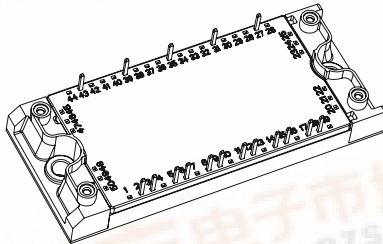


IGBT Sixpack Module, 21 A



ECONO2 6PACK

FEATURES

- Low diode V_F
- 10 μ s 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



RoHS
COMPLIANT

PRODUCT SUMMARY

V_{CES}	600 V
$V_{CE(on)}$ (typical)	1.88 V
t_{sc} at $T_J = 150\text{ }^{\circ}\text{C}$	> 10 μ s
I_C at $T_C = 80\text{ }^{\circ}\text{C}$	21 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
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C	$T_C = 25\text{ }^{\circ}\text{C}$	30	A
		$T_C = 80\text{ }^{\circ}\text{C}$	21	
Pulsed collector current See fig. C.T.5	I_{CM}		60	
Clamped inductive load current	I_{LM}		60	
Diode continuous forward current	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	30	
		$T_C = 80\text{ }^{\circ}\text{C}$	21	
Diode maximum forward current	I_{FM}		60	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT and Diode)	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	185	W
		$T_C = 80\text{ }^{\circ}\text{C}$	103	
Maximum operating junction temperature	T_J		150	$^{\circ}\text{C}$
Storage temperature range	T_{Stg}		- 40 to + 125	
Isolation voltage	V_{ISOL}		AC 2500 (minimum)	V

ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$BV_{(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 500\text{ }\mu\text{A}$	600	-	-	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 $125\text{ }^{\circ}\text{C}$)	-	0.6	-	V/ $^{\circ}\text{C}$
Collector to emitter voltage	$V_{CE(ON)}$	$I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$	-	1.88	2.30	V
		$I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$	-	2.24	3.11	
		$I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.18	2.68	
		$I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.68	3.28	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.5		5.5	
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 $125\text{ }^{\circ}\text{C}$)	-	- 9.6	-	mV/ $^{\circ}\text{C}$
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	-	100	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	700	-	
Diode forward voltage drop	V_{FM}	$I_F = 20\text{ A}$	-	1.26	1.49	V
		$I_F = 30\text{ A}$	-	1.38	1.72	
		$I_F = 20\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.22	1.49	
		$I_F = 30\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.38	1.78	
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 200	nA

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_G	$I_C = 20\text{ A}$ $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$	-	72	108	nC
Gate to emitter charge (turn-on)	Q_{GE}		-	16	24	
Gate to collector charge (turn-on)	Q_{GC}		-	24	36	
Turn-on switching loss	E_{on}	$I_C = 20\text{ A}$, $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$, $L = 200\text{ }\mu\text{H}$ $T_J = 25\text{ }^{\circ}\text{C}$ ⁽¹⁾	-	0.25	0.38	mJ
Turn-off switching loss	E_{off}		-	0.13	0.20	
Total switching loss	E_{tot}		-	0.38	0.57	
Turn-on switching loss	E_{on}	$I_C = 20\text{ A}$, $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$, $L = 200\text{ }\mu\text{H}$ $T_J = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾	-	0.33	0.49	
Turn-off switching loss	E_{off}		-	0.28	0.41	
Total switching loss	E_{tot}		-	0.60	0.90	
Turn-on delay time	$t_{d(ON)}$	$I_C = 20\text{ A}$, $V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$, $L = 200\text{ }\mu\text{H}$ $T_J = 125\text{ }^{\circ}\text{C}$	-	103	155	ns
Rise time	t_r		-	26	39	
Turn-off delay time	$t_{d(OFF)}$		-	126	189	
Fall time	t_f		-	107	160	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	1316	1974	pF
Output capacitance	C_{oes}		-	335	502	
Reverse transfer capacitance	C_{res}		-	40	60	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 60\text{ A}$ $R_G = 47\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	$V_{CC} = 300\text{ V}$, $I_P = 160\text{ A}$ to 270 A $R_G = 47\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V	10	-	-	μs
Diode peak reverse recovery current	I_{rr}	$T_J = 125\text{ }^{\circ}\text{C}$ $V_{CC} = 300\text{ V}$, $I_F = 20\text{ A}$, $L = 200\text{ }\mu\text{H}$ $V_{GE} = 15\text{ V}$, $R_G = 22\text{ }\Omega$	-	34	-	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}	-	-	1.13	°C/W
Junction to case DIODE		-	-	1.69	
Case to sink, flat, greased surface	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

