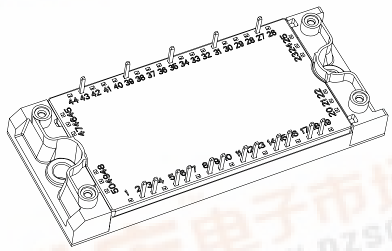
IGBT Sixpack Module, 48 A



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

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

PRODUCT SUMMARY	
V_{CES}	600 V
$V_{CE(on)}$ (typical)	1.89 V
t_{sc} at T_J = 150 °C	> 10 µs
I_C at T_C = 80 °C	48 A

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C	T_C = 25 °C	80	A
		T_C = 80 °C	48	
Pulsed collector current See fig. C.T.5	I_{CM}		160	
Clamped inductive load current	I_{LM}		160	
Diode continuous forward current	I_F	T_C = 25 °C	80	
		T_C = 80 °C	48	
Diode maximum forward current	I_{FM}		160	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT and Diode)	P_D	T_C = 25 °C	315	W
		T_C = 80 °C	177	
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	600	-	-	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)	-	0.73	-	V/°C
Collector to emitter voltage	$V_{CE(ON)}$	I_C = 50 A, V_{GE} = 15 V	-	1.89	2.30	V
		I_C = 100 A, V_{GE} = 15 V	-	2.56	3.24	
		I_C = 50 A, V_{GE} = 15 V, T_J = 125 °C	-	2.17	2.65	
		I_C = 100 A, V_{GE} = 15 V, T_J = 125 °C	-	3.05	3.93	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 µA	3.5	-	5.5	
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} = 600 V	-	-	100	µA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	750	-	
Diode forward voltage drop	V_{FM}	I_F = 50 A	-	1.34	1.68	V
		I_F = 100 A	-	1.62	2.19	
		I_F = 50 A, T_J = 125 °C	-	1.31	1.77	
		I_F = 100 A, T_J = 125 °C	-	1.65	2.43	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	100	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_G	I_C = 50 A V_{CC} = 460 V V_{GE} = 15 V	-	175	263	nC
Gate to emitter charge (turn-on)	Q_{GE}		-	22	33	
Gate to collector charge (turn-on)	Q_{GC}		-	86	129	
Turn-on switching loss	E_{on}	I_C = 50 A, V_{CC} = 300 V V_{GE} = 15 V, R_G = 10 Ω, L = 200 µH T_J = 25 °C (1)	-	0.25	0.38	mJ
Turn-off switching loss	E_{off}		-	0.55	0.83	
Total switching loss	E_{tot}		-	0.80	1.21	
Turn-on switching loss	E_{on}	I_C = 50 A, V_{CC} = 300 V V_{GE} = 15 V, R_G = 10 Ω, L = 200 µH T_J = 125 °C (1)	-	0.39	0.58	
Turn-off switching loss	E_{off}		-	0.82	1.23	
Total switching loss	E_{tot}		-	1.21	1.81	
Turn-on delay time	$t_{d(ON)}$	I_C = 50 A, V_{CC} = 300 V V_{GE} = 15 V, R_G = 10 Ω, L = 200 µH T_J = 125 °C	-	139	209	ns
Rise time	t_r		-	33	50	
Turn-off delay time	$t_{d(OFF)}$		-	164	246	
Fall time	t_f		-	84	126	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	3016	-	pF
Output capacitance	C_{oes}		-	742	-	
Reverse transfer capacitance	C_{res}		-	103	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 120 A R_G = 47 Ω, V_{GE} = 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	V_{CC} = 300 V, I_P = 370 A to 530 A 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} = 300 V, I_F = 10 A	-	67	-	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}	-	-	0.58	°C/W
Junction to case DIODE		-	-	1.25	
Case to sink, flat, greased surface	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

