



# STW20NK50Z

## N-CHANNEL 500V - 0.23Ω - 17A TO-247 Zener-Protected SuperMESH™ Power MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>w</sub>
STW20NK50Z	500 V	< 0.27 Ω	17 A	190 W

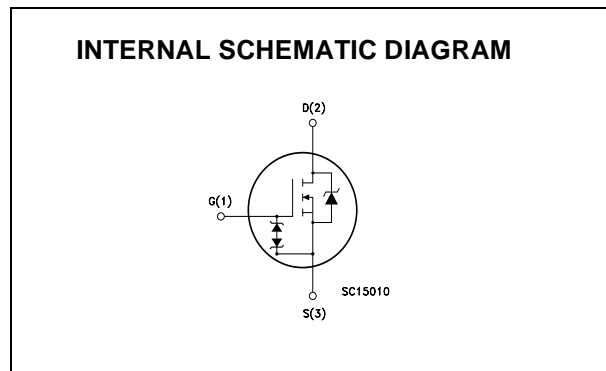
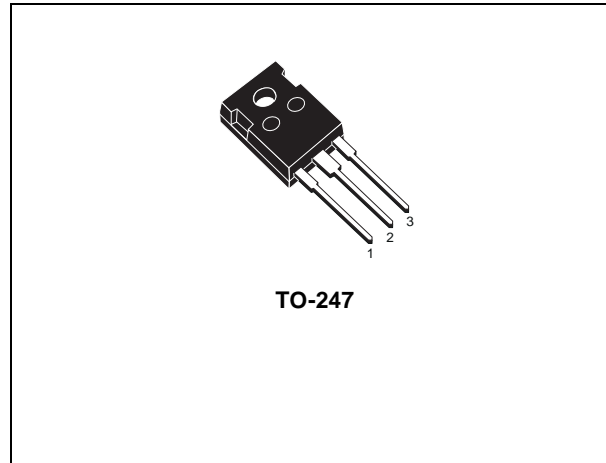
- TYPICAL R<sub>DS(on)</sub> = 0.23 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY

### DESCRIPTION

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES, ADAPTORS AND PFC



### ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STW20NK50Z	W20NK50Z	TO-247	TUBE

## STW20NK50Z

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	500	V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	500	V
V <sub>GS</sub>	Gate- source Voltage	± 30	V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	17	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	10.71	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	68	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	190	W
	Derating Factor	1.51	W/°C
V <sub>ESD(G-S)</sub>	Gate source ESD(HBM-C=100 pF, R=1.5 KΩ)	6000	V
dv/dt (1)	Peak Diode Recovery voltage slope	4.5	V/ns
T <sub>j</sub>	Operating Junction Temperature	-55 to 150	°C
T <sub>stg</sub>	Storage Temperature	-55 to 150	°C

(•) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 17A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

(\*) Limited only by maximum temperature allowed

### THERMAL DATA

R <sub>thj-case</sub>	Thermal Resistance Junction-case Max	0.66	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient Max	62.5	°C/W
T <sub>l</sub>	Maximum Lead Temperature For Soldering Purpose	300	°C

### AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)	17	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	850	mJ

### GATE-SOURCE ZENER DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV <sub>GSO</sub>	Gate-Source Breakdown Voltage	I <sub>gs</sub> = ± 1mA (Open Drain)	30			V

### PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

**ELECTRICAL CHARACTERISTICS** ( $T_{CASE} = 25^{\circ}C$  UNLESS OTHERWISE SPECIFIED)  
 ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1 \text{ mA}, V_{GS} = 0$	500			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}, T_C = 125^{\circ}C$			1 50	$\mu A$ $\mu A$
$I_{GSS}$	Gate-body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20 \text{ V}$			$\pm 10$	$\mu A$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 100 \mu A$	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10V, I_D = 8.5 \text{ A}$		0.23	0.27	$\Omega$

## DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (1)$	Forward Transconductance	$V_{DS} = 15 \text{ V}, I_D = 8.5 \text{ A}$		13		S
$C_{iss}$ $C_{oss}$ $C_{rss}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V, f = 1 \text{ MHz}, V_{GS} = 0$		2600 328 72		pF pF pF
$C_{oss \text{ eq.}} (3)$	Equivalent Output Capacitance	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 640V$		187		pF

## SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 250 \text{ V}, I_D = 8.5 \text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10 \text{ V}$ (Resistive Load see, Figure 3)		28 20		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 400 \text{ V}, I_D = 17 \text{ A},$ $V_{GS} = 10 \text{ V}$		85 15.5 42		nC nC nC

## SWITCHING OFF

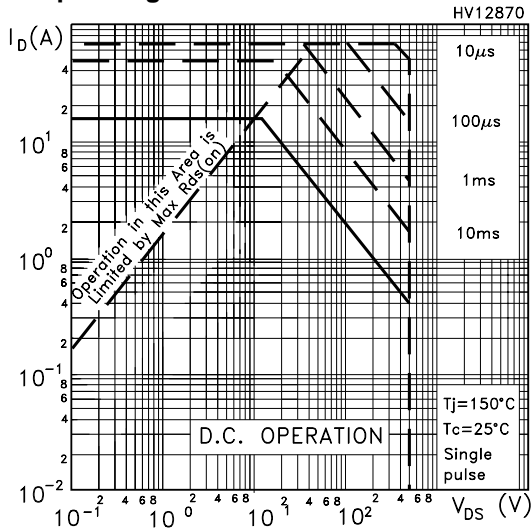
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 250 \text{ V}, I_D = 8.5 \text{ A}$ $R_G = 4.7\Omega, V_{GS} = 10 \text{ V}$ (Resistive Load see, Figure 3)		70 15		ns ns
$t_{r(voff)}$ $t_f$ $t_c$	Off-voltage Rise Time Fall Time Cross-over Time	$V_{DD} = 400 \text{ V}, I_D = 17 \text{ A},$ $R_G = 4.7\Omega, V_{GS} = 10V$ (Inductive Load see, Figure 5)		16 15 30		ns ns ns

## SOURCE DRAIN DIODE

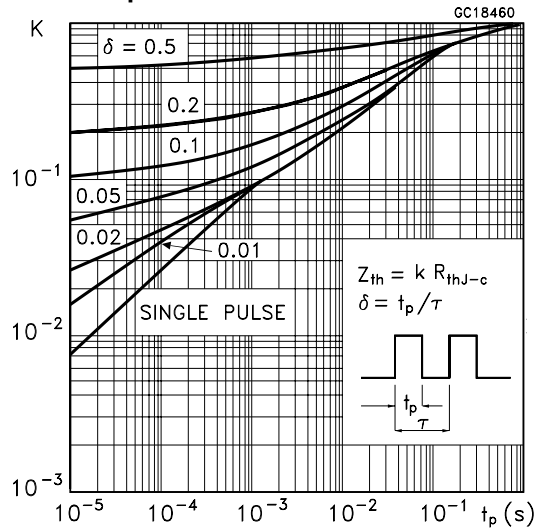
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM} (2)$	Source-drain Current Source-drain Current (pulsed)				17 68	A A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 17 \text{ A}, V_{GS} = 0$			1.6	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 17 \text{ A}, di/dt = 100 \text{ A}/\mu s$ $V_R = 100 \text{ V}, T_j = 150^{\circ}C$ (see test circuit, Figure 5)		355 5.72 26		ns $\mu C$ A

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.  
 2. Pulse width limited by safe operating area.  
 3.  $C_{oss \text{ eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

