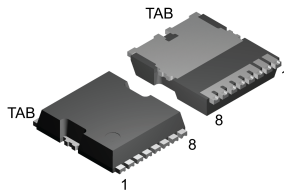
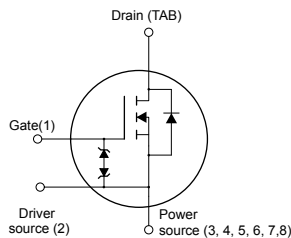


## N-channel 650 V, 53 mΩ typ., 55 A MDmesh DM6 Power MOSFET in a TO-LL package


**TO-LL type A2**


N-chG1DS2PS345678DTABZ


**Product status link**
[STO68N65DM6](#)
**Product summary**

<b>Order code</b>	STO68N65DM6
<b>Marking</b>	68N65DM6
<b>Package</b>	TO-LL type A2
<b>Packing</b>	Tape and reel

### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STO68N65DM6	650 V	65 mΩ	55 A

- Fast-recovery body diode
- Lower R<sub>DS(on)</sub> per area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected
- Excellent switching performance thanks to the extra driving source pin

### 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<sub>rr</sub>), recovery time (t<sub>rr</sub>) and excellent improvement in R<sub>DS(on)</sub> 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.

# 1 Electrical ratings

**Table 1. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	55	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	35	
$I_{DM}^{(2)}$	Drain current (pulsed)	172	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	240	W
$dv/dt^{(3)}$	Peak diode recovery voltage slope	100	V/ns
$di/dt^{(3)}$	Peak diode recovery current slope	1000	A/ $\mu\text{s}$
$dv/dt^{(4)}$	MOSFET $dv/dt$ ruggedness	100	V/ns
$T_{stg}$	Storage temperature range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating junction temperature range		$^\circ\text{C}$

1. Referred to TO-247 package.
2. Pulse width is limited by safe operating area.
3.  $I_{SD} \leq 55\text{ A}$ ,  $V_{DS} (\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$ .
4.  $V_{DS} \leq 520\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	0.52	$^\circ\text{C/W}$
$R_{thJB}$	Thermal resistance, junction-to-board <sup>(1)</sup>	43	$^\circ\text{C/W}$
	Thermal resistance, junction-to-board <sup>(2)</sup>	22	

1. When mounted on 1 inch<sup>2</sup> FR-4 pcb, standard footprint 2 Oz copper board.
2. When mounted on 40x40mm FR-4 pcb, 6 cm<sup>2</sup> 2 Oz copper board.

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive (pulse width limited by $T_J$ max.)	9	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	930	mJ

## 2 Electrical characteristics

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

**Table 4. On /off-states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	650			V
$I_{DSS}$	Zero-gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3.25	4.00	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 27.5\text{ A}$		53	65	m $\Omega$

1. Defined by design, not subject to production test.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$	-	3528	-	pF
$C_{oss}$	Output capacitance		-	258	-	pF
$C_{rSS}$	Reverse transfer capacitance		-	1.5	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }520\text{ V}$	-	609	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.25	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 48\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	80	-	nC
$Q_{gs}$	Gate-source charge		-	21.5	-	nC
$Q_{gd}$	Gate-drain charge		-	35	-	nC

1.  $C_{oss\text{ eq.}}$  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	$V_{DD} = 325\text{ V}$ , $I_D = 34\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	23	-	ns
$t_r$	Rise time		-	12	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Switching times test circuit for resistive load and Figure 18. Switching time waveform)	-	69	-	ns
$t_f$	Fall time		-	7.5	-	ns

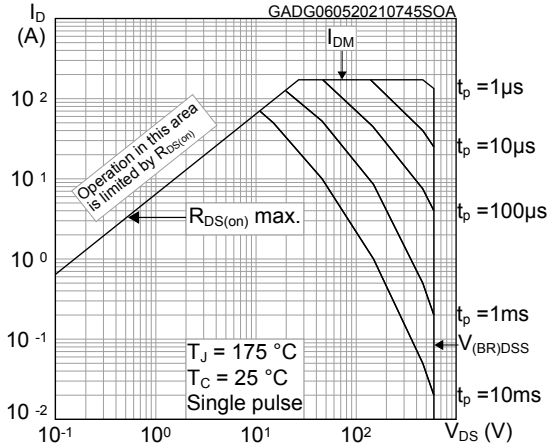
**Table 7. Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		55	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		172	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 48\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 48\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	135		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$	-	0.641		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	9.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 48\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	245		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	2.45		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	20		A

