



Is Now Part of



ON Semiconductor®

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

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@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.

74VHC221A

Dual Non-Retriggerable Monostable Multivibrator

Features

- High Speed: $t_{PD} = 8.1\text{ns}$ (Typ.) at $V_{CC} = 5\text{V}$
- Low Power Dissipation: $I_{CC} = 4\mu\text{A}$ (Max.) at $T_A = 25^\circ\text{C}$
- Active State: $I_{CC} = 600\mu\text{A}$ (Max.) at $T_A = 25^\circ\text{C}$
- High Noise Immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (Min.)
- Power down protection is provided on all inputs
- Pin and function compatible with 74HC221A

General Description

The VHC221A is an advanced high speed CMOS Monostable Multivibrator 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. Each multivibrator features both a negative, A, and a positive, B, transition triggered input, either of which can be used as an inhibit input. Also included is a clear input that when taken LOW resets the one-shot. The VHC221A can be triggered on the positive transition of the clear while A is held LOW and B is held HIGH. The VHC221A is non-retriggerable, and therefore cannot be retriggered until the output pulse times out. The output pulse width is determined by the equation:

$$PW = (R_x)(C_x)$$

where,

PW is in seconds, R is in ohms, and C is in farads.

Limits for R_x and C_x are:

External capacitor, C_x : No limit

External resistors, R_x : $V_{CC} = 2.0\text{V}$, $5\text{k}\Omega$ Min.
 $V_{CC} > 3.0\text{V}$, $1\text{k}\Omega$ Min

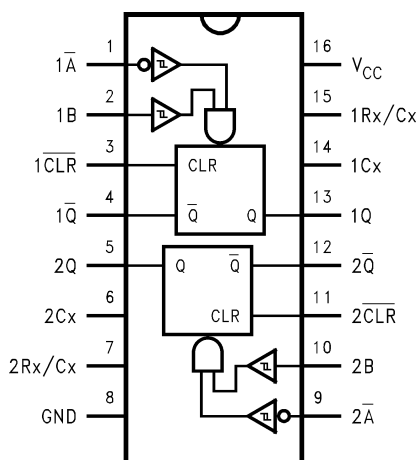
An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Ordering Information

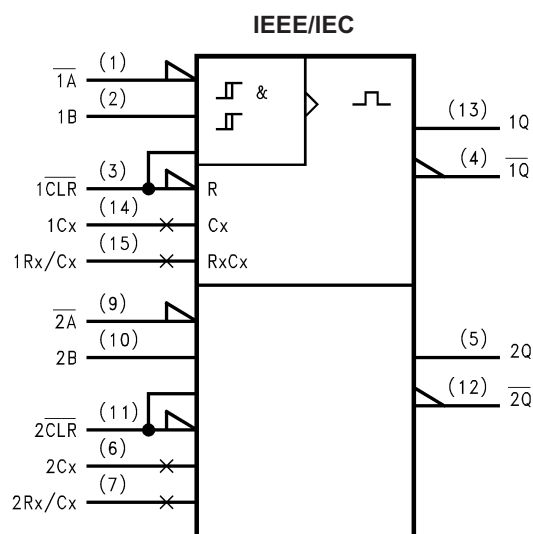
Order Number	Package Number	Package Description
74VHC221AM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC221ASJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHC221AMTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Connection Diagram



Logic Symbol



Truth Table

Inputs			Outputs		Function
A	B	CLR	Q	Q̄	
~	H	H	~	~	Output Enable
X	L	H	L	H	Inhibit
H	X	H	L	H	Inhibit
L	~	H	~	~	Output Enable
L	H	~	~	~	Output Enable
X	X	L	L	H	Reset

