

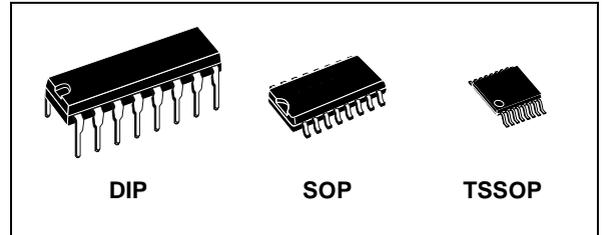
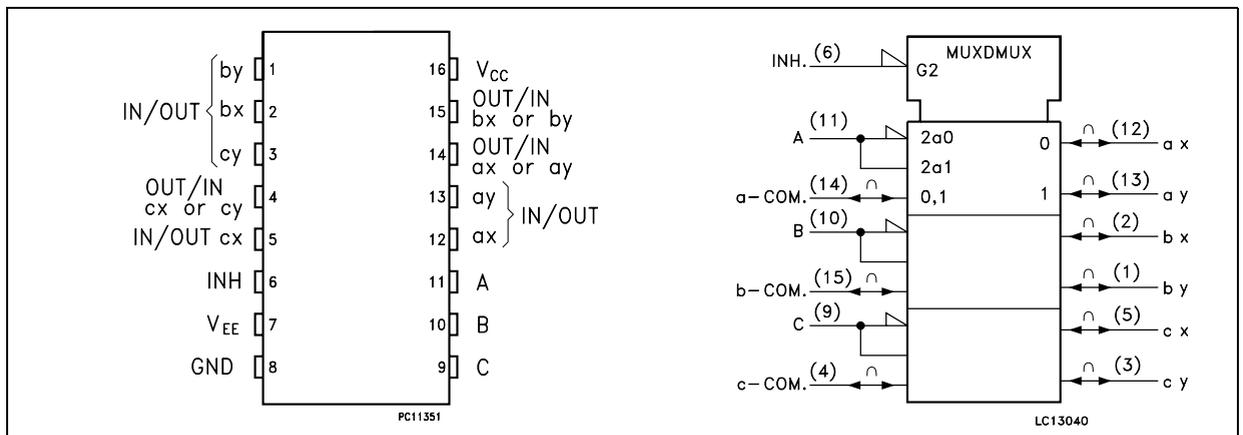
## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- **LOW POWER DISSIPATION:**  
 $I_{CC} = 4\mu A(\text{MAX.})$  at  $T_A = 25^\circ C$
- **LOGIC LEVEL TRANSLATION TO ENABLE 5V LOGIC SIGNAL TO COMMUNICATE WITH  $\pm 5V$  ANALOG SIGNAL**
- **LOW "ON" RESISTANCE:**  
 $70\Omega$  TYP. ( $V_{CC} - V_{EE} = 4.5V$ )  
 $50\Omega$  TYP. ( $V_{CC} - V_{EE} = 9V$ )
- **WIDE ANALOG INPUT VOLTAGE RANGE:**  
 $\pm 6V$
- **FAST SWITCHING:**  
 $t_{pd} = 15ns$  (TYP.) at  $T_A = 25^\circ C$
- **LOW CROSSTALK BETWEEN SWITCHES**
- **HIGH ON/OFF OUTPUT VOLTAGE RATIO**
- **WIDE OPERATING SUPPLY VOLTAGE RANGE** ( $V_{CC} - V_{EE}$ ) = 2V TO 12V
- **LOW SINE WAVE DISTORTION:**  
0.02% at  $V_{CC} - V_{EE} = 9V$
- **HIGH NOISE IMMUNITY:**  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4053**

### DESCRIPTION

The M74HC4053 is a triple two-channel analog MULTIPLEXER/DEMULTIPLEXER fabricated with silicon gate C<sup>2</sup>MOS technology and it is pin to pin compatible with the equivalent metal gate CMOS4000B series.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC4053B1R	
SOP	M74HC4053M1R	M74HC4053RM13TR
TSSOP		M74HC4053TTR

It contains 6 bidirectional and digitally controlled analog switches.

A built-in level shifting is included to allow an input range up to  $\pm 6V$  (peak) for an analog signal with digital control signal of 0 to 6V.

$V_{EE}$  supply pin is provided for analog input signals. It has an inhibit (INH) input terminal to disable all the switches when high. For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to GND.

A, B and C control inputs select one of a pair of channels.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

