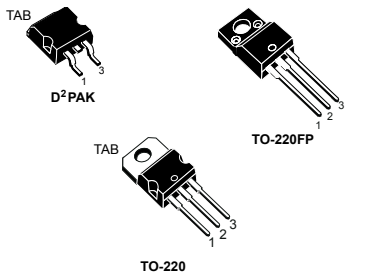
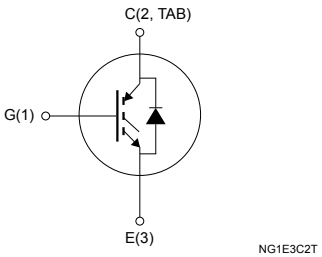
STGB6NC60HDT4, STGF6NC60HD, STGP6NC60HD

Datasheet

N-channel 600 V, 7 A, very fast IGBT





Features

- Low $V_{CE(sat)}$
- Low C_{RES}/C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High-frequency operation

Applications

- High-frequency inverters
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

Description

Using the latest high-voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs characterized by an outstanding performance. The “H” suffix identifies a family optimized for high-frequency applications which achieve very high switching performances (reduced tfall) while mantaining a low voltage drop.

Product status link
STGB6NC60HDT4
STGF6NC60HD
STGP6NC60HD

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D^2PAK, TO-220	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600		V
I_C	Continuous collector current at T_C = 25 °C	15	6	A
	Continuous collector current at T_C = 100 °C	7	3	
I_{CM} (1)	Collector current (pulsed)	21		A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Diode RMS forward current at T_C = 25 °C	10		A
P_{TOT}	Total power dissipation at T_C = 25 °C	62.5	25	W
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		2.5	kV
T_{STG}	Storage temperature range	-55 to 150		°C
T_J	Operating junction temperature range			°C

1. *Pulse width is limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D^2PAK, TO-220	TO-220FP	
R_{thJC}	Thermal resistance junction-case	2	5	°C/W
R_{thJA}	Thermal resistance junction-ambient	62.5		°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0 V, I_C = 1 mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15 V, I_C = 3 A		1.9	2.5	V
		V_{GE} = 15 V, I_C = 3 A, T_C = 125 °C		1.7		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 600 V			10	µA
		V_{GE} = 0 V, V_{CE} = 600 V, T_C = 125 °C (1)			1	mA
I_{GES}	Gate-emitter leakage current	V_{GE} = ±20 V, V_{CE} = 0 V			±100	nA

1. *Defined by design, not subject to production test*

Table 4. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	205	-	pF
C_{oes}	Output capacitance		-	32	-	
C_{res}	Reverse transfer capacitance		-	5.5	-	
Q_g	Total gate charge	V_{CE} = 390 V, I_C = 3 A, V_{GE} = 0 to 15 V (see Figure 18. Gate charge test circuit)	-	13.6	-	nC
Q_{ge}	Gate-emitter charge		-	3	-	
Q_{gc}	Gate-collector charge		-	6	-	
I_{CL}	Turn-off SOA minimum current	V_{clamp} = 390 V, T_J = 150 °C, R_G = 10 Ω, V_{GE} = 15 V	-	19	-	A

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 17. Test circuit for inductive load switching)	-	12	-	ns
t_r	Current rise time		-	5	-	
$(di/dt)_{on}$	Turn-on current slope		-	612	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see Figure 17. Test circuit for inductive load switching)	-	13	-	ns
t_r	Current rise time		-	4.3	-	
$(di/dt)_{on}$	Turn-on current slope		-	560	-	A/µs
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 17. Test circuit for inductive load switching)	-	40	-	ns
t_d(off)	Turn-off delay time		-	76	-	
t_f	Current fall time		-	100	-	
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see Figure 17. Test circuit for inductive load switching)	-	60	-	ns
t_d(off)	Turn-off delay time		-	98	-	
t_f	Current fall time		-	124	-	

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching energy	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V (see)Figure 17. Test circuit for inductive load switching	-	20	-	µJ
E_{off} (2)	Turn-off switching energy		-	68	-	
E_{ts}	Total switching energy		-	88	-	
E_{on} (1)	Turn-on switching energy	V_{CC} = 390 V, I_C = 3 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see)Figure 17. Test circuit for inductive load switching	-	37	-	µJ
E_{off} (2)	Turn-off switching energy		-	93	-	
E_{ts}	Total switching energy		-	130	-	

1. *Including the reverse recovery of the diode*
2. *Including the tail of the collector current*

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f	Forward on-voltage	I_f = 1.5 A	-	1.6	2.1	V
		I_f = 1.5 A, Tj = 125 °C	-	1.3		
t_{rr}	Reverse recovery time	I_f = 3 A ,V_R = 40 V, di/dt = 100 A/µs (see Figure 20. Diode reverse recovery waveform)	-	21		ns
Q_{rr}	Reverse recovery charge		-	14		nC
I_{rrm}	Reverse recovery current		-	1.36		A
t_{rr}	Reverse recovery time	I_f = 3 A ,V_R = 40 V, T_j = 125 °C, di/dt = 100 A/µs (see Figure 20. Diode reverse recovery waveform)	-	34		ns
Q_{rr}	Reverse recovery charge		-	32		nC
I_{rrm}	Reverse recovery current		-	1.88		A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

