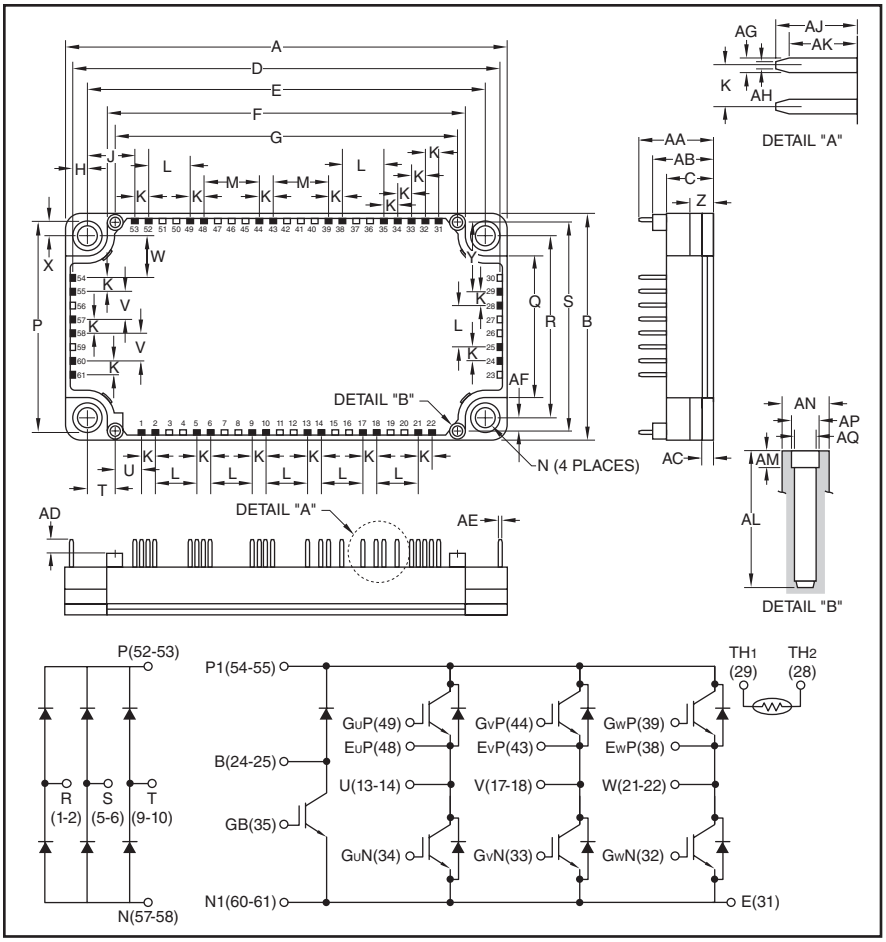
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272

CM35MX-24A

NX-Series CIB Module

(3Ø Converter + 3Ø Inverter + Brake)

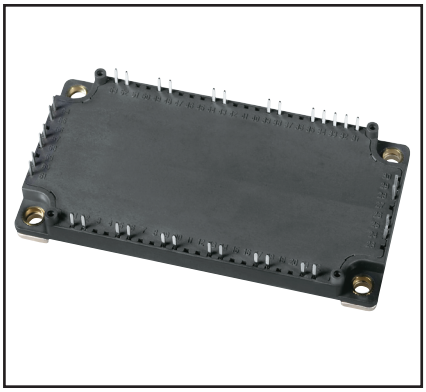
35 Amperes/1200 Volts



Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	4.79	121.7
B	2.44	62.0
C	0.51	13.0
D	4.65	118.1
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	2.30	58.4
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	0.28	7.25
V	0.3	7.62

Dimensions	Inches	Millimeters
W	0.46	11.66
X	0.16	4.2
Y	0.61	15.48
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	0.24	6.2
AL	0.49	12.5
AM	0.06	1.5
AN	0.17 Dia.	4.3 Dia.
AP	0.10 Dia.	2.5 Dia.
AQ	0.08 Dia.	2.1 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. CM35MX-24A is a 1200V (V_{CES}), 35 Ampere CIB Power Module.

