

Features

- 18 Mbps (max.) data rate when driven by a totem pole driver
- 6.8 Mbps (max.) data rate when driven by an open drain pole driver
- Bidirectional level translation without direction control pin
- Wide V_L voltage range of 1.65 to 3.6 V
- Wide V_{CC} voltage range of 1.80 to 5.5 V
- Power-down mode feature: when either supply is off, all I/Os are in high impedance
- Low quiescent current (max. 4 μ A)
- Able to be driven by totem pole and open drain drivers
- 5.5 V tolerant enable pin
- ESD performance on all pins: ± 2 kV HBM
- Small package and footprint: QFN10 (1.8 x 1.4 mm) package

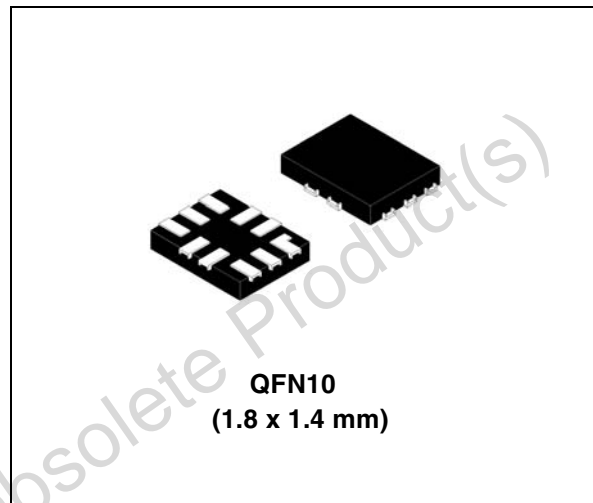


Table 1. Device summary

| Order code | Package | Packing |
|---------------|-------------------------|--|
| ST2329AQTRQTR | QFN10 (1.8 x 1.4 mm) | Tape and reel (3000 parts per reel) |

Applications

- Low voltage system level translation
- Mobile phones and other mobile devices
- I²C level translation
- UART level translation

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Obsolete Product(s) - Obsolete Product(s)

1 Description

The ST2329A is a 2-bit dual supply level translator which provides the level shifting capability to allow data transfer in a multi-voltage system. Externally applied voltages, V_{CC} and V_L , set the logic levels on either side of the device. It utilizes a transmission gate-based design that allows bidirectional level translation without a control pin.

The ST2329A accepts V_L from 1.65 to 3.6 V and V_{CC} from 1.80 to 5.5 V, making it ideal for data transfer between low-voltage ASICs/PLD and higher voltage systems. This device has a tri-state output mode which can be used to disable all I/Os.

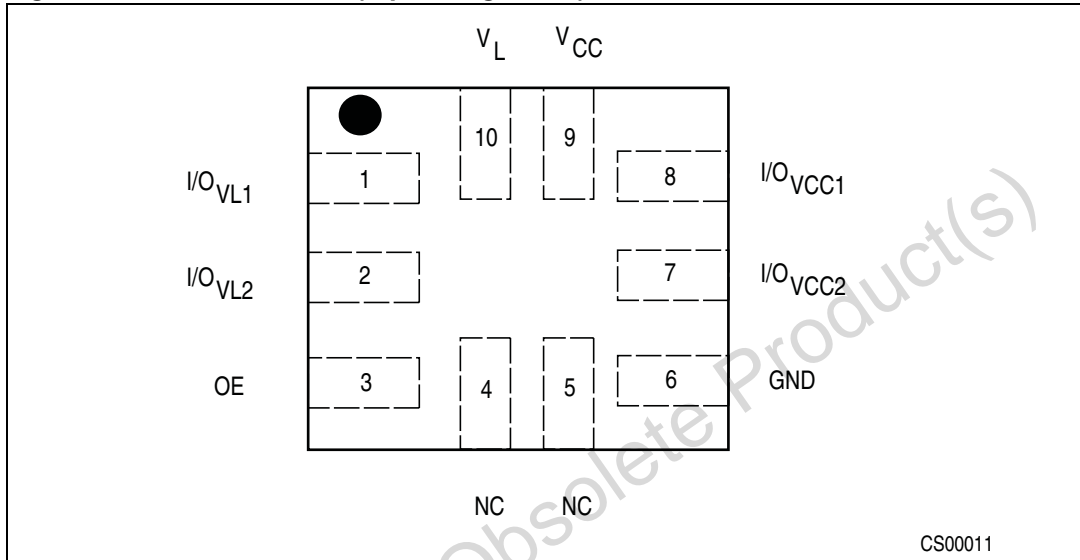
The ST2329A supports power-down mode when V_{CC} is grounded/floating and the device is disabled via the OE pin.

Obsolete Product(s) - Obsolete Product(s)

2 Pin settings

2.1 Pin connection

Figure 1. Pin connection (top through view)



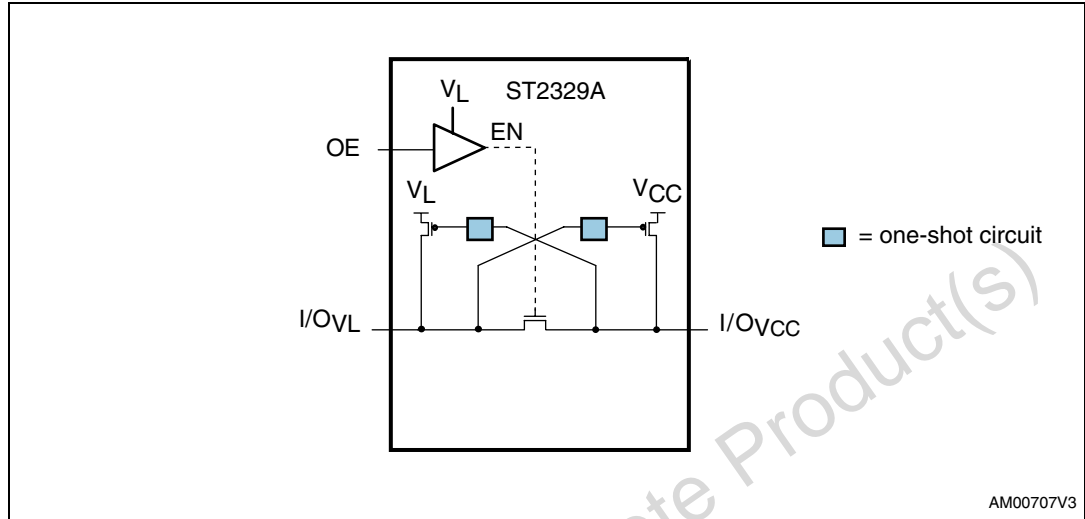
2.2 Pin description

Table 2. Pin description

| Pin number | Symbol | Name and function |
|------------|---------------------|-------------------|
| 1 | I/O _{VL1} | Data input/output |
| 2 | I/O _{VL2} | Data input/output |
| 3 | OE | Output enable |
| 4 | NC | No connection |
| 5 | NC | No connection |
| 6 | GND | Ground |
| 7 | I/O _{VCC2} | Data input/output |
| 8 | I/O _{VCC1} | Data input/output |
| 9 | V _{CC} | Supply voltage |
| 10 | V _L | Supply voltage |