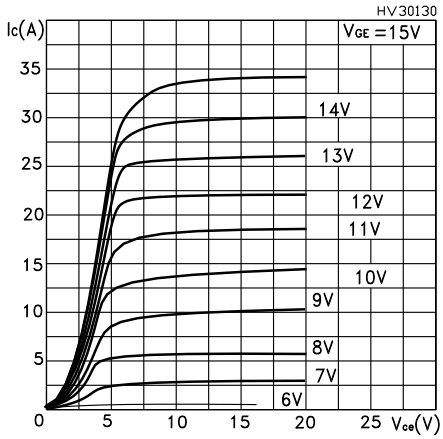


Figure 2. Transfer characteristics

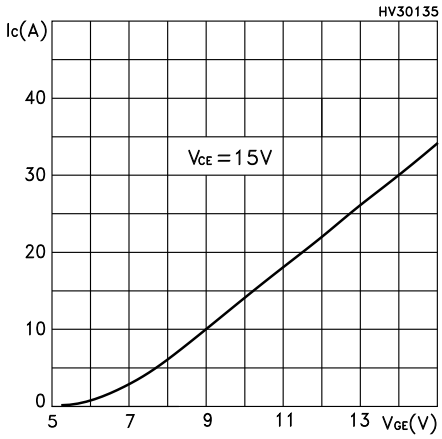


Figure 3. Transconductance

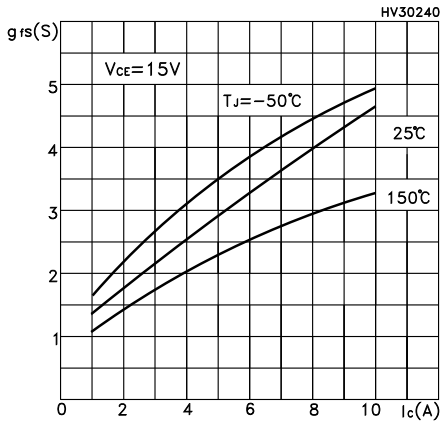


Figure 4. Collector-emitter on-voltage vs temperature

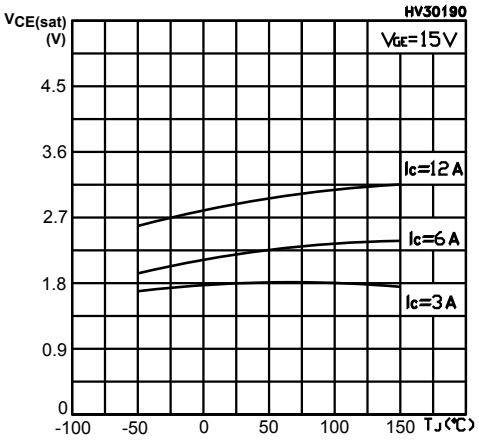


Figure 5. Gate charge vs gate-source voltage

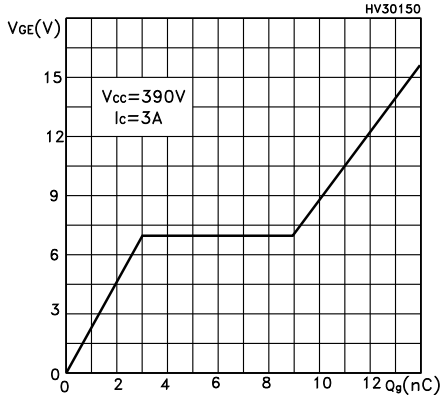


Figure 6. Capacitance variations

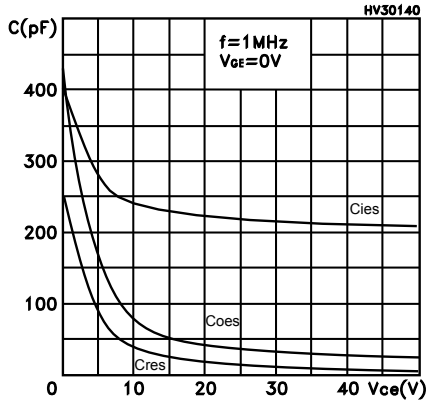


Figure 7. Normalized gate threshold voltage vs temperature

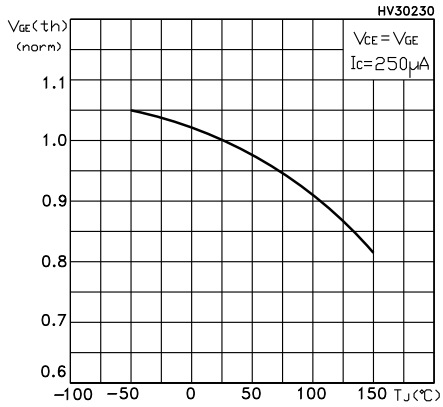


Figure 8. Collector-emitter on voltage vs collector current

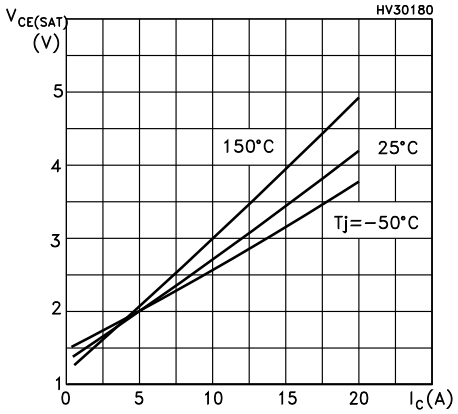


