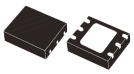
LDFM

Datasheet

500 mA very low drop voltage regulator



DFN6 (3x3)

DFN6 (2x2)

Maturity status link
LDFM

Features

- Input voltage from 2.5 to 16 V
- Very low dropout voltage (300 mV max. at 500 mA load)
- Low quiescent current (200 µA typ. @ 500 mA load)
- Available in 1 % precision
- 500 mA guaranteed output current
- Wide range of output voltages available on request: adjustable from 0.8 V, fixed up to 12 V in 100 mV steps
- Logic-controlled electronic shutdown
- Power Good
- Fast dynamic response to line and load changes
- Internal current and thermal protection
- Temperature range: - 40 °C to 125 °C

Applications

- PCs and laptop computers
- Battery-powered equipment
- Industrial and medical equipment
- Portable equipment

Description

The LDFM is a fast, very low drop linear regulator which operates from an input supply voltage in the range of 2.5 V to 16 V.

It is available in fixed and adjustable output voltage versions, from 0.8 V to 12 V.

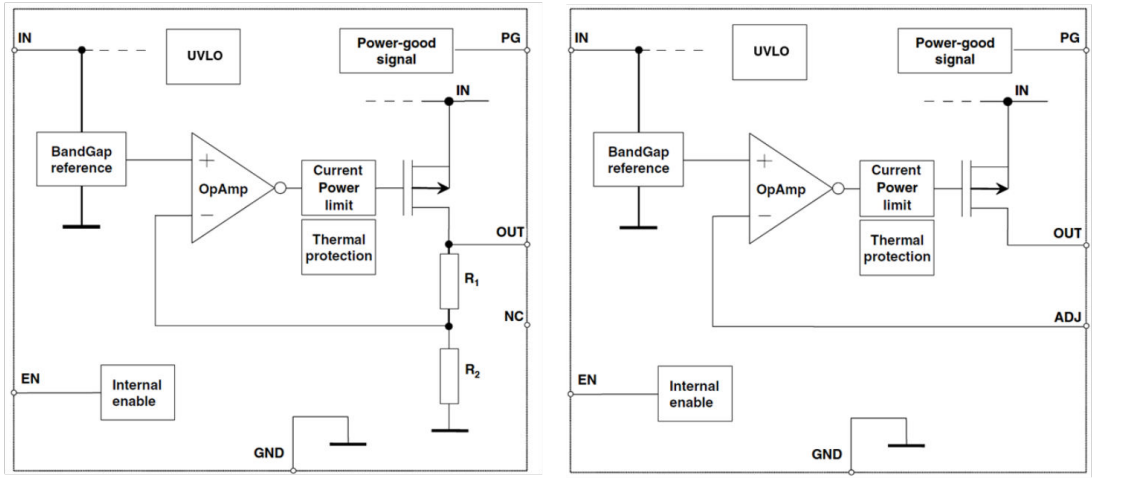
The LDFM features high output precision, very low dropout voltage, low noise, and low quiescent current, therefore suitable for low voltage microprocessors and memory applications.

Enable logic control pin and Power Good output.

Current and thermal protection are provided.

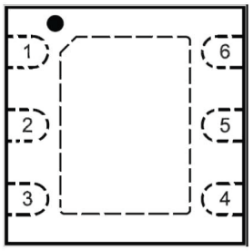
1 Block diagram

Figure 1. **Block diagram (generic version)**



2 Pin configuration

Figure 2. **Pin connection (top view)**



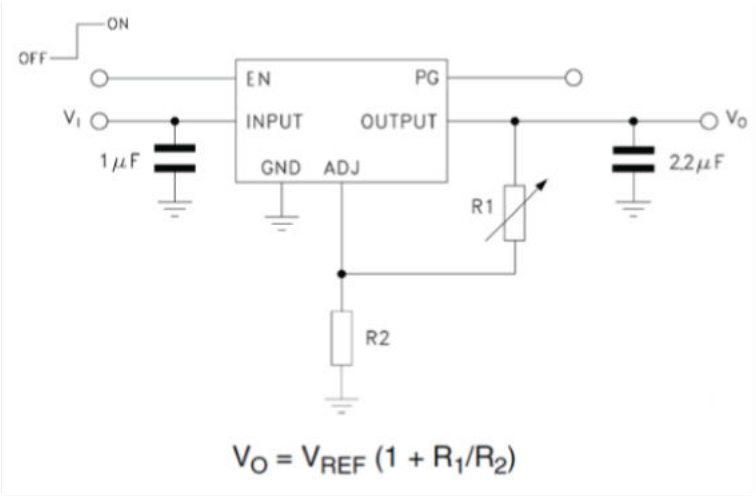
DFN6

Table 1. **Pin description DFN6-2x2 and 3x3**

Pin n°	Symbol	Function
2	ADJ/NC	For adjustable versions: error amplifier input pin. For fixed version: not connected
6	V_{IN}	Input voltage
1	V_{OUT}	Output voltage
5	EN	Enable pin logic input: low = shutdown, high = active
3	PG	Power good output
4	GND	Ground
exposed pad	GND	Ground

3 Typical application

Figure 3. **Adjustable version (PPAK and DFN6 packages only)**



DFN6 packages

AM13906

4 Absolute 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_{ADJ}	Adjust pin voltage	- 0.3 to 2	V
V_{PG}	Power Good pin voltage	- 0.3 to V_{IN} + 0.3	V
I_{LOAD}	Output current	Internally limited	mA
P_D	Power dissipation	Internally limited	mW
T_{STG}	Storage temperature range	- 65 to 150	°C
T_{OP}	Operating junction temperature range	- 40 to 125	°C

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

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		DFN6-2x2	DFN6-3x3	
R_{thJA}	Thermal resistance junction-ambient	65	55	°C/W
R_{thJC}	Thermal resistance junction-case	6.5	10	°C/W

5 Electrical characteristics

T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V (For V_{OUT} < 1.5 V; V_{IN} = 2.5 V.), C_{IN} = 1 µF, C_{OUT} = 2.2 µF, I_{LOAD} = 10 mA, V_{EN} = 2 V, unless otherwise specified.

