

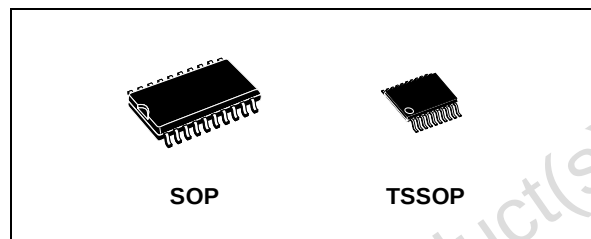
## OCTAL BUS BUFFER WITH 3 STATE OUTPUTS (INVERTED)

- HIGH SPEED:  $t_{PD} = 5.4 \text{ ns}$  (TYP.) at  $V_{CC} = 5V$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu A$  (MAX.) at  $T_A = 25^\circ C$
- COMPATIBLE WITH TTL OUTPUTS:  
 $V_{IH} = 2V$  (MIN.),  $V_{IL} = 0.8V$  (MAX)
- POWER DOWN PROTECTION ON INPUTS & OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 8 \text{ mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}(\text{OPR}) = 4.5V \text{ to } 5.5V$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 240
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE:  $V_{OLP} = 0.9V$  (MAX.)

### DESCRIPTION

The 74VHCT240A is an advanced high-speed CMOS OCTAL BUS BUFFER (3 STATE) fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

$\overline{G}$  enable input governs four BUS BUFFERS.



**Table 1: Order Codes**

| PACKAGE | T & R         |
|---------|---------------|
| SOP     | 74VHCT240AMTR |
| TSSOP   | 74VHCT240ATTR |

This device is designed to be used with 3 state memory address drivers, etc.

Power down protection is provided on all inputs and outputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage. This device can be used to interface 5V to 3V since all inputs are equipped with TTL threshold.

