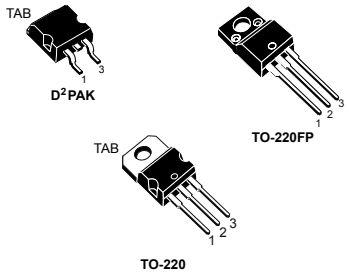
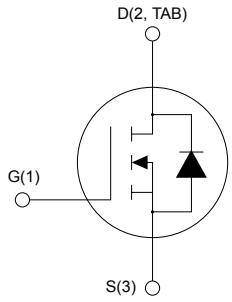
STB57N65M5, STF57N65M5, STP57N65M5

Datasheet

N-channel 650 V, 56 mΩ typ., 42 A, MDmesh M5 Power MOSFETs in D²PAK, TO-220FP and TO-220 packages





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Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D
STB57N65M5	650 V	63 mΩ	42 A
STF57N65M5			
STP57N65M5			

- 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.

Product status links
STB57N65M5
STF57N65M5
STP57N65M5

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D²PAK, TO-220	TO-220FP	
V_{GS}	Gate-source voltage	±25		V
I_D	Drain current (continuous) at T_C = 25 °C	42	42(1)	A
	Drain current (continuous) at T_C = 100 °C	26.5	26.5 (1)	
I_{DM}(2)	Drain current (pulsed)	168		A
P_{TOT}	Total power dissipation at T_C = 25 °C	250	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)		2.5	kV
T_J	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			°C

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 42 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	TO-220	TO-220FP	
R_{thJC}	Thermal resistance, junction-to-case	0.5		3.1	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	30(1)	62.5		°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_J max.)	7	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	960	mJ

2 Electrical characteristics

T_C = 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	
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 = 21 A		56	63	mΩ

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

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	-	4200	-	pF
C_{oss}	Output capacitance		-	115	-	pF
C_{rss}	Reverse transfer capacitance		-	9	-	pF
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	303	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related		-	93	-	pF
R_g	Gate input resistance	f = 1 MHz, I_D = 0 A	-	1.3	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 21 A, V_{GS} = 0 to 10 V (see Figure 17. Test circuit for gate charge behavior)	-	98	-	nC
Q_{gs}	Gate-source charge		-	23	-	nC
Q_{gd}	Gate-drain charge		-	40	-	nC

1. *$C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as C_{oss} while V_{DS} is rising from 0 V to the stated value.*
2. *$C_{o(er)}$ is an equivalent capacitance that provides the same stored energy as C_{oss} while V_{DS} is rising from 0 V to the stated value.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(v)}$	Voltage delay time	V_{DD} = 400 V, I_D = 28 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 18. Test circuit for inductive load switching and diode recovery times and Figure 21. Switching time waveform)	-	73	-	ns
$t_{r(v)}$	Voltage rise time		-	15	-	ns
$t_{f(i)}$	Current fall time		-	12	-	ns
$t_{c(off)}$	Crossing time		-	19	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		42	A
I_{SDM}(1)	Source-drain current (pulsed)		-		168	A
V_{SD}(2)	Forward on voltage	I_{SD} = 42 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 42 A, di/dt = 100 A/µs,	-	418		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V	-	8		µC
I_{RRM}	Reverse recovery current	(see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	40		A
t_{rr}	Reverse recovery time	I_{SD} = 42 A, di/dt = 100 A/µs,	-	528		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_J = 150 °C	-	12		µC
I_{RRM}	Reverse recovery current	(see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	44		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 and TO-220

