



# 74VHCT245A

## OCTAL BUS TRANSCEIVER (3-STATE)

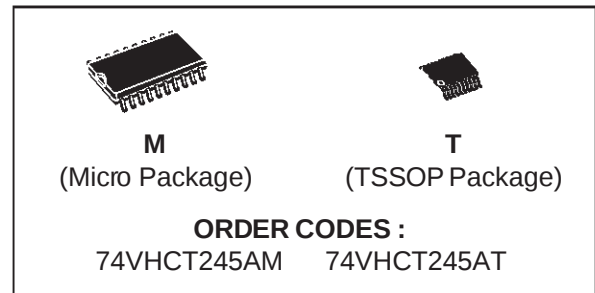
PRELIMINARY DATA

- HIGH SPEED:  $t_{PD} = 4.5 \text{ ns}$  (TYP.) at  $V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- COMPATIBLE WITH TTL OUTPUTS:  
 $V_{IH} = 2 \text{ V}$  (MIN),  $V_{IL} = 0.8 \text{ V}$  (MAX)
- POWER DOWN PROTECTION ON INPUTS & OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 8 \text{ mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \equiv t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 4.5V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 245
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE:  $V_{OLP} = 0.9 \text{ V}$  (Max.)

### DESCRIPTION

The 74VHCT245A is an advanced high-speed CMOS OCTAL BUS TRANSCEIVER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring  $C^2\text{MOS}$  technology.

This IC is intended for two-way asynchronous communication between data busses; the direction of data transmission is determined by the

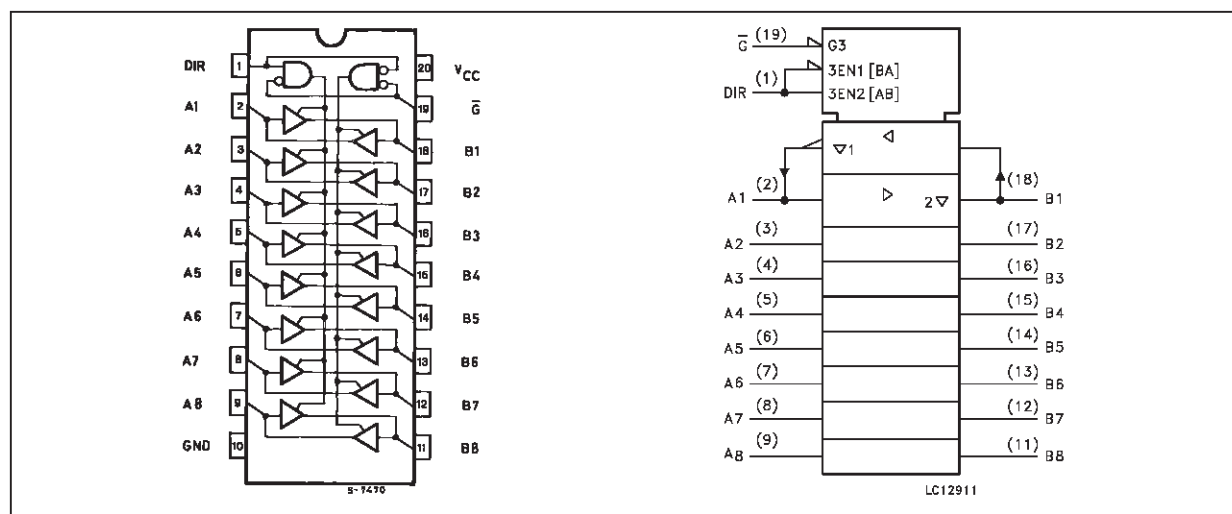


level of the DIR input. The enable input  $\overline{G}$  can be used to disable the device so that the busses are effectively isolated.

