



# STP20NF06 STF20NF06

## N-CHANNEL 60V - 0.06 Ω - 20A TO-220/TO-220FP STripFET™ II POWER MOSFET

**Table 1: General Features**

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP20NF06	60 V	< 0.07 Ω	20 A
STF20NF06	60 V	< 0.07 Ω	20 A(*)

- TYPICAL R<sub>DS(on)</sub> = 0.06 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- 175°C OPERATING TEMPERATURE
- HIGH dv/dt CAPABILITY
- APPLICATION ORIENTED CHARACTERIZATION

### DESCRIPTION

This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility

### APPLICATIONS

- DC MOTOR CONTROL
- DC-DC & DC-AC CONVERTERS

**Table 2: Order Codes**

Part Number	MARKING	PACKAGE	PACKAGING
STP20NF06	P20NF06	TO-220	TUBE
STF20NF06	F20NF06	TO-220FP	TUBE

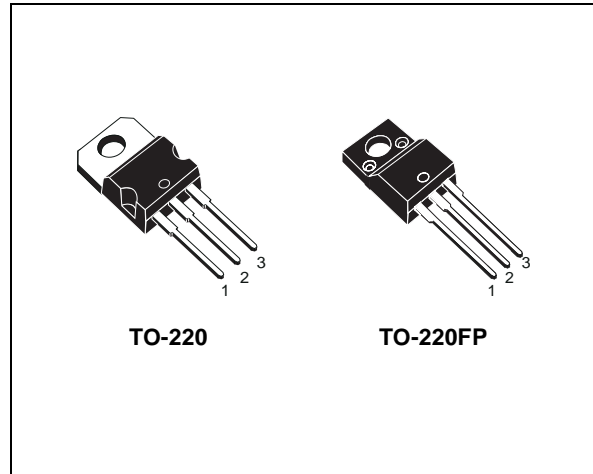
**Table 3: ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value		Unit
		STP20NF06	STF20NF06	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	60		V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	60		V
V <sub>GS</sub>	Gate- source Voltage	± 20		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	20	20(*)	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	14	14(*)	A
I <sub>DM</sub> (●)	Drain Current (pulsed)	80	80(*)	A
P <sub>tot</sub>	Total Dissipation at T <sub>C</sub> = 25°C	60	28	W
	Derating Factor	0.4	0.18	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	9		V/ns
E <sub>AS</sub> (2)	Single Pulse Avalanche Energy	120		mJ
T <sub>stg</sub>	Storage Temperature	-55 to 175		°C
T <sub>j</sub>	Operating Junction Temperature			

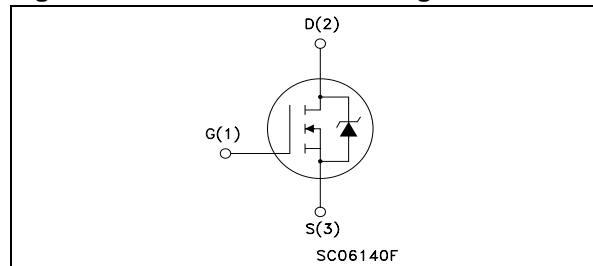
(●) Pulse width limited by safe operating area.

(\*) Refer to soa for the max allowable current value on FP-type due to R<sub>th</sub> value

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



## STP20NF06 STF20NF06

**Table 4: THERMAL DATA**

			TO-220	TO-220FP	
Rthj-case	Thermal Resistance Junction-case	Max	2.5	5.35	°C/W
Rthj-amb T <sub>I</sub>	Thermal Resistance Junction-ambient Maximum Lead Temperature For Soldering Purpose	Max	62.5 300		°C/W °C

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

**Table 5: 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	60			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> = ± 20V			±100	nA

**Table 6: ON <sup>(5)</sup>**

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> = 250 μA	2	3	4	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10 V I <sub>D</sub> = 10 A		0.06	0.07	Ω

