

### FEATURES

- 45 ns max Propagation Delay
- Single 5 V or Dual  $\pm 15$  V Supply Operation
- CMOS or TTL Compatible Output
- 250  $\mu\text{V}$  max Input Offset Voltage
- 500  $\mu\text{V}$  max Input Hysteresis Voltage
- 15 V max Differential Input Voltage
- Onboard Latch
- 60 mW Power Dissipation
- Available in 8-Pin Plastic and Hermetic Cerdip Packages
- Available in Tape and Reel in Accordance with EIA-481A Standard

### APPLICATIONS

- Zero-Crossing Detectors
- Oversvoltage Detectors
- Pulse-Width Modulators
- Precision Rectifiers
- Discrete A/D Converters
- Delta-Sigma Modulator A/Ds

### PRODUCT DESCRIPTION

The AD790 is a fast (45 ns), precise voltage comparator, with a number of features that make it exceptionally versatile and easy to use. The AD790 may operate from either a single 5 V supply or a dual  $\pm 15$  V supply. In the single-supply mode, the AD790's inputs may be referred to ground, a feature not found in other comparators. In the dual-supply mode it has the unique ability of handling a maximum differential voltage of 15 V across its input terminals, easing their interfacing to large amplitude and dynamic signals.

This device is fabricated using Analog Devices' Complementary Bipolar (CB) process—which gives the AD790's combination of fast response time and outstanding input voltage resolution (1 mV max). To preserve its speed and accuracy, the AD790 incorporates a "low glitch" output stage that does not exhibit the large current spikes normally found in TTL or CMOS output stages. Its controlled switching reduces power supply disturbances that can feed back to the input and cause undesired oscillations. The AD790 also has a latching function which makes it suitable for applications requiring synchronous operation.

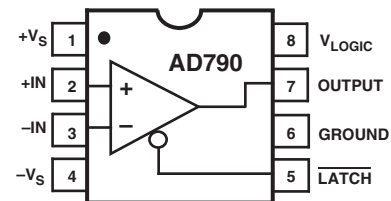
The AD790 is available in five performance grades. The AD790J and the AD790K are rated over the commercial temperature range of  $0^\circ\text{C}$  to  $70^\circ\text{C}$ . The AD790A and AD790B are rated over the industrial temperature range of  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ . The AD790S is rated over the military temperature range of  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ .

### REV. D

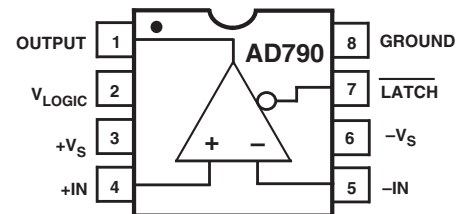
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### CONNECTION DIAGRAMS

8-Pin Plastic Mini-DIP (N)  
and Cerdip (Q) Packages



8-Pin SOIC (R) Package



### PRODUCT HIGHLIGHTS

1. The AD790's combination of speed, precision, versatility and low cost makes it suitable as a general purpose comparator in analog signal processing and data acquisition systems.
2. Built-in hysteresis and a low-glitch output stage minimize the chance of unwanted oscillations, making the AD790 easier to use than standard open-loop comparators.
3. The hysteresis combined with a wide input voltage range enables the AD790 to respond to both slow, low level (e.g., 10 mV) signals and fast, large amplitude (e.g., 10 V) signals.
4. A wide variety of supply voltages is acceptable for operation of the AD790, ranging from single 5 V to dual +5 V/-12 V,  $\pm 5$  V, or +5 V/ $\pm 15$  V supplies.
5. The AD790's power dissipation is the lowest of any comparator in its speed range.
6. The AD790's output swing is symmetric between  $V_{\text{LOGIC}}$  and ground, thus providing a predictable output under a wide range of input and output conditions.

