

EL5100, EL5101, EL5300

200MHz Slew Enhanced VFA

FN7330
Rev 3.00
May 3, 2007

The EL5100, EL5101, and EL5300 represent high-speed voltage feedback amplifiers based on the current feedback amplifier architecture. This gives the typical high slew rate benefits of a CFA family along with the stability and ease of use associated with the VFA type architecture. This family is available in single, dual, and triple versions, with 200MHz, 400MHz, and 700MHz versions. This family operates on single 5V or $\pm 5V$ supplies from minimum supply current. The EL5100 and EL5300 also feature an output enable function, which can be used to put the output in to a high-impedance mode. This enables the outputs of multiple amplifiers to be tied together for use in multiplexing applications.

Features

- Pb-free plus anneal available (RoHS compliant)
- Specified for 5V or $\pm 5V$ applications
- Power-down to 17 μA /amplifier
- -3dB bandwidth = 200MHz
- ± 0.1 dB bandwidth = 20MHz
- Low supply current = 2.5mA
- Slew rate = 2200V/ μs
- Low offset voltage = 4mV max
- Output current = 100mA
- $A_{VOL} = 1000$
- Diff gain/phase = 0.08%/0.1°

Applications

- Video amplifiers
- PCMCIA applications
- A/D drivers
- Line drivers
- Portable computers
- High speed communications
- RGB applications
- Broadcast equipment
- Active filtering

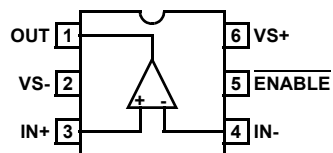
Ordering Information

| PART NUMBER | PART MARKING | TAPE AND REEL | PACKAGE | PKG. DWG. # |
|----------------------|--------------|---------------|--------------------------------|-------------|
| EL5100IS | 5100IS | - | 8 Ld SOIC (150 mil) | MDP0027 |
| EL5100IS-T7 | 5100IS | 7" | 8 Ld SOIC (150 mil) | MDP0027 |
| EL5100IS-T13 | 5100IS | 13" | 8 Ld SOIC (150 mil) | MDP0027 |
| EL5100ISZ (Note) | 5100ISZ | - | 8 Ld SOIC (150 mil) (Pb-free) | MDP0027 |
| EL5100ISZ-T7 (Note) | 5100ISZ | 7" | 8 Ld SOIC (150 mil) (Pb-free) | MDP0027 |
| EL5100ISZ-T13 (Note) | 5100ISZ | 13" | 8 Ld SOIC (150 mil) (Pb-free) | MDP0027 |
| EL5100IW-T7 | y | 7" (3k pcs) | 6 Ld SOT-23 | MDP0038 |
| EL5100IW-T7A | y | 7" (250 pcs) | 6 Ld SOT-23 | MDP0038 |
| EL5101IW-T7 | 2 | 7" (3k pcs) | 5 Ld SOT-23 | MDP0038 |
| EL5101IW-T7A | 2 | 7" (250 pcs) | 5 Ld SOT-23 | MDP0038 |
| EL5300IU | 5300IU | - | 16 Ld QSOP (150 mil) | MDP0040 |
| EL5300IU-T7 | 5300IU | 7" | 16 Ld QSOP (150 mil) | MDP0040 |
| EL5300IU-T13 | 5300IU | 13" | 16 Ld QSOP (150 mil) | MDP0040 |
| EL5300IUZ (Note) | 5300IUZ | - | 16 Ld QSOP (150 mil) (Pb-free) | MDP0040 |
| EL5300IUZ-T7 (Note) | 5300IUZ | 7" | 16 Ld QSOP (150 mil) (Pb-free) | MDP0040 |
| EL5300IUZ-T13 (Note) | 5300IUZ | 13" | 16 Ld QSOP (150 mil) (Pb-free) | MDP0040 |

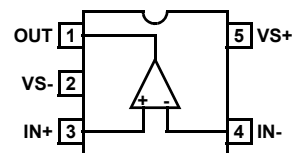
NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Pinouts

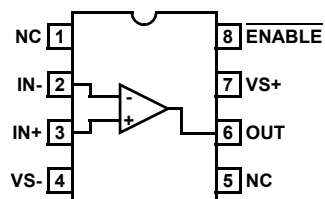
EL5100
(6 LD SOT-23)
TOP VIEW



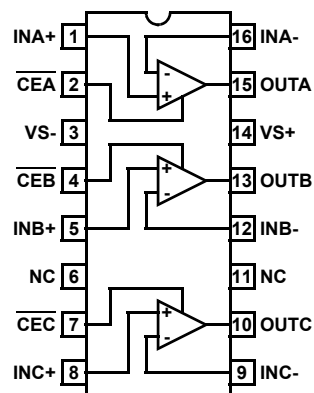
EL5101
(5 LD SOT-23)
TOP VIEW



EL5100
(8 LD SOIC)
TOP VIEW



EL5300
(16 LD QSOP)
TOP VIEW



Absolute Maximum Ratings ($T_A = +25^\circ\text{C}$)

Supply Voltage between V_{S+} and V_{S-} 13.2V
 Input Voltage $\pm V_S$
 Differential Input Voltage $\pm 4\text{V}$
 Maximum Output Current 80mA
 Maximum Slewrate from V_{S+} to V_{S-} 1V/ μs

Thermal Information

Storage Temperature Range -65°C to $+150^\circ\text{C}$
 Ambient Operating Temperature Range -40°C to $+85^\circ\text{C}$
 Operating Junction Temperature $+150^\circ\text{C}$
 Pb-free reflow profile see link below
<http://www.intersil.com/pbfree/Pb-FreeReflow.asp>

CAUTION: Stresses above those listed 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.

IMPORTANT NOTE: All parameters having Min/Max specifications are guaranteed. Typical values are for information purposes only. Unless otherwise noted, all tests are at the specified temperature and are pulsed tests, therefore: $T_J = T_C = T_A$

