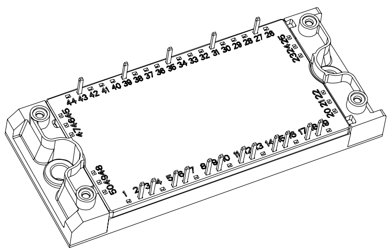
IGBT Sixpack Module, 35 A



ECONO2 6PACK

FEATURES

- Low diode V_F
- 10 µs short circuit capability
- Square RBSOA
- Low $V_{CE(on)}$ non punch through IGBT technology
- 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

Pb-free
RoHS COMPLIANT

PRODUCT SUMMARY	
V_{CES}	1200 V
$V_{CE(on)}$ (typical)	2.40 V
t_{sc} at T_J = 150 °C	> 10 µs
I_C at T_C = 80 °C	35 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
- UL approved E78996

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		1200	V
Continuous collector current	I_C	T_C = 25 °C	50	A
		T_C = 80 °C	35	
Pulsed collector current See fig. C.T.5	I_{CM}		100	
Clamped inductive load current	I_{LM}		100	
Diode continuous forward current	I_F	T_C = 25 °C	50	
		T_C = 80 °C	35	
Pulsed diode maximum forward current	I_{FM}		100	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT and DIODE)	P_D	T_C = 25 °C	284	W
		T_C = 80 °C	159	
Maximum operating junction temperature	T_J		150	°C
Storage temperature range	T_{Stg}		- 40 to + 125	
Isolation voltage	V_{ISOL}		AC 2500 (minimum)	V

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$BV_{(CES)}$	V_{GE} = 0 V, I_C = 500 µA	1200	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1 mA (25 °C to 125 °C)	-	0.7	-	V/°C
Collector to emitter voltage	$V_{CE(ON)}$	I_C = 35 A, V_{GE} = 15 V	-	2.40	2.60	V
		I_C = 50 A, V_{GE} = 15 V	-	2.75	3.00	
		I_C = 35 A, V_{GE} = 15 V, T_J = 125 °C	-	2.80	-	
		I_C = 50 A, V_{GE} = 15 V, T_J = 125 °C	-	3.30	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 µA	4.0	5.25	6.0	
Threshold voltage temperature coefficient	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	- 11	-	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	-	500	-	
Diode forward voltage drop	V_{FM}	I_F = 35 A	-	1.90	2.35	V
		I_F = 50 A	-	2.15	2.65	
		I_F = 35 A, T_J = 125 °C	-	2.00	-	
		I_F = 50 A, T_J = 125 °C	-	2.35	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_G	I_C = 35 A V_{CC} = 600 V V_{GE} = 15 V	-	255	385	nC
Gate to emitter charge (turn-on)	Q_{GE}		-	25	40	
Gate to collector charge (turn-on)	Q_{GC}		-	125	90	
Turn-on switching loss	E_{on}	I_C = 35 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 10 Ω, L = 400 µH T_J = 25 °C (1)	-	2.70	4.08	mJ
Turn-off switching loss	E_{off}		-	2.50	3.78	
Total switching loss	E_{tot}		-	5.20	7.85	
Turn-on switching loss	E_{on}	I_C = 35 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 10 Ω, L = 400 µH T_J = 125 °C (1)	-	3.75	5.45	
Turn-off switching loss	E_{off}		-	3.68	5.10	
Total switching loss	E_{tot}		-	7.43	10.55	
Turn-on delay time	$t_{d(ON)}$	I_C = 35 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 10 Ω, L = 400 µH T_J = 125 °C	-	50	65	ns
Rise time	t_r		-	35	50	
Turn-off delay time	$t_{d(OFF)}$		-	415	560	
Fall time	t_f		-	230	300	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	3475	-	pF
Output capacitance	C_{oes}		-	615	-	
Reverse transfer capacitance	C_{res}		-	90	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 100 A R_G = 10 Ω, V_{GE} = 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T_J = 150 °C V_{CC} = 900 V, V_P = 1200 V R_G = 10 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 = 35 A, L = 400 µH V_{GE} = 15 V, R_G = 10 Ω	-	73	-	A

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

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Junction to case IGBT	R_{thJC}	-	-	0.44	°C/W
Junction to case DIODE		-	-	0.80	
Case to sink, flat, greased surface MODULE	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

