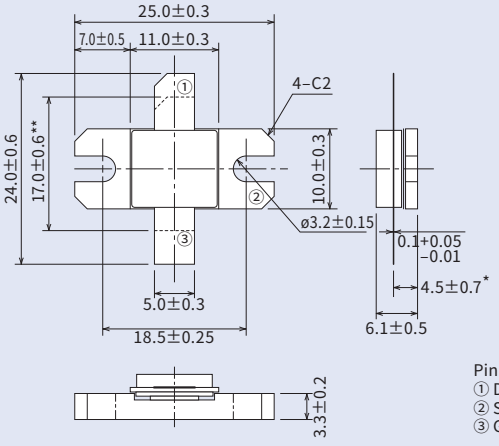


Pin No.
① Drain
② Source
③ Gate

* : The height of terminals shows root.

UNIT: mm

Ceramic (Large)



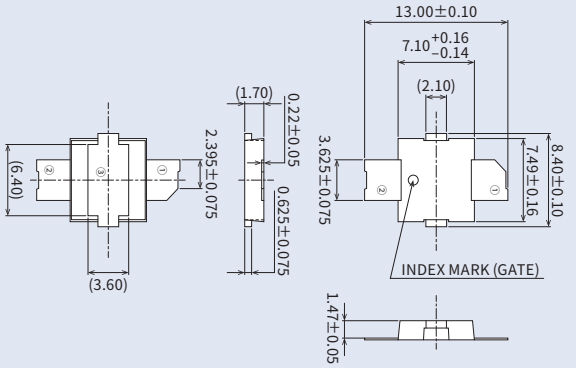
Pin No.
① Drain
② Source
③ Gate

* : The height of terminals shows root. ** : RDxxxxxC

UNIT: mm

PACKAGE OUTLINE

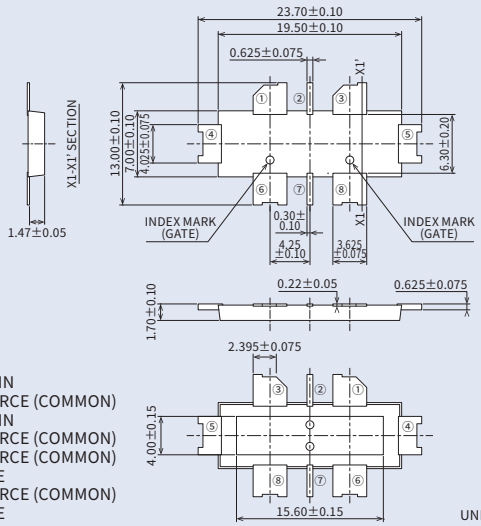
HPM005



Pin No.
① DRAIN
② GATE
③ SOURCE (COMMON)

UNIT: mm
( ): reference value

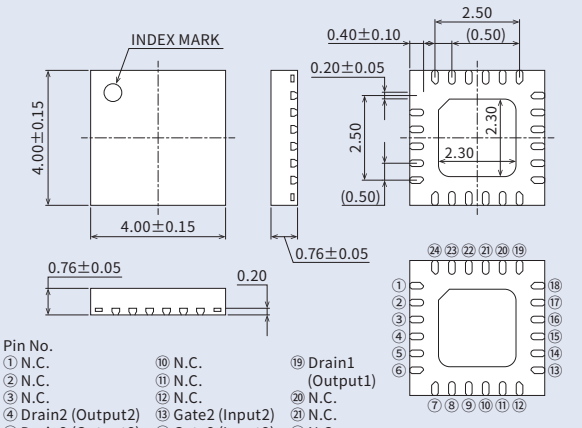
HPM006



Pin No.
① DRAIN
② SOURCE (COMMON)
③ DRAIN
④ SOURCE (COMMON)
⑤ SOURCE (COMMON)
⑥ GATE
⑦ SOURCE (COMMON)
⑧ GATE

UNIT: mm

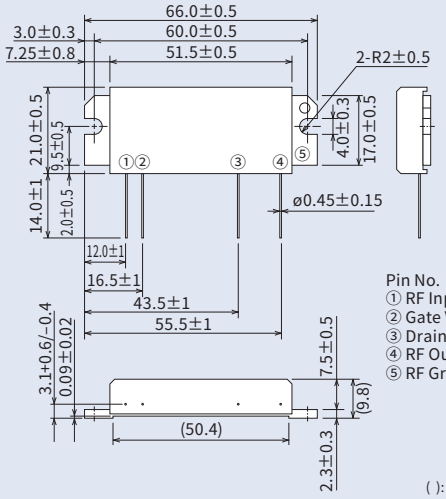
QFN (4mm)