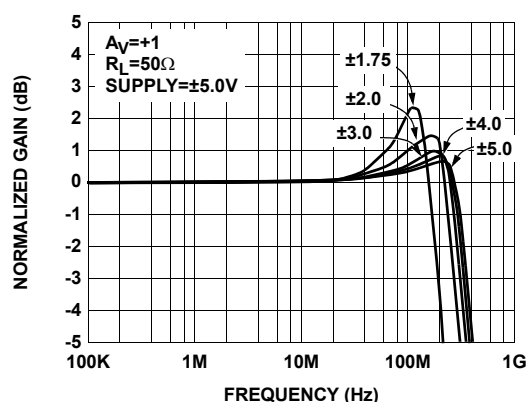
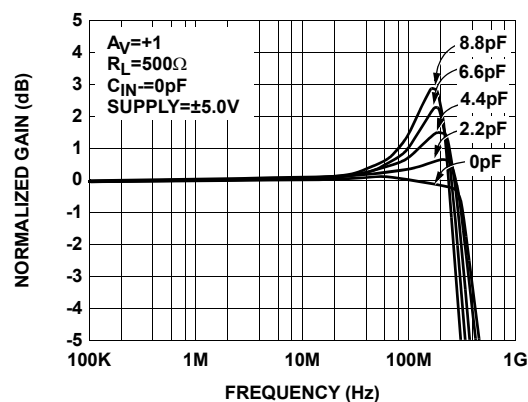
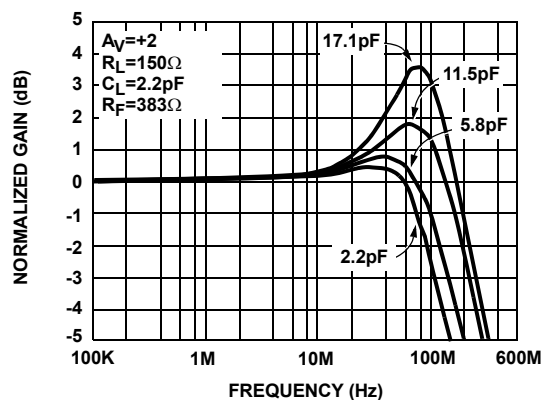
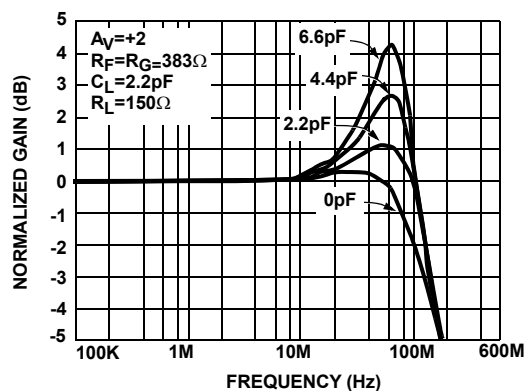
DC Electrical Specifications $V_S = \pm 5\text{V}$, $\text{GND} = 0\text{V}$, $T_A = +25^\circ\text{C}$, $V_{CM} = 0\text{V}$, $V_{OUT} = 0\text{V}$, $V_{ENABLE} = \text{GND or OPEN}$, Unless Otherwise Specified.

| PARAMETER | DESCRIPTION | CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------|--|---|--------------|-----------|--------------|------------------------------|
| V_{OS} | Offset Voltage | | -4 | 1 | 4 | mV |
| TCV_{OS} | Offset Voltage Temperature Coefficient | Measured from T_{MIN} to T_{MAX} | | 8 | | $\mu\text{V}/^\circ\text{C}$ |
| I_B | Input Bias Current | $V_{IN} = 0\text{V}$ | -6 | 2 | 6 | μA |
| I_{OS} | Input Offset Current | $V_{IN} = 0\text{V}$ | -2.5 | 0.5 | 2.5 | μA |
| TCI_{OS} | Input Bias Current Temperature Coefficient | Measured from T_{MIN} to T_{MAX} | | 8 | | $\text{nA}/^\circ\text{C}$ |
| PSRR | Power Supply Rejection Ratio | | 70 | 90 | | dB |
| CMRR | Common Mode Rejection Ratio | V_{CM} from -3V to +3V | 60 | 75 | | dB |
| CMIR | Common Mode Input Range | Guaranteed by CMRR test | -3 | | +3 | V |
| R_{IN} | Input Resistance | $V_{IN} = -3\text{V to } +3\text{V}$ | 0.7 | 1.2 | | $\text{M}\Omega$ |
| C_{IN} | Input Capacitance | | | 1 | | pF |
| $I_{S,ON}$ | Supply Current - Enabled | Per amplifier | 2.1 | 2.5 | 2.9 | mA |
| $I_{S,OFF}$ | Supply Current - Shut Down | V_{S+} , per amplifier | -5 | 0 | 5 | μA |
| | | V_{S-} , per amplifier | 5 | 17 | 25 | μA |
| PSOR | Power Supply Operating Range | | 3.3 | | 12 | V |
| AVOL | Open Loop Gain | $R_L = 1\text{k}\Omega$ to GND, V_{OUT} from -2.5V to +2.5V | 55 | 60 | | dB |
| V_{OP} | Positive Output Voltage Swing | $R_L = 150\Omega$ to GND | 3.2 | 3.4 | | V |
| | | $R_L = 1\text{k}\Omega$ to GND | 3.6 | 3.8 | | V |
| V_{ON} | Negative Output Voltage Swing | $R_L = 150\Omega$ to GND | | -3.4 | -3.2 | V |
| | | $R_L = 1\text{k}\Omega$ to GND | | -3.8 | -3.6 | V |
| I_{OUT} | Output Current | $R_L = 10\Omega$ to 0V | ± 60 | ± 100 | | mA |
| V_{IH-EN} | ENABLE pin Voltage for Power Up | | $V_{S+} - 4$ | | | V |
| V_{IL-EN} | ENABLE pin Voltage for Shut Down | | | | $V_{S+} - 1$ | V |
| I_{EN} | Enable Pin Current | Enabled, $V_{EN} = 0\text{V}$ | -1 | | 1 | μA |
| | | Disabled, $V_{EN} = 5\text{V}$ | 5 | 17 | 25 | μA |

Closed Loop AC Electrical Specifications $V_S = \pm 5V$, $T_A = 25^\circ C$, $V_{ENABLE} = 0V$, $A_V = +1$, $R_F = 0\Omega$, $R_L = 150\Omega$ to GND, unless otherwise specified.

| PARAMETER | DESCRIPTION | CONDITIONS | MIN | TYP | MAX | UNIT |
|------------|--|---|------|------|------|-----------------|
| BW | -3dB Bandwidth ($V_{OUT} = 200mV_{P-P}$) | $V_S = \pm 5V$, $A_V = 1$, $R_F = 0\Omega$ | 150 | 200 | | MHz |
| SR | Slew Rate | $R_L = 100\Omega$, $V_{OUT} = -3V$ to $+3V$, $A_V = +2$ | 1500 | 2200 | 4500 | V/ μs |
| t_R, t_F | Rise Time, Fall Time | $\pm 0.1V$ step | | 2.8 | | ns |
| OS | Overshoot | $\pm 0.1V$ step | | 10 | | % |
| t_{PD} | Propagation Delay | $\pm 0.1V$ step | | 3.2 | | ns |
| t_S | 0.1% Settling Time | $V_S = \pm 5V$, $R_L = 500\Omega$, $A_V = 1$, $V_{OUT} = \pm 2.5V$ | | 20 | | ns |
| dG | Differential Gain | $A_V = 2$, $R_L = 150\Omega$, $V_{INDC} = -1$ to $+1V$ | | 0.08 | | % |
| dP | Differential Phase | $A_V = 2$, $R_L = 150\Omega$, $V_{INDC} = -1$ to $+1V$ | | 0.1 | | $^\circ$ |
| e_N | Input Noise Voltage | $f = 10kHz$ | | 10 | | nV/ \sqrt{Hz} |
| i_N | Input Noise Current | $f = 10kHz$ | | 7 | | pA/ \sqrt{Hz} |
| t_{DIS} | Disable Time | | | 180 | | ns |
| t_{EN} | Enable Time | | | 650 | | ns |

