

# Low Noise, 8th Order, Clock Sweepable Cauer Lowpass Filter

## FEATURES

- 8th Order Filter in a 14-Pin Package
- 80dB or More Stopband Attenuation at  $2 \times f_{\text{CUTOFF}}$
- 50:1,  $f_{\text{CLK}}$  to  $f_{\text{CUTOFF}}$  Ratio (Cauer)  
100:1,  $f_{\text{CLK}}$  to  $f_{-3\text{dB}}$  Ratio (Transitional)
- $135\mu\text{V}_{\text{RMS}}$  Total Wideband Noise
- 0.03% THD or Better
- 100kHz Maximum  $f_{\text{CUTOFF}}$  Frequency
- Operates up to  $\pm 8\text{V}$  Power Supplies
- Input Frequency Range up to 50 Times the Filter Cutoff Frequency

## APPLICATIONS

- Antialiasing Filters
- Telecom Filters
- Sinewave Generators

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 LTCMOS is a trademark of Linear Technology Corporation.

## DESCRIPTION

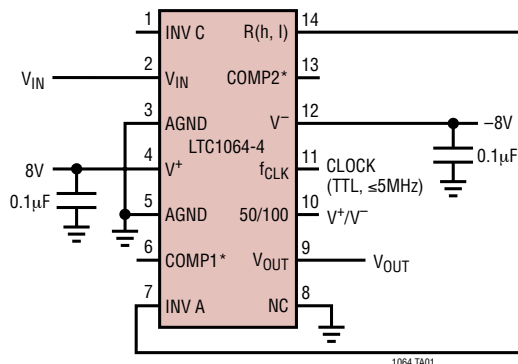
The LTC<sup>®</sup>1064-4 is an 8th order, clock sweepable Cauer lowpass switched capacitor filter. An external TTL or CMOS clock programs the value of the filter's cutoff frequency. With Pin 10 at  $V^+$ , the  $f_{\text{CLK}}$  to  $f_{\text{CUTOFF}}$  ratio is 50:1; the filter has a Cauer response and with compensation the passband ripple is  $\pm 0.1\text{dB}$ . The stopband attenuation is 80dB at  $2 \times f_{\text{CUTOFF}}$ . Cutoff frequencies up to 100kHz can be achieved. With Pin 10 at  $V^-$ , the  $f_{\text{CLK}}$  to  $f_{-3\text{dB}}$  ratio is 100:1, the filter has a transitional Butterworth-Cauer response with lower noise and lower delay nonlinearity than the Cauer response. The stopband attenuation at  $2.5 \times f_{-3\text{dB}}$  is 92dB. Cutoff frequencies up to 50kHz can be achieved.

The LTC1064-4 features low noise and low harmonic distortion even when input voltages up to  $3\text{V}_{\text{RMS}}$  are applied. The LTC1064-4 overall performance competes with equivalent multiple op amp active realizations. The LTC1064-4 is pin compatible with the LTC1064-1, LTC1064-2 and LTC1064-3.

The LTC1064-4 is manufactured using Linear Technology's enhanced LTCMOS<sup>™</sup> silicon gate process.

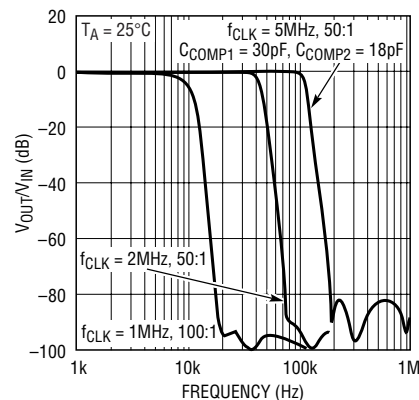
## TYPICAL APPLICATION

8th Order Clock Sweepable Lowpass Elliptic Filter



\* FOR FREQUENCIES ABOVE 20kHz AND MINIMUM PASSBAND RIPPLE REFER TO THE PIN DESCRIPTION SECTION FOR COMPENSATION GUIDELINES.  
 NOTE: THE POWER SUPPLIES SHOULD BE BYPASSED BY A  $0.1\mu\text{F}$  CAPACITOR CLOSE TO THE PACKAGE. BYPASSING PIN 10 WITH  $0.1\mu\text{F}$  CAPACITOR REDUCES CLOCK FEEDTHROUGH. THE CONNECTION BETWEEN PINS 7 AND 14 SHOULD BE PHYSICALLY DONE UNDER THE PACKAGE.

Frequency Response

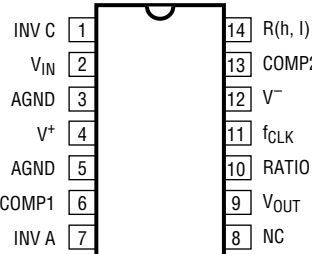
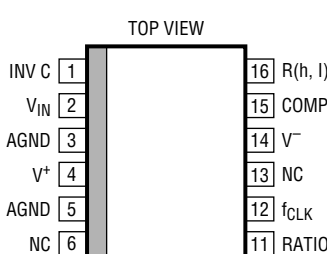


# LTC1064-4

## ABSOLUTE MAXIMUM RATINGS (Note 1)

|                                                                         |                |                                            |                |
|-------------------------------------------------------------------------|----------------|--------------------------------------------|----------------|
| Total Supply Voltage ( $V^+$ to $V^-$ ) .....                           | 16.5V          | Lead Temperature (Soldering, 10 sec) ..... | 300°C          |
| Input Voltage at Any Pin ..... $V^- - 0.3V \leq V_{IN} \leq V^+ + 0.3V$ |                | Operating Temperature Range                |                |
| Power Dissipation .....                                                 | 400mW          | LTC1064-4M ( <b>OBSOLETE</b> ) .....       | -55°C to 125°C |
| Storage Temperature Range .....                                         | -65°C to 150°C | LTC1064-4C .....                           | -40°C to 85°C  |

