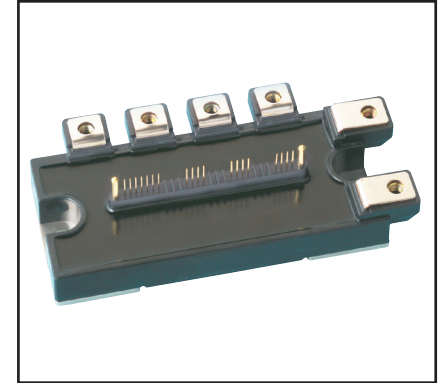
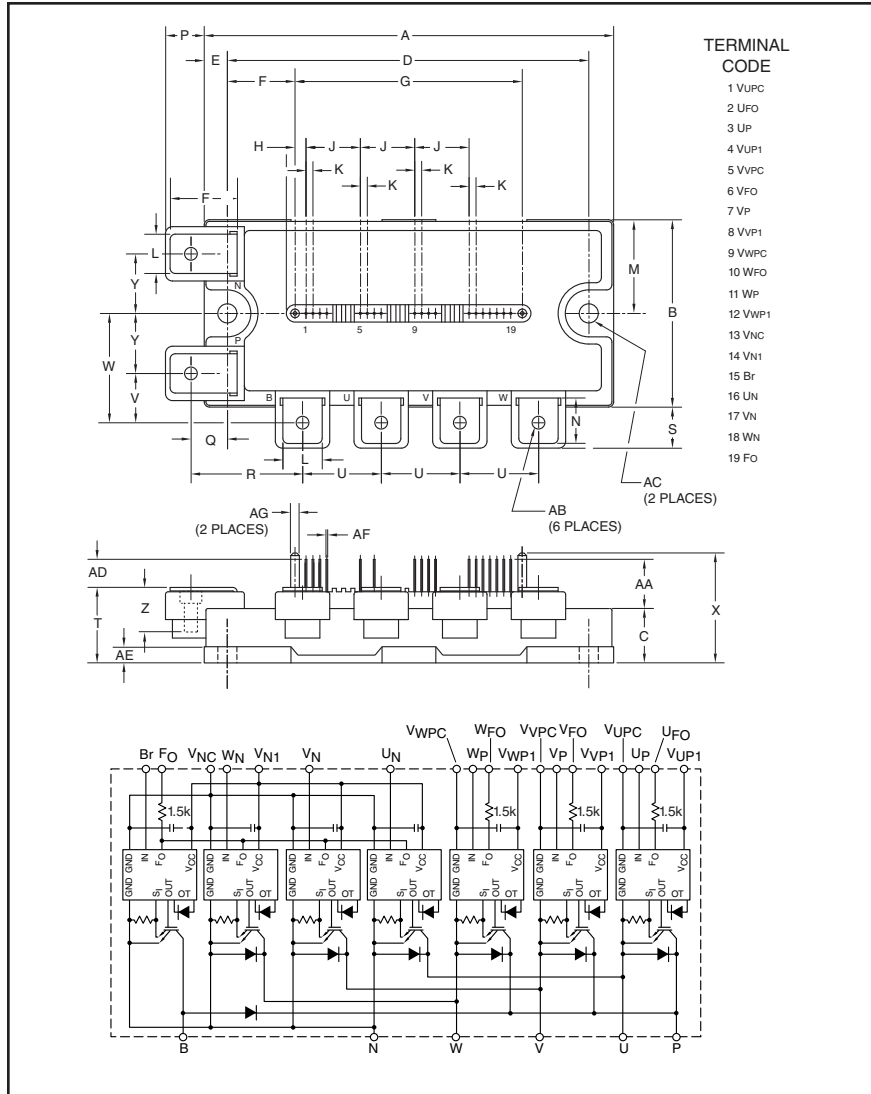


### Intellimod™ L1-Series Three Phase IGBT Inverter + Brake 100 Amperes/600 Volts



#### 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 Temperature Using On-chip Temperature Sensing
  - Under Voltage
- ☐ Low Loss Using 5th 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. PM100RL1A060 is a 600V, 100 Ampere Intellimod™ Intelligent Power Module.

