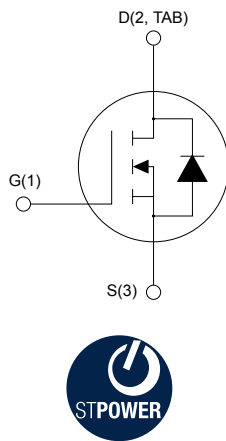
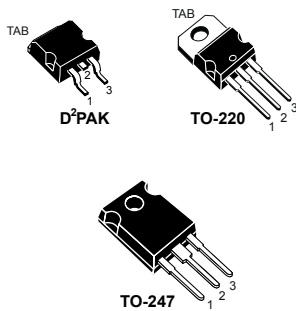




STB38N65M5, STP38N65M5, STW38N65M5

Datasheet

N-channel 650 V, 73 mΩ typ., 30 A MDmesh M5 Power MOSFETs in a D²PAK, TO-220 and TO-247 packages



AM01475v1_noZen

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STB38N65M5	650 V	95 mΩ	30 A
STP38N65M5			
STW38N65M5			

- Higher V_{DSS} rating
- Higher dv/dt capability
- Excellent switching performance
- Extremely low R_{DS(on)}
- 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

[STB38N65M5](#)

[STP38N65M5](#)

[STW38N65M5](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	30	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	19	A
$I_{DM}^{(1)}$	Drain current (pulsed)	120	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	190	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$
T_J	Maximum operating junction temperature	150	$^{\circ}\text{C}$

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 30\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$; $V_{DS}(\text{peak}) < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.
3. $V_{DS} \leq 520\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		D ² PAK	TO-220	TO-247	
R_{thJC}	Thermal resistance, junction-to-case	0.66			$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	30 ⁽¹⁾	62.5	50	$^{\circ}\text{C}/\text{W}$

1. When mounted on a standard 1 inch² area of FR-4 PCB with 2-oz copper.

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_J max.)	8	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	660	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test condition	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	μA
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$	-	-	± 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	$V_{GS} = 10\text{ V}$, $I_D = 15\text{ A}$	-	73	95	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	3000	-	pF
C_{oss}	Output capacitance		-	74	-	
C_{rss}	Reverse transfer capacitance		-	5.8	-	
$C_{o(tr)}^{(1)}$	Equivalent output capacitance time related	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	244	-	pF
$C_{o(er)}^{(2)}$	Equivalent output capacitance energy related		-	70	-	pF
R_g	Gate input resistance	$f = 1\text{ MHz}$ open drain	-	2.4	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 15\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 17. Test circuit for gate charge behavior)	-	71	-	nC
Q_{gs}	Gate-source charge		-	18	-	
Q_{gd}	Gate-drain charge		-	30	-	

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 condition	Min.	Typ.	Max.	Unit
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	66	-	ns
$t_{r(v)}$	Voltage rise time		-	9	-	
$t_{c(off)}$	Crossing time off	(see the Figure 18. Test circuit for inductive load switching and diode recovery times and Figure 21. Switching time waveform)	-	9	-	
$t_{f(i)}$	Current fall time		-	13	-	

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	30	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	120	
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 30\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 30\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ (see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	382	-	ns
Q_{rr}	Reverse recovery charge		-	6.6	-	μC
I_{RRM}	Reverse recovery current		-	35	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 30\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	522	-	ns
Q_{rr}	Reverse recovery charge		-	10.3	-	μC
I_{RRM}	Reverse recovery current		-	40	-	A

