

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, 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 ² PAK, 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

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified

Table 3. Static characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0\text{ V}$, $I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$		1.9	2.5	V
		$V_{GE} = 15\text{ V}$, $I_C = 3\text{ A}$, $T_C = 125\text{ }^{\circ}\text{C}$		1.7		
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.75		5.75	V
I_{CES}	Collector cut-off current	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$			10	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			1	mA
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$			± 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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$	-	205	-	pF
C_{oes}	Output capacitance		-	32	-	
C_{res}	Reverse transfer capacitance		-	5.5	-	
Q_g	Total gate charge	$V_{CE} = 390\text{ V}$, $I_C = 3\text{ A}$, $V_{GE} = 0\text{ to }15\text{ V}$ (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	$V_{clamp} = 390\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$, $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$	-	19	-	A

Table 5. Switching characteristics (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (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	-	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (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	-	
$t_r(V_{off})$	Off voltage rise time	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (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	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (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	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ (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	$V_{CC} = 390\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$ (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	$I_f = 1.5\text{ A}$	-	1.6	2.1	V
		$I_f = 1.5\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$	-	1.3		
t_{rr}	Reverse recovery time	$I_f = 3\text{ A}$, $V_R = 40\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$ (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	$I_f = 3\text{ A}$, $V_R = 40\text{ V}$, $T_J = 125\text{ }^\circ\text{C}$, $di/dt = 100\text{ A}/\mu\text{s}$ (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)

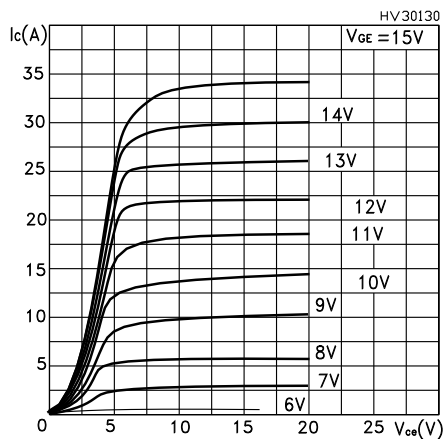
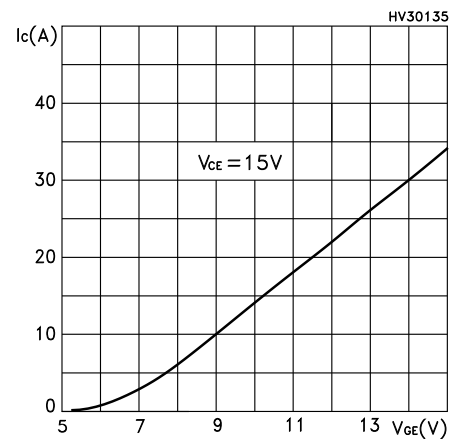
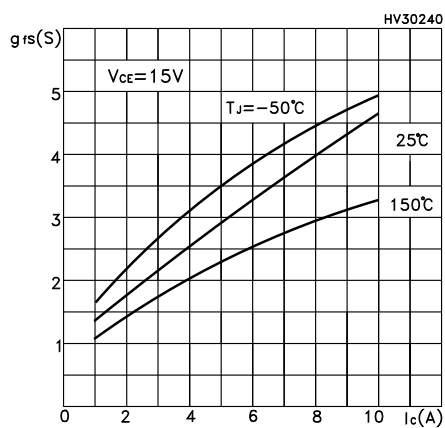
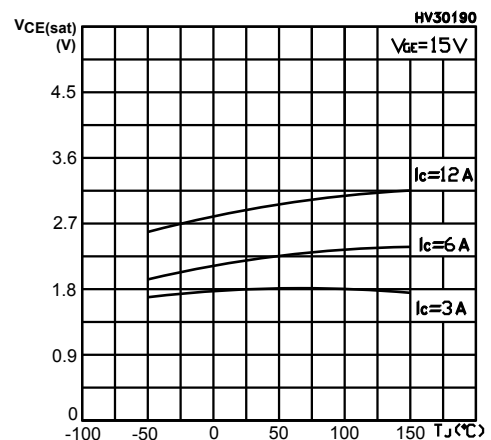
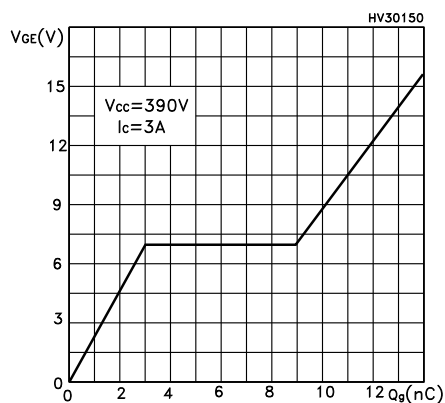
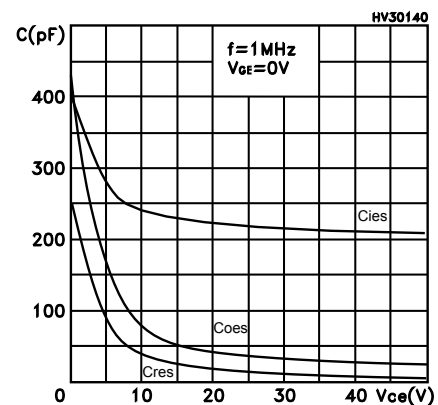
Figure 1. Output characteristics

