



Ultra-Fast Precision TTL Comparators

General Description

The Maxim MXL1016 (10ns typ) and MXL1116 (12ns typ) high-speed, complementary-output comparators are designed specifically to interface directly to TTL logic while operating from either a dual $\pm 5V$ supply or a single +5V supply.

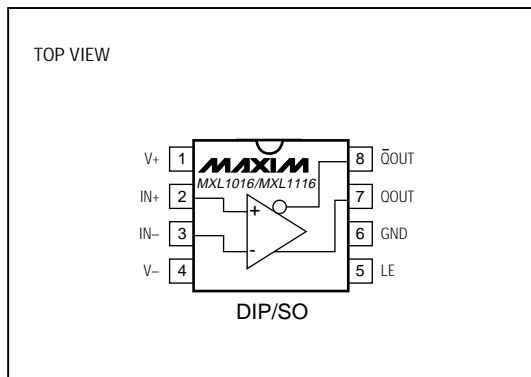
The MXL1016/MXL1116 remain stable with the outputs in the active region, which greatly reduces output instability common with slow-moving input signals. In addition, an output latch (LE) is provided.

For lower-power, higher-performance comparators, see the MAX912/MAX913 dual/single comparator data sheet. The MAX913 is an improved, plug-in replacement for the MXL1016 and MXL1116, and the MAX912 is the dual equivalent to the MAX913.

Applications

High-Speed A/D Converters
Zero-Crossing Detectors
Current Sense for Switching Regulators
High-Speed Sampling Circuits
High-Speed Triggers
Line Receivers
Extended Range V/F Converters
Fast Pulse Height/Width Discriminators

Pin Configuration



Features

- ♦ Ultra Fast (10ns typ)
- ♦ Single +5V or Dual $\pm 5V$ Supply Operation
- ♦ Input Common-Mode Extends to Negative Supply (MXL1116)
- ♦ Inputs Can Exceed the Positive Supply Up to +15V (MXL1116) Without Damage
- ♦ Complementary TTL Outputs
- ♦ Low Offset Voltage: 1mV
- ♦ No Minimum Input Slew-Rate Requirement
- ♦ No Power-Supply Current Spiking
- ♦ Output Latch

Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|------------|-----------------|---------------|
| MXL1016CN8 | 0°C to +70°C | 8 Plastic DIP |
| MXL1016CS8 | 0°C to +70°C | 8 SO |
| MXL1016MJ8 | -55°C to +125°C | 8 CERDIP |
| MXL1116CN8 | 0°C to +70°C | 8 Plastic DIP |
| MXL1116CS8 | 0°C to +70°C | 8 SO |

Pin Description

| PIN | NAME | FUNCTION |
|-----|------|---|
| 1 | V+ | Positive Power Supply, +5V |
| 2 | IN+ | Noninverting Input |
| 3 | IN- | Inverting Input |
| 4 | V- | Negative Power Supply, -5V for dual supply or GND for single supply |
| 5 | LE | Latch Enable, OOUT and QOUT are latched when LE is high |
| 6 | GND | Ground |
| 7 | OOUT | TTL Output |
| 8 | QOUT | Complementary TTL Output |

MXL1016/MXL1116

Ultra-Fast Precision TTL Comparators

ABSOLUTE MAXIMUM RATINGS

| | | | |
|------------------------------|--------------------------------|---|-----------------|
| Positive Supply Voltage..... | 7V | Output Current (continuous)..... | ±20mA |
| Negative Supply Voltage..... | -7V | Continuous Power Dissipation (T _A = +70°C) | |
| Differential Input Voltage | | Plastic DIP (derate 9.09mW/°C above +70°C)..... | 727mW |
| MXL1016..... | ±5V | SO (derate 5.88mW/°C above +70°C)..... | 471mW |
| MXL1116..... | ±15V | CERDIP (derate 8.00mW/°C above +70°C)..... | 640mW |
| Input Voltage (either input) | | Operating Temperature Ranges: | |
| MXL1016..... | Equal to Supplies | MXL1016C/MXL1116C..... | 0°C to +70°C |
| MXL1116..... | (V ₋ - 0.3V) to 15V | MXL1016MJ..... | -55°C to +125°C |
| Latch Pin Voltage..... | Equal to Supplies | Storage Temperature Range..... | -65°C to +150°C |
| | | Lead Temperature (soldering, 10sec)..... | +300°C |

