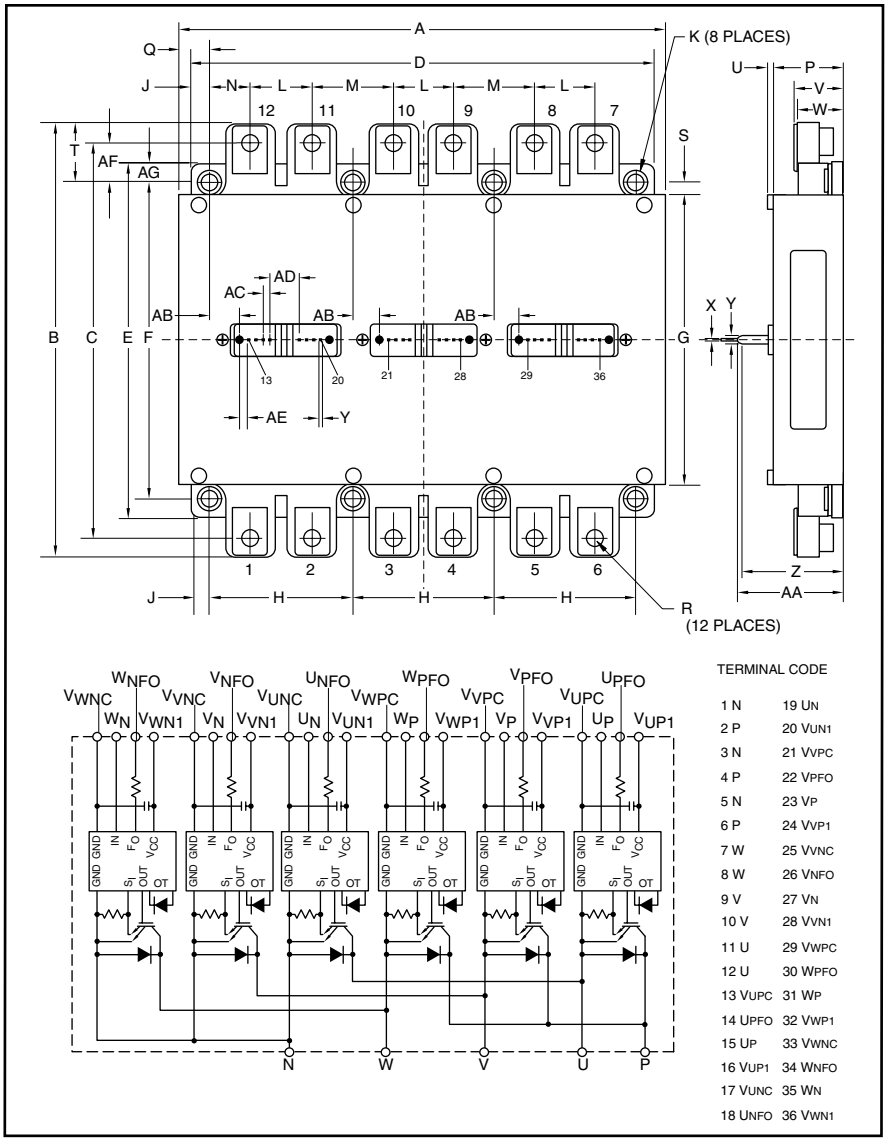
Powerex, Inc., 200 E. Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

# Intellimod™ L-Series

***Three Phase***
***IGBT Inverter***
***450 Amperes/600 Volts***




| TERMINAL CODE | |
|---|---|
| 1 N | 19 $U_N$ |
| 2 P | 20 $V_{UN1}$ |
| 3 N | 21 $V_{VPC}$ |
| 4 P | 22 $V_{PFO}$ |
| 5 N | 23 $V_P$ |
| 6 P | 24 $V_{VP1}$ |
| 7 W | 25 $V_{VNC}$ |
| 8 W | 26 $V_{NFO}$ |
| 9 V | 27 $V_N$ |
| 10 V | 28 $V_{VN1}$ |
| 11 U | 29 $V_{WPC}$ |
| 12 U | 30 $W_{PFO}$ |
| 13 $V_{UPC}$ | 31 $W_P$ |
| 14 $U_{PFO}$ | 32 $V_{WP1}$ |
| 15 $U_P$ | 33 $V_{WNC}$ |
| 16 $V_{UP1}$ | 34 $W_{NFO}$ |
| 17 $V_{UNC}$ | 35 $W_N$ |
| 18 $U_{NFO}$ | 36 $V_{WN1}$ |

