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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

TL431/TL431A

Programmable Shunt Regulator

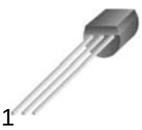
Features

- Programmable Output Voltage to 36 Volts
- Low Dynamic Output Impedance 0.2Ω Typical
- Sink Current Capability of 1.0 to 100mA
- Equivalent Full-Range Temperature Coefficient of 50ppm/°C Typical
- Temperature Compensated For Operation Over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn-on Response

Description

The TL431/TL431A are three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{REF} (approximately 2.5 volts) and 36 volts with two external resistors These devices have a typical dynamic output impedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic, making these devices excel lent replacement for zener diodes in many applications.

TO-92



1

1. Ref 2. Anode 3. Cathode

8-DIP

1

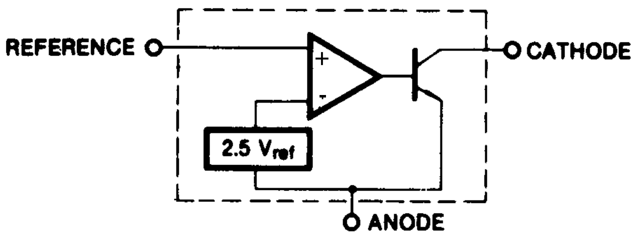
1.Cathode 2.3.4.5.7.NC
6.Anode 8.Ref

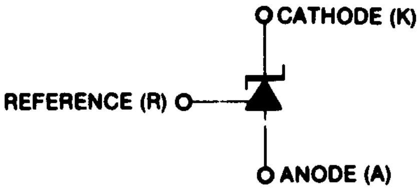
8-SOP

1

1. Cathode 2. 3. 6. 7. Anode
8. Ref 4. 5. NC

Internal Block Diagram





Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified.)

Parameter	Symbol	Value	Unit
Cathode Voltage	V_{KA}	37	V
Cathode Current Range (Continuous)	I_{KA}	-100 ~ +150	mA
Reference Input Current Range	I_{REF}	-0.05 ~ +10	mA
Power Dissipation D, LP Suffix Package P Suffix Package	P_D	 770 1000	 mW mW
Operating Temperature Range	T_{OPR}	-25 ~ +85	°C
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}	-	36	V
Cathode Current	I_{KA}	1.0	-	100	mA

Electrical Characteristics

(T_A = +25°C, unless otherwise specified)

Parameter	Symbol	Conditions		TL431			TL431A			Unit
				Min.	Typ.	Max.	Min.	Typ.	Max.	
Reference Input Voltage	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA		2.440	2.495	2.550	2.470	2.495	2.520	V
Deviation of Reference Input Voltage Over-Temperature (Note 1)	$\Delta V_{REF}/\Delta T$	$V_{KA}=V_{REF}$, I_{KA}=10mA $T_{MIN} \leq T_A \leq T_{MAX}$		-	4.5	17	-	4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	I_{KA} =10mA	ΔV_{KA}=10V-V_{REF}	-	- 1.0	-2.7	-	-1.0	-2.7	mV/V
			ΔV_{KA}=36V-10V	-	-0.5	-2.0	-	-0.5	-2.0	
Reference Input Current	I_{REF}	I_{KA}=10mA, R_1=10KΩ,$R_2=\infty$		-	1.5	4	-	1.5	4	μA
Deviation of Reference Input Current Over Full Temperature Range	$\Delta I_{REF}/\Delta T$	I_{KA}=10mA, R_1=10KΩ,$R_2=\infty$ T_A =Full Range		-	0.4	1.2	-	0.4	1.2	μA
Minimum Cathode Current for Regulation	$I_{KA(MIN)}$	$V_{KA}=V_{REF}$		-	0.45	1.0	-	0.45	1.0	mA
Off - Stage Cathode Current	$I_{KA(OFF)}$	V_{KA}=36V, V_{REF}=0		-	0.05	1.0	-	0.05	1.0	μA
Dynamic Impedance (Note 2)	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 to 100mA f ≥1.0KHz		-	0.15	0.5	-	0.15	0.5	Ω

