STGF20NB60S

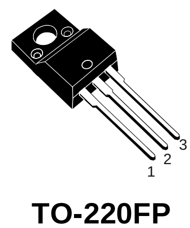
N-CHANNEL 13A - 600V TO-220FP PowerMESH™ IGBT

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)

Figure 1: Package



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 2: Internal Schematic Diagram

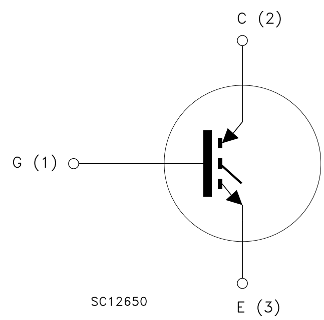


Table 2: Order Code

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

Rev. 3

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°C (#)	24	A
I_C	Collector Current (continuous) at T_C = 100°C (#)	13	A
I_{CM} (▪)	Collector Current (pulsed)	70	A
P_{TOT}	Total Dissipation at T_C = 25°C	40	W
	Derating Factor	0.32	W/°C
V_{ISO}	Insulation withstand voltage AC (t=1sec, Tc=25°C)	2500	V
T_{stg}	Storage Temperature	–55 to 150	°C
T_j	Operating Junction Temperature range		

(▪) Pulse width limited by safe operating area

Table 4: Thermal Data

		Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case			3.15	°C/W
Rthj-amb	Thermal Resistance Junction-ambient			62.5	°C/W
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)		300		°C

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°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 µA, V_{GE} = 0	600			V
I_{CES}	Collector cut-off Current (V_{GE} = 0)	V_{CE} = Max Rating, T_C = 25 °C V_{CE} = Max Rating, T_C = 125 °C			10 100	µA µA
I_{GES}	Gate-Emitter Leakage Current (V_{CE} = 0)	V_{GE} = ± 20V , V_{CE} = 0			±100	nA
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 250 µA	2.5		5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15V, I_C = 20 A, Tj= 25°C V_{GE} = 15V, I_C = 20A, Tj=150°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 V , I_C = 8 A		20		S
C_{ies} C_{oes} C_{res}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{CE} = 25 V, f= 1 MHz, V_{GE} = 0		1820 167 27		pF pF pF
Q_g Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	V_{CC} = 480 V, I_C = 20 A, V_{GE} = 15 V (see Figure 19)		83 10 27	115	nC nC nC
I_{CL}	Turn-off SOA minimum current	V_{clamp} = 480 V , Tj = 125°C R_G = 100 Ω	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 V, I_C = 20 A R_G= 100 Ω, V_{GE}= 15V (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 V, I_C = 20 A R_G= 100 Ω, V_{GE}= 15V, Tj= 125°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 V, I_C = 20 A, R_G = 100 Ω , V_{GE} = 15 V T_J = 25 °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	V_{cc} = 480 V, I_C = 20 A, R_G = 100 Ω , V_{GE} = 15 V Tj = 125 °C (see Figure 17)		2.4 1.1 2.4 1.2		µs µs µs µs

Table 9: Switching Energy

Symbol	Parameterr	Test Conditions	Min.	Typ.	Max	Unit
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	V_{CC} = 480 V, I_C = 20 A R_G= 100 Ω, V_{GE}= 15V, (see Figure 18)		0.84 7.4 8.24		mJ mJ mJ
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	V_{CC} = 480 V, I_C = 20 A R_G= 100 Ω, V_{GE}=15V,Tj=125°C (see Figure 18)		0.86 11.5 12.4		mJ mJ mJ

