

LM161/LM361

High Speed Differential Comparators

General Description

The LM161/LM361 is a very high speed differential input, complementary TTL output voltage comparator with improved characteristics over the SE529/NE529 for which it is a pin-for-pin replacement. The device has been optimized for greater speed performance and lower input offset voltage. Typically delay varies only 3 ns for over-drive variations of 5 mV to 500 mV. It may be operated from op amp supplies (±15V).

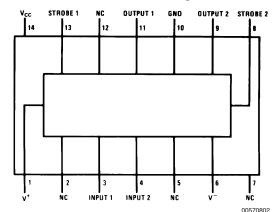
Complementary outputs having maximum skew are provided. Applications involve high speed analog to digital converters and zero-crossing detectors in disk file systems.

Features

- Independent strobes
- Guaranteed high speed: 20 ns max
- Tight delay matching on both outputs
- Complementary TTL outputs
- Operates from op amp supplies: ±15V
- Low speed variation with overdrive variation
- Low input offset voltage
- Versatile supply voltage range

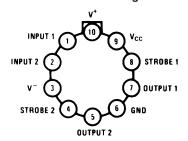
Connection Diagrams

Dual-In-Line Package



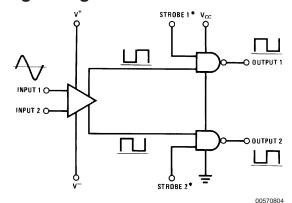
Top View
Order Number LM361M, LM361MX or LM361N
See NS Package Number M14A or N14A

Metal Can Package



Order Number LM161H/883 or LM361H See NS Package Number H10C

Logic Diagram



*Output is low when current is drawn from strobe pin.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Positive Supply Voltage, V+	+16V
Negative Supply Voltage, V-	-16V
Gate Supply Voltage, V _{CC}	+7V
Output Voltage	+7V
Differential Input Voltage	±5V
Input Common Mode Voltage	±6V
Power Dissipation	600 mW
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	T_{MIN} T_{MAX}
LM161	-55°C to +125°C
	-25°C to +85°C
LM361	0°C to +70°C
Lead Temp. (Soldering, 10 seconds)	260°C

	Min	Тур	Max			
LM361	5V		15V			
Supply Voltage V ⁻						
LM161	-6V		-15V			
LM361	-6V		-15V			
Supply Voltage $V_{\rm CC}$						
LM161	4.5V	5V	5.5V			
LM361	4.75V	5V	5.25V			
ESD Tolerance (Note 5)			1600V			
Soldering Information						
Dual-In-Line Package						
Soldering (10 second	ds)		260°C			
Small Outline Package						
Vapor Phase (60 see	conds)		215°C			
Infrared (15 seconds	s)		220°C			

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

Operating Conditions

	IVIIN	тур	wax
Supply Voltage V ⁺			
LM161	5V		15V

Electrical Characteristics

 $(V^{+} = +10V, V_{CC} = +5V, V^{-} = -10V, T_{MIN} \le T_{A} \le T_{MAX}, unless noted)$

	Conditions	Limits						
Parameter		LM161		LM361			Units	
		Min	Тур	Max	Min	Тур	Max	
Input Offset Voltage			1	3		1	5	mV
Input Bias Current	T _A =25°C		5			10		μΑ
				20			30	μA
Input Offset Current	T _A =25°C		2			2		μA
				3			5	μA
Voltage Gain	T _A =25°C		3			3		V/mV
Input Resistance	T _A =25°C, f=1 kHz		20			20		kΩ
Logical "1" Output Voltage	V _{CC} =4.75V,	2.4	3.3		2.4	3.3		V
	I _{SOURCE} =-0.5 mA							
Logical "0" Output Voltage	V _{CC} =4.75V,			0.4			0.4	V
	I _{SINK} =6.4 mA							
Strobe Input "1" Current	V _{CC} =5.25V,			200			200	μΑ
(Output Enabled)	V _{STROBE} =2.4V							
Strobe Input "0" Current	V _{CC} =5.25V,			-1.6			-1.6	mA
(Output Disabled)	V _{STROBE} =0.4V							
Strobe Input "0" Voltage	V _{CC} =4.75V			0.8			0.8	V
Strobe Input "1" Voltage	V _{CC} =4.75V	2			2			V
Output Short Circuit Current	V _{CC} =5.25V, V _{OUT} =0V	-18		-55	-18		-55	mA
	V+=10V, V-=-10V,							
Supply Current I+	V _{CC} =5.25V,			4.5				mA
	–55°C≤T _A ≤125°C							

