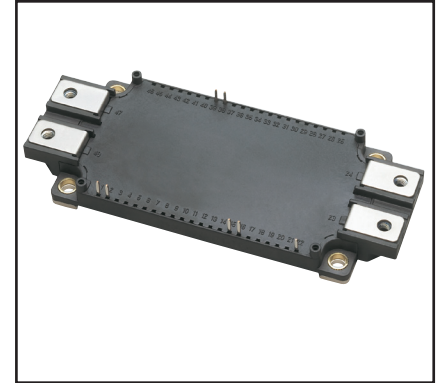
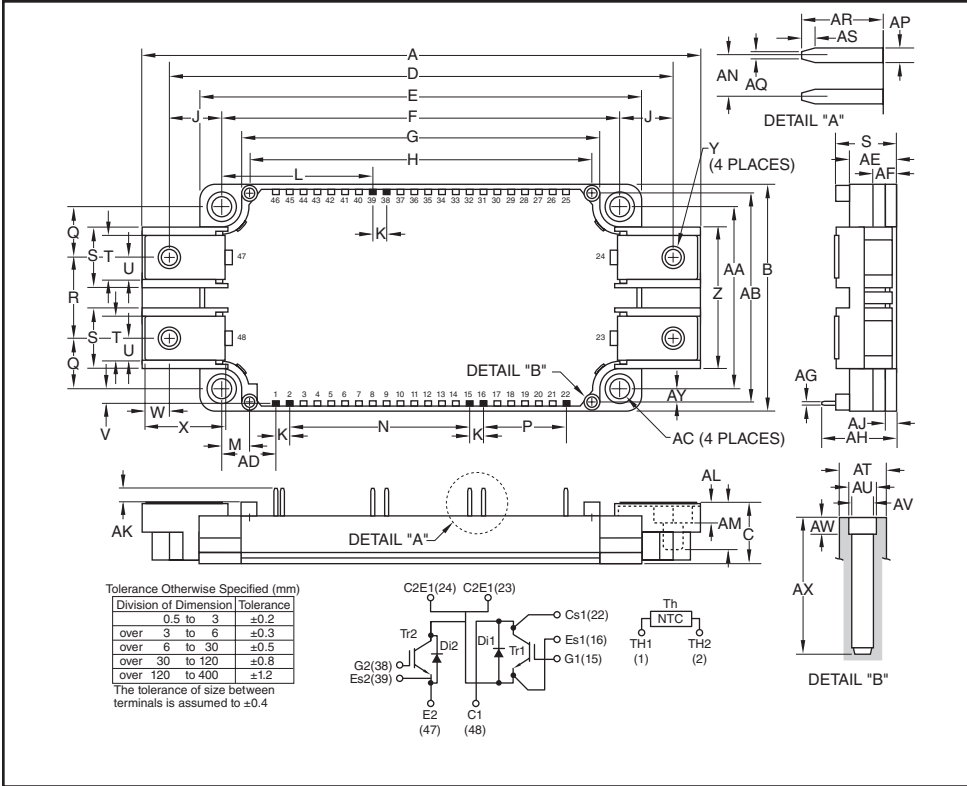


**Six IGBT  
 NX-Series Module  
 450 Amperes/1200 Volts**



**Description:**  
 Powerex IGBT Modules are designed for use in switching applications. Each module consists of six IGBT Transistors in a three phase 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 Six IGBT Power Module.

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

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

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

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

**Inverter Part IGBT/FWDi**

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

**Module**

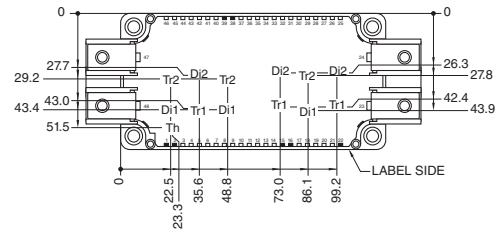
Characteristics	Symbol	Rating	Units
Isolation Voltage (Terminals to Baseplate, RMS, $f = 60\text{Hz}$ , AC 1 minute)	$V_{ISO}$	2500	Volts
Maximum Junction Temperature, Instantaneous Event (Overload)	$T_{j(max)}$	175	$^\circ\text{C}$
Maximum Case Temperature*4	$T_C(max)$	125	$^\circ\text{C}$
Operating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

\*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.