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

#### Outline Drawing and Circuit Diagram

| Dimensions | Inches | Millimeters |
|------------|--------|-------------|
| A          | 4.72   | 120.0       |
| B          | 2.17   | 55.0        |
| C          | 0.63   | 16.0        |
| D          | 4.17   | 106.0       |
| E          | 0.28   | 7.0         |
| F          | 0.78   | 19.75       |
| G          | 2.62   | 66.5        |
| H          | 0.13   | 3.25        |
| J          | 0.63   | 16.0        |
| K          | 0.08   | 2.0         |
| L          | 0.47   | 12.0        |
| M          | 1.08   | 27.5        |
| N          | 0.57   | 13.5        |
| P          | 0.43   | 11.0        |
| Q          | 0.42   | 10.75       |
| R          | 1.29   | 32.75       |

| Dimensions | Inches         | Millimeters   |
|------------|----------------|---------------|
| S          | 0.46           | 11.75         |
| T          | 0.86+0.04/0.02 | 22.0+1.0/-0.5 |
| U          | 0.91           | 23.0          |
| V          | 0.57           | 14.5          |
| W          | 1.26           | 32.0          |
| X          | 1.24           | 31.5          |
| Y          | 0.69           | 17.5          |
| Z          | Screw Depth 12 |               |
| AA         | 0.51           | 13.0          |
| AB         | M5 Metric      | M5            |
| AC         | 0.22 Dia.      | 5.5 Dia.      |
| AD         | 0.28           | 7.0           |
| AE         | 0.12           | 3.0           |
| AF         | 0.02 Sq.       | 0.5 Sq.       |
| AG         | 0.10 Dia.      | 2.5 Dia.      |

## PM100RL1A060

### Intellimod™ L1-Series

#### Three Phase IGBT Inverter + Brake

100 Amperes/600 Volts

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

| Characteristics                                                             | Symbol                 | PM100RL1A060 | Units            |
|-----------------------------------------------------------------------------|------------------------|--------------|------------------|
| Power Device Junction Temperature                                           | $T_j$                  | -20 to 150   | $^\circ\text{C}$ |
| Storage Temperature                                                         | $T_{\text{stg}}$       | -40 to 125   | $^\circ\text{C}$ |
| Mounting Torque, M5 Mounting Screws                                         | —                      | 31           | in-lb            |
| Mounting Torque, M5 Main Terminal Screws                                    | —                      | 31           | in-lb            |
| Module Weight (Typical)                                                     | —                      | 380          | Grams            |
| Supply Voltage, Surge (Applied between P - N)                               | $V_{\text{CC(surge)}}$ | 500          | Volts            |
| Self-protection Supply Voltage Limit (Short Circuit protection Capability)* | $V_{\text{CC(prot.)}}$ | 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 ( $T_C = 25^\circ\text{C}$ ) (Note 1)                          | $\pm I_C$           | 100 | Amperes |
| Peak Collector Current ( $T_C = 25^\circ\text{C}$ )                              | $\pm I_{\text{CP}}$ | 200 | Amperes |
| Collector Dissipation ( $T_C = 25^\circ\text{C}$ ) (Note 1)                      | $P_C$               | 390 | Watts   |

### IGBT Brake Sector

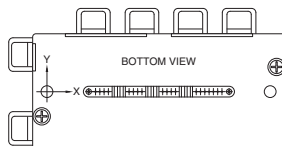
|                                                                                  |                     |     |         |
|----------------------------------------------------------------------------------|---------------------|-----|---------|
| Collector-Emitter Voltage ( $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ ) | $V_{\text{CES}}$    | 600 | Volts   |
| Collector Current ( $T_C = 25^\circ\text{C}$ ) (Note 1)                          | $\pm I_C$           | 50  | Amperes |
| Peak Collector Current ( $T_C = 25^\circ\text{C}$ )                              | $\pm I_{\text{CP}}$ | 100 | Amperes |
| Collector Dissipation ( $T_C = 25^\circ\text{C}$ ) (Note 1)                      | $P_C$               | 284 | Watts   |
| Diode Forward Current                                                            | $I_F$               | 50  | Amperes |
| Diode Rated DC Reverse Voltage ( $T_C = 25^\circ\text{C}$ )                      | $V_{\text{R(DC)}}$  | 600 | 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 $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ , $U_N-V_N-W_N-Br-V_{\text{NC}}$ )                                     | $V_{\text{CIN}}$ | 20 | Volts |
| Fault Output Supply Voltage<br>(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 ( $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ , $F_O$ Terminals)                                                                            | $I_{\text{FO}}$  | 20 | mA    |

