




# IGBT ECONO3 Module, 150 A



ECONO3 4 pack

### FEATURES

- Gen 5 non punch through (NPT) technology
- 10  $\mu$ s short circuit capability
- Square RBSOA
- HEXFRED low  $Q_{rr}$ , low switching energy
- Positive temperature coefficient
- Copper baseplate
- Operating frequencies 8 kHz to 60 kHz
- Low stray inductance design
- UL approved file E78996 
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS COMPLIANT

PRODUCT SUMMARY	
$V_{CES}$	1200 V
$I_{C(DC)}$ at $T_C = 57^\circ C$	150 A
$V_{CE(on)}$ typ. at 150 A	3.45 V
Package	ECONO3 4 pack
Circuit	4 pack with thermistor

### BENEFITS

- Benchmark efficiency for SMPS application in particular HF welding
- Rugged transient performance
- Low EMI, requires less snubbing
- Direct mounting to heatsink space saving
- PCB solderable terminals
- Low junction to case thermal resistance

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	$V_{CES}$		1200	V
Continuous collector current	$I_C$	$T_C = 25^\circ C$	182	A
		$T_C = 80^\circ C$	124	
Pulsed collector current	$I_{CM}$		370	
Clamped inductive load current	$I_{LM}$		370	
Diode continuous forward current	$I_F$	$T_C = 25^\circ C$	113	
		$T_C = 80^\circ C$	78	
Diode maximum forward current	$I_{FSM}$		730	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Maximum power dissipation	IGBT $P_D$	$T_C = 25^\circ C$	892	W
		$T_C = 80^\circ C$	500	
MODULE				
Operating junction temperature range	$T_J$		-55 to +150	$^\circ C$
Storage temperature range	$T_{Stg}$		-40 to +125	
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ s	3500	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	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 150\text{ A}$	-	3.45	4.0	
		$V_{GE} = 15\text{ V}, I_C = 200\text{ A}$	-	3.9	-	
		$V_{GE} = 15\text{ V}, I_C = 150\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.87	-	
		$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	4.42	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 1.5\text{ mA}$	4.1	4.9	6.5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}, (25\text{ }^\circ\text{C to } 125\text{ }^\circ\text{C})$	-	-12.3	-	mV/ $^\circ\text{C}$
Collector to emitter leaking current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	21	120	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	1.57	-	mA
Diode forward voltage drop	$V_{FM}$	$I_F = 100\text{ A}$	-	2.73	3.5	V
		$I_F = 150\text{ A}$	-	3.18	-	
		$I_F = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.8	-	
		$I_F = 150\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.4	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 440$	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)	$Q_g$	$I_C = 150\text{ A}$ $V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}$	-	1260	-	nC	
Gate to emitter charge (turn-on)	$Q_{ge}$		-	130	-		
Gate to collector charge (turn-on)	$Q_{gc}$		-	500	-		
Turn-on switching loss	$E_{on}$	$I_C = 150\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V},$ $R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	5.86	-	mJ	
Turn-off switching loss	$E_{off}$		-	4.7	-		
Total switching loss	$E_{tot}$		-	10.56	-		
Turn-on switching loss	$E_{on}$		$V_{CC} = 600\text{ V}, I_C = 150\text{ A}, V_{GE} = 15\text{ V},$ $R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	7.74		-
Turn-off switching loss	$E_{off}$			-	7.2		-
Total switching loss	$E_{tot}$			-	14.94		-
Turn-on delay time	$t_{d(on)}$	$I_C = 150\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V},$ $R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	474	-	ns	
Rise time	$t_r$		-	89	-		
Turn-off delay time	$t_{d(off)}$		-	520	-		
Fall time	$t_f$		-	101	-		
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 370\text{ A}, R_g = 4.7\text{ }\Omega,$ $V_{GE} = 15\text{ V to } 0, V_{CC} = 600\text{ V}, V_P = 1200\text{ V}$					
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}, V_{CC} = 900\text{ V}, V_P = 1200\text{ V},$ $R_g = 10\text{ }\Omega, V_{GE} = 15\text{ V to } 0$	10	-	-	$\mu\text{s}$	
Diode reverse recovery time	$T_J = 25\text{ }^\circ\text{C}$	$V_R = 400\text{ V}, I_F = 50\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$	-	210	-	ns	
	$T_J = 125\text{ }^\circ\text{C}$			345	-		
Diode peak reverse current	$T_J = 25\text{ }^\circ\text{C}$		-	13.8	-	A	
	$T_J = 125\text{ }^\circ\text{C}$		-	23.2	-		
Diode recovery charge	$T_J = 25\text{ }^\circ\text{C}$		-	1448	-	nC	
	$T_J = 125\text{ }^\circ\text{C}$		-	3990	-		