(2) Eon 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

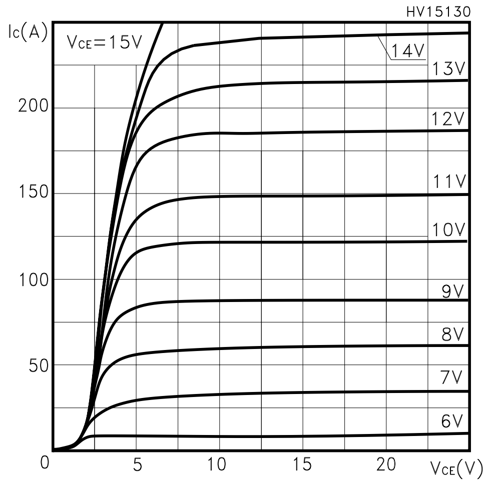


Figure 6: Transfer Characteristics

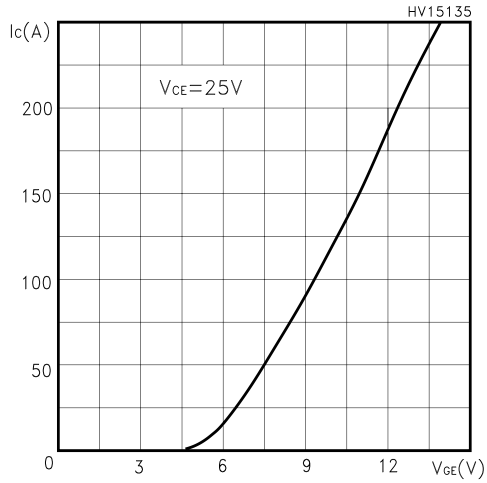


Figure 4: Transconductance

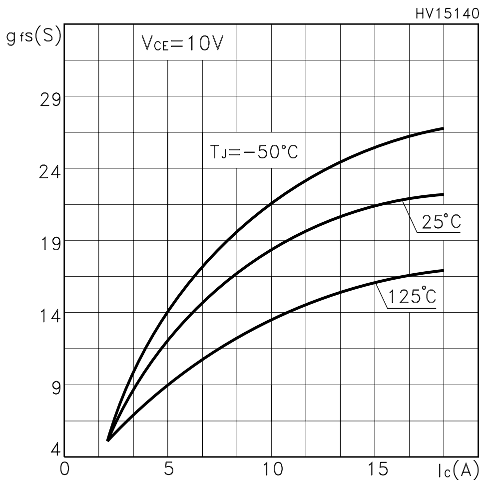


Figure 7: Normalized Collector-Emitter On Voltage vs Temperature

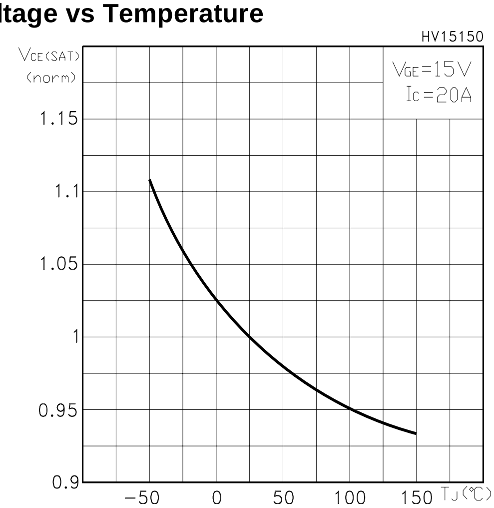


Figure 5: Collector-Emitter On Voltage vs Collector Current

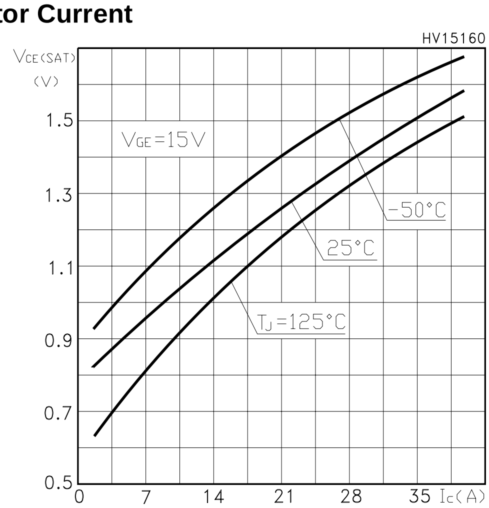


