LK112S

Low noise and low drop voltage regulator with shutdown function

Datasheet - production data

SOT23-5L

Features

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

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 µVrms. 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.

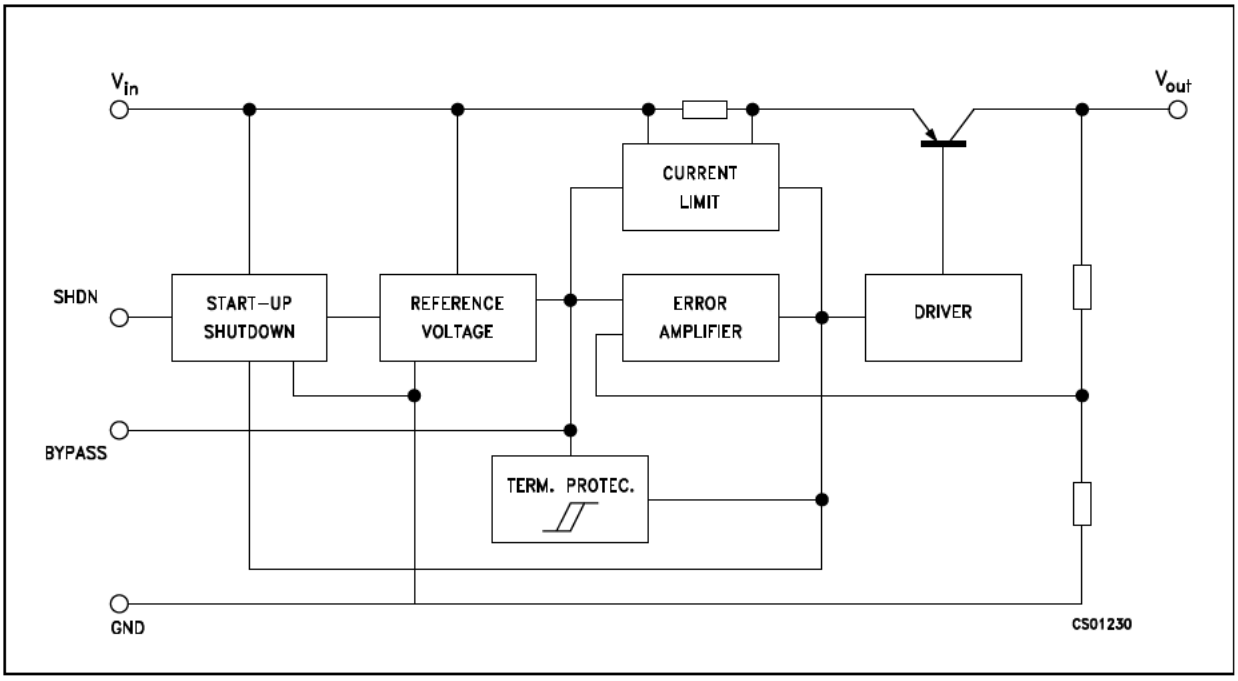
Table 1. Device summary

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

Contents

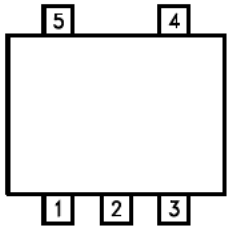
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connection (top view)



SC12360

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 µF 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 °C, V_{IN} = V_{OUT} +1 V, I_{OUT} = 0 mA, V_{SHDN} = 1.8 V, C_I = 1 µF, C_O = 2.2 µF, C_{BYPASS} = 0.1 µF 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	µA
		OFF mode, V_I = 8 V, V_{SHDN} = 0 V		0	0.1	µA
V_O	Output voltage	I_O = 30 mA	-2		+2	%
ΔV_O	Line regulation	V_I = V_O+1 V to V_O+6 V, $V_O \leq$ 5.6 V		0.7	20	mV
		V_I = V_O+1 V to V_O+6 V, $V_O >$ 5.6 V		0.8	40	mV
ΔV_O	Load regulation	I_O = 1 to 60 mA		15	30	mV
		I_O = 1 to 200 mA		30	90	mV
V_d	Dropout voltage	I_O = 60 mA		0.17	0.24	V
		I_O = 200 mA(1)		0.35	0.5	V
I_{SC}	Short-circuit current		200			mA
SVR	Supply voltage rejection	V_I = V_O+1.5 V, C_{BYP} = 0.1 µF C_O = 10 µF, f = 400 Hz, I_O = 30 mA		55		dB
eN	Output noise voltage	B= 10 Hz to 80 kHz, C_{BYP} = 0.1 µF C_O = 10 µF, V_I = V_O+1.5 V, I_O = 60 mA		30		µVrms
I_{SHDN}	Shutdown input current	V_{SHDN} = 1.8 V, output ON		12	35	µA
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 mA		0.09		mV/°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 VIN = 2.4 V

5 Typical characteristics

(Unless otherwise specified, T_J = 25 °C, C_I = 1 µF, C_O = 2.2 µF, C_{BYP} = 100 nF)

