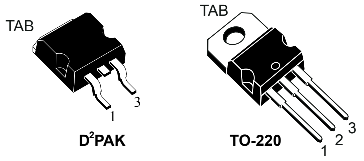
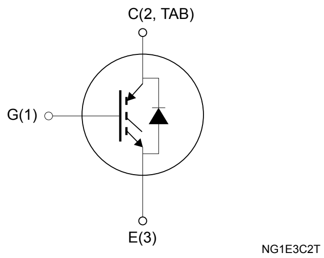
STGB10NC60HDT4, STGP10NC60HD

Datasheet

600 V, 10 A very fast IGBT





STPOWER

Product status links
STGB10NC60HDT4
STGP10NC60HD

Product summary	
Order code	**STGB10NC60HDT4**
Marking	GB10NC60HD
Package	D²PAK
Packing	Tape and reel
Order code	**STGP10NC60HD**
Marking	GP10NC60HD
Package	TO-220
Packing	Tube

Features

- Low on voltage drop ($V_{CE(sat)}$)
- Low C_{res} / C_{ies} ratio (no cross-conduction susceptibility)
- Very soft ultra-fast recovery antiparallel diode

Applications

- High frequency motor controls
- SMPS and PFC in both hard switch and resonant topologies
- Motor drives

Description

These devices are very fast IGBTs developed using advanced PowerMESH technology. This process guarantees an excellent trade-off between switching performance and low on-state behavior.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600	V
I_C (1)	Continuous collector current at T_C = 25 °C	20	A
	Continuous collector current at T_C = 100 °C	10	
I_{CL} (2)	Turn-off latching current	30	A
I_{CP} (3)	Pulsed collector current	30	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
P_{TOT}	Total power dissipation at T_C = 25 °C	65	W
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Calculated according to the iterative formula:* $I_C(T_C) = \frac{T_{J(\max)} - T_C}{R_{thJC} \times V_{CE(sat)(\max)}\left(T_{J(\max)}, I_C(T_C)\right)}$
2. V_{clamp} *= 80%* V_{CES}*,* T_J *=150 °C,* R_G *= 10 Ω,* V_{GE} *= 15 V.*
3. *Pulse width limited by maximum junction temperature.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case IGBT	1.9	°C/W
	Thermal resistance, junction-to-case diode	4	
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	°C/W

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 3. Static

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 = 5 A		1.9	2.5	V
		V_{GE} = 15 V, I_C = 5 A, T_J = 150 °C		1.7		
$V_{GE(th)}$	Gate threshold voltage	V_{CE} = V_{GE}, I_C = 250 µA	4.5		6.5	V
I_{CES}	Collector cut-off current	V_{GE} = 0 V, V_{CE} = 600 V			0.15	mA
		V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C (1)			1	
I_{GES}	Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = ±20 V			±100	nA
g_{fs} (2)	Forward transconductance	V_{CE} = 15 V, I_C = 5 A		3.5		S

1. *Specified by design, not tested in production.*
2. *Pulsed: pulse duration = 300 µs, duty cycle 1.5%.*

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{CE} = 25 V, f = 1 MHz, V_{GE} = 0 V	-	365	-	pF
C_{oes}	Output capacitance		-	43	-	pF
C_{res}	Reverse transfer capacitance		-	8.3	-	pF
Q_g	Total gate charge	V_{CC} = 390 V, I_C = 5 A, V_{GE} = 0 to 15 V (see Figure 18. Gate charge test circuit)	-	19.2	-	nC
Q_{ge}	Gate-emitter charge		-	4.5	-	nC
Q_{gc}	Gate-collector charge		-	7	-	nC

Table 5. **Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	14.2	-	ns
t_r	Current rise time		-	5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1000	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	14	-	ns
t_r	Current rise time		-	5	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	920	-	A/µs
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	27	-	ns
$t_{d(off)}$	Turn-off delay time		-	72	-	ns
t_f	Current fall time		-	85	-	ns
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	50	-	ns
$t_{d(off)}$	Turn-off delay time		-	108	-	ns
t_f	Current fall time		-	139	-	ns

