LM236-LM336

2.5V voltage references

Features

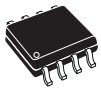
- Low temperature coefficient
- Wide operating current of 400µA to 10mA
- 0.2Ω dynamic impedance
- Guaranteed temperature stability
- Fast turn-on

Description

The LM236 and LM336 are precision 2.5V regulator diodes. These voltage reference monolithic ICs operate like 2.5V Zener diodes with a low temperature coefficient and a dynamic impedance of 0.2Ω A third pin enables adjusting the reference voltage and the temperature coefficient.



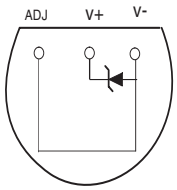
TO92
(Plastic package)



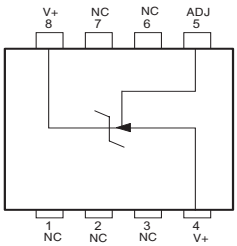
SO8
(Plastic micropackage)

Pin connections

TO92
(Bottom view)



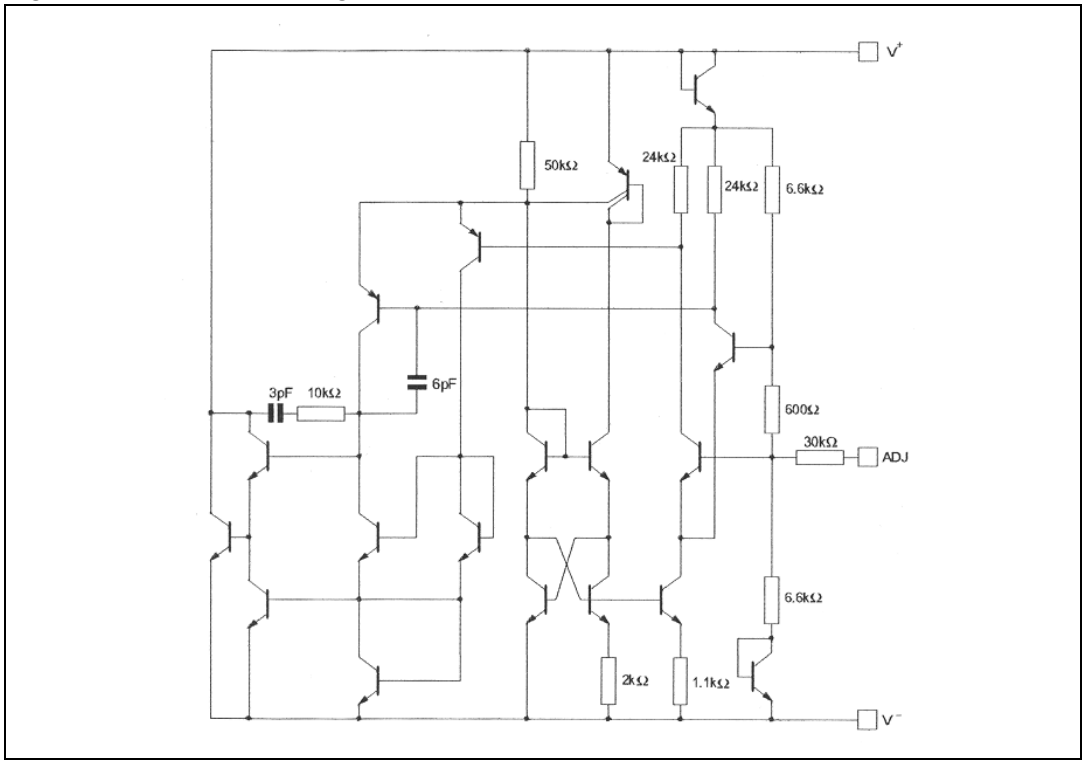
SO8
(Top view)



1- NC
2- NC
3- NC
4- V-
5- ADJ
6- NC
7- NC
8- V+

1 Schematic diagram

Figure 1. Schematic diagram



2 Absolute maximum ratings

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	LM236	LM336,B	Unit
I_R I_F	Current Reverse Forward	15 10		mA
T_{oper}	Operating free-air temperature range	-25 to +85	0 to +70	°C
T_{stg}	Storage temperature range	-65 to +150		°C

3 Electrical characteristics

Table 2. Electrical characteristics

Symbol	Parameter	LM236			LM336,B			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_R	Reference breakdown voltage T_{amb} = +25°C, I_R = 1mA LM236, LM336 LM336B	2.44	2.49	2.54	2.39 2.44	2.49 2.49	2.59 2.54	V
ΔV_R	Reverse breakdown voltage change with current 400µA ≤ I_R ≤ 10mA T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		2.6 3	6 10		2.6 3	10 12	mV
Z_D	Reverse dynamic impedance (I_R = 1mA) T_{amb} = +25°C $T_{min} \leq T_{amb} \leq T_{max}$		0.2 0.4	0.6 1		0.2 0.4	1 1.4	Ω
K_{VT}	Temperature stability (V_R = 2.49V, I_R = 1mA)		3.5	9		1.8	6	mV
K_{VH}	Long term stability (T_{amb} = +25°C ±0.1°C, I_R= 1mA)		20			20		ppm

