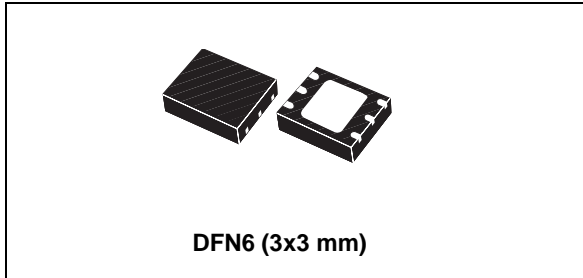


## Very low quiescent current BiCMOS voltage regulator

Datasheet - production data



The ST1L02 is suitable for data storage applications such as HDDs, where it can be used to supply the read channel and memory chips requiring 3.3 V.

The regulator is available in the small and thin DFN6 (3x3 mm) package.

**Table 1. Device summary**

Order code	Package
ST1L02PU18R	DFN6 (3x3 mm)
ST1L02PU33R	DFN6 (3x3 mm)

### Features

- Fixed output voltages: 1.8 V, 2.5 V, 3.3 V (1.5 V, upon customer request)
- Output voltage tolerance:  $\pm 2\%$  at 25 °C
- Output current capability: 1 A minimum
- Very low quiescent current: max. 500  $\mu\text{A}$  overtemperature range
- Typical dropout voltage 0.7 V (@  $I_O = 1 \text{ A}$ )
- Stable with low ESR ceramic capacitors
- Thermal shutdown protection with hysteresis
- Overcurrent protection
- Operating junction temperature range: from 0 to 125 °C

### Description

The ST1L02 is a low drop linear voltage regulator, which supplies up to 1 A output current.

It is available in several fixed output voltage versions. Thanks to BiCMOS technology, quiescent current is well-controlled and maintained below 650  $\mu\text{A}$  over the whole allowed junction temperature range.

The ST1L02 is stable with low ESR output ceramic capacitors.

Internal protection circuitry includes thermal protection with hysteresis and overcurrent limiting.

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## Contents

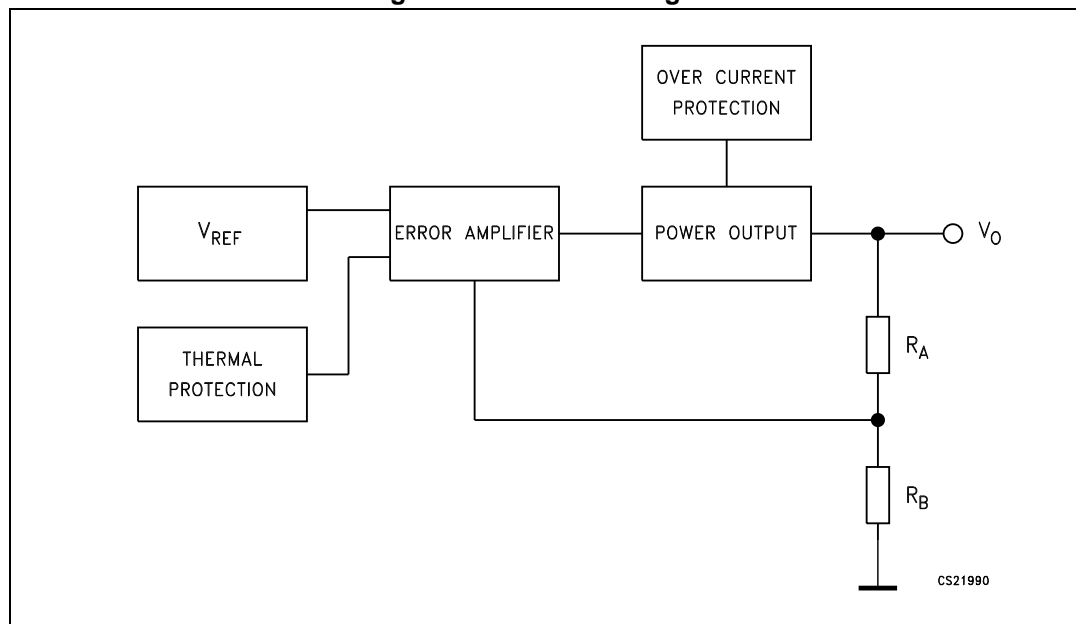
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# 1 Diagram

Figure 1. Schematic diagram



## 2 Pin configuration

Figure 2. Pin connection (top view)

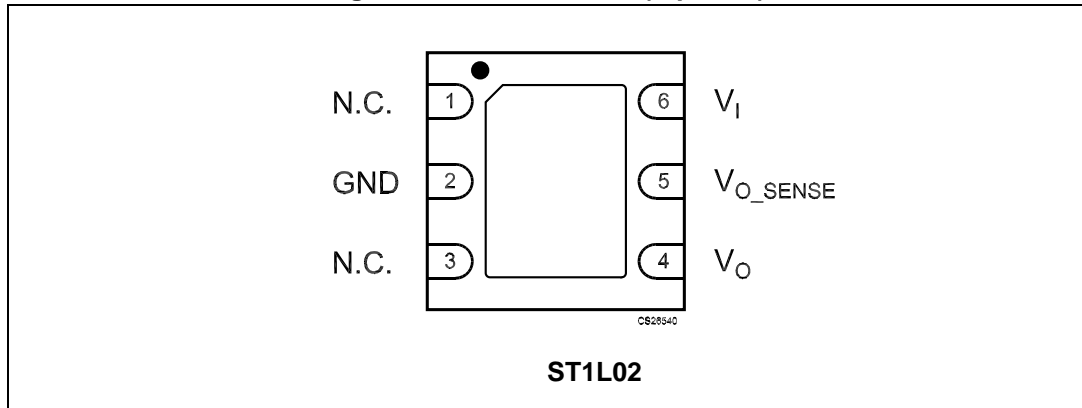


Table 2. Pin description

Pin	Symbol	Function
1, 3	N.C.	Not connected
2	GND	Ground. The exposed metallic pad of the package is connected to GND
4	$V_O$	Output voltage pin. Bypass with a 4.7 $\mu\text{F}$ capacitor to GND
5	$V_{O\_SENSE}$	Sense output voltage pin, to be connected to pin 4
6	$V_I$	Supply voltage input pin. Bypass with a 4.7 $\mu\text{F}$ capacitor to GND