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

2.1 Electrical characteristics (curves)

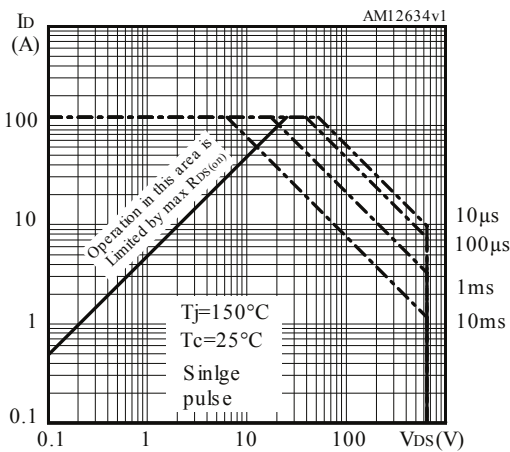
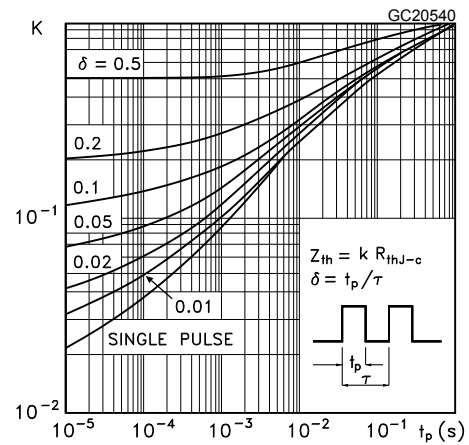
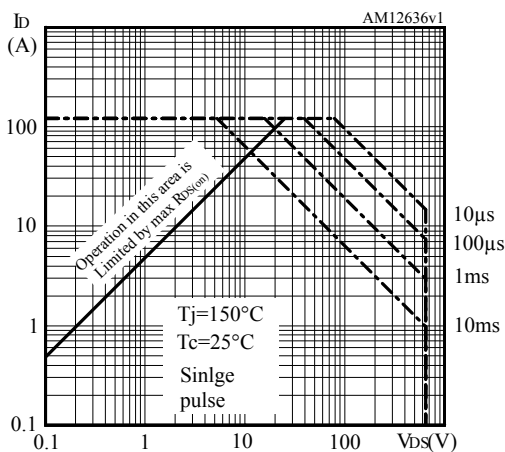
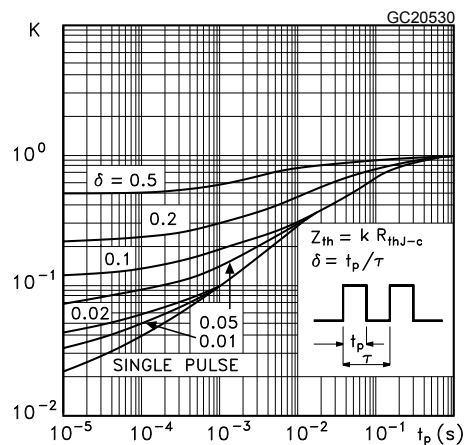
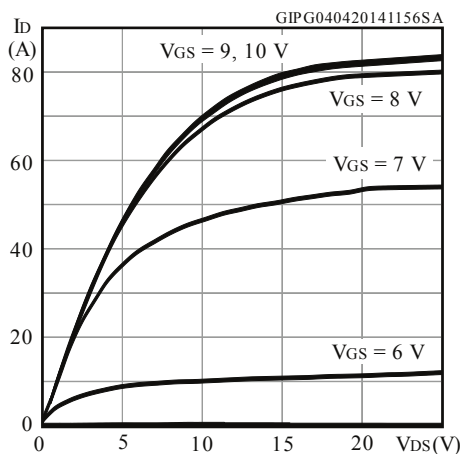
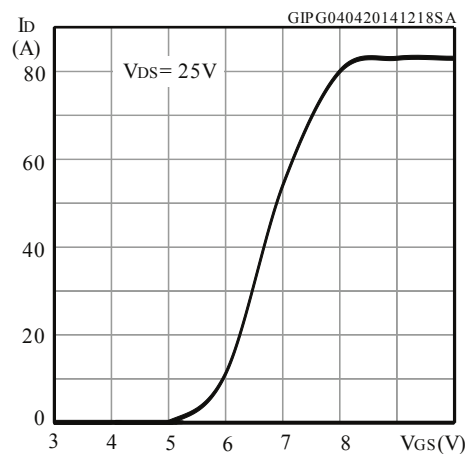
Figure 1. Safe operating area for D²PAK and TO-220