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

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

Characteristics	Symbol	CM35MX-24A	Units
Power Device Junction Temperature	T_j	-40 to 150	°C
Storage Temperature	T_{stg}	-40 to 125	°C
Mounting Torque, M5 Mounting Screws	—	31	in-lb
Module Weight (Typical)	—	270	Grams
Baseplate Flatness, On Centerline X, Y (See Below)	—	±0 ~ +100	µm
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal	V_{ISO}	2500	Volts

Inverter Sector

Collector-Emitter Voltage (G-E Short)	V_{CES}	1200	Volts
Gate-Emitter Voltage (C-E Short)	V_{GES}	±20	Volts
Collector Current (T_C = 105°C)*1	I_C	35	Amperes
Peak Collector Current (Pulse)*3	I_{CM}	70	Amperes
Emitter Current (T_C = 25°C)*1	I_E*2	35	Amperes
Peak Emitter Current (Pulse)*3	I_{EM}*2	70	Amperes
Maximum Collector Dissipation (T_C = 25°C)*1*4	P_C	295	Watts

Brake Sector

Collector-Emitter Voltage (G-E Short)	V_{CES}	1200	Volts
Gate-Emitter Voltage (C-E Short)	V_{GES}	±20	Volts
Collector Current (T_C = 121°C)*1	I_C	20	Amperes
Peak Collector Current (Pulse)*3	I_{CM}	40	Amperes
Maximum Collector Dissipation (T_C = 25°C)*1*4	P_C	260	Watts
Repetitive Peak Reverse Voltage (Clamp Diode Part)	V_{RRM}*2	1200	Volts
Forward Current (T_C = 25°C)*1	I_F*2	20	Amperes
Forward Current (Pulse)*3	I_{FM}*2	40	Amperes

Converter Sector

Repetitive Peak Reverse Voltage	V_{RRM}	1600	Volts
Recommended Input Voltage	E_a	440	Volts RMS
DC Output Current (3-Phase Full Wave Rectifying, T_C = 141°C)*1	I_O	35	Amperes
Surge Forward Current (sine Half-wave 1 Cycle Peak Value, F = 60Hz, Non-repetitive)	I_{FSM}	350	Amperes
Current Square Time (Value for One Cycle of Surge Current)	I^2t	510	A^2s

*1 Case temperature (T_C) and heatsink temperature (T_f) are defined on the surface of the baseplate and heatsink at just under the chip.
*2 I_E, I_{EM}, V_{EC}, t_{rr} and Q_{rr} represent ratings and characteristics of the anti-parallel, emitter-to-collector free-wheel diode (FWDi).
I_F, I_{FM}, I_{RRM}, V_{FM} and V_{RRM} represent ratings and characteristics of the clamp diode.
*3 Pulse width and repetition rate should be such that device junction temperature (T_j) does not exceed $T_{j(max)}$ rating.
*4 Junction temperature (T_j) should not increase beyond $T_{j(max)}$ rating.

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Electrical and Mechanical Characteristics, T_j = 25°C unless otherwise specified

Inverter Sector

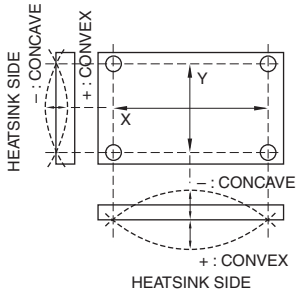
Characteristics		Symbol	Test Conditions	Min.	Typ.	Max.	Units
Collector Cutoff Current		I_{CES}	$V_{CE} = V_{CES}$, V_{GE} = 0V	—	—	1.0	mA
Gate-Emitter Threshold Voltage		$V_{GE(th)}$	I_C = 3.5mA, V_{CE} = 10V	6	7	8	Volts
Gate Leakage Current		I_{GES}	$V_{GE} = V_{GES}$, V_{CE} = 0V	—	—	0.5	µA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C = 35A, V_{GE} = 15V, T_j = 25°C*5	—	2.0	2.6	Volts
			I_C = 35A, V_{GE} = 15V, T_j = 125°C *5	—	2.2	—	Volts
			I_C = 35A, V_{GE} = 15V, Chip	—	1.9	—	Volts
Input Capacitance		C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	6.0	nF
Output Capacitance		C_{oes}		—	—	0.53	nF
Reverse Transfer Capacitance		C_{res}		—	—	0.12	nF
Total Gate Charge		Q_G	V_{CC} = 600V, I_C = 35A, V_{GE} = 15V	—	180	—	nC
Inductive	Turn-on Delay Time	$t_{d(on)}$	V_{CC} = 600V, I_C = 35A, V_{GE} = ±15V, R_G = 9.1Ω, I_E = 35A, Inductive Load Switching Operation	—	—	100	ns
Load	Turn-on Rise Time	t_r		—	—	50	ns
Switch	Turn-off Delay Time	$t_{d(off)}$		—	—	300	ns
Time	Turn-off Fall Time	t_f		—	—	600	ns
Reverse Recovery Time		t_{rr}*2		—	—	200	ns
Reverse Recovery Charge		Qrr*2		—	1.5	—	µC
Emitter-Collector Voltage		V_{EC}*2	I_E = 35A, V_{GE} = 0V, T_j = 25°C*5	—	2.6	3.4	Volts
			I_E = 35A, V_{GE} = 0V, T_j = 125°C*5	—	2.16	—	Volts
			I_E = 35A, V_{GE} = 0V, Chip	—	2.5	—	Volts

