STGB10HF60KD, STGD10HF60KD
STGF10HF60KD, STGP10HF60KD

10 A - 600 V - short-circuit rugged IGBT

Preliminary data

Features

■ Low on-voltage drop ($V_{CE(sat)}$)

■ Operating junction temperature up to 175 °C

■ Low C_{res} / C_{ies} ratio (no cross conduction susceptibility)

■ Tight parameter distribution

■ Ultrafast soft-recovery antiparallel diode

■ Short-circuit rugged

Applications

■ Motor drives

■ High frequency inverters

■ SMPS and PFC in both hard switch and resonant topologies

Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.


TO-220FP   TO-220

DPAK   D²PAK
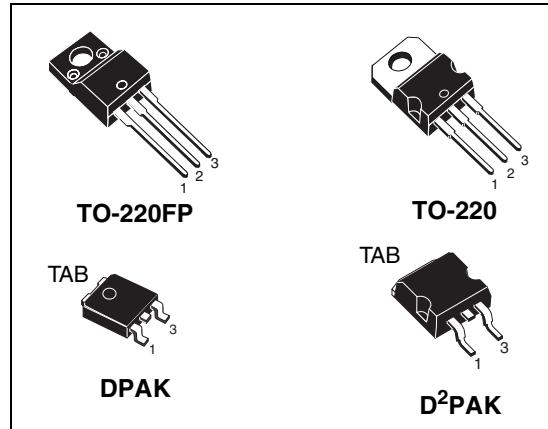
Figure 1.   Internal schematic diagram

C (2 or TAB)

G (1)

E (3)

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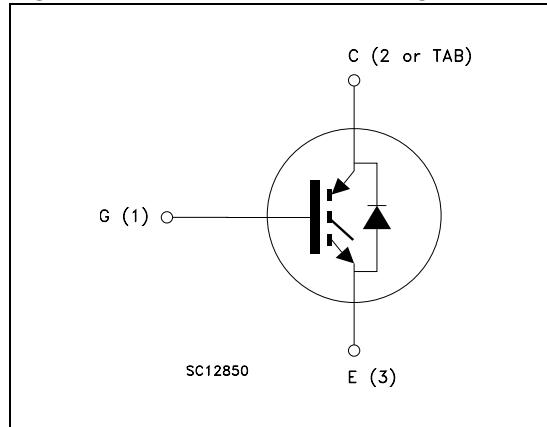
Table 1.   Device summary

Order codes	Marking	Package	Packaging
STGB10HF60KDT4	GB10HF60KD	D²PAK	Tape and reel
STGD10HF60KDT4	GD10HF60KD	DPAK	Tube
STGF10HF60KD	GF10HF60KD	TO-220FP	Tube
STGP10HF60KD	GP10HF60KD	TO-220	Tube

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Contents

1   Electrical ratings

Table 2.   Absolute maximum ratings

Symbol	Parameter	Value			Unit
		D²PAK TO-220	DPAK	TO-220FP	
V_{CES}	Collector-emitter voltage ($V_{GE} = 0$)	600			V
I_C[1]	Collector current (continuous) at T_C = 25 °C	20		9	A
I_C[1]	Collector current (continuous) at T_C = 100 °C	10		6	A
I_{CL} [2]	Turn-off latching current	TBD			A
I_{CP} [3]	Pulsed collector current	TBD			A
V_{GE}	Gate-emitter voltage	±20			V
I_F	Diode RMS forward current at T_C = 25 °C	10			A
I_{FSM}	Surge non repetitive forward current t_p = 10 ms sinusoidal	20			A
V_{ISO}	Isolations withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T_C = 25 °C)	-		2500	V
P_{TOT}	Total dissipation at T_C = 25 °C	80		30	W
t_{scw}	Short-circuit withstand time, V_{CE} = 0.5$V_{(BR)CES}$, T_C = 125 °C, R_G = 10 Ω, V_{GE} = 12 V	5			μs
T_j	Operating junction temperature	− 40 to 175			°C

1.   Calculated according to the iterative formula:

$$I_C(T_C) \; = \; \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, \; I_C(T_C))}$$

