

**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS****AZ393/393C****General Description**

The AZ393/393C series consists of two independent precision voltage comparators with an offset voltage specification as low as 1mV. The input common mode voltage range of these comparators includes ground, even when operated from a single power supply voltage. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

The AZ393/393C series is designed to directly interface with TTL and CMOS. AZ393C has more stringent input offset voltage than AZ393.

The AZ393/393C series can be widely used in applications such as battery charger, cordless telephone, switching power supply, DC-DC module and PC motherboard.

The AZ393/393C series are available in standard packages of DIP-8 and SOIC-8.

**Features**

- Wide Supply Voltage Range
  - Single Supply: 2.0V to 18V
  - Dual Supplies:  $\pm 1.0V$  to  $\pm 9V$
- Very Low Supply Current Drain: 0.4mA
  - Independent of Supply Voltage
- Low Input Bias Current: 25nA (Typical)
- Low Input Offset Current:  $\pm 5nA$  (Typical)
- Low Input Offset Voltage:  $\pm 1mV$  (Typical)
- Input Common Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equals to the Power Supply Voltage
- Low Output Saturation Voltage: 250mV at 4mA
- Open Collector Output

**Applications**

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

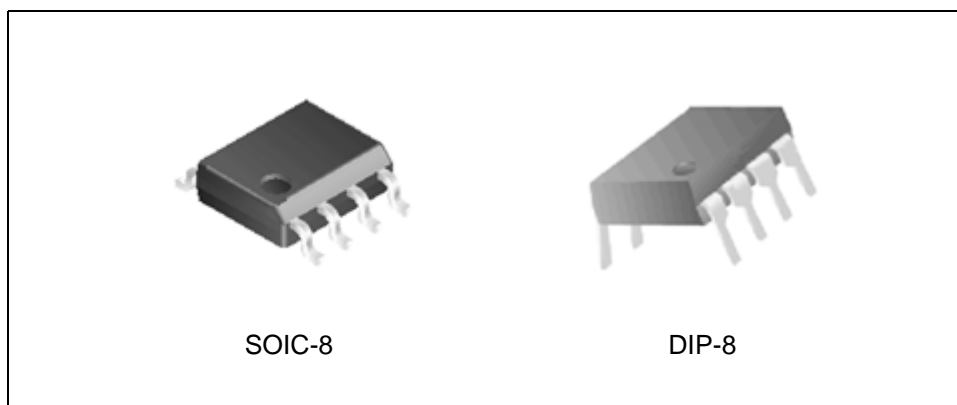


Figure 1. Package Types of AZ393/393C



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS**

