

## IGBT ECONO 3 Module, 100 A


**ECONO 3, 4 pack**

### FEATURES

- Trench gate field stop IGBT
- 5  $\mu$ s short circuit capability
- Square RBSOA
- HEXFRED low  $Q_{rr}$ , low switching energy
- Positive  $V_{CE(on)}$  temperature coefficient
- Copper baseplate
- 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**

### PRIMARY CHARACTERISTICS

$V_{CES}$	1200 V
$I_C(DC)$ at $T_C = 93\text{ }^\circ\text{C}$	100 A
$V_{CE(on)}$ typ. at 100 A	2.12 V
Package	ECONO 3
Circuit configuration	4 pack with thermistor

### BENEFITS

- Benchmark efficiency for SMPS appreciation 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	$I_C$	$T_C = 25\text{ }^\circ\text{C}$	170	A
		$T_C = 80\text{ }^\circ\text{C}$	115	
Pulsed collector current	$I_{CM}$		500	
Clamped inductive load current	$I_{LM}$		250	
Diode continuous forward current	$I_F$	$T_C = 25\text{ }^\circ\text{C}$	71	
		$T_C = 80\text{ }^\circ\text{C}$	49	
Diode maximum forward current	$I_{FSM}$		370	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Power dissipation	IGBT	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	595
			$T_C = 80\text{ }^\circ\text{C}$	333
<b>MODULE</b>				
Operating junction temperature range	$T_J$		-40 to +150	$^\circ\text{C}$
Storage temperature range	$T_{Stg}$		-40 to +150	
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1\text{ s}$	3500	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	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 6\text{ mA}$	1200	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$	-	1.8	-	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}$	-	2.12	2.43	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	1.88	-	
		$V_{GE} = 15\text{ V}, I_C = 100\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.35	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 6\text{ mA}$	4.6	5.8	7.6	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 6\text{ mA}$ ( $25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ )	-	-12.3	-	mV/ $^\circ\text{C}$
Collector to emitter leaking current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	1.1	75	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.72	-	mA
Diode forward voltage drop	$V_{FM}$	$I_F = 50\text{ A}, V_{GE} = 0\text{ V}$	-	2.59	3.15	V
		$I_F = 100\text{ A}, V_{GE} = 0\text{ V}$	-	3.38	-	
		$I_F = 50\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.69	-	
		$I_F = 100\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	3.74	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 750$	nA

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)							
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS	
Total gate charge (turn-on)	$Q_g$	$I_C = 100\text{ A}, V_{CC} = 960\text{ V}, V_{GE} = 15\text{ V}$	-	455	-	nC	
Gate to emitter charge (turn-on)	$Q_{ge}$		-	51	-		
Gate to collector charge (turn-on)	$Q_{gc}$		-	211	-		
Turn-on switching loss	$E_{on}$	$I_C = 100\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$	-	2.82	-	mJ	
Turn-off switching loss	$E_{off}$		-	3.47	-		
Total switching loss	$E_{tot}$		-	6.29	-		
Turn-on switching loss	$E_{on}$	$I_C = 100\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	4.09	-	mJ	
Turn-off switching loss	$E_{off}$		-	5.67	-		
Total switching loss	$E_{tot}$		-	9.76	-		
Turn-on delay time	$t_{d(on)}$	$I_C = 100\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, R_g = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$	-	63	-	ns	
Rise time	$t_r$		-	28	-		
Turn-off delay time	$t_{d(off)}$		-	222	-		
Fall time	$t_f$		-	150	-		
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 250\text{ A}, V_{GE} = 15\text{ V to } 0\text{ V}, R_g = 4.7\text{ }\Omega, V_{CC} = 700\text{ V}, V_p = 1200\text{ V}$	Full square				
Short circuit safe operating area	SCSOA	$V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	-	5	$\mu\text{s}$	
Diode reverse recovery time	$t_{rr}$	$I_F = 50\text{ A}, dI_F/dt = 200\text{ A}/\mu\text{s}, V_R = 400\text{ V}$	$T_J = 25\text{ }^\circ\text{C}$	-	190	-	ns
			$T_J = 125\text{ }^\circ\text{C}$	-	293	-	
Diode peak reverse current	$I_{rr}$		$T_J = 25\text{ }^\circ\text{C}$	-	12	-	A
			$T_J = 125\text{ }^\circ\text{C}$	-	18.6	-	
Diode recovery charge	$Q_{rr}$		$T_J = 25\text{ }^\circ\text{C}$	-	1140	-	nC
			$T_J = 125\text{ }^\circ\text{C}$	-	2725	-	