Table 4. Electrical characteristics for LDFM (fixed versions)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		16	V
V_{OUT}	V_{OUT} accuracy,	V_{OUT}+1 V≤ V_{IN} ≤ 16 V (1) I_{LOAD} = 10 mA	-1		1	%
		10 mA ≤ I_{LOAD} ≤ 500 mA T_J = -40 to 125 °C	-1.5		1.5	%
ΔV_{OUT}	Static line regulation	V_{OUT}+1 V ≤ V_{IN} ≤ 16 V(1)		0.01		%/V
		V_{OUT}+1 V ≤ V_{IN} ≤ 16 V,(1) T_J = -40 to 125 °C			0.04	
ΔV_{OUT}	Static load regulation	10 mA ≤ I_{LOAD} ≤ 500 mA		0.1		%/A
		10 mA ≤ I_{LOAD} ≤ 500 mA, T_J = -40 to 125 °C		0.15	0.4	
		10 mA ≤ I_{LOAD} ≤ 500 mA, T_J = -40 to 125 °C DFN6 version			10	mV
V_{DROP}	Dropout voltage (2)	I_{LOAD} = 500 mA, -40 °C < T_J < 125 °C		125	300	mV
I_Q	Quiescent current	ON mode: V_{EN} = 2 V I_{LOAD} = 10 mA to 500 mA, T_J = -40 to 125 °C		200	800	µA
		OFF Mode:V_{EN} = GND, PPAK and DFN versions		30		
		OFF Mode:V_{EN} = GND, PPAK and DFN versions, -40 °C < T_J < 125 °C			120	
I_{SC}	Short-circuit current			0.8		A
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 16 V, -40 °C<T_J<125 °C			0.8	V
	Enable input logic high		2			
I_{EN}	Enable pin input current	V_{EN} = V_{IN}		5	10	µA
PG	Power Good output threshold	Rising edge		0.92*V_{OUT}		V
		Falling edge		0.8*V_{OUT}		
	Power Good output voltage low	I_{SINK} = 6 mA, open drain output		0.4		
SVR	Supply voltage rejection	V_{IN} = 6 V +/- 0.5 V_{RIPPLE} Freq. = 120 Hz, V_{OUT} = 5 V		60		dB
		V_{IN} = 6 V +/- 0.5 V_{RIPPLE} Freq. = 10 kHz, V_{OUT} = 5 V		52		
e_N	Output noise voltage	Bw = 10 Hz to 100 kHz, I_{LOAD} = 100 mA. C_{OUT} = 2.2 µF		45		μV_{RMS}/ V_{OUT}

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
T_{SHDN}	Thermal shutdown			170		°C
	Hysteresis			10		

1. *For V_{OUT} < 1.5 V; V_{IN} = 2.5 V.*
2. *Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 1.5 V.*

T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V(For V_{OUT} < 1.5 V; V_{IN} = 2.5 V.), C_{IN} = 1 µF, C_{OUT} = 2.2 µF, I_{LOAD} = 10 mA, V_{EN} = 2 V, unless otherwise specified.

Table 5. Electrical characteristics for LDFM (adjustable version)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		16	V
V_{ADJ}	Reference voltage	V_{IN} = V_{OUT}+1 V (1)		0.8		V
	Reference voltage tolerance	V_{OUT}+1 V ≤ V_{IN} ≤ 16 V (1) I_{LOAD} = 10 mA	-1		1	%
		10 mA ≤ I_{LOAD} ≤ 500 mA T_J = -40 to 125 °C	-1.5		1.5	
ΔV_{OUT}	Static line regulation	V_{OUT}+1 V ≤ V_{IN} ≤ 16 V (1)		0.01		%/V
		V_{OUT}+1 V ≤ V_{IN} ≤ 16 V, (1)T_J = -40 to 125 °C			0.04	
ΔV_{OUT}	Static load regulation	10 mA ≤ I_{LOAD} ≤ 500 mA		0.06		%/A
		10 mA ≤ I_{LOAD} ≤ 500 mA, T_J = -40 to 125 °C		0.2	0.4	
		10 mA ≤ I_{LOAD} ≤ 500 mA, T_J = -40 to 125 °C DFN6 version			10	mV
V_{DROP}	Dropout voltage (2)	V_{OUT} fixed to 2.5 V, I_{LOAD} = 500 mA, -40 °C < T_J < 125 °C		125	300	mV
I_Q	Quiescent current	ON mode: V_{EN} = 2 V I_{LOAD} = 10 mA to 500 mA, T_J = -40 to 125 °C		200	800	µA
		OFF Mode:V_{EN} = GND, PPAK and DFN versions		30		
		OFF Mode:V_{EN} = GND, PPAK and DFN versions, -40 °C < T_J < 125 °C			120	
I_{SC}	Short-circuit current			0.8		A
V_{EN}	Enable input logic low	V_{IN}= 2.5 V to 16 V, -40 °C < T_J < 125 °C			0.8	V
	Enable input logic high		2			
I_{EN}	Enable pin input current	V_{EN} = V_{IN}		5	10	µA
PG	Power Good output threshold	Rising edge		0.92*V_{ADJ}		V
		Falling edge		0.8*V_{ADJ}		

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
PG	Power Good output voltage low	I_{SINK} = 6 mA, open drain output		0.4		V
SVR	Supply voltage rejection	$V_{IN} = V_{OUT}$+1 V +/- 0.5 V_{RIPPLE} Freq. = 120 Hz, V_{OUT} = 0.8 V		62		dB
		$V_{IN} = V_{OUT}$+1 V +/- 0.5 V_{RIPPLE} Freq. = 10 kHz, V_{OUT} = 0.8 V		55		
e_N	Output noise voltage	Bw = 10 Hz to 100 kHz, I_{LOAD} = 100 mA. C_{OUT} = 2.2 µF		50		$\mu V_{RMS}/V_{OUT}$
T_{SHDN}	Thermal shutdown			170		°C
	Hysteresis			10		

1. *For V_{OUT} < 1.5 V; V_{IN} = 2.5 V.*
2. *Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 1.5 V.*

6 Application information

6.1 External capacitors

The LDFM requires external capacitors for regulator stability. These capacitors must be selected to meet the requirements of minimum capacitance and equivalent series resistance (see and). It is advisable to locate the input/output capacitors as close as possible to the relative pins.

6.1.1 Input capacitor

An input capacitor with a minimum value of 1 µF is required with the LDFM. This capacitor must be located a distance of not more than 0.5" from the input pin of the device and returned to a clean analog ground. Any good quality ceramic capacitors can be used for this capacitor.

