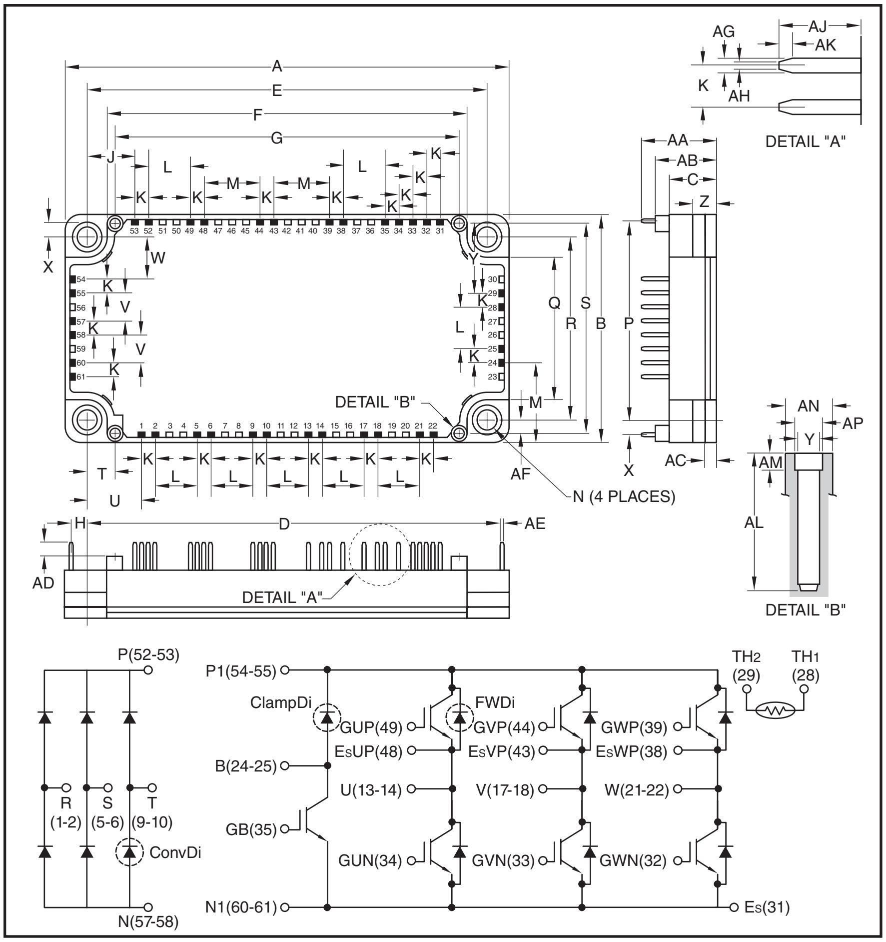
CM100MX-12A

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

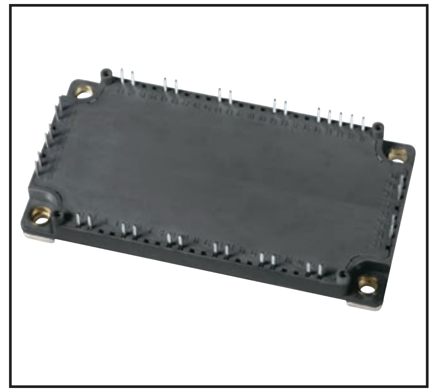
NX-Series CIB Module
(3Ø Converter + 3Ø Inverter + Brake)
100 Amperes/600 Volts



Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	4.79	121.7
B	2.44	62.0
C	0.51	13.0
D	4.49	114.05
E	4.33±0.02	110.0±0.5
F	3.89	99.0
G	3.72	94.5
H	0.16	4.06
J	0.51	13.09
K	0.15	3.81
L	0.45	11.43
M	0.6	15.24
N	0.22 Dia.	5.5 Dia.
P	2.13	54.2
Q	1.53	39.0
R	1.97±0.02	50.0±0.5
S	2.26	57.5
T	0.30	7.75
U	0.59	15.0

Dimensions	Inches	Millimeters
V	0.3	7.62
W	0.46	11.66
X	0.16	4.2
Y	0.08 Dia.	2.1 Dia.
Z	0.27	7.0
AA	0.81	20.5
AB	0.67	17.0
AC	0.12	3.0
AD	0.14	3.5
AE	0.03	0.8
AF	0.15	3.75
AG	0.05	1.15
AH	0.025	0.65
AJ	0.29	7.4
AK	0.047	1.2
AL	0.49	12.5
AM	0.06	1.5
AN	0.17 Dia.	4.3 Dia.
AP	0.10 Dia.	2.5 Dia.



