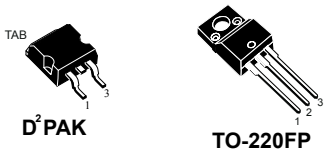
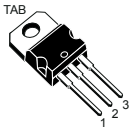
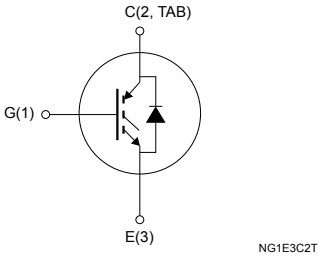
STGB19NC60KDT4, STGF19NC60KD, STGP19NC60KD

Datasheet

20 A, 600 V short-circuit rugged IGBT







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
- Short-circuit withstand time 10 µs
- IGBT co-packaged with ultra-fast freewheeling diode

Applications

- High frequency inverters
- 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.

Product status links
STGB19NC60KDT4
STGF19NC60KD
STGP19NC60KD

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK, TO-220	TO-220FP	
V_{CES}	Collector-emitter voltage (V_{GE} = 0 V)	600		V
I_C(1)	Continuous collector current at T_C = 25 °C	35	16	A
	Continuous collector current at T_C = 100 °C	20	10	
I_{CL}(2)	Turn-off latching current	75		A
I_{CP}(3)	Pulsed collector current	75		A
V_{GE}	Gate-emitter voltage	±20		V
I_F	Diode RMS forward current at T_C = 25 °C	20		A
I_{FSM}	Surge non repetitive forward current t_p = 10 ms sinusoidal	50		A
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_{scw}	Short-circuit withstand time V_{CE} = 300 V, T_J = 125 °C, R_G = 10 Ω, V_{GE} = 12 V	10		µs
P_{TOT}	Total power dissipation at T_C = 25 °C	125	32	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 and turn-off within RBSOA.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D²PAK, TO-220	TO-220FP	
R_{thJC}	Thermal resistance, junction-to-case IGBT	1.0	3.9	°C/W
	Thermal resistance, junction-to-case diode	3.0	5.6	
R_{thJA}	Thermal resistance, junction-to-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 = 12 A		2.0	2.75	V
		V_{GE} = 15 V, I_C = 12 A, T_J = 125 °C		1.65		
$V_{GE(th)}$	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

1. *Specified by design, not tested in production.*

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	-	1170	-	pF
C_{oes}	Output capacitance		-	127	-	pF
C_{res}	Reverse transfer capacitance		-	28	-	pF
Q_g	Total gate charge	V_{CC} = 480 V, I_C = 12 A, V_{GE} = 0 to 15 V (see Figure 18. Gate charge test circuit)	-	55	-	nC
Q_{ge}	Gate-emitter charge		-	11	-	nC
Q_{gc}	Gate-collector charge		-	26	-	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} = 480 V, I_C = 12 A,	-	30	-	ns
t_r	Current rise time	R_G = 10 Ω, V_{GE} = 15 V	-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	1450	-	A/µs
$t_{d(on)}$	Turn-on delay time	V_{CC} = 480 V, I_C = 12 A,	-	30	-	ns
t_r	Current rise time	R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C	-	8	-	ns
$(di/dt)_{on}$	Turn-on current slope	(see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	1380	-	A/µs
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 480 V, I_C = 12 A,	-	35	-	ns
$t_{d(off)}$	Turn-off delay time	R_G = 10 Ω, V_{GE} = 15 V	-	105	-	ns
t_f	Current fall time	(see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	85	-	ns
$t_r(V_{off})$	Off voltage rise time	V_{CC} = 480 V, I_C = 12 A,	-	65	-	ns
$t_{d(off)}$	Turn-off delay time	R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C	-	145	-	ns
t_f	Current fall time	(see Figure 16. Test circuit for inductive load switching and Figure 19. Switching waveform)	-	125	-	ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} (1)	Turn-on switching energy	V_{CE} = 480 V, I_C = 12 A,	-	165	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V	-	255	-	µJ
E_{ts}	Total switching energy	(see Figure 16. Test circuit for inductive load switching	-	420	-	µJ
E_{on} (1)	Turn-on switching energy	V_{CE} = 480 V, I_C = 12 A,	-	250	-	µJ
E_{off} (2)	Turn-off switching energy	R_G = 10 Ω, V_{GE} = 15 V, T_J = 125 °C	-	445	-	µJ
E_{ts}	Total switching energy	(see Figure 16. Test circuit for inductive load switching	-	695	-	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 = 12 A	-	1.9	-	V
		I_F = 12 A, T_J = 125 °C	-	1.6	-	
t_{rr}	Reverse recovery time	I_F = 12 A, V_R = 40 V, di/dt = 100 A/µs (see Figure 17. Diode reverse recovery waveform)	-	31	-	ns
Q_{rr}	Reverse recovery charge		-	30	-	nC
I_{rrm}	Reverse recovery current		-	2.0	-	A
t_{rr}	Reverse recovery time	I_F = 12 A, V_R = 40 V, di/dt = 100 A/µs,	-	50	-	ns
Qrr	Reverse recovery charge	T_J = 125 °C (see Figure 17. Diode reverse recovery waveform)	-	70	-	nC
I_{rr}	Reverse recovery current		-	4	-	A

