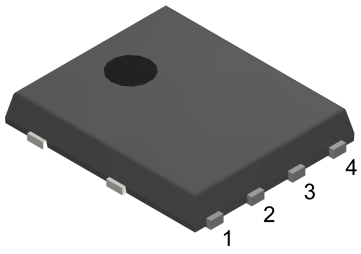
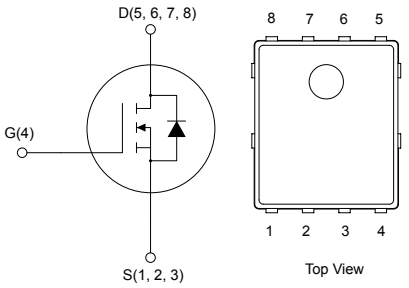
N-channel 60 V, 2.4 mΩ typ., 140 A, STripFET F7 Power MOSFET in a PowerFLAT 5x6 package



PowerFLAT™ 5x6



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STL140N6F7	60 V	2.8 mΩ	140 A	125 W

- Among the lowest $R_{DS(on)}$ on the market
- Excellent FoM (figure of merit)
- Low C_{rss}/C_{iss} ratio for EMI immunity
- High avalanche ruggedness
- Logic level $V_{GS(th)}$

Applications

- Switching applications

Description

This N-channel Power MOSFET utilizes STripFET F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching.

STPOWER

Product status
STL140N6F7

Product summary	
Order code	STL140N6F7
Marking	140N6F7
Package	PowerFLAT 5x6
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	60	V
V_{GS}	Gate-source voltage	±20	V
I_D[(1)]	Drain current (continuous) at T_{case} = 25 °C	140	A
	Drain current (continuous) at T_{case} = 100 °C	107	
I_{DM}[(1)(2)]	Drain current (pulsed)	560	A
I_D[(3)]	Drain current (continuous) at T_{pcb} = 25 °C	30	A
	Drain current (continuous) at T_{pcb} = 100 °C	21	
I_{DM}[(2)(3)]	Drain current (pulsed)	116	A
P_{TOT}[(1)]	Total power dissipation at T_{case} = 25 °C	125	W
P_{TOT}[(3)]	Total power dissipation at T_{pcb} = 25 °C	4.8	W
E_{AS}[(4)]	Single pulse avalanche energy	38	mJ
T_{stg}	Storage temperature range	-55 to 175	°C
T_j	Operating junction temperature range		

1. *This value is rated according to $R_{thj\text{-}c}$.*
2. *Pulse width is limited by safe operating area.*
3. *This value is rated according to $R_{thj\text{-}pcb}$*
4. *Starting T_j = 25 °C, I_D = 16 A, V_{DD} = 40 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}pcb}$[(1)]	Thermal resistance junction-pcb	31.3	°C/W
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.2	

1. *When mounted on a 1-inch² FR-4 board, 2oz Cu, t < 10 s*

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	60			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 60 V			1	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2		4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 15 A		2.4	2.8	mΩ

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	3110	-	pF
C_{oss}	Output capacitance		-	1520	-	
C_{rss}	Reverse transfer capacitance		-	193	-	
Q_g	Total gate charge	V_{DD} = 30 V, I_D = 30 A, V_{GS} = 0 to 10 V (see Figure 13. Test circuit for gate charge behavior)	-	55	-	nC
Q_{gs}	Gate-source charge		-	19	-	
Q_{gd}	Gate-drain charge		-	18	-	

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 30 V, I_D = 15 A R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	24	-	ns
t_r	Rise time		-	68	-	
$t_{d(off)}$	Turn-off delay time		-	39	-	
t_f	Fall time		-	20	-	

Table 6. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{SD} (1)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 30 A	-		1.2	V
t_{rr}	Reverse recovery time	I_{SD} = 30 A, di/dt = 100 A/µs, V_{DD} = 48 V (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	42.4		ns
Q_{rr}	Reverse recovery charge		-	38.2		nC
I_{RRM}	Reverse recovery current		-	1.8		A

1. *Pulse test: pulse duration = 300 µs, duty cycle 1.5%.*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