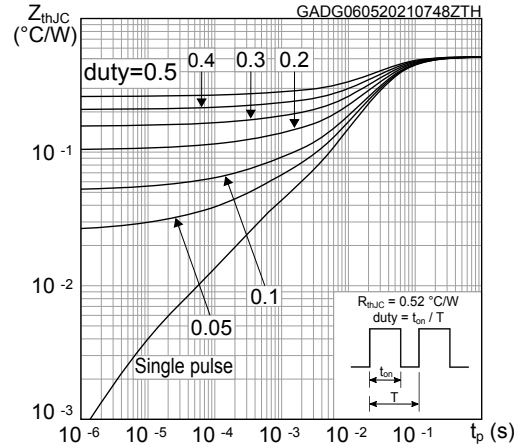
1. Pulse width is limited by safe operating area.
2. Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

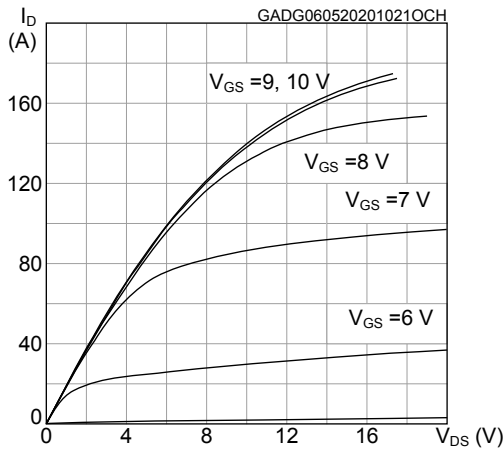
**Figure 1. Safe operating area**



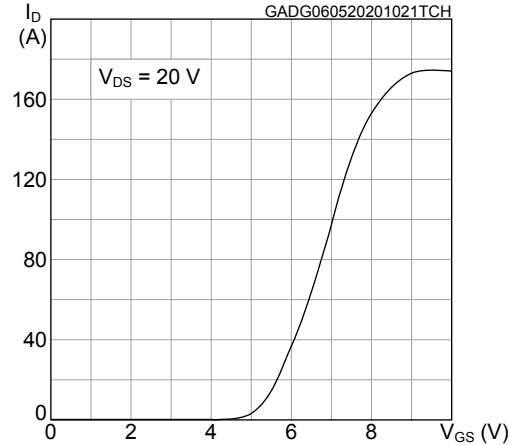
**Figure 2. Maximum transient thermal impedance**



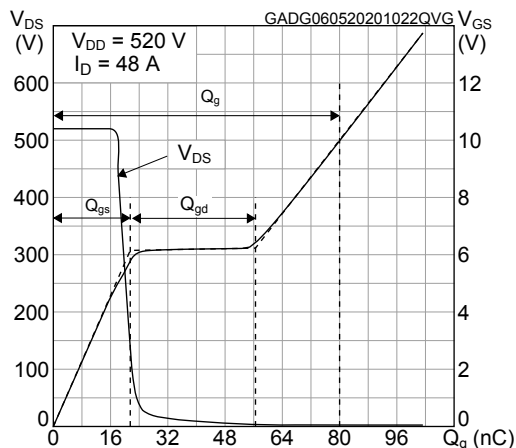
**Figure 3. Typical output characteristics**



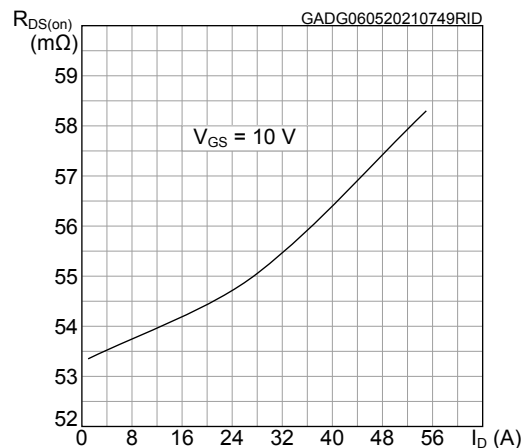
**Figure 4. Typical transfer characteristics**