2.1 Electrical characteristics (curves)

Figure 1. Typical output characteristics

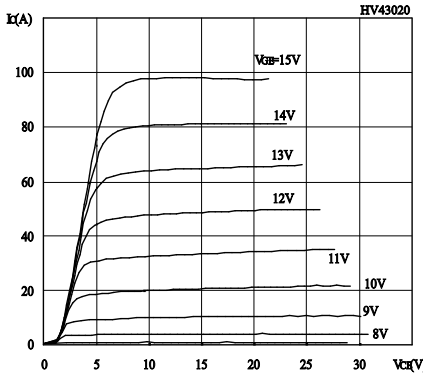


Figure 2. Typical transfer characteristics

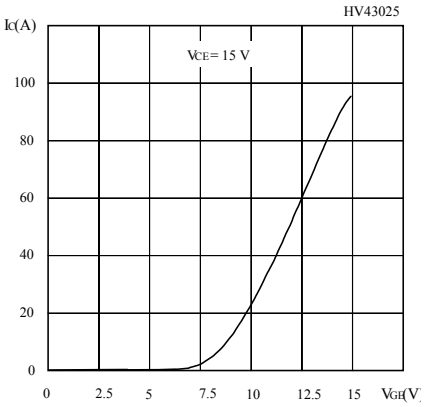


Figure 3. Typical collector-emitter on voltage vs temperature

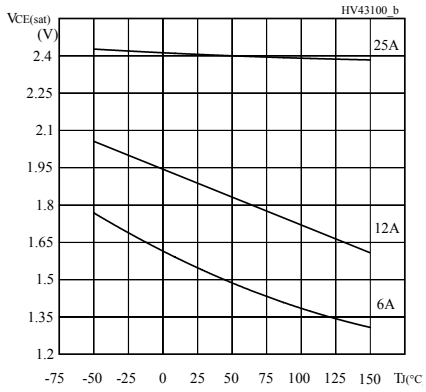


Figure 4. Typical gate charge characteristics

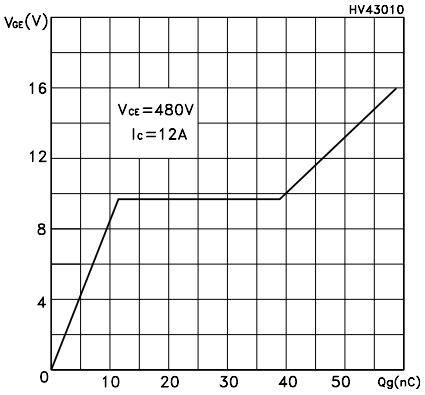


Figure 5. Typical capacitance characteristics

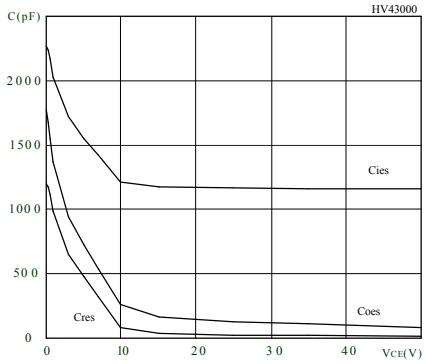


Figure 6. Normalized gate threshold vs temperature

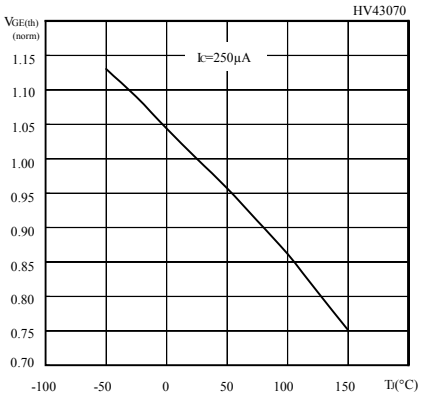


Figure 7. Typical collector-emitter on voltage vs collector current

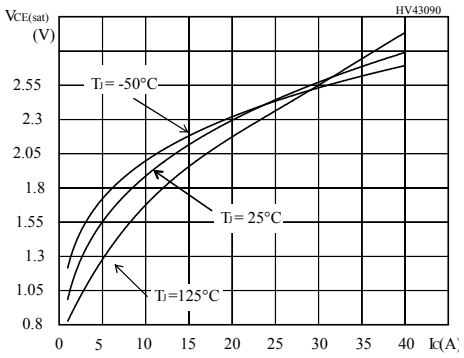


