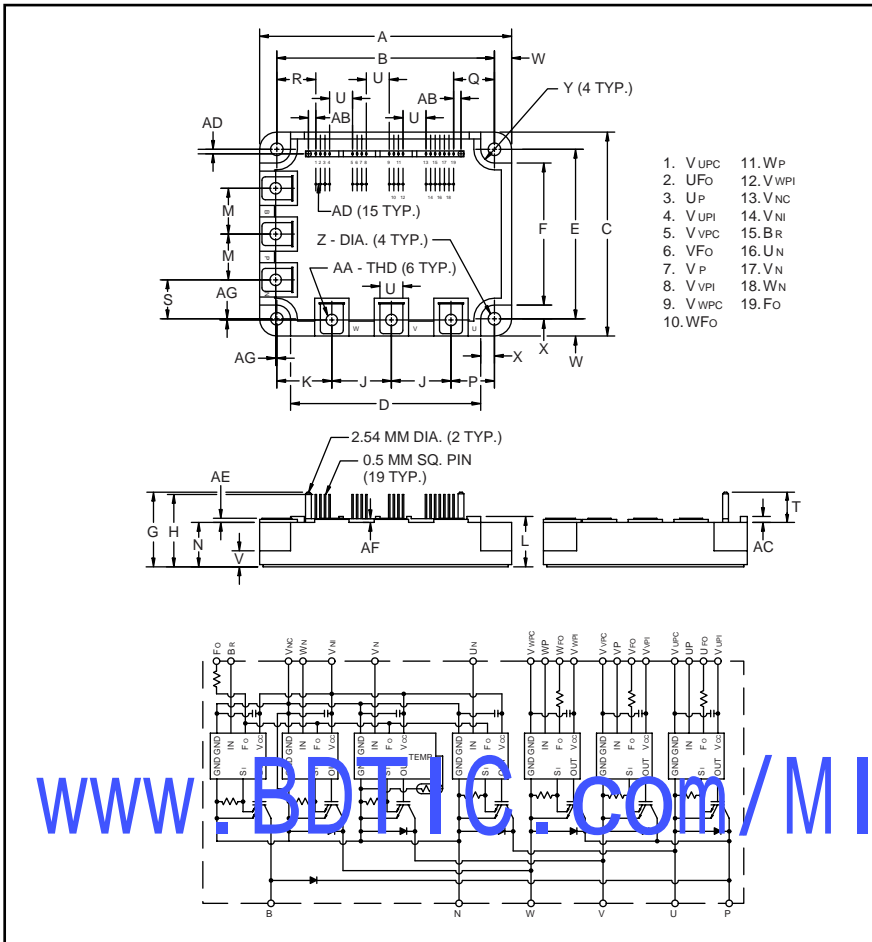


PM50RSA120

FLAT-BASE TYPE
INSULATED PACKAGE



Description:

Mitsubishi 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 Current
 - 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. PM50RSA120 is a 1200V, 50 Ampere Intelligent Power Module.

| Type | Current Rating Amperes | V _{CES} Volts (x 10) |
|------|---------------------------|----------------------------------|
| PM | 50 | 120 |

Outline Drawing and Circuit Diagram

| Dimensions | Inches | Millimeters |
|------------|--------------------|-------------|
| A | 4.33±0.04 | 110.0±1.0 |
| B | 3.74±0.02 | 95.0±0.5 |
| C | 3.50±0.04 | 89.0±1.0 |
| D | 3.27 | 83.0 |
| E | 2.91±0.02 | 74.0±0.5 |
| F | 2.44 | 62.0 |
| G | 1.28 | 32.6 |
| H | 1.24 | 31.6 |
| J | 1.02 | 26.0 |
| K | 0.94 | 24.0 |
| L | 0.87 +0.06/-0.22.0 | +1.5/-0.0 |
| M | 0.79 | 20.0 |
| N | 0.76 | 19.4 |
| P | 0.75 | 19.0 |
| Q | 0.708 | 17.98 |
| R | 0.670 | 17.02 |

| Dimensions | Inches | Millimeters |
|------------|-----------|-------------|
| S | 0.67 | 17.0 |
| T | 0.52 | 13.2 |
| U | 0.39 | 10.0 |
| V | 0.28 | 7.0 |
| W | 0.30 | 7.5 |
| X | 0.24 | 6.0 |
| Y | 0.24 Rad. | Rad. 6.0 |
| Z | 0.22 Dia. | Dia. 5.5 |
| AA | Metric M5 | M5 |
| AB | 0.127 | 3.22 |
| AC | 0.10 | 2.6 |
| AD | 0.08 | 2.0 |
| AE | 0.07 | 1.8 |
| AF | 0.06 | 1.6 |
| AG | 0.02±0.01 | 0.5±0.3 |

