

# NEC

NEC Electronics Inc.

## $\mu$ PC624 8-BIT HIGH-SPEED MULTIPLYING D/A CONVERTER

### 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

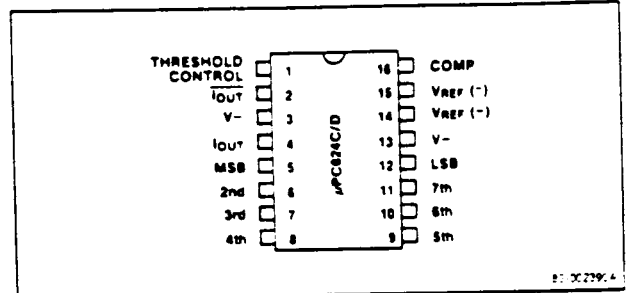
### Absolute Maximum Ratings

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

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.

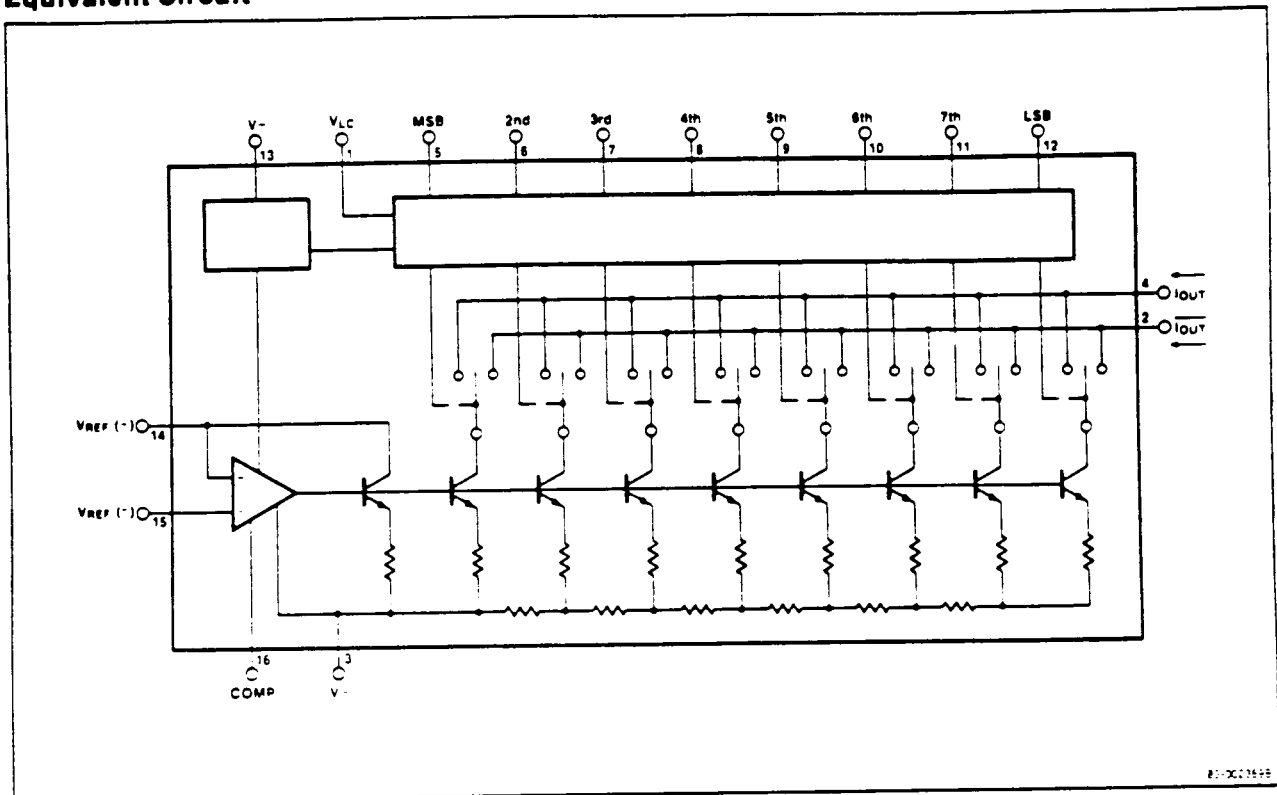
### Pin Configuration



### 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

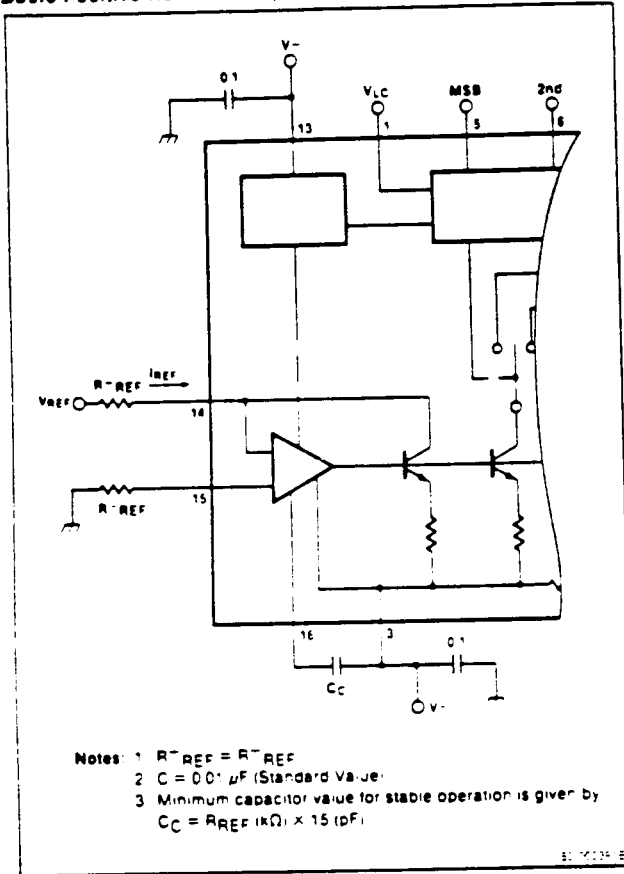
$T_A = +25^\circ\text{C}$ ,  $V_{\pm} = \pm 15\text{ V}$ ,  $I_{REF} = 2.0\text{ mA}$

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	$V_{TH} = V_{LC} - 1.3\text{ V}$
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/ $\%$	$V^- = 4.5\text{ to } 18\text{ V}$ , $I_{REF} = 1\text{ mA}$
			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	$V_{\pm} = \pm 5\text{ V}$ , $I_{REF} = 1\text{ mA}$

