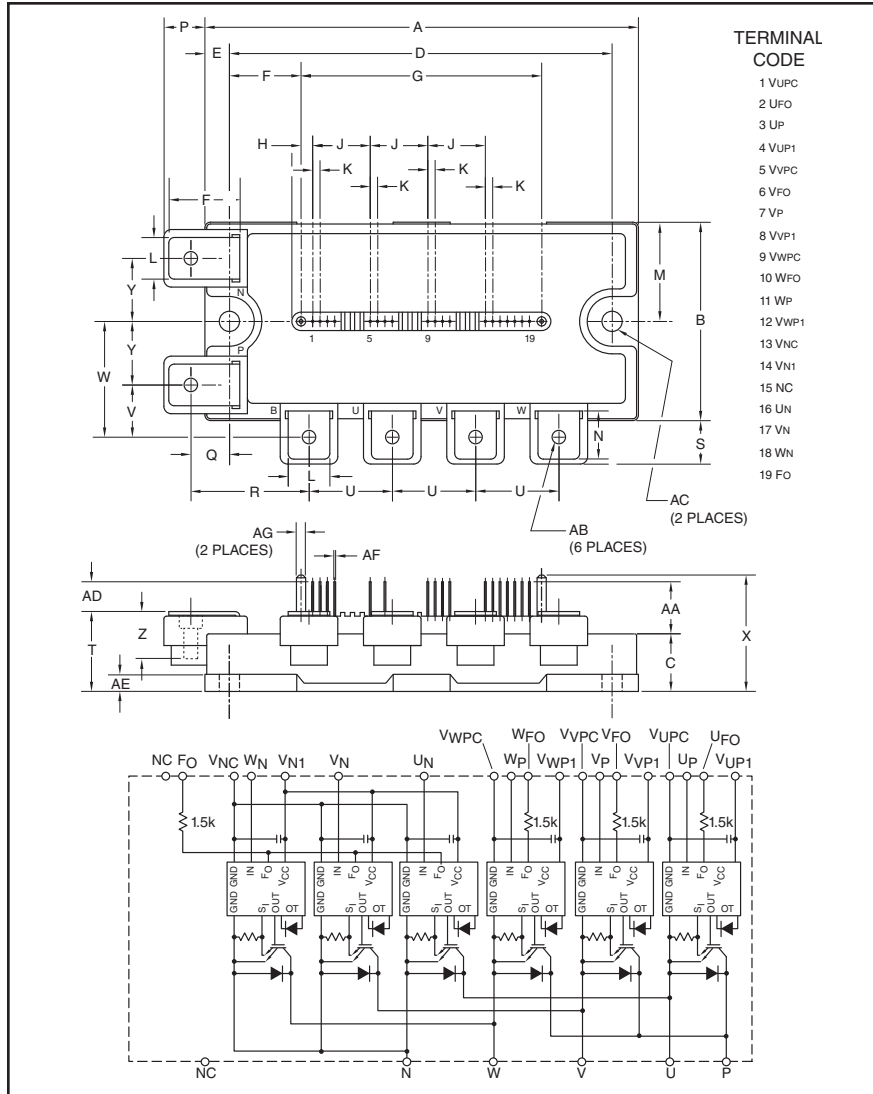
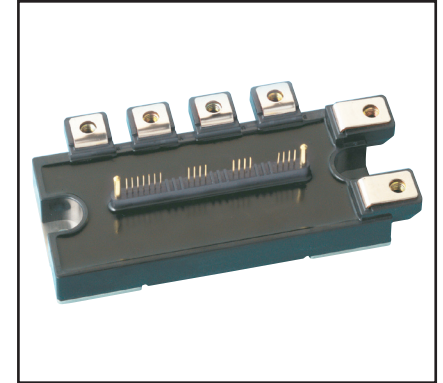


### Intellimod™ L1-Series Three Phase IGBT Inverter 50 Amperes/600 Volts



#### 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 Full Gate CSTBT™ IGBT Chip

#### Applications:

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

#### Ordering Information:

Example: Select the complete part number from the table below -i.e. PM50CL1A060 is a 600V, 50 Ampere Intellimod™ Intelligent Power Module.