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Electrical Characteristics (Continued)

 $(V^{+} = +10V, V_{CC} = +5V, V^{-} = -10V, T_{MIN} \le T_{A} \le T_{MAX}, unless noted)$

		Limits					Units	
Parameter	Conditions	LM161		LM361				
		Min	Тур	Max	Min	Тур	Max	1
	V ⁺ =10V, V ⁻ =-10V,							
Supply Current I ⁺	V _{CC} =5.25V,						5	mA
	0°C≤T _A ≤70°C							
	V ⁺ =10V, V ⁻ =-10V,							
Supply Current I ⁻	V _{CC} =5.25V,			10				mA
	–55°C≤T _A ≤125°C							
	V+=10V,							
Supply Current I ⁻	$V^{-}=-10V, V_{CC}=5.25V,$						10	mA
	0°C≤T _A ≤70°C							
	V ⁺ =10V, V ⁻ =-10V,							
Supply Current I _{CC}	V _{CC} =5.25V,			18				mA
	–55°C≤T _A ≤125°C							
	V+=10V, V-=-10V,							
Supply Current I _{CC}	V _{CC} =5.25V,						20	mA
	0°C≤T _A ≤70°C							
Transient Response	V _{IN} = 50 mV overdrive							
	(Note 3)							
Propagation Delay Time $(t_{pd(0)})$	T _A =25°C		14	20		14	20	ns
Propagation Delay Time $(t_{pd(1)})$	T _A =25°C		14	20		14	20	ns
Delay Between Output A and B	T _A =25°C		2	5		2	5	ns
Strobe Delay Time $(t_{pd(0)})$	T _A =25°C		8			8		ns
Strobe Delay Time (tpd(1))	T _A =25°C		8			8		ns

Note 1: The device may be damaged by use beyond the maximum ratings.

Note 2: Typical thermal impedances are as follows:

	H Package	J Package	N Package
θ_{jA}	165°C/W (Still Air) 67°C/W (400 LF/Min Air Flow)	112°C/W	105°C/W
θ_{iC}	25°C/W		

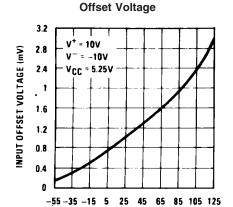
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Note 3: Measurements using AC Test circuit, Fanout = 1. The devices are faster at low supply voltages.

Note 4: Refer to RETS161X for LM161H and LM161J military specifications.

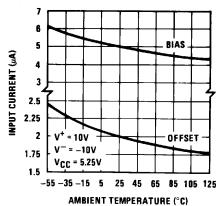
Note 5: Human body model, 1.5 k Ω in series with 100 pF.

Typical Performance Characteristics



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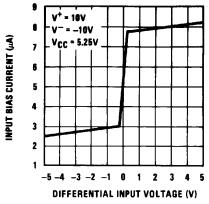
Input Currents vs Ambient Temperature



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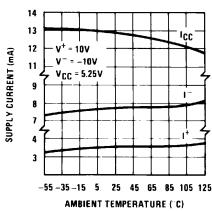
Input Characteristics

AMBIENT TEMPERATURE ("C)



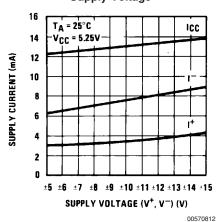
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Supply Current vs Ambient Temperature

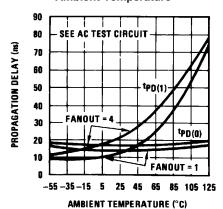


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Supply Current vs Supply Voltage



