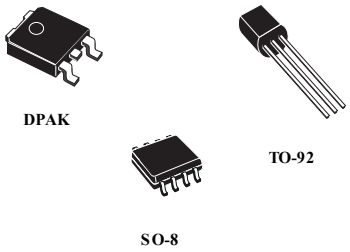
LM2931

Datasheet

Very low drop voltage regulators with inhibit function



Features

- AEC-Q100 qualified (DPAK only)
- Very low dropout voltage (90 mV typ. at 10 mA load)
- Low quiescent current (typ. 2.5 mA, at 100 mA load)
- Output current up to 100 mA
- fixed 3.3 V and 5 V output voltage version
- Internal current and thermal limit
- Load dump protection up to 60 V
- Reverse transient protection up to - 50 V
- Temperature range: - 40 to 125 °C
- Package available: TO-92, DPAK, SO-8 (with inhibit control)

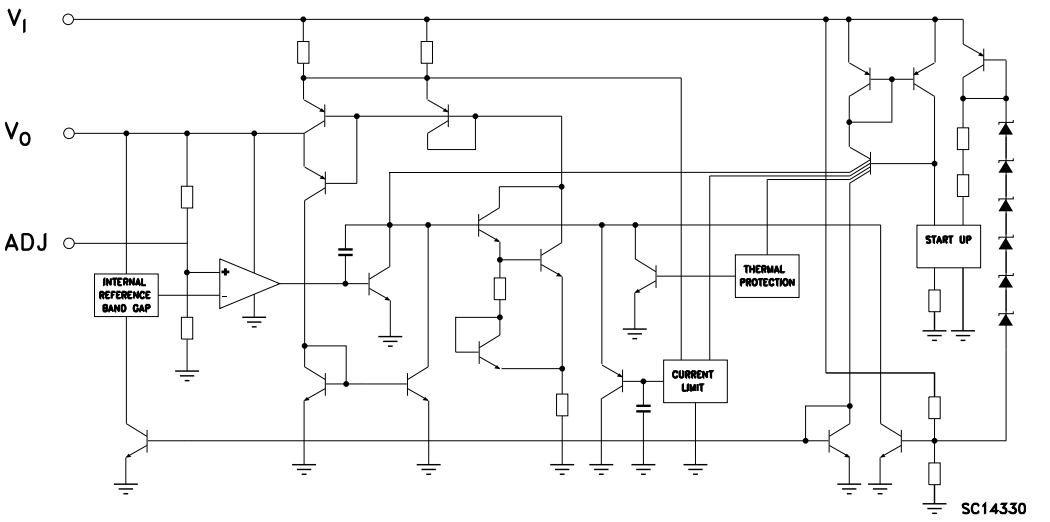
Maturity status link
LM2931

Description

The LM2931 are very low drop regulators. The very low drop voltage and the low quiescent current make them particular suitable for low noise, low power applications and in battery-powered systems. In the 8-pin configuration (SO-8), fully compatible with the older L78L family, a shutdown logic control function is available. This means that when the device is used as a local regulator it is possible to put a part of the board in standby, decreasing total power consumption. Ideal for automotive applications, LM2931 is protected from reverse battery installations or 2 battery jumps. During the transient, such as a 60 V load dump, when the input voltage can exceed the specified maximum operating input voltage of 26 V, the regulator automatically shuts down to protect both internal circuitry and the load.

1 Diagram

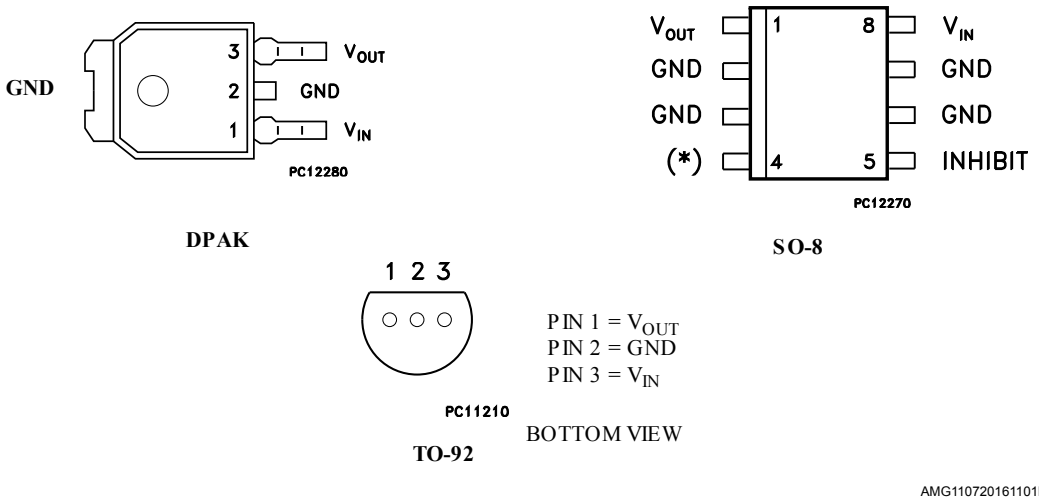
Figure 1. **Schematic diagram**



AMG110720161100MT

2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_I	DC positive input voltage	40	V
V_I	DC reverse input voltage	-15	V
V_I	Transient input voltage (T < 100 ms)	60	V
V_I	Transient reverse input voltage (T < 100 ms)	-50	V
V_{INH}	Inhibit input voltage	40	V
I_O	Output current	Internally limited	
T_{STG}	Storage temperature range	-65 to 150	°C
T_{OP}	Operating junction temperature range	-40 to 125	°C