### 3 Maximum ratings

**Table 3. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_I$	DC supply voltage	10	V
$P_{TOT}$	Power dissipation	Internally limited	W
$I_O$	Output current	Internally limited	A
$T_{OP}$	Operating junction temperature range	0 to 150	°C
$T_{STG}$	Storage temperature range <sup>(1)</sup>	-65 to 150	°C
$T_{LEAD}$	Lead temperature (soldering) 10 seconds	260	°C

1. Storage temperature >125 °C is acceptable only if the regulator is soldered to a PCBA.

*Note:* *Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.*

**Table 4. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance junction-case	10	°C/W
$R_{thJA}$	Thermal resistance junction-ambient	55	°C/W

## 4 Electrical characteristics

Refer to the typical application schematic,  $V_I = 4.5\text{ V to }7\text{ V}$ ,  $I_O = 5\text{ mA to }1\text{ A}$ ,  $C_I = 4.7\text{ }\mu\text{F}$ ,  $C_O = 4.7\text{ }\mu\text{F}$ ,  $T_J = 0\text{ to }125\text{ }^\circ\text{C}$  unless otherwise specified. Intended typical values are  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise specified.

**Table 5. ST1L02PU18R electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$V_I = 4.75\text{ V to }5.25\text{ V}$ , $T = 25\text{ }^\circ\text{C}$	1.76 4	1.8	1.83 6	V
$V_O$	Output voltage	$V_I = 4.75\text{ V to }5.25\text{ V}$	1.74 6	1.8	1.85 4	V
$\Delta V_O$	Line regulation	$V_I = 4.75\text{ V to }5.25\text{ V}$			15	mV
$\Delta V_O$	Load regulation	$V_I = 4.75\text{ V}$ , $I_O = 10\text{ mA to }1\text{ A}$			10	mV
$I_S$	Output current limit	$V_I = 5.5\text{ V}$	1.0			A
$I_{O\text{MIN}}$	Minimum output current for regulation				2	mA
$V_d$	Dropout voltage <sup>(1)</sup>	$I_O = 0.8\text{ A}$			1.6	V
		$I_O = 1\text{ A}$			1.6	V
$I_Q$	Quiescent current	$V_I = 5\text{ V}$ , $I_O = 2\text{ mA to }1\text{ A}$ , $T = 25\text{ }^\circ\text{C}$			500	$\mu\text{A}$
$I_Q$	Quiescent current	$V_I = 7\text{ V}$ , $I_O = 2\text{ mA to }1\text{ A}$			650	$\mu\text{A}$
SVR	Supply voltage rejection <sup>(2)</sup>	$V_I = 5 \pm 0.5\text{ V}$ , $I_O = 5\text{ mA}$ , $f = 120\text{ Hz}$	50	75		dB
eN	RMS output noise <sup>(2)</sup>	$B = 10\text{ Hz to }10\text{ kHz}$ , $V_I = 5\text{ V}$ , $I_O = 5\text{ mA}$		0.00 3		$\%V_O$
$\Delta V_O/\Delta I_O$	Load transient (rising) <sup>(3)</sup>	$V_I = 5\text{ V}$ , any 200 mA step from 100 mA to 1 A, $t_R \geq 1\text{ }\mu\text{s}$			5	$\%V_O$
$T_{SH}$	Thermal shutdown trip point <sup>(3)</sup>	$V_I = 5\text{ V}$		165		$^\circ\text{C}$

1. See minimum start-up voltage,  $V_I = 3.3\text{ V}$ .
2. Guaranteed by design. Not tested in production.
3.  $C_I = 10\text{ }\mu\text{F}$ ,  $C_O = 10\text{ }\mu\text{F}$ , X7R ceramic capacitors.

Refer to the typical application schematic,  $V_I = 4.5\text{ V to }7\text{ V}$ ,  $I_O = 5\text{ mA to }1\text{ A}$ ,  $C_I = 4.7\text{ }\mu\text{F}$ ,  $C_O = 4.7\text{ }\mu\text{F}$ ,  $T_J = 0\text{ to }125\text{ }^\circ\text{C}$ , unless otherwise specified. Intended typical values are  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise specified.