Figure 2. Reverse voltage change

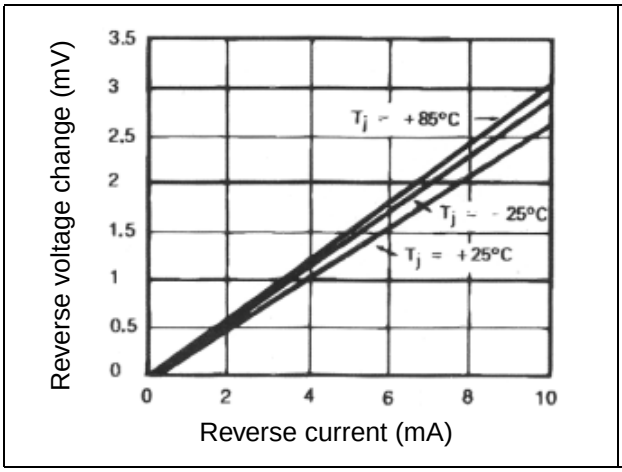


Figure 3. Zener noise voltage

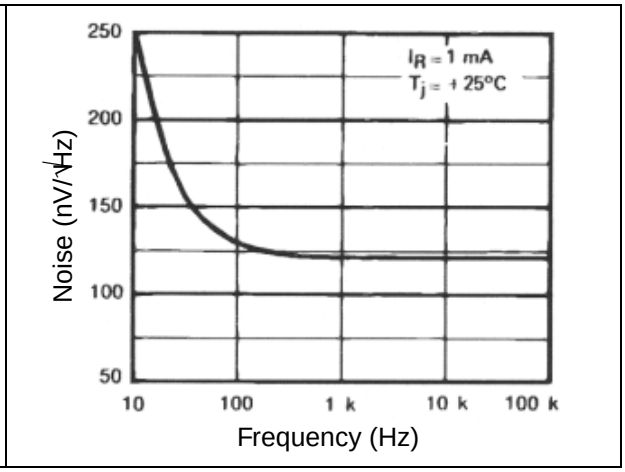


Figure 4. Dynamic impedance

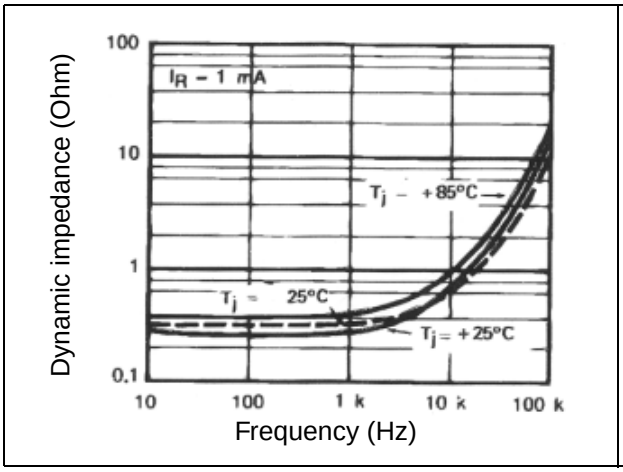


Figure 5. Response time

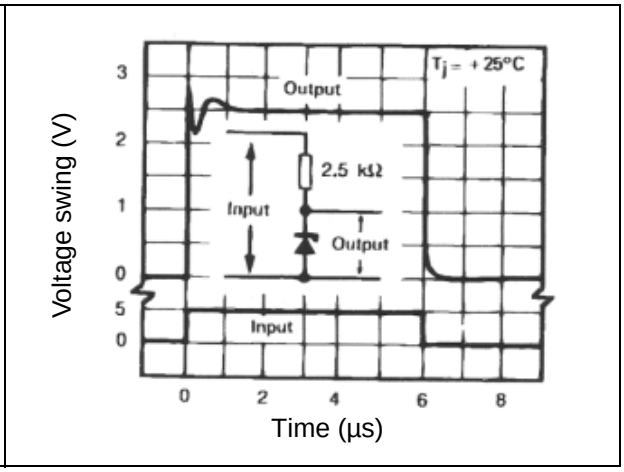


Figure 6. Reverse characteristics

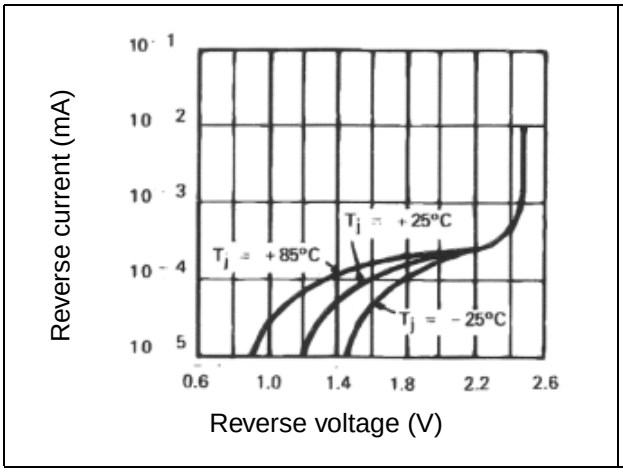


Figure 7. Forward characteristics

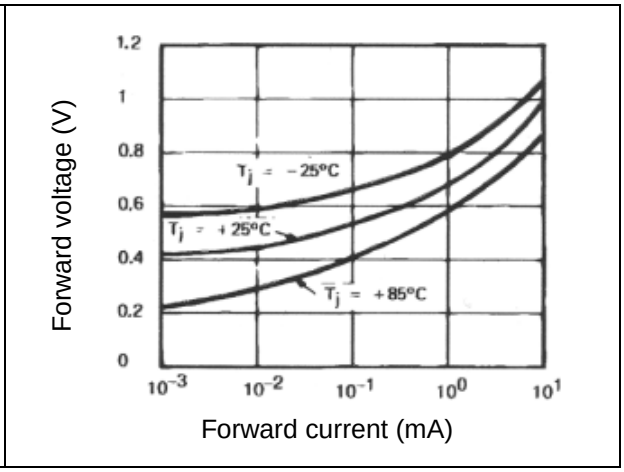
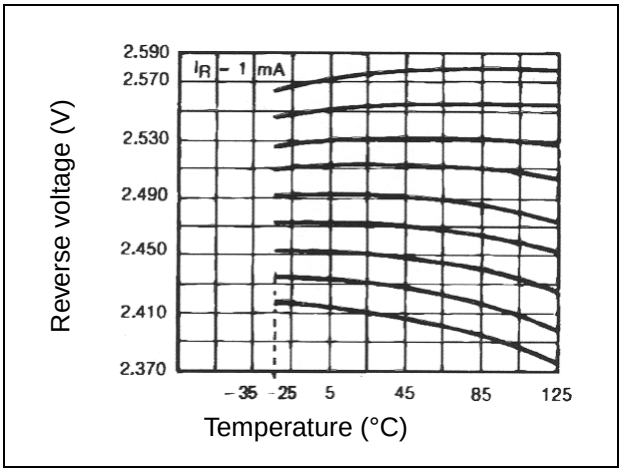


Figure 8. Temperature drift



4 Application information

The LM236, LM336 voltage references are easier to use than zener diodes. Their low impedance and wide current range facilitate biasing in any circuits. Besides, the breakdown voltage or the temperature coefficient can be adjusted so as to optimize the performance of the circuit.

