International
IOR Rectifier

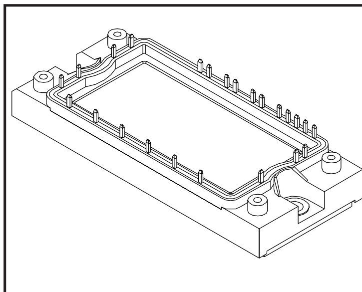
PD - 94552

GB25RF120K

IGBT PIM MODULE

Features
- Low VCE (on) Non Punch Through IGBT Technology
- Low Diode VF
- 10µs Short Circuit Capability
- Square RBSOA
- HEXFRED Antiparallel Diode with Ultrasoft Diode Reverse Recovery Characteristics
- Positive VCE (on) Temperature Coefficient
- Ceramic DBC Substrate
- Low Stray Inductance Design

Benefits
- Benchmark Efficiency for Motor Control
- Rugged Transient Performance
- Low EMI, Requires Less Snubbing
- Direct Mounting to Heatsink
- PCB Solderable Terminals
- Low Junction to Case Thermal Resistance
- UL Listed ①



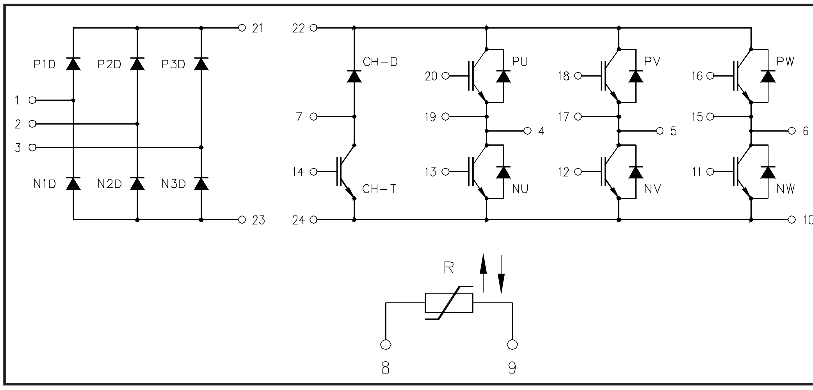
ECONO2 PIM

V_{CES} = 1200V

I_C = 25A, T_C=80°C

t_{sc} > 10µs, T_J=150°C

$V_{CE(on)}$ typ. = 2.40V



Absolute Maximum Ratings (T_J =25°C, unless otherwise indicated)

	Parameter	Symbol	Test Conditions		Ratings	Units
Inverter	Collector-to-Emitter Voltage	V_{CES}			1200	V
	Gate-to-Emitter Voltage	V_{GES}			±20	
	Collector Current	I_C	Continuous	25°C / 80°C	40 / 25	A
		I_{CM}		25°C	80	
	Diode Maximum Forward Current	I_{FM} ②		25°C	80	
	Power Dissipation	P_D	1 device	25°C	198	W
Input Rectifier	Repetitive Peak Reverse Voltage	V_{RRM}			1600	V
	Average Output Current	$I_{F(AV)}$	50/60Hz sine pulse	80°C	20	A
	Surge Current (Non Repetitive)	I_{FSM}	Rated V_{RRM} applied, 10ms, sine pulse		250	
	I^2t (Non Repetitive)	I^2t			316	A^2s
Brake	Collector-to-Emitter Voltage	V_{CES}			1200	V
	Gate-to-Emitter Voltage	V_{GES}			±20	
	Collector Current	I_C	Continuous	25°C / 80°C	25 / 15	A
		I_{CM}		25°C	50	
	Power Dissipation	P_D	1 device	25°C	104	W
	Repetitive Peak Reverse Voltage	V_{RRM}			1200	V
	Maximum Operating Junction Temperature	T_J	—	—	150	°C
	Storage Temperature Range	T_{STG}	—	—	-40 to +125	
	Isolation Voltage	V_{ISOL}	AC(1min.)		2500	V

Thermal and Mechanical Characteristics

Parameter	Symbol	Min	Typical	Maximum	Units
Junction-to-Case Inverter IGBT Thermal Resistance	R_{THJC}	—	—	0.63	°C/W
Junction-to-Case Inverter FRED Thermal Resistance		—	—	1.0	
Junction-to-Case Brake IGBT Thermal Resistance		—	—	1.2	
Junction-to-Case Brake Diode Thermal Resistance		—	—	2.3	
Junction-to-Case Input Rectifier Thermal Resistance		—	—	0.85	
Mounting Torque (M5)		2.7	—	3.3	Nm

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

		Parameter	Min.	Typ.	Max.	Units	Conditions	
Inverter IGBT	BV_{CES}	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 500μA	
	$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.0	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-125°C)	
	$V_{CE(on)}$	Collector-to-Emitter Voltage	—	2.40	2.70	V	I_C = 25A, V_{GE} = 15V	1,2
			—	2.95	3.30		I_C = 40A, V_{GE} = 15V	4,5
			—	2.85	—		I_C = 25A, V_{GE} = 15V, T_J = 125°C	
			—	3.55	—		I_C = 40A, V_{GE} = 15V, T_J = 125°C	
	$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		V_{CE} = V_{GE}, I_C = 250μA	3,4,5
	$\Delta V_{GE(th)}$	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	V_{CE} = V_{GE}, I_C = 1mA (25°C-125°C)	
	I_{CES}	Zero Gate Voltage Collector Current	—	11	100	μA	V_{GE} = 0V, V_{CE} = 1200V	
			—	750	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C	
	I_{GES}	Gate-to-Emitter Leakage Current	—	—	±200	nA	V_{GE} = ±20V	
	Q_g	Total Gate Charge (turn-on)	—	175	265	nC	I_C = 25A	7
	Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	17.5	30		V_{CC} = 400V	CT1
	Q_{gc}	Gate-to-Collector Charge (turn-on)	—	81	125		V_{GE} = 15V	
	E_{on}	Turn-On Switching Loss	—	2450	4450	μJ	I_C = 25A, V_{CC} = 600V	CT4
	E_{off}	Turn-Off Switching Loss	—	2050	3200		V_{GE} = 15V, R_G = 10Ω, L = 400μH	
	E_{tot}	Total Switching Loss	—	4500	7650		T_J = 25°C ③	
	E_{on}	Turn-On Switching Loss	—	3350	5650	μJ	I_C = 25A, V_{CC} = 600V	9,11
	E_{off}	Turn-Off Switching Loss	—	2850	3850		V_{GE} = 15V, R_G = 10Ω, L = 400μH	CT4
	E_{tot}	Total Switching Loss	—	6200	9500		T_J = 125°C ③	WF1,2
	$t_{d(on)}$	Turn-On delay time	—	80	104	ns	I_C = 25A, V_{CC} = 600V	10,12
	t_r	Rise time	—	50	70		V_{GE} = 15V, R_G = 10Ω, L = 400μH	CT4
	$t_{d(off)}$	Turn-Off delay time	—	510	1000		T_J = 125°C	WF1
	t_f	Fall time	—	230	299			WF2
	C_{ies}	Input Capacitance	—	2370	—	pF	V_{GE} = 0V	
	C_{oes}	Output Capacitance	—	455	—		V_{CC} = 30V	6
	C_{res}	Reverse Transfer Capacitance	—	60	—		f = 1.0Mhz	
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 80A R_G = 10Ω, V_{GE} = +15V to 0V	CT2
	SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	T_J = 150°C V_{CC} = 900V, V_P = 1200V R_G = 10Ω, V_{GE} = +15V to 0V	CT3 WF4
Inverter FRED	I_{rr}	Diode Peak Reverse Recovery Current	—	35	—	A	T_J = 125°C V_{CC} = 600V, I_F = 25A, L = 400μH V_{GE} = 15V, R_G = 10Ω	13,14,15 CT4
	V_{FM}	Diode Forward Voltage Drop	—	1.90	2.35	V	I_F = 25A	8
			—	2.25	2.80		I_F = 40A	
			—	2.00	—		I_F = 25A, T_J = 125°C	
			—	2.45	—		I_F = 40A, T_J = 125°C	