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


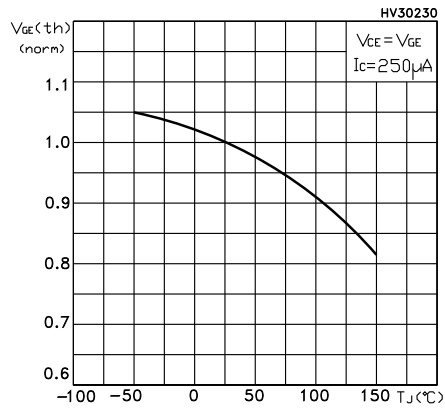
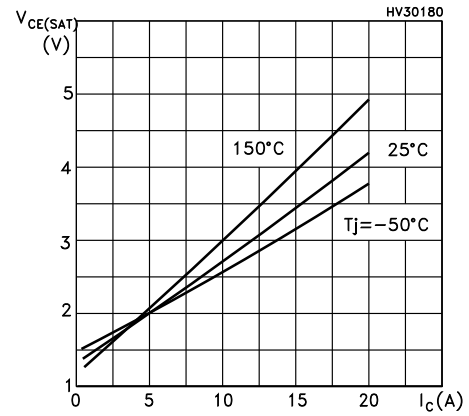
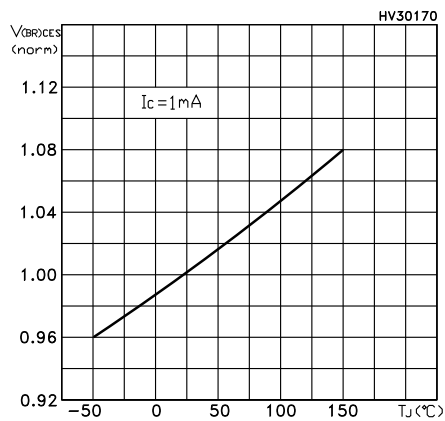
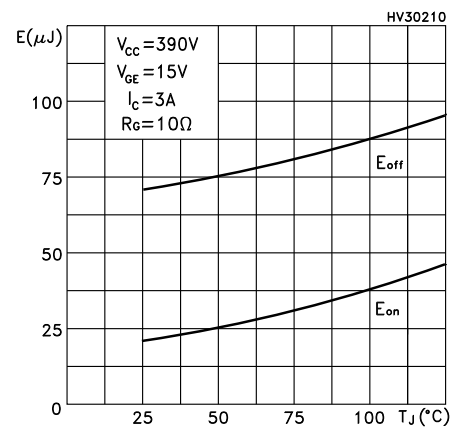
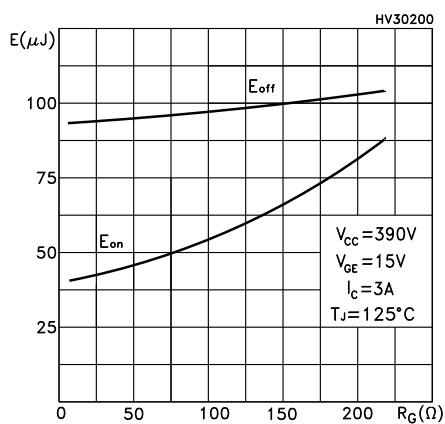
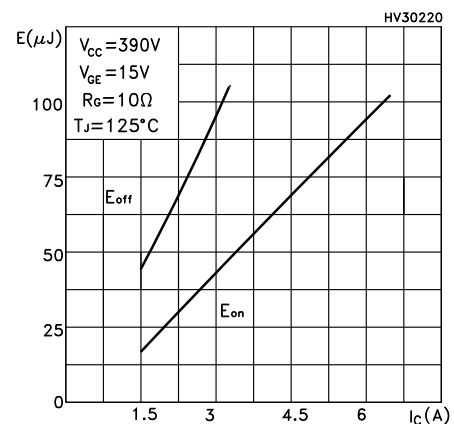
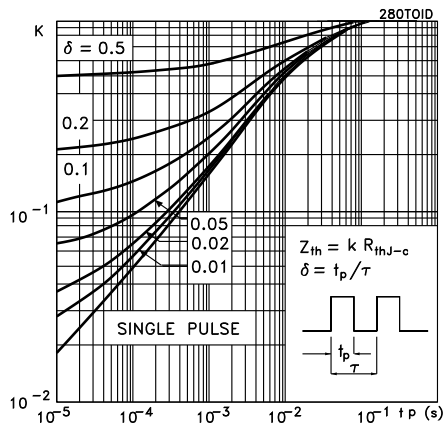
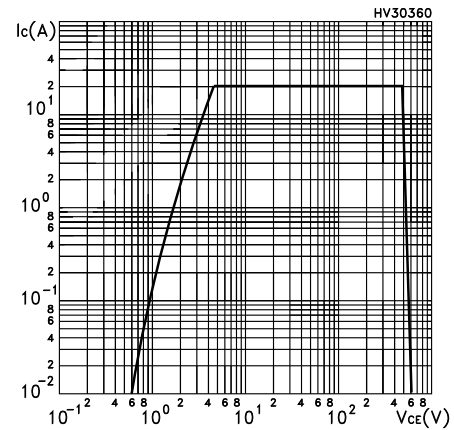
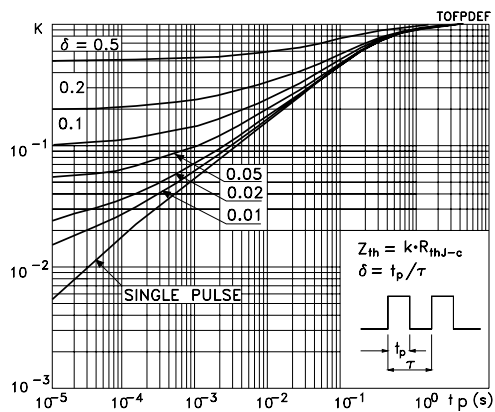
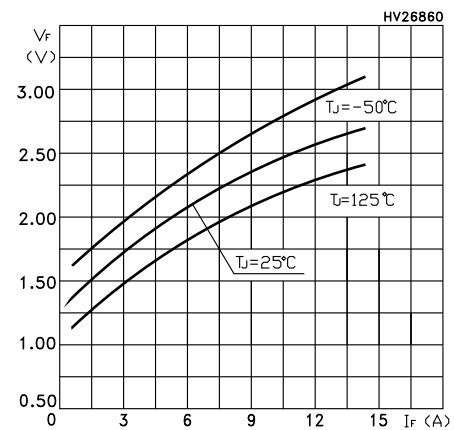
Figure 7. Normalized gate threshold voltage vs temperature

