

ICM7235

4-Digit Vacuum Fluorescent Display Driver



GENERAL DESCRIPTION

The ICM7235 family of display driver circuits provides the user with a single chip interface between digital logic or microprocessors to non-multiplexed 7-segment vacuum fluorescent displays.

The chips provide 28 high voltage open drain P-channel transistor outputs organized as four 7-segment digits. The devices are available with two input configurations. The basic devices provide four data-bit inputs and four digit select inputs. This configuration is suitable for interfacing with multiplexed BCD or binary output devices, such as the Intersil ICM7217, ICM7226 and ICL7135. The microprocessor interface devices (suffix M) provide data input latches and digit address latches under control of high-speed chip select inputs. These devices simplify the task of implementing a cost-effective alphanumeric 7-segment display for microprocessor systems, without requiring extensive ROM or CPU time for decoding and display updating.

The standard devices available will provide two different decoder configurations. The basic device will decode the four bit binary input into a seven-segment alphanumeric hexadecimal output (0-9, A-F). The "A" versions provide the Code "B" output (0-9, dash, E, H, L, P, blank). Either device will correctly decode true BCD to seven-segment decimal outputs.

FEATURES

- 28 High Voltage Outputs Drive Four 7-Segment Digits
- Multiplexed BCD Input (7235)
- High Speed Processor Interface (7235M)
- 7-Segment Hexadecimal or Code-B Output Versions Available
- Display Blanking Input
- Low Power Operation

ORDERING INFORMATION

ORDER PART NUMBER	TEMPERATURE RANGE	PACKAGE
ICM7235IPL	-20°C to +85°C	40 Pin CERDIP
ICM7235MIJL	-20°C to +85°C	40 Pin CERDIP
ICM7235MIPL	-20°C to +85°C	40 Pin PLASTIC
ICM7235AIJL	-20°C to +85°C	40 Pin PLASTIC
ICM7235AIPL	-20°C to +85°C	40 Pin PLASTIC
ICM7235AMJL	-20°C to +85°C	40 Pin CERDIP
ICM7235AMPL	-20°C to +85°C	40 Pin PLASTIC
ICM7235/D		DICE
ICM7235A/D		DICE
ICM7235AM/D		DICE
ICM7235M/D		DICE