INTERNAL NTC - THERMISTOR SPECIFICATIONS				
PARAMETER	SYMBOL	TEST CONDITIONS	VALUE	UNITS
Resistance	R25	$T_C = 25\text{ }^\circ\text{C}$	5000	$\Omega$
	R100	$T_C = 100\text{ }^\circ\text{C}$	$493 \pm 5\%$	
B-value	$B_{25/50}$	$R_2 = R_{25} \exp. [B_{25/50} (1/T_2 - 1/(298.15\text{ K}))]$	$3375 \pm 5\%$	K
Maximum operating temperature			220	$^\circ\text{C}$
Dissipation constant			2	mW/ $^\circ\text{C}$
Thermal time constant			8	s

THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
IGBT - junction-to-case (per switch)	$R_{thJC}$	-	-	0.21	$^\circ\text{C}/\text{W}$
DIODE - junction-to-case (per diode)	$R_{thJC}$	-	-	0.46	
Case to sink, flat, greased surface (per module)	$R_{thJS}$	-	0.015	-	
Mounting torque (M5)		3.0	-	6.0	Nm
Weight		-	285	-	g

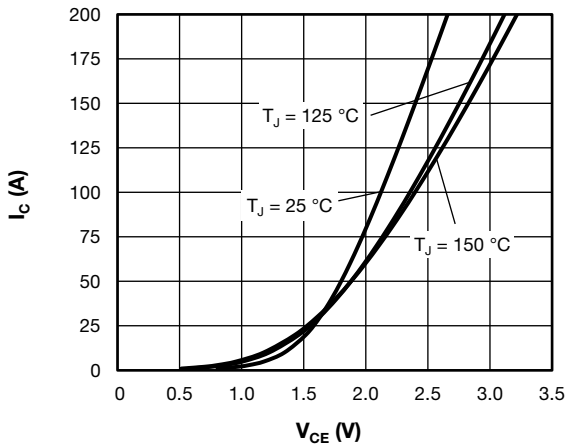


Fig. 1 - Typical Trench IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

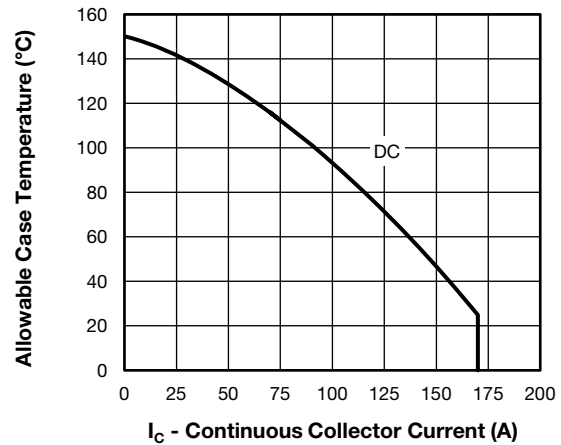


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

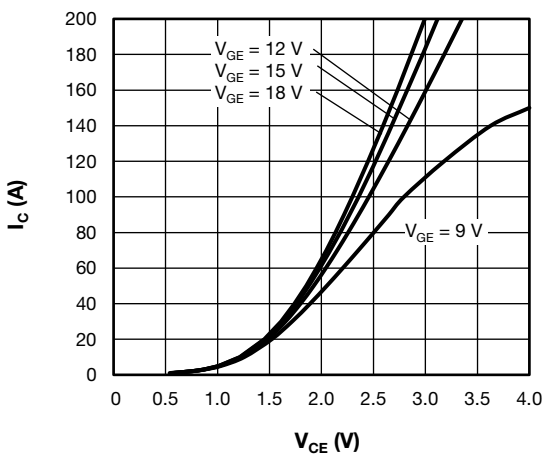


Fig. 2 - Typical Trench IGBT Output Characteristics,  $T_J = 125\text{ }^\circ\text{C}$

