19-0138; Rev. 2; 4/95

MAXIM

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 ±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.

Features

- ♦ **Ultra Fast (10ns typ)**
- ♦ **Single +5V or Dual ±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**

Applications

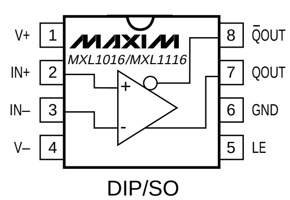
High-Speed A/D Converters
Zero-Crossing Detectors
Current Sense for Switching Regulators
High-Speed Sampling Circuits
High-Speed Triggers
Line Receivers
Extended Range V/F Converters
Fast Pulse Height/Width Discriminators

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 Configuration

TOP VIEW



DIP/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, QOUT and $\overline{\text{Q}}$OUT are latched when LE is high
6	GND	Ground
7	QOUT	TTL Output
8	$\overline{\text{Q}}$OUT	Complementary TTL Output

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ABSOLUTE MAXIMUM RATINGS

Positive Supply Voltage 7V
Negative Supply Voltage .... –7V
Differential Input Voltage
  MXL1016 .... ±5V
  MXL1116 .... ±15V
Input Voltage (either input)
  MXL1016 .... Equal to Supplies
  MXL1116 .... (V– – 0.3V) to 15V
Latch Pin Voltage .... Equal to Supplies

Output Current (continuous) .... ±20mA
Continuous Power Dissipation (T_A = +70°C)
  Plastic DIP (derate 9.09mW/°C above +70°C) 727mW
  SO (derate 5.88mW/°C above +70°C) 471mW
  CERDIP (derate 8.00mW/°C above +70°C) 640mW
Operating Temperature Ranges:
  MXL1016C/MXL1116C .... 0°C to +70°C
  MXL1016MJ .... –55°C to +125°C
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 MIN	MXL1016M TYP	MXL1016M MAX	MXL1016C MIN	MXL1016C TYP	MXL1016C MAX	UNITS
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	$\Delta V_{OS}/\Delta T$				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

ELECTRICAL CHARACTERISTICS – MXL1116

($V+ = 5V$, $V- = -5V$, V_{OUT} (Q) = 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}	$R_S \le 100\Omega$	$T_A = +25°C$		1.0	±3	mV
						3.5	
Input Offset-Voltage Drift	$\Delta V_{OS}/\Delta T$				5		µV/°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	$-5V \le V_{CM} \le 2.5V$		75	90		dB
		$0V \le V_{CM} \le 2.5V$, V_S = +5V, 0V		65	90		
Power-Supply Rejection Ratio	PSRR	Positive Supply: $4.6V \le V+ \le 5.4V$		60	75		dB
		Negative Supply: $-7V \le V- \le -2V$		80	100		
Small-Signal Voltage Gain	A_V	$1V \le V_{OUT} \le 2V$, $T_A = +25°C$		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, $T_A = +25°C$			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}	ΔV_{IN} = 100mV, OD = 5mV	$T_A = +25°C$		12	16	ns
						18	
		ΔV_{IN} = 100mV, OD = 20mV	$T_A = +25°C$		10	14	
						16	
Differential Propagation Delay (Note 3)	Δt_{PD}	ΔV_{IN} = 100mV, OD = 5mV, $T_A = +25°C$				3	ns
Latch Setup Time (Note 4)	t_{SU}				2		ns
Latch Hold Time (Note 4)	t_H				2		ns

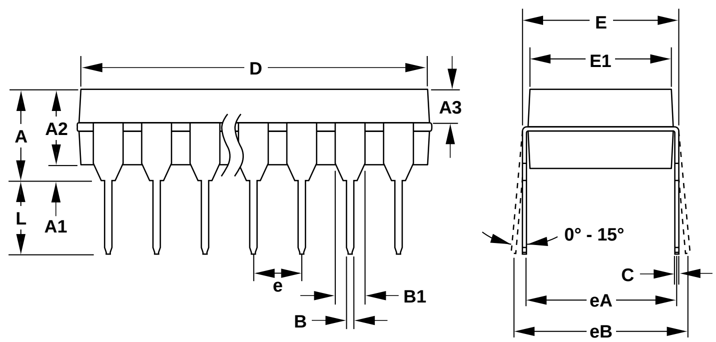
Note 1: Input offset voltage is defined as the average of the two input offset voltages, measured by forcing first one output, then the other to 1.4V. Input offset current is defined in the same way.

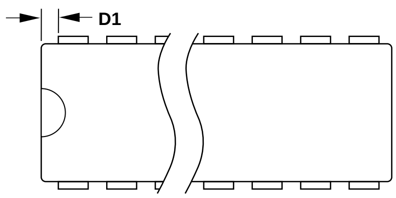
Note 2: Input bias current (I_B) is defined as the average of the two input currents.

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.

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

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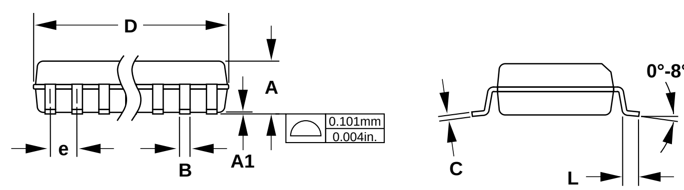

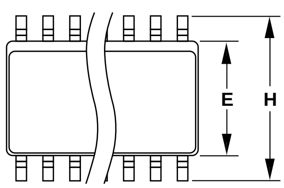

Narrow SO
SMALL-OUTLINE PACKAGE (0.150 in.)

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

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