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

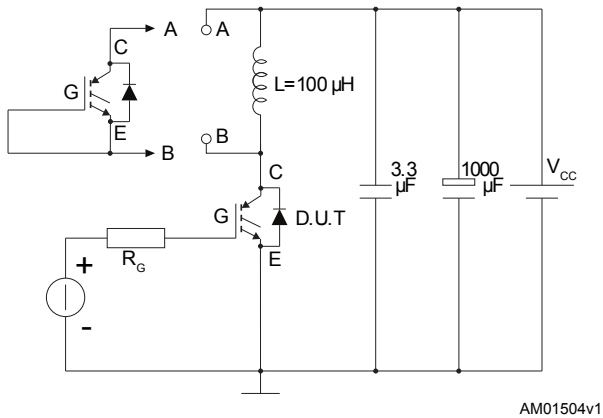


Figure 18. Gate charge test circuit

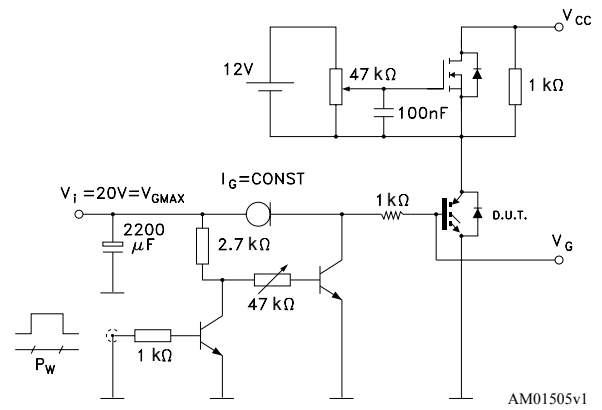


Figure 19. Switching waveform

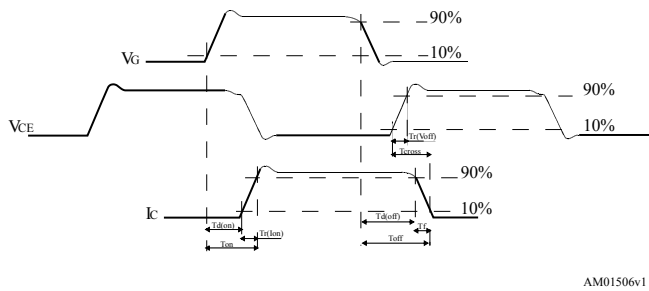
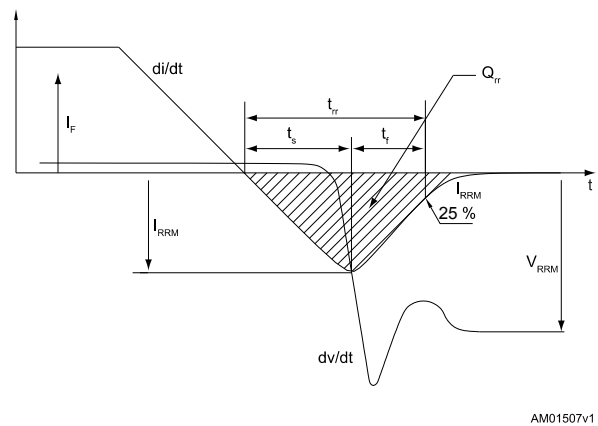