## PACKAGE/ORDER INFORMATION

|                                                                                                                                                                                                                                     |                                             |                                                                                                                                                                                                                                                    |                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <p>TOP VIEW</p>  <p>N PACKAGE<br/>14-LEAD PDIP</p> <p><math>T_{JMAX} = 110^\circ\text{C}</math>, <math>\theta_{JA} = 70^\circ\text{C/W}</math></p> | <p>ORDER PART NUMBER</p> <p>LTC1064-4CN</p> | <p>TOP VIEW</p>  <p>SW PACKAGE<br/>16-LEAD PLASTIC (WIDE) SO</p> <p><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 90^\circ\text{C/W}</math></p> | <p>ORDER PART NUMBER</p> <p>LTC1064-4CSW</p> |
| <p>J PACKAGE<br/>14-LEAD CERDIP</p> <p><b>OBSOLETE PACKAGE</b></p> <p>Consider the N14 Package for Alternate Source</p>                                                                                                             | <p>LTC1064-4MJ<br/>LTC1064-4CJ</p>          |                                                                                                                                                                                                                                                    |                                              |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_S = \pm 7.5\text{V}$ , 50:1,  $f_{CLK} = 1\text{MHz}$ ,  $f_C = 20\text{kHz}$ ,  $R_1 = 10\text{k}$ , TTL clock input level unless otherwise specified.

| PARAMETER                                                 | CONDITIONS                                                                                                 | MIN                                       | TYP                      | MAX | UNITS                          |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------------|-----|--------------------------------|
| Passband Gain                                             | Referenced to 0dB, 1Hz to $0.05f_{CUTOFF}$                                                                 | ● -0.5                                    |                          | 0.1 | dB                             |
| Gain TempCo                                               |                                                                                                            |                                           | 0.0002                   |     | dB/°C                          |
| Passband Edge Frequency, $f_C$                            |                                                                                                            |                                           | $20 \pm 1\%$             |     | kHz                            |
| Gain at $f_C$                                             | Referenced to Passband Gain, $f_C = 20\text{kHz}$                                                          | ● -0.4                                    |                          | 0.7 | dB                             |
| -3dB Frequency                                            | 50:1 (Cauer Response)                                                                                      |                                           | 21.5                     |     | kHz                            |
|                                                           | 100:1 (Transitional Response)                                                                              |                                           | 10                       |     | kHz                            |
| Passband Ripple (Note 2)                                  | $0.1f_C$ to $0.95f_C$ Referenced to Passband Gain                                                          | ● -0.15                                   |                          | 0.6 | dB                             |
| Stopband Attenuation                                      | At $1.7f_{CUTOFF}$                                                                                         | ● -56                                     | -60                      |     | dB                             |
| Stopband Attenuation                                      | At $2f_{CUTOFF}$                                                                                           |                                           | -80                      |     | dB                             |
| Input Frequency Range                                     | 50:1, Pin 10 at $V^+$<br>100:1, Pin 10 at $V^-$                                                            | 0<br>0                                    | $f_{CLK}$<br>$f_{CLK}/2$ |     | kHz<br>kHz                     |
| Output Voltage Swing and<br>Operating Input Voltage Range | $V_S = \pm 2.37\text{V}$<br>$V_S = \pm 5\text{V}$<br>$V_S = \pm 7.5\text{V}$                               | ● $\pm 1.1$<br>● $\pm 3.1$<br>● $\pm 5.0$ |                          |     | V<br>V<br>V                    |
| Total Harmonic Distortion                                 | $V_S = \pm 5\text{V}$ , Input = $1V_{RMS}$ at 1kHz<br>$V_S = \pm 7.5\text{V}$ , Input = $3V_{RMS}$ at 1kHz |                                           | 0.015<br>0.03            |     | %<br>%                         |
| Wideband Noise                                            | $V_S = \pm 5\text{V}$ , Input = GND 1Hz to 999kHz<br>$V_S = \pm 7.5\text{V}$ , Input = GND 1Hz to 999kHz   |                                           | 120<br>135               |     | $\mu V_{RMS}$<br>$\mu V_{RMS}$ |

**ELECTRICAL CHARACTERISTICS**

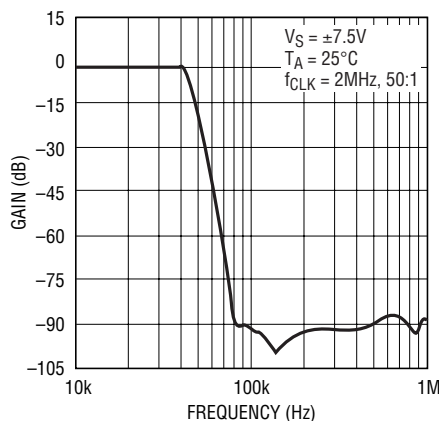
The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V_S = \pm 7.5\text{V}$ , 50:1,  $f_{\text{CLK}} = 1\text{MHz}$ ,  $f_C = 20\text{kHz}$ ,  $R_1 = 10\text{k}$ , TTL clock input level unless otherwise specified.

| PARAMETER                    | CONDITIONS                                                | MIN          | TYP      | MAX       | UNITS                        |
|------------------------------|-----------------------------------------------------------|--------------|----------|-----------|------------------------------|
| Output DC Offset             | $V_S = \pm 7.5\text{V}$                                   |              | $\pm 50$ | $\pm 160$ | mV                           |
| Output DC Offset TempCo      | $V_S = \pm 5\text{V}$                                     |              | -100     |           | $\mu\text{V}/^\circ\text{C}$ |
|                              | $V_S = \pm 7.5\text{V}$                                   |              | -200     |           | $\mu\text{V}/^\circ\text{C}$ |
| Input Impedance              |                                                           | 9            | 13       |           | $\text{k}\Omega$             |
| Output Impedance             | $f_{\text{OUT}} = 10\text{kHz}$                           |              | 2        |           | $\Omega$                     |
| Output Short-Circuit Current | Source/Sink                                               |              | 3/1      |           | mA                           |
| Clock Feedthrough            | Input = GND                                               |              | 200      |           | $\mu\text{V}_{\text{RMS}}$   |
| Maximum Clock Frequency      | $V_S = \pm 7.5\text{V}$ , 50% Duty Cycle (Note 3)         |              |          | 5         | MHz                          |
| Power Supply Current         | $V_S = \pm 2.37\text{V}$ , $f_{\text{CLK}} = 1\text{MHz}$ | ●            | 11       | 22        | mA                           |
|                              | $V_S = \pm 5\text{V}$ , $f_{\text{CLK}} = 1\text{MHz}$    | ●            | 14       | 23        | mA                           |
|                              |                                                           | ●            |          | 26        | mA                           |
|                              | $V_S = \pm 7.5\text{V}$ , $f_{\text{CLK}} = 1\text{MHz}$  | ●            | 17       | 28        | mA                           |
|                              |                                                           | ●            |          | 32        | mA                           |
| Power Supply Voltage Range   |                                                           | ● $\pm 2.37$ |          | $\pm 8$   | V                            |

