

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


RoHS
COMPLIANT

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
Speed	30 kHz to 150 kHz
Package	SOT-227
Circuit	Chopper high side switch

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
- Lower conduction losses and switching losses
- Low EMI, requires less snubbing

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C	$T_C = 25\text{ °C}$	111	A
		$T_C = 80\text{ °C}$	76	
Pulsed collector current	I_{CM}		120	
Clamped inductive load current	I_{LM}		120	
Diode continuous forward current	I_F	$T_C = 25\text{ °C}$	113	
		$T_C = 80\text{ °C}$	75	
Peak diode forward current	I_{FM}		200	
Gate to emitter voltage	V_{GE}		± 20	V
Power dissipation, IGBT	P_D	$T_C = 25\text{ °C}$	447	W
		$T_C = 80\text{ °C}$	250	
Power dissipation, diode	P_D	$T_C = 25\text{ °C}$	236	
		$T_C = 80\text{ °C}$	132	
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1$ min	2500	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	$V_{BR(CES)}$	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	600	-	-	V
Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 35\text{ A}$	-	1.69	1.88	
		$V_{GE} = 15\text{ V}$, $I_C = 70\text{ A}$	-	2.23	2.44	
		$V_{GE} = 15\text{ V}$, $I_C = 35\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.07	2.31	
		$V_{GE} = 15\text{ V}$, $I_C = 70\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.89	3.21	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 500\text{ }\mu\text{A}$	3	3.9	5	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-9	-	mV/ $^{\circ}\text{C}$
Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	1	100	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	0.07	2.0	mA
Diode reverse breakdown voltage	V_{BR}	$I_R = 1\text{ mA}$	600	-	-	V
Diode forward voltage drop	V_{FM}	$I_C = 35\text{ A}$, $V_{GE} = 0\text{ V}$	-	1.80	2.33	V
		$I_C = 70\text{ A}$, $V_{GE} = 0\text{ V}$	-	2.13	2.71	
		$I_C = 35\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.35	1.81	
		$I_C = 70\text{ A}$, $V_{GE} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.70	2.32	
Diode reverse leakage current	I_{RM}	$V_R = V_R$ rated	-	0.1	50	μA
		$T_J = 125\text{ }^{\circ}\text{C}$, $V_R = V_R$ rated	-	0.02	3	mA
Gate to emitter leakage current	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 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}			-	1.27	-		
Turn-off switching loss	E _{off}			-	1.28	-		
Total switching loss	E _{tot}			-	2.55	-		
Turn-on delay time	t _{d(on)}	I _C = 70 A, V _{CC} = 360 V, V _{GE} = 15 V, R _g = 5 Ω, L = 500 μH, T _J = 125 °C		-	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	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	T_J, T_{Stg}		-40	-	150	°C
Junction to case	R_{thJC}		-	-	0.28	°C/W
			-	-	0.53	
Case to heatsink	R_{thCS}	Flat, greased surface	-	0.05	-	
Weight			-	30	-	g
Mounting torque			-	-	1.3	Nm
Case style	SOT-227					

