# THE DATASHEET OF

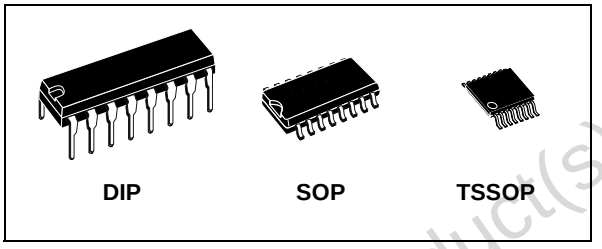
# 74HC4053B1

www.win-source.net 0086-755-83957316

# M74HC4053

## TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- LOW POWER DISSIPATION:
  $I_{CC}$ = 4μA(MAX.) at $T_A$=25°C
- LOGIC LEVEL TRANSLATION TO ENABLE 5V LOGIC SIGNAL TO COMMUNICATE WITH ±5V ANALOG SIGNAL
- LOW "ON" RESISTANCE:
  70Ω TYP. ($V_{CC}$ - $V_{EE}$ = 4.5V)
  50Ω TYP. ($V_{CC}$ - $V_{EE}$ = 9V)
- WIDE ANALOG INPUT VOLTAGE RANGE:
  ±6V
- FAST SWITCHING:
  $t_{pd}$ = 15ns (TYP.) at $T_A$ = 25 °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




**ORDER CODES**

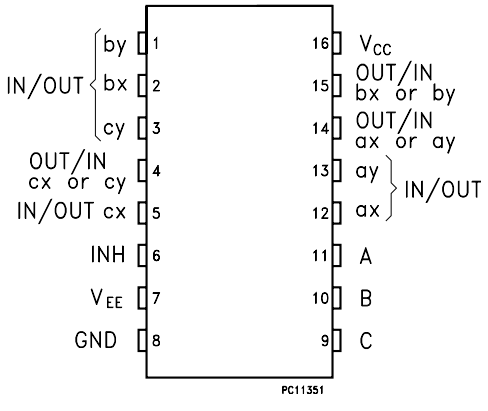
| PACKAGE | TUBE | T & R |
|---|---|---|
| DIP | M74HC4053B1R | |
| SOP | M74HC4053M1R | M74HC4053RM13TR |
| TSSOP | | M74HC4053TTR |

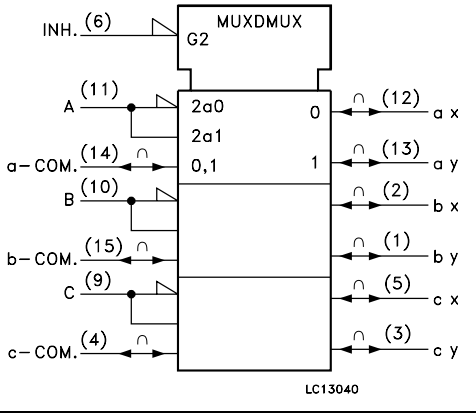
### DESCRIPTION

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

It contains 6 bidirectional and digitally controlled analog switches.
A built-in level shifting is included to allow an input range up to ±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, VEE 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.

### PIN CONNECTION AND IEC LOGIC SYMBOLS




Obsolete Product(s) - Obsolete Product(s)