\* $V_D = 13.5 \sim 16.5\text{V}$ , Inverter Part,  $T_j = 125^\circ\text{C}$

Note 1:  $T_C$  (under the chip) Measurement Point



| Arm<br>Axis | UP   |      | VP   |      | WP   |      | UN   |      | VN   |      | WN   |      | Br   |      |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|             | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi |
| X           | 28.6 | 28.6 | 65.4 | 65.4 | 87.4 | 87.4 | 38.6 | 38.6 | 54.6 | 54.6 | 76.6 | 76.6 | 18.0 | 19.3 |
| Y           | -9.0 | -0.4 | -9.0 | -0.4 | -9.0 | -0.4 | 6.5  | -1.1 | 6.5  | -1.1 | 6.5  | -1.1 | -8.5 | 5.4  |

**PM100RL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter + Brake**  
**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   |
|--------------------------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------|
| IGBT Inverter Sector                                   |                      |                                                                                                                                            |      |      |      |         |
| Collector-Emitter Saturation Voltage                   | V <sub>CE(sat)</sub> | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V, I <sub>C</sub> = 100A, T <sub>j</sub> = 25°C                                                  | —    | 1.75 | 2.35 | Volts   |
|                                                        |                      | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V, I <sub>C</sub> = 100A, T <sub>j</sub> = 125°C                                                 | —    | 1.75 | 2.35 | Volts   |
| Diode Forward Voltage                                  | V <sub>EC</sub>      | -I <sub>C</sub> = 100A, V <sub>CIN</sub> = 15V, V <sub>D</sub> = 15V                                                                       | —    | 1.7  | 2.8  | Volts   |
| Inductive Load Switching Times                         | t <sub>on</sub>      | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0 ⇔ 15V<br>V <sub>CC</sub> = 300V, I <sub>C</sub> = 100A<br>T <sub>j</sub> = 125°C                | 0.3  | 0.8  | 2.0  | μs      |
|                                                        | t <sub>rr</sub>      |                                                                                                                                            | —    | 0.4  | 0.8  | μs      |
|                                                        | t <sub>C(on)</sub>   |                                                                                                                                            | —    | 0.4  | 1.0  | μs      |
|                                                        | t <sub>off</sub>     |                                                                                                                                            | —    | 1.0  | 2.3  | μs      |
|                                                        | t <sub>C(off)</sub>  |                                                                                                                                            | —    | 0.3  | 1.0  | μs      |
| Collector-Emitter Cutoff Current                       | I <sub>CES</sub>     | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>D</sub> = 15V, T <sub>j</sub> = 25°C                                                           | —    | —    | 1.0  | mA      |
|                                                        |                      | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>D</sub> = 15V, T <sub>j</sub> = 125°C                                                          | —    | —    | 10   | mA      |
| IGBT Brake Sector                                      |                      |                                                                                                                                            |      |      |      |         |
| Collector-Emitter Saturation Voltage                   | V <sub>CE(sat)</sub> | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V, I <sub>C</sub> = 50A, T <sub>j</sub> = 25°C                                                   | —    | 1.75 | 2.35 | Volts   |
|                                                        |                      | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V, I <sub>C</sub> = 50A, T <sub>j</sub> = 125°C                                                  | —    | 1.75 | 2.35 | Volts   |
| Forward Voltage                                        | V <sub>FM</sub>      | I <sub>F</sub> = 50A                                                                                                                       | —    | 1.7  | 2.8  | Volts   |
| Collector-Emitter Cutoff Current                       | I <sub>CES</sub>     | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>D</sub> = 15V, T <sub>j</sub> = 25°C                                                           | —    | —    | 1.0  | mA      |
|                                                        |                      | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>D</sub> = 15V, T <sub>j</sub> = 125°C                                                          | —    | —    | 10   | mA      |
| Control Sector                                         |                      |                                                                                                                                            |      |      |      |         |
| Circuit Current                                        | I <sub>D</sub>       | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V, V <sub>N1</sub> -V <sub>NC</sub>                                                             | —    | 8    | 16   | mA      |
|                                                        |                      | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V, V <sub>XP1</sub> -V <sub>XPC</sub>                                                           | —    | 2    | 4    | mA      |
| Input ON Threshold Voltage                             | V <sub>th(on)</sub>  | Applied between U <sub>P</sub> -V <sub>UPC</sub> ,                                                                                         | 1.2  | 1.5  | 1.8  | Volts   |
| Input OFF Threshold Voltage                            | V <sub>th(off)</sub> | V <sub>P</sub> -V <sub>VPC</sub> , W <sub>P</sub> -V <sub>WPC</sub> , U <sub>N</sub> - V <sub>N</sub> - W <sub>N</sub> -Br-V <sub>NC</sub> | 1.7  | 2.0  | 2.3  | Volts   |
| Short Circuit Trip Level                               | SC                   | Inverter Part                                                                                                                              | 200  | —    | —    | Amperes |
| (-20°C ≤ T <sub>j</sub> ≤ 125°C, V <sub>D</sub> = 15V) |                      | Brake Part                                                                                                                                 | 100  | —    | —    | Amperes |
| Short Circuit Current Delay Time                       | t <sub>off(SC)</sub> | V <sub>D</sub> = 15V                                                                                                                       | —    | 0.2  | —    | μs      |
| Over Temperature Protection                            | OT                   | Trip Level                                                                                                                                 | 135  | —    | —    | °C      |
| (Detect T <sub>j</sub> of IGBT Chip)                   | OT <sub>(hys)</sub>  | Reset Level                                                                                                                                | —    | 20   | —    | °C      |
| Supply Circuit Under-voltage Protection                | UV                   | Trip Level                                                                                                                                 | 11.5 | 12.0 | 12.5 | Volts   |
| (-20 ≤ T <sub>j</sub> ≤ 125°C)                         | UV <sub>R</sub>      | Reset Level                                                                                                                                | —    | 12.5 | —    | Volts   |
| Fault Output Current*                                  | I <sub>FO(H)</sub>   | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V                                                                                               | —    | —    | 0.01 | mA      |
|                                                        | I <sub>FO(L)</sub>   | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V                                                                                               | —    | 10   | 15   | mA      |
| Fault Output Pulse Width*                              | t <sub>FO</sub>      | V <sub>D</sub> = 15V                                                                                                                       | 1.0  | 1.8  | —    | ms      |