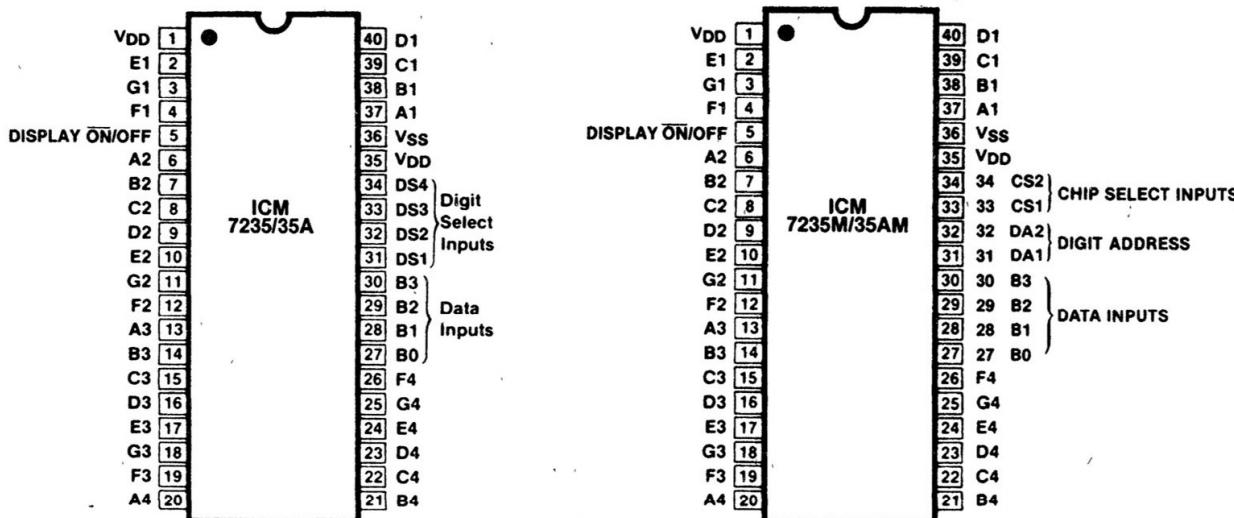


Figure 1: Pin Configurations

ABSOLUTE MAXIMUM RATINGS

Power Dissipation (Note 1) 0.5W @ +70°C
 Supply Voltage (V_{DD} - V_{SS}) 6.5 Volts
 Input Voltage (Note 2) V_{SS} -0.3V to V_{DD} +0.3V
 Output Voltage (Note 3) V_{DD} -35V

Operating Temperature Range -20°C to +85°C
 Storage Temperature Range -55°C to +125°C
 Lead Temperature (Soldering, 10sec) 300°C

Stresses above 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 above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