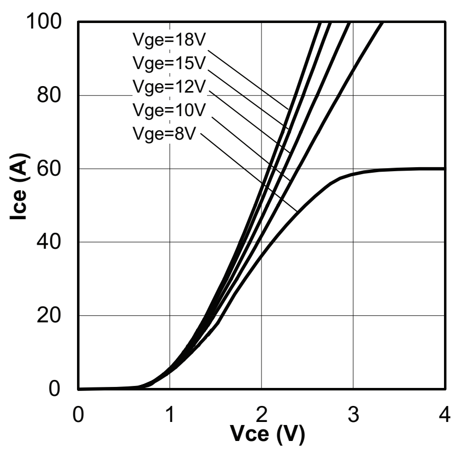


Fig. 1 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 µs

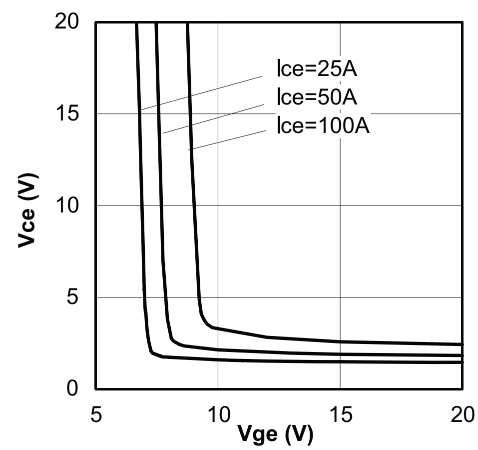


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

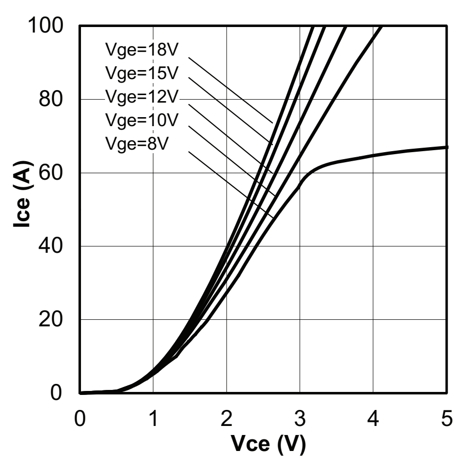


Fig. 2 - Typical IGBT Output Characteristics
T_J = 125 °C, t_p = 80 µs

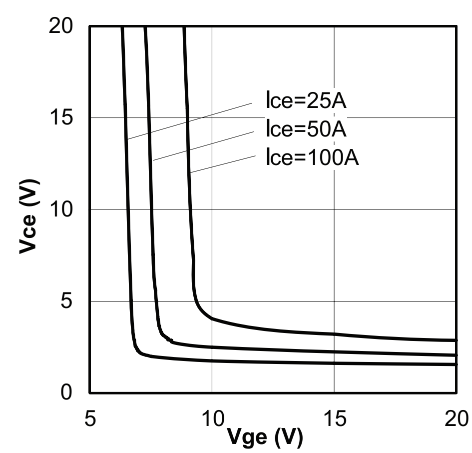


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

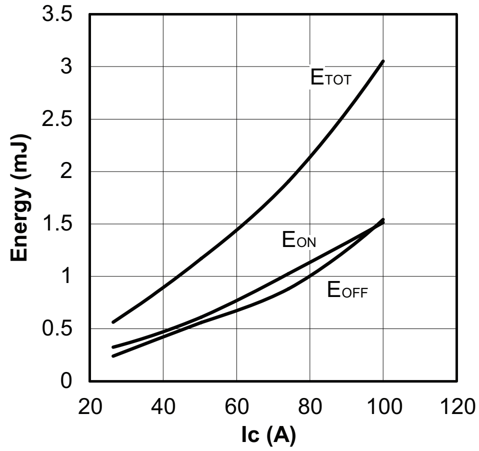


Fig. 5 - Typical Energy Loss vs. I_C
T_J = 125 °C; L = 200 µH; V_{CE} = 300 V,
R_G = 22 Ω; V_{GE} = 15 V