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

**Figure 1: Pin Connection And IEC Logic Symbols**

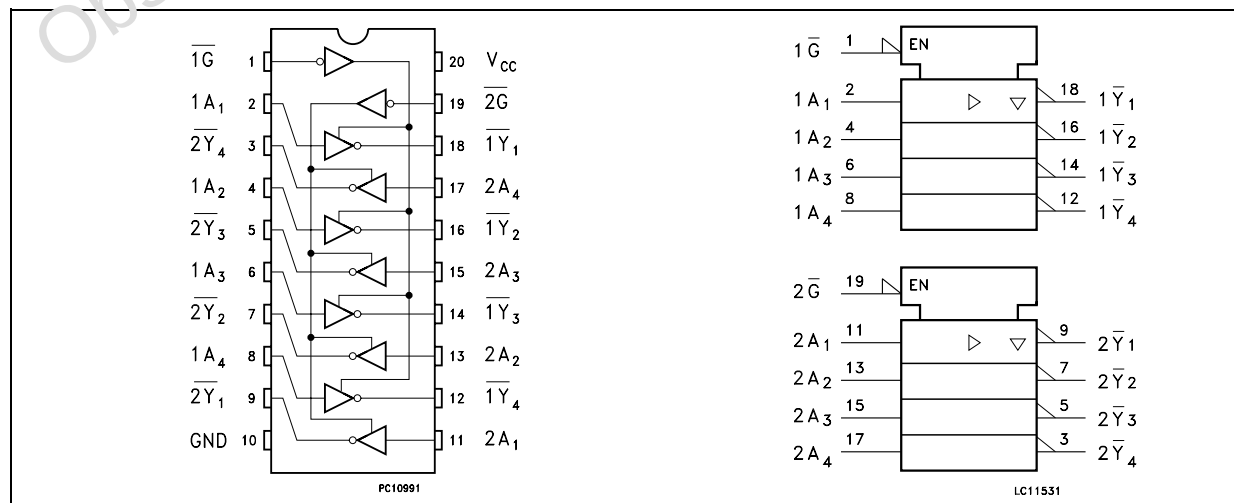


Figure 2: Input Equivalent Circuit

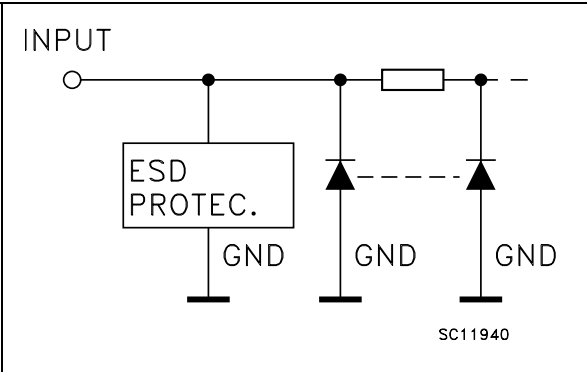


Table 2: Pin Description

| PIN N°         | SYMBOL          | NAME AND FUNCTION       |
|----------------|-----------------|-------------------------|
| 1              | $\overline{1G}$ | Output Enable Input     |
| 2, 4, 6, 8     | 1A1 to 1A4      | Data Inputs             |
| 9, 7, 5, 3     | 2Y1 to 2Y4      | Data Outputs            |
| 11, 13, 15, 17 | 2A1 to 2A4      | Data Inputs             |
| 18, 16, 14, 12 | 1Y1 to 1Y4      | Data Outputs            |
| 19             | 2G              | Output Enable Input     |
| 10             | GND             | Ground (0V)             |
| 20             | V <sub>CC</sub> | Positive Supply Voltage |

Table 3: Truth Table

| INPUTS         |                | OUTPUT           |
|----------------|----------------|------------------|
| $\overline{G}$ | A <sub>n</sub> | $\overline{Y_n}$ |
| L              | L              | H                |
| L              | H              | L                |
| H              | X              | Z                |

X: Don't Care  
Z: High Impedance

Table 4: Absolute Maximum Ratings

| Symbol                              | Parameter                            | Value                         | Unit |
|-------------------------------------|--------------------------------------|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage                       | -0.5 to +7.0                  | V    |
| V <sub>I</sub>                      | DC Input Voltage                     | -0.5 to +7.0                  | V    |
| V <sub>O</sub>                      | DC Output Voltage (see note 1)       | -0.5 to +7.0                  | V    |
| V <sub>O</sub>                      | DC Output Voltage (see note 2)       | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>                     | DC Input Diode Current               | - 20                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current              | ± 20                          | mA   |
| I <sub>O</sub>                      | DC Output Current                    | ± 25                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current | ± 50                          | mA   |
| T <sub>stg</sub>                    | Storage Temperature                  | -65 to +150                   | °C   |
| T <sub>L</sub>                      | 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  
1) Output in OFF State  
2) High or Low State

Table 5: Recommended Operating Conditions

| Symbol   | Parameter                                                         | Value         | Unit |
|----------|-------------------------------------------------------------------|---------------|------|
| $V_{CC}$ | Supply Voltage                                                    | 4.5 to 5.5    | V    |
| $V_I$    | Input Voltage                                                     | 0 to 5.5      | V    |
| $V_O$    | Output Voltage (see note 1)                                       | 0 to 5.5      | V    |
| $V_O$    | Output Voltage (see note 2)                                       | 0 to $V_{CC}$ | V    |
| $T_{op}$ | Operating Temperature                                             | -55 to 125    | °C   |
| dt/dv    | Input Rise and Fall Time (see note 3) ( $V_{CC} = 5.0 \pm 0.5V$ ) | 0 to 20       | ns/V |

1) Output in OFF State

2) High or Low State

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

Table 6: DC Specifications

| Symbol           | Parameter                             | Test Condition         |                                                                                    | Value                 |      |       |             |       |              | Unit  |      |
|------------------|---------------------------------------|------------------------|------------------------------------------------------------------------------------|-----------------------|------|-------|-------------|-------|--------------|-------|------|
|                  |                                       | V <sub>CC</sub><br>(V) |                                                                                    | T <sub>A</sub> = 25°C |      |       | -40 to 85°C |       | -55 to 125°C |       |      |
|                  |                                       |                        |                                                                                    | Min.                  | Typ. | Max.  | Min.        | Max.  | Min.         |       | Max. |
| V <sub>IH</sub>  | High Level Input Voltage              | 4.5 to 5.5             |                                                                                    | 2                     |      |       | 2           |       | 2            |       | V    |
| V <sub>IL</sub>  | Low Level Input Voltage               | 4.5 to 5.5             |                                                                                    |                       |      | 0.8   |             | 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         |       | 4.4          |       | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =-8 mA                                                              | 3.9                   |      |       | 3.8         |       | 3.7          |       |      |
| V <sub>OL</sub>  | Low Level Output Voltage              | 4.5                    | I <sub>O</sub> =50 μA                                                              |                       | 0.0  | 0.1   |             | 0.1   |              | 0.1   | V    |
|                  |                                       | 4.5                    | I <sub>O</sub> =8 mA                                                               |                       |      | 0.36  |             | 0.44  |              | 0.55  |      |
| I <sub>OZ</sub>  | High Impedance Output Leakage Current | 4.5 to 5.5             | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>C</sub> = 0V to 5.5V |                       |      | ±0.25 |             | ± 2.5 |              | ± 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 |              | ± 1.0 | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current              | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                            |                       |      | 4     |             | 40    |              | 40    | μA   |
| +I <sub>CC</sub> | Additional Worst Case Supply Current  | 5.5                    | One Input at 3.4V, other input at V <sub>CC</sub> or GND                           |                       |      | 1.35  |             | 1.5   |              | 1.5   | mA   |
| I <sub>OPP</sub> | Output Leakage Current                | 0                      | V <sub>OUT</sub> = 5.5V                                                            |                       |      | 0.5   |             | 5.0   |              | 5.0   | μA   |

