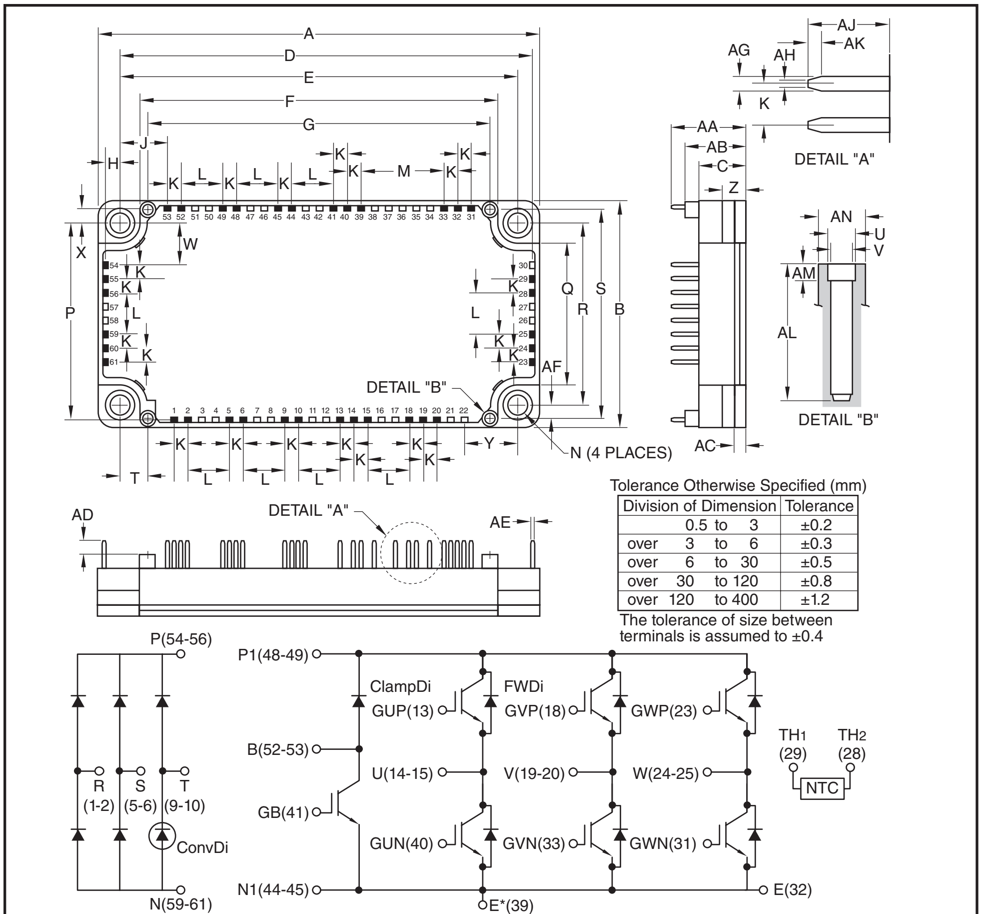
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272
www.pwrx.com

CM35MXA-24S

NX-Series CIB Module

(3Ø Converter + 3Ø Inverter + Brake)

35 Amperes/1200 Volts



Tolerance Otherwise Specified (mm)

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

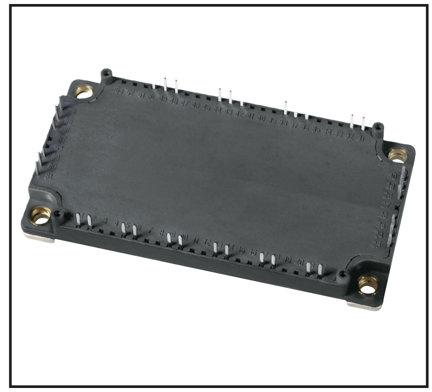
The tolerance of size between terminals is assumed to ±0.4

Caution: Each (two or three) pin terminal of P/N/P1/N1/U/V/W/B/R/S/T is connected in the module, however, all three pins should be used for external wiring.

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. CM35MXA-24S is a 1200V (V_{CES}), 35 Ampere CIB Power Module.

Type	Current Rating Amperes	V_{CES} Volts (x 50)
CM	35	24

CM35MXA-24S
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35 Amperes/1200 Volts

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

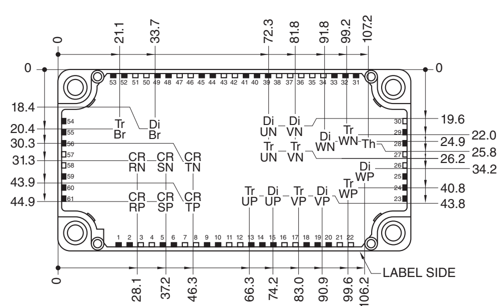
Inverter Part IGBT/FWDi

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 = 125°C)*2,*4	I_C	35	Amperes
Collector Current (Pulse, Repetitive)*3	I_{CRM}	70	Amperes
Total Power Dissipation (T_C = 25°C)*2,*4	P_{tot}	355	Watts
Emitter Current*2	I_E*1	35	Amperes
Emitter Current (Pulse, Repetitive)*3	I_{ERM}*1	70	Amperes
Maximum Junction Temperature, Instantaneous Event (Overload)	$T_{j(max)}$	175	°C

Brake Part IGBT/ClampDi

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,*4	I_C	35	Amperes
Collector Current (Pulse, Repetitive)*3	I_{CRM}	70	Amperes
Total Power Dissipation (T_C = 25°C)*2,*4	P_{tot}	355	Watts
Repetitive Peak Reverse Voltage (V_{GE} = 0V)	V_{RRM}	1200	Volts
Forward Current*2	I_F*1	35	Amperes
Forward Current (Pulse, Repetitive)*3	I_{FRM}*1	70	Amperes
Maximum Junction Temperature, Instantaneous Event (Overload)	$T_{j(max)}$	175	°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.



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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35 Amperes/1200 Volts

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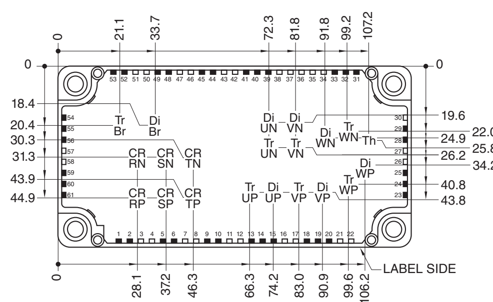
Converter Part ConvDi

Characteristics	Symbol	Rating	Units
Repetitive Peak Reverse Voltage (V_{GE} = 0V)	V_{RRM}	1600	Volts
Recommended AC Input Voltage (RMS)	E_a	480	Volts
DC Output Current (3-Phase Full Wave Rectifying, T_C = 125°C)*4	I_O	35	Amperes
Surge Forward Current (Sine Half Wave 1 Cycle Peak Value, f = 60Hz, Non-repetative)	I_{FSM}	350	Amperes
Current Square Time (Value for One Cycle of Surge Current)	I^2t	510	A^2s
Maximum Junction Temperature, Instantaneous Event (Overload)	$T_{j(max)}$	150	°C

Module

Characteristics	Symbol	Rating	Units
Isolation Voltage (Terminals to Baseplate, RMS, f = 60Hz, AC 1 minute)	V_{ISO}	2500	Volts
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

*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.