Thermal and Mechanical Characteristics, T_j = 25°C unless otherwise specified

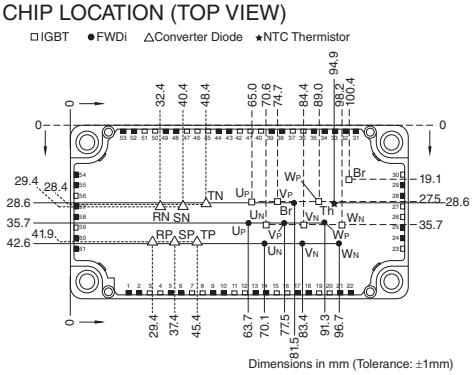
Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Thermal Resistance, Junction to Case**	$R_{th(j-c)}Q$	Per IGBT*1	—	—	0.42	°C/W
Thermal Resistance, Junction to Case**	$R_{th(j-c)}D$	Per FWDi*1	—	—	0.69	°C/W
Contact Thermal Resistance**	$R_{th(c-f)}$	Case to Heatsink (Per 1 Module) Thermal Grease Applied*1*7	—	0.015	—	°C/W
Internal Gate Resistance	R_{Gint}	T_C = 25°C	—	0	—	Ω
External Gate Resistance	R_G		8.9	—	89	Ω

**Thermal resistance values are per 1 element.
*1 Case temperature (T_C) and heatsink temperature (T_f) are defined on the surface of the baseplate and heatsink at just under the chip.
*2 I_E, I_{EM}, V_{EC}, t_{rr} and Q_{rr} represent ratings and characteristics of the anti-parallel, emitter-to-collector free-wheel diode (FWDi).
I_F, I_{FM}, I_{RRM}, V_{FM} and V_{RRM} represent ratings and characteristics of the clamp diode.
*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.
*7 Typical value is measured by using thermally conductive grease of λ = 0.9 [W/(m • K)].

BASEPLATE FLATNESS MEASUREMENT POINT



CHIP LOCATION (TOP VIEW)



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Electrical and Mechanical Characteristics, T_j = 25°C unless otherwise specified

Brake Sector

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Collector Cutoff Current	I_{CES}	$V_{CE} = V_{CES}$, V_{GE} = 0V	—	—	1.0	mA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	I_C = 2mA	6	7	8	Volts
Gate Leakage Current	I_{GES}	$V_{GE} = V_{GES}$, V_{CE} = 0V	—	—	0.5	µA
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 20A, V_{GE} = 15V, T_j = 25°C*5	—	2.0	2.6	Volts
		I_C = 20A, V_{GE} = 15V, T_j = 125°C*5	—	2.2	—	Volts
		I_C = 20A, V_{GE} = 15V, Chip	—	1.9	—	Volts
Input Capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V	—	—	5.1	nF
Output Capacitance	C_{oes}		—	—	0.45	nF
Reverse Transfer Capacitance	C_{res}		—	—	0.1	nF
Total Gate Charge	Q_G	V_{CC} = 600V, I_C = 20A, V_{GE} = 15V	—	150	—	nC
Repetitive Reverse Current	I_{RRM}*2	$V_R = V_{RRM}$	—	—	1.0	mA
Forward Voltage Drop	V_{FM}*2	I_F = 20A, T_j = 25°C*5	—	2.6	3.4	Volts
		I_F = 20A, T_j = 125°C*5	—	2.16	—	Volts
		I_F = 20A, Chip	—	2.5	—	Volts