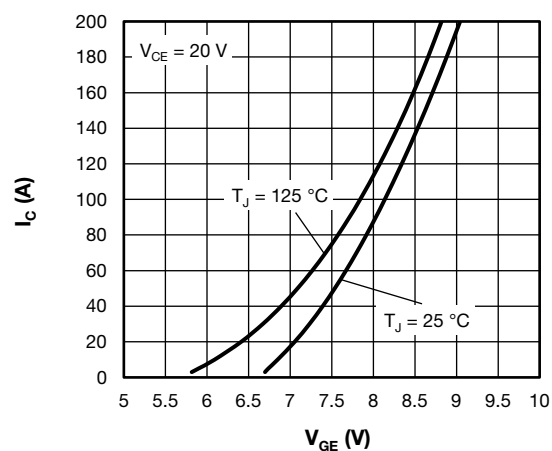


Fig. 4 - Typical Trench IGBT Transfer Characteristics

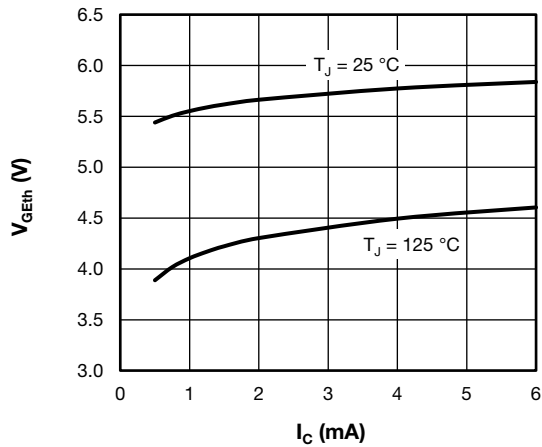


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

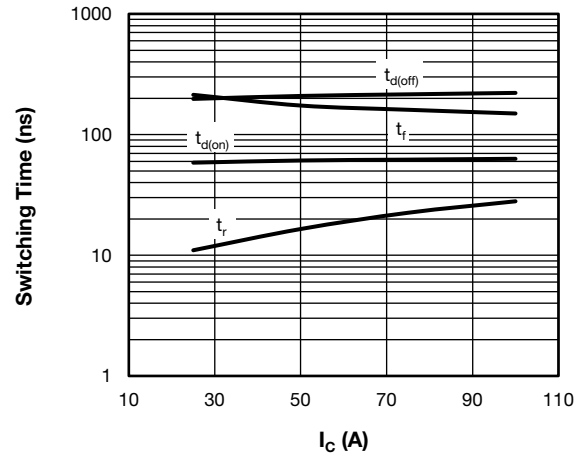


Fig. 8 - Typical Trench IGBT Switching Time vs.  $I_C$  with (Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\text{ }\Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

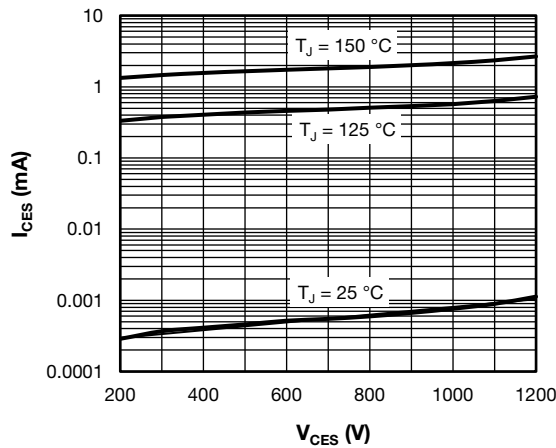


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

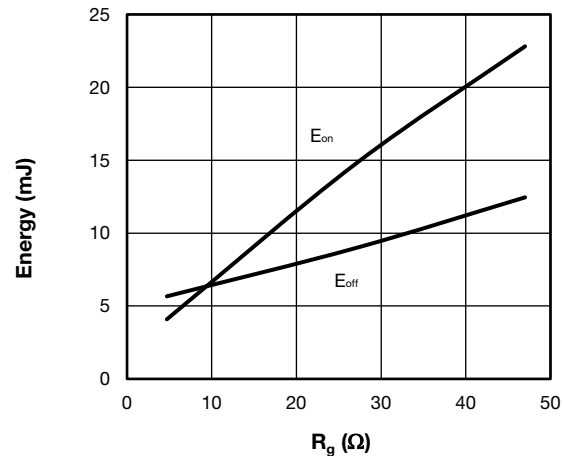


Fig. 9 - Typical Trench IGBT Energy Loss vs.  $R_g$  with (Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

