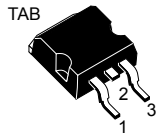
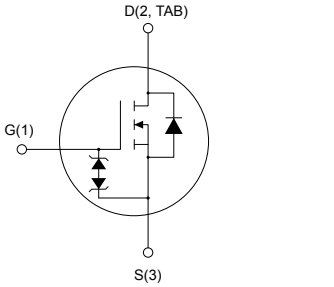
N-channel 600 V, 115 mΩ typ., 25 A, MDmesh DM6 Power MOSFET in a D²PAK package



D²PAK



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB33N60DM6	600 V	128 mΩ	25 A

- Fast-recovery body diode
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high-voltage N-channel Power MOSFET is part of the MDmesh DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge (Q_{rr}), recovery time (t_{rr}) and excellent improvement in $R_{DS(on)}$ per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift converters.

Product status link
STB33N60DM6

Product summary	
Order code	STB33N60DM6
Marking	33N60DM6
Package	D²PAK
Packing	Tape and reel

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	25	A
	Drain current (continuous) at T_C = 100 °C	16	A
I_{DM}(1)	Drain current (pulsed)	80	A
P_{TOT}	Total power dissipation at T_C = 25 °C	190	W
dv/dt(2)	Peak diode recovery voltage slope	100	V/ns
di/dt (2)	Peak diode recovery current slope	1000	A/µs
dv/dt(3)	MOSFET dv/dt ruggedness	100	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width is limited by safe operating area.*
2. *I_{SD} ≤ 25 A, $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V*
3. *V_{DS} ≤ 480 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.66	°C/W
R_{thJA}(1)	Thermal resistance, junction-to-ambient	30	°C/W

1. *When mounted on FR-4 board of 1 inch², 2oz Cu.*

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	360	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	V_{GS} = 0 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C (1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 12.5 A		115	128	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	-	1500	-	pF
C_{oss}	Output capacitance		-	115	-	pF
C_{rss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	225	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	1.8	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 25 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	35	-	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	15	-	nC

1. *$C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 12.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	14	-	ns
t_r	Rise time		-	9	-	ns
$t_{d(off)}$	Turn-off delay time		-	7	-	ns
t_f	Fall time		-	35	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		25	A
I_{SDM}(1)	Source-drain current (pulsed)		-		80	A
V_{SD}(2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 25 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	105		ns
Q_{rr}	Reverse recovery charge		-	0.47		µC
I_{RRM}	Reverse recovery current		-	9		A
t_{rr}	Reverse recovery time	I_{SD} = 25 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	210		ns
Q_{rr}	Reverse recovery charge		-	1.68		µC
I_{RRM}	Reverse recovery current		-	16		A

