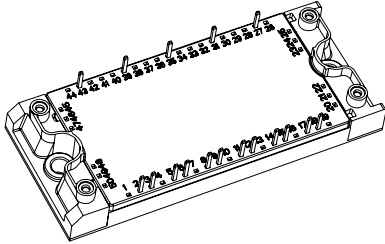


IGBT Sixpack Module, 35 A


ECONO2 6PACK

PRODUCT SUMMARY	
V_{CES}	1200 V
$V_{CE(on)}$ (typical)	2.40 V
t_{sc} at $T_J = 150\text{ }^\circ\text{C}$	> 10 μs
I_C at $T_C = 80\text{ }^\circ\text{C}$	35 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
- 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	$T_C = 25\text{ }^\circ\text{C}$	50	A
		$T_C = 80\text{ }^\circ\text{C}$	35	
Pulsed collector current See fig. C.T.5	I_{CM}		100	
Clamped inductive load current	I_{LM}		100	
Diode continuous forward current	I_F	$T_C = 25\text{ }^\circ\text{C}$	50	
		$T_C = 80\text{ }^\circ\text{C}$	35	
Pulsed diode maximum forward current	I_{FM}		100	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT and DIODE)	P_D	$T_C = 25\text{ }^\circ\text{C}$	284	W
		$T_C = 80\text{ }^\circ\text{C}$	159	
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	$BV_{(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 500\text{ }\mu\text{A}$	1200	-	-	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 $125\text{ }^\circ\text{C}$)	-	0.7	-	V/ $^\circ\text{C}$
Collector to emitter voltage	$V_{CE(ON)}$	$I_C = 35\text{ A}$, $V_{GE} = 15\text{ V}$	-	2.40	2.60	V
		$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$	-	2.75	3.00	
		$I_C = 35\text{ A}$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.80	-	
		$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	3.30	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	4.0	5.25	6.0	
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 $125\text{ }^\circ\text{C}$)	-	- 11	-	mV/ $^\circ\text{C}$
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$	-	-	100	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$	-	500	-	
Diode forward voltage drop	V_{FM}	$I_F = 35\text{ A}$	-	1.90	2.35	V
		$I_F = 50\text{ A}$	-	2.15	2.65	
		$I_F = 35\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.00	-	
		$I_F = 50\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	2.35	-	
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 specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_G	$I_C = 35\text{ A}$	-	255	385	nC
Gate to emitter charge (turn-on)	Q_{GE}	$V_{CC} = 600\text{ V}$	-	25	40	
Gate to collector charge (turn-on)	Q_{GC}	$V_{GE} = 15\text{ V}$	-	125	90	
Turn-on switching loss	E_{on}	$I_C = 35\text{ A}$, $V_{CC} = 600\text{ V}$	-	2.70	4.08	mJ
Turn-off switching loss	E_{off}	$V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $L = 400\text{ }\mu\text{H}$	-	2.50	3.78	
Total switching loss	E_{tot}	$T_J = 25\text{ }^\circ\text{C}$ ⁽¹⁾	-	5.20	7.85	
Turn-on switching loss	E_{on}	$I_C = 35\text{ A}$, $V_{CC} = 600\text{ V}$	-	3.75	5.45	
Turn-off switching loss	E_{off}	$V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $L = 400\text{ }\mu\text{H}$	-	3.68	5.10	
Total switching loss	E_{tot}	$T_J = 125\text{ }^\circ\text{C}$ ⁽¹⁾	-	7.43	10.55	
Turn-on delay time	$t_{d(ON)}$	$I_C = 35\text{ A}$, $V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$, $L = 400\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	50	65	ns
Rise time	t_r		-	35	50	
Turn-off delay time	$t_{d(OFF)}$		-	415	560	
Fall time	t_f		-	230	300	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$	-	3475	-	pF
Output capacitance	C_{oes}	$V_{CC} = 30\text{ V}$	-	615	-	
Reverse transfer capacitance	C_{res}	$f = 1\text{ MHz}$	-	90	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}$, $I_C = 100\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}$ $V_{CC} = 900\text{ V}$, $V_P = 1200\text{ V}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$ to 0 V	10	-	-	μs
Diode peak reverse recovery current	I_{rr}	$T_J = 125\text{ }^\circ\text{C}$ $V_{CC} = 600\text{ V}$, $I_F = 35\text{ A}$, $L = 400\text{ }\mu\text{H}$ $V_{GE} = 15\text{ V}$, $R_G = 10\text{ }\Omega$	-	73	-	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}	-	-	0.44	°C/W
Junction to case DIODE		-	-	0.80	
Case to sink, flat, greased surface MODULE	R _{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