Figure 9. Normalized breakdown voltage vs temperature

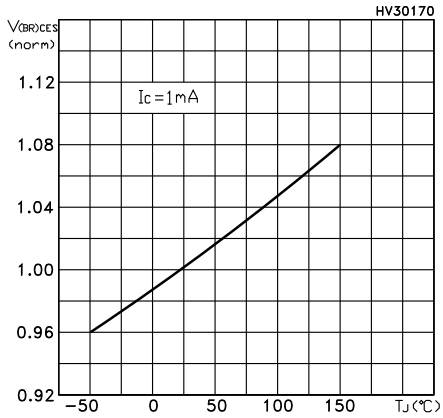


Figure 10. Switching energy vs temperature

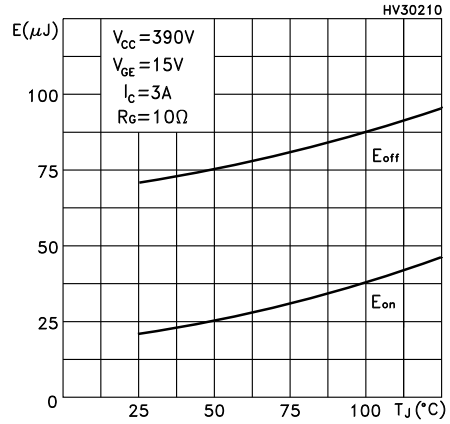


Figure 11. Switching energy vs gate resistance

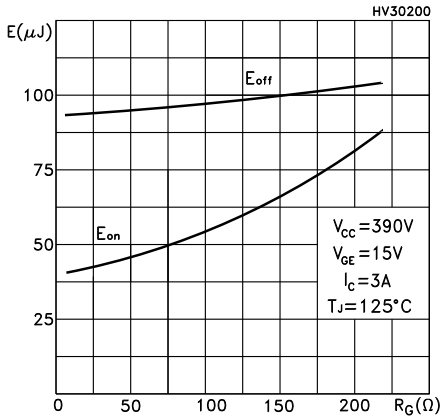


Figure 12. Switching energy vs collector current

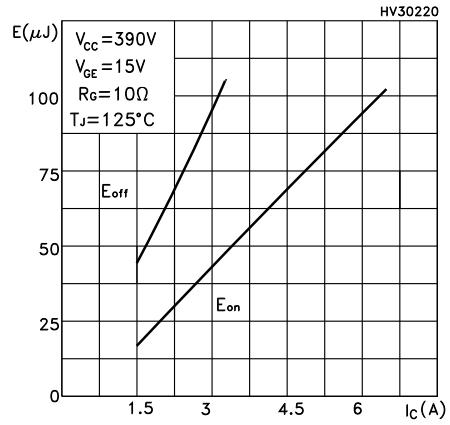


Figure 13. Thermal impedance for TO-220 / D²PAK

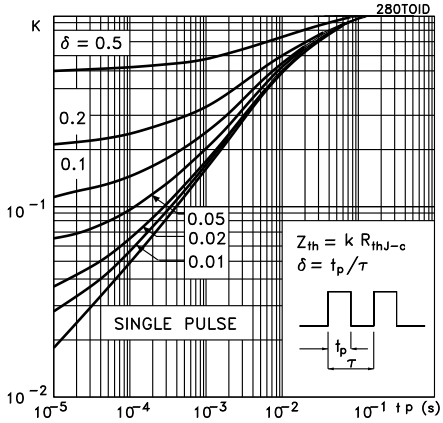


Figure 14. Turn-off SOA

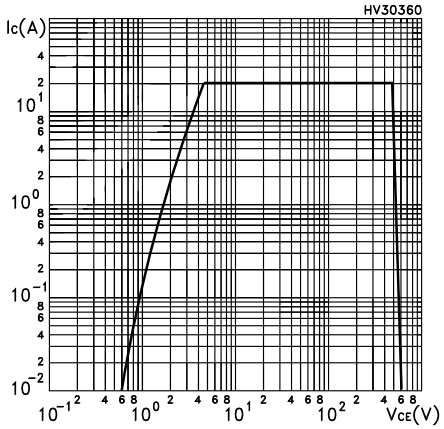


Figure 15. Thermal impedance for TO-220FP

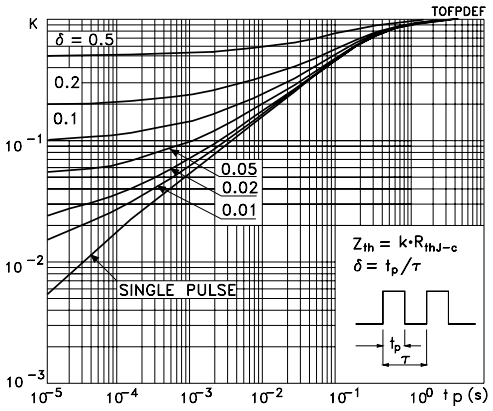
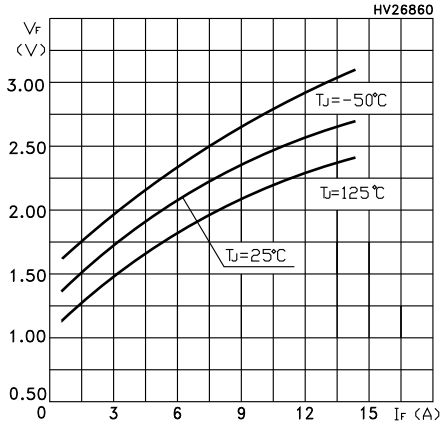


