LDL212

High PSRR, low drop linear regulator IC

Applications

- Consumer
- Industrial
- SMPS
- Point-of-load
- DC-DC post-regulation

Description

The LDL212 provides 1.2 A of maximum current from an input voltage range from 2.5 V to 18 V, with a typical dropout voltage of 350 mV @ 1.2 A. The high power supply rejection ratio of 87 dB at 120 Hz, and more than 40 dB at 100 kHz, makes the LDL212 suitable for direct regulation in SMPS and secondary linear regulation in DC-DC converters. The LDL212 goes to shutdown mode due to the enable logic control function, reducing the total current consumption. The device also includes the current limit, SOA and thermal protections.

Features

- Input voltage from 2.5 V to 18 V
- 20 V AMR
- Any fixed output voltages, from 1.2 V to 12 V in 100 mV steps (from 1.2 V to 6.6 V in 50 mV steps) available on request
- Adjustable version from 1.18 V to V_{IN}-$V_{DROP(MAX)}$
- Guaranteed output current 1.2 A
- Typical dropout 350 mV@1.2 A
- Undervoltage lockout
- Enable function
- Internal thermal, current and power limitation
- High PSRR: 87 dB @ 120 Hz, 75 dB @ 1 kHz
- Operating temperature range: -40 °C to 125 °C
- Packages SO-8 batwing plastic micropackage, DFN6 (3x3) and DFN6 (2x2)

Contents

1   Block diagram

Figure 1: Block diagram (fixed)

GIPD251120151438MT
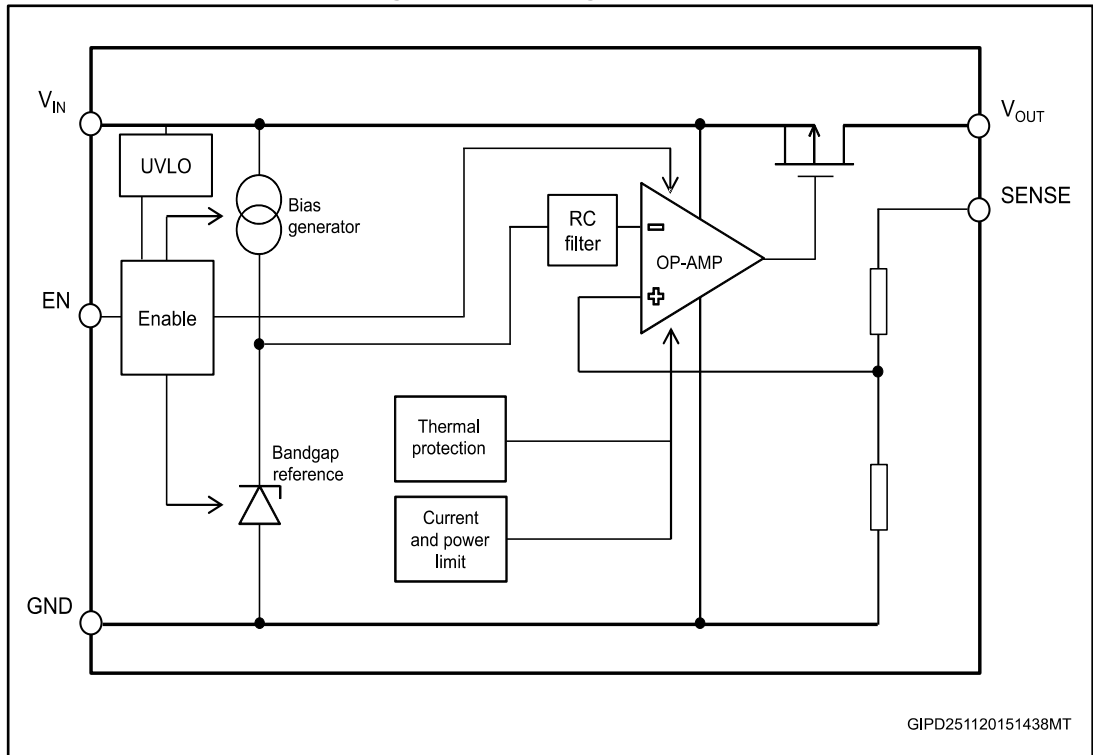
Figure 2: Block diagram (adjustable)

GIPD251120151438bMT
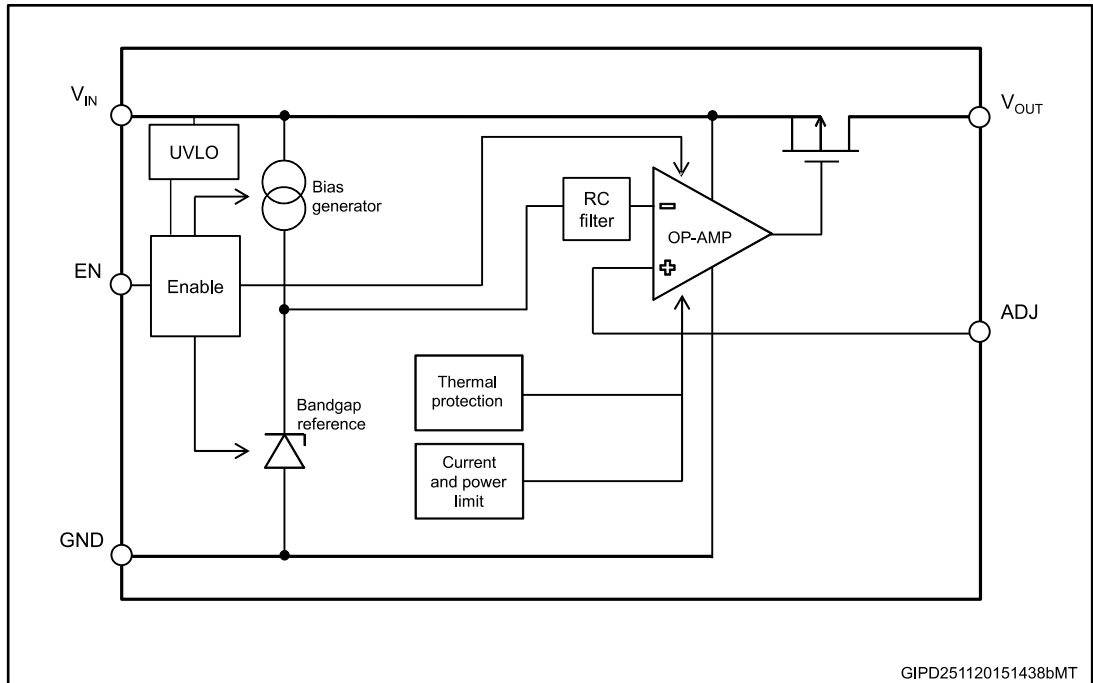
2 Pin configuration

Figure 3: Pin configuration (top view)
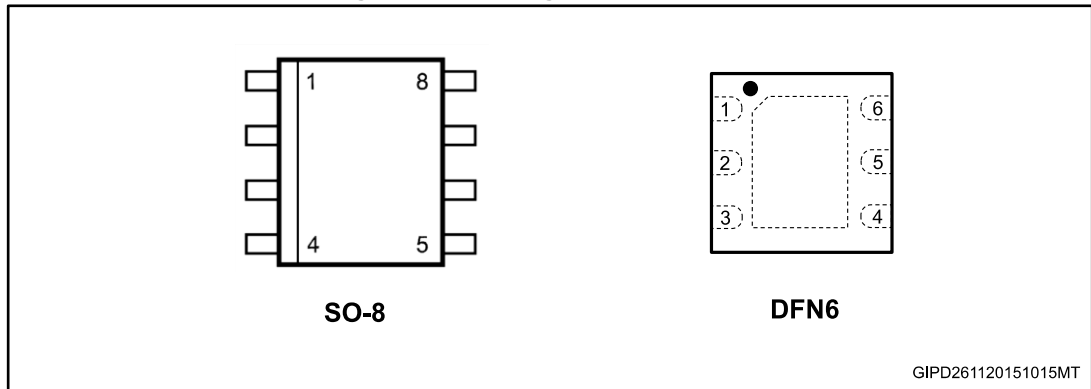
Table 1: Pin description

Pin name	Pin number (SO-8)	Pin number (DFN6)	Description
V_{IN}	4	4	Input voltage
V_{OUT}	1	3	Output voltage
GND	2, 3, 6, 7	1	Ground
ADJ/sense	8	2	Feedback pin for adjustable version / V_{OUT} sense [(1)] on fixed version
EN	5	6	Enable pin. The device is in off-state when this pin is pulled low
NC	-	5	Not connected

Notes:

[(1)] The sense pin on the fixed version must be connected to V_{OUT} for proper operation.