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

Figure 3. Safe operating area for TO-247

Figure 4. Normalized transient thermal impedance for TO-247

Figure 5. Output characteristics

Figure 6. Transfer characteristics


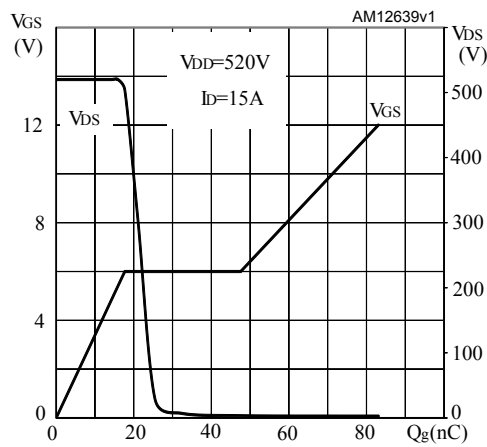
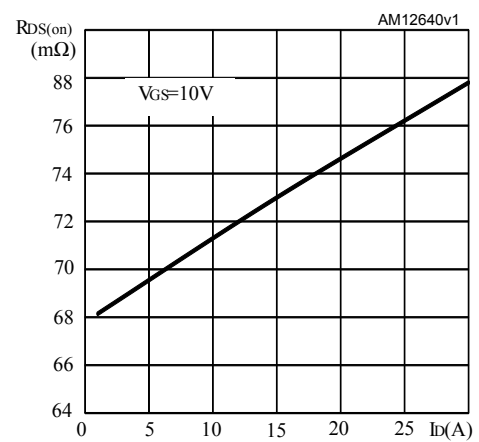
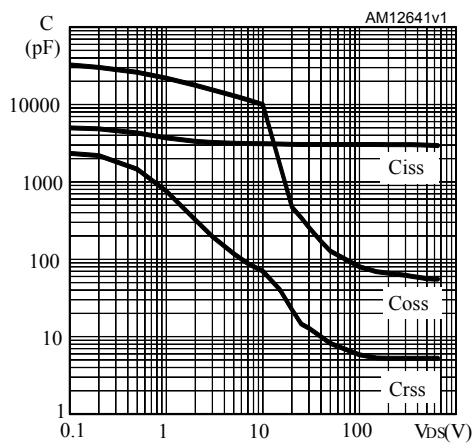
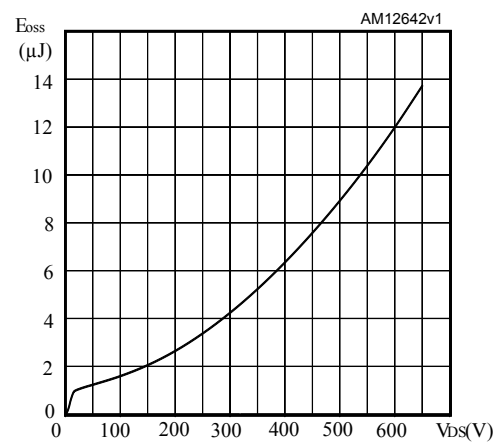
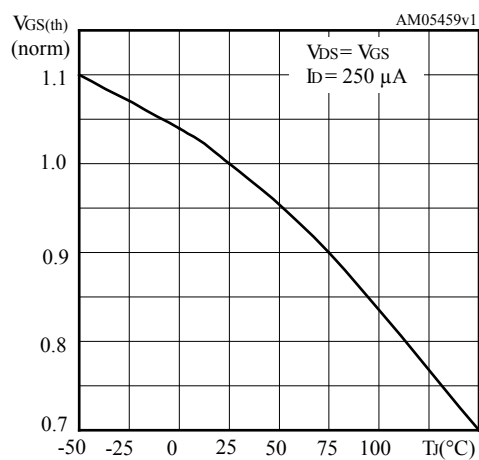
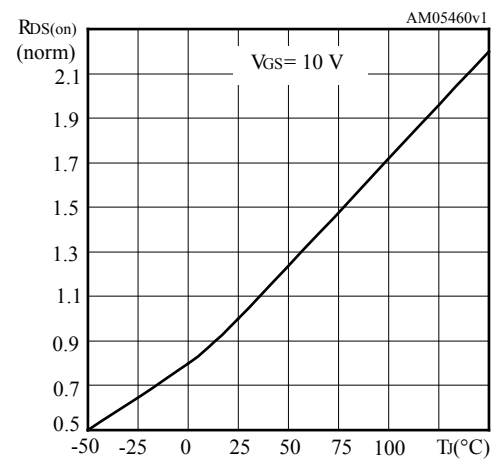
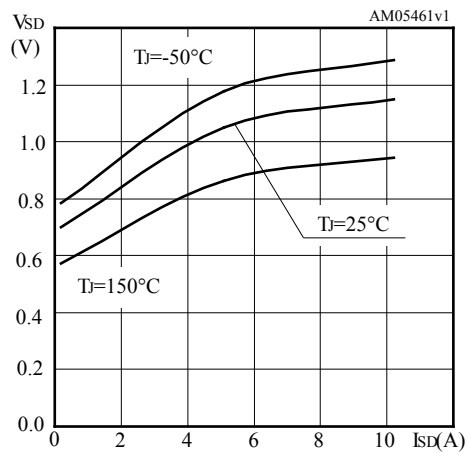
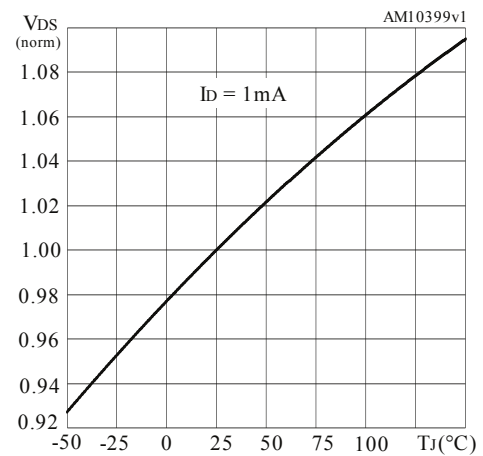
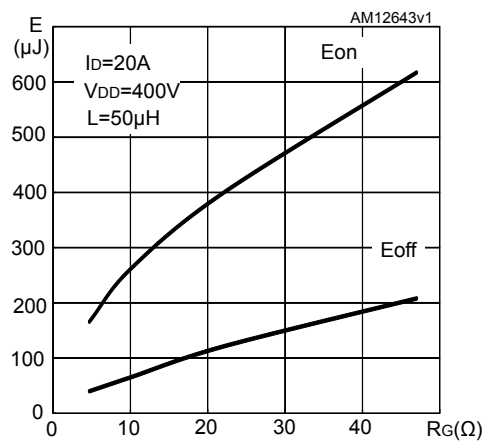
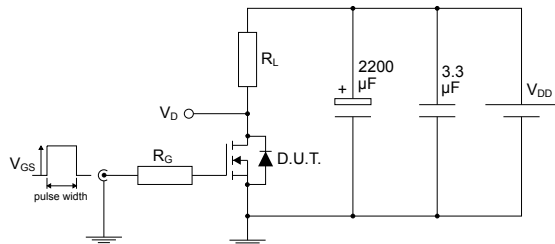
Figure 7. Gate charge vs gate-source voltage