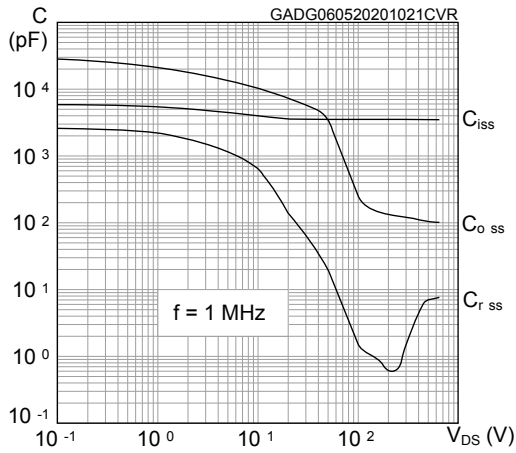
**Figure 5. Typical gate charge characteristics**



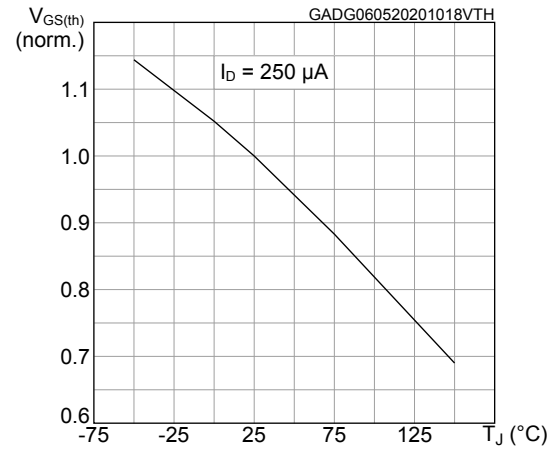
**Figure 6. Typical drain-source on-resistance**



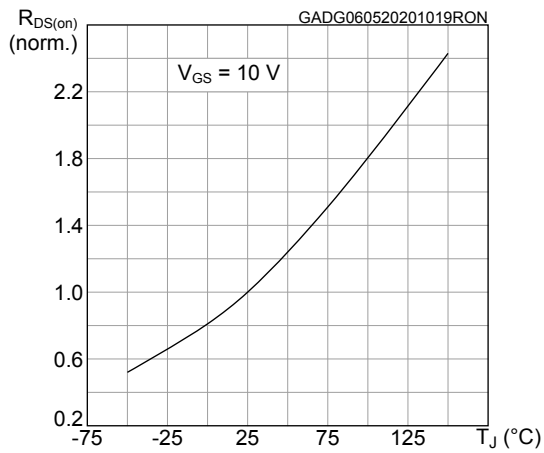
**Figure 7. Typical capacitance characteristics**



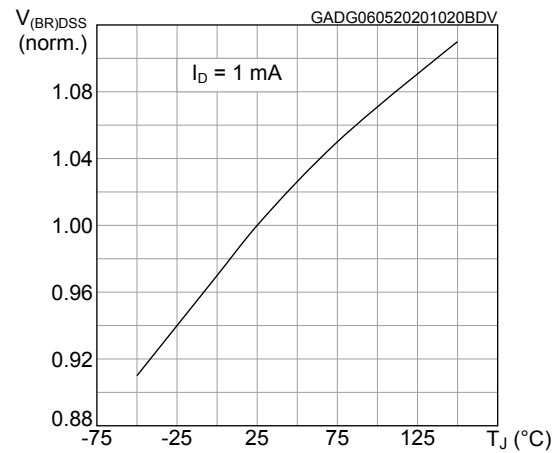
**Figure 8. Normalized gate threshold vs temperature**



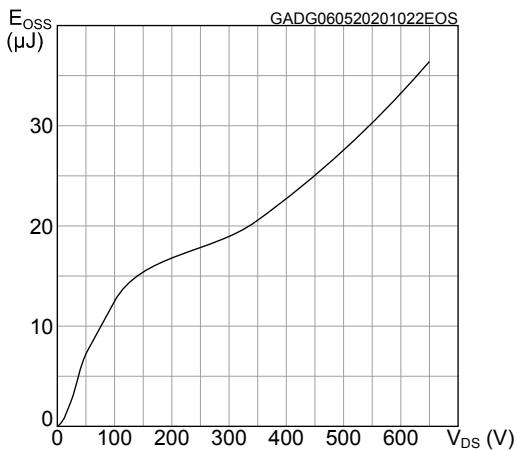
**Figure 9. Normalized on-resistance vs. temperature**