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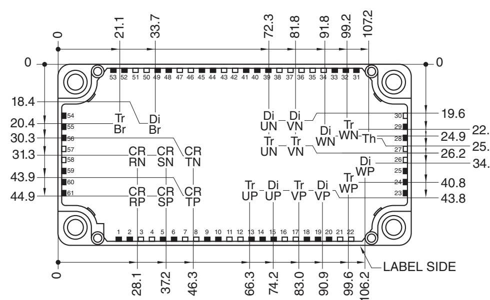
Electrical Characteristics, T_j = 25°C unless otherwise specified

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 = 3.5mA, V_{CE} = 10V	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 35A, V_{GE} = 15V, T_j = 25°C*6	—	1.80	2.25	Volts
	(Terminal)	I_C = 35A, V_{GE} = 15V, T_j = 125°C*6	—	2.00	—	Volts
		I_C = 35A, V_{GE} = 15V, T_j = 150°C*6	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 35A, V_{GE} = 15V, T_j = 25°C*6	—	1.70	2.15	Volts
	(Chip)	I_C = 35A, V_{GE} = 15V, T_j = 125°C*6	—	1.90	—	Volts
		I_C = 35A, V_{GE} = 15V, T_j = 150°C*6	—	1.95	—	Volts
Input Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	3.5	nF
Output Capacitance	C_{oes}		—	—	0.7	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.06	nF
Gate Charge	Q_G	V_{CC} = 600V, I_C = 35A, V_{GE} = 15V	—	82	—	nC
Turn-on Delay Time	$t_{d(on)}$	V_{CC} = 600V, I_C = 35A, V_{GE} = ±15V,	—	—	300	ns
Rise Time	t_r	R_G = 18Ω, Inductive Load	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$		—	—	600	ns
Fall Time	t_f		—	—	300	ns
Emitter-Collector Voltage	V_{EC}*1	I_E = 35A, V_{GE} = 0V, T_j = 25°C*6	—	1.80	2.25	Volts
	(Terminal)	I_E = 35A, V_{GE} = 0V, T_j = 125°C*6	—	1.80	—	Volts
		I_E = 35A, V_{GE} = 0V, T_j = 150°C*6	—	1.80	—	Volts
Emitter-Collector Voltage	V_{EC}*1	I_E = 35A, V_{GE} = 0V, T_j = 25°C*6	—	1.70	2.15	Volts
	(Chip)	I_E = 35A, V_{GE} = 0V, T_j = 125°C*6	—	1.70	—	Volts
		I_E = 35A, V_{GE} = 0V, T_j = 150°C*6	—	1.70	—	Volts
Reverse Recovery Time	t_{rr}*1	V_{CC} = 600V, I_E = 35A, V_{GE} = ±15V	—	—	300	ns
Reverse Recovery Charge	Q_{rr}*1	R_G = 18Ω, Inductive Load	—	1.9	—	µC
Turn-on Switching Energy per Pulse	E_{on}	V_{CC} = 600V, $I_C = I_E$ = 35A,	—	4.2	—	mJ
Turn-off Switching Energy per Pulse	E_{off}	V_{GE} = ±15V, R_G = 18Ω,	—	3.7	—	mJ
Reverse Recovery Energy per Pulse	E_{rr}*1	T_j = 150°C, Inductive Load	—	3.5	—	mJ
Internal Lead Resistance	$R_{CC' + EE'}$	Main Terminals-Chip, Per Switch, T_C = 25°C*4	—	—	5.7	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).
*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 Pulse width and repetition rate should be such as to cause negligible temperature rise.



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

Electrical Characteristics, T_j = 25°C unless otherwise specified

Brake Part IGBT/ClampDi

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 = 3.5mA, V_{CE} = 10V	5.4	6.0	6.6	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 35A, V_{GE} = 15V, T_j = 25°C*6	—	1.80	2.25	Volts
	(Terminal)	I_C = 35A, V_{GE} = 15V, T_j = 125°C*6	—	2.00	—	Volts
		I_C = 35A, V_{GE} = 15V, T_j = 150°C*6	—	2.05	—	Volts
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 35A, V_{GE} = 15V, T_j = 25°C*6	—	1.70	2.15	Volts
	(Chip)	I_C = 35A, V_{GE} = 15V, T_j = 125°C*6	—	1.90	—	Volts
		I_C = 35A, V_{GE} = 15V, T_j = 150°C*6	—	1.95	—	Volts
Input Capacitance	C_{ies}		—	—	3.5	nF
Output Capacitance	C_{oes}	V_{CE} = 10V, V_{GE} = 0V	—	—	0.7	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.06	nF
Gate Charge	Q_G	V_{CC} = 600V, I_C = 35A, V_{GE} = 15V	—	82	—	nC
Turn-on Delay Time	$t_{d(on)}$		—	—	300	ns
Rise Time	t_r	V_{CC} = 600V, I_C = 35A, V_{GE} = ±15V,	—	—	200	ns
Turn-off Delay Time	$t_{d(off)}$	R_G = 18Ω, Inductive Load	—	—	600	ns
Fall Time	t_f		—	—	300	ns
Forward Voltage	V_F	I_E = 35A, V_{GE} = 0V, T_j = 25°C*6	—	1.80	2.25	Volts
	(Terminal)	I_E = 35A, V_{GE} = 0V, T_j = 125°C*6	—	1.80	—	Volts
		I_E = 35A, V_{GE} = 0V, T_j = 150°C*6	—	1.80	—	Volts
Forward Voltage	V_F	I_E = 35A, V_{GE} = 0V, T_j = 25°C*6	—	1.70	2.15	Volts
	(Chip)	I_E = 35A, V_{GE} = 0V, T_j = 125°C*6	—	1.70	—	Volts
		I_E = 35A, V_{GE} = 0V, T_j = 150°C*6	—	1.70	—	Volts
Reverse Recovery Time	t_{rr}	V_{CC} = 600V, I_E = 35A, V_{GE} = ±15V	—	—	300	ns
Reverse Recovery Charge	Q_{rr}	R_G = 18Ω, Inductive Load	—	1.9	—	µC
Turn-on Switching Energy per Pulse	E_{on}	V_{CC} = 600V, $I_C = I_E$ = 35A,	—	4.2	—	mJ
Turn-off Switching Energy per Pulse	E_{off}	V_{GE} = ±15V, R_G = 18Ω,	—	3.7	—	mJ
Reverse Recovery Energy per Pulse	E_{rr}	T_j = 150°C, Inductive Load	—	3.5	—	mJ
Internal Gate Resistance	r_g		—	0	—	Ω

*6 Pulse width and repetition rate should be such as to cause negligible temperature rise.

