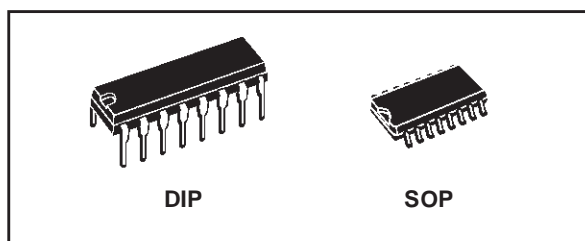




HCF4053B

TRIPLE 2-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

- LOW "ON" RESISTANCE : 125Ω (Typ.) OVER 15V p.p SIGNAL-INPUT RANGE FOR $V_{DD} - V_{EE} = 15V$
- HIGH "OFF" RESISTANCE : CHANNEL LEAKAGE $\pm 100pA$ (Typ.) at $V_{DD} - V_{EE} = 18V$
- BINARY ADDRESS DECODING ON CHIP
- HIGH DEGREE OF LINEARITY : $< 0.5\%$ DISTORTION TYP. at $f_{IS} = 1KHz, V_{IS} = 5 V_{pp}, V_{DD} - V_{SS} \geq 10V, R_L = 10K\Omega$
- VERY LOW QUIESCENT POWER DISSIPATION UNDER ALL DIGITAL CONTROL INPUT AND SUPPLY CONDITIONS : 0.2 μW (Typ.) at $V_{DD} - V_{SS} = V_{DD} - V_{EE} = 10V$
- MATCHED SWITCH CHARACTERISTICS : $R_{ON} = 5\Omega$ (Typ.) FOR $V_{DD} - V_{EE} = 15V$
- WIDE RANGE OF DIGITAL AND ANALOG SIGNAL LEVELS : DIGITAL 3 to 20, ANALOG TO 20V p.p.
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT
 $I_l = 100nA$ (MAX) AT $V_{DD} = 18V T_A = 25^\circ C$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



ORDER CODES

| PACKAGE | TUBE | T & R |
|---------|------------|---------------|
| DIP | HCF4053BEY | |
| SOP | HCF4053BM1 | HCF4053M013TR |

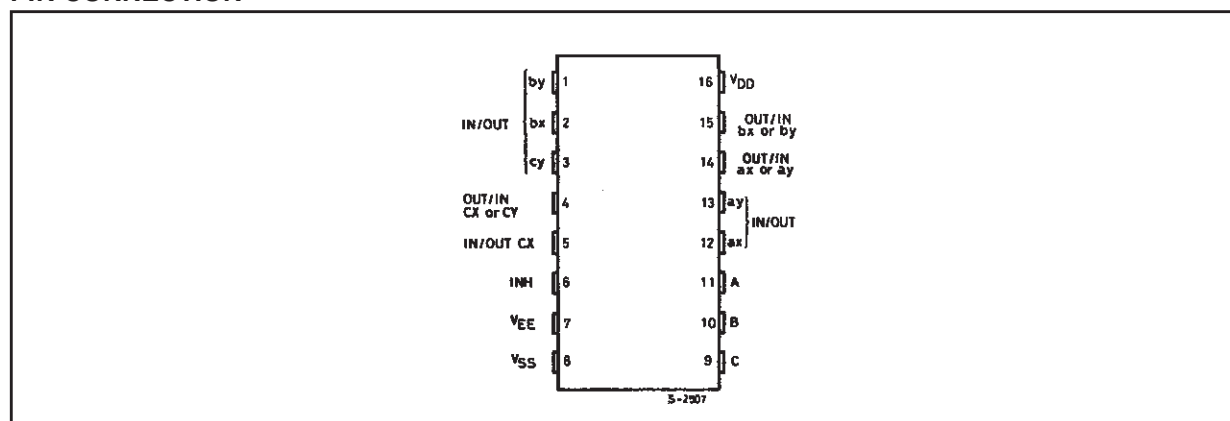
technology available in DIP and SOP packages. The HCF4053B analog multiplexer/demultiplexer is a digitally controlled analog switch having low ON impedance and very low OFF leakage current. This multiplexer circuit dissipate extremely low quiescent power over the full $V_{DD} - V_{SS}$ and $V_{DD} - V_{EE}$ supply voltage range, independent of the logic state of the control signals.

When a logic "1" is present at the inhibit input terminal all channel are off. This device is a triple 2-channel multiplexer having three separate digital control inputs, A, B, and C, and an inhibit input. Each control input selects one of a pair of channels which are connected in a single pole double-throw configuration.

