



STGF20NB60S

N-CHANNEL 13A - 600V TO-220FP

PowerMESH™ IGBT

Table 1: General Features

TYPE	V _{CES}	V _{CE(sat)} (Max) @ 25°C	I _C @ 100°C
STGF20NB60S	600 V	< 1.7 V	13 A

- LOW ON-VOLTAGE DROP (V_{cesat})
- HIGHT CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "S" identifies a family optimized to achieve minimum on-voltage drop for low frequency to applications (<1kHz).

APPLICATIONS

- LIGHT DIMMER
- STATIC RELAYS
- MOTOR CONTROL

Figure 1: Package

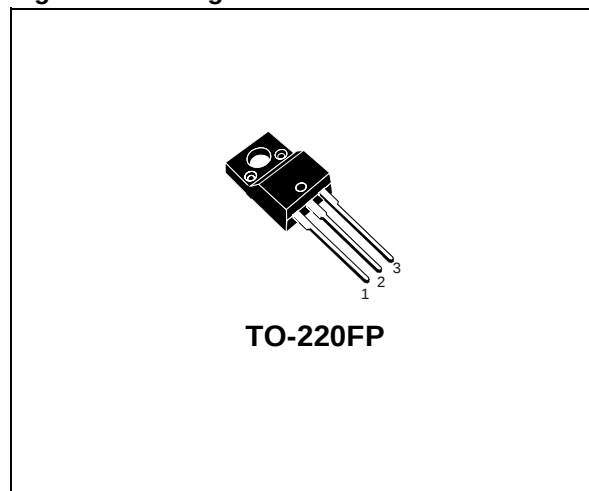


Figure 2: Internal Schematic Diagram

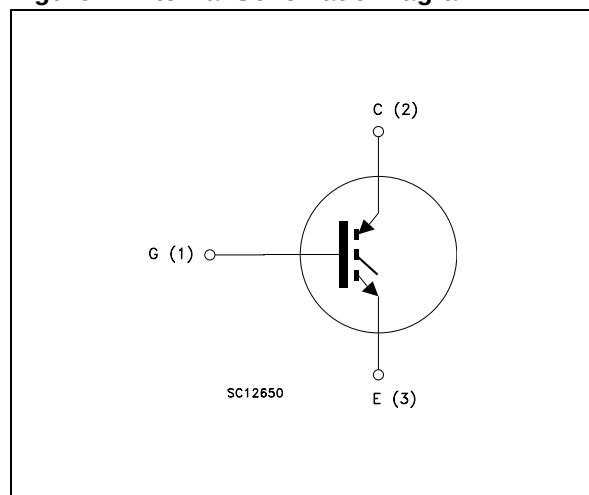


Table 2: Order Code

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGF20NB60S	GF20NB60S	TO-220FP	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage ($V_{GS} = 0$)	600	V
V_{ECR}	Emitter-Collector Voltage	20	V
V_{GE}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current (continuous) at $T_C = 25^\circ\text{C}$ (#)	24	A
I_C	Collector Current (continuous) at $T_C = 100^\circ\text{C}$ (#)	13	A
I_{CM} (■)	Collector Current (pulsed)	70	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	40	W
	Derating Factor	0.32	W/ $^\circ\text{C}$
V_{ISO}	Insulation withstand voltage AC ($t=1\text{sec}$, $T_C=25^\circ\text{C}$)	2500	V
T_{stg}	Storage Temperature	-55 to 150	$^\circ\text{C}$
T_j	Operating Junction Temperature range		