Description:
CIBs are low profile and thermally efficient. Each module consists of a three-phase diode converter section, a three-phase inverter section and a brake circuit. A thermistor is included in the package for sensing the baseplate temperature. 5th Generation CSTBT chips yield low loss.

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. CM100MX-12A is a 600V (V_{CES}), 100 Ampere CIB Power Module.

Type	Current Rating Amperes	V_{CES} Volts (x 50)
CM	100	12

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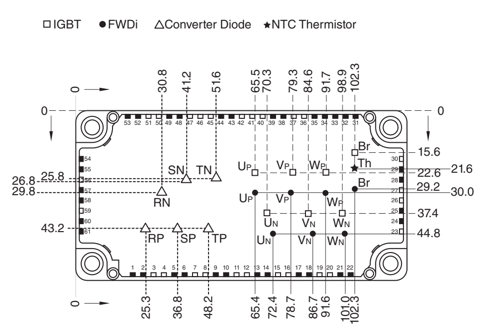
Absolute Maximum Ratings, T_j = 25°C unless otherwise specified

Characteristics	Symbol	CM100MX-12A	Units
Inverter Part IGBT/FWDi			
Collector-Emitter Voltage (G-E Short)	V_{CES}	600	Volts
Gate-Emitter Voltage (C-E Short)	V_{GES}	±20	Volts
Collector Current (DC, T_C = 75°C)*2,*4	I_C	100	Amperes
Collector Current (Pulse)*3	I_{CRM}	200	Amperes
Total Power Dissipation (T_C = 25°C)*2,*4	P_{tot}	400	Watts
Emitter Current*2	I_E*1	10	Amperes
Emitter Current (Pulse)*3	I_{ERM}*1	200	Amperes
Brake Part IGBT/ClampDi			
Collector-Emitter Voltage (G-E Short)	V_{CES}	600	Volts
Gate-Emitter Voltage (C-E Short)	V_{GES}	±20	Volts
Collector Current (DC, T_C = 97°C)*2,*4	I_C	50	Amperes
Collector Current (Pulse)*3	I_{CRM}	100	Amperes
Total Power Dissipation (T_C = 25°C)*2,*4	P_{tot}	280	Watts
Repetitive Peak Reverse Voltage	V_{RRM}	600	Volts
Forward Current (T_C = 25°C)*2	I_F	50	Amperes
Forward Current (Pulse)*3	I_{FRM}	100	Amperes
Converter Part ConvDi			
Repetitive Peak Reverse Voltage	V_{RRM}	800	Volts
Recommended AC Input Voltage	E_a	220	Volts
DC Output Current (3-Phase Full Wave Rectifying, f = 60Hz, T_C = 125°C)*2,*4	I_O	100	Amperes
Surge Forward Current (Sine Half-wave 1 Cycle Peak Value, f = 60Hz, Non-repetitive)	I_{FSM}	1000	Amperes
Current Square Time (Value for One Cycle of Surge Current)	I^2t	4160	A^2s
Module			
Isolation Voltage (Charged Part to Baseplate, RMS, f = 60Hz, AC 1 min.)	V_{ISO}	2500	Volts
Junction Temperature	T_j	-40 ~ +150	°C
Storage Temperature	T_{stg}	-40 ~ +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.



