

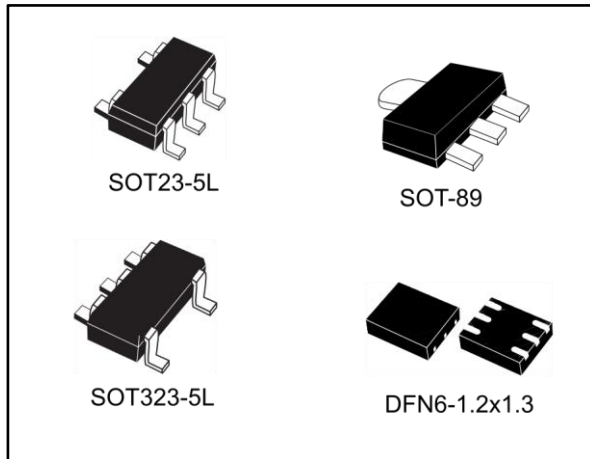


# THE DATASHEET OF LDK220M33R



**200 mA low quiescent current and low noise LDO**

Datasheet - production data

**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  $\mu$ A.

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

**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  $\mu$ A, 1  $\mu$ A in off mode)
- Low noise
- Output voltage tolerance:  $\pm 2.0\%$  @ 25  $^{\circ}$ 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
- Compatible with ceramic capacitor  
 $C_{OUT} = 1 \mu$ F
- Internal current and thermal limit
- Available in SOT23-5L, SOT323-5L, SOT-89 and DFN6-1.2x1.3 packages
- Temperature range: -40  $^{\circ}$ C to 125  $^{\circ}$ C

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# 1 Diagram

Figure 1: Block diagram (fixed version)

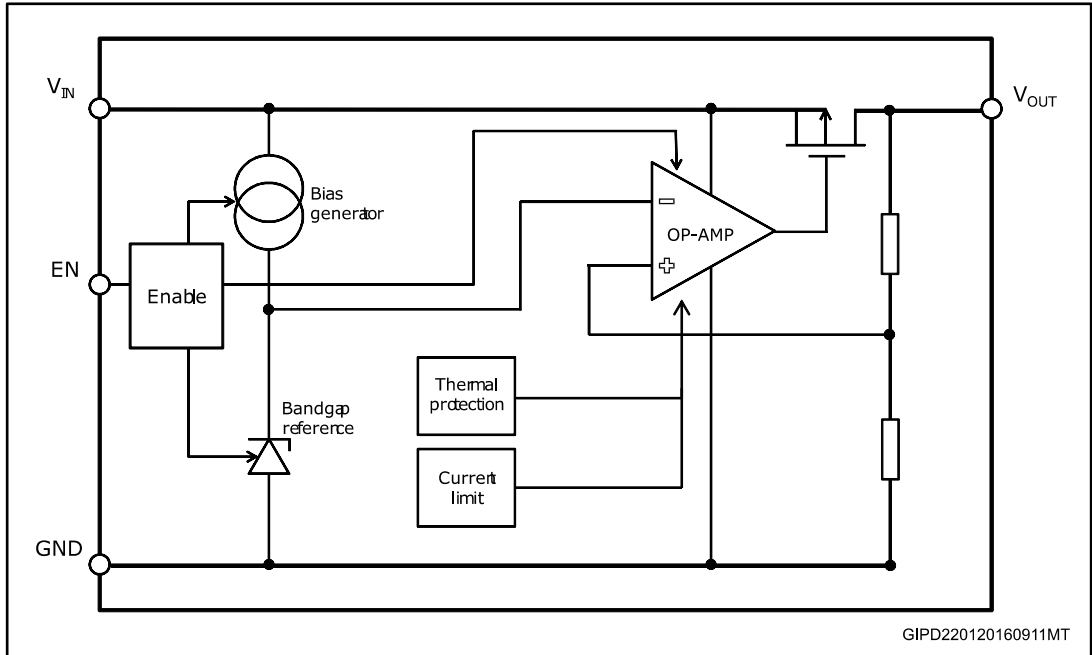
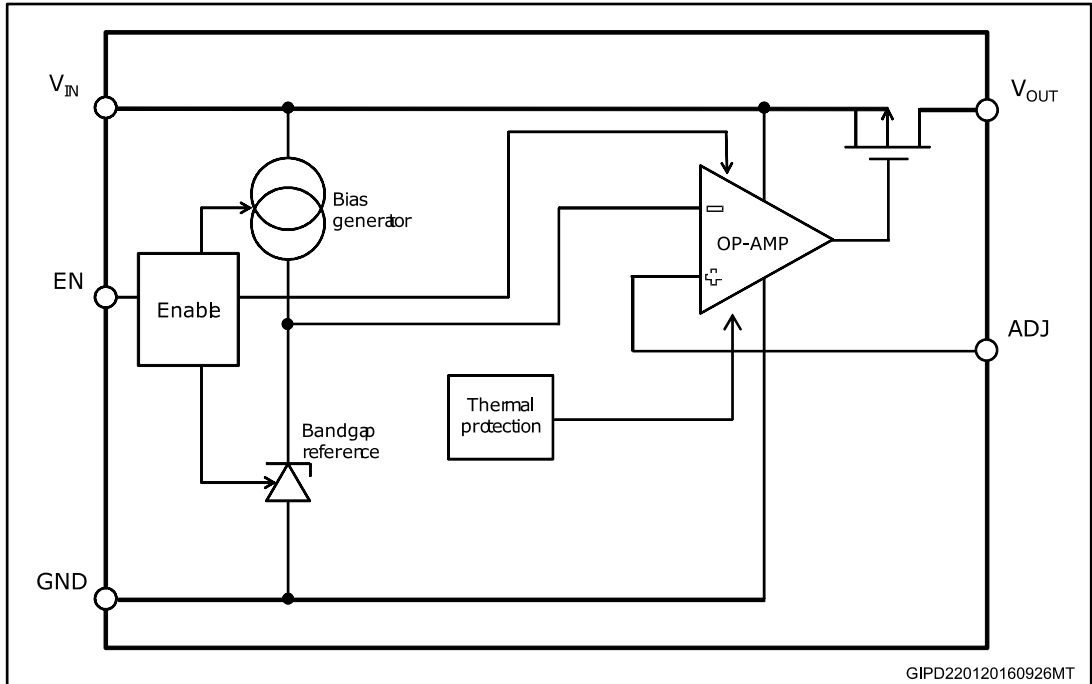


Figure 2: Block diagram (adjustable version)



## 2 Pin configuration

Figure 3: Pin connections (top view)

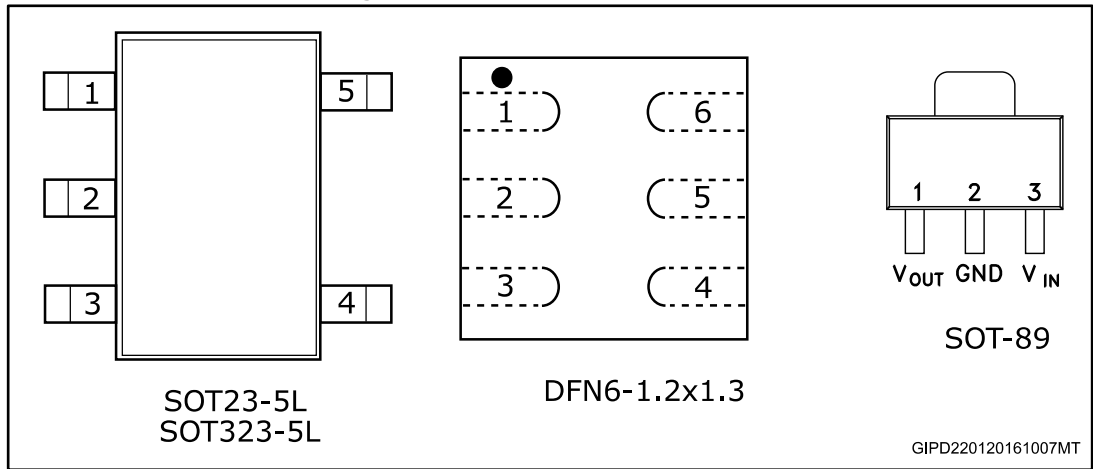


Table 1: Pin description (SOT23-5L, SOT323-5L)

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
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
5	GND	Common ground
6	IN	Input voltage of the LDO

Table 3: Pin description (SOT-89)

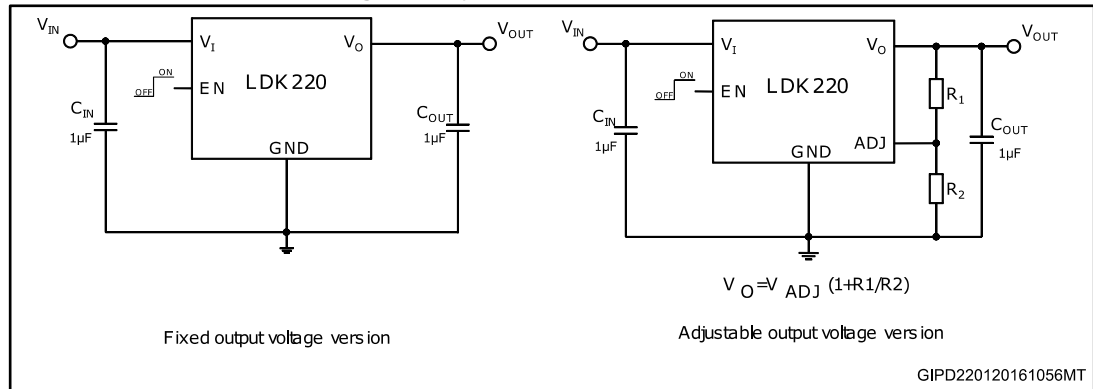
Pin n° <sup>(1)</sup>	Symbol	Function
1	OUT	Output voltage of the LDO
2	GND	Common ground
3	IN	Input voltage of the LDO

**Notes:**

<sup>(1)</sup> Adjustable version and enable pin are not available on the SOT-89 package.

