


GB10RF120K

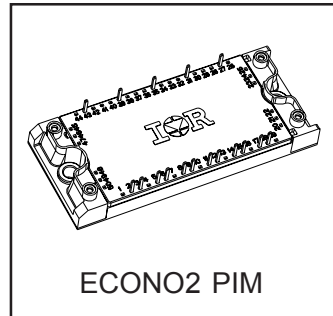
IGBT PIM MODULE

Features

- Low $V_{CE(on)}$ Non Punch Through IGBT Technology
- Low Diode V_F
- 10 μ s 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
- TOTALLY LEAD-FREE

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 

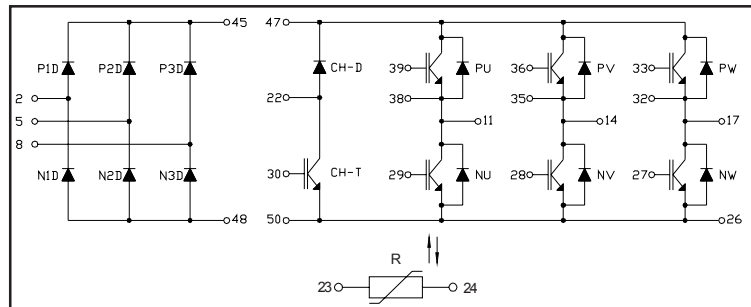


$$V_{CES} = 1200V$$

$$I_C = 13A @ T_C=80^\circ C$$

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

$$V_{CE(on)} \text{ typ.} = 2.68V$$



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	Continuous	25°C / 80°C	20 / 13	A
			Pulsed	25°C	40	
	Diode Maximum Forward Current	I_{FM}	Pulsed	25°C	40	
Power Dissipation	P_D	One IGBT	25°C	88	W	
Input Rectifier	Repetitive Peak Reverse Voltage	V_{RRM}			1600	V
	Average Output Current	$I_{F(AV)}$	50/60Hz sine pulse	80°C	13	A
	Surge Current (Non Repetitive)	I_{FSM}	Rated V_{RRM} applied, 10ms,		120	
	$I^2 t$ (Non Repetitive)	$i^2 t$	sine pulse		72	A ² s
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	20 / 13	A
			Pulsed	25°C	40	
	Power Dissipation	P_D	One IGBT	25°C	88	W
	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	$R_{\theta JC}$	-	-	1.42	°C/W
Junction-to-Case Inverter FRED Thermal Resistance		-	-	1.97	
Junction-to-Case Brake DIODE Thermal Resistance		-	-	1.97	
Junction-to-Case Brake IGBT Thermal Resistance		-	-	1.42	
Junction-to-Case Input Rectifier Thermal Resistance		-	-	1.11	
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	BV _(CES)	Collector-to-Emitter Breakdown Voltage	1200	-	-	V	V _{GE} = 0 I _C = 500μA
IGBT	ΔV _{(BR)CES} /ΔT _J	Temp. Coefficient of Breakdown Voltage	-	1.33	-	V/°C	V _{GE} = 0 I _C = 1mA (25°C - 125°C)
	V _{CE(ON)}	Collector-to-Emitter Voltage	-	2.68	3.03	V	I _C = 10A V _{GE} = 15V
			-	3.68	4.55		I _C = 20A V _{GE} = 15V
			-	3.19	3.61		I _C = 10A V _{GE} = 15V T _J = 125°C
			-	4.52	5.17		I _C = 20A V _{GE} = 15V T _J = 125°C
	V _{GE(th)}	Gate Threshold Voltage	4	-	6		V _{CE} = V _{GE} I _C = 250μA
	ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	-	-9.7	-	mV/°C	V _{CE} = V _{GE} I _C = 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 T _J = 125°C
	I _{GES}	Gate-to-Emitter Leakage Current	-	-	±200	nA	V _{GE} = ±20V
	Q _G	Total Gate Charge (turn-on)	-	48	72		I _C = 10A
	Q _{GE}	Gate-to-Emitter Charge (turn-on)	-	8	15	nC	V _{CC} = 600A
	Q _{GC}	Gate-to-Collector Charge (turn-on)	-	22	33		V _{GE} = 15V
	E _{ON}	Turn-On Switching Loss	-	0.96	1.44	mJ	I _C = 10A V _{CC} = 600V
	E _{OFF}	Turn-Off Switching Loss	-	0.46	0.70		V _{GE} = 15V R _G = 22Ω L = 1mH
	E _{TOT}	Total Switching Loss	-	1.42	2.14		T _J = 25°C ¹
	E _{ON}	Turn-On Switching Loss	-	1.25	1.88	mJ	I _C = 10A V _{CC} = 600V
	E _{OFF}	Turn-Off Switching Loss	-	0.69	0.95		V _{GE} = 15V R _G = 22Ω L = 1mH
	E _{TOT}	Total Switching Loss	-	1.94	2.83		T _J = 125°C ¹
	t _{d(on)}	Turn-On delay time	-	86	130	ns	I _C = 10A V _{CC} = 600V
	t _r	Rise time	-	21	32		V _{GE} = 15V R _G = 22Ω L = 1mH
	t _{d(off)}	Turn-Off delay time	-	118	180		T _J = 125°C
	t _f	Fall time	-	274	410		
C _{ies}	Input Capacitance	-	750	1150	pF	V _{GE} = 0	
C _{oes}	Output Capacitance	-	190	290		V _{CC} = 30V	