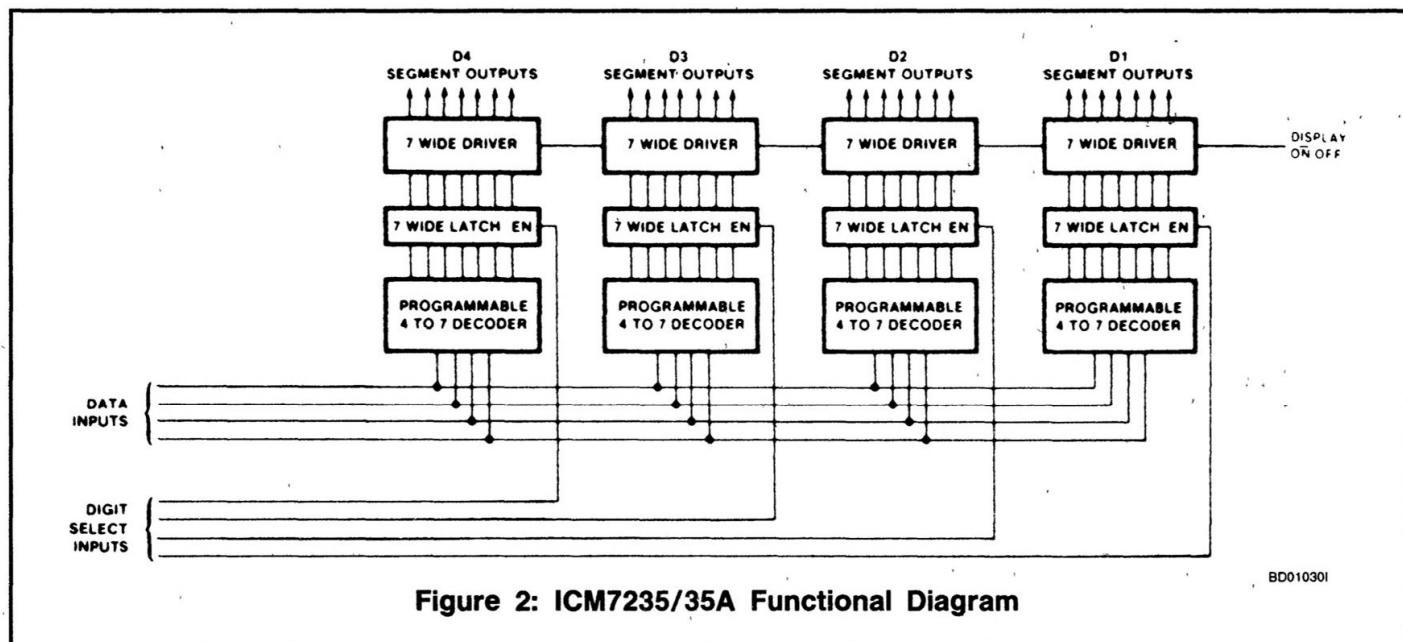


Figure 2: ICM7235/35A Functional Diagram

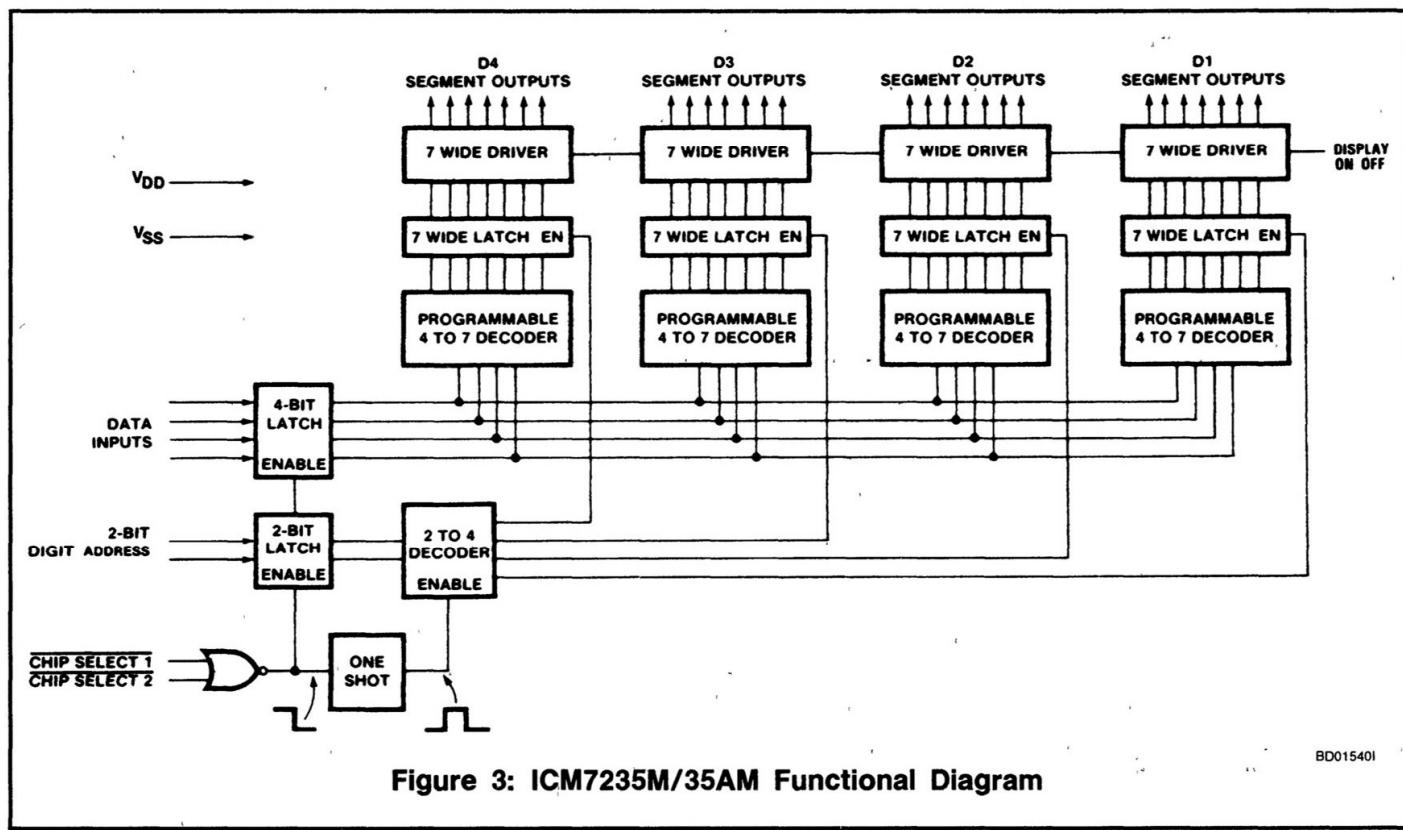


Figure 3: ICM7235M/35AM Functional Diagram

ELECTRICAL CHARACTERISTICS (All parameters measured with $V_{DD} = 5V \pm 10\%$, $V_{SS} = 0V$, $T_A = 25^\circ C$, unless stated otherwise).