(■) Pulse width limited by safe operating area

Table 4: Thermal Data

		Min.	Typ.	Max.	
$R_{thj-case}$	Thermal Resistance Junction-case			3.15	$^\circ\text{C/W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient			62.5	$^\circ\text{C/W}$
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)		300		$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)**Table 5: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	$I_C = 250\ \mu\text{A}$, $V_{GE} = 0$	600			V
$V_{BR(ECS)}$	Emitter-Collector Breakdown Voltage	$I_C = 1\text{mA}$, $V_{GE} = 0$	20			V
I_{CES}	Collector cut-off Current ($V_{GE} = 0$)	$V_{CE} = \text{Max Rating}$, $T_C = 25^\circ\text{C}$ $V_{CE} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$			10 100	μA μA
I_{GES}	Gate-Emitter Leakage Current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{V}$, $V_{CE} = 0$			± 100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$, $I_C = 250\ \mu\text{A}$	2.5		5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{V}$, $I_C = 20\text{A}$, $T_j = 25^\circ\text{C}$ $V_{GE} = 15\text{V}$, $I_C = 20\text{A}$, $T_j = 150^\circ\text{C}$		1.25 1.2	1.7	V V

(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

ELECTRICAL CHARACTERISTICS (CONTINUED)**Table 6: Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	$V_{CE} = 10\text{ V}$, $I_C = 8\text{ A}$		20		S
C_{ies}	Input Capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$		1820		pF
C_{oes}	Output Capacitance			167		pF
C_{res}	Reverse Transfer Capacitance			27		pF
Q_g Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 19)		83 10 27	115	nC nC nC
I_{CL}	Turn-off SOA minimum current	$V_{clamp} = 480\text{ V}$, $T_j = 125^\circ\text{C}$ $R_G = 100\ \Omega$	80			A

(1) Pulsed: Pulse duration= 300 μs , duty cycle 1.5%**Table 7: Switching On**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Current Slope	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$ (see Figure 17)		92 70 340		ns ns A/ μs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on Delay Time Current Rise Time Turn-on Delay Time	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125^\circ\text{C}$ (see Figure 17)		80 73 320		ns ns A/ μs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_c $t_r(V_{off})$ $t_{d(off)}$ t_f	Cross-over Time Off Voltage Rise Time Turn-off Delay Time Current Fall Time	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$, $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$ $T_j = 25^\circ\text{C}$ (see Figure 17)		1.6 0.78 1.1 0.79		μs μs μs μs
t_c $t_r(V_{off})$ $t_{d(off)}$ t_f	Cross-over Time Off Voltage Rise Time Turn-off Delay Time Current Fall Time			2.4 1.1 2.4 1.2		μs μs μs μs

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
E_{on} (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$, (see Figure 18)		0.84 7.4 8.24		mJ mJ mJ
E_{on} (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	$V_{CC} = 480\text{ V}$, $I_C = 20\text{ A}$ $R_G = 100\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125^\circ\text{C}$ (see Figure 18)		0.86 11.5 12.4		mJ mJ mJ

(2) E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode.

(3) Turn-off losses include also the tail of the collector current.

