T-46-09-05

National Semiconductor

54F/74F164
Serial-In, Parallel-Out Shift Register

General Description

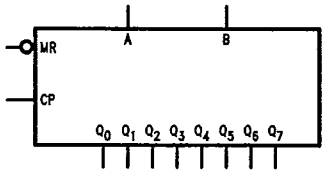
The 'F164 is a high-speed 8-bit serial-in/parallel-out shift register. Serial data is entered through a 2-input AND gate synchronous with the LOW-to-HIGH transition of the clock. The device features an asynchronous Master Reset which clears the register, setting all outputs LOW independent of the clock.

Features

- Typical shift frequency of 90 MHz
- Asynchronous Master Reset
- Gated serial data input
- Fully synchronous data transfers

Ordering Code: See Section 5

Logic Symbols



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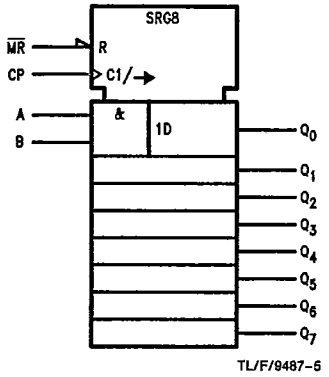
IEEE/IEC



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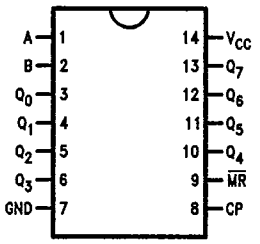
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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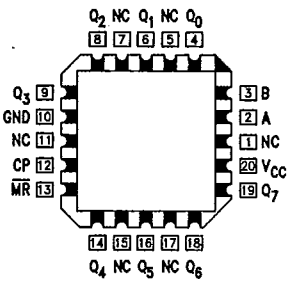
Pin Assignment for LCC and PCC



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Unit Loading/Fan Out: See Section 2 for U.L. definitions

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
A, B	Data Inputs	1.0/1.0	20 μA/−0.6 mA
CP	Clock Pulse Input (Active Rising Edge)	1.0/1.0	20 μA/−0.6 mA
$\overline{MR}$	Master Reset Input (Active LOW)	1.0/1.0	20 μA/−0.6 mA
Q_0–Q_7	Outputs	50/33.3	−1 mA/20 mA

Functional Description

The 'F164 is an edge-triggered 8-bit shift register with serial data entry and an output from each of the eight stages. Data is entered serially through one of two inputs (A or B); either of these inputs can be used as an active HIGH Enable for data entry through the other input. An unused input must be tied HIGH.

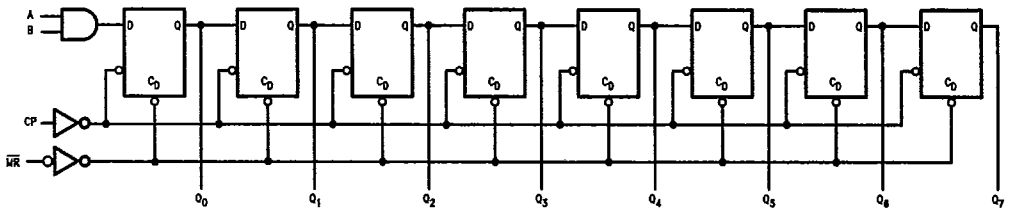
Each LOW-to-HIGH transition on the Clock (CP) input shifts data one place to the right and enters into Q_0 the logical AND of the two data inputs (A • B) that existed before the rising clock edge. A LOW level on the Master Reset ($\overline{MR}$) input overrides all other inputs and clears the register asynchronously, forcing all Q outputs LOW.