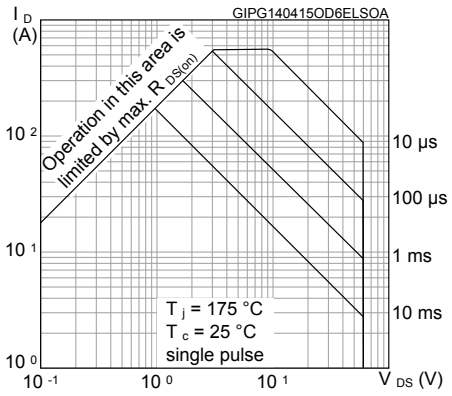


Figure 2. Thermal impedance

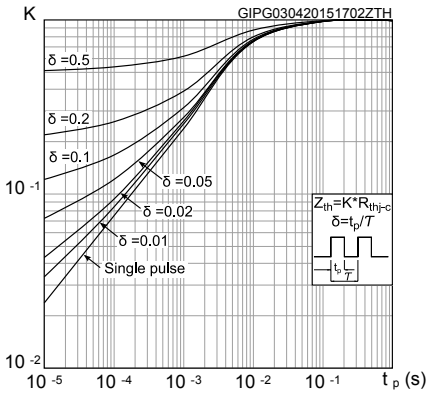


Figure 3. Output characteristics

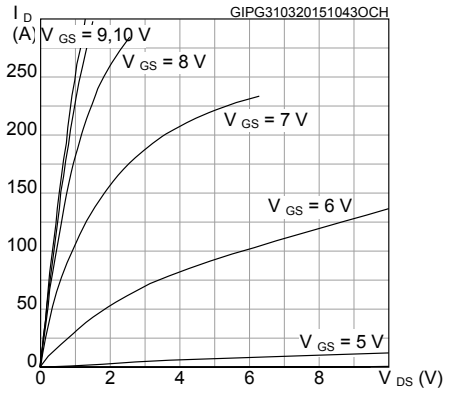


Figure 4. Transfer characteristics

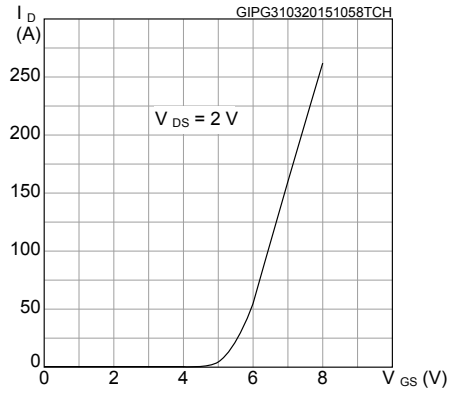


Figure 5. Gate charge vs gate-source voltage

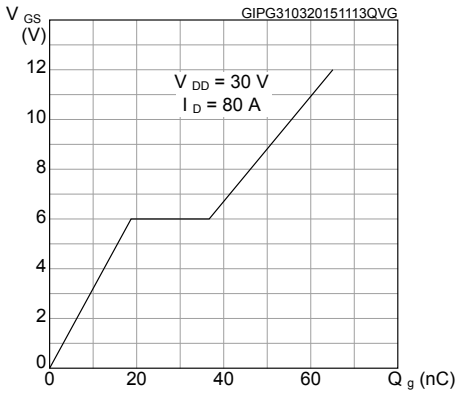


Figure 6. Static drain-source on-resistance

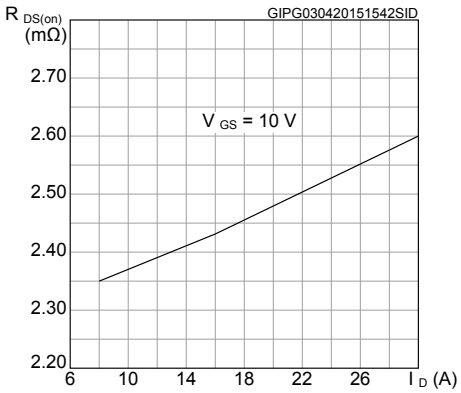


