DESCRIPTION

The Model AD 351 IC Comparator is the first monolithic comparator to offer performance previously available only in discrete modular designs. Its key features are low initial bias and offset currents; the temperature sensitivity of these parameters is 1-2 orders of magnitude lower than attainable with presently available designs. High input impedance combined with low bias and offset currents are features that can only be obtained by additional circuitry at the inputs of IC Comparators having lesser performance. Other significant advantages, such as operation with ±15VDC power supplies, high gain, voltage offset zero-ability and high common mode voltage range open up a variety of new high resolution applications where precise comparison is to be made between two inputs at arbitrary voltage levels.

The Model AD 351 offers a high-performance alternative to the μA 710 and similar designs. These outstanding advantages are obtained by manufacturing techniques utilizing 5 ohm-centimeter substrate material (rather than 1 ohm-centimeter) and avoiding the gold doping process used in the manufacture of other popular ICs. This new process sacrifices speed but improves the device with respect to such specifications as breakdown voltage, bias current and input impedance. Operation can now be directly from ±15VDC supplies. Analog instrumentation applications demanding high accuracy, as opposed to crude GO-NO GO decisions between binary levels, can be realized with a minimum of additional circuitry or design time.

The chart compares presently available IC Comparators to the Model AD 351.

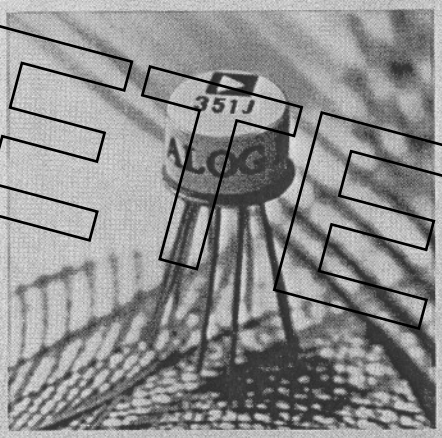
	UNITS	AD351J	μA710C*	LM306*	NE518K*	MC1440G*
Bias Current, max. (25°C)	μA	0.25	25	25	50	75
Offset Current, max. (25°C)	μA	0.1	5	5	9	10
Voltage Gain, min.	V/V	15K	1K	40K (typ.)	1.4K	85
CM Voltage, min.	Volts	±10	±5	±5	±5	±5
Supply Voltage	Volts	±15	+12,-6	+12,-7	+6,-3	±6
Response Time	nsec	0.4	0.04	0.04	0.08	0.1
Price (100+)	$	7.80	1.90	6.80	5.00	8.00

*Published Data as of September 1, 1969

MODEL AD 351J/K/S
BIPOLAR COMPARATOR

FEATURES

- Low Bias Current - 250 nA, max.
- Low Offset Current - 100 nA, max.
- High Input Impedance - 10^7 ohms
- Offset Voltage Trimmable to Zero
- Operation from ±15VDC Supplies
- Wide CMV Range - ±10V, min.
- High Voltage Gain - 25,000 min.



APPLICATIONS

- A/D Converter
- Precision Level Detector
- Zero Crossing Detector
- Precision Integrator Reset
- Grading and Sorting

ANALOG DEVICES INC
221 FIFTH ST., CAMBRIDGE, MASS. 02142
TEL: 617/492-6000 TWX: 710/320-0326

CO32-40-10/69 PRINTED IN U.S.A.

MODEL AD 351 — BIPOLAR COMPARATOR

ELECTRICAL SPECIFICATIONS FOR ALL MODELS

$T_a = 25°C$; $V^+ = +V_s = +15V$; $-V_s = -15V$ unless otherwise noted (pins 3 and 4 open)

VOLTAGE GAIN, min		15,000
RATED OUTPUT		
Output resistance, typ	($7V > V_o > 1V$)	10,000Ω
Positive output level, min	(Adjustable below 7V by varying V^+)	7V
Negative output level, max	($V_{in} \geq 15mV$; 2mA sink)	+0.4V
Output sink current, min	($V_{in} \geq 15mV$; $V_o = 0.4V$)	2mA
INPUT OFFSET VOLTAGE, max	($V_o = 5V$; $R_s \leq 200\Omega$)	±6.0mV
	with 20k Trim Pot. Adj.	0.0mV
INPUT BIAS CURRENT, max	($V_o = 5V$)	+250nA
INPUT OFFSET CURRENT, max	($V_o = 5V$)	±100nA
INPUT IMPEDANCE		
Differential, typ		10MΩ||4pF
DELAY TIME, typ	($V_o = 2.5V$; $V_{in} = 5mV$ overdrive (see Figs. 4,5)	250nsec
INPUT VOLTAGE RANGE, min		±10V
Differential input voltage range		±10V
Common mode rejection, min	($V_o = 5V$; $V_{cm} = \pm 10V$)	+70dB
POWER SUPPLY		
Positive supply current, typ		2.5mA
Negative supply current, typ		0.5mA
Power consumption, typ		45mW
MECHANICAL		
Case style-pin configuration		TO–100