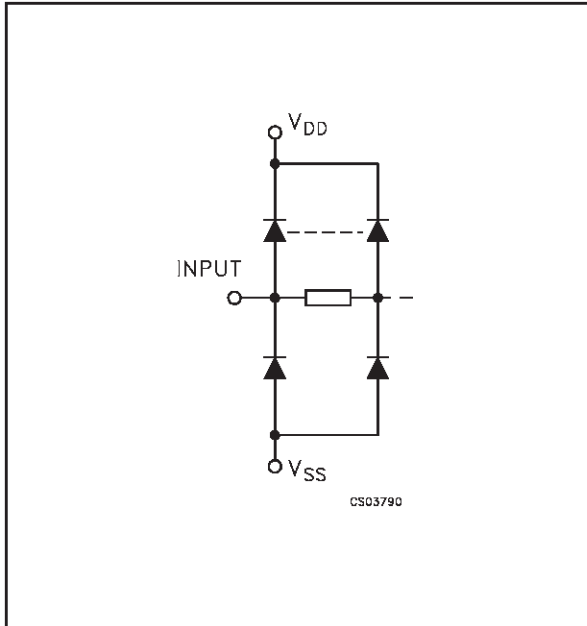
DESCRIPTION

The HCF4053B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor

PIN CONNECTION



INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

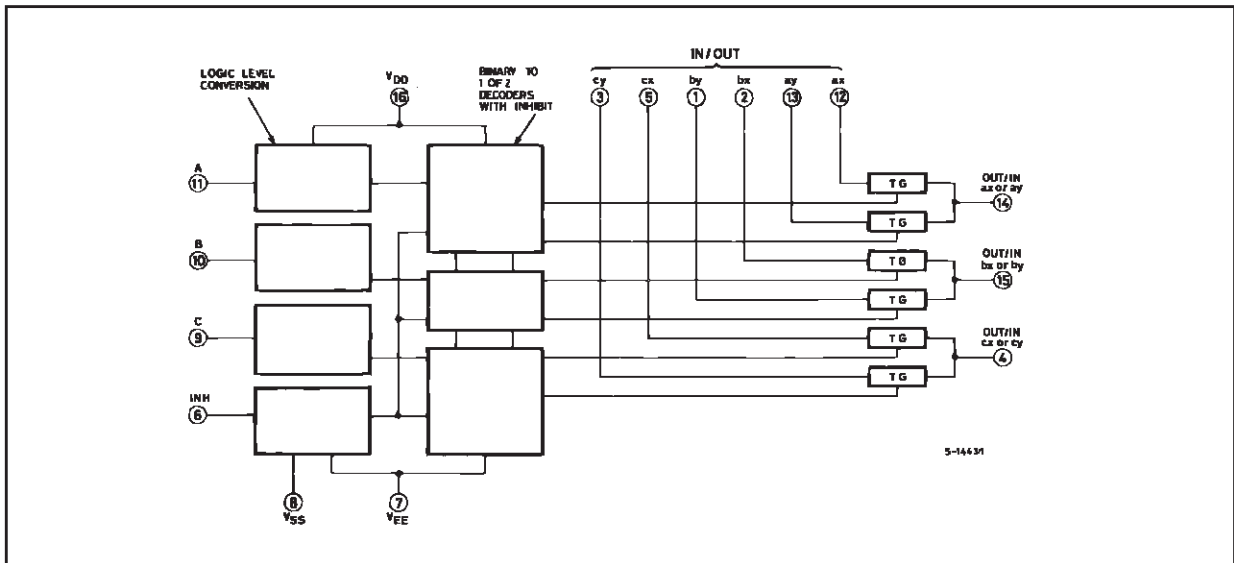
| PIN No | SYMBOL | NAME AND FUNCTION |
|--------------------|----------|--------------------------------|
| 11, 10, 9 | A, B, C | Binary Control Inputs |
| 6 | INH | Inhibit Inputs |
| 12, 13, 2, 1, 5, 3 | IN/OUT | ax,ay,bx,by,cx,cy Input/Output |
| 14 | OUT/IN | ax or ay |
| 15 | OUT/IN | bx or by |
| 4 | OUT/IN | cx or cy |
| 7 | V_{EE} | Supply Voltage |
| 8 | V_{SS} | Negative Supply Voltage |
| 16 | V_{DD} | Positive Supply Voltage |

