

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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

PRIMARY CHARACTERISTICS

V_{CES}	1200 V
I_C at $T_C = 66\text{ }^{\circ}\text{C}$	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	$T_C = 25\text{ }^{\circ}\text{C}$	64	A
		$T_C = 80\text{ }^{\circ}\text{C}$	44	
Pulsed collector current, see fig. C.T.5	I_{CM}	$T_J = 150\text{ }^{\circ}\text{C}$, $t_p = 6\text{ ms}$, $V_{GE} = 15\text{ V}$	180	
Clamped inductive load current	I_{LM}		150	
Diode continuous forward current	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	40	
		$T_C = 80\text{ }^{\circ}\text{C}$	25	
Diode maximum forward current	I_{FM}		150	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	231	W
		$T_C = 80\text{ }^{\circ}\text{C}$	130	
Isolation voltage	V_{ISOL}		AC 2500 (min)	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	$BV_{(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 2\text{ mA}$	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	mV/ $^{\circ}\text{C}$
Threshold voltage temperature coefficient	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 2\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-13	-	
Zero gate voltage collector current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$	-	1	50	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	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}	$V_{GE} = \pm 20\text{ V}$	-	-	± 200	nA

SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ 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 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 V	5	-	-	μs
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	-	μs
		$T_J = 125\text{ }^{\circ}\text{C}$	-	0.74	-	
Total reverse recovery charge	Q_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$	-	0.12	-	μC
		$T_J = 125\text{ }^{\circ}\text{C}$	-	0.4	-	

Note

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

INTERNAL NTC - THERMISTOR SPECIFICATIONS

PARAMETER	SYMBOL	TEST CONDITIONS	TYP.	UNITS
Resistance	R_{25}	$T_C = 25\text{ }^{\circ}\text{C}$	5000	Ω
	R_{100}	$T_C = 100\text{ }^{\circ}\text{C}$	$493 \pm 5\%$	
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	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

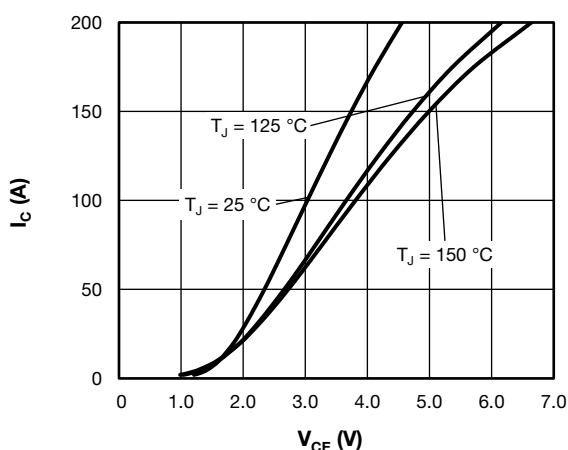
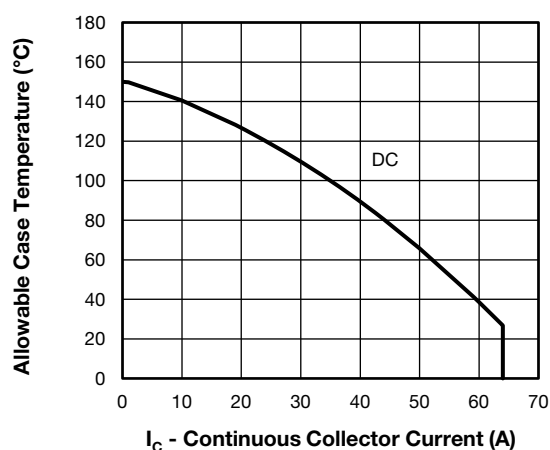

Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$


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

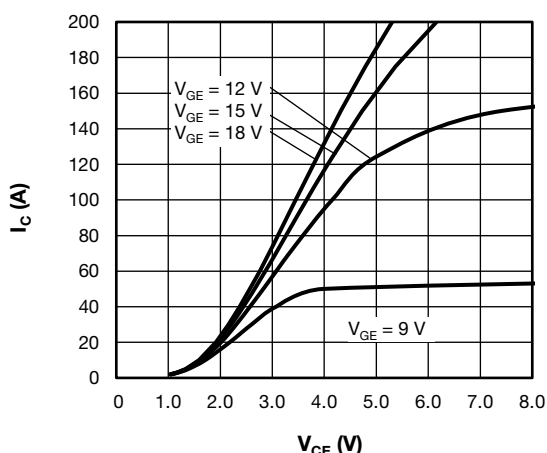
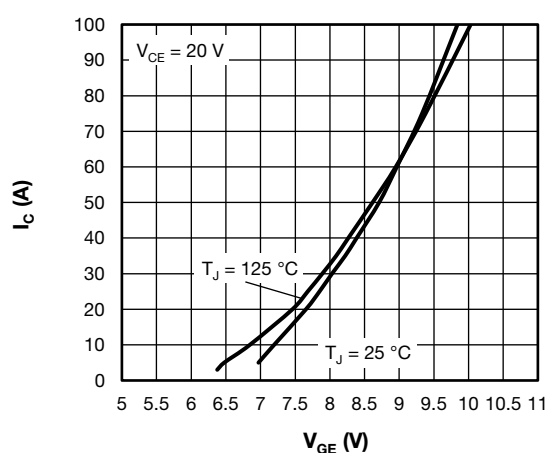

Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$


Fig. 4 - Typical Trench IGBT Transfer Characteristics

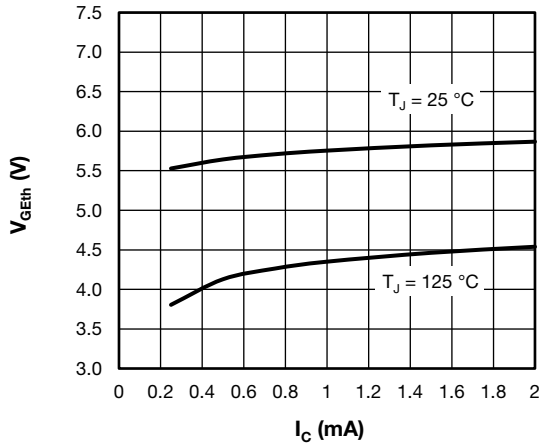


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

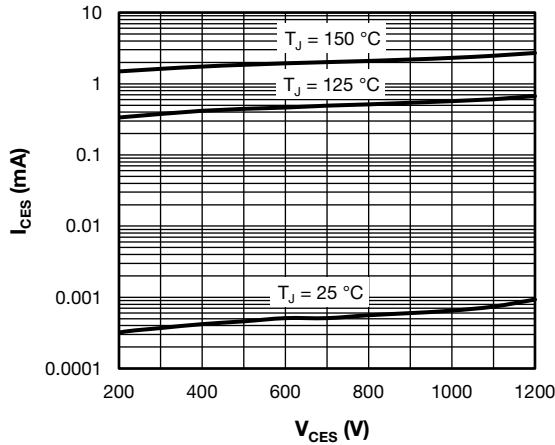


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

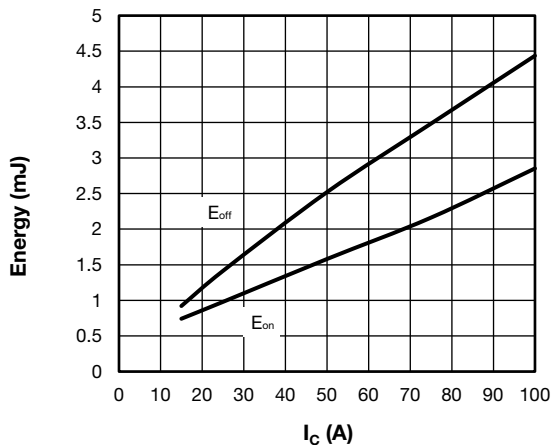


Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C (with Antiparallel Diode)

