

## Low noise and low drop voltage regulator with shutdown function

Datasheet - production data



### Description

The LK112S is a low-dropout linear regulator with shutdown function. The internal switch can be controlled by TTL or CMOS logic levels. The device is ON when the control pin is pulled to a high logic level. An external capacitor can be connected to the noise bypass pin to reduce the output noise level to 30  $\mu\text{V}_{\text{rms}}$ . An internal PNP pass transistor is used to achieve a low-dropout voltage.

The LK112S has a very low quiescent current in ON mode while in OFF mode the  $I_q$  is reduced to 100 nA max. The internal thermal shutdown circuitry limits the junction temperature below 150 °C. The load current is internally monitored and in the presence of a short-circuit or overcurrent conditions at the output, the device shuts down.

### Features

- Output current up to 200 mA
- Low-dropout voltage (500 mV max. at  $I_{\text{OUT}} = 200 \text{ mA}$ )
- Very low quiescent current: 0.1  $\mu\text{A}$  in OFF mode and max. 250  $\mu\text{A}$  in ON mode at  $I_{\text{OUT}} = 0 \text{ mA}$
- Low output noise: typ. 30  $\mu\text{V}$  at  $I_{\text{OUT}} = 60 \text{ mA}$  and  $10 \text{ Hz} < f < 80 \text{ kHz}$
- Wide range of output voltages
- Internal current and thermal limit
- $V_{\text{OUT}}$  tolerance  $\pm 2\%$  (at 25 °C)
- Operative input voltage from:  $V_{\text{OUT}} + 0.5$  to 14 V (for  $V_{\text{OUT}} > 2 \text{ V}$ ) or from 2.5 V to 14 V (for  $V_{\text{OUT}} < 2 \text{ V}$ )

**Table 1. Device summary**

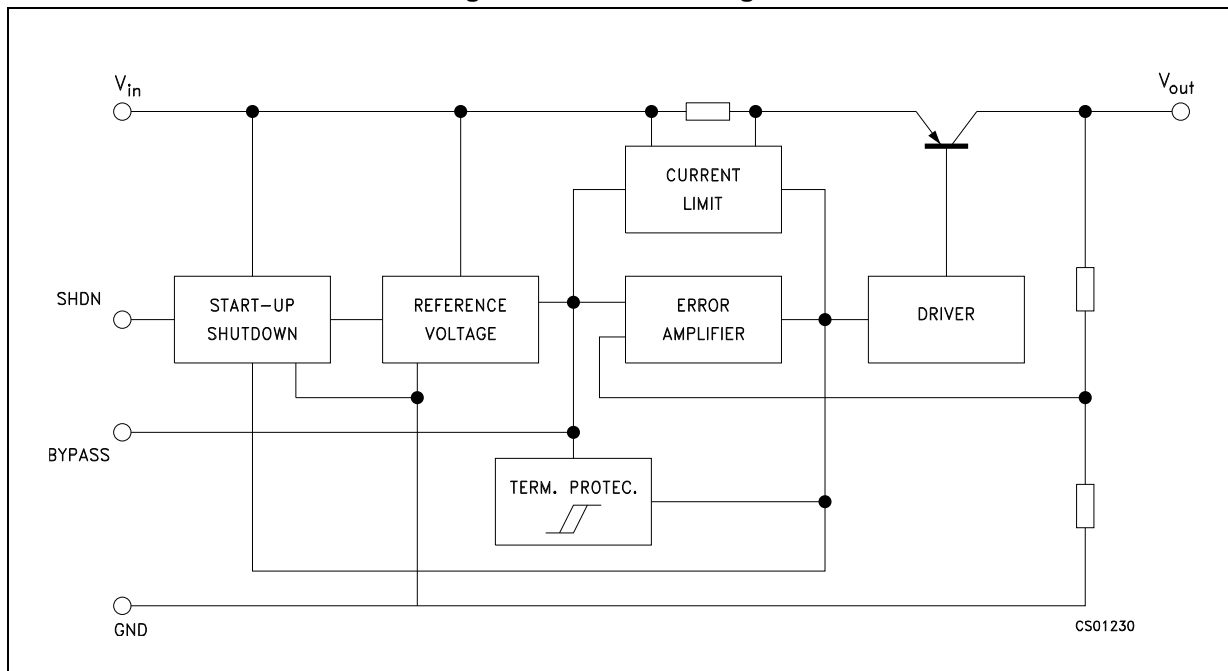
Part number	Output voltage
LK112SM18TR	1.8 V
LK112SM33TR	3.3 V
LK112SM50TR	5.0 V

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# 1 Diagram

Figure 1. Schematic diagram



## 2 Pin configuration

Figure 2. Pin connection (top view)

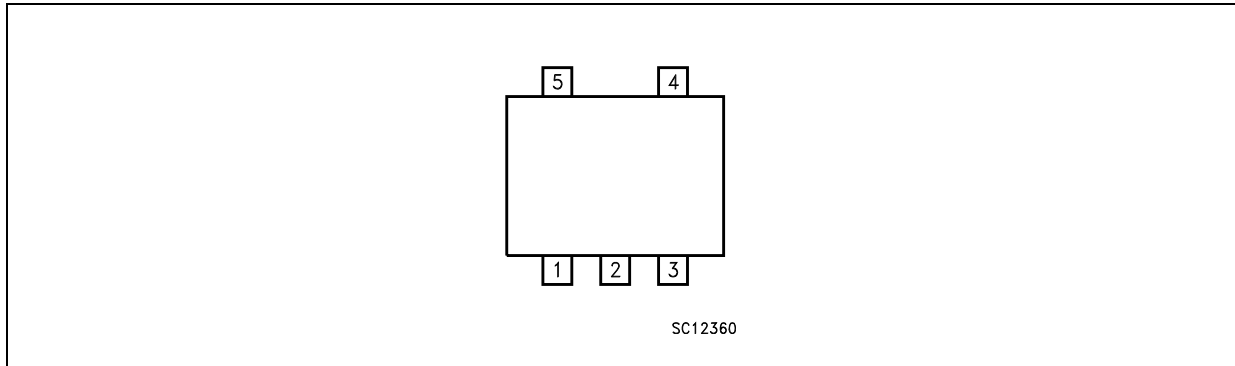


Table 2. Pin description

Pin n°	Symbol	Note
1	SHDN	Shutdown input disables the regulator when it is connected to GND or to a positive voltage lower than 0.6 V
2	GND	Ground pin: internally connected to the die attach flag to decrease the total thermal resistance and increase the package ability to dissipate power
3	Bypass	Bypass pin: 0.1 $\mu$ F bypass to improve the thermal noise performance
4	OUT	Output port
5	IN	Input port

