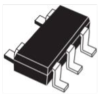
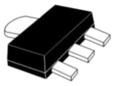
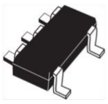
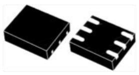
200 mA low quiescent current and low noise LDO


SOT23-5L


SOT-89


SOT323-5L


DFN6-1.2x1.3

Maturity status link
LDK220

Features

- Input voltage from 2.5 to 13.2 V
- Very low-dropout voltage (100 mV typ. @ 100 mA load)
- Low quiescent current (typ. 55 µA, 1 µA in off mode)
- Low noise
- Output voltage tolerance: ± 2.0% @ 25 °C
- 200 mA guaranteed output current
- 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
- Output discharge function
- Compatible with ceramic capacitor C_{OUT} = 1 µF
- Internal current and thermal limit
- Available in SOT23-5L, SOT323-5L, SOT-89 and DFN6-1.2x1.3 packages
- Temperature range: -40 °C to 125 °C

Applications

- Battery-powered equipment
- TV
- Set-top box
- PC and laptop
- Industrial

Description

The LDK220 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 13.2 V, with a typical dropout voltage of 100 mV.

A ceramic capacitor stabilizes it on the output.

The very low drop voltage, low quiescent current and low noise make it suitable for battery-powered applications.

The enable logic control function puts the LDK220 in shutdown mode allowing a total current consumption lower than 1 µA.

The device also includes a short-circuit constant current limiting and thermal protection.

1 Diagram

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

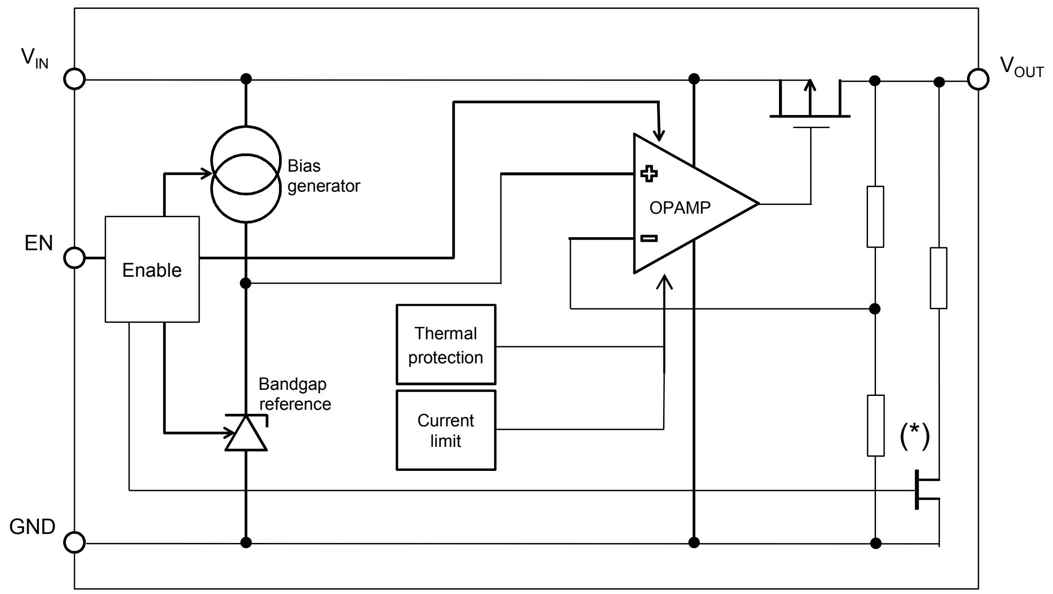
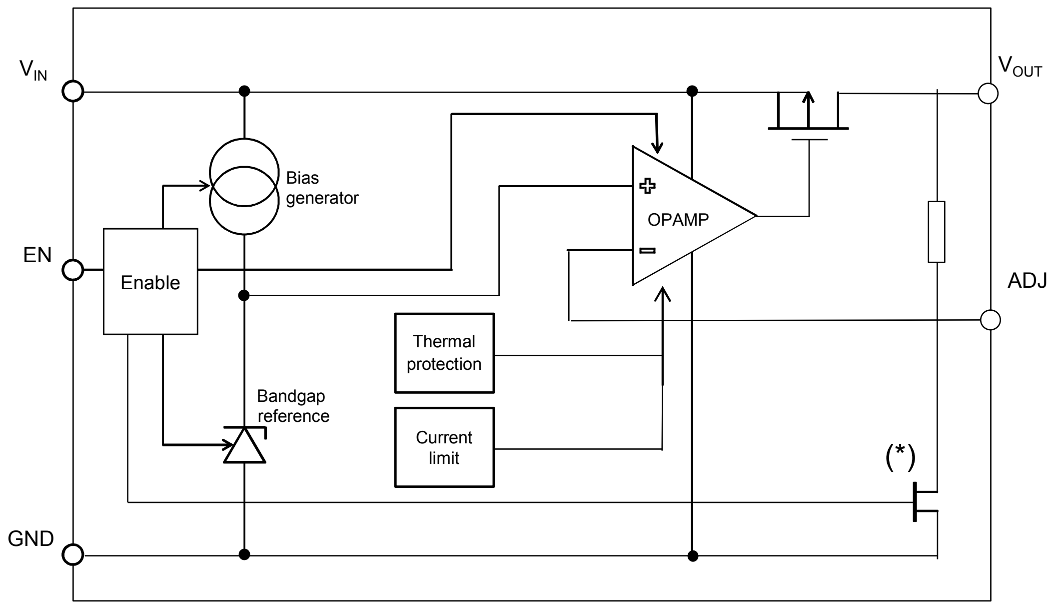


Figure 2. **Block diagram (adjustable version)**



(*) The device embeds autodischarge function (active when Enable in low). To avoid damages to the discharge function, we discourage to apply any external voltage to V_{OUT} pin when Enable pin is low.

2 Pin configuration

Figure 3. Pin connections (top view)

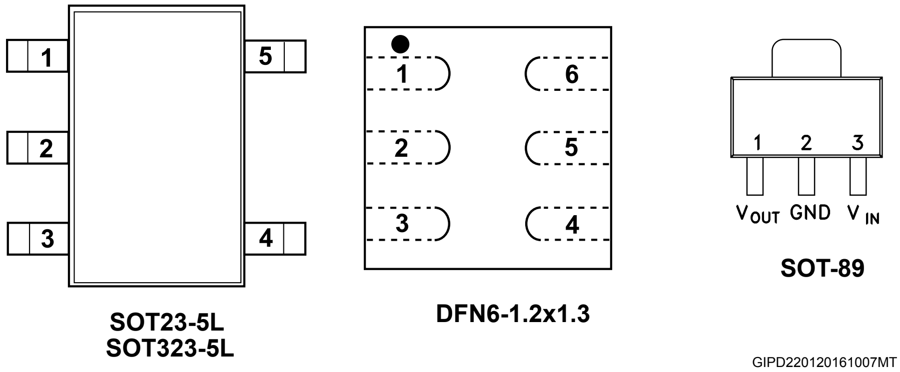


Table 1. Pin description (SOT23-5L, SOT323-5L)

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. EN cannot be left floating.
4	ADJ/NC	Adjustable pin on ADJ version, not connected on fixed version
5	OUT	Output voltage of the LDO

Table 2. Pin description (DFN6)