Figure 8. Normalized breakdown voltage vs temperature

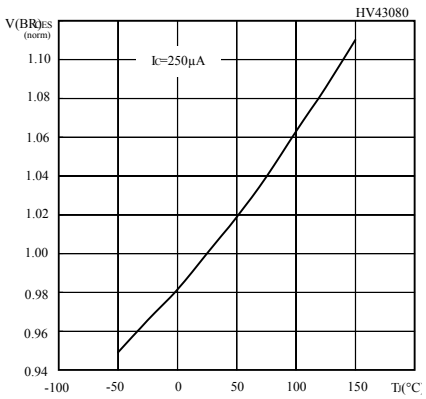


Figure 9. Typical switching energy vs temperature

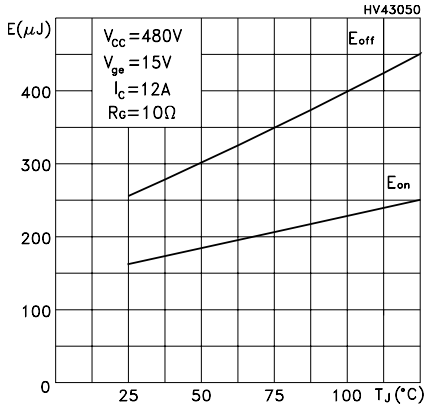


Figure 10. Typical switching energy vs gate resistance

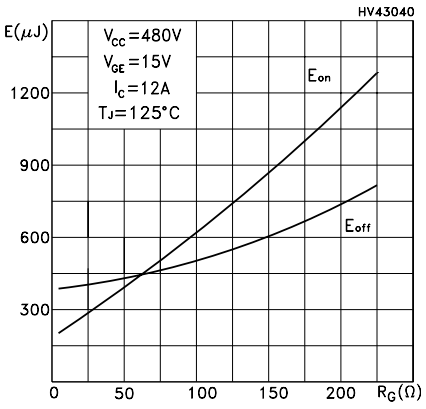


Figure 11. Typical switching energy vs collector current

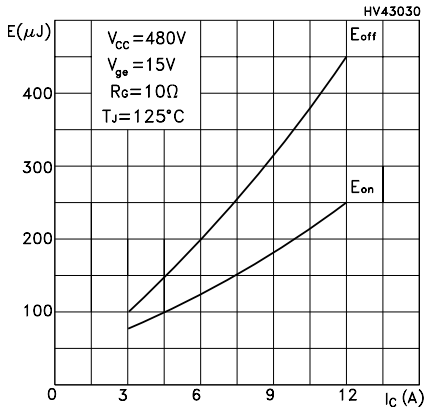


Figure 12. Turn-off SOA

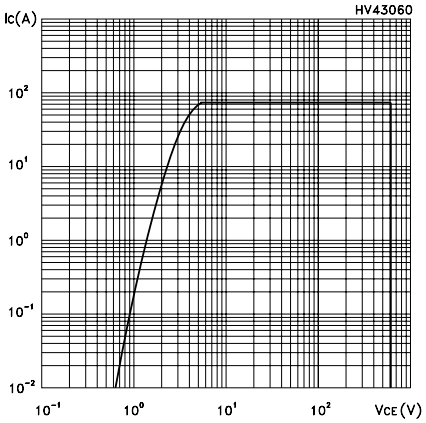


Figure 13. Emitter-collector diode characteristics

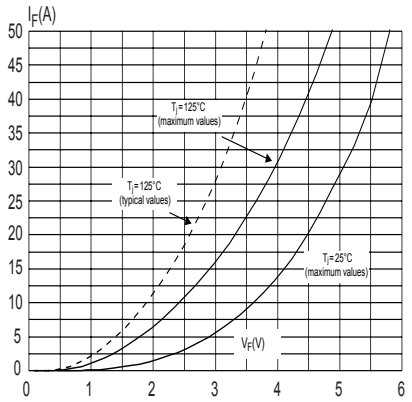


Figure 14. Normalized transient thermal impedance for D²PAK and TO-220

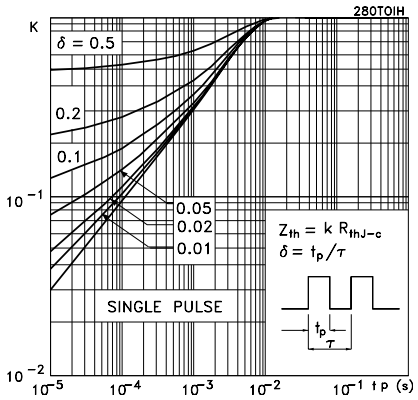
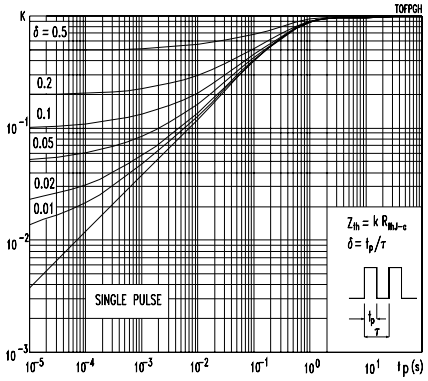


