

Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	4.33±0.04	110.0±1.0
B	3.74±0.02	95.0±0.5
C	3.50±0.04	89.0±1.0
D	3.27	83.0
E	2.91±0.02	74.0±0.5
F	2.44	62.0
G	1.28	32.6
H	1.24	31.6
J	1.02	26.0
K	0.94	24.0
L	0.87 +0.06/-0.22.0	+1.5/-0.0
M	0.79	20.0
N	0.76	19.4
P	0.75	19.0
Q	0.708	17.98
R	0.670	17.02

Dimensions	Inches	Millimeters
S	0.67	17.0
T	0.52	13.2
U	0.39	10.0
V	0.28	7.0
W	0.30	7.5
X	0.24	6.0
Y	0.24 Rad.	Rad. 6.0
Z	0.22 Dia.	Dia. 5.5
AA	Metric M5	M5
AB	0.127	3.22
AC	0.10	2.6
AD	0.08	2.0
AE	0.07	1.8
AF	0.06	1.6
AG	0.02±0.01	0.5±0.3



**Description:**

Mitsubishi Intelligent Power Modules are isolated base modules designed for power switching applications operating at frequencies to 20kHz. Built-in control circuits provide optimum gate drive and protection for the IGBT and free-wheel diode power devices.

**Features:**

- Complete Output Power Circuit
- Gate Drive Circuit
- Protection Logic
  - Short Circuit
  - Over Current
  - Over Temperature
  - Under Voltage

**Applications:**

- Inverters
- UPS
- Motion/Servo Control
- Power Supplies

**Ordering Information:**

Example: Select the complete part number from the table below -i.e. PM50RSA120 is a 1200V, 50 Ampere Intelligent Power Module.

Type	Current Rating Amperes	V <sub>CES</sub> Volts (x 10)
PM	50	120

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

Ratings	Symbol	PM50RSA120	Units
Power Device Junction Temperature	$T_j$	-20 to 150	$^\circ\text{C}$
Storage Temperature	$T_{\text{stg}}$	-40 to 125	$^\circ\text{C}$
Case Operating Temperature	$T_C$	-20 to 100	$^\circ\text{C}$
Mounting Torque, M5 Mounting Screws	—	1.47 ~ 1.96	N · m
Mounting Torque, M5 Main Terminal Screw	—	1.47 ~ 1.96	N · m
Module Weight (Typical)	—	550	Grams
Supply Voltage Protected by OC and SC ( $V_D = 13.5 - 16.5\text{V}$ , Inverter Part, $T_j = 125^\circ\text{C}$ )	$V_{\text{CC(prot.)}}$	800	Volts
Isolation Voltage (Main Terminal to Baseplate, AC 1 min.)	$V_{\text{RMS}}$	2500	Volts

**Control Sector**

Supply Voltage (Applied between $V_{\text{UP1}}-V_{\text{UPC}}$ , $V_{\text{VP1}}-V_{\text{VPC}}$ , $V_{\text{WP1}}-V_{\text{WPC}}$ , $V_{\text{N1}}-V_{\text{NC}}$ )	$V_D$	20	Volts
Input Voltage (Applied between $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ , $U_N \cdot V_N \cdot W_N \cdot B_r-V_{\text{NC}}$ )	$V_{\text{CIN}}$	20	Volts
Fault Output Supply Voltage Applied between ( $U_{\text{FO}}-V_{\text{UPC}}$ , $V_{\text{FO}}-V_{\text{VPC}}$ , $W_{\text{FO}}-V_{\text{WPC}}$ , $F_O-V_{\text{NC}}$ )	$V_{\text{FO}}$	20	Volts
Fault Output Current (Sink Current at $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ and $F_O$ Terminal)	$I_{\text{FO}}$	20	mA

**IGBT Inverter Sector**

Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ )	$V_{\text{CES}}$	1200	Volts
Collector Current, ( $T_C = 25^\circ\text{C}$ )	$I_C$	50	Amperes
Peak Collector Current, ( $T_C = 25^\circ\text{C}$ )	$I_{\text{CP}}$	100	Amperes
Supply Voltage (Applied between P - N)	$V_{\text{CC}}$	900	Volts
Supply Voltage, Surge (Applied between P - N)	$V_{\text{CC(surge)}}$	1000	Volts
Collector Dissipation	$P_C$	347	Watts

