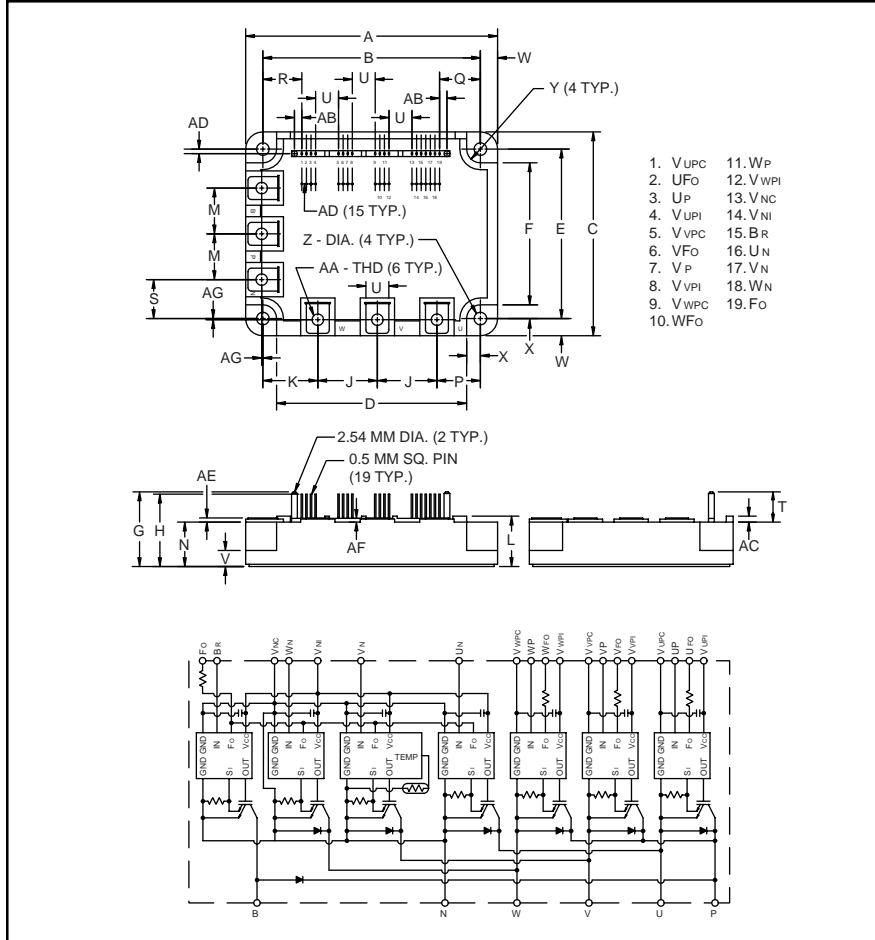


### Intellimod™ Module Three Phase + Brake IGBT Inverter Output 50 Amperes/1200 Volts



**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

- 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 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          | 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/-0.022.0 | +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          | 0.31      | 8.0         |
| 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      | 0.5         |

| Type | Current Rating<br>Amperes | V <sub>CE</sub><br>Volts (x 10) |
|------|---------------------------|---------------------------------|
| PM   | 50                        | 120                             |



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**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

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

| Characteristics  | 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  | —                      | 17         | in-lb            |
| Mounting Torque, M5 Main Terminal Screw  | —                      | 17         | in-lb            |
| 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, AC 1 minute, 60Hz Sinusoidal  | $V_{\text{RMS}}$       | 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 ( $U_P$ , $V_P$ , $W_P$ , $U_N$ , $V_N$ , $W_N$ , $B_r$ )  | $V_{\text{CIN}}$ | 20 | Volts |
| Fault Output Supply Voltage  | $V_{\text{FO}}$  | 20 | Volts |
| Fault Output Current   | $I_{\text{FO}}$  | 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, $\pm$   | $I_C$                  | 50   | Amperes |
| Peak Collector Current, $\pm$  | $I_{\text{CP}}$        | 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, $\pm$                      | $I_C$                  | 15   | Amperes |
| Peak Collector Current, $\pm$                 | $I_{\text{CP}}$        | 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   |

**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/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                    | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$  | 59   | 112  | —    | Amperes          |
| Over Current Trip Level Brake Part      |                       |  | 22   | 50   | —    | Amperes          |
| Short Circuit Trip Level Inverter Part  | SC                    | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$  | —    | 183  | —    | Amperes          |
| Short Circuit Trip Level Brake Part     |                       |  | —    | 95   | —    | 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                         | $I_D$                 | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{N1}}-V_{\text{NC}}$   | —    | 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             | $V_{\text{CIN(off)}}$ | $U_P, V_P, W_P, U_N, V_N, W_N, B_r$  | 1.7  | 2.0  | 2.3  | Volts            |
| PWM Input Frequency                     | $f_{\text{PWM}}$      | 3- $\emptyset$ 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               |