2.   Vclamp = 80% of V_{CES}, T_j =175 °C, R_G=10 Ω, V_{GE}=15 V

3.   Pulse width limited by maximum junction temperature and turn-off within RBSOA

Table 3.   Thermal data

Symbol	Parameter	Value			Unit
		D²PAK TO-220	DPAK	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case IGBT	1.8	1.9	5	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case diode	4	4.5	7	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5	100	62.5	°C/W

2 Electrical characteristics

$(T_j = 25\ °C$ unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE}= 0$)	$I_C= 1$ mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}= 15$ V, $I_C= 5$ A $V_{GE}= 15$ V, $I_C= 5$ A, $T_j = 150\ °C$		2 1.6		V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}= V_{GE}$, $I_C= 250$ µA	4.5		6.5	V
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE}= ±20$ V, $T_j = 150\ °C$			±100	nA
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE}= 600$ V $V_{CE}= 600$ V, $T_j = 150\ °C$			150 1	µA mA
g_{fs} [1]	Forward transconductance	$V_{CE} = 15$ V , $I_C = 5$ A		3		S

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{CE} = 25$ V, f = 1 MHz, $V_{GE}= 0$	-	TBD TBD TBD	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	$V_{CE} = 390$ V, $I_C = 5$ A, $V_{GE} = 15$ V *(see Figure 3)*	-	TBD TBD TBD	-	nC nC nC

Table 6. **Switching on/off (inductive load)**

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} = 390 V, I_C = 5 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 2)*	-	TBD TBD TBD	-	ns ns A/µs
$t_{d(on)}$ t_r $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 390 V, I_C = 5 A R_G= 10 Ω, V_{GE}= 15 V, T_j = 150 °C *(see Figure 2)*	-	TBD TBD TBD	-	ns ns A/µs
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 5 A, R_{GE} = 10 Ω, V_{GE} = 15 V *(see Figure 2)*	-	TBD TBD TBD	-	ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 390 V, I_C = 5 A, R_{GE} = 10 Ω, V_{GE} = 15 V T_j = 150 °C *(see Figure 2)*	-	TBD TBD TBD	-	ns ns ns

Table 7. **Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
Eon [1] E_{off} [2] E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 5 A R_G= 10 Ω, V_{GE}= 15 V, *(see Figure 2)*	-	TBD TBD TBD	-	µJ µJ µJ
Eon [1] E_{off} [2] E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 390 V, I_C = 5 A R_G= 10 Ω, V_{GE}= 15 V, T_j = 150 °C *(see Figure 2)*	-	TBD TBD TBD	-	µJ µJ µJ

1. Eon is the turn-on losses when a typical diode is used in the test circuit. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs and diode are at the same temperature (25°C and 125°C)

2. Turn-off losses include also the tail of the collector current.

Table 8.   Collector-emitter diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
V_F	Forward on-voltage	$I_F = 5$ A $I_F = 5$ A, $T_j = 150$ °C	-	2.1 1.8	2.4	V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 5$ A, $V_R = 40$ V, di/dt = 100 A/µs *(see Figure 5)*	-	24 17 1.5		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_F = 5$ A, $V_R = 40$ V, $T_j = 150$ °C, di/dt = 100 A/µs *(see Figure 5)*	-	TBD TBD TBD		ns nC A

3   Test circuits

Figure 2.   Test circuit for inductive load
              switching

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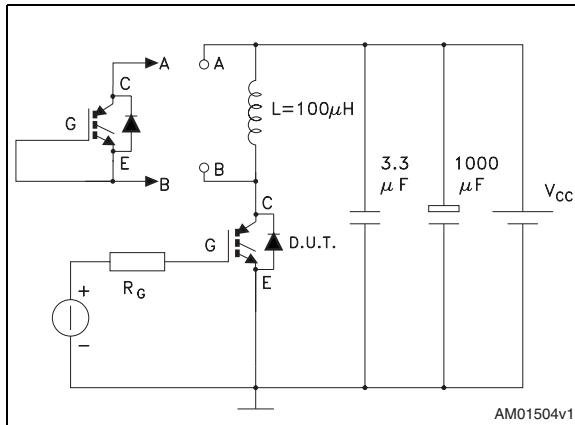
Figure 3.   Gate charge test circuit


