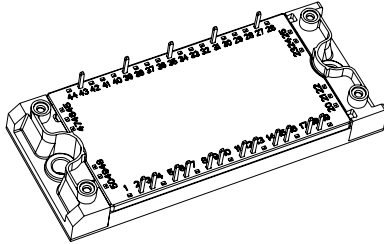


IGBT Sixpack Module, 21 A


ECONO2 6PACK

PRODUCT SUMMARY	
V_{CES}	600 V
$V_{CE(on)}$ (typical)	1.88 V
t_{sc} at $T_J = 150\text{ }^\circ\text{C}$	> 10 μs
I_C at $T_C = 80\text{ }^\circ\text{C}$	21 A

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


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

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 °C to 125 °C)	-	0.6	-	V/°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 °C to 125 °C)	-	-9.6	-	mV/°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	$t_{d(ON)}$			-	103		155
Rise time	t_r	$I_C = 20\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 22\text{ }\Omega, L = 200\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	26	39	ns	
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	$T_J = 150\text{ }^\circ\text{C}, I_C = 60\text{ A}$ $R_G = 47\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	Fullsquare				
Short circuit safe operating area	SCSOA	$V_{CC} = 300\text{ V},$ $I_P = 160\text{ A to } 270\text{ A}$ $R_G = 47\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	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