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**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

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

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|-----------------|--------|-----------------|------|------|------|-------|
|-----------------|--------|-----------------|------|------|------|-------|

**IGBT Inverter Sector**

|                                      |               |  |     |      |     |               |
|--------------------------------------|---------------|--|-----|------|-----|---------------|
| 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                | $V_{FM}$      | $-I_C = 50\text{A}, V_D = 15\text{V}, V_{CIN} = 5\text{V}$                         | —   | 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 | $\mu\text{S}$ |
|                                      | $t_{rr}$      | $V_D = 15\text{V}, V_{CIN} = 0 \sim 15\text{V}$                                    | —   | 0.15 | 0.3 | $\mu\text{S}$ |
|                                      | $t_{C(on)}$   | $V_{CC} = 600\text{V}, I_C = 50\text{A}$   | —   | 0.4  | 1.0 | $\mu\text{S}$ |
|                                      | $t_{off}$     | $T_j = 125^\circ\text{C}$  | —   | 2.5  | 3.5 | $\mu\text{S}$ |
|                                      | $t_{C(off)}$  |  | —   | 0.7  | 1.2 | $\mu\text{S}$ |

**Brake Sector**

|                                      |               |  |   |     |     |       |
|--------------------------------------|---------------|--|---|-----|-----|-------|
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A}, T_j = 25^\circ\text{C}$  | — | 2.8 | 3.8 | Volts |
|                                      |               | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A}, T_j = 125^\circ\text{C}$ | — | 2.5 | 3.5 | 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    |



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**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

### 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 |
|                                     | $R_{th(j-c)D}$ | Each Inverter FWDi                                | —    | —    | 1.0   | °C/Watt |
|                                     | $R_{th(c-f)Q}$ | Each Brake IGBT                                   | —    | —    | 0.9   | °C/Watt |
|                                     | $R_{th(c-f)D}$ | Each Brake FWDi                                   | —    | —    | 2.0   | °C/Watt |
| Contact Thermal Resistance          | $R_{th(c-f)}$  | Case to Fin Per Module,<br>Thermal Grease Applied | —    | —    | 0.027 | °C/Watt |

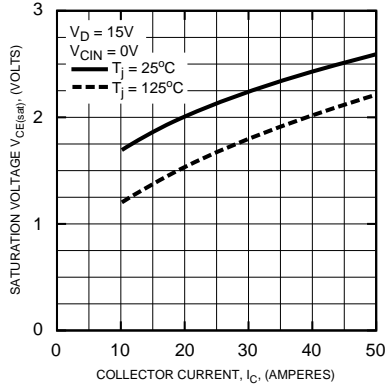
### Recommended Conditions for Use

| Characteristic      | Symbol         | Condition  | Value          | Units   |
|---------------------|----------------|--|----------------|---------|
| Supply Voltage      | $V_{CC}$       | Applied across P-N Terminals   | 0 ~ 800        | Volts   |
|                     | $V_D$          | Applied between $V_{UP1}$ - $V_{UPC}$ ,<br>$V_{N1}$ - $V_{NC}$ , $V_{VP1}$ - $V_{VPC}$ , $V_{WP1}$ - $V_{WPC}$ | $15 \pm 1.5$   | Volts   |
| Input ON Voltage    | $V_{CIN(on)}$  | Applied between  | 0 ~ 0.8        | Volts   |
| Input OFF Voltage   | $V_{CIN(off)}$ | $U_P$ , $V_P$ , $W_P$ , $U_N$ , $V_N$ , $W_N$ , $B_r$  | $4.0 \sim V_D$ | Volts   |
| PWM Input Frequency | $f_{PWM}$      | Using Application Circuit  | 5 ~ 20         | kHz     |
| Minimum Dead Time   | $t_{DEAD}$     | Input Signal   | $\geq 3.0$     | $\mu S$ |

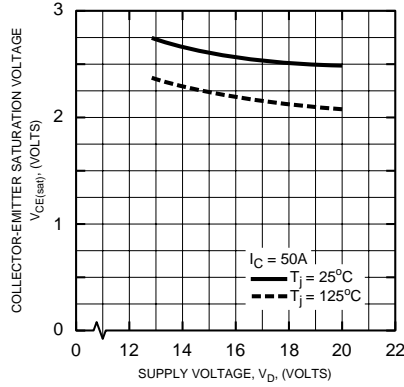
**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

**Inverter Part**

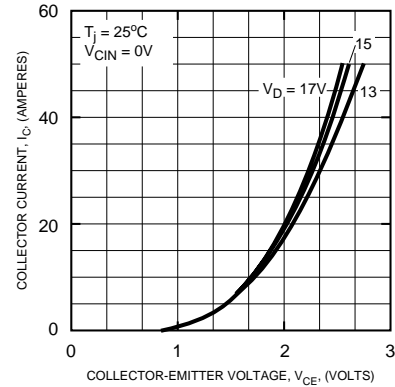
**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



