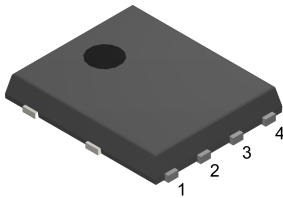
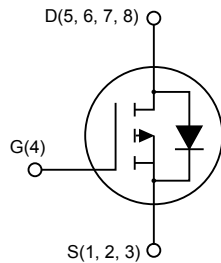


P-channel 40 V, 11.5 mΩ typ., 60 A STripFET F6 Power MOSFET in a PowerFLAT 5x6 package


PowerFLAT 5x6


AM01475v4


Product status link
[STL60P4LLF6](#)
Product summary

Order code	STL60P4LLF6
Marking	60P4LLF6
Package	PowerFLAT 5x6
Packing	Tape and reel

Note: For the P-channel Power MOSFETs the actual polarity of the voltages and the current must be reversed.

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STL60P4LLF6	40 V	14 mΩ	60 A

- Very low on-resistance
- Very low gate charge
- High avalanche ruggedness
- Low gate drive power loss

Applications

- Switching applications

Description

This device is a P-channel Power MOSFET developed using the STripFET F6 technology, with a new trench gate structure. The resulting Power MOSFET exhibits very low R_{DS(on)} in all packages.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	40	V
V_{GS}	Gate-source voltage	±20	V
$I_D^{(1)}$	Drain current (continuous) at $T_C = 25\text{ °C}$	60	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	42	A
$I_{DM}^{(1)(3)}$	Drain current (pulsed)	240	A
$I_D^{(2)}$	Drain current (continuous) at $T_{pcb} = 25\text{ °C}$	13	A
	Drain current (continuous) at $T_{pcb} = 100\text{ °C}$	9.3	A
$I_{DM}^{(2)(3)}$	Drain current (pulsed)	52	A
$P_{TOT}^{(1)}$	Total power dissipation at $T_C = 25\text{ °C}$	100	W
$P_{TOT}^{(2)}$	Total power dissipation at $T_{pcb} = 25\text{ °C}$	4.8	W
	Derating factor ⁽²⁾	0.03	W/°C
T_{stg}	Storage temperature	-55 to 175	°C
T_J	Maximum junction temperature	175	°C

1. The value is limited by $R_{thj-case}$.
2. The value is limited by $R_{thj-pcb}$.
3. Pulse width is limited by safe operating area.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	1.5	°C/W
$R_{thj-pcb}^{(1)}$	Thermal resistance junction-pcb, single operation	31.3	°C/W

1. When mounted on FR-4 board of 1 inch², 2oz Cu, $t < 10\text{ s}$.

Note: For the P-channel Power MOSFET, current polarity of voltages and current have to be reversed.

2 Electrical characteristics

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

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	40			V
I_{DSS}	Zero gate voltage Drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 40\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 40\text{ V}$, $T_C = 125\text{ °C}$			10	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	1			V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 6.5\text{ A}$		11.5	14	m Ω
		$V_{GS} = 4.5\text{ V}$, $I_D = 6.5\text{ A}$		15	19	

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	3525	-	pF
C_{oss}	Output capacitance		-	344	-	pF
C_{rSS}	Reverse transfer capacitance		-	238	-	pF
Q_g	Total gate charge	$V_{DD} = 20\text{ V}$, $I_D = 13\text{ A}$, $V_{GS} = 4.5\text{ V}$ (see Figure 13. Gate charge test circuit)	-	34	-	nC
Q_{gs}	Gate-source charge		-	11.3	-	nC
Q_{gd}	Gate-drain charge		-	13.8	-	nC

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 20\text{ V}$, $I_D = 6.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 12. Switching times test circuit for resistive load)	-	49.4	-	ns
t_r	Rise time		-	60.6	-	ns
$t_{d(off)}$	Turn-off-delay time		-	170	-	ns
t_f	Fall time		-	20	-	ns

Note: For the P-channel Power MOSFET, current polarity of voltages and current have to be reversed.