**AZ393/393C**

**Pin Configuration**

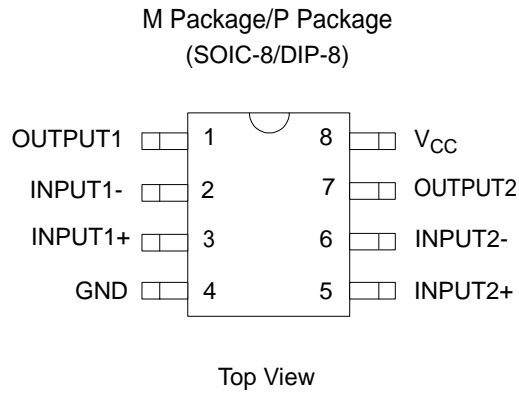


Figure 2. Pin Configuration of AZ393/393C

**Functional Block Diagram**

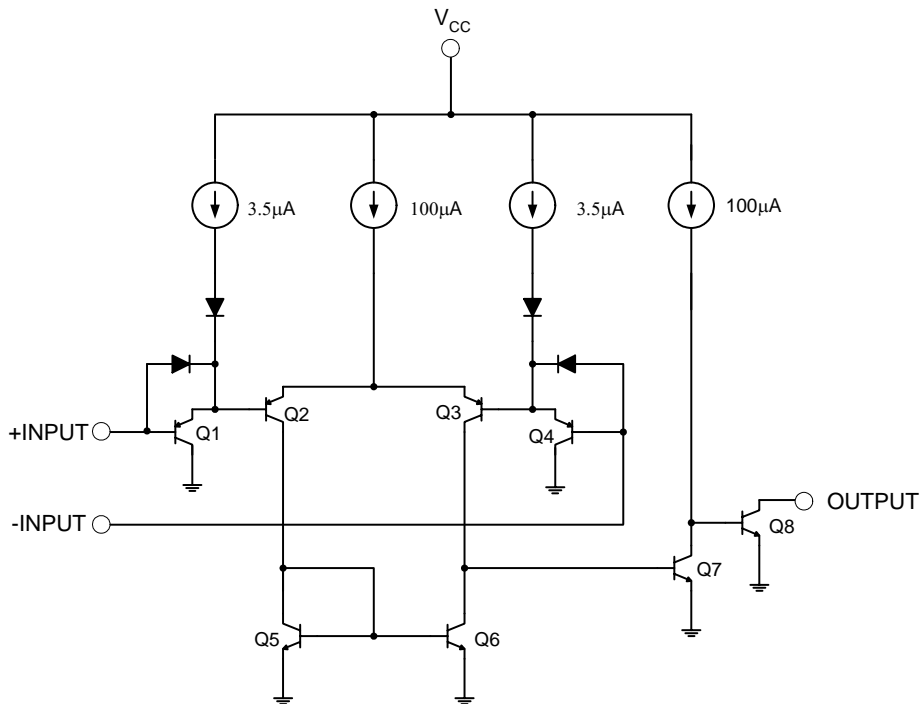
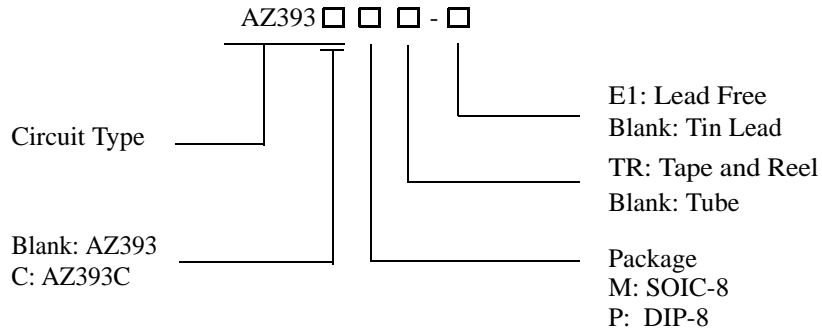


Figure 3. Functional Block Diagram of AZ393/393C  
(Each Comparator)



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**Ordering Information**



Package	Input Offset Voltage		Part Number		Marking ID		Packing Type
			Tin Lead	Lead Free	Tin Lead	Lead Free	
SOIC-8	Maximum Value	5mV	AZ393M	AZ393M-E1	AZ393M	AZ393M-E1	Tube
		5mV	AZ393MTR	AZ393MTR-E1	AZ393M	AZ393M-E1	Tape & Reel
		2mV	AZ393CM	AZ393CM-E1	393CM	393CM-E1	Tube
		2mV	AZ393CMTR	AZ393CMTR-E1	393CM	393CM-E1	Tape & Reel
DIP-8	Maximum Value	5mV	AZ393P	AZ393P-E1	AZ393P	AZ393P-E1	Tube
		2mV	AZ393CP	AZ393CP-E1	AZ393CP	AZ393CP-E1	Tube

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

**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS****AZ393/393C****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value		Unit
Supply Voltage	$V_{CC}$	20		V
Differential Input Voltage	$V_{ID}$	20		V
Input Voltage	$V_{IN}$	-0.3 to 20		V
Input Current ( $V_{IN} < -0.3V$ ) (Note 2)	$I_{IN}$	50		mA
Power Dissipation ( $T_A=25^\circ C$ )	$P_D$	DIP-8	780	mW
		SOIC-8	660	
Output Short Circuit to Ground		Continuous		
Operating Junction Temperature	$T_J$	150		$^\circ C$
Storage Temperature Range	$T_{STG}$	-65 to 150		$^\circ C$
Lead Temperature (Soldering, 10 seconds)	$T_{LEAD}$	260		$^\circ C$

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  $-0.3 V_{DC}$  (at  $25^\circ C$ ).

**Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{CC}$	2	18	V
Operating Temperature Range	$T_A$	-40	85	$^\circ C$



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**Electrical Characteristics**

$V_{CC}=5V$ ,  $GND=0V$ ,  $T_A=25^{\circ}C$ , unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Unit
Input Offset Voltage	(Note 3)	AZ393	1.0	5.0	mV
		AZ393C	1.0	2.0	
Input Bias Current	$I_{IN+}$ or $I_{IN-}$ with output in linear range, $V_{CM}=0V$ , (Note 4)		25	250	nA
Input Offset Current	$I_{IN+}-I_{IN-}$ , $V_{CM}=0V$		5.0	50	nA
Input Common Mode Voltage Range	$V_{CC}=15V$ (Note 5)	0		$V_{CC}-1.5$	V
Supply Current	$R_L=\infty$ , $V_{CC}=5V$		0.4	1.0	mA
	$R_L=\infty$ , $V_{CC}=18V$		1.0	2.5	
Voltage Gain	$R_L \geq 15k\Omega$ , $V_{CC}=15V$ , $V_O=1V$ to $11V$	50	200		V/mV
Large Signal Response Time	$V_{IN}$ =TTL logic swing, $V_{REF}=1.4V$ , $V_{RL}=5V$ , $R_L=5.1k\Omega$		300		ns
Response Time	$V_{RL}=5V$ , $R_L=5.1k\Omega$ , (Note 6)		1.3		$\mu s$
Output Sink Current	$V_{IN-}=1V$ , $V_{IN+}=0$ , $V_O \leq 1.5V$	6.0	16		mA
Saturation Voltage	$V_{IN-}=1V$ , $V_{IN+}=0$ , $I_{SINK} \leq 4mA$		250	400	mV
Output Leakage Current	$V_{IN-}=0$ , $V_{IN+}=1V$ , $V_O=5V$		0.1		nA

Note 3: At output switch point,  $V_O=1.4V$ ,  $R_S=0$  with  $V_{CC}$  from 5V to 15V, and over the full common-mode range (0V to  $V_{CC}-1.5V$ ), at  $25^{\circ}C$ .

Note 4: The direction of the input current is out of the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines.

Note 5: The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is  $V_{CC}-1.5V$ , but either or both inputs can go to +18V without damage, independent of the magnitude of  $V_{CC}$ .

Note 6: The response time specified is a 100mV input step with 5mV overdrive. For large overdrive signals 300ns can be obtained.



