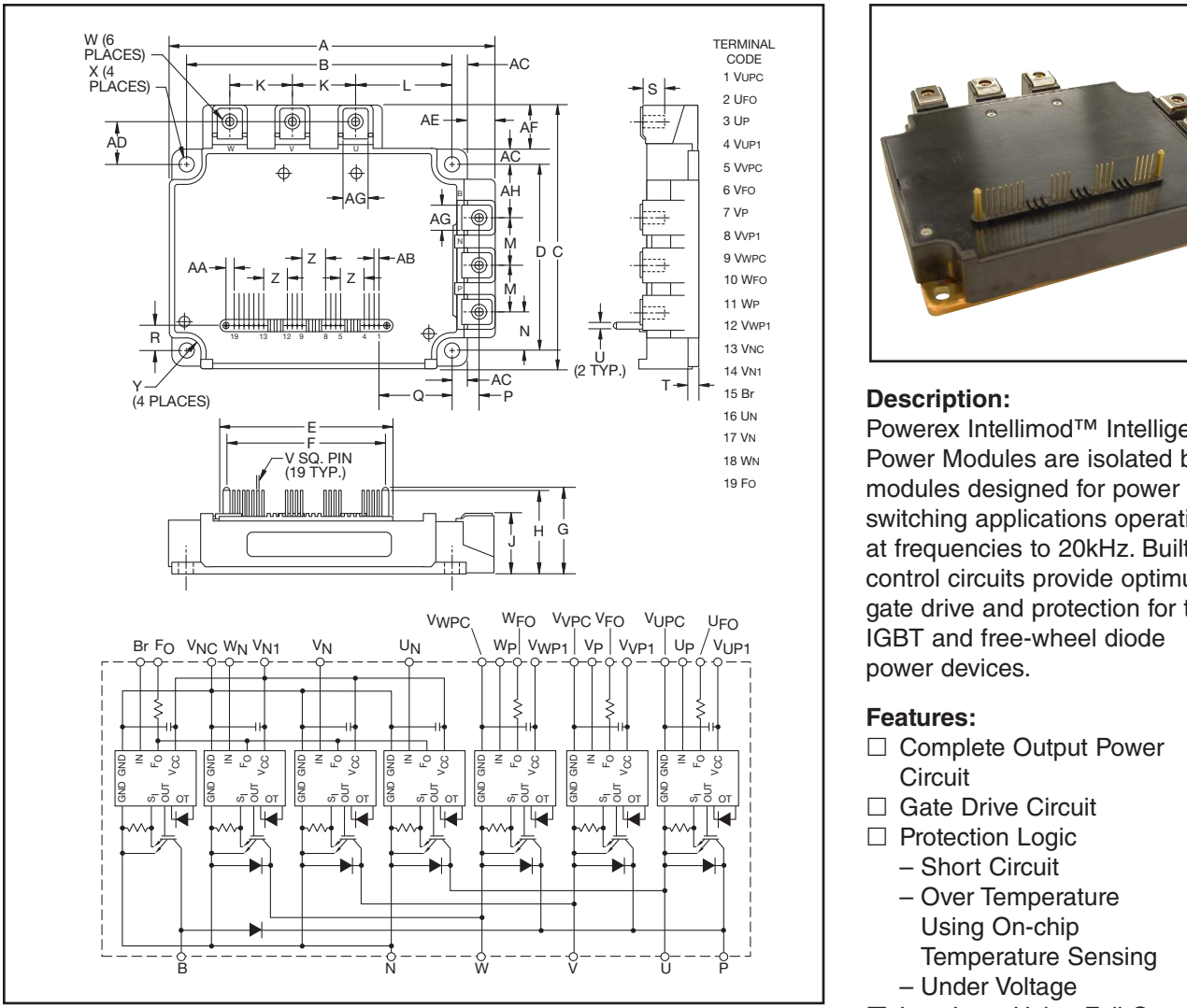
# PM150RL1A120

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

## *Intellimod™ L1-Series*

***Three Phase***
***IGBT Inverter + Brake***
***150 Amperes/1200 Volts***




**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 5.31 | 135.0 |
| B | 4.33±0.02 | 110±0.5 |
| C | 4.33 | 110.0 |
| D | 3.07 | 78.0±0.5 |
| E | 2.81 | 71.5 |
| F | 2.62 | 66.5 |
| G | 1.37 | 34.7 |
| H | 1.32 | 33.6 |
| J | 0.95+0.04/-0.01 | 24.1+1.0/-0.5 |
| K | 1.02 | 26.0 |
| L | 1.59 | 40.5 |
| M | 0.79 | 20.0 |
| N | 0.65 | 16.5 |
| P | 0.43±0.01 | 11.0±0.3 |
| Q | 1.19 | 30.15 |
| R | 0.43 | 11.0 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| S | 0.51 | 13.0 |
| T | 0.16 | 4.0 |
| U | 0.1 Dia. | Dia.2.5 |
| V | 0.02 Sq. | Sq. 0.5 |
| W | M5 Metric | M5 |
| X | 0.22 Dia. | Dia. 5.5 |
| Y | 0.24 Rad. | Rad. 6 |
| Z | 0.39 | 10.0 |
| AA | 0.13 | 3.25 |
| AB | 0.08 | 2.0 |
| AC | 0.24 | 6.05 |
| AD | 0.71 | 18.0 |
| AE | 0.46 | 11.7 |
| AF | 0.74 | 18.7 |
| AG | 0.41 | 10.5 |
| AH | 0.85 | 21.5 |



### 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 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. PM150RL1A120 is a 1200V, 150 Ampere Intellimod™ Intelligent Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 10) |
|---|---|---|
| PM | 150 | 120 |

***PM150RL1A120***
***Intellimod™ L1-Series***
***Three Phase IGBT Inverter + Brake***
*150 Amperes/1200 Volts*