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

		Parameter	Min.	Typ.	Max.	Units	Conditions	
Input Rectifier	V_{FM}	Maximum Forward Voltage Drop	—	—	1.5	V	I_F = 25A	17
	I_{RM}	Maximum Reverse Leakage Current	—	—	0.1	mA	T_J = 25°C, V_R = 1600V	
			—	—	1.0		T_J = 150°C, V_R = 1600V	
	r_T	Forward Slope Resistance	—	—	10.4	mΩ	T_J = 150°C	
	$V_{F(TO)}$	Conduction Threshold Voltage	—	—	0.85	V		
Brake IGBT	BV_{CES}	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V_{GE} = 0V, I_C = 500µA	
	$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.6	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-125°C)	
	$V_{CE(on)}$	Collector-to-Emitter Voltage	—	2.30	2.50	V	I_C = 12.5A, V_{GE} = 15V	20,21
			—	3.00	3.25		I_C = 25A, V_{GE} = 15V	23,24
			—	2.70	—		I_C = 12.5A, V_{GE} = 15V, T_J = 125°C	
			—	3.70	—		I_C = 25A, V_{GE} = 15V, T_J = 125°C	
	$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		V_{CE} = V_{GE}, I_C = 250µA	22,23,24
	$\Delta V_{GE(th)}$	Threshold Voltage temp. coefficient	—	-10	—	mV/°C	V_{CE} = V_{GE}, I_C = 1mA (25°C-125°C)	
	I_{CES}	Zero Gate Voltage Collector Current	—	8.0	50	µA	V_{GE} = 0V, V_{CE} = 1200V	
			—	370	—		V_{GE} = 0V, V_{CE} = 1200V, T_J = 125°C	
	I_{GES}	Gate-to-Emitter Leakage Current	—	—	±200	nA	V_{GE} = ±20V	
	Q_g	Total Gate Charge (turn-on)	—	96	145	nC	I_C = 12.5A	26
	Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	46	70		V_{CC} = 400V	CT1
	Q_{gc}	Gate-to-Collector Charge (turn-on)	—	10	15		V_{GE} = 15V	
	E_{on}	Turn-On Switching Loss	—	1050	1200	µJ	I_C = 12.5A, V_{CC} = 600V	CT4
	E_{off}	Turn-Off Switching Loss	—	750	1000		V_{GE} = 15V, R_G = 22Ω, L = 400µH	
	E_{tot}	Total Switching Loss	—	1800	2200		T_J = 25°C ③	
	E_{on}	Turn-On Switching Loss	—	1350	1500	µJ	I_C = 12.5A, V_{CC} = 600V	28,30
	E_{off}	Turn-Off Switching Loss	—	1100	1250		V_{GE} = 15V, R_G = 22Ω, L = 400µH	CT4
	E_{tot}	Total Switching Loss	—	2450	2750		T_J = 125°C ③	WF3,4
	$t_{d(on)}$	Turn-On delay time	—	50	65	ns	I_C = 12.5A, V_{CC} = 600V	29,31
	t_r	Rise time	—	36	50		V_{GE} = 15V, R_G = 22Ω, L = 400µH	CT4
	$t_{d(off)}$	Turn-Off delay time	—	350	400		T_J = 125°C	WF3
	t_f	Fall time	—	210	275			WF4
	C_{ies}	Input Capacitance	—	2370	—	pF	V_{GE} = 0V	
	C_{oes}	Output Capacitance	—	460	—		V_{CC} = 30V	25
	C_{res}	Reverse Transfer Capacitance	—	60	—		f = 1.0Mhz	
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 150°C, I_C = 50A R_G = 22Ω, V_{GE} = +15V to 0V	CT2
	SCSOA	Short Circuit Safe Operating Area	10	—	—	µs	T_J = 150°C V_{CC} = 900V, V_P = 1200V R_G = 22Ω, V_{GE} = +15V to 0V	CT3
Brake Diode	I_{rr}	Diode Peak Reverse Recovery Current	—	24	—	A	V_{CC} = 600V, I_F = 12.5A, L = 400µH V_{GE} = 15V, R_G = 22Ω, T_J = 125°C	32,33,34 CT4
	V_{FM}	Diode Forward Voltage Drop	—	1.90	2.10	V	I_F = 8.0A	27
			—	2.40	2.65		I_F = 16A	
			—	2.00	—		I_F = 8.0A, T_J = 125°C	
			—	2.65	—		I_F = 16A, T_J = 125°C	
NTC	R	Resistance	4538	5000	5495	Ω	T_J = 25°C	16
			468.6	493.3	518.0		T_J = 100°C	
	B	B Value	3307	3375	3443	K	T_J = 25 / 50 °C	

Note:

① For UL Applications, T_J is limited to +125°C. (See File E78996).

② Power dependent on temperature. T_J not to exceed T_J max.

③ Energy losses include "tail" and diode reverse recovery.