Figure 16. Emitter-collector diode characteristics



3 Test circuits

Figure 17. Test circuit for inductive load switching

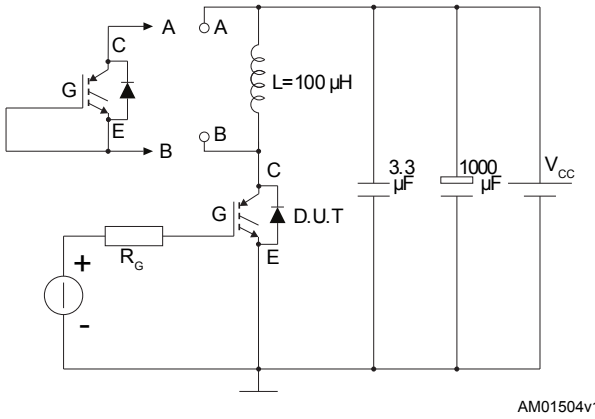


Figure 18. Gate charge test circuit

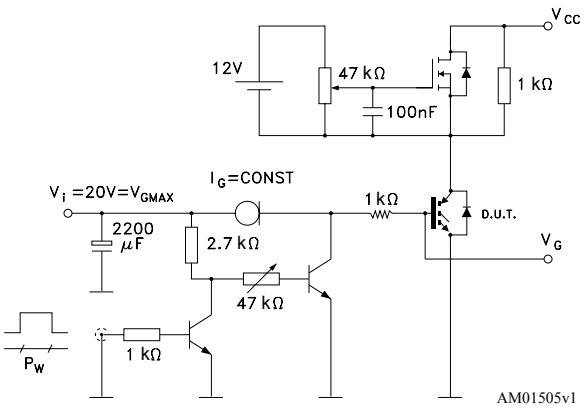


Figure 19. Switching waveform

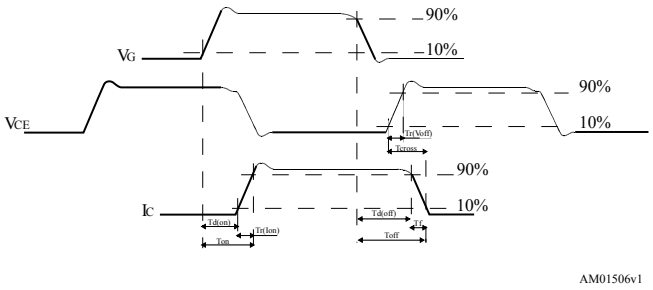
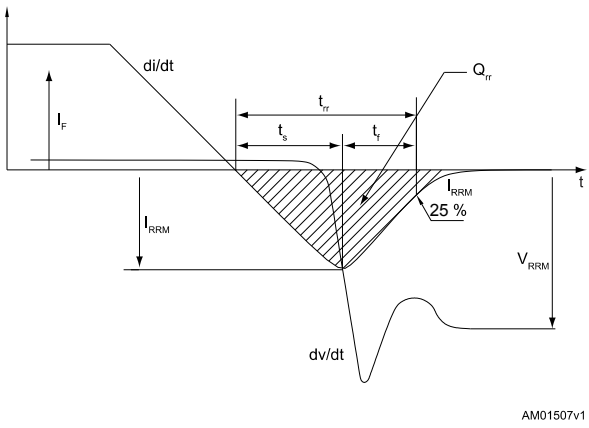