Table 7: AC Electrical Characteristics (Input  $t_r = t_f = 3ns$ )

| Symbol                               | Parameter              | Test Condition                        |                        |          | Value                 |      |      |             |      |              | Unit |      |
|--------------------------------------|------------------------|---------------------------------------|------------------------|----------|-----------------------|------|------|-------------|------|--------------|------|------|
|                                      |                        | V <sub>CC</sub> <sup>(*)</sup><br>(V) | C <sub>L</sub><br>(pF) |          | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                      |                        |                                       |                        |          | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time | 5.0                                   | 15                     |          |                       | 5.4  | 7.4  | 1.0         | 8.5  | 1.0          | 8.5  | ns   |
|                                      |                        | 5.0                                   | 50                     |          |                       | 5.9  | 8.4  | 1.0         | 9.5  | 1.0          | 9.5  |      |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable Time    | 5.0                                   | 15                     | RL = 1KΩ |                       | 8.3  | 10.4 | 1.0         | 12.0 | 1.0          | 12.0 | ns   |
|                                      |                        | 5.0                                   | 50                     |          |                       | 8.8  | 11.4 | 1.0         | 13.0 | 1.0          | 13.0 |      |
| t <sub>PZL</sub><br>t <sub>PZH</sub> | Output Enable Time     | 5.0                                   | 50                     | RL = 1KΩ |                       | 8.2  | 11.4 | 1.0         | 13.0 | 1.0          | 13.0 | ns   |

(\*) Voltage range is  $5.0V \pm 0.5V$

Table 8: Capacitive Characteristics

| Symbol           | Parameter                              | Test Condition | Value                 |      |      |             |      |              |    |    | Unit |
|------------------|----------------------------------------|----------------|-----------------------|------|------|-------------|------|--------------|----|----|------|
|                  |                                        |                | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |    |    |      |
|                  |                                        | Min.           | Typ.                  | Max. | Min. | Max.        | Min. | Max.         |    |    |      |
| C <sub>IN</sub>  | Input Capacitance                      |                |                       | 6    | 10   |             | 10   |              | 10 | pF |      |
| C <sub>OUT</sub> | Output Capacitance                     |                |                       | 9    |      |             |      |              |    | pF |      |
| C <sub>PD</sub>  | Power Dissipation Capacitance (note 1) |                |                       | 19   |      |             |      |              |    | 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.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$  (pF or Circuit)

Table 9: Dynamic Switching Characteristics

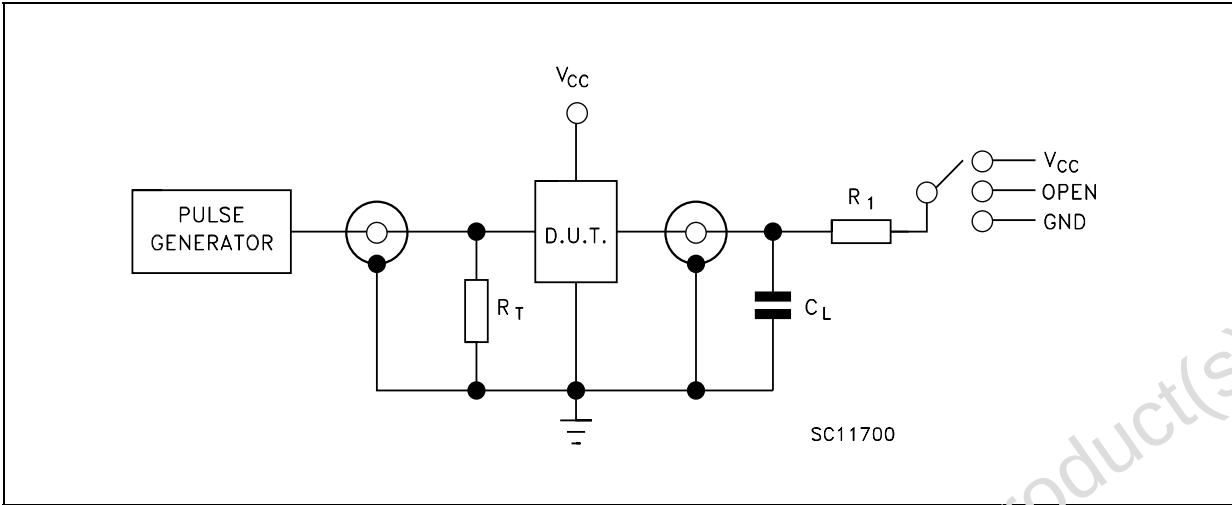
| Symbol           | Parameter                                    | Test Condition         |                        | Value                 |      |      |              |      |              | Unit |      |
|------------------|----------------------------------------------|------------------------|------------------------|-----------------------|------|------|--------------|------|--------------|------|------|
|                  |                                              | V <sub>CC</sub><br>(V) |                        | T <sub>A</sub> = 25°C |      |      | -40 to 85 °C |      | -55 to 125°C |      |      |
|                  |                                              |                        |                        | Min.                  | Typ. | Max. | Min.         | Max. | Min.         |      | Max. |
| V <sub>OLP</sub> | Dynamic Low Voltage Quiet Output (note 1, 2) | 5.0                    | C <sub>L</sub> = 50 pF |                       | 0.9  | 1.1  |              |      |              |      | V    |
| V <sub>OLV</sub> |                                              |                        |                        | 1.1                   | 0.9  |      |              |      |              |      |      |
| V <sub>IHD</sub> | Dynamic High Voltage Input (note 1, 3)       | 5.0                    |                        | 2.0                   |      |      |              |      |              |      |      |
| 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.