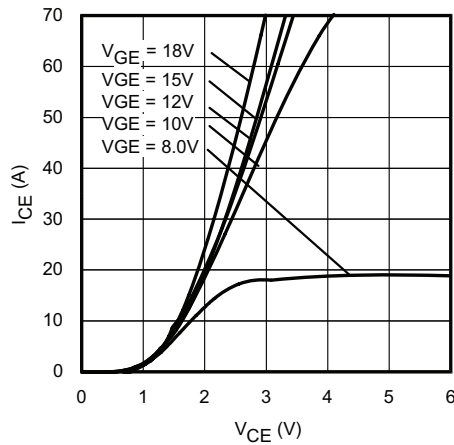


Fig. 1 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 μs

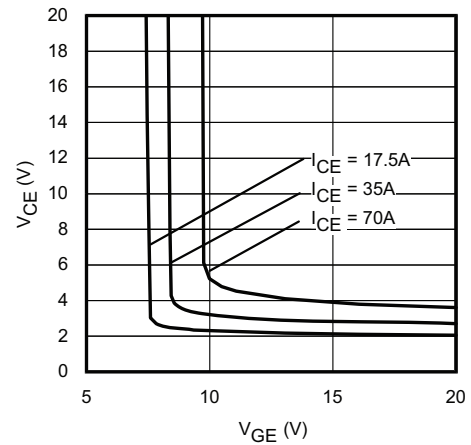


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

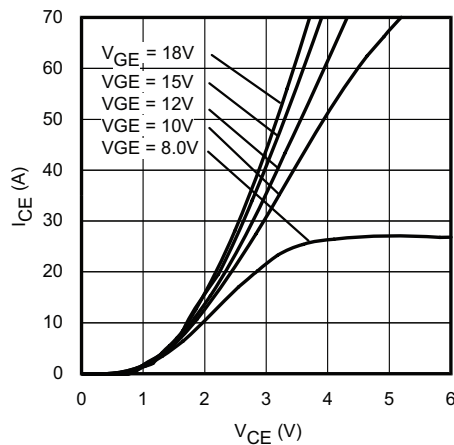


Fig. 2 - Typical IGBT Output Characteristics
T_J = 125 °C; t_p = 80 μs

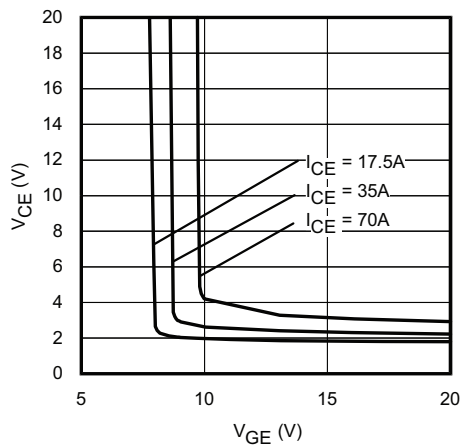


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

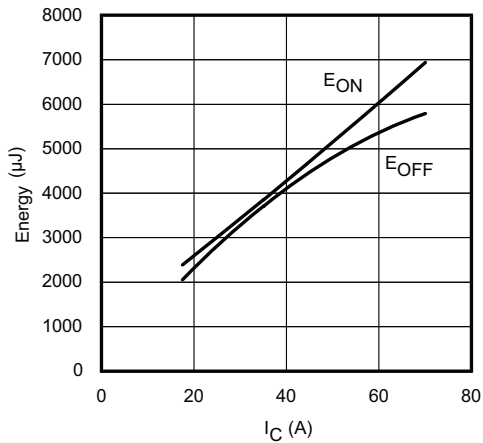


Fig. 5 - Typical Energy Loss vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$; $L = 400\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $R_G = 10\text{ }\Omega$; $V_{GE} = 15\text{ V}$

