

OCTAL DUAL SUPPLY BUS TRANSCEIVER

- **HIGH SPEED:**
 $t_{PD} = 8.5 \text{ ns (MAX.)}$ at
 $V_{CCA}=5.0V \ V_{CCB} = 3.3V$
- **LOW POWER DISSIPATION:**
 $I_{CCA} = I_{CCB} = 5\mu A(\text{MAX.})$ at $T_A=25^\circ C$
- **LOW NOISE:** $V_{OLP} = 0.3V$ (TYP.) at
 $V_{CCA}=5.5V \ V_{CCB}=3.3V$
- **SYMMETRICAL OUTPUT IMPEDANCE:**
 $|I_{OH}| = I_{OL} = 24mA$ (MIN)
- **BALANCED PROPAGATION DELAYS:**
 $t_{PLH} \cong t_{PHL}$
- **OPERATING VOLTAGE RANGE:**
 $V_{CCA}(\text{OPR}) = 4.5V$ to $5.5V$ (1.2V Data Retention)
 $V_{CCB}(\text{OPR}) = 2.7V$ to $3.6V$ (1.2V Data Retention)
PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 4245
- **IMPROVED LATCH-UP IMMUNITY**

DESCRIPTION

The 74LVX4245 is a dual supply low voltage CMOS OCTAL BUS TRANSCEIVER fabricated with sub-micron silicon gate and double-layer metal wiring C²MOS technology. Designed for use as an interface between a 5V bus and a 3.3V bus in a mixed 5V/3.3V supply systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

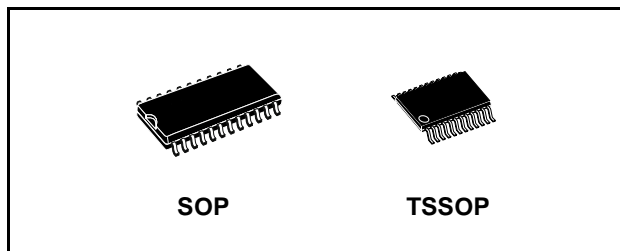


Table 1: Order Codes

| PACKAGE | T & R |
|---------|--------------|
| SOP | 74LVX4245MTR |
| TSSOP | 74LVX4245TTR |

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.

The A-port interfaces with the 5V bus, the B-port with the 3.3V bus.