H = HIGH Voltage Level

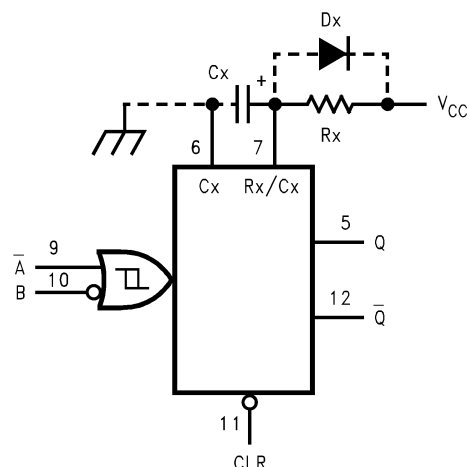
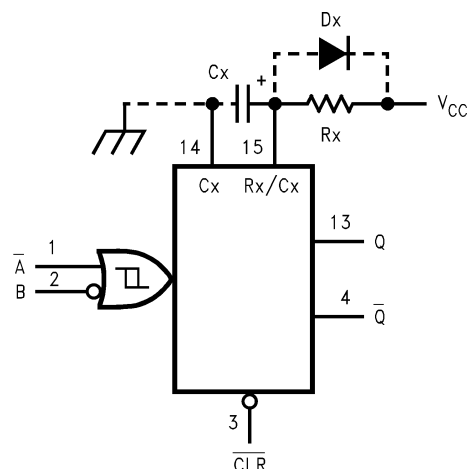
L = LOW Voltage Level

~ = HIGH-to-LOW Transition

~ = LOW-to-HIGH Transition

X = Don't Care

Block Diagrams



Note A: Cx, Rx, Dx are external Capacitor, Resistor, and Diode, respectively.

Note B: External clamping diode, Dx;

External capacitor is charged to V_{CC} level in the wait state, i.e. when no trigger is applied.

If the supply voltage is turned off, Cx discharges mainly through the internal (parasitic) diode. If Cx is sufficiently large and V_{CC} drops rapidly, there will be some possibility of damaging the IC through inrush current or latch-up. If the capacitance of the supply voltage filter is large enough and V_{CC} drops slowly, the inrush current is automatically limited and damage to the IC is avoided.

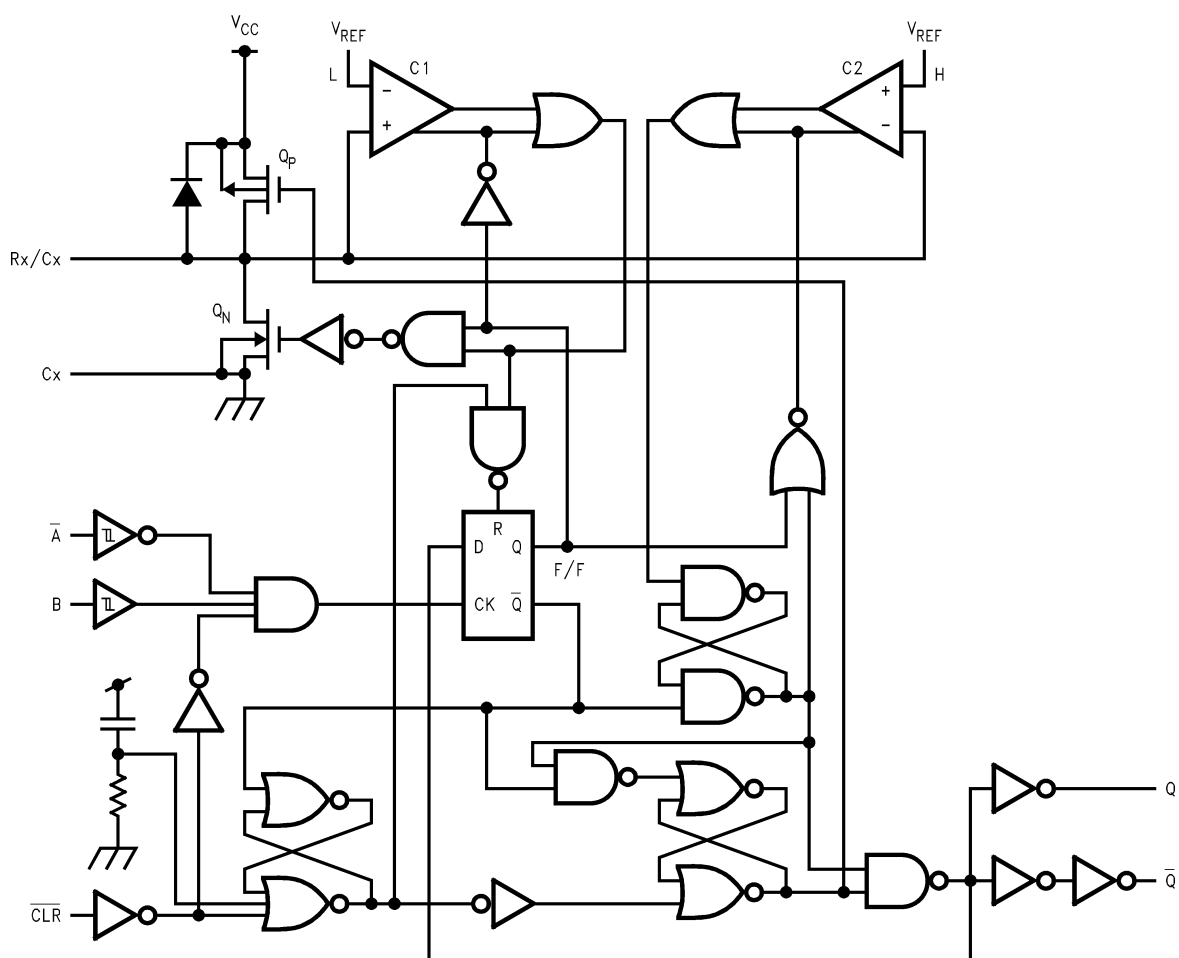
The maximum value of forward current through the parasitic diode is ± 20 mA. In the case of a large Cx, the limit of fall time of the supply voltage is determined as follows:

