

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



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 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	BV _(CES)	V _{GE} = 0 V, I _C = 2 mA	1200	-	-	V
Collector to emitter voltage	V _{CE(ON)}	I _C = 50 A, V _{GE} = 15 V	-	2.34	2.80	
		I _C = 50 A, V _{GE} = 15 V, T _J = 125 °C	-	2.66	-	
Gate threshold voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C = 2 mA	4.6	5.9	7.6	mV/°C
Threshold voltage temperature coefficient	ΔV _{GE(th)} /ΔT _J	V _{CE} = V _{GE} , I _C = 2 mA (25 °C to 125 °C)	-	-13	-	
Zero gate voltage collector current	I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V	-	1	50	μA
		V _{GE} = 0 V, V _{CE} = 1200 V, T _J = 125 °C	-	670	-	
Diode forward voltage drop	V _{FM}	I _F = 50 A	-	3.30	4.5	V
		I _F = 50 A, T _J = 125 °C	-	3.60	-	
Gate to emitter leakage current	I _{GES}	V _{GE} = ± 20 V	-	-	± 200	nA

SWITCHING CHARACTERISTICS (T _J = 25 °C unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q _G	I _C = 50 A V _{CC} = 960 V V _{GE} = 15 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 A, V _{CC} = 600 V V _{GE} = 15 V, R _G = 4.7 Ω, L = 500 μH T _J = 25 °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 A, V _{CC} = 600 V V _{GE} = 15 V, R _G = 4.7 Ω, L = 500 μH T _J = 125 °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 A, V _{CC} = 600 V V _{GE} = 15 V, R _G = 4.7 Ω, L = 500 μH T _J = 125 °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 °C, I _C = 150 A, V _{CC} = 800 V, V _P = 1200 V, R _G = 4.7 Ω, V _{GE} = 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T _J = 150 °C V _{CC} = 600 V, V _P = 1200 V R _G = 10 Ω, V _{GE} = 15 V to 0 V	5	-	-	μs
Diode peak reverse recovery current	I _{rr}	T _J = 25 °C	-	1.3	-	A
		T _J = 125 °C	-	2.0	-	
Diode reverse recovery time	t _{rr}	T _J = 25 °C	-	0.453	-	μs
		T _J = 125 °C	-	0.74	-	
Total reverse recovery charge	Q _{rr}	T _J = 25 °C	-	0.12	-	μC
		T _J = 125 °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 °C	5000	Ω
	R ₁₀₀	T _C = 100 °C	493 ± 5 %	
B-value	B _{25/50}	R ₂ = R ₂₅ exp. [B _{25/50} (1/T ₂ - 1/(298.15K))]	3375 ± 5 %	K
Maximum operating temperature			220	°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

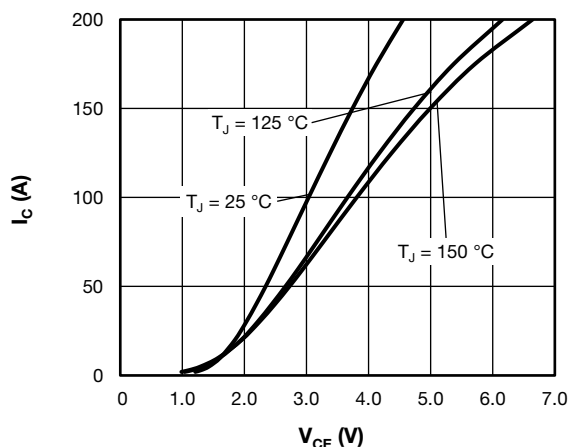
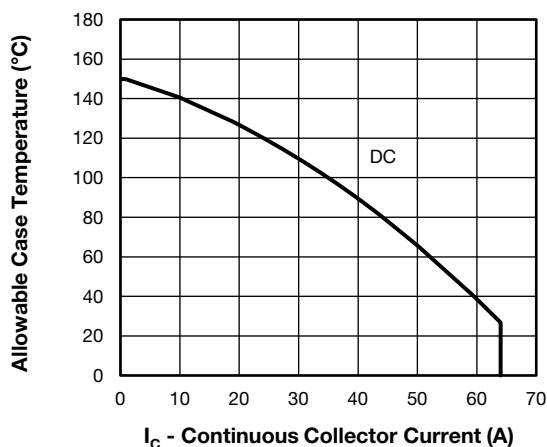
Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$ 