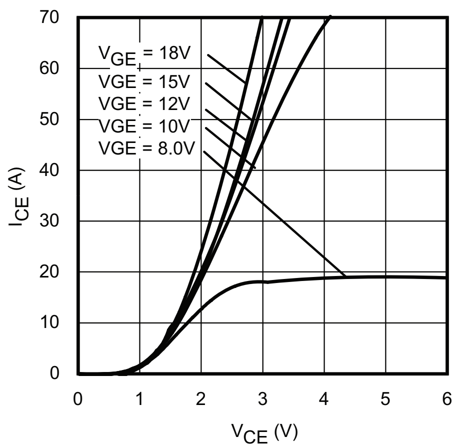


Fig. 1 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 µs

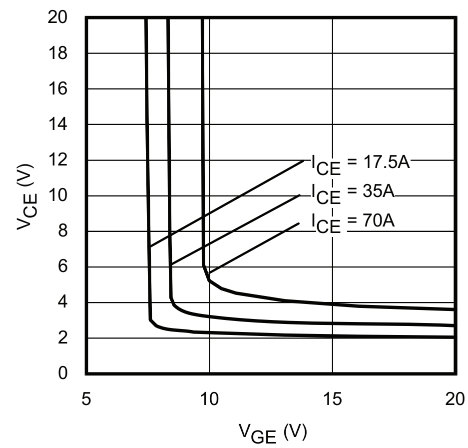


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

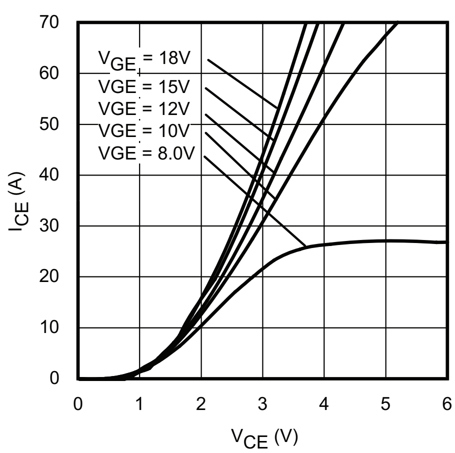


Fig. 2 - Typical IGBT Output Characteristics
T_J = 125 °C, t_p = 80 µs

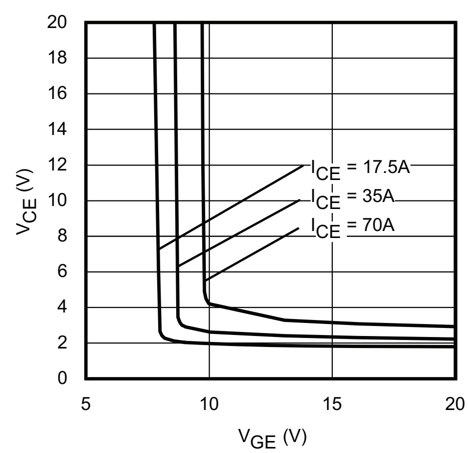


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

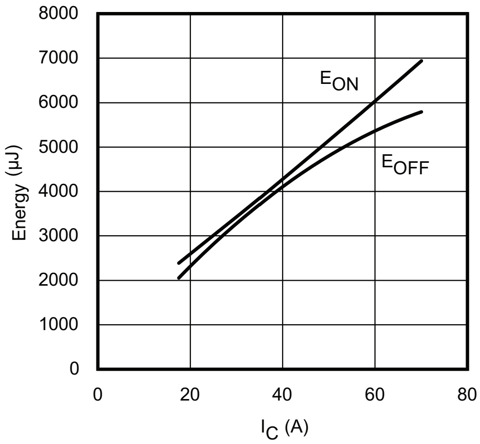


Fig. 5 - Typical Energy Loss vs. I_C
T_J = 125 °C; L = 400 µH; V_{CE} = 600 V
R_G = 10 Ω; V_{GE} = 15 V

