

LOW VOLTAGE CMOS OCTAL BUS TRANSCEIVER WITH (3-STATE)

- HIGH SPEED:
 $t_{PD} = 5.7 \text{ ns (TYP.)}$ at $V_{CC} = 3.3 \text{ V}$
- COMPATIBLE WITH TTL OUTPUTS
- LOW POWER DISSIPATION:
 $I_{CC} = 5 \mu\text{A (MAX.)}$ at $T_A = 25^\circ\text{C}$
- LOW NOISE:
 $V_{OLP} = 0.5 \text{ V (TYP.)}$ at $V_{CC} = 3.3 \text{ V}$
- 75Ω TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 12 \text{ mA (MIN)}$ at $V_{CC} = 3.0 \text{ V}$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:
 $V_{CC(OPR)} = 2 \text{ V to } 3.6 \text{ V (1.2V Data Retention)}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 245
- IMPROVED LATCH-UP IMMUNITY

DESCRIPTION

The 74LVQ245 is a low voltage CMOS OCTAL BUS TRANSCEIVER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring C²MOS technology. It is ideal for low power and low noise 3.3V applications.

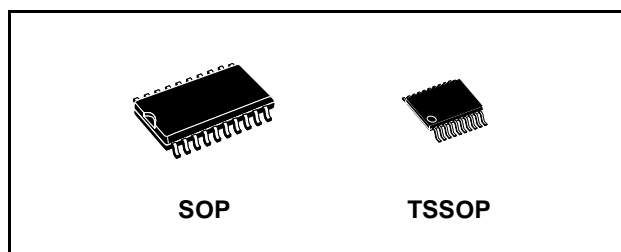


Table 1: Order Codes

| PACKAGE | T & R |
|---------|-------------|
| SOP | 74LVQ245MTR |
| TSSOP | 74LVQ245TTR |

This IC is intended for two-way asynchronous communication between data buses and the direction of data transmission is determined by DIR input. The enable input \bar{G} can be used to disable the device so that the buses are effectively isolated.

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

All floating bus terminals during High Impedance State must be held HIGH or LOW.

