

**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A****General Description**

The AS393/393A consist of two independent precision voltage comparators with a typical offset voltage of 1.0mV and high gain. They are specifically designed to operate from a single power supply over wide range of voltages. Operation from split power supply is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

The AS393/393A series are compatible with industry standard 393. AS393A has more stringent input offset voltage than AS393.

The AS393 is available in standard DIP-8, SOIC-8 TSSOP-8 packages, AS393A is available in standard DIP-8 and SOIC-8 packages.

**Features**

- Wide Supply Voltage Range
  - Single Supply: 2.0V to 36V
  - Dual Supplies:  $\pm 1.0V$  to  $\pm 18V$
- Low Supply Current Drain: 0.6mA
- Low Input Bias Current: 25nA (Typical)
- Low Input Offset Current:  $\pm 5.0nA$  (Typical)
- Low Input Offset Voltage: 1.0mV (Typical)
- Input Common Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equals to the Power Supply Voltage
- Low Output Saturation Voltage: 200mV at 4mA
- Open Collector Output

**Applications**

- Battery Charger
- Cordless Telephone
- Switching Power Supply
- DC-DC Module
- PC Motherboard
- Communication Equipment

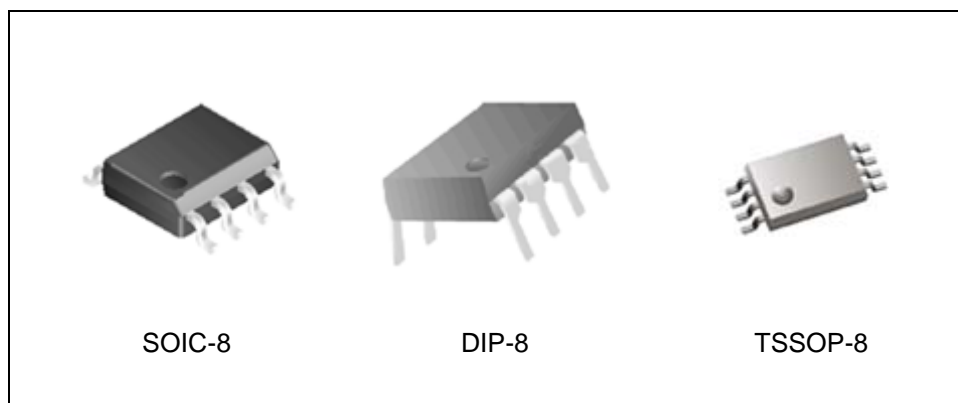


Figure 1. Package Types of AS393/393A



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Pin Configuration**

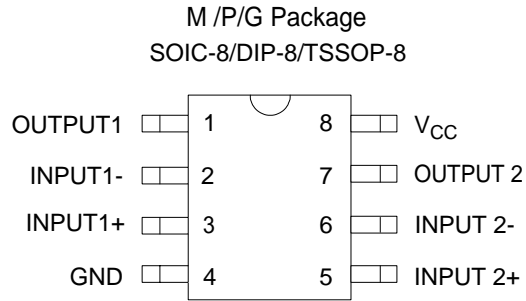


Figure 2. Pin Configuration of AS393/393A (Top View)

**Functional Block Diagram**

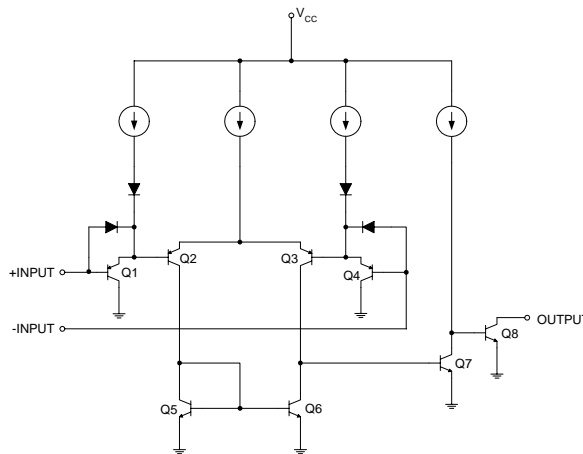
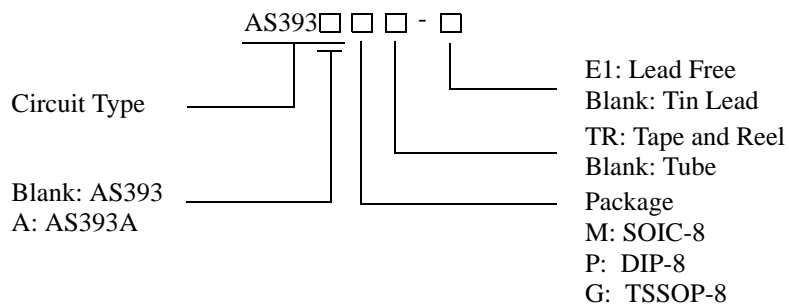


