STGF20NB60S

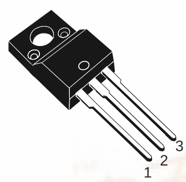
N-CHANNEL 13A - 600V TO-220FP PowerMESH™ IGBT

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

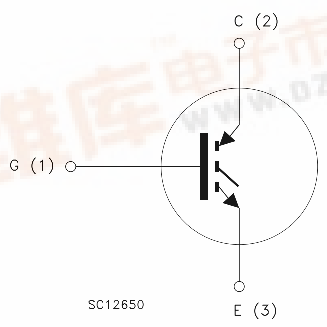


TO-220FP

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).

Figure 2: Internal Schematic Diagram



APPLICATIONS

- LIGHT DIMMER
- STATIC RELAYS
- MOTOR CONTROL

Table 2: Order Code

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

Rev. 2

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
$V_{BR(ECS)}$	Emitter-Collector Breakdown Voltage	I_C = 1mA, V_{GE} = 0	20			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

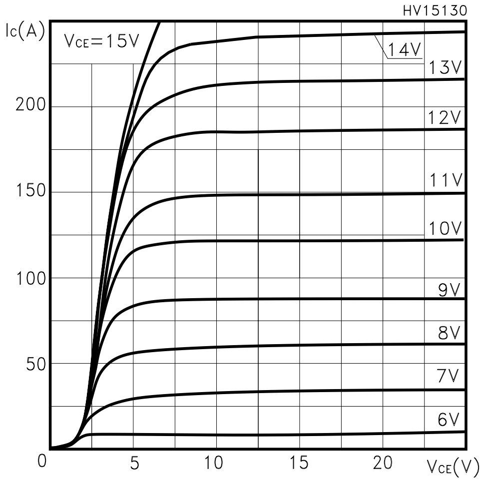


Figure 6: Transfer Characteristics

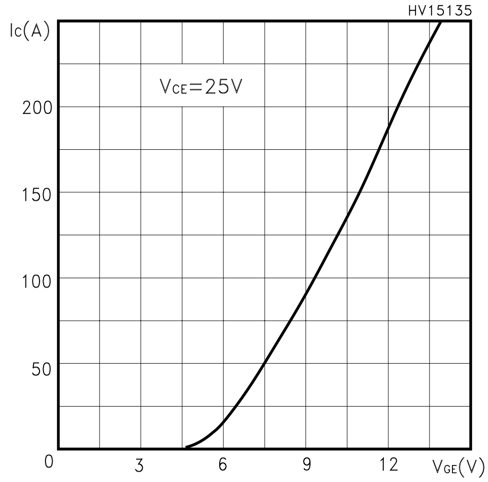


Figure 4: Transconductance

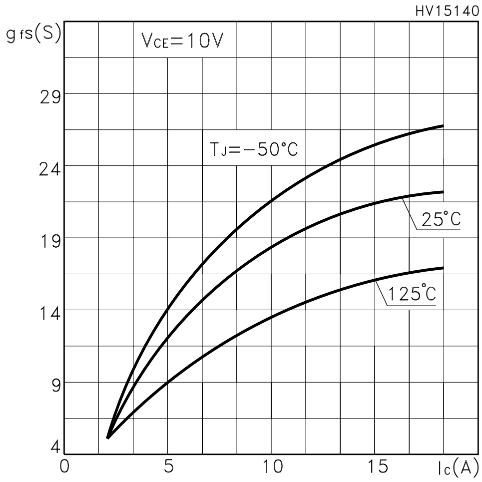


Figure 7: Normalized Collector-Emitter On Voltage vs Temperature

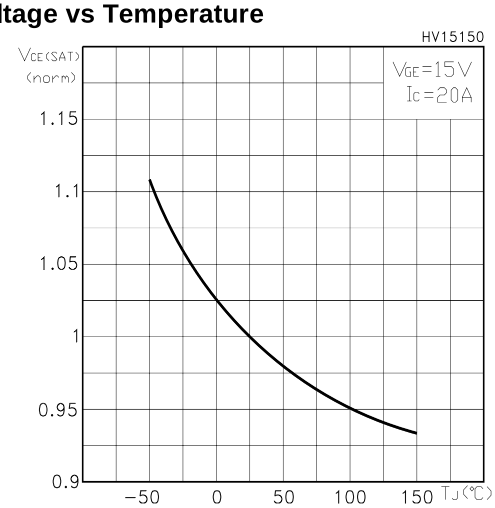


Figure 5: Collector-Emitter On Voltage vs Collector Current

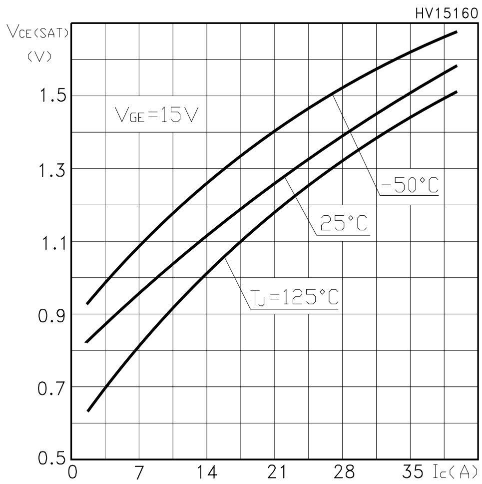


Figure 8: Gate Threshold vs Temperature

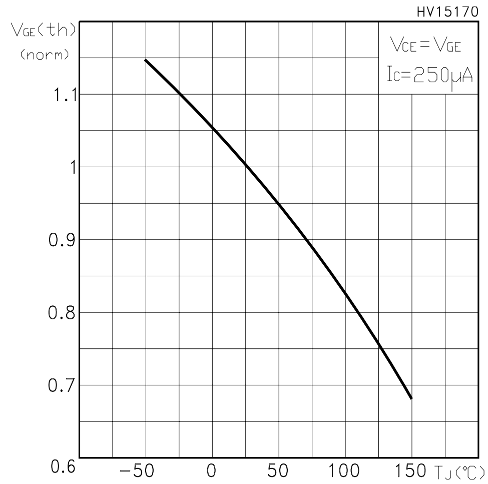


