

### Description

The  $\mu$ PC624 is a monolithic multiplying digital-to-analog converter designed for high speed performance and design/application flexibility. Advanced circuit design allows settling time of 85 ns. The outputs are high impedance dual complementary current types, which allow simple resistive loading, op-amp voltage conversion, and other configurations. The adjustable threshold logic input allows connection to all popular logic families.

### Features

- ☐ Wide range multiplying capability
- ☐ Wide power supply range  $\pm 5$  V to  $\pm 18$  V
- ☐ High output impedance and compliance
- ☐ Variable logic threshold
- ☐ Direct interface to TTL, CMOS, PMOS
- ☐ Differential current outputs
- ☐ Pin to pin compatible with PMI'S DAC-08

### Ordering Information

| Part Number  | Package     | Operating Temperature Range |
|--------------|-------------|-----------------------------|
| $\mu$ PC624C | Plastic DIP | -20°C to +70°C              |
| $\mu$ PC624D | Ceramic DIP | -20°C to +80°C              |

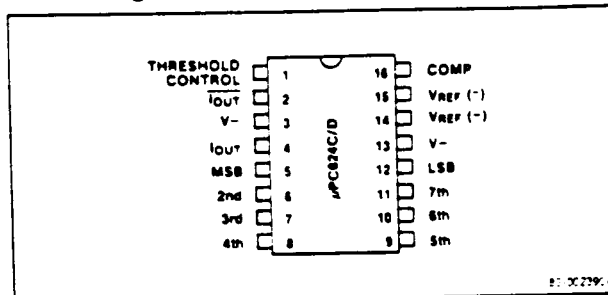
### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$

|                                        |                                 |
|----------------------------------------|---------------------------------|
| Supply Voltage                         | 36 V                            |
| Logic Inputs                           | $V^-$ to $(V^- - 36 \text{ V})$ |
| Logic Threshold Control Voltage        | $V^-$ to $V^-$                  |
| Analog Current Outputs                 | 4.2 mA                          |
| Reference Inputs                       | $V^-$ to $V^-$                  |
| Reference Input Differential Voltage   | $\pm 18 \text{ V}$              |
| Reference Input Current                | 5.0 mA                          |
| Power Dissipation, D or C Package      | 500 mW                          |
| Operating Temperature Range, D Package | -20 to +80°C                    |
| Operating Temperature Range, C Package | -20 to +70°C                    |
| Storage Temperature Range, D Package   | -55 to +150°C                   |
| Storage Temperature Range, C Package   | -55 to +125°C                   |