Figure 20. Diode reverse recovery waveform

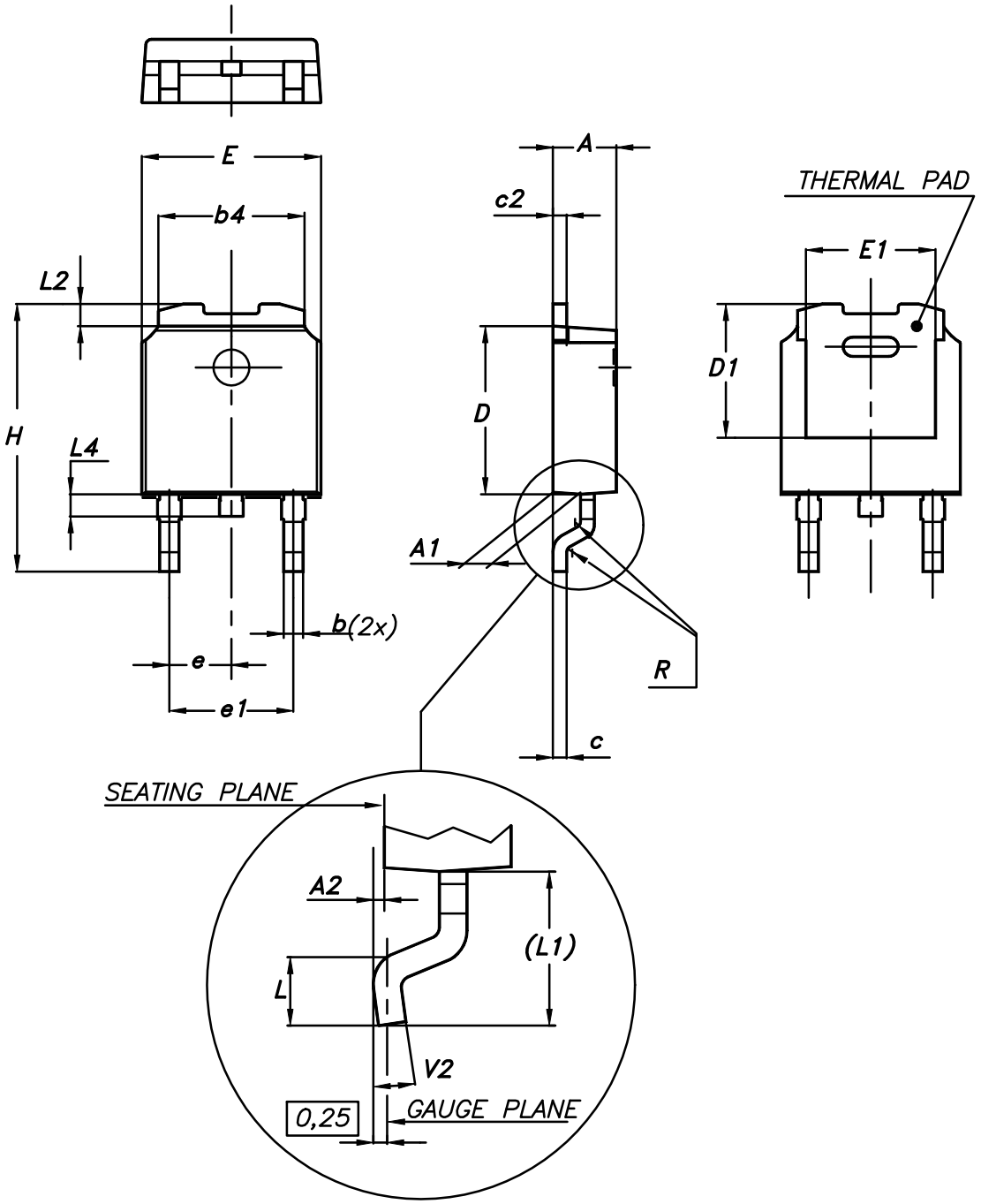


4 Package information

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.

4.1 D²PAK (TO-263) type A package information

Figure 21. **DPAK (TO-252) type A package outline**



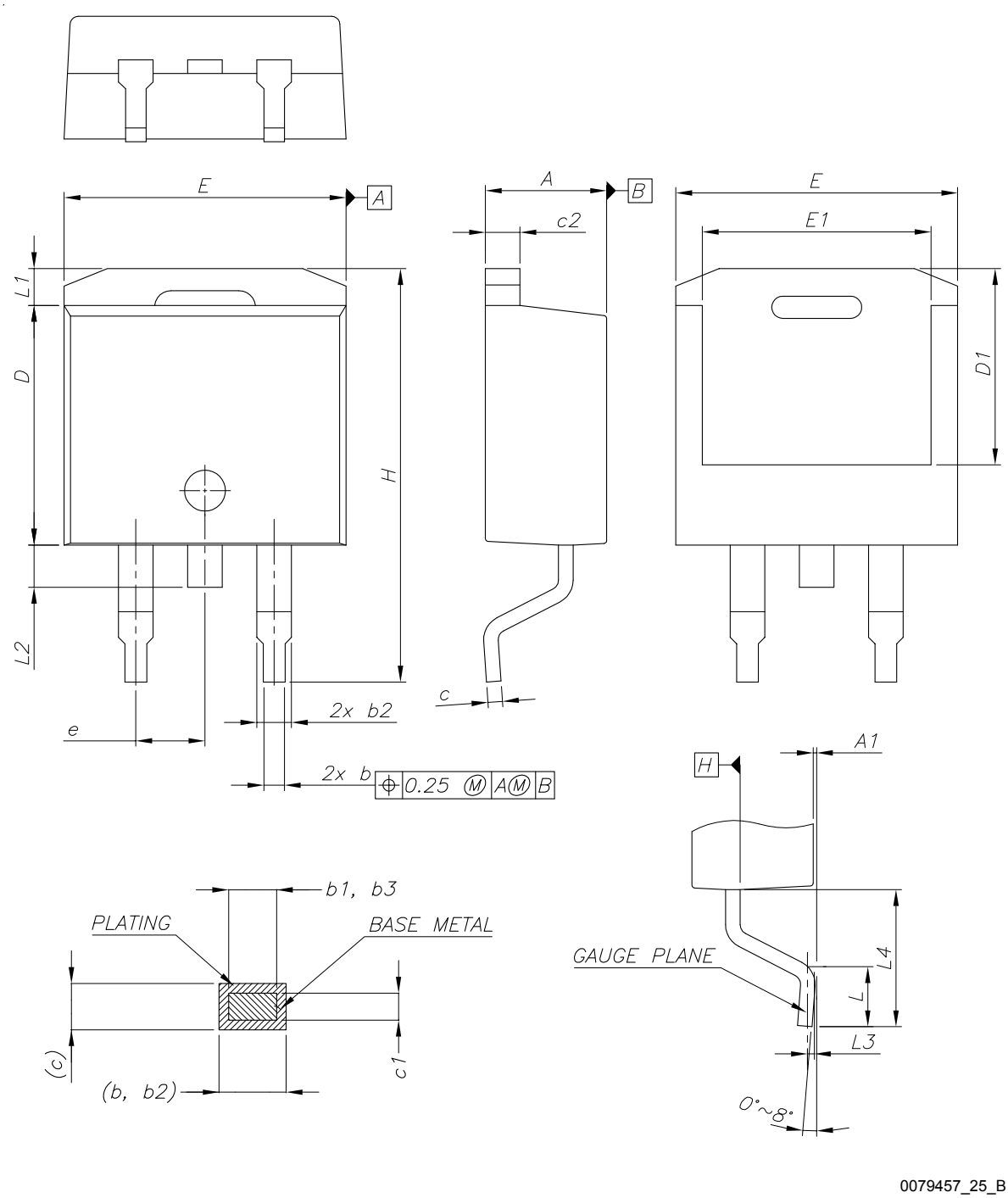
0068772_A_25

Table 8. **DPAK (TO-252) type A 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	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.159	2.286	2.413
e1	4.445	4.572	4.699
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