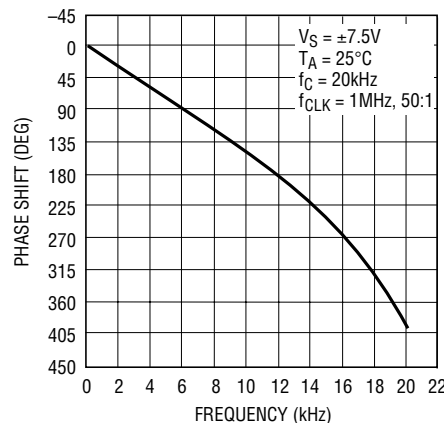
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

**Note 2:** For tighter passband ripple specifications please consult with LTC's marketing.

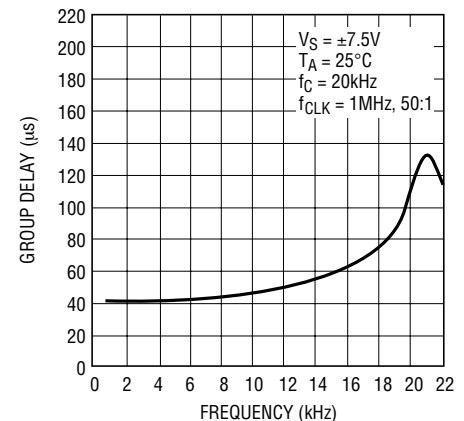
**Note 3:** Not tested, guaranteed by design.

**TYPICAL PERFORMANCE CHARACTERISTICS****Gain vs Frequency**

1064-4 G01

**Passband Phase Shift vs Frequency**

1064-4 G02

**Passband Group Delay**

1064-4 G03

TYPICAL PERFORMANCE CHARACTERISTICS

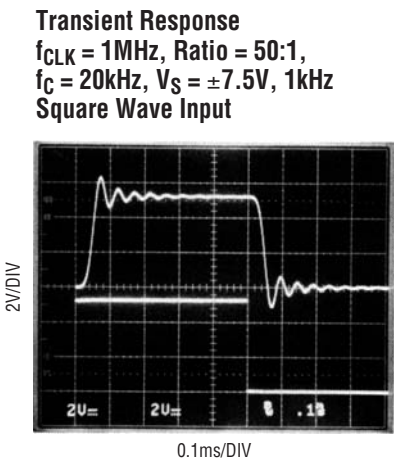
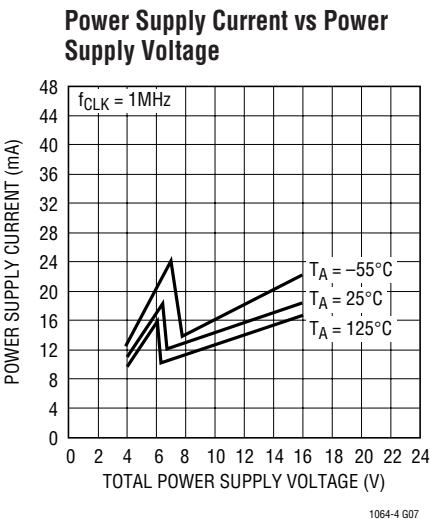
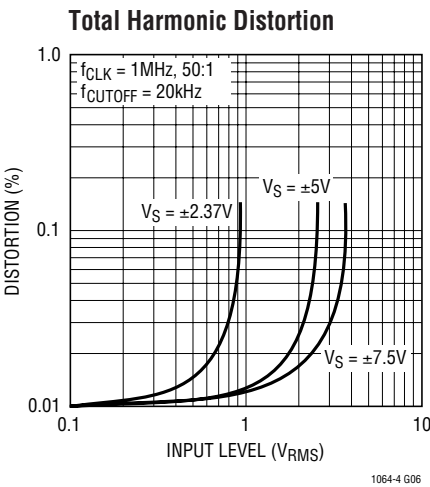
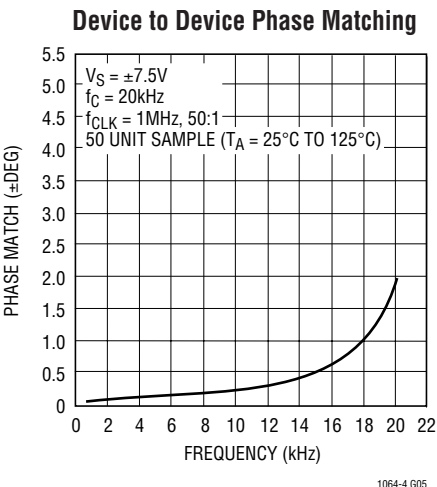
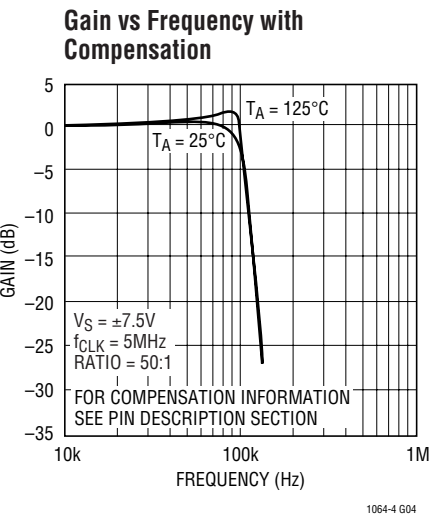


Table 1. Wideband Noise ( $\mu V_{RMS}$ ). Input Grounded,  $f_{CLK} = 1MHz$

|           |                      | $V_S = \pm 2.37V$      | $V_S = \pm 5V$         | $V_S = \pm 7.5V$       |
|-----------|----------------------|------------------------|------------------------|------------------------|
| Pin 10 to | $f_{CLK}/f_{CUTOFF}$ | Noise<br>$\mu V_{RMS}$ | Noise<br>$\mu V_{RMS}$ | Noise<br>$\mu V_{RMS}$ |
| $V^+$     | 50:1                 | 120                    | 135                    | 145                    |
| $V^-$     | 100:1                | 100                    | 120                    | 130                    |

## TYPICAL PERFORMANCE CHARACTERISTICS

**Table 2. Gain/Phase, Pin 10 at V<sup>+</sup>, Typical Response**  
 $f_{\text{CUTOFF}} = 1\text{kHz}$ ,  $V_S = \pm 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ ,  $f_{\text{CLK}} = 50\text{kHz}$ , Ratio = 50:1

| FREQUENCY(kHz) | GAIN (dB) | PHASE (deg) |
|----------------|-----------|-------------|
| 0.200          | -0.075    | -59.990     |
| 0.400          | -0.050    | -122.400    |
| 0.600          | 0.020     | 169.300     |
| 0.800          | 0.060     | 88.500      |
| 1.000          | 0.090     | -26.100     |
| 1.200          | -15.640   | -175.100    |
| 1.400          | -34.700   | 126.500     |
| 1.600          | -51.700   | 87.600      |
| 1.800          | -68.600   | 38.400      |
| 2.000          | -84.110   | -47.860     |

**Table 3. Gain/Delay, Pin 10 at V<sup>+</sup>, Typical Response**  
 $f_{\text{CUTOFF}} = 1\text{kHz}$ ,  $V_S = \pm 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ ,  $f_{\text{CLK}} = 50\text{kHz}$ , Ratio = 50:1

| FREQUENCY(kHz) | GAIN (dB) | DELAY (ms) |
|----------------|-----------|------------|
| 0.200          | -0.074    | 0.844      |
| 0.300          | -0.070    | 0.867      |
| 0.400          | -0.050    | 0.899      |
| 0.500          | -0.020    | 0.949      |
| 0.600          | 0.020     | 1.021      |
| 0.700          | 0.050     | 1.122      |
| 0.800          | 0.060     | 1.275      |
| 0.900          | 0.120     | 1.592      |
| 1.000          | 0.090     | 2.160      |
| 1.100          | -5.020    | 2.070      |
| 1.200          | -15.650   | 1.288      |

**Table 4. Gain/Phase, Pin 10 at V<sup>-</sup>, Typical Response**  
 $f_{-3\text{dB}} = 1\text{kHz}$ ,  $V_S = \pm 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ ,  $f_{\text{CLK}} = 100\text{kHz}$ , Ratio = 100:1

| FREQUENCY(kHz) | GAIN (dB) | PHASE (deg) |
|----------------|-----------|-------------|
| 0.200          | -0.179    | -60.090     |
| 0.400          | -0.440    | -122.000    |
| 0.600          | -0.810    | 170.800     |
| 0.800          | -1.480    | 91.900      |
| 1.000          | -3.500    | -16.300     |
| 1.200          | -17.720   | -140.500    |
| 1.400          | -35.700   | 164.800     |
| 1.600          | -52.700   | 135.000     |
| 1.800          | -71.900   | 114.000     |
| 2.000          | -96.160   | -49.670     |

**Table 5. Gain/Delay, Pin 10 at V<sup>-</sup>, Typical Response**  
 $f_{-3\text{dB}} = 1\text{kHz}$ ,  $V_S = \pm 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ ,  $f_{\text{CLK}} = 100\text{kHz}$ , Ratio = 100:1

| FREQUENCY(kHz) | GAIN (dB) | DELAY (ms) |
|----------------|-----------|------------|
| 0.200          | -0.174    | 0.842      |
| 0.300          | -0.300    | 0.861      |
| 0.400          | -0.440    | 0.888      |
| 0.500          | -0.610    | 0.933      |
| 0.600          | -0.810    | 0.999      |
| 0.700          | -1.090    | 1.095      |
| 0.800          | -1.480    | 1.242      |
| 0.900          | -2.080    | 1.503      |
| 1.000          | -3.500    | 1.832      |
| 1.100          | -8.720    | 1.724      |
| 1.200          | -17.720   | 1.183      |

**Table 6. Gain/Phase, Pin 10 at GND**  
 $V_S = \pm 5\text{V}$ ,  $T_A = 25^\circ\text{C}$

| FREQUENCY(kHz) | GAIN (dB) | PHASE (deg) |
|----------------|-----------|-------------|
| 0.200          | -0.383    | -47.140     |
| 0.400          | -1.000    | -92.000     |
| 0.600          | -1.300    | -134.300    |
| 0.800          | -0.280    | -178.800    |
| 1.000          | 2.670     | 109.200     |
| 1.200          | -3.500    | 6.000       |
| 1.400k         | -12.510   | -47.400     |
| 1.600          | -20.000   | -88.800     |
| 1.800          | -27.300   | -127.800    |
| 2.000          | -35.000   | -164.200    |

## TYPICAL PERFORMANCE CHARACTERISTICS

Table 7. Gain/Phase for Figure 6.