$$t_f \geq (V_{CC} - 0.7) C_x / 20\text{mA}$$

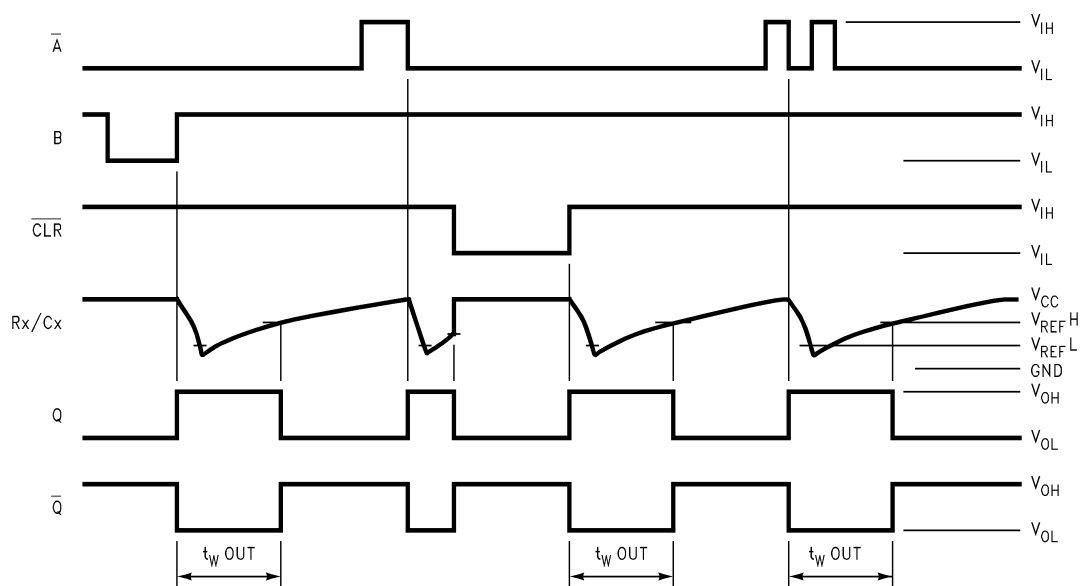
(t_f is the time between the supply voltage turn off and the supply voltage reaching $0.4 V_{CC}$)

In the event a system does not satisfy the above condition, an external clamping diode (Dx) is needed to protect the IC from inrush current.

System Diagram



Timing Chart



Functional Description

1. Stand-by State

The external capacitor (Cx) is fully charged to V_{CC} in the Stand-by State. That means, before triggering, the Q_P and Q_N transistors which are connected to the Rx/Cx node are in the off state. Two comparators that relate to the timing of the output pulse, and two reference voltage supplies turn off. The total supply current is only leakage current.

2. Trigger Operation

Trigger operation is effective in any of the following three cases. First, the condition where the $\overline{A}$ input is LOW, and B input has a rising signal; second, where the B input is HIGH, and the A input has a falling signal; and third, where the $\overline{A}$ input is LOW and the B input is HIGH, and the $\overline{CLR}$ input has a rising signal.

After a trigger becomes effective, comparators C1 and C2 start operating, and Q_N is turned on. The external capacitor discharges through Q_N . The voltage level at the Rx/Cx node drops. If the Rx/Cx voltage level falls to the internal reference voltage V_{refL} , the output of C1 becomes LOW. The flip-flop is then reset and Q_N turns off. At that moment C1 stops but C2 continues operating.