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

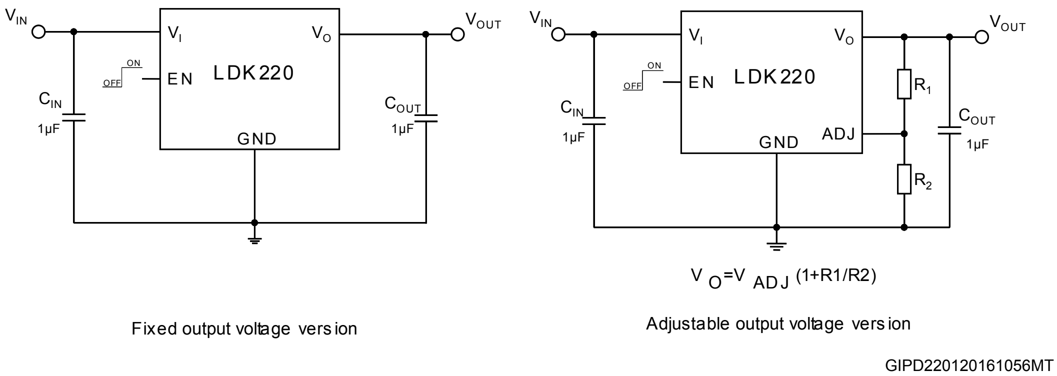
Table 3. Pin description (SOT-89)

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

1. *Adjustable version and enable pin are not available on the SOT-89 package.*

3 Typical application

Figure 4. Typical application circuits



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

4 Maximum ratings

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	- 0.3 to 14	V
V_{OUT}	DC output voltage	- 0.3 to VI + 0.3	V
V_{EN}	Enable input voltage	- 0.3 to VI + 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	500	mW
T_{STG}	Storage temperature range	- 65 to 150	°C
T_{OP}	Operating junction temperature range	- 40 to 125	°C

1. *Maximum power dissipation has to be calculated taking into account the package 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	SOT323-5L	SOT-89	DFN-6	Unit
R_{thJA}	Thermal resistance junction-ambient	160	246	110	237	°C/W
R_{thJC}	Thermal resistance junction-case	68	134	15	104	°C/W

5 Electrical characteristics

Table 6. LDK220 electrical characteristics for fixed output version. 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.

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		13.2	V
V_{OUT}	V_{OUT} accuracy	I_{OUT} = 1 mA, T_J = 25 °C	-2		2	%
		I_{OUT} = 1 mA, -40 °C < T_J < 125 °C	-3		3	%
ΔV_{OUT}	Static line regulation	V_{OUT} + 1 V ≤ V_{IN} ≤ 13.2 V, I_{OUT} = 1 mA		0.001	0.05	%/V
ΔV_{OUT}	Static load regulation	I_{OUT} = 1 mA to 200 mA		0.001	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		20		$\mu V_{RMS}/V$
SVR	Supply voltage rejection	V_{IN} = V_{OUTNOM}+ 0.5 V+/-V_{RIPPLE} V_{RIPPLE} = 0.1 V frequency = 120 Hz to 1 kHz I_{OUT} = 10 mA		55		dB
		V_{IN} = V_{OUTNOM} + 0.5 V+/-V_{RIPPLE} I_{OUT} = 10 mA V_{RIPPLE} = 0.1 V frequency = 10 kHz		50		
I_Q	Quiescent current	V_{IN} = V_{OUT} +1 V I_{OUT} = 0 mA,-40 °C < T_J < 125 °C		55	90	μA
		V_{OUT} +1 V ≤ V_{IN} ≤ 13.2 V (2) 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		0.1	1	
I_{SC}	Short-circuit current (2)	R_L = 0		400		mA
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 13.2 V, -40 °C < T_J < 125 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 13.2 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.*
2. *The maximum current has to be limited according to the maximum power dissipation.*

Table 7. LDK220 electrical characteristics for adjustable version. 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.

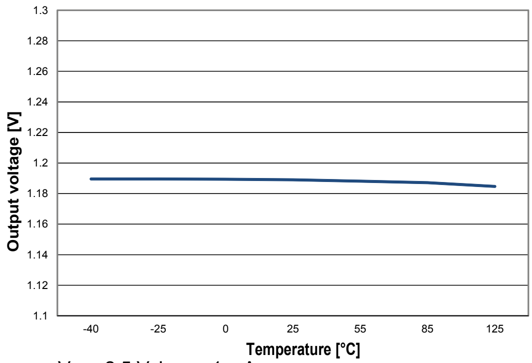
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		13.2	V
V_{ADJ}	Adjustable voltage	T_J = 25 °C		1.185		V
	Adjustable voltage accuracy	T_J = 25 °C	-2		+2	%
		40 °C < T_J < 125 °C	-3		+3	
ΔV_{OUT}	Static line regulation	V_{OUT} +1 V ≤ V_{IN} ≤ 13.2 V I_{OUT}=1 mA		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		
		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		100		µV_{RMS}/V
I_{ADJ}	Adjust pin current				1	µA
SVR	Supply voltage rejection	V_{IN} = V_{OUTNOM} + 0.5 V+/-V_{RIPPLE} V_{RIPPLE} = 0.1 V frequency = 120 Hz to1 kHz, I_{OUT} = 10 mA		60		dB
		V_{RIPPLE} = 0.1 V V_{IN} = V_{OUTNOM}+0.5 V+/-V_{RIPPLE} frequency = 10 kHz, I_{OUT} = 10 mA		45		
I_Q	Quiescent current	V_{OUT} +1 V ≤ V_{IN} ≤ 13.2 V I_{OUT} = 0 mA, -40 °C < T_J < 125 °C		55	90	µA
		V_{OUT} +1 V ≤ V_{IN} ≤ 13.2 V I_{OUT} = 200 mA,-40 °C < T_J < 125 °C (2)		60	100	
		V_{IN} input current in off mode: V_{EN} = GND,T_J = 25 °C		0.1	1	
I_{SC}	Short-circuit current (2)	R_L = 0		400		mA
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 13.2 V -40 °C < T_J < 125 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 13.2 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.*
2. *The maximum current has to be limited according to the maximum power dissipation.*

6 Typical characteristics

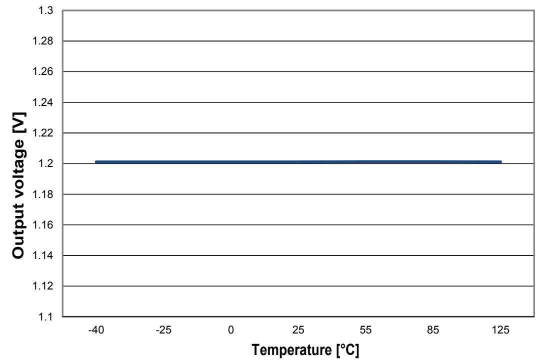
($C_{IN} = C_{OUT} = 1\ \mu F$, V_{EN} to V_{IN})

Figure 5. Output voltage vs. temperature ($V_{OUT} = V_{ADJ}$, $I_{OUT} = 1\ mA$)



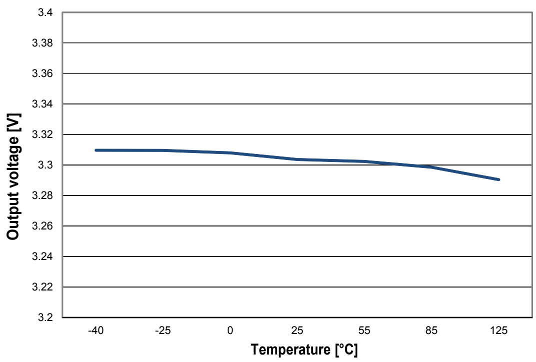
$V_{IN} = 2.5\ V$, $I_{OUT} = 1\ mA$

Figure 6. Output voltage vs. temperature ($V_{OUT} = V_{ADJ}$, $I_{OUT} = 200\ mA$)