4.2 D²PAK (TO-263) type B package information

Figure 22. D²PAK (TO-263) type B package outline

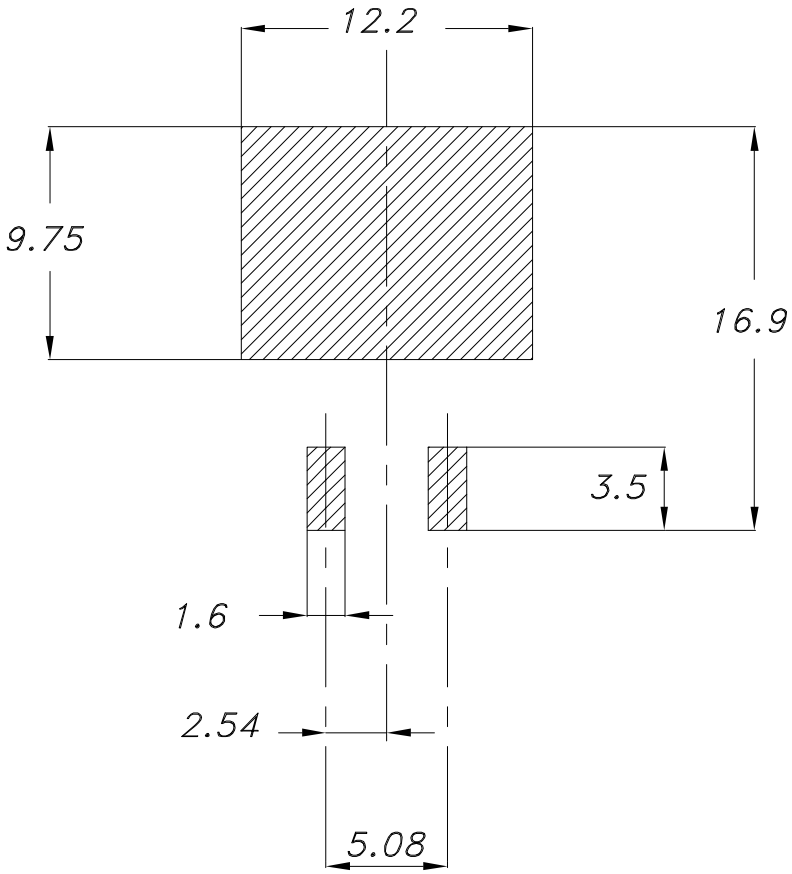


0079457_25_B

Table 9. D²PAK (TO-263) type B mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
b3	1.36		1.46
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e		2.54 BSC	
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 23. D²PAK (TO-263) recommended footprint (dimensions are in mm)



Footprint

4.2.1 Packing information

Figure 24. D²PAK tape outline

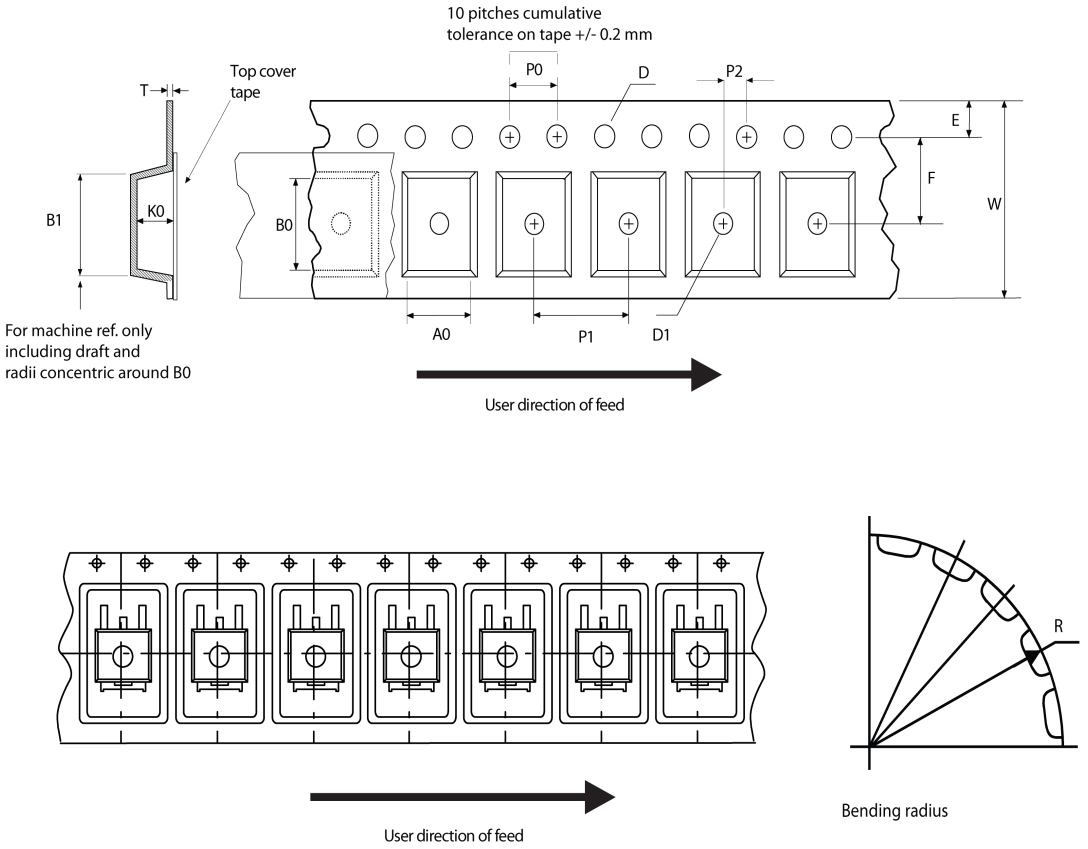
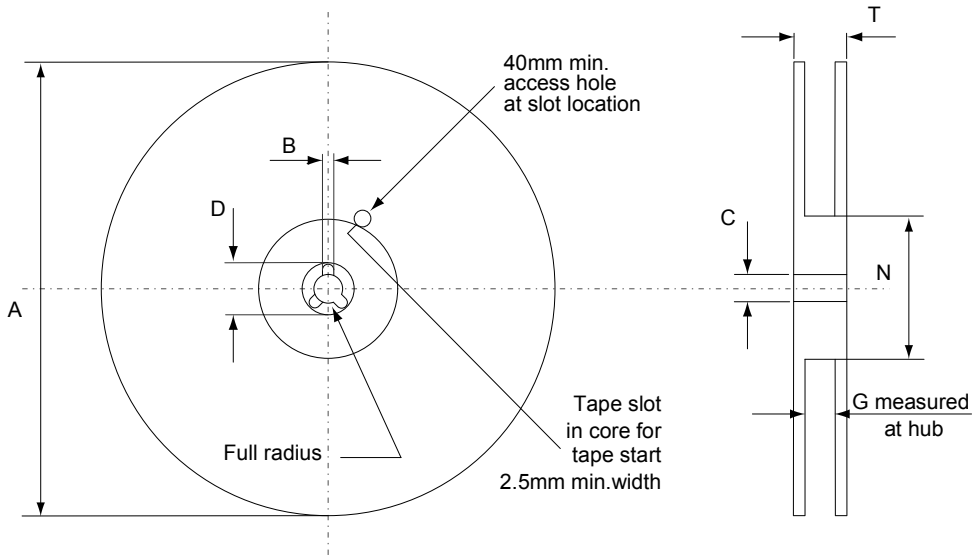