### 3 Typical application

Figure 4: Typical application circuits



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 $V_I + 0.3$	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	500	mW
$T_{STG}$	Storage temperature range	- 65 to 150	°C
$T_{OP}$	Operating junction temperature range	- 40 to 125	°C

**Notes:**

<sup>(1)</sup> Maximum power dissipation has to be calculated taking into account the package thermal performance.



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

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

**Table 6: LDK220 electrical characteristics for fixed output version**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{IN}$	Operating input voltage		2.5		13.2	V
$V_{OUT}$	$V_{OUT}$ accuracy	$I_{OUT} = 1\text{ mA}$ , $T_J = 25\text{ °C}$	-2		2	%
		$I_{OUT} = 1\text{ mA}$ , $-40\text{ °C} < T_J < 125\text{ °C}$	-3		3	%
$\Delta V_{OUT}$	Static line regulation	$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 13.2\text{ V}$ , $I_{OUT} = 1\text{ mA}$		0.001	0.05	%/V
$\Delta V_{OUT}$	Static load regulation	$I_{OUT} = 1\text{ mA}$ to 200 mA		0.001	0.003	%/mA
$V_{DROP}$	Dropout voltage <sup>(1)</sup>	$I_{OUT} = 100\text{ mA}$ , $V_{OUT} = 3.3\text{ V}$		100		mV
		$I_{OUT} = 200\text{ mA}$ , $V_{OUT} = 3.3\text{ V}$ $40\text{ °C} < T_J < 125\text{ °C}$		200	350	
$e_N$	Output noise voltage	10 Hz to 100 kHz, $I_{OUT} = 10\text{ mA}$		20		$\mu\text{V}_{RMS}/\text{V}$
SVR	Supply voltage rejection	$V_{IN} = V_{OUT(NOM)} + 0.5\text{ V} + / - V_{RIPPLE}$ $V_{RIPPLE} = 0.1\text{ V}$ frequency = 120 Hz to 1 kHz $I_{OUT} = 10\text{ mA}$		55		dB
		$V_{IN} = V_{OUT(NOM)} + 0.5\text{ V} + / - V_{RIPPLE}$ $V_{RIPPLE} = 0.1\text{ V}$ frequency = 10 kHz $I_{OUT} = 10\text{ mA}$		50		
$I_Q$	Quiescent current	$V_{IN} = V_{OUT} + 1\text{ V}$ $I_{OUT} = 0\text{ mA}$ , $-40\text{ °C} < T_J < 125\text{ °C}$		55	90	$\mu\text{A}$
		$V_{OUT} + 1\text{ V} \leq V_{IN} \leq 13.2\text{ V}$ <sup>(2)</sup> $I_{OUT} = 200\text{ mA}$ , $-40\text{ °C} < T_J < 125\text{ °C}$		60	100	
		$V_{IN}$ input current in off mode: $V_{EN} = \text{GND}$ , $T_J = 25\text{ °C}$		0.1	1	
$I_{SC}$	Short-circuit current <sup>(2)</sup>	$R_L = 0$		400		mA
$V_{EN}$	Enable input logic low	$V_{IN} = 2.5\text{ V}$ to 13.2 V, $-40\text{ °C} < T_J < 125\text{ °C}$			0.4	V
	Enable input logic high	$V_{IN} = 2.5\text{ V}$ to 13.2 V, $-40\text{ °C} < T_J < 125\text{ °C}$	1.2			
$I_{EN}$	Enable pin input current	$V_{EN} = V_{IN}$		0.1	100	nA

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
T <sub>SHDN</sub>	Thermal shutdown			160		°C
	Hysteresis			20		
C <sub>OUT</sub>	Output capacitor	Capacitance (see <a href="#">Section 6: "Typical performance characteristics"</a> )	1		22	µF

**Notes:**

- (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.

T<sub>J</sub> = 25 °C, V<sub>IN</sub> = V<sub>OUT(NOM)</sub> + 1 V, C<sub>IN</sub> = C<sub>OUT</sub> = 1 µF, I<sub>OUT</sub> = 1 mA, V<sub>EN</sub> = V<sub>IN</sub>, unless otherwise specified.

**Table 7: LDK220 electrical characteristics for adjustable version**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>IN</sub>	Operating input voltage		2.5		13.2	V
V <sub>ADJ</sub>	Adjustable voltage	T <sub>J</sub> = 25 °C		1.185		V
	Adjustable voltage accuracy	T <sub>J</sub> = 25 °C	-2		+2	%
40 °C < T <sub>J</sub> < 125 °C		-3		+3		
ΔV <sub>OUT</sub>	Static line regulation	V <sub>OUT</sub> +1 V ≤ V <sub>IN</sub> ≤ 13.2 V I <sub>OUT</sub> =1 mA		0.001	0.05	%/V
ΔV <sub>OUT</sub>	Static load regulation	I <sub>OUT</sub> = 1 mA to 200 mA		0.0002	0.003	%/mA
V <sub>DROP</sub>	Dropout voltage <sup>(1)</sup>	I <sub>OUT</sub> = 100 mA, V <sub>OUT</sub> = 3.3 V		100		
		I <sub>OUT</sub> = 200 mA, V <sub>OUT</sub> = 3.3 V 40 °C < T <sub>J</sub> < 125 °C		200	350	mV
e <sub>N</sub>	Output noise voltage	10 Hz to 100 kHz, I <sub>OUT</sub> = 10 mA		100		µV <sub>RMS</sub> /V
I <sub>ADJ</sub>	Adjust pin current				1	µA
SVR	Supply voltage rejection	V <sub>IN</sub> = V <sub>OUTNOM</sub> + 0.5 V +/- V <sub>RIPPLE</sub> V <sub>RIPPLE</sub> = 0.1 V Frequency = 120 Hz to 1 kHz I <sub>OUT</sub> = 10 mA		60		dB
		V <sub>RIPPLE</sub> = 0.1 V V <sub>IN</sub> = V <sub>OUTNOM</sub> +0.5 V +/- V <sub>RIPPLE</sub> frequency = 10 kHz, I <sub>OUT</sub> = 10 mA		45		

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I <sub>Q</sub>	Quiescent current	V <sub>OUT</sub> +1 V ≤ V <sub>IN</sub> ≤ 13.2 V I <sub>OUT</sub> = 0 mA, -40 °C < T <sub>J</sub> < 125 °C		55	90	μA
		V <sub>OUT</sub> +1 V ≤ V <sub>IN</sub> ≤ 13.2 V <sup>(2)</sup> I <sub>OUT</sub> = 200 mA, -40 °C < T <sub>J</sub> < 125 °C		60	100	
		V <sub>IN</sub> input current in off mode: V <sub>EN</sub> = GND, T <sub>J</sub> = 25 °C		0.1	1	
I <sub>SC</sub>	Short-circuit current <sup>(2)</sup>	R <sub>L</sub> = 0		400		mA
V <sub>EN</sub>	Enable input logic low	V <sub>IN</sub> = 2.5 V to 13.2 V -40 °C < T <sub>J</sub> < 125 °C			0.4	V
	Enable input logic high	V <sub>IN</sub> = 2.5 V to 13.2 V -40 °C < T <sub>J</sub> < 125 °C	1.2			
I <sub>EN</sub>	Enable pin input current	V <sub>EN</sub> = V <sub>IN</sub>		0.1	100	nA
T <sub>SHDN</sub>	Thermal shutdown			160		°C
	Hysteresis			20		
C <sub>OUT</sub>	Output capacitor	Capacitance (see <a href="#">Section 6: "Typical performance characteristics"</a> )	1		22	μF