Thermal and Mechanical 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 IGBT*1	—	—	0.48	°C/W
Thermal Resistance, Junction to Case**	$R_{th(j-c)}D$	Per FWDi*1	—	—	1.1	°C/W
Contact Thermal Resistance**	$R_{th(c-f)}$	Case to Heatsink (Per 1 Module) Thermal Grease Applied*1*7	—	0.015	—	°C/W
Internal Gate Resistance	R_{Gint}	T_C = 25°C	—	0	—	Ω
External Gate Resistance	R_G		15	—	150	Ω

Converter Sector, T_j = 25°C unless otherwise specified

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 Drop	V_F	I_F = 35A	—	1.2	1.6	Volts
Thermal Resistance, Junction to Case**	$R_{th(j-c)}$	Per FWDi*1	—	—	0.45	K/W
Contact Thermal Resistance**	$R_{th(c-f)}$	Thermal Grease Applied*1*7	—	0.015	—	°C/W

NTC Thermistor Sector, T_j = 25°C unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Zero Power Resistance	R	T_C = 25°C*1	4.85	5.00	5.15	kΩ
Deviation of Resistance	ΔR/R	T_C = 100°C, R_{100} = 493Ω*1	–7.3	—	+7.8	%
B Constant	$B_{(25/50)}$	$B = (\ln R_1 - \ln R_2) / (1/T_1 - 1/T_2)$*6	—	3375	—	K
Power Dissipation	P_{25}	T_C = 25°C*1	—	—	10	mW

**Thermal resistance values are per 1 element.
*1 Case temperature (T_C) and heatsink temperature (Tf) are defined on the surface of the baseplate and heatsink at just under the chip.
*2 I_E, I_{EM}, V_{EC}, t_{rr} and Q_{rr} represent ratings and characteristics of the anti-parallel, emitter-to-collector free-wheel diode (FWDi).
I_F, I_{FM}, I_{RRM}, V_{FM} and V_{RRM} represent ratings and characteristics of the clamp diode.
*5 Pulse width and repetition rate should be such as to cause negligible temperature rise.
*6 R_1: Resistance at Absolute Temperature T_1(K), R_2: Resistance at Absolute Temperature T_2(K), T(K) = T(°C) + 273.15
*7 Typical value is measured by using thermally conductive grease of λ = 0.9 [W/(m • K)].

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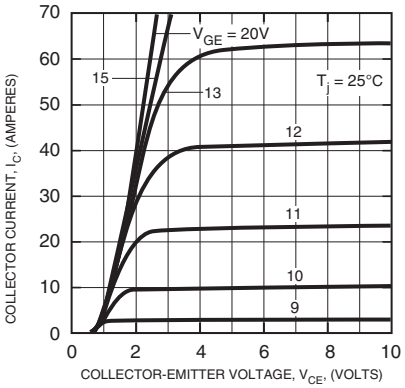
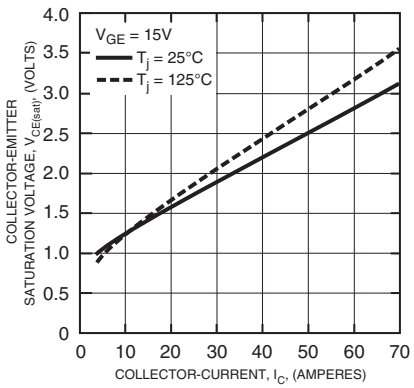
35 Amperes/1200 Volts

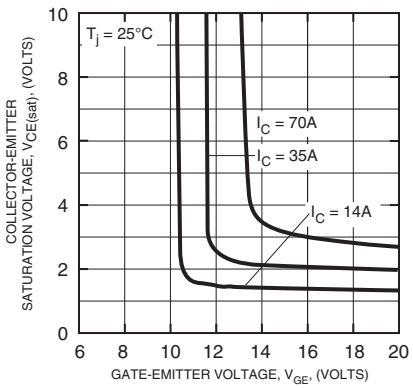
OUTPUT CHARACTERISTICS (INVERTER PART - TYPICAL)



