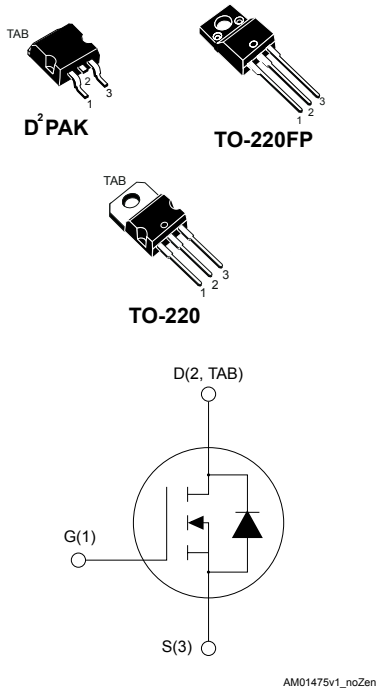




N-channel 650 V, 56 mΩ typ., 42 A, MDmesh M5 Power MOSFETs in D²PAK, TO-220FP and TO-220 packages



Features

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

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

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
		D ² PAK, 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

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- 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
		D ² PAK	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

- 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

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			100	
I_{GSS}	Gate body leakage current	$V_{GS} = \pm 25\text{ V}$, $V_{DS} = 0\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 21\text{ A}$		56	63	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	4200	-	pF
C_{oss}	Output capacitance		-	115	-	pF
C_{rss}	Reverse transfer capacitance		-	9	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	303	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	93	-	pF
R_g	Gate input resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	1.3	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 21\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (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

- $C_{o(tr)}$ 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.
- $C_{o(er)}$ 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	$V_{DD} = 400\text{ V}$, $I_D = 28\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (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	$I_{SD} = 42\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$ (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	418		ns
Q_{rr}	Reverse recovery charge		-	8		μC
I_{RRM}	Reverse recovery current		-	40		A
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see Figure 18. Test circuit for inductive load switching and diode recovery times)	-	528		ns
Q_{rr}	Reverse recovery charge		-	12		μC
I_{RRM}	Reverse recovery current		-	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)