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{SD}^{(1)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 6.5\text{ A}$	-		1.1	V
t_{rr}	Reverse recovery time	$I_{SD} = 13\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	29		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 24\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	27.6		nC
I_{RRM}	Reverse recovery current	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	1.9		A

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

Note: For the P-channel Power MOSFET, current polarity of voltages and current have to be reversed.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

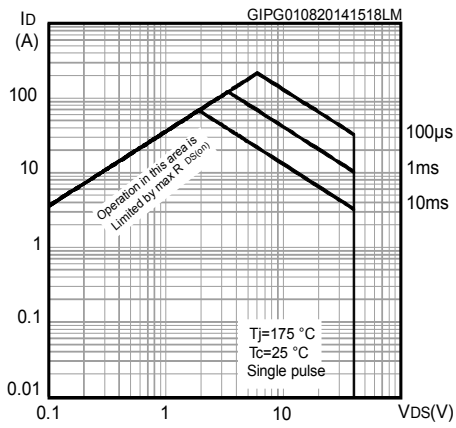


Figure 2. Thermal impedance

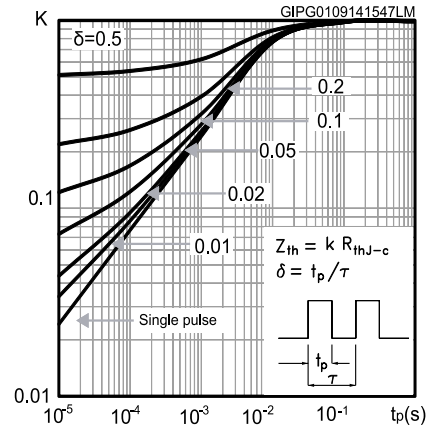