**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 6.77 | 172.0 |
| B | 5.90 | 150.0 |
| C | 5.39 | 137.0 |
| D | 6.38 | 162.0 |
| E | 4.84 | 123.0 |
| F | 4.33 | 110.0 |
| G | 3.90 | 99.0 |
| H | 1.97 | 50.0 |
| J | 0.236 | 6.0 |
| K | 5.5 Metric | M5.5 |
| L | 0.866 | 22.0 |
| M | 1.10 | 28.0 |
| N | 0.55 | 14.0 |
| P | 0.945 | 24.0 |
| Q | 0.43 | 11.0 |
| R | M6 Metric | M6 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| S | 0.217 | 5.5 |
| T | 0.79 | 20.0 |
| U | 0.08 | 2.0 |
| V | 0.67 | 17.0 |
| W | 0.62 | 15.8 |
| X | 0.025 Sq. | Sq. 0.64 |
| Y | 0.1 Dia | Dia. 2.5 |
| Z | 1.40 | 35.5 |
| AA | 1.44 | 36.6 |
| AB | 0.36 | 9.08 |
| AC | 0.10 | 2.54 |
| AD | 0.40 | 10.16 |
| AE | 0.127 | 3.22 |
| AF | 0.53 | 13.5 |
| AG | 0.256 | 6.5 |

**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
- ☐ Low EMI/RFI

**Applications:**
- ☐ Inverters
- ☐ UPS
- ☐ Motion/Servo Control
- ☐ Power Supplies

**Ordering Information:**
Example: Select the complete part number from the table below -i.e. PM450CLA060 is a 600V, 450 Ampere Intellimod™ Intelligent Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 10) |
|---|---|---|
| PM | 450 | 60 |

***PM450CLA060***
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## Absolute Maximum Ratings, $T_j$ = 25°C unless otherwise specified

| Characteristics | Symbol | PM450CLA060 | Units |
|---|---|---|---|
| Power Device Junction Temperature | $T_j$ | -20 to 150 | °C |
| Storage Temperature | $T_{stg}$ | -40 to 125 | °C |
| Mounting Torque, M5 Mounting Screws | — | 31 | in-lb |
| Mounting Torque, M6 Main Terminal Screws | — | 40 | in-lb |
| Module Weight (Typical) | — | 1250 | Grams |
| Supply Voltage, Surge (Applied between P - N) | $V_{CC(surge)}$ | 500 | Volts |
| Self-protection Supply Voltage Limit (Short Circuit protection Capability)* | $V_{CC(prot.)}$ | 400 | Volts |
| Isolation Voltage, AC 1 minute, 60Hz Sinusoidal | $V_{ISO}$ | 2500 | Volts |

*$V_D$ = 13.5 ~ 16.5V, Inverter Part, Tj = 125°C

## IGBT Inverter Sector

| | | | |
|---|---|---|---|
| Collector-Emitter Voltage ($V_D$ = 15V, $V_{CIN}$ = 15V) | $V_{CES}$ | 600 | Volts |
| Collector Current ($T_C$ = 25°C) | $\pm I_C$ | 450 | Amperes |
| Peak Collector Current ($T_C$ = 25°C) | $\pm I_{CP}$ | 900 | Amperes |
| Collector Dissipation ($T_C$ = 25°C) | $P_C$ | 1041 | Watts |

## Control Sector

| | | | |
|---|---|---|---|
| Supply Voltage (Applied between $V_{UP1}$-$V_{UPC}$, $V_{VP1}$-$V_{VPC}$, $V_{WP1}$-$V_{WPC}$, $V_{UN1}$-$V_{UNC}$, $V_{WN1}$-$V_{WNC}$, $V_{N1}$-$V_{NC}$) | $V_D$ | 20 | Volts |
| Input Voltage (Applied between $U_P$-$V_{UPC}$, $V_P$-$V_{VPC}$, $W_P$-$V_{WPC}$, $U_N$-$V_{UNC}$, $V_N$-$V_{VNC}$, $W_N$-$V_{WNC}$) | $V_{CIN}$ | 20 | Volts |
| Fault Output Supply Voltage (Applied between $U_{PFO}$-$V_{UPC}$, $V_{PFO}$-$V_{VPC}$, $W_{PFO}$-$V_{WPC}$, $U_{NFO}$-$V_{UNC}$, $V_{NFO}$-$V_{VNC}$, $W_{NFO}$-$V_{WNC}$) | $V_{FO}$ | 20 | Volts |
| Fault Output Sink Current at $U_{PFO}$, $V_{PFO}$, $W_{PFO}$, $U_{NFO}$, $V_{NFO}$, $W_{NFO}$ Terminals | $I_{FO}$ | 20 | mA |