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{SUPP}	Operating Supply Voltage Range ($V_{DD} - V_{SS}$)		4		6	V
I_{STBY}	Supply Current	Measured V_{DD} to V_{SS} Test circuit; display blank or OFF		10	50	μA
I_{DD}	Supply Current	Measured V_{DD} to Display			100	mA
V_{SEG}	Segment OFF Output Voltage	$I_{SLK} = 10\mu A$	30			V
I_{LS}	Segment OFF Leakage Current	$V_{SEG} = V_{DD} - 30V$		0.1	10	μA
I_{SEG}	Segment ON Current	$V_{SEG} = V_{DD} - 2V$	1.5	2.5		mA

INPUT CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IH}	Logical "1" Input Voltage	Referred to V_{SS}	3			V
V_{IL}	Logical "0" Input Voltage	Referred to V_{SS}			15	V
I_{ILK}	Input Leakage Current	Pins 27-34		± 0.1	± 1	μA
C_{IN}	Input Capacitance	Pins 27-34		5		pF
$I_{ILK(ON/OFF)}$	ON/OFF Input Leakage	All Devices		± 0.1	± 1	μA
$C_{IN(ON/OFF)}$	ON/OFF Input Capacitance	All Devices		200		pF

AC CHARACTERISTICS – MULTIPLEXED INPUT CONFIGURATION

t_{WH}	Digit Select Active Pulse Width		1			μs
t_{DS}	Data Setup Time		500			ns
t_{DH}	Data Hold Time		200			ns
t_{IDS}	Inter-Digit Select Time		2			μs

AC CHARACTERISTICS – MICROPROCESSOR INTERFACE

t_{WL}	Chip Select Active Pulse Width	Other Chip Select either held active, or both driven together	200			ns
t_{DS}	Data Setup Time		100			ns
t_{DH}	Data Hold Time		10	0		ns
t_{ICS}	Inter-Chip Select Time		2			μs

NOTES: 1. This limit refers to that of the package and will not be realized during normal operation.

2. Due to the SCR structure inherent in the CMOS process used to fabricate these devices, connecting any input terminal to a voltage in excess of V_{DD} or V_{SS} may cause destructive device latch-up. For this reason, it is recommended that inputs from external sources operating on a different power supply be applied only after the device's own power supply has been established, and that on multiple supply systems the supply to the ICM7235 be turned on first.
3. This value refers to the display outputs only.

INPUT DEFINITIONS

In this table, V_{DD} and V_{SS} are considered to be normal operating input logic levels. Actual input low and high levels are specified under Operating Characteristics. For lowest power consumption, input signals should swing to either V_{DD} or V_{SS} .

INPUT	TERMINAL	TEST CONDITIONS	FUNCTION		
B0	27	$V_{DD} = \text{Logical One}$ $V_{SS} = \text{Logical Zero}$	Ones (Least Significant)	Data Input Bits	
B1	28	$V_{DD} = \text{Logical One}$ $V_{SS} = \text{Logical Zero}$	Twos		
B2	29	$V_{DD} = \text{Logical One}$ $V_{SS} = \text{Logical Zero}$	Fours		
B3	30	$V_{DD} = \text{Logical One}$ $V_{SS} = \text{Logical Zero}$	Eights (Most Significant)		
ON/OFF	5	$V_{DD} = \text{OFF}$, $V_{SS} = \text{ON}$			Display ON/OFF Input