Figure 15. Normalized transient thermal impedance for TO-220FP



3 Test circuits

Figure 16. Test circuit for inductive load switching

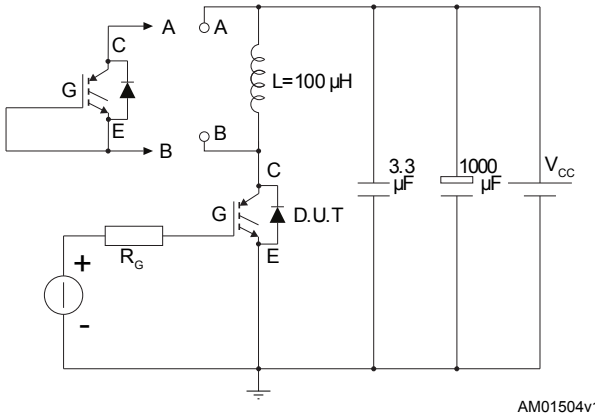


Figure 17. Diode reverse recovery waveform

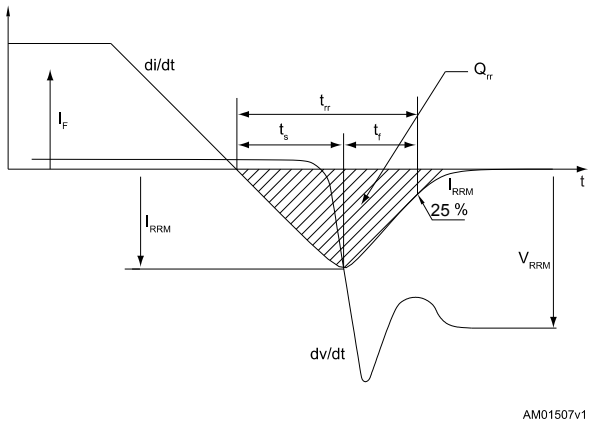


Figure 18. Gate charge test circuit

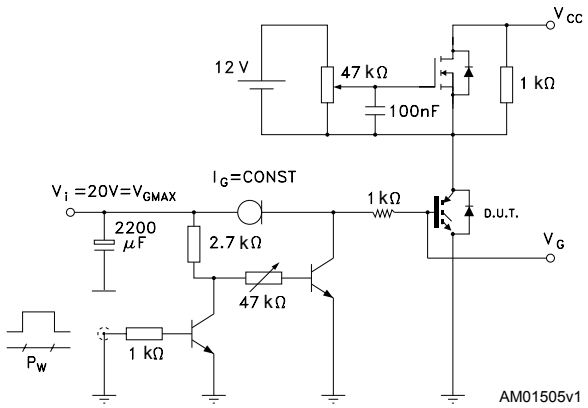
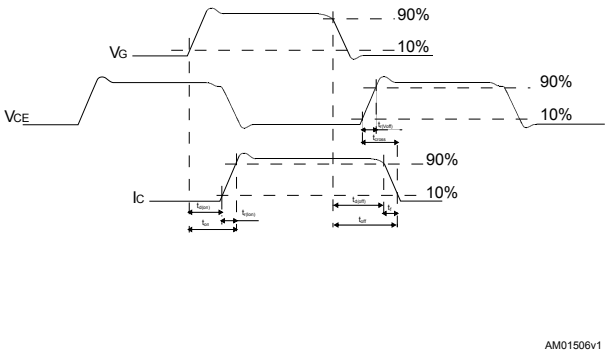


