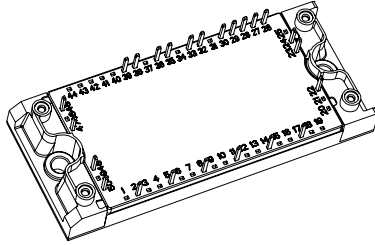


IGBT PIM Module, 25 A


ECONO2 PIM
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
- Speed 8 to 60 kHz
- Totally lead (Pb)-free
- Designed and qualified for industrial market


RoHS
COMPLIANT

PRODUCT SUMMARY

V_{CES}	1200 V
$V_{CE(on)}$	2.4 V
t_{sc} at $T_J = 150\text{ }^\circ\text{C}$	> 10 μ s
I_C at $T_C = 80\text{ }^\circ\text{C}$	25 A

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

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS	
Inverter	Collector to emitter voltage	V_{CES}		1200	V	
	Gate to emitter voltage	V_{GES}		± 20		
	Continuous collector current	I_C		$T_C = 25\text{ }^\circ\text{C}$	40	A
				$T_C = 80\text{ }^\circ\text{C}$	25	
	Pulsed collector current See fig. C.T.5	I_{CM}			80	A
	Diode maximum forward current	I_{FM}	Pulsed		80	A
Power dissipation	P_D		One IGBT 25 $^\circ\text{C}$	198	W	
Input rectifier	Repetitive peak reverse voltage	V_{RRM}		1600	V	
	Average output current	$I_{F(AV)}$	50/60 Hz sine pulse 80 $^\circ\text{C}$	20	A	
	Surge current (non-repetitive)	I_{FSM}	Rated V_{RRM} applied, 10 ms, sine pulse	250		
	I^2t (non-repetitive)	I^2t		316	A ² s	
Brake	Collector to emitter voltage	V_{CES}		1200	V	
	Gate to emitter voltage	V_{GES}		± 20		
	Continuous collector current	I_C		$T_C = 25\text{ }^\circ\text{C}$	40	A
				$T_C = 80\text{ }^\circ\text{C}$	25	
	Pulsed collector current See fig. C.T.5	I_{CM}			80	A
	Power dissipation	P_D		One IGBT 25 $^\circ\text{C}$	198	W
	Maximum operating junction temperature	T_J			150	$^\circ\text{C}$
	Storage temperature range	T_{Stg}			- 40 to + 125	
Isolation voltage	V_{ISOL}	AC (1 min)		2500		

ELECTRICAL SPECIFICATIONS (T _J = 25 °C unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Inverter IGBT	Collector to emitter breakdown voltage	BV _(CES)	V _{GE} = 0 V, I _C = 500 μA	1200	-	-	V
	Temperature coefficient of breakdown voltage	ΔV _{(BR)CES} /ΔT _J	V _{GE} = 0 V, I _C = 1 mA (25 °C to 125 °C)	-	1.0	-	V/°C
	Collector to emitter voltage	V _{CE(on)}	I _C = 25 A, V _{GE} = 15 V	-	2.40	2.70	V
			I _C = 40 A, V _{GE} = 15 V	-	2.95	3.30	
			I _C = 25 A, V _{GE} = 15 V, T _J = 125 °C	-	2.85	-	
			I _C = 40 A, V _{GE} = 15 V, T _J = 125 °C	-	3.55	-	
	Gate threshold voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C = 250 μA	4.0	5.0	6.0	
	Threshold voltage temp. coefficient	ΔV _{GE(th)} /ΔT _J	V _{CE} = V _{GE} , I _C = 1 mA (25 °C to 125 °C)	-	- 10	-	mV/°C
	Zero gate voltage collector current	I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V	-	-	100	μA
			V _{GE} = 0 V, V _{CE} = 1200 V T _J = 125 °C	-	750	-	
	Gate to emitter leakage current	I _{GES}	V _{GE} = ± 20 V	-	-	± 200	nA
	Total gate charge (turn-on)	Q _G	I _C = 25 A	-	175	265	nC
	Gate to emitter charge (turn-on)	Q _{GE}	V _{CC} = 400 V	-	17.5	30	
	Gate to collector charge (turn-on)	Q _{GC}	V _{GE} = 15 V	-	81	125	
	Turn-on switching loss	E _{on}	I _C = 25 A, V _{CC} = 600 V	-	2.45	4.45	mJ
	Turn-off switching loss	E _{off}	V _{GE} = 15 V, R _G = 10 Ω, L = 400 μH, T _J = 25 °C ⁽¹⁾	-	2.05	3.20	
	Total switching loss	E _{tot}		-	4.50	7.65	
	Turn-on switching loss	E _{on}	I _C = 25 A, V _{CC} = 600 V	-	3.35	5.65	
	Turn-off switching loss	E _{off}	V _{GE} = 15 V, R _G = 10 Ω, L = 400 μH, T _J = 125 °C ⁽¹⁾	-	2.85	3.85	
	Total switching loss	E _{tot}		-	6.20	9.50	
	Turn-on delay time	t _{d(on)}	I _C = 25 A, V _{CC} = 600 V V _{GE} = 15 V, R _G = 10 Ω, L = 400 μH, T _J = 125 °C	-	80	104	ns
	Rise time	t _r		-	50	70	
	Turn-off delay time	t _{d(off)}		-	510	1000	
Fall time	t _f	-		230	299		
Input capacitance	C _{ies}	V _{GE} = 0 V	-	2370	-	pF	
Output capacitance	C _{oes}	V _{CC} = 30 V	-	455	-		
Reverse transfer capacitance	C _{res}	f = 1 MHz	-	60	-		
Inverter IGBT	Reverse bias safe operating area	RBSOA	T _J = 150 °C, I _C = 80 A R _G = 47 Ω, V _{GE} = 15 V to 0 V	Fullsquare			
	Short circuit safe operating area	SCSOA	I _P = 180 A to 270 A V _{CC} = 900 V R _G = 47 Ω, V _{GE} = 15 V to 0 V	10	-	-	μs
	Diode peak reverse recovery current	I _{rr}	T _J = 125 °C V _{CC} = 600 V, I _F = 25 A, L = 400 μH, R _G = 10 Ω, V _{GE} = 15 V	-	35	-	A
	Diode forward voltage drop	V _{FM}	I _F = 25 A	-	1.90	2.35	V
			I _F = 40 A	-	2.25	2.80	
I _F = 25 A, T _J = 125 °C			-	2.00	-		
I _F = 40 A, T _J = 125 °C			-	2.45	-		

ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Input rectifier	Maximum forward voltage drop	V_{FM}	$I_F = 25\text{ A}$	-	-	1.5	V
	Maximum reverse leakage current	I_{RM}	$T_J = 25\text{ }^\circ\text{C}, V_R = 1600\text{ V}$	-	-	0.1	mA
			$T_J = 150\text{ }^\circ\text{C}, V_R = 1600\text{ V}$	-	-	1.0	
	Forward slope resistance	r_T	$T_J = 150\text{ }^\circ\text{C}$	-	-	10.4	m Ω
Conduction threshold voltage	$V_{F(TO)}$	-		-	0.85	V	
Brake IGBT	Collector to emitter breakdown voltage	$BV_{(CES)}$	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	1200	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	1.0	-	V/ $^\circ\text{C}$
	Collector to emitter voltage	$V_{CE(on)}$	$I_C = 25\text{ A}, V_{GE} = 15\text{ V}$	-	2.4	2.7	V
			$I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	-	2.95	3.3	
			$I_C = 25\text{ A}, V_{GE} = 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.85	-	
			$I_C = 40\text{ A}, V_{GE} = 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	3.55	-	
	Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	4.0	5.0	6.0	
	Threshold voltage temperature coefficient	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ ($25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$)	-	-10	-	mV/ $^\circ\text{C}$
	Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	-	100	μA
			$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$ $T_J = 125\text{ }^\circ\text{C}$	-	750	-	
	Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 200	nA
	Total gate charge (turn-on)	Q_G	$I_C = 25\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$	-	175	265	nC
	Gate to emitter charge (turn-on)	Q_{GE}		-	17.5	30	
	Gate to collector charge (turn-on)	Q_{GC}		-	81	125	
	Turn-on switching loss	E_{on}	$I_C = 25\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 102\text{ }\Omega, L = 400\text{ }\mu\text{H},$ $T_J = 25\text{ }^\circ\text{C}^{(1)}$	-	2.45	4.45	mJ
	Turn-off switching loss	E_{off}		-	2.05	3.20	
	Total switching loss	E_{tot}		-	4.50	7.65	
Turn-on switching loss	E_{on}	$I_C = 15\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega, L = 400\text{ }\mu\text{H},$ $T_J = 125\text{ }^\circ\text{C}^{(1)}$	-	3.35	5.65	mJ	
Turn-off switching loss	E_{off}		-	2.85	3.85		
Total switching loss	E_{tot}		-	6.20	9.50		
Turn-on delay time	$t_{d(on)}$	$I_C = 25\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega, L = 400\text{ }\mu\text{H},$ $T_J = 125\text{ }^\circ\text{C}$	-	80	104	ns	
Rise time	t_r		-	50	70		
Turn-off delay time	$t_{d(off)}$		-	510	1000		
Fall time	t_f		-	230	299		
Brake IGBT	Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	2370	-	pF
	Output capacitance	C_{oes}		-	455	-	
	Reverse transfer capacitance	C_{res}		-	60	-	
	Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 80\text{ A}$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	Fullsquare			
	Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}$ $V_{CC} = 900\text{ V}, V_P = 1200\text{ V}$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	10	-	-	μs

ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Brake Diode	Diode peak reverse recovery current	I_{rr}	$T_J = 125\text{ }^\circ\text{C}$ $V_{CC} = 600\text{ V}$, $I_F = 25\text{ A}$, $L = 400\text{ }\mu\text{H}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$	-	35	-	A
	Diode forward voltage drop	V_{FM}	$I_F = 25\text{ A}$	-	1.90	2.35	V
			$I_F = 40\text{ A}$	-	2.25	2.80	
			$I_F = 25\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.0	-	
			$I_F = 40\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.45	-	
NTC	Resistance	R	$T_J = 25\text{ }^\circ\text{C}$	4538	5000	5495	Ω
			$T_J = 100\text{ }^\circ\text{C}$	468.6	493.3	518	
	B value	B	$T_J = 25\text{ }^\circ\text{C}/50\text{ }^\circ\text{C}$	3307	3375	3443	K

Note

(1) Energy losses include “tail” and diode reverse recovery

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Junction to case inverter IGBT thermal resistance	R_{thJC}	-	-	0.63	$^\circ\text{C}/\text{W}$
Junction to case inverter FRED thermal resistance		-	-	1.0	
Junction to case brake DIODE thermal resistance		-	-	1.0	
Junction to case brake IGBT thermal resistance		-	-	0.63	
Junction to case input rectifier thermal resistance		-	-	0.85	
Case to sink, flat, greased surface	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

INVERTER

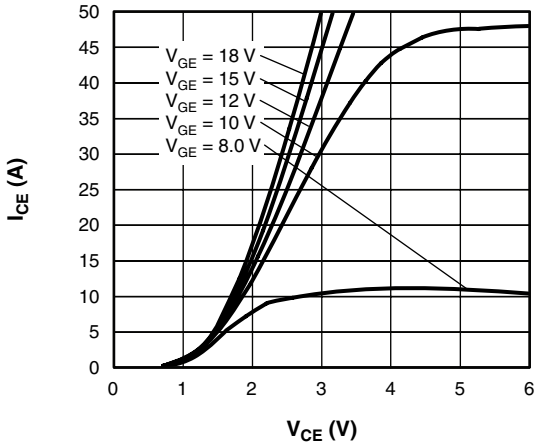


Fig. 1 - Typical IGBT Output Characteristics
 $T_J = 25\text{ }^\circ\text{C}$; $t_p = 80\text{ }\mu\text{s}$

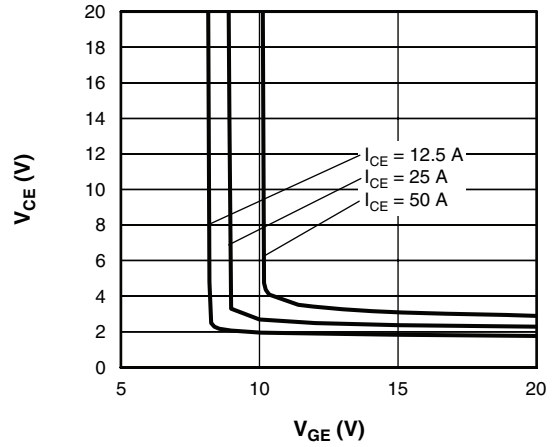


Fig. 4 - Typical V_{CE} vs. V_{GE}
 $T_J = 25\text{ }^\circ\text{C}$

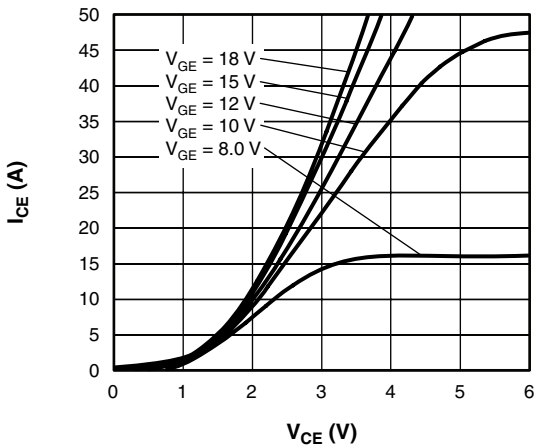


Fig. 2 - Typical IGBT Output Characteristics
 $T_J = 125\text{ }^\circ\text{C}$; $t_p = 80\text{ }\mu\text{s}$