Table 6. **Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching energy	V_{CE} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V (see Figure 16. Test circuit for inductive load switching	-	31.8	-	µJ
E_{off} (2)	Turn-off switching energy		-	95	-	µJ
E_{ts}	Total switching energy		-	126.8	-	µJ
E_{on} (1)	Turn-on switching energy	V_{CE} = 390 V, I_C = 5 A, R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C (see Figure 16. Test circuit for inductive load switching	-	61.8	-	µJ
E_{off} (2)	Turn-off switching energy		-	173	-	µJ
E_{ts}	Total switching energy		-	234.8	-	µJ

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

Table 7. **Diode switching characteristics (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_F	Forward on-voltage	I_F = 5 A	-	2	2.45	V
		I_F= 5 A, T_J=125 °C	-	1.7		
t_{rr}	Reverse recovery time	I_F = 5 A, V_R = 40 V, di/dt = 100 A/µs (see Figure 17. Diode reverse recovery waveform)	-	22		ns
Q_{rr}	Reverse recovery charge		-	14		nC
I_{rrm}	Reverse recovery current		-	1.3		A
t_{rr}	Reverse recovery time	I_F = 5 A, V_R = 40 V, di/dt = 100 A/µs, T_J = 125 °C (see Figure 17. Diode reverse recovery waveform)	-	33		ns
Qrr	Reverse recovery charge		-	30		nC
I_{rr}	Reverse recovery current		-	1.85		A