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS – MXL1016

(V₊ = 5V, V₋ = -5V, V_{OUT} (Q) = 1.4V, V_{LE} = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

| PARAMETER | SYMBOL | CONDITIONS | MXL1016M | | | MXL1016C | | | UNITS | |
|---|----------------------|--|--|------|-----|----------|------|-----|-------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| Input Offset Voltage (Note 1) | V _{OS} | R _S ≤ 100Ω | T _A = +25°C | | | 0.8 | ±2 | 1.0 | ±3 | mV |
| | | | | | | 3 | | | 3.5 | |
| Input Offset-Voltage Drift | ΔV _{OS} /ΔT | | | | | 4 | | 4 | | μV/°C |
| Input Offset Current (Note 1) | I _{OS} | | T _A = +25°C | | | 0.3 | 1 | 0.3 | 1 | μA |
| | | | | | | 1.3 | | | 1.3 | |
| Input Bias Current (Note 2) | I _B | | T _A = +25°C | | | 5 | 10 | 5 | 10 | μA |
| | | | | | | 13 | | | 13 | |
| Input Voltage Range | V _{CM} | | -3.75 | +3.5 | | -3.75 | +3.5 | | | V |
| | | Single 5V supply | +1.25 | +3.5 | | +1.25 | +3.5 | | | |
| Common-Mode Rejection Ratio | CMRR | -3.75V ≤ V _{CM} ≤ 3.5 | 80 | 96 | | 80 | 96 | | | dB |
| Power-Supply Rejection Ratio | PSRR | Positive supply: 4.6V ≤ V ₊ ≤ 5.4V | 60 | 75 | | 60 | 75 | | | dB |
| | | Negative supply: -2V ≥ V ₋ ≥ -7V | 80 | 100 | | 80 | 100 | | | |
| Small-Signal Voltage Gain | A _V | 1V ≤ V _{OUT} ≤ 2V, T _A = +25°C | 1400 | 3000 | | 1400 | 3000 | | | V/V |
| Output High Voltage | V _{OH} | V ₊ ≥ 4.6V | I _{OUT} = 1mA | | | 2.7 | 3.4 | 2.7 | 3.4 | V |
| | | | I _{OUT} = 10mA | | | 2.4 | 3.0 | 2.4 | 3.0 | |
| Output Low Voltage | V _{OL} | | I _{SINK} = 4mA | | | 0.3 | 0.5 | 0.3 | 0.5 | V |
| | | | I _{SINK} = 10mA, T _A = +25°C | | | 0.4 | | | 0.4 | |
| Positive Supply Current | I ₊ | | 25 | 35 | | 25 | 35 | | | mA |
| Negative Supply Current | I ₋ | | 3 | 5 | | 3 | 5 | | | mA |
| Latch Pin High Input Voltage | V _{IH} | | 2.0 | | | 2.0 | | | | V |
| Latch Pin Low Input Voltage | V _{IL} | | 0.8 | | | 0.8 | | | | V |
| Latch Pin Current | I _{IL} | V _{LE} = 0V | -500 | | | -500 | | | | μA |
| Propagation Delay (Note 3) | t _{PD} | ΔV _{IN} = 100mV, OD = 5mV | T _A = +25°C | | | 10 | 14 | 10 | 14 | ns |
| | | | | | | 16 | | | 16 | |
| | | ΔV _{IN} = 100mV, OD = 20mV | T _A = +25°C | | | 9 | 12 | 9 | 12 | |
| | | | | | | 15 | | | 15 | |
| Differential Propagation Delay (Note 3) | Δt _{PD} | ΔV _{IN} = 100mV, OD = 5mV, T _A = +25°C | 3 | | | 3 | | | | ns |
| Latch Setup Time | t _{SU} | (Note 4) | 2 | | | 2 | | | | ns |

Ultra-Fast Precision TTL Comparators

ELECTRICAL CHARACTERISTICS – MXL1116

($V_+ = 5V$, $V_- = -5V$, $V_{OUT(O)} = 1.4V$, $V_{LE} = 0V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Specifications for V_{OS} , I_B , $CMRR$ and A_V are valid for single-supply operation, $V_+ = 5V$, $V_- = 0V$.)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|--------------------------|---|---------------------|-------|---------|---------------|------------------|
| Input Offset Voltage (Note 1) | V_{OS} | $R_S \leq 100\Omega$ | $T_A = +25^\circ C$ | 1.0 | ± 3 | | mV |
| | | | | | | 3.5 | |
| Input Offset-Voltage Drift | $\Delta V_{OS}/\Delta T$ | | | | 5 | | $\mu V/^\circ C$ |
| Input Offset Current (Note 1) | I_{OS} | | | | 0.5 | 2 | μA |
| Input Bias Current, Sourcing (Note 2) | I_B | | | | 10 | 20 | μA |
| Input Voltage Range | V_{CM} | | | V_- | | $(V_+ - 2.5)$ | V |
| | | Single 5V supply | | 0 | | 2.5 | |
| Common-Mode Rejection Ratio | CMRR | $-5V \leq V_{CM} \leq 2.5V$ | | 75 | 90 | | dB |
| | | $0V \leq V_{CM} \leq 2.5V$, $V_S = +5V$, $0V$ | | 65 | 90 | | |
| Power-Supply Rejection Ratio | PSRR | Positive Supply: $4.6V \leq V_+ \leq 5.4V$ | | 60 | 75 | | dB |
| | | Negative Supply: $-7V \leq V_- \leq -2V$ | | 80 | 100 | | |
| Small-Signal Voltage Gain | A_V | $1V \leq V_{OUT} \leq 2V$, $T_A = +25^\circ C$ | | 1400 | 3000 | | V/V |
| Output High Voltage | V_{OH} | $I_{SOURCE} = 1mA$ | | 2.7 | 3.4 | | V |
| | | $I_{SOURCE} = 10mA$ | | 2.4 | 3.0 | | |
| Output Low Voltage | V_{OL} | $I_{SINK} = 4mA$ | | | 0.3 | 0.5 | V |
| | | $I_{SINK} = 10mA$, $T_A = +25^\circ C$ | | | 0.4 | | |
| Positive Supply Current | I_+ | | | | 27 | 38 | mA |
| Negative Supply Current | I_- | | | | 5 | 7 | mA |
| Latch Pin High Input Voltage | V_{IH} | | | 2.0 | | | V |
| Latch Pin Low Input Voltage | V_{IL} | | | | | 0.8 | V |
| Latch Input Current | I_{IL} | $V_{LE} = 0V$ | | | -20 | -500 | μA |
| Propagation Delay (Note 3) | t_{PD} | $\Delta V_{IN} = 100mV$, OD = 5mV | $T_A = +25^\circ C$ | | 12 | 16 | ns |
| | | | | | | 18 | |
| | | $\Delta V_{IN} = 100mV$, OD = 20mV | $T_A = +25^\circ C$ | | 10 | 14 | |
| | | | | | | 16 | |
| Differential Propagation Delay (Note 3) | Δt_{PD} | $\Delta V_{IN} = 100mV$, OD = 5mV, $T_A = +25^\circ C$ | | | | 3 | ns |
| Latch Setup Time (Note 4) | t_{SU} | | | | 2 | | ns |
| Latch Hold Time (Note 4) | t_H | | | | 2 | | ns |