Figure 3. Output voltage vs temperature V_{out}=2.5 V

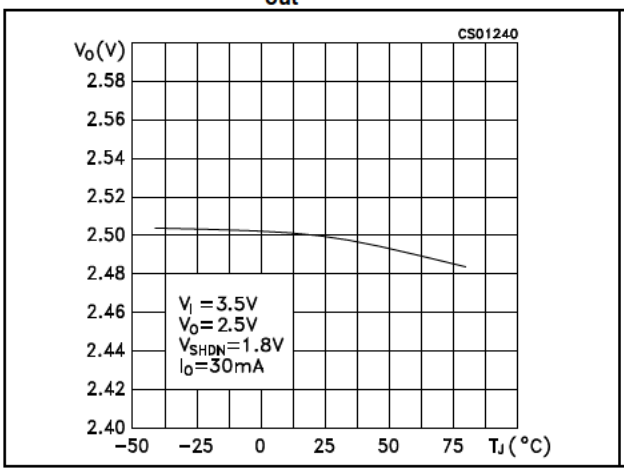


Figure 4. Output voltage vs temperature V_{out}=3.8 V

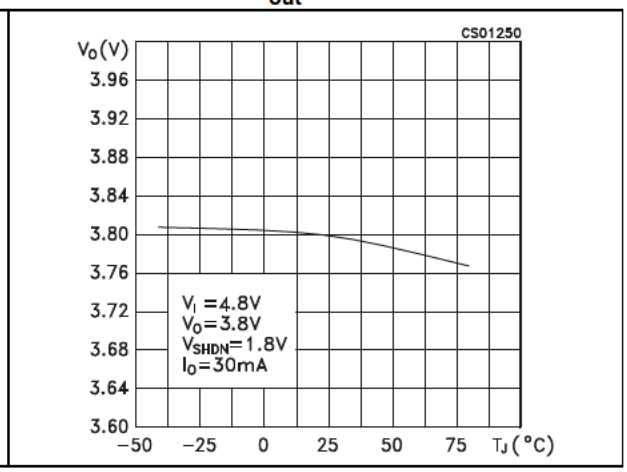


Figure 5. Line regulation vs temperature

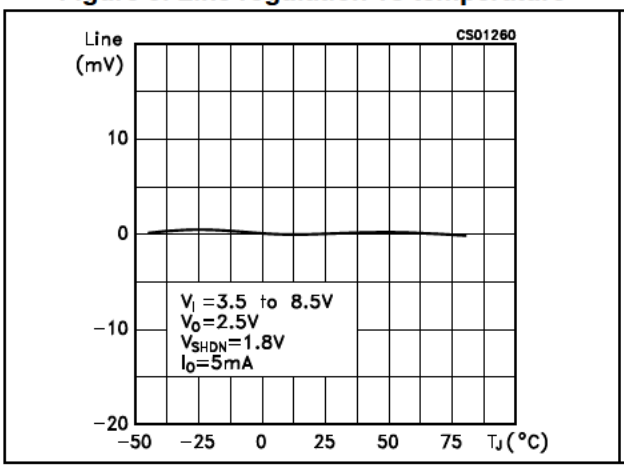


Figure 6. Load regulation vs temperature

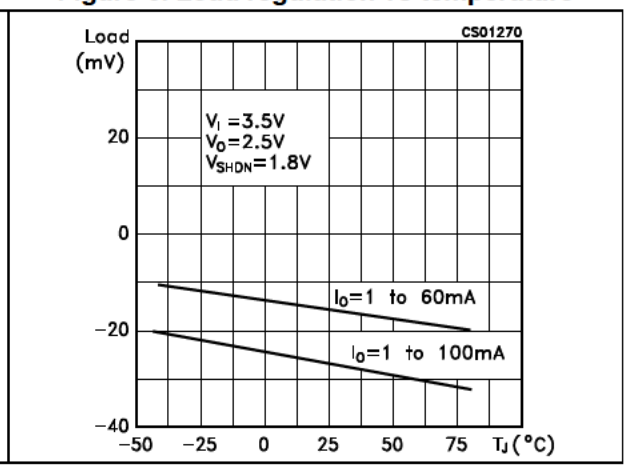


Figure 7. Dropout voltage vs temperature

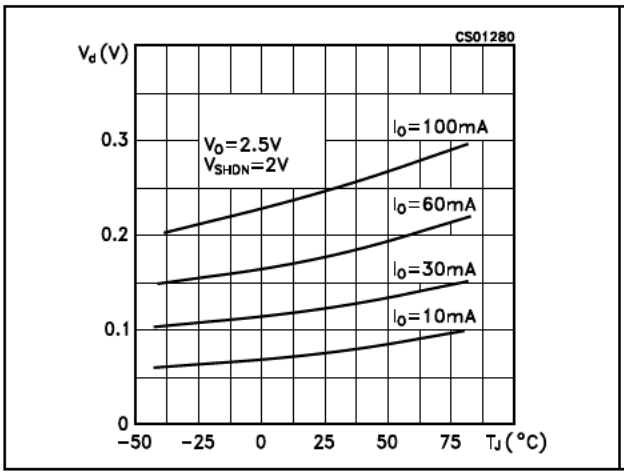