Figure 9 represents a LM336 with a 10kΩ potentiometer to adjust the reverse breakdown voltage which can be adjusted without altering the temperature coefficient of the circuit. The adjustment range is generally sufficient to adjust the initial tolerance of the circuit and the inaccuracy of the amplifier circuit.

To obtain a lower temperature coefficient two diodes can be connected in series as indicated in *Figure 10*.

When the circuit is adjusted to 2.49V the temperature coefficient is minimized.

For a correct temperature coefficient, the diodes should be at the same ambient temperature as the LM336. The value of R1 is not critical (2-20kΩ).

Figure 9. LM336 with pot for adjustment of breakdown voltage

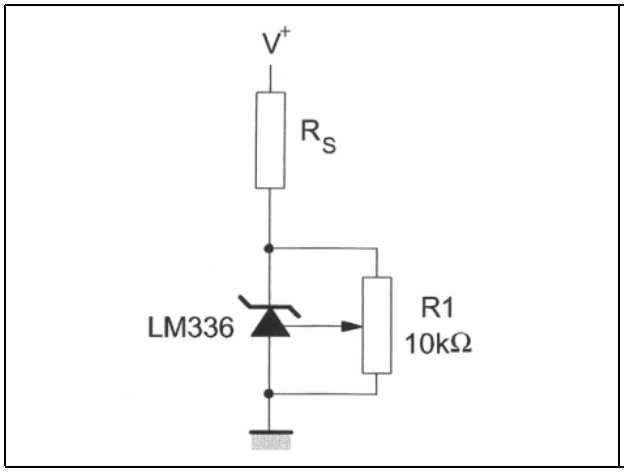
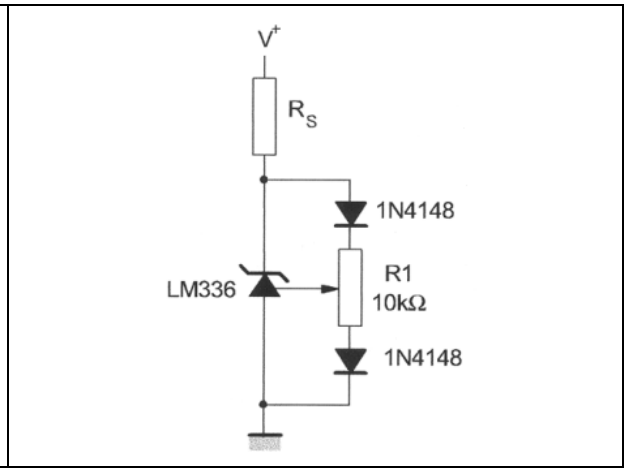