Inverter

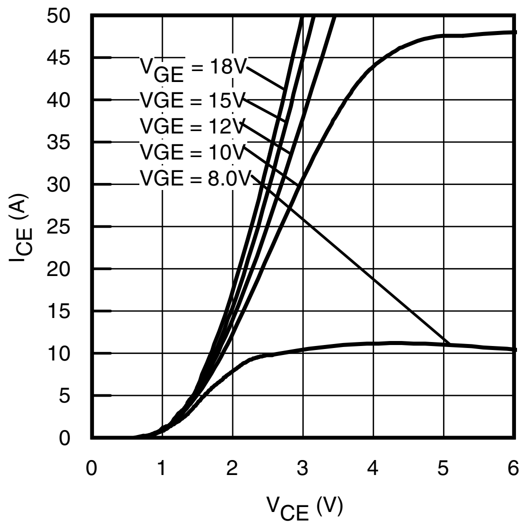


Fig. 1 - Typ. IGBT Output Characteristics
$T_J = 25°C$; tp = 80µs

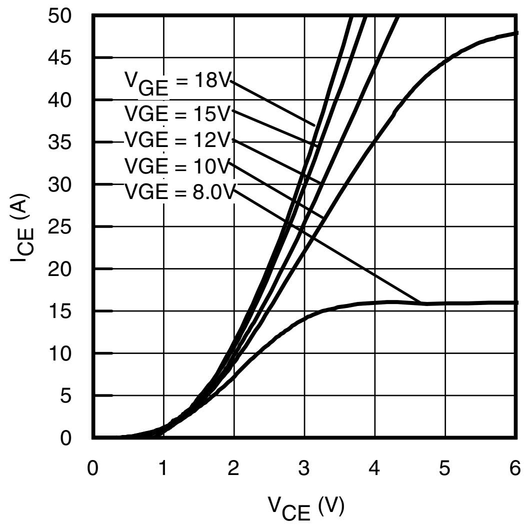


Fig. 2 - Typ. IGBT Output Characteristics
$T_J = 125°C$; tp = 80µs

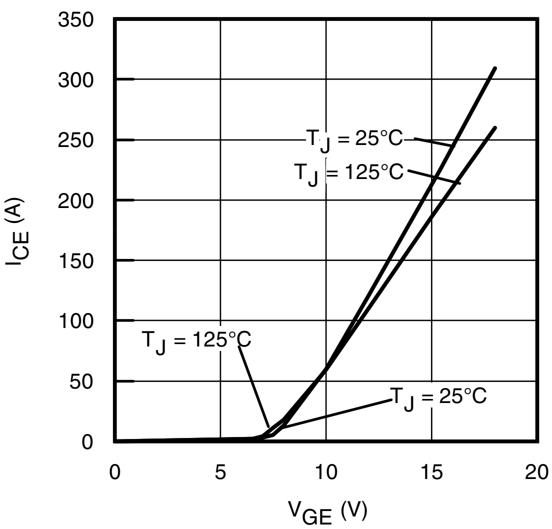


Fig. 3 - Typ. Transfer Characteristics
$V_{CE} = 50V$; tp = 10µs

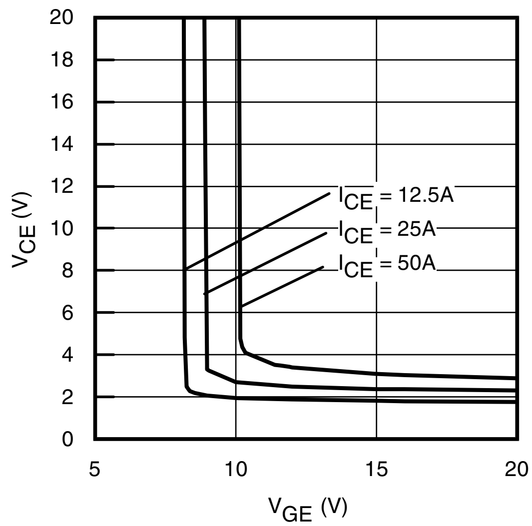


Fig. 4 - Typical V_{CE} vs. V_{GE}
$T_J = 25°C$

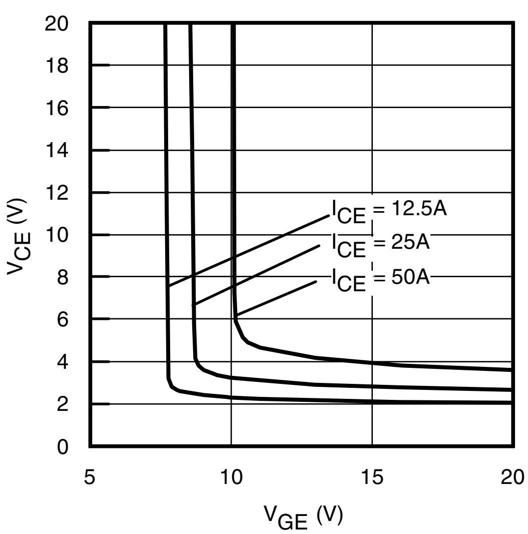


Fig.5 - Typical V_{CE} vs. V_{GE}
$T_J = 125°C$

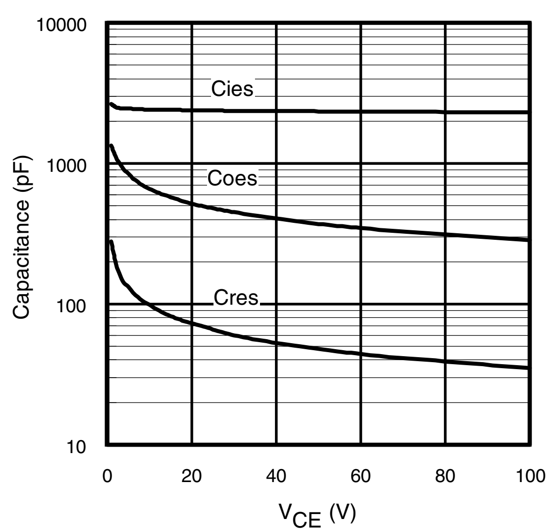


Fig. 6- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

Inverter

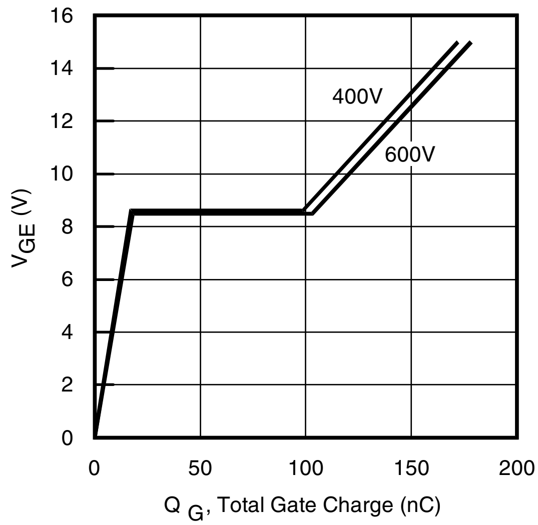


Fig. 7 - Typical Gate Charge vs. V_{GE}
I_{CE} = 25A; L = 1mH

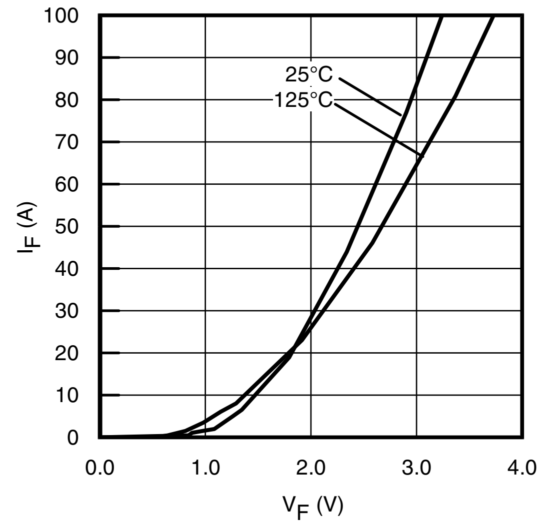


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

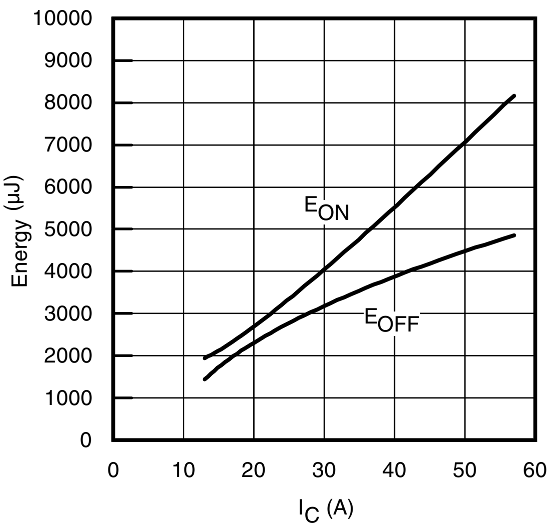


Fig. 9 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 10Ω; V_{GE}= 15V

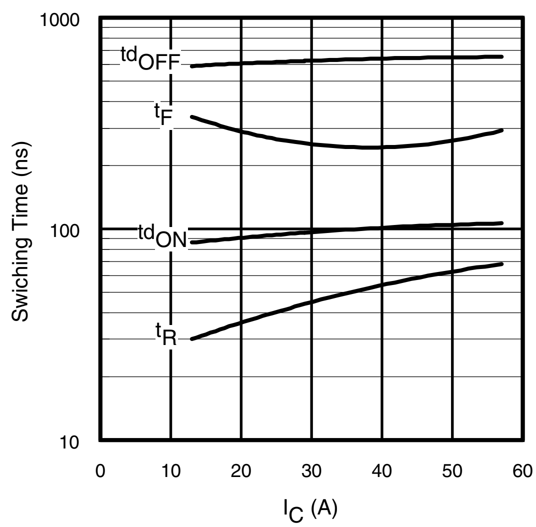


Fig. 10 - Typ. Switching Time vs. I_C
T_J = 125°C; L = 400µH; V_{CE} = 600V,R_G = 10Ω;V_{GE} = 15V

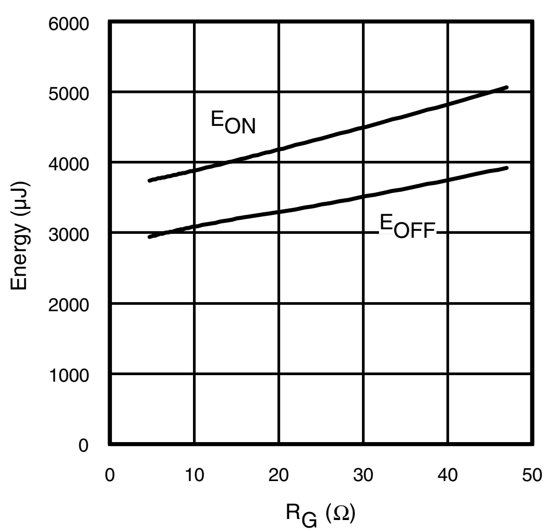


Fig. 11 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 25A; V_{GE}= 15V

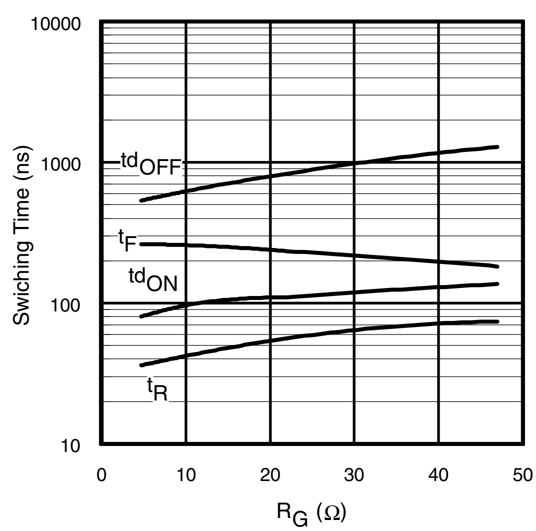


Fig. 12 - Typ. Switching Time vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 25A; V_{GE}= 15V

