


## IGBT Fourpack Module, 50 A



**ECONO 2**  
(Package example)

### FEATURES

- Trench gate field stop IGBT
- Square RBSOA
- HEXFRED® low  $Q_{rr}$ , low switching energy
- Positive  $V_{CE(on)}$  temperature coefficient
- Copper baseplate
- Low stray inductance design
- Designed and qualified for industrial market
- 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
$I_C$ at $T_C = 66\text{ °C}$	50 A
$V_{CE(on)}$ (typical)	2.34 V
Speed	8 kHz to 30 kHz
Package	ECONO 2
Circuit configuration	4 pack

### 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	$I_C$	$T_C = 25\text{ °C}$	64	A
		$T_C = 80\text{ °C}$	44	
Pulsed collector current, see fig. C.T.5	$I_{CM}$	$T_J = 150\text{ °C}$ , $t_p = 6\text{ ms}$ , $V_{GE} = 15\text{ V}$	180	
Clamped inductive load current	$I_{LM}$		150	
Diode continuous forward current	$I_F$	$T_C = 25\text{ °C}$	40	
		$T_C = 80\text{ °C}$	25	
Diode maximum forward current	$I_{FM}$		150	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	V
Maximum power dissipation (IGBT)	$P_D$	$T_C = 25\text{ °C}$	231	W
		$T_C = 80\text{ °C}$	130	
Isolation voltage	$V_{ISOL}$		AC 2500 (min)	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	$BV_{(CES)}$	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	1200	-	-	V
Collector to emitter voltage	$V_{CE(ON)}$	$I_C = 50\text{ A}, V_{GE} = 15\text{ V}$	-	2.34	2.80	
		$I_C = 50\text{ A}, V_{GE} = 15\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	2.66	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$	4.6	5.9	7.6	
Threshold voltage temperature coefficient	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$ (25 °C to 125 °C)	-	-13	-	mV/°C
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$	-	1	50	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	670	-	
Diode forward voltage drop	$V_{FM}$	$I_F = 50\text{ A}$	-	3.30	4.5	V
		$I_F = 50\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.60	-	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 200$	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)	$Q_G$	$I_C = 50\text{ A}$ $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$	-	154	-	nC
Gate to emitter charge (turn-on)	$Q_{GE}$		-	17	-	
Gate to collector charge (turn-on)	$Q_{GC}$		-	79	-	
Turn-on switching loss	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}$ $T_J = 25\text{ }^\circ\text{C}$ (1)	-	1.17	-	mJ
Turn-off switching loss	$E_{off}$		-	1.50	-	
Total switching loss	$E_{tot}$		-	2.67	-	
Turn-on switching loss	$E_{on}$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$ (1)	-	1.58	-	mJ
Turn-off switching loss	$E_{off}$		-	2.52	-	
Total switching loss	$E_{tot}$		-	4.10	-	
Turn-on delay time	$t_{d(on)}$	$I_C = 50\text{ A}, V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}, R_G = 4.7\text{ }\Omega, L = 500\text{ }\mu\text{H}$ $T_J = 125\text{ }^\circ\text{C}$	-	44	-	ns
Rise time	$t_r$		-	11	-	
Turn-off delay time	$t_{d(off)}$		-	96	-	
Fall time	$t_f$		-	187	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 150\text{ A}, V_{CC} = 800\text{ V},$ $V_P = 1200\text{ V}, R_G = 4.7\text{ }\Omega,$ $V_{GE} = 15\text{ V to }0\text{ V}$	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}$ $V_{CC} = 600\text{ V}, V_P = 1200\text{ V}$ $R_G = 10\text{ }\Omega, V_{GE} = 15\text{ V to }0\text{ V}$	5	-	-	$\mu\text{s}$
Diode peak reverse recovery current	$I_{rr}$	$T_J = 25\text{ }^\circ\text{C}$	-	1.3	-	A
		$T_J = 125\text{ }^\circ\text{C}$	-	2.0	-	
Diode reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$	-	0.453	-	$\mu\text{s}$
		$T_J = 125\text{ }^\circ\text{C}$	-	0.74	-	
Total reverse recovery charge	$Q_{rr}$	$T_J = 25\text{ }^\circ\text{C}$	-	0.12	-	$\mu\text{C}$
		$T_J = 125\text{ }^\circ\text{C}$	-	0.4	-	

