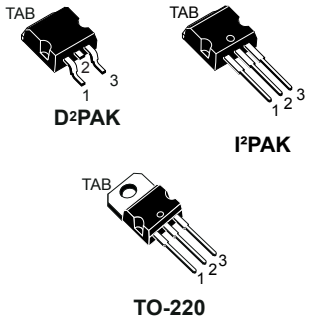
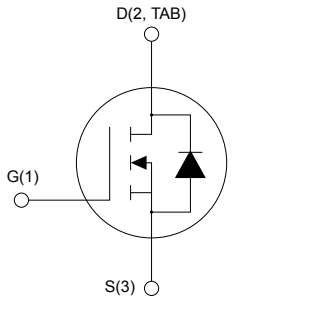
STB20N65M5, STI20N65M5, STP20N65M5

Datasheet

N-channel 650 V, 160 mΩ typ., 18 A MDmesh M5 Power MOSFETs in a D²PAK, I²PAK and TO-220 packages





Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB20N65M5	650 V	190 mΩ	18 A
STI20N65M5			
STP20N65M5			

- 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
STB20N65M5
STI20N65M5
STP20N65M5

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 °C	18	A
I_D	Drain current (continuous) at T_C = 100 °C	11.3	A
I_{DM}(1)	Drain current (pulsed)	72	A
P_{TOT}	Total power dissipation at T_C = 25 °C	130	W
dv/dt(2)	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 18 A, di/dt ≤ 400 A/µs; V_{DS} (peak) < $V_{(BR)DSS}$, V_{DD} = 400 V.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D^2PAK	I^2PAK TO-220	
R_{thJC}	Thermal resistance, junction-to-case	0.96		°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	30(1)	62.5	°C/W

1. *When mounted on a standard 1 inch^2 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.)	4	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	270	mJ

2 Electrical characteristics

T_C = 25 °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 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_{DS} = 0 V, V_{GS} = ±25 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 = 9 A	-	160	190	mΩ

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 V, f = 1 MHz, V_{GS} = 0 V	-	1434	-	pF
C_{oss}	Output capacitance		-	38	-	
C_{rss}	Reverse transfer capacitance		-	3.7	-	
$C_{o(tr)}$(1)	Equivalent output capacitance time related	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	118	-	pF
$C_{o(er)}$(2)	Equivalent output capacitance energy related		-	35	-	pF
R_g	Gate input resistance	f = 1 MHz open drain	-	3.5	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 9 A, V_{GS} = 0 to 10 V (see the Figure 15. Test circuit for gate charge behavior)	-	36	-	nC
Q_{gs}	Gate-source charge		-	7.5	-	
Q_{gd}	Gate-drain charge		-	18	-	

1. *$C_{o(tr)}$ is an equivalent capacitance that provides the same charging time as Coss 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 V, I_D = 12 A, R_G = 4.7 Ω, V_{GS} = 10 V (see the Figure 16. Test circuit for inductive load switching and diode recovery times and Figure 19. Switching time waveform)	-	43	-	ns
$t_{r(v)}$	Voltage rise time		-	7.5	-	
$t_{c(off)}$	Crossing time off		-	11.5	-	
$t_{f(i)}$	Current fall time		-	7.5	-	

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	18	A
I_{SDM}(1)	Source-drain current (pulsed)		-	-	72	
V_{SD}(2)	Forward on voltage	I_{SD} = 18 A, V_{GS} = 0 V	-	-	1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 18 A, di/dt = 100 A/µs	-	288	-	ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V (see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	4	-	µC
I_{RRM}	Reverse recovery current		-	27	-	A
t_{rr}	Reverse recovery time	I_{SD} = 18 A, di/dt = 100 A/µs	-	342	-	ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_J = 150 °C (see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	4.7	-	µC
I_{RRM}	Reverse recovery current		-	28	-	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