Figure 1: Pin Connection And IEC Logic Symbols

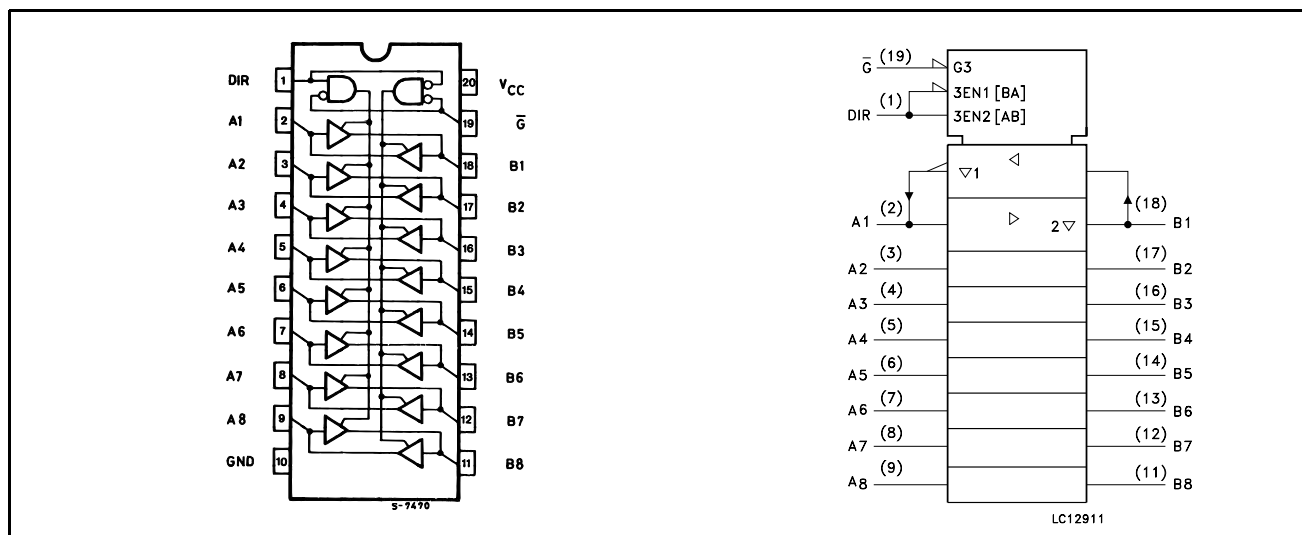


Figure 2: Input Equivalent Circuit

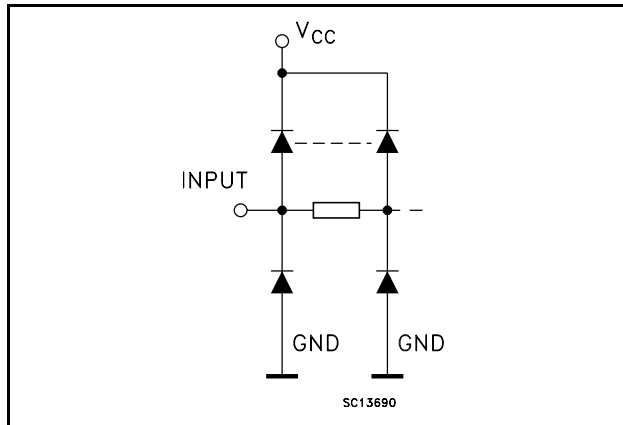


Table 2: Pin Description

| PIN N° | 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 | Output Enable Input |
| 10 | GND | Ground (0V) |
| 20 | V _{CC} | Positive Supply Voltage |

Table 3: Truth Table

| INPUTS | | FUNCTION | | OUTPUT |
|----------------|-----|----------|--------|--------|
| \overline{G} | DIR | A BUS | B BUS | |
| L | L | OUTPUT | INPUT | A = B |
| L | H | INPUT | OUTPUT | B = A |
| H | X | Z | Z | Z |

X : Don't Care
Z : High Impedance

Table 4: Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|-------------------------------------|---|-------------------------------|------|
| V _{CC} | Supply Voltage | -0.5 to +7 | V |
| V _I | DC Bus I/O Voltage (DIR, \overline{G}) | -0.5 to V _{CC} + 0.5 | V |
| V _{I/O} | DC Bus I/O 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 | ± 50 | mA |
| I _{CC} or I _{GND} | DC V _{CC} or Ground Current | ± 400 | mA |
| 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

Table 5: Recommended Operating Conditions

| Symbol | Parameter | Value | Unit |
|-----------------|--|----------------------|------|
| V _{CC} | Supply Voltage (note 1) | 2 to 3.6 | V |
| V _I | Input Voltage (DIR, \overline{G}) | 0 to V _{CC} | V |
| V _O | DC Bus I/O Voltage | 0 to V _{CC} | V |
| T _{op} | Operating Temperature | -55 to 125 | °C |
| dt/dv | Input Rise and Fall Time V _{CC} = 3.0V (note 2) | 0 to 10 | ns/V |

1) Truth Table guaranteed: 1.2V to 3.6V

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

