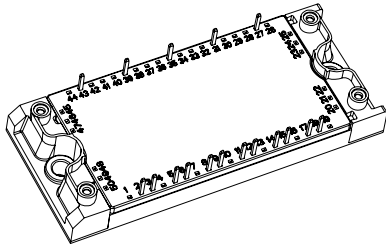


## IGBT Sixpack Module, 48 A


**ECONO2 6PACK**

PRODUCT SUMMARY	
$V_{CES}$	600 V
$V_{CE(on)}$ (typical)	1.89 V
$t_{sc}$ at $T_J = 150\text{ }^\circ\text{C}$	> 10 $\mu\text{s}$
$I_C$ at $T_C = 80\text{ }^\circ\text{C}$	48 A

### FEATURES

- Low diode  $V_F$
- 10  $\mu\text{s}$  short circuit capability
- Square RBSOA
- Low  $V_{CE(on)}$  non punch through IGBT technology
- HEXFRED<sup>®</sup> 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	$I_C$	$T_C = 25\text{ }^\circ\text{C}$	80	A
		$T_C = 80\text{ }^\circ\text{C}$	48	
Pulsed collector current See fig. C.T.5	$I_{CM}$		160	
Clamped inductive load current	$I_{LM}$		160	
Diode continuous forward current	$I_F$	$T_C = 25\text{ }^\circ\text{C}$	80	
		$T_C = 80\text{ }^\circ\text{C}$	48	
Diode maximum forward current	$I_{FM}$		160	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Maximum power dissipation (IGBT and Diode)	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	315	W
		$T_C = 80\text{ }^\circ\text{C}$	177	
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



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ 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)	-	0.73	-	V/°C
Collector to emitter voltage	$V_{CE(ON)}$	$I_C = 50\text{ A}, V_{GE} = 15\text{ V}$	-	1.89	2.30	V
		$I_C = 100\text{ A}, V_{GE} = 15\text{ V}$	-	2.56	3.24	
		$I_C = 50\text{ A}, V_{GE} = 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.17	2.65	
		$I_C = 100\text{ A}, V_{GE} = 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	3.05	3.93	
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)	-	- 11	-	mV/°C
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}$	-	-	100	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	750	-	
Diode forward voltage drop	$V_{FM}$	$I_F = 50\text{ A}$	-	1.34	1.68	V
		$I_F = 100\text{ A}$	-	1.62	2.19	
		$I_F = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.31	1.77	
		$I_F = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.65	2.43	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	100	nA

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	$Q_G$	$I_C = 50\text{ A}$ $V_{CC} = 460\text{ V}$ $V_{GE} = 15\text{ V}$	-	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	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega, L = 200\text{ }\mu\text{H}$ $T_J = 25\text{ }^\circ\text{C}$ (1)	-	0.25	0.38	mJ
Turn-off switching loss	$E_{off}$		-	0.55	0.83	
Total switching loss	$E_{tot}$		-	0.80	1.21	
Turn-on switching loss	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega, L = 200\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$ (1)	-	0.39	0.58	mJ
Turn-off switching loss	$E_{off}$		-	0.82	1.23	
Total switching loss	$E_{tot}$		-	1.21	1.81	
Turn-on delay time	$t_{d(ON)}$	$I_C = 50\text{ A}, V_{CC} = 300\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 10\text{ }\Omega, L = 200\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	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	$C_{ies}$	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	3016	-	pF
Output capacitance	$C_{oes}$		-	742	-	
Reverse transfer capacitance	$C_{res}$		-	103	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 120\text{ A}$ $R_G = 47\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	Fullsquare			
Short circuit safe operating area	SCSOA	$V_{CC} = 300\text{ V},$ $I_P = 370\text{ A to } 530\text{ A}$ $R_G = 47\text{ }\Omega, V_{GE} = 15\text{ V to } 0\text{ V}$	10	-	-	$\mu\text{s}$
Diode peak reverse recovery current	$I_{rr}$	$T_J = 125\text{ }^\circ\text{C}$ $V_{CC} = 300\text{ V}, I_F = 10\text{ A}$	-	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 <sub>thJC</sub>	-	-	0.58	°C/W
Junction to case DIODE		-	-	1.25	
Case to sink, flat, greased surface	R <sub>thCS</sub>	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