Figure 3. Output characteristics

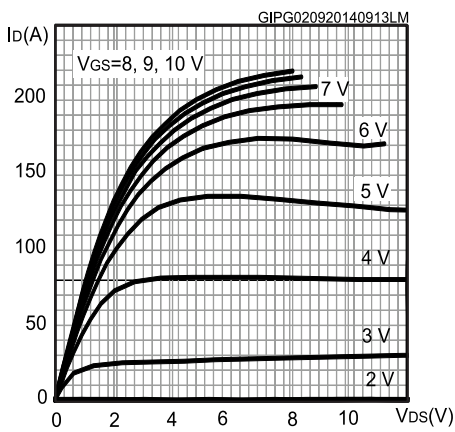


Figure 4. Transfer characteristics

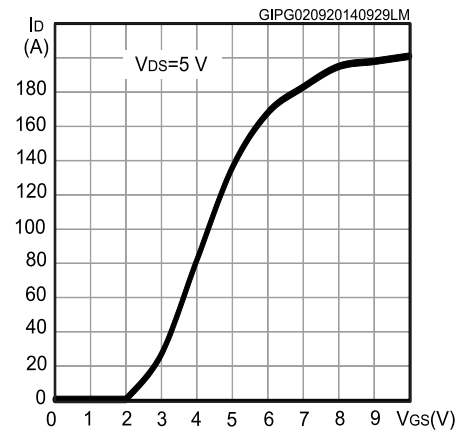


Figure 5. Normalized gate threshold voltage vs temperature

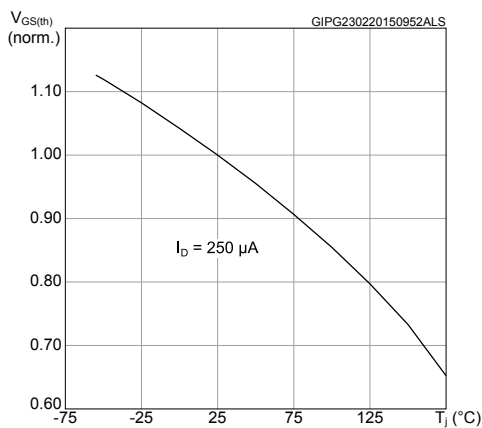


Figure 6. Normalized $V_{(BR)DSS}$ vs temperature

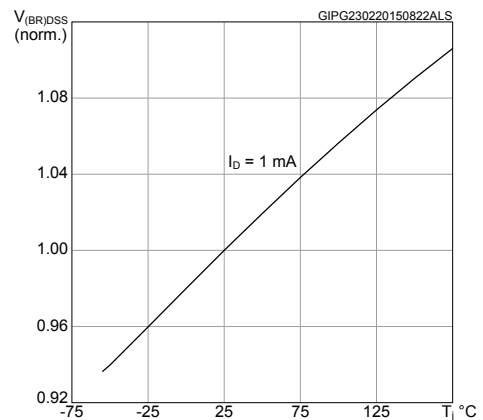


Figure 7. Static drain-source on-resistance

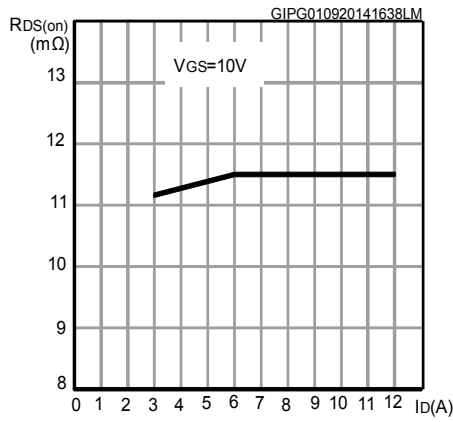


Figure 8. Normalized on-resistance vs. temperature

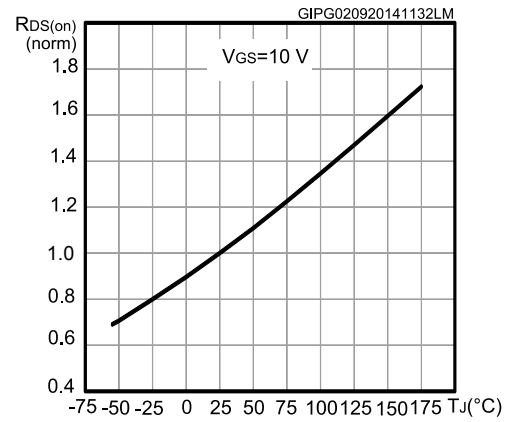


Figure 9. Gate charge vs gate-source voltage

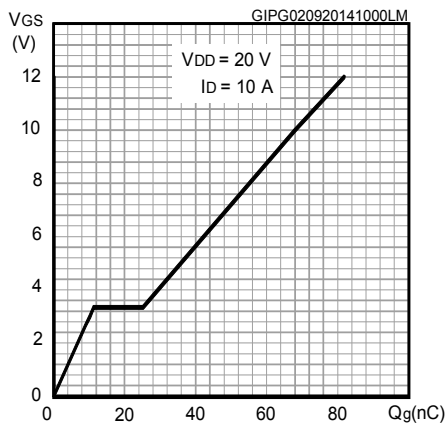


Figure 10. Capacitance variations voltage

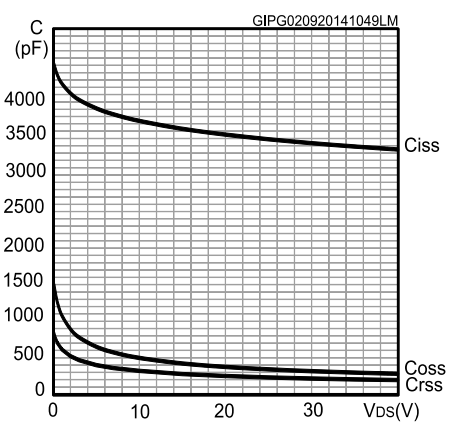
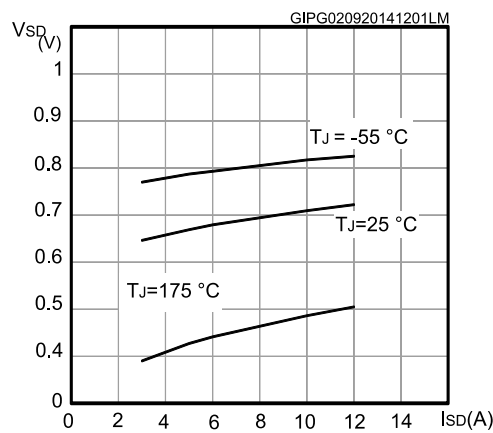