Figure 8. Static drain-source on-resistance

Figure 9. Capacitance variations

Figure 10. Output capacitance stored energy

Figure 11. Normalized gate threshold voltage vs temperature

Figure 12. Normalized on-resistance vs temperature


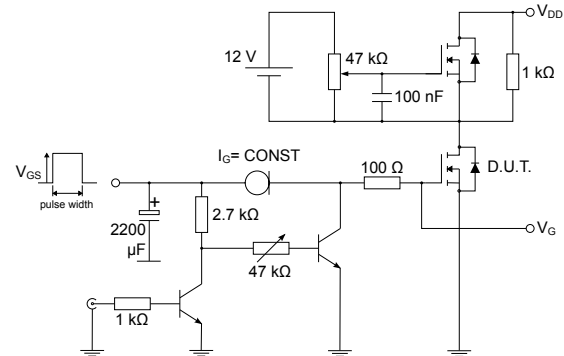
Figure 13. Drain-source diode forward characteristics

Figure 14. Normalized $V_{(BR)DSS}$ vs temperature

Figure 15. Switching energy vs gate resistance


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

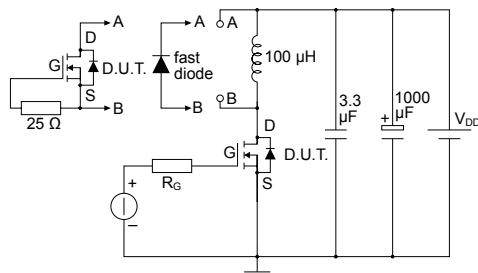
3 Test circuits

Figure 16. Test circuit for resistive load switching times


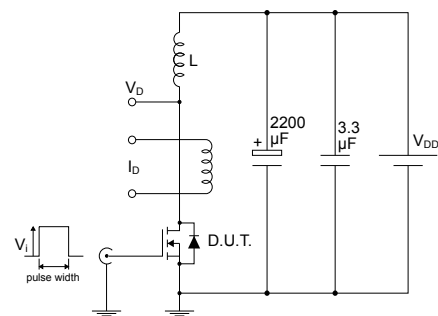
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Figure 17. Test circuit for gate charge behavior


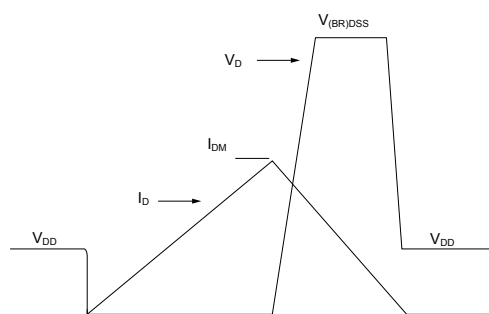
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Figure 18. Test circuit for inductive load switching and diode recovery times