**Comment:** Stress 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.

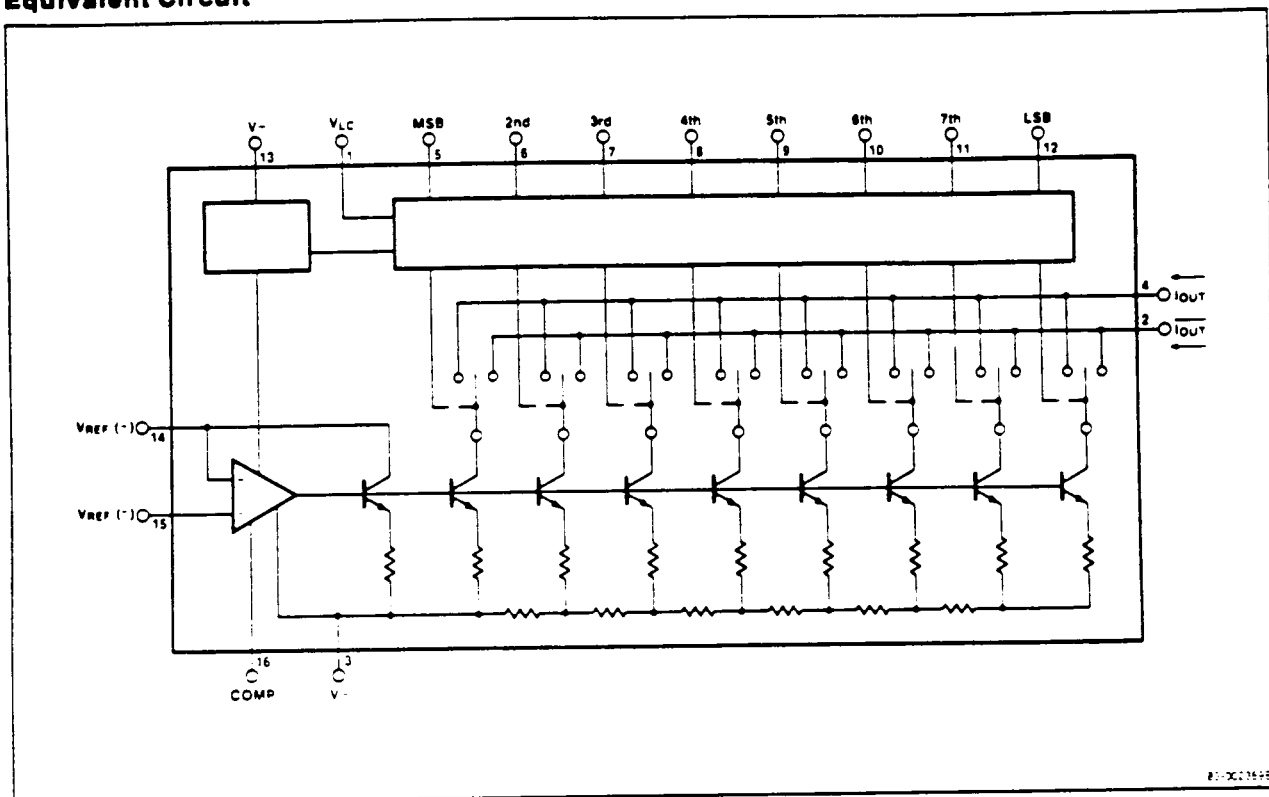
### Pin Configuration



### Pin Identification

| Pin | Name              | Function                   |
|-----|-------------------|----------------------------|
| 1   | Threshold Control |                            |
| 2   | IOUT              | Current Output             |
| 3   | V-                | Power Supply Negative      |
| 4   | IOUT              | Current Output             |
| 5   | MSB               | Data Bit 1                 |
| 6   | 2nd               | Data Bit 2                 |
| 7   | 3rd               | Data Bit 3                 |
| 8   | 4th               | Data Bit 4                 |
| 9   | 5th               | Data Bit 5                 |
| 10  | 6th               | Data Bit 6                 |
| 11  | 7th               | Data Bit 7                 |
| 12  | LSB               | Data Bit 8                 |
| 13  | V-                | Power Supply Positive      |
| 14  | VREF-             | Positive Reference Voltage |
| 15  | VREF-             | Negative Reference Voltage |
| 16  | Compensation      | Amp Compensation           |

Equivalent Circuit



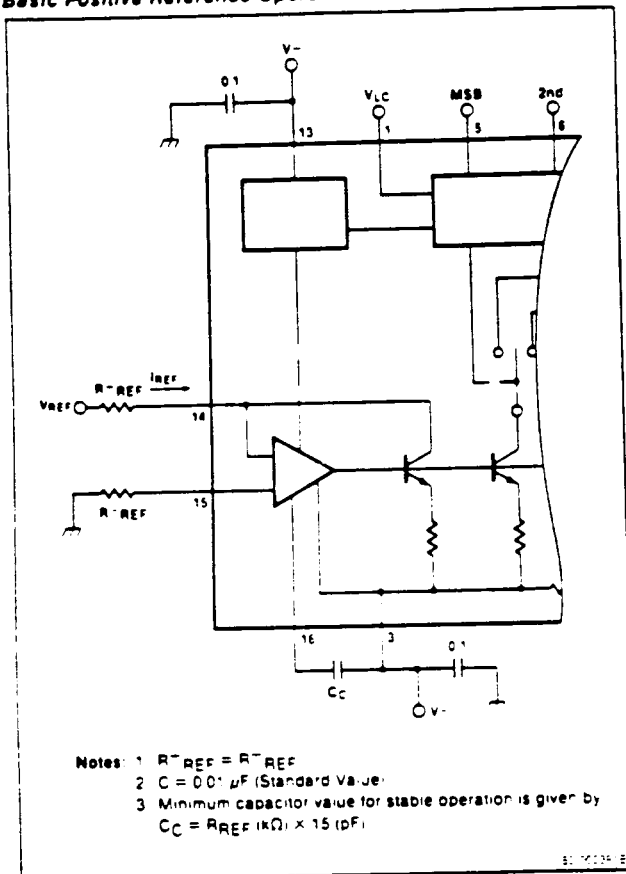
## Electrical Characteristics

$T_A = +25^\circ\text{C}$ ,  $V_{EE} = \pm 15\text{ V}$ ,  $I_{REF} = 2.0\text{ mA}$