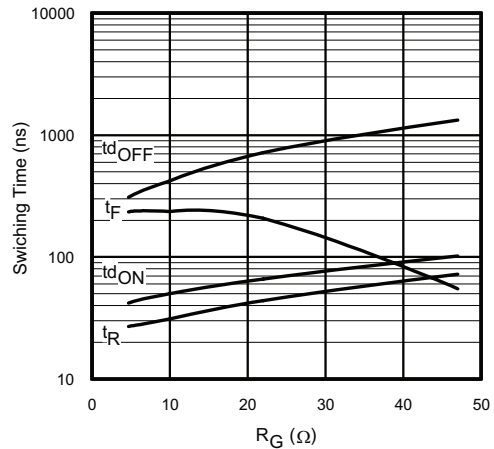


Fig. 8 - Typical Switching Time vs. R_G
 $T_J = 125\text{ }^\circ\text{C}$; $L = 400\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $I_{CE} = 35\text{ A}$; $V_{GE} = 15\text{ V}$

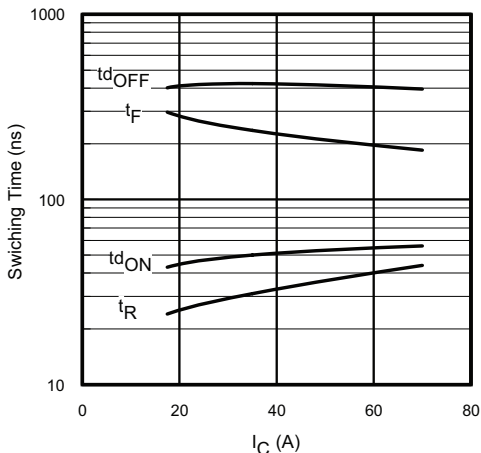


Fig. 6 - Typical Switching Time vs. I_C
 $T_J = 125\text{ }^\circ\text{C}$; $L = 400\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $R_G = 10\text{ }\Omega$; $V_{GE} = 15\text{ V}$

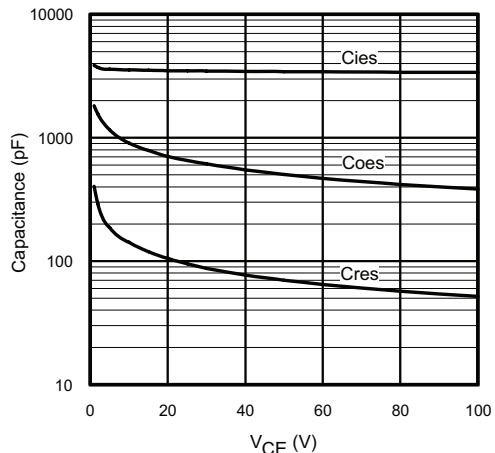


Fig. 9 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

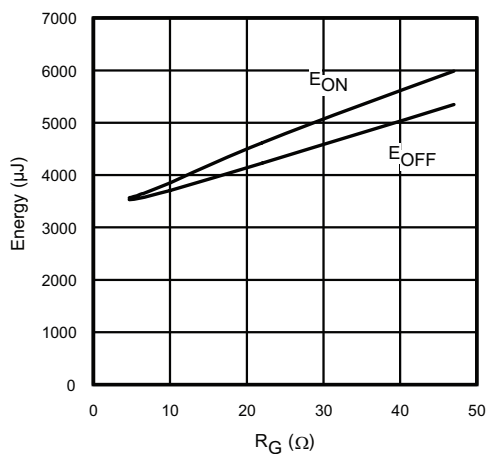


Fig. 7 - Typical Energy Loss vs. R_G
 $T_J = 125\text{ }^\circ\text{C}$; $L = 400\text{ }\mu\text{H}$; $V_{CE} = 600\text{ V}$
 $I_{CE} = 35\text{ A}$; $V_{GE} = 15\text{ V}$

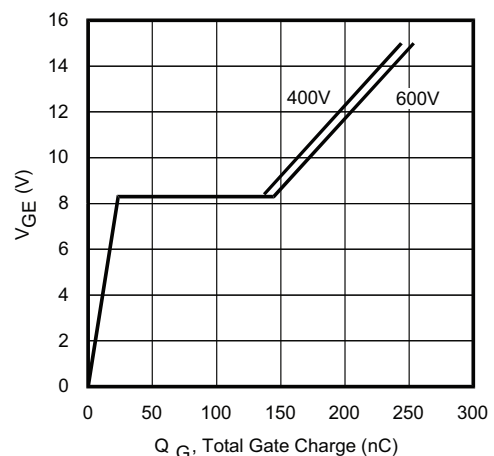


Fig. 10 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 35\text{ A}$; $L = 600\text{ }\mu\text{H}$