Figure 8. Short-circuit current vs dropout voltage

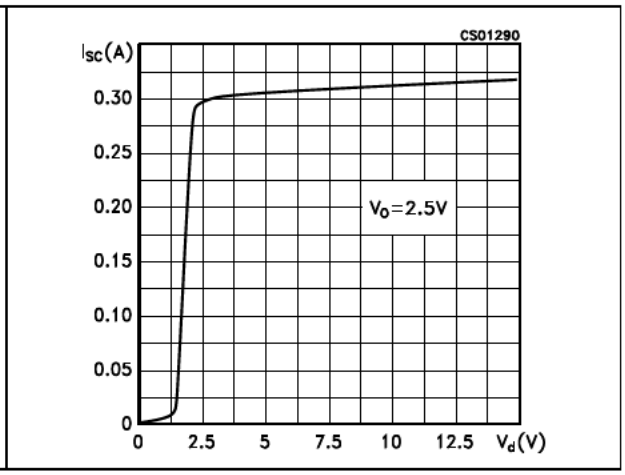


Figure 9. Output voltage vs input voltage

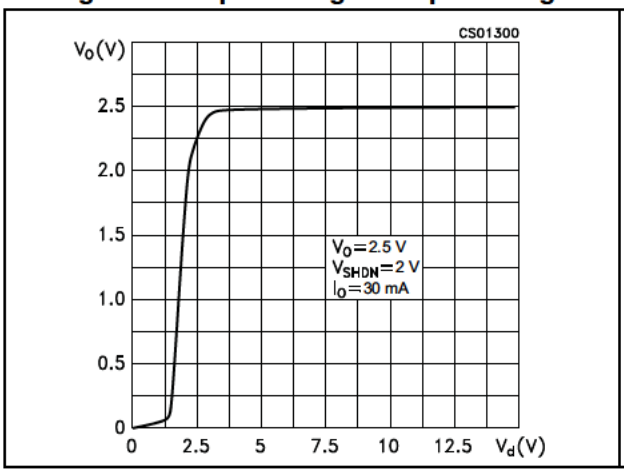


Figure 10. Shutdown voltage vs temperature

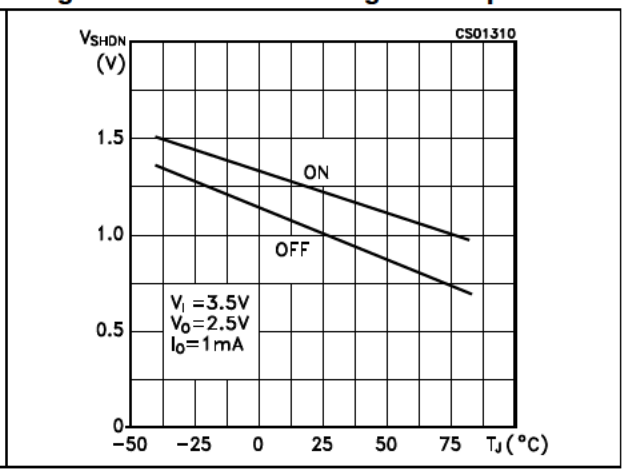


Figure 11. Shutdown current vs shutdown voltage

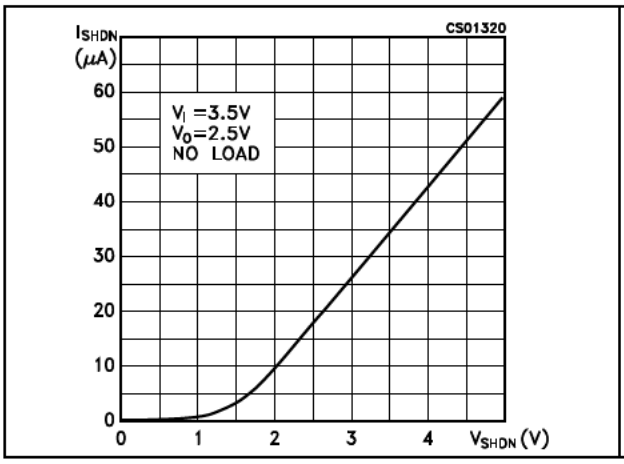


Figure 12. Supply voltage rejection vs temperature

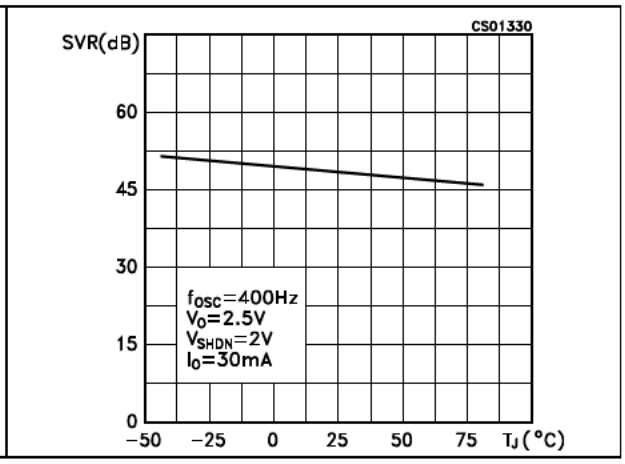


