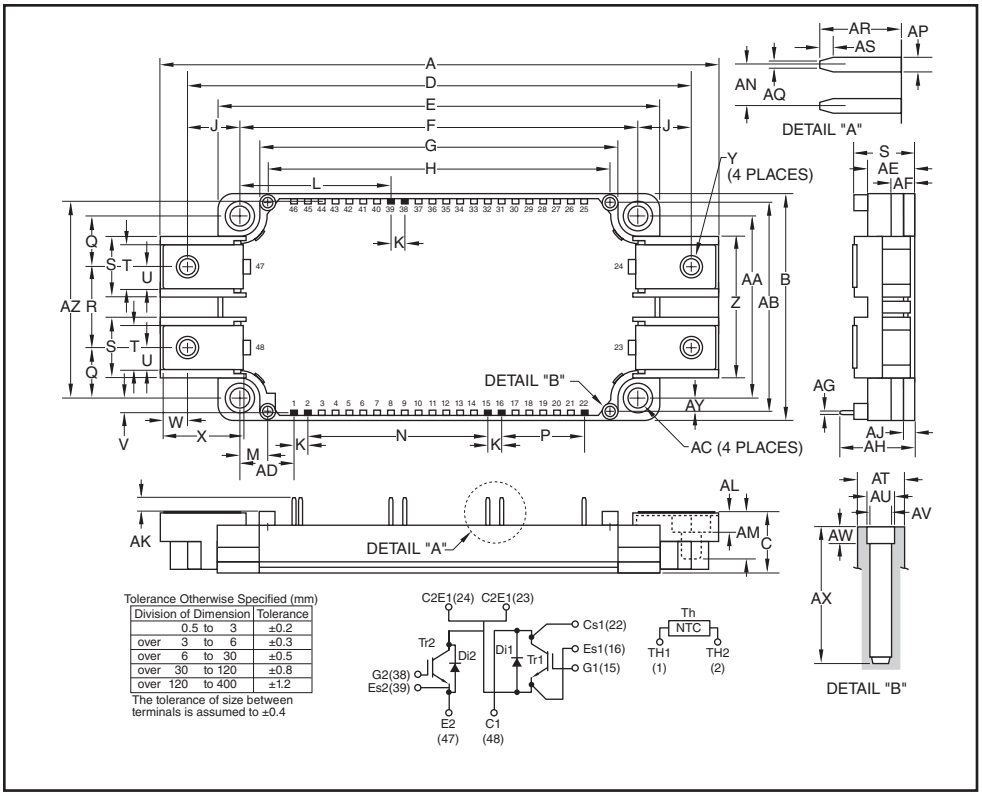
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272
www.pwrx.com

# CM450DX-24S

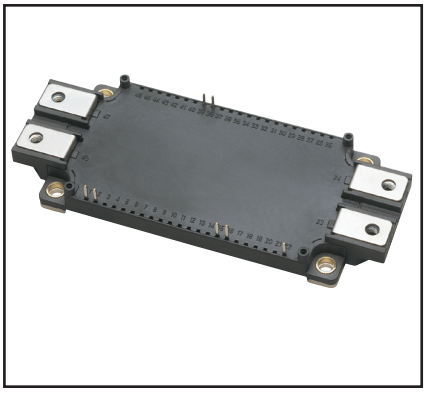
## Dual IGBT
## NX-Series Module
### 450 Amperes/1200 Volts




**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 5.98 | 152.0 |
| B | 2.44 | 62.0 |
| C | 0.67+0.04/-0.02 | 17.0+1.0/-0.5 |
| D | 5.39 | 137.0 |
| E | 4.79 | 121.7 |
| F | 4.33±0.02 | 110.0±0.5 |
| G | 3.89 | 99.0 |
| H | 3.72 | 94.5 |
| J | 0.53 | 13.5 |
| K | 0.15 | 3.81 |
| L | 1.64 | 41.66 |
| M | 0.30 | 7.75 |
| N | 1.95 | 49.53 |
| P | 0.9 | 22.86 |
| Q | 0.55 | 14.0 |
| R | 0.87 | 22.0 |
| S | 0.67 | 17.0 |
| T | 0.48 | 12.0 |
| U | 0.24 | 6.0 |
| V | 0.16 | 4.2 |
| W | 0.37 | 6.5 |
| X | 0.83 | 21.14 |
| Y | M6 | M6 |
| Z | 1.53 | 39.0 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| AA | 1.97±0.02 | 50.0±0.5 |
| AB | 2.26 | 57.5 |
| AC | 0.22 Dia. | 5.5 Dia. |
| AD | 0.6 | 15.0 |
| AE | 0.51 | 13.0 |
| AF | 0.27 | 7.0 |
| AG | 0.03 | 0.8 |
| AH | 0.81 | 20.5 |
| AJ | 0.12 | 3.0 |
| AK | 0.14 | 3.5 |
| AL | 0.26 | 6.5 |
| AM | 0.53 | 13.5 |
| AN | 0.15 | 3.81 |
| AP | 0.05 | 1.15 |
| AQ | 0.025 | 0.65 |
| AR | 0.29 | 7.4 |
| AS | 0.05 | 1.2 |
| AT | 0.17 Dia. | 4.3 Dia. |
| AU | 0.102 Dia. | 2.6 Dia. |
| AV | 0.088 Dia. | 2.25 Dia. |
| AW | 0.12 | 3.0 |
| AX | 0.49 | 12.5 |
| AY | 0.14 | 3.75 |
| AZ | 2.13 | 54.2 |