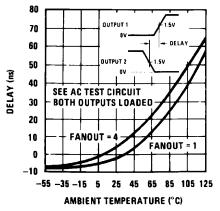
Propagation Delay vs Ambient Temperature

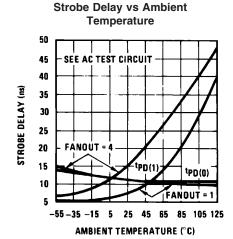


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Typical Performance Characteristics (Continued)

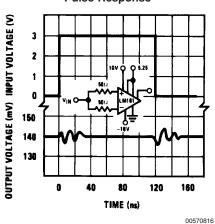
Delay of Output 1 With Respect to Output 2 vs **Ambient Temperature**



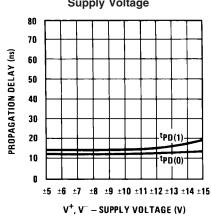


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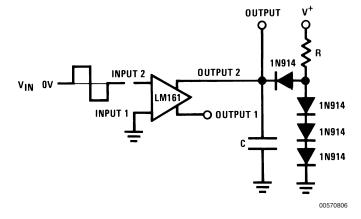


Propagation Delay vs Supply Voltage



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AC Test Circuit



 $V_{IN} = \pm 50 \text{ mV}$

FANOUT = 1

FANOUT = 4

 $V^{-} = -10V$

C=15 pF

C = 30 pF

 $V^{+} = +10V$

R = 2.4k

 $R = 680\Omega$

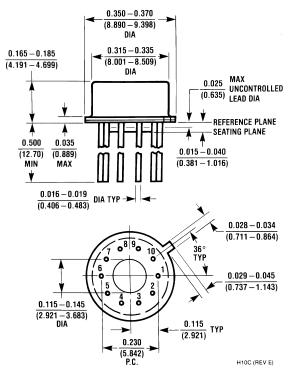
 $V_{CC} = 5.25V$

Schematic Diagram LM161 • STROBE1 • V_{CC} ₹R10 100 R9 **₹**R8 **≹**R7 1k D12 Q15 **₹**R3 9k D10 O NON-INVERTING OUTPUT1 R11 235 R12 800 O GND R1 1450 **₹** O STROBE2 R15 R15 1.4k ₹R16 ₹R2 1450 ≹R13 1k Q5 Q20 R19 5k Q6 Q19 R5 1.3k **₹**R6 1.3k **D**9 O INVERTING OUTPUT2 D5 **Z** R17 **₹** D6 Q2 +INPUT1 O-Q10 Q7 Q22 R18 800 -INPUT2 O **₹**R20 3.2k D8 R21 387 Q12 Q13 400

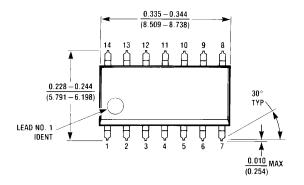
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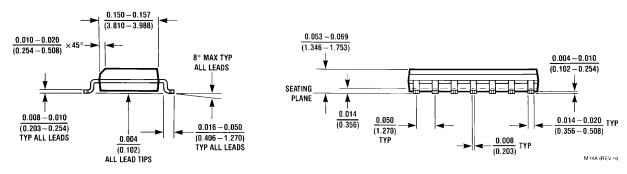
R10, R16: 85 R11, R17: 205

Physical Dimensions inches (millimeters) unless otherwise noted



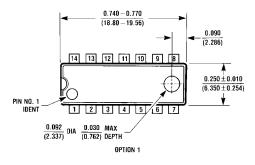
Metal Can Package (H) Order Number LM161H/883, or LM361H **NS Package Number H10C**

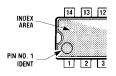




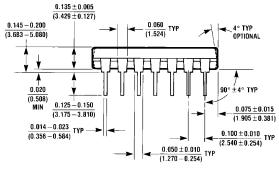
Order Number LM361M or LM361MX **NS Package Number M14A**

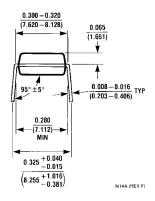
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)





OPTION 02





Molded Dual-In-Line Package (N) Order Number LM361N NS Package Number N14A

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