



# STW20NM50

N-CHANNEL 500V - 0.20Ω - 20A TO-247

MDmesh™ Power MOSFET

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STW20NM50	500V	< 0.25Ω	20 A

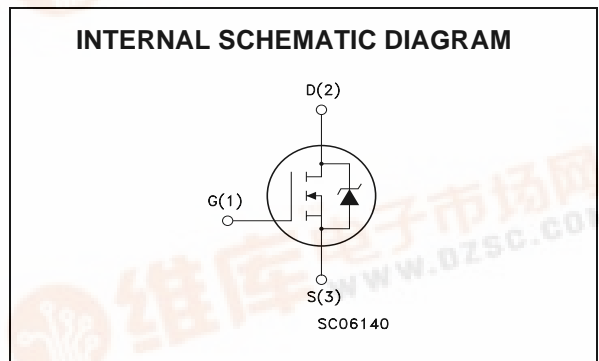
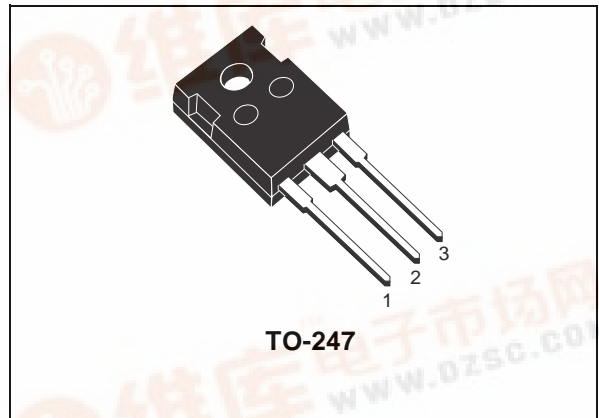
- TYPICAL R<sub>DS(on)</sub> = 0.20Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS

### DESCRIPTION

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.

### APPLICATIONS

The MDmesh™ family is very suitable for increasing power density of high voltage converters allowing system miniaturization and higher efficiencies.



### 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	20	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	12.6	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	80	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	214	W
	Derating Factor	1.44	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	15	V/ns
T <sub>stg</sub>	Storage Temperature	-65 to 150	°C
T <sub>j</sub>	Max. Operating Junction Temperature	150	°C

(•)Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 20A, di/dt ≤ 400A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STW20NM50

### THERMAL DATA

Rthj-case	Thermal Resistance Junction-case	Max	0.585	°C/W
Rthj-amb	Thermal Resistance Junction-ambient	Max	30	°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)	10	A
E <sub>AS</sub>	Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = 5 A, V <sub>DD</sub> = 35 V)	650	mJ

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0	500			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C			1 100	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ±30V			±100	nA

### ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	3	4	5	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 10A		0.20	0.25	Ω

### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (1)	Forward Transconductance	V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)max</sub> , I <sub>D</sub> = 10A		10		S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		1480		pF
C <sub>OSS</sub>	Output Capacitance			285		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			34		pF
C <sub>OSS</sub> eq. (2)	Equivalent Output Capacitance	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 400V		130		pF
R <sub>G</sub>	Gate Input Resistance	f=1 MHz Gate DC Bias = 0 Test Signal Level = 20mV Open Drain		1.6		Ω

1. Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %.

2. C<sub>OSS</sub> eq. is defined as a constant equivalent capacitance giving the same charging time as C<sub>OSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

**ELECTRICAL CHARACTERISTICS (CONTINUED)**  
SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = 250V, I_D = 10 A$ $R_G = 4.7\Omega, V_{GS} = 10 V$ (see test circuit, Figure 3)		24		ns
$t_r$	Rise Time			16		ns
$Q_g$	Total Gate Charge	$V_{DD} = 400 V, I_D = 20 A,$ $V_{GS} = 10 V$		40	56	nC
$Q_{gs}$	Gate-Source Charge			13		nC
$Q_{gd}$	Gate-Drain Charge			19		nC