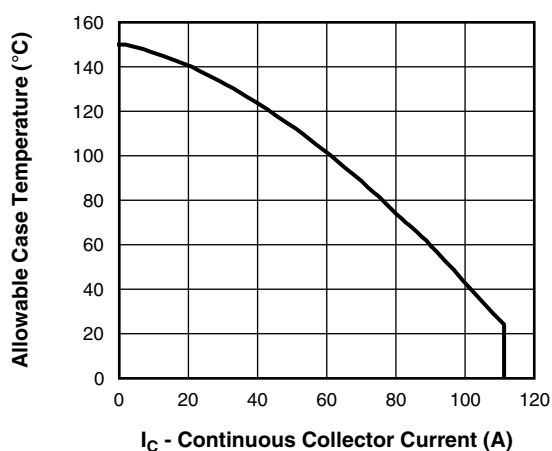


Fig. 1 - Maximum DC IGBT Collector Current vs. Case Temperature

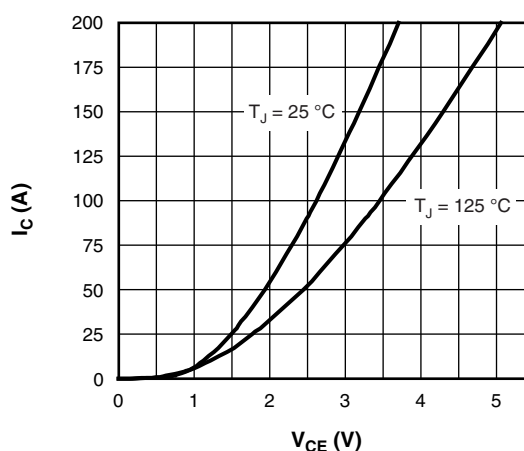


Fig. 3 - Typical IGBT Collector Current Characteristics

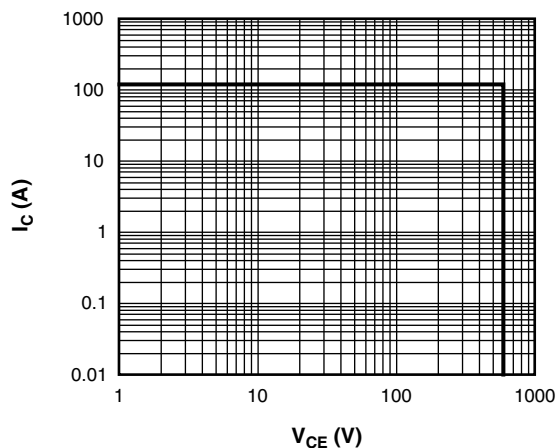


Fig. 2 - IGBT Reverse Bias SOA
 $T_J = 150^\circ\text{C}$, $V_{GE} = 15\text{ V}$