Table 6: 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 | 3.0 to 3.6 | | 2.0 | | | 2.0 | | 2.0 | | V |
| V _{IL} | Low Level Input Voltage | | | | | 0.8 | | 0.8 | | 0.8 | V |
| V _{OH} | High Level Output Voltage | 3.0 | I _O =-50 μA | 2.9 | 2.99 | | 2.9 | | 2.9 | | V |
| | | | I _O =-12 mA | 2.58 | | | 2.48 | | 2.48 | | |
| | | | I _O =-24 mA | | | | 2.2 | | 2.2 | | |
| V _{OL} | Low Level Output Voltage | 3.0 | I _O =50 μA | | 0.002 | 0.1 | | 0.1 | | 0.1 | V |
| | | | I _O =12 mA | | 0 | 0.36 | | 0.44 | | 0.44 | |
| | | | I _O =24 mA | | | | | 0.55 | | 0.55 | |
| I _I | Input Leakage Current | 3.6 | V _I = V _{CC} or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I _{OZ} | High Impedance Output Leakage Current | 3.6 | V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND | | | ± 0.3 | | ± 3 | | ± 10 | μA |
| I _{CC} | Quiescent Supply Current | 3.6 | V _I = V _{CC} or GND | | | 4 | | 40 | | 40 | μA |
| I _{OLD} | Dynamic Output Current (note 1, 2) | 3.6 | V _{OLD} = 0.8 V max | | | | 36 | | 25 | | mA |
| I _{OHD} | | | V _{OHD} = 2 V min | | | | -25 | | -25 | | mA |

1) Maximum test duration 2ms, one output loaded at time

2) Incident wave switching is guaranteed on transmission lines with impedances as low as 75Ω

Table 7: Dynamic Switching 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. |
| V _{OLP} | Dynamic Low Voltage Quiet Output (note 1, 2) | 3.3 | C _L = 50 pF | | 0.5 | 0.8 | | | | | V |
| V _{OLV} | | | | -0.8 | -0.5 | | | | | | |
| V _{IHD} | Dynamic High Voltage Input (note 1, 3) | 3.3 | | 2 | | | | | | | V |
| V _{ILD} | Dynamic Low Voltage Input (note 1, 3) | 3.3 | | | | 0.8 | | | | | V |

1) Worst case package.