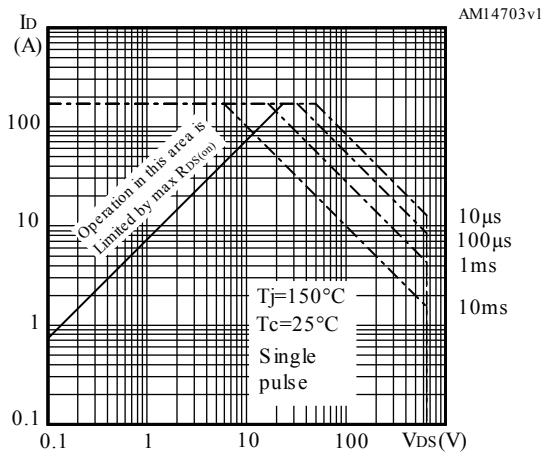
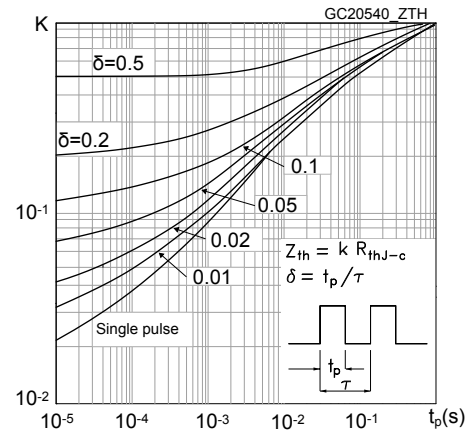
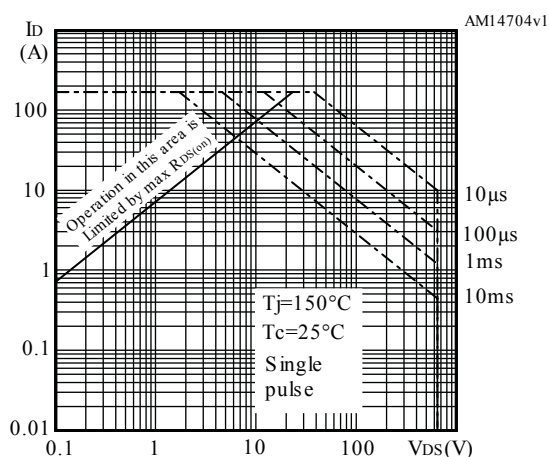
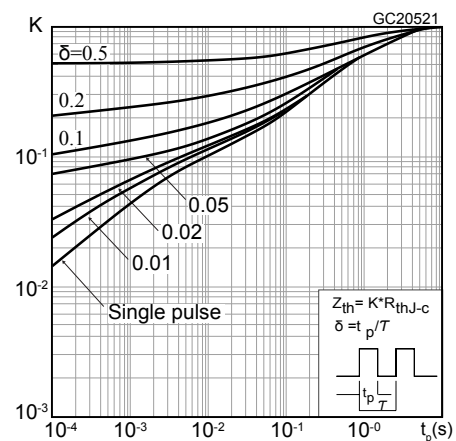
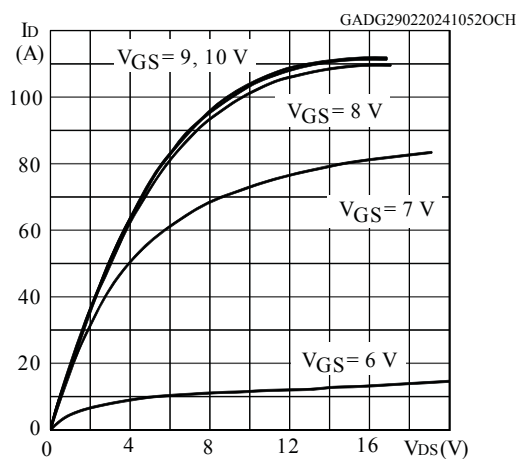
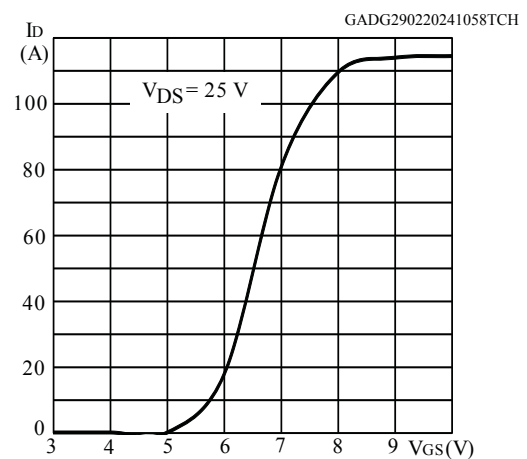
Figure 1. Safe operating area for D²PAK and TO-220

