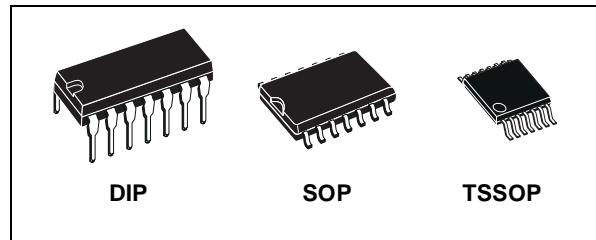




M74HC4016

QUAD BILATERAL SWITCH

- HIGH SPEED:
 $t_{PD} = 9\text{ns}$ (TYP.) at $V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 1\mu\text{A}$ (MAX.) at $T_A = 25^\circ\text{C}$
- LOW "ON" RESISTANCE:
 $R_{ON} = 60\Omega$ TYP. AT $V_{CC} = 9\text{V}$, $I_{I/O} = 100\mu\text{A}$
- WIDE OPERATING VOLTAGE RANGE
 V_{CC} (OPR) = 2V TO 12V
- SINE WAVE DISTORTION:
 0.042% at $V_{CC} = 9\text{V}_{pp}$, $f = 1\text{KHz}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (MIN.)
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 4016



ORDER CODES

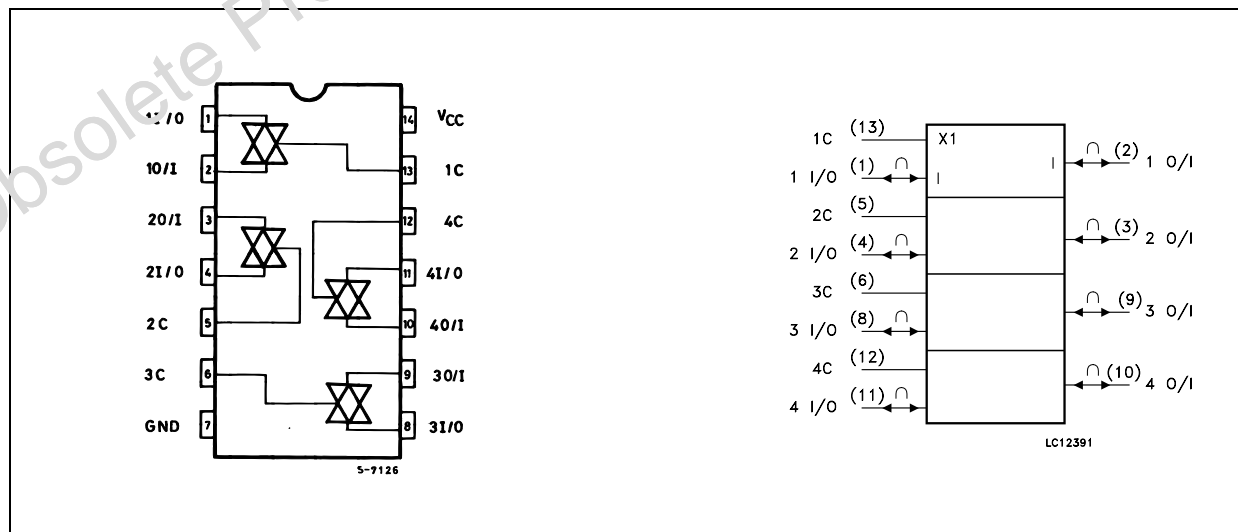
| PACKAGE | TUBE | T & R |
|---------|--------------|-----------------|
| DIP | M74HC4016B1R | |
| SOP | M74HC4016M1R | M74HC4016RM13TR |
| TSSOP | | M74HC4016TTR |