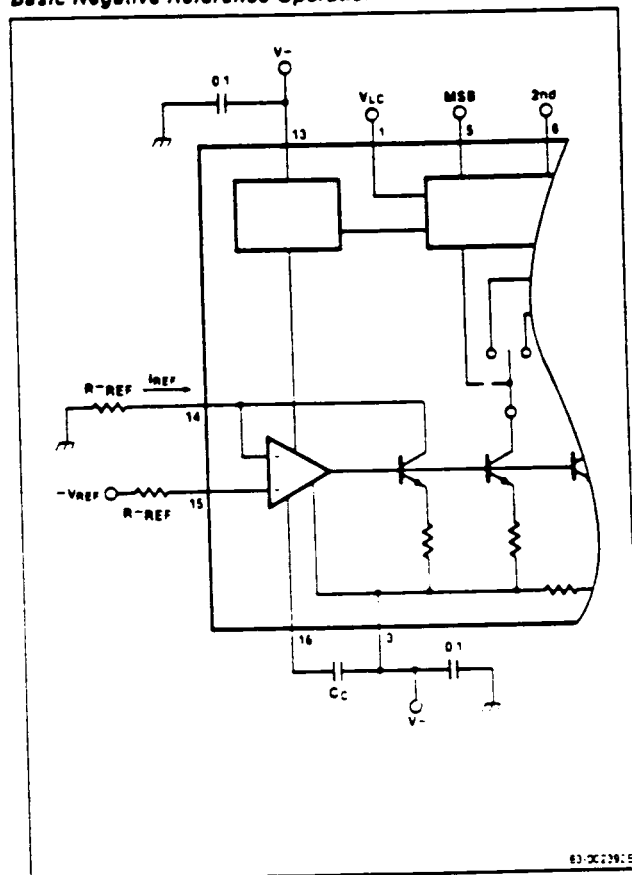
| Parameter                            | Symbol                    | Limits |           |           | Unit                  | Test Conditions                                                     |
|--------------------------------------|---------------------------|--------|-----------|-----------|-----------------------|---------------------------------------------------------------------|
|                                      |                           | Min.   | Typ.      | Max.      |                       |                                                                     |
| Resolution                           |                           | 8      | 8         | 8         | Bit                   |                                                                     |
| Monotonicity                         |                           | 8      | 8         | 8         | Bit                   |                                                                     |
| Nonlinearity                         | NL                        |        |           | 0.19      | %FSR                  |                                                                     |
| Settling Time                        | $T_S$                     |        | 85        | 150       | ns                    | $\pm 1/2$ LSB, $R_L \leq 50\ \Omega$ All bits ON/OFF                |
| Full Scale Temperature Coefficient   |                           |        | 10        | 50        | ppm/ $^\circ\text{C}$ |                                                                     |
| Output Voltage Compliance            | $V_{OC}$                  | -10    |           | +18       | V                     | $\Delta I_{FS} \leq 1/2$ LSB                                        |
| Full Scale Current                   | $I_{FS}$                  | 1.94   | 1.99      | 2.04      | mA                    | $V_{REF} = 10.000\text{ V}$ , $R_{REF} = 5.000\text{ k}\Omega$      |
| Full Scale Symmetry                  | $I_{FS} - I_{FS}$         |        | $\pm 1.0$ | $\pm 8.0$ | $\mu\text{A}$         |                                                                     |
| Zero Scale Offset Current            | $I_{ZS}$                  |        | 0.2       | 2.0       | $\mu\text{A}$         |                                                                     |
| Output Current Range                 | $I_O$                     | 0      | 2.0       | 2.1       | mA                    | $V^- = 5.0\text{ V}$                                                |
|                                      |                           | 0      | 2.0       | 4.2       | mA                    | $V^- = 8.0\text{ V to } -18\text{ V}$                               |
| Low Level Input Voltage              | $V_{IL}$                  |        |           | 0.8       | V                     | $V_{LC} = 0\text{ V}$ , Bit "OFF"                                   |
| High Level Input Voltage             | $V_{IH}$                  | 2.0    |           |           | V                     | $V_{LC} = 0\text{ V}$ , Bit "ON"                                    |
| Low Level Input Current              | $I_{IL}$                  |        | -2.0      | -10       | $\mu\text{A}$         | $V_{LC} = 0\text{ V}$ , $V_{IN} = -10\text{ V to } -0.8\text{ V}$   |
| High Level Input Current             | $I_{IH}$                  |        | 0.002     | 10        | $\mu\text{A}$         | $V_{LC} = 0\text{ V}$ , $V_{IN} = 2.0\text{ V to } 18\text{ V}$     |
| Logic Input Swing                    | $V_{IS}$                  | -10    |           | -18       | V                     |                                                                     |
| Logic Threshold Range                | $V_{TH}$                  | -10    |           | -13.5     | V                     | $V_{TH} \approx V_{LC} - 1.3\text{ V}$                              |
| Reference Bias Current               | $I_{b-}$                  |        |           | -3        | $\mu\text{A}$         |                                                                     |
| Reference Input Slew Rate            | $\Delta I_{REF}/\Delta T$ | 4.0    | 8.0       |           | mA/ $\mu\text{s}$     | $R_{REF} \leq 200\ \Omega$ , $C_C = 0\text{ pF}$                    |
| Power Supply Voltage Rejection Ratio | $SVRR - V$                |        | 0.0003    | 0.01      | %FSR/ $\%$            | $V^- = 4.5\text{ to } 18\text{ V}$ , $I_{REF} = 1\text{ mA}$        |
|                                      | $SVRR - V$                |        | 0.002     | 0.01      | %FSR/ $\%$            | $V^- = -4.5\text{ to } -18\text{ V}$ , $I_{REF} = 1\text{ mA}$      |
| Power Supply Current                 | $I^-$                     |        | 2.5       | 3.8       | mA                    |                                                                     |
|                                      | $I^-$                     |        | -6.5      | -7.8      | mA                    |                                                                     |
|                                      | $I^-$                     |        | 2.4       | 3.8       | mA                    | $V^- = 5\text{ V}$ , $V^+ = -15\text{ V}$ , $I_{REF} = 2\text{ mA}$ |
|                                      | $I^-$                     |        | -6.4      | -7.8      | mA                    | $V^- = 5\text{ V}$ , $V^+ = -15\text{ V}$ , $I_{REF} = 2\text{ mA}$ |
|                                      | $I^-$                     |        | 2.3       | 3.8       | mA                    | $V^\pm = \pm 5\text{ V}$ , $I_{REF} = 1\text{ mA}$                  |
|                                      | $I^-$                     |        | -4.3      | -5.8      | mA                    | $V^\pm = \pm 5\text{ V}$ , $I_{REF} = 1\text{ mA}$                  |