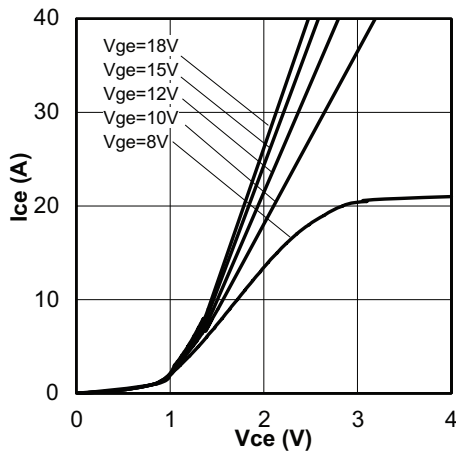


Fig. 1 - IGBT Output Characteristics
T_J = 25 °C; t_p = 80 μs

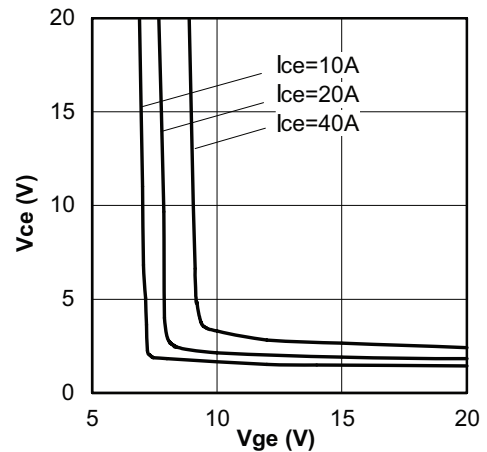


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

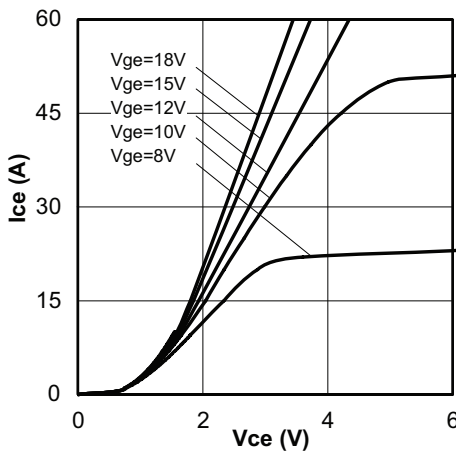


Fig. 2 - Typical IGBT Output Characteristics
T_J = 125 °C, t_p = 80 μs

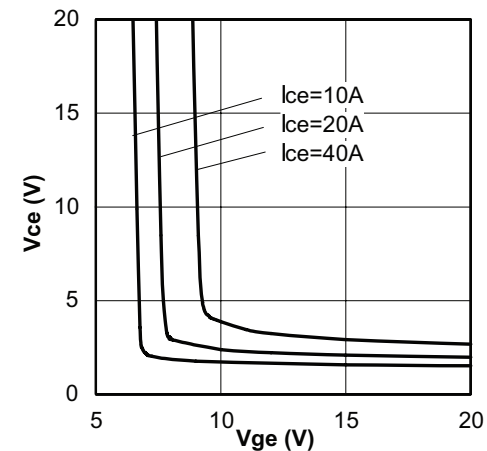


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

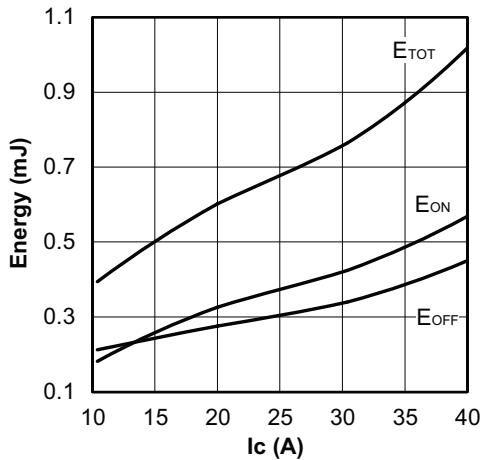


Fig. 5 - Typical Energy Loss vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$; $L = 200\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$,
 $R_G = 22\text{ }\Omega$; $V_{GE} = 15\text{ V}$

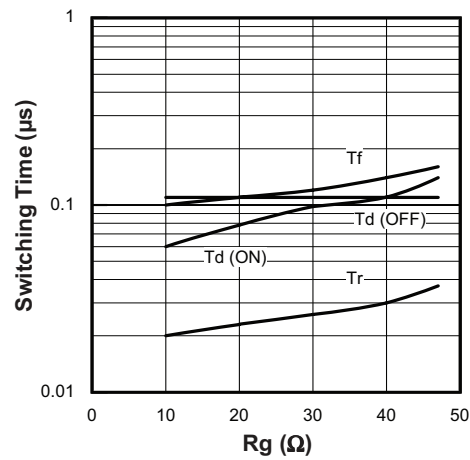


Fig. 8 - Typical Switching Time vs. R_G
 $T_J = 125\text{ }^\circ\text{C}$; $L = 200\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $I_{CE} = 20\text{ A}$; $V_{GE} = 15\text{ V}$

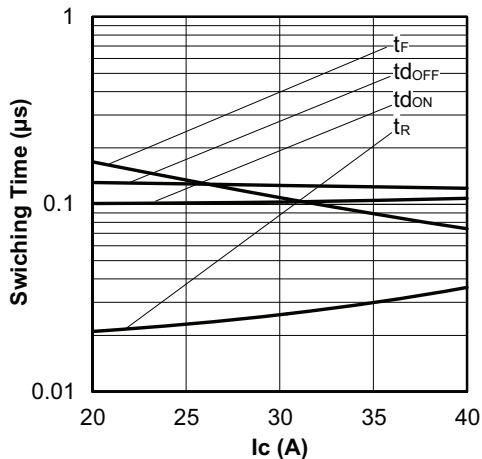


Fig. 6 - Typical Switching Time vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$; $L = 200\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$,
 $R_G = 22\text{ }\Omega$; $V_{GE} = 15\text{ V}$

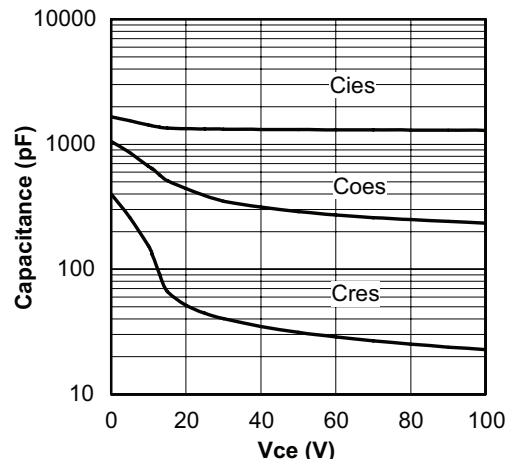


Fig. 9 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

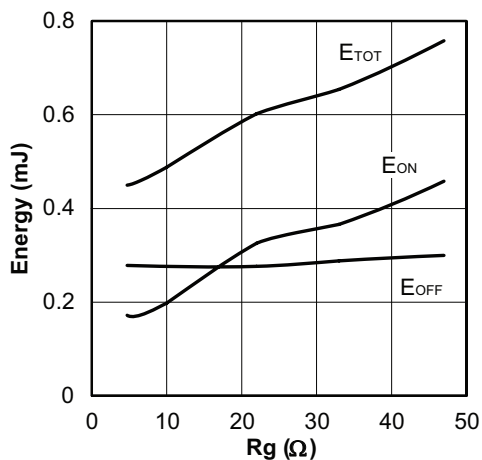


Fig. 7 - Typical Energy Loss vs. R_G
 $T_J = 125\text{ }^\circ\text{C}$; $L = 200\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $I_{CE} = 20\text{ A}$; $V_{GE} = 15\text{ V}$