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


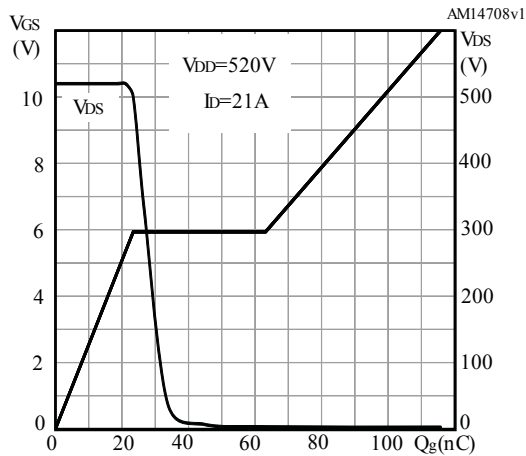
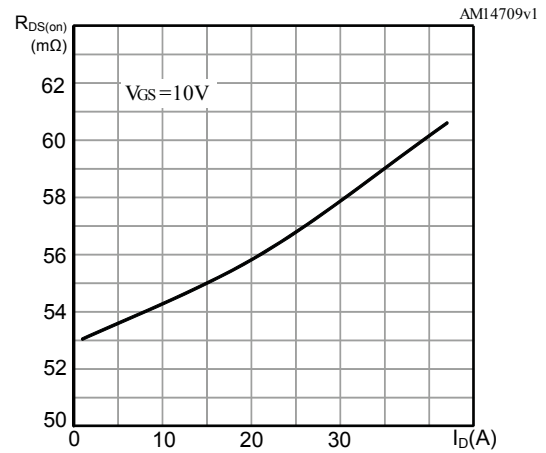
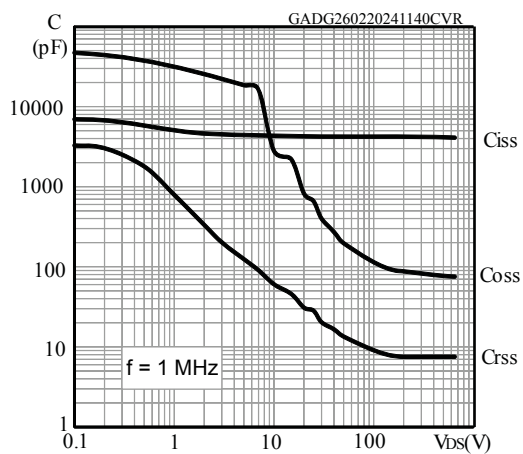
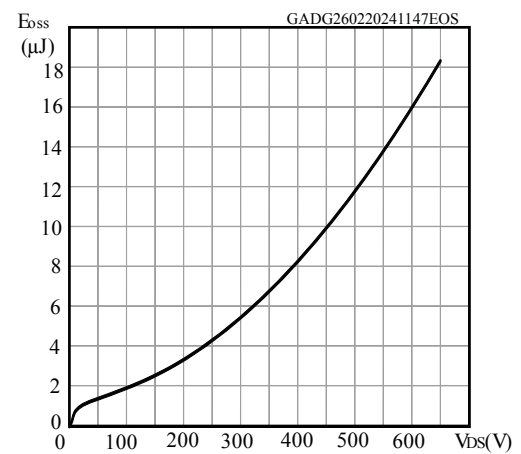
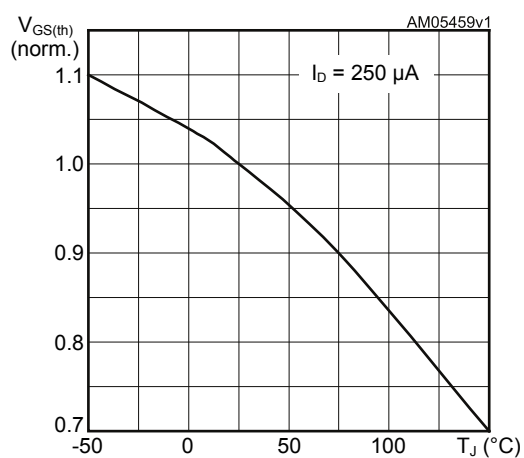
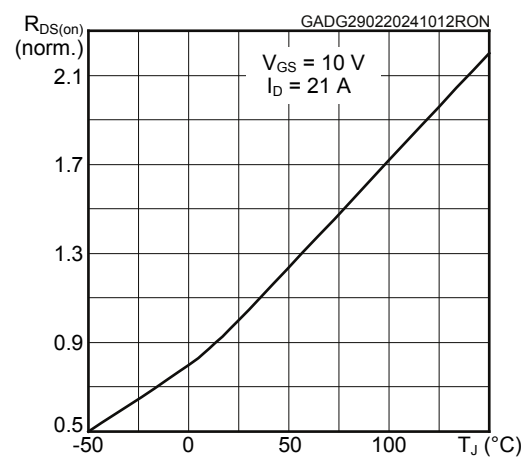
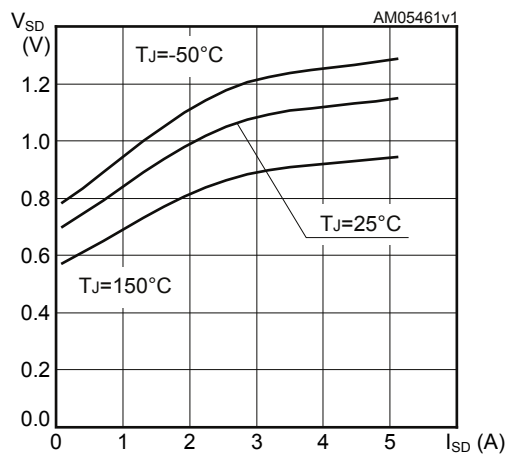
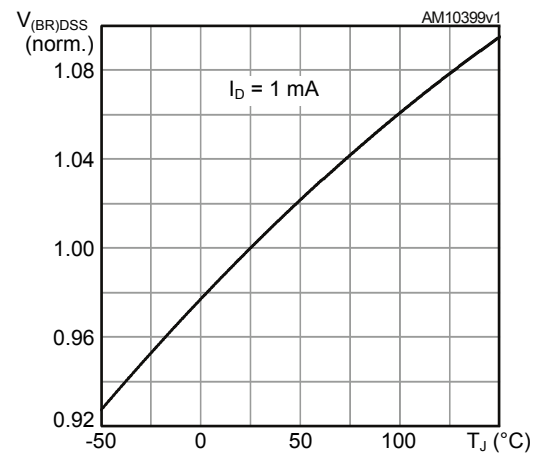
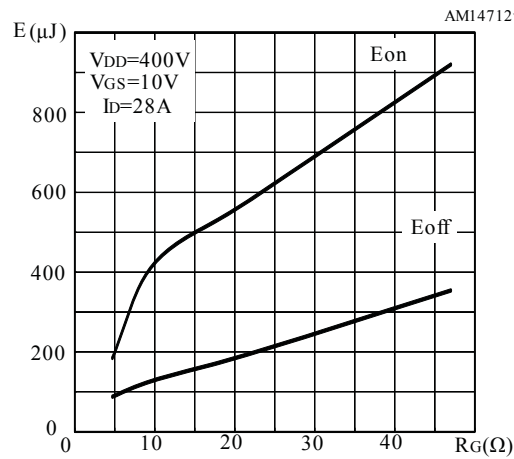
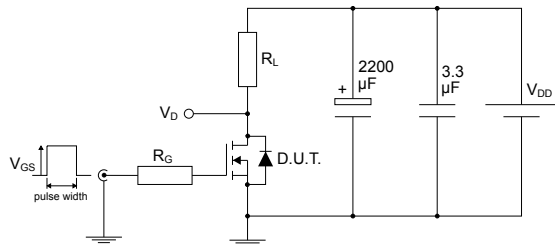
Figure 7. Typical gate charge characteristics

