

GB15RF120K

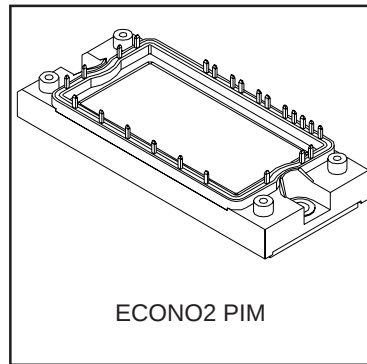
IGBT PIM MODULE

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

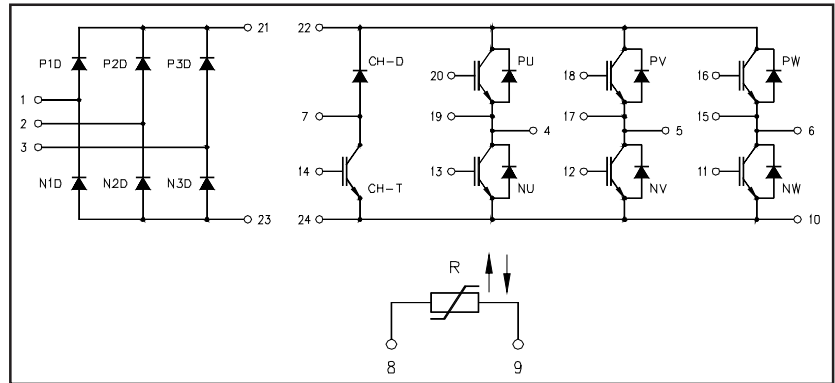


$$V_{CES} = 1200V$$

$$I_C = 15A, T_C=80^{\circ}C$$

$$t_{sc} > 10\mu s, T_J=150^{\circ}C$$

$$V_{CE(on)} \text{ typ.} = 2.55V$$



Absolute Maximum Ratings ($T_J = 25^{\circ}C$, 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	$25^{\circ}C / 80^{\circ}C$	25 / 15	A
		I_{CM}		$25^{\circ}C$	50	
	Diode Maximum Forward Current	$I_{FM} \text{ } \textcircled{D}$		$25^{\circ}C$	50	
	Power Dissipation	P_D	1 device	$25^{\circ}C$	125	W
Input Rectifier	Repetitive Peak Reverse Voltage	V_{RRM}			1600	V
	Average Output Current	$I_{F(AV)}$	50/60Hz sine pulse	$80^{\circ}C$	15	A
	Surge Current (Non Repetitive)	I_{FSM}	Rated V_{RRM} applied, 10ms, sine pulse		120	A^2s
	I^2t (Non Repetitive)	I^2t			72	
Brake	Collector-to-Emitter Voltage	V_{CES}			1200	V
	Gate-to-Emitter Voltage	V_{GES}			± 20	
	Collector Current	I_C	Continuous	$25^{\circ}C / 80^{\circ}C$	15 / 7.5	A
		I_{CM}		$25^{\circ}C$	30	
	Power Dissipation	P_D	1 device	$25^{\circ}C$	83	W
	Repetitive Peak Reverse Voltage	V_{RRM}			1200	V
	Maximum Operating Junction Temperature	T_J			150	$^{\circ}C$
	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}	—	—	1.0	$^{\circ}C/W$
Junction-to-Case Inverter FRED Thermal Resistance		—	—	1.6	
Junction-to-Case Brake IGBT Thermal Resistance		—	—	1.5	
Junction-to-Case Diode Thermal Resistance		—	—	2.3	
Junction-to-Case Input Rectifier Thermal Resistance		—	—	1.0	
Mounting Torque (M5)		2.7	—	3.3	Nm

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

		Parameter	Min.	Typ.	Max.	Units	Conditions	Ref. Fig
Inverter IGBT	BV_{CES}	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
	$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	1.1	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1mA (25^\circ\text{C}-125^\circ\text{C})$	
	$V_{CE(on)}$	Collector-to-Emitter Voltage	—	2.55	2.80	V	$I_C = 15A, V_{GE} = 15V$	1,2
			—	3.15	3.50		$I_C = 25A, V_{GE} = 15V$	4,5
			—	3.05	—		$I_C = 15A, V_{GE} = 15V, T_J = 125^\circ\text{C}$	
			—	3.85	—		$I_C = 25A, V_{GE} = 15V, T_J = 125^\circ\text{C}$	
	$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$	3,4,5
	$\Delta V_{GE(th)}$	Threshold Voltage temp. coefficient	—	-11	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1mA (25^\circ\text{C}-125^\circ\text{C})$	
	I_{CES}	Zero Gate Voltage Collector Current	—	8	50	μA	$V_{GE} = 0V, V_{CE} = 1200V$	
			—	370	—		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 125^\circ\text{C}$	
	I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 200	nA	$V_{GE} = \pm 20V$	
	Q_g	Total Gate Charge (turn-on)	—	95	145	nC	$I_C = 15A$	7
	Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	10	15		$V_{CC} = 400V$	CT1
	Q_{gc}	Gate-to-Collector Charge (turn-on)	—	45	70		$V_{GE} = 15V$	
	E_{on}	Turn-On Switching Loss	—	1300	2300	μJ	$I_C = 15A, V_{CC} = 600V$	CT4
	E_{off}	Turn-Off Switching Loss	—	900	1550		$V_{GE} = 15V, R_G = 22\Omega, L = 400\mu H$	
	E_{tot}	Total Switching Loss	—	2200	3850		$T_J = 25^\circ\text{C} \text{ } \textcircled{3}$	
	E_{on}	Turn-On Switching Loss	—	1700	2850	μJ	$I_C = 15A, V_{CC} = 600V$	9,11
	E_{off}	Turn-Off Switching Loss	—	1250	1900		$V_{GE} = 15V, R_G = 22\Omega, L = 400\mu H$	CT4
	E_{tot}	Total Switching Loss	—	2950	4750		$T_J = 125^\circ\text{C} \text{ } \textcircled{3}$	WF1,2
	$t_{d(on)}$	Turn-On delay time	—	50	65	ns	$I_C = 15A, V_{CC} = 600V$	10,12
	t_r	Rise time	—	50	70		$V_{GE} = 15V, R_G = 22\Omega, L = 400\mu H$	CT4
	$t_{d(off)}$	Turn-Off delay time	—	300	540		$T_J = 125^\circ\text{C}$	WF1
	t_f	Fall time	—	220	286			WF2
	C_{ies}	Input Capacitance	—	1285	—	pF	$V_{GE} = 0V$	6
	C_{oes}	Output Capacitance	—	280	—		$V_{CC} = 30V$	
	C_{res}	Reverse Transfer Capacitance	—	35	—		$f = 1Mhz$	
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 50A$ $R_G = 22\Omega, V_{GE} = +15V \text{ to } 0V$	CT2
	SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$T_J = 150^\circ\text{C}$ $V_{CC} = 900V, V_P = 1200V$ $R_G = 22\Omega, V_{GE} = +15V \text{ to } 0V$	CT3
Inverter FRED	I_{rr}	Diode Peak Reverse Recovery Current	—	22	—	A	$T_J = 125^\circ\text{C}$	13,14,15
			—	22	—		$V_{CC} = 600V, I_F = 15A, L = 400\mu H$ $V_{GE} = 15V, R_G = 22\Omega$	CT4
	V_{FM}	Diode Forward Voltage Drop	—	2.15	2.55	V	$I_F = 15A$	8
			—	2.60	3.05		$I_F = 25A$	
			—	2.30	—		$I_F = 15A, T_J = 125^\circ\text{C}$	
			—	2.90	—		$I_F = 25A, T_J = 125^\circ\text{C}$	