Table 6. ST1L02PU33 electrical characteristics

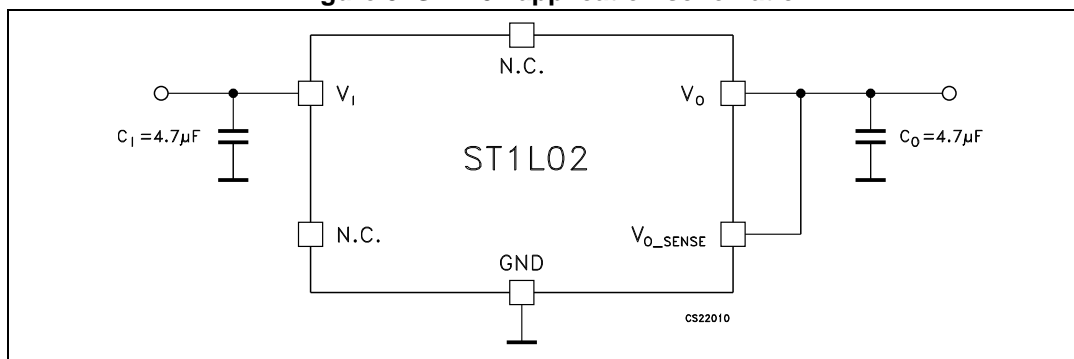
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_O$	Output voltage	$V_I = 4.75\text{ V to }5.25\text{ V}$ , $T = 25\text{ }^\circ\text{C}$	3.234	3.3	3.366	V
$V_O$	Output voltage	$V_I = 4.75\text{ V to }5.25\text{ V}$	3.217 5	3.3	3.382 5	V
$\Delta V_O$	Line regulation	$V_I = 4.75\text{ V to }5.25\text{ V}$			15	mV
$\Delta V_O$	Load regulation	$V_I = 4.75\text{ V}$ , $I_O = 10\text{ mA to }1\text{ A}$			10	mV
$I_S$	Output current limit	$V_I = 5.5\text{ V}$	1.0			A
$I_{O\text{MIN}}$	Minimum output current for regulation				2	mA
$V_d$	Dropout voltage	$I_O = 0.8\text{ A}$		0.6	1.0	V
		$I_O = 1\text{ A}$		0.7	1.1	V
$I_Q$	Quiescent current	$V_I = 5\text{ V}$ , $I_O = 2\text{ mA to }1\text{ A}$ , $T = 25\text{ }^\circ\text{C}$			500	$\mu\text{A}$
$I_Q$	Quiescent current	$V_I = 7\text{ V}$ , $I_O = 2\text{ mA to }1\text{ A}$			650	$\mu\text{A}$
SVR	Supply voltage rejection <sup>(2)</sup>	$V_I = 5 \pm 0.5\text{ V}$ , $I_O = 5\text{ mA}$ , $f = 120\text{ Hz}$	50	75		dB
eN	RMS output noise <sup>(2)</sup>	$B = 10\text{ Hz to }10\text{ kHz}$ , $V_I = 5\text{ V}$ , $I_O = 5\text{ mA}$		0.00 3		$\%V_O$
$\Delta V_O/\Delta I_O$	Load transient (rising) <sup>(1)</sup>	$V_I = 5\text{ V}$ , any 200 mA step from 100 mA to 1 A, $t_R \geq 1\text{ }\mu\text{s}$			5	$\%V_O$
$T_{SH}$	Thermal shutdown trip point <sup>(2)</sup>	$V_I = 5\text{ V}$		165		$^\circ\text{C}$

1.  $C_I = 10\text{ }\mu\text{F}$ ,  $C_O = 10\text{ }\mu\text{F}$ , X7R ceramic capacitors.

2. Guaranteed by design. Not tested in production.

## 5 Typical application

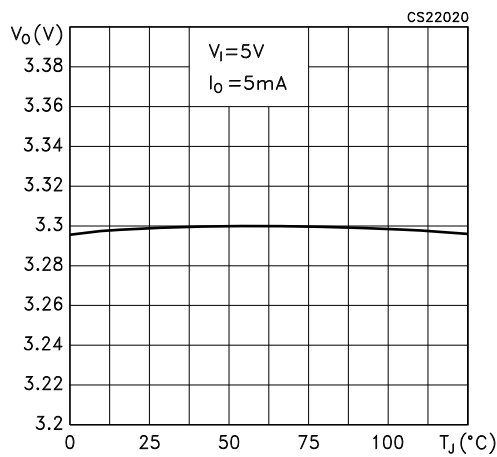
Figure 3. ST1L02 application schematic



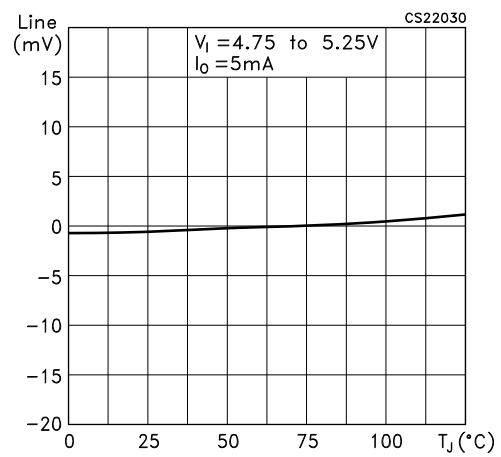
*Note:* The regulator is stable both with tantalum and ceramic capacitors on the input and the output. The expected values of the input and output ceramic capacitors are from  $1\mu F$  to  $22\mu F$  with  $4.7\mu F$  typical. The input capacitor has to be connected within 1 cm from  $V_I$  terminal. The output capacitor has also to be connected within 1 cm from output pin. There is not any upper limit to the value of the input capacitor.

## 6 Typical characteristics

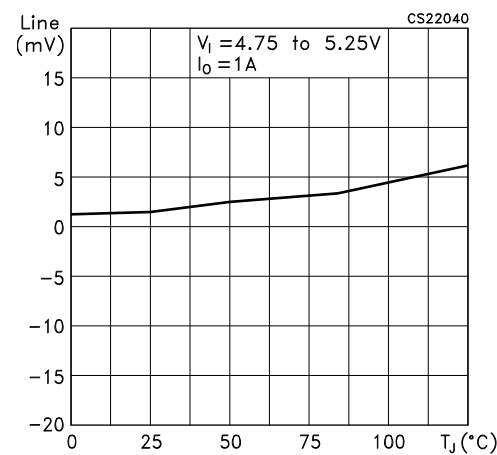
**Figure 4. Output voltage vs temperature**



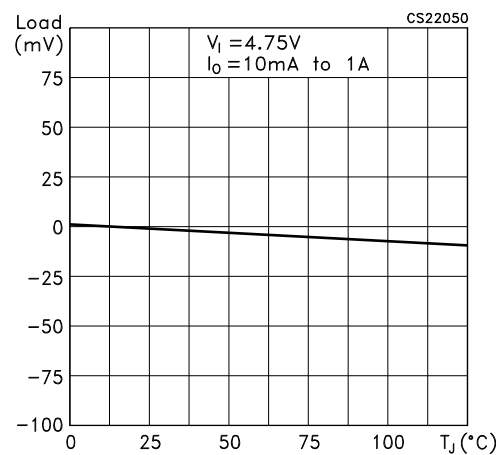
**Figure 5. Line regulation vs temperature**  
 $I_o = 5 mA$