Figure 19. Switching waveform

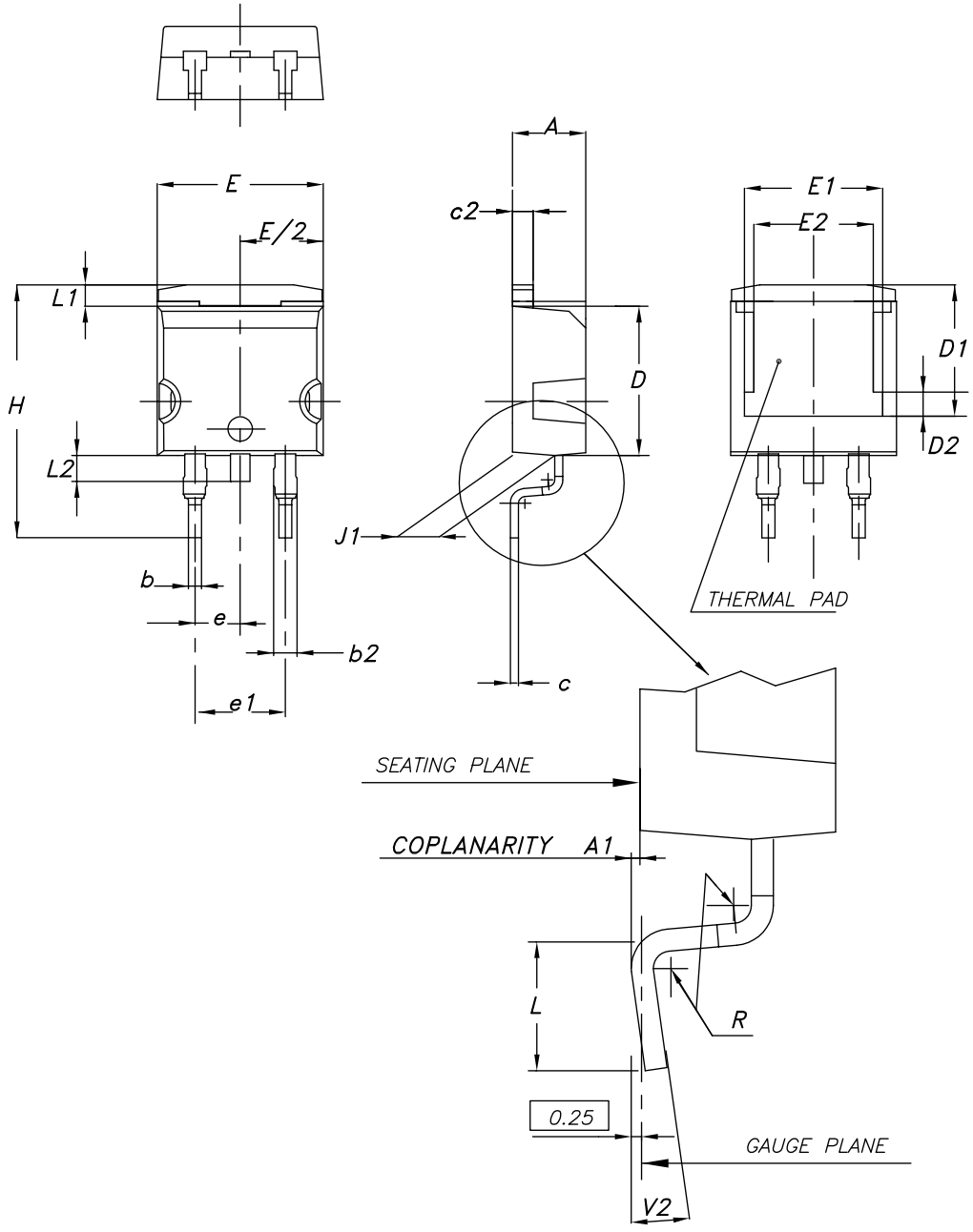


4 Package information

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 A2 package information