## Typical Applications

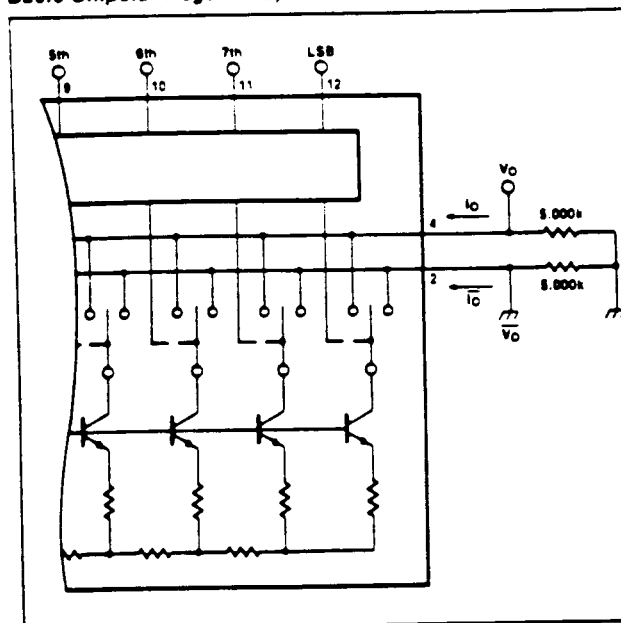
### Basic Positive Reference Operation



### Basic Negative Reference Operation



### Basic Unipolar Negative Operation

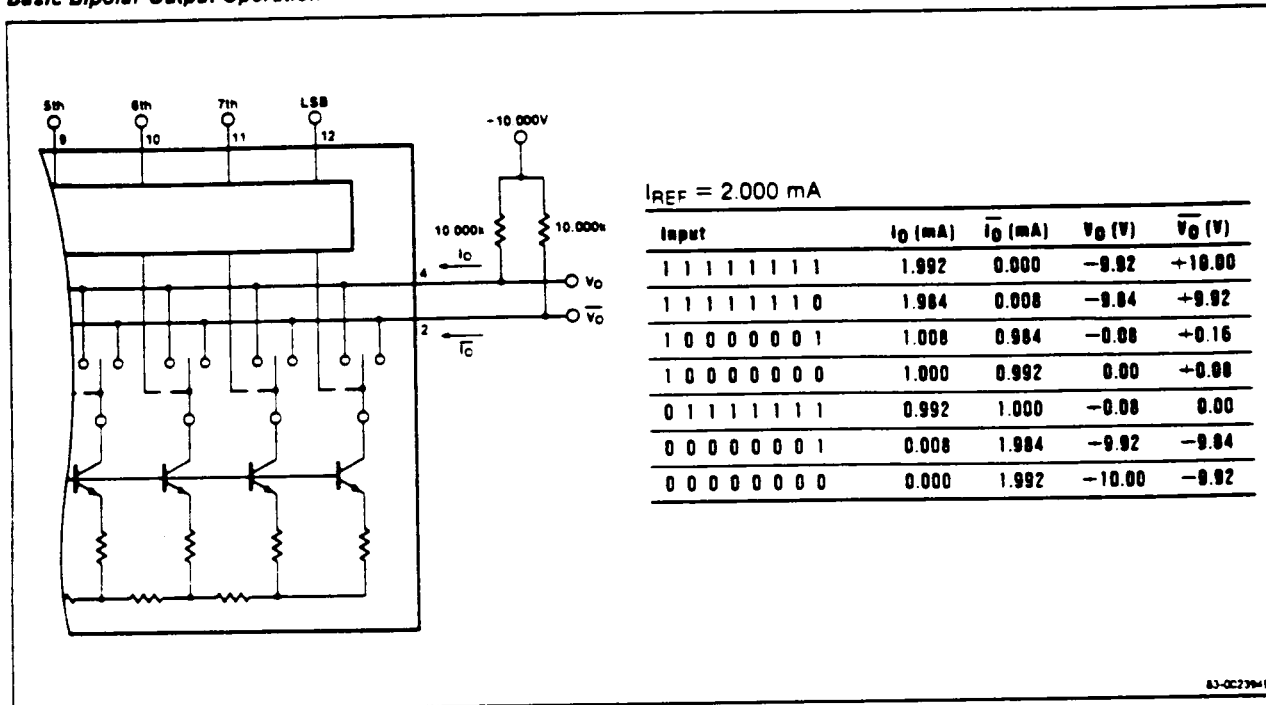


$I_{REF} = 2.000 \text{ mA}$

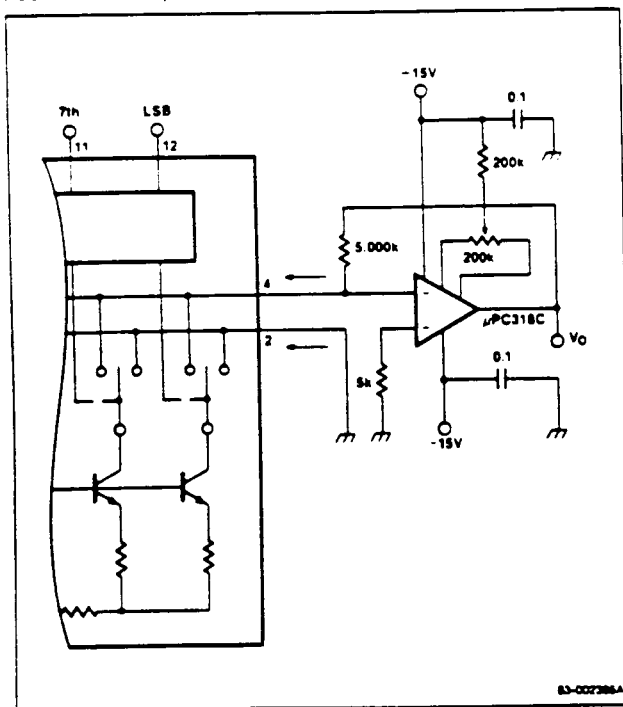
| Input         | $I_O (\text{mA})$ | $\bar{I}_O (\text{mA})$ | $V_O (\text{V})$ | $\bar{V}_O (\text{V})$ |
|---------------|-------------------|-------------------------|------------------|------------------------|
| 1 1 1 1 1 1 1 | 1.992             | 0.000                   | -9.96            | 0.00                   |
| 1 1 1 1 1 1 0 | 1.984             | 0.008                   | -9.92            | -0.04                  |
| 1 0 0 0 0 0 1 | 1.008             | 0.994                   | -5.04            | -4.92                  |
| 1 0 0 0 0 0 0 | 1.000             | 0.992                   | -5.00            | -4.96                  |
| 0 1 1 1 1 1 1 | 0.992             | 1.000                   | -4.96            | -5.00                  |
| 0 0 0 0 0 0 1 | 0.008             | 1.984                   | -0.04            | -9.92                  |
| 0 0 0 0 0 0 0 | 0.000             | 1.992                   | 0.00             | -9.96                  |