**Table 7: DYNAMIC**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> <sup>(5)</sup>	Forward Transconductance	V <sub>DS</sub> = 15 V I <sub>D</sub> = 8 A		10		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>DS</sub> = 25V f = 1 MHz V <sub>GS</sub> = 0		400 100 40		pF pF pF

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## ELECTRICAL CHARACTERISTICS (continued)

**Table 8: SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 30\text{ V}$ $I_D = 10\text{ A}$ $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (Resistive Load, Figure )		5 15		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 30\text{ V}$ $I_D = 20\text{ A}$ $V_{GS} = 10\text{ V}$		14 3.0 5.5	18	nC nC nC

**Table 9: SWITCHING OFF**

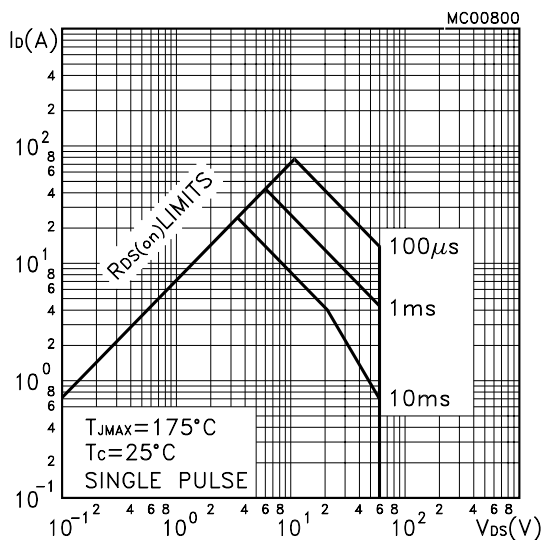
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 30\text{ V}$ $I_D = 10\text{ A}$ $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (Resistive Load, Figure 3)		15 5		ns ns

**Table 10: SOURCE DRAIN DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}^{(1)}$	Source-drain Current Source-drain Current (pulsed)				20 80	A A
$V_{SD}^{(2)}$	Forward On Voltage	$I_{SD} = 20\text{ A}$ $V_{GS} = 0$			1.5	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 20\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 20\text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		50 80 3.2		ns $\mu\text{C}$ A

