

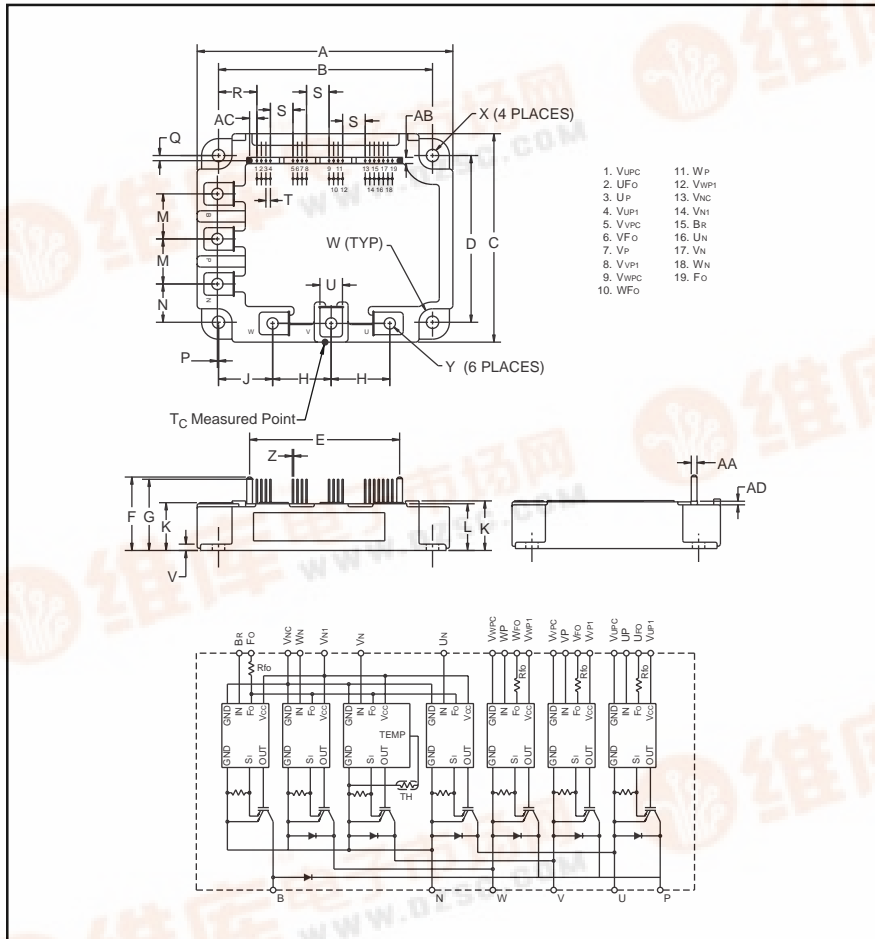


Powerex, Inc., 200 Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

## PM100RSD060

### Intellimod™ Module

Three Phase + Brake  
IGBT Inverter Output  
100 Amperes/600 Volts



#### Description:

Powerex Intellimod™ 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
- Low Loss Using 4th Generation IGBT Chip

#### Applications:

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

#### Ordering Information:

Example: Select the complete part number from the table below -i.e. PM100RSD060 is a 600V, 100 Ampere Intellimod™ Intelligent Power Module.

#### 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          | 2.91±0.02        | 74.0±0.5       |
| E          | 2.62             | 66.44          |
| F          | 1.28             | 32.6           |
| G          | 1.24             | 31.6           |
| H          | 1.02             | 26.0           |
| J          | 0.94             | 24.0           |
| K          | 0.87 +0.04/-0.02 | 22.0 +1.0/-0.5 |
| L          | 0.84             | 21.2           |
| M          | 0.79             | 20.0           |
| N          | 0.69             | 17.5           |
| P          | 0.02±0.01        | 0.5±0.3        |

| Dimensions | Inches     | Millimeters |
|------------|------------|-------------|
| Q          | 0.08±0.02  | 2.0±0.5     |
| R          | 0.670      | 17.02       |
| S          | 0.39       | 10.0        |
| T          | 0.08       | 2.0         |
| U          | 0.39       | 10.0        |
| V          | 0.16       | 4.0         |
| W          | 0.24 Rad.  | Rad. 6.0    |
| X          | 0.217 Dia. | M5.5        |
| Y          | 0.197      | M5          |
| Z          | 0.2 Sq.    | Sq. 0.5     |
| AA         | 0.10       | 2.54        |
| AB         | 0.18       | 4.5         |
| AC         | 0.13       | 3.22        |
| AD         | 0.06       | 1.6         |

| Type | Current Rating<br>Amperes | V <sub>CEs</sub><br>Volts (x 10) |
|------|---------------------------|----------------------------------|
| PM   | 100                       | 60                               |