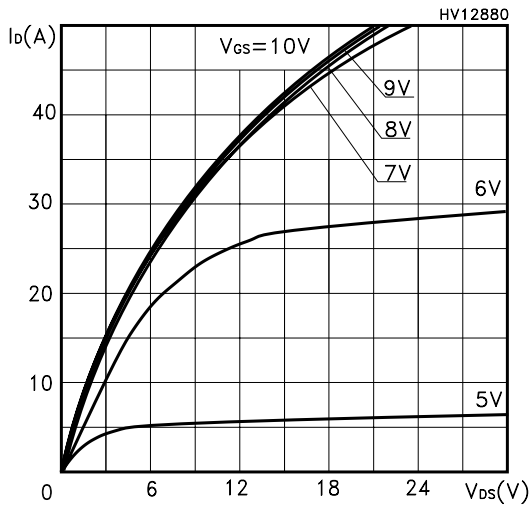
Safe Operating Area For TO-247



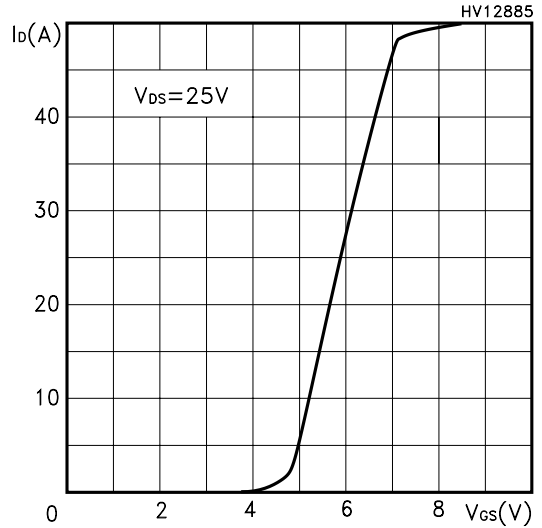
Thermal Impedance For TO-247



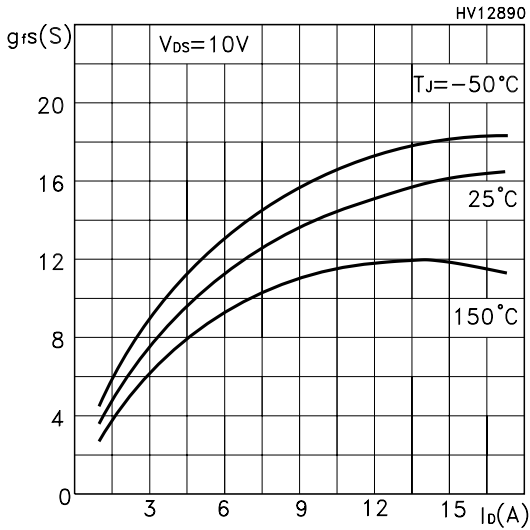
Output Characteristics



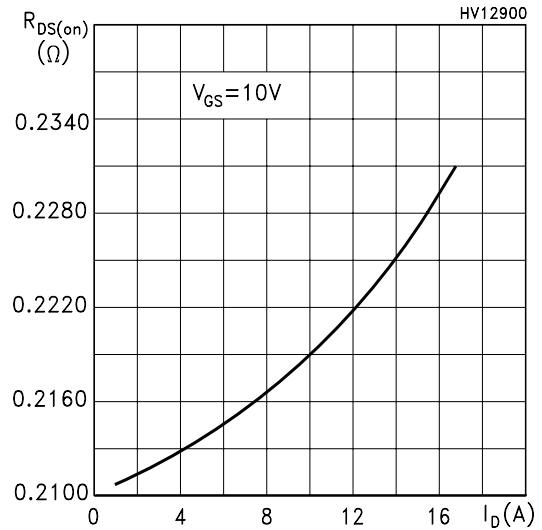
Transfer Characteristics