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

**Figure 3: Safe Operating Area for TO-220**



**Figure 4: Safe Operating Area for TO-220FP**

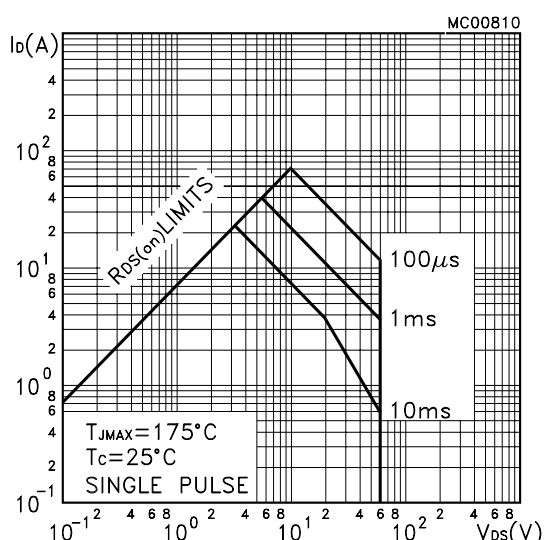


Figure 5: Thermal Impedance

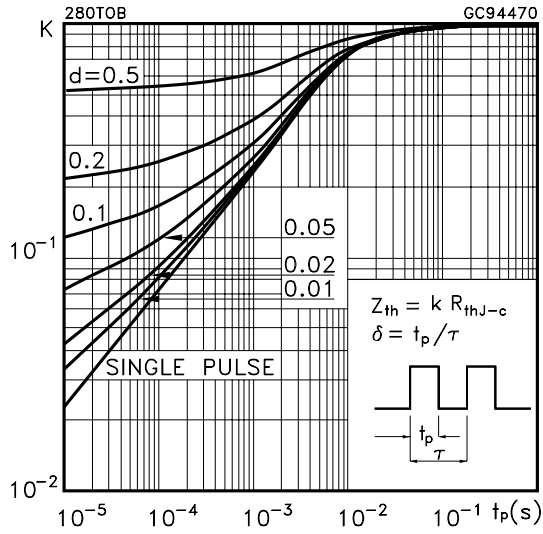


Figure 6: Thermal Impedance for TO-220FP

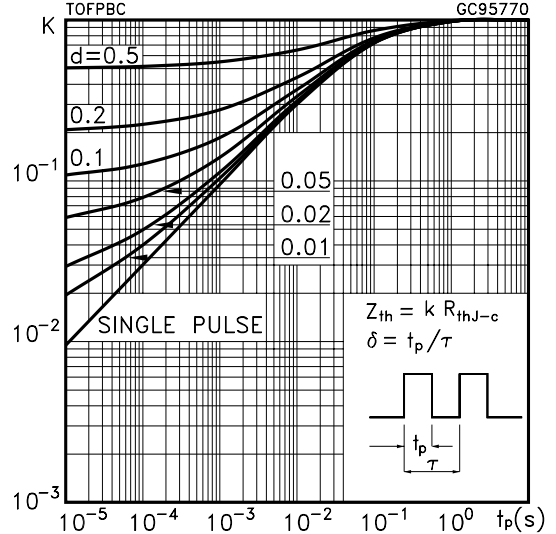