Figure 1: Control Input Equivalent Circuit

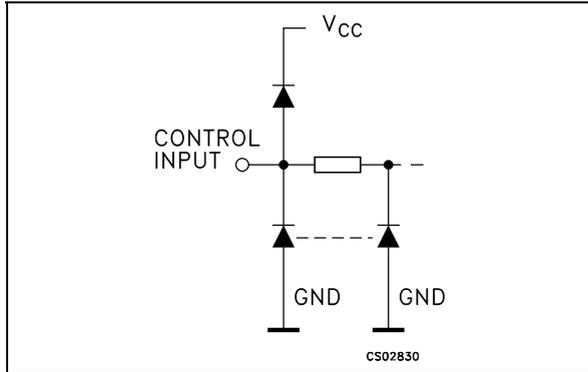


Figure 2: I/O Equivalent Circuit

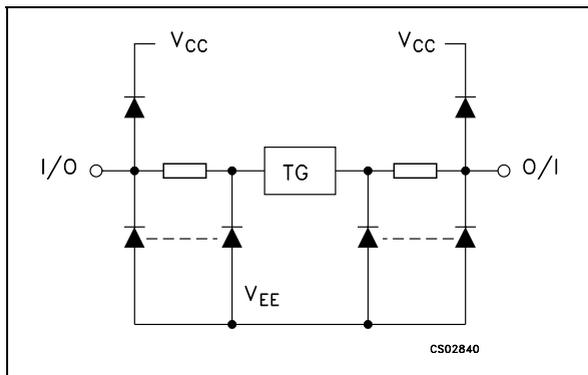


Figure 3: Functional Diagram

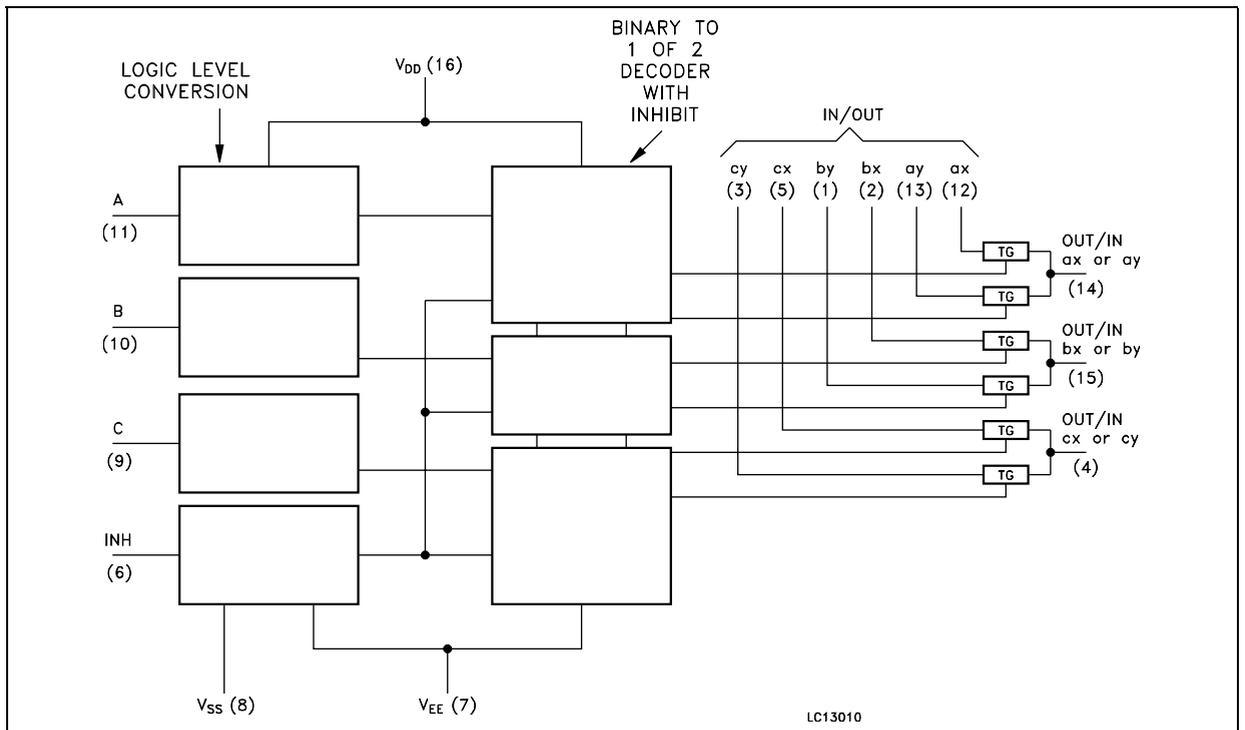


Table 1: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
2, 1	bx, by	Independent Input Outputs
5, 3	cx, cy	Independent Input Outputs
6	INH	INHIBIT Input
7	V <sub>EE</sub>	Negative Supply Voltage
11, 10, 9	A, B, C	Select Inputs
12, 13	ax, ay	Independent Input Outputs
14, 15, 4	ax to cy	Common Output/Input
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

Table 2: Truth Table

INPUT STATE		ON CHANNEL
INH	A or B or C	
L	L	ax or bx or cx
L	H	ay or by or cy
H	X	NONE

X: Don't care

**Table 3: Absolute Maximum Ratings**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to +7	V
$V_{CC} - V_{EE}$	Supply Voltage	-0.5 to +13	V
$V_I$	Control Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_{I/O}$	Switch I/O Voltage	$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
$I_{CK}$	Control Input Diode Current	$\pm 20$	mA
$I_{I/O}$	I/O Diode Current	$\pm 20$	mA
$I_T$	Switch Through Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500(*)	mW
$T_{stg}$	Storage Temperature	-65 to +150	°C
$T_L$	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

(\*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

**Table 4: Recommended Operating Conditions**

Symbol	Parameter	Value	Unit	
$V_{CC}$	Supply Voltage	2 to 6	V	
$V_{EE}$	Supply Voltage	-6 to 0	V	
$V_{CC} - V_{EE}$	Supply Voltage	2 to 12	V	
$V_I$	Input Voltage	0 to $V_{CC}$	V	
$V_{I/O}$	I/O Voltage	$V_{EE}$ to $V_{CC}$	V	
$T_{op}$	Operating Temperature	-55 to 125	°C	
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
		$V_{CC} = 4.5V$	0 to 500	
		$V_{CC} = 6.0V$	0 to 400	