### 3 Maximum ratings

**Table 3. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_I$	DC input voltage	16	V
$V_{SHDN}$	DC input voltage	16	V
$I_O$	Output current	Internally limited	
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_{OP}$	Operating junction temperature range	-40 to 125	°C

**Table 4. Thermal data**

Symbol	Parameter	SOT23-5L	Unit
$R_{thJC}$	Thermal resistance junction-case	81	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	255	°C/W

## 4 Electrical characteristics

$T_J = 25\text{ }^\circ\text{C}$ ,  $V_{IN} = V_{OUT} + 1\text{ V}$ ,  $I_{OUT} = 0\text{ mA}$ ,  $V_{SHDN} = 1.8\text{ V}$ ,  $C_I = 1\text{ }\mu\text{F}$ ,  $C_O = 2.2\text{ }\mu\text{F}$ ,  $C_{BYPASS} = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 5. LK112S electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_d$	Quiescent current	ON mode (except $I_{SHDN}$ )		175	250	$\mu\text{A}$
		OFF mode, $V_I = 8\text{ V}$ , $V_{SHDN} = 0\text{ V}$		0	0.1	$\mu\text{A}$
$V_O$	Output voltage	$I_O = 30\text{ mA}$	-2		+2	%
$\Delta V_O$	Line regulation	$V_I = V_O + 1\text{ V}$ to $V_O + 6\text{ V}$ , $V_O \leq 5.6\text{ V}$		0.7	20	mV
		$V_I = V_O + 1\text{ V}$ to $V_O + 6\text{ V}$ , $V_O > 5.6\text{ V}$		0.8	40	mV
$\Delta V_O$	Load regulation	$I_O = 1$ to $60\text{ mA}$		15	30	mV
		$I_O = 1$ to $200\text{ mA}$		30	90	mV
$V_d$	Dropout voltage	$I_O = 60\text{ mA}$		0.17	0.24	V
		$I_O = 200\text{ mA}^{(1)}$		0.35	0.5	V
$I_{SC}$	Short-circuit current		200			mA
SVR	Supply voltage rejection	$V_I = V_O + 1.5\text{ V}$ , $C_{BYP} = 0.1\text{ }\mu\text{F}$ $C_O = 10\text{ }\mu\text{F}$ , $f = 400\text{ Hz}$ , $I_O = 30\text{ mA}$		55		dB
eN	Output noise voltage	$B = 10\text{ Hz}$ to $80\text{ kHz}$ , $C_{BYP} = 0.1\text{ }\mu\text{F}$ $C_O = 10\text{ }\mu\text{F}$ , $V_I = V_O + 1.5\text{ V}$ , $I_O = 60\text{ mA}$		30		$\mu\text{Vrms}$
$I_{SHDN}$	Shutdown input current	$V_{SHDN} = 1.8\text{ V}$ , output ON		12	35	$\mu\text{A}$
$V_{SHDN}$	Shutdown input logic	Output ON	1.8			V
		Output OFF			0.6	
$\Delta V_O/T_J$	Output voltage temperature coefficient	$I_O = 10\text{ mA}$		0.09		$\text{mV}/^\circ\text{C}$

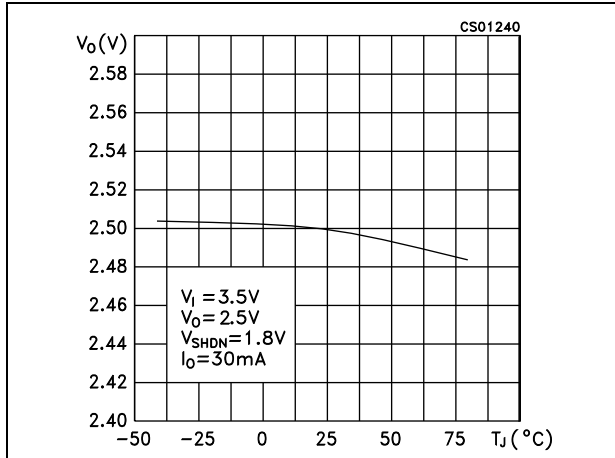
1. For versions with an output voltage higher than 2.1 V only.

*Note:* For versions with an output voltage lower than 2 V  $V_{IN} = 2.4\text{ V}$

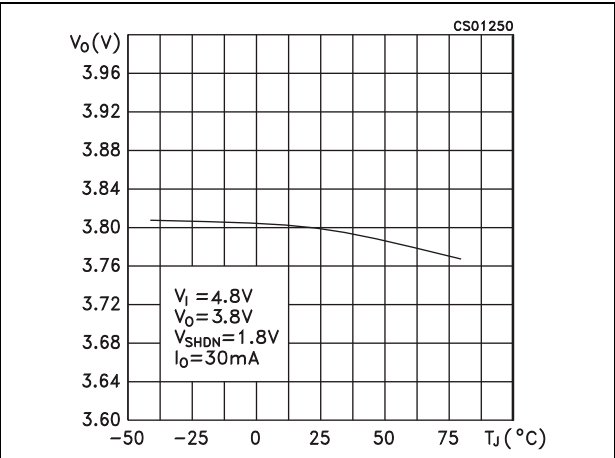
# 5 Typical characteristics

(Unless otherwise specified,  $T_J = 25\text{ }^\circ\text{C}$ ,  $C_I = 1\text{ }\mu\text{F}$ ,  $C_O = 2.2\text{ }\mu\text{F}$ ,  $C_{BYP} = 100\text{ nF}$ )

