

54F/74F164A Serial-In, Parallel-Out Shift Register

General Description

The 'F164A 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. The 'F164A is a faster version of the 'F164.

Features

- Typical shift frequency of 90 MHz
- Asynchronous Master Reset
- Gated serial data input
- Fully synchronous data transfers
- Guaranteed 4000V min ESD protection
- 'F164A is a faster version of the 'F164

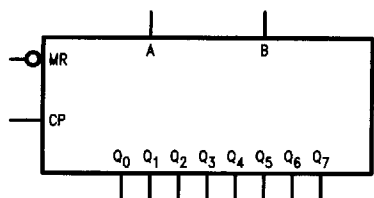
Ordering Code: See Section 11

Commercial	Military	Package Number	Package Description
74F164APC		N14A	14-Lead (0.300" Wide) Molded Dual-In-Line
	54F164ADM (Note 2)	J14A	14-Lead Ceramic Dual-In-Line
74F164ASC (Note 1)		M14A	14-Lead (0.150" Wide) Molded Small Outline, JEDEC
74F164ASJ (Note 1)		M14D	14-Lead (0.300" Wide) Molded Small Outline, EIAJ
	74F164AFM (Note 2)	W14B	14-Lead Cerpack
	74F164ALM (Note 2)	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

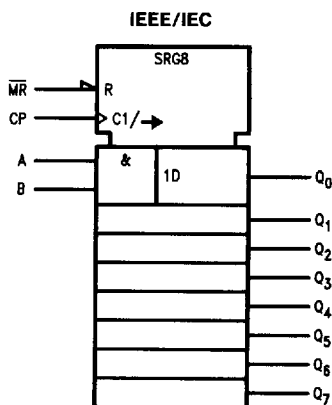
Note 1: Devices also available in 13" reel. Use suffix = SCX and SJX.

Note 2: Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

Logic Symbols



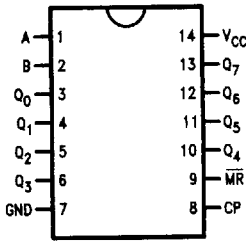
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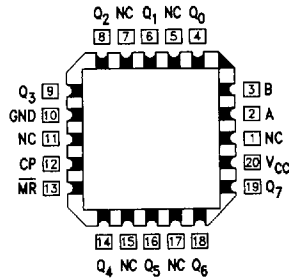
Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



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Pin Assignment for LCC



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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 _H /I _L 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
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 '164A 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 Q₀ the logical AND of the two data inputs (A • B) that existed before the rising clock edge. A LOW level on the Master Reset (MR) input overrides all other inputs and clears the register asynchronously, forcing all Q outputs LOW.

Mode Select Table

Operating Mode	Inputs			Outputs	
	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

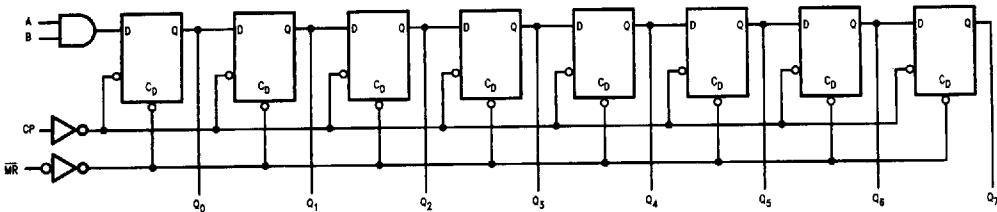
H(h) = HIGH Voltage Levels

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, please 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
Plastic	-55°C to +150°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)
ESD Last Passing Voltage (Min)	4000V

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			Units	V _{CC}	Conditions
		Min	Typ	Max			
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 I _{OH} = -1 mA I _{OH} = -1 mA
		74F 10% V _{CC}	2.5				
		74F 5% V _{CC}	2.7				
V _{OL}	Output LOW Voltage	54F 10% V _{CC}		0.5	V	Min	I _{OL} = 20 mA I _{OL} = 20 mA
		74F 10% V _{CC}		0.5			
I _{IH}	Input HIGH Current	54F		20.0	μA	Max	V _{IN} = 2.7V
		74F		5.0			
I _{BVI}	Input HIGH Current Breakdown Test	54F		100	μA	Max	V _{IN} = 7.0V
		74F		7.0			
I _{CEX}	Output HIGH Leakage Current	54F		250	μA	Max	V _{OUT} = V _{CC}
		74F		50			
V _{ID}	Input Leakage Test	74F	4.75		V	0.0	I _{ID} = 1.9 μA All other pins grounded
I _{OD}	Output Leakage Circuit Current	74F		3.75	μA	0.0	V _{IOD} = 150 mV All other pins grounded
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 _{CC}	Power Supply Current		35	55	mA	Max	CP = HIGH MR = GND, A, B = GND

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

Symbol	Parameter	74F			54F		74F		Units	Fig. No.
		$T_A = +25^\circ\text{C}$ $V_{CC} = +5.0\text{V}$ $C_L = 50\text{ pF}$			$T_A, V_{CC} = \text{Mil}$ $C_L = 50\text{ pF}$		$T_A, V_{CC} = \text{Com}$ $C_L = 50\text{ pF}$			
		Min	Typ	Max	Min	Max	Min	Max		
f_{max}	Maximum Clock Frequency	80	120		60		80		MHz	2-1
t_{PLH}	Propagation Delay CP to Q_n	3.0	4.8	7.5	2.5	9.0	3.0	7.5	ns	2-3
t_{PHL}		3.5	5.0	8.0	3.0	8.5	3.5	8.0		
t_{PHL}	Propagation Delay $\overline{\text{MR}}$ to Q_n	5.0	7.0	10.0	4.0	12.5	5.0	10.5	ns	2-3

AC Operating Requirements: See Section 2 for Waveforms

Symbol	Parameter	74F		54F		74F		Units	Fig. No.
		$T_A = +25^\circ\text{C}$ $V_{CC} = +5.0\text{V}$		$T_A, V_{CC} = \text{Mil}$		$T_A, V_{CC} = \text{Com}$			
		Min	Max	Min	Max	Min	Max		
$t_s(\text{H})$	Setup Time, HIGH or LOW A or B to CP	4.5		5.5		4.5		ns	2-6
$t_s(\text{L})$		4.0		4.0		4.0			
$t_h(\text{H})$	Hold Time, HIGH or LOW A or B to CP	1.0		1.0		1.0		ns	2-4
$t_h(\text{L})$		1.0		1.0		1.0			
$t_w(\text{H})$	CP Pulse Width	4.0		4.0		4.0		ns	2-4
$t_w(\text{L})$	HIGH or LOW	7.0		7.0		7.0		ns	2-4
$t_w(\text{L})$	$\overline{\text{MR}}$ Pulse Width, LOW	4.0		5.0		4.0		ns	2-4
t_{rec}	Recovery Time $\overline{\text{MR}}$ to CP	5.0		6.5		5.0		ns	2-6