Figure 20. D²PAK (TO-263) type A2 package outline



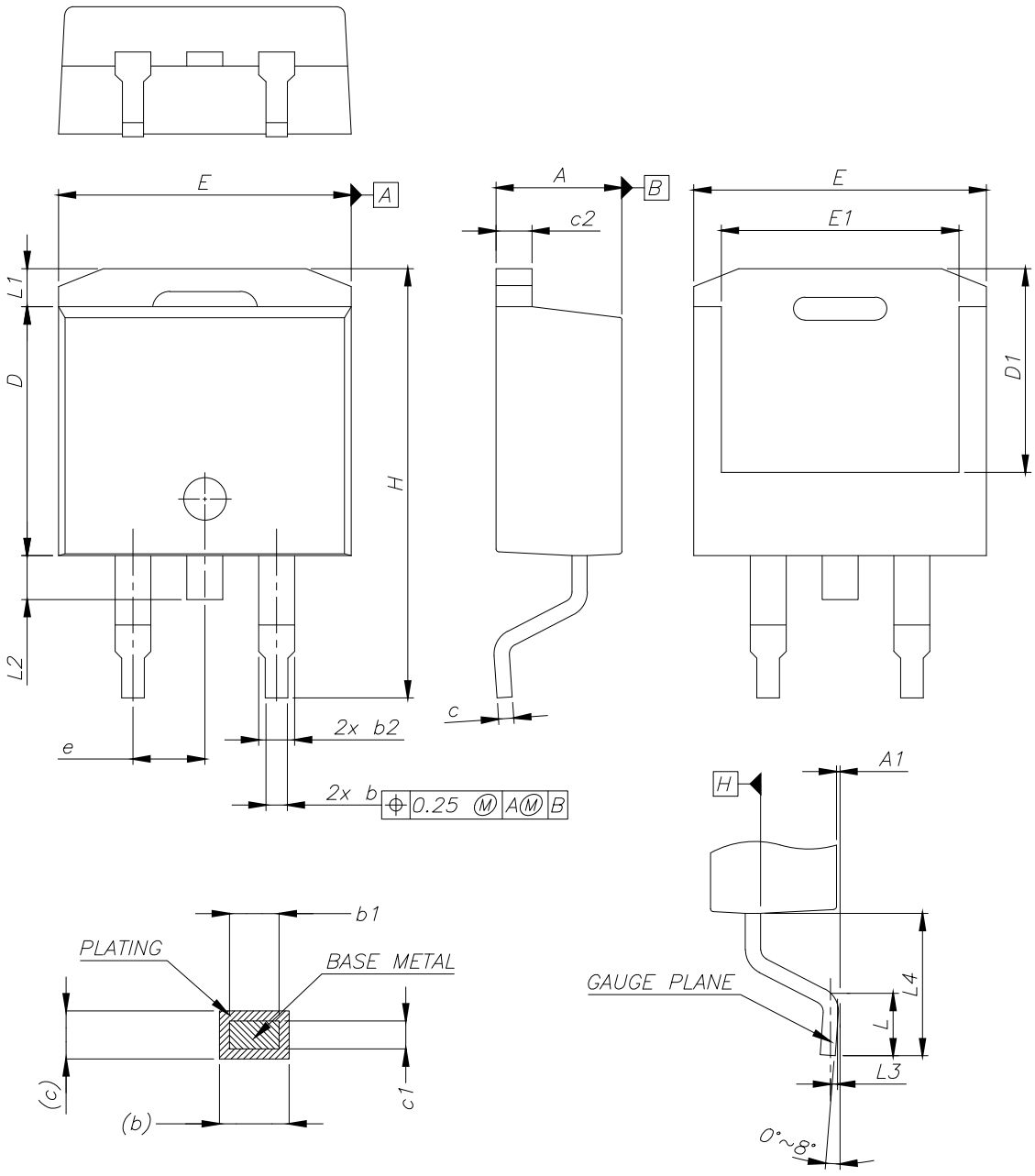
0079457_A2_27

Table 8. **D²PAK (TO-263) type A2 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