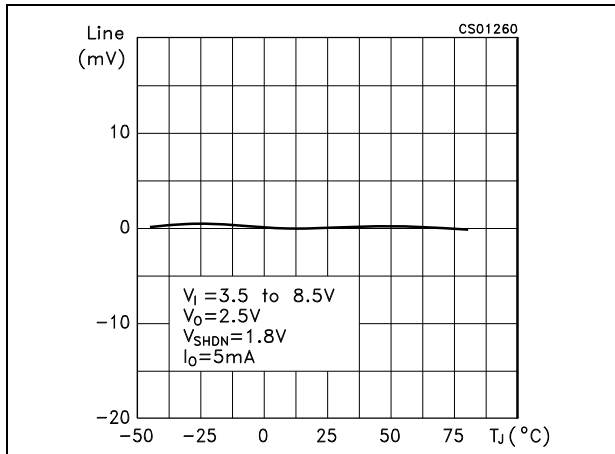
**Figure 3. Output voltage vs temperature**  
 $V_{out}=2.5\text{ V}$



**Figure 4. Output voltage vs temperature**  
 $V_{out}=3.8\text{ V}$



**Figure 5. Line regulation vs temperature**



**Figure 6. Load regulation vs temperature**

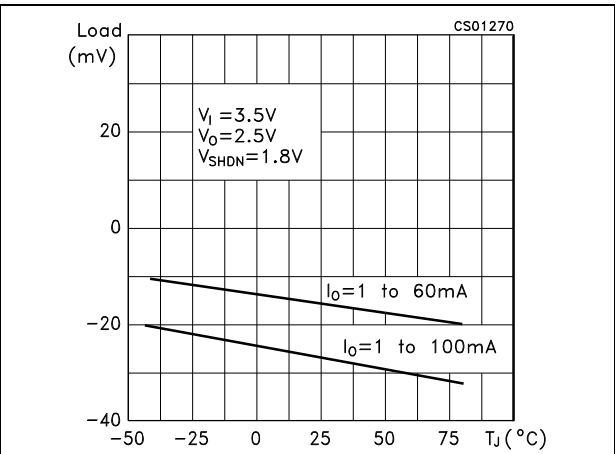


Figure 7. Dropout voltage vs temperature

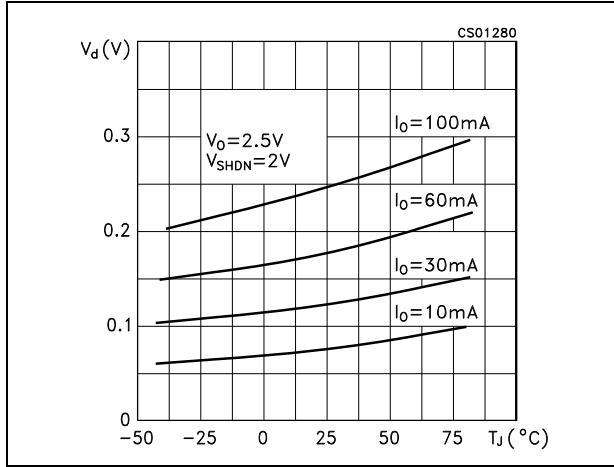


Figure 8. Short-circuit current vs dropout voltage

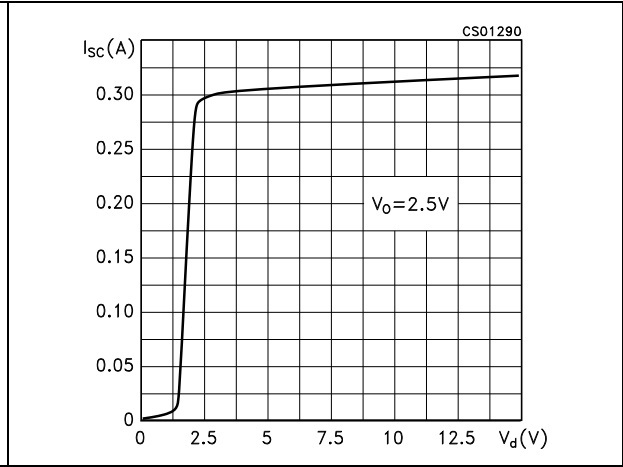


Figure 9. Output voltage vs input voltage