Figure 7. Capacitance variations

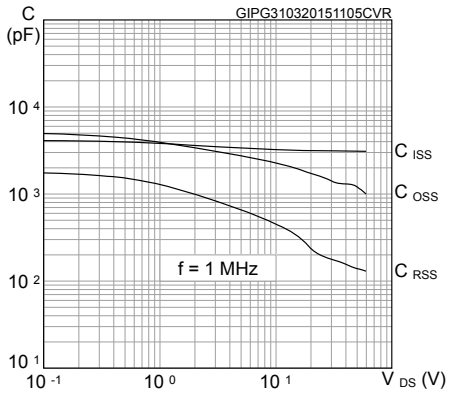


Figure 8. Normalized gate threshold voltage vs temperature

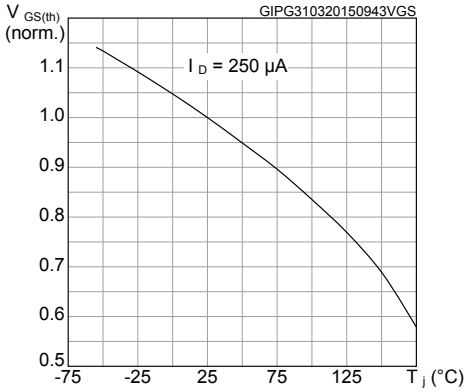


Figure 9. Normalized on-resistance vs temperature

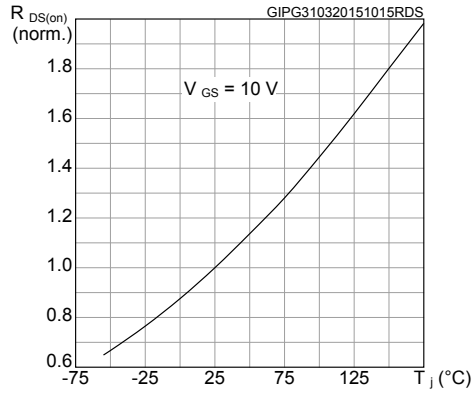


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

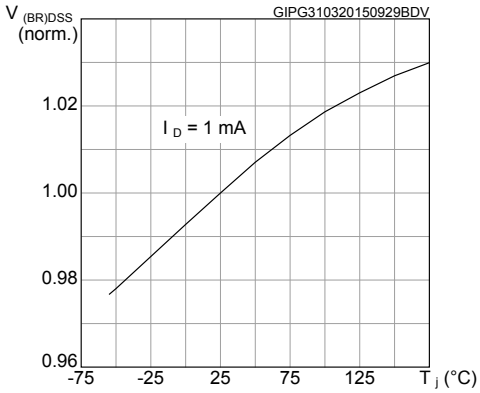
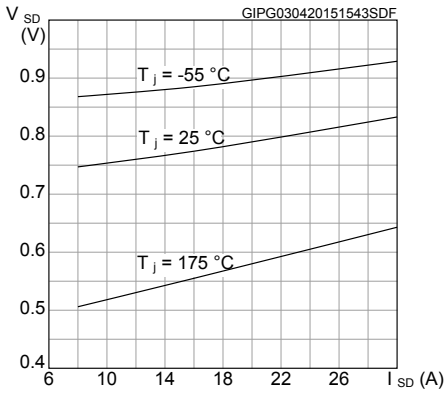


