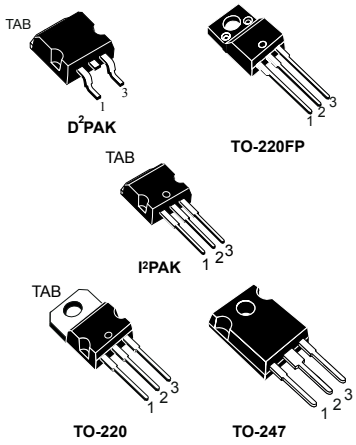
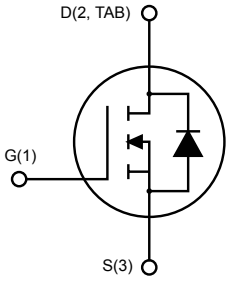
STB42N65M5, STF42N65M5, STI42N65M5
STP42N65M5, STW42N65M5

Datasheet

N-channel 650 V, 70 mΩ typ., 33 A, MDmesh M5 Power MOSFETs in D²PAK, TO-220FP, I²PAK, TO-220 and TO-247 packages





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STPOWER

Product status
STB42N65M5
STF42N65M5
STI42N65M5
STP42N65M5
STW42N65M5

Features

Order codes	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D	Package
STB42N65M5	710 V	79 mΩ	33 A	D²PAK
STF42N65M5				TO-220FP
STI42N65M5				I²PAK
STP42N65M5				TO-220
STW42N65M5				TO-247

- Extremely low $R_{DS(on)}$
- Low gate charge and input capacitance
- Excellent switching performance
- 100% avalanche tested

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs based on the MDmesh M5 innovative vertical process technology combined with the well-known PowerMESH horizontal layout. The resulting products offer extremely low on-resistance, making them particularly suitable for applications requiring high power and superior efficiency.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK, I²PAK, TO-220, TO-247	TO-220FP	
V_{GS}	Gate-source voltage	±25		V
I_D	Drain current (continuous) at T_C = 25 °C	33	33(1)	A
	Drain current (continuous) at T_C = 100 °C	20.8	20.8 (1)	A
I_{DM}(2)	Drain current (pulsed)	132	132	A
P_{TOT}	Total power dissipation at T_C = 25 °C	190	40	W
dv/dt(3)	Peak diode recovery voltage slope	15		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		2500	V
T_j	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 33 A, di/dt ≤ 400 A/µs, V_{DD} = 400 V, $V_{DS(peak)}$ < $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value					Unit
		D²PAK	I²PAK	TO-220	TO-247	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.66				3.1	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient		62.5		50	62.5	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	30					°C/W

1. *When mounted on an 1 inch² FR-4, 2 Oz copper board.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_{jmax})	11	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	950	mJ

2 Electrical characteristics

(T_{CASE} = 25 °C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS} = 0 V	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 650 V			1	µA
		V_{GS} = 0 V, V_{DS} = 650 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate body leakage current	V_{GS} = ±25 V, V_{DS}= 0 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on- resistance	V_{GS} = 10 V, I_D = 16.5 A		70	79	mΩ

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	4650	-	pF
C_{oss}	Output capacitance			110		
C_{rss}	Reverse transfer capacitance			3.2		
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	100	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related			285	-	
R_g	Gate input resistance	f = 1 MHz, I_D = 0 A	-	1.1	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 33 A, V_{GS} = 0 to 10 V (see Figure 20. Test circuit for gate charge behavior)	-	98	-	nC
Q_{gs}	Gate-source charge			28	-	
Q_{gd}	Gate-drain charge			39		

1. *$C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*
2. *$C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	V_{DD} = 400 V, I_D = 20 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 21. Test circuit for inductive load switching and diode recovery times and Figure 24. Switching time waveform)	-	52	-	ns
$t_{r(v)}$	Voltage rise time			8.4		
$t_{f(i)}$	Current fall time			8.7		
$t_{c(off)}$	Crossing time			14		

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		33	A
I_{SDM} (1)	Source-drain current (pulsed)				132	
V_{SD} (2)	Forward on voltage	I_{SD} = 33 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 33 A, di/dt = 100 A/µs	-	400		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V		7		µC
I_{RRM}	Reverse recovery current	(see Figure 21. Test circuit for inductive load switching and diode recovery times)		35		A
t_{rr}	Reverse recovery time	I_{SD} = 33 A, di/dt = 100 A/µs	-	532		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_j = 150 °C		10		µC
I_{RRM}	Reverse recovery current	(see Figure 21. Test circuit for inductive load switching and diode recovery times)		38		A

1. *Pulse width limited by safe operating area.*
2. *Pulsed: pulse duration = 300 µs, duty cycle 1.5%.*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for D²PAK, I²PAK, TO-220

