

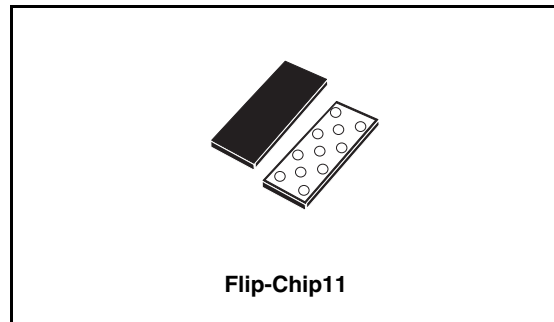


## ST4G3235

### 4-bit dual supply bus buffer level translator with a side series resistor

#### Features

- High speed:  $t_{PD} = 4.3\text{ns}$  (Max.) at  $T_A = 85^\circ\text{C}$   
 $V_{CCB} = 1.65\text{V}$ ;  $V_{CCA} = 3.0\text{V}$
- Low power dissipation:  
 $I_{CCA} = I_{CCB} = 5\mu\text{A}$  (Max.) at  $T_A = 85^\circ\text{C}$
- Symmetrical output impedance:  
 $|I_{OHA}| = |I_{OLA}| = 10\text{mA}$  Min at  
 $V_{CCA} = 2.75\text{V}$ ;  $V_{CCB} = 1.4\text{V}$  to  $3.6\text{V}$   
 $|I_{OHB}| = |I_{OLB}| = 4\text{mA}$  Min at  
 $V_{CCB} = 1.65\text{V}$ ;  $V_{CCA} = 1.4$  to  $3.6\text{V}$
- Balanced propagation delays:  
 $t_{PLH} \cong t_{PHL}$
- Power down protection on inputs and outputs
- $26\Omega$  series resistor on a side outputs
- Operating voltage range:  
 $V_{CCA}(\text{Opr}) = 1.4\text{V}$  to  $3.6\text{V}$   
 $V_{CCB}(\text{Opr}) = 1.4\text{V}$  to  $3.6\text{V}$
- Max data rates:  
380Mbps (1.8V to 3.3V translation)  
260Mbps (<1.8V to 3.3V translation)  
260Mbps (translate to 2.5V)  
210Mbps (translate to 1.5V)
- Latch-up performance exceeds 500mA (JEDEC 17)
- ESD performance:  
HBM > 2000V (MIL STD 883 method 3015);  
MM > 200V
- R<sub>OH</sub>S compliant for Flip-Chip package



#### Description

The ST4G3235 is a dual supply low voltage CMOS 4-bit bus buffer level translator fabricated with sub-micron silicon gate and five-layer metal wiring C<sup>2</sup>MOS technology. Designed for use as an interface between a 3.3V bus and a 2.5V or 1.8V bus in a mixed 3.3V/1.8V, 3.3V/2.5V, 1.8V/1.4V and 2.5V/1.8V supply systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

This IC is intended for one-way asynchronous communication between data buses. The input and output power down protections disable the device when both power supply are down, so that the buses are effectively isolated.

The input tolerant buffers allow to translate  $V_{CCB}$  compatible signals and greater signals than  $V_{CCB}$  up/down to  $V_{CCA}$  and viceversa.

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

Table 1. Device summary

| Part number | Package     | Packaging           |
|-------------|-------------|---------------------|
| ST4G3235BJR | Flip-Chip11 | 4000 parts per reel |

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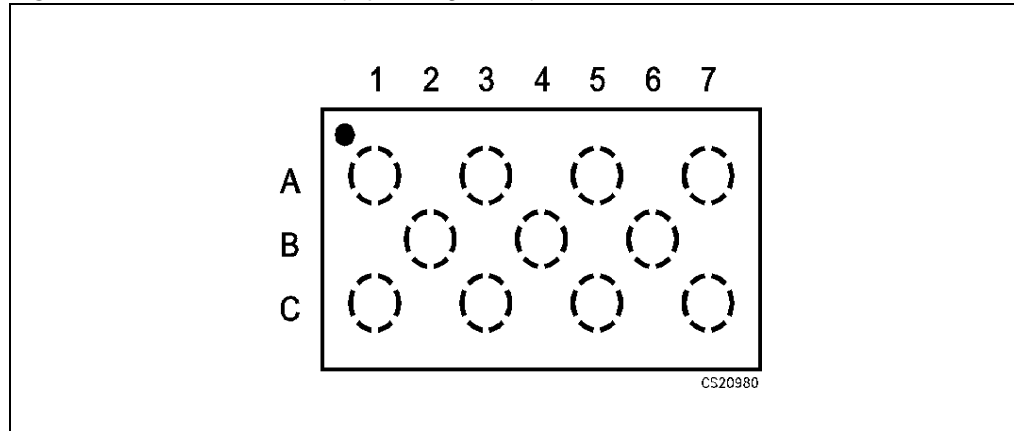
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# 1 Pin settings