Figure 20. Diode reverse recovery waveform



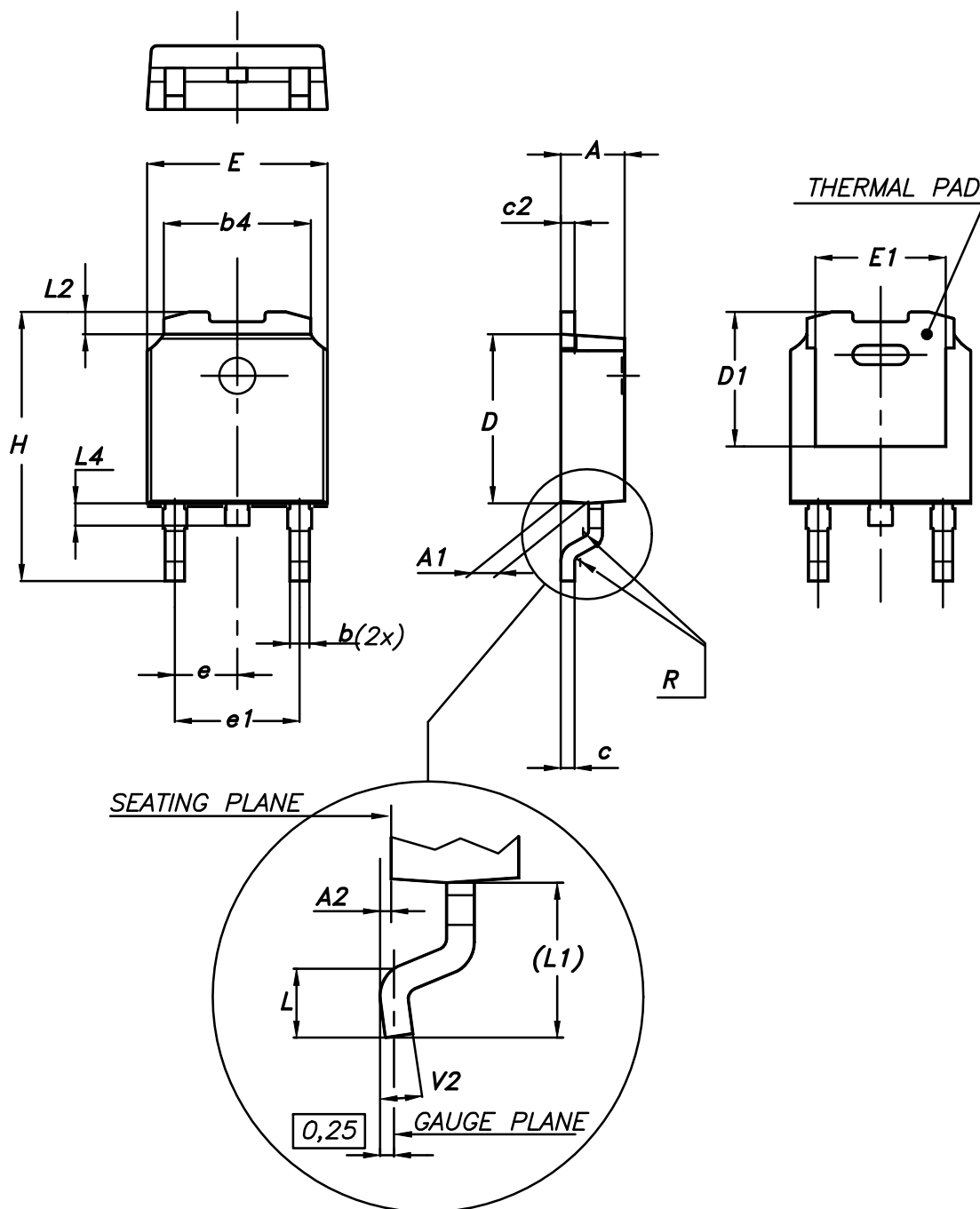


4 Package information

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