Typical Performance Curves

FIGURE 1. GAIN vs FREQUENCY FOR VARIOUS C_L FIGURE 2. GAIN vs FREQUENCY FOR VARIOUS C_L FIGURE 3. GAIN vs FREQUENCY FOR VARIOUS C_{IN} FIGURE 4. GAIN vs FREQUENCY FOR VARIOUS C_{IN}

Typical Performance Curves (Continued)

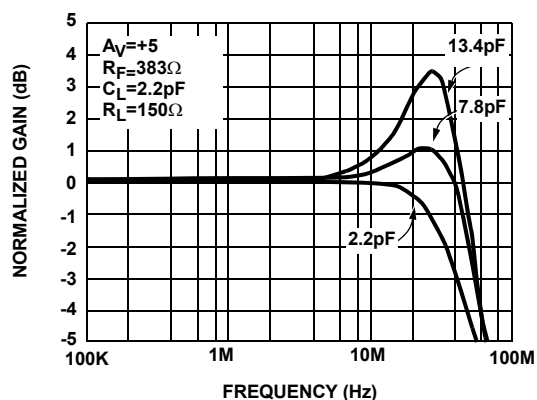
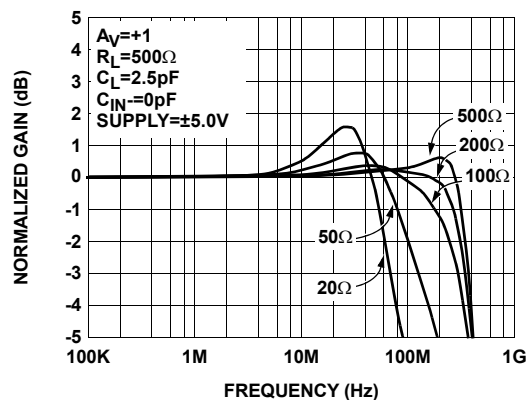
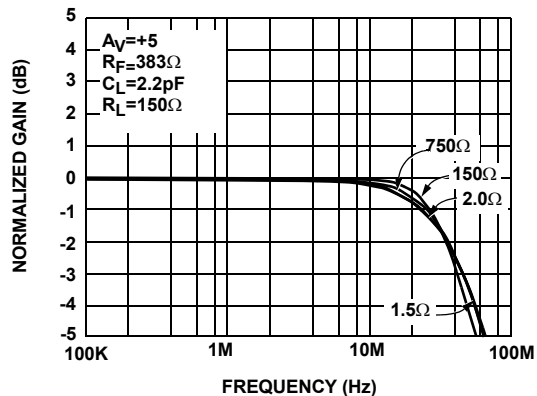
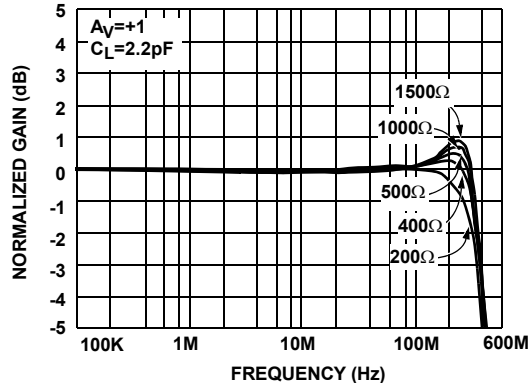
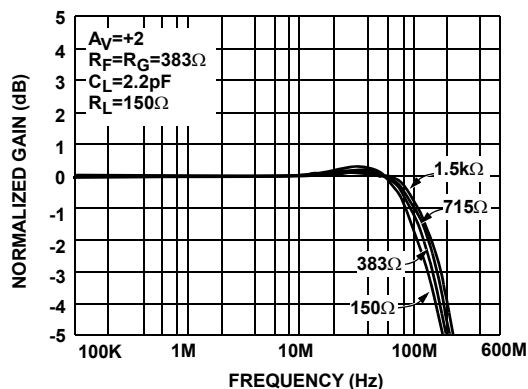
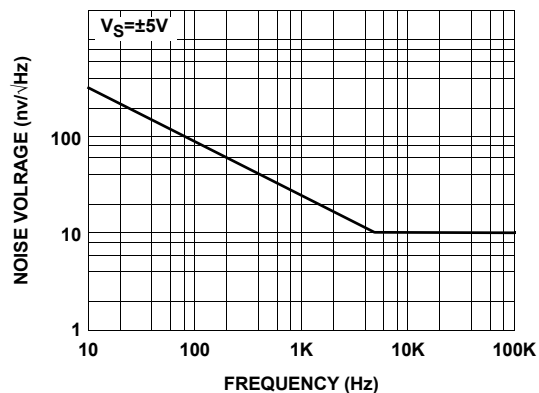
FIGURE 5. GAIN vs FREQUENCY FOR VARIOUS C_{IN} (-)FIGURE 6. GAIN vs FREQUENCY FOR VARIOUS R_L FIGURE 7. GAIN vs FREQUENCY FOR VARIOUS R_L FIGURE 8. GAIN vs FREQUENCY FOR VARIOUS R_L FIGURE 9. GAIN vs FREQUENCY FOR VARIOUS R_L 

FIGURE 10. EQUIVALENT INPUT VOLTAGE NOISE vs FREQUENCY

Typical Performance Curves (Continued)

