"High Side Chopper" IGBT SOT-227 (Warp 2 Speed IGBT), 70 A

SOT-227

FEATURES

- NPT warp 2 speed IGBT technology with positive temperature coefficient
- Square RBSOA
- Low $V_{CE(on)}$
- FRED Pt® hyperfast rectifier
- Fully isolated package
- Very low internal inductance (≤ 5 nH typical)
- Industry standard outline
- UL approved file E78996
- Compliant to RoHS Directive 2002/95/EC

RoHS COMPLIANT

BENEFITS

- Designed for increased operating efficiency in power conversion: UPS, SMPS, welding, induction heating
- Easy to assemble and parallel
- Direct mounting to heatsink
- Plug-in compatible with other SOT-227 packages
- Higher switching frequency up to 150 kHz
- Lower conduction losses and switching losses
- Low EMI, requires less snubbing

PRODUCT SUMMARY	
V_{CES}	600 V
I_C DC	70 A at 88 °C
$V_{CE(on)}$ typical at 70 A, 25 °C	2.23 V
I_F DC	70 A at 86 °C

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C	T_C = 25 °C	111	A
		T_C = 80 °C	76	
Pulsed collector current	I_{CM}		120	
Clamped inductive load current	I_{LM}		120	
Diode continuous forward current	I_F	T_C = 25 °C	113	
		T_C = 80 °C	75	
Peak diode forward current	I_{FM}		200	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	T_C = 25 °C	447	W
		T_C = 80 °C	250	
Power dissipation, diode	P_D	T_C = 25 °C	236	
		T_C = 80 °C	132	
RMS isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	V

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{BR(CES)}$	V_{GE} = 0 V, I_C = 1 mA	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 35 A	-	1.69	1.88	V
		V_{GE} = 15 V, I_C = 70 A	-	2.23	2.44	
		V_{GE} = 15 V, I_C = 35 A, T_J = 125 °C	-	2.07	2.31	
		V_{GE} = 15 V, I_C = 70 A, T_J = 125 °C	-	2.89	3.21	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 500 μA	3	3.9	5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 1 mA (25 °C to 125 °C)	-	- 9	-	mV/°C
Collector to emitter leakage current	I_{CES}	V_{GE} = 0 V, V_{CE} = 600 V	-	1	100	μA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C	-	0.07	2.0	mA
Diode reverse breakdown voltage	V_{BR}	I_R = 1 mA	600	-	-	V
Diode forward voltage drop	V_{FM}	I_C = 35 A, V_{GE} = 0 V	-	1.80	2.33	V
		I_C = 70 A, V_{GE} = 0 V	-	2.13	2.71	
		I_C = 35 A, V_{GE} = 0 V, T_J = 125 °C	-	1.35	1.81	
		I_C = 70 A, V_{GE} = 0 V, T_J = 125 °C	-	1.70	2.32	
Diode reverse leakage current	I_{RM}	V_R = V_R rated	-	0.1	50	μA
		T_J = 125 °C, V_R = V_R rated	-	0.02	3	mA
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 200	nA

