200 mA high accuracy and high PSRR voltage regulator

SOT23-5L

SOT-89

Features

- Input voltage from 2.5 to 18 V
- Very low-dropout voltage (100 mV typ. @ 100 mA load)
- Low quiescent current (typ. 60 µA, 1 µA in off mode)
- High PSRR: 88 dB @ 120 Hz
- Low noise
- Output voltage tolerance: ± 0.5% @ 25 °C (LDK320A) or ± 2% 25 °C
- Output current up to 200 mA
- Wide range of output voltages available on request: fixed from 1.2 V to 12 V with 100 mV step and adjustable
- Logic-controlled electronic shutdown
- Compatible with ceramic capacitor C_{OUT} = 1 µF
- Current, SOA and thermal protections
- Available in SOT23-5L and SOT-89 packages
- Temperature range: -40 °C to 125 °C

Applications

- DSC
- TV
- BD, DVD
- PC
- Industrial

Maturity status link
LDK320

Description

The LDK320 is a low drop voltage regulator, which provides a maximum output current of 200 mA from an input voltage in the range of 2.5 V to 18 V, with a typical dropout voltage of 100 mV.

It is stabilized with a ceramic capacitor on the output.

The very good dynamic characteristic, combined with low drop voltage and low quiescent current make it suitable for low power battery-powered applications.

The enable logic control function allows the LDK320 to be in shutdown mode by consuming a total current lower than 1 µA.

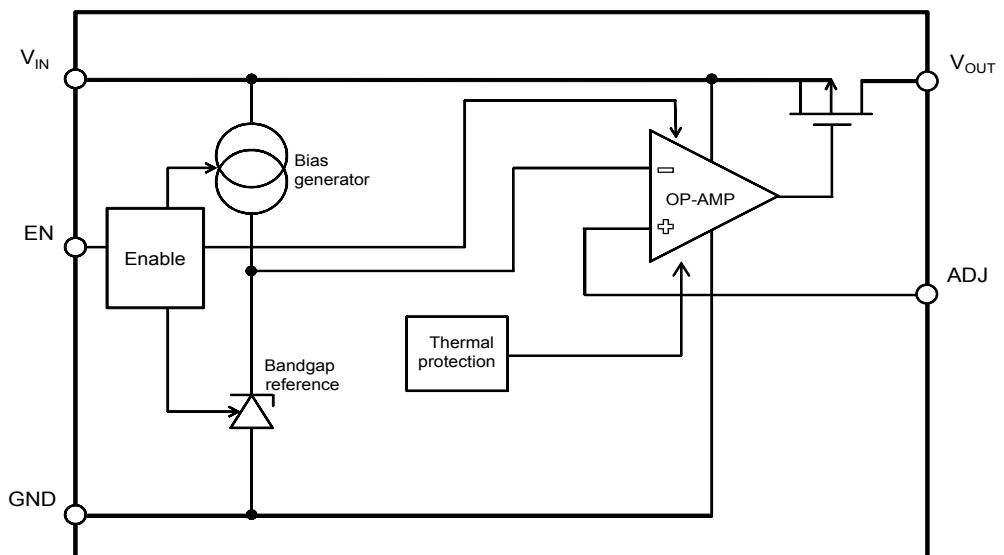This device also includes a short-circuit current limiting, thermal and SOA protections.

1 Diagram

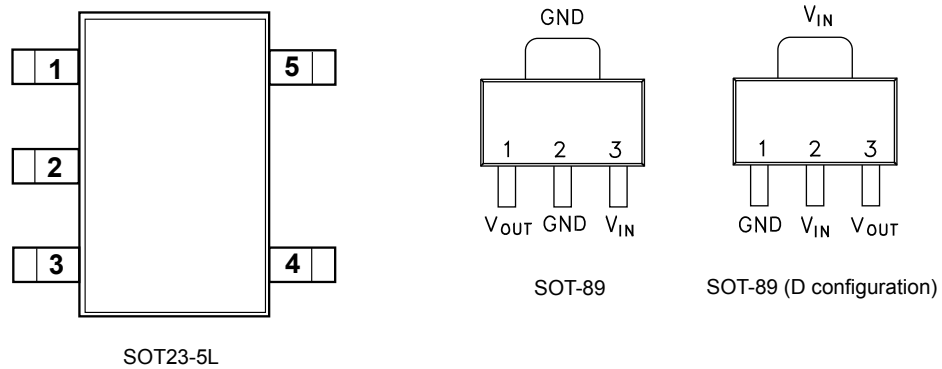**Figure 1. Block diagram (fixed version)**
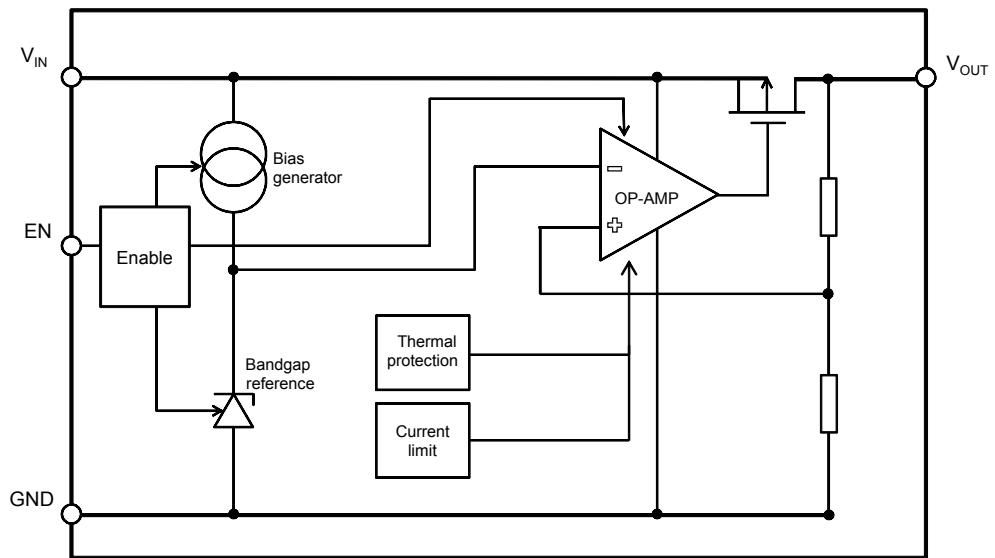
GIPD030820151330MT

Figure 2. Block diagram (adjustable version)

GIPD030820151331MT

2 Pin configuration

Figure 3. Pin connection (top view)

SOT23-5L

SOT-89

SOT-89 (D configuration)

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Table 1. Pin description (SOT23-5L)

Pin n°	Symbol	Function
1	IN	Input voltage of the LDO
2	GND	Common ground
3	EN	Enable pin logic input: low = shutdown, high = active
4	ADJ/NC	Adjustable pin on ADJ version, not connected on fixed version
5	OUT	Output voltage of the LDO

Table 2. Pin description (SOT-89)

Pin n°	Symbol	Function
1	OUT	Output voltage of the LDO
2	GND	Common ground
3	IN	Input voltage of the LDO
TAB	GND	Common ground

Table 3. Pin description (SOT-89, D configuration)

Pin n°	Symbol	Function
1	GND	Common ground
2	IN	Input voltage of the LDO
3	OUT	Output voltage of the LDO
TAB	IN	Input voltage of the LDO