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



Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272 www.pwr.com

PM100RL1A060

Intellimod™ L1-Series

Three Phase IGBT Inverter + Brake

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 |
|-----------------|--------|-----------------|------|------|------|-------|
|-----------------|--------|-----------------|------|------|------|-------|

## Thermal Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

| Characteristic                      | Symbol         | Condition                                                  | Min. | Typ. | Max.  | Units                 |
|-------------------------------------|----------------|------------------------------------------------------------|------|------|-------|-----------------------|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | IGBT (Per 1 Element) (Note 1)                              | —    | —    | 0.32* | $^\circ\text{C/Watt}$ |
| Inverter Part                       | $R_{th(j-c)D}$ | FWDi (Per 1 Element) (Note 1)                              | —    | —    | 0.52* | $^\circ\text{C/Watt}$ |
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | IGBT (Note 1)                                              | —    | —    | 0.44* | $^\circ\text{C/Watt}$ |
| Brake Part                          | $R_{th(j-c)D}$ | FWDi (Note 1)                                              | —    | —    | 0.75* | $^\circ\text{C/Watt}$ |
| Contact Thermal Resistance          | $R_{th(c-f)}$  | Case to Fin Per Module,<br>Thermal Grease Applied (Note 1) | —    | —    | 0.038 | $^\circ\text{C/Watt}$ |

## Recommended Conditions for Use

| Characteristic                  | Symbol         | Condition                                                                                                      | Value          | Units         |
|---------------------------------|----------------|----------------------------------------------------------------------------------------------------------------|----------------|---------------|
| Supply Voltage                  | $V_{CC}$       | Applied across P-N Terminals                                                                                   | $\leq 400$     | Volts         |
| Control Supply Voltage**        | $V_D$          | Applied between $V_{UP1}$ - $V_{UPC}$ ,<br>$V_{VP1}$ - $V_{VPC}$ , $V_{WP1}$ - $V_{WPC}$ , $V_{N1}$ - $V_{NC}$ | $15.0 \pm 1.5$ | Volts         |
| Input ON Voltage                | $V_{CIN(on)}$  | Applied between $U_P$ - $V_{UPC}$ ,                                                                            | $\leq 0.8$     | Volts         |
| Input OFF Voltage               | $V_{CIN(off)}$ | $V_P$ - $V_{VPC}$ , $W_P$ - $V_{WPC}$ , $U_N$ - $V_{NC}$ , $W_N$ - $Br$ - $V_{NC}$                             | $\geq 9.0$     | Volts         |
| PWM Input Frequency             | $f_{PWM}$      | —                                                                                                              | $\leq 20$      | kHz           |
| Arm Shoot-through Blocking Time | $t_{DEAD}$     | Input Signal                                                                                                   | $\geq 2.0$     | $\mu\text{s}$ |