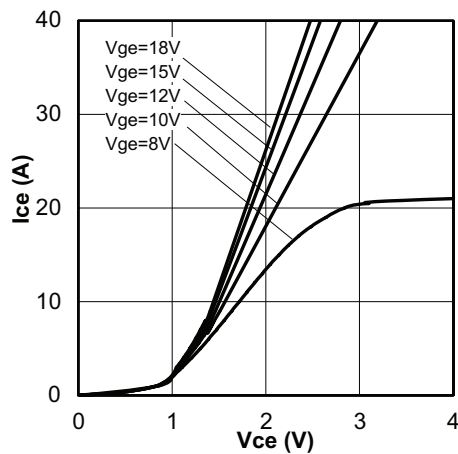


Fig. 1 - IGBT Output Characteristics
 $T_J = 25\text{ °C}$; $t_p = 80\text{ μs}$

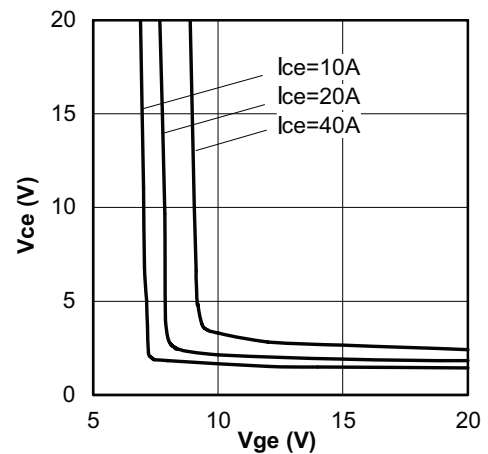


Fig. 3 - Typical V_{CE} vs. V_{GE}
 $T_J = 25\text{ °C}$

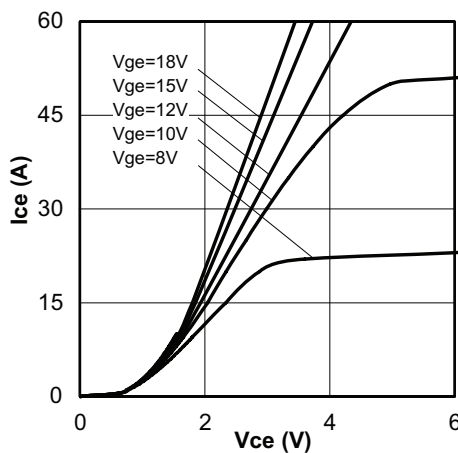


Fig. 2 - Typical IGBT Output Characteristics
 $T_J = 125\text{ °C}$, $t_p = 80\text{ μs}$

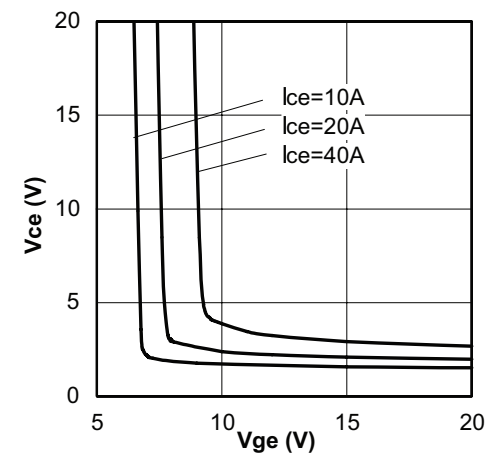


Fig. 4 - Typical V_{CE} vs. V_{GE}
 $T_J = 125\text{ °C}$

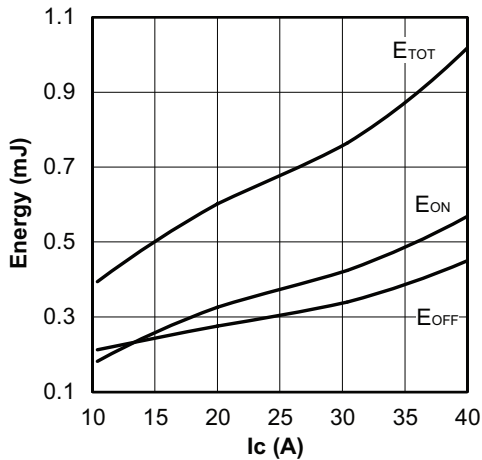


Fig. 5 - Typical Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 200\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$,
 $R_G = 22\ \Omega$; $V_{GE} = 15\ \text{V}$