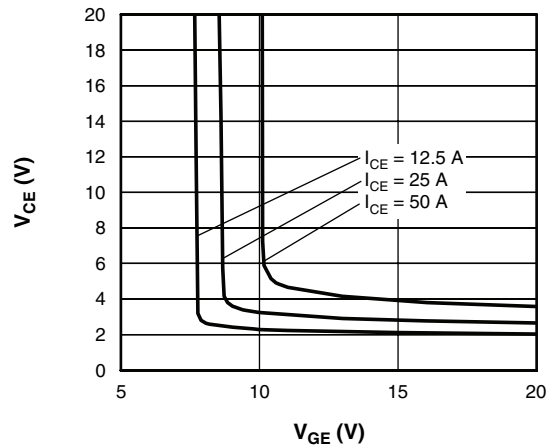


Fig. 5 - Typical V_{CE} vs. V_{GE}
 $T_J = 125\text{ }^\circ\text{C}$

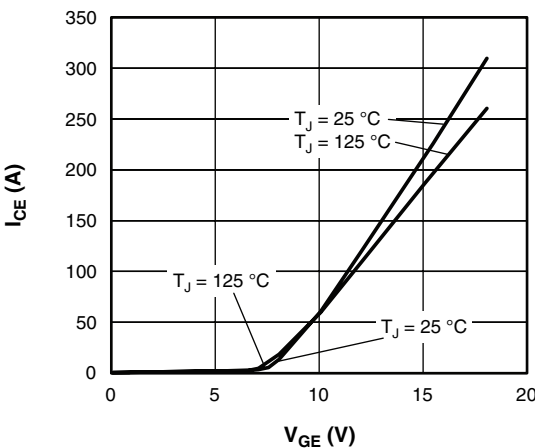


Fig. 3 - Typical Transfer Characteristics
 $V_{CE} = 50\text{ V}$; $t_p = 10\text{ }\mu\text{s}$

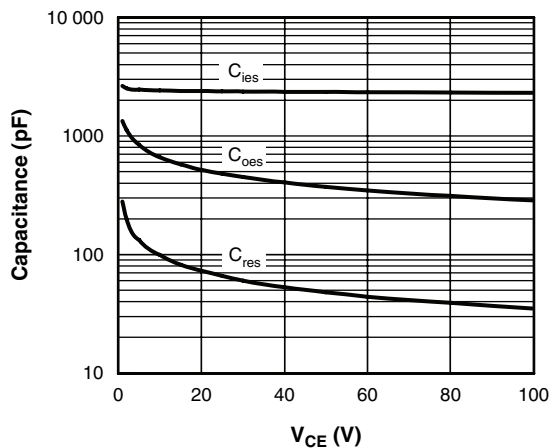


Fig. 6 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

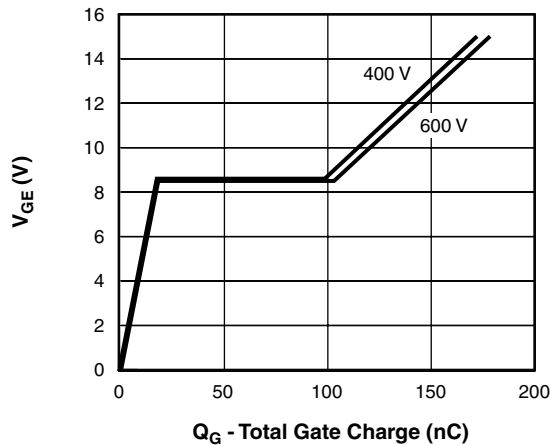


Fig. 7 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 25 \text{ A}$; $L = 1 \text{ mH}$

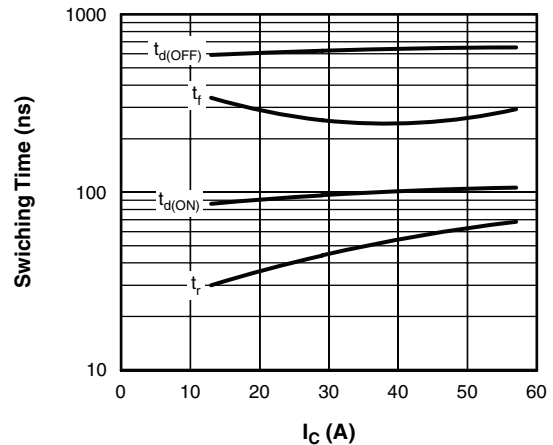


Fig. 10 - Typical Switching Time vs. I_C
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$;
 $R_G = 10 \text{ } \Omega$; $V_{GE} = 15 \text{ V}$

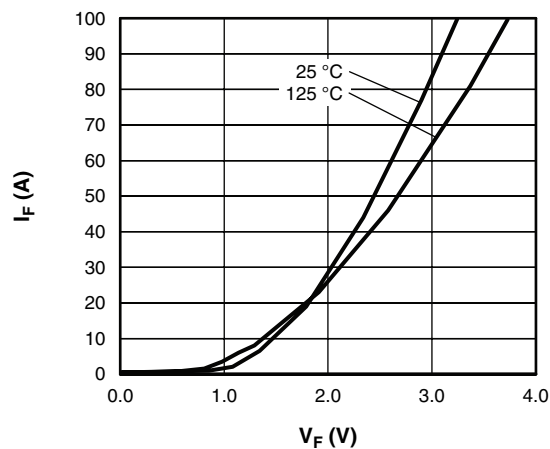


Fig. 8 - Typical Diode Forward Characteristics
 $t_p = 80 \text{ } \mu\text{s}$

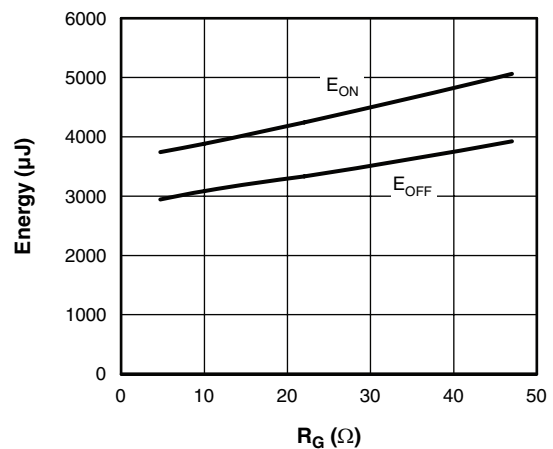


Fig. 11 - Typical Energy Loss vs. R_G
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$;
 $I_{CE} = 25 \text{ A}$; $V_{GE} = 15 \text{ V}$

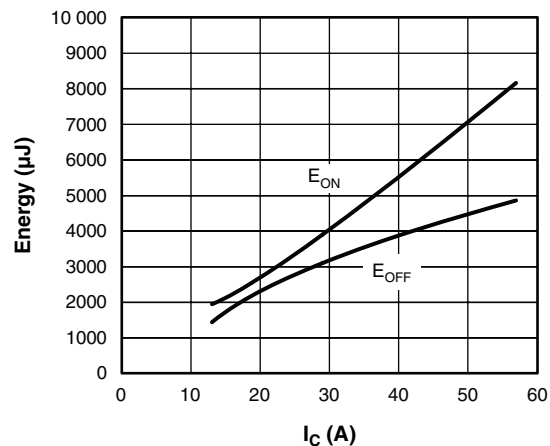


Fig. 9 - Typical Energy Loss vs. I_C
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$;
 $R_G = 10 \text{ } \Omega$; $V_{GE} = 15 \text{ V}$