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

| Characteristics | Symbol | PM150RL1A120 | 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, M5 Main Terminal Screws | — | 31 | in-lb |
| Module Weight (Typical) | — | 800 | Grams |
| Supply Voltage, Surge (Applied between P - N) | $V_{CC(surge)}$ | 1000 | Volts |
| Self-protection Supply Voltage Limit (Short Circuit protection Capability)* | $V_{CC(prot.)}$ | 800 | Volts |
| Isolation Voltage, AC 1 minute, 60Hz Sinusoidal | $V_{ISO}$ | 2500 | Volts |

## IGBT Inverter Sector

| | | | |
|---|---|---|---|
| Collector-Emitter Voltage ($V_D$ = 15V, $V_{CIN}$ = 15V) | $V_{CES}$ | 1200 | Volts |
| Collector Current ($T_C$ = 25°C) (Note 1) | $\pm I_C$ | 150 | Amperes |
| Peak Collector Current ($T_C$ = 25°C) | $\pm I_{CP}$ | 300 | Amperes |
| Collector Dissipation ($T_C$ = 25°C) (Note 1) | $P_C$ | 833 | Watts |

## IGBT Brake Sector

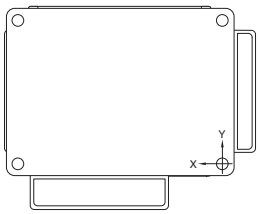
| | | | |
|---|---|---|---|
| Collector-Emitter Voltage ($V_D$ = 15V, $V_{CIN}$ = 15V) | $V_{CES}$ | 1200 | Volts |
| Collector Current ($T_C$ = 25°C) (Note 1) | $\pm I_C$ | 75 | Amperes |
| Peak Collector Current ($T_C$ = 25°C) | $\pm I_{CP}$ | 150 | Amperes |
| Collector Dissipation ($T_C$ = 25°C) (Note 1) | $P_C$ | 595 | Watts |
| Diode Forward Current | $I_F$ | 75 | Amperes |
| Diode Rated DC Reverse Voltage ($T_C$ = 25°C) | $V_{R(DC)}$ | 1200 | Volts |