3 Typical application

Figure 4. Typical application circuits

Fixed output voltage version

Adjustable output voltage version

$$V_O = V_{ADJ} \ (1 + R1/R2)$$

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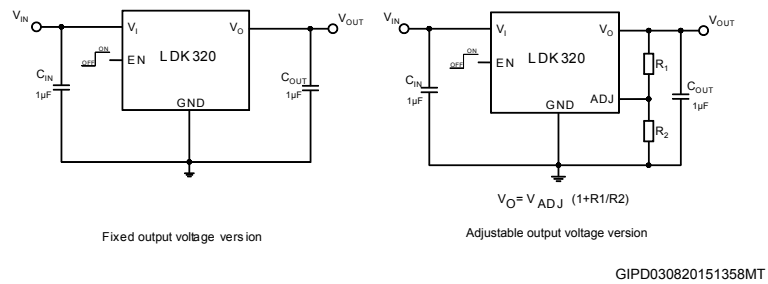
Note: *Adjustable version and enable pin are not available on SOT-89 package.*

4 Maximum ratings

Table 4. Absolute maximun ratings

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	- 0.3 to 20	V
V_{OUT}	DC output voltage	- 0.3 to V_I + 0.3	V
V_{EN}	Enable input voltage	- 0.3 to V_I + 0.3	V
V_{ADJ}	ADJ pin voltage	- 0.3 to 2	V
I_{OUT}	Output current	Internally limited	mA
P_D [1]	Power dissipation	Internally limited	mW
T_{STG}	Storage temperature range	- 65 to 150	°C
T_{OP}	Operating junction temperature range	- 40 to 125	°C

1. Maximum power dissipation must be calculated by taking into account the package and thermal performance.

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 5. Thermal data

Symbol	Parameter	SOT23-5L	SOT-89	Unit
R_{thJA}	Thermal resistance junction-ambient	160	110	°C/W
R_{thJC}	Thermal resistance junction-case	68	15	°C/W

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 6. LDK320 electrical characteristics (fixed output version)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		18	V
V_{OUT}	V_{OUT} accuracy	T_J = 25 °C	-2		2	%
		-40 °C < T_J < 125 °C	-3		3	%
	V_{OUT} accuracy, LDK320A	T_J = 25 °C	-0.5		0.5	%
		-40 °C < T_J < 125 °C	-1.5		1.5	%
ΔV_{OUT}	Static line regulation	V_{OUT} +1 V ≤ V_{IN} ≤ 18 V		0.001	0.05	%/V
ΔV_{OUT}	Static load regulation	I_{OUT} = 1 mA to 200 mA, V_{OUT} ≤ 2 V		10	15	mV
		I_{OUT} = 1 mA to 200 mA, V_{OUT} > 2 V		0.001	0.003	%/mA
V_{DROP}	Dropout voltage [1]	I_{OUT} = 100 mA, V_{OUT} = 3.3 V		100		
		I_{OUT} = 200 mA, V_{OUT} = 3.3 V 40 °C < T_J < 125 °C		200	350	mV
e_N	Output noise voltage	10 Hz to 100 kHz, I_{OUT} = 10 mA		63		µV_{RMS}/V
SVR	Supply voltage rejection	f = 120 Hz, I_{OUT} = 10 mA, V_{OUT} = 3.3 V		88		dB
		f = 1 kHz I_{OUT} = 10 mA, V_{OUT} = 3.3 V		65		
		f = 10 kHz, I_{OUT} = 10 mA V_{OUT} = 3.3 V		48		
I_Q	Quiescent current	V_{OUT} +1 V V_{IN} 18 V, I_{OUT} = 0 mA, -40 °C < T_J < 125 °C		60	90	µA
		V_{IN} = V_{OUT} +1 V I_{OUT} = 200 mA, -40 °C < T_J < 125 °C		70	100	
		V_{IN} input current in OFF mode: V_{EN} = G_{ND} T_J = 25 °C		0.2	1	
I_{SC}	Short-circuit current	R_L = 0		330		mA
		R_L = 0, V_{IN} = 16 V		200		

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 18 V, -40 °C < T_J < 125 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 18 V, -40 °C < T_J < 125 °C	1.2			
I_{EN}	Enable pin input current	V_{EN} = V_{IN}		0.1	100	nA
T_{SHDN}	Thermal shutdown			160		°C
	Hysteresis			20		
C_{OUT}	Output capacitor	Capacitance (see Section 6 Typical characteristics)	1		22	µF

1. Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value.

T_J = 25 °C, V_{IN} = 2.5 V, C_{IN} = C_{OUT} = 1 µF, I_{OUT} = 1 mA, V_{EN} = V_{IN}, unless otherwise specified.

Table 7. LDK320 electrical characteristics (ADJ version)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		18	V
V_{ADJ}	Adjustable voltage	T_J = 25 °C		1.185		V
	Adjustable voltage accuracy	T_J = 25 °C	-2		+2	%
		40 °C < T_J < 125 °C	-3		+3	
	Adjustable voltage, LDK320A	T_J = 25 °C		1.2		V
	Adjustable voltage accuracy, LDK320A	T_J = 25 °C	-0.5		+0.5	%
		40 °C < T_J < 125 °C	-1.5		+1.5	
ΔV_{OUT}	Static line regulation	V_{OUT} + 1 V ≤ V_{IN} ≤ 18 V		0.001	0.05	%/V
ΔV_{OUT}	Static load regulation	I_{OUT} = 1 mA to 200 mA		0.0002	0.003	%/mA
V_{DROP}	Dropout voltage [1]	I_{OUT} = 100 mA, V_{OUT} = 3.3 V		100		mV
		I_{OUT} = 200 mA, V_{OUT} = 3.3 V 40 °C < T_J < 125 °C		200	350	
e_N	Output noise voltage	10 Hz to 100 kHz I_{OUT} = 10 mA		60		$µV_{RMS}$
I_{ADJ}	Adjust pin current				1	µA
SVR	Supply voltage rejection	f = 120 Hz I_{OUT} = 10 mA, V_{OUT} = V_{ADJ}		83		dB
		f = 1 kHz I_{OUT} = 10 mA, V_{OUT} = V_{ADJ}		73		
		f = 10 kHz I_{OUT} = 10 mA, V_{OUT} = V_{ADJ}		58		

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_Q	Quiescent current	V_{OUT} +1 V ≤ V_{IN} ≤ 18 V, I_{OUT} = 0 mA, -40 °C < T_J < 125 °C		50	90	µA
		V_{IN} = V_{OUT} + 1 V, I_{OUT} = 200 mA, -40 °C < T_J < 125 °C		60	100	
		V_{IN} input current in OFF mode: V_{EN} = GND, T_J = 25 °C		0.2	1	
I_{SC}	Short-circuit current	R_L = 0		330		mA
		R_L = 0, V_{IN} = 16 V		200		
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 18 V, -40 °C < T_J < 125 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 18 V, -40 °C < T_J < 125 °C	1.2			
I_{EN}	Enable pin input current	V_{EN} = V_{IN}		0.1	100	nA
T_{SHDN}	Thermal shutdown			160		°C
	Hysteresis			20		
C_{OUT}	Output capacitor	Capacitance (see Section 6 Typical characteristics)	1		22	µF

6 Typical characteristics

Unless otherwise specified: T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} = C_{OUT} = 1 µF.

