FAIRCHILD

SEMICONDUCTOR ™

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DM9370
7-Segment Decoder/Driver/Latch
# with Open-Collector Outputs

General Description

The DM9370 is a 7-segment decoder driver incorporating
input latches and output circuits to directly drive incandes-
cent displays. It can also be used to drive common anode
LED displays in either a multiplexed mode or directly with
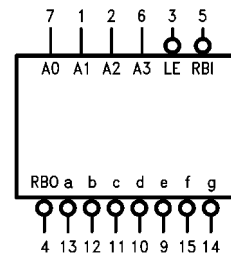the aid of external current limiting resistors.

Ordering Code:

Order Number	Package Number	Package Description
DM9370	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Connection Diagram
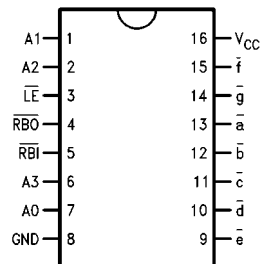
Logic Symbol

V_{CC} = Pin 16
GND = Pin 8

Pin Descriptions

Pin Names	Description
A0–A3	Address Inputs
$\overline{LE}$	Latch Enable Input (Active LOW)
$\overline{RBI}$	Ripple Blanking Input (Active LOW)
$\overline{RBO}$	Ripple Blanking as Output (Active LOW)
	as Input (Active LOW)
$\overline{a}$–$\overline{g}$	Segment Outputs (Active LOW)

Truth Table

BINARY STATE	INPUTS						OUTPUTS								DISPLAY
	$\overline{LE}$	$\overline{RBI}$	A3	A2	A1	A0	$\overline{a}$	$\overline{b}$	$\overline{c}$	$\overline{d}$	$\overline{e}$	$\overline{f}$	$\overline{g}$	$\overline{RBO}$	
--	H	*	X	X	X	X	←			STABLE			→	H	STABLE
0	L	L	L	L	L	L	H	H	H	H	H	H	H	L	BLANK
0	L	H	L	L	L	L	L	L	L	L	L	L	H	H	0
1	L	X	L	L	L	H	H	L	L	H	H	H	H	H	1
2	L	X	L	L	H	L	L	L	H	L	L	H	L	H	2
3	L	X	L	L	H	H	L	L	L	L	H	H	L	H	3
4	L	X	L	H	L	L	H	L	L	H	H	L	L	H	4
5	L	X	L	H	L	H	L	H	L	L	H	L	L	H	5
6	L	X	L	H	H	L	L	H	L	L	L	L	L	H	6
7	L	X	L	H	H	H	L	L	L	L	L	H	H	H	7
8	L	X	H	L	L	L	L	L	L	L	L	L	L	H	8
9	L	X	H	L	L	H	L	L	L	H	H	L	L	H	9
10	L	X	H	L	H	L	L	L	L	H	L	L	L	H	A
11	L	X	H	L	H	H	H	H	L	L	L	L	L	H	b
12	L	X	H	H	L	L	L	H	H	L	L	L	H	H	C
13	L	X	H	H	L	H	H	L	L	L	L	H	L	H	d
14	L	X	H	H	H	L	L	H	H	L	L	L	L	H	E
15	L	X	H	H	H	H	L	H	H	H	L	L	L	H	F
X	X	X	X	X	X	X	H	H	H	H	H	H	H	L**	BLANK

*The $\overline{RBI}$ will blank the display only if binary zero is stored in the latches.

**$\overline{RBO}$ used as an input overdrives all other input conditions.

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

Functional Description

The DM9370 has active LOW outputs capable of sinking in excess of 25 mA which allows it to drive a wide variety of 7-segment incandescent displays directly. It may also be used to drive common anode LED displays, multiplexed or directly with the aid of suitable current limiting resistors. This device accepts a 4-bit binary code and produces output drive to the appropriate segments of the 7-segment display. It has a hexadecimal decode format which produces numeric codes "0" through "9" and alpha codes "A" through "F" using upper and lower case fonts.