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

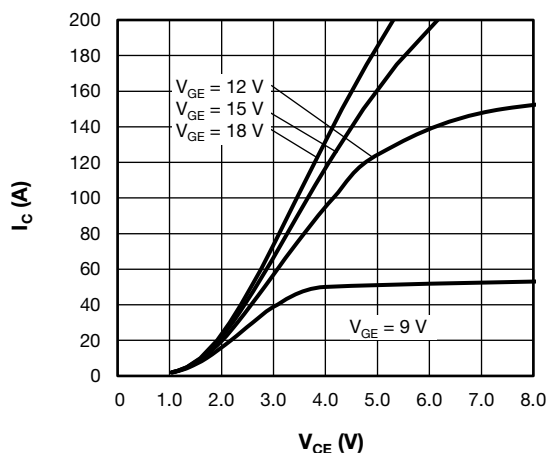
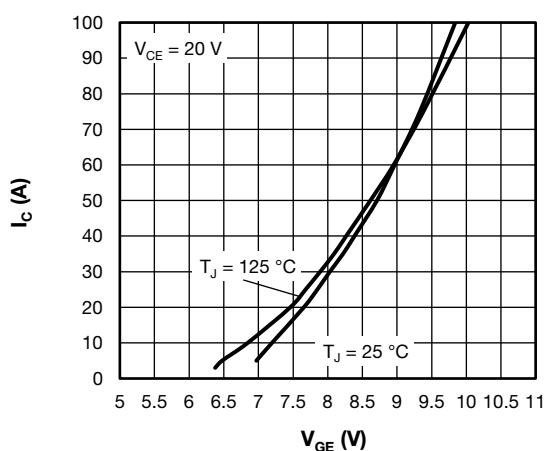
Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$ 

Fig. 4 - Typical Trench IGBT Transfer Characteristics

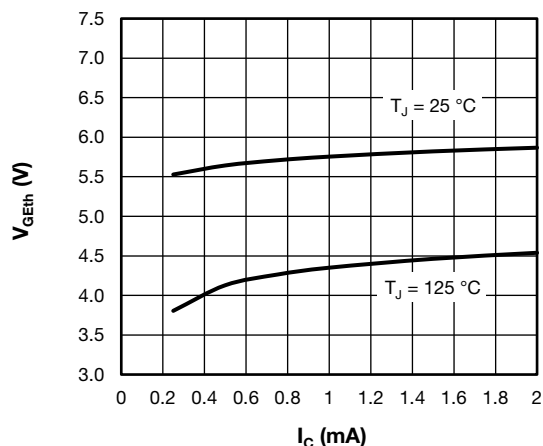
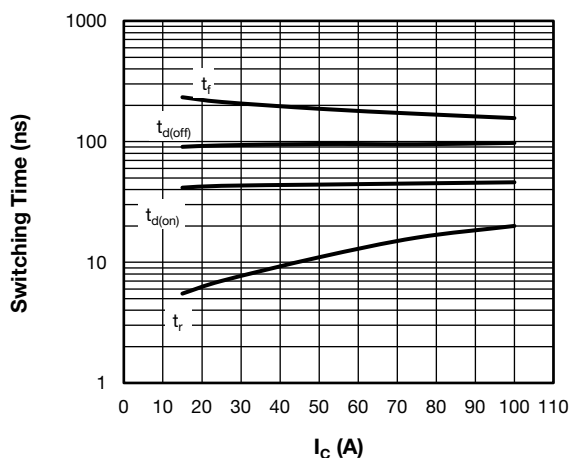