Figure 10. Temperature coefficient adjustment



Typical applications

Figure 11. 2.5V reference

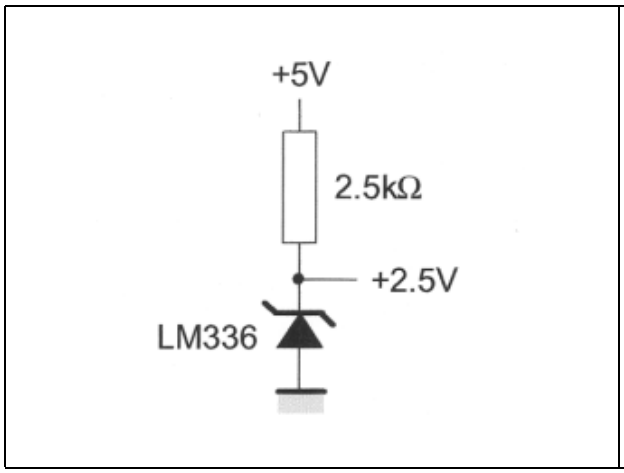


Figure 12. Wide input range reference

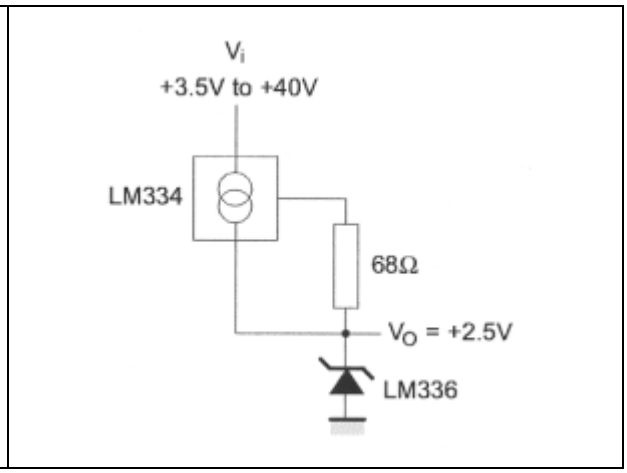


