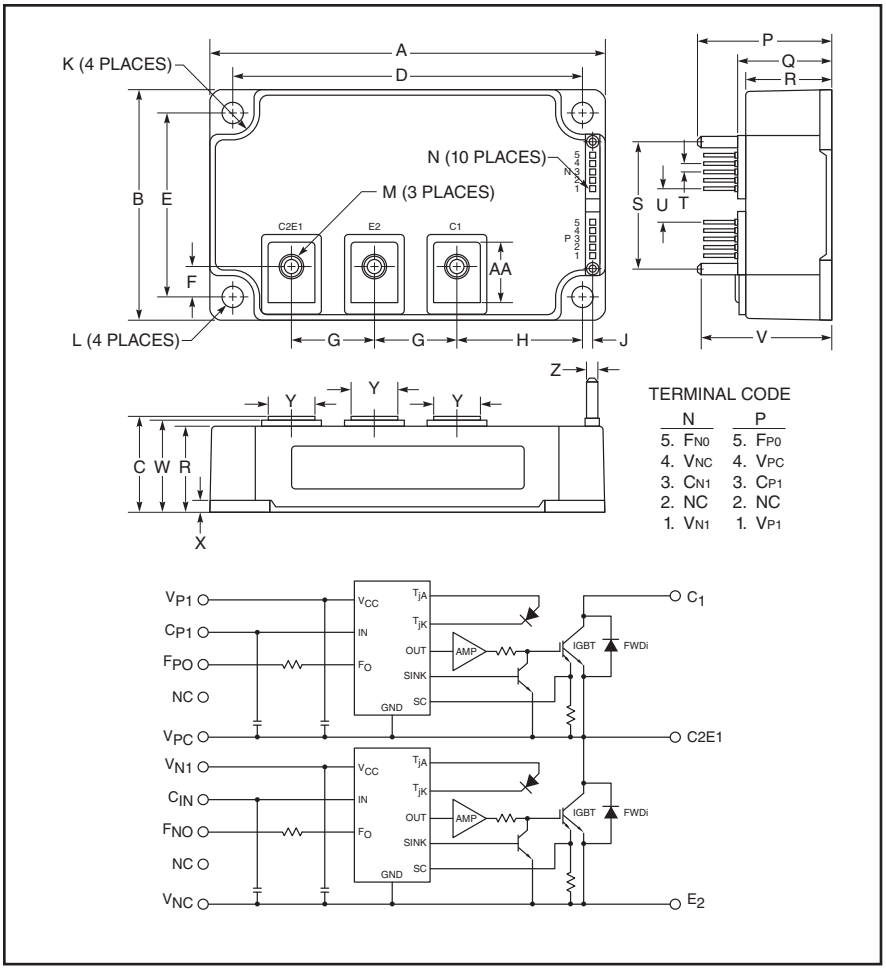
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272
www.pwrx.com

# PM400DV1A060

## Intellimod™ Module

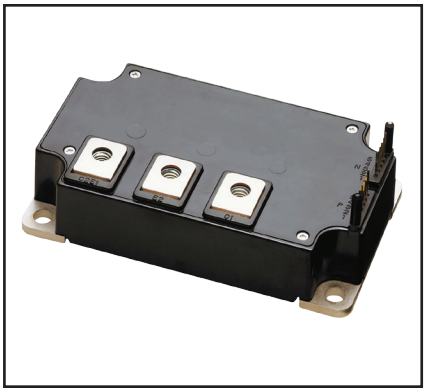
***Single Phase***
***IGBT Inverter Output***
***400 Amperes/600 Volts***




**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 4.72 | 120.0 |
| B | 2.76 | 70.0 |
| C | 1.14 +0.04/-0.02 | 29.0 +1.0/-0.5 |
| D | 4.17±0.010 | 106.0±0.25 |
| E | 2.20±0.010 | 56.0±0.25 |
| F | 0.37 | 9.3 |
| G | 0.98 | 25.0 |
| H | 1.50 | 38.0 |
| J | 0.12±0.02 | 3.0±0.5 |
| K | 0.26 Rad. | 6.5 Rad. |
| L | 0.26 Dia. | 6.5 Dia. |
| M | M6 Metric | M6 |
| N | 0.025 Sq. | 0.64 Sq. |

| Dimensions | Inches | Millimeters |
|---|---|---|
| P | 1.59 | 40.5 |
| Q | 1.14 | 29.0 |
| R | 1.02 | 26.0 |
| S | 1.52 | 38.5 |
| T | 0.10 | 2.54 |
| U | 0.40 | 10.16 |
| V | 1.54 | 39.0 |
| W | 1.10 | 28.0 |
| X | 0.14 | 3.5 |
| Y | 0.55 | 14.0 |
| Z | 0.14 Dia. | 3.5 Dia. |
| AA | 0.72 | 18.3 |