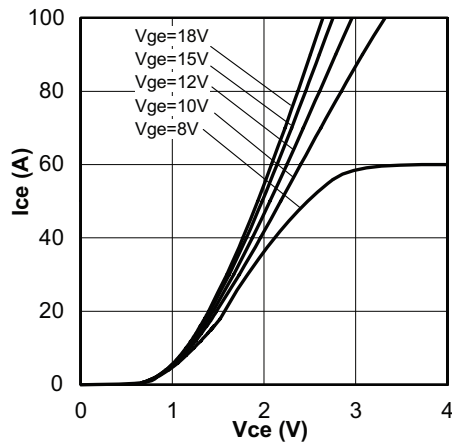


Fig. 1 - Typical IGBT Output Characteristics  
T<sub>J</sub> = 25 °C; t<sub>p</sub> = 80 μs

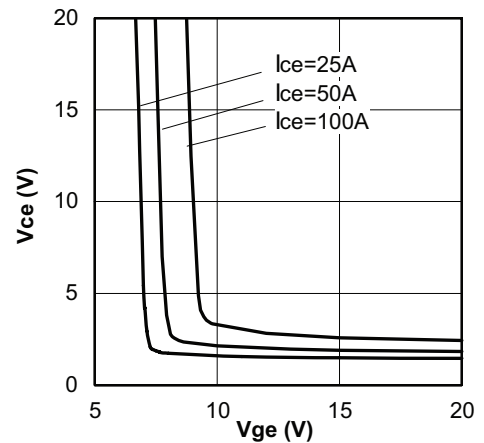


Fig. 3 - Typical V<sub>CE</sub> vs. V<sub>GE</sub>  
T<sub>J</sub> = 25 °C

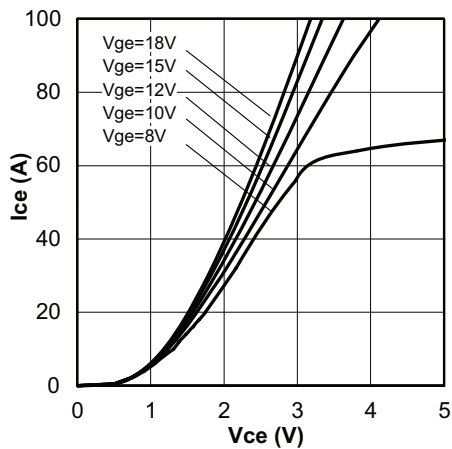


Fig. 2 - Typical IGBT Output Characteristics  
T<sub>J</sub> = 125 °C, t<sub>p</sub> = 80 μs

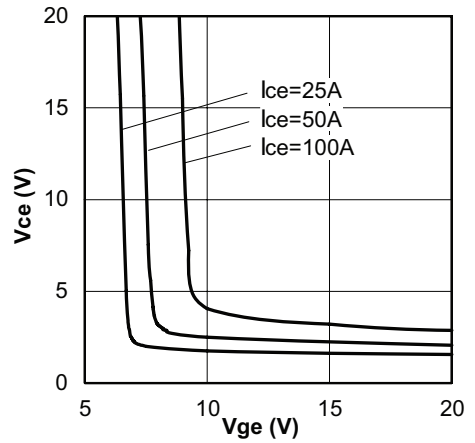


Fig. 4 - Typical V<sub>CE</sub> vs. V<sub>GE</sub>  
T<sub>J</sub> = 125 °C

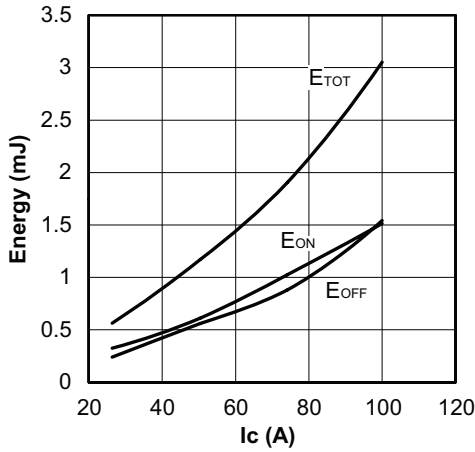


Fig. 5 - Typical Energy Loss vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 200\text{ }\mu\text{H}$ ;  $V_{CE} = 300\text{ V}$ ,  
 $R_G = 22\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

