



74VHC4051, 8-Channel Analog Multiplexer 74VHC4052, Dual 4-Channel Analog Multiplexer 74VHC4053, Triple 2-Channel Analog Multiplexer

Features

- Wide analog input voltage range: ±6V
- Low "ON" resistance: 50 Typ. (V_{CC}-V_{EE} = 4.5V)
- 30 Typ. $(V_{CC}-V_{EE} = 9V)$
- Logic level translation to enable 5V logic with ±5V analog signals
- Low quiescent current: 80µA maximum
- Matched switch characteristic
- Pin and function compatible with the 74HC4051/ 4052/4053

General Description

These multiplexers are digitally controlled analog switches implemented in 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 vice-versa. Also these switches contain linearization circuitry which lowers the "ON" resistance and increases switch linearity. These devices allow control of up to ±6V (peak) analog signals with digital control signals of 0 to 6V. Three supply pins are provided for V_{CC}, ground, and V_{FF}. This enables the connection of 0–5V logic signals when $V_{CC} = 5V$ and an analog input range of $\pm 5V$ when V_{FF} = 5V. All three devices also have an inhibit control which when high will disable all switches to their off state. All analog inputs and outputs and digital inputs are protected from electrostatic damage by diodes to V_{CC} and ground.

VHC4051: This device connects together the outputs of 8 switches, thus achieving an 8 channel Multiplexer. The binary code placed on the A, B, and C select lines determines which one of the eight switches is "ON", and connects one of the eight inputs to the common output.

VHC4052: This device connects together the outputs of 4 switches in two sets, thus achieving a pair of 4-channel multiplexers. The binary code placed on the A, and B select lines determine which switch in each 4 channel section is "ON", connecting one of the four inputs in each section to its common output. This enables the implementation of a 4-channel differential multiplexer.

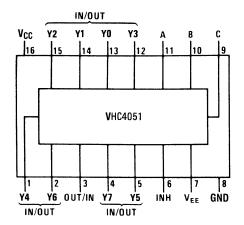
VHC4053: This device contains 6 switches whose outputs are connected together in pairs, thus implementing a triple 2 channel multiplexer, or the equivalent of 3 single-pole-double throw configurations. Each of the A, B, or C select lines independently controls one pair of switches, selecting one of the two switches to be "ON".

Ordering Information

		T
Order Number	Package Number	Package Description
74VHC4051M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC4051WM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74VHC4051MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHC4051N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
74VHC4052M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC4052WM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74VHC4052MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74VHC4053M	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHC4053WM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74VHC4053MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

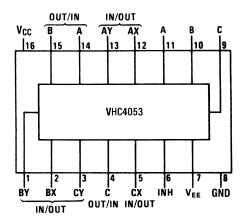
Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering number.

Connection Diagrams



Top View

Top View



Top View

Truth Tables

74VHC4051

	Inp			
INH	С	В	Α	"ON" Channel
Н	Х	Х	Х	None
L	L	L	L	Y0
L	L	L	Н	Y1
L	L	Н	L	Y2
L	L	Н	Н	Y3
L	Н	L	L	Y4
L	Н	L	Н	Y5
L	Н	Н	L	Y6
L	Н	Н	Н	Y7

74VHC4052

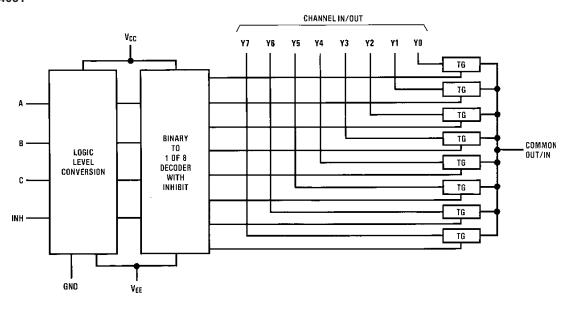
	Inputs		"ON" C	hannels
INH	В	Α	Х	Υ
Н	Х	Х	None	None
L	L	L	0X	0Y
L	L	Н	1X	1Y
L	Н	L	2X	2Y
L	Н	Н	3X	3Y