Inverter

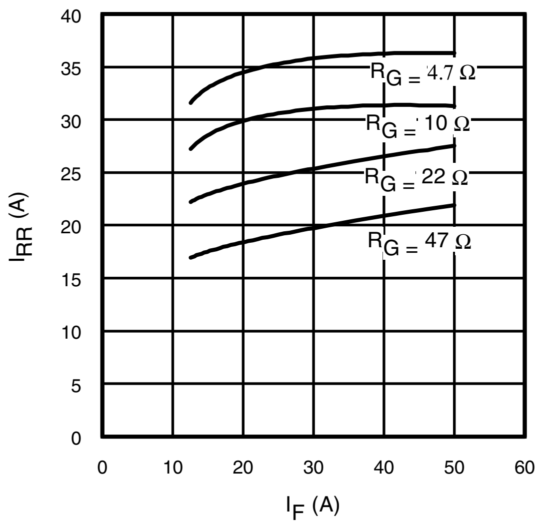


Fig. 13 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

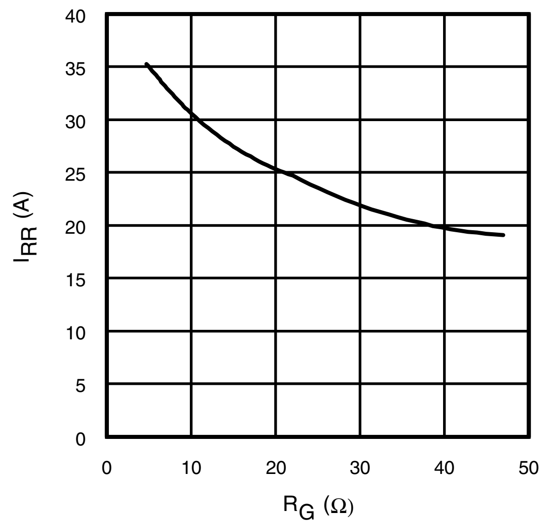


Fig. 14 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 25A

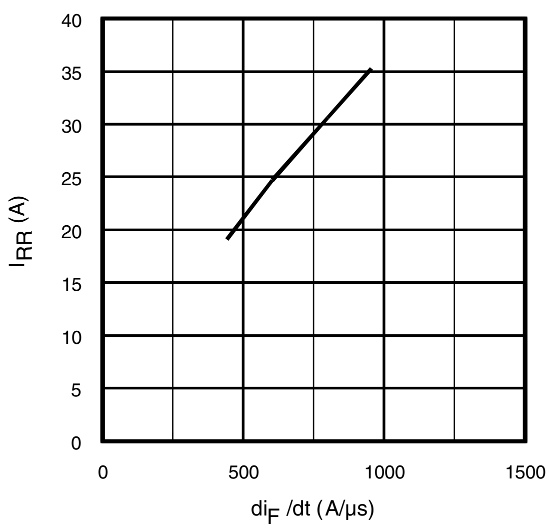


Fig. 15 - Typical Diode I_{RR} vs. di_F / dt
V_{CC} = 600V; V_{GE} = 15V; I_F = 25A; T_J = 125°C

Thermistor

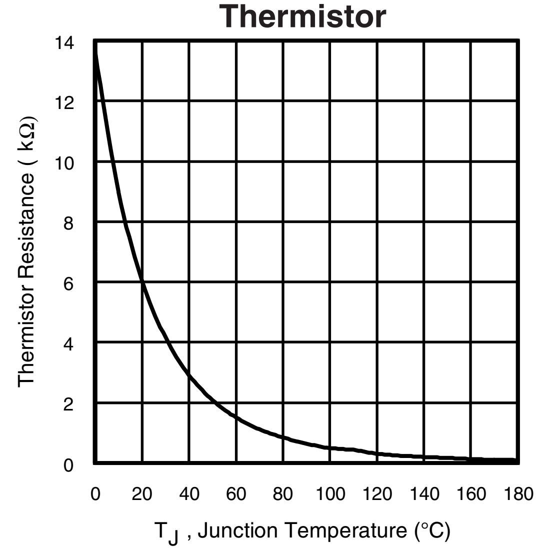


Fig. 16 - Thermistor Resistance vs. Temperature

Input Rectifier

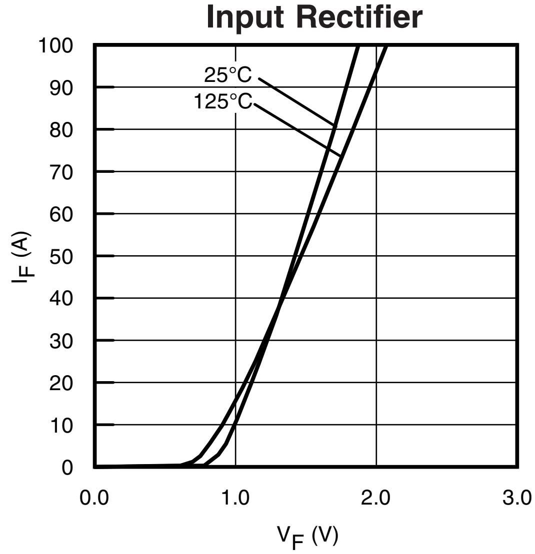


Fig. 17 - Typ. Diode Forward Characteristics
tp = 80µs

Inverter

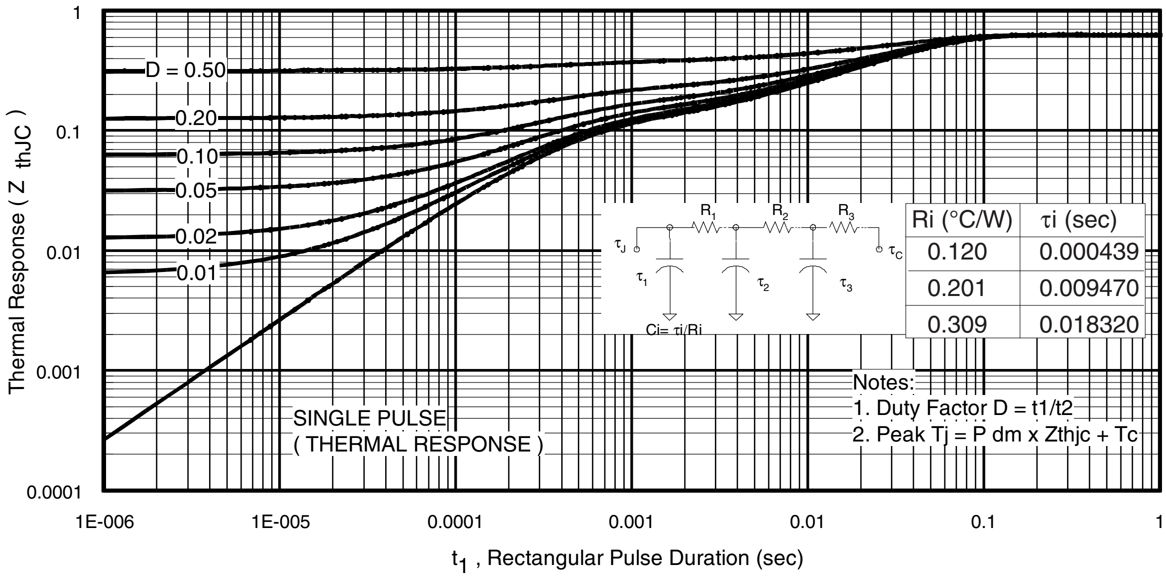


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter IGBT)