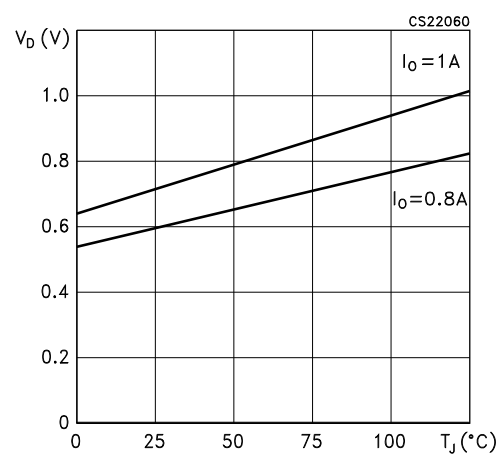
**Figure 6. Line regulation vs temperature**  
 $I_o = 1 A$



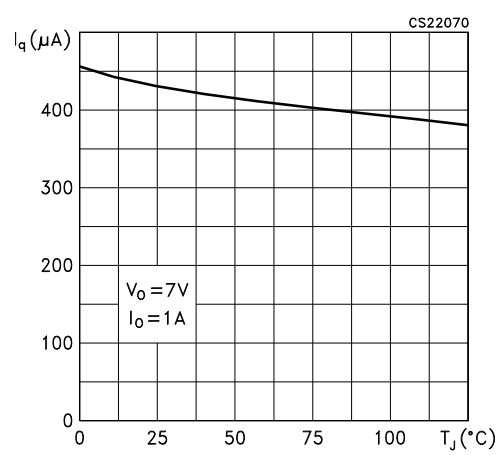
**Figure 7. Load regulation vs temperature**



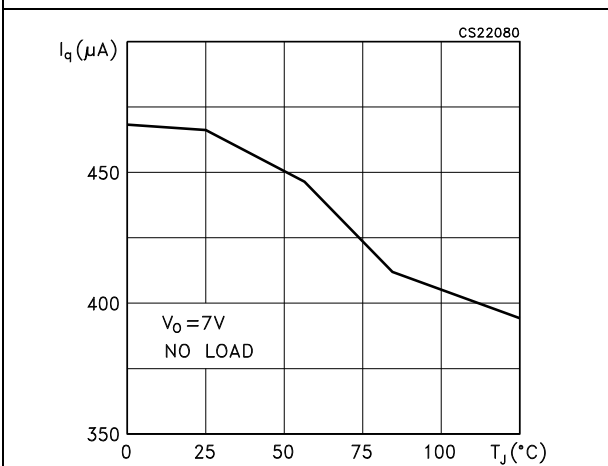
**Figure 8. Dropout voltage vs temperature**



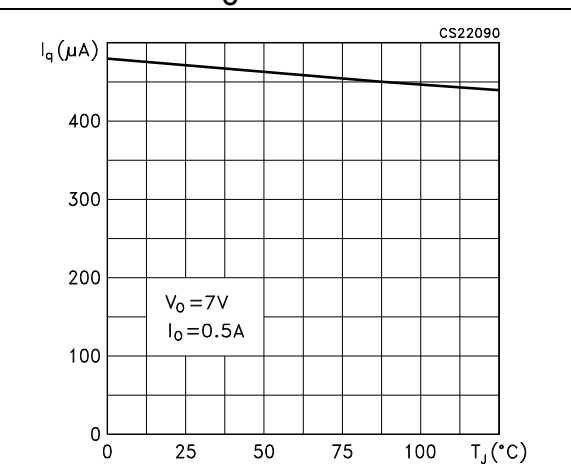
**Figure 9. Quiescent current vs temperature**  
 $I_o = 1 A$



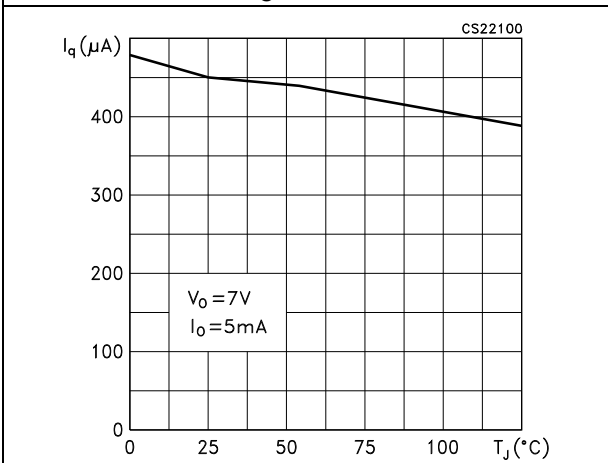
**Figure 10. Quiescent current vs temperature no load**



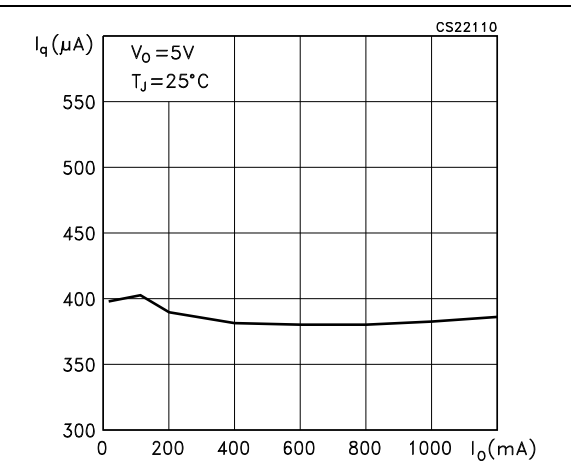
**Figure 11. Quiescent current vs temperature  $I_O = 500$  mA**



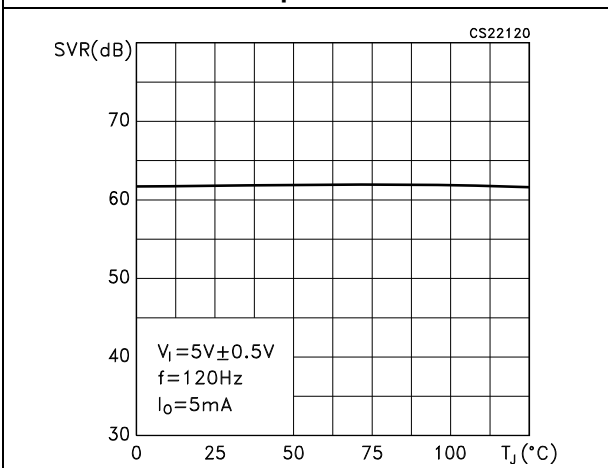
**Figure 12. Quiescent current vs temperature  $I_O = 5$  mA**