**Description:**
Powerex IGBT Modules are designed for use in switching applications. Each module consists of two IGBT Transistors in a half-bridge configuration with each transistor having a reverse-connected super-fast recovery free-wheel diode. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

**Features:**
- ☐ Low Drive Power
- ☐ Low $V_{CE(sat)}$
- ☐ Discrete Super-Fast Recovery Free-Wheel Diode
- ☐ Isolated Baseplate for Easy Heat Sinking

**Applications:**
- ☐ AC Motor Control
- ☐ Motion/Servo Control
- ☐ Photovoltaic/Fuel Cell

**Ordering Information:**
Example: Select the complete module number you desire from the table below -i.e. CM450DX-24S is a 1200V ($V_{CES}$), 450 Ampere Dual IGBT Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 50) |
|---|---|---|
| CM | 450 | 24 |

***CM450DX-24S***
***Dual IGBT NX-Series Module***
*450 Amperes/1200 Volts*

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

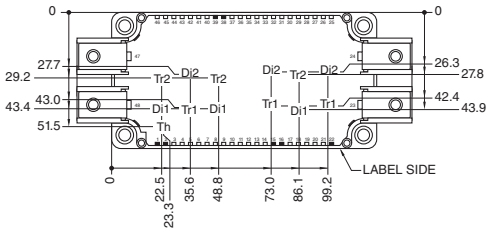
### Inverter Part IGBT/FWDi

| Characteristics | Symbol | Rating | Units |
|---|---|---|---|
| Collector-Emitter Voltage ($V_{GE}$ = 0V) | $V_{CES}$ | 1200 | Volts |
| Gate-Emitter Voltage ($V_{CE}$ = 0V) | $V_{GES}$ | ±20 | Volts |
| Collector Current (DC, $T_C$ = 119°C)*2,*4 | $I_C$ | 450 | Amperes |
| Collector Current (Pulse, Repetitive)*3 | $I_{CRM}$ | 900 | Amperes |
| Total Power Dissipation ($T_C$ = 25°C)*2,*4 | $P_{tot}$ | 3405 | Watts |
| Emitter Current (DC)*2 | $I_E$*1 | 450 | Amperes |
| Emitter Current (Pulse, Repetitive)*3 | $I_{ERM}$*1 | 900 | Amperes |

### Module

| Characteristics | Symbol | Rating | Units |
|---|---|---|---|
| Isolation Voltage (Terminals to Baseplate, RMS, f = 60Hz, AC 1 minute) | $V_{ISO}$ | 2500 | Volts |
| Maximum Junction Temperature, Instantaneous Event (Overload) | $T_{j(max)}$ | 175 | °C |
| Maximum Case Temperature*4 | $T_{C(max)}$ | 125 | °C |
| Operating Junction Temperature, Continuous Operation (Under Switching) | $T_{j(op)}$ | -40 to +150 | °C |
| Storage Temperature | $T_{stg}$ | -40 to +125 | °C |

*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).
*2 Junction temperature ($T_j$) should not increase beyond maximum junction temperature ($T_{j(max)}$) rating.
*3 Pulse width and repetition rate should be such that device junction temperature ($T_j$) does not exceed $T_{j(max)}$ rating.
*4 Case temperature ($T_C$) and heatsink temperature ($T_s$) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure to the right for chip location. The heatsink thermal resistance should be measured just under the chips.




Tr1 / Tr2: IGBT, Di1 / Di2: FWDi, Th: NTC Thermistor
Each mark points to the center position of each chip.