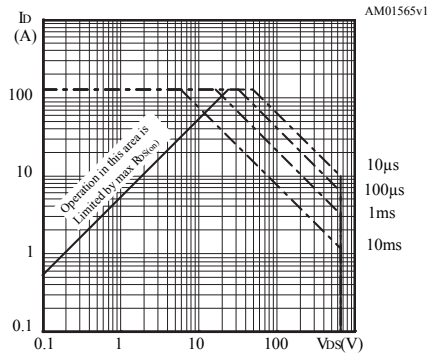


Figure 2. Thermal impedance for D²PAK, I²PAK, TO-220

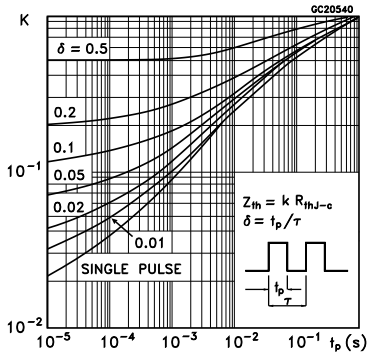


Figure 3. Safe operating area for TO-247

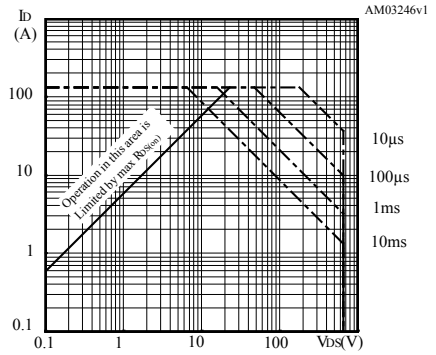


Figure 4. Thermal impedance for TO-247

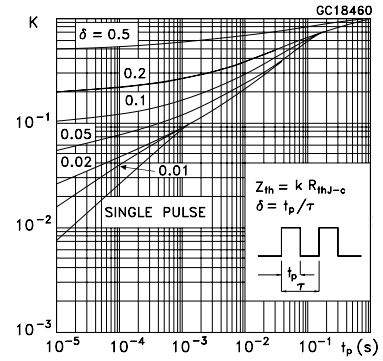


Figure 5. Safe operating area for TO-220FP

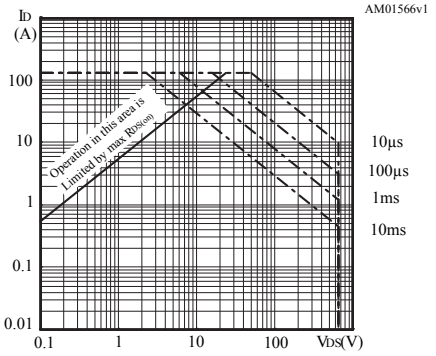


Figure 6. Thermal impedance for TO-220FP

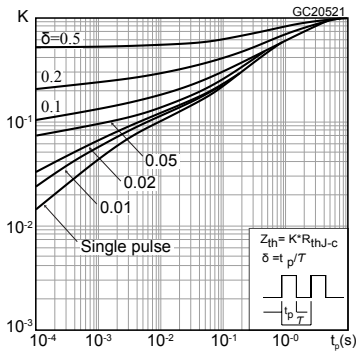


Figure 7. Output characteristics

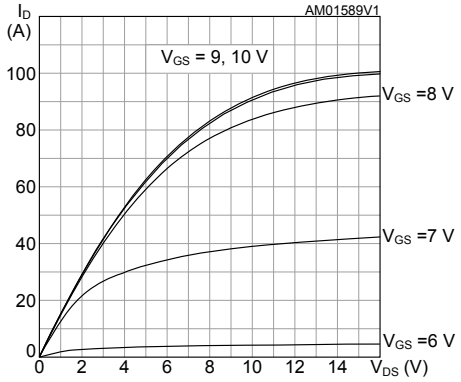


Figure 8. Transfer characteristics

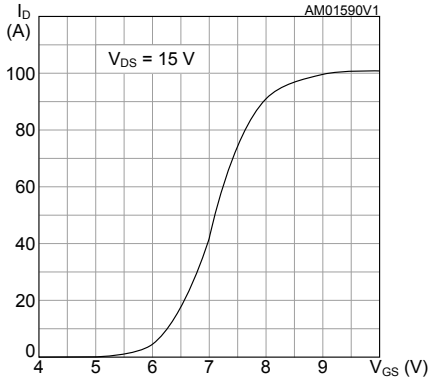


Figure 9. Gate charge vs gate-source voltage

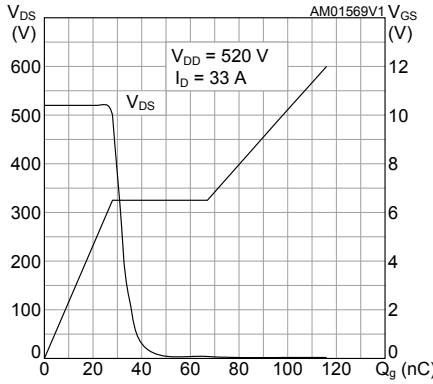


Figure 10. Static drain-source on-resistance

