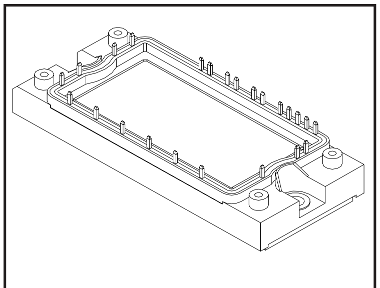
GB25RF120K

IGBT PIM MODULE



ECONO2PIM

V_{CES} = 1200V

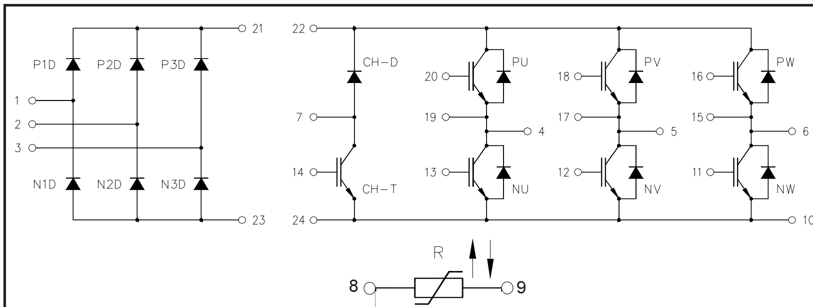
I_C = 25A @ T_C=80°C

t_{sc} > 10µs @ T_J =150°C

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

Features

- Low VCE (on) Non Punch Through IGBT Technology
- Low Diode VF
- 10µs Short Circuit Capability
- Square RBSOA
- HEXFRED Antiparallel Diode with Ultrasoft Reverse Recovery Characteristics
- Positive V_{CE} (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 Approved E78996

Absolute Maximum Ratings

	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	Continuos	25°C / 80°C	40 / 25	
		I_{CM}	Pulsed	25°C	80	A
	Diode Maximum Forward Current	I_{FM}	Pulsed	25°C	80	
	Power Dissipation	P_D	One IGBT	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,		250	
	I^2 t (Non Repetitive)	I^2t	sine pulse		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}	Pulsed	25°C	50	
	Power Dissipation	P_D	One IGBT	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 (1 min)		2500	V

Thermal and Mechanical Characteristics

Parameter	Symbol	Min	Typical	Maximum	Units
Junction-to-Case Inverter IGBT Thermal Resistance		-	-	0.63	°C/W
Junction-to-Case Inverter FRED Thermal Resistance		-	-	1.0	
Junction-to-Case Brake DIODE Thermal Resistance	$R_{\theta HJC}$	-	-	1.2	
Junction-to-Case Brake IGBT Thermal Resistance		-	-	2.3	
Junction-to-Case Input Rectifier Thermal Resistance		-	-	0.85	
Case-to-Sink, flat, greased surface	$R_{\theta CS}$	-	0.05	-	
Mounting Torque (M5)		2.7	-	3.3	Nm
Weight			170		g

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} = 0 IC = 500µA
	$\Delta V_{(BR)CES}/\Delta T_J$	Temp. Coefficient of Breakdown Voltage	-	1.0	-	V/°C	V_{GE} = 0 IC = 1mA (25°C - 125°C)
	$V_{CE(ON)}$	Collector-to-Emitter Voltage	-	2.40	2.70	V	I_C = 25A V_{GE} = 15V
			-	2.95	3.30		I_C = 40A V_{GE} = 15V
			-	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} IC = 250µA
	$\Delta V_{GE}(th)/\Delta T_J$	Thresold Voltage temp. coefficient	-	-10	-	mV/°C	V_{CE} = V_{GE} IC = 1mA (25°C-125°C)
	I_{CES}	Zero Gate Voltage Collector Current	-	-	100	µA	V_{GE} = 0 V_{CE} = 1200V
			-	750	-		V_{GE} = 0 V_{CE} = 1200V Tj = 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
	Q_{GE}	Gate-to-Emitter Charge (turn-on)	-	17.5	30		V_{CC} = 400A
	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
	E_{OFF}	Turn-Off Switching Loss	-	2050	3200		V_{GE} = 15V R_G = 10Ω L = 400µH
	E_{TOT}	Total Switching Loss	-	4500	7650		Tj = 25°C [1]
	E_{ON}	Turn-On Switching Loss	-	3350	5650	µJ	I_C = 25A V_{CC} = 600V
	E_{OFF}	Turn-Off Switching Loss	-	2850	3850		V_{GE} = 15V R_G = 10Ω L = 400µH
	E_{TOT}	Total Switching Loss	-	6200	9500		Tj = 125°C [1]
	$t_{d(on)}$	Turn-On delay time	-	80	104	ns	I_C = 25A V_{CC} = 600V
	t_r	Rise time	-	50	70		V_{GE} = 15V R_G = 10Ω L = 400µH
	$t_{d(off)}$	Turn-Off delay time	-	510	1000		Tj = 125°C
	t_f	Fall time	-	230	299		
	C_{ies}	Input Capacitance	-	2370	-	pF	V_{GE} = 0
	C_{oes}	Output Capacitance	-	455	-		V_{CC} = 30V
	C_{res}	Reverse Transfer Capacitance	-	60	-		f = 1Mhz
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				Tj = 150°C I_C = 80A R_G = 10Ω V_{GE} = 15V to 0
	SCSOA	Short Circuit Safe Operating Area	10	-	-	µs	Tj = 150°C V_{CC} = 900V V_P = 1200V R_G = 10Ω V_{GE} = 15V to 0
Inverter IGBT	I_{rr}	Diode Peak Rev. Recovery Current	-	35	-	A	Tj = 125°C V_{CC} = 600V I_F = 25A L = 400µH V_{GE} = 15V R_G = 10Ω
	V_{FM}	Diode Forward Voltage Drop	-	1.90	2.35	V	I_F = 25A
			-	2.25	2.80		I_F = 40A
			-	2.00	-		I_F = 25A Tj = 125°C
			-	2.45	-		I_F = 40A Tj = 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
	I_{RM}	Maximum Reverse Leakage Current	-	-	0.1	mA	Tj = 25°C V_R = 1600V
			-	-	1.0		Tj = 150°C V_R = 1600V
	r_T	Forward Slope Resistance	-	-	10.4	mΩ	Tj = 150°C
	$V_{F(TO)}$	Conduction Thresold Voltage	-	-	0.85	V	
Brake IGBT	$BV_{(CES)}$	Collector-to-Emitter Breakdown Voltage	1200	-	-	V	V_{GE} = 0 IC = 500µA
	$\Delta V_{(BR)CES}/\Delta T_J$	Temp. Coefficient of Breakdown Voltage	-	1.6	-	V/°C	V_{GE} = 0 IC = 1mA (25°C - 125°C)
	$V_{CE(ON)}$	Collector-to-Emitter Voltage	-	2.30	2.50	V	I_C = 12.5A V_{GE} = 15V
			-	3.00	3.25		I_C = 25A V_{GE} = 15V
			-	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} IC = 250µA
	$\Delta V_{GE}(th)/\Delta T_J$	Thresold Voltage temp. coefficient	-	-10	-	mV/°C	V_{CE} = V_{GE} IC = 1mA (25°C-125°C)
	I_{CES}	Zero Gate Voltage Collector Current	-	-	100	µA	V_{GE} = 0 V_{CE} = 1200V
			-	370	-		V_{GE} = 0 V_{CE} = 1200V Tj = 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
	Q_{GE}	Gate-to-Emitter Charge (turn-on)	-	46	70		V_{CC} = 400A
	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
	E_{OFF}	Turn-Off Switching Loss	-	750	1000		V_{GE} = 15V R_G = 22Ω L = 400µH
	E_{TOT}	Total Switching Loss	-	1800	2200		Tj = 25°C [1]
	E_{ON}	Turn-On Switching Loss	-	1350	1500	µJ	I_C = 12.5A V_{CC} = 600V
	E_{OFF}	Turn-Off Switching Loss	-	1100	1250		V_{GE} = 15V R_G = 22Ω L = 400µH
	E_{TOT}	Total Switching Loss	-	2450	2750		Tj = 125°C [1]
	$t_{d(on)}$	Turn-On delay time	-	50	65	ns	I_C = 12.5A V_{CC} = 600V
	t_r	Rise time	-	36	50		V_{GE} = 15V R_G = 22Ω L = 400µH
	$t_{d(off)}$	Turn-Off delay time	-	350	400		Tj = 125°C
	t_f	Fall time	-	210	275		
	C_{ies}	Input Capacitance	-	2370	-	pF	V_{GE} = 0
	C_{oes}	Output Capacitance	-	460	-		V_{CC} = 30V
	C_{res}	Reverse Transfer Capacitance	-	60	-		f = 1Mhz
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				Tj = 150°C I_C = 50A R_G = 22Ω V_{GE} = 15V to 0
	SCSOA	Short Circuit Safe Operating Area	10	-	-	µs	Tj = 150°C V_{CC} = 900V V_P = 1200V R_G = 22Ω V_{GE} = 15V to 0
Brake Diode	I_{rr}	Diode Peak Rev. Recovery Current	-	24	-	A	V_{CC} = 600V I_F = 12.5A L = 400µH V_{GE} = 15V to 0 R_G = 22Ω Tj = 125°C
	V_{FM}	Diode Forward Voltage Drop	-	1.90	2.10	V	I_F = 8A
			-	2.40	2.65		I_F = 16A
			-	2	-		I_F = 8A Tj = 125°C
			-	2.65	-		I_F = 16A Tj = 125°C
NTC	R	Resistance	4538	5000	5495	Ω	Tj = 25°C
			468.6	493.3	518		Tj = 100°C
	B	B Value	3307	3375	3443	K	Tj = 25°C / 50°C