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

**PM50CL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter**  
50 Amperes/600 Volts

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

| Characteristics                                                  | Symbol                 | PM50CL1A060 | 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            |
| Supply Voltage Protected by 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)                          | $\pm I_C$           | 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   |

**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 $U_P-V_{\text{UPC}}$ , $V_P-V_{\text{VPC}}$ , $W_P-V_{\text{WPC}}$ , $U_N-V_{\text{NC}}$ , $V_N-V_{\text{NC}}$ )                          | $V_{\text{CIN}}$ | 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 (Sink Current at $U_{\text{FO}}$ , $V_{\text{FO}}$ , $W_{\text{FO}}$ , $F_O$ Terminals)                                                             | $I_{\text{FO}}$  | 20 | mA    |

**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-Emitter Saturation Voltage | $V_{\text{CE(sat)}}$ | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 0\text{V}$ , $I_C = 50\text{A}$ ,<br>$T_j = 25^\circ\text{C}$                                                    | —    | 1.75 | 2.35 | Volts         |
|                                      |                      | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 0\text{V}$ , $I_C = 50\text{A}$ ,<br>$T_j = 125^\circ\text{C}$                                                   | —    | 1.75 | 2.35 | Volts         |
| Diode Forward Voltage                | $V_{\text{EC}}$      | $-I_C = 50\text{A}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_D = 15\text{V}$                                                                                | —    | 1.7  | 2.8  | Volts         |
| Inductive Load Switching Times       | $t_{\text{on}}$      | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 0 \leftrightarrow 15\text{V}$<br>$V_{\text{CC}} = 300\text{V}$ , $I_C = 50\text{A}$<br>$T_j = 125^\circ\text{C}$ | 0.3  | 0.8  | 2.0  | $\mu\text{s}$ |
|                                      | $t_{\text{rr}}$      |                                                                                                                                                         | —    | 0.4  | 0.8  | $\mu\text{s}$ |
|                                      | $t_{\text{C(on)}}$   |                                                                                                                                                         | —    | 0.4  | 1.0  | $\mu\text{s}$ |
|                                      | $t_{\text{off}}$     |                                                                                                                                                         | —    | 1.0  | 2.3  | $\mu\text{s}$ |
|                                      | $t_{\text{C(off)}}$  |                                                                                                                                                         | —    | 0.3  | 1.0  | $\mu\text{s}$ |
| Collector-Emitter Cutoff Current     | $I_{\text{CES}}$     | $V_{\text{CE}} = V_{\text{CES}}$ , $V_D = 15\text{V}$ , $T_j = 25^\circ\text{C}$                                                                        | —    | —    | 1.0  | mA            |
|                                      |                      | $V_{\text{CE}} = V_{\text{CES}}$ , $V_D = 15\text{V}$ , $T_j = 125^\circ\text{C}$                                                                       | —    | —    | 10   | mA            |

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

**PM50CL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter**  
**50 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>Control Sector</b>                                                                |               |                                                                       |      |      |      |                  |
| Circuit Current                                                                      | $I_D$         | $V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{N1}-V_{NC}$               | —    | 6    | 12   | mA               |
|                                                                                      |               | $V_D = 15\text{V}, V_{CIN} = 15\text{V}, V_{P1}-V_{PC}$               | —    | 2    | 4    | mA               |
| Input ON Threshold Voltage                                                           | $V_{th(on)}$  | Applied between $U_P-V_{UPC}$ ,                                       | 1.2  | 1.5  | 1.8  | Volts            |
| Input OFF Threshold Voltage                                                          | $V_{th(off)}$ | $V_P-V_{VPC}, W_P-V_{WPC}, U_N-V_N, W_N-V_{NC}$                       | 1.7  | 2.0  | 2.3  | Volts            |
| Short Circuit Trip Level                                                             | SC            | $-20^\circ\text{C} \leq T_j \leq 125^\circ\text{C}, V_D = 15\text{V}$ | 100  | —    | —    | Amperes          |
| Short Circuit Current Delay Time                                                     | $t_{off(SC)}$ | $V_D = 15\text{V}$                                                    | —    | 0.2  | —    | $\mu\text{s}$    |
| Over Temperature Protection<br>(Detect $T_j$ of IGBT Chip)                           | OT            | Trip Level                                                            | 135  | —    | —    | $^\circ\text{C}$ |
|                                                                                      | $OT_{(hys)}$  | Hysteresis Level                                                      | —    | 20   | —    | $^\circ\text{C}$ |
| 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            |
|                                                                                      | $UV_R$        | Reset Level                                                           | —    | 12.5 | —    | Volts            |
| Fault Output Current*                                                                | $I_{FO(H)}$   | $V_D = 15\text{V}, V_{CIN} = 15\text{V}$                              | —    | —    | 0.01 | mA               |
|                                                                                      | $I_{FO(L)}$   | $V_D = 15\text{V}, V_{CIN} = 15\text{V}$                              | —    | 10   | 15   | mA               |
| Fault Output Pulse Width*                                                            | $t_{FO}$      | $V_D = 15\text{V}$                                                    | 1.0  | 1.8  | —    | ms               |