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage


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

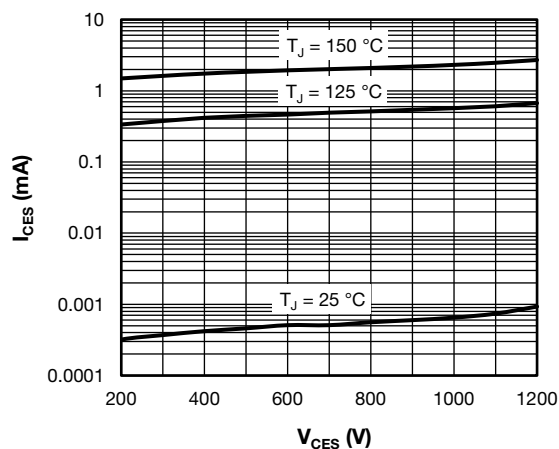
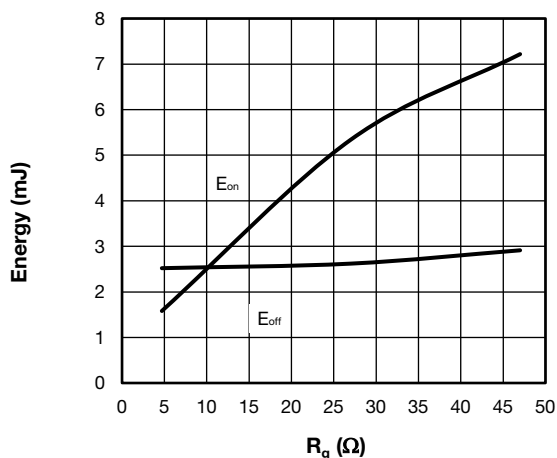
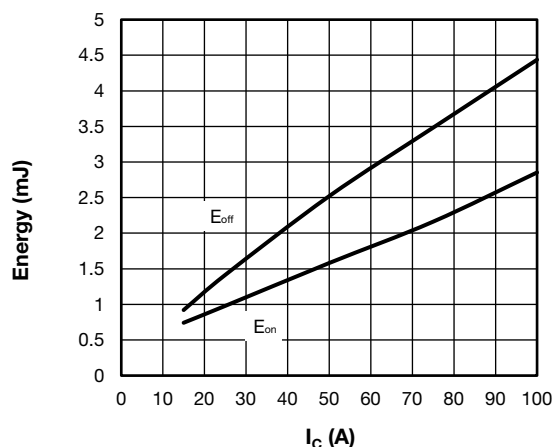
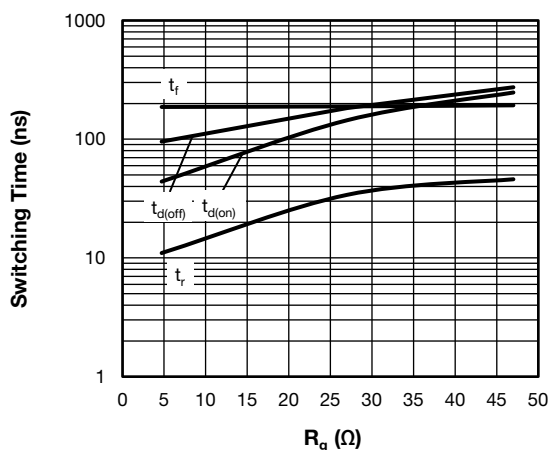
 $T_J = 125^\circ\text{C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = +15\text{ V}/-15\text{ V}$, $L = 500\ \mu\text{H}$