[1] Energy Losses include "tail" and diode reverse recovery

Inverter

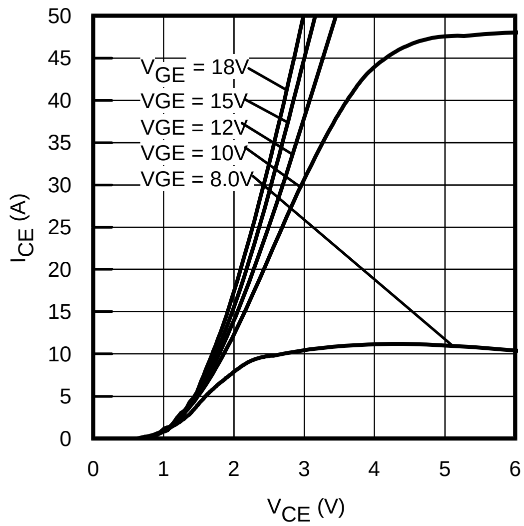


Fig. 1 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

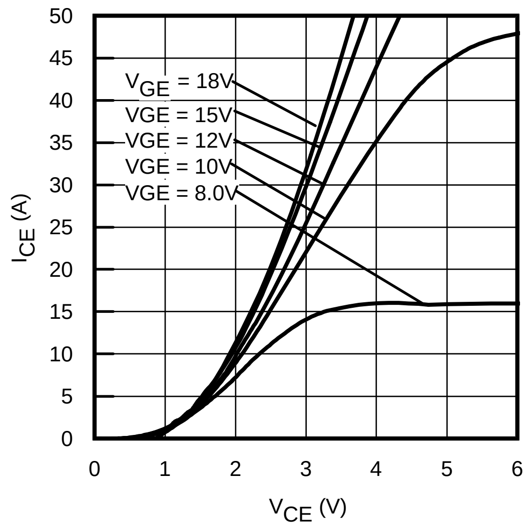


Fig. 2 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

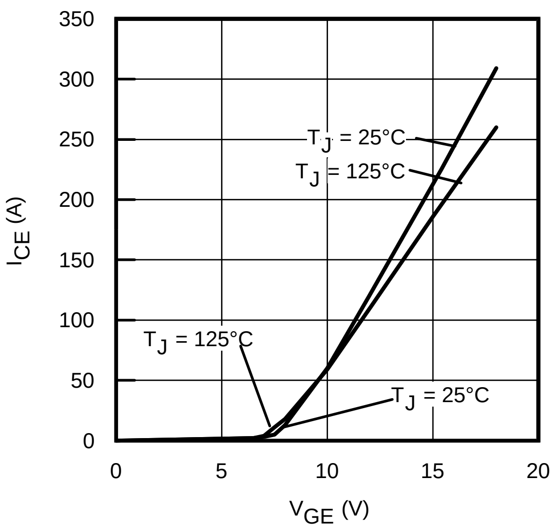


Fig. 3 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

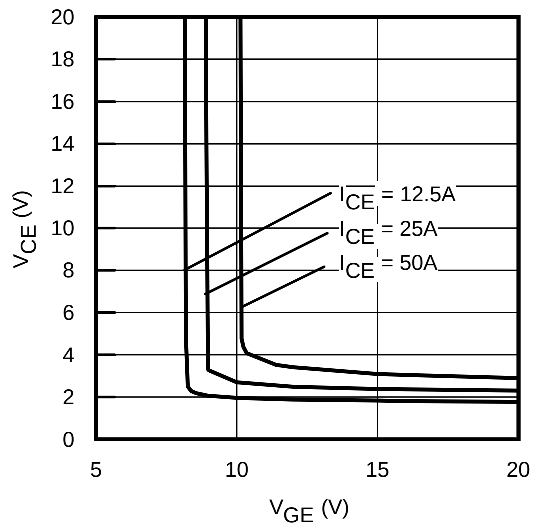


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

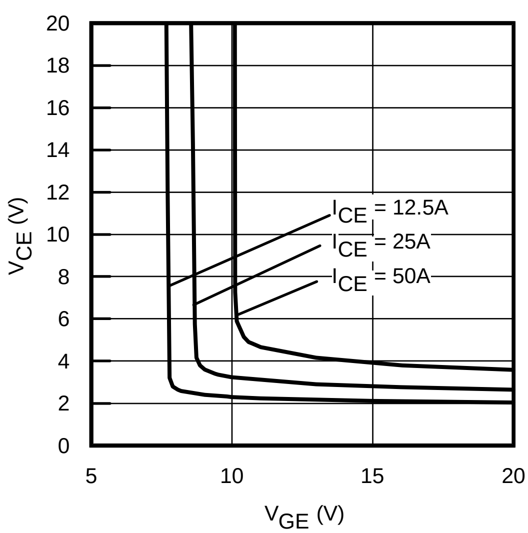


Fig.5 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

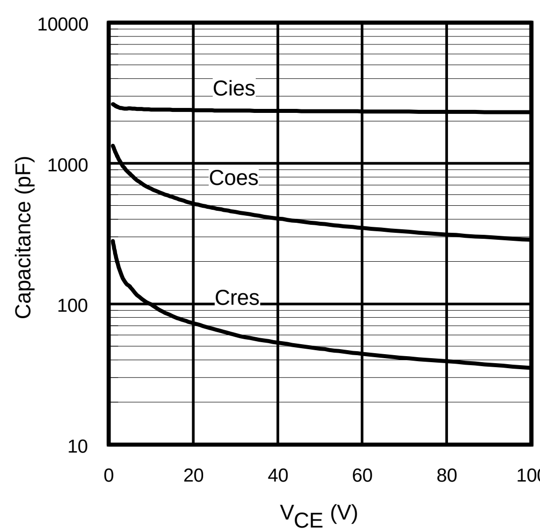


Fig. 6- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

Inverter

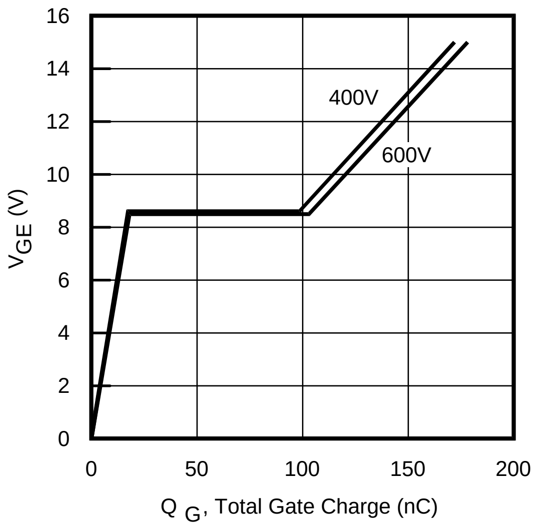


Fig. 7 - Typical Gate Charge vs. V_{GE}
I_{CE} = 25A; L = 1mH

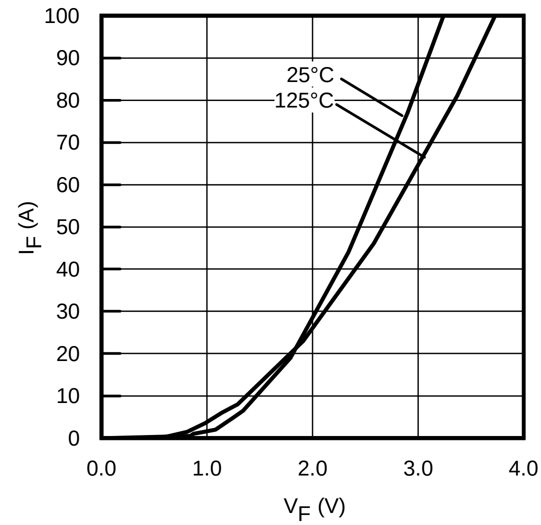


Fig. 8 - Typ. Diode Forward Characteristics