Figure 5. Output voltage vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 1 mA)
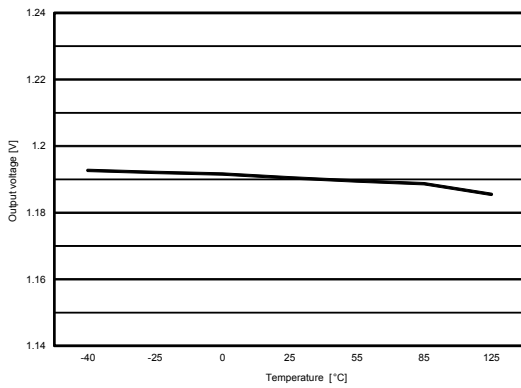
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Figure 6. Output voltage vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 200 mA)
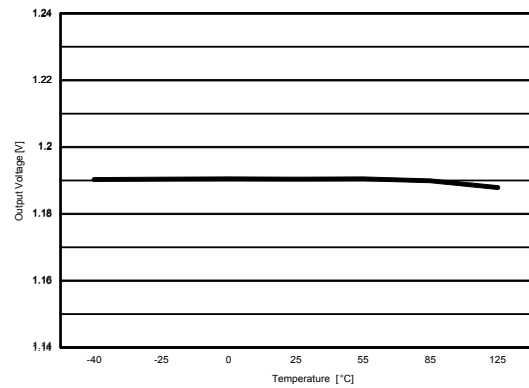
GIPD040820151208MT

Figure 7. Output voltage vs. temperature (V_{IN} = 4.3 V, V_{OUT} = 3.3 V, I_{OUT} = 1 mA)
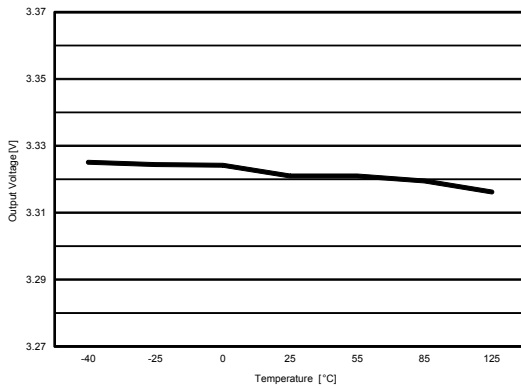
GIPD040820151209MT

Figure 8. Output voltage vs. temperature (V_{IN} = 4.3 V, V_{OUT} = 3.3 V, I_{OUT} = 200 mA)
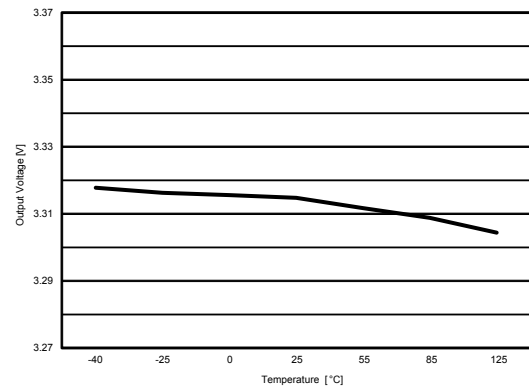
GIPD040820151210MT

Figure 9. Line regulation vs. temperature (V_{IN} = 4.3 to 18 V, V_{OUT} = 3.3 V, I_{OUT} = 1 mA)
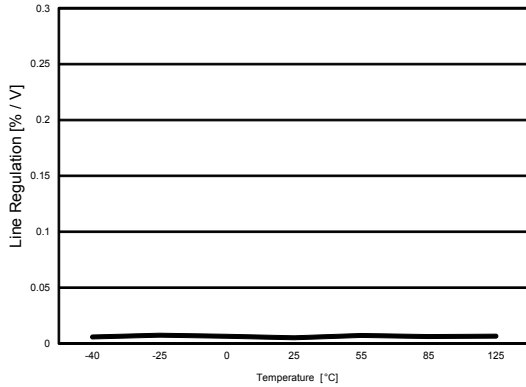
GIPD040820151211MT

Figure 10. Line regulation vs. temperature (V_{IN} = 2.5 to 18 V, V_{OUT} = V_{ADJ}, I_{OUT} = 1 mA)
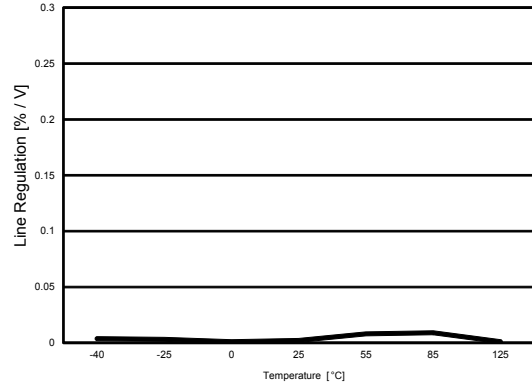
GIPD040820151212MT

Figure 11. Load regulation vs. temperature (V_{IN} = 4.3 V, V_{OUT} = 3.3 V, I_{OUT} = 1 to 200 mA)
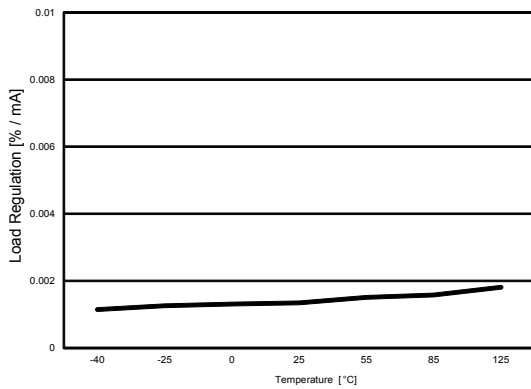
GIPD040820151213MT

Figure 12. Load regulation vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 1 to 200 mA)
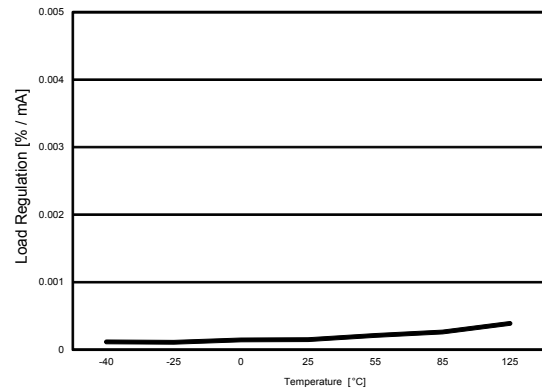
GIPD040820151214MT

Figure 13. Enable thresholds vs. temperature (I_{OUT} = 1 mA)
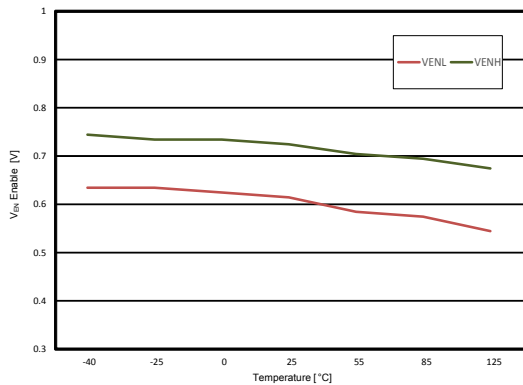
GIPD040820151215MT