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

| | Symbol | Ratings | Units |
|--|------------------------|-------------|------------------|
| Power Device Junction Temperature | T_j | -20 to 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -40 to 125 | $^\circ\text{C}$ |
| Case Operating Temperature | T_C | -20 to 100 | $^\circ\text{C}$ |
| Mounting Torque, M5 Mounting Screws | — | 1.47 ~ 1.96 | N · m |
| Mounting Torque, M5 Main Terminal Screw | — | 1.47 ~ 1.96 | N · m |
| Module Weight (Typical) | — | 550 | Grams |
| Supply Voltage Protected by OC and SC ($V_D = 13.5 - 16.5\text{V}$, Inverter Part, $T_j = 125^\circ\text{C}$) | $V_{\text{CC(prot.)}}$ | 800 | Volts |
| Isolation Voltage (Main Terminal to Baseplate, AC 1 min.) | V_{RMS} | 2500 | 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_{UPC} , V_P-V_{VPC} , W_P-V_{WPC} , $U_N \cdot V_N \cdot W_N \cdot B_r-V_{\text{NC}}$) | V_{CIN} | 20 | Volts |
| Fault Output Supply Voltage Applied between ($U_{\text{FO}}-V_{\text{UPC}}$, $V_{\text{FO}}-V_{\text{VPC}}$, $W_{\text{FO}}-V_{\text{WPC}}$, F_O-V_{NC}) | V_{FO} | 20 | Volts |
| Fault Output Current (Sink Current at U_{FO} , V_{FO} , W_{FO} and F_O Terminal) | I_{FO} | 20 | mA |

IGBT Inverter Sector

| | | | |
|--|------------------------|------|---------|
| Collector-Emitter Voltage ($V_D = 15\text{V}$, $V_{\text{CIN}} = 15\text{V}$) | V_{CES} | 1200 | Volts |
| Collector Current, ($T_C = 25^\circ\text{C}$) | I_C | 50 | Amperes |
| Peak Collector Current, ($T_C = 25^\circ\text{C}$) | I_{CP} | 100 | Amperes |
| Supply Voltage (Applied between P - N) | V_{CC} | 900 | Volts |
| Supply Voltage, Surge (Applied between P - N) | $V_{\text{CC(surge)}}$ | 1000 | Volts |
| Collector Dissipation | P_C | 347 | Watts |

Brake Sector

| | | | |
|--|------------------------|------|---------|
| Collector-Emitter Voltage | V_{CES} | 1200 | Volts |
| Collector Current, ($T_C = 25^\circ\text{C}$) | I_C | 15 | Amperes |
| Peak Collector Current, ($T_C = 25^\circ\text{C}$) | I_{CP} | 30 | Amperes |
| Supply Voltage (Applied between P - N) | V_{CC} | 900 | Volts |
| Supply Voltage, Surge (Applied between P - N) | $V_{\text{CC(surge)}}$ | 1000 | Volts |
| Collector Dissipation | P_C | 138 | Watts |
| Diode Forward Current | I_F | 15 | Amperes |
| Diode DC Reverse Voltage | $V_{\text{R(DC)}}$ | 1200 | Volts |