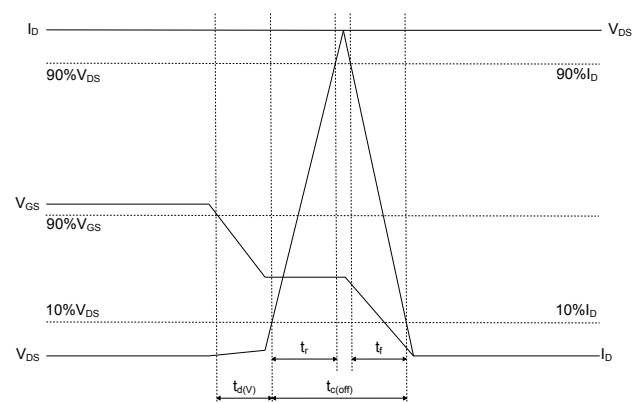
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Figure 19. Unclamped inductive load test circuit


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Figure 20. Unclamped inductive waveform


AM01472v1

Figure 21. Switching time waveform


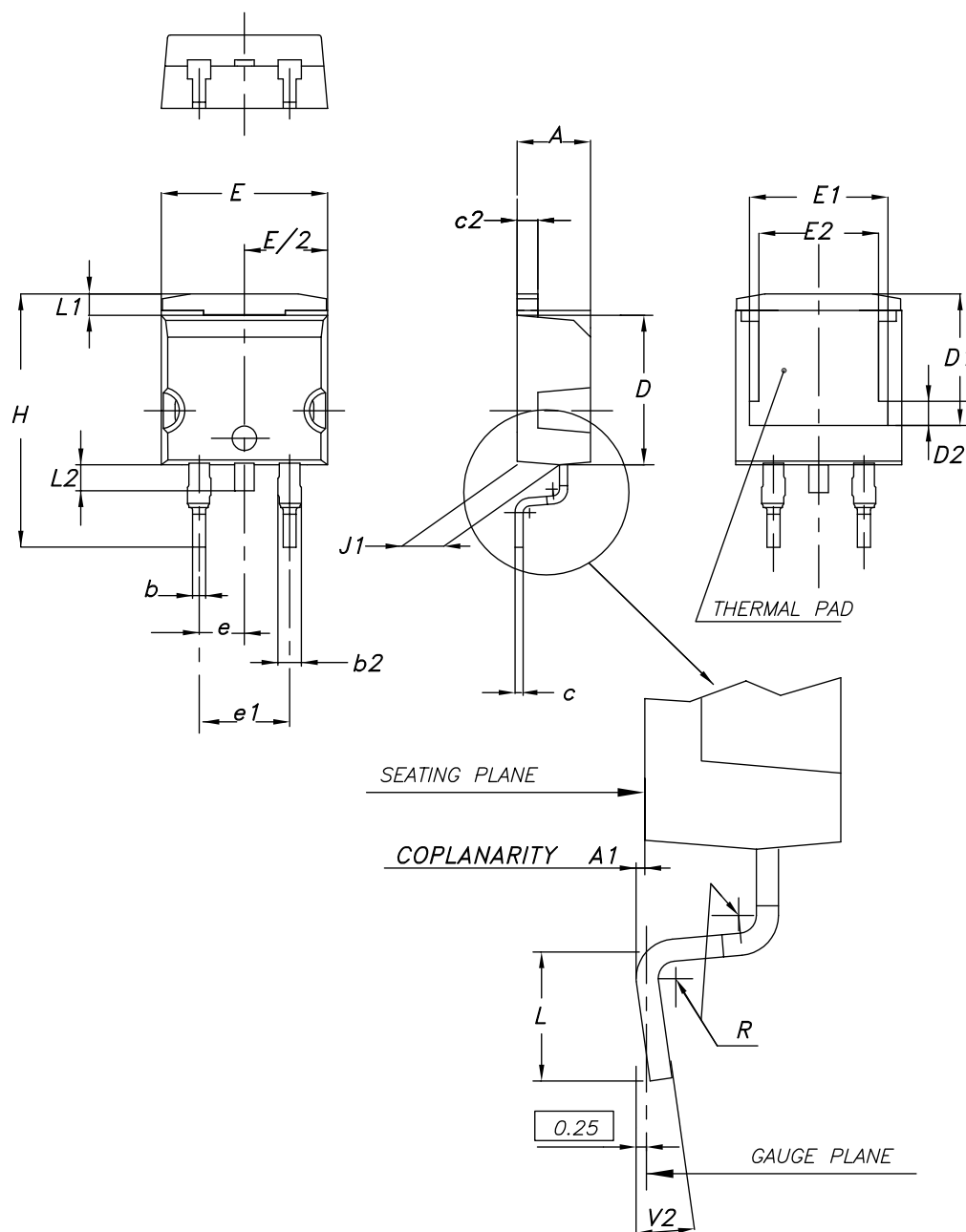
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4 Package information