**Brake Sector**

Collector-Emitter Voltage	$V_{\text{CES}}$	1200	Volts
Collector Current, ( $T_C = 25^\circ\text{C}$ )	$I_C$	15	Amperes
Peak Collector Current, ( $T_C = 25^\circ\text{C}$ )	$I_{\text{CP}}$	30	Amperes
Supply Voltage (Applied between P - N)	$V_{\text{CC}}$	900	Volts
Supply Voltage, Surge (Applied between P - N)	$V_{\text{CC(surge)}}$	1000	Volts
Collector Dissipation	$P_C$	138	Watts
Diode Forward Current	$I_F$	15	Amperes
Diode DC Reverse Voltage	$V_{\text{R(DC)}}$	1200	Volts

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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>Control Sector</b>						
Over Current Trip Level Inverter Part	OC	$-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$	59	112	—	Amperes
Over Current Trip Level Brake Part			22	50	—	Amperes
Short Circuit Trip Level Inverter Part	SC	$-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$	—	183	—	Amperes
Short Circuit Trip Level Brake Part			—	95	—	Amperes
Over Current Delay Time	$t_{\text{off}}(\text{OC})$	$V_D = 15\text{V}$	—	10	—	$\mu\text{s}$
Over Temperature Protection	OT	Trip Level	111	118	125	$^\circ\text{C}$
	$\text{OT}_r$	Reset Level	—	100	—	$^\circ\text{C}$
Supply Circuit Under Voltage Protection	UV	Trip Level	11.5	12.0	12.5	Volts
	$\text{UV}_r$	Reset Level	—	12.5	—	Volts
Supply Voltage	$V_D$	Applied between $V_{\text{UP}1}$ - $V_{\text{UPC}}$ , $V_{\text{VP}1}$ - $V_{\text{VPC}}$ , $V_{\text{WP}1}$ - $V_{\text{WPC}}$ , $V_{\text{N}1}$ - $V_{\text{NC}}$	13.5	15	16.5	Volts
Circuit Current	$I_D$	$V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{N}1}$ - $V_{\text{NC}}$	—	44	60	mA
		$V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{XP}1}$ - $V_{\text{XPC}}$	—	13	18	mA
Input ON Threshold Voltage	$V_{\text{th}}(\text{on})$	Applied between	1.2	1.5	1.8	Volts
Input OFF Threshold Voltage	$V_{\text{th}}(\text{off})$	$U_P$ - $V_{\text{UPC}}$ , $V_P$ - $V_{\text{VPC}}$ , $W_P$ - $V_{\text{WPC}}$ , $U_N$ · $V_N$ · $W_N$ · $B_r$ - $V_{\text{NC}}$	1.7	2.0	2.3	Volts
PWM Input Frequency	$f_{\text{PWM}}$	3- $\phi$ Sinusoidal	—	15	20	kHz
Fault Output Current	$I_{\text{FO}}(\text{H})$	$V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$	—	—	0.01	mA
	$I_{\text{FO}}(\text{L})$	$V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$	—	10	15	mA
Minimum Fault Output Pulse Width	$t_{\text{FO}}$	$V_D = 15\text{V}$	1.0	1.8	—	ms

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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
<b>IGBT Inverter Sector</b>						
Collector Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, T_j = 25^\circ\text{C}$	—	—	1.0	mA
		$V_{CE} = V_{CES}, T_j = 125^\circ\text{C}$	—	—	10	mA
Emitter-Collector Voltage	$V_{EC}$	$-I_C = 50\text{A}, V_D = 15\text{V}, V_{CIN} = 5\text{V}$	—	2.5	3.5	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A}$	—	2.5	3.5	Volts
		$V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A},$ $T_j = 125^\circ\text{C}$	—	2.2	3.2	Volts
Inductive Load Switching Times	$t_{on}$		0.5	1.0	2.5	$\mu\text{s}$
	$t_{rr}$	$V_D = 15\text{V}, V_{CIN} = 0 \leftrightarrow 15\text{V}$	—	0.15	0.3	$\mu\text{s}$
	$t_{C(on)}$	$V_{CC} = 600\text{V}, I_C = 50\text{A}$	—	0.4	1.0	$\mu\text{s}$
	$t_{off}$	$T_j = 125^\circ\text{C}$	—	2.0	3.0	$\mu\text{s}$
	$t_{C(off)}$		—	0.7	1.2	$\mu\text{s}$
<b>Brake Sector</b>						
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 15\text{A},$ $T_j = 25^\circ\text{C}$	—	2.8	3.8	Volts
		$V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 15\text{A},$ $T_j = 125^\circ\text{C}$	—	2.2	3.2	Volts
Diode Forward Voltage	$V_{FM}$	$-I_C = 15\text{A}, V_D = 15\text{V}, V_{CIN} = 5\text{V}$	—	2.5	3.5	Volts
Collector Cutoff Current	$I_{CES}$	$V_{CE} = V_{CES}, T_j = 25^\circ\text{C}$	—	—	1	mA
		$V_{CE} = V_{CES}, T_j = 125^\circ\text{C}$	—	—	10	mA