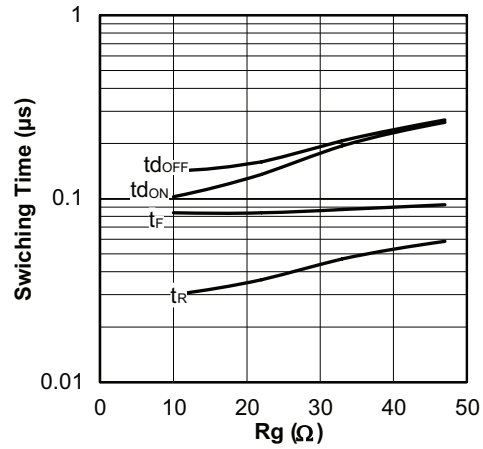


Fig. 8 - Typical Switching Time vs.  $R_G$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 200\text{ }\mu\text{H}$ ;  $V_{CE} = 300\text{ V}$   
 $I_{CE} = 50\text{ A}$ ;  $V_{GE} = 15\text{ V}$

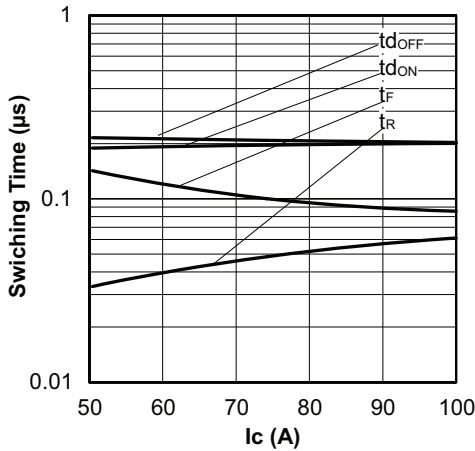


Fig. 6 - Typical Switching Time vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 200\text{ }\mu\text{H}$ ;  $V_{CE} = 300\text{ V}$ ,  
 $R_G = 22\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

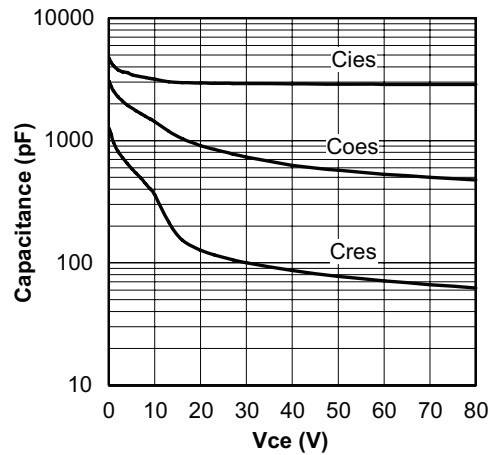


Fig. 9 - Typical Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

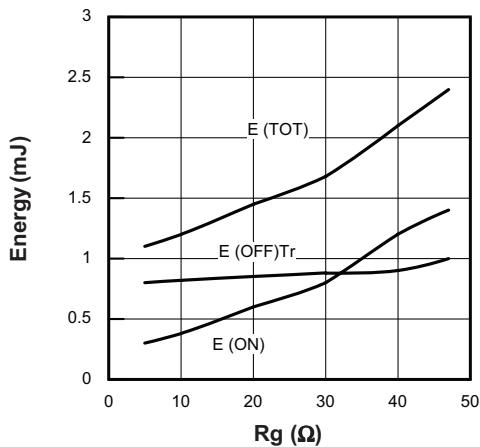


Fig. 7 - Typical Energy Loss vs.  $R_G$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 200\text{ }\mu\text{H}$ ;  $V_{CE} = 300\text{ V}$   
 $I_{CE} = 50\text{ A}$ ;  $V_{GE} = 15\text{ V}$