3   Typical application

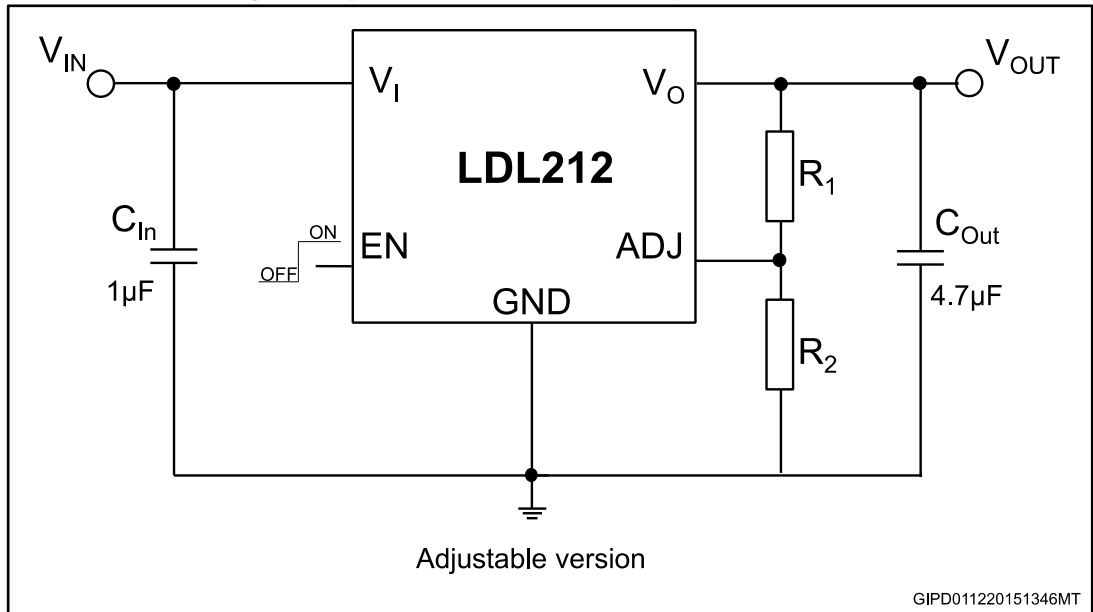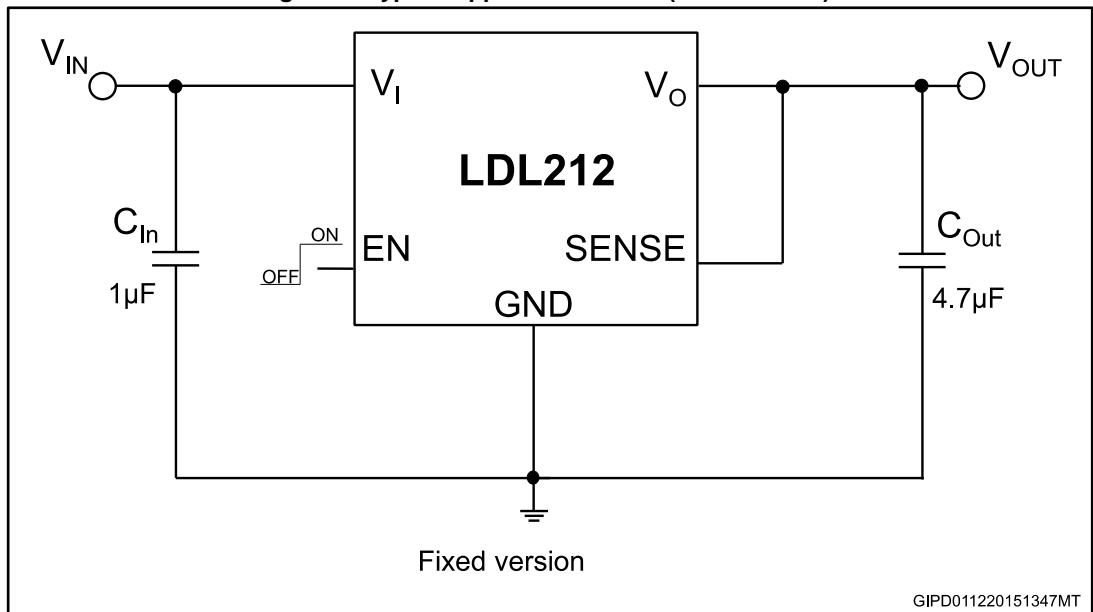**Figure 4: Typical application circuit (adjustable version)**

Adjustable version

Figure 5: Typical application circuit (fixed version)

Fixed version

R1 and R2 are calculated according to the following formula: $R_1 = R_2 \times (V_{OUT}/V_{ADJ} - 1)$. The output voltage of the adjustable version can be set from 1.18 V to V_{IN}-$V_{DROP(MAX)}$, where $V_{DROP(MAX)}$ is the maximum dropout voltage, as defined in *Table 4: "Electrical characteristics"*.

4 Maximum ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	- 0.3 to 20	V
V_{OUT}	DC output voltage	- 0.3 to V_{IN} + 0.3	V
V_{EN}	Enable input voltage	- 0.3 to V_{IN} + 0.3	V
V_{SENSE}	Output sense pin voltage	- 0.3 to V_{IN} + 0.3	V
V_{ADJ}	ADJ pin voltage	- 0.3 to 2	V
I_{OUT}	Output current	Internally limited	mA
P_D	Power dissipation	Internally limited	mW
T_{STG}	Storage temperature range	- 55 to 150	°C
T_{OP}	Operating junction temperature range	- 40 to 125	°C

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
SO-8 batwing plastic micropackage	Thermal resistance junction-to-case	20	°C/W
	Thermal resistance junction-to-ambient	55	
DFN6 (2x2)	Thermal resistance junction-to-case	15	
	Thermal resistance junction-to-ambient	65	
DFN6 (3x3)	Thermal resistance junction-to-case	10	
	Thermal resistance junction-to-ambient	55	

5   Electrical characteristics

T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} = 1 µF, C_{OUT} = 4.7 µF, I_{OUT} = 10 mA, V_{EN} = V_{IN}, unless otherwise specified. [a]

Table 4: Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		18	V
V_{UVLO}	Turn-on threshold			2.3	2.4	V
	Hysteresis			200		mV
V_{OUT}	V_{OUT} accuracy	I_{OUT} = 10 mA	-2		2	%
		T_J = 25 °C				
		I_{OUT} = 10 mA	-3		3	%
		-40 °C < T_J < 125 °C				
V_{ADJ}	Adjustable pin voltage	V_{IN} = 2.5 V I_{OUT} = 10 mA		1.18		V
		T_J = 25 °C	-2		+2	%
		V_{IN} = 2.5 V I_{OUT} = 10 mA -40 °C < T_J < 125 °C	-3		+3	%
I_{ADJ}	Adjustable pin current	V_{IN} = 2.5 V I_{OUT} = 10 mA		20		nA
ΔV_{OUT}	Line regulation	V_{OUT} + 1 V ≤ V_{IN} ≤ 18 V I_{OUT} = 10 mA		0.002	0.01	%/V
ΔV_{OUT}	Load regulation	I_{OUT} = 10 mA to 1.2 A		0.0001	0.0005	%/mA
V_{DROP}	Dropout voltage [(1)]	I_{OUT} = 1.2 A V_{OUT} > 3 V -40 °C < T_J < 125 °C		350	600	mV
eN	Output noise voltage	10 Hz to 100 kHz, I_{OUT} = 100 mA		60		µV$_{RMS}$/V$_{OUT}$
SVR	Supply voltage rejection	V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE}		87		dB
		V_{RIPPLE} = 0.5 V, f = 120 Hz				
		V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE}		75		
		V_{RIPPLE} = 0.5 V, f = 1 kHz				
		V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE}		50		
		V_{RIPPLE} = 0.5 V, f = 100 kHz				
I_Q	Quiescent current	I_{OUT} = 0 mA to 1.2 A -40 °C < T_J < 125 °C		250	380	µA
		V_{IN} input current in OFF mode		0.3	1.5	

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[a] For $V_{OUT(NOM)}$ ≤ 1.5 V, V_{IN} = 2.7 V.

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
		V_{EN} = GND V_{IN} = 18 V				
I_{SC}	Short-circuit current	R_L = 0	1.5	2		A
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 18 V -40 °C < T_J < 85 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 18 V -40 °C < T_J < 85 °C	1.2			
I_{EN}	Enable input current			1.5		µA
		V_{EN} = V_{IN} , V_{IN} = 18 V		16	20	
T_{ON}	Turn-on time [2]			120		µs
T_{SHDN}	Thermal shutdown			175		°C
	Hysteresis			25		

Notes:

[1] Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification is not valid for output voltages below 2.2 V.

[2] Turn-on time is the time measured between the enable input just exceeding V_{EN} high value and the output voltage just reaching 95% of its nominal value.

6 Typical performance characteristics

Figure 6: Output voltage vs temperature
(V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 0 mA)

Figure 7: Output voltage vs temperature
(V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 1200 mA)

Figure 8: Output voltage vs temperature
(V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 10 mA)

Figure 9: Output voltage vs temperature
(V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 1200 mA)

Figure 10: Line regulation vs temperature
(V_{IN} = 6 to 18 V, V_{OUT} = 5 V, I_{OUT} = 10 mA)

Figure 11: Line regulation vs temperature
(V_{IN} = 2.5 to 18 V, V_{OUT} = V_{ADJ}, I_{OUT} = 10 mA)