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

| Characteristics  | Symbol                 | PM100RSD060 | 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  | —                      | 31          | in-lb            |
| Mounting Torque, M5 Main Terminal Screws   | —                      | 31          | in-lb            |
| Module Weight (Typical)  | —                      | 560         | Grams            |
| Supply Voltage Protected by OC and SC ( $V_D = 13.5 - 16.5\text{V}$ , Inverter Part) $T_j = 125^\circ\text{C}$ | $V_{\text{CC(prot.)}}$ | 400         | Volts            |
| Isolation Voltage, AC 1 minute, 60Hz Sinusoidal  | $V_{\text{ISO}}$       | 2500        | Volts            |

**IGBT Inverter Sector**

|  |                        |     |         |
|--|------------------------|-----|---------|
| Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ ) | $V_{\text{CES}}$       | 600 | Volts   |
| Collector Current, $\pm$ ( $T_C = 25^\circ\text{C}$ )                            | $I_C$                  | 100 | Amperes |
| Peak Collector Current, $\pm$ ( $T_C = 25^\circ\text{C}$ )                       | $I_{\text{CP}}$        | 200 | Amperes |
| Supply Voltage (Applied between P - N)   | $V_{\text{CC}}$        | 400 | Volts   |
| Supply Voltage, Surge (Applied between P - N)                                    | $V_{\text{CC(surge)}}$ | 500 | Volts   |
| Collector Dissipation ( $T_C = 25^\circ\text{C}$ )                               | $P_C$                  | 328 | Watts   |

**IGBT Brake Sector**

|  |                    |     |         |
|--|--------------------|-----|---------|
| Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ ) | $V_{\text{CES}}$   | 600 | Volts   |
| Collector Current, $\pm$ ( $T_C = 25^\circ\text{C}$ )                            | $I_C$              | 30  | Amperes |
| Peak Collector Current, $\pm$ ( $T_C = 25^\circ\text{C}$ )                       | $I_{\text{CP}}$    | 60  | Amperes |
| FWDi Rated DC Reverse Voltage ( $T_C = 25^\circ\text{C}$ )                       | $V_{\text{R(DC)}}$ | 600 | Volts   |
| FWDi Forward Current ( $T_C = 25^\circ\text{C}$ )                                | $I_F$              | 30  | Amperes |
| Collector Dissipation ( $T_C = 25^\circ\text{C}$ )                               | $P_C$              | 176 | Watts   |

**Control Sector**

|  |                  |    |       |
|--|------------------|----|-------|
| Supply Voltage Applied between ( $V_{\text{UP1}}-V_{\text{U1PC}}$ , $V_{\text{VP1}}-V_{\text{V1PC}}$ , $V_{\text{WP1}}-V_{\text{W1PC}}$ , $V_{\text{N1}}-V_{\text{N1C}}$ )   | $V_D$            | 20 | Volts |
| Input Voltage Applied between ( $U_P-V_{\text{U1PC}}$ , $V_P-V_{\text{V1PC}}$ , $W_P-V_{\text{W1PC}}$ , $U_N-V_{\text{N1C}}$ , $W_N-V_{\text{N1C}}$ , $B_1-V_{\text{N1C}}$ ) | $V_{\text{CIN}}$ | 20 | Volts |
| Fault Output Supply Voltage (Applied between $F_O$ and $V_C$ )   | $V_{\text{FO}}$  | 20 | Volts |
| Fault Output Current ( $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ , $F_O$ )   | $I_{\text{FO}}$  | 20 | mA    |



