

## Low input voltage, 200 mA ultra-low noise LDO

### Features



Flip-Chip4



SOT23-5L

- Input voltage from 1.1 V to 5.5 V
- Ultra-low dropout voltage (190 mV max. at 200 mA load)
- Low ground current (18  $\mu$ A typ. at no load)
- Output voltage tolerance:  $\pm 2\%$  overtemperature,  $\pm 1\%$  at 25 °C
- 200 mA guaranteed output current
- Ultra-low output noise: 8.8  $\mu$ V<sub>RMS</sub> (10 Hz to 100 kHz)
- 50 mV output voltage steps (available on request) from 0.6 V to 4.0 V
- Logic-controlled electronic shutdown
- Thermal shutdown
- Output active discharge function
- Packages: Flip-chip4 0.65 x 0.65 mm<sup>2</sup> and SOT23-5L

### Applications

#### Maturity status link

LD56020

- Smartphones/tablets
- Image sensors
- VCO and RF modules

### Description

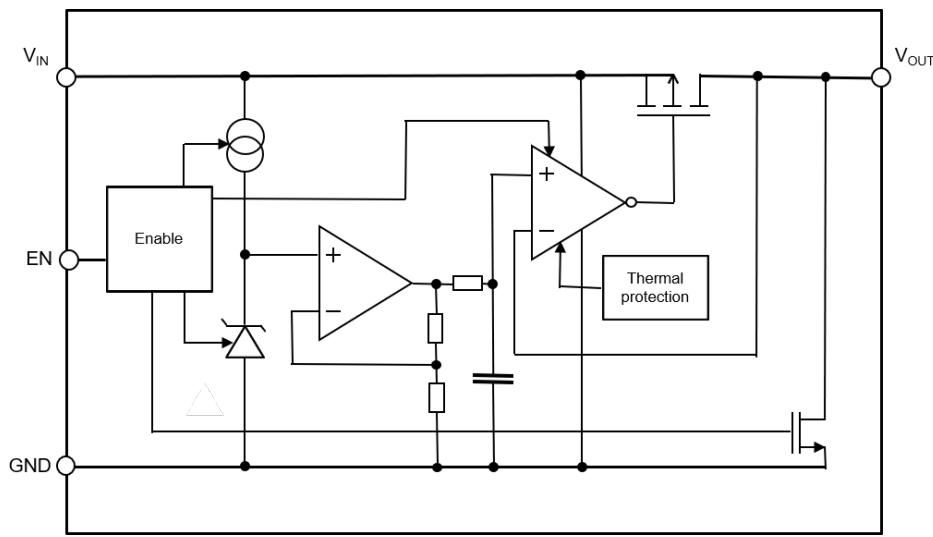
The LD56020 is a high accuracy voltage regulator which provides 0.2 A of current. It is available in CSP 0.65 x 0.65 mm<sup>2</sup> package, SOT23-5L, allowing the maximum space saving.

The device is stabilized with a small ceramic capacitor on input and output. The ultra-low drop, low quiescent current and short-circuit current foldback make the LD56020 suitable for low power battery-operated applications.

An enable logic control function puts the LD56020 in shutdown mode allowing a total current consumption lower than 0.1  $\mu$ A. Thermal protection is also included.

## 1 Diagram

Figure 1. Block diagram



## 2 Pin configuration

Figure 2. Pin connection

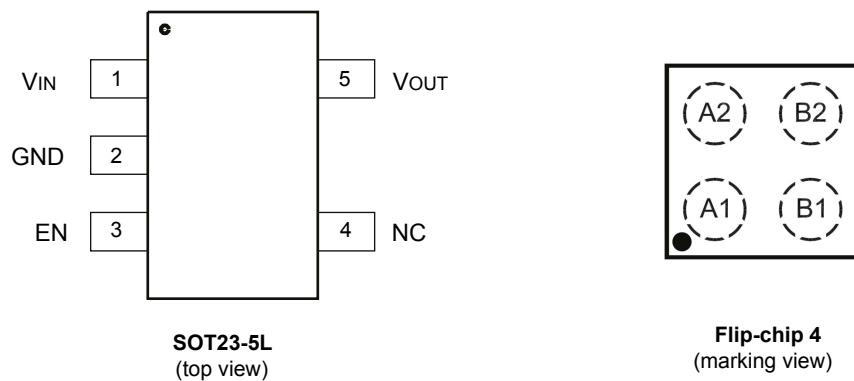
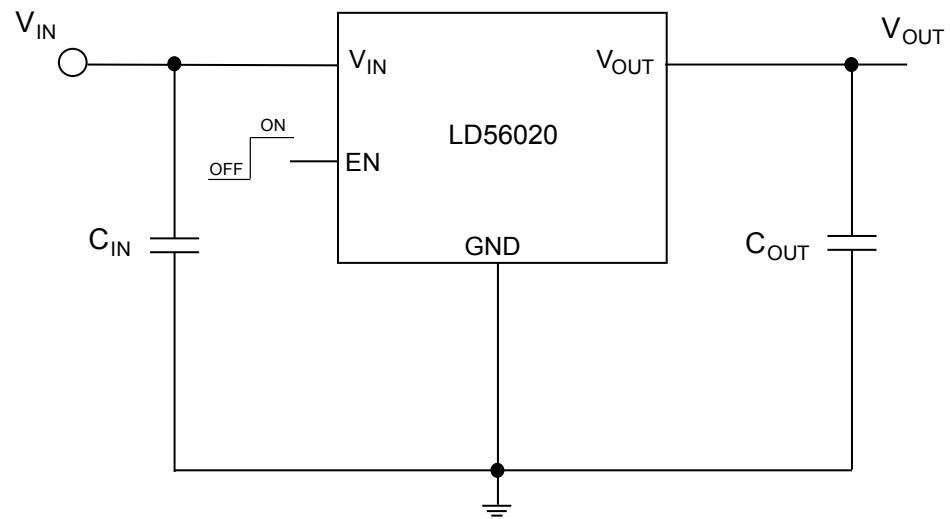


Table 1. Pin description

Symbol	SOT23-5L	Flip-Chip 4	Description
$V_{IN}$	1	A1	LDO Supply voltage
$V_{OUT}$	5	A2	LDO Output voltage
GND	2	B2	Ground
EN	3	B1	Enable input: set $V_{EN}$ = high to turn on the device; $V_{EN}$ = low to turn off the device. This pin is internally pulled down via a $1\text{ M}\Omega$ resistor
NC	4	-	Not internally connected: can be connected to GND
Exposed pad	-	-	Must be connected to GND.