1. *Pulse width is 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

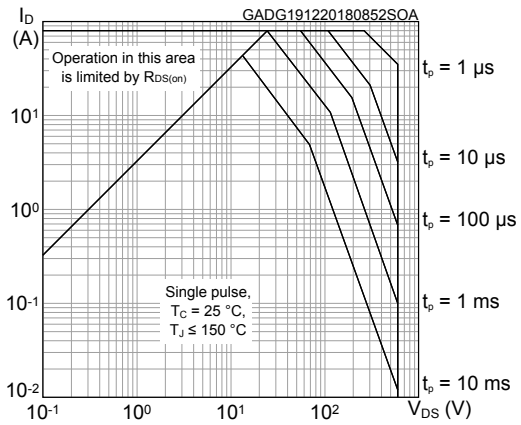


Figure 2. Normalized thermal impedance

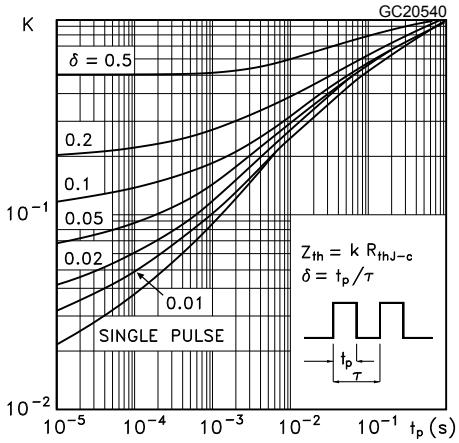


Figure 3. Output characteristics

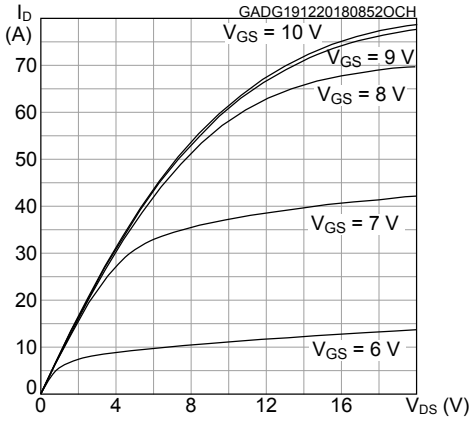


Figure 4. Transfer characteristics

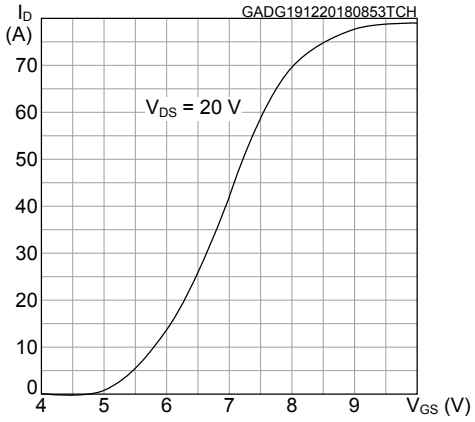


Figure 5. Gate charge vs gate-source voltage

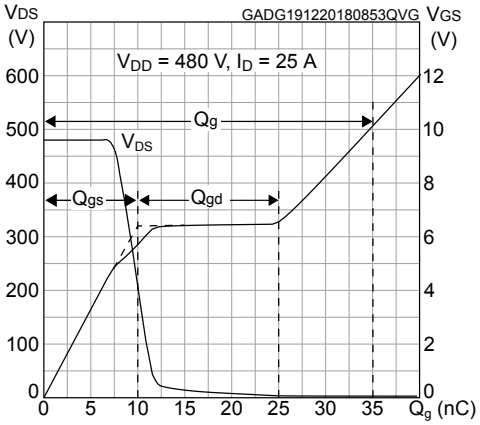


Figure 6. Capacitance variations

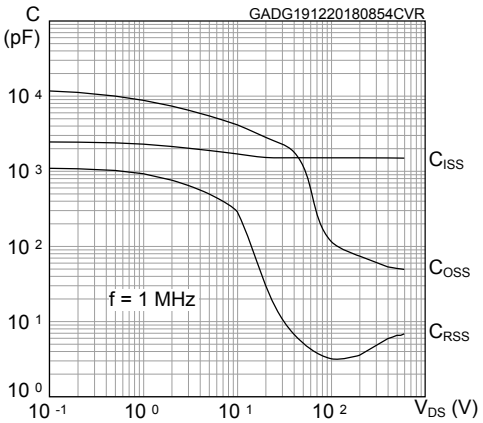