**Figure 13. Quiescent current vs output current**



**Figure 14. Supply voltage rejection vs temperature**



**Figure 15. Supply voltage rejection vs frequency**

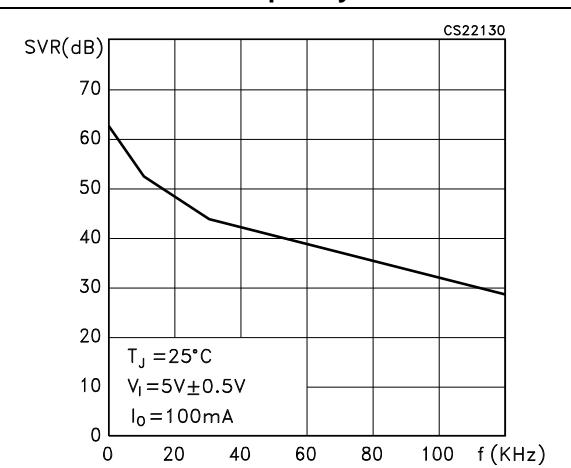


Figure 16. Output noise vs frequency

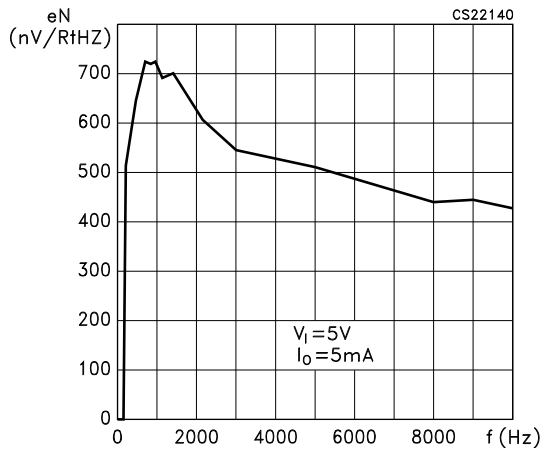
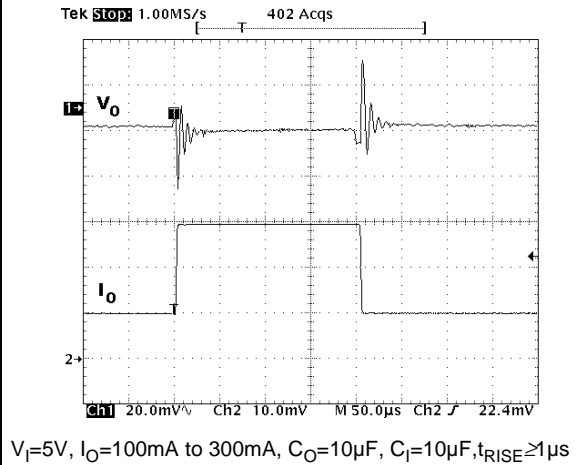
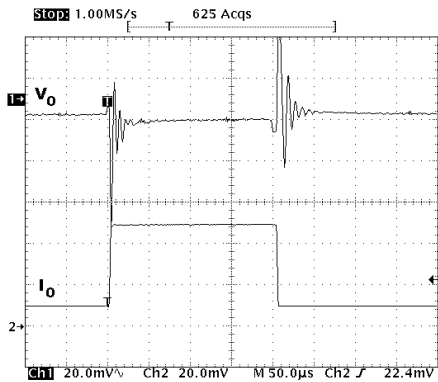


Figure 17.  $V_O$  change with step load change  $I_O = 100$  to  $300$  mA



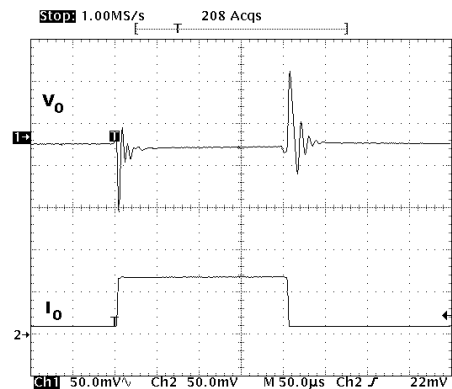
$V_1=5V, I_O=100mA$  to  $300mA, C_O=10\mu F, C_I=10\mu F, t_{RISE} \geq 1\mu s$

Figure 18.  $V_O$  change with step load change  $I_O = 300$  to  $500$  mA



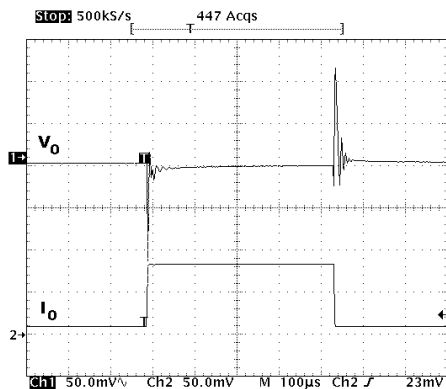
$V_1=5V, I_O=300mA$  to  $500mA, C_O=10\mu F, C_I=10\mu F, t_{RISE} \geq 1\mu s$

Figure 19.  $V_O$  change with step load change  $I_O = 500$  to  $700$  mA



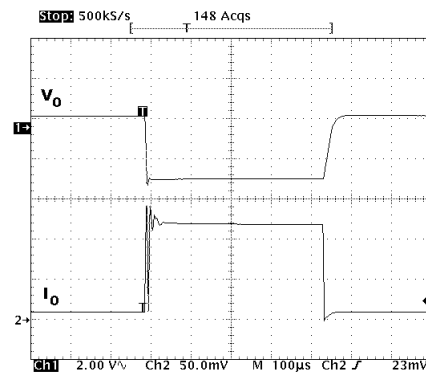
$V_1=5V, I_O = 500mA$  to  $700mA, C_O=10\mu F, C_I=10\mu F, t_{RISE} \geq 1\mu s, T_J = 25^\circ C$