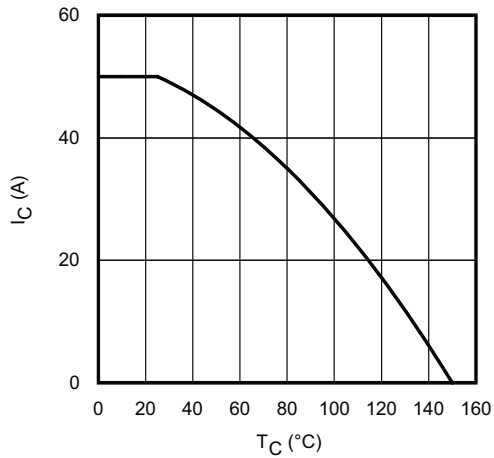


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

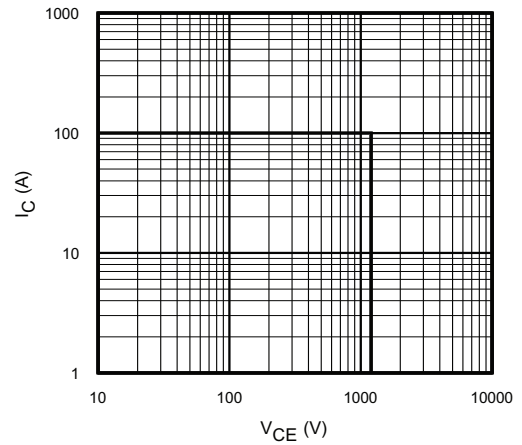
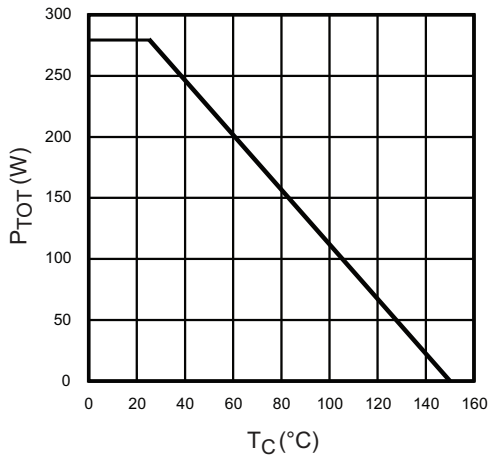
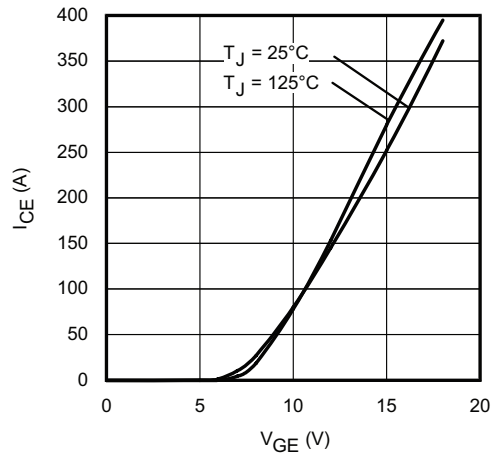
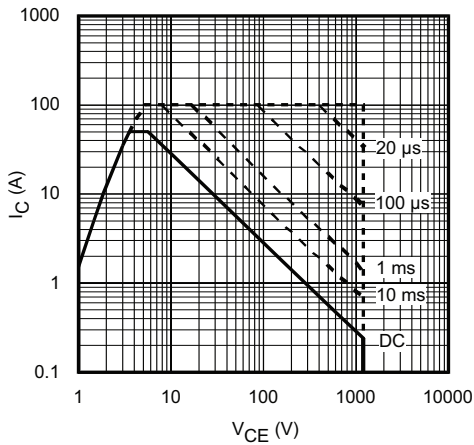
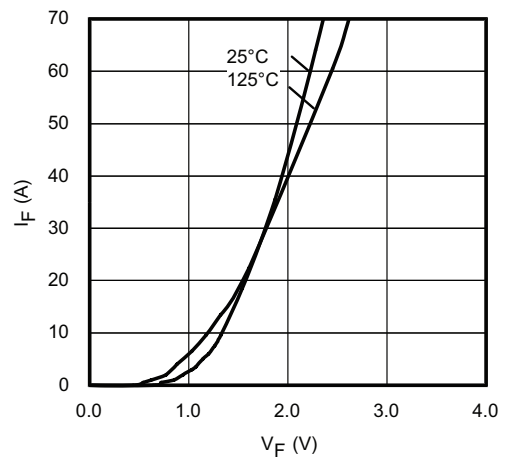