6.1.2 Output capacitor

It is possible to use ceramic capacitors but the output capacitor must meet the requirements for minimum amount of capacitance and E.S.R. (equivalent series resistance) value.

A minimum capacitance of 2.2 µF is a good choice to guarantee the stability of the regulator. However, other C_{OUT} values can be used according to and , showing the allowable ESR range as a function of the output capacitance.

The output capacitor must maintain its ESR in the stable region over the full operating temperature range to assure stability. Also, capacitor tolerance and variation with temperature must be kept in consideration in order to assure the minimum amount of capacitance at all times.

6.2 Enable pin operation

The Enable pin can be used to turn OFF the regulator when pulled down, so drastically reducing the current consumption. When the enable feature is not used, this pin must be tied to V_{IN} to keep the regulator output ON at all times. To assure proper operation, the signal source used to drive the Enable pin must be able to swing above and below the specified thresholds listed in the electrical characteristics section (V_{EN}). The Enable pin must not be left floating because it is not internally pulled down/up.

6.3 Power Good

The LDFM features an open drain Power Good (PG) pin to sequence external supplies or loads and to provide fault detection. This function is active when enable is high. This pin requires an external resistor (R_{PG}) to pull PG high when the output is within the PG tolerance window. Typical values for this resistor range from 10 kΩ to 100 kΩ.

7 Typical performance characteristics

$C_{IN} = C_{OUT} = 1\ \mu F$, $V_{IN} = V_{OUT} + 1$ V, V_{EN} to V_{IN}, $I_{OUT} = 10$ mA, unless otherwise specified.

Figure 4. Output voltage vs temperature

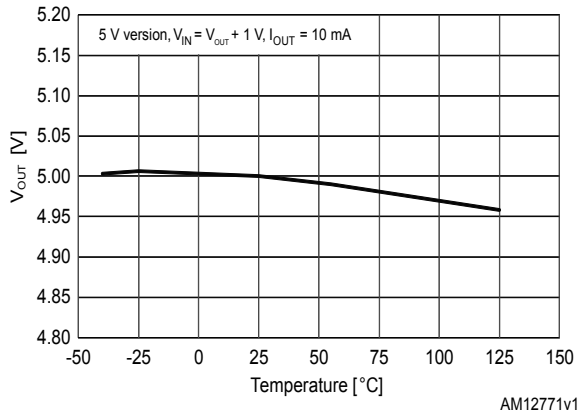


Figure 5. Output voltage vs temperature for adjustable

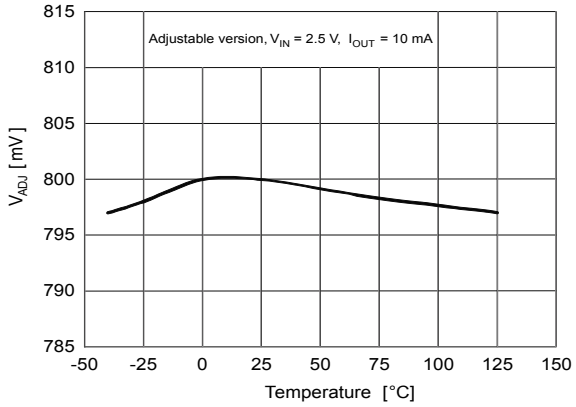


Figure 6. Line regulation vs temperature

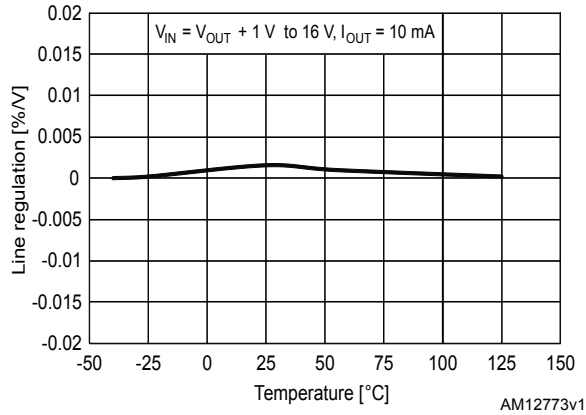


Figure 7. Load regulation vs temperature

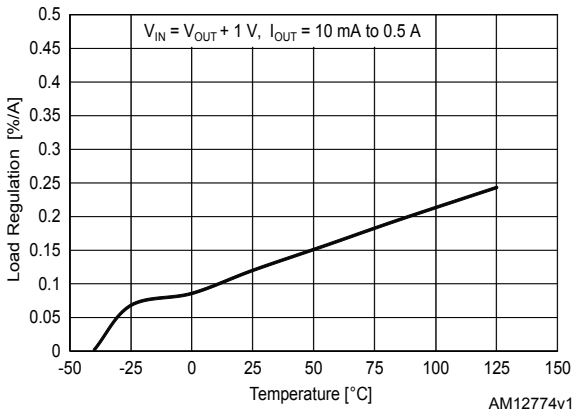


Figure 8. Short-circuit current vs drop voltage

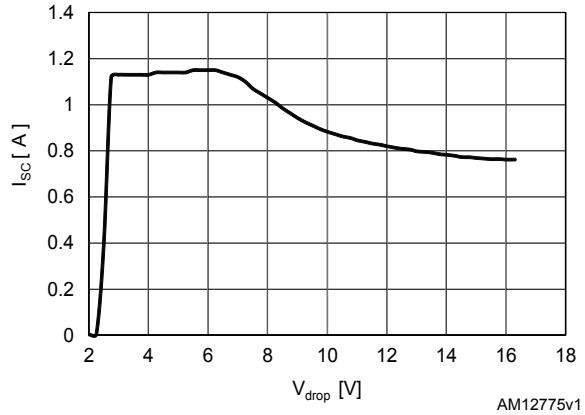


Figure 9. Dropout voltage vs temperature

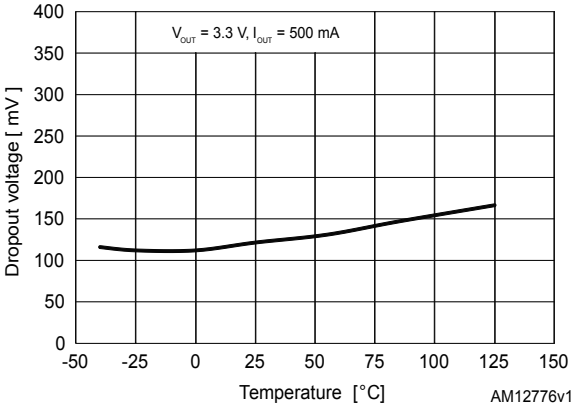


Figure 10. Quiescent current vs temperature (I_{OUT} = 10 mA)