DESCRIPTION

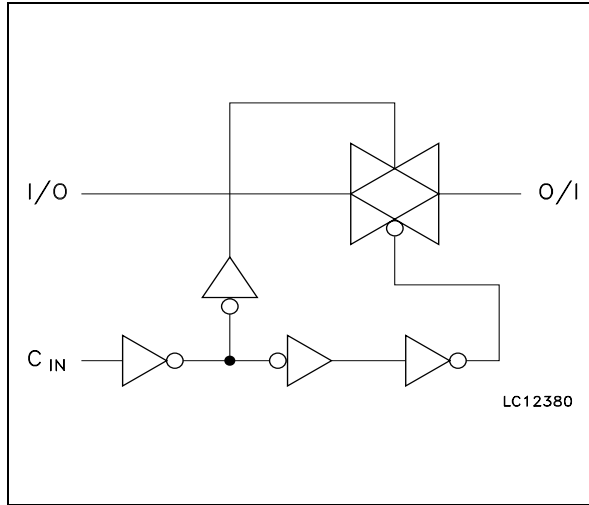
The M74HC4016 is an high speed CMOS QUAD BILATERAL SWITCH fabricated with silicon gate C²MOS technology.

The C input is provided to control the switch; the switch is on when the C input is held high and off when C is held low.

PIN CONNECTION AND LOGIC SYMBOLS



LOGIC DIAGRAM



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------------|-----------------|-----------------------------|
| 1, 4, 8, 11 | 1 to 4 I/O | Independent Inputs/Outputs |
| 2, 3, 9, 10 | 1 to 4 O/I | Independent Outputs/Inputs |
| 13, 5, 6, 12 | 1C to 4C | Enable Inputs (Active High) |
| 7 | GND | Ground (0V) |
| 14 | V _{CC} | Positive Supply Voltage |

TRUTH TABLE

| CONTROL | SWITCH FUNCTION |
|---------|-----------------|
| H | ON |
| L | OFF |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-------------------------------------|--|-------------------------------|------|
| V _{CC} | Supply Voltage | -0.5 to +13 | V |
| V _{IN} | DC Input Voltage | -0.5 to V _{CC} + 0.5 | V |
| V _{I/O} | DC Input/Output Voltage | -0.5 to V _{CC} + 0.5 | V |
| I _{OK} | Control Input DC Diode Current | ± 20 | mA |
| I _{I/O} | I/O DC Diode Current | ± 20 | mA |
| I _O | DC Output Source Sink Current Per Output Pin | ± 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

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit | |
|---------------------------------|--------------------------|-------------------------|-----------|----|
| V _{CC} | Supply Voltage | 2 to 12 | V | |
| V _{IN} | Input Voltage (Control) | 0 to V _{CC} | V | |
| V _{I/O} | I/O Voltage | 0 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 | |
| | | V _{CC} = 10.0V | 0 to 250 | |

DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|------------------|---|------------------------|--|-----------------------|------|-------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V _{IHC} | High Level Control Input Voltage | 2.0 | | 1.5 | | | 1.5 | | 1.5 | | V |
| | | 4.5 | | 3.15 | | | 3.15 | | 3.15 | | |
| | | 9.0 | | 6.3 | | | 6.3 | | 6.3 | | |
| | | 12.0 | | 8.4 | | | 8.4 | | 8.4 | | |
| V _{ILC} | Low Level Control Input Voltage | 2.0 | | | | 0.5 | | 0.5 | | 0.5 | V |
| | | 4.5 | | | | 1.35 | | 1.35 | | 1.35 | |
| | | 9.0 | | | | 2.5 | | 2.5 | | 2.5 | |
| | | 12.0 | | | | 3.6 | | 3.6 | | 3.6 | |
| R _{ON} | ON Resistance | 4.5 | V _{IN} = V _{IHC} | | 160 | 320 | | 400 | | 450 | Ω |
| | | 9.0 | V _{I/O} = V _{CC} to GND | | 85 | 170 | | 213 | | 260 | |
| | | 12.0 | I _{I/O} = 100μA | | 60 | 120 | | 150 | | 180 | |
| | | 4.5 | V _{IN} = V _{IHC} | | 80 | 160 | | 200 | | 250 | |
| | | 9.0 | V _{I/O} = V _{CC} or GND | | 60 | 120 | | 150 | | 200 | |
| | | 12.0 | I _{I/O} = 100μA | | 50 | 100 | | 125 | | 150 | |
| ΔR _{ON} | Difference of ON Resistance between switches | 4.5 | V _{IN} = V _{IHC} | | 16 | | | | | | Ω |
| | | 9.0 | V _{I/O} = V _{CC} or GND | | 9 | | | | | | |
| | | 12.0 | I _{I/O} ≤ 100μA | | 6 | | | | | | |
| I _{OFF} | Input/Output Leakage Current (SWITCH OFF) | 12.0 | V _{OS} = V _{CC} or GND V _{IS} = V _{CC} or GND V _{IN} = V _{ILC} | | | ± 0.1 | | ± 1 | | ± 2 | μA |
| I _{IZ} | Switch Input Leakage Current (SWITCH ON, OUTPUT OPEN) | 12.0 | V _{OS} = V _{CC} or GND V _{IN} = V _{IHC} | | | ± 0.1 | | ± 1 | | ± 2 | μA |
| I _{IN} | Control Input Current | 6.0 | V _{IN} = V _{CC} or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I _{CC} | Quiescent Supply Current | 6.0 | | | | 1 | | 10 | | 20 | μA |
| | | 9.0 | V _{IN} = V _{CC} or GND | | | 4 | | 40 | | 80 | |
| | | 12.0 | | | | 8 | | 80 | | 160 | |