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


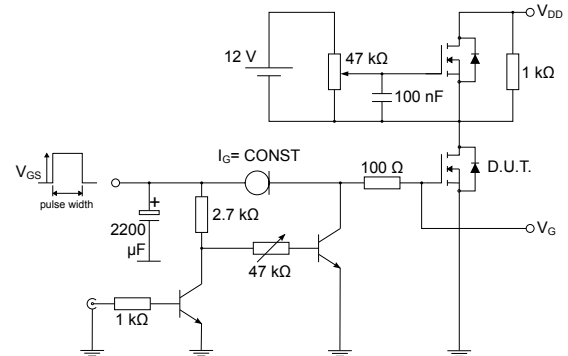
Figure 13. Typical reverse diode forward characteristics

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.

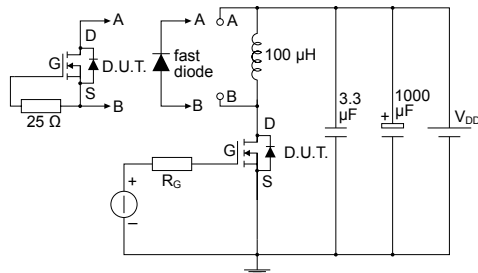
3 Test circuits

Figure 16. Test circuit for resistive load switching times


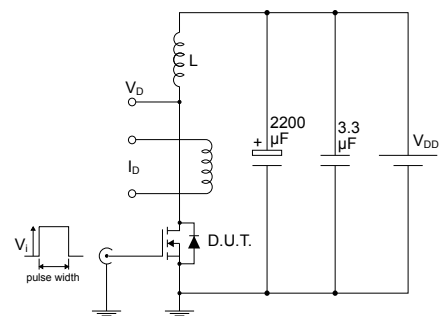
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Figure 17. Test circuit for gate charge behavior


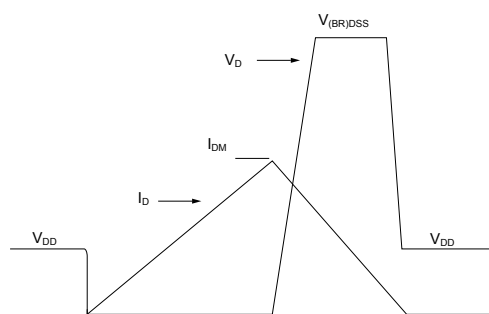
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Figure 18. Test circuit for inductive load switching and diode recovery times