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 100 Amperes/600 Volts

**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             | $I_{CES}$     | $V_{CE} = V_{CES}, T_j = 25^\circ\text{C},$<br>$V_D = 15\text{V}$                        | —    | —    | 1.0  | mA            |
|                                      |               | $V_{CE} = V_{CES}, T_j = 125^\circ\text{C},$<br>$V_D = 15\text{V}$                       | —    | —    | 10   | mA            |
| Diode Forward Voltage                | $V_{EC}$      | $-I_C = 100\text{A}, V_D = 15\text{V}, V_{CIN} = 15\text{V}$                             | —    | 2.2  | 3.3  | Volts         |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 100\text{A},$<br>$T_j = 25^\circ\text{C}$  | —    | 1.7  | 2.3  | Volts         |
|                                      |               | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 100\text{A},$<br>$T_j = 125^\circ\text{C}$ | —    | 1.7  | 2.3  | Volts         |
| Inductive Load Switching Times       | $t_{on}$      |  | 0.8  | 1.2  | 2.4  | $\mu\text{S}$ |
|                                      | $t_{rr}$      | $V_D = 15\text{V}, V_{CIN} = 0 \sim 15\text{V}$  | —    | 0.15 | 0.3  | $\mu\text{S}$ |
|                                      | $t_{C(on)}$   | $V_{CC} = 300\text{V}, I_C = 100\text{A}$  | —    | 0.4  | 1.0  | $\mu\text{S}$ |
|                                      | $t_{off}$     | $T_j = 125^\circ\text{C}$  | —    | 2.4  | 3.3  | $\mu\text{S}$ |
|                                      | $t_{C(off)}$  |  | —    | 0.6  | 1.2  | $\mu\text{S}$ |
| <b>IGBT Brake Sector</b>             |               |  |      |      |      |               |
| Collector Cutoff Current             | $I_{CES}$     | $V_{CE} = V_{CES}, T_j = 25^\circ\text{C},$<br>$V_D = 15\text{V}$                        | —    | —    | 1.0  | mA            |
|                                      |               | $V_{CE} = V_{CES}, T_j = 125^\circ\text{C},$<br>$V_D = 15\text{V}$                       | —    | —    | 10   | mA            |
| FWDi Forward Voltage                 | $V_{FM}$      | $-I_F = 30\text{A}$  | —    | 2.5  | 3.5  | Volts         |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 30\text{A},$<br>$T_j = 25^\circ\text{C}$   | —    | 1.8  | 2.5  | Volts         |
|                                      |               | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 30\text{A},$<br>$T_j = 125^\circ\text{C}$  | —    | 1.9  | 2.6  | Volts         |



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| Characteristics  | Symbol                | Test Conditions  | Min. | Typ. | Max. | Units            |
|--|-----------------------|--|------|------|------|------------------|
| <b>Control Sector</b>  |                       |  |      |      |      |                  |
| Over Current Trip Level Inverter Part<br>( $V_D = 15\text{V}$ )                      | OC                    | $T_j = -20^\circ\text{C}$  | —    | —    | 520  | Amperes          |
|  |                       | $T_j = 25^\circ\text{C}$   | 264  | 311  | 430  | Amperes          |
|  |                       | $T_j = 125^\circ\text{C}$  | 158  | —    | —    | Amperes          |
| Over Current Trip Level Brake Part   | OC                    | $-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$             | 39   | 53   | —    | Amperes          |
| Short Circuit Trip Level Inverter Part   | SC                    | $-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ , $V_D = 15\text{V}$             | —    | 360  | —    | Amperes          |
| Short Circuit Trip Level Brake Part  |                       |  | —    | 79   | —    | Amperes          |
| Over Current Delay Time  | $t_{\text{off(OC)}}$  | $V_D = 15\text{V}$   | —    | 10   | —    | $\mu\text{S}$    |
| Over Temperature Protection ( $V_D = 15\text{V}$ )<br>(Lower Arm)                    | OT                    | Trip Level   | 111  | 118  | 125  | $^\circ\text{C}$ |
|  | $\text{OT}_R$         | Reset Level  | —    | 100  | —    | $^\circ\text{C}$ |
| Supply Circuit Under Voltage Protection<br>( $-20 \leq T_j \leq 125^\circ\text{C}$ ) | UV                    | Trip Level   | 11.5 | 12.0 | 12.5 | Volts            |
|  | $\text{UV}_R$         | Reset Level  | —    | 12.5 | —    | Volts            |
| Circuit Current  | $I_D$                 | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{N1}-V_{NC}$                 | —    | 44   | 60   | 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   | $V_{\text{CIN(on)}}$  | Applied between  | 1.2  | 1.5  | 1.8  | Volts            |
| Input OFF Threshold Voltage  | $V_{\text{CIN(off)}}$ | $U_P, V_P, W_P, U_N, V_N, W_N, B_r-V_{NC}$   | 1.7  | 2.0  | 2.3  | Volts            |
| Fault Output Current*  | $I_{\text{FO(H)}}$    | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$                                   | —    | —    | 0.01 | mA               |
|  | $I_{\text{FO(L)}}$    | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$                                   | —    | 10   | 15   | mA               |
| Minimum Fault Output Pulse Width*  | $t_{\text{FO}}$       | $V_D = 15\text{V}$   | 1.0  | 1.8  | —    | mS               |