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

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

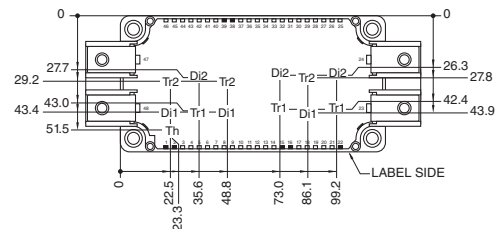
**Inverter Part IGBT/FWDI**

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	$\mu\text{A}$
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$I_C = 45\text{mA}, V_{CE} = 10V$	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Terminal)	$I_C = 450\text{A}, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_C = 450\text{A}, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	2.00	—	Volts
		$I_C = 450\text{A}, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Chip)	$I_C = 450\text{A}, V_{GE} = 15V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_C = 450\text{A}, V_{GE} = 15V, T_j = 125^\circ\text{C}^{*5}$	—	1.90	—	Volts
		$I_C = 450\text{A}, V_{GE} = 15V, T_j = 150^\circ\text{C}^{*5}$	—	1.95	—	Volts
Input Capacitance	$C_{ies}$		—	—	45	nF
Output Capacitance	$C_{oes}$	$V_{CE} = 10V, V_{GE} = 0V$	—	—	9.0	nF
Reverse Transfer Capacitance	$C_{res}$		—	—	0.75	nF
Gate Charge	$Q_G$	$V_{CC} = 600V, I_C = 450\text{A}, V_{GE} = 15V$	—	1050	—	nC
Turn-on Delay Time	$t_{d(on)}$		—	—	800	ns
Rise Time	$t_r$	$V_{CC} = 600V, I_C = 450\text{A}, V_{GE} = \pm 15V,$	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$	$R_G = 0\Omega, \text{Inductive Load}$	—	—	600	ns
Fall Time	$t_f$		—	—	300	ns
Emitter-Collector Voltage	$V_{EC}^{*1}$ (Terminal)	$I_E = 450\text{A}, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.80	2.25	Volts
		$I_E = 450\text{A}, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.80	—	Volts
		$I_E = 450\text{A}, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.80	—	Volts
Emitter-Collector Voltage	$V_{EC}^{*1}$ (Chip)	$I_E = 450\text{A}, V_{GE} = 0V, T_j = 25^\circ\text{C}^{*5}$	—	1.70	2.15	Volts
		$I_E = 450\text{A}, V_{GE} = 0V, T_j = 125^\circ\text{C}^{*5}$	—	1.70	—	Volts
		$I_E = 450\text{A}, V_{GE} = 0V, T_j = 150^\circ\text{C}^{*5}$	—	1.70	—	Volts
Reverse Recovery Time	$t_{rr}^{*1}$	$V_{CC} = 600V, I_E = 450\text{A}, V_{GE} = \pm 15V$	—	—	300	ns
Reverse Recovery Charge	$Q_{rr}^{*1}$	$R_G = 0\Omega, \text{Inductive Load}$	—	24	—	$\mu\text{C}$
Turn-on Switching Energy per Pulse	$E_{on}$	$V_{CC} = 600V, I_C = I_E = 450\text{A}, V_{GE} = \pm 15V$	—	54.9	—	mJ
Turn-off Switching Energy per Pulse	$E_{off}$	$R_G = 0\Omega, T_j = 150^\circ\text{C}$	—	48.0	—	mJ
Reverse Recovery Energy per Pulse	$E_{rr}^{*1}$	Inductive Load	—	32.4	—	mJ
Internal Lead Resistance	$R_{CC}^{*4} + EE^{*4}$	Main Terminals-Chip, Per Switch, $T_C = 25^\circ\text{C}^{*4}$	—	—	0.7	m $\Omega$
Internal Gate Resistance	$r_g$	Per Switch	—	4.3	—	$\Omega$

\*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, D1 / D2: FWDI, Th: NTC Thermistor  
 Each mark points to the center position of each chip.