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

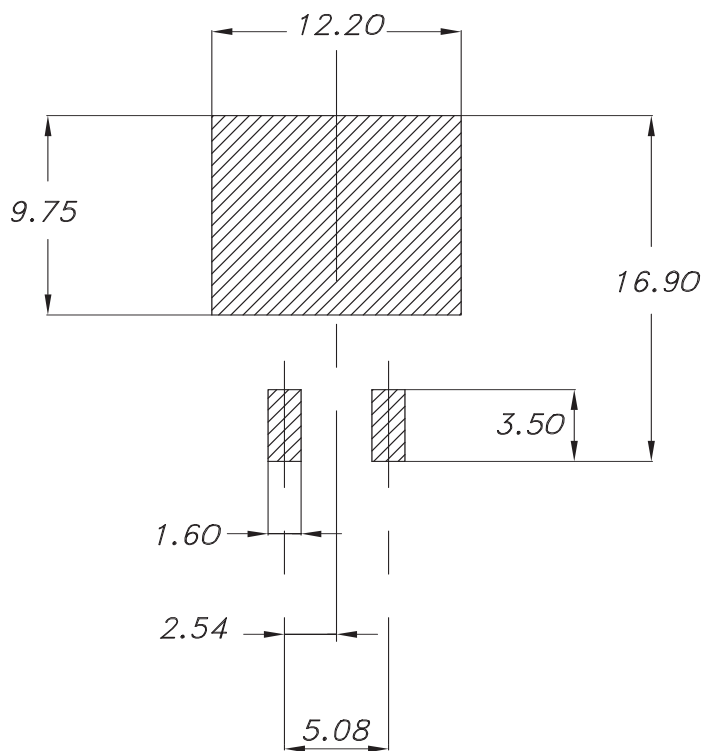


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Table 8. D²PAK (TO-263) type A2 package mechanical data

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°

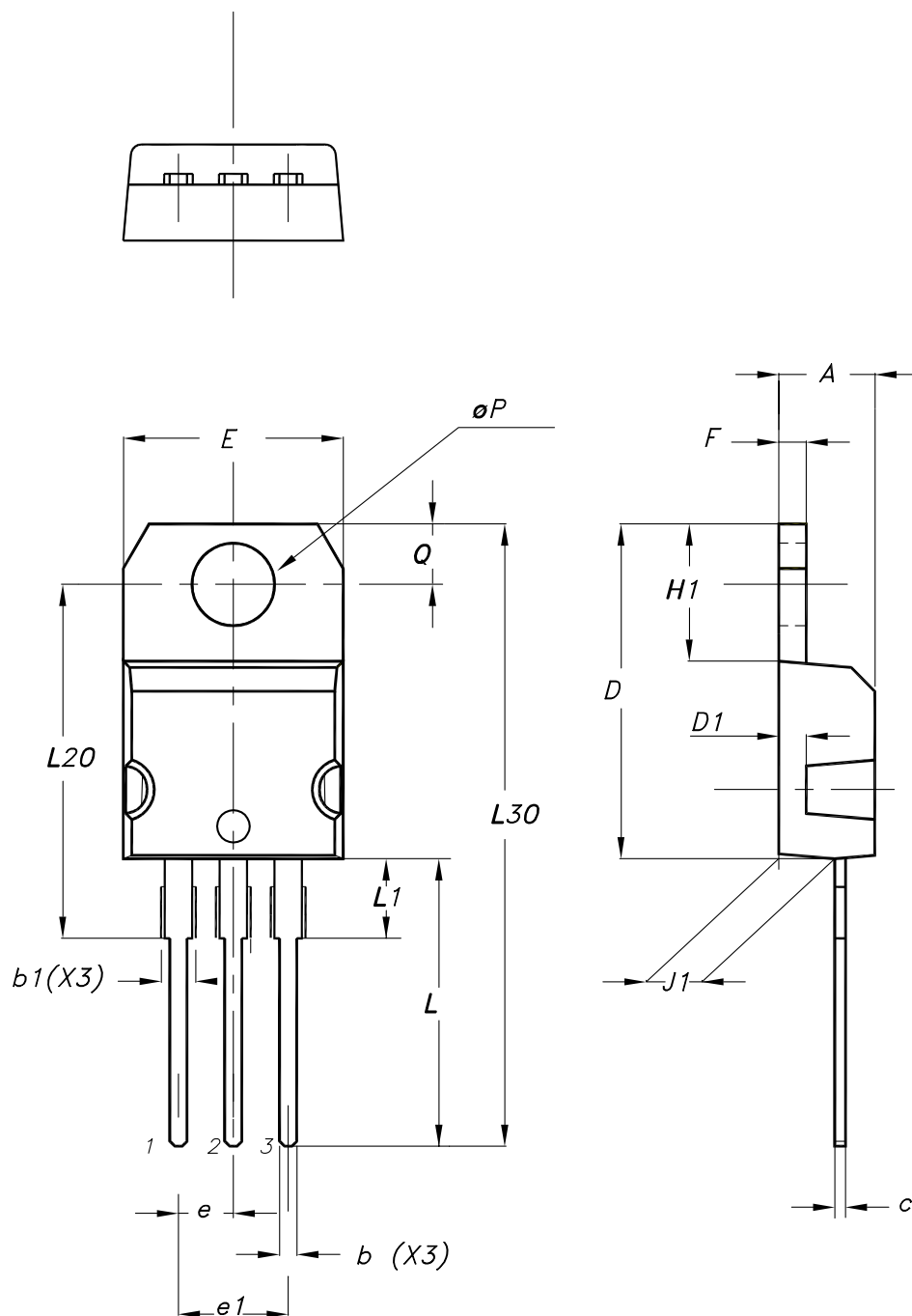
Figure 23. D²PAK (TO-263) recommended footprint (dimensions are in mm)



