

74157, 74158, LS157, LS158, S157, S158

Data Selectors/Multiplexers

Logic Products

DESCRIPTION

The '157 is a quad 2-input multiplexer which selects four bits of data from two sources under the control of a common Select input (S). The Enable input (\bar{E}) is active LOW. When \bar{E} is HIGH, all of the outputs (Y) are forced LOW regardless of all other input conditions.

Moving data from two groups of registers to four common output busses is a common use of the '157. The state of the Select input determines the particular register from which the data comes. It can also be used as a function generator. The device is useful for implementing highly irregular logic by generating any four of the 16 different functions of two variables with one variable common.

'157 Quad 2-Input Data Selector/Multiplexer (Non-Inverted)
'158 Quad 2-Input Data Selector/Multiplexer (Inverted)
Product Specification

TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
74157	13ns	30mA
74LS157	13ns	9.7mA
74S157	7.4ns	50mA
74158	13ns	30mA
74LS158	13ns	4.8mA
74S158	6ns	40mA

ORDERING CODE

PACKAGES	COMMERCIAL RANGES $V_{CC} = 5V \pm 5\%$; $T_A = 0^\circ C$ to $+70^\circ C$
Plastic DIP	N74157N, N74LS158N, N74S157N N74LS157N, N74S158N, N74LS158N
Plastic SO	N74LS157D, N74S158D

NOTE:

For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

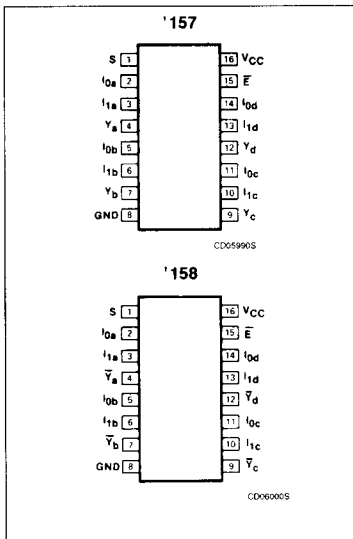
INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

PINS	DESCRIPTION	74	74S	74LS
S, \bar{E}	Inputs	1ul	2Sul	2LSul
Data	Inputs	1ul	1Sul	1LSul
All	Outputs	10ul	10Sul	10LSul

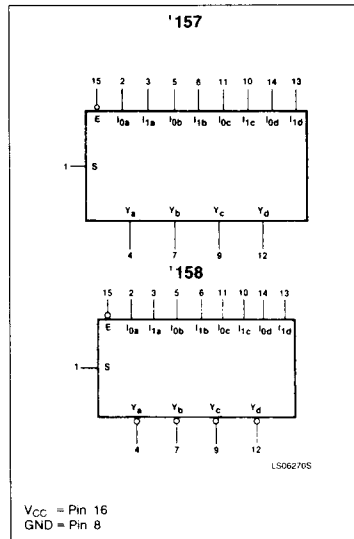
NOTE:

Where a 74 unit load (ul) is understood to be $40\mu A$ I_{IH} and $-1.6mA$ I_{IL} , a 74S unit load (Sul) is $50\mu A$ I_{IH} and $-2.0mA$ I_{IL} , and a 74LS unit load (LSul) is $20\mu A$ I_{IH} and $-0.4mA$ I_{IL} .