ICM7235, ICM7235A MULTIPLEXED-BINARY INPUT CONFIGURATION

INPUT	TERMINAL	TEST CONDITIONS	FUNCTION		
D1	31	$V_{DD} = \text{Active}$ $V_{SS} = \text{Inactive}$	D1 Digit Select (Least Significant)		
D2	32		D2 Digit Select		
D3	33		D3 Digit Select		
D4	34		D4 Digit Select (Most Significant)		

ICM7235M, ICM7235AM MICROPROCESSOR INTERFACE INPUT CONFIGURATION

INPUT	DESCRIPTION	TERMINAL	TEST CONDITIONS	FUNCTION
DA1	Digit ADDRESS Bit 1 (LSB)	31	V _{DD} = Logical One V _{SS} = Logical Zero	DA2 & DA1 serve as a two bit Digit Address Input DA2, DA1 = 00 selects D4 DA2, DA1 = 01 selects D3 DA2, DA1 = 10 selects D2 DA2, DA1 = 11 selects D1
DA2	Digit ADDRESS Bit 2 (MSB)	32		
CS1	Chip Select 1	33		
CS2	Chip Select 2	34	V _{DD} = Inactive V _{SS} = Active	When both CS1 and CS2 are taken to V _{SS} the data at the Data and Digit Address inputs are written into the input latches. On the rising edge of either Chip Select, the data is decoded and written into the output latches.