C _{res}	Reverse Transfer Capacitance	-	20	35		f = 1Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 125°C I _C = 40A R _G = 22Ω V _{GE} = 15V to 0	
SCSOA	Short Circuit Safe Operating Area	10	-	-	μs	T _J = 150°C V _{CC} = 960V V _P = 1200V R _G = 22Ω V _{GE} = 15V to 0	
Inverter IGBT	I _{rr}	Diode Peak Rev. Recovery Current	-	22	-	A	T _J = 125°C V _{CC} = 600V I _F = 10A L = 1mH V _{GE} = 15V R _G = 22Ω
	V _{FM}	Diode Forward Voltage Drop		2.02	2.50	V	I _F = 10A
				2.53	3.35		I _F = 20A
				2.13	2.63		I _F = 10A T _J = 125°C
		2.81	3.57	I _F = 20A 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	-	-	1.12	V	I _F = 10A
	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	-	-	18.1	mΩ	T _J = 150°C
V _{F(TO)}	Conduction Threshold Voltage	-	-	0.78	V		
Brake IGBT	BV _(CES)	Collector-to-Emitter Breakdown Voltage	1200	-	-	V	V _{GE} = 0 IC = 500μA
	ΔV _{(BR)CES/ΔT_J}	Temp. Coefficient of Breakdown Voltage	-	1.33	-	V/°C	V _{GE} = 0 IC = 1mA (25°C - 125°C)
	V _{CE(ON)}	Collector-to-Emitter Voltage	-	2.68	3.03	V	I _C = 10A V _{GE} = 15V
			-	3.68	4.55		I _C = 20A V _{GE} = 15V
			-	3.19	3.61		I _C = 10A V _{GE} = 15V T _J = 125°C
			-	4.52	5.17		I _C = 20A V _{GE} = 15V T _J = 125°C
	V _{GE(th)}	Gate Threshold Voltage	4.0	-	6.0		V _{CE} = V _{GE} IC = 250μA
	ΔV _{GE(th)/ΔT_J}	Threshold Voltage temp. coefficient	-	-9.7	-	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 T _J = 125°C
	I _{GES}	Gate-to-Emitter Leakage Current	-	-	±200	nA	V _{GE} = ±20V
	Q _G	Total Gate Charge (turn-on)	-	48	72	nC	I _C = 10A
	Q _{GE}	Gate-to-Emitter Charge (turn-on)	-	8	15		V _{CC} = 600A
	Q _{GC}	Gate-to-Collector Charge (turn-on)	-	22	33		V _{GE} = 15V
	E _{ON}	Turn-On Switching Loss	-	0.96	1.44	mJ	I _C = 10A V _{CC} = 600V
	E _{OFF}	Turn-Off Switching Loss	-	0.46	0.70		V _{GE} = 15V R _G = 22Ω L = 1mH
	E _{TOT}	Total Switching Loss	-	1.42	2.14		T _J = 25°C ¹
	E _{ON}	Turn-On Switching Loss	-	1.25	1.88	mJ	I _C = 10A V _{CC} = 600V
	E _{OFF}	Turn-Off Switching Loss	-	0.69	0.95		V _{GE} = 15V R _G = 22Ω L = 1mμH
	E _{TOT}	Total Switching Loss	-	1.94	2.830		T _J = 125°C ¹
t _{d(on)}	Turn-On delay time	-	86	130	ns	I _C = 10A V _{CC} = 600V	
t _r	Risetime	-	21	32		V _{GE} = 15V R _G = 22Ω L = 1mH	
t _{d(off)}	Turn-Off delay time	-	118	180		T _J = 125°C	
t _f	Fall time	-	274	410			
C _{ies}	Input Capacitance	-	750	1150	pF	V _{GE} = 0	
C _{oes}	Output Capacitance	-	190	290		V _{CC} = 30V	
C _{res}	Reverse Transfer Capacitance	-	20	35		f = 1Mhz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 125°C I _C = 40A R _G = 22Ω V _{GE} = 15V to 0	
SCSOA	Short Circuit Safe Operating Area	10	-	-	μs	T _J = 150°C V _{CC} = 960V, V _P = 1200V R _G = 22Ω V _{GE} = 15V to 0	
Brake Diode	I _{rr}	Diode Peak Rev. Recovery Current	-	22	-	A	T _J = 125°C V _{CC} = 600V I _F = 10A L = 1mH V _{GE} = 15V R _G = 22Ω
	V _{FM}	Diode Forward Voltage Drop	-	2.02	2.5	V	I _F = 10A
-	-	-	2.53	3.35	I _F = 20A		
-	-	-	2.13	2.63	I _F = 10A T _J = 125°C		
-	-	-	2.81	3.57	I _F = 20A T _J = 125°C		
NTC	R	Resistance	-	5000	-	Ω	T _J = 25°C
	-	-	-	493.3	-		T _J = 100°C
B	B Value	-	3375	-	K	T _J = 25°C / 50°C	