**Thermal Characteristics**

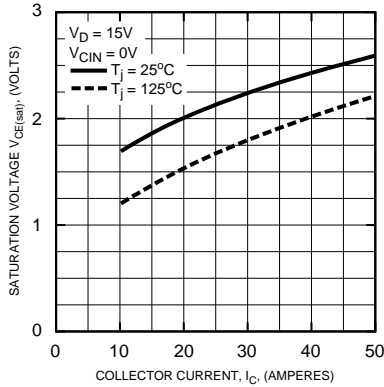
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Case Thermal Resistance	$R_{th(j-c)Q}$	Each Inverter IGBT	—	—	0.36	°C/Watt
	$R_{th(j-c)F}$	Each Inverter FWDi	—	—	1.0	°C/Watt
	$R_{th(c-f)Q}$	Each Brake IGBT	—	—	0.9	°C/Watt
	$R_{th(c-f)F}$	Each Brake FWDi	—	—	2.0	°C/Watt
Contact Thermal Resistance	$R_{th(c-f)}$	Case to Fin Per Module, Thermal Grease Applied	—	—	0.027	°C/Watt

**Recommended Conditions for Use**

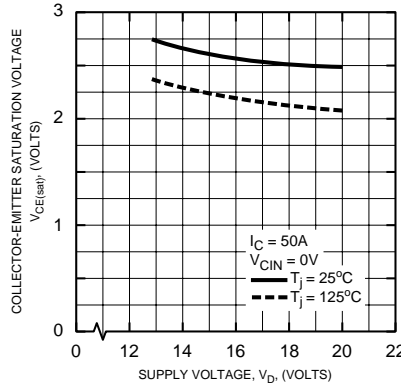
Characteristic	Symbol	Condition	Value	Units
Supply Voltage	$V_{CC}$	Applied across P-N Terminals	0 ~ 800	Volts
	$V_D$	Applied between $V_{UP1}$ - $V_{UPC}$ , $V_{N1}$ - $V_{NC}$ , $V_{VP1}$ - $V_{VPC}$ , $V_{WP1}$ - $V_{WPC}$	$15 \pm 1.5$	Volts
Input ON Voltage	$V_{CIN(on)}$	Applied between	0 ~ 0.8	Volts
Input OFF Voltage	$V_{CIN(off)}$	$U_P$ - $V_{UPC}$ , $V_P$ - $V_{VPC}$ , $W_P$ - $V_{WPC}$ , $U_N$ · $V_N$ · $W_N$ · $B_r$ - $V_{NC}$	$4.0 \sim V_D$	Volts
PWM Input Frequency	$f_{PWM}$	Using Application Circuit	5 ~ 20	kHz
Minimum Dead Time	$t_{dead}$	Input Signal	$\geq 3$	$\mu s$

### Inverter Part

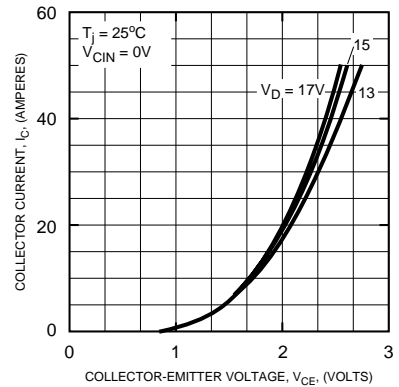
**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



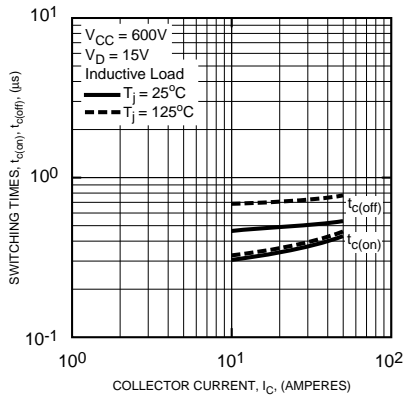
**COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)**