2.1 Electrical characteristics (curves)

Figure 1. Typical output characteristics

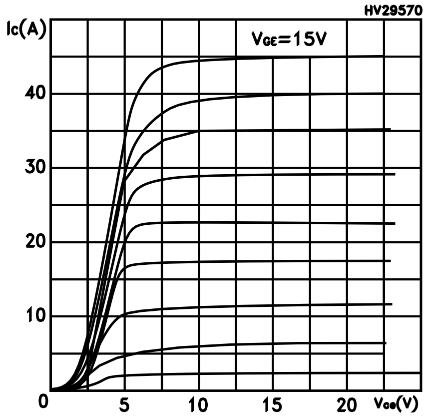


Figure 2. Typical transfer characteristics

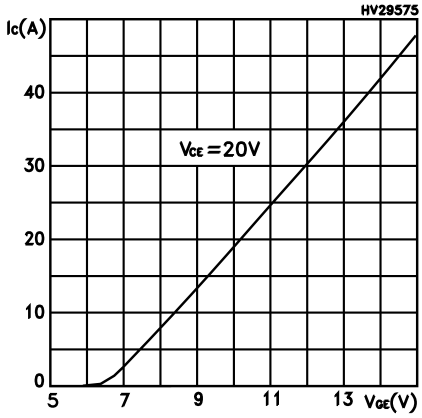


Figure 3. Typical transconductance characteristics

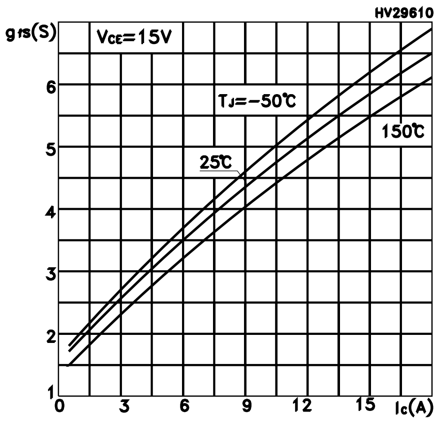


Figure 4. Typical collector-emitter on voltage vs temperature

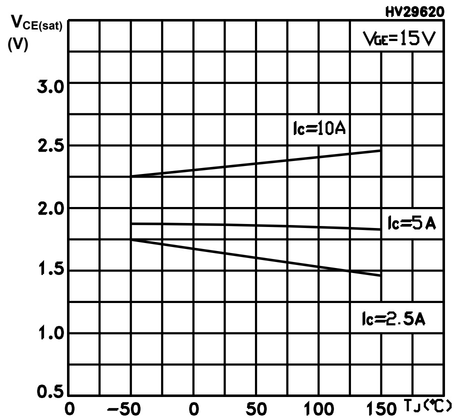


Figure 5. Typical gate charge characteristics

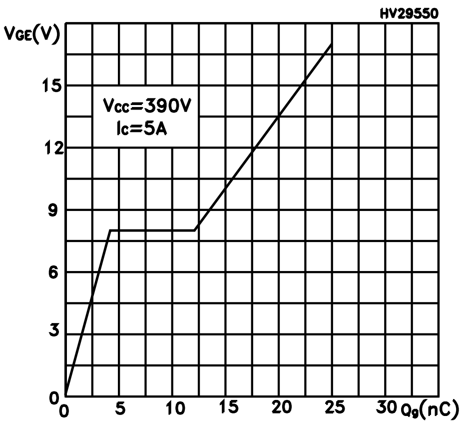


Figure 6. Typical capacitance characteristics

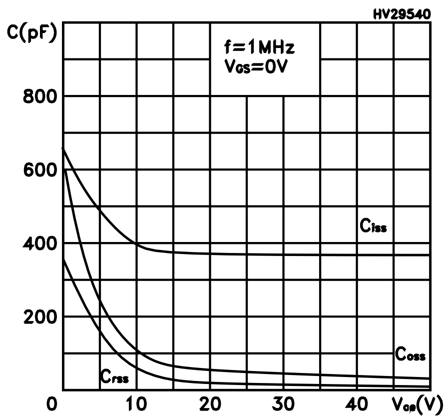


Figure 7. Normalized gate threshold vs temperature

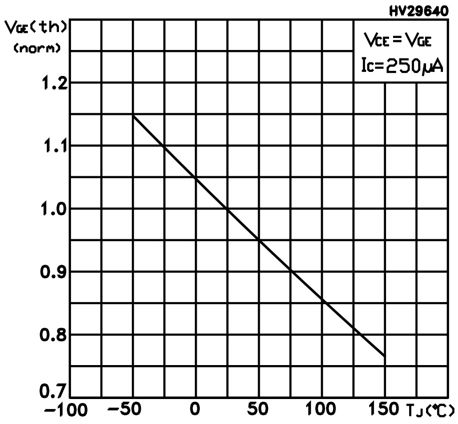