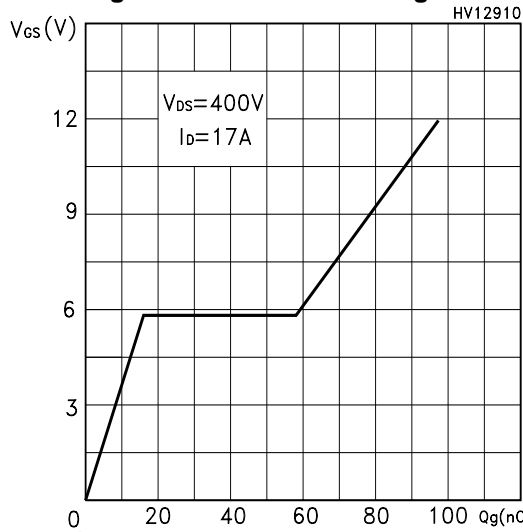
Transconductance



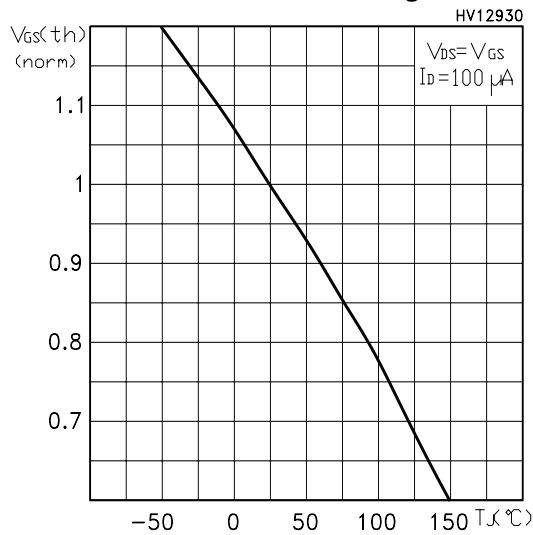
Static Drain-source On Resistance



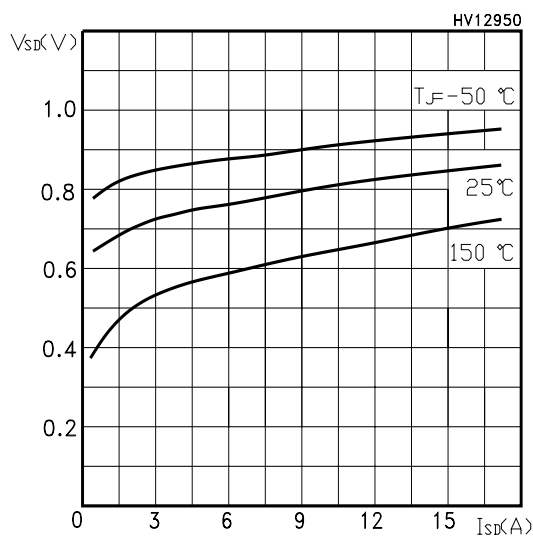
Gate Charge vs Gate-source Voltage



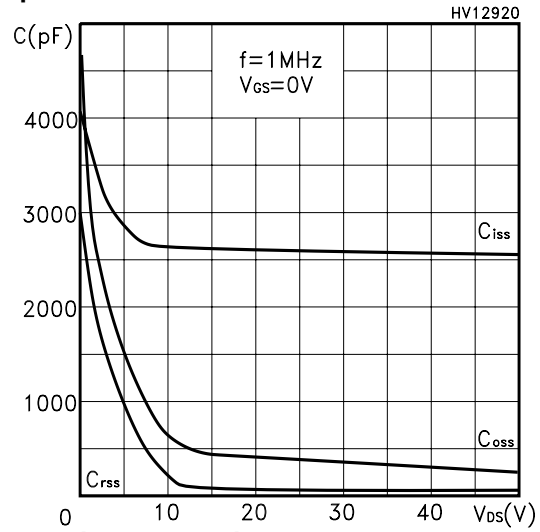
Normalized Gate Threshold Voltage vs Temp.