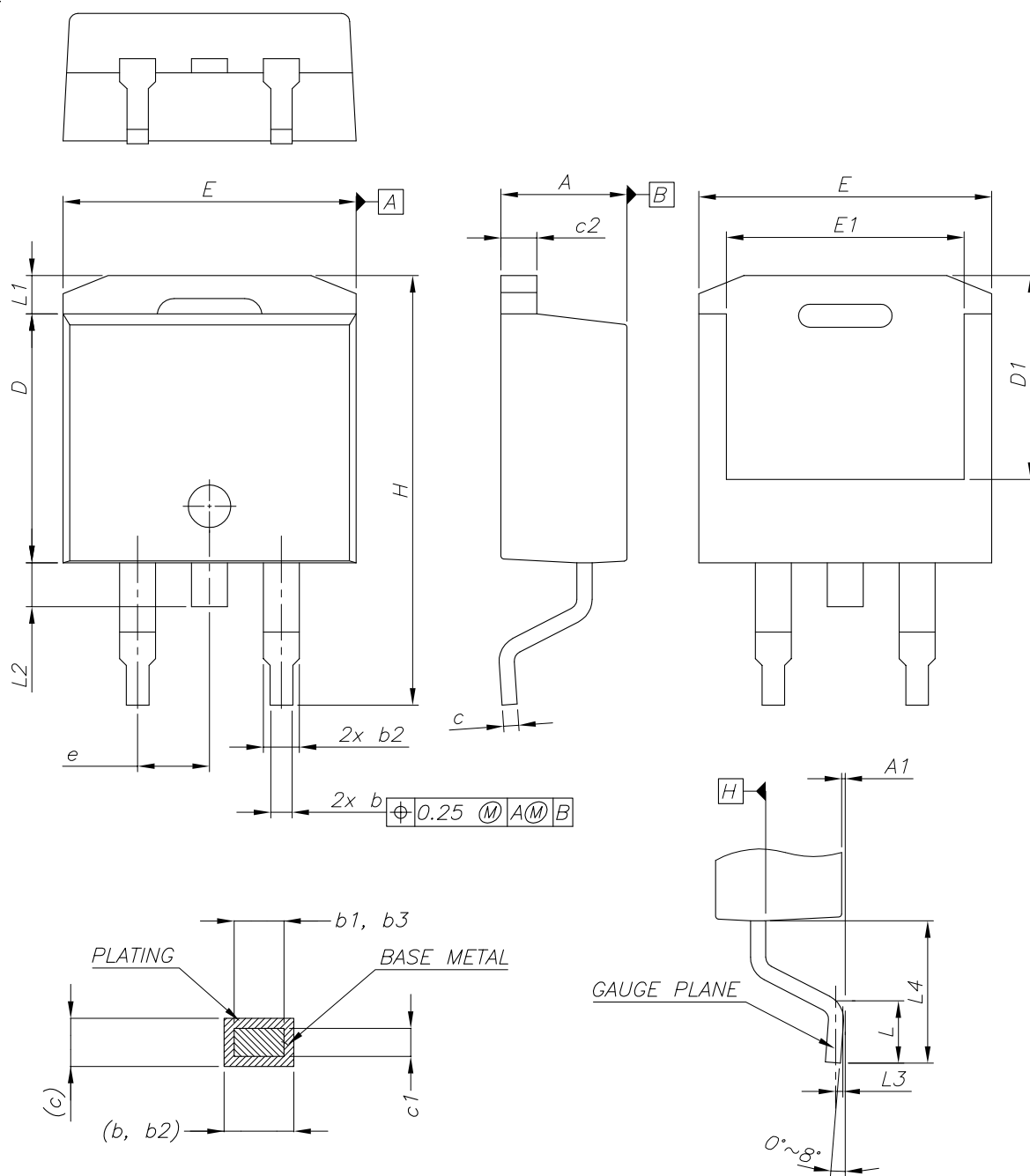
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Table 8. DPAK (TO-252) type A mechanical data