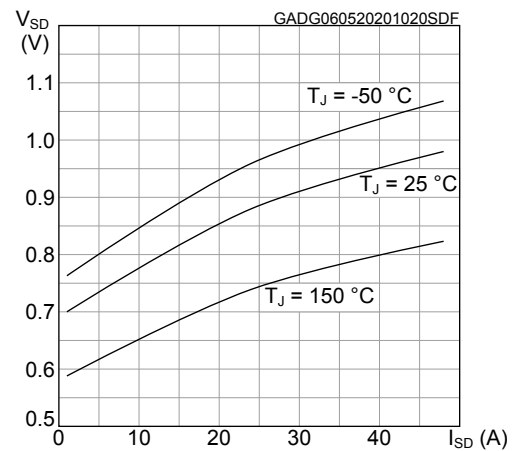
**Figure 10. Normalized breakdown voltage vs temperature**



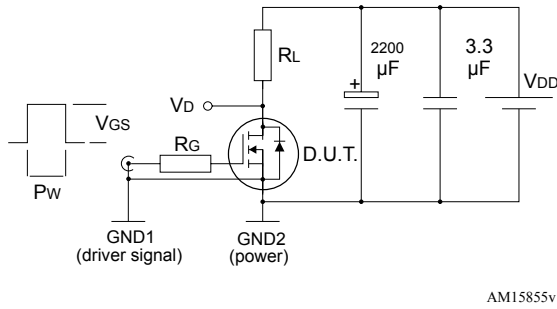
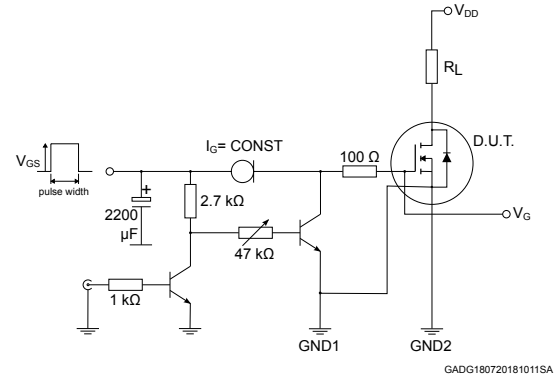
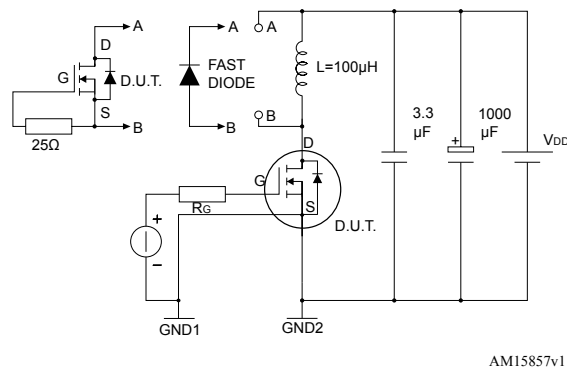
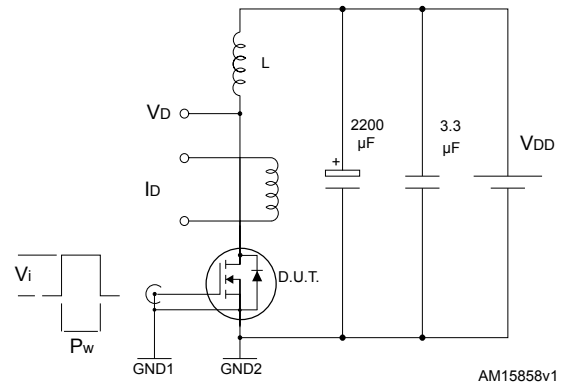
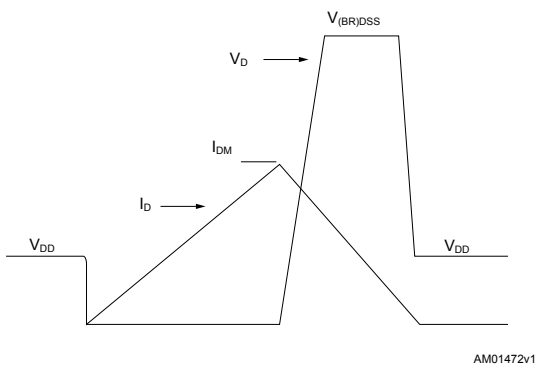
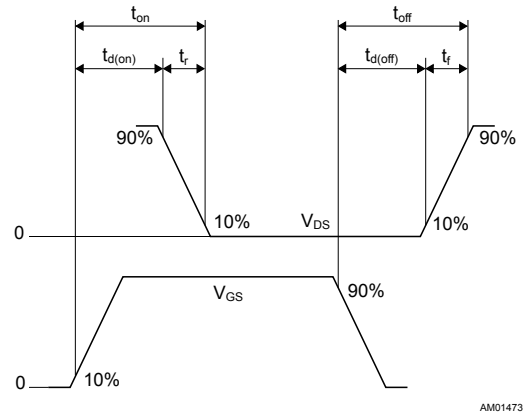
**Figure 11. Typical output capacitance stored energy**