Figure 3: Output Characteristics

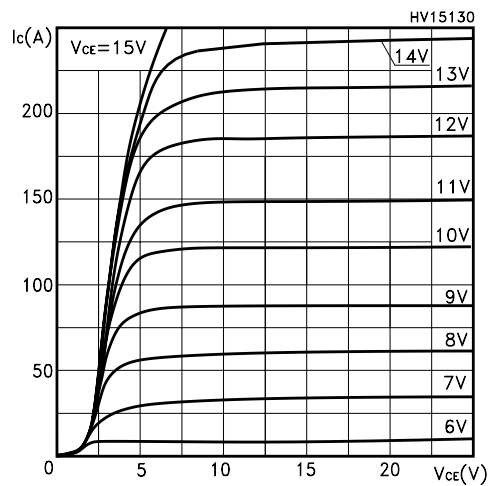


Figure 4: Transconductance

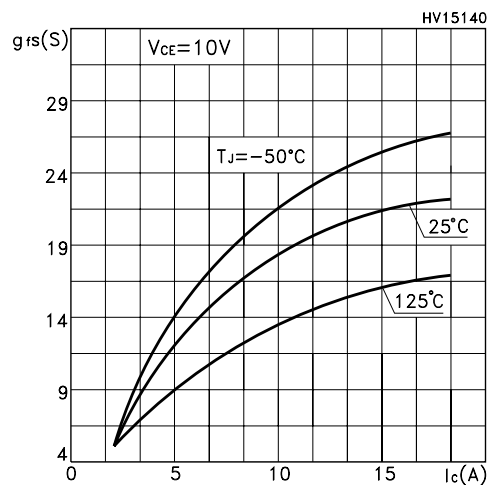


Figure 5: Collector-Emitter On Voltage vs Collector Current

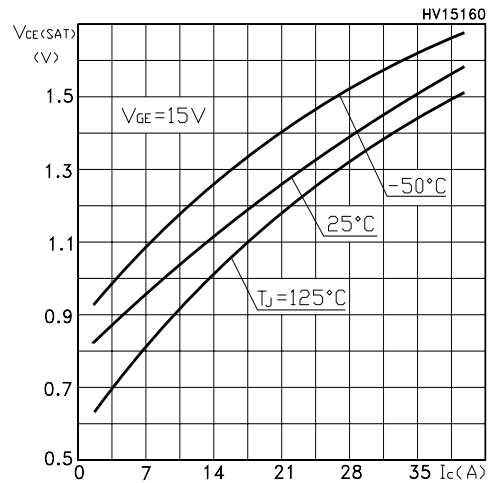


Figure 6: Transfer Characteristics

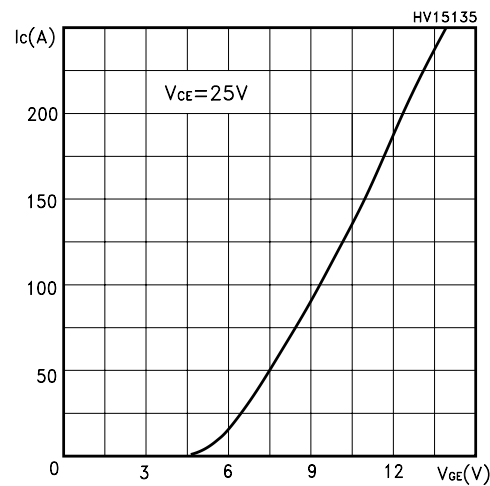


Figure 7: Normalized Collector-Emitter On Voltage vs Temperature

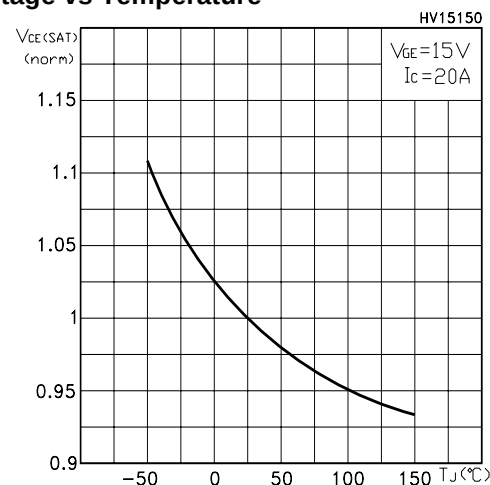


Figure 8: Gate Threshold vs Temperature

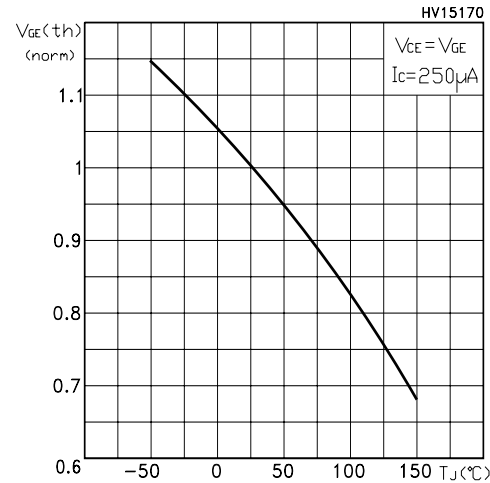