Figure 3: Test Circuit



| TEST               | SWITCH   |
|--------------------|----------|
| $t_{PLH}, t_{PHL}$ | Open     |
| $t_{PZL}, t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}, t_{PHZ}$ | GND      |

$C_L = 15/50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = R_1 = 1\text{K}\Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

Figure 4: Waveform - Propagation Delays ( $f=1\text{MHz}$ ; 50% duty cycle)

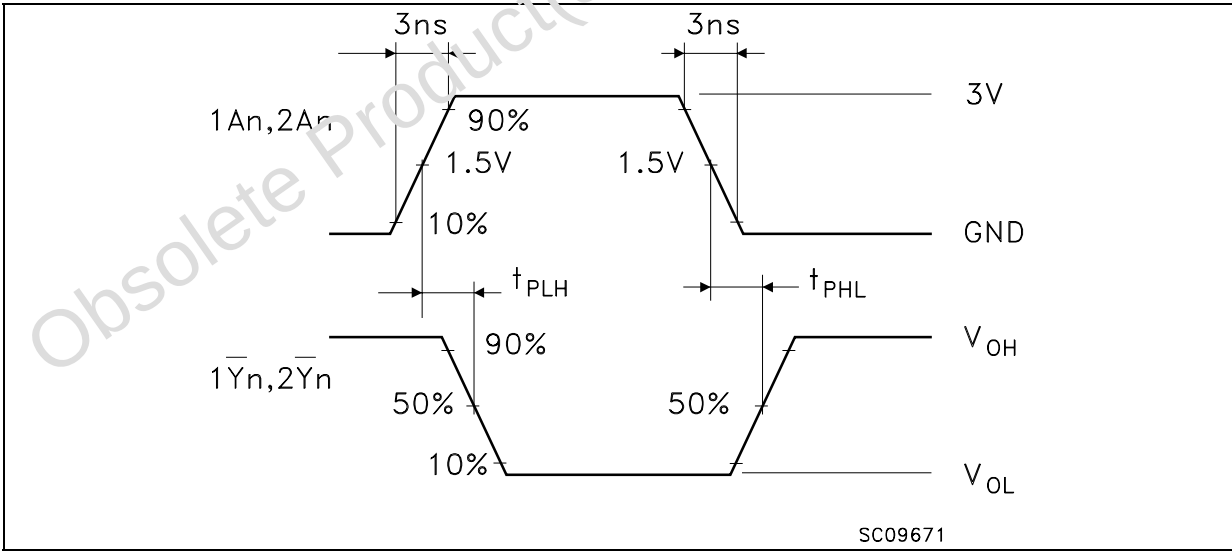
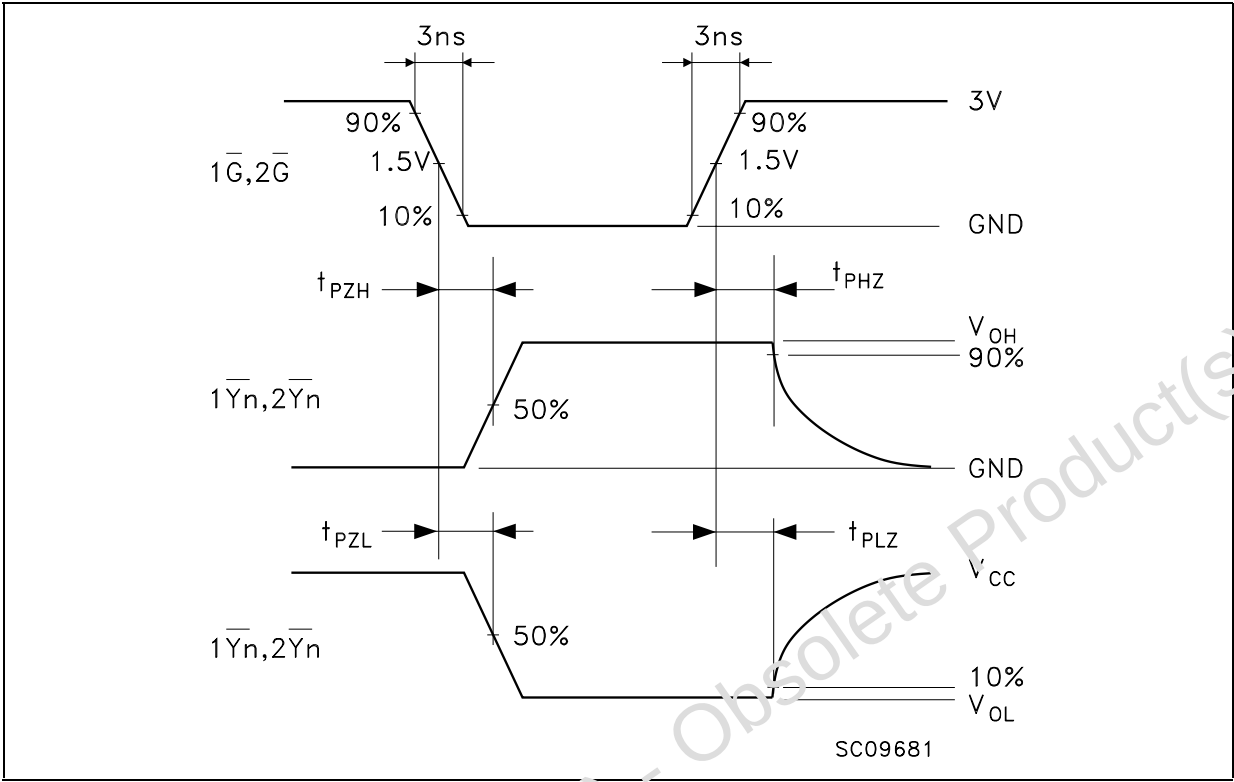
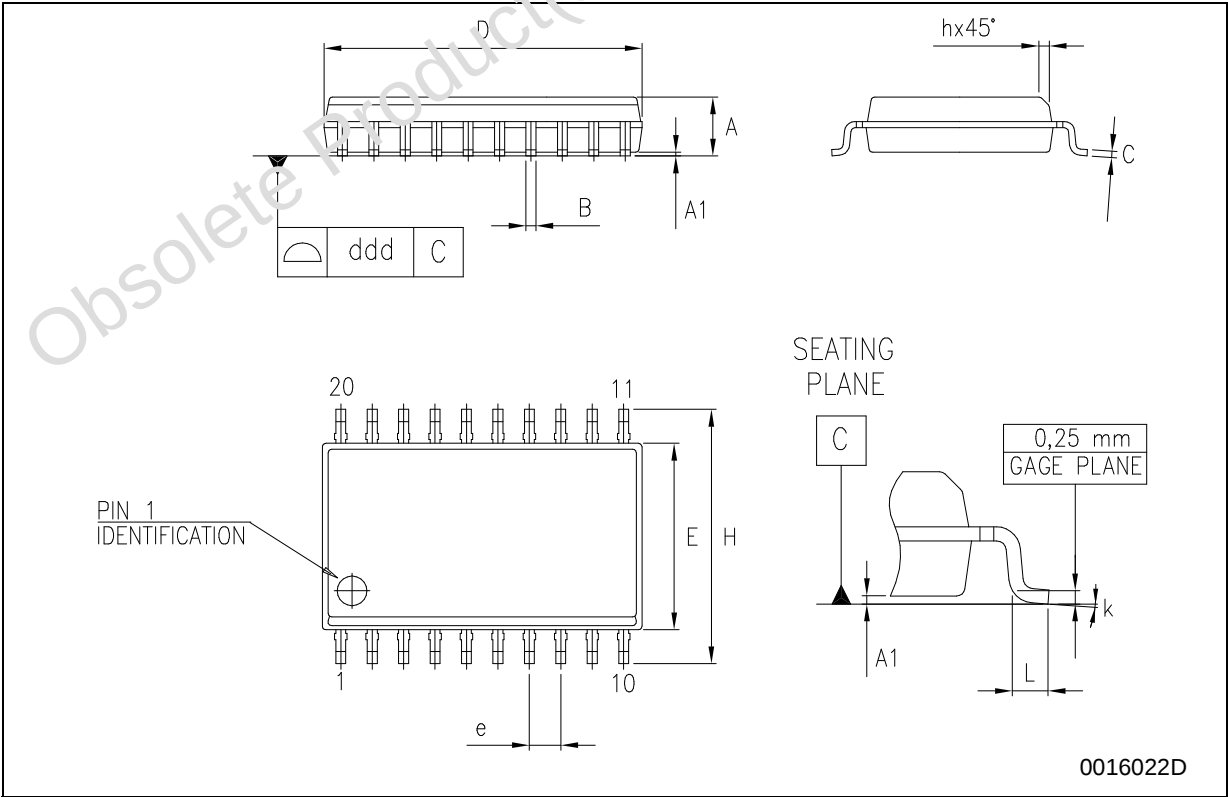