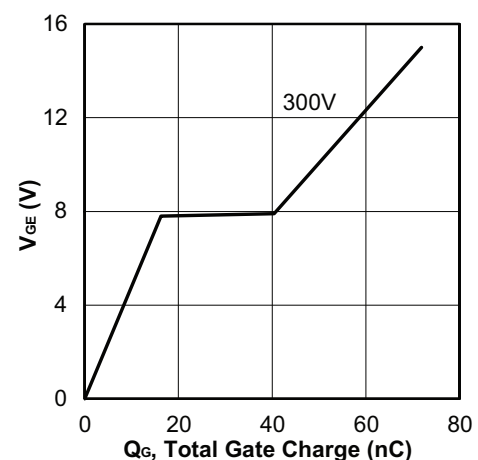


Fig. 10 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 20\text{ A}$

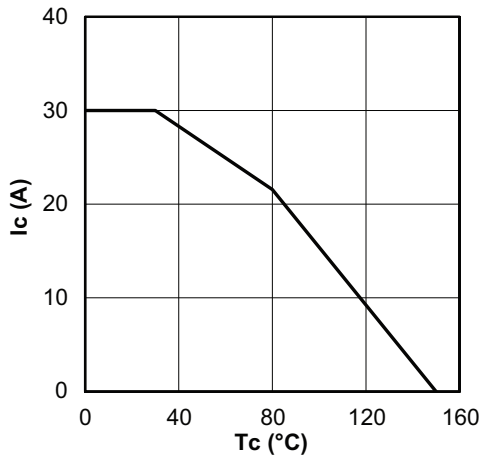


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

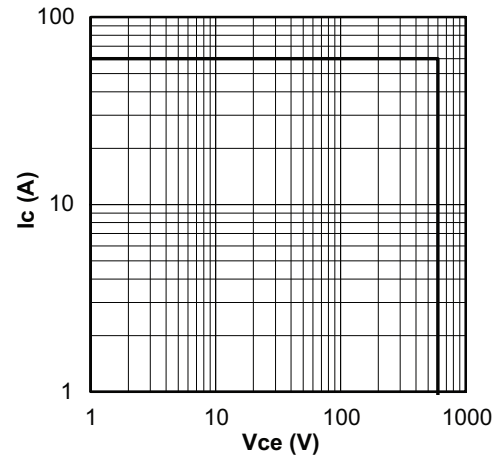


Fig. 14 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

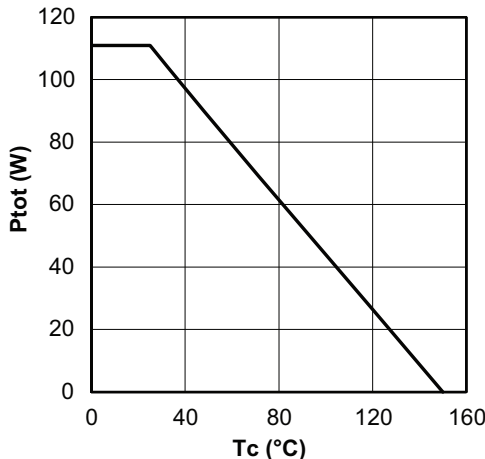


Fig. 12 - Power Dissipation vs. Case Temperature (IGBT only)

