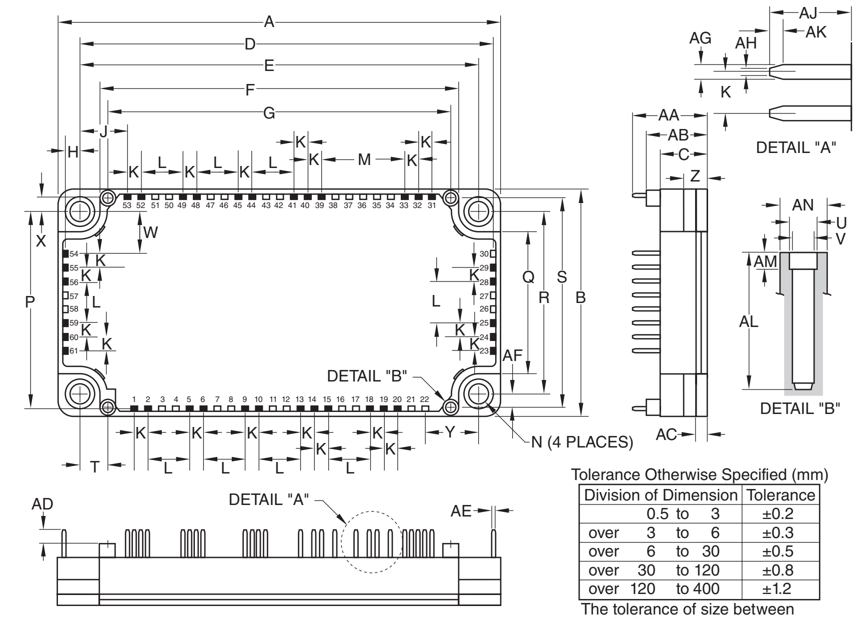
CM100MXA-24S

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

NX-S Series CIB Module

(3Ø Converter + 3Ø Inverter + Brake)

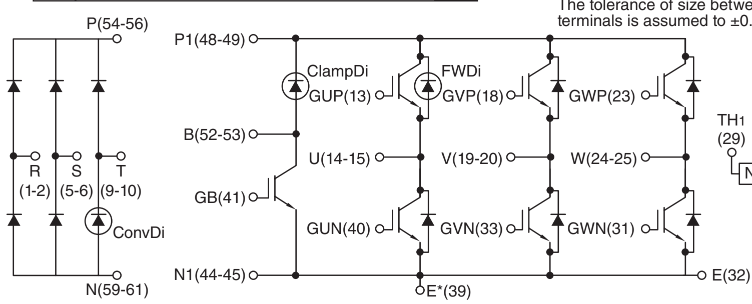
100 Amperes/1200 Volts



Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

Tolerance Otherwise Specified (mm)

The tolerance of size between terminals is assumed to ±0.4

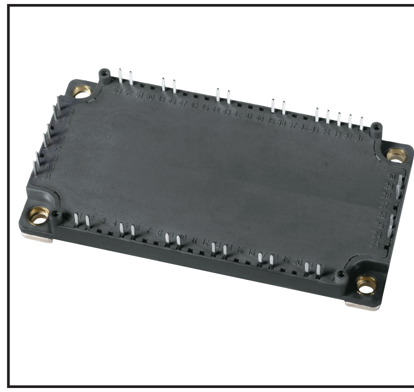


*Use both two terminals (R/S/T/P/N/P1/B/N1/U/V/W) for the external connection.

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	0.9	22.86
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	0.102 Dia.	2.6 Dia.

Dimensions	Inches	Millimeters
V	0.088 Dia.	2.25 Dia.
W	0.46	11.66
X	0.16	4.2
Y	0.59	15.0
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	0.05	1.2
AL	0.49	12.5
AM	0.12	3.0
AN	0.17 Dia.	4.3 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. 6th 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. CM100MXA-24S is a 1200V (V_{CES}), 100 Ampere CIB Power Module.