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4.2 TO-220 type A package information

Figure 24. TO-220 type A package outline



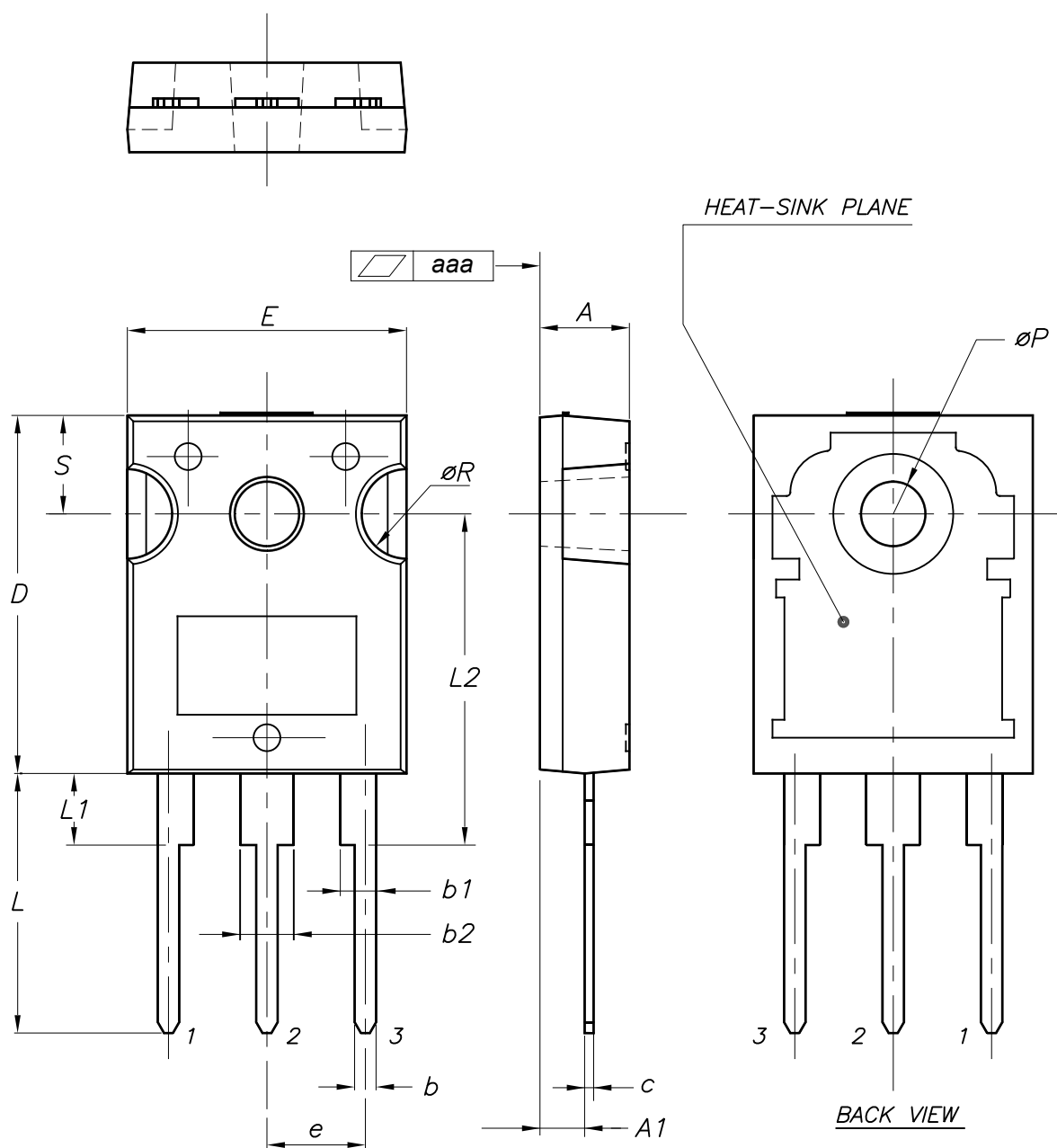
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Table 9. TO-220 type A package mechanical data