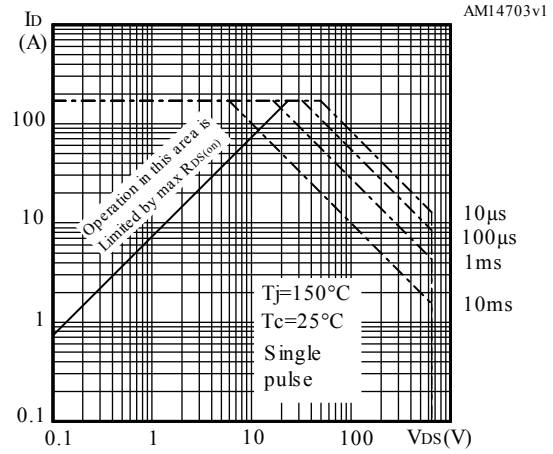


Figure 2. Normalized transient thermal impedance for D²PAK and TO-220

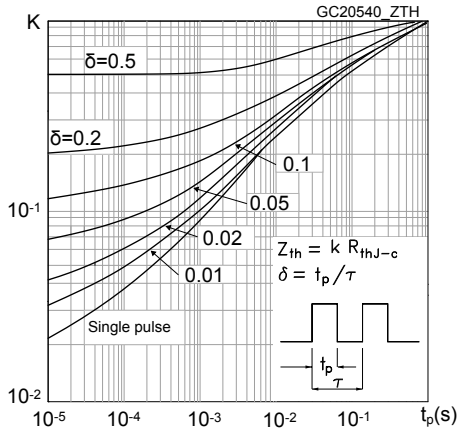


Figure 3. Safe operating area for TO-220FP

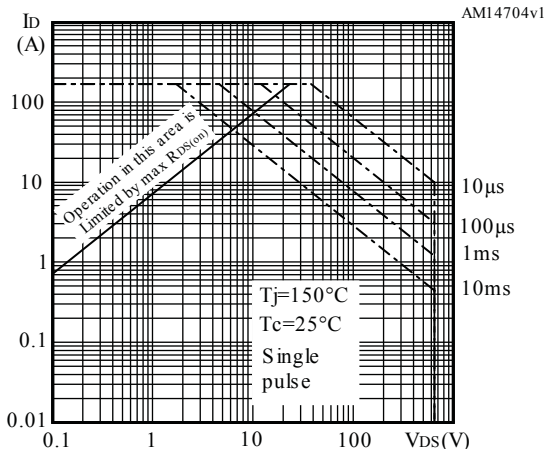


Figure 4. Normalized transient thermal impedance for TO-220FP

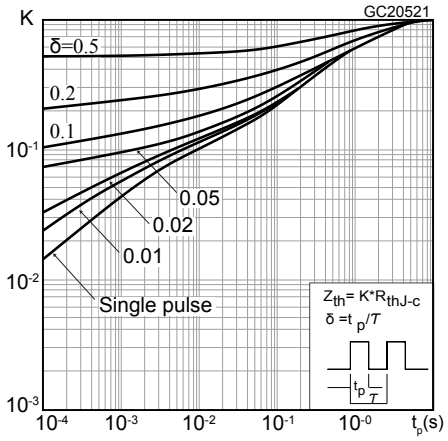


Figure 5. Typical output characteristics

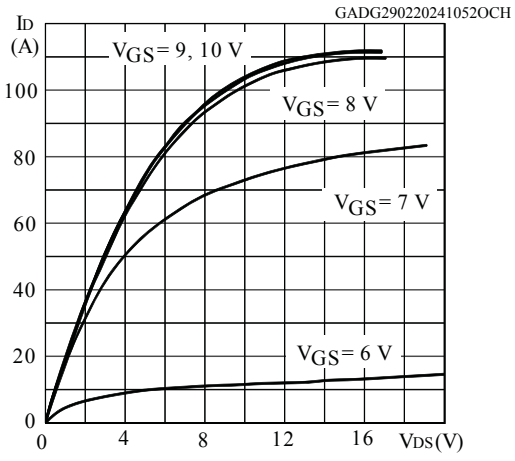


Figure 6. Typical transfer characteristics

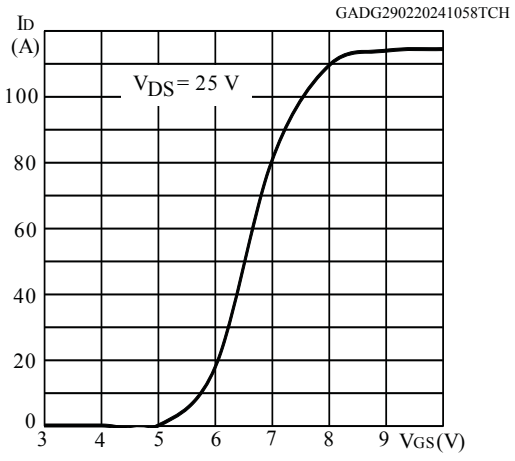


Figure 7. Typical gate charge characteristics

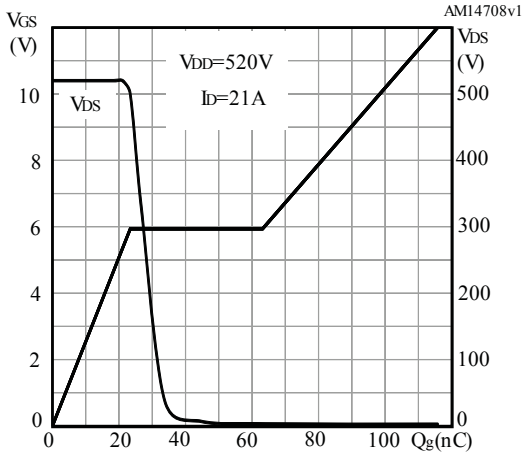


Figure 8. Typical drain-source on-resistance

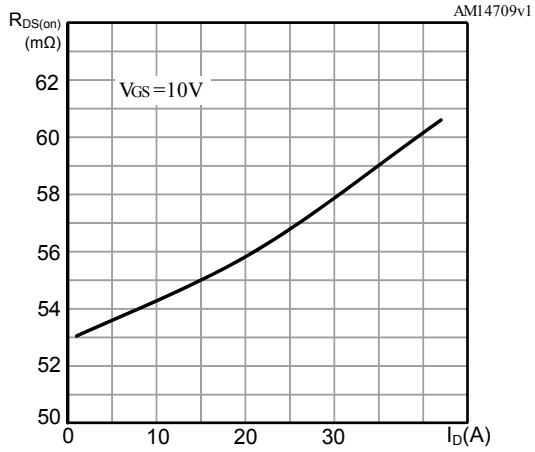


Figure 9. Typical capacitance characteristics