Table 5: DC Specifications

Symbol	Parameter	Test Condition			Value						Unit	
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
V <sub>IHC</sub>	High Level Input Voltage	2.0			1.5			1.5		1.5		V
		4.5			3.15			3.15		3.15		
		6.0			4.2			4.2		4.2		
V <sub>ILC</sub>	Low Level Input Voltage	2.0					0.5		0.5		0.5	V
		4.5					1.35		1.35		1.35	
		6.0					1.8		1.8		1.8	
R <sub>ON</sub>	ON Resistance	4.5	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> to V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		85	180		225		270	Ω
		4.5	-4.5			55	120		150		180	
		6.0	-6.0			50	100		125		150	
		2.0	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		150						
		4.5	GND			70	150		190		230	
		4.5	-4.5			50	100		125		150	
6.0	-6.0		45	80		100		120				
ΔR <sub>ON</sub>	Difference of ON Resistance between switches	4.5	GND	V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub> V <sub>I/O</sub> = V <sub>CC</sub> or V <sub>EE</sub> I <sub>I/O</sub> ≤ 2mA		10	30		35		45	Ω
		4.5	-4.5			5	12		15		18	
		6.0	-6.0			5	10		12		15	
I <sub>OFF</sub>	Input/Output Leakage Current (SWITCH OFF)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>IS</sub> = GND or V <sub>CC</sub> V <sub>I</sub> = V <sub>ILC</sub> or V <sub>IHC</sub>			±0.06		± 0.6		± 1.2	μA
		6.0	-6.0				± 0.1		± 1		± 2	
I <sub>Iz</sub>	Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN)	6.0	GND	V <sub>OS</sub> = V <sub>CC</sub> or GND V <sub>I</sub> = V <sub>IHC</sub> or V <sub>ILC</sub>			±0.06		± 0.6		± 1.2	μA
		6.0	-6.0				± 0.1		± 1		± 2	
I <sub>I</sub>	Input Leakage Current	6.0	GND	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 0.1		± 1	μA
I <sub>CC</sub>	Quiescent Supply Current	6.0	GND	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	μA
		6.0	-6.0				8		80		160	

Table 6: AC Electrical Characteristics ( $C_L = 50$  pF, Input  $t_r = t_f = 6$  ns)

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$\Phi_{I/O}$	Phase Difference Between Input and Output	2.0	GND			25	60		75		90	ns
		4.5	GND			6	12		15		18	
		6.0	GND			5	10		13		15	
		4.5	-4.5			4						
$t_{PZL}$ $t_{PZH}$	Output Enable Time	2.0	GND	$R_L = 1\text{K}\Omega$		50	225		280		340	ns
		4.5	GND			14	45		56		68	
		6.0	GND			12	38		48		58	
		4.5	-4.5			14						
$t_{PLZ}$ $t_{PHZ}$	Output Disable Time	2.0	GND	$R_L = 1\text{K}\Omega$		95	225		280		340	ns
		4.5	GND			30	45		56		68	
		6.0	GND			26	38		48		58	
		4.5	-4.5			26						

Table 7: Capacitive Characteristics

Symbol	Parameter	Test Condition			Value						Unit	
		$V_{CC}$ (V)	$V_{EE}$ (V)		$T_A = 25^\circ\text{C}$			$-40$ to $85^\circ\text{C}$		$-55$ to $125^\circ\text{C}$		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
$C_{IN}$	Input Capacitance	5.0				5	10		10		10	pF
$C_{I/O}$	Common Terminal Capacitance	5.0	-5.0			11	20		20		20	pF
$C_{I/O}$	Switch Terminal Capacitance	5.0	-5.0			7	15		15		15	pF
$C_{IOS}$	Feed Through Capacitance	5.0	-5.0			0.75	2		2		2	pF
$C_{PD}$	Power Dissipation Capacitance (note 1)	5.0	GND			67						pF

1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

Table 8: Analog Switch Characteristics (GND = 0V; T<sub>A</sub> = 25°C)

Symbol	Parameter	Test Condition			Value	Unit	
		V <sub>CC</sub> (V)	V <sub>EE</sub> (V)	V <sub>IN</sub> (V <sub>p-p</sub> )			
	Sine Wave Distortion	2.25	-2.25	4	0.025	% rowspan="3">f <sub>IN</sub> = 1 KHz R <sub>L</sub> = 10 KΩ, C <sub>L</sub> = 50 pF	
		4.5	-4.5	8			0.020
		6.0	-6.0	11			0.018
f <sub>MAX</sub>	Frequency Response (Switch ON) (*)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	120	MHz	
		4.5	-4.5		190		
		6.0	-6.0		200		
f <sub>MAX</sub>	Frequency Response (Switch ON) (**)	2.25	-2.25	Adjust f <sub>IN</sub> voltage to obtain 0 dBm at V <sub>OS</sub> . Increase f <sub>IN</sub> Frequency until dB meter reads -3dB R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10 pF, f <sub>IN</sub> = 1KHz sine wave	95	MHz	
		4.5	-4.5		150		
		6.0	-6.0		190		
	Feed through Attenuation (Switch OFF)	2.25	-2.25	V <sub>IN</sub> is centered at (V <sub>CC</sub> - V <sub>EE</sub> )/2 Adjust input for 0 dBm R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB	
		4.5	-4.5		-50		
		6.0	-6.0		-50		
	Crosstalk (Control Input to Signal Output)	2.25	-2.25	Adjust R <sub>L</sub> at set up so that I <sub>S</sub> = 0A. R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz square wave	60	mV	
		4.5	-4.5		140		
		6.0	-6.0		200		
	Crosstalk (between any two Switches)	2.25	-2.25	Adjust V <sub>IN</sub> to obtain 0dBm at input R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50 pF, f <sub>IN</sub> = 1KHz sine wave	-50	dB	
		4.5	-4.5		-50		
		6.0	-6.0		-50		