## 1.1 Pin connection

Figure 1. Pin connection (top through view)



## 1.2 Pin description

Table 2. Pin description

| Pin N° | Symbol    | Name and function                 |
|--------|-----------|-----------------------------------|
| A1     | A4        | Data input ( $V_{CCA}$ referred)  |
| A3     | A3        | Data input ( $V_{CCA}$ referred)  |
| A5     | A2        | Data output ( $V_{CCA}$ referred) |
| A7     | A1        | Data output ( $V_{CCA}$ referred) |
| C1     | B4        | Data output ( $V_{CCB}$ referred) |
| C3     | B3        | Data output ( $V_{CCB}$ referred) |
| C5     | B2        | Data input ( $V_{CCB}$ referred)  |
| C7     | B1        | Data input ( $V_{CCB}$ referred)  |
| B2     | GND       | Ground (0V)                       |
| B6     | $V_{CCA}$ | Positive supply voltage           |
| B4     | $V_{CCB}$ | Positivoltage                     |

## 2 Device summary

Figure 2. Input equivalent circuit

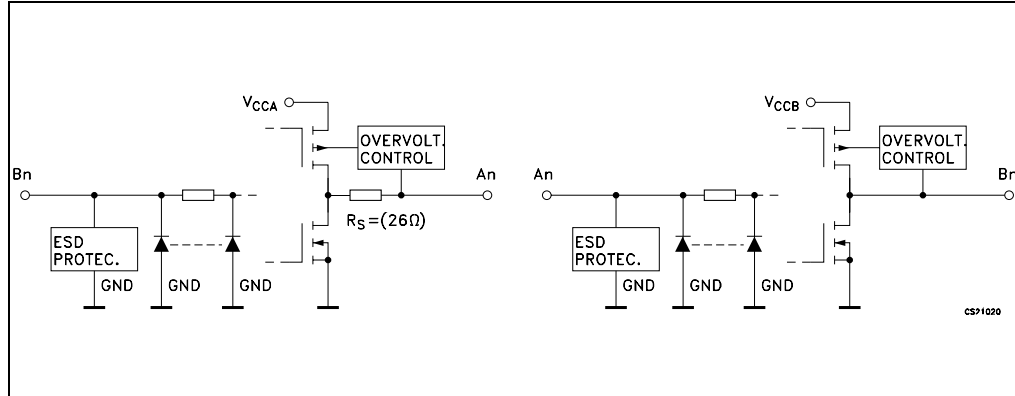


Figure 3. Logic diagram

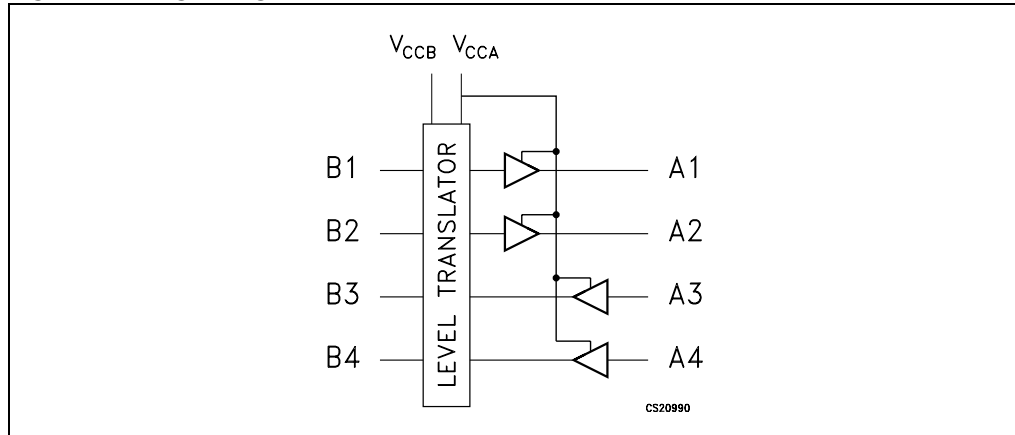


Table 3. Truth table

| Inputs Bn (V <sub>CCB</sub> Referred) | Outputs An (V <sub>CCA</sub> Referred) |
|---------------------------------------|--|
| L                                     | L                                      |
| H                                     | H                                      |
| <b>n = 1..2</b>                       |  |
| Inputs An (V <sub>CCB</sub> Referred) | Outputs Bn (V <sub>CCA</sub> Referred) |
| L                                     | L                                      |
| H                                     | H                                      |
| <b>n = 3..4</b>                       |  |

### 3 Maximum rating

Stressing the device above the rating listed in the “Absolute Maximum Ratings” table 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 the Operating sections of this specification is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 4. Absolute maximum ratings**

| Symbol    | Parameter  | Value                   | Unit |
|-----------|--|-------------------------|------|
| $V_{CCA}$ | Output supply voltage  | -0.5 to +4.6            | V    |
| $V_{CCB}$ | Input supply voltage   | -0.5 to $V_{CCA} + 0.5$ | V    |
| $V_O$     | DC output voltage (Power down mode:<br>$V_{CCA}=V_{CCB}=Gnd$ ) | -0.5 to +4.6            | V    |