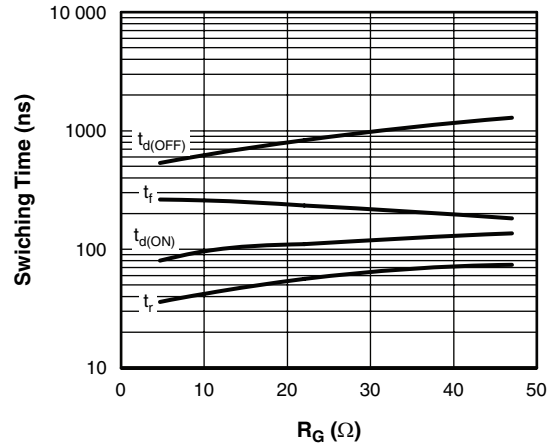


Fig. 12 - Typical Switching Time vs. R_G
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$;
 $I_{CE} = 25 \text{ A}$; $V_{GE} = 15 \text{ V}$

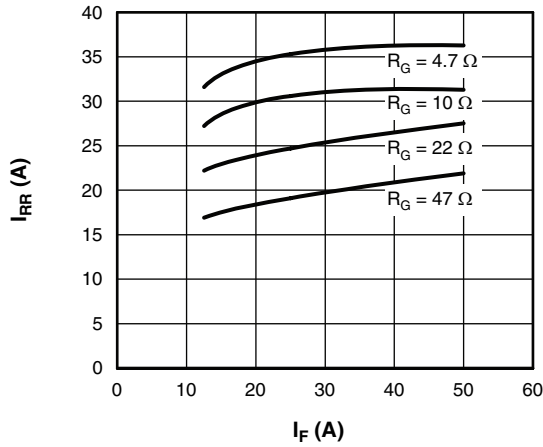
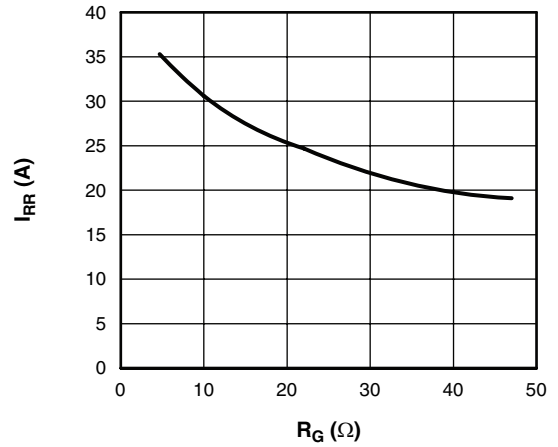
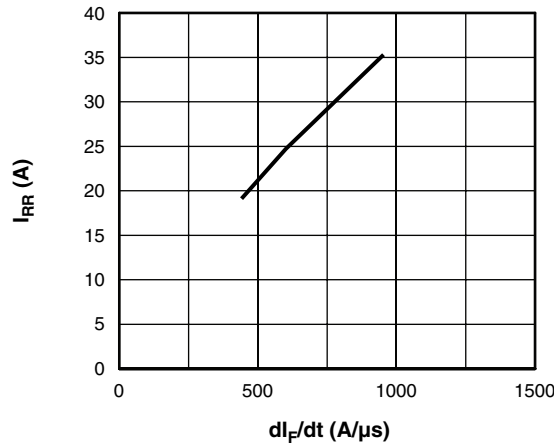
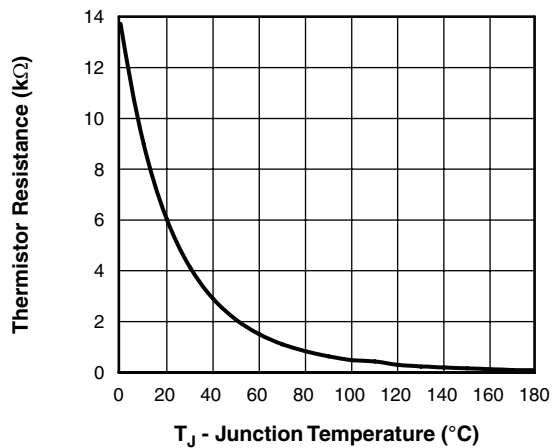
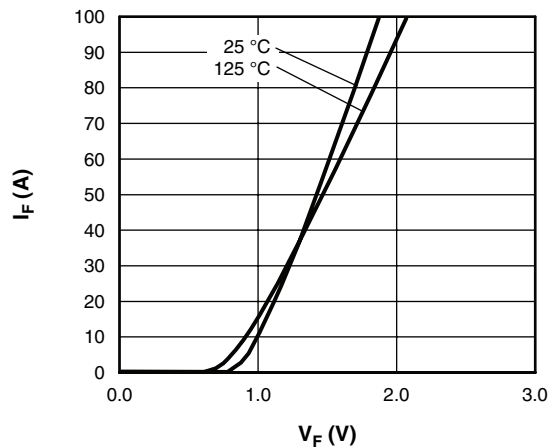

 Fig. 13 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

 Fig. 14 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 25\text{ A}$

 Fig. 15 - Typical Diode I_{RR} vs. di/dt
 $V_{CC} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $I_F = 25\text{ A}$; $T_J = 125^\circ\text{C}$
THERMISTOR


Fig. 16 - Thermistor Resistance vs. Temperature

INPUT RECTIFIER

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

INVERTER

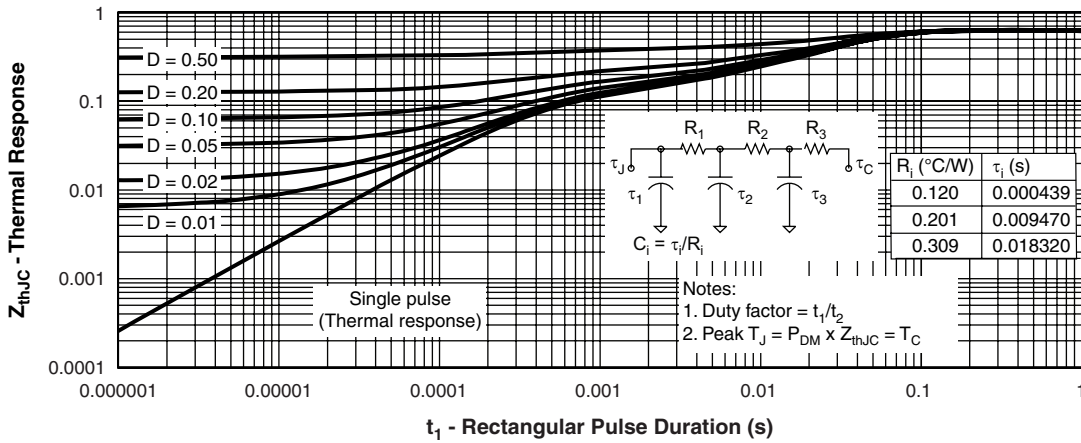


Fig. 18 - Maximum Transient Thermal Impedance, Junction to Case (Inverter IGBT)