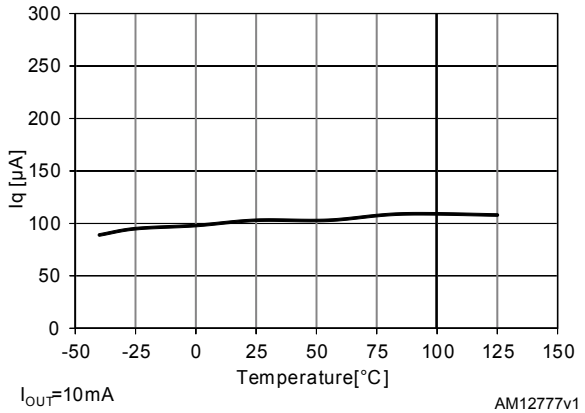


Figure 11. Quiescent current vs temperature (I_{OUT} = 500 mA)

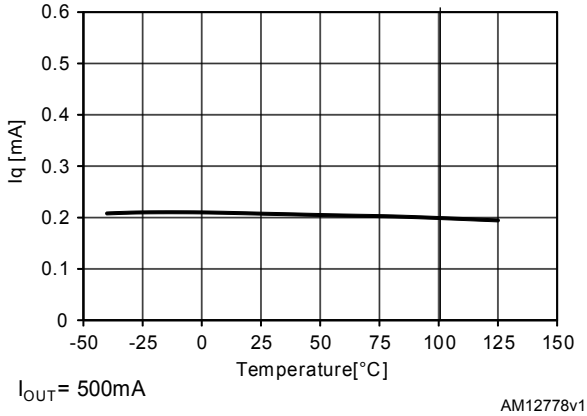


Figure 12. Shutdown current vs temperature

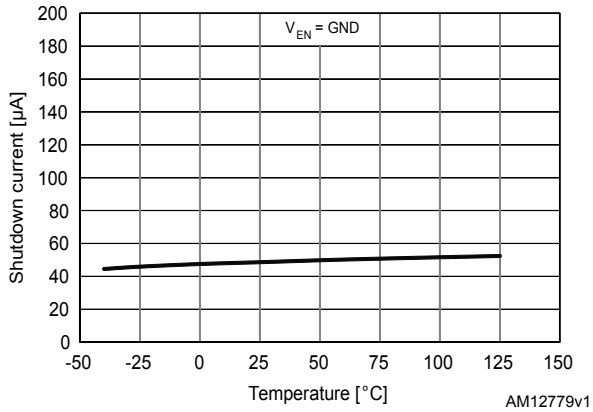


Figure 13. Enable pin current vs temperature

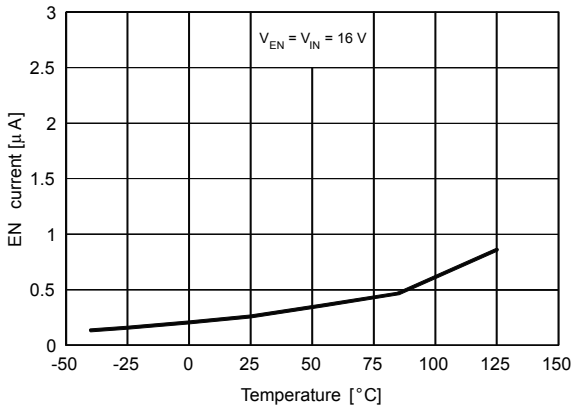


Figure 14. Enable high threshold vs temperature

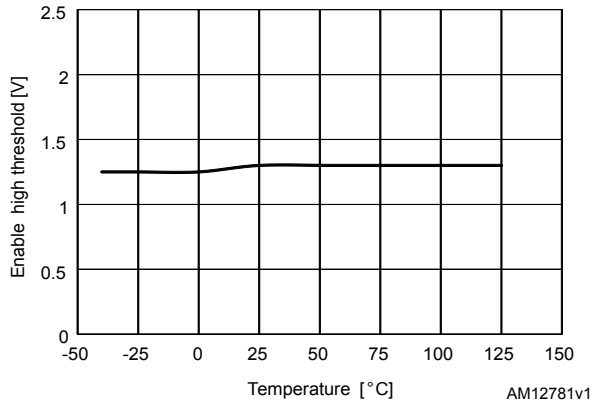


Figure 15. Enable low threshold vs temperature

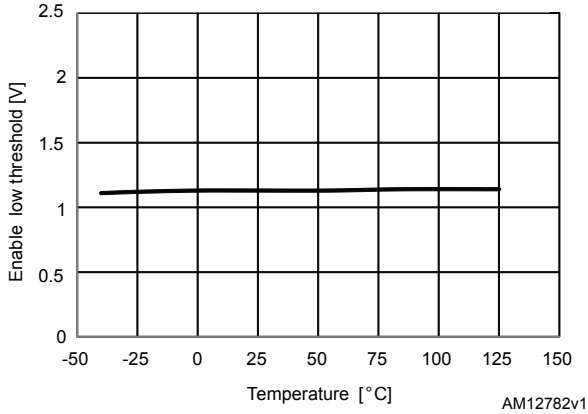
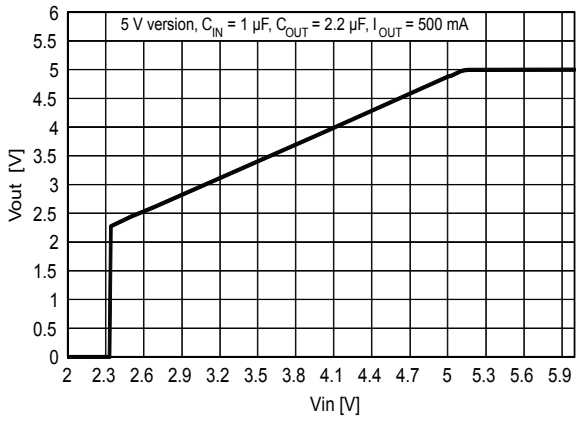
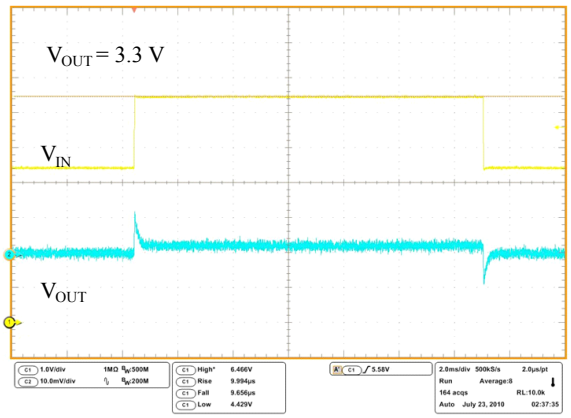