Figure 12: Load regulation vs temperature
(V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 10 to 1200 mA)
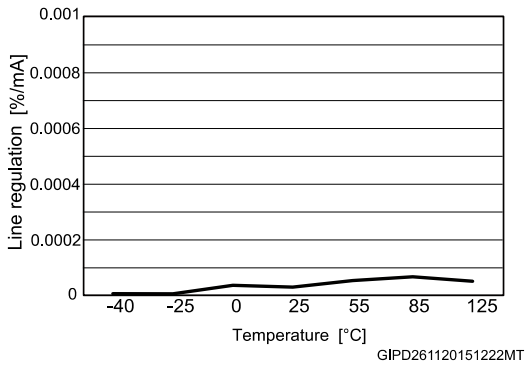
Figure 13: Load regulation vs temperature
(V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 0 to 1200 mA)
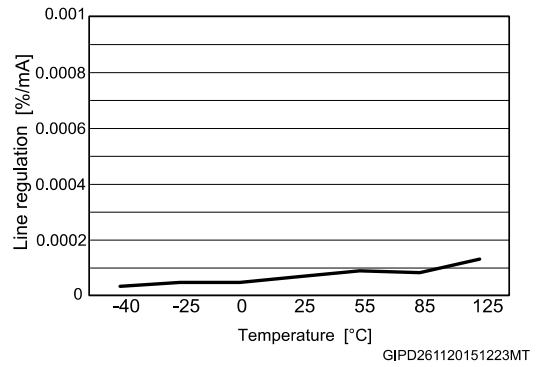
Figure 14: Enable thresholds vs temperature
(V_{OUT} = V_{ADJ})
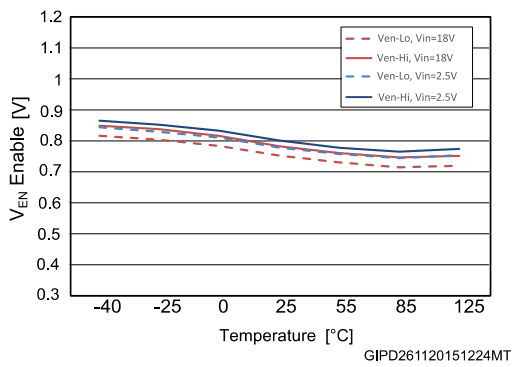
Figure 15: Enable thresholds vs temperature
(V_{OUT} = 5 V)
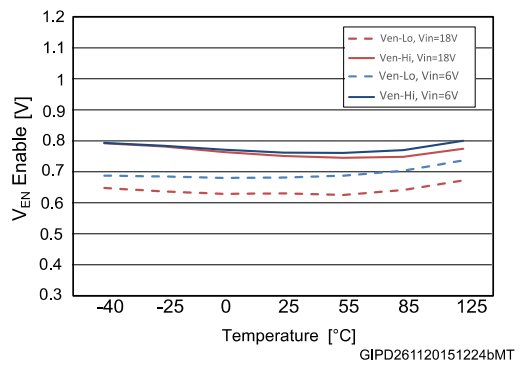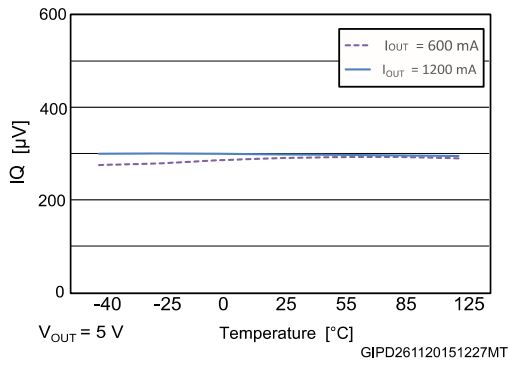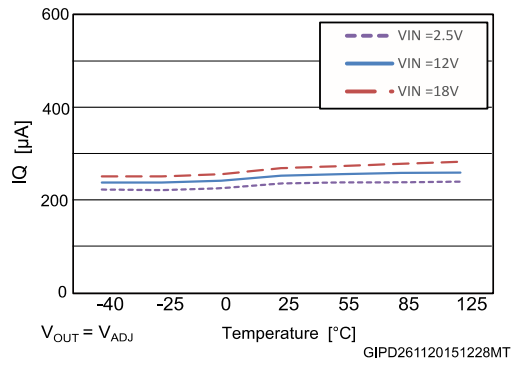

Figure 16: Dropout voltage vs temperature
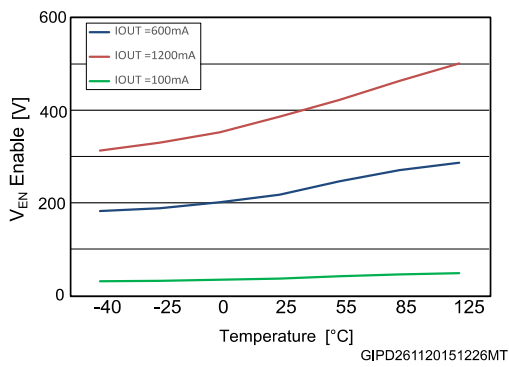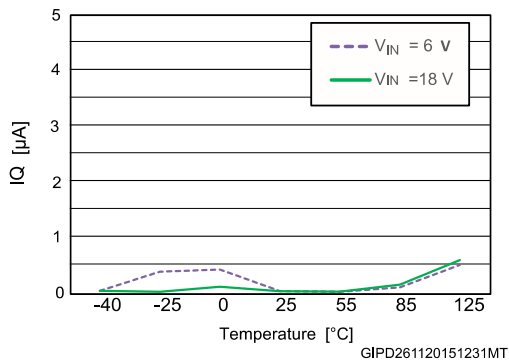

Figure 17: Quiescent current vs temperature
(V_{OUT} = 5 V, I_{OUT} = 0 mA)
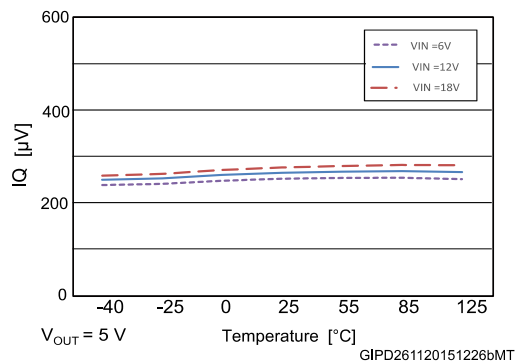
Figure 18: Quiescent current vs temperature
(V_OUT = 5 V, I_OUT = 600 mA, 1.2 A)

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Figure 19: Quiescent current vs temperature
(V_OUT = V_ADJ, I_OUT = 0 mA)

GIPD261120151228MT

Figure 20: Quiescent current vs temperature
(V_OUT = V_ADJ, I_OUT = 600 mA)

GIPD261120151229MT
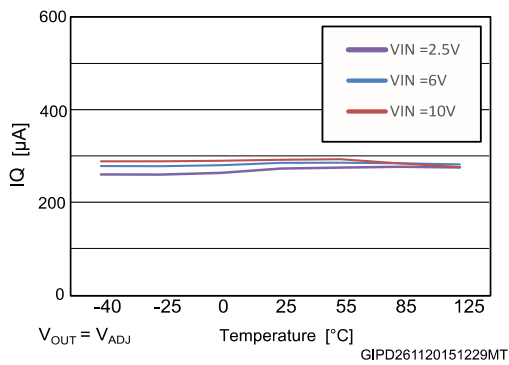
Figure 21: Quiescent current vs temperature
(V_OUT = V_ADJ, I_OUT = 1.2 A)

GIPD261120151230MT
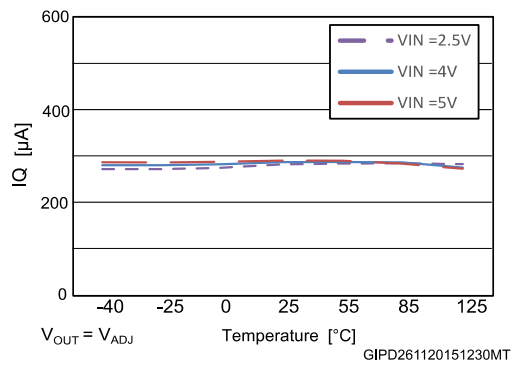
Figure 22: Off-state current vs temperature
(V_OUT = 5 V)

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Figure 23: Off-state current vs temperature
(V_OUT = V_ADJ)

GIPD261120151232MT
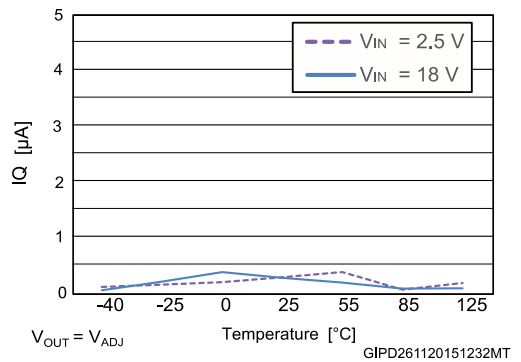
Figure 24: Short-circuit current vs dropout voltage (V$_{OUT}$ = 5 V)
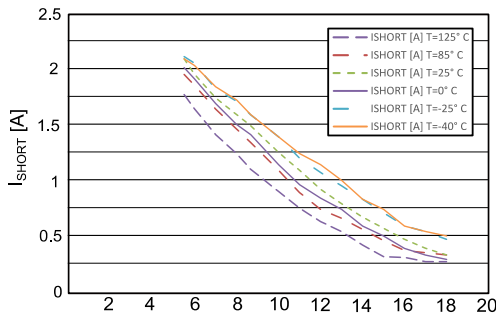
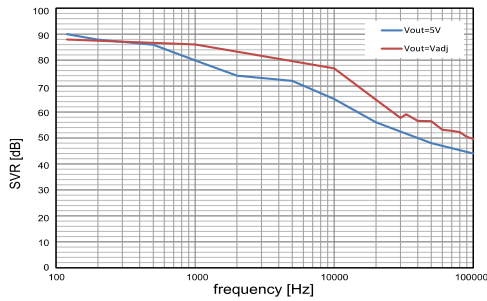V$_{EN}$ to V$_{IN}$, C$_{IN}$=1µF, C$_{OUT}$=4.7 µF