¹ Energy Losses include "tail" and diode reverse recovery

Inverter

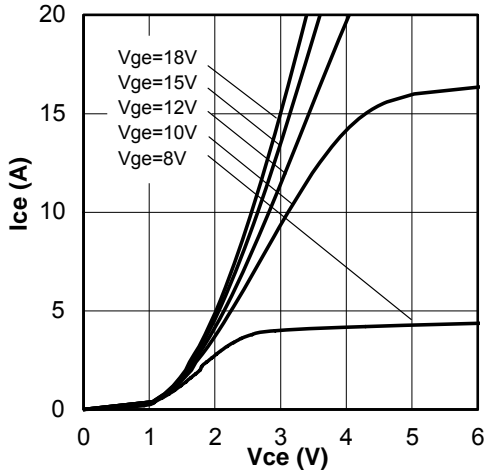


Fig. 1 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

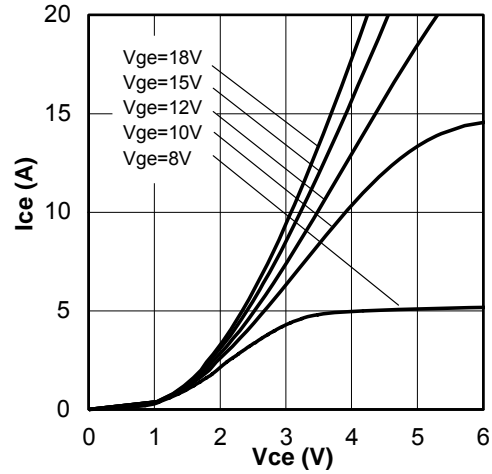


Fig. 2 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

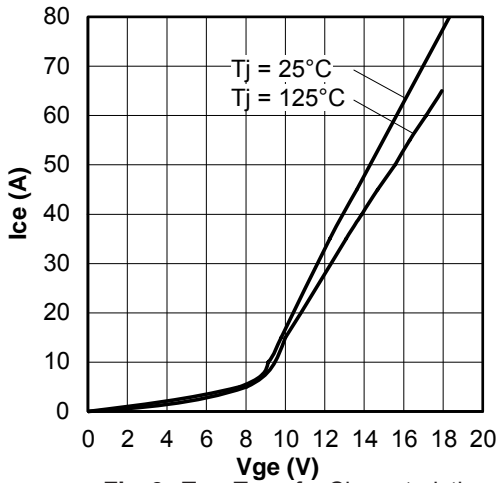


Fig. 3 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

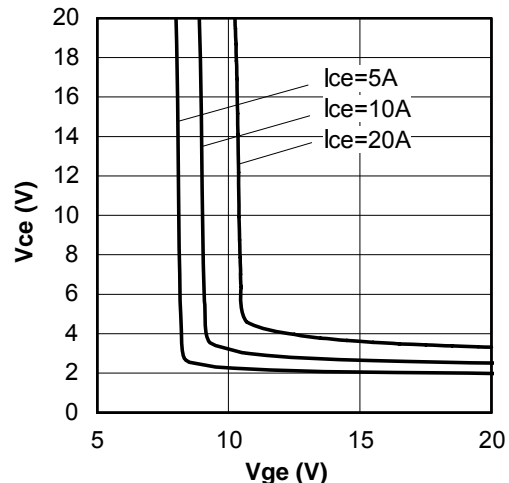


Fig. 4 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

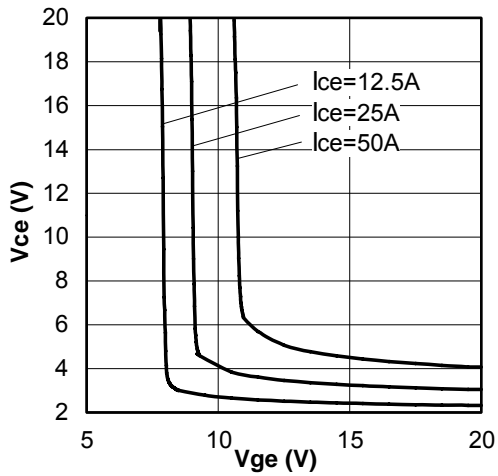


Fig. 5 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

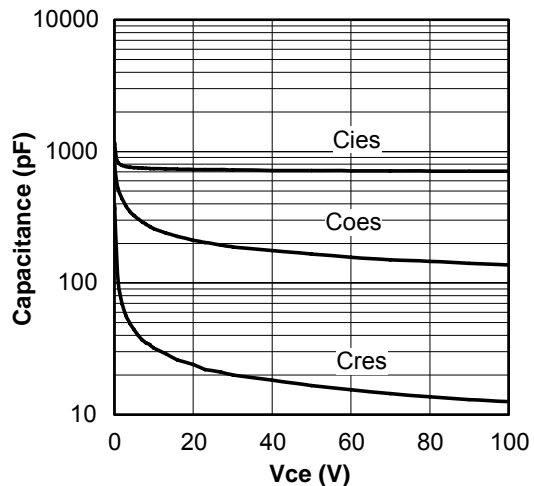


Fig. 6 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0$; $f = 1\text{MHz}$

Inverter

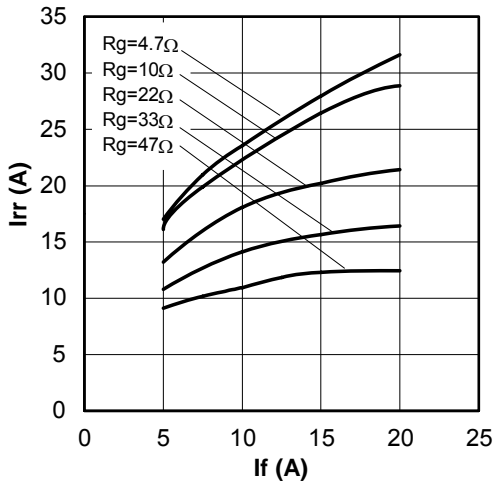


Fig. 13 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

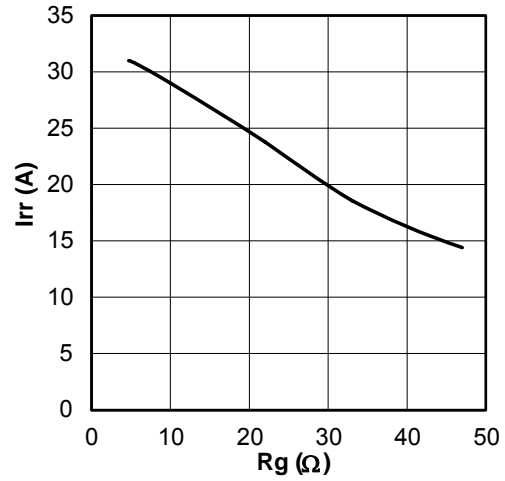


Fig. 14 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}; I_F = 10\text{A}$

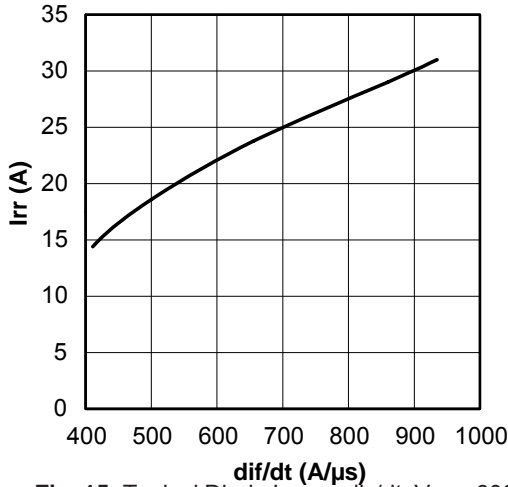


Fig. 15 - Typical Diode I_{RR} vs. di_F/dt ; $V_{CC} = 600\text{V}$;
 $V_{GE} = 15\text{V}; I_{CE} = 10\text{A}; T_J = 125^\circ\text{C}$