 Fig. 14 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{ V}$


Fig. 12 - Power Dissipation vs. Case Temperature


 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
 $t_p = 80\ \mu\text{s}$

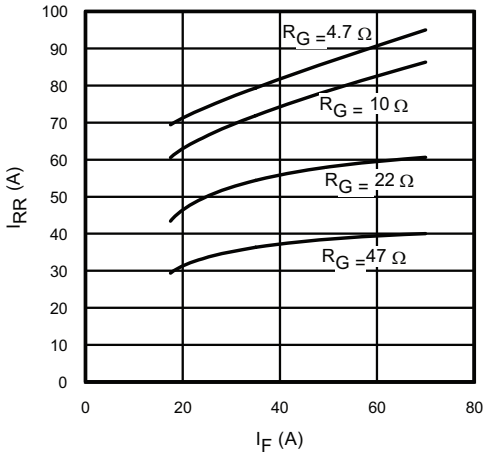


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 125^\circ\text{C}$

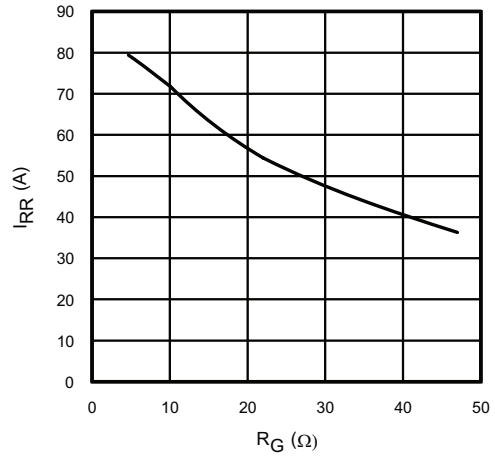


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 125^\circ\text{C}$; $I_F = 35\text{ A}$

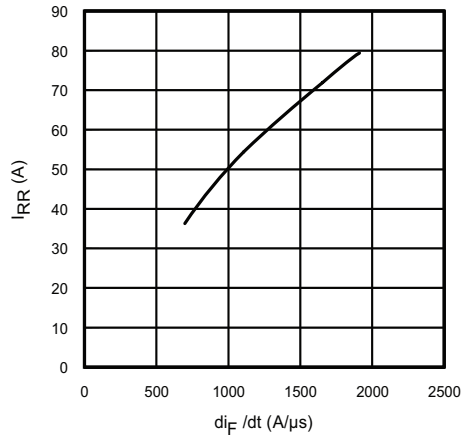


Fig. 19 - Typical Diode I_{RR} vs. di_F/dt ; $V_{CC} = 600\text{ V}$;
 $V_{GE} = 15\text{ V}$; $I_{CE} = 35\text{ A}$; $T_J = 125^\circ\text{C}$