### 3 Typical application diagram

Figure 3. Application diagram



## 4 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{IN}$	Input supply voltage	- 0.3 to 7	V
$V_{OUT}$	Output voltage	- 0.3 to 7	V
$I_{OUT}$	Output current	Internally limited	A
EN	Enable pin voltage	- 0.3 to $V_{IN} + 0.3$	V
PD	Power dissipation	Internally limited	W
ESD	Charge device model	$\pm 1000$	V
	Human body model	$\pm 2000$	
$T_{J-OP}$	Operating junction temperature	- 40 to 125	°C
$T_{J-MAX}$	Maximum junction temperature	150	°C
$T_{STG}$	Storage temperature	- 55 to 150	°C

Table 3. Thermal data

Symbol	Parameter	Flip-Chip4	SOT23-5L	Unit
$R_{thja}$	Thermal resistance, junction-to-ambient	210	200	°C/W

## 5 Electrical characteristics

$V_{IN} = V_{OUT(NOM)} + 0.3 \text{ V}$ ;  $I_{OUT} = 1 \text{ mA}$ ;  $C_{IN} = 1 \mu\text{F}$ ,  $C_{OUT} = 1 \mu\text{F}$ ;  $V_{EN} = 1 \text{ V}$ ; typical values are at  $T_J = 25^\circ\text{C}$ ; min/max values are at  $-40^\circ\text{C} \leq T_J \leq 85^\circ\text{C}$ , unless otherwise specified.

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{IN}$	Operating input voltage		1.1		5.5	V
$V_{OUT}$	Output voltage accuracy	$V_{OUT(NOM)} + 0.3 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}; V_{OUT} \geq 1.5 \text{ V}$	-2.0		+2.0	%
		$V_{OUT(NOM)} + 0.3 \text{ V} \leq V_{IN} \leq 5.5 \text{ V}; V_{OUT} \leq 1.5 \text{ V}$	-30		+30	mV
$V_{OUT}$	Output voltage range	50 mV steps	0.6		4.0	V
$\Delta V_{OUT-IN}$	$V_{IN}$ Static regulation	$V_{OUT(NOM)} + 0.3 \text{ V} \leq V_{IN} \leq 5.0 \text{ V}, I_{OUT} = 1 \text{ mA}$		0.01	0.1	%/V
$\Delta V_{OUT}$	Static load regulation for CSP	$I_{OUT} = 1 \text{ mA}$ to 200 mA		1.5	5	mV
	Static load regulation for SOT 23-5L	$I_{OUT} = 1 \text{ mA}$ to 200 mA		15	20	
$V_{DROP}$	Dropout voltage for CSP	$I_{OUT} = 0.05 \text{ A}; V_{OUT} = 1.05 \text{ V}$		40	90	mV
		$V_{OUT} = 97\% \text{ of } V_{OUT(NOM)}$				
		$I_{OUT} = 0.10 \text{ A}; V_{OUT} = 1.05 \text{ V}$		70	130	
		$V_{OUT} = 97\% \text{ of } V_{OUT(NOM)}$				
	Dropout voltage for SOT 23-5L	$I_{OUT} = 0.11 \text{ A}; V_{OUT} = 1.2 \text{ V}$		60	140	mV
		$V_{OUT} = 97\% \text{ of } V_{OUT(NOM)}$				
		$I_{OUT} = 0.2 \text{ A}; V_{OUT} = 1.2 \text{ V}$		110	190	
		$V_{OUT} = 97\% \text{ of } V_{OUT(NOM)}$				
		$I_{OUT} = 0.10 \text{ A}; V_{OUT} = 1.05 \text{ V}$		80	100	
$eN$	Output noise voltage	$V_{OUT(NOM)} = 1.0 \text{ V}; V_{IN} = 1.5 \text{ V}$				$\mu\text{V}_{\text{RMS}}$
		10 Hz to 100 kHz, $I_{OUT} = 1 \text{ mA}$		8.8		
		$V_{IN} = V_{OUT(NOM)} + 0.3 \text{ V} \pm V_{RIPPLE}$				
		$V_{RIPPLE} = 0.2 \text{ V}_{\text{pp}}, \text{ Freq} = 100 \text{ Hz}, I_{OUT} = 20 \text{ mA}$		90		
		$V_{IN} = V_{OUT(NOM)} + 0.3 \text{ V} \pm V_{RIPPLE}$				
		$V_{RIPPLE} = 0.2 \text{ V}_{\text{pp}} \text{ Freq} = 1 \text{ kHz}, I_{OUT} = 20 \text{ mA}$		95		
$SVR_{IN}$	$V_{IN}$ Supply voltage rejection	$V_{IN} = V_{OUT(NOM)} + 0.3 \text{ V} \pm V_{RIPPLE}$				dB
		$V_{RIPPLE} = 0.2 \text{ V}_{\text{pp}} \text{ Freq} = 10 \text{ kHz}, I_{OUT} = 20 \text{ mA}$		85		
		$V_{IN} = V_{OUT(NOM)} + 0.3 \text{ V} \pm V_{RIPPLE}$				
		$V_{RIPPLE} = 0.2 \text{ V}_{\text{pp}} \text{ Freq} = 100 \text{ kHz}, I_{OUT} = 20 \text{ mA}$		55		
$I_Q$	Quiescent current	$I_{OUT} = 0 \text{ mA}$		20	25	$\mu\text{A}$
$I_{Q\_OFF}$	Standby Current	$V_{EN} = \text{GND}$		0.01	1	$\mu\text{A}$

