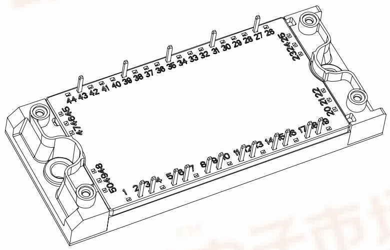
IGBT Sixpack Module, 13 A



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)	2.64 V
t_{sc} at T_J = 150 °C	> 10 µs
I_C at T_C = 80 °C	13 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	20	A
		T_C = 80 °C	13	A
Pulsed collector current See fig. C.T.5	I_{CM}		40	A
Clamped inductive load current	I_{LM}		40	A
Diode continuous forward current	I_F	T_C = 25 °C	20	A
		T_C = 80 °C	12	A
Pulsed diode maximum forward current	I_{FM}		40	A
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT and diode)	P_D	T_C = 25 °C	151	W
		T_C = 80 °C	85	W
Maximum operating junction temperature	T_J		150	°C
Storage temperature range	T_{Stg}		- 40 to + 125	°C
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)	-	0.87	-	V/°C
Collector to emitter voltage	$V_{CE(ON)}$	I_C = 10 A, V_{GE} = 15 V	-	2.64	2.85	V
		I_C = 20 A, V_{GE} = 15 V	-	3.59	3.94	
		I_C = 10 A, V_{GE} = 15 V, T_J = 125 °C	-	3.17	3.46	
		I_C = 20 A, V_{GE} = 15 V, T_J = 125 °C	-	4.48	4.97	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 µA	4	-	6	
Threshold voltage temperature coefficient	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	- 10.4	-	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	-	
Diode forward voltage drop	V_{FM}	I_F = 10 A	-	2.00	2.28	V
		I_F = 20 A	-	2.48	2.90	
		I_F = 10 A, T_J = 125 °C	-	2.16	2.51	
		I_F = 20 A, T_J = 125 °C	-	2.87	3.42	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	nA

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction to case IGBT	R_{thJC}	-	-	1.42	°C/W
Junction to case diode		-	-	1.97	
Case to sink, flat, greased surface	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

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 = 10 A V_{CC} = 600 V V_{GE} = 15 V	-	48	75	nC
Gate to emitter charge (turn-on)	Q_{GE}		-	8	15	
Gate to collector charge (turn-on)	Q_{GC}		-	22	33	
Turn-on switching loss	E_{ON}	I_C = 10 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 22 Ω, L = 1 mH T_J = 25 °C [1]	-	0.84	1.26	mJ
Turn-off switching loss	E_{OFF}		-	0.36	0.54	
Total switching loss	E_{TOT}		-	1.20	1.81	
Turn-on switching loss	E_{ON}	I_C = 10 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 22 Ω, L = 1 mH T_J = 125 °C [1]	-	1.14	1.71	
Turn-off switching loss	E_{OFF}		-	0.64	0.96	
Total switching loss	E_{TOT}		-	1.78	2.67	
Turn-on delay time	$t_{d(ON)}$	I_C = 10 A, V_{CC} = 600 V V_{GE} = 15 V, R_G = 22 Ω, L = 1 mH T_J = 125 °C	-	83	124	ns
Rise time	t_r		-	21	32	
Turn-off delay time	$t_{d(OFF)}$		-	115	172	
Fall time	t_f		-	279	420	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	750	1150	pF
Output capacitance	C_{oes}		-	190	290	
Reverse transfer capacitance	C_{res}		-	20	35	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 40 A R_G = 22 Ω, V_{GE} = 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T_J = 150 °C V_{CC} = 960 V, V_P = 1200 V R_G = 22 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 = 10 A, L = 1 mH V_{GE} = 15 V, R_G = 22 Ω	-	22	-	A