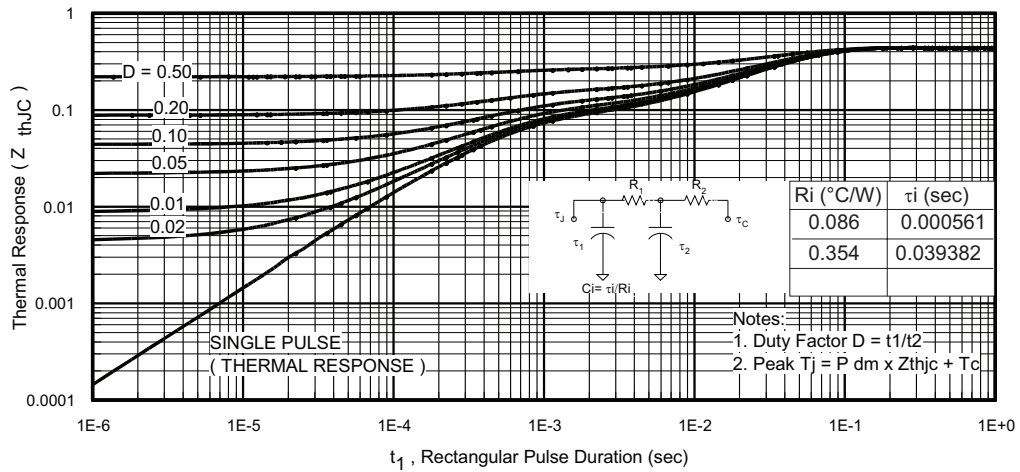


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

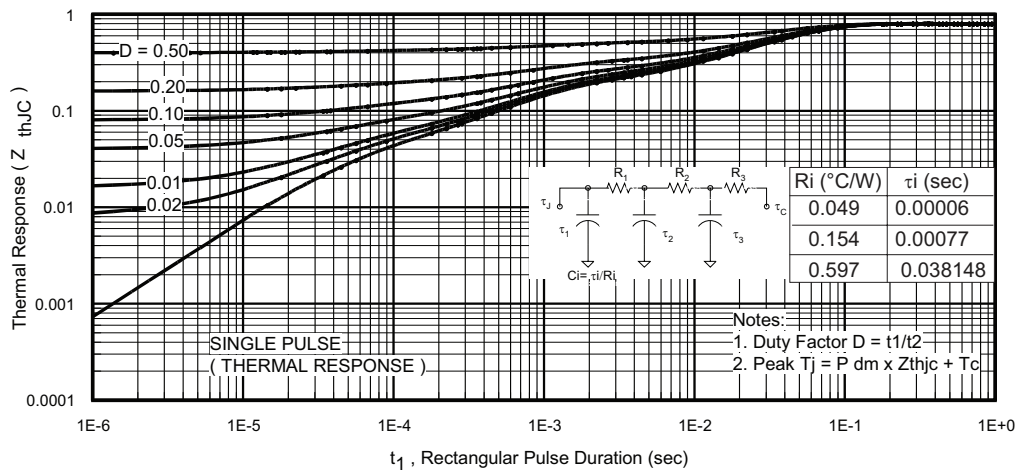


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (DIODE)