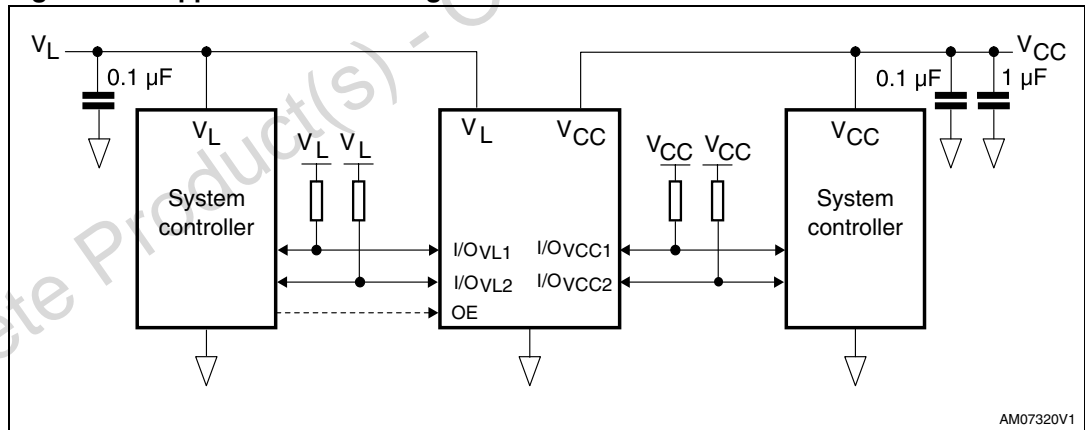
3 Device block diagrams

Figure 2. ST2329A block diagram



1. ST2329A has 2 channels. For simplicity, the diagram above shows only 1 channel.
2. When OE is LOW, all I/Os are in high impedance mode.

Figure 3. Application block diagram



4 Supplementary notes

4.1 Driver requirements

The ST2329A may be driven by an open drain or totem pole driver and the nature of the device output is “open drain”. It must not be used to drive a pull-down resistor as the impedance of the output at HIGH state depends on the pull-up resistor placed at the I/Os.

As the device has pull-up resistors on both the I/O_{VCC} and I/O_{VL} ports, the user needs to ensure that the driver is able to sink the required amount of current. For example, if the settings are V_{CC} = 5.5 V, V_L = 4.3 V, and the pull-up resistor is 10 kΩ then the driver must be able to sink at least $(5.5 \text{ V} / 10 \text{ k}\Omega) + (4.3 \text{ V} / 10 \text{ k}\Omega) = 1 \text{ mA}$ and still meet the V_{IL} requirements of the ST2329A.

4.2 Load driving capability

To support the open drain system, the one-shot transistor is turned on only during high transition at the output side. When it drives a high state, after the one-shot transistor is turned off, only the pull-up resistor is able to maintain the state. In this case, the resistive load is not recommended.

4.3 Power-off feature

In some applications where it might be required to turn off one of the power supplies powering up the level translator, the user may turn off the V_{CC} only when the OE pin is low (device is disabled). There is no current consumption in V_L due to floating gates or other causes, and the I/Os are in a high impedance state in this mode.

4.4 Truth table

Table 3. Truth table

| Enable | Bidirectional input/output | |
|------------------|----------------------------|-------------------|
| OE | I/O _{VCC} | I/O _{VL} |
| H ⁽¹⁾ | H ⁽²⁾ | H ⁽¹⁾ |
| H ⁽¹⁾ | L | L |
| L | Z ⁽³⁾ | Z ⁽³⁾ |

1. High level V_L power supply referred.
2. High level V_{CC} power supply referred.
3. Z = high impedance.

5 Maximum rating

Stressing the device above the rating listed in [Table 4: Absolute maximum ratings](#) may cause permanent damage to the device. These are stress ratings only, and operation of the device at these or any other conditions above those indicated in [Table 5: Recommended operating conditions](#) of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 4. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|--------------|--|------------------------|------|
| V_L | Supply voltage | -0.3 to 4.6 | V |
| V_{CC} | Supply voltage | -0.3 to 6.5 | V |
| V_{OE} | DC control input voltage | -0.3 to 6.5 | V |
| $V_{I/OVL}$ | DC I/O _{VL} input voltage (OE = GND or V_L) | -0.3 to $V_L + 0.3$ | V |
| $V_{I/OVCC}$ | DC I/O _{VCC} input voltage (OE = GND or V_L) | -0.3 to $V_{CC} + 0.3$ | V |
| I_{IK} | DC input diode current | -20 | mA |
| $I_{I/OVL}$ | DC output current | ±25 | mA |
| $I_{I/OVCC}$ | DC output current | ±258 | mA |
| I_{SCTOUT} | Short-circuit duration, continuous | 40 | mA |
| P_D | Power dissipation ⁽¹⁾ | 500 | mW |
| T_{STG} | Storage temperature | -65 to 150 | °C |
| TL | Lead temperature (10 seconds) | 300 | °C |
| ESD | Electrostatic discharge protection (HBM) | ±2 | kV |

1. 500 mW: 65 °C derated to 300 mW by 10 mW / °C: 65 °C to 85 °C.

Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------------|--|------|-----|----------|------|
| V_L | Supply voltage | 1.65 | – | 3.6 | V |
| $V_{CC}^{(1)}$ | Supply voltage | 1.8 | – | 5.5 | V |
| V_{OE} | Input voltage (OE output enable pin, V_L power supply referred) | 0 | – | 3.6 | V |
| $V_{I/OVL}$ | I/O _{VL} voltage | 0 | – | V_L | V |
| $V_{I/OVCC}$ | I/O _{VCC} voltage | 0 | – | V_{CC} | V |
| T_{op} | Operating temperature | -40 | – | 85 | °C |
| dt/dV | Input rise and fall time | 0 | – | 1 | ns/V |

1. V_{CC} must be greater than V_L .

6 Electrical characteristics

6.1 DC characteristics

Over recommended operating conditions unless otherwise noted. All typical values are at $T_A = 25\text{ }^\circ\text{C}$.