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Figure 25: Short-circuit current vs dropout voltage (V$_{OUT}$ = V$_{ADJ}$)
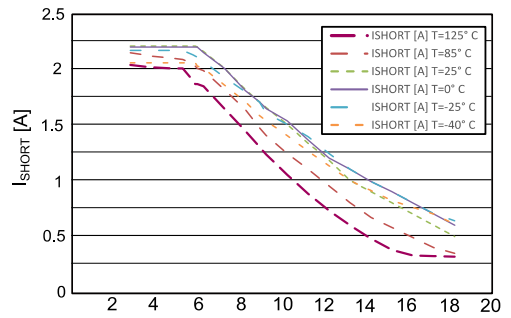
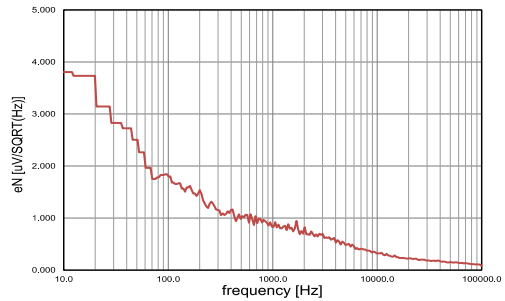V$_{EN}$ to V$_{IN}$, C$_{IN}$=1µF, C$_{OUT}$=4.7 µF

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Figure 26: SVR versus frequency

For V$_{OUT}$ = 5V, V$_{IN}$ = V$_{EN}$= from 5.5 to 6.5V, I$_{OUT}$ = 10mA, C$_{IN}$ = 1µF, C$_{OUT}$ = 4.7µF
For V$_{OUT}$ = V$_{ADJ}$, V$_{IN}$ = V$_{EN}$= from 2.5 to 3.5V, I$_{OUT}$ = 10mA, No C$_{IN}$, C$_{OUT}$ = 4.7µF

GIPD261120151236MT
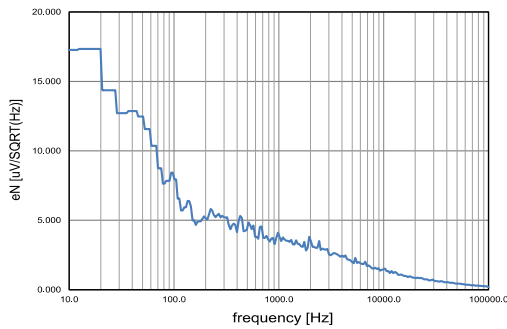
Figure 27: Output noise spectral density (V$_O$ = V$_{ADJ}$)

V$_{IN}$= V$_{EN}$ = 2.5V, V$_{OUT}$ = V$_{ADJ}$, I$_{OUT}$ = 100mA, C$_{IN}$ = 1µF, C$_{OUT}$ = 4.7µF

GIPD261120151237MT

Figure 28: Output noise spectral density (V$_O$ = 5 V)

V$_{IN}$ = V$_{EN}$ = 6V, V$_{OUT}$ = 5V, I$_{OUT}$ = 100mA, C$_{IN}$ = 1µF, C$_{OUT}$ = 4.7 µF

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Figure 29: Output noise spectral density (V$_O$ = 12 V)
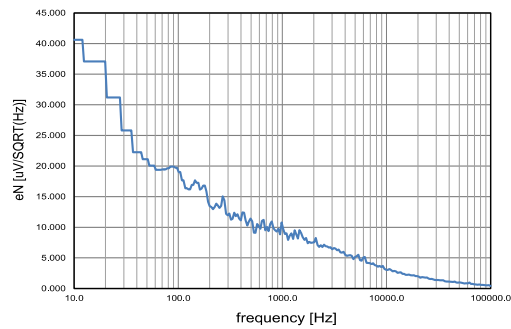
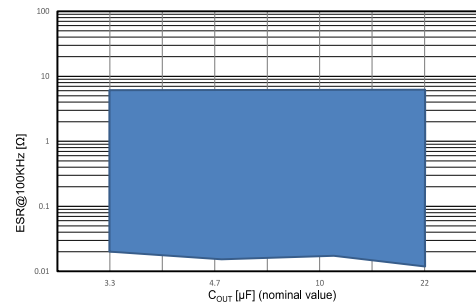V$_{IN}$ = V$_{EN}$ = 6V, V$_{OUT}$ = 5V, I$_{OUT}$ = 100mA, C$_{IN}$ = 1µF, C$_{OUT}$ = 4.7 µF

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Figure 30: Stability plan (V$_{OUT}$ = 5 V)
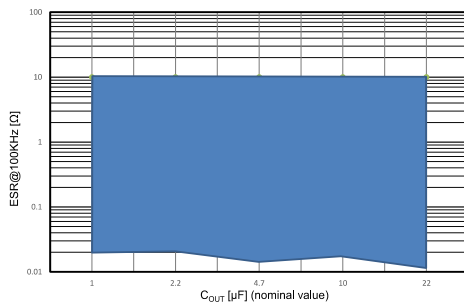
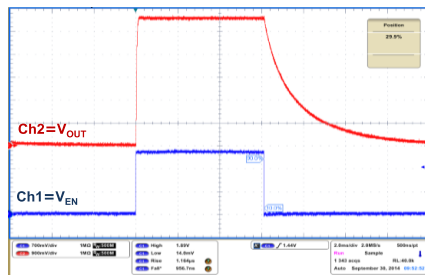V$_{EN}$ = V$_{IN}$ = from 6 V to 18 V, I$_{OUT}$ = from 10 mA to 1.2 A
(according to Max I$_{OUT}$ vs V$_{drop}$ characteristics), C$_{IN}$ = 1 µF

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Figure 31: Stability plan (V$_{OUT}$ = V$_{ADJ}$)

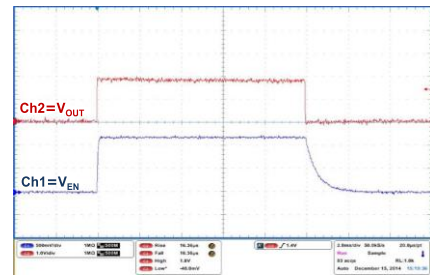V$_{EN}$ = V$_{IN}$ = from 2.5 V to 18 V, I$_{OUT}$ = from 10 mA to 1.2 A
(according to Max I$_{OUT}$ vs Vdrop characteristics), C$_{IN}$ = 1 µF

GIPD301120151005MT
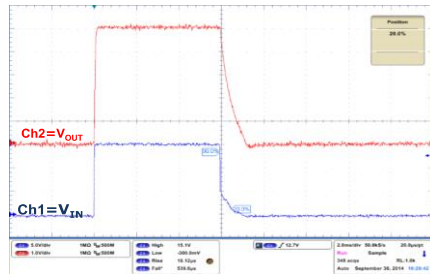
Figure 32: Startup with enable (V$_{OUT}$ = 5 V)

V$_{IN}$ = 15 V, V$_{EN}$ from 0 to 2 V, I$_{OUT}$ = 10 mA C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ = 1 µs

GIPD301120151405MT

Figure 33: Startup with enable (V$_{OUT}$ = V$_{ADJ}$)

V$_{IN}$ = 15 V, V$_{EN}$ from 0 to 2 V, I$_{OUT}$ = 10 mA C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ = 1 µs

GIPD301120151406MT

Figure 34: Turn-on time (V$_{OUT}$ = 5 V)

V$_{EN}$ = V$_{IN}$ = from 0 to 15 V, I$_{OUT}$ = 10 mA, C$_{OUT}$ = 1 µF T$_{rise}$ = 10 µs

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Figure 35: Turn-on time (V$_{OUT}$ = V$_{ADJ}$)
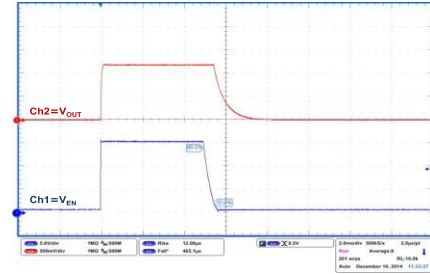
V$_{EN}$ = V$_{IN}$ = from 0 to 15 V, I$_{OUT}$ = 10 mA, C$_{IN}$ = 1 µF C$_{OUT}$ = 4.7 µF, trise = 10 µs

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Figure 36: Line transient (V$_{OUT}$ = 5 V)	**Figure 37: Line transient (V$_{OUT}$ = V$_{ADJ}$)**
V$_{IN}$ = from 6 to 15 V, I$_{OUT}$ = 10 mA , C$_{OUT}$ = 4.7 µF, tr = 5 µs	V$_{IN}$ = from 3.5 to 15 V, I$_{OUT}$ = 10 mA, NO C$_{IN}$, C$_{OUT}$ = 4.7 µF, tr = 5 µs
GIPD301120151409MT	GIPD301120151410MT
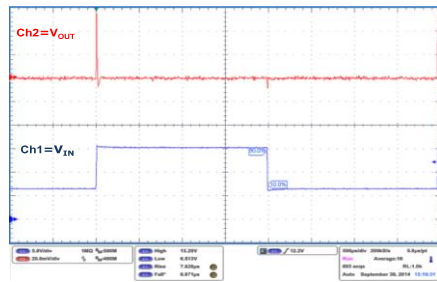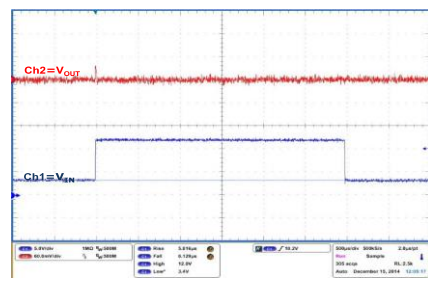
Figure 38: Load transient (V$_{OUT}$ = 5 V)	**Figure 39: Load transient (V$_{OUT}$ = V$_{ADJ}$)**
V$_{EN}$ to V$_{CC}$ V$_{IN}$ = 6 V, I$_{OUT}$ = from 10 mA to 1.2 A , C$_{IN}$ = 1 µF C$_{OUT}$ = 4.7 µF T$_{rise}$ = 5 µs	V$_{EN}$ to V$_{CC}$ V$_{IN}$ = 3.5 V, I$_{OUT}$ = from 10 mA to 1.2 A , C$_{IN}$ = 1 µf C$_{OUT}$ = 4.7 µF T$_{rise}$ = 5 µs
GIPD301120151411MT	GIPD301120151412MT
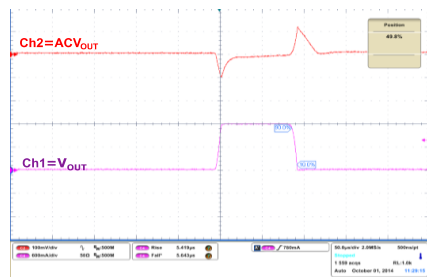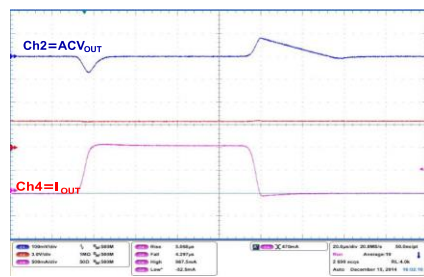
7 Package information

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.