INTERNAL NTC - THERMISTOR SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNITS
Resistance	R <sub>25</sub>	T <sub>C</sub> = 25 °C	5000	Ω
	R <sub>100</sub>	T <sub>C</sub> = 100 °C	493 ± 5 %	
B-value	B <sub>25/50</sub>	R <sub>2</sub> = R <sub>25</sub> exp. [B <sub>25/50</sub> (1/T <sub>2</sub> - 1/(298.15 K))]	3375 ± 5 %	K
Maximum operating temperature			220	°C
Dissipation constant			2	mW/°C
Thermal time constant			8	s

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
IGBT - Junction to case (per switch)	R <sub>thJC</sub>	-	-	0.14	°C/W
DIODE - Junction to case (per diode)	R <sub>thJC</sub>	-	-	0.3	
Case to sink, flat, greased surface (per module)	R <sub>thJS</sub>	-	0.015	-	
Mounting torque (M5)		3.0	-	6.0	Nm
Weight		-	290	-	g

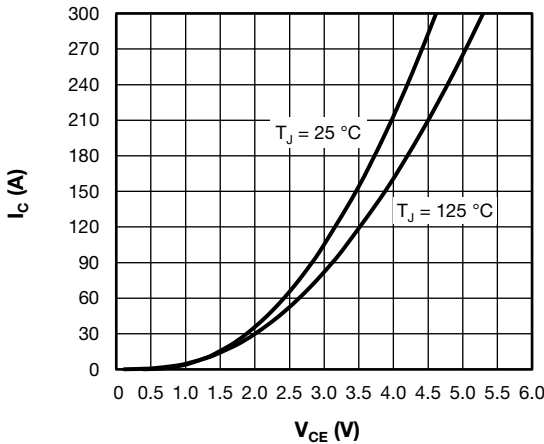


Fig. 1 - Typical IGBT Output Characteristics, V<sub>GE</sub> = 15 V

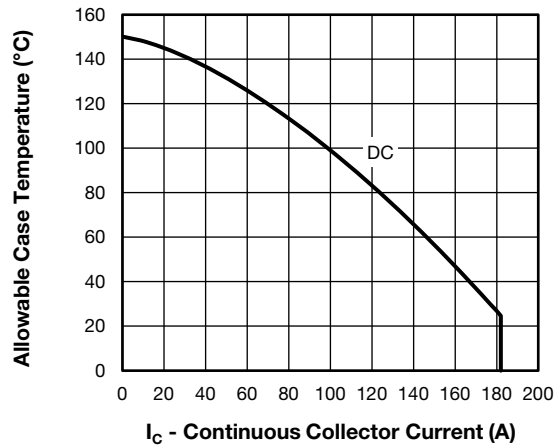


Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

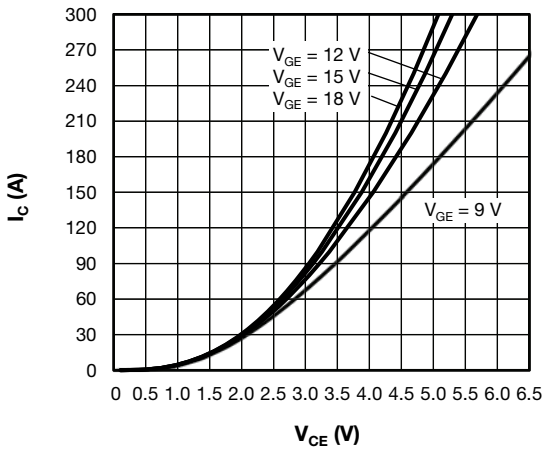


Fig. 2 - Typical IGBT Output Characteristics, T<sub>J</sub> = 125 °C

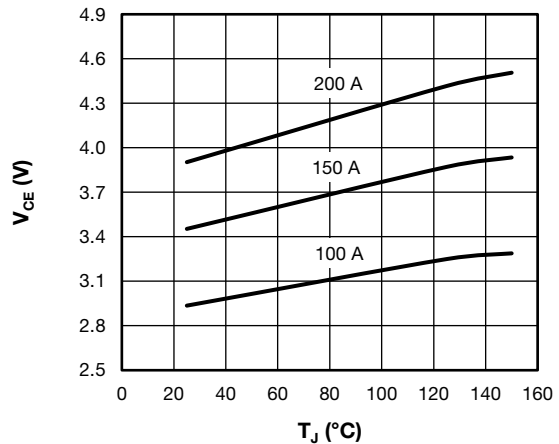


Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

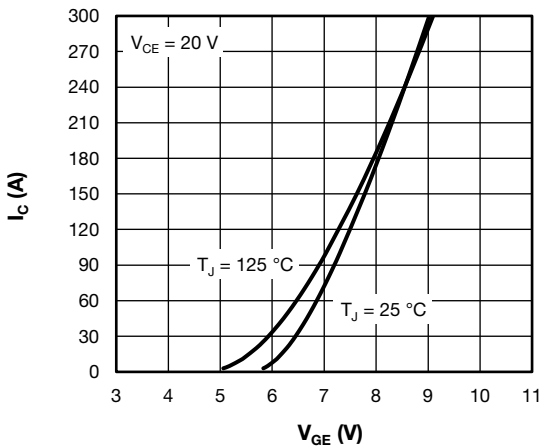


Fig. 5 - Typical IGBT Transfer Characteristics

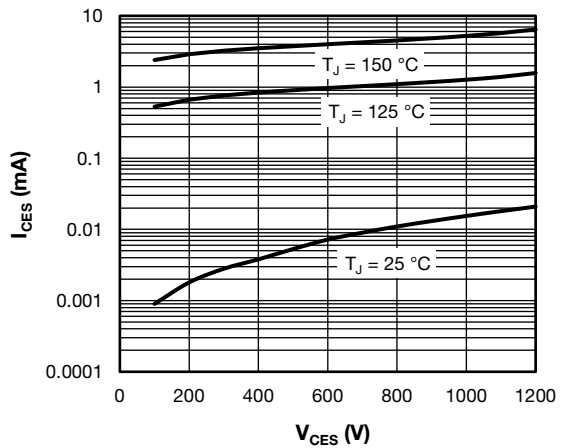


Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

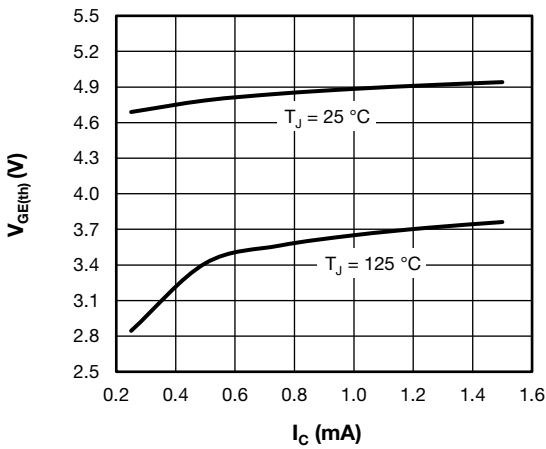