**Note**

(1) Energy losses include "tail" and diode reverse recovery

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



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{Stg}$		-40	-	150	°C
Junction to case IGBT	$R_{thJC}$		-	-	0.54	°C/W
Junction to case DIODE	$R_{thJC}$		-	-	1	
Case to sink per module	$R_{thCS}$		-	0.05	-	
Mounting torque (M5)			2.7	-	3.3	Nm
Weight			-	170	-	g

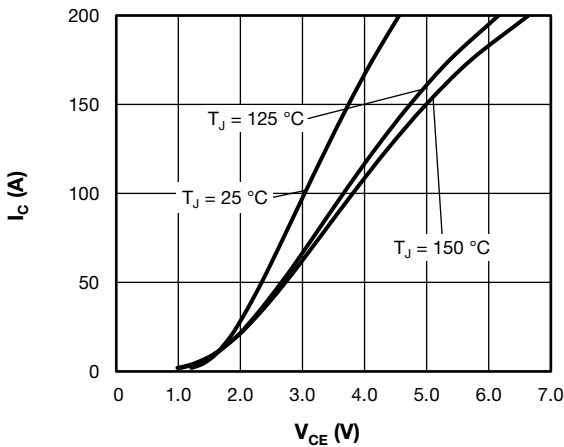


Fig. 1 - Typical Trench IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

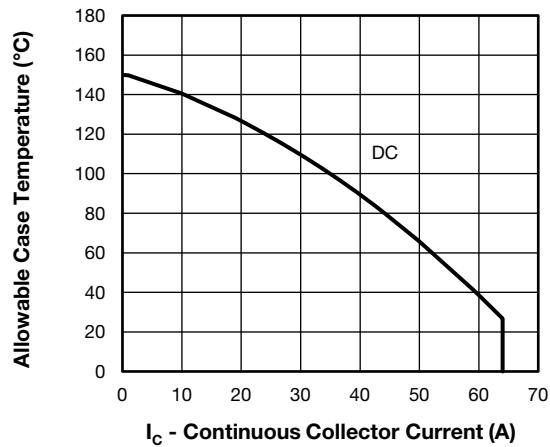


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

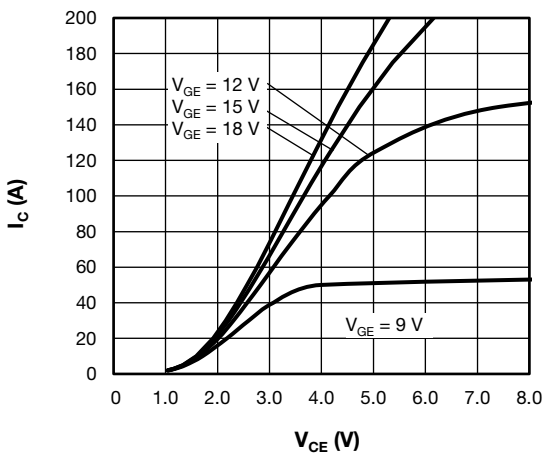


Fig. 2 - Typical Trench IGBT Output Characteristics,  $T_J = 125\text{ °C}$