Figure 14. Dropout voltage vs. temperature
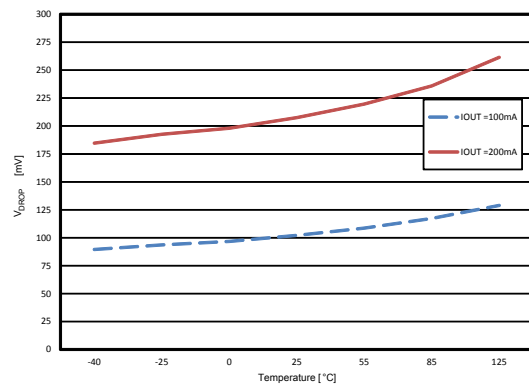
GIPD040820151216MT

Figure 15. Quiescent current vs. input voltage (I_{OUT} = 1 mA)
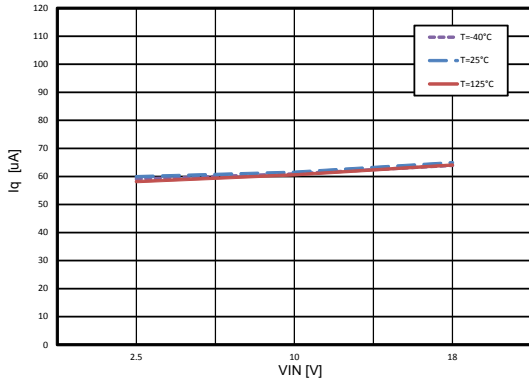
GIPD040820151217MT

Figure 16. Quiescent current vs. temperature (I_{OUT} = 1 mA)
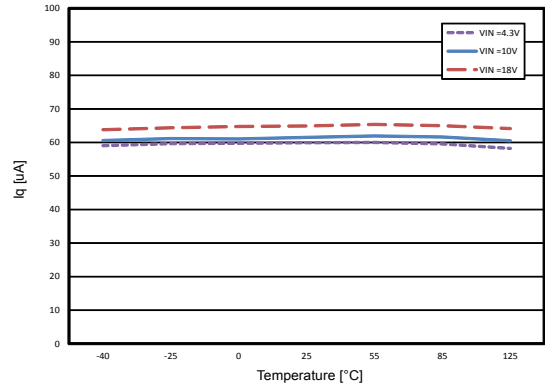
GIPD040820151218MT

Figure 17. Quiescent current vs. output current (V_{IN} = 4.3 V)
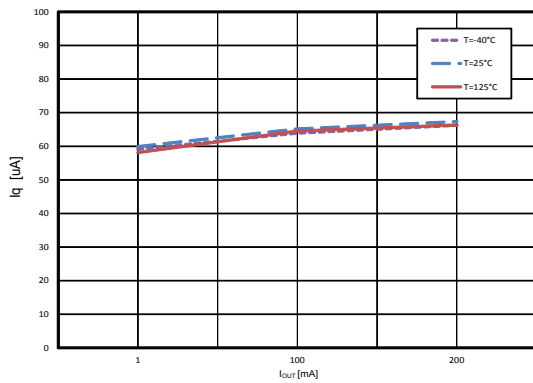
GIPD040820151219MT

Figure 18. Quiescent current vs. temperature (I_{OUT} = 200 mA)
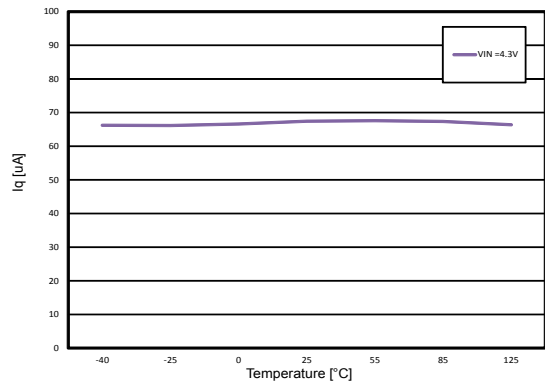
GIPD040820151220MT

Figure 19. Off-state current vs. temperature
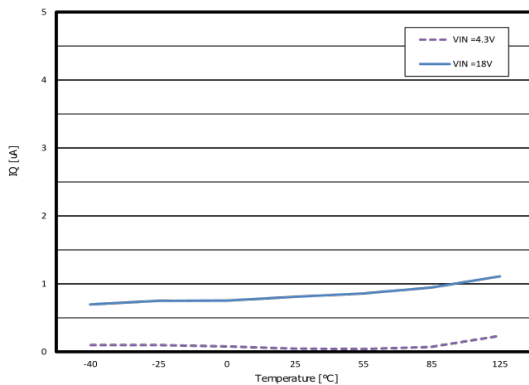
GIPD040820151221MT

Figure 20. Short-circuit current vs. temperature (V_{IN} = 4.3 V)
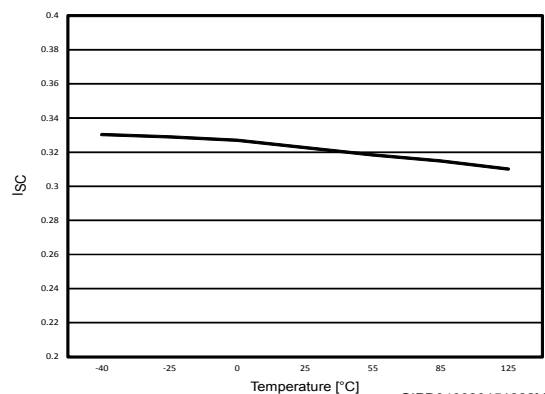
GIPD040820151222MT

Figure 21. Dropout voltage vs. I_{OUT}

GIPD040820151223MT
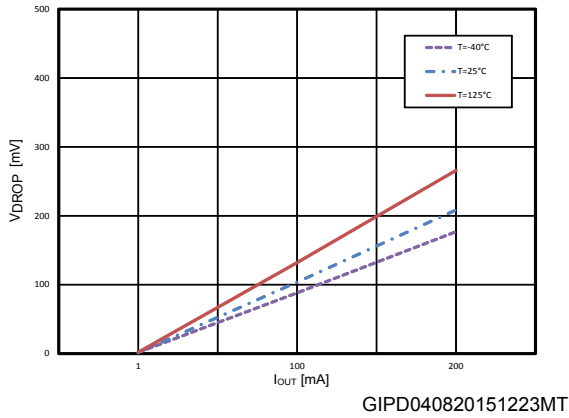
Figure 22. Short-cicuit current vs. drop voltage

GIPD040820151224MT
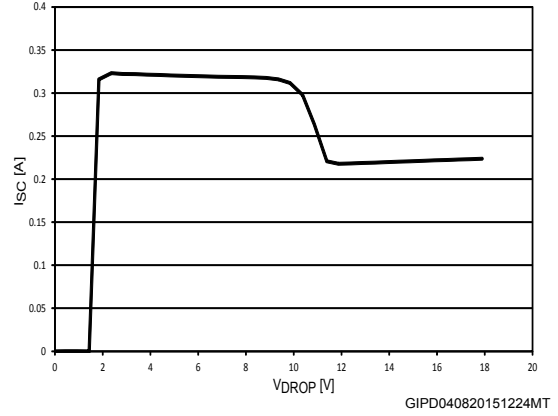
Figure 23. SVR vs. frequency