tp = 80µs

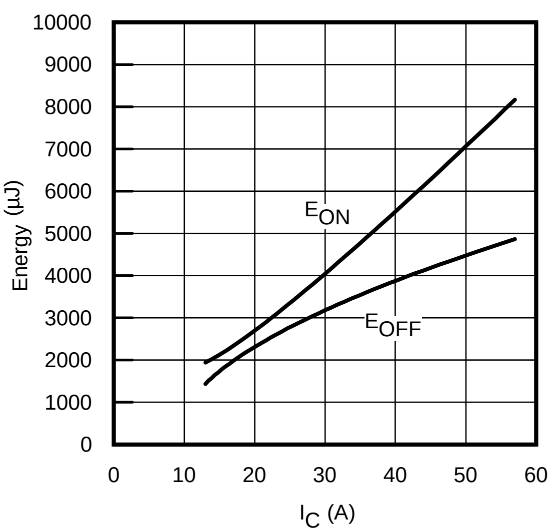


Fig. 9 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 10Ω; V_{GE}= 15V

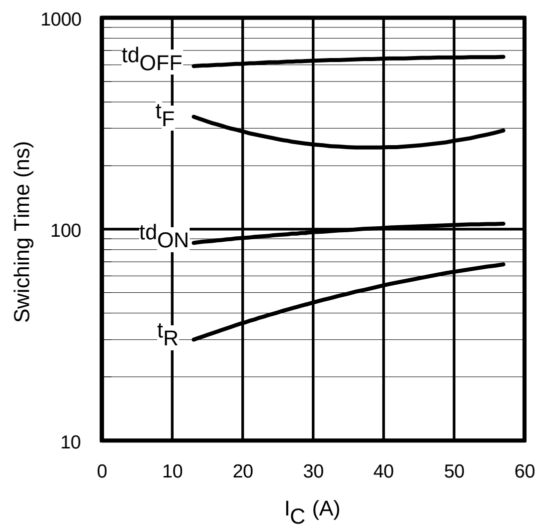


Fig. 10 - Typ. Switching Time vs. I_C
T_J = 125°C; L = 400µH; V_{CE} = 600V,R_G = 10Ω;V_{GE} = 15V

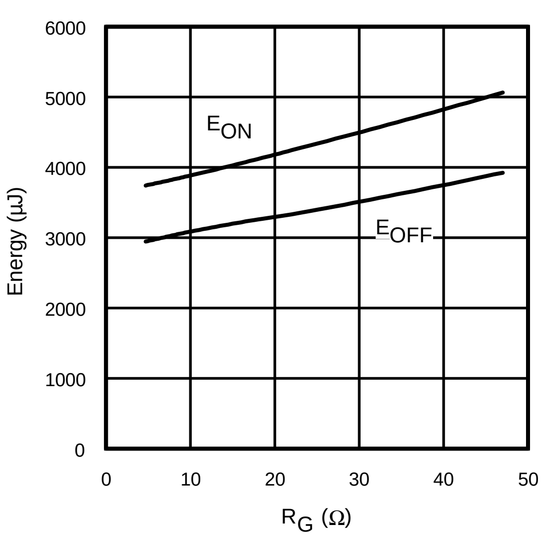


Fig. 11 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 25A; V_{GE}= 15V

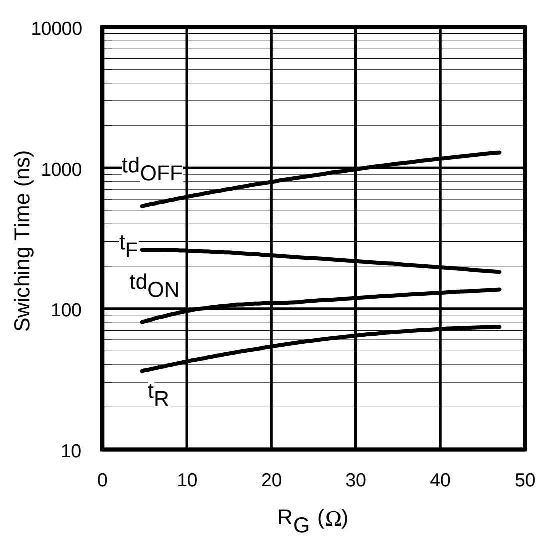


Fig. 12 - Typ. Switching Time vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 25A; V_{GE}= 15V

Inverter

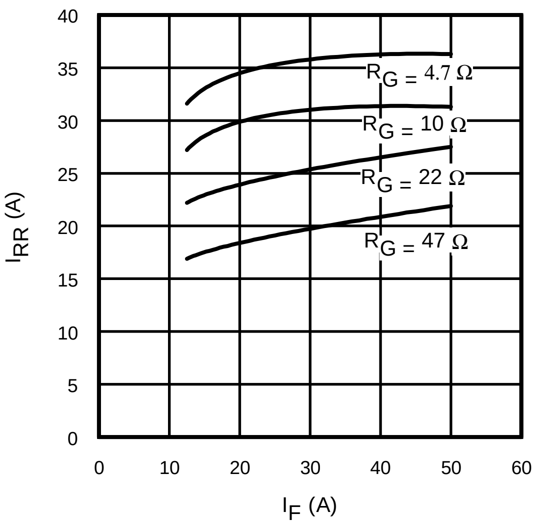


Fig. 13 - Typical Diode I_{RR} vs. I_F
T_J = 125°C

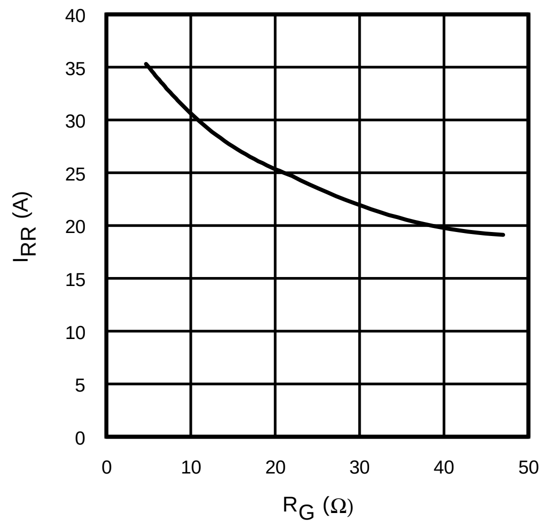


Fig. 14 - Typical Diode I_{RR} vs. R_G
T_J = 125°C; I_F = 25A

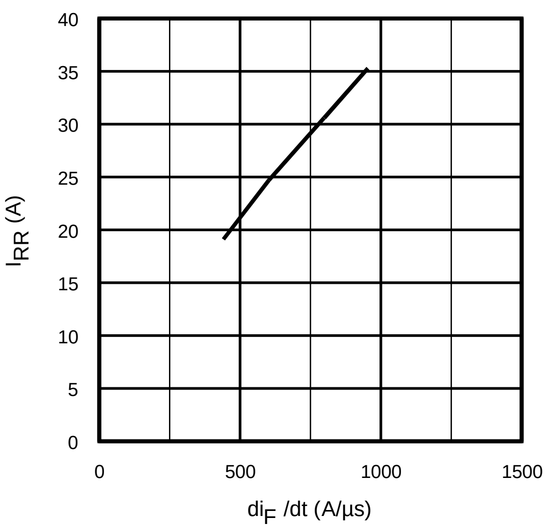


Fig. 15 - Typical Diode I_{RR} vs. di_F / dt
V_{CC} = 600V; V_{GE} = 15V; I_F = 25A; T_J = 125°C