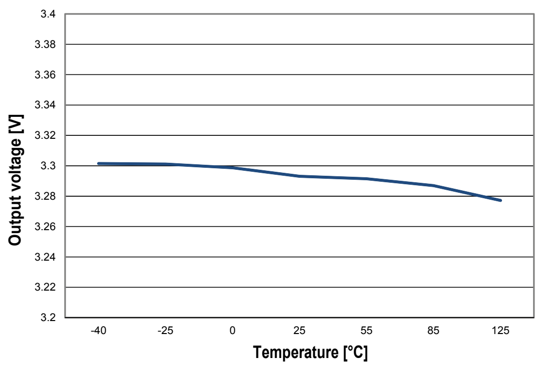
$V_{IN} = 2.5\ V$, $I_{OUT} = 200\ mA$

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



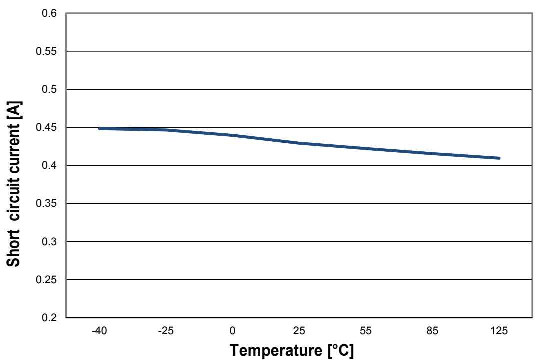
$V_{IN} = 4.3\ V$, $I_{OUT} = 1\ mA$

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



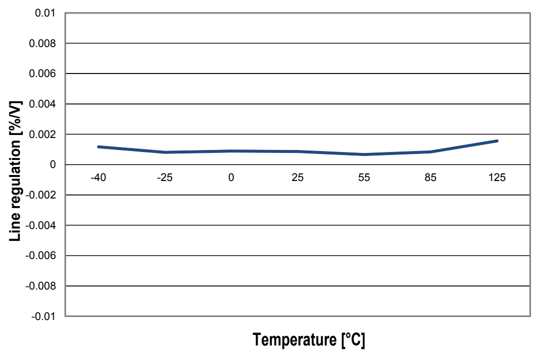
$V_{IN} = 4.3\ V$, $I_{OUT} = 200\ mA$

Figure 9. Short-circuit current vs. temperature



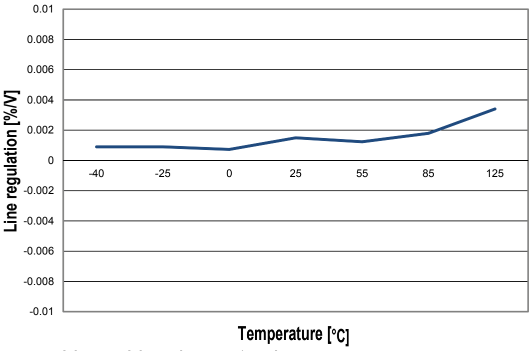
$V_{IN} = 4\ V$

Figure 10. Line regulation vs. temperature ($V_{OUT} = 3.3\ V$)



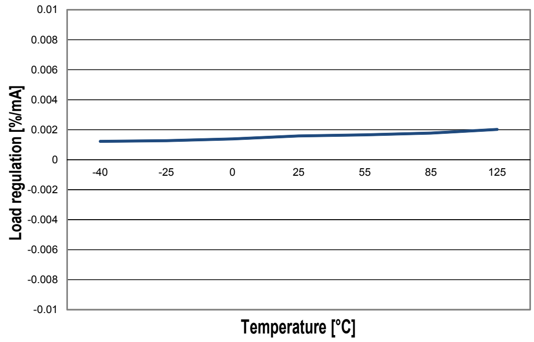
$V_{OUT} = 3.3\ V$, $I_{OUT} = 1\ mA$

Figure 11. Line regulation vs. temperature (V_{OUT} = V_{ADJ})



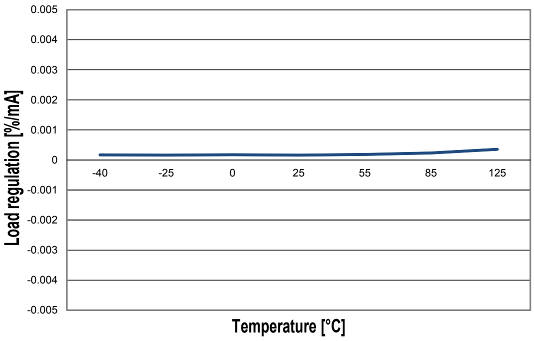
V_{OUT} = V_{ADJ}, I_{OUT} = 1 mA

Figure 12. Load regulation vs. temperature (V_{OUT} = 3.3 V)



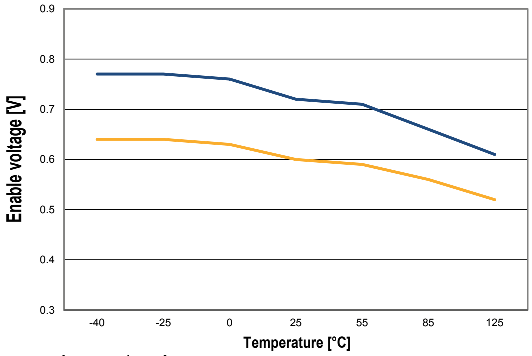
V_{OUT} = 3.3 V, I_{OUT} = 1 mA to 200 mA

Figure 13. Load regulation vs. temperature (V_{OUT} = V_{ADJ})



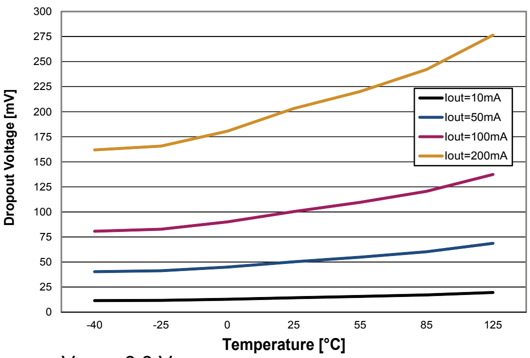
I_{OUT} = 1 mA to 200 mA

Figure 14. Enable thresholds vs. temperature



I_{OUT} = 1 mA

Figure 15. Dropout voltage vs. temperature



V_{OUT} = 3.3 V

Figure 16. Quiescent current vs. temperature (I_{OUT} = 0 mA)

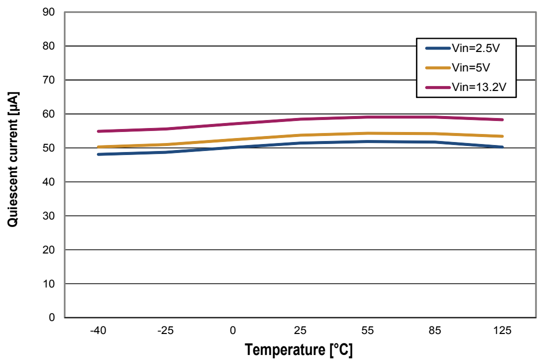


Figure 17. Quiescent current vs. temperature (I_{OUT} = 200 mA)