Table 6. DC characteristics

| Symbol | Parameter | V_L | V_{CC} | Test conditions | Value | | | | | Unit |
|-------------|--|------------------|--------------|-----------------|----------------------------------|-----|-----|--|-----|------|
| | | | | | $T_A = 25\text{ }^\circ\text{C}$ | | | $-40\text{ to }85\text{ }^\circ\text{C}$ | | |
| | | | | | Min | Typ | Max | Min | Max | |
| V_{IHL} | High level input voltage (I/O_{VL}) | 1.65 | V_L to 5.5 | - | 1.4 | - | - | 1.4 | - | V |
| | | 2.0 | | | 1.6 | - | - | 1.6 | - | |
| | | 2.5 | | | 2.0 | - | - | 2.0 | - | |
| | | 3.0 | | | 2.4 | - | - | 2.4 | - | |
| | | 3.6 | | | 2.8 | - | - | 2.8 | - | |
| V_{ILL} | Low level input voltage (I/O_{VL}) | 1.65 | V_L to 5.5 | - | - | - | 0.3 | - | 0.3 | V |
| | | 2.0 | | | - | - | 0.4 | - | 0.4 | |
| | | 2.5 | | | - | - | 0.5 | - | 0.5 | |
| | | 3.0 | | | - | - | 0.6 | - | 0.6 | |
| | | 3.6 | | | - | - | 0.8 | - | 0.8 | |
| V_{IHC} | High level input voltage (I/O_{VCC}) | 1.65 to V_{CC} | - | 1.8 | 1.6 | - | - | 1.6 | - | V |
| | | | | 2.5 | 2.3 | - | - | 2.3 | - | |
| | | | | 3.0 | 2.7 | - | - | 2.7 | - | |
| | | | | 3.6 | 3.3 | - | - | 3.3 | - | |
| | | | | 4.3 | 3.5 | - | - | 3.5 | - | |
| | | | | 5.5 | 4.2 | - | - | 4.2 | - | |
| V_{ILC} | Low level input voltage (I/O_{VCC}) | 1.65 - 2.5 | 3 - 5.5 | - | - | - | - | 0.3 | - | V |
| | | 2.7 - 3.6 | 3.6 - 5.5 | - | - | - | - | 0.5 | - | |
| V_{IH-OE} | High level input voltage (OE) | 1.65 | V_L to 5.5 | - | 1.0 | - | - | 1.0 | - | V |
| | | 2.0 | | | 1.2 | - | - | 1.2 | - | |
| | | 2.5 | | | 1.4 | - | - | 1.4 | - | |
| | | 3.0 | | | 1.6 | - | - | 1.6 | - | |
| | | 3.6 | | | 2.0 | - | - | 2.0 | - | |

Table 6. DC characteristics (continued)

| Symbol | Parameter | V _L | V _{CC} | Test conditions | Value | | | | | Unit |
|---------------------|--|----------------|-----------------------|--|------------------------|------|------|--------------|------|------|
| | | | | | T _A = 25 °C | | | -40 to 85 °C | | |
| | | | | | Min | Typ | Max | Min | Max | |
| V _{IL-OE} | Low level input voltage (OE) | 1.65 | V _L to 5.5 | | - | - | 0.33 | - | 0.33 | V |
| | | 2.0 | | | - | - | 0.40 | - | 0.40 | |
| | | 2.5 | | | - | - | 0.50 | - | 0.50 | |
| | | 3.0 | | | - | - | 0.60 | - | 0.60 | |
| | | 3.6 | | | - | - | 0.75 | - | 0.75 | |
| V _{OLL} | Low level output voltage (I/O _{VL}) | 1.65 to 3.6 | V _L to 5.5 | I _O = 1.0 mA I/O _{VCC} ≤ 0.15 V | - | - | 0.40 | - | 0.40 | V |
| V _{OLC} | Low level output voltage (I/O _{VCC}) | 1.65 to 3.6 | V _L to 5.5 | I _O = 1.0 mA I/O _{VL} ≤ 0.15 V | - | - | 0.40 | - | 0.40 | V |
| I _{OE} | Control input leakage current (OE) | 1.65 to 3.6 | V _L to 5.5 | V _{OE} = GND or V _L | - | - | ±0.1 | - | ±0.1 | µA |
| I _{IO_LKG} | High impedance leakage current (I/O _{VL} , I/O _{VCC}) | 1.65 to 3.6 | V _L to 5.5 | OE = GND | - | - | ±0.1 | - | ±0.1 | µA |
| I _{QVCC} | Quiescent supply current V _{CC} | 1.65 to 3.6 | V _L to 5.5 | Only pull-up resistor connected to I/O | - | 3 | 3.5 | - | 4 | µA |
| I _{QVL} | Quiescent supply current V _L | 1.65 to 3.6 | V _L to 5.5 | only pull-up resistor connected to I/O | - | 0.01 | 0.1 | - | 1 | µA |
| I _{Z-VCC} | High impedance quiescent supply current V _{CC} | 1.65 to 3.6 | V _L to 5.5 | OE = GND; only pull-up resistor connected to I/O | - | 3 | 3.5 | - | 4 | µA |
| I _{Z-VL} | High impedance quiescent supply current V _L | 1.65 to 3.6 | V _L to 5.5 | OE = GND; only pull-up resistor connected to I/O | - | 0.01 | 0.1 | - | 1 | µA |

6.2 AC characteristics

6.2.1 Device driven by open drain driver

Load $C_L = 15 \text{ pF}$; $R_{up} = 4.7 \text{ k}\Omega$; driver $t_r = t_f \leq 2 \text{ ns}$ overtemperature range $-40 \text{ }^\circ\text{C}$ to $85 \text{ }^\circ\text{C}$.

Table 7. AC characteristics - test conditions: $V_L = 1.65 - 1.8 \text{ V}$

| Symbol | Parameter | $V_{CC} = 1.8 - 2.5 \text{ V}$ | | $V_{CC} = 2.7 - 3.6 \text{ V}$ | | $V_{CC} = 4.3 - 5.5 \text{ V}$ | | Unit | |
|--|--|--------------------------------|------|--------------------------------|------|--------------------------------|------|------|----|
| | | Min | Max | Min | Max | Min | Max | | |
| t_{RVCC} | Rise time I/O_{VCC} | – | 80.0 | – | 60.0 | – | 45.0 | ns | |
| t_{FVCC} | Fall time I/O_{VCC} | – | 23.2 | – | 33.9 | – | 53.3 | ns | |
| t_{RVL} | Rise time I/O_{VL} | – | 60.0 | – | 45.0 | – | 35.0 | ns | |
| t_{FVL} | Fall time I/O_{VL} | – | 16.4 | – | 17.6 | – | 16.9 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O_{VL-LH} to I/O_{VCC-LH} I/O_{VL-HL} to I/O_{VCC-HL} | t_{PLH} | – | 3.4 | – | 2.0 | – | 2.0 | ns |
| | | t_{PHL} | – | 13.9 | – | 19.1 | – | 30.2 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O_{VCC-LH} to I/O_{VL-LH} I/O_{VCC-HL} to I/O_{VL-LH} | t_{PLH} | – | 2.0 | – | 2.0 | – | 2.6 | ns |
| | | t_{PHL} | – | 8.6 | – | 9.0 | – | 9.5 | ns |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | En | – | 10 | – | 10 | – | 10 | ns |
| | | Dis | – | 40 | – | 40 | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | – | 1.8 | – | 2.2 | – | 3.4 | MHz | |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

