LD39030

Datasheet

300 mA very low dropout linear regulator IC

DFN4 1x1

Maturity status link
LD39030

Features

- Input voltage from 1.5 to 5.5 V
- Ultra low dropout voltage (300 mV typ. at 300 mA load)
- Very low quiescent current (20 µA typ. at no load, 0.03 µA typ. in off mode)
- Output voltage tolerance: ± 0.5 % (A version) or ± 2.0 % @ 25 °C (standard version)
- 300 mA guaranteed output current
- High PSRR (80 dB@1 kHz, 50 db@100 kHz)
- Wide range of output voltages available on request: from 0.8 V up to 5.0 V in 50 mV step
- Logic-controlled electronic shutdown
- Internal soft-start
- Optional output voltage discharge feature
- Compatible with ceramic capacitor C_{OUT} = 0.47 µF
- Internal constant current and thermal protections
- Available in DFN4 1x1
- Operating temperature range: -40 °C to 125 °C

Applications

- Mobile phones
- Tablets
- Digital still cameras (DSC)
- Cordless phones and similar battery-powered systems
- Portable media players

Description

The LD39030 high accuracy voltage regulator provides 300 mA of maximum current from an input voltage ranging from 1.5 V to 5.5 V, with a typical dropout voltage of 300 mV.

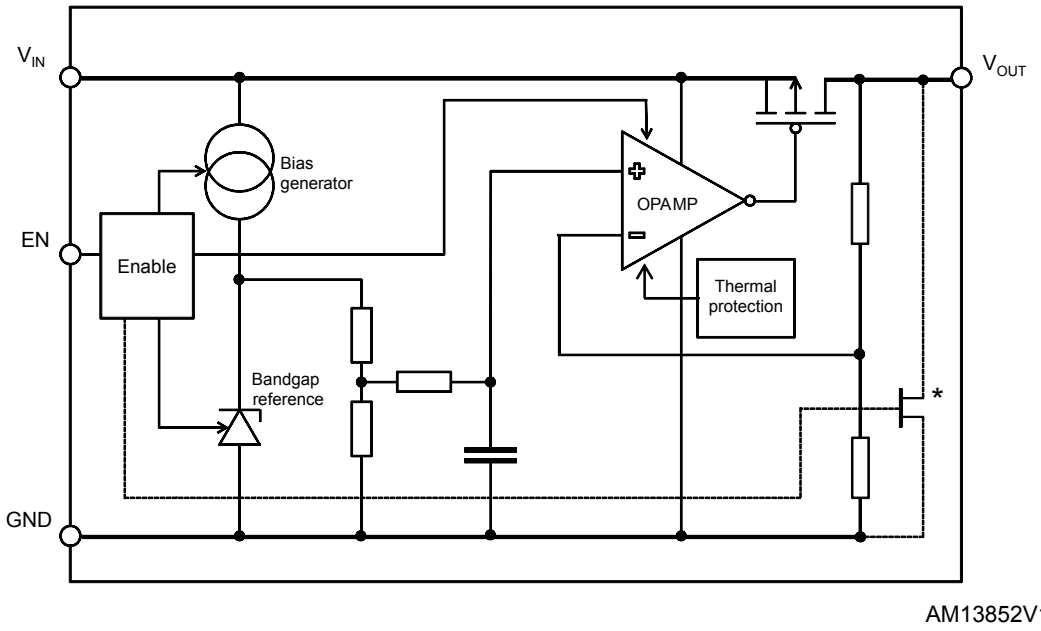
It is available in DFN4 1 x 1 package, allowing the maximum space saving.

The device is stabilized with a ceramic capacitor on the output. The ultra low drop voltage, low quiescent current and low noise features, together with the internal soft-start circuit, make the LD39030 suitable for low power battery-operated applications.

An enable logic control function puts the LD39030 in shutdown mode allowing a total current consumption lower than 0.1 µA. Constant current and thermal protection are provided.

1 Diagram

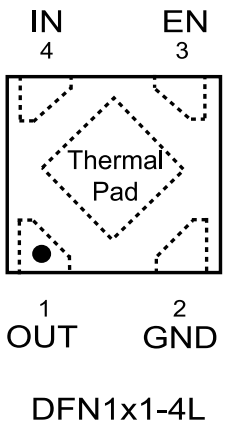
Figure 2. **Block diagram**



Note: The output discharge MOSFET is optional.