Figure 7: Output Characteristics

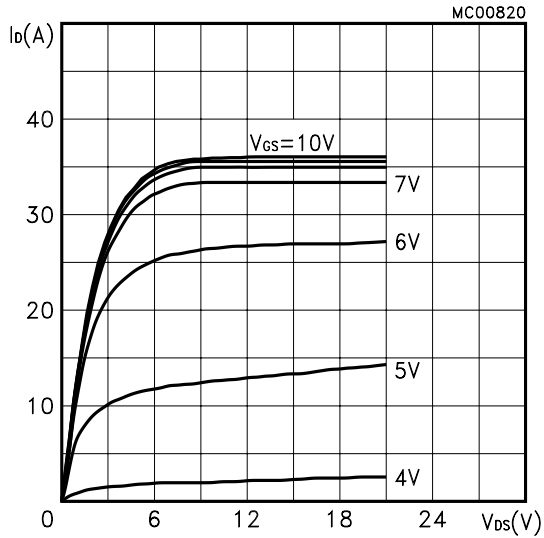


Figure 8: Transfer Characteristics

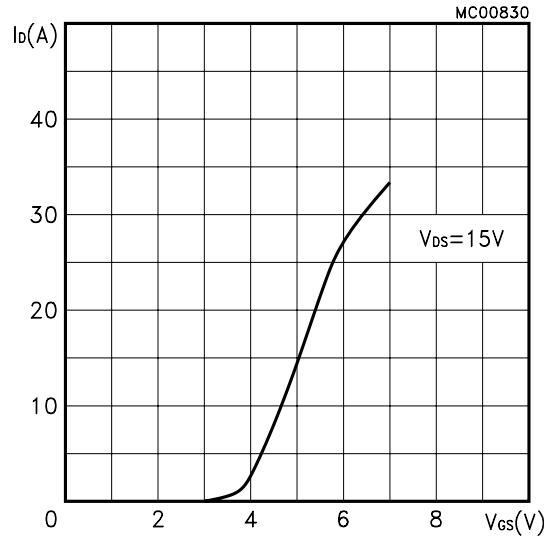


Figure 9: Transconductance

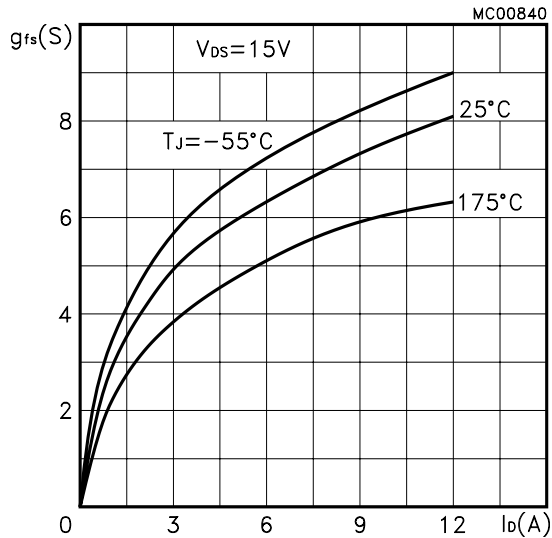


Figure 10: Static Drain-source On Resistance

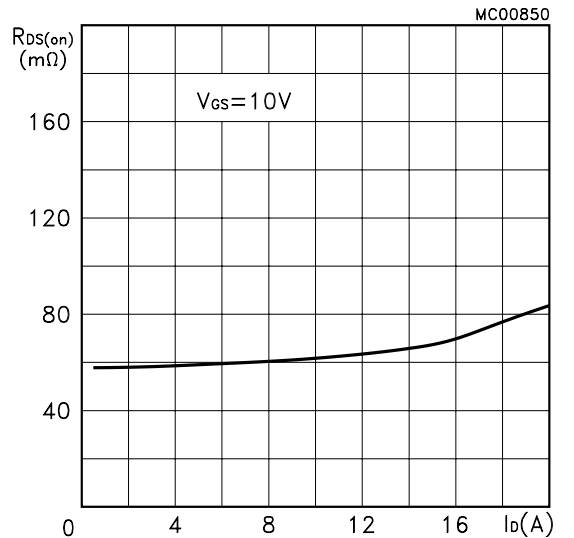