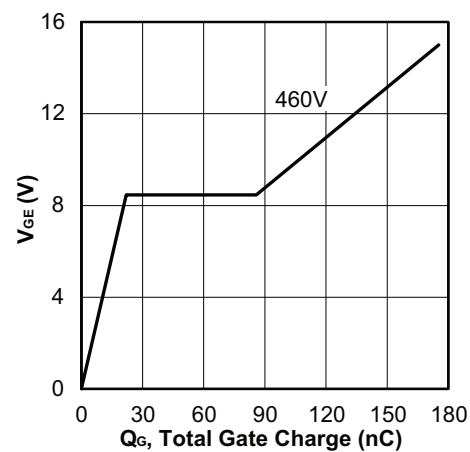


Fig. 10 - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 50\text{ A}$

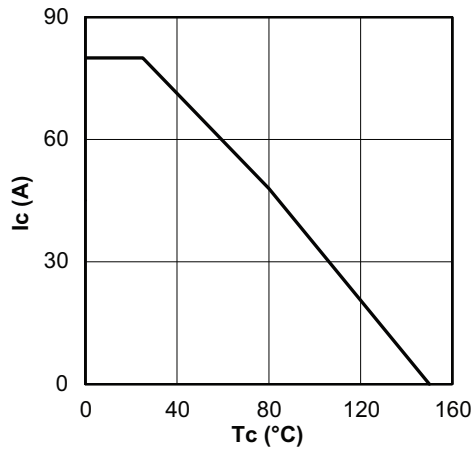


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

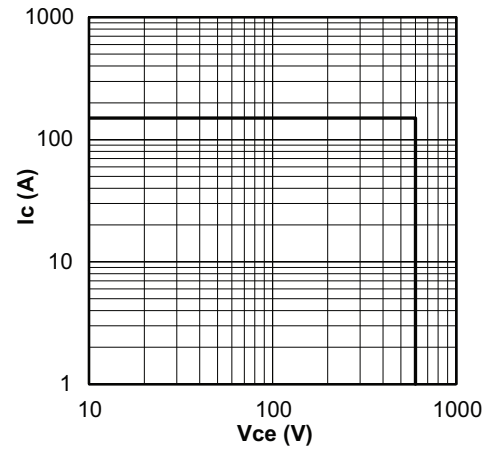


Fig. 14 - Reverse Bias SOA  
 $T_J = 150^\circ\text{C}$ ;  $V_{GE} = 15\text{ V}$

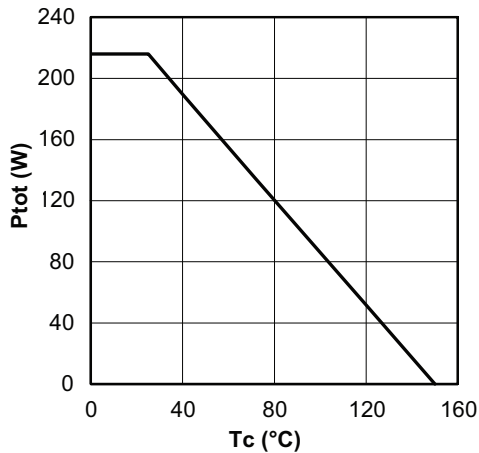


Fig. 12 - Power Dissipation vs. Case Temperature (IGBT only)

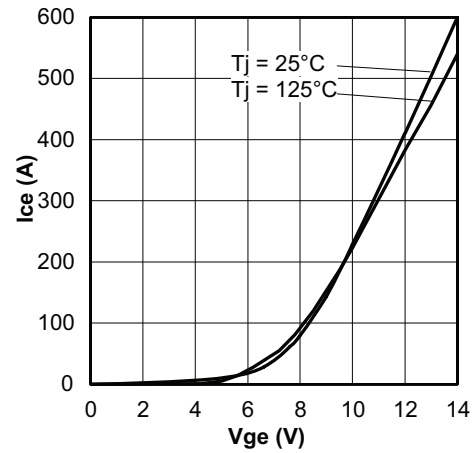


Fig. 15 - Typical Transfer Characteristics  
 $V_{CE} = 50\text{ V}$ ;  $t_p = 10\ \mu\text{s}$