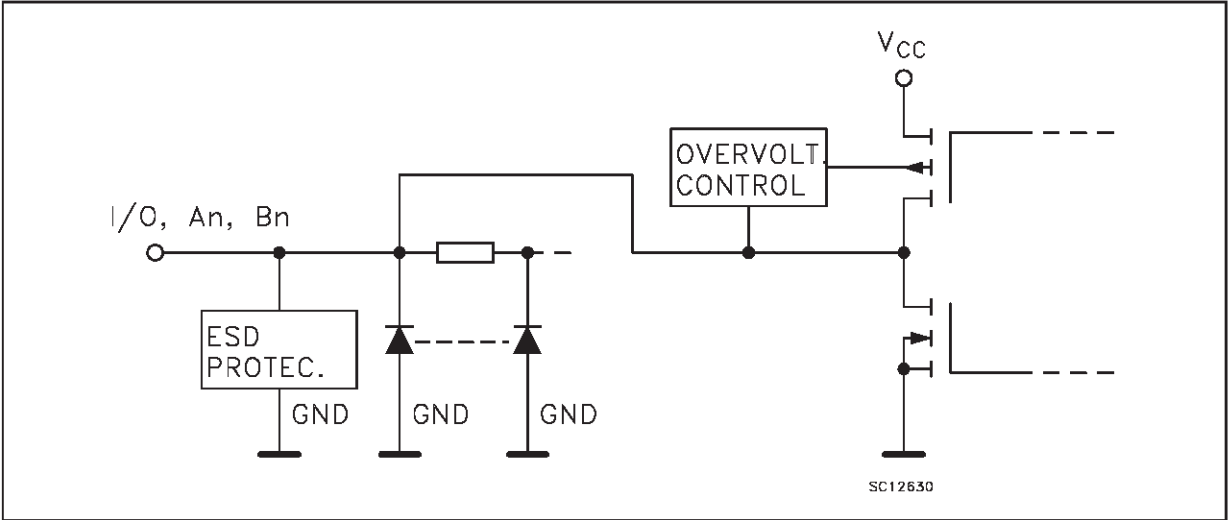
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

IT IS PROHIBITED TO APPLY A SIGNAL TO A TERMINAL WHEN IT IS IN OUTPUT MODE AND WHEN A BUS TERMINAL IS FLOATING (HIGH IMPEDANCE STATE) IT IS REQUESTED TO FIX THE INPUT LEVEL BY MEANS OF EXTERNAL PULL DOWN OR PULL UP RESISTOR.

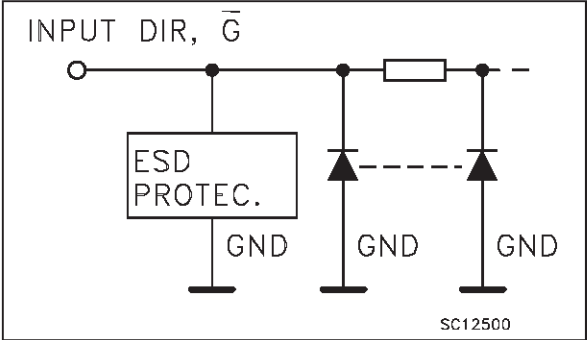
### PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT/OUTPUT EQUIVALENT CIRCUIT



INPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No                         | SYMBOL   | NAME AND FUNCTION       |
|--------------------------------|----------|-------------------------|
| 1                              | DIR      | Directional Control     |
| 2, 3, 4, 5, 6, 7, 8, 9         | A1 to A8 | Data Inputs/Outputs     |
| 18, 17, 16, 15, 14, 13, 12, 11 | B1 to B8 | Data Inputs/Outputs     |
| 19                             | G-bar    | Output Enable Input     |
| 10                             | GND      | Ground (0V)             |
| 20                             | VCC      | Positive Supply Voltage |

TRUTH TABLE

| INPUT |     | FUNCTION |        | OUTPUT |
|-------|-----|----------|--------|--------|
| G-bar | DIR | A BUS    | B BUS  |        |
| L     | L   | OUTPUT   | INPUT  | A = B  |
| L     | H   | INPUT    | OUTPUT | B = A  |
| H     | X   | Z        | Z      | Z      |