**Figure 1: Control Input Equivalent Circuit**

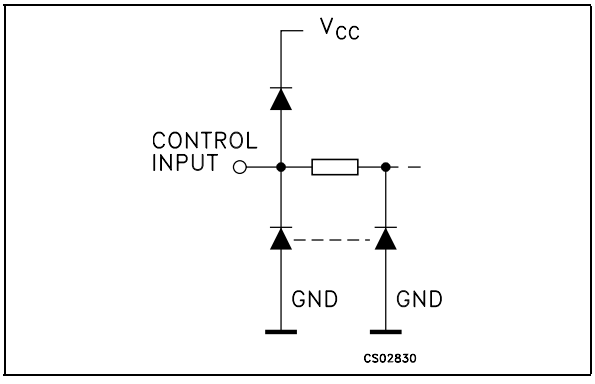



**Figure 2: I/O Equivalent Circuit**

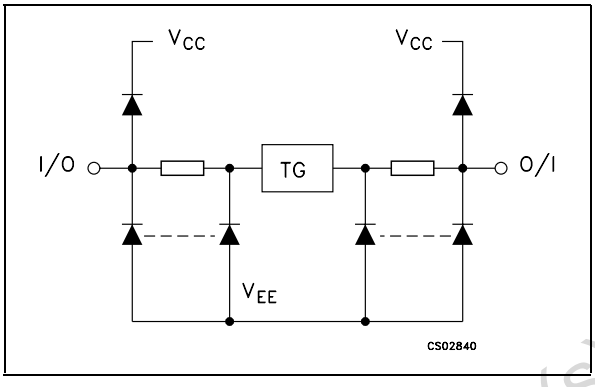



**Table 1: Pin Description**

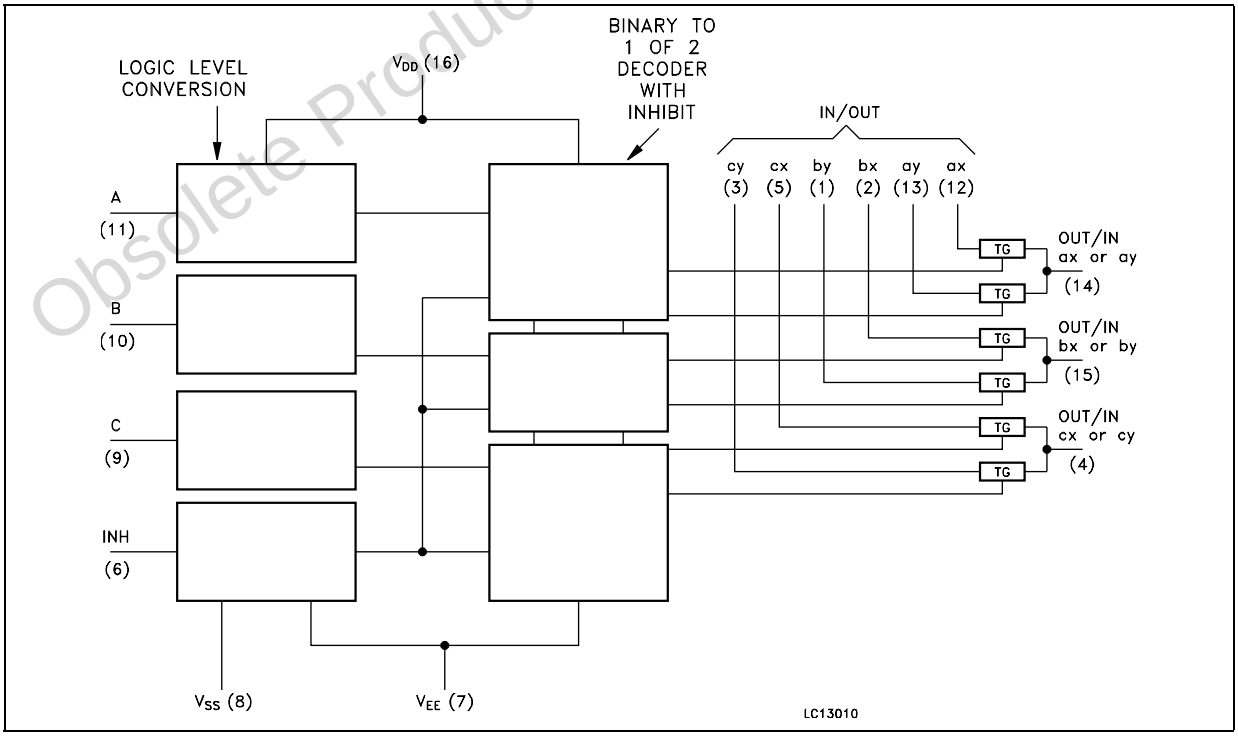
| PIN N° | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 2, 1 | bx, by | Independent Input Outputs |
| 5, 3 | cx, cy | Independent Input Outputs |
| 6 | INH | INHIBIT Input |
| 7 | $V_{EE}$ | Negative Supply Voltage |
| 11, 10, 9 | A, B, C | Select Inputs |
| 12, 13 | ax, ay | Independent Input Outputs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

**Figure 3: Functional Diagram**

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### 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 | ± 20 | mA |
| $I_{IOK}$ | I/O Diode Current | ± 20 | mA |
| $I_T$ | Switch Through Current | ± 25 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 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 | |

Obsolete Product(s) - Obsolete Product(s)

### Table 5: DC Specifications

| Symbol | Parameter | Test Condition | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $V_{EE}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $V_{IHC}$ | 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 | | |
| $V_{ILC}$ | 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 | |
| $R_{ON}$ | ON Resistance | 4.5 | GND | $V_I = V_{IHC}$ or $V_{ILC}$<br>$V_{I/O} = V_{CC}$ to $V_{EE}$<br>$I_{I/O} \leq 2mA$ | | 85 | 180 | | 225 | | 270 | Ω |
| | | 4.5 | -4.5 | | | 55 | 120 | | 150 | | 180 | |
| | | 6.0 | -6.0 | | | 50 | 100 | | 125 | | 150 | |
| | | 2.0 | GND | $V_I = V_{IHC}$ or $V_{ILC}$<br>$V_{I/O} = V_{CC}$ or $V_{EE}$<br>$I_{I/O} \leq 2mA$ | | 150 | | | | | | |
| | | 4.5 | GND | | | 70 | 150 | | 190 | | 230 | |
| | | 4.5 | -4.5 | | | 50 | 100 | | 125 | | 150 | |
| | | 6.0 | -6.0 | | | 45 | 80 | | 100 | | 120 | |
| $\Delta R_{ON}$ | Difference of ON Resistance between switches | 4.5 | GND | $V_I = V_{IHC}$ or $V_{ILC}$<br>$V_{I/O} = V_{CC}$ or $V_{EE}$<br>$I_{I/O} \leq 2mA$ | | 10 | 30 | | 35 | | 45 | Ω |
| | | 4.5 | -4.5 | | | 5 | 12 | | 15 | | 18 | |
| | | 6.0 | -6.0 | | | 5 | 10 | | 12 | | 15 | |
| $I_{OFF}$ | Input/Output Leakage Current (SWITCH OFF) | 6.0 | GND | $V_{OS} = V_{CC}$ or GND<br>$V_{IS}$ = GND or $V_{CC}$<br>$V_I = V_{ILC}$ or $V_{IHC}$ | | | ±0.06 | | ± 0.6 | | ± 1.2 | µA |
| | | 6.0 | -6.0 | | | | ± 0.1 | | ± 1 | | ± 2 | |
| $I_{IZ}$ | Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN) | 6.0 | GND | $V_{OS} = V_{CC}$ or GND<br>$V_I = V_{IHC}$ or $V_{ILC}$ | | | ±0.06 | | ± 0.6 | | ± 1.2 | µA |
| | | 6.0 | -6.0 | | | | ± 0.1 | | ± 1 | | ± 2 | |
| $I_I$ | Input Leakage Current | 6.0 | GND | $V_I = V_{CC}$ or GND | | | ± 0.1 | | ± 0.1 | | ± 1 | µA |
| $I_{CC}$ | Quiescent Supply Current | 6.0 | GND | $V_I = V_{CC}$ or GND | | | 4 | | 40 | | 80 | µA |
| | | 6.0 | -6.0 | | | | 8 | | 80 | | 160 | |