Type	Current Rating Amperes	V_{CES} Volts (x 50)
CM	100	24

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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,*3	I_C	100	Amperes
Collector Current (Pulse, Repetitive)*4	I_{CRM}	200	Amperes
Total Power Dissipation (T_C = 25°C)*2,*3	P_{tot}	750	Watts
Emitter Current (T_C = 25°C)*2,*3	I_E*1	100	Amperes
Emitter Current (Pulse, Repetitive)*4	I_{ERM}*1	200	Amperes
Maximum Junction Temperature	$T_{j(max)}$	175	°C

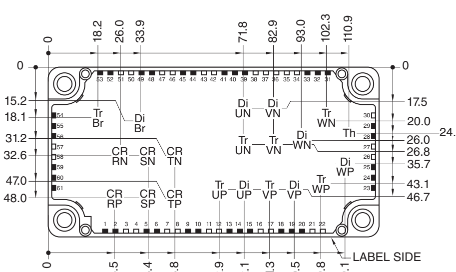
Brake Part IGBT/FWDi

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 = 125°C)*2,*3	I_C	50	Amperes
Collector Current (Pulse, Repetitive)*4	I_{CRM}	100	Amperes
Total Power Dissipation (T_C = 25°C)*2,*3	P_{tot}	425	Watts
Repetitive Peak Reverse Voltage (V_{GE} = 0V)	V_{RRM}	1200	Volts
Forward Current (T_C = 25°C)*2,*3	I_F*1	50	Amperes
Forward Current (Pulse, Repetitive)*4	I_{FRM}*1	100	Amperes
Maximum Junction Temperature	$T_{j(max)}$	175	°C

Converter Part ConvDi

Characteristics	Symbol	Rating	Units
Repetitive Peak Reverse Voltage	V_{RRM}	1200	Volts
Recommended AC Input Voltage	E_a	440	V_{RMS}
DC Output Current (3-phase Full Wave Rectifying, T_C = 125°C)*2,*3	I_O	100	Amperes
Surge Forward Current (Sine Half Wave 1 Cycle Peak Value, f = 60 Hz, Non-repetitive)	I_{FSM}	1000	Amperes
Current Square Time (Value for One Cycle of Surge Current)	I^2t	4165	A^2s
Maximum Junction Temperature	$T_{j(max)}$	150	°C

*1 Represent ratings and characteristics of the anti-parallel, emitter-to-collector free wheeling diode (FWDi).
*2 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.
*3 Junction temperature (T_j) should not increase beyond maximum junction temperature ($T_{j(max)}$) rating.
*4 Pulse width and repetition rate should be such that device junction temperature (T_j) does not exceed $T_{j(max)}$ rating.



Each mark points to the center position of each chip.

Tr*P / Tr*N / TrBr (* = U/V/W): IGBT
DiBr: Clamp Di
Th: NTC Thermistor
Di*P / Di*N (* = U/V/W): FWDi
CR*P / CR*N (* = R/S/T): Conv Di

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Module

Characteristics	Symbol	Rating	Units
Maximum Case Temperature*2	$T_{C(max)}$	125	°C
Operating Junction Temperature	$T_{j(op)}$	-40 to +150	°C
Storage Temperature	T_{stg}	-40 to +125	°C
Isolation Voltage (Terminals to Baseplate, f = 60Hz, AC 1 minute)	V_{ISO}	2500	Volts

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	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 = 10mA, V_{CE} = 10V	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Terminal)	I_C = 100A, V_{GE} = 15V, T_j = 25°C*5	—	1.80	2.25	Volts
		I_C = 100A, V_{GE} = 15V, T_j = 125°C*5	—	2.00	—	Volts
		I_C = 100A, V_{GE} = 15V, T_j = 150°C*5	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$ (Chip)	I_C = 100A, V_{GE} = 15V, T_j = 25°C*5	—	1.70	2.15	Volts
		I_C = 100A, V_{GE} = 15V, T_j = 125°C*5	—	1.90	—	Volts
		I_C = 100A, V_{GE} = 15V, T_j = 150°C*5	—	1.95	—	Volts
Input Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	10	nF
Output Capacitance	C_{oes}		—	—	2.0	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.17	nF
Gate Charge	Q_G	V_{CC} = 600V, I_C = 100A, V_{GE} = 15V	—	233	—	nC
Turn-on Delay Time	$t_{d(on)}$	V_{CC} = 600V, I_C = 100A, V_{GE} = ±15V, R_G = 6.2Ω, Inductive Load	—	—	300	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	V_{EC}*1 (Terminal)	I_E = 100A, V_{GE} = 0V, T_j = 25°C*5	—	1.80	2.25	Volts
		I_E = 100A, V_{GE} = 0V, T_j = 125°C*5	—	1.80	—	Volts
		I_E = 100A, V_{GE} = 0V, T_j = 150°C*5	—	1.80	—	Volts
Emitter-Collector Voltage	V_{EC}*1 (Chip)	I_E = 100A, V_{GE} = 0V, T_j = 25°C*5	—	1.70	2.15	Volts
		I_E = 100A, V_{GE} = 0V, T_j = 125°C*5	—	1.70	—	Volts
		I_E = 100A, V_{GE} = 0V, T_j = 150°C*5	—	1.70	—	Volts
Reverse Recovery Time	t_{rr}*1	V_{CC} = 600V, I_E = 100A, V_{GE} = ±15V	—	—	300	ns
Reverse Recovery Charge	Q_{rr}*1	R_G = 6.2Ω, Inductive Load	—	5.3	—	µC
Internal Lead Resistance	$R_{CC'+EE'}$	Main Terminals-Chip, Per Switch, T_C = 25°C*2	—	—	3.5	mΩ
Internal Gate Resistance	r_g	Per Switch	—	0	—	Ω