2 Pin configuration

Figure 3. **Pin connection (top view)**



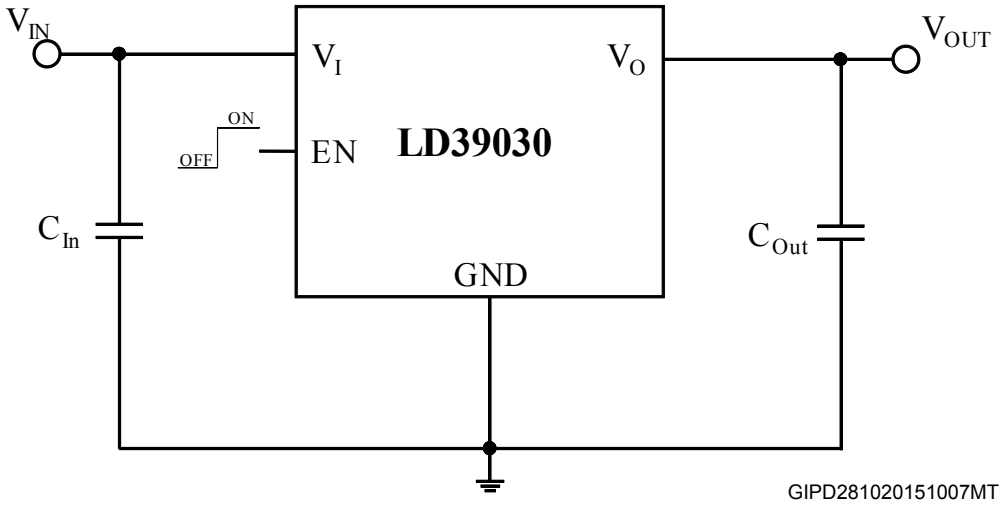
DFN1x1-4L

Table 1. **Pin description**

Pin n° DFN4 1x1	Symbol	Function
1	OUT	Output voltage
2	GND	Common ground
3	EN	Enable pin logic input: Low = shutdown, High = active
4	IN	Input voltage
Thermal pad	GND	Connect to GND on the PCB

3 Typical application

Figure 4. **Typical application circuits**



4 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	Input voltage	- 0.3 to 7	V
V_{OUT}	Output voltage	- 0.3 to V_{IN} + 0.3	V
V_{EN}	Enable input voltage	- 0.3 to 7	V
I_{OUT}	Output current	Internally limited	mA
P_D	Power dissipation	Internally limited	mW
T_{STG}	Storage temperature range	- 40 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
R_{thJA}	Thermal resistance junction-ambient	250	°C/W

Table 4. ESD Performance

Symbol	Parameter	Test conditions	Value	Unit
ESD	ESD Protection voltage	HBM	4	kV
		MM	400	V
		CDM	500	V

5 Electrical characteristics

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

Table 5. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		1.5		5.5	V
V_{OUT}	V_{OUT} accuracy (LD39030)	I_{OUT} = 1 mA, T_J = 25 °C	-2		2	%
		I_{OUT} = 1 mA, -40 °C < T_J < 125 °C	-3		3	%
V_{OUT}	V_{OUT} accuracy (LD39030A)	I_{OUT} = 1 mA, T_J = 25 °C	-0.5		0.5	%
		I_{OUT} = 1 mA, -40 °C < T_J < 125 °C	-1.5		1.5	%
ΔV_{OUT}	Static line regulation (1)	$V_{OUT(NOM)}$ + 1 V ≤ V_{IN} ≤ 5.5 V, I_{OUT} = 10 mA		0.02		%/V
		-40 °C < T_J < 125 °C			0.2	
ΔV_{OUT}	Static load regulation	I_{OUT} = 0 mA to 300 mA		18		mV
		-40 °C < T_J < 125 °C			0.01	%/mA
V_{DROP}	Dropout voltage	I_{OUT} = 30 mA,V_{OUT} = 2.8 V		35		mV
		I_{OUT} = 300 mA, V_{OUT} = 2.8 V -40 °C < T_J < 125 °C		330		
e_N	Output noise voltage	10 Hz to 100 kHz, I_{OUT} = 10 mA		45		µVRMS/V
SVR	Supply voltage rejection	V_{IN} = $V_{OUT(NOM)}$+ 1 V +/- V_{RIPPLE} V_{RIPPLE} = 0.2 V Freq .=1 kHz I_{OUT} = 30 mA		80		dB
		V_{IN} = $V_{OUT(NOM)}$+ 1 V +/- V_{RIPPLE} V_{RIPPLE} = 0.2 V Freq. = 100 kHz I_{OUT} = 30 mA		55		
I_Q	Quiescent current	I_{OUT} = 0 mA		20	40	µA
		I_{OUT} = 300 mA		130		
$I_{Standby}$	Standby Current	V_{IN} input current in OFF MODE: V_{EN} = GND		0.03	1	µA
I_{SC}	Short circuit current	R_L = 0		480		mA
R_{ON}	Output voltage discharge MOSFET	(only on LD39030DT, LD39030ADT)		100		Ω

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{EN}	Enable input logic low	V_{IN} = 1.5 V to 5.5 V -40 °C < T_J < 125 °C			0.4	V
	Enable input logic high	V_{IN} = 1.5 V to 5.5 V -40 °C < T_J < 125 °C	1			
I_{EN}	Enable pin input current	V_{EN} = V_{IN}			100	nA
T_{ON} (2)	Turn on time			100		µs
T_{SHDN}	Thermal shutdown			160		°C
	Hysteresis			20		
C_{OUT}	Output capacitor	Capacitance (see)Figure 18. Stability area vs. (C_{OUT}, ESR)	0.47		22	µF

1. *Not applicable for $V_{OUT(NOM)}$ > 4.5 V*
2. *Turn-on time is time measured between the enable input just exceeding VEN high value and the output voltage just reaching 95 % of its nominal value*

6 Application information

6.1 Soft start function

The LD39030 has an internal soft start circuit. By increasing the startup time up to 100µs, without the need of any external soft start capacitor, this feature is able to keep the regulator inrush current at startup under control.