Pin No.
① N.C.
② N.C.
③ N.C.
④ Drain2 (Output2)
⑤ Drain2 (Output2)
⑥ Drain2 (Output2)
⑦ N.C.
⑧ N.C.
⑨ N.C.
⑩ N.C.
⑪ N.C.
⑫ N.C.
⑬ Gate2 (Input2)
⑭ Gate2 (Input2)
⑮ Gate2 (Input2)
⑯ N.C.
⑰ N.C.
⑱ N.C.
⑲ Drain1 (Output1)
⑳ N.C.
㉑ N.C.
㉒ N.C.
㉓ N.C.
㉔ Gate1 (Input1)
㉕ Source (GND)

UNIT: mm
( ): reference value

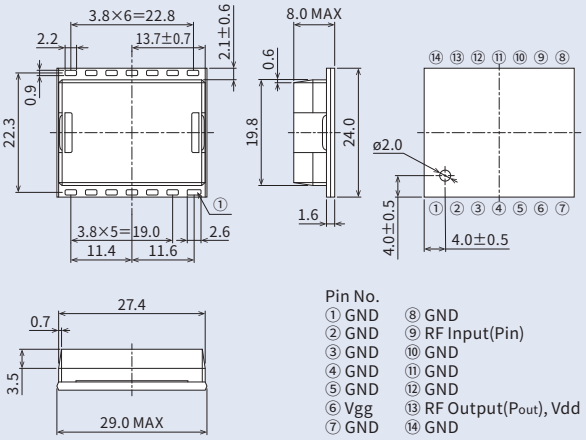
H2S



Pin No.
① RF Input(Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value

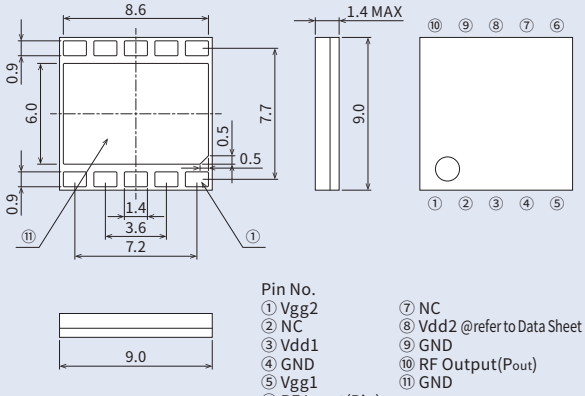
H60



Pin No.
① GND
② GND
③ GND
④ GND
⑤ GND
⑥ Vgg
⑦ GND
⑧ GND
⑨ RF Input(Pin)
⑩ GND
⑪ GND
⑫ GND
⑬ RF Output(Pout), Vdd
⑭ GND

UNIT: mm

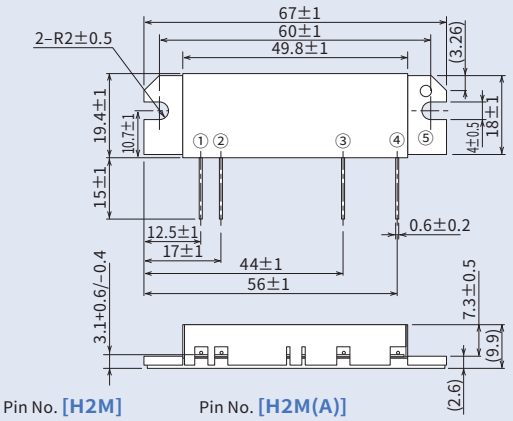
H61



Pin No.
① Vgg2
② NC
③ Vdd1
④ GND
⑤ Vgg1
⑥ RF Input(Pin)
⑦ NC
⑧ Vdd2 @refer to Data Sheet
⑨ GND
⑩ RF Output(Pout)
⑪ GND

UNIT: mm
tolerance of no designation ; ±0.15

H2M/H2M(A)

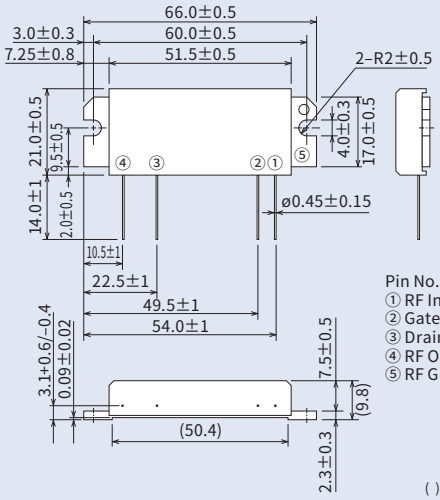


Pin No. [H2M]
① RF Input (Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin))