PM50RSA120

FLAT-BASE TYPE
INSULATED PACKAGE

Electrical and Mechanical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|----------------------|--|------|------|------|------------------|
| Control Sector | | | | | | |
| Over Current Trip Level Inverter Part | OC | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$, $V_D = 15\text{V}$ | 59 | 112 | — | Amperes |
| Over Current Trip Level Brake Part | | | 22 | 50 | — | Amperes |
| Short Circuit Trip Level Inverter Part | SC | $-20^\circ\text{C} \leq T \leq 125^\circ\text{C}$, $V_D = 15\text{V}$ | — | 183 | — | Amperes |
| Short Circuit Trip Level Brake Part | | | — | 95 | — | Amperes |
| Over Current Delay Time | $t_{\text{off(OC)}}$ | $V_D = 15\text{V}$ | — | 10 | — | μs |
| Over Temperature Protection | OT | Trip Level | 111 | 118 | 125 | $^\circ\text{C}$ |
| | OT_r | Reset Level | — | 100 | — | $^\circ\text{C}$ |
| Supply Circuit Under Voltage Protection | UV | Trip Level | 11.5 | 12.0 | 12.5 | Volts |
| | UV_r | Reset Level | — | 12.5 | — | Volts |
| Supply Voltage | V_D | Applied between V_{UP1} - V_{UPC} , V_{VP1} - V_{VPC} , V_{WP1} - V_{WPC} , V_{N1} - V_{NC} | 13.5 | 15 | 16.5 | Volts |
| Circuit Current | I_D | $V_D = 15\text{V}$, $V_{CIN} = 15\text{V}$, V_{N1} - V_{NC} | — | 44 | 60 | mA |
| | | $V_D = 15\text{V}$, $V_{CIN} = 15\text{V}$, V_{XP1} - V_{XPC} | — | 13 | 18 | mA |
| Input ON Threshold Voltage | $V_{\text{th(on)}}$ | Applied between | 1.2 | 1.5 | 1.8 | Volts |
| Input OFF Threshold Voltage | $V_{\text{th(off)}}$ | U_P - V_{UPC} , V_P - V_{VPC} , W_P - V_{WPC} , U_N · V_N · W_N · B_r - V_{NC} | 1.7 | 2.0 | 2.3 | Volts |
| PWM Input Frequency | f_{PWM} | 3- ϕ Sinusoidal | — | 15 | 20 | kHz |
| Fault Output Current | $I_{FO(H)}$ | $V_D = 15\text{V}$, $V_{FO} = 15\text{V}$ | — | — | 0.01 | mA |
| | | $V_D = 15\text{V}$, $V_{FO} = 15\text{V}$ | — | 10 | 15 | mA |
| Minimum Fault Output Pulse Width | t_{FO} | $V_D = 15\text{V}$ | 1.0 | 1.8 | — | ms |

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 Cutoff Current | I_{CES} | $V_{CE} = V_{CES}, T_j = 25^\circ\text{C}$ | — | — | 1.0 | mA |
| | | $V_{CE} = V_{CES}, T_j = 125^\circ\text{C}$ | — | — | 10 | mA |
| Emitter-Collector Voltage | V_{EC} | $-I_C = 50\text{A}, V_D = 15\text{V}, V_{CIN} = 5\text{V}$ | — | 2.5 | 3.5 | Volts |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A}$ | — | 2.5 | 3.5 | Volts |
| | | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 50\text{A},$ $T_j = 125^\circ\text{C}$ | — | 2.2 | 3.2 | Volts |
| Inductive Load Switching Times | t_{on} | | 0.5 | 1.0 | 2.5 | μs |
| | t_{rr} | $V_D = 15\text{V}, V_{CIN} = 0 \leftrightarrow 15\text{V}$ | — | 0.15 | 0.3 | μs |
| | $t_{C(on)}$ | $V_{CC} = 600\text{V}, I_C = 50\text{A}$ | — | 0.4 | 1.0 | μs |
| | t_{off} | $T_j = 125^\circ\text{C}$ | — | 2.0 | 3.0 | μs |
| | $t_{C(off)}$ | | — | 0.7 | 1.2 | μs |
| Brake Sector | | | | | | |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 15\text{A},$ $T_j = 25^\circ\text{C}$ | — | 2.8 | 3.8 | Volts |
| | | $V_D = 15\text{V}, V_{CIN} = 0\text{V}, I_C = 15\text{A},$ $T_j = 125^\circ\text{C}$ | — | 2.2 | 3.2 | Volts |
| Diode Forward Voltage | V_{FM} | $I_C = 15\text{A}, V_D = 15\text{V}, V_{CIN} = 5\text{V}$ | — | 3.5 | 3.5 | Volts |
| Collector Cutoff Current | I_{CES} | $V_{CE} = V_{CES}, T_j = 25^\circ\text{C}$ | — | — | 1 | mA |
| | | $V_{CE} = V_{CES}, T_j = 125^\circ\text{C}$ | — | — | 10 | mA |