6.2 Output discharge function

The LD39030 integrates a MOSFET connected between Vout and GND. This transistor is activated when the EN pin goes to low logic level and has the function to quickly discharge the output capacitor when the device is disabled by the user.

The device is available with or without auto-discharge feature.

See Section 9 Ordering information for more details.

6.3 Input and output capacitors

The LD39030 requires external capacitors to assure the regulator control loop stability.

Any good quality ceramic capacitor can be used but, the X5R and the X7R are suggested since they guarantee a very stable combination of capacitance and ESR overtemperature.

Locating the input/output capacitors as closer as possible to the relative pins is recommended.

The LD39030 requires an input capacitor with a minimum value of 1 µF.

This capacitor must be located as closer as possible to the input pin of the device and returned to a clean analog ground.

The control loop of the LD39030 is designed to work with an output ceramic capacitor.

This capacitor must meet the requirements of minimum capacitance and equivalent series resistance (ESR), as shown in Figure 18. Stability area vs. (C_{OUT}, ESR). To assure stability, the output capacitor must maintain its ESR and capacitance in the stable region, over the full operating temperature range.

The LD39030 shows stability with a minimum effective output capacitance of 220 nF.

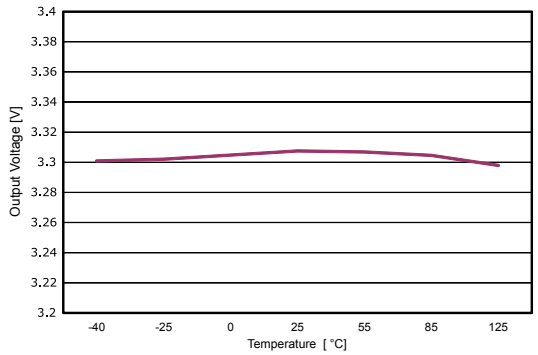
However, to keep stability in all operating conditions (temperature, input voltage and load variations), a minimum output capacitor of 0.47 µF is recommended.

The suggested combination of 1 µF input and output capacitors offers a good compromise among the stability of the regulator, optimum transient response and total PCB area occupation.

7 Typical characteristics

(C_{IN} = C_{OUT} = 1 µF, V_{EN} to V_{IN}, T_J = 25°C unless otherwise specified)

Figure 5. Output voltage vs. temperature (I_{OUT} = 1 mA)



V_{IN} = 4.3 V, I_{OUT} = 1 mA

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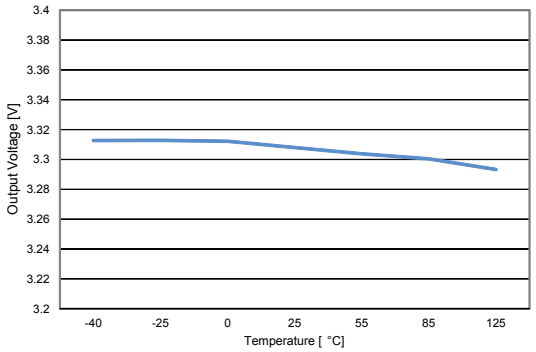
Figure 6. Output voltage vs. temperature (I_{OUT} = 200 mA)



V_{IN}=4.3V, I_{OUT}=200mA

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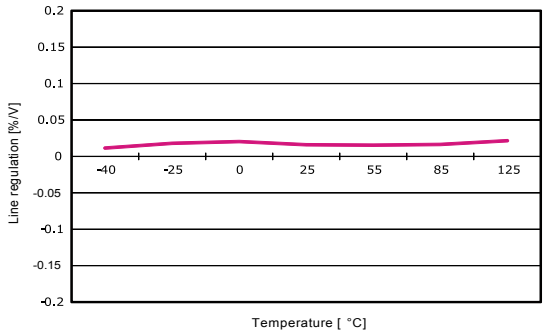
Figure 7. Line regulation vs. temperature