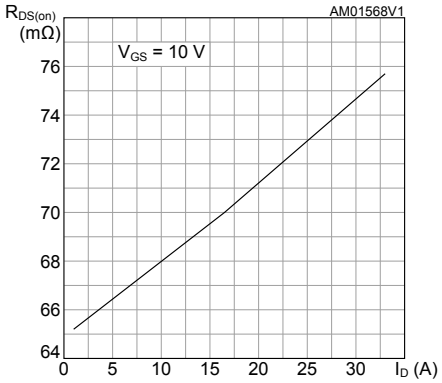


Figure 11. Capacitance variations

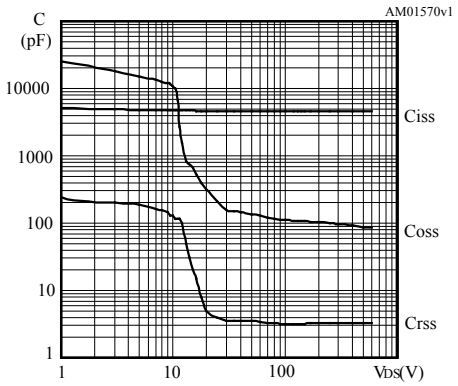


Figure 12. Output capacitance stored energy

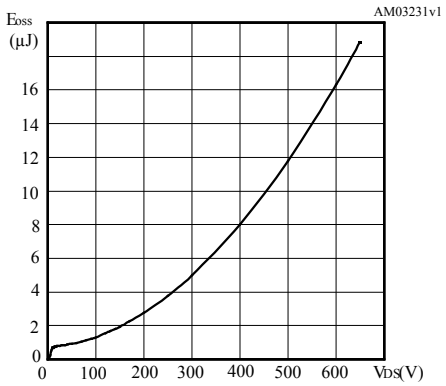


Figure 13. Normalized gate threshold voltage vs temperature

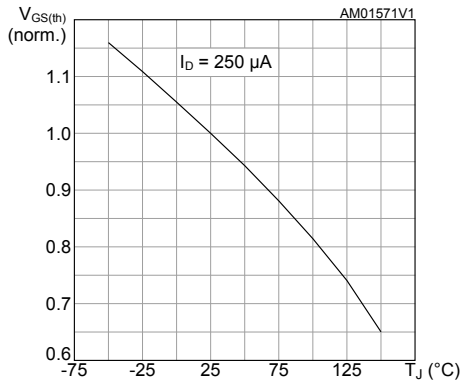


Figure 14. Normalized on-resistance vs temperature

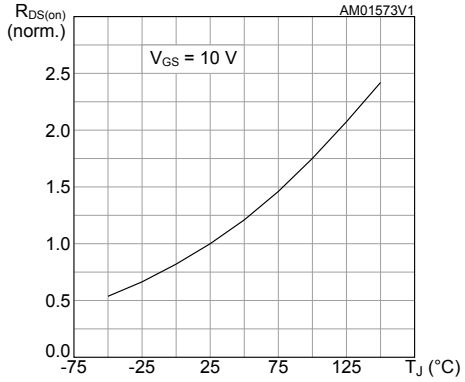


Figure 15. Source-drain diode forward characteristics

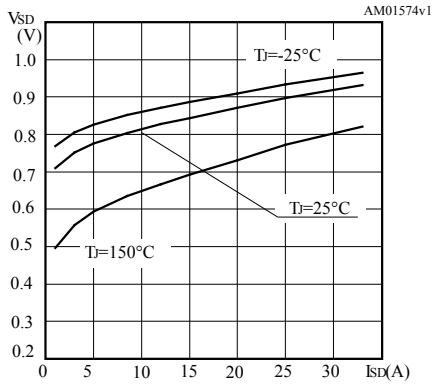


Figure 16. Normalized $V_{(BR)DSS}$ vs temperature

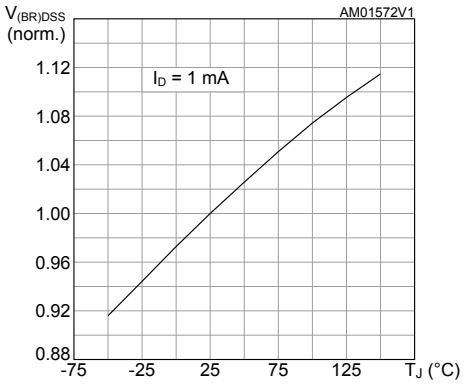
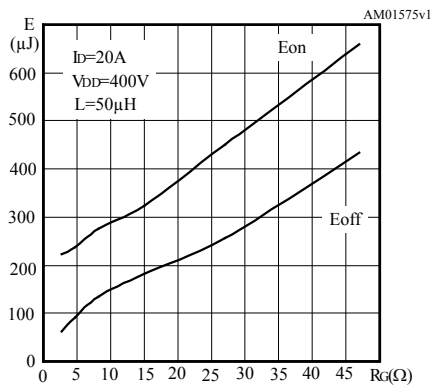


Figure 17. Switching energy vs gate resistance



Note: E_{on} including reverse recovery of a SiC diode.