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_g	I_C = 50 A, V_{CC} = 400 V, V_{GE} = 15 V		-	320	-	nC
Gate to emitter charge (turn-on)	Q_{ge}			-	42	-	
Gate to collector charge (turn-on)	Q_{gc}			-	110	-	
Turn-on switching loss	E_{on}	I_C = 70 A, V_{CC} = 360 V, V_{GE} = 15 V, R_g = 5 Ω, L = 500 μH, T_J = 25 °C	Energy losses include tail and diode recovery (see fig. 18)	-	1.15	-	mJ
Turn-off switching loss	E_{off}			-	1.16	-	
Total switching loss	E_{tot}			-	2.31	-	
Turn-on switching loss	E_{on}	I_C = 70 A, V_{CC} = 360 V, V_{GE} = 15 V, R_g = 5 Ω, L = 500 μH, T_J = 125 °C		-	1.27	-	
Turn-off switching loss	E_{off}			-	1.28	-	
Total switching loss	E_{tot}			-	2.55	-	
Turn-on delay time	$t_{d(on)}$			-	208	-	ns
Rise time	t_r			-	69	-	
Turn-off delay time	$t_{d(off)}$			-	208	-	
Fall time	t_f			-	100	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 120 A, R_g = 22 Ω, V_{GE} = 15 V to 0 V, V_{CC} = 400 V, V_P = 600 V		Fullsquare			
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 200 V		-	59	93	ns
Diode peak reverse current	I_{rr}			-	4	6	A
Diode recovery charge	Q_{rr}			-	118	279	nC
Diode reverse recovery time	t_{rr}	I_F = 50 A, dI_F/dt = 200 A/μs, V_R = 200 V, T_J = 125 °C		-	130	159	ns
Diode peak reverse current	I_{rr}			-	11	13	A
Diode recovery charge	Q_{rr}			-	715	995	nC

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNITS
Maximum junction and storage temperature range		T_J, T_{Stg}	- 40	-	150	°C
Thermal resistance, junction to case	IGBT	R_{thJC}	-	-	0.28	°C/W
	Diode		-	-	0.53	
Thermal resistance, case to sink per module		R_{thCS}	-	0.05	-	
Mounting torque, 6-32 or M3 screw			-	-	1.3	Nm
Weight			-	30	-	g