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

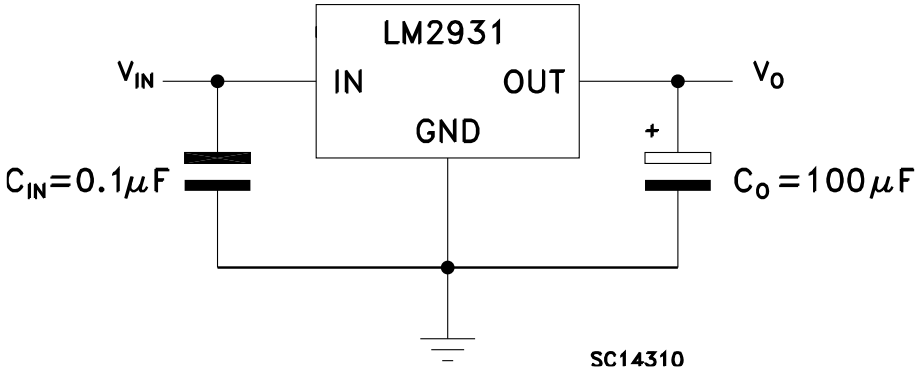
Table 2. Thermal data

Symbol	Parameter	SO-8	DPAK	TO-92	Unit
R_{thJC}	Thermal resistance junction-case	20	8	57	°C/W
R_{thJA}	Thermal resistance junction-ambient	55 (1)	100	200	°C/W

1. *Considering 6 cm^2 of copper board heat-sink.*

4 Application circuits

Figure 3. **Application circuit for fixed output**



AMG110720161102MT

5 Electrical characteristics

Refer to the application circuit Figure 3. Application circuit for fixed output, T_J = 25 °C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14 V, I_O = 10 mA, V_{INH} = 0 V, unless otherwise specified.

Table 3. Electrical characteristics of LM2931A33

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_I	Maximum operating input voltage	I_O = 10 mA, T_J = -40 to 125 °C	26			V
V_O	Output voltage		3.175	3.3	3.425	V
V_O	Output voltage	I_O = 100 mA, V_I = 6 to 26 V T_J = -40 to 125°C	3.135	3.3	3.465	V
DV_O	Line regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	33	
DV_O	Load regulation	I_O = 5 to 100 mA		10	33	mV
V_d	Dropout voltage(1)	I_O = 10 mA		90	250	mV
		I_O = 100 mA		250	600	
I_d	Quiescent current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V, R_{LOAD} = 330 Ω		0.3	1	mA
I_{SC}	Short circuit current		100	300		mA
SVR	Supply voltage rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz	55	78		dB
V_{IL}	Control input voltage low	T_J = -40 to 125 °C		2	1.2	V
V_{IH}	Control input voltage high	T_J = -40 to 125 °C	3.25	2		V
I_{INH}	Inhibit input current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient input voltage	R_{LOAD} = 330 Ω, T < 100 ms	60	70		V
V_I	Reverse polarity input voltage	V_O = ± 0.3 V, R_{LOAD} = 330 Ω	-15	-50		V
V_I	Reverse polarity input voltage transient	R_{LOAD} = 330 Ω, T < 100 ms	-50			V
eN	Output noise voltage	B = 10 Hz to 100 kHz		330		μV_{RMS}

1. *V_d measured when the output voltage has dropped 100 mV from the nominal value obtained at 14 V.*

Refer to the application circuit Figure 3. Application circuit for fixed output, T_J = 25 °C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14 V, I_O = 10 mA, V_{INH} = 0 V, unless otherwise specified.

Table 4. Electrical characteristics of LM2931A50

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_I	Maximum operating input voltage	I_O = 10 mA, T_J = -40 to 125 °C	26			V
V_O	Output voltage		4.81	5	5.19	V
V_O	Output voltage	I_O = 100 mA, V_I = 6 to 26 V T_J = -40 to 125 °C	4.75	5	5.25	V
DV_O	Line regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	30	
DV_O	Load regulation	I_O = 5 to 100 mA		15	50	mV
V_d	Dropout voltage(1)	I_O = 10 mA		90	200	mV

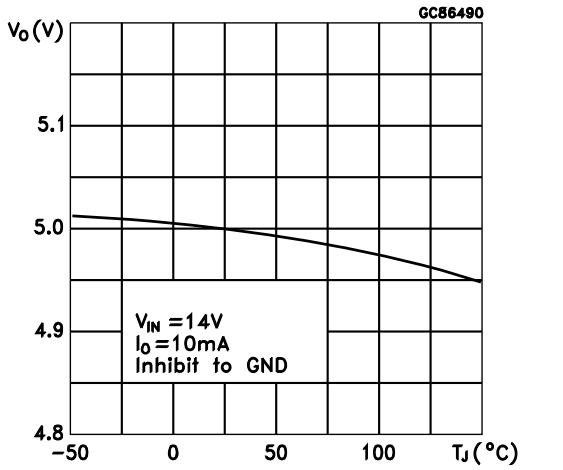
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_d	Dropout voltage(1)	I_O = 100 mA		250	600	mV
I_d	Quiescent current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V, R_{LOAD} = 500 Ω		0.3	1	mA
I_{SC}	Short circuit current		100	300		mA
SVR	Supply voltage rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz	55	75		dB
V_{IL}	Control input voltage low	T_J = -40 to 125 °C		2	1.2	V
V_{IH}	Control input voltage high	T_J = -40 to 125 °C	3.25	2		V
I_{INH}	Inhibit input current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient input voltage	R_{LOAD} = 500 Ω, T < 100 ms	60	70		V
V_I	Reverse polarity input voltage	V_O = ± 0.3 V, R_{LOAD} = 500 Ω	-15	-50		V
V_I	Reverse polarity input voltage transient	R_{LOAD} = 500 Ω, T < 100 ms	-50			V
eN	Output noise voltage	B = 10 Hz to 100 kHz		500		μV_{RMS}

1. *V_d measured when the output voltage has dropped 100 mV from the nominal value obtained at 14 V.*

6 Typical characteristics

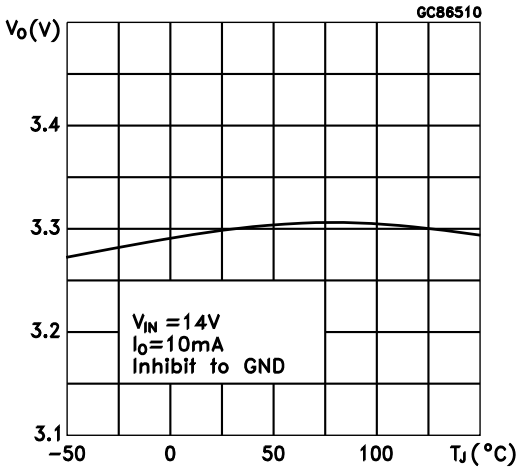
Unless otherwise specified C_I = 0.1 µF, C_O = 100 µF.