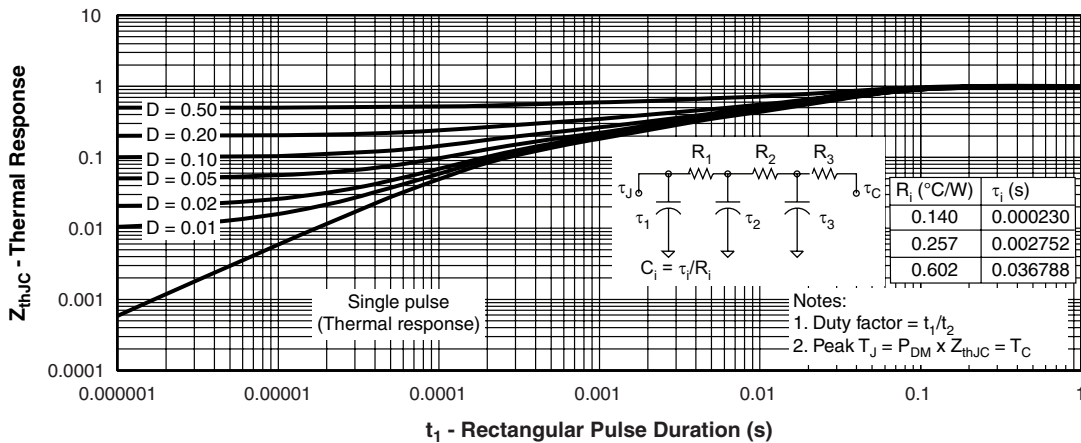


Fig. 19 - Maximum Transient Thermal Impedance, Junction to Case (Inverter FRED)

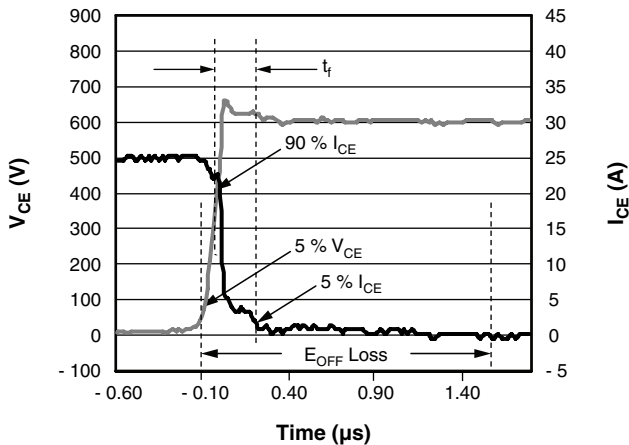


Fig. WF1 - Typical Turn-Off Loss Waveform at $T_J = 125^{\circ}\text{C}$ using Fig. C.T.4

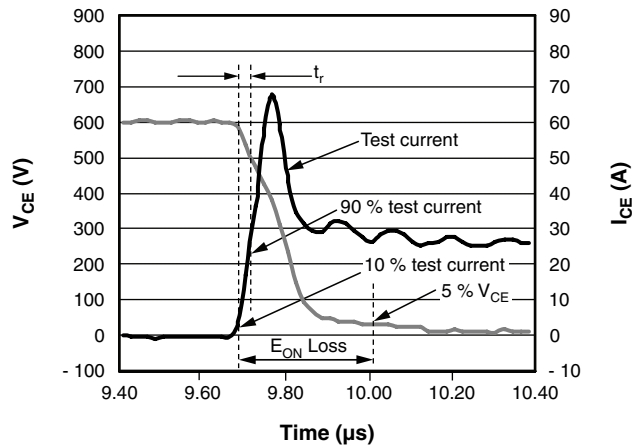


Fig. WF2 - Typical Turn-On Loss Waveform at $T_J = 125^{\circ}\text{C}$ using Fig. C.T.4

BRAKE

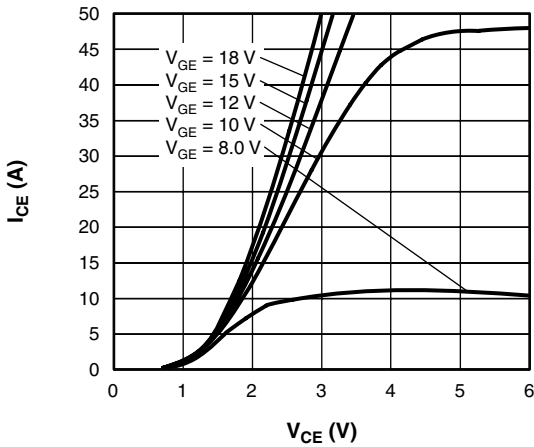


Fig. 20 - Typical IGBT Output Characteristics
 $T_J = 25\text{ }^\circ\text{C}$; $t_p = 80\text{ }\mu\text{s}$

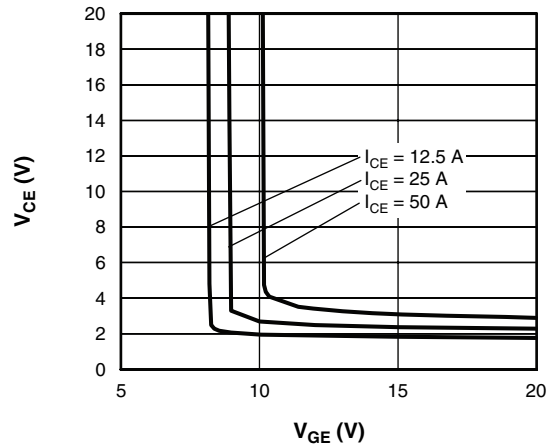


Fig. 23 - Typical V_{CE} vs. V_{GE}
 $T_J = 25\text{ }^\circ\text{C}$

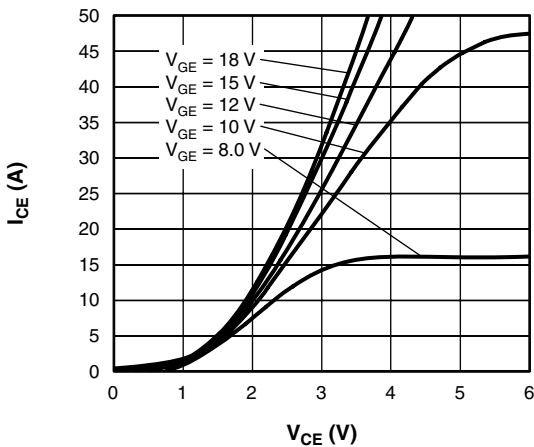


Fig. 21 - Typical IGBT Output Characteristics
 $T_J = 125\text{ }^\circ\text{C}$; $t_p = 80\text{ }\mu\text{s}$