Figure 20.  $V_O$  change with step load change  $I_O = 700$  to  $900$  mA

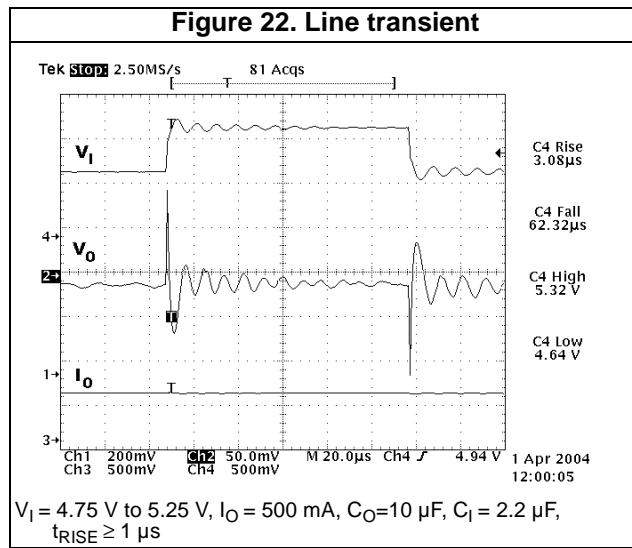


$V_1=5V, I_O=700mA$  to  $900mA, C_O=10\mu F, C_I=10\mu F, t_{RISE} \geq 1\mu s, T_J=25^\circ C$

Figure 21.  $V_O$  change with step load change  $I_O = 10$  mA to short-circuit



$V_1=5V, I_O=10mA$  to short-circuit,  $C_O=10\mu F, C_I=10\mu F, t_{RISE} \geq 1\mu s, T_J=25^\circ C$



## 7 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 23. DFN6 (3x3 mm) drawings

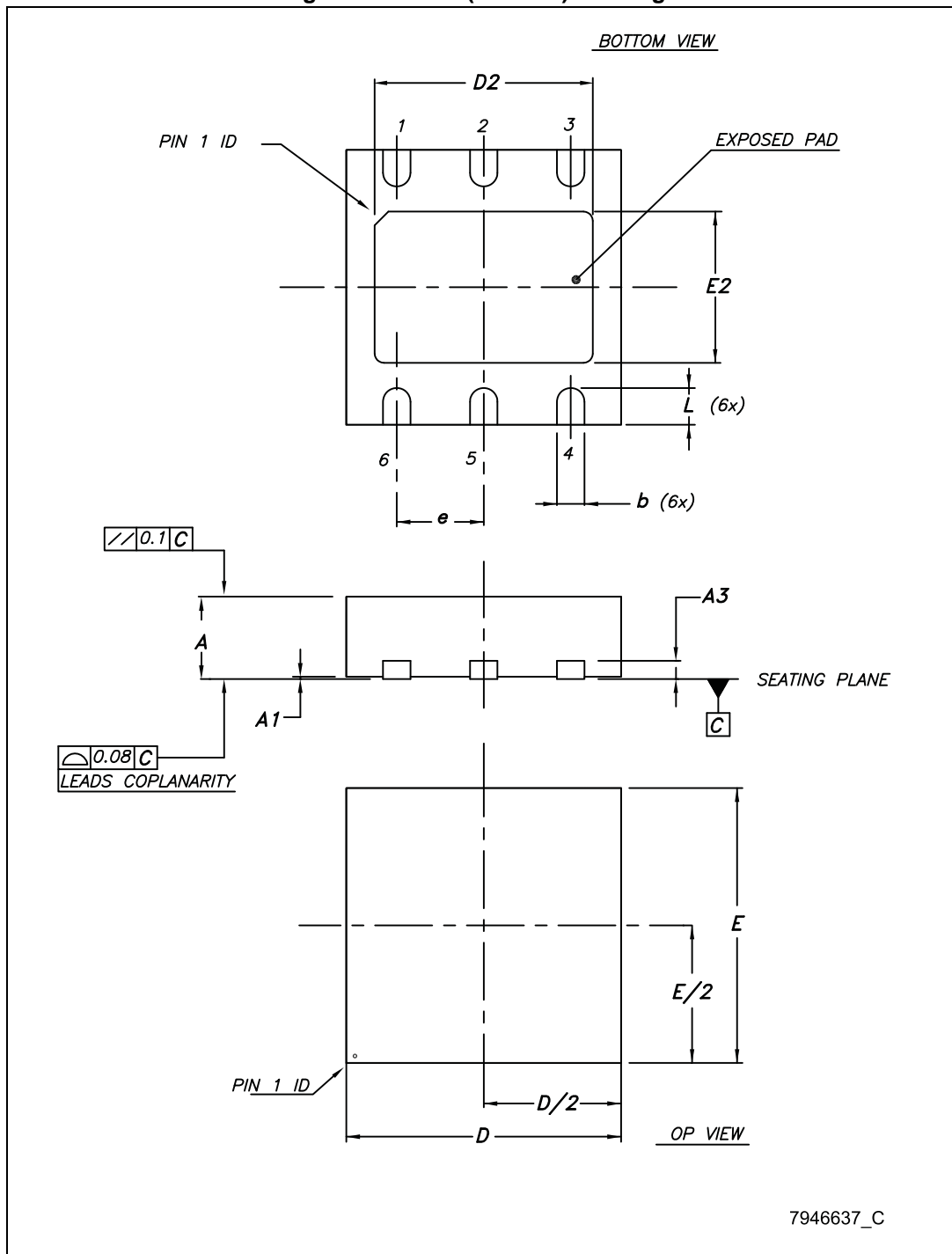
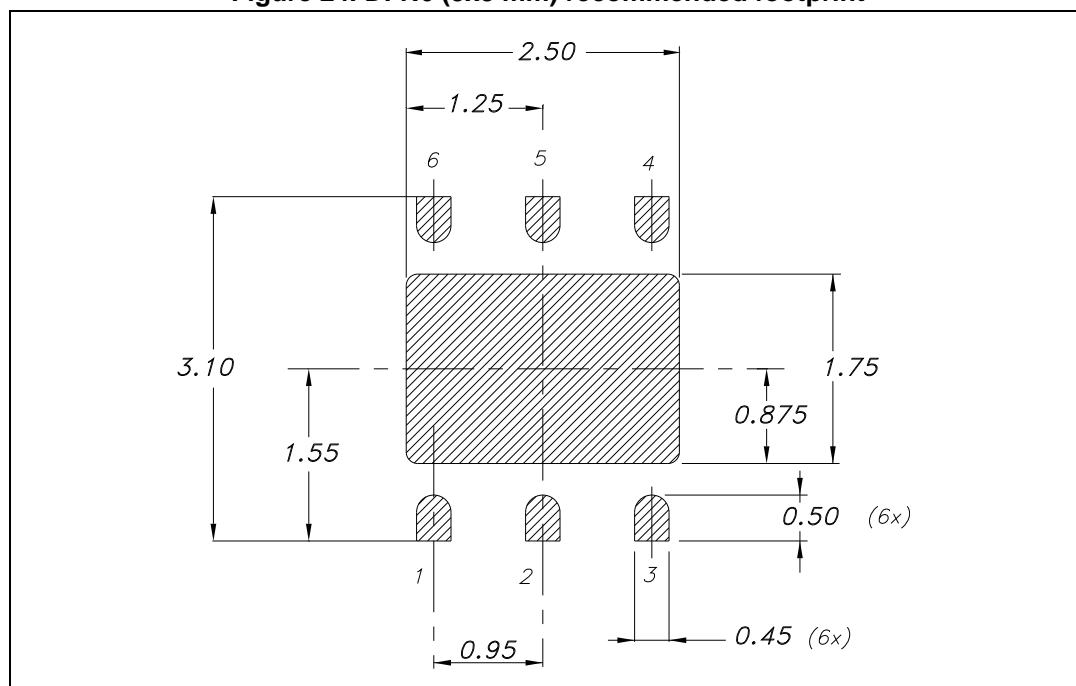