Figure 11. Source-drain diode forward characteristics



3 Test circuits

Figure 12. Switching times test circuit for resistive load

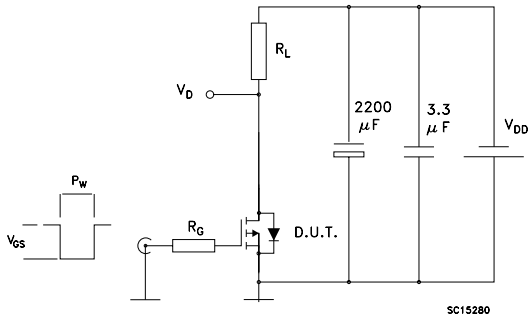


Figure 13. Gate charge test circuit

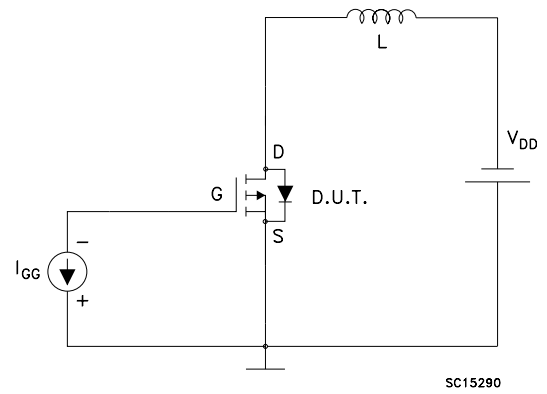
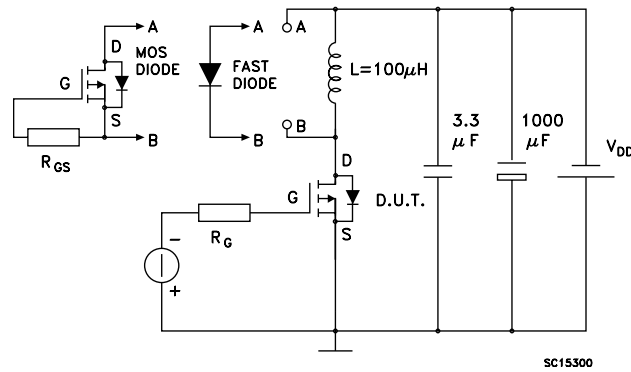


