



**THE DATASHEET OF
M74HC05RM13TR**

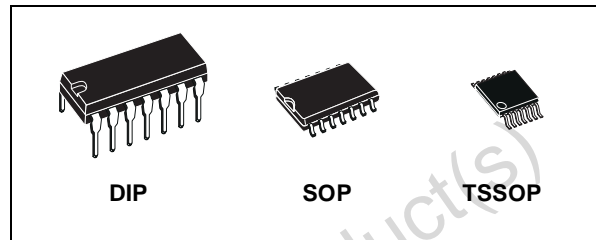




M74HC05

HEX INVERTER (OPEN DRAIN)

- HIGH SPEED:
 $t_{PD} = 10\text{ns}$ (TYP.) at $V_{CC} = 6\text{V}$
- LOW POWER DISSIPATION:
 $I_{CC} = 1\mu\text{A}$ (MAX.) at $T_A=25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (MIN.)
- WIDE OPERATING VOLTAGE RANGE:
 V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 05



ORDER CODES

| PACKAGE | TUBE | T & R |
|---------|------------|---------------|
| DIP | M74HC05B1R | |
| SOP | M74HC05M1R | M74HC05RM13TR |
| TSSOP | | M74HC05TTR |

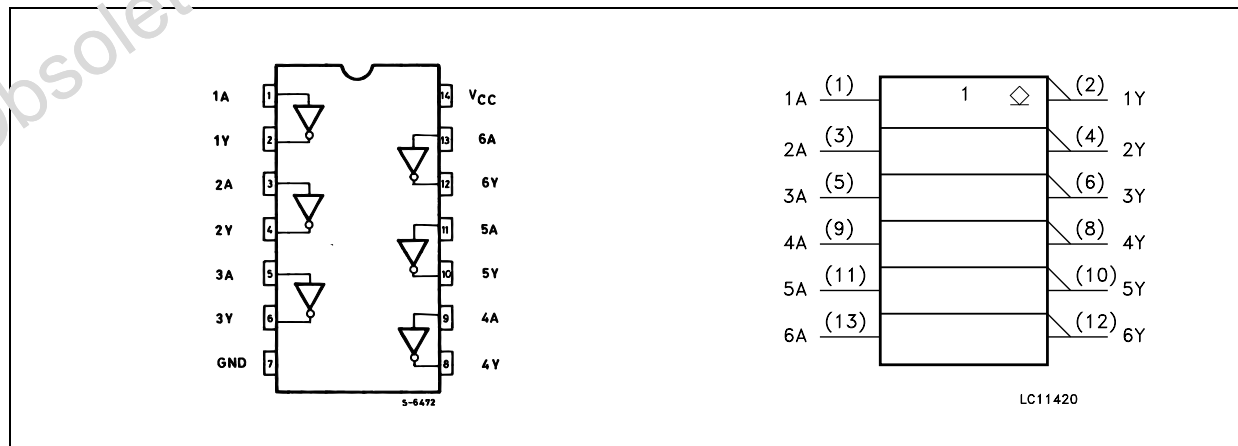
DESCRIPTION

The M74HC05 is an high speed CMOS HEX INVERTER (OPEN DRAIN) fabricated with silicon gate C²MOS technology.

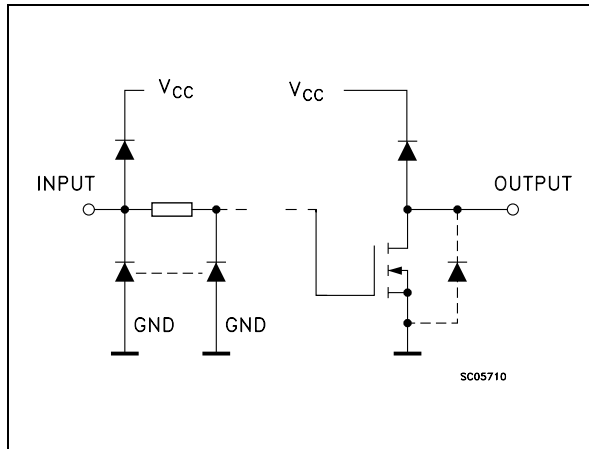
The internal circuit is composed of 3 stages including buffer output, which enables high noise immunity and stable output.