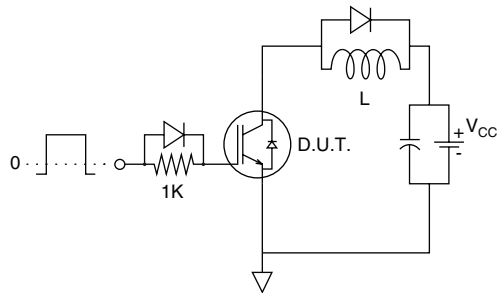


Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

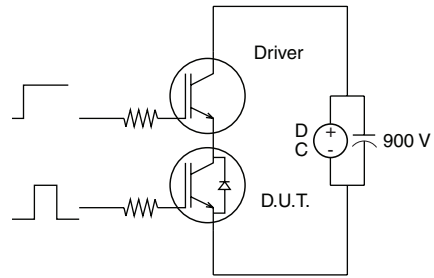


Fig. C.T.3 - S.C. SOA Circuit

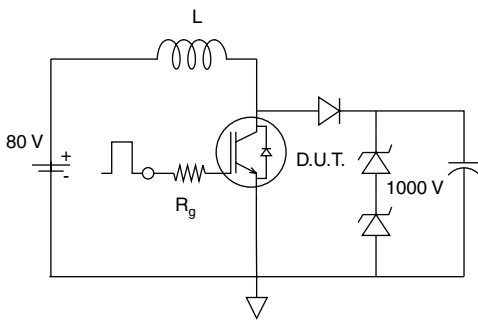


Fig. C.T.2 - RBSOA Circuit

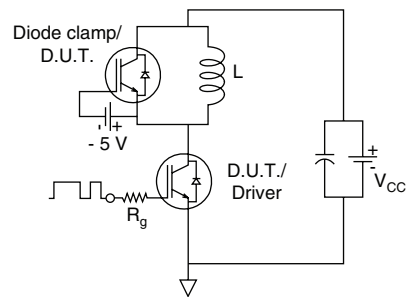


Fig. C.T.4 - Switching Loss Circuit

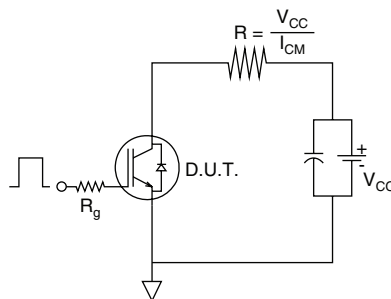
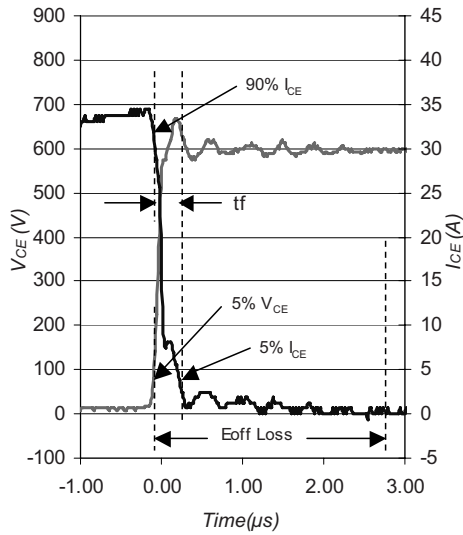
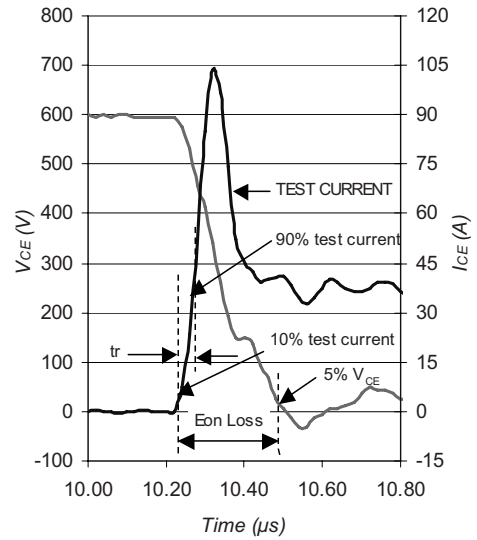


Fig. C.T.5 - Resistive Load Circuit


 Fig. WF1 - Typical Turn-Off Loss Waveform at $T_J = 125^\circ\text{C}$ using Fig. CT.4

 Fig. WF2 - Typical Turn-On Loss Waveform at $T_J = 125^\circ\text{C}$ using Fig. CT.4

ORDERING INFORMATION TABLE

Device code	G	B	35	X	F	120	K
	①	②	③	④	⑤	⑥	⑦

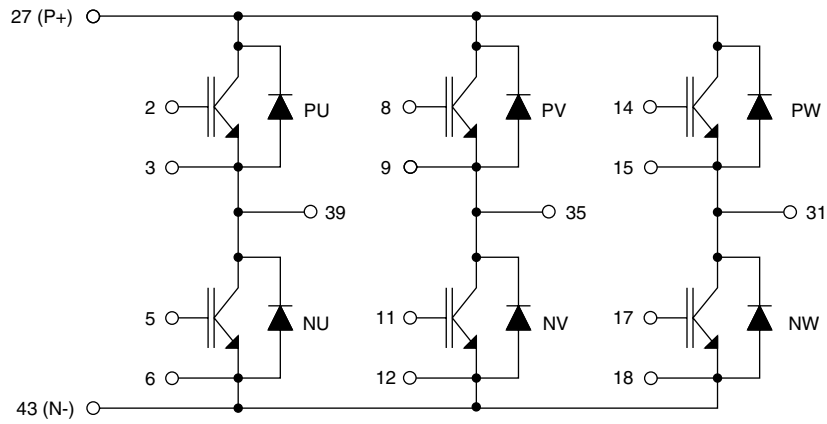
- 1** - Insulated Gate Bipolar Transistor (IGBT)
- 2** - IGBT Generation 5 NPT
- 3** - Current rating (35 = 35 A)
- 4** - Circuit configuration
(X = Sixpack or three phase inverter)
- 5** - Package (F = ECONO2)
- 6** - Voltage rating (120 = 1200 V)
- 7** - Ultrafast (Speed 8 to 60 kHz)

GB35XF120K

Vishay High Power Products IGBT Sixpack Module, 35 A



CIRCUIT CONFIGURATION



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



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