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I <sub>LIM</sub>	Output current limit	V <sub>OUT</sub> = 0.9 × V <sub>OUT(NOM)</sub>	250	300		mA
I <sub>SC</sub>	Short-circuit current	V <sub>OUT</sub> = 0 (foldback protection)		100	TBD	mA
V <sub>EN</sub>	Enable input logic low			0.2		V
	Enable input logic high		0.7			
I <sub>EN</sub>	Enable pin input current	V <sub>EN</sub> = 1.1 V (internal pull-down)		0.2	0.5	μA
T <sub>ON</sub>	Turn-on time	V <sub>OUT(NOM)</sub> = 1.0 V		150		μs
T <sub>SHDN</sub>	Thermal shutdown			160		°C
	Hysteresis			20		

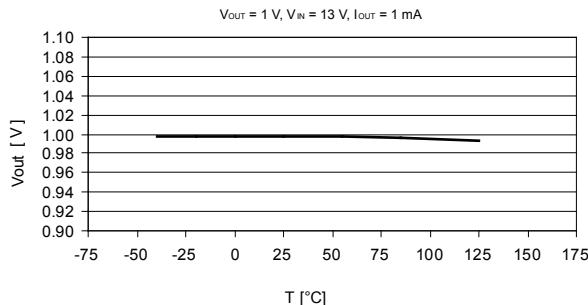
**Table 5. Recommended Input and output capacitors**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
C <sub>IN</sub>	Input capacitance	Stability	0.7	1		μF
C <sub>OUT</sub>	Output capacitance		0.7	1	10	
ESR	Output/Input capacitance		5		500	mΩ

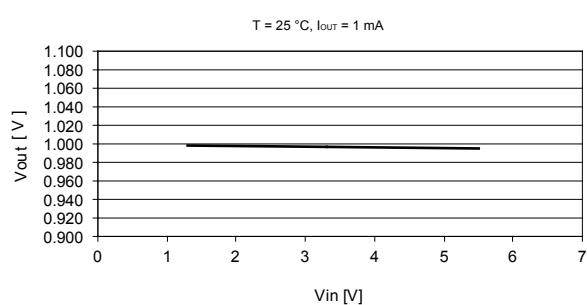
## 6 Typical performance characteristics

The following plots are referred to LD56020 in the typical application circuit and, unless otherwise noted, at  $T_A = 25^\circ\text{C}$

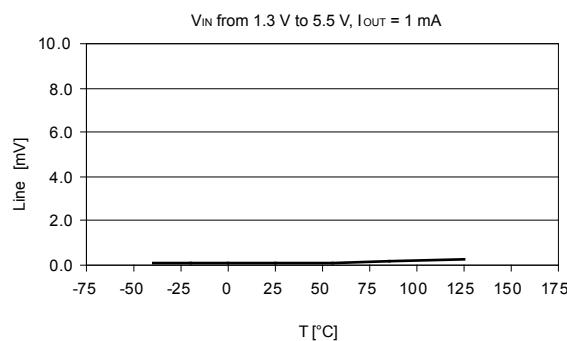
**Figure 4. Output voltage vs. temperature ( $V_{IN} = 1.4 \text{ V}$ )**



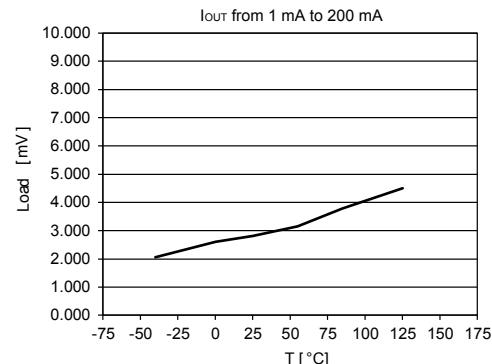
**Figure 5. Output voltage vs.  $V_{IN}$**



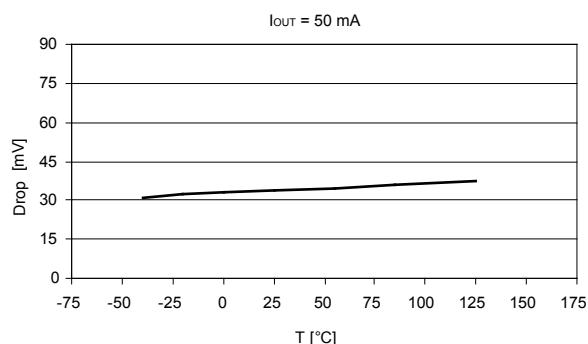
**Figure 6. Line regulation vs. temperature**



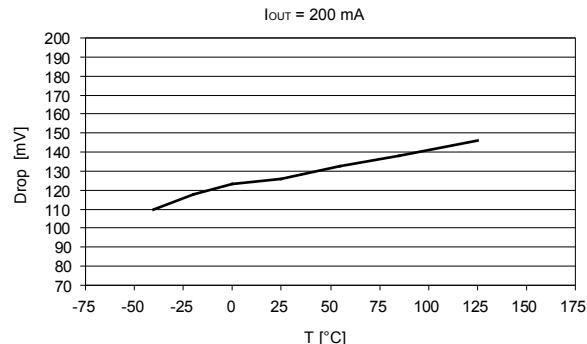
**Figure 7. Load regulation vs. temperature**