Table 8. AC characteristics - test conditions: $V_L = 2.5 - 2.7 \text{ V}$

| Symbol | Parameter | $V_{CC} = 2.7 - 3.6 \text{ V}$ | | $V_{CC} = 4.3 - 5.5 \text{ V}$ | | Unit | |
|-----------------|--|--------------------------------|------|--------------------------------|------|------|----|
| | | Min | Max | Min | Max | | |
| t_{RVCC} | Rise time I/O_{VCC} | – | 70.0 | – | 50.0 | ns | |
| t_{FVCC} | Fall time I/O_{VCC} | – | 14.8 | – | 19.1 | ns | |
| t_{RVL} | Rise time I/O_{VL} | – | 50.0 | – | 35.0 | ns | |
| t_{FVL} | Fall time I/O_{VL} | – | 9.8 | – | 10.0 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O_{VL-LH} to I/O_{VCC-LH} I/O_{VL-HL} to I/O_{VCC-HL} | t_{PLH} | – | 2.0 | – | 2.0 | ns |
| | | t_{PHL} | – | 8.2 | – | 11.6 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O_{VCC-LH} to I/O_{VL-LH} I/O_{VCC-HL} to I/O_{VL-LH} | t_{PLH} | – | 2.0 | – | 2.0 | ns |
| | | t_{PHL} | – | 5.3 | – | 5.9 | ns |

Table 8. AC characteristics - test conditions: $V_L = 2.5 - 2.7$ V (continued)

| Symbol | Parameter | | $V_{CC} = 2.7 - 3.6$ V | | $V_{CC} = 4.3 - 5.5$ V | | Unit | |
|--|--------------------------------|--|------------------------|-----|------------------------|-----|------|----|
| | | | Min | Max | Min | Max | | |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | | En | – | 6 | – | 6 | ns |
| | | | Dis | – | 40 | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | | – | 2.2 | – | 3.0 | MHz | |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

Table 9. AC characteristics - test conditions: $V_L = 2.7 - 3.6$ V

| Symbol | Parameter | | $V_{CC} = 4.3 - 5.5$ V | | Unit | |
|--|--|--|------------------------|------|------|-----|
| | | | Min | Max | | |
| t_{RVCC} | Rise time I/O _{VCC} | | – | 55.0 | ns | |
| t_{FVCC} | Fall time I/O _{VCC} | | – | 17.2 | ns | |
| t_{RVL} | Rise time I/O _{VL} | | – | 40.0 | ns | |
| t_{FVL} | Fall time I/O _{VL} | | – | 9.7 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O _{VL-LH} to I/O _{VCC-LH} I/O _{VL-HL} to I/O _{VCC-HL} | | t_{PLH} | – | 2.0 | ns |
| | | | t_{PHL} | – | 10.6 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O _{VCC-LH} to I/O _{VL-LH} I/O _{VCC-HL} to I/O _{VL-HL} | | t_{PLH} | – | 2.0 | ns |
| | | | t_{PHL} | – | 4.8 | ns |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | | En | – | 6 | ns |
| | | | Dis | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | | – | – | 3.0 | MHz |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

6.2.2 Device driven by totem pole driver

Load $C_L = 15 \text{ pF}$; $R_{up} = 10 \text{ k}\Omega$; driver $t_r = t_f \leq 2 \text{ ns}$ overtemperature range $-40 \text{ }^\circ\text{C}$ to $85 \text{ }^\circ\text{C}$.

Table 10. AC characteristics - test conditions: $V_L = 1.65 - 1.8 \text{ V}$

| Symbol | Parameter | $V_{CCB} = 1.8 - 2.5 \text{ V}$ | | $V_{CCB} = 2.7 - 3.6 \text{ V}$ | | $V_{CCB} = 4.3 - 5.5 \text{ V}$ | | Unit | |
|--|--|---------------------------------|------|---------------------------------|------|---------------------------------|------|------|----|
| | | Min | Max | Min | Max | Min | Max | | |
| t_{RVCC} | Rise time I/O _{VCC} | – | 7.2 | – | 4.6 | – | 1.4 | ns | |
| t_{FVCC} | Fall time I/O _{VCC} | – | 23.2 | – | 33.9 | – | 53.3 | ns | |
| t_{RVL} | Rise time I/O _{VL} | – | 5.9 | – | 5.7 | – | 5.5 | ns | |
| t_{FVL} | Fall time I/O _{VL} | – | 16.4 | – | 17.6 | – | 16.9 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O _{VL-LH} to I/O _{VCC-LH} I/O _{VL-HL} to I/O _{VCC-HL} | t_{PLH} | – | 5.5 | – | 4.1 | – | 3.6 | ns |
| | | t_{PHL} | – | 13.9 | – | 19.1 | – | 30.2 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O _{VCC-LH} to I/O _{VL-LH} I/O _{VCC-HL} to I/O _{VL-HL} | t_{PLH} | – | 4.5 | – | 3.9 | – | 3.6 | ns |
| | | t_{PHL} | – | 8.6 | – | 9.0 | – | 9.5 | ns |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | En | – | 10 | – | 10 | – | 10 | ns |
| | | Dis | – | 40 | – | 40 | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | – | 6.4 | – | 4.5 | – | 3.0 | MHz | |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

Table 11. AC characteristics - test conditions: $V_L = 2.5 - 2.7 V$

| Symbol | Parameter | $V_{CC} = 2.7 - 3.6 V$ | | $V_{CC} = 4.3 - 5.5 V$ | | Unit | |
|--|--|------------------------|------|------------------------|------|------|----|
| | | Min | Max | Min | Max | | |
| t_{RVCC} | Rise time I/O_{VCC} | – | 3.8 | – | 2.8 | ns | |
| t_{FVCC} | Fall time I/O_{VCC} | – | 14.8 | – | 19.1 | ns | |
| t_{RVL} | Rise time I/O_{VL} | – | 3.3 | – | 3.2 | ns | |
| t_{FVL} | Fall time I/O_{VL} | – | 9.8 | – | 10.0 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O_{VCC-LH} to I/O_{VL-LH} I/O_{VCC-HL} to I/O_{VL-HL} | t_{PLH} | – | 3.2 | – | 2.8 | ns |
| | | t_{PHL} | – | 8.2 | – | 11.6 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O_{VCC-LH} to I/O_{VL-LH} I/O_{VCC-HL} to I/O_{VL-HL} | t_{PLH} | – | 2.6 | – | 2.0 | ns |
| | | t_{PHL} | – | 5.3 | – | 5.9 | ns |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | En | – | 6 | – | 6 | ns |
| | | Dis | – | 40 | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | – | 9 | – | 6.8 | MHz | |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