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

PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|--------------------|-----------------|-------------------------|
| 1, 3, 5, 9, 11, 13 | 1A to 6A | Data Inputs |
| 2, 4, 6, 8, 10, 12 | 1Y to 6Y | Data Outputs |
| 7 | GND | Ground (0V) |
| 14 | V _{CC} | Positive Supply Voltage |

TRUTH TABLE

| A | Y |
|---|---|
| L | Z |
| H | L |

Z : High Impedance

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-------------------------------------|--------------------------------------|-------------------------------|------|
| V _{CC} | Supply Voltage | -0.5 to +7 | V |
| V _I | DC Input Voltage | -0.5 to V _{CC} + 0.5 | V |
| V _O | DC Output Voltage | -0.5 to V _{CC} + 0.5 | V |
| I _{IK} | DC Input Diode Current | ± 20 | mA |
| I _{OK} | DC Output Diode Current | ± 20 | mA |
| I _O | DC Output 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

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit | |
|---------------------------------|--------------------------|------------------------|-----------|----|
| V _{CC} | Supply Voltage | 2 to 6 | V | |
| V _I | Input Voltage | 0 to V _{CC} | V | |
| V _O | Output 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 | ns |
| | | V _{CC} = 6.0V | 0 to 400 | ns |

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 _{IH} | 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 _{IL} | 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 | |
| V _{OL} | Low Level Output Voltage | 2.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | I _O =20 μA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | I _O =4.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| | | 6.0 | I _O =5.2 mA | | 0.18 | 0.26 | | 0.33 | | 0.40 | |
| I _I | Input Leakage Current | 6.0 | V _I = V _{CC} or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I _{OZ} | Output Leakage Current | 6.0 | V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND | | | ± 0.5 | | ± 5 | | ± 10 | μA |
| I _{CC} | Quiescent Supply Current | 6.0 | V _I = V _{CC} or GND | | | 1 | | 10 | | 20 | μA |

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input t_r = t_f = 6ns)

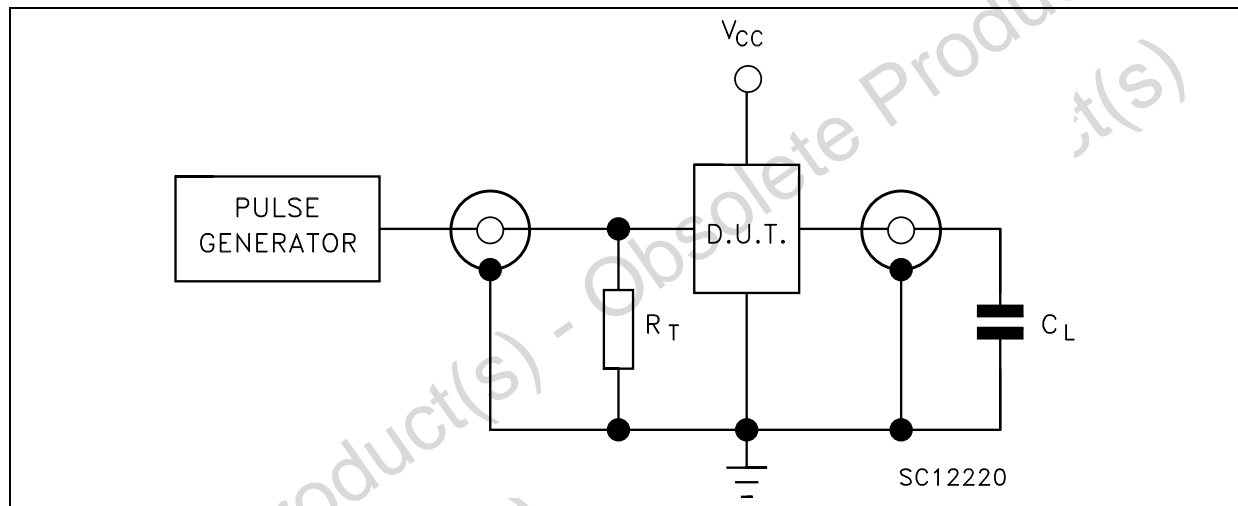
| Symbol | Parameter | Test Condition | | Value | | | | | | Unit | |
|------------------|------------------------|------------------------|-----------------------|-----------------------|------|------|-------------|------|--------------|------|------|
| | | V _{CC} (V) | | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t _{THL} | Output Transition Time | 2.0 | | | 30 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 8 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 7 | 13 | | 16 | | 19 | |
| t _{PLZ} | Propagation Delay Time | 2.0 | R _L = 1 KΩ | | 20 | 90 | | 115 | | 135 | ns |
| | | 4.5 | | | 11 | 18 | | 23 | | 27 | |
| | | 6.0 | | | 10 | 15 | | 20 | | 23 | |
| t _{PZL} | Propagation Delay Time | 2.0 | R _L = 1 KΩ | | 33 | 90 | | 115 | | 135 | ns |
| | | 4.5 | | | 9 | 18 | | 23 | | 27 | |
| | | 6.0 | | | 8 | 15 | | 20 | | 23 | |