74VHC4053

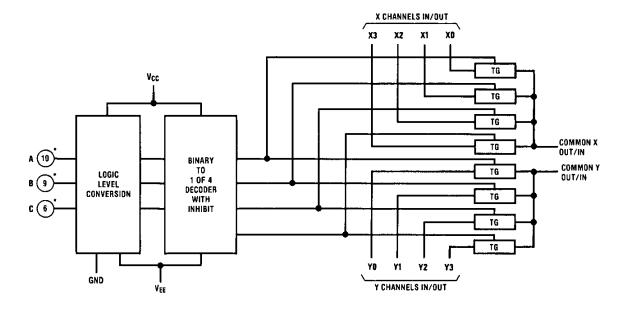
	Inp	ut		"OI	N" Chanr	nels
INH	С	В	B A C B		В	Α
Н	Х	Х	Х	None	None	None
L	L	L	L	CX	BX	AX
L	L	L	Н	CX	BX	AY
L	L	Н	L	CX	BY	AX
L	L	Н	Н	CX	BY	AY
L	Н	L	L	CY	BX	AX
L	Н	L	Н	CY	BX	AY
L	Н	Н	L	CY	BY	AX
L	Н	Н	Н	CY	BY	AY

Logic Diagrams

74VHC4051



74VHC4052



74VHC4053 BINARY TO 1 OF 2 DECODERS WITH INHIBIT LOGIC LEVEL Conversion IN/OUT \textbf{V}_{CC} CY CX ВУ ВХ AY AX ŦG OUT/IN AX or AY TG TG OUT/IN BX or BY TG TG OUT/IN CX or CY INH GND V_{EE}

Absolute Maximum Ratings⁽¹⁾

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	-0.5 to +7.5V
V _{EE}	Supply Voltage	+0.5 to -7.5V
V _{IN}	Control Input Voltage	–1.5 to V _{CC} +1.5V
V _{IO}	Switch I/O Voltage	V_{EE} –0.5 to V_{CC} +0.5V
I _{IK} , I _{OK}	Clamp Diode Current	±20mA
I _{OUT}	Output Current, per pin	±25mA
I _{CC}	V _{CC} or GND Current, per pin	±50mA
T _{STG}	Storage Temperature Range	–65°C to +150°C
P _D	Power Dissipation ⁽²⁾	600mW
	S.O. Package only	500mW
TL	Lead Temperature (Soldering 10 seconds)	260°C

Note:

- 1. Unless otherwise specified all voltages are referenced to ground.
- 2. Power Dissipation temperature derating; plastic "N" package: -12mW/°C from 65°C to 85°C.

Recommended Operating Conditions

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	Min.	Max.	Units
V _{CC}	Supply Voltage	2	6	V
V _{EE}	Supply Voltage	0	-6	V
V _{IN} , V _{OUT}	DC Input or Output Voltage	0	V _{CC}	V
T _A	Operating Temperature Range	-40	+85	°C
t _r , t _f	Input Rise or Fall Times			
	V _{CC} = 2.0V		1000	ns
	$V_{CC} = 2.0V$ $V_{CC} = 4.5V$ $V_{CC} = 6.0V$		500	
	V _{CC} = 6.0V		400	