## Typical Applications (Cont.)

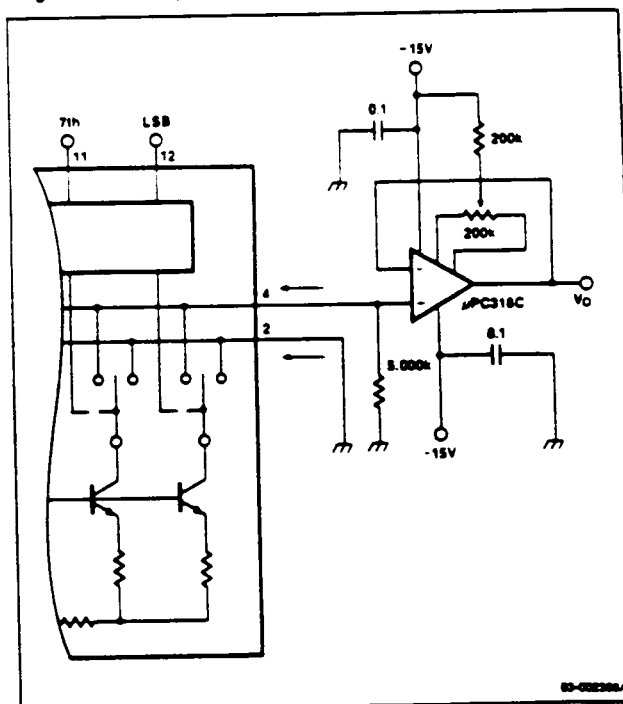
### Basic Bipolar Output Operation



### Positive Low Impedance Output Operation

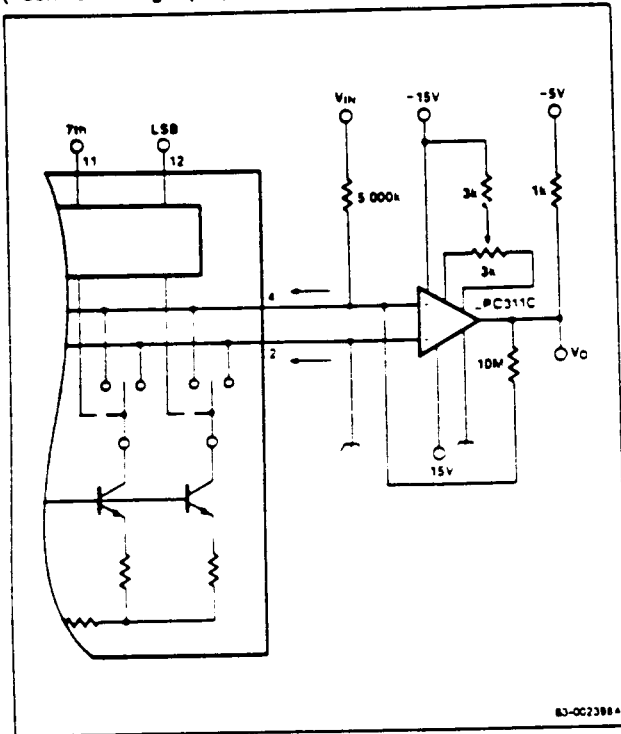


### Negative Low Impedance Output Operation

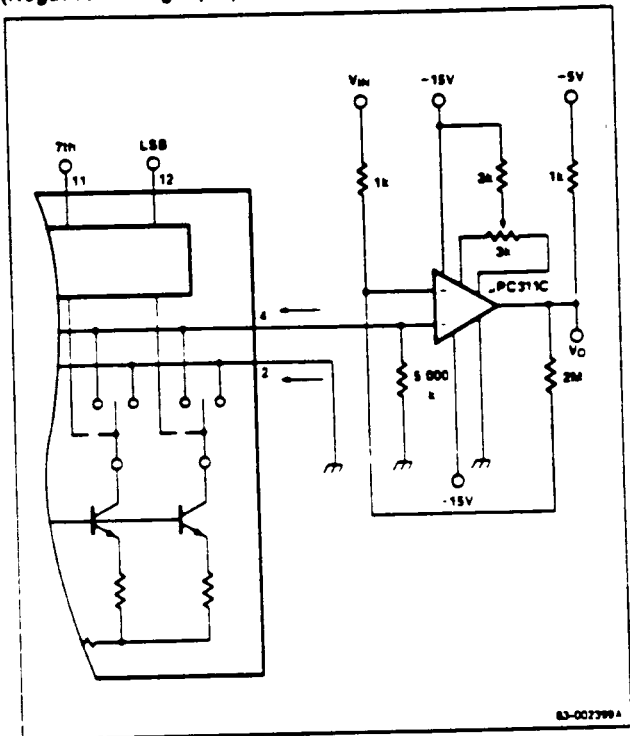


### Typical Applications (Cont.)

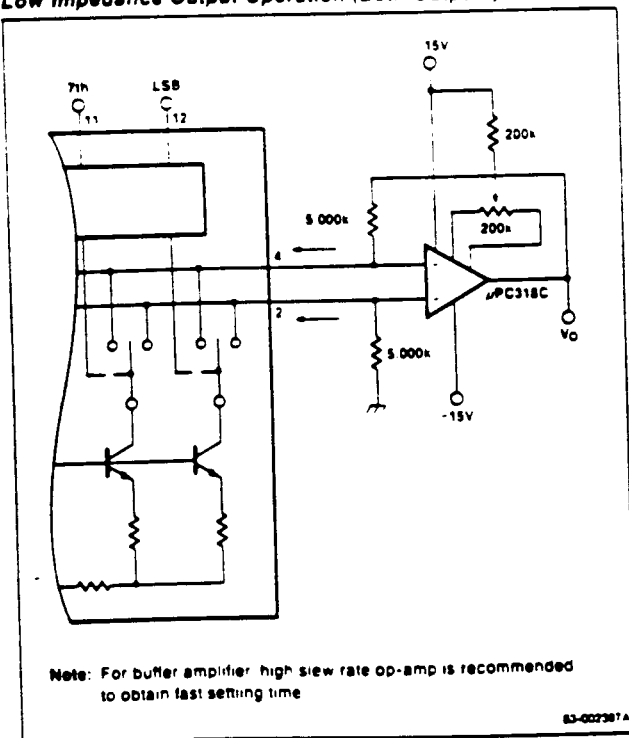
Comparator Connection Method for A/D Conversion  
(Positive Analog Input)