Mode Select Table

Operating Mode	Inputs			Outputs	
	$\overline{MR}$	A	B	Q_0	Q_1–Q_7
Reset (Clear)	L	X	X	L	L-L
Shift	H	l	l	L	q_0–q_6
	H	l	h	L	q_0–q_6
	H	h	l	L	q_0–q_6
	H	h	h	H	q_0–q_6

H(h) = HIGH Voltage Levels
L(l) = LOW Voltage Levels
X = Immaterial
q_n = Lower case letters indicate the state of the referenced input or output one setup time prior to the LOW-to-HIGH clock transition.

Logic Diagram



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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +175°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V_{CC} = 0V)	
Standard Output	−0.5V to V_{CC}
TRI-STATE® Output	−0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I_{OL} (mA)

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	
Military	−55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

DC Electrical Characteristics

Symbol	Parameter		54F/74F Min	54F/74F Typ	54F/74F Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage		2.0			V		Recognized as a HIGH Signal
V_{IL}	Input LOW Voltage				0.8	V		Recognized as a LOW Signal
V_{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I_{IN} = −18 mA
V_{OH}	Output HIGH Voltage	54F 10% V_{CC}	2.5			V	Min	I_{OH} = −1 mA
		74F 10% V_{CC}	2.5					I_{OH} = −1 mA
		74F 5% V_{CC}	2.7					I_{OH} = −1 mA
V_{OL}	Output LOW Voltage	54F 10% V_{CC}			0.5	V	Min	I_{OL} = 20 mA
		74F 10% V_{CC}			0.5			I_{OL} = 20 mA
I_{IH}	Input HIGH Current				20	μA	Max	V_{IN} = 2.7V
I_{BVI}	Input HIGH Current Breakdown Test				100	μA	Max	V_{IN} = 7.0V
I_{IL}	Input LOW Current				−0.6	mA	Max	V_{IN} = 0.5V
I_{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V_{OUT} = 0V
I_{CEX}	Output HIGH Leakage Current				250	μA	Max	V_{OUT} = V_{CC}
I_{CC}	Power Supply Current			35	55	mA	Max	CP = HIGH $\overline{MR}$ = GND, A, B = GND

AC Electrical Characteristics: See Section 2 for Waveforms and Load Configurations

Symbol	Parameter	74F $T_A = +25°C$ $V_{CC} = +5.0V$ $C_L = 50\ pF$			54F $T_A, V_{CC} = Mil$ $C_L = 50\ pF$		74F $T_A, V_{CC} = Com$ $C_L = 50\ pF$		Units	Fig No
		Min	Typ	Max	Min	Max	Min	Max		
f_{max}	Maximum Clock Frequency	80	90		50		80		MHz	2-1
t_{PLH} t_{PHL}	Propagation Delay CP to Q_n	3.5 5.0	6.0 7.5	8.0 10.0	3.5 4.0	11.0 13.0	4.5 5.0	9.0 11.0	ns	2-3
t_{PHL}	Propagation Delay $\overline{MR}$ to Q_n	5.5	10.5	13.0	5.5	16.0	5.5	14.0	ns	2-3

AC Operating Requirements: See Section 2 for Waveforms

Symbol	Parameter	74F $T_A = +25°C$ $V_{CC} = +5.0V$		54F $T_A, V_{CC} = Mil$		74F $T_A, V_{CC} = Com$		Units	Fig No
		Min	Max	Min	Max	Min	Max		
$t_s(H)$ $t_s(L)$	Setup Time, HIGH or LOW A or B to CP	7.0 7.0		7.0 7.0		7.0 7.0		ns	2-6
$t_h(H)$ $t_h(L)$	Hold Time, HIGH or LOW A or B to CP	1.0 1.0		1.0 1.0		1.0 1.0			
$t_w(H)$ $t_w(L)$	CP Pulse Width HIGH or LOW	4.0 7.0		4.0 7.0		4.0 7.0		ns	2-4
$t_w(L)$	$\overline{MR}$ Pulse Width, LOW	7.0		7.0		7.0		ns	2-4
t_{rec}	Recovery Time $\overline{MR}$ to CP	7.0		7.0		7.0		ns	2-6

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