Figure 16. Output voltage vs input voltage



AM12783v1

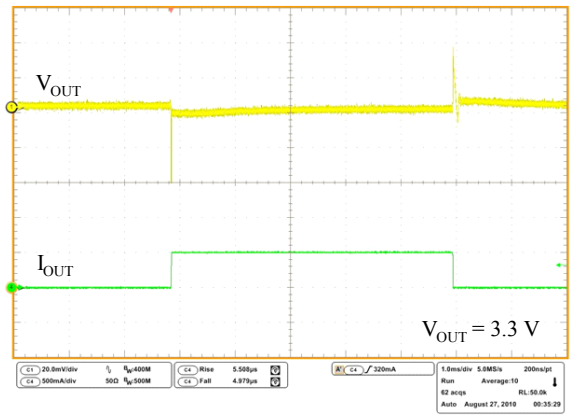
Figure 17. Line transient



V_{IN} = from 4.5 to 6.5 V, I_{OUT} = 10 mA, t_{rise} = t_{fall} = 10 µs, C_{OUT} = 2.2 µF

AMG060720161104MT

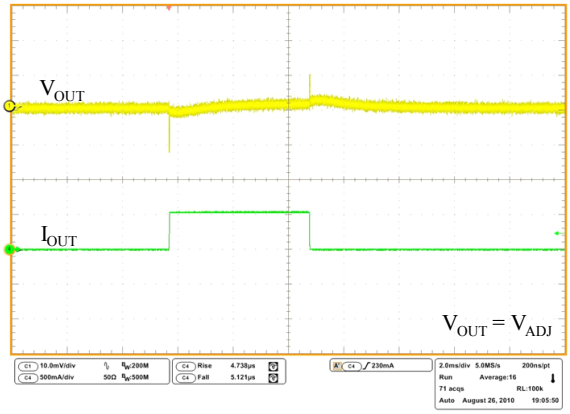
Figure 18. Load transient (V_{OUT} = 3.3 V)



V_{EN} = V_{IN} = 4.5 V, I_{OUT} = from 1 to 500 mA, t_{rise} = t_{fall} = 5 µs, C_{OUT} = 2.2 µF

AMG060720161103MT

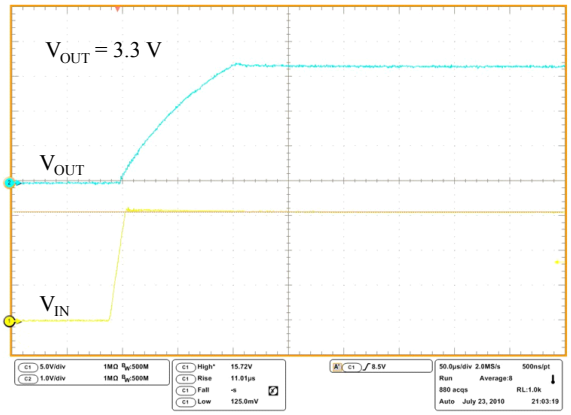
Figure 19. Load transient (V_{OUT} = V_{ADJ})



V_{EN} = V_{IN} = 4.5 V, I_{OUT} = from 1 to 500 mA, t_{rise} = t_{fall} = 5 µs, C_{OUT} = 2.2 µF

AMG060720161102MT

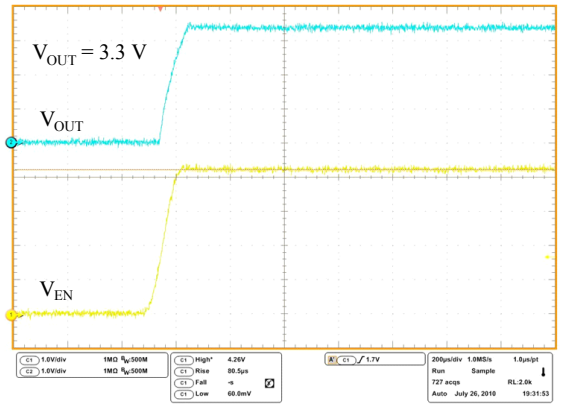
Figure 20. Startup transient



V_{EN} = V_{IN} = from 0 to 16 V, I_{OUT} = 10 mA, t_{rise} = 10 µs, C_{OUT} = 2.2 µF

AMG060720161101MT

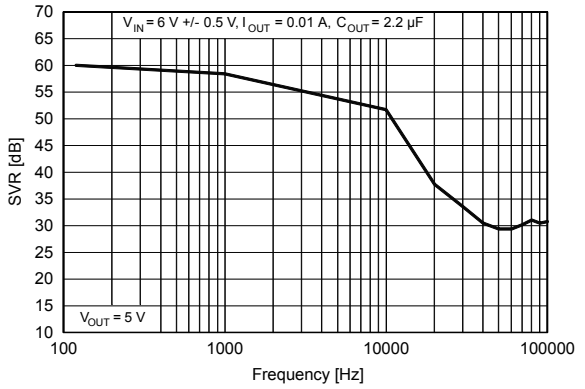
Figure 21. Enable transient



V_{IN} = 4.3 V, V_{EN} = from 0 to 4.3 V, I_{OUT} = 10 mA, t_{rise} = 100 µs, C_{OUT} = 2.2 µF

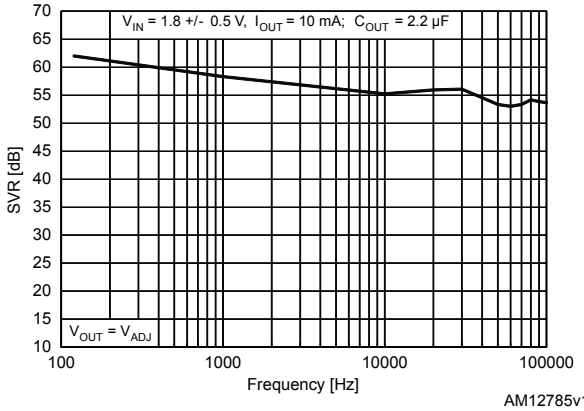
AMG060720161100MT

Figure 22. SVR vs frequency (V_{OUT} = 5 V)