X: "H" or "L"  
Z: High impedance

**ABSOLUTE MAXIMUM RATINGS**

| Symbol                | Parameter                               | Value                  | Unit               |
|-----------------------|-----------------------------------------|------------------------|--------------------|
| $V_{CC}$              | Supply Voltage                          | -0.5 to +7.0           | V                  |
| $V_I$                 | DC Input Voltage (DIR, $\overline{G}$ ) | -0.5 to +7.0           | V                  |
| $V_{I/O}$             | DC Bus I/O Voltage (see note 1)         | -0.5 to +7.0           | V                  |
| $V_{I/O}$             | DC Bus I/O Voltage (see note 2)         | -0.5 to $V_{CC} + 0.5$ | V                  |
| $I_{IK}$              | DC Input Diode Current                  | - 20                   | mA                 |
| $I_{OK}$              | DC Output Diode Current                 | $\pm 20$               | mA                 |
| $I_O$                 | DC Output Current                       | $\pm 25$               | mA                 |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current           | $\pm 75$               | mA                 |
| $T_{stg}$             | Storage Temperature                     | -65 to +150            | $^{\circ}\text{C}$ |
| $T_L$                 | Lead Temperature (10 sec)               | 300                    | $^{\circ}\text{C}$ |

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

1) Output in Off State

2) High or Low State.  $I_O$  absolute maximum rating must be observed.

**RECOMMENDED OPERATING CONDITIONS**

| Symbol    | Parameter                                                                | Value         | Unit               |
|-----------|--------------------------------------------------------------------------|---------------|--------------------|
| $V_{CC}$  | Supply Voltage                                                           | 4.5 to 5.5    | V                  |
| $V_I$     | Input Voltage (DIR, $\overline{G}$ )                                     | 0 to 5.5      | V                  |
| $V_{I/O}$ | Bus I/O Voltage (see note 1)                                             | 0 to 5.5      | V                  |
| $V_{I/O}$ | Bus I/O Voltage (see note 2)                                             | 0 to $V_{CC}$ | V                  |
| $T_{op}$  | Operating Temperature                                                    | -40 to +85    | $^{\circ}\text{C}$ |
| dt/dv     | Input Rise and Fall Time (see note 3) ( $V_{CC} = 5.0 \pm 0.5\text{V}$ ) | 0 to 20       | ns/V               |

1) Output in Off State

2) High or Low State.  $I_O$  absolute maximum rating must be observed.

3)  $V_{IN}$  from 0.8 to 2V

## DC SPECIFICATIONS

| Symbol           | Parameter                             | Test Conditions        |                                                                                    | Value                  |      |       |              |      | Unit |
|------------------|---------------------------------------|------------------------|------------------------------------------------------------------------------------|------------------------|------|-------|--------------|------|------|
|                  |                                       | V <sub>CC</sub><br>(V) |                                                                                    | T <sub>A</sub> = 25 °C |      |       | -40 to 85 °C |      |      |
|                  |                                       |                        |                                                                                    | Min.                   | Typ. | Max.  | Min.         | Max. |      |
| V <sub>IH</sub>  | High Level Input Voltage              | 4.5 to 5.5             |                                                                                    | 2                      |      |       | 2            |      | V    |
| V <sub>IL</sub>  | Low Level Input Voltage               | 4.5 to 5.5             |                                                                                    |                        |      | 0.8   |              | 0.8  | V    |
| V <sub>OH</sub>  | High Level Output Voltage             | 4.5                    | I <sub>O</sub> =-50 μA                                                             | 4.4                    | 4.5  |       | 4.4          |      | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =-8 mA                                                              | 3.94                   |      |       | 3.8          |      |      |
| V <sub>OL</sub>  | Low Level Output Voltage              | 4.5                    | I <sub>O</sub> =50 μA                                                              |                        | 0.0  | 0.1   |              | 0.1  | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =8 mA                                                               |                        |      | 0.36  |              | 0.44 |      |
| I <sub>OZ</sub>  | High Impedance Output Leakage Current | 5.5                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = 0V to 5.5V |                        |      | ±0.25 |              | ±2.5 | μA   |
| I <sub>I</sub>   | Input Leakage Current                 | 0 to 5.5               | V <sub>I</sub> = 5.5V or GND                                                       |                        |      | ±0.1  |              | ±1.0 | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current              | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                            |                        |      | 4     |              | 40   | μA   |
| ΔI <sub>CC</sub> | Additional Worst Case Supply Current  | 5.5                    | One Input at 3.4V,<br>other input at V <sub>CC</sub> or GND                        |                        |      | 1.35  |              | 1.5  | mA   |
| I <sub>OPD</sub> | Output Leakage Current                | 0                      | V <sub>OUT</sub> = 5.5V                                                            |                        |      | 0.5   |              | 5.0  | μA   |

AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3 ns)

| Symbol                                 | Parameter                           | Test Condition             |                     |                      | Value                  |      |      |              |      | Unit |
|----------------------------------------|-------------------------------------|----------------------------|---------------------|----------------------|------------------------|------|------|--------------|------|------|
|                                        |                                     | V <sub>CC</sub> (*)<br>(V) | C <sub>L</sub> (pF) |                      | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                                        |                                     |                            |                     |                      | Min.                   | Typ. | Max. | Min.         | Max. |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time              | 5.0                        | 15                  |                      |                        | 4.5  | 7.5  | 1.0          | 8.5  | ns   |
|                                        |                                     | 5.0                        | 50                  |                      |                        | 5.5  | 8.5  | 1.0          | 9.5  |      |
| t <sub>PZL</sub><br>t <sub>PZH</sub>   | Output Enable Time                  | 5.0                        | 15                  | R <sub>L</sub> = 1KΩ |                        | 9.0  | 14.5 | 1.0          | 15.5 | ns   |
|                                        |                                     | 5.0                        | 50                  |                      |                        | 10.0 | 15.5 | 1.0          | 16.5 |      |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub>   | Output Disable Time                 | 5.0                        | 50                  | R <sub>L</sub> = 1KΩ |                        | 9.5  | 15.0 | 1.0          | 16.0 | ns   |
| t <sub>OSLH</sub><br>t <sub>OSHL</sub> | Output to Output Skew Time (note 1) | 5.0                        | 50                  |                      |                        |      | 1.0  |              | 1.0  | ns   |

(\*) Voltage range is 5V ± 0.5V

Note 1: Parameter guaranteed by design. t<sub>SOZH</sub> = |t<sub>PLHm</sub> - t<sub>PLHl</sub>|, t<sub>SOHL</sub> = |t<sub>PHLm</sub> - t<sub>PHLl</sub>|

## CAPACITIVE CHARACTERISTICS

| Symbol           | Parameter                              | Test Conditions | Value                  |      |      |              |      | Unit |
|------------------|----------------------------------------|-----------------|------------------------|------|------|--------------|------|------|
|                  |                                        |                 | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                  |                                        |                 | Min.                   | Typ. | Max. | Min.         | Max. |      |
| C <sub>IN</sub>  | Input Capacitance                      |                 |                        | 4    | 10   |              | 10   | pF   |
| C <sub>I/O</sub> | Bus Input Capacitance                  |                 |                        | 8    |      |              |      | pF   |
| C <sub>PD</sub>  | Power Dissipation Capacitance (note 1) |                 |                        | 13   |      |              |      | pF   |

1) C<sub>PD</sub> 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CD}/8$  (per circuit)