Figure 5: Waveform - Output Enable And Disable Time (f=1MHz; 50% duty cycle)



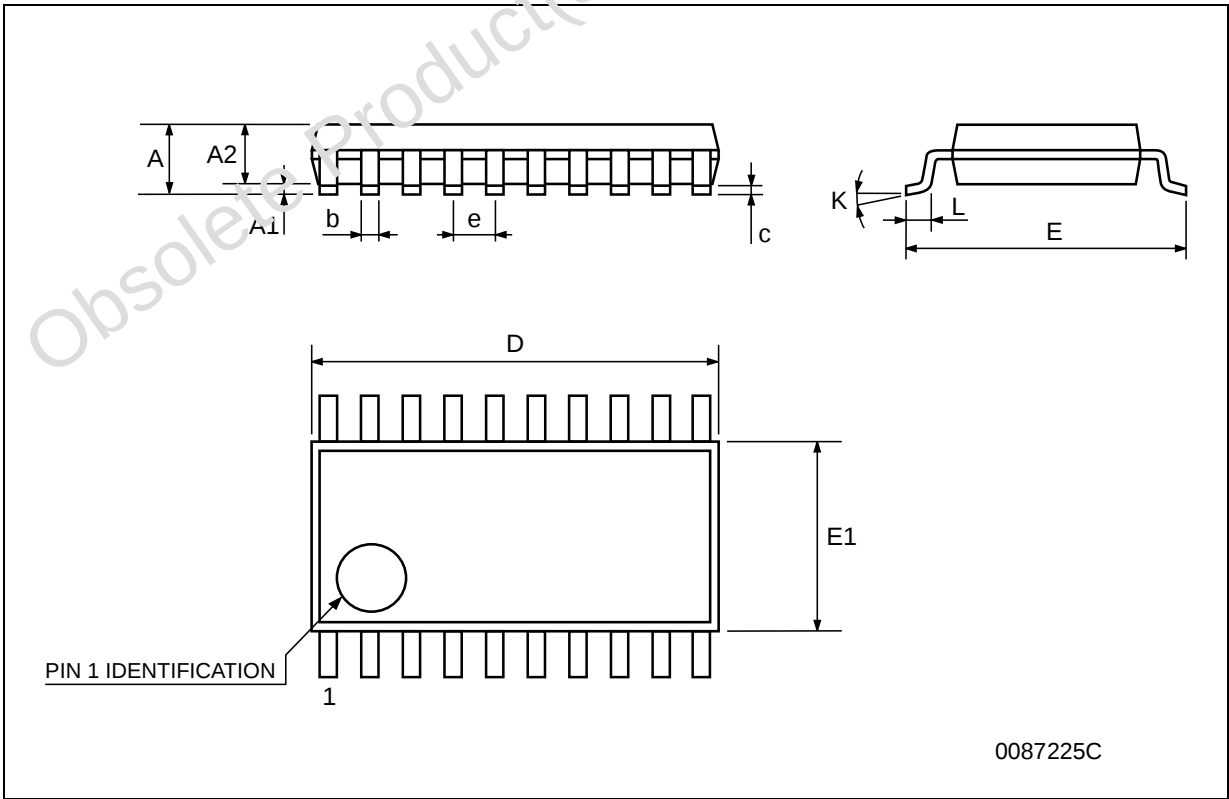
SO-20 MECHANICAL DATA

| DIM. | mm.   |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.35  |      | 2.65  | 0.093 |       | 0.104 |
| A1   | 0.1   |      | 0.30  | 0.004 |       | 0.012 |
| B    | 0.33  |      | 0.51  | 0.013 |       | 0.020 |
| C    | 0.23  |      | 0.32  | 0.009 |       | 0.013 |
| D    | 12.60 |      | 13.00 | 0.496 |       | 0.512 |
| E    | 7.4   |      | 7.6   | 0.291 |       | 0.299 |
| e    |       | 1.27 |       |       | 0.050 |       |
| H    | 10.00 |      | 10.65 | 0.394 |       | 0.419 |
| h    | 0.25  |      | 0.75  | 0.010 |       | 0.030 |
| L    | 0.4   |      | 1.27  | 0.016 |       | 0.050 |
| k    | 0°    |      | 8°    | 0°    |       | 8°    |
| ddd  |       |      | 0.100 |       |       | 0.004 |