Typical Response, Pin 10 at  $V^+$ ,  $f_{\text{CUTOFF}} = 40\text{kHz}$ ,  
 $V_S = \pm 7.5\text{V}$ ,  $f_{\text{CLK}} = 2\text{MHz}$ , Ratio = 50:1

| FREQUENCY (kHz) | GAIN (dB) | PHASE (deg) |
|-----------------|-----------|-------------|
| 10.000          | -0.094    | -75.900     |
| 12.000          | -0.100    | -91.400     |
| 14.000          | -0.090    | -107.200    |
| 16.000          | -0.080    | -123.300    |
| 18.000          | -0.060    | -139.600    |
| 20.000          | -0.040    | -156.500    |
| 22.000          | -0.020    | -173.800    |
| 24.000          | 0.000     | 168.200     |
| 26.000          | 0.020     | 149.400     |
| 28.000          | 0.030     | 130.000     |
| 30.000          | 0.020     | 109.400     |
| 32.000          | 0.010     | 87.700      |
| 34.000          | -0.020    | 64.600      |
| 36.000          | -0.030    | 39.500      |
| 38.000          | -0.010    | 11.400      |
| 40.000          | -0.070    | -22.000     |
| 42.000          | -0.920    | -64.100     |
| 44.000          | -4.000    | -110.100    |
| 46.000          | -8.970    | -147.000    |
| 48.000          | -14.320   | -173.500    |
| 50.000          | -19.460   | 166.800     |

Table 8. Gain/Phase for Figure 7.

Typical Response, Pin 10 at  $V^+$ ,  $f_{\text{CUTOFF}} = 100\text{kHz}$ ,  
 $V_S = \pm 7.5\text{V}$ ,  $T_A = 25^\circ\text{C}$ ,  $f_{\text{CLK}} = 5\text{MHz}$ , Ratio = 50:1

| FREQUENCY (kHz) | GAIN (dB) | PHASE (deg) |
|-----------------|-----------|-------------|
| 10.000          | -0.096    | -32.390     |
| 20.000          | -0.100    | -64.900     |
| 30.000          | -0.080    | -98.100     |
| 40.000          | -0.040    | -132.300    |
| 50.000          | 0.020     | -168.200    |
| 60.000          | 0.070     | 153.600     |
| 70.000          | 0.040     | 112.100     |
| 80.000          | -0.120    | 66.400      |
| 90.000          | -0.460    | 14.600      |
| 100.000         | -1.310    | -49.300     |
| 110.000         | -5.640    | -129.000    |
| 120.000         | -14.530   | 167.800     |
| 130.000         | -23.800   | 126.700     |
| 140.000         | -32.600   | 96.200      |
| 150.000         | -41.000   | 71.300      |
| 160.000         | -49.200   | 49.200      |
| 170.000         | -57.500   | 29.000      |
| 180.000         | -66.500   | 9.800       |
| 190.000         | -77.770   | -2.320      |
| 200.000         | -92.050   | 76.740      |

Table 9. Gain/Phase for Figure 7.

Typical Response, Pin 10 at  $V^+$ ,  $f_{\text{CUTOFF}} = 100\text{kHz}$ ,  
 $V_S = \pm 7.5\text{V}$ ,  $T_A = 125^\circ\text{C}$ ,  $f_{\text{CLK}} = 5\text{MHz}$ , Ratio = 50:1

| FREQUENCY (kHz) | GAIN (dB) | PHASE (deg) |
|-----------------|-----------|-------------|
| 10.000          | -0.071    | -33.800     |
| 20.000          | -0.040    | -67.800     |
| 30.000          | 0.050     | -102.500    |
| 40.000          | 0.190     | -138.300    |
| 50.000          | 0.410     | -176.100    |
| 60.000          | 0.670     | 143.100     |
| 70.000          | 0.920     | 98.400      |
| 80.000          | 1.150     | 48.200      |
| 90.000          | 1.530     | -10.900     |
| 100.000         | 1.110     | -96.500     |

| FREQUENCY (kHz) | GAIN (dB) | PHASE (deg) |
|-----------------|-----------|-------------|
| 110.000         | -7.420    | 172.100     |
| 120.000         | -18.240   | 119.400     |
| 130.000         | -28.000   | 83.300      |
| 140.000         | -37.000   | 54.000      |
| 150.000         | -45.700   | -27.600     |
| 160.000         | -54.300   | 2.100       |
| 170.000         | -63.300   | -24.900     |
| 180.000         | -73.610   | -60.210     |
| 190.000         | -85.300   | -138.990    |
| 200.000         | -83.390   | 129.580     |

## PIN FUNCTIONS (Pin Numbers Refer to the 14-Pin Package)

**INV C, COMP1, INV A, COMP2 (Pins 1, 6, 7 and 13):** To obtain a Cauer response with minimum passband ripple and cutoff frequencies above 20kHz, compensating components are required. Figure 6 uses  $\pm 7.5\text{V}$  power supplies and compensation components to achieve up to 40kHz *sweepable* cutoff frequencies and  $\pm 0.1\text{dB}$  passband ripple. Table 7 lists the typical amplitude response of Figure 6. Figure 7 illustrates the compensation scheme required to obtain a 100kHz cutoff frequency; Graph 4 and Tables 8 and 9 list the typical response of Figure 7 for 25°C and 125°C ambient temperature. As shown the ripple increases at high temperatures but still a  $\pm 0.25\text{dB}$  figure can be obtained for ambient temperatures below 70°C.

**V<sub>IN</sub>, V<sub>OUT</sub> (Pins 2, 9):** The input Pin 2 is connected to a 12k resistor tied to the inverting input of an op amp. Pin 2 is protected against static discharge. The device's output, Pin 9, is the output of an op amp which can typically source/sink 3mA/1mA. Although the internal op amps are unity gain stable, driving long coax cables is not recommended.

When testing the device for noise and distortion, the output, Pin 9, should be buffered (Figure 4). *The op amp power supply wire (or trace) should be connected directly to the power source.* To eliminate any output clock feedthrough, Pin 9 should be buffered with a simple R, C lowpass filter (Figure 5). The cutoff frequency of the output filter should be  $f_{\text{CLK}}/3$ .