Obsolete Product(s) - Obsolete Product(s)

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

| Symbol | Parameter | Test Condition | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $V_{EE}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°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 | $R_L$ = 1KΩ | | 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 | $R_L$ = 1KΩ | | 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°C | | | -40 to 85°C | | -55 to 125°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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

Obsolete Product(s) - Obsolete Product(s)

**Table 8: Analog Switch Characteristics** (GND = 0V;$T_A$ = 25°C)

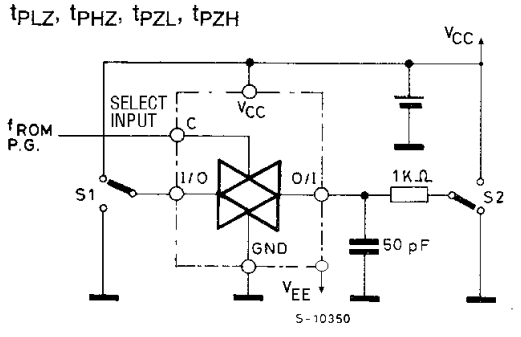
| Symbol | Parameter | Test Condition | | | | Value | Unit |
|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $V_{EE}$ (V) | $V_{IN}$ ($V_{p-p}$) | | Typ. | |
| | Sine Wave Distortion | 2.25 | -2.25 | 4 | $f_{IN}$ = 1 KHz $R_L$ = 10 KΩ, $C_L$ = 50 pF | 0.025 | % |
| | | 4.5 | -4.5 | 8 | | 0.020 | |
| | | 6.0 | -6.0 | 11 | | 0.018 | |
| $f_{MAX}$ | Frequency Response (Switch ON) (*) | 2.25 | -2.25 | Adjust $f_{IN}$ voltage to obtain 0 dBm at $V_{OS}$. Increase $f_{IN}$ Frequency until dB meter reads -3dB $R_L$ = 50Ω, $C_L$ = 10 pF, $f_{IN}$ = 1KHz sine wave | | 120 | MHz |
| | | 4.5 | -4.5 | | | 190 | |
| | | 6.0 | -6.0 | | | 200 | |
| $f_{MAX}$ | Frequency Response (Switch ON) (**) | 2.25 | -2.25 | Adjust $f_{IN}$ voltage to obtain 0 dBm at $V_{OS}$. Increase $f_{IN}$ Frequency until dB meter reads -3dB $R_L$ = 50Ω, $C_L$ = 10 pF, $f_{IN}$ = 1KHz sine wave | | 95 | MHz |
| | | 4.5 | -4.5 | | | 150 | |
| | | 6.0 | -6.0 | | | 190 | |
| | Feed through Attenuation (Switch OFF) | 2.25 | -2.25 | $V_{IN}$ is centered at ($V_{CC}$ - $V_{EE}$)/2 Adjust input for 0 dBm $R_L$ = 600Ω, $C_L$ = 50 pF, $f_{IN}$ = 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 $R_L$ at set up so that $I_S$ = 0A. $R_L$ = 600Ω, $C_L$ = 50 pF, $f_{IN}$ = 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 $V_{IN}$ to obtain 0dBm at input $R_L$ = 600Ω, $C_L$ = 50 pF, $f_{IN}$ = 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.