**Figure 12. Typical reverse diode forward characteristics**



### 3 Test circuits

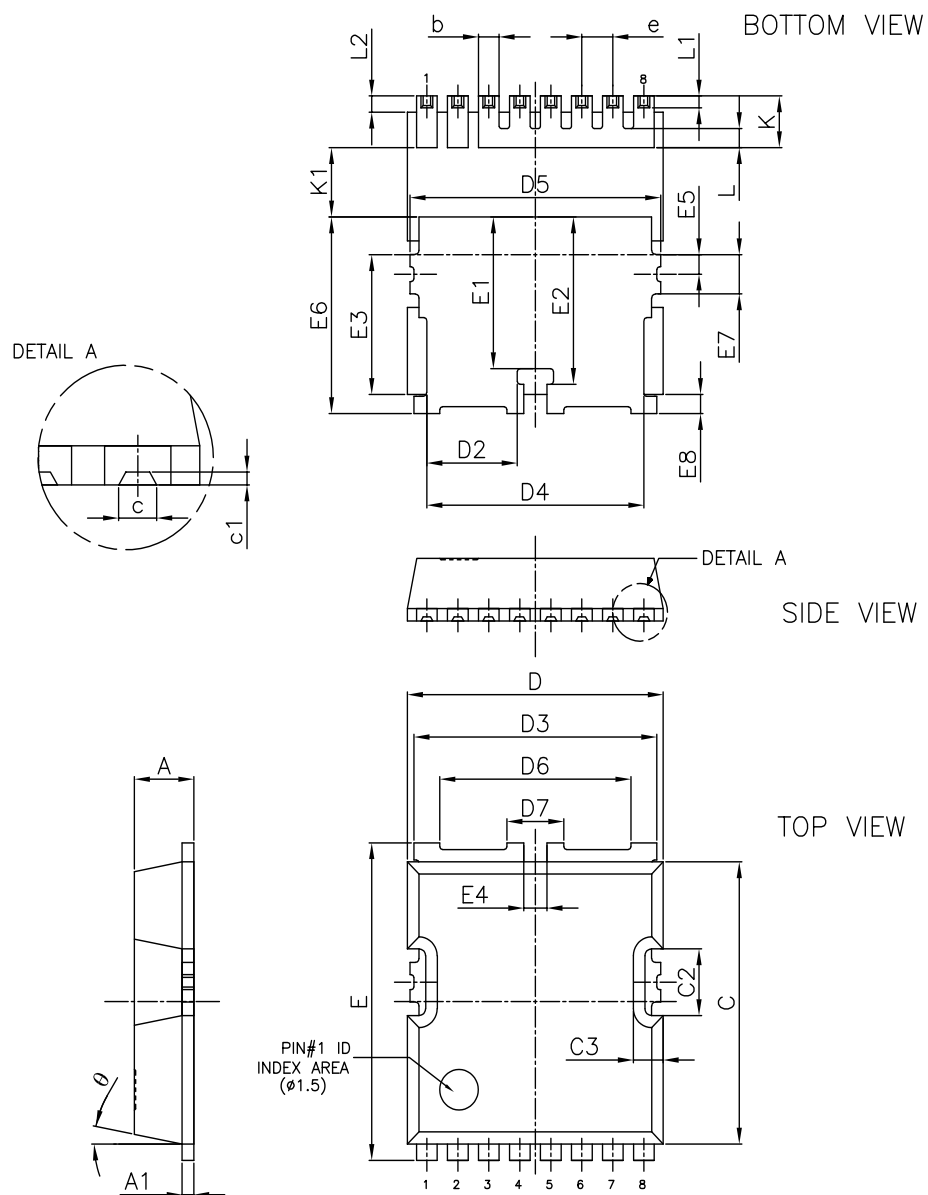
**Figure 13. Switching times test circuit for resistive load**