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

Brake 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	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 = 5mA, V_{CE} = 10V	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 50A, V_{GE} = 15V, T_j = 25°C*5	—	1.80	2.25	Volts
	(Terminal)	I_C = 50A, V_{GE} = 15V, T_j = 125°C*5	—	2.00	—	Volts
		I_C = 50A, V_{GE} = 15V, T_j = 150°C*5	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 50A, V_{GE} = 15V, T_j = 25°C*5	—	1.70	2.15	Volts
	(Chip)	I_C = 50A, V_{GE} = 15V, T_j = 125°C*5	—	1.90	—	Volts
		I_C = 50A, V_{GE} = 15V, T_j = 150°C*5	—	1.95	—	Volts
Input Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	5.0	nF
Output Capacitance	C_{oes}		—	—	1.0	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.08	nF
Gate Charge	Q_G	V_{CC} = 600V, I_C = 50A, V_{GE} = 15V	—	117	—	nC
Turn-on Delay Time	$t_{d(on)}$	V_{CC} = 600V, I_C = 50A, V_{GE} = ±15V,	—	—	300	ns
Rise Time	t_r	R_G = 13Ω, Inductive Load	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$		—	—	600	ns
Fall Time	t_f		—	—	300	ns
Internal Gate Resistance	r_g	Per Switch	—	0	—	Ω
Repetitive Peak Reverse Current	I_{RRM}	$V_R = V_{RRM}$, V_{GE} = 0V	—	—	1	mA
Forward Voltage	V_F	I_F = 50A, V_{GE} = 0V, T_j = 25°C*5	—	1.80	2.25	Volts
	(Terminal)	I_F = 50A, V_{GE} = 0V, T_j = 125°C*5	—	1.80	—	Volts
		I_F = 50A, V_{GE} = 0V, T_j = 150°C*5	—	1.80	—	Volts
Forward Voltage	V_F	I_F = 50A, V_{GE} = 0V, T_j = 25°C*5	—	1.70	2.15	Volts
	(Chip)	I_F = 50A, V_{GE} = 0V, T_j = 125°C*5	—	1.70	—	Volts
		I_F = 50A, V_{GE} = 0V, T_j = 150°C*5	—	1.70	—	Volts
Reverse Recovery Time	t_{rr}	V_{CC} = 600V, I_F = 50A, V_{GE} = ±15V	—	—	300	ns
Reverse Recovery Charge	Q_{rr}	R_G = 13Ω, Inductive Load	—	2.7	—	µC

*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

Converter Part ConDi

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Repetitive Peak Reverse Current	I_{RRM}	$V_R = V_{RRM}$, T_j = 150°C	—	—	20	mA
Forward Voltage	V_F (Terminal)	I_F = 75A*5	—	1.28	1.8	Volts

NTC Thermistor Part

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Zero Power Resistance	R_{25}	T_C = 25°C*2	4.85	5.00	5.15	kΩ
Deviation of Resistance	ΔR/R	T_C = 100°C*2, 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*2	—	—	10	mW

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

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]

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

Thermal Resistance, Junction to Case*2	$R_{th(j-c)}Q$	Per Inverter IGBT, per 1/6 Module	—	—	0.20	K/W
Thermal Resistance, Junction to Case*2	$R_{th(j-c)}D$	Per Inverter FWDi, per 1/6 Module	—	—	0.29	K/W
Thermal Resistance, Junction to Case*2	$R_{th(j-c)}Q$	Brake Part IGBT	—	—	0.35	K/W
Thermal Resistance, Junction to Case*2	$R_{th(j-c)}D$	Brake Part ClampDi	—	—	0.63	K/W
Thermal Resistance, Junction to Case*2	$R_{th(j-c)}D$	Converter Part ConvDi, per 1/6 Module	—	—	0.24	K/W
Contact Thermal Resistance, Case to Heatsink*2	$R_{th(c-s)}$	Thermal Grease Applied, per 1 Module*7	—	0.015	—	K/W

