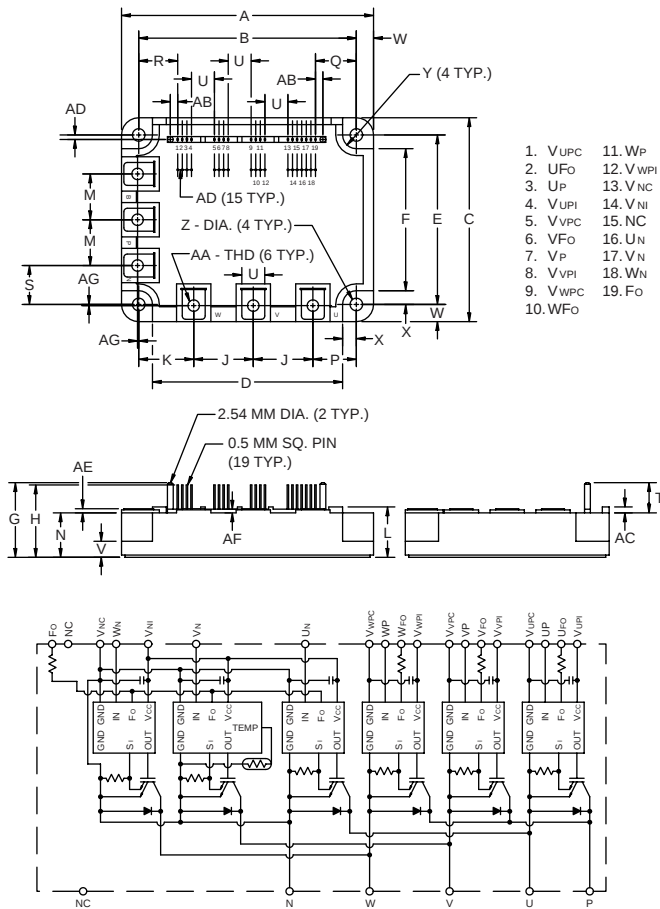


# PM150CSA060

FLAT-BASE TYPE  
INSULATED PACKAGE



## 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. PM150CSA060 is a 600V, 150 Ampere Intelligent Power Module.

| Type | Current Rating<br>Amperes | V <sub>CES</sub><br>Volts (x 10) |
|------|---------------------------|----------------------------------|
| PM   | 150                       | 60                               |

## 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          | 0.27      | 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     |

# PM150CSA060

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

|                                                                                       | Symbol                 | Ratings     | 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 Screws                                              | —                      | 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) | $V_{\text{CC(prot.)}}$ | 400         | Volts            |
| Isolation Voltage (Main Terminal to Baseplate, AC 1 min.)                             | $V_{\text{iso}}$       | 2500        | Vrms             |

## 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 $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ , $U_N \cdot V_N \cdot W_N-V_{\text{NC}}$ )                         | $V_{\text{CIN}}$ | 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 of $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ and $F_O$ Terminal)                                                         | $I_{\text{FO}}$  | 20 | mA    |

## IGBT Inverter Sector

|                                                                                  |                        |     |         |
|----------------------------------------------------------------------------------|------------------------|-----|---------|
| Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ ) | $V_{\text{CES}}$       | 600 | Volts   |
| Collector Current, ( $T_C = 25^\circ\text{C}$ )                                  | $I_C$                  | 150 | Amperes |
| Peak Collector Current, ( $T_C = 25^\circ\text{C}$ )                             | $I_{\text{CP}}$        | 300 | Amperes |
| Supply Voltage (Applied between P - N)                                           | $V_{\text{CC}}$        | 450 | Volts   |
| Supply Voltage, Surge (Applied between P - N)                                    | $V_{\text{CC(surge)}}$ | 500 | Volts   |
| Collector Dissipation                                                            | $P_C$                  | 500 | Watts   |