AC ELECTRICAL CHARACTERISTICS ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$)

| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|------------------------|---|-----------------|-------------------------|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| $\Phi_{I/O}$ | Phase Difference Between Input and Output | 2.0 | | | 20 | 50 | | 65 | | 75 | ns |
| | | 4.5 | | | 5 | 10 | | 13 | | 15 | |
| | | 9.0 | | | 4 | 8 | | 10 | | 12 | |
| | | 12.0 | | | 3 | 7 | | 9 | | 11 | |
| t_{PZL} t_{PZH} | Output Enable Time | 2.0 | $R_L = 1\text{K}\Omega$ | | 40 | 100 | | 125 | | 150 | ns |
| | | 4.5 | | | 10 | 20 | | 25 | | 30 | |
| | | 9.0 | | | 8 | 15 | | 20 | | 24 | |
| | | 12.0 | | | 7 | 14 | | 18 | | 21 | |
| t_{PLZ} t_{PHZ} | Output Disable Time | 2.0 | $R_L = 1\text{K}\Omega$ | | 60 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 15 | 30 | | 38 | | 45 | |
| | | 9.0 | | | 10 | 26 | | 33 | | 36 | |
| | | 12.0 | | | 8 | 24 | | 30 | | 32 | |

CAPACITIVE CHARACTERISTICS

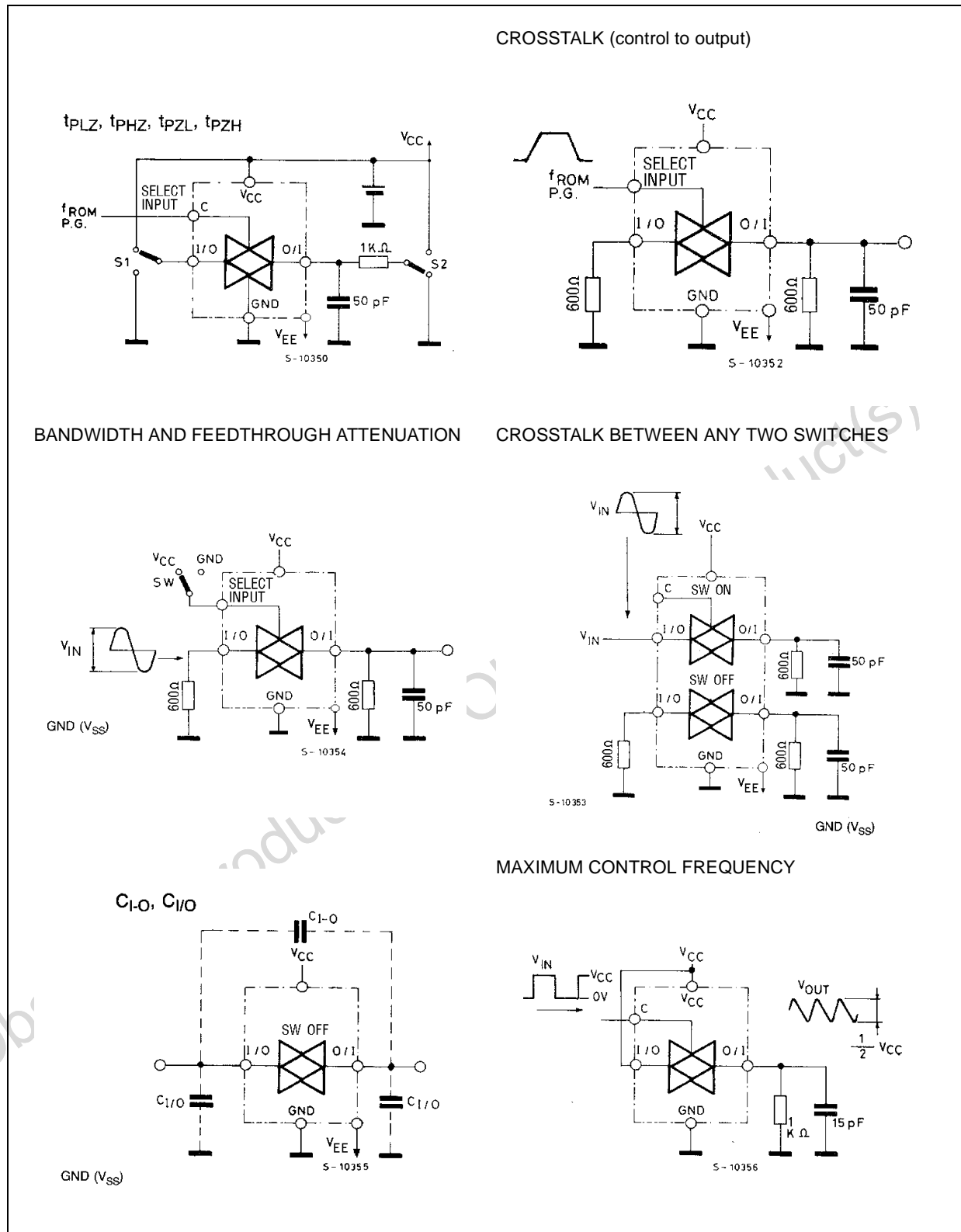
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|-----------|--|-----------------|--|--------------------------|------|------|------------------------------------|------|-------------------------------------|------|------|
| | | V_{CC} (V) | | $T_A = 25^\circ\text{C}$ | | | $-40 \text{ to } 85^\circ\text{C}$ | | $-55 \text{ to } 125^\circ\text{C}$ | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| C_{IN} | Input Capacitance | | | | 5 | 10 | | 10 | | 10 | pF |
| $C_{I/O}$ | Switch Terminal Capacitance | | | | 5 | | | | | | pF |
| C_{IOS} | Feed Through Capacitance | | | | 1 | | | | | | pF |
| C_{PD} | Power Dissipation Capacitance (note 1) | | | | 15 | | | | | | 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. $I_{CC(oper)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

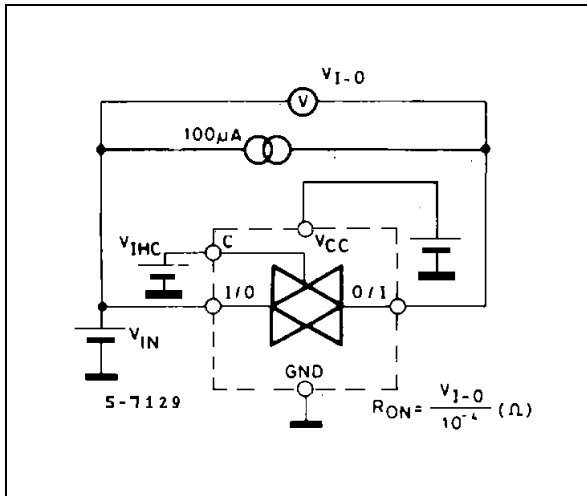
ANALOG SWITCH CHARACTERISTICS (GND = 0V; T_A = 25°C)

