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## 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).

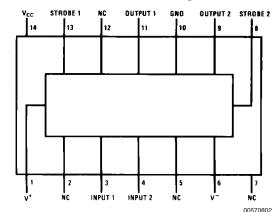
Complementary outputs having maximum skew are provided. Applications involve high speed analog to digital converters and zero-crossing detectors in disk file systems.

#### **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**

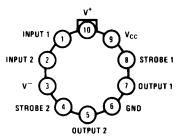
#### **Dual-In-Line Package**



Top View

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

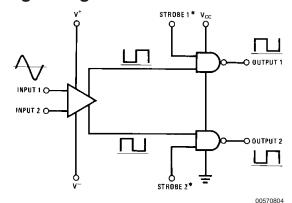
#### Metal Can Package



00570803

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 <sub>CC</sub>	+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 $V_{CC}$					
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 secon	ds)		260°C		
Small Outline Package					
Vapor Phase (60 se	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	iviax
Supply Voltage V <sup>+</sup>			
LM161	5V		15V

## **Electrical Characteristics**

 $(V^{+} = +10V, V_{CC} = +5V, V^{-} = -10V, T_{MIN} \le T_{\Delta} \le T_{M\Delta X}, \text{ unless noted})$ 

		Limits						
Parameter	Conditions		LM161		LM361			Units
		Min	Тур	Max	Min	Тур	Max	1
Input Offset Voltage			1	3		1	5	mV
Input Bias Current	T <sub>A</sub> =25°C		5			10		μΑ
				20			30	μA
Input Offset Current	T <sub>A</sub> =25°C		2			2		μA
				3			5	μA
Voltage Gain	T <sub>A</sub> =25°C		3			3		V/mV
Input Resistance	T <sub>A</sub> =25°C, f=1 kHz		20			20		kΩ
Logical "1" Output Voltage	V <sub>CC</sub> =4.75V,	2.4	3.3		2.4	3.3		V
	I <sub>SOURCE</sub> =-0.5 mA							
Logical "0" Output Voltage	V <sub>CC</sub> =4.75V,			0.4			0.4	V
	I <sub>SINK</sub> =6.4 mA							
Strobe Input "1" Current	V <sub>CC</sub> =5.25V,			200			200	μΑ
(Output Enabled)	V <sub>STROBE</sub> =2.4V							
Strobe Input "0" Current	V <sub>CC</sub> =5.25V,			-1.6			-1.6	mA
(Output Disabled)	V <sub>STROBE</sub> =0.4V							
Strobe Input "0" Voltage	V <sub>CC</sub> =4.75V			0.8			0.8	V
Strobe Input "1" Voltage	V <sub>CC</sub> =4.75V	2			2			V
Output Short Circuit Current	V <sub>CC</sub> =5.25V, V <sub>OUT</sub> =0V	-18		-55	-18		-55	mA
	V <sup>+</sup> =10V, V <sup>-</sup> =-10V,							
Supply Current I+	V <sub>CC</sub> =5.25V,			4.5				mA
	–55°C≤T <sub>A</sub> ≤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						
Parameter	Conditions	LM161		LM361			Units	
		Min	Тур	Max	Min	Тур	Max	
	V <sup>+</sup> =10V, V <sup>-</sup> =-10V,							
Supply Current I <sup>+</sup>	V <sub>CC</sub> =5.25V, 0°C≤T <sub>A</sub> ≤70°C						5	mA
Supply Current I⁻	V <sup>+</sup> =10V, V <sup>-</sup> =−10V, V <sub>CC</sub> =5.25V, −55°C≤T <sub>A</sub> ≤125°C			10				mA
Supply Current I⁻	V <sup>+</sup> =10V, V <sup>-</sup> =-10V,V <sub>CC</sub> =5.25V, 0°C≤T <sub>A</sub> ≤70°C						10	mA
Supply Current I <sub>CC</sub>	V <sup>+</sup> =10V, V <sup>-</sup> =-10V, V <sub>CC</sub> =5.25V, -55°C≤T <sub>A</sub> ≤125°C			18				mA
Supply Current I <sub>CC</sub>	V+=10V, V <sup>-</sup> =-10V, V <sub>CC</sub> =5.25V, 0°C≤T <sub>A</sub> ≤70°C						20	mA
Transient Response	V <sub>IN</sub> = 50 mV overdrive (Note 3)							
Propagation Delay Time (tpd(0))	T <sub>A</sub> =25°C		14	20		14	20	ns
Propagation Delay Time (t <sub>pd(1)</sub> )	T <sub>A</sub> =25°C		14	20		14	20	ns
Delay Between Output A and B	T <sub>A</sub> =25°C		2	5		2	5	ns
Strobe Delay Time (t <sub>pd(0)</sub> )	T <sub>A</sub> =25°C		8			8		ns
Strobe Delay Time (tpd(1))	T <sub>A</sub> =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
$\theta_{jA}$	165°C/W (Still Air) 67°C/W (400 LF/Min Air Flow)	112°C/W	105°C/W
A:C	25°C/W		

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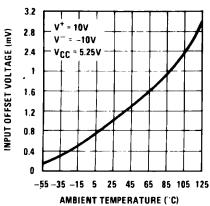
Note 3: Measurements using AC Test circuit, Fanout = 1. The devices are faster at low supply voltages.