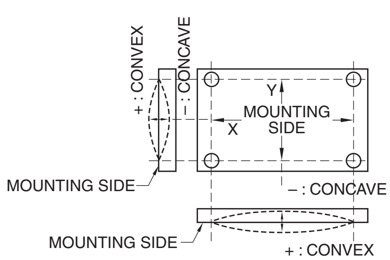
Mechanical Characteristics

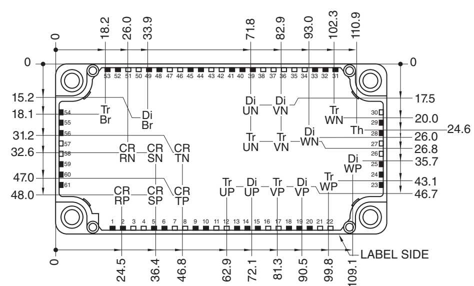
Mounting Torque	M_s	Mounting to Heatsink, M5 Screw	22	27	31	in-lb
Weight	m		—	300	—	Grams
Creepage Distance	d_s	Terminal to Terminal	6.47	—	—	mm
		Terminal to Baseplate	14.27	—	—	mm
Clearance	d_a	Terminal to Terminal	6.47	—	—	mm
		Terminal to Baseplate	12.33	—	—	mm
Flatness of Baseplate	e_c	On Centerline X, Y*8	±0	—	±100	µm

Recommended Operating Conditons, T_a = 25°C

(DC) Supply Voltage	V_{CC}	Applied Across P-N/P1-N1 Terminals	—	600	850	Volts
Gate (-Emitter Drive) Voltage	$V_{GE(on)}$	Applied Across GB-Es / G*P-*/ G*N-Es (* = U, V, W) Terminals	13.5	15.0	16.5	Volts
External Gate Resistance	R_G	Inverter Part IGBT	6.2	—	62	Ω
		Brake Part IGBT	13	—	130	Ω

*2 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.





Each mark points to the center position of each chip.

Tr*P / Tr*N / TrBr (* = U/V/W): IGBT
DiBr: Clamp Di
Th: NTC Thermistor
Di*P / Di*N (* = U/V/W): FWDi
CR*P / CR*N (* = R/S/T): Conv Di

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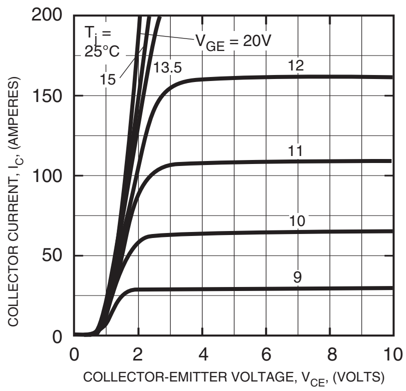
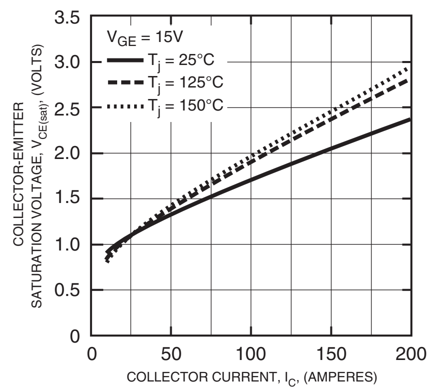
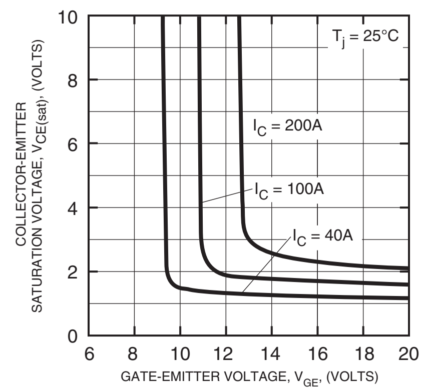
OUTPUT CHARACTERISTICS (INVERTER PART - CHIP - TYPICAL)