SWITCHING OFF

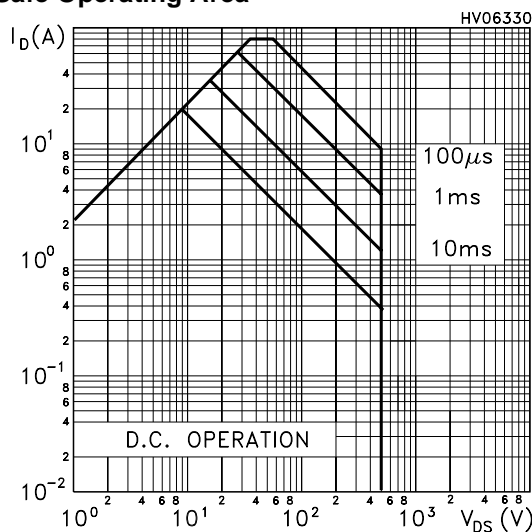
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(voff)}$	Off-voltage Rise Time	$V_{DD} = 400 V, I_D = 20 A,$ $R_G = 4.7\Omega, V_{GS} = 10 V$ (see test circuit, Figure 5)		9		ns
$t_f$	Fall Time			8.5		ns
$t_c$	Cross-over Time			23		ns

SOURCE DRAIN DIODE

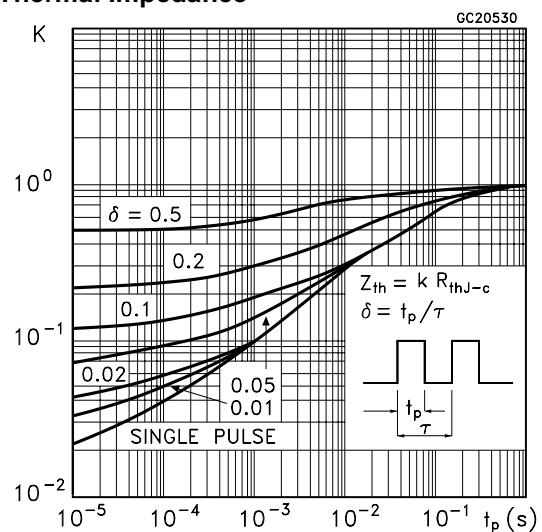
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				20	A
$I_{SDM} (2)$	Source-drain Current (pulsed)				80	A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 20 A, V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20 A, di/dt = 100 A/\mu s,$ $V_{DD} = 100 V, T_j = 25^\circ C$ (see test circuit, Figure 5)		350		ns
$Q_{rr}$	Reverse Recovery Charge			4.6		$\mu C$
$I_{rrm}$	Reverse Recovery Current			26		A
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20 A, di/dt = 100 A/\mu s,$ $V_{DD} = 100 V, T_j = 150^\circ C$ (see test circuit, Figure 5)		435		ns
$Q_{rr}$	Reverse Recovery Charge			5.9		$\mu C$
$I_{rrm}$	Reverse Recovery Current			27		A