Table 12. AC characteristics - test conditions: $V_L = 2.7 - 3.6 V$

| Symbol | Parameter | $V_{CC} = 4.3 - 5.5 V$ | | Unit | |
|--|--|------------------------|------|------|----|
| | | Min | Max | | |
| t_{RVCC} | Rise time I/O_{VCC} | – | 2.9 | ns | |
| t_{FVCC} | Fall time I/O_{VCC} | – | 17.2 | ns | |
| t_{RVL} | Rise time I/O_{VL} | – | 3.0 | ns | |
| t_{FVL} | Fall time I/O_{VL} | – | 9.7 | ns | |
| $t_{I/OVL-VCC}$ | Propagation delay time I/O_{VL-LH} to I/O_{VCC-LH} I/O_{VL-HL} to I/O_{VCC-HL} | t_{PLH} | – | 2.7 | ns |
| | | t_{PHL} | – | 10.6 | ns |
| $t_{I/OVCC-VL}$ | Propagation delay time I/O_{VCC-LH} to I/O_{VL-LH} I/O_{VCC-HL} to I/O_{VL-HL} | t_{PLH} | – | 1.9 | ns |
| | | t_{PHL} | – | 4.8 | ns |
| t_{PZL} t_{PZH} t_{PLZ} t_{PHZ} | Output enable and disable time | En | – | 6 | ns |
| | | Dis | – | 40 | ns |
| D_R | Data rate ⁽¹⁾ | – | 7.2 | MHz | |

1. The data rate is guaranteed based on the condition that the output I/O signal rise/fall time is less than 15% of the input I/O signal period; the input I/O signal is at 50% duty cycle and the output I/O signal duty cycle deviation not less than 30%.

Figure 4. Test circuit

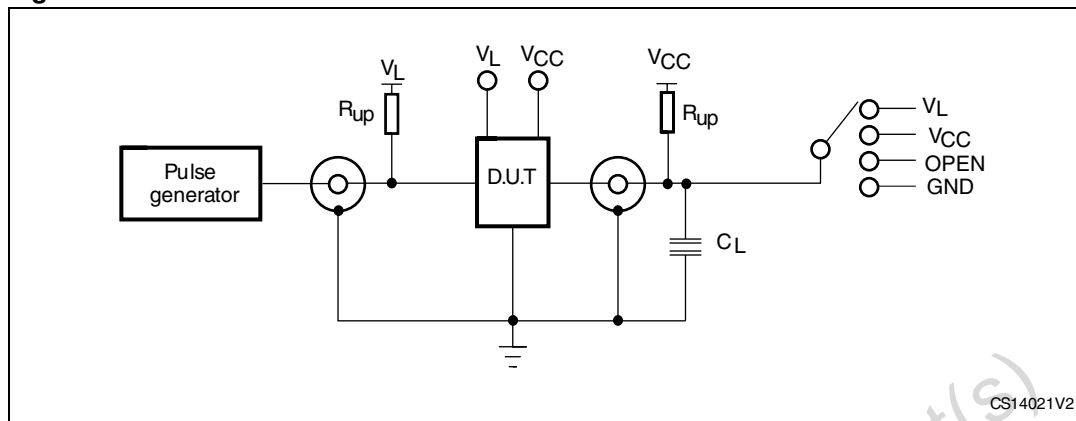


Table 13. Test circuit switches

| Test | Switch | | |
|-------------------------------------|--------------------------------------|---------------------------------------|--------------------|
| | Driving I/O _{V_L} | Driving I/O _{V_{CC}} | Open drain driving |
| t _{PLH} , t _{PHL} | Open | Open | Open |

7 Waveforms

Table 14. Waveform symbol value

| Symbol | Driving I/O _{VL} | | Driving I/O _{VCC} | |
|-----------------|---|---|---|---|
| | $1.8\text{ V} \leq V_L \leq V_{CC} \leq 2.5\text{ V}$ | $3.3\text{ V} \leq V_L \leq V_{CC} \leq 5.0\text{ V}$ | $1.8\text{ V} \leq V_L \leq V_{CC} \leq 2.5\text{ V}$ | $3.3\text{ V} \leq V_L \leq V_{CC} \leq 5.0\text{ V}$ |
| V _{IH} | V _L | V _L | V _{CC} | V _{CC} |
| V _{IM} | 50% V _L | 50% V _L | 50% V _{CC} | 50% V _{CC} |
| V _{OM} | 50% V _{CC} | 50% V _{CC} | 50% V _L | 50% V _L |
| V _X | V _{OL} + 0.15V | V _{OL} + 0.3V | V _{OL} + 0.15V | V _{OL} + 0.3V |
| V _Y | V _{OH} - 0.15V | V _{OH} - 0.3V | V _{OH} - 0.15V | V _{OH} - 0.3V |

Figure 5. Waveform - propagation delay (f = 1 MHz; 50% duty cycle)