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

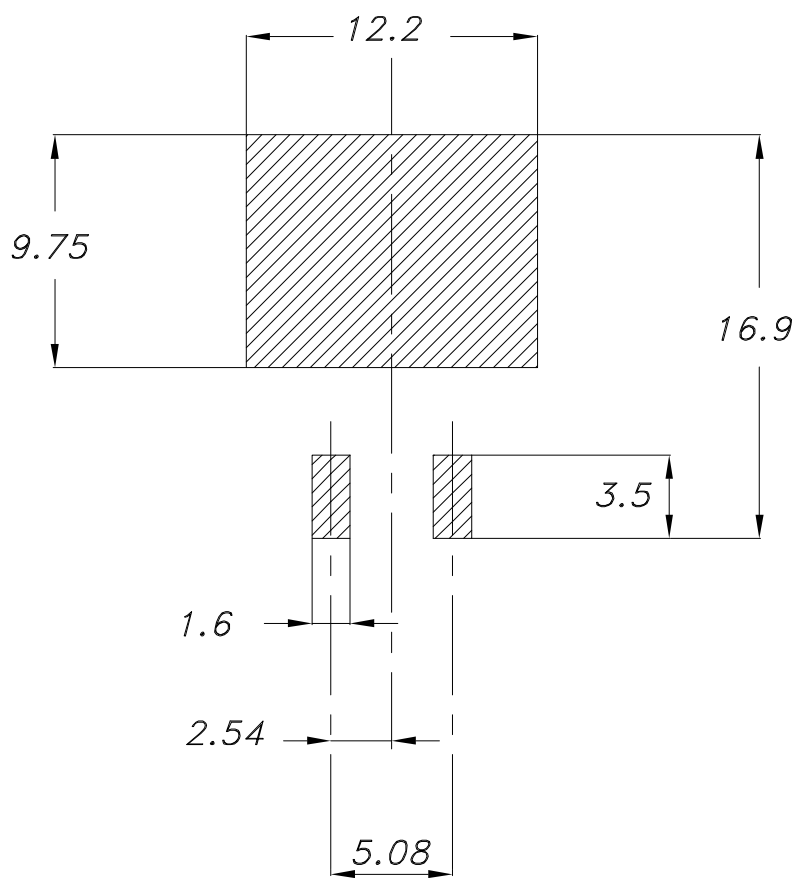


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Table 9. D²PAK (TO-263) type B mechanical data

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

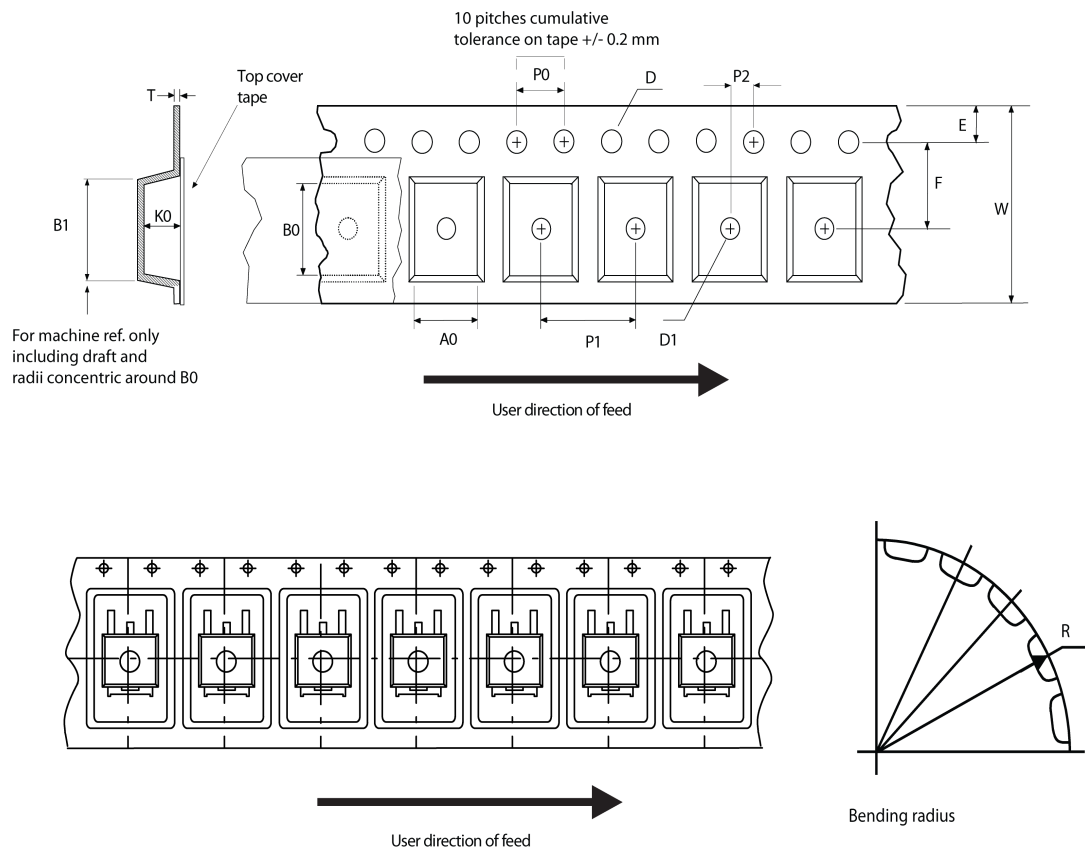
Figure 23. D²PAK (TO-263) recommended footprint (dimensions are in mm)