**AGND (Pins 3, 5):** For dual supply operation these pins should be connected to a ground plane. For single supply operation both pins should be tied to one half supply (Figure 2).

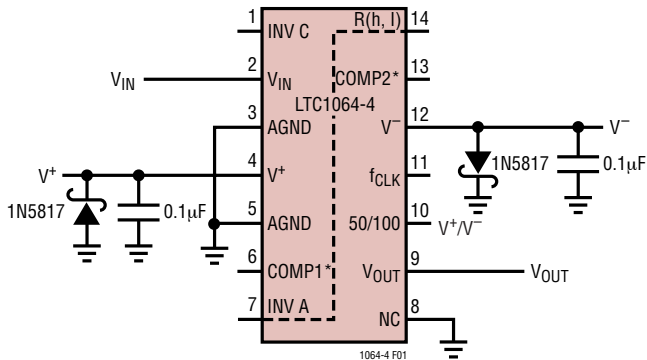
**V<sup>+</sup>, V<sup>-</sup> (Pins 4, 12):** Should be bypassed with a 0.1 $\mu\text{F}$  capacitor to an adequate analog ground. Low noise, nonswitching power supplies are recommended. *To avoid latchup when the power supplies exhibit high turn-on transients, a 1N5817 Schottky diode should be added from the V<sup>+</sup> and V<sup>-</sup> pins to ground (Figures 1 and 2).*

**INV A, R(h, l) (Pins 7, 14):** A very short connection between Pin 7 and Pin 14 is recommended. This connection should be preferably done under the IC package. In a breadboard, use a one inch, or less, shielded coaxial cable; the shield should be grounded. In a PC board, use a one inch trace or less; surround the trace by a ground plane.

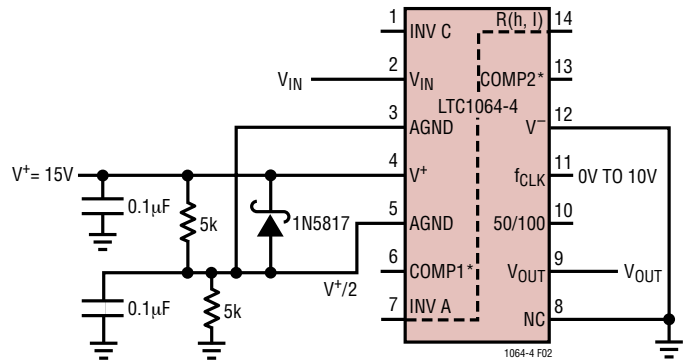
**NC (Pin 8):** Pin 8 is not internally connected, it should be preferably grounded.

**50/100 Ratio (Pin 10):** For an  $f_{\text{CLK}}/f_{\text{C}}$  ratio of 50:1, Pin 10 should be tied to V<sup>+</sup>. For an  $f_{\text{CLK}}/f_{-3\text{dB}}$  ratio of 100:1, Pin 10 should be tied to V<sup>-</sup>. When Pin 10 is at midsupplies (i.e. ground), the filter response is neither Cauer nor transitional. Table 6 illustrates this response. Bypassing Pin 10 with a 0.1 $\mu\text{F}$  capacitor reduces the already small clock feedthrough.

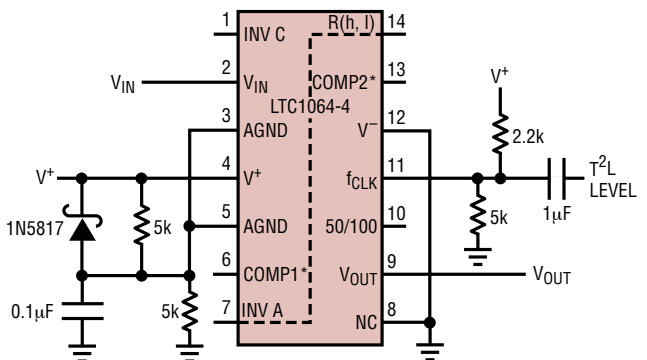
## TYPICAL APPLICATIONS



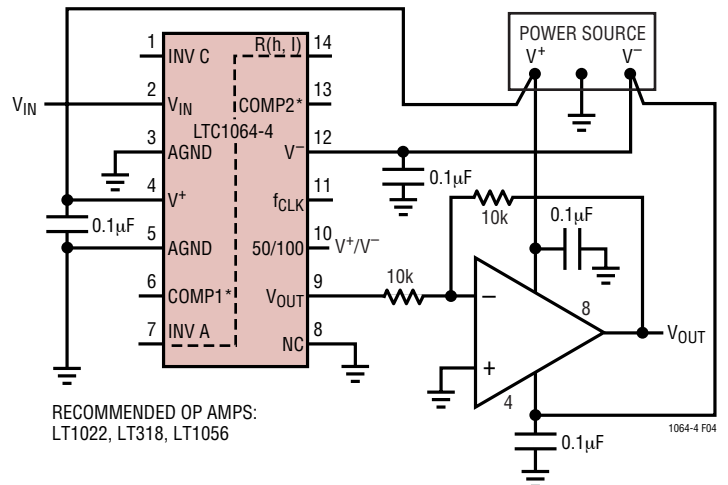
**Figure 1. Using Schottky Diodes to Protect the IC from Power Supply Spikes**



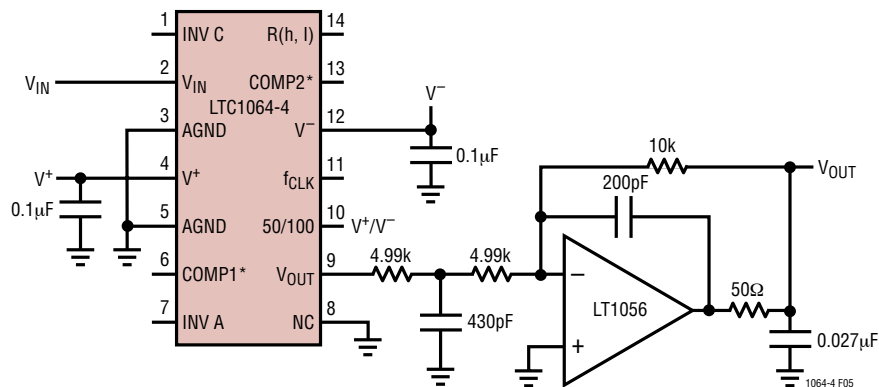
**Figure 2. Single Supply Operation. If Fast Power Up or Down Transients are Expected, Use a 1N5817 Schottky Diode Between Pin 4 and Pin 5.**