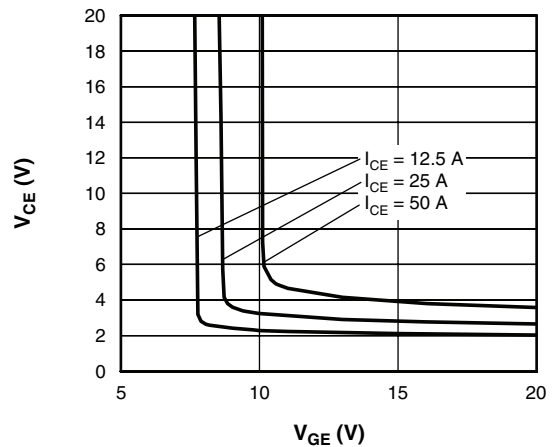


Fig. 24 - Typical V_{CE} vs. V_{GE}
 $T_J = 125\text{ }^\circ\text{C}$

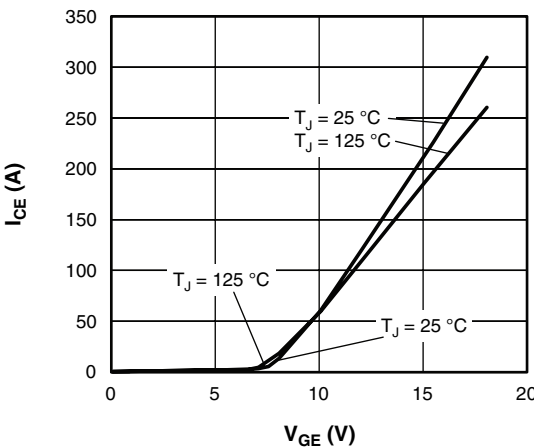


Fig. 22 - Typical Transfer Characteristics
 $V_{CE} = 50\text{ V}$; $t_p = 10\text{ }\mu\text{s}$

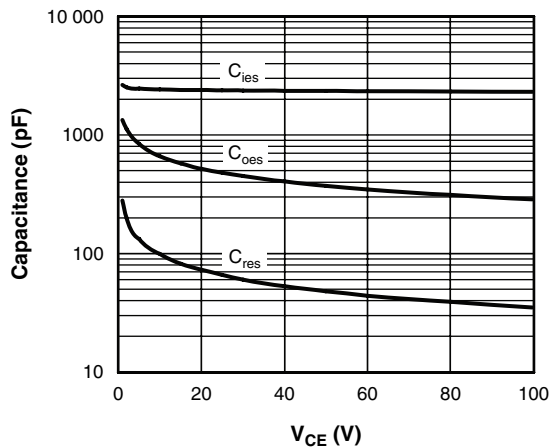


Fig. 25 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

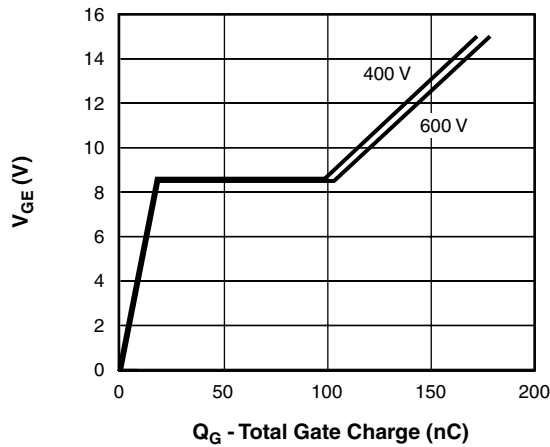


Fig. 26 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 25 \text{ A}$; $L = 1 \text{ mH}$

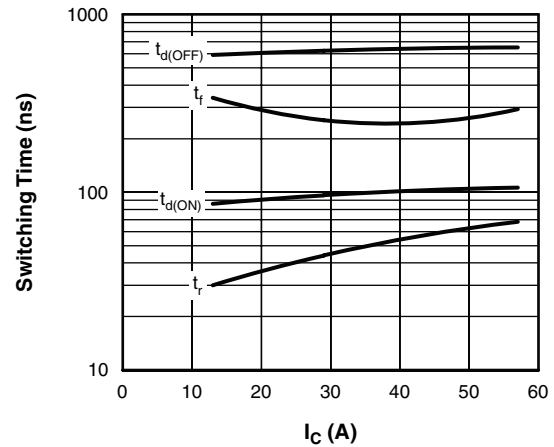


Fig. 29 - Typical Switching Time vs. I_C
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$; $R_G = 10 \text{ } \Omega$; $V_{GE} = 15 \text{ V}$

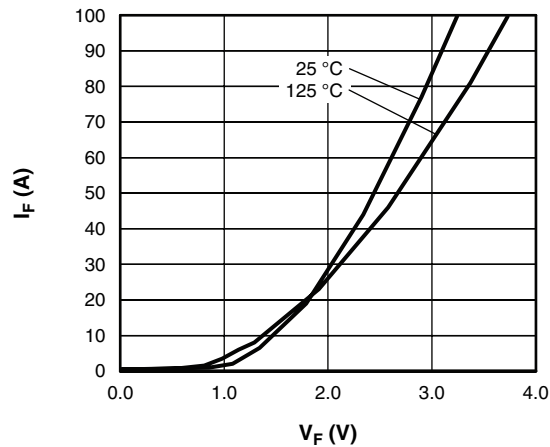


Fig. 27 - Typical Diode Forward Characteristics
 $t_p = 80 \text{ } \mu\text{s}$

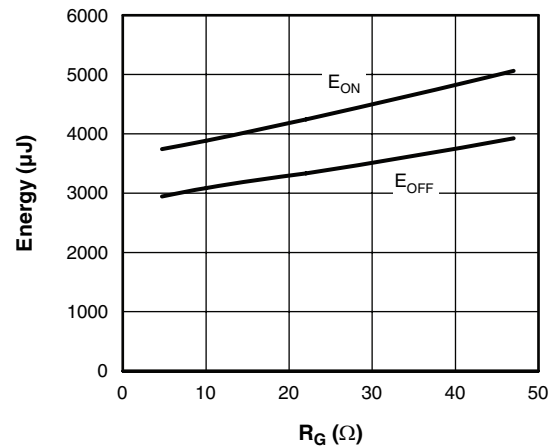


Fig. 30 - Typical Energy Loss vs. R_G
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$; $I_{CE} = 25 \text{ A}$; $V_{GE} = 15 \text{ V}$

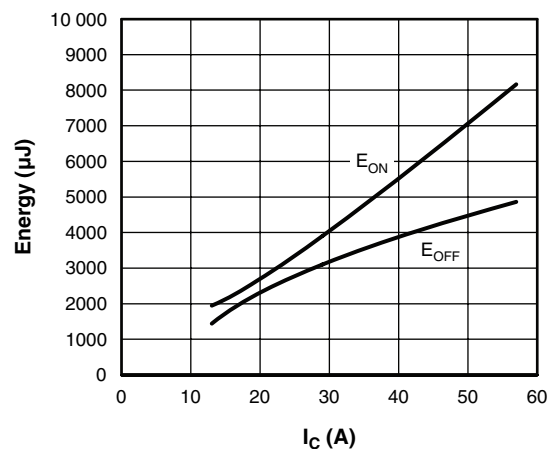


Fig. 28 - Typical Energy Loss vs. I_C
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$; $R_G = 10 \text{ } \Omega$; $V_{GE} = 15 \text{ V}$