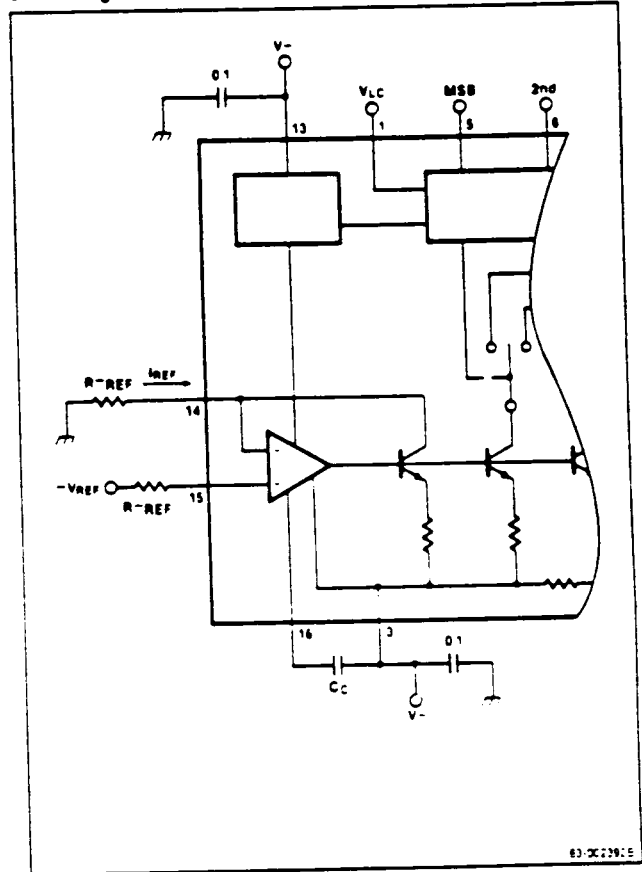
## μPC624

### Typical Applications

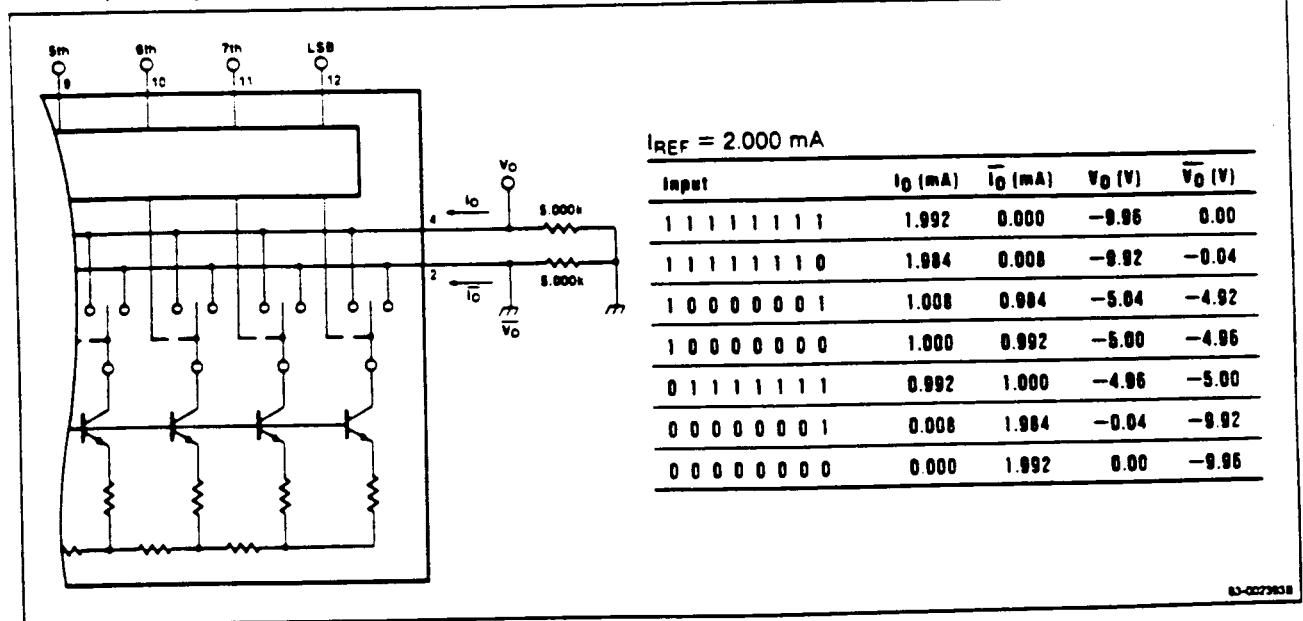
#### Basic Positive Reference Operation



#### Basic Negative Reference