Figure 14. Test circuit for inductive load switching and diode recovery times

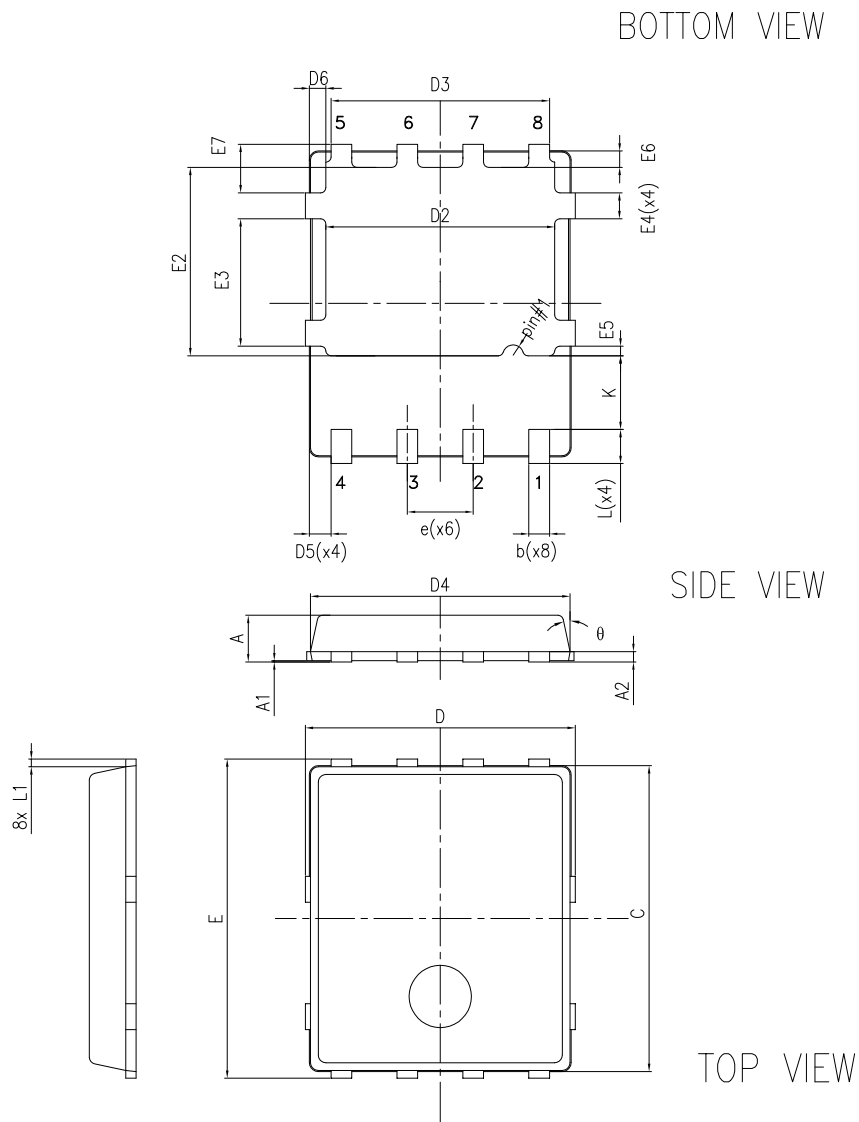


4 Package information

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 R package information

Figure 15. PowerFLAT 5x6 type R package outline



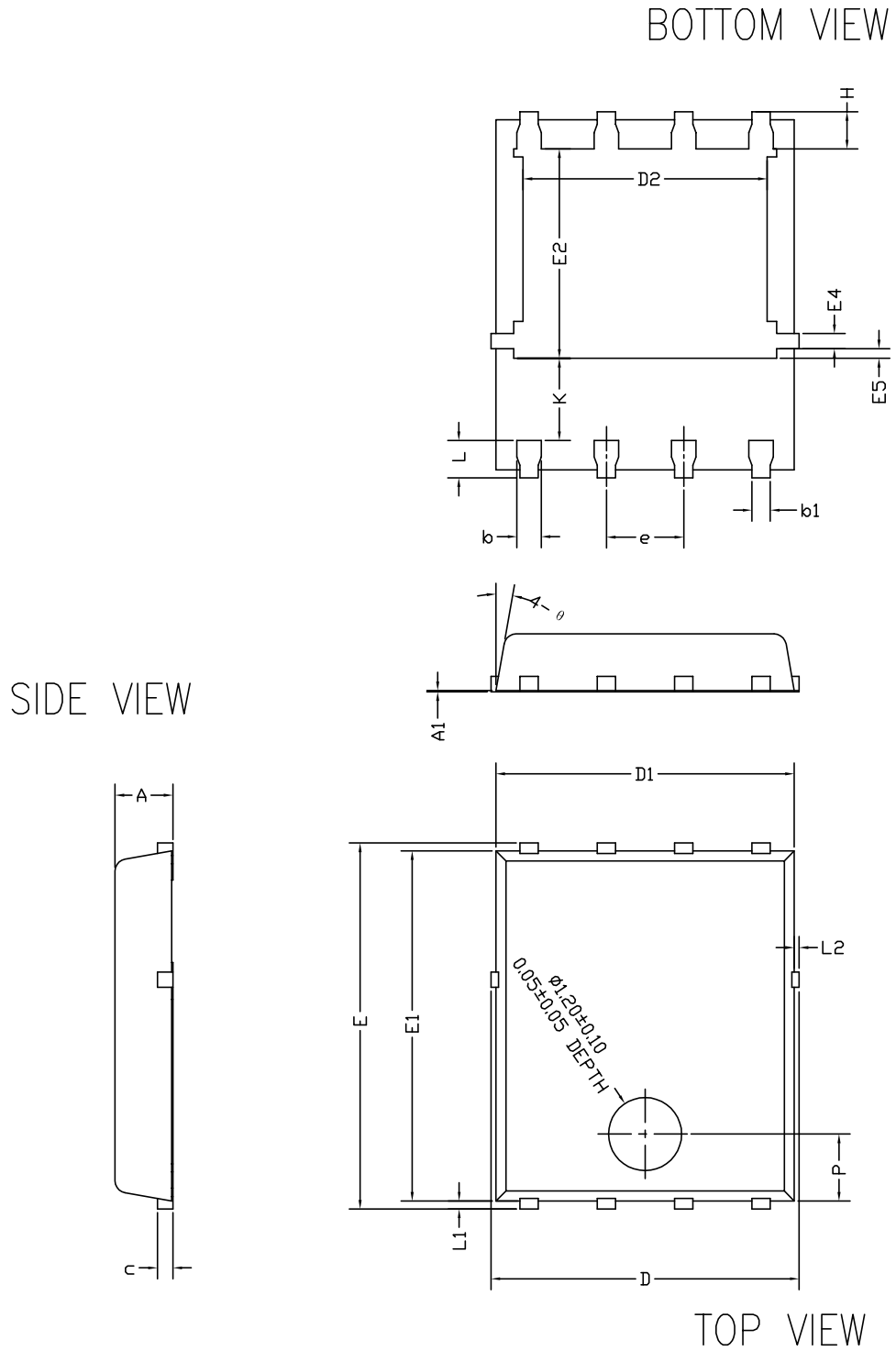
A0ER_8231817_Rev20

Table 7. PowerFLAT 5x6 type R 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	1.275		1.575
L	0.60		0.80
L1	0.05	0.15	0.25
θ	0°		12°