**Figure 14. Test circuit for gate charge behavior**

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

**Figure 16. Unclamped inductive load test circuit**

**Figure 17. Unclamped inductive waveform**

**Figure 18. Switching time waveform**


## 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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-LL type A2 package information

**Figure 19. TO-LL type A2 package outline**



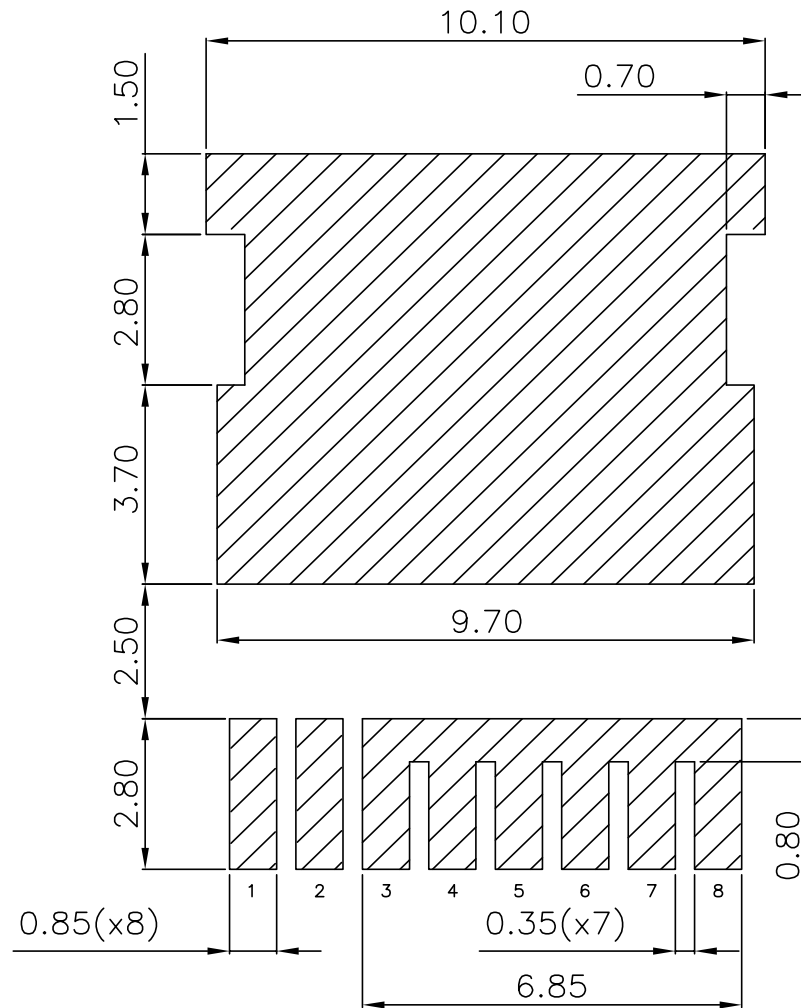
DM00276569\_5\_type\_A2



**Table 8. TO-LL type A2 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.40
A1	0.40	0.48	0.60
b	0.70	0.80	0.90
c		0.46	
c1		0.15	
C	10.28	10.38	10.48
C2	2.35	2.45	2.55
C3		1.16	
D	9.80	9.90	10.00
D2	3.30	3.50	3.70
D3	9.30	9.40	9.50
D4	8.20	8.40	8.60
D5	9.50	9.70	9.90
D6		7.40	
D7		2.20	
e		1.20	
E	11.48	11.68	11.88
E1		5.58	
E2		6.15	
E3		5.14	
E4		0.90	
E5		0.72	
E6	7.03	7.23	7.43
E7		1.44	
E8	0.50	0.70	0.90
K	1.70	1.90	2.10
K1	2.40		
L		0.70	
L1		0.44	
L2	0.40	0.60	0.80
θ		11°	