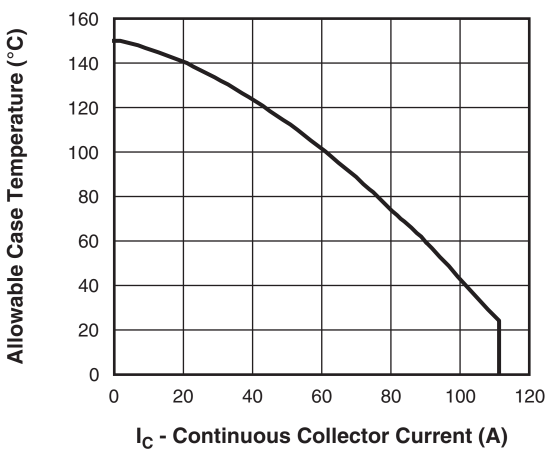


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

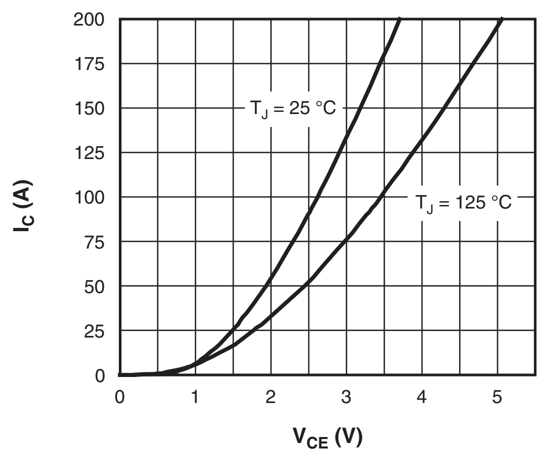


Fig. 3 - Typical IGBT Collector Current Characteristics

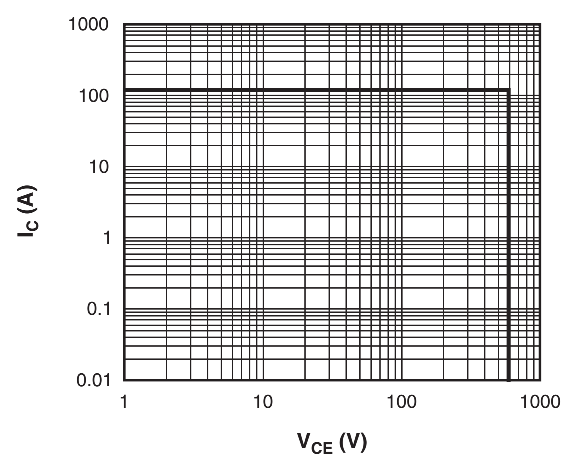


Fig. 2 - IGBT Reverse Bias SOA
T_J = 150 °C, V_{GE} = 15 V

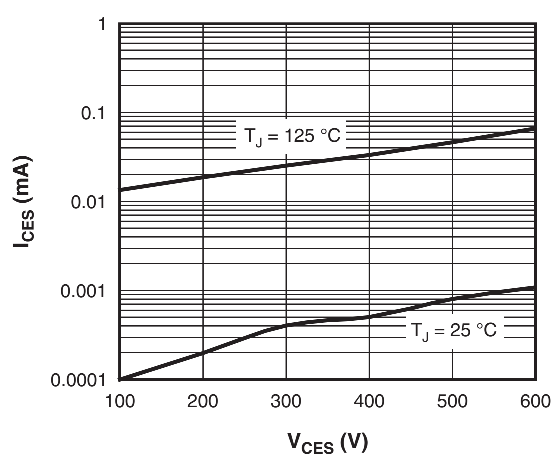


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

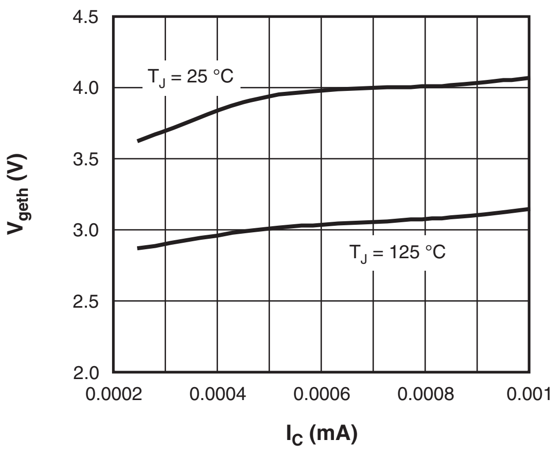


Fig. 5 - Typical IGBT Threshold Voltage

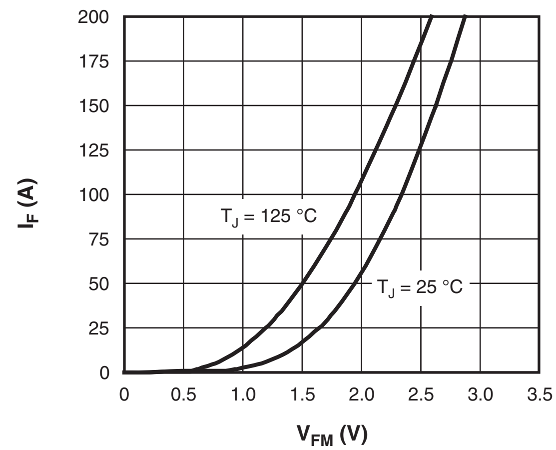


