



**MOTOROLA**

**Advance Information**

**MPU-BUS-COMPATIBLE  
8-BIT D-TO-A CONVERTER**

The MC6890 is a self-contained, bus-compatible, 8 bit ( $\pm 0.19\%$  accuracy) D-to-A converter system capable of interfacing directly with 8-bit microprocessors.

Available in both commercial and military temperature ranges, this monolithic converter contains master/slave registers to prevent transparency to data transitions during active enable; a laser-trimmed, low-TC, 2.5 V precision bandgap reference; and high stability, laser-trimmed, thin-film resistors for both reference input and output span and bipolar offset control.

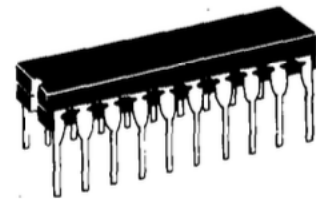
A reset pin provides for overriding stored data and forcing  $I_{out}$  to zero.

- Direct Data Bus Link with All Popular TTL Level MPU's
- $\pm 1/2$  LSB Nonlinearity Over Temperature
- Fast Settling Time: 200 ns Typ
- Internal 2.5-V Precision Laser-Trimmed Voltage Reference (May Also Be Used Externally)
- Minimum Enable Pulse Width: 70 ns
- Fast Enable: 10 ns Maximum Data Hold Time
- Reset Pin to Override Data
- Output Voltage Ranges: +5, +10, +20, or  $\pm 2.5$ ,  $\pm 5$ ,  $\pm 10$  Volts
- Low Power: 90 mW Typ
- +5 V and -5 V to -15 V Supplies