- T_{MIN}= -25 °C, T_{MAX}= +85 °C

Test Circuits

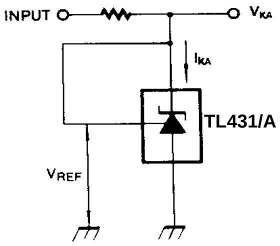


Figure 1. Test Circuit for V_{KA}=V_{REF}

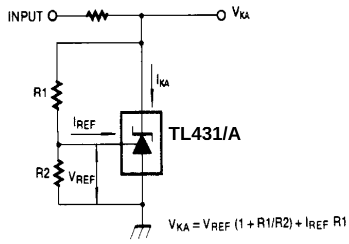


Figure 2. Test Circuit for $V_{KA} \geq V_{REF}$

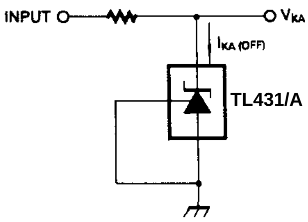


Figure 3. Test Circuit for $I_{KA(OFF)}$

Typical Perfomance Characteristics

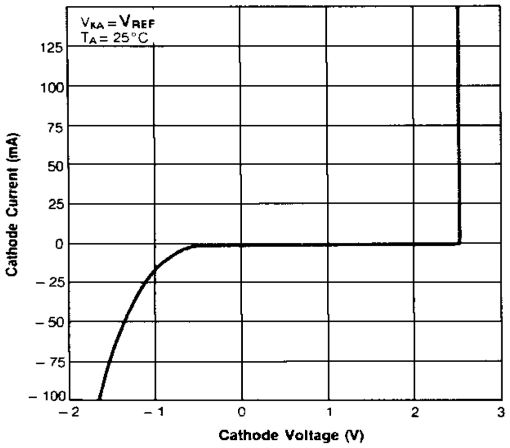


Figure 1. Cathode Current vs. Cathode Voltage

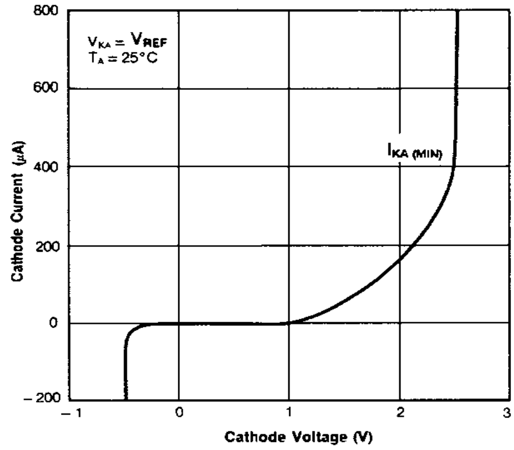


Figure 2. Cathode Current vs. Cathode Voltage

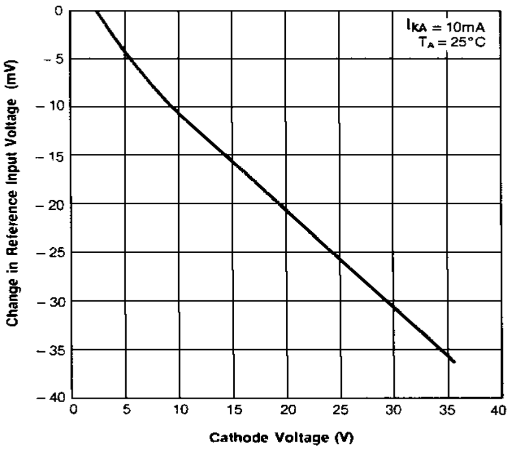


Figure 3. Change In Reference Input Voltage vs. Cathode Voltage

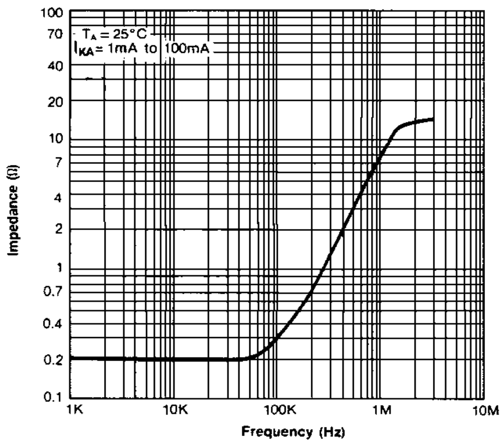