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

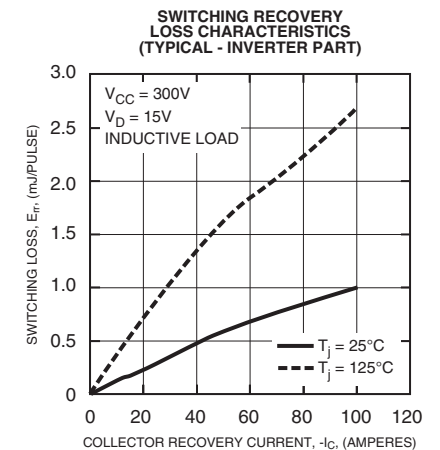
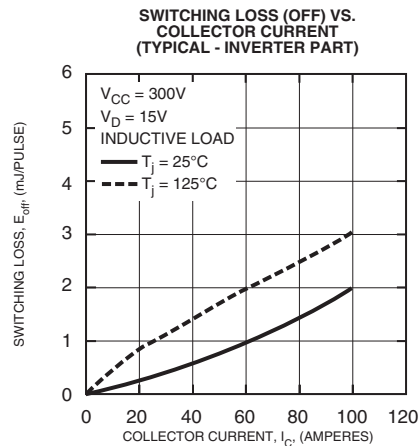
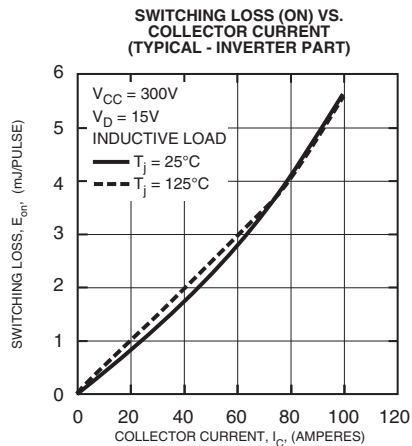
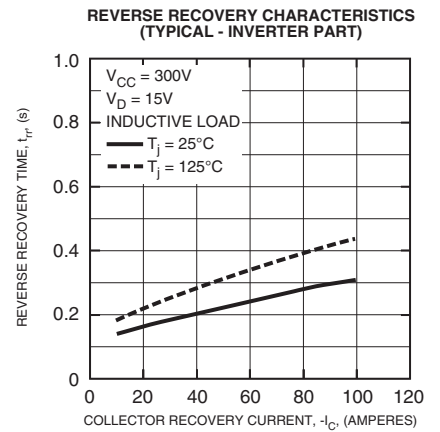
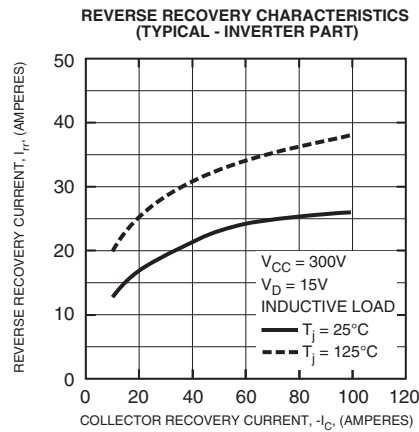
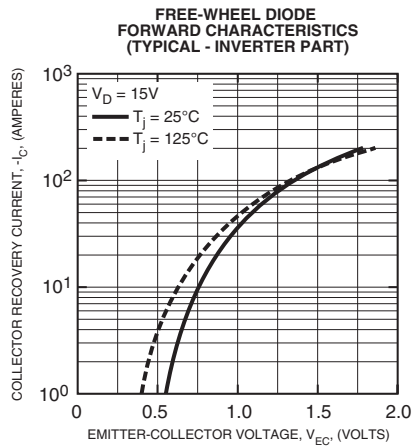
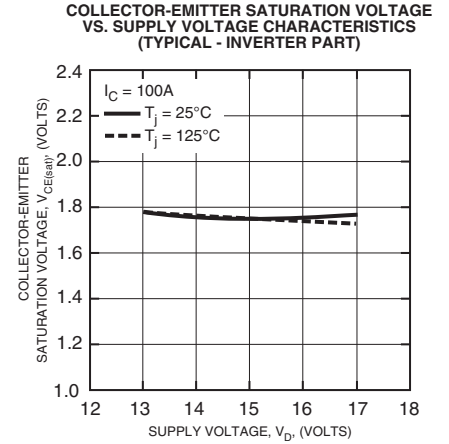
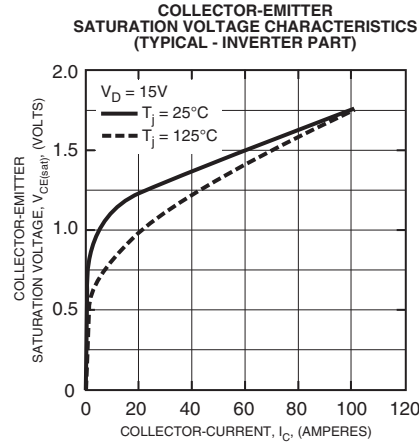
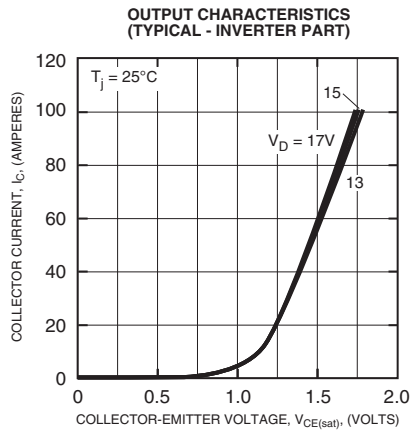
\*\* With ripple satisfying the following conditions:  $dv/dt$  swing  $\leq \pm 5V/\mu\text{s}$ , Variation  $\leq 2V$  peak to peak.