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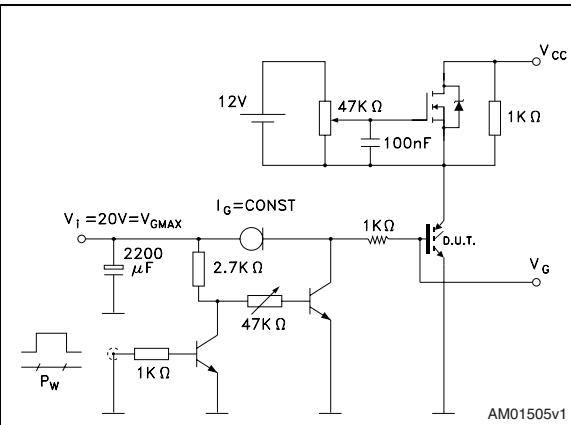
Figure 4.   Switching waveforms

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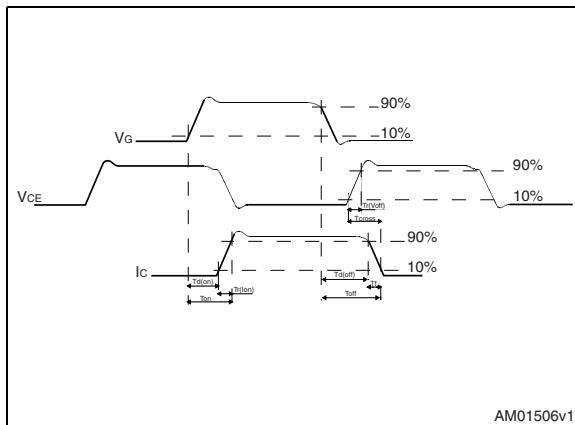
Figure 5.   Diode recovery times waveform

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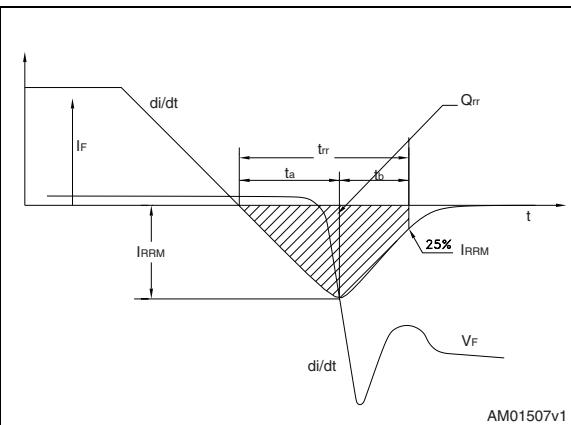
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

D²PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	**Typ**	**Max**	**Min**	**Typ**	**Max**
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°