| $V_I$     | DC Input Voltage (Power down mode:<br>$V_{CCA}=V_{CCB}=Gnd$ )  | -0.5 to +4.6            | V    |
| $V_{OA}$  | DC output voltage (A1, A2 Outputs)                             | -0.5 to $V_{CCA} + 0.5$ | V    |
| $V_{OB}$  | DC output voltage (B3, B4 Outputs)                             | -0.5 to $V_{CCA} + 0.5$ | V    |
| $V_{IA}$  | DC input voltage (A3, A4 Inputs)                               | -0.5 to +4.6            | V    |
| $V_{IB}$  | DC input voltage (B1, B2 Inputs)                               | -0.5 to +4.6            | V    |
| $I_{IK}$  | DC input diode Current   | - 20                    | mA   |
| $I_{OK}$  | DC output diode current  | - 50                    | mA   |
| $I_{OA}$  | DC output current  | $\pm 50$                | mA   |
| $I_{CCA}$ | DC $V_{CCA}$ or ground current                                 | $\pm 100$               | mA   |
| $I_{CCB}$ | DC $V_{CCB}$ or ground current                                 | $\pm 100$               | mA   |
| $P_d$     | Power dissipation  | 400                     | mW   |
| $T_{stg}$ | Storage temperature  | -65 to +150             | °C   |
| $T_L$     | Lead temperature (10 sec)                                      | 260                     | °C   |

### 3.1 Recommended operating conditions

**Table 5. Recommended operating conditions**

| Symbol    | Parameter                               | Value                      | Unit     |      |
|-----------|---|----------------------------|----------|------|
| $V_{CCA}$ | Supply voltage                          | 1.4 to 3.6                 | V        |      |
| $V_{CCB}$ | Supply voltage                          | 1.4 to 3.6                 | V        |      |
| $V_{IB}$  | Input voltage (B1, B2)                  | 0 to $V_{CCB}$             | V        |      |
| $V_{IA}$  | Input voltage (A3, A4)                  | 0 to $V_{CCA}$             | V        |      |
| $V_{OB}$  | Output voltage (B3, B4)                 | 0 to $V_{CCB}$             | V        |      |
| $V_{OA}$  | Output voltage (A1, A2)                 | 0 to $V_{CCA}$             | V        |      |
| $T_{op}$  | Operating temperature                   | -40 to 85                  | °C       |      |
| dt/dv     | Input rise and fall time <sup>(1)</sup> | $V_{CCB} = 3.0$ to $3.6V$  | 0 to 10  | ns/V |
|           |   | $V_{CCB} = 2.3$ to $2.7V$  | 0 to 20  | ns/V |
|           |   | $V_{CCB} = 1.4$ to $1.95V$ | 0 to 100 | ns/V |