## PM100RL1A060

### Intellimod™ L1-Series

### Three Phase IGBT Inverter + Brake

100 Amperes/600 Volts



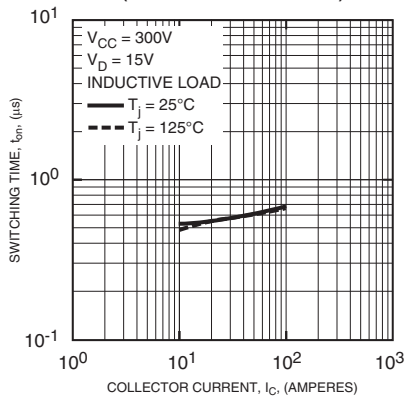
## PM100RL1A060

### Intellimod™ L1-Series

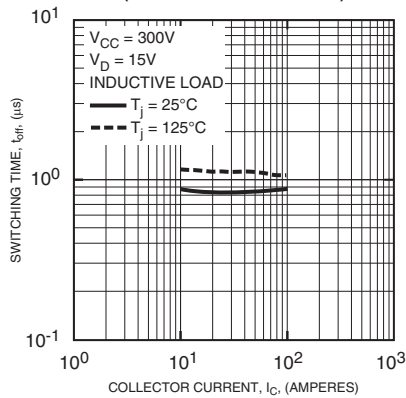
### Three Phase IGBT Inverter + Brake

100 Amperes/600 Volts

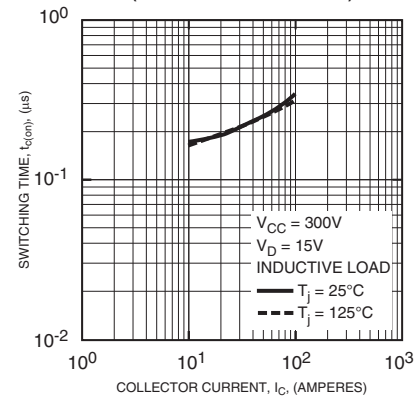
SWITCHING TIME (ON) VS.  
COLLECTOR CURRENT  
(TYPICAL - INVERTER PART)