3 Test circuits

Figure 19. Test circuit for resistive load switching times

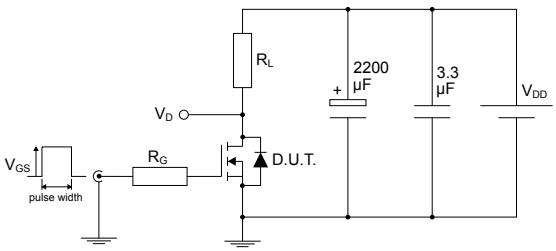


Figure 20. Test circuit for gate charge behavior

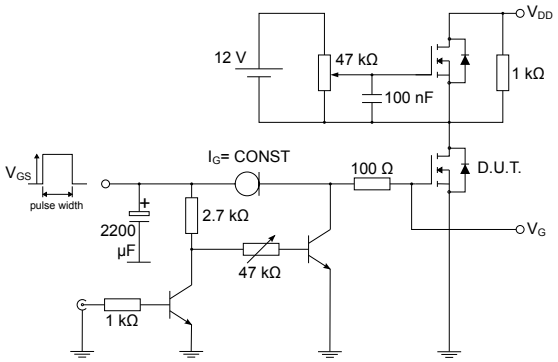


Figure 21. Test circuit for inductive load switching and diode recovery times

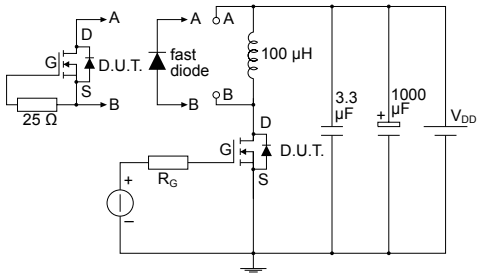


Figure 22. Unclamped inductive load test circuit

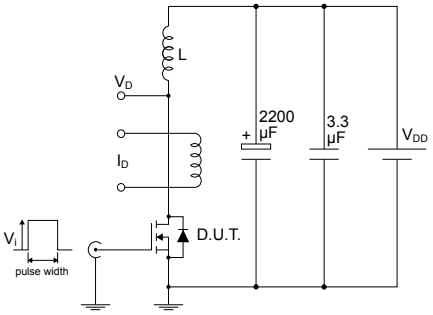


Figure 23. Unclamped inductive waveform

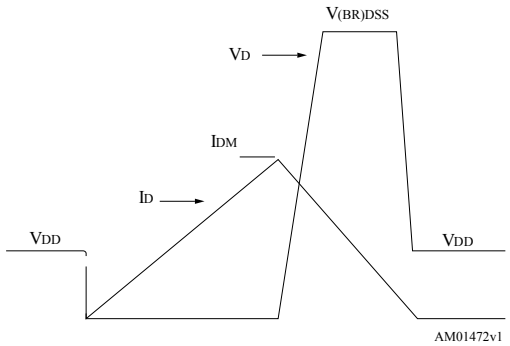
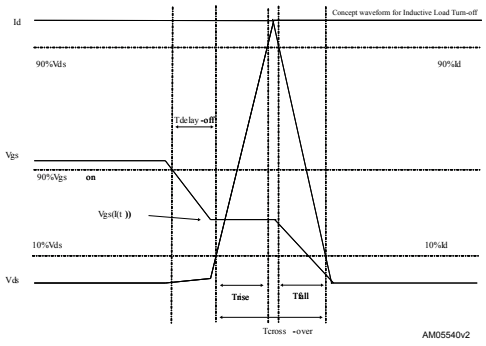


Figure 24. Switching time waveform



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 A2 package information

Figure 25. D²PAK (TO-263) type A2 package outline

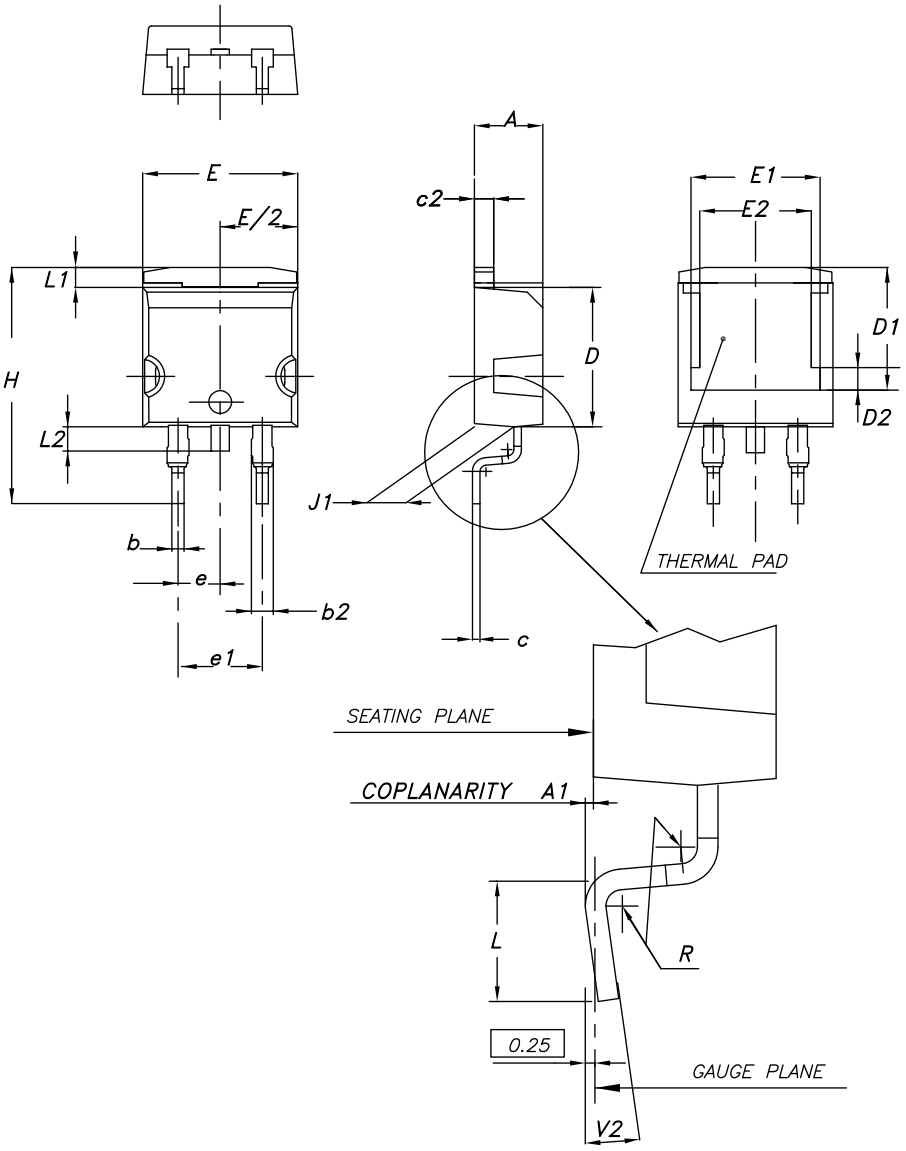


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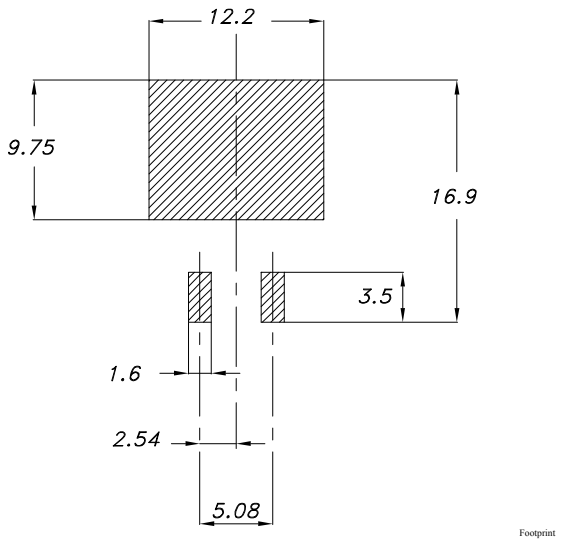
Table 8. **D²PAK (TO-263) type A2 package mechanical data**