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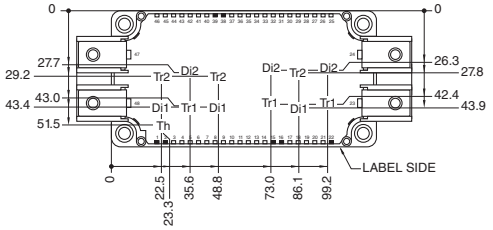
## Electrical Characteristics, $T_j$ = 25°C unless otherwise specified

### Inverter Part IGBT/FWDi

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Collector-Emitter Cutoff Current | $I_{CES}$ | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V | — | — | 1.0 | mA |
| Gate-Emitter Leakage Current | $I_{GES}$ | $V_{GE} = V_{GES}$, $V_{CE}$ = 0V | — | — | 0.5 | µA |
| Gate-Emitter Threshold Voltage | $V_{GE(th)}$ | $I_C$ = 45mA, $V_{CE}$ = 10V | 5.4 | 6.0 | 6.6 | Volts |
| Collector-Emitter Saturation Voltage (Terminal) | $V_{CE(sat)}$ | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 25°C*5 | — | 1.80 | 2.25 | Volts |
| | | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 125°C*5 | — | 2.00 | — | Volts |
| | | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 150°C*5 | — | 2.05 | — | Volts |
| Collector-Emitter Saturation Voltage (Chip) | $V_{CE(sat)}$ | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 25°C*5 | — | 1.70 | 2.15 | Volts |
| | | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 125°C*5 | — | 1.90 | — | Volts |
| | | $I_C$ = 450A, $V_{GE}$ = 15V, $T_j$ = 150°C*5 | — | 1.95 | — | Volts |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 10V, $V_{GE}$ = 0V | — | — | 45 | nF |
| Output Capacitance | $C_{oes}$ | | — | — | 9.0 | nF |
| Reverse Transfer Capacitance | $C_{res}$ | | — | — | 0.75 | nF |
| Gate Charge | $Q_G$ | $V_{CC}$ = 600V, $I_C$ = 450A, $V_{GE}$ = 15V | — | 1050 | — | nC |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$ = 600V, $I_C$ = 450A, $V_{GE}$ = ±15V, $R_G$ = 0Ω, Inductive Load | — | — | 800 | ns |
| Rise Time | $t_r$ | | — | — | 200 | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | — | — | 600 | ns |
| Fall Time | $t_f$ | | — | — | 300 | ns |
| Emitter-Collector Voltage (Terminal) | $V_{EC}$*1 | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 25°C*5 | — | 1.80 | 2.25 | Volts |
| | | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 125°C*5 | — | 1.80 | — | Volts |
| | | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 150°C*5 | — | 1.80 | — | Volts |
| Emitter-Collector Voltage (Chip) | $V_{EC}$*1 | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 25°C*5 | — | 1.70 | 2.15 | Volts |
| | | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 125°C*5 | — | 1.70 | — | Volts |
| | | $I_E$ = 450A, $V_{GE}$ = 0V, $T_j$ = 150°C*5 | — | 1.70 | — | Volts |
| Reverse Recovery Time | $t_{rr}$*1 | $V_{CC}$ = 600V, $I_E$ = 450A, $V_{GE}$ = ±15V | — | — | 300 | ns |
| Reverse Recovery Charge | $Q_{rr}$*1 | $R_G$ = 0Ω, Inductive Load | — | 24 | — | µC |
| Turn-on Switching Energy per Pulse | $E_{on}$ | $V_{CC}$ = 600V, $I_C$ = $I_E$ = 450A, $V_{GE}$ = ±15V | — | 54.9 | — | mJ |
| Turn-off Switching Energy per Pulse | $E_{off}$ | $R_G$ = 0Ω, $T_j$ = 150°C | — | 48.0 | — | mJ |
| Reverse Recovery Energy per Pulse | $E_{rr}$*1 | Inductive Load | — | 32.4 | — | mJ |
| Internal Lead Resistance | $R_{CC' + EE'}$ | Main Terminals-Chip, Per Switch, $T_C$ = 25°C*4 | — | — | 0.7 | mΩ |
| Internal Gate Resistance | $r_g$ | Per Switch | — | 4.3 | — | Ω |

*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).
*4 Case temperature ($T_C$) and heatsink temperature ($T_s$) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure to the right for chip location. The heatsink thermal resistance should be measured just under the chips.
*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.




Tr1 / Tr2: IGBT, Di1 / Di2: FWDi, Th: NTC Thermistor
Each mark points to the center position of each chip.

## Electrical Characteristics, $T_j$ = 25°C unless otherwise specified (continued)

### NTC Thermistor Part

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Zero Power Resistance | $R_{25}$ | $T_C$ = 25°C*4 | 4.85 | 5.00 | 5.15 | kΩ |
| Deviation of Resistance | ΔR/R | $T_C$ = 100°C*4, $R_{100}$ = 493Ω | -7.3 | — | +7.8 | % |
| B Constant | $B_{(25/50)}$ | Approximate by Equation*6 | — | 3375 | — | K |
| Power Dissipation | $P_{25}$ | $T_C$ = 25°C*4 | — | — | 10 | mW |