Operation

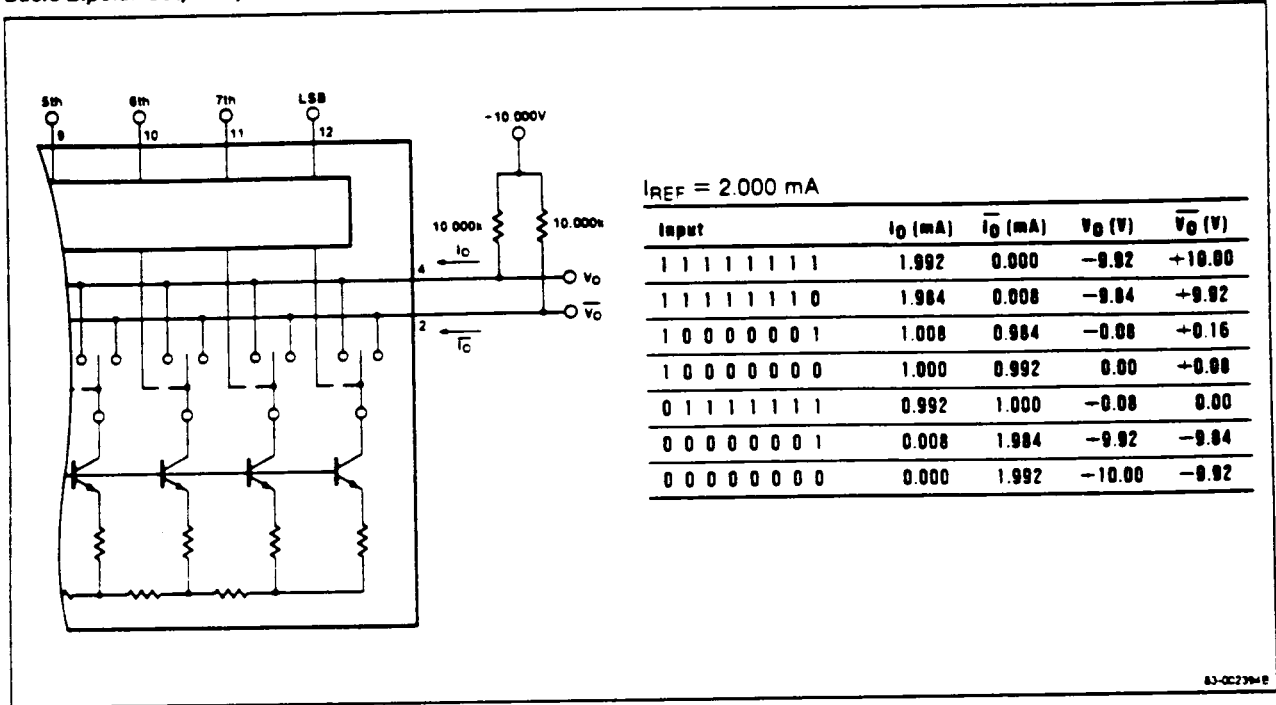


#### Basic Unipolar Negative Operation

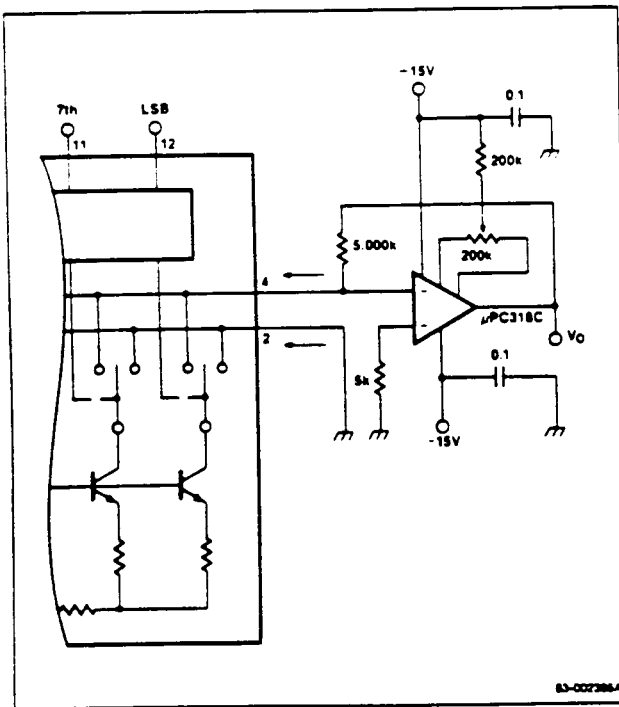


## Typical Applications (Cont.)

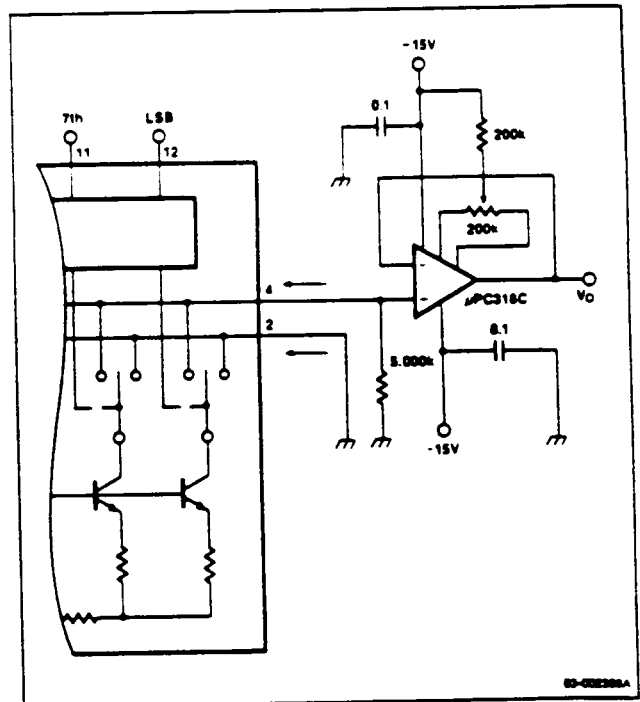