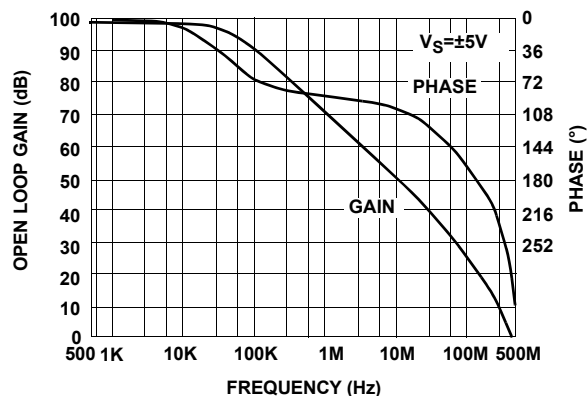


FIGURE 11. OPEN LOOP GAIN AND PHASE vs FREQUENCY

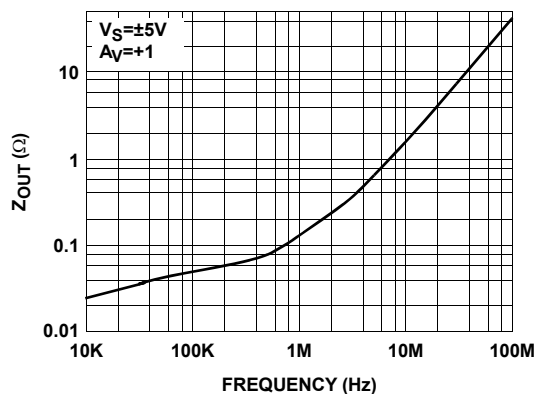
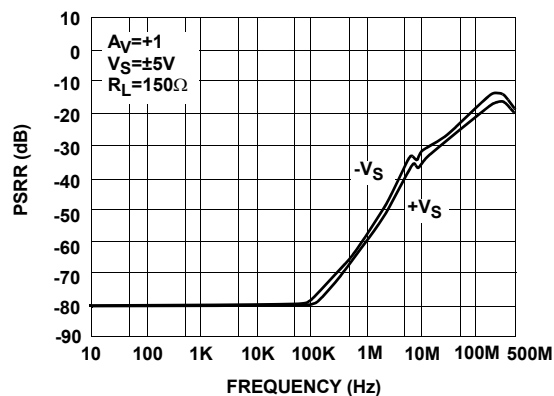
FIGURE 12. Z_{OUT} vs FREQUENCY

FIGURE 13. PSRR vs FREQUENCY

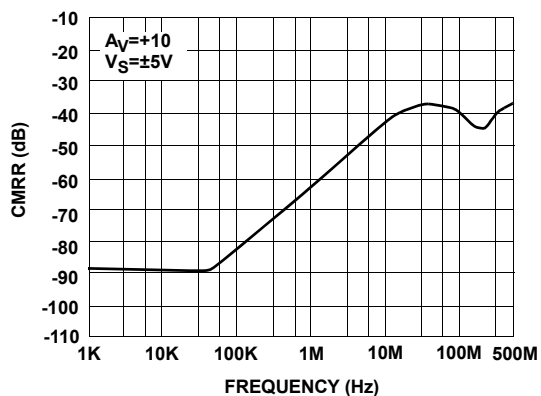


FIGURE 14. CMRR vs FREQUENCY

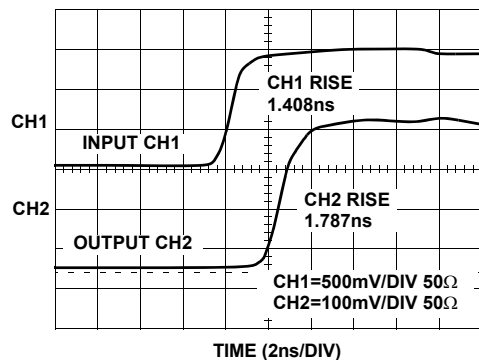


FIGURE 15. LARGE SIGNAL RISE TIME

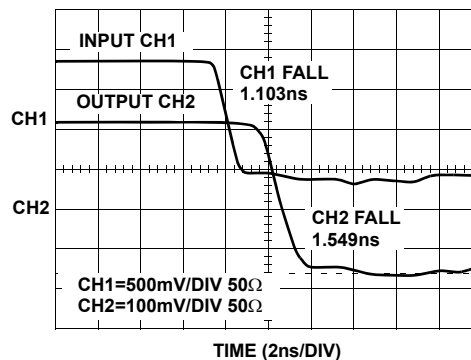


FIGURE 16. LARGE SIGNAL FALL TIME

Typical Performance Curves (Continued)

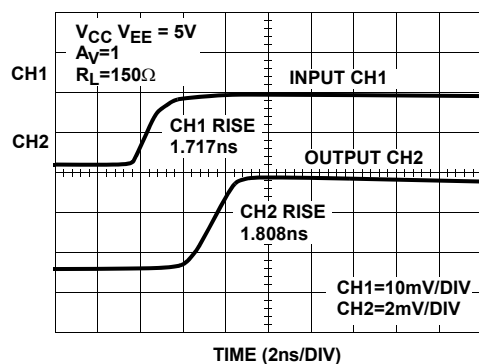


FIGURE 17. SMALL SIGNAL RISE TIME

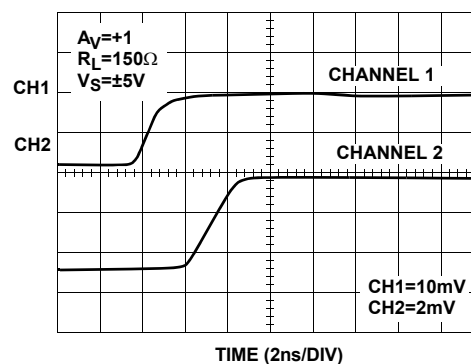


FIGURE 18. SMALL SIGNAL RISE TIME

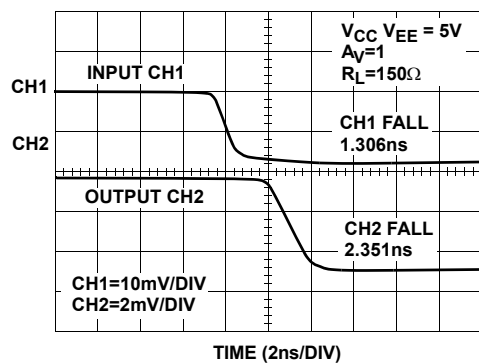


FIGURE 19. SMALL SIGNAL FALL TIME

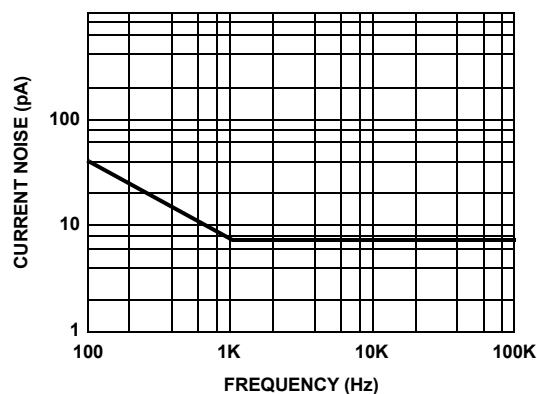
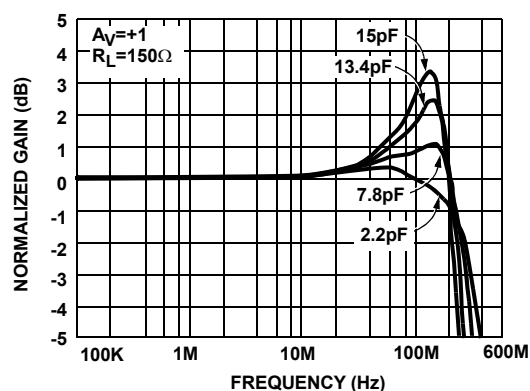
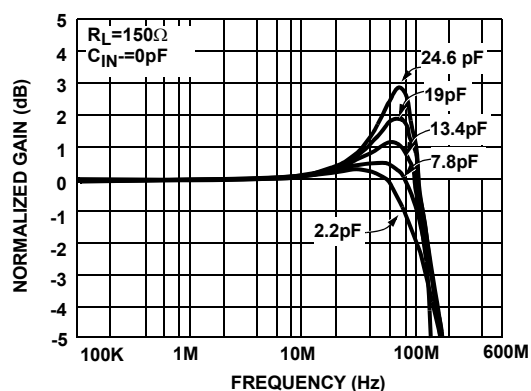