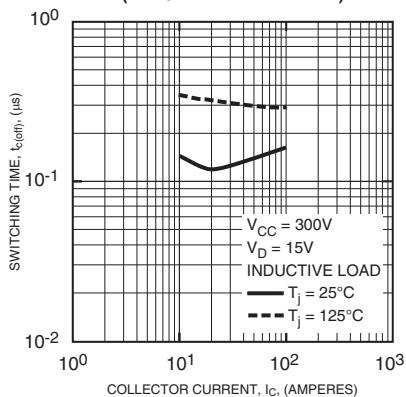
SWITCHING TIME (OFF) VS.  
COLLECTOR CURRENT  
(TYPICAL - INVERTER PART)



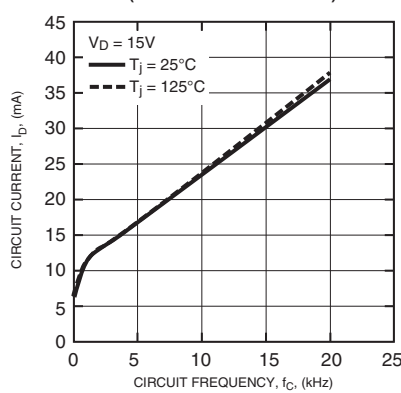
SWITCHING TIME (ON) VS.  
COLLECTOR CURRENT  
(TYPICAL - INVERTER PART)



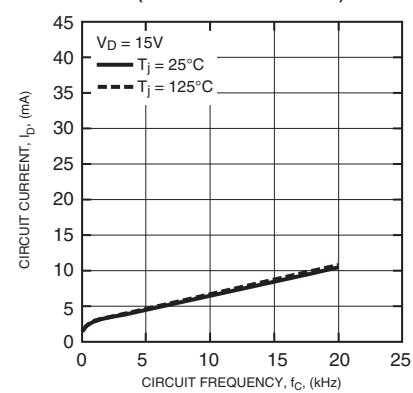
SWITCHING TIME (OFF) VS.  
COLLECTOR CURRENT  
(TYPICAL - INVERTER PART)



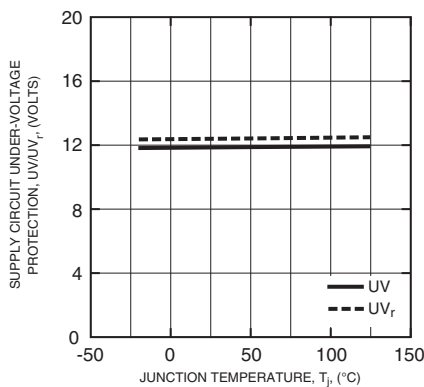
CIRCUIT CURRENT VS.  
CARRIER FREQUENCY CHARACTERISTICS  
(N-SIDE - INVERTER PART)



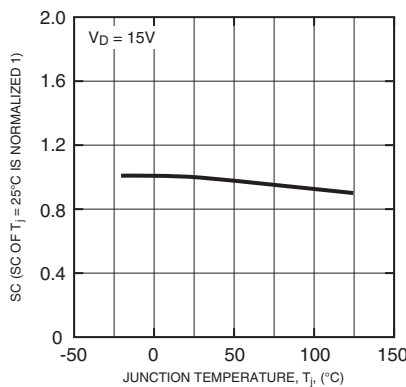
CIRCUIT CURRENT VS.  
CARRIER FREQUENCY CHARACTERISTICS  
(P-SIDE - INVERTER PART)



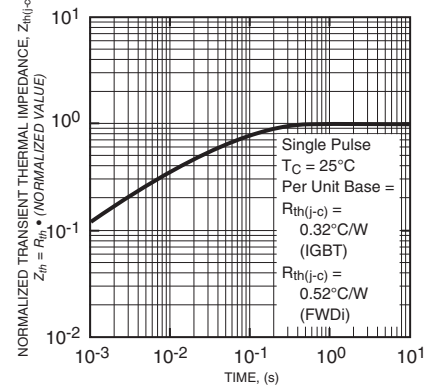
SUPPLY CIRCUIT UNDER-VOLTAGE  
PROTECTION CHARACTERISTICS  
(TYPICAL - INVERTER PART)



SHORT CIRCUIT TRIP LEVEL  
CHARACTERISTICS  
(TYPICAL - INVERTER PART)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(IGBT & FWDI - INVERTER PART)



## PM100RL1A060

### Intellimod™ L1-Series

### Three Phase IGBT Inverter + Brake

100 Amperes/600 Volts

