FAIRCHILD SEMICONDUCTOR™

August 1984
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MM74HC4066
Quad Analog Switch

General Description

The MM74HC4066 devices are digitally controlled analog switches utilizing advanced silicon-gate CMOS technology. These switches have low "ON" resistance and low "OFF" leakages. They are bidirectional switches, thus any analog input may be used as an output and visa-versa. Also the MM74HC4066 switches contain linearization circuitry which lowers the "ON" resistance and increases switch linearity. The MM74HC4066 devices allow control of up to 12V (peak) analog signals with digital control signals of the same range. Each switch has its own control input which disables each switch when LOW. All analog inputs and outputs and digital inputs are protected from electrostatic damage by diodes to V_{CC} and ground.

Features

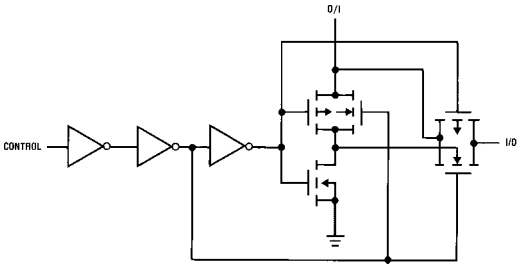
- Typical switch enable time: 15 ns
- Wide analog input voltage range: 0–12V
- Low "ON" resistance: 30 typ. (MM74HC4066)
- Low quiescent current: 80 μA maximum (74HC)
- Matched switch characteristics
- Individual switch controls

Ordering Code:

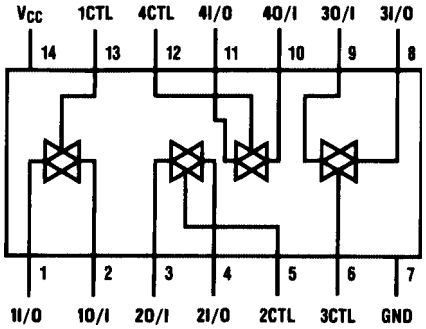
Order Number	Package Number	Package Description
MM74HC4066M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC4066MX_NL	M14A	Pb-Free 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74HC4066SJ	M14D	Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
MM74HC4066MTC	MTC14	14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
MM74HC4066N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.
Pb-Free package per JEDEC J-STD-020B.

Schematic Diagram



Connection Diagram



Top View

Truth Table

Input	Switch
CTL	I/O–O/I
L	"OFF"
H	"ON"

Absolute Maximum Ratings (Note 1)

(Note 2)

Supply Voltage (V_{CC})	−0.5 to +15V
DC Control Input Voltage (V_{IN})	−1.5 to V_{CC} +1.5V
DC Switch I/O Voltage (V_{IO})	V_{EE}−0.5 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	12	V
DC Input or Output Voltage			
(V_{IN}, V_{OUT})	0	V_{CC}	V
Operating Temperature Range (T_A)	−40	+85	°C
Input Rise or Fall Times			
(t_r, t_f) V_{CC} = 2.0V		1000	ns
V_{CC} = 4.5V		500	ns
V_{CC} = 9.0V		400	ns