# AD790—SPECIFICATIONS

**DUAL SUPPLY** (Operation @ 25°C and +V<sub>S</sub> = 15 V, -V<sub>S</sub> = -15 V, V<sub>LOGIC</sub> = 5 V unless otherwise noted.)

Parameter	Conditions	AD790J/A			AD790K/B			AD790S			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
RESPONSE CHARACTERISTIC Propagation Delay, t <sub>PD</sub>	100 mV Step 5 mV Overdrive T <sub>MIN</sub> to T <sub>MAX</sub>		40	45 45/50		40	45 45/50		40	45 60	ns ns
OUTPUT CHARACTERISTICS Output HIGH Voltage, V <sub>OH</sub>	1.6 mA Source 6.4 mA Source T <sub>MIN</sub> to T <sub>MAX</sub>		4.65 <b>4.3</b>	4.45		4.65 <b>4.3</b>	4.45		4.65 <b>4.3</b>	4.45	V V
Output LOW Voltage, V <sub>OL</sub>	1.6 mA Sink 6.4 mA Sink T <sub>MIN</sub> to T <sub>MAX</sub>		0.35 0.44	0.5 0.5/0.5		0.35 0.44	0.5 0.5		0.35 0.44	0.5 0.5	V V V
INPUT CHARACTERISTICS Offset Voltage <sup>1</sup>	T <sub>MIN</sub> to T <sub>MAX</sub>		0.2	<b>1.0</b> 1.5		0.05	<b>0.25</b> 0.5		0.2	<b>1.0</b> 1.5	mV mV
Hysteresis <sup>2</sup>	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>0.3</b>	0.4	0.6	<b>0.3</b>	0.4	<b>0.5</b>	<b>0.3</b>	0.4	<b>0.65</b>	mV
Bias Current	Either Input T <sub>MIN</sub> to T <sub>MAX</sub>		2.5	5 6.5		1.8	<b>3.5</b> 4.5		2.5	5 7	μA μA
Offset Current	T <sub>MIN</sub> to T <sub>MAX</sub>		0.04	<b>0.25</b> 0.3		0.02	<b>0.15</b> 0.2		0.04	<b>0.25</b> 0.4	μA μA
Power Supply Rejection Ratio DC	V <sub>S</sub> ±20% T <sub>MIN</sub> to T <sub>MAX</sub>	<b>80</b> 76	90 88		<b>88</b> 85	100 93		<b>80</b> 76	90 85		dB dB
Input Voltage Range Differential Voltage	V <sub>S</sub> ≤ ±15 V			±V <sub>S</sub>			±V <sub>S</sub>			±V <sub>S</sub>	V
Common Mode		-V <sub>S</sub>		+V <sub>S</sub> -2 V	-V <sub>S</sub>		+V <sub>S</sub> -2 V	-V <sub>S</sub>		+V <sub>S</sub> -2 V	V
Common Mode Rejection Ratio	-10 V < V <sub>CM</sub> < +10 V T <sub>MIN</sub> to T <sub>MAX</sub>	<b>80</b> 76	95 90		<b>88</b> 85	105 100		<b>80</b> 76	95 88		dB dB
Input Impedance	T <sub>MIN</sub> to T <sub>MAX</sub>		20  2			20  2			20  2		MΩ  pF
LATCH CHARACTERISTICS Latch Hold Time, t <sub>H</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>		25	35		25	35		25	35	ns
Latch Setup Time, t <sub>S</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>		5	10		5	10		5	10	ns
LOW Input Level, V <sub>IL</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>			0.8			<b>0.8</b>			<b>0.8</b>	V
HIGH Input Level, V <sub>IH</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>1.6</b>			<b>1.6</b>			<b>1.6</b>			V
Latch Input Current	T <sub>MIN</sub> to T <sub>MAX</sub>		2.3	5 7		2.3	<b>3.5</b> 5		2.3	5 8	μA μA
SUPPLY CHARACTERISTICS Diff Supply Voltage <sup>3</sup>	V <sub>LOGIC</sub> = 5 V T <sub>MIN</sub> to T <sub>MAX</sub>	<b>4.5</b>		33	<b>4.5</b>		<b>33</b>	<b>4.7</b>		<b>33</b>	V
Logic Supply	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>4.0</b>		7	<b>4.0</b>		7	<b>4.2</b>		7	V
Quiescent Current											
+V <sub>S</sub>	+V <sub>S</sub> = 15 V		8	<b>10</b>		8	<b>10</b>		8	<b>10</b>	mA
-V <sub>S</sub>	-V <sub>S</sub> = -15 V		4	5		4	5		4	5	mA
V <sub>LOGIC</sub>	V <sub>LOGIC</sub> = 5 V		2	<b>3.3</b>		2	<b>3.3</b>		2	<b>3.3</b>	mA
Power Dissipation				<b>242</b>			<b>242</b>			<b>242</b>	mW
TEMPERATURE RANGE Rated Performance	T <sub>MIN</sub> to T <sub>MAX</sub>		0 to 70/-40	to +85		0 to 70/-40	to +85		-55 to +125		°C

