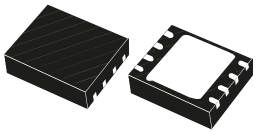
LDLN050

Datasheet

500 mA, high performance low dropout linear regulator



DFN8 (3 x 3 mm)
wettable flanks

Maturity status link
LDLN050

Features

- Input voltage range: 2.7 V to 6.5 V
- Very low output voltage noise: 13 μV_{RMS}/V_{OUT}
- Low quiescent current: 48 μA typical
- 500 mA guaranteed output current
- Fast start-up time: 50 μs
- High PSRR: 65 dB at 100 Hz
- AEC-Q100 grade 1 qualified
- -40 °C to 125 °C ambient operative temperature range
- Very low dropout: 190 mV at max. I_{OUT}
- Adjustable (from 1.25 V to 6 V) or fixed output voltage on request (from 1.0 V to 4.3 V)
- Stable with low ESR capacitor: min. 2 μF
- Current limit and thermal protections
- DFN8 (3 x 3 mm) wettable flank package

Applications

- Automotive Infotainment
- Low noise POL
- Automotive noise sensitive ECU
- Wireless communication
- Industrial applications

Description

The LDLN050 is a 500 mA LDO regulator, designed to be used in several environments. The LDLN050 has a very low-resistance pass element (PMOS) that is even very fast during the turn-on.

Thanks to its low-noise design, the LDLN050 can be used to supply noise sensitive circuits such as sensors, MCUs and wireless ICs in automotive and industrial applications.

The LDO low current consumption (typically 48 μA) is also used on battery-supplied applications.

On the adjustable version, the output voltage can be set to any desired value between 1.25 V and 6 V. Fixed voltage versions, between 1.0 V and 4.3 V (with 0.1 V step) can be provided upon request.

On the fixed voltage versions only, an external capacitor can be connected to C_{NR} pin to further reduce the noise on the regulated output voltage.

The LDLN050 is available in DFN8 (3 x 3 mm) with wettable flank package and it is automotive grade qualified according to AEC-Q100 level 1.

1 Diagram

Figure 1. **Block diagram, adjustable version**

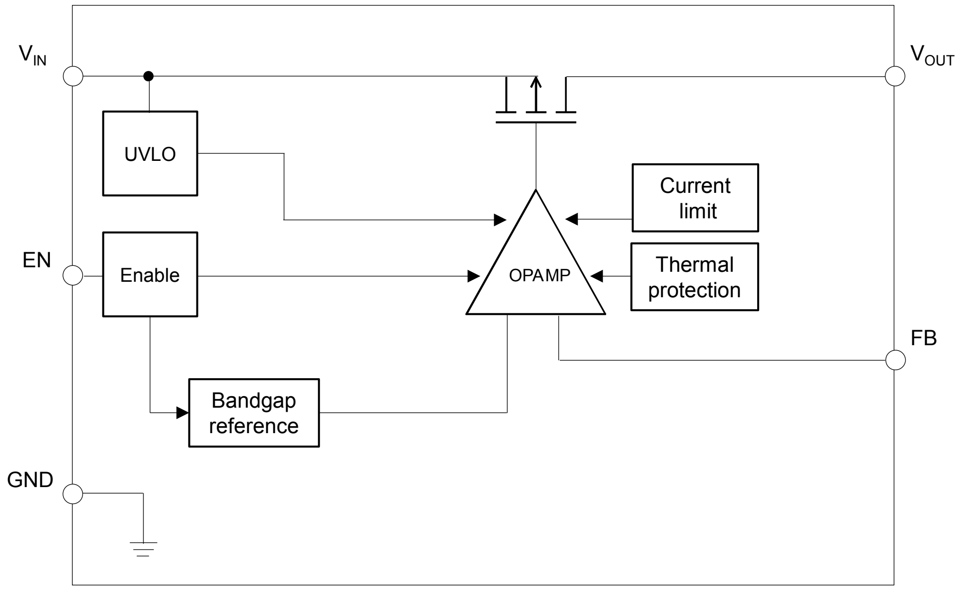
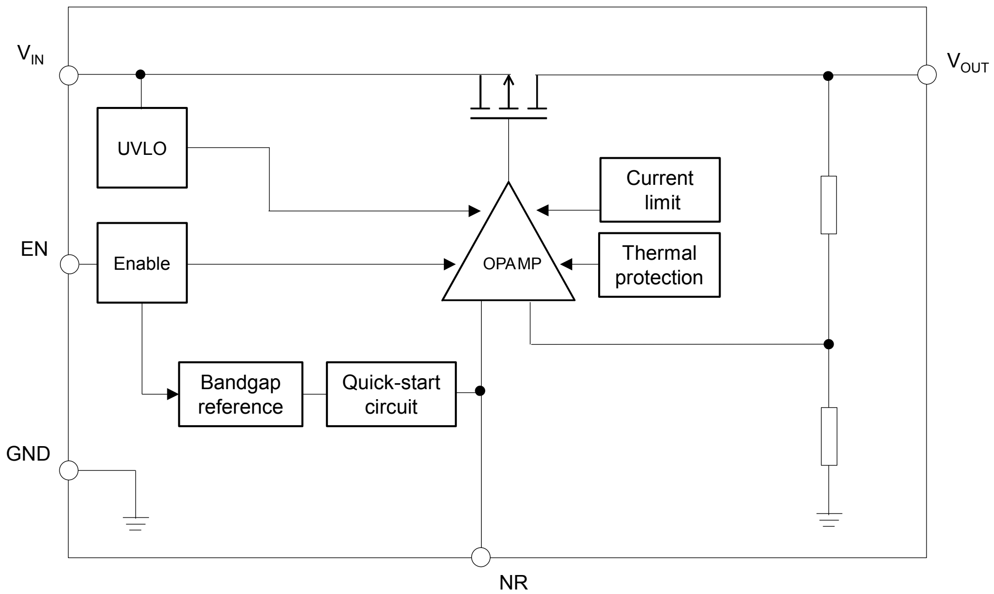


