

MM74HC221A

Dual Non-Retriggerable Monostable Multivibrator

General Description

The MM74HC221A high speed monostable multivibrators (one shots) utilize advanced silicon-gate CMOS technology. They feature speeds comparable to low power Schottky TTL circuitry while retaining the low power and high noise immunity characteristic of CMOS circuits.

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 MM74HC221A can be triggered on the positive transition of the clear while A is held LOW and B is held HIGH.

The MM74HC221A is a non-retriggerable, and therefore cannot be retriggered until the output pulse times out.

Pulse width stability over a wide range of temperature and supply is achieved using linear CMOS techniques. The output pulse equation is simply: $PW = (R_{EXT}) (C_{EXT})$; where PW

is in seconds, R is in ohms, and C is in farads. All inputs are protected from damage due to static discharge by diodes to V_{CC} and ground.

Features

- Typical propagation delay: 40 ns
- Wide power supply range: 2V–6V
- Low quiescent current: 80 μ A maximum (74HC Series)
- Low input current: 1 μ A maximum
- Fanout of 10 LS-TTL loads
- Simple pulse width formula $T = RC$
- Wide pulse range: 400 ns to ∞ (typ)
- Part to part variation: $\pm 5\%$ (typ)
- Schmitt Trigger A & B inputs enable infinite signal input rise or fall times

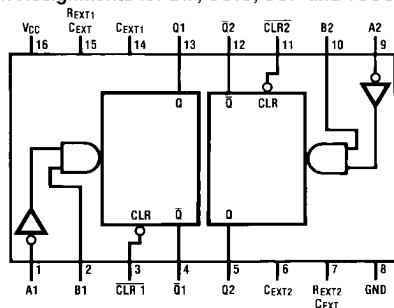
Ordering Code:

Order Number	Package Number	Package Description
MM74HC221AM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC221ASJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
MM74HC221AMTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
MM74HC221AN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), MS-001, 0.300" Wide

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

Connection Diagrams

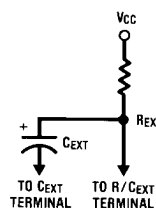
Pin Assignments for DIP, SOIC, SOP and TSSOP



Top View

Note: Pin 6 and Pin 14 must be hard-wired to GND.

Timing Component



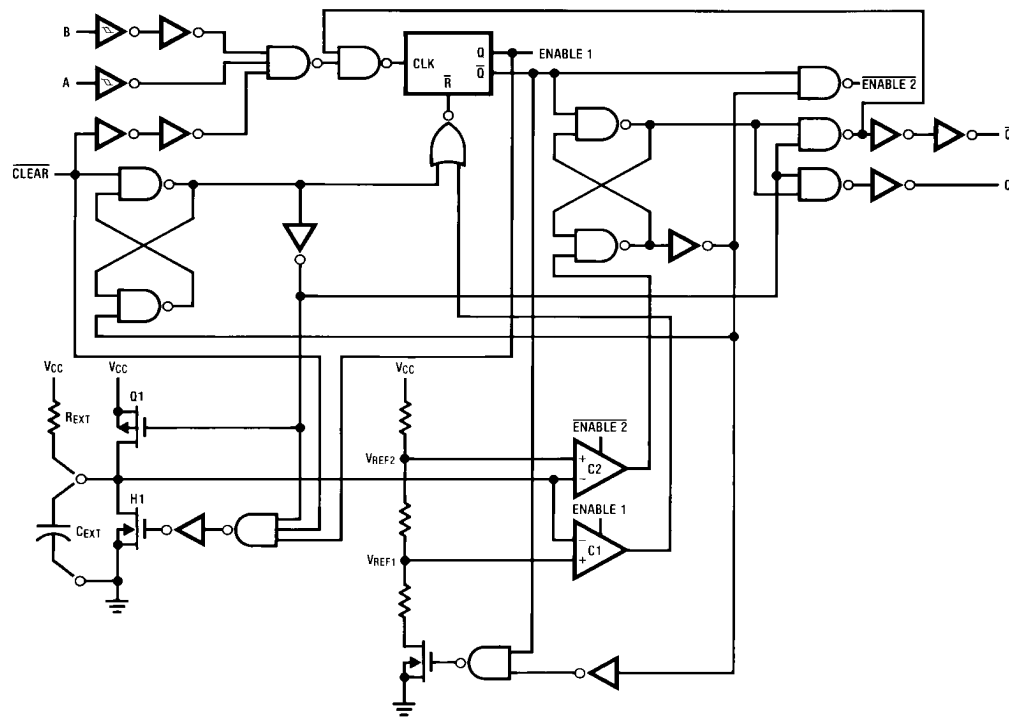
MM74HC221A Dual Non-Retriggerable Monostable Multivibrator