Figure 11. Source-drain diode forward characteristics



3 Test circuits

Figure 12. Test circuit for resistive load switching times

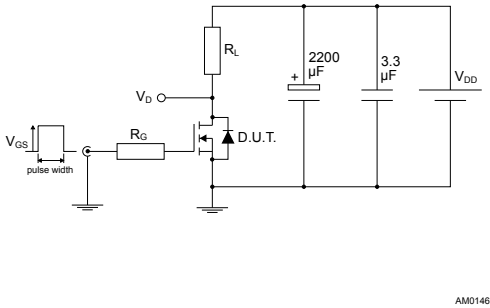


Figure 13. Test circuit for gate charge behavior

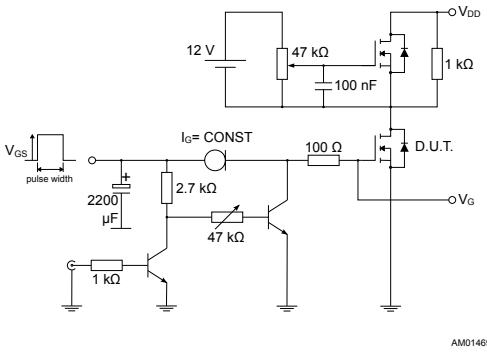


Figure 14. Test circuit for inductive load switching and diode recovery times

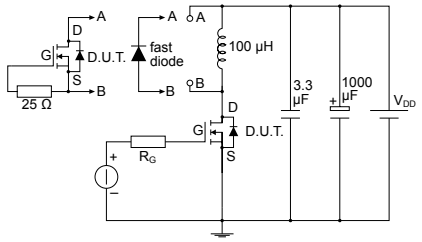


Figure 15. Unclamped inductive load test circuit

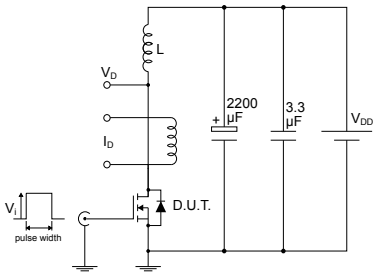


Figure 16. Unclamped inductive waveform

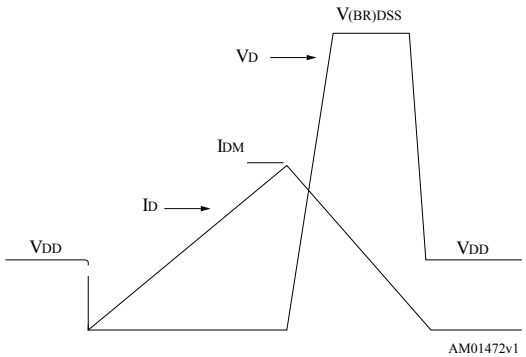
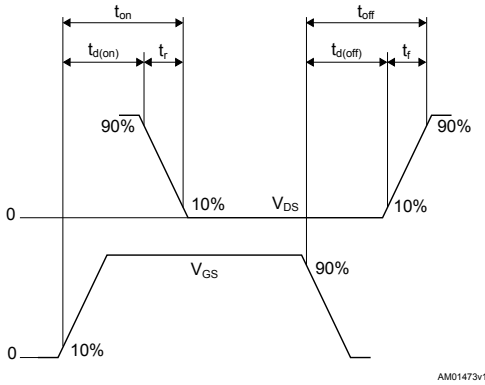


Figure 17. Switching time waveform



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. ECOPACK is an ST trademark.