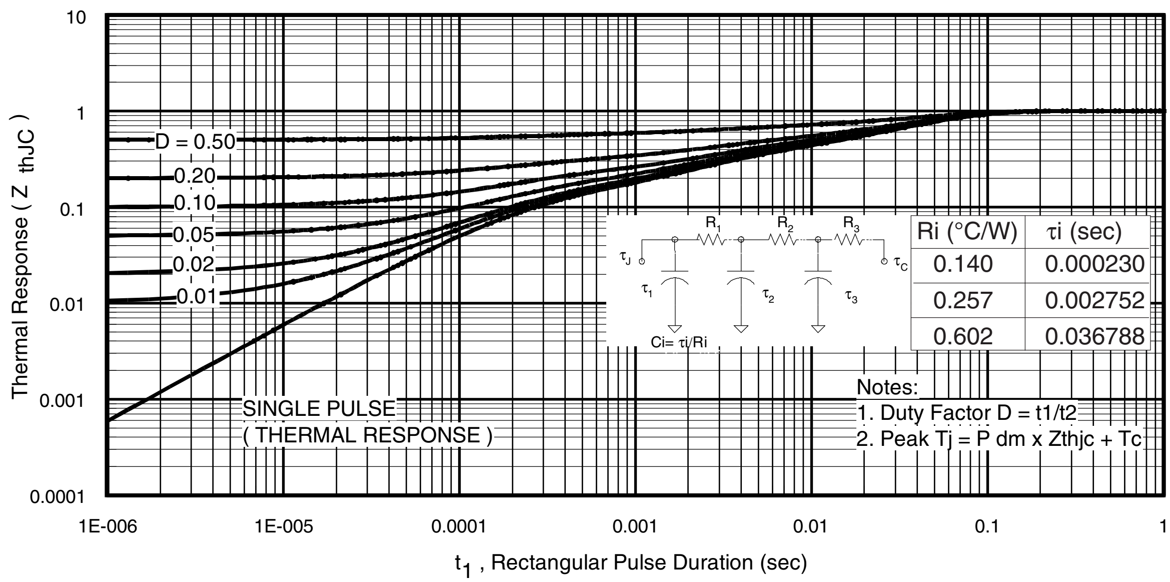


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter FRED)