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

		Parameter	Min.	Typ.	Max.	Units	Conditions	Ref. Fig
Input Rectifier	V _{FM}	Maximum Forward Voltage Drop	—	—	1.3	V	I _F = 15A	17
	I _{RM}	Maximum Reverse Leakage Current	—	—	0.05	mA	T _J = 25°C, V _R = 1600V	
			—	—	1.0		T _J = 150°C, V _R = 1600V	
	r _T	Forward Slope Resistance	—	—	16.4	mΩ	T _J = 150°C	
	V _{F(TO)}	Conduction Threshold Voltage	—	—	0.77	V		
Brake IGBT	BV _{CES}	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	V _{GE} = 0V, I _C = 500μA	
	ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	1.5	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-125°C)	
	V _{CE(on)}	Collector-to-Emitter Voltage	—	2.35	2.50		I _C = 7.5A, V _{GE} = 15V	20,21
			—	3.10	3.30		I _C = 15A, V _{GE} = 15V	23,24
			—	2.75	—		I _C = 7.5A, V _{GE} = 15V, T _J = 125°C	
			—	3.80	—		I _C = 15A, 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
	ΔV _{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	50	μA	V _{GE} = 0V, V _{CE} = 1200V	
			—	350	—		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)	—	55	85	nC	I _C = 7.5A	26
	Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	24	40		V _{CC} = 600V	CT1
	Q _{gc}	Gate-to-Collector Charge (turn-on)	—	7	15		V _{GE} = 15V	
	E _{on}	Turn-On Switching Loss	—	700	800	μJ	I _C = 7.5A, V _{CC} = 600V	CT4
	E _{off}	Turn-Off Switching Loss	—	350	450		V _{GE} = 15V, R _G = 47Ω, L = 200μH	
	E _{tot}	Total Switching Loss	—	1050	1250		T _J = 25°C ③	
	E _{on}	Turn-On Switching Loss	—	975	1150	μJ	I _C = 7.5A, V _{CC} = 600V	28,30
	E _{off}	Turn-Off Switching Loss	—	525	900		V _{GE} = 15V, R _G = 47Ω, L = 200μH	CT4
	E _{tot}	Total Switching Loss	—	1500	2050		T _J = 125°C ③	WF3,4
	t _{d(on)}	Turn-On delay time	—	50	65	ns	I _C = 7.5A, V _{CC} = 600V	29,31
	t _r	Rise time	—	45	65		V _{GE} = 15V, R _G = 47Ω, L = 200μH	CT4
	t _{d(off)}	Turn-Off delay time	—	365	400		T _J = 125°C	WF3
	t _f	Fall time	—	135	180			WF4
	C _{ies}	Input Capacitance	—	740	—	pF	V _{GE} = 0V	25
	C _{oes}	Output Capacitance	—	95	—		V _{CC} = 30V	
	C _{res}	Reverse Transfer Capacitance	—	20	—		f = 1Mhz	
	RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 150°C, I _C = 30A R _G = 47Ω, 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 = 47Ω, V _{GE} = +15V to 0V	CT3
Brake Diode	I _{rr}	Diode Peak Reverse Recovery Current	—	13	—	A	V _{CC} = 600V, I _F = 7.5A, L = 400μH V _{GE} = 15V, R _G = 47Ω, T _J = 125°C	32,33,34 CT4
	V _{FM}	Diode Forward Voltage Drop	—	1.90	2.10	V	I _F = 7.5A	27
			—	2.40	2.70		I _F = 15A	
			—	2.00	—		I _F = 7.5A, T _J = 125°C	
			—	2.65	—		I _F = 15A, 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 Application, T_J is limited to +125°C (See File 78996).
- ② Power dependent on temperature. T_J not to exceed T_{JMAX}
- ③ Energy losses include "tail" and diode reverse recovery.