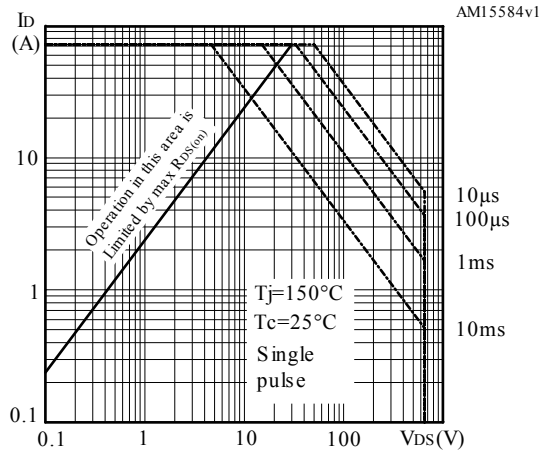


Figure 2. Normalized transient thermal impedance

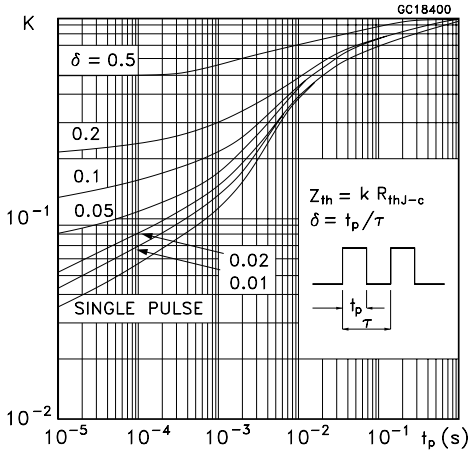


Figure 3. Output characterisics

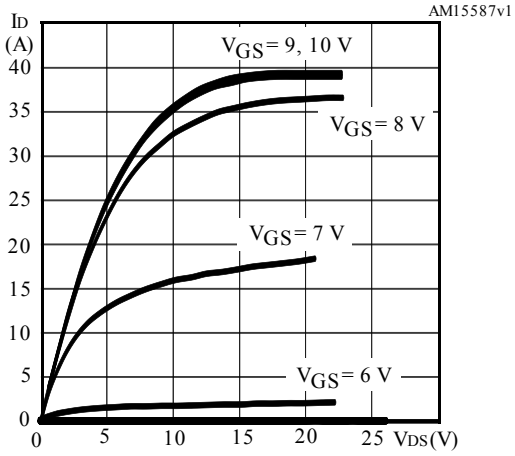


Figure 4. Transfer characteristics

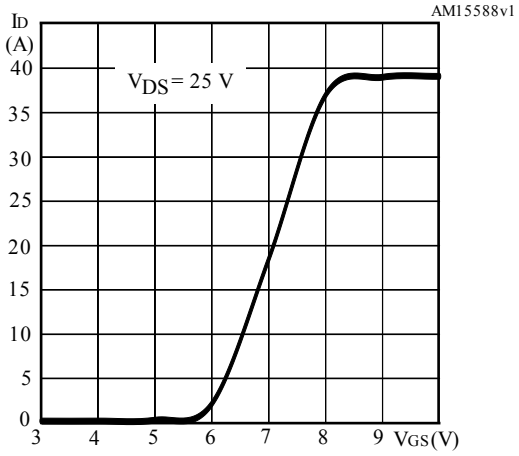


Figure 5. Gate charge vs gate-source voltage

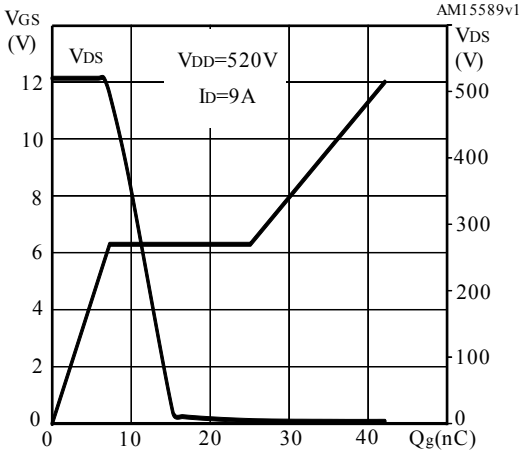


Figure 6. Static drain-source on-resistance

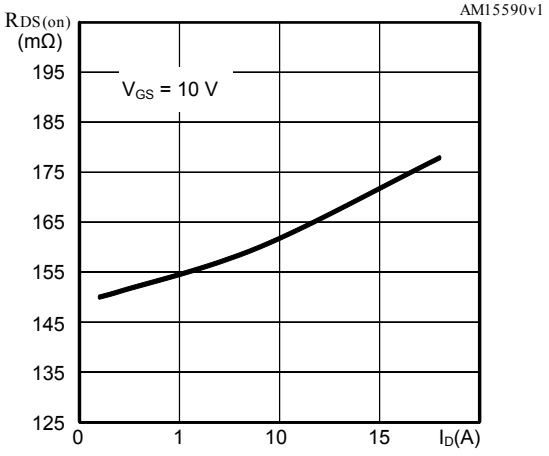


Figure 7. Capacitance variations

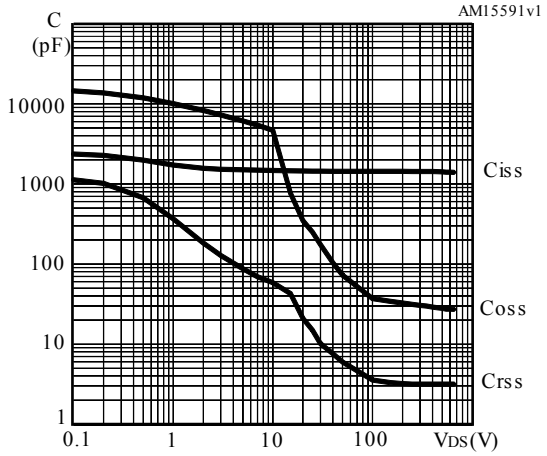


Figure 8. Output capacitance stored energy