## DYNAMIC SWITCHING CHARACTERISTICS

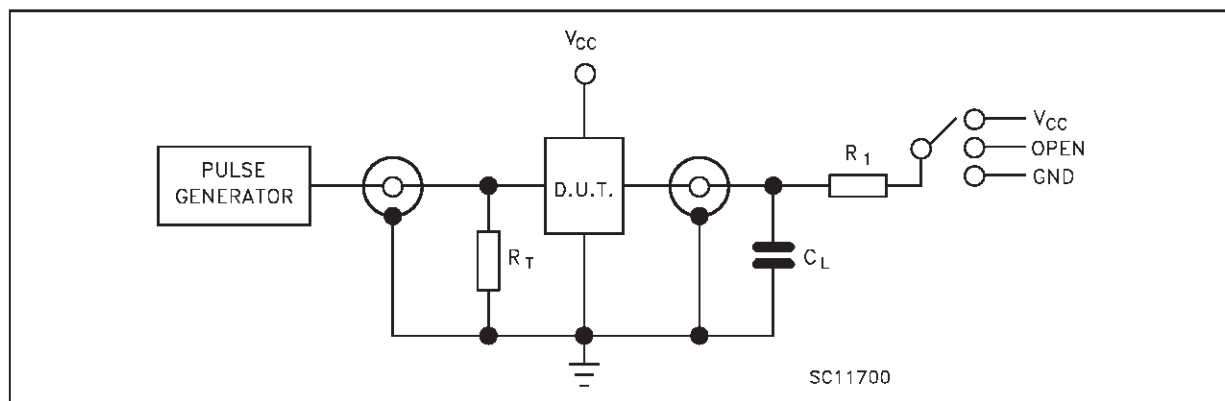
| Symbol           | Parameter                                    | Test Conditions        |                        | Value                  |      |      |              |      | Unit |
|------------------|----------------------------------------------|------------------------|------------------------|------------------------|------|------|--------------|------|------|
|                  |                                              | V <sub>CC</sub><br>(V) |                        | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                  |                                              |                        |                        | Min.                   | Typ. | Max. | Min.         | Max. |      |
| V <sub>OLP</sub> | Dynamic Low Voltage Quiet Output (note 1, 2) | 5.0                    | C <sub>L</sub> = 50 pF |                        | 0.6  | 0.9  |              |      | V    |
| V <sub>OLV</sub> |                                              |                        |                        | -0.9                   | -0.6 |      |              |      |      |
| V <sub>IHD</sub> | Dynamic High Voltage Input (note 1, 3)       | 5.0                    |                        | 2                      |      |      |              |      |      |
| V <sub>ILD</sub> | Dynamic Low Voltage Input (note 1, 3)        | 5.0                    |                        |                        |      | 0.8  |              |      |      |

1) Worst case package.

2) Max number of outputs defined as (n). Data inputs are driven 0V to 3.0V, (n-1) outputs switching and one output at GND.

3) Max number of data inputs (n) switching. (n-1) switching 0V to 3.0V. Inputs under test switching: 3.0V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f=1MHz.

## TEST CIRCUIT



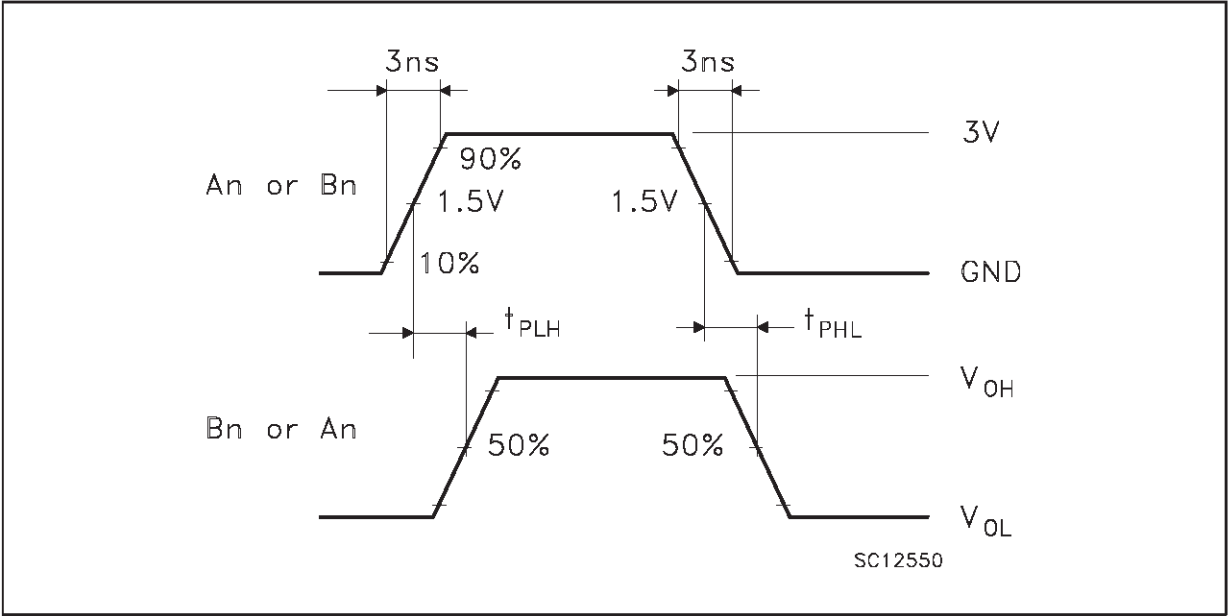
| TEST                                | SWITCH          |
|-------------------------------------|-----------------|
| t <sub>PLH</sub> , t <sub>PHL</sub> | Open            |
| t <sub>PZL</sub> , t <sub>PLZ</sub> | V <sub>CC</sub> |
| t <sub>PZH</sub> , t <sub>PHZ</sub> | GND             |