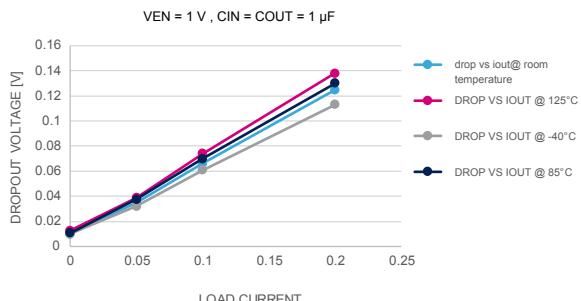
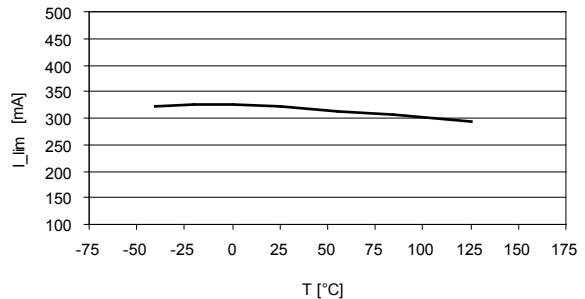
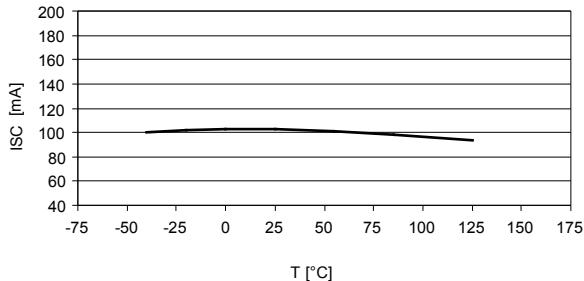
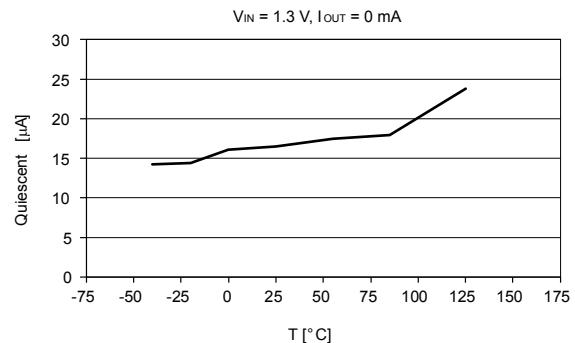
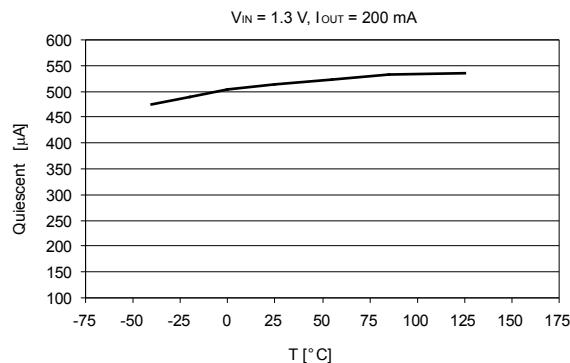
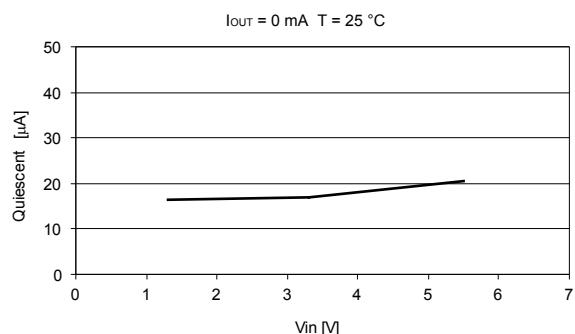


