



# STW20NM50FD

## N-CHANNEL 500V - 0.22Ω - 20A TO-247 FDmesh™ Power MOSFET (with FAST DIODE)

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STW20NM50FD	500V	<0.25Ω	20 A

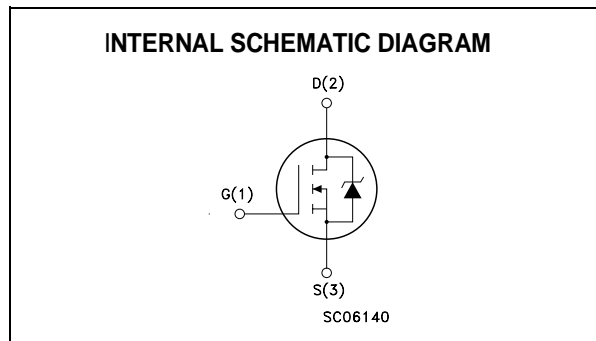
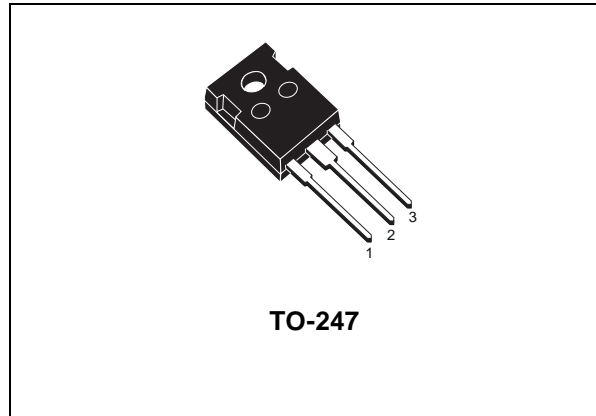
- TYPICAL R<sub>DS(on)</sub> = 0.22Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE
- TIGHT PROCESS CONTROL AND HIGH MANUFACTURING YIELDS

### DESCRIPTION

The FDmesh™ associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

### APPLICATIONS

- ZVS PHASE-SHIFT FULL BRIDGE CONVERTERS FOR SMPS AND WELDING EQUIPMENT



### 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	14	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	1.42	W/°C
dv/dt(1)	Peak Diode Recovery voltage slope	20	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>.

(\*)Limited only by maximum temperature allowed

## STW20NM50FD

### 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>I</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> = I <sub>AR</sub> , V <sub>DD</sub> = 35 V)	700	mJ

### ELECTRICAL CHARACTERISTICS (TCASE = 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 10	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		0.22	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		9		S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0		1380		pF
C <sub>oss</sub>	Output Capacitance			290		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			40		pF
C <sub>oss eq.</sub> (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		2.8		Ω

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

2. C<sub>oss eq.</sub> 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	$V_{DD} = 250V, I_D = 10 A$ $R_G = 4.7\Omega, V_{GS} = 10V$		22		ns
$t_r$	Rise Time	(see test circuit, Figure 3)		20		ns
$Q_g$	Total Gate Charge	$V_{DD} = 400V, I_D = 20A,$ $V_{GS} = 10V$		38	53	nC
$Q_{gs}$	Gate-Source Charge			18		nC
$Q_{gd}$	Gate-Drain Charge			10		nC

SWITCHING OFF

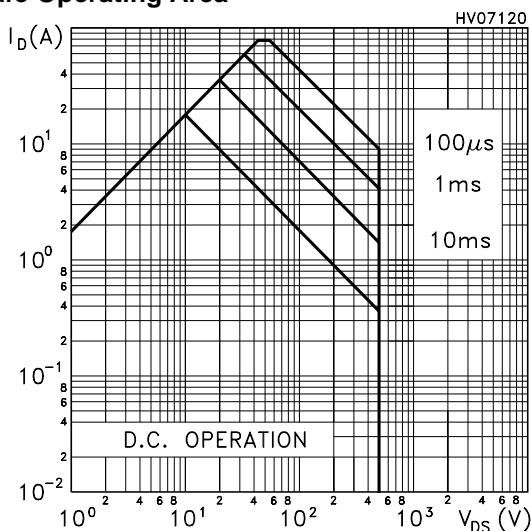
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	$V_{DD} = 400V, I_D = 20 A,$ $R_G = 4.7\Omega, V_{GS} = 10V$		6		ns
$t_f$	Fall Time	(see test circuit, Figure 5)		15		ns
$t_c$	Cross-over Time			30		ns