C<sub>L</sub> = 15/50 pF or equivalent (includes jig and probe capacitance)

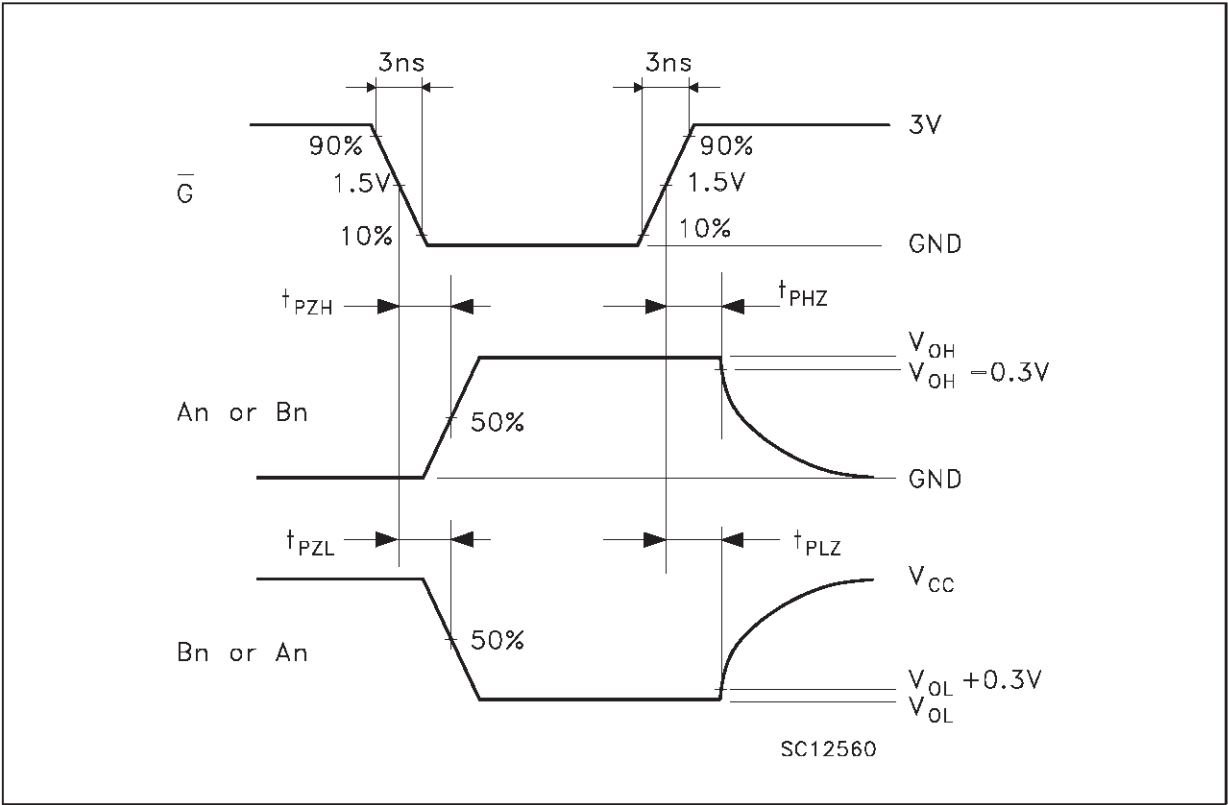
R<sub>L</sub> = R<sub>1</sub> = 1KΩ or equivalent