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

Safe Operating Area

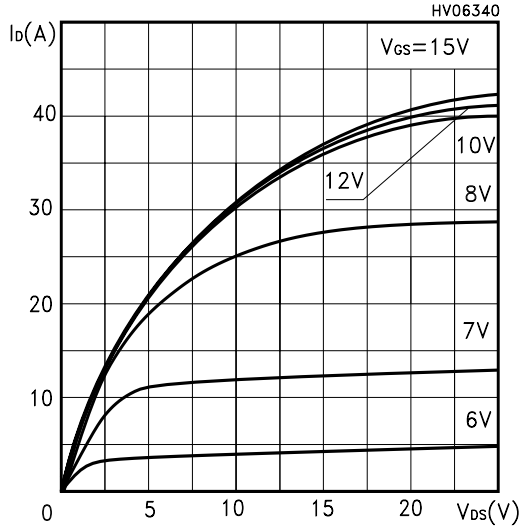


Thermal Impedance

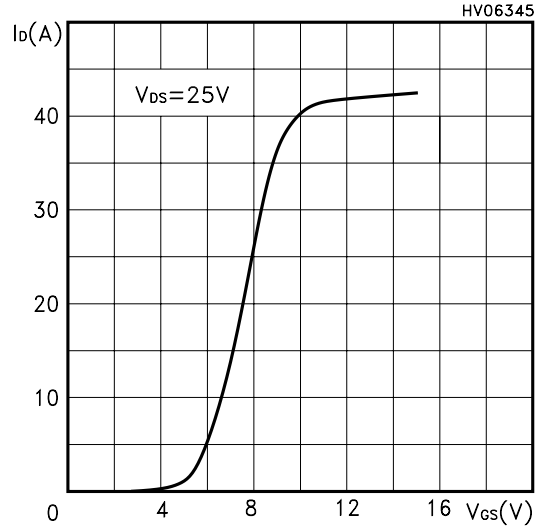


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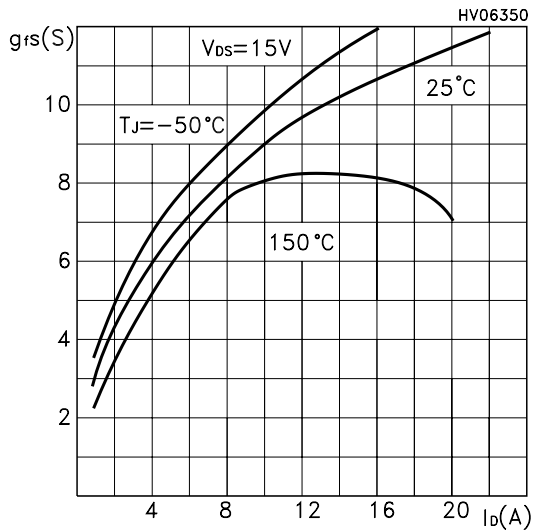
## Output Characteristics