Comparator Connection Method for A/D Conversion  
(Negative Analog Input)



Low Impedance Output Operation (Both Outputs)

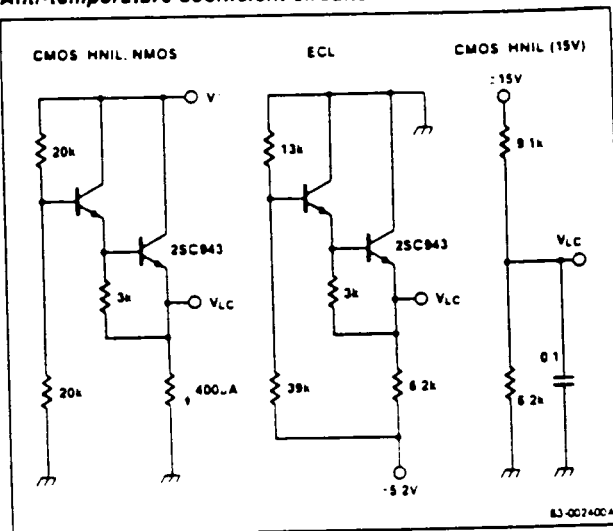


## Interfacing with Various Logic Families

The logic threshold is set about 1.4 V above  $V_{LC}$ . This enables TTL level acceptance by simply grounding pin 1. By placing an appropriate voltage at the logic threshold control pin (pin 1), various threshold values are available for the other logic families.