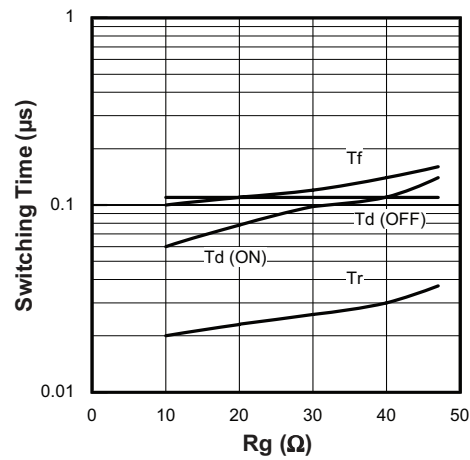


Fig. 8 - Typical Switching Time vs. R_G
 $T_J = 125^\circ\text{C}$; $L = 200\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$
 $I_{CE} = 20\ \text{A}$; $V_{GE} = 15\ \text{V}$

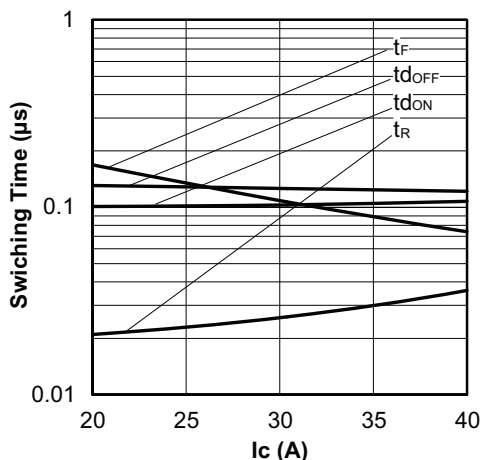


Fig. 6 - Typical Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 200\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$,
 $R_G = 22\ \Omega$; $V_{GE} = 15\ \text{V}$

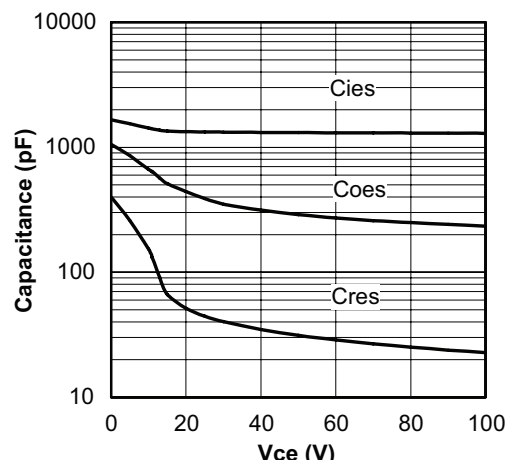


Fig. 9 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\ \text{V}$; $f = 1\ \text{MHz}$

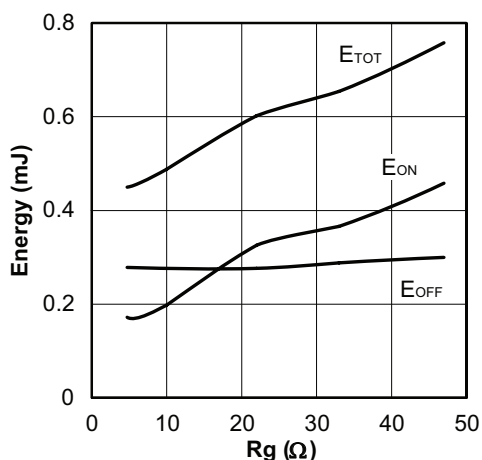


Fig. 7 - Typical Energy Loss vs. R_G
 $T_J = 125^\circ\text{C}$; $L = 200\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$
 $I_{CE} = 20\ \text{A}$; $V_{GE} = 15\ \text{V}$