Figure 13. Supply voltage rejection vs output current

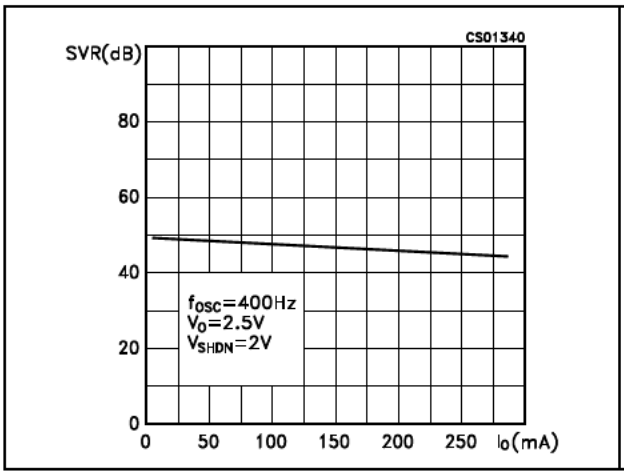


Figure 14. Supply voltage rejection vs frequency

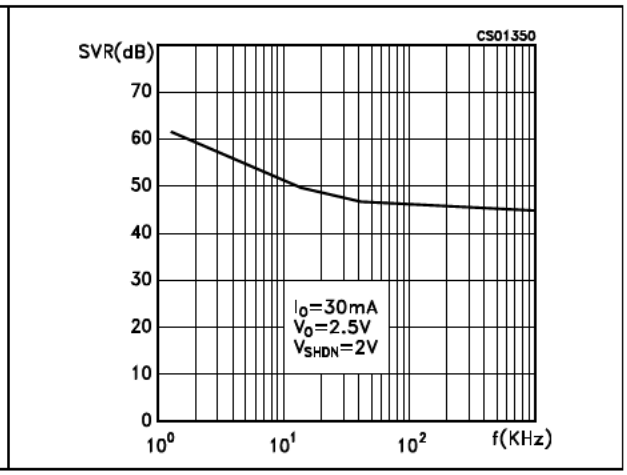


Figure 15. Supply voltage rejection vs temperature

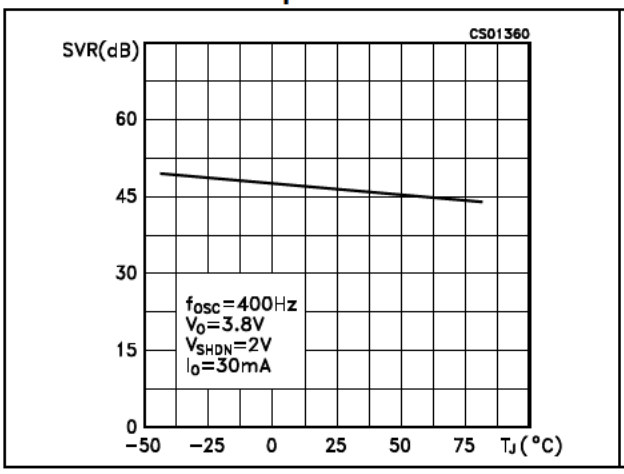


Figure 16. Shutdown current vs temperature

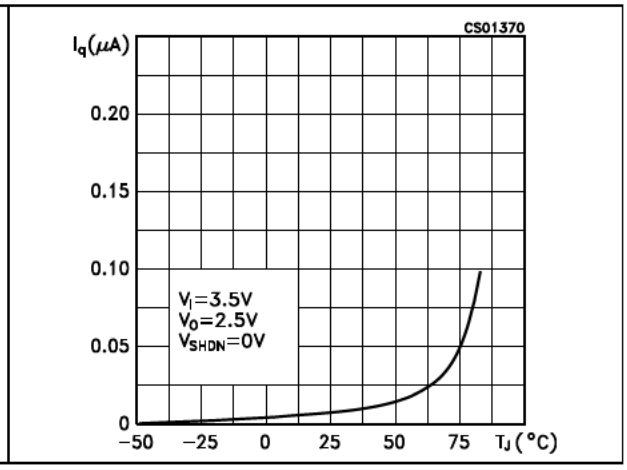


Figure 17. Quiescent current vs input voltage

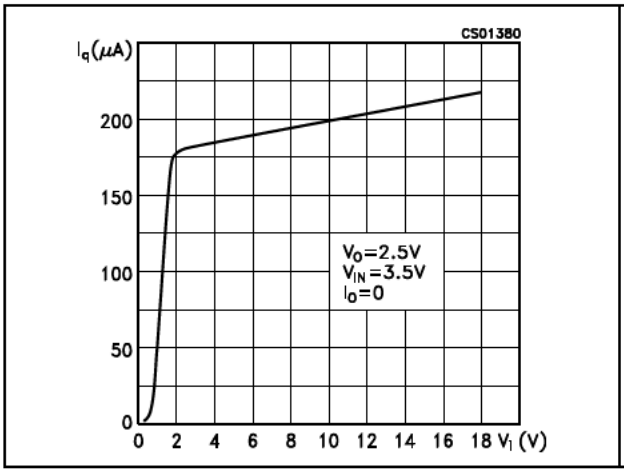