Fig. 8 - Typical Diode Forward Characteristics

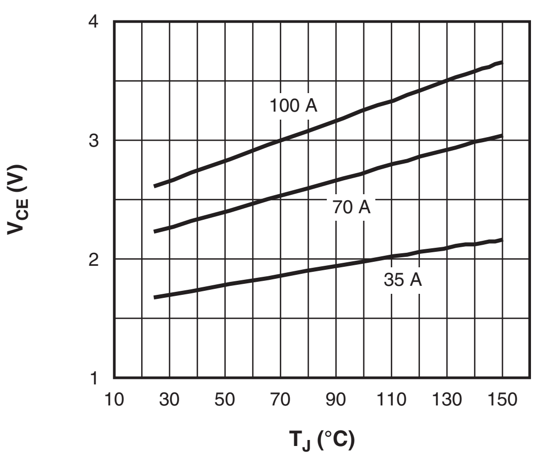


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

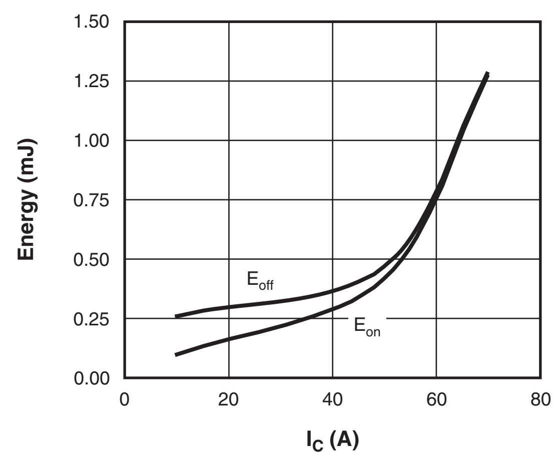


Fig. 9 - Typical IGBT Energy Loss vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 360 V,
R_g = 5 Ω, V_{GE} = 15 V

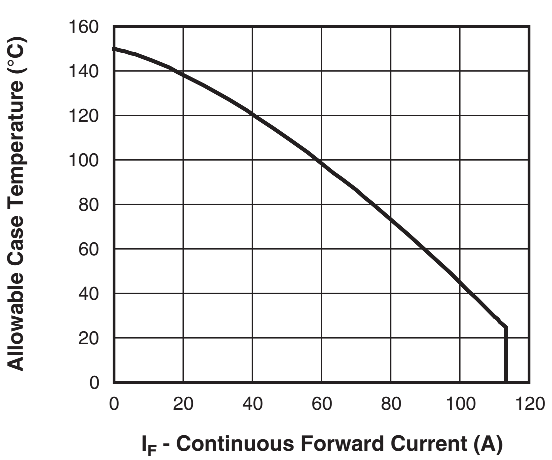


Fig. 7 - Maximum DC Forward Current vs. Case Temperature

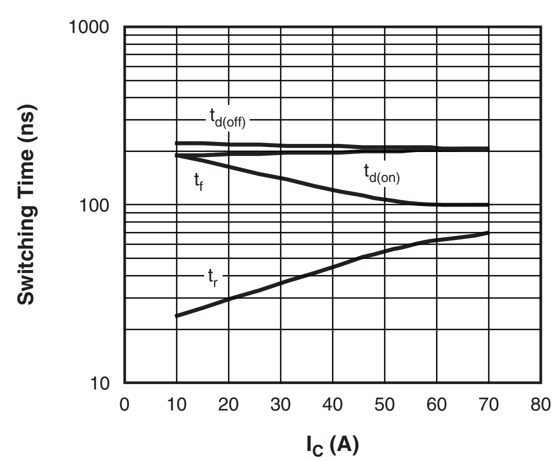


Fig. 10 - Typical IGBT Switching Time vs. I_C
T_J = 125 °C, L = 500 µH, V_{CC} = 360 V,
R_g = 5 Ω, V_{GE} = 15 V