Figure 7. Static drain-source on-resistance

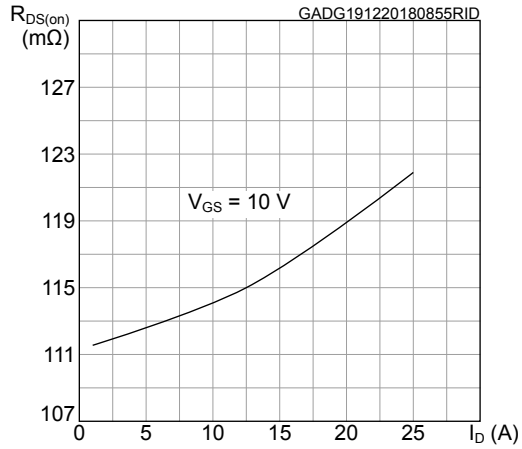


Figure 8. Normalized on-resistance vs temperature

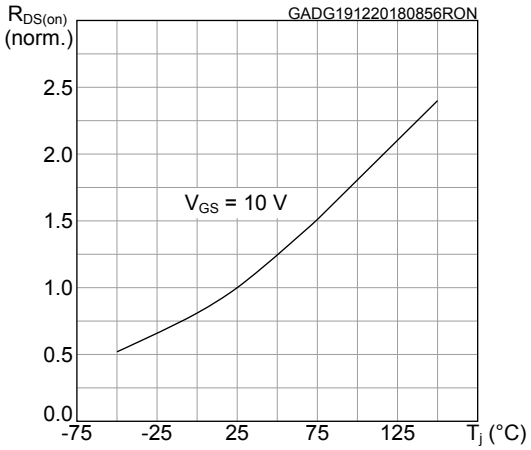


Figure 9. Normalized gate threshold voltage vs temperature

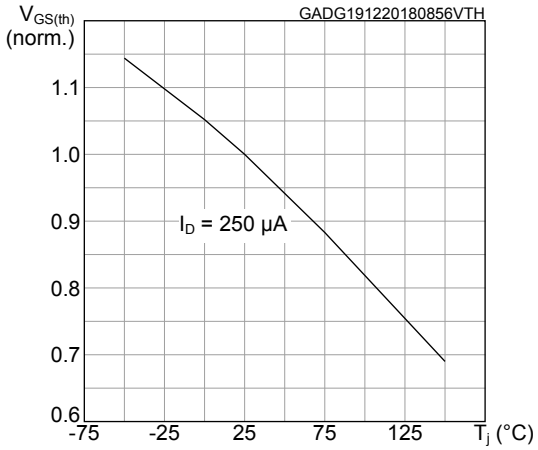


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

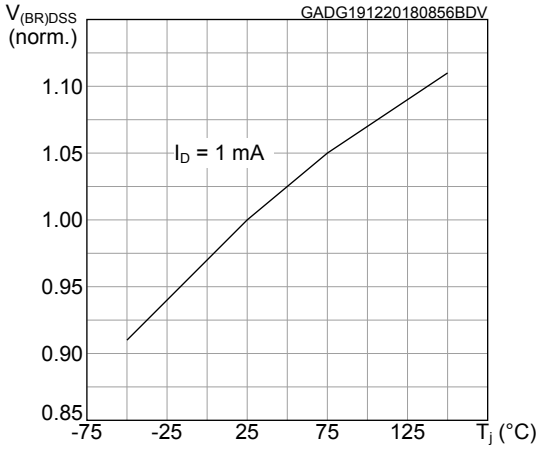


Figure 11. Output capacitance stored energy

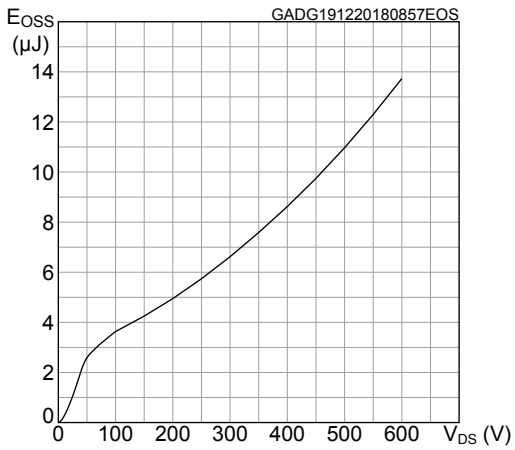
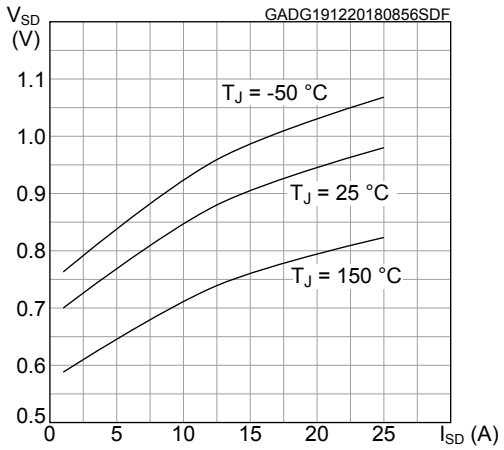
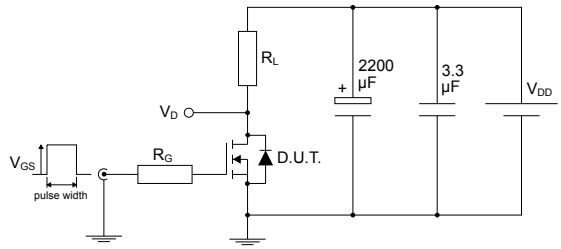