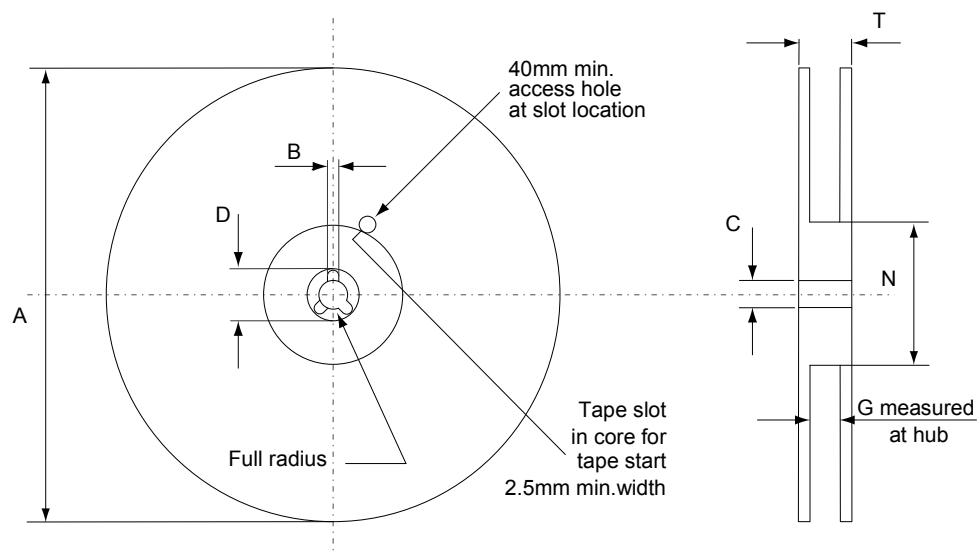
Footprint

4.2.1 Packing information

Figure 24. D²PAK tape outline



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Figure 25. D²PAK reel outline


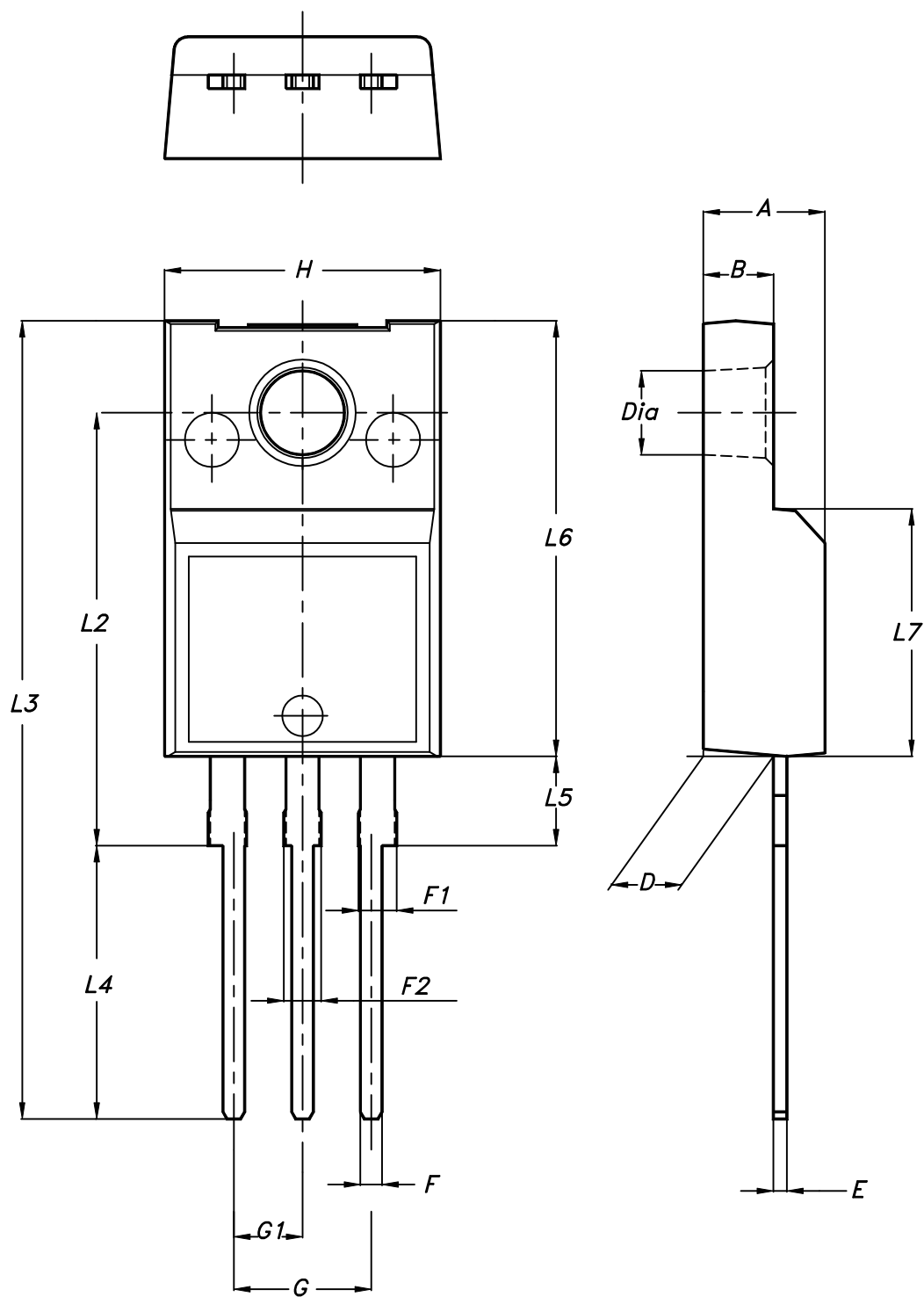
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Table 10. D²PAK tape and reel mechanical data