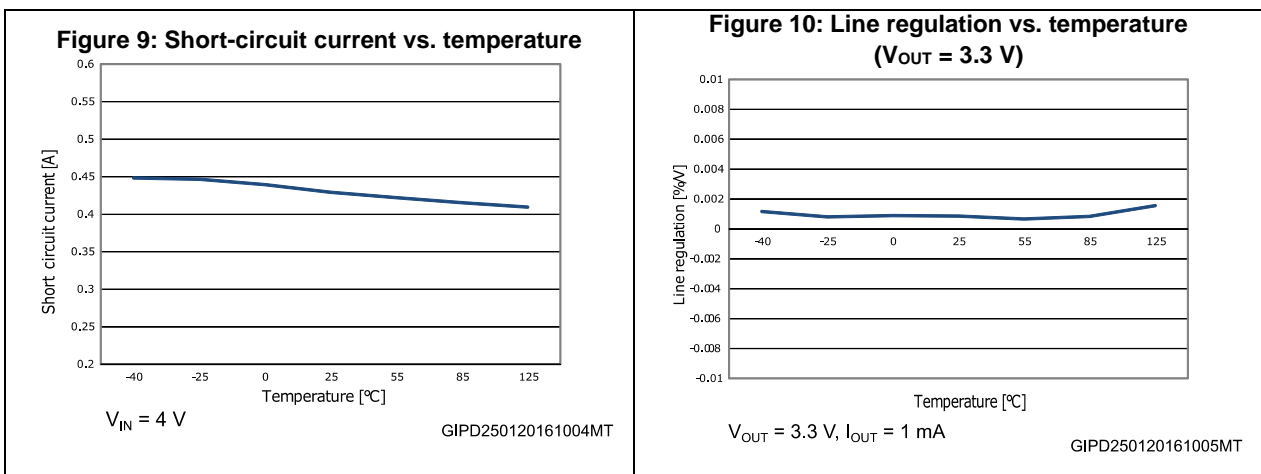
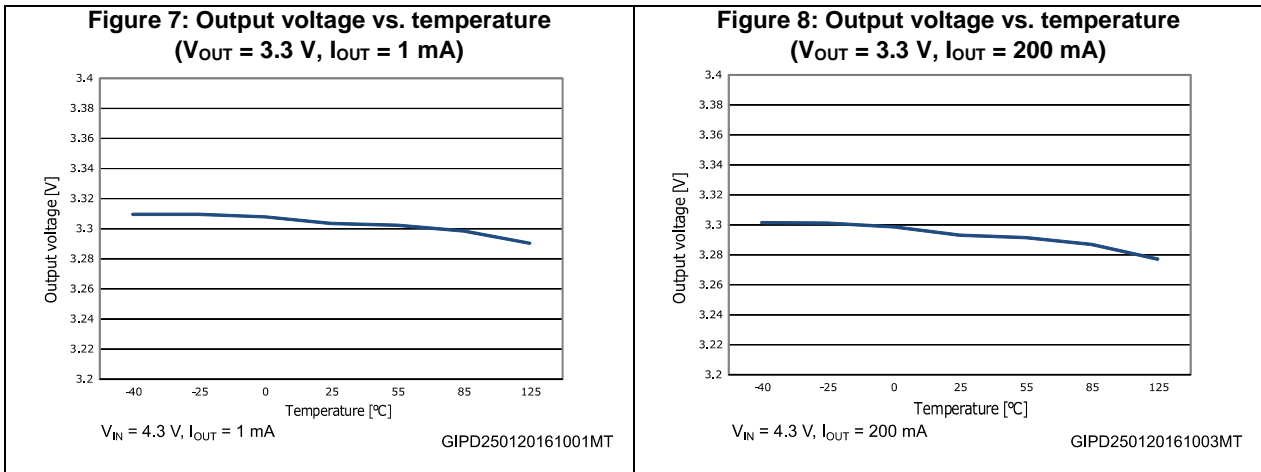
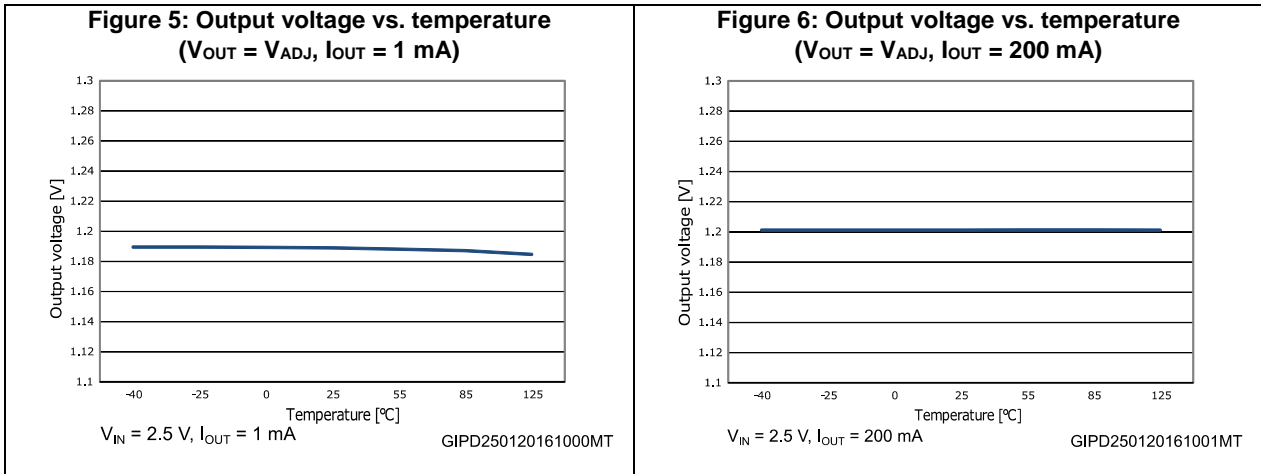
**Notes:**

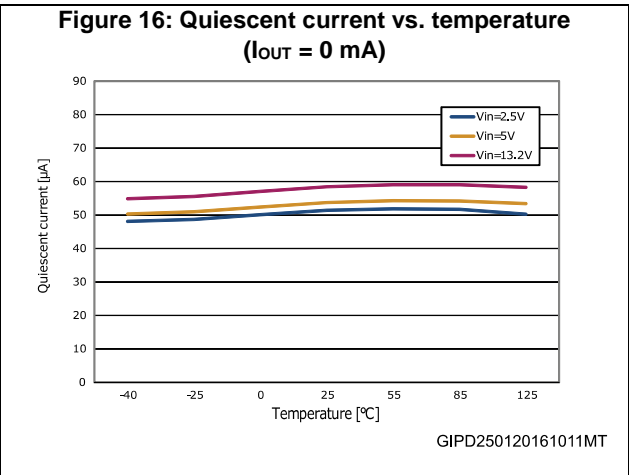
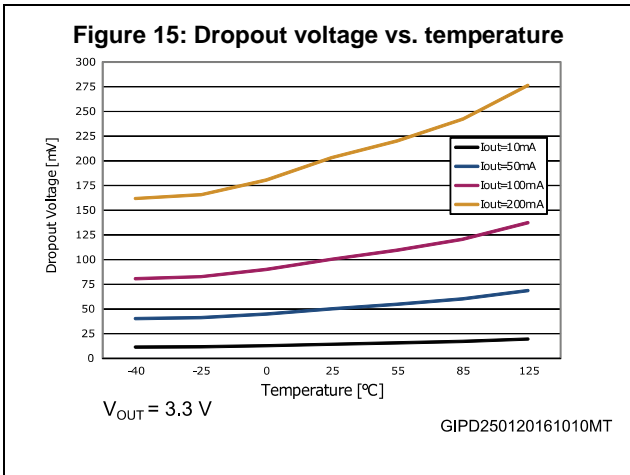
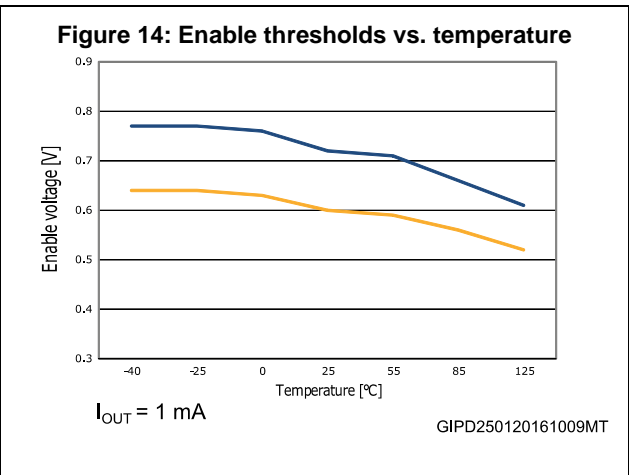
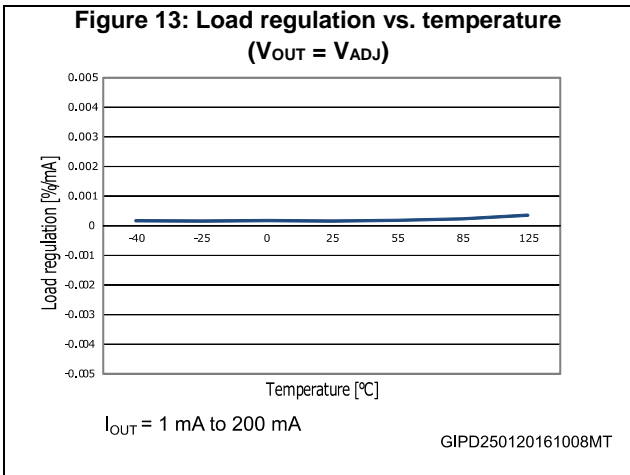
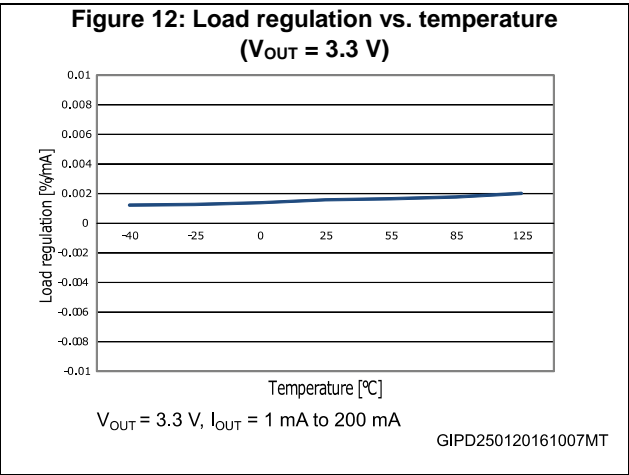
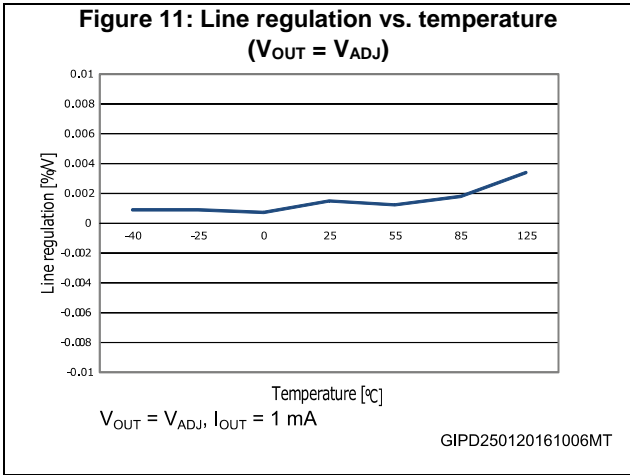
<sup>(1)</sup> Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value.