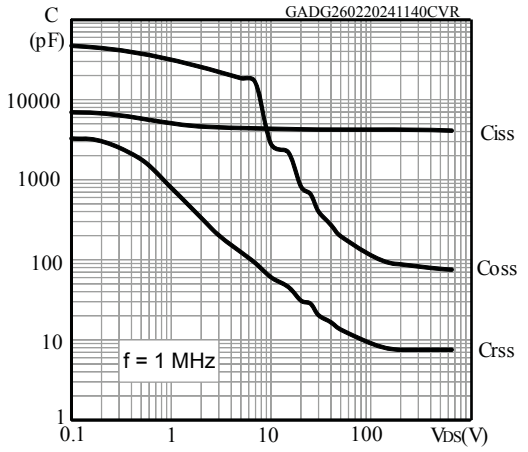


Figure 10. Typical output capacitance stored energy

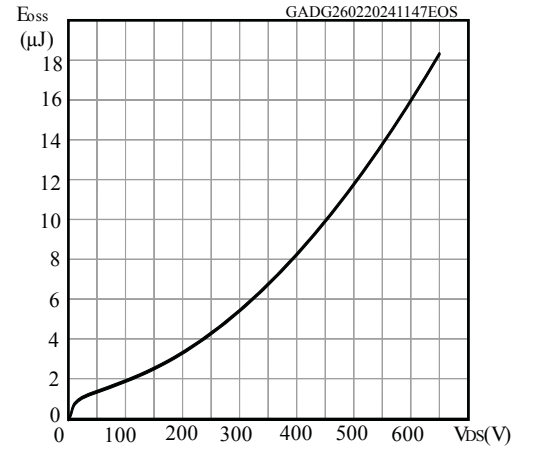


Figure 11. Normalized gate threshold vs temperature

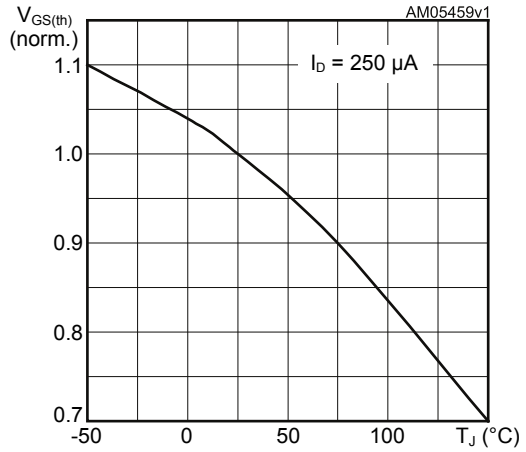


Figure 12. Normalized on-resistance vs temperature

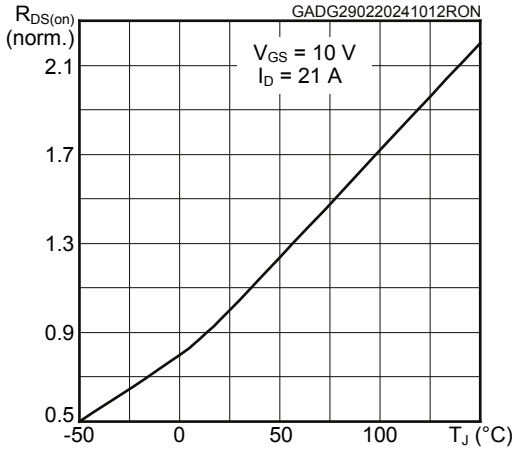


Figure 13. Typical reverse diode forward characteristics

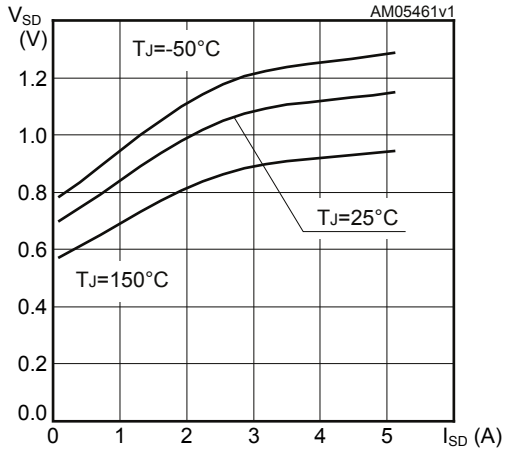


Figure 14. Normalized breakdown voltage vs temperature

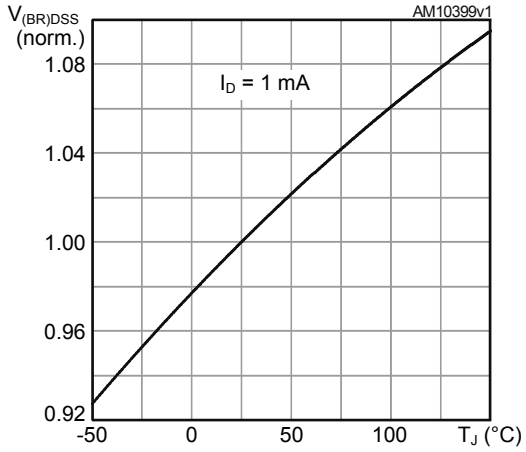
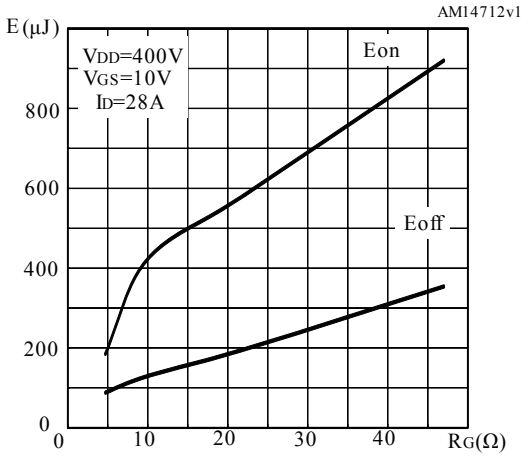


Figure 15. Typical inductive load switching energy vs gate resistance



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

3 Test circuits

Figure 16. Test circuit for resistive load switching times