V_{IN} = 4.3 V to 5.5 V, I_{OUT} = 10 mA

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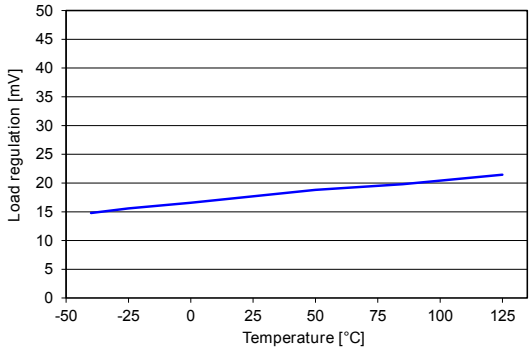
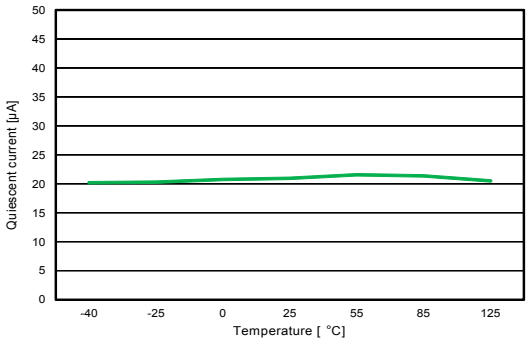
Figure 8. Load regulation vs. temperature



V_{IN} = 2.8 V, V_{OUT} = 1.8 V I_O = 0.3 A

GIPD281020151129MT

Figure 9. Quiescent current vs. temperature (I_{OUT} = 0 mA)



V_{IN} = 4.3 V, I_{OUT} = 0 mA

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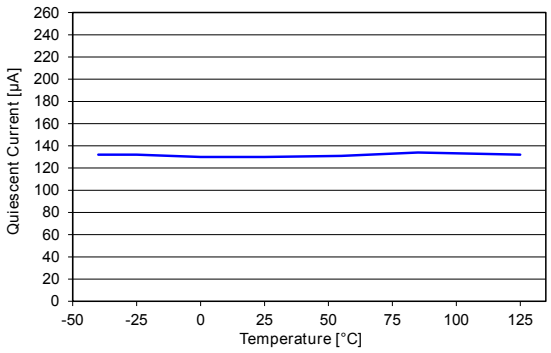
Figure 10. Quiescent current vs. temperature (I_{OUT} = 200 mA)



V_{IN} = 2.8 V, V_{OUT}=1.8 V I_O = 0.3 A

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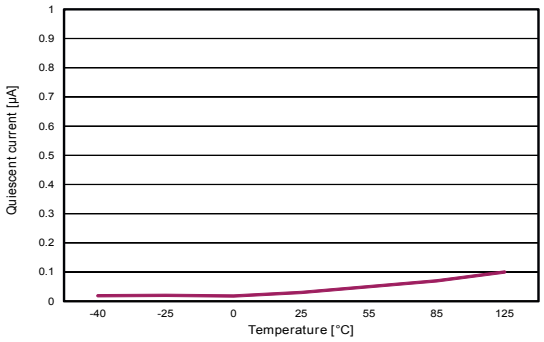
Figure 11. Shutdown current vs. temperature



V_{IN} = V, V_{EN} = GND

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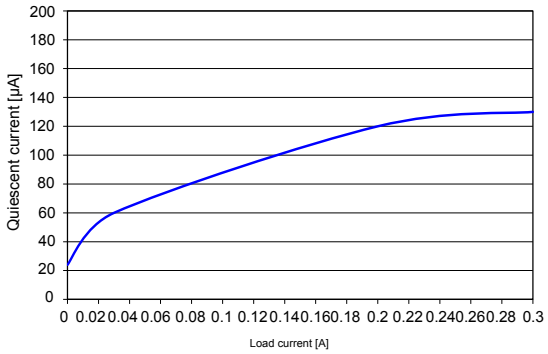
Figure 12. Quiescent current vs. load current



V_{IN} = 2.8 V, V_{OUT} = 1.8 V I_O = 0 to 0.3 A

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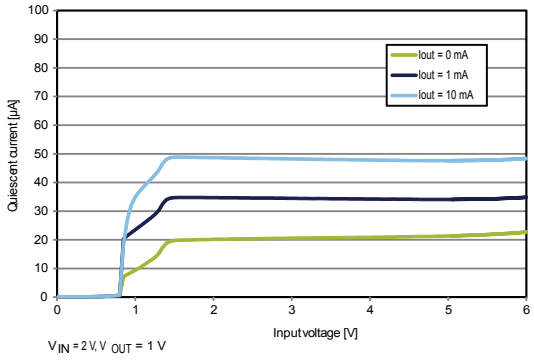
Figure 13. Quiescent current vs. input voltage



V_{IN} = 2 V, V_{OUT} = 1 V

AM13863V1

Figure 14. Dropout voltage vs. temperature

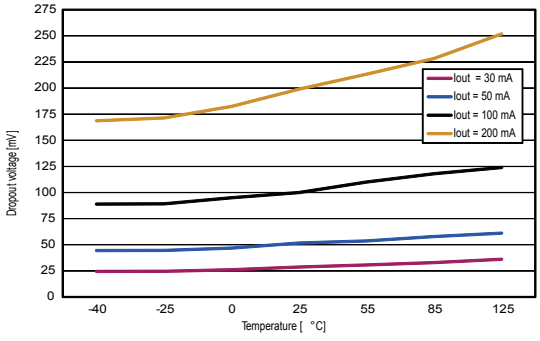


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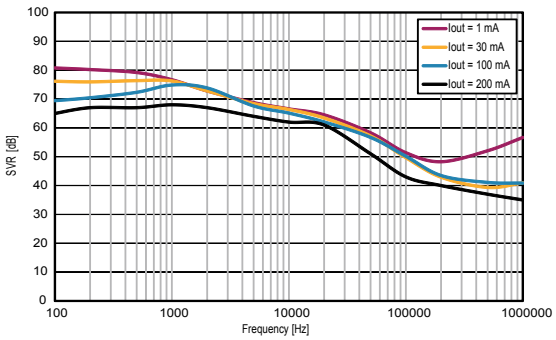
Figure 15. Supply voltage rejection vs. frequency