Figure 4. Dynamic Impedance Frequency

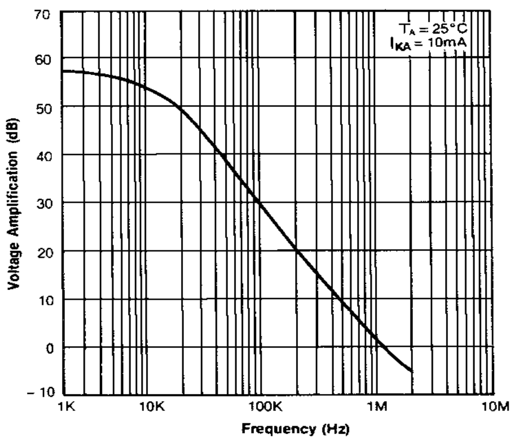


Figure 5. Small Signal Voltage Amplification vs. Frequency

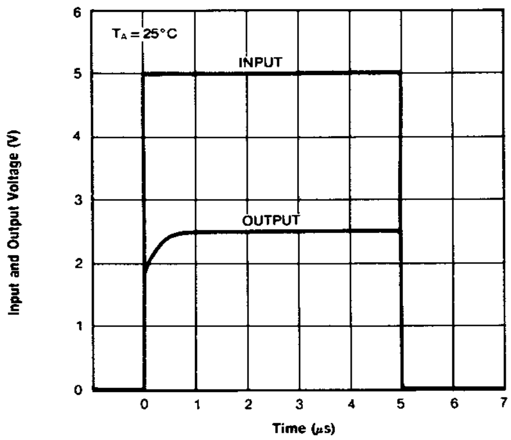


Figure 6. Pulse Response

Typical Application

$$V_O = \left(1 + \frac{R_1}{R_2}\right)V_{ref}$$

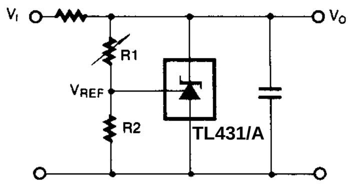


Figure 10. Shunt Regulator

$$V_O = V_{ref}\left(1 + \frac{R_1}{R_2}\right)$$

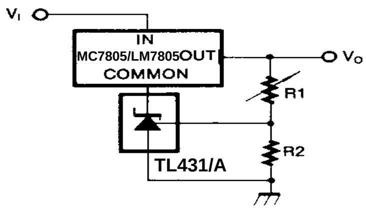


Figure 11. Output Control for Three-Termianl Fixed Regulator

$$V_O = \left(1 + \frac{R_1}{R_2}\right)V_{ref}$$

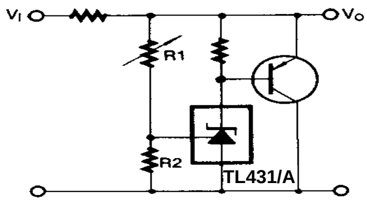
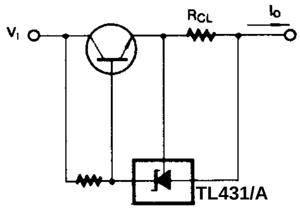
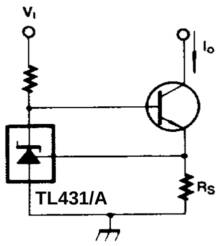