<sup>(2)</sup> The maximum current has to be limited according to the maximum power dissipation.

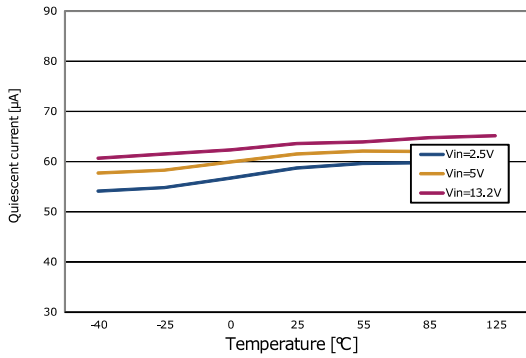
## 6 Typical performance characteristics

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



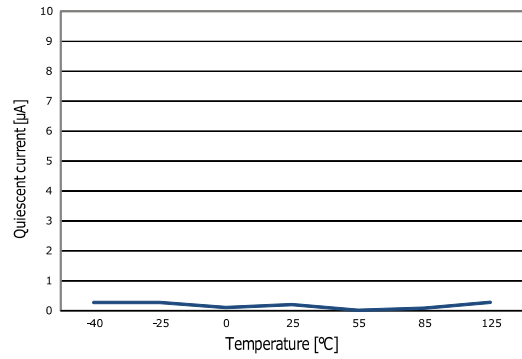


**Figure 17: Quiescent current vs. temperature (I<sub>OUT</sub> = 200 mA)**



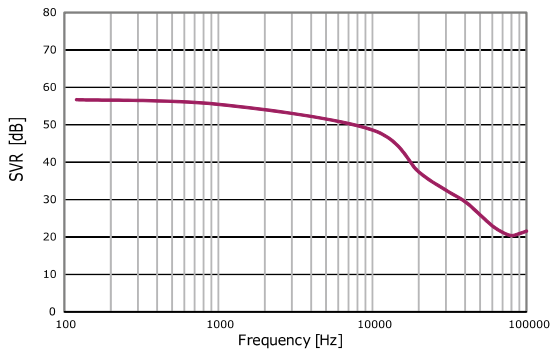
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**Figure 18: Off-state current vs. temperature**



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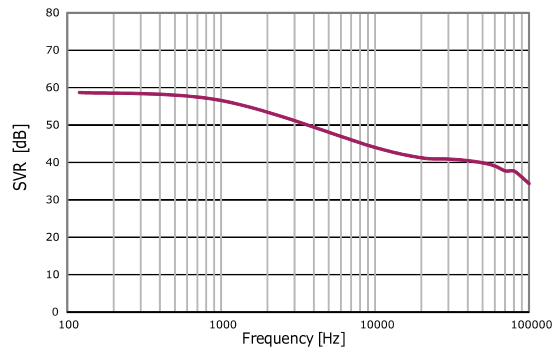
**Figure 19: SVR vs. frequency (V<sub>OUT</sub> = 3.3 V)**



V<sub>IN</sub> = 3.7 V +/- 100 mV, V<sub>OUT</sub> = 3.3 V, C<sub>OUT</sub> = 1 µF

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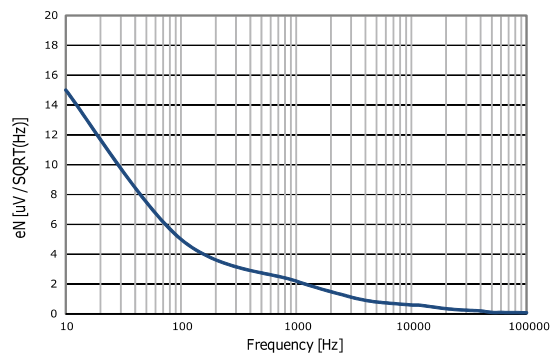
**Figure 20: SVR vs. frequency (V<sub>OUT</sub> = V<sub>ADJ</sub>)**



V<sub>IN</sub> = 2.5 V +/- 100 mV, V<sub>OUT</sub> = V<sub>ADJ</sub>, C<sub>OUT</sub> = 1 µF

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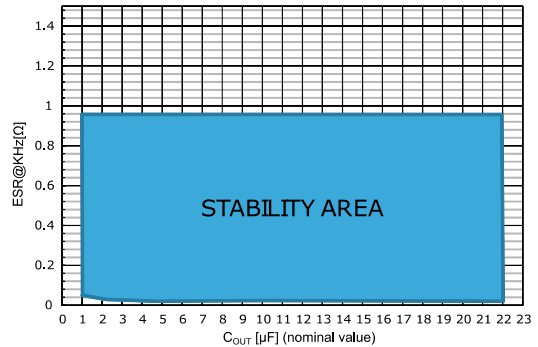
**Figure 21: Output noise spectral density**



V<sub>OUT</sub> = 3.3 V, C<sub>IN</sub> = C<sub>OUT</sub> = 1 µF

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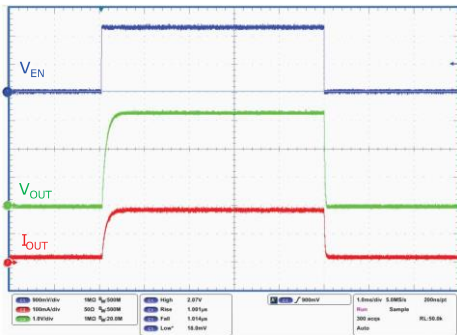
**Figure 22: Stability vs. (C<sub>OUT</sub>, ESR)**



V<sub>IN</sub> from 2.5 to 13.2 V, I<sub>OUT</sub> from 0 to 200 mA, C<sub>IN</sub> = 1 µF

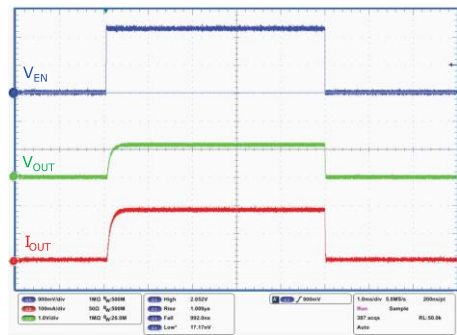
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Figure 23: Startup with enable ( $V_{OUT} = 3.3\text{ V}$ )



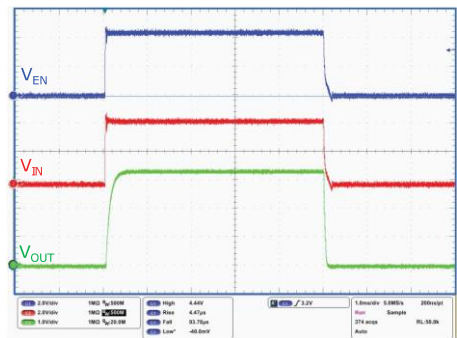
$V_{IN} = 4.3\text{ V}$ ,  $V_{EN} = 0\text{ V to } 2\text{ V}$ ,  $I_{OUT} = 0.2\text{ A}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $T_r = T_f = 1\text{ }\mu\text{s}$   
GIPD250120161426MT

Figure 24: Startup with enable ( $V_{OUT} = V_{ADJ}$ )