2) Max number of outputs defined as (n). Data inputs are driven 0V to 3.3V, (n-1) outputs switching and one output at GND.

3) Max number of data inputs (n) switching. (n-1) switching 0V to 3.3V. Inputs under test switching: 3.3V to threshold (V_{ILD}), 0V to threshold (V_{IHD}), f=1MHz.

Table 8: AC Electrical Characteristics ($C_L = 50 \text{ pF}$, $R_L = 500 \Omega$, Input $t_r = t_f = 3\text{ns}$)

| 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. |
| t_{PLH} t_{PHL} | Propagation Delay Time | 2.7 | | | 6.7 | 11.0 | | 13.0 | | 15.0 | ns |
| | | 3.3(*) | | | 5.7 | 9.0 | | 10.5 | | 12.0 | |
| t_{PZL} t_{PZH} | Output Enable Time | 2.7 | | | 9.3 | 15.0 | | 17.5 | | 20.0 | ns |
| | | 3.3(*) | | | 7.5 | 12.0 | | 14.0 | | 16.0 | |
| t_{PLZ} t_{PHZ} | Output Disable Time | 2.7 | | | 7.5 | 12.0 | | 14.0 | | 16.0 | ns |
| | | 3.3(*) | | | 6.6 | 10.0 | | 11.5 | | 13.0 | |
| t_{OSLH} t_{OSHL} | Output To Output Skew Time (note1, 2) | 2.7 | | | 0.5 | 1.0 | | 1.0 | | 1.0 | ns |
| | | 3.3(*) | | | 0.5 | 1.0 | | 1.0 | | 1.0 | |

1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW ($t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$)

2) Parameter guaranteed by design

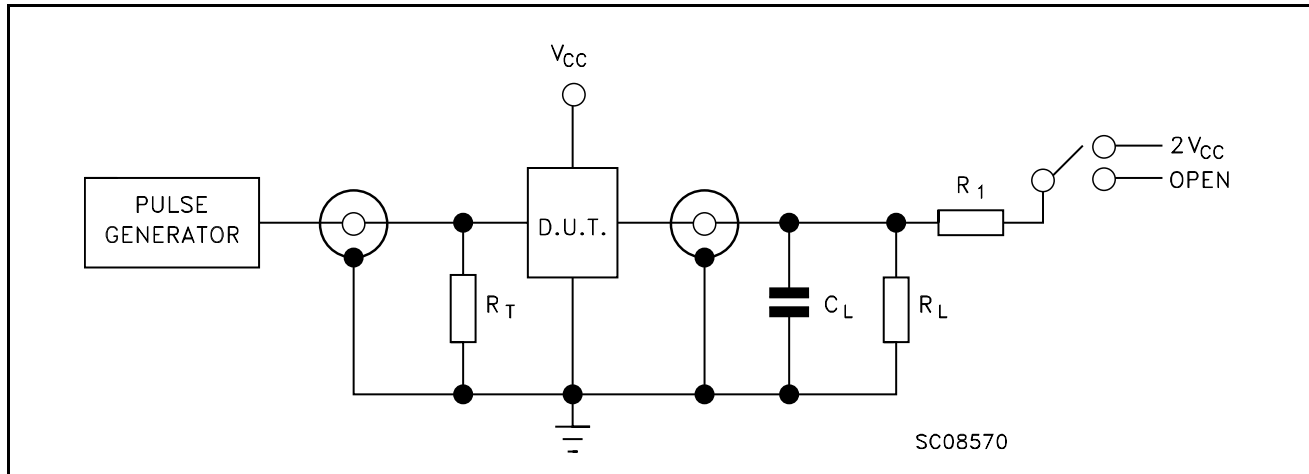
(*) Voltage range is $3.3\text{V} \pm 0.3\text{V}$