Figure 12. High Current Shunt Regulator



$$I_O = \frac{V_{REF}}{R_{CL}}$$

Figure 13. Current Limit or Current Source

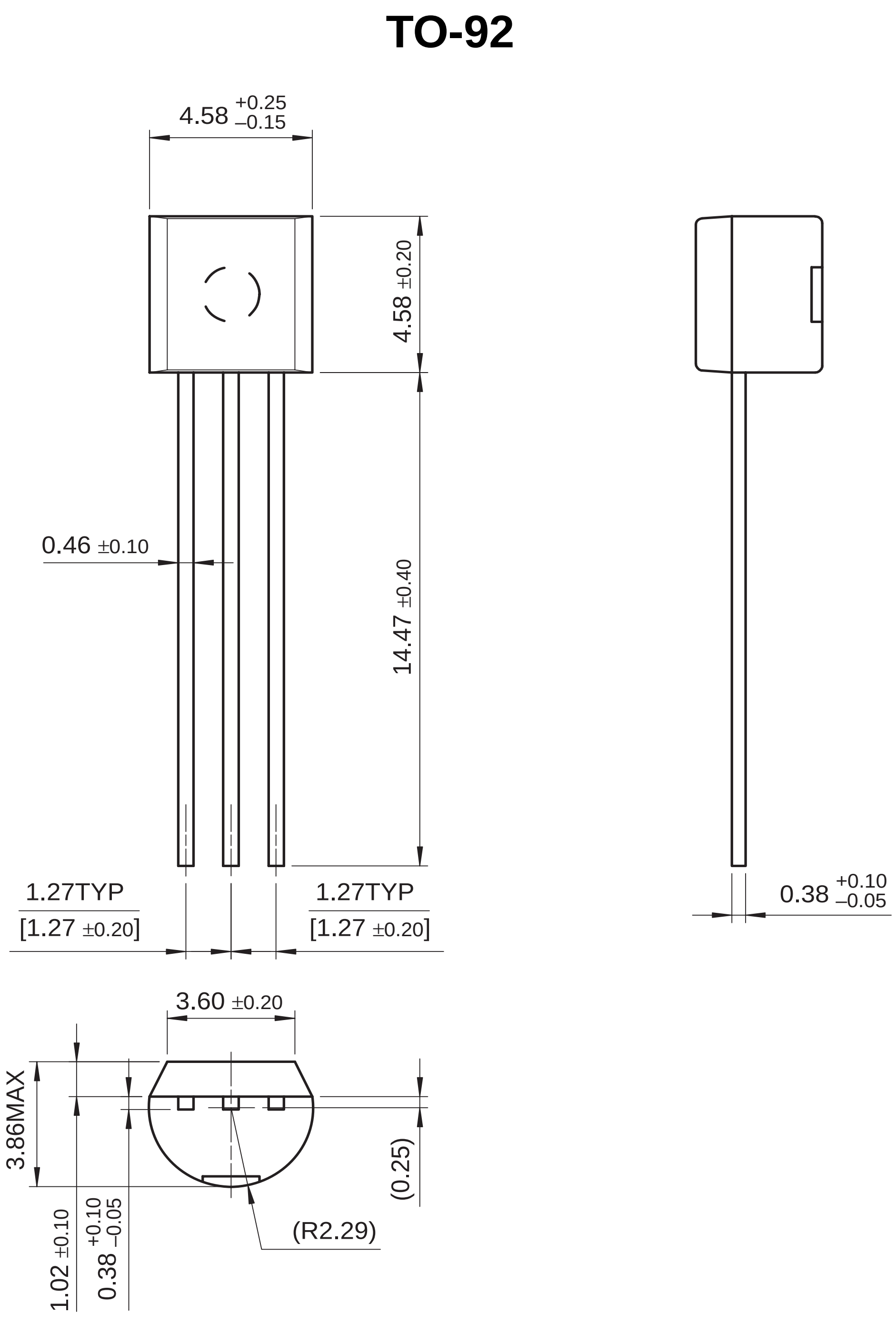


$$I_O = \frac{V_{REF}}{R_S}$$

Figure 14. Constant-Current Sink