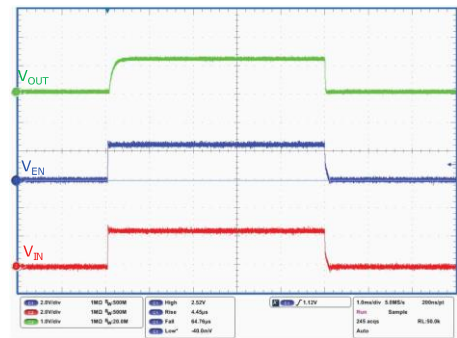
$V_{IN} = 2.5\text{ V}$ ,  $V_{EN} = 0\text{ V to } V_{IN}$ ,  $I_{OUT} = 0.2\text{ A}$ ,  $V_{OUT} = V_{ADJ}$ ,  $T_r = T_f = 1\text{ }\mu\text{s}$   
GIPD250120161427MT

Figure 25: Turn-on time ( $V_{OUT} = 3.3\text{ V}$ )



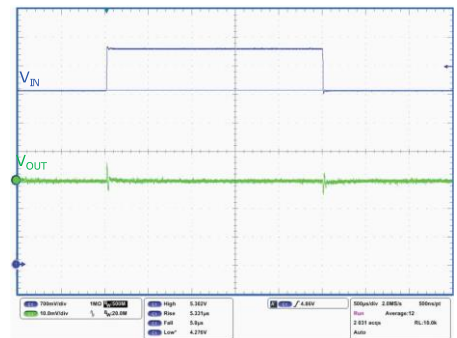
$V_{IN} = V_{EN} = 0\text{ V to } 4.3\text{ V}$ ,  $I_{OUT} = 0.2\text{ A}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $T_r = 5\text{ }\mu\text{s}$   
GIPD250120161428MT

Figure 26: Turn-on time ( $V_{OUT} = V_{ADJ}$ )



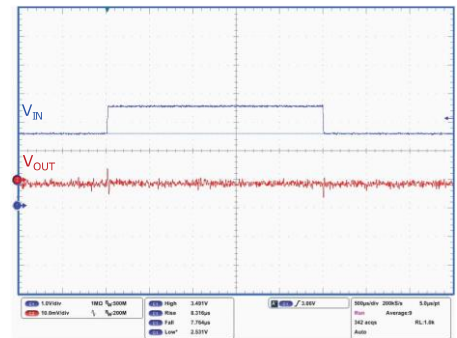
$V_{IN} = V_{EN} = 0\text{ V to } 2.5\text{ V}$ ,  $I_{OUT} = 0.2\text{ A}$ ,  $V_{OUT} = V_{ADJ}$ ,  $T_r = 5\text{ }\mu\text{s}$   
GIPD250120161429MT

Figure 27: Line transient ( $V_{OUT} = 3.3\text{ V}$ )



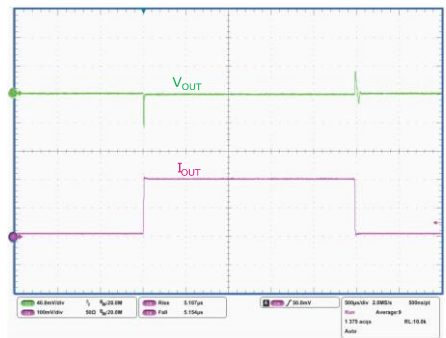
$V_{IN} = V_{EN} = 4.3\text{ V to } 5.3\text{ V}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $T_r = T_f = 5\text{ }\mu\text{s}$   
GIPD250120161430MT

Figure 28: Line transient ( $V_{OUT} = V_{ADJ}$ )



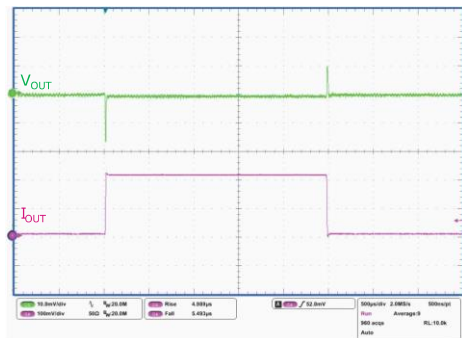
$V_{IN} = V_{EN} = 2.5\text{ V to } 3.5\text{ V}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $V_{OUT} = V_{ADJ}$ ,  $T_r = T_f = 5\text{ }\mu\text{s}$   
GIPD250120161431MT

Figure 29: Load transient ( $V_{OUT} = 3.3\text{ V}$ )



$V_{IN} = V_{EN} = 4.3\text{ V}$ ,  $I_{OUT} = 1\text{ mA to }0.2\text{ A}$ ,  $V_{OUT} = 3.3\text{ V}$ ,  $T_r = T_f = 5\text{ }\mu\text{s}$   
GIPD250120161432MT

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



$V_{IN} = V_{EN} = 2.5\text{ V}$ ,  $I_{OUT} = 1\text{ mA to }0.2\text{ A}$ ,  $V_{OUT} = V_{ADJ}$ ,  $T_r = T_f = 5\text{ }\mu\text{s}$   
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](http://www.st.com). ECOPACK® is an ST trademark.

### 7.1 SOT23-5L package information

Figure 31: SOT23-5L package outline

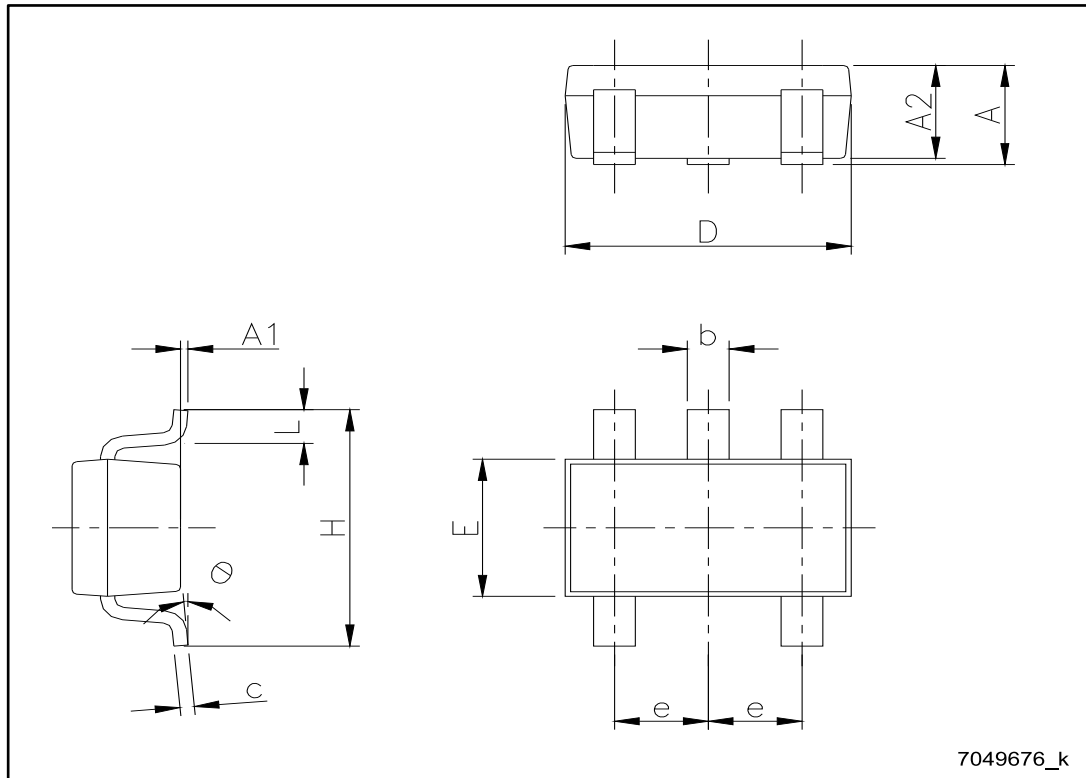
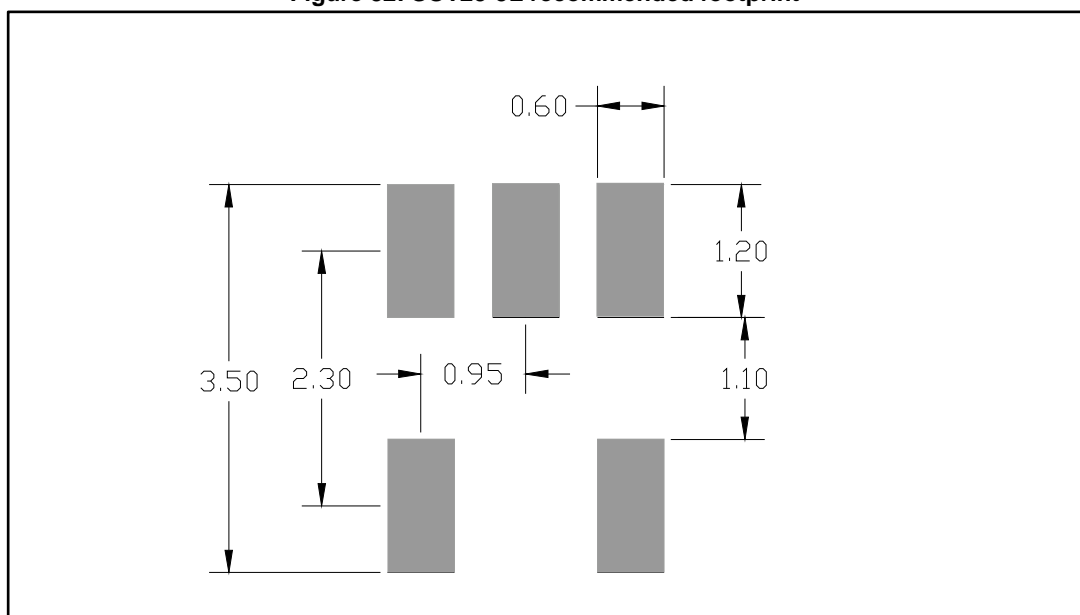