SOURCE DRAIN DIODE

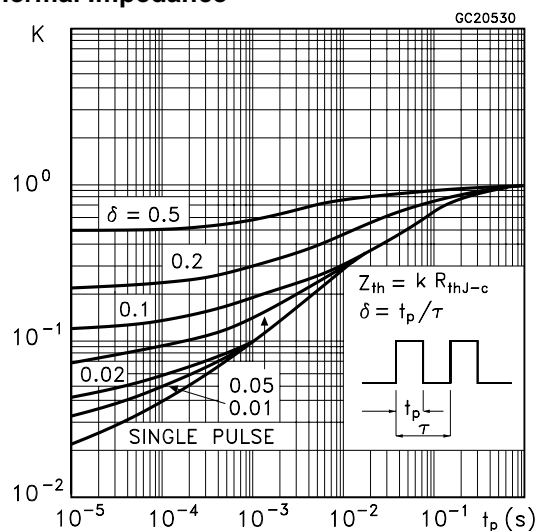
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				20	A
$I_{SDM(2)}$	Source-drain Current (pulsed)				80	A
$V_{SD(1)}$	Forward On Voltage	$I_{SD} = 20 A, V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 20 A, di/dt = 100A/\mu s,$ $V_{DD} = 60V, T_j = 150^\circ C$		245		ns
$Q_{rr}$	Reverse Recovery Charge	(see test circuit, Figure 5)		2		$\mu C$
$I_{RRM}$	Reverse Recovery Current			16		A