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


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

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

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

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

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

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

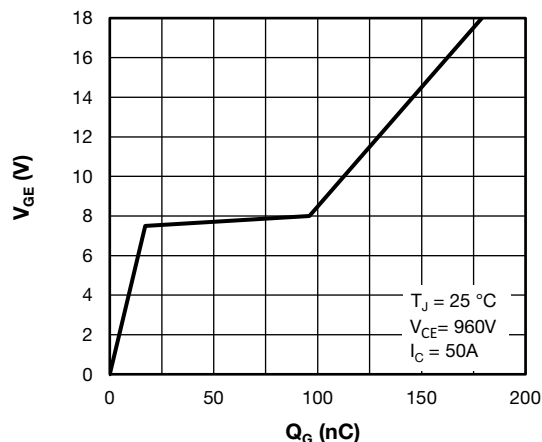


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

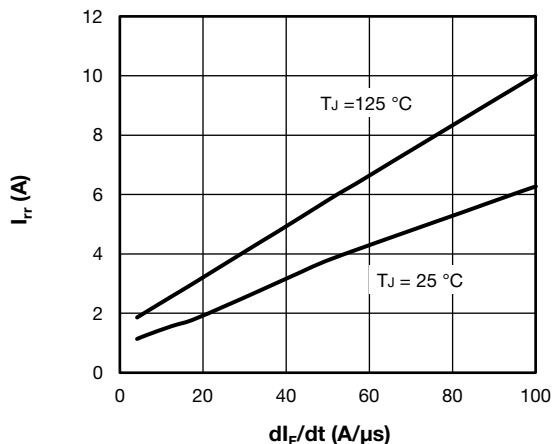


Fig. 14 - Typical Diode Reverse Recovery Current vs. dI_F/dt

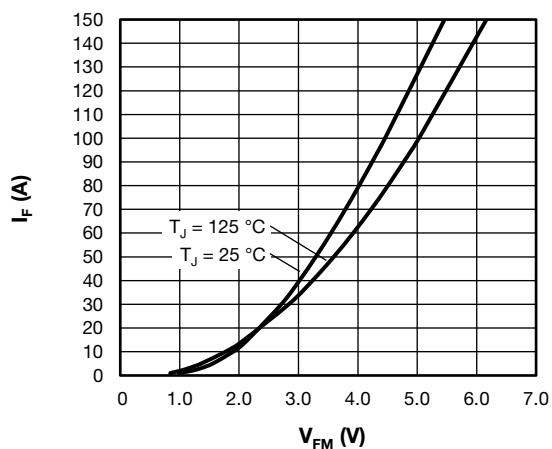


Fig. 12 - Typical Diode Forward Characteristics

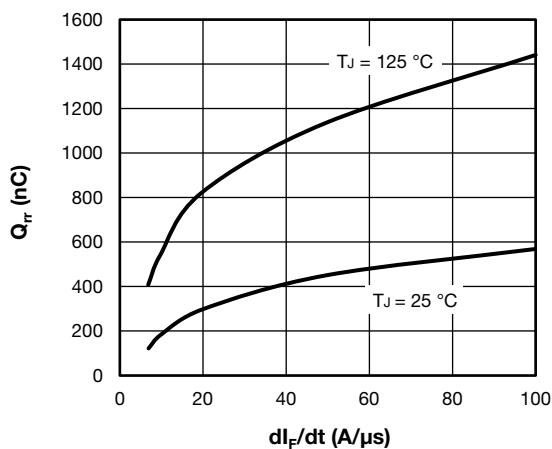


Fig. 15 - Typical Diode Reverse Recovery Charge vs. dI_F/dt

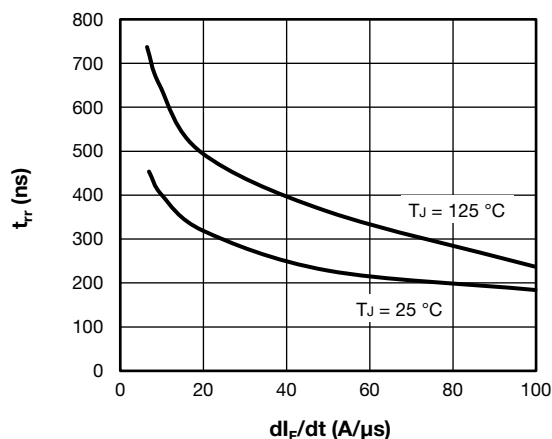


Fig. 13 - Typical Diode Reverse Recovery Time vs. dI_F/dt

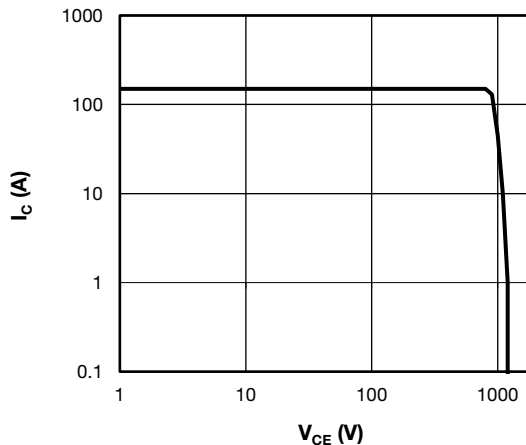


Fig. 16 - Trench IGBT Reverse BIAS SOA
 $T_J = 150\text{ °C}$, $I_C = 150\text{ A}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{ V} / 0\text{ V}$, $V_{CC} = 800\text{ V}$,
 $V_p = 1200\text{ V}$