Note 1: Absolute 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		2.0V		1.5	1.5	1.5	V
	Input Voltage		4.5V		3.15	3.15	3.15	V
			9.0V		6.3	5.3	6.3	V
			12.0V		8.4	8.4	8.4	V
V_{IL}	Maximum LOW Level		2.0V		0.5	0.5	0.5	V
	Input Voltage		4.5V		1.35	1.35	1.35	V
			9.0V		2.7	2.7	2.7	V
			12.0V		3.6	3.6	3.6	V
R_{ON}	Maximum "ON" Resistance	V_{CTL} = V_{IH}, I_S = 2.0 mA	4.5V	100	170	200	220	Ω
	(Note 5)	V_{IS} = V_{CC} to GND	9.0V	50	85	105	110	Ω
		(Figure 1)	12.0	30	70	85	90	Ω
			2.0V	120	180	215	240	Ω
		V_{CTL} = V_{IH}, I_S = 2.0 mA	4.5V	50	80	100	120	Ω
		V_{IS} = V_{CC}or GND	9.0V	35	60	75	80	Ω
		(Figure 1)	12.0V	20	40	60	70	Ω
R_{ON}	Maximum "ON" Resistance	V_{CTL} = V_{IH}	4.5V	10	15	20	20	Ω
	Matching	V_{IS} = V_{CC} to GND	9.0V	5	10	15	15	Ω
			12.0V	5	10	15	15	Ω
I_{IN}	Maximum Control	V_{IN} = V_{CC} or GND			±0.1	±1.0	±1.0	µA
	Input Current	V_{CC} = 2–6V						
I_{IZ}	Maximum Switch "OFF"	V_{OS} = V_{CC} or GND	6.0V	10	±60	±600	±600	nA
	Leakage Current	V_{IS} = GND or V_{CC}	9.0V	15	±80	±800	±800	nA
		V_{CTL} = V_{IL} (Figure 3)	12.0V	20	±100	±1000	±1000	nA
I_{IZ}	Maximum Switch "ON"	V_{IS} = V_{CC} to GND	6.0V	10	±40	±150	±150	nA
	Leakage Current	V_{CTL} = V_{IH}	9.0V	15	±50	±200	±200	nA
		V_{OS} = OPEN (Figure 2)	12.0V	20	±60	±300	±300	nA
I_{CC}	Maximum Quiescent	V_{IN} = V_{CC} or GND	6.0V		2.0	20	40	µA
	Supply Current	I_{OUT} = 0 µA	9.0V		4.0	40	80	µA
			12.0V		8.0	80	160	µA

Note 4: For a power supply of 5V ±10% the worst case on resistance (R_{ON}) occurs 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 occurs for CMOS at the higher voltage and so the 5.5V values should be used.

Note 5: At supply voltages (V_{CC}–GND) approaching 2V the analog switch on resistance becomes extremely non-linear. Therefore it is recommended that these devices be used to transmit digital only when using these supply voltages.

AC Electrical Characteristics

V_{CC} = 2.0V–6.0V V_{EE} = 0V–12V, C_L = 50 pF (unless otherwise specified)

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_{PHL}, t_{PLH}	Maximum Propagation		2.0V	25	50	30	75	ns
	Delay Switch In to Out		4.5V	5	10	13	15	ns
			9.0V	4	8	10	12	ns
			12.0V	3	7	11	13	ns
t_{PZL}, t_{PZH}	Maximum Switch Turn	R_L = 1 kΩ	2.0V	30	100	125	150	ns
	"ON" Delay		4.5V	12	20	25	30	ns
			9.0V	6	12	15	18	ns
			12.0V	5	10	13	15	ns
t_{PHZ}, t_{PLZ}	Maximum Switch Turn	R_L = 1 kΩ	2.0V	60	168	210	252	ns
	"OFF" Delay		4.5V	25	36	45	54	ns
			9.0V	20	32	40	48	ns
			12.0V	15	30	38	45	
f_{MAX}	Minimum Frequency	R_L = 600Ω	4.5V	40				MHz
	Response (Figure 7)	V_{IS} = 2 V_{PP} at (V_{CC}/2)	9.0V	100				MHz
	20 log (V_O/V_I) = −3 dB	(Note 6) (Note 7)						
	Crosstalk Between	R_L = 600Ω, F = 1 MHz						
	any Two Switches	(Note 7) (Note 8)	4.5V	−52				dB
	(Figure 8)		9.0V	−50				dB
	Peak Control to Switch	R_L = 600Ω, F = 1 MHz	4.5V	100				mV
	Feedthrough Noise (Figure 9)	C_L = 50 pF	9.0V	250				mV
	Switch OFF Signal	R_L = 600Ω, F = 1 MHz						
	Feedthrough	$V_{(CT)}V_{IL}$						
	Isolation	(Note 7) (Note 8)	4.5V	−42				dB
	(Figure 10)		9.0V	−44				dB
THD	Total Harmonic	R_L = 10 kΩ, C_L = 50 pF,						
	Distortion	F = 1 kHz						
	(Figure 11)	V_{IS} = 4 V_{PP}	4.5V	.013				%
		V_{IS} = 8 V_{PP}	9.0V	.008				%
C_{IN}	Maximum Control			5	10	10	10	pF
	Input Capacitance							
C_{IN}	Maximum Switch			20				pF
	Input Capacitance							
C_{IN}	Maximum Feedthrough	V_{CTL} = GND		0.5				pF
	Capacitance							
C_{PD}	Power Dissipation			15				pF
	Capacitance							