PRICE	AD 351J	AD 351K	AD 351S
1–24	$11.70	$18.	$24.
25–99	$ 9.95	$15.30	$20.40

TEMPERATURE SPECIFICATIONS: $T_l°C < T_a < T_h°C$

PARAMETER	CONDITIONS	MIN	MODEL	MAX	UNITS
Temp. Coeff. Input Offset Volt.	$V_o = 5V$ $T_l = -55°C$ $T_h = +125°C$		S	±10	µV/°C
Input Bias Current				750	nA
Voltage Gain		15000			V/V
Temp. Coeff. Input Offset Volt.	$V_o = 5V$ $T_l = 0°C$ $T_h = 70°C$		J	±20	µV/°C
Input Bias Current				4	nA/°C
Temp. Coeff. Input Offset Volt.	$V_o = 5V$ $T_l = 0°C$ $T_h = 70°C$		K	±5	µV/°C
Input Bias Current				4	nA/°C

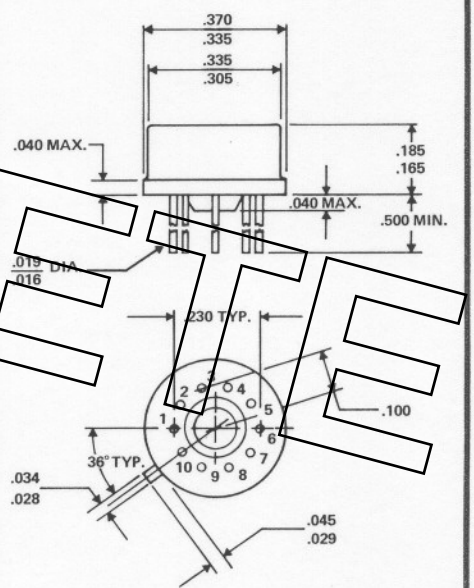
NOTE:
For operating at elevated temperatures, the device must be derated based on a 150°C maximum junction temperature and a thermal resistance of 150°C/W junction to ambient or 45°C/W junction to case for the metal-can package.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS

Positive Supply Volt.	+18V
Negative Supply Volt.	−18V
Peak Output Current	10mA
Diff. Input Voltage	±10V
Input Voltage	$\pm V_s$
Int. Power Dissipation (see note)	500mW
Oper. Temp. Range	-55°C to +125°C
Storage Temp. Range	-65°C to +150°C
Lead Temp. (soldering, 60 sec.)	300°C

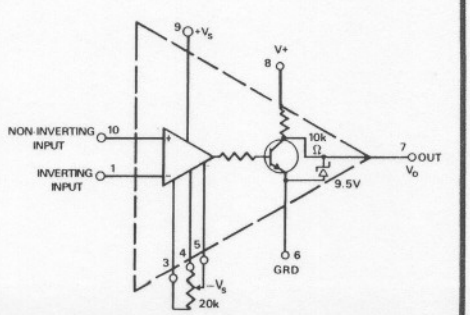
OUTLINE DIMENSIONS



BOTTOM VIEW

Mates with Barnes Socket MFQ–023–10B (Available from Analog Devices, Inc.)

CONNECTION DIAGRAM



CAUTION: CASE CONNECTED TO PIN 5. PIN 2 NOT USED.

