



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

74VHC164 8-Bit Serial-In, Parallel-Out Shift Register

Features

- High Speed: $f_{MAX} = 175\text{MHz}$ at $V_{CC} = 5\text{V}$
- Low power dissipation: $I_{CC} = 4\mu\text{A}$ (max.) at $T_A = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min.)
- Power down protection provided on all inputs
- Low noise: $V_{OLP} = 0.8\text{V}$ (max.)
- Pin and function compatible with 74HC164


General Description

The VHC164 is an advanced high-speed CMOS device fabricated with silicon gate CMOS technology. It achieves the high-speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The VHC164 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. An input protection circuit insures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

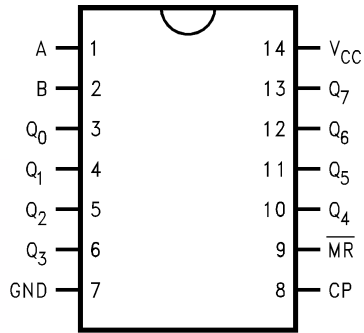
Ordering Information

Order Number	Package Number	Package Description
74VHC164M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC164SJ	M14D	14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC164MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHC164N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

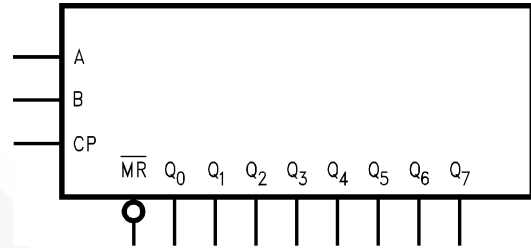
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

 All packages are lead free per JEDEC: J-STD-020B standard.

Connection Diagram



Logic Symbol



Pin Description

Pin Names	Description
A, B	Data Inputs
CP	Clock Pulse Input (Active Rising Edge)
$\overline{\text{MR}}$	Master Reset Input (Active LOW)
Q_0 – Q_7	Outputs

Function Table

Operating Mode	Inputs			Outputs	
	$\overline{\text{MR}}$	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 = HIGH Voltage Levels

L = LOW Voltage Levels

X = Immaterial

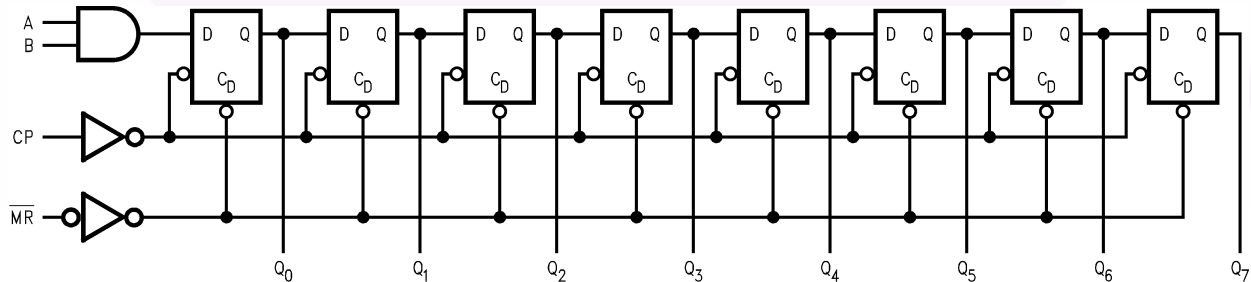
Q = Lower case letters indicate the state of the referenced input or output one setup time prior to the LOW-to-HIGH clock transition.

Functional Description

The VHC164 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 ($A \cdot B$) that existed before the rising clock edge. A LOW level on the Master Reset ($\overline{\text{MR}}$) input overrides all other inputs and clears the register asynchronously, forcing all Q outputs LOW.

Logic Diagram



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

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	-0.5V to +7.0V
V_{IN}	DC Input Voltage	-0.5V to +7.0V
V_{OUT}	DC Output Voltage	-0.5V to $V_{CC} + 0.5V$
I_{IK}	Input Diode Current	-20mA
I_{OK}	Output Diode Current	$\pm 20mA$
I_{OUT}	DC Output Current	$\pm 25mA$
I_{CC}	DC V_{CC}/GND Current	$\pm 75mA$
T_{STG}	Storage Temperature	-65°C to +150°C
T_L	Lead Temperature (Soldering, 10 seconds)	260°C

Recommended Operating Conditions⁽¹⁾

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating
V_{CC}	Supply Voltage	2.0V to 5.5V
V_{IN}	Input Voltage	0V to +5.5V
V_{OUT}	Output Voltage	0V to V_{CC}
T_{OPR}	Operating Temperature	-40°C to +85°C
t_r, t_f	Input Rise and Fall Time, $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$	0ns/V ~ 100ns/V 0ns/V ~ 20ns/V

Note:

- Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40°C to +85°C		Units	
				Min.	Typ.	Max.	Min.	Max.		
V _{IH}	HIGH Level Input Voltage	2.0		1.50			1.50		V	
		3.0–5.5		0.7 × V _{CC}			0.7 × V _{CC}			
V _{IL}	LOW Level Input Voltage	2.0				0.50		0.50	V	
		3.0–5.5				0.3 × V _{CC}		0.3 × V _{CC}		
V _{OH}	HIGH Level Output Voltage	2.0	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50μA	1.9	2.0		1.9		V
		3.0			2.9	3.0		2.9		
		4.5			4.4	4.5		4.4		
		3.0		I _{OH} = -4mA	2.58			2.48		
		4.5		I _{OH} = -8mA	3.94			3.80		
V _{OL}	LOW Level Output Voltage	2.0	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50μA		0.0	0.1		0.1	V
		3.0				0.0	0.1		0.1	
		4.5				0.0	0.1		0.1	
		3.0		I _{OL} = 4mA			0.36		0.44	
		4.5		I _{OL} = 8mA			0.36		0.44	
I _{IN}	Input Leakage Current	0–5.5	V _{IN} = 5.5V or GND			±0.1		±1.0	μA	
I _{CC}	Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND			4.0		40.0	μA	

Noise Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C		Units
				Typ.	Limits	
V _{OLP} ⁽²⁾	Quiet Output Maximum Dynamic V _{OL}	5.0	C _L = 50pF	0.5	0.8	V
V _{OLV} ⁽²⁾	Quiet Output Minimum Dynamic V _{OL}	5.0	C _L = 50pF	-0.5	-0.8	V
V _{IHD} ⁽²⁾	Minimum HIGH Level Dynamic Input Voltage	5.0	C _L = 50pF		3.5	V
V _{ILD} ⁽²⁾	Maximum LOW Level Dynamic Input Voltage	5.0	C _L = 50pF		1.5	V

Note:

2. Parameter guaranteed by design.

AC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
f _{MAX}	Maximum Clock Frequency	3.3 ± 0.3	C _L = 15pF, R _L = 1kΩ	80	125		65		MHz
			C _L = 50pF, R _L = 1kΩ	50	75		45		
		5.0 ± 0.5	C _L = 15pF, R _L = 1kΩ	125	175		105		
			C _L = 50pF, R _L = 1kΩ	85	115		75		
t _{PLH} , t _{PHL}	Propagation Delay Time (CP-Q _n)	3.3 ± 0.3	C _L = 15pF, R _L = 1kΩ		8.4	12.8	1.0	15.0	ns
			C _L = 50pF, R _L = 1kΩ		10.9	16.3	1.0	18.5	
		5.0 ± 0.5	C _L = 15pF, R _L = 1kΩ		5.8	9.0	1.0	10.5	
			C _L = 50pF, R _L = 1kΩ		7.3	11.0	1.0	12.5	
t _{PHL}	Propagation Delay Time (MR-Q _n)	3.3 ± 0.3	C _L = 15pF, R _L = 1kΩ		8.3	12.8	1.0	15.0	ns
			C _L = 50pF, R _L = 1kΩ		10.8	16.3	1.0	18.5	
		5.0 ± 0.5	C _L = 15pF, R _L = 1kΩ		5.2	8.6	1.0	10.0	
			C _L = 50pF, R _L = 1kΩ		6.7	10.6	1.0	12.0	
C _{IN}	Input Capacitance		V _{CC} = Open		4	10		10	pF
C _{PD}	Power Dissipation Capacitance		⁽³⁾		76				pF

Note:

3. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained from the equation:

$$I_{CC(\text{opr.})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

AC Operating Requirements

Symbol	Parameter	V _{CC} (V) ⁽⁴⁾	T _A = 25°C		T _A = -40°C to +85°C		Units
			Typ.	Guaranteed Minimum	Min.	Max.	
t _{W(L)} , t _{W(H)}	Minimum Pulse Width (CP)	3.3		5.0	5.0	ns	
		5.0		5.0	5.0		
t _{W(L)}	Minimum Pulse Width (MR)	3.3		5.0	5.0	ns	
		5.0		5.0	5.0		
t _S	Minimum Setup Time	3.3		5.0	6.0	ns	
		5.0		4.5	4.5		
t _H	Minimum Hold Time	3.3		0.0	0.0	ns	
		5.0		1.0	1.0		
t _{REC}	Minimum Removal Time (MR)	3.3		2.5	2.5	ns	
		5.0		2.5	2.5		

Note:

4. V_{CC} is 3.3 ± 0.3V or 5.0 ± 0.5V



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 2009.
- E. LANDPATTERN STANDARD: SOP65P640X110-14M.
- F. DRAWING FILE NAME: MKT-MTC14rev7.





NOTES:

- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DRAWING FILENAME: MKT-M14Drev4.





NOTES:

- A. CONFORMS TO JEDEC MS-012, VARIATION AB, ISSUE C
- B. ALL DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS
- D. LAND PATTERN STANDARD: SOIC127P600X145-14M
- E. CONFORMS TO ASME Y14.5M, 2009
- D. DRAWING FILENAME: MKT-M14Arev14



ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative