

## Quad OP-Amp and Programmable Voltage Reference

### General Description

The LD8104 consists of 4 low-offset voltage amplifiers and a high-accuracy 2.5V voltage reference in a SOP-16 package. The output voltage can be set at any value from  $V_{ADJ}$  to 19V, with two external resistors. The LD8104 provides a low cost and space saving solution for the applications of such as power supplies and motherboards.

The LD8104 is available in a SOP-16 package. It can operate over the ambient temperature ranging from  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ .

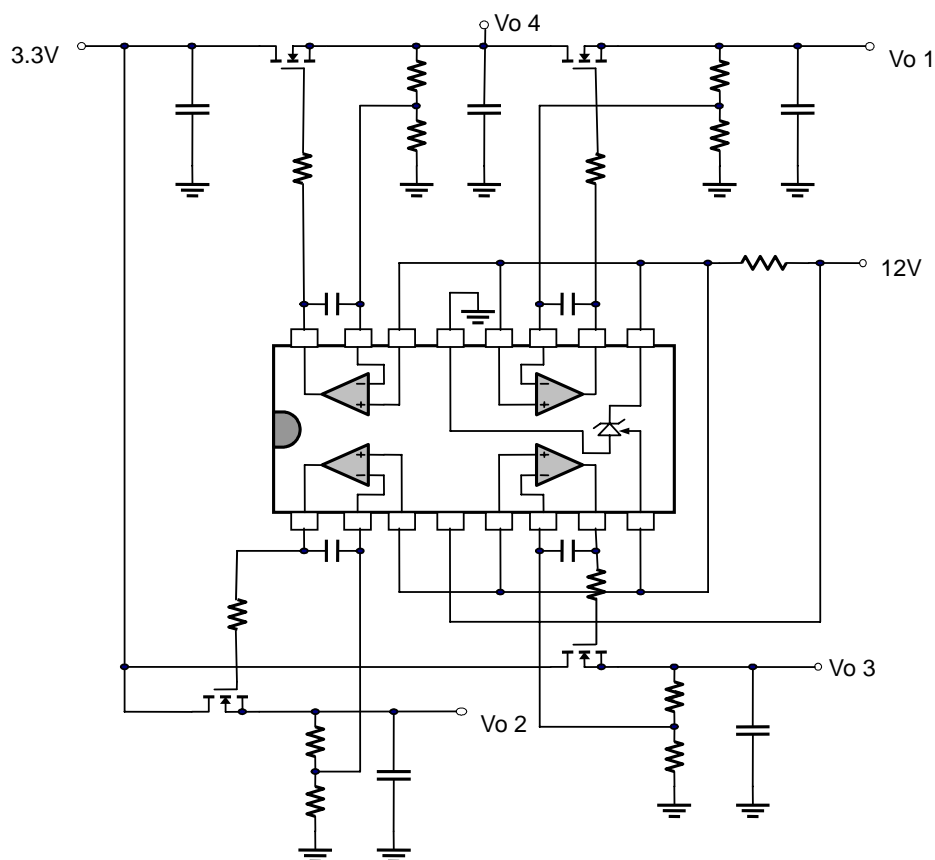
### Features

- Precision  $\pm 1\%$  voltage reference
- $V_{ADJ}$  sinking current capability: 1mA to 100mA
- Low input offset voltage ( $< 0.5\text{mV}$  typ.)
- Max. 19V voltage rating
- Adjustable output voltage:  $V_{ADJ}$  to 19 V
- SOP-16 package