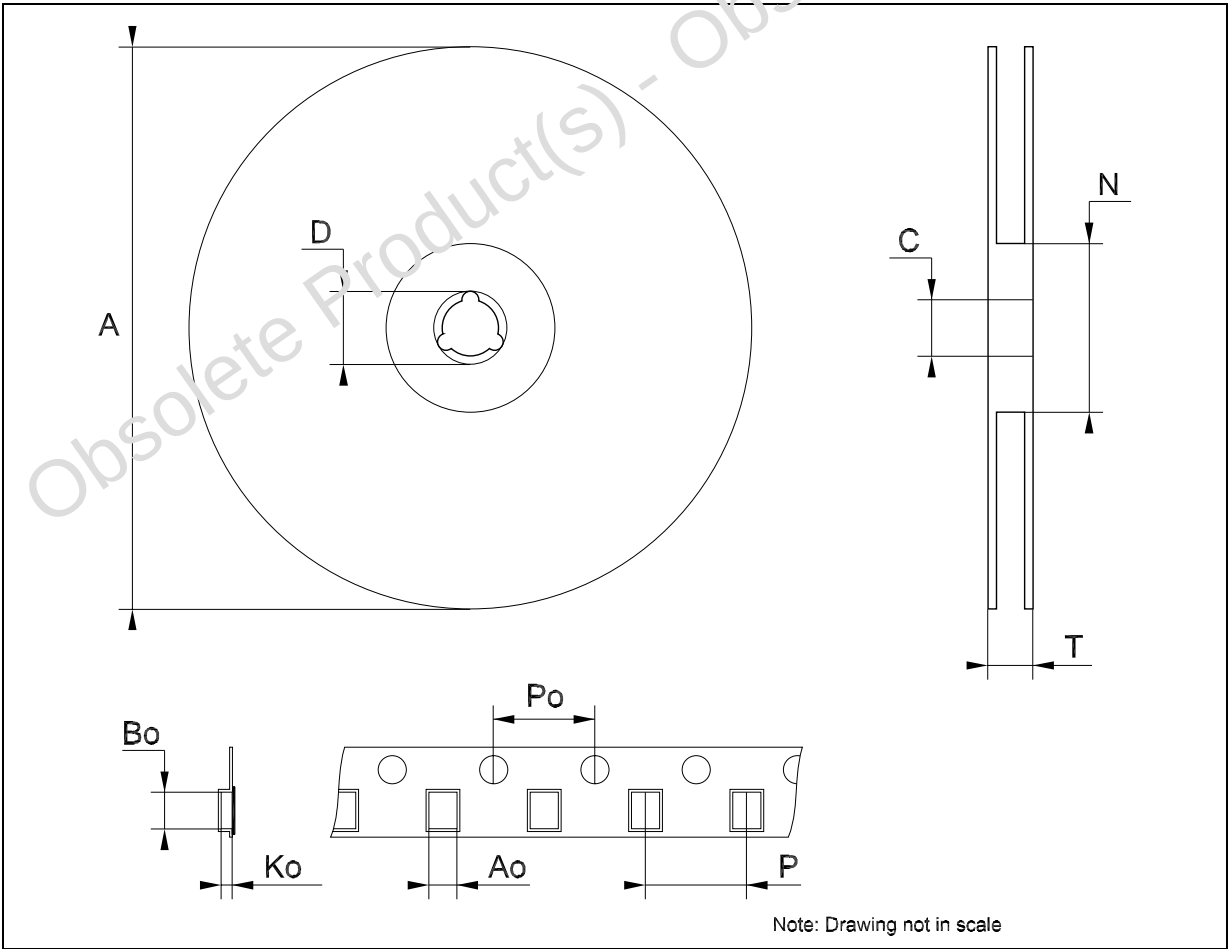
TSSOP20 MECHANICAL DATA

| 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    | 6.4  | 6.5      | 6.6  | 0.252 | 0.256      | 0.260  |
| 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  |