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

Note 5: Human body model, 1.5 k $\Omega$  in series with 100 pF.

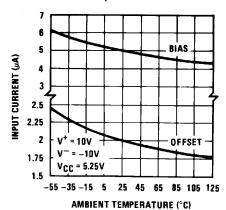
## **Typical Performance Characteristics**





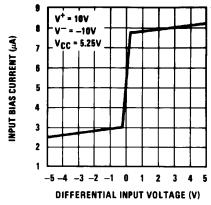
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## Input Currents vs Ambient Temperature



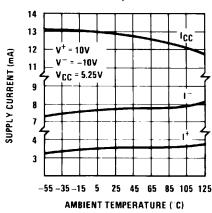
00570000

#### **Input Characteristics**



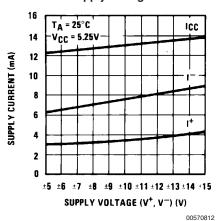
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#### Supply Current vs Ambient Temperature

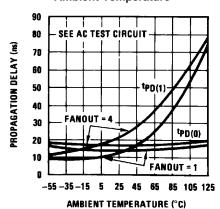


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#### Supply Current vs Supply Voltage



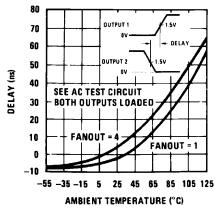
Propagation Delay vs Ambient Temperature



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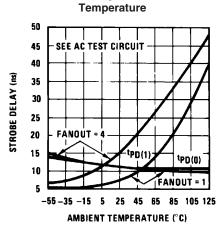
## **Typical Performance Characteristics** (Continued)

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



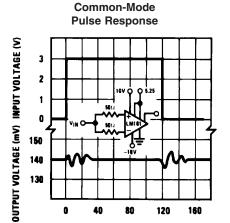
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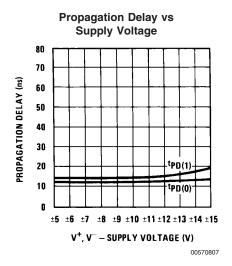


Strobe Delay vs Ambient

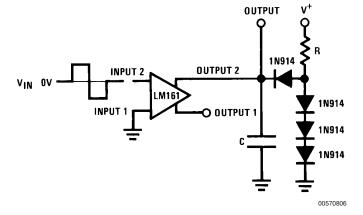
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TIME (ns)



**AC Test Circuit** 



 $V_{IN} = \pm 50 \text{ mV}$   $V^+ = +10V$ 

FANOUT = 1R = 2.4k FANOUT = 4  $R = 680\Omega$ 

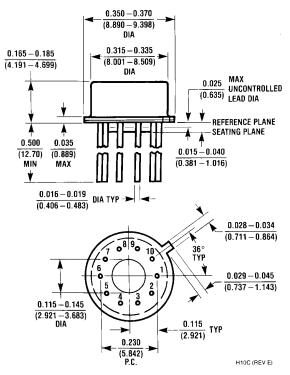
 $V^{-} = -10V$  $V_{CC} = 5.25V$  C=15 pF

C = 30 pF

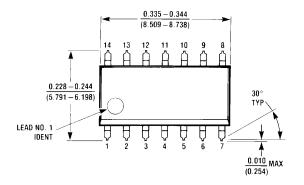
#### **Schematic Diagram** LM161 • STROBE1 • V<sub>CC</sub> ₹R10 100 R9 **≱**R7 **1**k Q16 D12 Q15 **≹**R3 9k D10 O NON-INVERTING OUTPUT1 R11 235 R12 800 O GND R1 1450 **₹** O STROBE2 R15 R15 1.4k ≹R16 100 **≹**R13 **1**k Q5 Q20 R19 5k ≹ Q6 Q19 R5 1.3k **R**6 1.3k **7** D9 O INVERTING OUTPUT2 R17 **★** 235 **★** D5 **7** D6 Q2 +INPUT1 O-Q10 Q7 Q22 R18 **★** -INPUT2 O **≹**R20 3.2k D8 R21 387 Q12 Q13 400 00570801

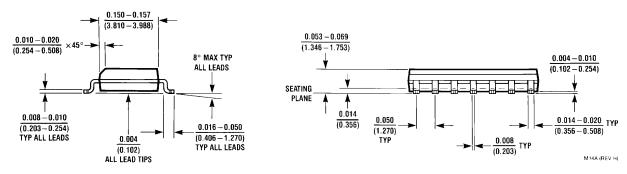
R10, R16: 85 R11, R17: 205

## **Physical Dimensions** inches (millimeters) unless otherwise noted



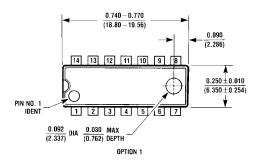
Metal Can Package (H) Order Number LM161H/883, or LM361H **NS Package Number H10C** 

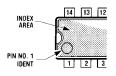




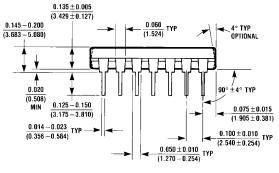
Order Number LM361M or LM361MX **NS Package Number M14A** 

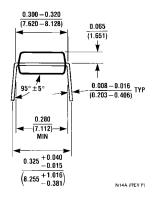
#### Physical Dimensions inches (millimeters) unless otherwise noted (Continued)





OPTION 02





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

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