After Q_N turns off, the voltage at the Rx/Cx node starts rising at a rate determined by the time constant of external capacitor Cx and resistor Rx.

Upon triggering, output Q becomes HIGH, following some delay time of the internal F/F and gates. It stays HIGH even if the voltage of Rx/Cx changes from falling to rising. When Rx/Cx reaches the internal reference voltage V_{refH} , the output of C2 becomes LOW, the output Q goes LOW and C2 stops its operation. That means, after triggering, when the voltage level of the Rx/Cx node reaches V_{refH} , the IC returns to its MONOSTABLE state.

With large values of Cx and Rx, and ignoring the discharge time of the capacitor and internal delays of the IC, the width of the output pulse, t_W (OUT), is as follows:

$$t_W \text{ (OUT)} = 1.0 \text{ Cx Rx}$$

3. Reset Operation

In normal operation, the $\overline{CLR}$ input is held HIGH. If $\overline{CLR}$ is LOW, a trigger has no affect because the Q output is held LOW and the trigger control F/F is reset. Also, Q_P turns on and Cx is charged rapidly to V_{CC} .

This means if $\overline{CLR}$ is set LOW, the IC goes into a wait state.

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	±20mA
I_{OUT}	DC Output Current	±25mA
I_{CC}	DC V_{CC} / GND Current	±50mA
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 (CLR only) $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$	0ns/V ~ 100ns/V 0ns/V ~ 20ns/V
	External Capacitor, Cx	No Limitation ⁽²⁾ F
	External Resistor, Rx	>5k Ω ⁽²⁾ ($V_{CC} = 2.0V$) >1k Ω ⁽²⁾ ($V_{CC} > 3.0V$)

Notes:

- Unused inputs must be held HIGH or LOW. They may not float.
- The maximum allowable values of Cx and Rx are a function of the leakage of capacitor Cx, the leakage of the device, and leakage due to board layout and surface resistance.
Susceptibility to externally induced noise signals may occur for $R_x > 1\text{ M}\Omega$.

DC Electrical Characteristics

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40° 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		V
		3.0				0.0	0.1		
		4.5				0.0	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 _{IN}	Rx/Cx Terminal Off-State Current	5.5	V _{IN} = V _{CC} or GND			±0.25		±2.50	μA
I _{CC}	Quiescent Supply Current	5.5	V _{IN} = V _{CC} or GND			4.0		40.0	μA
I _{CC}	Active—State ⁽³⁾ Supply Current	3.0	V _{IN} = V _{CC} or GND, Rx/Cx = 0.5 V _{CC}		160	250		280	μA
		4.5			380	500		650	
		5.5			560	750		975	

Note:

3. Per circuit.

AC Electrical Characteristics⁽⁴⁾

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
t _{PLH} , t _{PHL}	Propagation Delay Time (A, B—Q, $\bar{Q}$)	3.3 ± 0.3	C _L = 15pF		13.4	20.6	1.0	24.0	ns
			C _L = 50pF		15.9	24.1	1.0	27.5	
		5.0 ± 0.5	C _L = 15pF		8.1	12.0	1.0	14.0	ns
			C _L = 50pF		9.6	14.0	1.0	16.0	
t _{PLH} , t _{PHL}	Propagation Delay Time (CLR Trigger—Q, $\bar{Q}$)	3.3 ± 0.3	C _L = 15pF		14.5	22.4	1.0	26.0	ns
			C _L = 50pF		17.0	25.9	1.0	29.5	
		5.0 ± 0.5	C _L = 15pF		8.7	12.9	1.0	15.0	ns
			C _L = 50pF		10.2	14.9	1.0	17.0	
t _{PLH} , t _{PHL}	Propagation Delay Time (CLR—Q, $\bar{Q}$)	3.3 ± 0.3	C _L = 15pF		10.3	15.8	1.0	18.5	ns
			C _L = 50pF		12.8	19.3	1.0	22.0	
		5.0 ± 0.5	C _L = 15pF		6.3	9.4	1.0	11.0	ns
			C _L = 50pF		7.8	11.4	1.0	13.0	
t _{WOUT}	Output Pulse Width	2.0	C _X = 28pF, C _L = 50pF, R _X = 6kΩ		415				
		3.3 ± 0.3			345				ns
		5.0 ± 0.5			312				
		3.3 ± 0.3	C _L = 50pF, C _x = 28pF, R _x = 2kΩ		160	240		300	ns
		5.0 ± 0.5			133	200		240	
		3.3 ± 0.3	C _L = 50pF, C _x = 0.01μF, R _x = 10kΩ	90	100	110	90	110	μs
		5.0 ± 0.5		90	100	110	90	110	
		3.3 ± 0.3	C _L = 50pF, C _x = 0.1μF, R _x = 10kΩ	0.9	1.0	1.1	0.9	1.1	ms
		5.0 ± 0.5		0.9	1.0	1.1	0.9	1.1	
Δt _{WOUT}	Output Pulse Width Error Between Circuits (In same Package)				±1				%
C _{IN}	Input Capacitance		V _{CC} = Open		4	10		10	pF
C _{PD}	Power Dissipation Capacitance		⁽⁵⁾		73				pF