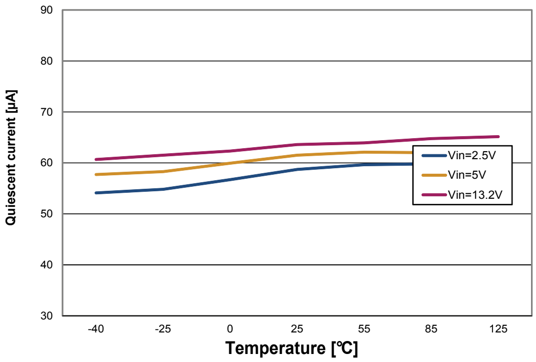


Figure 18. Off-state current vs. temperature

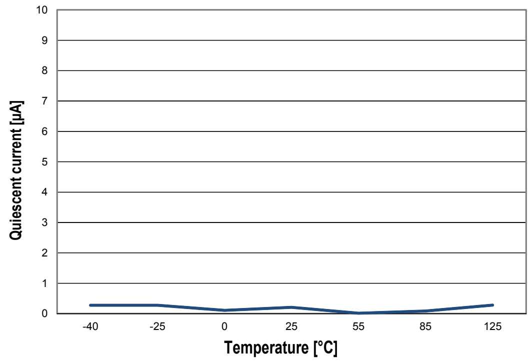
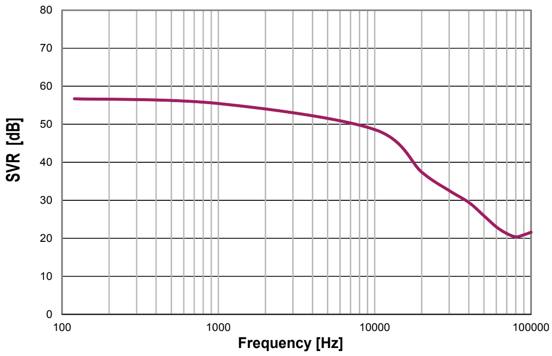
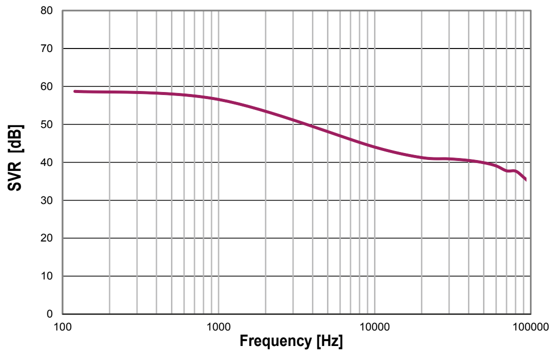


Figure 19. SVR vs. frequency (V_{OUT} = 3.3 V)



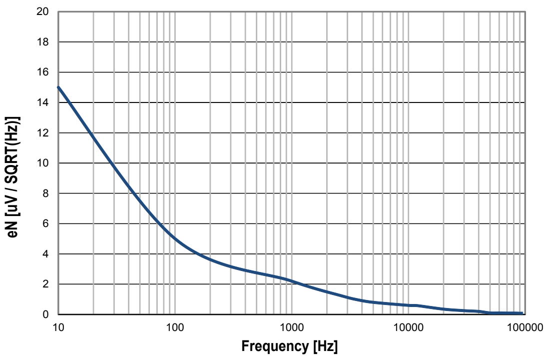
V_{IN} = 3.7 V +/-100 mV, V_{OUT} = 3.3 V, C_{OUT} = 1 µF

Figure 20. SVR vs. frequency (V_{OUT} = V_{ADJ})



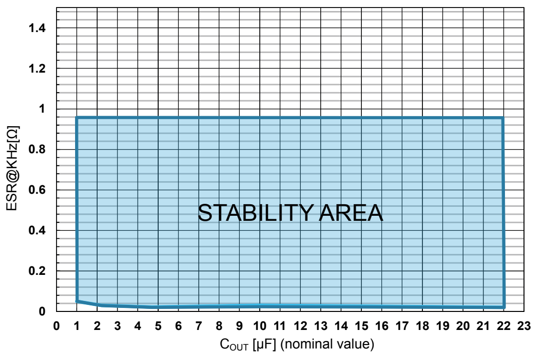
V_{IN} = 2.5 V +/- 100 mV, V_{OUT} = V_{ADJ}, C_{OUT} = 1 µF

Figure 21. Output noise spectral density



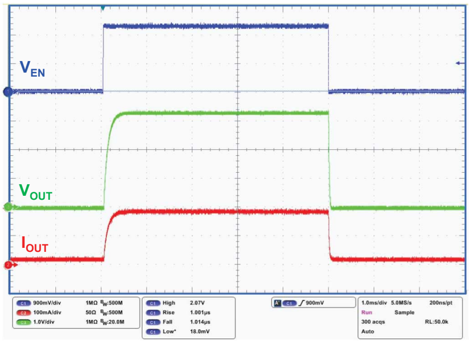
V_{OUT} = 3.3 V, C_{IN} = C_{OUT} = 1 µF

Figure 22. Stability vs. (C_{OUT}, ESR)



V_{IN} from 2.5 to 13.2 V, I_{OUT} from 0 to 200 mA, C_{IN} = 1 µF

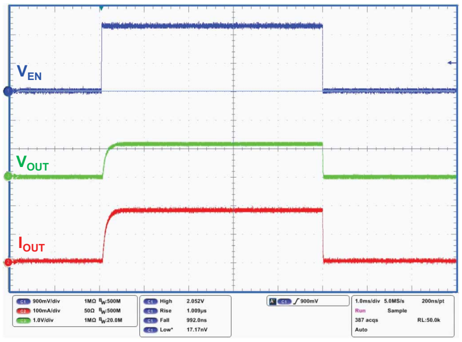
Figure 23. **Startup with enable (V_{OUT} = 3.3 V)**



V_{IN} = 4.3 V, V_{EN} = 0 V to 2 V, I_{OUT} = 0.2 A, V_{OUT} = 3.3 V, T_r = T_f = 1 µs

GIPD250120161426MT

Figure 24. **Startup with enable (V_{OUT} = V_{ADJ})**



V_{IN} = 2.5 V, V_{EN} = 0 V to V_{IN}, I_{OUT} = 0.2 A, V_{OUT} = V_{ADJ}, T_r = T_f = 1 µs

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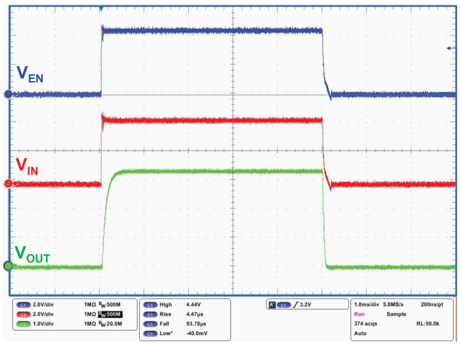
Figure 25. **Turn-on time (V_{OUT} = 3.3 V)**



V_{IN} = V_{EN} = 0 V to 4.3 V, I_{OUT} = 0.2 A, V_{OUT} = 3.3 V, T_r = 5 µs

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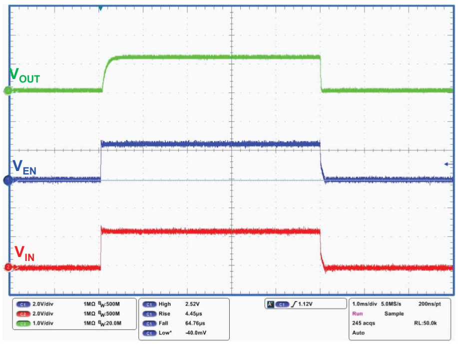
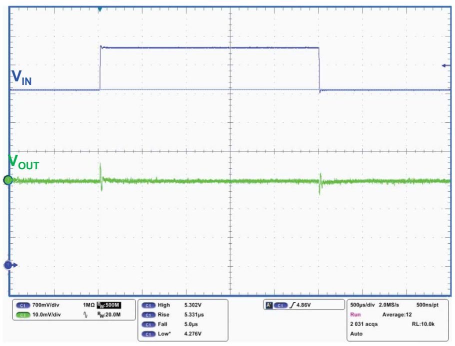
Figure 26. **Turn-on time (V_{OUT} = V_{ADJ})**