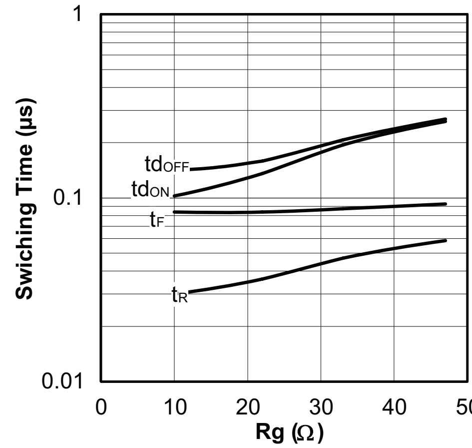


Fig. 8 - Typical Switching Time vs. R_G
T_J = 125 °C; L = 200 µH; V_{CE} = 300 V
I_{CE} = 50 A; V_{GE} = 15 V

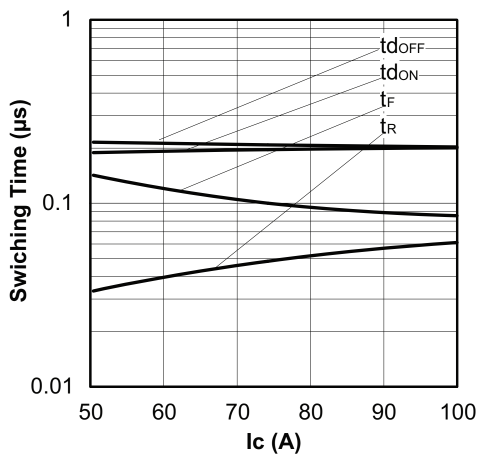


Fig. 6 - Typical Switching Time vs. I_C
T_J = 125 °C; L = 200 µH; V_{CE} = 300 V,
R_G = 22 Ω; V_{GE} = 15 V

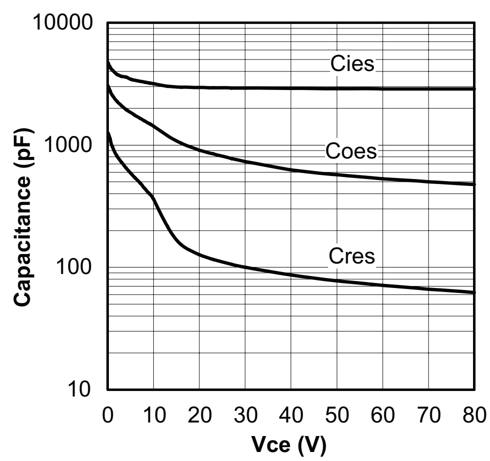


Fig. 9 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

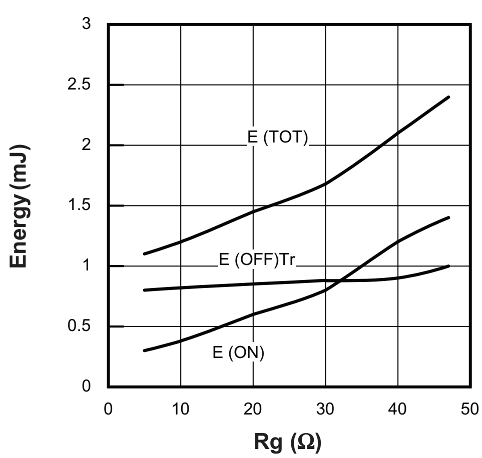


Fig. 7 - Typical Energy Loss vs. R_G
T_J = 125 °C; L = 200 µH; V_{CE} = 300 V
I_{CE} = 50 A; V_{GE} = 15 V