Figure 8: Gate Threshold vs Temperature

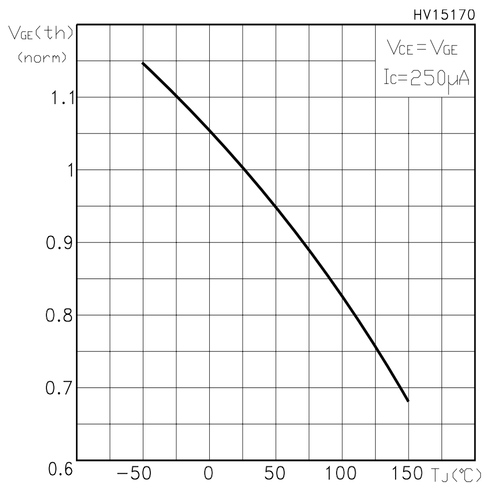


Figure 9: Normalized Breakdown Voltage vs Temperature

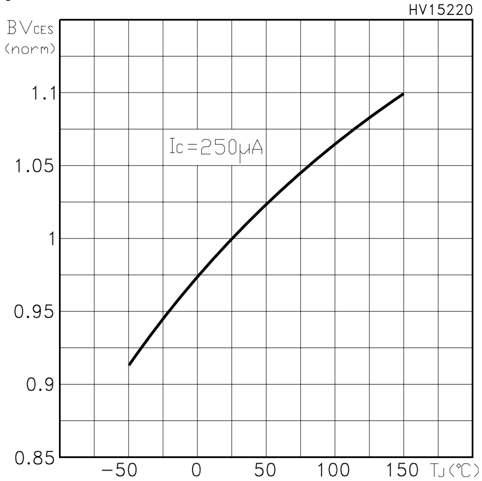


Figure 12: Gate Charge vs Gate-Emitter Voltage

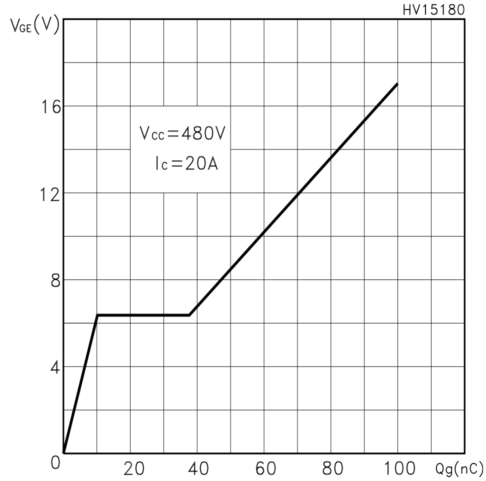


Figure 10: Capacitance Variations

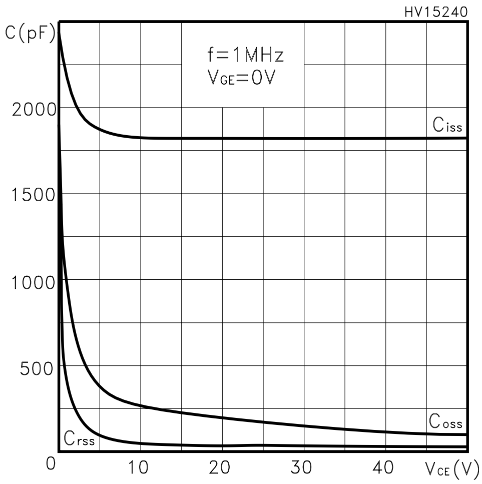


Figure 13: Switching Losses vs Gate Charge

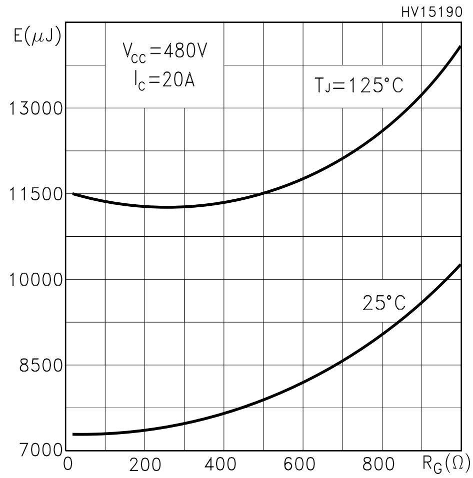