TRUTH TABLE

| INHIBIT | C or B or A | |
|---------|-------------|----------------|
| 0 | 0 | ax or bx or cx |
| 0 | 1 | ay or by or cy |
| 1 | X | NONE |

X : Don't Care

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------|---|------------------------|------|
| V_{DD} | Supply Voltage | -0.5 to +22 | V |
| V_I | DC Input Voltage | -0.5 to $V_{DD} + 0.5$ | V |
| I_I | DC Input Current | ± 10 | mA |
| P_D | Power Dissipation per Package | 200 | mW |
| | Power Dissipation per Output Transistor | 100 | mW |
| T_{op} | Operating Temperature | -55 to +125 | °C |
| T_{stg} | Storage Temperature | -65 to +150 | °C |

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

All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS


| Symbol | Parameter | Value | Unit |
|----------|-----------------------|---------------|------|
| V_{DD} | Supply Voltage | 3 to 20 | V |
| V_I | Input Voltage | 0 to V_{DD} | V |
| T_{op} | Operating Temperature | -55 to 125 | °C |

DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | | | Value | | | | | | Unit | |
|-------------------------------------|--|-----------------------------------|---|-----------------|-----------------|--------------------------|---------------|-----------|-----------------------------|---------|------------------------------|---------|---------------|
| | | V_{IS} (V) | V_{EE} (V) | V_{SS} (V) | V_{DD} (V) | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| I_L | Quiescent Device Current (all switches ON or all switches OFF) | | | | 5 | | 0.04 | 5 | | 150 | | 150 | μA |
| | | | | | 10 | | 0.04 | 10 | | 300 | | 300 | |
| | | | | | 15 | | 0.04 | 20 | | 600 | | 600 | |
| | | | | | 20 | | 0.08 | 100 | | 3000 | | 3000 | |
| SWITCH | | | | | | | | | | | | | |
| R_{ON} | Resistance | $0 \leq V_I \leq V_{DD}$ | 0 | 0 | 5 | | 470 | 1050 | | 1200 | | 1200 | Ω |
| | | | | | 10 | | 180 | 400 | | 520 | | 520 | |
| | | | | | 15 | | 125 | 280 | | 360 | | 360 | |
| Δ_{ON} | Resistance Δ_{RON} (between any 2 of 4 switches) | $0 \leq V_I \leq V_{DD}$ | 0 | 0 | 5 | | 10 | | | | | | Ω |
| | | | | | 10 | | 10 | | | | | | |
| | | | | | 15 | | 5 | | | | | | |
| OFF* | Channel Leakage Current (All Channel OFF) (COMMON O/I) | | 0 | 0 | 18 | | ± 0.1 | 100 | | 1000 | | 1000 | nA |
| OFF* | Channel Leakage Current (Any Channel OFF) | | 0 | 0 | 18 | | ± 0.1 | 100 | | 1000 | | 1000 | nA |
| C_I | Input Capacitance | | -5 | -5 | 5 | | 5 | | | | | | pF |
| C_O | Output Capacitance | | | | | 9 | | | | | | | |
| C_{IO} | Feed through | | | | | 0.2 | | | | | | | |
| CONTROL (Address or Inhibit) | | | | | | | | | | | | | |
| V_{IL} | Input Low Voltage | $= V_{DD}$ thru $1\text{K}\Omega$ | $V_{EE} = V_{SS}$ $R_L = 1\text{K}\Omega$ to V_{SS} $I_{IS} < 2\mu\text{A}$ (on all OFF channels) | 5 | | | 1.5 | | 1.5 | | 1.5 | V | |
| | | | | 10 | | | 3 | | 3 | | 3 | | |
| | | | | 15 | | | 4 | | 4 | | 4 | | |
| V_{IH} | Input High Voltage | $= V_{DD}$ thru $1\text{K}\Omega$ | $V_{EE} = V_{SS}$ $R_L = 1\text{K}\Omega$ to V_{SS} $I_{IS} < 2\mu\text{A}$ (on all OFF channels) | 5 | 3.5 | | | 3.5 | | 3.5 | | V | |
| | | | | 10 | 7 | | | 7 | | 7 | | | |
| | | | | 15 | 11 | | | 11 | | 11 | | | |
| I_{IH}, I_{IL} | Input Leakage Current | | $V_I = 0/18\text{V}$ | | 18 | | $\pm 10^{-3}$ | ± 0.1 | | ± 1 | | ± 1 | μA |
| C_I | Input Capacitance | | | | | | 5 | 7.5 | | | | | pF |

* Determined by minimum feasible leakage measurement for automating testing.