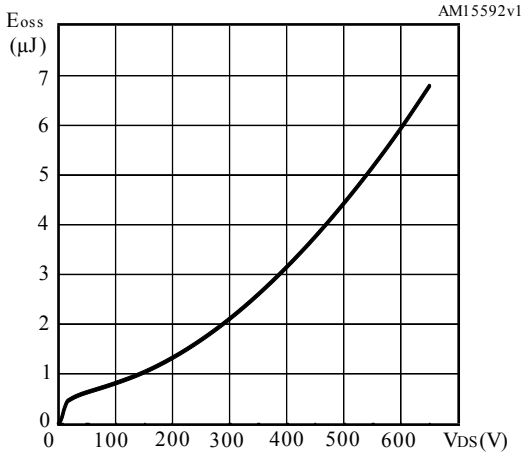


Figure 9. Normalized gate threshold voltage vs temperature

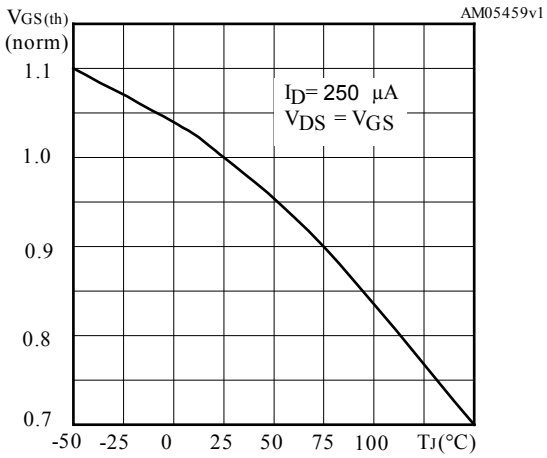


Figure 10. Normalized on-resistance vs temperature

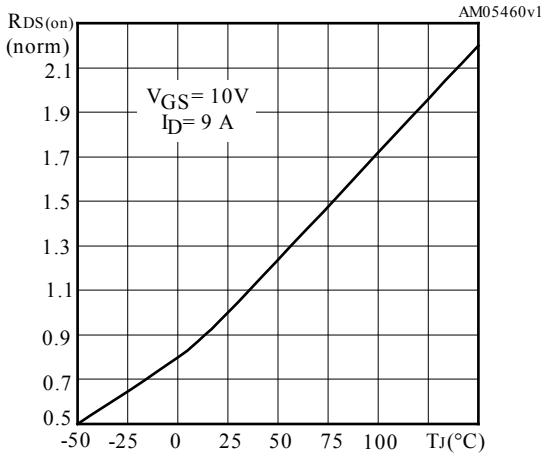


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

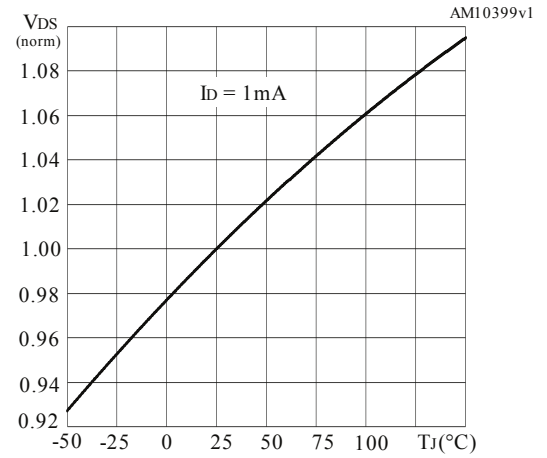


Figure 12. Drain-source diode forward characteristics

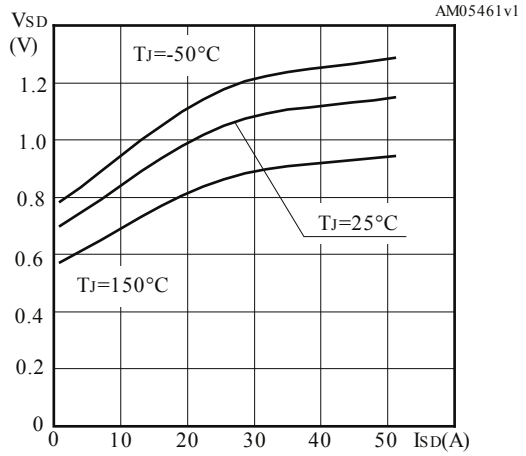
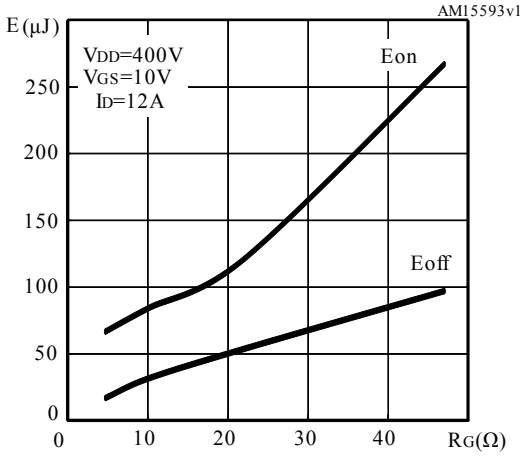


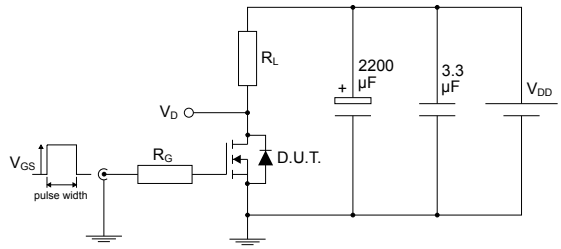
Figure 13. Switching energy vs gate resistance