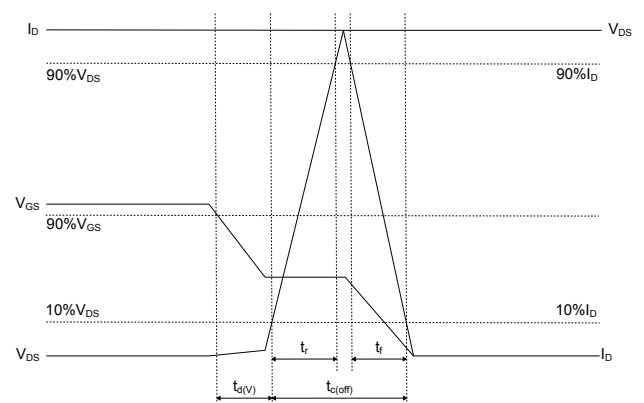
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Figure 19. Unclamped inductive load test circuit


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Figure 20. Unclamped inductive waveform


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Figure 21. Switching time waveform


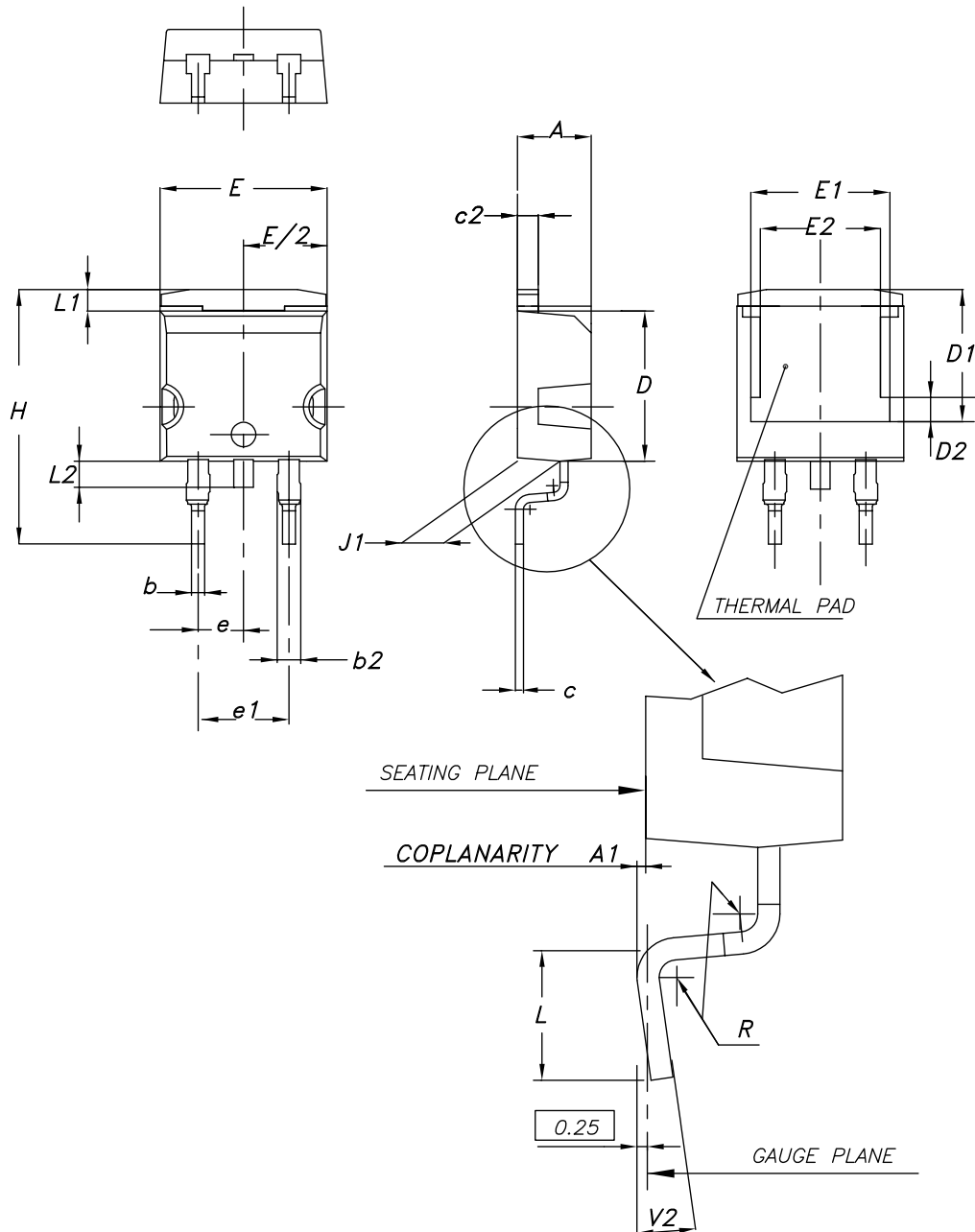
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4 Package information