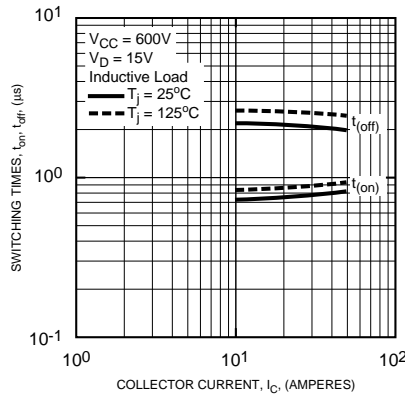
**OUTPUT CHARACTERISTICS (TYPICAL)**



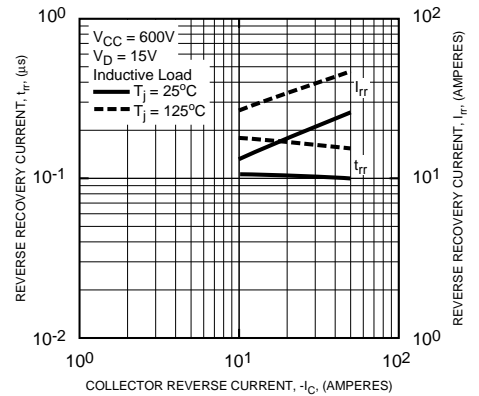
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



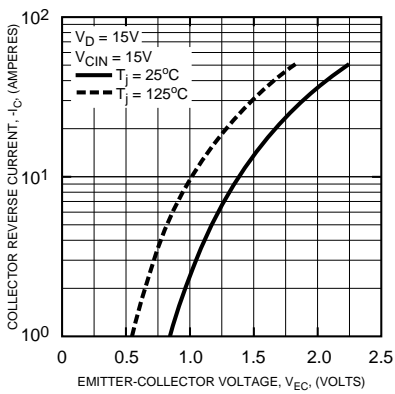
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



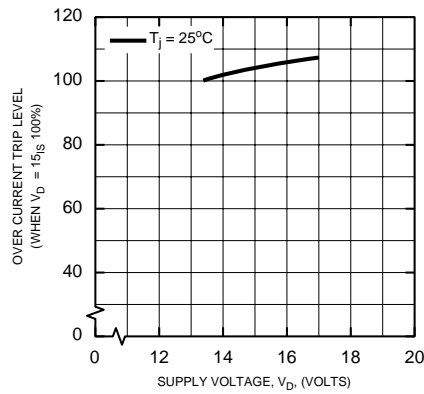
**REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)**