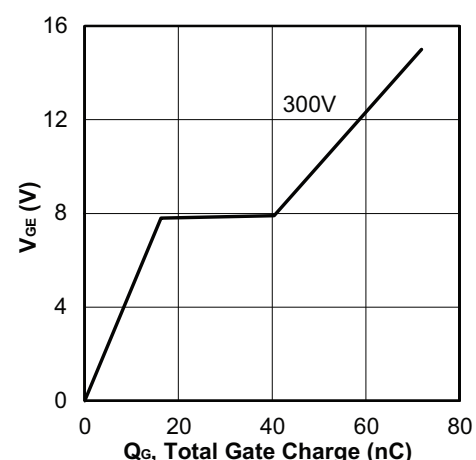


Fig. 10 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 20\ \text{A}$

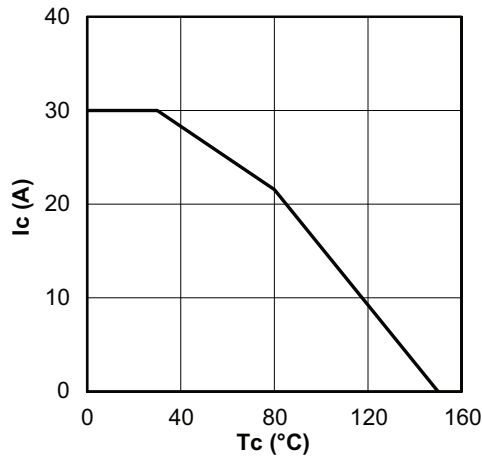


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

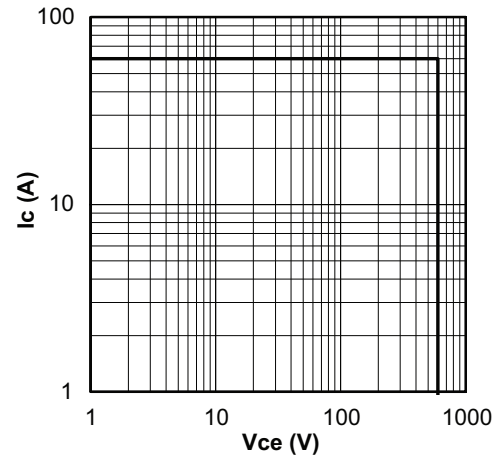


Fig. 14 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{ V}$

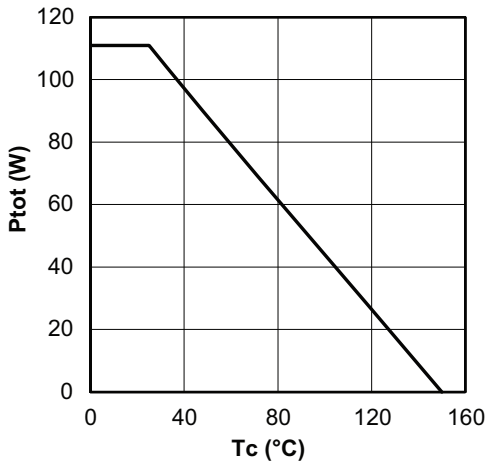


Fig. 12 - Power Dissipation vs. Case Temperature (IGBT only)

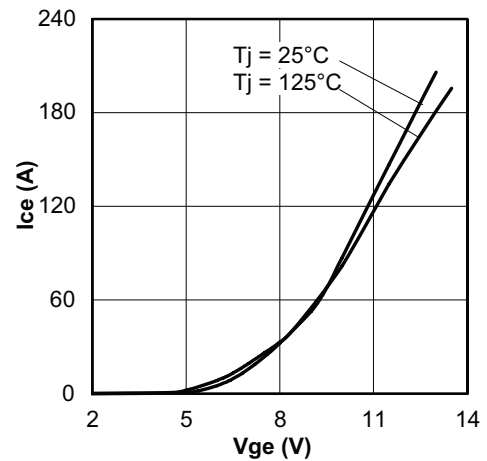


Fig. 15 - Typical Transfer Characteristics
 $V_{CE} = 50\text{ V}$; $t_p = 10\text{ }\mu\text{s}$