Figure 12. Source-drain diode forward characteristics



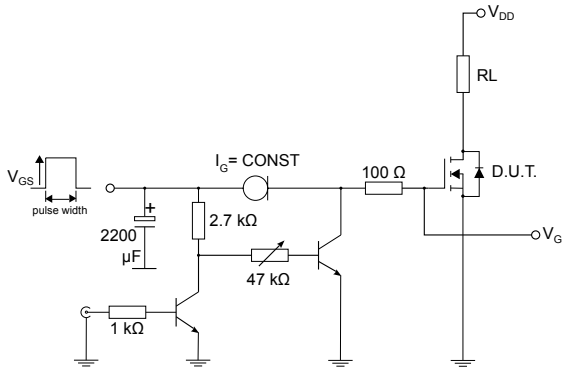
3 Test circuits

Figure 13. Test circuit for resistive load switching times



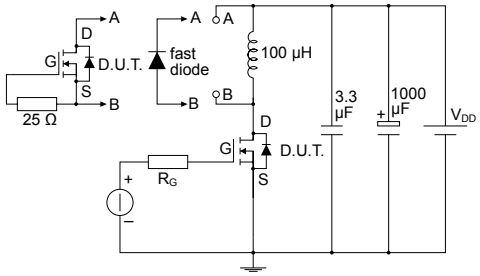
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Figure 14. Test circuit for gate charge behavior



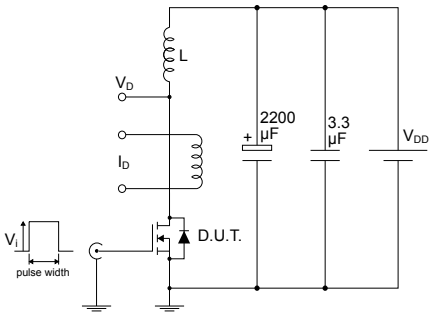
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Figure 15. Test circuit for inductive load switching and diode recovery times



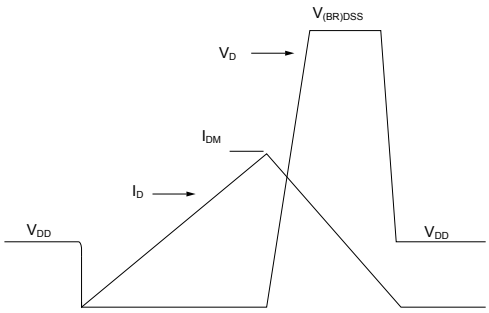
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Figure 16. Unclamped inductive load test circuit



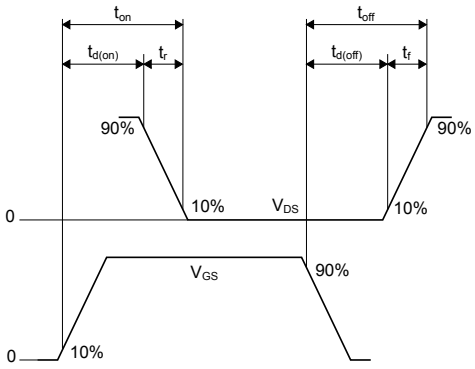
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Figure 17. Unclamped inductive waveform



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Figure 18. Switching time waveform