Table 8: SOT23-5L package mechanical data

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
$\theta$	0°		8°

Figure 32: SOT23-5L recommended footprint



Dimensions are in mm

## 7.2 SOT23-5L packing information

Figure 33: SOT23-5L tape and reel outline

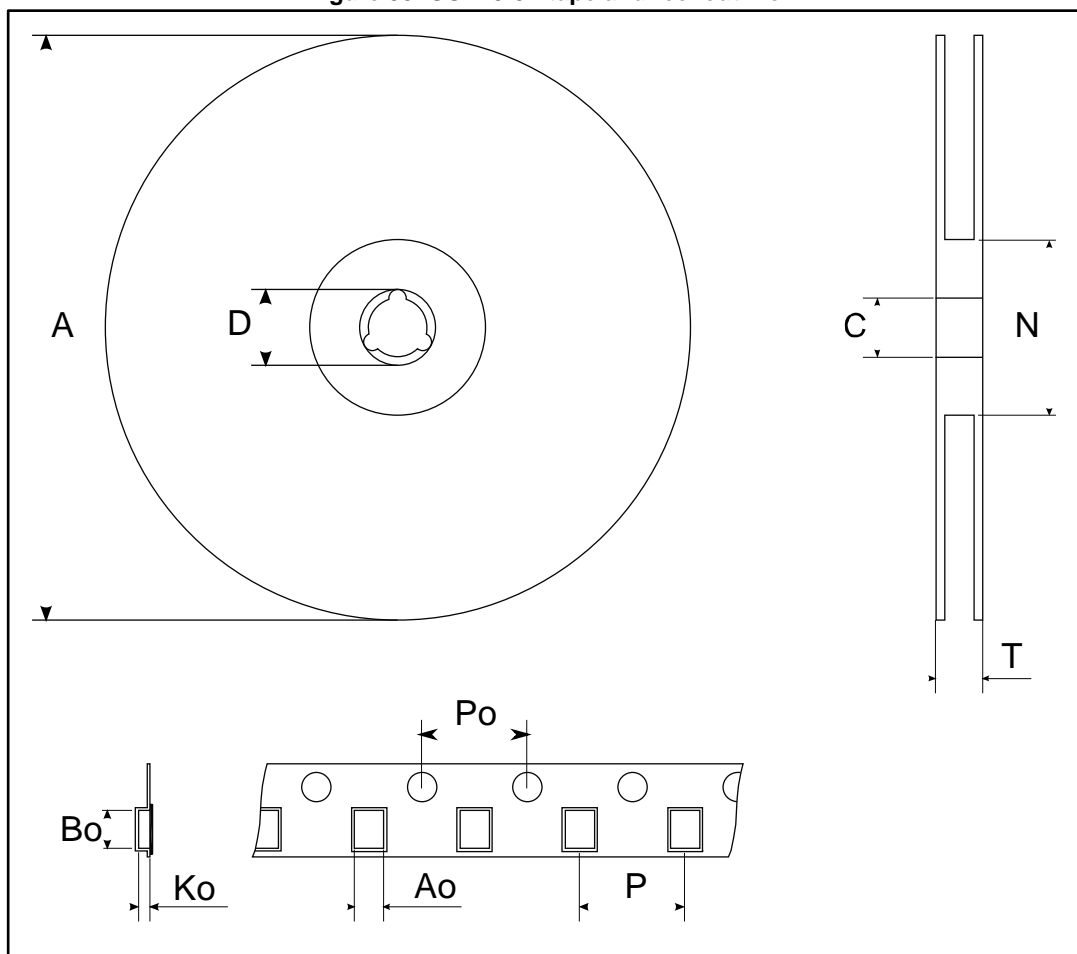


Table 9: SOT23-5L tape and reel mechanical data

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

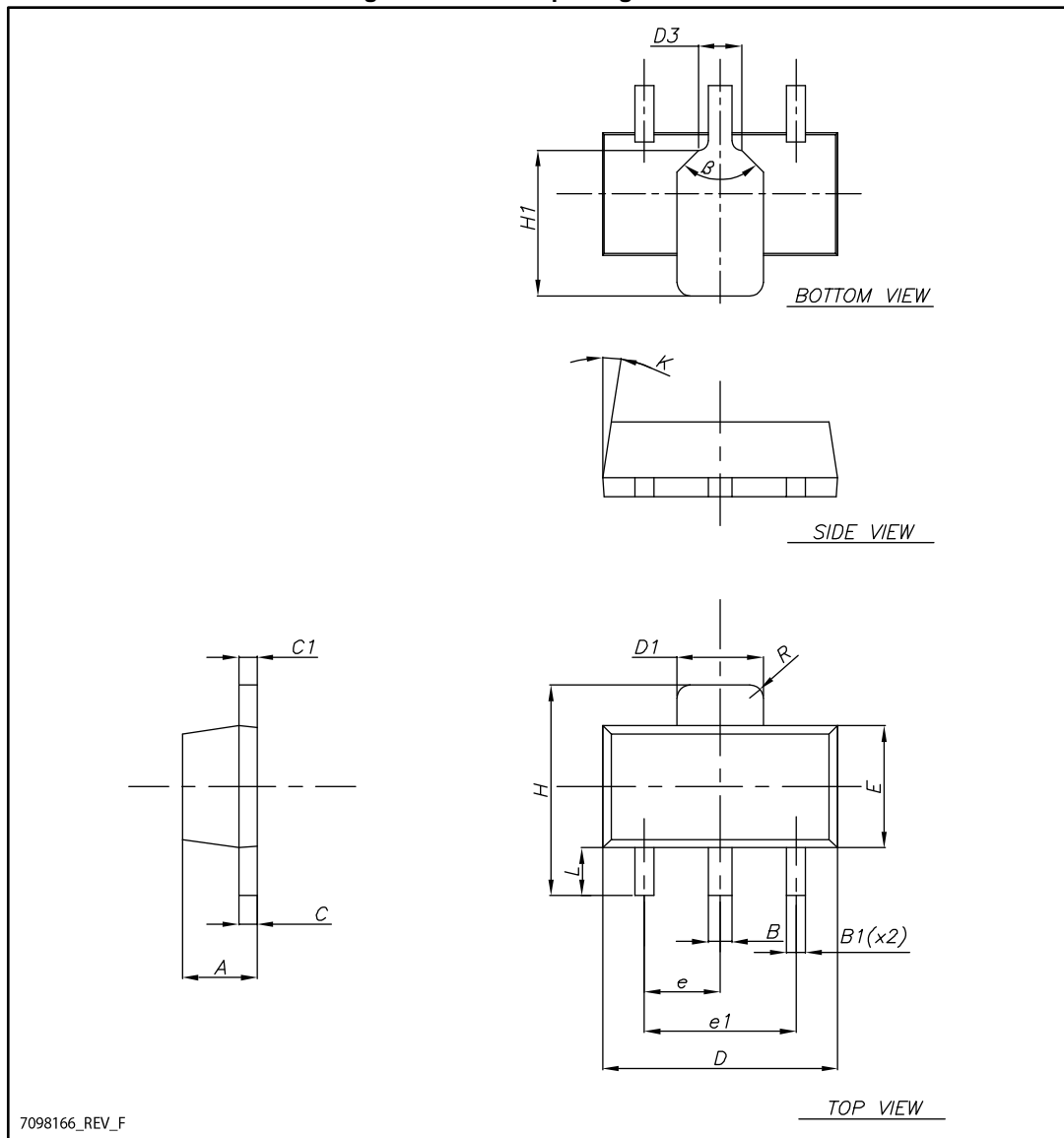
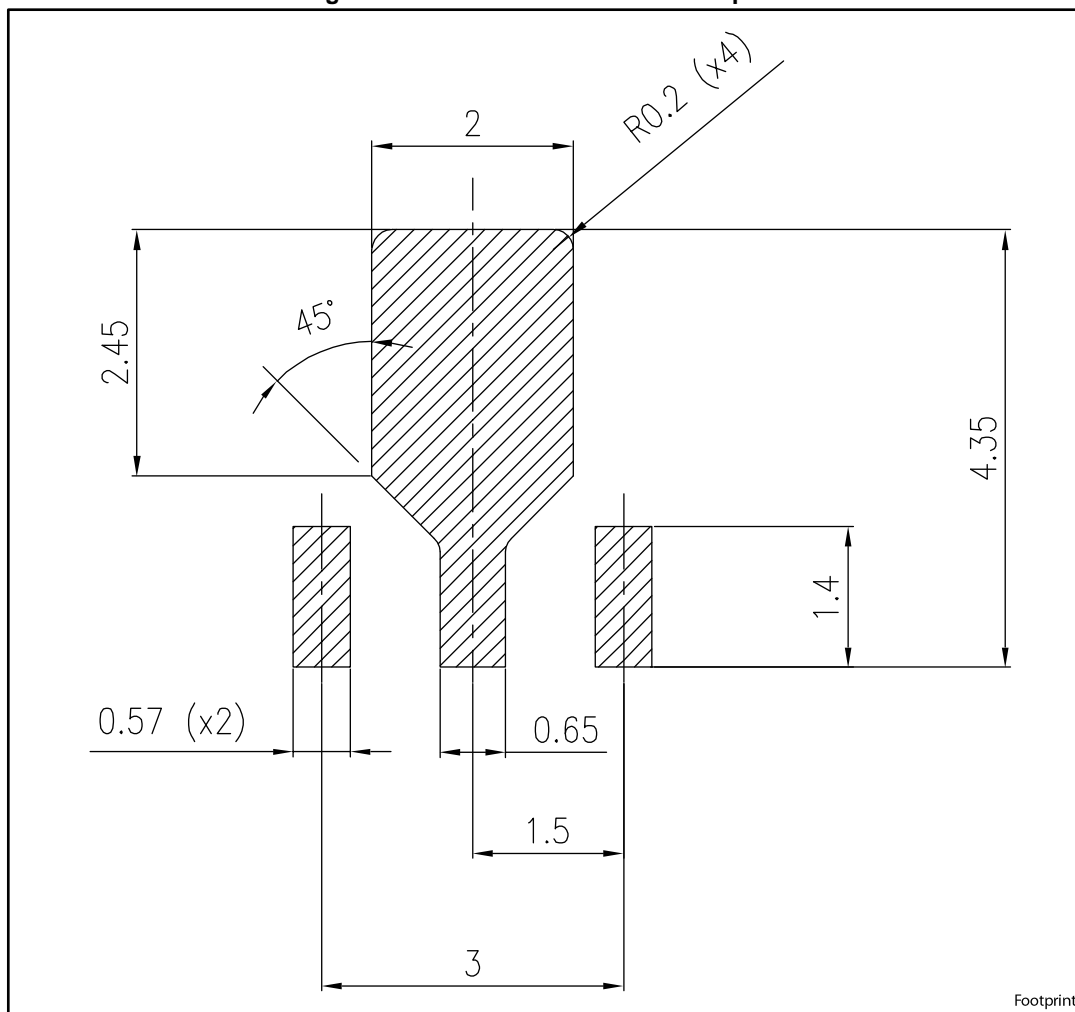