Figure 9: Normalized Breakdown Voltage vs Temperature

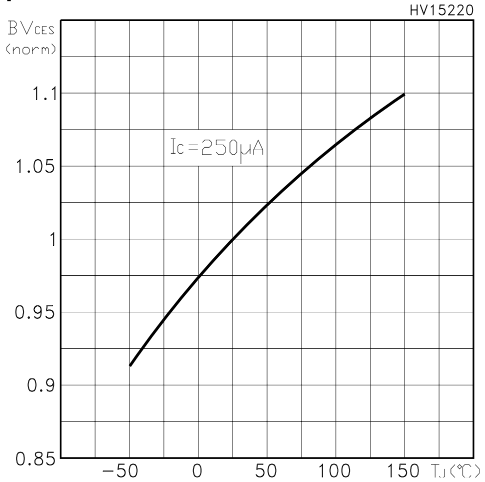


Figure 12: Gate Charge vs Gate-Emitter Voltage

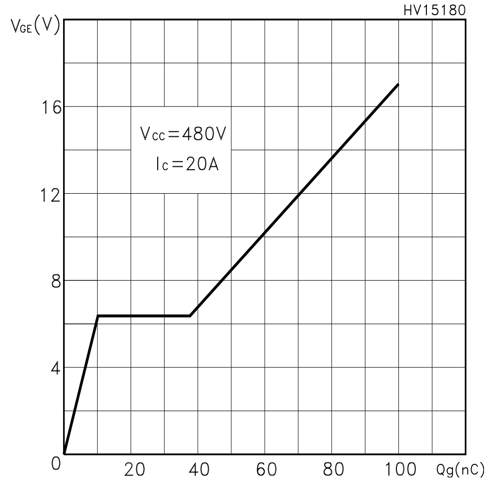


Figure 10: Capacitance Variations

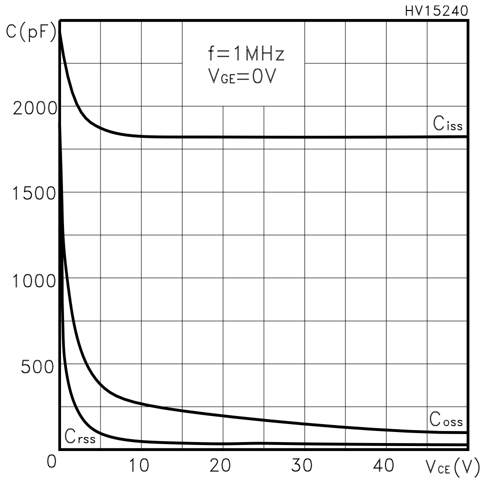


Figure 13: Switching Losses vs Gate Charge

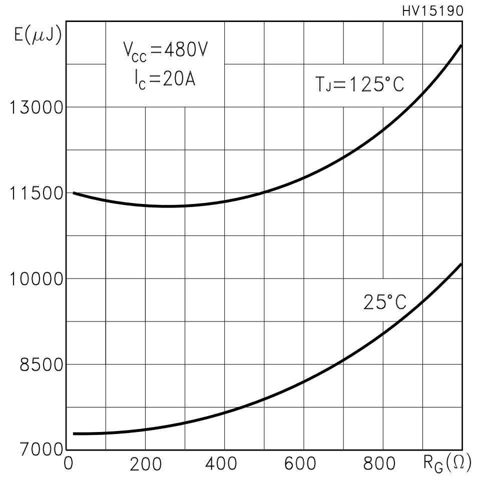


Figure 11: Switching Losses vs Temperature

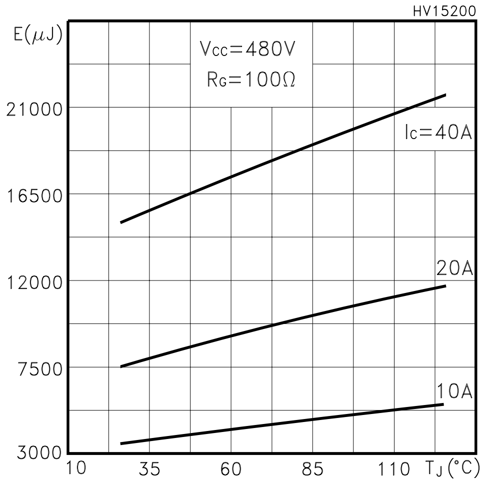


Figure 14: Switching Losses vs Collector Current

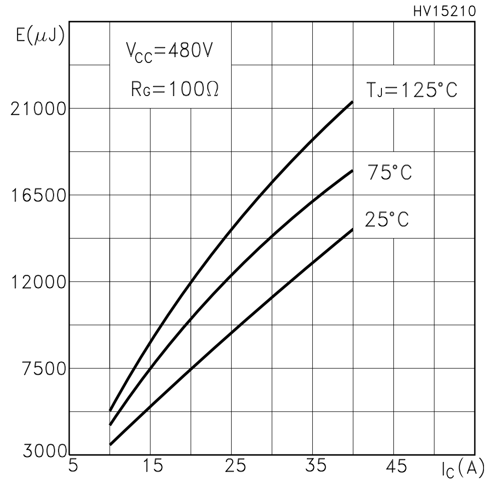


Figure 15: Thermal Impedance