4.1 PowerFLAT 5x6 type C package information

Figure 18. PowerFLAT 5x6 type C package outline

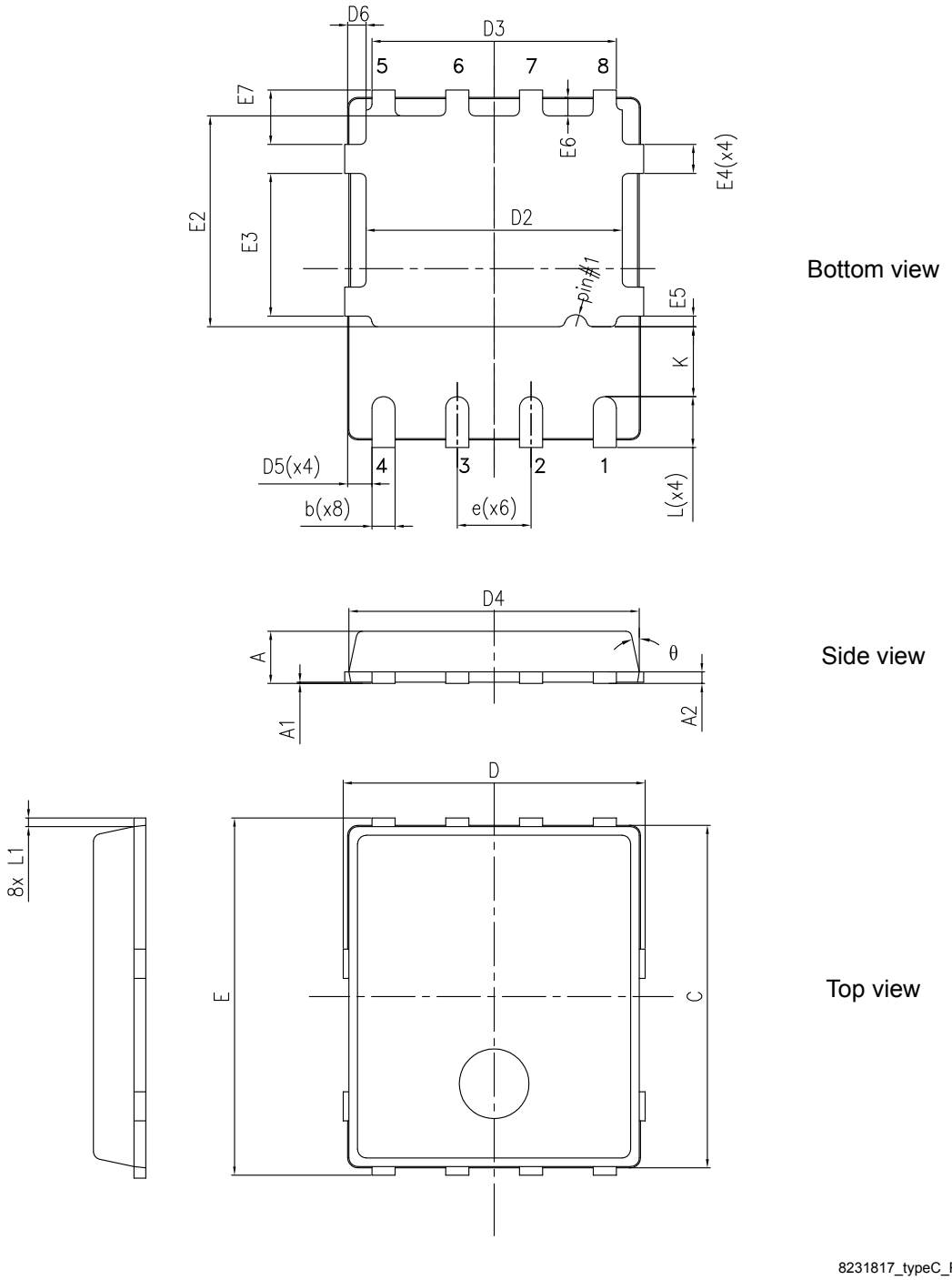
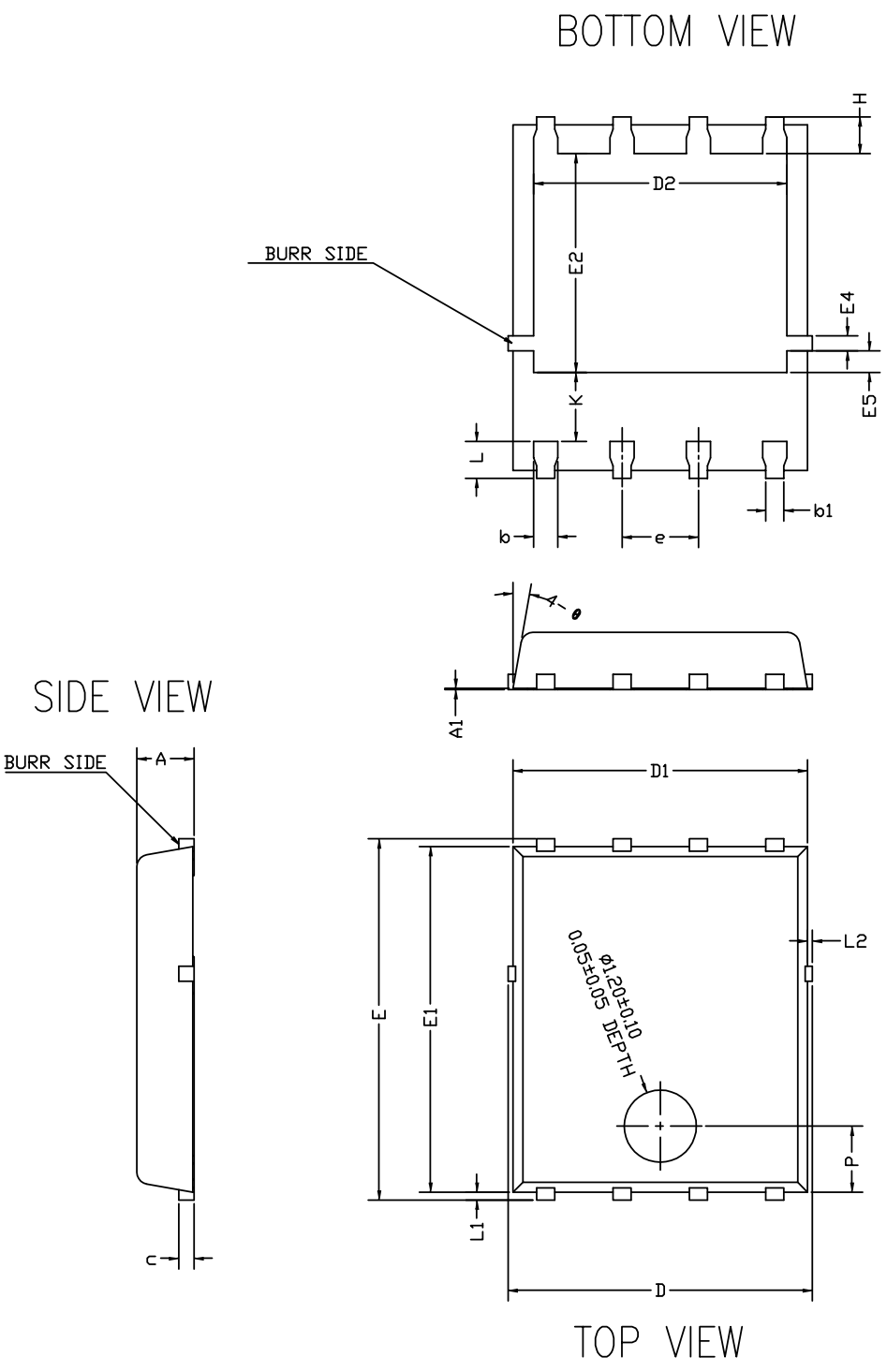