FIGURE 20. CURRENT NOISE

FIGURE 21. GAIN vs FREQUENCY FOR VARIOUS C_L FIGURE 22. GAIN vs FREQUENCY FOR VARIOUS C_L

Typical Performance Curves (Continued)

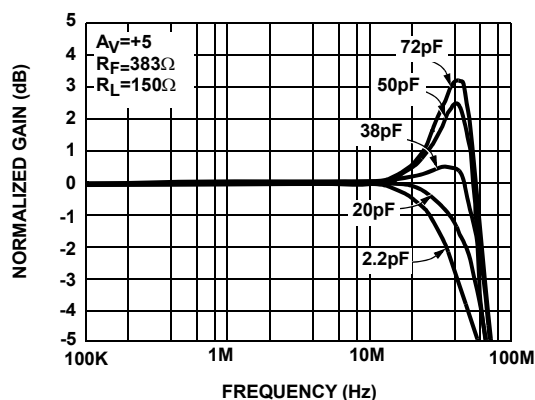
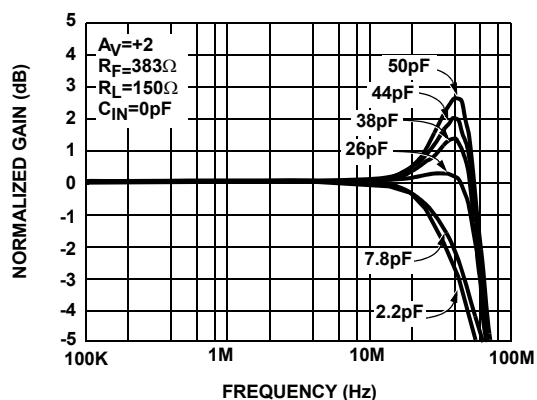
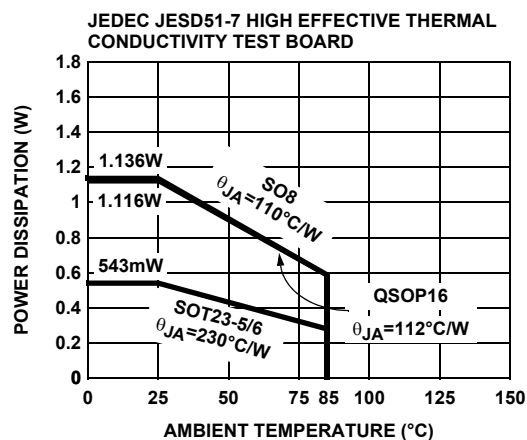
FIGURE 23. GAIN vs FREQUENCY FOR VARIOUS C_L FIGURE 24. GAIN vs FREQUENCY FOR VARIOUS C_L 

FIGURE 25. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

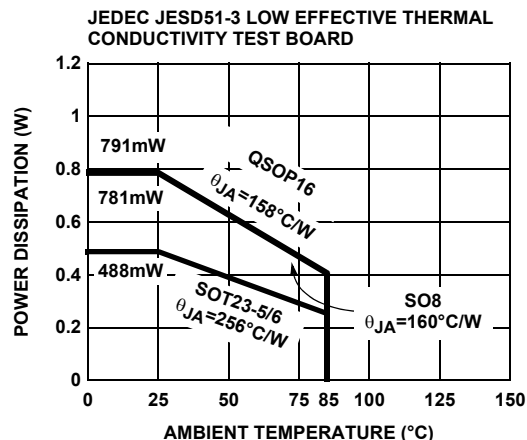


FIGURE 26. PACKAGE POWER DISSIPATION vs AMBIENT TEMPERATURE

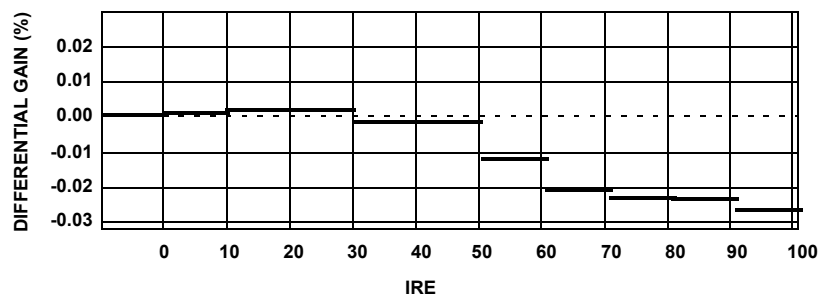


FIGURE 27. DIFFERENTIAL GAIN (%)

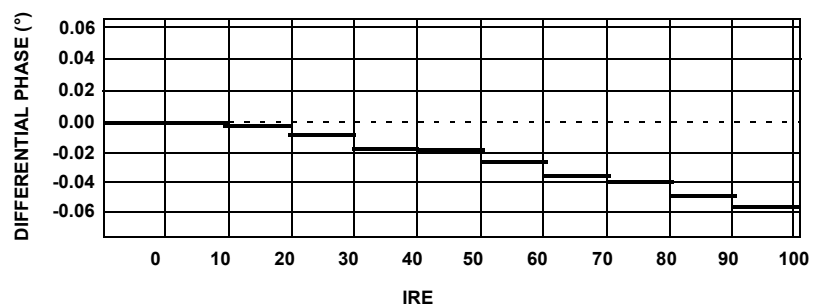


FIGURE 28. DIFFERENTIAL PHASE (°)

Application Information

Video Amplifier with Reduced Size Output Capacitance

Capacitance

If you have a video line driver $Z = 75\Omega$, the DC decoupling capacitor could be relatively large.

$$C = \frac{1}{2\pi \times R \times f} =$$

$$f = 10\text{Hz}, R = Z = 75\Omega, \quad C = 132\mu\text{F}$$

By using the circuit below, C could be reduced to $C2 = 22\mu\text{F}$.