Figure 13. Precision power regulator with low temperature coefficient

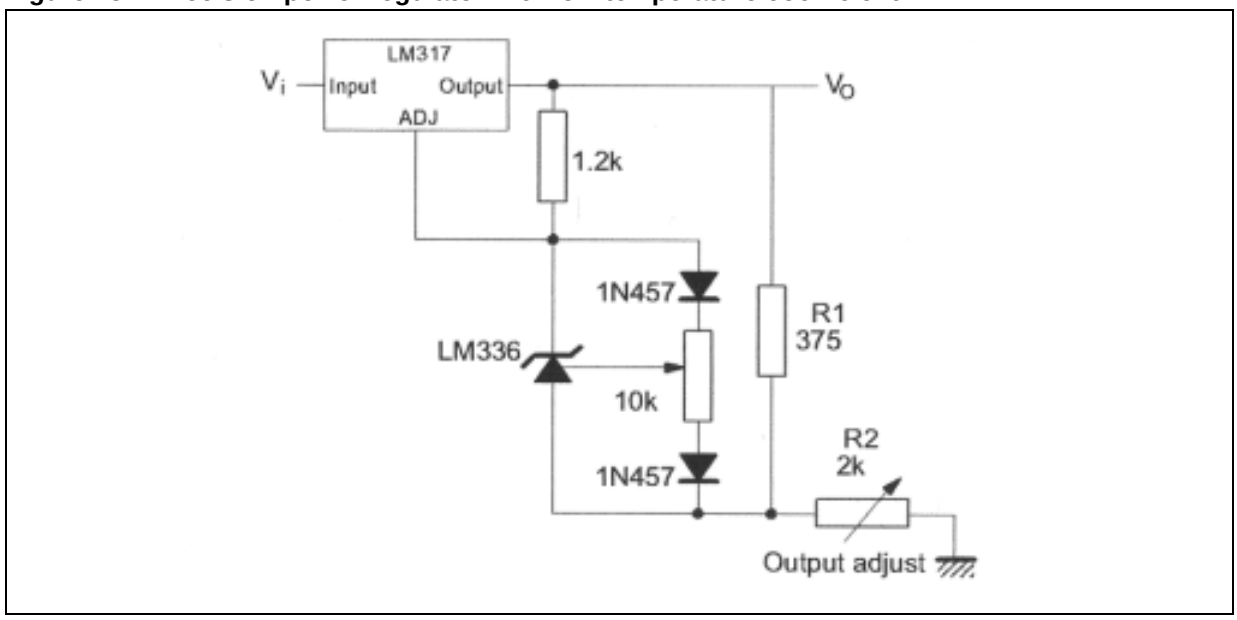


Figure 14. Adjustable shunt regulator

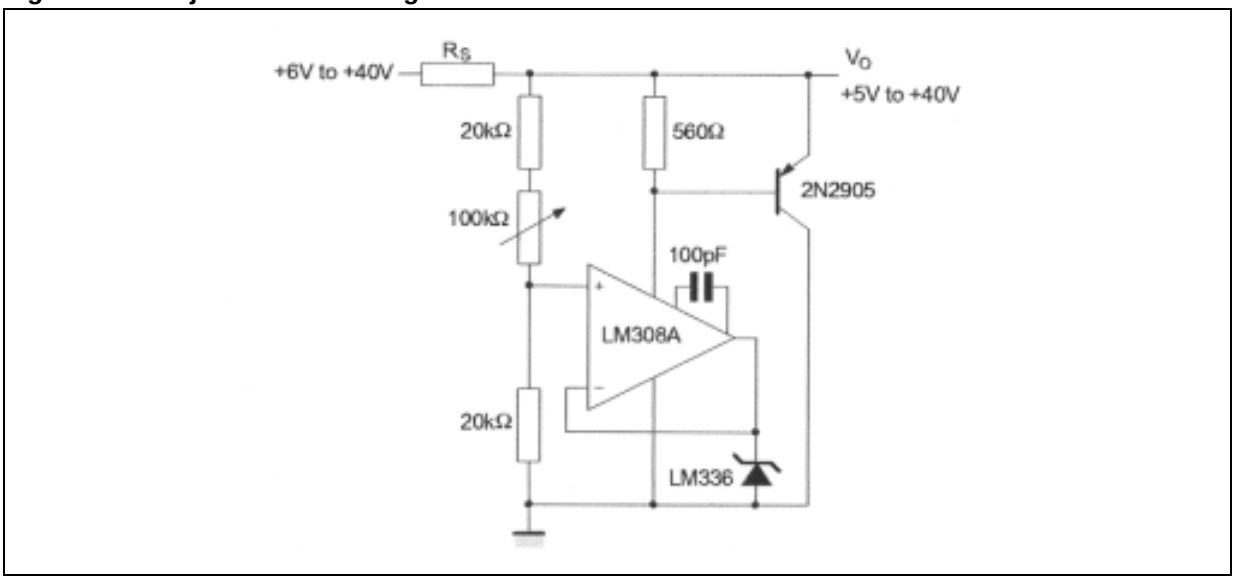


Figure 15. Linear ohmmeter