Figure 18. Quiescent current vs shutdown voltage

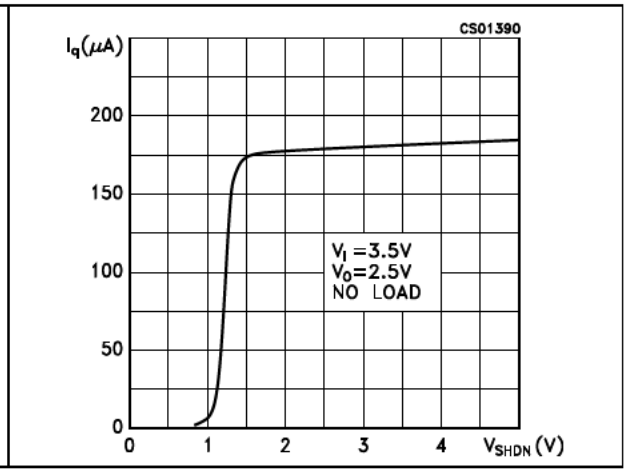


Figure 19. Quiescent current vs temperature

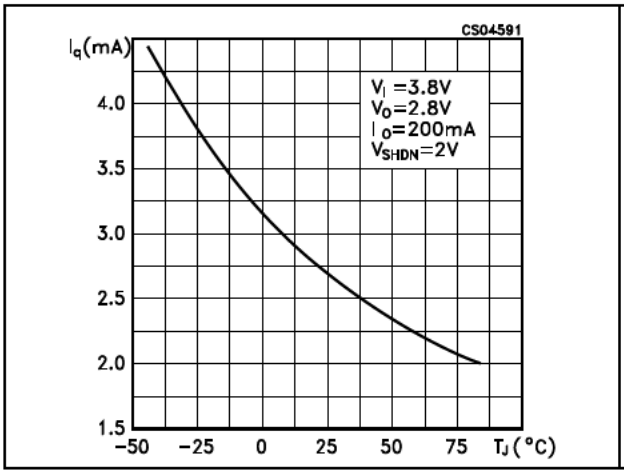


Figure 20. Reverse current vs reverse voltage

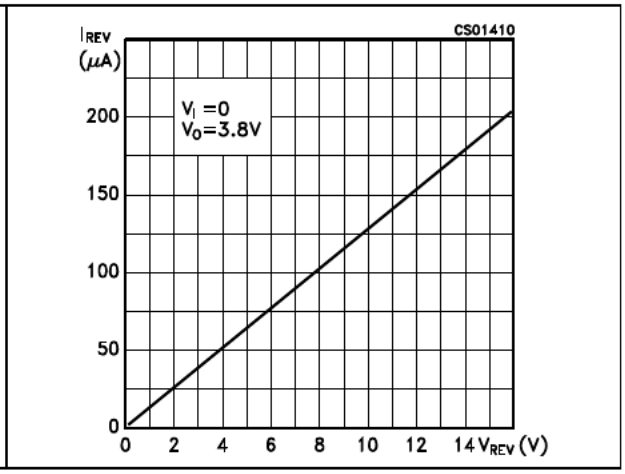


Figure 21. Stability

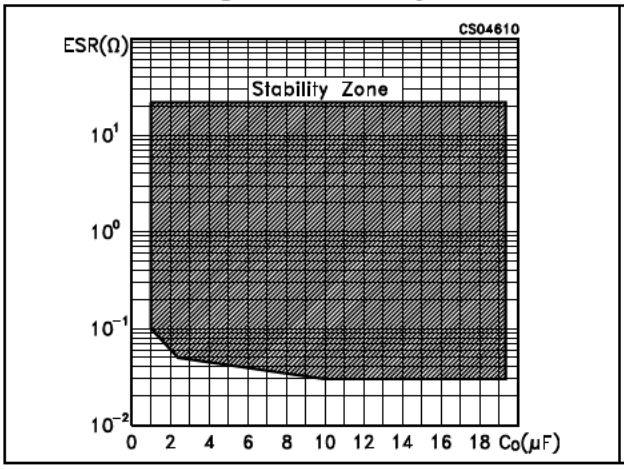


Figure 22. Noise spectrum

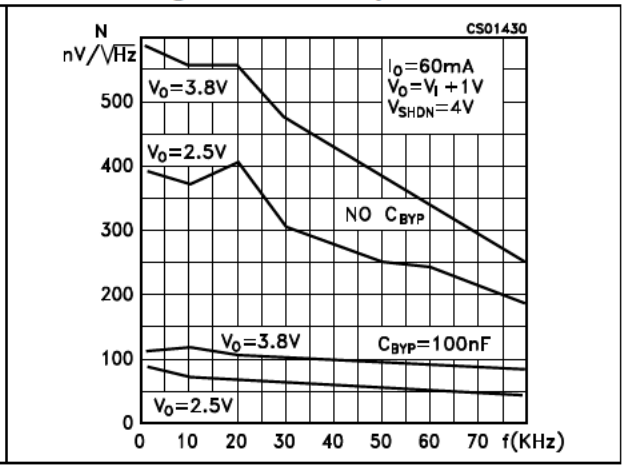
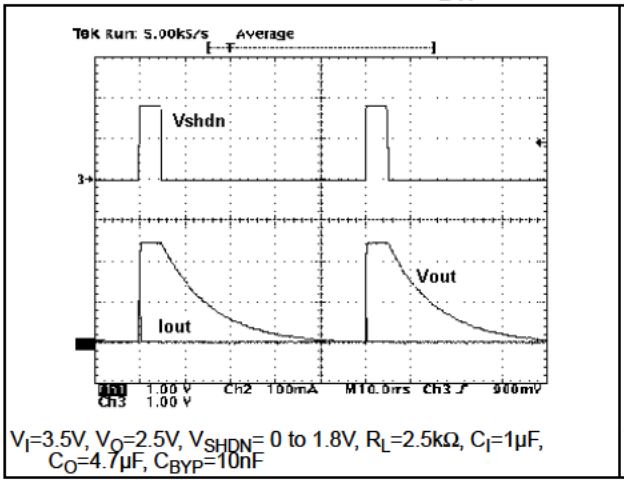
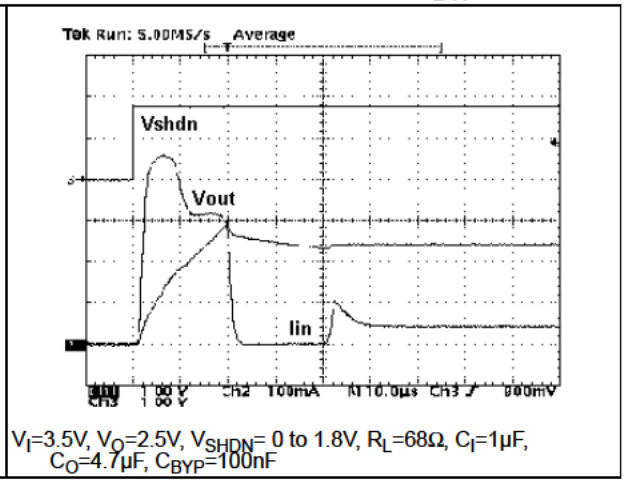