Figure 11: Switching Losses vs Temperature

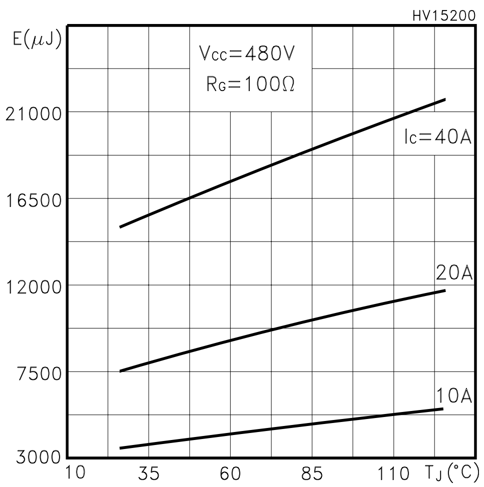


Figure 14: Switching Losses vs Collector Current

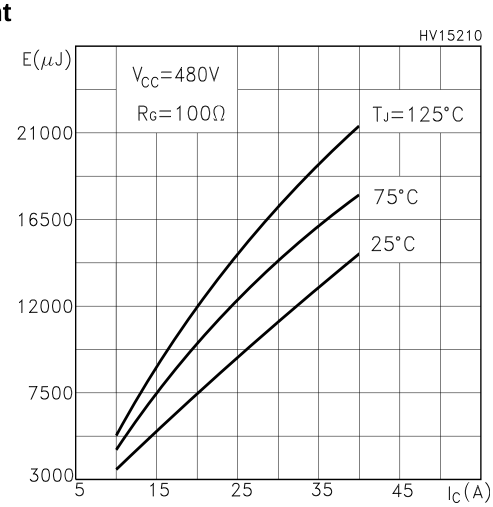


Figure 15: Thermal Impedance

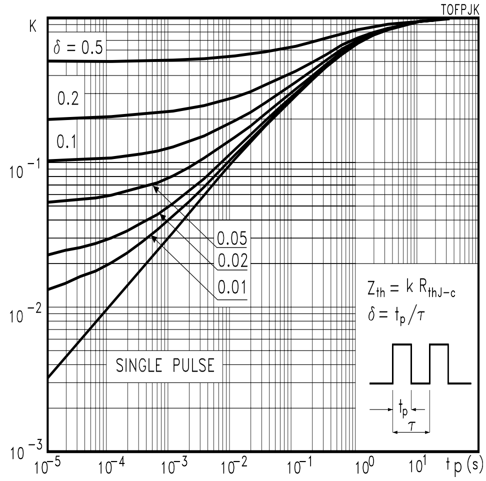


Figure 16: Collector-Emitter Diode Characteristics

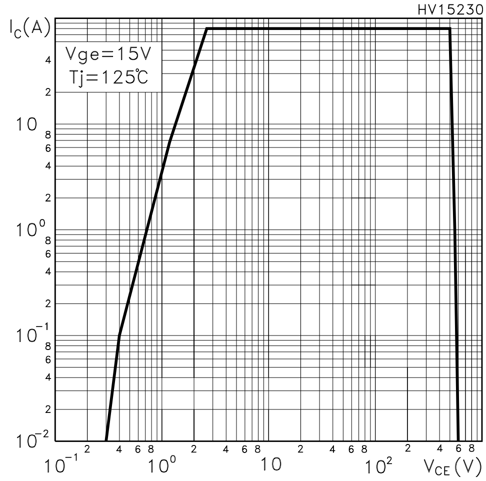


Figure 17: Test Circuit for Inductive Load Switching

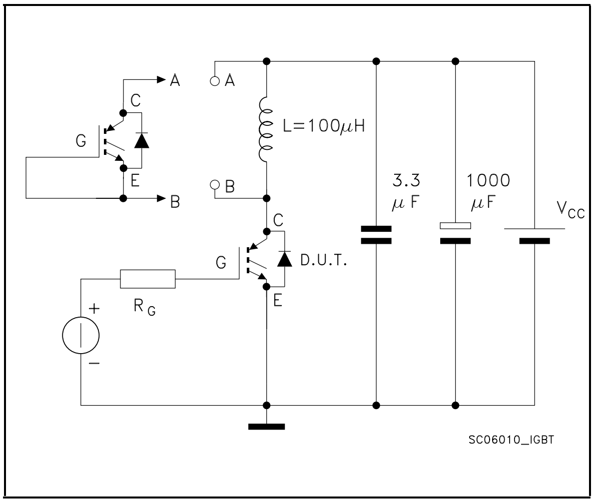