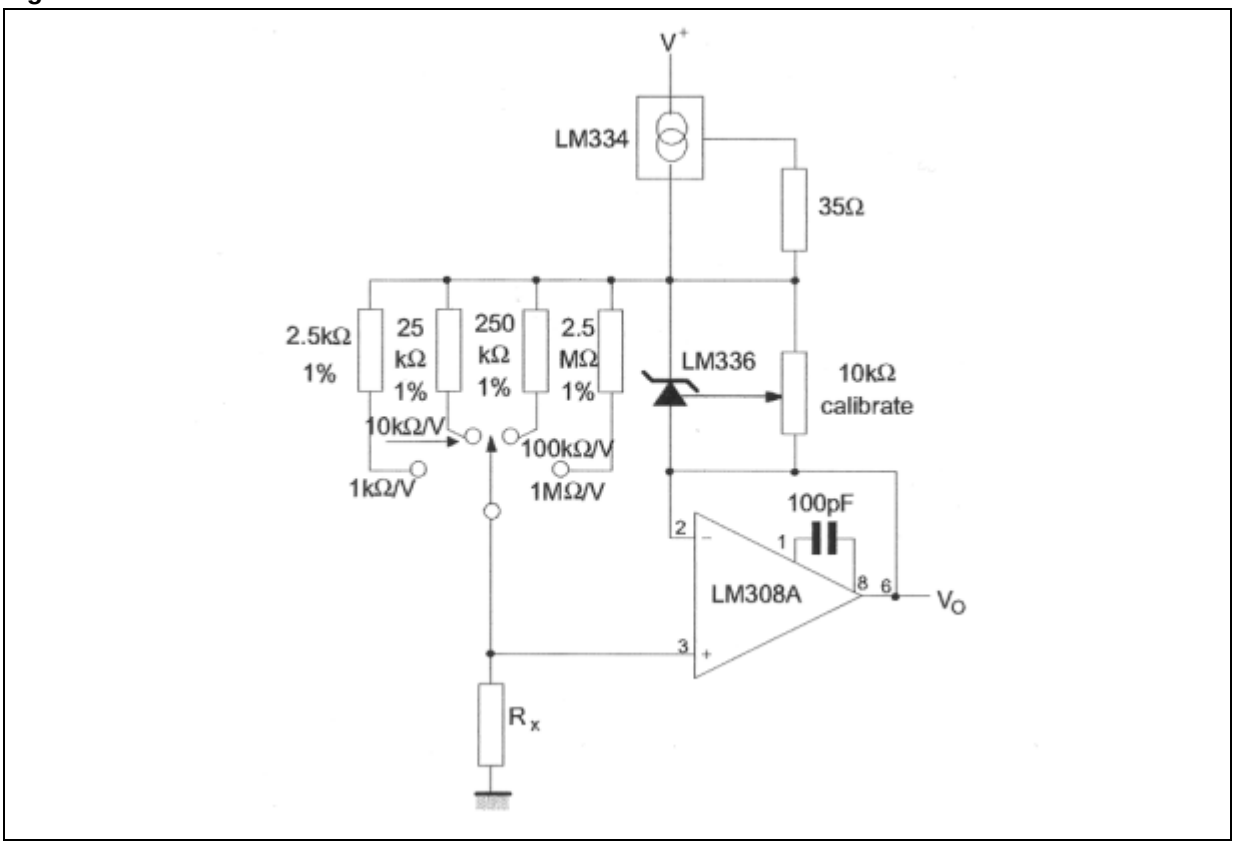


Figure 16. Bipolar output reference

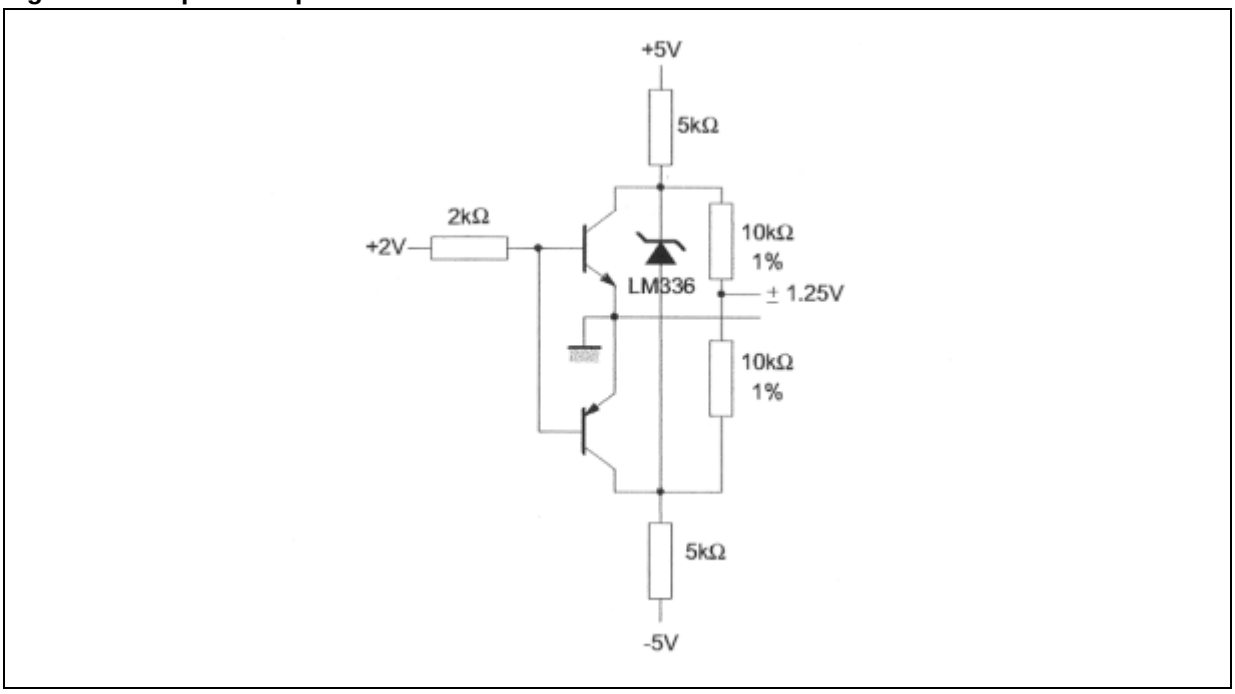


Figure 17. 5V buffered reference

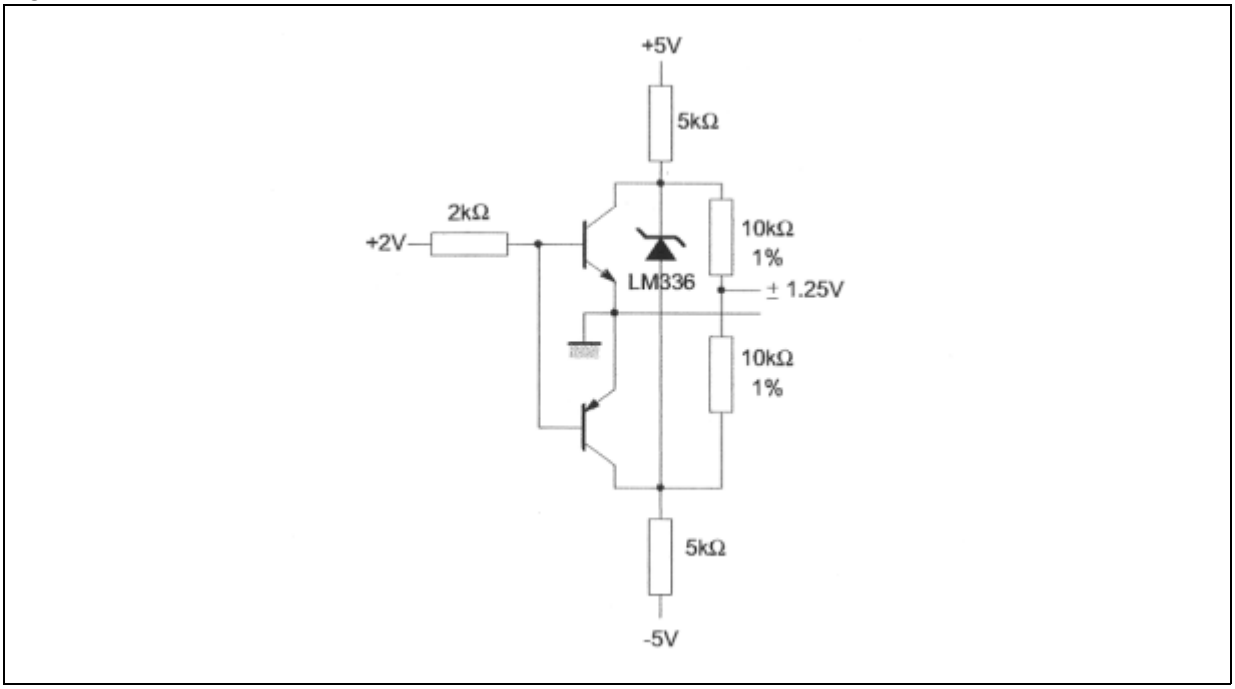
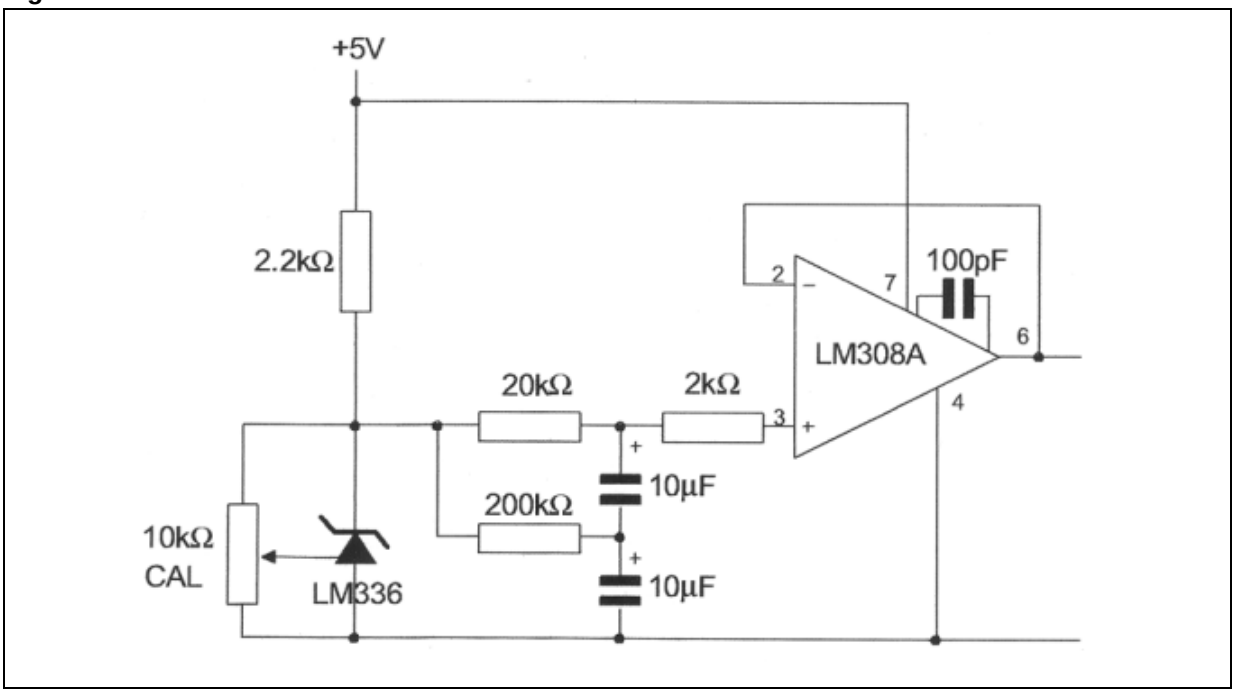


