National Semiconductor

PRELIMINARY

MM74C956 4-Digit, 17-Segment Alpha-Numeric Display Driver, with Memory, Decoder, and LED Drivers

General Description

The MM74C956 monolithic LED intelligent display driver circuit is manufactured using standard complementary MOS technology. The convention and speed of the data entry procedure is designed to be microprocessor bus and TTL compatible with no interface circuitry required.

The integrated circuit has memory to store four 7-bit ASCII words corresponding to the four digits, an ASCII to 17-segment alpha-numeric ROM decoder, multiplexing and drive circuitry to drive four 17-segment digits. It has direct drive capabilities of 2.5 mA/segment average current.

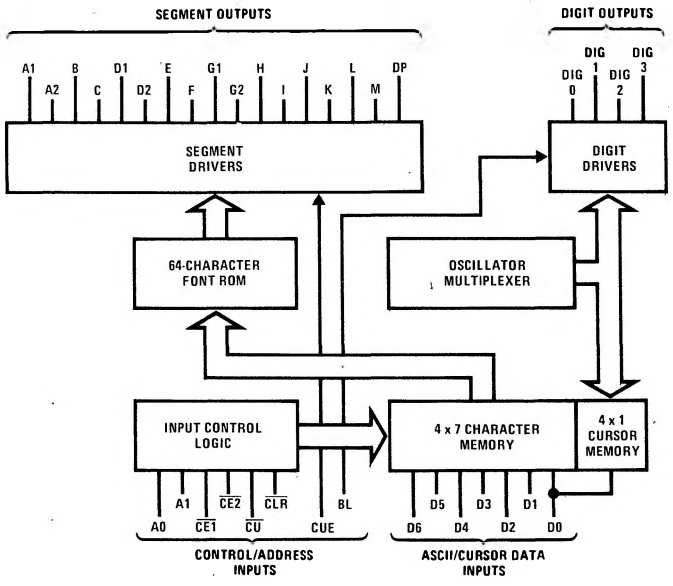
The internal memory can be written asynchronously through the 7-bit data bus (D0–D6) into the digit location addressed by the 2-bit address bus (A0, A1). For multiple chip circuits, two chip select inputs ($\overline{CE1}$, $\overline{CE2}$) can be decoded or a one-of-n decoder can be used for displays incorporating more than four MM74C956's.

The cursor function will cause all segments of a digit to be lit but will not write over the contents of the memory corresponding to that digit. Therefore, when the cursor is erased, the original character will reappear at that digit location.

Features

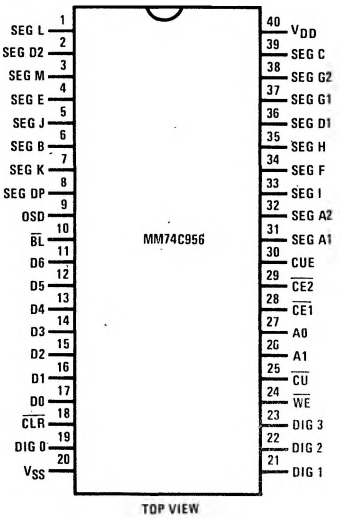
- Microprocessor bus compatible
- All inputs are TTL compatible; 5V power supply
- On-chip memory
- On-chip decoder converts from standard 7-bit ASCII to alpha-numeric
- On-chip multiplexing with LED segment and digit drivers
- Independent and asynchronous digit access
- Independent cursor function: can be disabled
- Display clear function
- Display blank function
- Two chip select inputs for multiple chip systems

Block Diagram



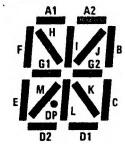
Connection Diagram

Dual-In-Line Package



TOP VIEW

Segment Designation



Absolute Maximum Ratings (Note 1)

Voltage at Any Pin	$-0.3V$ to $V_{CC}+0.3V$	Package Dissipation	700 mW
Operating Temperature Range		Operating V_{CC} Range	4.5V to 5.5V
MM74C956	$-40°C$ to $+85°C$	V_{CC}	6.0V
Storage Temperature Range	$-65°C$ to $+150°C$	Lead Temperature (Soldering, 10 seconds)	300°C