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

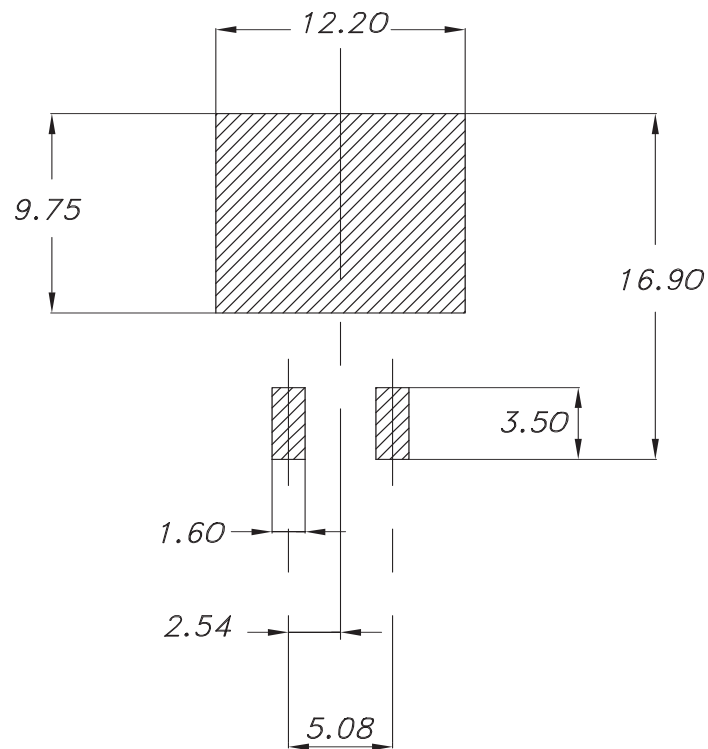
Figure 22. D²PAK (TO-263) type A2 package outline



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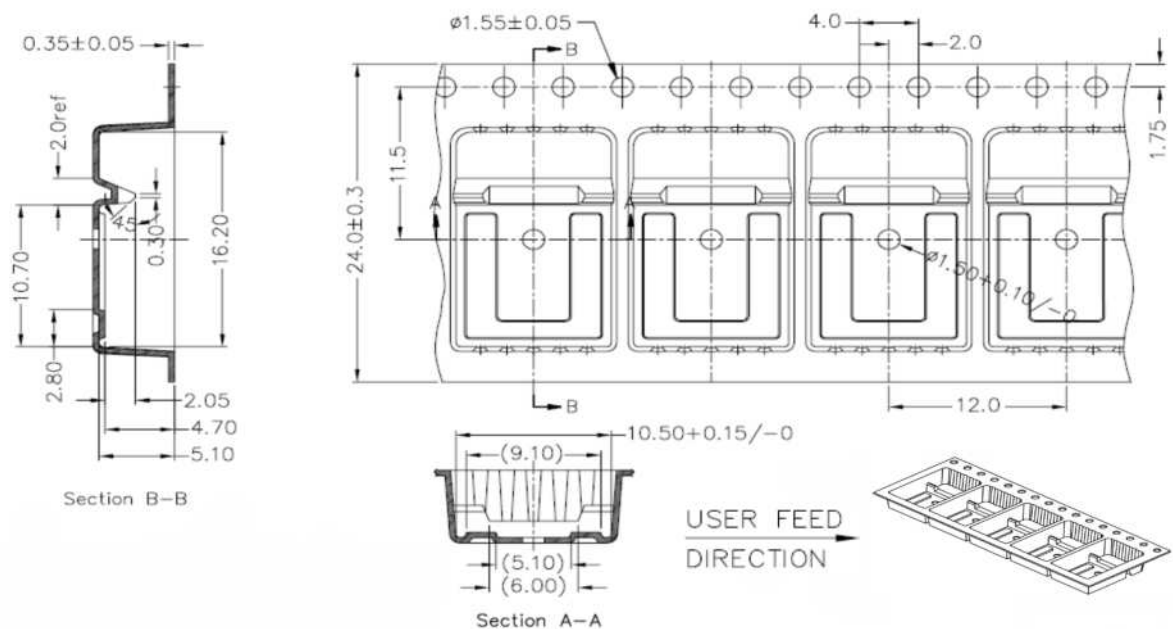
Table 8. D²PAK (TO-263) type A2 package mechanical data