Thermistor

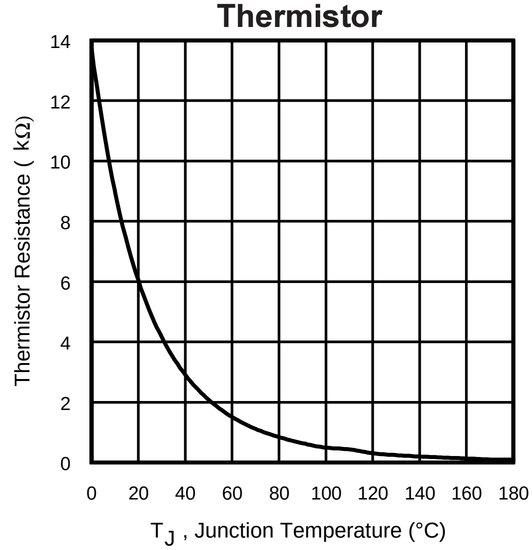


Fig. 16 - Thermistor Resistance vs. Temperature

Input Rectifier

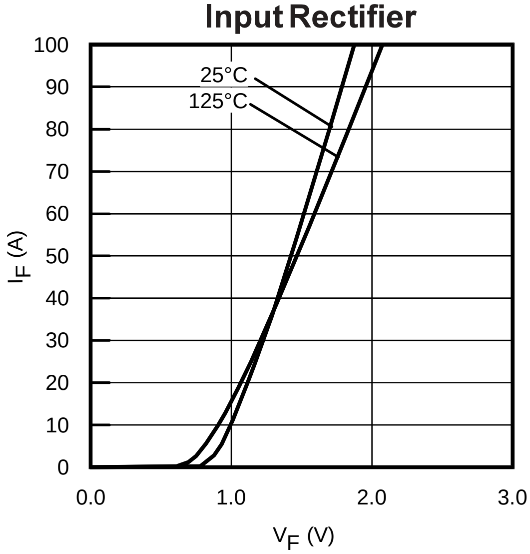


Fig. 17 - Typ. Diode Forward Characteristics
tp = 80µs

Inverter

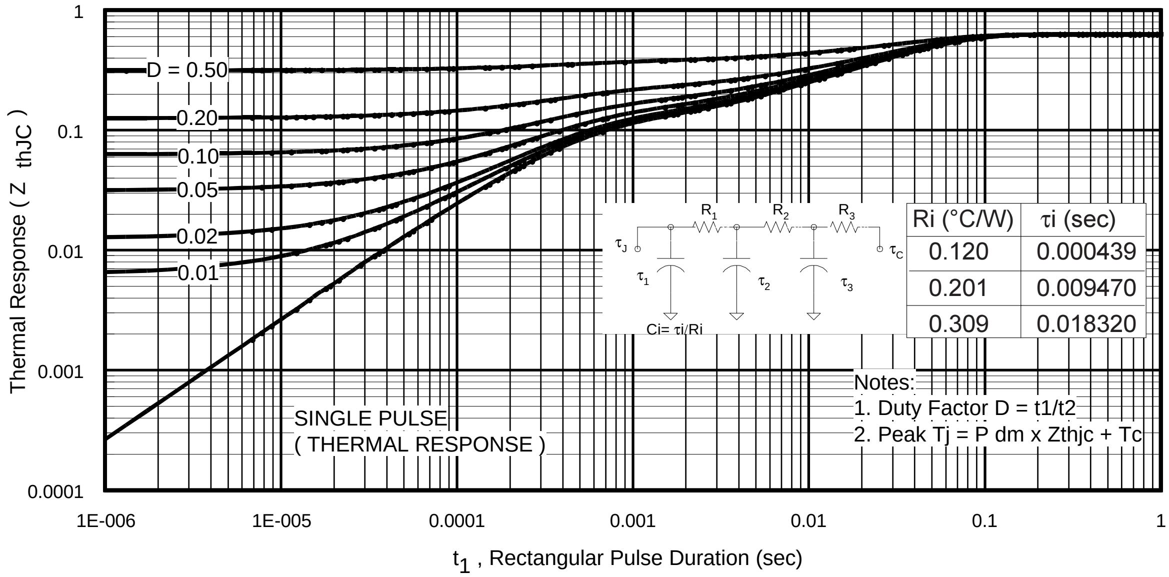


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter IGBT)

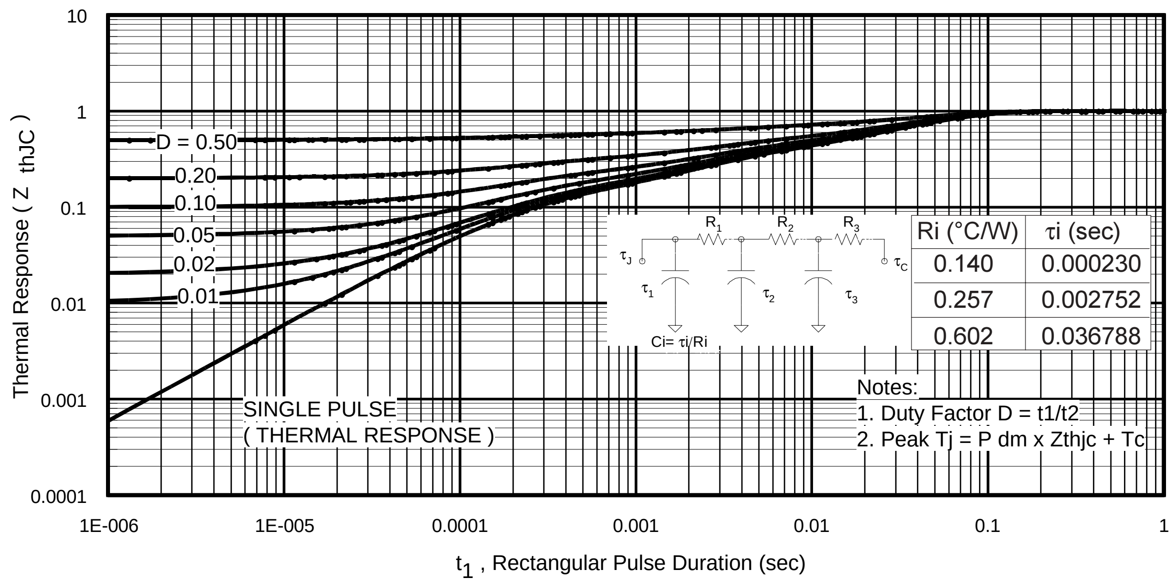


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter FRED)