Notes:

4. Refer to 74VHC221A Timing Chart.

5. 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 by the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}^1 \cdot \text{Duty} / 100 + I_{CC} / 2 \text{ (per Circuit)}$$

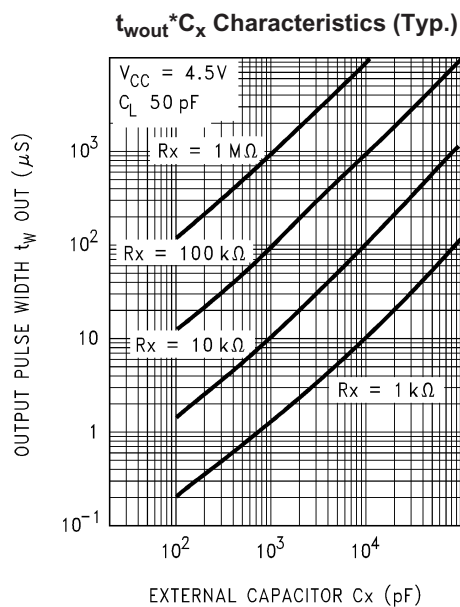
I_{CC}¹: Active Supply Current

Duty: %

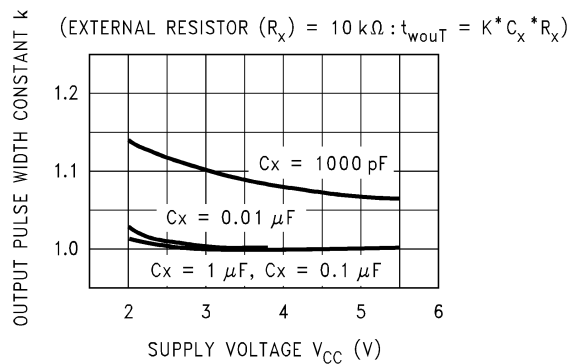
AC Operating Requirement

Symbol	Parameter	V _{CC} (V)	T _A = 25°C			T _A = -40°C to +85°C		Units
			Min.	Typ.	Max.	Min.	Max.	
t _{W(L)}	Minimum Trigger	3.3	5.0			5.0		ns
t _{W(H)}	Pulse Width	5.0	5.0			5.0		
t _{W(L)}	Minimum Clear Pulse Width	3.3	5.0			5.0		ns
		5.0	5.0			5.0		