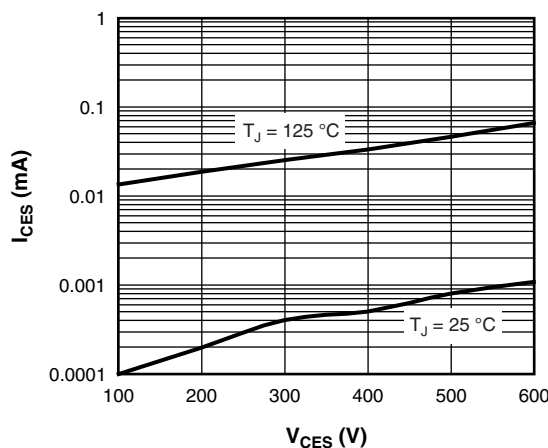


Fig. 4 - Typical IGBT Zero Gate Voltage Collector Current

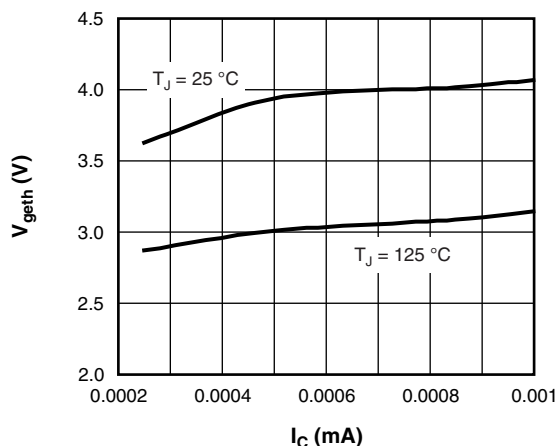


Fig. 5 - Typical IGBT Threshold Voltage

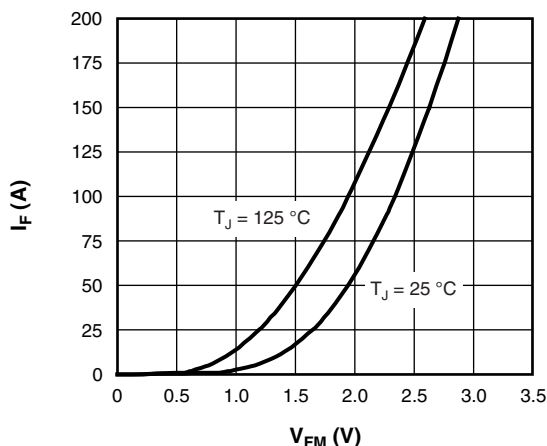


Fig. 8 - Typical Diode Forward Characteristics

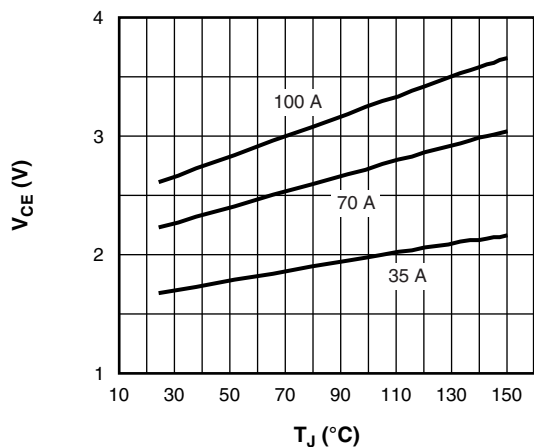


Fig. 6 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, $V_{GE} = 15$ V

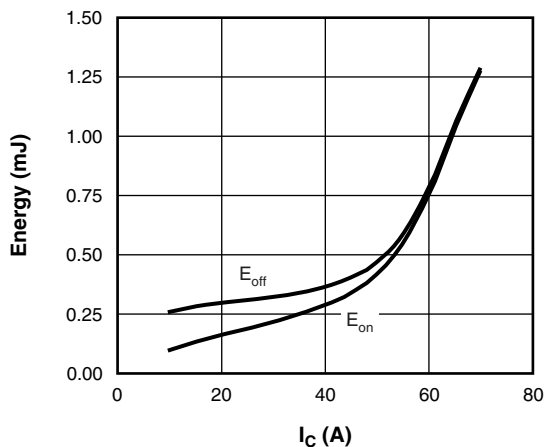


Fig. 9 - Typical IGBT Energy Loss vs. I_C
 $T_J = 125^\circ C$, $L = 500 \mu H$, $V_{CC} = 360$ V,
 $R_g = 5 \Omega$, $V_{GE} = 15$ V

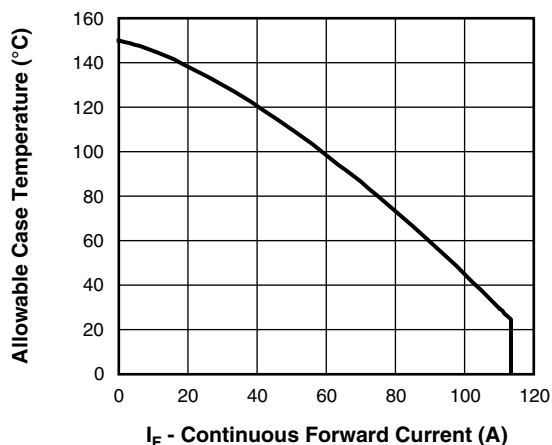


Fig. 7 - Maximum DC Forward Current vs. Case Temperature

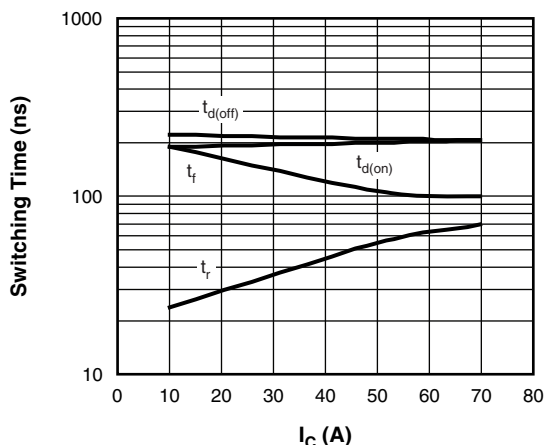


Fig. 10 - Typical IGBT Switching Time vs. I_C
 $T_J = 125^\circ C$, $L = 500 \mu H$, $V_{CC} = 360$ V,
 $R_g = 5 \Omega$, $V_{GE} = 15$ V

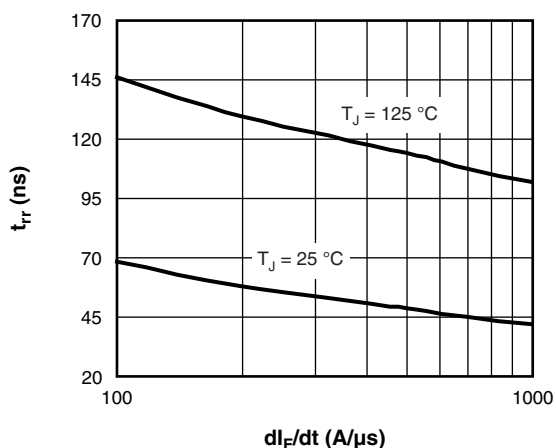


Fig. 11 - Typical t_{rr} Diode vs. dI_F/dt
 $V_R = 200\text{ V}$, $I_F = 50\text{ A}$