Dimensions in mm (Tolerance: ±1mm)

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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 Cutoff Current		I_{CES}	$V_{CE} = V_{CES}$, V_{GE} = 0V	—	—	1.0	mA
Gate Leakage Current		I_{GES}	$V_{GE} = V_{GES}$, V_{CE} = 0V	—	—	0.5	µA
Gate-Emitter Threshold Voltage		$V_{GE(th)}$	I_C = 10mA, V_{CE} = 10V	5	6	7	Volts
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	T_j = 25°C, I_C = 100A, V_{GE} = 15V*5	—	1.7	2.1	Volts
			T_j = 125°C, I_C = 100A, V_{GE} = 15V*5	—	1.9	—	Volts
			I_C = 100A, V_{GE} = 15V, Chip*5	—	1.6	—	Volts
Input Capacitance		C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	13.3	nF
Output Capacitance		C_{oes}		—	—	1.4	nF
Reverse Transfer Capacitance		C_{res}		—	—	0.45	nF
Total Gate Charge		Q_G	V_{CC} = 300V, I_C = 100A, V_{GE} = 15V	—	270	—	nC
Inductive	Turn-on Delay Time	$t_{d(on)}$	V_{CC} = 300V, I_C = 100A, V_{GE} = ±15V,	—	—	100	ns
Load	Turn-on Rise Time	t_r	R_G = 6.2Ω, Inductive Load	—	—	100	ns
Switch	Turn-off Delay Time	$t_{d(off)}$		—	—	300	ns
Time	Turn-off Fall Time	t_f		—	—	600	ns
Emitter-Collector Voltage		V_{EC}*1	T_j = 25°C, I_E = 100A, V_{GE} = 0V*5	—	2.0	2.8	Volts
			T_j = 125°C, I_E = 100A, V_{GE} = 0V*5	—	1.95	—	Volts
			I_E = 100A, V_{GE} = 0V, Chip	—	1.9	—	Volts
Reverse Recovery Time		t_{rr}*1	V_{CC} = 300V, I_E = 100A, V_{GE} = ±15V	—	—	200	ns
Reverse Recovery Charge		Q_{rr}*1	R_G = 6.2Ω, Inductive Load	—	3.6	—	µC
Internal Gate Resistance		r_g	T_C = 25°C, Per Switch	—	0	—	Ω
External Gate Resistance		R_G		6.0	—	62	Ω

*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).
*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.

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Electrical Characteristics, T_j = 25°C unless otherwise specified

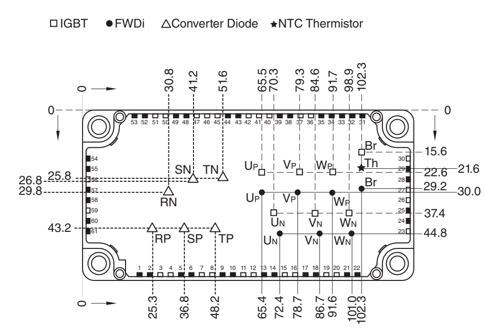
Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Brake Part IGBT/ClampDi						
Collector Cutoff Current	I_{CES}	$V_{CE} = V_{CES}$, V_{GE} = 0V	—	—	1.0	mA
Gate Leakage Current	I_{GES}	$V_{GE} = V_{GES}$, V_{CE} = 0V	—	—	0.5	μA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	I_C = 5mA, V_{CE} = 0V	5	6	7	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	T_j = 25°C, I_C = 50A, V_{GE} = 15V*5	—	1.7	2.1	Volts
		T_j = 125°C, I_C = 50A, V_{GE} = 15V*5	—	1.9	—	Volts
		I_C = 50A, V_{GE} = 15V, Chip	—	1.6	—	Volts
Input Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	9.3	nF
Output Capacitance	C_{oes}		—	—	1.0	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.3	nF
Total Gate Charge	Q_G	V_{CC} = 300V, I_C = 50A, V_{GE} = 15V	—	200	—	nC
Internal Gate Resistance	r_g	T_C = 25°C	—	0	—	Ω
Repetitive Reverse Current	I_{RRM}	$V_R = V_{RRM}$	—	—	1.0	mA
Forward Voltage Drop	V_F	T_j = 25°C, I_F = 50A*5	—	2.0	2.8	Volts
		T_j = 125°C, I_F = 50A*5	—	1.95	—	Volts
		I_F = 50A, Chip	—	1.9	—	Volts
External Gate Resistance	R_G		13	—	125	Ω
Converter Part						
Repetitive Peak Reverse Current	I_{RRM}	$V_R = V_{RRM}$, T_j = 150°C	—	—	20	mA
Forward Voltage Drop	V_F	I_F = 100A*5	—	1.2	1.6	Volts
NTC Thermistor Part						
Zero Power Resistance	R_{25}	T_C = 25°C*4	4.85	5.00	5.15	kΩ
Deviation of Resistance	ΔR/R	R_{100} = 493Ω, T_C = 100°C*4	-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

*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.