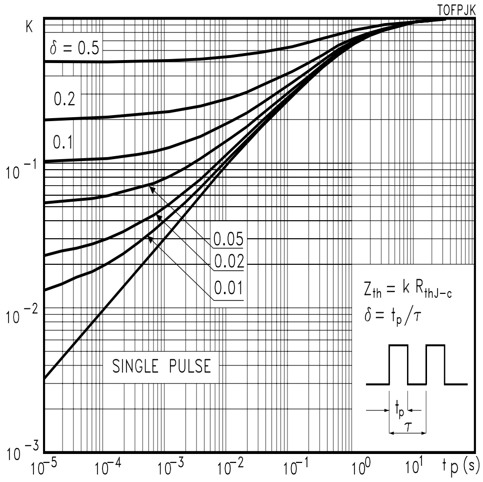


Figure 16: Collector-Emitter Diode Characteristics

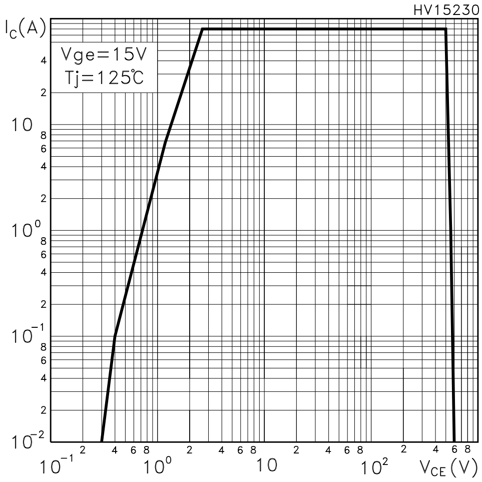


Figure 17: Test Circuit for Inductive Load Switching

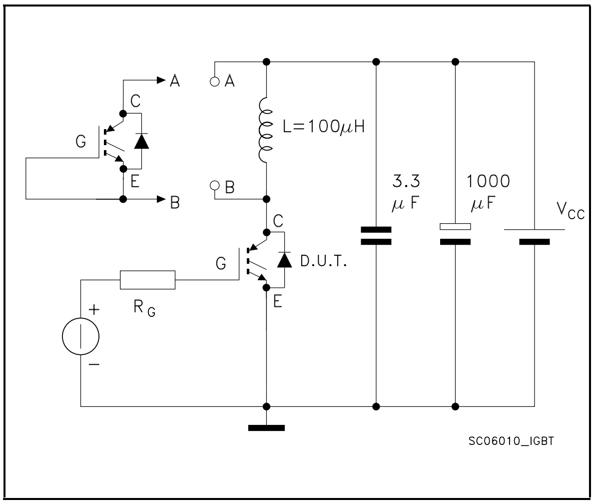


Figure 18: Switching Waveforms

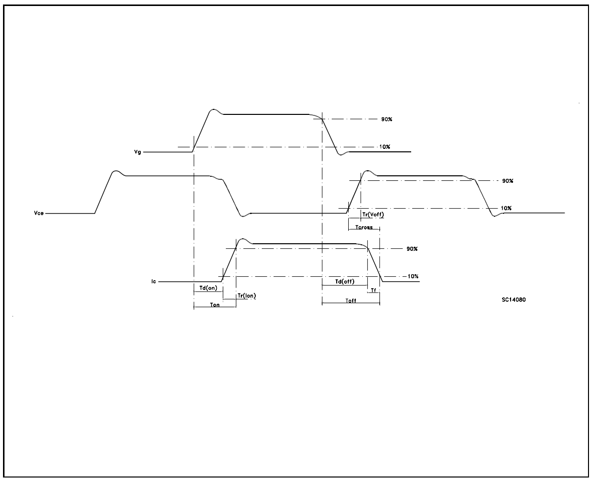
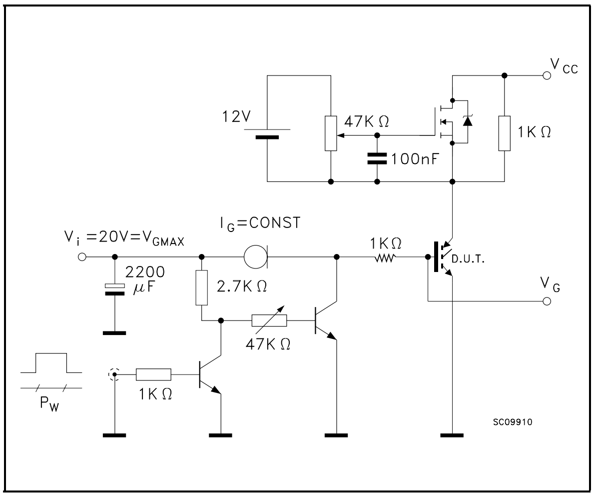


Figure 19: Gate Charge Test Circuit



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

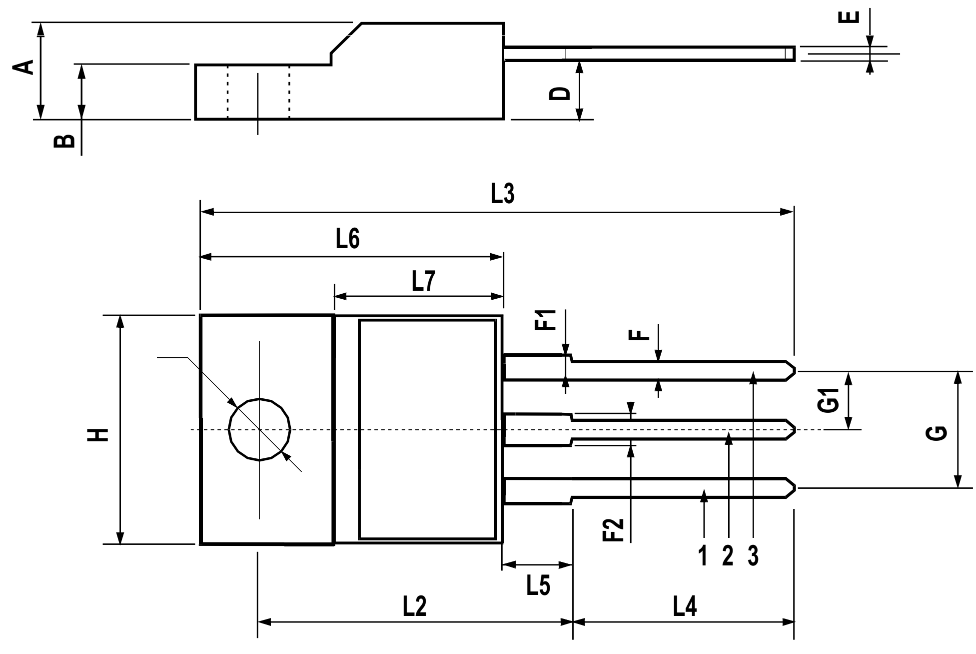


Table 10: Revision History

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