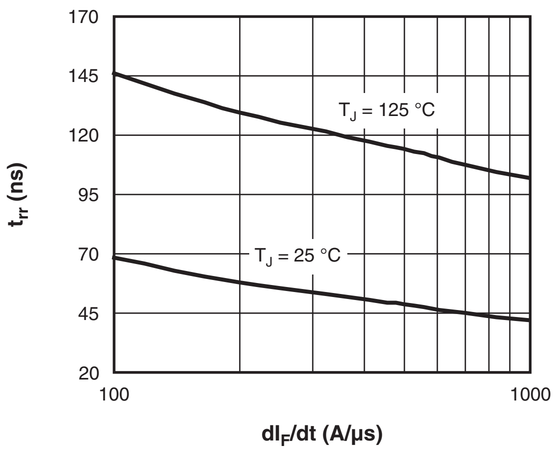


Fig. 11 - Typical t_{rr} Diode vs. dI_F/dt
V_R = 200 V, I_F = 50 A

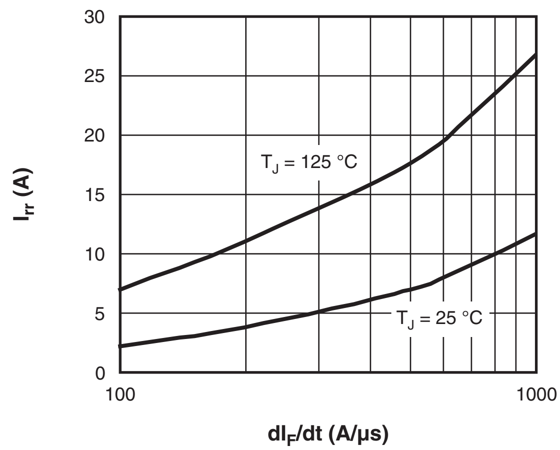


Fig. 12 - Typical I_{rr} Diode vs. dI_F/dt
V_{RR} = 200 V, I_F = 50 A

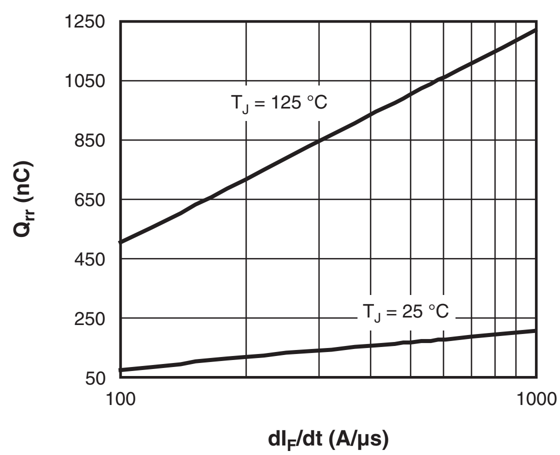


Fig. 13 - Typical Q_{rr} Diode vs. dI_F/dt
V_R = 200 V, I_F = 50 A

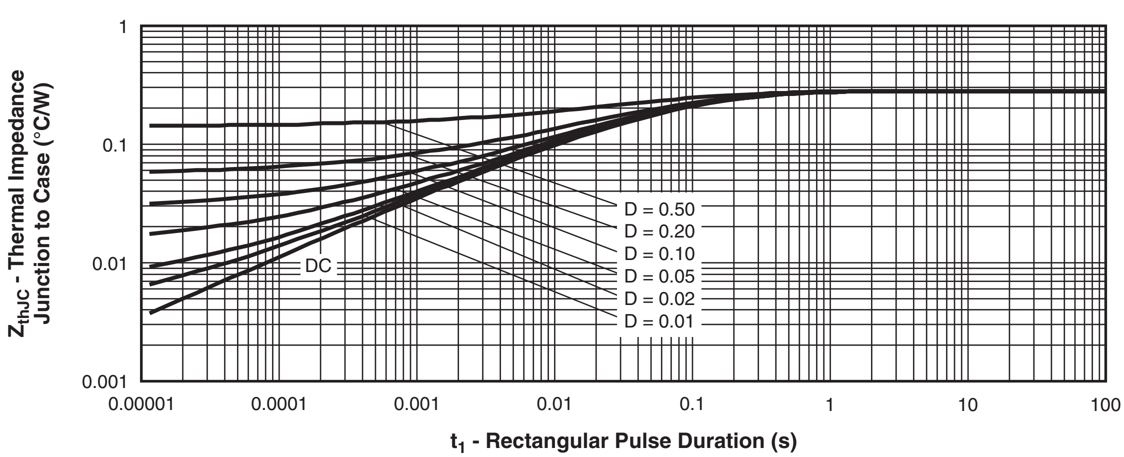