7.1 DFN6 (3x3) package information

Figure 40: DFN6 (3x3) package outline
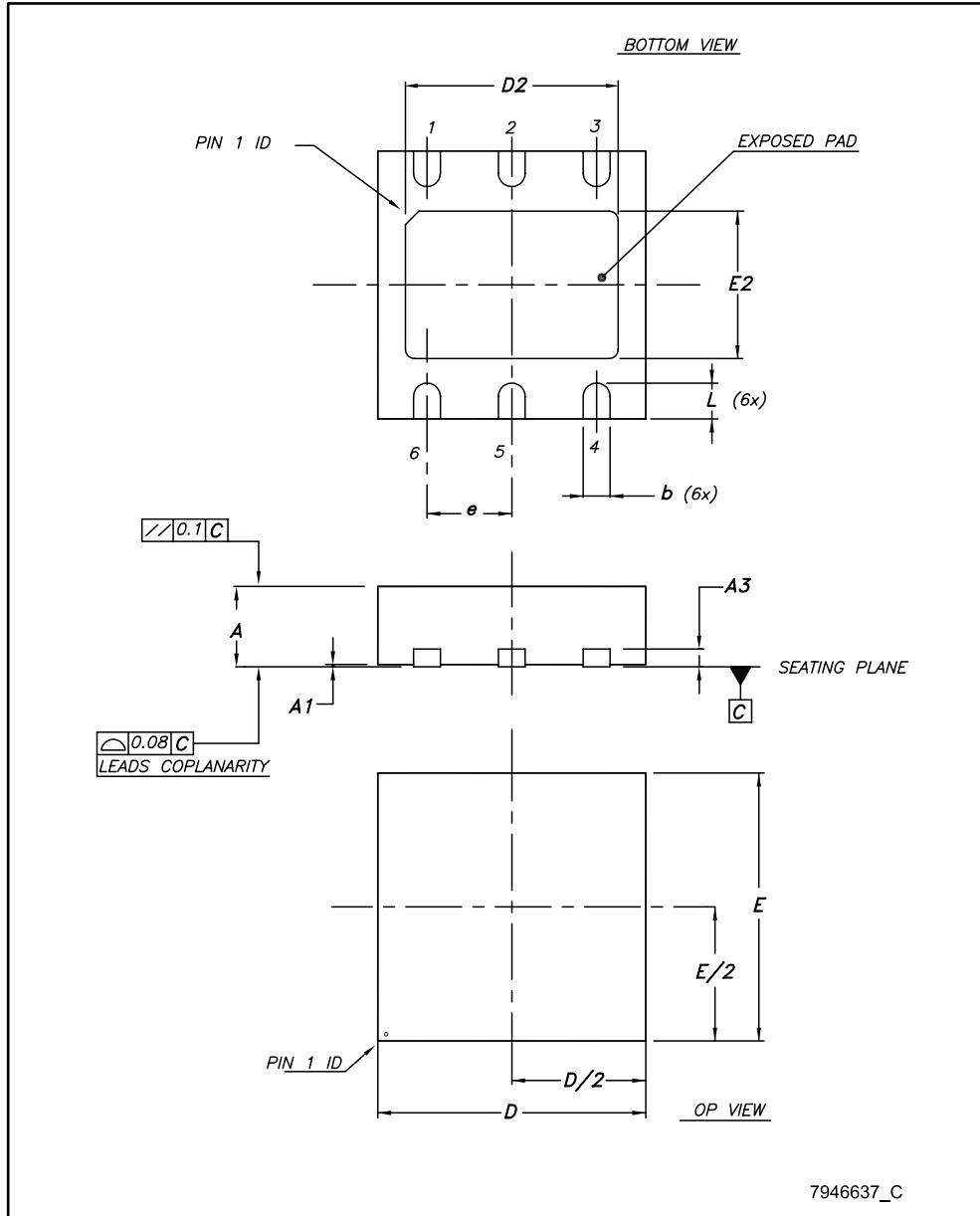
Table 5: DFN6 (3x3) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1
A1	0	0.02	0.05
A3		0.20	
b	0.23		0.45
D	2.90	3	3.10
D2	2.23		2.50
E	2.90	3	3.10
E2	1.50		1.75
e		0.95	
L	0.30	0.40	0.50

Figure 41: DFN6 (3x3) recommended footprint
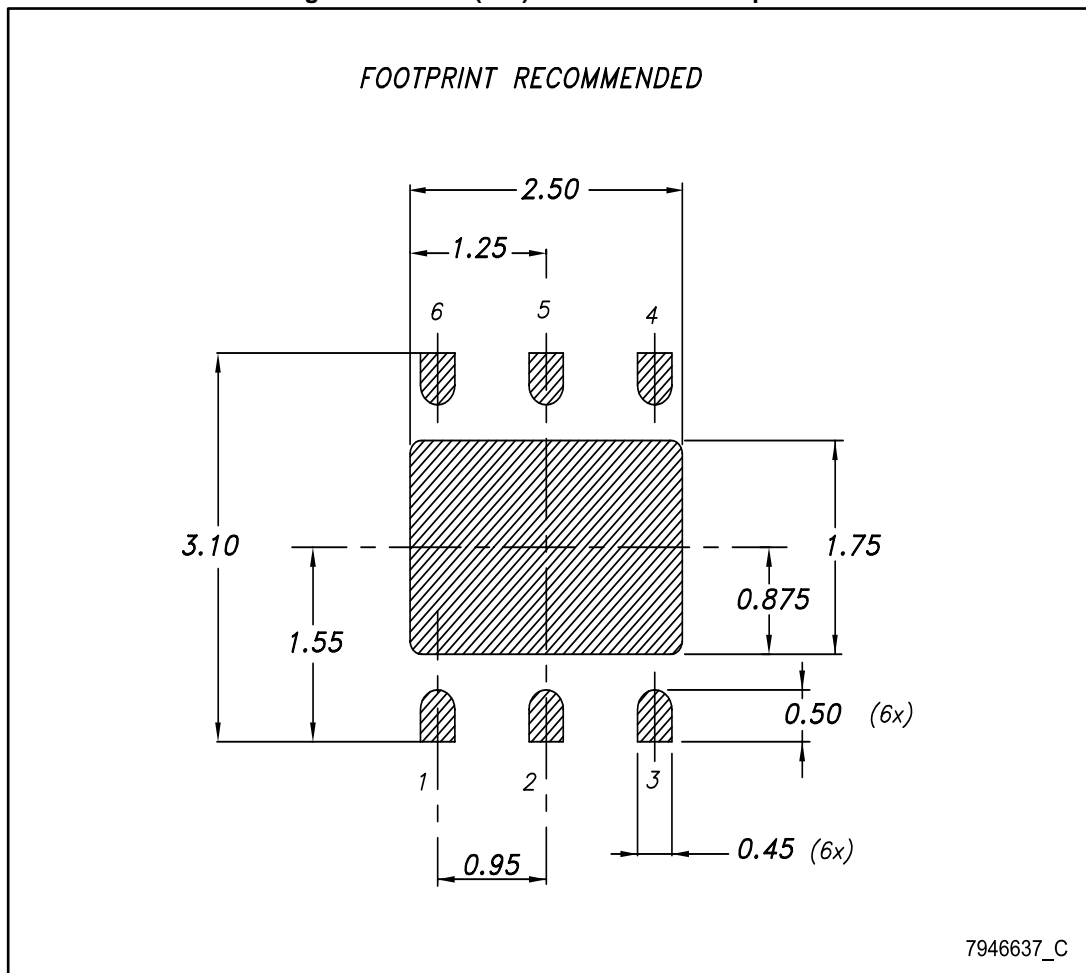
7.2 DFN6 (3x3) packing information