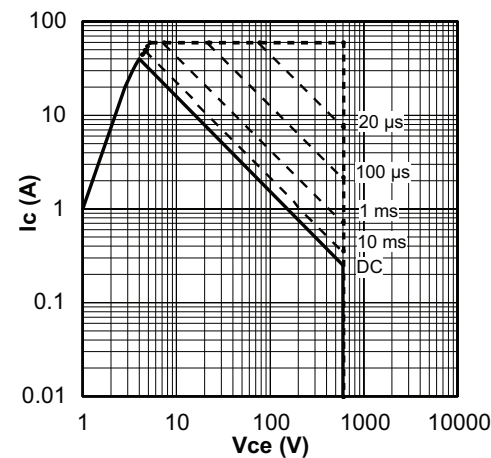


Fig. 13 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$

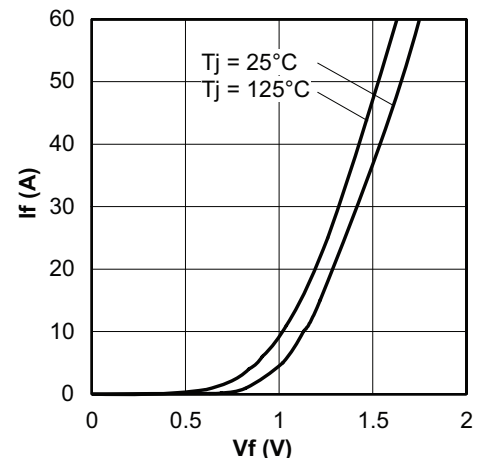


Fig. 16 - Typical Diode Forward Characteristics
 $t_p = 80\text{ }\mu\text{s}$

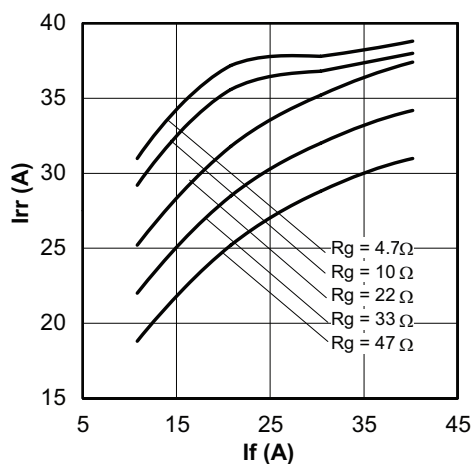


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

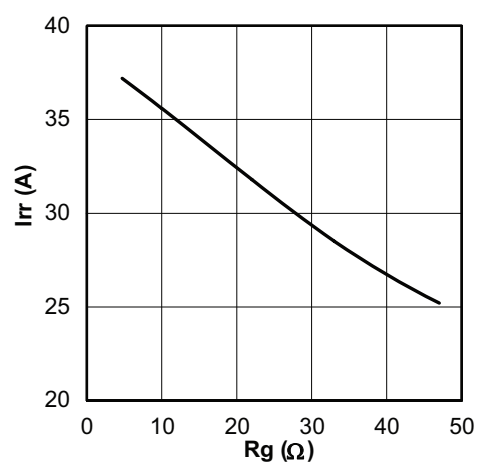


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 20\text{ A}$

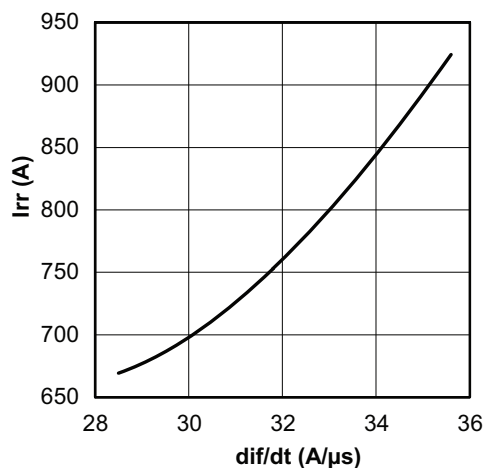


Fig. 19 - Typical Diode I_{RR} vs. dI_F/dt ; $V_{CC} = 600\text{ V}$;
 $V_{GE} = 15\text{ V}$; $I_{CE} = 20\text{ A}$; $T_J = 125^\circ\text{C}$