All inputs 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

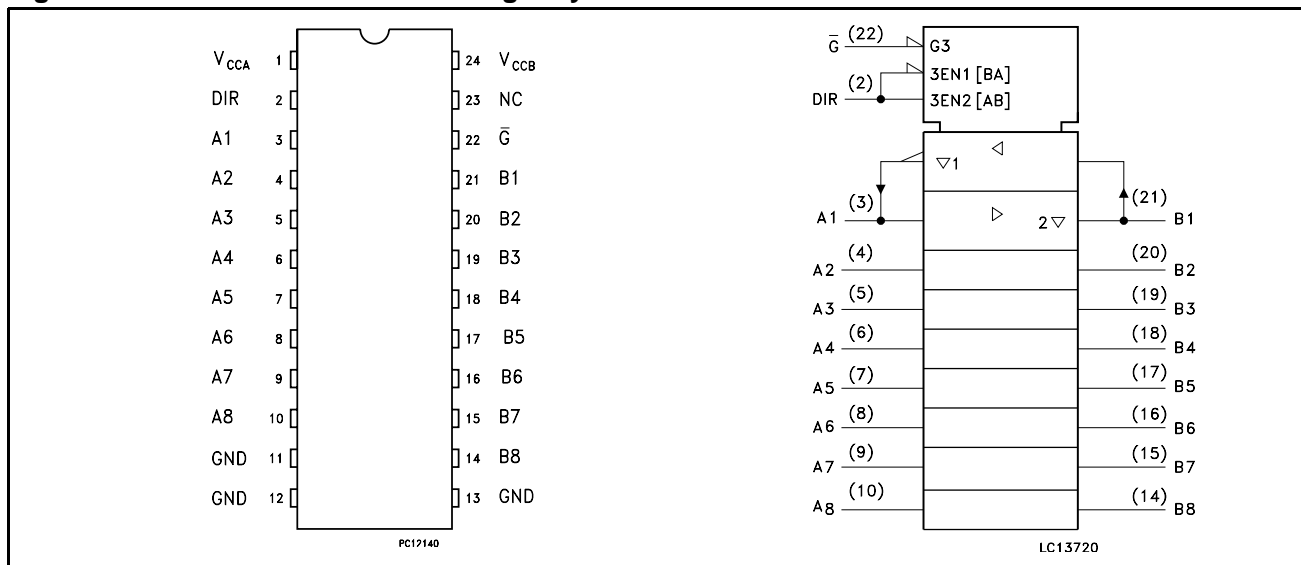


Figure 2: Input And Output Equivalent Circuit

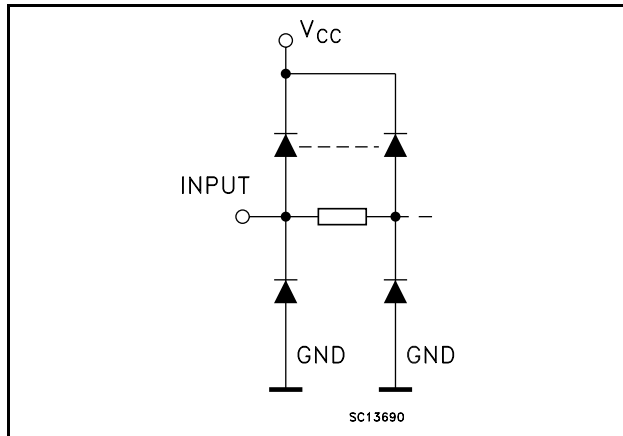


Table 2: Pin Description

| PIN N° | SYMBOL | NAME QND FUNCTION |
|--------------------------------|------------------|-------------------------|
| 2 | DIR | Directional Control |
| 3, 4, 5, 6, 7, 8, 9, 10 | A1 to A8 | Data Inputs/Outputs |
| 21, 20, 19, 18, 17, 16, 15, 14 | B1 to B8 | Data Inputs/Outputs |
| 22 | G | Output Enable Input |
| 11, 12, 13 | GND | Ground (0V) |
| 23 | NC | Not Connected |
| 1 | V _{CCA} | Positive Supply Voltage |
| 24 | V _{CCB} | 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 _{CCA} | Supply Voltage | -0.5 to +7.0 | V |
| V _{CCB} | Supply Voltage | -0.5 to +7.0 | V |
| V _I | DC Input Voltage | -0.5 to V _{CCA} + 0.5 | V |
| V _{I/OA} | DC I/O Voltage | -0.5 to V _{CCA} + 0.5 | V |
| V _{I/OB} | DC I/O Voltage | -0.5 to V _{CCB} + 0.5 | V |
| I _{IK} | DC Input Diode Current | ± 20 | mA |
| I _{OK} | DC Output Diode Current | ± 50 | mA |
| I _{OA} | DC Output Current | ± 50 | mA |
| I _{OB} | DC Output Current | ± 50 | mA |
| I _{CCA} | DC V _{CC} or Ground Current | ± 200 | mA |
| I _{CCB} | DC V _{CC} or Ground Current | ± 100 | mA |
| P _d | Power Dissipation | 180 | 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

Table 5: Recommended Operating Conditions

| Symbol | Parameter | Value | Unit |
|------------|-----------------------------------|----------------|------|
| V_{CCA} | Supply Voltage (note 1) | 4.5 to 5.5 | V |
| V_{CCB} | Supply Voltage (note 1) | 2.7 to 3.6 | V |
| V_I | Input Voltage | 0 to V_{CCA} | V |
| $V_{I/OA}$ | I/O Voltage | 0 to V_{CCA} | V |
| $V_{I/OB}$ | I/O Voltage | 0 to V_{CCB} | V |
| T_{op} | Operating Temperature | -55 to 125 | °C |
| dt/dv | Input Rise and Fall Time (note 2) | 0 to 10 | ns/V |

1) V_{IN} from 30% to 70% of V_{CC} 2) $V_{CCA} = 4.5$ to $5.5V$; $V_{CCB} = 2.7$ to $3.6V$;Table 6: DC Specifications For V_{CCA}

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|-------------------|---|------------------|------------------|---|----------------------|------|-----------|------------------------------|---------|-------------------------------|---------|---------------|
| | | V_{CCA} (V) | V_{CCB} (V) | | $T_A = 25\text{ °C}$ | | | $-40\text{ to }85\text{ °C}$ | | $-55\text{ to }125\text{ °C}$ | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V_{IHA} | High Level Input Voltage | 4.5 | 3.3 | | 2.0 | | | 2.0 | | 2.0 | | V |
| | | 5.5 | 3.3 | | 2.0 | | | 2.0 | | 2.0 | | |
| V_{ILA} | Low Level Input Voltage | 4.5 | 3.3 | | | | 0.8 | | 0.8 | | 0.8 | V |
| | | 5.5 | 3.3 | | | | 0.8 | | 0.8 | | 0.8 | |
| V_{OHA} | High Level Output Voltage | 4.5 | 3.0 | $I_O = -100\text{ }\mu\text{A}$ | 4.4 | 4.5 | | 4.4 | | 4.4 | | V |
| | | 4.5 | 3.0 | $I_O = -24\text{ mA}$ | 3.86 | | | 3.76 | | 3.76 | | |
| V_{OLA} | Low Level Output Voltage | 4.5 | 3.0 | $I_O = 100\text{ }\mu\text{A}$ | | 0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | 3.0 | $I_O = 24\text{ mA}$ | | | 0.36 | | 0.44 | | 0.44 | |
| I_{IA} | Input Leakage Current | 5.5 | 3.6 | $V_I = V_{CC}$ or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I_{OZA} | High Impedance Output Leakage Current | 5.5 | 3.6 | $V_{IA} = V_{IHA}$ or V_{ILA} $V_{IB} = V_{IHB}$ or V_{ILB} $V_{I/OA} = V_{CCA}$ or GND | | | ± 0.5 | | ± 5 | | ± 5 | μA |
| I_{CCTA} | Quiescent Supply Current | 5.5 | 3.6 | $V_{IA} = V_{CCA}$ or GND $V_{IB} = V_{CCB}$ or GND | | | 5 | | 50 | | 50 | μA |
| ΔI_{CCTA} | Maximum Quiescent Supply Current / Input (An, DIR, G) | 5.5 | 3.6 | $V_{IA} = V_{CCA} - 2.1V$ $V_{IB} = V_{CCB}$ or GND | | | 1.35 | | 1.5 | | 1.5 | mA |