Truth Table

Inputs			Outputs	
Clear	A	B	Q	\bar{Q}
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⌊	⌋
H	↓	H	⌊	⌋
↑	L	H	⌊	⌋

H = HIGH Level
 L = LOW Level
 ↑ = Transition from LOW-to-HIGH
 ↓ = Transition from HIGH-to-LOW
 ⌊ = One HIGH Level Pulse
 ⌋ = One LOW Level Pulse
 X = Irrelevant

Logic Diagram



Absolute Maximum Ratings(Note 1)

(Note 2)

Supply Voltage (V_{CC})	-0.5V to +7.0V
DC Input Voltage (V_{IN})	-1.5V to $V_{CC}+1.5V$
DC Output Voltage (V_{OUT})	-0.5V to $V_{CC}+0.5V$
Clamp Diode Current (I_{IK}, I_{OK})	± 20 mA
DC Output Current, per pin (I_{OUT})	± 25 mA
DC V_{CC} or GND Current, per pin (I_{CC})	± 50 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C
Power Dissipation (P_D)	
(Note 3)	600 mW
S.O. Package only	500 mW
Lead Temperature (T_L)	
(Soldering 10 seconds)	260°C

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	2	6	V
DC Input or Output Voltage (V_{IN}, V_{OUT})	0	V_{CC}	V
Operating Temperature Range (T_A)	-40	+85	°C
Maximum Input Rise and Fall Time (Clear Input)			
$V_{CC} = 2.0V$		1000	ns
$V_{CC} = 4.5V$		500	ns
$V_{CC} = 6.0V$		400	ns

Note 1: Maximum Ratings are those values beyond which damage to the device may occur.

Note 2: Unless otherwise specified all voltages are referenced to ground.

Note 3: Power Dissipation temperature derating — plastic "N" package: — 12 mW/°C from 65°C to 85°C.

DC Electrical Characteristics (Note 4)

Symbol	Parameter	Conditions	V _{CC}	T _A = 25°C		T _A = -40 to 85°C		T _A = -55 to 125°C		Units
				Typ	Guaranteed Limits					
V _{IH}	Minimum HIGH Level Input Voltage		2.0V		1.5	1.5	1.5	V		
			4.5V		3.15	3.15	3.15	V		
			6.0V		4.2	4.2	4.2	V		
V _{IL}	Maximum LOW Level Input Voltage		2.0V		0.3	0.3	0.3	V		
			4.5V		0.9	0.9	0.9	V		
			6.0V		1.2	1.2	1.2	V		
V _{OH}	Minimum HIGH Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0V	2.0	1.9	1.9	1.9	V		
			4.5V	4.5	4.4	4.4	4.4	V		
			6.0V	6.0	5.9	5.9	5.9	V		
		V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5V	4.2	3.98	3.84	3.7	V		
			6.0V	5.7	5.48	5.34	5.2	V		
V _{OL}	Maximum LOW Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0V	0	0.1	0.1	0.1	V		
			4.5V	0	0.1	0.1	0.1	V		
			6.0V	0	0.1	0.1	0.1	V		
		V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5V	0.2	0.26	0.33	0.4	V		
			6.0V	0.2	0.26	0.33	0.4	V		
I _{IN}	Maximum Input Current (Pins 7, 15)	V _{IN} = V _{CC} or GND	6.0V		±0.5	±5.0	±5.0	μA		
I _{IN}	Maximum Input Current (all other pins)	V _{IN} = V _{CC} or GND	6.0V		±0.1	±1.0	±1.0	μA		
I _{CC}	Maximum Quiescent Supply Current (standby)	V _{IN} = V _{CC} or GND I _{OUT} = 0 μA	6.0V		8.0	80	160	μA		
I _{CC}	Maximum Active Supply Current (per monostable)	V _{IN} = V _{CC} or GND R/C _{EXT} = 0.5V _{CC}	2.0V	36	80	110	130	μA		
			4.5V	0.33	1.0	1.3	1.6	mA		
			6.0V	0.7	2.0	2.6	3.2	mA		

Note 4: For a power supply of $5V \pm 10\%$ the worst-case output voltages (V_{OH} and V_{OL}) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst-case V_{IH} and V_{IL} occur at $V_{CC} = 5.5V$ and 4.5V respectively. (The V_{IH} value at 5.5V is 3.85V.) The worst-case leakage current (I_{IN} , I_{CC} , and I_{OZ}) occur for CMOS at the higher voltage and so the 6.0V values should be used.