4.2 PowerFLAT 5x6 type R SUBCON package information

Figure 16. PowerFLAT 5x6 type R SUBCON package outline

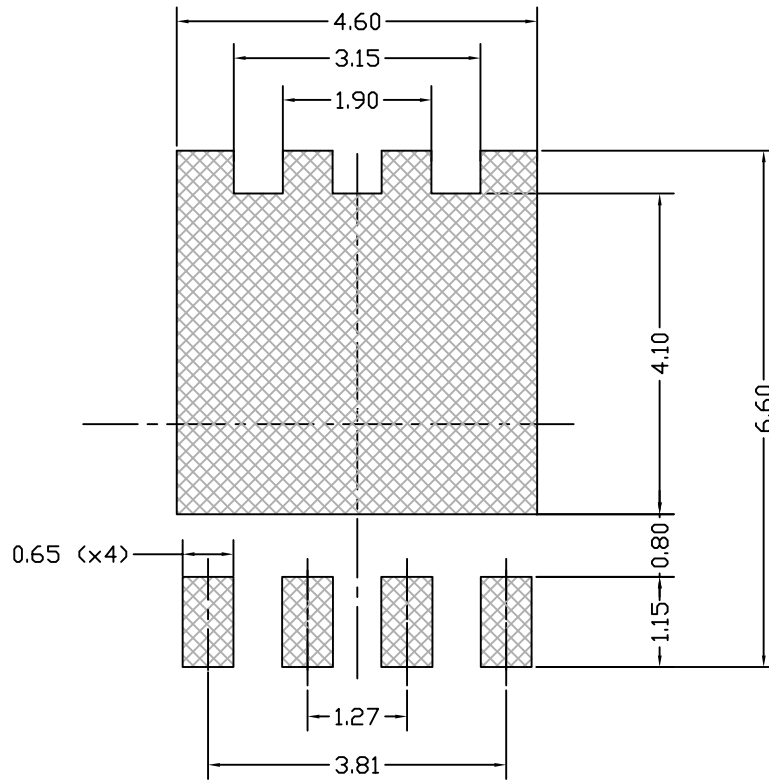


8472137_SUBCON_998G_Type_R_REV4

Table 8. PowerFLAT 5x6 type R 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			5.10
D1	4.80	4.90	5.00
D2	3.91	4.01	4.11
e	1.17	1.27	1.37
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.34	3.44	3.54
E4	0.15	0.25	0.35
E5	0.06	0.16	0.26
H	0.51	0.61	0.71
K	1.10		
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°