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°

Figure 26. **D²PAK (TO-263) recommended footprint (dimensions are in mm)**



4.2 D²PAK packing information

Figure 27. **D²PAK tape outline**

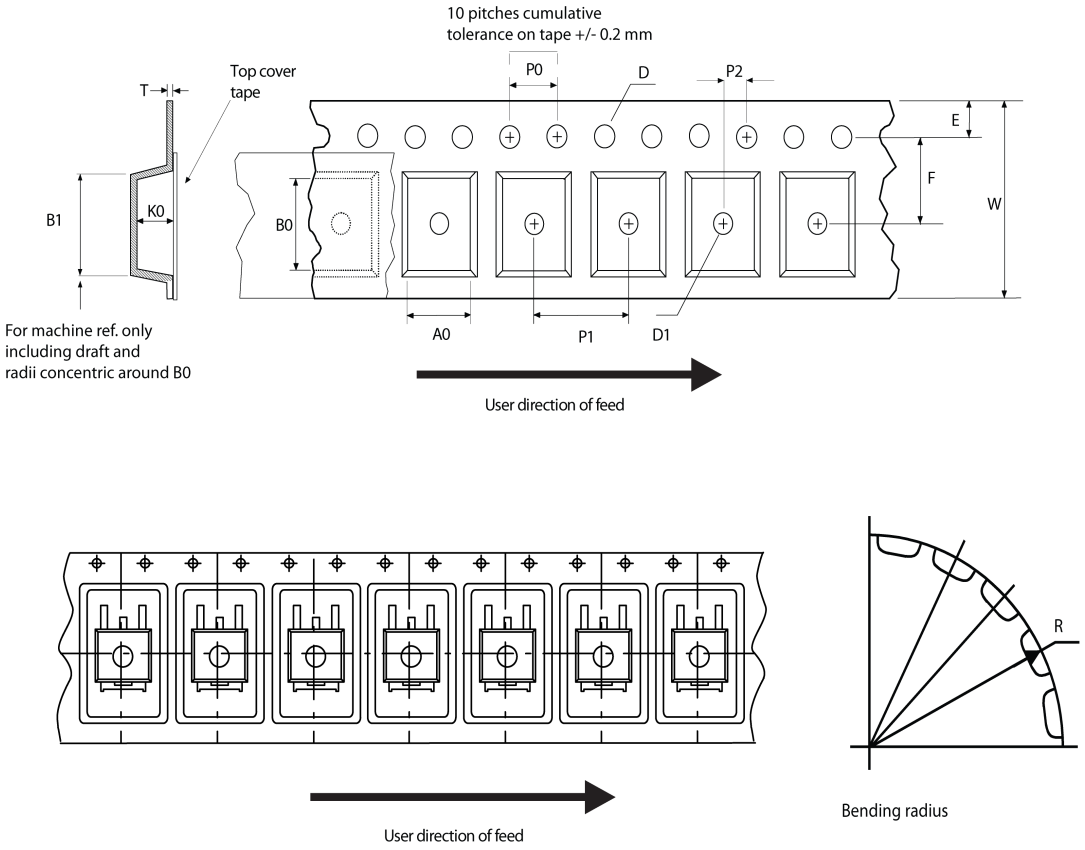


Figure 28. **D²PAK reel outline**

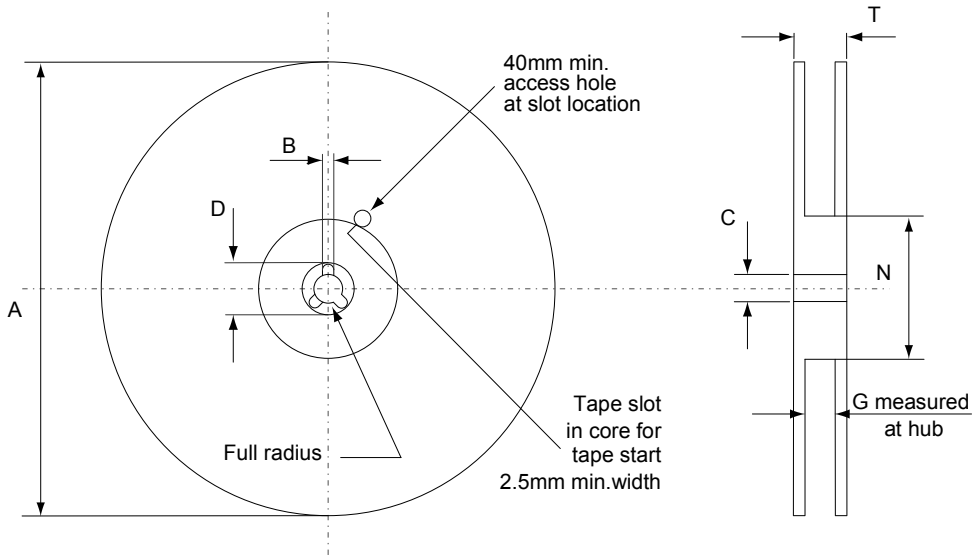


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Table 9. **D²PAK tape and reel mechanical data**