# PM150CSA060

FLAT-BASE TYPE  
INSULATED PACKAGE

## 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                   | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$                                                                                 | 210  | 300  | —    | Amperes          |
| Short Circuit Trip Level Inverter Part  | SC                   | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$                                                                                 | —    | 420  | —    | Amperes          |
| Over Current Delay Time                 | $t_{\text{off(OC)}}$ | $V_D = 15\text{V}$                                                                                                                                     | —    | 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 $V_{\text{UP1}}-V_{\text{UPC}}$ ,<br>$V_{\text{VP1}}-V_{\text{VPC}}$ , $V_{\text{WP1}}-V_{\text{WPC}}$ , $V_{\text{N1}}-V_{\text{NC}}$ | 13.5 | 15   | 16.5 | Volts            |
| Circuit Current                         | $I_D$                | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{N1}}-V_{\text{NC}}$                                                                     | —    | 40   | 55   | mA               |
|                                         |                      | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{XP1}}-V_{\text{XPC}}$                                                                   | —    | 13   | 18   | mA               |
| Input ON Threshold Voltage              | $V_{\text{th(on)}}$  | Applied between                                                                                                                                        | 1.2  | 1.5  | 1.8  | Volts            |
| Input OFF Threshold Voltage             | $V_{\text{th(off)}}$ | $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ ,<br>$U_N \cdot V_N \cdot W_N-V_{\text{NC}}$                                        | 1.7  | 2.0  | 2.3  | Volts            |
| PWM Input Frequency                     | $f_{\text{PWM}}$     | 3- $\phi$ Sinusoidal                                                                                                                                   | —    | 15   | 20   | kHz              |
| Fault Output Current                    | $I_{\text{FO(H)}}$   | $V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$                                                                                                      | —    | —    | 0.01 | mA               |
|                                         | $I_{\text{FO(L)}}$   | $V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$                                                                                                      | —    | 10   | 15   | mA               |
| Minimum Fault Output Pulse Width        | $t_{\text{FO}}$      | $V_D = 15\text{V}$                                                                                                                                     | 1.0  | 1.8  | —    | ms               |

# PM150CSA060

FLAT-BASE TYPE  
INSULATED PACKAGE

## 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            |
| Diode Forward Voltage                | $V_{EC}$      | $-I_C = 150\text{A}, V_D = 15\text{V}, V_{CIN} = 15\text{V}$                        | —    | 2.2  | 3.3  | Volts         |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 150\text{A}$                          | —    | 1.8  | 2.7  | Volts         |
|                                      |               | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 150\text{A}, T_j = 125^\circ\text{C}$ | —    | 1.75 | 2.63 | Volts         |
| Inductive Load Switching Times       | $t_{on}$      |                                                                                     | 0.4  | 0.8  | 2.0  | $\mu\text{s}$ |
|                                      | $t_{rr}$      | $V_D = 15\text{V}, V_{CIN} = 0 \leftrightarrow 15\text{V}$                          | —    | 0.15 | 0.3  | $\mu\text{s}$ |
|                                      | $t_{C(on)}$   | $V_{CC} = 300\text{V}, I_C = 150\text{A}$                                           | —    | 0.4  | 1.0  | $\mu\text{s}$ |
|                                      | $t_{off}$     | $T_j = 125^\circ\text{C}$                                                           | —    | 2.0  | 2.9  | $\mu\text{s}$ |
|                                      | $t_{C(off)}$  |                                                                                     | —    | 0.6  | 1.2  | $\mu\text{s}$ |

## Thermal Characteristics

| Characteristic                      | Symbol         | Condition                                         | Min. | Typ. | Max.  | Units                 |
|-------------------------------------|----------------|---------------------------------------------------|------|------|-------|-----------------------|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | Each IGBT                                         | —    | —    | 0.25  | $^\circ\text{C/Watt}$ |
|                                     | $R_{th(j-c)F}$ | Each FWDi                                         | —    | —    | 0.47  | $^\circ\text{C/Watt}$ |
| Contact Thermal Resistance          | $R_{th(c-f)}$  | Case to Fin Per Module,<br>Thermal Grease Applied | —    | —    | 0.027 | $^\circ\text{C/Watt}$ |