**Thermal Characteristics**

| Characteristic                      | Symbol         | Condition                                                  | Min. | Typ. | Max.  | Units                 |
|-------------------------------------|----------------|------------------------------------------------------------|------|------|-------|-----------------------|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | IGBT (Per 1 Element) (Note 1)                              | —    | —    | 0.44  | $^\circ\text{C/Watt}$ |
|                                     | $R_{th(j-c)D}$ | FWDi (Per 1 Element) (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 | $^\circ\text{C/Watt}$ |

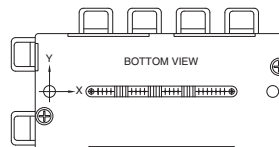
**Recommended Conditions for Use**

| 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               | $V_{CIN(off)}$ | $V_P-V_{VPC}, W_P-V_{WPC}, U_N-V_N, W_N-V_{NC}$                                          | $\geq 9.0$     | Volts         |
| PWM Input Frequency             | $f_{PWM}$      | —                                                                                        | $\leq 20$      | kHz           |
| Arm Shoot-through Blocking Time | $t_{DEAD}$     | Input Signal                                                                             | $\geq 2.0$     | $\mu\text{s}$ |

\*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.

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

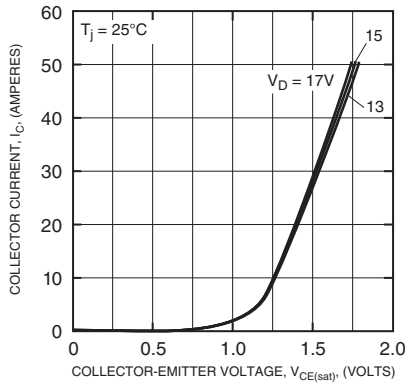
Note 1:  $T_C$  (under the chip) Measurement Point



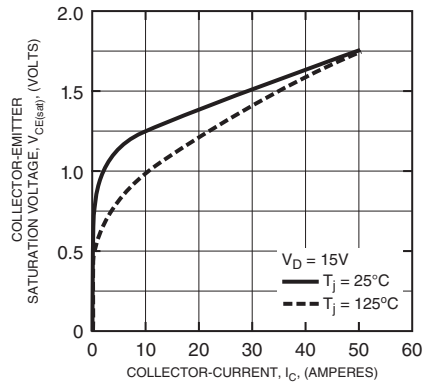
| Arm \ Axis | UP   |      | VP   |      | WP   |      | UN   |      | VN   |      | WN   |      |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|
|            | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi |
| X          | 28.7 | 28.7 | 65.4 | 65.4 | 85.0 | 85.0 | 37.2 | 37.2 | 55.8 | 55.8 | 75.4 | 75.4 |
| Y          | -6.3 | 0.2  | -6.3 | 0.2  | -6.3 | 0.2  | 5.4  | -0.9 | 5.4  | -0.9 | 5.4  | -0.9 |