Fig. 6 - Typical IGBT Gate Threshold Voltage

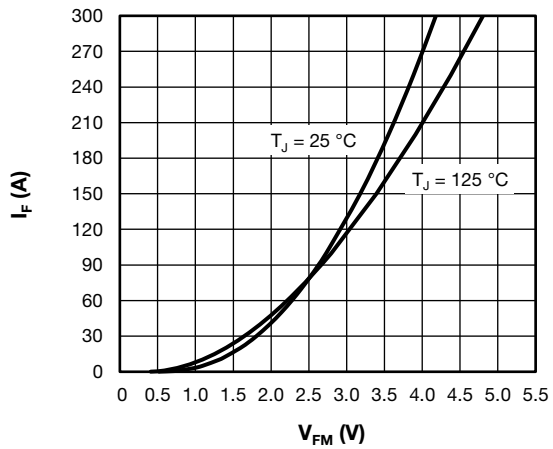


Fig. 9 - Typical Diode Forward Characteristics

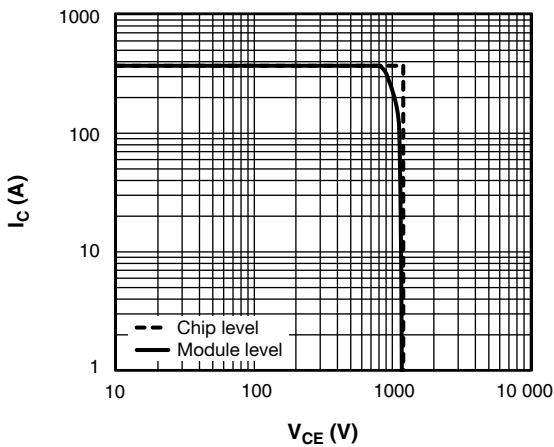


Fig. 7 - IGBT Reverse BIAS SOA  $T_J = 150\text{ }^\circ\text{C}$ ,  $V_{GE} = 15\text{ V}$

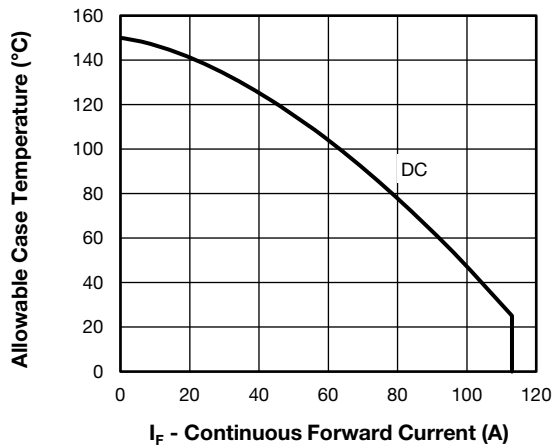


Fig. 10 - Maximum Diode Continuous Forward Current vs. Case Temperature

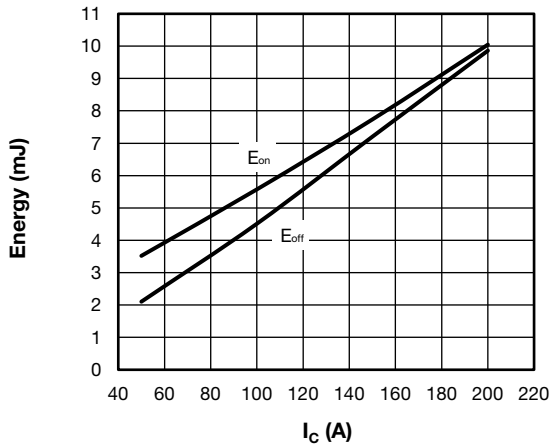


Fig. 11 - Typical IGBT Energy Loss vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

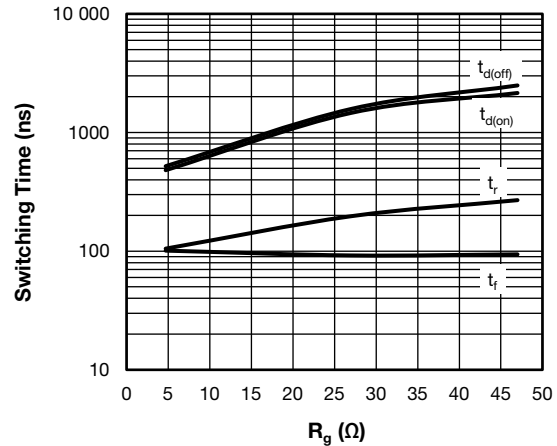


Fig. 14 - Typical IGBT Switching Time vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 150\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