Figure 3. Functional Block Diagram of AS393/393A (Each comparator)

**Ordering Information**





**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Ordering Information (Continued)**

Package	Temperature Range	Part Number		Marking ID		Packing Type
		Tin Lead	Lead Free	Tin Lead	Lead Free	
SOIC-8	-40 to 85°C	AS393M	AS393M-E1	AS393M	AS393M-E1	Tube
		AS393MTR	AS393MTR-E1	AS393M	AS393M-E1	Tape & Reel
			AS393AM-E1		AS393AM-E1	Tube
			AS393AMTR-E1		AS393AM-E1	Tape & Reel
DIP-8		AS393P	AS393P-E1	AS393P	AS393P-E1	Tube
			AS393AP-E1		AS393AP-E1	Tube
TSSOP-8			AS393G-E1		EG3C	Tube
			AS393GTR-E1		EG3C	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

**Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value		Unit
Supply Voltage	V <sub>CC</sub>	40		V
Differential Input Voltage	V <sub>ID</sub>	40		V
Input Voltage	V <sub>IN</sub>	-0.3 to 40		V
Input Current (V <sub>IN</sub> < -0.3V) (Note 2)	I <sub>IN</sub>	50		mA
Output Short-Circuit Current to Ground		Continuous		
Power Dissipation (T <sub>A</sub> =25°C)	P <sub>D</sub>	DIP-8	780	mW
		SOIC-8	660	
		TSSOP-8	570	
Operating Junction Temperature	T <sub>J</sub>	150		°C
Storage Temperature	T <sub>STG</sub>	-65 to 150		°C
Lead Temperature (Soldering, 10 sec)	T <sub>LEAD</sub>	260		°C

Note 1: Stresses greater than 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Note 2: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the comparators to go to the V+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3 V<sub>DC</sub> (at 25°C).



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{CC}$	2	36	V
Operating Temperature Range	$T_A$	-40	85	°C

**Electrical Characteristics**

Limits in standard typeface are for  $T_A=25^{\circ}\text{C}$ , **bold** typeface applies over  $T_A=-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (Note 3),  $V_{CC}=5\text{V}$ ,  $\text{GND}=0\text{V}$ , unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Unit	
Input Offset Voltage	$V_O=1.4\text{V}$ , $R_S=0\Omega$ , $V_{CC}=5\text{V}$ to $30\text{V}$	AS393		1.0	5.0	mV
					<b>7</b>	
		AS393A		1.0	3.0	
					<b>5</b>	
Input Bias Current	$I_{IN+}$ or $I_{IN-}$ with output in Linear Range, $V_{CM}=0\text{V}$		25	250	nA	
				<b>400</b>		
Input Offset Current	$I_{IN+}-I_{IN-}$ , $V_{CM}=0\text{V}$		5.0	50	nA	
				<b>200</b>		
Input Common Mode Voltage Range (Note 4)	$V_{CC}=30\text{V}$	0		$V_{CC}-1.5$	V	
Supply Current	$R_L=\infty$	$V_{CC}=5\text{V}$		0.6	1.0	mA
					<b>2</b>	
		$V_{CC}=30\text{V}$		0.7	1.7	
					<b>3</b>	
Voltage Gain	$V_{CC}=15\text{V}$ , $R_L \geq 15\text{k}\Omega$ , $V_O=1\text{V}$ to $11\text{V}$	50	200		V/mV	
Large Signal Response Time	$V_{IN}$ =TTL Logic Swing, $V_{REF}=1.4\text{V}$ , $V_{RL}=5\text{V}$ , $R_L=5.1\text{k}$		200		ns	
Response Time	$V_{RL}=5\text{V}$ , $R_L=5.1\text{K}$		1.3		$\mu\text{s}$	
Output Sink Current	$V_{IN-}=1\text{V}$ , $V_{IN+}=0$ , $V_O=1.5\text{V}$	6.0	16		mA	
Output Leakage Current	$V_{IN-}=0\text{V}$ , $V_{IN+}=1\text{V}$ , $V_O=5\text{V}$		0.1		nA	
	$V_{IN-}=0\text{V}$ , $V_{IN+}=1\text{V}$ , $V_O=30\text{V}$			<b>1</b>	$\mu\text{A}$	
Saturation Voltage	$V_{IN-}=1\text{V}$ , $V_{IN+}=0$ , $I_{SINK} \leq 4\text{mA}$		200	400	mV	
				<b>500</b>		