Figure 8. Typical collector-emitter on voltage vs collector current

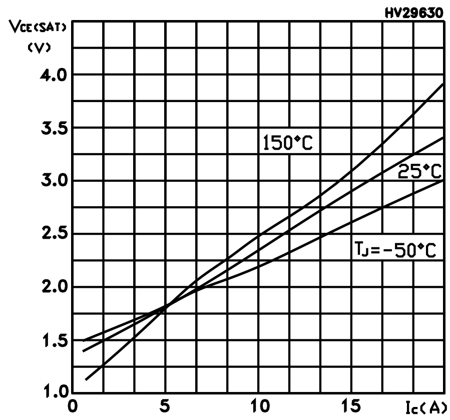


Figure 9. Normalized breakdown voltage vs temperature

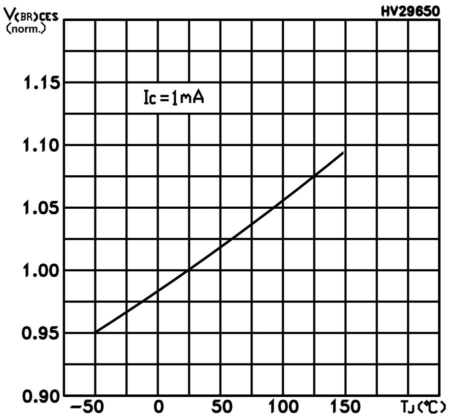


Figure 10. Typical switching energy vs temperature

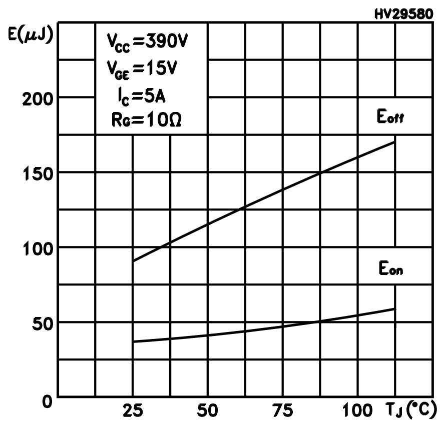


Figure 11. Typical switching energy vs gate resistance

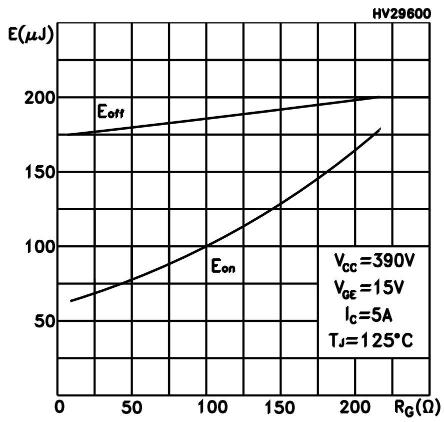


Figure 12. Typical switching energy vs collector current

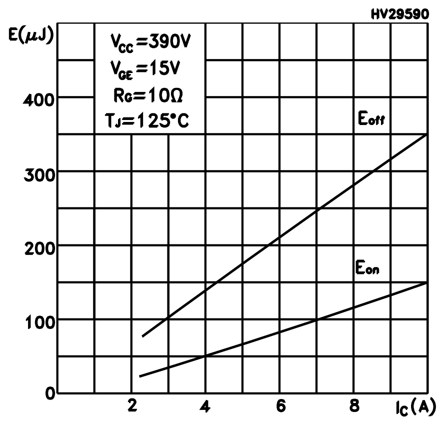


Figure 13. Normalized transient thermal impedance

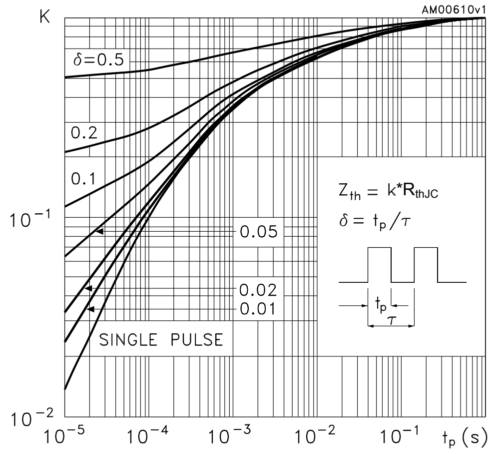


Figure 14. Safe operating area

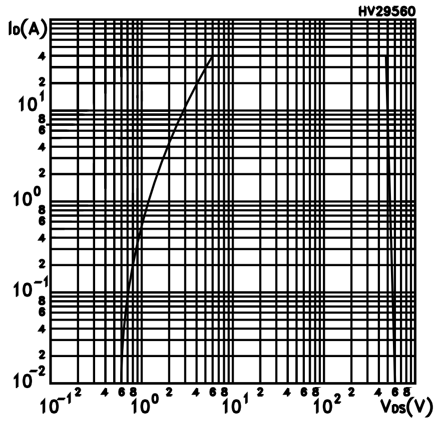
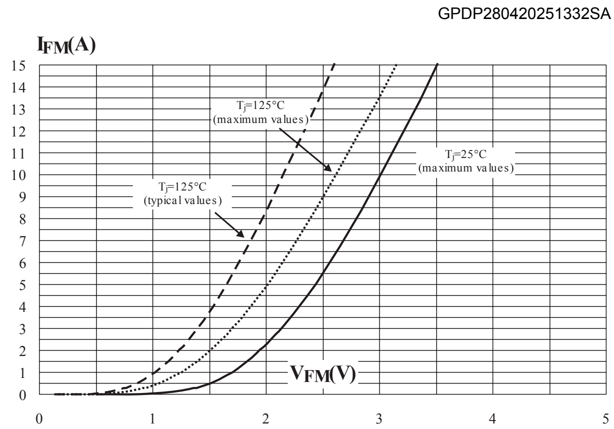