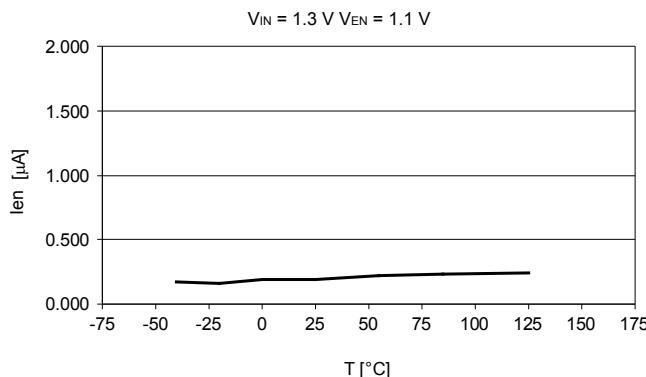
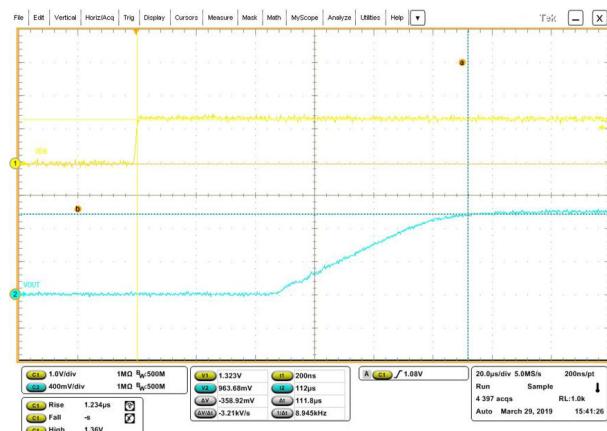
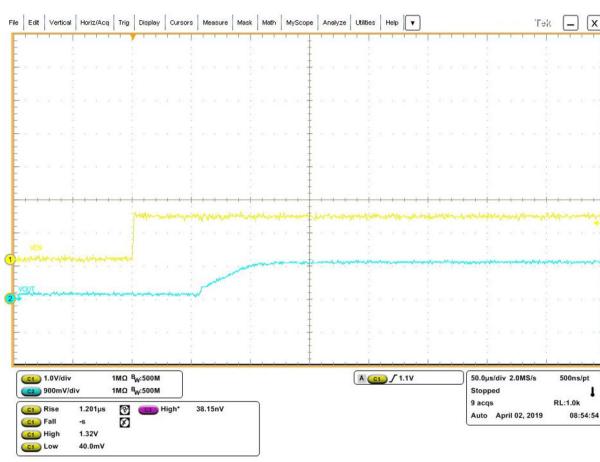
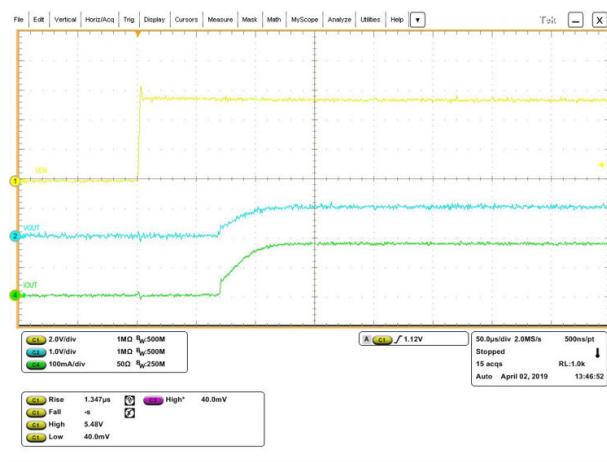
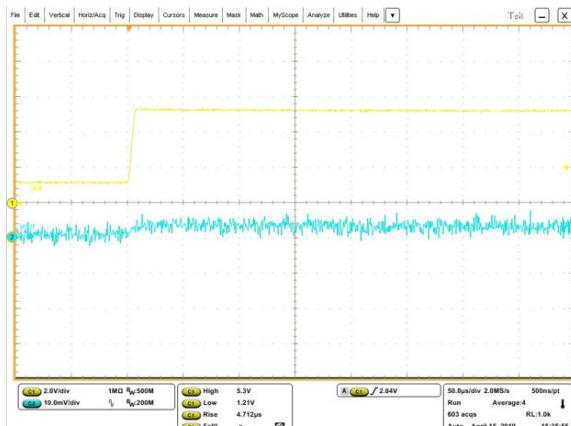
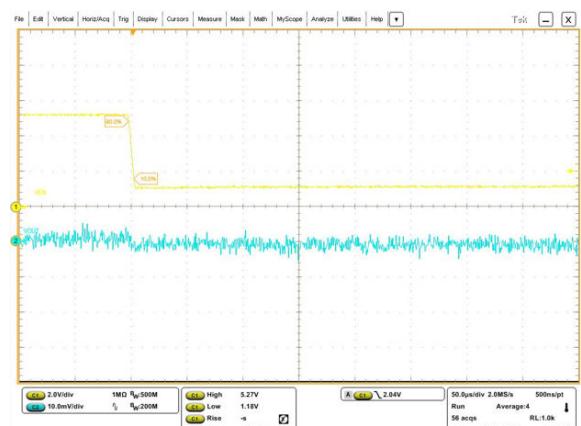
**Figure 8. Dropout voltage vs. temperature, ( $I_{OUT} = 50 \text{ mA}$ )**

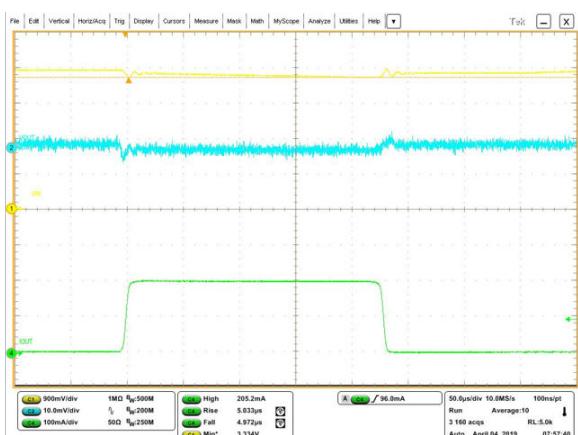
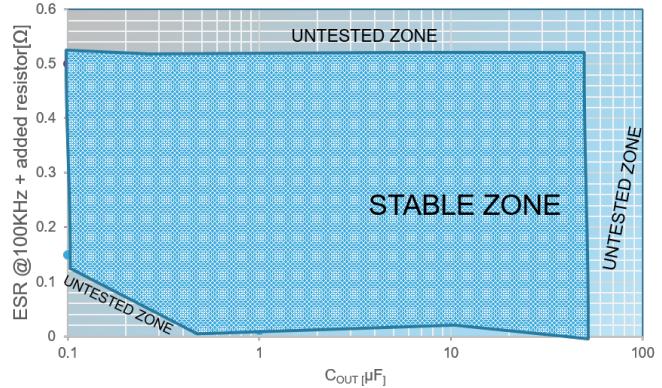