**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS**

**AZ393/393C**

**Typical Performance Characteristics**

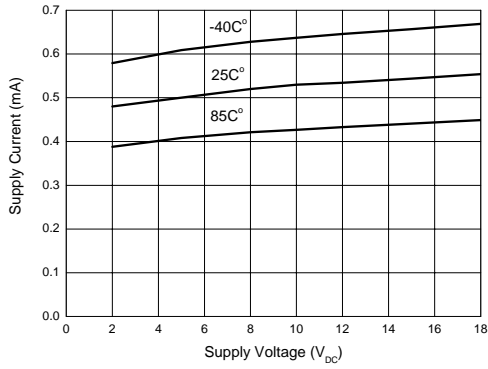


Figure 4. Supply Voltage vs. Supply Current

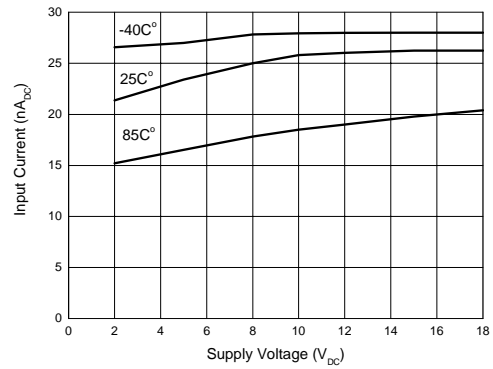


Figure 5. Supply Voltage vs. Input Current

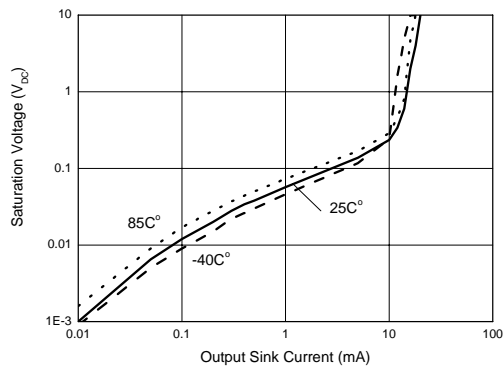


Figure 6. Output Sink Current vs. Saturation Voltage

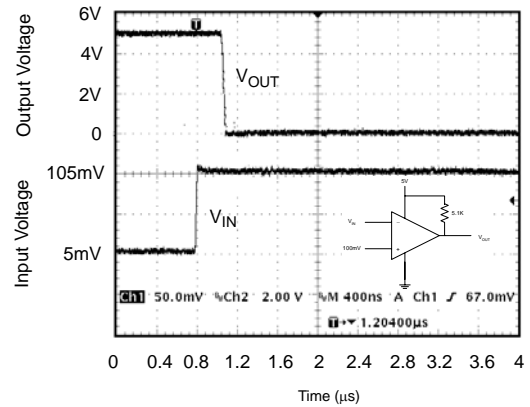


Figure 7. Response Time for 5mV Input Overdrive - Negative Transition