## NOTES

<sup>1</sup>Defined as the average of the input voltages at the low to high and high to low transition points. Refer to Figure 6.

<sup>2</sup>Defined as half the magnitude between the input voltages at the low to high and high to low transition points. Refer to Figure 6.

<sup>3</sup>+V<sub>S</sub> must be no lower than (V<sub>LOGIC</sub> - 0.5 V) in any supply operating conditions, except during power up.

All min and max specifications are guaranteed. Specifications shown in **boldface** are tested on all production units at final test.

Specifications subject to change without notice.

**SINGLE SUPPLY** (Operation @ 25°C and +V<sub>S</sub> = V<sub>LOGIC</sub> = 5 V, -V<sub>S</sub> = 0 V unless otherwise noted.)<sup>1</sup>

Parameter	Conditions	AD790J/A			AD790K/B			AD790S			Unit	
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
RESPONSE CHARACTERISTIC	100 mV Step											
Propagation Delay, t <sub>PD</sub>	5 mV Overdrive T <sub>MIN</sub> to T <sub>MAX</sub>		45	50		45	50		45	50	ns	
				50/60			50/60			65	ns	
OUTPUT CHARACTERISTICS												
Output HIGH Voltage, V <sub>OH</sub>	1.6 mA Source			4.65			4.65			4.65		
	6.4 mA Source	<b>4.3</b>		4.45	<b>4.3</b>		4.45	<b>4.3</b>		4.45	V	
	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>4.3</b>			<b>4.3</b>			<b>4.3</b>			V	
Output LOW Voltage, V <sub>OL</sub>	1.6 mA Sink			0.35			0.35			0.35	V	
	6.4 mA Sink			0.44	<b>0.5</b>		0.44	<b>0.5</b>		0.44	<b>0.5</b>	V
	T <sub>MIN</sub> to T <sub>MAX</sub>				<b>0.5</b>			<b>0.5</b>		<b>0.5</b>	V	
INPUT CHARACTERISTICS												
Offset Voltage <sup>2</sup>			0.45	<b>1.5</b>		0.35	<b>0.6</b>		0.45	<b>1.5</b>	mV	
	T <sub>MIN</sub> to T <sub>MAX</sub>			2.0			<b>0.85</b>			<b>2.0</b>	mV	
Hysteresis <sup>3</sup>	T <sub>MIN</sub> to T <sub>MAX</sub>	0.3	0.5	0.75	<b>0.3</b>	0.5	<b>0.65</b>	<b>0.3</b>	0.7	<b>1.0</b>	mV	
Bias Current	Either Input		2.7	5		2.0	<b>3.5</b>		2.7	5	μA	
	T <sub>MIN</sub> to T <sub>MAX</sub>			7			5			8	μA	
Offset Current			0.04	<b>0.25</b>		0.02	<b>0.15</b>		0.04	<b>0.25</b>	μA	
	T <sub>MIN</sub> to T <sub>MAX</sub>			0.3			<b>0.2</b>			<b>0.4</b>	μA	
Power Supply Rejection Ratio DC	4.5 V ≤ V <sub>S</sub> ≤ 5.5 V	<b>80</b>	90		<b>86</b>	100		<b>80</b>	90		dB	
	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>76/76</b>	88		<b>82</b>	93		<b>76</b>	85		dB	
Input Voltage Range												