R<sub>T</sub> = Z<sub>out</sub> of pulse generator (typically 50Ω)

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

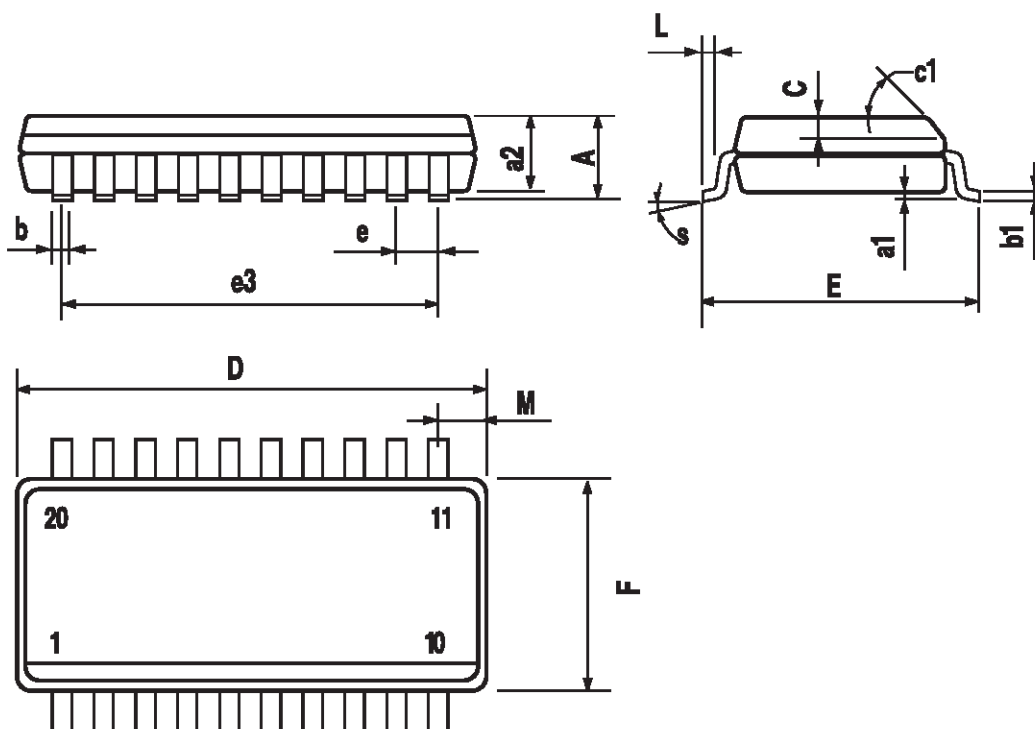


WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)