| Symbol | Parameter | Test Condition | | Value | Unit |
|------------------|--|------------------------|---|--|-------|
| | | V _{CC} (V) | V _{IN} (V _{p-p}) | Typ. | |
| | Sine Wave Distortion (THD) | 4.5 | 4.5 | f _{IN} = 1 KHz R _L = 10 KΩ, C _L = 50 pF | 0.118 |
| | | 9.0 | 9.0 | | 0.042 |
| | | 12.0 | 12.0 | | 0.032 |
| f _{MAX} | Frequency Response (Switch ON) | 4.5 | 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 = 50 pF | 23 | MHz |
| | | 9.0 | | 38 | |
| | | 12.0 | | 42 | |
| | Feed through Attenuation (Switch OFF) | 4.5 | V _{IN} is centered at V _{CC} /2. Adjust input for 0 dBm R _L = 600Ω C _L = 50 pF, f _{IN} = 1MHz sine wave | -50 | dB |
| | | 9.0 | | -50 | |
| | | 12.0 | | -50 | |
| | Crosstalk (Control Input to Signal Output) | 4.5 | R _L = 600Ω, C _L = 50 pF, f _{IN} = 1MHz square wave (t _r = t _f = 6ns) | 8 | mV |
| | | 9.0 | | 23 | |
| | | 12.0 | | 40 | |
| | Crosstalk (Between Any Switches) | 4.5 | Adjust V _{IN} to Obtain 0 dBm at input R _L = 600Ω, C _L = 50 pF, f _{IN} = 1MHz sine wave | -50 | dB |
| | | 9.0 | | -50 | |
| | | 12.0 | | -50 | |

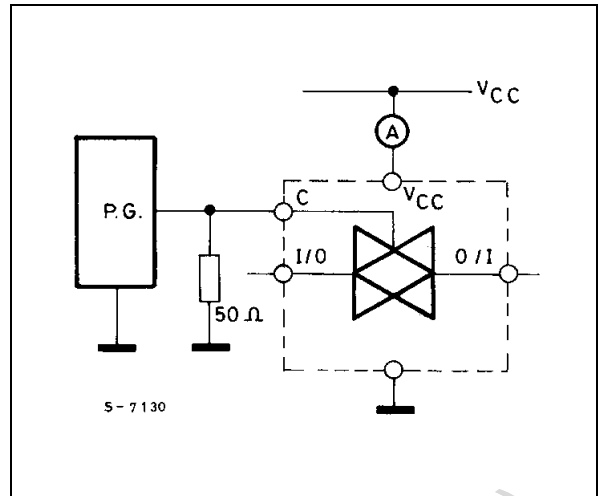
SWITCHING CHARACTERISTICS TEST CIRCUIT



CHANNEL RESISTANCE (R_{ON})



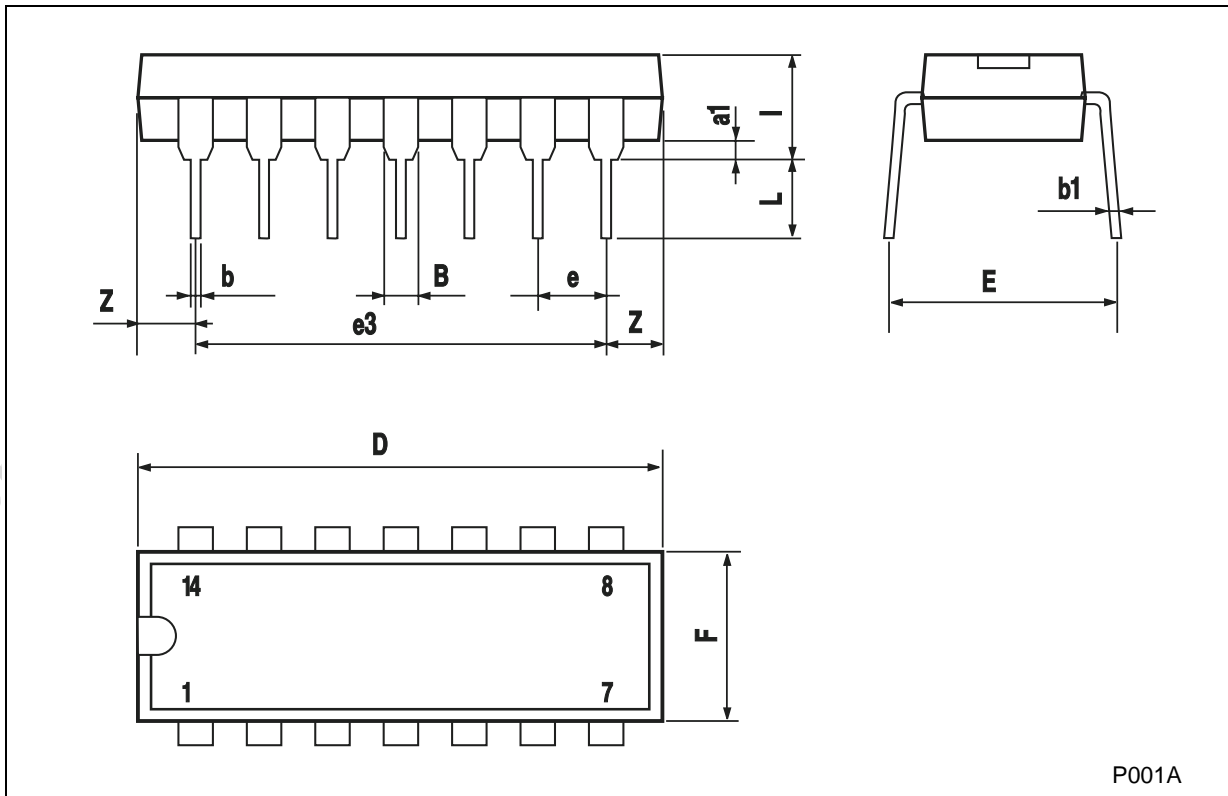
I_{CC} (Opr.)