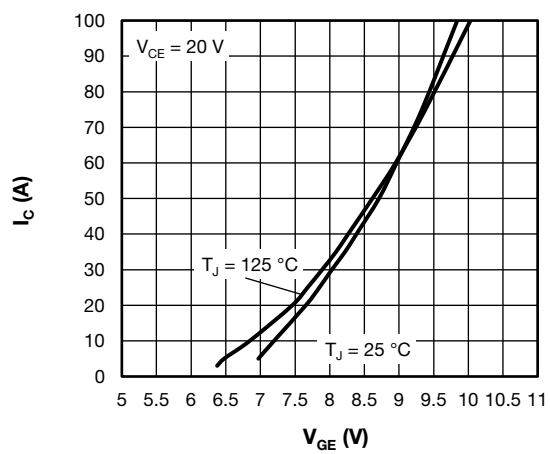


Fig. 4 - Typical Trench IGBT Transfer Characteristics

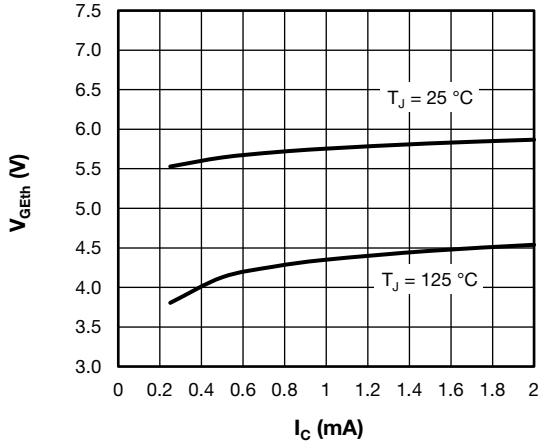


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

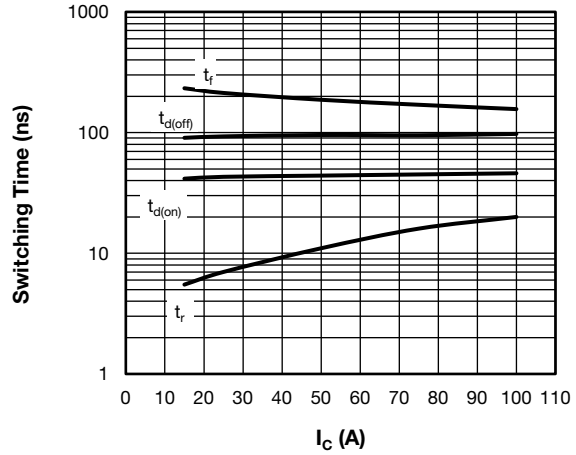


Fig. 8 - Typical Trench IGBT Switching Time vs.  $I_C$   
(with Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

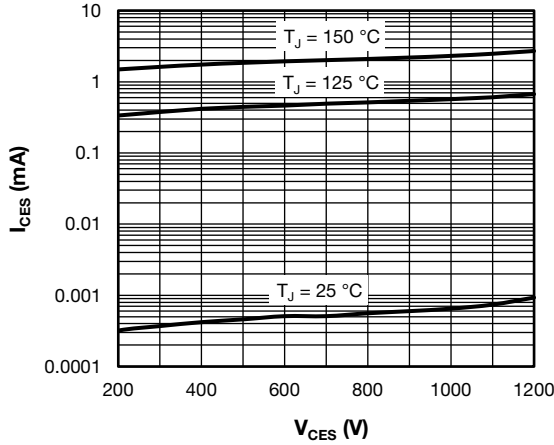


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

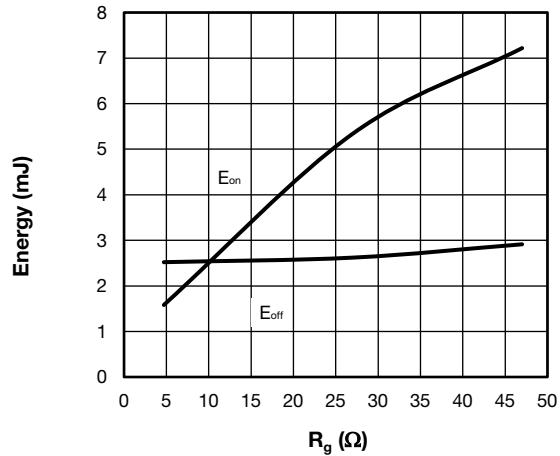


Fig. 9 - Typical Trench IGBT Energy Loss vs.  $R_g$   
(with Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 40\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