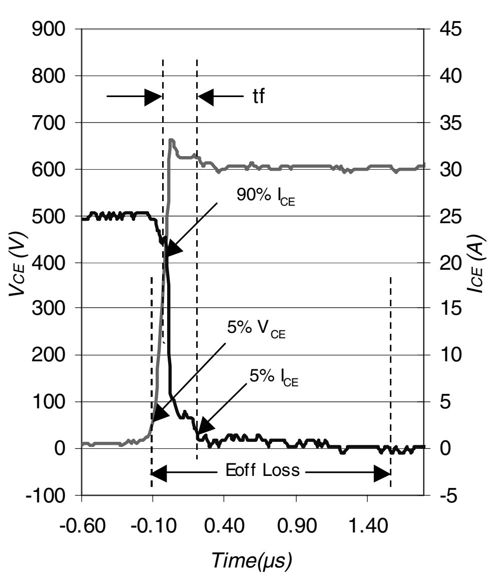


Fig. WF1- Typ. Turn-off Loss Waveform
@ T_J = 125°C using Fig. CT.4

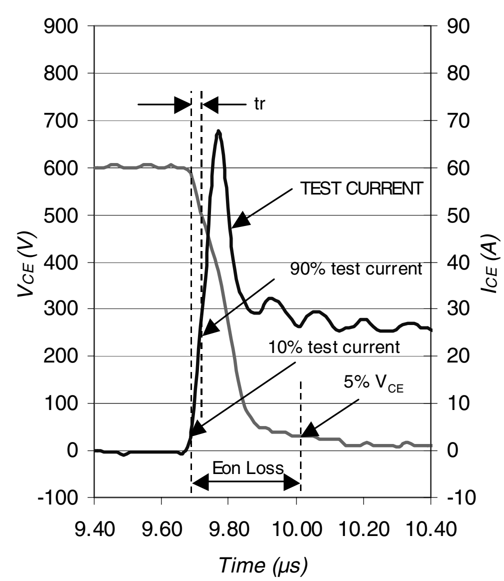


Fig. WF2- Typ. Turn-on Loss Waveform
@ T_J = 125°C using Fig. CT.4

Brake

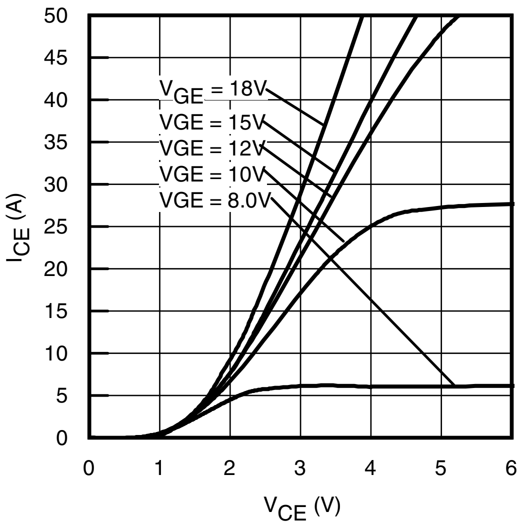


Fig. 20 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

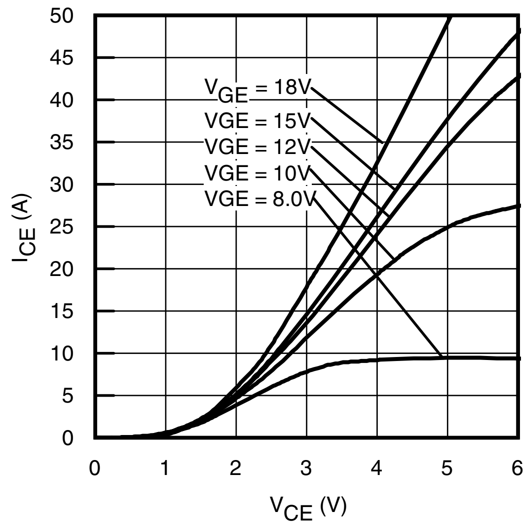


Fig. 21 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

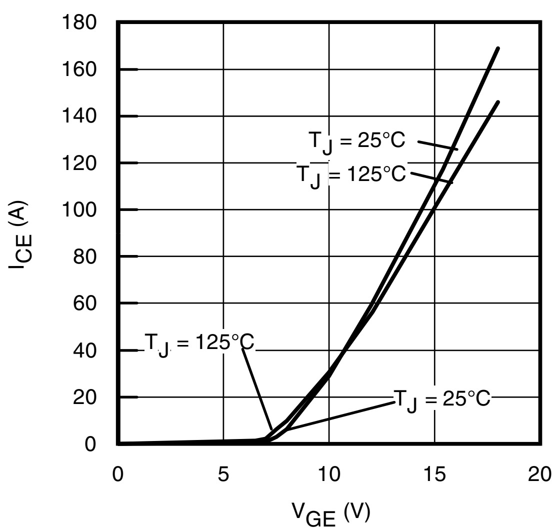


Fig. 22 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

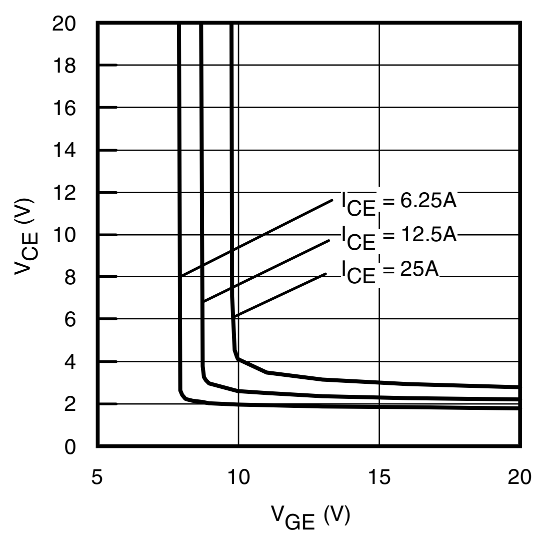


Fig. 23 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

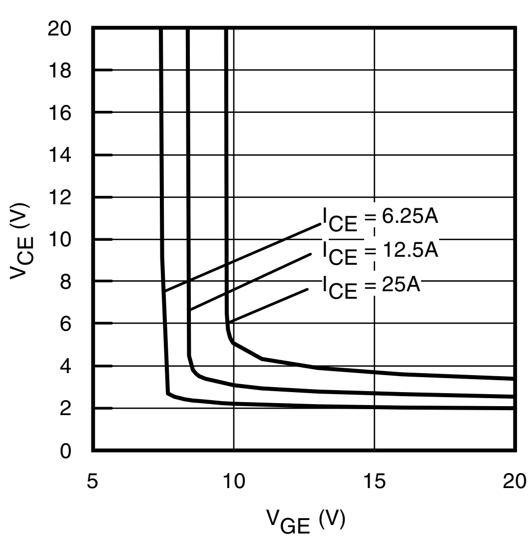


Fig.24 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

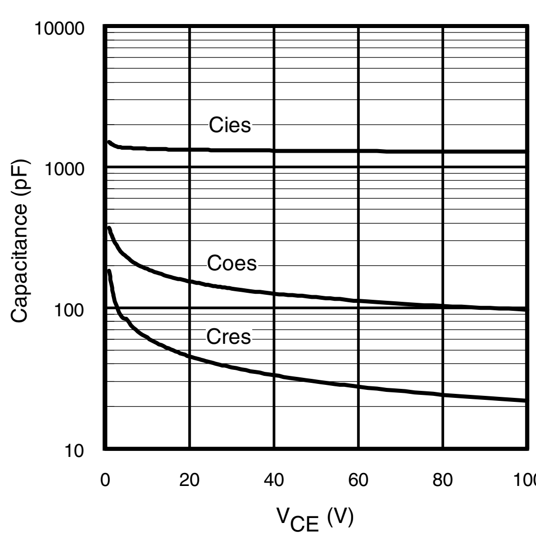


Fig. 25- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

Brake

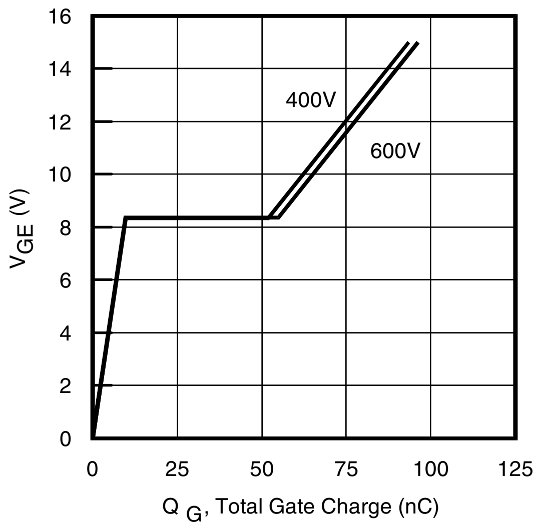


Fig. 26 - Typical Gate Charge vs. V_{GE}
I_{CE} = 12.5A; L = 1mH

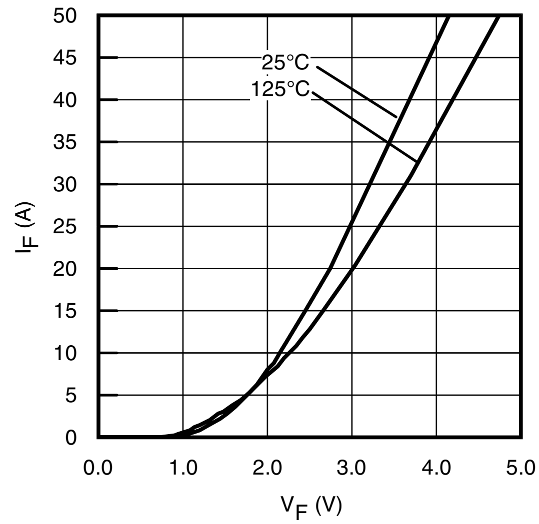


Fig. 27 - Typ. Diode Forward Characteristics
tp = 80µs

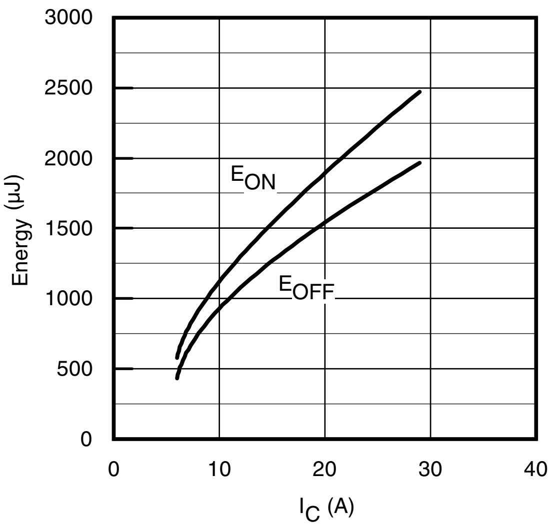


Fig. 28 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 22Ω; V_{GE}= 15V

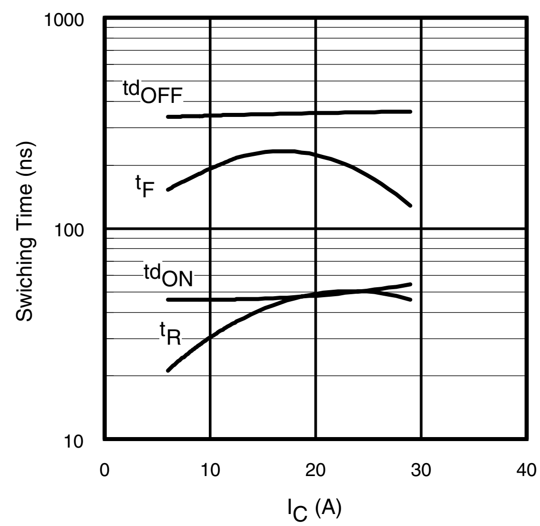


Fig. 29 - Typ. Switching Time vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 22Ω;V_{GE}= 15V

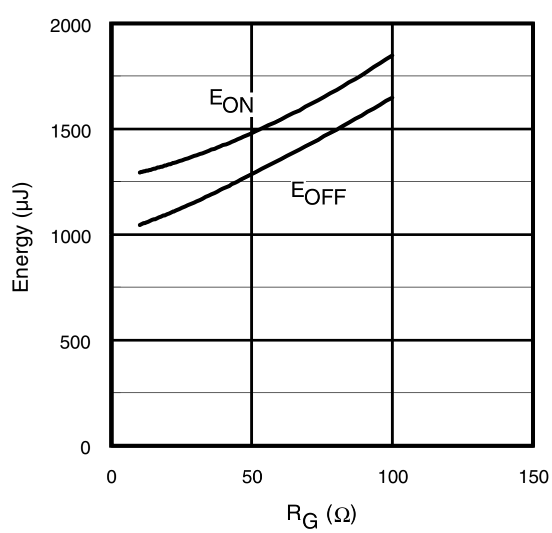


Fig. 30 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 12.5A; V_{GE}= 15V

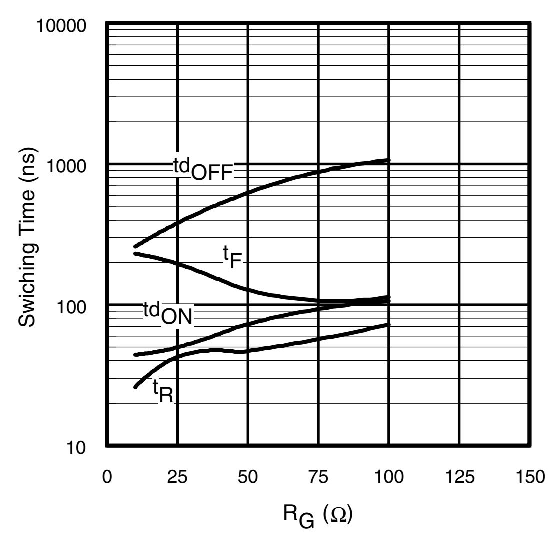


Fig. 31 - Typ. Switching Time vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 12.5A; V_{GE}= 15V