V_{IN} 2 V +/ - 200 m V, V_{OUT} = 1 V, C $_{OUT}$ = 1 µF

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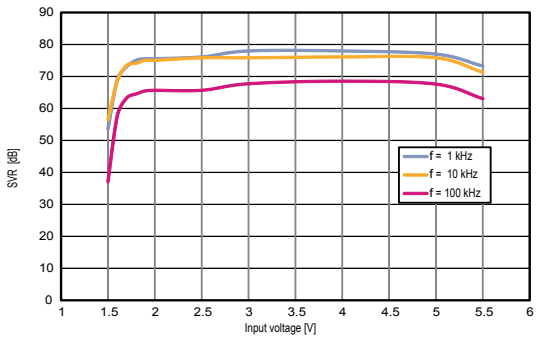
Figure 16. Supply voltage rejection vs. input voltage



I_{OUT} = 30mA , V_{OUT} = 1 V, C_{OUT} = 1 µF

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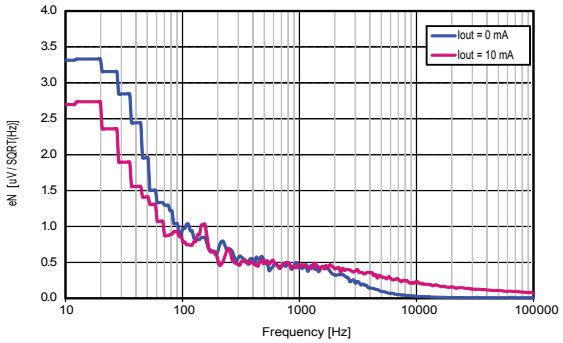
Figure 17. Output noise spectral density



V_{IN} = 2.0 V, V_{OUT} =1.0 V, C_{IN} = C_{OUT} = 1 µF

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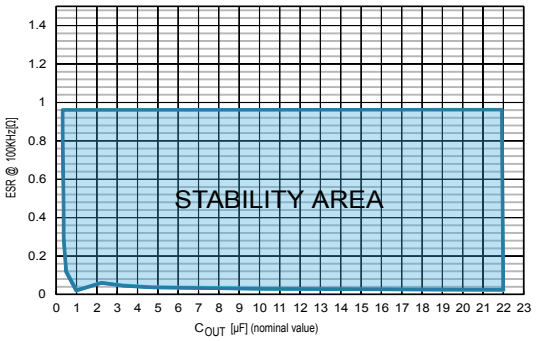
Figure 18. Stability area vs. (C_{OUT}, ESR)



V_{IN} from 2 to 5.5 V, I_{OUT} from 0 to 300 mA, C_{IN} = 1 µF

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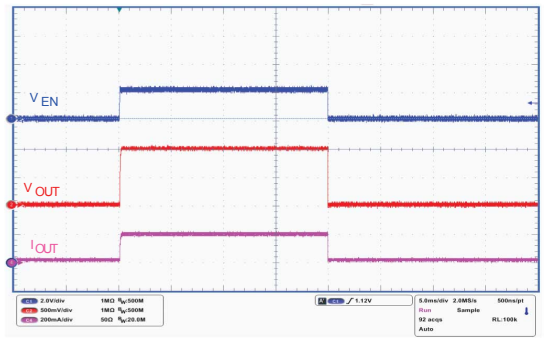
Figure 19. Enable startup (V_{OUT} = 1 V)



V_{IN} = 2 V , V_{EN} = 0 V to V_{IN}, I_{OUT} = 0.2 A , V_{OUT} =1 V, T_r = 5 µs

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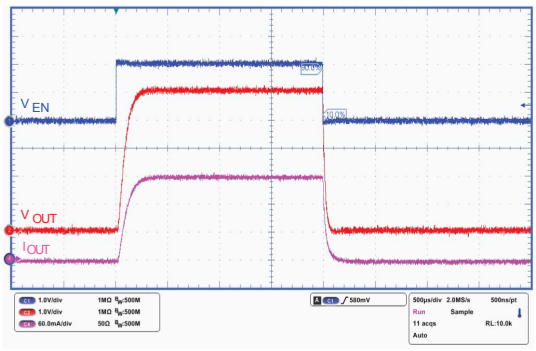
Figure 20. Enable startup (V_{OUT} = 5 V)



V_{IN} = 5.5 V ,V_{EN} = 0 V to 2 V, I $_{OUT}$ = 0.2A , V_{OUT} = 5 V, T_r = 5 µs