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 29. **TO-220FP package outline**

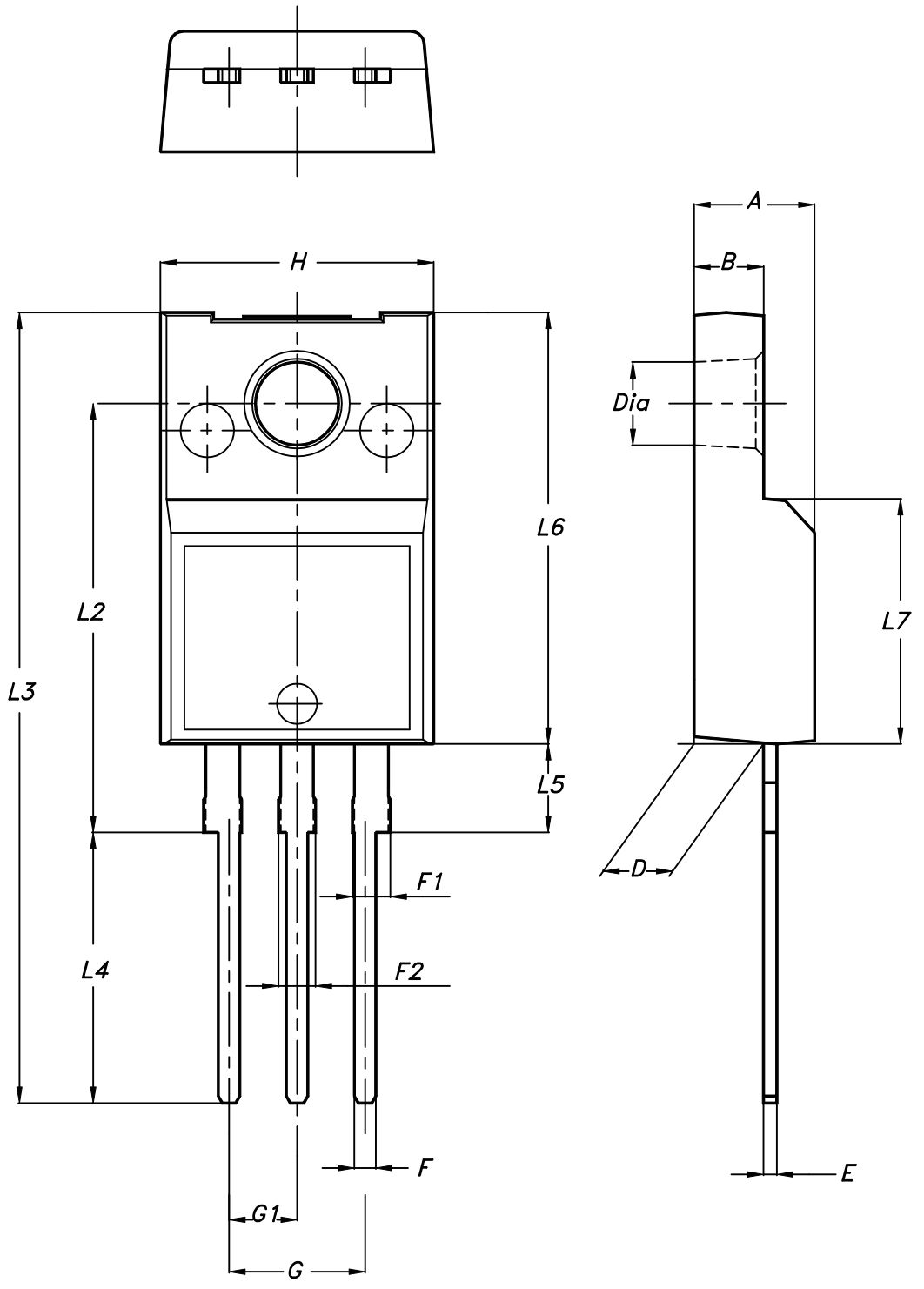

Table 10. **TO-220FP package mechanical data**

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 I²PAK package information

Figure 30. I²PAK package outline

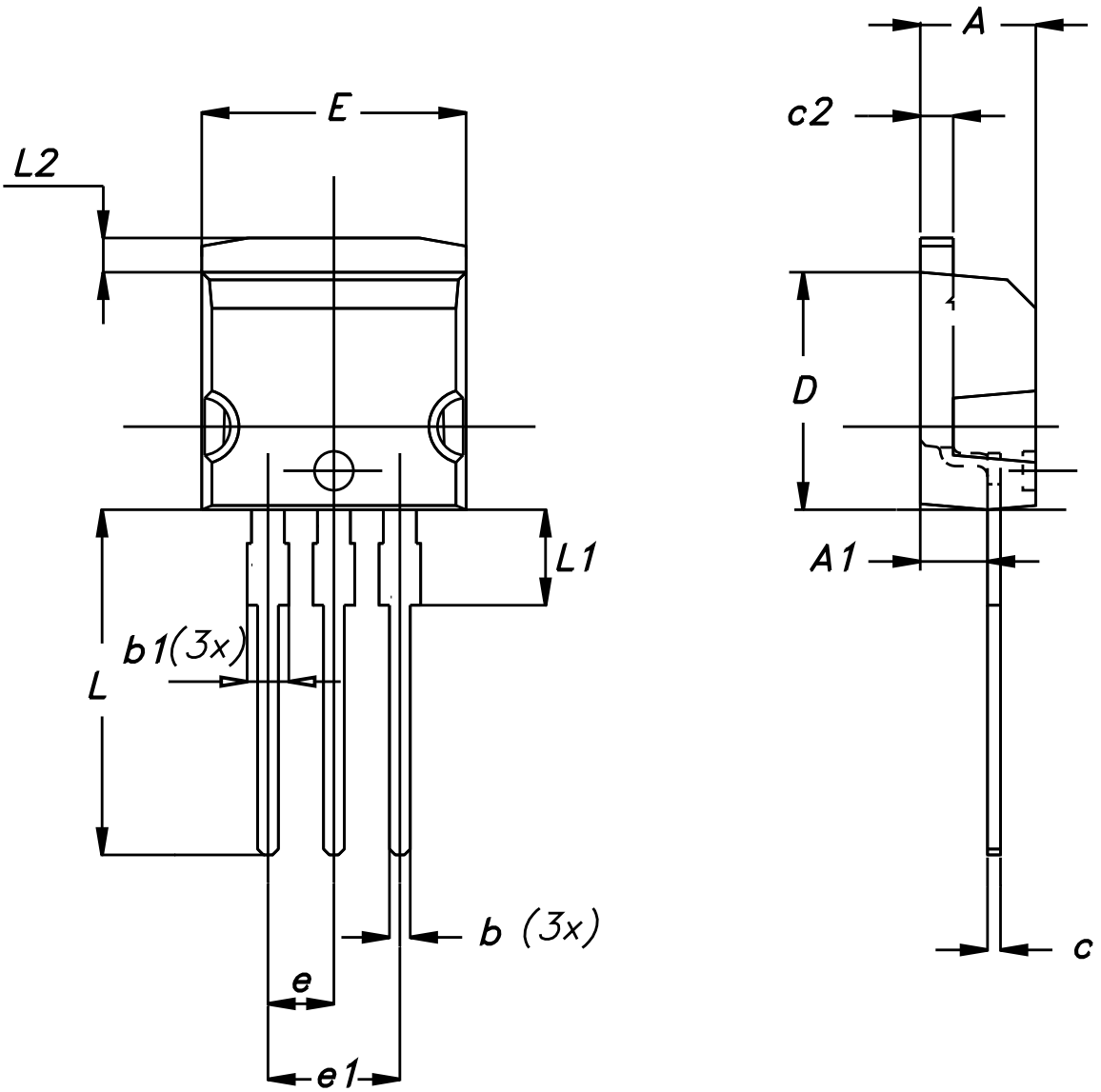

Table 11. I²PAK package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	-	4.60
A1	2.40	-	2.72
b	0.61	-	0.88
b1	1.14	-	1.70
c	0.49	-	0.70
c2	1.23	-	1.32
D	8.95	-	9.35
e	2.40	-	2.70
e1	4.95	-	5.15
E	10	-	10.40
L	13	-	14
L1	3.50	-	3.93
L2	1.27	-	1.40