DC Electrical Characteristics⁽³⁾

							T _A = 25°C	T _A = -40 to 85°C	
Symbol	Parameter		Conditions	V _{EE}	V _{CC}	Тур.	Guaranteed Limits		Units
V _{IH}	Minimum HIGH Leve	l Input			2.0V		1.5	1.5	V
	Voltage				4.5V		3.15	3.15	
					6.0V		4.2	4.2	
V _{IL}	Maximum LOW Leve	l Input			2.0V		0.5	0.5	V
	Voltage				4.5V		1.35	1.35	
					6.0V		1.8	1.8	
R _{ON}	Maximum "ON" Resis	stance ⁽⁴⁾	$V_{INH} = V_{IL}, I_{S} = 2.0 \text{mA},$	GND	4.5V	40	160	200	Ω
			$V_{IS} = V_{CC}$ to V_{EE} (Fig. 1)	-4.5V	4.5V	30	120	150	
				-6.0V	6.0V	20	100	125	
			$V_{INH} = V_{IL}, I_{S} = 2.0 \text{mA},$	GND	2.0V	100	230	280	Ω
			$V_{IS} = V_{CC}$ or V_{EE} (Fig. 1)	GND	4.5V	40	110	140]
				-4.5V	4.5V	20	90	120	
				-6.0V	6.0V	15	80	100]
R _{ON}	Maximum "ON" Resis	stance	$V_{INH} = V_{IL}$	GND	4.5V	10	20	25	Ω
	Matching		$V_{IS} = V_{CC}$ to GND	-4.5V	4.5V	5	10	15	
				-6.0V	6.0V	5	10	12	
I _N	Maximum Control Input Current		$V_{IN} = V_{CC}$ or GND, $V_{CC} = 2 - 6V$				±.05	±0.5	μA
I _{CC}	Maximum Quiescent	Supply	$V_{IN} = V_{CC}$ or GND,	GND	6.0V		4	40	μA
	Current		$I_{OUT} = 0\mu A$	-6.0V	6.0V		8	80	
I _{IZ}	Maximum Switch "OF	F" Leakage	$V_{OS} = V_{CC}$ or V_{EE} ,	GND	6.0V		±60	±300	nA
	Current (Switch Inpu	t)	$V_{IS} = V_{EE} \text{ or } V_{CC},$ $V_{INH} = V_{IH} \text{ (Fig. 2)}$	-6.0V	6.0V		±100	±500	
I_{IZ}	Maximum Switch	VHC4051	$V_{IS} = V_{CC}$ to V_{EE} ,	GND	6.0V		±0.1	±1.0	μA
	"ON" Leakage Current		$V_{INH} = V_{IL}$ (Fig. 3)	-6.0V	6.0V		±0.2	±2.0	
	Curront	VHC4052	10 00 EE,	GND	6.0V		±0.050	±0.5	
			$V_{INH} = V_{IL}$ (Fig. 3)	-6.0V	6.0V		±0.1	±1.0	
		VHC4053	$V_{IS} = V_{CC}$ to V_{EE} ,	GND	6.0V		±0.05	±0.5	
			$V_{INH} = V_{IL}$ (Fig. 3)	-6.0V	6.0V		±0.5	±0.5	
I _{IZ}	Maximum Switch	VHC4051	$V_{OS} = V_{CC}$ or V_{EE} ,	GND	6.0V		±0.1	±1.0	μA
	Current V _{INI} VHC4052 V _{OS}	$V_{IS} = V_{EE} \text{ or } V_{CC},$ $V_{INH} = V_{IH}$	-6.0V	6.0V		±0.2	±2.0		
		(Common Pin) VHC4052	VHC4052	$V_{OS} = V_{CC}$ or V_{EE} ,	GND	6.0V		±0.05	±0.5
			$V_{IS} = V_{EE} \text{ or } V_{CC},$ $V_{INH} = V_{IH}$	-6.0V	6.0V		±0.1	±1.0	_
		VHC4053	$V_{OS} = V_{CC}$ or V_{EE} ,	GND	6.0V		±0.05	±0.5	
			$V_{IS} = V_{EE} \text{ or } V_{CC},$ $V_{INH} = V_{IH}$	-6.0V	6.0V		±0.05	±0.5	

Notes:

- 3. For a power supply of 5V \pm 10% the worst case on resistances (R_{ON}) occurs for VHC 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 occur for CMOS at the higher voltage and so the 5.5V values should be used.
- 4. At supply voltages (V_{CC}–V_{EE}) 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.
- 5. Adjust 0dB for f = 1kHz (Null R1/R_{ON} Attenuation).

AC Electrical Characteristics

 V_{CC} = 2.0V - 6.0V, V_{EE} = 0V - 6V, C_L = 50pF (unless otherwise specified)

						T _A =2	25°C	T _A = -40 to 85°C	
Symbol	Parameter	Conditions		V _{EE}	V _{CC}	Тур.		aranteed Limits	Units
t _{PHL} , t _{PLH}	Maximum Propagation			GND	3.3V	25	35	40	ns
	Delay Switch In to Out			GND	4.5V	5	12	15	1
				-4.5V	4.5V	4	8	12	1
				-6.0V	6.0V	3	7	11	1
t _{PZL} , t _{PZH}	Maximum Switch Turn	$R_L = 1k\Omega$		GND	3.3V	92	200	250	ns
	"ON" Delay			GND	4.5V		69	87	1
				-4.5V	4.5V	16	46	58	1
				-6.0V	6.0V	15	41	51	1
t _{PHZ} , t _{PLZ}	Maximum Switch Turn			GND	3.3V	65	170	210	ns
	"OFF" Delay			GND	4.5V	28	58	73	-
				-4.5V	4.5V	18	37	46	
			-6.0V	6.0V	16	32	41	†	
f _{MAX}	Minimum Switch			GND	4.5V	30			MHz
	Frequency Response 20 log $(V_I/V_O) = 3dB$			-4.5V	4.5V	35			-
	Control to Switch	$R_L = 600\Omega$,	$V_{IS} = 4 V_{PP}$	0V	4.5V	1080			mV
	Feedthrough Noise	f = 1MHz, $C_L = 50pF$	$V_{IS} = 8 V_{PP}$	-4.5V	4.5V	250			
	Crosstalk Between any	$R_L = 600\Omega$,	$V_{IS} = 4 V_{PP}$	0V	4.5	-52			dB
	Two Switches	f = 1 MHz	$V_{IS} = 8 V_{PP}$	-4.5V	4.5V	-50]
	Switch OFF Signal	$R_L = 600\Omega$,	$V_{IS} = 4 V_{PP}$	0V	4.5V	-42			dB
	Feedthrough Isolation	f = 1 MHz, $V_{CTL} = V_{IL}$	$V_{IS} = 8 V_{PP}$	-4.5V	4.5V	-44			
THD	Sinewave Harmonic	$R_L = 10k\Omega$,	$V_{IS} = 4 V_{PP}$	0V	4.5V	0.013			%
	Distortion	$C_L = 50pF,$ f = 1kHz	$V_{IS} = 8 V_{PP}$	-4.5V	4.5V	0.008			
C _{IN}	Maximum Control Input Capacitance					5	10	10	pF
C _{IN}	Maximum Switch Input Capacitance	Input 4051 Common 4052 Common 4053 Common				15 90 45 30			pF
C _{IN}	Maximum Feedthrough Capacitance					5			pF