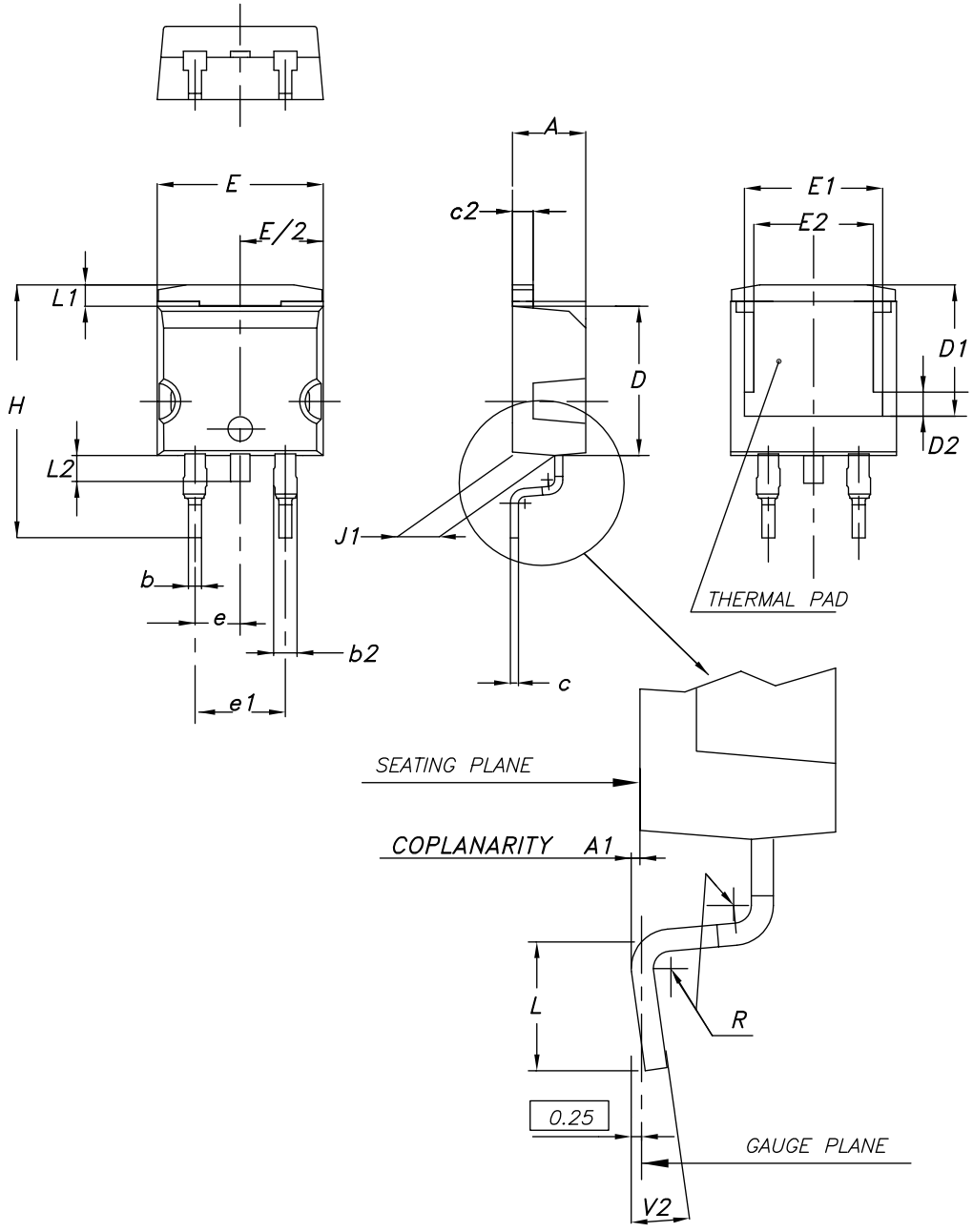
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4 Package information