$T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

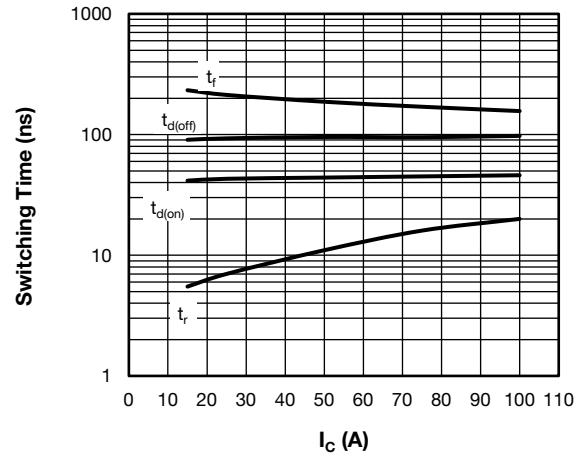


Fig. 8 - Typical Trench IGBT Switching Time vs. I_C (with Antiparallel Diode)

$T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

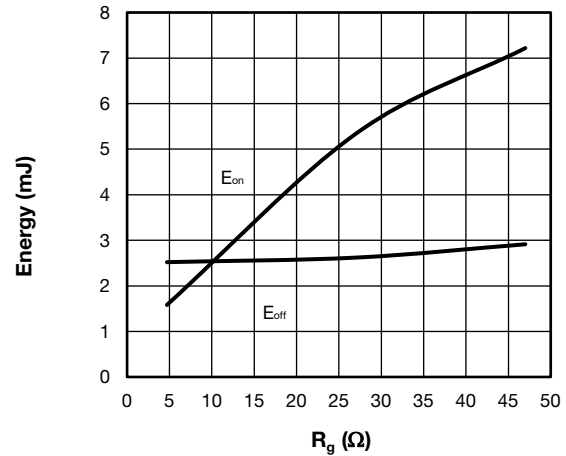


Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g (with Antiparallel Diode)

$T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $I_C = 40\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

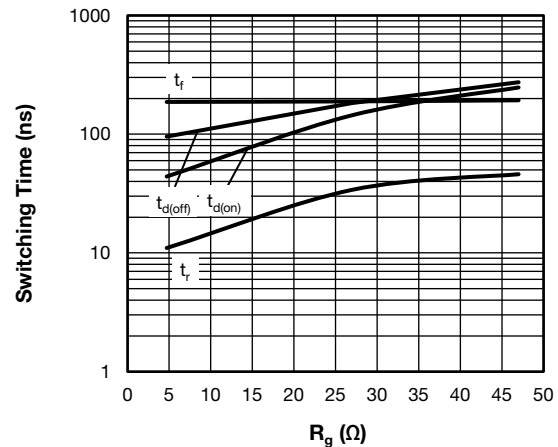


Fig. 10 - Typical Trench IGBT Switching Time vs. R_g (with Antiparallel Diode)

$T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $I_C = 50\text{ A}$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\text{ }\mu\text{H}$