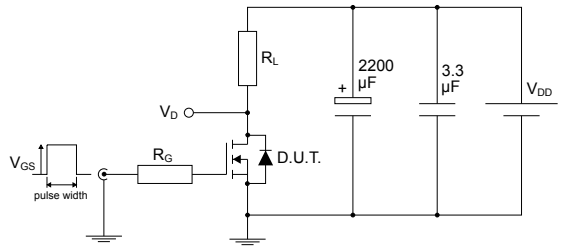


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Figure 17. Test circuit for gate charge behavior

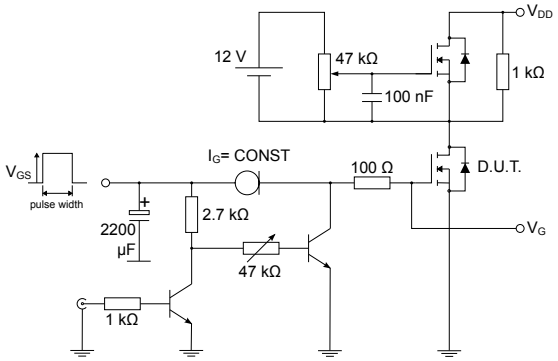

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Figure 18. Test circuit for inductive load switching and diode recovery times

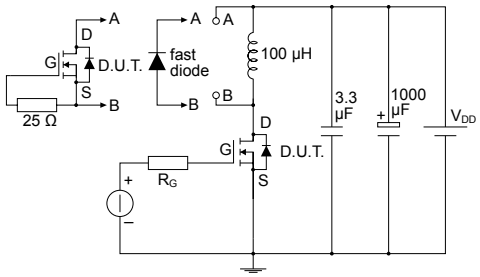

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Figure 19. Unclamped inductive load test circuit

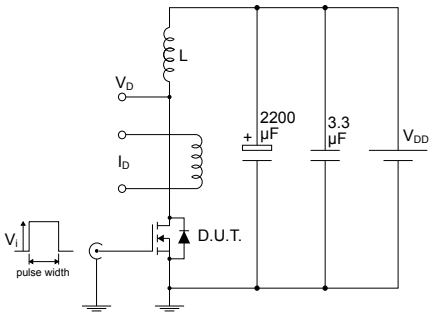

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Figure 20. Unclamped inductive waveform

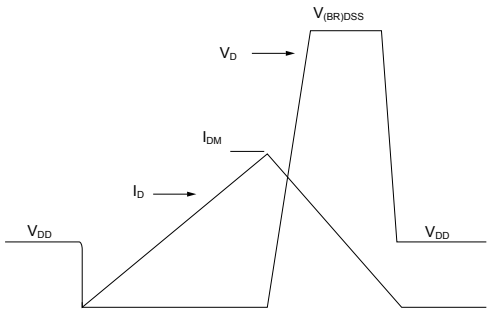

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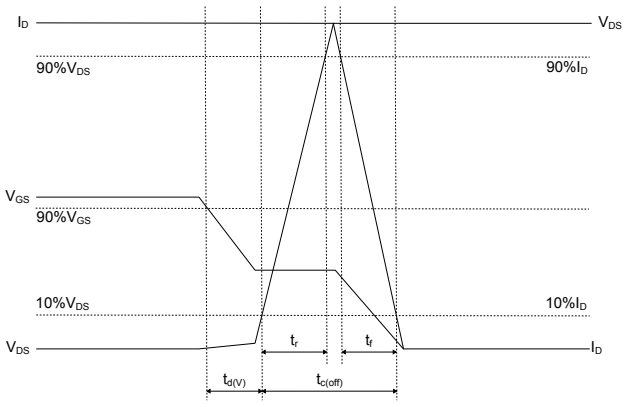
Figure 21. Switching time waveform