Figure 18. Low noise buffered reference

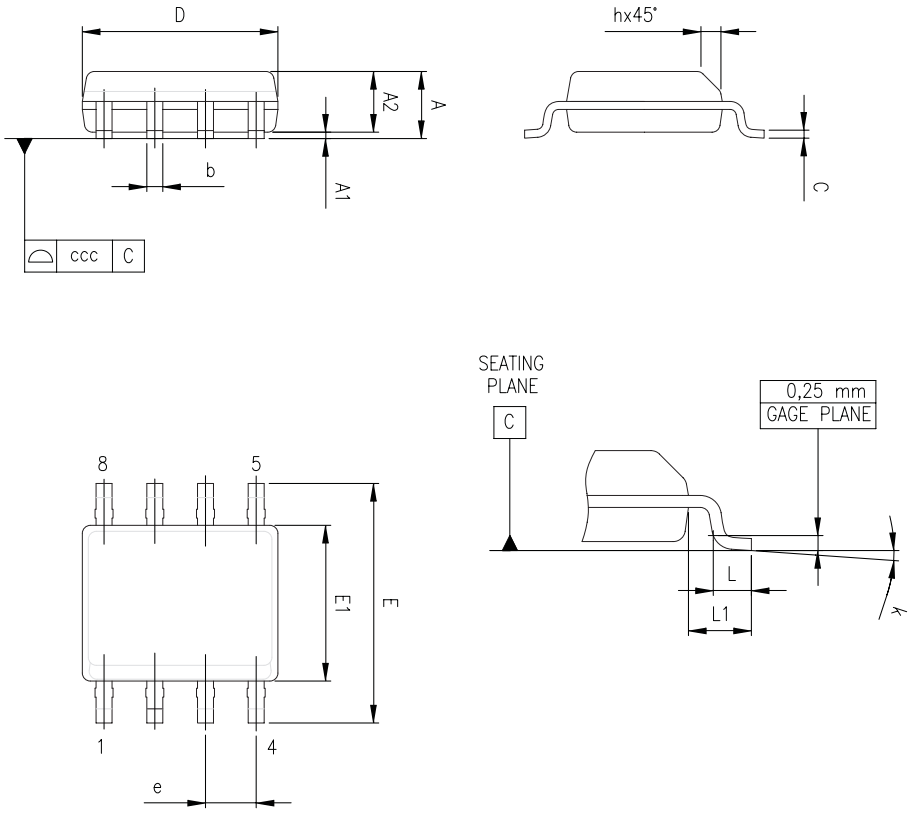


5 Package information

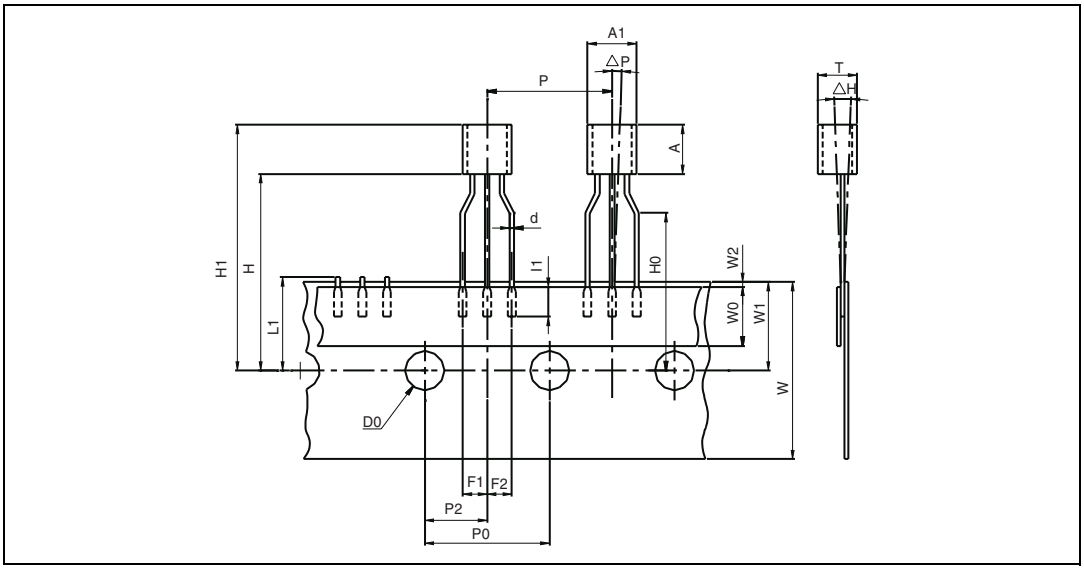
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5.1 SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
H	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	1°		8°	1°		8°
ccc			0.10			0.004

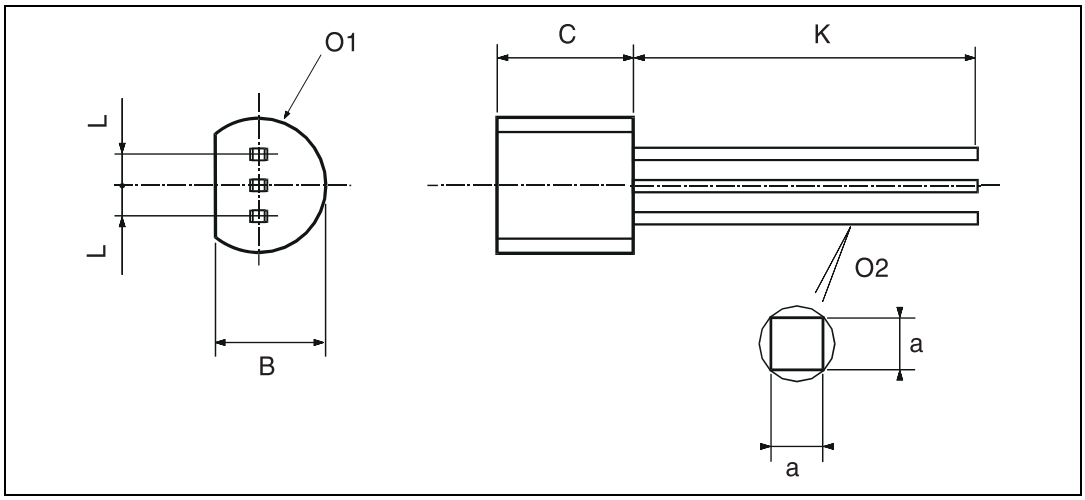


5.2 TO-92 ammopack and tape & reel package mechanical data



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
AL			5.0			0.197
A			5.0			0.197
T			4.0			0.157
d		0.45			0.018	
I1	2.5			0.098		
P	11.7	12.7	13.7	0.461	0.500	0.539
PO	12.4	12.7	13	0.488	0.500	0.512
P2	5.95	6.35	6.75	0.234	0.250	0.266
F1/F2	2.4	2.5	2.8	0.094	0.098	0.110
Δh	-1	0	1	-0.039	0	0.039
ΔP	-1	0	1	-0.039	0	0.039
W	17.5	18.0	19.0	0.689	0.709	0.748
W0	5.7	6	6.3	0.224	0.236	0.248
W1	8.5	9	9.75	0.335	0.354	0.384
W2			0.5			0.020
H			20			0.787
H0	15.5	16	16.5	0.610	0.630	0.650
H1			25			0.984
DO	3.8	4.0	4.2	0.150	0.157	0.165
L1			11			0.433

5.3 TO-92 bulk package mechanical data



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