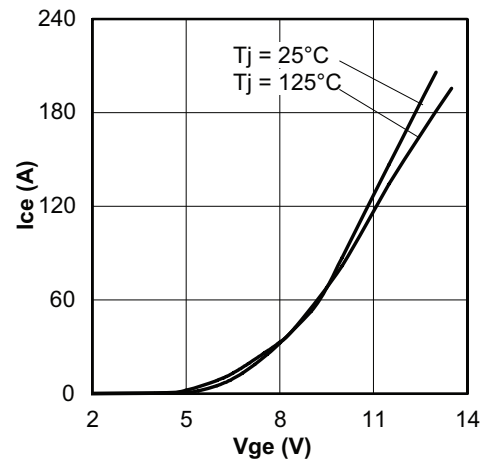


Fig. 15 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 μs

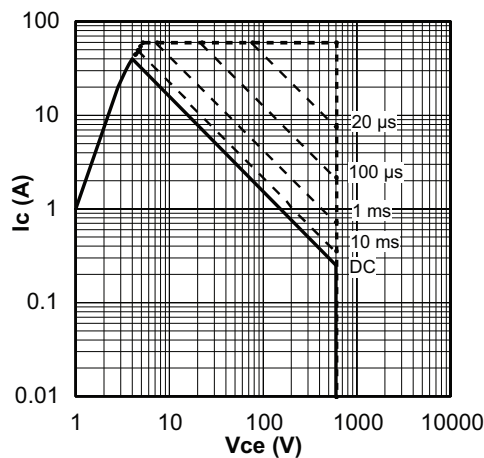


Fig. 13 - Forward SOA
T_C = 25 °C; T_J ≤ 150 °C

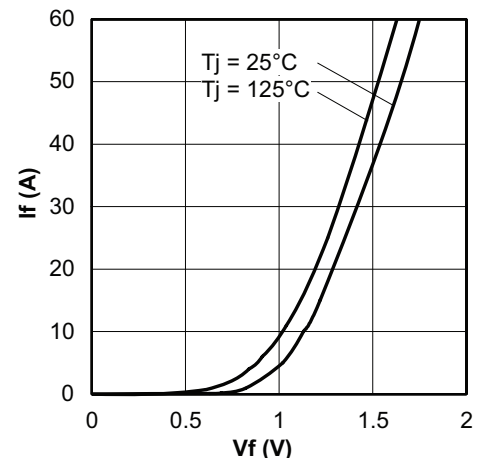


Fig. 16 - Typical Diode Forward Characteristics
t_p = 80 μs

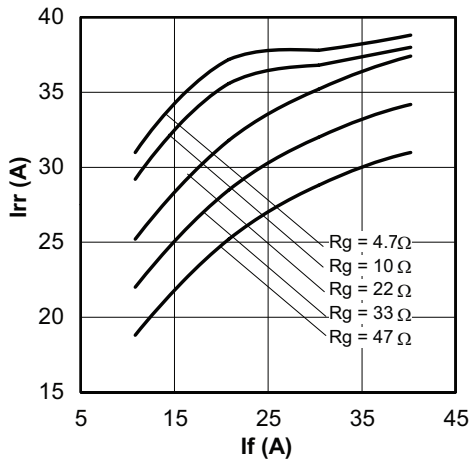


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125\text{ }^\circ\text{C}$

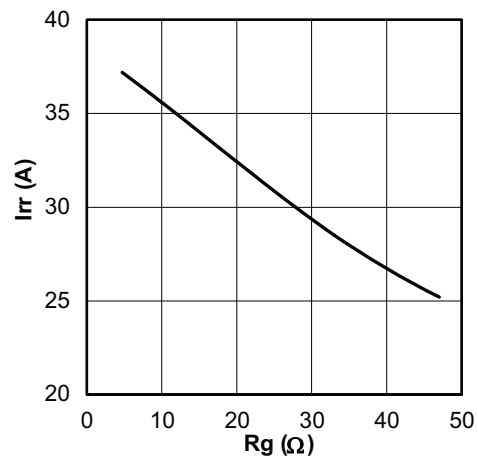


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125\text{ }^\circ\text{C}$; $I_F = 20\text{ A}$

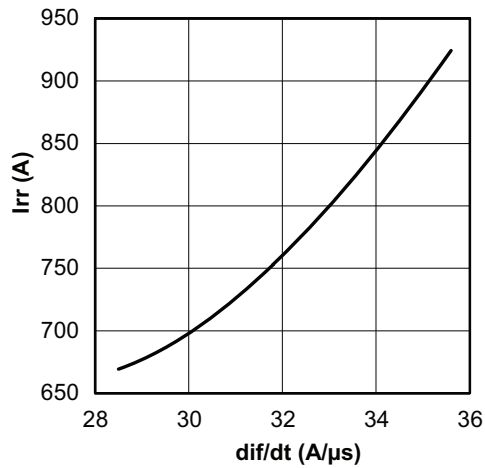


Fig. 19 - Typical Diode I_{RR} vs. di_F/dt ; $V_{CC} = 600\text{ V}$;
 $V_{GE} = 15\text{ V}$; $I_{CE} = 20\text{ A}$; $T_J = 125\text{ }^\circ\text{C}$