### Thermal Resistance Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| Thermal Resistance, Junction to Case*4 | $R_{th(j-c)}Q$ | IGBT Part | — | — | 44 | K/kW |
| Thermal Resistance, Junction to Case*4 | $R_{th(j-c)}D$ | FWDi Part | — | — | 78 | K/kW |
| Contact Thermal Resistance, Case to Heatsink*4 | $R_{th(c-f)}$ | Thermal Grease Applied, Per 1 Module*7 | — | 15 | — | K/kW |

### Mechanical Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| Mounting Torque | $M_t$ | Main Terminals, M6 Screw | 31 | 35 | 40 | in-lb |
| Mounting Torque | $M_s$ | Mounting to Heatsink, M5 Screw | 22 | 27 | 31 | in-lb |
| Creepage Distance | $d_s$ | Terminal to Terminal | 11.26 | — | — | mm |
| | | Terminal to Baseplate | 12.46 | — | — | mm |
| Clearance | $d_a$ | Terminal to Terminal | 10.00 | — | — | mm |
| | | Terminal to Baseplate | 10.12 | — | — | mm |
| Weight | m | | — | 350 | — | Grams |
| Flatness of Baseplate | $e_c$ | On Centerline X, Y*8 | ±0 | — | ±100 | μm |

### Recommended Operating Conditons, $T_a$ = 25°C

| | | | | | | |
|---|---|---|---|---|---|---|
| DC Supply Voltage | $V_{CC}$ | Applied Across C1-E2 Terminals | — | 600 | 850 | Volts |
| Gate-Emitter Drive Voltage | $V_{GE(on)}$ | Applied Across G1-Es1/G2-Es2 Terminals | 13.5 | 15.0 | 16.5 | Volts |
| External Gate Resistance | $R_G$ | Per Switch | 0 | — | 10 | Ω |

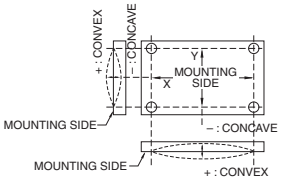
*4 Case temperature ($T_C$) and heatsink temperature ($T_s$) is measured on the surface (mounting side) of the baseplate and the heatsink side just under the chips. Refer to the figure to the right for chip location. The heatsink thermal resistance should be measured just under the chips.

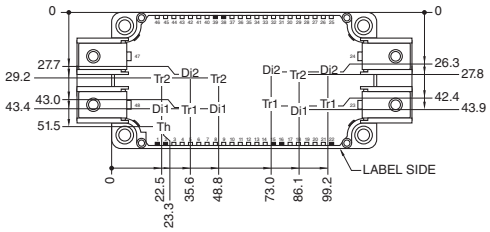
*6 $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}})/(\frac{1}{T_{25}} - \frac{1}{T_{50}})$

$R_{25}$; Resistance at Absolute Temperature $T_{25}$ [K]; $T_{25}$ = 25 [°C] + 273.15 = 298.15 [K]
$R_{50}$; Resistance at Absolute Temperature $T_{50}$ [K]; $T_{50}$ = 50 [°C] + 273.15 = 323.15 [K]

*7 Typical value is measured by using thermally conductive grease of λ = 0.9 [W/(m • K)].

*8 Baseplate (mounting side) flatness measurement points (X, Y) are shown in the figure below.




Tr1 / Tr2: IGBT, Di1 / Di2: FWDi, Th: NTC Thermistor
Each mark points to the center position of each chip.

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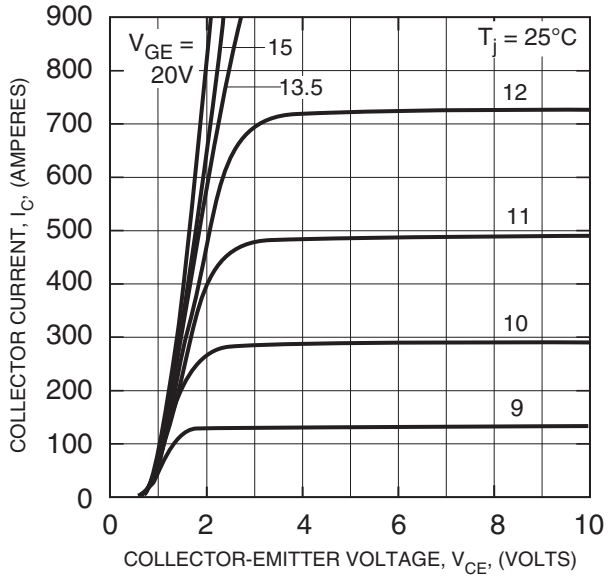
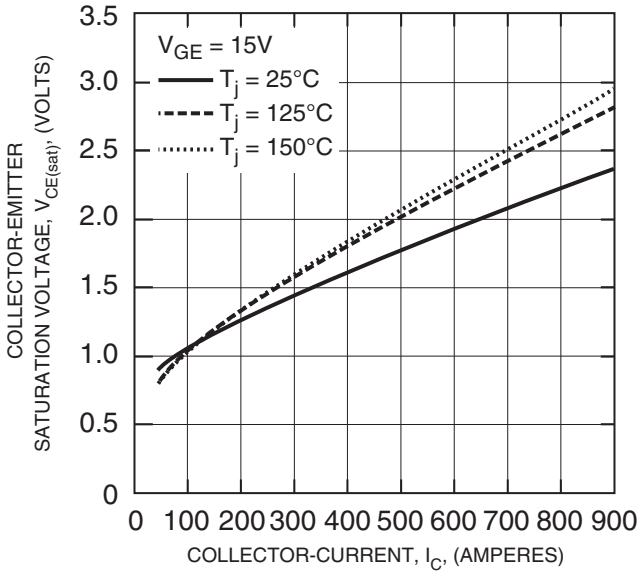
**OUTPUT CHARACTERISTICS (TYPICAL)**