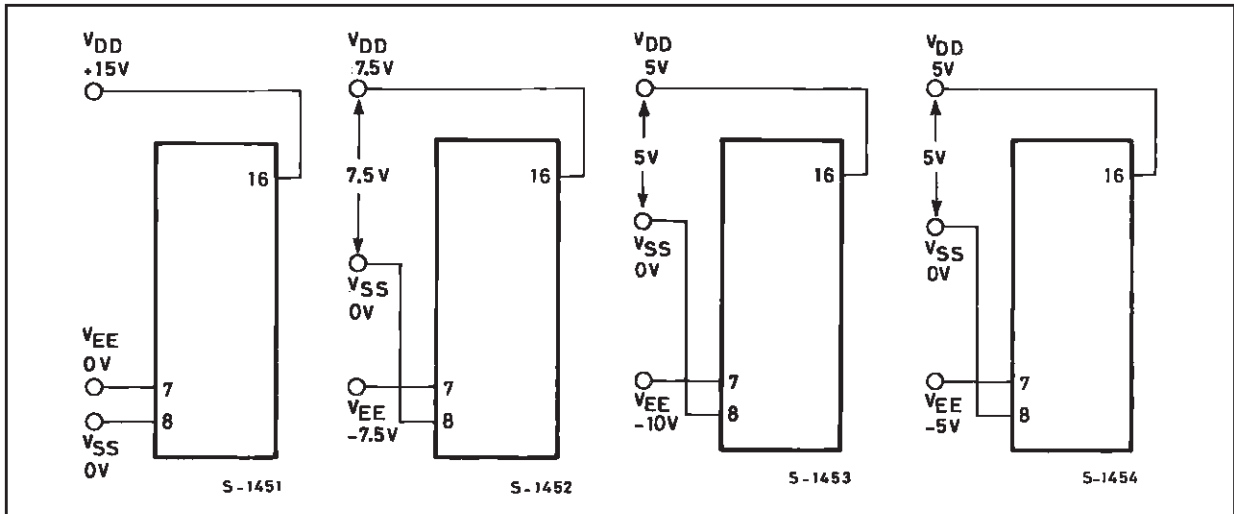
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$, $C_L = 50\text{pF}$, all input square wave rise and fall time = 20 ns)

| Parameter | Test Condition | | | | | | | Value | | | Unit | |
|--|-----------------|------------------------|----------------|---|-----------------|-----------------|--|-------|------|------|---------|----|
| | V_{EE} (V) | R_L (K Ω) | f_I (KHz) | V_I (V) | V_{SS} (V) | V_{DD} (V) | | Min. | Typ. | Max. | | |
| Propagation Delay Time (signal input to output) | | 200 | | V_{DD}  | | 5 | | | 30 | 60 | ns | |
| | | | | | | 10 | | | 15 | 30 | | |
| | | | | | | 15 | | | 11 | 20 | | |
| Frequency Response Channel "ON" (sine wave input) at $20 \log V_O/V_I = -3\text{dB}$ | $= V_{SS}$ | 1 | | 5(*) | | 10 | V_O at Common OUT/IN | | 25 | | MHz | |
| | | | | | | | V_O at any channel | | 60 | | | |
| Feed through (all channels OFF) at $20 \log V_O/V_I = -40\text{dB}$ | $= V_{SS}$ | 1 | | 5(*) | | 10 | V_O at Common OUT/IN | | 10 | | MHz | |
| | | | | | | | V_O at any channel | | 8 | | | |
| Frequency Signal Crosstalk at $20 \log V_O/V_I = -40\text{dB}$ | $= V_{SS}$ | 1 | | 5(*) | | 10 | Between any 2 Sections (IN pin 2, OUT pin 14) | | 2.5 | | MHz | |
| | | | | | | | Between any 2 Sections (IN pin 15, OUT pin 14) | | 6 | | | |
| Sine Wave Distortion $f_{IS} = 1\text{KHz}$ Sine Wave | $= V_{SS}$ | 10 | 1 | 2(*) | | 5 | | | 0.3 | | % | |
| | | | | 3(*) | | 10 | | | 0.2 | | | |
| | | | | 5(*) | | 15 | | | 0.12 | | | |
| CONTROL (Address or Inhibit) | | | | | | | | | | | | |
| Propagation Delay: Address to Signal OUT (Channels ON or OFF) | 0 | | | | | 0 | 5 | | | 360 | 720 | ns |
| | 0 | | | | | 0 | 10 | | | 160 | 320 | |
| | 0 | | | | | 0 | 15 | | | 120 | 240 | |
| | -5 | | | | | 0 | 5 | | | 225 | 450 | |
| Propagation Delay: Inhibit to Signal OUT (Channel turning ON) | 0 | 1 | | | | 0 | 5 | | | 360 | 720 | ns |
| | 0 | | | | | 0 | 10 | | | 160 | 320 | |
| | 0 | | | | | 0 | 15 | | | 120 | 240 | |
| | -10 | | | | | 0 | 5 | | | 200 | 400 | |
| Propagation Delay: Inhibit to Signal OUT (Channel turning OFF) | 0 | 10 | | | | | 5 | | | 200 | 450 | ns |
| | 0 | | | | | | 10 | | | 90 | 210 | |
| | 0 | | | | | | 15 | | | 70 | 160 | |
| | -10 | | | | | | 5 | | | 130 | 300 | |
| Address or Inhibit to Signal Crosstalk | 0 | 10 ⁽¹⁾ | | | 0 | 10 | $V_C = V_{DD} - V_{SS}$ (square wave) | | 65 | | mV peak | |