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



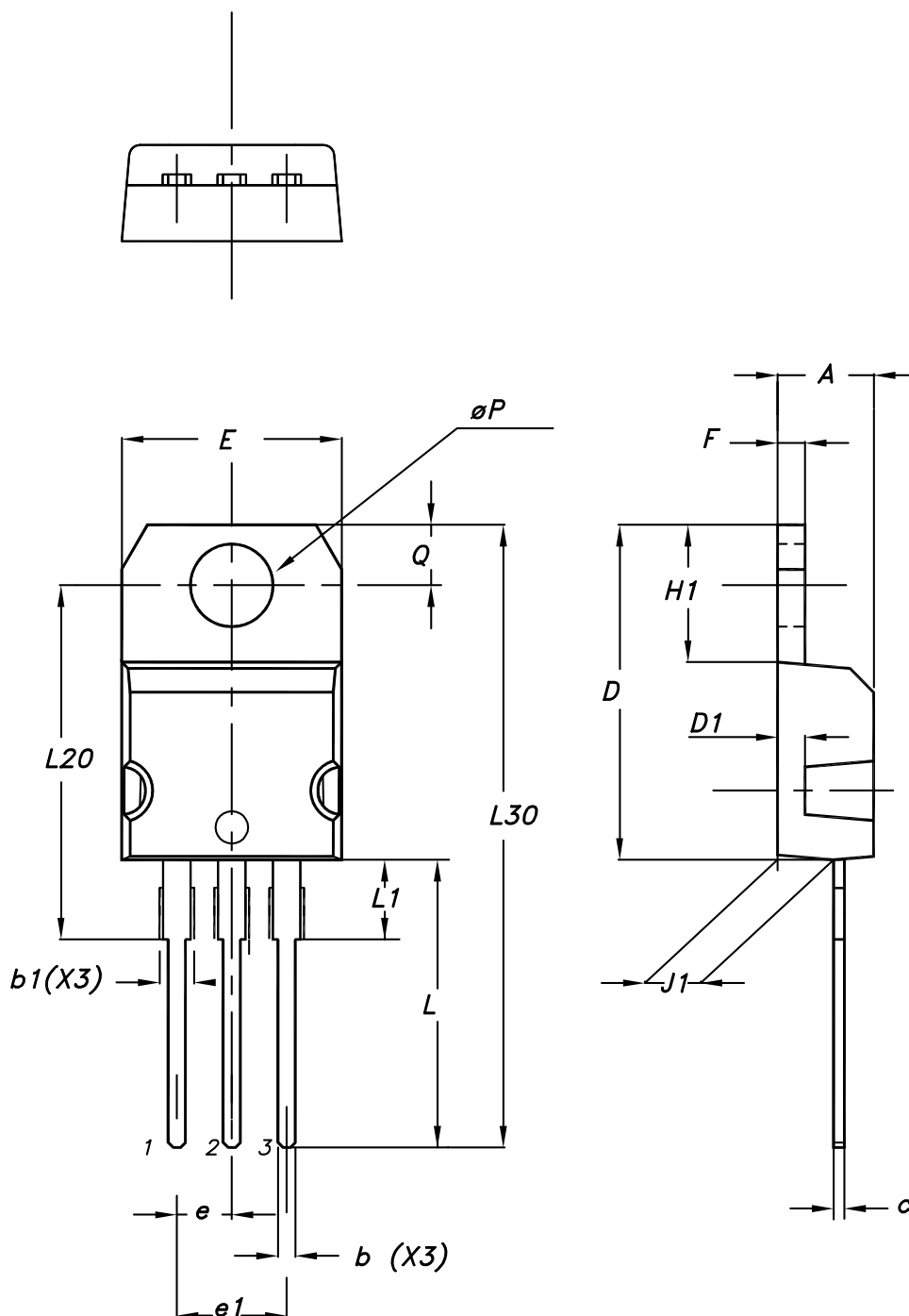
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Table 11. TO-220FP package mechanical data

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



0015988_typeA_Rev_22

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	D ² PAK	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 <i>Figure 10</i> .
26-Apr-2007	4	Inserted package I ² PAK
20-Nov-2017	5	<p>Part number STGB6NC60HD-1 has been moved to a separate datasheet.</p> <p>Updated information on cover page.</p> <p>Updated <i>Table 2: "Absolute maximum ratings"</i> and <i>Table 4: "Static characteristics"</i>.</p> <p>Updated <i>Section 2.1: "Electrical characteristics (curves)"</i>.</p> <p>Updated <i>Section 4: "Package information"</i>.</p> <p>Minor text changes</p>
23-Oct-2018	6	<p>Updated title in coverpage and Table 4. Dynamic characteristics.</p> <p>Minor text changes.</p>

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