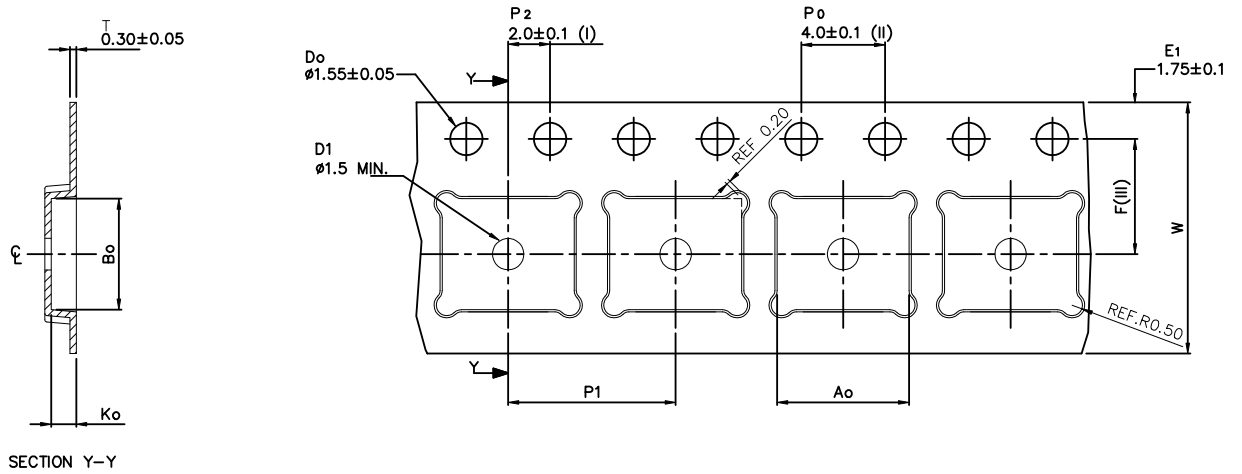
Figure 17. PowerFLAT 5x6 recommended footprint (dimensions are in mm)



8231817_FOOTPRINT_simp_Rev_20

4.3 PowerFLAT 5x6 packing information

Figure 18. PowerFLAT 5x6 tape (dimensions are in mm)



A ₀	6.30	+/- 0.1
B ₀	5.30	+/- 0.1
K ₀	1.20	+/- 0.1
F	5.50	+/- 0.1
P ₁	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 19. PowerFLAT 5x6 package orientation in carrier tape