(1) Both ends of channel.

* Peak to Peak voltage symmetrical about $(V_{DD} - V_{EE}) / 2$

TYPICAL BIAS VOLTAGES



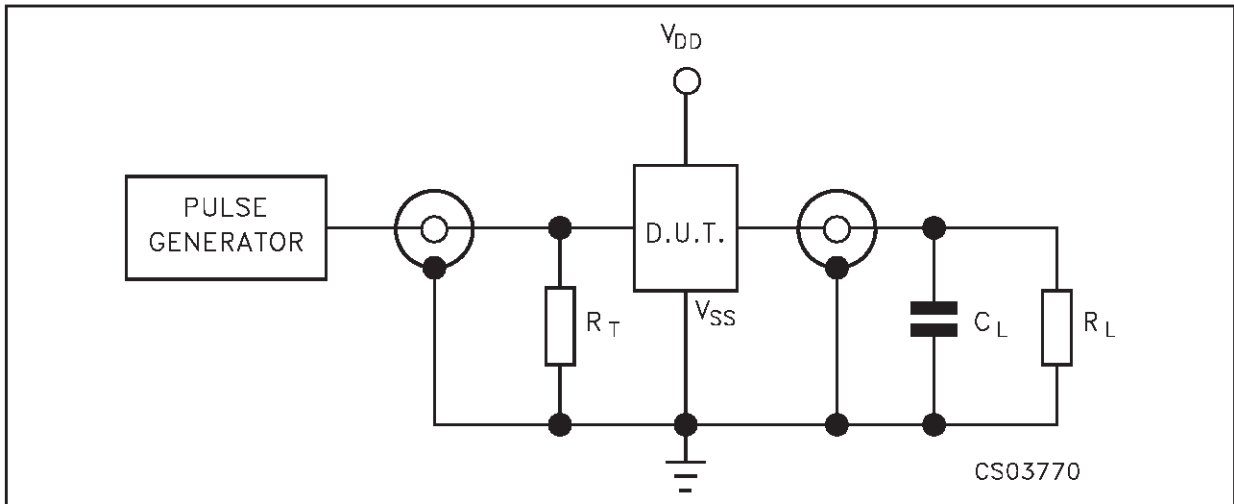
The ADDRESS (digital-control inputs) and INHIBIT logic levels are : "0"= V_{SS} and "1"= V_{DD} . The analog signal (through the TG) may swing from V_{EE} to V_{DD}