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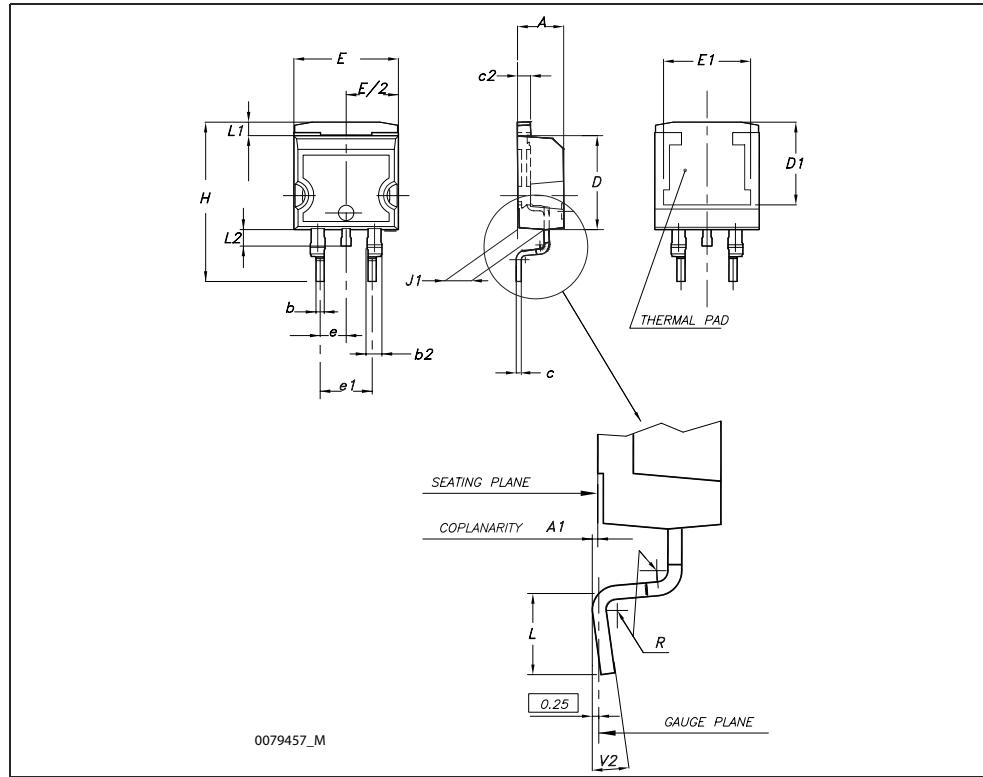
TO-252 (DPAK) mechanical data

DIM.	mm.		
	min.	typ	max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0 °		8 °

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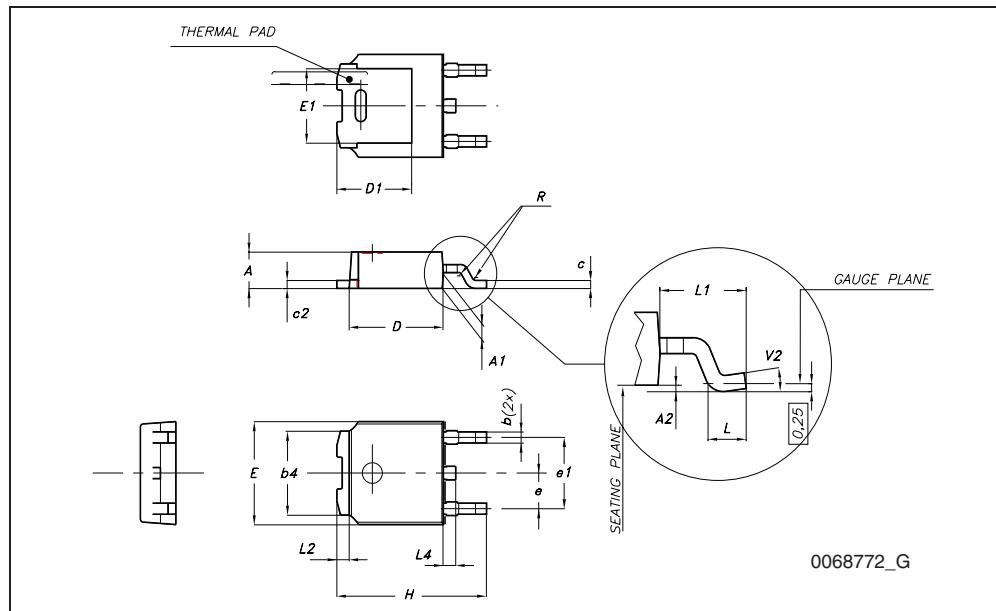
TO-220FP mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.5
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