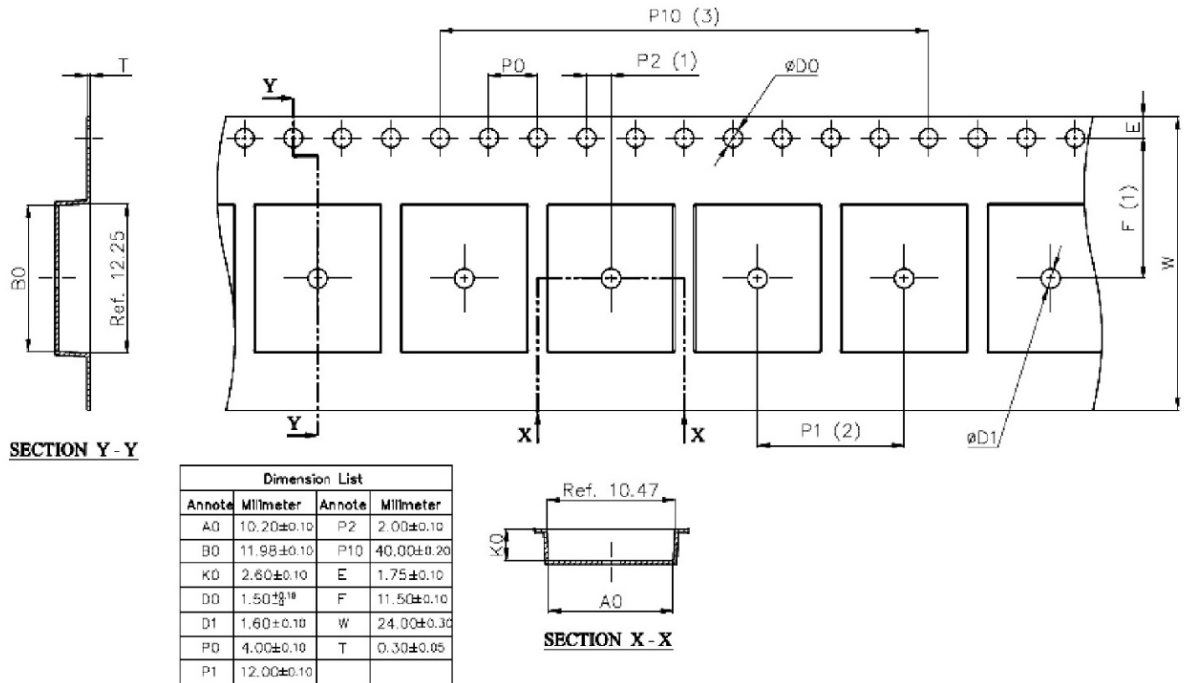
Figure 20. TO-LL type A2 recommended footprint (dimensions are in mm)



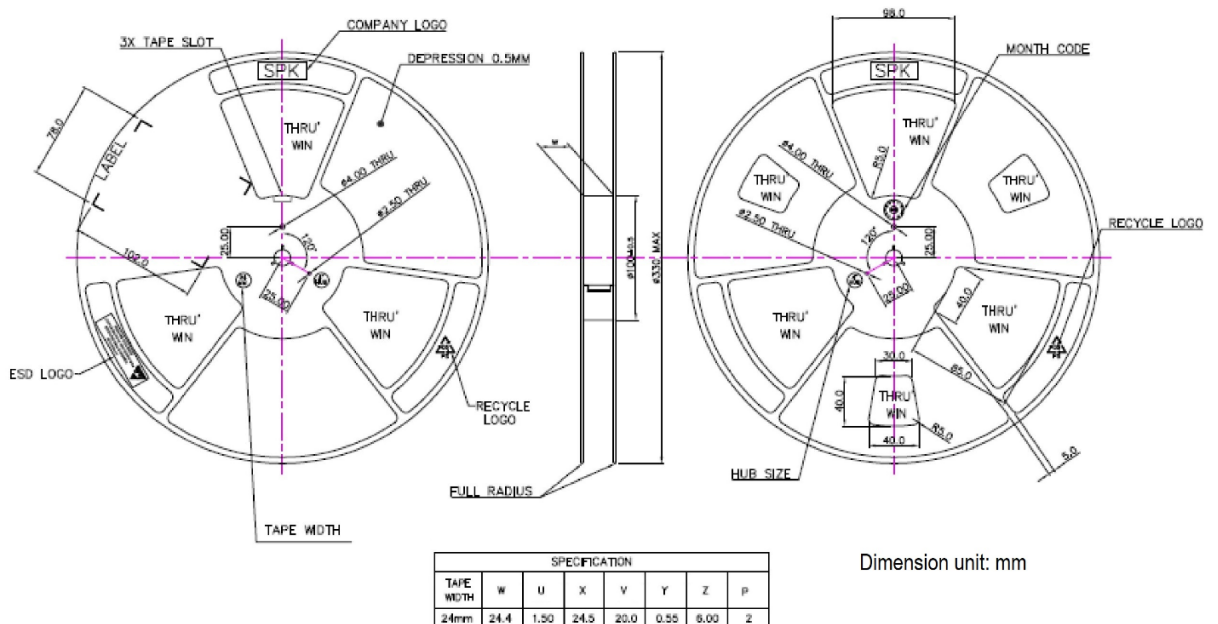
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## 4.2 TO-LL packing information