AC Test Circuits and Switching Time Waveforms

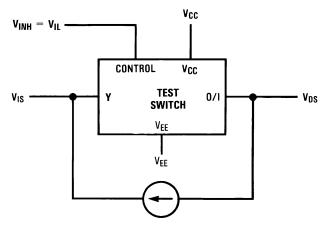


Figure 1. "ON" Resistance

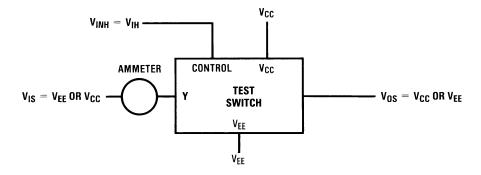


Figure 2. "OFF" Channel Leakage Current

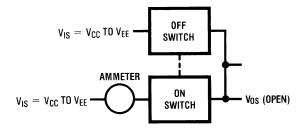


Figure 3. "ON" Channel Leakage Current

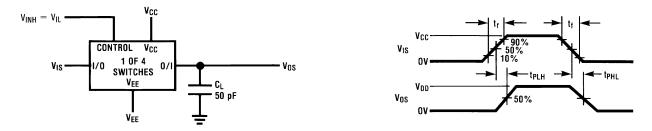


Figure 4. t_{PHL} , t_{PLH} Propagation Delay Time Signal Input to Signal Output

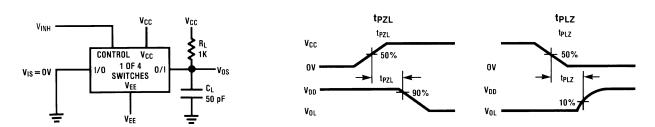


Figure 5. t_{PZL} , t_{PLZ} Propagation Delay Time Control to Signal Output

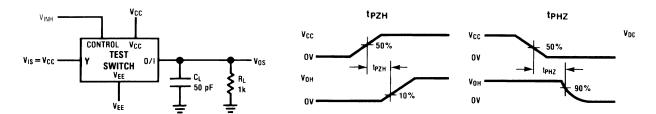


Figure 6. t_{PZH} , t_{PHZ} Propagation Delay Time Control to Signal Output

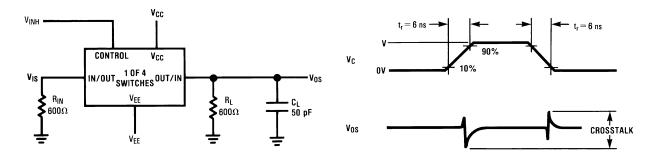


Figure 7. Crosstalk: Control Input to Signal Output

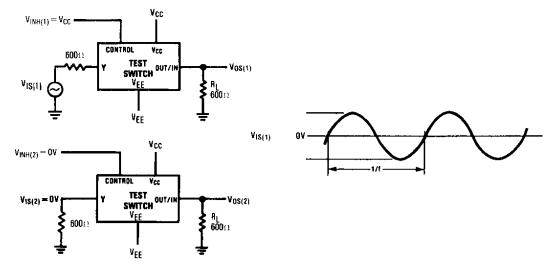
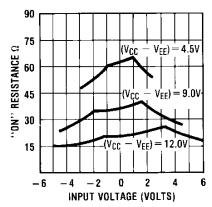