V_{IN} = V_{EN} = 0 V to 2.5 V, I_{OUT} = 0.2 A, V_{OUT} = V_{ADJ}, Tr = 5 µs

GIPD250120161429MT

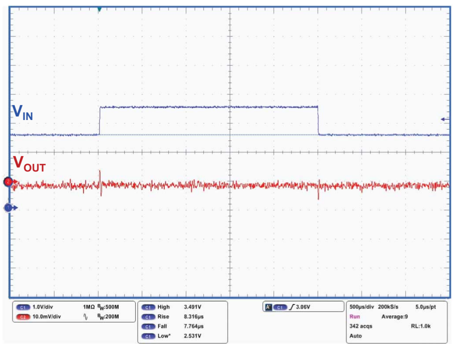
Figure 27. **Line transient (V_{OUT} = 3.3 V)**



V_{IN} = V_{EN} = 4.3 V to 5.3 V, I_{OUT} = 1 mA, V_{OUT} = 3.3 V, T_r = T_f = 5 µs

GIPD250120161430MT

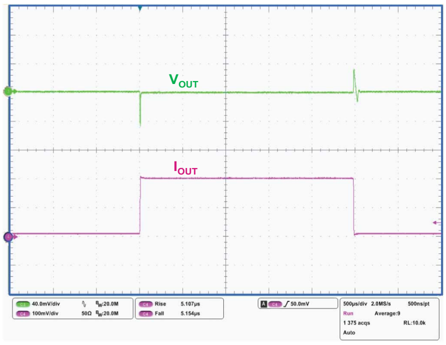
Figure 28. **Line transient (V_{OUT} = V_{ADJ})**



V_{IN} = V_{EN} = 2.5 V to 3.5 V, I_{OUT} = 1 mA, V_{OUT} = V_{ADJ}, T_r = T_f = 5 µs

GIPD250120161431MT

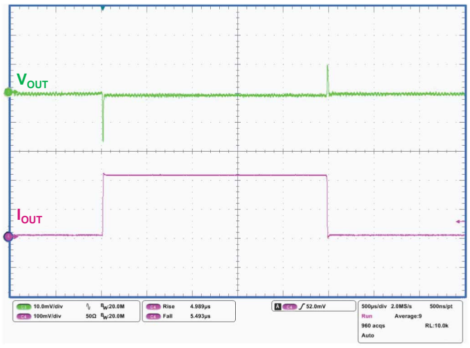
Figure 29. Load transient (V_{OUT} = 3.3 V)



V_{IN} = V_{EN} = 4.3 V, I_{OUT} = 1 mA to 0.2 A, V_{OUT} = 3.3 V, T_r = T_f = 5 µs

GIPD250120161432MT

Figure 30. Load transient (V_{OUT} = V_{ADJ})



V_{IN} = V_{EN} = 2.5 V, I_{OUT} = 1 mA to 0.2 A, V_{OUT} = V_{ADJ}, T_r = T_f = 5 µs

GIPD250120161433MT

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 mechanical data

Figure 31. **SOT23-5L package outline**

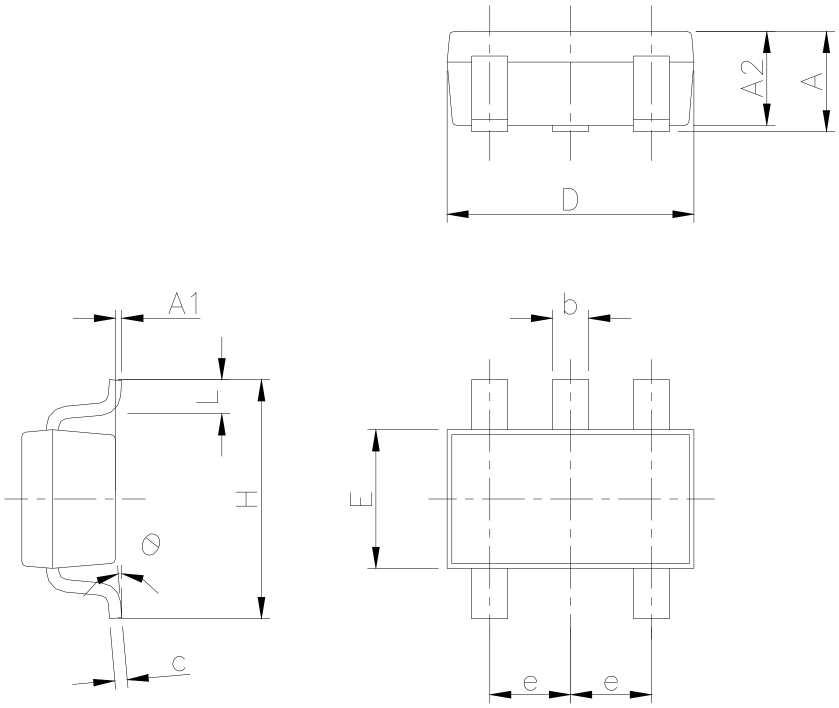
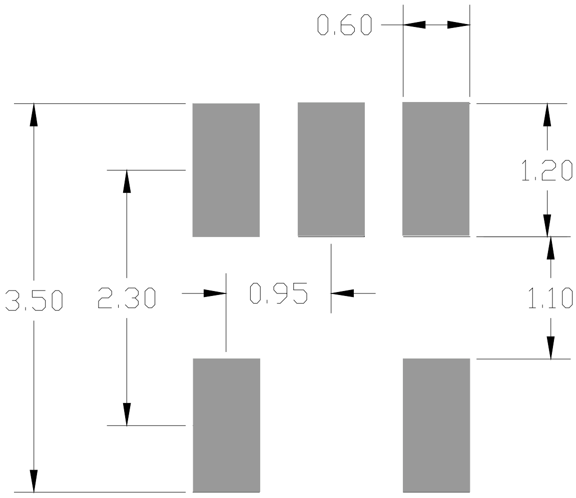


Table 8. **SOT23-5L package mechanical data**

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 32. SOT23-5L recommended footprint