Note

[1] Energy losses include "tail" and diode reverse recovery

INVERTER

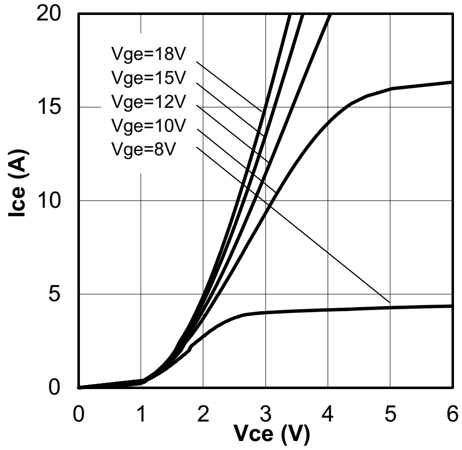


Fig. 1 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 µs

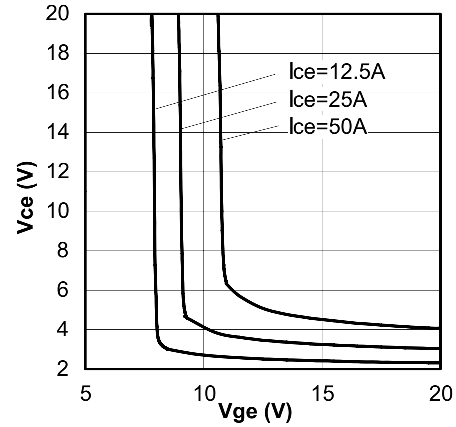


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

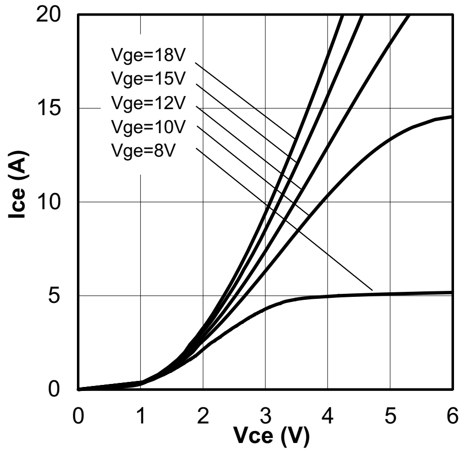


Fig. 2 - Typical IGBT Output Characteristics
T_J = 125 °C, t_p = 80 µs

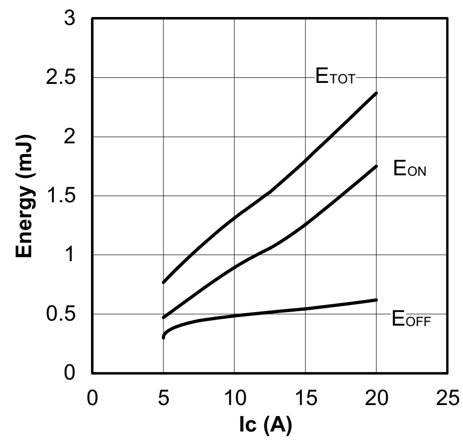


Fig. 5 - Typical Energy Loss vs. I_C
T_J = 125 °C; L = 1 mH; V_{CE} = 600 V
R_G = 22 Ω; V_{GE} = 15 V

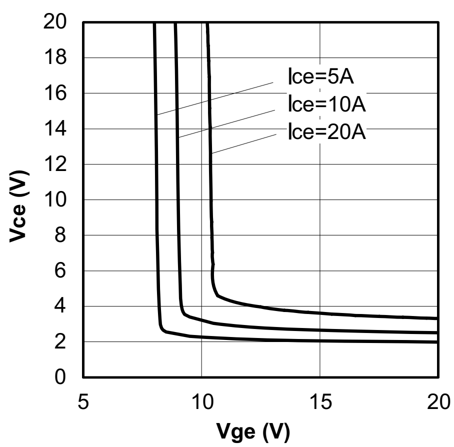


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

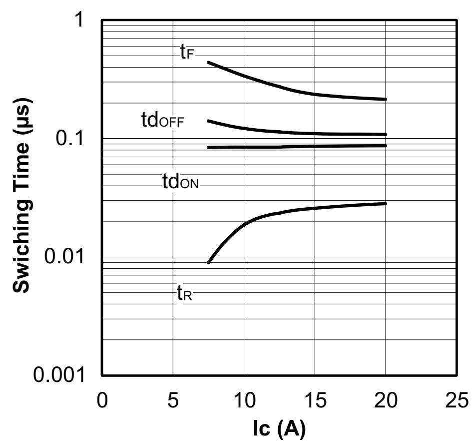


Fig. 6 - Typical Switching Time vs. I_C
T_J = 125 °C; L = 1 mH; V_{CE} = 600 V
R_G = 22 Ω; V_{GE} = 15 V