Brake

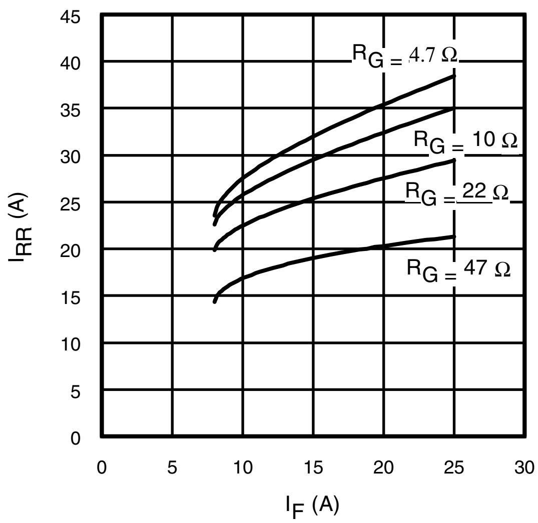


Fig. 32 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

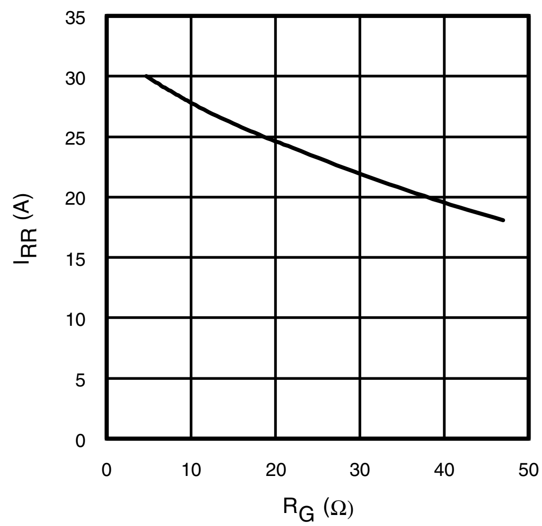


Fig. 33- Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 12.5A

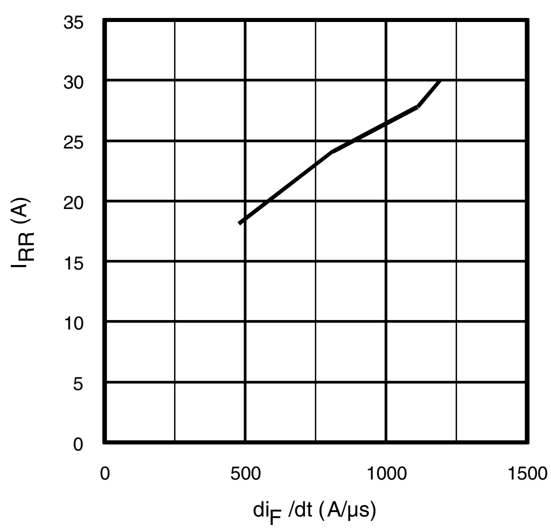


Fig. 34 - Typical Diode I_{RR} vs. di_F / dt
V_{CC} = 600V; V_{GE} = 15V; I_F = 12.5A; T_J = 125°C

Brake

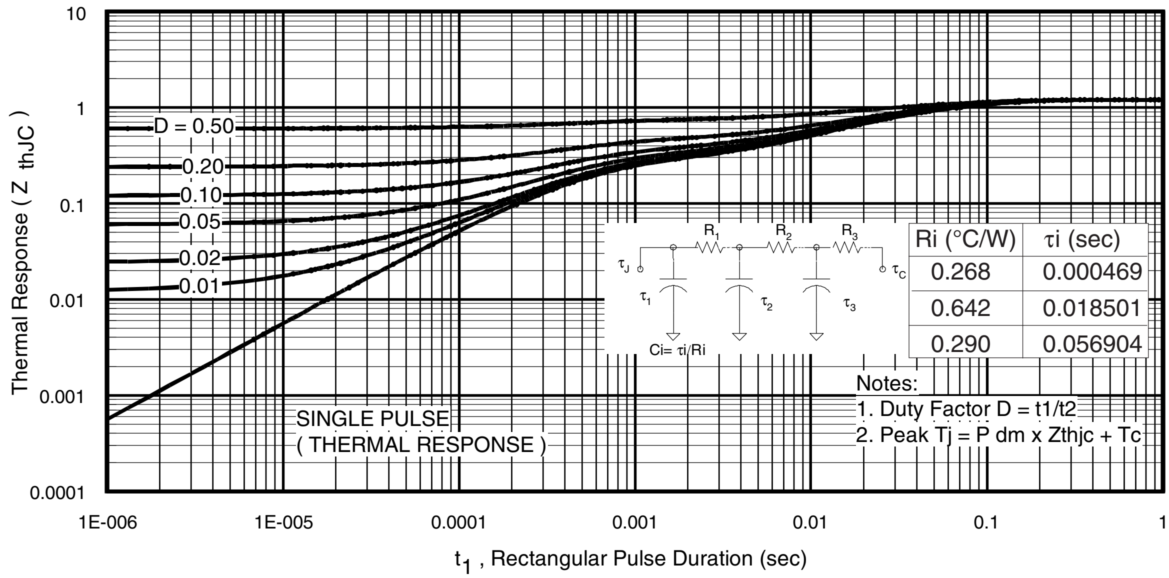


Fig 35. Maximum Transient Thermal Impedance, Junction-to-Case (Brake IGBT)

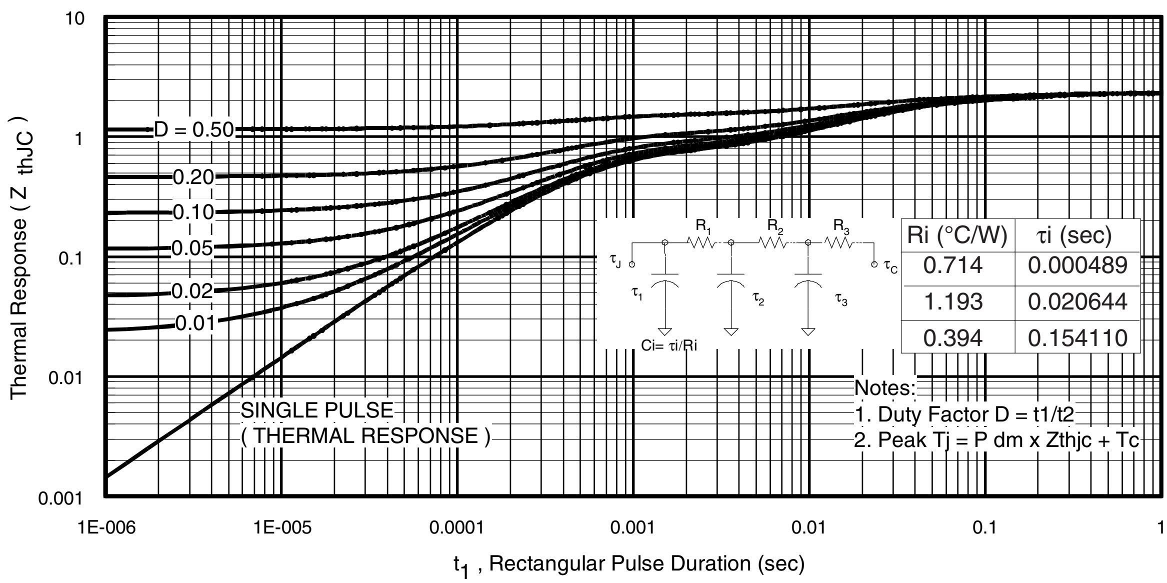


Fig 36. Maximum Transient Thermal Impedance, Junction-to-Case (Brake Diode)

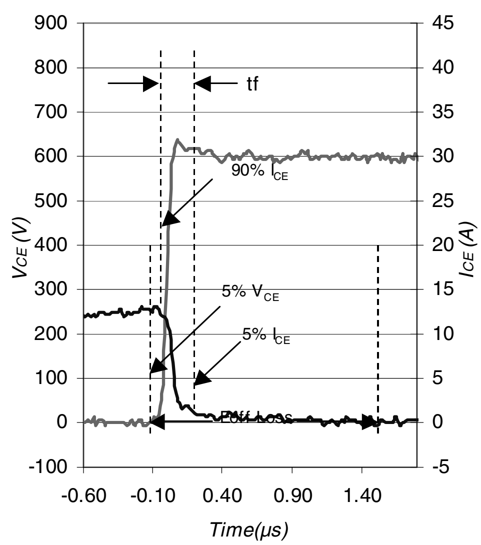


Fig. WF3- Typ. Turn-off Loss Waveform
@ T_J = 125°C using Fig. CT.4

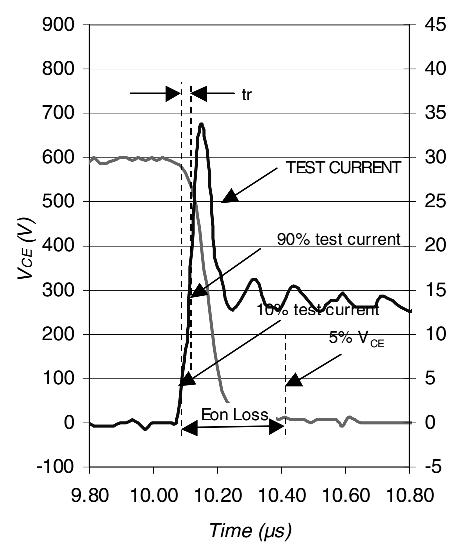


Fig. WF4- Typ. Turn-on Loss Waveform
@ T_J = 125°C using Fig. CT.4

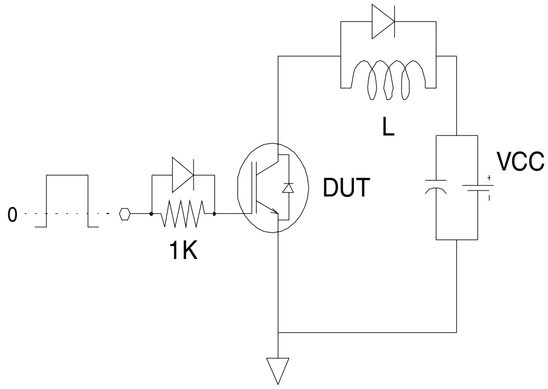


Fig.C.T.1 - Gate Charge Circuit (turn-off)