Note 1: Input offset voltage is defined as the average of the two input offset voltages, measured by forcing first one output, then the other to 1.4V. Input offset current is defined in the same way.

Note 2: Input bias current (I_B) is defined as the average of the two input currents.

Note 3: t_{PD} and Δt_{PD} cannot be measured in automatic handling equipment with low values of overdrive. Correlation tests have shown that t_{PD} and Δt_{PD} limits shown can be guaranteed by design, if additional DC tests are performed to guarantee that all internal bias conditions are correct. For low overdrive conditions, V_{OS} is added to overdrive.

Note 4: Input latch setup time, t_{SU} , is the interval in which the input signal must be stable prior to asserting the latch signal. The hold time, t_H , is the interval after the latch is asserted in which the input signal must be stable.

MXL1016/MXL1116

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Package Information

**Plastic DIP
PLASTIC
DUAL-IN-LINE
PACKAGE
(0.300 in.)**

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | — | 0.200 | — | 5.08 |
| A1 | 0.015 | — | 0.38 | — |
| A2 | 0.125 | 0.175 | 3.18 | 4.45 |
| A3 | 0.055 | 0.080 | 1.40 | 2.03 |
| B | 0.016 | 0.022 | 0.41 | 0.56 |
| B1 | 0.045 | 0.065 | 1.14 | 1.65 |
| C | 0.008 | 0.012 | 0.20 | 0.30 |
| D1 | 0.005 | 0.080 | 0.13 | 2.03 |
| E | 0.300 | 0.325 | 7.62 | 8.26 |
| E1 | 0.240 | 0.310 | 6.10 | 7.87 |
| e | 0.100 | — | 2.54 | — |
| eA | 0.300 | — | 7.62 | — |
| eB | — | 0.400 | — | 10.16 |
| L | 0.115 | 0.150 | 2.92 | 3.81 |

| PKG. | DIM | PINS | INCHES | | MILLIMETERS | |
|------|-----|------|--------|-------|-------------|-------|
| | | | MIN | MAX | MIN | MAX |
| P | D | 8 | 0.348 | 0.390 | 8.84 | 9.91 |
| P | D | 14 | 0.735 | 0.765 | 18.67 | 19.43 |
| P | D | 16 | 0.745 | 0.765 | 18.92 | 19.43 |
| P | D | 18 | 0.885 | 0.915 | 22.48 | 23.24 |
| P | D | 20 | 1.015 | 1.045 | 25.78 | 26.54 |
| N | D | 24 | 1.14 | 1.265 | 28.96 | 32.13 |

21-0043A

**Narrow SO
SMALL-OUTLINE
PACKAGE
(0.150 in.)**

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.007 | 0.010 | 0.19 | 0.25 |
| E | 0.150 | 0.157 | 3.80 | 4.00 |
| e | 0.050 | | 1.27 | |
| H | 0.228 | 0.244 | 5.80 | 6.20 |
| L | 0.016 | 0.050 | 0.40 | 1.27 |

| DIM | PINS | INCHES | | MILLIMETERS | |
|-----|------|--------|-------|-------------|-------|
| | | MIN | MAX | MIN | MAX |
| D | 8 | 0.189 | 0.197 | 4.80 | 5.00 |
| D | 14 | 0.337 | 0.344 | 8.55 | 8.75 |
| D | 16 | 0.386 | 0.394 | 9.80 | 10.00 |

21-0041A

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