GIPD040820151225MT
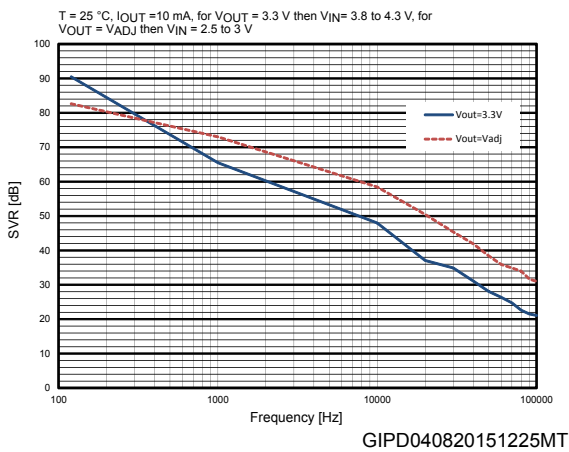
Figure 24. Output noise spectral density

GIPD040820151226MT
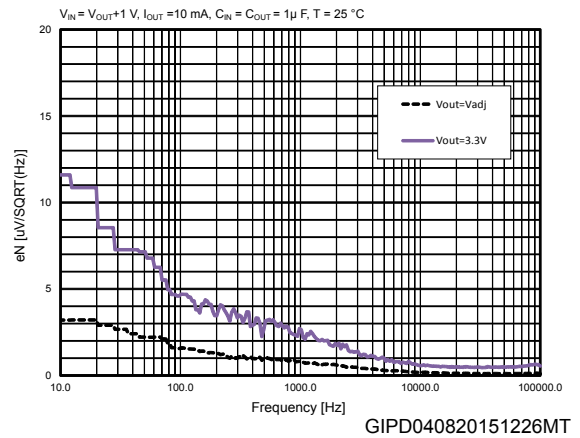
Figure 25. Stability plan (V_{OUT} = 3.3 V)

GIPD040820151227MT
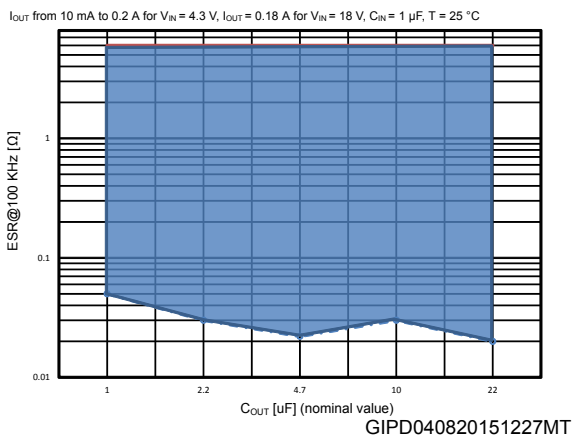
Figure 26. Stability plan (V_{OUT} = V_{ADJ})

GIPD040820151228MT
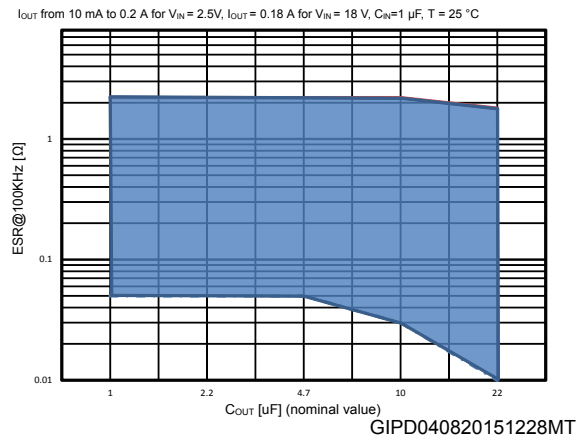
Figure 27. Startup with enable (V$_{OUT}$ = 3.3 V)

VIN = 4.3 V, VEN = from 0 to Vin, IOUT = 200 mA, C$_{IN}$ = COUT = 1 µF trise = tfall = 1 µs

Ch1=V$_{EN}$

Ch2=V$_{OUT}$
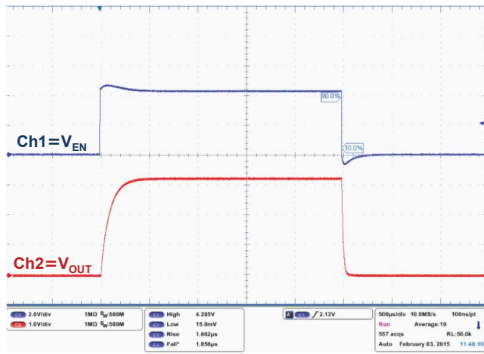
GIPD040820151229MT

Figure 28. Startup with enable (V$_{OUT}$ = V$_{ADJ}$)

V$_{IN}$ = 18 V, V$_{EN}$ = from 0 to V$_{in}$, I$_{OUT}$ =200 mA, C$_{IN}$ = C$_{OUT}$ =1 µF trise = t$_{fall}$ = 1 µs

Ch1=V$_{EN}$

Ch2=V$_{OUT}$
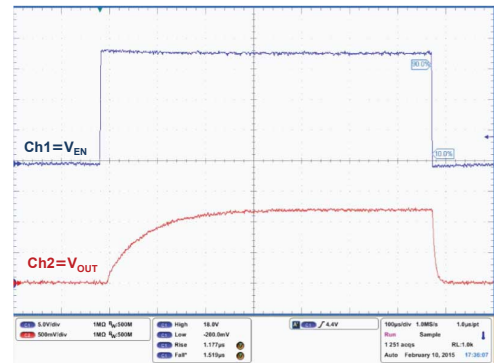
GIPD040820151230MT

Figure 29. Turn-on time (V$_{OUT}$ = 3.3 V)

V$_{IN}$ = V$_{EN}$ = from 0 to 4.3 V, I$_{OUT}$ = 200 mA, C$_{IN}$ = C$_{OUT}$ = 1 µF, T$_{rise}$ = 1 µs

Ch1=V$_{IN}$

Ch2=V$_{OUT}$
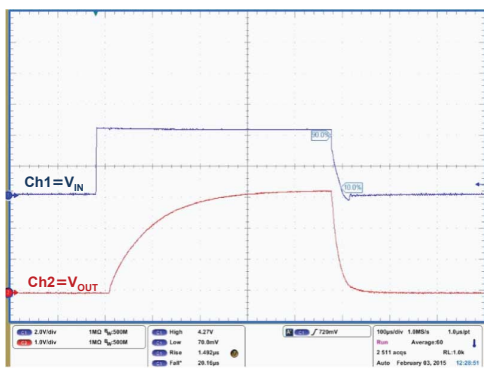
GIPD040820151231MT

Figure 30. Turn-on time (V$_{OUT}$ = V$_{ADJ}$)

V$_{IN}$ = V$_{EN}$ = from 0 to 18 V, I$_{OUT}$ = 200 mA V$_{OUT}$ = V$_{REF}$, C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ = 5 µs