## Control Sector

| | | | |
|---|---|---|---|
| Supply Voltage (Applied between $V_{UP1}$-$V_{UPC}$, $V_{VP1}$-$V_{VPC}$, $V_{WP1}$-$V_{WPC}$, $V_{N1}$-$V_{NC}$) | $V_D$ | 20 | Volts |
| Input Voltage (Applied between $U_P$-$V_{UPC}$, $V_P$-$V_{VPC}$, $W_P$-$V_{WPC}$, $U_N$- $V_N$- $W_N$-Br-$V_{NC}$) | $V_{CIN}$ | 20 | Volts |
| Fault Output Supply Voltage (Applied between $U_{FO}$-$V_{UPC}$, $V_{FO}$-$V_{VPC}$, $W_{FO}$-$V_{WPC}$, $F_O$-$V_{NC}$) | $V_{FO}$ | 20 | Volts |
| Fault Output Current ($U_{FO}$, $V_{FO}$, $W_{FO}$, $F_O$ Terminals) | $I_{FO}$ | 20 | mA |

*VD = 13.5 ~ 16.5V, Inverter Part, $T_j$ = 125°C

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




| Arm / Axis | UP | | VP | | WP | | UN | | VN | | WN | | Br | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi |
| X | 25.2 | 25.2 | 58.8 | 58.8 | 88.8 | 88.8 | 37.2 | 37.3 | 70.8 | 70.8 | 88.8 | 88.8 | 11.4 | 7.5 |
| Y | 57.1 | 46.8 | 57.1 | 46.80 | 57.1 | 46.8 | 28.4 | 38.6 | 28.4 | 38.6 | 28.4 | 38.6 | 28.0 | 60.8 |

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*150 Amperes/1200 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, $I_C$ = 150A, $T_j$ = 25°C | — | 1.65 | 2.15 | Volts |
| | | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 150A, $T_j$ = 125°C | — | 1.85 | 2.35 | Volts |
| Diode Forward Voltage | $V_{EC}$ | $-I_C$ = 150A, $V_{CIN}$ = 15V, $V_D$ = 15V | — | 2.3 | 3.3 | Volts |
| Inductive Load Switching Times | $t_{on}$ | $V_D$ = 15V, $V_{CIN}$ = 0 ⇔ 15V, $V_{CC}$ = 600V, $I_C$ = 150A, $T_j$ = 125°C | 0.3 | 0.8 | 2.0 | µs |
| | $t_{rr}$ | | — | 0.3 | 0.8 | µs |
| | $t_{C(on)}$ | | — | 0.4 | 1.0 | µs |
| | $t_{off}$ | | — | 1.2 | 2.8 | µs |
| | $t_{C(off)}$ | | — | 0.4 | 1.2 | µs |
| Collector-Emitter Cutoff Current | $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $T_j$ = 25°C | — | — | 1.0 | mA |
| | | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $T_j$ = 125°C | — | — | 10 | mA |
| **IGBT Brake Sector** | | | | | | |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 50A, $T_j$ = 25°C | — | 1.65 | 2.15 | Volts |
| | | $V_D$ = 15V, $V_{CIN}$ = 0V, $I_C$ = 50A, $T_j$ = 125°C | — | 1.85 | 2.35 | Volts |
| Forward Voltage | $V_{FM}$ | $I_F$ = 50A | — | 2.3 | 3.3 | Volts |
| Collector-Emitter Cutoff Current | $I_{CES}$ | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $T_j$ = 25°C | — | — | 1.0 | mA |
| | | $V_{CE}$ = $V_{CES}$, $V_D$ = 15V, $T_j$ = 125°C | — | — | 10 | mA |
| **Control Sector** | | | | | | |
| Circuit Current | $I_D$ | $V_D$ = 15V, $V_{CIN}$ = 15V, $V_{N1}$-$V_{NC}$ | — | 8 | 16 | mA |
| | | $V_D$ = 15V, $V_{CIN}$ = 15V, $V_{XP1}$-$V_{XPC}$ | — | 2 | 4 | mA |
| Input ON Threshold Voltage | $V_{th(on)}$ | Applied between $U_P$-$V_{UPC}$, $V_P$-$V_{VPC}$, $W_P$-$V_{WPC}$, $U_N$- $V_N$- $W_N$-Br-$V_{NC}$ | 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 | Inverter Part | 300 | — | — | Amperes |
| (-20°C ≤ $T_j$ ≤ 125°C, $V_D$ = 15V) | | Brake Part | 150 | — | — | Amperes |
| Short Circuit Current Delay Time | $t_{off(SC)}$ | $V_D$ = 15V | — | 0.2 | — | µs |
| Over Temperature Protection | OT | Trip Level | 135 | — | — | °C |
| (Detect $T_j$ of IGBT Chip) | $OT_{(hys)}$ | Reset Level | — | 20 | — | °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 |
| Fault Output Current* | $I_{FO(H)}$ | $V_D$ = 15V, $V_{CIN}$ = 15V | — | — | 0.01 | mA |
| | $I_{FO(L)}$ | $V_D$ = 15V, $V_{CIN}$ = 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 protections schemes of either upper or lower arm device operates to protect it.