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

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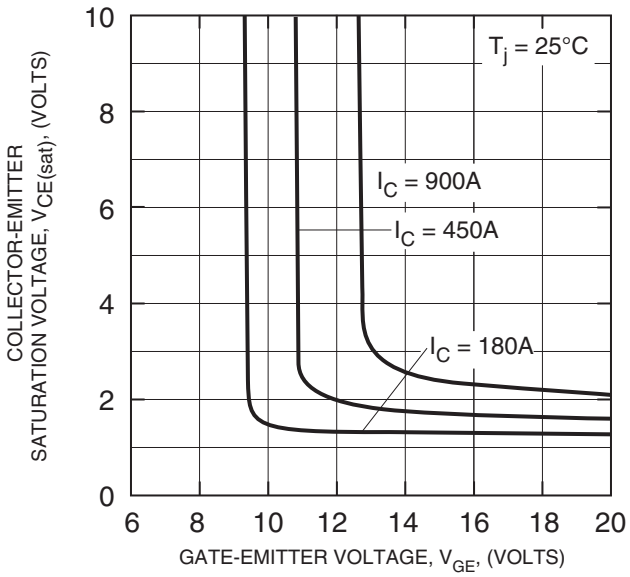
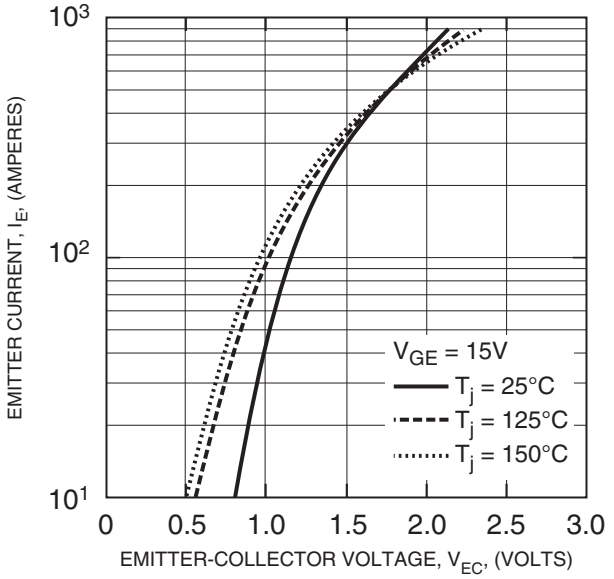



**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



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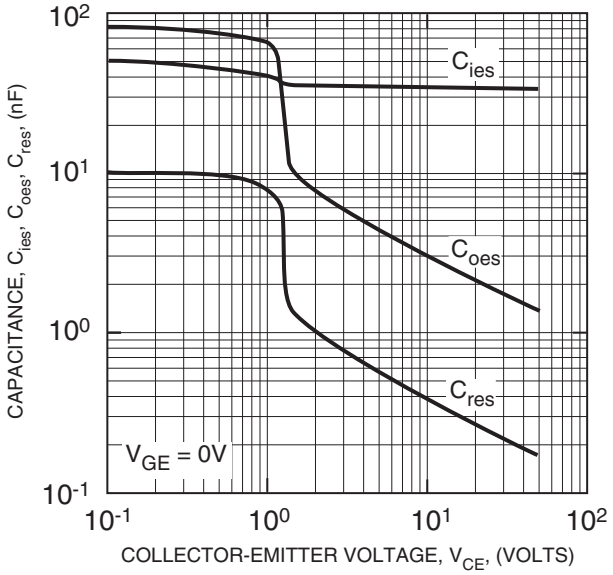
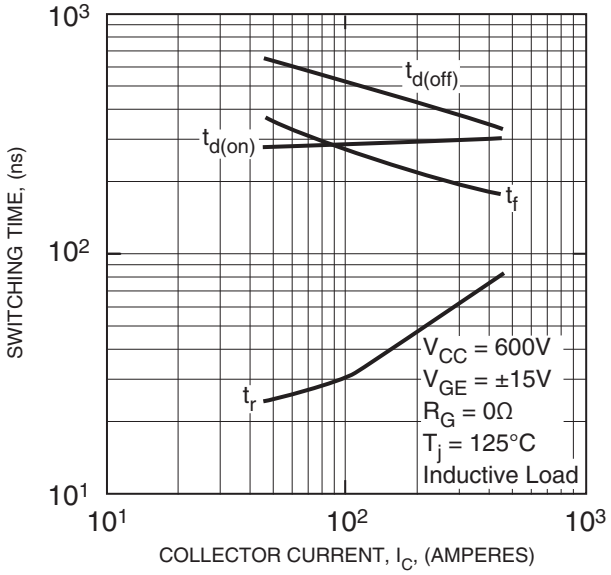
**CAPACITANCE VS. $V_{CE}$ (TYPICAL)**