DC Electrical Characteristics $T_A = 25°C$

Parameter		Conditions	Min	Typ	Max	Units
$V_{IN(1)}$	Logical "1" Input Voltage	$V_{CC} = 5.0V$	2.4			V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5.0V$			0.8	V
$I_{IN(1)}$	Logical "1" Input Current	$V_{CC} = 5V$, $V_{IN} = 5V$		0.005	1.0	μA
$I_{IN(0)}$	Logical "0" Input Current	$V_{CC} = 5V$, $V_{IN} = 0V$	-100.0	25.0		μA
I_{CC}	Supply Current	$V_{CC} = 5V$ @ $T_A = 25°C$ All Outputs Open All Inputs @ 5V		0.5	1.0	mA
OUTPUT DRIVE (Notes 2 and 3)						
Peak Output Source Current (I_{SOURCE}) (P-Channel Segment Driver with 1 Segment On)		$V_{CC} = 5.0V$, $V_{OUT} = 1.9V$ $T_A = 25°C$			14.8	mA
Peak Output Source Current (I_{SOURCE}) (P-Channel Segment Driver with 17 Segments On)		$V_{CC} = 10V$, $V_{OUT} = 3.3V$ $T_A = 25°C$	4.2			mA
Peak Output Sink Current (I_{SINK}) (N-Channel Digit Driver with 3 Segments On)		$V_{CC} = 5.0V$, $V_{OUT} = 0.25V$ $T_A = 25°C$	18.5			mA
Peak Output Sink Current (I_{SINK}) (N-Channel Digit Driver with 17 Segments On)		$V_{CC} = 10V$, $V_{OUT} = 1.3V$ $T_A = 25°C$			172.0	mA

AC Electrical Characteristics $T_A = 25°C$, $V_{CC} = 5.0V$

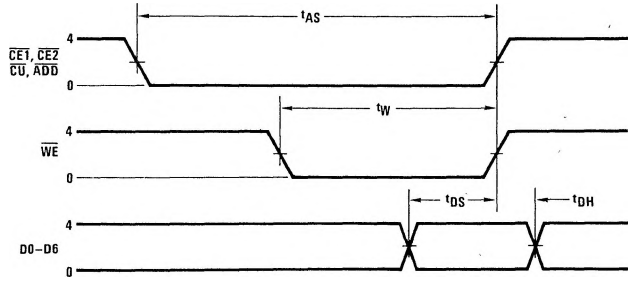
Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_w	Write Pulse Width	All Inputs Swing from 0V-4V	240			ns
t_{DS}	Data Set-Up Time	All Inputs Swing from 0V-4V	100			ns
t_{DH}	Data Hold Time	All Inputs Swing from 0V-4V	50			ns
t_{AS}	Address Set-Up Time	All Inputs Swing from 0V-4V	300			ns
t_{AH}	Address Hold Time	All Inputs Swing from 0V-4V	0			ns
t_{CLR}	Clear Time	All Inputs Swing from 0V-4V	1			μs

Note 1: Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. Except for Operating Range they are not meant to imply that the devices should be operated at these limits. The table of Electrical Characteristics provides conditions for actual device operation.

Note 2: Average drive current = peak drive current ÷ 4.

Note 3: Current/segment is dependent upon total number of segments on. Maximum current occurs with 1 segment on; minimum current occurs with 17 segments on.

Timing Diagram for data access



Functional Description

Entry into Data Memory

To enter an ASCII code, the $\overline{CE1}$ and $\overline{CE2}$ inputs must be low, $\overline{CU}$ must be high. When the address is set up at A0 and A1, the $\overline{WE}$ can go low, at which time the internal RAM will respond to the data inputs (D0–D6). Note that the data need not be set up prior to the $\overline{WE}$ transition.

All digits can be cleared by holding the $\overline{CLR}$ input low for the specified interval.

Entry into Cursor Memory

This is accomplished by setting the $\overline{CE1}$ and $\overline{CE2}$ inputs as well as the $\overline{CU}$ input low. The cursor memory consists of 4 bits corresponding to the four digits, each one addressable by way of the A0 and A1 inputs. Once the address is stable, the $\overline{WE}$ input must go low and the cursor memory will respond to the D0 input. That is, if D0 is high, a cursor will be written and if D0 is low, the cursor will be erased. $\overline{CLR}$ will not erase a cursor. A cursor will only be displayed when CUE is high and the cursor function can be bypassed by tying CUE low. A flashing cursor can be implemented by pulsing CUE; this results in alternately displaying the cursor and the character originally written in that digit. CUE will not alter the contents of either the cursor or data memory.