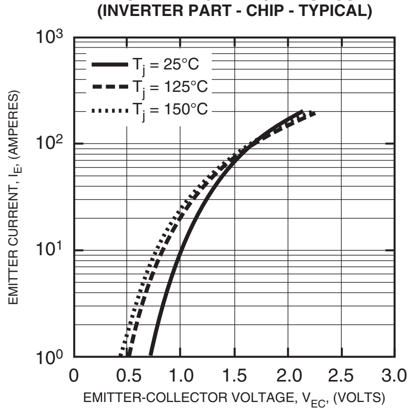
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - CHIP - TYPICAL)



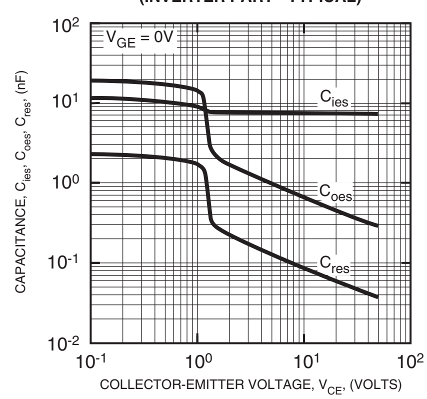
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - CHIP - TYPICAL)



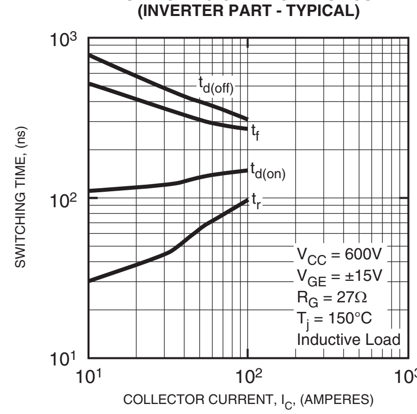
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (INVERTER PART - CHIP - TYPICAL)



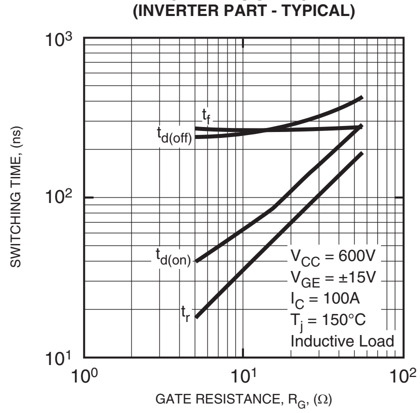
CAPACITANCE VS. V_{CE} (INVERTER PART - TYPICAL)



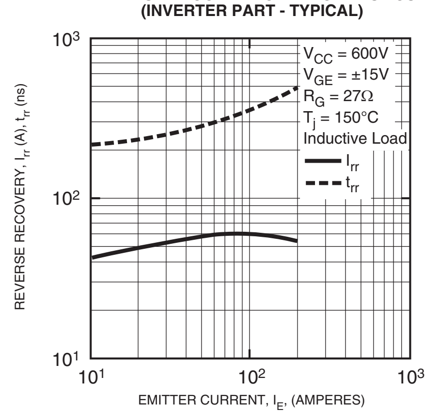
HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



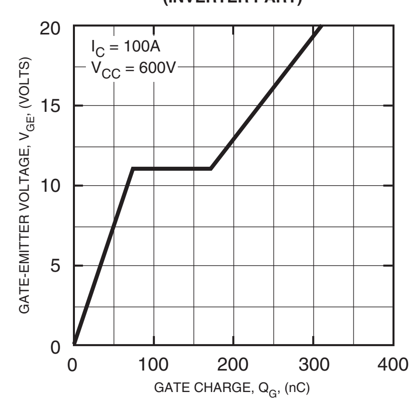
SWITCHING TIME VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



REVERSE RECOVERY CHARACTERISTICS (INVERTER PART - TYPICAL)