CAPACITIVE CHARACTERISTICS

| 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. |
| C _{IN} | Input Capacitance | 5.0 | | | 5 | 10 | | 10 | | 10 | pF |
| C _{OUT} | Output Capacitance | 5.0 | | | 10 | | | | | | pF |
| C _{PD} | Power Dissipation Capacitance (note 1) | 5.0 | | | 6.5 | | | | | | pF |

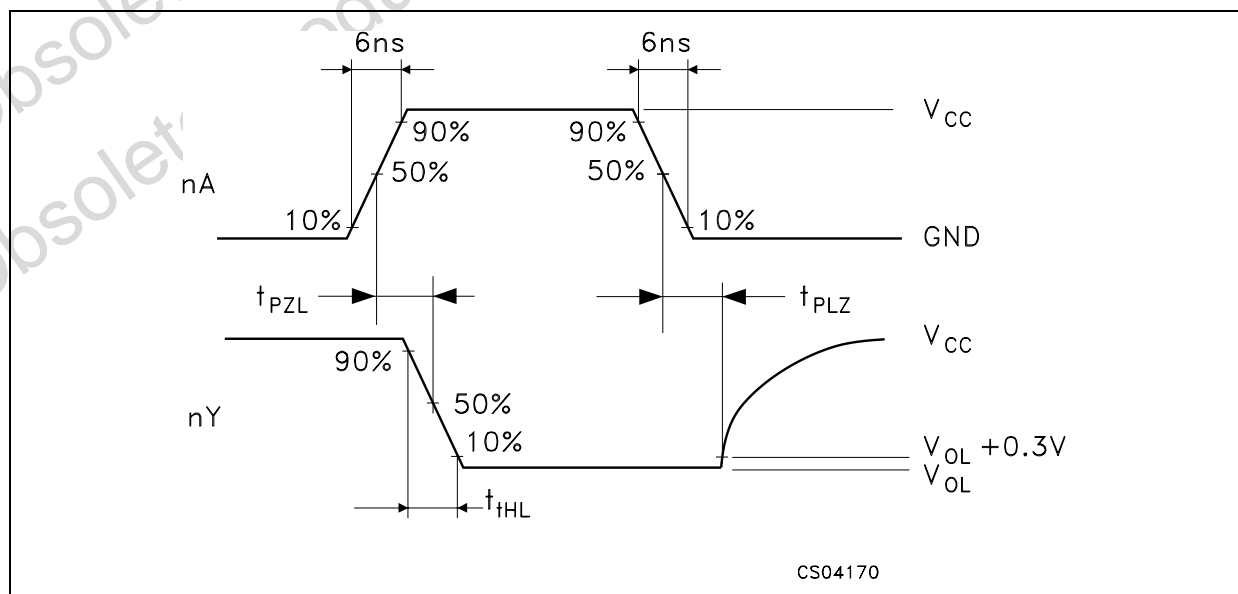
1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. I_{CC(opr)} = C_{PD} × V_{CC} × f_{IN} + I_{CC}/6 (per gate)