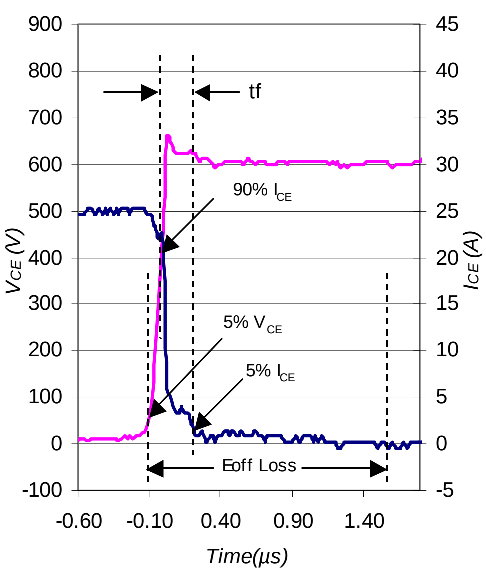


Fig. WF1- Typ. Turn-off Loss Waveform
@ T_J = 125°C using Fig. CT.4

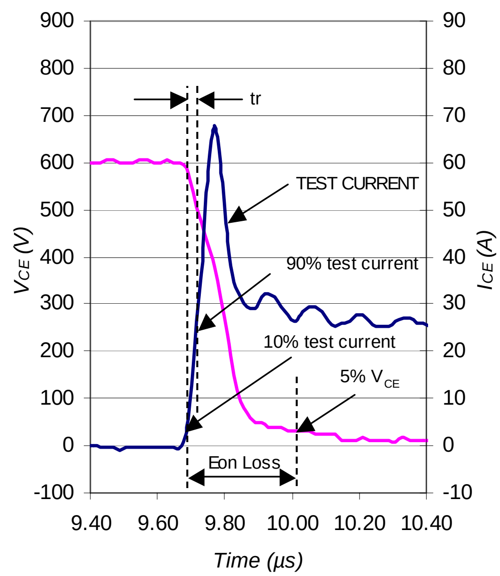


Fig. WF2- Typ. Turn-on Loss Waveform
@ T_J = 125°C using Fig. CT.4

Brake

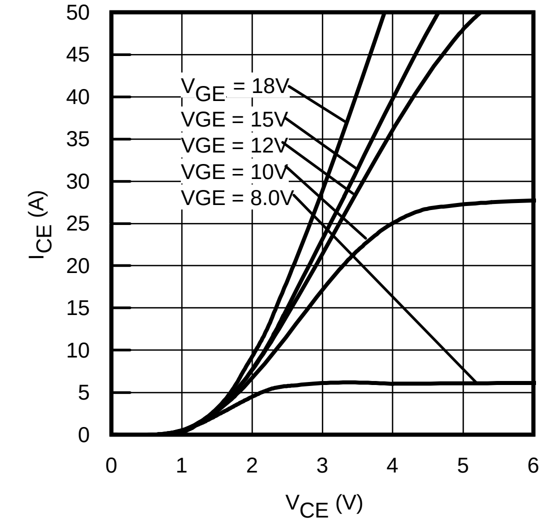


Fig. 20 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 80µs

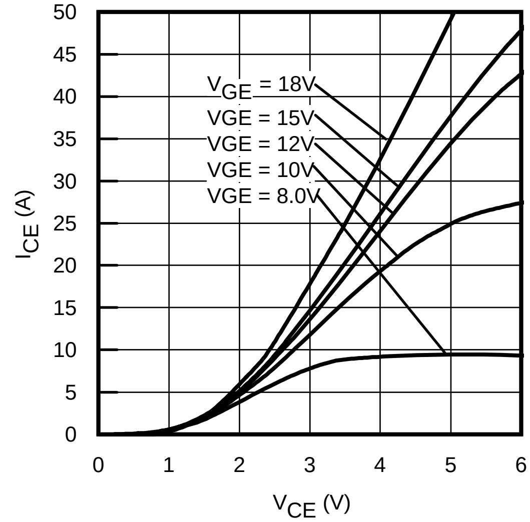


Fig. 21 - Typ. IGBT Output Characteristics
T_J = 125°C; tp = 80µs

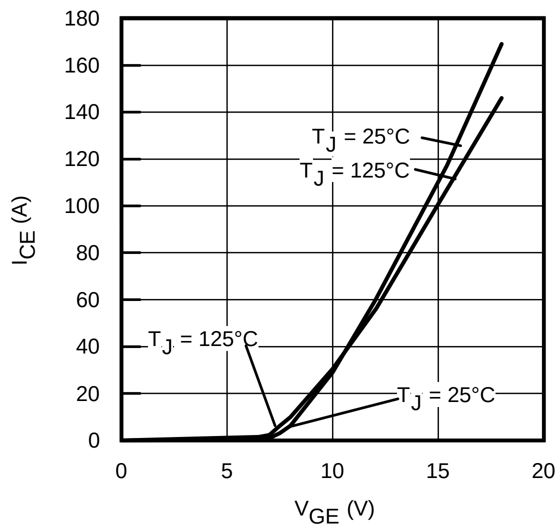


Fig. 22 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 10µs

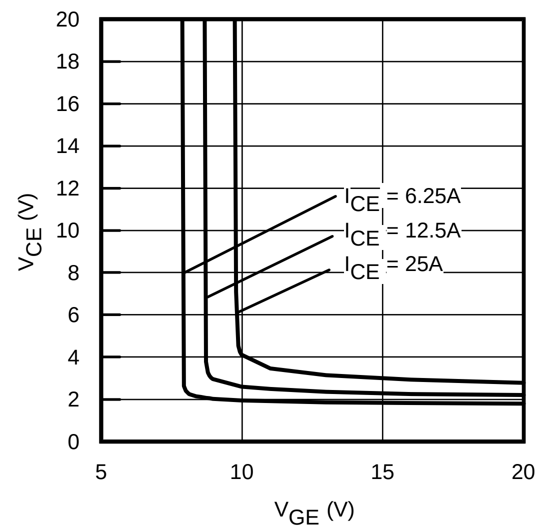


Fig. 23 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

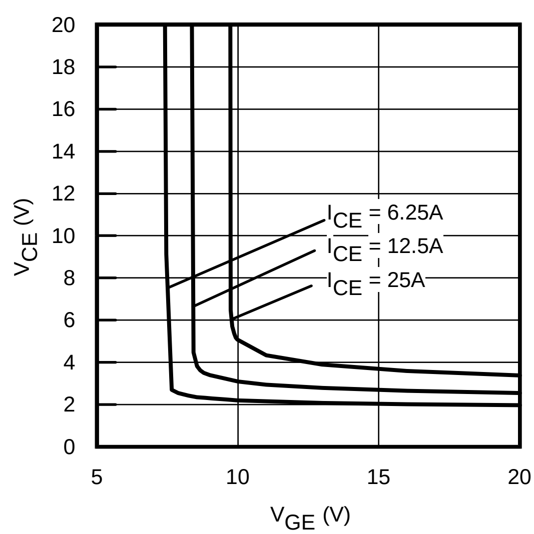


Fig.24 - Typical V_{CE} vs. V_{GE}
T_J = 125°C

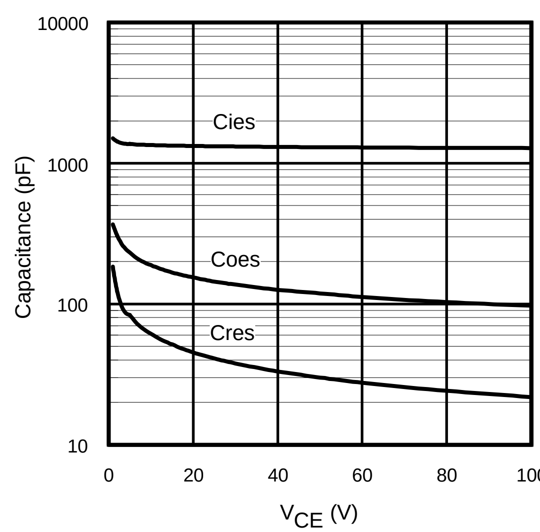