PM50RSA120

FLAT-BASE TYPE
INSULATED PACKAGE

Thermal Characteristics

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Units |
|-------------------------------------|----------------|---|------|------|-------|---------|
| Junction to Case Thermal Resistance | $R_{th(j-c)Q}$ | Each Inverter IGBT | — | — | 0.36 | °C/Watt |
| | $R_{th(j-c)F}$ | Each Inverter FWDi | — | — | 1.0 | °C/Watt |
| | $R_{th(c-f)Q}$ | Each Brake IGBT | — | — | 0.9 | °C/Watt |
| | $R_{th(c-f)F}$ | Each Brake FWDi | — | — | 2.0 | °C/Watt |
| Contact Thermal Resistance | $R_{th(c-f)}$ | Case to Fin Per Module, Thermal Grease Applied | — | — | 0.027 | °C/Watt |

Recommended Conditions for Use

| Characteristic | Symbol | Condition | Value | Units |
|---------------------|----------------|--|----------------|---------|
| Supply Voltage | V_{CC} | Applied across P-N Terminals | 0 ~ 800 | Volts |
| | V_D | Applied between V_{UP1} - V_{UPC} , V_{N1} - V_{NC} , V_{VP1} - V_{VPC} , V_{WP1} - V_{WPC} | 15 ± 1.5 | Volts |
| Input ON Voltage | $V_{CIN(on)}$ | Applied between | 0 ~ 0.8 | Volts |
| Input OFF Voltage | $V_{CIN(off)}$ | U_P - V_{UPC} , V_P - V_{VPC} , W_P - V_{WPC} , U_N · V_N · W_N · B_r - V_{NC} | $4.0 \sim V_D$ | Volts |
| PWM Input Frequency | f_{PWM} | Using Application Circuit | 5 ~ 20 | kHz |
| Minimum Dead Time | t_{dead} | Input Signal | ≥ 3 | μs |

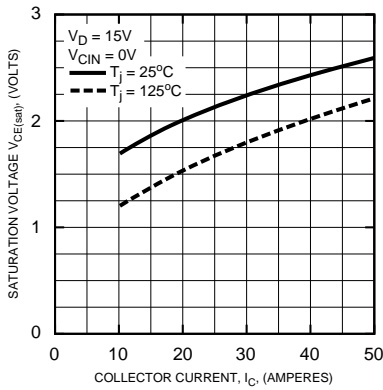
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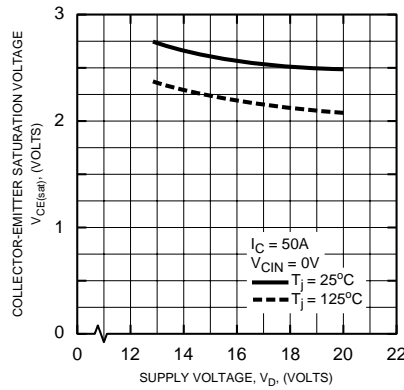
FLAT-BASE TYPE
INSULATED PACKAGE

Inverter Part

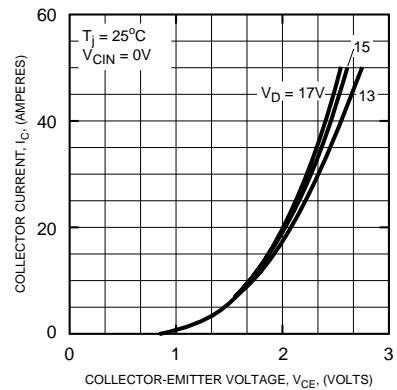
SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



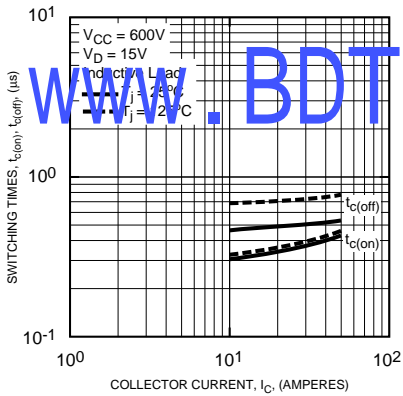
COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)