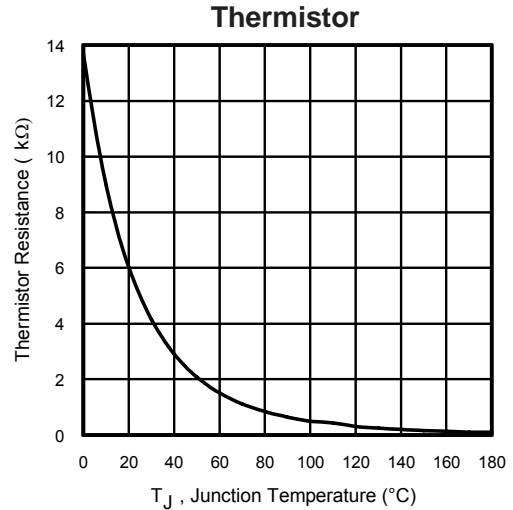


Fig. 16 - Thermistor Resistance vs. Temperature

Input Rectifier

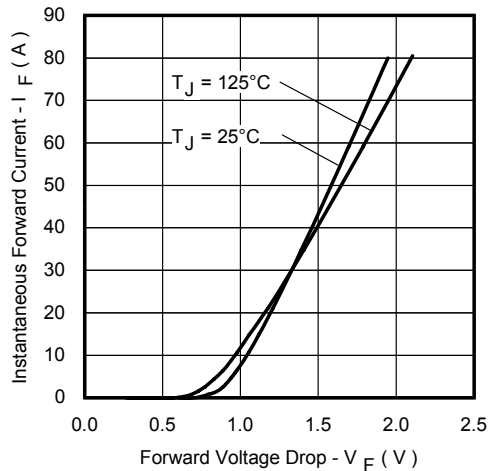


Fig. 17- Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

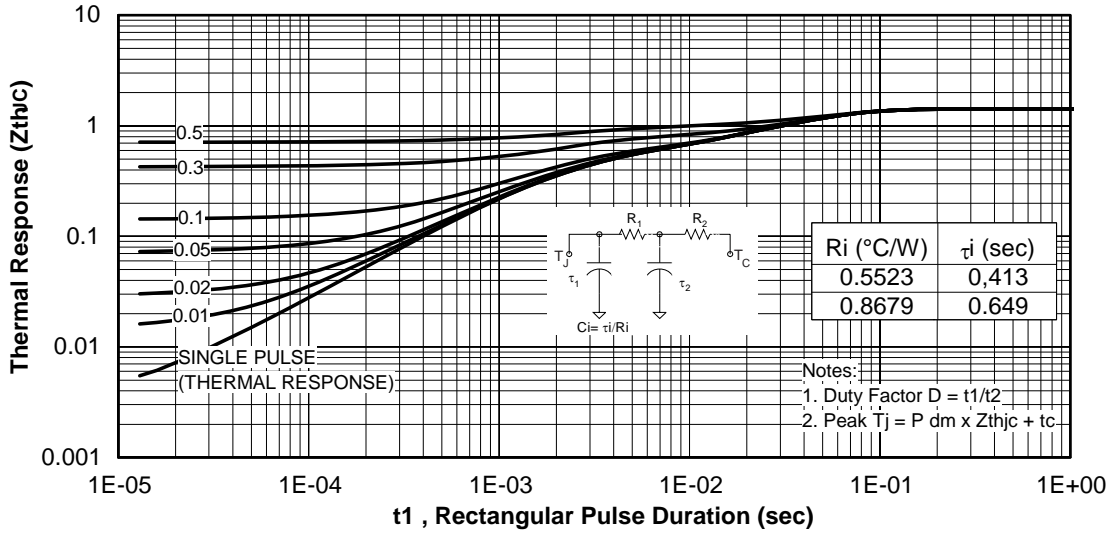


Fig 18. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

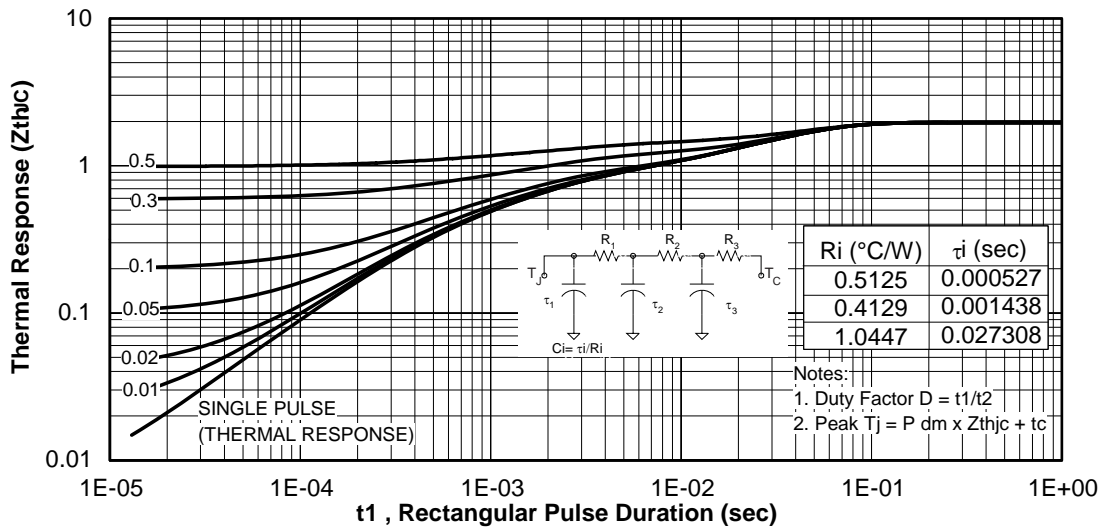


Fig 19. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

Brake

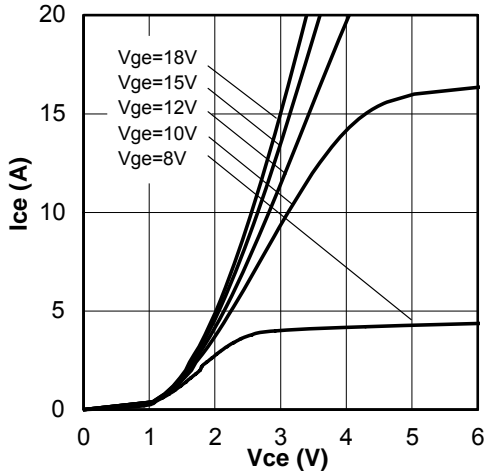


Fig. 20 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