4.2 D²PAK (TO-263) type B package information

Figure 21. **D²PAK (TO-263) type B package outline**

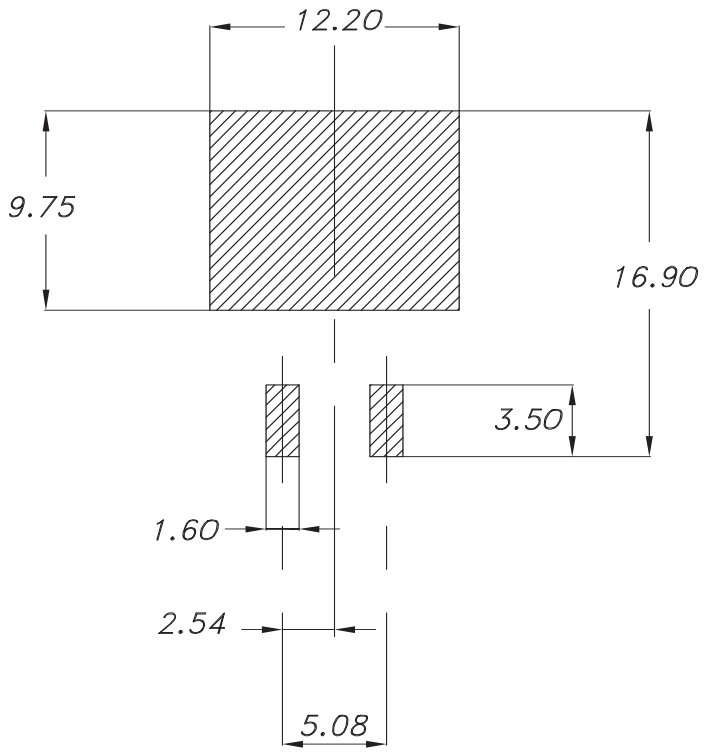


0079457_27_B

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

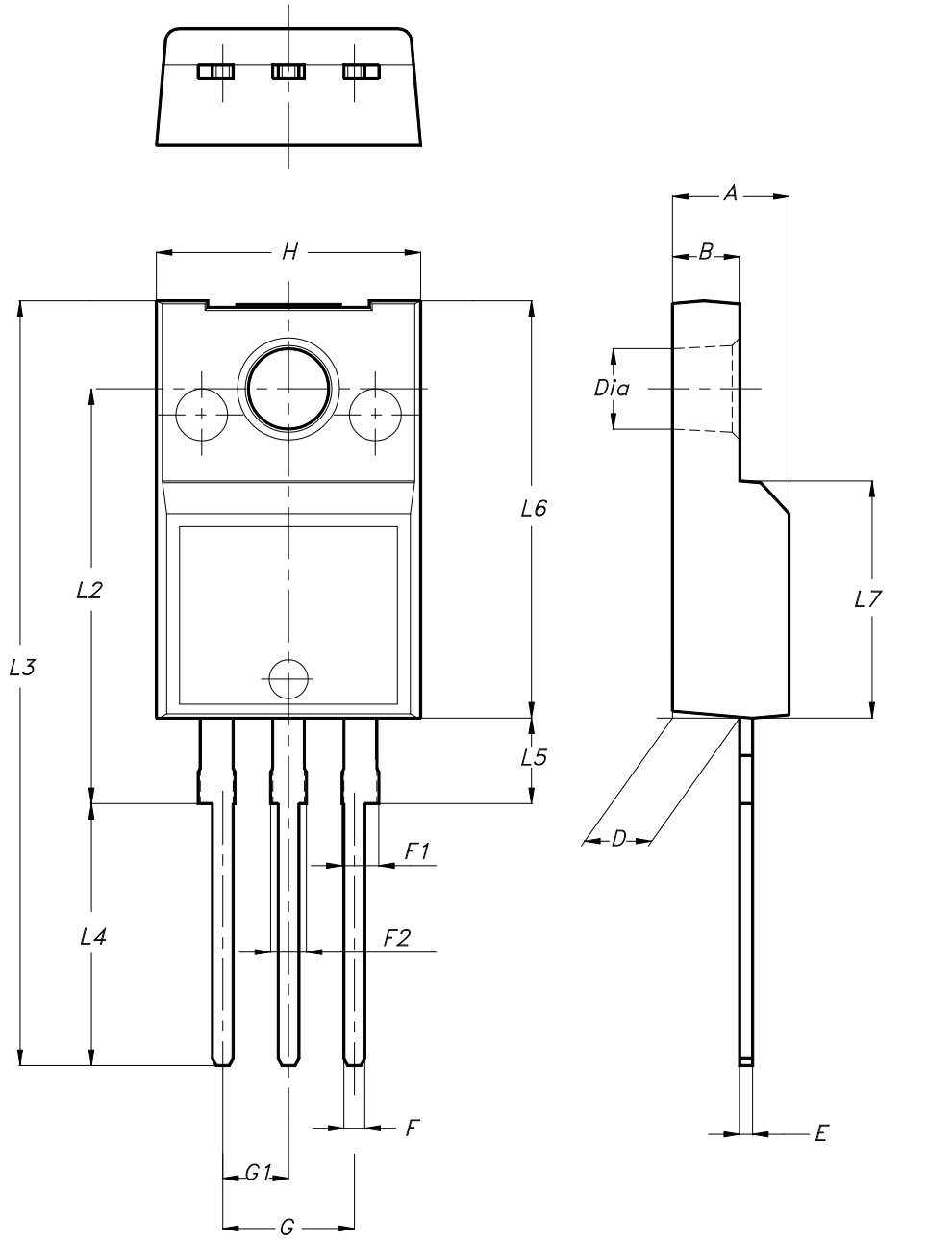
Dim.	mm		
	Min.	Typ.	Max.
A	4.36		4.56
A1	0.00		0.25
b	0.70		0.90
b1	0.51		0.89
b2	1.17		1.37
c	0.38		0.694
c1	0.38		0.534
c2	1.19		1.34
D	8.60		9.00
D1	6.90		7.50
E	10.15		10.55
E1	8.10		8.70
e	2.54 BSC		
H	15.00		15.60
L	1.90		2.50
L1			1.65
L2			1.78
L3		0.25	
L4	4.78		5.28

Figure 22. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



4.3 TO-220FP type B package information

Figure 23. **TO-220FP type B package outline**



7012510_B_rev.14

Table 10. **TO-220FP type B package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.4 TO-220 type A package information