**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
  - – Under Voltage

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

**Ordering Information:**
Example: Select the complete part number from the table below -i.e. PM400DV1A060 is a 600V, 400 Ampere Intellimod™ Intelligent Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 10) |
|---|---|---|
| PM | 400 | 60 |

***PM400DV1A060***
***Intellimod™ Module***
***Single Phase IGBT Inverter Output***
*400 Amperes/600 Volts*

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

| Characteristics | Symbol | PM400DV1A060 | Units |
|---|---|---|---|
| Supply Voltage Protected by SC ($V_D$ = 13.5 ~16.5V, Inverter Part, $T_j$ = 125°C Start) | $V_{CC(prot)}$ | 400 | Volts |
| Surge Supply Voltage (Applied between C1-E2, Surge Value) | $V_{CC(surge)}$ | 500 | Volts |
| Storage Temperature | $T_{stg}$ | -40 to 125 | °C |
| Case Operating Temperature | $T_C$ | -20 to 100 | °C |
| Mounting Torque, M6 Mounting Screws (Typical) | $M_s$ | 43 | in-lb |
| Mounting Torque, M6 Main Terminal Screws (Typical) | $M_t$ | 43 | in-lb |
| Module Weight (Typical) | m | 510 | Grams |
| Isolation Voltage, (60Hz, Sinusoidal, Charged Part to Baseplate, AC 1 minute, RMS) | $V_{isol}$ | 2500 | Volts |

## Inverter Sector

| | | | |
|---|---|---|---|
| Collector-Emitter Voltage ($V_D$ = 15V, $V_{CIN}$ = 15V) | $V_{CES}$ | 600 | Volts |
| Collector Current ($T_C$ = 25°C) | $I_C$ | 400 | Amperes |
| Peak Collector Current (Pulse) | $I_{CRM}$ | 800 | Amperes |
| Total Power Dissipation ($T_C$ = 25°C)*1 | $P_{tot}$ | 1262 | Watts |
| Emitter Current ($T_C$ = 25°C) | $I_E$ | 400 | Amperes |
| Peak Emitter Current (Pulse) | $I_{ERM}$ | 800 | Amperes |
| Power Device Junction Temperature | $T_j$ | -20 to 150 | °C |

## Control Sector

| | | | |
|---|---|---|---|
| Supply Voltage (Applied Between $V_{P1}$-$V_{PC}$, $V_{N1}$-$V_{NC}$) | $V_D$ | 20 | Volts |
| Input Voltage (Applied Between $C_{P1}$-$V_{PC}$, $C_{N1}$-$V_{NC}$) | $V_{CIN}$ | 20 | Volts |
| Fault Output Supply Voltage (Applied Between $F_{PO}$-$V_{PC}$, $F_{NO}$-$V_{NC}$) | $V_{FO}$ | 20 | Volts |
| Fault Output Current (Sink Current at $F_{PO}$, $F_{NO}$ Terminals) | $I_{FO}$ | 20 | mA |

*1 Case temperature ($T_C$) measured point is just under the chips.