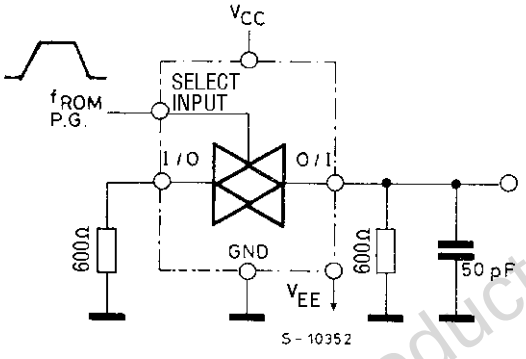
Obsolete Product(s) - Obsolete Product(s)

**Figure 4: Switching Characteristics Test Circuit**

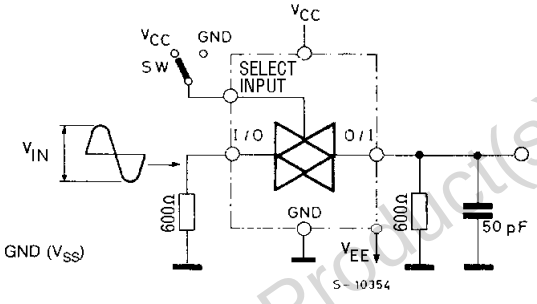
$t_{PLZ}$, $t_{PHZ}$, $t_{PZL}$, $t_{PZH}$



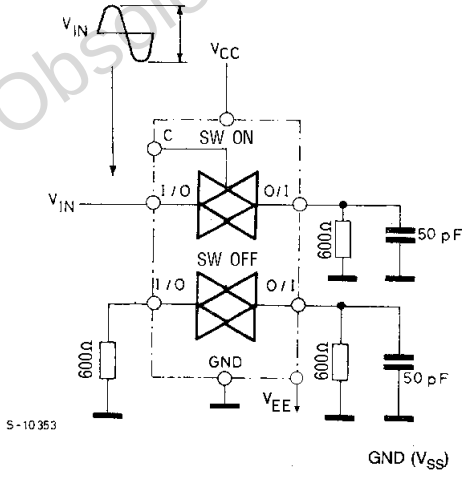

CROSSTALK (control to output)




BANDWIDTH AND FEEDTHROUGH ATTENUATION




CROSSTALK BETWEEN ANY TWO SWITCHES




$C_{I-O}$, $C_{I/O}$

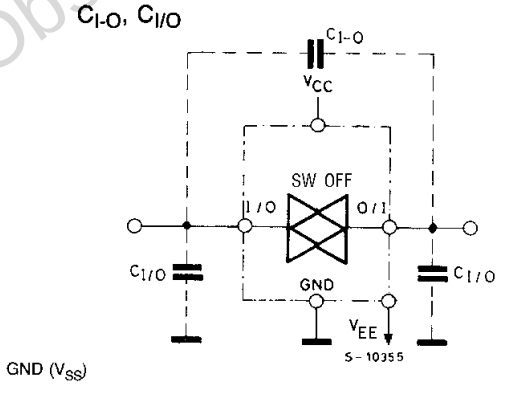



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**Figure 5: Switching Characteristics Waveform**