### Basic Bipolar Output Operation



### Positive Low Impedance Output Operation

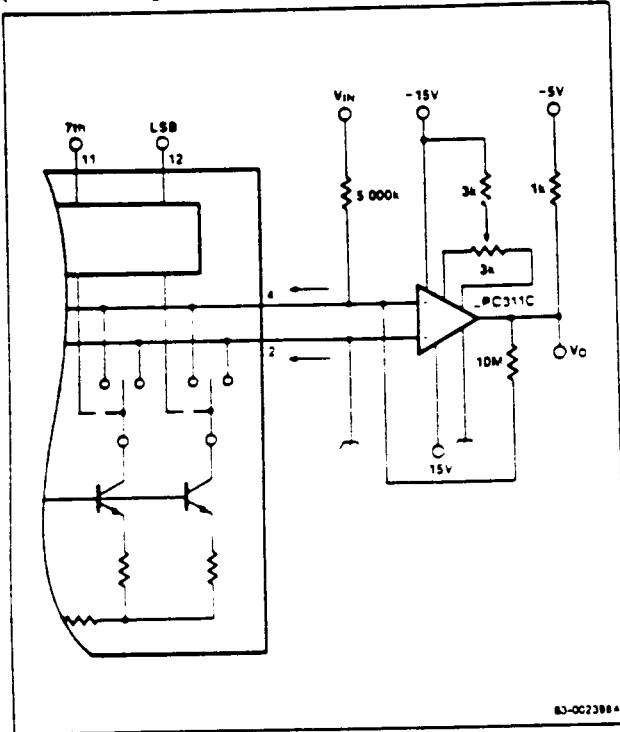


### Negative Low Impedance Output Operation