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

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



Dimensions in mm (Tolerance: ±1mm)

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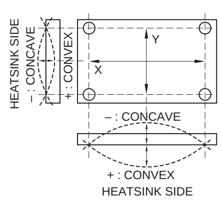
Thermal Resistance Characteristics, T_j = 25°C unless otherwise specified

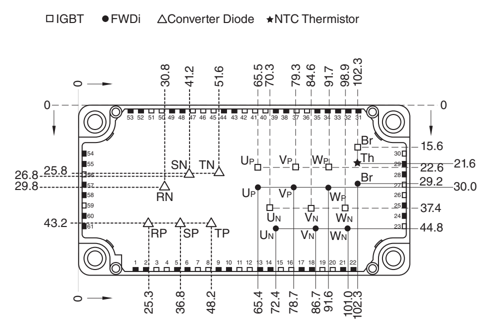
Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Thermal Resistance, Junction to Case	$R_{th(j-c)}Q$	Per Inverter IGBT*4	—	—	0.31	°C/W
Thermal Resistance, Junction to Case	$R_{th(j-c)}D$	Per Inverter FWDi*4	—	—	0.59	°C/W
Thermal Resistance, Junction to Case	$R_{th(j-c)}Q$	Brake IGBT*4	—	—	0.44	°C/W
Thermal Resistance, Junction to Case	$R_{th(j-c)}D$	Brake ClampDi*4	—	—	0.85	°C/W
Thermal Resistance, Junction to Case	$R_{th(j-c)}D$	Per ConvDi*4	—	—	0.24	°C/W
Contact Thermal Resistance	$R_{th(c-s)}$	Case to Heatsink, Per 1 Module Thermal Grease Applied*4,*7	—	0.015	—	°C/W

Mechanical Characteristics

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Mounting Torque, M5 Mounting Screws			—	31		in-lb
Module Weight (Typical)			—	270		Grams
Isolation Voltage, (Charged Part to Baseplate, RMS, f = 60Hz, AC 1 min.)			V_{ISO}	2500		Volts
Flatness of Baseplate*8			e_c	±0 to +100		μm

*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.
*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.





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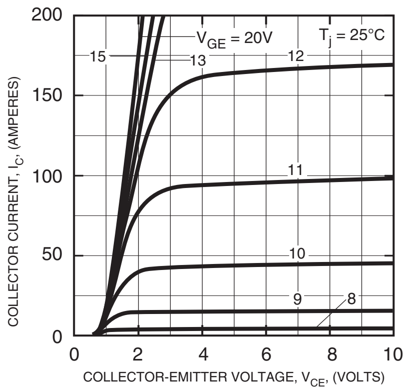
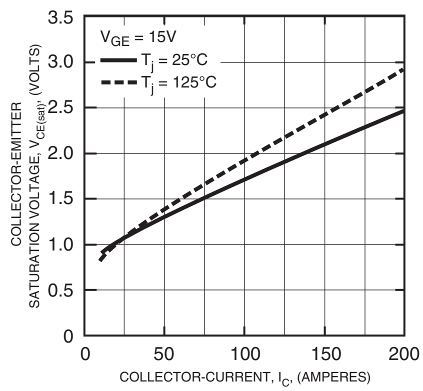
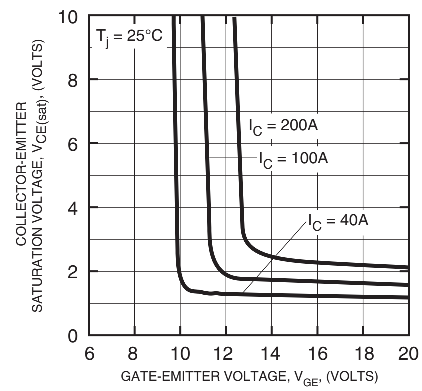
OUTPUT CHARACTERISTICS (INVERTER PART - TYPICAL)