SPECIAL CONSIDERATIONS

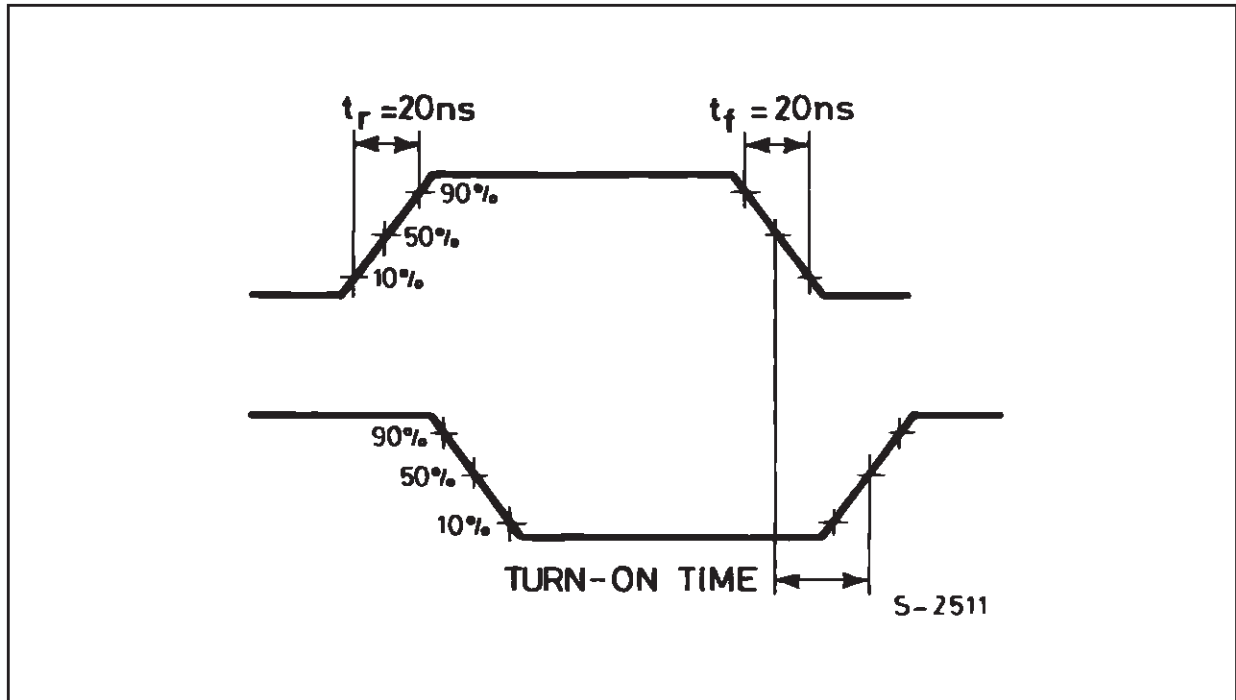
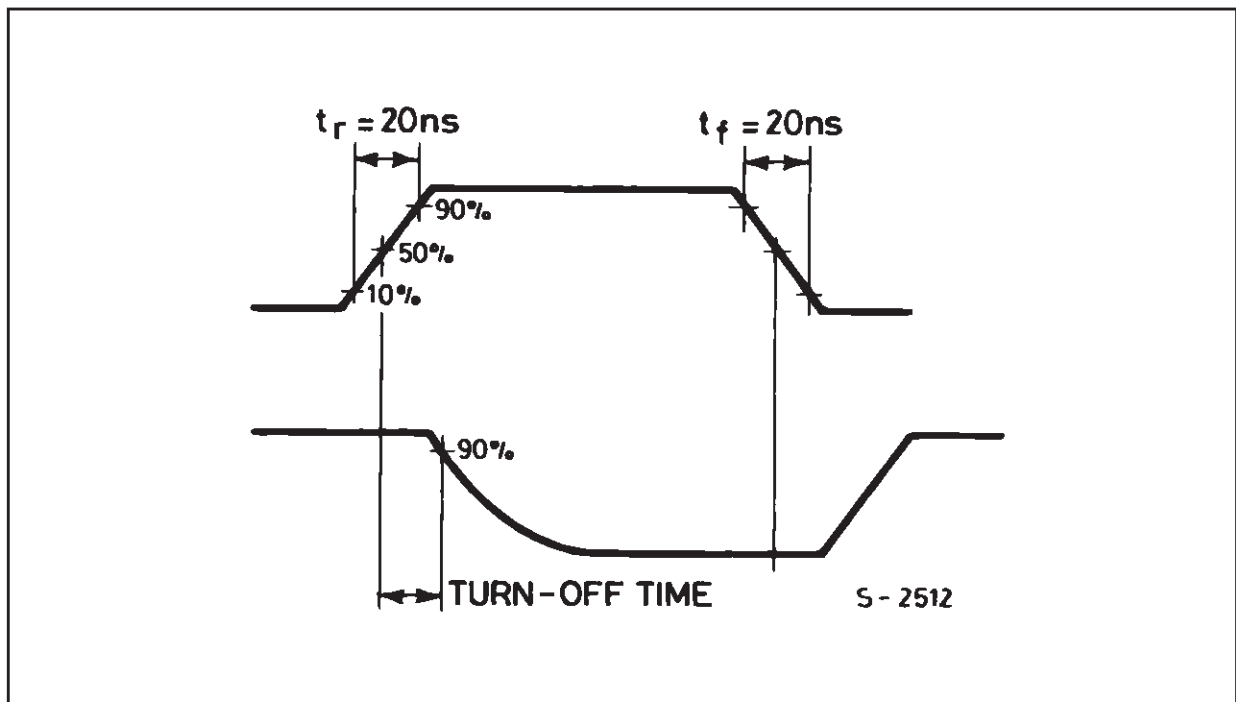
Control of analog signals up to 20V peak to peak can be achieved by digital signal amplitudes of 4.5 to 20V (if $V_{DD} - V_{SS} = 3V$, a $V_{DD} - V_{EE}$ of up to 13V can be controlled; for $V_{DD} - V_{EE}$ level differences above 13V, a $V_{DD} - V_{SS}$ of at least 4.5V is required. For example, if $V_{DD} = +5$, $V_{SS} = 0$, and $V_{EE} = -13.5$, analog signals from -13.5V to 4.5V can be controlled by digital inputs of 0 to 4.5V. In