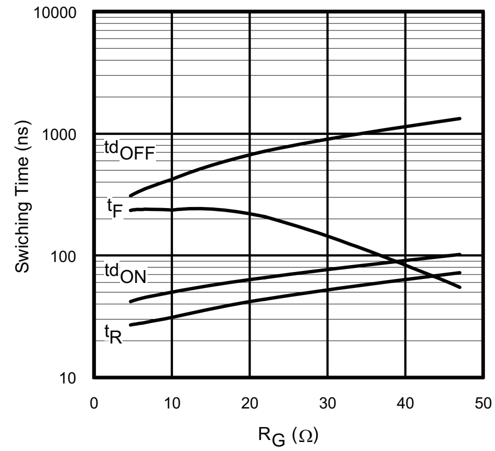


Fig. 8 - Typical Switching Time vs. R_G
T_J = 125 °C; L = 400 µH; V_{CE} = 600 V
I_{CE} = 35 A; V_{GE} = 15 V

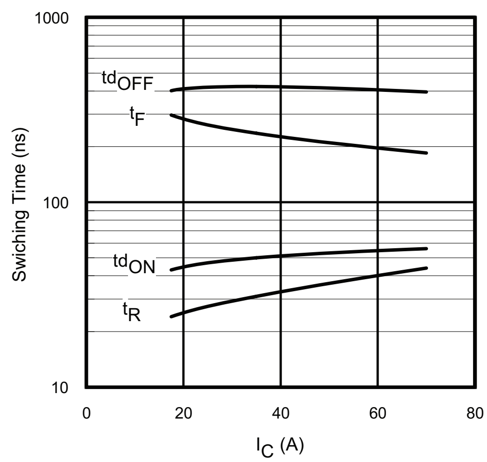


Fig. 6 - Typical Switching Time vs. I_C
T_J = 125 °C; L = 400 µH; V_{CE} = 600 V
R_G = 10 Ω; V_{GE} = 15 V

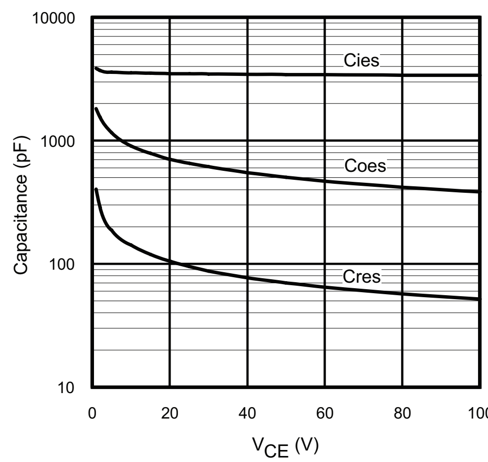


Fig. 9 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

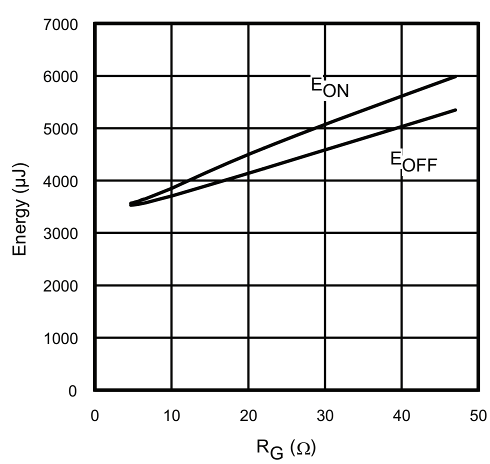


Fig. 7 - Typical Energy Loss vs. R_G
T_J = 125 °C; L = 400 µH; V_{CE} = 600 V
I_{CE} = 35 A; V_{GE} = 15 V