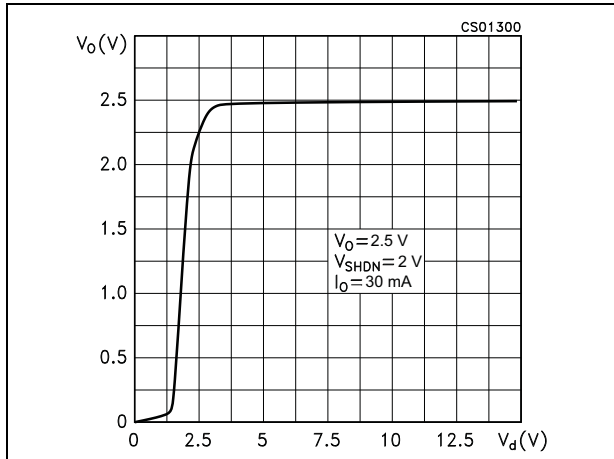


Figure 10. Shutdown voltage vs temperature

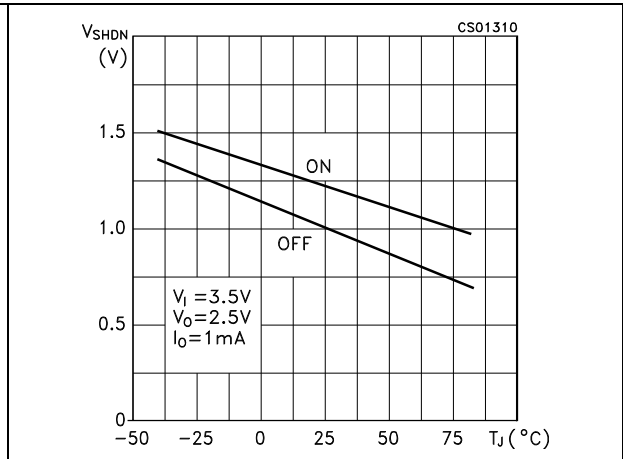


Figure 11. Shutdown current vs shutdown voltage

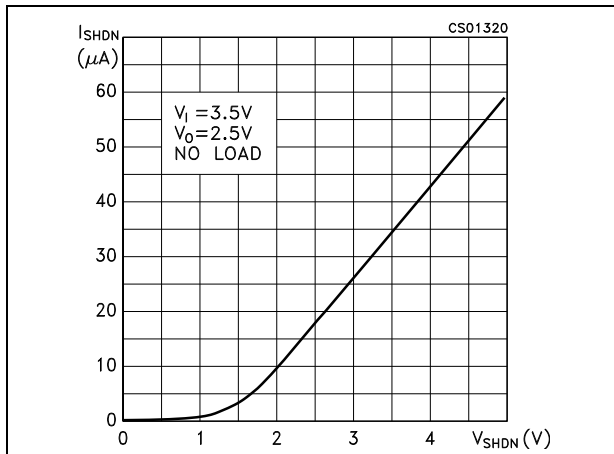


Figure 12. Supply voltage rejection vs temperature

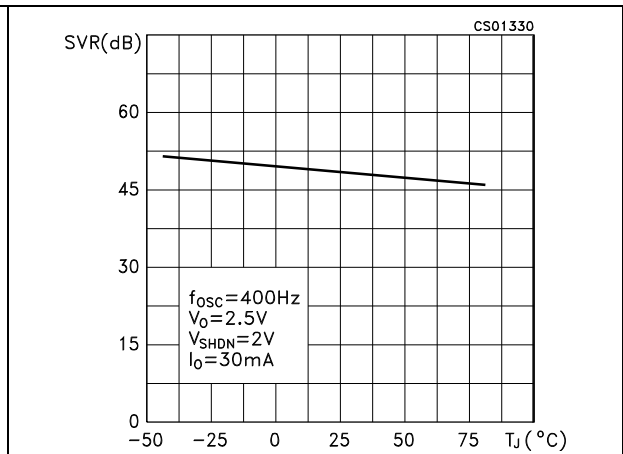




Figure 13. Supply voltage rejection vs output current

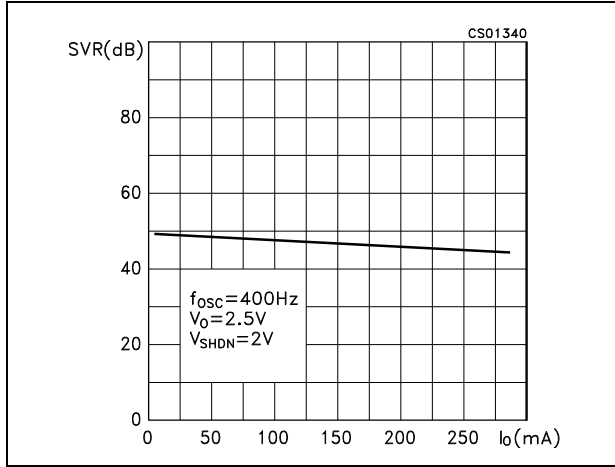


Figure 14. Supply voltage rejection vs frequency

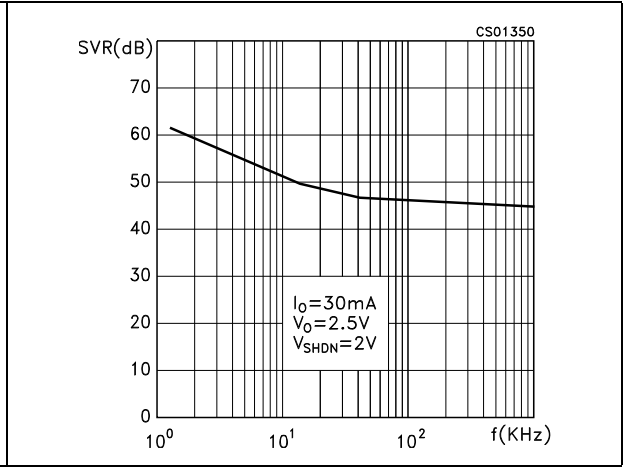


Figure 15. Supply voltage rejection vs temperature