AC Electrical Characteristics

Symbol

Parameter

Conditions

Typ

Guaranteed Limit

Units

t_{PLH}

Maximum Trigger Propagation Delay A, B or Clear to Q

22

36

ns

t_{PHL}

Maximum Trigger Propagation Delay A, B or Clear to Q̄

25

42

ns

t_{PHL}

Maximum Propagation Delay Clear to Q

20

31

ns

t_{PLH}

Maximum Propagation Delay Clear to Q̄

22

33

ns

t_W

Minimum Pulse Width A, B or Clear

14

26

ns

t_{REM}

Minimum Clear Removal Time

0

ns

t_{WQ(MIN)}

Minimum Output Pulse Width

C_{EXT} = 28 pF

R_{EXT} = 2 kΩ

400

ns

t_{WQ}

Output Pulse Width

C_{EXT} = 1000 pF

R_{EXT} = 10 kΩ

10

μs

AC Electrical Characteristics

Symbol

Parameter

Conditions

V_{CC}

T_A = 25°C

T_A = -40 to 85°C

T_A = -55 to 125°C

Units

Typ

Guaranteed Limits

t_{PLH}

Maximum Trigger Propagation Delay A, B or Clear to Q

2.0V

77

169

194

210

ns

4.5V

26

42

51

57

ns

6.0V

21

32

39

44

ns

t_{PHL}

Maximum Trigger Propagation Delay A, B or Clear to Q̄

2.0V

88

197

229

250

ns

4.5V

29

48

60

67

ns

6.0V

24

38

46

51

ns

t_{PHL}

Maximum Propagation Delay Clear to Q

2.0V

54

114

132

143

ns

4.5V

23

34

41

45

ns

6.0V

19

28

33

36

ns

t_{PLH}

Maximum Propagation Delay Clear to Q̄

2.0V

56

116

135

147

ns

4.5V

25

36

42

46

ns

6.0V

20

29

34

37

ns

t_W

Minimum Pulse Width A, B, Clear

2.0V

57

123

144

157

ns

4.5V

17

30

37

42

ns

6.0V

12

21

27

30

ns

t_{REM}

Minimum Clear Removal Time

2.0V

0

0

0

ns

4.5V

0

0

0

ns

6.0V

0

0

0

ns

t_{TLH}, t_{THL}

Maximum Output Rise and Fall Time

2.0V

30

75

95

110

ns

4.5V

8

15

19

22

ns

6.0V

7

13

16

19

ns

t_{WQ(MIN)}

Minimum Output Pulse Width

C_{EXT} = 28 pF

R_{EXT} = 2 kΩ

R_{EXT} = 6 kΩ (V_{CC} = 2V)

2.0V

1.5

μs

4.5V

450

ns

6.0V

380

ns

t_{WQ}

Output Pulse Width

C_{EXT} = 0.1 μF

R_{EXT} = 10 kΩ

Min

5.0V

1

0.9

0.86

0.85

ms

Max

5.0V

1

1.1

1.14

1.15

ms

C_{PD}

Power Dissipation Capacitance (Note 5)

87

pF

C_{IN}

Maximum Input Capacitance (Pins 7 & 15)

12

20

20

20

pF

C_{IN}

Maximum Input Capacitance (other inputs)