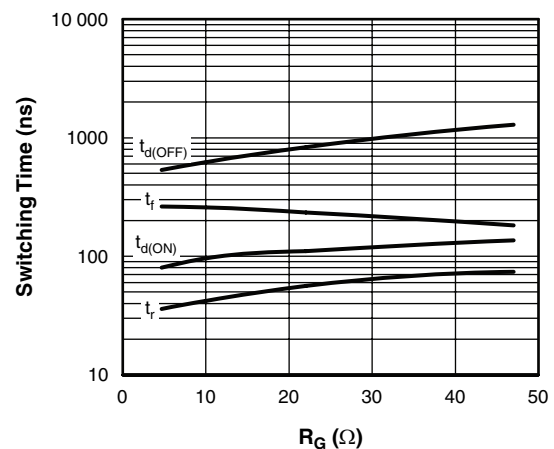


Fig. 31 - Typical Switching Time vs. R_G
 $T_J = 125 \text{ }^\circ\text{C}$; $L = 400 \text{ } \mu\text{H}$; $V_{CE} = 600 \text{ V}$; $I_{CE} = 25 \text{ A}$; $V_{GE} = 15 \text{ V}$

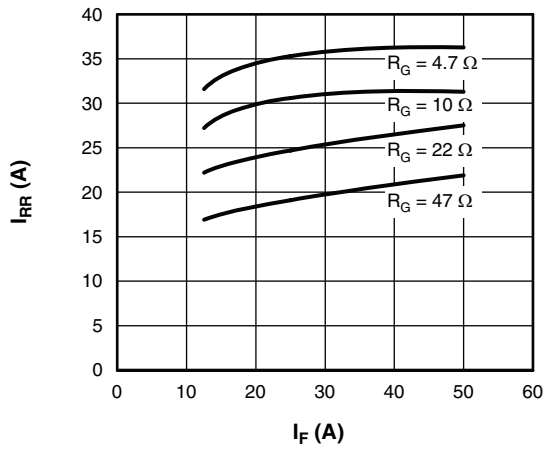


Fig. 32 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

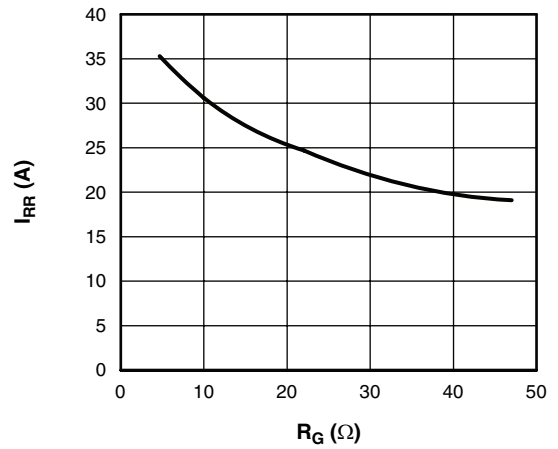


Fig. 33 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 25\text{ A}$

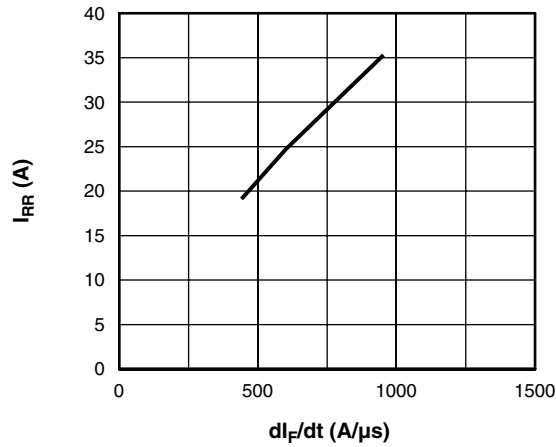


Fig. 34 - Typical Diode I_{RR} vs. di/dt
 $V_{CC} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $T_J = 125^\circ\text{C}$; $I_F = 25\text{ A}$

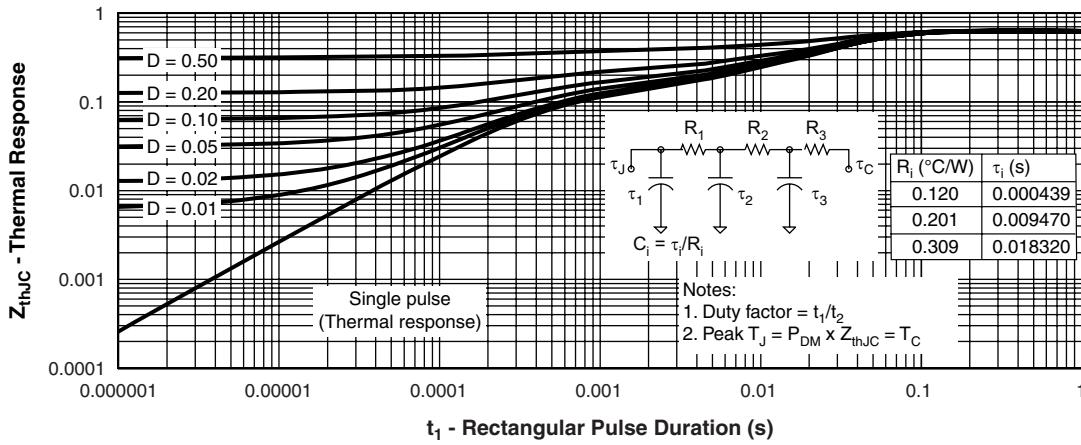


Fig. 35 - Maximum Transient Thermal Impedance, Junction to Case (Brake IGBT)

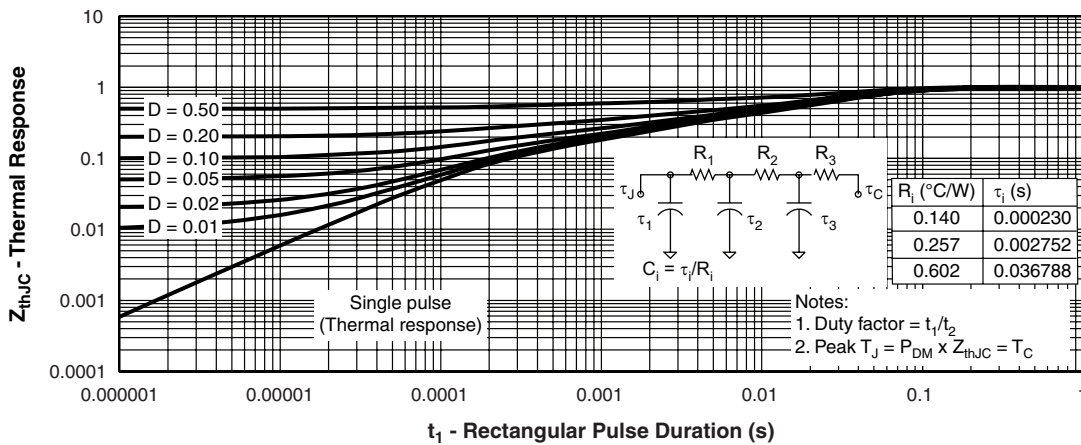


Fig. 36 - Maximum Transient Thermal Impedance, Junction to Case (Brake Diode)