Note 3: These specifications are limited to  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ . Limits over temperature are guaranteed by design, but not tested in production.

Note 4: The input common-mode voltage of either input signal voltage should not be allowed to go negatively by more than 0.3V (at  $25^{\circ}\text{C}$ ). The upper end of the common-mode voltage range is  $V_{CC}-1.5\text{V}$  (at  $25^{\circ}\text{C}$ ), but either or both inputs can go to +18V without damages, independent of the magnitude of the  $V_{CC}$ .



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Typical Performance Characteristics**

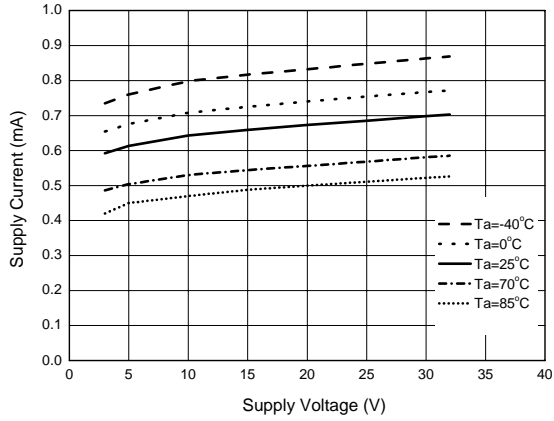


Figure 4. Supply Voltage vs. Supply Current

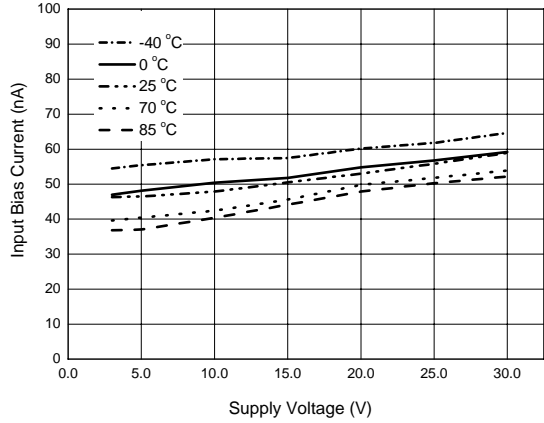


Figure 5. Supply Voltage vs. Input Bias Current

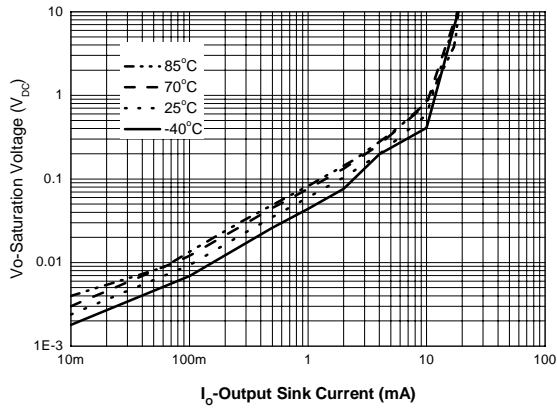


Figure 6. Output Sink Current vs. Saturation Voltage

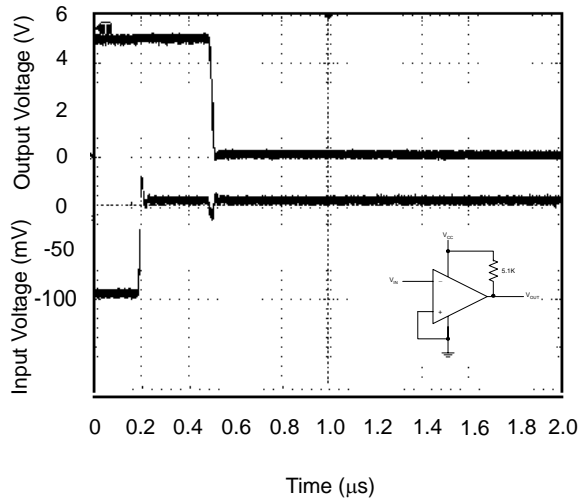


Figure 7. Response Time for 5mV Input Overdrive - Negative Transition



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Typical Performance Characteristics (Continued)**