***PM400DV1A060***
***Intellimod™ Module***
***Single Phase IGBT Inverter Output***
*400 Amperes/600 Volts*

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

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **IGBT Inverter Sector** | | | | | | |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 400A, Pulsed, $T_j$ = 25°C | — | 1.90 | 2.35 | Volts |
| | | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 400A, Pulsed, $T_j$ = 125°C | — | 1.90 | 2.35 | Volts |
| Emitter-Collector Voltage | $V_{EC}$ | $I_E$ = 400A, $V_D$ = 15V, $V_{CIN}$ = 15V | — | 1.7 | 2.8 | Volts |
| Switching Times | $t_{on}$ | $V_D$ = 15V, $V_{CIN}$ = 0 ~ 15V, $V_{CC}$ = 300V, $I_C$ = 400A, $T_j$ = 125°C, Inductive Load | 0.3 | 0.8 | 2.0 | µs |
| | $t_{rr}$ | | — | 0.4 | 0.8 | µs |
| | $t_{C(on)}$ | | — | 0.4 | 1.0 | µs |
| | $t_{off}$ | | — | 1.0 | 2.3 | µs |
| | $t_{C(off)}$ | | — | 0.3 | 1.0 | µs |
| Collector-Emitter Cutoff Current | $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $V_{CIN}$ = 15, $T_j$ = 25°C | — | — | 1.0 | mA |
| | | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $V_{CIN}$ = 15, $T_j$ = 125°C | — | — | 10.0 | mA |
| **Control Sector** | | | | | | |
| Circuit Current | $I_D$ | $V_D$ = 15V, $V_{CIN}$ = 15V, $V_{P1}$-$V_{PC}$ | — | 2 | 4 | mA |
| | | $V_D$ = 15V, $V_{CIN}$ = 15V, $V_{N1}$-$V_{NC}$ | — | 2 | 4 | mA |
| Input ON Threshold Voltage | $V_{th(on)}$ | Applied Between $C_{P1}$-$V_{PC}$, $C_{N1}$-$V_{NC}$ | 1.2 | 1.5 | 1.8 | Volts |
| Input OFF Threshold Voltage | $V_{th(off)}$ | | 1.7 | 2.0 | 2.3 | Volts |
| Short Circuit Trip Level | SC | -20°C ≤ $T_j$ ≤ 125°C, $V_D$ = 15V | 600 | — | — | Amperes |
| Short Circuit Current Delay Time | $t_{off(SC)}$ | $V_D$ = 15V | — | 0.2 | — | µs |
| Over Temperature Protection | OT | Trip Level | 135 | — | — | °C |
| (Detect Temperature of Chip) | $OT_{(hys)}$ | Reset Level | — | 20 | — | °C |
| Supply Circuit Under Voltage Protection | $UV_t$ | Trip Level | 11.5 | 12.0 | 12.5 | Volts |
| (-20 ≤ $T_j$ ≤ 125°C) | $UV_r$ | Reset Level | — | 12.5 | — | Volts |
| Fault Output Current | $I_{FO(H)}$ | $V_D$ = 15V, $V_{FO}$ = 15V*2 | — | — | 0.01 | mA |
| | $I_{FO(L)}$ | $V_D$ = 15V, $V_{FO}$ = 15V*2 | — | 10 | 15 | mA |
| Fault Output Pulse Width | $t_{FO}$ | $V_D$ = 15V*2 | 1.0 | 1.8 | — | ms |

*2 Fault output is given only when the internal SC, OT and UV protection.
Fault output of SC, OT and UV protection operate by lower arms.
Fault output of SC protecton given pulse.
Fault output of OT, UV protection given pulse while over trip level.

## Thermal Characteristics

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | Inverter IGBT (Per 1 Element)*3 | — | — | 0.099 | K/Watt |
| | $R_{th(j-c)D}$ | Inverter FWDi (Per 1 Element)*3 | — | — | 0.153 | K/Watt |
| Contact Thermal Resistance | $R_{th(c-s)}$ | Case to Heatsink (Per 1 Module), Thermal Grease Applied*3 | — | 0.018 | — | K/Watt |

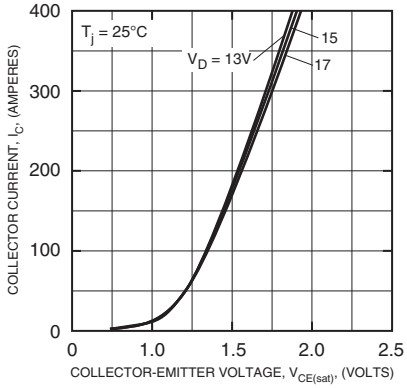
## Recommended Conditions for Use

| Characteristic | Symbol | Condition | Value | Units |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | Applied Across C1-E2 Terminals | ≤ 400 | Volts |
| Control Supply Voltage | $V_D$ | Applied Between $V_{P1}$-$V_{PC}$, $V_{N1}$-$V_{NC}$*4 | 15 ±1.5 | Volts |
| Input ON Voltage | $V_{CIN(on)}$ | Applied Between | ≤ 0.8 | Volts |
| Input OFF Voltage | $V_{CIN(off)}$ | $C_{P1}$-$V_{PC}$, $C_{N1}$-$V_{NC}$ | ≥ 4.0 | Volts |
| PWM Input Frequency | $f_{PWM}$ | Using Application Circuit | ≤ 20 | kHz |
| Arm Shoot-Through Blocking Time | $t_{DEAD}$ | For IPM's each Input Signal | ≥ 3.0 | µs |