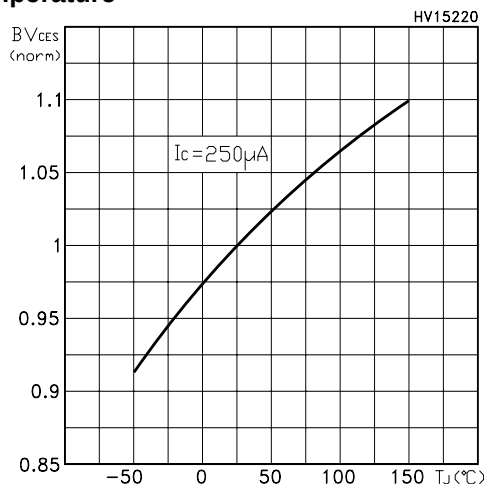
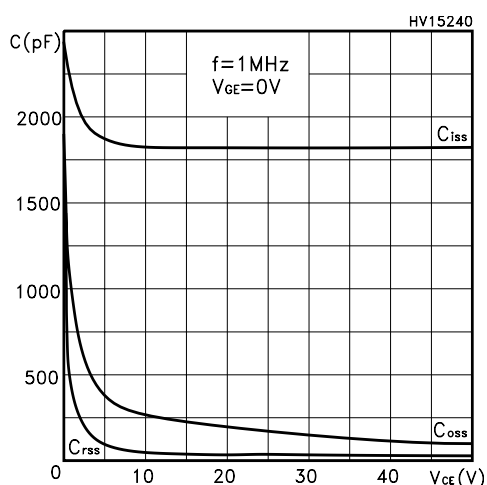
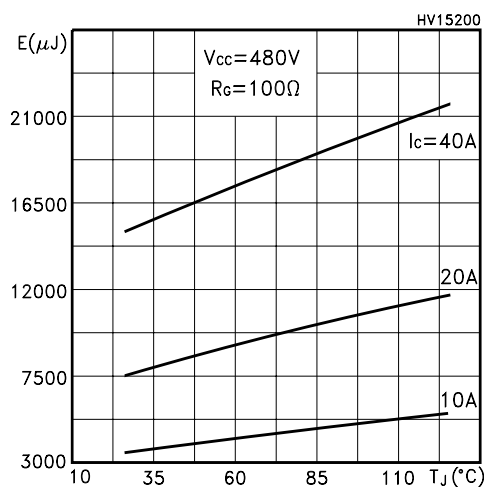
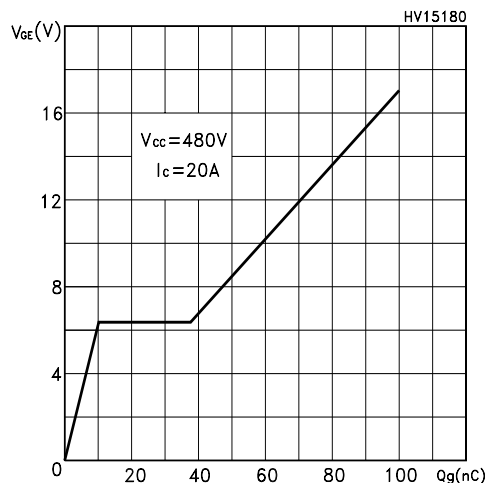
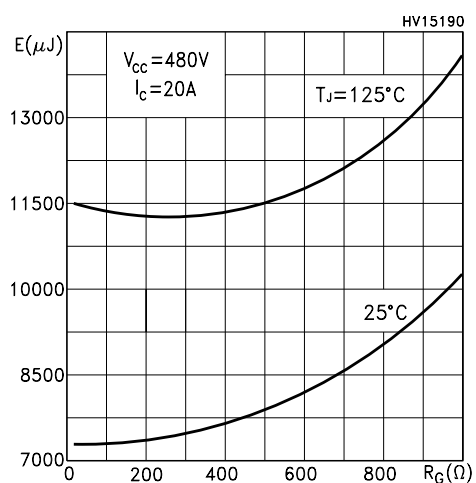
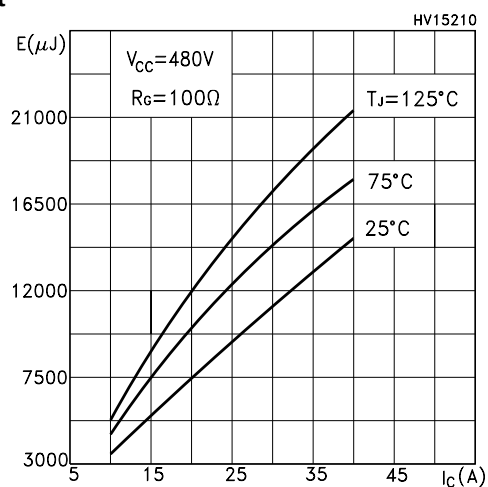
Figure 9: Normalized Breakdown Voltage vs Temperature**Figure 10: Capacitance Variations****Figure 11: Switching Losses vs Temperature****Figure 12: Gate Charge vs Gate-Emitter Voltage****Figure 13: Switching Losses vs Gate Charge****Figure 14: Switching Losses vs Collector Current**