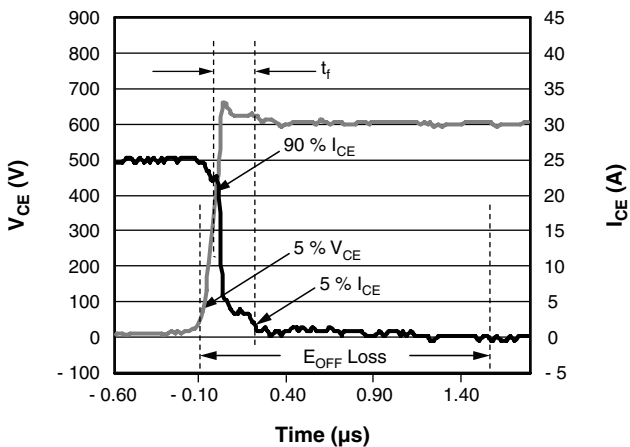


Fig. WF3 - Typical Turn-Off Loss Waveform at $T_J = 125^{\circ}\text{C}$ using Fig. C.T.4

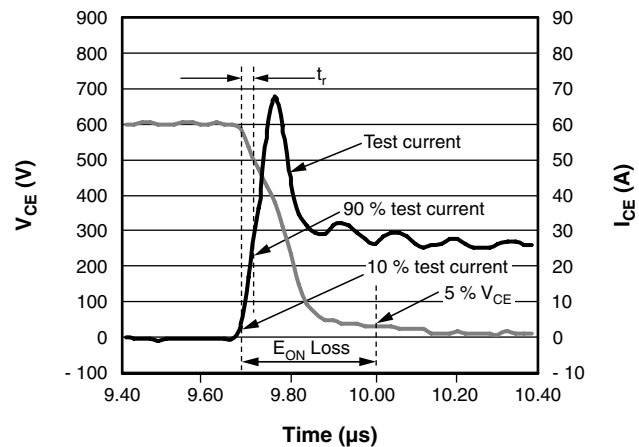


Fig. WF4 - Typical Turn-On Loss Waveform at $T_J = 125^{\circ}\text{C}$ using Fig. C.T.4

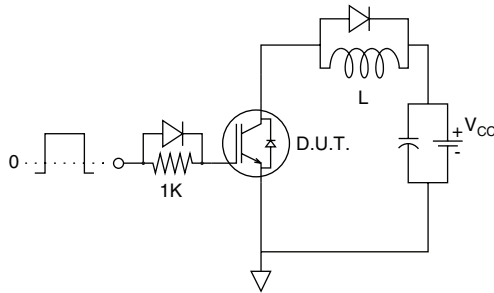


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

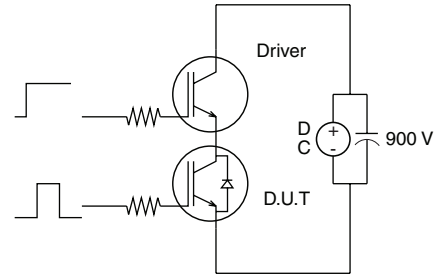


Fig. C.T.3 - S.C. SOA Circuit

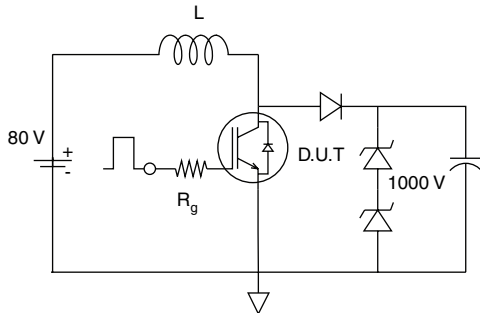


Fig. C.T.2 - RBSOA Circuit

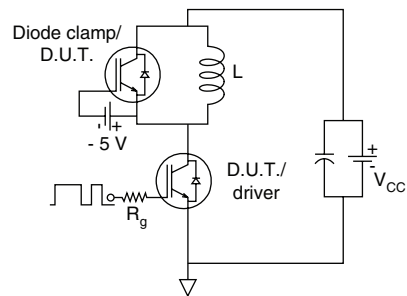


Fig. C.T.4 - Switching Loss Circuit

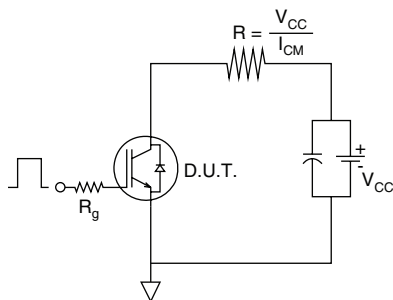
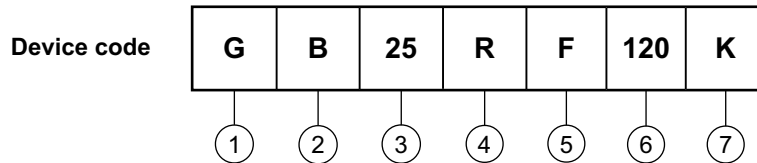


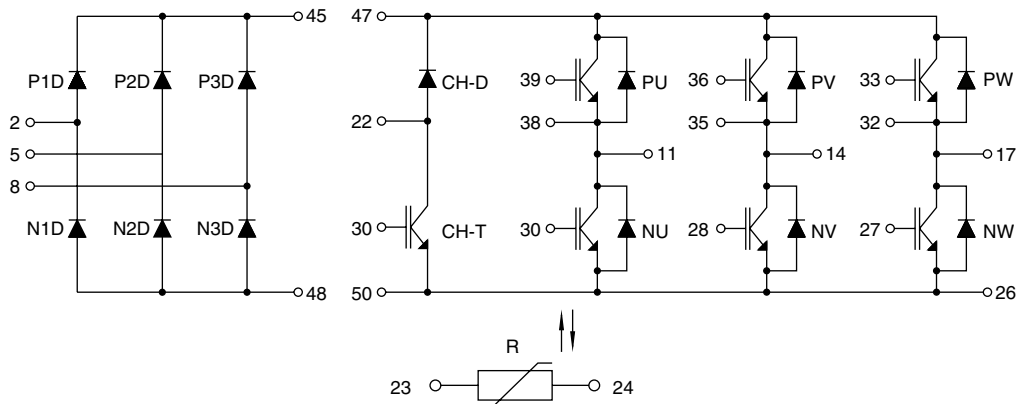
Fig. C.T.5 - Resistive Load Circuit

ORDERING INFORMATION TABLE



- 1** - Insulated Gate Bipolar Transistor (IGBT)
- 2** - IGBT Generation 5 NPT
- 3** - Current rating (25 = 25 A)
- 4** - Circuit configuration
(R = Three phase bridge-brake-inverter with thermistor)
- 5** - Package (F = ECONO2)
- 6** - Voltage rating (120 = 1200 V)
- 7** - Ultrafast (Speed 8 to 60 kHz)

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	http://www.vishay.com/doc?95083
Part marking information	http://www.vishay.com/doc?95071



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