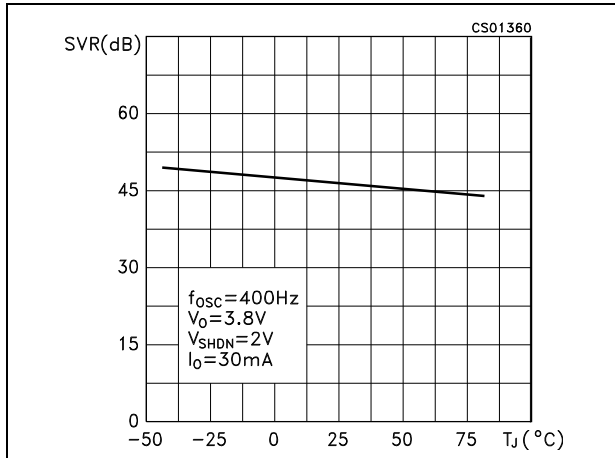


Figure 16. Shutdown current vs temperature

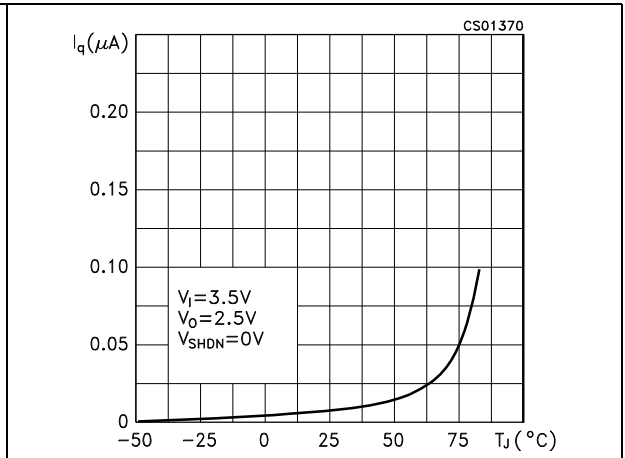


Figure 17. Quiescent current vs input voltage

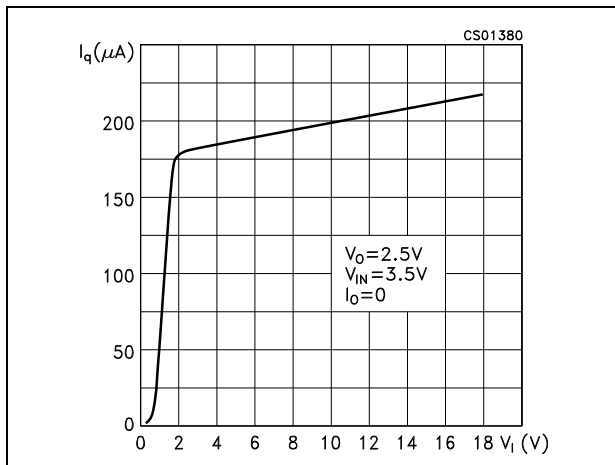


Figure 18. Quiescent current vs shutdown voltage

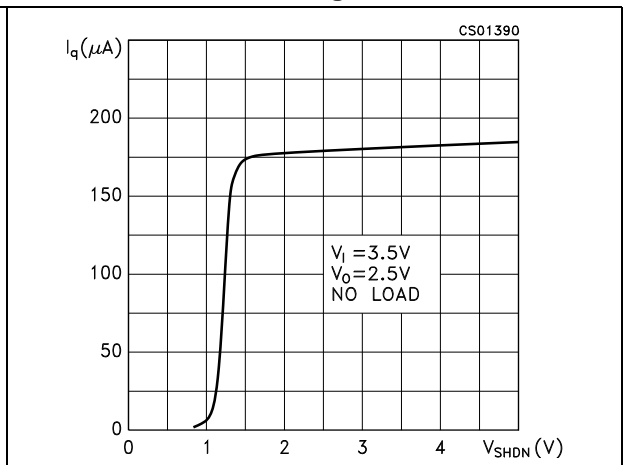


Figure 19. Quiescent current vs temperature

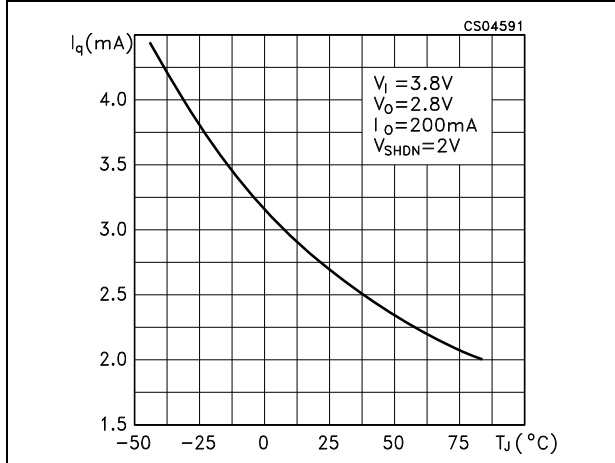


Figure 20. Reverse current vs reverse voltage

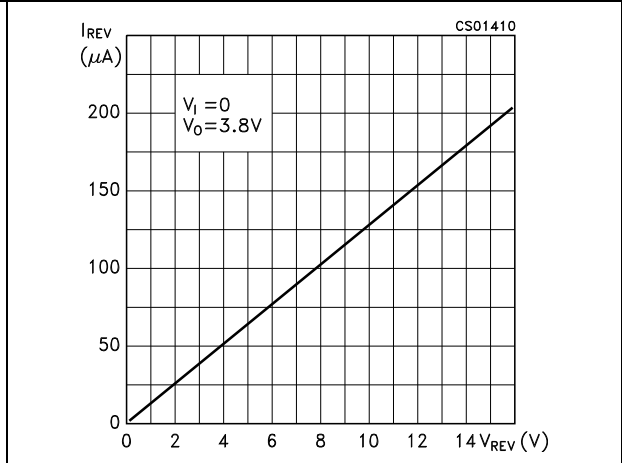


Figure 21. Stability