Figure 2. **Block diagram, fixed version**



2 Pin configuration

Figure 3. Pin connection, DFN8 – 3 x 3 (top view)

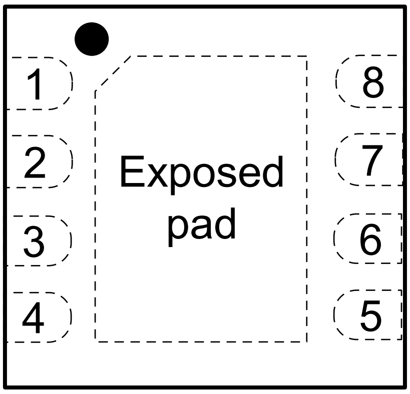


Table 1. Pin description

Pin	Symbol	Function
1	OUT	Output pin
2	N.C.	Not internally connected
3	FB (ADJ) NR (FIXED)	Feedback pin on adjustable version Noise reduction on fixed version
4	GND	Ground connection
5	EN	Enable pin logic input: Low=shutdown, High=active This pin is not internally pulled up. Don't leave floating.
6	N.C.	Not internally connected
7	N.C.	Not internally connected
8	IN	Input pin
Exp. Pad.	Exposed thermal Pad	Must be connected to GND

3 Typical application diagram

Figure 4. Typical application circuit for adjustable version

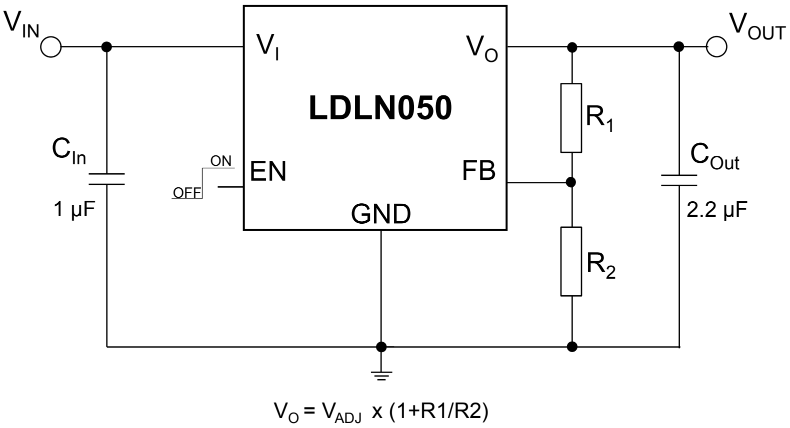
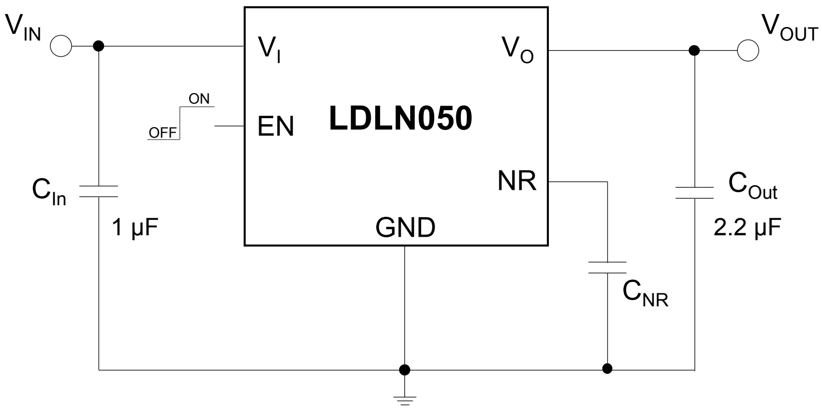


Figure 5. Typical application circuit for fixed output version



4 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	Input voltage pin	-0.3 to 7	V
V_{EN}	Enable pin	-0.3 to V_{IN} + 0.3	V
V_{OUT}	DC output voltage	-0.3 to V_{IN} + 0.3	V
V_{FB}	Feedback pin	-0.3 to 1.6	V
I_{OUT}	Output current	Internally limited	A
P_{DIS}	Maximum Power dissipation	Refer to Table 3. Thermal data	W
T_{ST}	Storage temperature range	-55 to 150	°C
T_j	Operating Junction temperature range	-40 to 150	°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	DFN8 3x3 mm	Unit
R_{thJA}	Thermal resistance junction-ambient	51	°C/W
Ψ_{J-T}	Thermal characterization parameter junction to top of package	2.4	°C/W

Note: JEDEC 2S2P (4L) board as per JESD 51-7 with two thermal vias.

Table 4. Electrostatic discharge

Symbol	Parameter	DFN8 3x3	Unit
HBM	Human Body Model	+/-2000	V
CDM	Charged Device Model	+/- 750	V

5 Electrical characteristics

If not differently specified, T_J = -40 °C to +125 °C, typical values refer to T_J = +25 °C, V_{IN} = V_{OUT} + 0.5 V or 2.7 V (whichever is greater), I_{OUT} = 1 mA, V_{EN} = V_{IN}, C_{OUT} = 2.2 µF, C_{NR} = 10 nF.