**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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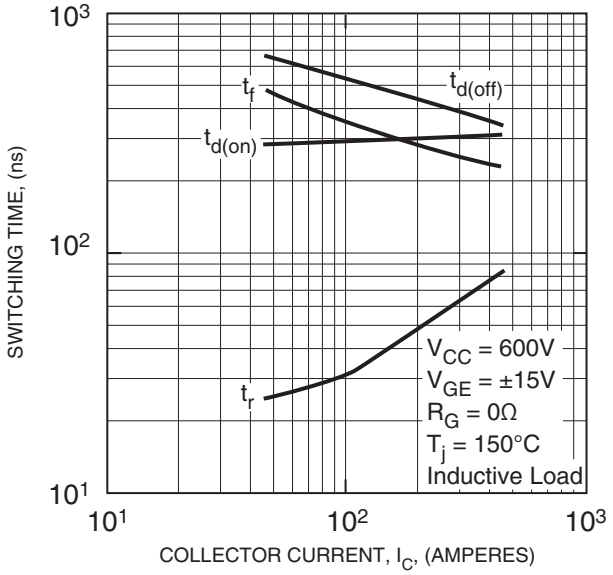
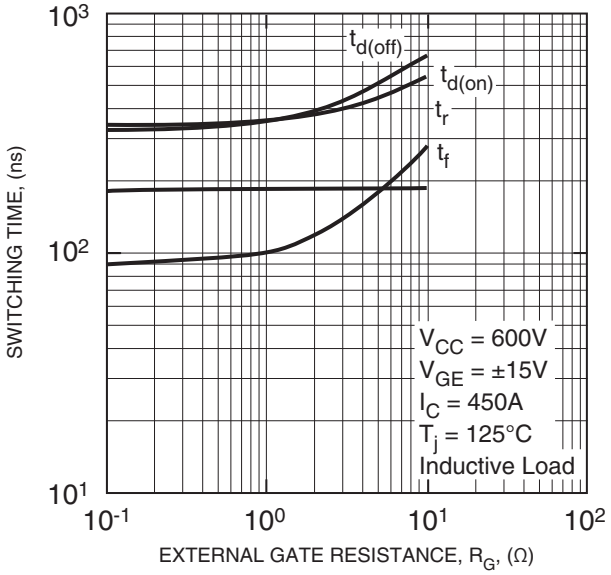



**SWITCHING TIME VS. GATE RESISTANCE (TYPICAL)**



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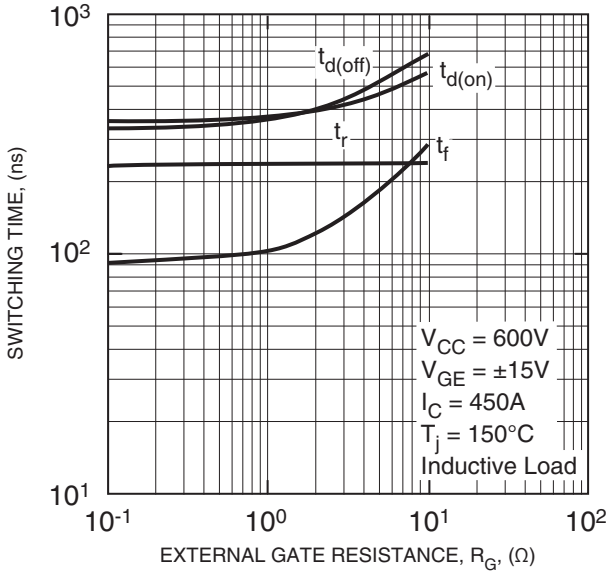
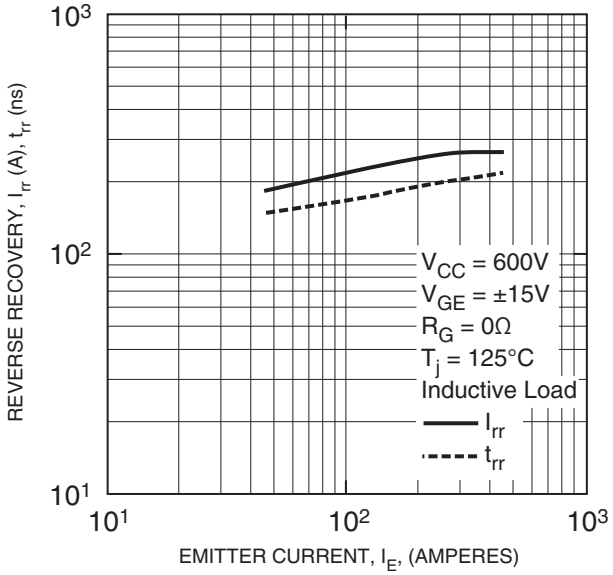