L		1.27			0.05	
B	3.2	3.7	4.2	0.126	0.1457	0.1654
O1	4.45	5.00	5.2	0.1752	0.1969	0.2047
C	4.58	5.03	5.33	0.1803	0.198	0.2098
K	12.7			0.5		
O2	0.407	0.5	0.508	0.016	0.0197	0.02
a	0.35			0.0138		

6 Ordering information

Table 3. Order codes

Part number	Temperature range	Package	Packing	Marking
LM236D/DT	-25°C to +85°C	SO-8	Tube or Tape & reel	LM236
LM236Z/ZT/AP	-25°C to +85°C	TO-92	Bulk or Tape & reel or Ammopack	LM236
LM336D/DT	-25°C to +85°C	SO-8	Tube or Tape & reel	LM336
LM336Z/ZT/AP	-25°C to +85°C	TO-92	Bulk or Tape & reel or Ammopack	LM336
LM336BD/BDT	0°C to 70°C	SO-8	Tube or Tape & reel	LM336B
LM336BZ/BZT/BAP	0°C to 70°C	TO-92	Bulk or Tape & reel or Ammopack	LM336B

7 Revision history

Date	Revision	Changes
2-May-1997	1	Initial release.
24-May-2003	2	Caption of pinout diagram for TO-92 package changed to indicate top view.
29-May-2007	3	Corrected caption of pinout diagram for TO-92 package on cover page (previous version is wrong, should be bottom view). Updated *Section 5: Package information* and *Table 3: Order codes*.

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