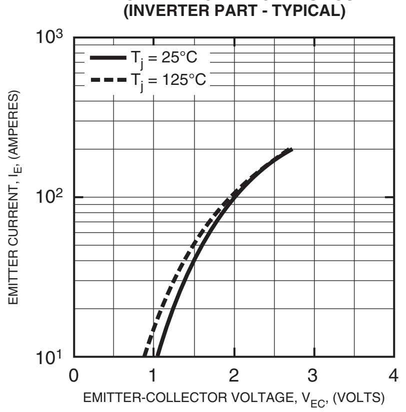
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - TYPICAL)



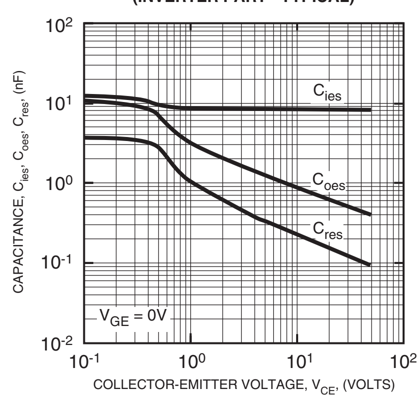
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - TYPICAL)



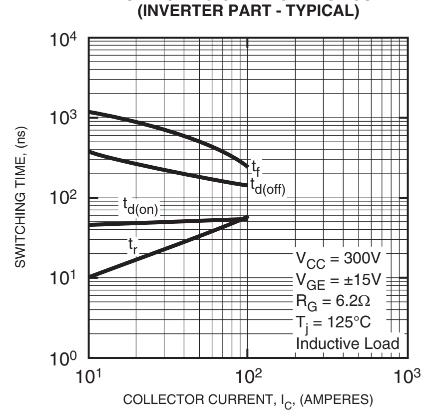
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (INVERTER PART - TYPICAL)



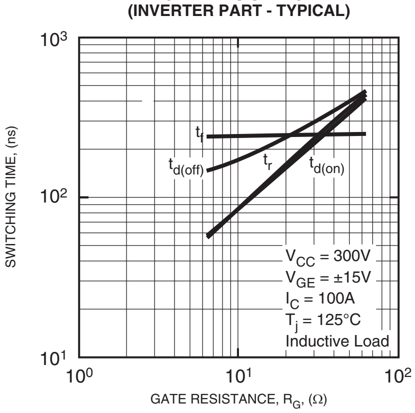
CAPACITANCE VS. V_{CE} (INVERTER PART - TYPICAL)



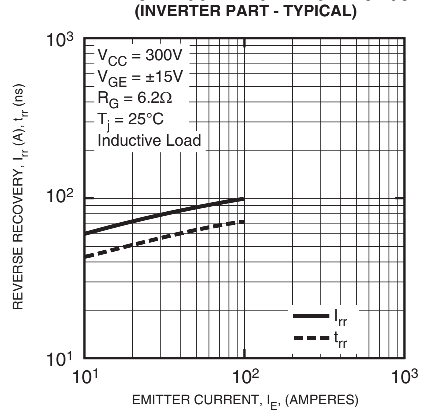
HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



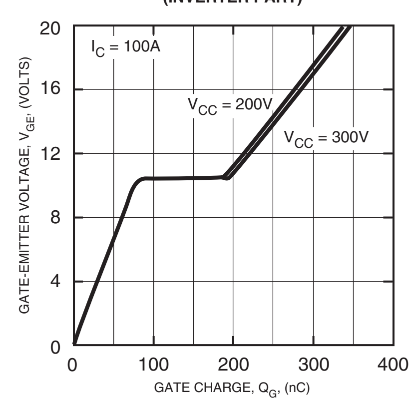
SWITCHING TIME VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



REVERSE RECOVERY CHARACTERISTICS (INVERTER PART - TYPICAL)



GATE CHARGE VS. V_{GE} (INVERTER PART)