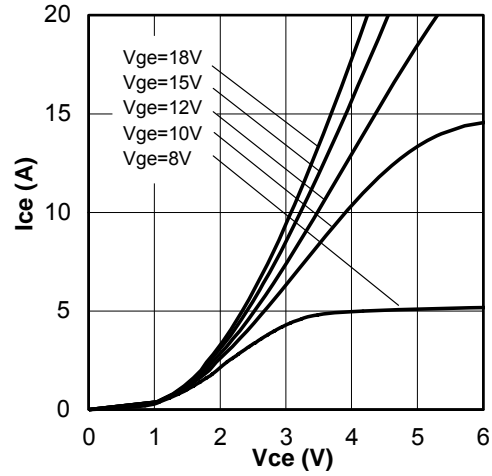


Fig. 21 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

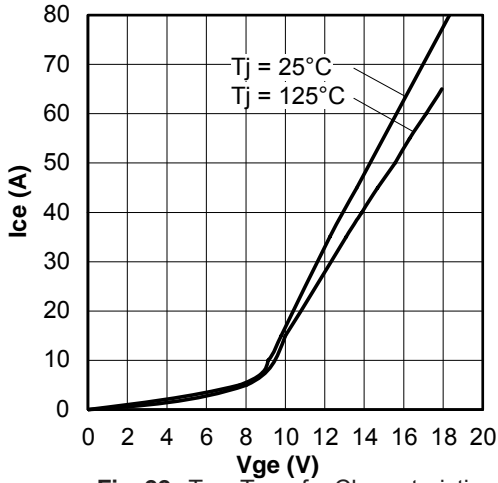


Fig. 22 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

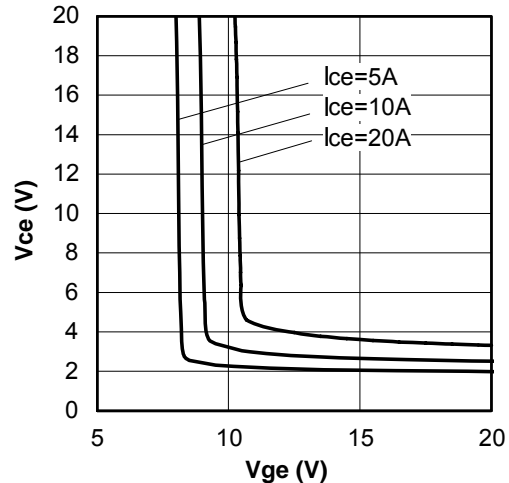


Fig. 23 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

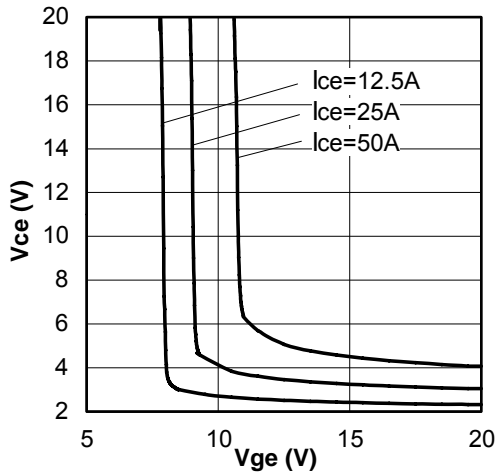


Fig. 24 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

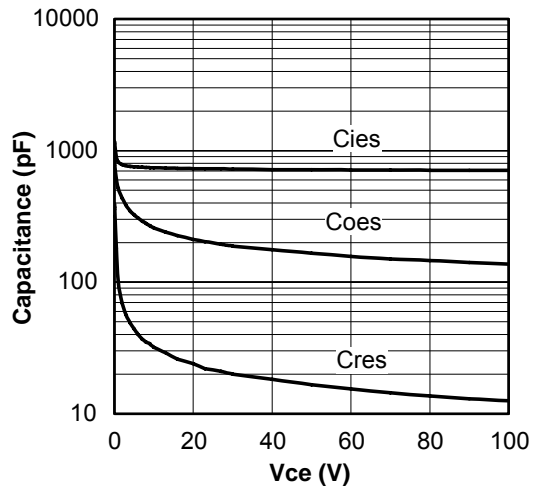


Fig. 25 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0$; $f = 1\text{MHz}$