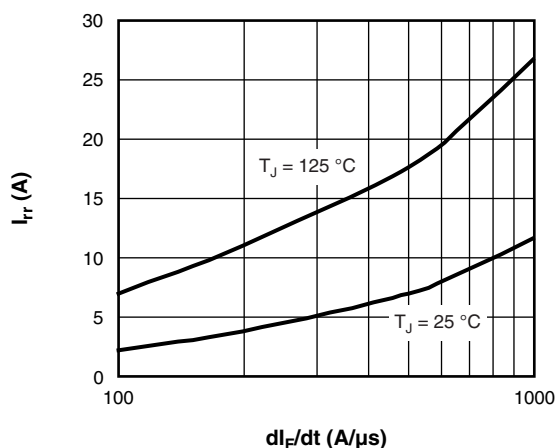


Fig. 12 - Typical I_{rr} Diode vs. dI_F/dt
 $V_{RR} = 200\text{ V}$, $I_F = 50\text{ A}$

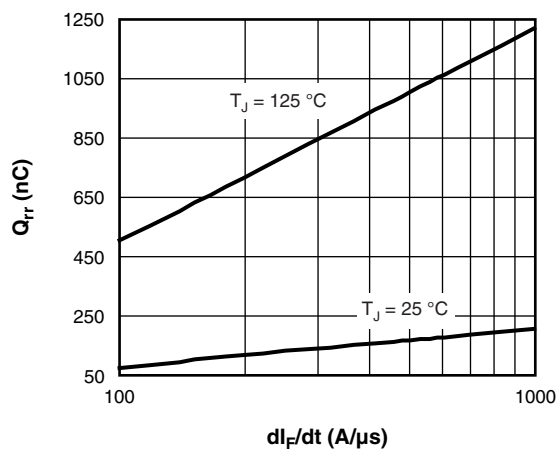


Fig. 13 - Typical Q_{rr} Diode vs. dI_F/dt
 $V_R = 200\text{ V}$, $I_F = 50\text{ A}$