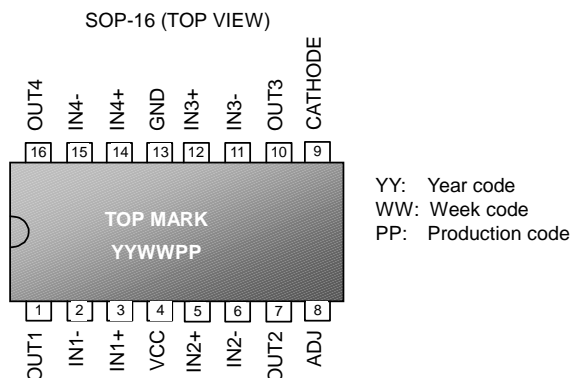
### Applications

- Switching Power Supply
- Motherboard
- Portable Device

### Typical Application



## Pin Configuration

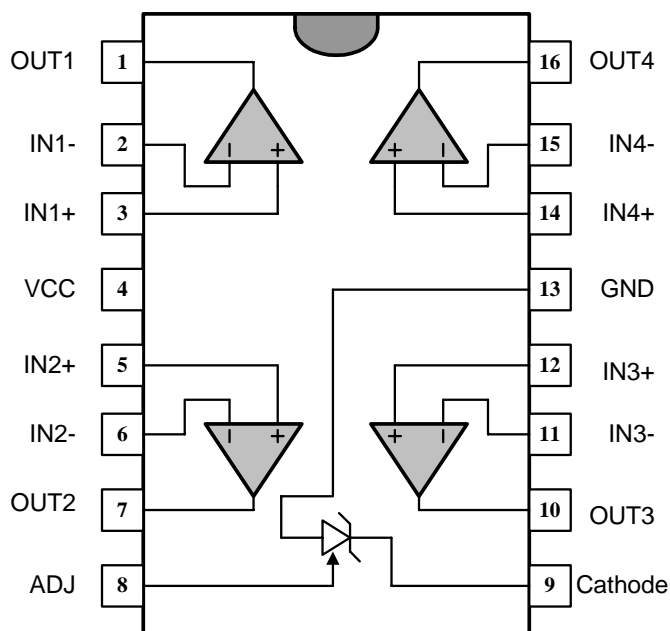


## Ordering Information

Part number	Package	TOP MARK	Shipping
LD8104 CS	SOP-16	LD8104CS	2500 /tape & reel
LD8104 PS	SOP-16 (PB Free)	LD8104PS	2500 /tape & reel

## Pin Descriptions

PIN	NAME	FUNCTION
1	OUT1	Output of OP-amp 1
2	IN1-	Negative terminal of OP-amp 1
3	IN1+	Positive terminal of OP-amp 1
4	VCC	Supply voltage
5	IN2+	Positive terminal of OP-amp 2
6	IN2-	Negative terminal of OP-amp 2
7	OUT2	Output of OP-amp 2
8	ADJ	It's an internal 2.5V reference voltage, which can be used to adjust output voltage.
9	Cathode	Cathode voltage. The force voltage can be set to any value ranging from $V_{ADJ}$ to 19V.
10	OUT3	Output of OP-amp 3
11	IN3-	Negative terminal of OP-amp 3
12	IN3+	Positive terminal of OP-amp 3
13	GND	Ground
14	IN4+	Positive terminal of OP-amp 4
15	IN4-	Negative terminal of OP-amp 4
16	OUT4	Output of OP-amp 4

**Block Diagram**

**Absolute Maximum Ratings**

Supply Voltage $V_{CC}$ .....	21V
Supply Current ( $V_{CC}=5V$ , over all operating temperature range).....	2.4mA
Supply Current ( $V_{CC}=21V$ , over all operating temperature range).....	4mA
Differential Input Voltage (IN1+ to IN1-, IN2+ to IN2-).....	21V
Input Voltage.....	-0.3V to $V_{CC}+0.3V$
Operating Temperature Range.....	-40°C to 105°C
Maximum Junction Temperature.....	150°C
Storage Temperature Range.....	-65°C to 150°C
Lead Temperature (Soldering, 10 sec.).....	260°C
Junction-to-Ambient Thermal Resistance.....	150°C/W

**Caution:**

Stresses beyond the ratings specified in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