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

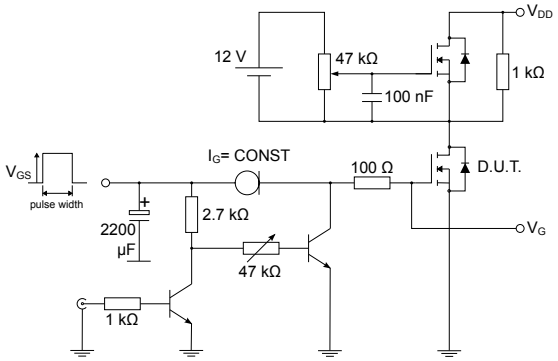
3 Test circuits

Figure 14. Test circuit for resistive load switching times



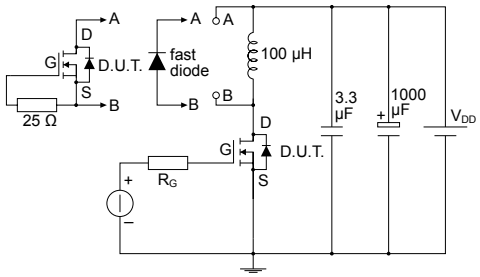
AM01468v1

Figure 15. Test circuit for gate charge behavior



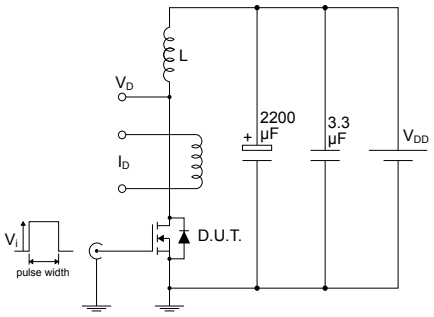
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Figure 16. Test circuit for inductive load switching and diode recovery times



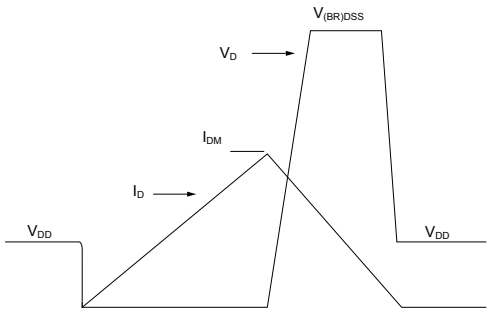
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Figure 17. Unclamped inductive load test circuit