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35 Amperes/1200 Volts

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

Converter Part ConvDi

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Repetitive Peak Reverse Current	I_{RRM}	$V_R = V_{RRM}$, T_j = 150°C	—	—	4.0	mA
Forward Voltage	V_F (Terminal)	I_F = 35A*6	—	1.2	1.6	Volts

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*7	—	3375	—	K
Power Dissipation	P_{25}	T_C = 25°C*4	—	—	10	mW

Thermal Resistance Characteristics

Thermal Resistance, Junction to Case*4	$R_{th(j-c)}Q$	Per Inverter IGBT	—	—	0.42	K/W
Thermal Resistance, Junction to Case*4	$R_{th(j-c)}D$	Per Inverter FWDi	—	—	0.69	K/W
Thermal Resistance, Junction to Case*4	$R_{th(j-c)}Q$	Per Brake IGBT	—	—	0.42	K/W
Thermal Resistance, Junction to Case*4	$R_{th(j-c)}D$	Per Brake ClampDi	—	—	0.69	K/W
Thermal Resistance, Junction to Case*4	$R_{th(j-c)}D$	Per Converter ConvDi	—	—	0.45	K/W
Contact Thermal Resistance, Case to Heatsink*4	$R_{th(c-f)}$	Thermal Grease Applied, Per 1 Module*8	—	15	—	K/kW

*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.

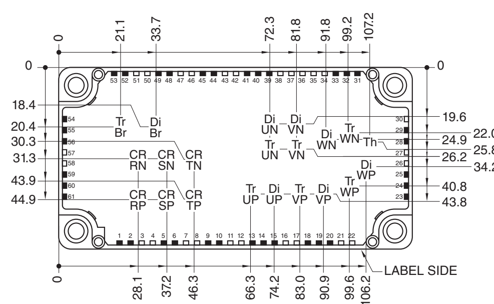
*6 Pulse width and repetition rate should be such as to cause negligible temperature rise.

*7 $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

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]

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



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35 Amperes/1200 Volts

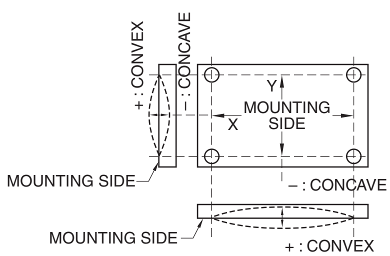
MechanicalCharacteristics, T_j = 25°C unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Mounting Torque	M_S	Mounting to Heatsink, M5 Screw	22	27	31	in-lb
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
Weight	m			300		g
Flatness of Baseplate	e_c	On Centerline X, Y*5	±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-*P/G*N-Es (* = U, V, W) Terminals	13.5	15.0	16.5	Volts
External Gate Resistance	R_G	Per Switch Inverter IGBT	18	—	180	Ω
		Per Switch Brake IGBT	18	—	180	Ω

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



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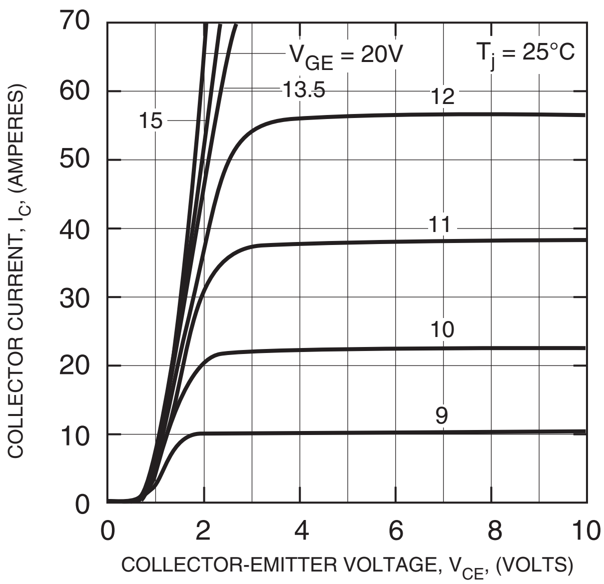
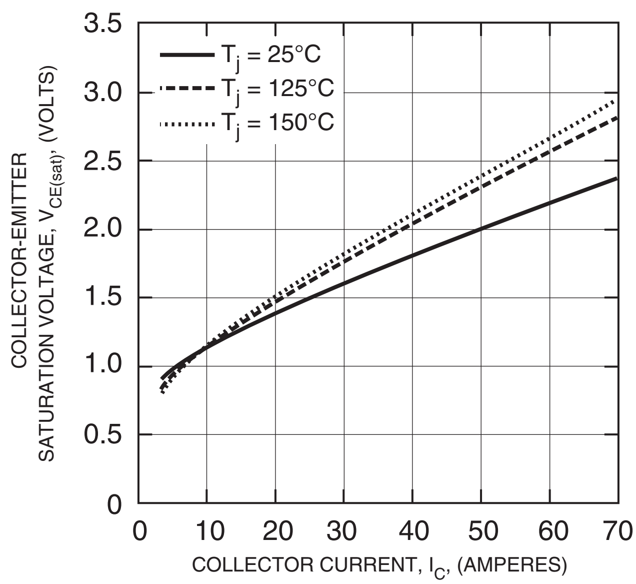
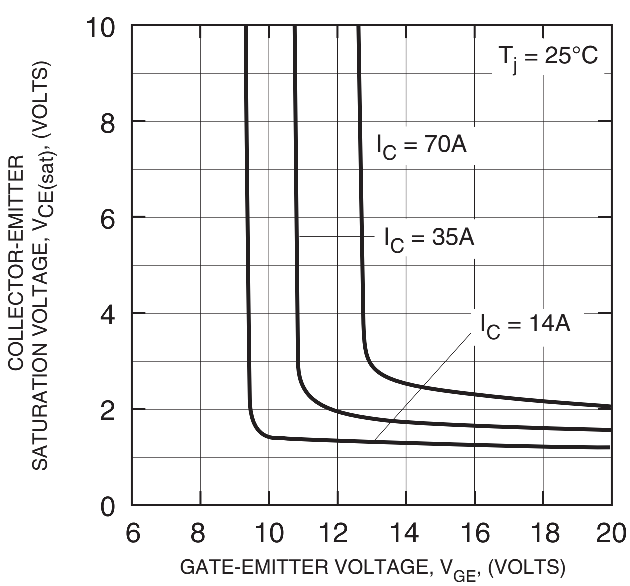
OUTPUT CHARACTERISTICS
(INVERTER PART - TYPICAL)



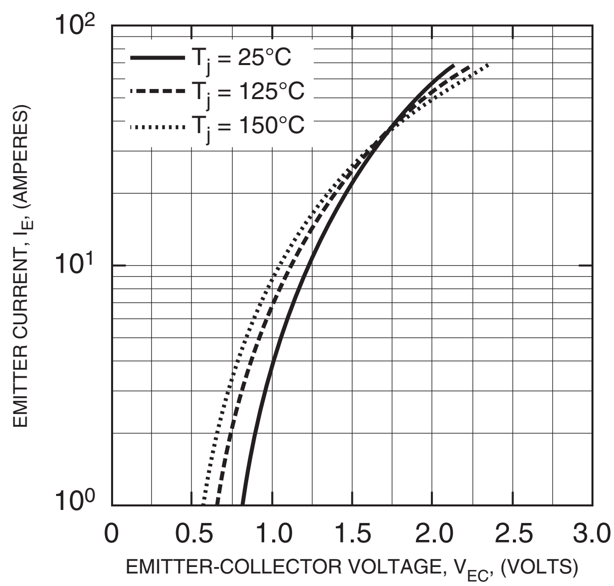
COLLECTOR-EMITTER
SATURATION VOLTAGE CHARACTERISTICS
(INVERTER PART - TYPICAL)