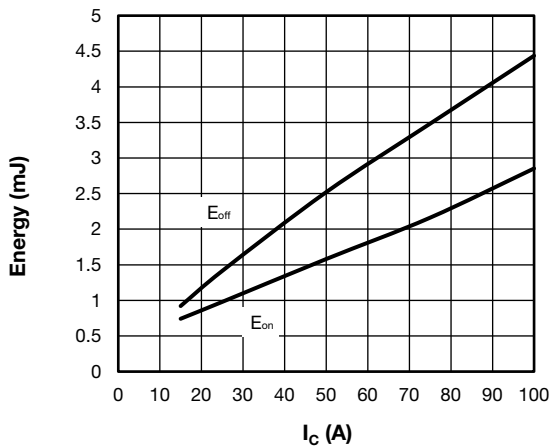


Fig. 7 - Typical Trench IGBT Energy Loss vs.  $I_C$   
(with Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

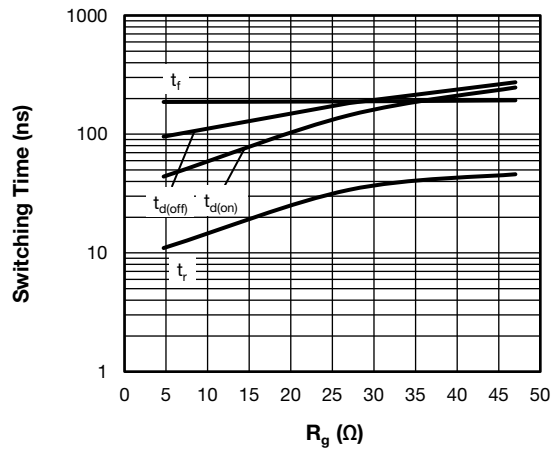


Fig. 10 - Typical Trench IGBT Switching Time vs.  $R_g$   
(with Antiparallel Diode)  
 $T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 50\text{ A}$ ,  $V_{GE} = +15\text{ V}/-15\text{ V}$ ,  $L = 500\ \mu\text{H}$