## Electrical and Mechanical Characteristics, $T_j$ = 25°C unless otherwise specified

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **IGBT Inverter Sector** | | | | | | |
| Collector-Emitter Cutoff Current | $I_{CES}$ | $V_{CE} = V_{CES}$, $V_{CIN}$ = 15V, $T_j$ = 25°C | — | — | 1.0 | mA |
| | | $V_{CE} = V_{CES}$, $V_{CIN}$ = 15V, $T_j$ = 125°C | — | — | 10 | mA |
| Diode Forward Voltage | $V_{EC}$ | $-I_C$ = 450A, $V_{CIN}$ = 15V, $V_D$ = 15V | — | 2.6 | 3.7 | Volts |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 450A, $T_j$ = 25°C | — | 1.7 | 2.2 | Volts |
| | | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 450A, $T_j$ = 125°C | — | 1.8 | 2.3 | Volts |
| Inductive Load Switching Times | $t_{on}$ | $V_D$ = 15V, $V_{CIN}$ = 0 ↔ 15V<br>$V_{CC}$ = 300V, $I_C$ = 450A<br>$T_j$ = 125°C | 0.5 | 1.0 | 2.4 | µs |
| | $t_{rr}$ | | — | 0.2 | 0.4 | µs |
| | $t_{C(on)}$ | | — | 0.4 | 1.0 | µs |
| | $t_{off}$ | | — | 2.2 | 3.5 | µs |
| | $t_{C(off)}$ | | — | 0.6 | 1.1 | µs |
| **Control Sector** | | | | | | |
| Short Circuit Trip Level | SC | -20°C ≤ $T_j$ ≤ 125°C, $V_D$ = 15V | 900 | — | — | Amperes |
| Short Circuit Current Delay Time | $t_{off(SC)}$ | $V_D$ = 15V | — | 0.2 | — | µs |
| Over Temperature Protection | OT | Trip Level | 135 | 145 | — | °C |
| (Detect $T_j$ of IGBT Chip) | $OT_R$ | Reset Level | — | 125 | — | °C |
| Supply Circuit Under-voltage Protection | UV | Trip Level | 11.5 | 12.0 | 12.5 | Volts |
| (-20 ≤ $T_j$ ≤ 125°C) | $UV_R$ | Reset Level | — | 12.5 | — | Volts |
| Circuit Current | $I_D$ | Upper Arm $V_D$ = 15V, $V_{CIN}$ = 15V | — | 11 | 18 | mA |
| | | Lower Arm $V_D$ = 15V, $V_{CIN}$ = 15V | — | 11 | 18 | mA |
| Input ON Threshold Voltage | $V_{th(on)}$ | Applied between $U_P$-$V_{UPC}$, $V_P$-$V_{VPC}$, | 1.2 | 1.5 | 1.8 | Volts |
| Input OFF Threshold Voltage | $V_{th(off)}$ | $W_P$-$V_{WPC}$, $U_N$-$V_{UNC}$, $V_N$-$V_{VNC}$, $W_N$-$V_{WNC}$ | 1.7 | 2.0 | 2.3 | Volts |
| Fault Output Current* | $I_{FO(H)}$ | $V_D$ = 15V, $V_{FO}$ = 15V | — | — | 0.01 | mA |
| | $I_{FO(L)}$ | $V_D$ = 15V, $V_{FO}$ = 15V | — | 10 | 15 | mA |
| Fault Output Pulse Width* | $t_{FO}$ | $V_D$ = 15V | 1.0 | 1.8 | — | ms |

*Fault output is given only when the internal SC, OT and UV protection of either upper or lower arms is tripped.

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## Thermal Characteristics

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | IGBT (Per 1/6 Module) (Note 1) | — | — | 0.12 | °C/Watt |
| | $R_{th(j-c)D}$ | FWDi (Per 1/6 Module) (Note 1) | — | — | 0.19 | °C/Watt |
| Contact Thermal Resistance | $R_{th(c-f)}$ | Case to Fin Per Module, Thermal Grease Applied | — | — | 0.014 | °C/Watt |

Note 1: If you use this value, $R_{th(f-a)}$ should be measured just under the chips.