Table 7. DFN6 (3x3 mm) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1
A1	0	0.02	0.05
A3		0.20	
b	0.23		0.45
D	2.90	3	3.10
D2	2.23		2.50
E	2.90	3	3.10
E2	1.50		1.75
		0.95	
L	0.30	0.40	0.50

Figure 24. DFN6 (3x3 mm) recommended footprint



# 8 Packaging information

Figure 25. DFN6 (3x3 mm) tape

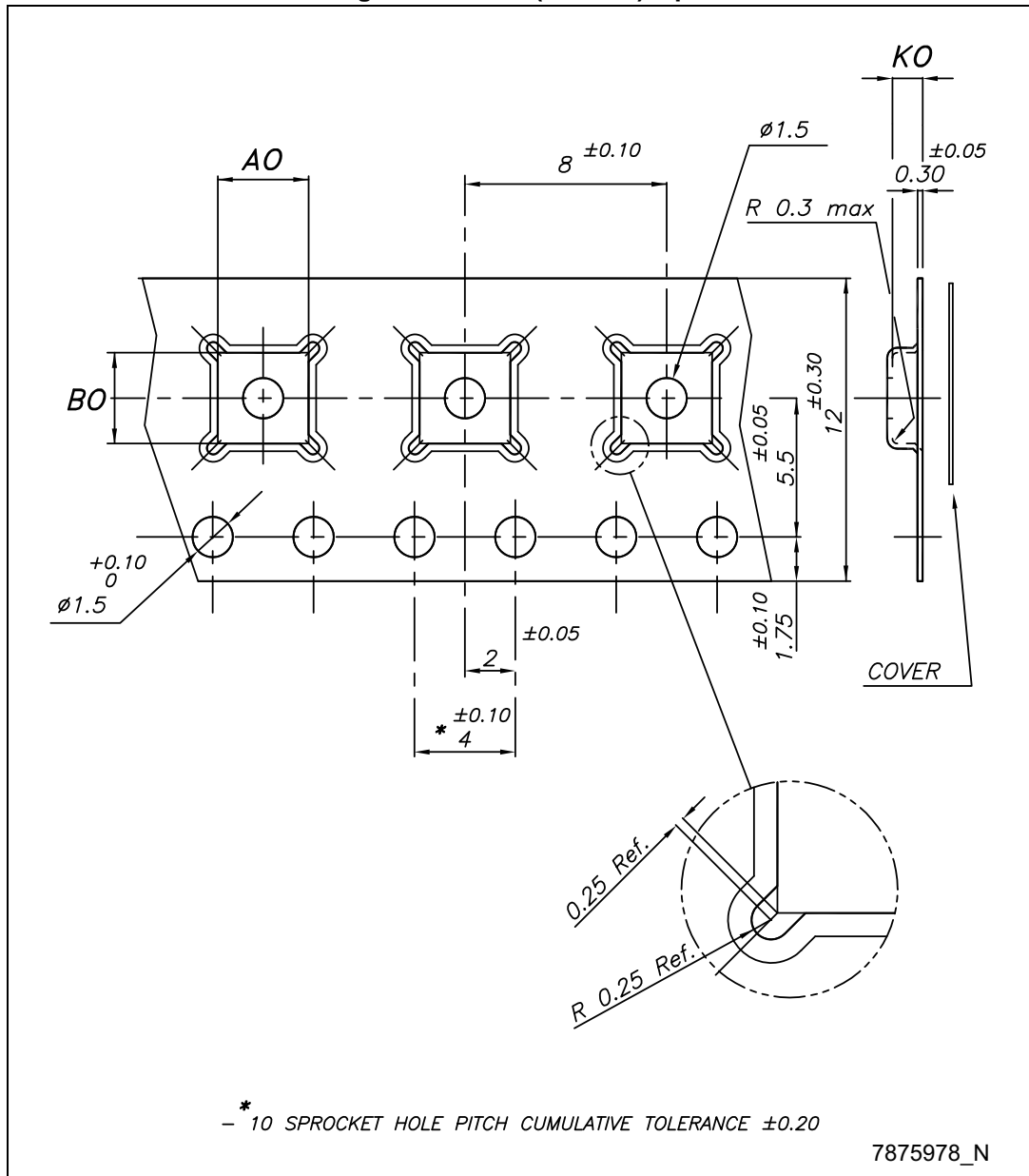


Figure 26. DFN6 (3x3 mm) reel

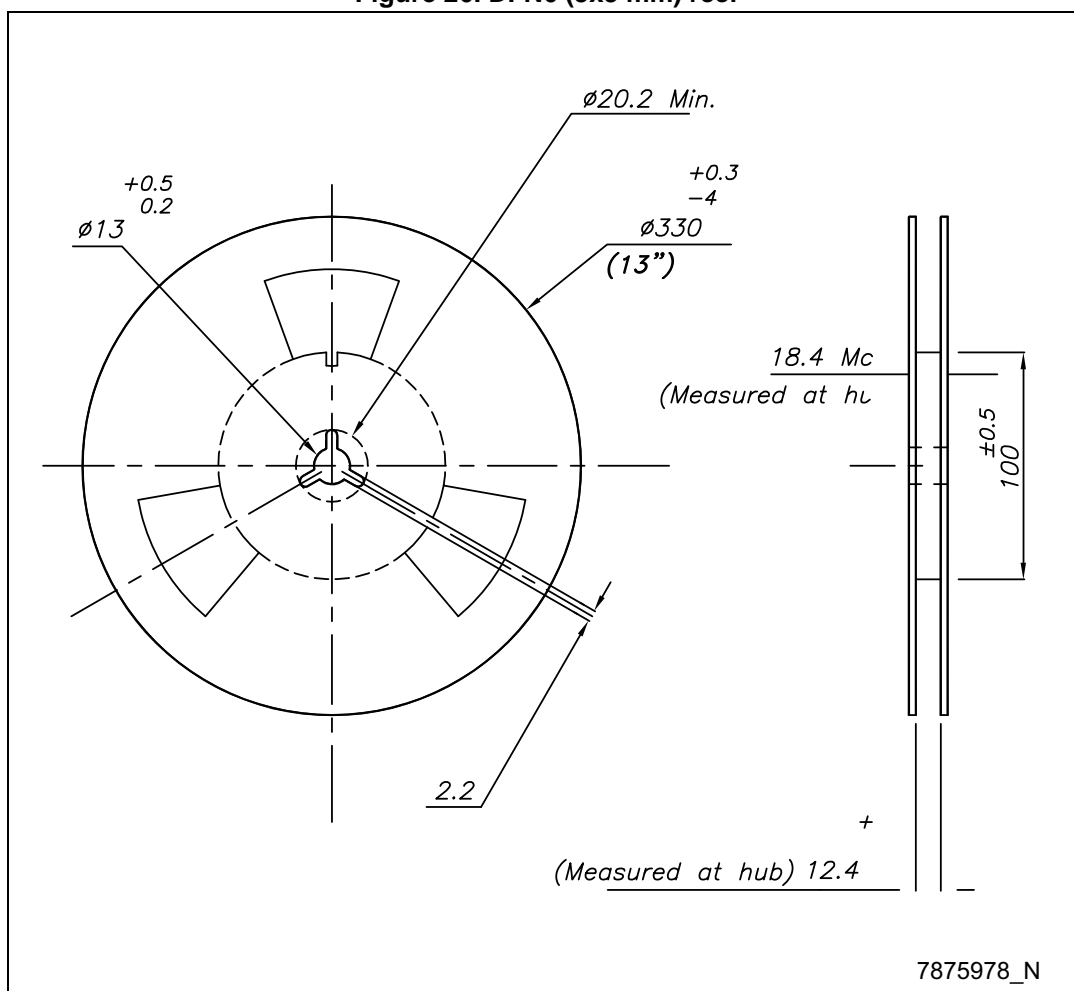


Table 8. DFN6 (3x3 mm) tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A0	3.20	3.30	3.40
B0	3.20	3.30	3.40
K0	1	1.10	1.20

## 9 Revision history

**Table 9. Document revision history**

Date	Revision	Changes
25-Feb-2005	1	First release.
10-Jan-2006	2	Add new order codes and tables of the electrical characteristics.
16-May-2006	3	General feature has been updated and add note 3 in table 6.
05-Jul-2006	4	Updated mechanical data DFN6 (3x3).
22-Feb-2007	5	Add note in <a href="#">Figure 2</a> and in order codes.
03-Apr-2007	6	Add order codes and mechanical data DFN6D.
05-Sep-2007	7	Add <a href="#">Table 1</a> in cover page.
12-Mar-2008	8	Removed: mechanical data DFN6.
09-Apr-2014	9	<p>Changed the part number ST1L02xx to ST1L02.</p> <p>Changed the title in cover page.</p> <p>Updated <a href="#">Features</a> and <a href="#">Description</a>.</p> <p>Changed the <a href="#">Table 1: Device summary</a>.</p> <p>Updated <a href="#">Figure 2</a>, and <a href="#">Table 2</a>.</p> <p>Updated <a href="#">Section 4: Electrical characteristics</a>.</p> <p>Deleted figure titled: ST1L02PM application schematic.</p> <p>Updated title of: <a href="#">Figure 5</a>, <a href="#">Figure 6</a>, <a href="#">Figure 9</a>, <a href="#">Figure 10</a>, <a href="#">Figure 11</a>, <a href="#">Figure 12</a>, <a href="#">Figure 17</a>, <a href="#">Figure 18</a>, <a href="#">Figure 19</a>, <a href="#">Figure 20</a> and <a href="#">Figure 21</a>.</p> <p>Updated package mechanical data.</p>

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