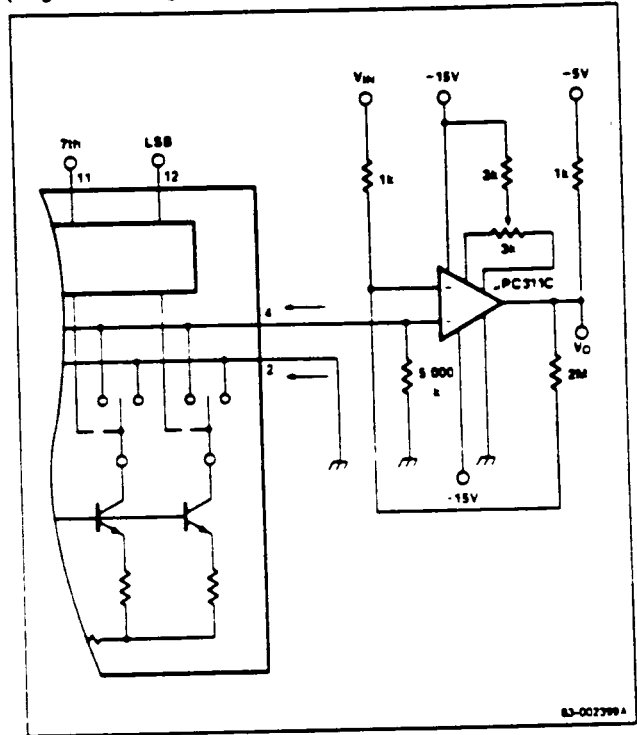


**Typical Applications (Cont.)**

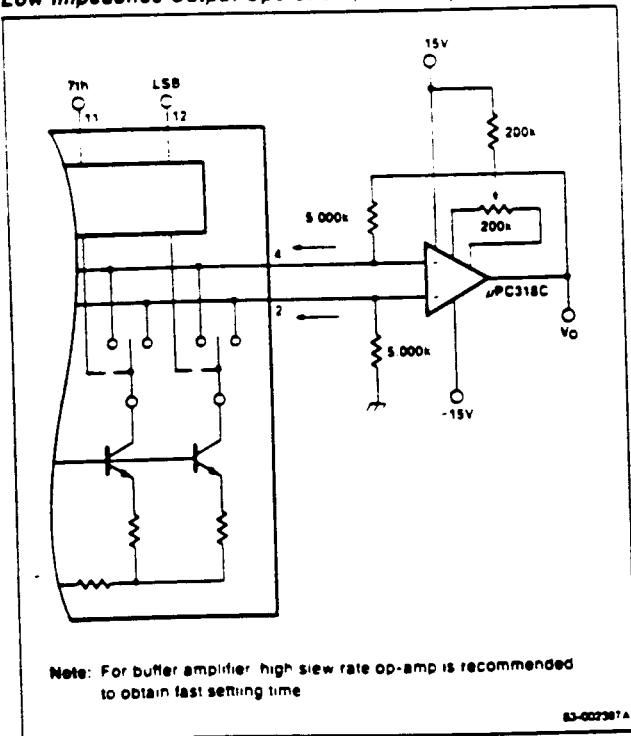
**Comparator Connection Method for A/D Conversion  
(Positive Analog Input)**