(\*) Input COMMON Terminal, and measured at SWITCH Terminal

(\*\*) Input SWITCH Terminal, and measured at common Terminal

NOTE: These characteristics are determined by the design of the device.

Figure 4: Switching Characteristics Test Circuit

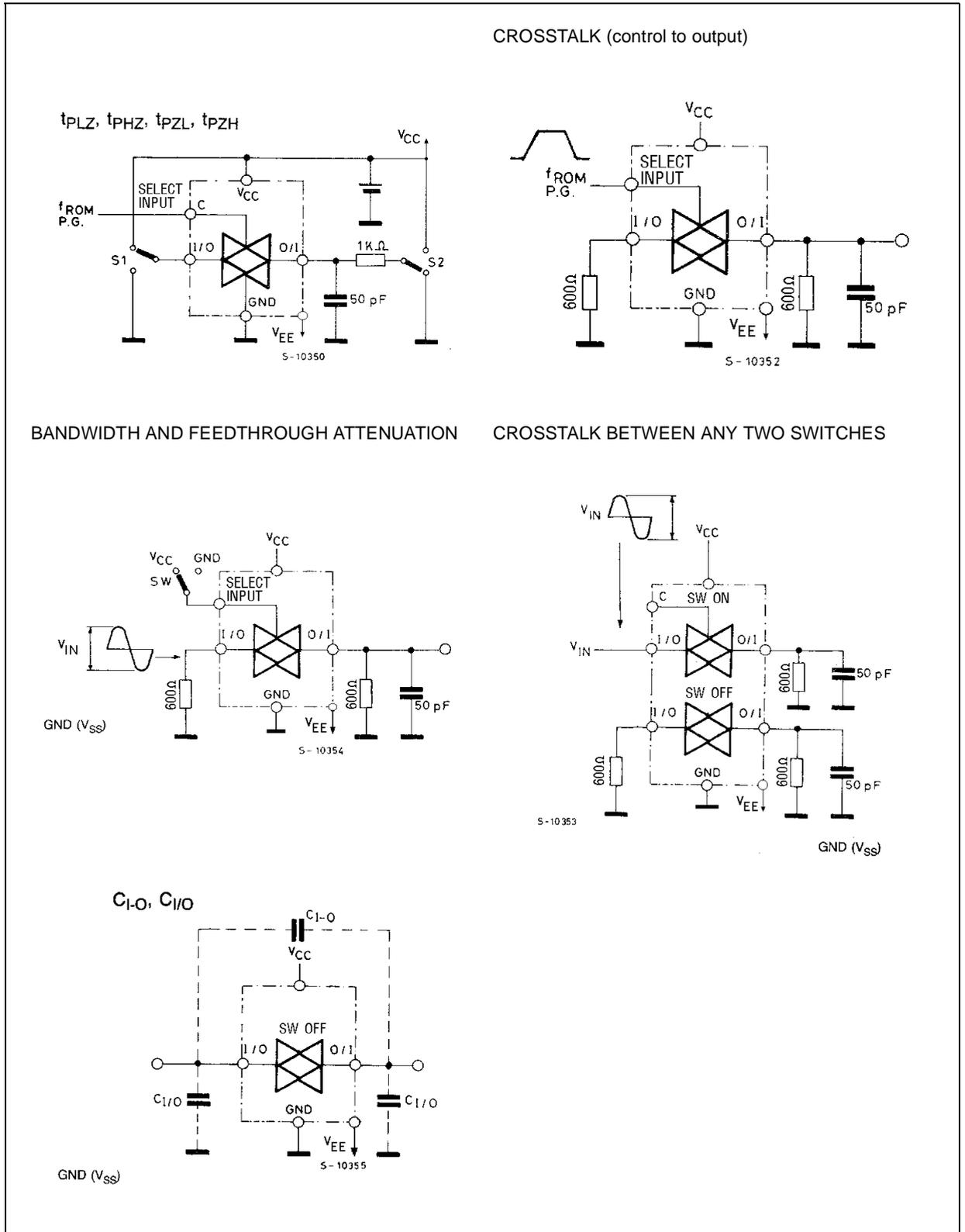


Figure 5: Switching Characteristics Waveform

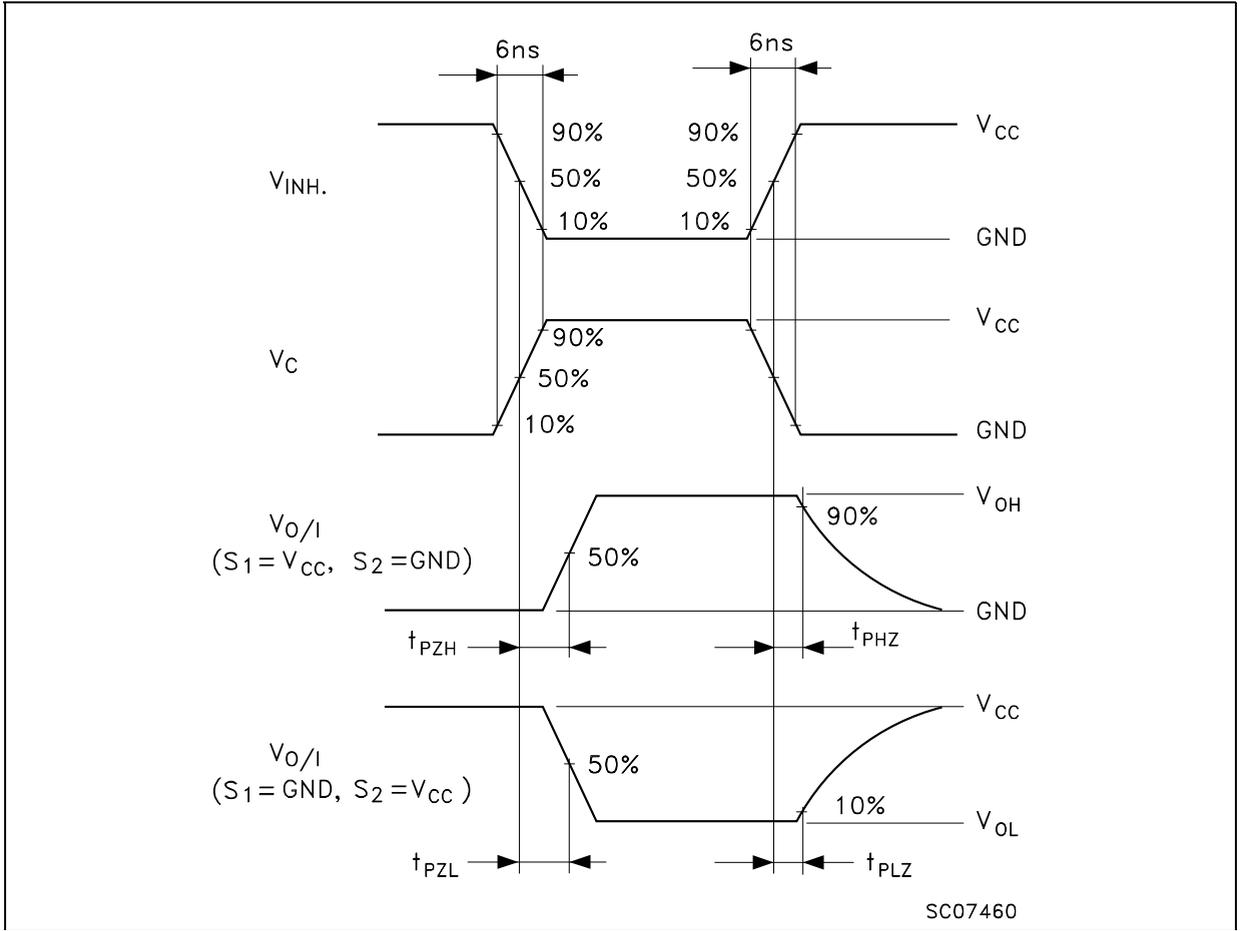


Figure 6: Channel Resistance ( $R_{ON}$ )