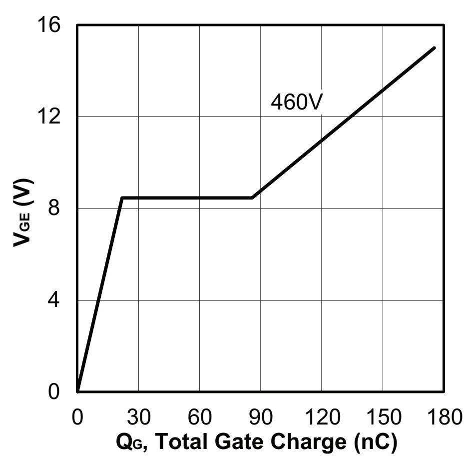


Fig. 10 - Typical Gate Charge vs. V_{GE}
I_{CE} = 50 A

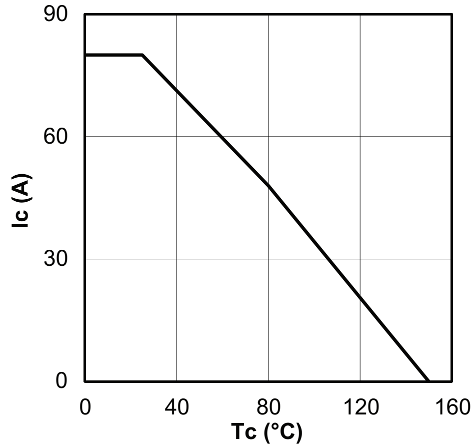


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

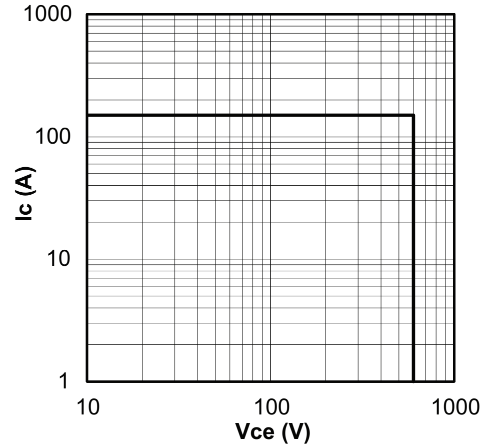


Fig. 14 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

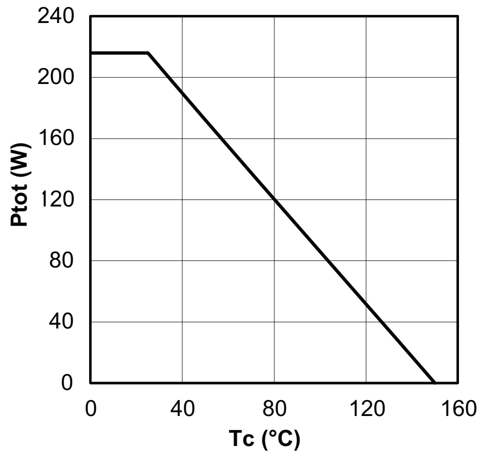


Fig. 12 - Power Dissipation vs. Case Temperature (IGBT only)