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage [1]		2.7		6.5	V
V_{ADJ}	Reference voltage for Adj	T_{AMB} = 25 °C	1.196	1.208	1.22	V
V_{OUT}	Output voltage range		V_{ADJ}		6	V
	Output voltage accuracy [1]	1 mA < I_{OUT} < 500 mA V_{OUT} + 0.5 V < V_{IN} < 6.5 V V_{OUT} > 2.2 V	-2		2	%
		1 mA < I_{OUT} < 500 mA V_{OUT} + 0.5 V < V_{IN} < 6.5 V V_{OUT} up to 2.2 V	-3		3	%
	Line regulation [1]	V_{OUT}+ 0.5 V < V_{IN} < 6.5 V		0.02		%/V
	Load Regulation	0.5 mA < I_{OUT} < 500 mA		0.005		%/mA
V_{DO}	Dropout Voltage [2]	I_{OUT} = 500 mA		190	500	mV
I_{LIM}	Output current limit	V_{OUT} = 0.9 x V_{OUTNOM}, V_{IN} = V_{OUTNOM} + 0.9 V, V_{IN} > 2.7 V	800			mA
I_{GND}	Ground pin current	I_{OUT} = 10 mA		48	65	µA
		I_{OUT} = 500 mA		70	120	
I_{SHDN}	Shutdown current	V_{EN} = 0 V			1	µA
I_{FB}	Feedback pin current (Adj)	V_{OUTNOM} = 1.2 V	-0.5		0.5	µA
P_{SRR}	Power supply rejection ration	V_{IN} = 4.3 V; F = 100 Hz		65		dB
		V_{OUT} = 3.3 V; F = 1 KHz		47		
		C_{NR} = 10 nF; F = 10 KHz		45		dB
		I_{OUT} = 100 mA; F = 100 KHz		38		
V_{NOISE}	Output noise	BW = 10 Hz to 100 KHz, V_{OUT} = 2.8 V, C_{NR} = 10 nF		13xV_{OUT}		$µV_{RMS}$
		BW = 10 Hz to 100 KHz, V_{OUT} = 2.8 V, no CNR		25xV_{OUT}		$µV_{RMS}$
T_{STR}	Start-up time V_{OUT} = 10% to 90%	Without CNR		45		µsec
		CNR = 1 nF		45		
		CNR = 10 nF		50		
		CNR = 47 nF		50		
V_{EN} (H)	Enable input logic level High		1.2			V
V_{EN} (L)	Enable input logic level Low				0.4	V

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{EN}	Enable pin current (EN = H)	$V_{EN} = V_{IN} = 6.5$ V		0.03	1	µA
UVLO	Undervoltage lockout	V_{IN} rising	1.9	2.2	2.65	V
V_{HYS}	UVLO Hysteresis	V_{IN} falling		0.07		V
T_{op}	Operating ambient temperature range		-40		125	°C
T_{SD}	Thermal shutdown temperature	High temp threshold		165		°C
		Thermal hysteresis		20		

1. *Minimum $V_{IN} = V_{OUT} + V_{DO}$ or 2.7 V, whichever is greater.*
2. *Input voltage = V_{OUTNOM} - 100 mV. This specification does not apply to V_{OUTNOM} < 2.8 V.*

6 Typical characteristics

C_{IN} = 1 µF, C_{OUT} = 2.2 µF, V_{EN} = V_{IN} = 3.8 V, V_{OUT} = 3.3 V, T_j = 25 °C unless otherwise specified.

Figure 6. Output voltage vs. temperature (I_{OUT} = 1 mA)

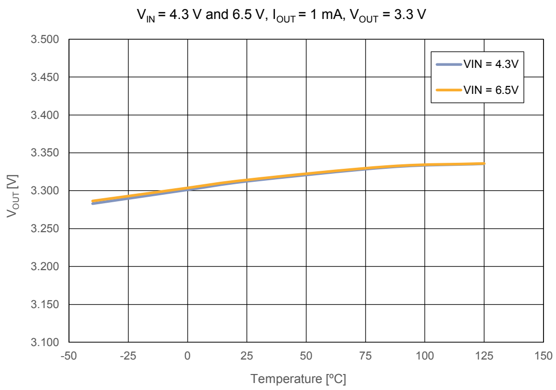


Figure 7. Output voltage vs. temperature (I_{OUT} = 500 mA)