Fig. 14 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

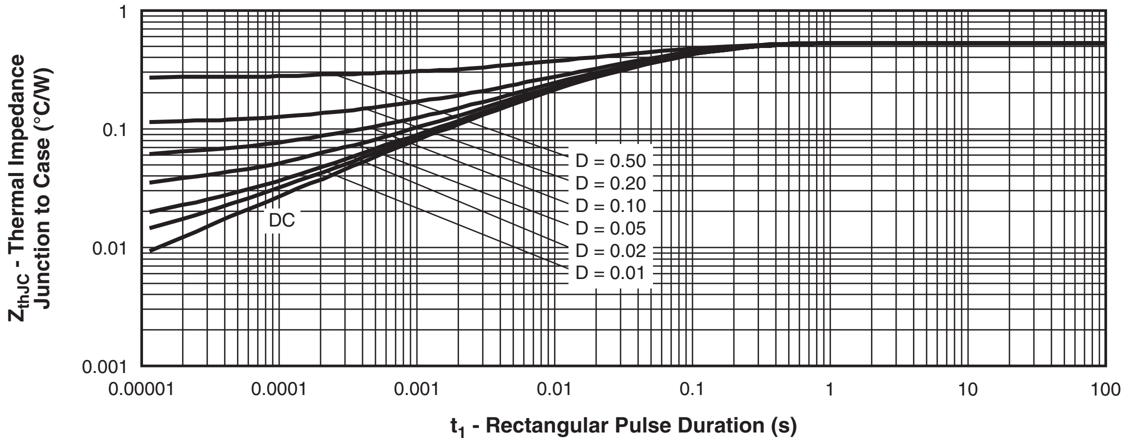
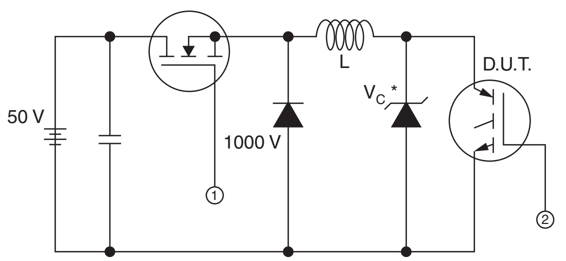


Fig. 15 - Maximum Thermal Impedance Z_{thJC} Characteristics (DIODE)



* Driver same type as D.U.T.; V_C = 80 % of $V_{ce(max)}$
* Note: Due to the 50 V power supply, pulse width and inductor will increase to obtain Id