certain applications, the external load resistor current may include both V_{DD} and signal-line components. To avoid drawing V_{DD} current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.8V (calculated from R_{ON} values shown in DC SPECIFICATIONS). No V_{DD} current will flow through R_L if the switch current flows into leads 4, 14 and 15.

TEST CIRCUIT

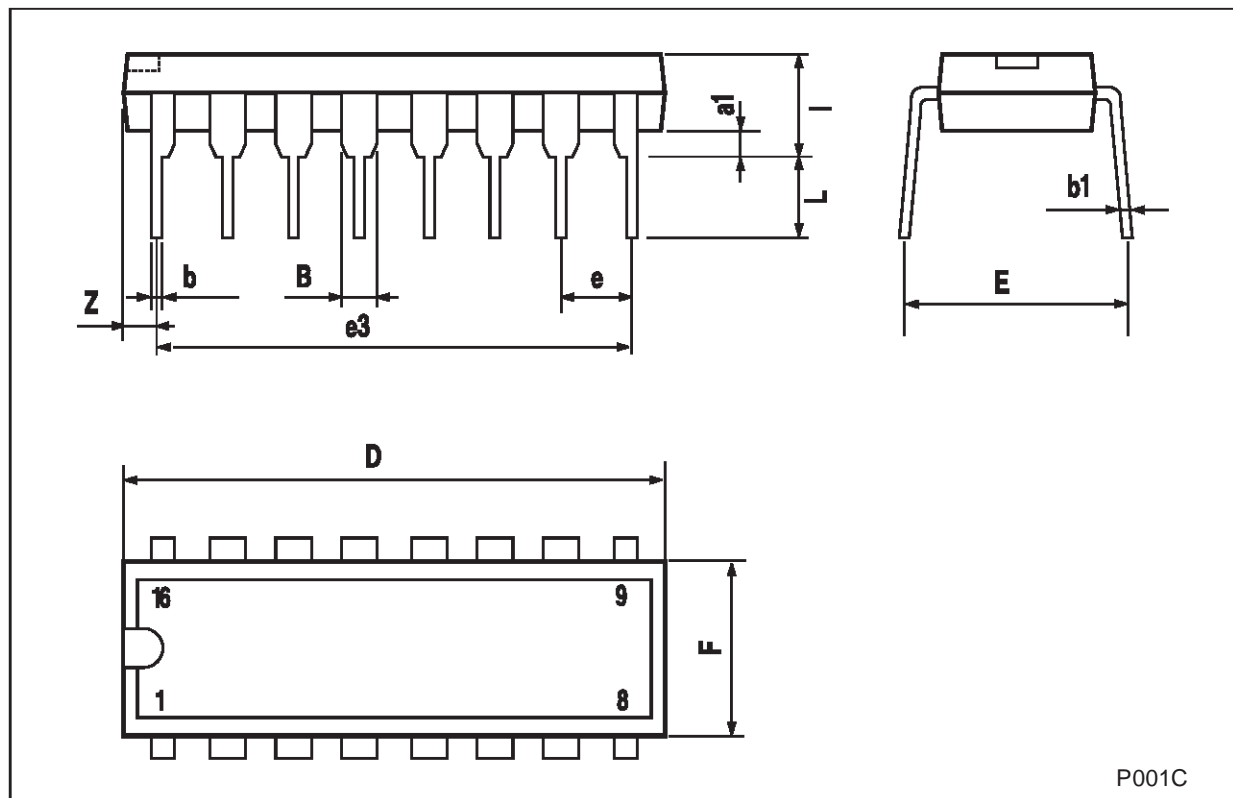


$C_L = 50pF$ or equivalent (includes jig and probe capacitance)
 $R_L = 200K\Omega$
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