**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

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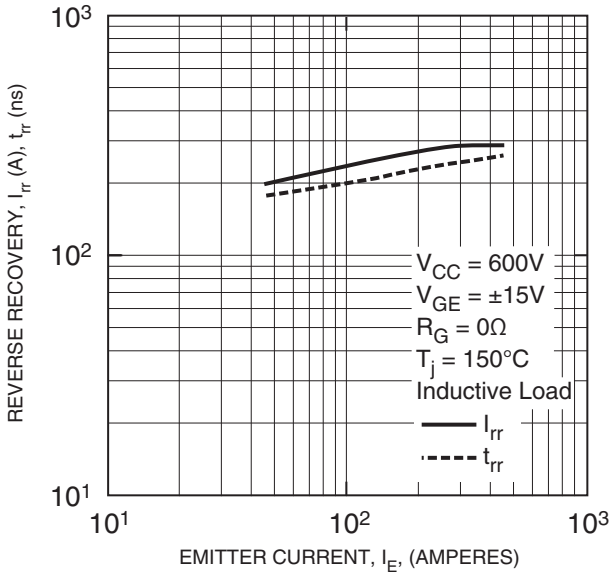
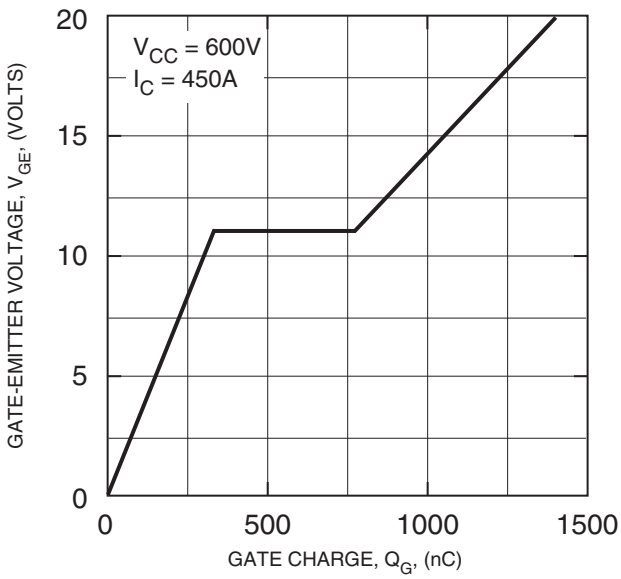



**GATE CHARGE VS. $V_{GE}$**



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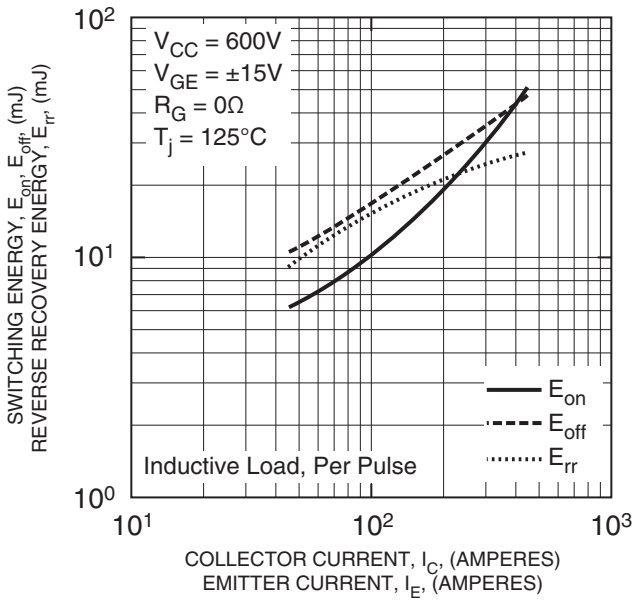
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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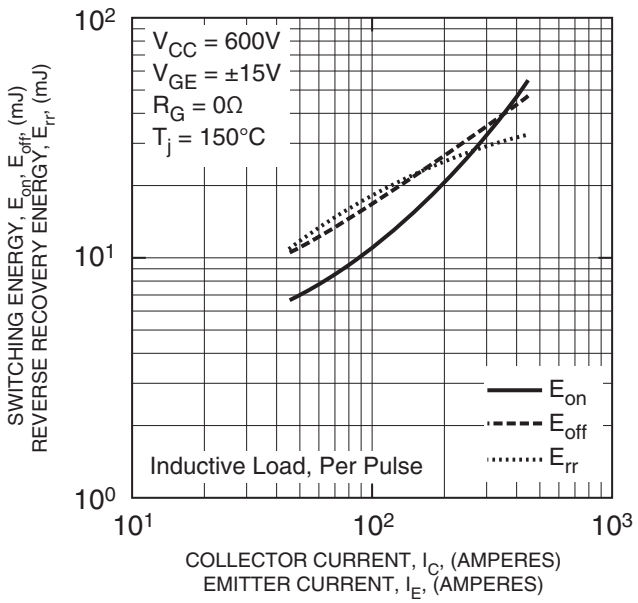