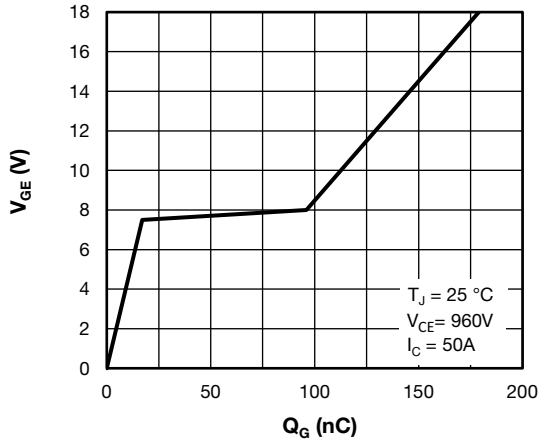


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

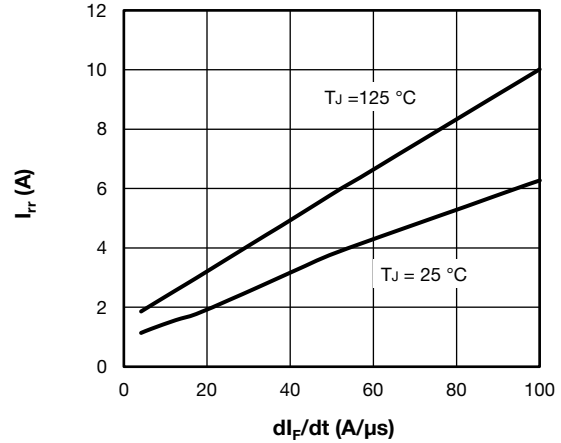


Fig. 14 - Typical Diode Reverse Recovery Current vs.  $di_F/dt$

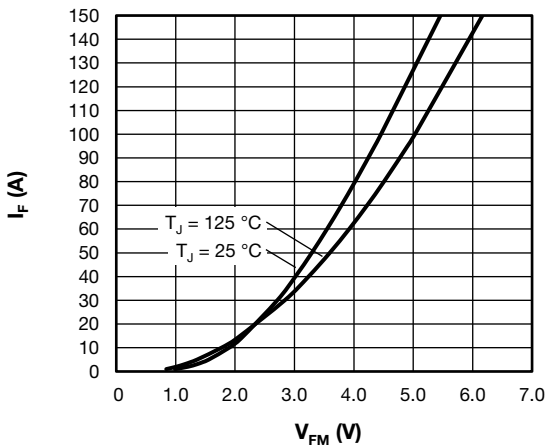


Fig. 12 - Typical Diode Forward Characteristics

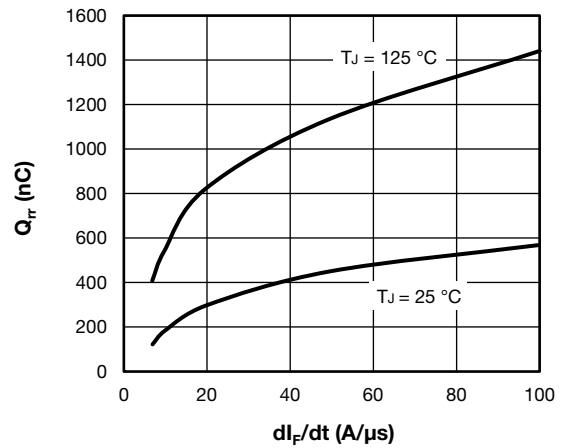


Fig. 15 - Typical Diode Reverse Recovery Charge vs.  $di_F/dt$

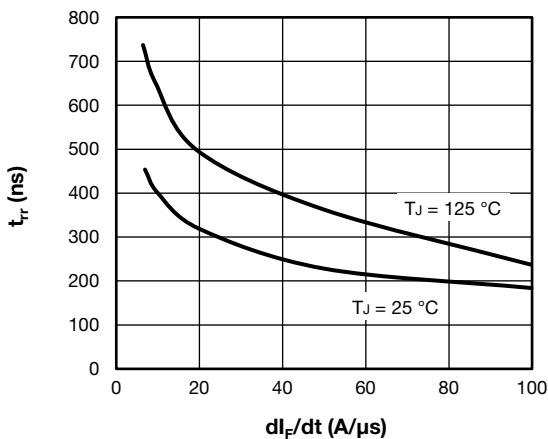


Fig. 13 - Typical Diode Reverse Recovery Time vs.  $di_F/dt$

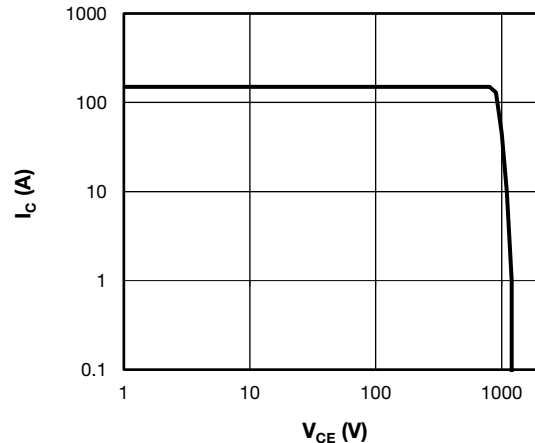


Fig. 16 - Trench IGBT Reverse BIAS SOA  
 $T_J = 150\text{ °C}$ ,  $I_C = 150\text{ A}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{ V} / 0\text{ V}$ ,  $V_{CC} = 800\text{ V}$ ,  
 $V_p = 1200\text{ V}$