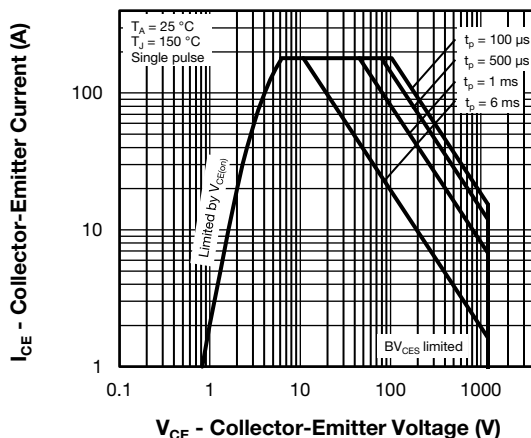
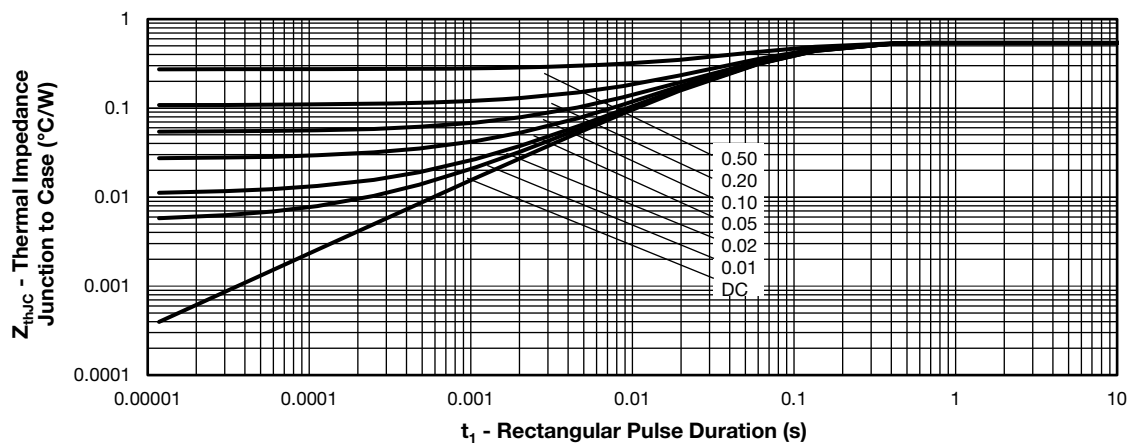
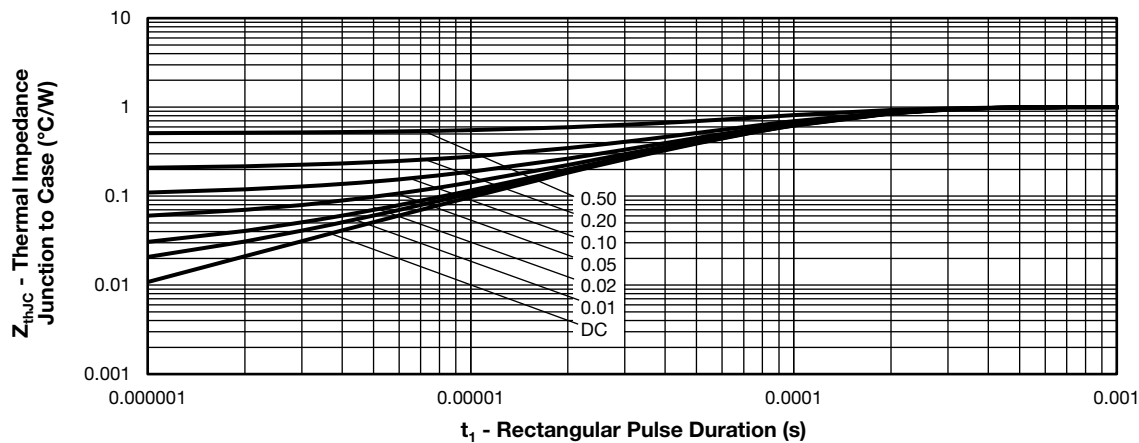