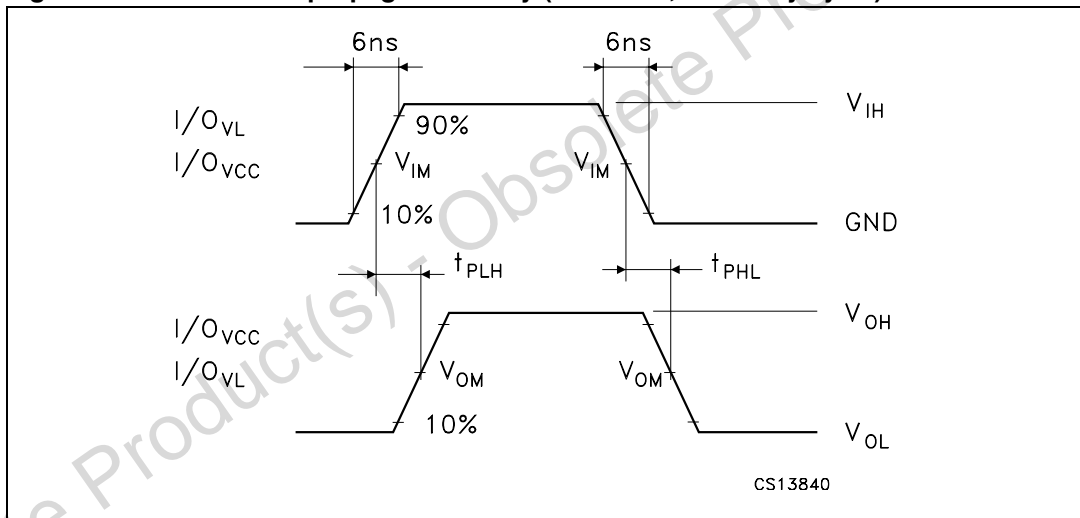
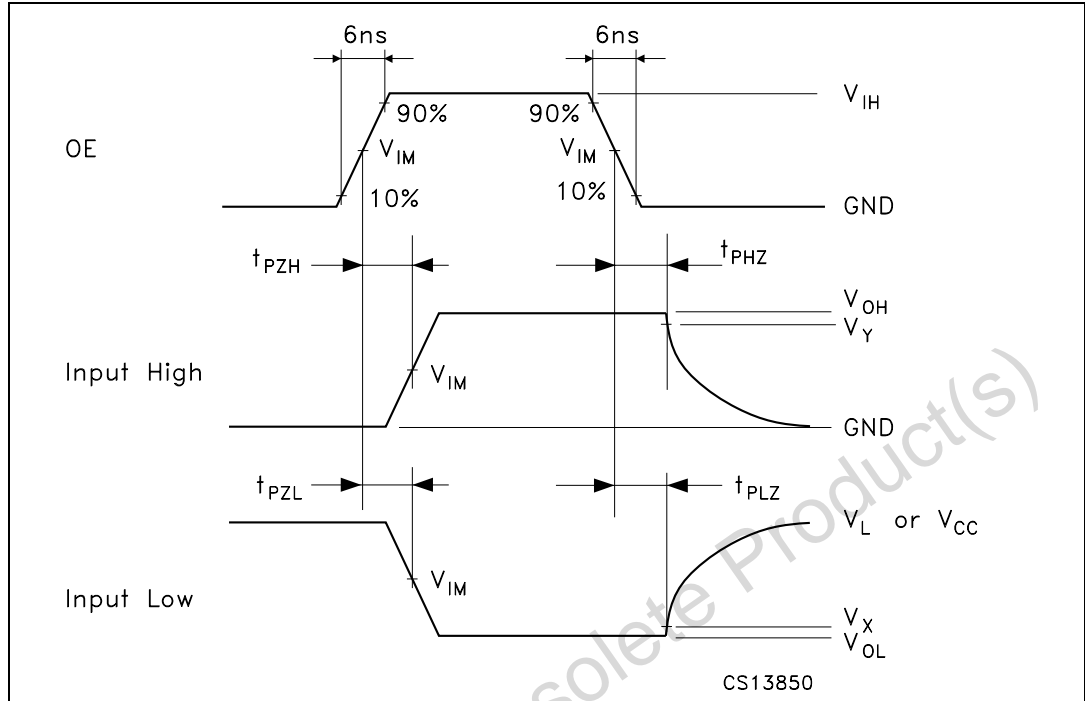


Figure 6. Waveform - output enable and disable time (f = 1 MHz; 50% duty cycle)



8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Figure 7. Package outline for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch

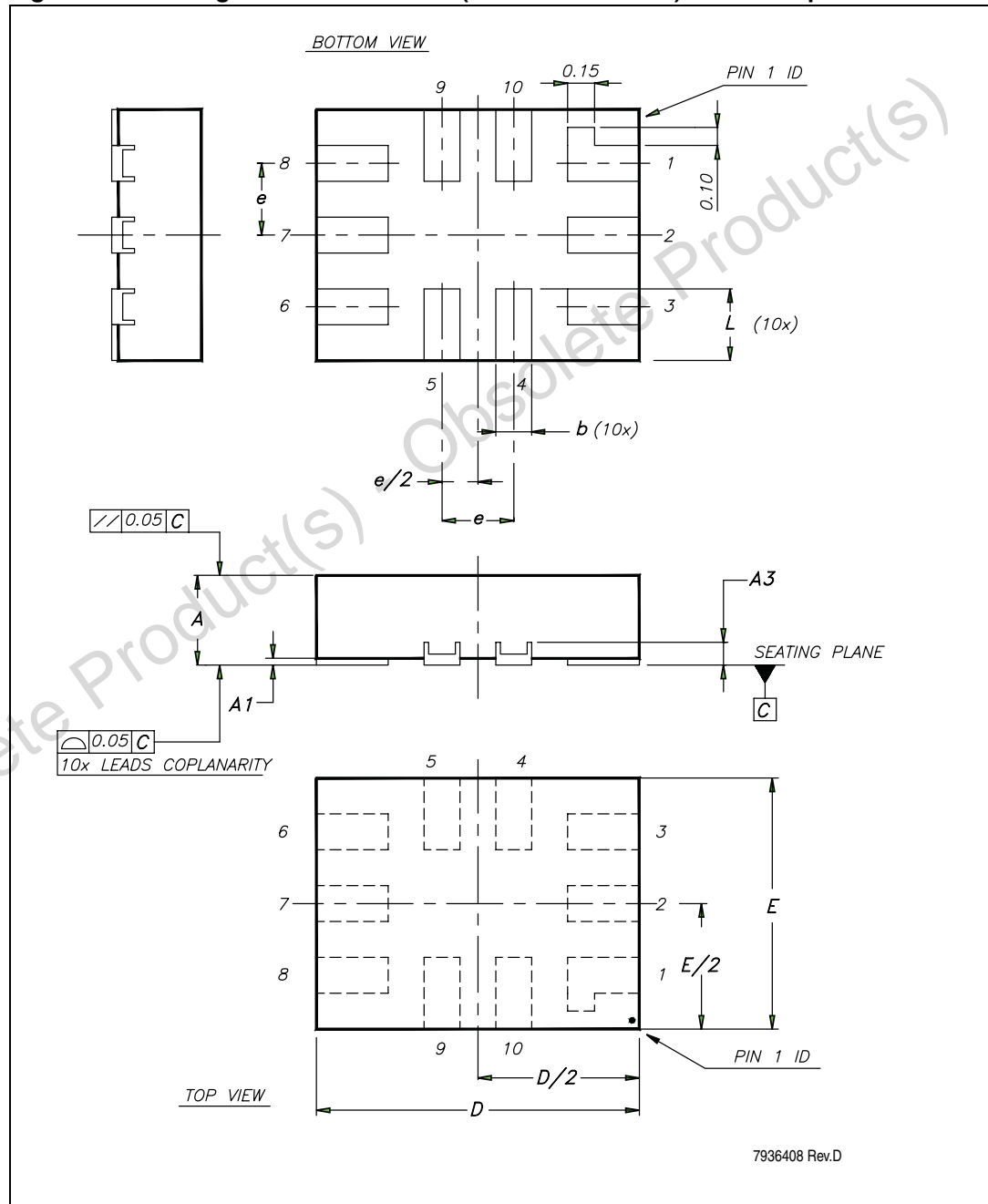


Table 15. Mechanical data for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch

| Symbol | Millimeters | | |
|--------|-------------|------|------|
| | Typ | Min | Max |
| A | 0.50 | 0.45 | 0.55 |
| A1 | 0.02 | 0 | 0.05 |
| A3 | 0.127 | | |
| b | 0.20 | 0.15 | 0.25 |
| D | 1.80 | 1.75 | 1.85 |
| E | 1.40 | 1.35 | 1.45 |
| e | 0.40 | | |
| L | 0.40 | 0.35 | 0.45 |