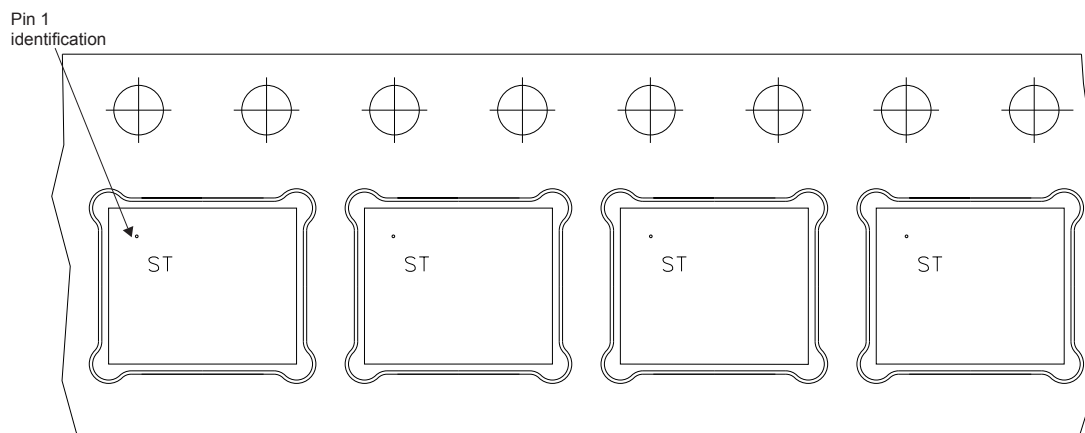
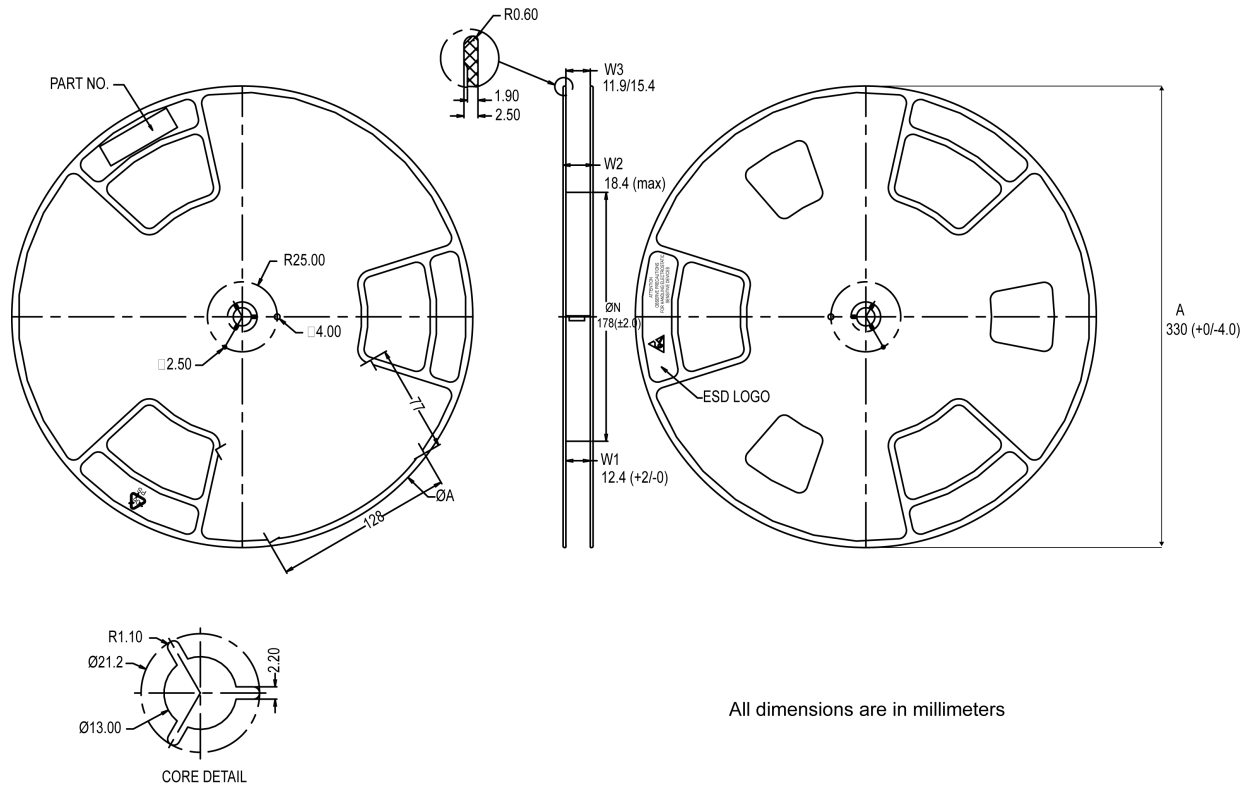


Figure 20. PowerFLAT 5x6 reel



All dimensions are in millimeters

8234350_Reel_rev_C

Revision history

Table 9. Document revision history

Date	Revision	Changes
04-Sep-2014	1	Initial release.
16-Dec-2014	2	Document status promoted from preliminary data to production data. Minor text changes.
24-Feb-2020	3	Updated Section 4 Package information . Minor text changes.

Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics (curves)	5
3	Test circuits	7
4	Package information	8
4.1	PowerFLAT 5x6 type R package information	8
4.2	PowerFLAT 5x6 type R SUBCON package information	10
4.3	PowerFLAT 5x6 packing information	13
	Revision history	15

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