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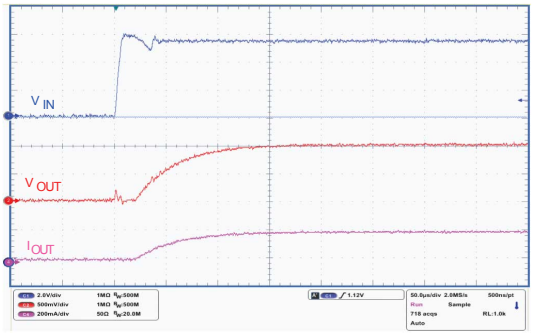
Figure 21. Turn-on time (V_{OUT} = 1 V)



$V_{IN} = V_{EN}$ = from 0 V to 5.5 V, I_{OUT} = 0.2 A, V_{OUT} = 1 V, T_r = 5 µs

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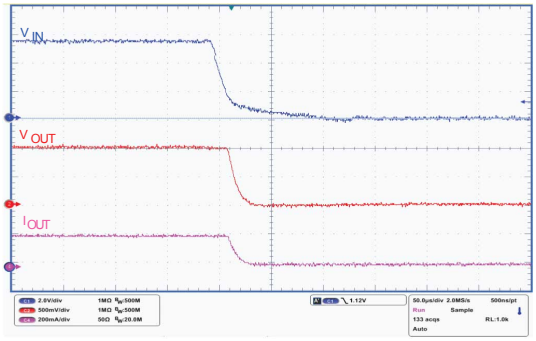
Figure 22. Turn-off time (V_{OUT} = 1 V)



$V_{IN} = V_{EN}$ = from 5.5 V to 0 V, I_{OUT} = 0.2 A, V_{OUT} = 1 V, T_f = 5 µs

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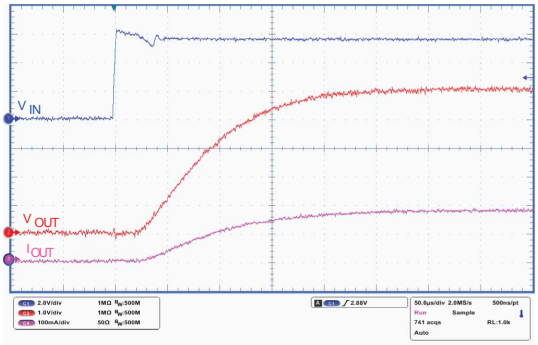
Figure 23. Turn-on time (V_{OUT} = 5 V)



$V_{IN} = V_{EN}$ = from 0 V to 5.5 V, I_{OUT} = 0.2A, V_{OUT} = 5 V, T_r = 5 µs

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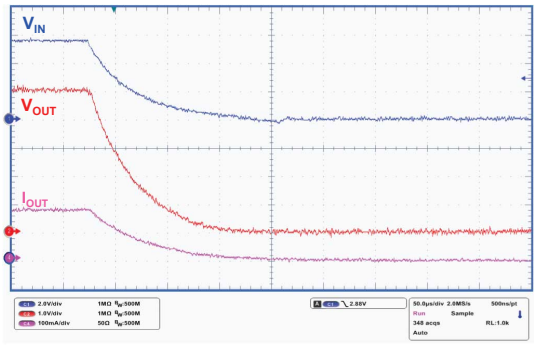
Figure 24. Turn-off time (V_{OUT} = 5 V)



$V_{IN} = V_{EN}$ = from 5.5 V to 0 V, I_{OUT} = 0.2 A, V_{OUT} = 5 V, T_f = 5 µs

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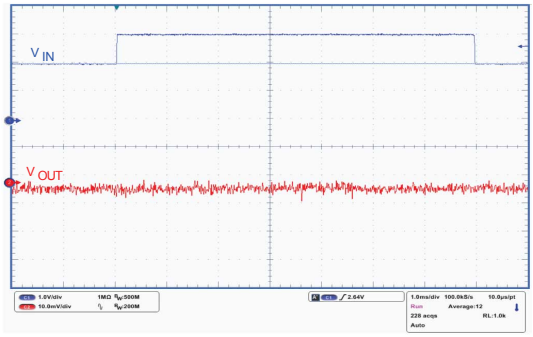
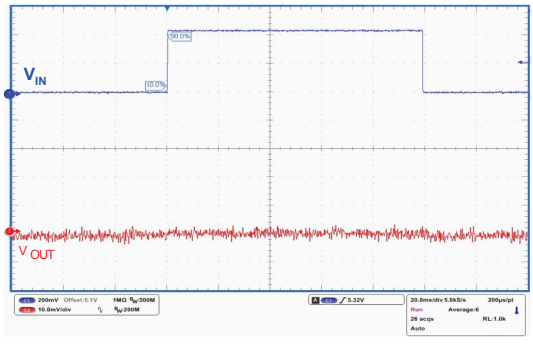
Figure 25. Line transient (V_{OUT} = 1 V)