Figure 4. Output voltage vs temperature



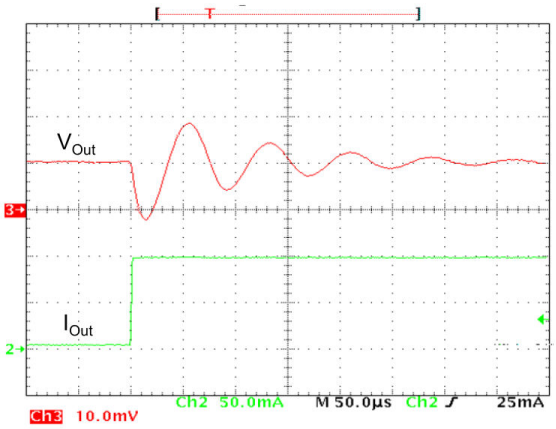
AMG110720161200MT

Figure 5. Output voltage vs temperature



AMG110720161201MT

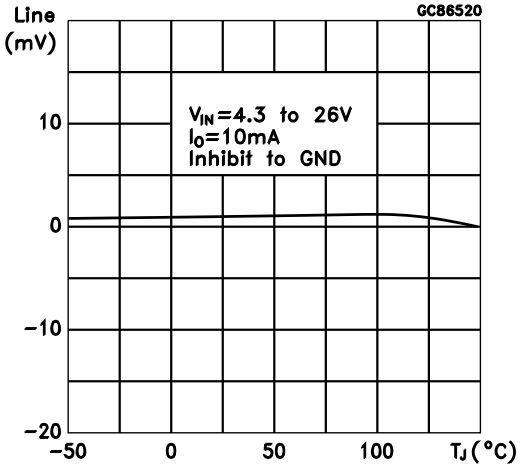
Figure 6. Load transient



I_O = 5 to 100 mA, V_{IN}=14V, T= 25°C, C_{in}=0.1 µF, C_{out}=100 µF
Rise Time = 500ns, Fall Time =1µs