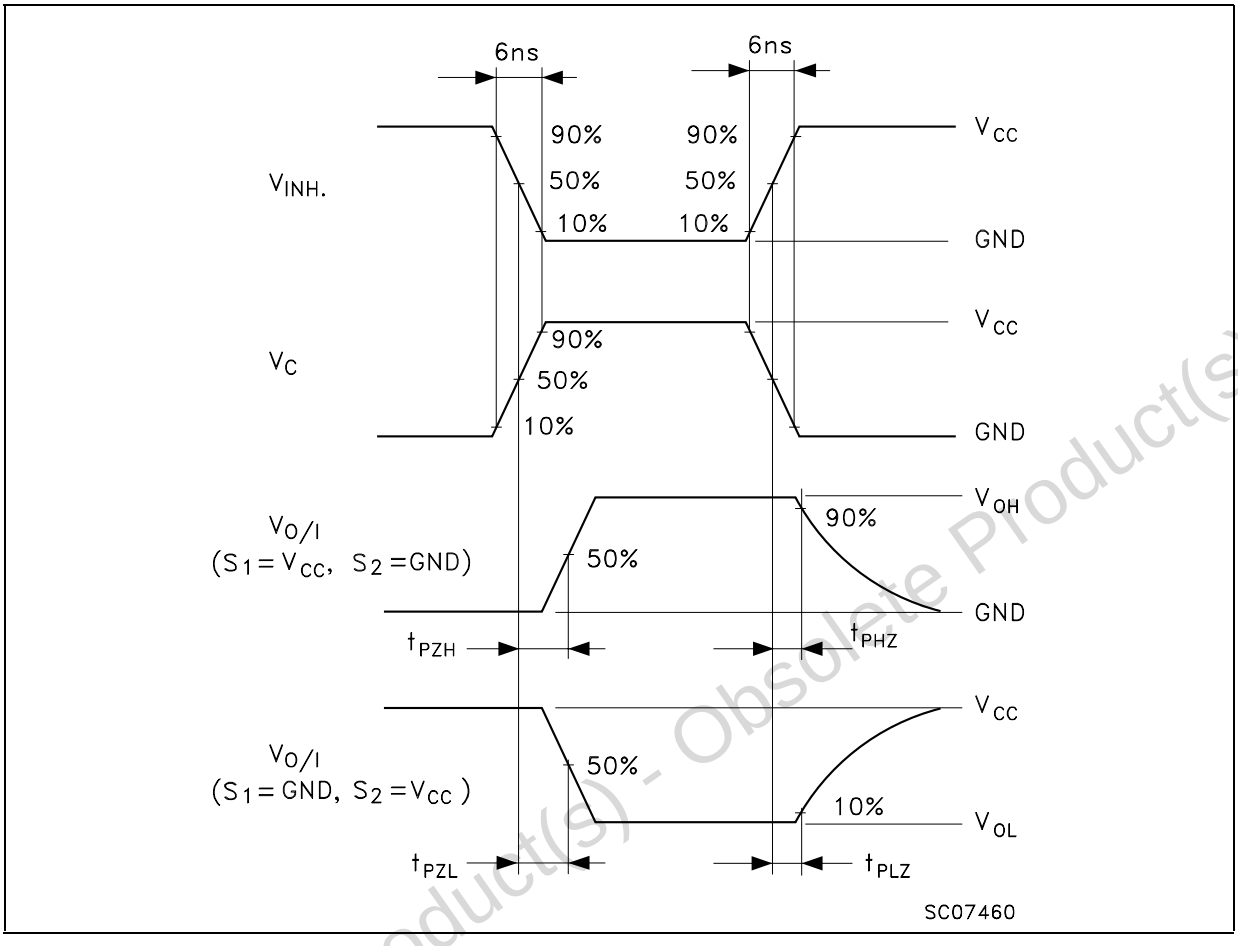



**Figure 6:** Channel Resistance ($R_{ON}$)

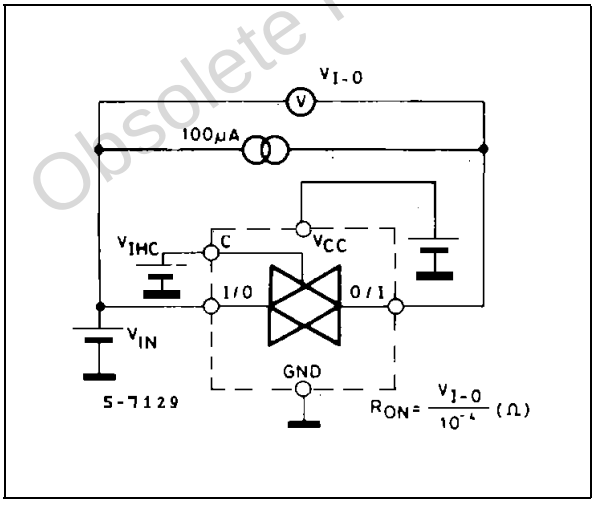
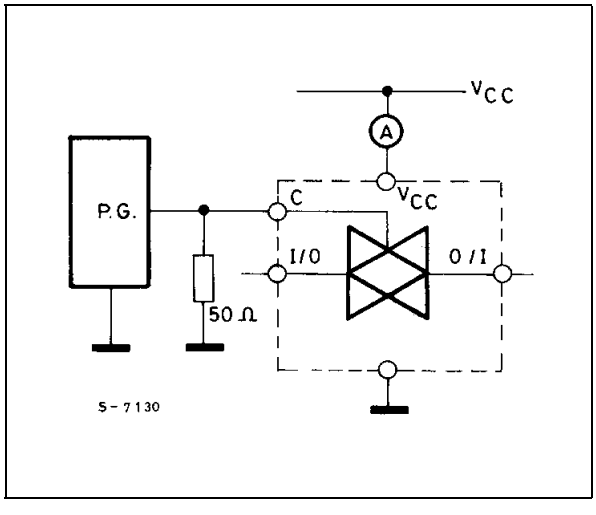