**PM50CL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter**  
**50 Amperes/600 Volts**

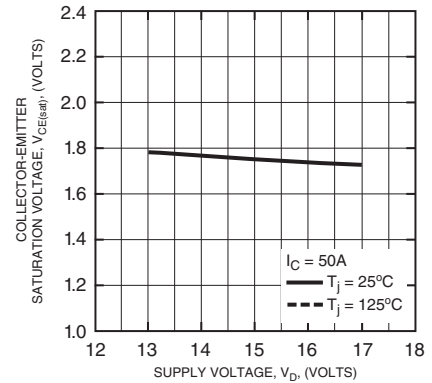
**OUTPUT CHARACTERISTICS (TYPICAL)**



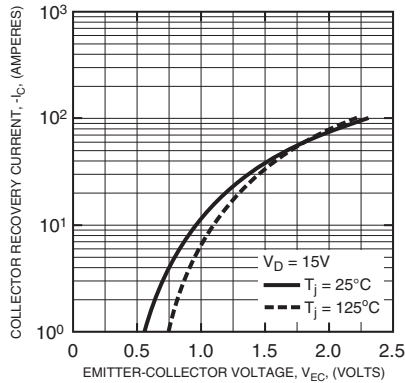
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



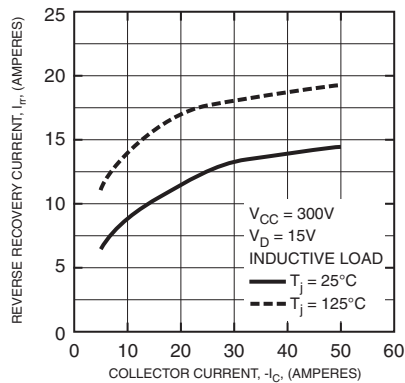
**COLLECTOR-EMITTER SATURATION VOLTAGE VS. SUPPLY VOLTAGE CHARACTERISTICS (TYPICAL)**



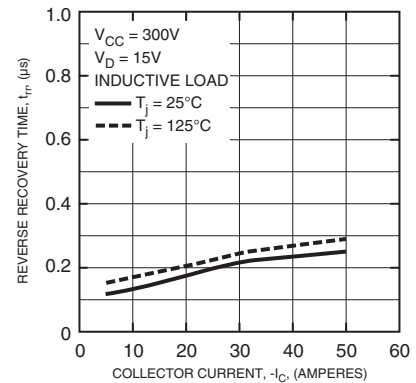
**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



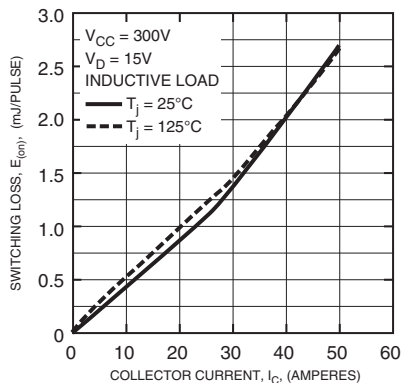
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



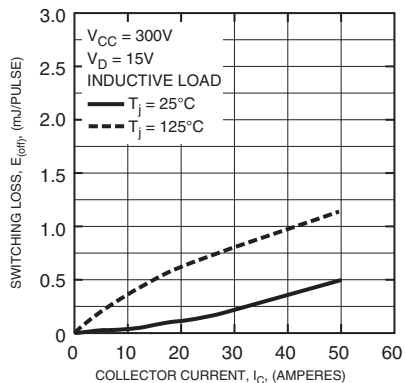
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



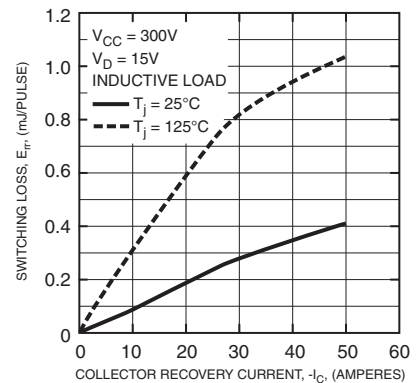
**SWITCHING LOSS (ON) VS. COLLECTOR CURRENT (TYPICAL)**



**SWITCHING LOSS (OFF) VS. COLLECTOR CURRENT (TYPICAL)**



**SWITCHING RECOVERY LOSS CHARACTERISTICS (TYPICAL)**



**PM50CL1A060**  
**Intellimod™ L1-Series**  
**Three Phase IGBT Inverter**  
**50 Amperes/600 Volts**