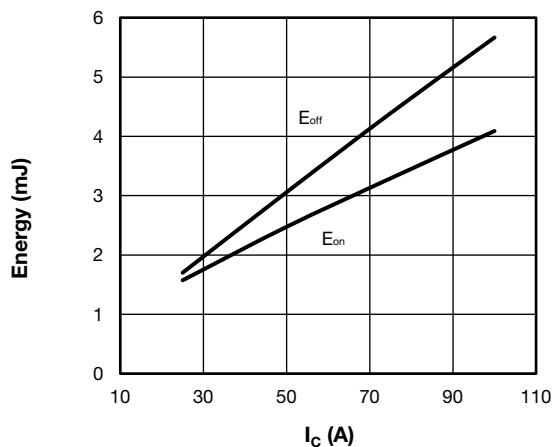


Fig. 7 - Typical IGBT Energy Loss vs.  $I_C$  with (Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\text{ }\Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

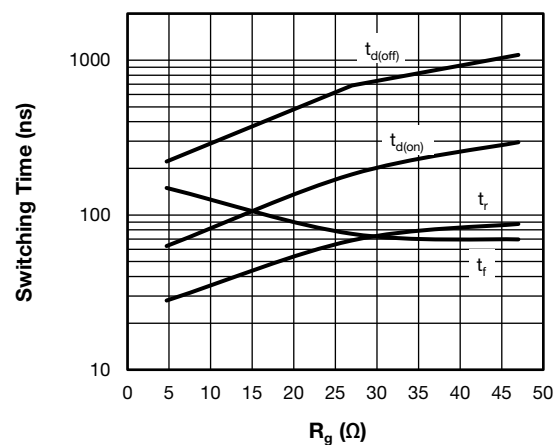


Fig. 10 - Typical Trench IGBT Switching Time vs.  $R_g$  with (Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 100\text{ A}$ ,  $V_{GE} = 15\text{ V}$ ,  $L = 500\text{ }\mu\text{H}$

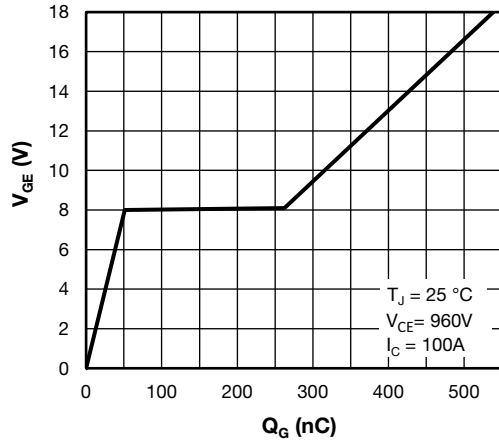


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

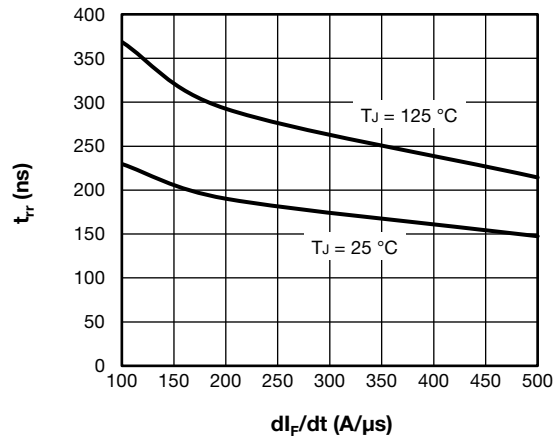


Fig. 14 - Typical Diode Reverse Recovery Time vs.  $di_F/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