Figure 8. Crosstalk Between Any Two Switches

Typical Performance Characteristics

Typical "On" Resistance vs Input Voltage



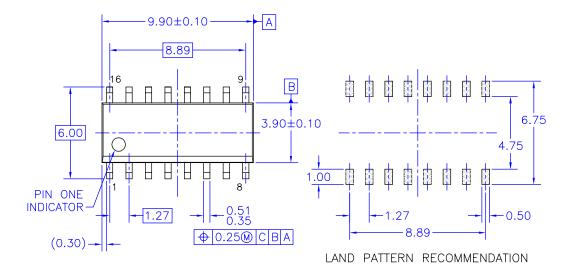
$$V_{CC} = -V_{EE}$$

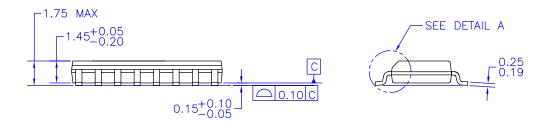
Special Considerations

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 pins, the voltage drop across the switch must not exceed 1.2V (calculated from the ON resistance).

Physical Dimensions

Dimensions are in millimeters unless otherwise noted.





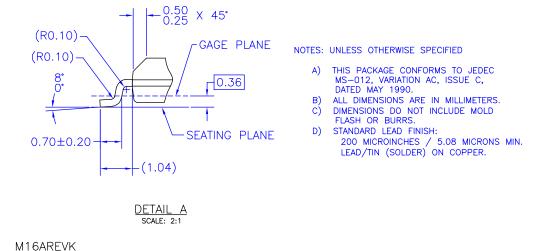


Figure 9. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A

Physical Dimensions (Continued)

Dimensions are in inches (millimeters) unless otherwise noted.

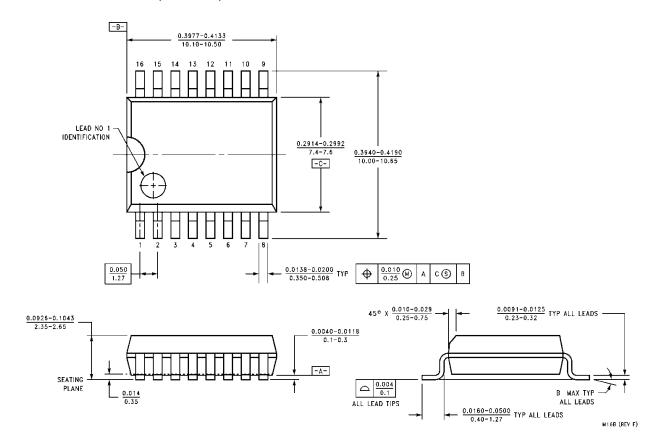


Figure 10. 16-Lead Small Outline Intergrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Package Number M16B

Physical Dimensions (Continued) Dimensions are in millimeters unless otherwise noted. Α 5.00±0.10 4.55 5.90 4.45 7.35 В 6.4 0.65 4.4±0.1 45 3.2 O.2 CBA ALL LEAD TIPS 5.00 PIN #1 IDENT. LAND PATTERN RECOMMENDATION (F) 0.11-SEE DETAIL A ALL LEAD TIPS 1.1 MAX (0.90) ○ 0.1 C 0.09-0.20 -C-0.10±0.05 0.65 0.19 - 0.30 **TOP AND BOTTOM** + 0.10M A BS CS GAGE PLANE NOTES: 0.25 0°-8° A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, **B. DIMENSIONS ARE IN MILLIMETERS** C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS 0.6±0.1 SEATING PLANE D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1994 E. DRAWING FILE NAME: MTC16REV4 **DETAIL** A F. LAND PATTERN RECOMMENDATION PER IPC7351 - ID# TSOP65P640X110-16N

Figure 11. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC16

MTC16rev4

Physical Dimensions (Continued)

Dimensions are in inches (millimeters) unless otherwise noted.

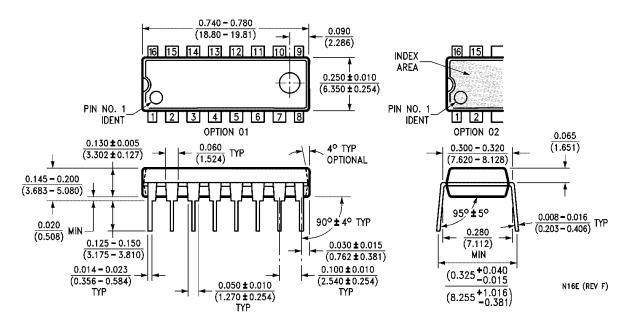


Figure 12. 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E





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