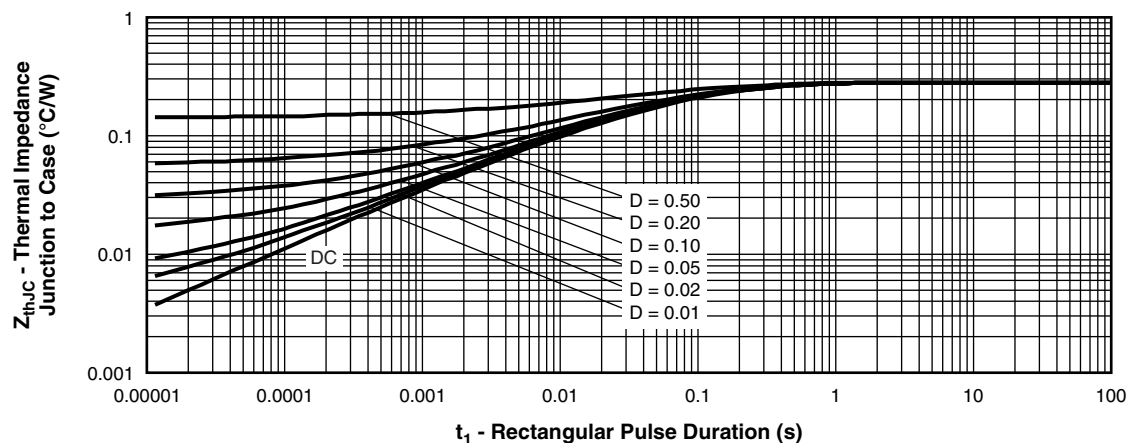


Fig. 14 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

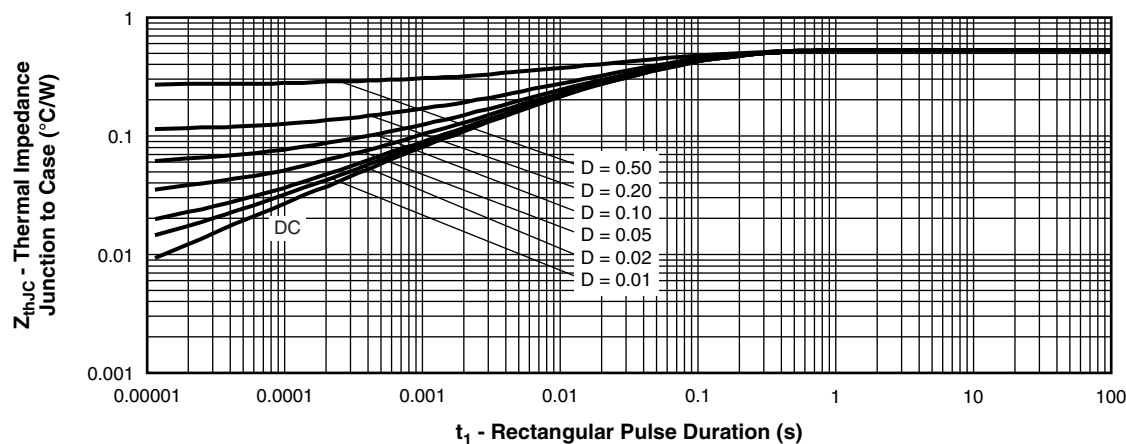


Fig. 15 - Maximum Thermal Impedance Z_{thJC} Characteristics (DIODE)

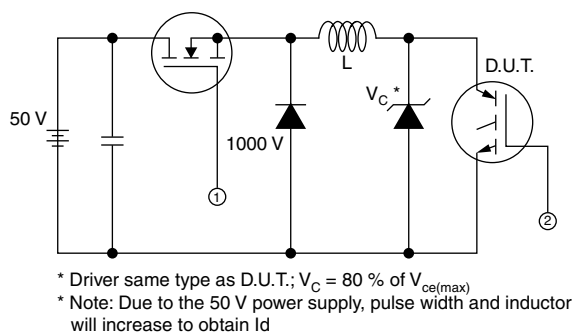


Fig. 16 - Clamped Inductive Load Test Circuit

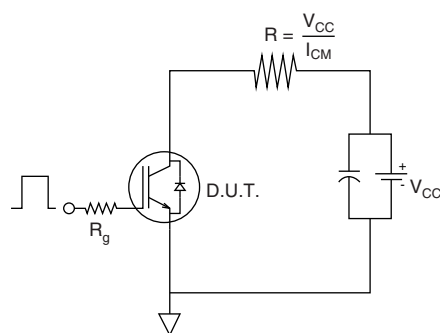


Fig. 17 - Pulsed Collector Current Test Circuit

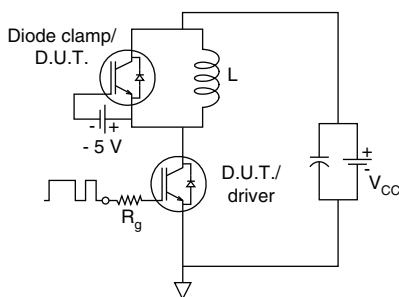


Fig. 18 - Switching Loss Test Circuit

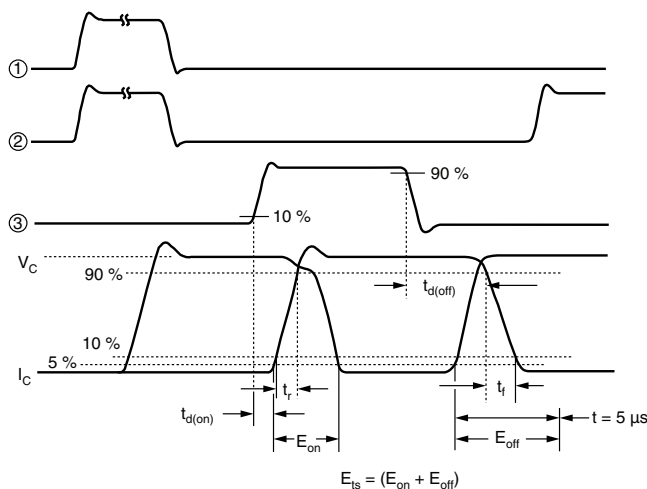
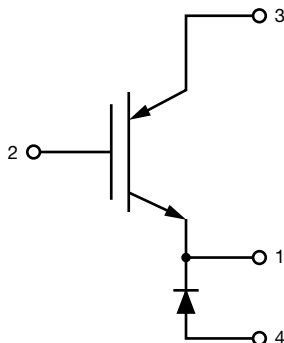


Fig. 19 - Switching Loss Waveforms Test Circuit

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

DIMENSIONS in millimeters (inches)



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



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