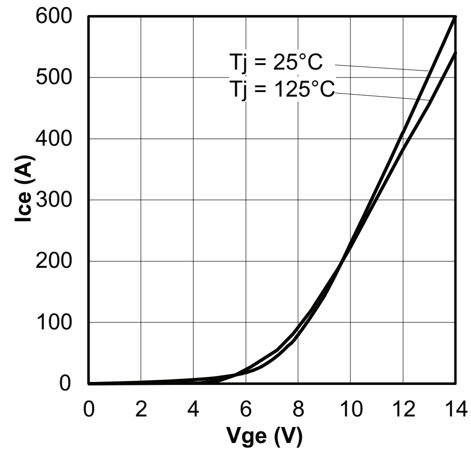


Fig. 15 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

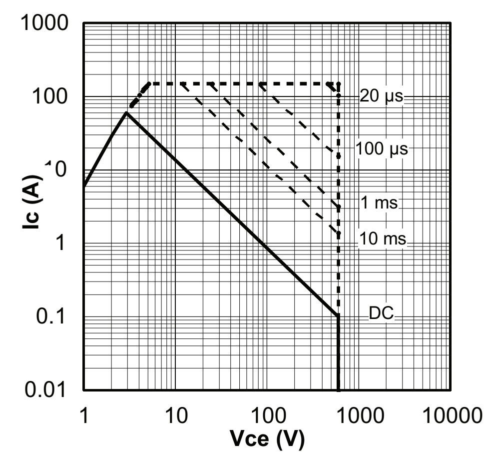


Fig. 13 - Forward SOA
T_C = 25 °C; $T_J \leq$ 150 °C

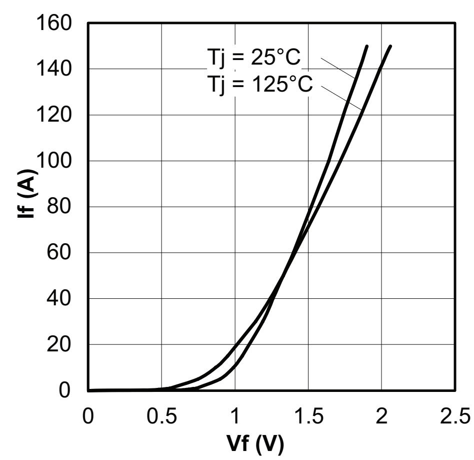


Fig. 16 - Typical Diode Forward Characteristics
t_p = 80 µs

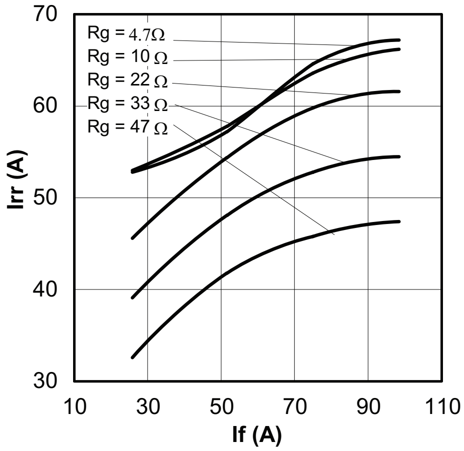


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125 °C

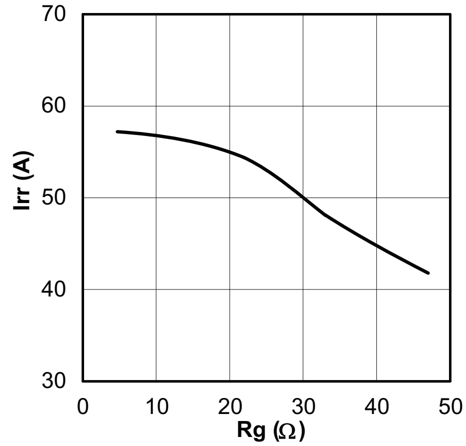


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125 °C; I_F = 10 A

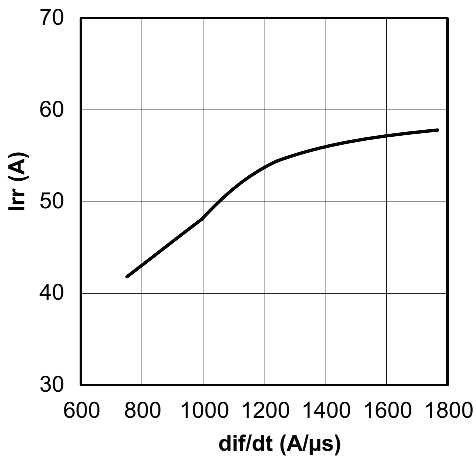


Fig. 19 - Typical Diode I_{RR} vs. dI_F/dt; V_{CC} = 300 V;
V_{GE} = 15 V; I_{CE} = 50 A; T_J = 125 °C