Inverter

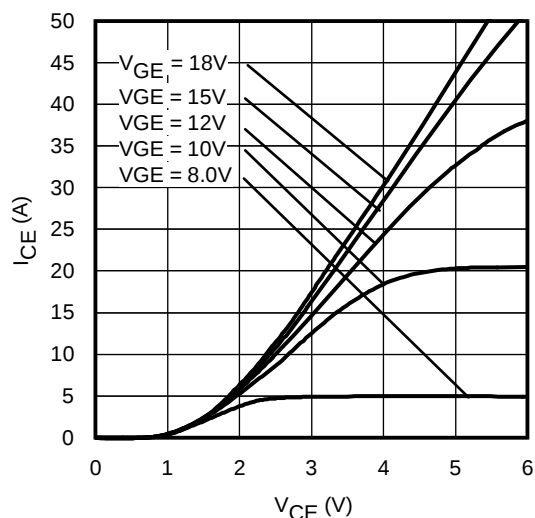


Fig. 1 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

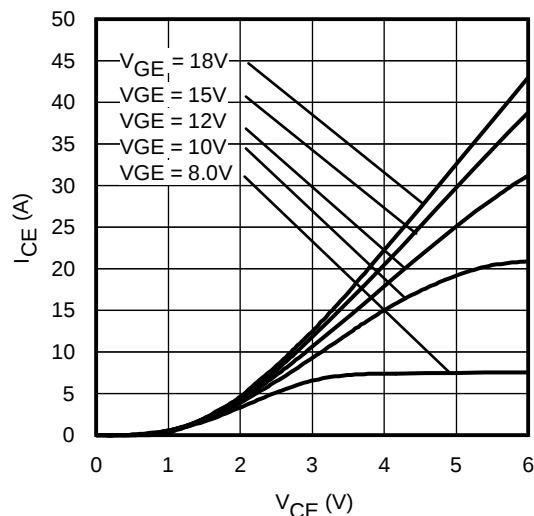


Fig. 2 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

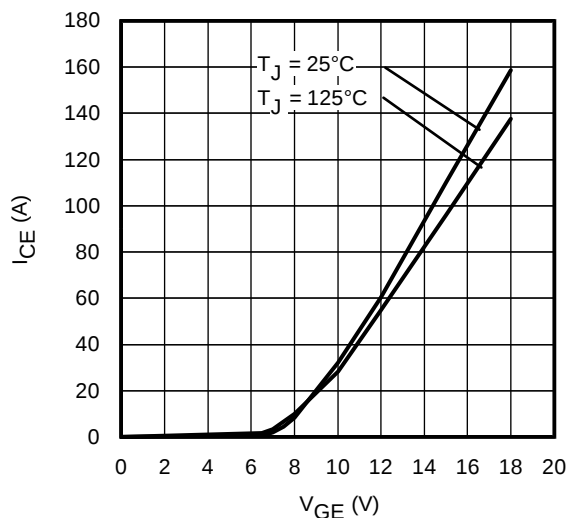


Fig. 3 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

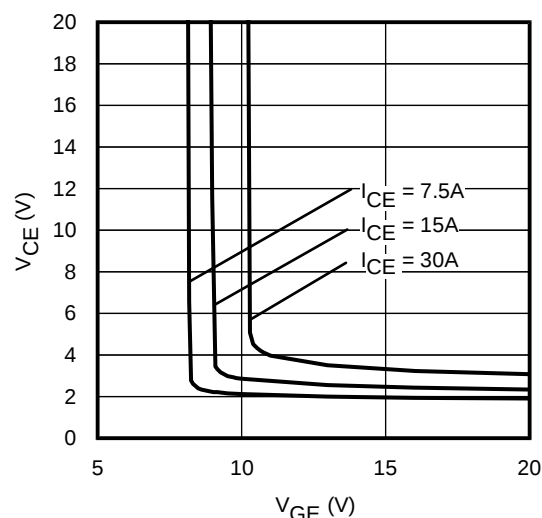


Fig. 4 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

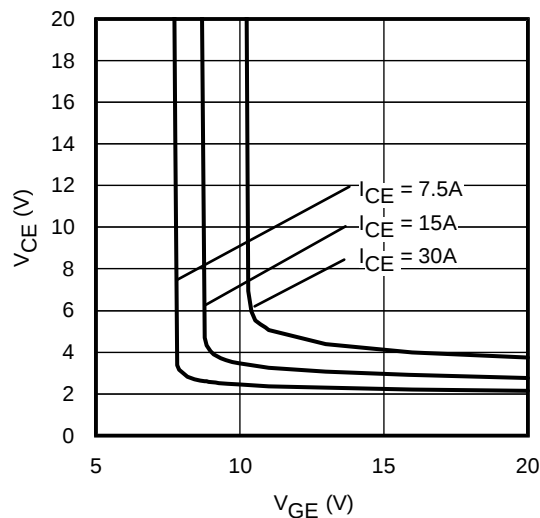


Fig. 5 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

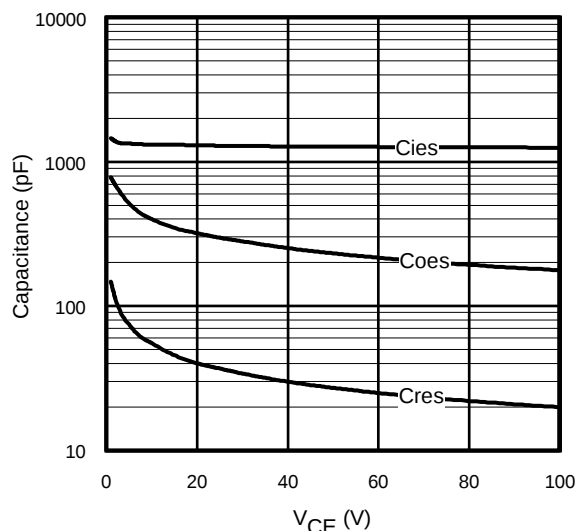


Fig. 6 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

Inverter

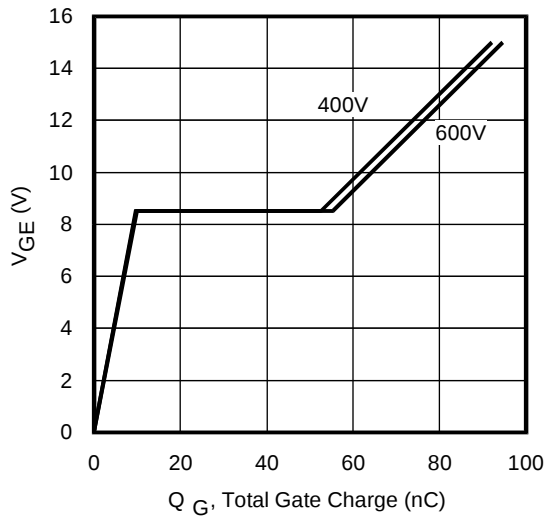


Fig. 7 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 15A$; $L = 1.0mH$

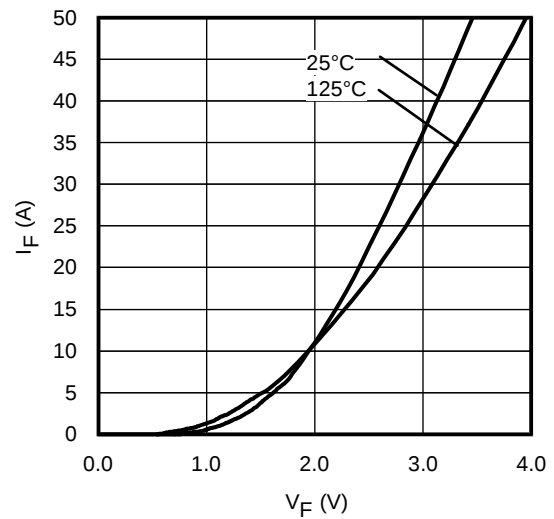


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu s$

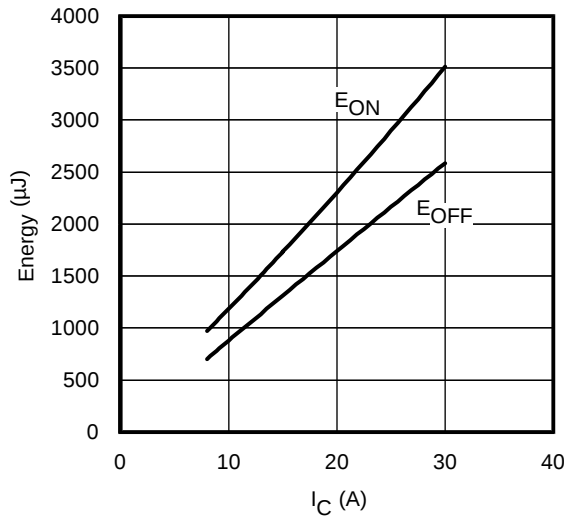


Fig. 9 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ C$; $L=400\mu H$; $V_{CE} = 600V$, $R_G = 22\Omega$; $V_{GE} = 15V$

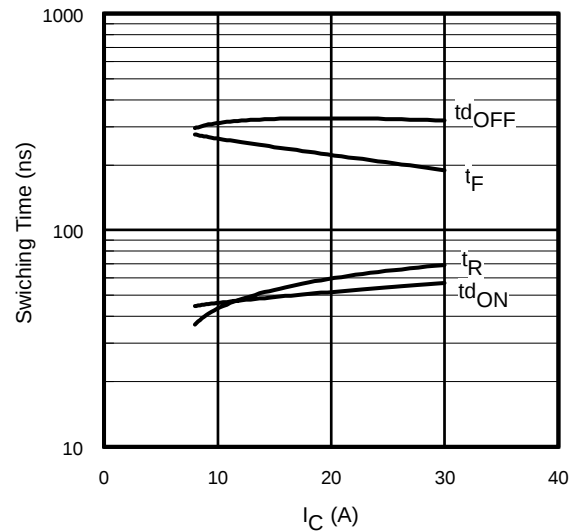


Fig. 10 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ C$; $L=400\mu H$; $V_{CE} = 600V$, $R_G = 22\Omega$; $V_{GE} = 15V$

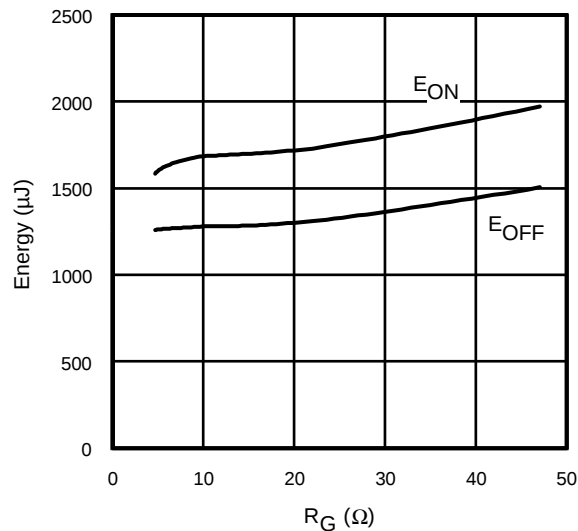


Fig. 11 - Typ. Energy Loss vs. R_G
 $T_J = 125^\circ C$; $L=400\mu H$; $V_{CE} = 600V$, $I_{CE} = 15A$; $V_{GE} = 15V$

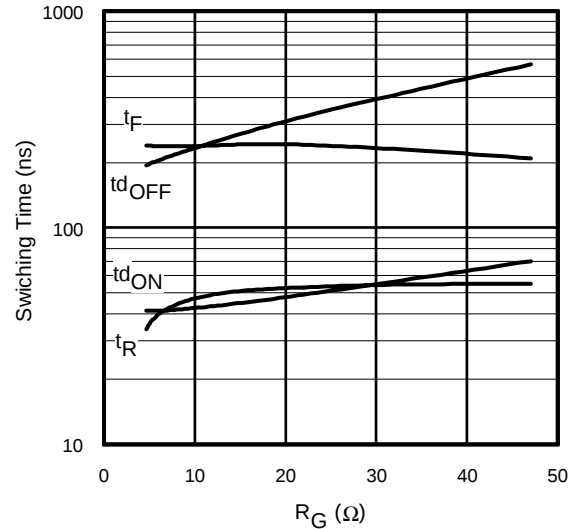


Fig. 12 - Typ. Switching Time vs. R_G
 $T_J = 125^\circ C$; $L=400\mu H$; $V_{CE} = 600V$, $I_{CE} = 15A$; $V_{GE} = 15V$