Table 7: DC Specifications For V_{CCB}

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|-------------------|--|------------------|------------------|--|--------------------------|------|-----------|-----------------------------|---------|------------------------------|---------|---------------|
| | | V_{CCA} (V) | V_{CCB} (V) | | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V_{IHB} | High Level Input Voltage | 5.0 | 3.6 | | 2.0 | | | 2.0 | | 2.0 | | V |
| | | 5.0 | 2.7 | | 2.0 | | | 2.0 | | 2.0 | | |
| V_{ILB} | Low Level Input Voltage | 5.0 | 3.6 | | | | 0.8 | | 0.8 | | 0.8 | V |
| | | 5.0 | 2.7 | | | | 0.8 | | 0.8 | | 0.8 | |
| V_{OHB} | High Level Output Voltage | 4.5 | 3.0 | $I_O = -100\ \mu\text{A}$ | 2.9 | 3.0 | | 2.9 | | 2.9 | | V |
| | | 4.5 | 3.0 | $I_O = -12\ \text{mA}$ | 2.48 | | | 2.4 | | 2.4 | | |
| | | 4.5 | 2.7 | $I_O = -8\ \text{mA}$ | 2.26 | | | 2.2 | | 2.2 | | |
| V_{OLB} | Low Level Output Voltage | 4.5 | 3.0 | $I_O = 100\ \mu\text{A}$ | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | 3.0 | $I_O = 12\ \text{mA}$ | | | 0.31 | | 0.40 | | 0.40 | |
| | | 4.5 | 2.7 | $I_O = 8\ \text{mA}$ | | | 0.31 | | 0.40 | | 0.40 | |
| I_{IB} | Input Leakage Current | 5.5 | 3.6 | $V_I = V_{CCA}$ or GND | | | ± 0.1 | | ± 1 | | ± 1 | μA |
| I_{OZB} | High Impedance Output Leakage Current | 5.5 | 3.6 | $V_{IA} = V_{IHA}$ or V_{ILA} $V_{I/OB} = V_{CCB}$ or GND | | | ± 0.5 | | ± 5 | | ± 5 | μA |
| I_{CCIB} | Quiescent Supply Current | 5.5 | 3.6 | $V_{IA} = V_{CCA}$ or GND $V_{IB} = V_{CCB}$ or GND | | | 5 | | 50 | | 5 | μA |
| ΔI_{CCIB} | Maximum Quiescent Supply Current / Input | 5.5 | 3.6 | $V_{IA} = V_{CCA}$ or GND $V_{IB} = V_{CCB} - 0.6\text{V}$ | | | 0.35 | | 0.5 | | 0.35 | mA |

Table 8: Dynamic Switching Characteristics

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|-------------|--|------------------|------------------|--|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|
| | | V_{CCA} (V) | V_{CCB} (V) | | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| V_{OLPA} | Dynamic Low Level Quiet Output (note 1, 2) | 5.0 | 3.3 | | | 1.0 | 1.5 | | | | | V |
| | | 5.0 | 3.3 | | -1.2 | -0.6 | | | | | | |
| V_{OLPB} | Dynamic Low Level Quiet Output (note 1, 2) | 5.0 | 3.3 | | | 0.8 | 1.2 | | | | | V |
| | | 5.0 | 3.3 | | -0.8 | -0.5 | | | | | | |
| V_{IHDA} | Dynamic High Voltage Input (note 1, 3) | 5.0 | 3.3 | | | | 2 | | | | | V |
| $V_{ILD A}$ | Dynamic Low Voltage Input (note 1, 3) | 5.0 | 3.3 | | 0.8 | | | | | | | V |
| $V_{IHD B}$ | Dynamic High Voltage Input (note 1, 3) | 5.0 | 3.3 | | | | 2 | | | | | V |
| $V_{ILD B}$ | Dynamic Low Voltage Input (note 1, 3) | 5.0 | 3.3 | | 0.8 | | | | | | | V |

1) Worst case package

2) Max number of output 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: 3V to threshold (V_{ILD}). 0V to threshold (V_{IHD}) $f = 1\text{MHz}$

Table 9: AC Electrical Characteristics ($C_L = 50\text{pF}$, Input $t_r = t_f = 3\text{ns}$)

| Symbol | Parameter | Test Condition | | Value ⁽³⁾ | | | | | | Unit | |
|--------------------------|--|------------------|--|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|
| | | V_{CCB} (V) | | $T_A = 25^\circ\text{C}$ | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| t_{PLH} | Propagation Delay Time (An to Bn) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.1 | 8.5 | 1.0 | 9.0 | 1.0 | 10.0 | |
| t_{PHL} | Propagation Delay Time (An to Bn) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.3 | 8.5 | 1.0 | 9.0 | 1.0 | 10.0 | |
| t_{PZL} | Output Enable Time (\bar{G} to Bn) | 2.7 | | | | | 1.0 | 11.5 | 1.0 | 12.5 | ns |
| | | 3.0(*) | | 1.0 | 6.5 | 10.0 | 1.0 | 10.5 | 1.0 | 11.5 | |
| t_{PZH} | Output Enable Time (\bar{G} to Bn) | 2.7 | | | | | 1.0 | 11.5 | 1.0 | 11.5 | ns |
| | | 3.0(*) | | 1.0 | 6.7 | 10.0 | 1.0 | 10.5 | 1.0 | 11.5 | |
| t_{PLZ} | Output Disable Time (\bar{G} to Bn) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 6.0 | 9.5 | 1.0 | 10.0 | 1.0 | 11.0 | |
| t_{PHZ} | Output Disable Time (\bar{G} to Bn) | 2.7 | | | | | 1.0 | 7.5 | 1.0 | 8.5 | ns |
| | | 3.0(*) | | 1.0 | 3.3 | 6.5 | 1.0 | 7.0 | 1.0 | 8.0 | |
| t_{PLH} | Propagation Delay Time (Bn to An) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.4 | 8.5 | 1.0 | 9.0 | 1.0 | 10.0 | |
| t_{PHL} | Propagation Delay Time (Bn to An) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.5 | 8.5 | 1.0 | 9.0 | 1.0 | 10.0 | |
| t_{PZL} | Output Enable Time (\bar{G} to An) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.2 | 9.0 | 1.0 | 9.5 | 1.0 | 10.5 | |
| t_{PZH} | Output Enable Time (\bar{G} to An) | 2.7 | | | | | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| | | 3.0(*) | | 1.0 | 5.8 | 9.0 | 1.0 | 9.5 | 1.0 | 10.5 | |
| t_{PLZ} | Output Disable Time (\bar{G} to An) | 2.7 | | | | | 1.0 | 7.5 | 1.0 | 8.5 | ns |
| | | 3.0(*) | | 1.0 | 3.9 | 7.0 | 1.0 | 7.5 | 1.0 | 8.5 | |
| t_{PHZ} | Output Disable Time (\bar{G} to An) | 2.7 | | | | | 1.0 | 7.5 | 1.0 | 8.5 | ns |
| | | 3.0(*) | | 1.0 | 2.9 | 6.5 | 1.0 | 7.0 | 1.0 | 8.0 | |
| t_{OSLH} t_{OSHL} | Output To Output Skew Time (note 1, 2) | 2.7 | | | 0.5 | 1.0 | | 1.5 | | 1.5 | ns |
| | | 3.3(**) | | | 0.5 | 1.0 | | 1.5 | | 1.5 | |