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

**Electrical Characteristics,  $T_j = 25^\circ\text{C}$  unless otherwise specified (continued)**

**NTC Thermistor Part**

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Zero Power Resistance	$R_{25}$	$T_C = 25^\circ\text{C}^{*4}$	4.85	5.00	5.15	k $\Omega$
Deviation of Resistance	$\Delta R/R$	$T_C = 100^\circ\text{C}^{*4}$ , $R_{100} = 493\Omega$	-7.3	—	+7.8	%
B Constant	$B_{(25/50)}$	Approximate by Equation <sup>*6</sup>	—	3375	—	K
Power Dissipation	$P_{25}$	$T_C = 25^\circ\text{C}^{*4}$	—	—	10	mW

**Thermal Resistance Characteristics**

Thermal Resistance, Junction to Case <sup>*4</sup>	$R_{th(j-c)Q}$	IGBT Part	—	—	44	K/kW
Thermal Resistance, Junction to Case <sup>*4</sup>	$R_{th(j-c)D}$	FWDi Part	—	—	78	K/kW
Contact Thermal Resistance, Case to Heatsink <sup>*4</sup>	$R_{th(c-f)}$	Thermal Grease Applied, Per 1 Module <sup>*7</sup>	—	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	11.55	—	—	mm
		Terminal to Baseplate	12.32	—	—	mm
Clearance	$d_a$	Terminal to Terminal	10.00	—	—	mm
		Terminal to Baseplate	10.85	—	—	mm
Weight	$m$		—	350	—	Grams
Flatness of Baseplate	$e_c$	On Centerline X, Y <sup>*8</sup>	$\pm 0$	—	$\pm 100$	$\mu\text{m}$

**Recommended Operating Conditions,  $T_a = 25^\circ\text{C}$**

DC Supply Voltage	$V_{CC}$	Applied Across P-N Terminals	—	600	850	Volts
Gate-Emitter Drive Voltage	$V_{GE(on)}$	Applied Across	13.5	15.0	16.5	Volts
		G*P-Es*P/G*N-Es*N Terminals				
External Gate Resistance	$R_G$	Per Switch	0	—	10	$\Omega$

<sup>\*4</sup> 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.

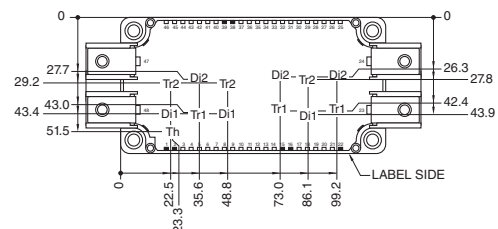
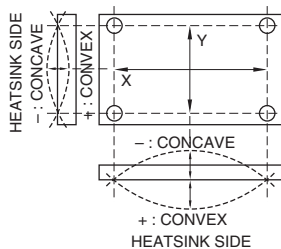
<sup>\*6</sup>  $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

$R_{25}$ : Resistance at Absolute Temperature  $T_{25}$  [K];  $T_{25} = 25 [^\circ\text{C}] + 273.15 = 298.15$  [K]

$R_{50}$ : Resistance at Absolute Temperature  $T_{50}$  [K];  $T_{50} = 50 [^\circ\text{C}] + 273.15 = 323.15$  [K]

<sup>\*7</sup> Typical value is measured by using thermally conductive grease of  $\lambda = 0.9$  [W/(m \* K)].