Fig. 25- Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

Brake

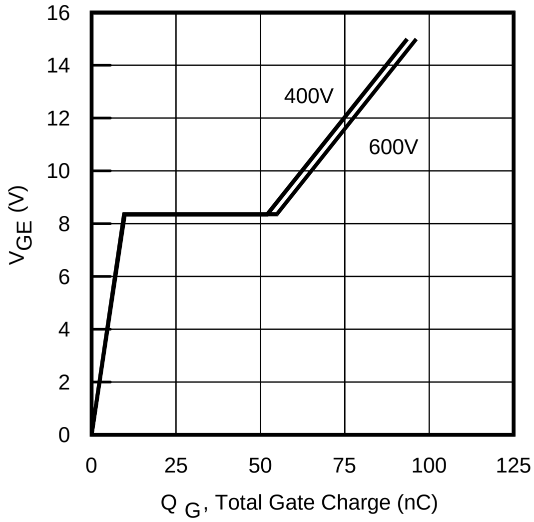


Fig. 26 - Typical Gate Charge vs. V_{GE}
I_{CE} = 12.5A; L = 1mH

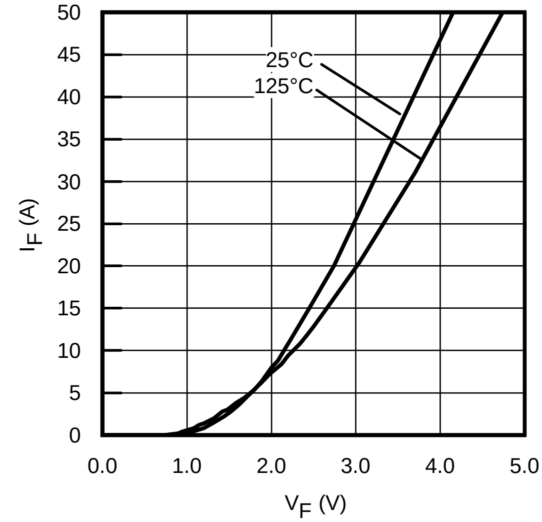


Fig. 27 - Typ. Diode Forward Characteristics
tp = 80µs

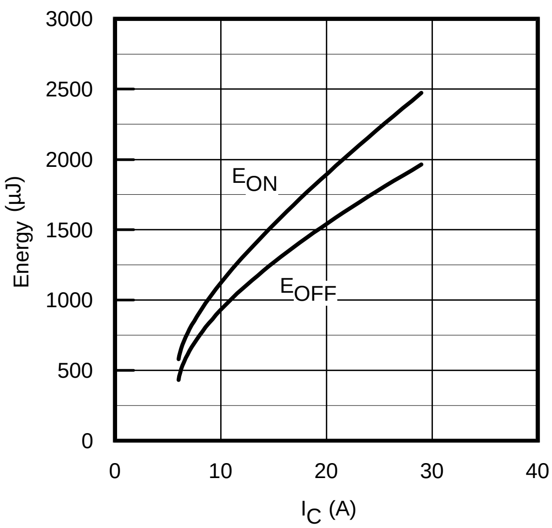


Fig. 28 - Typ. Energy Loss vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 22Ω; V_{GE}= 15V

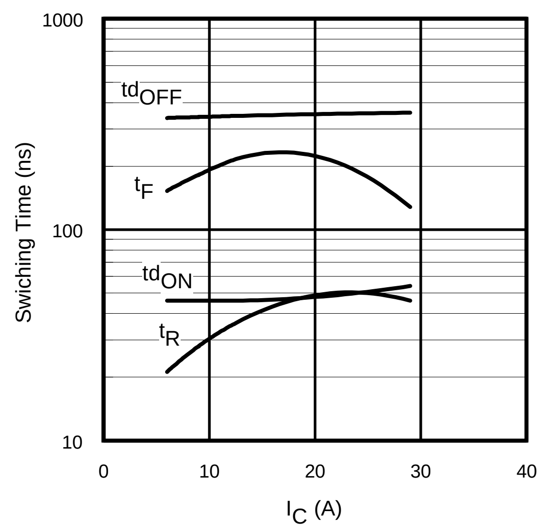


Fig. 29 - Typ. Switching Time vs. I_C
T_J = 125°C; L=400µH; V_{CE}= 600V,R_G= 22Ω;V_{GE}= 15V

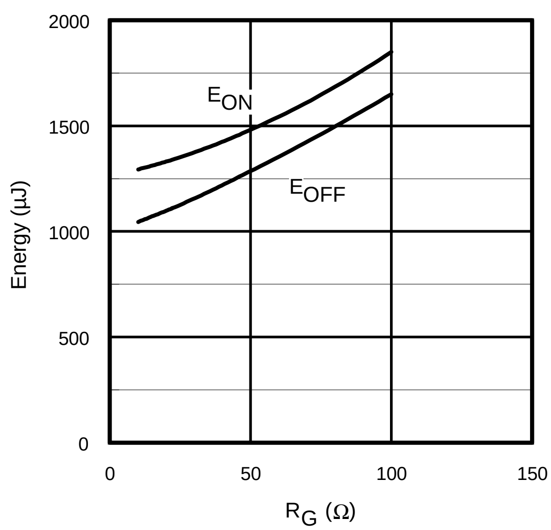


Fig. 30 - Typ. Energy Loss vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 12.5A; V_{GE}= 15V

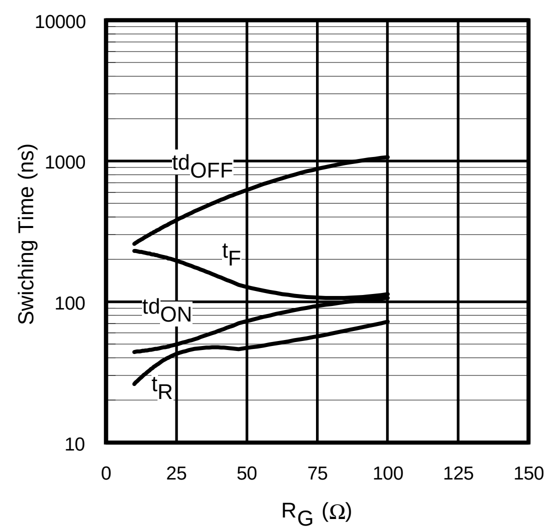


Fig. 31 - Typ. Switching Time vs. R_G
T_J = 125°C; L=400µH; V_{CE}= 600V, I_{CE}= 12.5A; V_{GE}= 15V