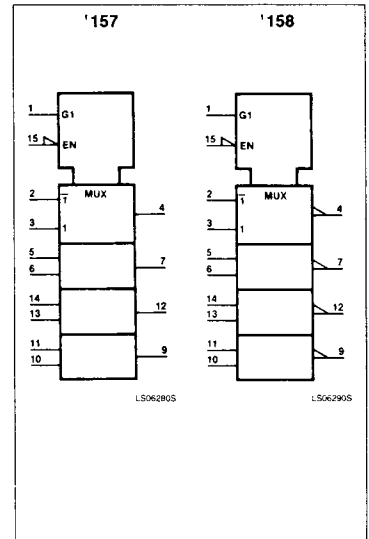
PIN CONFIGURATION



LOGIC SYMBOL



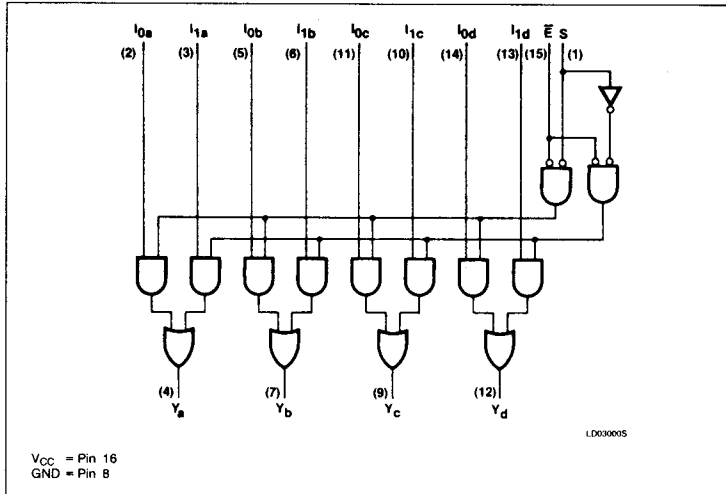
LOGIC SYMBOL (IEEE/IEC)



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LOGIC DIAGRAM, '157



The device is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. Logic equations for the outputs are shown below:

$$Y_a = \bar{E} \cdot (I_{1a} \cdot S + I_{0a} \cdot \bar{S})$$

$$Y_b = \bar{E} \cdot (I_{1b} \cdot S + I_{0b} \cdot \bar{S})$$

$$Y_c = \bar{E} \cdot (I_{1c} \cdot S + I_{0c} \cdot \bar{S})$$

$$Y_d = \bar{E} \cdot (I_{1d} \cdot S + I_{0d} \cdot \bar{S})$$

The '158 is similar but has inverting outputs:

$$\bar{Y}_a = \bar{E} \cdot (I_{1a} \cdot S + I_{0a} \cdot \bar{S})$$

$$\bar{Y}_b = \bar{E} \cdot (I_{1b} \cdot S + I_{0b} \cdot \bar{S})$$

$$\bar{Y}_c = \bar{E} \cdot (I_{1c} \cdot S + I_{0c} \cdot \bar{S})$$

$$\bar{Y}_d = \bar{E} \cdot (I_{1d} \cdot S + I_{0d} \cdot \bar{S})$$

FUNCTION TABLE, '157

ENABLE	SELECT INPUT	DATA INPUTS		OUTPUT
\bar{E}	S	I ₀	I ₁	Y
H	X	X	X	L
L	H	X	L	L
L	H	X	H	H
L	L	L	X	L
L	L	H	X	H

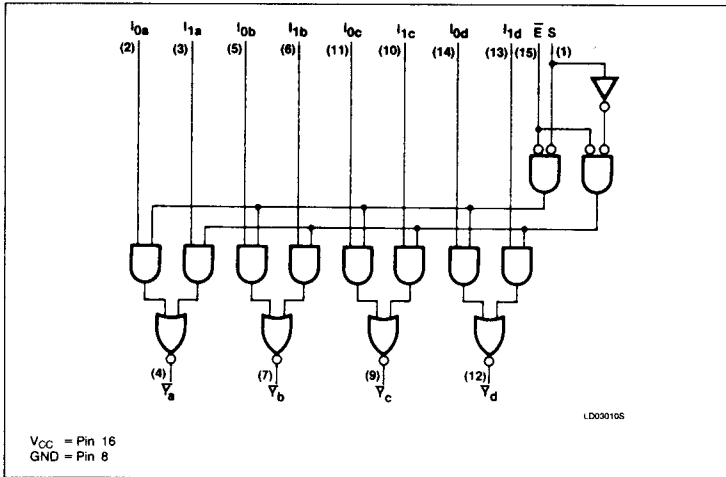
H = HIGH voltage level
L = LOW voltage level
X = Don't care