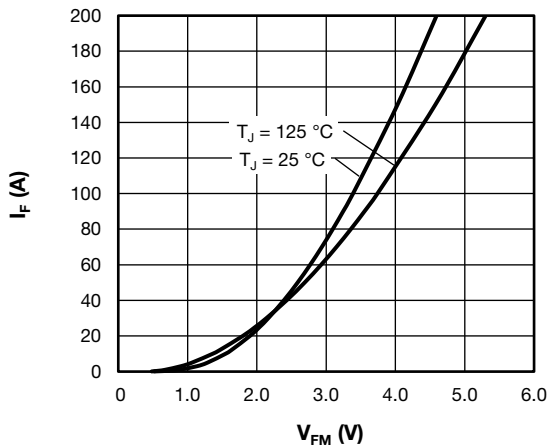


Fig. 12 - Typical Diode Forward Characteristics

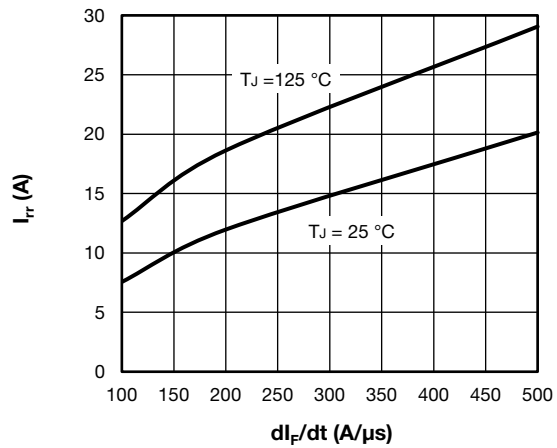


Fig. 15 - Typical Diode Reverse Recovery Current vs.  $di_F/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

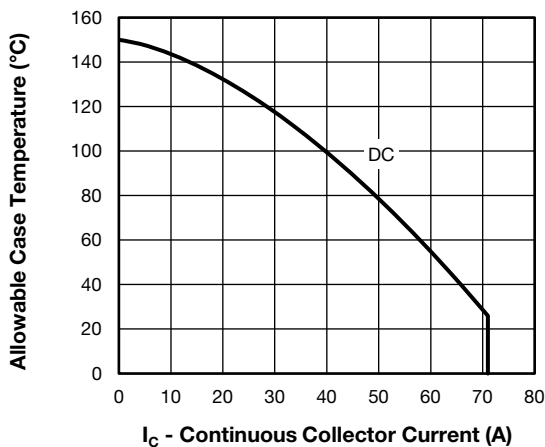


Fig. 13 - Maximum Diode Continuous Forward Current vs. Case Temperature

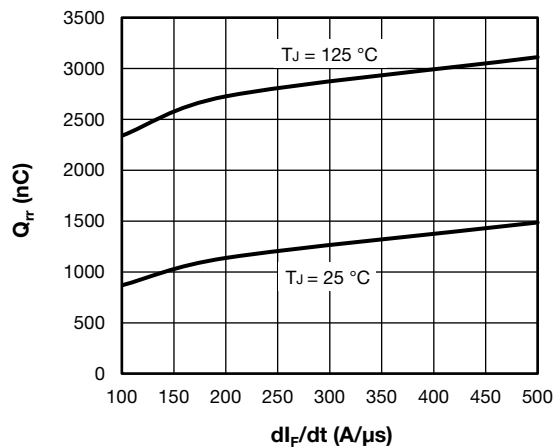


Fig. 16 - Typical Diode Reverse Recovery Charge vs.  $di_F/dt$   
 $V_{rr} = 400\text{ V}$ ,  $I_F = 50\text{ A}$

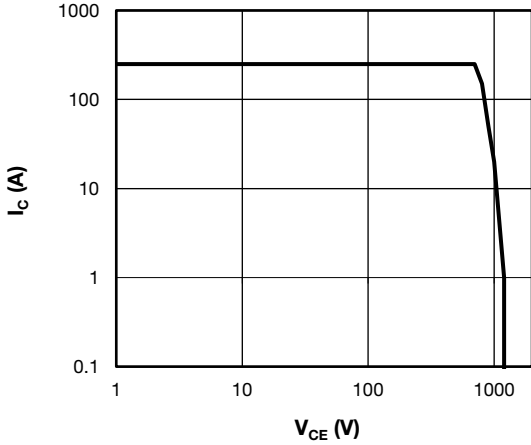


Fig. 17 - Trench IGBT Reverse BIAS SOA  
 $T_J = 150\text{ }^\circ\text{C}$ ,  $I_C = 200\text{ A}$ ,  $R_\theta = 10\ \Omega$ ,  $V_{GE} = +15\text{ V/0 V}$ ,  
 $V_{CC} = 600\text{ V}$ ,  $V_p = 1200\text{ V}$