**MC6890**

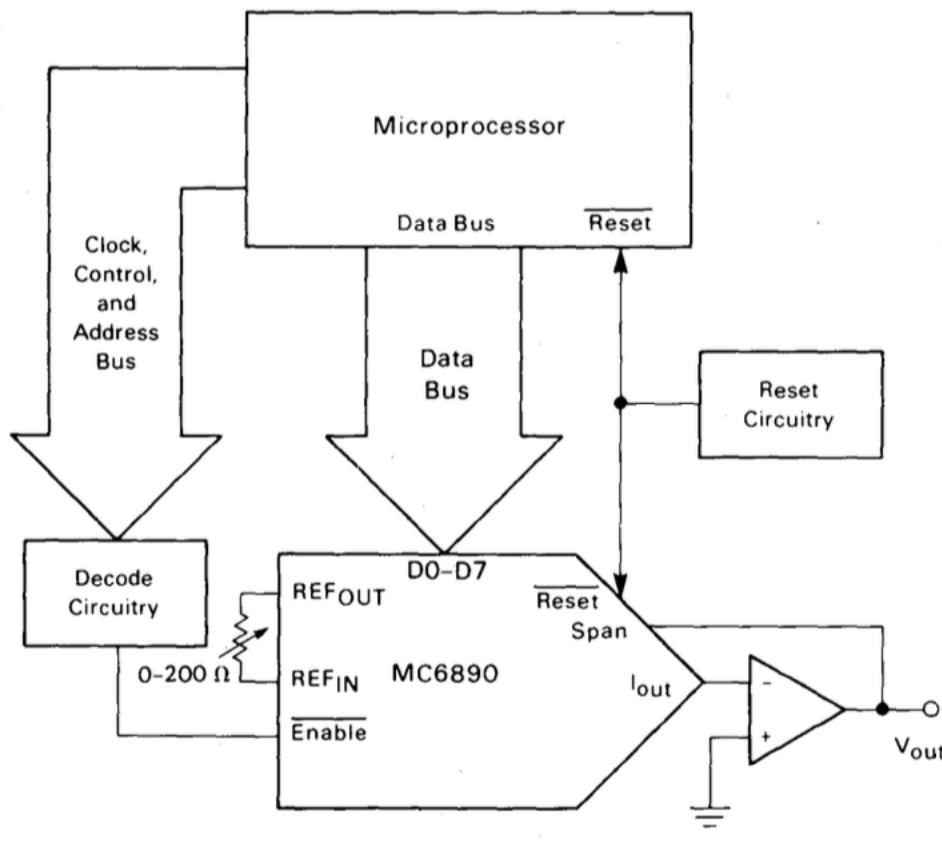
**8-BIT  
MPU-BUS-COMPATIBLE  
DAC**

**SILICON MONOLITHIC  
INTEGRATED CIRCUIT**

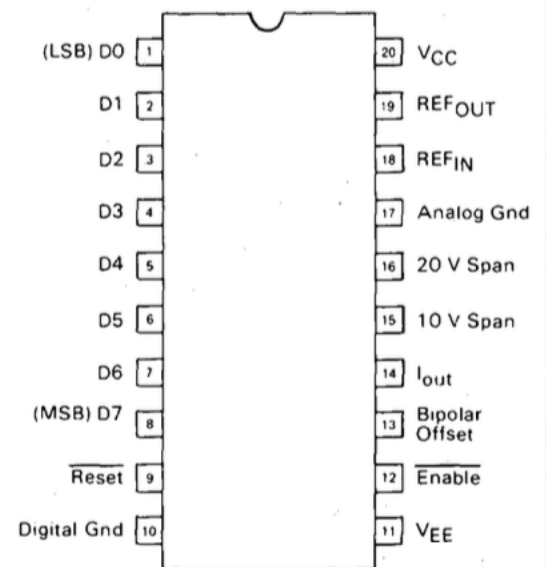


**L SUFFIX  
CASE 732-03**

**OPERATION WITH AN MPU**



**PIN CONNECTIONS**



**ORDERING INFORMATION**

Device	Temperature Range	Package
MC6890L	0° to +70°C	Ceramic DIP
MC6890AL	-55° to +125°C	Ceramic DIP

This document contains information on a new product. Specifications and information herein are subject to change without notice.

# MC6890

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	V <sub>CC</sub> V <sub>EE</sub>	+7.0 -18	Vdc
Digital Input Voltage, Pins 1-8, 12 Pin 9	V <sub>in</sub>	-3.0 to +7.0 0 to +7.0	Vdc
Applied Output Voltage	V <sub>14</sub>	V <sub>EE</sub> +2.0 to V <sub>EE</sub> +24	Vdc
Reference Amplifier Input	V <sub>18</sub>	±7.5	Vdc
Operating Temperature Range MC6890L, MC6890AL	T <sub>A</sub>	0 to +70 -55 to +125	°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C
Junction Temperature	T <sub>J</sub>	+150	°C