TYPICAL PERFORMANCE CURVES

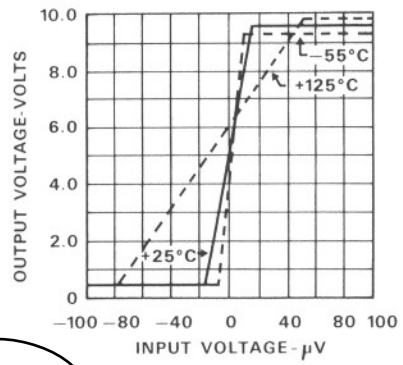


Fig. 1. Voltage Transfer Characteristic

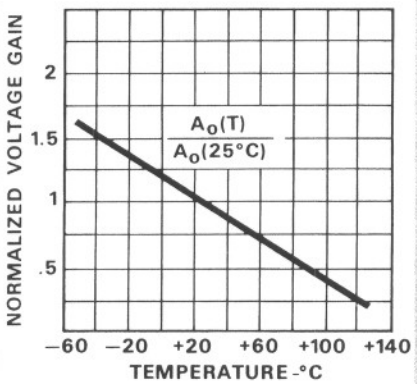


Fig. 2. Voltage Gain As A Function Of Ambient Temperature

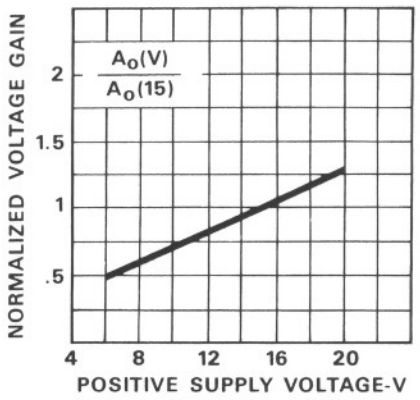


Fig. 3. Voltage Gain As A Function Of Supply Voltage

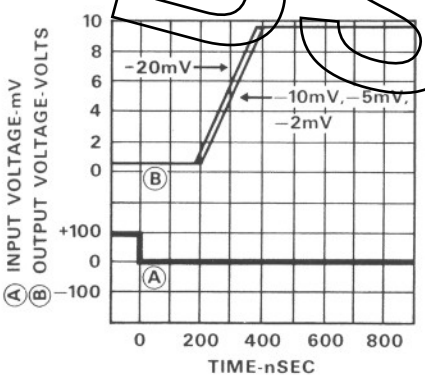


Fig. 4. Response Time For Various Input Overdrives

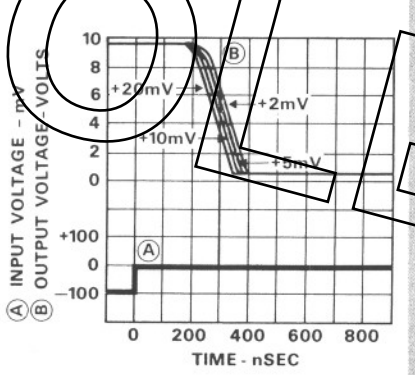


Fig. 5. Response Time For Various Input Overdrives

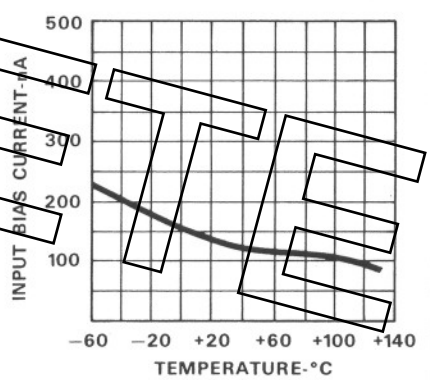


Fig. 6. Input Bias Current As A Function Of Ambient Temperature

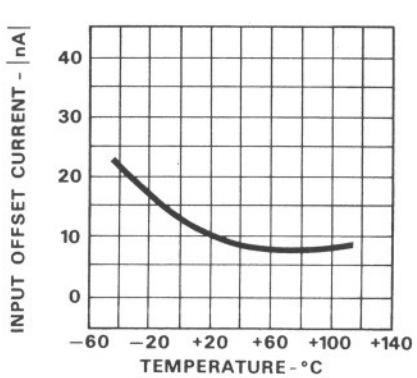


Fig. 7. Input Offset Current As A Function Of Ambient Temperature

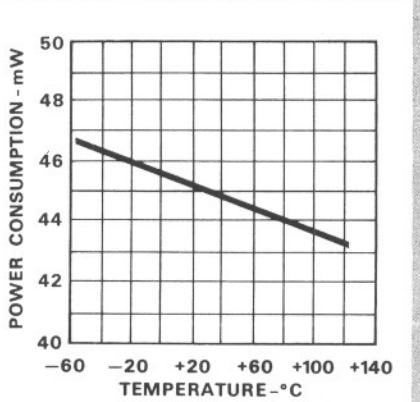
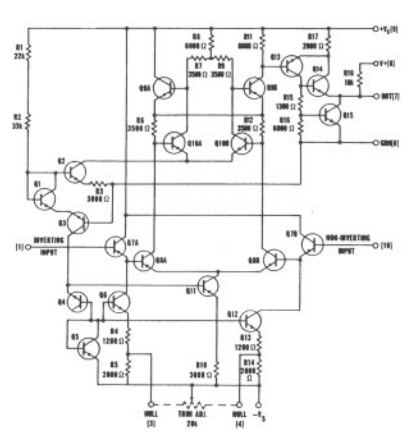