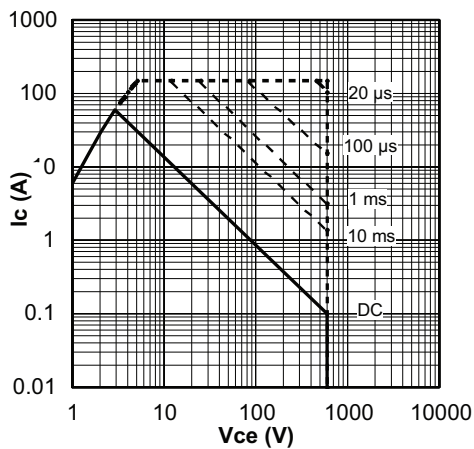


Fig. 13 - Forward SOA  
 $T_C = 25^\circ\text{C}$ ;  $T_J \leq 150^\circ\text{C}$

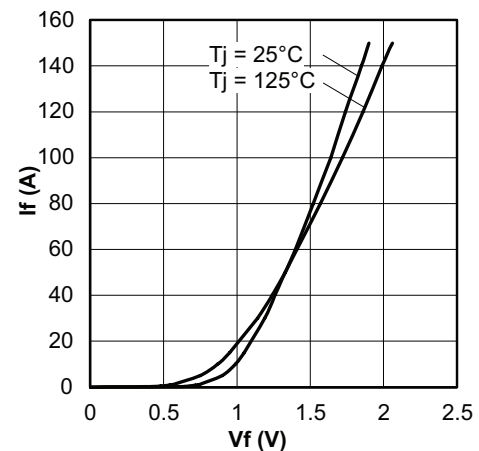


Fig. 16 - Typical Diode Forward Characteristics  
 $t_p = 80\ \mu\text{s}$

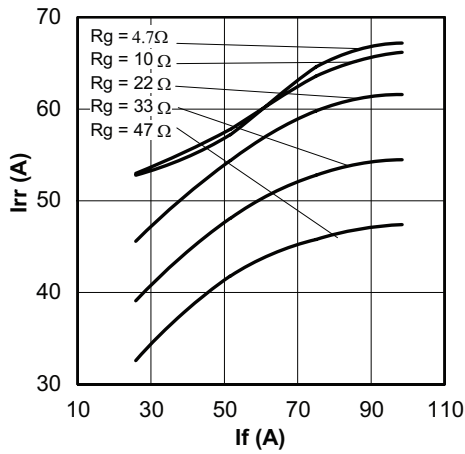


Fig. 17 - Typical Diode  $I_{RR}$  vs.  $I_F$   
 $T_J = 125^\circ\text{C}$

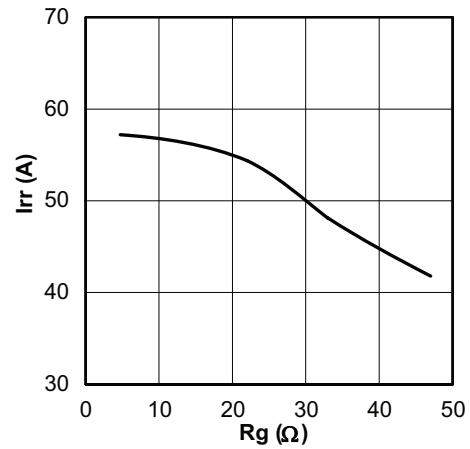


Fig. 18 - Typical Diode  $I_{RR}$  vs.  $R_G$   
 $T_J = 125^\circ\text{C}$ ;  $I_F = 10\text{ A}$

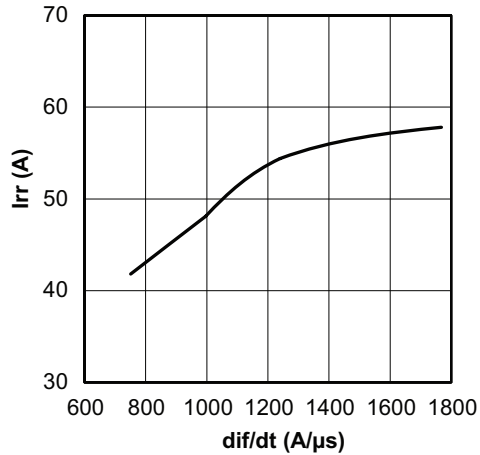


Fig. 19 - Typical Diode  $I_{RR}$  vs.  $dI_F/dt$ ;  $V_{CC} = 300\text{ V}$ ;  
 $V_{GE} = 15\text{ V}$ ;  $I_{CE} = 50\text{ A}$ ;  $T_J = 125^\circ\text{C}$