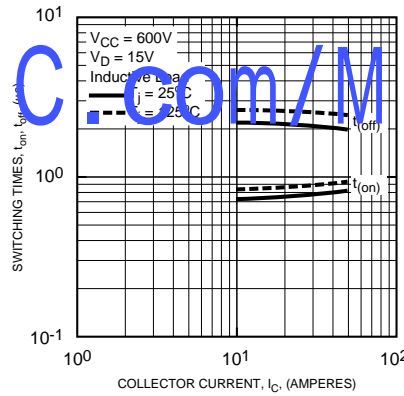
OUTPUT CHARACTERISTICS (TYPICAL)



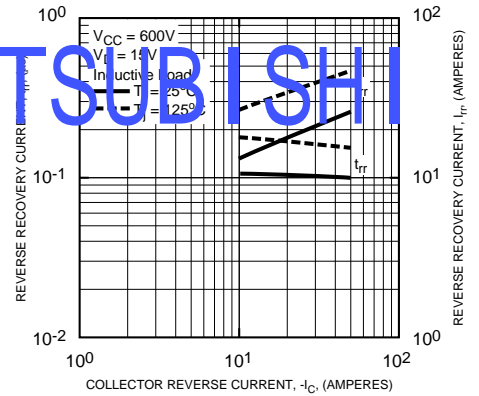
SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)



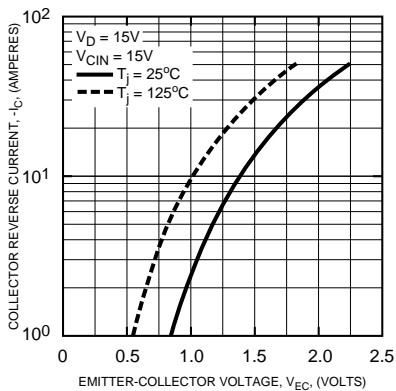
SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)



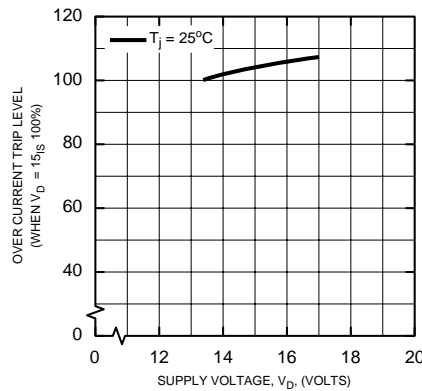
REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)



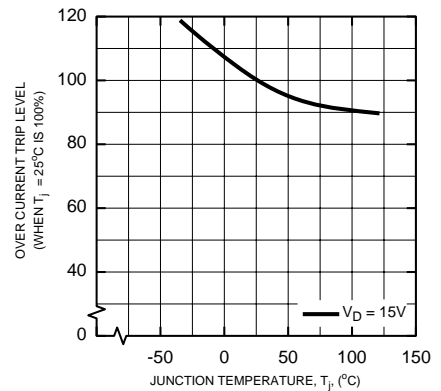
DIODE FORWARD CHARACTERISTICS



OVER CURRENT TRIP LEVEL VS. SUPPLY VOLTAGE (TYPICAL)



OVER CURRENT TRIP LEVEL VS. TEMPERATURE (TYPICAL)