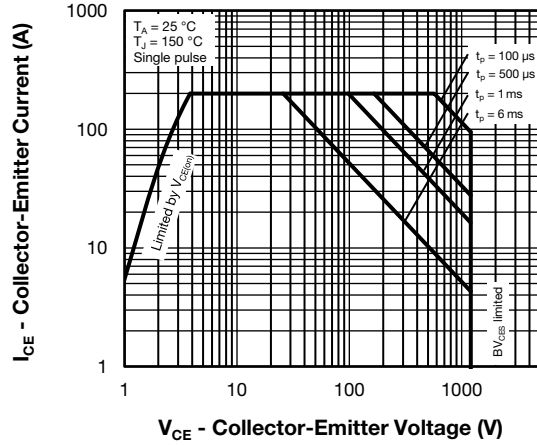


Fig. 18 - Trench IGBT Safe Operating Area

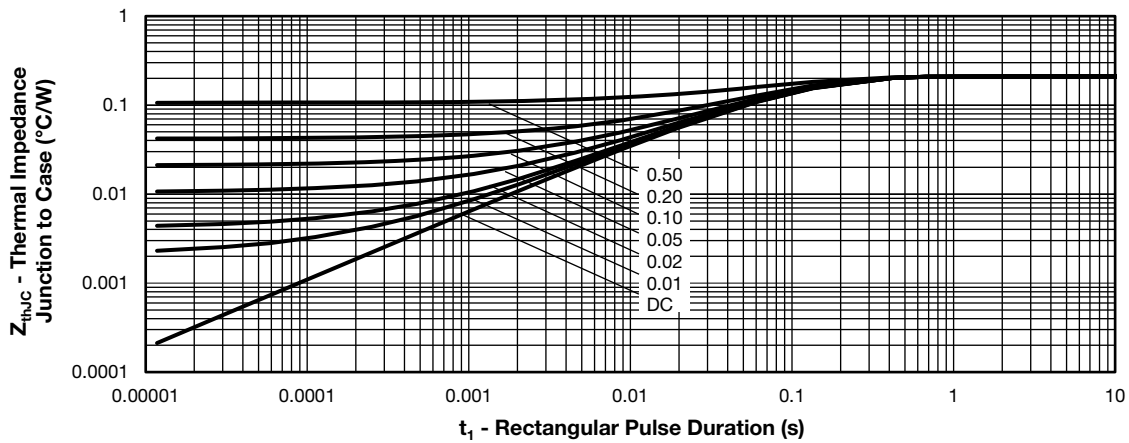


Fig. 19 - Maximum Trench IGBT Thermal Impedance  $Z_{thJC}$  Characteristics

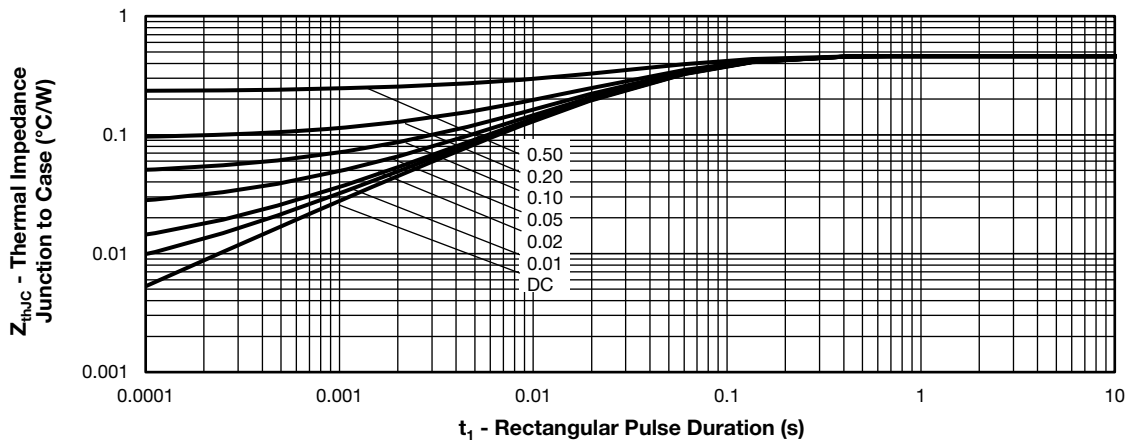


Fig. 20 - Maximum Diode Thermal Impedance  $Z_{thJC}$  Characteristics



**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>G</b>	<b>T</b>	<b>100</b>	<b>Y</b>	<b>G</b>	<b>120</b>	<b>U</b>	<b>T</b>
	1	2	3	4	5	6	7	8	9