Brake

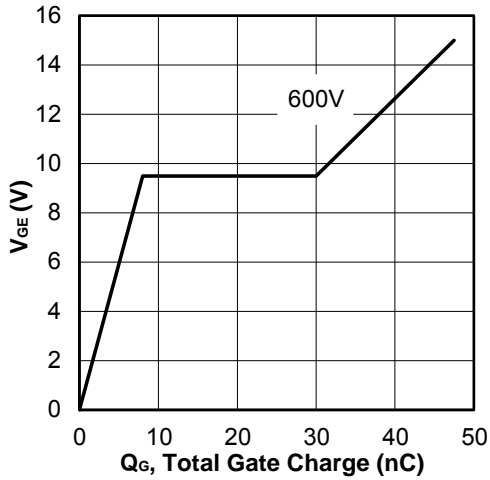


Fig. 26 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 10A$

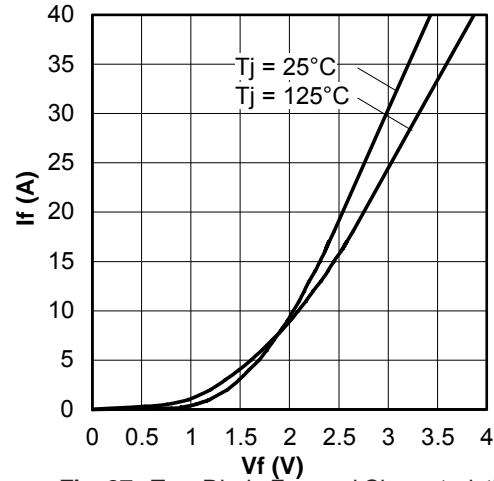


Fig. 27 - Typ. Diode Forward Characteristics
 $t_p = 80\mu s$

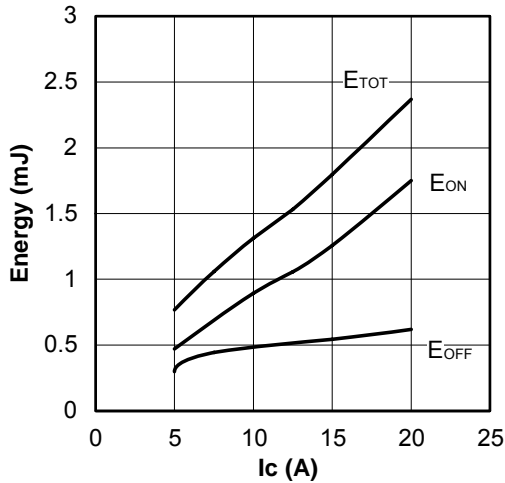


Fig. 28 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ C$; $L = 1mH$; $V_{CE} = 600V$; $R_G = 22\Omega$; $V_{GE} = 15V$

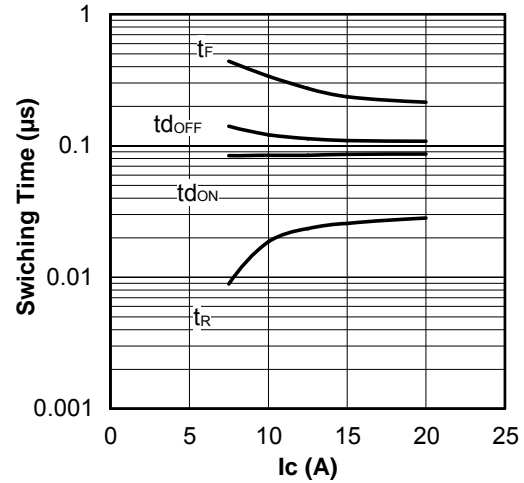


Fig. 29 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ C$; $L = 1mH$; $V_{CE} = 600V$; $R_G = 22\Omega$; $V_{GE} = 15V$

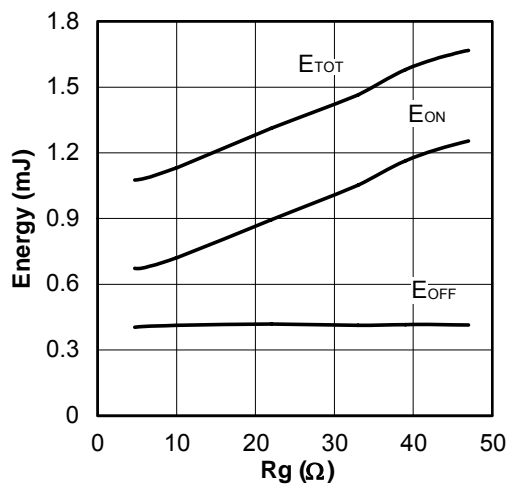


Fig. 30 - Typ. Energy Loss vs. R_G
 $T_J = 125^\circ C$; $L = 1mH$; $V_{CE} = 600V$; $I_{CE} = 10A$; $V_{GE} = 15V$

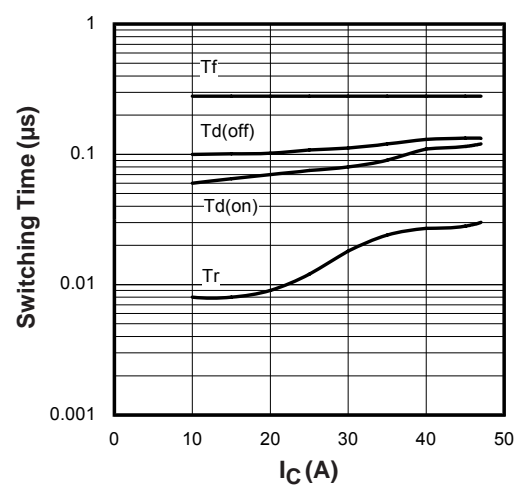


Fig. 31 - Typ. Switching Time vs. R_G
 $T_J = 125^\circ C$; $L = 1mH$; $V_{CE} = 600V$; $I_{CE} = 10A$; $V_{GE} = 15V$