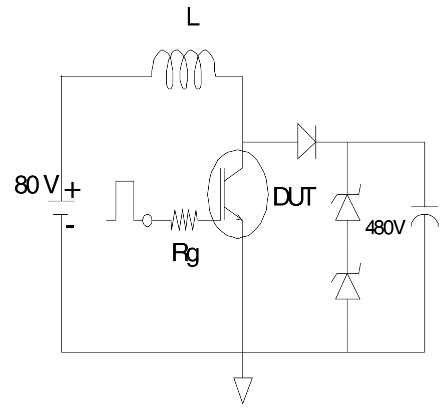


Fig.C.T.2 - RBSOA Circuit

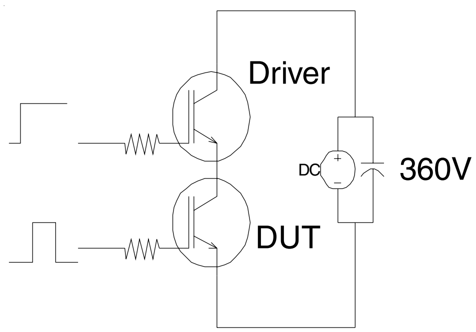


Fig.C.T.3 - S.C.SOA Circuit

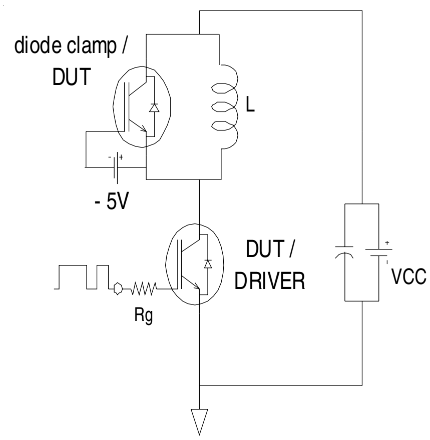


Fig.C.T.4 - Switching Loss Circuit

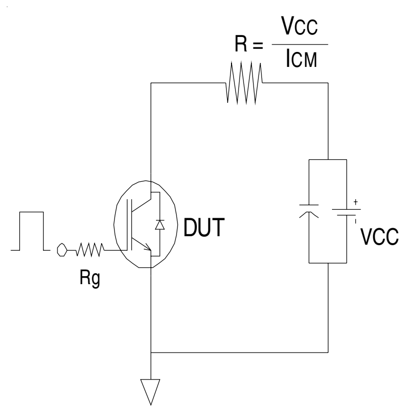
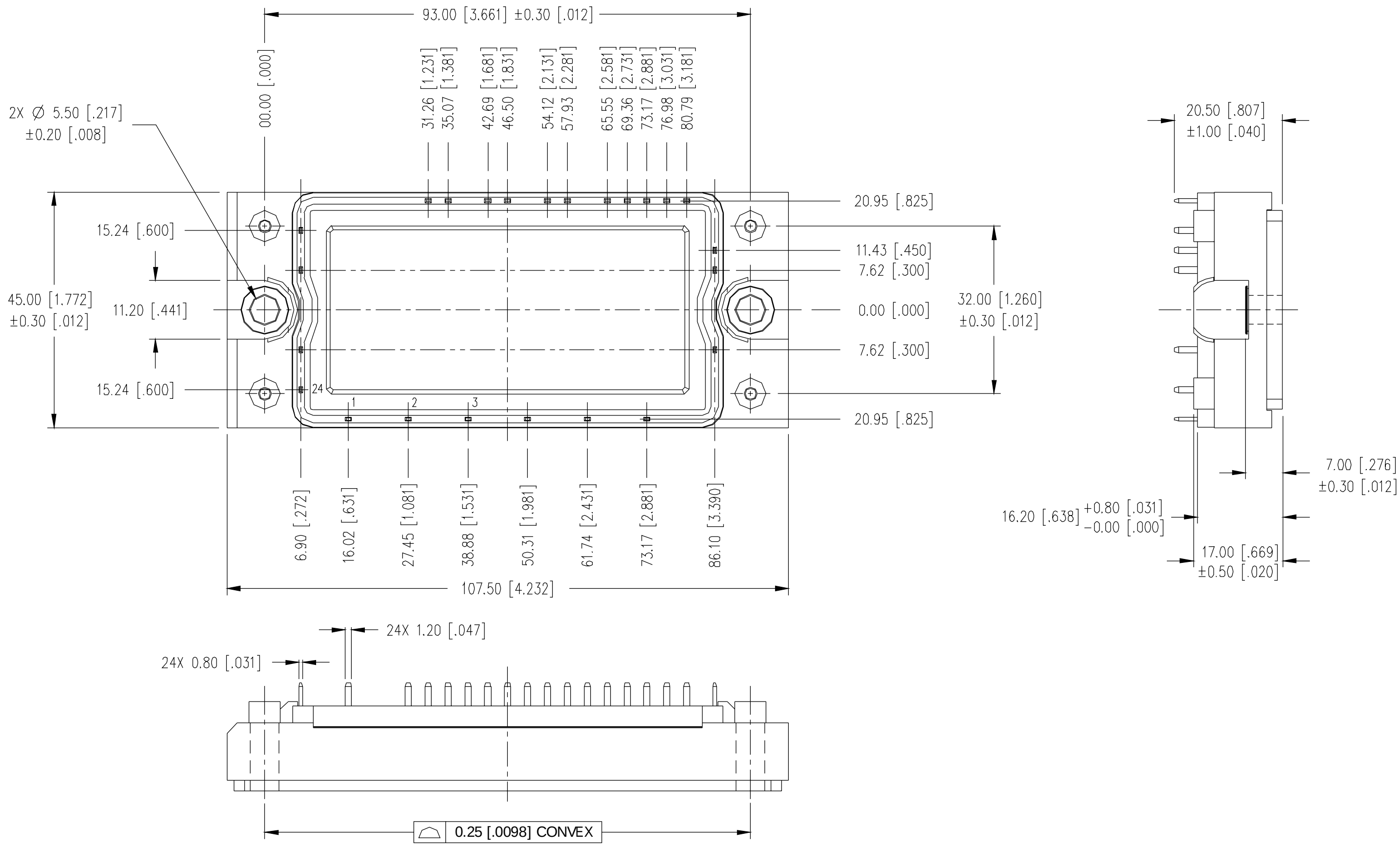


Fig.C.T.5 - Resistive Load Circuit

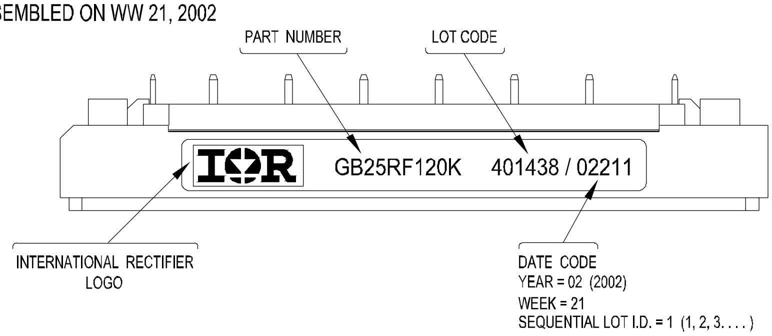
Econo2 PIM Package Outline

Dimensions are shown in millimeters (inches)



Econo2 PIM Part Marking Information

EXAMPLE: THIS IS A GB25RF120K
LOT CODE: 401438
ASSEMBLED ON WW 21, 2002



Data and specifications subject to change without notice.
This product has been designed and qualified for Industrial market.
Qualification Standards can be found on IR's Web site.

International
IOR Rectifier

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