Latches on the four data inputs are controlled by an active LOW latch enable $\overline{LE}$. When the $\overline{LE}$ is LOW, the state of the outputs is determined by the input data. When the $\overline{LE}$ goes HIGH, the last data present at the inputs is stored in the latches and the outputs remain stable. The $\overline{LE}$ pulse width necessary to accept and store data is typically 30 ns which allows data to be strobed into the DM9370 at normal TTL speeds. This feature means that data can be routed directly from high speed counters and frequency dividers into the display without slowing down the system clock or providing intermediate data storage.

The latch/decoder combination is a simple system which drives incandescent displays with multiplexed data inputs from MOS time clocks, DVMs, calculator chips, etc. Data inputs are multiplexed while the displays are in static mode. This lowers component and insertion costs since several circuits—seven diodes per display, strobe drivers, a separate display voltage source, and clock failure detect circuits—traditionally found in incandescent multiplexed display systems are eliminated. It also allows low strobing rates to be used without display flicker.

Another DM9370 feature is the reduced loading on the data inputs when the Latch Enable is HIGH (only 10 μA typ). This allows many DM9370s to be driven from a MOS device in multiplex mode without the need for drivers on the data lines. The DM9370 also provides automatic blanking of the leading and/or trailing-edge zeroes in a multidigit decimal number, resulting in an easily readable decimal display conforming to normal writing practice. In an 8-digit mixed integer fraction decimal representation, using the automatic blanking capability, 0060.0300 would be displayed as 60.03. Leading-edge zero suppression is obtained by connecting the Ripple Blanking Output ($\overline{RBO}$) of a decoder to the Ripple Blanking Input ($\overline{RBI}$) of the next lower stage device. The most significant decoder stage should have the $\overline{RBI}$ input grounded; and since suppression of the least significant integer zero in a number is not usually desired, the $\overline{RBI}$ input of this decoder stage should be left open. A similar procedure for the fractional part of a display will provide automatic suppression of trailing-edge zeroes. The $\overline{RBO}$ terminal of the decoder can be OR-tied with a modulating signal via an isolating buffer to achieve pulse duration intensity modulation. A suitable signal can be generated for this purpose by forming a variable frequency multivibrator with a cross coupled pair of TTL or DTL gates.

Numerical Designation

Logic Diagram
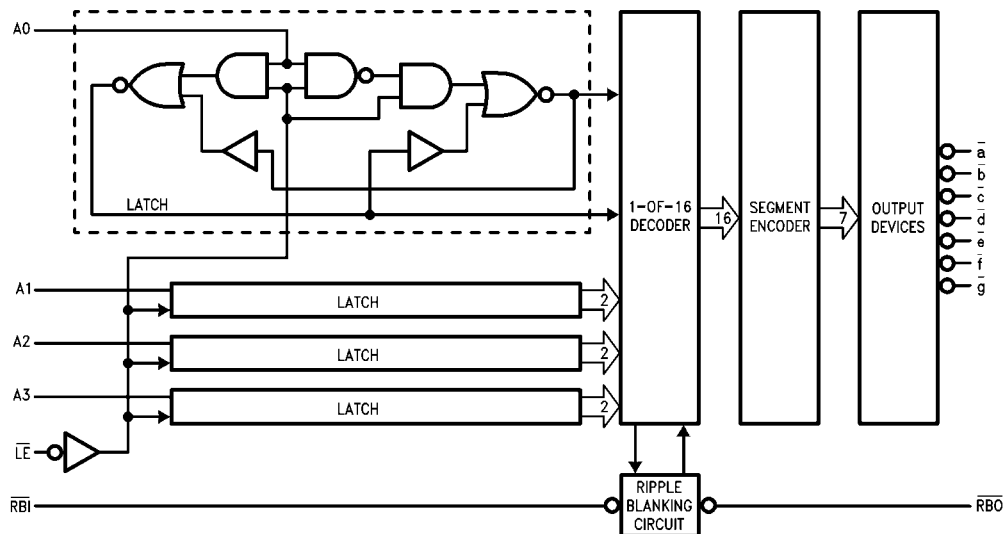
Absolute Maximum Ratings(Note 1)