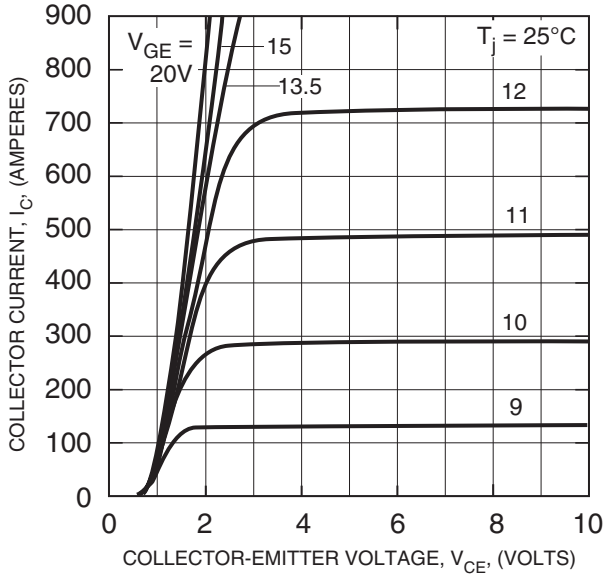
<sup>\*8</sup> Baseplate (mounting side) flatness measurement points (X, Y) are shown in the figure below.



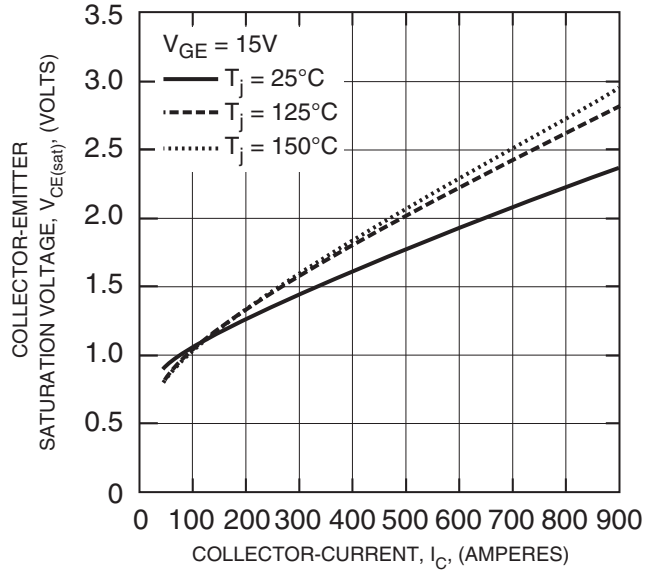
Tr1 / Tr2: IGBT, D1 / D2: FWDi, Th: NTC Thermistor  
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**CM450DX-24S**  
**Six IGBT NX-Series Module**  
 450 Amperes/1200 Volts