Figure 24. **TO-220 type A package outline**

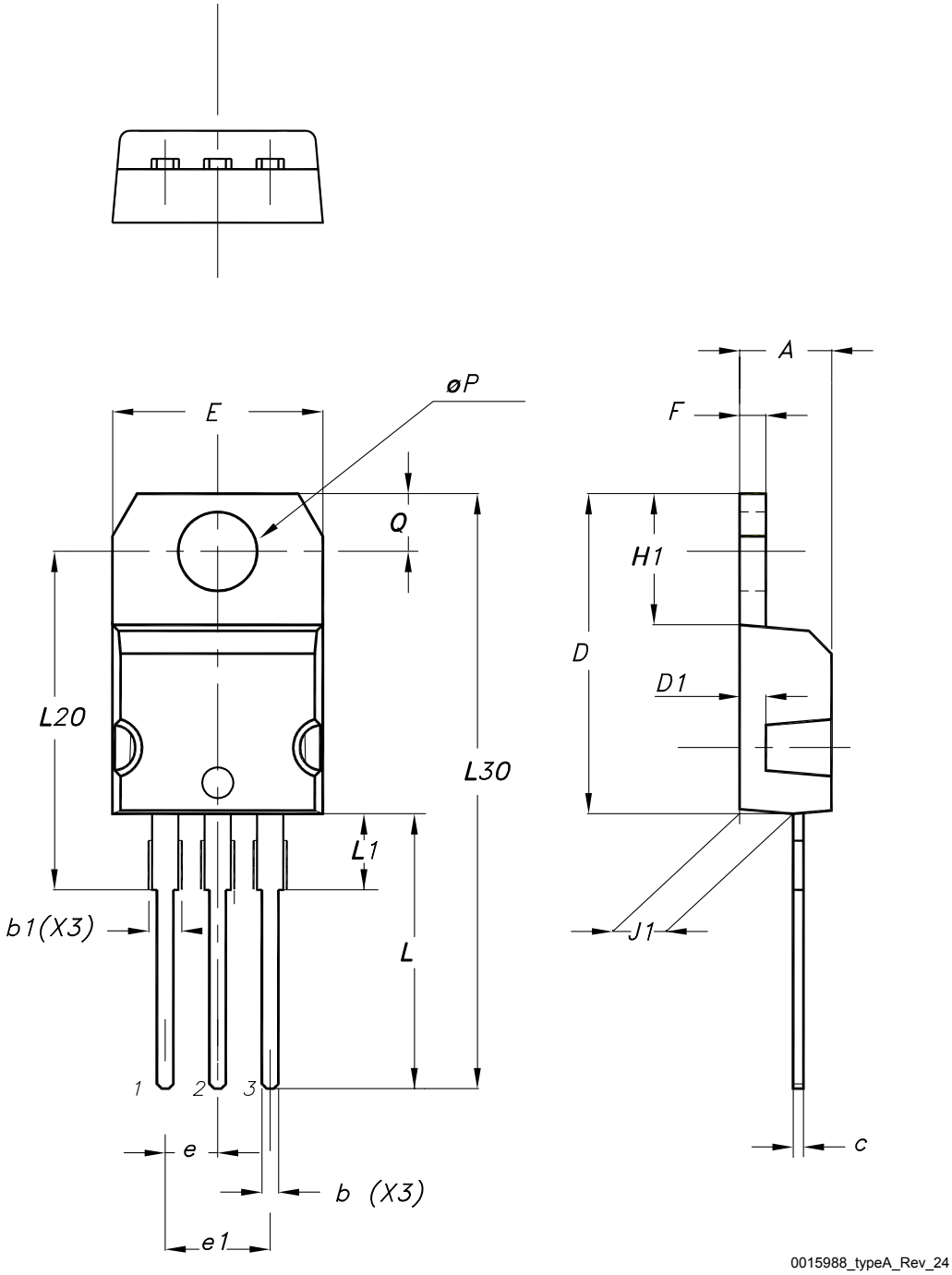
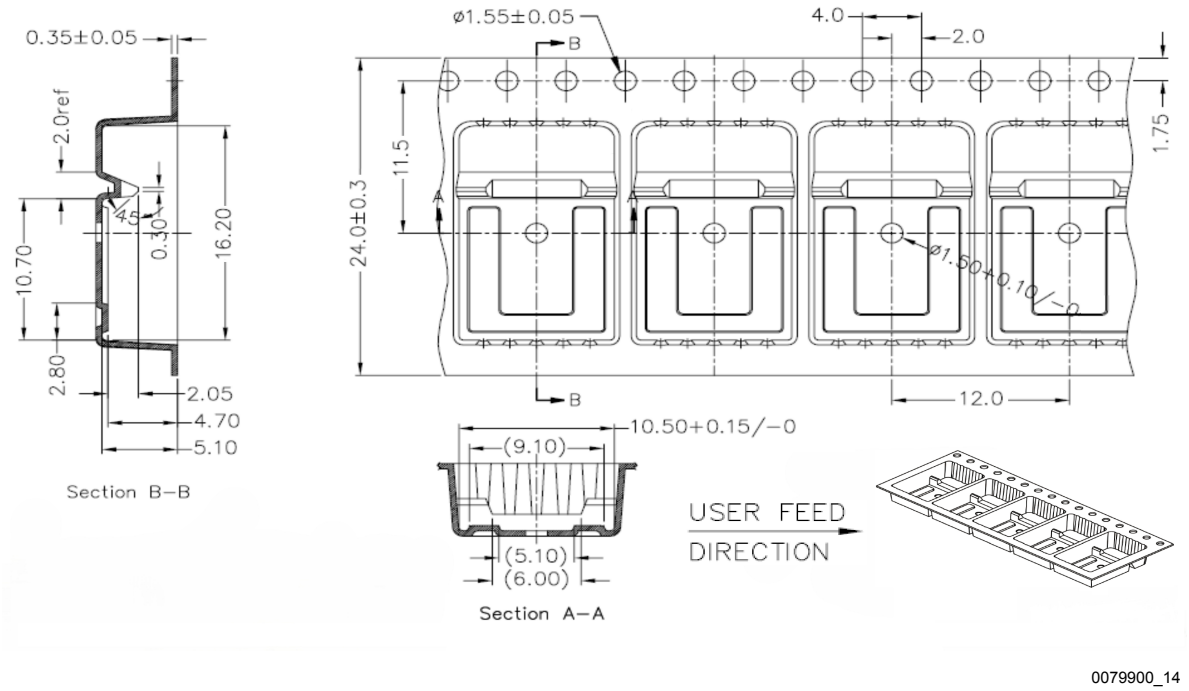


Table 11. **TO-220 type A package mechanical data**

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

4.5 D²PAK packing information

Figure 25. **D²PAK tape drawing (dimensions are in mm)**



Revision history

Table 12. **Document revision history**

Date	Revision	Changes
08-May-2008	1	Initial release
28-May-2008	2	– Value on Table 3: Thermal resistance has been changed. – Inserted Figure 16: Thermal impedance for TO-220, D²PAK and Figure 17: Thermal impedance for TO-220FP
31-Jul-2012	3	Added: *Figure 18* and *Figure 19* on page 8.
17-Jul-2017	4	Modified internal schematic diagram on cover page. Modified *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"*, and *Table 4: "Static characteristics"*. Modified *Figure 3: "Transfer characteristics"*, *Figure 4: "Collectoremitter on voltage vs temperature"* and *Figure 8: "Collector-emitter on voltage vs collector current"*. Updated *Section 4: "Package information"*. Minor text changes.
13-Jun-2025	5	Updated Section 4: Package information. Minor text changes.