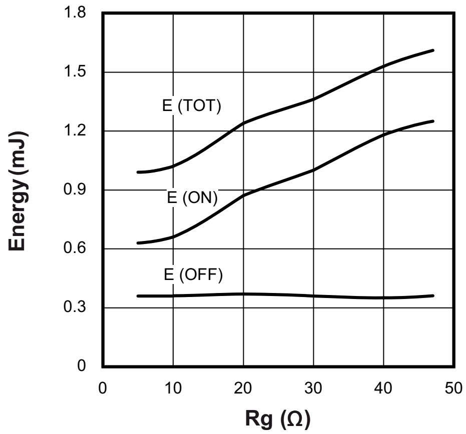


Fig. 7 - Typical Energy Loss vs. R_G
T_J = 125 °C; L = 1 mH; V_{CE} = 600 V
I_{CE} = 10 A; V_{GE} = 15 V

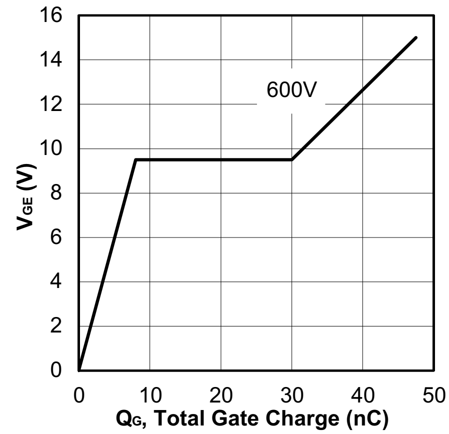


Fig. 10 - Typical Gate Charge vs. V_{GE}
I_{CE} = 10 A

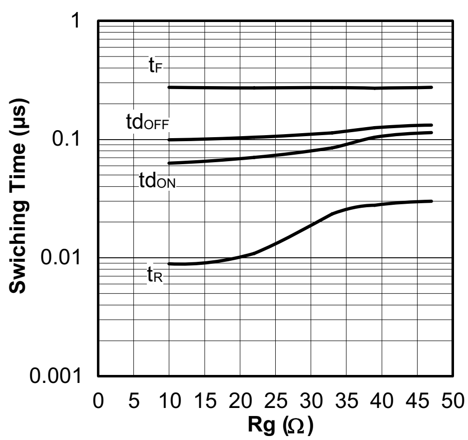


Fig. 8 - Typical Switching Time vs. R_G
T_J = 125 °C; L = 1 mH; V_{CE} = 600 V
I_{CE} = 10 A; V_{GE} = 15 V