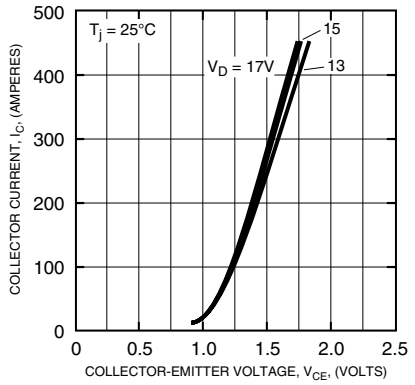
## Recommended Conditions for Use

| Characteristic | Symbol | Condition | Value | Units |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | Applied across P-N Terminals | ≤400 | Volts |
| Control Supply Voltage* | $V_D$ | Applied between $V_{UP1}$-$V_{UPC}$, $V_{VP1}$-$V_{VPC}$, $V_{WP1}$-$V_{WPC}$, $V_{UN1}$-$V_{UNC}$, $V_{VN1}$-$V_{VNC}$, $V_{WN1}$-$V_{WNC}$ | 15.0 ± 1.5 | Volts |
| Input ON Voltage | $V_{CIN(on)}$ | Applied between $U_P$-$V_{UPC}$, $U_N$-$V_{UNC}$, $V_N$-$V_{VNC}$, $V_P$-$V_{VPC}$, $W_N$-$V_{WNC}$, $W_P$-$V_{WPC}$ | ≤0.8 | Volts |
| Input OFF Voltage | $V_{CIN(off)}$ | | ≥9.0 | Volts |
| PWM Input Frequency | $f_{PWM}$ | — | ≤20 | kHz |
| Arm Shoot-through Blocking Time | $t_{DEAD}$ | Input Signal | ≥3.0 | µs |

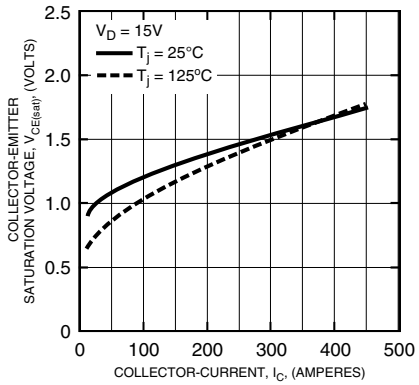
*With ripple satisfying the following conditions: dv/dt swing ≤ ±5V/µs, Variation ≤ 2V peak to peak.

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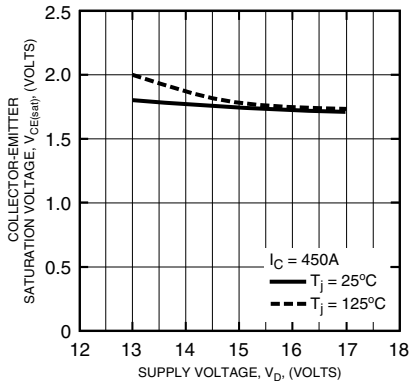
**OUTPUT CHARACTERISTICS (TYPICAL - INVERTER PART)**



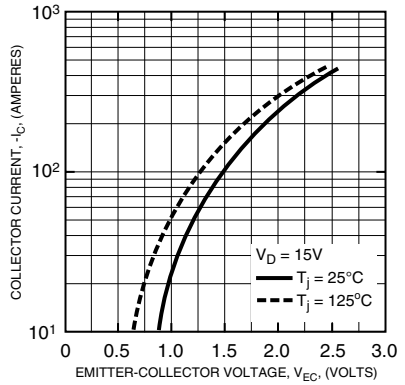

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL - INVERTER PART)**



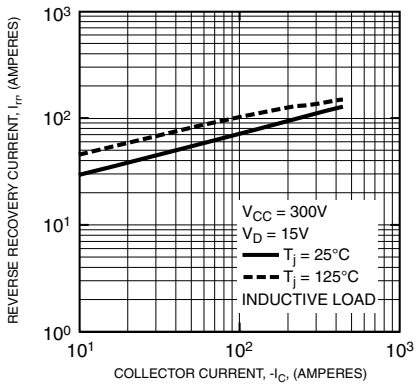

**COLLECTOR-EMITTER SATURATION VOLTAGE VS. SUPPLY VOLTAGE CHARACTERISTICS (TYPICAL - INVERTER PART)**



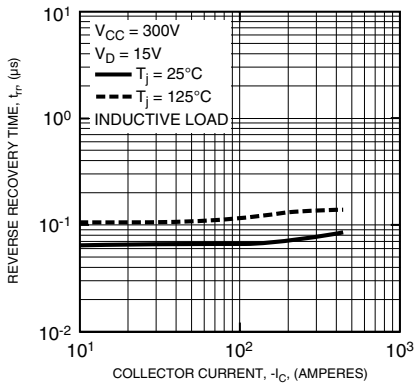

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL - INVERTER PART)**



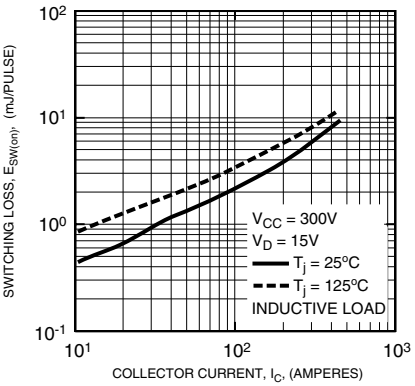

**REVERSE RECOVERY CHARACTERISTICS (TYPICAL - INVERTER PART)**



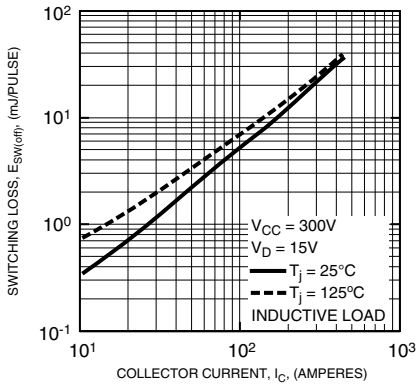

**REVERSE RECOVERY CHARACTERISTICS (TYPICAL - INVERTER PART)**



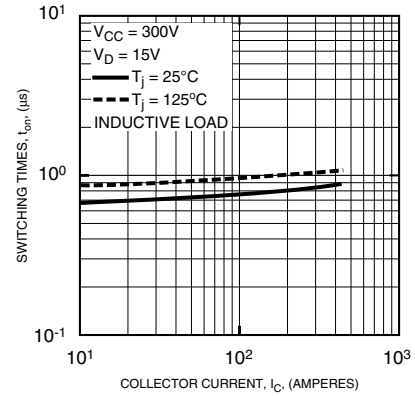

**SWITCHING LOSS (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**




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

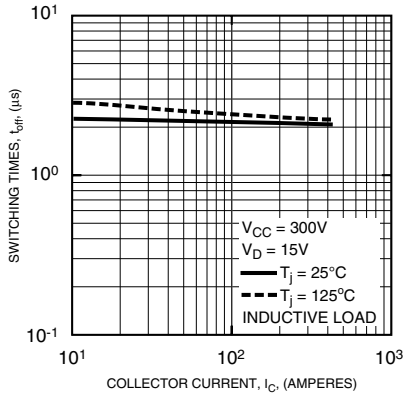



**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**

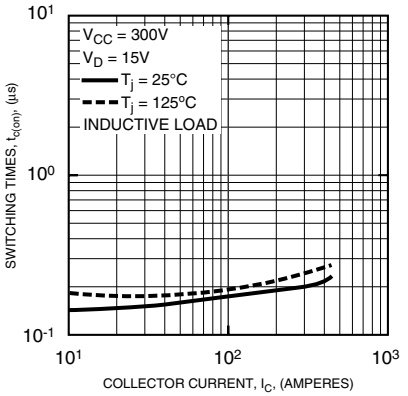


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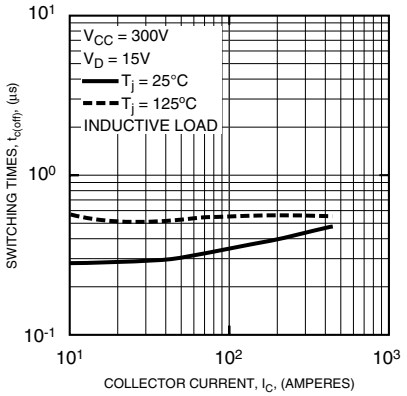
**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**



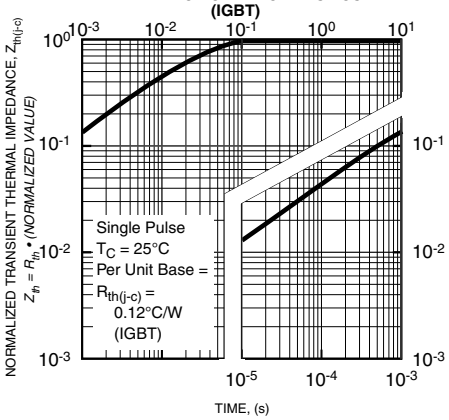

**SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**




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




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi)**