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



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



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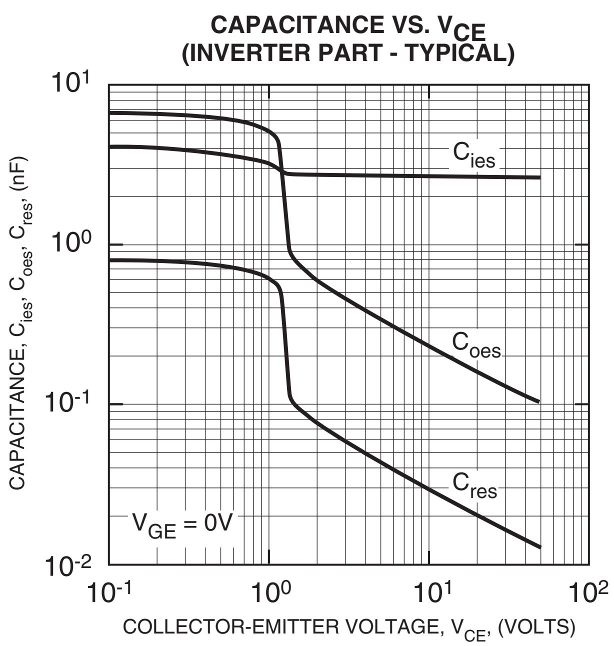
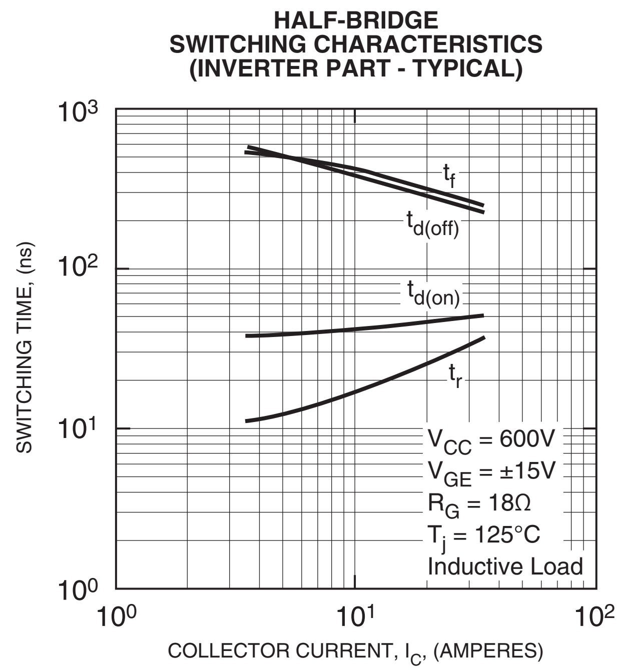
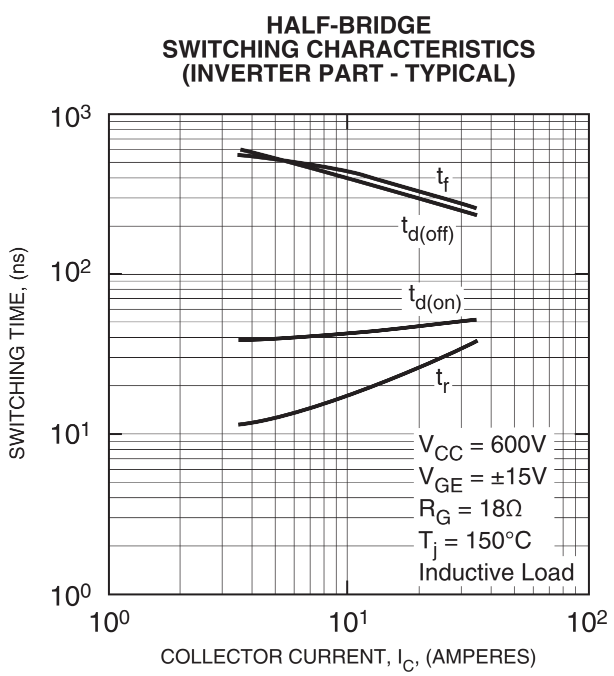
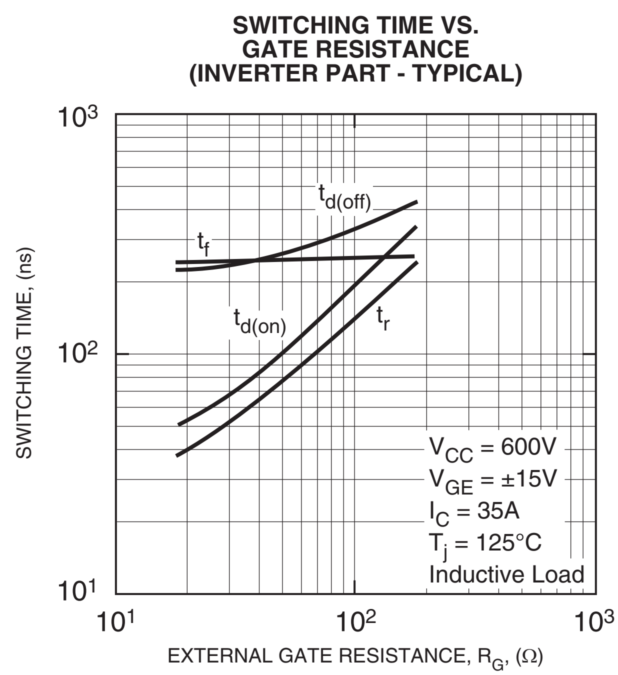
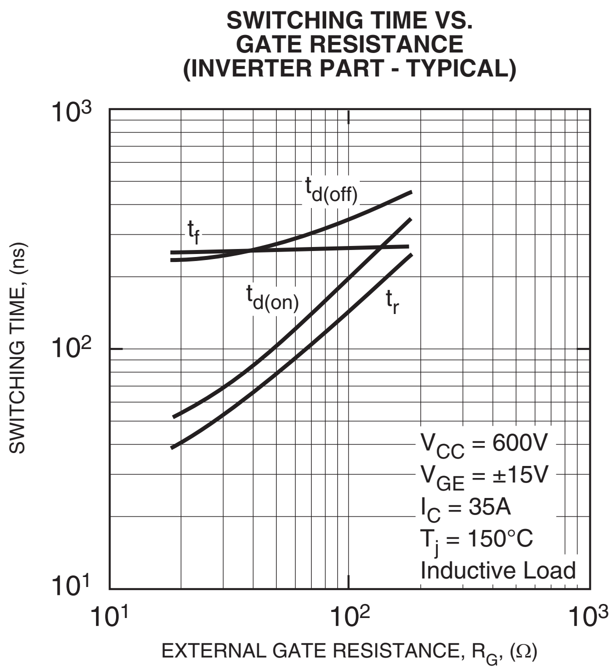


