

## 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

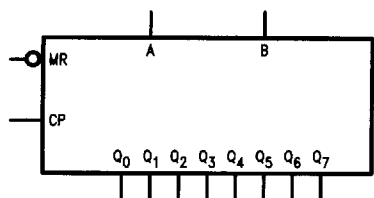
**Ordering Code:** See Section 11

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

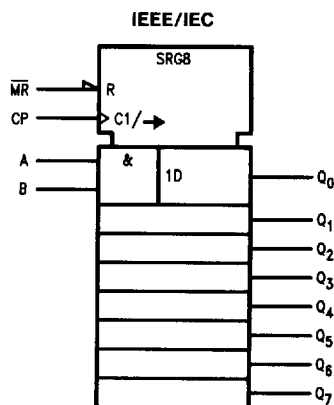
**Note 1:** Devices also available in 13" reel. Use suffix = SCX and SJX.

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

### Logic Symbols



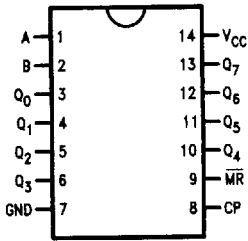
TL/F/10613-1



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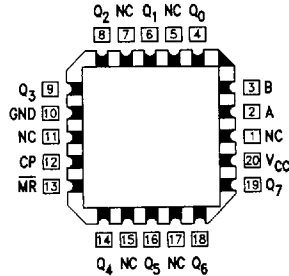
## Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



TL/F/10613-2

Pin Assignment for LCC



TL/F/10613-3

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

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I <sub>H</sub> /I <sub>L</sub> Output I <sub>O</sub> H/I <sub>O</sub> L
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 <sub>0</sub> -Q <sub>7</sub>	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 Q<sub>0</sub> 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 <sub>0</sub>	Q <sub>1</sub> -Q <sub>7</sub>
Reset (Clear)	L	X	X	L	L-L
Shift	H	l	l	L	Q <sub>0</sub> -Q <sub>6</sub>
	H	l	h	L	Q <sub>0</sub> -Q <sub>6</sub>
	H	h	l	L	Q <sub>0</sub> -Q <sub>6</sub>
	H	h	h	H	Q <sub>0</sub> -Q <sub>6</sub>

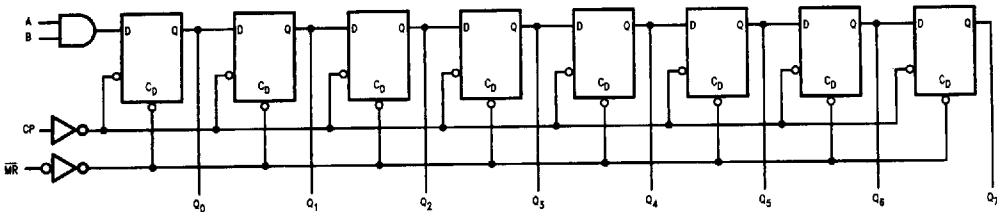
H(h) = HIGH Voltage Levels

L(l) = LOW Voltage Levels

X = Immaterial

Q<sub>n</sub> = 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



TL/F/10613-5

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 <sub>CC</sub> 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 <sub>CC</sub> = 0V)	
Standard Output	-0.5V to V <sub>CC</sub>
TRI-STATE® Output	-0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (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 <sub>CC</sub>	Conditions
			Min	Typ	Max			
V <sub>IH</sub>	Input HIGH Voltage		2.0			V		Recognized as a HIGH Signal
V <sub>IL</sub>	Input LOW Voltage					V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage					V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 5% V <sub>CC</sub>	2.5 2.5 2.7			V	Min	I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -1 mA
V <sub>OL</sub>	Output LOW Voltage	54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub>	0.5 0.5			V	Min	I <sub>OL</sub> = 20 mA I <sub>OL</sub> = 20 mA
I <sub>IH</sub>	Input HIGH Current	54F 74F	20.0 5.0			μA	Max	V <sub>IN</sub> = 2.7V
I <sub>BVI</sub>	Input HIGH Current Breakdown Test	54F 74F	100 7.0			μA	Max	V <sub>IN</sub> = 7.0V
I <sub>CEX</sub>	Output HIGH Leakage Current	54F 74F	250 50			μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
V <sub>ID</sub>	Input Leakage Test	74F	4.75			V	0.0	I <sub>ID</sub> = 1.9 μA All other pins grounded
I <sub>OD</sub>	Output Leakage Circuit Current	74F	3.75			μA	0.0	V <sub>IOD</sub> = 150 mV All other pins grounded
I <sub>IL</sub>	Input LOW Current		-0.6			mA	Max	V <sub>IN</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current		-60      -150			mA	Max	V <sub>OUT</sub> = 0V
I <sub>CC</sub>	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		
$f_{\text{max}}$	Maximum Clock Frequency	80	120		60		80		MHz	2-1
$t_{\text{PLH}}$	Propagation Delay CP to $Q_n$	3.0	4.8	7.5	2.5	9.0	3.0	7.5	ns	2-3
$t_{\text{PHL}}$		3.5	5.0	8.0	3.0	8.5	3.5	8.0		
$t_{\text{PHL}}$	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
$t_{\text{rec}}$	Recovery Time $\overline{\text{MR}}$ to CP	5.0		6.5		5.0		ns	2-6