Figure 42: DFN6 (3x3) tape outline

*− *10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.20*

7875978_N
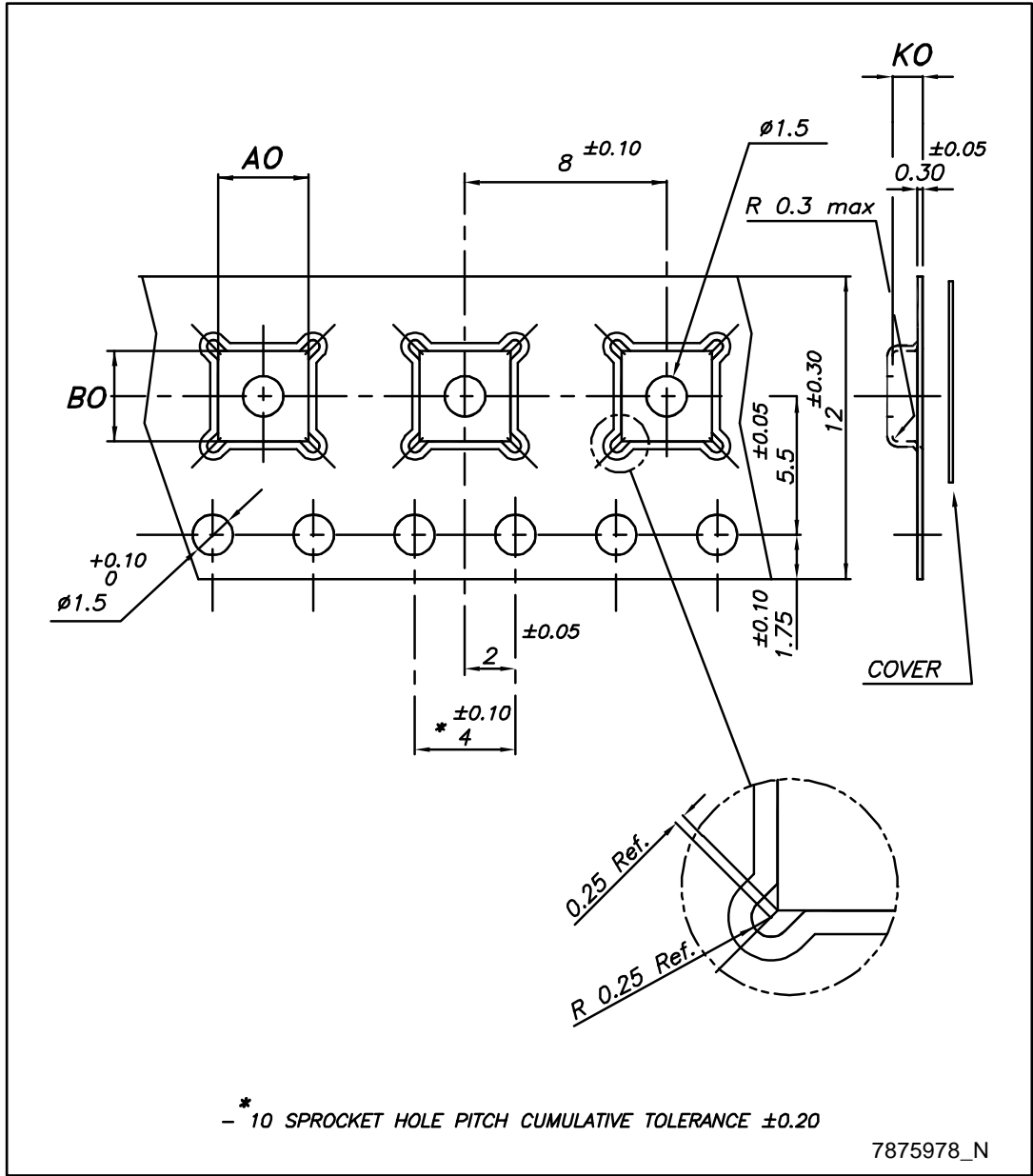
Figure 43: DFN6 (3x3) reel outline

ø20.2 Min.

+0.5
0.2
ø13

+0.3
−4
ø330
(13")

18.4 Mc
(Measured at h∟

±0.5
100

2.2

+
(Measured at hub) 12.4

7875978_N
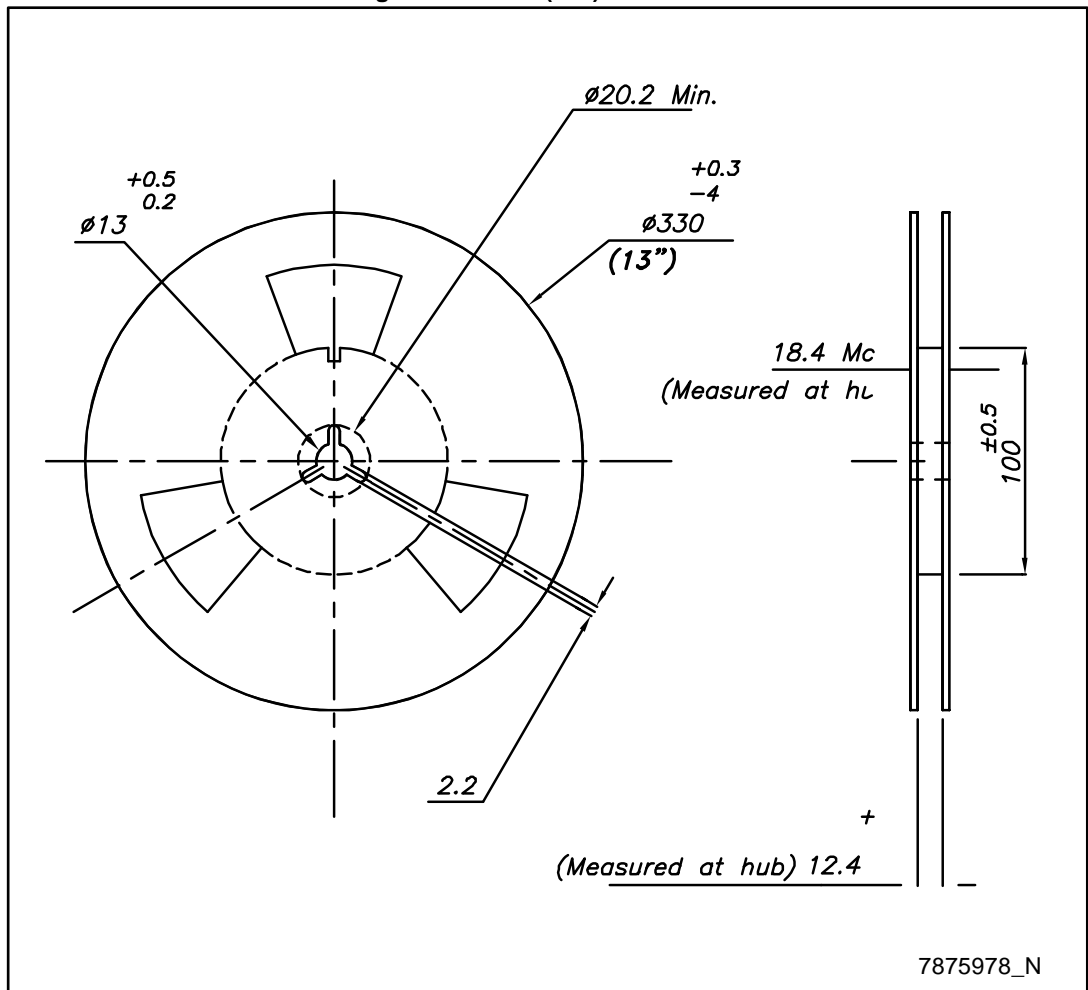
Table 6: DFN6 (3x3) tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A0	3.20	3.30	3.40
B0	3.20	3.30	3.40
K0	1	1.10	1.20

7.3 DFN6 (2x2) package information

Figure 44: DFN6 (2x2) package outline
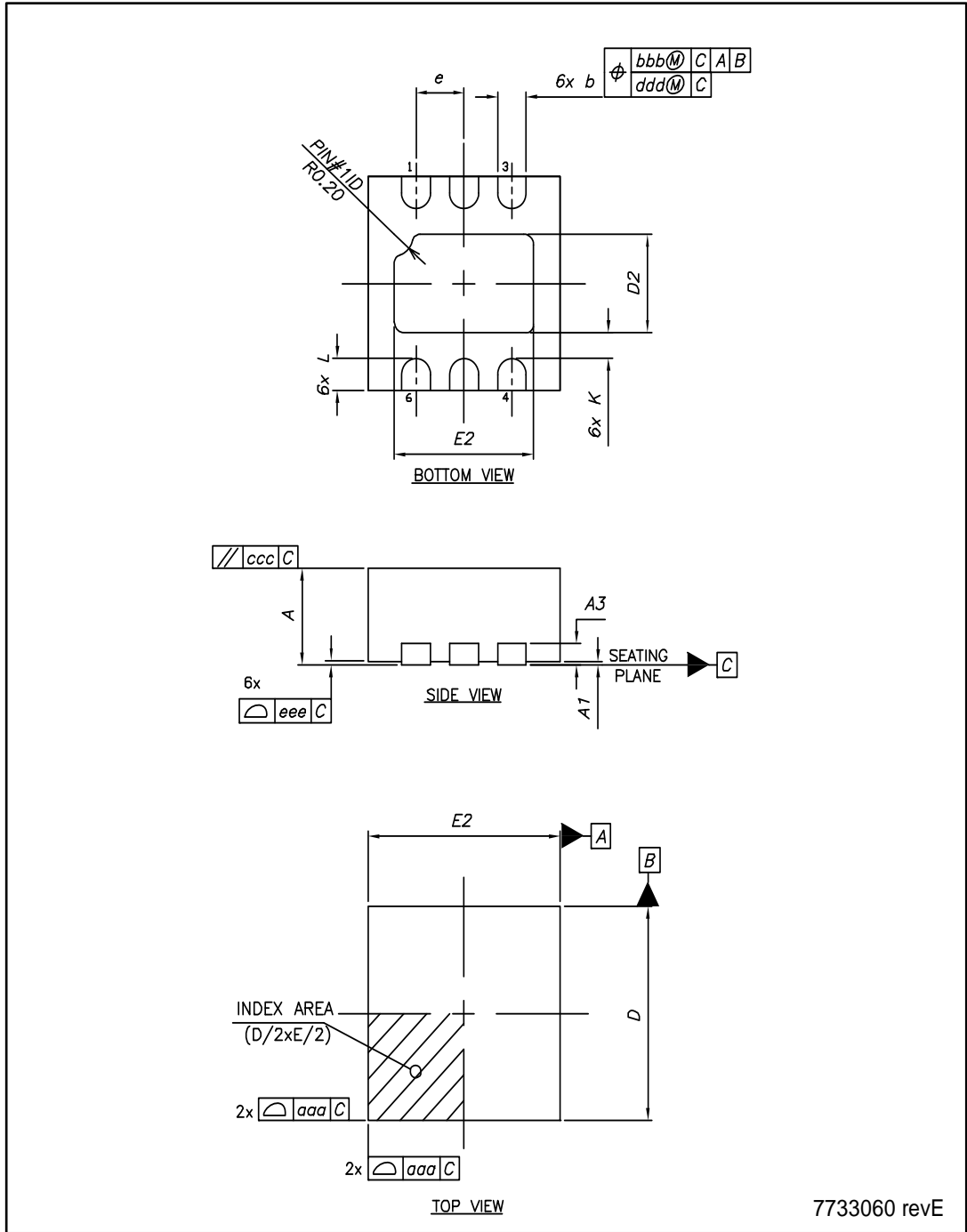
Table 7: DFN6 (2x2) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	-	0.203 ref	-
b	0.25	0.30	0.35
D	-	2.00	-
E	-	2.00	-
e	-	0.50	-
D2	0.77	0.92	1.02
E2	1.30	1.45	1.55
K	0.15	-	-
L	0.20	0.30	0.40
aaa	-	0.05	-
bbb	-	0.10	-
ccc	-	0.10	-
ddd	-	0.05	-
eee	-	0.08	-