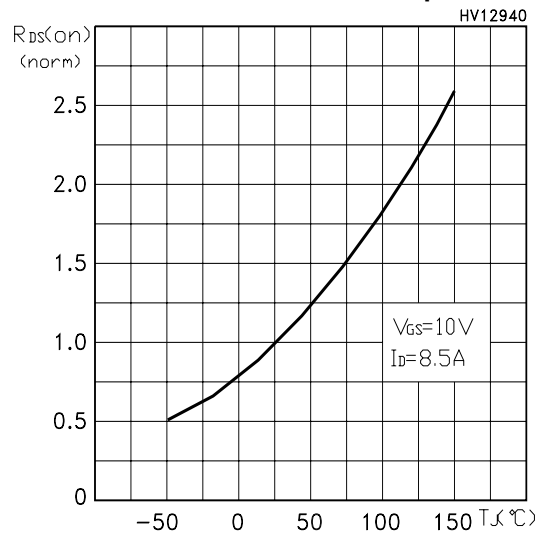
Source-drain Diode Forward Characteristics



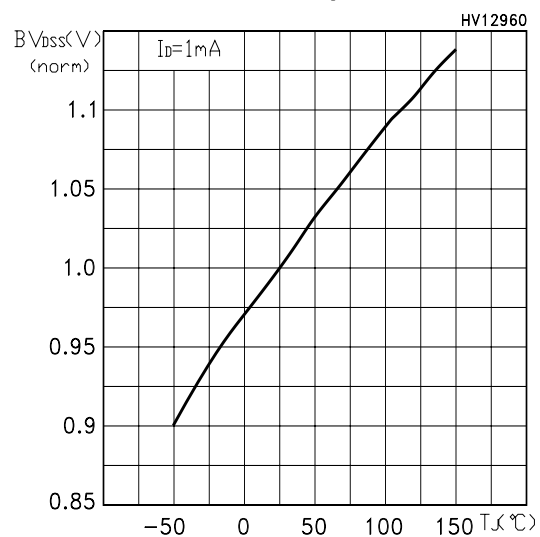
Capacitance Variations



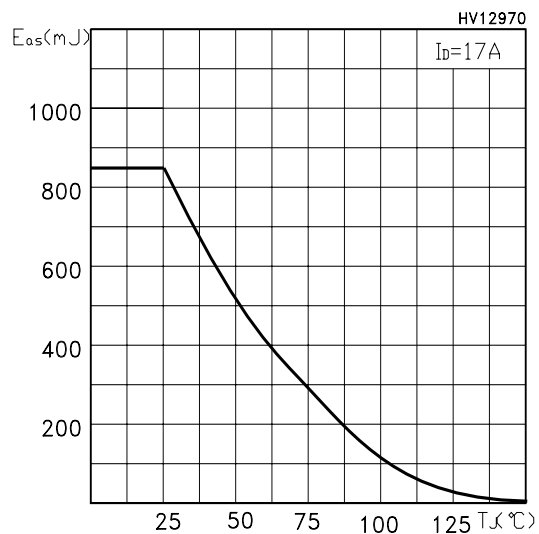
Normalized On Resistance vs Temperature



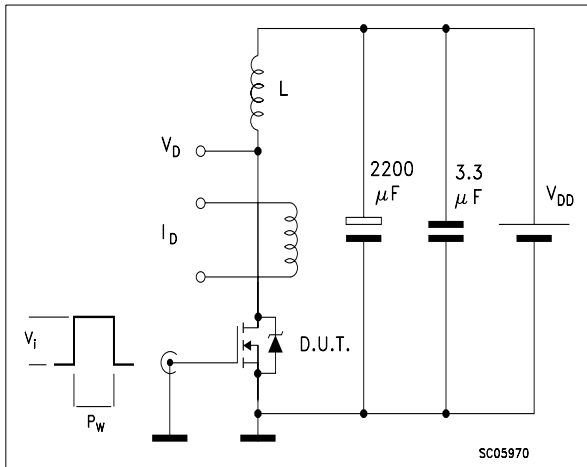
Normalized BVDSS vs Temperature



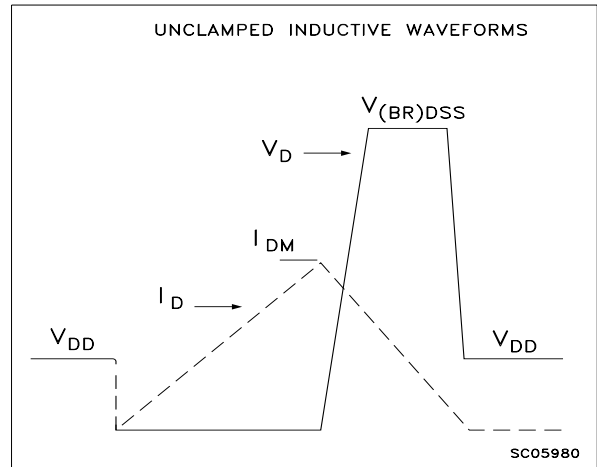