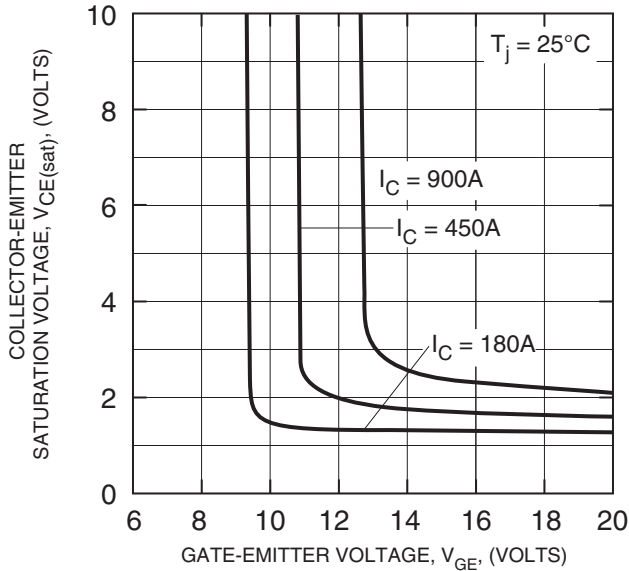
**OUTPUT CHARACTERISTICS (TYPICAL)**



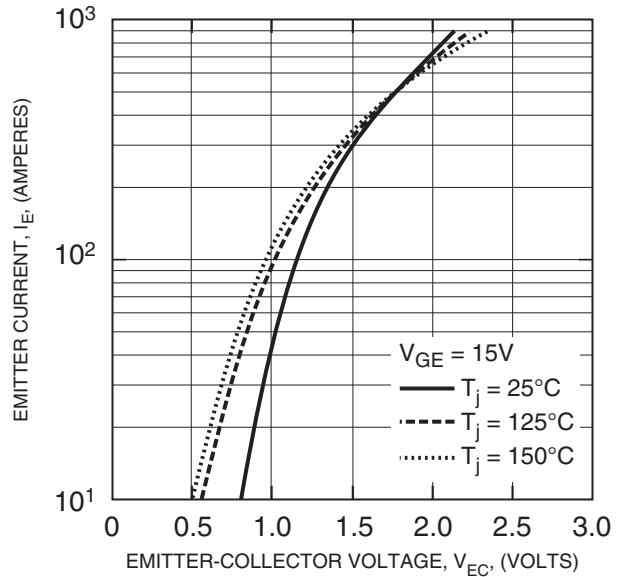
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



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

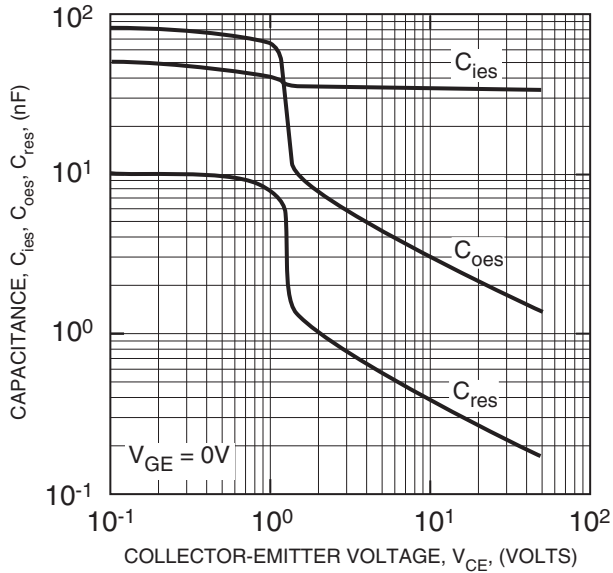


**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**

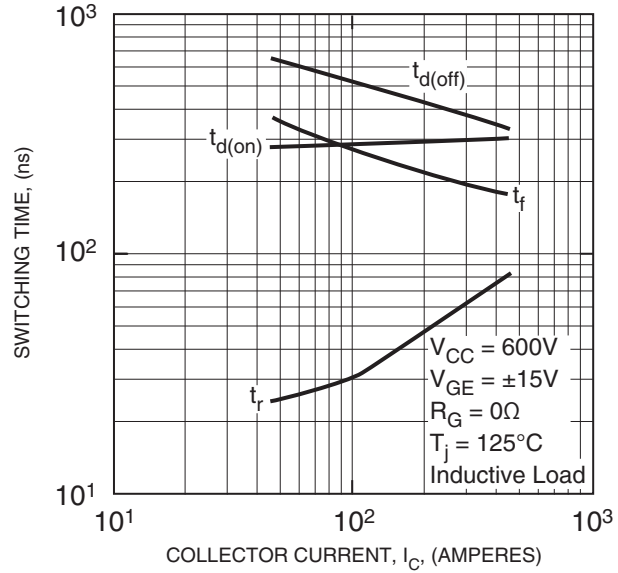


**CM450DX-24S**  
**Six IGBT NX-Series Module**  
 450 Amperes/1200 Volts

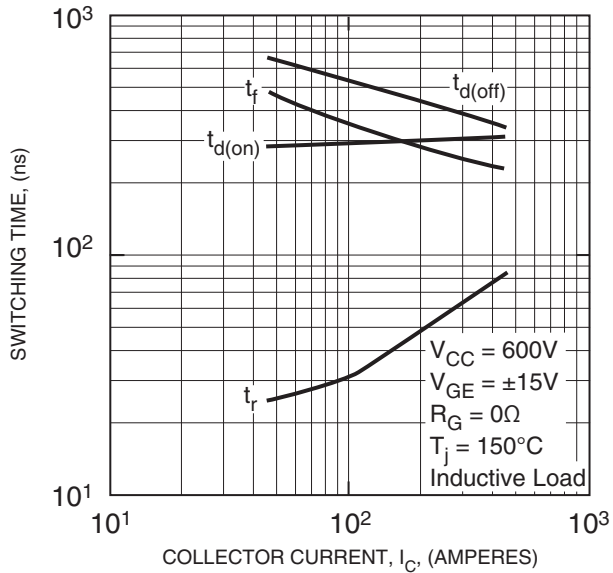
**CAPACITANCE VS.  $V_{CE}$**   
 (TYPICAL)