6

10

10

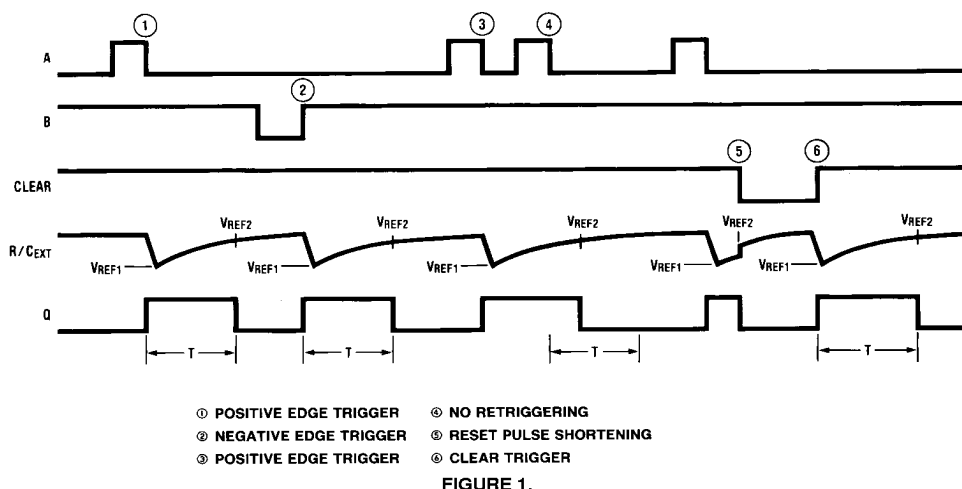
10

pF

Note 5:

C_{PD} determines the no load dynamic power consumption, P_D = C_{PD} V_{CC}²f + I_{CC} V_{CC}, and the no load dynamic current consumption, I_S = C_{PD} V_{CC}f + I_{CC}.

Theory of Operation



TRIGGER OPERATION

As shown in Figure 1 and the logic diagram before an input trigger occurs, the monostable is in the quiescent state with the Q output LOW, and the timing capacitor C_{EXT} completely charged to V_{CC} . When the trigger input A goes from V_{CC} to GND (while inputs B and clear are held to V_{CC}) a valid trigger is recognized, which turns on comparator C1 and N-channel transistor N11. At the same time the output latch is set. With transistor N1 on, the capacitor C_{EXT} rapidly discharges toward GND until V_{REF1} is reached. At this point the output of comparator C1 changes state and transistor N1 turns off. Comparator C1 then turns off while at the same time comparator C2 turns on. With transistor N1 off, the capacitor C_{EXT} begins to charge through the timing resistor, R_{EXT} , toward V_{CC} . When the voltage across C_{EXT} equals V_{REF2} , comparator C2 changes state causing the output latch to reset (Q goes LOW) while at the same time disabling comparator C2. This ends the timing cycle with the monostable in the quiescent state, waiting for the next trigger.

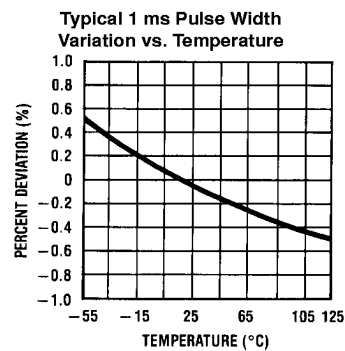
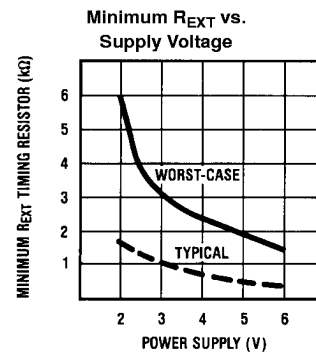
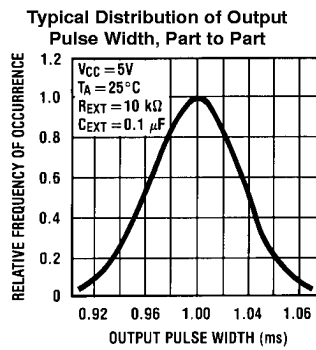
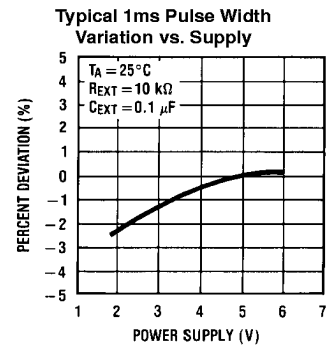
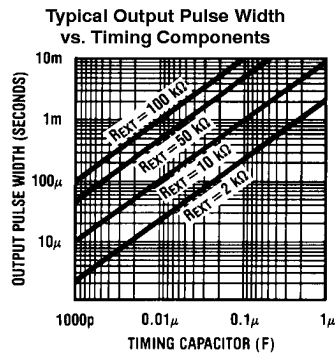
A valid trigger is also recognized when trigger input B goes from GND to V_{CC} (while input A is at GND and input clear is at V_{CC}). The MM74HC221 can also be triggered when clear goes from GND to V_{CC} (while A is at Gnd and B is at V_{CC}).