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

3) Typical values at $V_{CCA} = 5.0\text{V}$, $V_{CCB} = 3.3\text{V}$

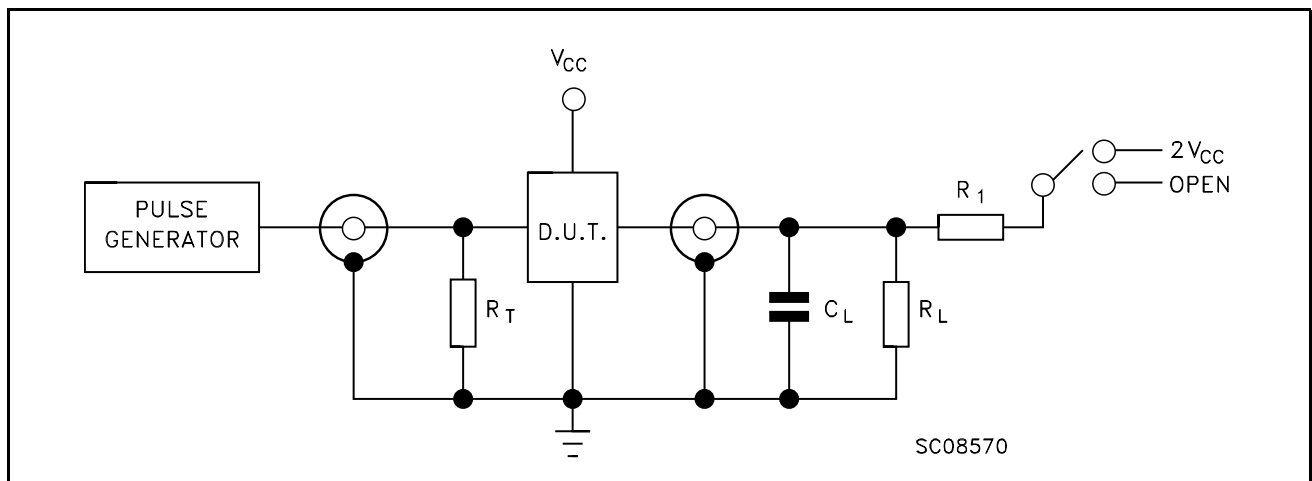
(*) Voltage range is $3.0\text{V} \pm 0.3\text{V}$

Table 10: Capacitive Characteristics

| Symbol | Parameter | Test Condition | | | Value | | | | | | Unit | |
|------------------|--|-------------------------|-------------------------|--|------------------------|------|------|--------------|------|--------------|------|------|
| | | V _{CCA} (V) | V _{CCB} (V) | | T _A = 25 °C | | | -40 to 85 °C | | -55 to 125°C | | |
| | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| C _{INA} | Input Capacitance | open | open | | | 4.5 | 10 | | 10 | | 10 | V |
| C _{I/O} | Input/Output Capacitance | 3.3 | 5.0 | | | 10 | | | | | | V |
| C _{PD} | Dynamic Low Level Quiet Output (note 1) A to B | 3.3 | 5.0 | | | 55 | | | | | | V |
| C _{PD} | Dynamic Low Level Quiet Output (note 1) B to A | 3.3 | 5.0 | | | 40 | | | | | | V |

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 current can be obtained by the following equation. I_{CC(opr)} = C_{PD} × V_{CC} × f_{IN} + I_{CC}/8 (per circuit)

Figure 3: Test Circuit



| TEST | SWITCH |
|--------------------------------------|------------------|
| t _{PLH} , t _{PHL} | Open |
| t _{PZLH} , t _{PLZ} | 2V _{CC} |
| t _{PZH} , t _{PHZ} | Open |

C_L = 50pF or equivalent (includes jig and probe capacitance)
 R_L = R₁ = 500Ω or equivalent
 R_T = Z_{OUT} of pulse generator (typically 50Ω)