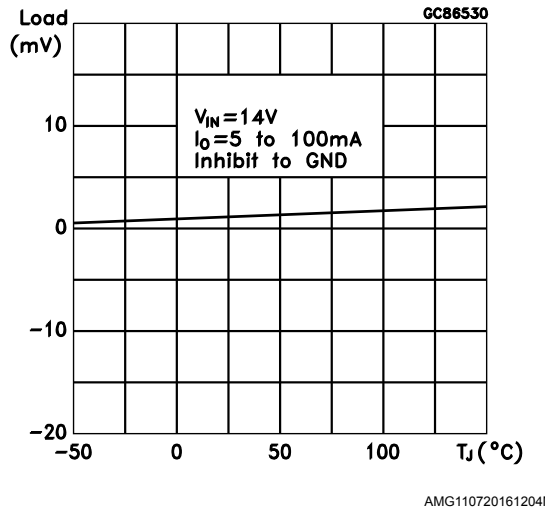
AMG150320171502MT

Figure 7. Line regulation vs temperature



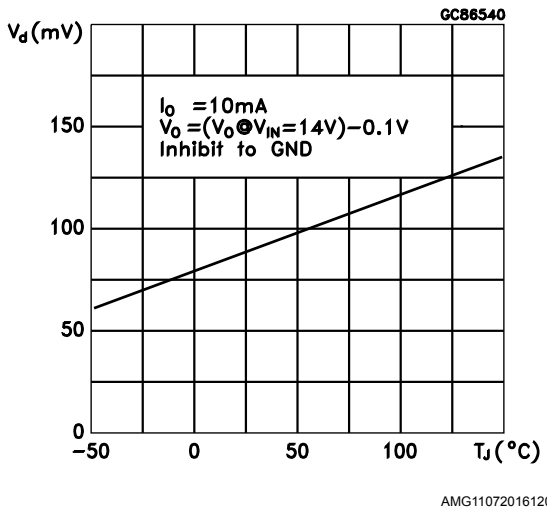
AMG110720161203MT

Figure 8. Load regulation vs temperature



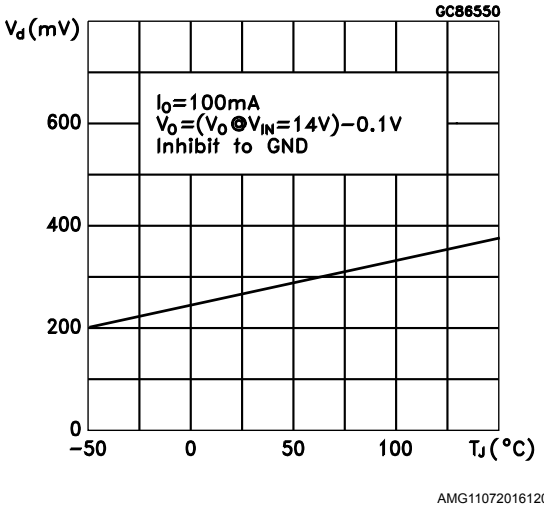
AMG110720161204MT

Figure 9. Dropout voltage vs temperature



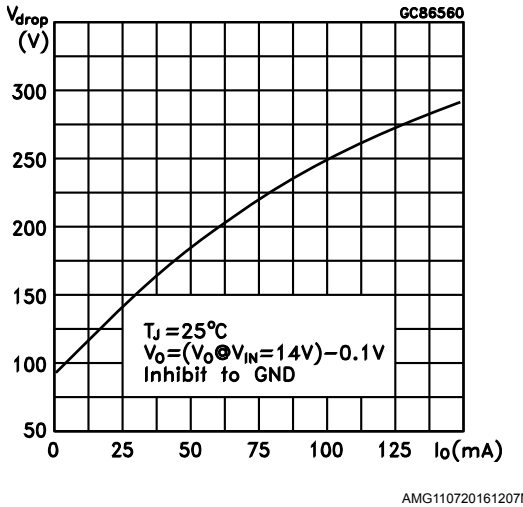
AMG110720161205MT

Figure 10. Dropout voltage vs temperature



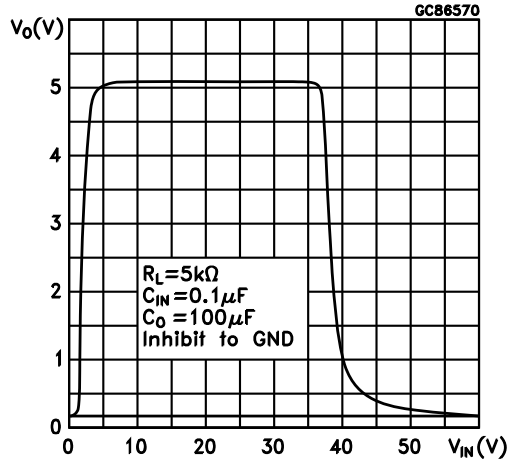
AMG110720161206MT

Figure 11. Dropout voltage vs output current



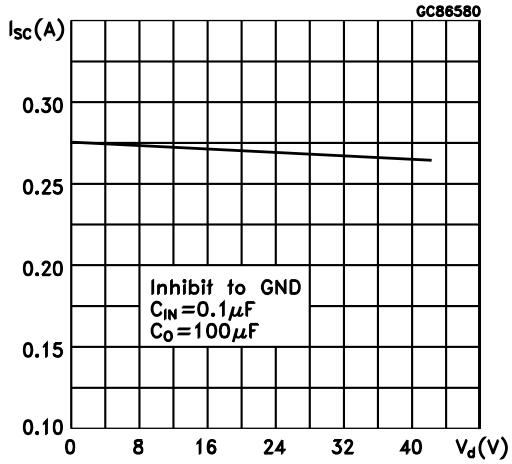
AMG110720161207MT

Figure 12. Output voltage vs input voltage



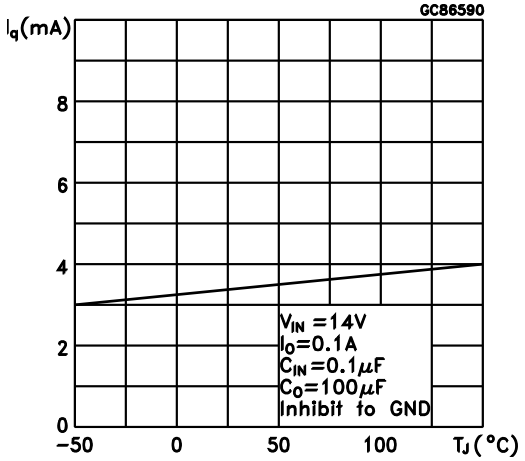
AMG110720161208MT

Figure 13. Short circuit current vs drop voltage



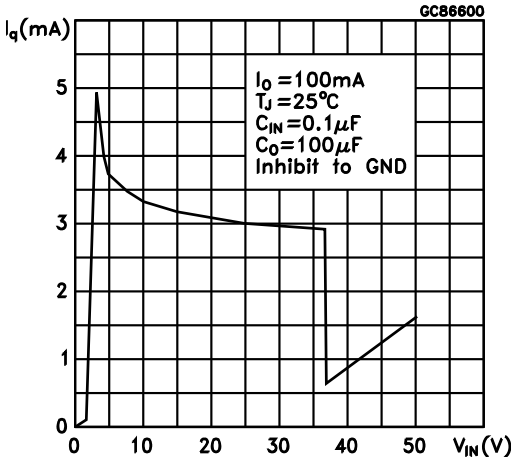
AMG110720161209MT

Figure 14. Quiescent current vs temperature



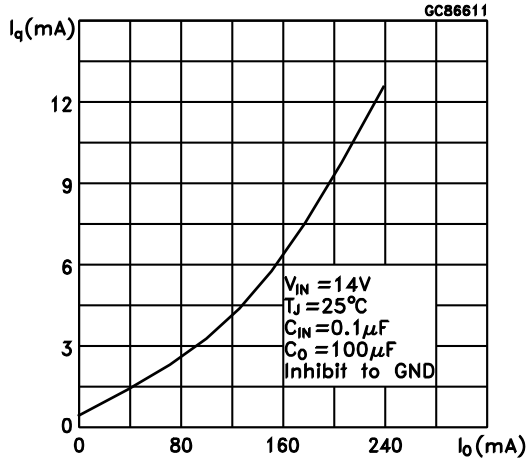
AMG110720161210MT

Figure 15. Quiescent current vs input voltage