Figure 45: DFN6 (2x2) recommended footprint

Notes:
1) This footprint is able to ensure insulation up to 32 Vrms (according to CEI IEC 664-1)
2) The device must be positioned within $\quad$ ⊕ | 0.02 | A | B

7733060 revE
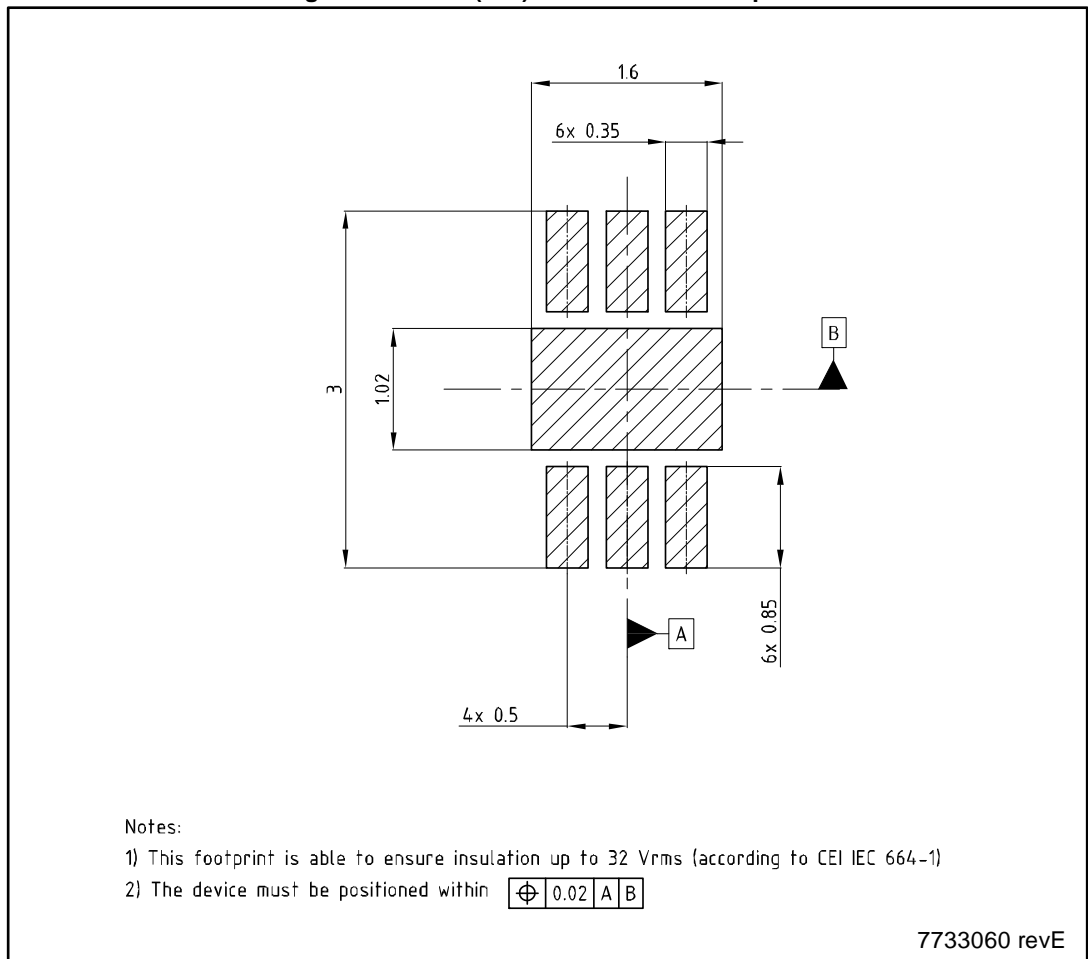
7.4 DFN6 (2x2) packing information

Figure 46: DFN6 (2x2) reel outline

Note: Drawing not in scale
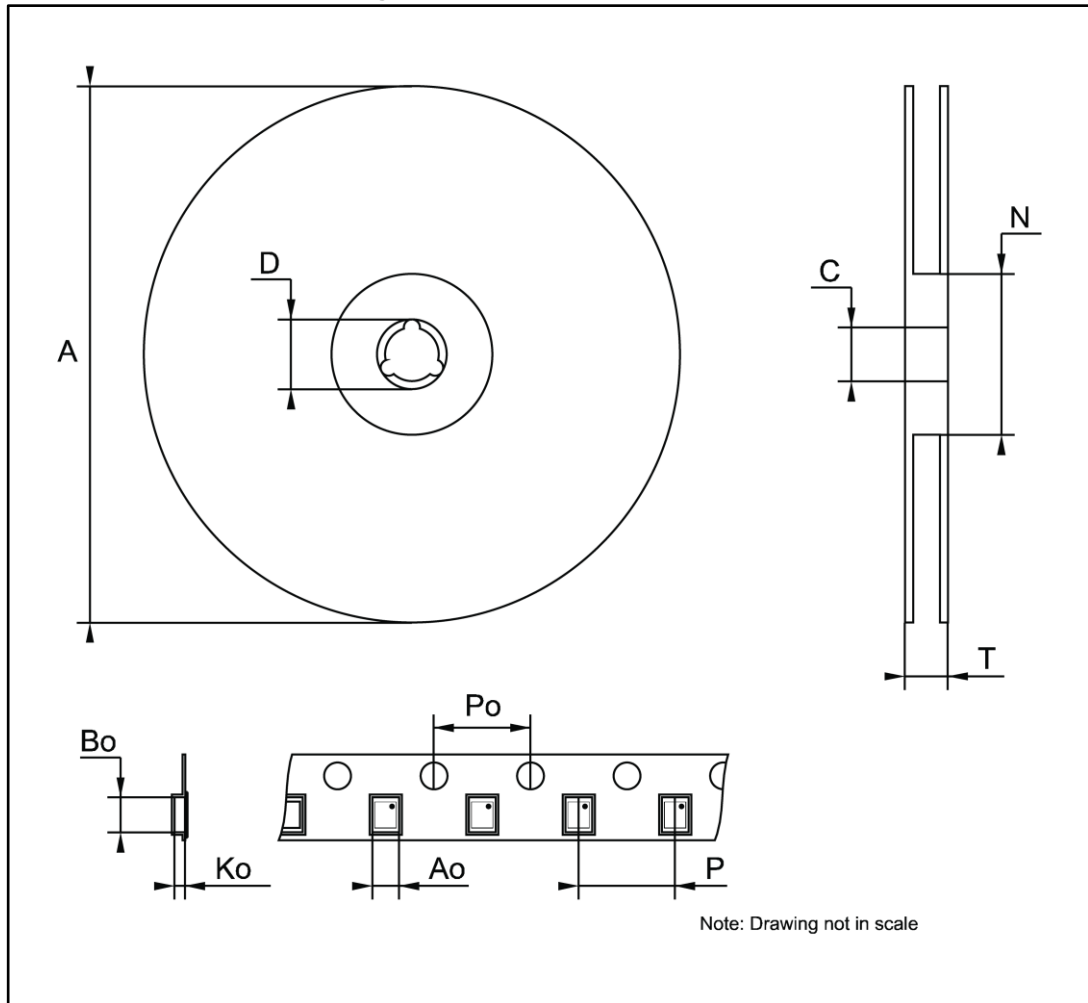
Table 8: DFN6 (2x2) tape and reel mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A			180
C	12.8		13.2
D	20.2		
N	60		
T			14.4
A0		2.4	
B0		2.4	
K0		1.3	
P0		4	
P		4	