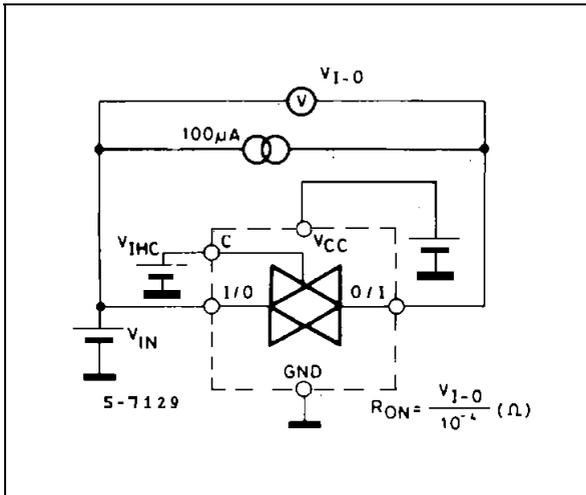
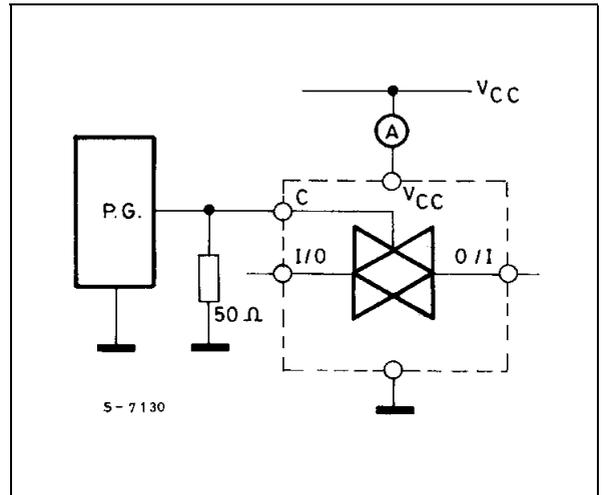
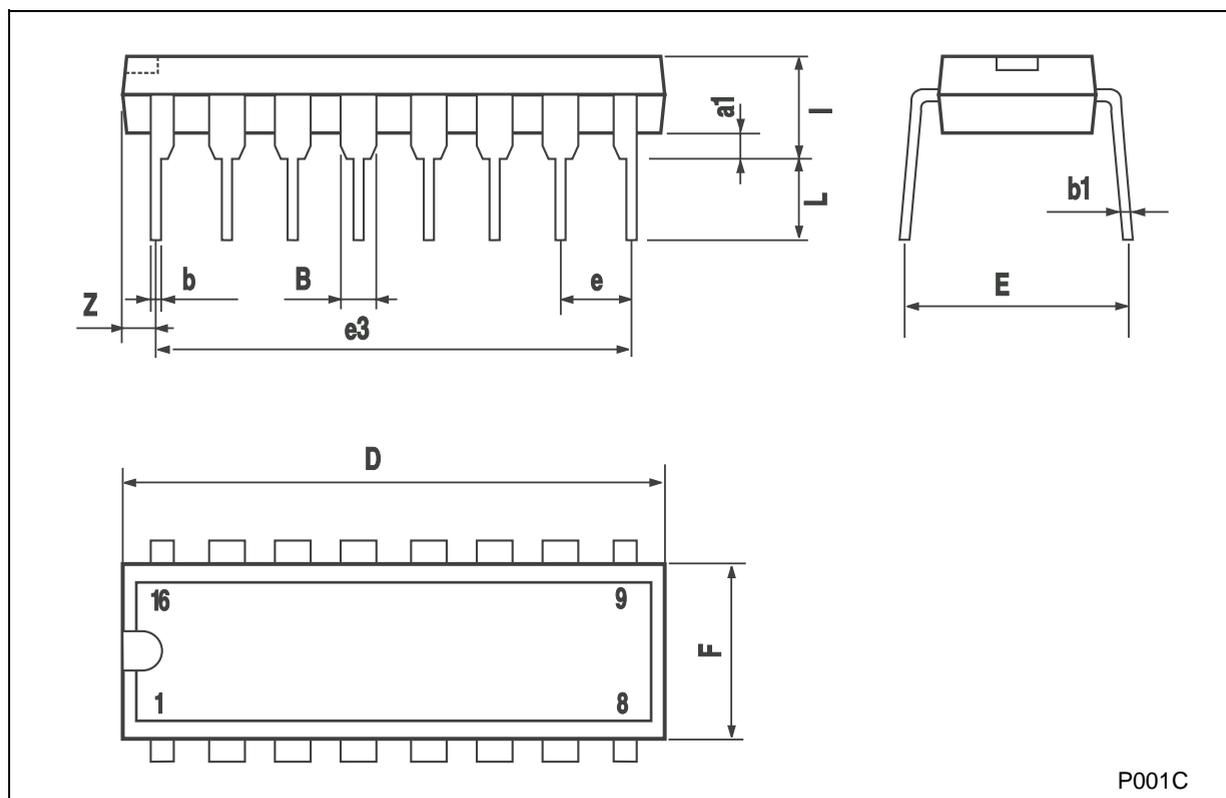


Figure 7:  $I_{CC}$  (Opr.)