Figure 11: Gate Charge vs Gate-source Voltage

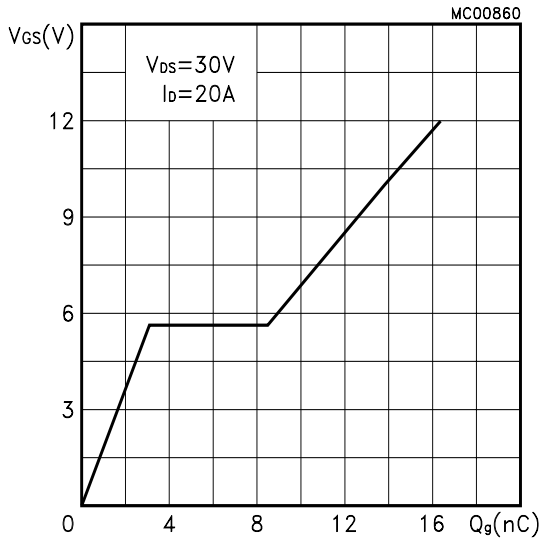


Figure 13: Normalized Gate Threshold Voltage vs Temperature

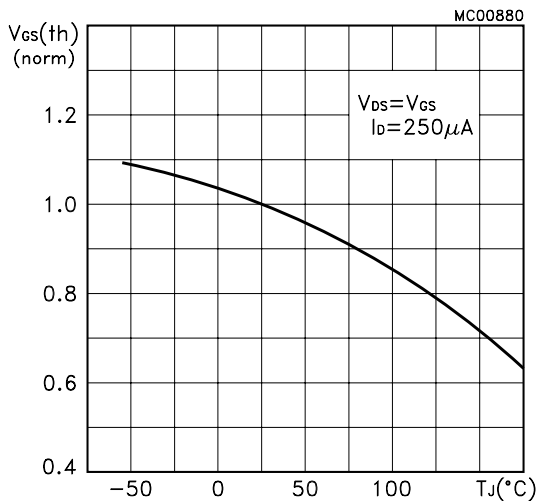


Figure 15: Source-drain Diode Forward Characteristics

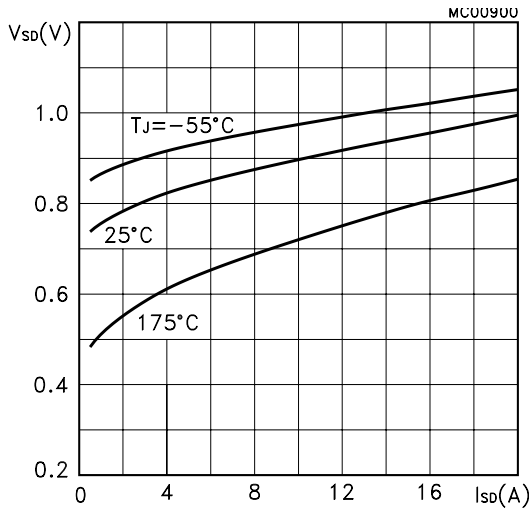


Figure 12: Capacitance Variations