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

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

## Thermal Characteristics, $T_j$ = 25°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) | — | — | 0.15* | °C/Watt |
| Inverter Part | $R_{th(j-c)D}$ | FWDi (Per 1 Element) (Note 1) | — | — | 0.23* | °C/Watt |
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | IGBT (Note 1) | — | — | 0.21* | °C/Watt |
| Brake Part | $R_{th(j-c)D}$ | FWDi (Note 1) | — | — | 0.36* | °C/Watt |
| Contact Thermal Resistance | $R_{th(c-f)}$ | Case to Fin Per Module, Thermal Grease Applied (Note 1) | — | — | 0.027 | °C/Watt |

## Recommended Conditions for Use

| Characteristic | Symbol | Condition | Value | Units |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | Applied across P-N Terminals | ≤800 | Volts |
| Control Supply Voltage** | $V_D$ | Applied between $V_{UP1}$-$V_{UPC}$, $V_{VP1}$-$V_{VPC}$, $V_{WP1}$-$V_{WPC}$, $V_{N1}$-$V_{NC}$ | 15.0 ±1.5 | Volts |
| Input ON Voltage | $V_{CIN(on)}$ | Applied between $U_P$-$V_{UPC}$, $V_P$-$V_{VPC}$, $W_P$-$V_{WPC}$, $U_N$- $V_N$- $W_N$-Br-$V_{NC}$ | ≤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 | ≥2.5 | µs |

* 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 ≤ ±5V/µs, Variation ≤ 2V peak to peak.

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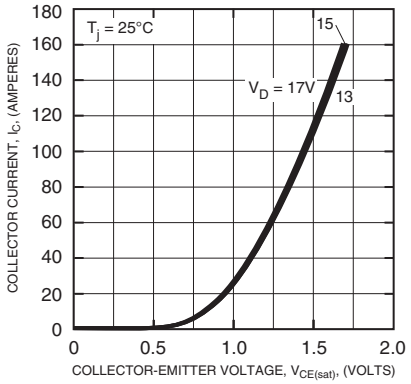
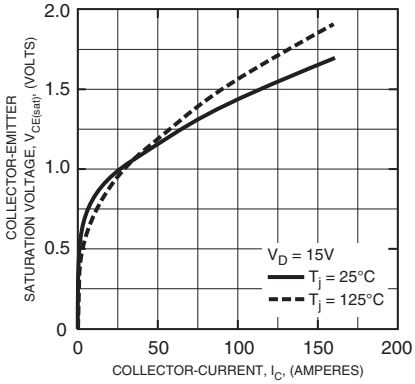
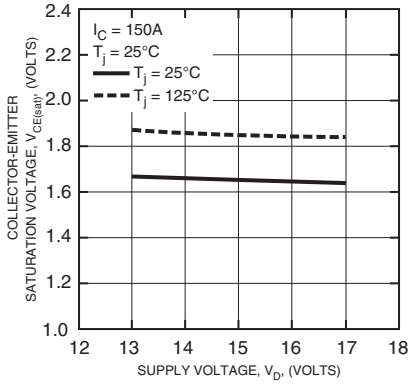
**OUTPUT CHARACTERISTICS (TYPICAL - INVERTER PART)**