7.5 SO8-batwing package information

Figure 47: SO-8 batwing package outline
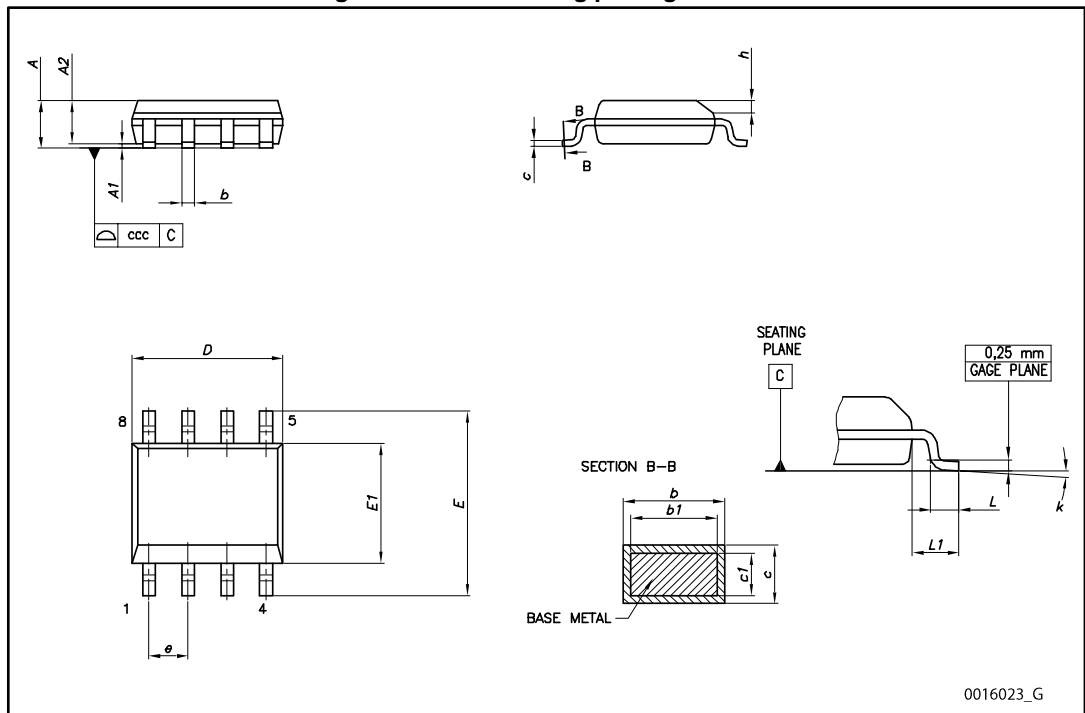
Table 9: SO-8 batwing mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A			1.75
A1	0.10		0.25
A2	1.25		
b	0.31		0.51
b1	0.28		0.48
c	0.10		0.25
c1	0.10		0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27	
h	0.25		0.50
L	0.40		1.27
L1		1.04	
L2		0.25	
k	0°		8°
ccc			0.10

Figure 48: SO-8 batwing recommended footprint

0016023_GU
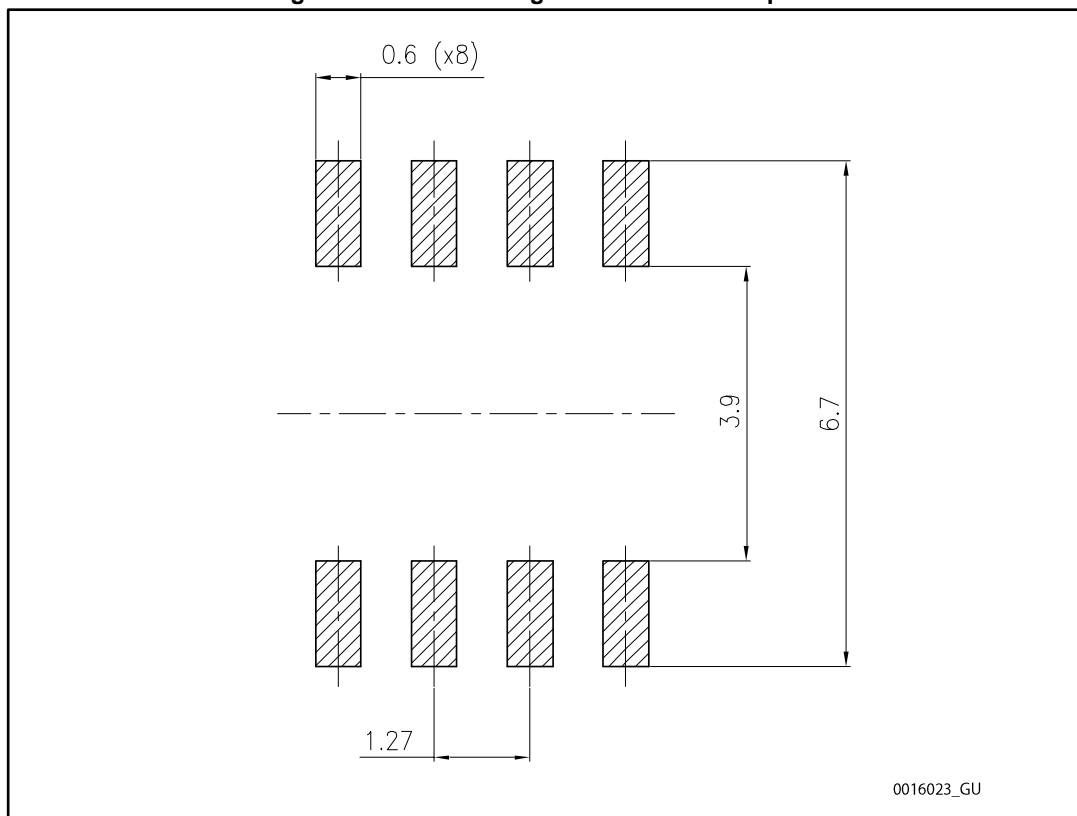
7.6   SO8-batwing packing information

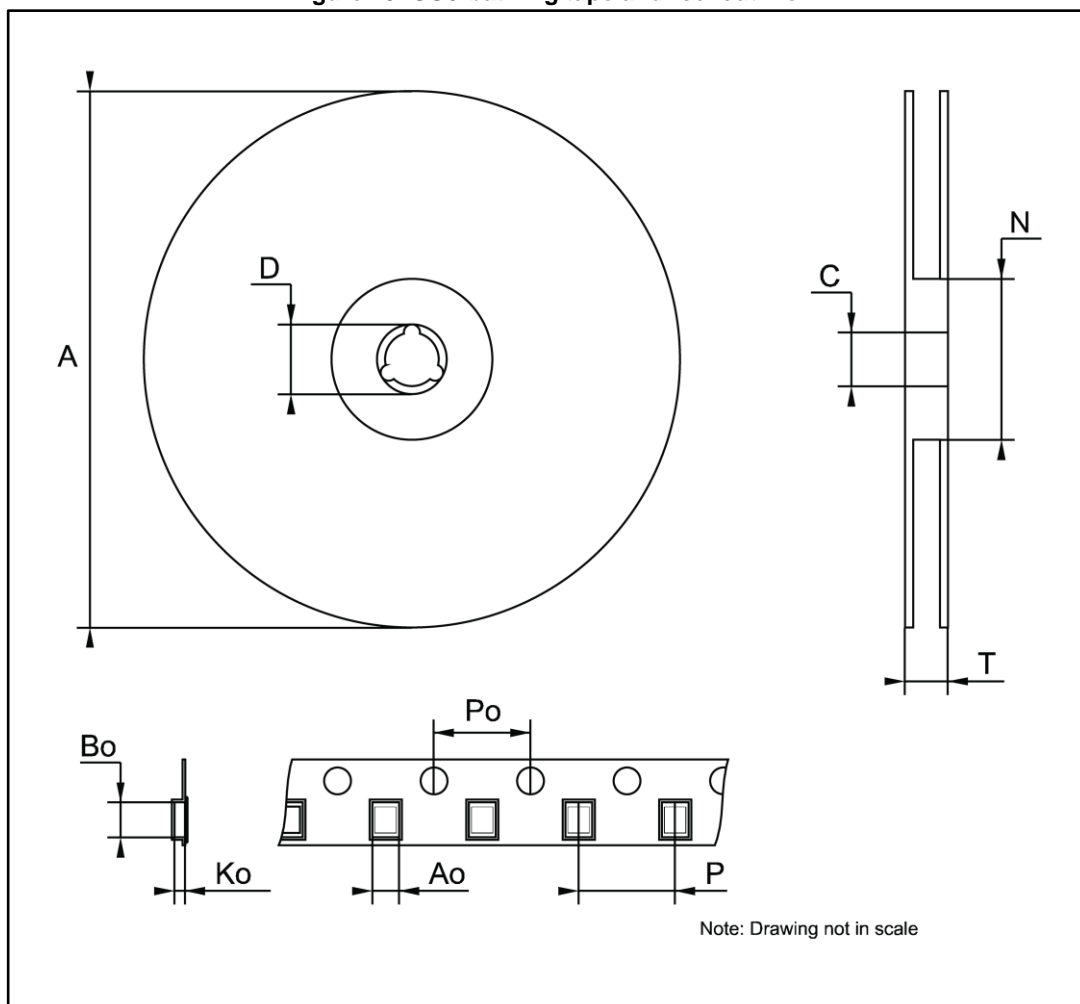**Figure 49: SO8-batwing tape and reel outline**

Note: Drawing not in scale

Table 10: SO8-batwing mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A			330
C	12.8		13.2
D	20.2		
N	60		
T			22.4
A0	8.1		8.5
B0	5.5		5.9
K0	2.1		2.3
P0	3.9		4.1
P	7.9		8.1

8 Ordering information

Table 11: Order code

DFN6 (3x3)	DFN6 (2x2)	SO-8 batwing plastic micropackage	Output voltage (V)
LDL212PU12R			1.2
LDL212PU15R			1.5
LDL212PU18R			1.8
LDL212PU25R			2.5
LDL212PU30R			3
	LDL212D33R		3.3
LDL212PU50R			5
LDL212PUR	LDL212PVR	LDL212DR	Adjustable

9 Revision history

Table 12: Document revision history

Date	Revision	Changes
02-Mar-2016	1	Initial release.
19-Sep-2016	2	Updated *Table 3: "Thermal data"* and *Section 5: "Electrical characteristics"*. Minor text changes.

IMPORTANT NOTICE – PLEASE READ CAREFULLY