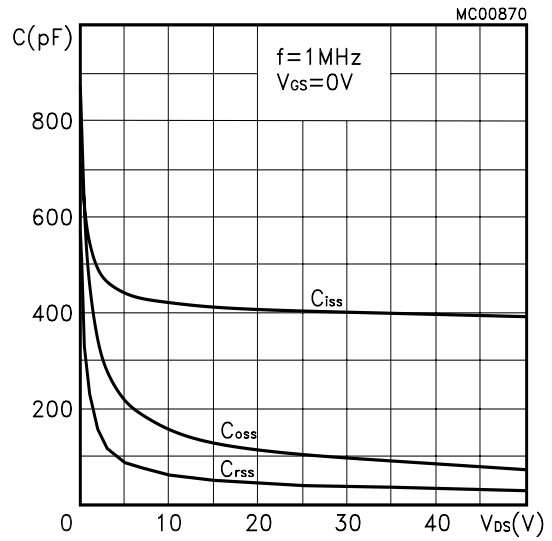


Figure 14: Normalized on Resistance vs Temperature

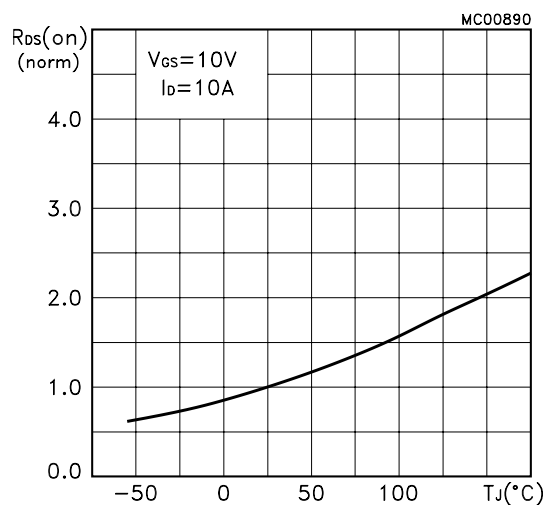


Figure 16: Normalized Breakdown Voltage Temperature

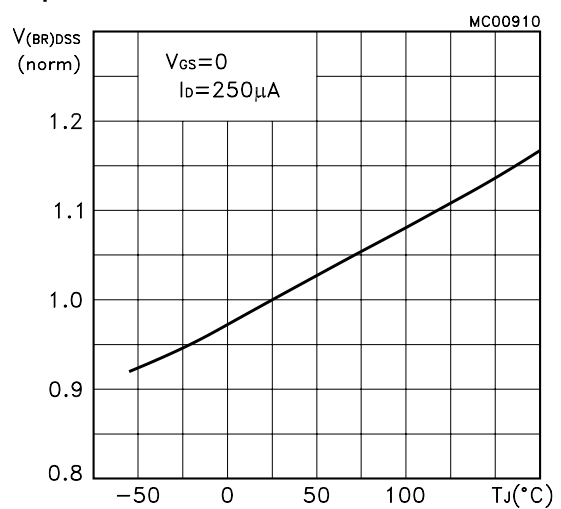


Figure 17: Unclamped Inductive Load Test Circuit

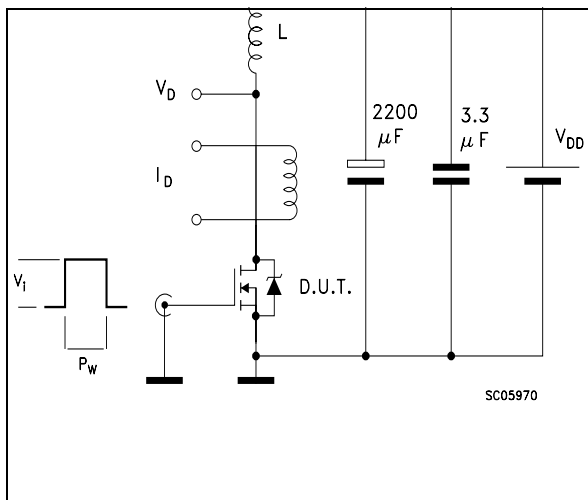