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



**Low Impedance Output Operation (Both Outputs)**

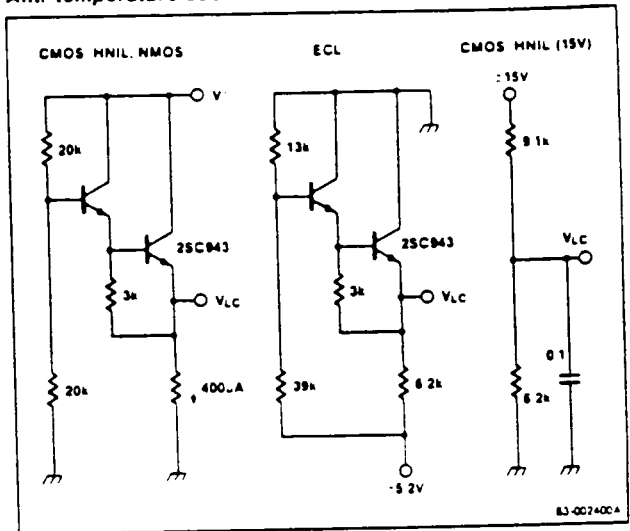


## Interfacing with Various Logic Families

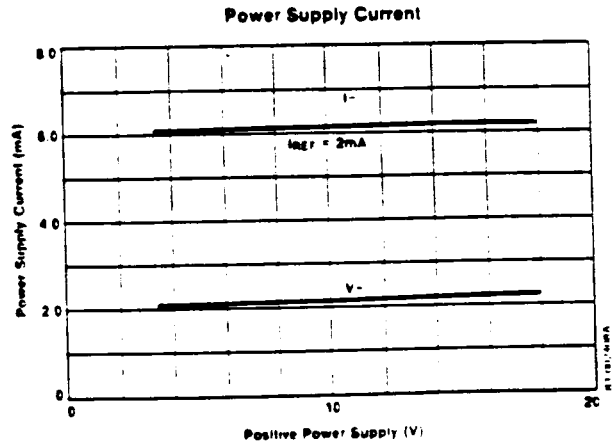
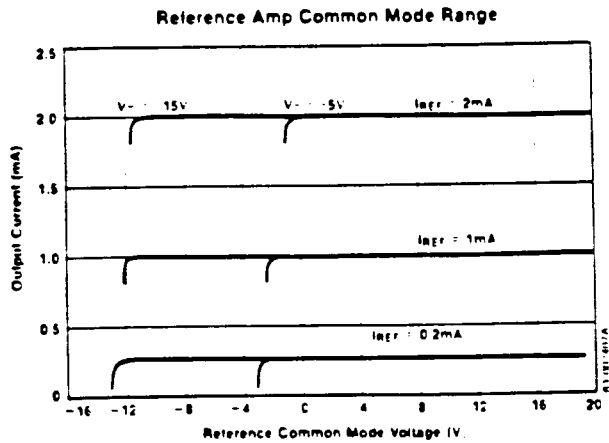
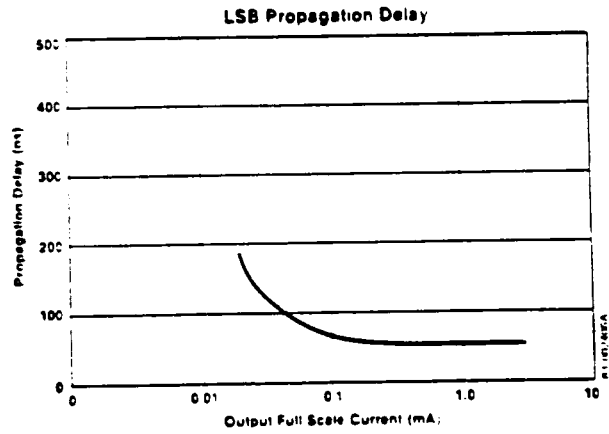
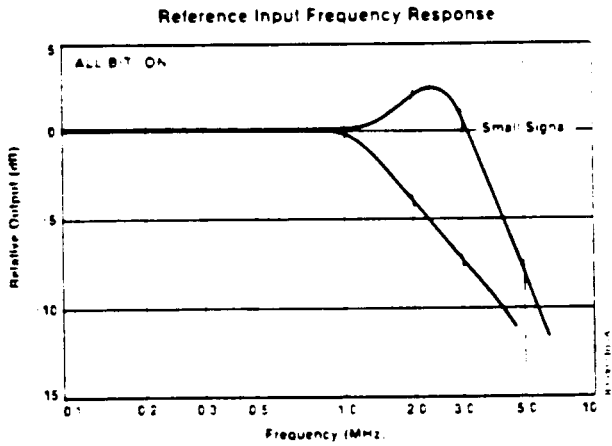