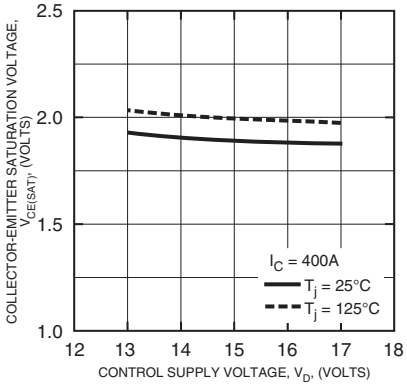
*3 When using the $R_{th(s-a)}$ case temperature ($T_C$) is measured point is just under chips.
*4 With ripple satisfying the following conditions: dv/dt swing ≤ ±5V/µs, variation ≤ 2V peak to peak.

***PM400DV1A060***
***Intellimod™ Module***
***Single Phase IGBT Inverter Output***
*400 Amperes/600 Volts*

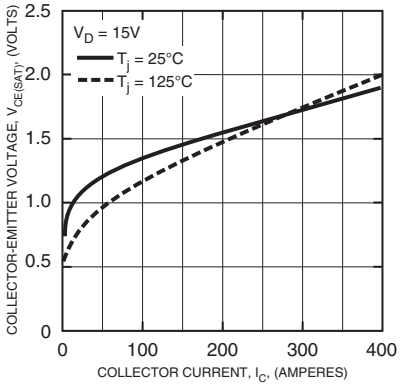
**OUTPUT CHARACTERISTICS (TYPICAL)**



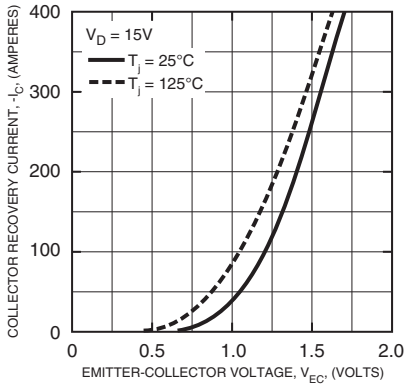

**COLLECTOR-EMITTER SATURATON VOLTAGE CHARACTERISTICS (TYPICAL)**



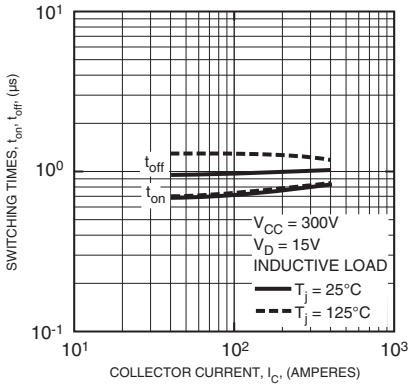

**SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



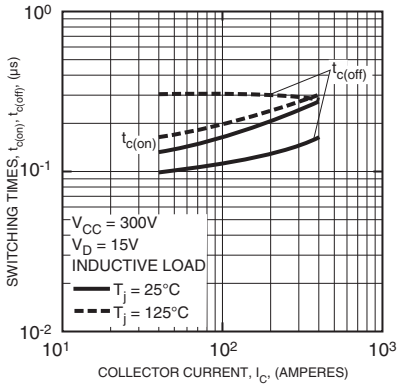

**DIODE FORWARD CHARACTERISTICS (TYPICAL)**



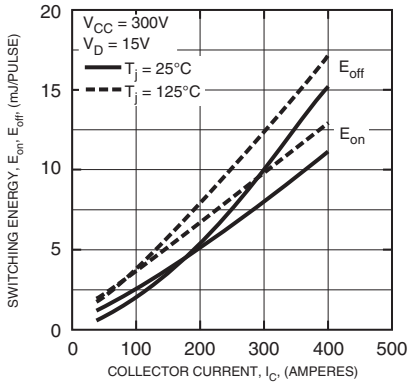

**SWITCHING TIME VS. COLLECTOR CURRENT CHARACTERISTICS (TYPICAL)**



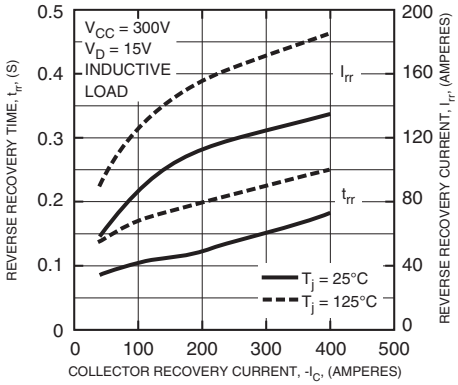