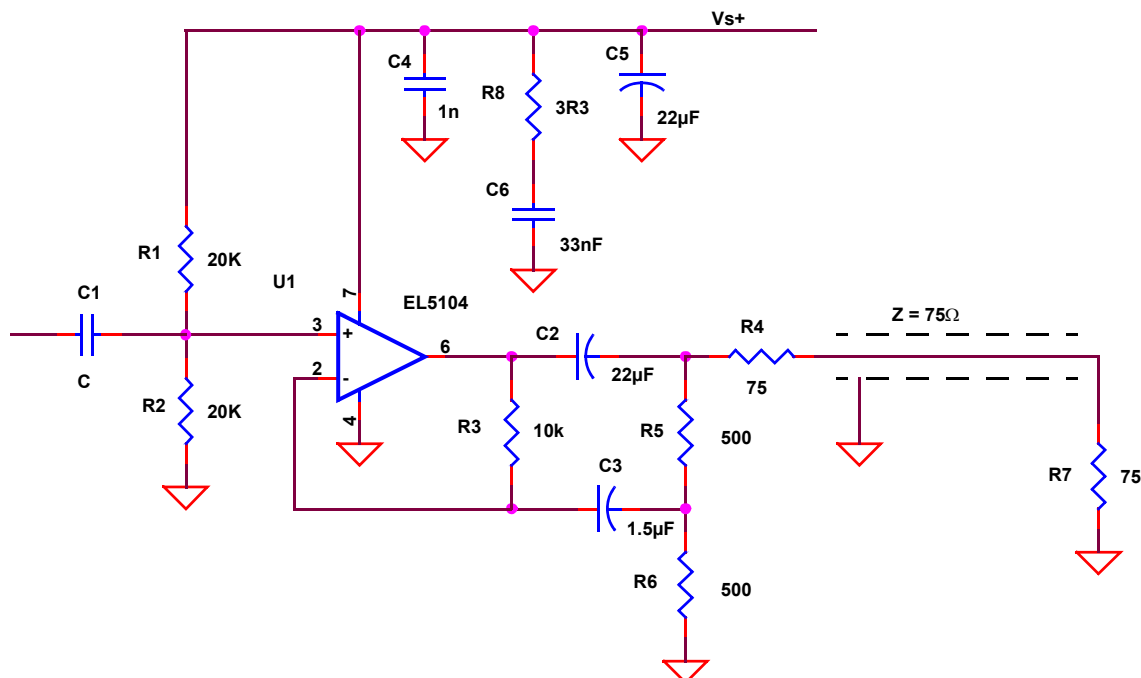


FIGURE 29.

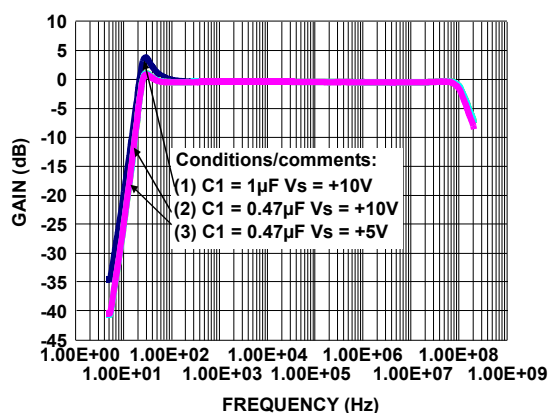


FIGURE 30. VIDEO-

The test result is shown on Figure 30.

By selecting a different value for $C1$, we could reduce the effect, created by $C3$ $R3$ and get flat response from 16Hz with an 1/5 value, price and size output capacitor. There is another, very important issue by using high bandwidth amplifiers.

In the past when the bandwidth of the operational amplifier ended at a few hundred kHz even at few MHz, the power-supply bypass was not a very critical issue, since a $0.1\mu\text{F}$ capacitor "did the job", but today's amplifiers could have bandwidth, what used to be reserved for microwave circuits not to long time ago.

Therefore that high bandwidth amplifiers require the same respect what we reserve for microwave circuits. Particularly the power supply bypass and the pcb-layout could very heavily influence the performance of a modern high bandwidth amplifiers. It could happen above a few MHz, but it will happen above 100MHz, that the capacitor will behave like an inductor.

The reason for that is the very small but not zero value serial inductance of the capacitor.

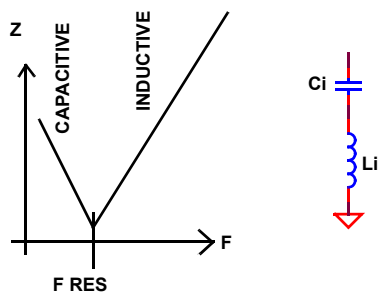


FIGURE 31.

The capacitor will behave as a capacitor up to its resonance frequency, above the resonance frequency it will behave as an inductor.

Just 1nHy inductance serial with 1nF capacitance will have serial resonance at:

$$F = \frac{1}{2\pi\sqrt{L \times C}}$$

$$C = 1\text{nF}, L = 1\text{nHy}, F = 159\text{ MHz}$$

And another 1nHy is very easy to get together with the inductance of traces on the pcb, and therefore you could encounter resonances from ca 50MHz and above anywhere. So if the amplifier has a bandwidth of a few hundred MHz, the proper power supply by-pass could become a serious if not difficult task.

Intuitively, you would use capacitors value 0.1μF parallel with a few μF tantalum, and to cure the effect of its serial resonance put a smaller one parallel to it.

The result will surprise you, because you will get even something worse than without the small capacitor.

What is happening there? Just look what we get:

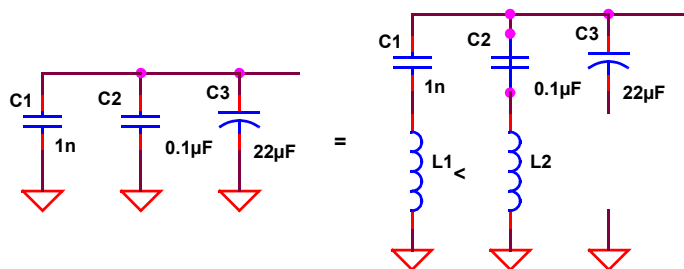


FIGURE 32.

Above its serial resonance $C2^*$ the ideal capacitance of $C2$ is a short, the Tantalum capacitor for high frequencies is not effective, the left over is $C1$ capacitor and $L1 + L2$ inductors, we get a parallel tank circuit, which is at its resonance a high impedance path and do not carry any high frequency current, it does not work as bypass at all!

The impedance of a parallel tank circuit at resonance is dependent from its Q. High Q high impedance.

The Q of a parallel tank circuit could be reduced by bypassing it with a resistor, or adding a resistor in serial to one of the reactive components. Since the bypassing would short the DC supply we do have to go to add resistor in serial to the reactive component, we will add a resistor serial with the inductor. (See Figure 33.)