Differential Voltage				±V <sub>S</sub>			±V <sub>S</sub>			±V <sub>S</sub>	V	
Common Mode		0		+V <sub>S</sub> -2 V	0		+V <sub>S</sub> -2 V	0		+V <sub>S</sub> -2 V	V	
Input Impedance			20  2			20  2			20  2		MΩ  pF	
LATCH CHARACTERISTICS												
Latch Hold Time, t <sub>H</sub>			25	35		25	35		25	35	ns	
Latch Setup Time, t <sub>S</sub>			5	10		5	10		5	10	ns	
LOW Input Level, V <sub>IL</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>			0.8			<b>0.8</b>			<b>0.8</b>	V	
HIGH Input Level, V <sub>IH</sub>	T <sub>MIN</sub> to T <sub>MAX</sub>	<b>1.6</b>			<b>1.6</b>			<b>1.6</b>			V	
Latch Input Current	T <sub>MIN</sub> to T <sub>MAX</sub>		2.3	5		2.3	<b>3.5</b>		2.3	5	μA	
				7			5			8	μA	
SUPPLY CHARACTERISTICS												
Supply Voltage <sup>4</sup>	T <sub>MIN</sub> to T <sub>MAX</sub>	4.5		7	4.5		7	4.7		7	V	
Quiescent Current			10	<b>12</b>		10	<b>12</b>		10	<b>12</b>	mA	
Power Dissipation				<b>60</b>			<b>60</b>			<b>60</b>	mW	
TEMPERATURE RANGE												
Rated Performance	T <sub>MIN</sub> to T <sub>MAX</sub>		0 to 70/-40	to +85		0 to 70/-40	to +85		-55 to +125		°C	

## NOTES

<sup>1</sup>Pin 1 tied to Pin 8, and Pin 4 tied to Pin 6.<sup>2</sup>Defined as the average of the input voltages at the low to high and high to low transition points. Refer to Figure 6.<sup>3</sup>Defined as half the magnitude between the input voltages at the low to high and high to low transition points. Refer to Figure 6.<sup>4</sup>-V<sub>S</sub> must not be connected above ground.All min and max specifications are guaranteed. Specifications shown in **boldface** are tested on all production units at final test.

Specifications subject to change without notice.

# AD790

## ABSOLUTE MAXIMUM RATINGS<sup>1,2</sup>

Supply Voltage	±18 V
Internal Power Dissipation <sup>2</sup>	500 mW
Differential Input Voltage	±16.5 V
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	
(N, R)	-65°C to +125°C
(Q)	-65°C to +150°C
Lead Temperature Range (Soldering 60 sec)	300°C
Logic Supply Voltage	7 V

### NOTES

<sup>1</sup>Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

<sup>2</sup>Thermal characteristics: plastic N-8 package:  $\theta_{JA} = 90^\circ\text{C}/\text{watt}$ ; ceramic Q-8 package:  $\theta_{JA} = 110^\circ\text{C}/\text{watt}$ ,  $\theta_{JC} = 30^\circ\text{C}/\text{watt}$ . SOIC (R-8) package:  $\theta_{JA} = 160^\circ\text{C}/\text{watt}$ ;  $\theta_{JC} = 42^\circ\text{C}/\text{watt}$ .

## ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD790JN	0°C to 70°C	Plastic DIP	N-8
AD790JR	0°C to 70°C	SOIC	SO-8
AD790JR-REEL	0°C to 70°C	Reel	
AD790JR-REEL7	0°C to 70°C	SOIC	R-8
AD790KN*	0°C to 70°C	Plastic DIP	N-8
AD790AQ	-40°C to +85°C	Cerchip	Q-8
AD790BQ*	-40°C to +85°C	Cerchip	Q-8
AD790SQ	-55°C to +125°C	Cerchip	Q-8

\*Not for new designs; obsolete April 2002.

For military processed devices, please refer to the standard Microcircuit Drawing (SMD) available at [www.dsccl.dla.mil/programs/milspec/default.asp](http://www.dsccl.dla.mil/programs/milspec/default.asp)

SMD Part Number	ADI Equivalent
5962-9150501MPA*	AD790 SQ/883

\*Not for new designs; obsolete April 2002.



Figure 1. Basic Dual Supply Configuration (N, Q Package Pinout)



Figure 2. Basic Single Supply Configuration (N, Q Package Pinout)

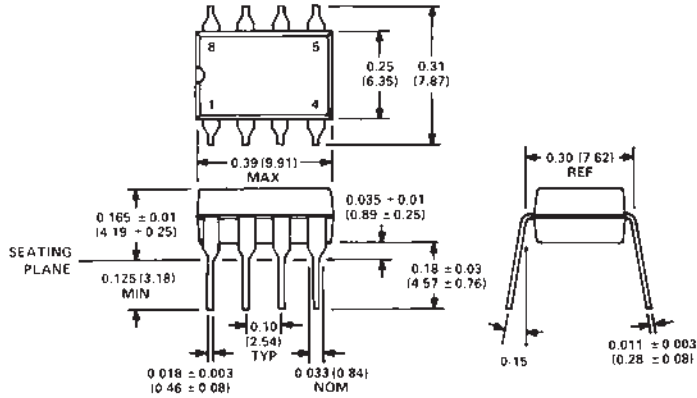


Figure 3. Response Time Test Circuit (N, Q Package Pinout)

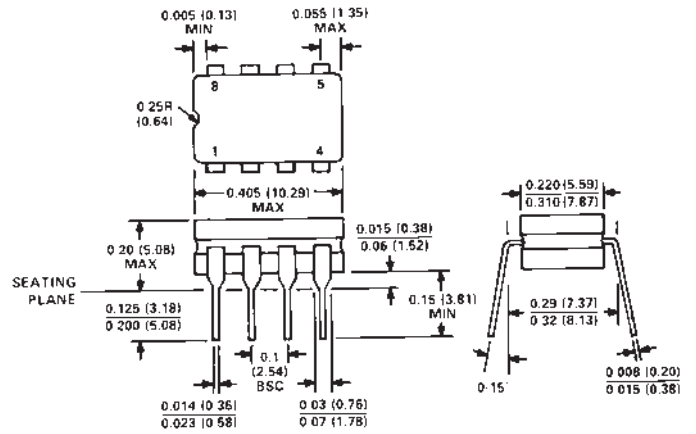
OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

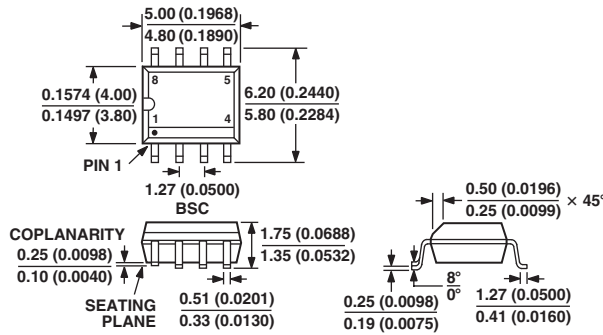
8-Pin Plastic Mini-DIP (N-8) Package



8-Pin Cerdip (Q-8) Package



SOIC (R-8) Package



CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN  
 COMPLIANT TO JEDEC STANDARDS MS-012 AA