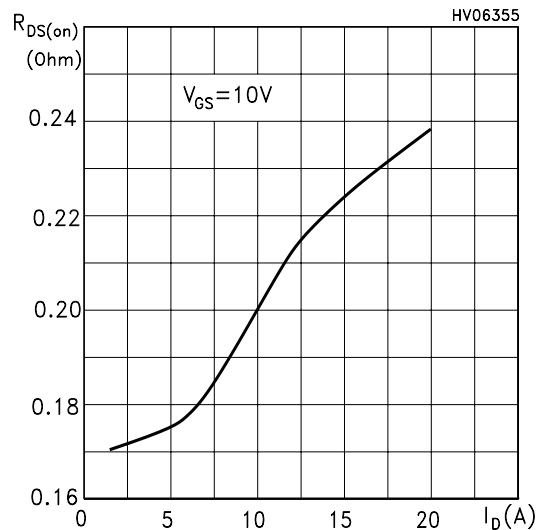
## Transfer Characteristics



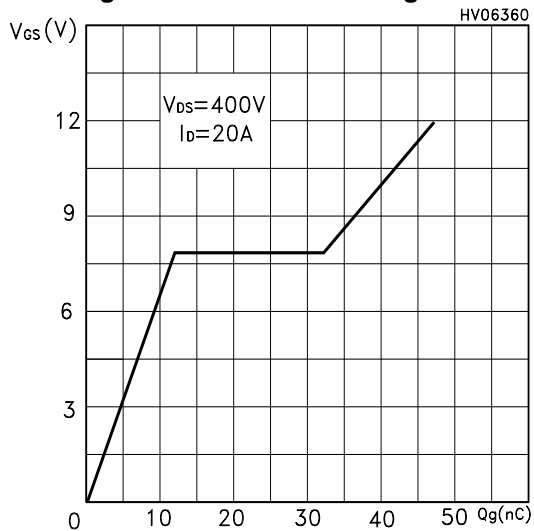
## Transconductance



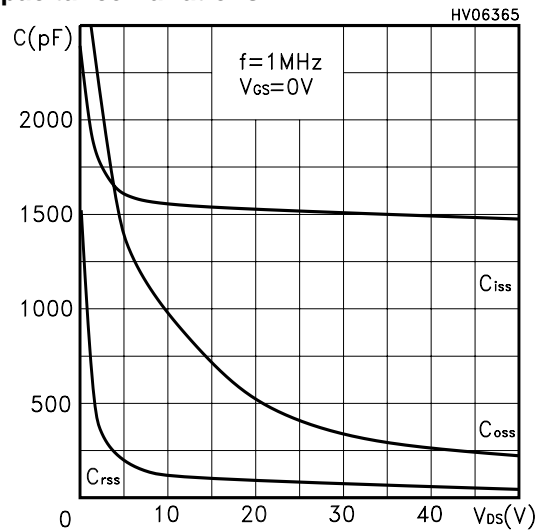
## Static Drain-source On Resistance



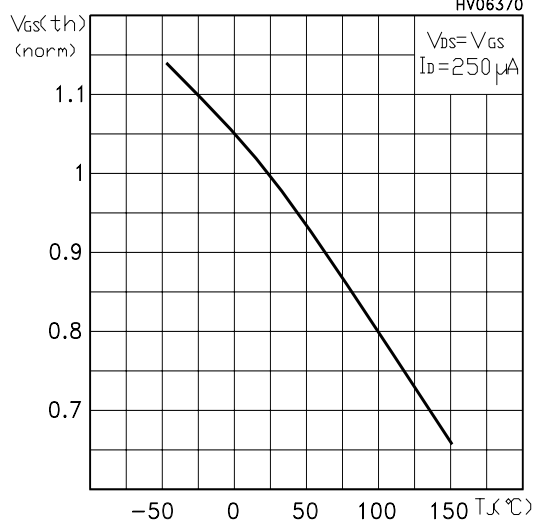
## Gate Charge vs Gate-source Voltage



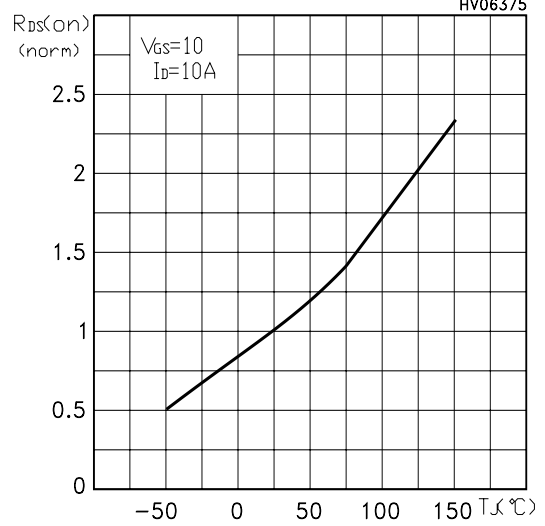
## Capacitance Variations



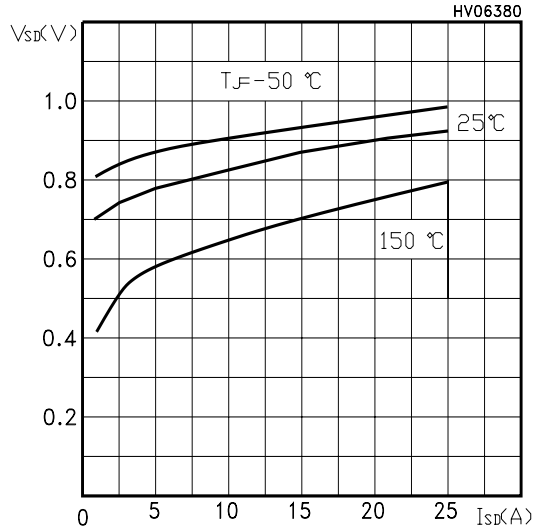
Normalized Gate Threshold Voltage vs Temp. HV06370