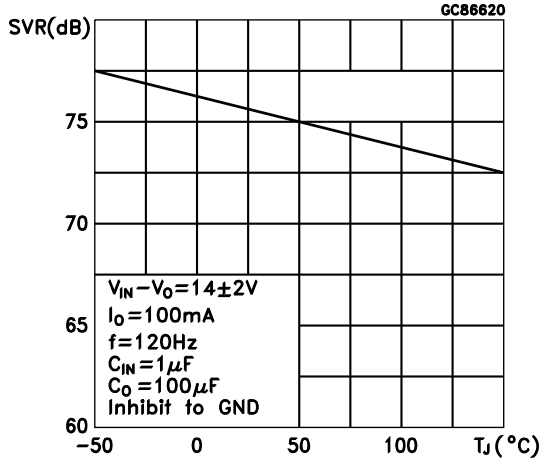
AMG110720161211MT

Figure 16. Quiescent current vs output current



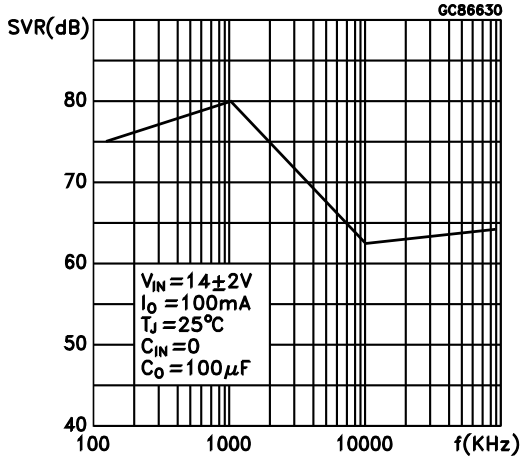
AMG110720161212MT

Figure 17. Supply voltage rejection vs temperature



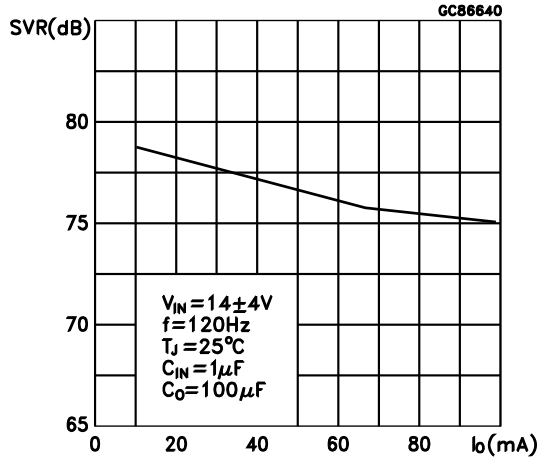
AMG110720161213MT

Figure 18. Supply voltage rejection vs frequency



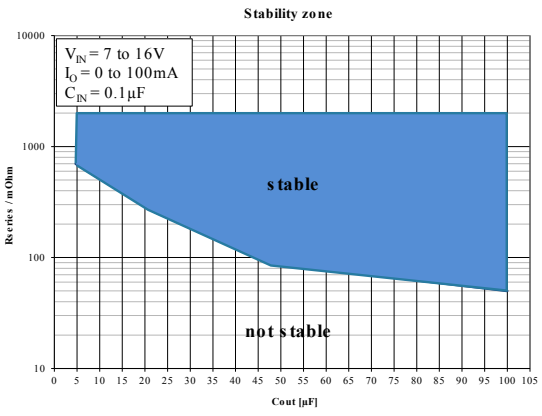
AMG110720161214MT

Figure 19. Supply voltage rejection vs output current



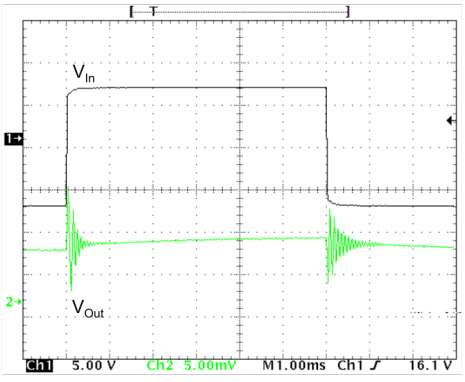
AMG110720161215MT

Figure 20. Stability vs C_O



AMG150320171500MT

Figure 21. Line transient



V_{IN}= 6 to 20 V, R_L=500 Ohm, T= 25°C, C_{in}=0, C_{out}=100 µF, Rise Fall-Time = 200ns

AMG150320171501MT

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. ECOPACK is an ST trademark.

7.1 DPAK package information

Figure 22. **DPAK package outline**

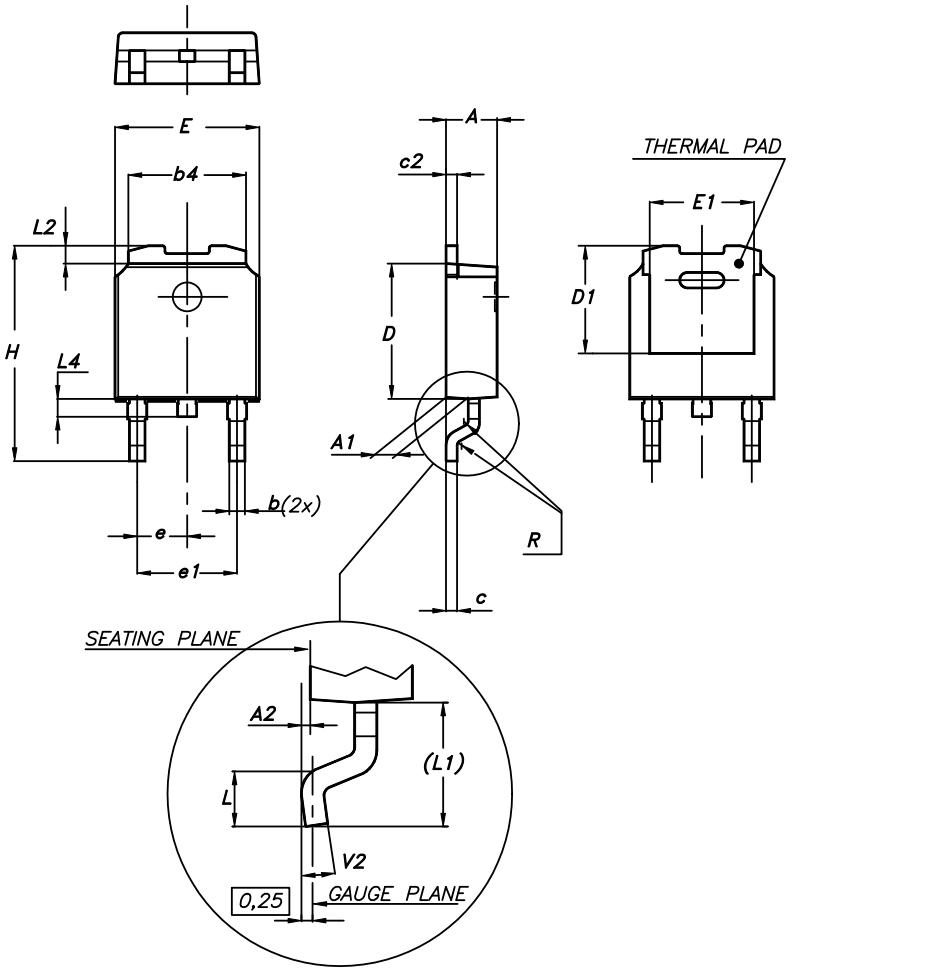
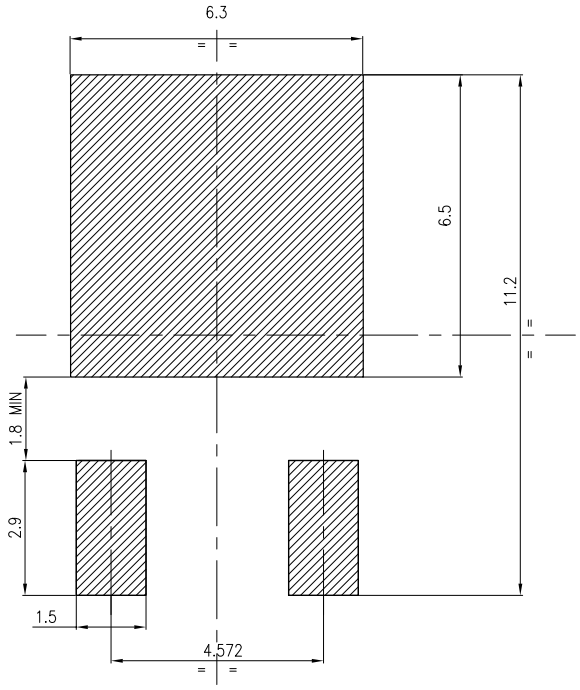