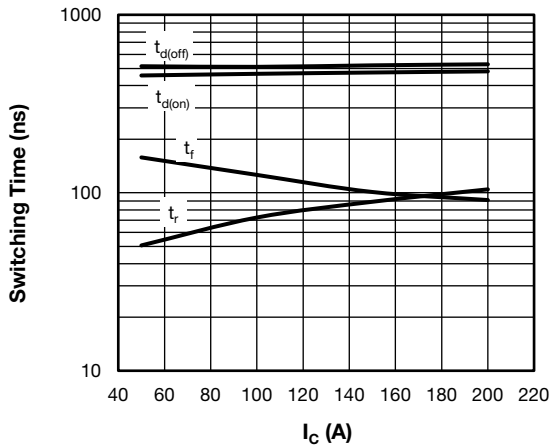


Fig. 12 - Typical IGBT Switching Time vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

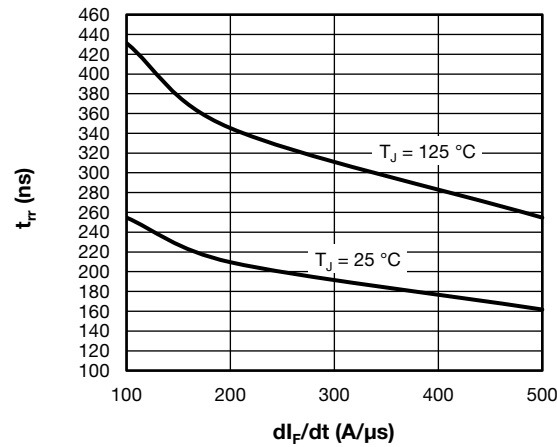


Fig. 15 - Typical Diode Reverse Recovery Time vs.  $di_F/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

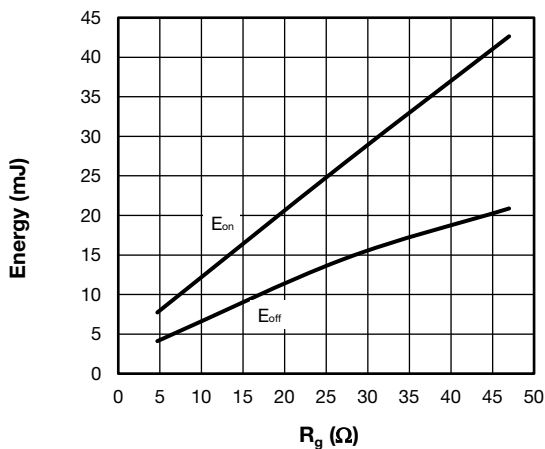


Fig. 13 - Typical IGBT Energy Loss vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 150\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\ \mu\text{H}$

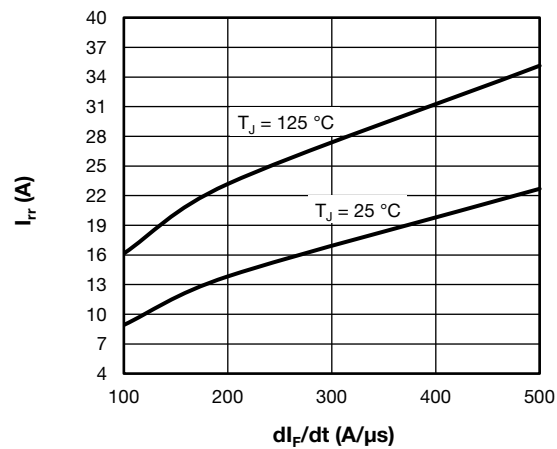


Fig. 16 - Typical Diode Reverse Recovery Current vs.  $di_F/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

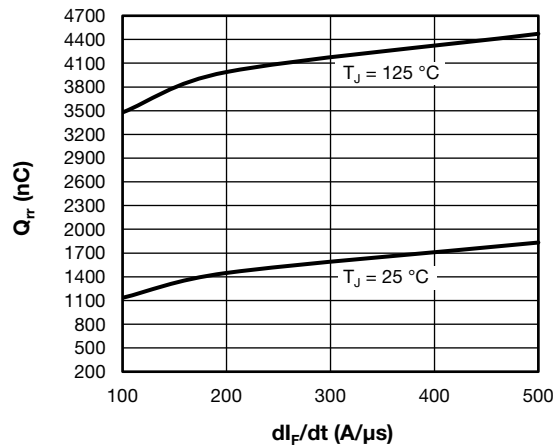


Fig. 17 - Typical Diode Reverse Recovery Charge vs.  $di_F/dt$ ,  $V_{rr} = 400$  V,  $I_F = 50$  A