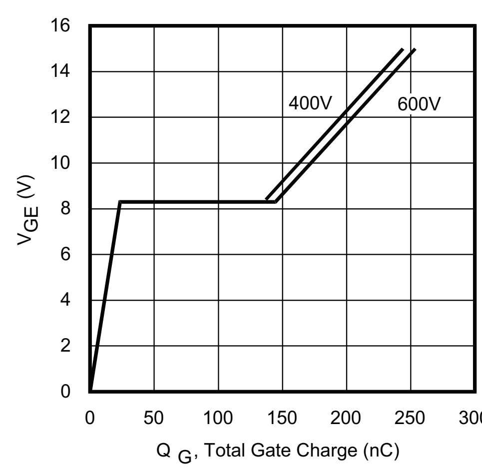


Fig. 10 - Typical Gate Charge vs. V_{GE}
I_{CE} = 35 A; L = 600 µH

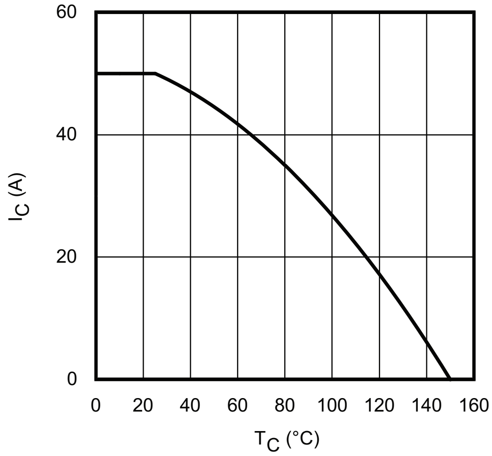


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

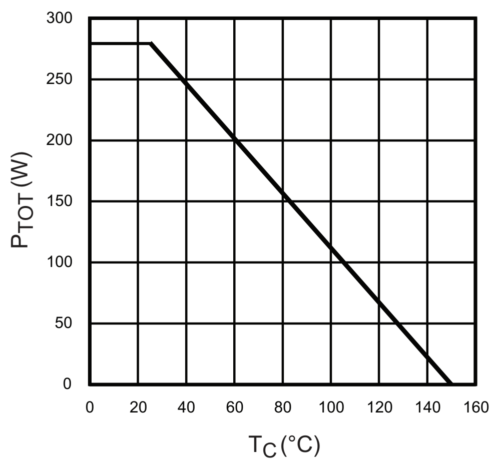


Fig. 12 - Power Dissipation vs. Case Temperature

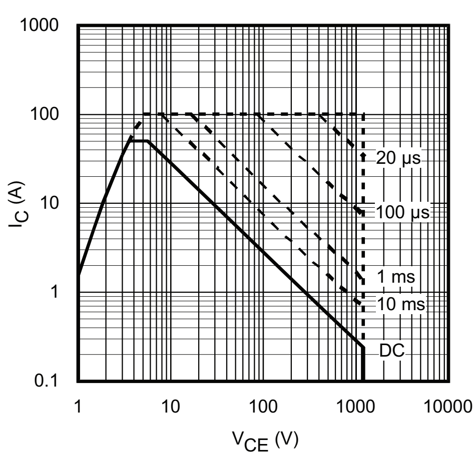


Fig. 13 - Forward SOA
T_C = 25 °C; $T_J \leq$ 150 °C

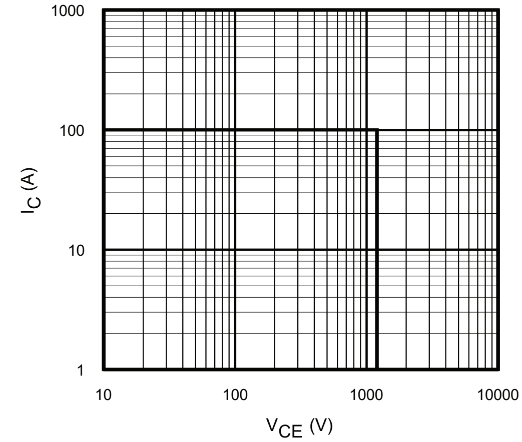


Fig. 14 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

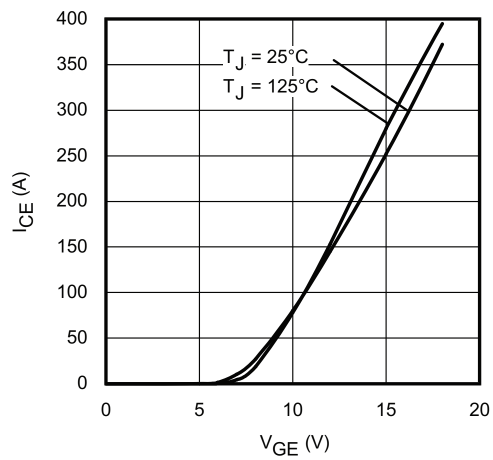