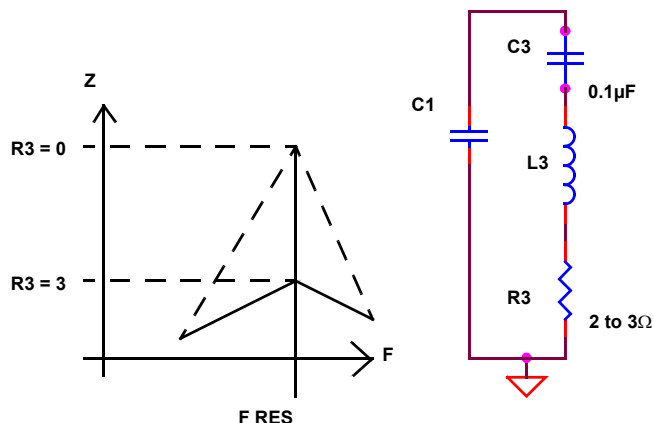


FIGURE 33.

The final power supply bypass circuit will look:

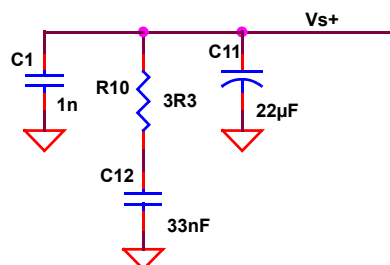
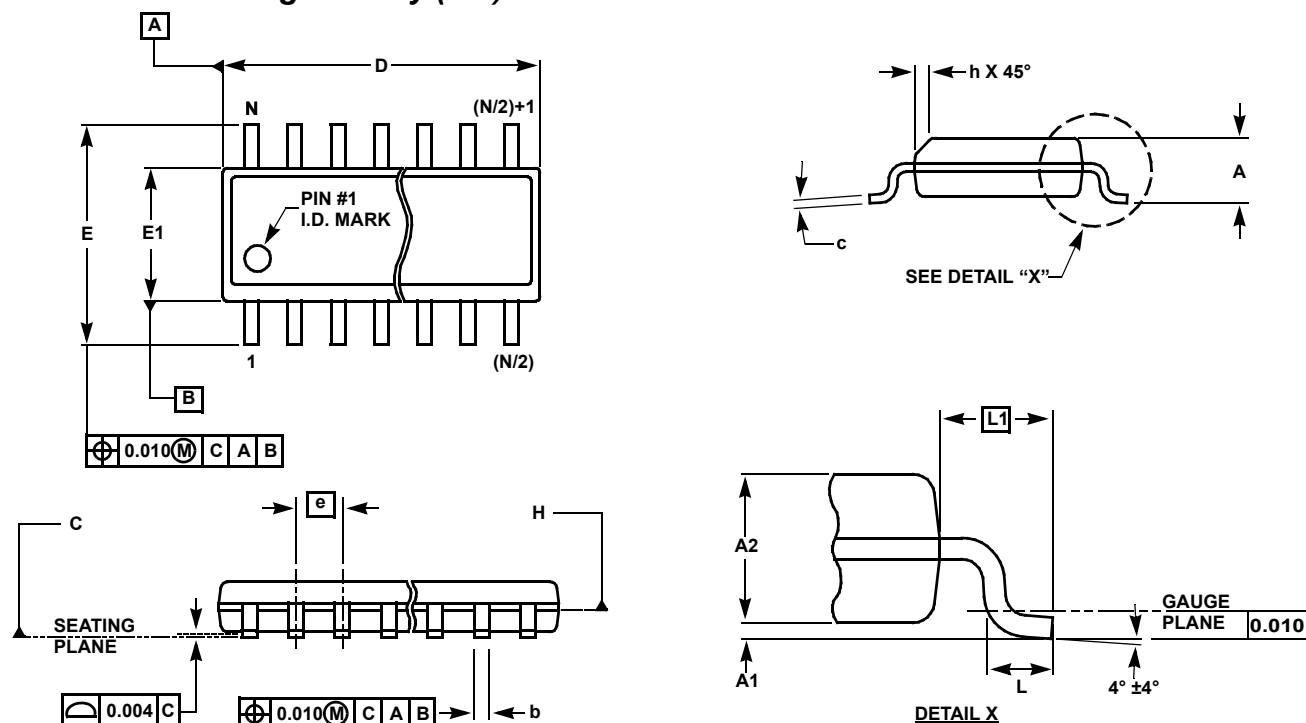


FIGURE 34.

Small Outline Package Family (SO)



MDP0027

SMALL OUTLINE PACKAGE FAMILY (SO)

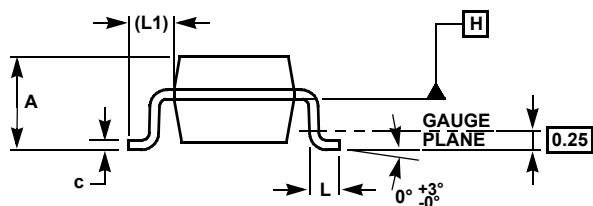
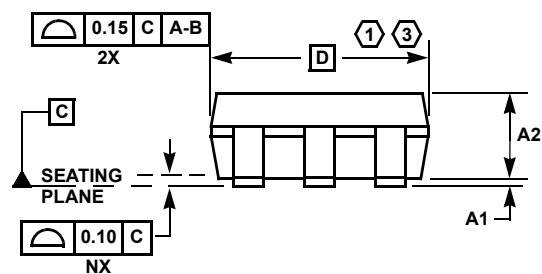
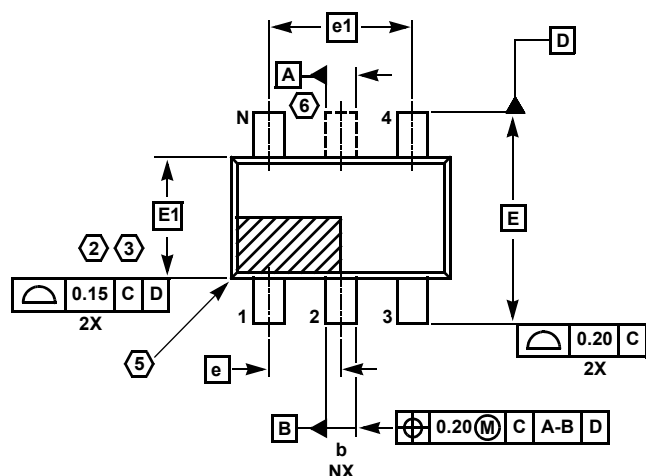
| SYMBOL | INCHES | | | | | | | TOLERANCE | NOTES |
|--------|--------|-------|------------------|---------------------------|------------------|------------------|------------------|-------------|-------|
| | SO-8 | SO-14 | SO16 (0.150") | SO16 (0.300") (SOL-16) | SO20 (SOL-20) | SO24 (SOL-24) | SO28 (SOL-28) | | |
| A | 0.068 | 0.068 | 0.068 | 0.104 | 0.104 | 0.104 | 0.104 | MAX | - |
| A1 | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.007 | 0.007 | ± 0.003 | - |
| A2 | 0.057 | 0.057 | 0.057 | 0.092 | 0.092 | 0.092 | 0.092 | ± 0.002 | - |
| b | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | 0.017 | ± 0.003 | - |
| c | 0.009 | 0.009 | 0.009 | 0.011 | 0.011 | 0.011 | 0.011 | ± 0.001 | - |
| D | 0.193 | 0.341 | 0.390 | 0.406 | 0.504 | 0.606 | 0.704 | ± 0.004 | 1, 3 |
| E | 0.236 | 0.236 | 0.236 | 0.406 | 0.406 | 0.406 | 0.406 | ± 0.008 | - |
| E1 | 0.154 | 0.154 | 0.154 | 0.295 | 0.295 | 0.295 | 0.295 | ± 0.004 | 2, 3 |
| e | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | Basic | - |
| L | 0.025 | 0.025 | 0.025 | 0.030 | 0.030 | 0.030 | 0.030 | ± 0.009 | - |
| L1 | 0.041 | 0.041 | 0.041 | 0.056 | 0.056 | 0.056 | 0.056 | Basic | - |
| h | 0.013 | 0.013 | 0.013 | 0.020 | 0.020 | 0.020 | 0.020 | Reference | - |
| N | 8 | 14 | 16 | 16 | 20 | 24 | 28 | Reference | - |