Figure 23. Start-up transient C_{BYP}=10 nF



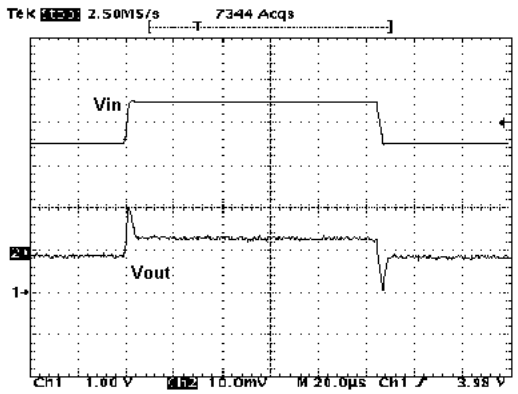
V_I=3.5V, V_O=2.5V, V_{SHDN}= 0 to 1.8V, R_L=2.5kΩ, C_I=1μF, C_O=4.7μF, C_{BYP}=10nF

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



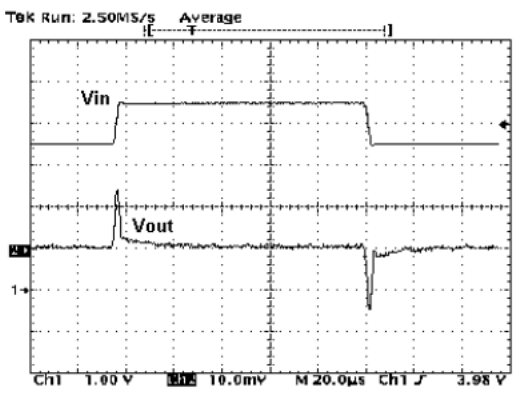
V_I=3.5V, V_O=2.5V, V_{SHDN}= 0 to 1.8V, R_L=68Ω, C_I=1μF, C_O=4.7μF, C_{BYP}=100nF

Figure 25. Line transient Co=100 µF



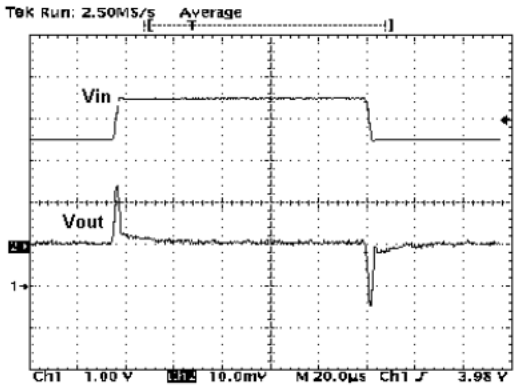
V_I=3.5 to 4.5V, V_O=2.5V, V_{SHDN}= 1.8V, I_O=30mA, no C_I, C_O=100µF, C_{BYP}=10nF, t_s=t_f=2µs

Figure 26. Line transient Co=10 µF



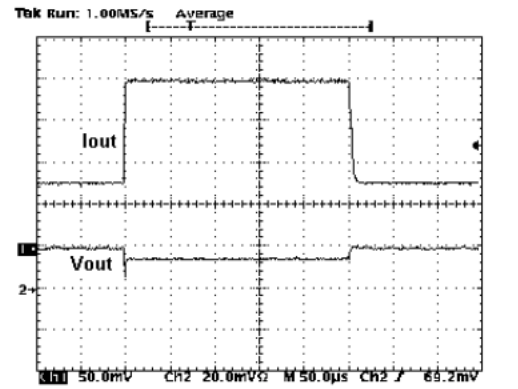
V_I=3.5 to 4.5V, V_O=2.5V, V_{SHDN}= 1.8V, I_O=30mA, no C_I, C_O=10µF, C_{BYP}=10nF, t_s=t_f=2µs

Figure 27. Line transient Co=1 µF



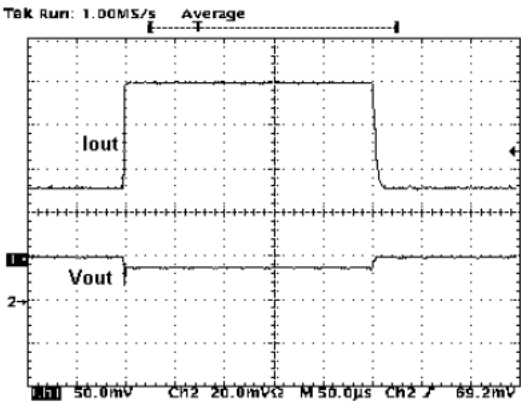
V_I=3.5 to 4.5V, V_O=2.5V, V_{SHDN}= 1.8V, I_O=30mA, no C_I, C_O=1µF, C_{BYP}=1nF, t_s=t_f=2µs