Note: Dimensions are in mm

7.2 SOT23-5L packing information

Figure 33. **SOT23-5L tape and reel outline**

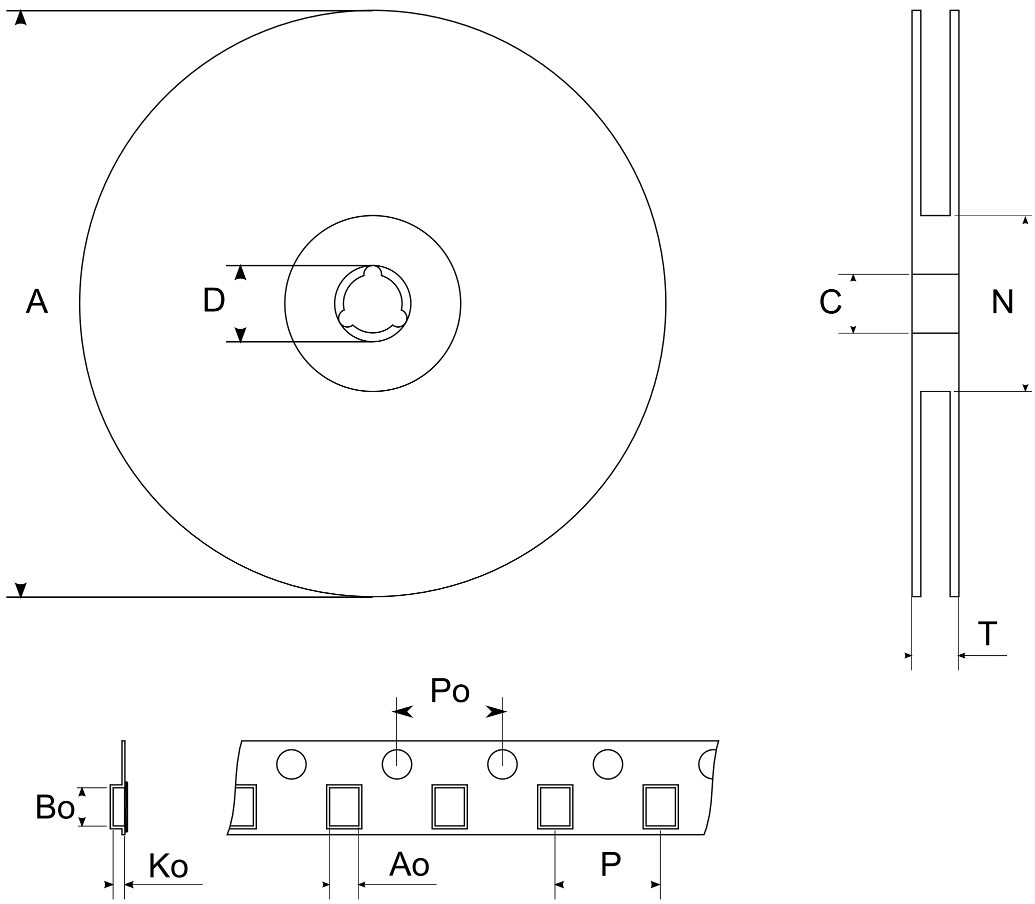


Table 9. **SOT23-5L tape and reel mechanical data**

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 34. SOT-89 package outline

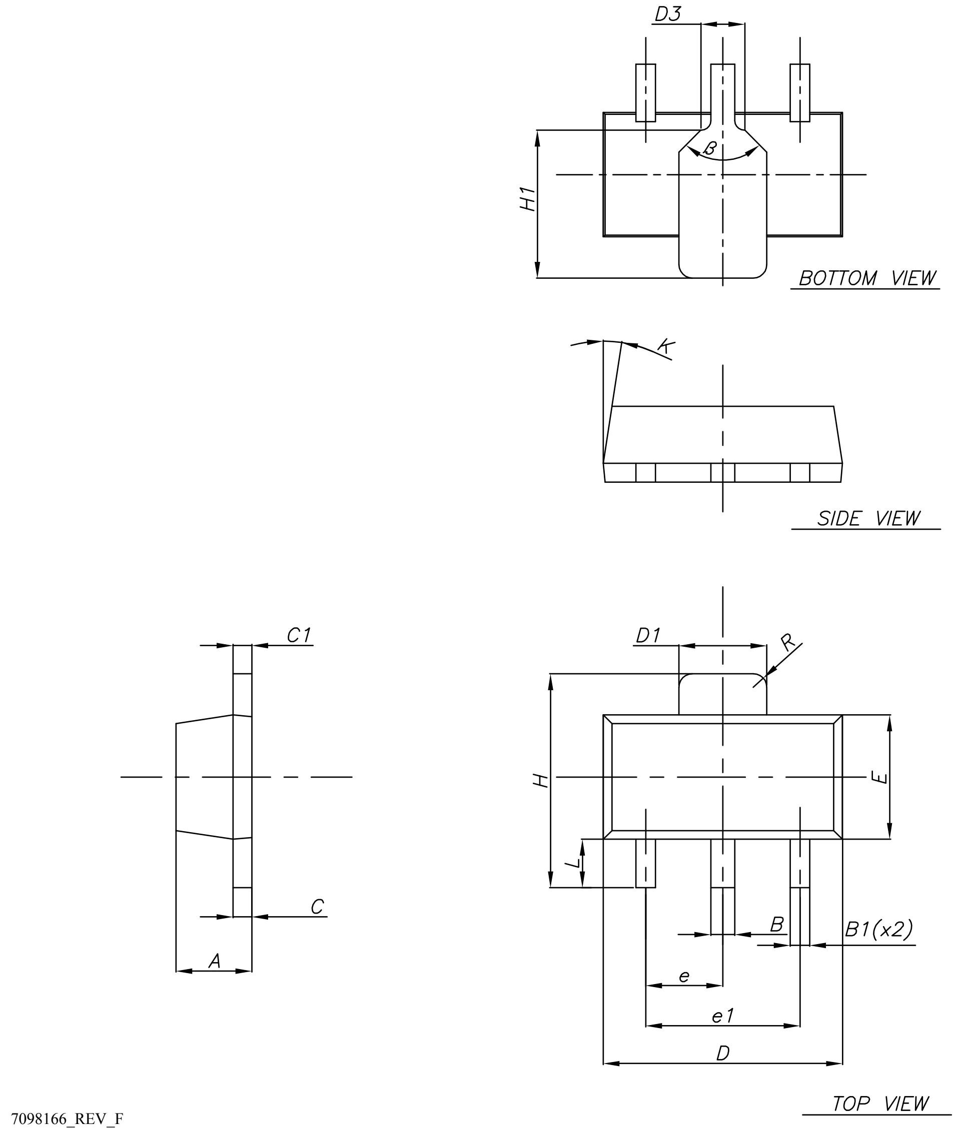
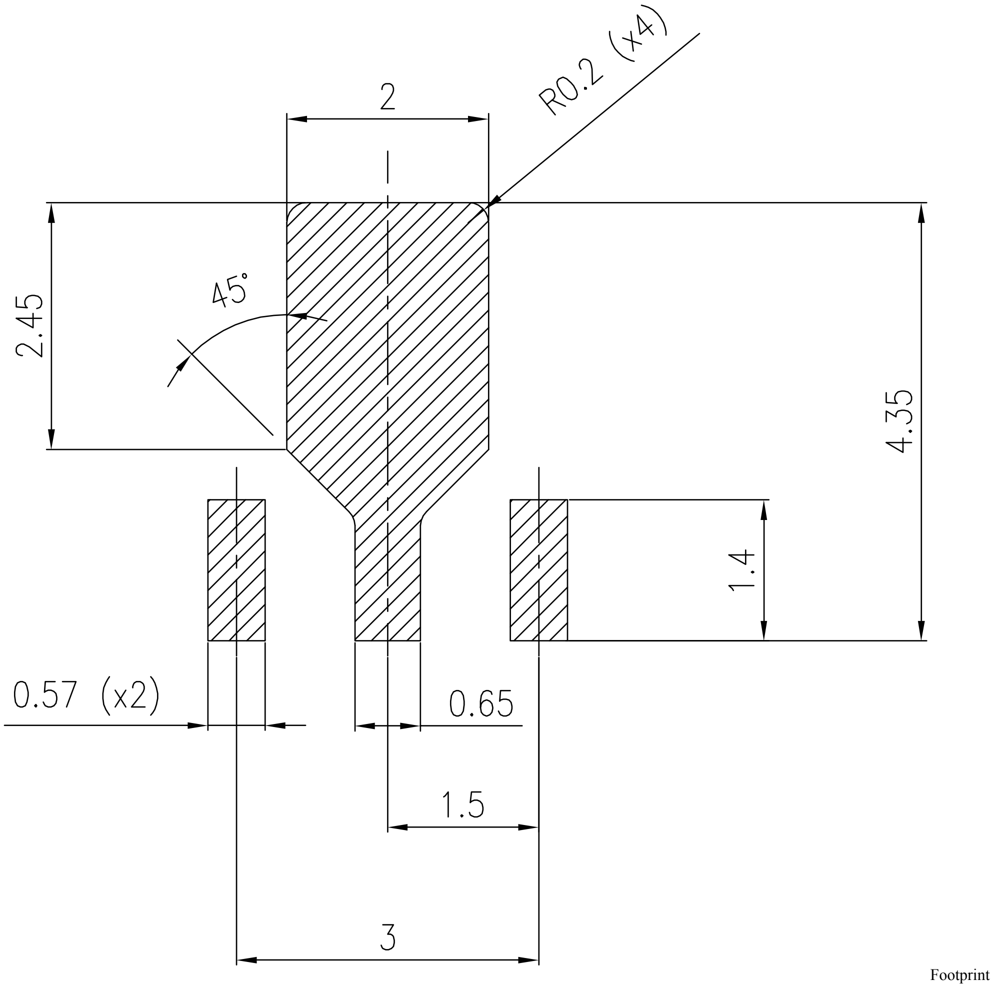