Figure 18: Unclamped Inductive Waveform

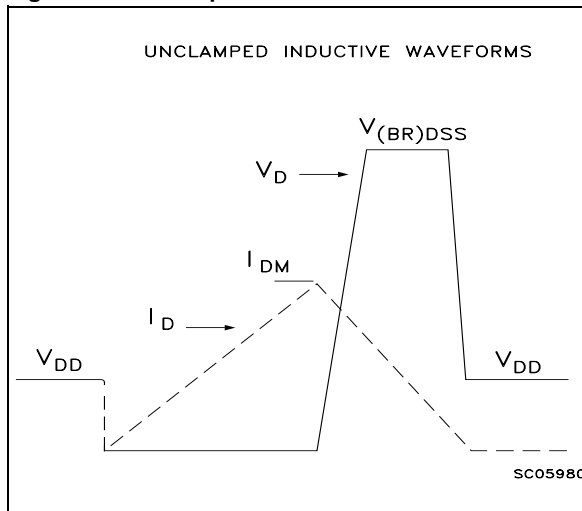


Figure 19: Switching Times Test Circuits For Resistive Load

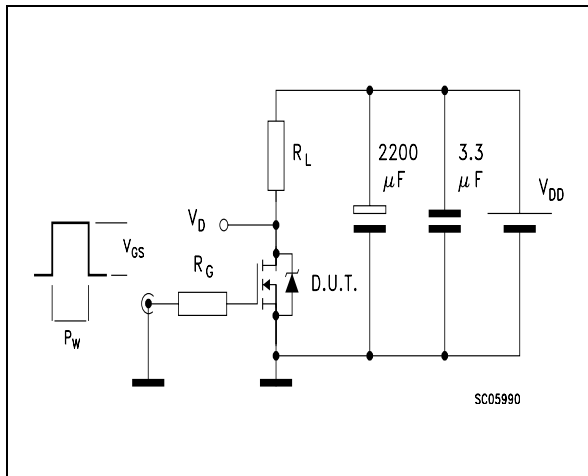


Figure 20: Gate Charge test Circuit

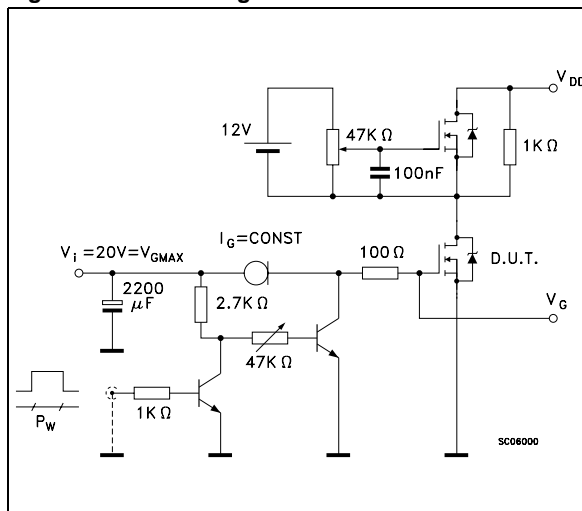
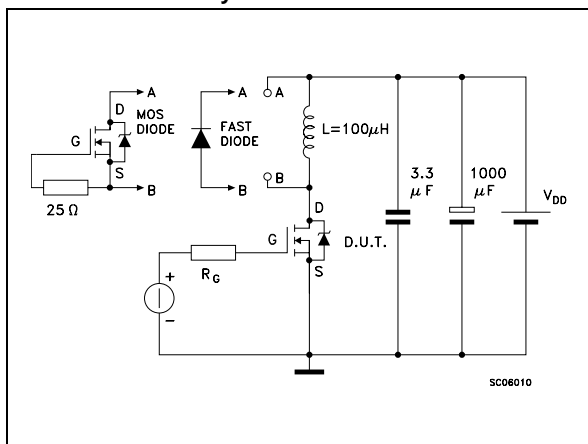
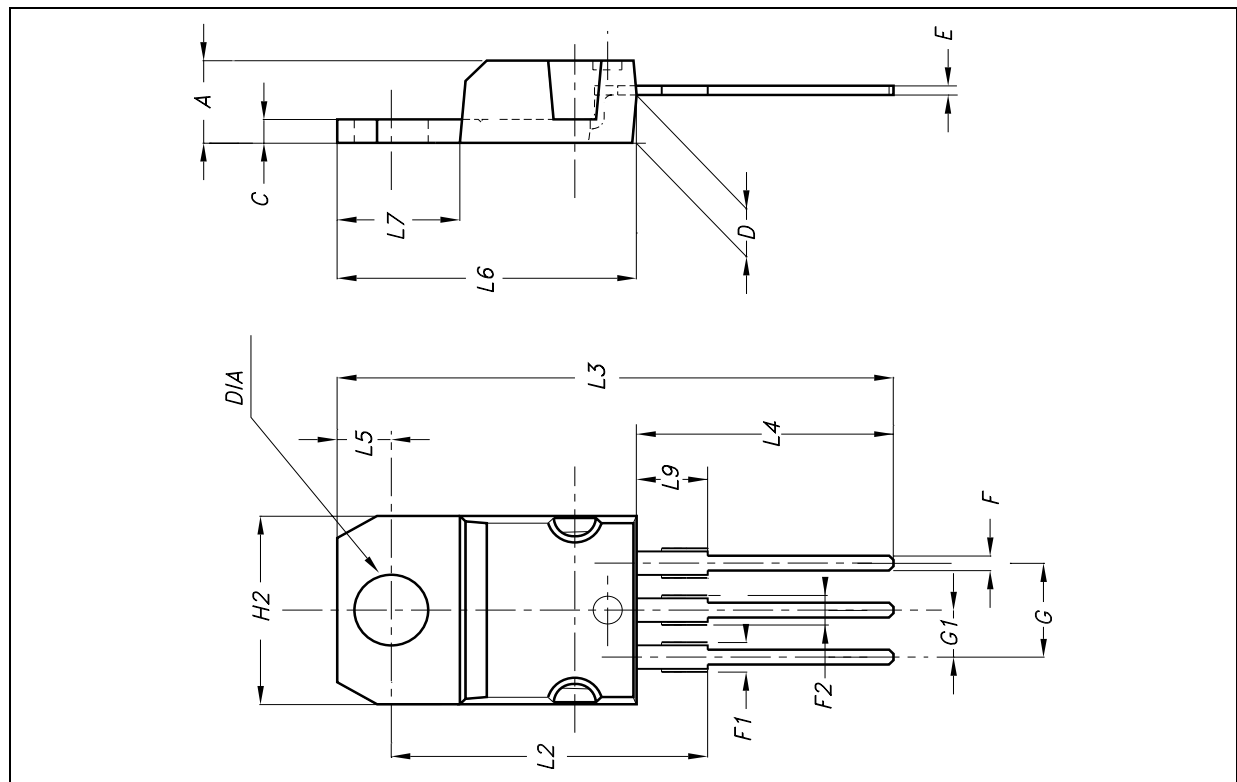