Figure 28. Load transient Vo=2.5 V, Co=2.2 µF



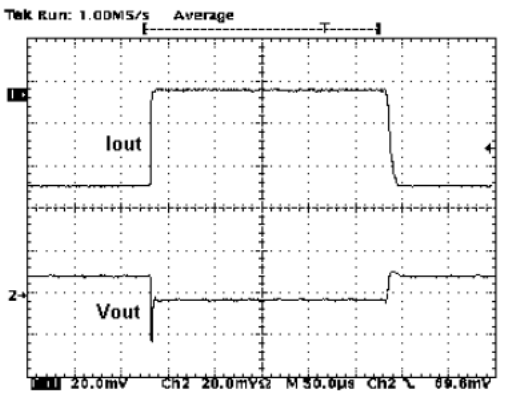
V_I=3.5V, V_O=2.5V, V_{SHDN}= 1.8V, I_O=50 to 100mA, C_I=1µF, C_O=2.2µF, C_{BYP}=10nF, t_s=t_f=250ns

Figure 29. Load transient Vo=2.5 V, Co=10 µF



V_I=3.5V, V_O=2.5V, V_{SHDN}= 1.8V, I_O=50 to 100mA, C_I=1µF, C_O=10µF, C_{BYP}=100nF, t_s=t_f=250ns

Figure 30. Load transient Vo=3.8 V,Co=2.2 µF



V_I=4.8V, V_O=3.8V, V_{SHDN}= 1.8V, I_O=50 to 100mA, C_I=1µF, C_O=2.2µF, C_{BYP}=10nF, t_s=t_f=250ns

6 Package mechanical data

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.

Figure 31. SOT23-5L mechanical drawings

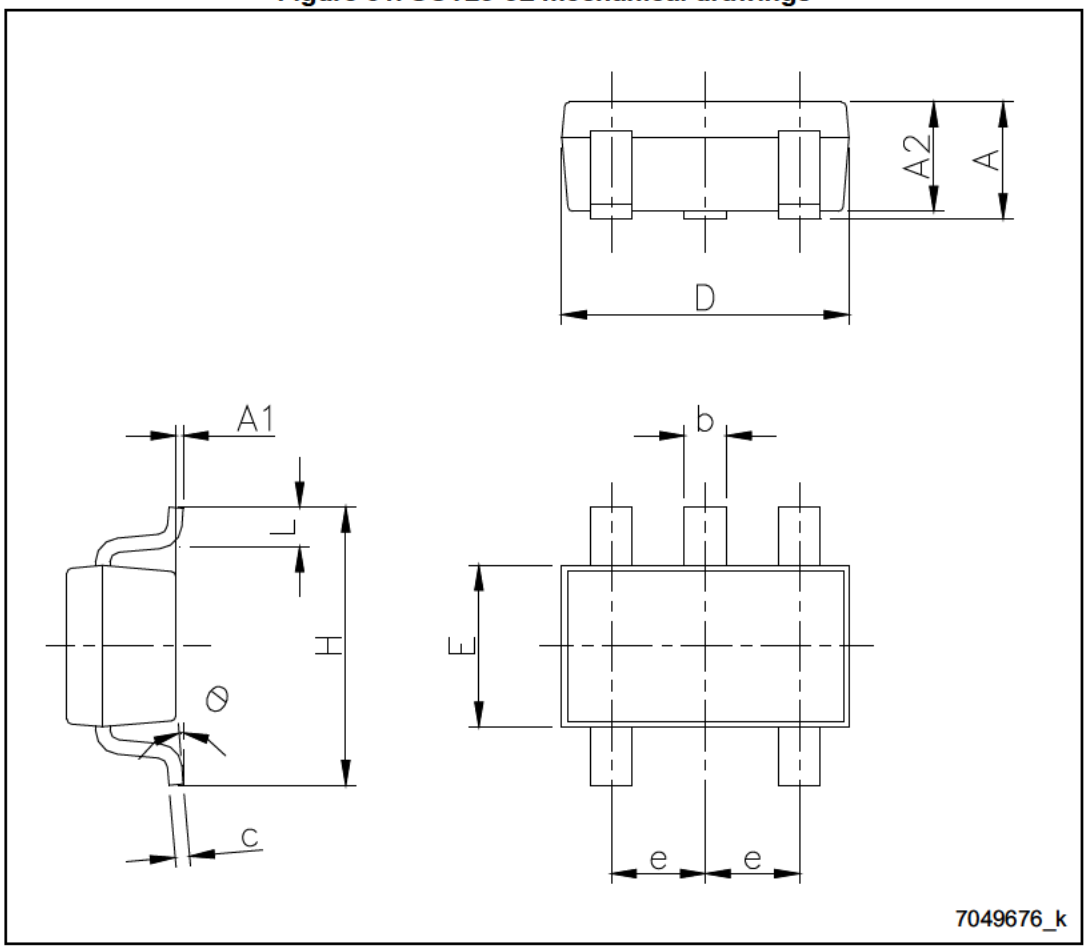
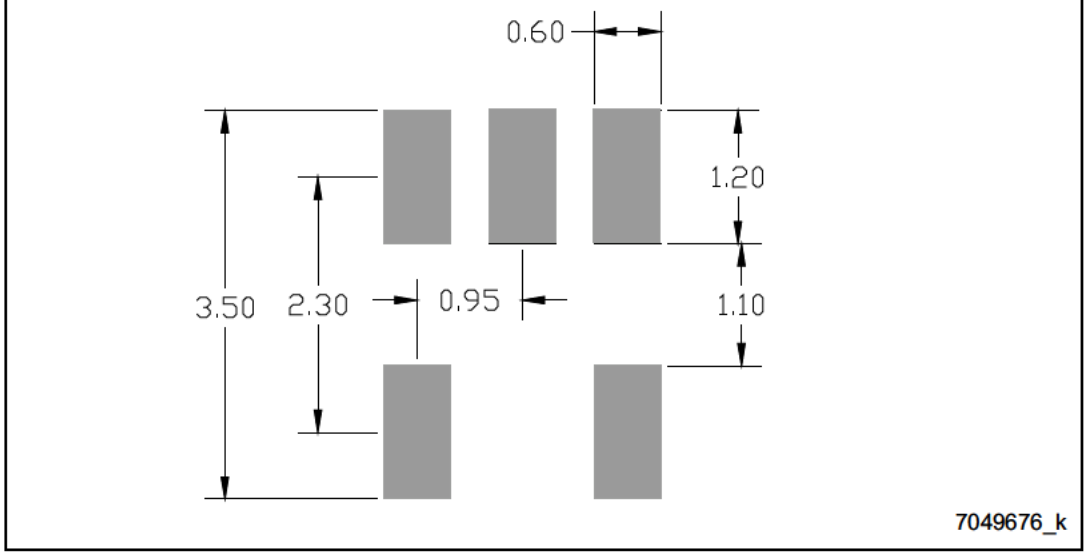