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

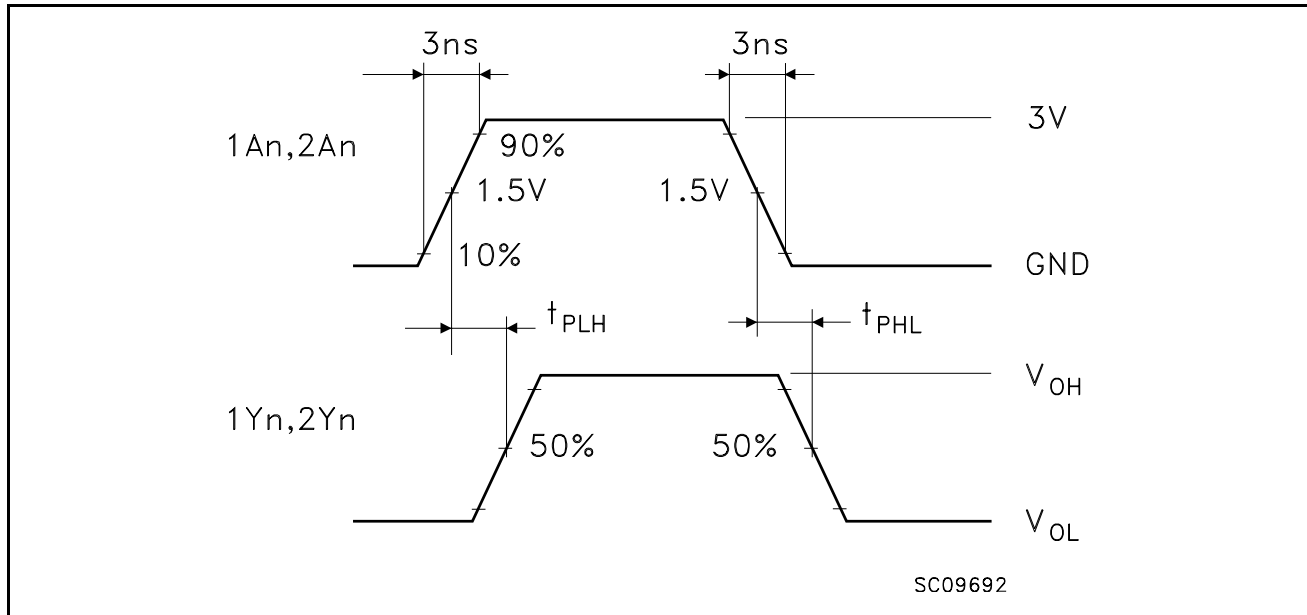