## SO-20 MECHANICAL DATA

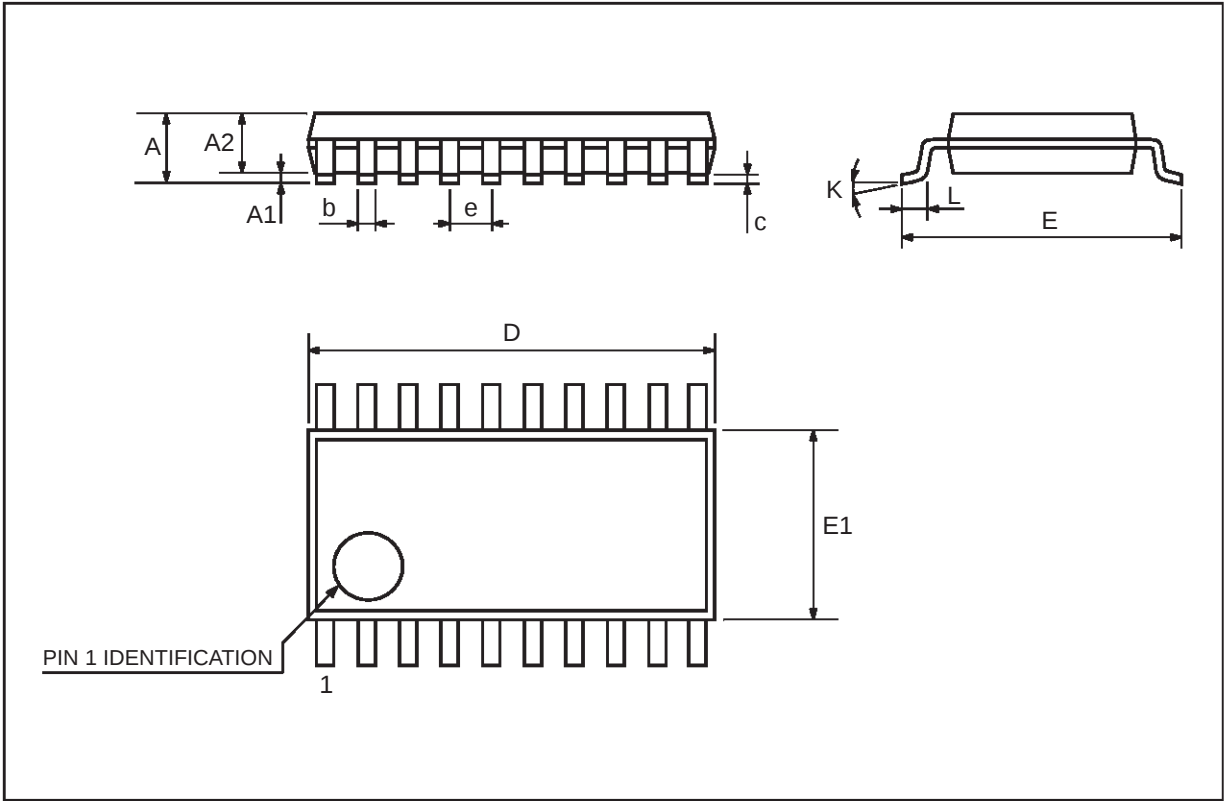
| DIM. | mm        |       |       | inch  |       |       |
|------|-----------|-------|-------|-------|-------|-------|
|      | MIN.      | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |           |       | 2.65  |       |       | 0.104 |
| a1   | 0.10      |       | 0.20  | 0.004 |       | 0.007 |
| a2   |           |       | 2.45  |       |       | 0.096 |
| b    | 0.35      |       | 0.49  | 0.013 |       | 0.019 |
| b1   | 0.23      |       | 0.32  | 0.009 |       | 0.012 |
| C    |           | 0.50  |       |       | 0.020 |       |
| c1   | 45 (typ.) |       |       |       |       |       |
| D    | 12.60     |       | 13.00 | 0.496 |       | 0.512 |
| E    | 10.00     |       | 10.65 | 0.393 |       | 0.419 |
| e    |           | 1.27  |       |       | 0.050 |       |
| e3   |           | 11.43 |       |       | 0.450 |       |
| F    | 7.40      |       | 7.60  | 0.291 |       | 0.299 |
| L    | 0.50      |       | 1.27  | 0.19  |       | 0.050 |
| M    |           |       | 0.75  |       |       | 0.029 |
| S    | 8 (max.)  |       |       |       |       |       |



P013L

TSSOP20 MECHANICAL DATA

| DIM. | mm   |          |      | inch   |            |        |
|------|------|----------|------|--------|------------|--------|
|      | MIN. | TYP.     | MAX. | MIN.   | TYP.       | MAX.   |
| A    |      |          | 1.1  |        |            | 0.433  |
| A1   | 0.05 | 0.10     | 0.15 | 0.002  | 0.004      | 0.006  |
| A2   | 0.85 | 0.9      | 0.95 | 0.335  | 0.354      | 0.374  |
| b    | 0.19 |          | 0.30 | 0.0075 |            | 0.0118 |
| c    | 0.09 |          | 0.2  | 0.0035 |            | 0.0079 |
| D    | 6.4  | 6.5      | 6.6  | 0.252  | 0.256      | 0.260  |
| E    | 6.25 | 6.4      | 6.5  | 0.246  | 0.252      | 0.256  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169  | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |        | 0.0256 BSC |        |
| K    | 0°   | 4°       | 8°   | 0°     | 4°         | 8°     |
| L    | 0.50 | 0.60     | 0.70 | 0.020  | 0.024      | 0.028  |



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