Fig. 17 - Trench IGBT Safe Operating Area


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

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

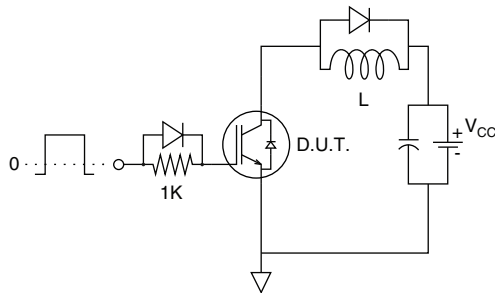


Fig. 20 - Gate Charge Circuit (Turn-Off)

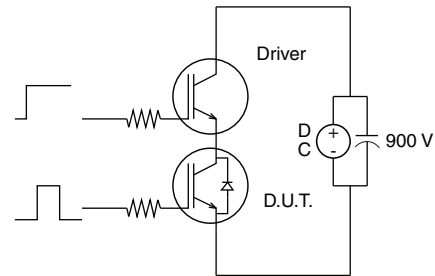


Fig. 22 - S.C. SOA Circuit

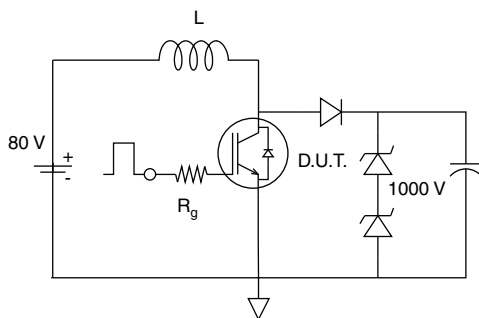


Fig. 21 - RBSOA Circuit

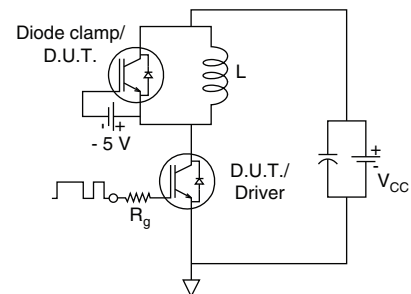


Fig. 23 - Switching Loss Circuit

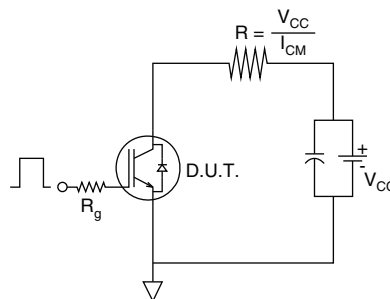
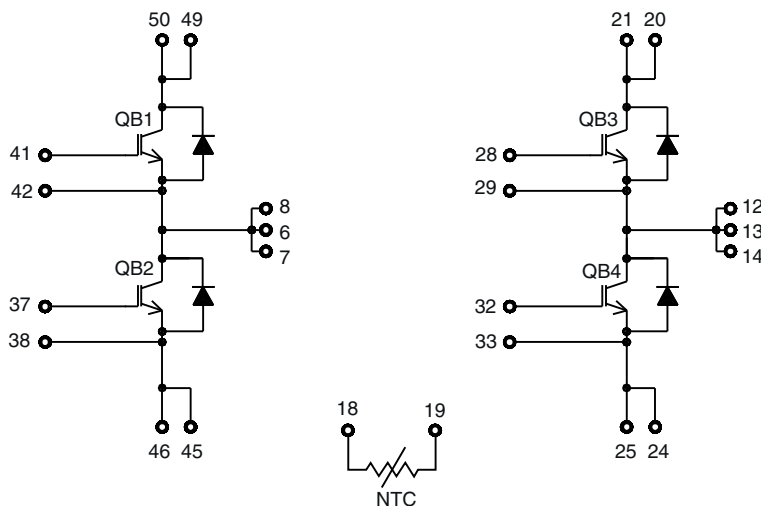