Fig. 16 - Clamped Inductive Load Test Circuit

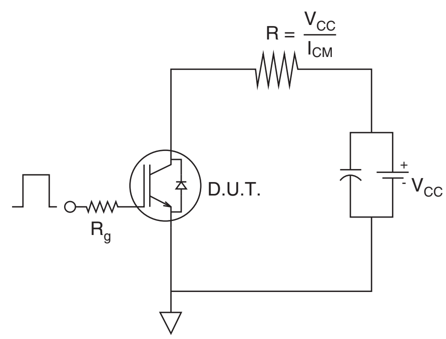


Fig. 17 - Pulsed Collector Current Test Circuit

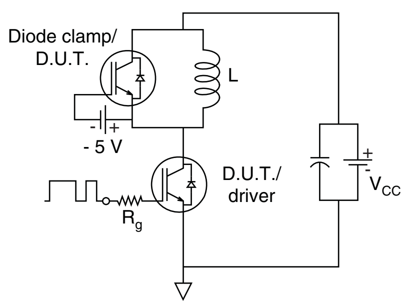


Fig. 18 - Switching Loss Test Circuit

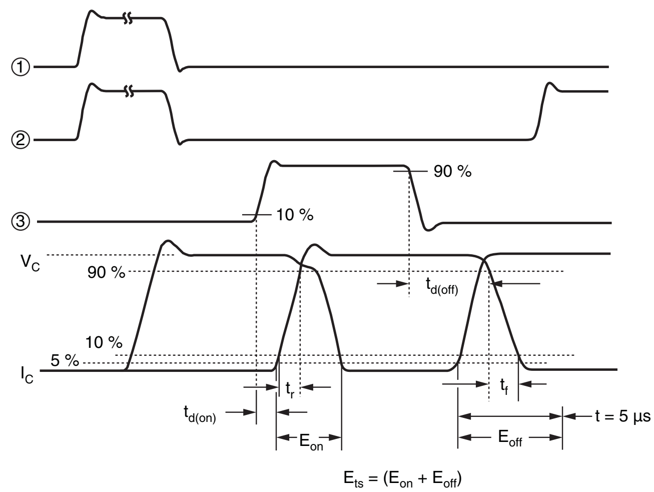


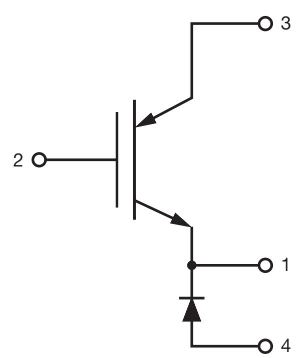
Fig. 19 - Switching Loss Waveforms Test Circuit

ORDERING INFORMATION TABLE

Device code	VS-	G	B	70	N	A	60	U	F
	1	2	3	4	5	6	7	8	9

- **1** - Vishay Semiconductors product
- **2** - Insulated Gate Bipolar Transistor (IGBT)
- **3** - B = IGBT Generation 5
- **4** - Current rating (70 = 70 A)
- **5** - Circuit configuration (N = High Side Chopper)
- **6** - Package indicator (A = SOT-227)
- **7** - Voltage rating (60 = 600 V)
- **8** - Speed/type (U = Ultrafast IGBT)
- **9** - F = F/W FRED Pt® diode

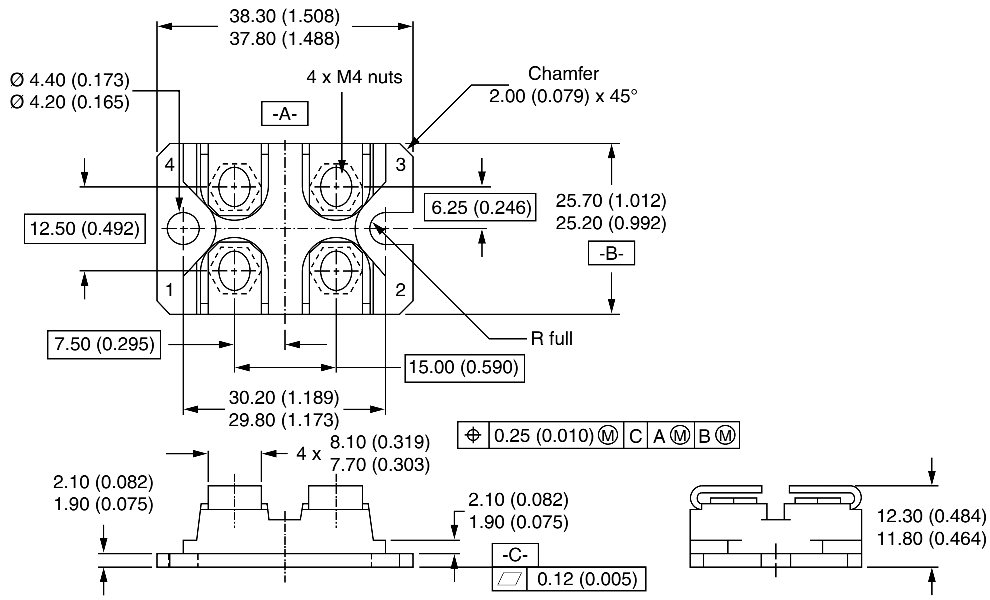
CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	http://www.vishay.com/doc?95036
Packaging information	http://www.vishay.com/doc?95037

SOT-227

DIMENSIONS in millimeters (inches)



Notes

- Dimensioning and tolerancing per ANSI Y14.5M-1982
- Controlling dimension: millimeter

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