Fig. 15 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

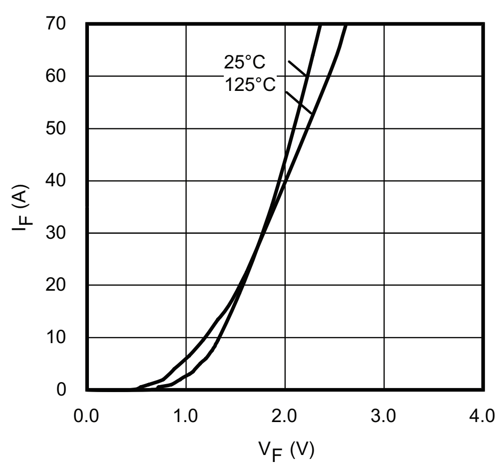


Fig. 16 - Typical Diode Forward Characteristics
t_p = 80 µs

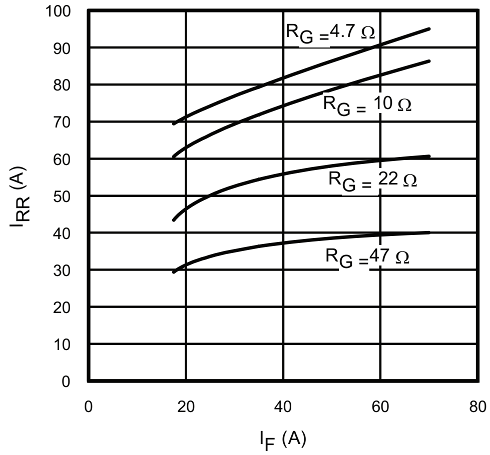


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125 °C

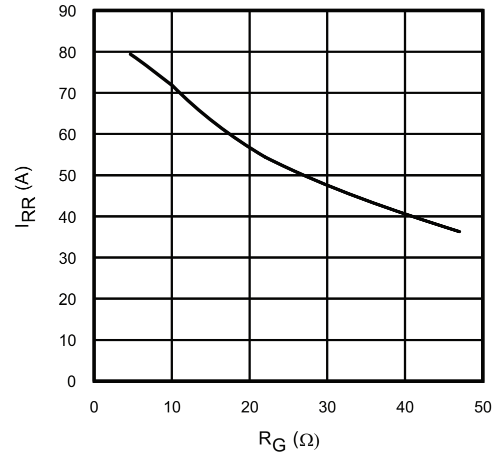


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125 °C; I_F = 35 A

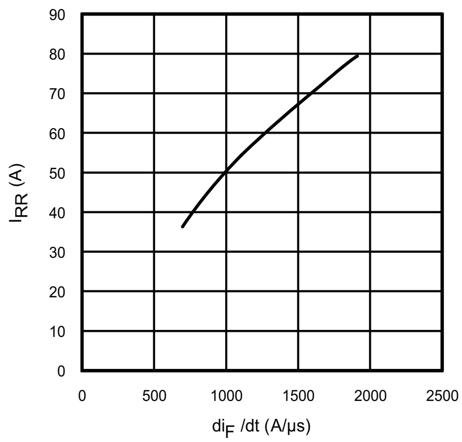


Fig. 19 - Typical Diode I_{RR} vs. dI_F/dt; V_{CC} = 600 V;
V_{GE} = 15 V; I_{CE} = 35 A; T_J = 125 °C