Pin No. [H2M(A)]
① RF Input (Pin)+VGG1
② Final Stage Gate Voltage(VGG2)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value

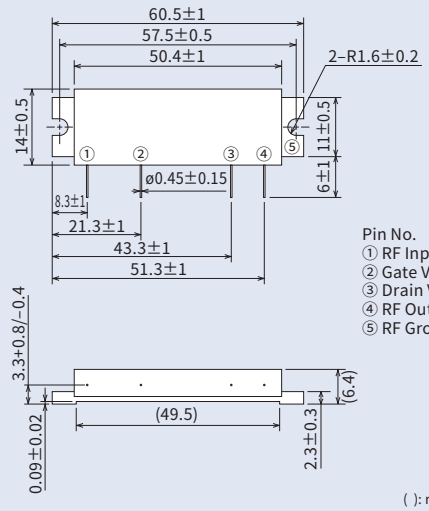
H2RS



Pin No.
① RF Input(Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value

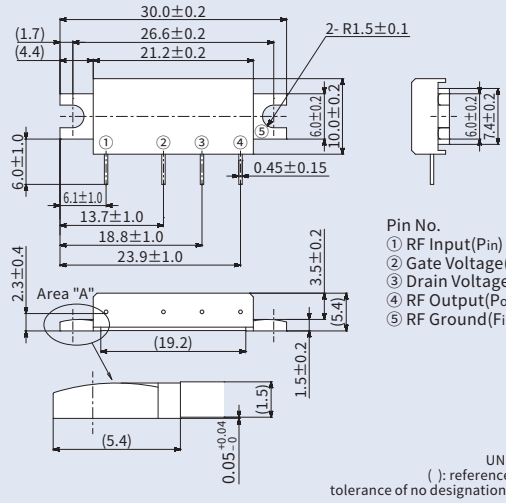
H11S



Pin No.
① RF Input(Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value

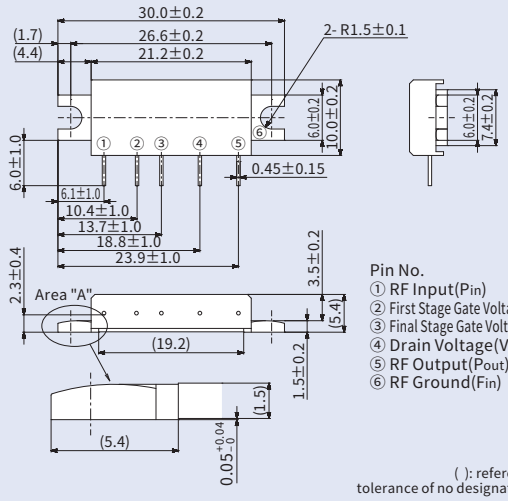
H46S



Pin No.
① RF Input(Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value
tolerance of no designation ; ±0.5

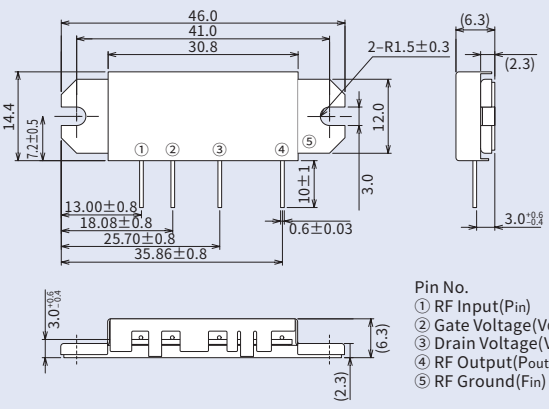
H54



Pin No.
① RF Input(Pin)
② First Stage Gate Voltage(VGG1)
③ Final Stage Gate Voltage(VGG2)
④ Drain Voltage(VDD)
⑤ RF Output(Pout)
⑥ RF Ground(Fin)

UNIT: mm
( ): reference value
tolerance of no designation ; ±0.5

H57



Pin No.
① RF Input(Pin)
② Gate Voltage(VGG)
③ Drain Voltage(VDD)
④ RF Output(Pout)
⑤ RF Ground(Fin)

UNIT: mm
( ): reference value

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Keep safety first in your circuit designs!

- Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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eco Changes **for a greener tomorrow**

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New publication effective Sep. 2016.
Specifications subject to change without notice.

H-CX624-N KI-1609 Printed in Japan (TOT)