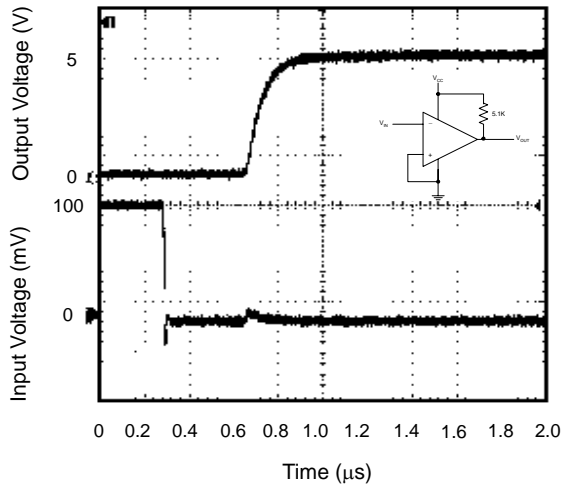


Figure 8. Response Time for 5mV Input Overdrive - Positive Transition

**Typical Applications**

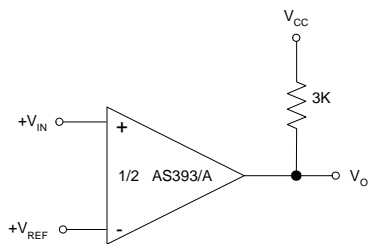


Figure 9. Basic Comparator

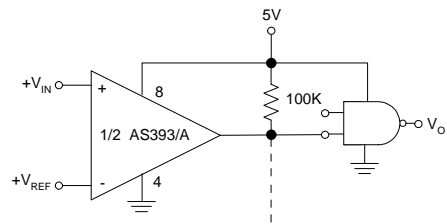


Figure 10. Driving CMOS



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Typical Applications (Continued)**