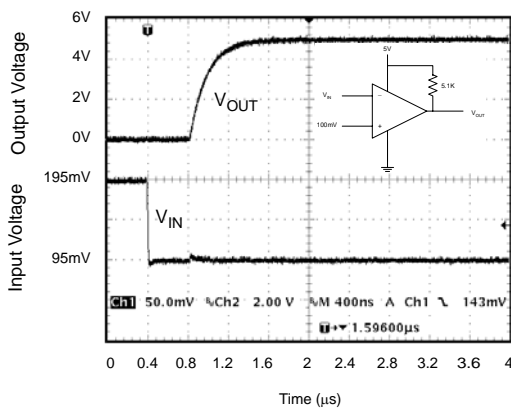


Figure 8. Response Time for 5mV Input Overdrive - Positive Transition



**Typical Application**

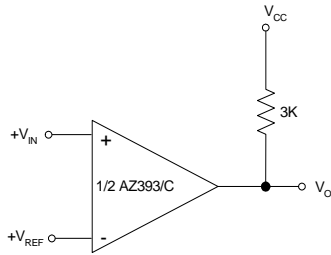


Figure 9. Basic Comparator

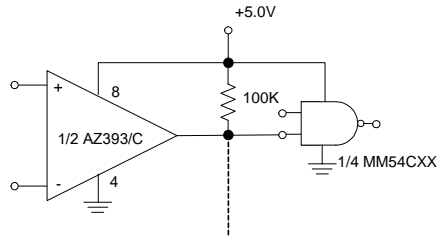


Figure 10. Driving CMOS/TTL

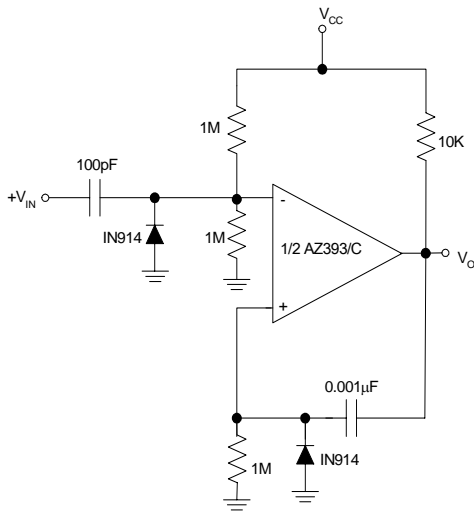


Figure 11. One Shot Multivibrator

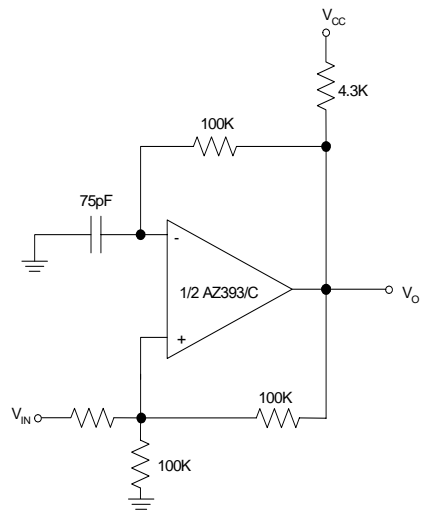


Figure 12. Squarewave Oscillator



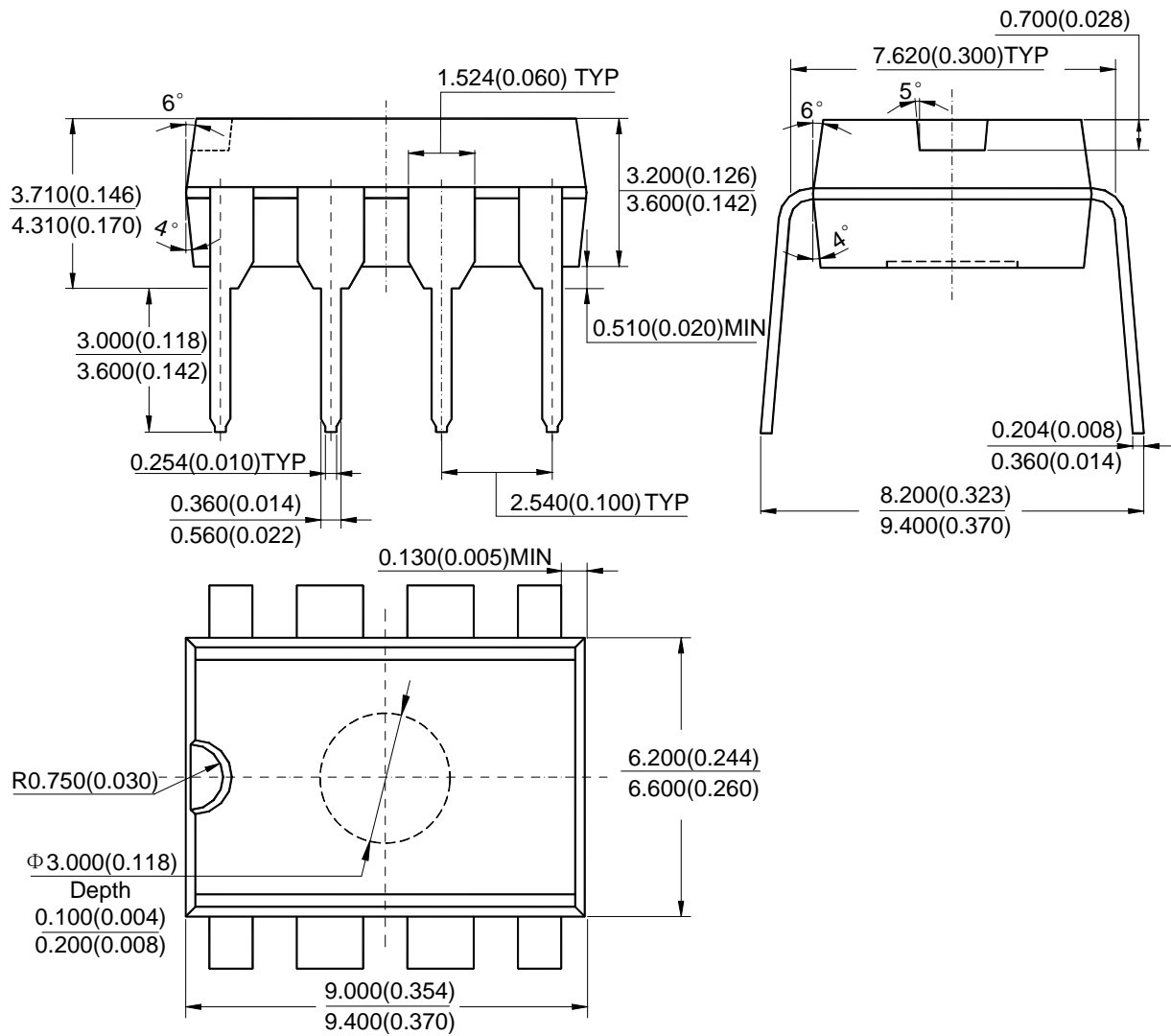
**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS**