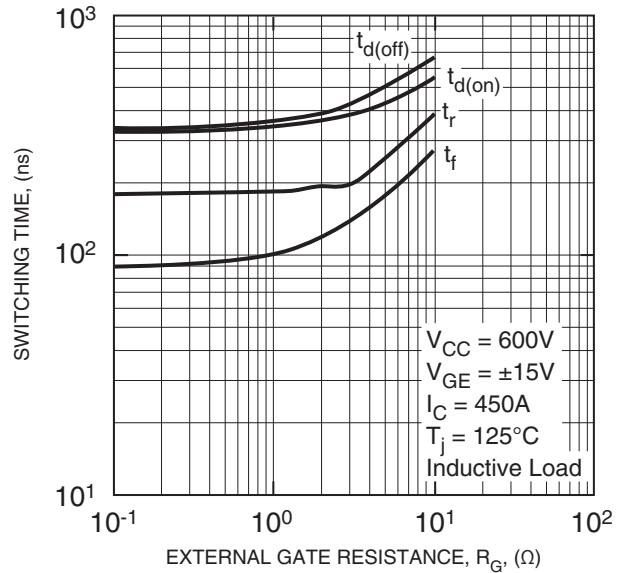
**HALF-BRIDGE SWITCHING CHARACTERISTICS**  
 (TYPICAL)