Figure 15: Thermal Impedance

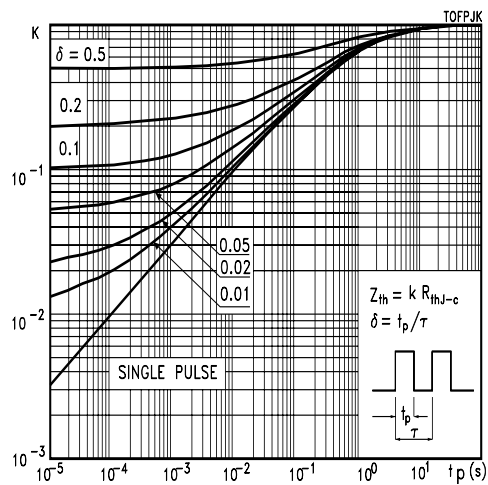


Figure 16: Collector-Emitter Diode Characteristics

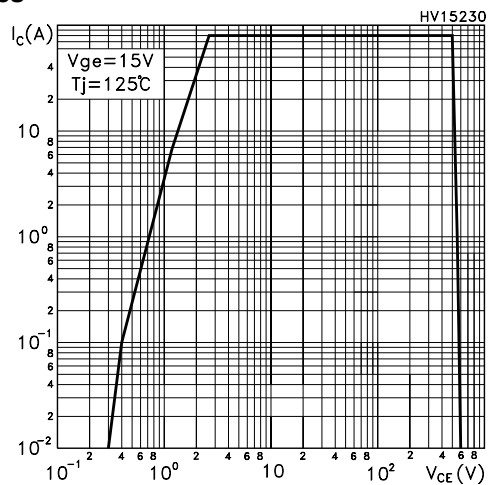


Figure 17: Test Circuit for Inductive Load Switching

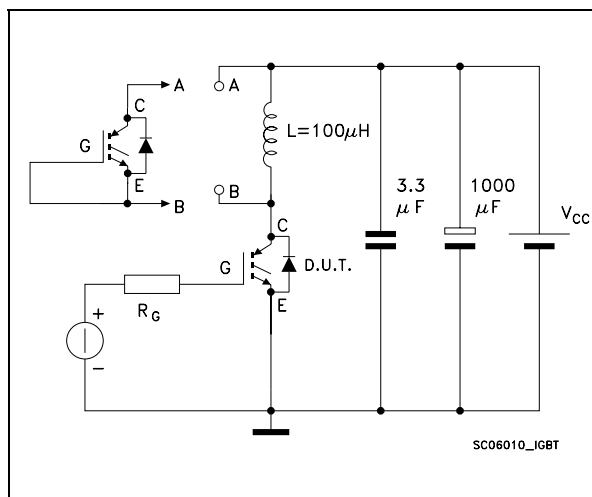


Figure 18: Switching Waveforms

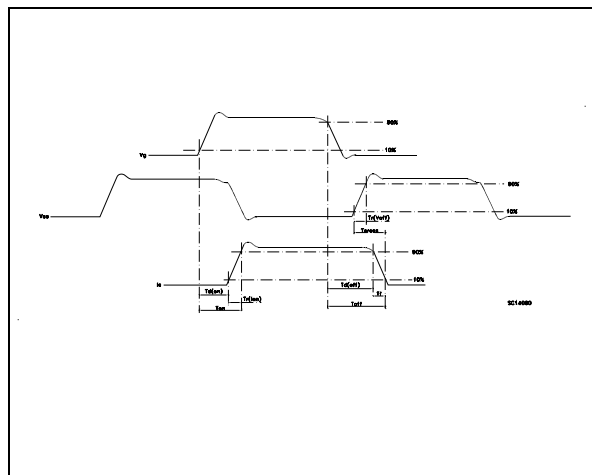
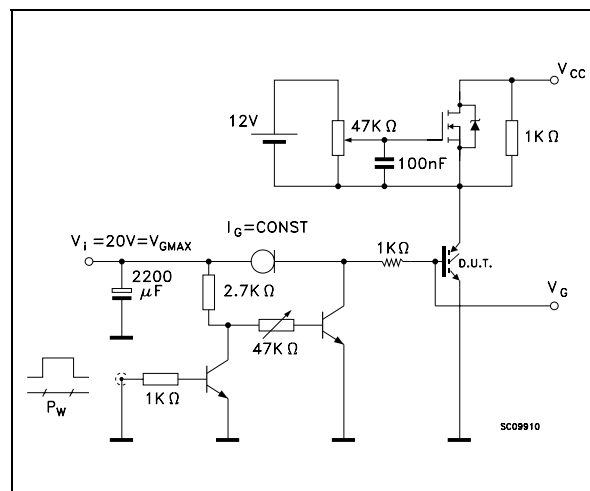