AM05540v2

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 22. **D²PAK (TO-263) type A2 package outline**

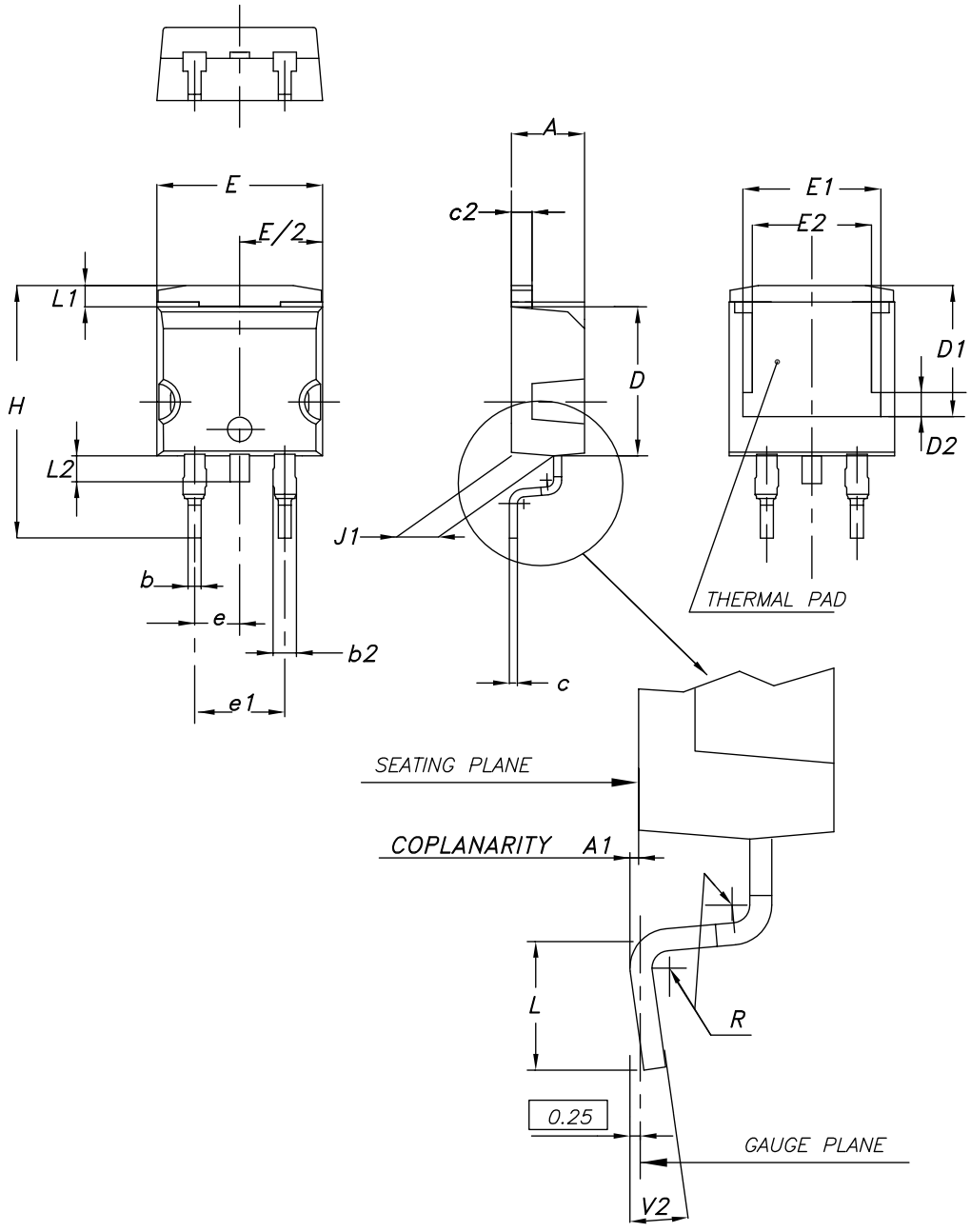


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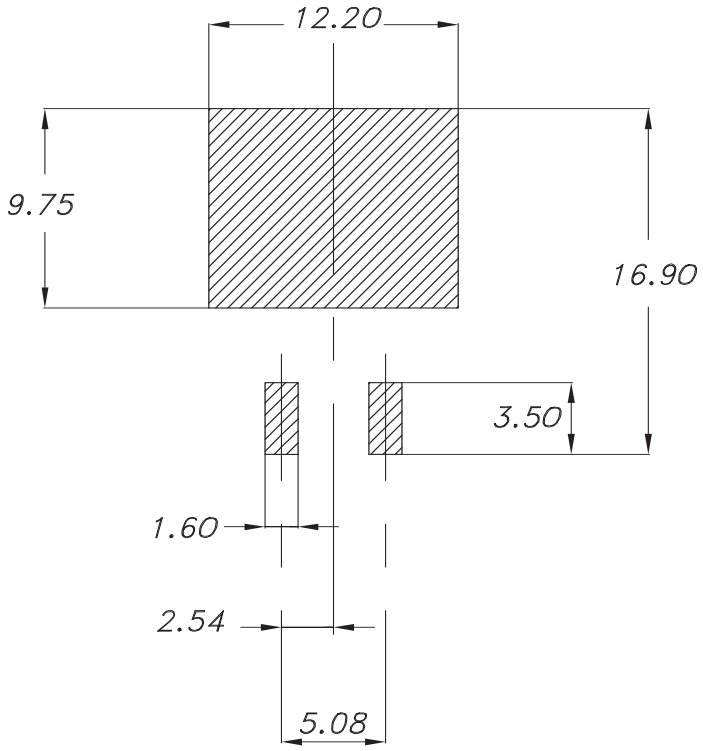
Table 8. **D²PAK (TO-263) type A2 package mechanical data**