Inverter

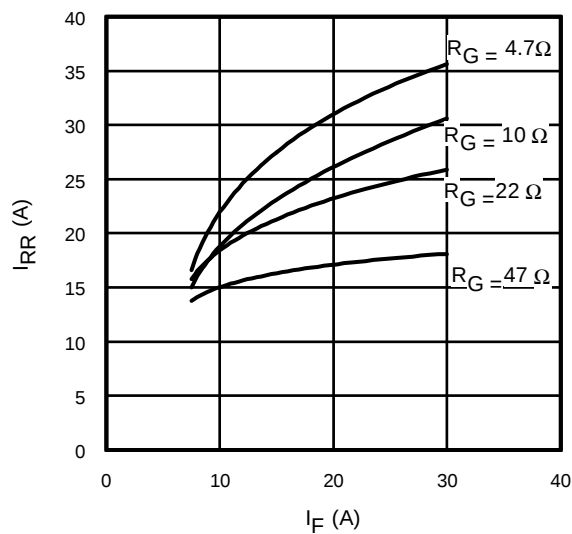


Fig. 13 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

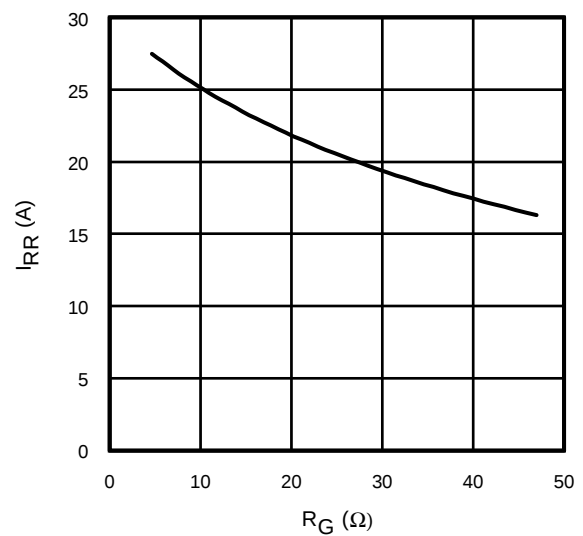


Fig. 14 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 15\text{A}$

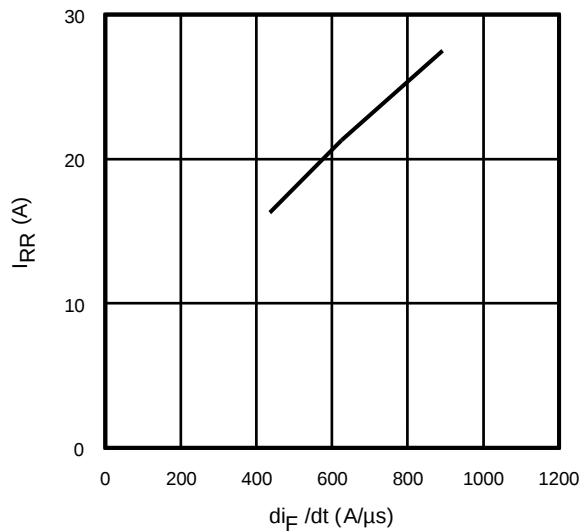


Fig. 15 - Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$; $I_{CE} = 15\text{A}$; $T_J = 125^\circ\text{C}$

Thermistor

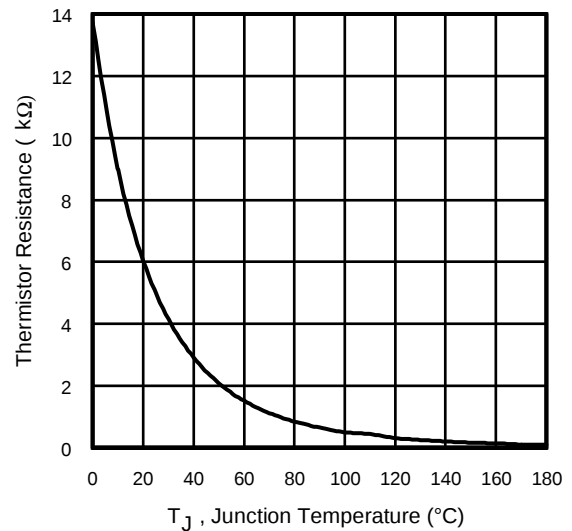


Fig. 16 - Thermistor Resistance vs. Temperature

Input Rectifier

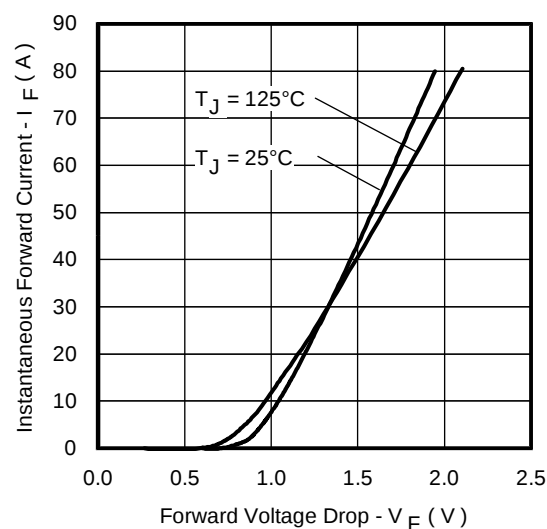


Fig. 17 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

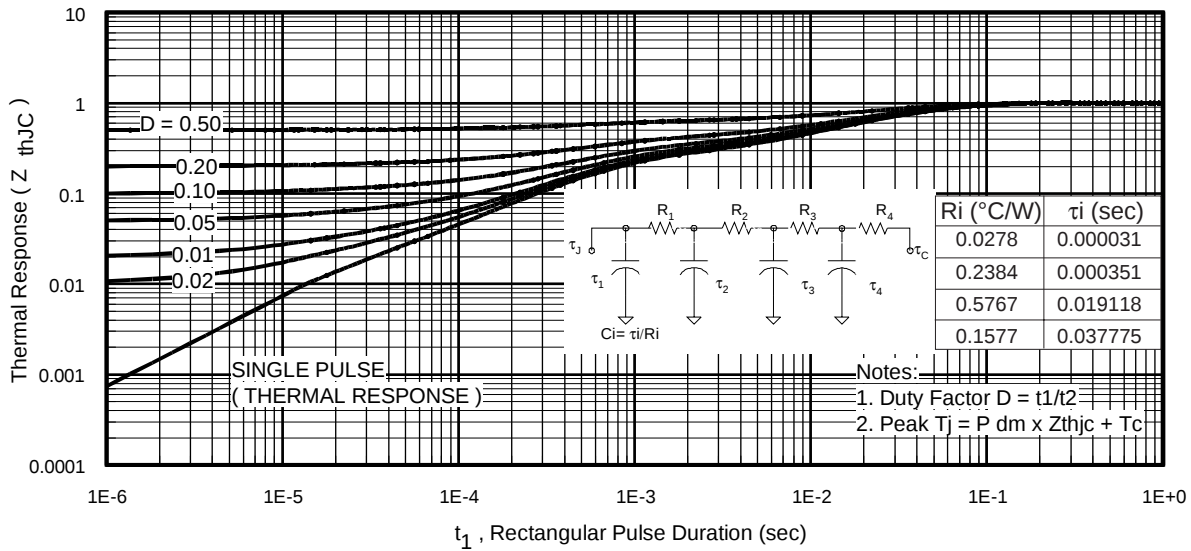


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter IGBT)

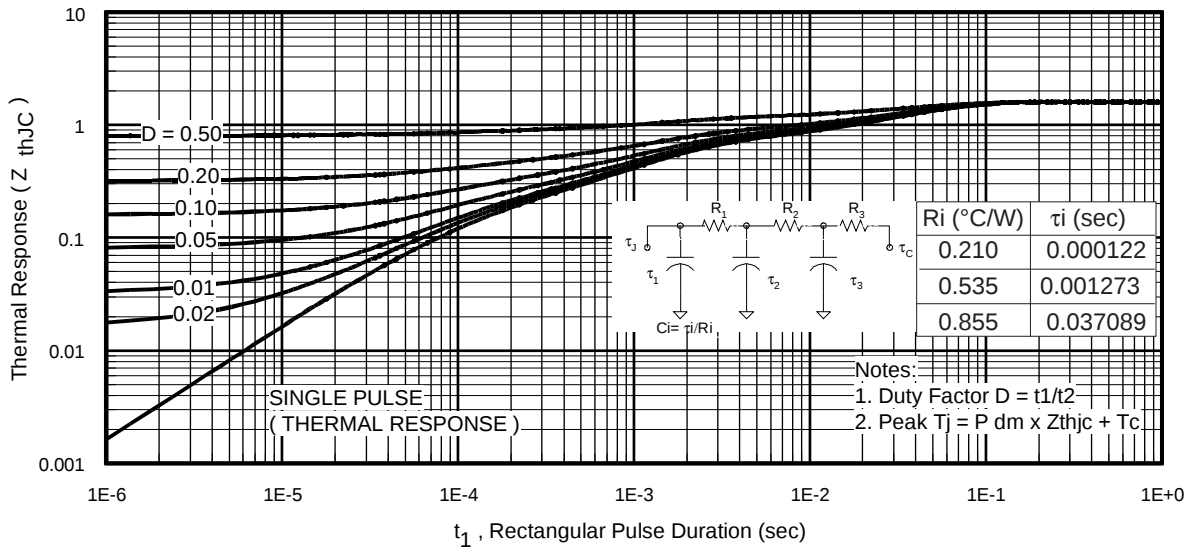


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (Inverter FRED)