**AZ393/393C**

**Mechanical Dimensions**

**DIP-8**

**Unit: mm(inch)**







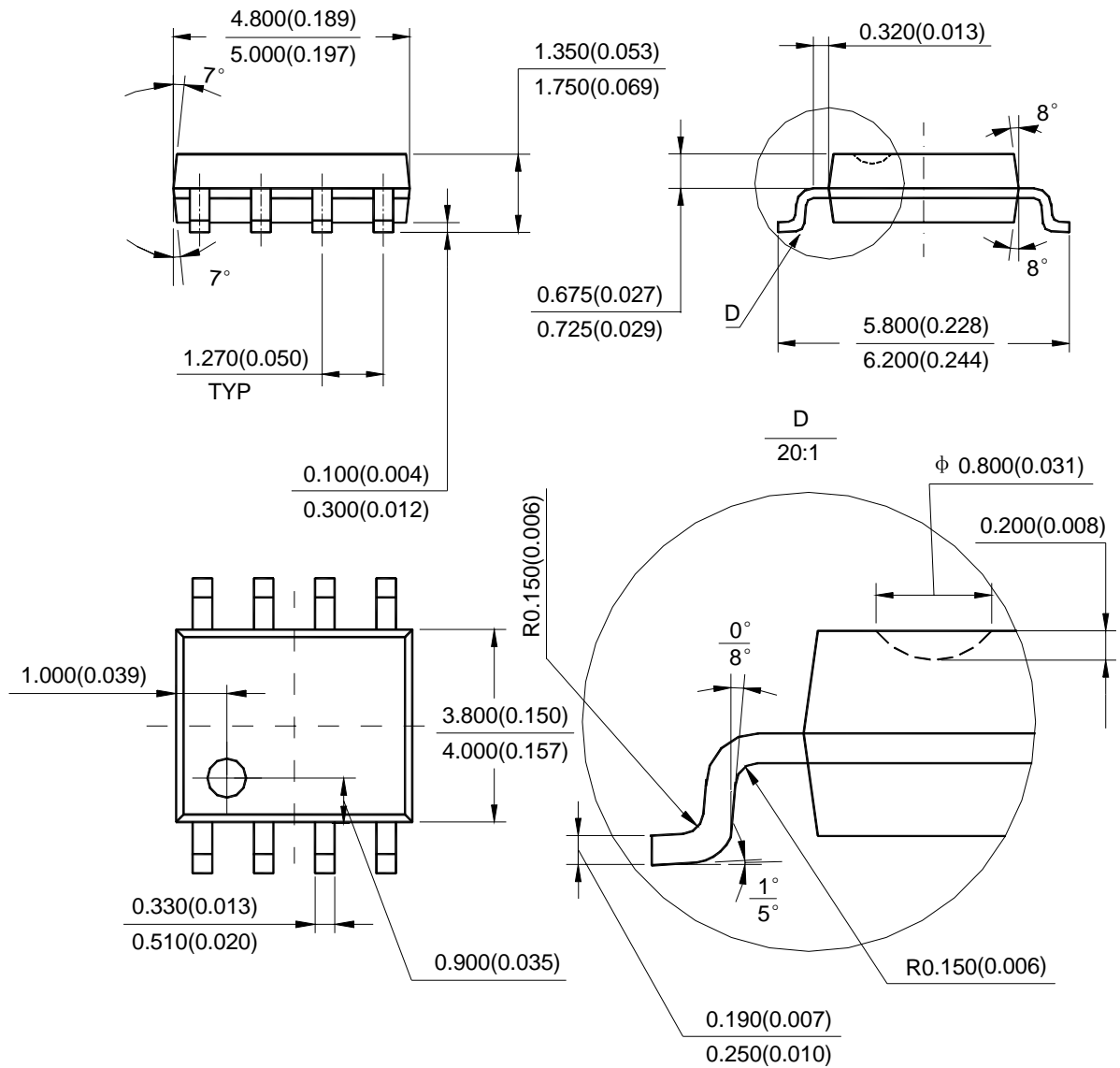
**LOW POWER LOW OFFSET VOLTAGE DUAL COMPARATORS**

**AZ393/393C**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**





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