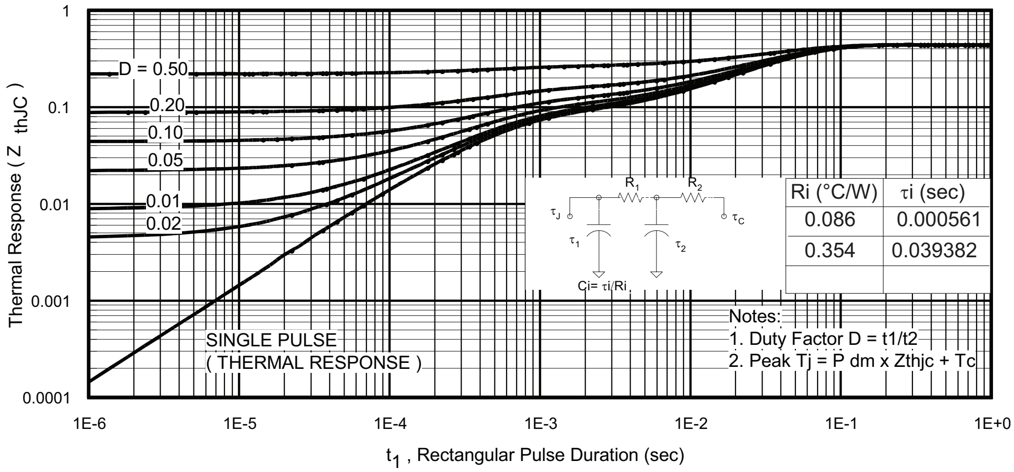


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

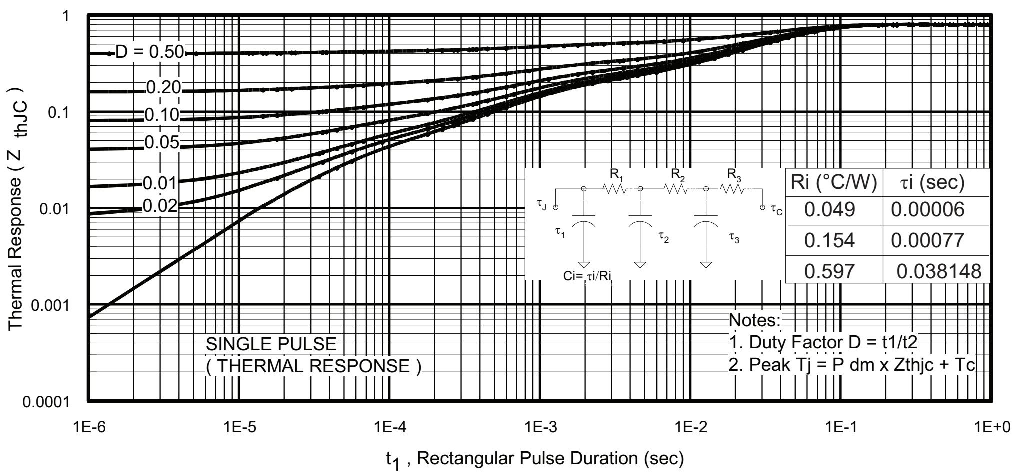


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

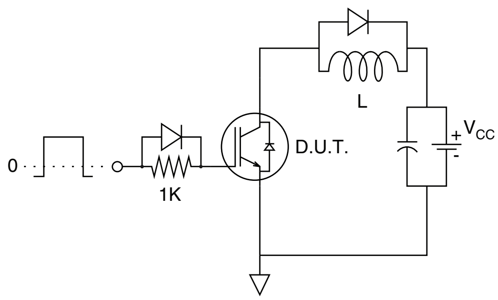


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

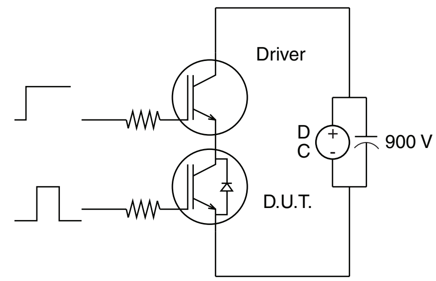


Fig. C.T.3 - S.C. SOA Circuit

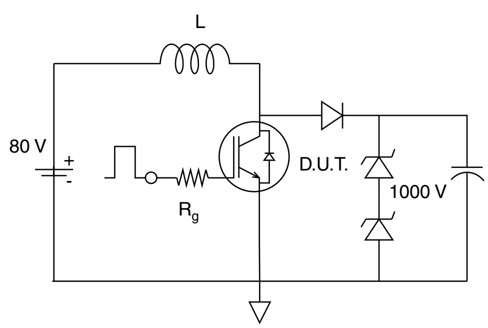


Fig. C.T.2 - RBSOA Circuit

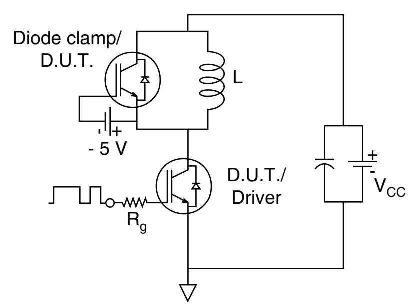


Fig. C.T.4 - Switching Loss Circuit

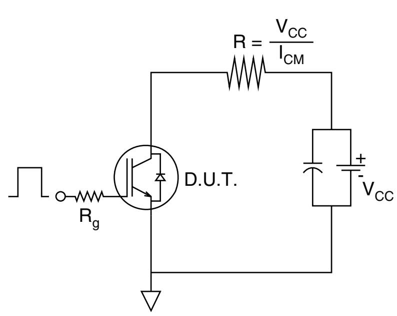


Fig. C.T.5 - Resistive Load Circuit

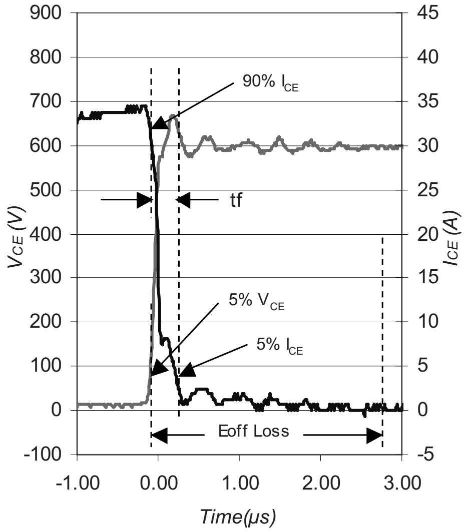