Fig. 8. Power Consumption As A Function Of Ambient Temperature



SCHEMATIC DIAGRAM

UNIQUE ADVANTAGES OF THE MODEL AD351

HIGH BREAKDOWN VOLTAGE

The manufacturing process chosen for Model 351 incorporates 5 ohm-centimeter material and eliminates the gold doping process, resulting in a number of significant performance improvements. One of the most salient is higher breakdown voltage. This enables the Model 351 to operate directly from ±15VDC power supplies, making it compatible with analog systems designed around standard operational amplifiers. Another advantage is high common mode voltage range of ±10V min., thus, directly accepting signal levels typical of op amp outputs. These two features eliminate the need for additional external circuitry 1) to reduce power supply voltage to +12,–6VDC , as is common with μA 710 designs, and 2) to protect input circuitry from overvoltage (±7V is maximum with other ICs.) Figure 9 illustrates typical additional circuitry required with conventional IC Comparators.

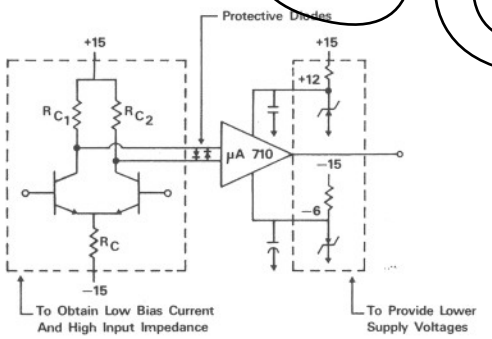


FIGURE 9. Additional Circuitry Required For μA 710 To Achieve Some Of The Performance Of Model 351

LOWER INPUT CURRENTS & HIGH INPUT IMPEDANCE

Often it is necessary to add input circuitry to the μA 710, LM 306, and others, to reduce the input bias and offset currents and increase input impedance to reduce resolution errors due to bias-caused voltage drops in the source resistance. The low bias and offset currents, low temperature sensitivity, and $10^7\Omega$ input impedance of the Model 351 eliminate this need. Improvements of 1-2 orders of magnitude are attained. Higher source impedances can be accepted with yet less error caused by I_bR_s and $R_s\Delta I_b/\Delta T$. Fig. 9 also shows the inconvenience and added cost resulting from the extra input circuitry required with conventional IC Comparators.

VOLTAGE OFFSET ZERO-ABILITY AND HIGH GAIN

The ability easily to trim offset voltage to zero, combined with high voltage gain and high common mode rejection, results in improved input resolution, formerly attainable only with discrete designs. The μA 710 and many of its successors suffer from fixed offset and low gain, thus only allowing applications where crude resolution is acceptable. (Note that with gain of 1000, an input difference of 5 millivolts is required to produce a 5V output swing).

PRECAUTIONS

As is necessarily the case with high gain comparators, the user should use caution when laying out the Model AD 351 and its associated circuitry. These and other high gain comparators are very sensitive to stray capacitances between the output and the positive input and/or the trim terminals. Naturally, the power-supply should be adequately by-passed.

For many applications, it is desirable that hysteresis be employed to provide a small deadband. This also speeds response through the linear region and minimizes noise susceptibility. As a further measure, the frequency response should be limited to suit the application to avoid any spurious spikes that may occur.*

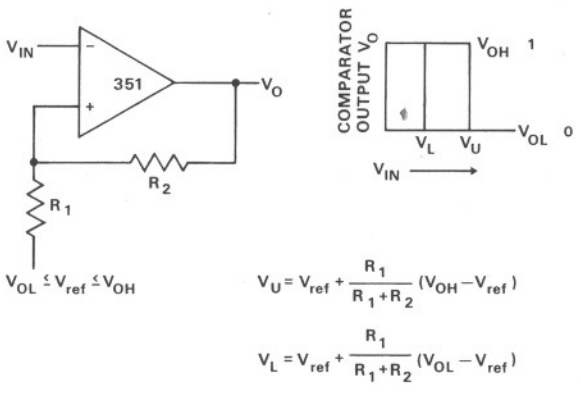


FIGURE 10. Comparison Of Like Polarity Signals With Hysteresis

*The user is welcome to contact the factory or local representative for further applications assistance.