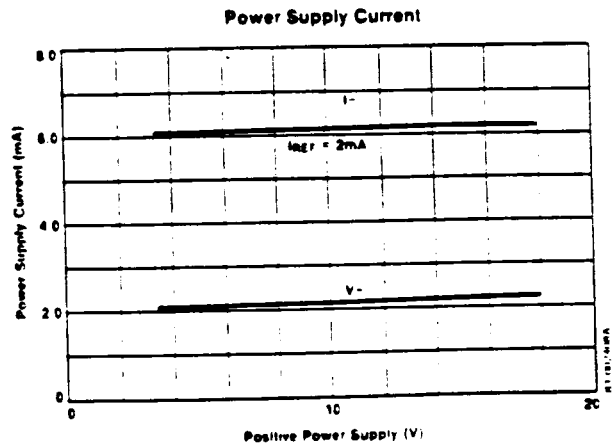
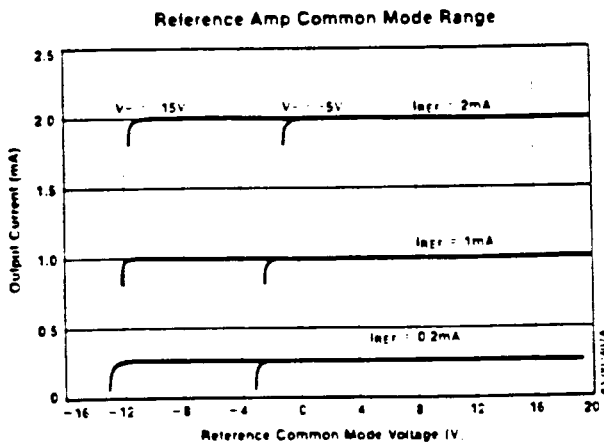
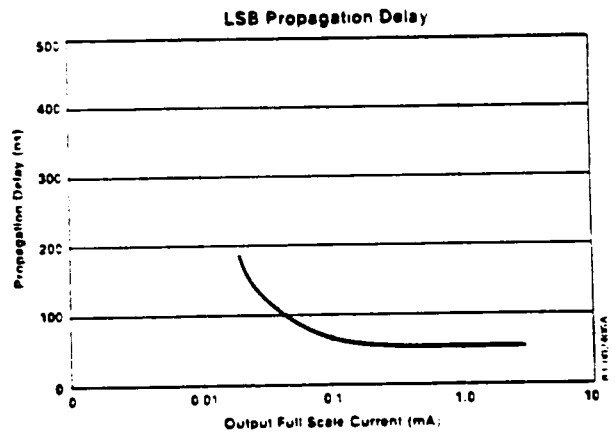
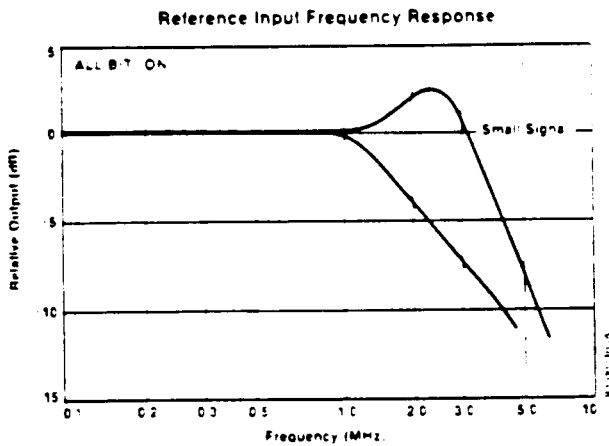
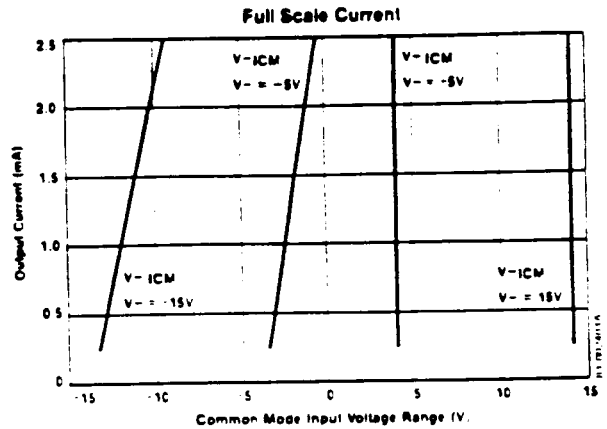
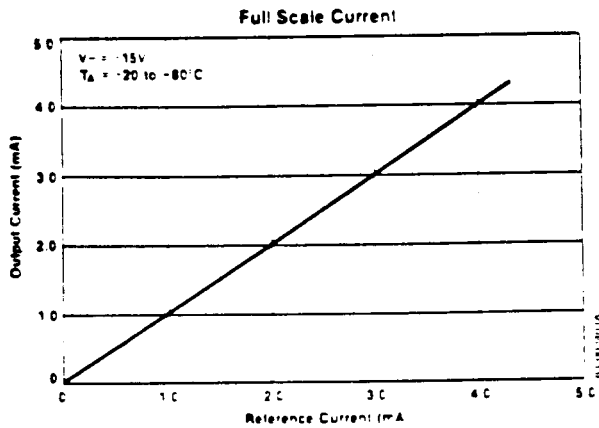
TTL interface permission gives the interval logic threshold  $-4 \text{ mV}/^{\circ}\text{C}$  temperature coefficient.  $V_{TH} = V_{LC} + 1.4 \text{ V} - 0.004 \text{ V} \times (T_A - 25^{\circ}\text{C})$ .