Table 10: SOT-89 mechanical data

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	
$\beta$		90°	

Figure 35: SOT-89 recommended footprint



## 7.4 SOT-89 packing information

Figure 36: SOT-89 carrier tape outline

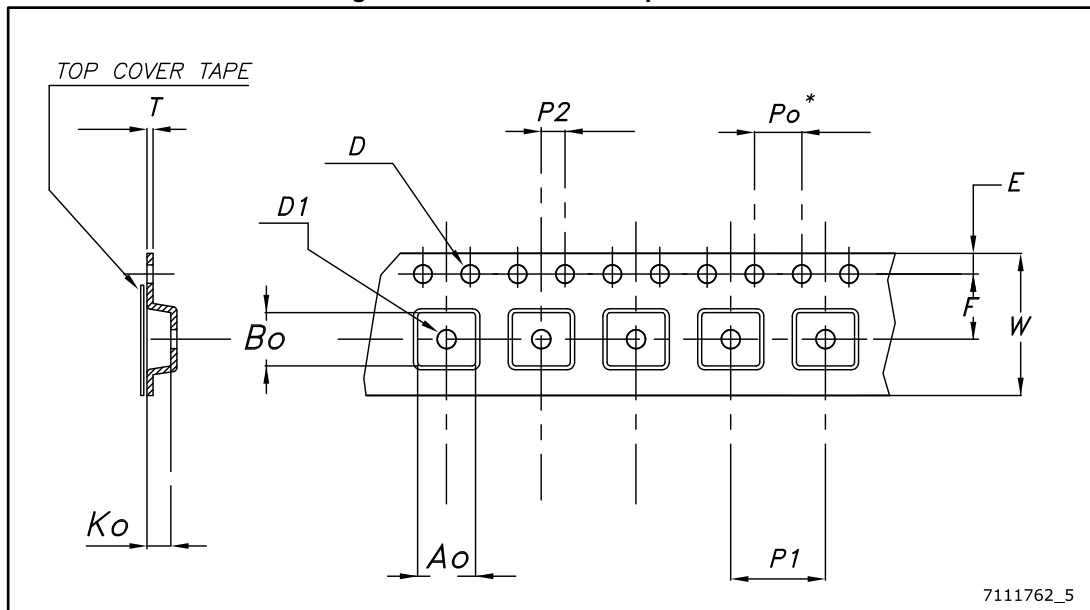


Table 11: SOT-89 carrier tape mechanical data

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

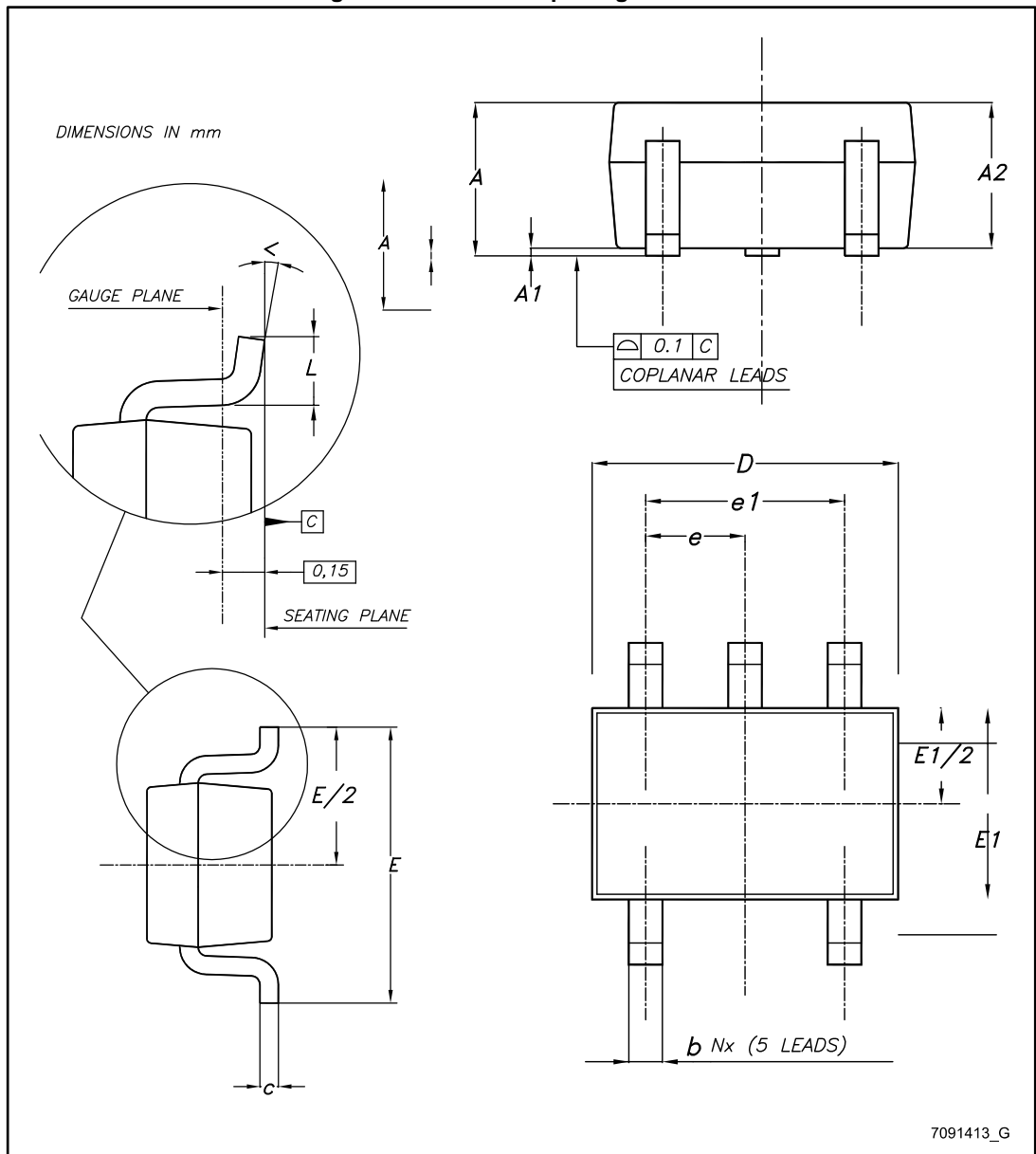
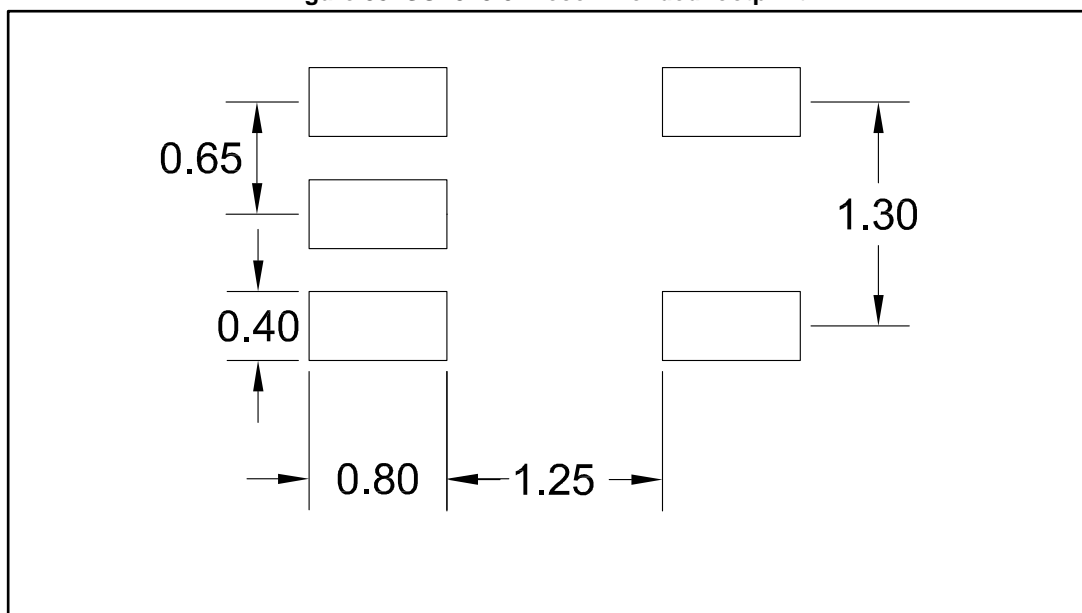