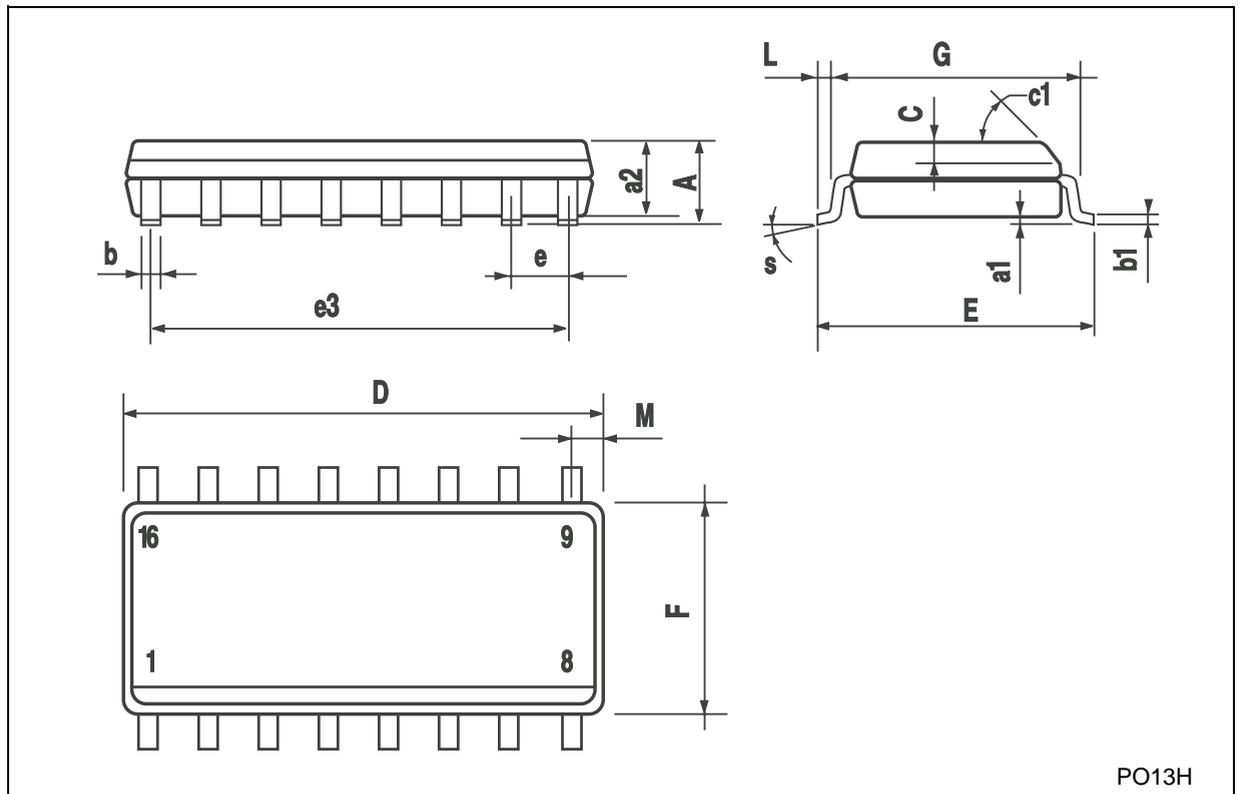
### Plastic DIP-16 (0.25) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
l			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