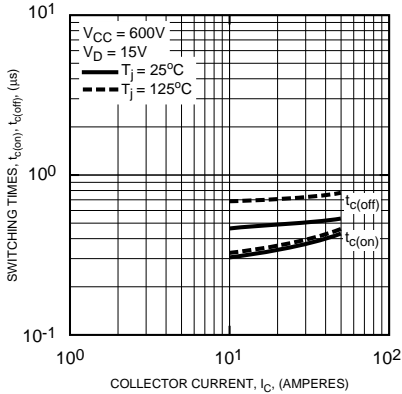
**COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)**



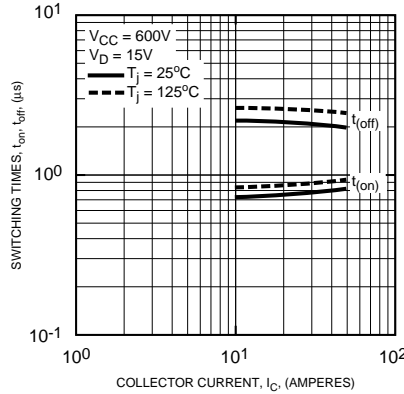
**OUTPUT CHARACTERISTICS (TYPICAL)**



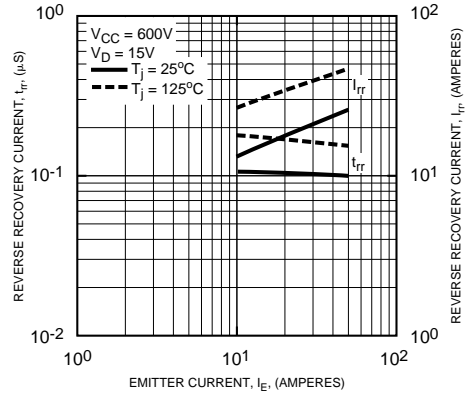
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



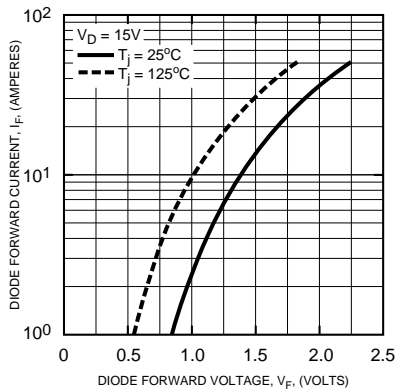
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)**



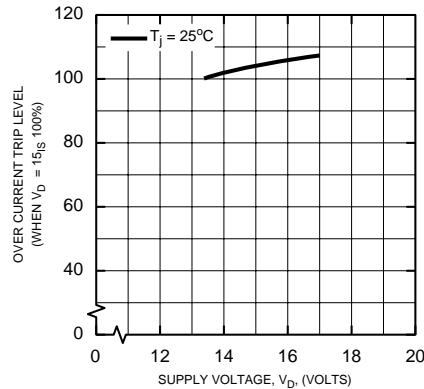
**REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)**