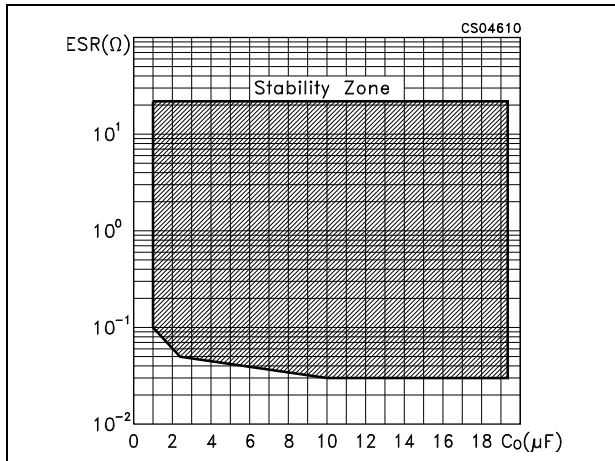


Figure 22. Noise spectrum

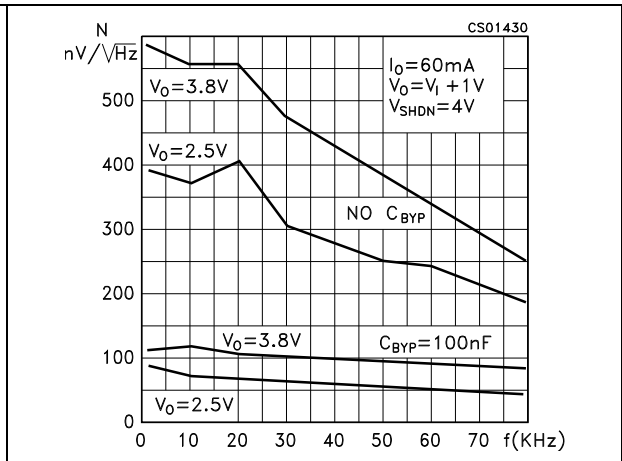


Figure 23. Start-up transient  $C_{BYP}=10$  nF

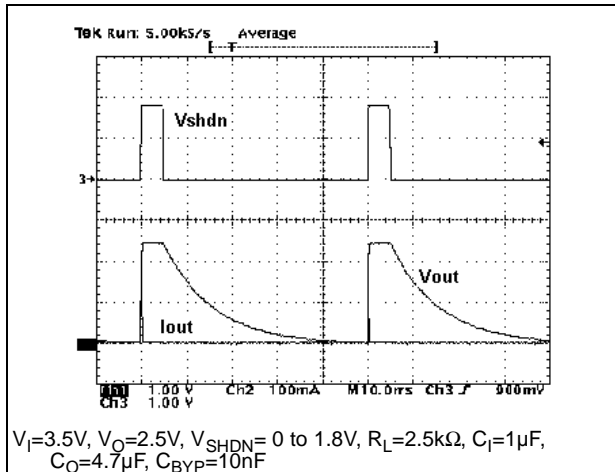


Figure 24. Start-up transient  $C_{BYP}=100$  nF

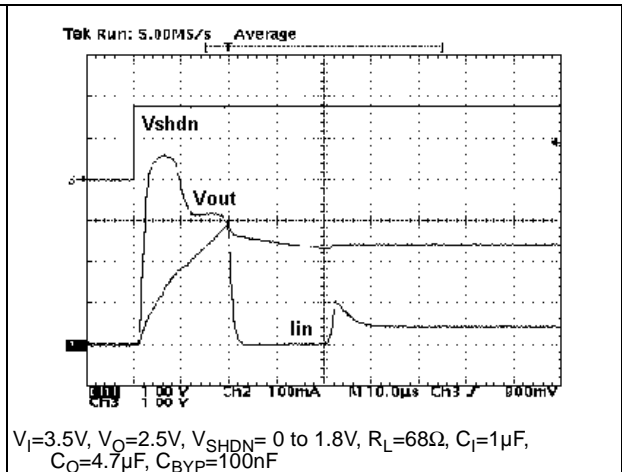


Figure 25. Line transient  $C_o=100\ \mu\text{F}$

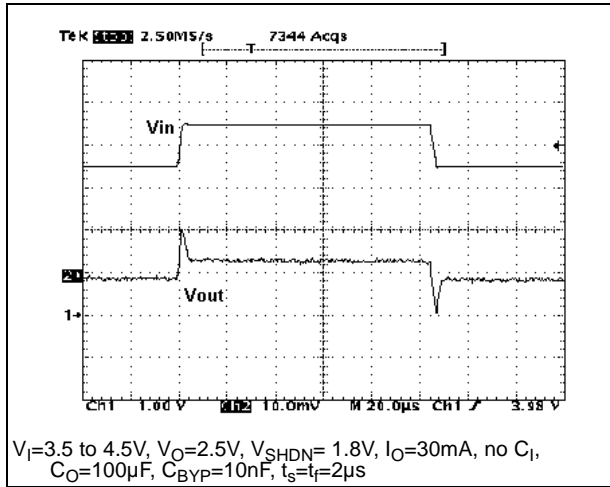


Figure 26. Line transient  $C_o=10\ \mu\text{F}$

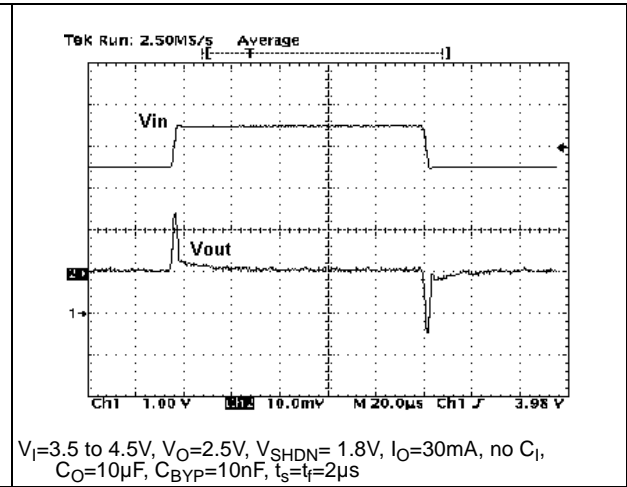


Figure 27. Line transient  $C_o=1\ \mu\text{F}$

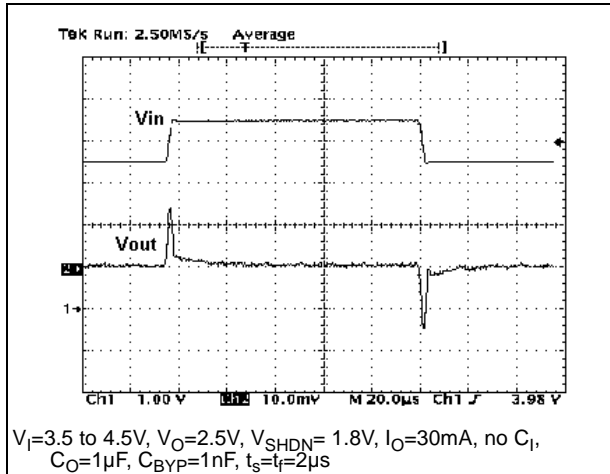