Table 7. PowerFLAT 5x6 type C package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.00
A1	0.02		0.05
A2		0.25	
b	0.30		0.50
C	5.80	6.00	6.20
D	5.00	5.20	5.40
D2	4.15		4.45
D3	4.05	4.20	4.35
D4	4.80	5.00	5.20
D5	0.25	0.40	0.55
D6	0.15	0.30	0.45
e		1.27	
E	5.95	6.15	6.35
E2	3.50		3.70
E3	2.35		2.55
E4	0.40		0.60
E5	0.08		0.28
E6	0.20	0.325	0.45
E7	0.75	0.90	1.05
K	1.05		1.35
L	0.725		1.025
L1	0.05	0.15	0.25
θ	0°		12°

4.2 PowerFLAT 5x6 type SUBCON package information

Figure 19. **PowerFLAT 5x6 type SUBCON package outline**

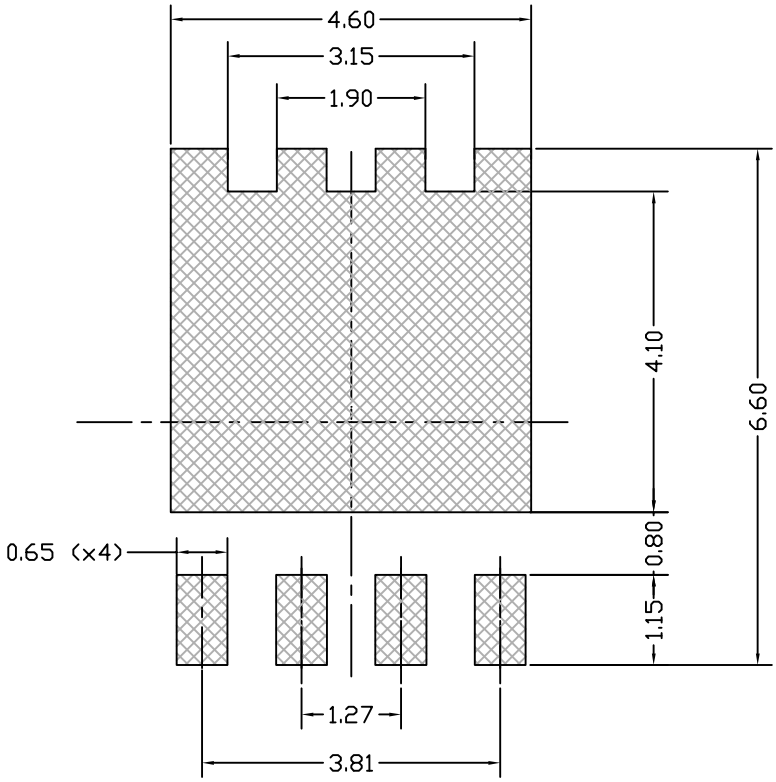


8231817_SUBCON_REV4

Table 8. PowerFLAT 5x6 type SUBCON package mechanical data

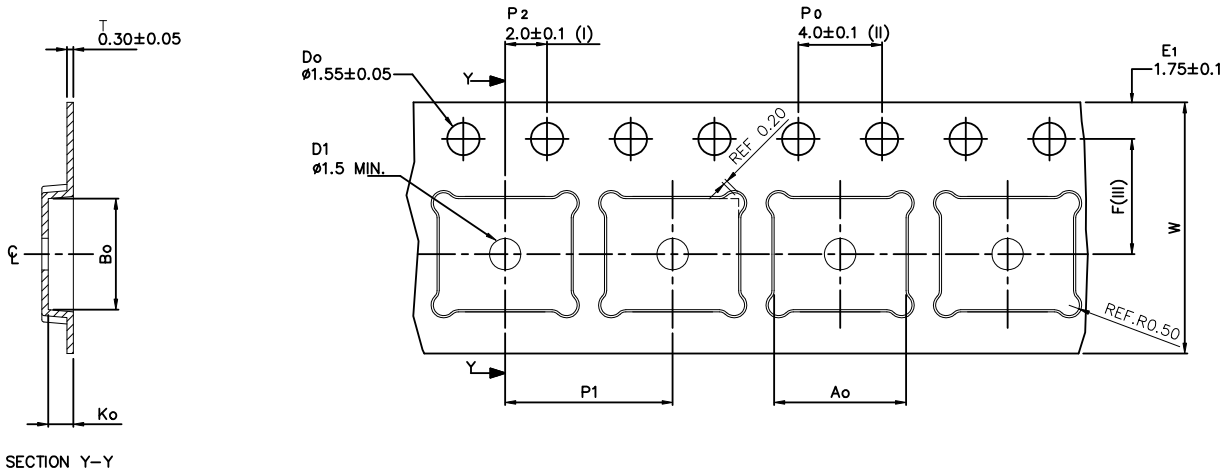
Dim.	mm		
	Min.	Typ.	Max.
A	0.90	0.95	1.00
A1		0.02	
b	0.35	0.40	0.45
b1		0.30	
c	0.21	0.25	0.34
D	4.80		5.10
D1	4.80	4.90	5.00
D2	4.01	4.21	4.31
e	1.17	1.27	1.37
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.54	3.64	3.74
E4	0.15	0.25	0.35
E5	0.26	0.36	0.46
H	0.51	0.61	0.71
K	0.95		
L	0.51	0.61	0.71
L1	0.06	0.13	0.20
L2			0.10
P	1.00	1.10	1.20
θ	8°	10°	12°

Figure 20. **PowerFLAT 5x6 recommended footprint (dimensions are in mm)**



4.3 PowerFLAT 5x6 packing information

Figure 21. PowerFLAT 5x6 tape (dimensions are in mm)



Ao	6.30 +/– 0.1
Bo	5.30 +/– 0.1
Ko	1.20 +/– 0.1
F	5.50 +/– 0.1
P1	8.00 +/– 0.1
W	12.00 +/– 0.3

(I) Measured from centreline of sprocket hole to centreline of pocket.

(II) Cumulative tolerance of 10 sprocket holes is ±0.20.