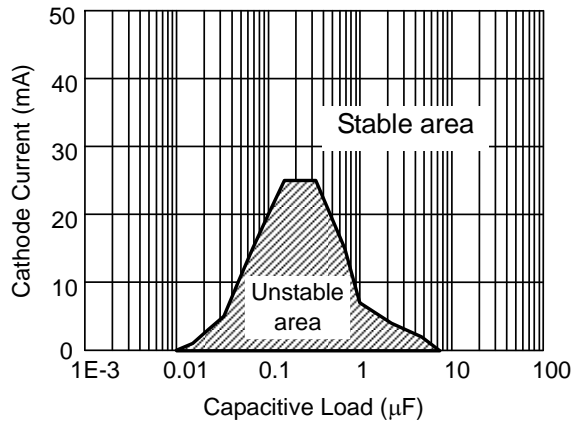
**Electrical Characteristics**

 (T<sub>A</sub> = +25°C unless otherwise stated)

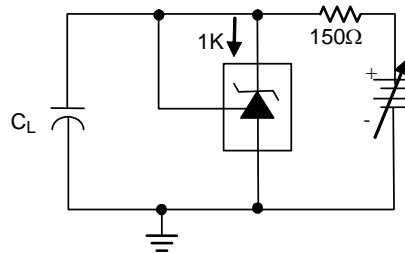
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
OP-Amp1, OP-Amp2, OP-Amp3 & OP-Amp4					
Input Offset voltage (Common mode Voltage =0V)	25°C		1	5	mV
	-40°C~105°C			6	mV
Input Offset Voltage Drift			7		μV/°C
Input Bias Current	25°C		20	150	nA
	-40°C~105°C			200	NA
Input Offset Current	25°C		2	75	nA
	-40°C~105°C			150	nA
Input Common Mode Voltage	V <sub>CC</sub> =19V, 25°C	0		V <sub>CC</sub> -1.5	V
	V <sub>CC</sub> =19V, -40°C~105°C	0		V <sub>CC</sub> -2	V
Common Mode Rejection Ratio	25°C	70	85		dB
	-40°C~105°C	60			dB
Equivalent Input Noise Voltage	F=1KHz, R <sub>s</sub> =100Ω, V <sub>CC</sub> =19V		50		nV/√Hz
Output Source Current	V <sub>CC</sub> =15V, V <sub>O</sub> =2V Differential Input Voltage = 1V	20	40		mA
Output Sink Current	V <sub>CC</sub> =15V, V <sub>O</sub> =2V Differential Input Voltage = -1V	10	20		mA
	V <sub>CC</sub> =15V, V <sub>O</sub> =0.2V Differential Input Voltage = -1V	12	50		μA
Output Short Current	V <sub>CC</sub> =15V		40	60	mA
Output Voltage --- High Level	V <sub>CC</sub> =19V, R <sub>L</sub> =2K, 25°C	15	16		V
	V <sub>CC</sub> =19V, R <sub>L</sub> =2K, -40°C~105°C	15	16		V
	V <sub>CC</sub> =19V, R <sub>L</sub> =10K, 25°C	15	17		V
	V <sub>CC</sub> =19V, R <sub>L</sub> =10K, -40°C~105°C	15	17		V
Output Voltage --- Low Level	R <sub>L</sub> =10K, -40°C~105°C		5	20	mV
				20	mV
Large Signal Voltage Gain (OP2)	V <sub>CC</sub> =15V, R <sub>L</sub> =2K, V <sub>O</sub> =1.4V~11.4V, 25°C	50	100		V/mV
	V <sub>CC</sub> =15V, R <sub>L</sub> =2K, V <sub>O</sub> =1.4V~11.4V, -40°C~105°C	25			V/mV
Slew Rate at Unity Gain	V <sub>IN</sub> =0.5V~2V, V <sub>CC</sub> =15V R <sub>L</sub> =2K, C <sub>L</sub> =100pF, Unity Gain	0.2	0.4		V/μS
Supply Voltage Rejection Ratio	Common Mode Voltage=0V V <sub>CC</sub> =5~19V	65	100		dB