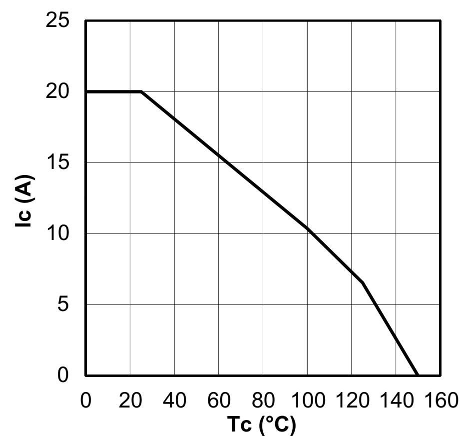


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

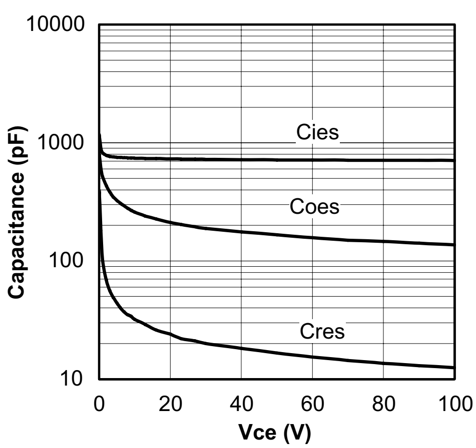


Fig. 9 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

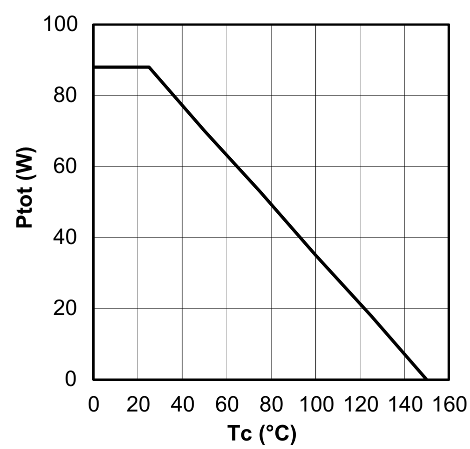


Fig. 12 - Power Dissipation vs. Case Temperature

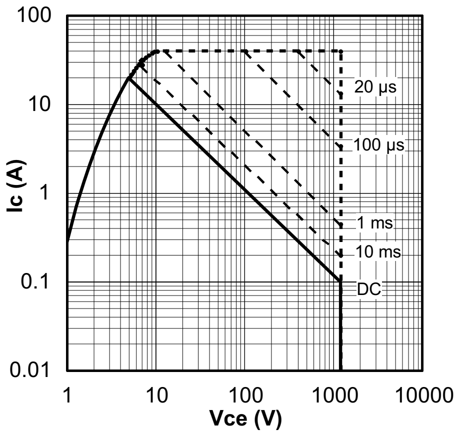


Fig. 13 - Forward SOA
T_C = 25 °C; $T_J \leq$ 150 °C

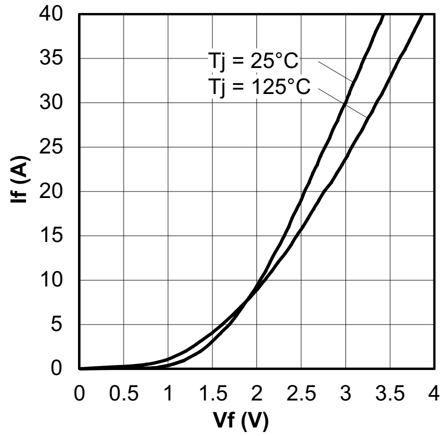


Fig. 16 - Typical Diode Forward Characteristics
t_p = 80 µs

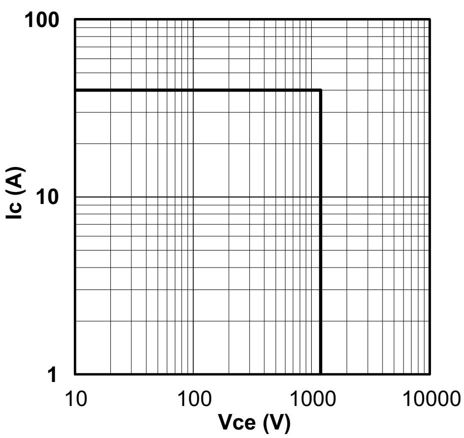


Fig. 14 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

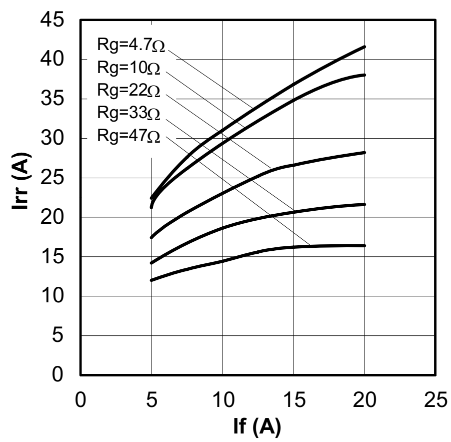


Fig. 17 - Typical Diode I_{RR} vs. I_F
T_J = 125 °C

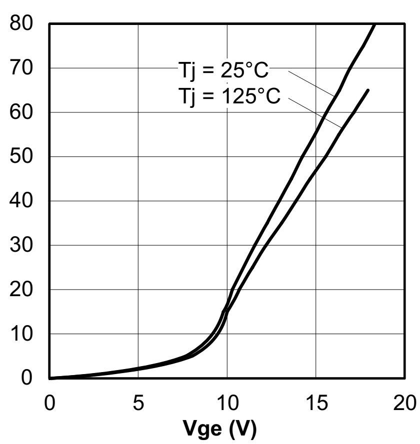


Fig. 15 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

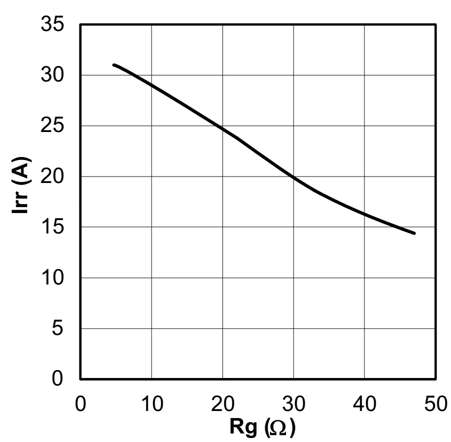


Fig. 18 - Typical Diode I_{RR} vs. R_G
T_J = 125 °C; I_F = 10 A

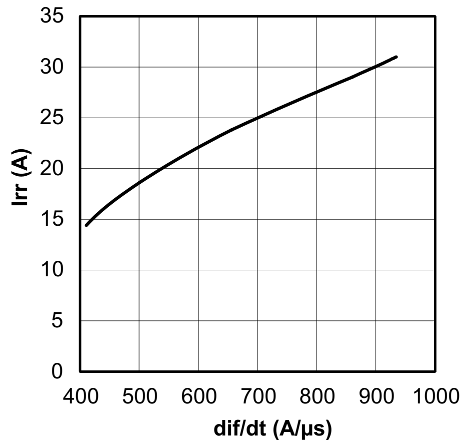


Fig. 19 - Typical Diode I_{RR} vs. dI_F/dt; V_{CC} = 600 V;
V_{GE} = 15 V; I_{CE} = 10 A; T_J = 125 °C