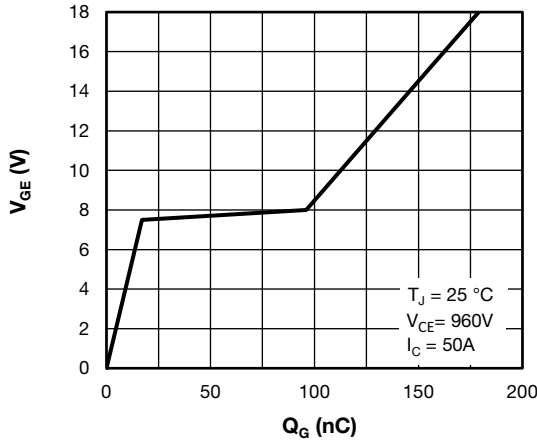


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

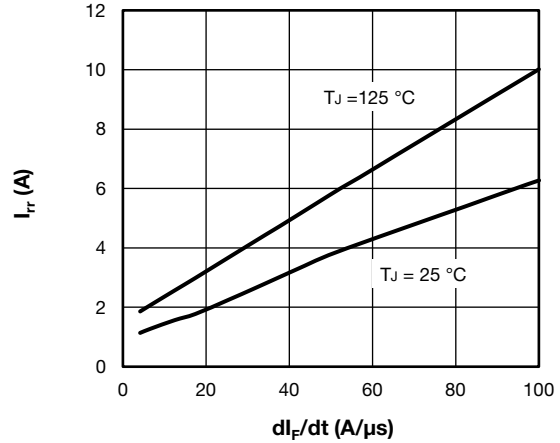


Fig. 14 - Typical Diode Reverse Recovery Current vs. dl_F/dt

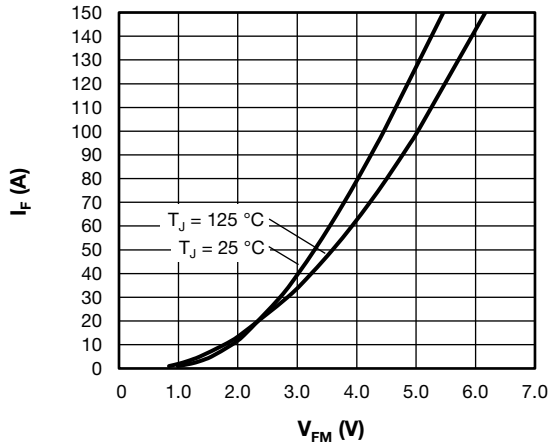


Fig. 12 - Typical Diode Forward Characteristics

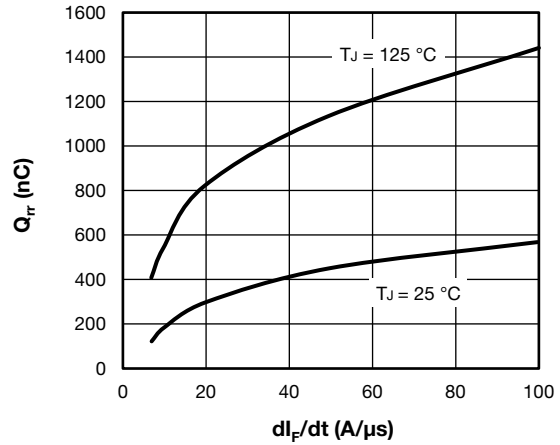


Fig. 15 - Typical Diode Reverse Recovery Charge vs. dl_F/dt

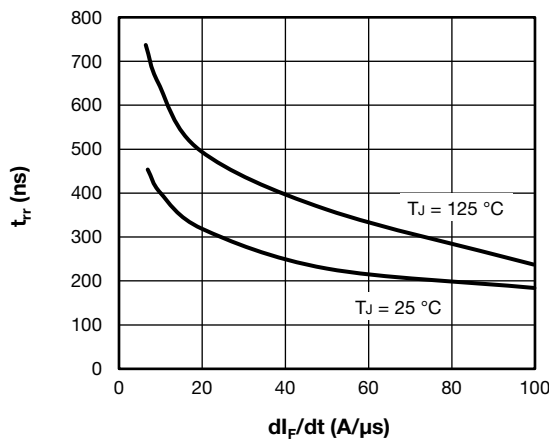


Fig. 13 - Typical Diode Reverse Recovery Time vs. dl_F/dt

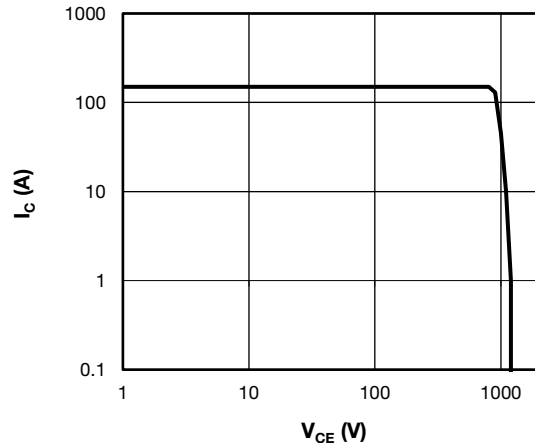


Fig. 16 - Trench IGBT Reverse BIAS SOA
 $T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 150\text{ A}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V} / 0\text{ V}$, $V_{CC} = 800\text{ V}$,
 $V_p = 1200\text{ V}$