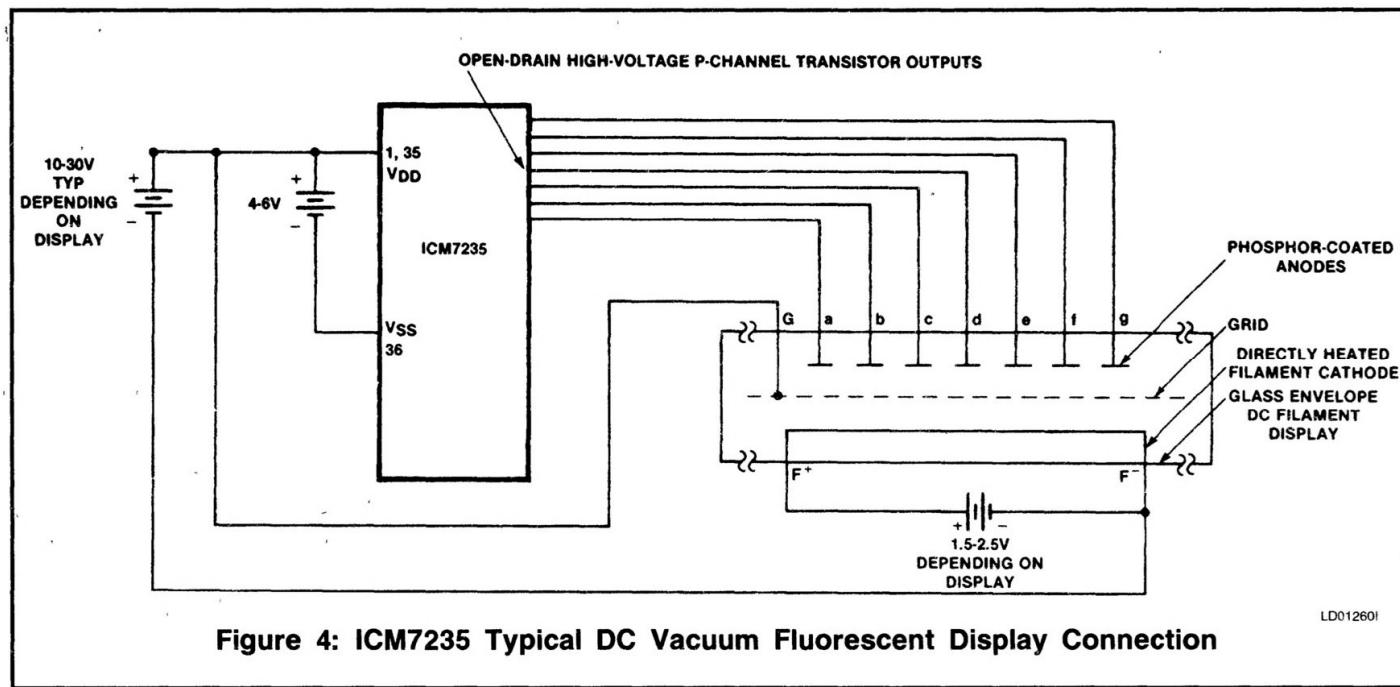


Figure 4: ICM7235 Typical DC Vacuum Fluorescent Display Connection

VACUUM FLUORESCENT DISPLAYS (4 DIGIT) AVAILABLE FROM:

N.E.C. Electronics, Inc.
Models FIP4F8S and FIP5F8S

CIRCUIT DESCRIPTION

Each device in the ICM7235 family provides signals for directly driving the anode terminals of a four-digit, 7-segment non-multiplexed vacuum fluorescent display. The outputs are taken from the drains of high-voltage, low-leakage P-channel FETs. Each is capable of withstanding $> -35V$ with respect to V_{DD}. In addition, the inclusion of an ON/OFF input allows the user to disable all segments by connecting pin 5 to V_{DD}; this same input may also be used as a brightness control by applying a signal swinging between V_{DD} and V_{SS} and varying its duty cycle.

The ICM7235 may also be used to drive nonmultiplexed common cathode LED displays by connecting each segment output to its corresponding display input, and tying the common cathode to V_{SS}. Using a power supply of 5V and an LED with a forward drop of 1.7V results in an "ON" segment current of about 3mA, enough to provide sufficient brightness for displays of up to 0.3" character height.

Note that these devices have two V_{DD} terminals, and each should be connected to the positive supply voltage. This double connection is necessary to minimize the effects of bond wire resistance, which could be a problem due to the high display currents.

Input Configurations and Output Codes

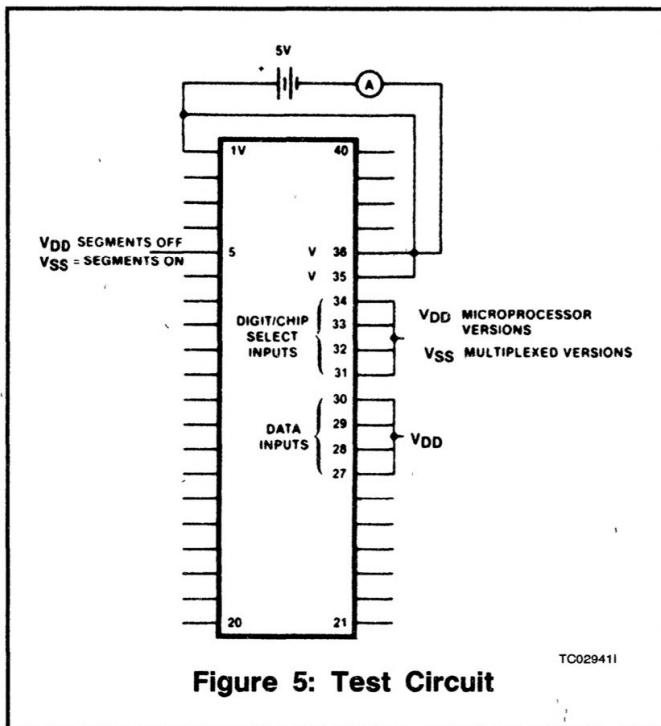
The standard devices in the ICM7235 family accept a four-bit true binary (i.e., positive level = logical one) input at pins 27 through 30, least significant bit at pin 27 ascending to the most significant bit at pin 30. The ICM7235 and ICM7235M decode this binary input into a 7-segment alphanumeric hexadecimal output, while the ICM7235A and ICM7235AM decode the binary input into the same 7-segment output as the ICM7218 "Code B," i.e., 0-9, dash, E, H, L, P, blank. These codes are shown explicitly in Table 1. Either decoder option will correctly decode true BCD to a 7-segment decimal output.

These devices are actually mask-programmable to provide any 16 combinations of the 7-segment outputs decoded from the four input bits. For larger quantity orders, (10K pcs. minimum) custom decoder options can be arranged. Contact your Intersil Sales Office for details.

The ICM7235 and ICM7235A devices are intended to accept multiplexed binary or BCD output. These devices provide four separate Digit select lines (least significant digit at pin 31 ascending to most significant digit at pin 34). Each Digit Select line when taken to a positive level decodes and stores in its respective output latches the character corresponding to the data at the input port, pins 27 through 30.

The ICM7235M and 7235AM devices are intended to accept data from a data bus under processor control.

In these devices, the four data input bits and the 2-bit Digit Select code (DA1 pin 31, DA2 pin 32) are written into input buffer latches when both Chip Select inputs ($\overline{CS1}$ pin 33, $\overline{CS2}$ pin 34) are taken to V_{SS}. On the rising edge of either Chip Select input, the content of the data input latches is decoded and stored in the output latches of the digit selected by the contents of the select code latches. A select code of 00 writes into D₄, 01 writes into D₃, 10 writes into D₂ and 11 writes into D₁. The timing relationships for inputting data are shown in Figure 7, and the chip select pulse widths and data setup and hold times are specified under Operating Characteristics.



TYPICAL PERFORMANCE CHARACTERISTICS

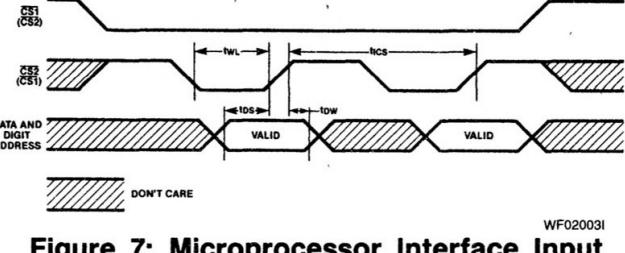
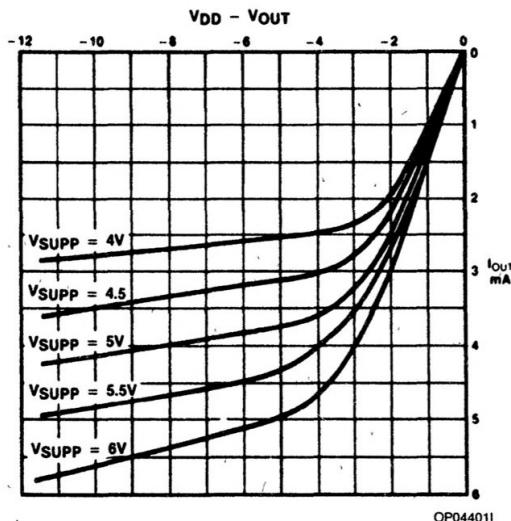


TABLE 1: Output Codes

BINARY				HEXADECIMAL ICM7235 ICM7235M	CODE B ICM7235A ICM7235AM
B3	B2	B1	B0		
0	0	0	0	0	0
0	0	0	1	1	1
0	0	1	0	2	2
0	0	1	1	3	3
0	1	0	0	4	4
0	1	0	1	5	5
0	1	1	0	6	6
0	1	1	1	7	7
1	0	0	0	8	8
1	0	0	1	9	9
1	0	1	0	A	-
1	0	1	1	b	E
1	1	0	0	C	H
1	1	0	1	d	L
1	1	1	0	E	P
1	1	1	1	F	(BLANK)