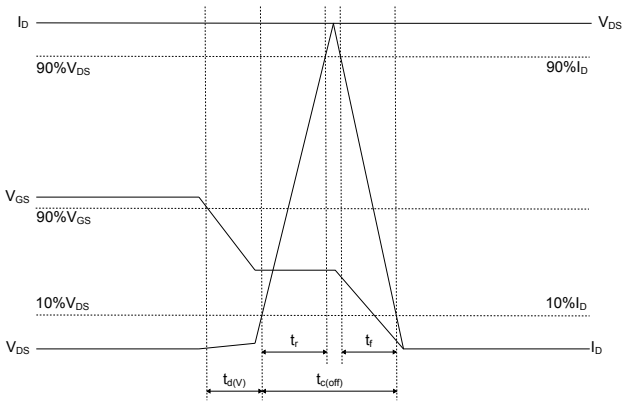
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Figure 18. Unclamped inductive waveform



AM01472v1

Figure 19. Switching time waveform



AM05540v2

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 A package information

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

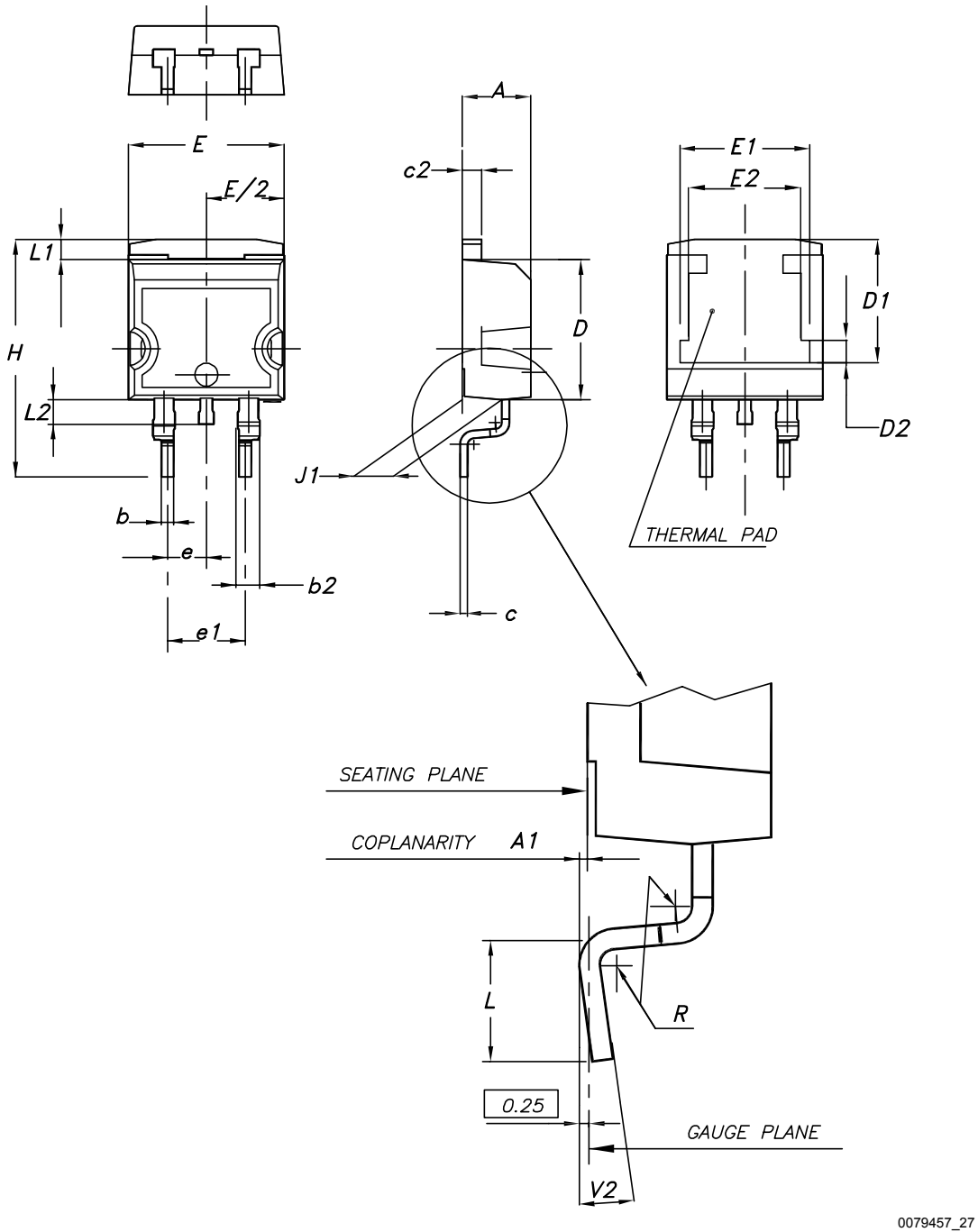
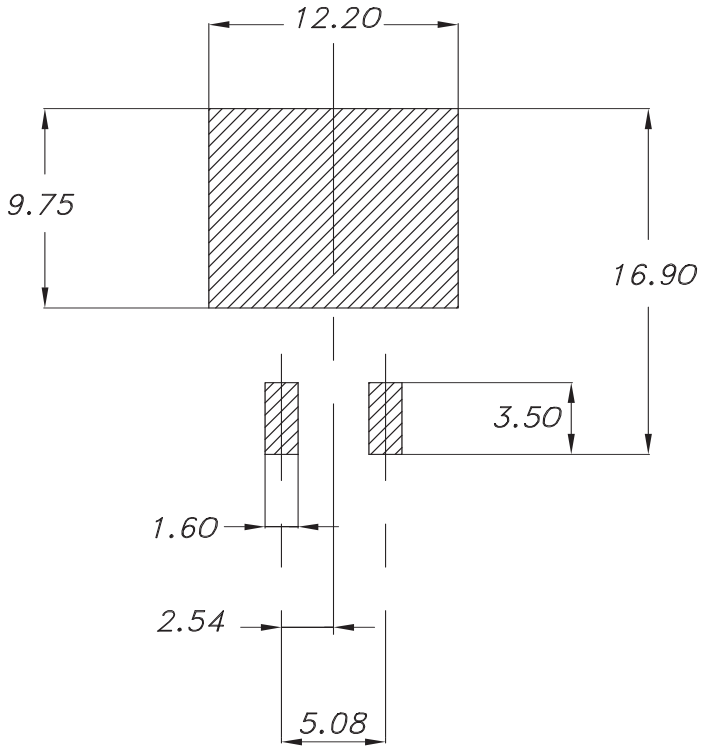