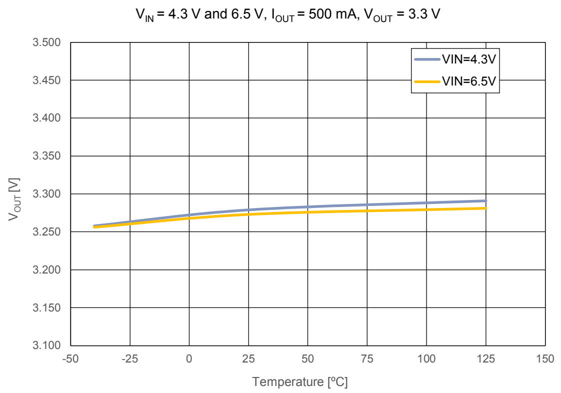


Figure 8. Line regulation vs. temperature

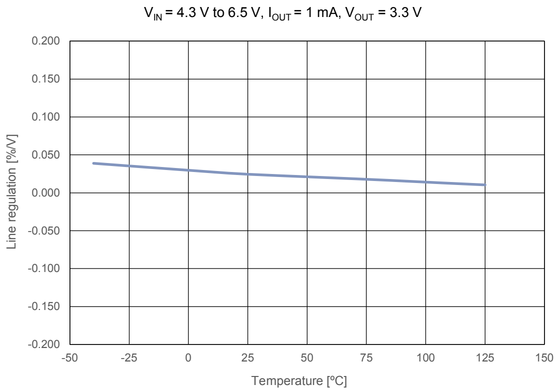


Figure 9. Load regulation vs. temperature

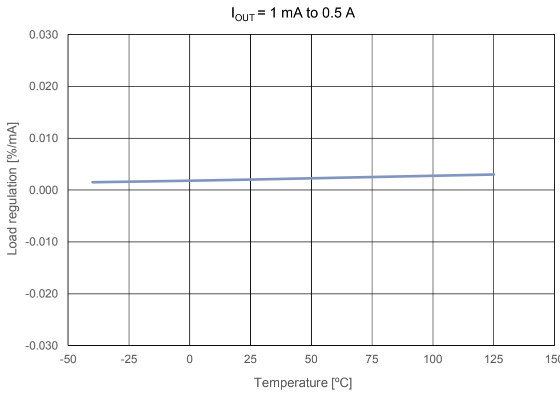


Figure 10. Quiescent current vs. temperature

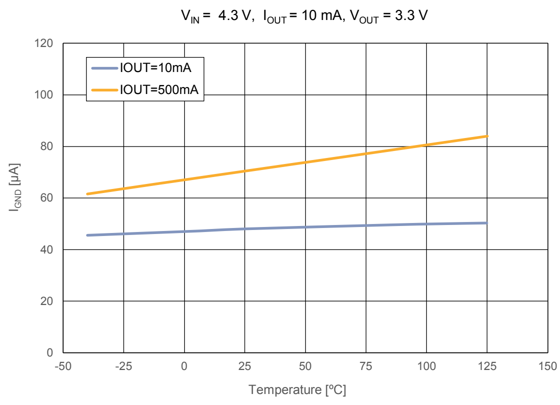


Figure 11. Quiescent current vs. load current

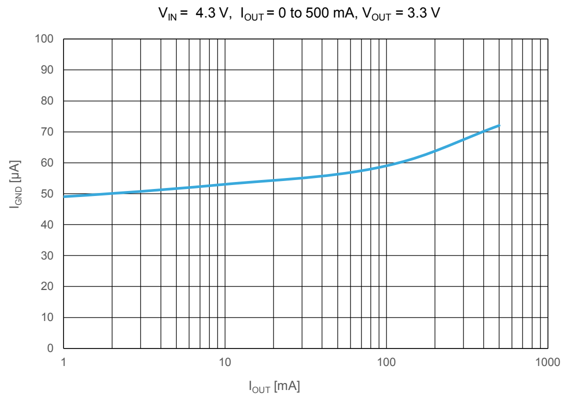


Figure 12. Supply current vs. input voltage

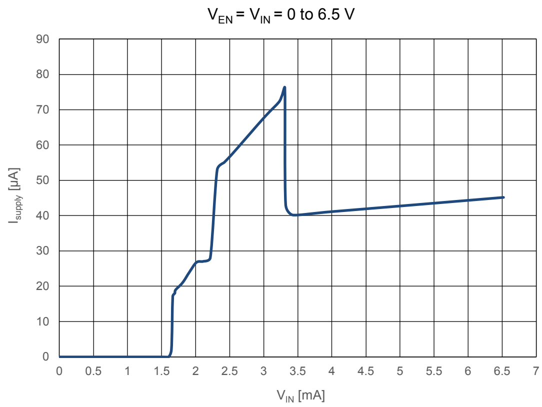


Figure 13. Off-state current vs. temperature

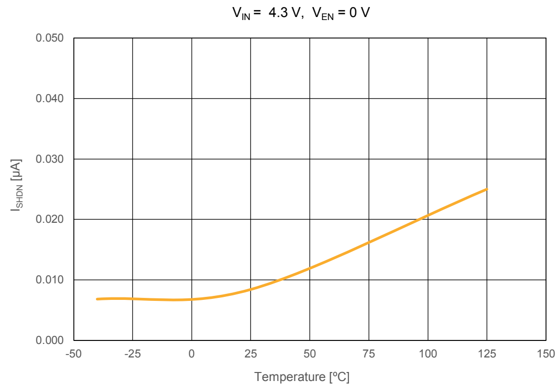


Figure 14. Dropout voltage vs. temperature

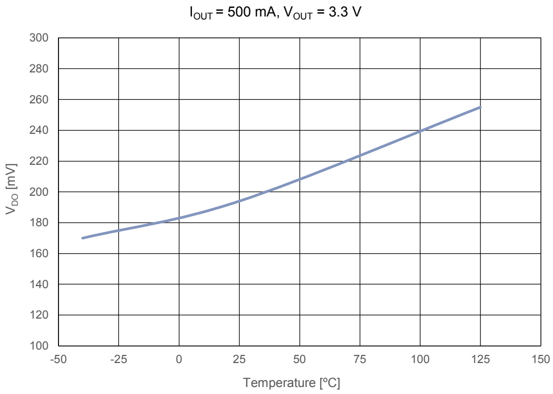


Figure 15. Dropout voltage vs. load current

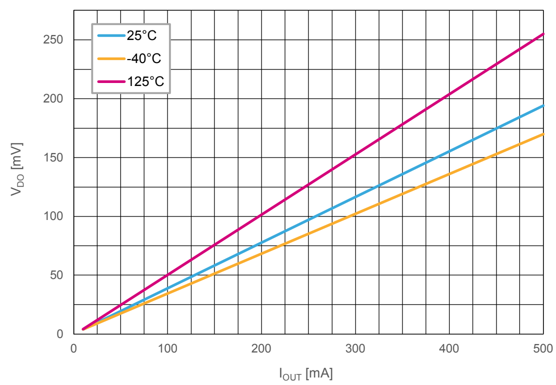


Figure 16. Short circuit current vs. temperature

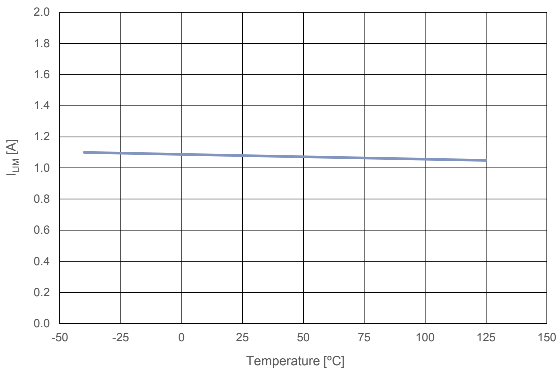


Figure 17. Enable thresholds vs. temperature