Note 6: Adjust 0 dBm for F = 1 kHz (Null R_L/R_{ON} Attenuation).

Note 7: V_{IS} is centered at V_{CC}/2.

Note 8: Adjust input for 0 dBm.

AC Test Circuits and Switching Time Waveforms

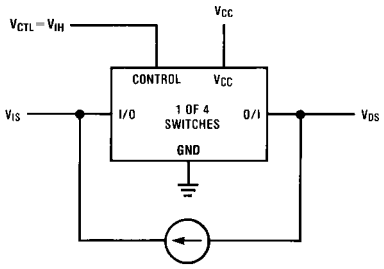


FIGURE 1. "ON" Resistance

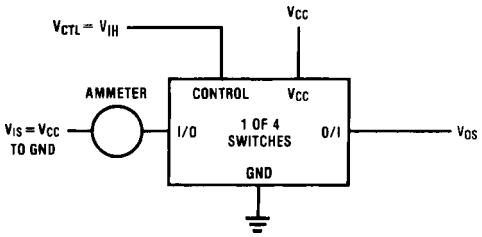


FIGURE 2. "ON" Channel Leakage Current

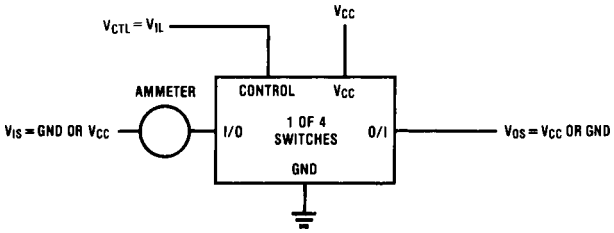


FIGURE 3. "OFF" Channel Leakage Current

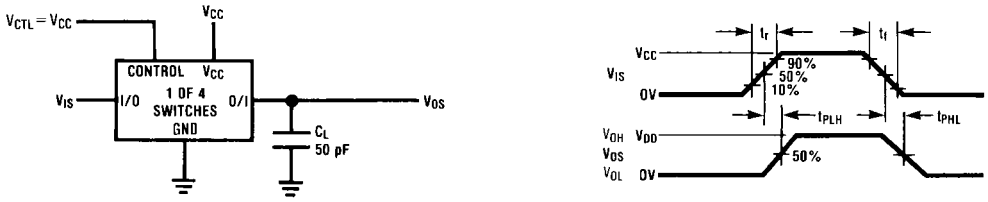


FIGURE 4. t_{PHL}, t_{PLH} Propagation Delay Time Signal Input to Signal Output

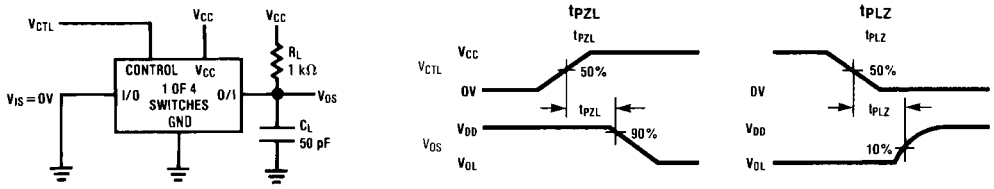


FIGURE 5. t_{PZL}, t_{PLZ} Propagation Delay Time Control to Signal Output