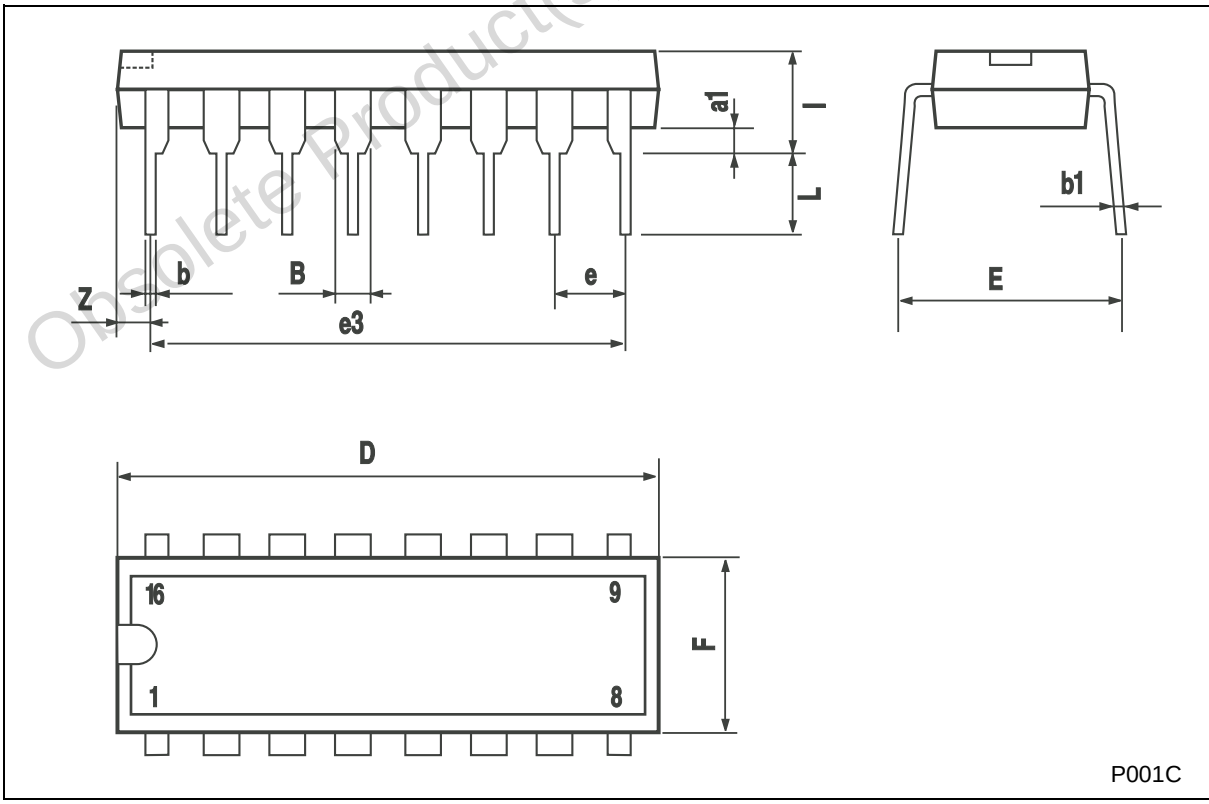

**Figure 7:** $I_{CC}$ (Opr.)




Obsolete Product(s) - Obsolete Product(s)

## 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 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.27 | | | 0.050 |

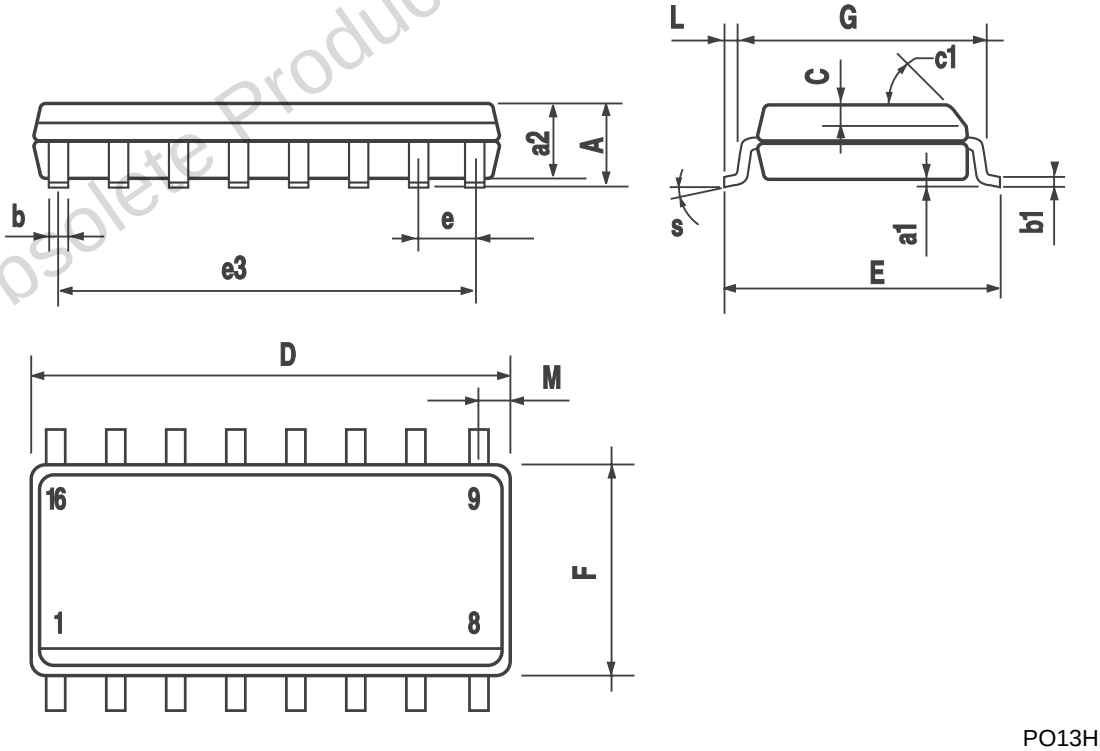



P001C

Obsolete Product(s) - Obsolete Product(s)