**ELECTRICAL CHARACTERISTICS** (V<sub>CC</sub> = 5.0 V, V<sub>EE</sub> = -12 V, Pin 18 loaded only by Pin 19 through 100 Ω. Reset high, T<sub>A</sub> = T<sub>low</sub> to T<sub>high</sub><sup>(1)</sup>, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Digital Input Logic Levels High Level, Logic 1 Low Level, Logic 0	V <sub>IH</sub> V <sub>IL</sub>	2.0 —	— —	— 0.8	Vdc
Digital Input Current Data (V <sub>IH</sub> = 3.0 V) (V <sub>IL</sub> = 0.4 V) Enable (V <sub>IH</sub> = 3.0 V) (V <sub>IL</sub> = 0.4 V) Reset (V <sub>IH</sub> = V <sub>CC</sub> ) (V <sub>IL</sub> = 0.4 V)	I <sub>IH</sub> I <sub>IL</sub> I <sub>IH</sub> I <sub>IL</sub> I <sub>IH</sub> I <sub>IL</sub>	— — — — — —	0.001 0.5 0.001 -6.5 0.001 -1.0	1.0 -10 1.0 -100 1.0 -15	μA μA μA μA μA μA
Full Scale Output Current — Unipolar	I <sub>O</sub>	-1.50	-1.992	-2.50	mA
Unipolar Zero Output — All Bits Off (T <sub>A</sub> = 25°C)	—	—	0.010	0.20	μA
Output Voltage Temperature Coefficient  Unipolar Zero Bipolar Zero Full Scale Range	TC <sub>VO</sub>	— — —	±1.0 ±5.0 ±20	±2.0 ±15 ±50	ppm of FSR/°C
Output Voltage, Full Scale Range (See Figure 3) (T <sub>A</sub> = 25°C) (10 V Span) (20 V Span) (5.0 V Span)	V <sub>O</sub>	9.861 19.722 4.930	9.961 19.922 4.980	10.061 20.122 5.030	Vdc
Output Voltage, Bipolar Zero (MSB on) (See Figure 4) (T <sub>A</sub> = 25°C) (10 V Span) (20 V Span) (5.0 V Span)	V <sub>O</sub>	— — —	0 0 0	±20 ±40 ±10	mV
DAC Output Resistance — Exclusive of Span Resistors (T <sub>A</sub> = 25°C) (See Figure 5)	R <sub>O</sub>	1.0	5.0	—	MΩ
Resolution	—	8.0	8.0	8.0	Bits
Nonlinearity — Relative Accuracy (See Terminology)	NL	—	—	±0.19 (±1/2 LSB)	%
Differential Nonlinearity	Monotonicity Guaranteed				
Differential Nonlinearity (T <sub>A</sub> = 25°C) (See Terminology)	—	—	—	±0.29 (±3/4 LSB)	%
Reference Input Resistor	R <sub>REF</sub>	3800	4900	6800	Ω
Reference Output Voltage (T <sub>A</sub> = 25°C)	V <sub>REF</sub>	2.470	2.500	2.530	Vdc
Reference Output Impedance (T <sub>A</sub> = 25°C) I <sub>load</sub> = 0-3.0 mA	—	—	0.3	1.0	Ω
Reference Short Circuit Current (T <sub>A</sub> = 25°C)	I <sub>REF</sub>	15	30	50	mA
Reference Output Voltage Temperature Coefficient	TC <sub>VO(REF)</sub>	—	±20	—	ppm/°C
Power Supply Range	V <sub>CC</sub> V <sub>EE</sub>	4.5 -16.5	5.0 -12	5.5 -4.5	Vdc
Power Supply Current — All Bits Low (V <sub>CC</sub> = 5.0 V) (V <sub>EE</sub> = -5.0 V) (V <sub>EE</sub> = -15 V)	I <sub>CC</sub> I <sub>EE</sub> I <sub>EE</sub>	— — —	10 -10 -10	20 -15 -15	mA
Power Supply Rejection (T <sub>A</sub> = 25°C) To V <sub>CC</sub> (V <sub>CC</sub> = 4.5 to 5.5 V) To V <sub>EE</sub> (V <sub>EE</sub> = -4.5 V to -16.5 V)	PSR	— —	0.010 0.10	±1/10 ±1/2	LSB
Power Dissipation — All Bits Low For V <sub>CC</sub> = 4.5 V, V <sub>EE</sub> = -4.5 V For V <sub>CC</sub> = 5.5 V, V <sub>EE</sub> = -16.5 V	P <sub>D</sub>	— —	90 220	158 358	mW

NOTE 1: T<sub>low</sub> = -55°C for MC6890A, 0° for MC6890  
T<sub>high</sub> = +125°C for MC6890A, +70°C for MC6890