Figure 25. **D²PAK reel outline**



AM06038v1

Table 10. **D²PAK tape and reel mechanical data**

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

4.3 TO-220FP package information

Figure 26. **TO-220FP package outline**

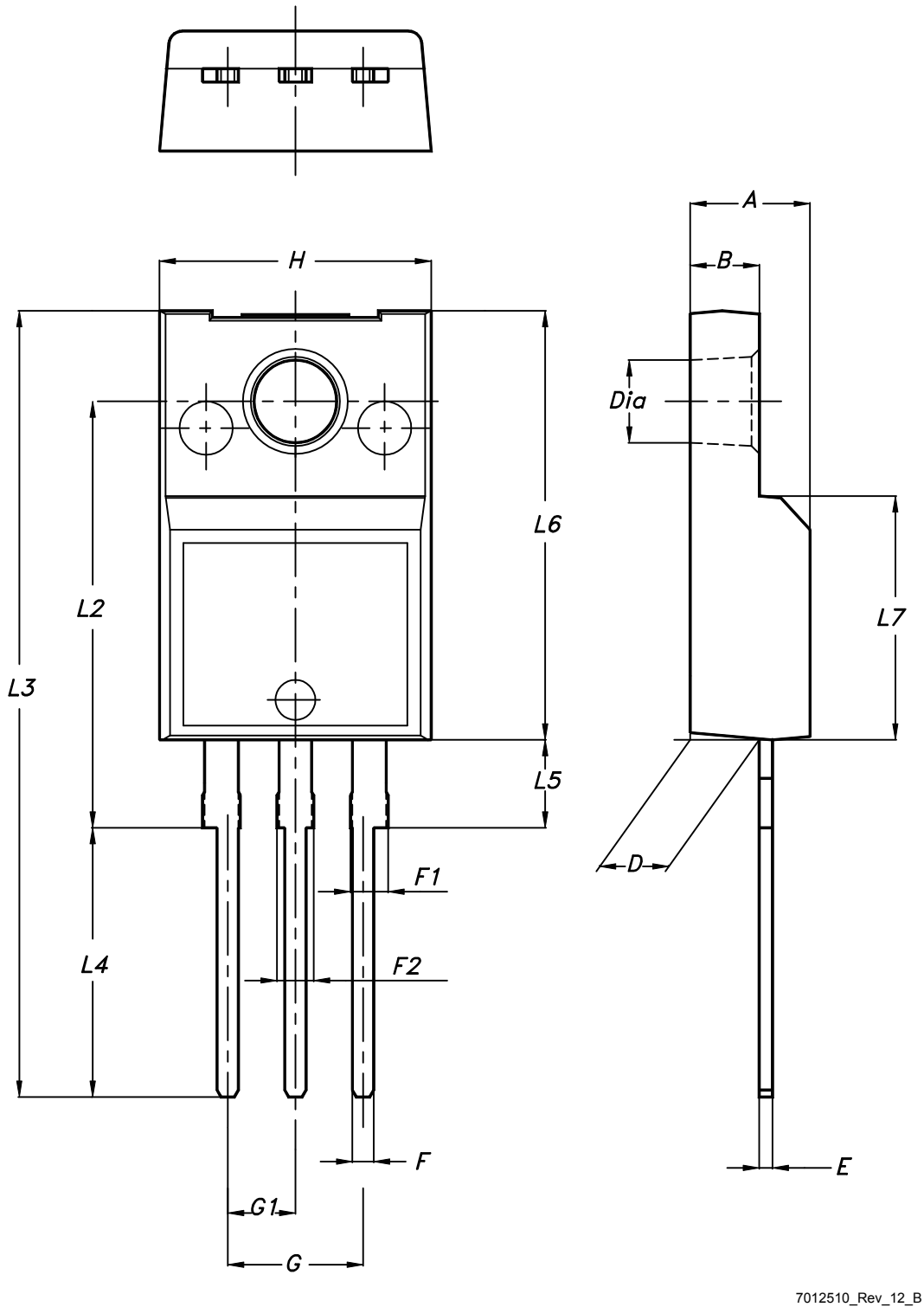


Table 11. **TO-220FP package mechanical data**

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		1.70
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