**Figure 9. Dropout voltage vs. temperature, ( $I_{OUT} = 200 \text{ mA}$ )**



**Figure 10. Dropout voltage vs. output current**

**Figure 11.  $I_{LIM}$  vs. temperature**

**Figure 12.  $I_{short}$  vs. temperature**

**Figure 13. Quiescent current vs. temperature**

**Figure 14. Quiescent current vs. temperature  $I_{OUT} = 200$  mA**

**Figure 15. Quiescent current vs. input voltage**


**Figure 16. Enable current vs. temperature**

**Figure 17. Turn-on time**

**Figure 18. Turn-on time  $I_{OUT} = 0 \text{ mA}$** 

**Figure 19. Turn-on time  $I_{OUT} = 200 \text{ mA}$** 

**Figure 20. Line regulation transient**

**Figure 21. Line regulation transient ( $I_{OUT} = 1 \mu\text{A}$ )**


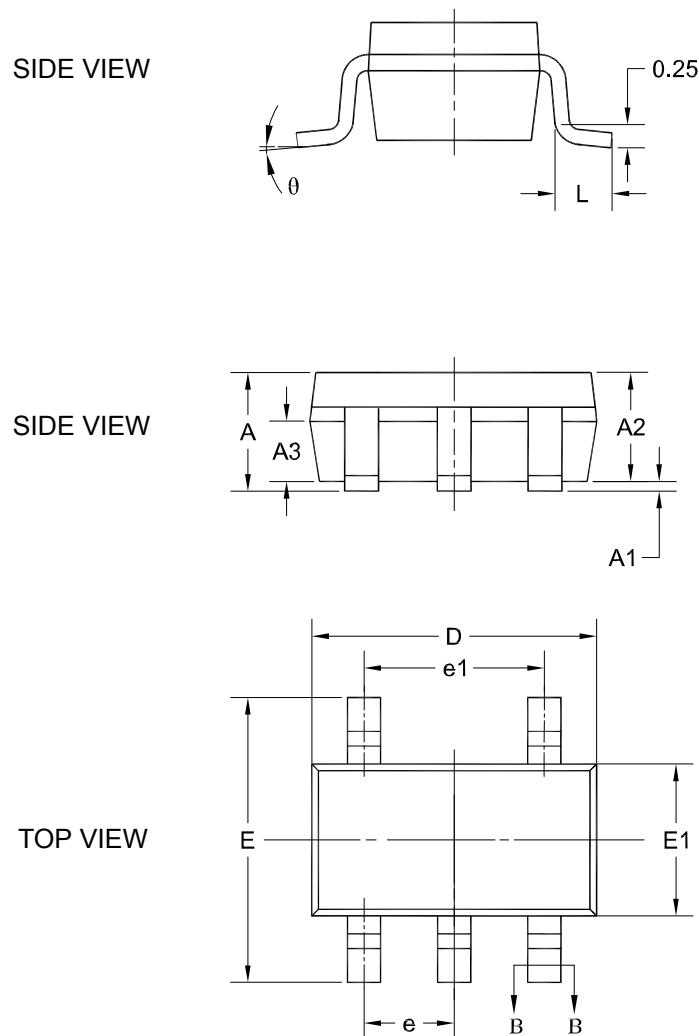
**Figure 22. Load transient**

 $V_{EN}=1\text{ V}$ ,  $V_{IN}=3.3\text{ V}$ ,  $I_{OUT}=1\text{ mA}$  to  $200\text{ mA}$ ,  $t_r=t_f=5\text{ }\mu\text{s}$   $C_{IN}=C_{OUT}=1\text{ }\mu\text{F}$ 
**Figure 23. Stability plane**

 $V_{EN}=1\text{ V}$   $V_{IN}=\text{from } V_{out}(\text{nom})+0.3\text{ V}$  to  $5.5\text{ V}$   $I_{OUT}=\text{from } 1\text{ mA}$  to  $200\text{ mA}$ ,  $C_{IN}=1\text{ }\mu\text{F}$

## 7 Package information

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.