Blanking the Display

Display blanking can be realized by using the $\overline{BL}$ input. By taking $\overline{BL}$ low, the display will be disabled while leaving the contents of the data and cursor memory unchanged. A flashing display will occur if $\overline{BL}$ is pulsed. The display is blanked by $\overline{BL}$ regardless of whether a cursor or character is being displayed.

Illegal Code

If an illegal ASCII code is entered into the data memory (i.e., D6 = D5) the display will automatically be blanked for the corresponding digit.

OSD Pin

Taking the OSD pin high disables the internal oscillator and prohibits normal multiplex scanning. This pin is pulled low internally and is primarily meant to be used in testing the part only. This pin should be grounded or left open in normal operation.

Clearing the Display

Pulsing the $\overline{CLR}$ pin low for the specified time will clear all internal data memories while leaving the cursor memories unchanged.

TABLE I. DATA AND CURSOR ENTRY FUNCTION EXAMPLE

Assume initially D6 = 1 and D5 – D0 = 0 for all internal digit memories. Cursor memory is cleared. Table is intended to be read in sequence.

	$\overline{BL}$	$\overline{CE1}$	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A1	A0	D6	D5	D4	D3	D2	D1	D0	DIG 3	DIG 2	DIG 1	DIG 0
DATA ENTRY FUNCTION	0	X	X	X	X	X	1	X	X	X	X	X	X	X	X	X				
	1	1	0	X	X	X	1	X	X	X	X	X	X	X	X	X				
	1	0	1	X	X	X	1	X	X	X	X	X	X	X	X	X				
	1	0	0	X	X	1	1	X	X	X	X	X	X	X	X	X				
	1	0	0	X	1	0	1	0	0	1	0	0	0	1	1	1				
	1	0	0	X	1	0	1	1	0	0	1	1	0	1	0	0				
	X	X	X	X	X	X	0	X	X	X	X	X	X	X	X	X				
	1	0	0	X	1	0	1	0	0	1	0	0	0	0	0	1				
	1	0	0	X	1	0	1	0	1	1	0	0	0	0	1	0				
	1	0	0	X	1	0	1	1	0	1	0	0	0	0	1	1				
	1	0	0	X	1	0	1	1	1	1	0	0	0	1	0	0				
CURSOR ENTRY FUNCTION	1	0	0	1	0	0	1	0	0	X	X	X	X	X	X	1				
	1	0	0	1	0	0	1	0	1	X	X	X	X	X	X	1				
	1	0	0	1	0	0	1	1	1	X	X	X	X	X	X	1				
	1	0	0	1	0	0	1	1	0	X	X	X	X	X	X	1				
	1	X	X	0	1	1	1	X	X	X	X	X	X	X	X	X				
	1	X	X	1	1	1	1	X	X	X	X	X	X	X	X	X				
	1	0	0	1	0	0	1	0	0	X	X	X	X	X	X	0				
	1	0	0	0	0	0	1	1	0	X	X	X	X	X	X	0				
	1	X	X	1	1	1	1	X	X	X	X	X	X	X	X	X				
	0	X	X	X	1	1	1	X	X	X	X	X	X	X	X	X				
	1	X	X	1	1	1	1	X	X	X	X	X	X	X	X	X				
	1	X	X	1	1	X	0	X	X	X	X	X	X	X	X	X				
	1	0	0	1	0	0	1	1	1	X	X	X	X	X	X	0				
	1	0	0	1	0	0	1	0	1	X	X	X	X	X	X	0				

X = don't care

TABLE II. ROM OUTPUT FONT FOR ASCII TO ALPHA-NUMERIC DECODING

Character Set				D0	L	H	L	H	L	H	L	H
				D1	L	L	H	H	L	L	H	H
				D2	L	L	L	L	H	H	H	H
D6	D5	D4	D3									
L	H	L	L		!	"	#	$	%	&	'	
L	H	L	H	(	)	*	+	,	-	.	/	
L	H	H	L	0	1	2	3	4	5	6	7	
L	H	H	H	8	9	:	;	<	=	>	?	
H	L	L	L	@	A	B	C	D	E	F	G	
H	L	L	H	H	I	J	K	L	M	N	O	
H	L	H	L	P	Q	R	S	T	U	V	W	
H	L	H	H	X	Y	Z	[	\	]	^	_	

Typical Application