TEST CIRCUIT



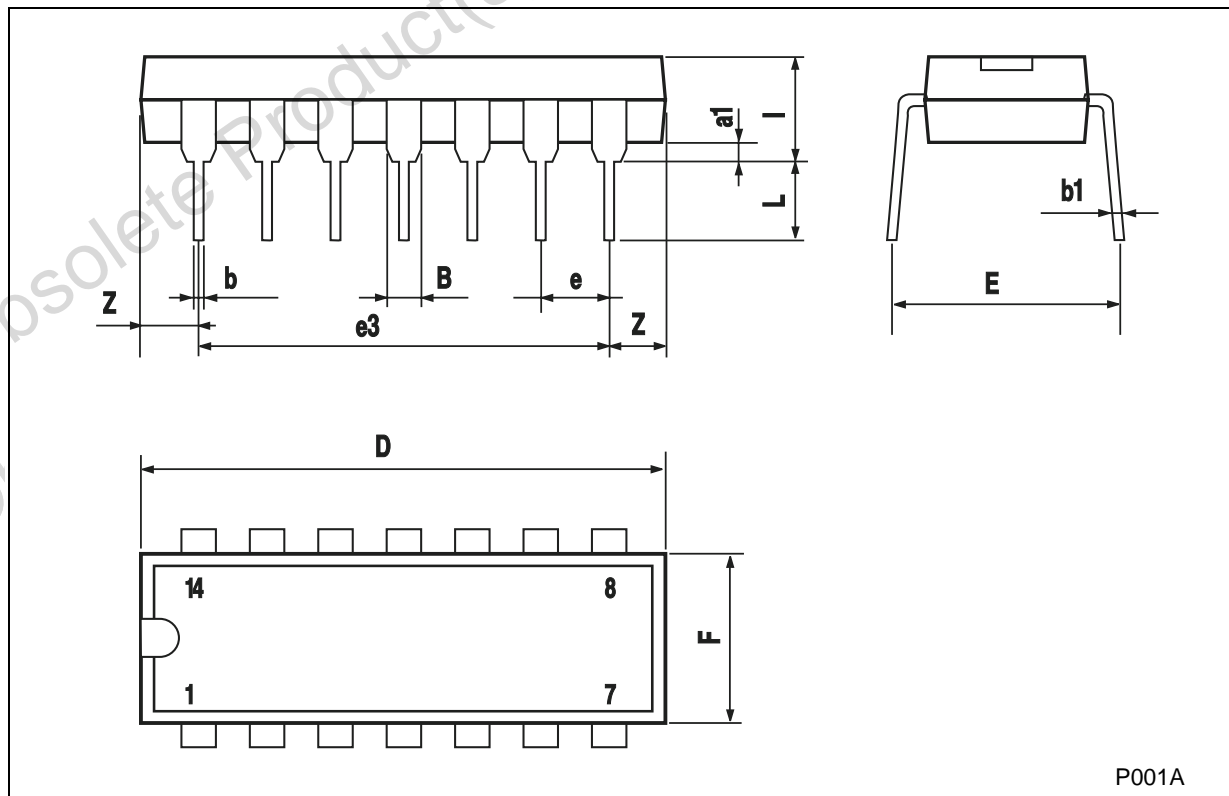
C_L = 50pF or equivalent (includes jig and probe capacitance)
 R_T = Z_{OUT} of pulse generator (typically 50Ω)

WAVEFORM : PROPAGATION DELAY TIMES (f=1MHz; 50% duty cycle)



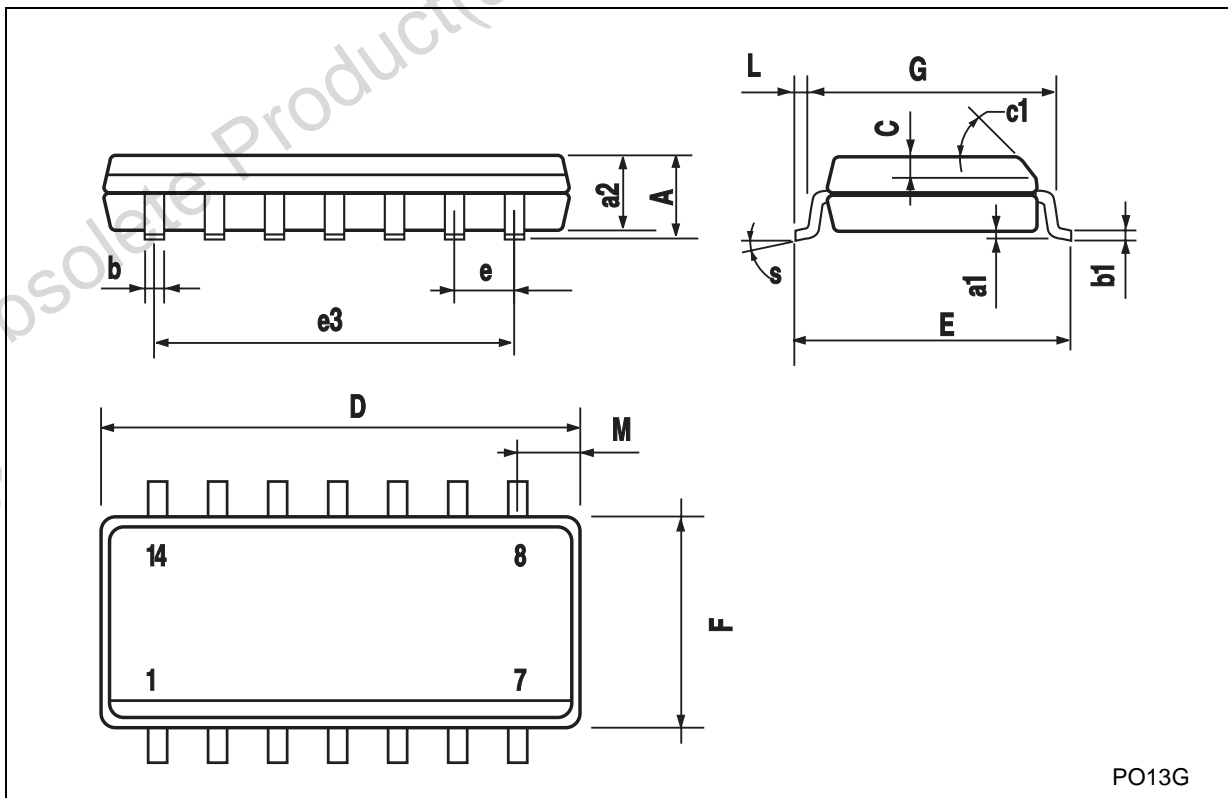
| | | | | | | |
|---------------------------------------|--|--|--|--|--|--|
| Plastic DIP-14 MECHANICAL DATA | | | | | | |
|---------------------------------------|--|--|--|--|--|--|