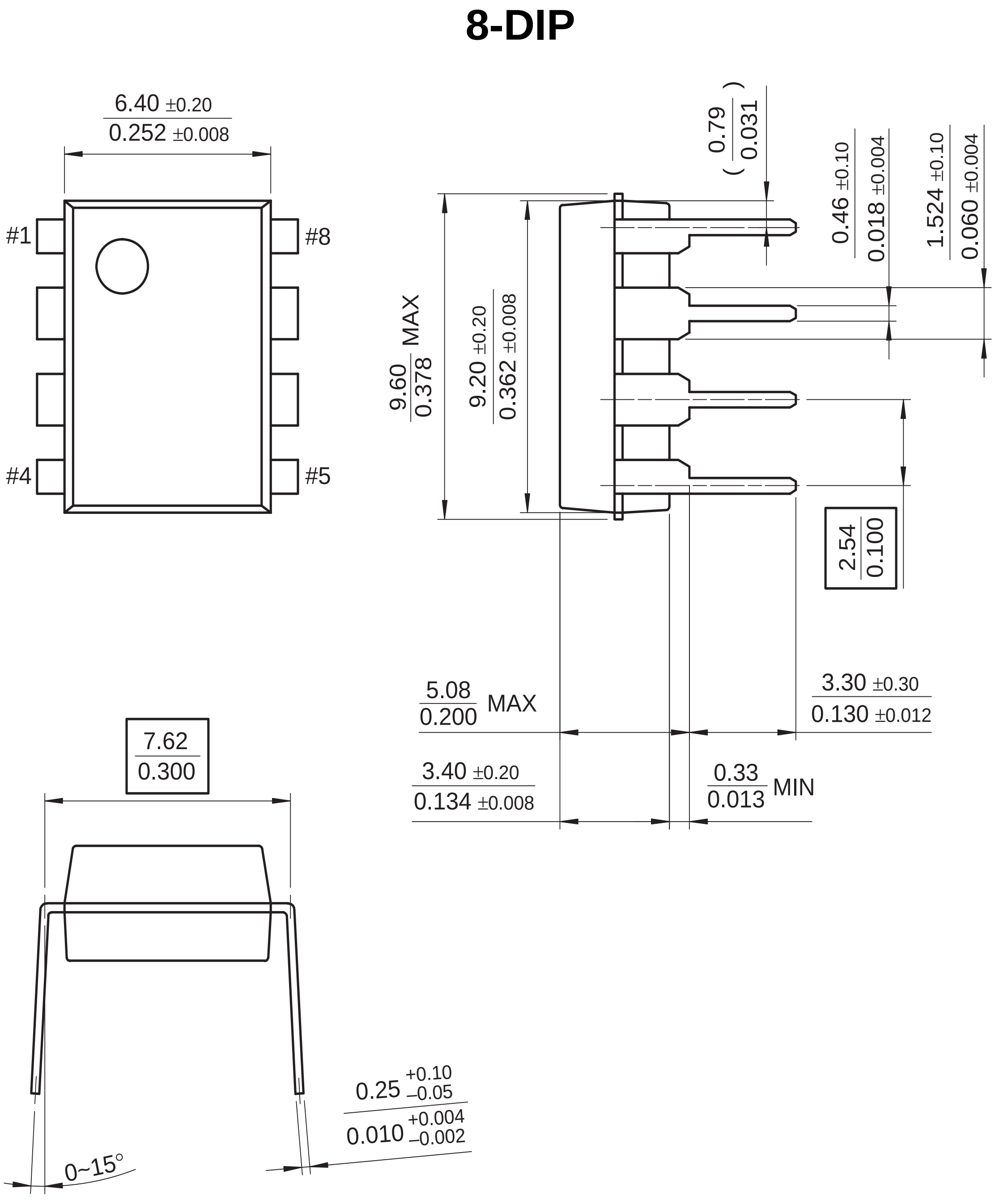
Mechanical Dimensions

Package



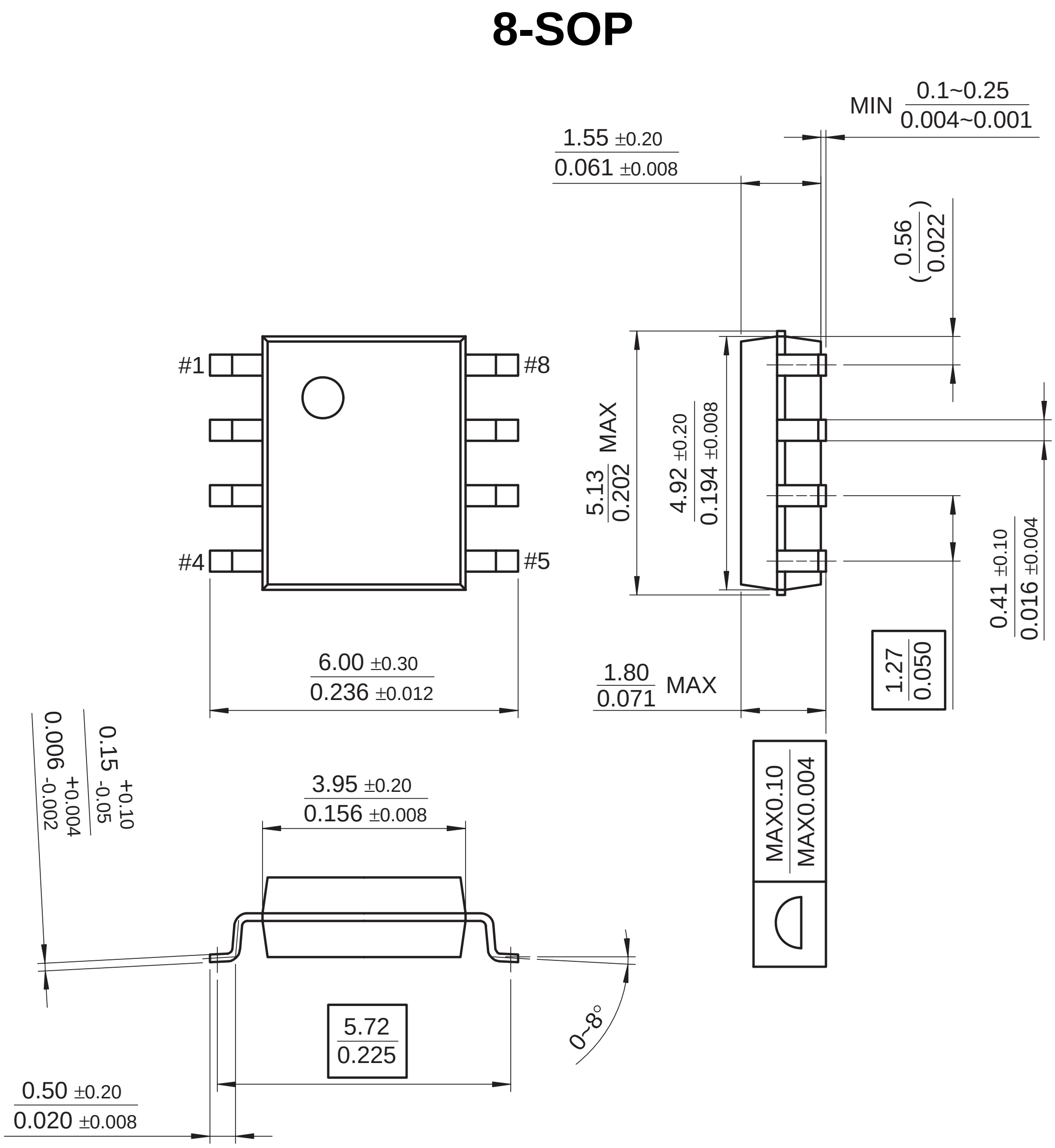
Mechanical Dimensions (Continued)

Package



Mechanical Dimensions (Continued)

Package



Ordering Information

Product Number	Output Voltage Tolerance	Package	Operating Temperature
TL431ACLP	1%	TO-92	-25 ~ + 85^{o}C
TL431ACD		8-SOP	
TL431CLP	2%	TO-92	
TL431CP		8-DIP	
TL431CD		8-SOP	

2/22/11 0.0m 001
Stock#DS400301

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