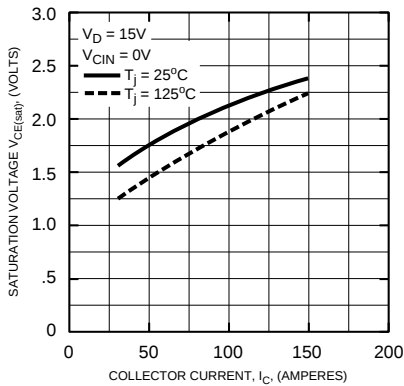
## Recommended Conditions for Use

| Characteristic      | Symbol         | Condition                                                                          | Value        | Units         |
|---------------------|----------------|------------------------------------------------------------------------------------|--------------|---------------|
| Supply Voltage      | $V_{CC}$       | Applied across P-N Terminals                                                       | 0 ~ 400      | 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   | $V_{CIN(off)}$ | $U_P-V_{UPC}, V_P-V_{VPC}, W_P-V_{WPC}, U_N \cdot V_N \cdot W_N-V_{NC}$            | $4.0 - V_D$  | Volts         |
| PWM Input Frequency | $f_{PWM}$      | Using Application Circuit                                                          | 5 ~ 20       | kHz           |
| Minimum Dead Time   | $t_{dead}$     | Input Signal                                                                       | $\geq 2.5$   | $\mu\text{s}$ |

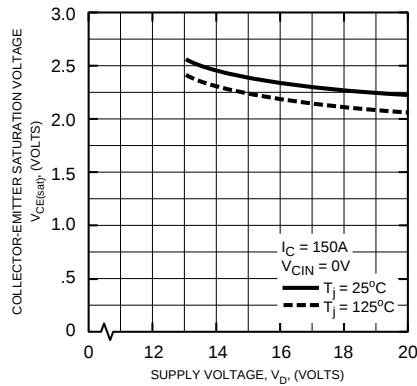
# PM150CSA060

FLAT-BASE TYPE  
INSULATED PACKAGE

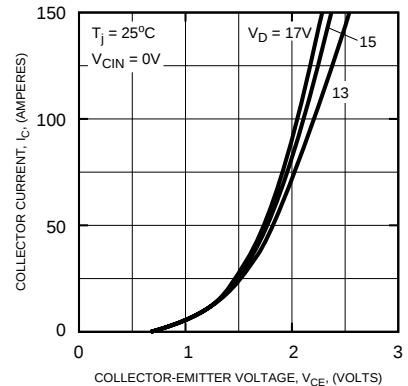
SATURATION VOLTAGE  
CHARACTERISTICS (TYPICAL)



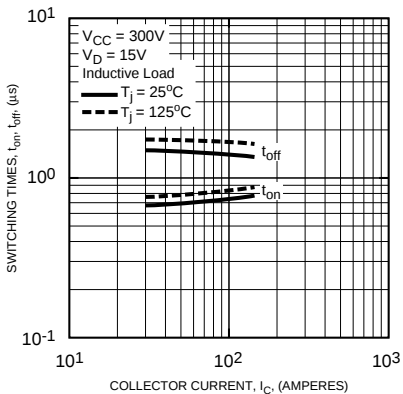
COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS (TYPICAL)



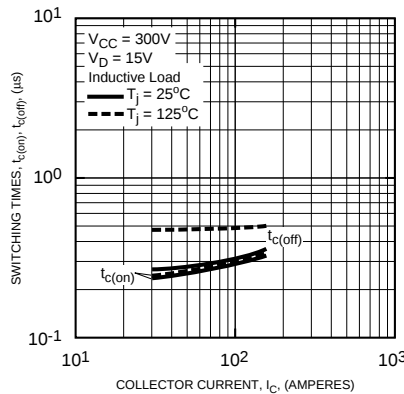
OUTPUT CHARACTERISTICS  
(TYPICAL)



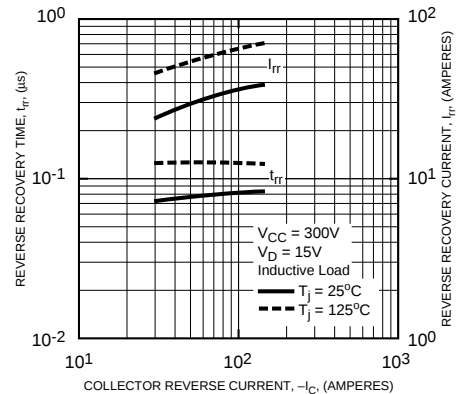
SWITCHING TIME VS.  
COLLECTOR CURRENT (TYPICAL)