Table 10. **SOT-89 mechanical data**

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 35. **SOT-89 recommended footprint**



7.4 SOT-89 packing information

Figure 36. SOT-89 carrier tape outline

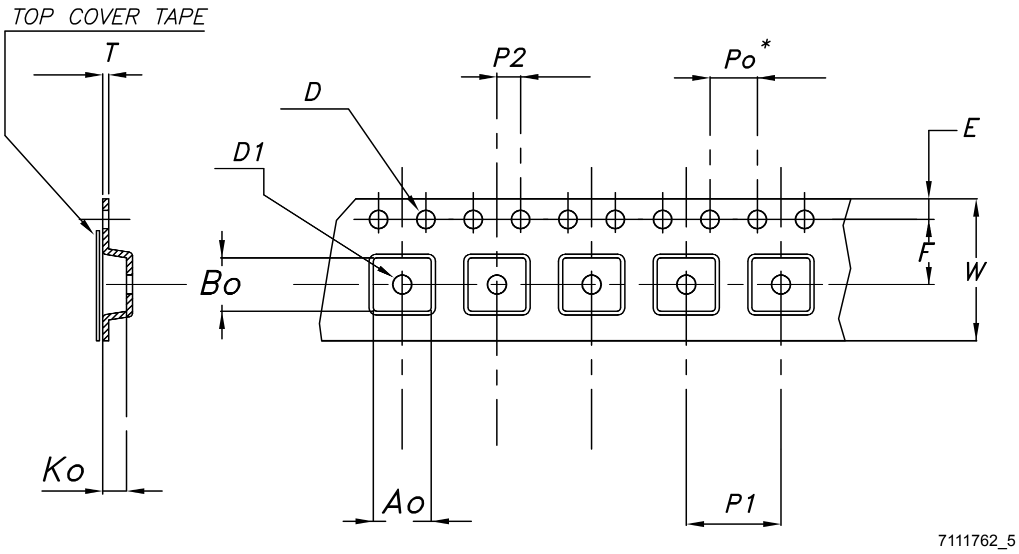


Table 11. SOT-89 carrier tape mechanical data

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

7.5 SOT323-5L package information

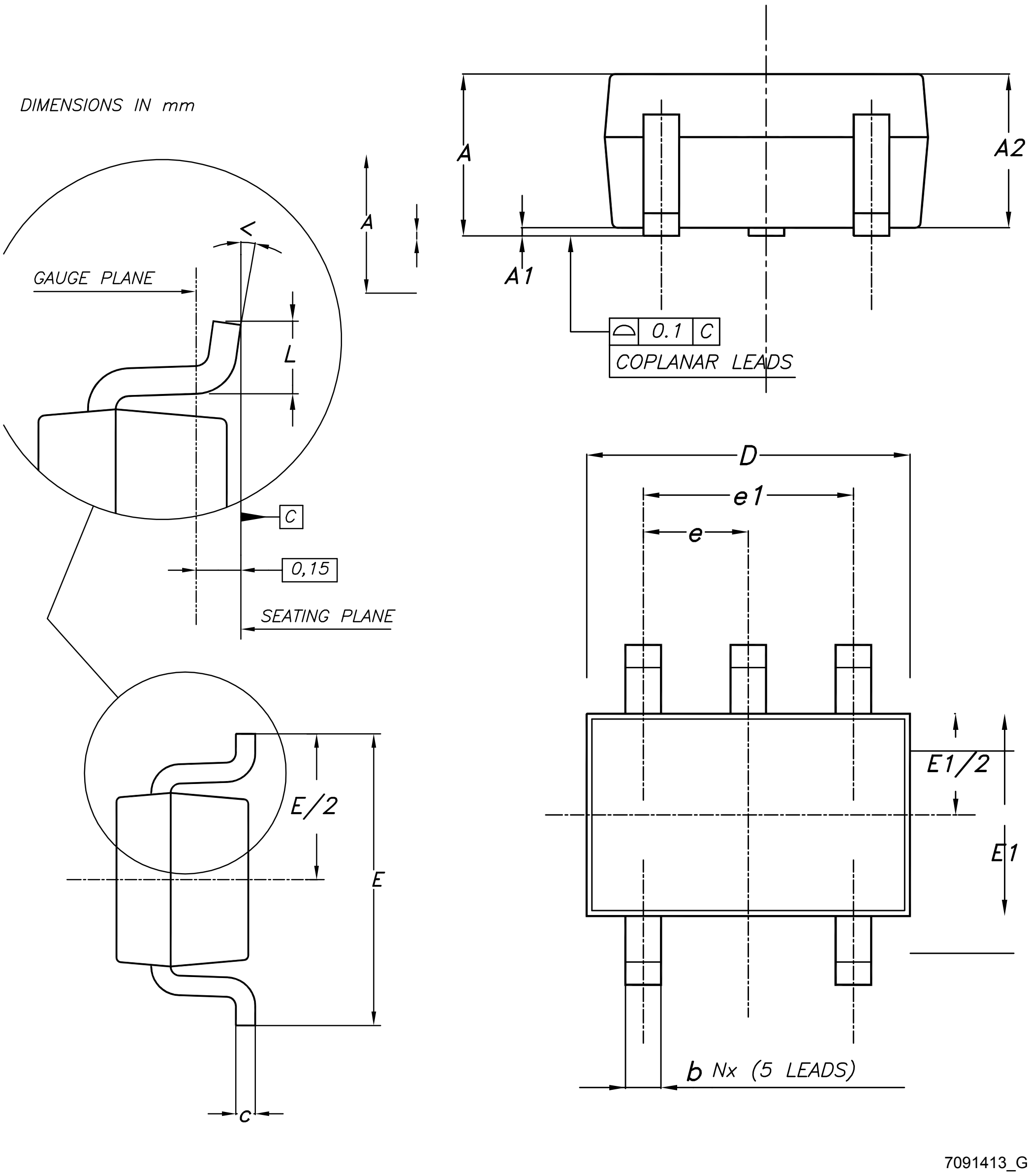
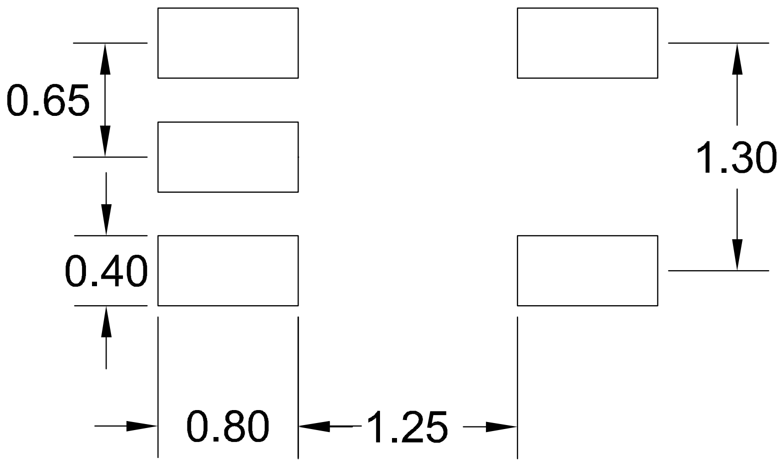