**SWITCHING TIME VS. COLLECTOR CURRENT CHARACTERISTICS (TYPICAL)**



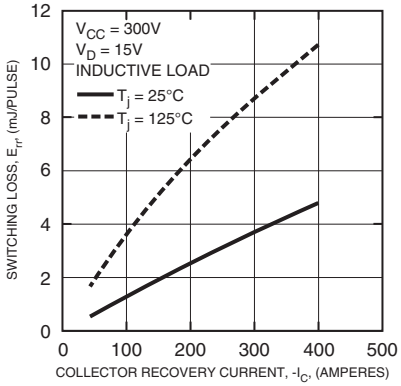

**SWITCHING LOSS COLLECTOR CURRENT CHARACTERISTICS (TYPICAL)**




**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

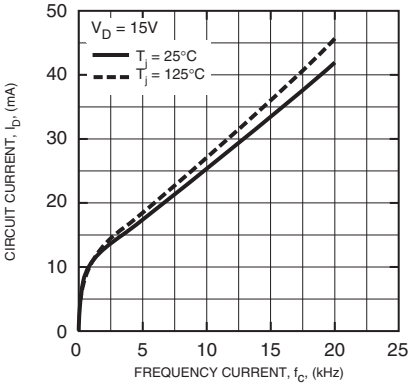



**SWITCHING REVERSE RECOVERY LOSS CHARACTERISTICS (TYPICAL)**

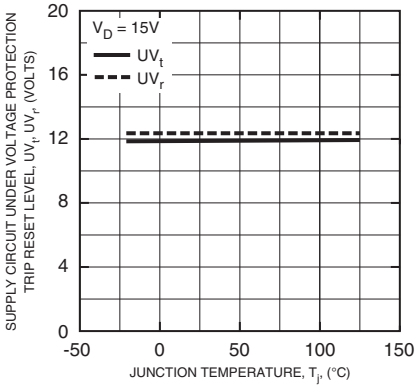


***PM400DV1A060***
***Intellimod™ Module***
***Single Phase IGBT Inverter Output***
*400 Amperes/600 Volts*

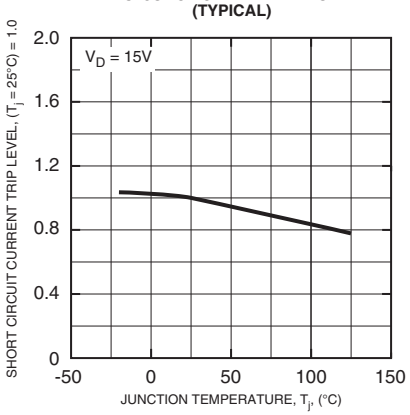
**CIRCUIT CURRENT VS. FREQUENCY CURRENT (TYPICAL)**



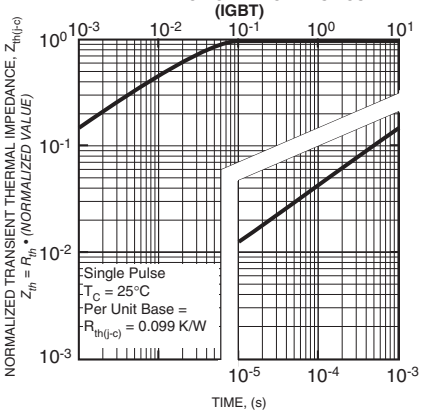

**CONTROL SUPPLY VOLTAGE TRIP-RESET LEVEL TEMPERATURE DEPENDANCY (TYPICAL)**




**SHORT CIRCUIT TRIP LEVEL VS. JUNCTION TEMPERATURE (TYPICAL)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi)**