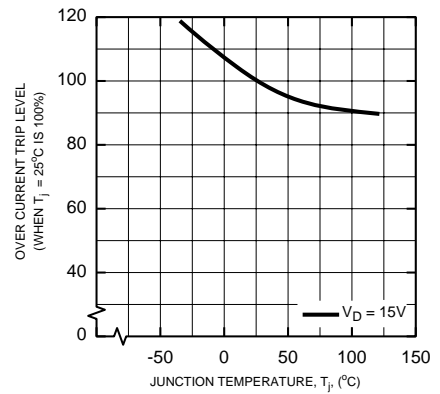
**DIODE FORWARD CHARACTERISTICS**



**OVER CURRENT TRIP LEVEL VS. SUPPLY VOLTAGE (TYPICAL)**

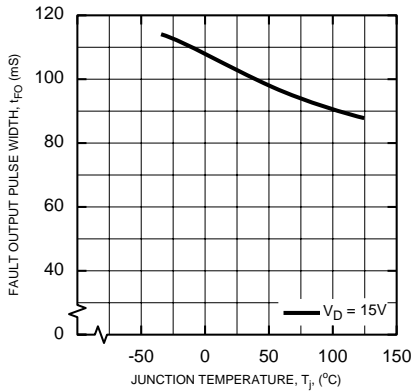


**OVER CURRENT TRIP LEVEL VS. TEMPERATURE (TYPICAL)**

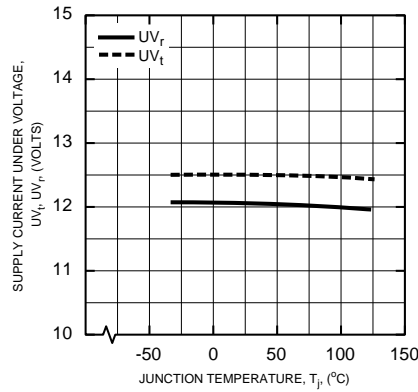


Inverter Part

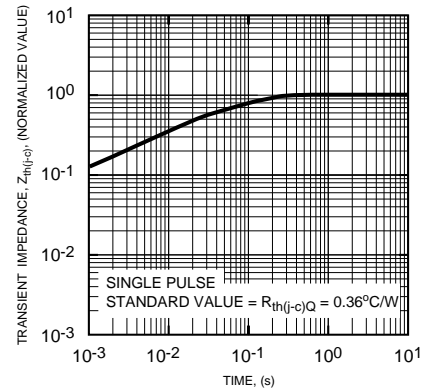
FAULT OUTPUT PULSE WIDTH VS. TEMPERATURE (TYPICAL)



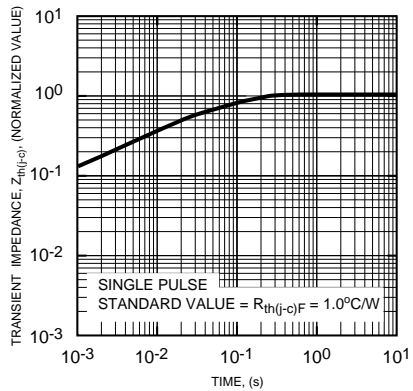
CONTROL SUPPLY VOLTAGE DROP PROTECTION VS. TEMPERATURE (TYPICAL)

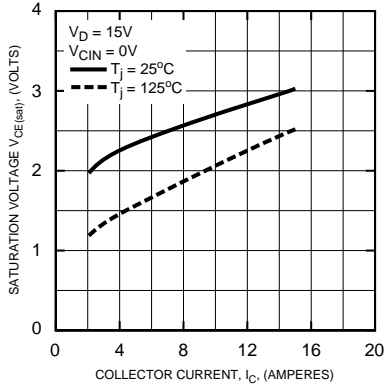
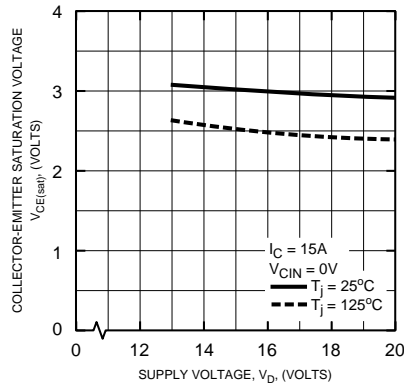
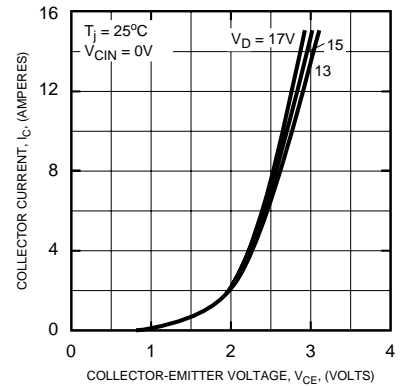
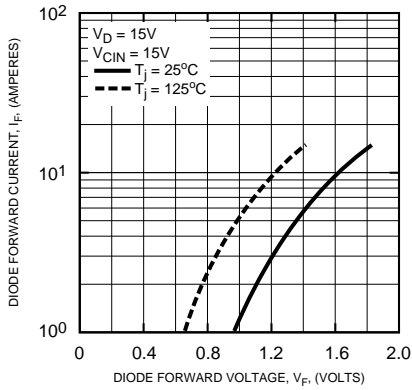
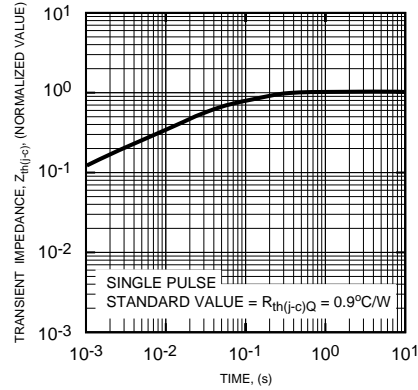


TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each IGBT)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each FWD)



**Brake Part**
**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**

**COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)**

**OUTPUT CHARACTERISTICS (TYPICAL)**

**DIODE FORWARD CHARACTERISTICS (TYPICAL)**

**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each IGBT)**

**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each FWDi)**