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

4.3 TO-247 package information

Figure 25. TO-247 package outline



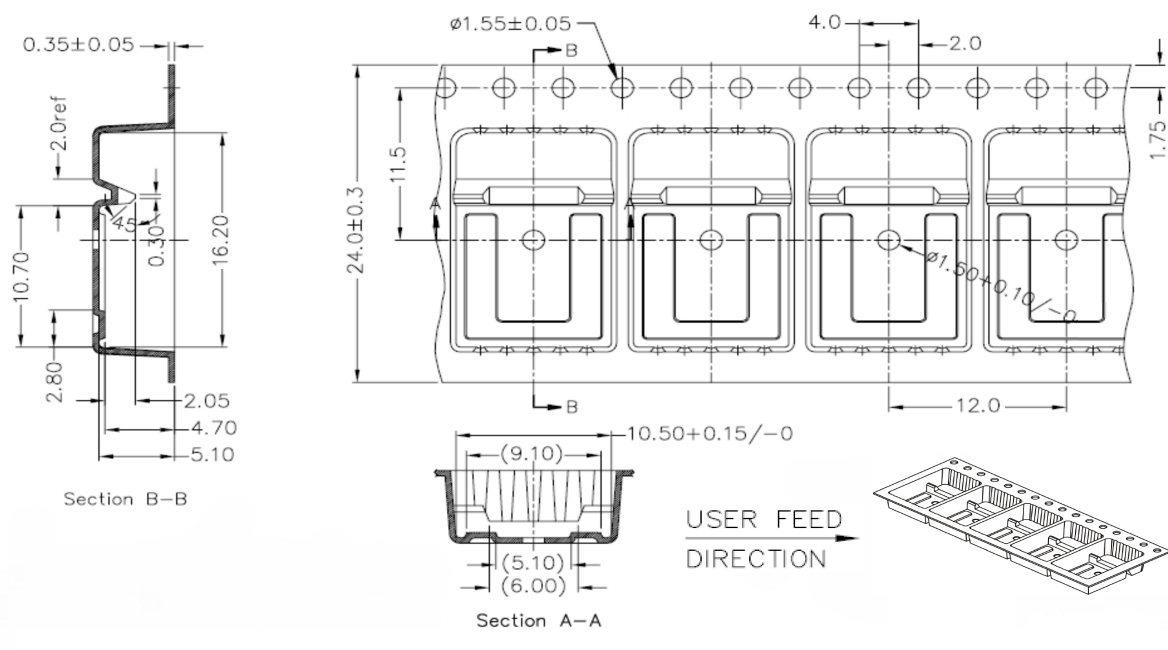
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Table 10. TO-247 package mechanical data

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
aaa		0.04	0.10

4.4 D²PAK packing information

Figure 26. D²PAK tape drawing (dimensions are in mm)



DM01095771_2



5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STB38N65M5	38N65M5	D ² PAK	Tape and reel
STP38N65M5		TO-220	Tube
STW38N65M5		TO-247	

Revision history

Table 12. Document revision history

Date	Revision	Changes
22-Feb-2012	1	First release.
21-Jun-2012	2	Document status changed from preliminary data to production data. Added <i>Section 2.1: Electrical characteristics (curves)</i> .
05-Mar-2013	3	Added dv/dt value on <i>Table 2: Absolute maximum ratings</i> .
09-Apr-2014	4	The part number STF38N65M5 has been moved to a separate datasheet. Minor text changes.
19-Sep-2025	5	Updated <i>Section 4: Package information</i> . Minor text changes.



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