Fig. WF1 - Typical Turn-Off Loss Waveform at T_J = 125 °C using Fig. CT.4

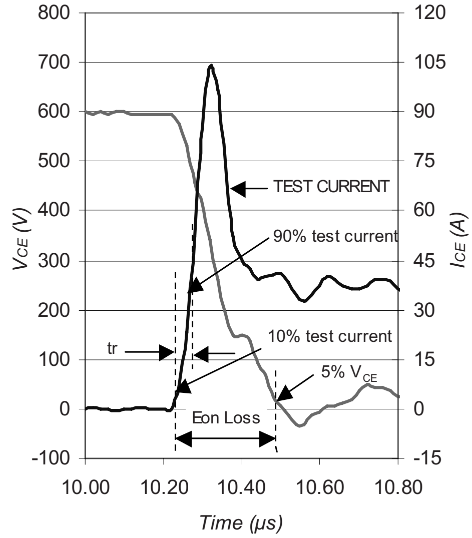


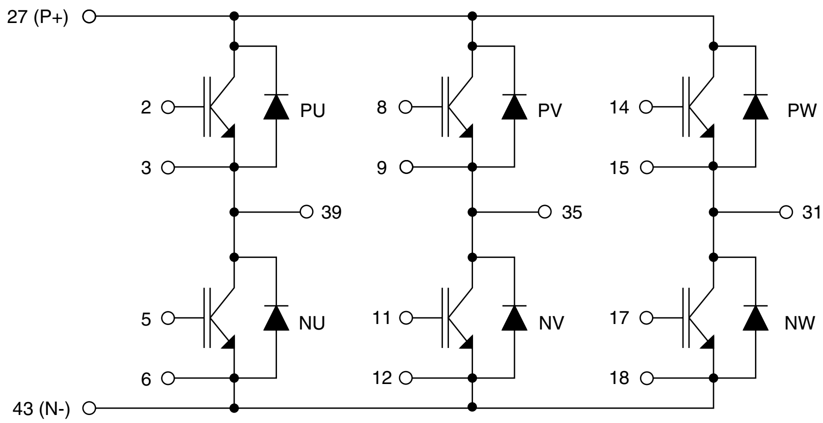
Fig. WF2 - Typical Turn-On Loss Waveform at T_J = 125 °C using Fig. CT.4

ORDERING INFORMATION TABLE

Device code	G	B	35	X	F	120	K
	1	2	3	4	5	6	7

1 - Insulated Gate Bipolar Transistor (IGBT)
2 - IGBT Generation 5 NPT
3 - Current rating (35 = 35 A)
4 - Circuit configuration
(X = Sixpack or three phase inverter)
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?95090
Part marking information	http://www.vishay.com/doc?95089

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