Table 12: SOT323-5L package mechanical data

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	1.36	0.46
<	0°		8°

Figure 38: SOT323-5L recommended footprint



### 7.6 DFN6 1.2x1.3 package information

Figure 39: DFN6 package outline

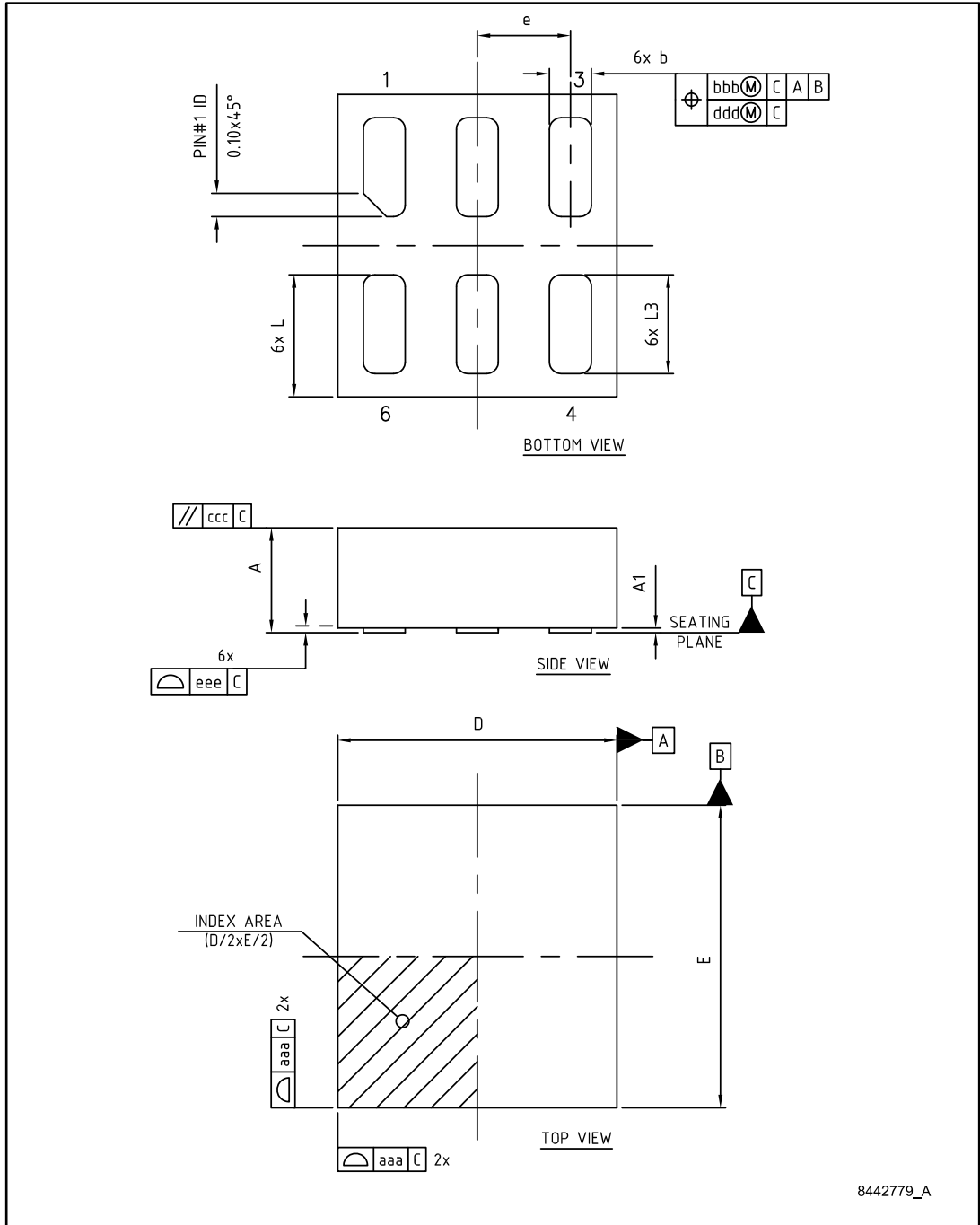
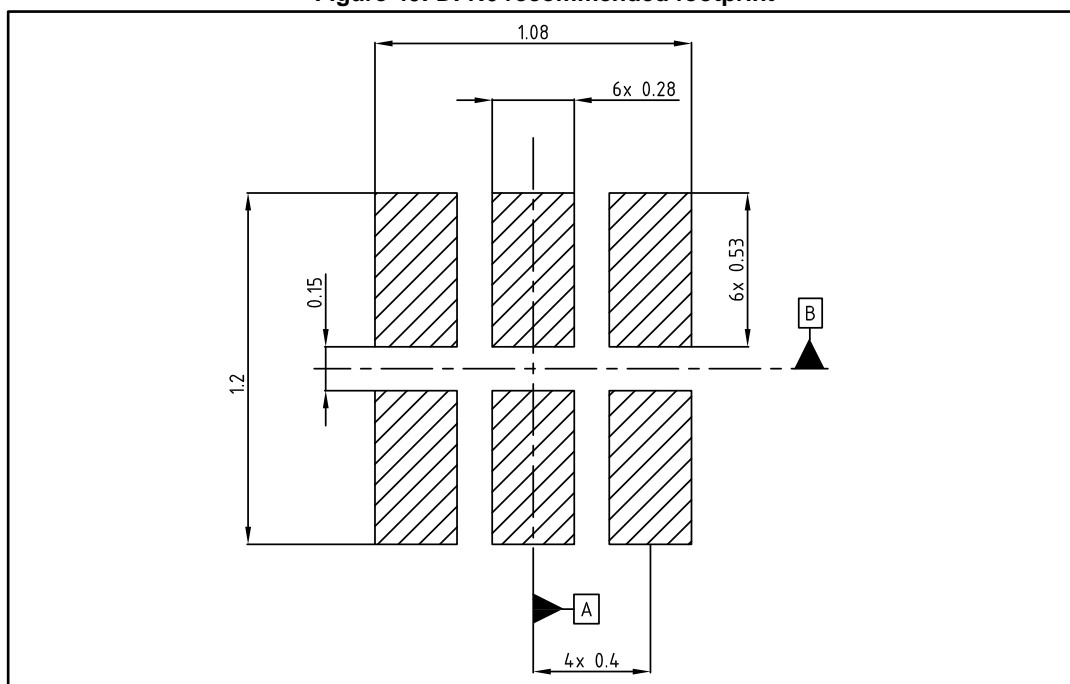


Table 13: DFN6 package mechanical data

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
LDK220C36R	LDK220M36R	LDK220U36R	LDK220PU36R	3.6
LDK220C40R	LDK220M40R		LDK220PU40R	4
LDK220C50R	LDK220M50R	LDK220U50R	LDK220PU50R	5
LDK220C-R	LDK220M-R		LDK220PU-R	adj

## 9 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, <i>Table 6: LDK220 electrical characteristics for fixed output version</i> , <i>Table 7: LDK220 electrical characteristics for adjustable version</i> , <i>Table 8: SOT23-5L mechanical data</i> , and <i>Section 6: Typical characteristics</i> . Minor text changes.
19-May-2015	3	Added SOT-89 package. Updated features in cover page. Updated <i>Section 2: Pin configuration</i> , <i>Section 3: Typical application</i> , <i>Table 5: Thermal data</i> , <i>Section 7: Package information</i> and <i>Section 8: Ordering information</i> . Minor text changes.
24-Oct-2016	4	Updated <i>Table 7: "LDK220 electrical characteristics for adjustable version"</i> and <i>Section 7: "Package information"</i> . Minor text changes.

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