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



4.2 D²PAK packing information

Figure 24. D²PAK tape outline

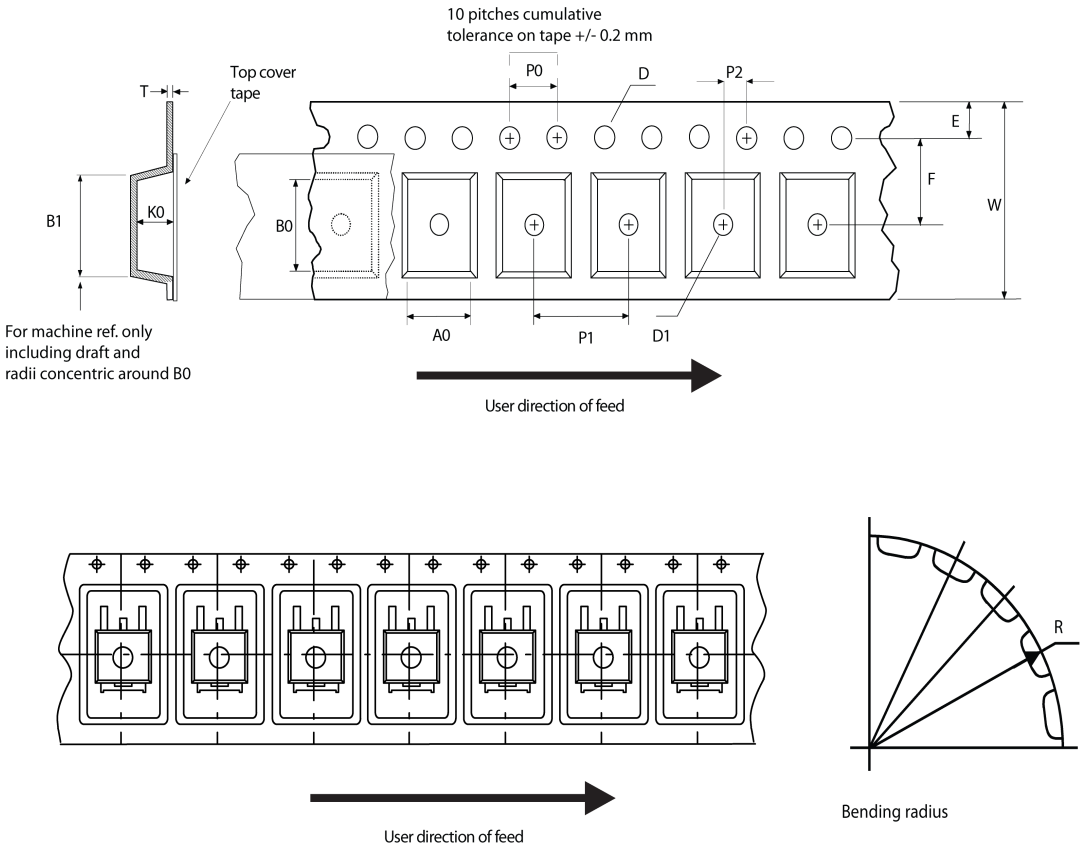


Figure 25. **D²PAK reel outline**

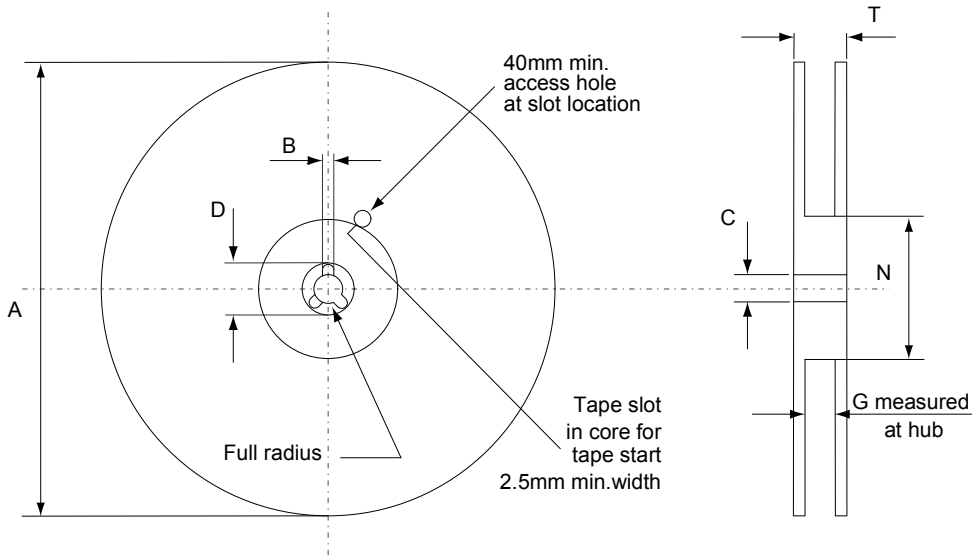


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Table 