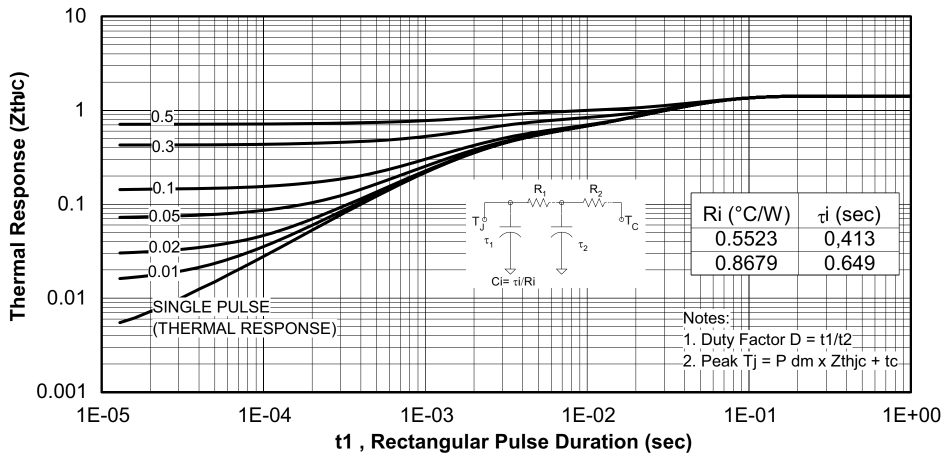


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

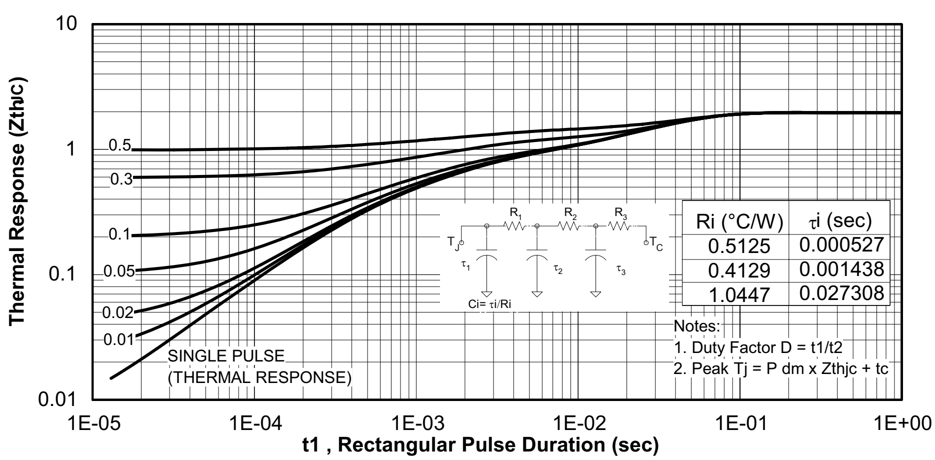


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

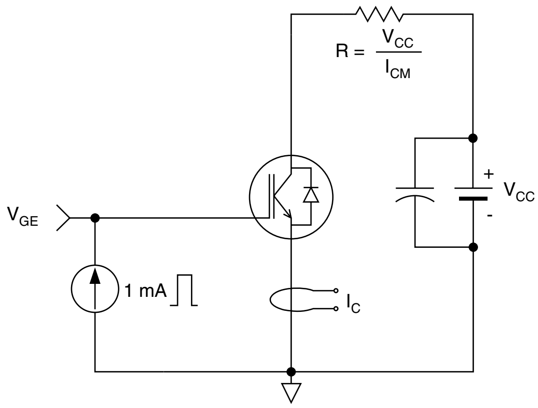


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

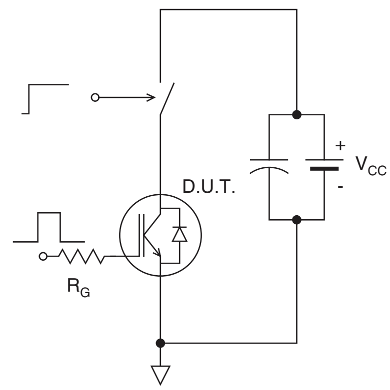


Fig. C.T.3 - S.C. SOA Circuit

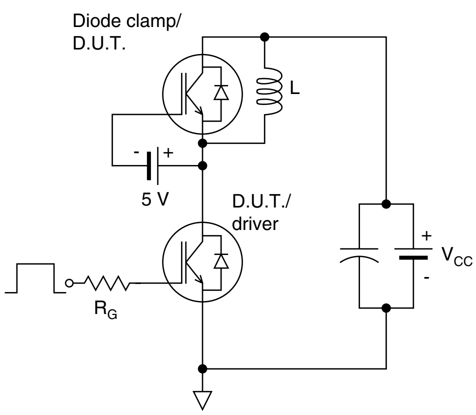


Fig. C.T.2 - RBSOA Circuit