Figure 15. Emitter-collector diode characteristics



3 Test circuits

Figure 16. Test circuit for inductive load switching

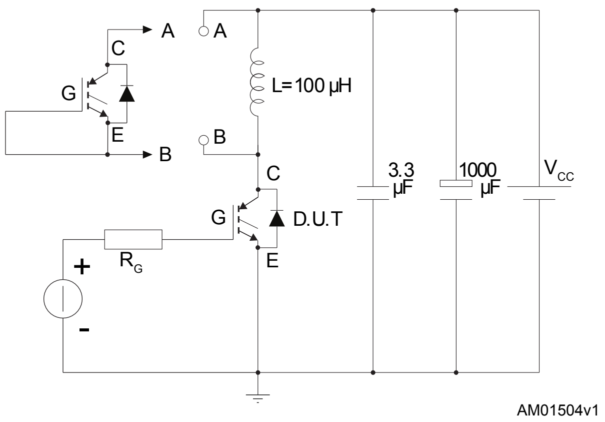


Figure 17. Diode reverse recovery waveform

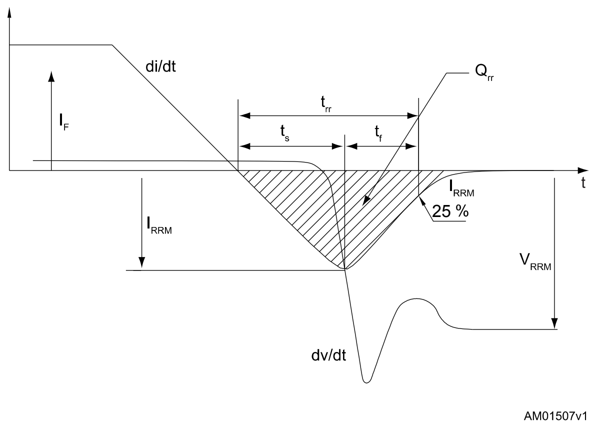


Figure 18. Gate charge test circuit

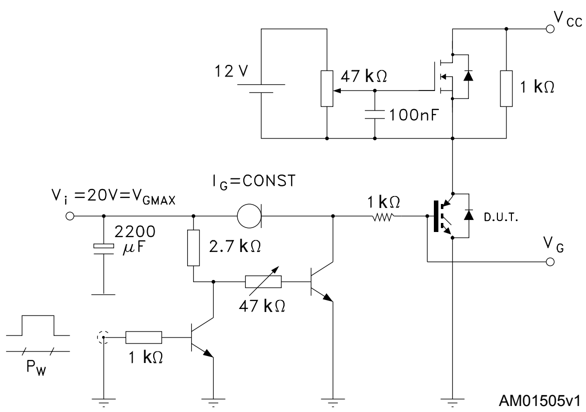
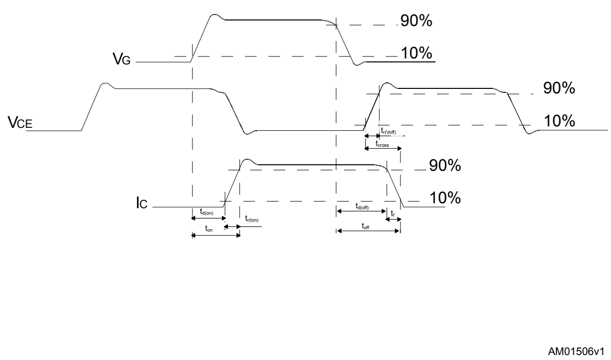