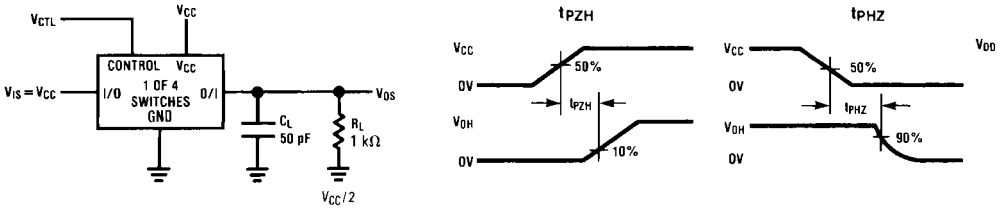


FIGURE 6. t_{PZH}, t_{PHZ} Propagation Delay Time Control to Signal Output

AC Test Circuits and Switching Time Waveforms (Continued)

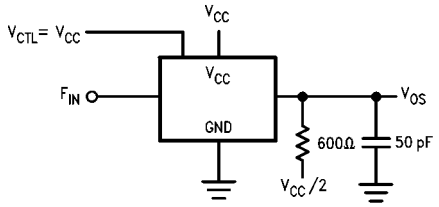


FIGURE 7. Frequency Response

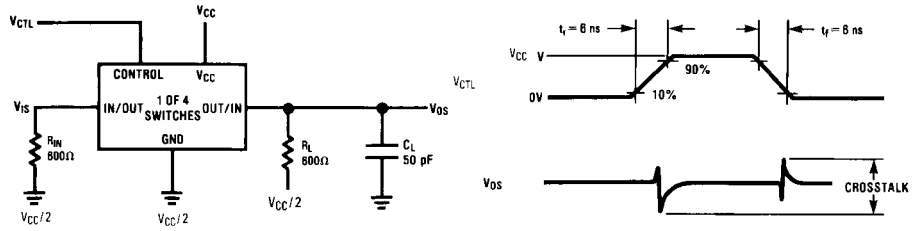


FIGURE 8. Crosstalk: Control Input to Signal Output

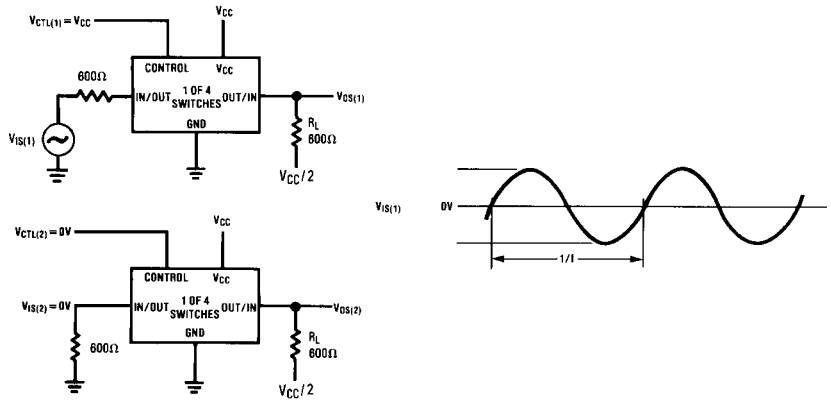


FIGURE 9. Crosstalk Between Any Two Switches

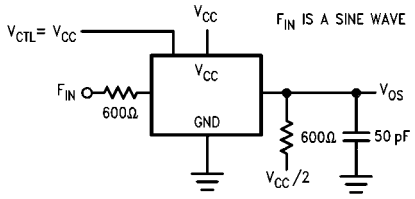


FIGURE 10. Switch OFF Signal Feedthrough Isolation

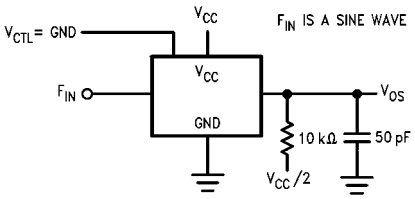
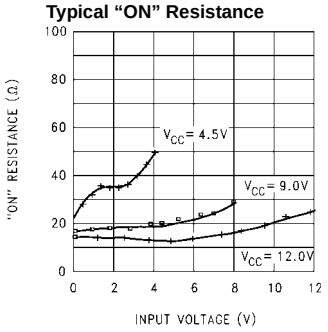