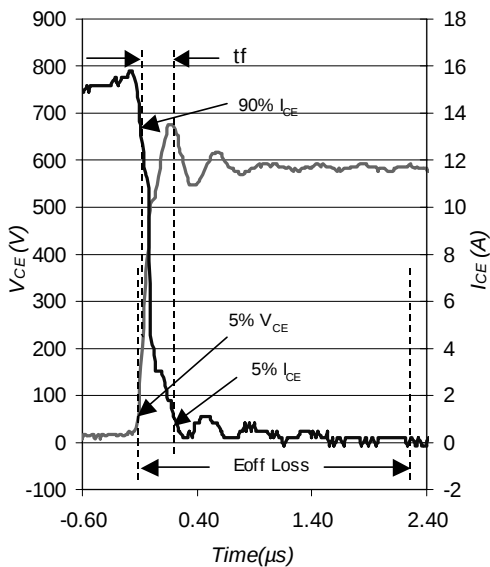


Fig. WF1- Typ. Turn-off Loss Waveform
@ $T_j = 125^\circ\text{C}$ using Fig. CT.4

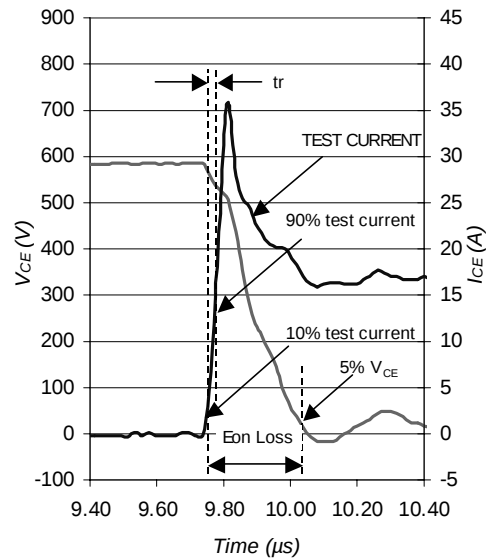


Fig. WF2- Typ. Turn-on Loss Waveform
@ $T_j = 125^\circ\text{C}$ using Fig. CT.4

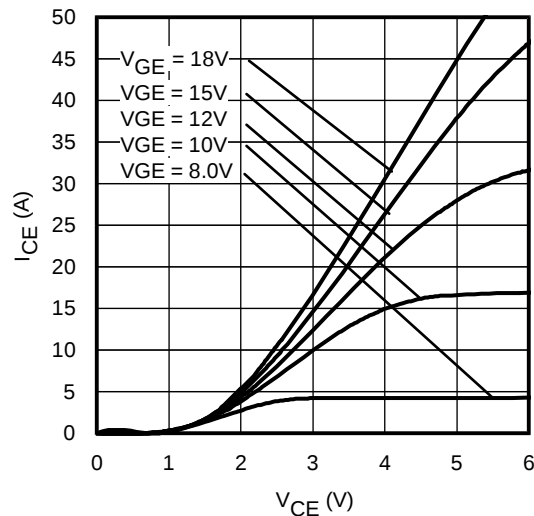


Fig. 20 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

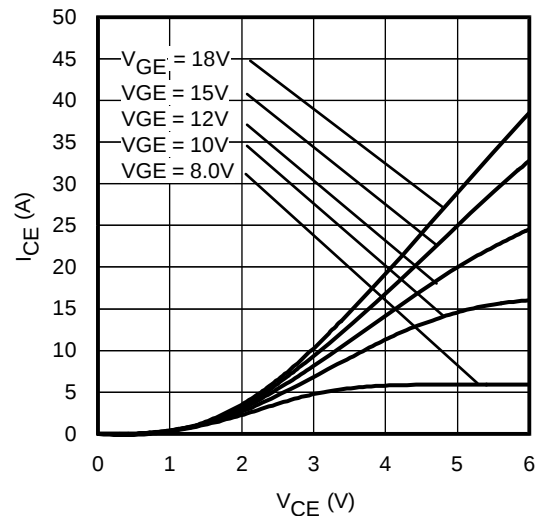


Fig. 21 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

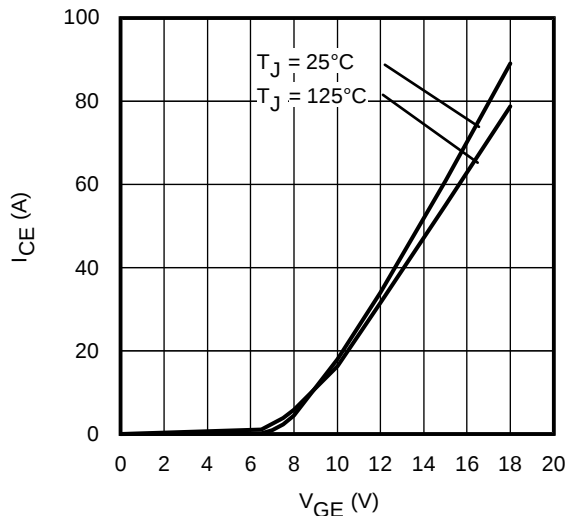


Fig. 22 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

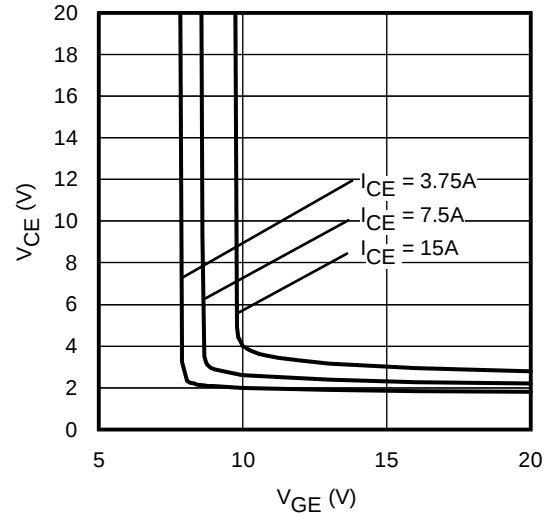


Fig. 23 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

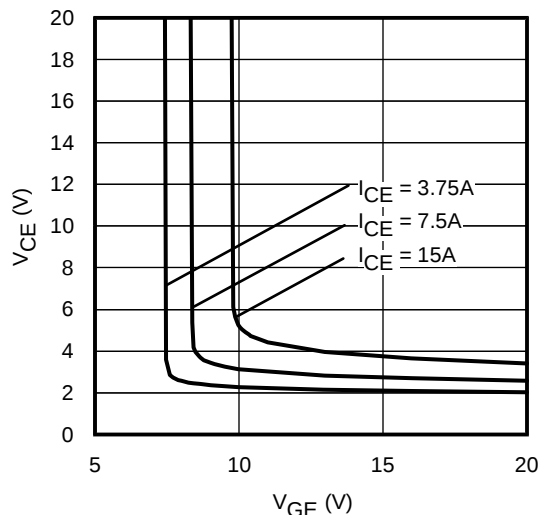


Fig. 24 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

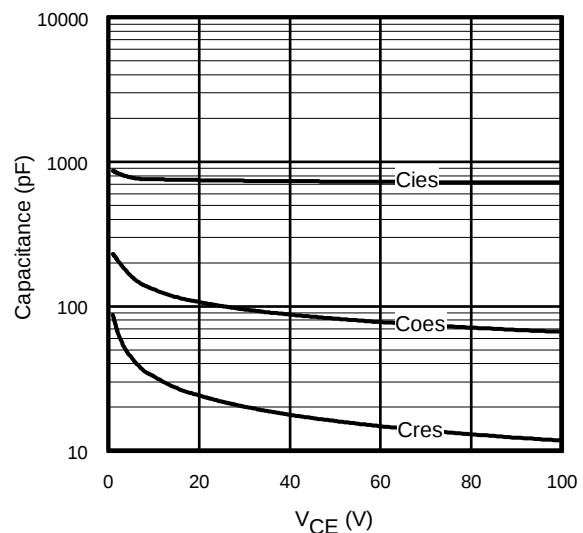


Fig. 25 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

Brake