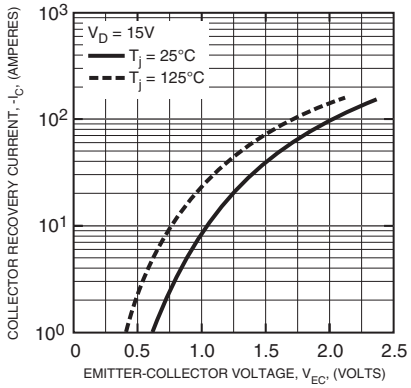

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL - INVERTER PART)**



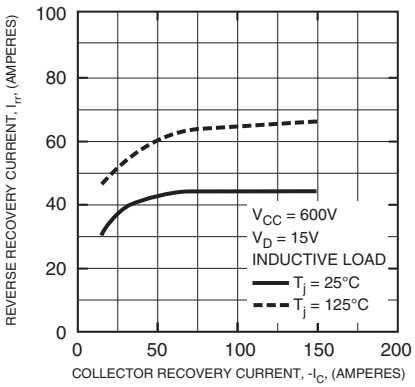

**COLLECTOR-EMITTER SATURATION VOLTAGE VS. SUPPLY VOLTAGE CHARACTERISTICS (TYPICAL - INVERTER PART)**



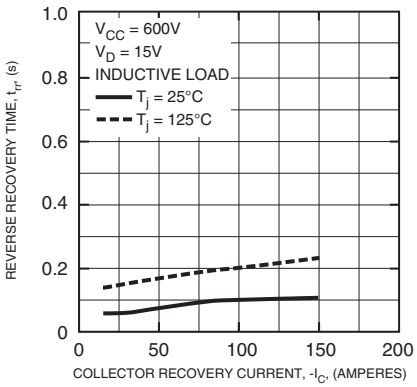

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL - INVERTER PART)**



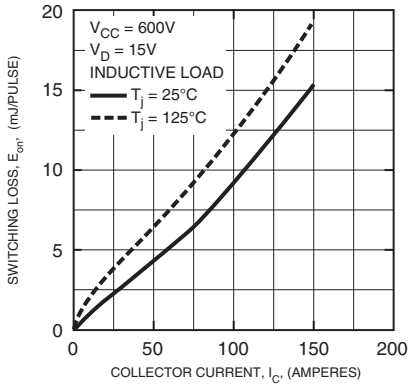

**REVERSE RECOVERY CHARACTERISTICS (TYPICAL - INVERTER PART)**



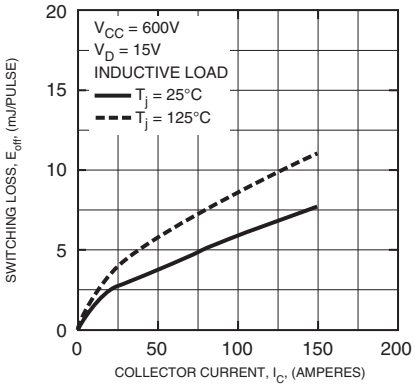

**REVERSE RECOVERY CHARACTERISTICS (TYPICAL - INVERTER PART)**



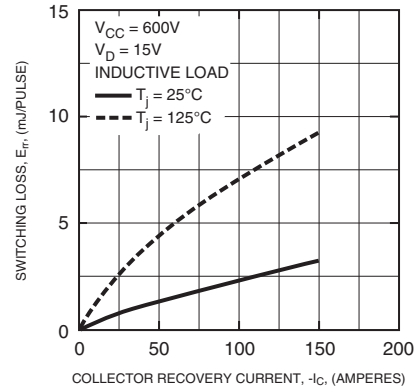

**SWITCHING LOSS (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**




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




**SWITCHING RECOVERY LOSS CHARACTERISTICS (TYPICAL - INVERTER PART)**



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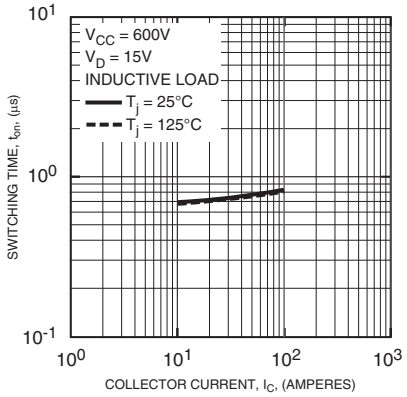
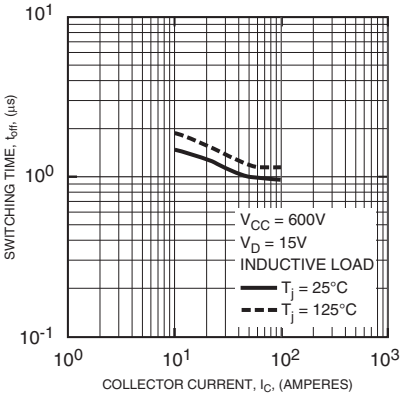
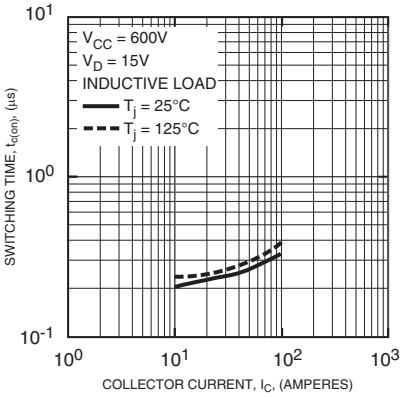
**SWITCHING TIME (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**