Table 8. D²PAK (TO-263) type A package mechanical data

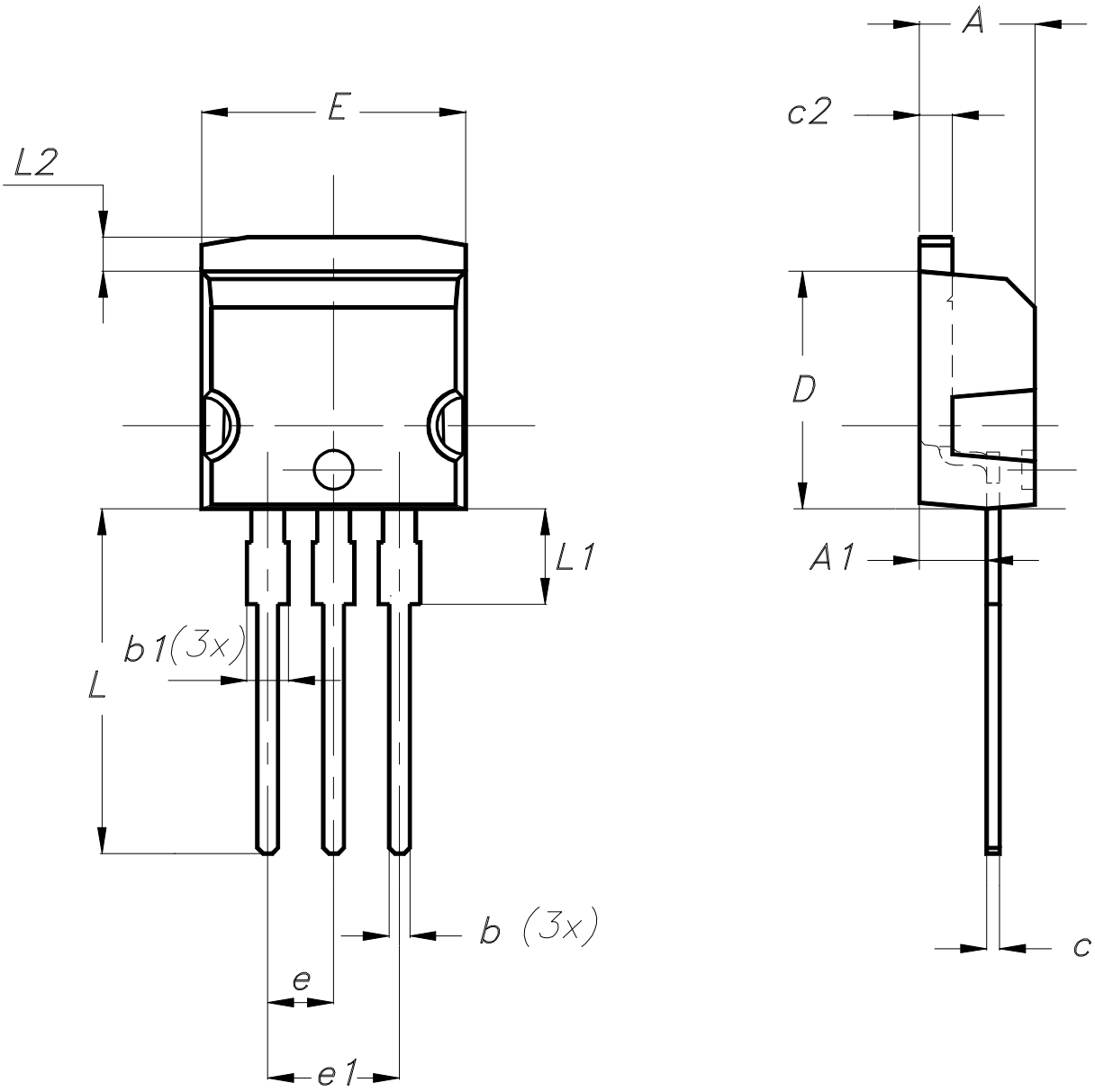
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 I²PAK package information