4.5 TO-220 type A package information

Figure 31. **TO-220 type A package outline**

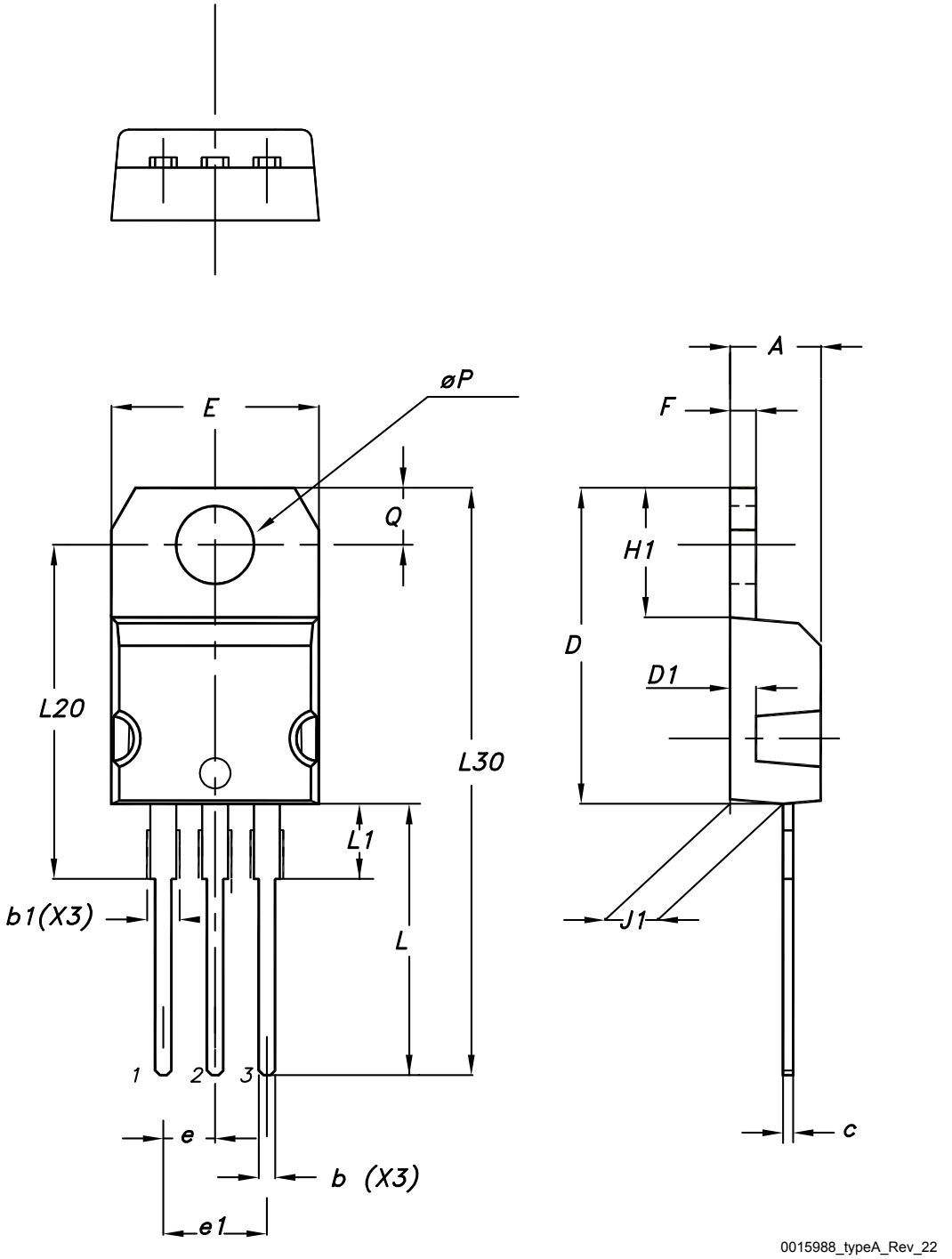

Table 12. **TO-220 type A package mechanical data**

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

4.6 TO-247 package information

Figure 32. **TO-247 package outline**

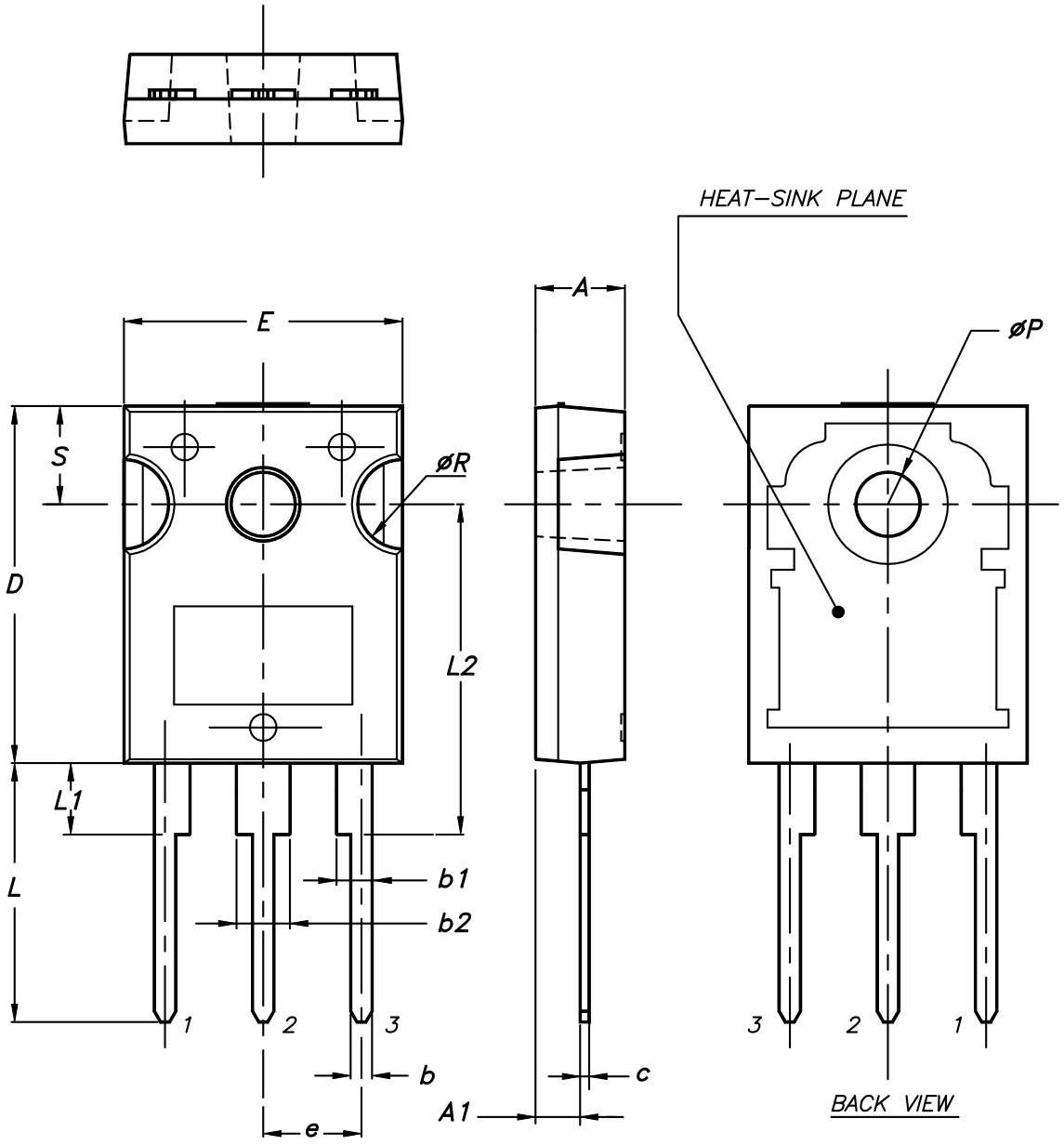

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Table 13. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

5 Ordering information

Table 14. **Order codes**

Order code	Marking	Package	Packing
STB42N65M5	42N65M5	D²PAK	Tape and reel
STF42N65M5		TO-220FP	Tube
STI42N65M5		I²PAK	
STP42N65M5		TO-220	
STW42N65M5		TO-247	

Revision history

Table 15. **Document revision history**

Date	Version	Changes
16-Jan-2009	1	First release.
15-May-2009	2	Updated *figures 9*, *10*, *11* and *17*
12-Jun-2009	3	*Figure 15* has been updated
02-May-2019	4	Modified features and description on cover page. Updated Section 4 Package information. Minor text changes.

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