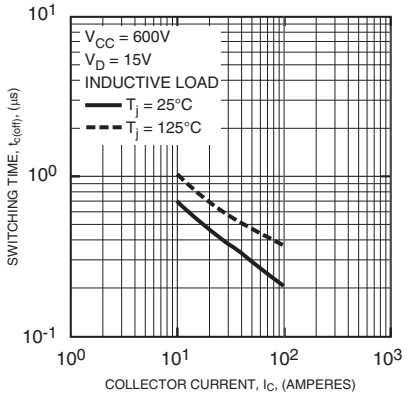

**SWITCHING TIME (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**



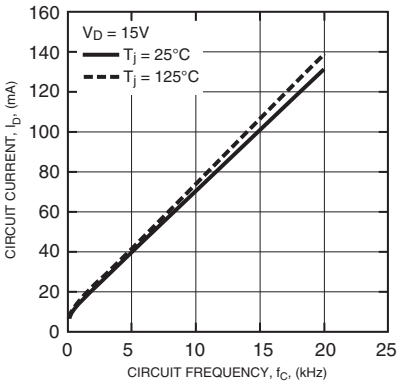

**SWITCHING TIME (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**



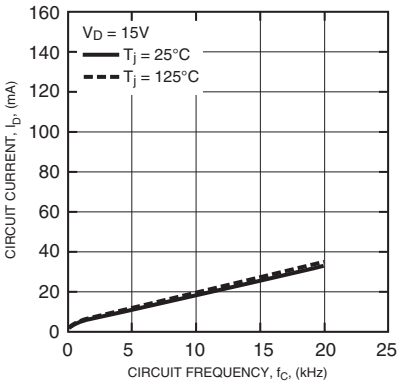

**SWITCHING TIME (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART)**



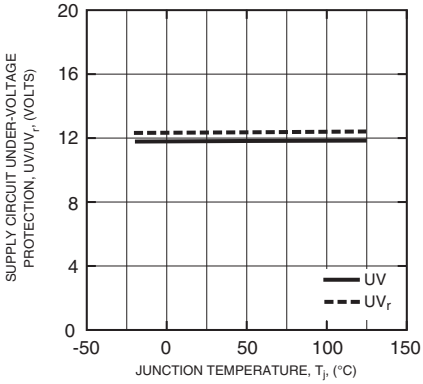

**CIRCUIT CURRENT VS. CARRIER FREQUENCY CHARACTERISTICS (N-SIDE - INVERTER PART)**



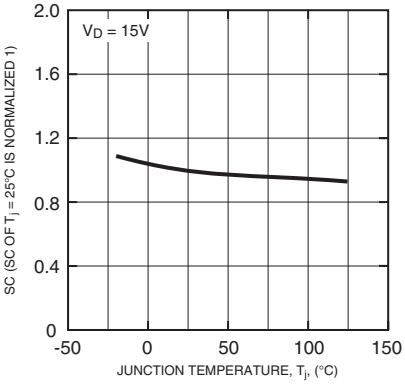

**CIRCUIT CURRENT VS. CARRIER FREQUENCY CHARACTERISTICS (P-SIDE - INVERTER PART)**



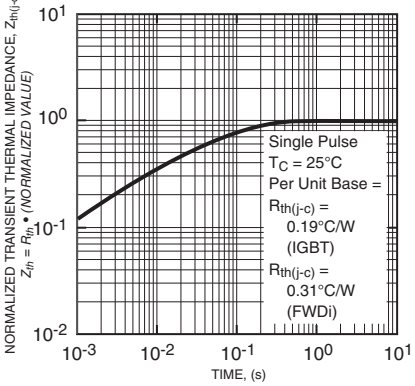