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)


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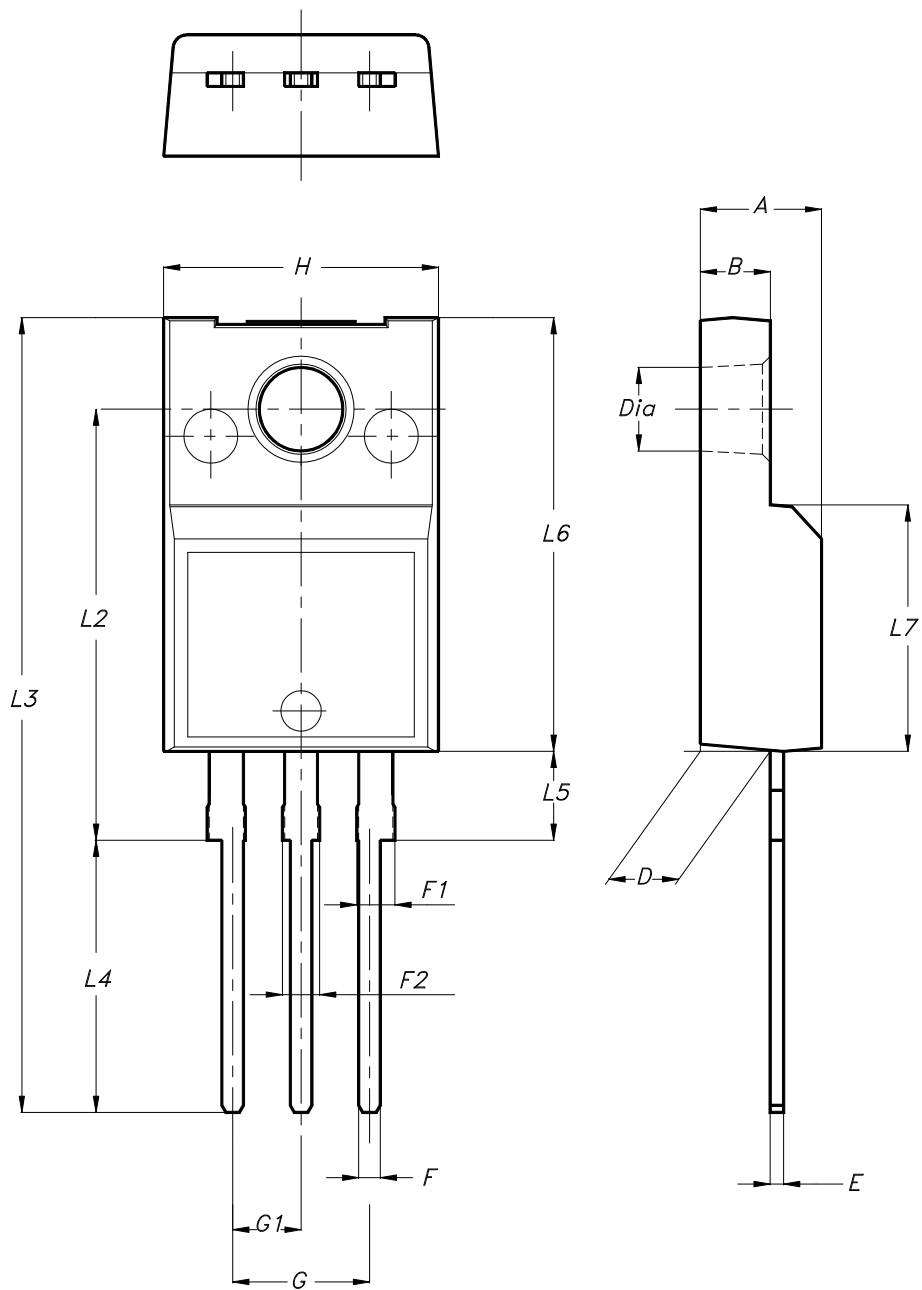
4.2 D²PAK packing information

Figure 24. D²PAK tape drawing (dimensions are in mm)