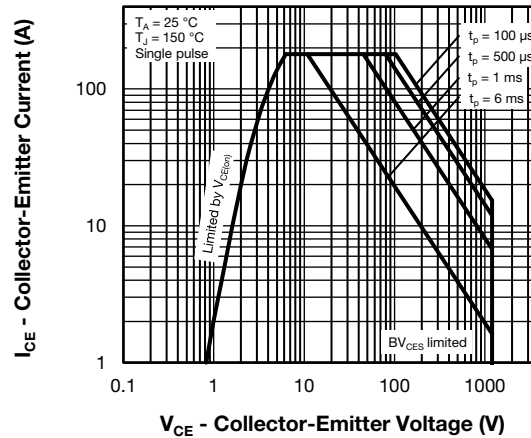


Fig. 17 - Trench IGBT Safe Operating Area

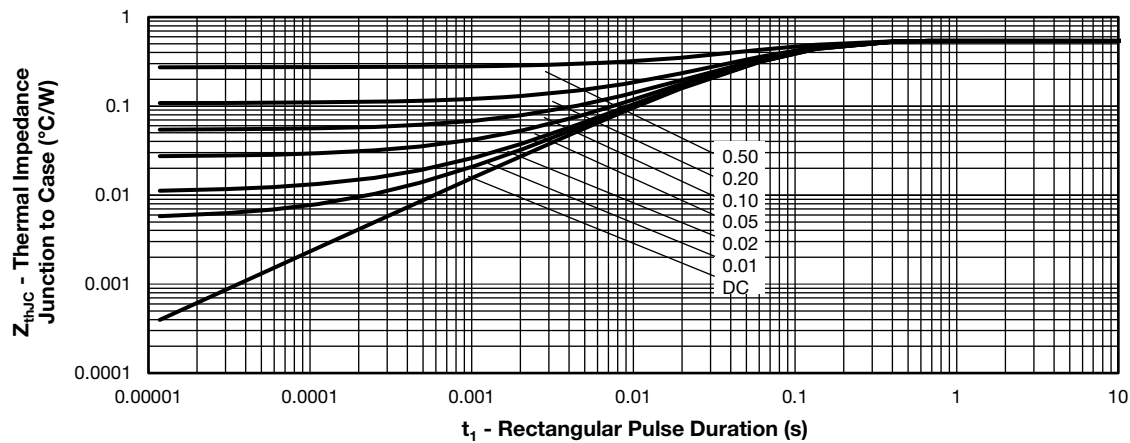


Fig. 18 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

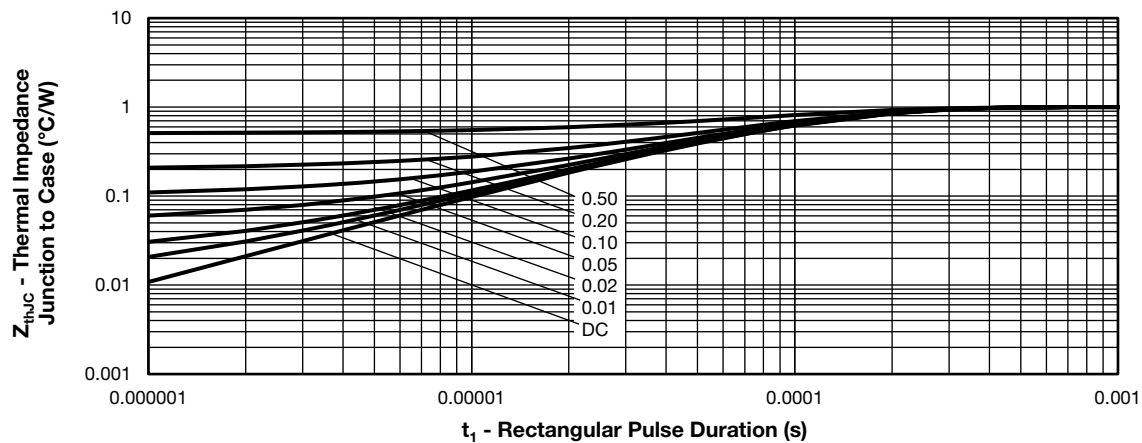


Fig. 19 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

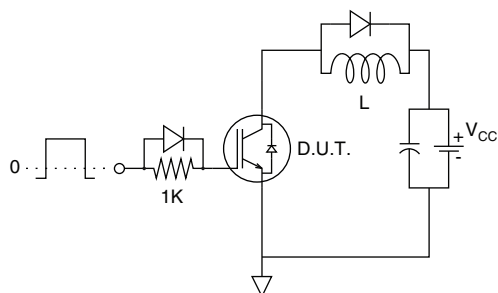


Fig. 20 - Gate Charge Circuit (Turn-Off)

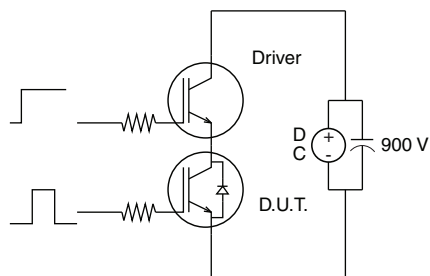


Fig. 22 - S.C. SOA Circuit