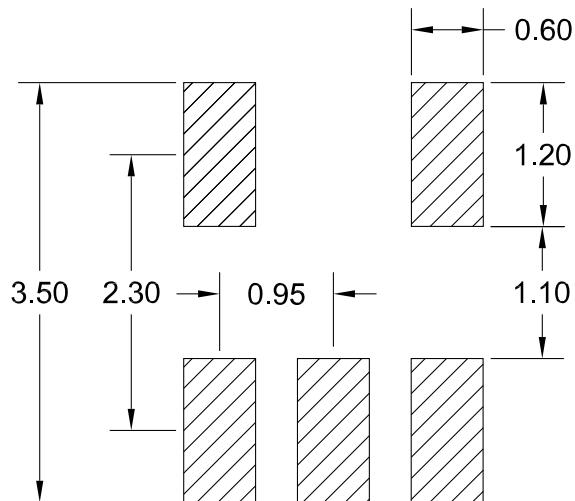
### 7.1 SOT23-5L package information

Figure 24. SOT23-5L package outline



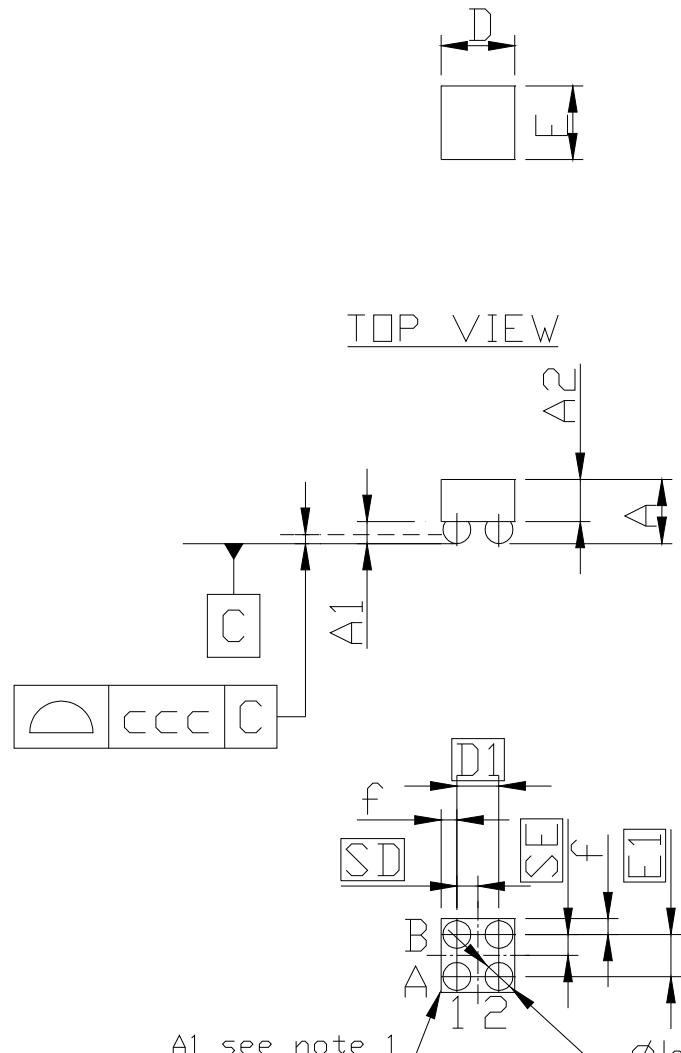
**Table 6.** SOT23-5L mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.25
A1	0.04		0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.33		0.41
b1	0.32	0.35	0.38
c	0.15		0.19
c1	0.14	0.15	0.16
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e		0.95 CS	
e1		1.90 BSC	
L	0.30		0.60
Θ	0		8°

**Figure 25.** SOT23-5L recommended footprint

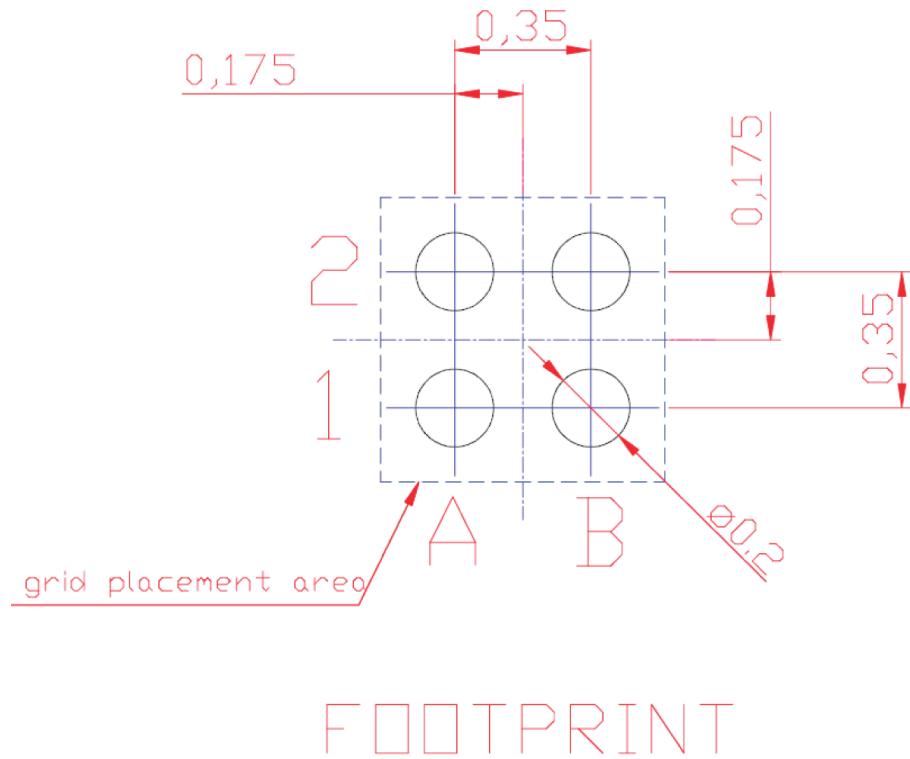
## 7.2 Flip-chip 4 package information

Figure 26. Flip-chip 4 package mechanical outline



**Table 7. Flip-chip 4 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.375	0.410	0.445
A1	0.145	0.160	0.175
A2	0.230	0.250	0.270
b	0.189	0.210	0.231
D	0.660	0.690	0.72
D1		0.350	
E	0.660	0.690	0.720
E1		0.350	
SD		0.175	
SE		0.175	
f		0.170	
ccc		0.075	

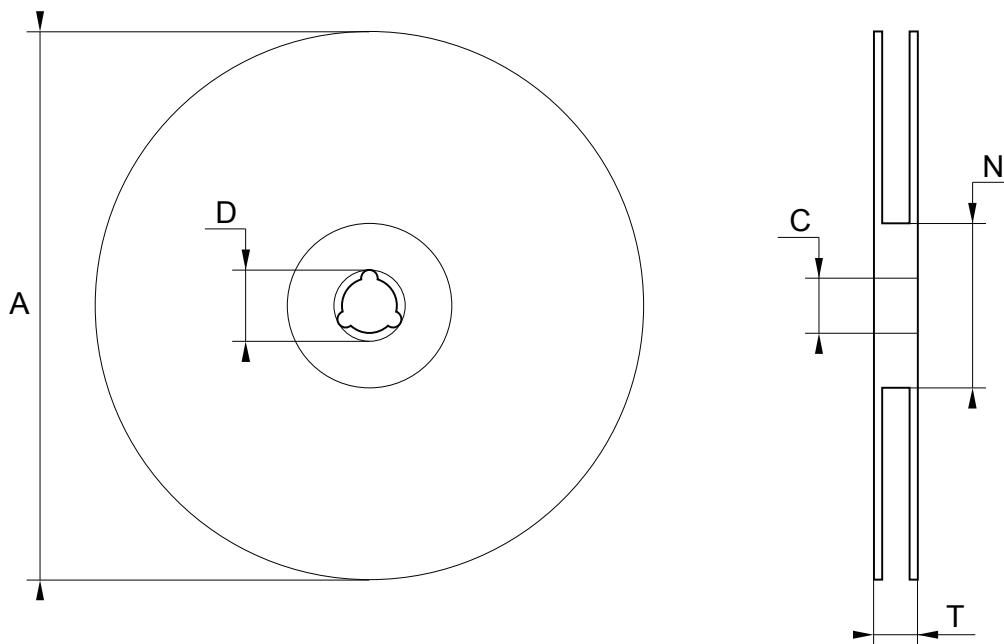
**Figure 27. Flip-chip 4 package footprint**