Brake

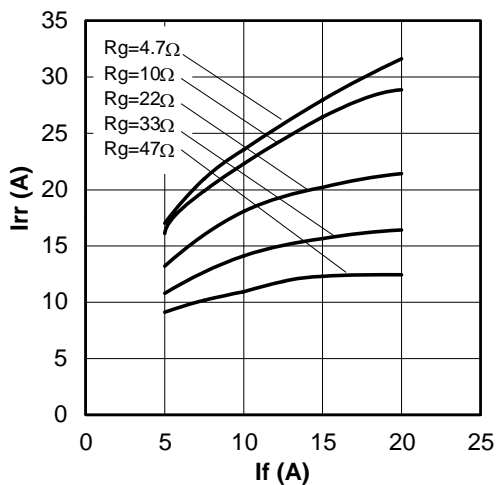


Fig. 32 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

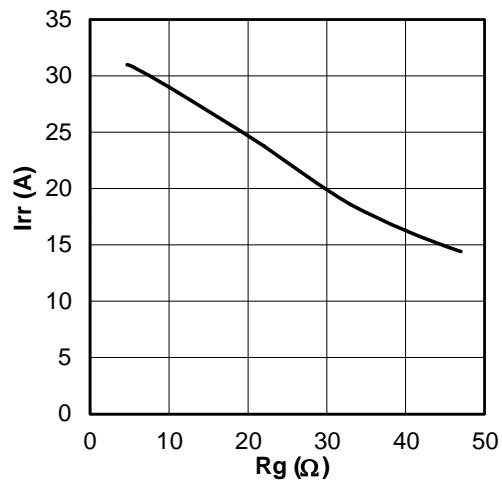


Fig. 33 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 10\text{A}$

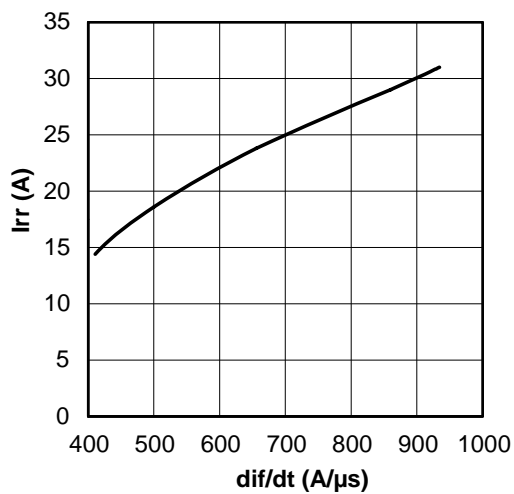


Fig. 34- Typical Diode I_{RR} vs. di_F/dt ; $V_{CC}=600\text{V}$;
 $V_{GE}=15\text{V}$; $I_{CE}=10\text{A}$; $T_J = 125^\circ\text{C}$

Brake

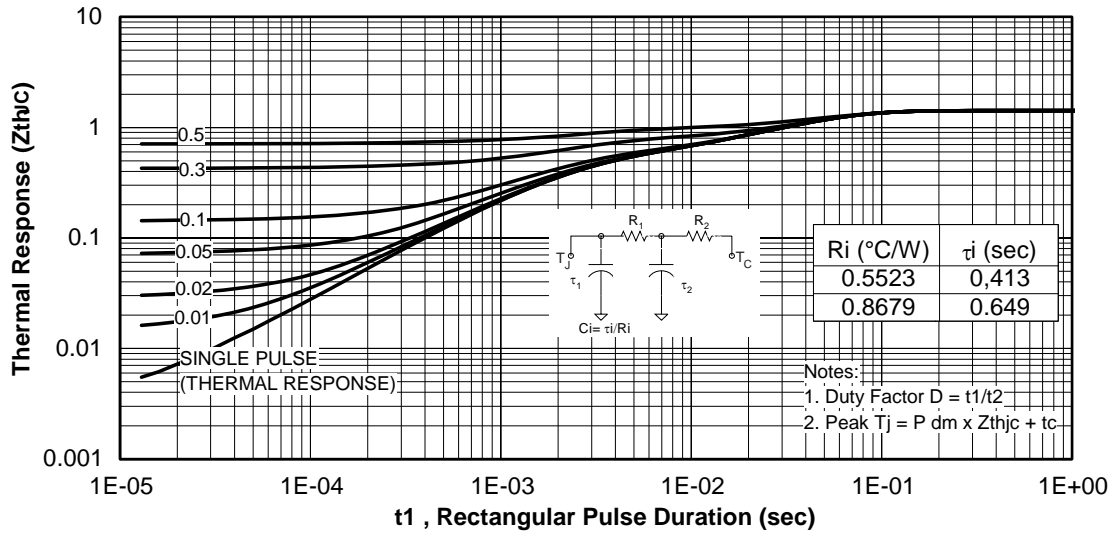


Fig. 35 - Maximum Transient Thermal Impedance, Junction-to-Case (Brake IGBT)

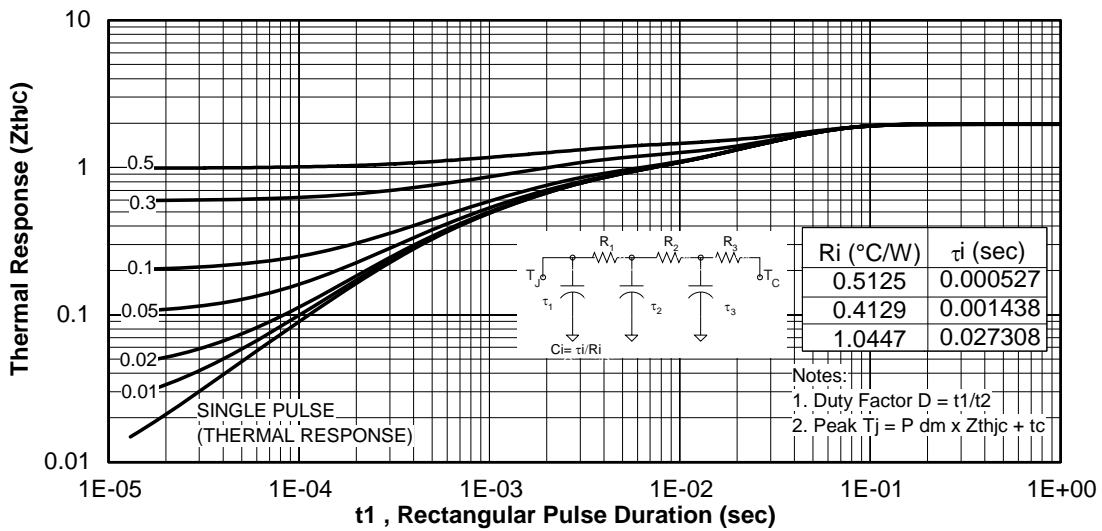


Fig. 36 - Maximum Transient Thermal Impedance, Junction-to-Case (Brake DIODE)

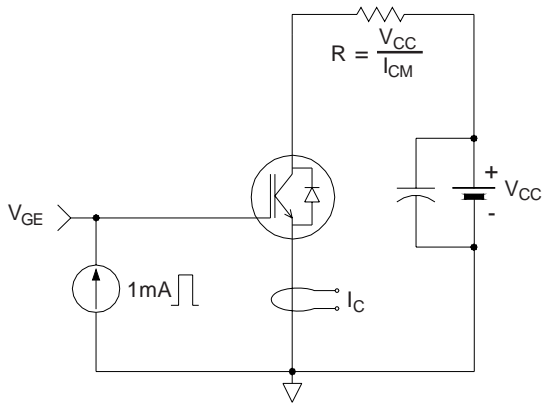


Fig.C.T.1 - Gate Charge Circuit (turn-off)