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4.3

Figure 25. TO-220FP type B package outline



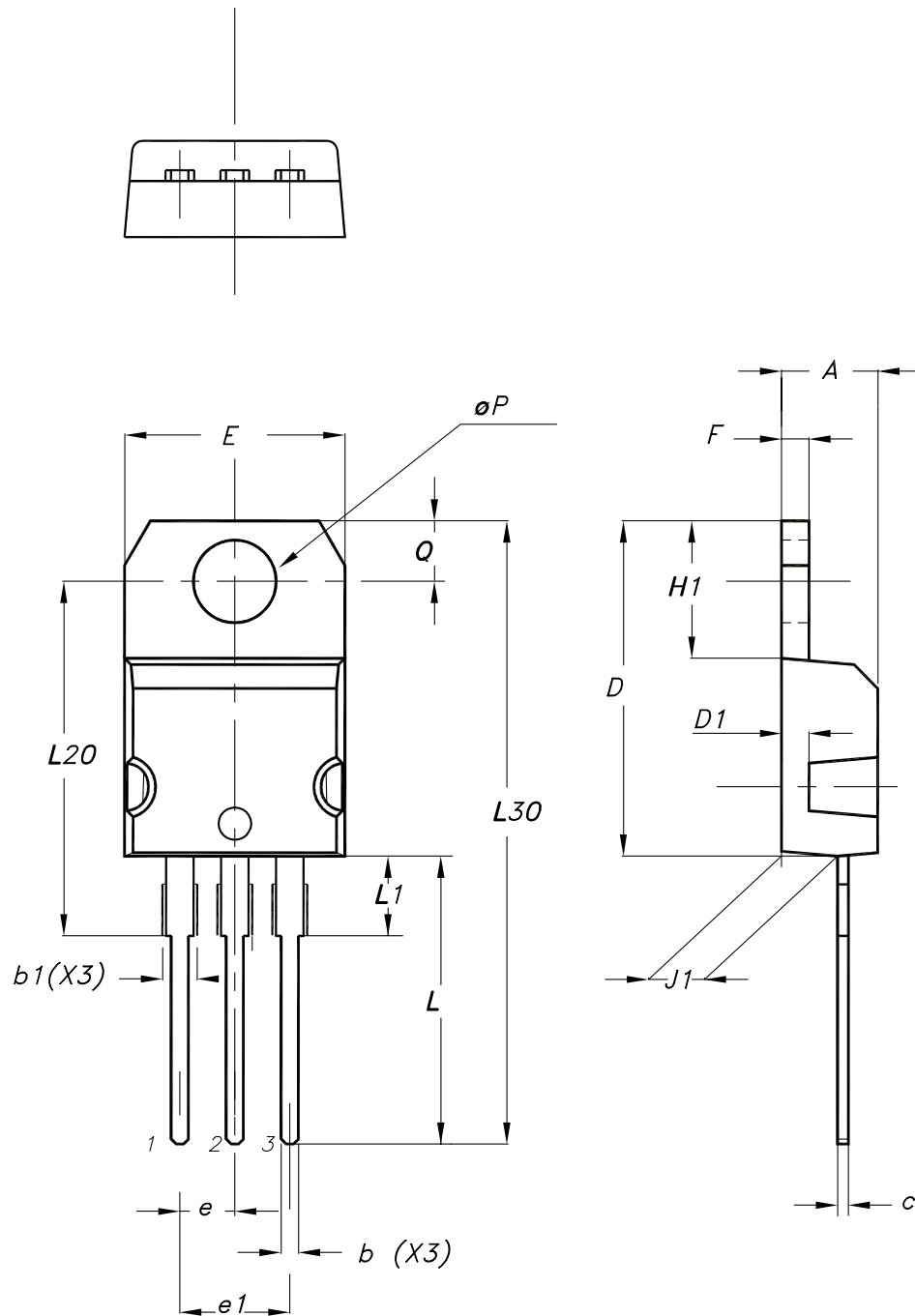
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Table 9. TO-220FP type B package mechanical data

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 26. TO-220 type A package outline



0015988_typeA_Rev_24

Table 10. 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 11. Order codes

Order code	Marking	Package	Packing
STB57N65M5	57N65M5	D ² PAK	Tape and reel
STF57N65M5		TO-220FP	Tube
STP57N65M5		TO-220	

Revision history

Table 12. 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 <i>Section 2.1: Electrical characteristics (curves)</i> .
21-Aug-2012	3	Updated symbols and parameters in <i>Table 6: Switching times</i> . 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 <i>Table 3. Avalanche characteristics</i> . Updated <i>Section 4: Package information</i> . Minor text changes.
20-Aug-2025	6	Updated Section 4: Package information .

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