| 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 |



SO-14 MECHANICAL DATA

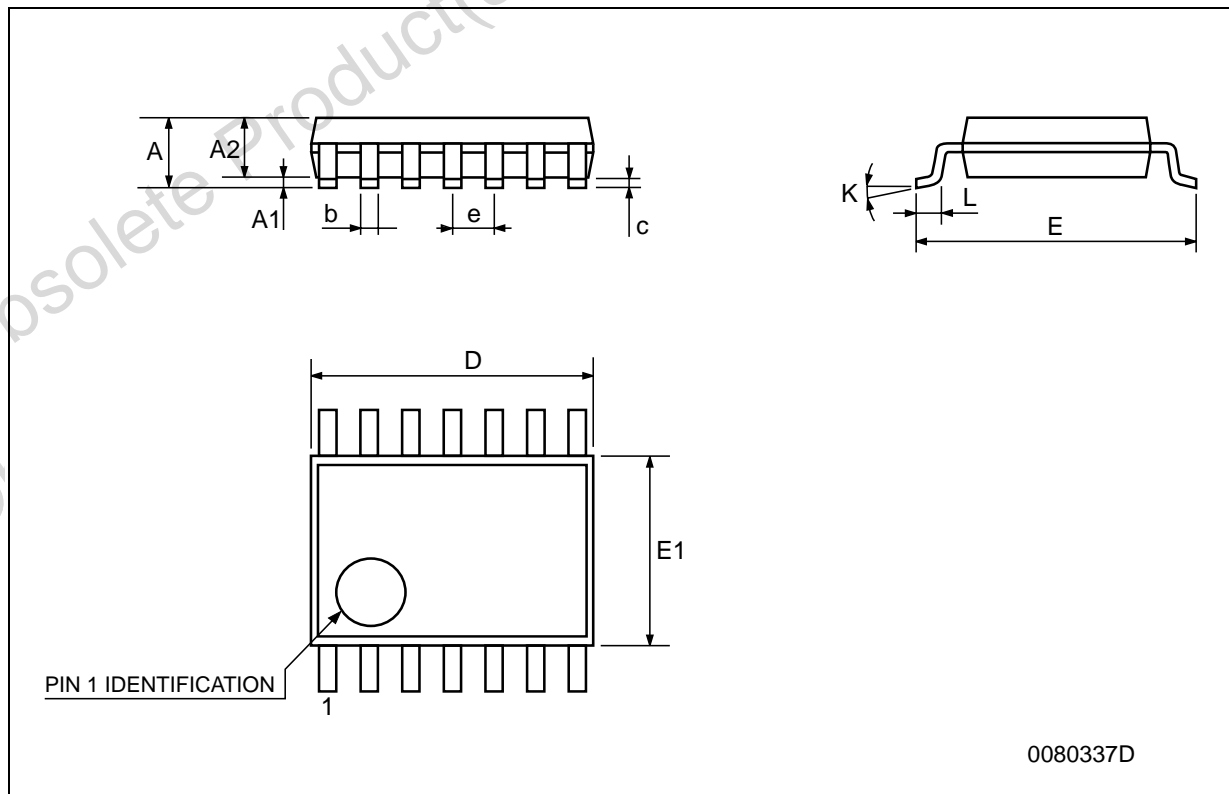
| DIM. | mm. | | | inch | | |
|------|------------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.75 | | | 0.068 |
| a1 | 0.1 | | 0.2 | 0.003 | | 0.007 |
| a2 | | | 1.65 | | | 0.064 |
| b | 0.35 | | 0.46 | 0.013 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 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.) | | | | | |



PO13G

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 |



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