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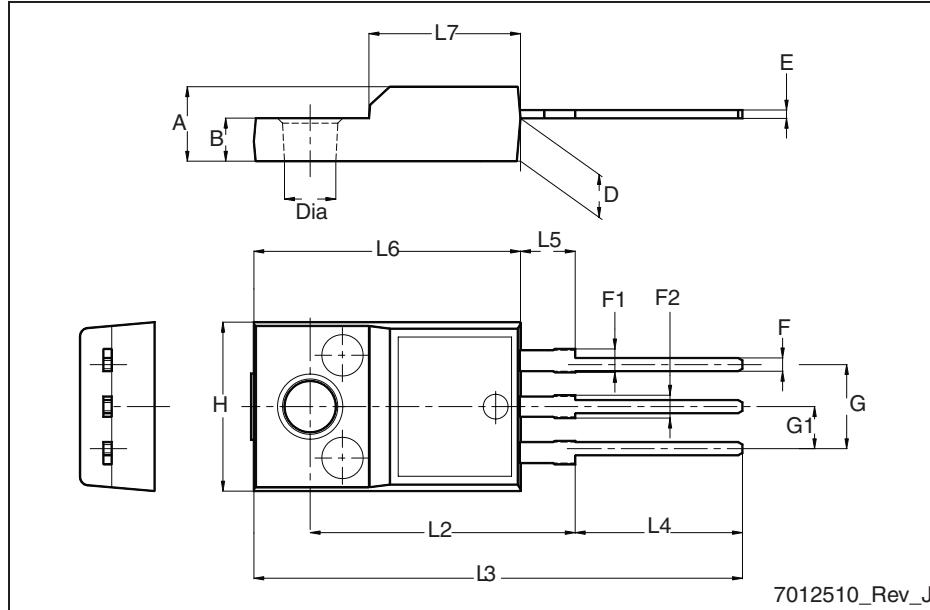
TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

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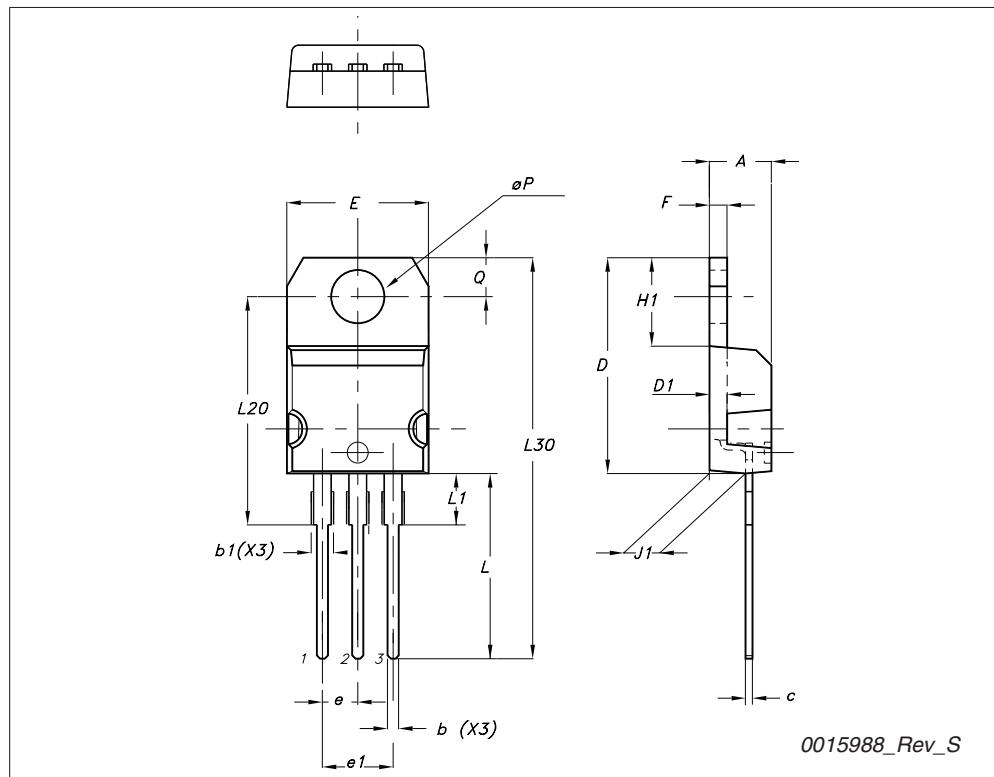
5 Revision history

Table 9. Document revision history

Date	Revision	Changes
18-Aug-2009	1	Initial release

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