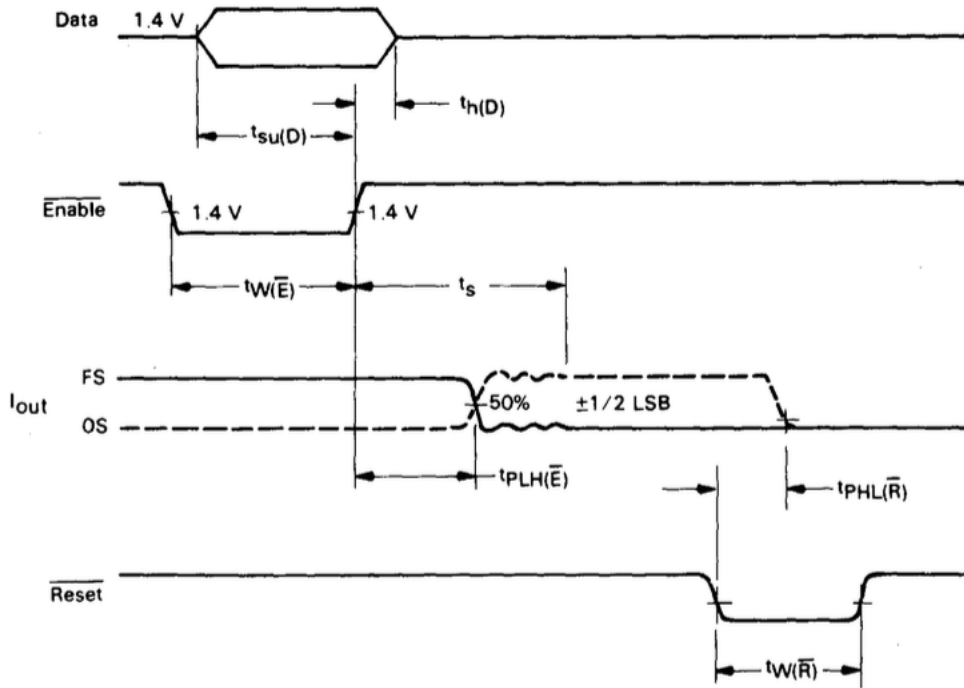
# MC6890

**AC SPECIFICATIONS** ( $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = -12\text{ V}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted.)

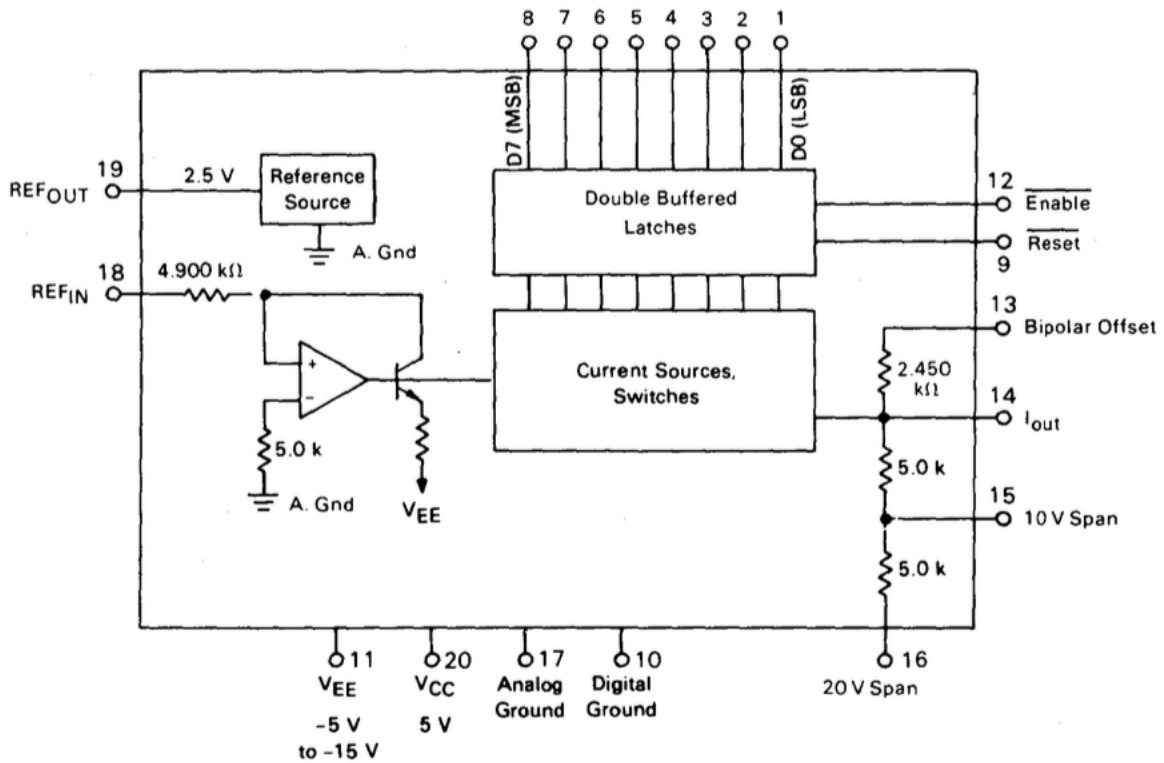
Characteristic	Symbol	Min	Typ	Max	Unit
Current Settling Time (Enable Positive Edge to $\pm 1/2$ LSB Output)	$t_s$	—	200	300*	ns
Data Setup Time	$t_{su(D)}$	70	40	—	ns
Data Hold Time	$t_{h(D)}$	10	0	—	ns
Pulse Widths Enable Reset	$t_{W(\bar{E})}$ $t_{W(\bar{R})}$	70 100*	20 —	— —	ns
Propagation Delays Enable, Low to High Reset, High to Low ( $I_O < 1.0\ \mu\text{A}$ )	$t_{PLH(\bar{E})}$ $t_{PHL(\bar{R})}$	— —	100 250	— —	ns