## Anti-temperature coefficient circuits



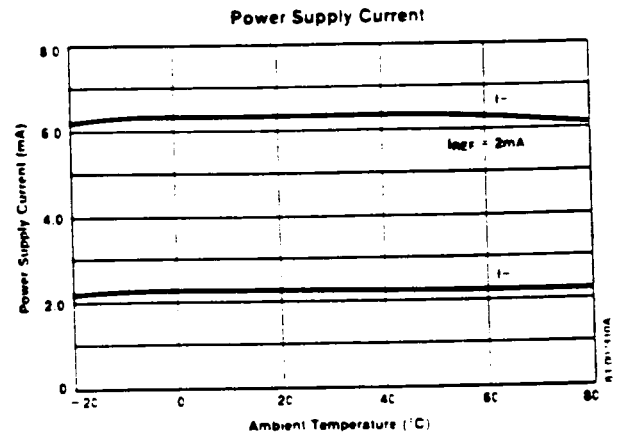
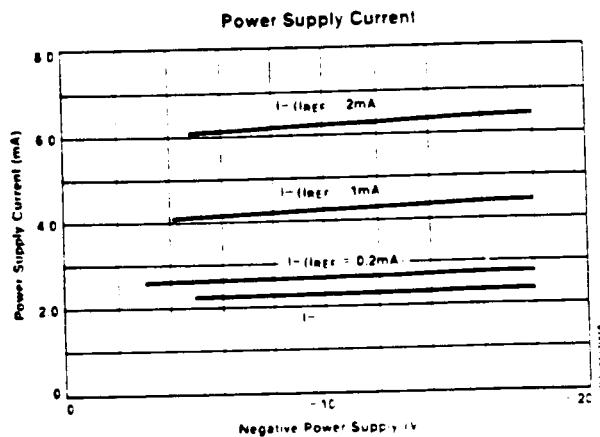
# Operating Characteristics

(T<sub>A</sub> = 25°C)



## Operating Characteristics (Cont.)

(T<sub>A</sub> = 25°C)



### A/D Conversion Program List

|                  |             |                                                                |                                           |
|------------------|-------------|----------------------------------------------------------------|-------------------------------------------|
| 0000             | MVI         | A 89H                                                          | : CONTROL WORD FOR 8255                   |
| 0002             | OUT         | (8255)                                                         | : PROGRAM TO 8255                         |
| 0004             | MVI         | B 80H                                                          | : BIT POINTER INITIALIZE                  |
| 0006             | MOV         | A B                                                            | : BIT SET WORD                            |
| 0007             | BIT TEST    | OUT (PORT B,                                                   | : BIT SET OUTPUT TO PB OF 8255            |
| 0009             | MOV         | C A                                                            |                                           |
| 000A             | NOP         |                                                                |                                           |
| 000B             | IN          | (PORT C)                                                       | : READ COMPARATOR                         |
| 000C             | RRC         |                                                                | : A <sub>0</sub> — CARRY FLG              |
| 000E             | JC          | DEC POINTER                                                    | : COMPARATOR TEST                         |
| 0011             | MOV         | A C                                                            |                                           |
| 0012             | SUB         | B                                                              | : BIT RESET                               |
| 0013             | MOV         | C A                                                            |                                           |
| 0014             | DEC POINTER | MOV A B                                                        |                                           |
| 0015             | RRC         |                                                                | : DECREMENT BIT POINTER                   |
| 0016             | JC          | RETURN                                                         | : LSB WAS TESTED?                         |
| 0019             | MOV         | B A                                                            |                                           |
| 001A             | ORA         | C                                                              | : NEW BIT SET WORD                        |
| 001B             | JMP         | BIT TEST                                                       |                                           |
| 001E             | RETURN      | RET (MAIN PROGRAM)                                             | : CONVERSION END & RETURN TO MAIN PROGRAM |
| PROGRAM MEMORY   |             | : 31 BYTE                                                      |                                           |
| CONVERSION TIME  |             | : 371 μs (741 STATE) MAX. 323 μs (645 STATE) MIN (@ φ = 2 MHz) |                                           |
| WORKING REGISTER |             | : B & C (C REGISTER, FINAL ANSWER MEMORY)                      |                                           |