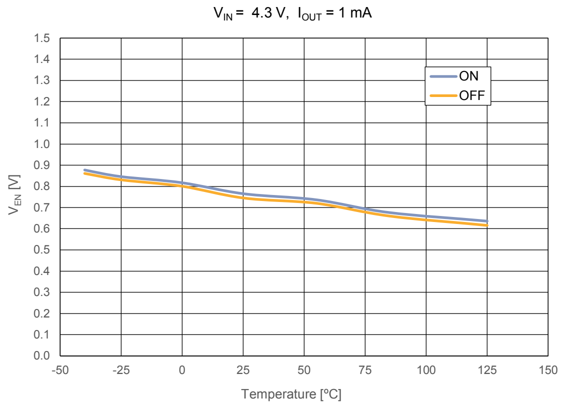


Figure 18. UVLO thresholds vs. temperature

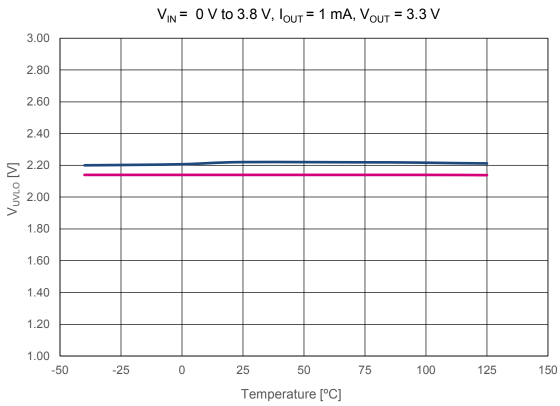


Figure 19. Enable pin current vs. temperature

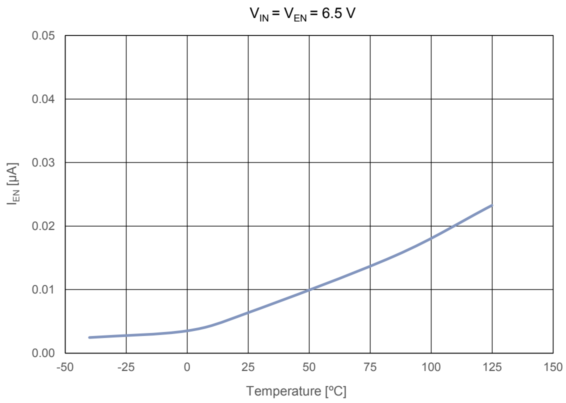


Figure 20. PSRR vs. Frequency (no C_{NR})

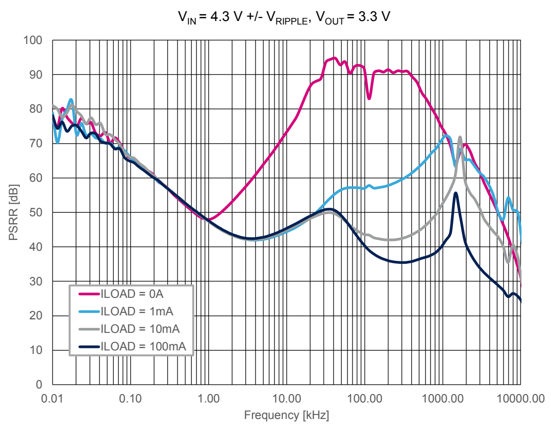


Figure 21. PSRR vs. frequency (C_{NR} = 10 nF)

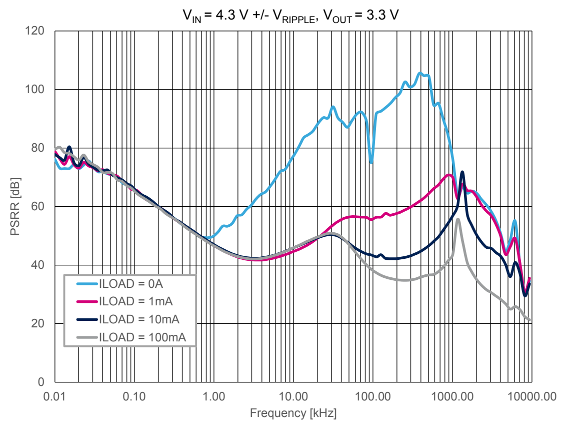


Figure 22. **Output noise spectrum (C_{NR} = 10 nF)**

$V_{EN} = V_{IN} = 4.3$ V, $V_{OUT} = 3.3$ V, $C_{NR} = 10$ nF, $C_{OUT} = 2.2$ µF

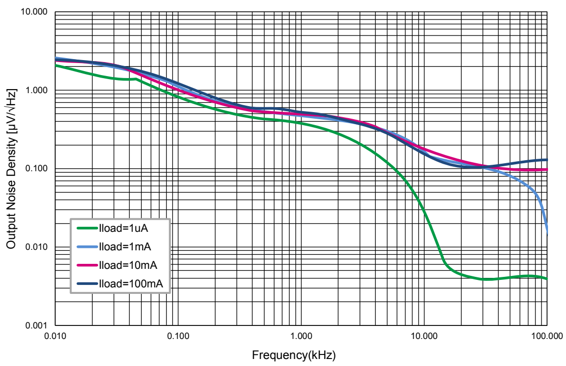


Figure 23. **Output noise spectrum vs. C_{NR}**

$V_{EN} = V_{IN} = 4.3$ V, $V_{OUT} = 3.3$ V, $I_{OUT} = 100$ mA, $C_{OUT} = 2.2$ µF

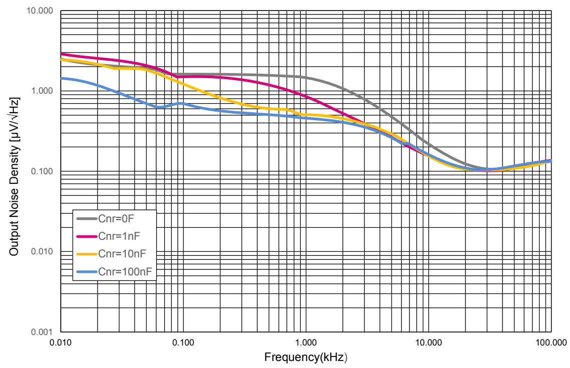


Figure 24. **Line transient**

V_{IN} from 3.8 V to 4.8 V, $I_{OUT} = 1$mA, T = 25°C, $C_{IN} = 500$ nF, $C_{OUT} = 2.2$ µF, $C_{NR} = 10$ nF