Tape & Reel SO-20 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    |      |     | 30.4 |       |      | 1.197  |
| Ao   | 10.8 |     | 11   | 0.425 |      | 0.433  |
| Bo   | 13.2 |     | 13.4 | 0.520 |      | 0.528  |
| Ko   | 3.1  |     | 3.3  | 0.122 |      | 0.130  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |     | 12.1 | 0.468 |      | 0.476  |



Tape & Reel TSSOP20 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   | 6.8  |     | 7    | 0.268 |      | 0.276  |
| Bo   | 6.9  |     | 7.1  | 0.272 |      | 0.280  |
| Ko   | 1.7  |     | 1.9  | 0.067 |      | 0.075  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |     | 12.1 | 0.468 |      | 0.476  |

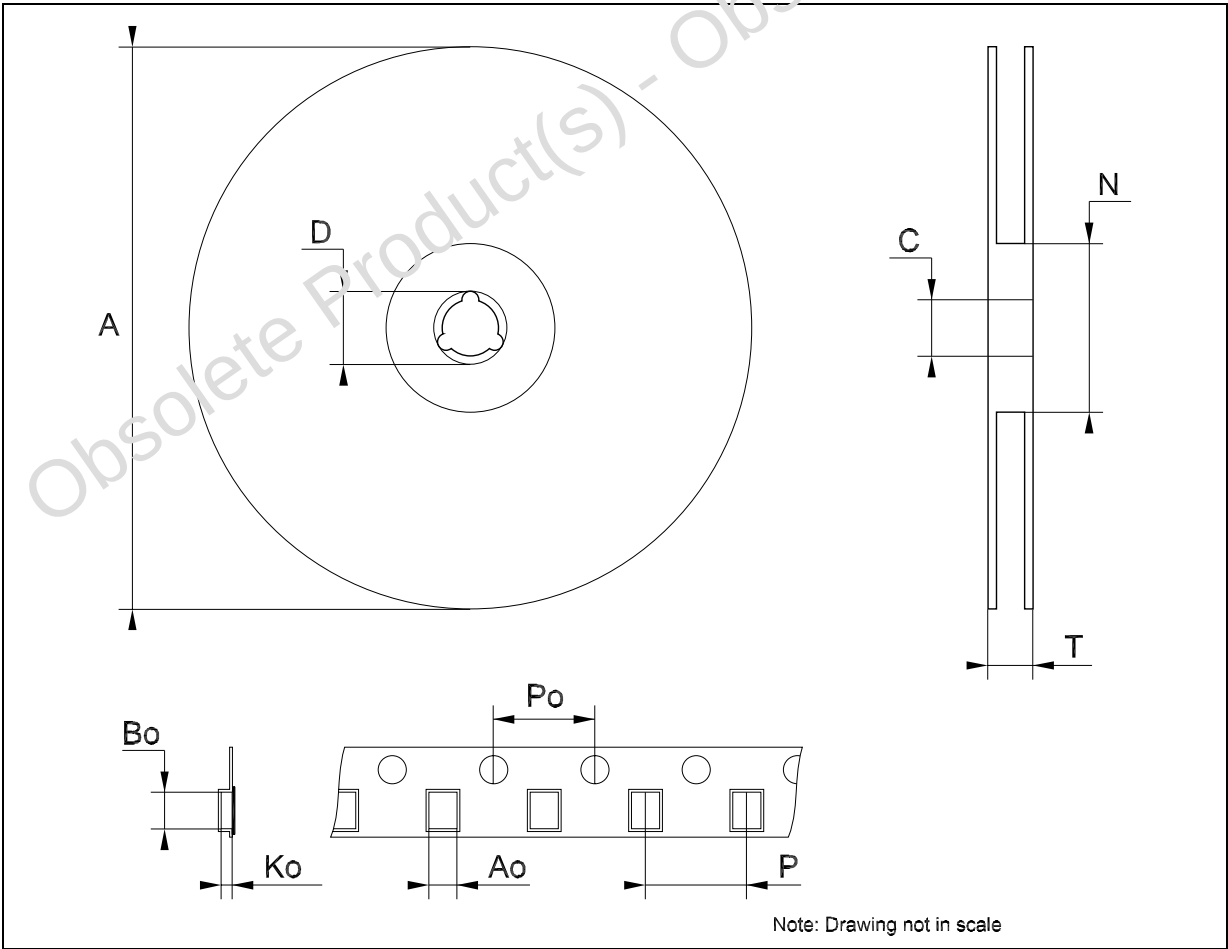


Table 10: Revision History

| Date        | Revision | Description of Changes         |
|-------------|----------|--------------------------------|
| 16-Dec-2004 | 4        | Order Codes Revision - pag. 1. |

Obsolete Product(s) - Obsolete Product(s)

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