WAVEFORM 1 : CHANNEL BEING TURNED ON ($R_L = 1K\Omega$, $f=1MHz$; 50% duty cycle)WAVEFORM 2 : CHANNEL BEING TURNED OFF ($R_L = 1K\Omega$, $f=1MHz$; 50% duty cycle)

Plastic DIP-16 (0.25) MECHANICAL DATA

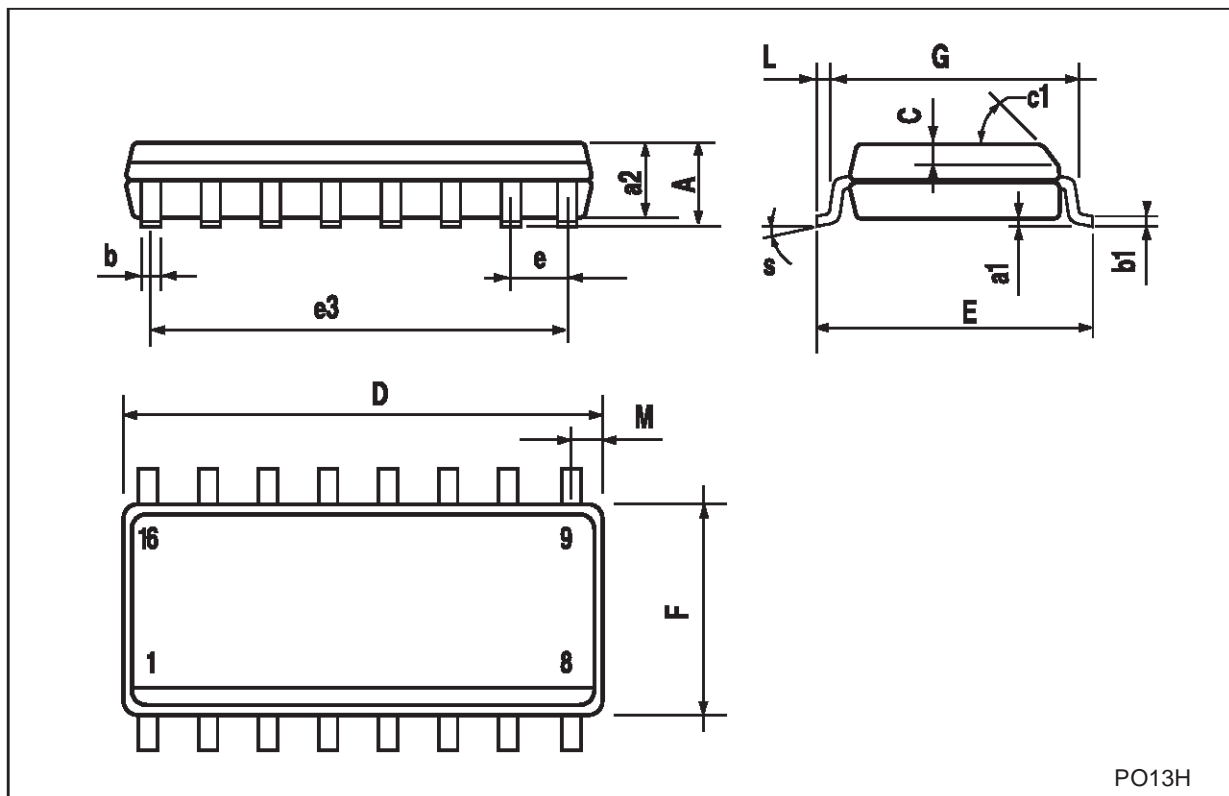
| DIM. | mm. | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 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

SO-16 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| 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

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