4.4 TO-220 type A package information

Figure 27. **TO-220 type A package outline**

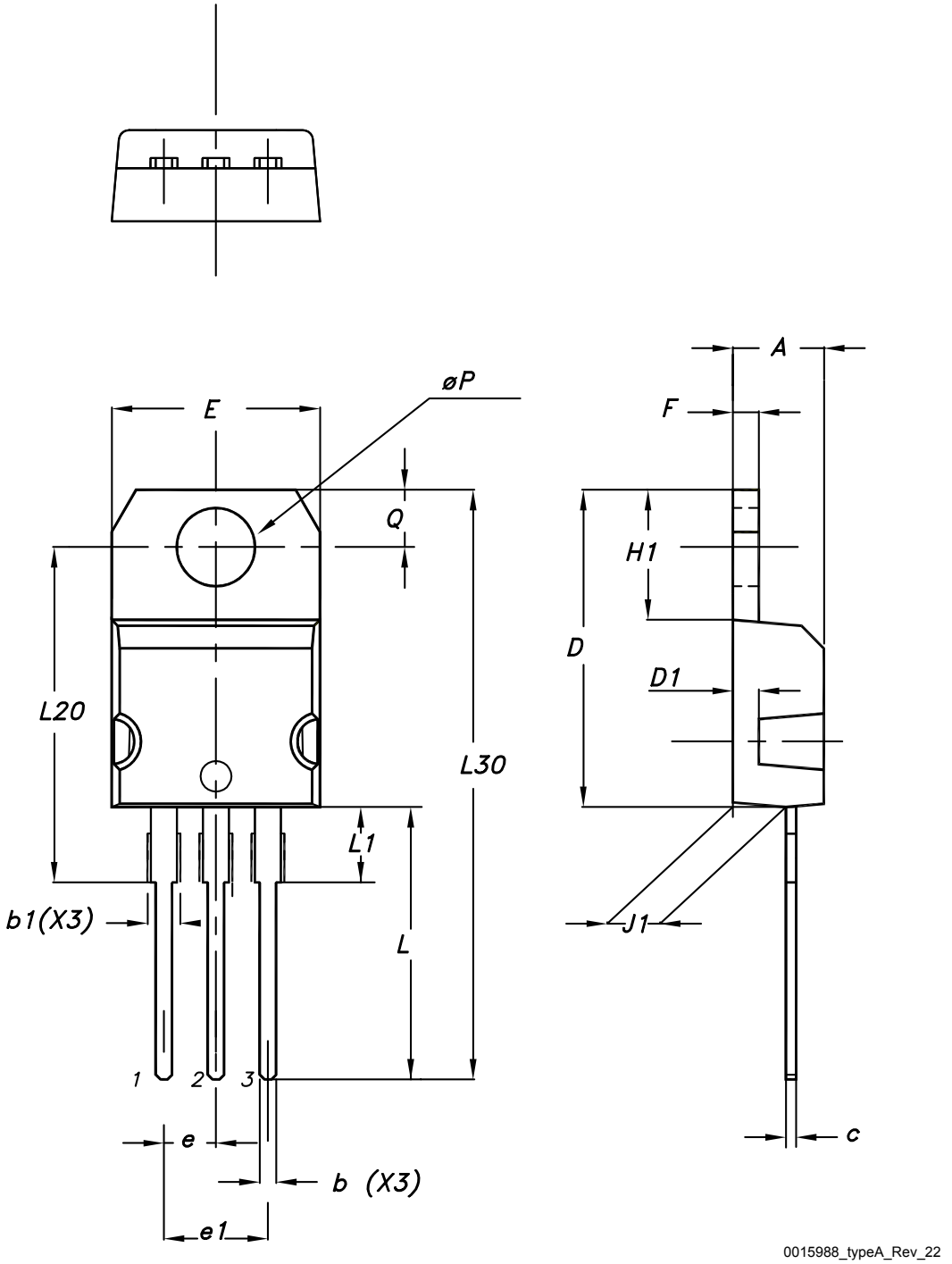


Table 12. **TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

5 Ordering information

Table 13. **Ordering information**

Order code	Marking	Package	Packing
STGB6NC60HDT4	GB6NC60HD	D²PAK	Tape and reel
STGF6NC60HD	GF6NC60HD	TO-220FP	Tube
STGP6NC60HD	GP6NC60HD	TO-220	Tube

Revision history

Table 14. **Document revision history**

Date	Revision	Changes
28-Nov-2005	1	First release
07-Mar-2006	2	Complete version
31-Jul-2006	3	Modified *Figure 10*.
26-Apr-2007	4	Inserted package I^2PAK
20-Nov-2017	5	Part number STGB6NC60HD-1 has been moved to a separate datasheet. Updated information on cover page. Updated *Table 2: "Absolute maximum ratings"* and *Table 4: "Static characteristics"*. Updated *Section 2.1: "Electrical characteristics (curves)"*. Updated *Section 4: "Package information"*. Minor text changes
23-Oct-2018	6	Updated title in coverpage and Table 4. Dynamic characteristics. Minor text changes.

Contents

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3 **Test circuits** 8
4 **Package information** 9
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