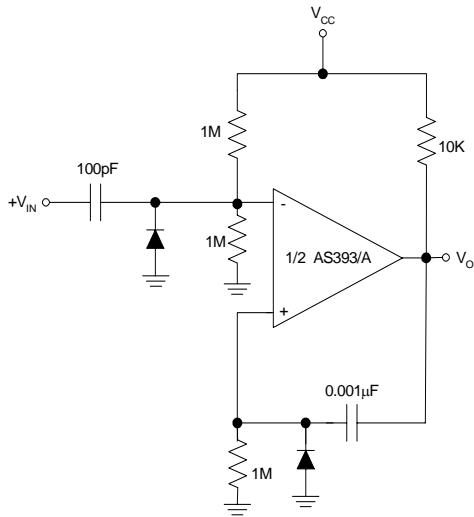


Figure 11. One Shot Multivibrator

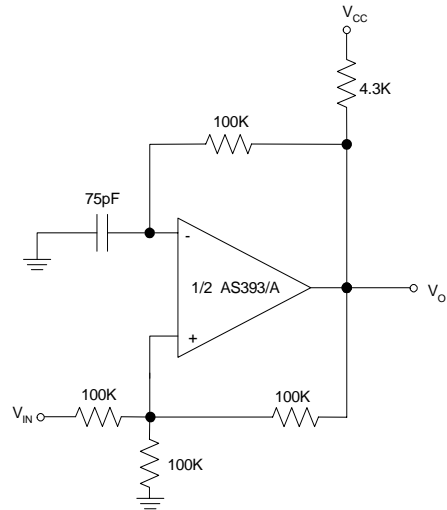


Figure 12. Squarewave Oscillator

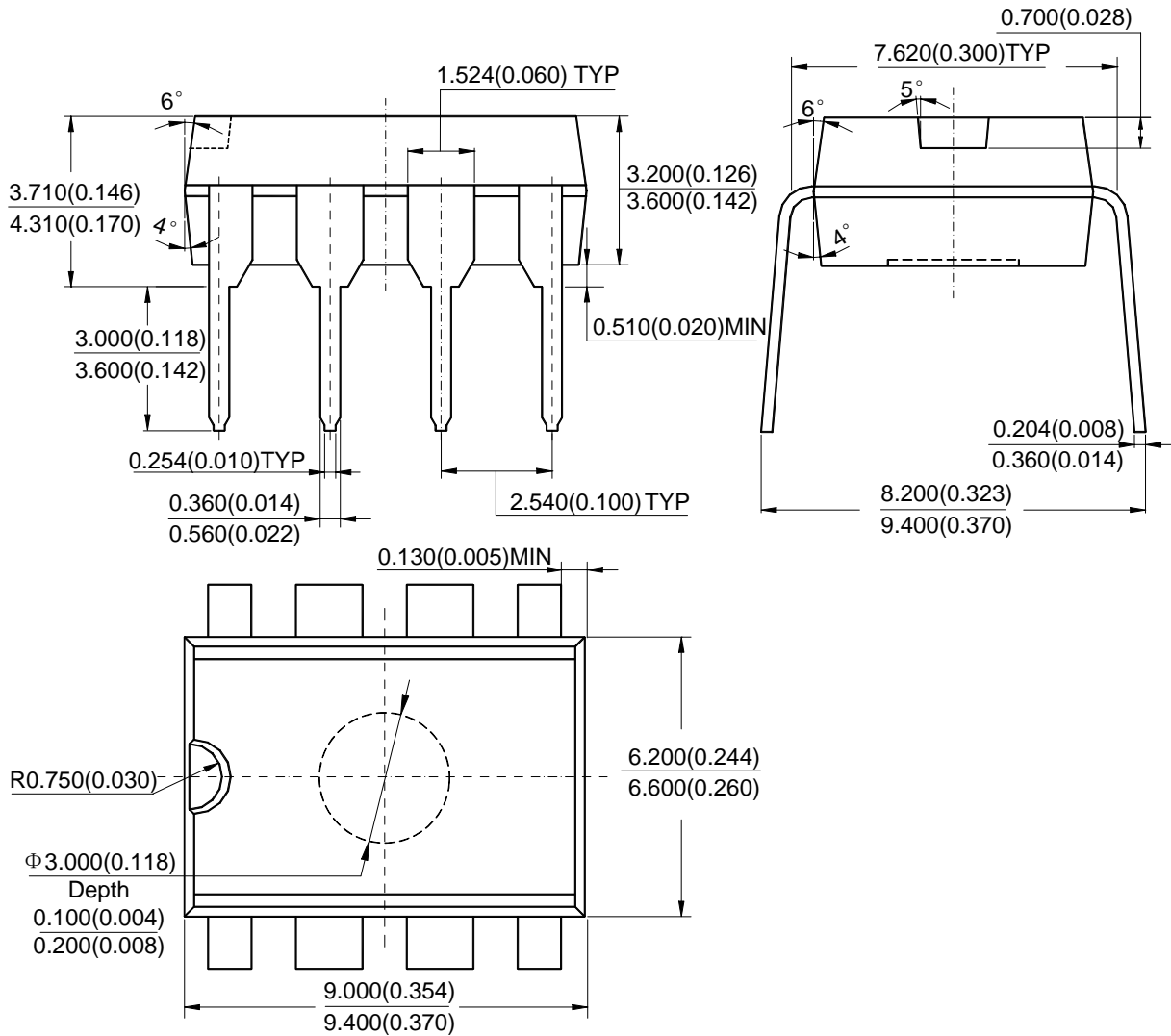


**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Mechanical Dimensions**

**DIP-8**

**Unit: mm(inch)**





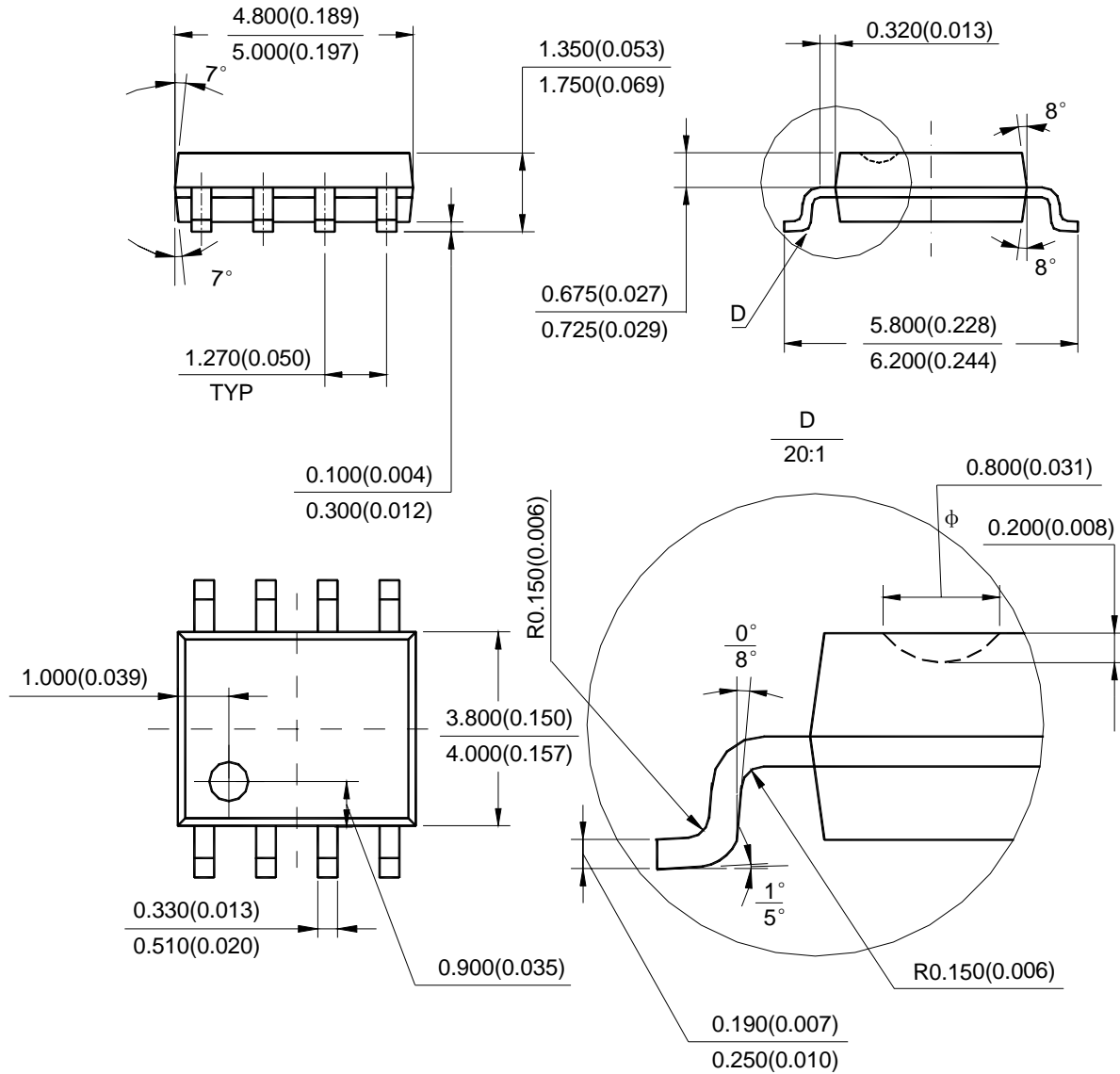


**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**



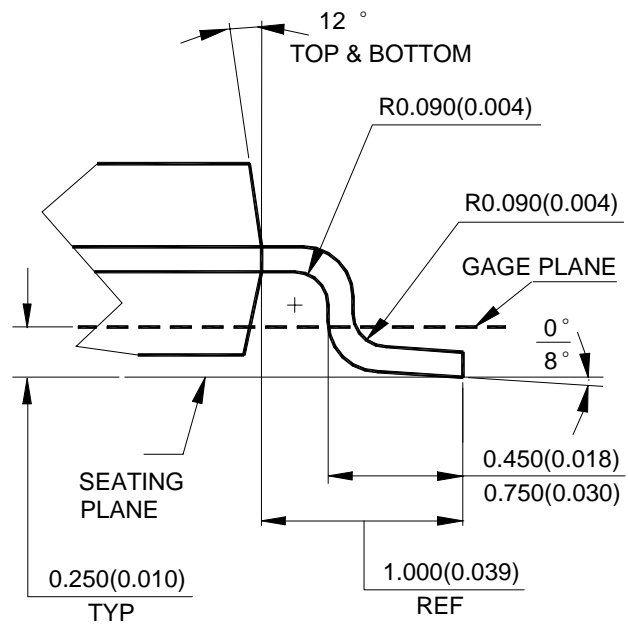
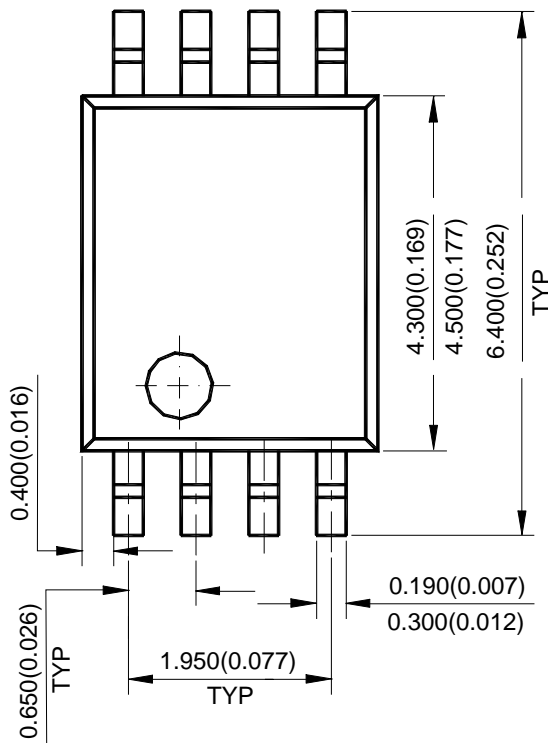
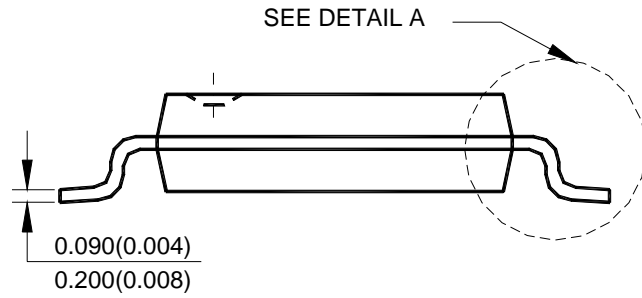
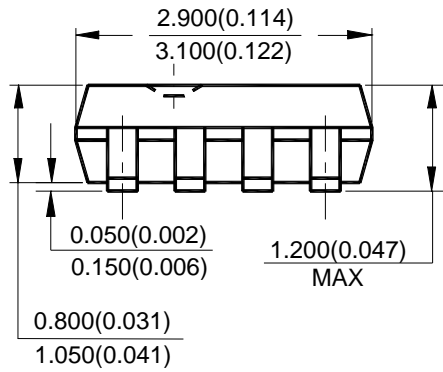


**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS AS393/393A**

**Mechanical Dimensions (Continued)**

**TSSOP-8**

**Unit: mm(inch)**





BCD Semiconductor Manufacturing Limited

<http://www.bcdsemi.com>