Figure 28. Load transient  $V_o=2.5\ \text{V}$ ,  $C_o=2.2\ \mu\text{F}$

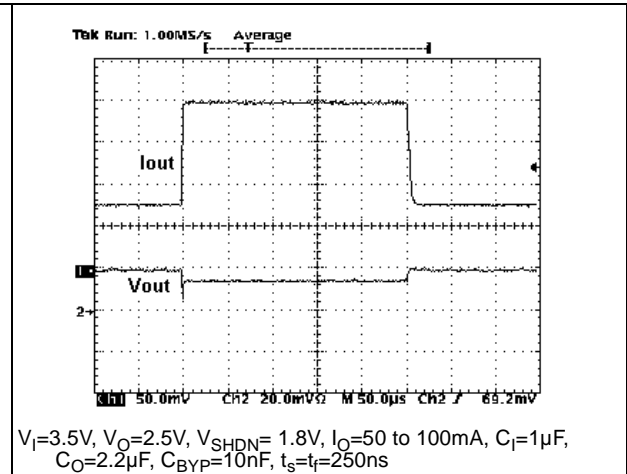


Figure 29. Load transient  $V_o=2.5\ \text{V}$ ,  $C_o=10\ \mu\text{F}$

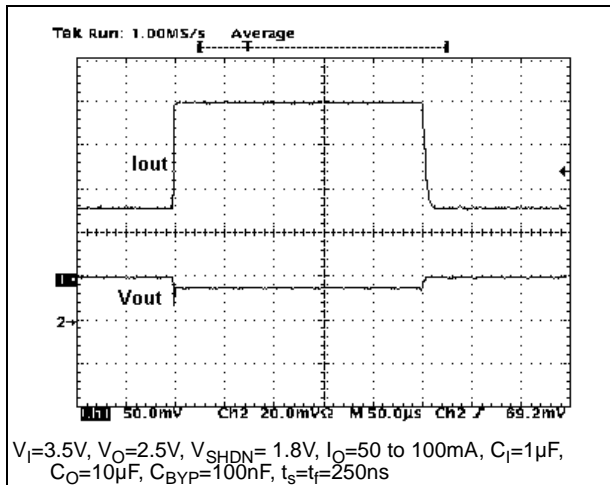
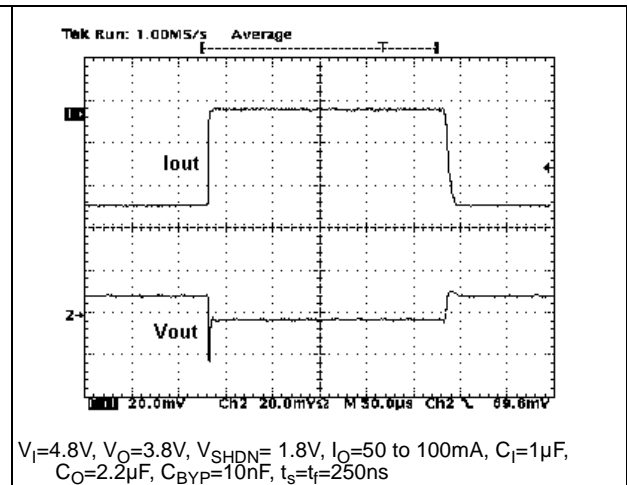


Figure 30. Load transient  $V_o=3.8\ \text{V}$ ,  $C_o=2.2\ \mu\text{F}$



## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

Figure 31. SOT23-5L mechanical drawings

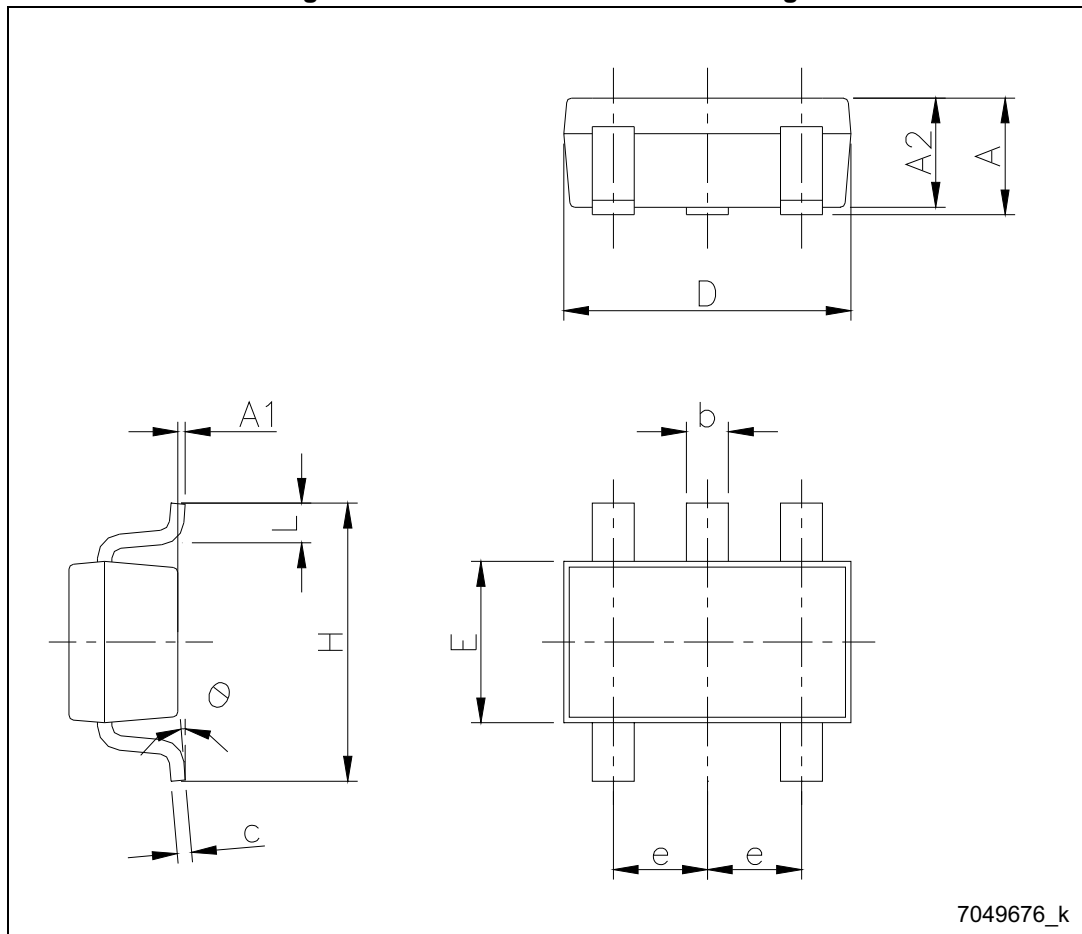
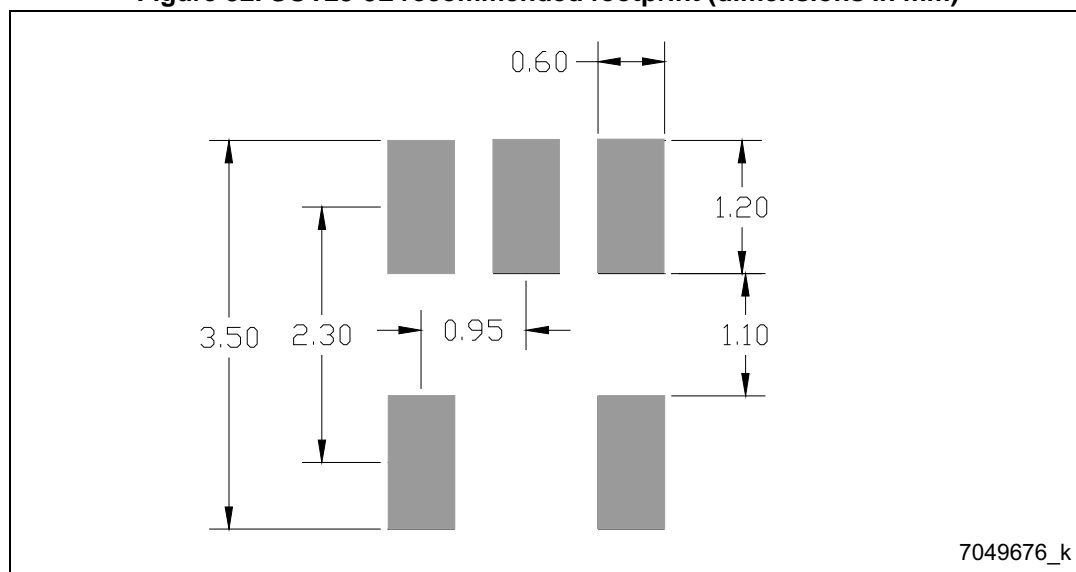