(III) Measured from centreline of sprocket hole to centreline of pocket

Base and bulk quantity 3000 pcs
All dimensions are in millimeters

8234350_Tape_rev_C

Figure 22. PowerFLAT 5x6 package orientation in carrier tape

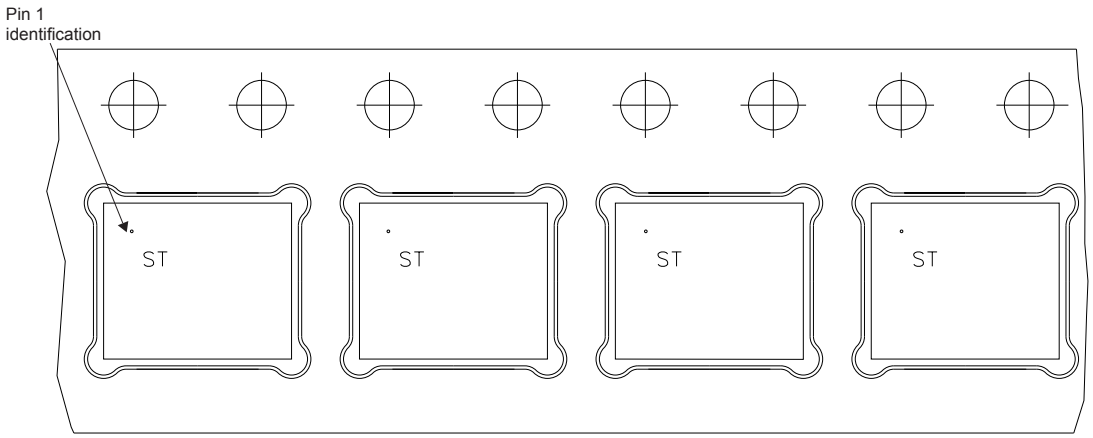
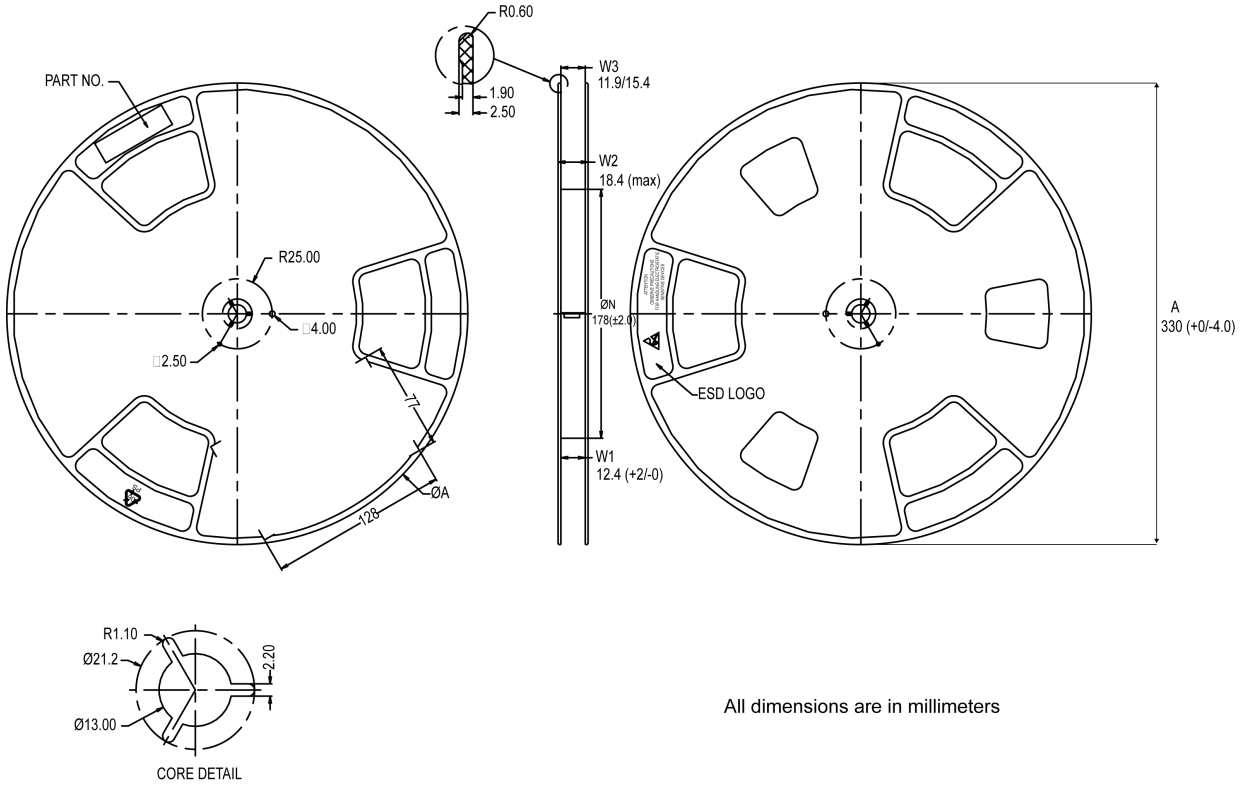


Figure 23. **PowerFLAT 5x6 reel**



All dimensions are in millimeters

8234350_Reel_rev_C

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3 **Test circuits** 6

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Revision history

Table 9. Document revision history

Date	Revision	Changes
02-Aug-2013	1	First release.
18-Mar-2014	2	Updated V_{DS} value in *Table 2: Absolute maximum ratings* and *Table 4: On /off states*. Updated *Section 4: Package mechanical data.* Minor text changes.
09-Apr-2015	3	Text edits and formatting changes throughout document On cover page: -updated title description -updated device 'Features' and 'Description' Updated s*ection 1 Electrical ratings* Updated *section 2 Electrical characteristics* Added *section 2.1 Electrical characteristics (curves)* Updated and renamed *Section 4 Package information* (was Package mechanical data) Updated and renamed *Section 4.2 Packing information* (was Section 5 Packaging mechanical data)
19-May-2015	4	In *Section 2.1 Electrical characteristics (curves)*: - Updated *Figure 24: Capacitance variations*
21-Apr-2017	5	Added E_{AS} in *Table 2: "Absolute maximum ratings"* Updated *Section 4.1: "PowerFLAT™ 5x6 type C package information"* Minor text changes.
10-Sep-2019	6	Added: *Section 4.2 PowerFLAT 5x6 type SUBCON package information*. Minor text changes.
01-Oct-2019	7	Updated Section 4.2 PowerFLAT 5x6 type SUBCON package information. Minor text changes