Figure 19. Switching waveform



4 Package information

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 B package information

Figure 20. D²PAK (TO-263) type B package outline

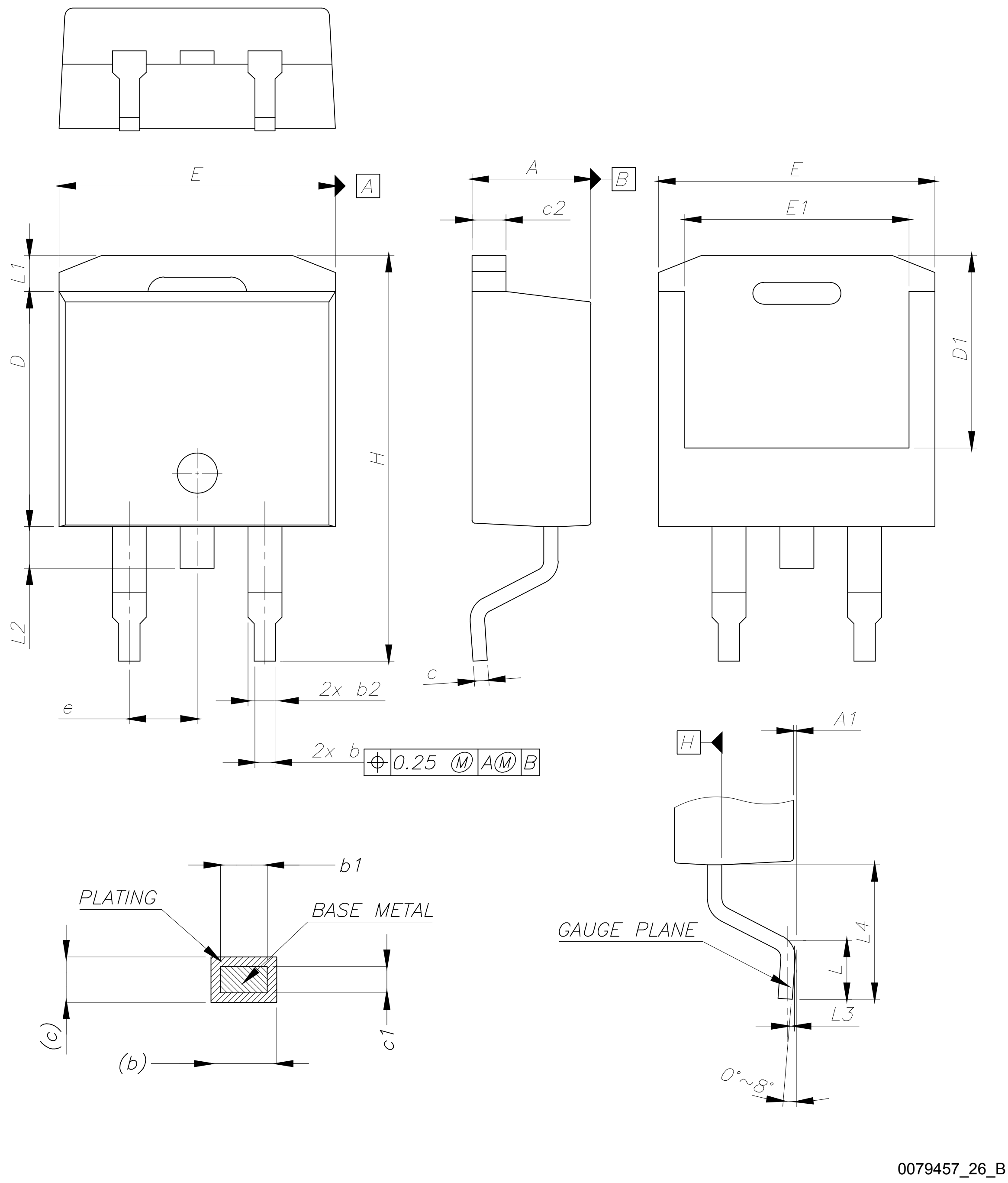
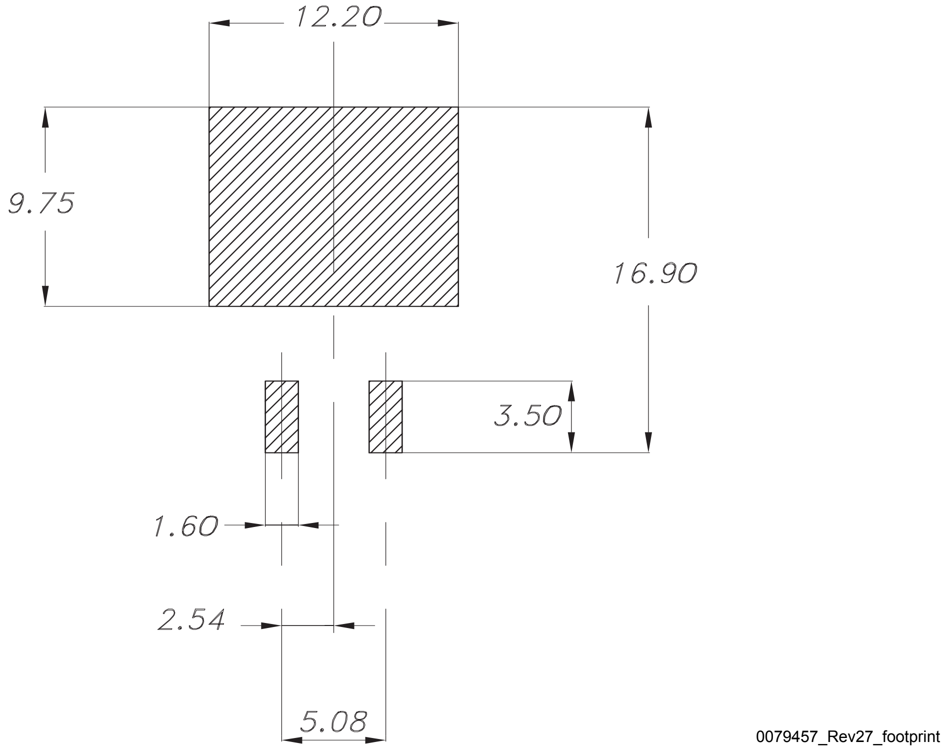