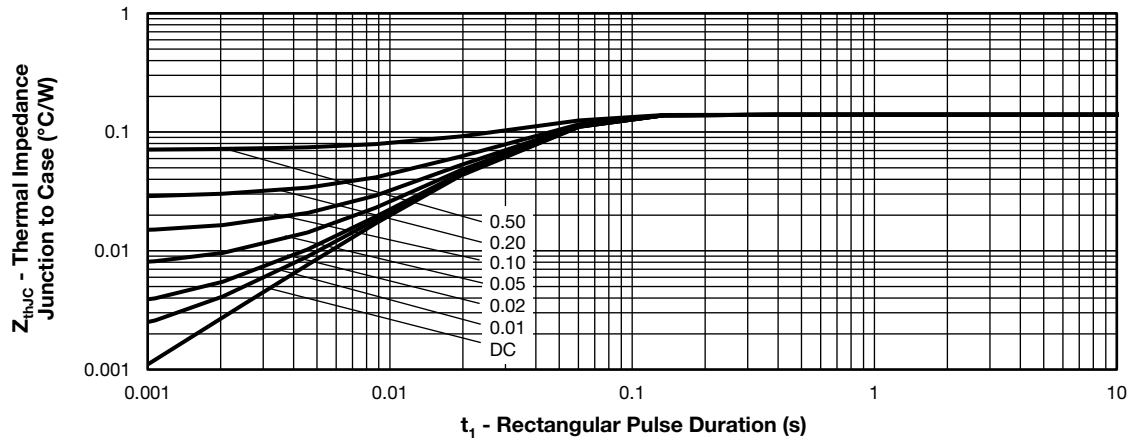


Fig. 18 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (IGBT)

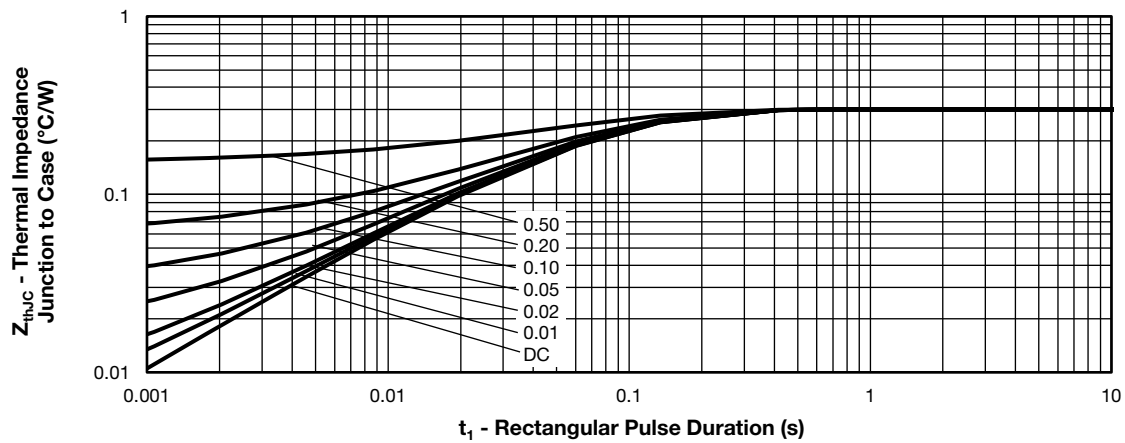


Fig. 19 - Maximum Thermal Impedance  $Z_{thJC}$  Characteristics (Diode)

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>G</b>	<b>B</b>	<b>150</b>	<b>Y</b>	<b>G</b>	<b>120</b>	<b>N</b>	<b>T</b>
	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- 1** - Vishay Semiconductors product
- 2** - Insulated gate bipolar transistor (IGBT)
- 3** - B = IGBT Generation 5 NPT
- 4** - Current rating (150 = 150 A)
- 5** - Circuit configuration (Y = 4 pack)
- 6** - Package indicator (G = ECONO3)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed / type (N = ultrafast with reduced diode, speed 8 kHz to 60 kHz)
- 9** - NTC Thermistor