Table 9: 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 | 3.3 | | | 5 | | | | | | pF |
| $C_{I/O}$ | I/O Capacitance | 3.3 | | | 10 | | | | | | pF |
| C_{PD} | Power Dissipation Capacitance (note 1) | 3.3 | $f_{IN} = 10\text{MHz}$ | | 20 | | | | | | 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$ (per circuit)

Figure 3: Test Circuit



| TEST | SWITCH |
|-----------------------|-----------|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} | $2V_{CC}$ |
| t_{PZH} , t_{PHZ} | Open |

C_L = 50pF or equivalent (includes jig and probe capacitance)

$R_L = R_1$ = 500 Ω or equivalent

R_T = Z_{OUT} of pulse generator (typically 50 Ω)

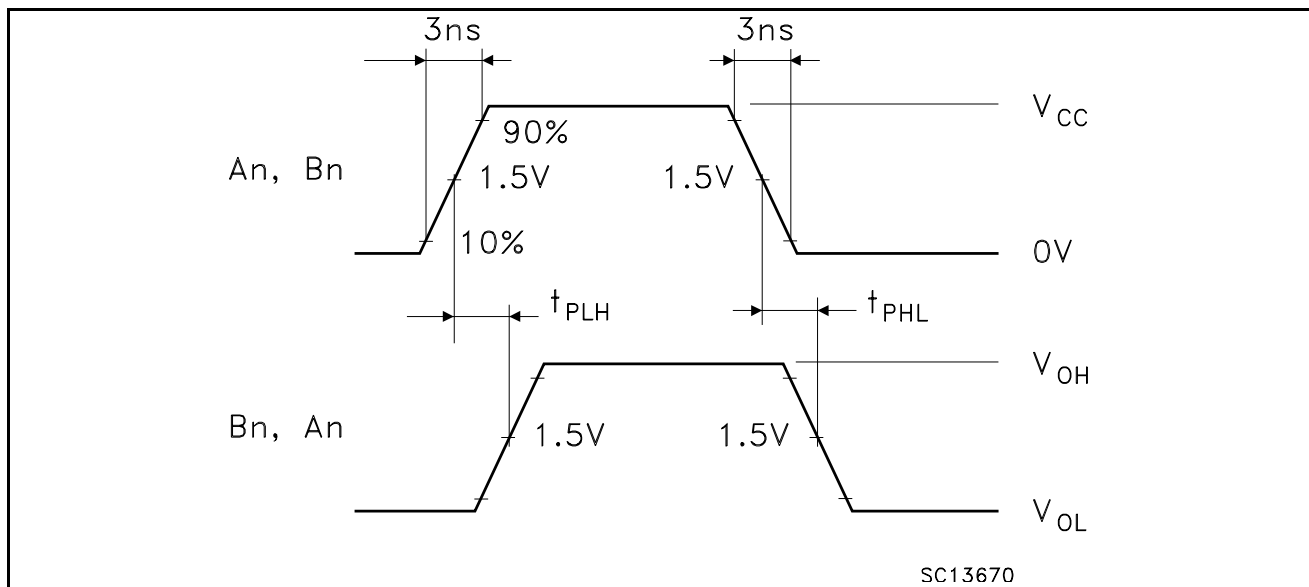
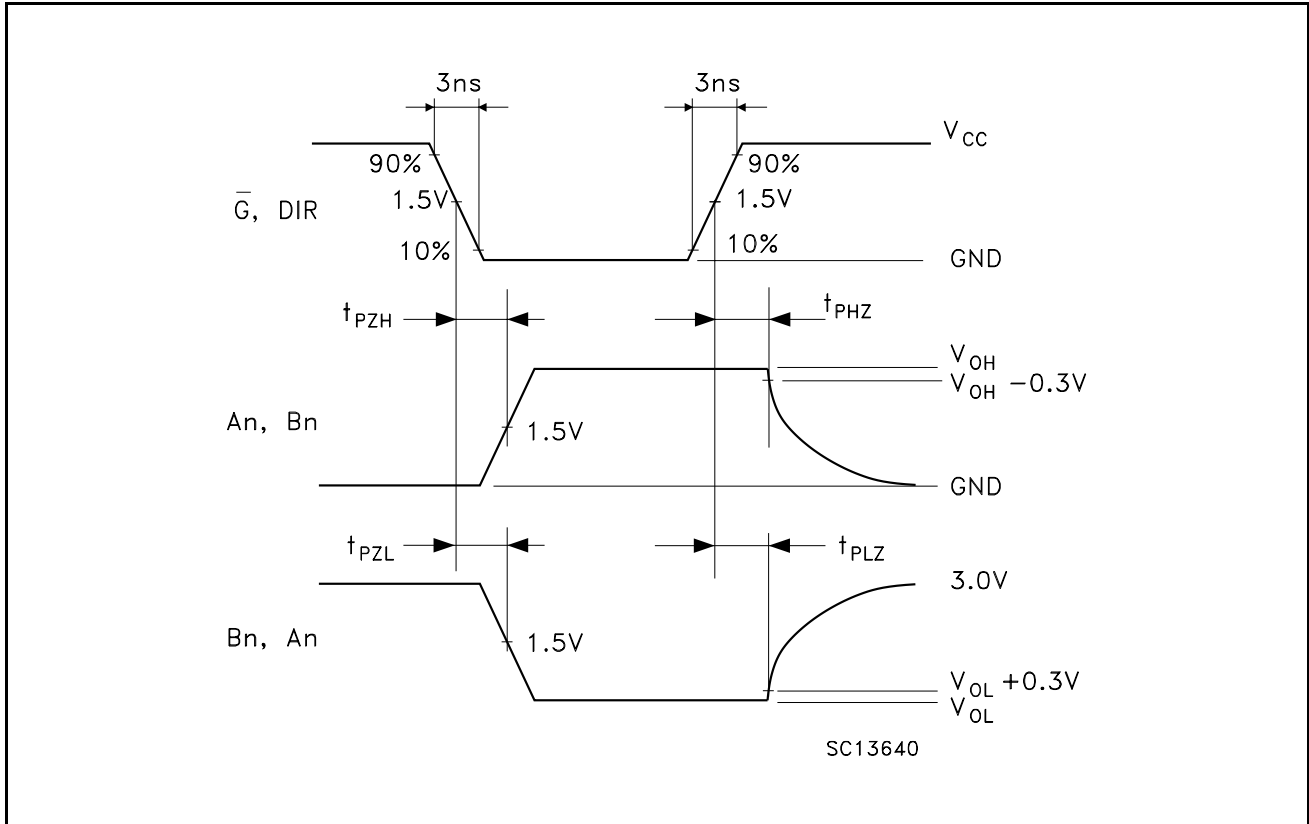
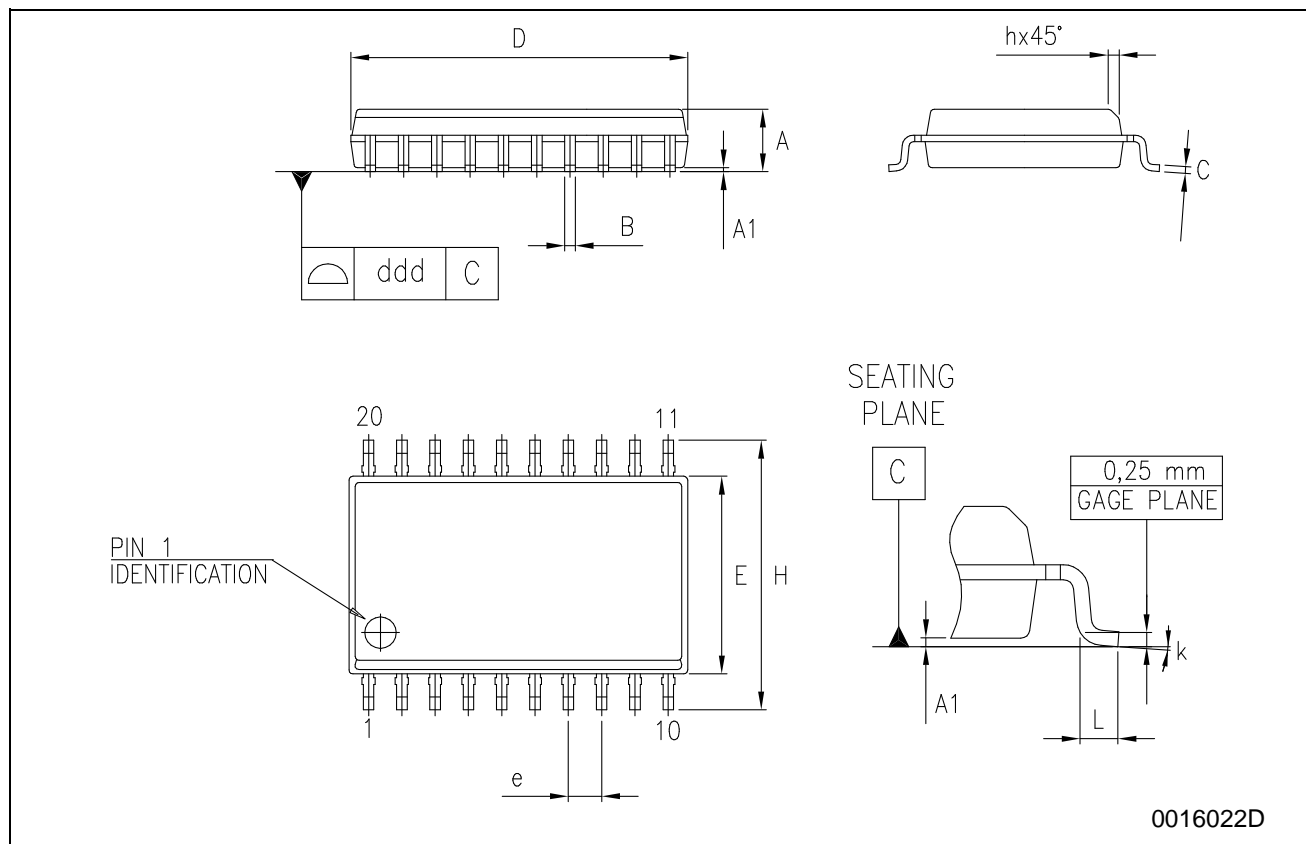
Figure 4: Waveform - Propagation Delays ($f=1\text{MHz}$; 50% duty cycle)