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

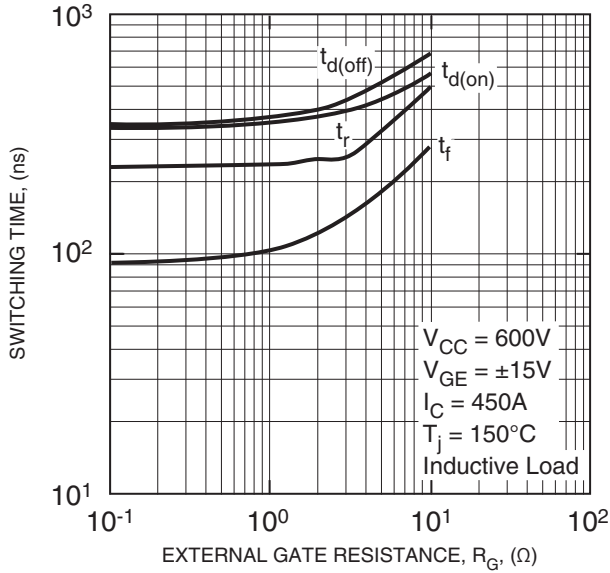


**SWITCHING TIME VS. GATE RESISTANCE**  
 (TYPICAL)

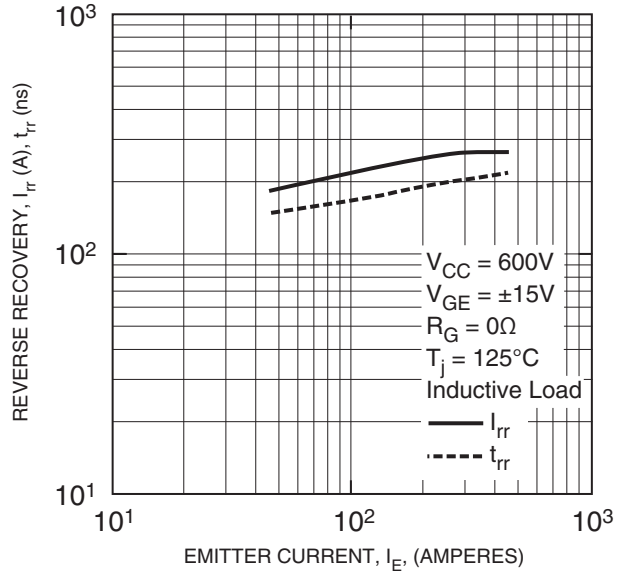


**CM450DX-24S**  
**Six IGBT NX-Series Module**  
 450 Amperes/1200 Volts

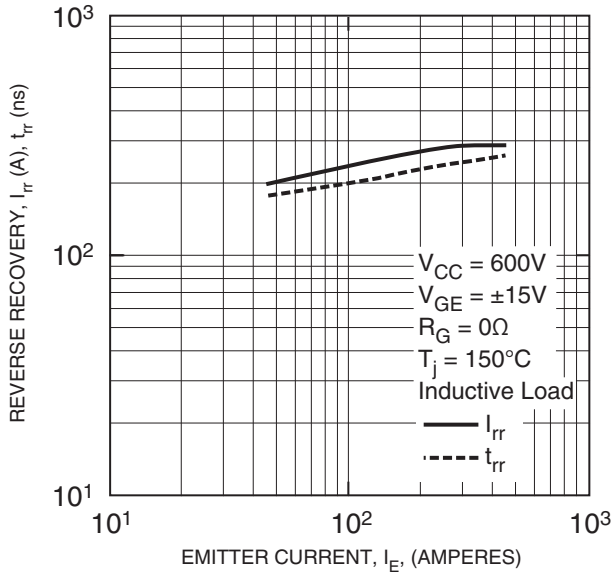
**SWITCHING TIME VS. GATE RESISTANCE (TYPICAL)**



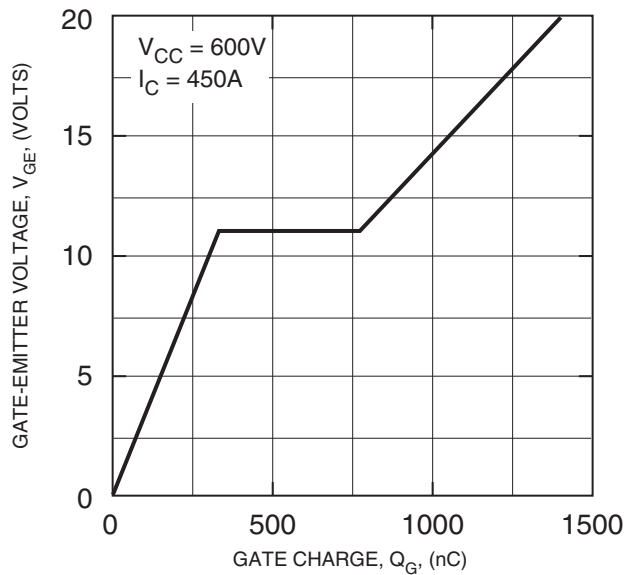
**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

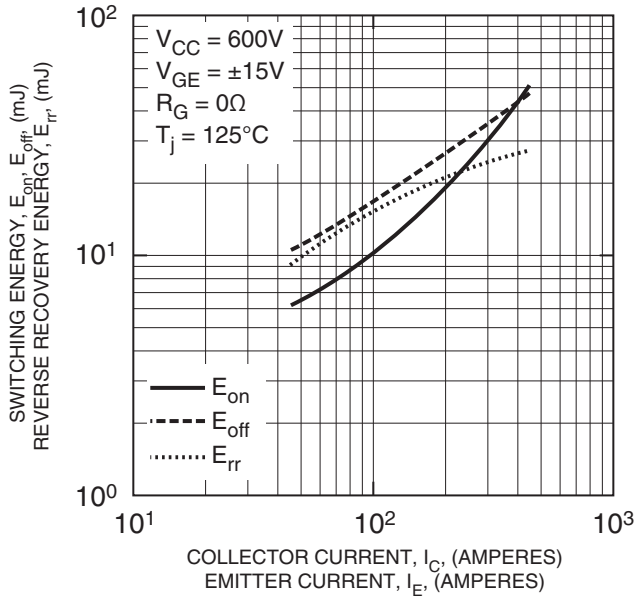


**GATE CHARGE VS.  $V_{GE}$**

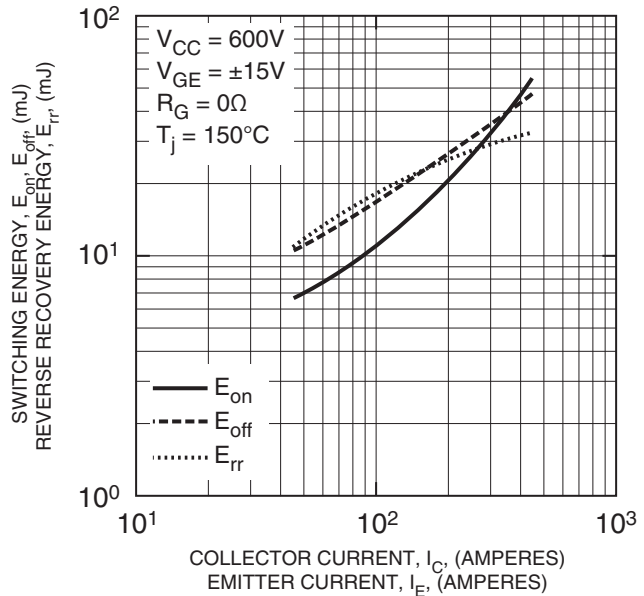


**CM450DX-24S**  
**Six IGBT NX-Series Module**  
 450 Amperes/1200 Volts

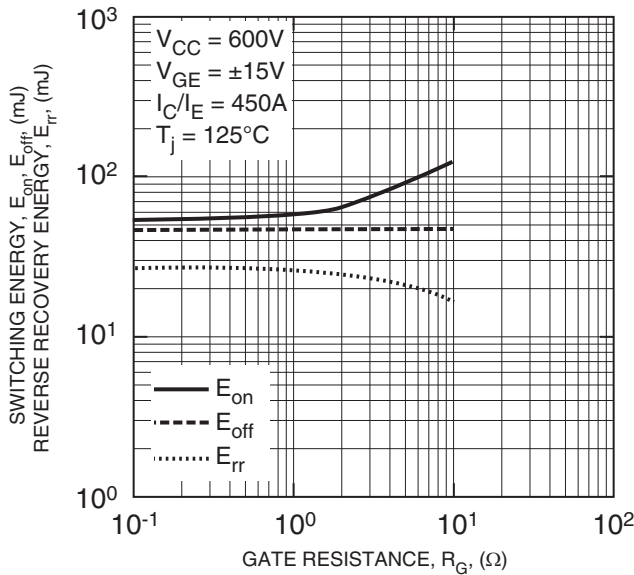
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



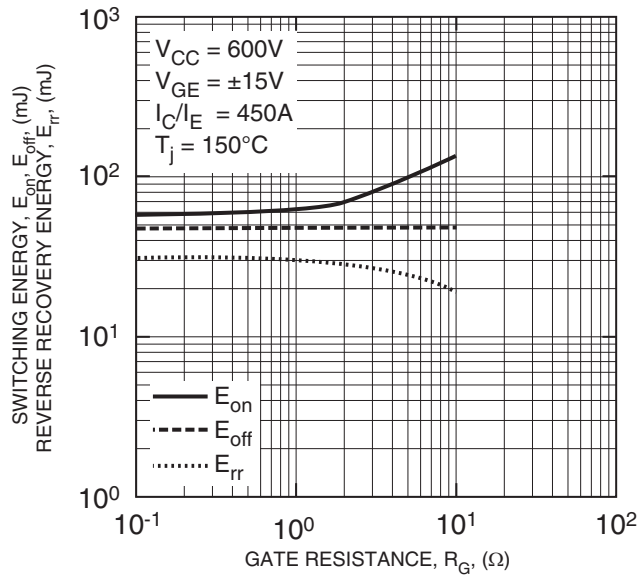
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



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