FUNCTION TABLE, '158

ENABLE	SELECT INPUT	DATA INPUTS		OUTPUT
\bar{E}	S	I ₀	I ₁	\bar{Y}
H	X	X	X	H
L	L	L	X	H
L	L	H	X	L
L	H	X	L	H
L	H	X	H	L

H = HIGH voltage level
L = LOW voltage level
X = Don't care

LOGIC DIAGRAM, '158



ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

PARAMETER	74	74LS	74S	UNIT
V _{CC} Supply voltage	7.0	7.0	7.0	V
V _{IN} Input voltage	-0.5 to +5.5	-0.5 to +7.0	-0.5 to +5.5	V
I _{IN} Input current	-30 to +5	-30 to +1	-30 to +5	mA
V _{OUT} Voltage applied to output in HIGH output state	-0.5 to +V _{CC}	-0.5 to +V _{CC}	-0.5 to +V _{CC}	V
T _A Operating free-air temperature range	0 to 70			°C

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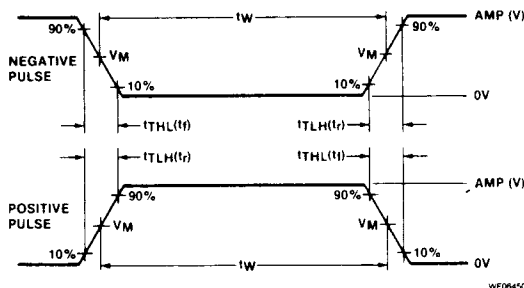
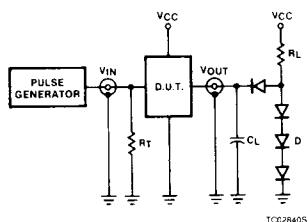
RECOMMENDED OPERATING CONDITIONS

PARAMETER	74			74LS			74S			UNIT
	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
V _{CC} Supply voltage	4.75	5.0	5.25	4.75	5.0	5.25	4.75	5.0	5.25	V
V _{IH} HIGH-level input voltage	2.0			2.0			2.0			V
V _{IL} LOW-level input voltage			+0.8			+0.8			+0.8	V
I _{IK} Input clamp current			-12			-18			-18	mA
I _{OH} HIGH-level output current			-800			-400			-1000	μA
I _{OL} LOW-level output current			16			8			20	mA
T _A Operating free-air temperature	0		70	0		70	0		70	°C

NOTE:

V_{IL} = +0.7V MAX for 54S at +125°C only.

TEST CIRCUITS AND WAVEFORMS



V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.

Test Circuit For 74 Totem-Pole Outputs

DEFINITIONS

R_L = Load resistor to V_{CC}; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of Pulse Generators.

D = Diodes are 1N916, 1N3064, or equivalent.

t_{TLH}, t_{THL} Values should be less than or equal to the table entries.

Input Pulse Definition

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	Pulse Width	t _{TLH}	t _{THL}
74	3.0V	1MHz	500ns	7ns	7ns
74LS	3.0V	1MHz	500ns	15ns	6ns
74S	3.0V	1MHz	500ns	2.5ns	2.5ns

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DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

PARAMETER	TEST CONDITIONS ¹		74157, 158			74LS157, 158			74S157, 158			UNIT	
			Min	Typ ²	Max	Min	Typ ²	Max	Min	Typ ²	Max		
V _{OH} HIGH-level output voltage	V _{CC} = MIN, V _{IH} = MIN, V _{IL} = MAX, I _{OH} = MAX		2.4	3.4		2.7	3.4		2.7	3.4		V	
V _{OL} LOW-level output voltage	V _{CC} = MIN, V _{IH} = MIN, V _{IL} = MAX			0.2	0.4		0.35	0.5			0.5	V	
	I _{OL} = 4mA (74LS)						0.25	0.4				V	
V _{IK} Input clamp voltage	V _{CC} = MIN, I _I = I _{IK}				-1.5			-1.5			-1.2	V	
I _I Input current at maximum input voltage	V _{CC} = MAX	V _I = 5.5V			1.0						1.0	mA	
		V _I = 7.0V	S, \bar{E} inputs					0.2				mA	
			Data inputs						0.1			mA	
I _{IH} HIGH-level input current	V _{CC} = MAX	V _I = 2.4V	S, \bar{E} inputs		40							μ A	
			Data inputs		40							μ A	
		V _I = 2.7V	S, \bar{E} inputs					40			100	μ A	
			Data inputs					20			50	μ A	
I _{IL} LOW-level input current	V _{CC} = MAX	V _I = 0.4V	S, \bar{E} inputs		-1.6			-0.8				mA	
			Data inputs		-1.6			-0.4				mA	
		V _I = 0.5V	S, \bar{E} inputs								-4	mA	
			Data inputs								-2	mA	
I _{OS} Short-circuit output current ³	V _{CC} = MAX		-18		-55	-20		-100	-40		-100	mA	
I _{CC} Supply current ^{4, 5} (total)	V _{CC} = MAX	Note 4	'157 '158		30	48						mA	
		Note 4	'LS157					9.7	16			mA	
		Note 4	'LS158					4.8	8			mA	
		Note 5	'S157 All inputs = 4.5V								50	78	mA
		Note 5	'S158 All inputs = 4.5V								39	61	mA
		Note 5	'S158 I _{oa} , I _{ob} , I _{oc} , I _{od} at 4.5V, other inputs at 0V									41	81