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



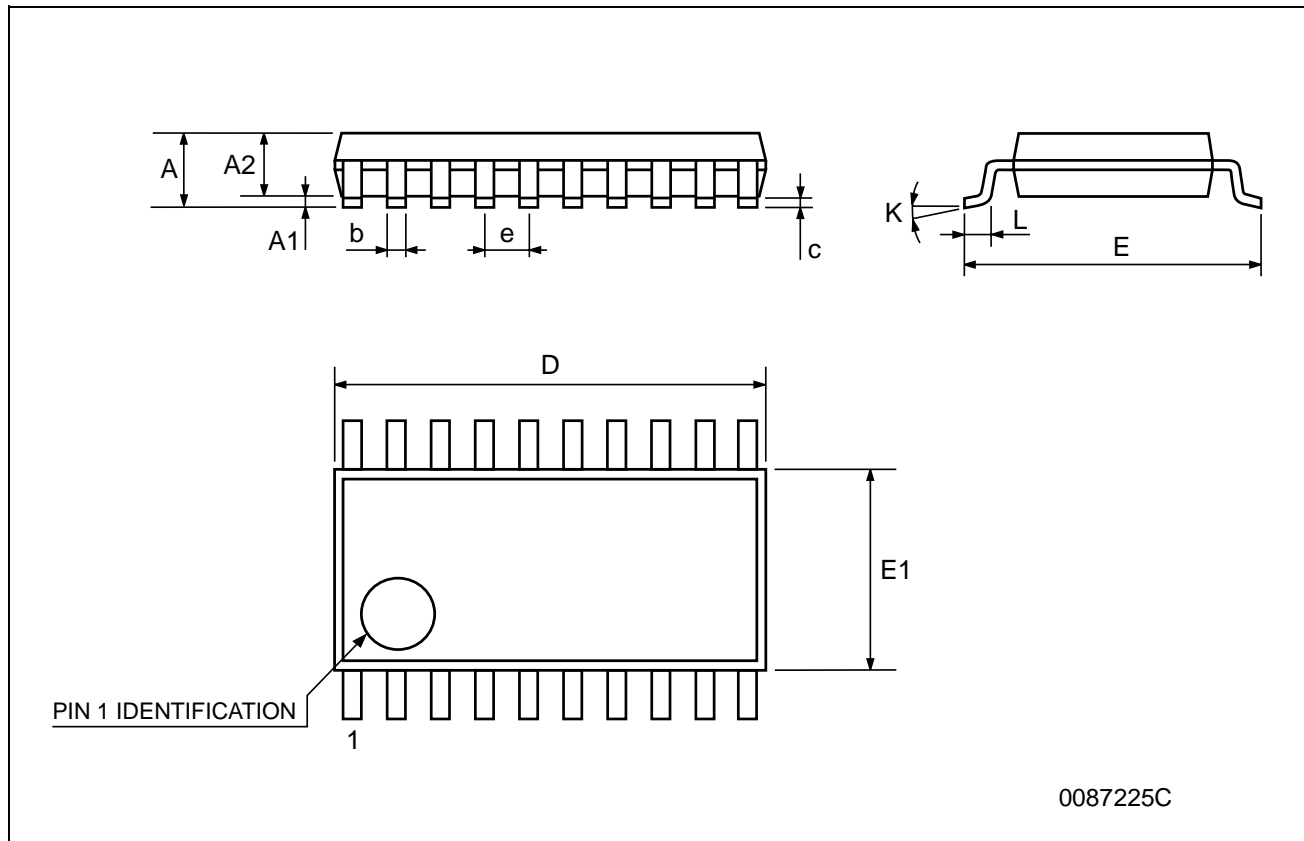
SO-20 MECHANICAL DATA

| 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 |



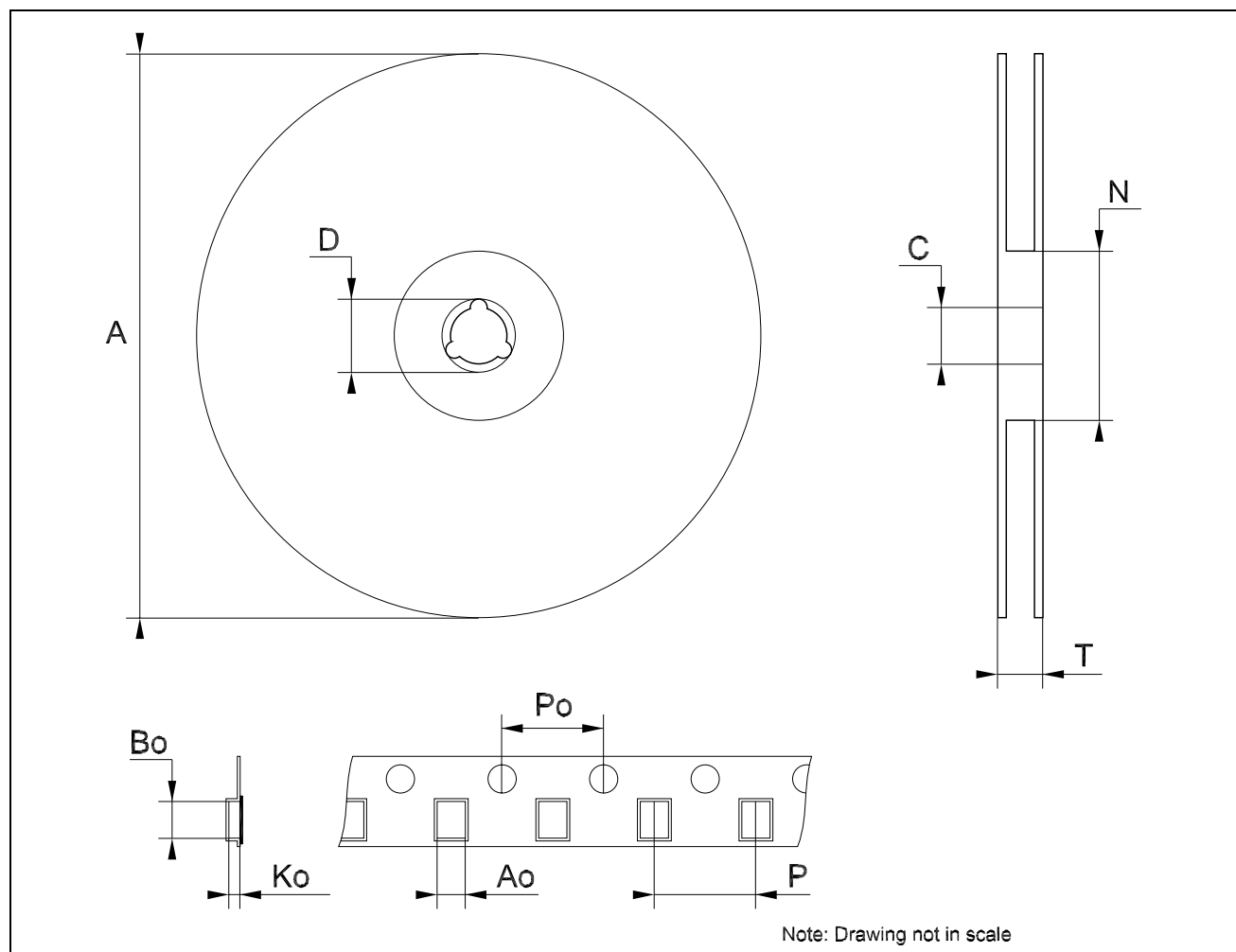
TSSOP20 MECHANICAL DATA

| 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 |