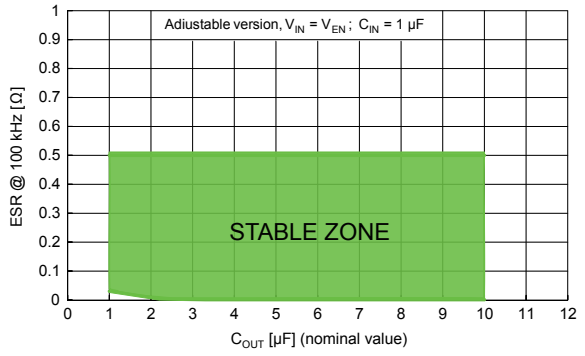
AM12784v1

Figure 23. SVR vs frequency (V_{OUT} = V_{ADJ})



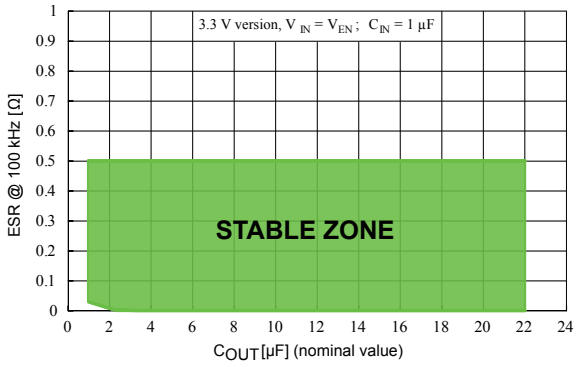
AM12785v1

Figure 24. Stability plane adj (C_{OUT}, ESR)



AM12786v1

Figure 25. Stability plane 3.3 V (C_{OUT}, ESR)



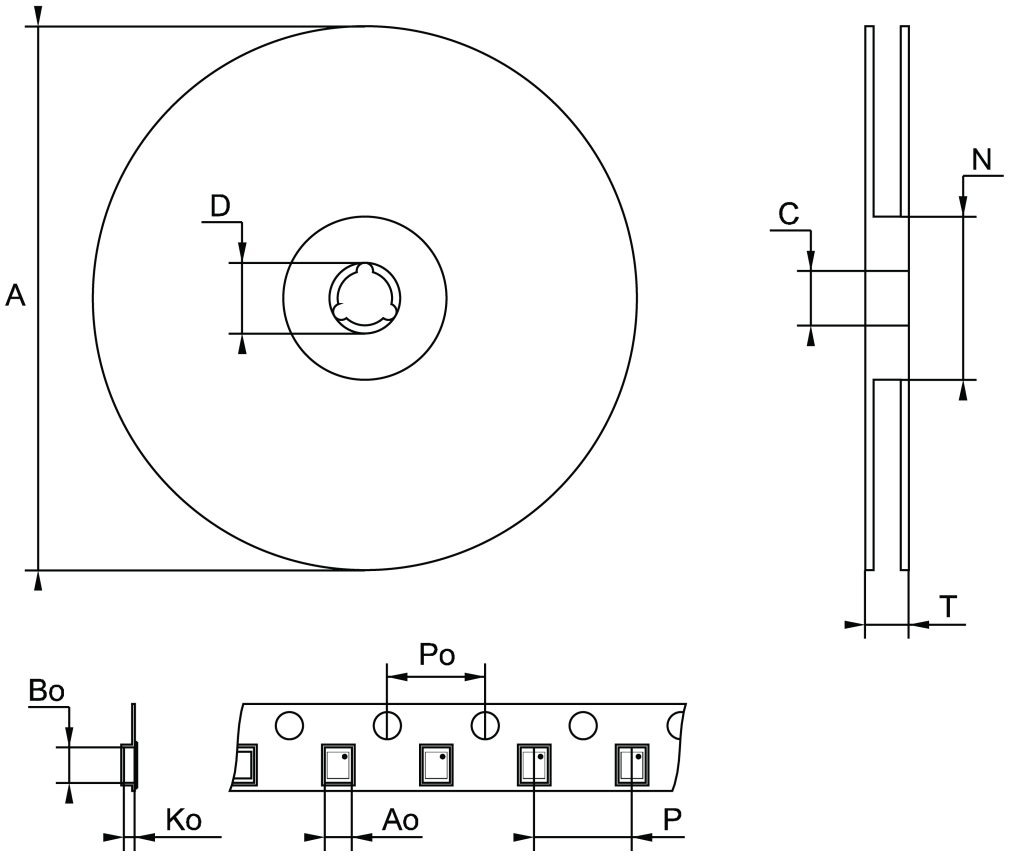
AM12787v1

8 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.