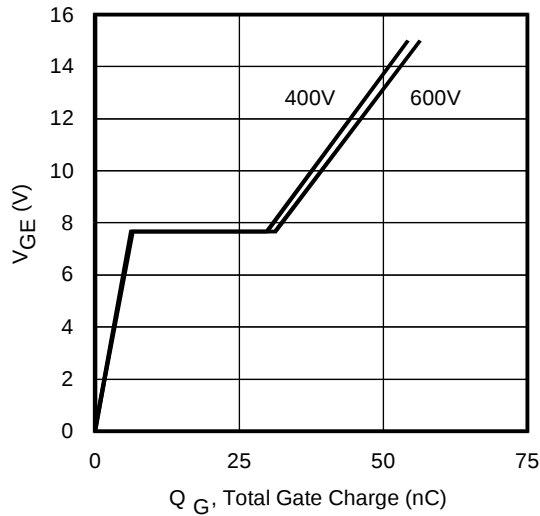


Fig. 26 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 7.5A$; $L = 1.0mH$

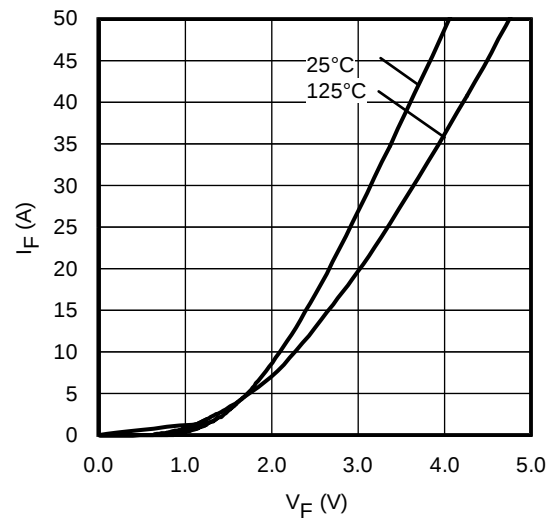


Fig. 27 - Typ. Diode Forward Characteristics
 $t_p = 80\mu s$

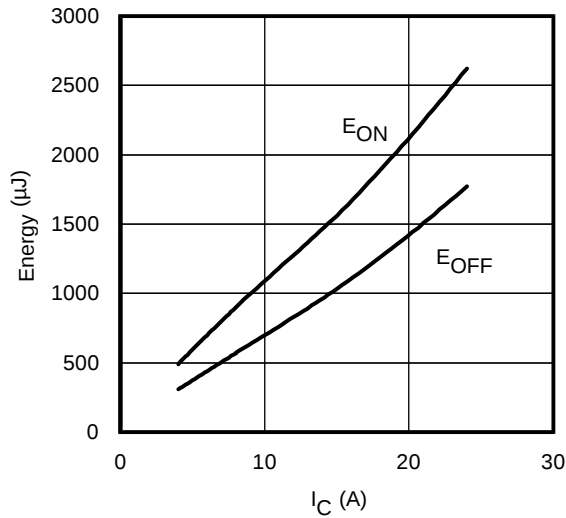


Fig. 28 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ C$; $L = 400\mu H$; $V_{CE} = 600V$, $R_G = 47\Omega$; $V_{GE} = 15V$

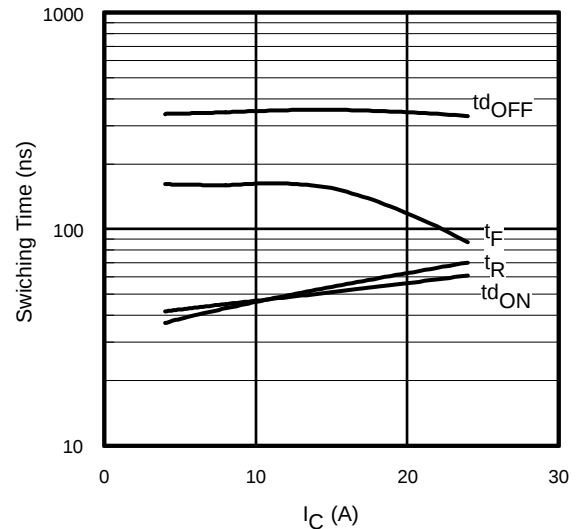


Fig. 29 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ C$; $L = 400\mu H$; $V_{CE} = 600V$, $R_G = 47\Omega$; $V_{GE} = 15V$

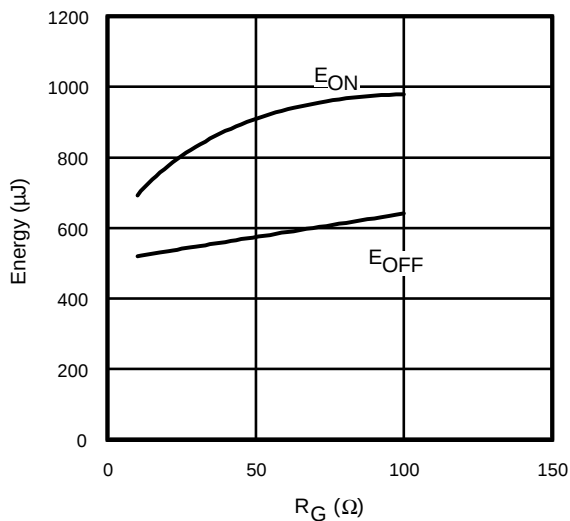


Fig. 30 - Typ. Energy Loss vs. R_G
 $T_J = 125^\circ C$; $L = 400\mu H$; $V_{CE} = 600V$, $I_{CE} = 8.0A$; $V_{GE} = 15V$

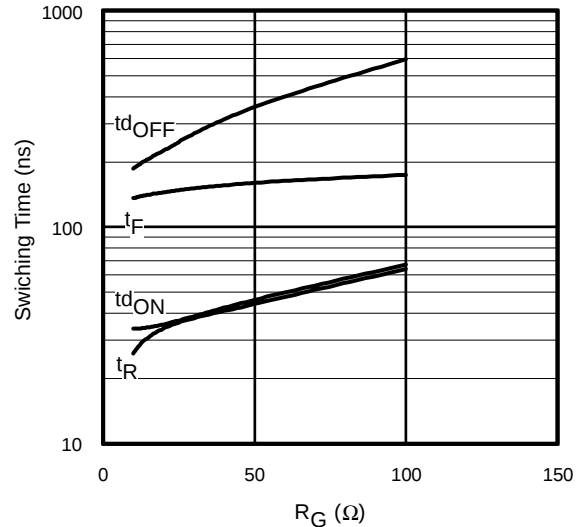


Fig. 31 - Typ. Switching Time vs. R_G
 $T_J = 125^\circ C$; $L = 400\mu H$; $V_{CE} = 600V$, $I_{CE} = 8.0A$; $V_{GE} = 15V$