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



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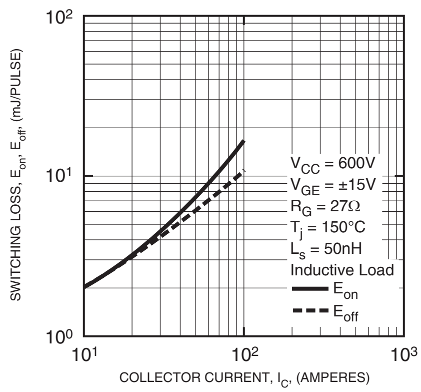
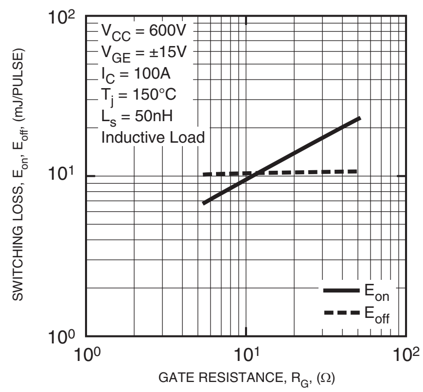
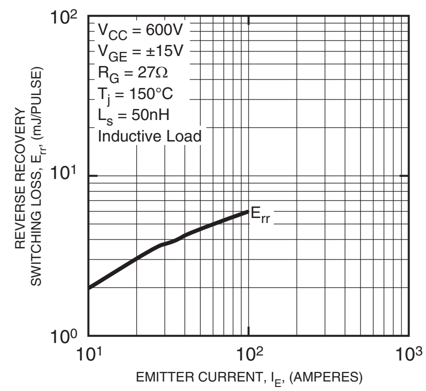
SWITCHING LOSS VS. COLLECTOR CURRENT (INVERTER PART - TYPICAL)



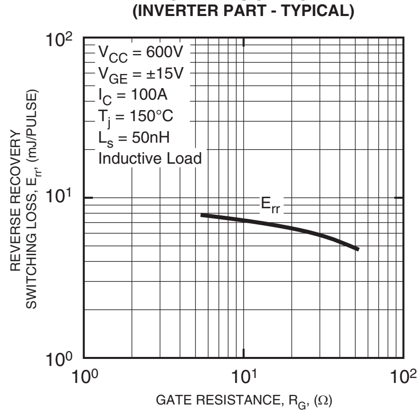
SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



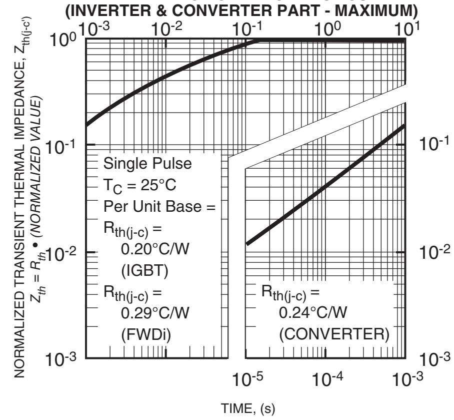
REVERSE RECOVERY SWITCHING LOSS VS. EMITTER CURRENT (INVERTER PART - TYPICAL)



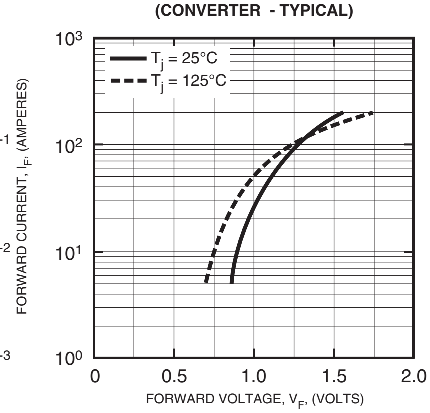
REVERSE RECOVERY SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



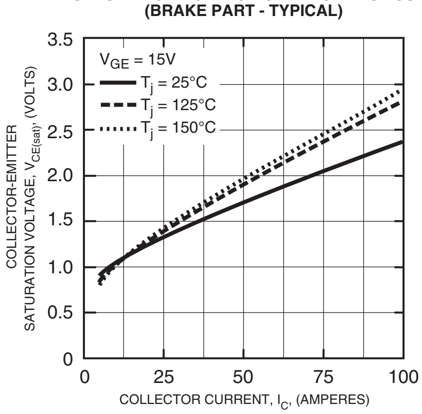
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (INVERTER & CONVERTER PART - MAXIMUM)



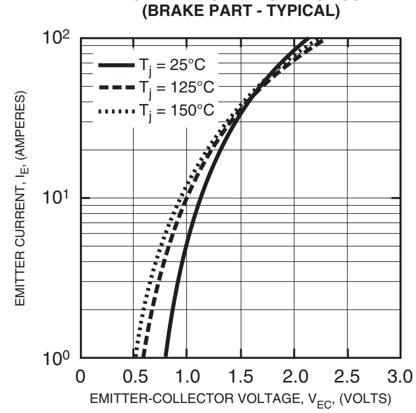
RECTIFIER DIODE FORWARD CHARACTERISTICS (CONVERTER - TYPICAL)



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



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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (BRAKE PART - MAXIMUM)