Ch1=V$_{IN}$

Ch2=V$_{OUT}$
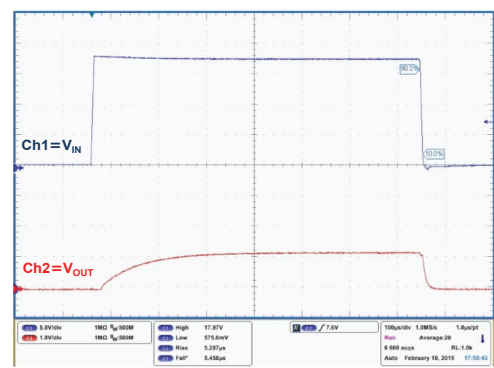
GIPD040820151232MT

Figure 31. Line transient (V$_{OUT}$ = 3.3 V, rise)

V$_{IN}$ = V$_{EN}$ = from 4.3 to 8.3 V, I$_{OUT}$ = 10 mA, C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ = 5 µs

Ch1=V$_{IN}$

Ch2=V$_{OUT}$
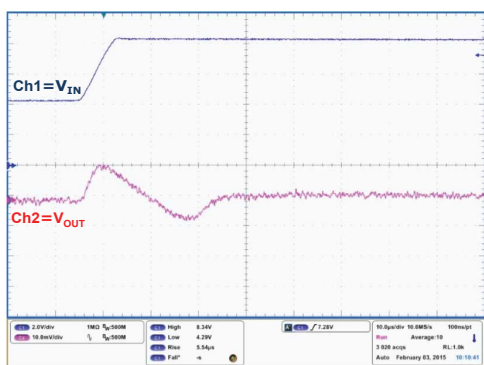
GIPD040820151233MT

Figure 32. Line transient (V$_{OUT}$ = 3.3 V, fall)

V$_{IN}$ = V$_{EN}$ = from 4.3 to 8.3 V, I$_{OUT}$ =10 mA, C$_{IN}$ = C$_{OUT}$ =1 µF T$_{fall}$ = 5 µs

Ch1=V$_{IN}$

Ch2=V$_{OUT}$
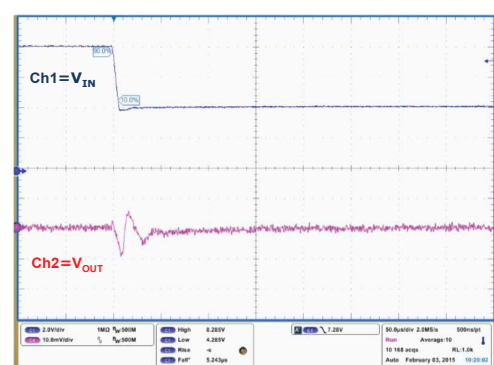
GIPD040820151234MT

Figure 33. Load transient (V$_{OUT}$ = 3.3 V, rise)

V$_{IN}$ = V$_{EN}$ = 4.3 V, I$_{OUT}$ = from 1 to 200 mA, C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ = 5 µs
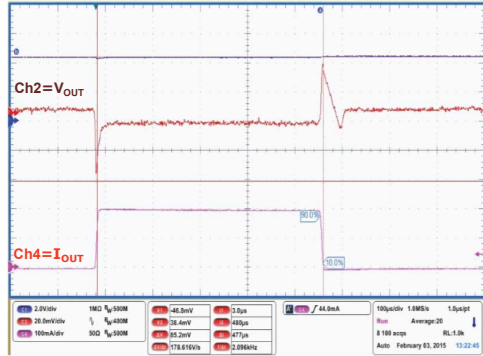

GIPD040820151236MT

Figure 34. Load transient (V$_{OUT}$ = V$_{ADJ}$, fall)

V$_{IN}$ = V$_{EN}$ = 2.5 V, I$_{OUT}$ = from 1 to 200 mA, C$_{IN}$ = C$_{OUT}$ = 1 µF T$_{rise}$ - T$_{fall}$ = 5 µs
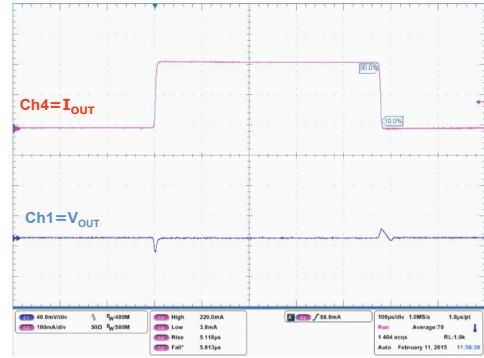
GIPD040820151237bMT

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 SOT23-5L package information

Figure 35. SOT23-5L package outline
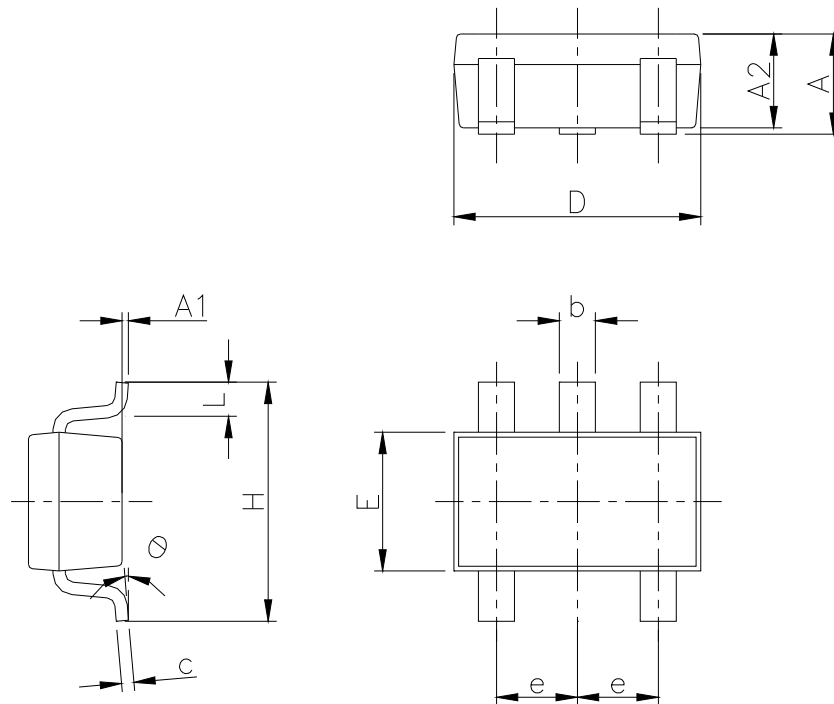
7049676_k

Table 8. SOT23-5L package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.90		1.45
A1	0		0.15
A2	0.90		1.30
b	0.30		0.50
c	0.09		0.20
D		2.95	
E		1.60	
e		0.95	
H		2.80	
L	0.30		0.60
θ	0°		8°