Figure 37. SOT323-5L package outline

Table 12. **SOT323-5L package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.10
A1	0		0.10
A2	0.80	0.90	1
b	0.15		0.30
c	0.10		0.22
D	1.80	2	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e		0.65	
e1		1.30	
L	0.26	0.36	0.46
<	0°		8°

Figure 38. **SOT323-5L recommended footprint**



7.6 DFN6 package information

Figure 39. DFN6 package outline

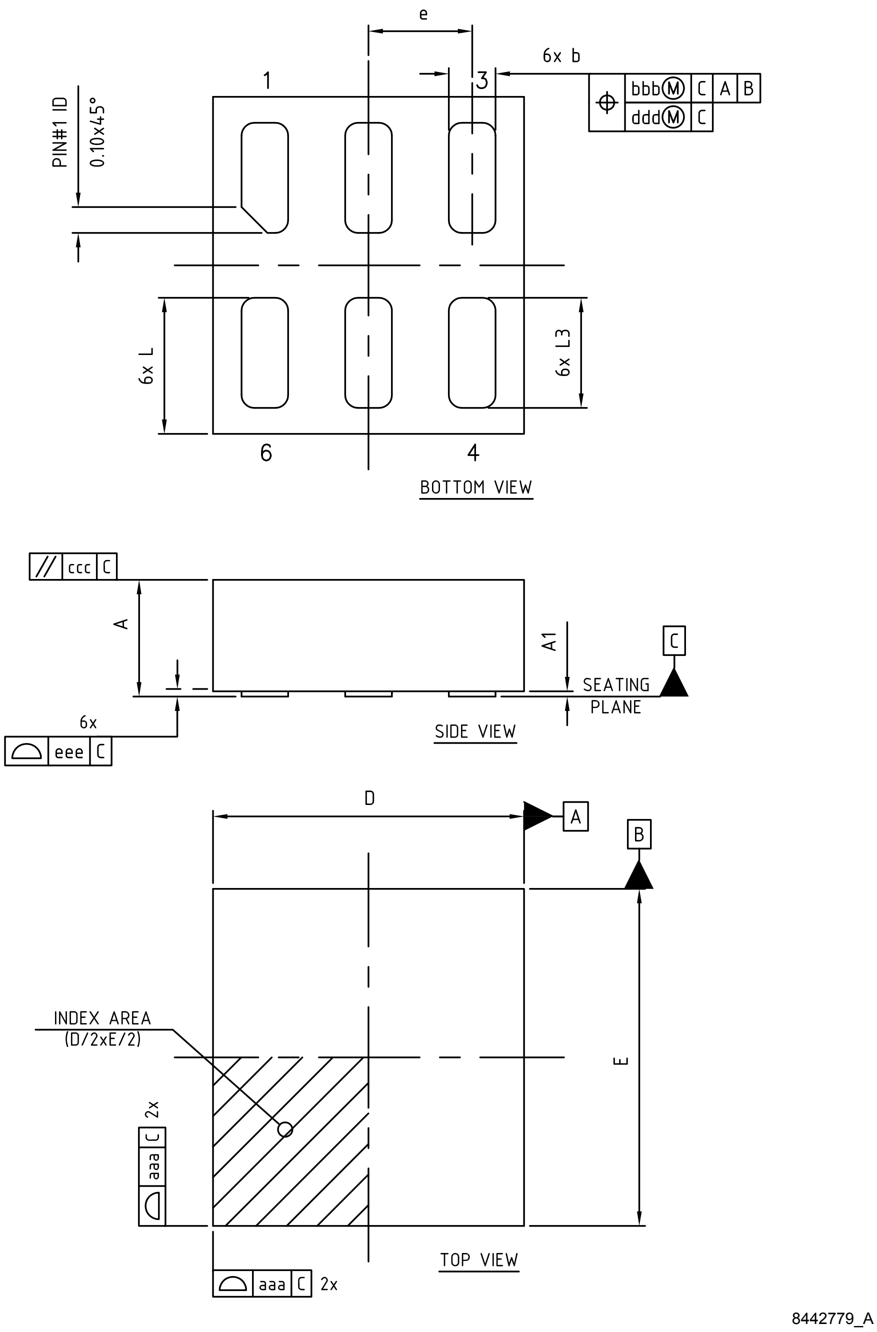
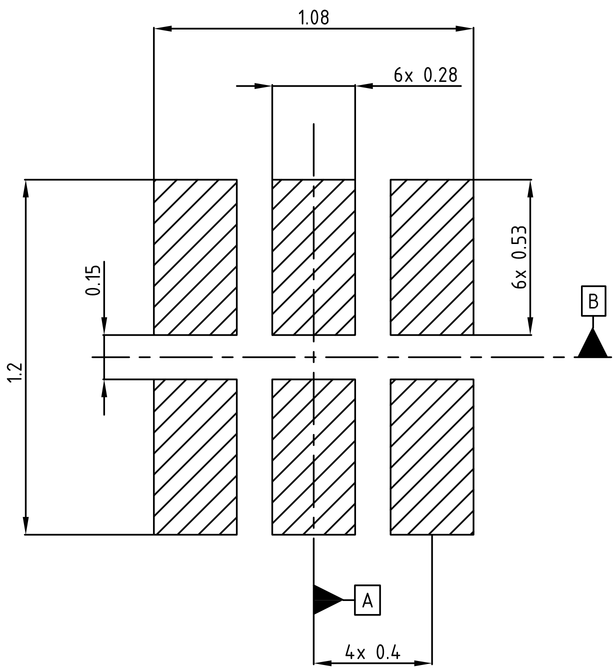


Table 13. **DFN6 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.41	0.45	0.50
A1	0.00	0.02	0.05
D	-	1.20	-
E	-	1.30	-
e	-	0.40	-
b	0.15	0.18	0.25
L	0.475	0.525	0.575
L3	0.375	0.425	0.475
aaa	-	0.05	-
bbb	-	0.10	-
ccc	-	0.05	-
ddd	-	0.05	-
eee	-	0.05	-

Figure 40. **DFN6 recommended footprint**



8 Ordering information

Table 14. **Order codes**

SOT323-5L	SOT23-5L	SOT-89	DFN6	Output voltage (V)
LDK220C25R	LDK220M25R		LDK220PU25R	2.5
LDK220C27R	LDK220M27R		LDK220PU27R	2.7
LDK220C30R	LDK220M30R	LDK220U30R	LDK220PU30R	3
LDK220C32R	LDK220M32R		LDK220PU32R	3.2
LDK220C33R	LDK220M33R	LDK220U33R	LDK220PU33R	3.3
	LDK220M35R			3.5
LDK220C36R	LDK220M36R	LDK220U36R	LDK220PU36R	3.6
LDK220C40R	LDK220M40R		LDK220PU40R	4
LDK220C50R	LDK220M50R	LDK220U50R	LDK220PU50R	5
LDK220C-R	LDK220M-R		LDK220PU-R	ADJ

Revision history

Table 15. Document revision history

Date	Revision	Changes
19-Mar-2014	1	Initial release.
24-Nov-2014	2	Updated the features in cover page, Table 6: LDK220 electrical characteristics for fixed output version, Table 7: LDK220 electrical characteristics for adjustable version, Table 8: SOT23-5L mechanical data, and Section 6: Typical characteristics. Minor text changes.
19-May-2015	3	Added SOT-89 package. Updated features in cover page. Updated Section 2: Pin configuration, Section 3: Typical application, Table 5: Thermal data, Section 7: Package information and Section 8: Ordering information. Minor text changes.
24-Oct-2016	4	Updated Table 7: "LDK220 electrical characteristics for adjustable version" and Section 7: "Package information". Minor text changes.
20-Dec-2019	5	Updated Section 1 Diagram.
12-Feb-2020	6	Added new part number LDK220M35R in Table 14. Order codes.