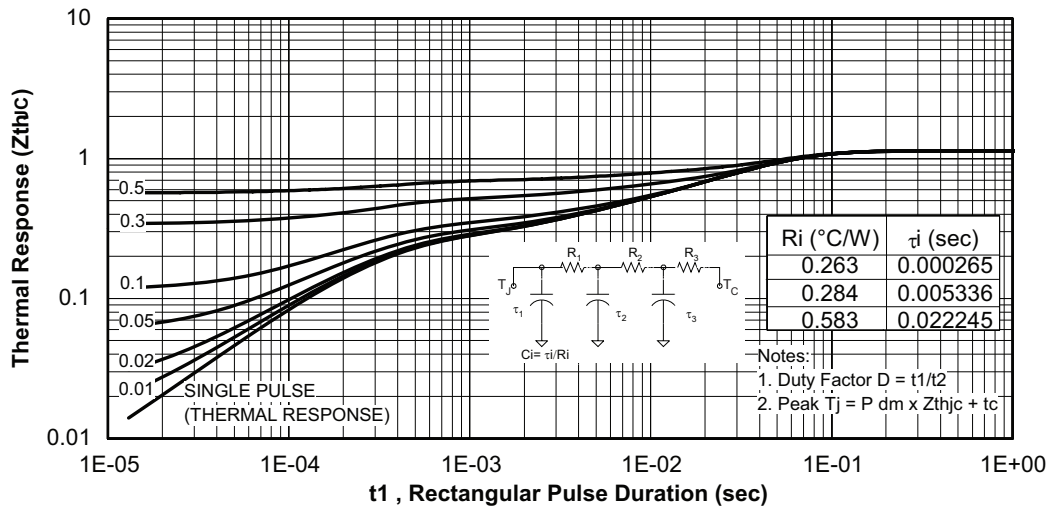


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

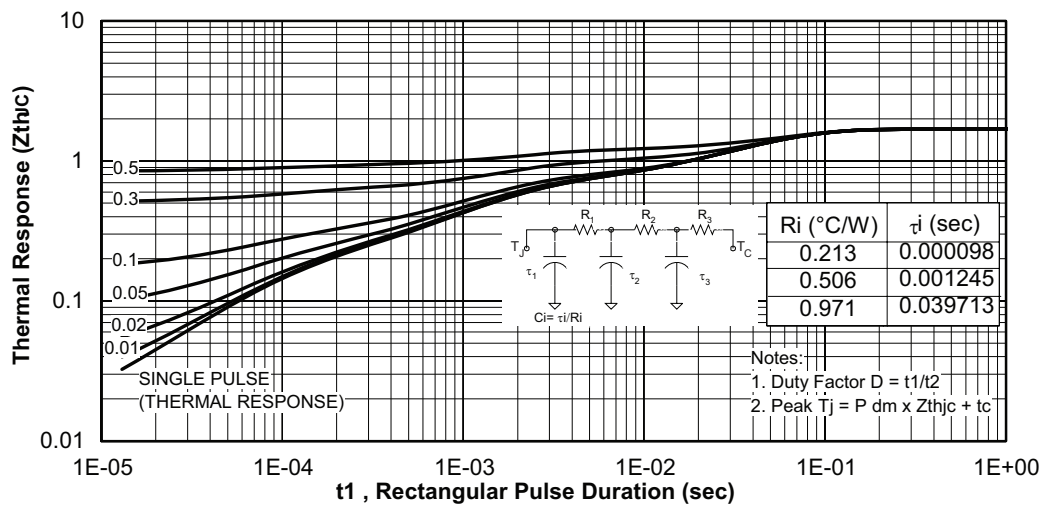


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

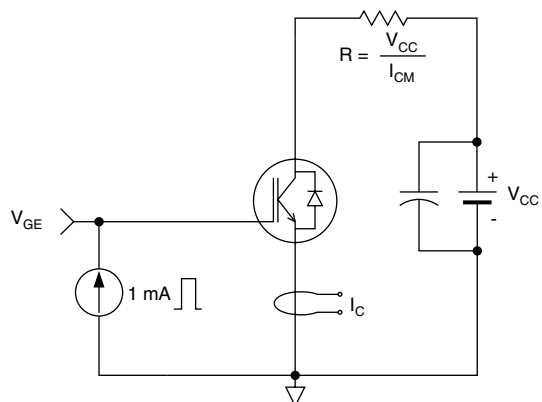


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

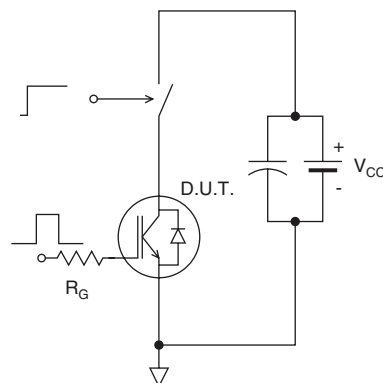


Fig. C.T.3 - S.C. SOA Circuit

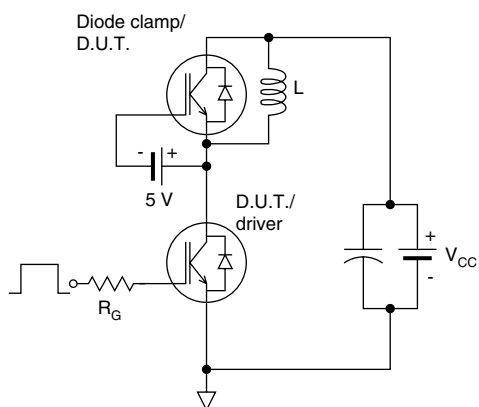


Fig. C.T.2 - RBSOA Circuit