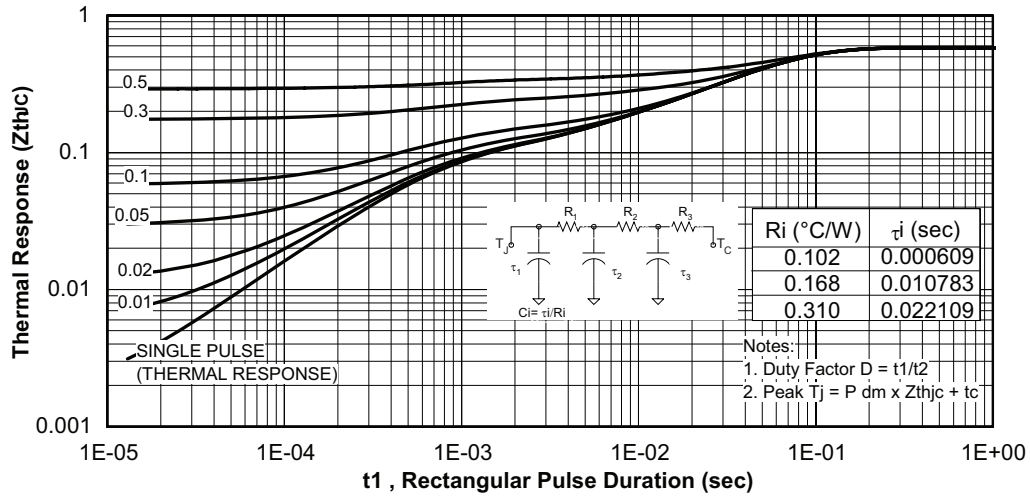


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

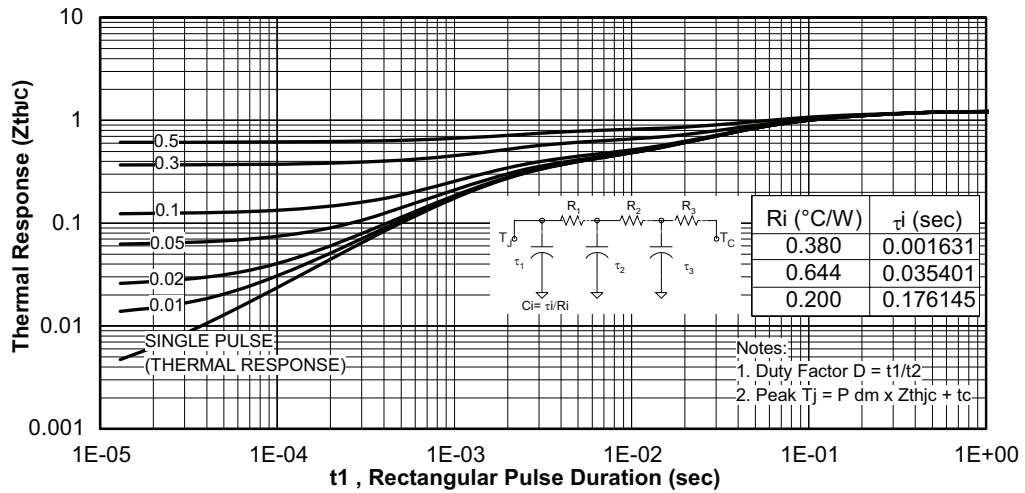


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

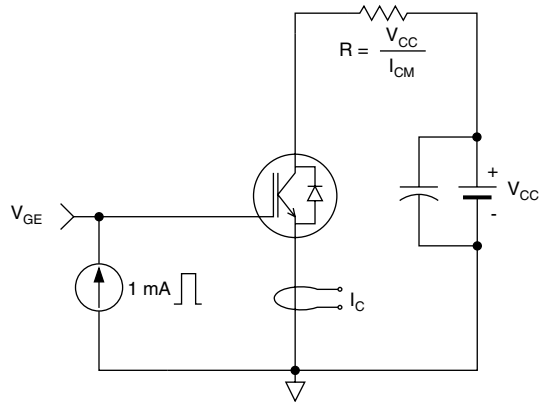


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

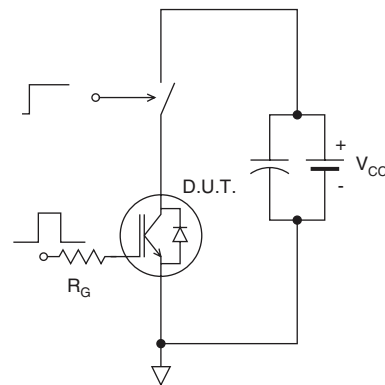


Fig. C.T.3 - S.C. SOA Circuit

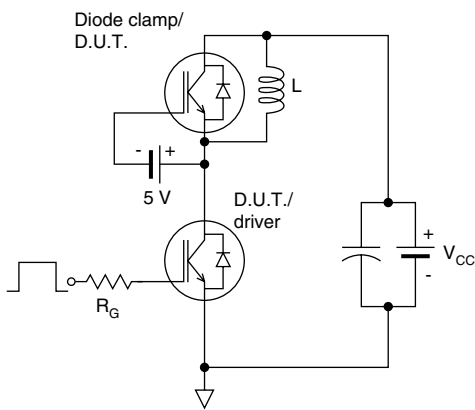


Fig. C.T.2 - RB SOA Circuit

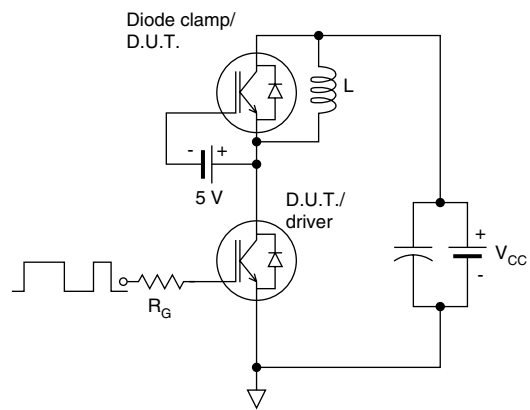


Fig. C.T.4 - Switching Loss Circuit