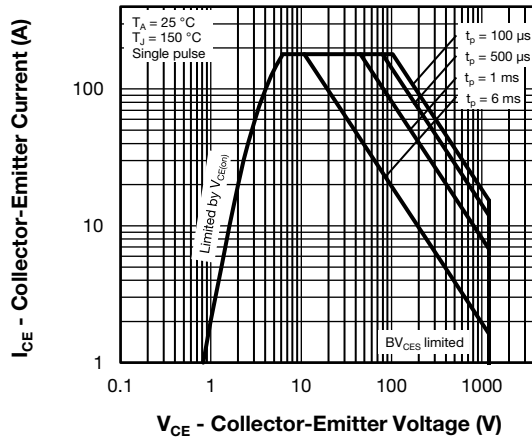


Fig. 17 - Trench IGBT Safe Operating Area

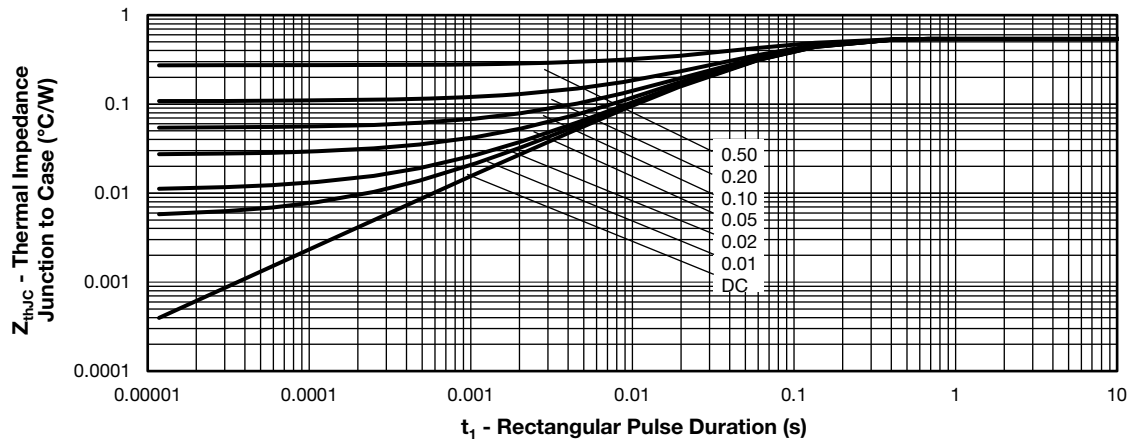


Fig. 18 - Maximum Trench IGBT Thermal Impedance  $Z_{thJC}$  Characteristics

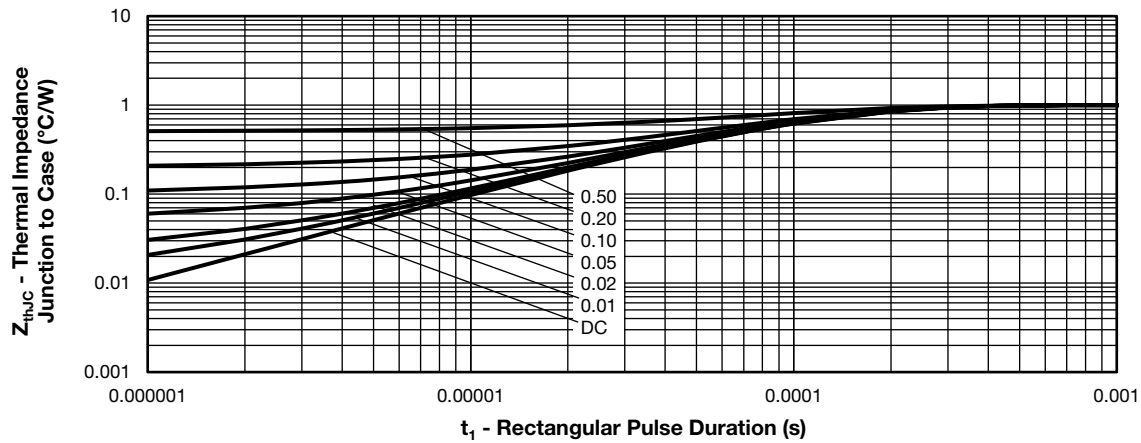


Fig. 19 - Maximum Diode Thermal Impedance  $Z_{thJC}$  Characteristics

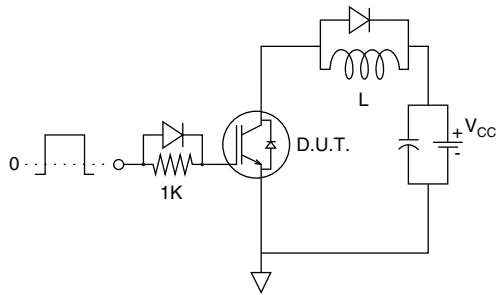


Fig. 20 - Gate Charge Circuit (Turn-Off)