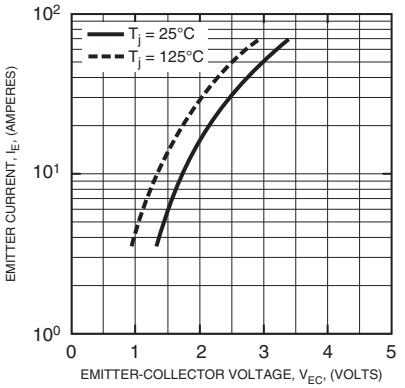
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - TYPICAL)



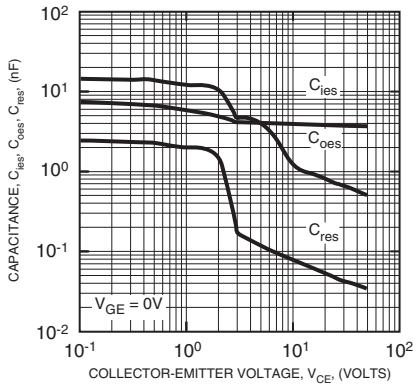
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (INVERTER PART - TYPICAL)



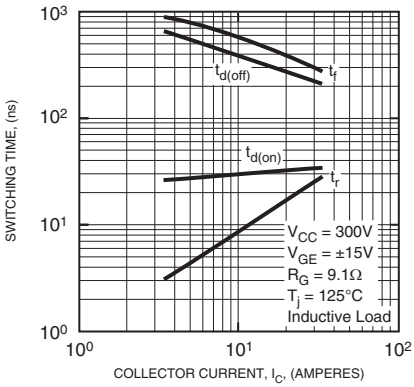
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (INVERTER PART - TYPICAL)



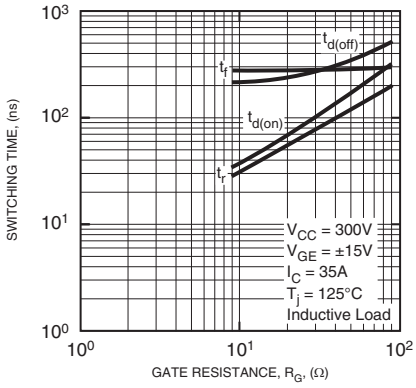
CAPACITANCE VS. V_{CE} (INVERTER PART - TYPICAL)



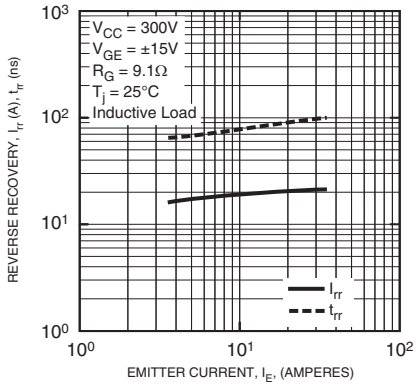
HALF-BRIDGE SWITCHING CHARACTERISTICS (INVERTER PART - TYPICAL)



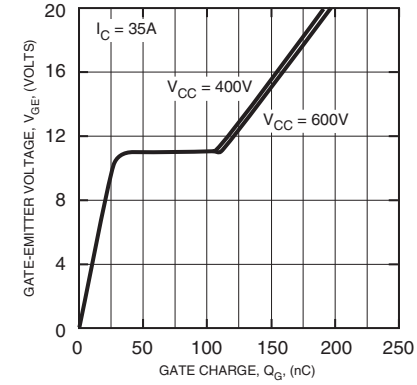
SWITCHING TIME VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



REVERSE RECOVERY CHARACTERISTICS (INVERTER PART - TYPICAL)