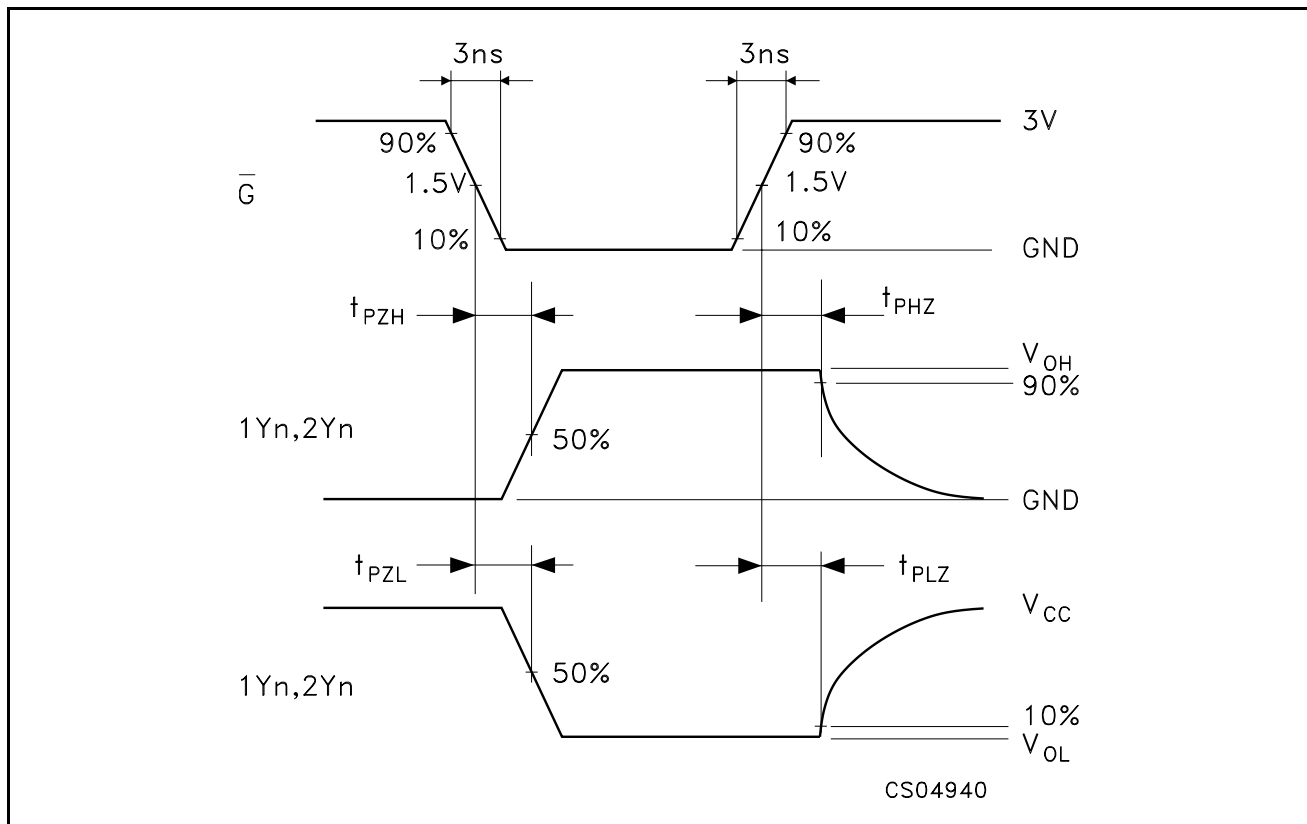
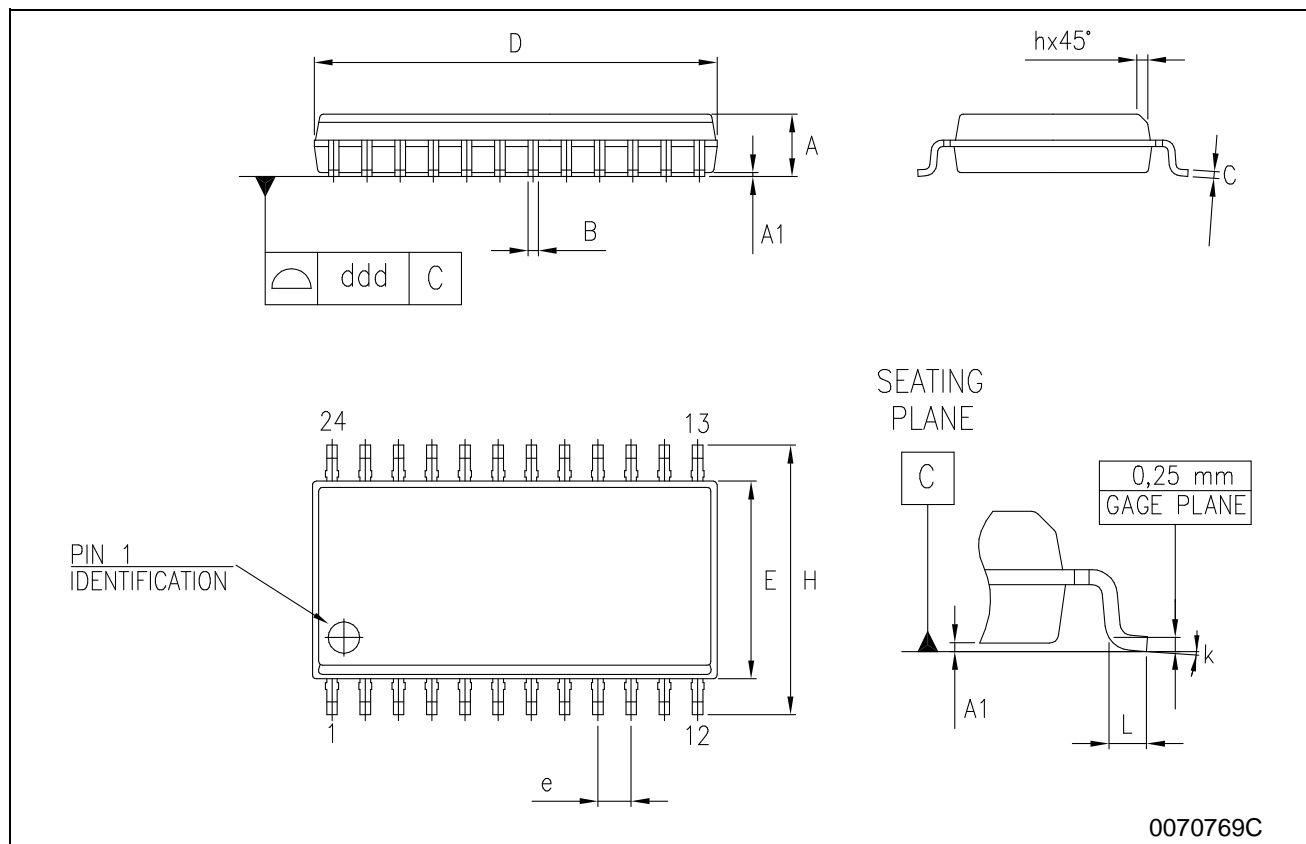