$V_{IN} = V_{EN}$ = from 2 V to 3 V, I_{OUT} = 10 mA, V_{OUT} = 1 V, $T_r = T_f$ = 5 µs

AM13875V1

Figure 26. Line transient (V_{OUT} = 5 V)



$V_{IN} = V_{EN}$ = from 5.1 V to 5.5 V, I_{OUT} = 10 mA, V_{OUT} = 5 V, $T_r = T_f$ = 5 µs

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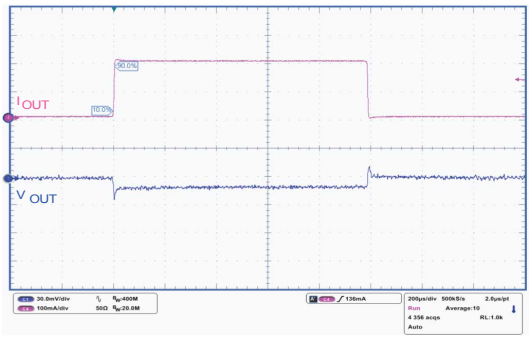
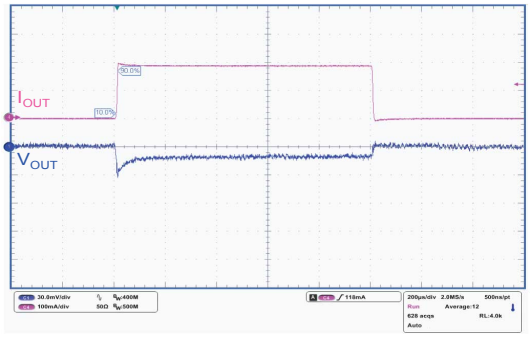
Figure 27. Load transient (V_{OUT} = 1 V)



V_{IN} =V_{EN} = 2 V, I_{OUT} = from 0 to 0.2 A , V_{OUT} = 1 V, t_r= t_f = 5 µs

AM13877V1

Figure 28. Load transient (V_{OUT} = 5 V)



V_{IN} =V_{EN} = 5.5 V, I_{OUT} = from 0 to 0.2 A , V_{OUT} = 5 V, t_r= t_f = 5 µs

AM13878V1

8 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.