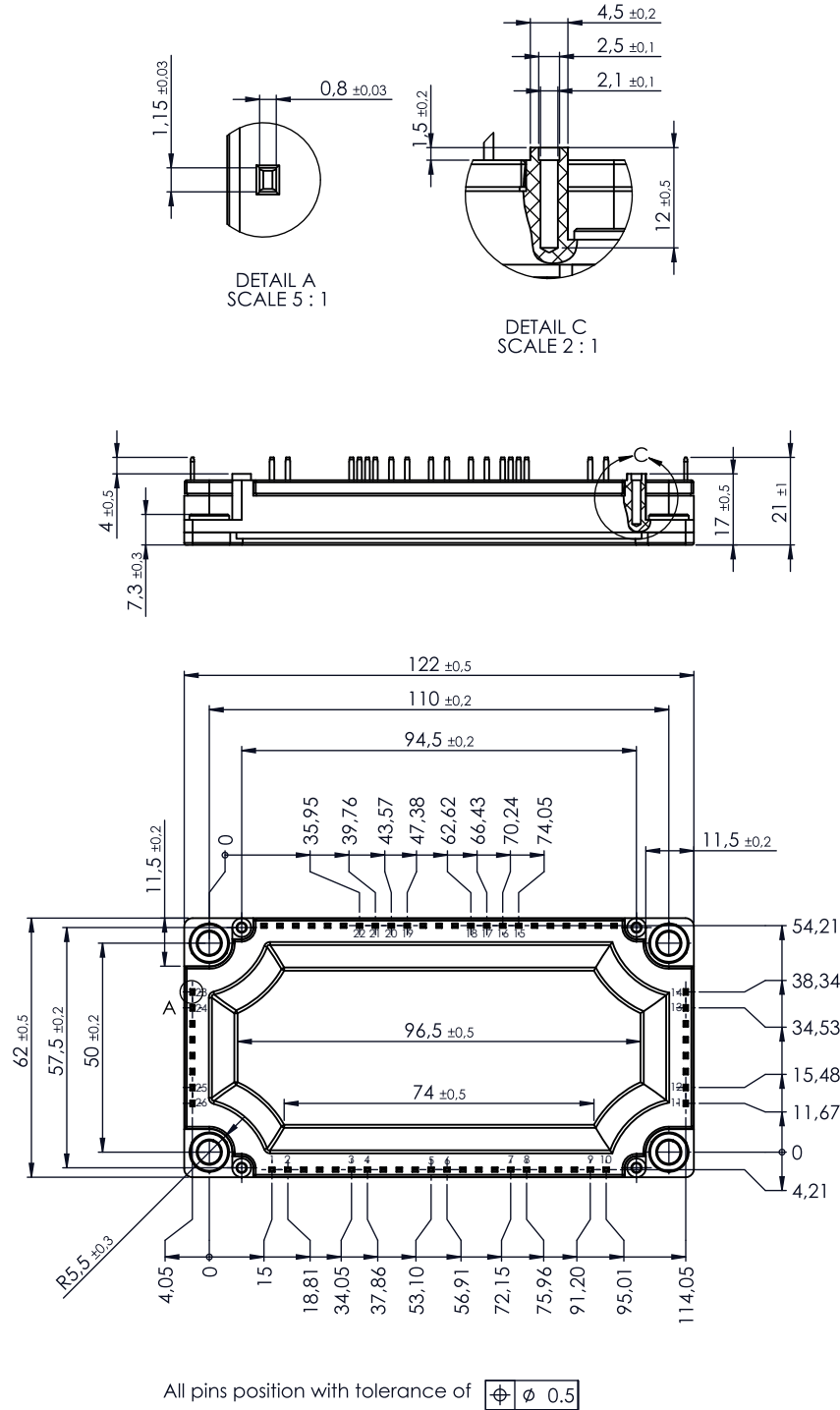
CIRCUIT CONFIGURATION		
CIRCUIT	CIRCUIT CONFIGURATION CODE	CIRCUIT DRAWING
4 pack with thermistor	Y	

LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95686">www.vishay.com/doc?95686</a>



### ECONO3 4 Pack

**DIMENSIONS** in millimeters and inches







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