Table 5. **DPAK mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	

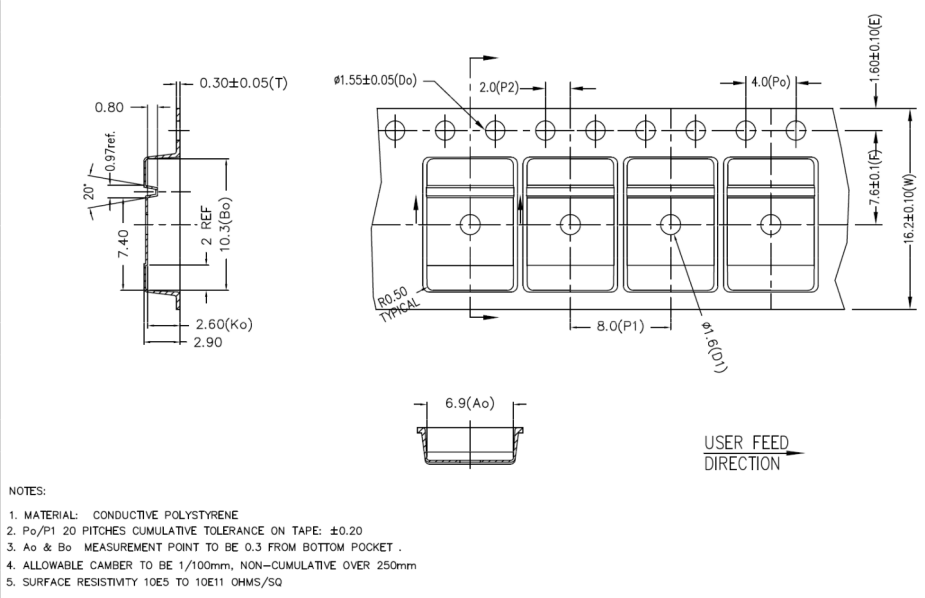
Dim.	mm		
	Min.	Typ.	Max.
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 23. DPAK recommended footprint (dimensions are in mm)



7.2 DPAK packing information

Figure 24. **DPAK tape outline**



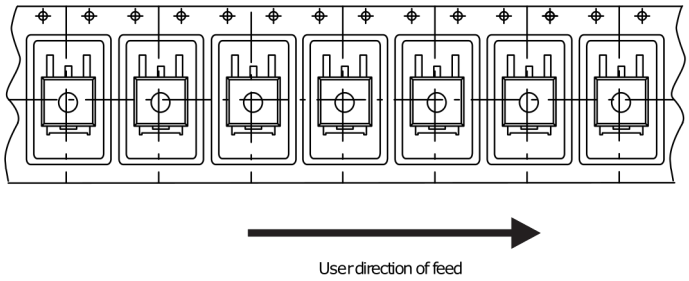
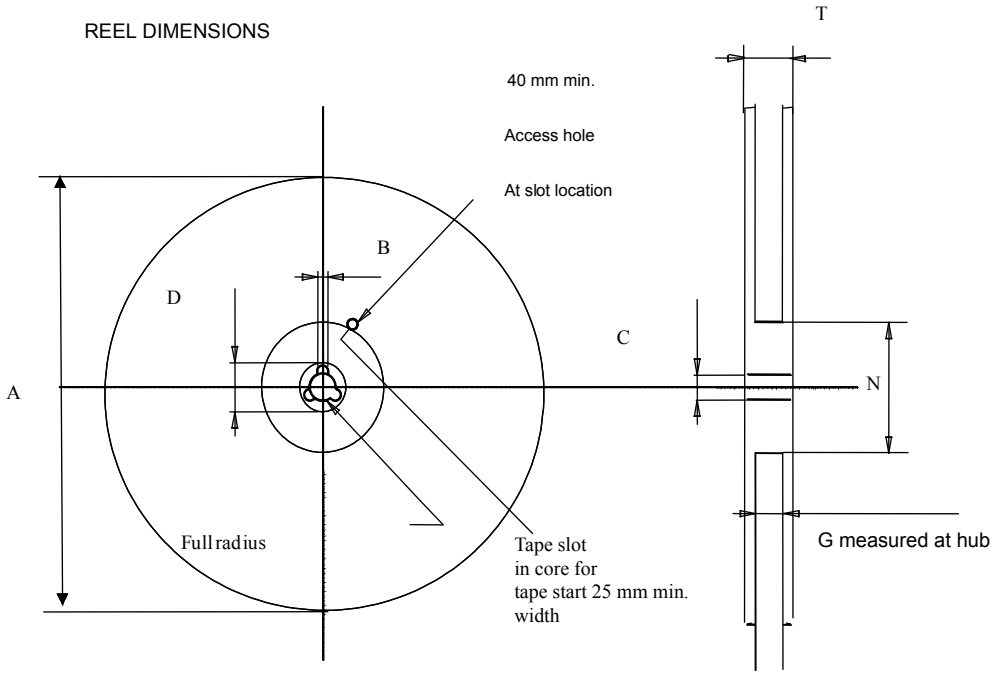