\*Not 100% tested, guaranteed by design

**FIGURE 1 — TIMING DIAGRAM**



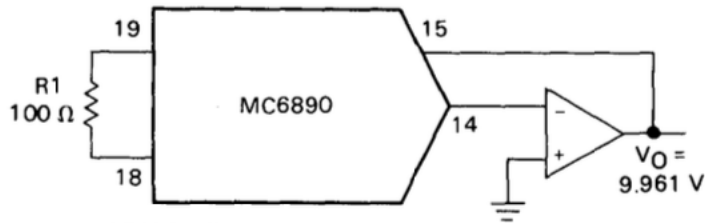
**FIGURE 2 — BLOCK DIAGRAM**



TEST FIGURES

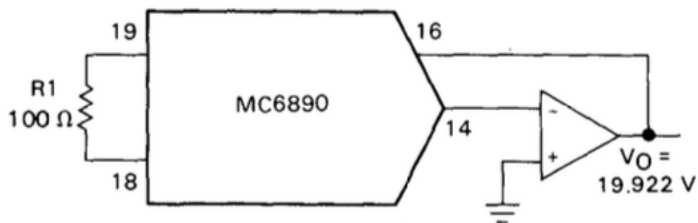
UNIPOLAR CONFIGURATIONS

FIGURE 3A



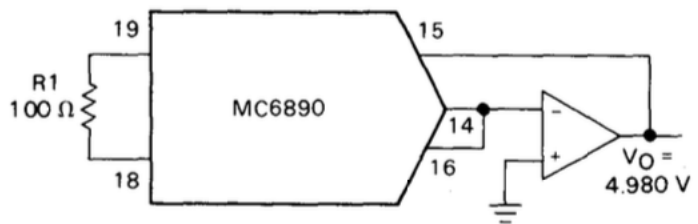
+10 V Configuration  
Latched Input Code: 11111111

FIGURE 3B



+20 V Configuration  
Latched Input Code: 11111111

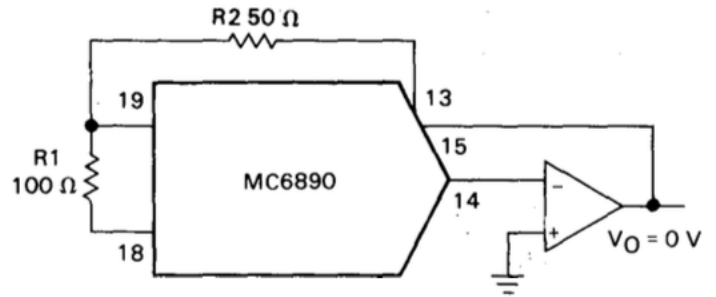
FIGURE 3C



+5.0 V Configuration  
Latched Input Code: 11111111

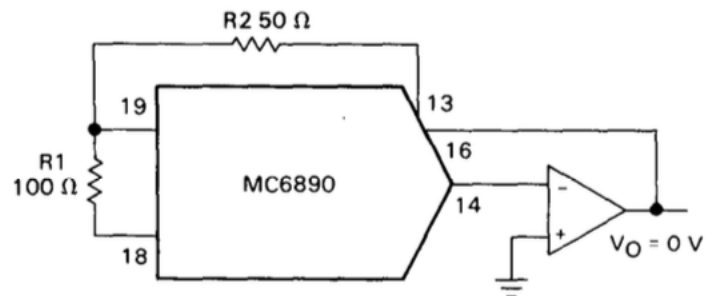
BIPOLAR CONFIGURATIONS

FIGURE 4A



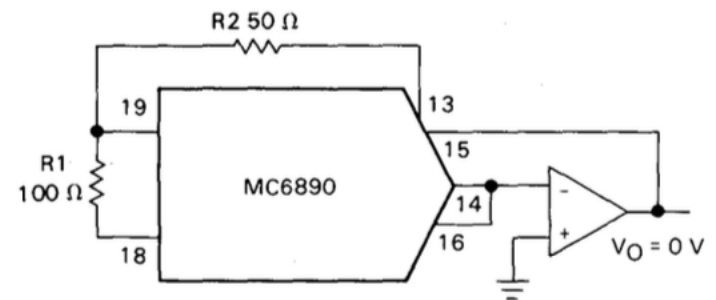
±5.0 V Configuration  
Latched Input Code: 10000000