Figure 19: Gate Charge Test Circuit



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	.0385		0.417
L5	2.9		3.6	0.114		0.141
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

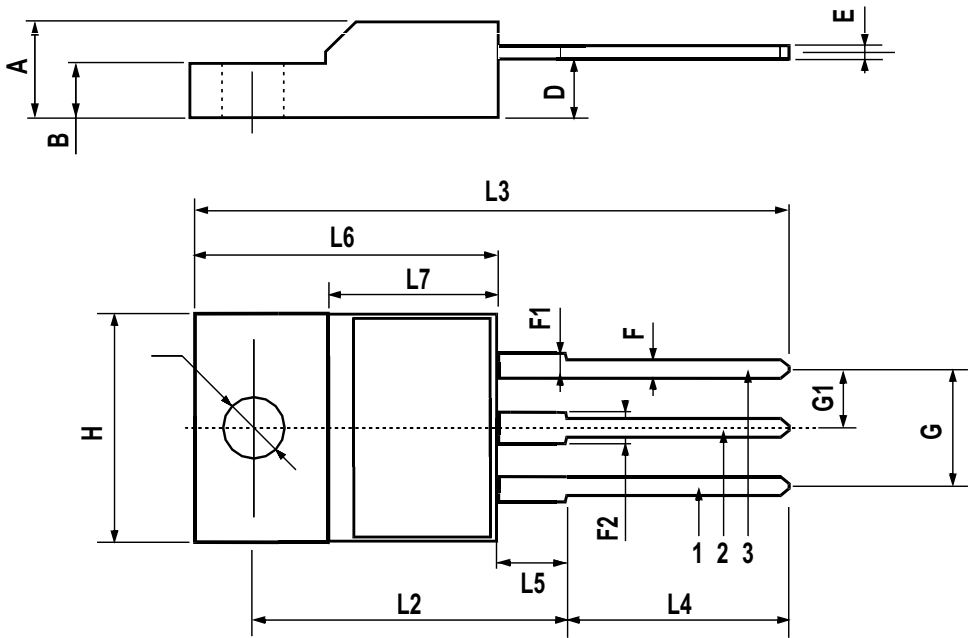


Table 10: Revision History

Date	Revision	Description of Changes
17-Dec-2004	2	New template, no content change

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