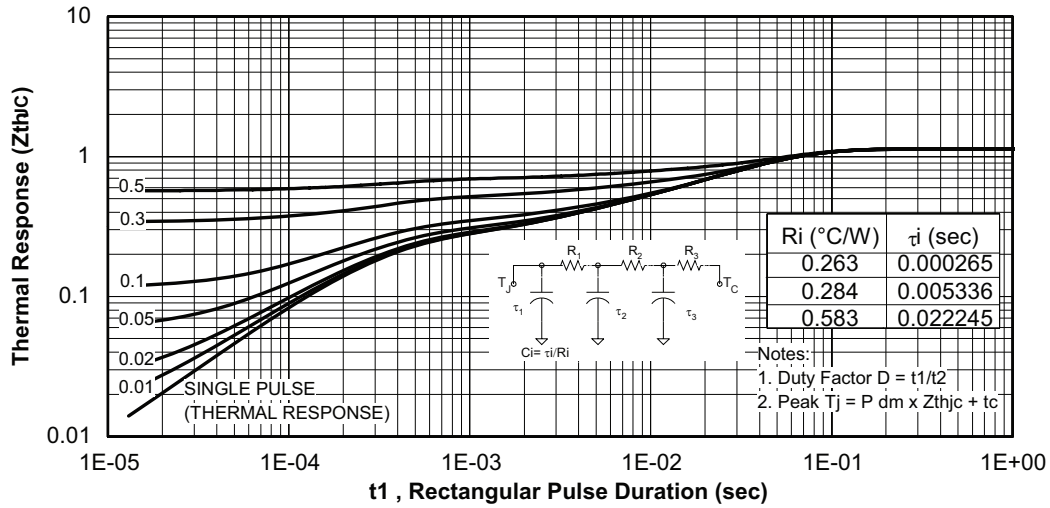


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

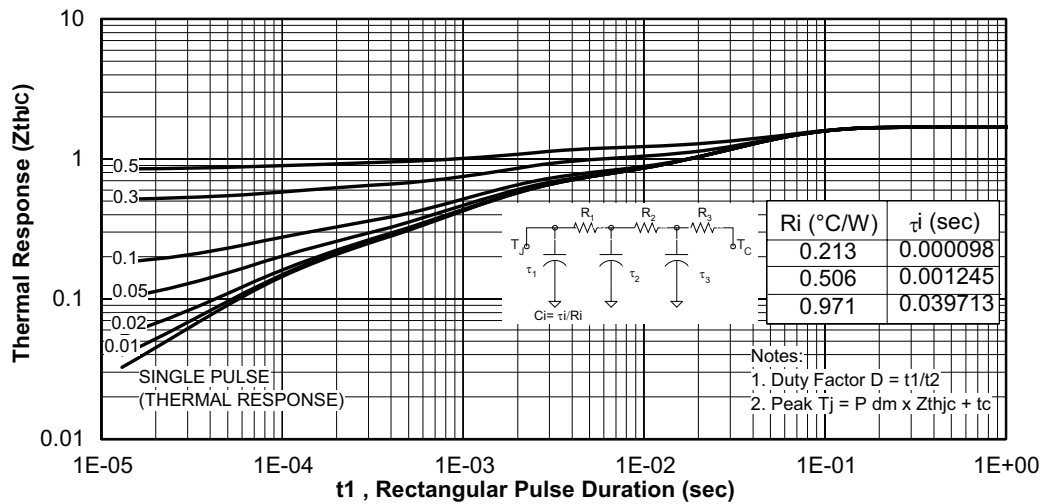


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

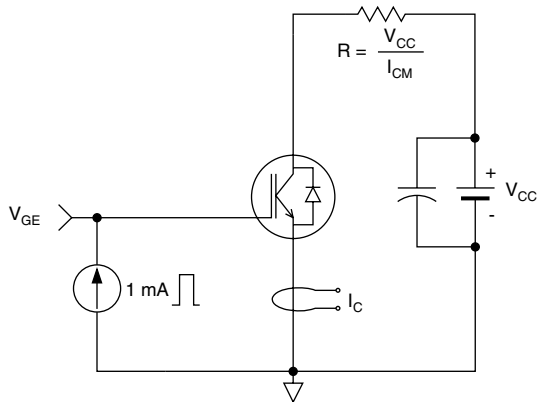


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

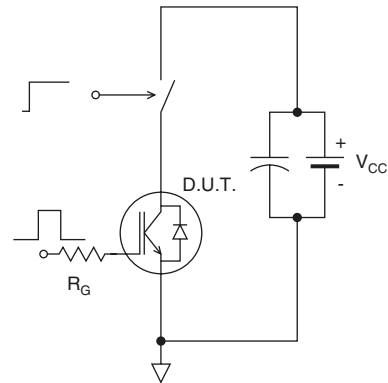


Fig. C.T.3 - S.C. SOA Circuit

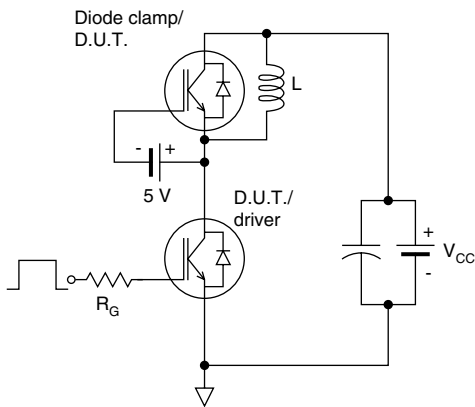