Maximum Avalanche Energy vs Temperature



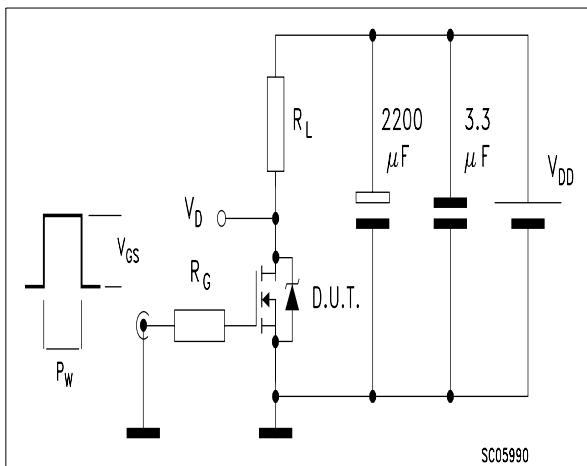
**Fig. 1: Unclamped Inductive Load Test Circuit**



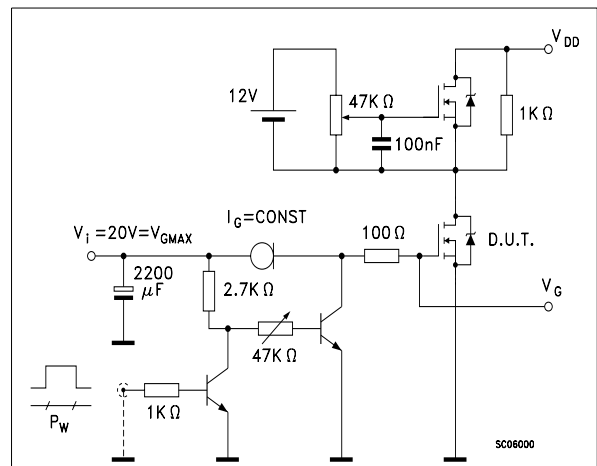
**Fig. 2: Unclamped Inductive Waveform**



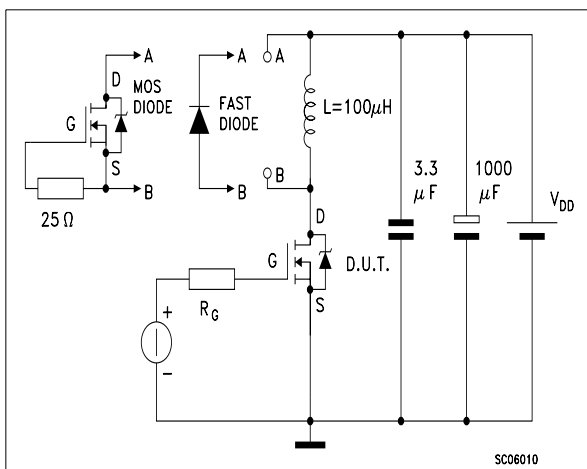
**Fig. 3: Switching Times Test Circuit For Resistive Load**