Normalized On Resistance vs Temperature HV06375

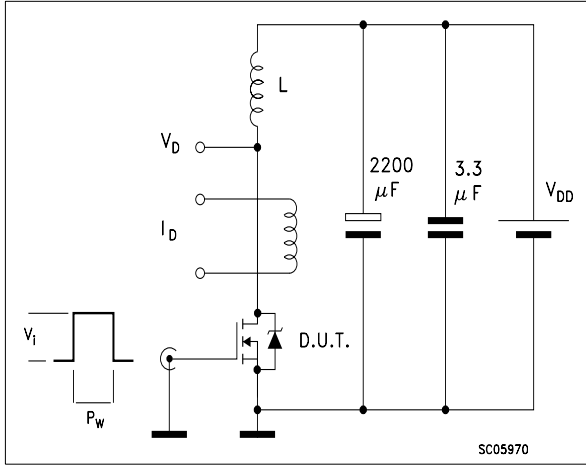


Source-drain Diode Forward Characteristics HV06380

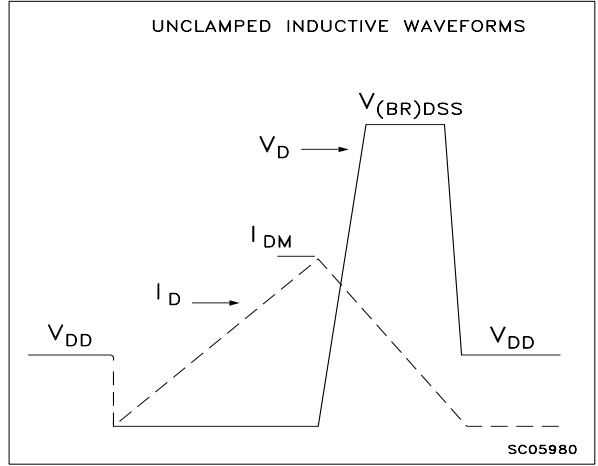


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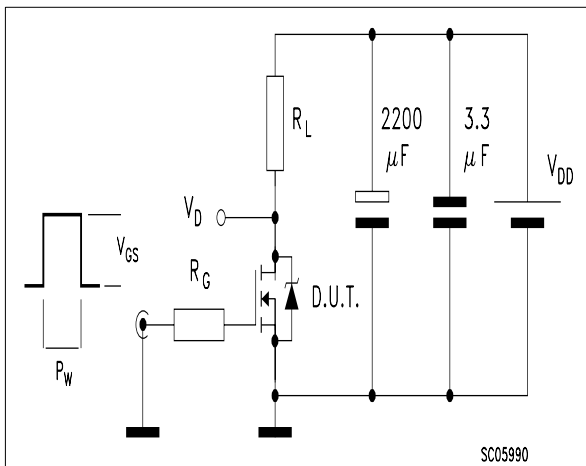
**Fig. 1: Unclamped Inductive Load Test Circuit**



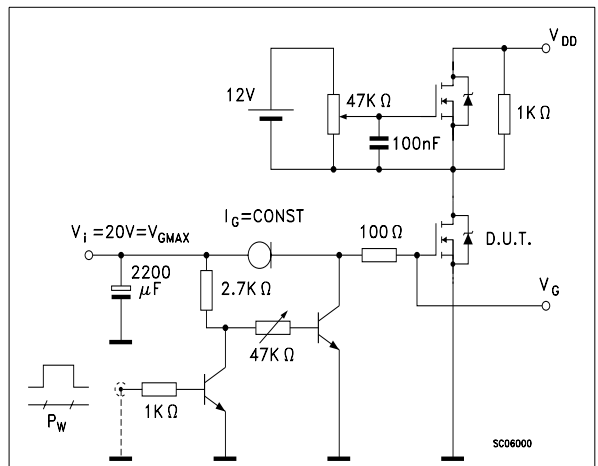
**Fig. 2: Unclamped Inductive Waveform**