Fig. C.T.2 - RBSOA Circuit

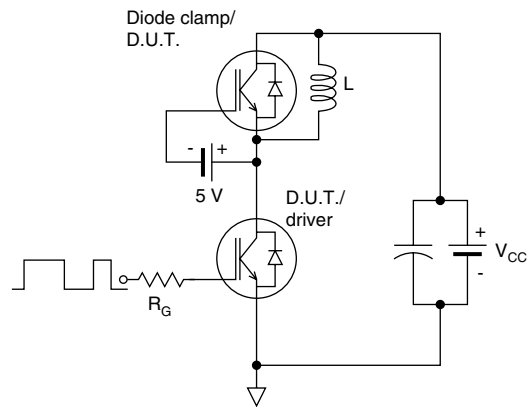


Fig. C.T.4 - Switching Loss Circuit

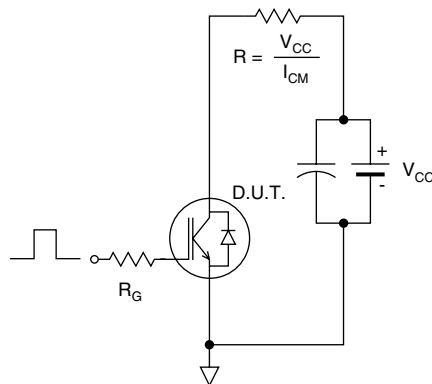
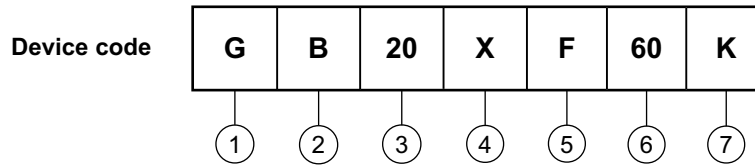
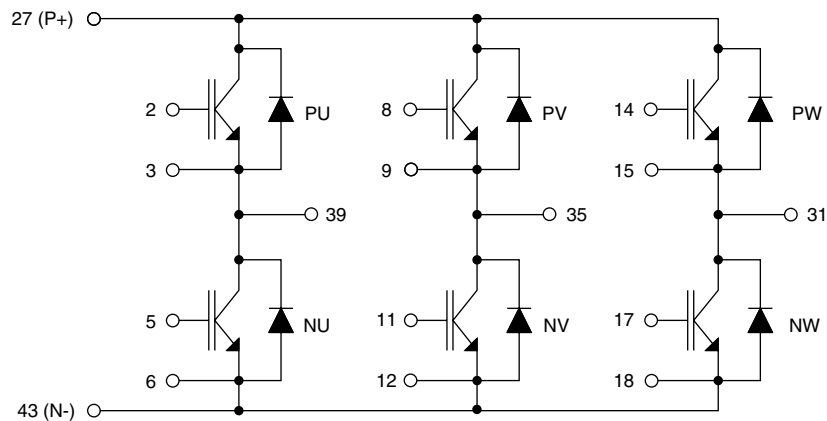


Fig. C.T.5 - Resistive Load Circuit

ORDERING INFORMATION TABLE


- 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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