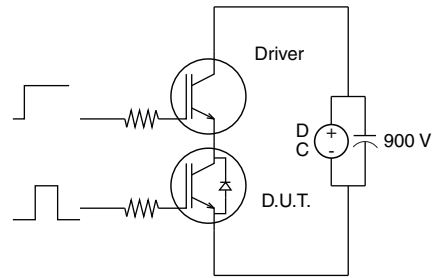


Fig. 22 - S.C. SOA Circuit

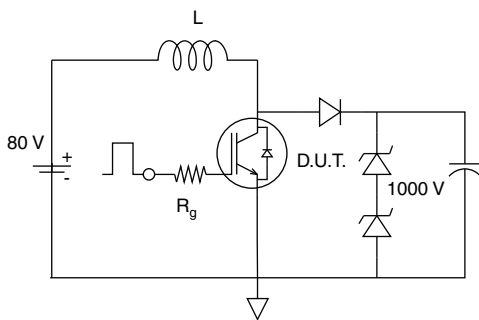


Fig. 21 - RBSOA Circuit

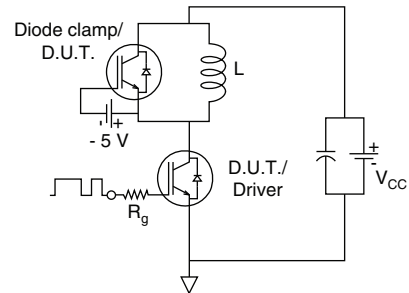


Fig. 23 - Switching Loss Circuit

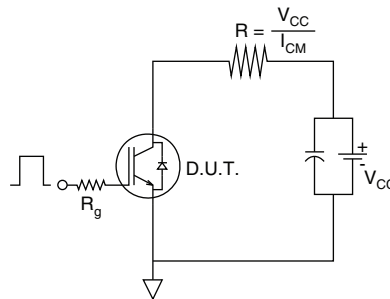


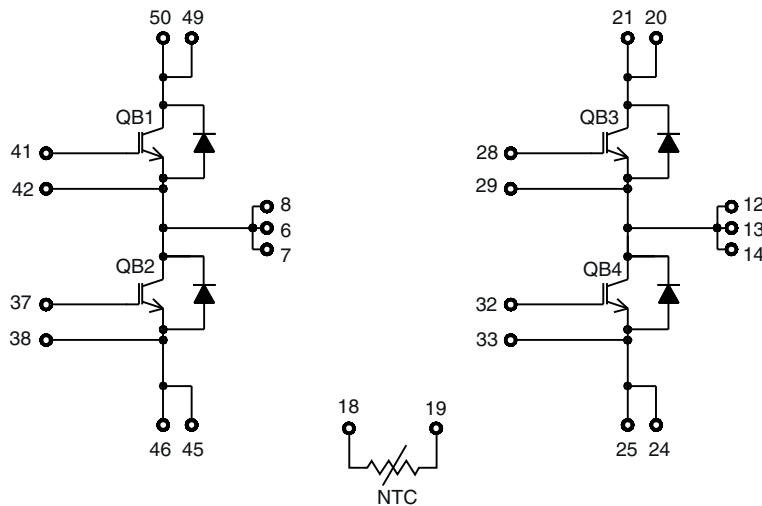
Fig. 24 - Resistive Load Circuit

## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>G</b>	<b>T</b>	<b>50</b>	<b>Y</b>	<b>F</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** - T = Trench gate field stop IGBT
- 4** - Current rating (50 = 50 A)
- 5** - Circuit configuration (Y = 4 pack)
- 6** - Package indicator (F = ECONO 2)
- 7** - Voltage rating (120 = 1200 V)
- 8** - Speed/type (N = ultrafast with reduced diode, speed 8 kHz to 60 kHz)
- 9** - NTC Thermistor