\*Fault output is given only when the internal OC, SC, OT and UV protections schemes of either upper or lower device operate to protect it.



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### Thermal Characteristics

| Characteristic                      | Symbol         | Condition   | Min. | Typ. | Max.   | Units   |
|-------------------------------------|----------------|---|------|------|--------|---------|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | Each IGBT   | —    | —    | 0.38   | °C/Watt |
| Inverter Part                       | $R_{th(j-c)F}$ | Each FWDi   | —    | —    | 0.70   | °C/Watt |
|                                     | $R_{th(j-c)Q}$ | Each IGBT*  | —    | —    | 0.23** | °C/Watt |
|                                     | $R_{th(j-c)F}$ | Each FWDi*  | —    | —    | 0.36** | °C/Watt |
|                                     | $R_{th(j-c)Q}$ | Each IGBT   | —    | —    | 0.71   | °C/Watt |
| Brake Part                          | $R_{th(j-c)F}$ | Each FWDi   | —    | —    | 1.66   | °C/Watt |
|                                     | $R_{th(j-c)Q}$ | Each IGBT*  | —    | —    | 0.45** | °C/Watt |
|                                     | $R_{th(j-c)F}$ | Each FWDi*  | —    | —    | 0.96** | °C/Watt |
|                                     | $R_{th(c-f)}$  | Case to Fin Per Module,<br>Thermal Grease Applied | —    | —    | 0.027  | °C/Watt |

\* $T_C$  measured point is just under chip.

\*\*If you use this value,  $R_{th(f-a)}$  should be measured just under the chips.

### Recommended Conditions for Use

| Characteristic            | Symbol         | Condition  | Value       | Units |
|---------------------------|----------------|--|-------------|-------|
| Supply Voltage            | $V_{CC}$       | Applied across P-N Terminals   | 0 ~ 400     | Volts |
| Control Supply Voltage*** | $V_D$          | Applied between $V_{UP1}$ - $V_{UPC}$ ,<br>$V_{N1}$ - $V_{NC}$ , $V_{VP1}$ - $V_{VPC}$ , $V_{WP1}$ - $V_{WPC}$ | 15 ± 1.5    | Volts |
| Input ON Voltage          | $V_{CIN(on)}$  | Applied between  | 0 ~ 0.8     | Volts |
| Input OFF Voltage         | $V_{CIN(off)}$ | $U_P, V_P, W_P, U_N, V_N, W_N, B_r$ - $V_{NC}$   | 4.0 ~ $V_D$ | Volts |
| PWM Input Frequency       | $f_{PWM}$      | Using Application Circuit  | 5 ~ 20      | kHz   |
| Minimum Dead Time         | $t_{DEAD}$     | Input Signal   | ≥ 2.5       | μS    |

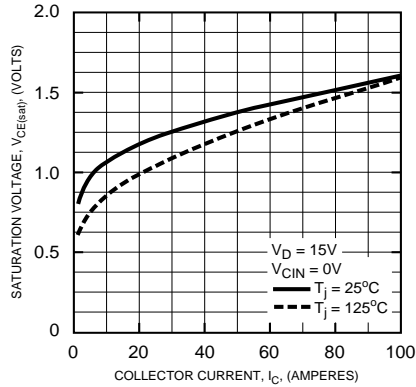
\*\*\* With ripple satisfying the following conditions:  $dv/dt$  swing ≤ ±5V/μs, Variation ≤ 2V peak to peak.