**Figure 3. Level Shifting the Input T<sup>2</sup>L Clock for Single Supply Operation ≥6V.**



**Figure 4. Buffering the Filter Output. The Buffer Op Amp Should Not Share the LTC1064-4 Power Lines.**

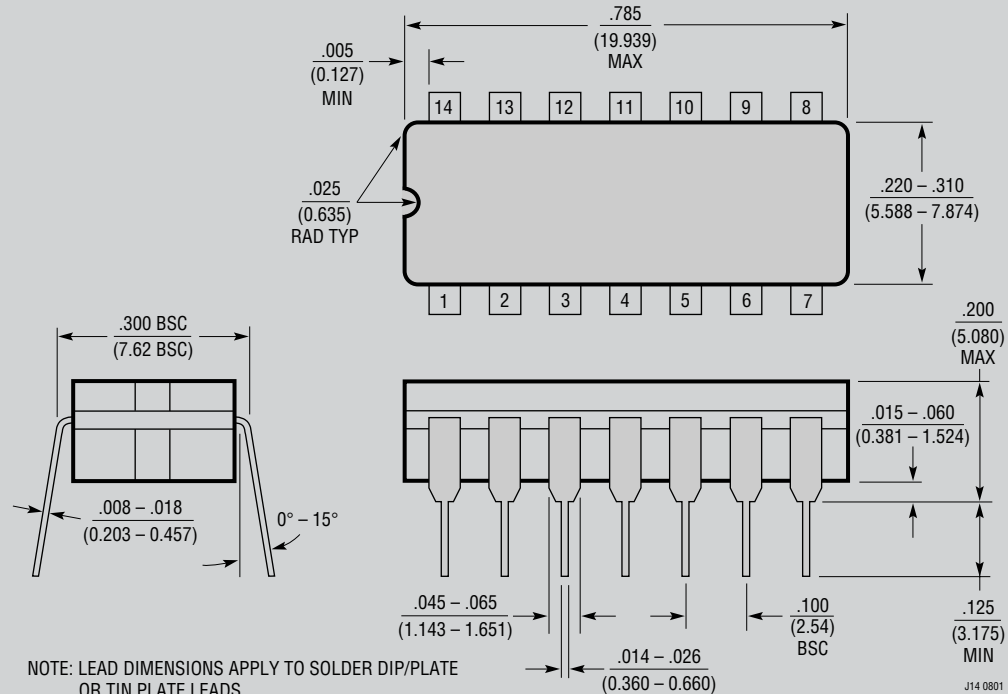


**Figure 5. Adding an Output Buffer-Filter to Eliminate Any Clock Feedthrough. Passband Error of Output Buffer is ±0.1dB to 50kHz, -3dB at 94kHz.**



## PACKAGE DESCRIPTION

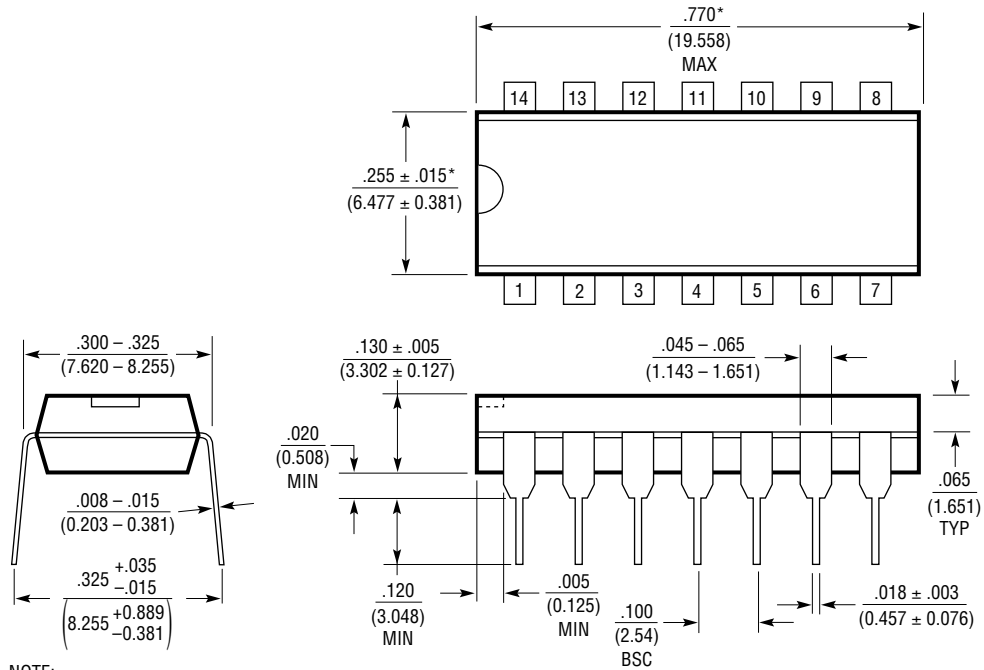
**J Package**  
**14-Lead Cerdip (Narrow 0.300, Hermetic)**  
 (LTC DWG # 05-08-1110)