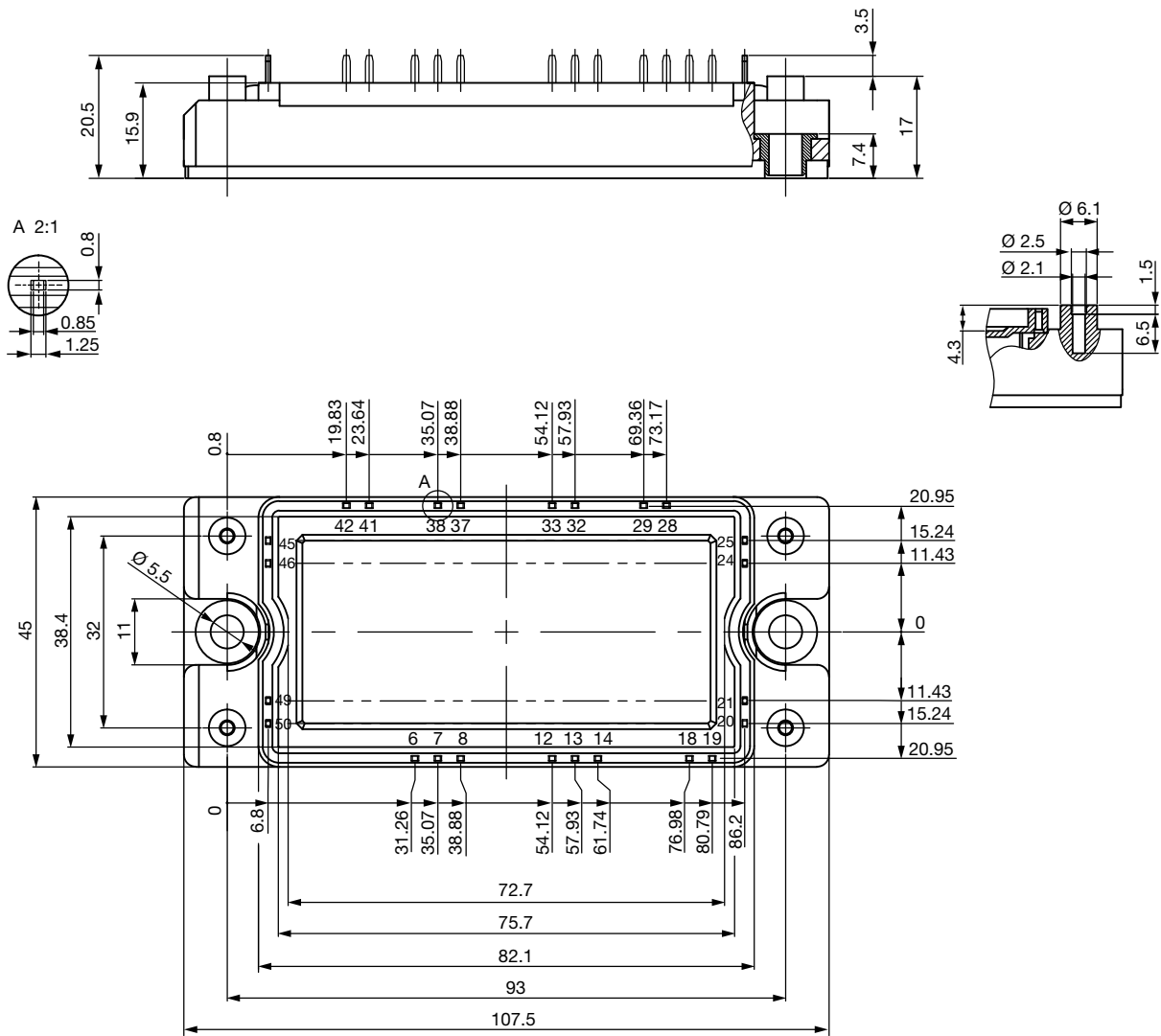
## CIRCUIT CONFIGURATION







**DIMENSIONS** in millimeters





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