Figure 25. **DPAK reel outline**



7.3 SO8 package information

Figure 26. **SO-8 package outline**

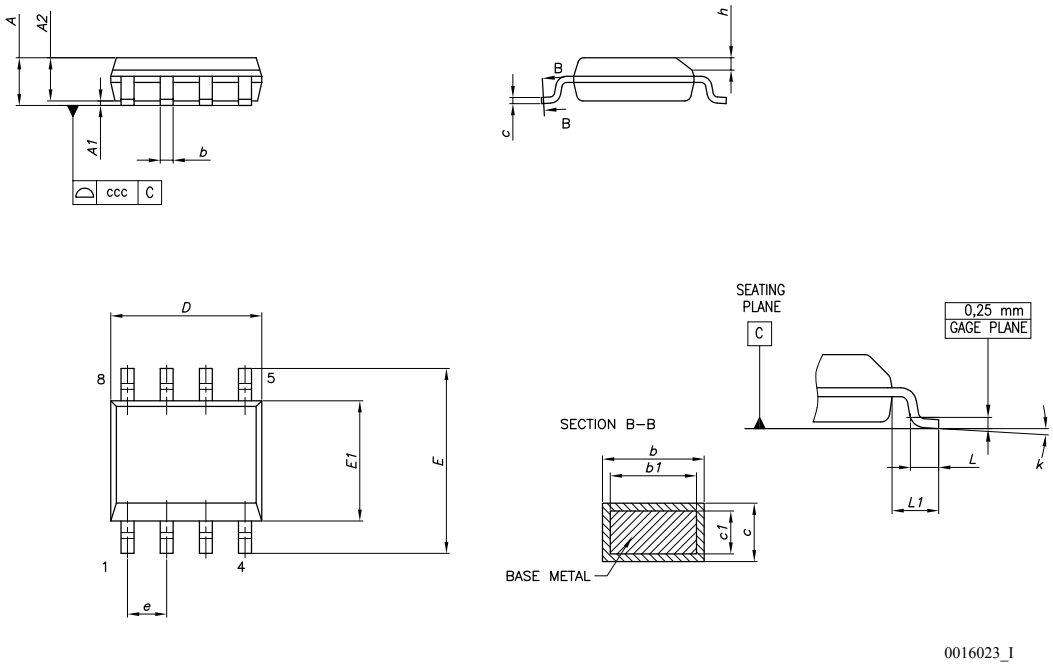
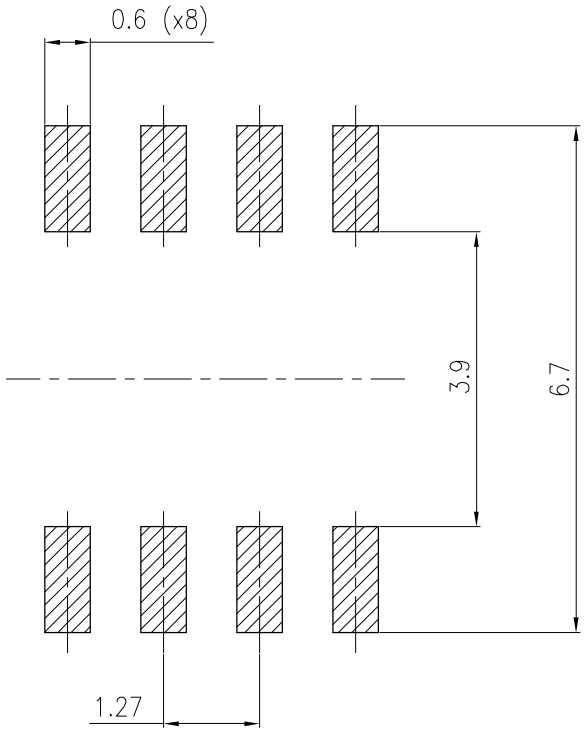


Table 6. **SO-8 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			1.75
A1	0.10		0.25
A2	1.25		
b	0.28		0.48
c	0.17		0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27	
h	0.25		0.50
L	0.40		1.27
L1		1.04	
k	0°		8°
ccc			0.10