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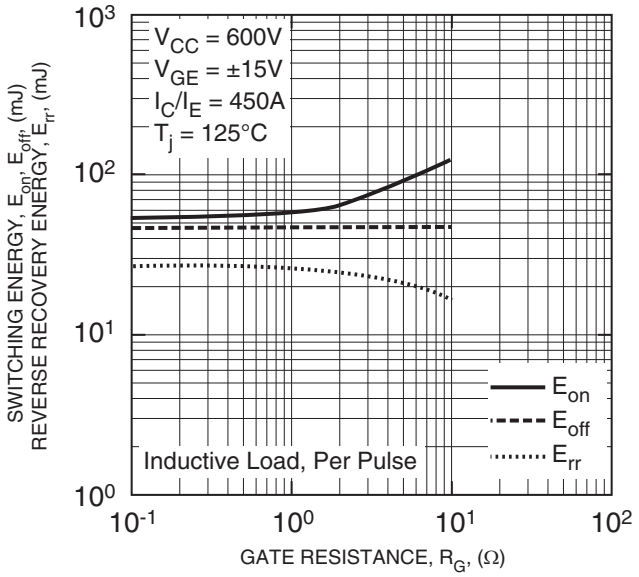


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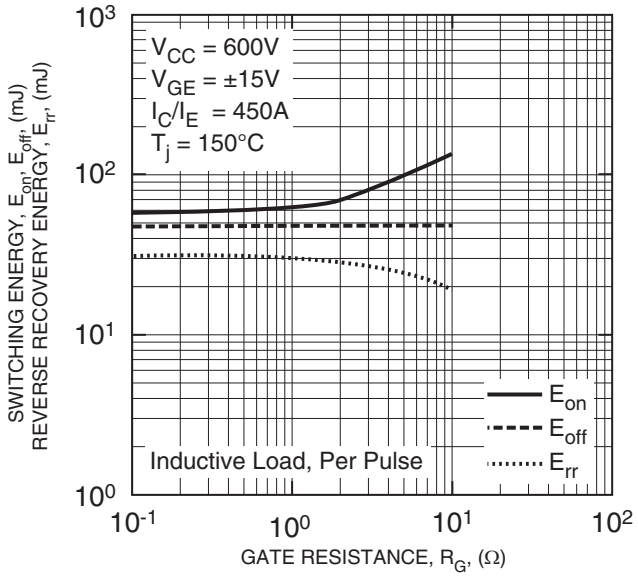

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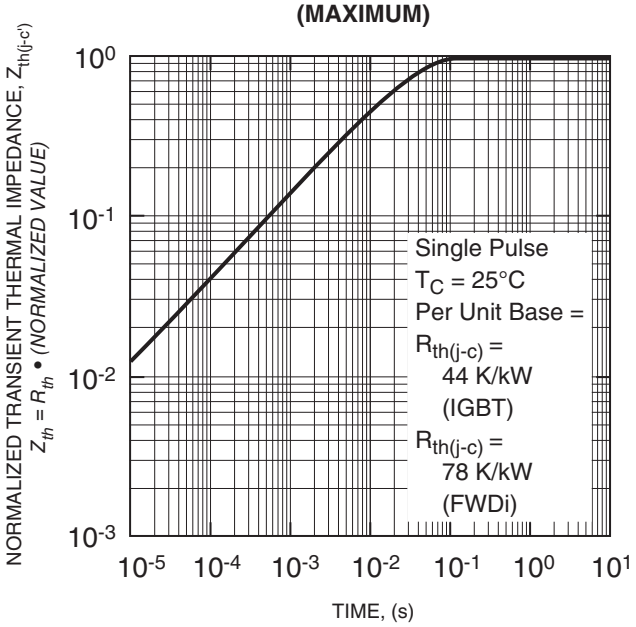
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**




**TEMPERATURE CHARACTERISTICS (NTC THERMISTOR PART - TYPICAL)**