Figure 21: Test Circuit For Inductive Load Switching And Diode Recovery Times



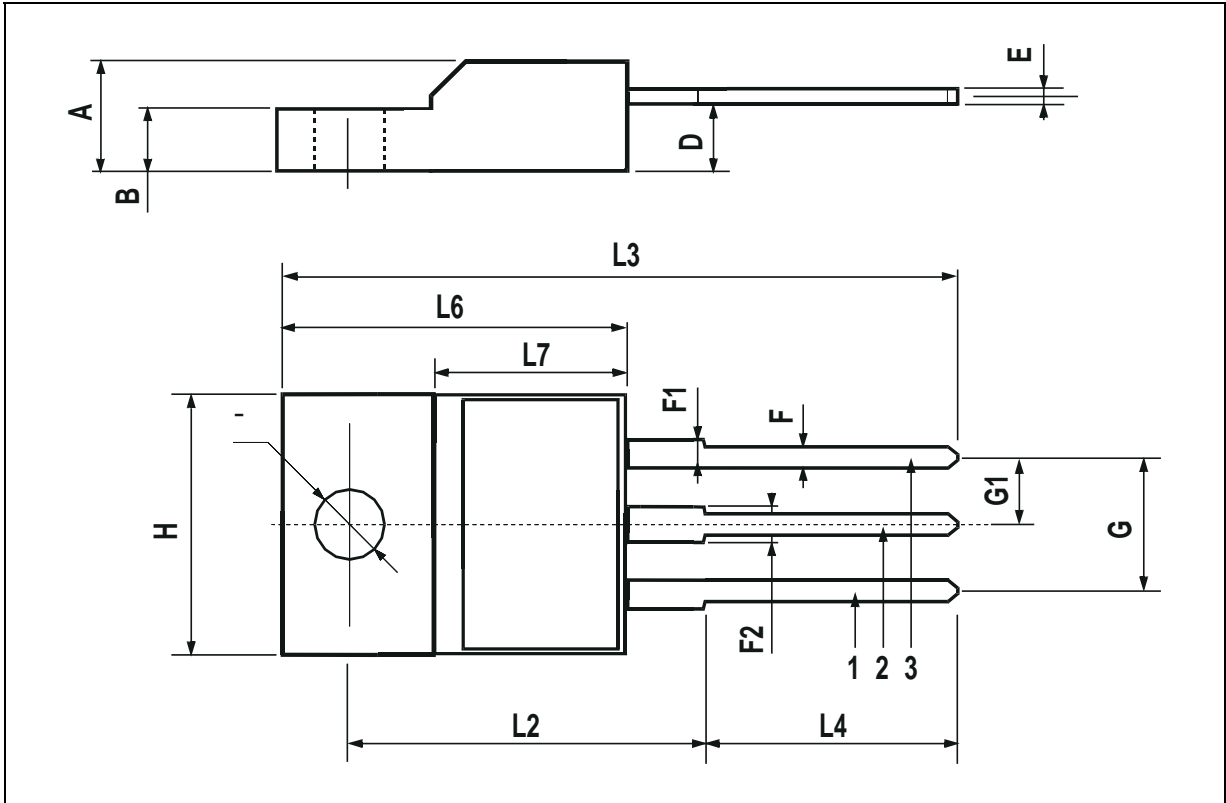
TO-220 MECHANICAL DATA

DIM.	mm.			inch.		
	MIN.	TYP.	MAX.	MIN.	TYP.	TYP.
A	4.4		4.6	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.40		2.70	0.094		0.106
H2	10		10.40	0.393		0.409
L2		16.40			0.645	
L3		28.90			1.137	
L4	13		14	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.20		6.60	0.244		0.260
L9	3.50		3.93	0.137		0.154
DIA	3.75		3.85	0.147		0.151



**TO-220FP MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	0.385		0.417
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126





## STP20NF06 STF20NF06

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**Table 11:Revision History**

Date	Revision	Description of Changes
07-Nov-2004	1.0	FIRST ISSUE

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