8.1 DFN6 (2x2) packing information

Figure 26. DFN6 (2 x 2 mm) reel outline



Note: Drawing not in scale

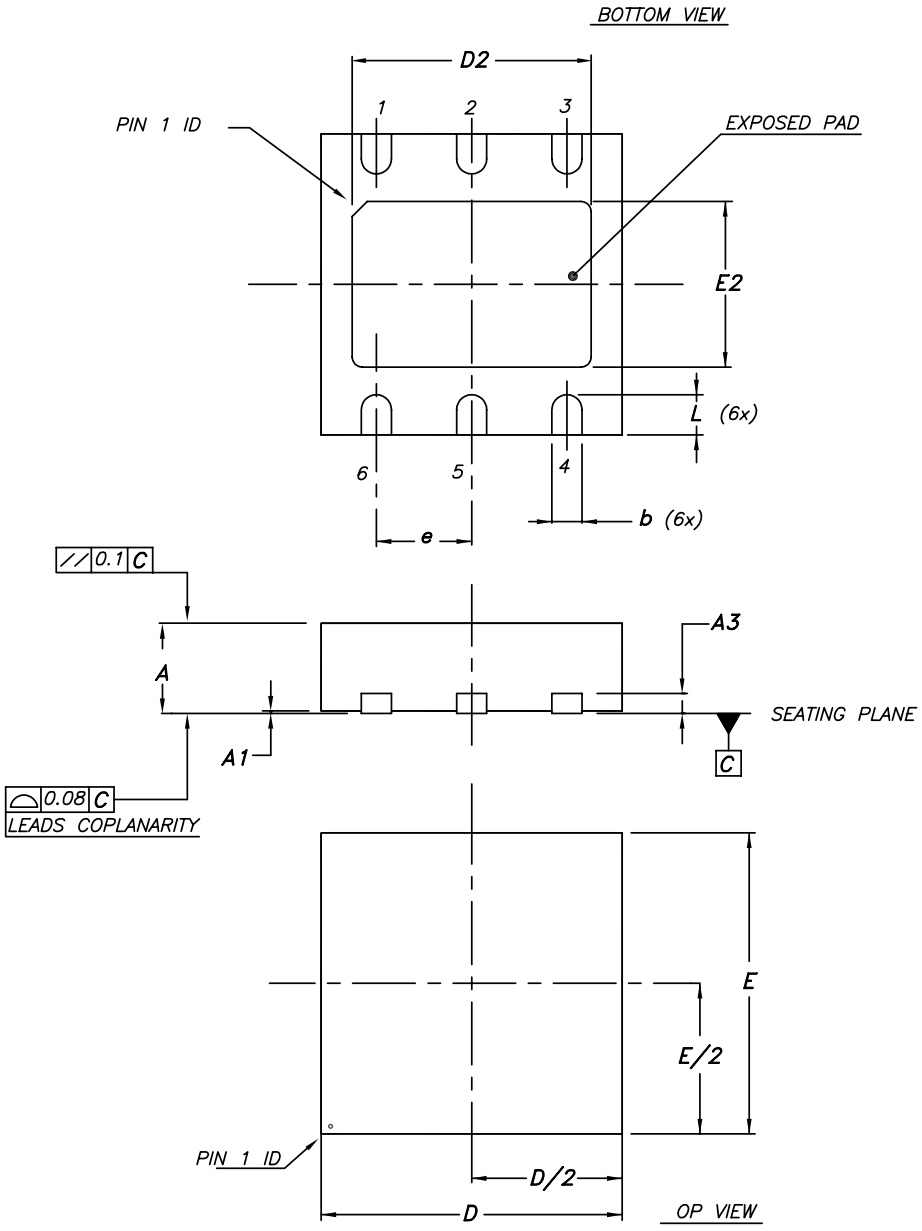
Table 6. DFN6 (2 x 2 mm) tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			180
C	12.8		13.2
D	20.2		
N	60		
T			14.4
A0		2.4	