It should be noted that in the quiescent state C_{EXT} is fully charged to V_{CC} causing the current through resistor R_{EXT} to be zero. Both comparators are "off" with the total device current due only to reverse junction leakages. An added feature of the MM74HC221 is that the output latch is set via the input trigger without regard to the capacitor voltage. Thus, propagation delay from trigger to Q is independent of the value of C_{EXT} , R_{EXT} , or the duty cycle of the input waveform.

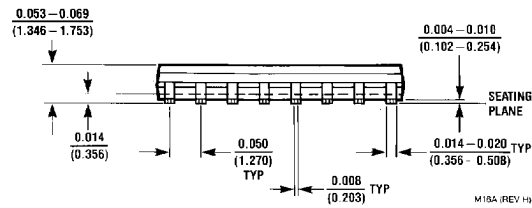
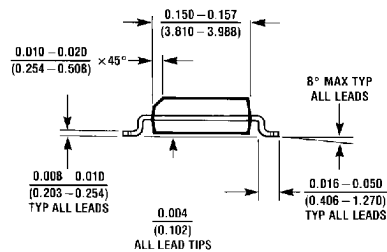
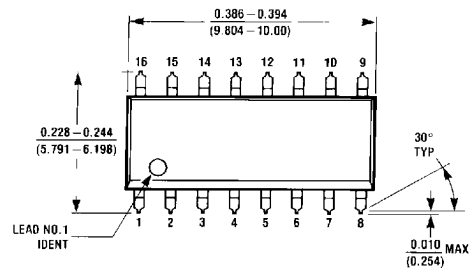
The MM74HC221 is non-retriggerable and will ignore input transitions on A and B until it has timed out 3 and 4.

RESET OPERATION

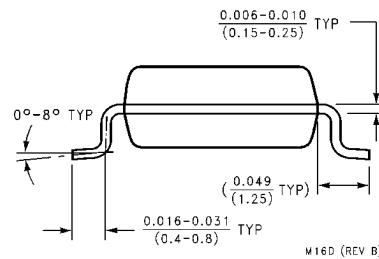
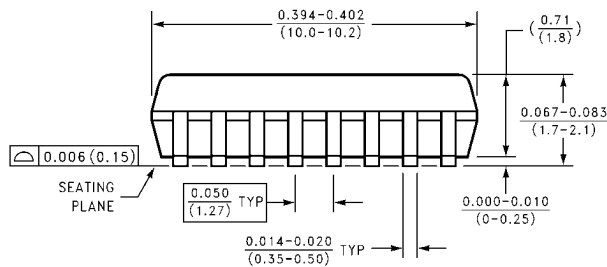
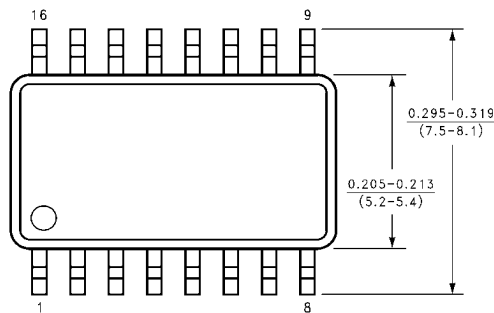
These one shots may be reset during the generation of the output pulse. In the reset mode of operation, an input pulse on clear sets the reset latch and causes the capacitor to be fast charged to V_{CC} by turning on transistor Q1 5. When the voltage on the capacitor reaches V_{REF2} , the reset latch will clear and then be ready to accept another pulse. If the clear input is held LOW, any trigger inputs that occur will be inhibited and the Q and \bar{Q} outputs of the output latch will not change. Since the Q output is reset when an input low level is detected on the Clear input, the output pulse T can be made significantly shorter than the minimum pulse width specification.



Note: R and C are not subjected to temperature. The C is polypropylene.