8.1 DFN4 1x1 package information

Figure 29. **DFN4 1x1 package outline**

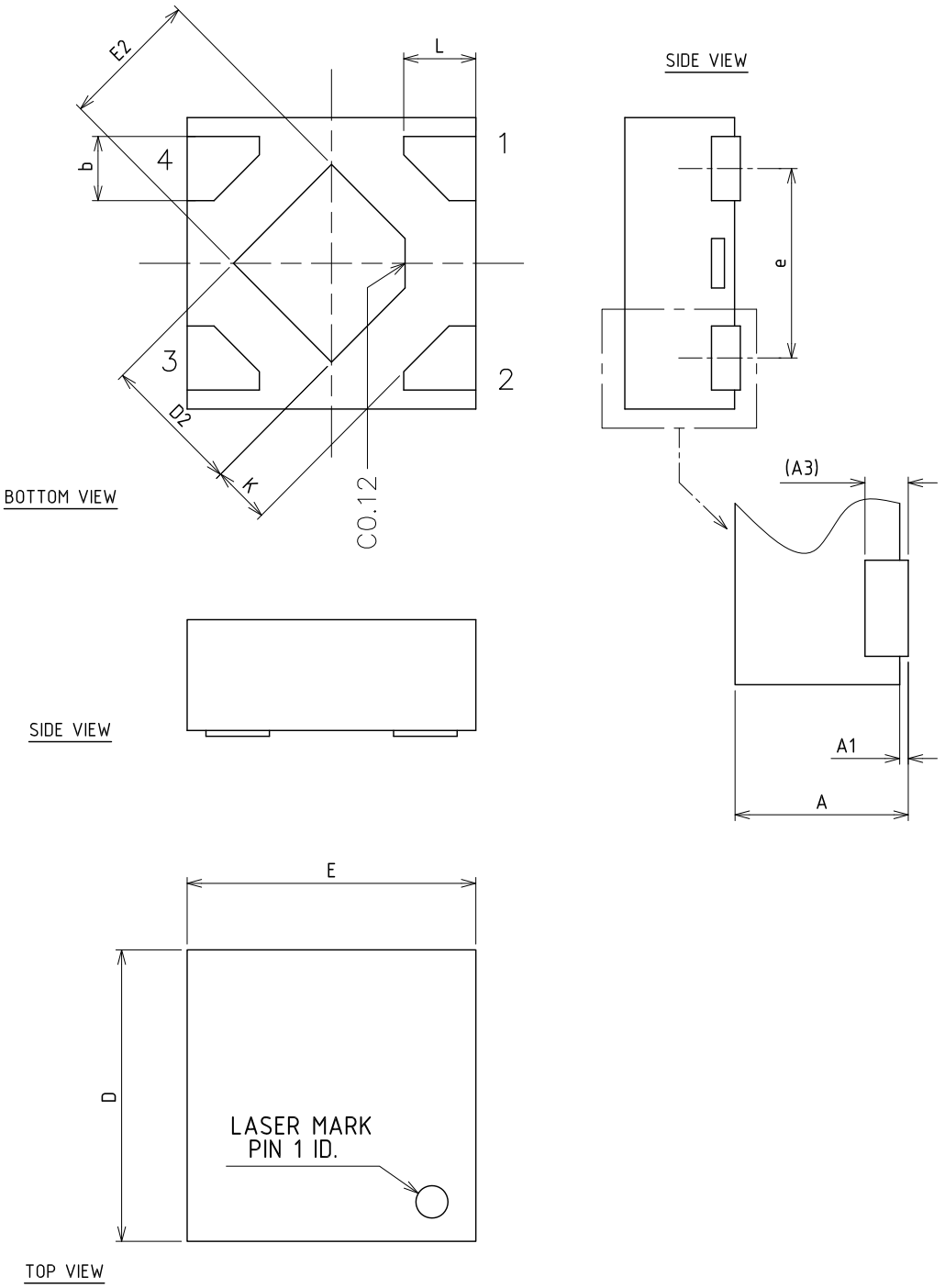


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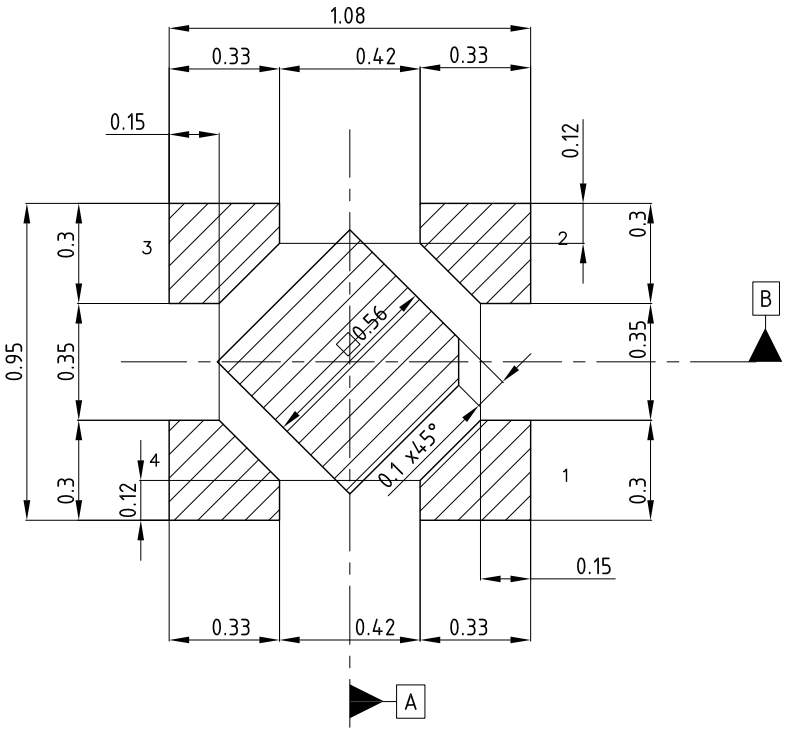
Table 6. **DFN4 1x1 mechanical data**

Dim.	mm.		
	Min.	Typ.	Max.
A	0.34	0.37	0.40
A1	0	0.02	0.05
A3		0.10	
b	0.17	0.22	0.27
D	0.95	1.00	1.05
D2	0.43	0.48	0.53
E	0.95	1.00	1.05
E2	0.43	0.48	0.53
e		0.65	
L	0.20	0.25	0.30
K	0.15		

Figure 30. **DFN4 1x1 recommended footprint**



Notes:

1) This footprint is able to ensure insulation up to 10 Vrms (according to CEI IEC 664-1)

2) The device must be positioned within ⌖ 0.02 A B

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9 Ordering information

Table 7. **Order code**

Order code	Output voltage (V)	Auto-dishcarge	Tolerance %	Marking
LD39030DTPU12R(1)	1.2	Yes	2	X5
LD39030ADTPU12R			0.5	W5
LD39030DTPU18R	1.8	Yes	2	X7
LD39030ADTPU18R			0.5	W7
LD39030DTPU25R (1)	2.5	Yes	2	XA
LD39030ADTPU25R (1)			0.5	WA
LD39030DTPU28R	2.8	Yes	2	XC
LD39030ADTPU28R			0.5	WC
LD39030DTPU30R V	3.0	Yes	2	XF
LD39030ADTPU30R V			0.5	WF
LD39030DTPU33R	3.3	Yes	2	XJ

1. *Available on request.*

Revision history

Table 8. **Document revision history**

Date	Revision	Changes
16-Nov-2015	1	Initial release.
18-May-2016	2	Updated *Section 9: "Ordering information"*. Minor text changes.
30-Aug-2016	3	Updated Ordering information. Minor text changes.
17-May-2018	4	Updated: V_{OUT} parameter Table 5. Electrical characteristics and Section 9 Ordering information.

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