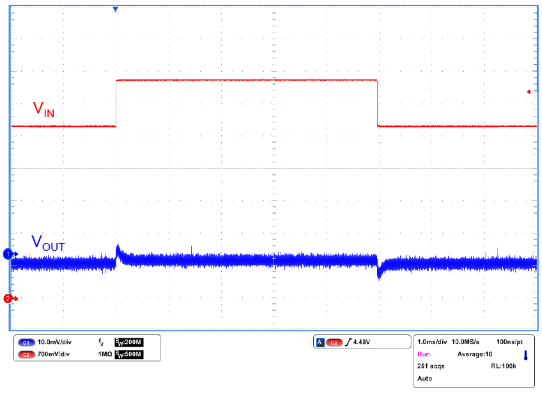


Figure 25. **Load transient**

I_{OUT} = from 1 mA to 500 mA, $C_{IN} = 500$ nF, $C_{OUT} = 2.2$ µF, $C_{NR} = 10$ nF, $t_r = 5$ µs

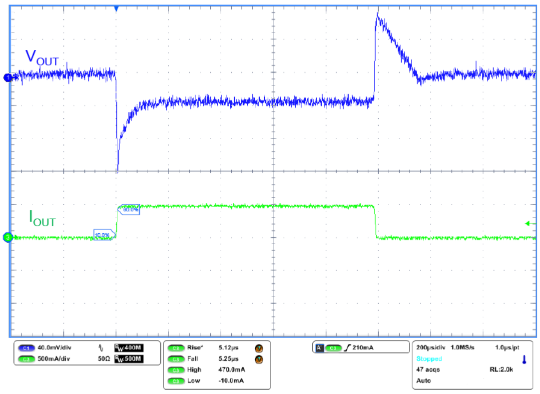


Figure 26. **Startup transient**

$V_{IN} = V_{EN}$ = from 0 V to 5.5 V and back, $I_{OUT} = 1$ mA , $t_{RISE} = 500$ µs, $C_{NR} = 10$ nF, $V_{OUT} = 3.3$ V

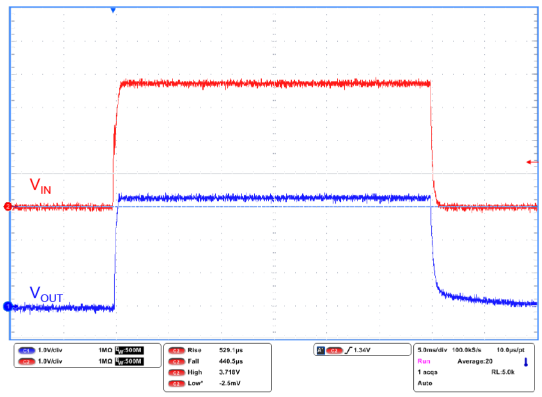


Figure 27. **Enable startup (C_{NR} = 1 nF)**

V_{EN} = 0 to 3.8 V, $I_{OUT} = 1$ mA, $C_{IN} = 500$ nF ,$C_{OUT} = 2.2$ µF, $C_{NR} = 1$ nF, $t_r = 1$ µs,$V_{OUT} = 3.3$ V

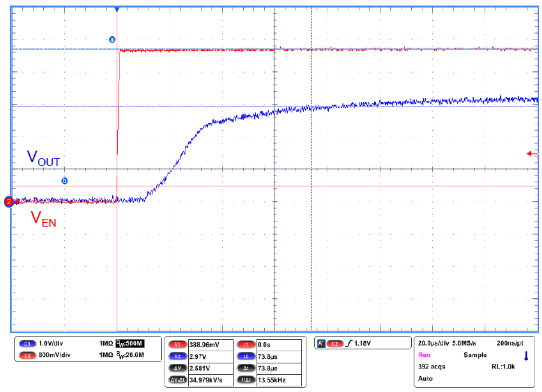


Figure 28. Enable startup (C_{NR} = 2.2 nF)

V_{EN} = 0 to 3.8 V, I_{OUT} = 1 mA, C_{IN} = 500 nF ,C_{OUT} = 2.2 µF, C_{NR} = 2.2 nF, t_r = 1 µs, V_{OUT} = 3.3 V

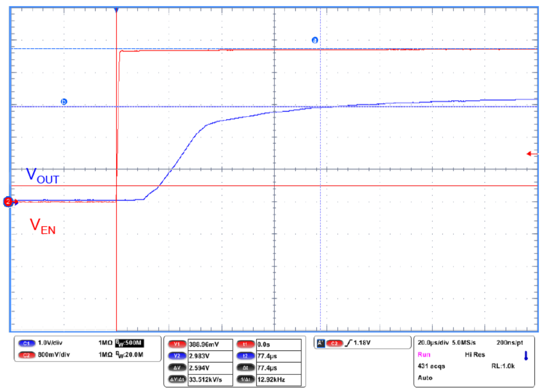


Figure 29. Enable startup (C_{NR} = 10 nF)

V_{EN} = 0 to 3.8 V, I_{OUT} = 1 mA, C_{IN} = 500 nF, C_{OUT} = 2.2 µF, C_{NR} = 10 nF, t_r = 1 µs, V_{OUT} = 3.3 V