1. VI from 0.8V to 2.0V at  $V_{CC} = 3.0V$

## 4 Electrical characteristics

Table 6. DC Specification for  $V_{CCA}$

| Symbol    | Parameter                         | Test condition                  |                                 |                              | Value                |      |                |                              |                | Unit    |
|-----------|-----------------------------------|---------------------------------|---------------------------------|------------------------------|----------------------|------|----------------|------------------------------|----------------|---------|
|           |                                   | $V_{CCB}$<br>(V) <sup>(1)</sup> | $V_{CCA}$<br>(V) <sup>(1)</sup> |                              | $T_A = 25\text{ °C}$ |      |                | $-40\text{ to }85\text{ °C}$ |                |         |
|           |                                   |                                 |                                 |                              | Min.                 | Typ. | Max.           | Min.                         | Max.           |         |
| $V_{IHA}$ | High level input voltage (A3-A4)  | 1.4 to 3.6V                     | 1.4                             |                              | 0.65 $V_{CCA}$       |      |                | 0.65 $V_{CCA}$               |                | V       |
|           |                                   |                                 | 1.8                             |                              | 0.65 $V_{CCA}$       |      |                | 0.65 $V_{CCA}$               |                |         |
|           |                                   |                                 | 2.5                             |                              | 1.6                  |      |                | 1.6                          |                |         |
|           |                                   |                                 | 3.3                             |                              | 2.0                  |      |                | 2.0                          |                |         |
| $V_{ILA}$ | Low level input voltage (A3-A4)   | 1.4 to 3.6V                     | 1.4                             |                              |                      |      | 0.35 $V_{CCA}$ |                              | 0.35 $V_{CCA}$ | V       |
|           |                                   |                                 | 1.8                             |                              |                      |      | 0.35 $V_{CCA}$ |                              | 0.35 $V_{CCA}$ |         |
|           |                                   |                                 | 2.5                             |                              |                      |      | 0.7            |                              | 0.7            |         |
|           |                                   |                                 | 3.3                             |                              |                      |      | 0.8            |                              | 0.8            |         |
| $V_{OHA}$ | High level output voltage (A1-A2) | 1.4 to 3.6V                     | 1.4                             | $I_O = -100\mu A$            | 1.2                  |      |                | 1.2                          |                | V       |
|           |                                   |                                 | 2.75                            | $I_O = -0.4mA$               | 2.5                  |      |                | 2.5                          |                |         |
|           |                                   |                                 | 2.75                            | $I_O = -10mA$                | 2.2                  |      |                | 2.2                          |                |         |
|           |                                   |                                 | 2.3                             | $I_O = -6mA$                 | 1.8                  |      |                | 1.8                          |                |         |
|           |                                   |                                 | 1.65                            | $I_O = -2mA$                 | 1.4                  |      |                | 1.4                          |                |         |
|           |                                   |                                 | 1.4                             | $I_O = -1mA$                 | 1.1                  |      |                | 1.1                          |                |         |
| $V_{OLA}$ | Low level output voltage (A1-A2)  | 1.4 to 3.6V                     | 1.4                             | $I_O = 100\mu A$             |                      |      | 0.20           |                              | 0.20           | V       |
|           |                                   |                                 | 2.75                            | $I_O = 1mA$                  |                      |      | 0.40           |                              | 0.40           |         |
|           |                                   |                                 | 2.75                            | $I_O = 10mA$                 |                      |      | 0.55           |                              | 0.55           |         |
|           |                                   |                                 | 2.3                             | $I_O = 6mA$                  |                      |      | 0.40           |                              | 0.40           |         |
|           |                                   |                                 | 1.65                            | $I_O = 2mA$                  |                      |      | 0.25           |                              | 0.25           |         |
|           |                                   |                                 | 1.4                             | $I_O = 1mA$                  |                      |      | 0.20           |                              | 0.20           |         |
| $I_{IA}$  | Input leakage current (A3-A4)     | 2.7                             | 3.6                             | $V_{IA} = V_{CCA}$<br>or GND |                      |      | $\pm 0.5$      |                              | $\pm 5$        | $\mu A$ |
|           |                                   | 1.4                             | 2.7                             | $V_{IA} = 3.6V$<br>or GND    |                      |      | $\pm 0.5$      |                              | $\pm 5$        | $\mu A$ |