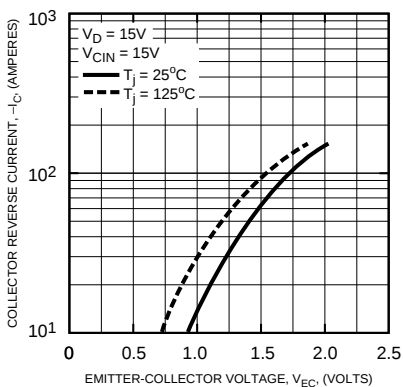
SWITCHING TIME VS.  
COLLECTOR CURRENT (TYPICAL)



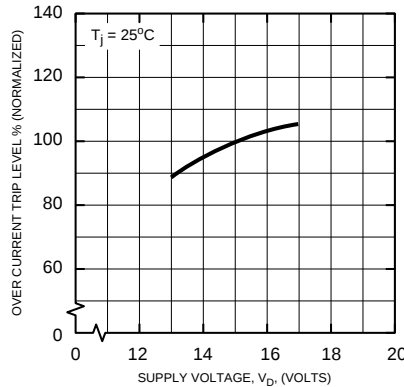
REVERSE RECOVERY CURRENT VS.  
COLLECTOR CURRENT (TYPICAL)



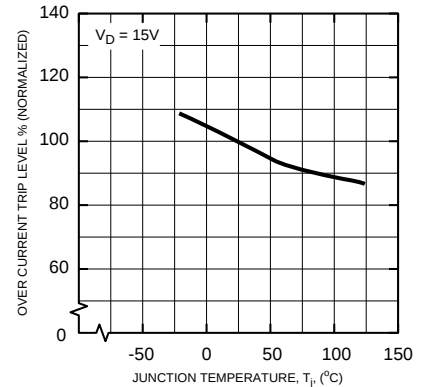
DIODE FORWARD CHARACTERISTICS



OVER CURRENT TRIP LEVEL VS.  
SUPPLY VOLTAGE (TYPICAL)



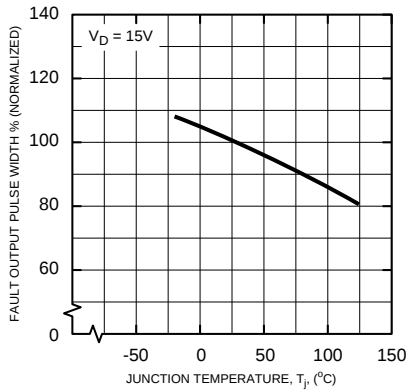
OVER CURRENT TRIP LEVEL VS.  
TEMPERATURE (TYPICAL)



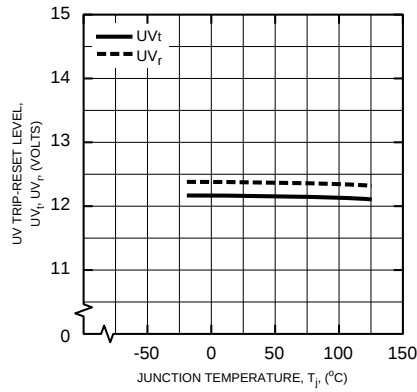
# PM150CSA060

FLAT-BASE TYPE  
INSULATED PACKAGE

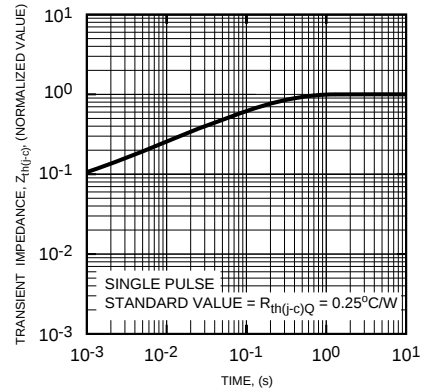
FAULT OUTPUT PULSE WIDTH VS.  
TEMPERATURE (TYPICAL)



CONTROL SUPPLY VOLTAGE TRIP-RESET  
LEVEL TEMPERATURE DEPENDENCY  
(TYPICAL)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(Each IGBT)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(Each FWDi)