Fig. 24 - Resistive Load Circuit

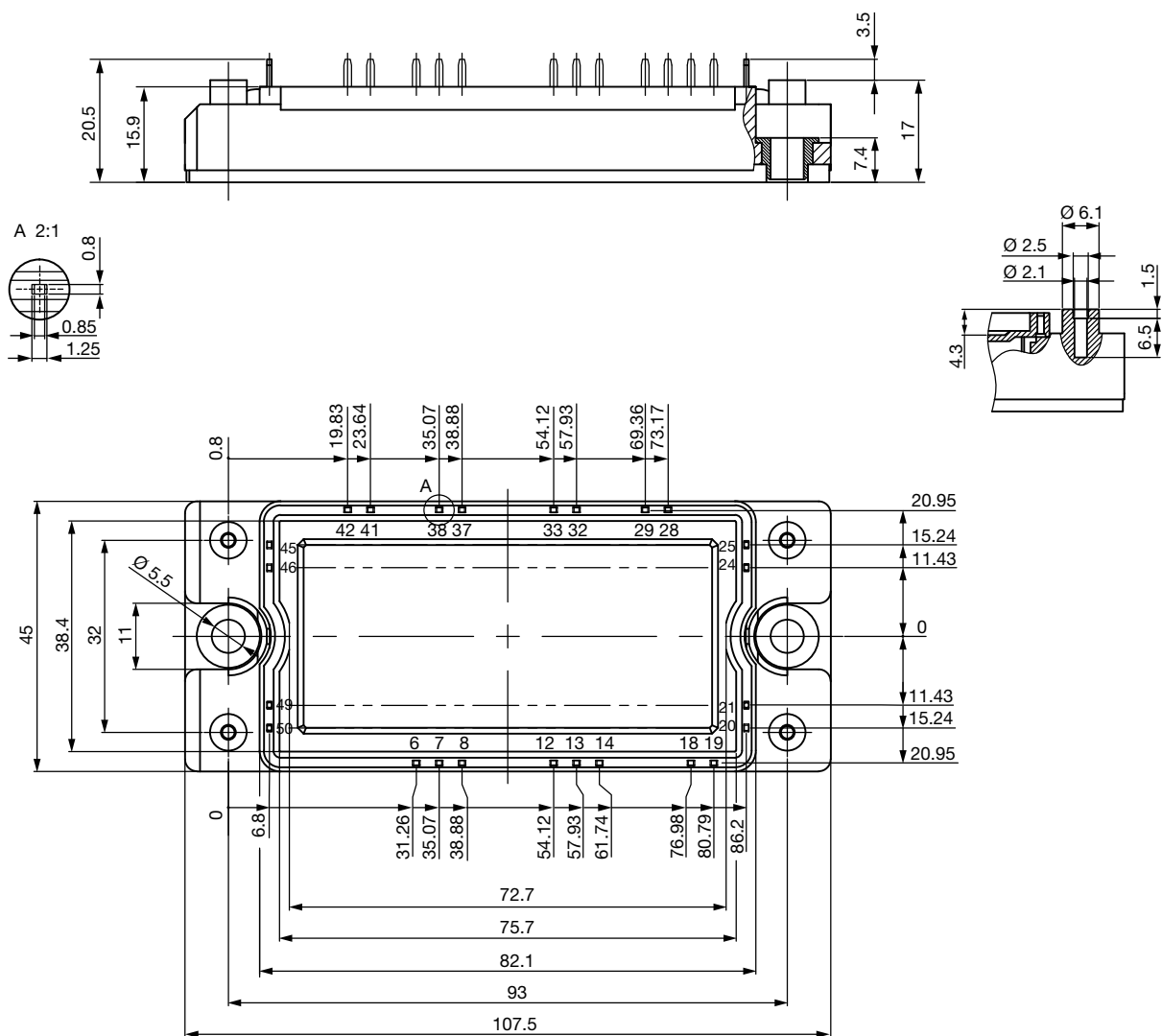
ORDERING INFORMATION TABLE

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




DIMENSIONS in millimeters





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