9. **D²PAK tape and reel mechanical data**

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 26. **TO-220FP type B package outline**

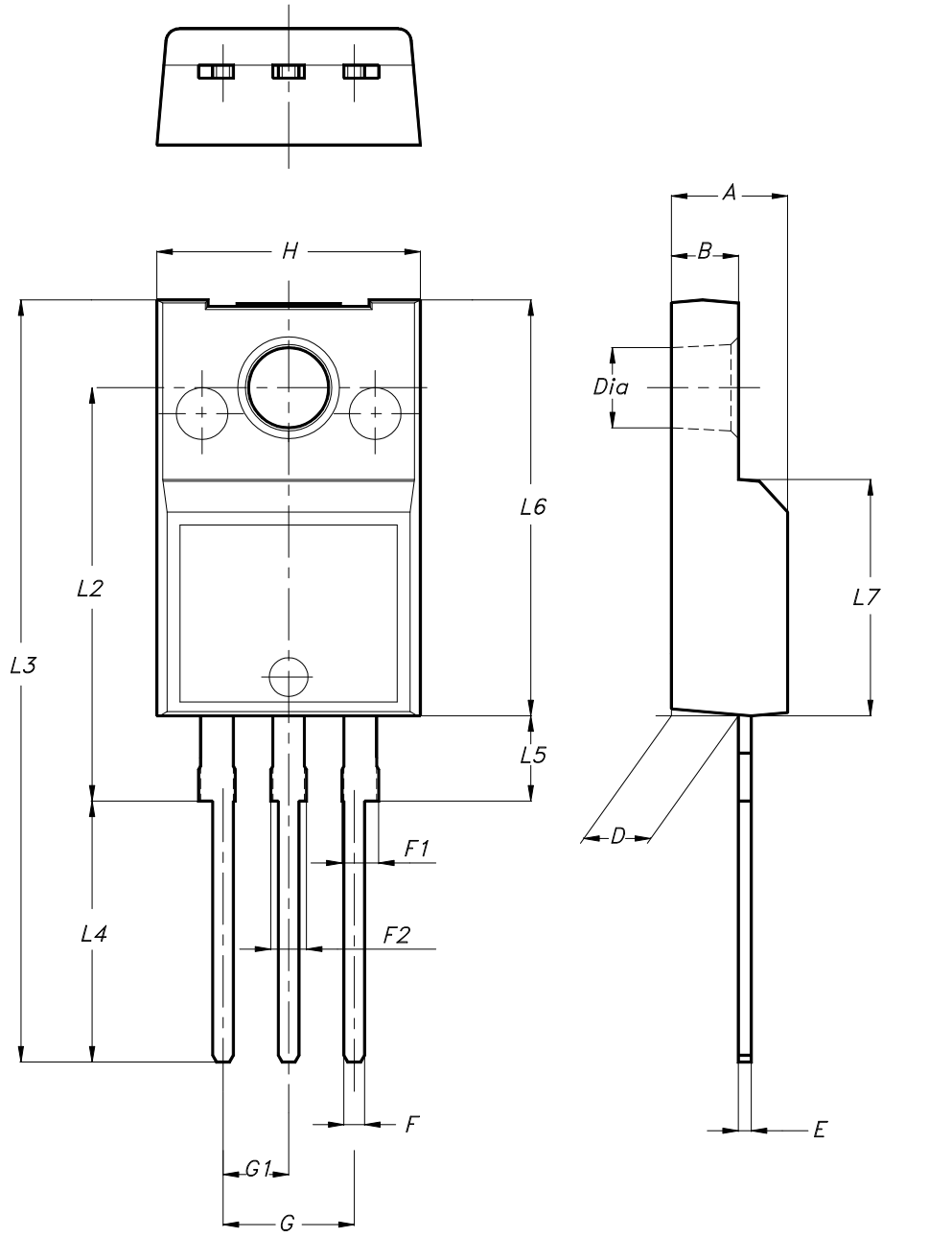

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Table 10. **TO-220FP type B package mechanical data**