Figure 8. Footprint recommendation for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch

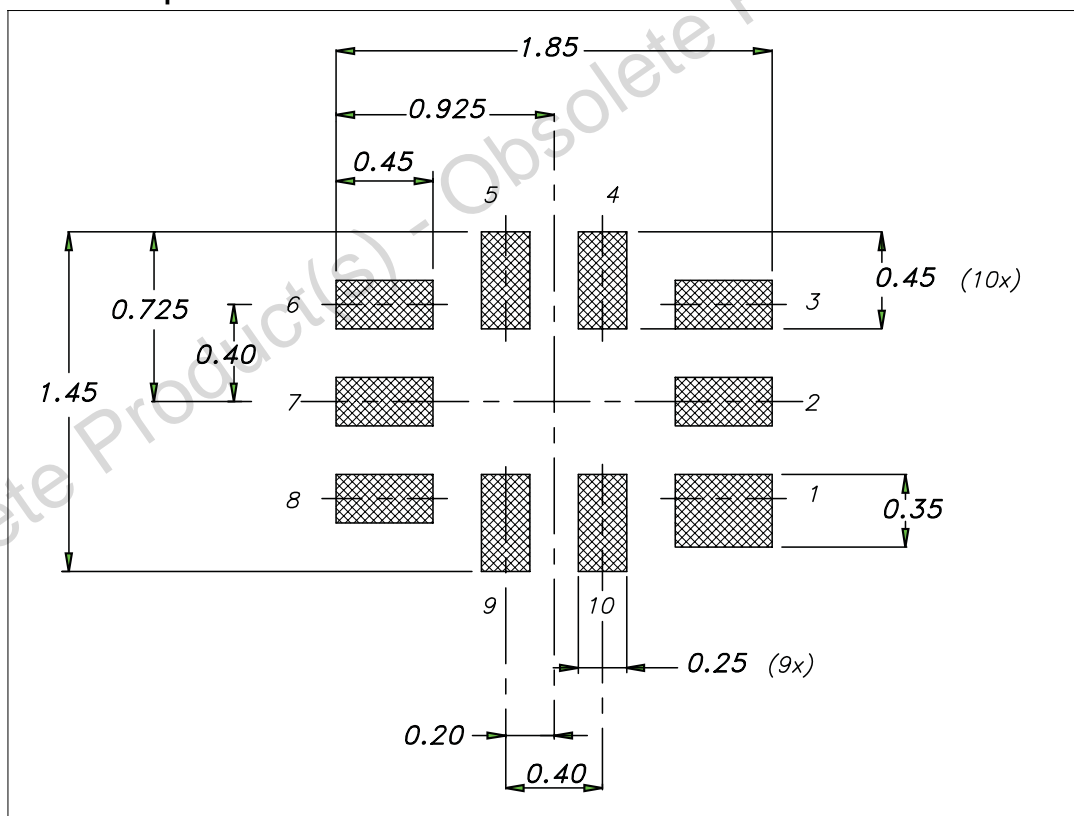


Figure 9. Carrier tape for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch

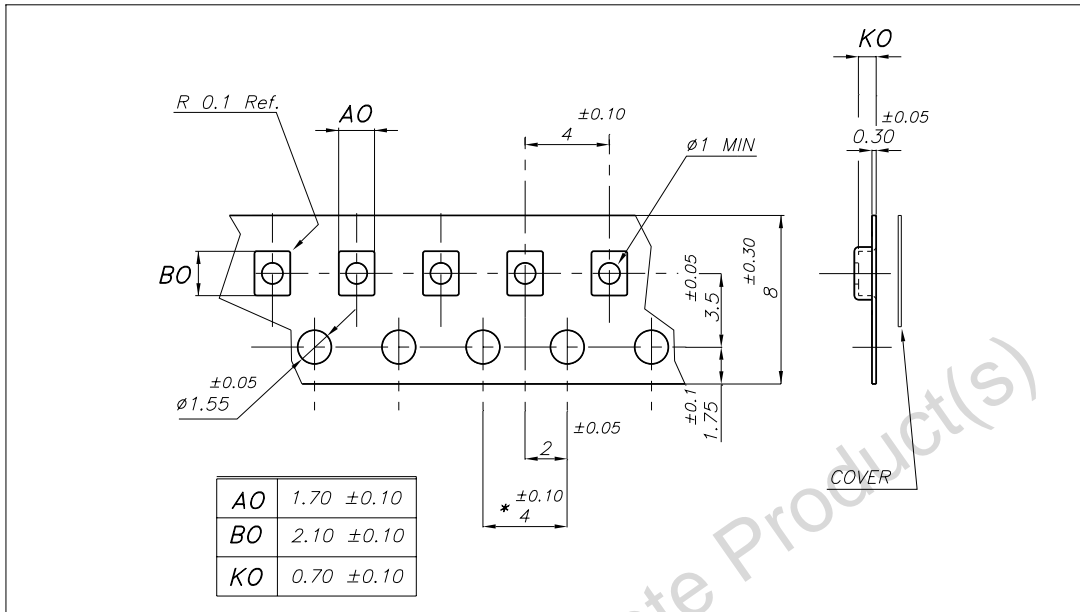


Figure 10. Reel information for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch

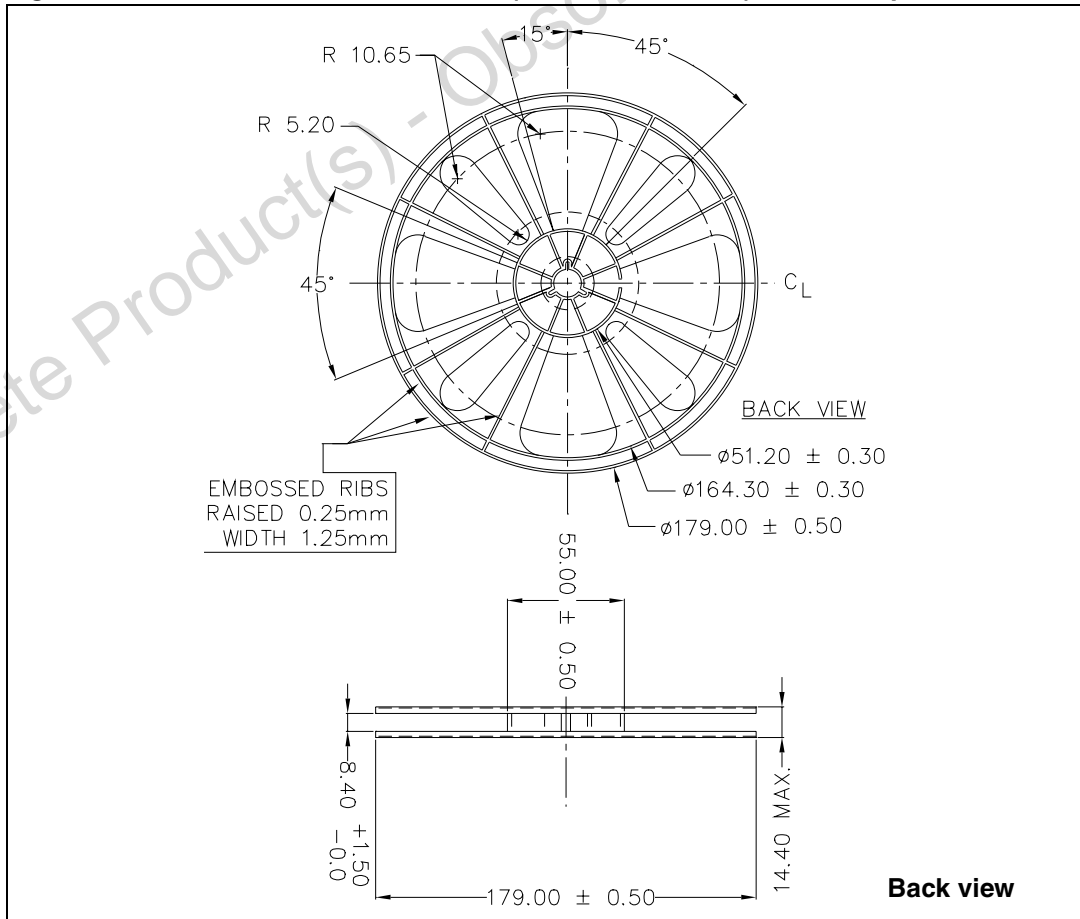
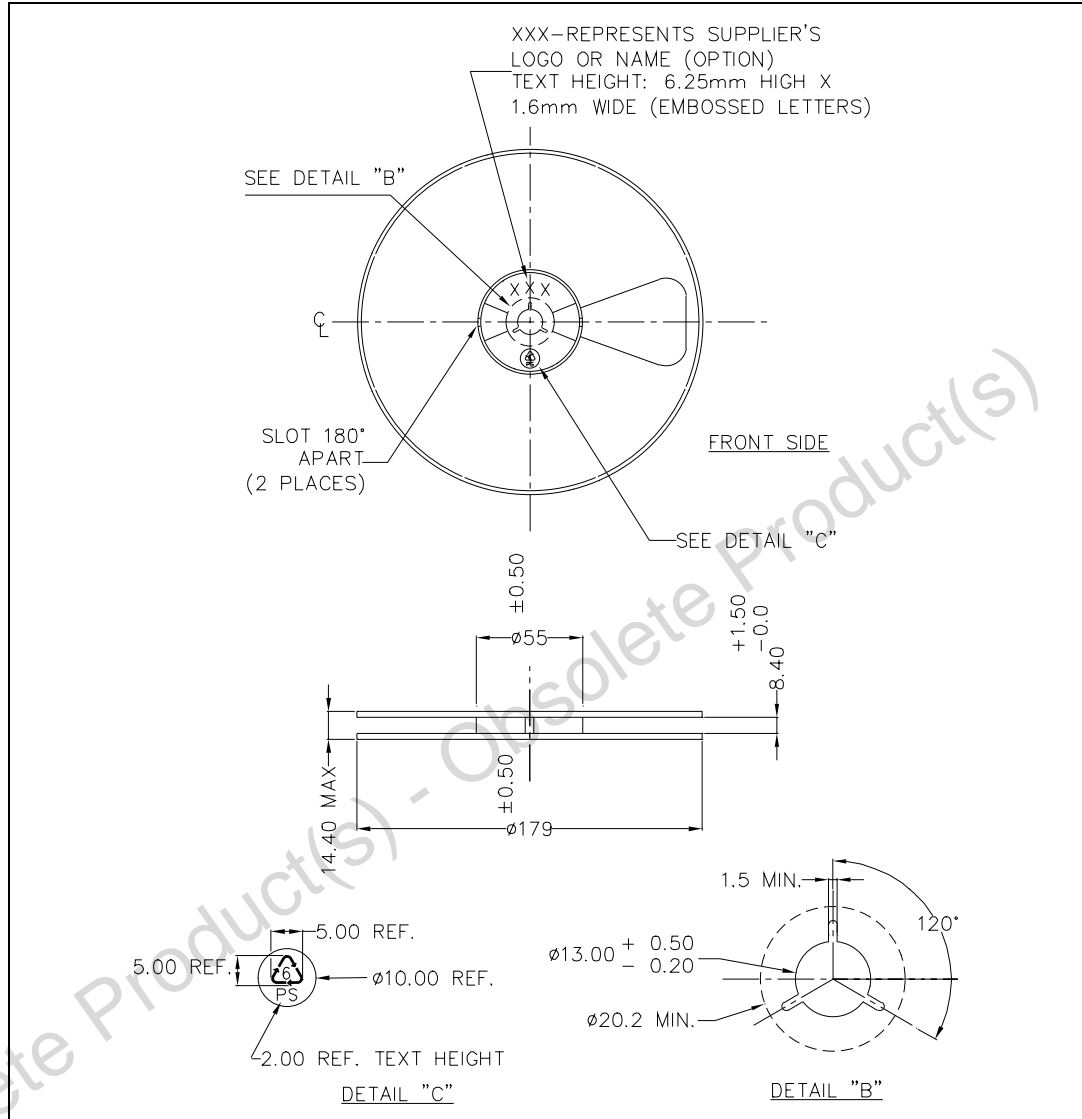


Figure 11. Reel information for QFN10 (1.8 x 1.4 x 0.5 mm) - 0.40 mm pitch



9 Revision history

Table 16. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 16-Jul-2008 | 1 | Initial release. |
| 22-Jun-2009 | 2 | Document status promoted from Preliminary data to datasheet. Updated: Features section and <i>Chapter 6: Electrical characteristics</i> . Modified: <i>Section 8</i> . |
| 02-Mar-2011 | 3 | Document reformatted, moved <i>Description</i> from page 1 to page 5, minor text changes and corrected typo throughout the document. |

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