- 1** - Vishay Semiconductors product
- 2** - Insulated gate bipolar transistor (IGBT)
- 3** - T = Trench IGBT technology
- 4** - Current rating (100 = 100 A)
- 5** - Circuit configuration (Y = 4 pack)
- 6** - Package indicator (G = ECONO 3)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed / type (U = Ultrafast IGBT)
- 9** - NTC thermistor

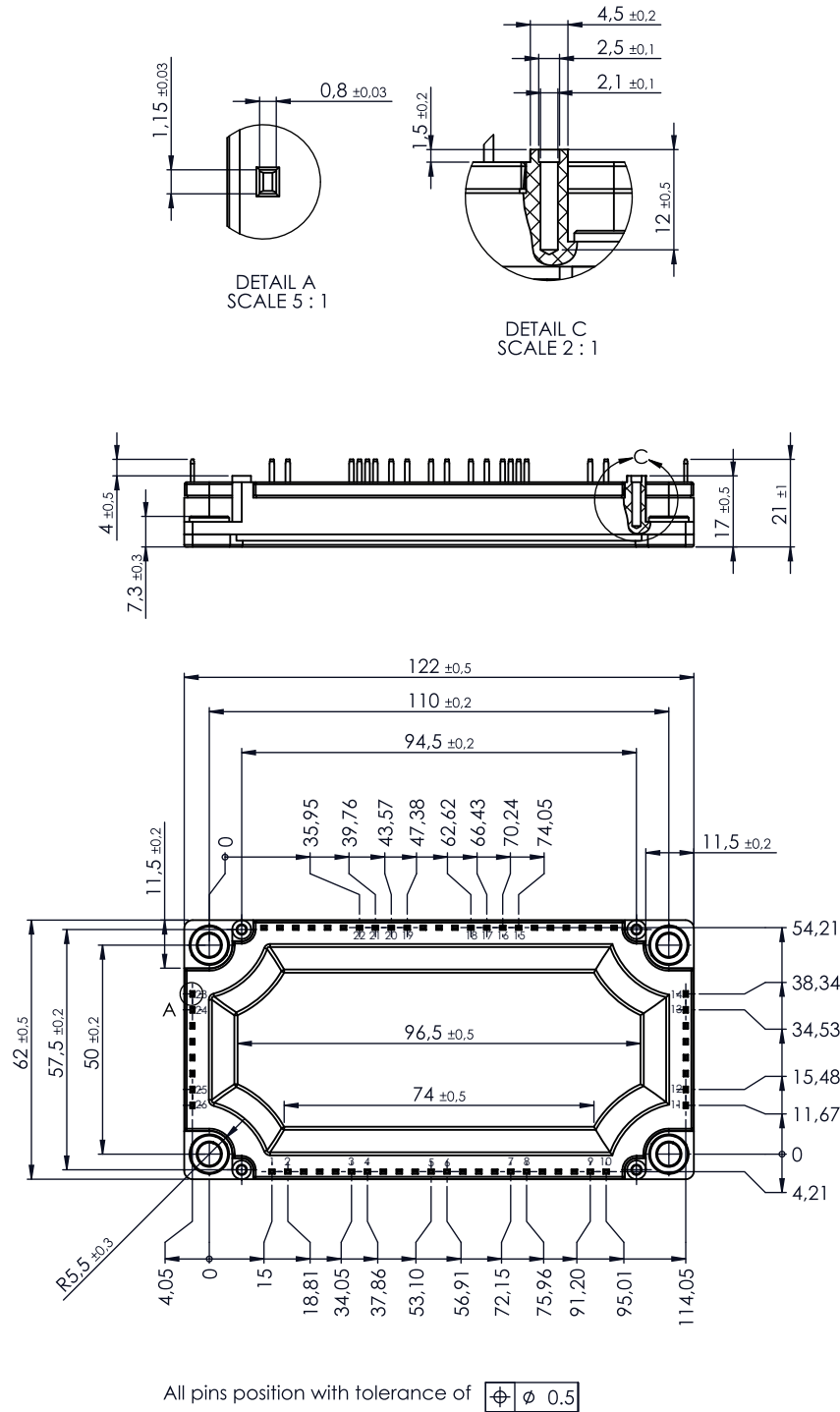
<b>CIRCUIT CONFIGURATION</b>		
<b>CIRCUIT</b>	<b>CIRCUIT CONFIGURATION CODE</b>	<b>CIRCUIT DRAWING</b>
4 pack with thermistor	Y	

<b>LINKS TO RELATED DOCUMENTS</b>	
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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