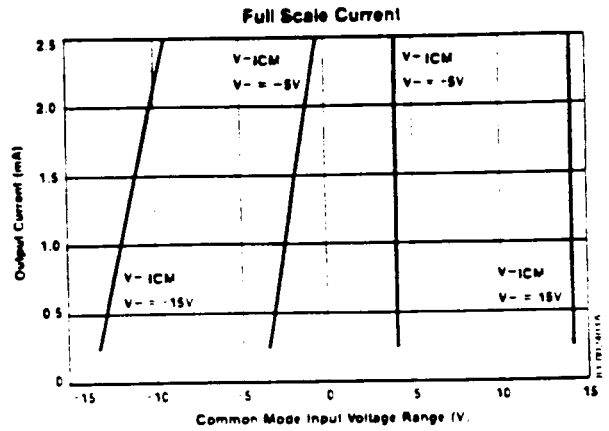
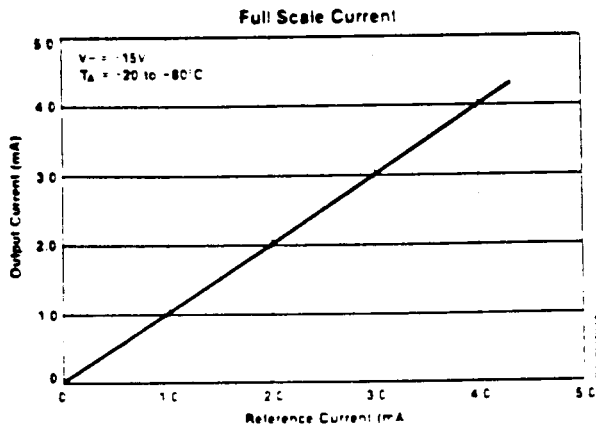
The logic threshold is set about 1.4 V above  $V_{LC}$ . This enables TTL level acceptance by simply grounding pin 1. By placing an appropriate voltage at the logic threshold control pin (pin 1), various threshold values are available for the other logic families.