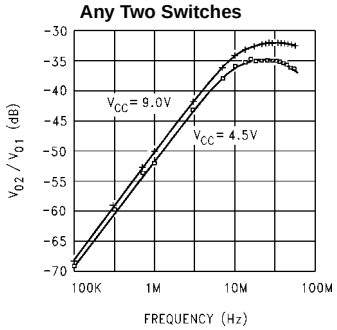
FIGURE 11. Sinewave Distortion

Typical Performance Characteristics

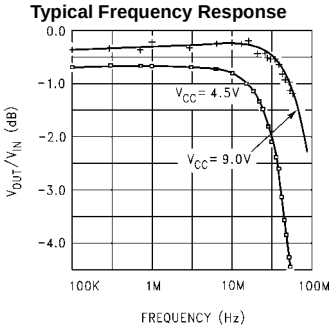
Typical "ON" Resistance



Typical Crosstalk Between Any Two Switches



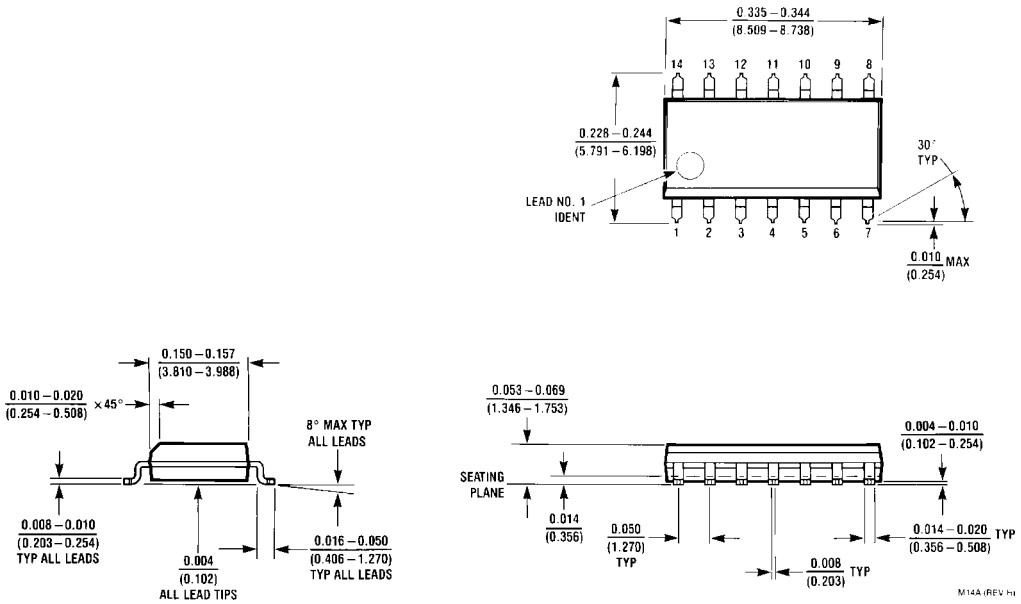
Typical Frequency Response



Special Considerations

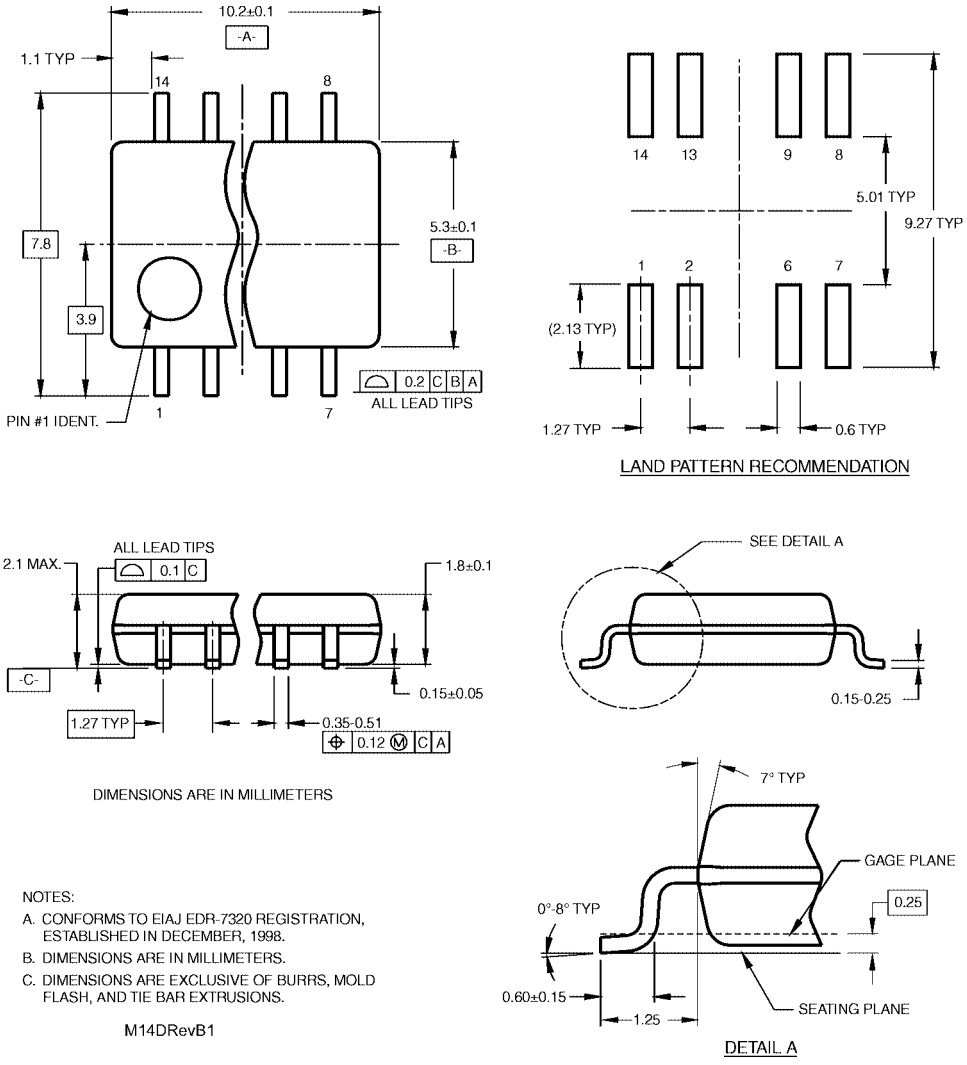
In certain applications the external load-resistor current may include both V_{CC} and signal line components. To avoid drawing V_{CC} current when switch current flows into the analog switch input pins, the voltage drop across the switch must not exceed 0.6V (calculated from the ON resistance).

Physical Dimensions inches (millimeters) unless otherwise noted



14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
Package Number M14A

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



NOTES:

A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.