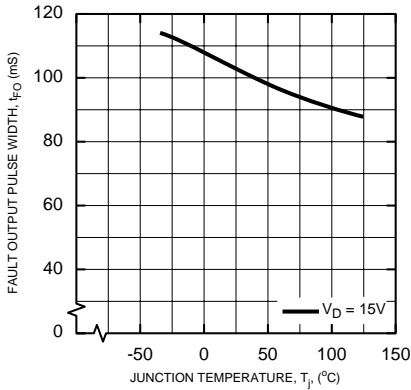


PM50RSA120

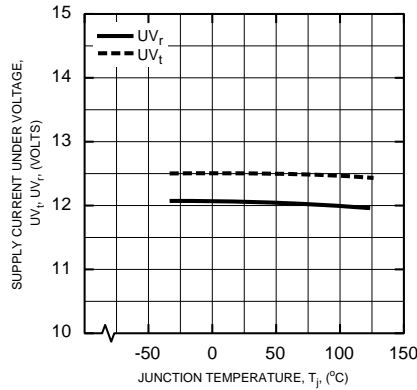
FLAT-BASE TYPE
INSULATED PACKAGE

Inverter Part

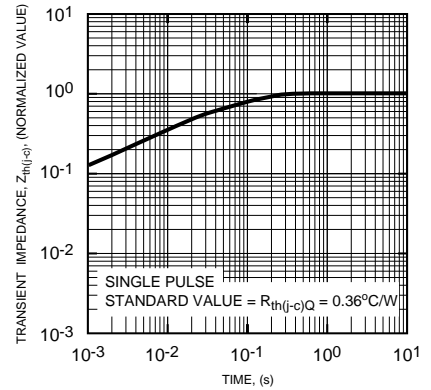
FAULT OUTPUT PULSE WIDTH VS. TEMPERATURE (TYPICAL)



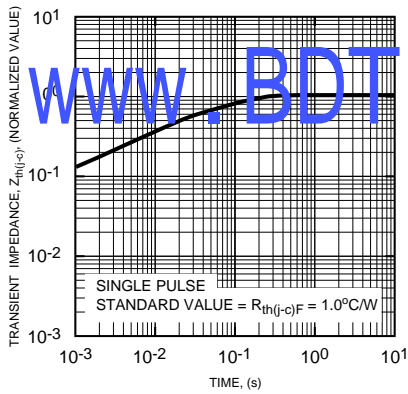
CONTROL SUPPLY VOLTAGE DROP PROTECTION VS. TEMPERATURE (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each IGBT)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each FWD)



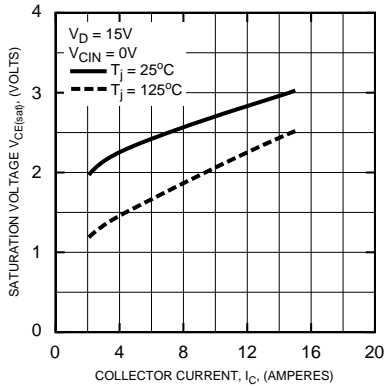
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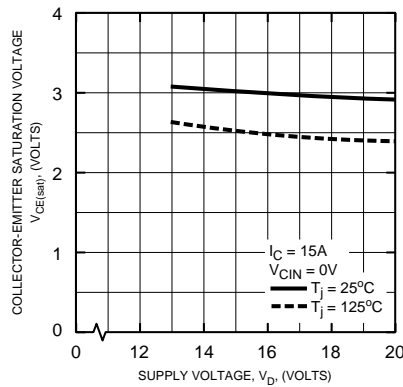
FLAT-BASE TYPE
INSULATED PACKAGE

Brake Part

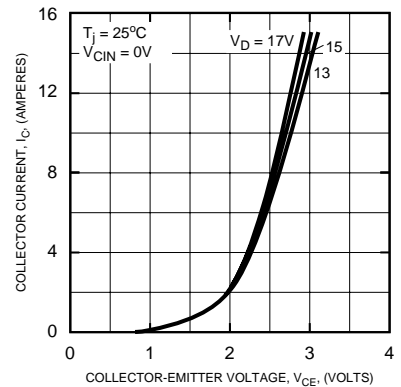
SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



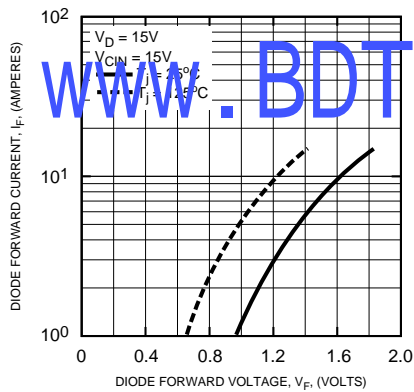
COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)



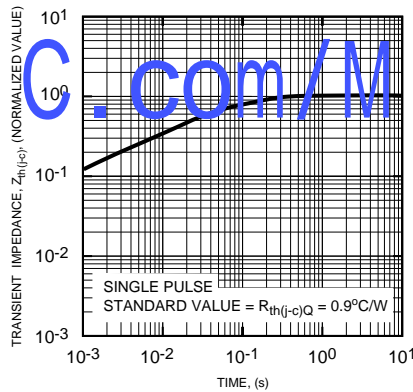
OUTPUT CHARACTERISTICS (TYPICAL)



DIODE FORWARD CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each IGBT)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (Each FWDI)