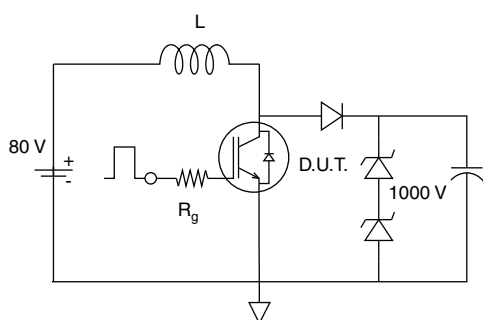


Fig. 21 - RBSOA Circuit

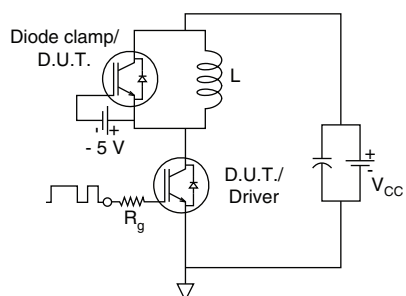


Fig. 23 - Switching Loss Circuit

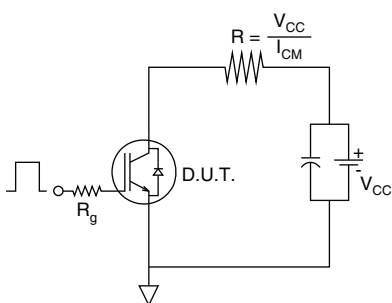
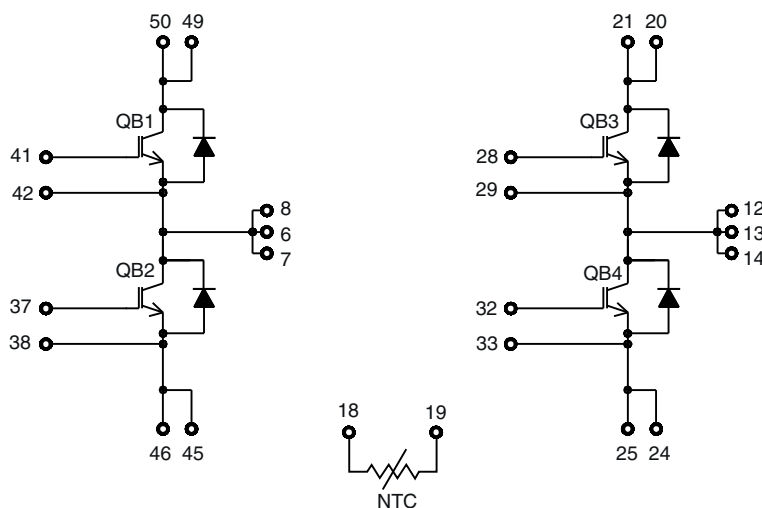


Fig. 24 - Resistive Load Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	T	50	Y	F	120	N	T
	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




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