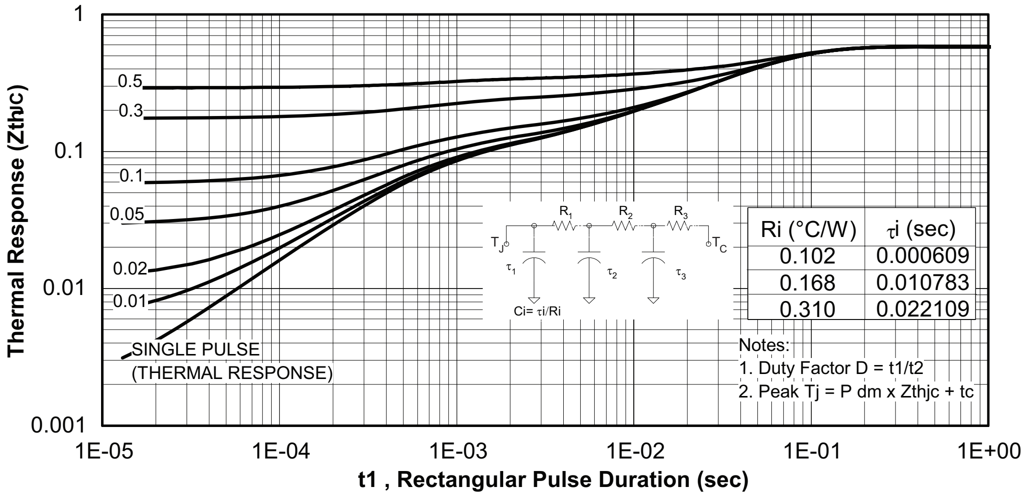


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

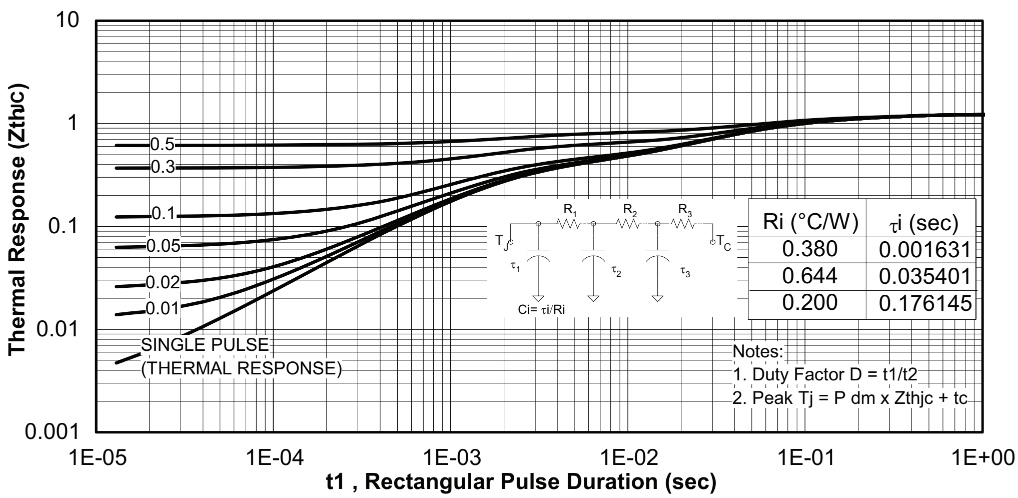


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

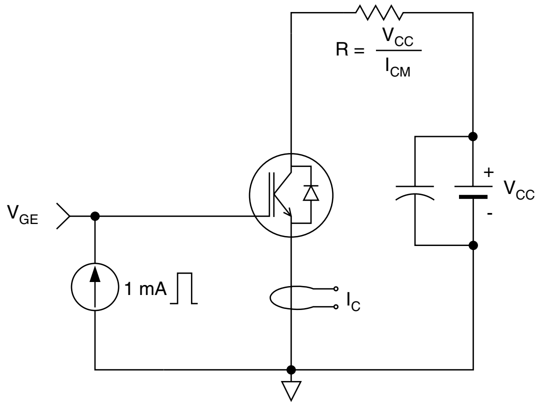


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

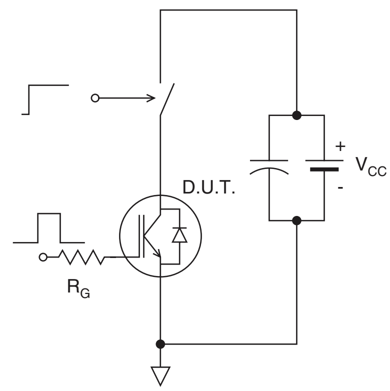


Fig. C.T.3 - S.C. SOA Circuit

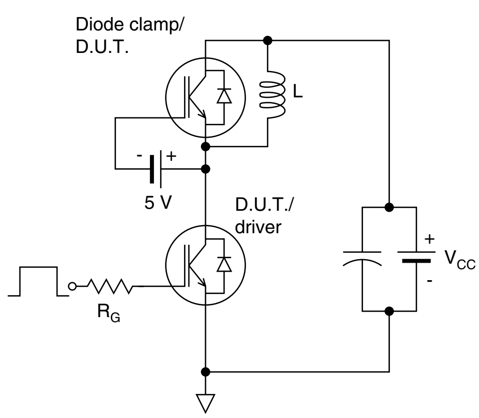


Fig. C.T.2 - RBSOA Circuit

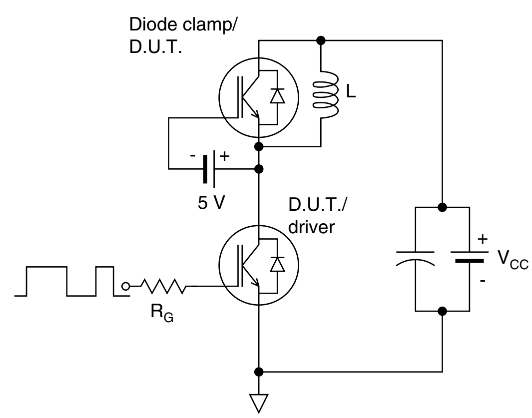


Fig. C.T.4 - Switching Loss Circuit

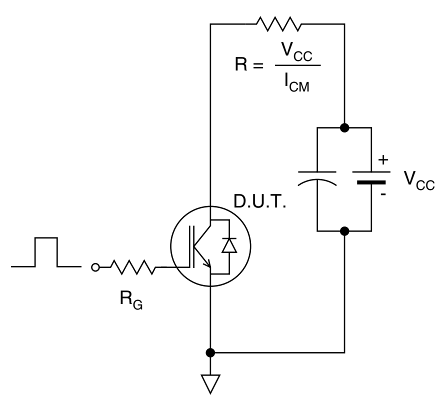


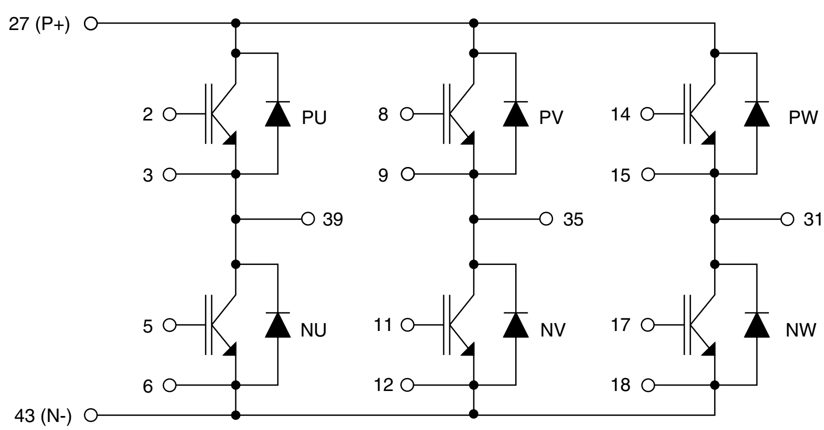
Fig. C.T.5 - Resistive Load Circuit

ORDERING INFORMATION TABLE

Device code	G	B	50	X	F	60	K
	1	2	3	4	5	6	7

1 - Insulated Gate Bipolar Transistor (IGBT)
2 - B = IGBT Generation 5 NPT
3 - Current rating (50 = 50 A)
4 - Circuit configuration (X = Sixpack or three phase inverter)
5 - Package indicator (F = ECONO2)
6 - Voltage rating (60 = 600 V)
7 - Speed/type (K = Ultrafast IGBT/Speed 8 to 60 kHz)

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	http://www.vishay.com/doc?95089
Part marking information	http://www.vishay.com/doc?95090

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