**Fig. 4: Gate Charge test Circuit**

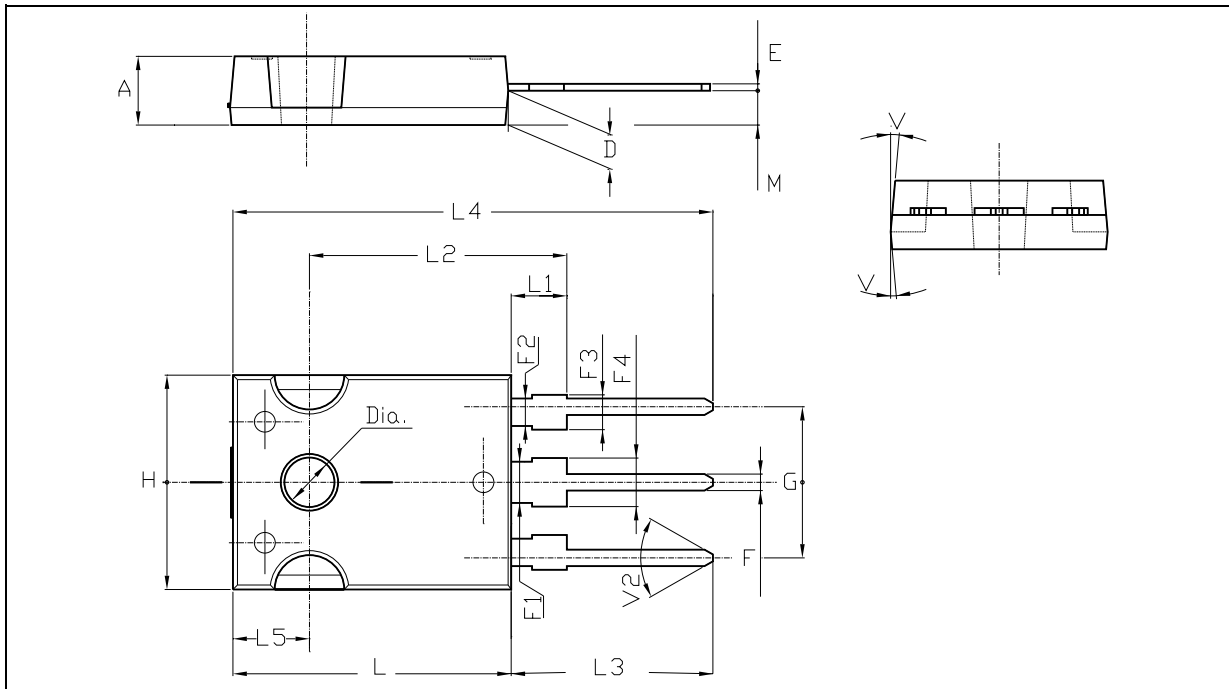


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



**TO-247 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.85		5.15	0.19		0.20
D	2.20		2.60	0.08		0.10
E	0.40		0.80	0.015		0.03
F	1		1.40	0.04		0.05
F1		3			0.11	
F2		2			0.07	
F3	2		2.40	0.07		0.09
F4	3		3.40	0.11		0.13
G		10.90			0.43	
H	15.45		15.75	0.60		0.62
L	19.85		20.15	0.78		0.79
L1	3.70		4.30	0.14		0.17
L2		18.50			0.72	
L3	14.20		14.80	0.56		0.58
L4		34.60			1.36	
L5		5.50			0.21	
M	2		3	0.07		0.11
V		5°			5°	
V2		60°			60°	
Dia	3.55		3.65	0.14		0.143





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