Brake

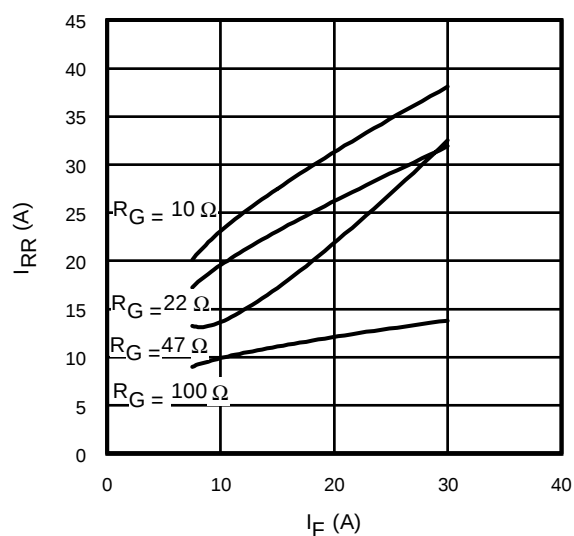


Fig. 32 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

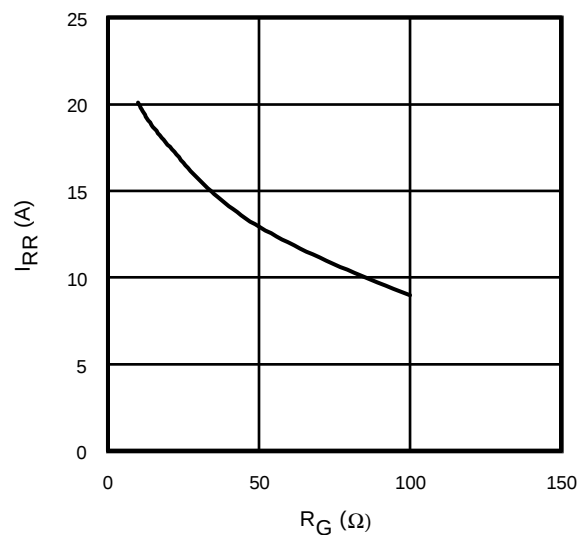


Fig. 33- Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 7.5\text{A}$

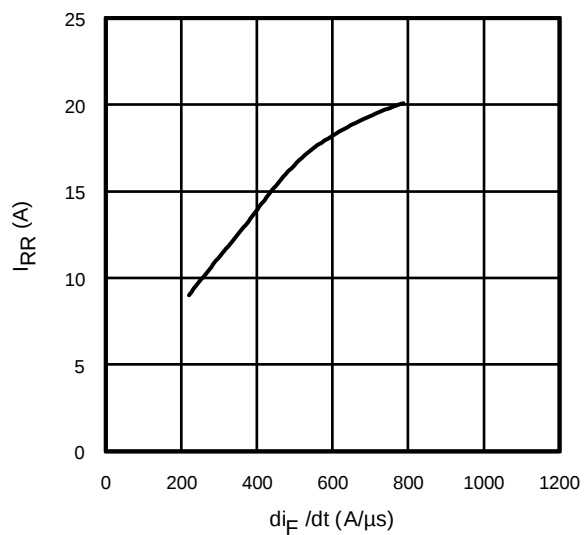


Fig. 34- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 600\text{V}$; $V_{GE} = 15\text{V}$; $I_{CE} = 7.5\text{A}$; $T_J = 125^\circ\text{C}$

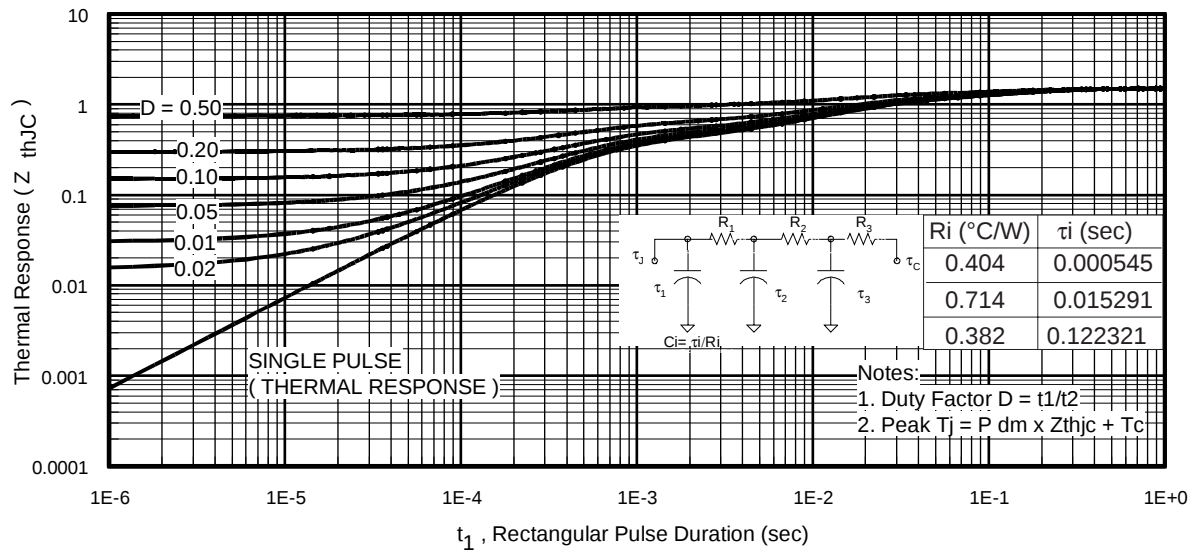


Fig 35. Maximum Transient Thermal Impedance, Junction-to-Case (Brake IGBT)

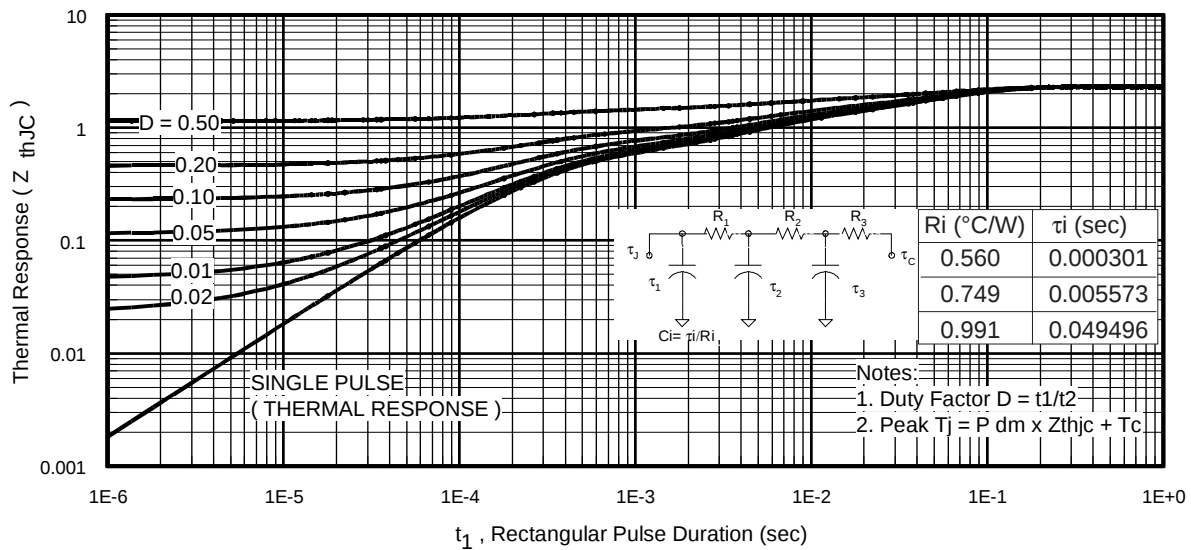


Fig 36. Maximum Transient Thermal Impedance, Junction-to-Case (Brake Diode)

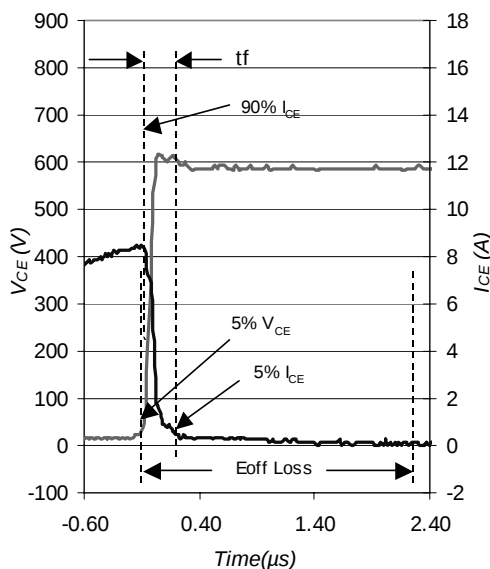


Fig. WF3- Typ. Turn-off Loss Waveform
@ $T_j = 125^\circ\text{C}$ using Fig. CT.4