## SO-16 MECHANICAL DATA

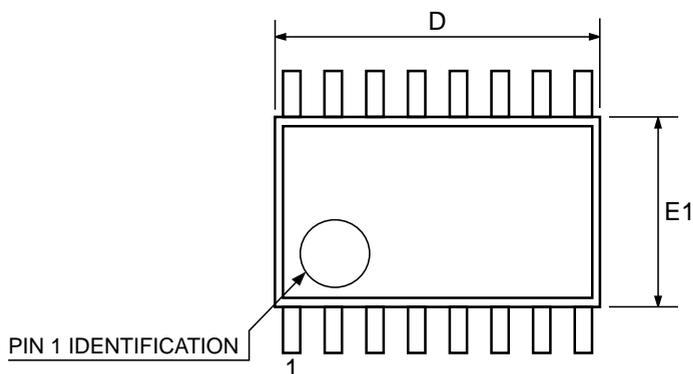
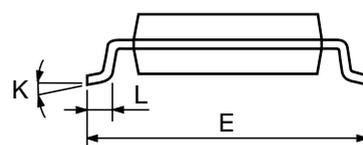
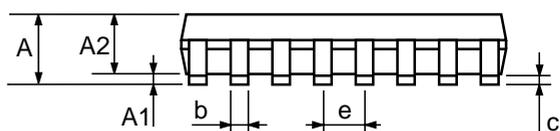
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.008
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8			° (max.)		



PO13H

## TSSOP16 MECHANICAL DATA

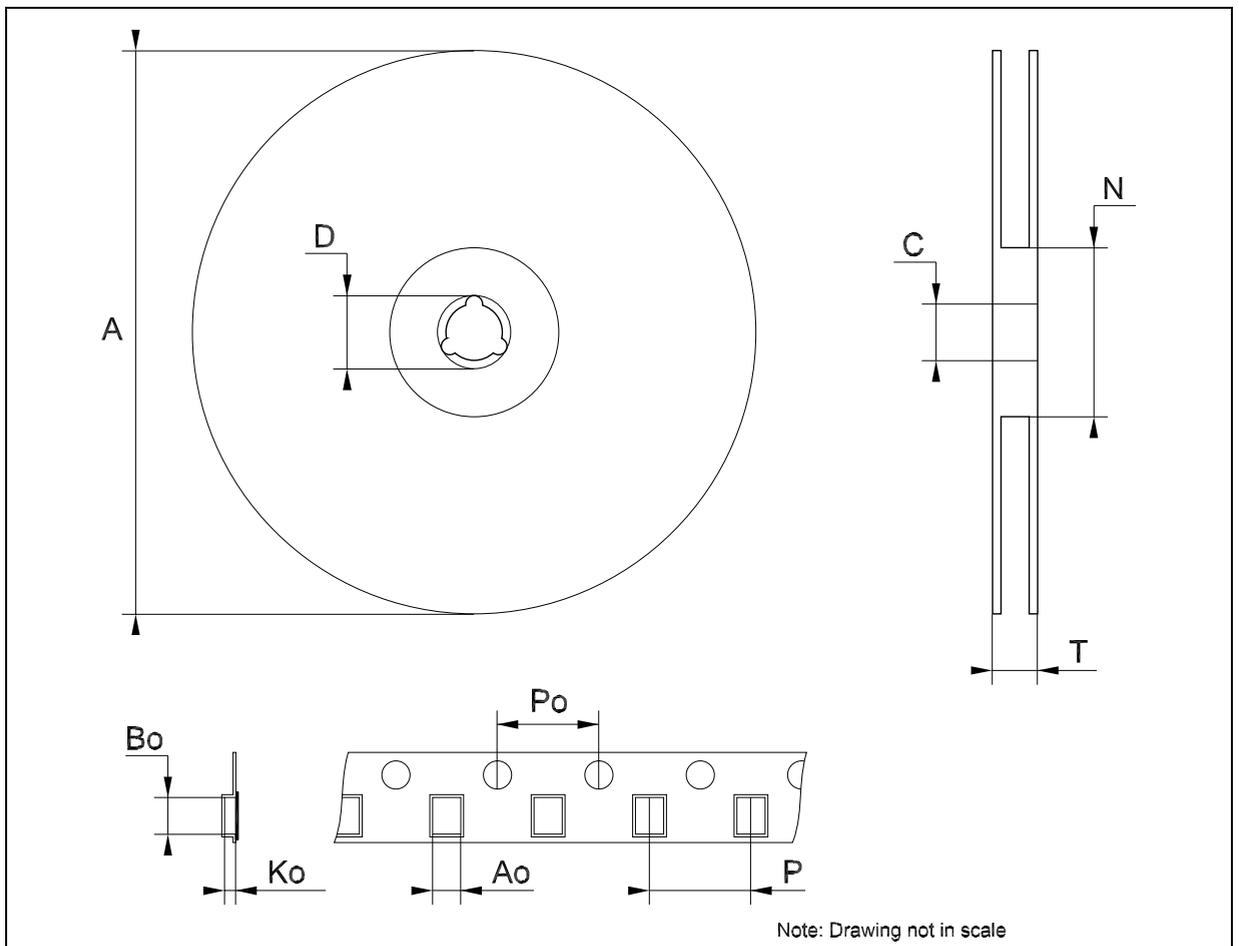
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