Obsolete Product(s) - Obsolete Product(s)

Plastic DIP-14 MECHANICAL DATA

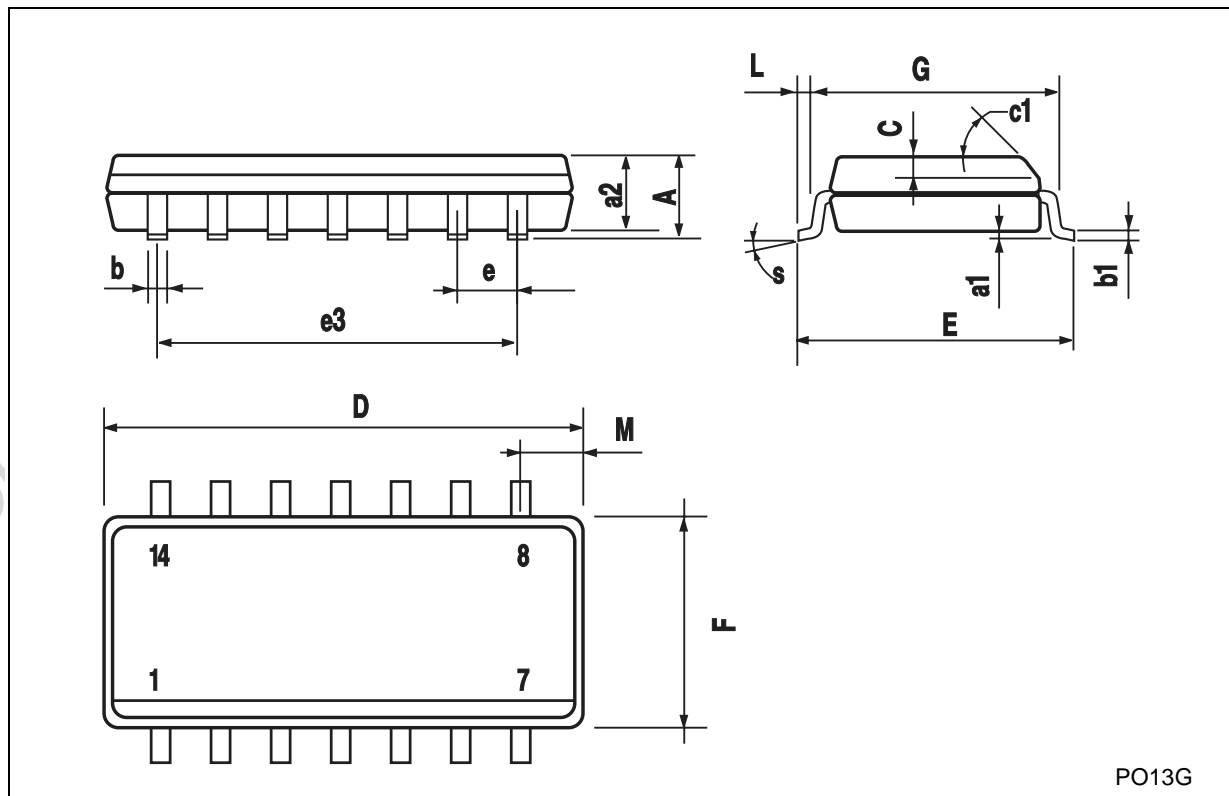
| DIM. | mm. | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 15.24 | | | 0.600 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 5.1 | | | 0.201 |
| L | | 3.3 | | | 0.130 | |
| Z | 1.27 | | 2.54 | 0.050 | | 0.100 |