#### IMPORTANT NOTICE

BCD Semiconductor Manufacturing Limited reserves the right to make changes without further notice to any products or specifications herein. BCD Semiconductor Manufacturing Limited does not assume any responsibility for use of any its products for any particular purpose, nor does BCD Semiconductor Manufacturing Limited assume any liability arising out of the application or use of any its products or circuits. BCD Semiconductor Manufacturing Limited does not convey any license under its patent rights or other rights nor the rights of others.

---

#### MAIN SITE

**BCD Semiconductor Manufacturing Limited**  
- Wafer Fab  
**Shanghai SIM-BCD Semiconductor Manufacturing Limited**  
800, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

**BCD Semiconductor Manufacturing Limited**  
- IC Design Group  
**Advanced Analog Circuits (Shanghai) Corporation**  
8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

#### REGIONAL SALES OFFICE

**Shenzhen Office**  
**Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office**  
**Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office**  
27B, Tower C, 2070, Middle Shen Nan Road, Shenzhen 518031, China  
Tel: +86-755-8368 3987, Fax: +86-755-8368 3166

**Taiwan Office**  
**BCD Semiconductor (Taiwan) Company Limited**  
4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei,  
Taiwan  
Tel: +886-2-2656 2808, Fax: +886-2-2656 2806

**USA Office**  
**BCD Semiconductor Corporation**  
3170 De La Cruz Blvd., Suite 105, Santa Clara,  
CA 95054-2411, U.S.A  
Tel: +1-408-988 6388, Fax: +1-408-988 6386