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Gain Bandwidth Product	$V_{CC}=19V, R_L=2K, C_L=100pF$ $F=100KHz, V_{IN}=10mV$	0.5	0.9		MHz
Total Harmonic Distortion	$V_{CC}=19V, R_L=2K, C_L=100pF$ $V_O=2V_{pp}, f=1KHz, A_V=20dB$		0.02		%
ADJ Voltage					
Cathode Current		1		100	mA
ADJ Voltage	$25^{\circ}C, I_K=10mA,$	2.475	2.5	2.525	V
	$-40^{\circ}C \sim 105^{\circ}C, I_K=10mA,$	2.45	2.5	2.55	V
ADJ Voltage Deviation	$-40^{\circ}C \sim 105^{\circ}C, I_K=10mA,$		7	30	mV
Ratio of Change in ADJ Input Voltage to Change in Cathode Voltage	$I_K=10mA,$ $\Delta V(\text{Cathode to GND})=(19\sim 3V)$	-2	-1.1		mV/V
ADJ Input Current	$25^{\circ}C, I_K=10mA,$		1.5	2.5	$\mu A$
	$-40^{\circ}C \sim 105^{\circ}C, I_K=10mA,$			3	$\mu A$
ADJ Input Current Deviation	$-40^{\circ}C \sim 105^{\circ}C$		0.8	1.2	$\mu A$
Minimum Cathode Current for Regulation	$V(\text{Cathode to GND})=V_{ADJ}$			0.5	mA
Off-State Cathode Current			180	500	nA
Dynamic Impedance	$\Delta I_K = 1\sim 100mA, f < 1KHz$		0.2	0.5	$\Omega$

**Application Information**

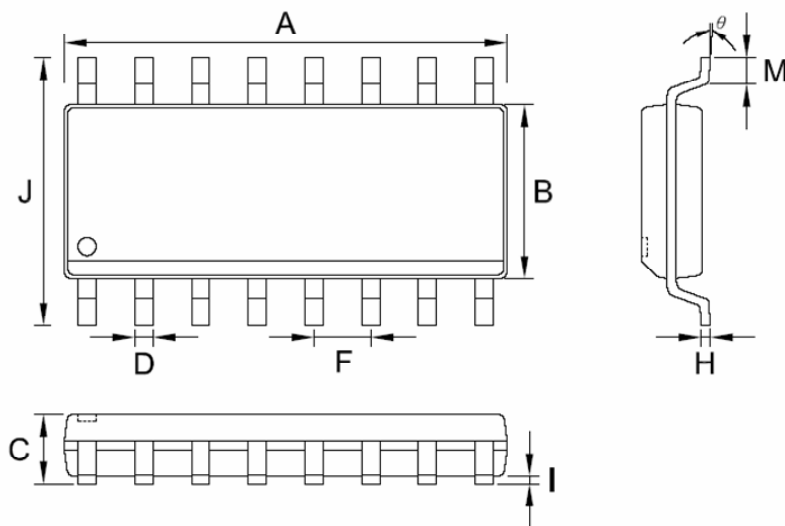


**Fig. 1 Stability Boundary Conditions**



**Fig. 2 Test Circuit of Stability Boundary Conditions**

- Note: 1. For the shunt regulators like TL431, the stability of capacitive load should be taken into account carefully. As shown in figure1, the areas within the curves represent the conditions that may cause the  $V_{ADJ}$  to oscillate.
2. Please add a 0.1uF between VCC and GND for output voltage stability.

**Package Information**
**SOP-16**


Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	9.804	10.008	0.386	0.394
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.406 TYP.		0.016 TYP.	
F	1.270 TYP.		0.050 TYP.	
H	0.203 TYP.		0.008 TYP.	
I	0.102	0.254	0.004	0.010
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

**Important Notice**

Leadtrend Technology Corp. reserves the right to make changes or corrections to its products at any time without notice. Customers should verify the datasheets are current and complete before placing order.