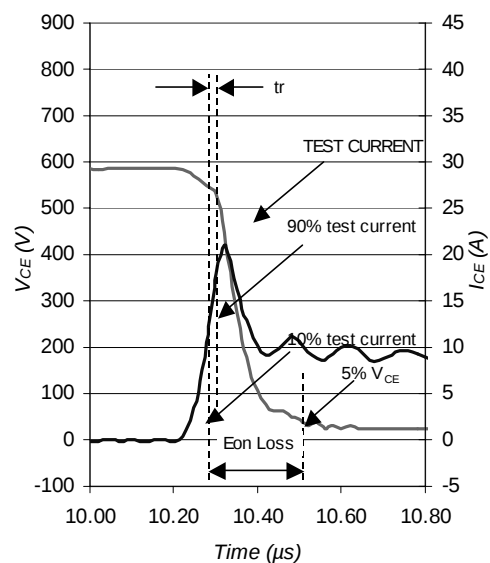


Fig. WF4- Typ. Turn-on Loss Waveform
@ $T_j = 125^\circ\text{C}$ using Fig. CT.4

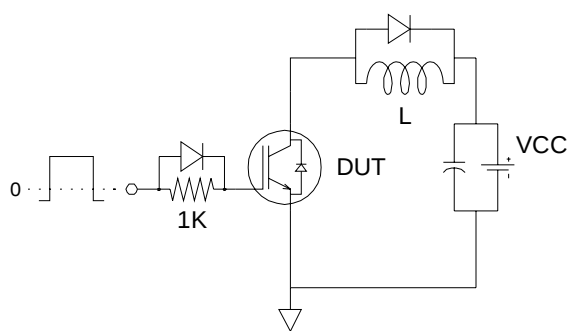


Fig.C.T.1 - Gate Charge Circuit (turn-off)

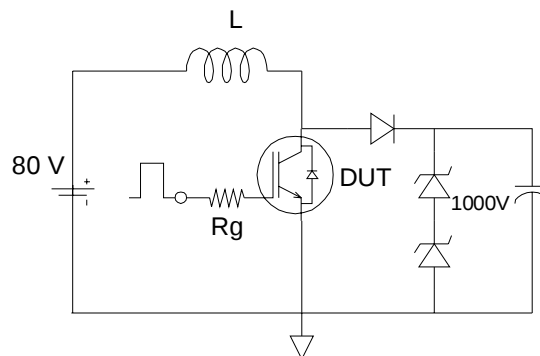


Fig.C.T.2 - RBSOA Circuit

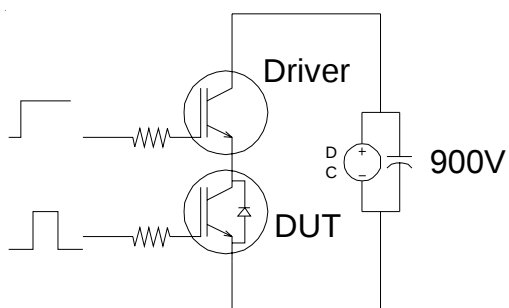


Fig.C.T.3 - S.C. SOA Circuit

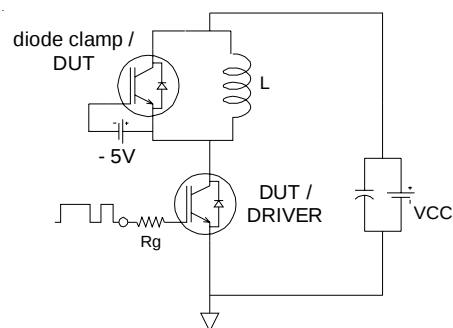


Fig.C.T.4 - Switching Loss Circuit

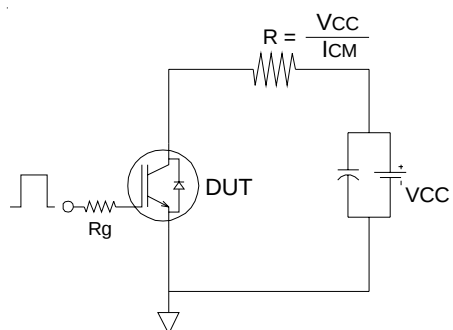
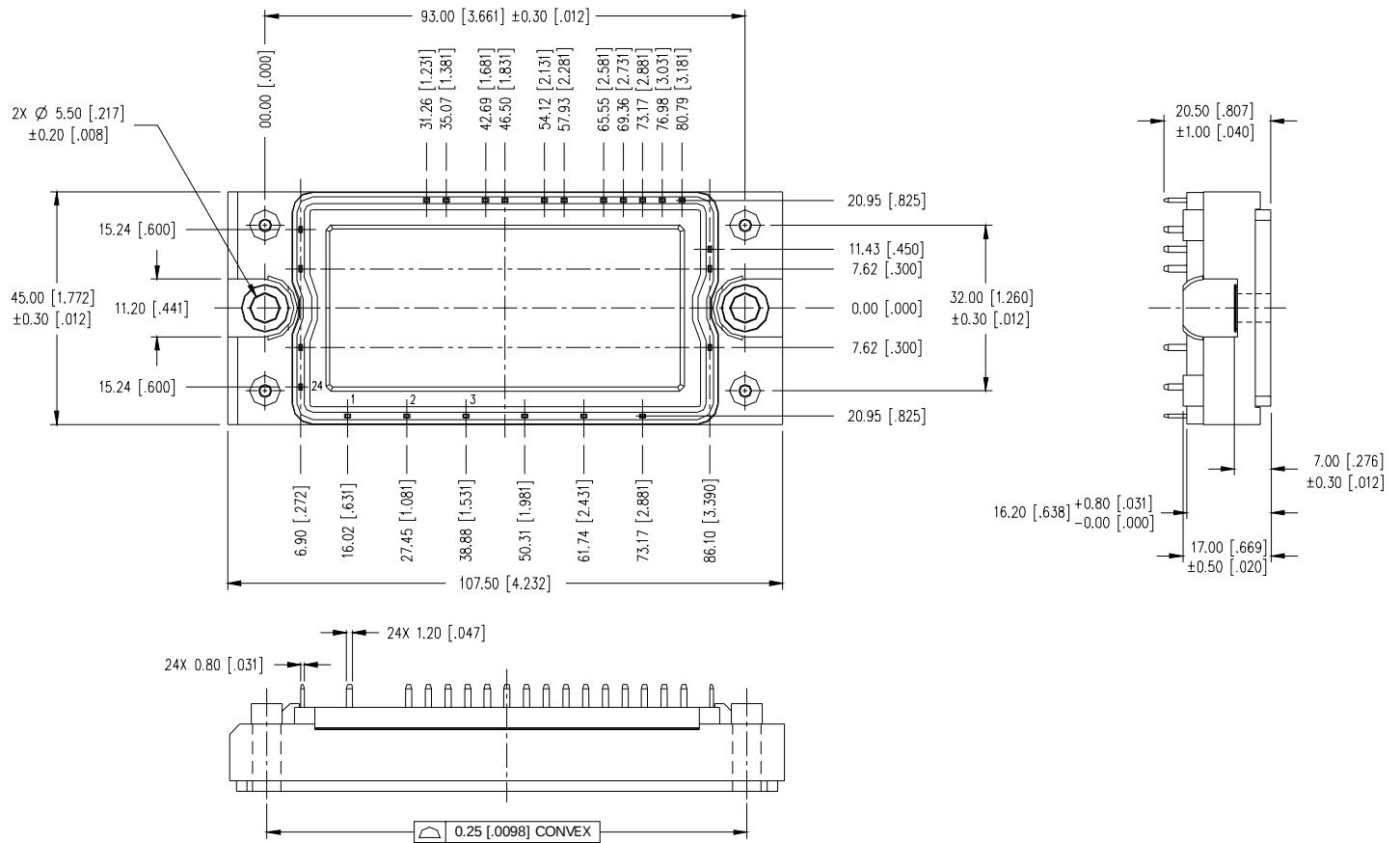


Fig.C.T.5 - Resistive Load Circuit

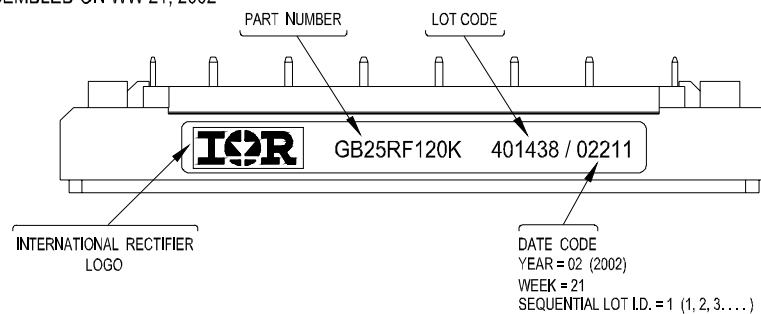
Econo2 PIM Package Outline

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
IR Rectifier

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TAC Fax: (310) 252-7903

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