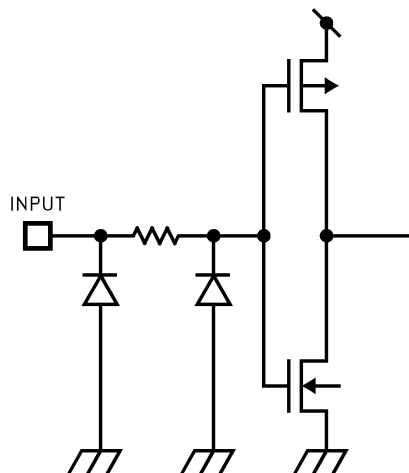
Device Characteristics

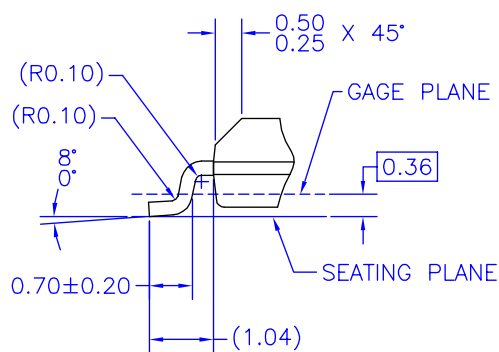
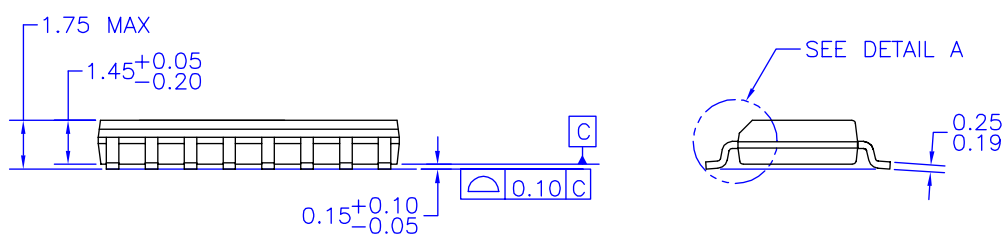
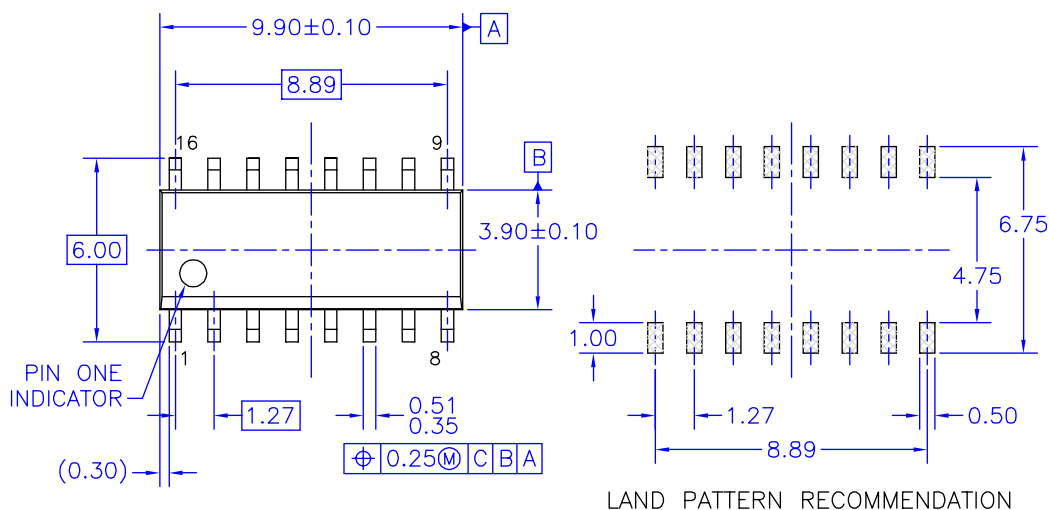


Output Pulse Width Constant K-Supply Voltage (Typical)