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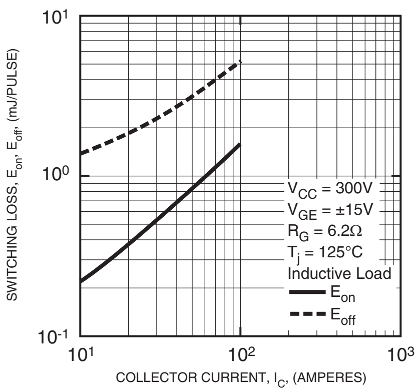
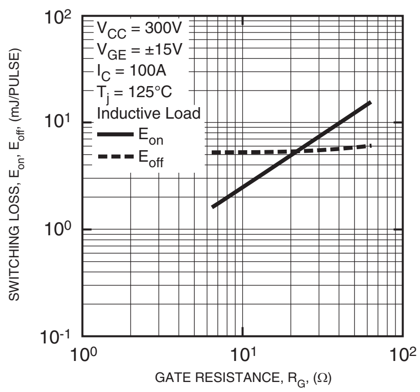
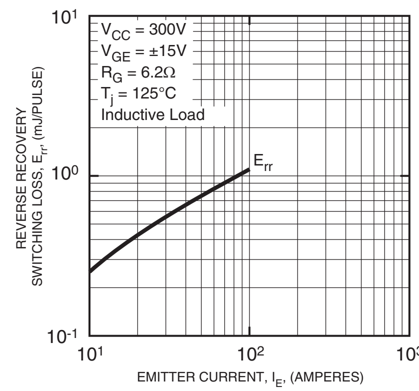
SWITCHING LOSS VS. COLLECTOR CURRENT (INVERTER PART - TYPICAL)



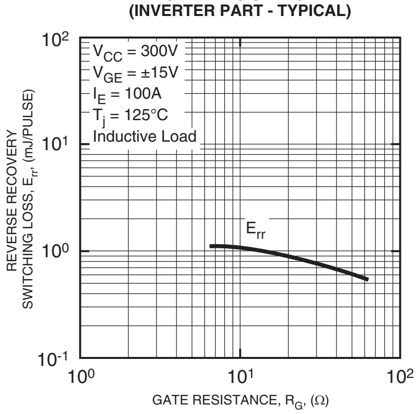
SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



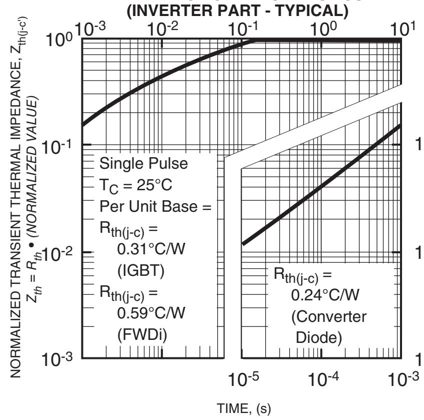
REVERSE RECOVERY SWITCHING LOSS VS. EMITTER CURRENT (INVERTER PART - TYPICAL)



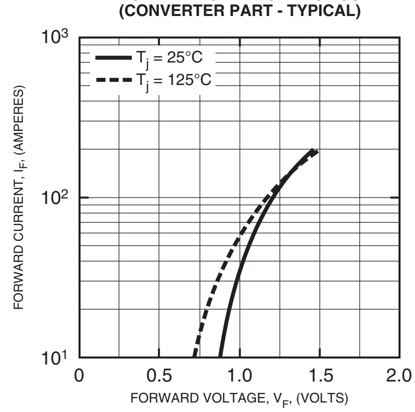
REVERSE RECOVERY SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



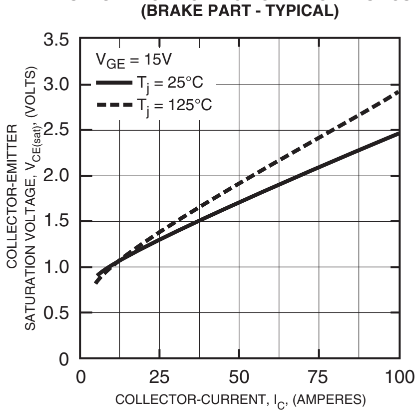
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (INVERTER PART - TYPICAL)



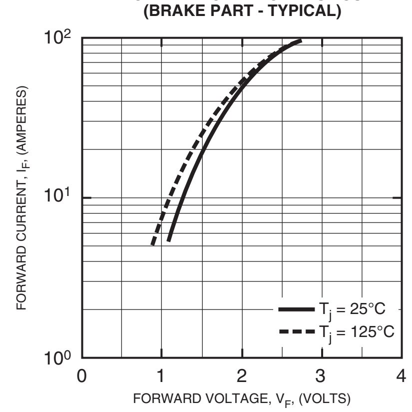
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (CONVERTER PART - TYPICAL)



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



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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (BRAKE PART - TYPICAL)