Table 6. SOT23-5L mechanical data

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	2.09		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 in mm)



# 7 Packaging mechanical data

Figure 33.SOT23-5L tape and reel drawings

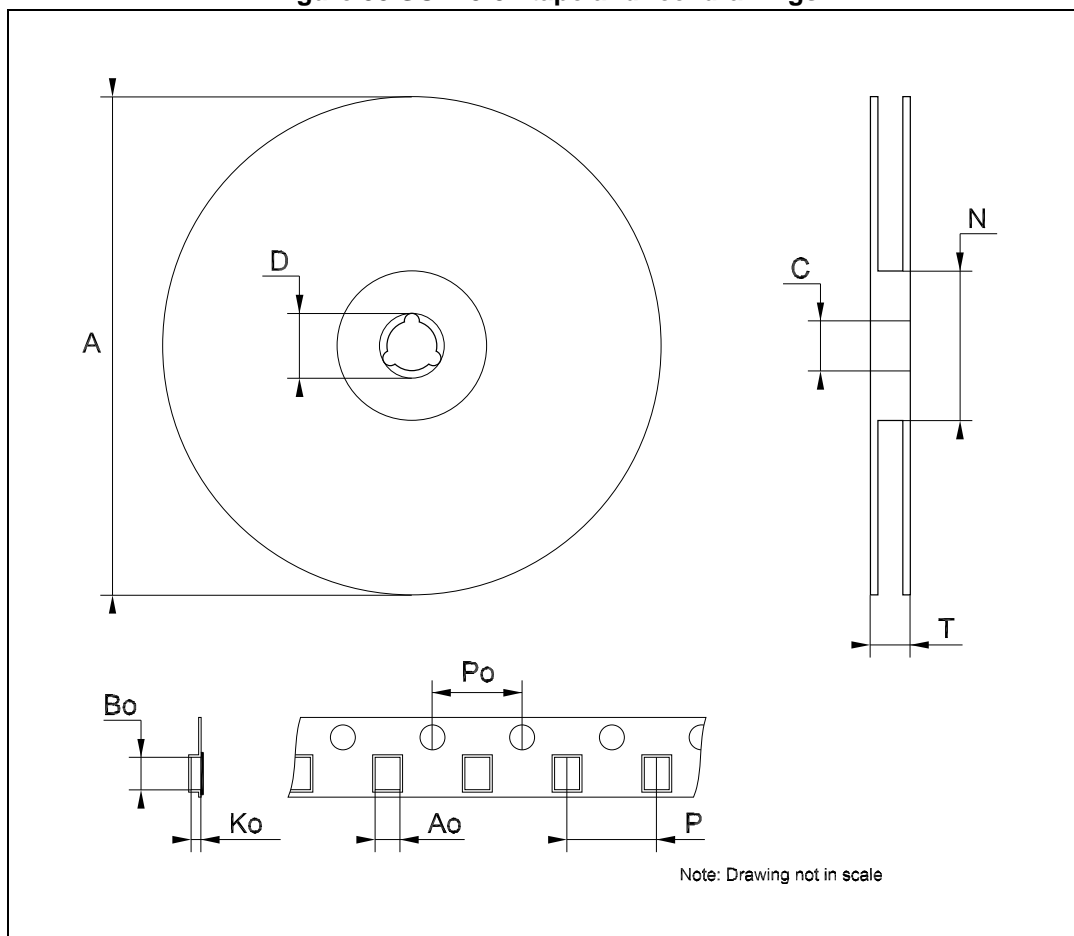


Figure 34.SOT23-5L tape and reel mechanical data

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

## 8 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
31-Aug-2004	3	Mistake on fig. 19.
31-Jan-2005	4	Change maturity code.
12-Jun-2006	5	Order codes updated.
17-Oct-2006	6	The T <sub>OP</sub> value on table 2 updated.
20-Jul-2007	7	Add <a href="#">Table 1</a> in cover page.
21-Sep-2007	8	Features updated.
11-Dec-2007	9	Modified: <a href="#">Table 6</a> .
12-Feb-2008	10	Modified: <a href="#">Table 6</a> .
10-Jul-2008	11	Modified: <a href="#">Table 1</a> and <a href="#">Table 6</a> .
11-Feb-2014	12	Part number LK112Sxx changed to LK112S. Updated the title and the <a href="#">Description</a> in cover page, <a href="#">Table 2: Pin description</a> , <a href="#">Section 5: Typical characteristics</a> and <a href="#">Section 6: Package mechanical data</a> . Added <a href="#">Section 7: Packaging mechanical data</a> . Minor text changes.



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