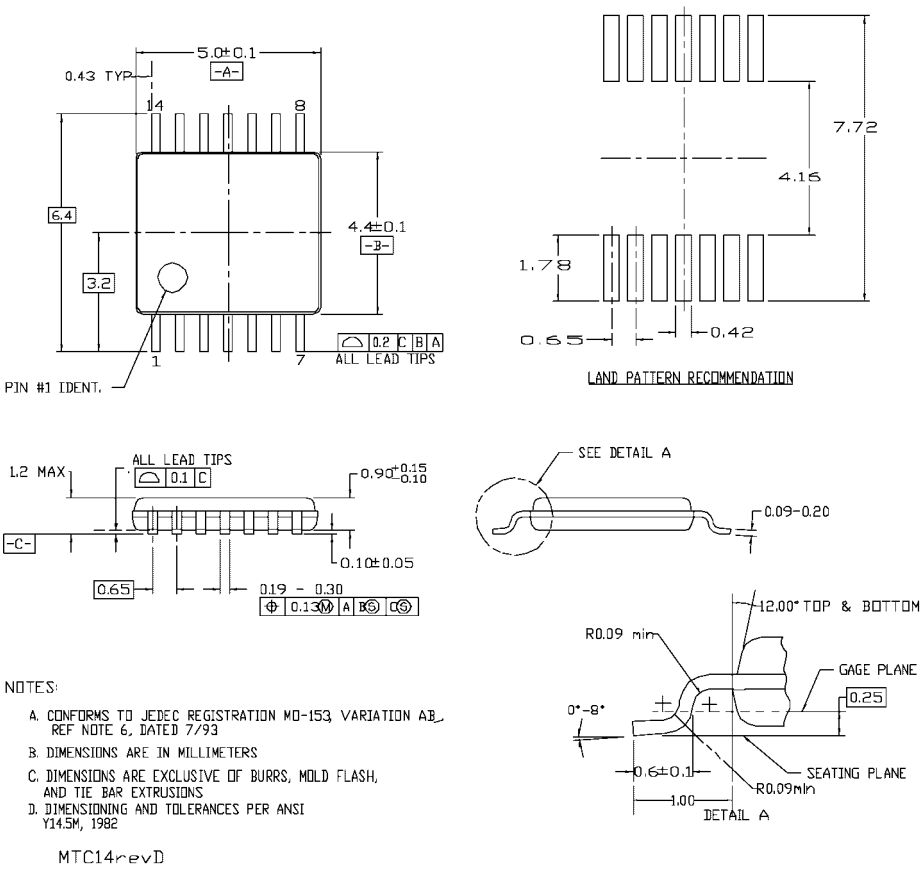
B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M14DRevB1

Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M14D

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



NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATED 7/93

B. DIMENSIONS ARE IN MILLIMETERS

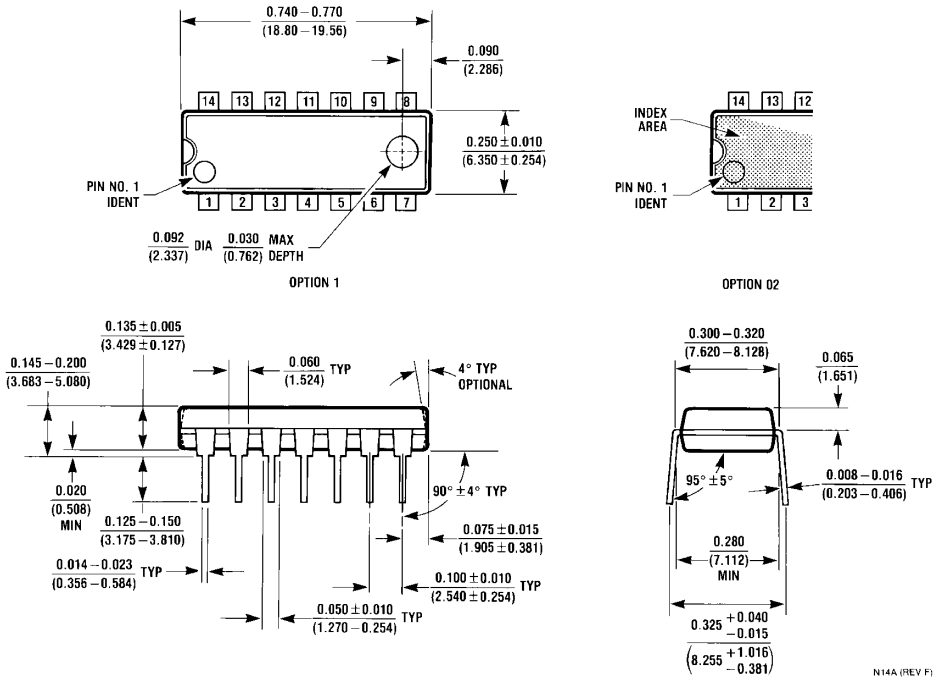
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS

D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982

MTC14revD

14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC14

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



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N14A