Brake

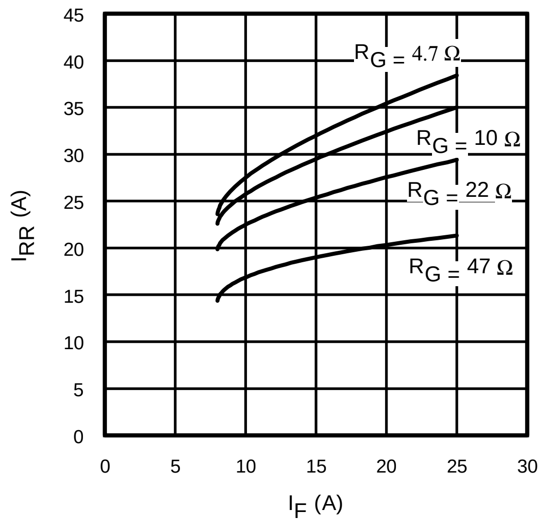


Fig. 32 - Typical Diode I_{RR} vs. I_F
$T_J = 125°C$

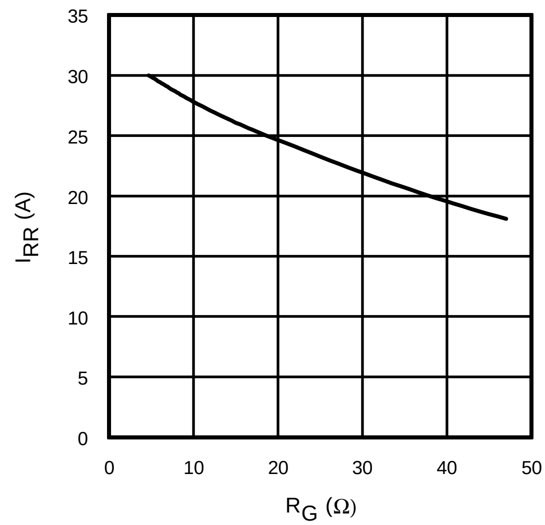


Fig. 33- Typical Diode I_{RR} vs. R_G
$T_J = 125°C$; $I_F = 12.5A$

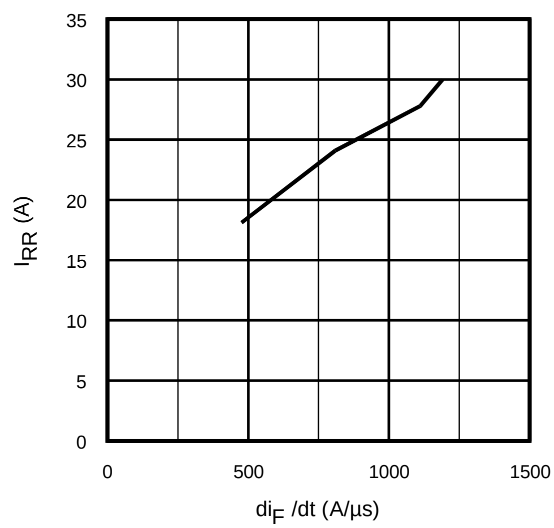
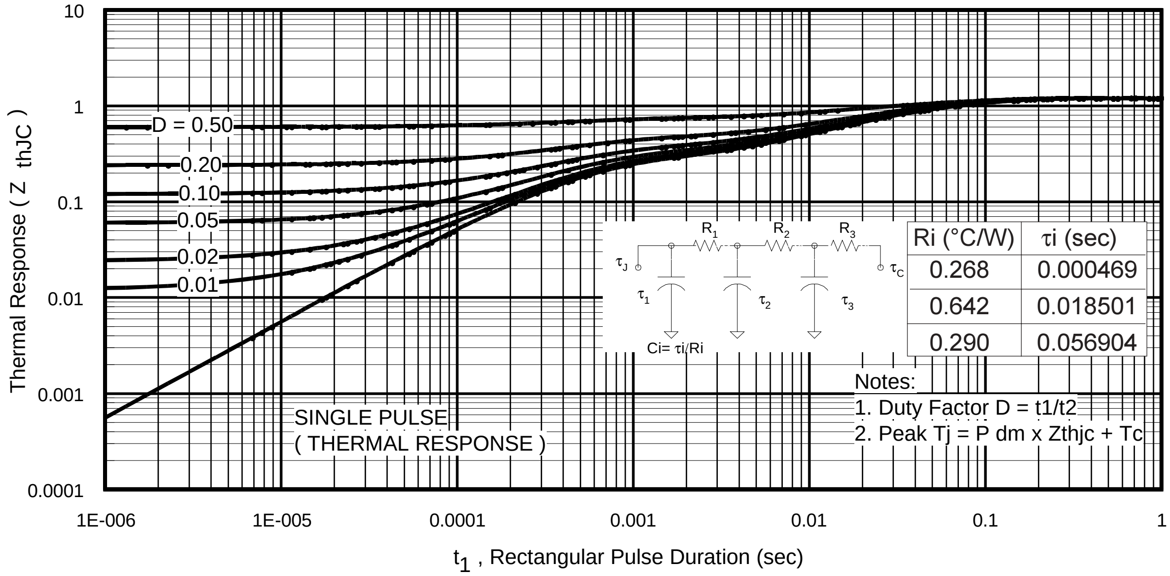


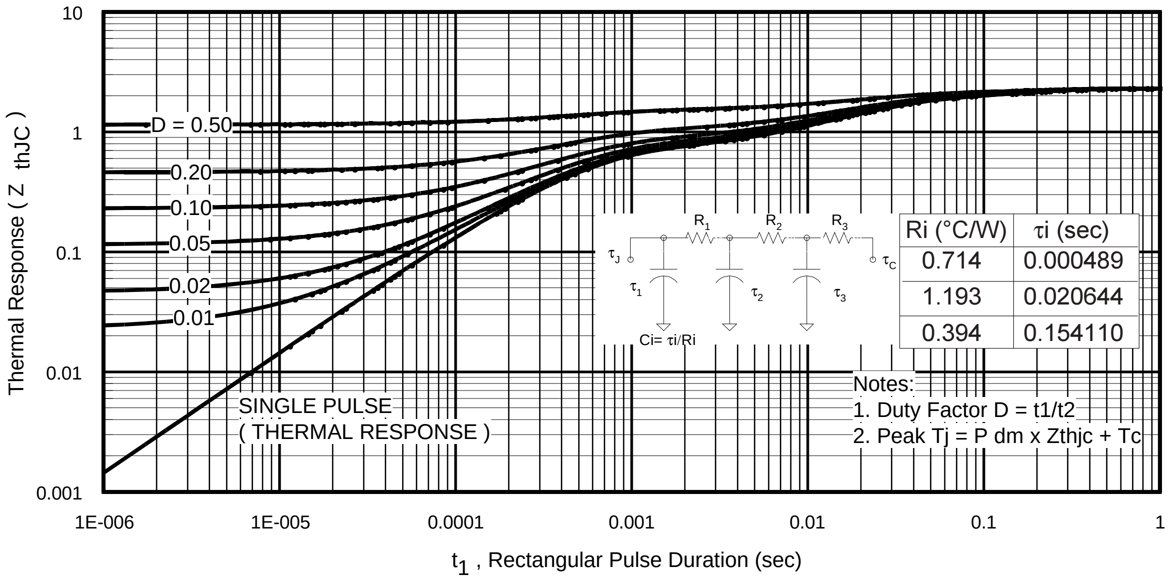
Fig. 34 - Typical Diode I_{RR} vs. di_F / dt
$V_{CC} = 600V$; $V_{GE} = 15V$; $I_F = 12.5A$; $T_J = 125°C$

Brake



Ri (°C/W)	τi (sec)
0.268	0.000469
0.642	0.018501
0.290	0.056904

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



Ri (°C/W)	τi (sec)
0.714	0.000489
1.193	0.020644
0.394	0.154110

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

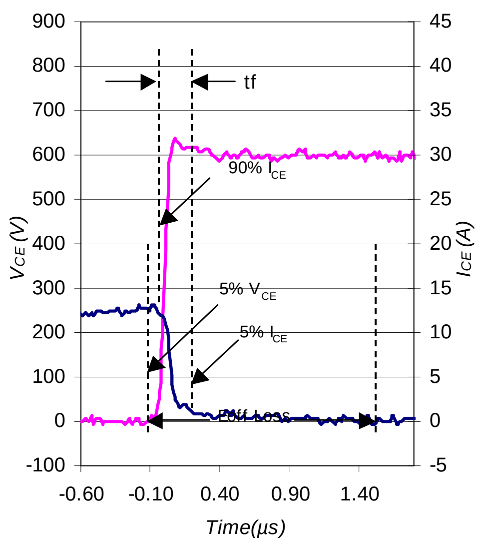


Fig. WF3- Typ. Turn-off Loss Waveform @ T_J = 125°C using Fig. CT.4

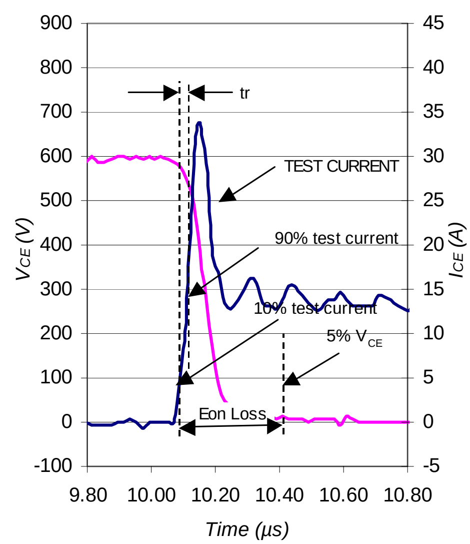


Fig. WF4- Typ. Turn-on Loss Waveform @ T_J = 125°C using Fig. CT.4

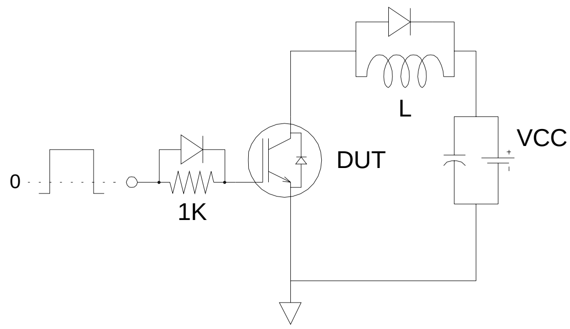


Fig.C.T.1 - Gate Charge Circuit (turn-off)