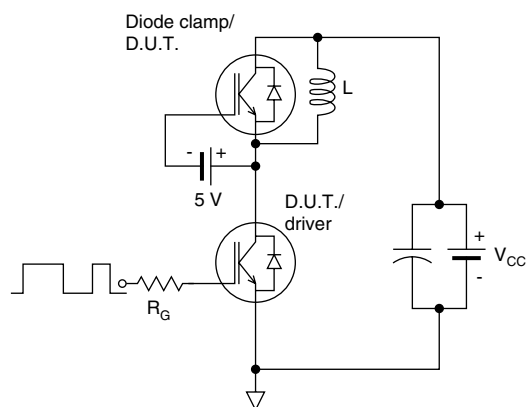


Fig. C.T.4 - Switching Loss Circuit

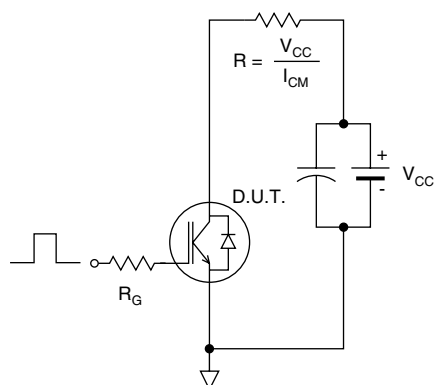
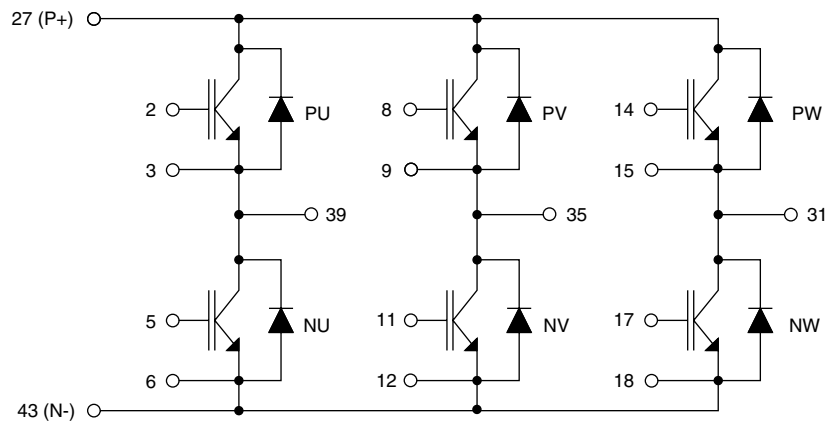


Fig. C.T.5 - Resistive Load Circuit

ORDERING INFORMATION TABLE

Device code	G	B	20	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 (20 = 20 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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