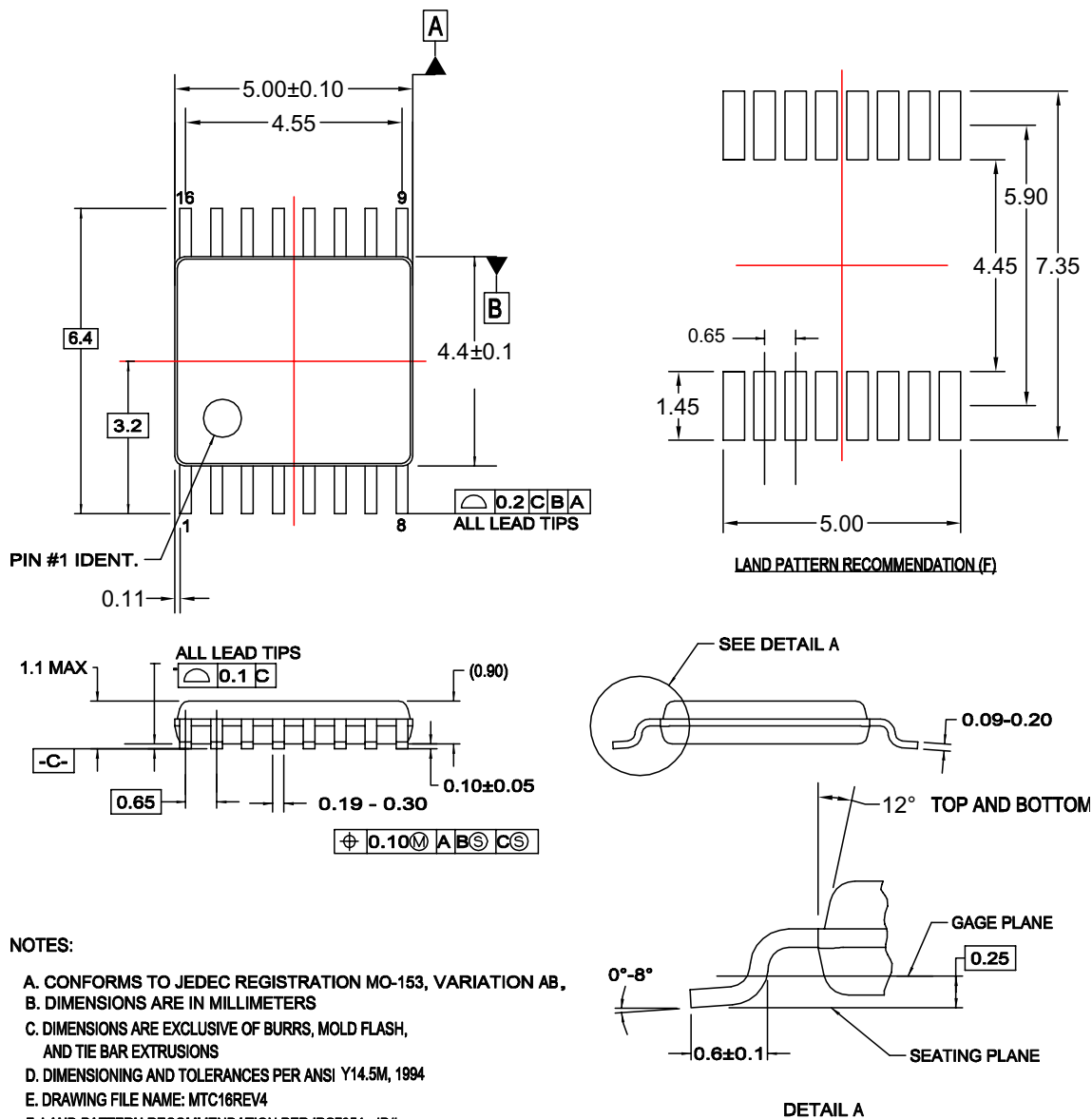
Input Equivalent Circuit





Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



MTC16rev4

Figure 3. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC16

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACE [®]	<i>i-Lo</i> [™]	Power-SPM [™]	TinyBoost [™]
Across the board. Around the world. [™]	ImpliedDisconnect [™]	PowerTrench [®]	TinyBuck [™]
ActiveArray [™]	IntelliMAX [™]	Programmable Active Droop [™]	TinyLogic [®]
Bottomless [™]	ISOPANAR [™]	QFET [®]	TINYOPTO [™]
Build it Now [™]	MICROCOUPLER [™]	QS [™]	TinyPower [™]
CoolFET [™]	MicroPak [™]	QT Optoelectronics [™]	TinyWire [™]
CROSSVOLT [™]	MICROWIRE [™]	Quiet Series [™]	TruTranslation [™]
CTL [™]	Motion-SPM [™]	RapidConfigure [™]	μSerDes [™]
Current Transfer Logic [™]	MSX [™]	RapidConnect [™]	UHC [®]
DOVE [™]	MSXPro [™]	ScalarPump [™]	UniFET [™]
E ² CMOS [™]	OCX [™]	SMART START [™]	VCX [™]
EcoSPARK [®]	OCXPro [™]	SPM [®]	Wire [™]
EnSigna [™]	OPTOLOGIC [®]	STEALTH [™]	
FACT Quiet Series [™]	OPTOPLANAR [®]	SuperFET [™]	
FACT [®]	PACMAN [™]	SuperSOT [™] 3	
FAST [®]	PDP-SPM [™]	SuperSOT [™] 6	
FASTr [™]	POP [™]	SuperSOT [™] 8	
FPS [™]	Power220 [®]	SyncFET [™]	
FRFET [®]	Power247 [®]	TCM [™]	
GlobalOptoisolator [™]	PowerEdge [™]	The Power Franchise [®]	
GTO [™]	PowerSaver [™]		
HiSeC [™]			

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. I26

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