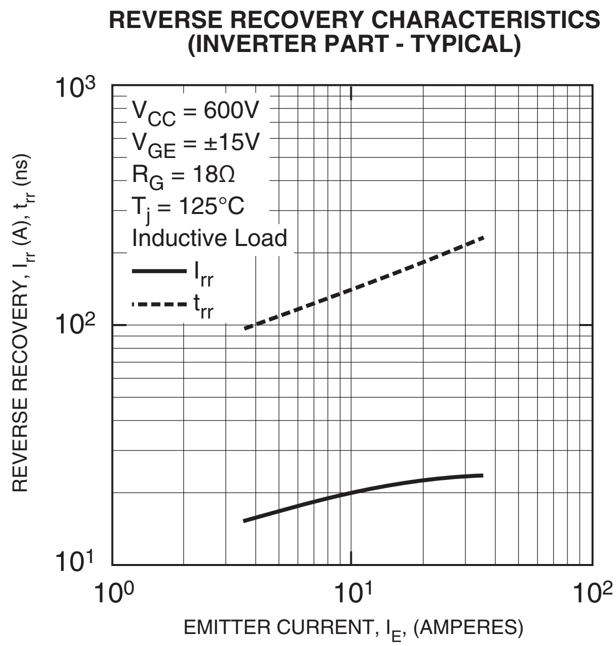


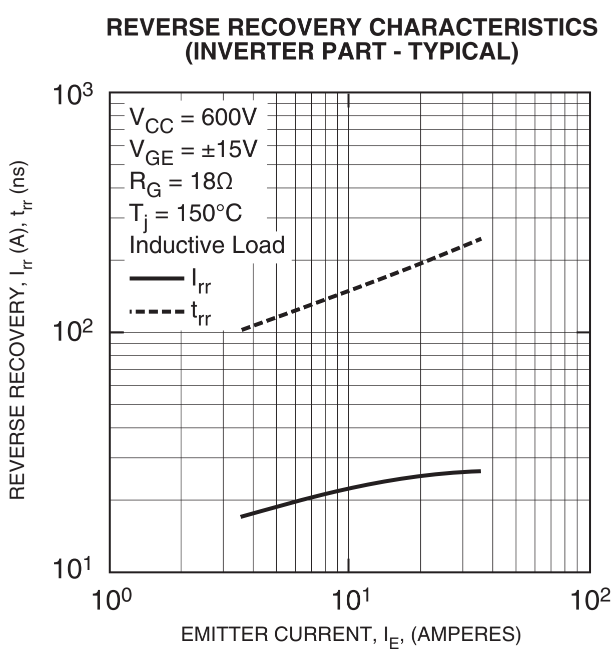


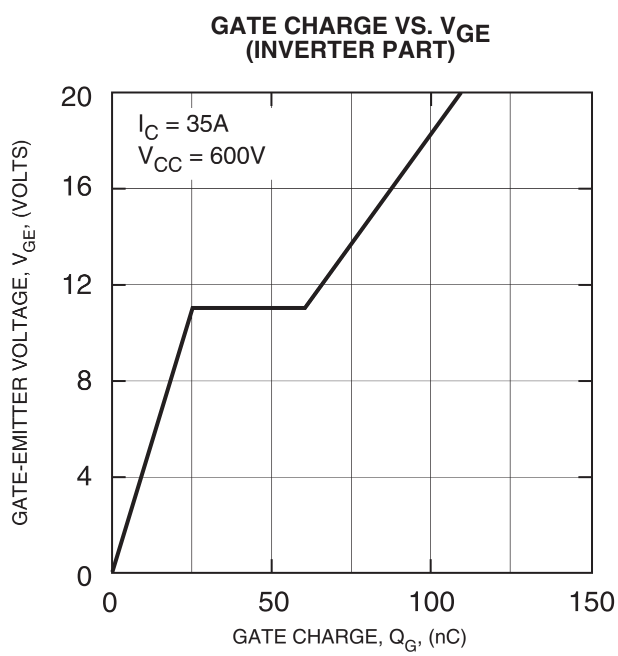


CM35MXA-24S
NX-Series CIB Module
(3Ø Converter + 3Ø Inverter + Brake)
35 Amperes/1200 Volts









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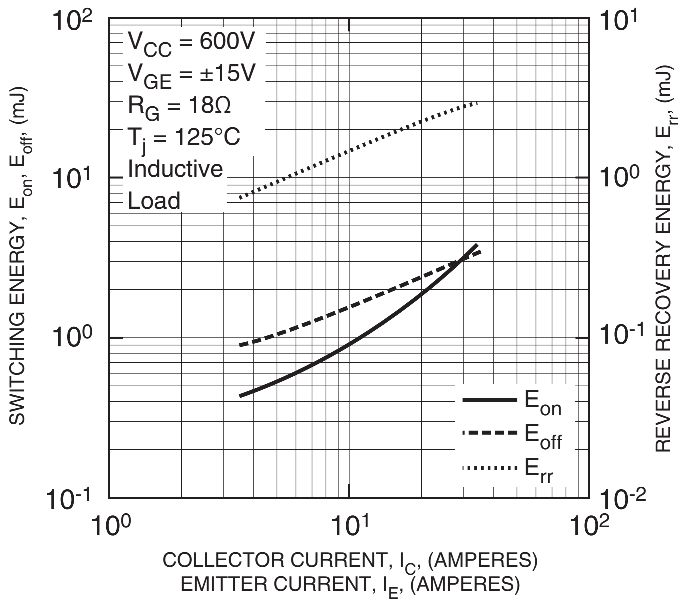
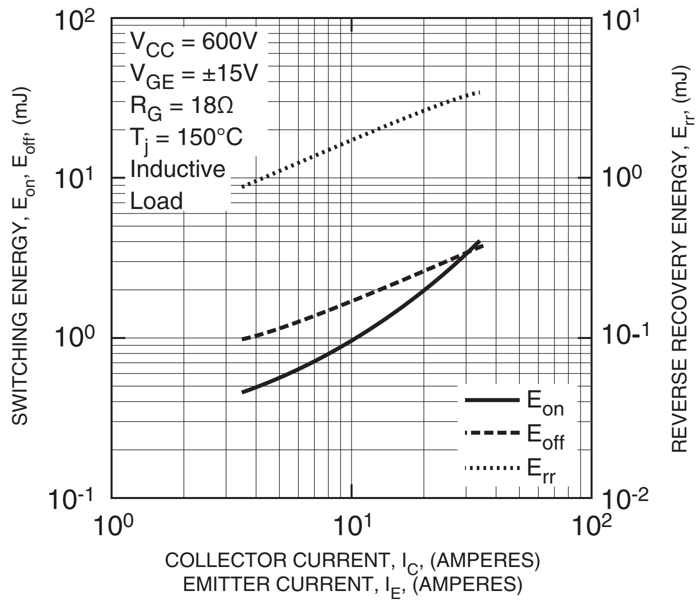
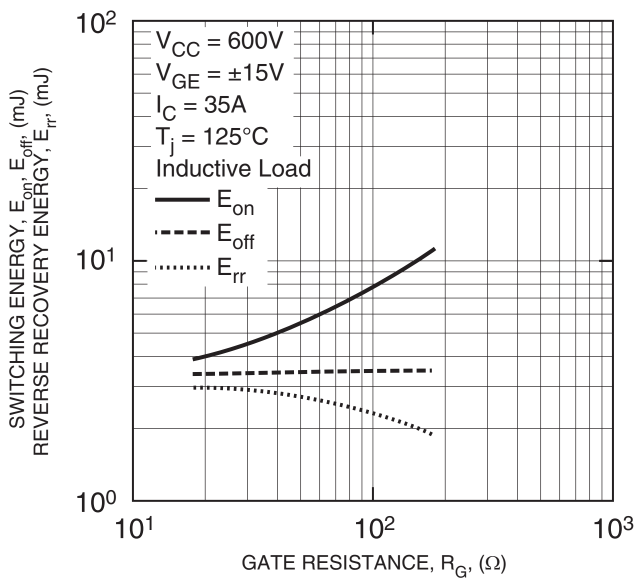
HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