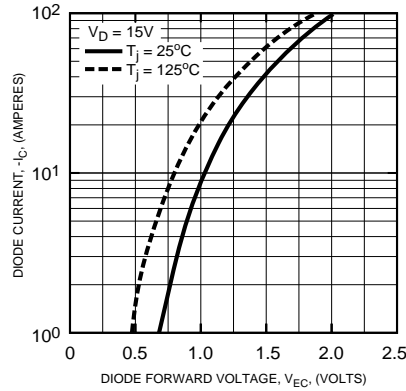
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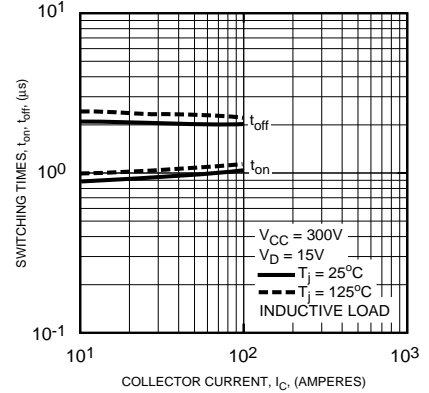
**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) (INVERTER PART)**



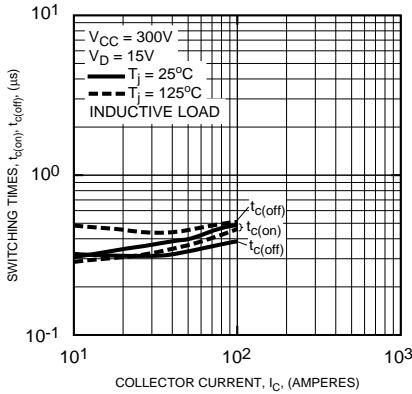
**DIODE FORWARD CHARACTERISTICS (INVERTER PART)**



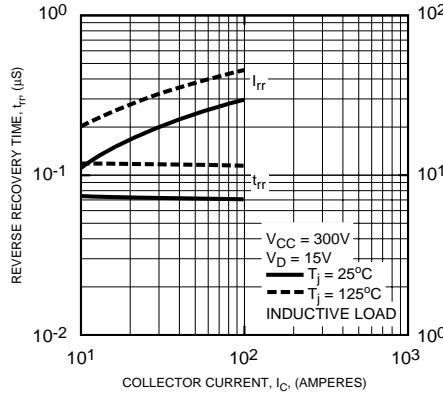
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



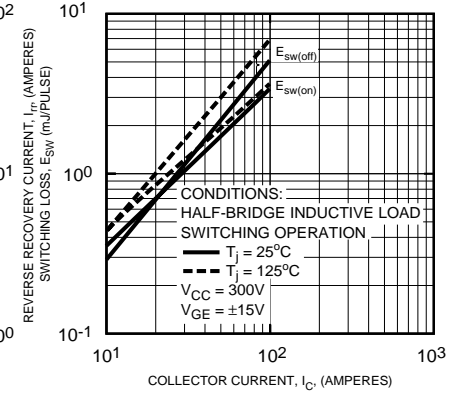
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



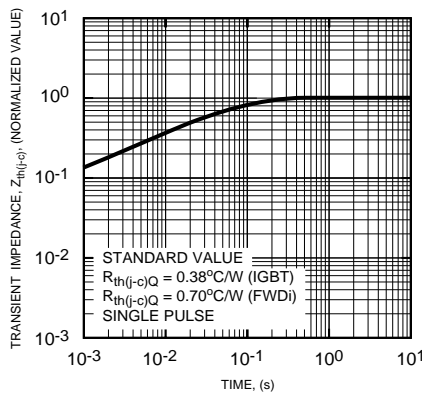
**REVERSE RECOVERY CURRENT VS. COLLECTOR CURRENT (TYPICAL)**



**SWITCHING LOSS CHARACTERISTICS**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi - INVERTER PART)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi - BRAKE PART)**