Table 8. D²PAK (TO-263) type B mechanical data

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



4.2 TO-220 type A package information

Figure 22. TO-220 type A package outline

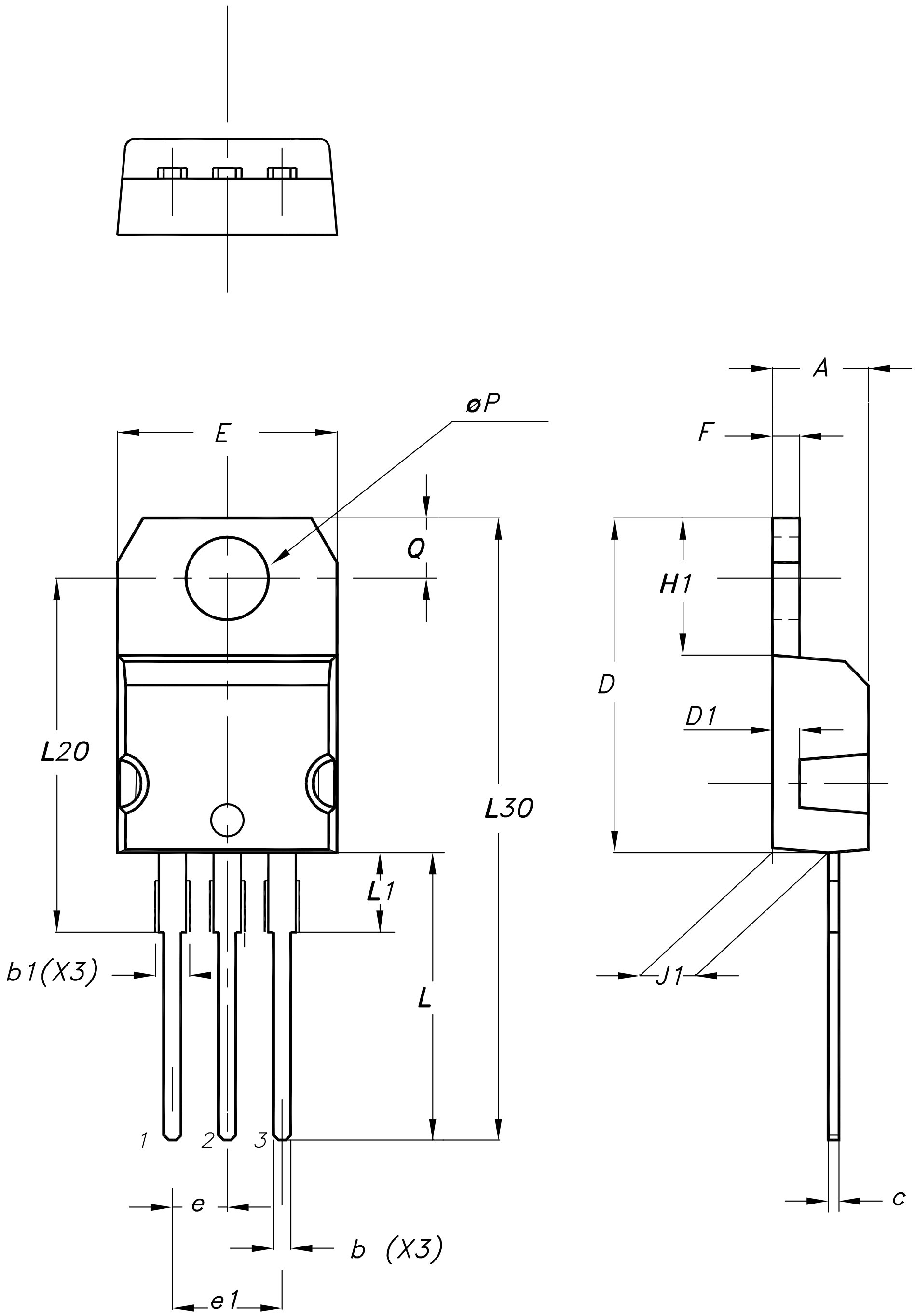


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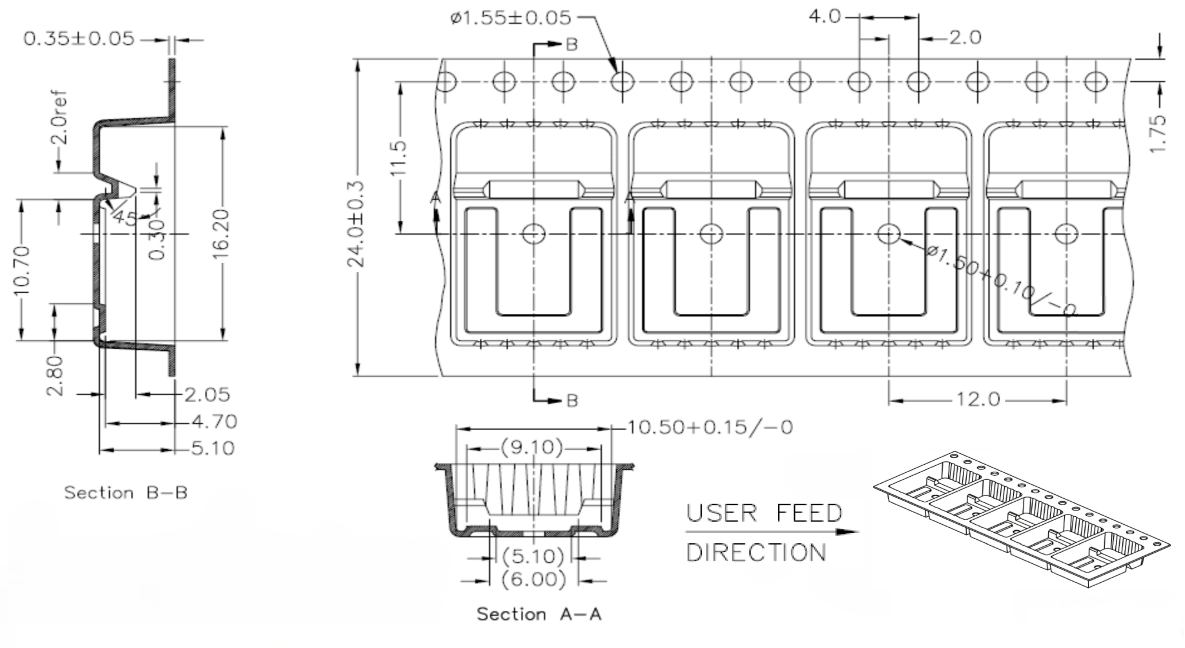
Table 9. TO-220 type A package mechanical data

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
Slug flatness		0.03	0.10

4.3 D²PAK packing information

Figure 23. D²PAK tape drawing (dimensions are in mm)



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Revision history

Table 10. Document revision history

Date	Revision	Changes
30-Jan-2006	1	Initial release
06-Nov-2006	2	Complete version.
08-Feb-2007	3	The document has been reformatted
05-Oct-2007	4	Added TO-220FP, *Table 2* has been updated
16-Dec-2008	5	Added DPAK package
05-May-2025	6	The part numbers STGD10NC60HD and STGF10NC60HD have been removed and the document has been updated accordingly. Updated Section 4: Package information.

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Revision history **14**