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



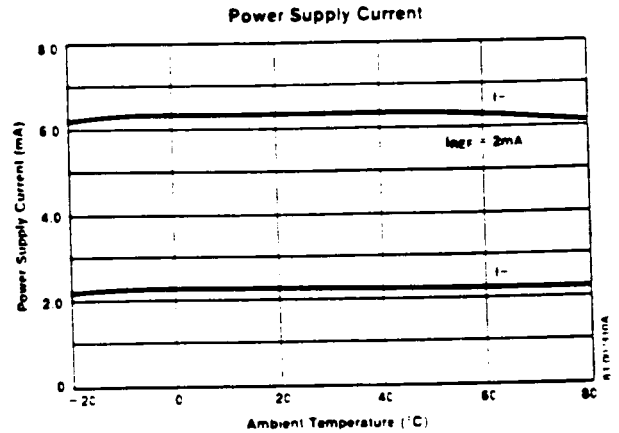
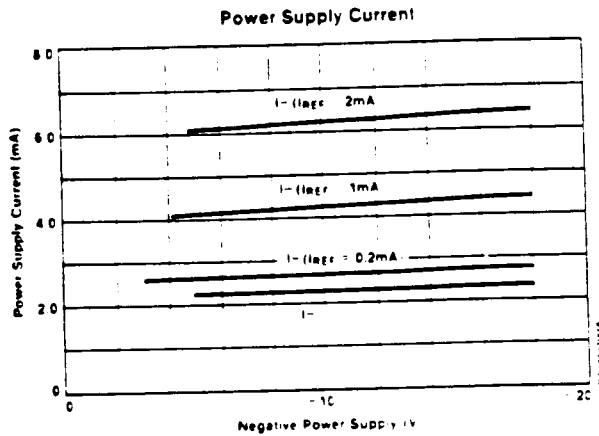
**Operating Characteristics**  
( $T_A = 25^\circ\text{C}$ )





## 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)	