Figure 22. I²PAK package outline



0004982_Rev_10

Table 9. I²PAK package mechanical data

Dim.	mm	
	Min.	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	10.00	10.40
L	13.00	14.00
L1	3.50	3.93
L2	1.27	1.40

4.3 TO-220 type A package information

Figure 23. **TO-220 type A package outline**

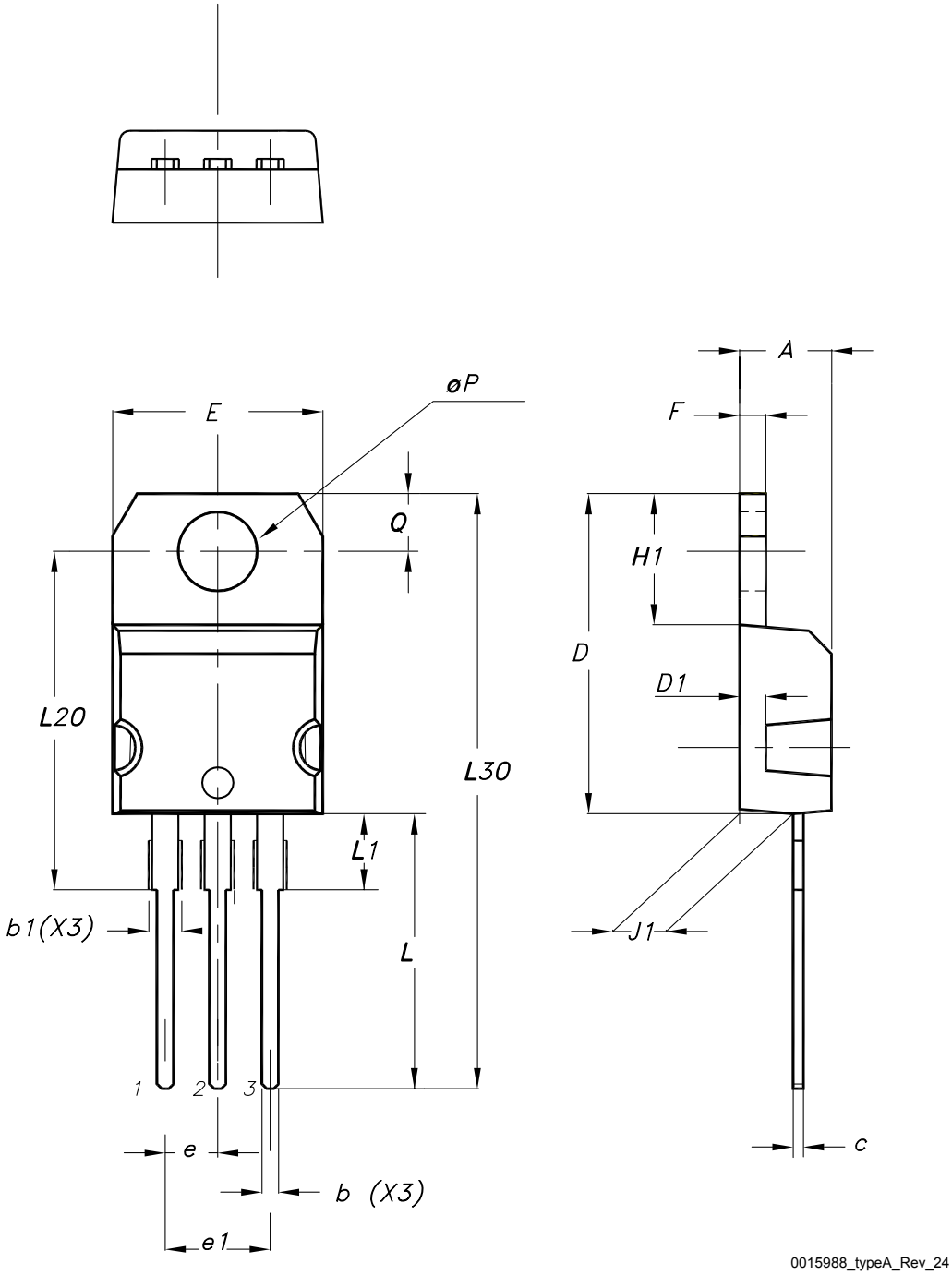
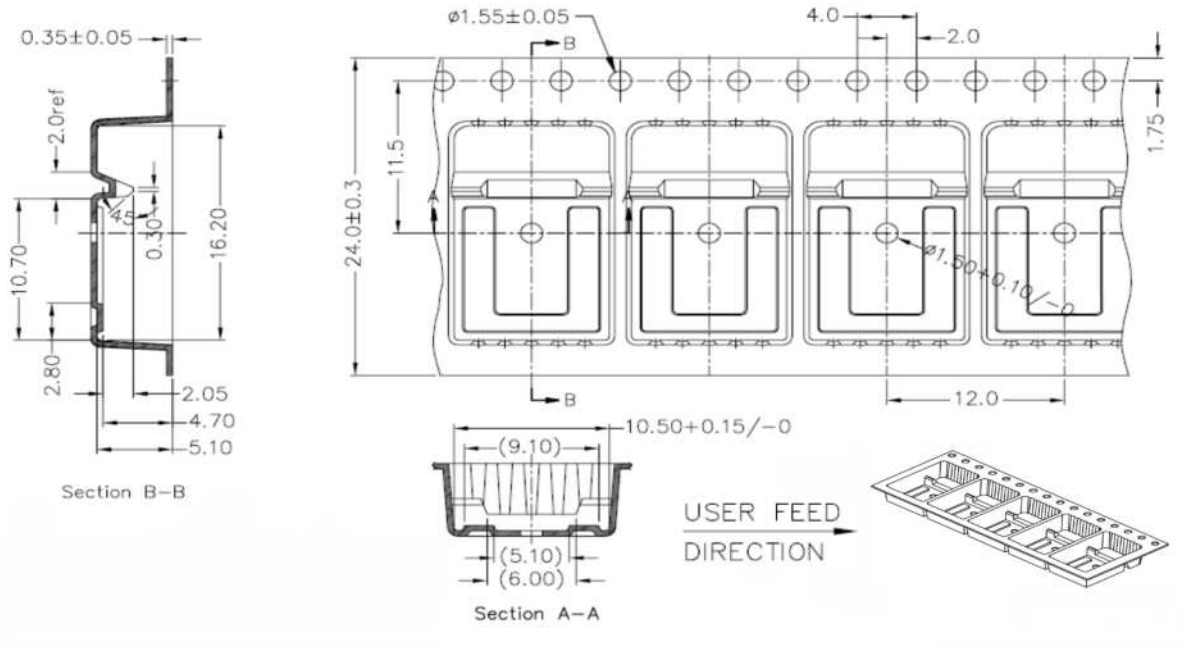


Table 10. **TO-220 type A package mechanical data**

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

4.4 D²PAK packing information

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



DM01095771_2

5 Ordering information

Table 11. **Order codes**

Order codes	Marking	Package	Packing
STB20N65M5	20N65M5	D²PAK	Tape and reel
STI20N65M5		I²PAK	Tube
STP20N65M5		TO-220	

Revision history

Table 12. **Document revision history**

Date	Revision	Changes
06-Mar-2012	1	First release.
01-Feb-2013	2	The part numbers STF20N65M5 and STFI20N65M5 have been moved to a separate datasheet. Added: part numbers STB20N65M5 and STI20N65M5. Modified: *note1* on *Table 2*, *Table 4* values and typical values of *Table 5*, *6*, *7*, *8*. Added: $R_{thj\text{-}pcb}$ and *note1* on *Table 3*. Updated: *Section 4: Package mechanical data*. Added: *Section 2.1: Electrical characteristics (curves)*.
25-Jul-2025	3	Removed order code STW20N65M5. Updated Section 4: Package information. Minor text changes.

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