NOTES:

Rev. M 2/07

1. Plastic or metal protrusions of 0.006" maximum per side are not included.
2. Plastic interlead protrusions of 0.010" maximum per side are not included.
3. Dimensions "D" and "E1" are measured at Datum Plane "H".
4. Dimensioning and tolerancing per ASME Y14.5M-1994

SOT-23 Package Family



MDP0038

SOT-23 PACKAGE FAMILY

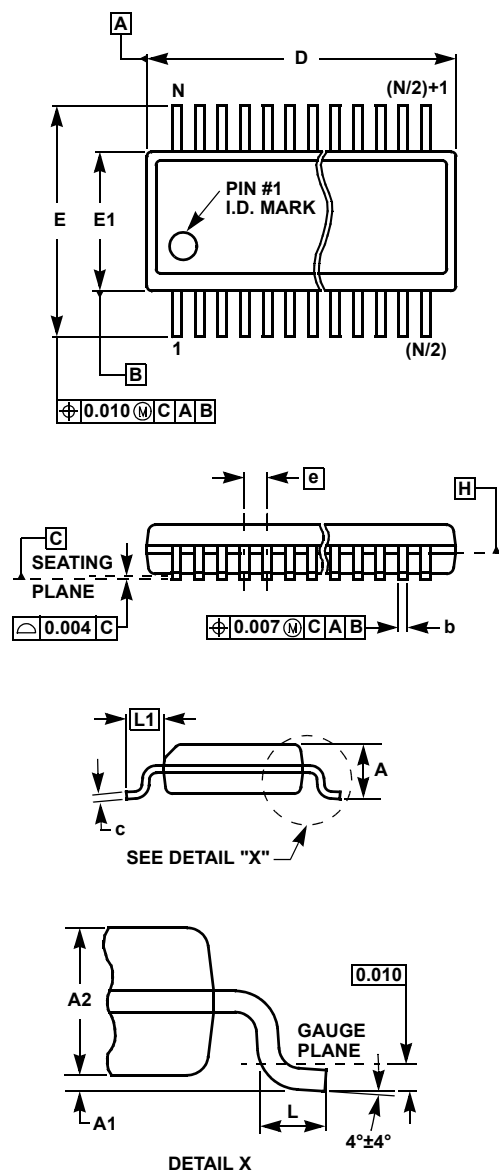
| SYMBOL | MILLIMETERS | | TOLERANCE |
|--------|-------------|---------|-----------|
| | SOT23-5 | SOT23-6 | |
| A | 1.45 | 1.45 | MAX |
| A1 | 0.10 | 0.10 | ±0.05 |
| A2 | 1.14 | 1.14 | ±0.15 |
| b | 0.40 | 0.40 | ±0.05 |
| c | 0.14 | 0.14 | ±0.06 |
| D | 2.90 | 2.90 | Basic |
| E | 2.80 | 2.80 | Basic |
| E1 | 1.60 | 1.60 | Basic |
| e | 0.95 | 0.95 | Basic |
| e1 | 1.90 | 1.90 | Basic |
| L | 0.45 | 0.45 | ±0.10 |
| L1 | 0.60 | 0.60 | Reference |
| N | 5 | 6 | Reference |

Rev. F 2/07

NOTES:

1. Plastic or metal protrusions of 0.25mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25mm maximum per side are not included.
3. This dimension is measured at Datum Plane "H".
4. Dimensioning and tolerancing per ASME Y14.5M-1994.
5. Index area - Pin #1 I.D. will be located within the indicated zone (SOT23-6 only).
6. SOT23-5 version has no center lead (shown as a dashed line).

Quarter Size Outline Plastic Packages Family (QSOP)



MDP0040

QUARTER SIZE OUTLINE PLASTIC PACKAGES FAMILY

| SYMBOL | INCHES | | | TOLERANCE | NOTES |
|--------|--------|--------|--------|-------------|-------|
| | QSOP16 | QSOP24 | QSOP28 | | |
| A | 0.068 | 0.068 | 0.068 | Max. | - |
| A1 | 0.006 | 0.006 | 0.006 | ± 0.002 | - |
| A2 | 0.056 | 0.056 | 0.056 | ± 0.004 | - |
| b | 0.010 | 0.010 | 0.010 | ± 0.002 | - |
| c | 0.008 | 0.008 | 0.008 | ± 0.001 | - |
| D | 0.193 | 0.341 | 0.390 | ± 0.004 | 1, 3 |
| E | 0.236 | 0.236 | 0.236 | ± 0.008 | - |
| E1 | 0.154 | 0.154 | 0.154 | ± 0.004 | 2, 3 |
| e | 0.025 | 0.025 | 0.025 | Basic | - |
| L | 0.025 | 0.025 | 0.025 | ± 0.009 | - |
| L1 | 0.041 | 0.041 | 0.041 | Basic | - |
| N | 16 | 24 | 28 | Reference | - |

Rev. F 2/07

NOTES:

1. Plastic or metal protrusions of 0.006" maximum per side are not included.
2. Plastic interlead protrusions of 0.010" maximum per side are not included.
3. Dimensions "D" and "E1" are measured at Datum Plane "H".
4. Dimensioning and tolerancing per ASME Y14.5M-1994.

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