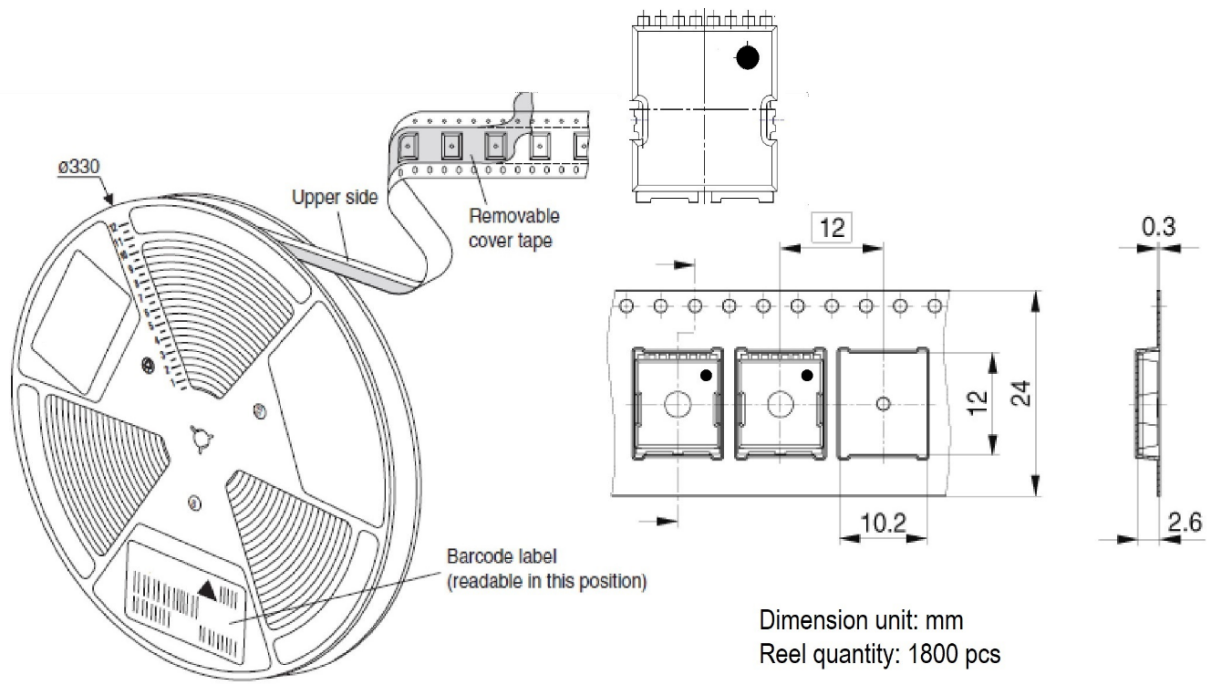
**Figure 21. Carrier tape outline and dimensions**



**Figure 22. Reel outline and dimensions**



**Figure 23. TO-LL orientation in tape pocket**



## Revision history

Table 9. Document revision history

Date	Version	Changes
06-May-2021	1	First release.

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[IPS60R360PFD7SAKMA1](#) [IPS60R600PFD7SAKMA1](#)