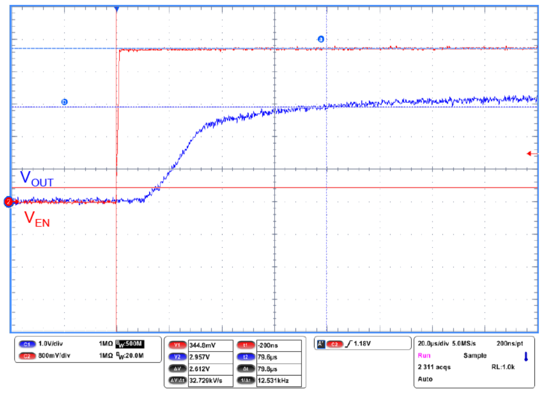


Figure 30. Enable startup (C_{NR} = 47 nF)

V_{EN} = 0 to 3.8 V, I_{OUT} = 1 mA, C_{IN} = 500 nF, C_{OUT} = 2.2 µF, C_{NR} = 47 nF, t_r = 1 µs, V_{OUT} = 3.3 V

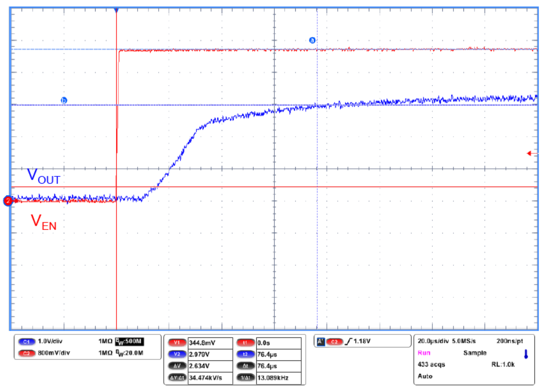
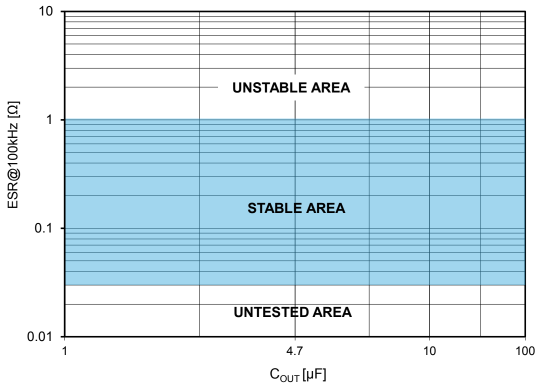


Figure 31. Tested stability area

V_{EN} = V_{IN} = from 3.8 V to 6.5 V, I_{OUT} = from 0 mA to 0.5 A, T = 25 °C, C_{IN} = 500 nF, C_{NR} = 10 nF, V_{OUT} = 3.3 V

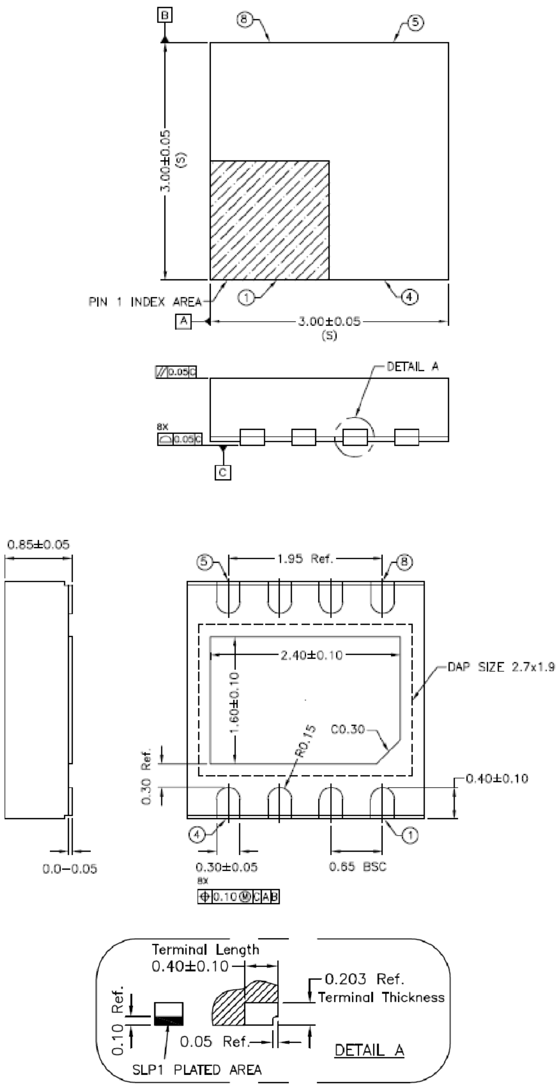


7 Package information

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 DFN8 3 x 3 package information