Dim.	mm		
	Min.	Typ.	Max.
B0		2.4	
K0		1.3	
P0		4	
P		4	

8.2 DFN6 (3x3) package information

Figure 27. **DFN6 (3x3) package outline**

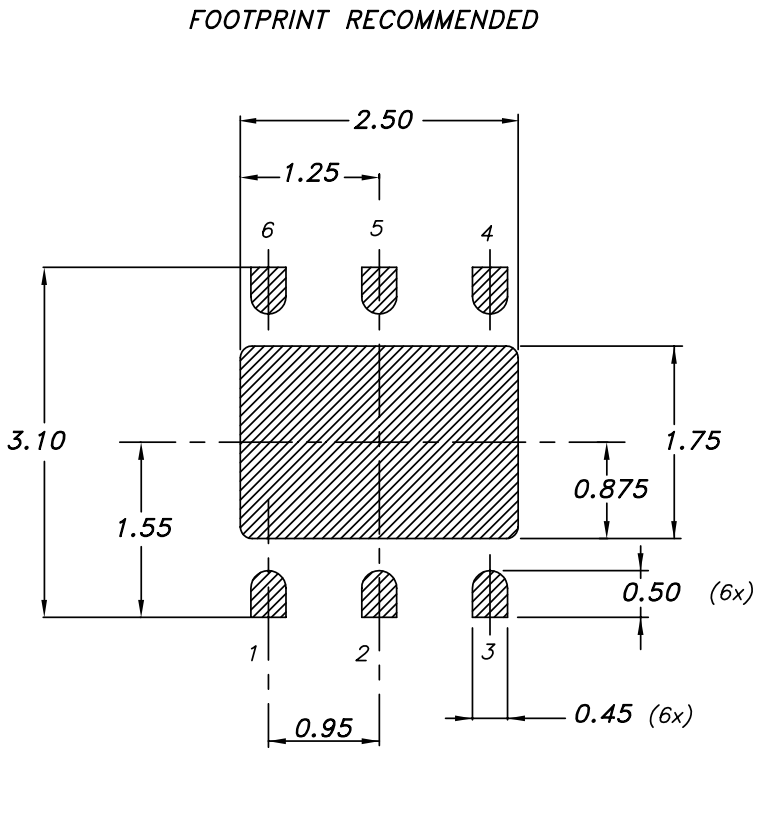


7946637_C

Table 7. **DFN6 (3x3) mechanical data**

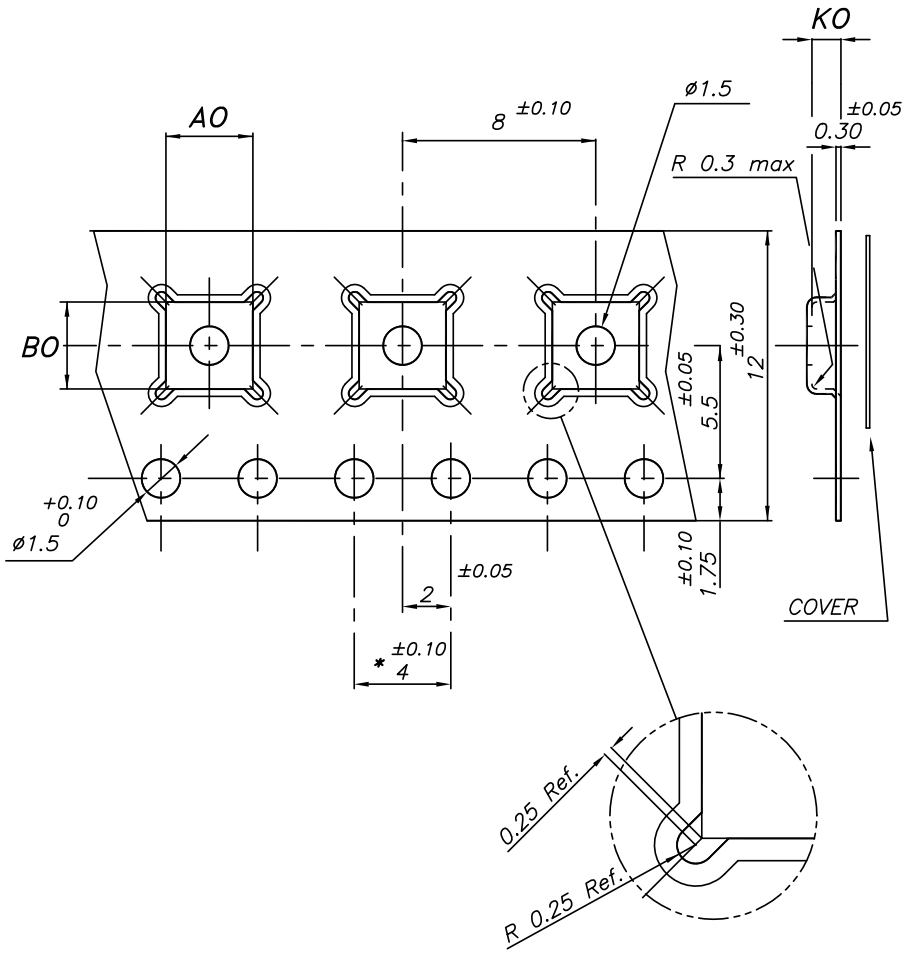
Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1
A1	0	0.02	0.05
A3		0.20	
b	0.23		0.45
D	2.90	3	3.10
D2	2.23		2.50
E	2.90	3	3.10
E2	1.50		1.75
e		0.95	
L	0.30	0.40	0.50

Figure 28. **DFN6 (3x3) recommended footprint**



8.3 DFN6 (3x3 mm) packing information

Figure 29. **DFN6 (3x3) tape outline**



– * 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.20

7875978_N

Figure 30. **DFN6 (3x3 mm) reel outline**

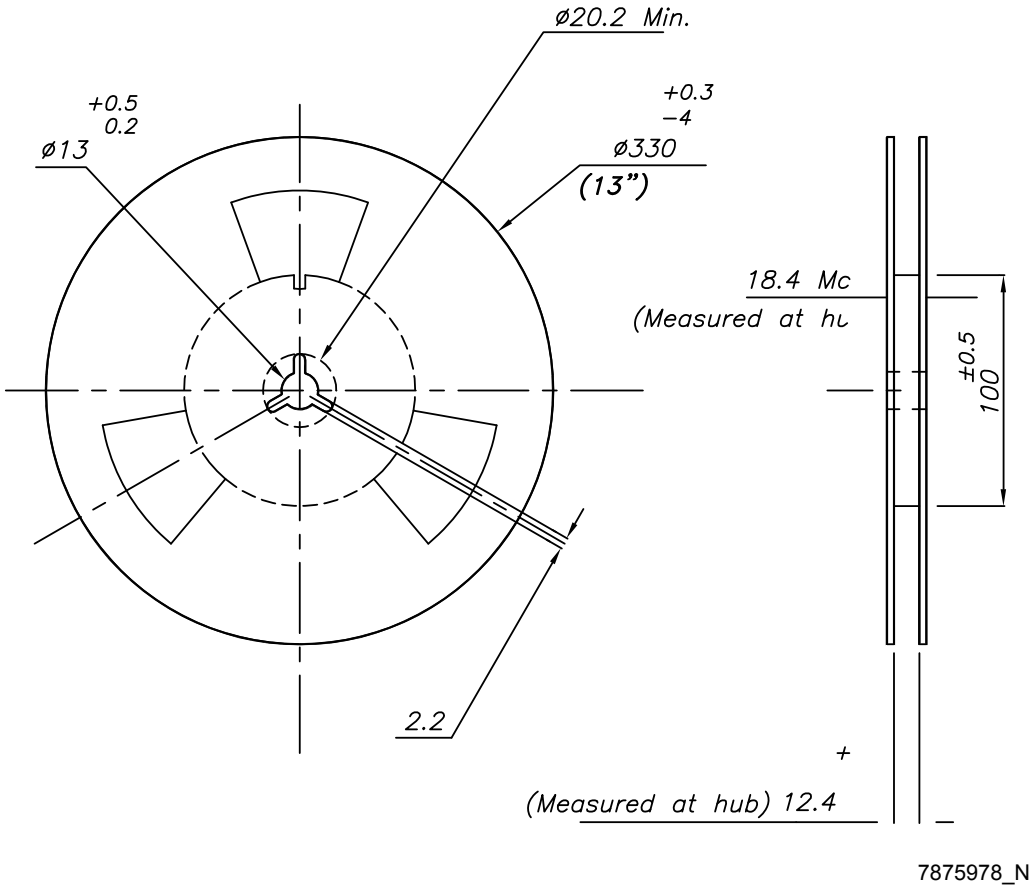


Table 8. **DFN6 (3x3) tape and reel mechanical data**

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

9 Ordering information

Table 9. **Order code**

DFN6 (2x2)	DFN6 (3x3)	Output voltage
LDFM33PVR	LDFM33PUR	3.3 V
LDFMPVR	LDFMPUR	ADJ from 0.8 V

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
28-Aug-2012	1	Initial release.
22-Nov-2013	2	Part numbers LDFM and LDFM50 have been unified under LDFM. Updated the Features and the Description in cover page. Cancelled *Table1: Device summary.* Updated *Section 2: Pin configuration, Section 3: Typical application, Section 4: Absolute maximum ratings, Section 5: Electrical characteristics* and *Section 8: Package information.* Added *Section 8.7: DFN6 (3 x 3 mm) packing information* and *Section 9: Order code.* Minor text changes.
15-Jun-2015	3	Updated *Table 5: Electrical characteristics for LDFM (fixed versions)* and *Table 6: Electrical characteristics for LDFM (adjustable version)*. Minor text changes.
05-Sep-2016	4	Updated *Section 9: "Ordering information"*. Minor text changes.
05-Jul-2017	5	Updated Section 9: "Ordering information". Minor text changes.
03-May-2021	6	Added unit ΔVOUT in Table 6. Updated Figure 6 and Figure 14.
22-Aug-2024	7	Updated Table 9, Updated Figure 2 Updated Figure in cover page

Contents

List of tables

List of figures

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.