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



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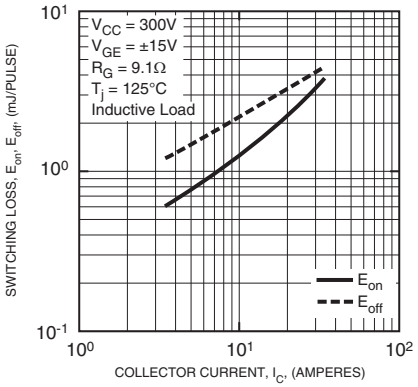
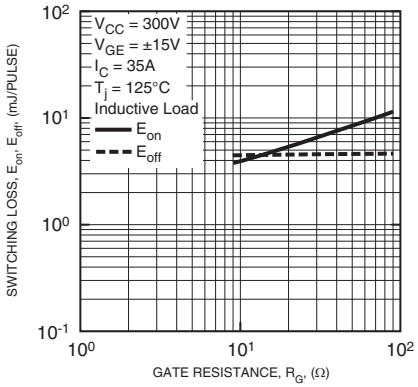
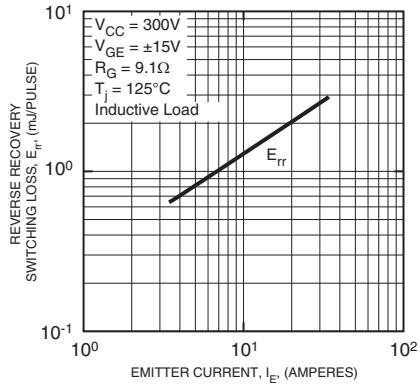
SWITCHING LOSS VS. COLLECTOR CURRENT (INVERTER PART - TYPICAL)



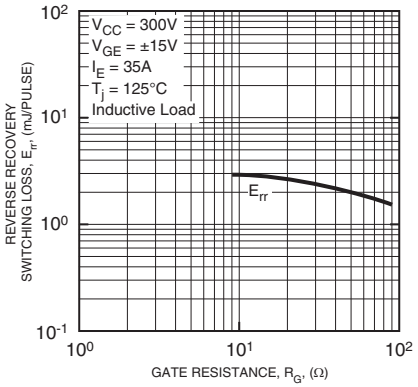
SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



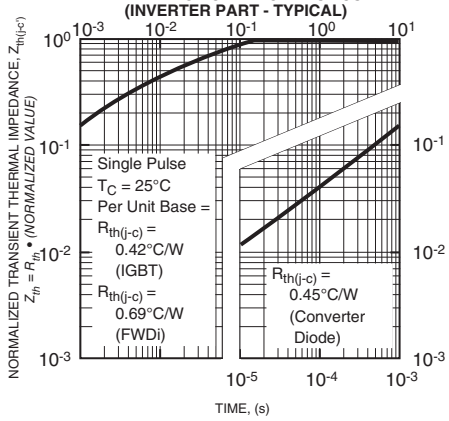
REVERSE RECOVERY SWITCHING LOSS VS. EMITTER CURRENT (INVERTER PART - TYPICAL)



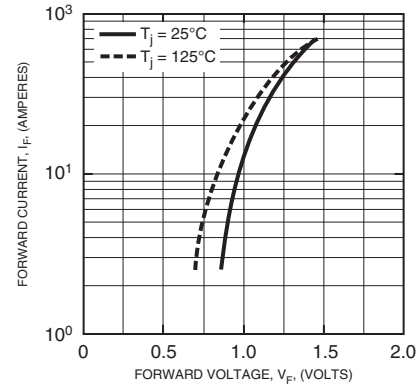
REVERSE RECOVERY SWITCHING LOSS VS. GATE RESISTANCE (INVERTER PART - TYPICAL)



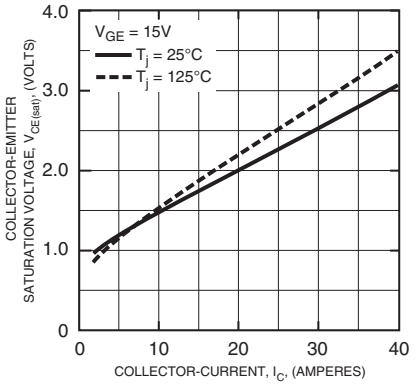
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (INVERTER PART - TYPICAL)



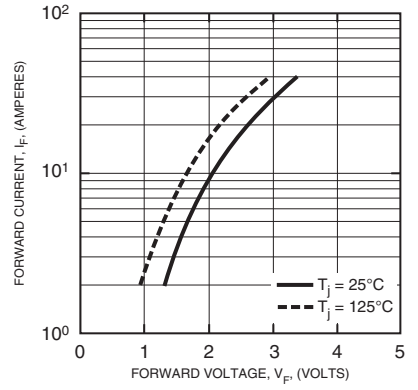
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (CONVERTER PART - TYPICAL)



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



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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (BRAKE PART - TYPICAL)