## 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.) | | | | | |

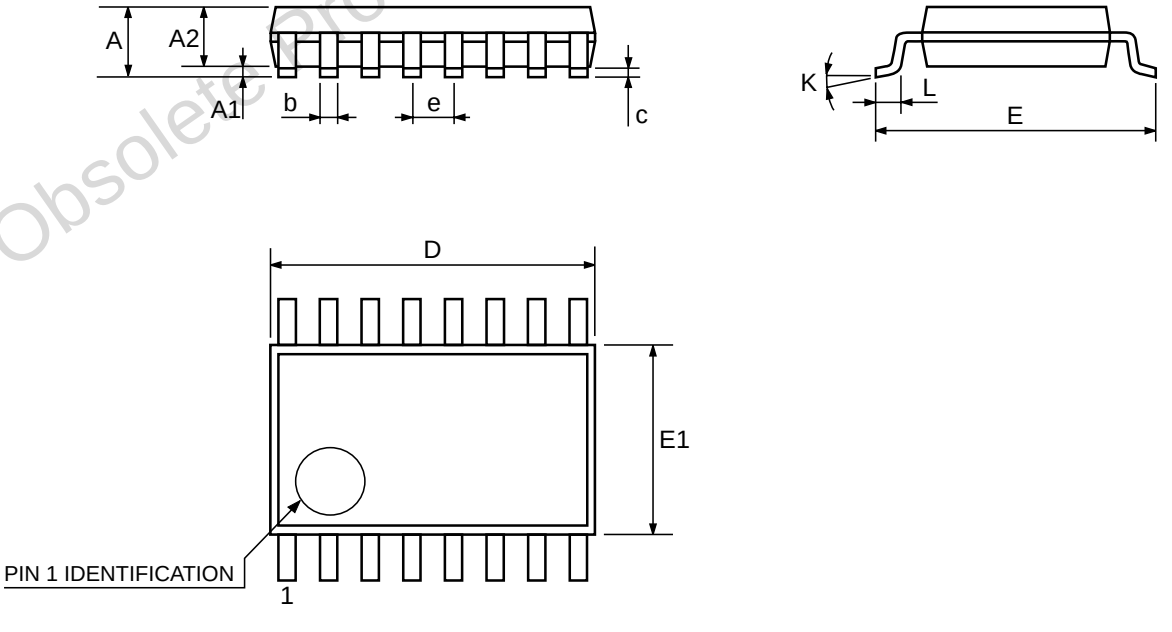



PO13H

Obsolete Product(s) - Obsolete Product(s)

# 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 |

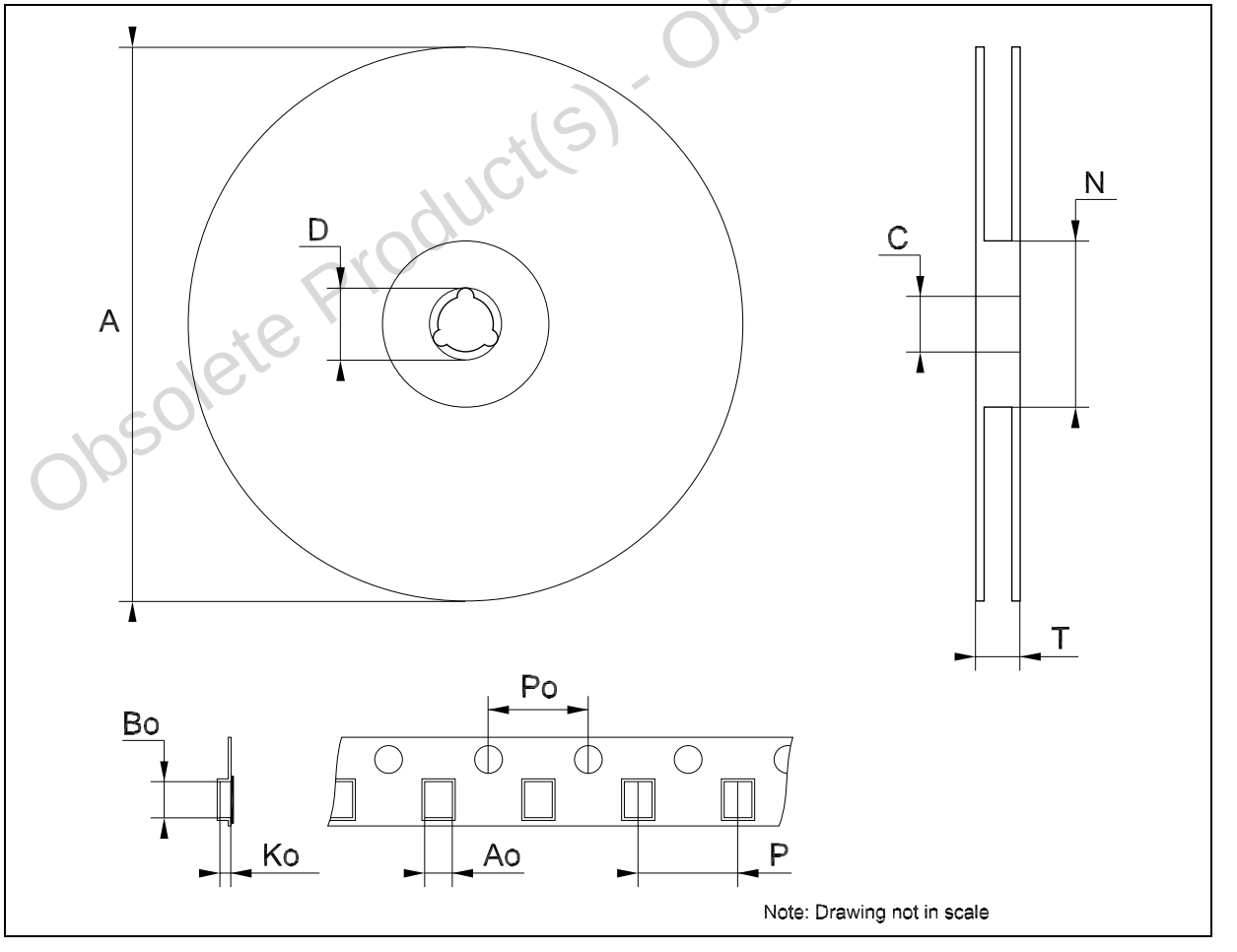



0080338D

Obsolete Product(s) - Obsolete Product(s)