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

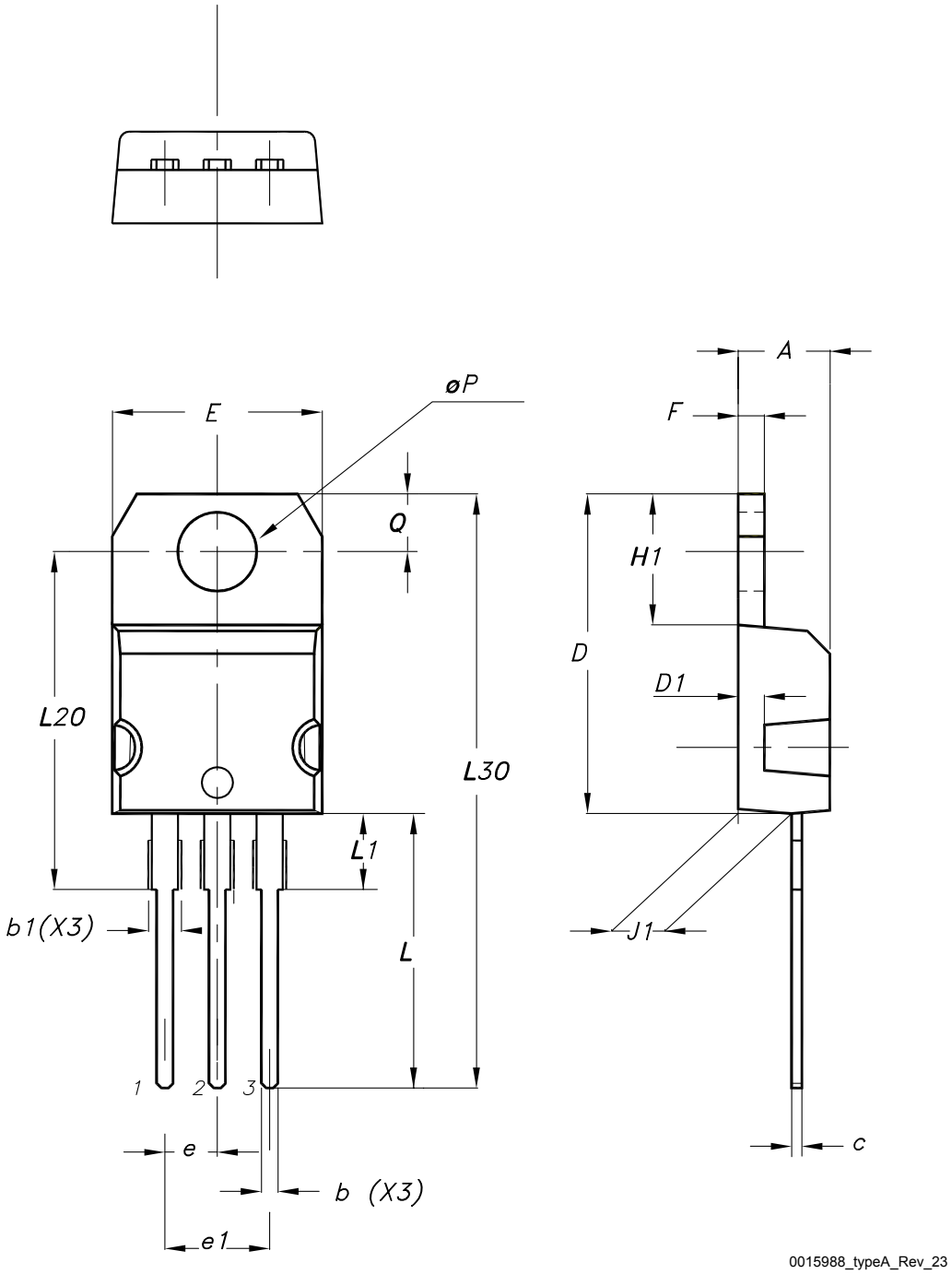

Table 11. **TO-220 type A package mechanical data**

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

5 Ordering information

Table 12. **Order codes**

Order code	Marking	Package	Packing
STB57N65M5	57N65M5	D²PAK	Tape and reel
STF57N65M5		TO-220FP	Tube
STP57N65M5		TO-220	

Revision history

Table 13. **Document revision history**

Date	Version	Changes
06-Apr-2012	1	First release.
04-Jul-2012	2	Document status promoted from preliminary to production data. Added *Section 2.1: Electrical characteristics (curves)*.
21-Aug-2012	3	Updated symbols and parameters in *Table 6: Switching times*. Minor text change on the cover page.
04-Dec-2012	4	The part number STW57N65M5 has been moved to a separate datasheet.
01-Mar-2024	5	The part number STI57N65M5 has been moved to a separate datasheet and the document has been updated accordingly. Modified I_{AR} value in Table 3. Avalanche characteristics. Updated Section 4: Package information. Minor text changes.

Contents