**OBSOLETE PACKAGE**

## PACKAGE DESCRIPTION

**N Package**  
**14-Lead PDIP (Narrow 0.300)**  
 (LTC DWG # 05-08-1510)



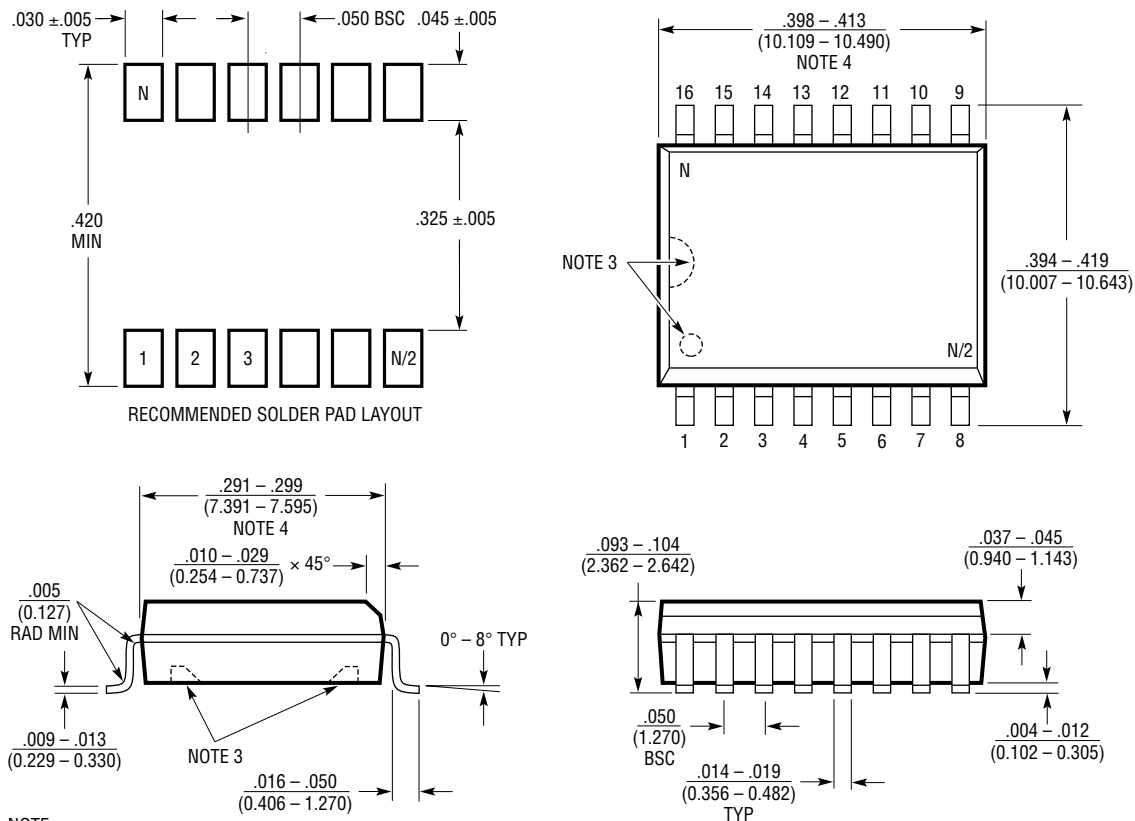
NOTE:  
 1. DIMENSIONS ARE  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

N14 1002

## PACKAGE DESCRIPTION

### SW Package 16-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



- NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
  2. DRAWING NOT TO SCALE
  3. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
  4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S16 (WIDE) 0502

TYPICAL APPLICATIONS

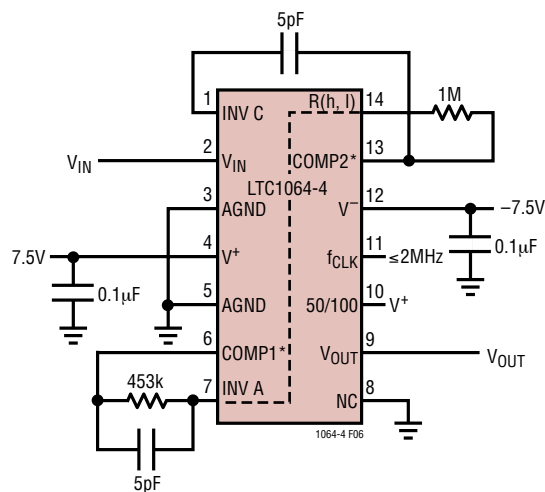


Figure 6. Compensating LTC1064-4 for Passband Ripple of ±0.1dB and fCUTOFF Sweeps to 40kHz.

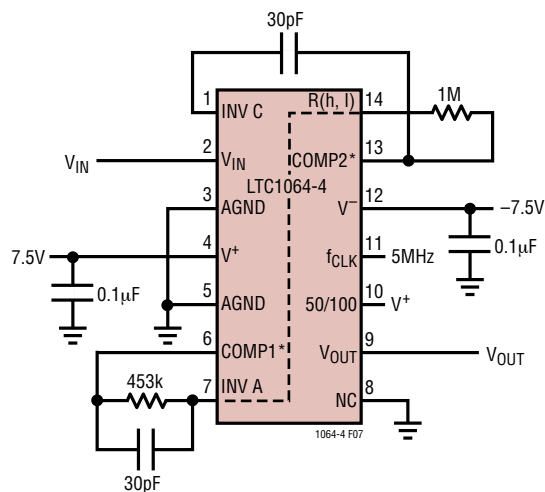


Figure 7. Compensating LTC1064-4 for fCUTOFF = 100kHz, Gain at fCUTOFF = -1.3dB, Table 8.

RELATED PARTS

| PART NUMBER | DESCRIPTION                               | COMMENTS                                                |
|-------------|-------------------------------------------|---------------------------------------------------------|
| LTC1069-1   | 8th Order Elliptic Lowpass                | S0-8 Package, Low Power                                 |
| LTC1069-6   | Single Supply, 8th Order Elliptic Lowpass | S0-8 Package, Very Low Power                            |
| LTC1569-6   | DC Accurate, 10th Order Lowpass           | Internal Precision Clock, Low Power, S0-8 Package       |
| LTC1569-7   | DC Accurate, 10th Order Lowpass           | Internal Precision Clock, Delay Equalized, S0-8 Package |