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

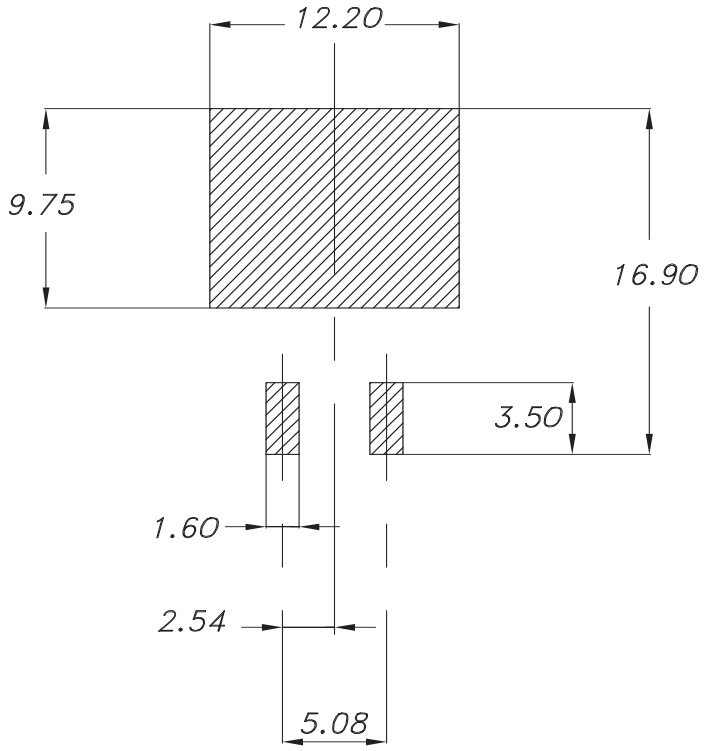


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Table 8. D²PAK (TO-263) type A2 package mechanical data

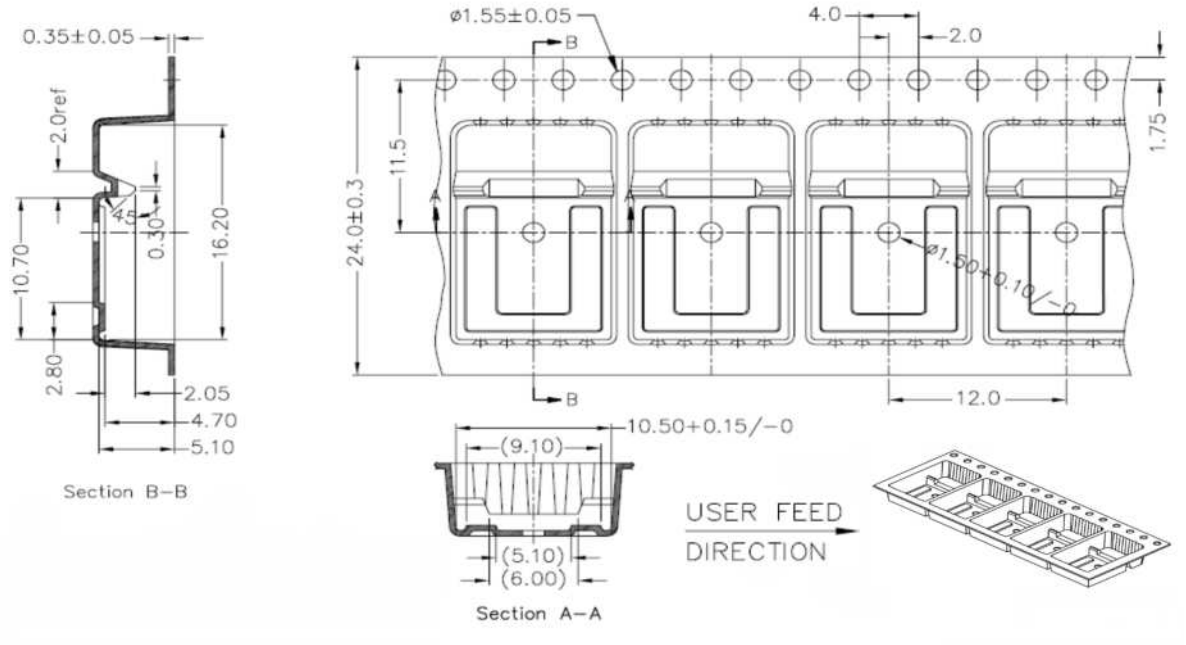
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.70	8.90	9.10
E2	7.30	7.50	7.70
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 20. D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 D²PAK packing information

Figure 21. D²PAK tape drawing (dimensions are in mm)



Revision history

Table 9. **Document revision history**

Date	Version	Changes
01-Feb-2019	1	First release.
02-Jul-2020	2	Updated *Table 1. Absolute maximum ratings* and *Table 7. Source drain diode.*
02-Sep-2025	3	Updated Section 4: Package information. Minor text changes.

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