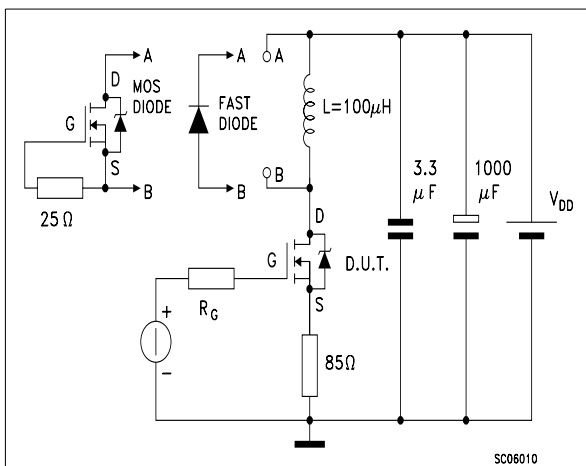
**Fig. 3: Switching Times Test Circuit For Resistive Load**



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

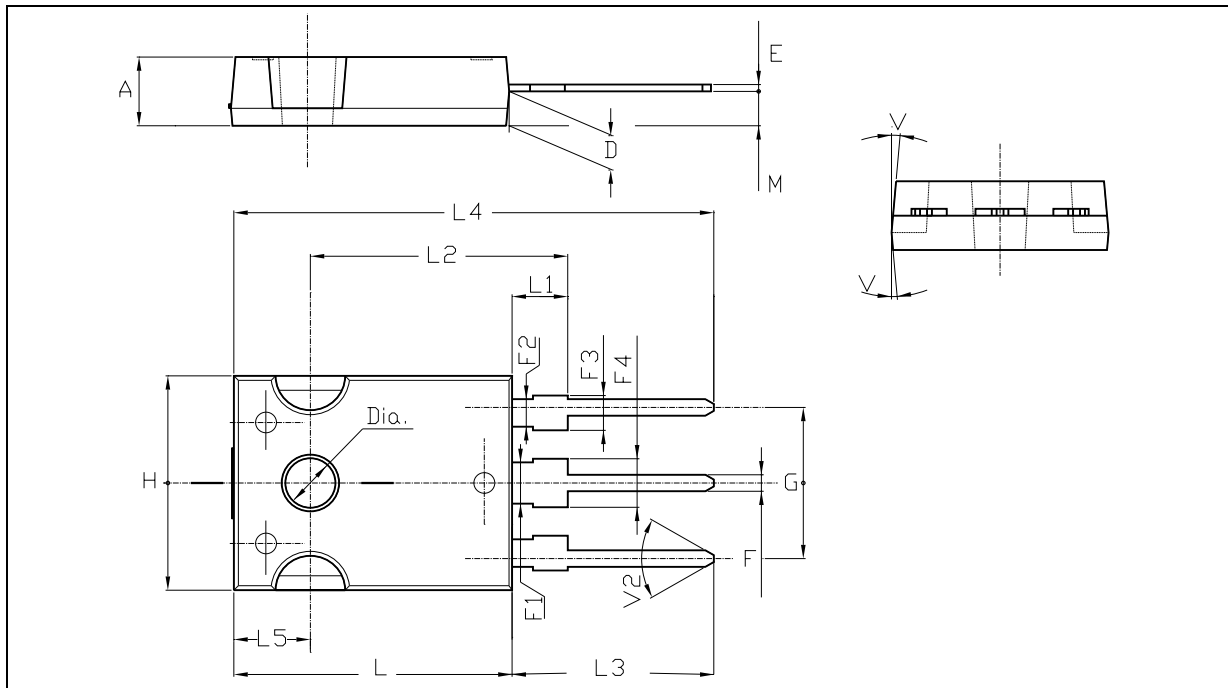


**Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times**



**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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