## 7.3 Flip-chip 4 packing information

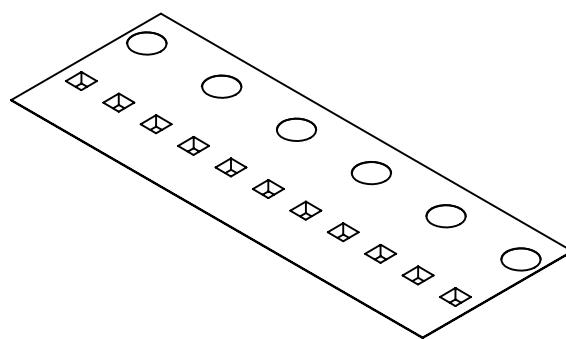
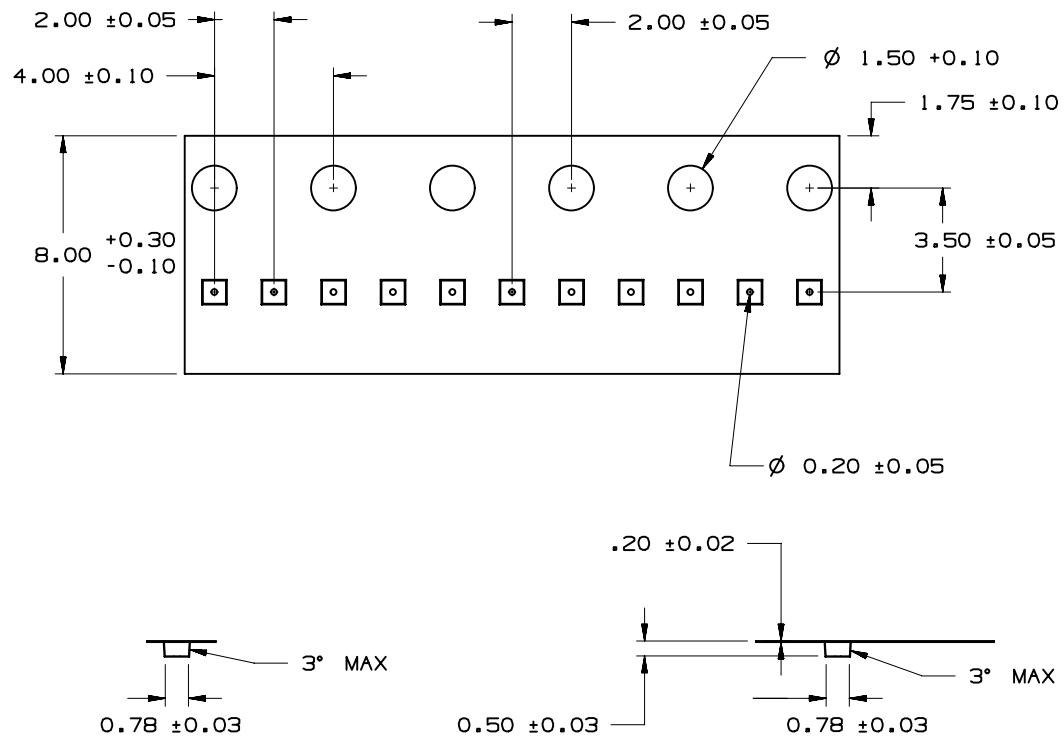
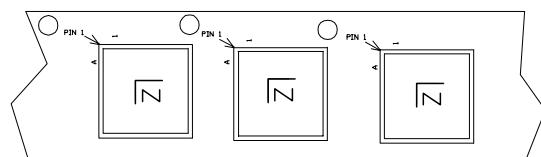
Table 8. Reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			180
C	12.8	13	13.2
D	20.2		
N	60		
T			14.4

Figure 28. Reel



Note: Drawing not in scale

**Figure 29. Tape drawing**

**Figure 30. Reel orientation**
**MARKING VIEW**


## 8 Ordering information

Table 9. Order codes

Order code	Package	Output voltage	Marking	Packing
LD56020M100R	SOT23-5L	1.0 V		Tape and reel
LD56020M110R		1.1 V		
LD56020M120R		1.2 V		
LD56020M180R		1.8 V		
LD56020M300R <sup>(1)</sup>		3.0 V		
LD56020M330R <sup>(1)</sup>		3.3 V		
LD56020J100R	Flip-Chip4	1.0 V	L1	Tape and reel
LD56020J110R		1.1 V	L2	
LD56020J115R		1.15	L5	
LD56020J120R		1.2 V	L3	
LD56020J180R		1.8 V	L4	
LD56020J300R <sup>(1)</sup>		3.0 V		
LD56020J330R <sup>(1)</sup>		3.3 V		

1. Available on request.

## Revision history

**Table 10. Document revision history**

Date	Revision	Changes
01-Mar-2022	1	Initial release.
26-Aug-2024	2	Update <a href="#">Table 9</a>

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