Figure 27. **SO-8 recommended footprint**



7.4 SO-8 packing information

Figure 28. **SO-8 tape and reel outline**

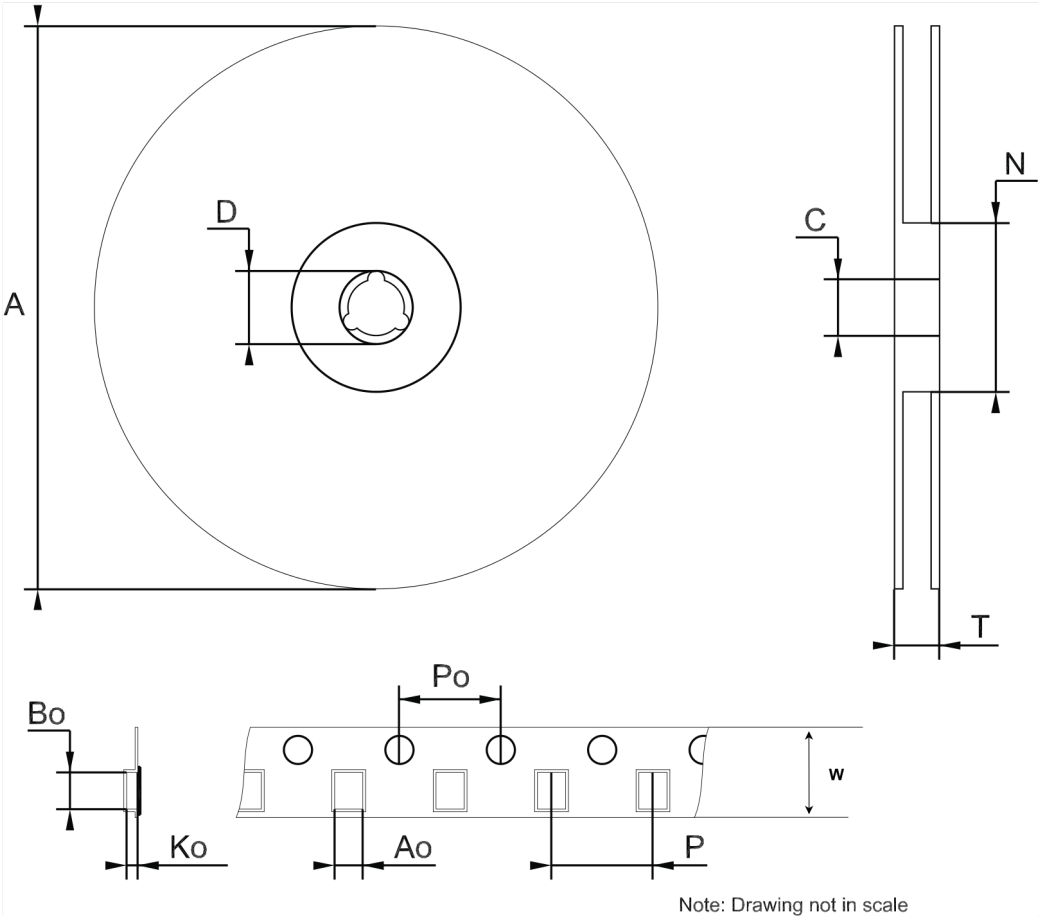


Table 7. **SO-8 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A			330
C	12.8		13.2
D	20.2		
N	50		
T			22.4
Ao	6.4	6.5	6.6
Bo	5.2		5.4
Ko	2.1		2.3
Po	3.9		4.1
P	7.9		8.1
W	11.7	12.0	12.3

7.5 TO-92 package information

Figure 29. **TO-92 package outline**

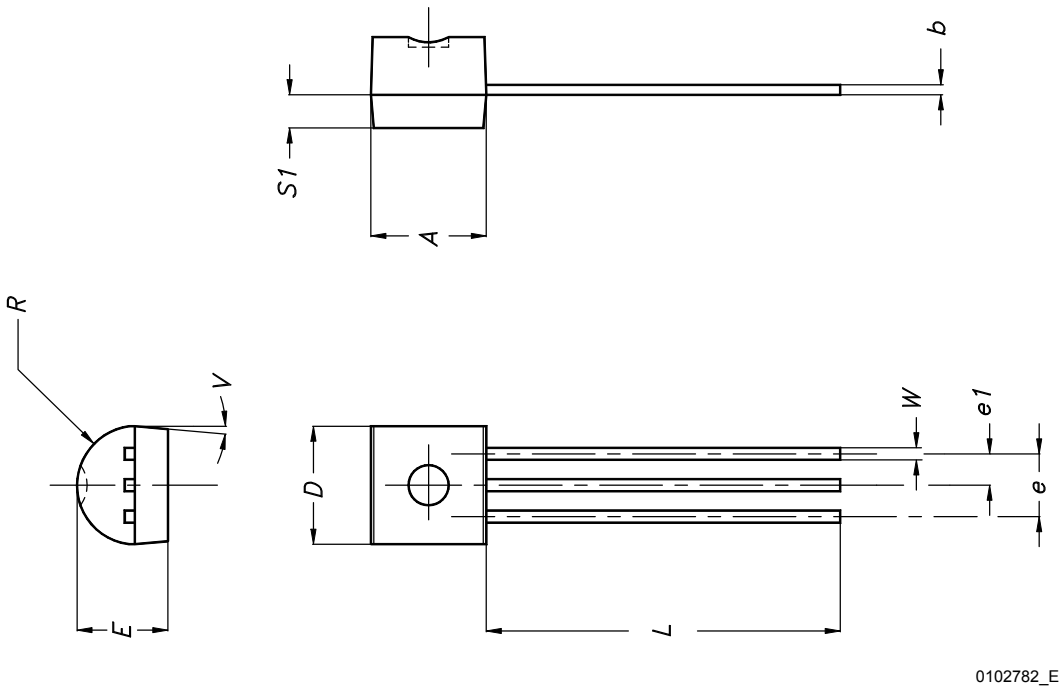


Table 8. **TO-92 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.32		4.95
b	0.36		0.51
D	4.45		4.95
E	3.30		3.94
e	2.41		2.67
e1	1.14		1.40
L	12.70		15.49
R	2.16		2.41
S1	0.92		1.52
W	0.41		0.56
V		5°	

8 Ordering information

Table 9. **Order code**

DPAK	TO-92 (bag)	SO-8	Output voltages
Standard			
		LM2931AD33R	3.3 V
LM2931ADT50R	LM2931AZ50R	LM2931AD50R	5.0 V

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
21-Jun-2004	12	Document updated.
16-Jun-2006	13	Order codes updated.
27-Jul-2007	14	Added Table 1 in cover page.
21-Aug-2007	15	Added root part number - (see Table 1).
22-Nov-2007	16	Modified: Table 1.
11-Feb-2008	17	Modified: Table 1 on page 1.
10-Jul-2008	18	Removed package TO-220, modified Table 1 on page 1.
26-May-2010	19	Modified: V_I values Table 4 on page 6, Table 5 on page 7 and Table 6 on page 8.
02-Nov-2011	20	Modified: Figure 4 on page 6. Added: (*) ADJ pin on the Adjustable version, Not Connected in the fixed output version. on page 4 and Inhibit pin: regulator is enabled when VINH < 1.2 V , disabled when VINH > 3.25 V on page 6.
09-Apr-2014	21	Part numbers LM2931XX, LM2931AXX33 and LM2931AXX50 changed to LM2931. Updated the description in cover page Section 2: Pin configuration and Section 7: Package information. Added Section 8: Revision history. Minor text changes.
16-Mar-2017	22	Updated features in cover page, removed Table 1. Device summary from cover page, Table 3: "Electrical characteristics of LM2931A33/LM2931A33Y" , Table 4: "Electrical characteristics of LM2931A50/ LM2931A50Y" and Table 5: "Electrical characteristics of LM2931 (adjustable version)". Updated Section 7: "Package information". Added Section 8: "Ordering information". Minor text changes.
23-Feb-2018	23	Updated Section 4: Application circuits.
23-09-2024	24	Removed Electrical characteristics of LM2931 (adjustable version). Updated Section 6

Contents

List of tables

List of figures