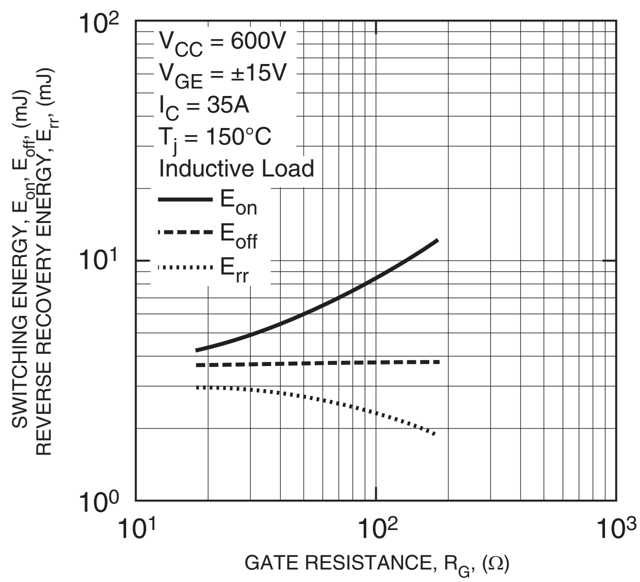
HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



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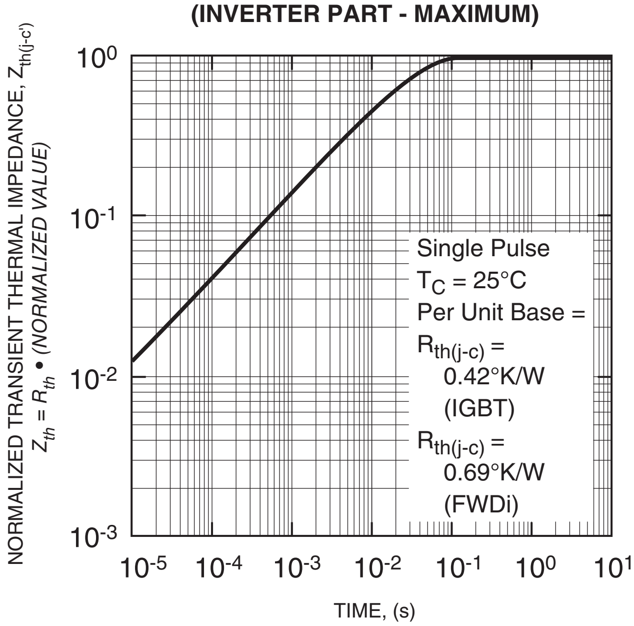
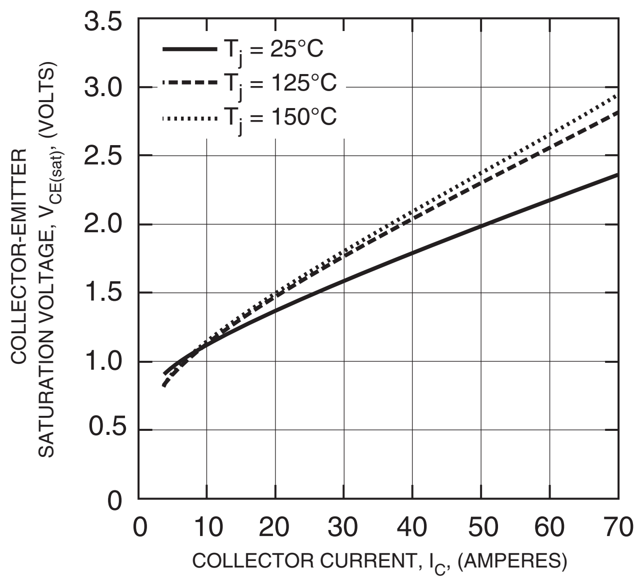
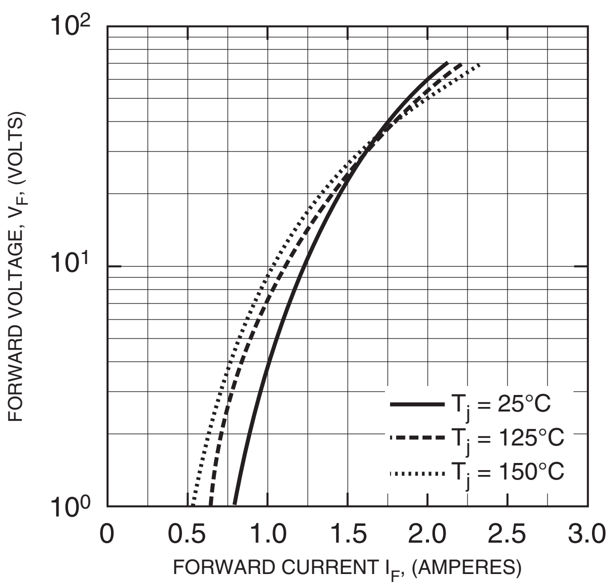
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (INVERTER PART - MAXIMUM)



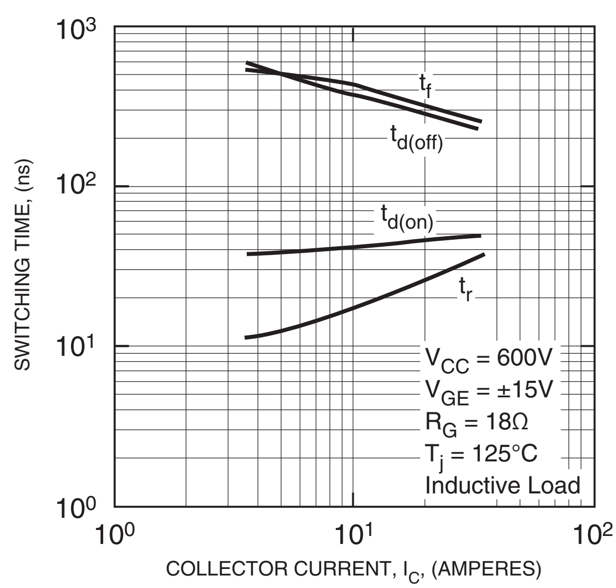
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (BRAKE PART - TYPICAL)