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	0°C to +70°C
Storage Temperature Range	−65°C to +150°C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−80	μA
I_{OL}	LOW Level Output Current			3.2	mA
T_A	Free Air Operating Temperature	0		70	°C
t_S (H)	Setup Time HIGH or LOW			30	ns
t_S (L)	A_n to $\overline{LE}$			20	
t_H (H)	Hold Time HIGH or LOW			0	ns
t_H (L)	A_n to $\overline{LE}$			0	
t_W (L)	$\overline{LE}$ Pulse Width LOW			45	ns

Electrical Characteristics

Over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −12 mA				−1.5	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max		2.4	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IH} = Min			0.2	0.4	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V				1	mA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.4V				−1.6	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)		−20		−70	mA
V_{OH}	Output HIGH Voltage $\overline{RBO}$	V_{CC} = Min, I_{OH} −80 μA		2.4			V
V_{OL}	Output LOW Voltage $\overline{RBO}$	I_{OL} = 3.2 mA	V_{CC} = Min			0.4	V
	$\overline{a-g}$	I_{OL} = 25 mA				0.4	
I_{OH}	Output HIGH Current, $\overline{a-g}$					250	μA
I_{CC}	Power Supply Current	V_{CC} = Max				105	μA
		A_1, A_2, A_3, $\overline{LE}$ = GND V_{CC} = Max, Outputs OPEN				105	mA
		A_0, A_1, A_2, $\overline{LE}$ = GND V_{CC} = Max, Outputs OPEN				94	

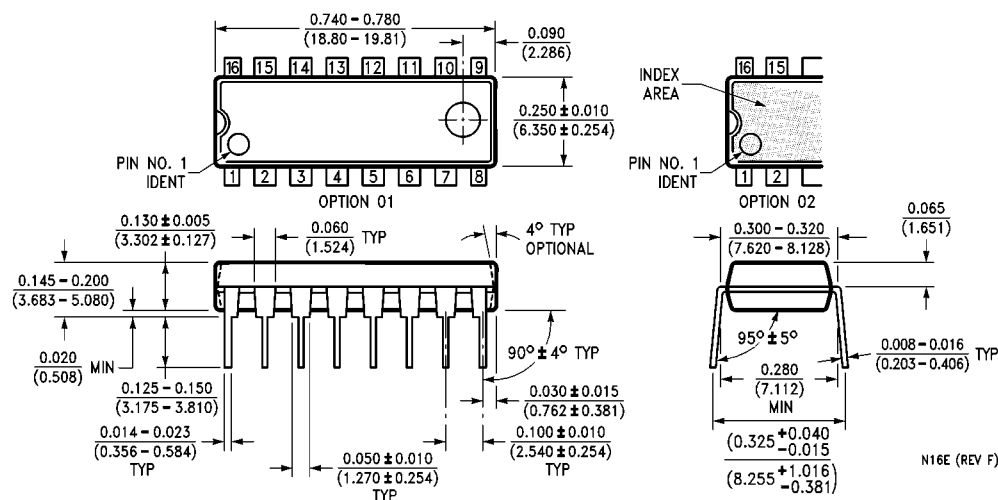**Note 2:** All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 3: Not more than one output should be shorted at a time.

Switching Characteristics

V_{CC} = +5.0V, T_A = +25°C

Symbol	Parameter	C_L = 15 PF, R_L = 500Ω		Units
		Min	Max	
t_{PLH}	Propagation Delay		75	ns
t_{PHL}	A_n to $\overline{a-g}$		50	
t_{PLH}	Propagation Delay		90	ns
t_{PHL}	$\overline{LE}$ to $\overline{a-g}$		70	

Physical Dimensions inches (millimeters) unless otherwise noted

16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
Package Number N16E

N16E (REV F)

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