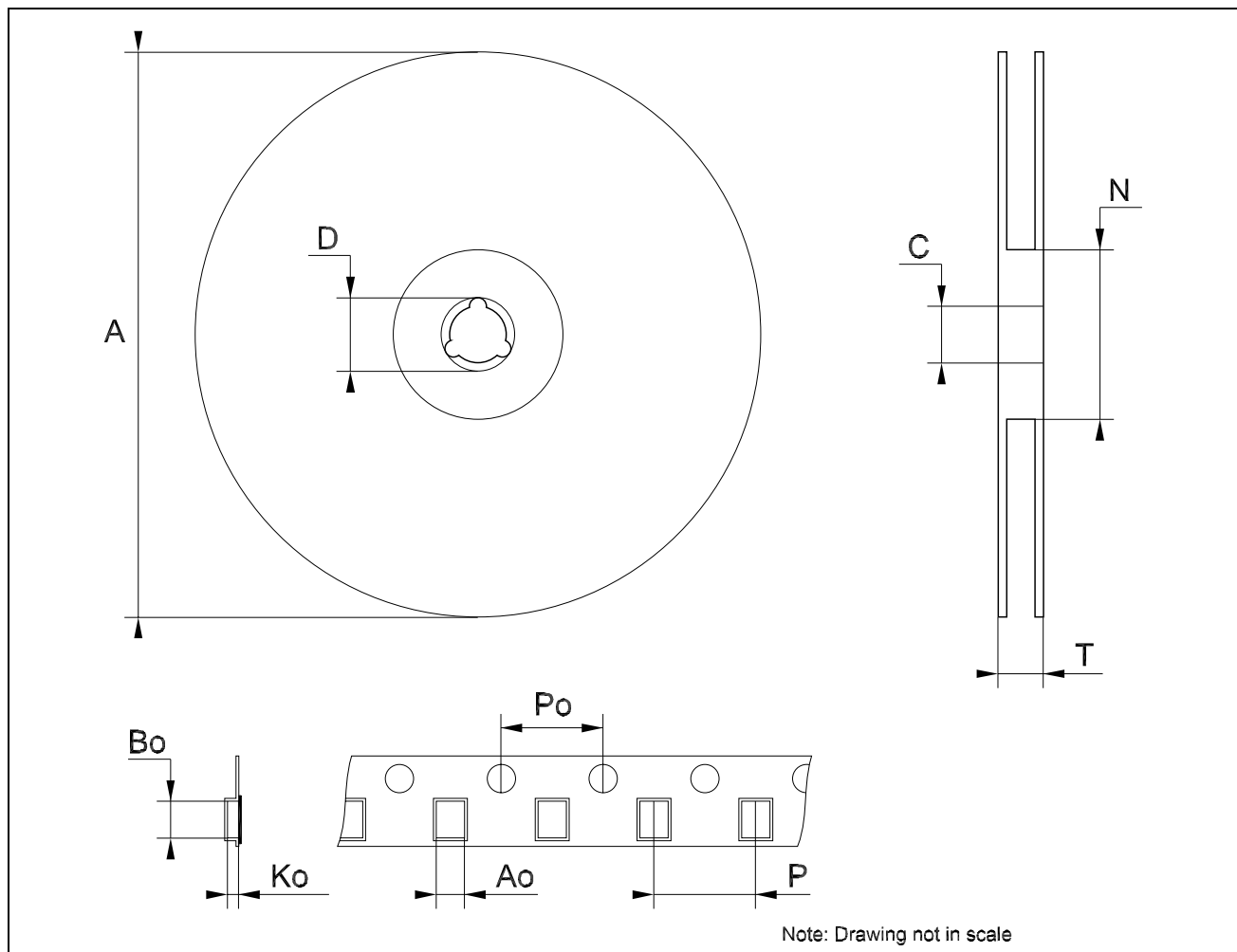


Table 10: Revision History

| Date | Revision | Description of Changes |
|-------------|----------|-----------------------------------|
| 29-Jul-2004 | 5 | Ordering Codes Revision - pag. 1. |

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