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



HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



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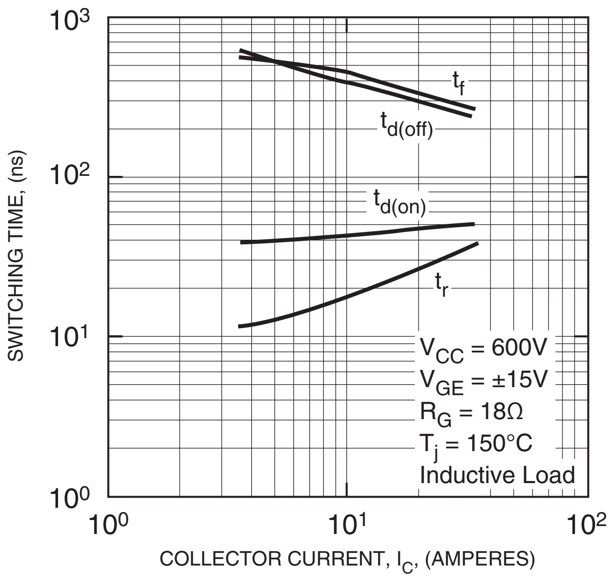
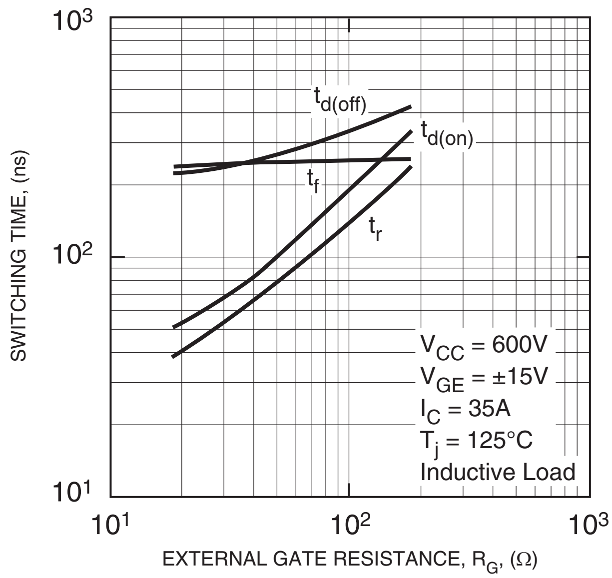
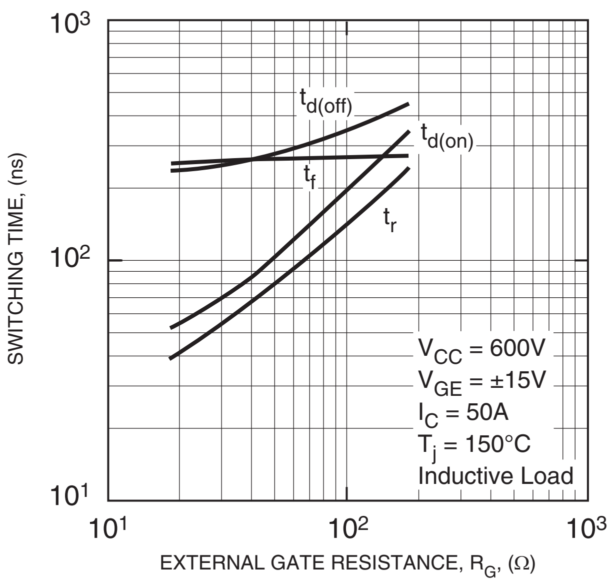
HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



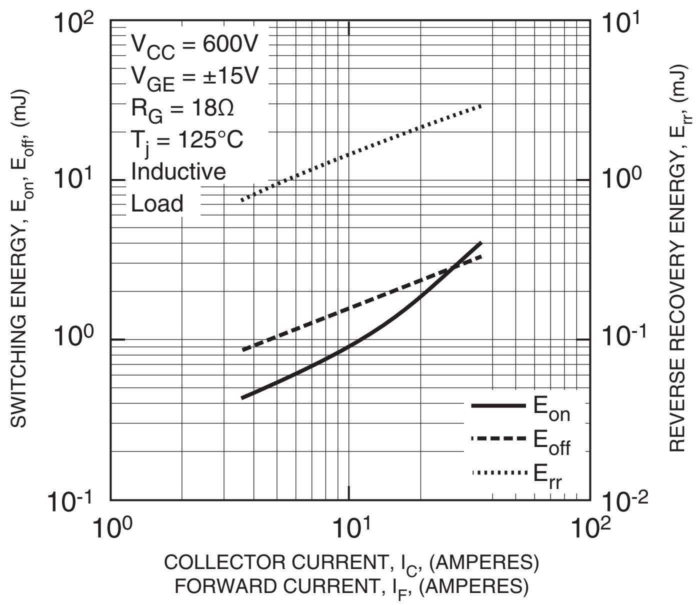
SWITCHING TIME VS. GATE RESISTANCE (BRAKE - TYPICAL)



SWITCHING TIME VS. GATE RESISTANCE (BRAKE - TYPICAL)



HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



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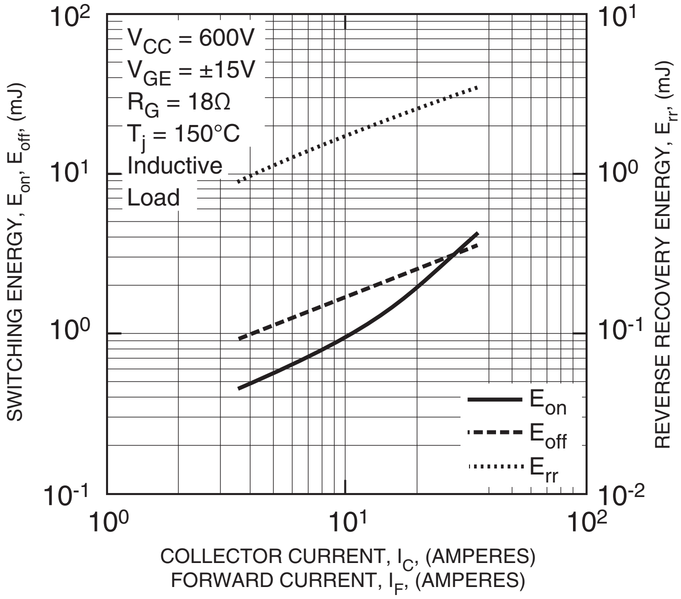
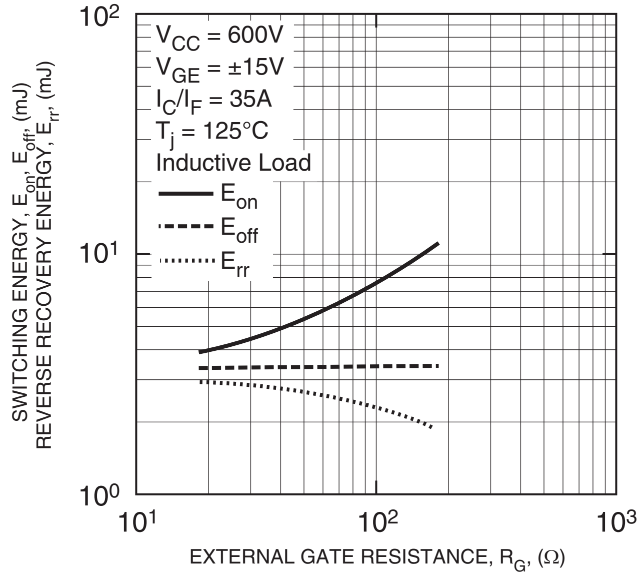
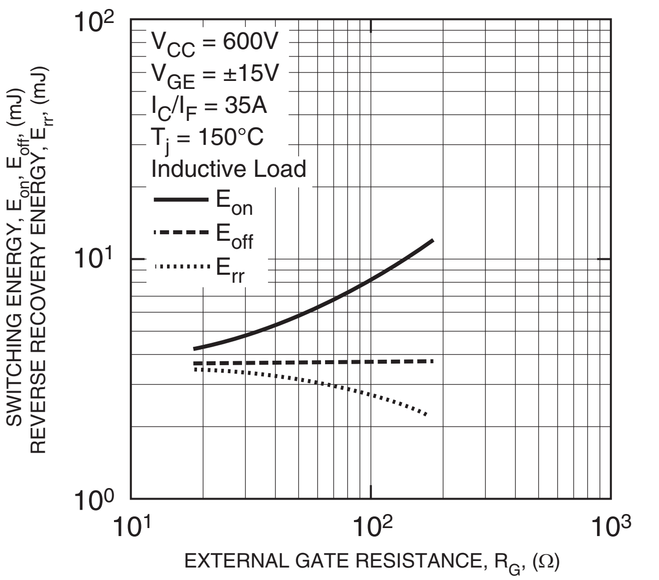
HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



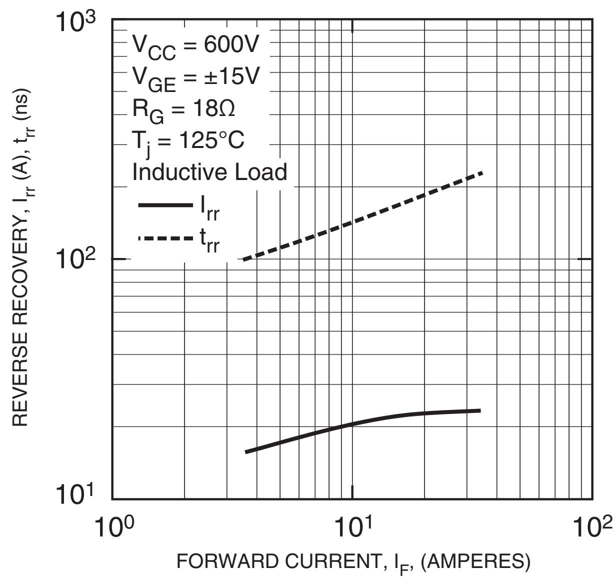
HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



HALF-BRIDGE SWITCHING CHARACTERISTICS (BRAKE PART - TYPICAL)



REVERSE RECOVERY CHARACTERISTICS (BRAKE PART - TYPICAL)



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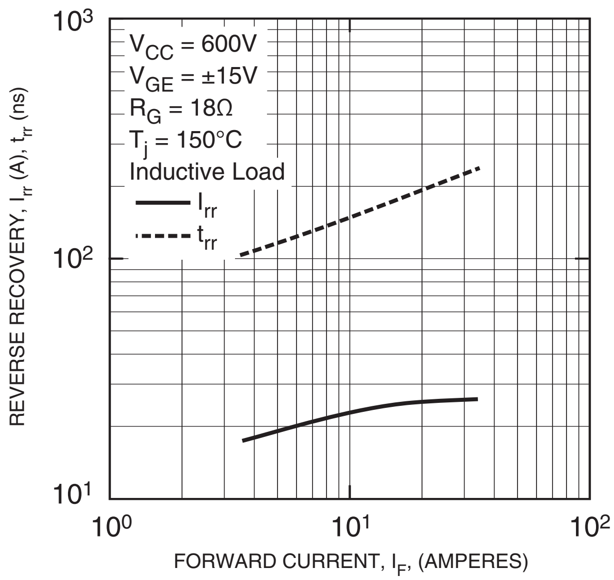
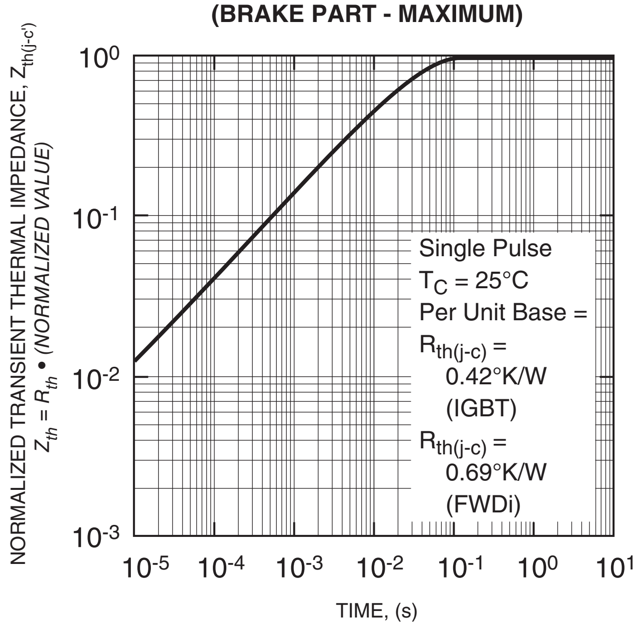
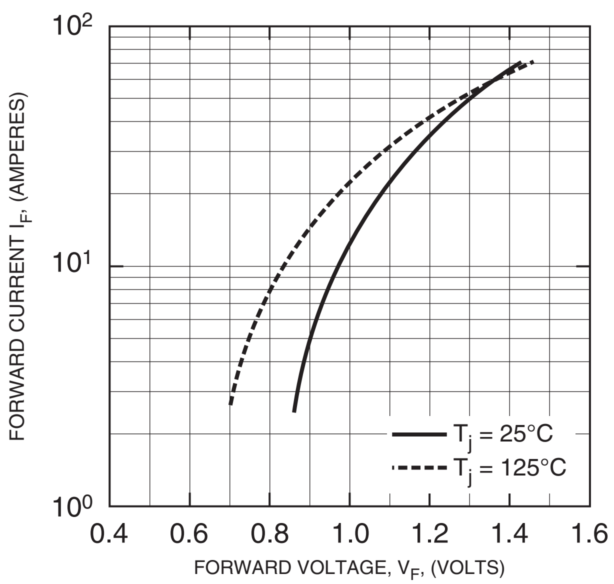
REVERSE RECOVERY CHARACTERISTICS (BRAKE PART - TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (BRAKE PART - MAXIMUM)



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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (CONVERTER PART - MAXIMUM)