P001A

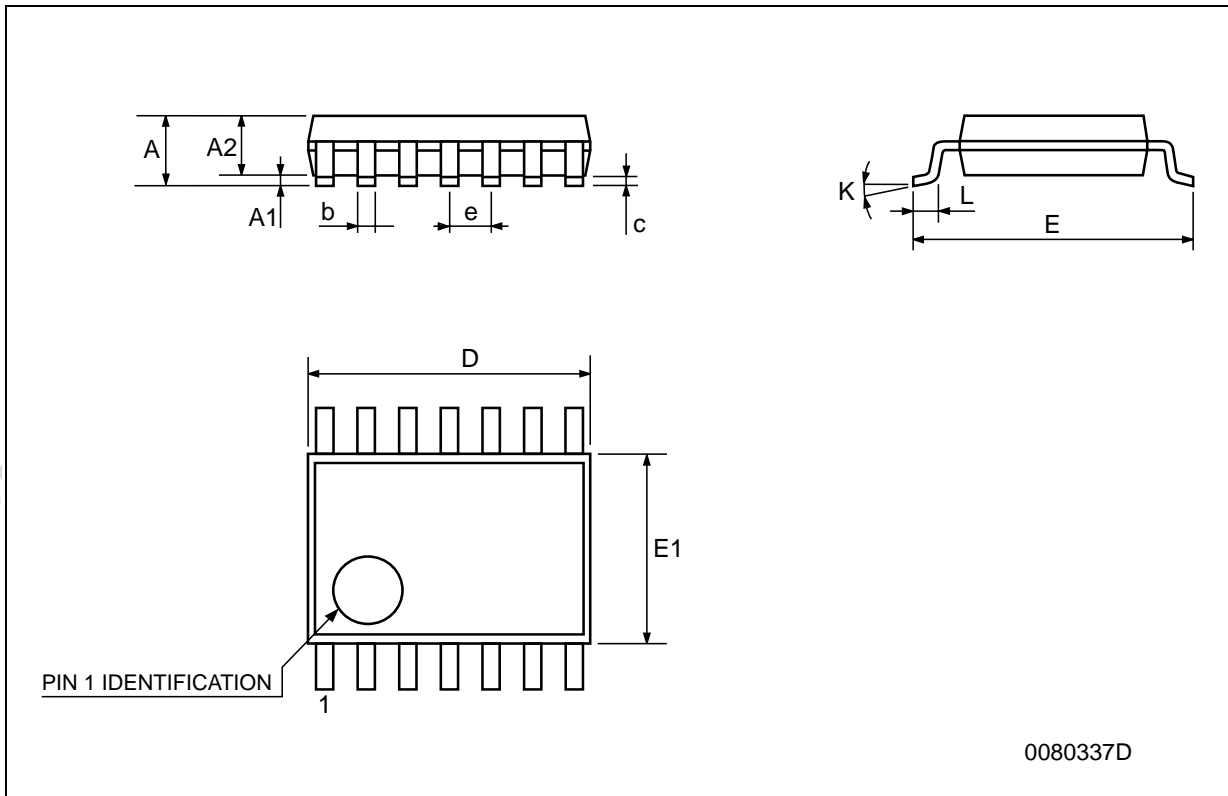
SO-14 MECHANICAL DATA

| 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 | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| 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 | | | 0.68 | | | 0.026 |
| S | 8° (max.) | | | | | |



TSSOP14 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 | | 0.0089 |
| 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 |



Obsolete Product(s) - Obsolete Product(s)

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