Figure 18: Switching Waveforms

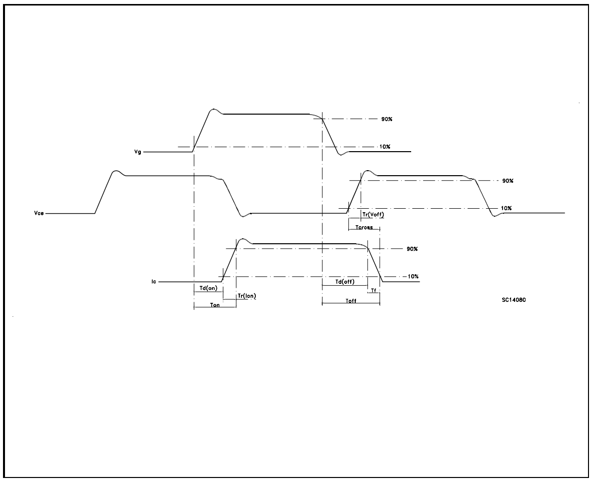
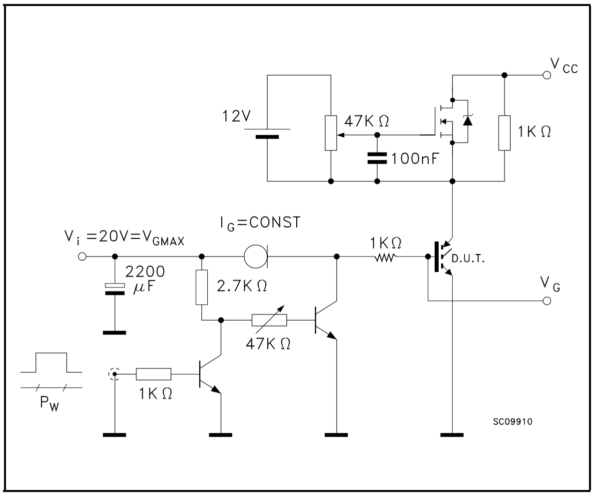


Figure 19: Gate Charge Test Circuit



In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

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

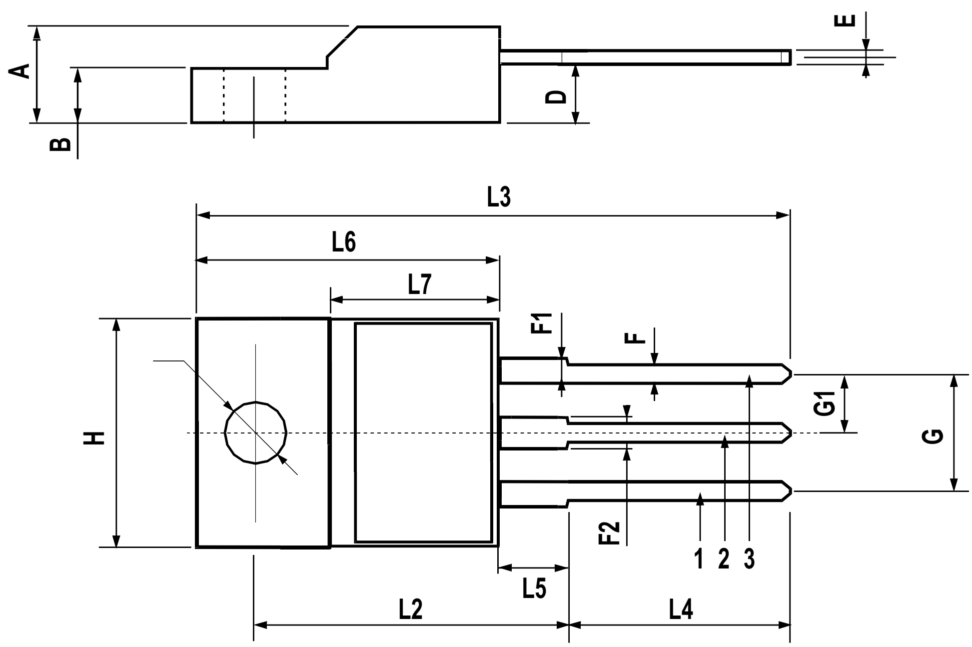


Table 10: Revision History

Date	Revision	Description of Changes
17-Dec-2004	2	New template, no content change
05-Aug-2005	3	Some values changed in table 6