FIGURE 4B



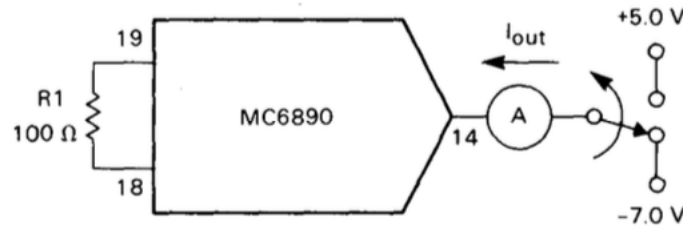
±10 V Configuration  
Latched Input Code: 10000000

FIGURE 4C



±2.5 V Configuration  
Latched Input Code: 10000000

FIGURE 5 TEST CONFIGURATION FOR DAC OUTPUT IMPEDANCE



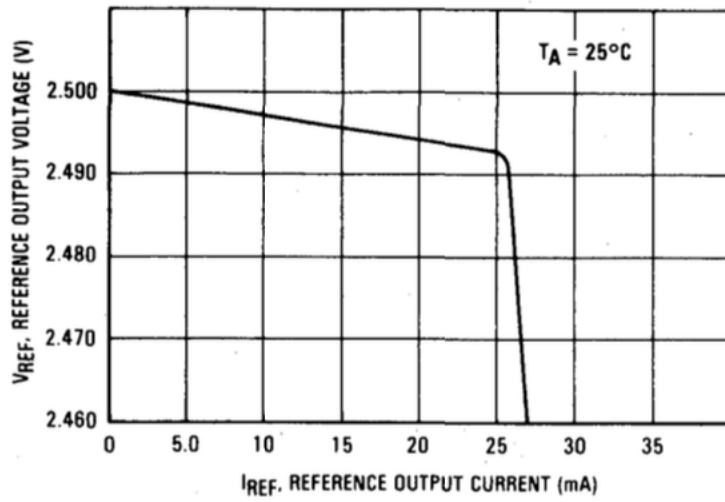
Latched Input Code: 11111111

$$R_{out} = \frac{12 \text{ V}}{\Delta I_{out}}$$



TYPICAL PERFORMANCE CURVES

FIGURE 7 — REFERENCE VOLTAGE versus EXTERNAL LOAD CURRENT\*



\*External load current is in addition to Reference Input Current (Pin 18) of D/A converter.

FIGURE 8 — DIGITAL INPUT CHARACTERISTICS

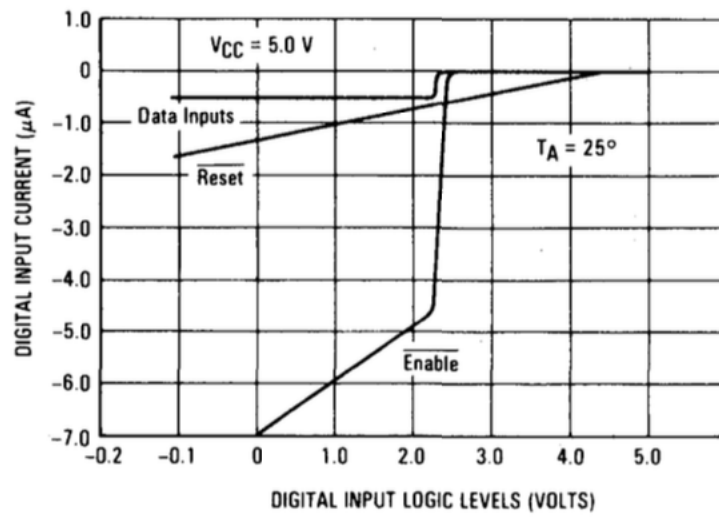


FIGURE 9 — TYPICAL APPLICATION OF THE MC6890 IN A MC6800 SERIES MPU SYSTEM