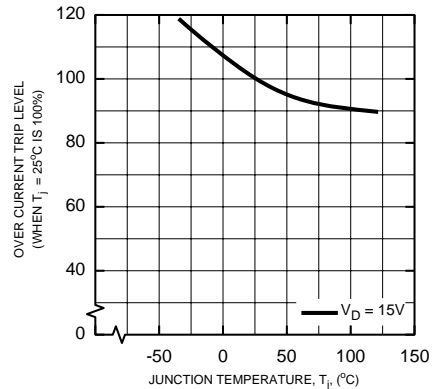
**DIODE FORWARD CHARACTERISTICS**



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

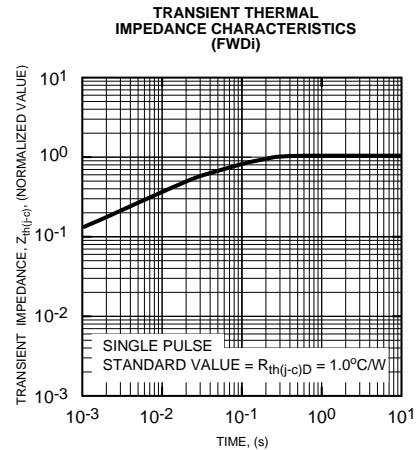
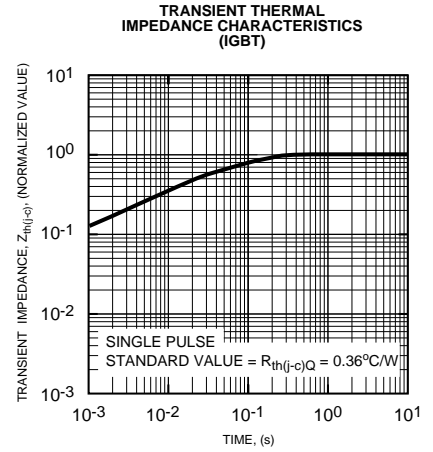
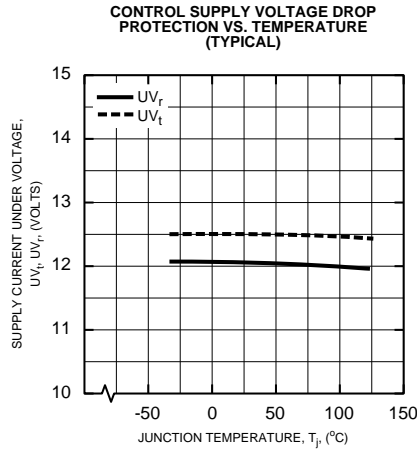
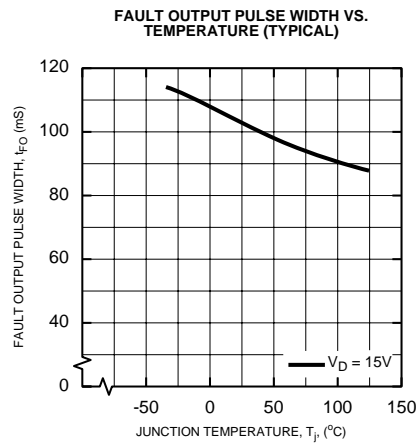


**OVER CURRENT TRIP LEVEL VS. TEMPERATURE (TYPICAL)**



**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

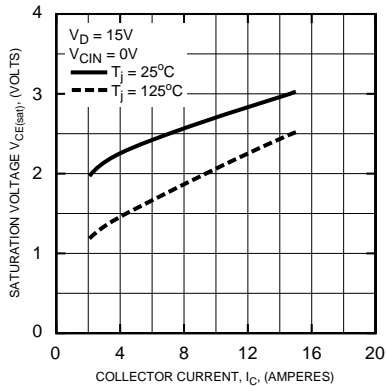
**Inverter Part**



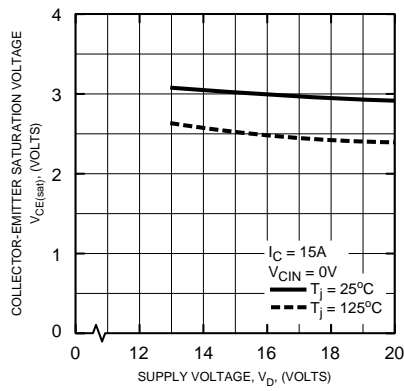
**PM50RSA120**  
**Intellimod™ Module**  
**Three Phase + Brake IGBT Inverter Output**  
**50 Amperes/1200 Volts**

**Brake Part**

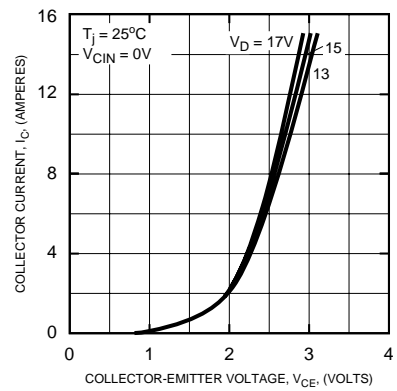
**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



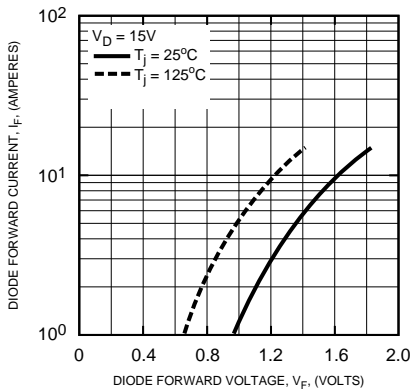
**COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)**



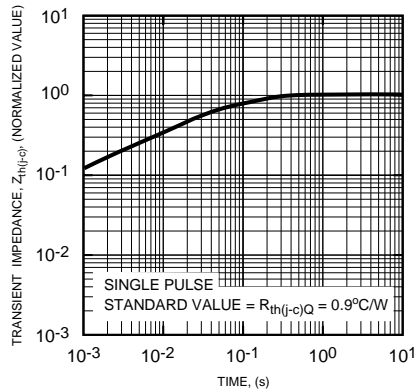
**OUTPUT CHARACTERISTICS (TYPICAL)**



**DIODE FORWARD CHARACTERISTICS (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWD)**