Figure 5: Waveform - Output Enable And Disable Time ($f=1\text{MHz}$; 50% duty cycle)



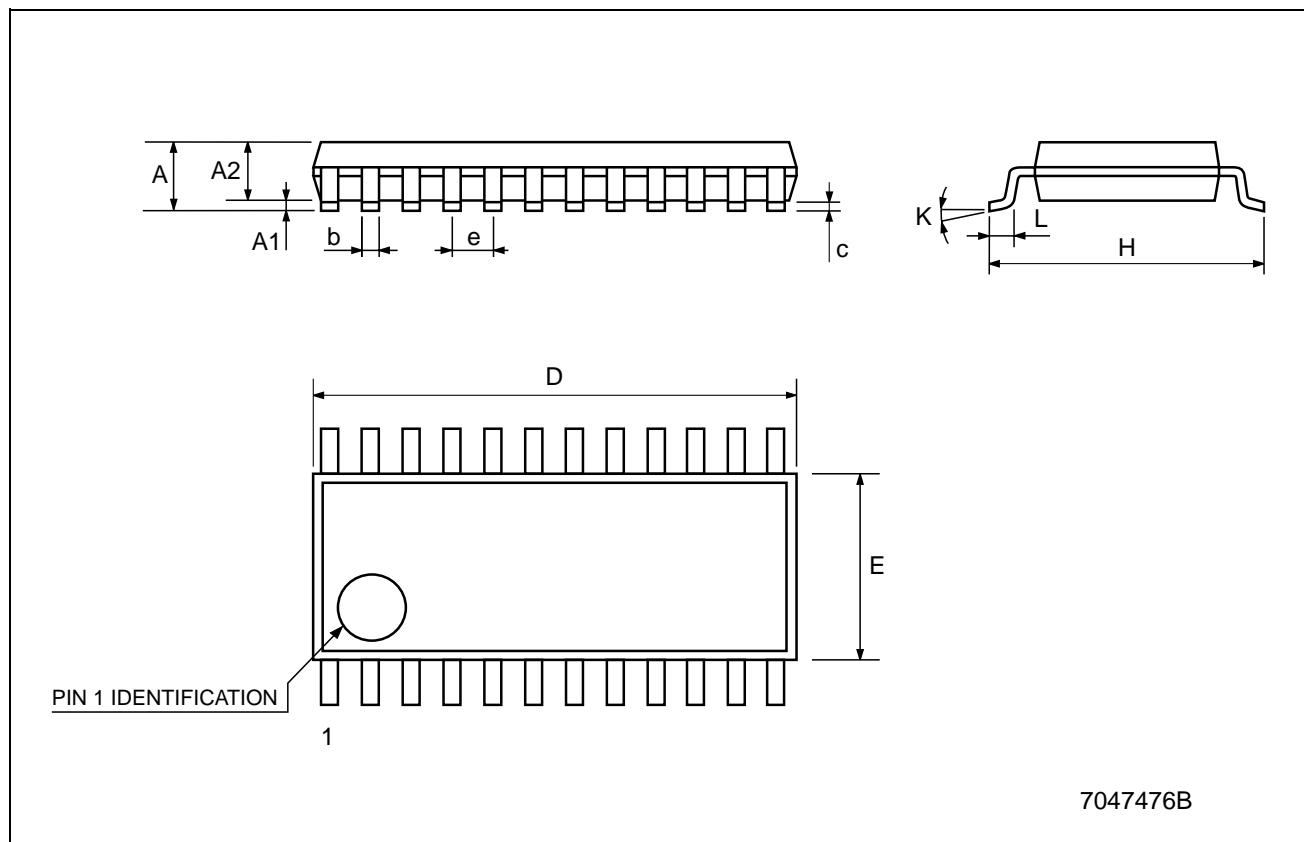
SO-24 MECHANICAL DATA

| 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 | 15.20 | | 15.60 | 0.598 | | 0.614 |
| 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 |



TSSOP24 MECHANICAL DATA

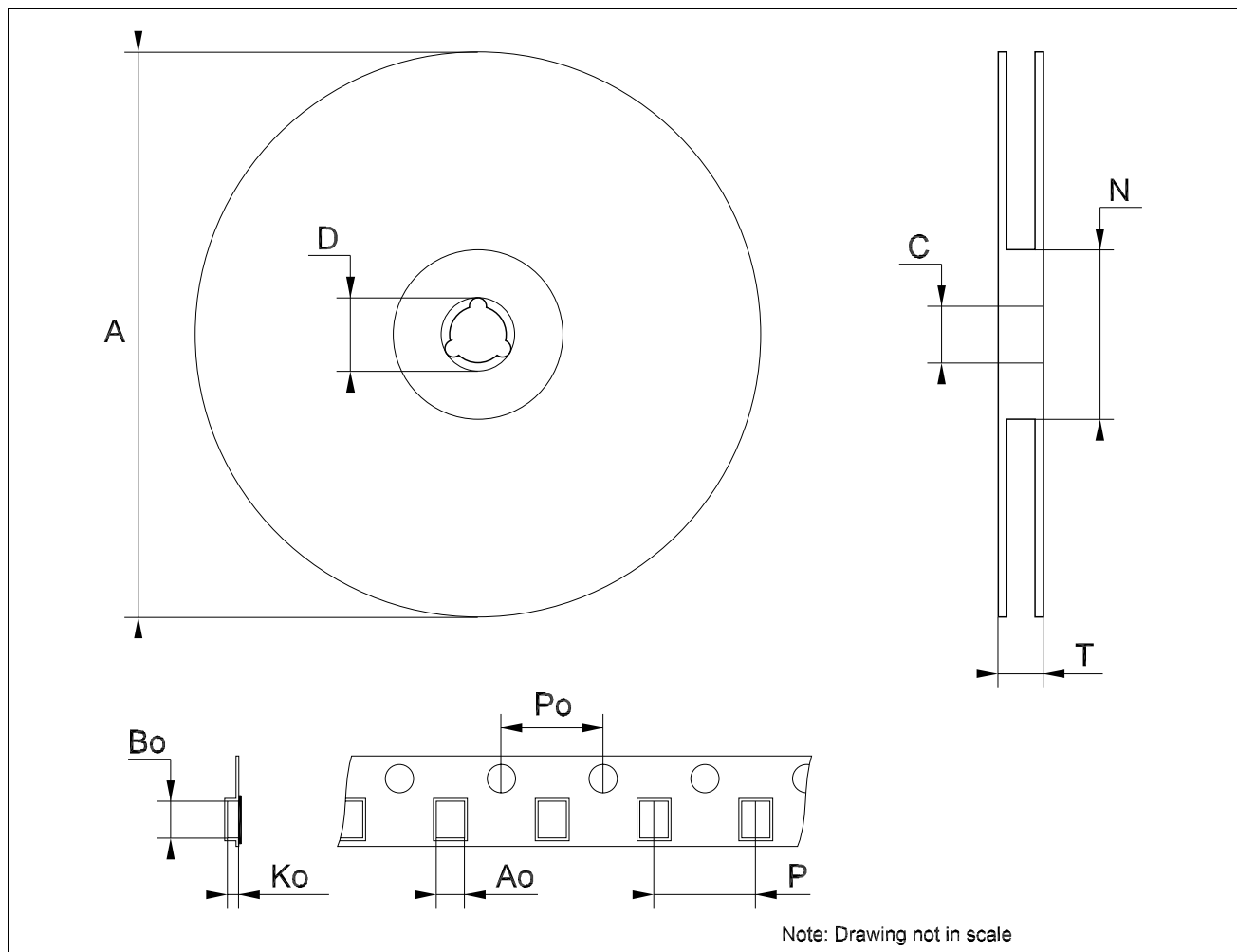
| DIM. | mm. | | | inch | | |
|------|------|----------|------|--------|------------|--------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.1 | | | 0.043 |
| A1 | 0.05 | | 0.15 | 0.002 | | 0.006 |
| A2 | | 0.9 | | | 0.035 | |
| b | 0.19 | | 0.30 | 0.0075 | | 0.0118 |
| c | 0.09 | | 0.20 | 0.0035 | | 0.0079 |
| D | 7.7 | | 7.9 | 0.303 | | 0.311 |
| E | 4.3 | | 4.5 | 0.169 | | 0.177 |
| e | | 0.65 BSC | | | 0.0256 BSC | |
| H | 6.25 | | 6.5 | 0.246 | | 0.256 |
| K | 0° | | 8° | 0° | | 8° |
| L | 0.50 | | 0.70 | 0.020 | | 0.028 |