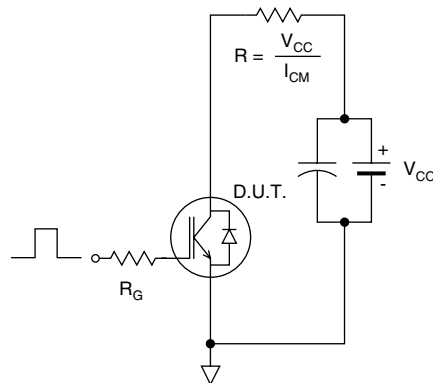


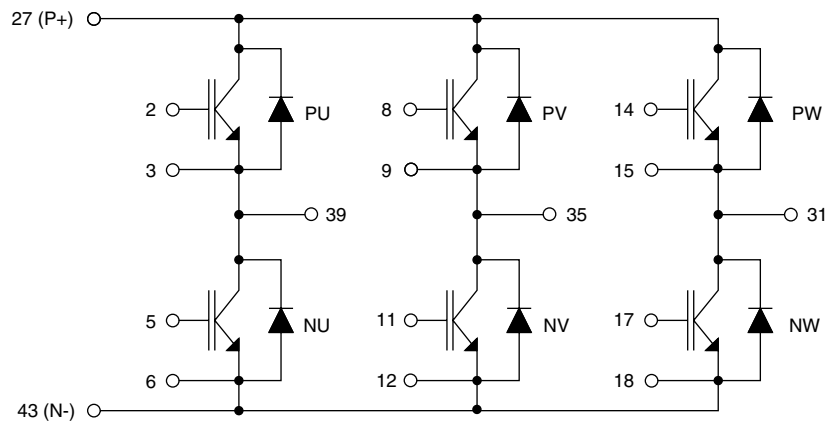
Fig. C.T.5 - Resistive Load Circuit



**ORDERING INFORMATION TABLE**

Device code	<b>G</b>	<b>B</b>	<b>50</b>	<b>X</b>	<b>F</b>	<b>60</b>	<b>K</b>
	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	<a href="http://www.vishay.com/doc?95089">http://www.vishay.com/doc?95089</a>
Part marking information	<a href="http://www.vishay.com/doc?95090">http://www.vishay.com/doc?95090</a>



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