Figure 36. SOT23-5L recommended footprint
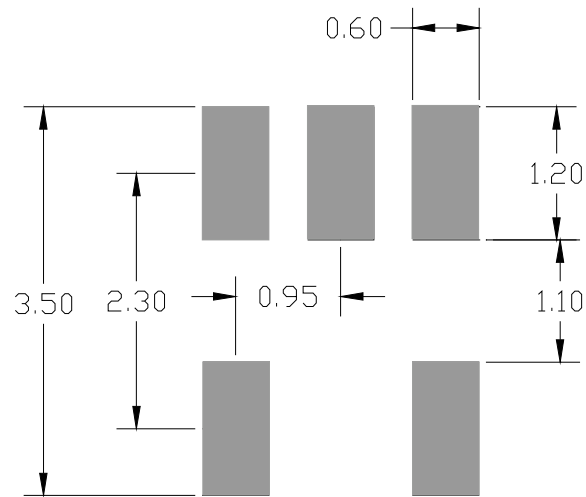
Note: Dimensions are in mm

7.2 SOT23-5L packing information

Figure 37. SOT23-5L tape and reel outline
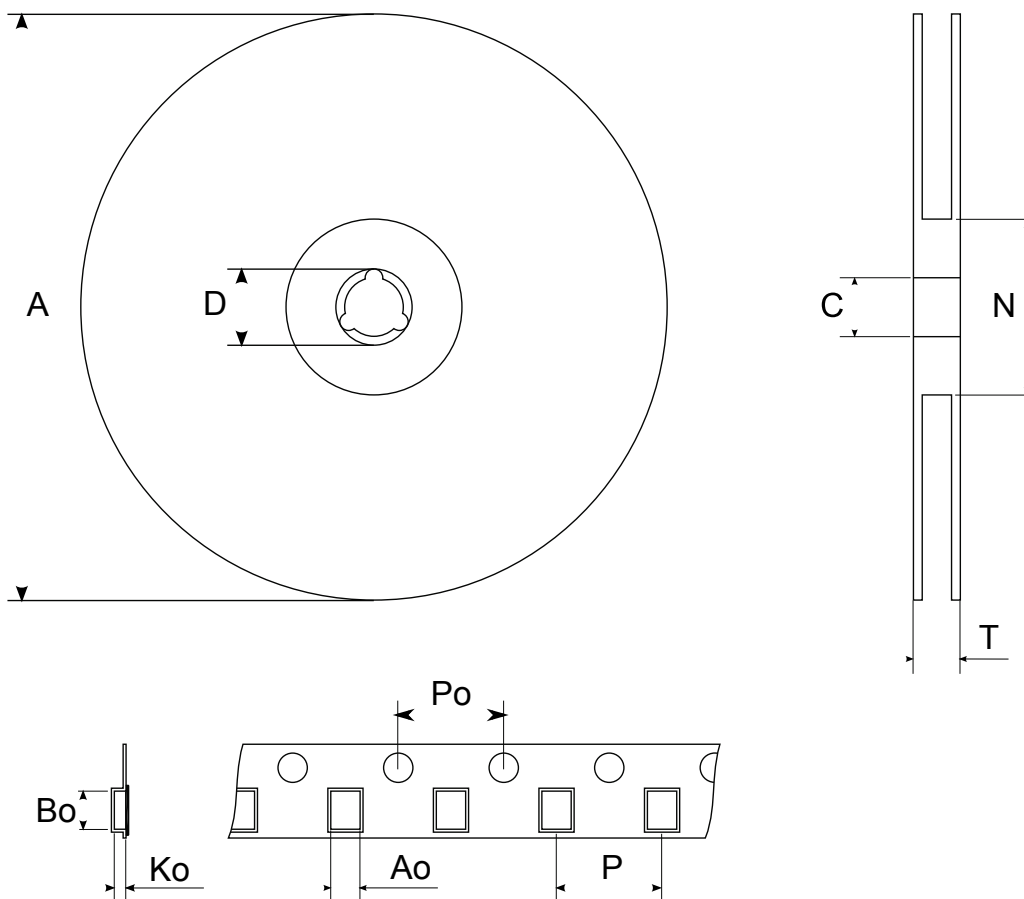
Table 9. SOT23-5L tape and reel mechanical data

Dim.	mm		
	Min.	**Typ.**	**Max.**
A			180
C	12.8	13.0	13.2
D	20.2		
N	60		
T			14.4
Ao	3.13	3.23	3.33
Bo	3.07	3.17	3.27
Ko	1.27	1.37	1.47
Po	3.9	4.0	4.1
P	3.9	4.0	4.1

7.3 SOT-89 package information

Figure 38. SOT-89 package outline
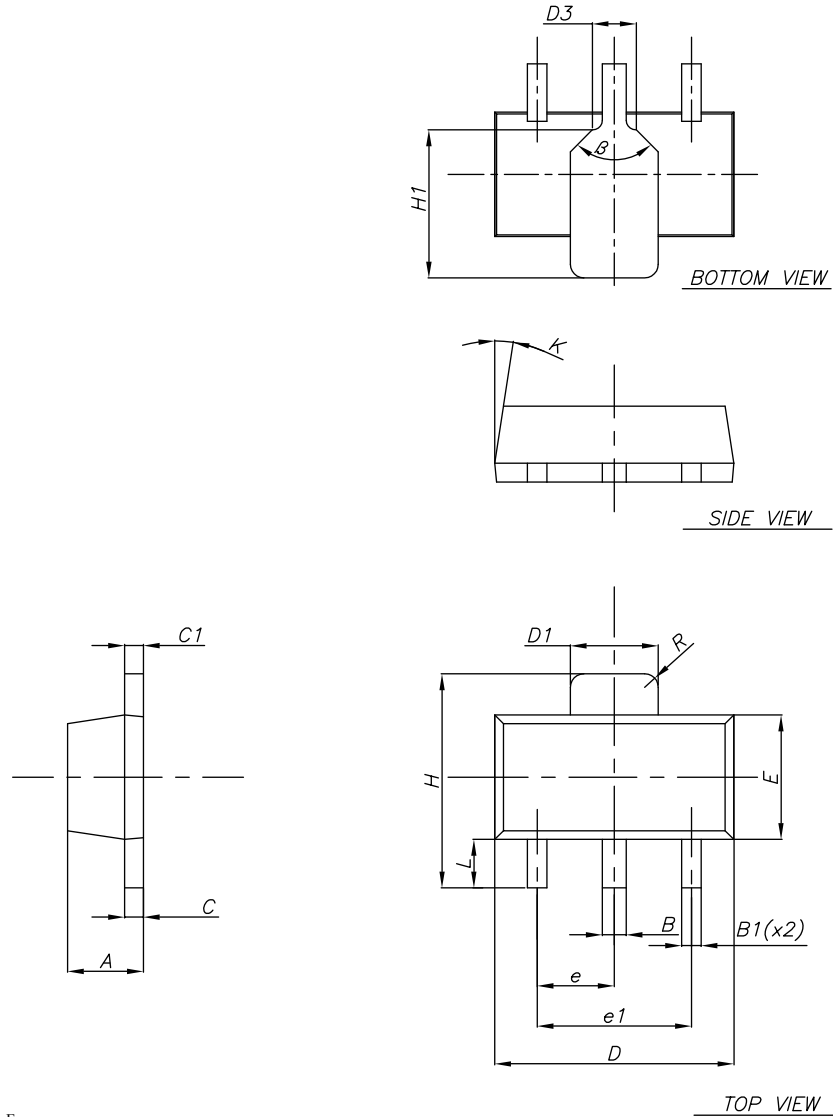
7098166_REV_F