## Tape & 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 |

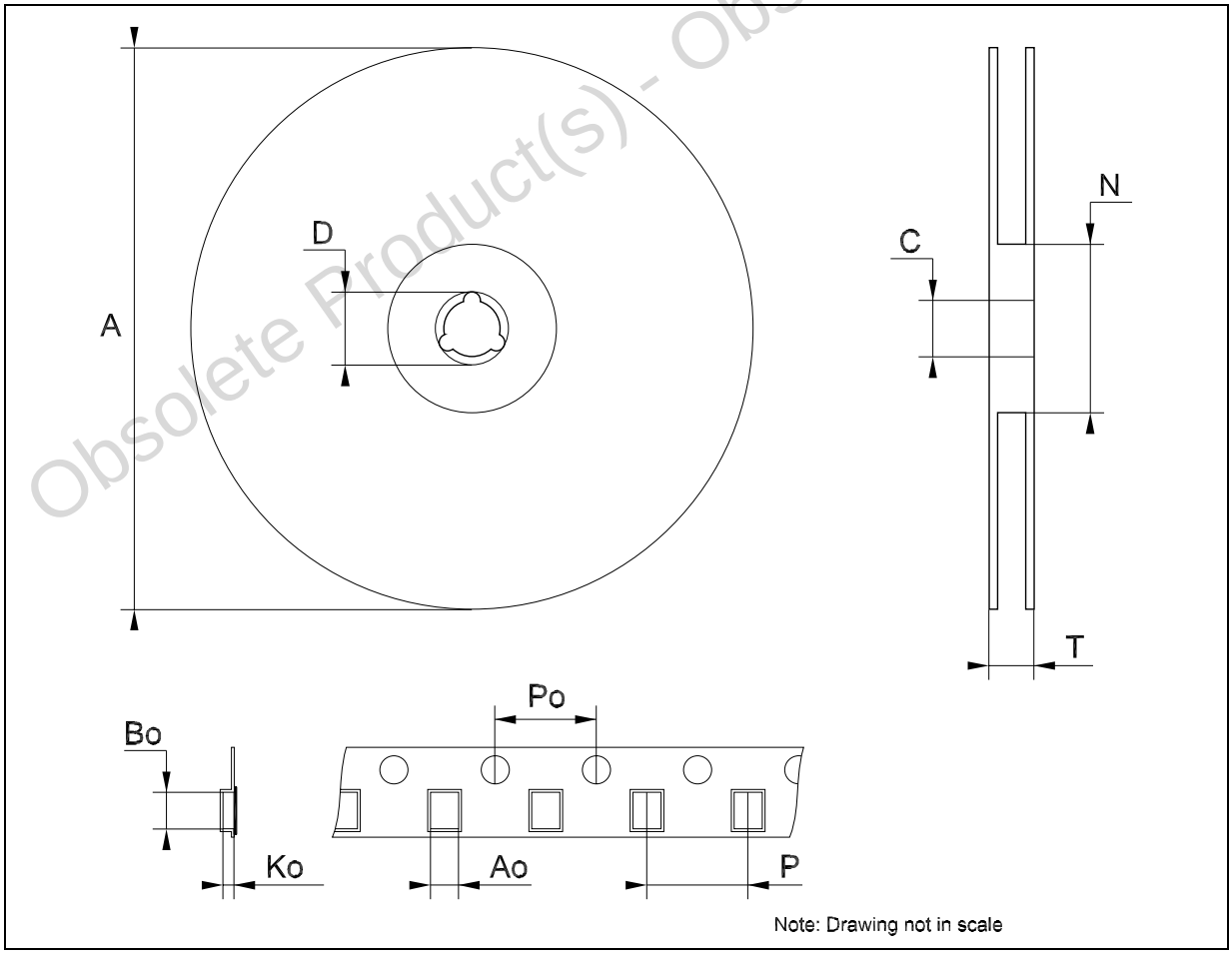



Note: Drawing not in scale

Obsolete Product(s) - Obsolete Product(s)

## 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 |




Note: Drawing not in scale

Obsolete Product(s) - Obsolete Product(s)

**Table 9: Revision History**

| Date | Revision | Description of Changes |
|---|---|---|
| 17-May-2004 | 3 | Typing Error Pin Connection - Page 1 |

Obsolete Product(s) - Obsolete Product(s)

Obsolete Product(s) - Obsolete Product(s)

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