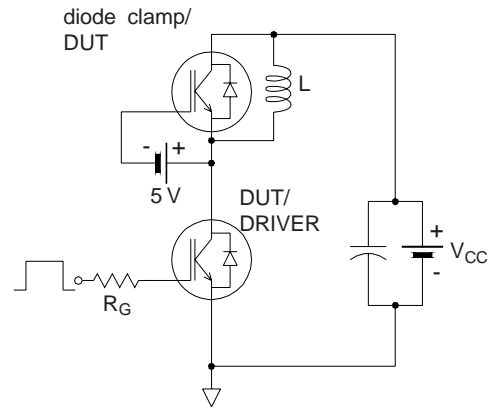


Fig.C.T.2 - RBSOA Circuit

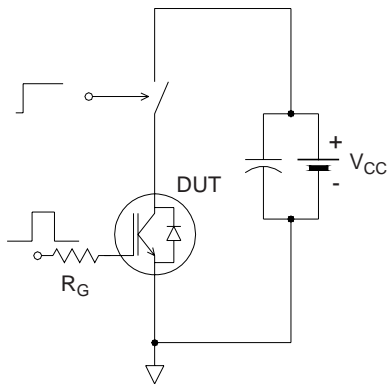


Fig.C.T.3 - S.C. SOA Circuit

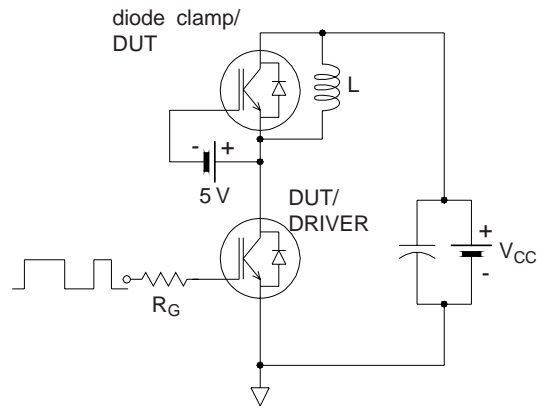


Fig.C.T.4 - Switching Loss Circuit

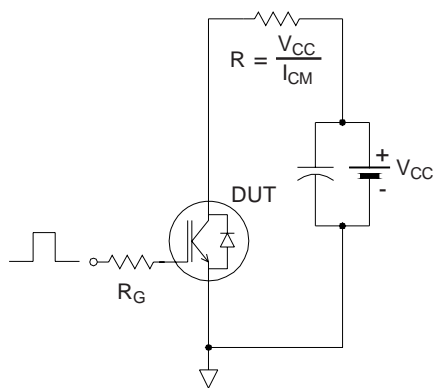
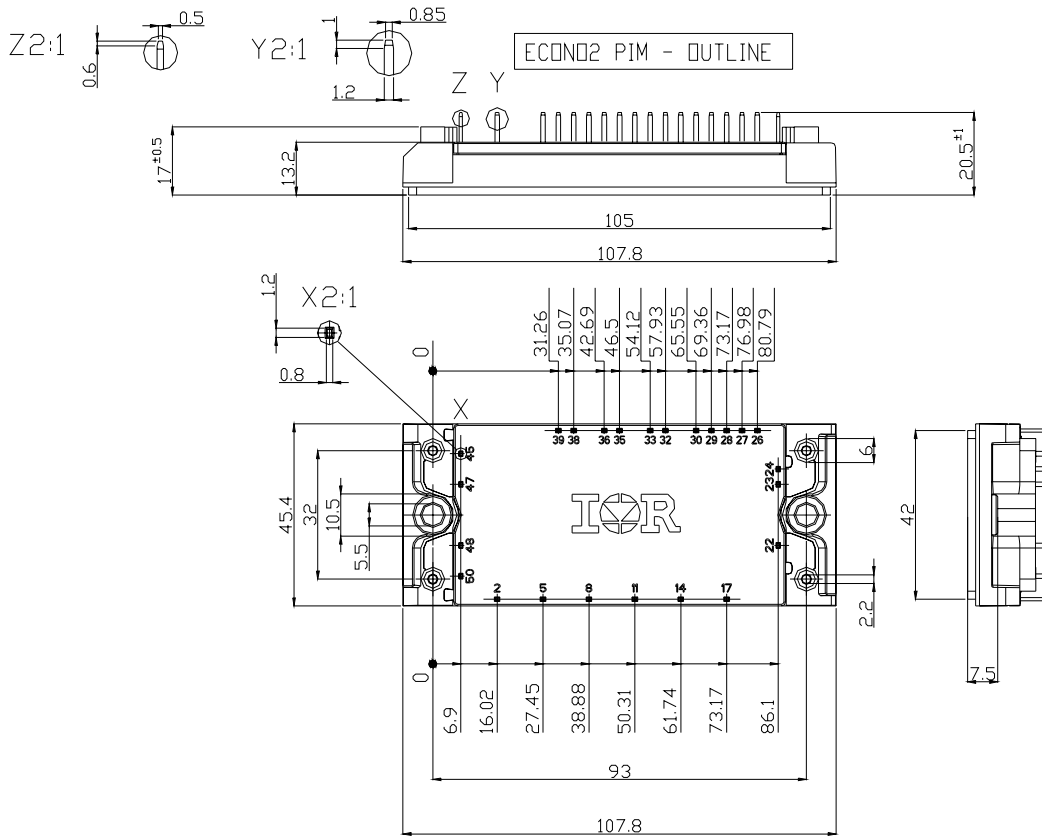


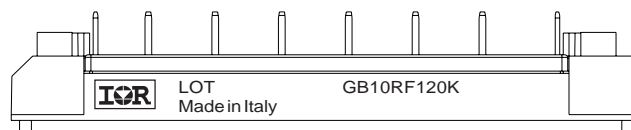
Fig.C.T.5 - Resistive Load Circuit

Econo2 PIM Package Outline

Dimensions are shown in millimeters (inches)



Econo2 PIM Part Marking Information



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.

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