Figure 32. DFN8 3x3 package drawing outline



7.2 DFN8 (3 x 3 mm) packing information

Figure 33. DFN8-3x3 tape outline

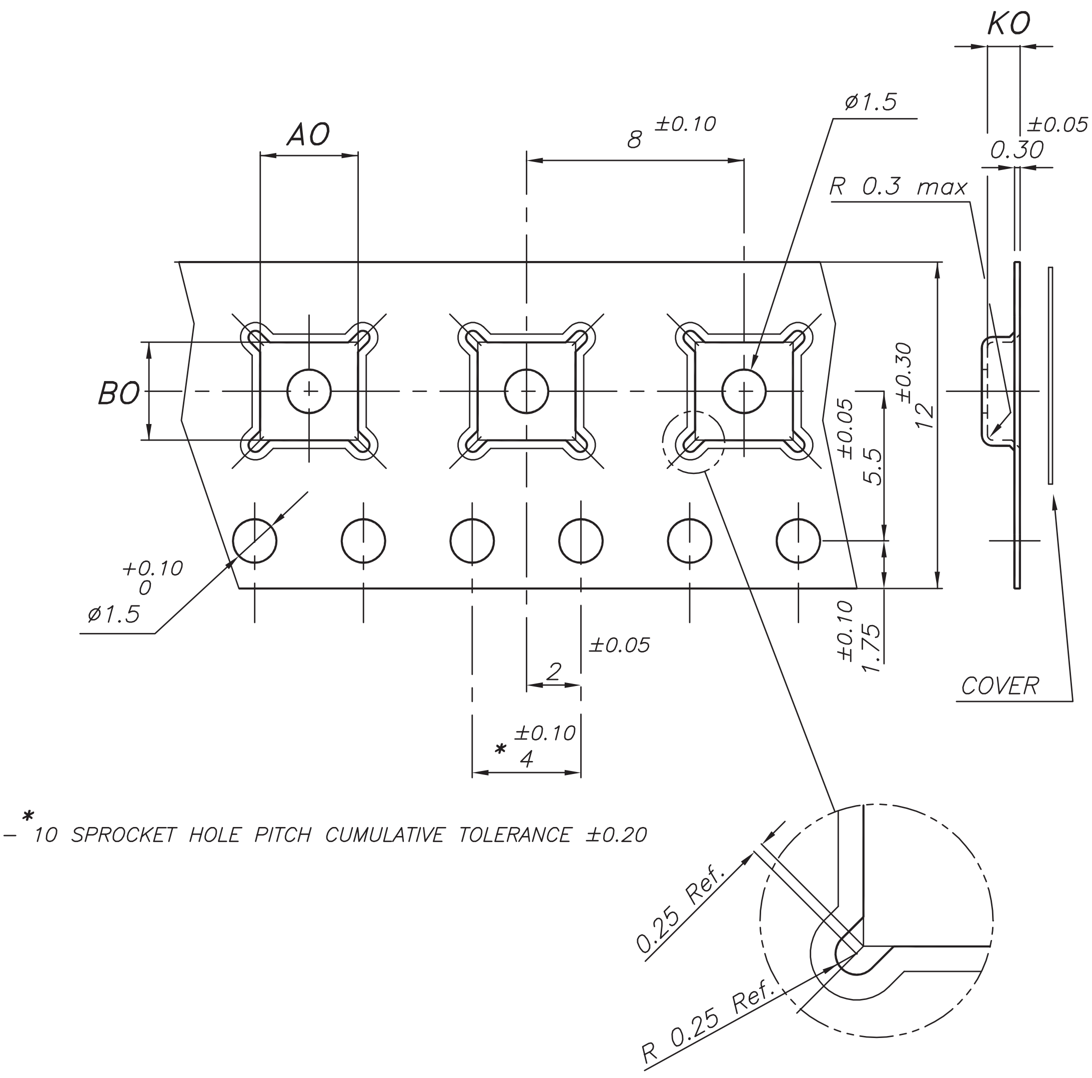
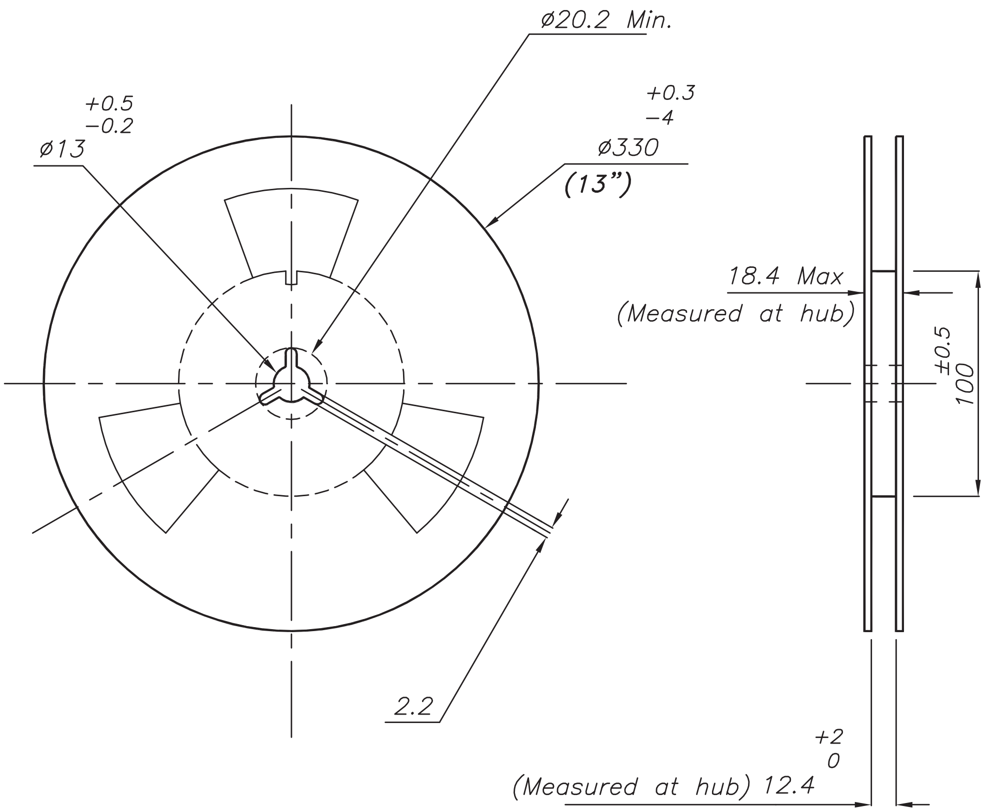


Table 6. DFN8-3x3 tape mechanical data

Dim.	mm
	Value
Ao	3.30 ±0.10
Bo	3.30 ±0.10
Ko	1.10 ±0.10

Figure 34. DFN8-3x3 reel outline



8 Ordering information

Table 7. Order code

Order codes	DFN8 3x3		
	Marking	Grade	Output voltage
LDLN050PU33RY	LN33	Automotive	3.3 V

Revision history

Table 8. Document revision history

Date	Revision	Changes
10-Jan-2019	1	Initial release.

Contents

List of tables

List of figures

IMPORTANT NOTICE – PLEASE READ CAREFULLY