**SUPPLY CIRCUIT UNDER-VOLTAGE PROTECTION CHARACTERISTICS (TYPICAL - INVERTER PART)**




**SHORT CIRCUIT TRIP LEVEL CHARACTERISTICS (TYPICAL - INVERTER PART)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi - INVERTER PART)**



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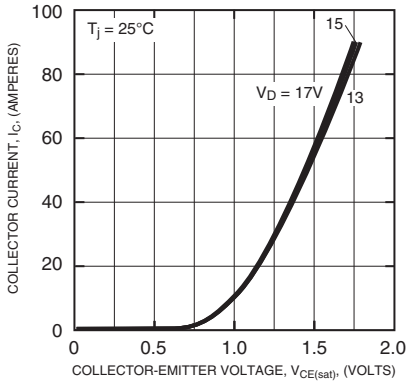
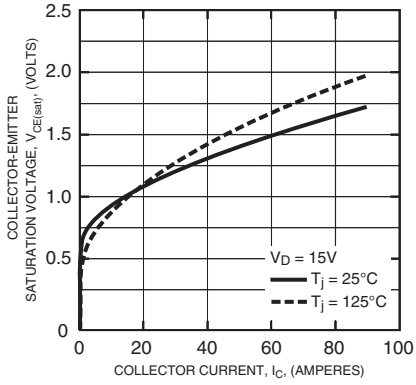
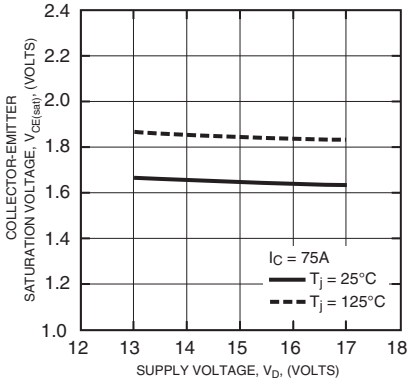
**OUTPUT CHARACTERISTICS (TYPICAL - BRAKE PART)**



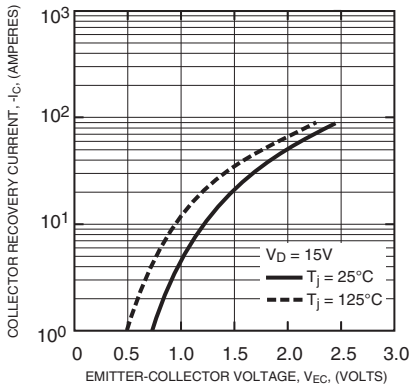

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL - BRAKE PART)**




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




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




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi - BRAKE PART)**