Table 6. SOT23-5L mechanical data

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
θ	0		8

Figure 32. SOT23-5L recommended footprint (dimensions in mm)



7 Packaging mechanical data

Figure 33.SOT23-5L tape and reel drawings

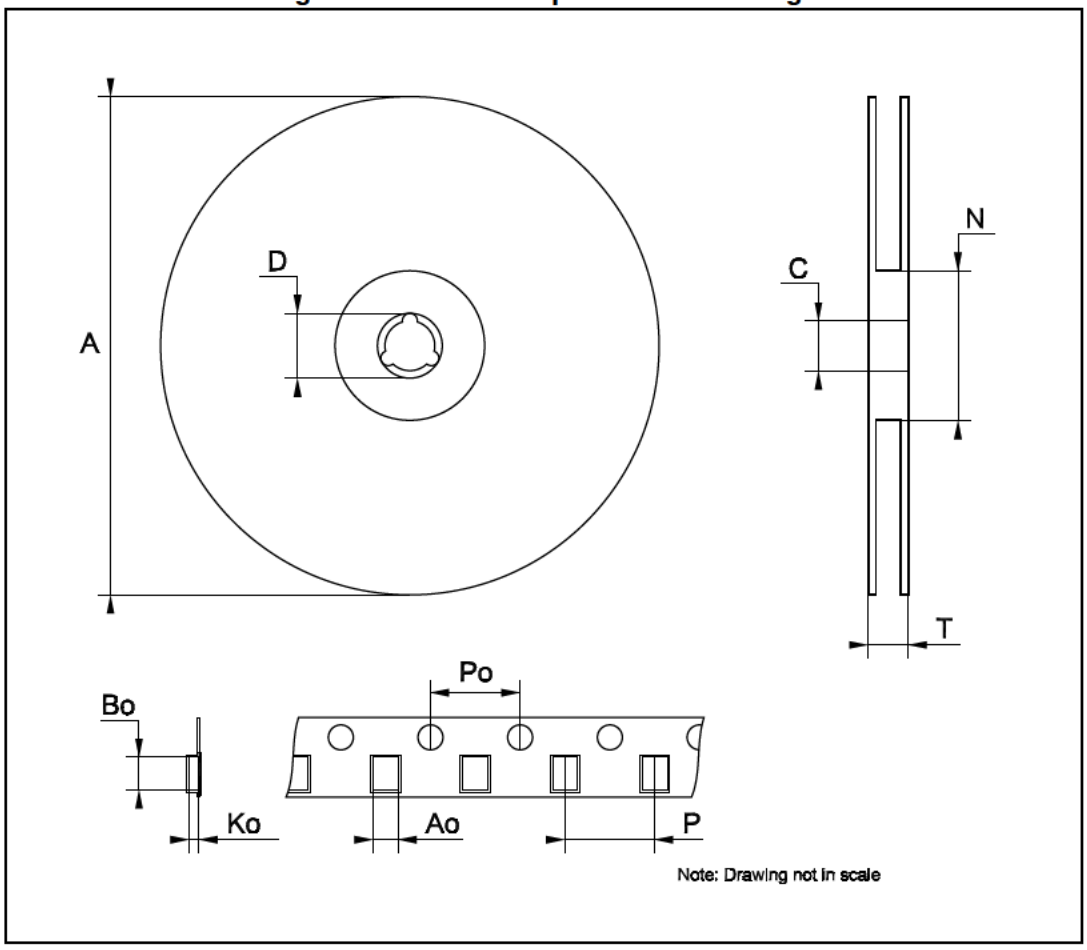


Figure 34.SOT23-5L tape and reel mechanical data

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_{OP} value on table 2 updated.
20-Jul-2007	7	Add *Table 1* in cover page.
21-Sep-2007	8	Features updated.
11-Dec-2007	9	Modified: *Table 6*.
12-Feb-2008	10	Modified: *Table 6*.
10-Jul-2008	11	Modified: *Table 1* and *Table 6*.
11-Feb-2014	12	Part number LK112Sxx changed to LK112S. Updated the title and the *Description* in cover page, *Table 2: Pin description*, *Section 5: Typical characteristics* and *Section 6: Package mechanical data*. Added *Section 7: Packaging mechanical data*. Minor text changes.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.
Information in this document supersedes and replaces all information previously supplied.
The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com