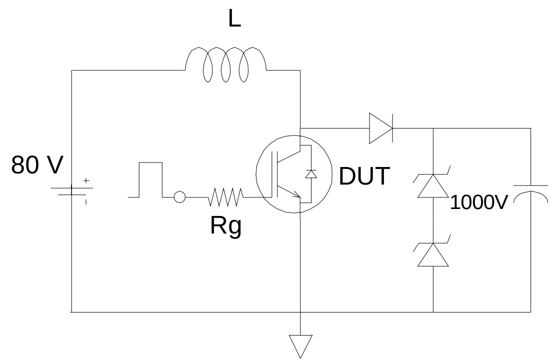


Fig.C.T.2 - RBSOA Circuit

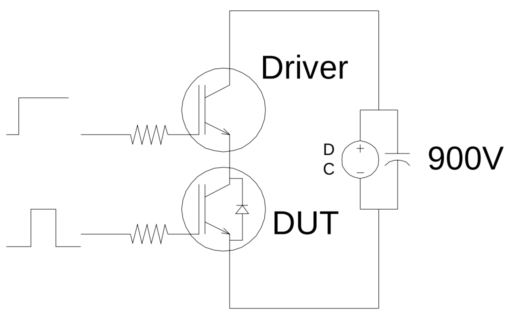


Fig.C.T.3 - S.C. SOA Circuit

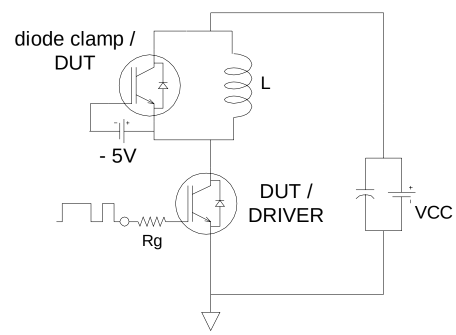


Fig.C.T.4 - Switching Loss Circuit

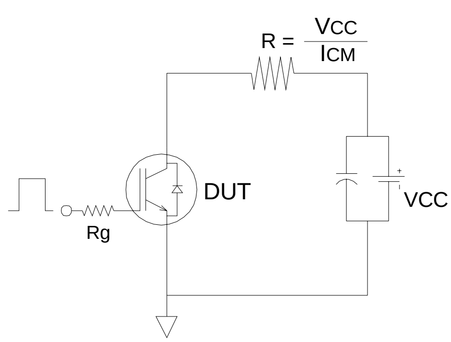
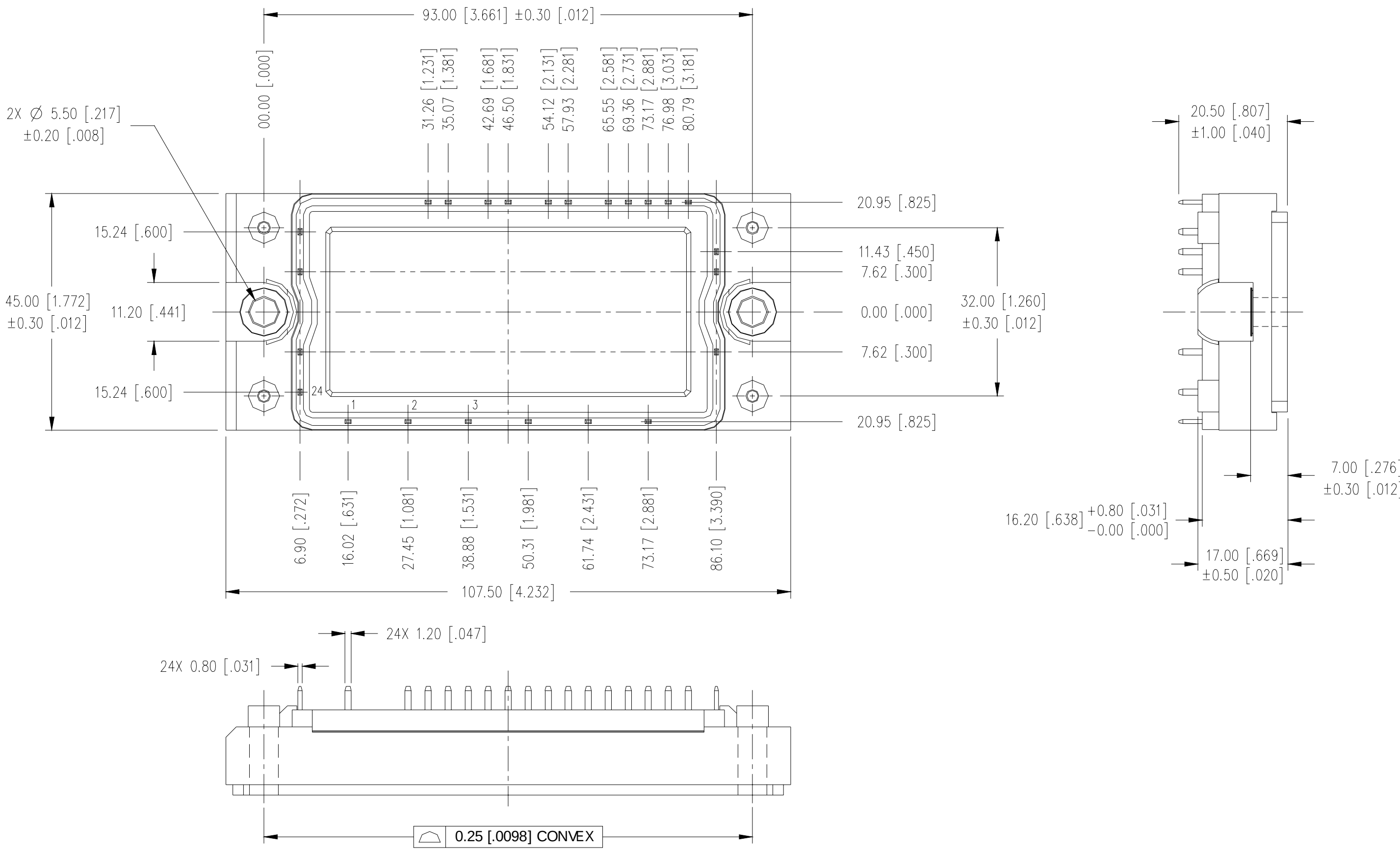


Fig.C.T.5 - Resistive Load Circuit

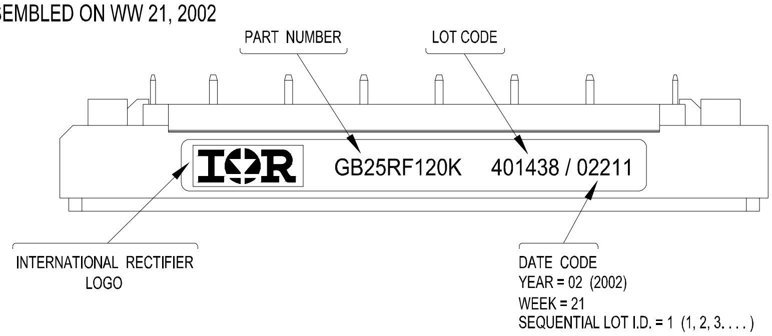
Econo2 PIM Package Outline

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
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