7047476B

Tape & Reel SO-24 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 | 0.425 | | 0.433 |
| Bo | 15.7 | | 15.9 | 0.618 | | 0.626 |
| Ko | 2.9 | | 3.1 | 0.114 | | 0.122 |
| Po | 3.9 | | 4.1 | 0.153 | | 0.161 |
| P | 11.9 | | 12.1 | 0.468 | | 0.476 |



Tape & Reel TSSOP24 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 | 8.2 | | 8.4 | 0.323 | | 0.331 |
| 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 |

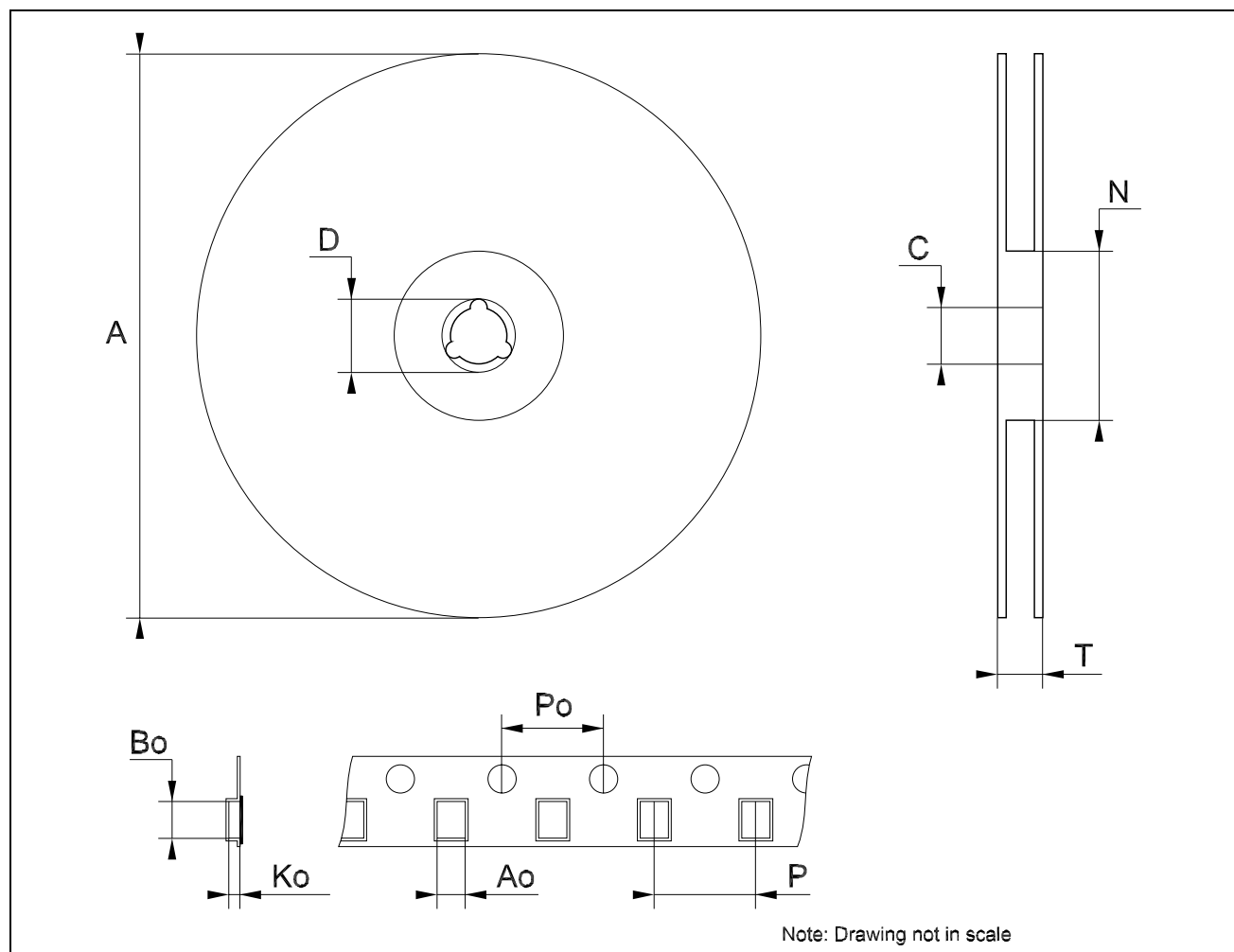


Table 11: Revision History

| Date | Revision | Description of Changes |
|-------------|----------|-----------------------------------|
| 27-Aug-2004 | 6 | Ordering Codes Revision - pag. 1. |

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