0080338D

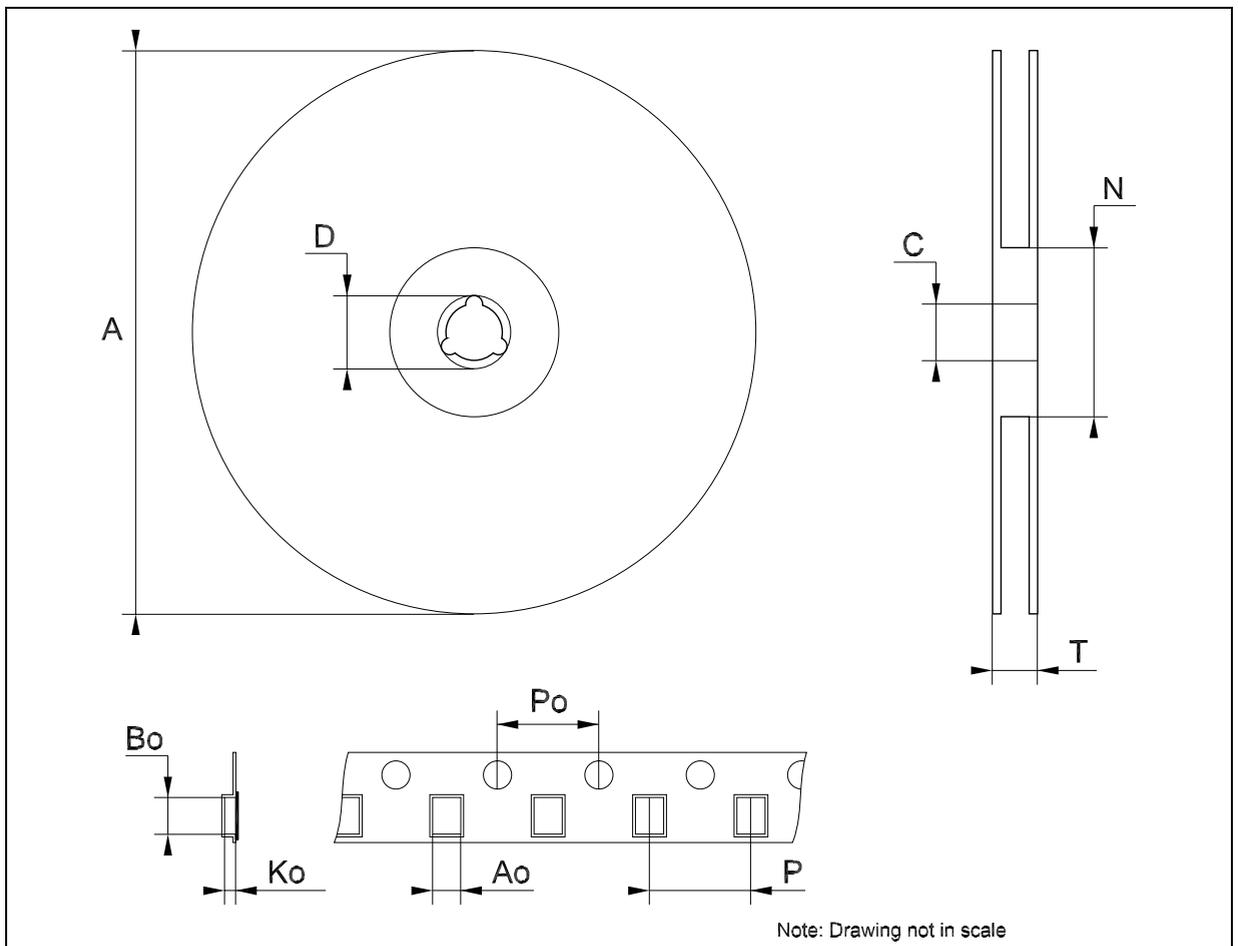
## Tape &amp; Reel SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



## Tape & Reel TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



**Table 9: Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
17-May-2004	3	Typing Error Pin Connection - Page 1

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