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

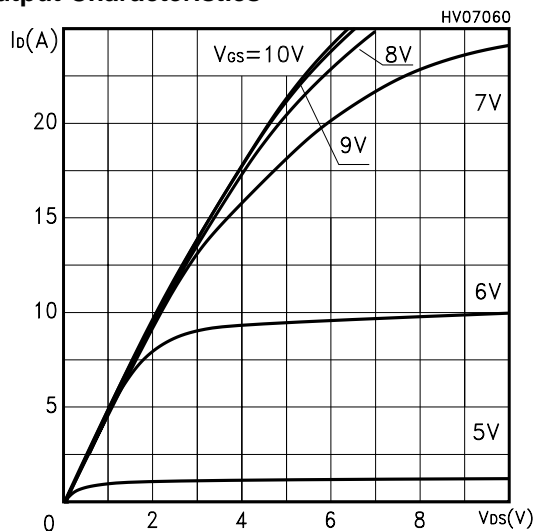
Safe Operating Area



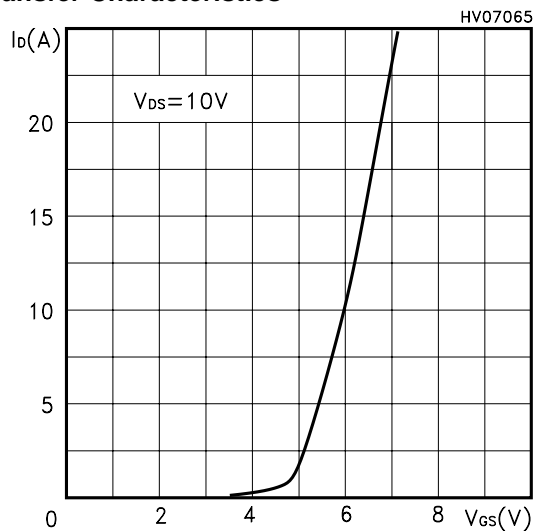
Thermal Impedance



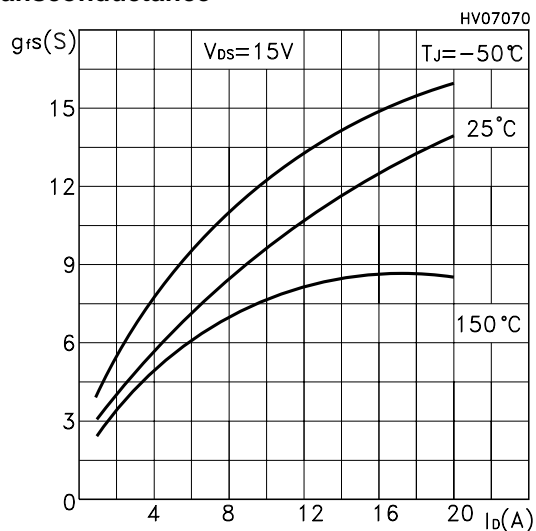
Output Characteristics



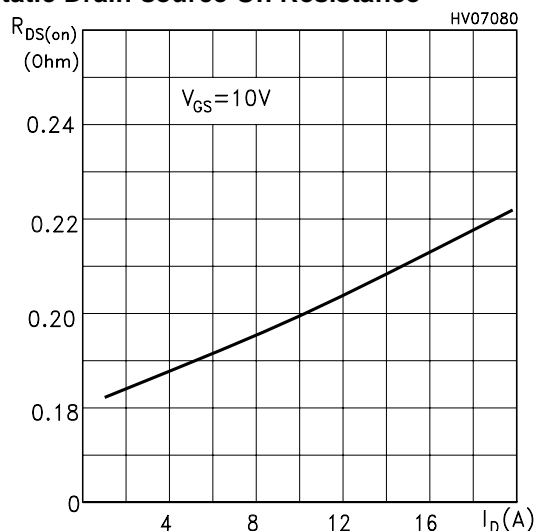
Transfer Characteristics



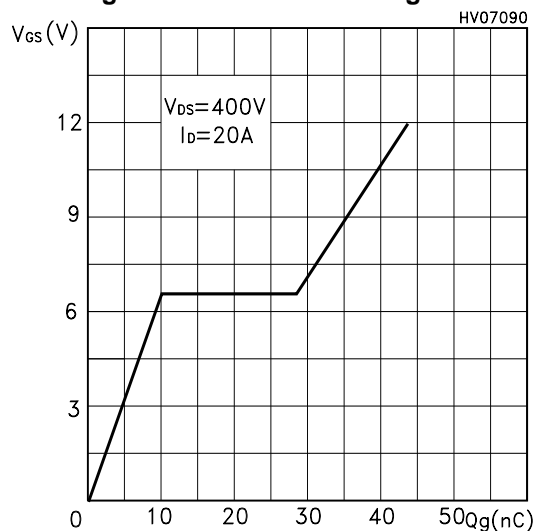
Transconductance



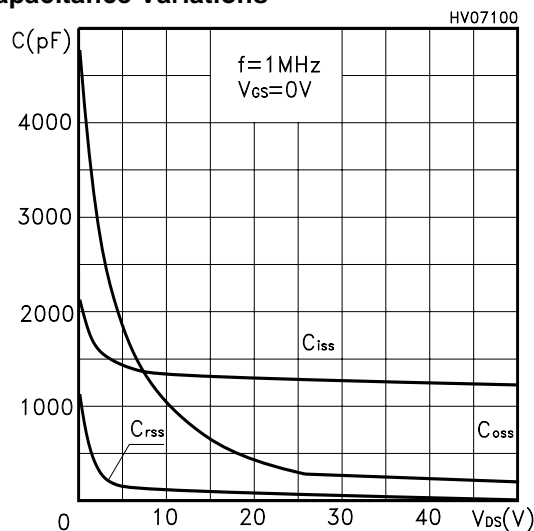
Static Drain-source On Resistance



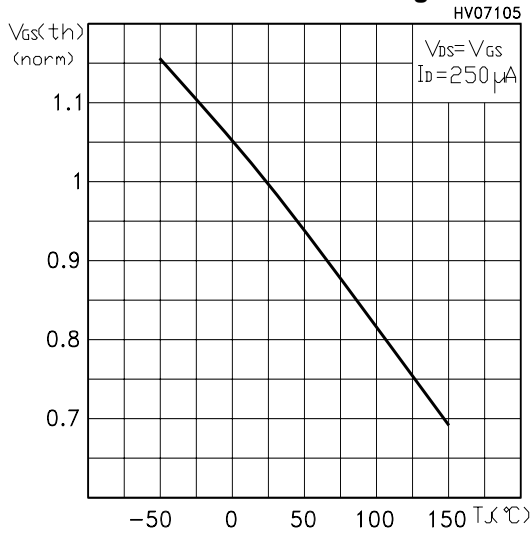