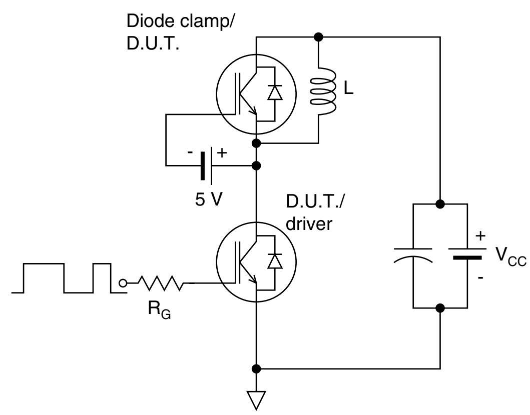


Fig. C.T.4 - Switching Loss Circuit

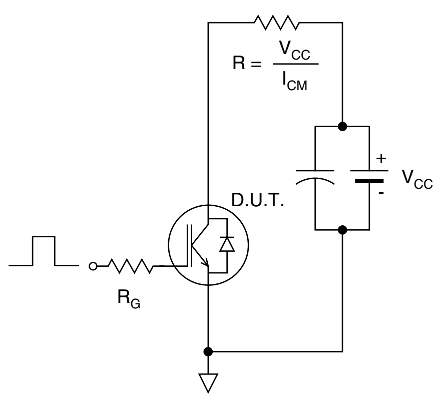


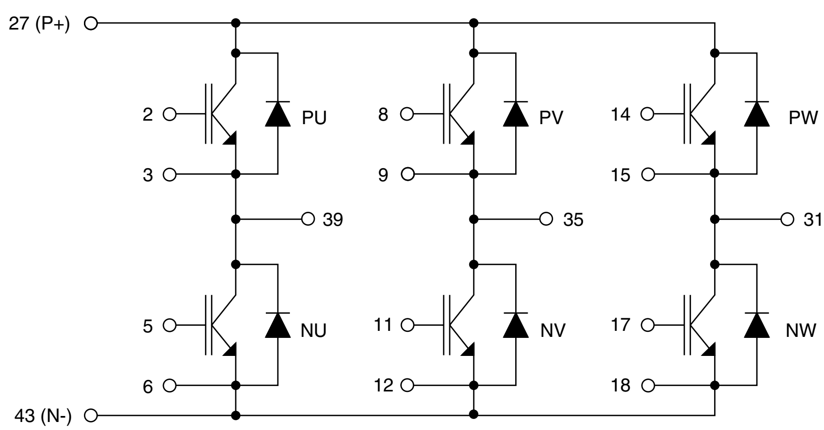
Fig. C.T.5 - Resistive Load Circuit

ORDERING INFORMATION TABLE

Device code	G	B	10	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 (10 = 10 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?95089
Part marking information	http://www.vishay.com/doc?95090

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