Table 10. **SOT-89 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	1.40		1.60
B	0.44		0.56
B1	0.36		0.48
C	0.35		0.44
C1	0.35		0.44
D	4.40		4.60
D1	1.62		1.83
D3		0.90	
E	2.29		2.60
e	1.42		1.57
e1	2.92		3.07
H	3.94		4.25
H1	2.70		3.10
K	1°		8°
L	0.89		120
R		0.25	
β		90°	

Figure 39. SOT-89 recommended footprint
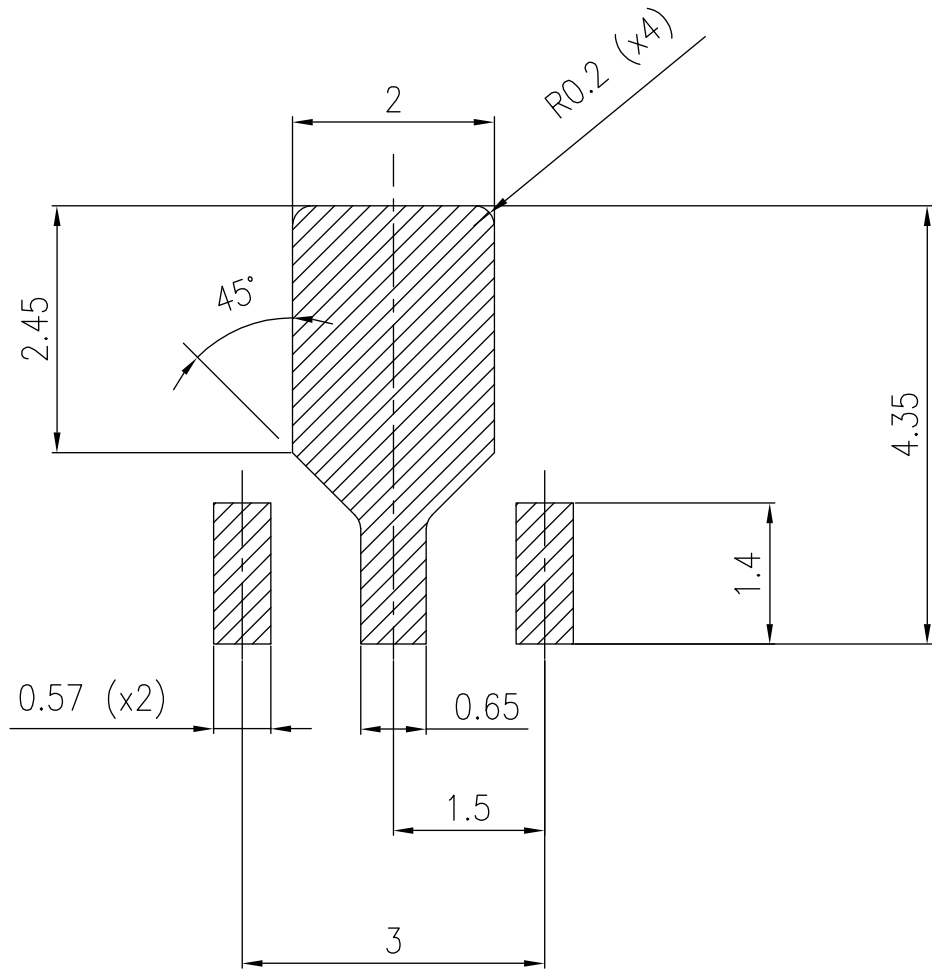
Footprint

7.4 SOT-89 packing information

Figure 40. SOT-89 carrier tape outline
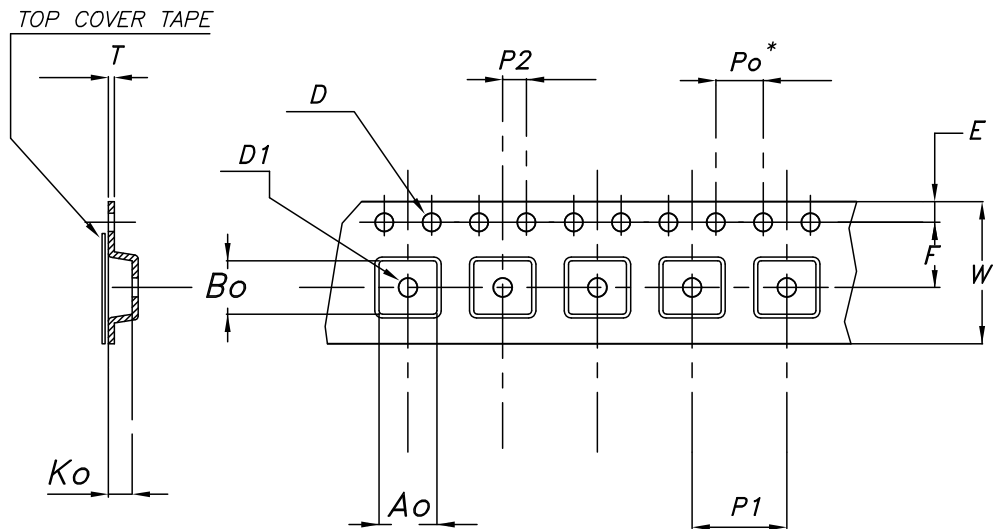
7111762_5

Table 11. SOT-89 carrier tape mechanical data

Dim.	mm	
	Value	Tolerance
Ao	4.91	± 0.10
Bo	4.52	± 0.10
Ko	1.90	± 0.10
F	5.50	± 0.10
E	1.75	± 0.10
W	12	± 0.30
P2	2	± 0.10
Po	4	± 0.10
P1	8	± 0.10
T	0.30	± 0.10
D	Ø 1.55	± 0.05
D1	Ø 1.60	± 0.10

8 Ordering information

Table 12. Order code

SOT23-5L	SOT-89 (D configuration)	SOT-89	Accuracy (%)	Output voltage
LDK320AM-R			0.5	ADJ
LDK320M-R			2	
LDK320AM12R [1]			0.5	1.2
LDK320M12R [1]			2	
LDK320AM15R [1]			0.5	1.5
LDK320M15R [1]			2	
LDK320AM18R [1]			0.5	1.8
LDK320M18R [1]			2	
LDK320AM25R [1]			0.5	2.5
LDK320M25R [1]			2	
LDK320AM30R	LDK320ADU30R [1]		0.5	3
LDK320M30R			2	
LDK320AM33R	LDK320ADU33R		0.5	3.3
LDK320M33R			2	
LDK320AM36R [1]			0.5	3.6
LDK320M36R [1]			2	
LDK320AM50R	LDK320ADU50R	LDK320AU50R	0.5	5
LDK320M50R			2	
LDK320AM120R [1]	LDK320ADU120R [1]		0.5	12
LDK320M120R [1]			2	

1. *Available on request.*

Revision history

Table 13. Document revision history

Date	Revision	Changes
16-Nov-2015	1	First release.
01-Jun-2016	2	Document status promoted from preliminary data to production data. Updated title and features in cover page. Updated Section 8: "Ordering information". Minor text changes.
05-Jul-2017	3	Updated Section 8: "Ordering information". Minor text changes.
09-Oct-2018	4	Updated ΔV_{OUT} test condition in Table 6. LDK320 electrical characteristics (fixed output version). Added new order code LDK320AU50R in Table 12. Order code.

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