Gate Charge vs Gate-source Voltage



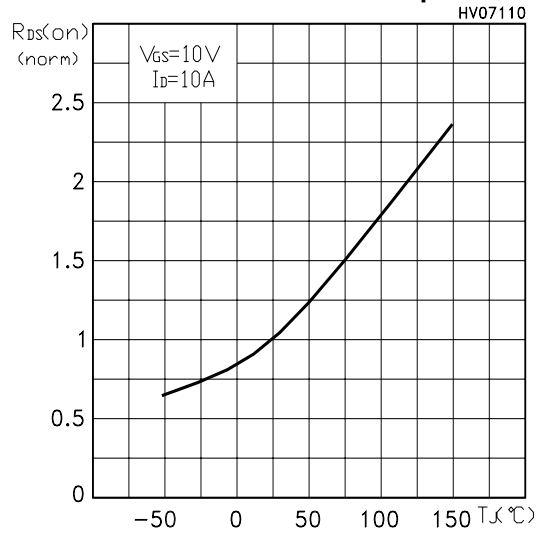
Capacitance Variations



Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

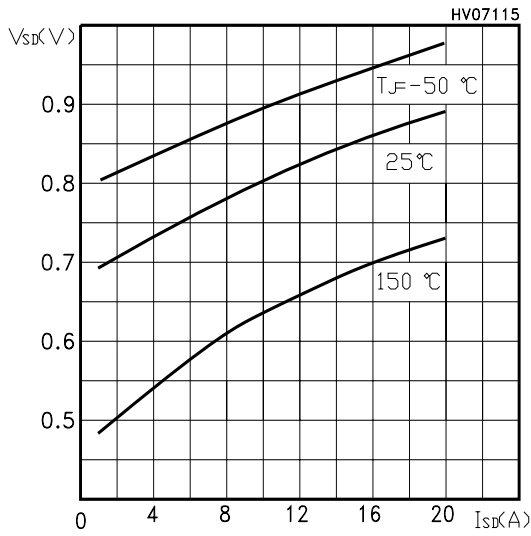


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuits For Resistive Load



Fig. 4: Gate Charge test Circuit

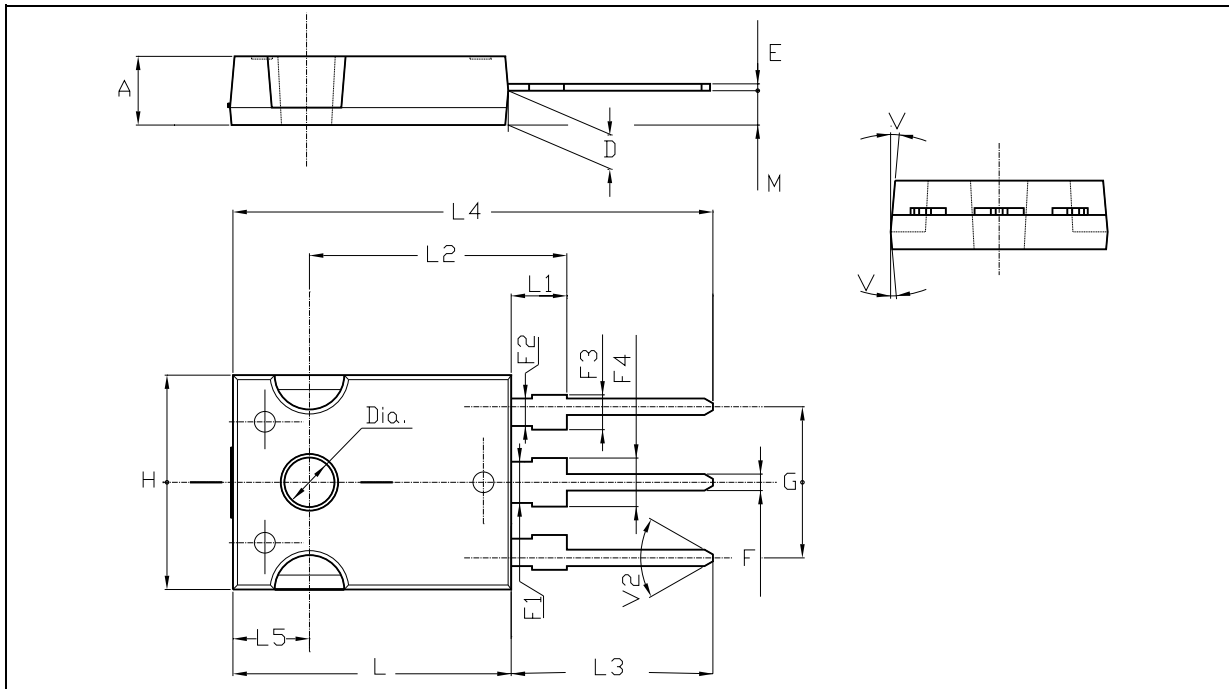


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



**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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