Physical Dimensions inches (millimeters) unless otherwise noted


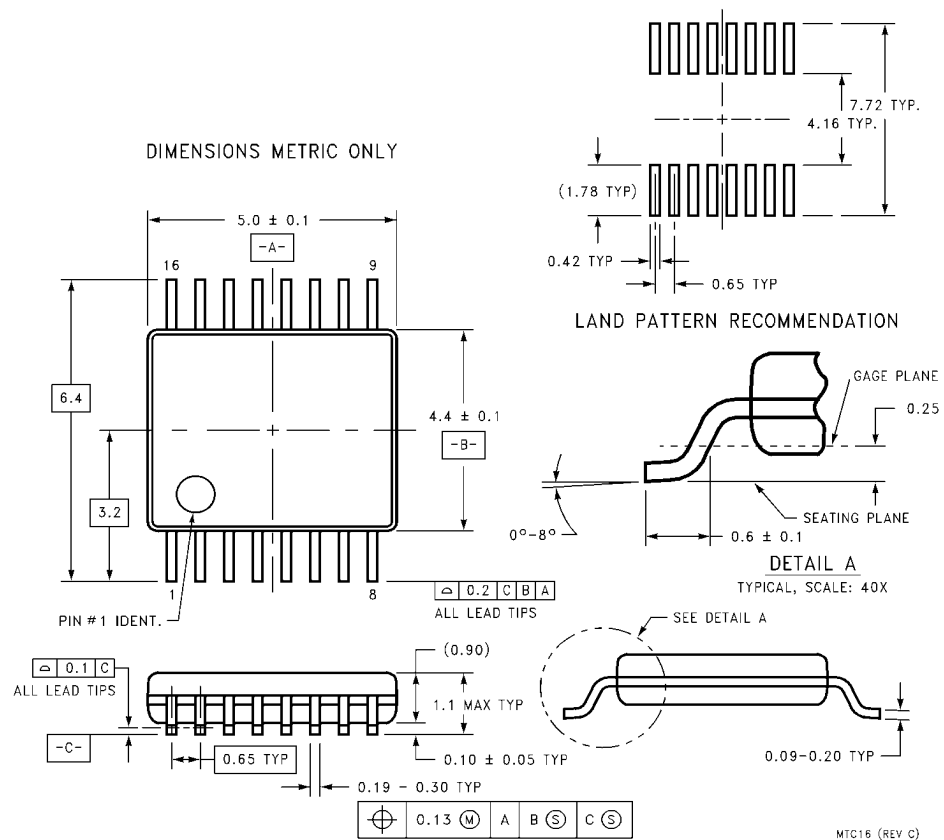
M16A (REV H)

**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M16A**


M16D (REV B)

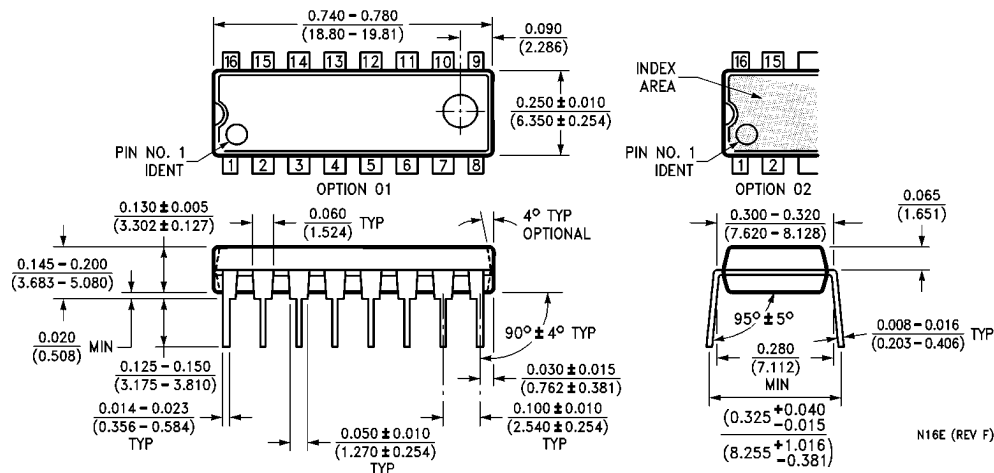
**16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M16D**

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



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

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N16E

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