NOTES:

- For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
- All typical values are at V_{CC} = 5V, T_A = 25°C.
- I_{OS} is tested with V_{OUT} = +0.5V and V_{CC} = V_{CC} MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.
- I_{CC} is measured with 4.5V applied to all inputs and all outputs open.
- I_{CC} is measured with all outputs open.

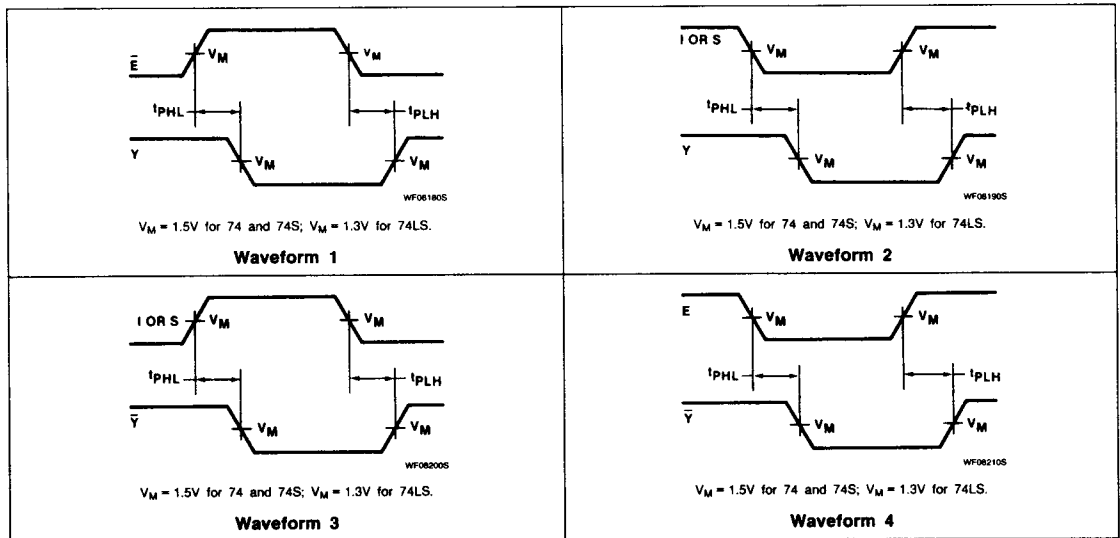
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AC ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$, $V_{CC} = 5.0\text{V}$

PARAMETER	TEST CONDITIONS	74		74LS		74S		UNIT
		$C_L = 15\text{pF}$, $R_L = 400\Omega$		$C_L = 15\text{pF}$, $R_L = 2\text{k}\Omega$		$C_L = 15\text{pF}$, $R_L = 280\Omega$		
		Min	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL} Propagation delay Data to output	Waveform 2, '157		14 14		14 14		7.5 6.5	ns
t_{PLH} t_{PHL} Propagation delay Enable to output	Waveform 1, '157		20 21		20 21		12.5 12	ns
t_{PLH} t_{PHL} Propagation delay Select to output	Waveform 2, '157		23 27		23 27		15 15	ns
t_{PLH} t_{PHL} Propagation delay Data to output	Waveform 3, '158		14 14		12 15		6.0 6.0	ns
t_{PLH} t_{PHL} Propagation delay Enable to output	Waveform 4, '158		20 21		17 24		11.5 12	ns
t_{PLH} t_{PHL} Propagation delay Select to output	Waveform 3, '158		23 27		20 24		12 12	ns

AC WAVEFORMS



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