Table 6. DC Specification for  $V_{CCA}$ 

| Symbol            | Parameter  | Test condition                  |                                 |  | Value                |      |           |                              |          | Unit          |
|-------------------|--|---------------------------------|---------------------------------|--|----------------------|------|-----------|------------------------------|----------|---------------|
|                   |  | $V_{CCB}$<br>(V) <sup>(1)</sup> | $V_{CCA}$<br>(V) <sup>(1)</sup> |  | $T_A = 25\text{ °C}$ |      |           | $-40\text{ to }85\text{ °C}$ |          |               |
|                   |  |                                 |                                 |  | Min.                 | Typ. | Max.      | Min.                         | Max.     |               |
| $I_{OFF}$         | Power off leakage current                          | 0                               | 0                               | $V_{IB}=\text{GND}$<br>to 3.6V<br>$V_{OA}=\text{GND}$<br>to 3.6V<br>$V_{IA}=\text{GND}$<br>to 3.6V<br>$V_{OB}=\text{GND}$<br>to 3.6V |                      |      | $\pm 1.0$ |                              | $\pm 10$ | $\mu\text{A}$ |
| $I_{CCIA}$        | Quiescent supply current                           | <b>1.4 to 3.6V</b>              | <b>1.4 to 3.6V</b>              | $V_{IA}=V_{CCA}$<br>or GND<br>$V_{IB}=V_{CCB}$<br>or GND   |                      |      | 0.5       |                              | 5        | $\mu\text{A}$ |
| $\Delta I_{CCIA}$ | Maximum quiescent supply current / Input ( $A_n$ ) | 2.7                             | 3.6                             | $V_{IA}=V_{CCA}$<br>- 0.6V<br>$V_{IA}=V_{CCA}$<br>or GND<br>$V_{IB}=V_{CCB}$<br>or GND   |                      |      |           |                              | 0.75     | mA            |
|                   |  | 1.95                            | 3.6                             |  |                      |      |           |                              |          |               |
|                   |  | 1.95                            | 2.7                             |  |                      |      |           |                              |          |               |

1.  $V_{CC}$  range =  $3.3\pm 0.3$ ;  $2.5\pm 0.2\text{V}$ ;  $1.8\pm 0.15\text{V}$



Table 7. DC Specification for  $V_{CCB}$ 

| Symbol    | Parameter                         | Test condition                  |                                 |                           | Value                |      |               |                              |               | Unit    |
|-----------|-----------------------------------|---------------------------------|---------------------------------|---------------------------|----------------------|------|---------------|------------------------------|---------------|---------|
|           |                                   | $V_{CCB}$<br>(V) <sup>(1)</sup> | $V_{CCA}$<br>(V) <sup>(1)</sup> |                           | $T_A = 25\text{ °C}$ |      |               | $-40\text{ to }85\text{ °C}$ |               |         |
|           |                                   |                                 |                                 |                           | Min.                 | Typ. | Max.          | Min.                         | Max.          |         |
| $V_{IHB}$ | High level input voltage (B1-B2)  | 1.4                             | <b>1.4 to 3.6V</b>              |                           | $0.65V_{CCB}$        |      |               | $0.65V_{CCB}$                |               | V       |
|           |                                   | 1.8                             |                                 |                           | $0.65V_{CCB}$        |      |               | $0.65V_{CCB}$                |               |         |
|           |                                   | 2.5                             |                                 |                           | 1.6                  |      |               | 1.6                          |               |         |
|           |                                   | 3.3                             |                                 |                           | 2.0                  |      |               | 2.0                          |               |         |
| $V_{ILB}$ | Low level input voltage (B1-B2)   | 1.4                             | <b>1.4 to 3.6V</b>              |                           |                      |      | $0.35V_{CCB}$ |                              | $0.35V_{CCB}$ | V       |
|           |                                   | 1.8                             |                                 |                           |                      |      | $0.35V_{CCB}$ |                              | $0.35V_{CCB}$ |         |
|           |                                   | 2.5                             |                                 |                           |                      | 0.7  |               | 0.7                          |               |         |
|           |                                   | 3.3                             |                                 |                           |                      | 0.8  |               | 0.8                          |               |         |
| $V_{OHB}$ | High level output voltage (B3-B4) | 1.4                             | <b>1.4 to 3.6V</b>              | $I_O = -100\mu A$         | 1.3                  |      |               | 1.3                          |               | V       |
|           |                                   | 1.8                             |                                 | $I_O = -100\mu A$         | 1.6                  |      |               | 1.6                          |               |         |
|           |                                   | 2.75                            |                                 | $I_O = -24mA$             | 2.2                  |      |               | 2.2                          |               |         |
|           |                                   | 2.75                            |                                 | $I_O = -18mA$             | 1.7                  |      |               | 1.7                          |               |         |
|           |                                   | 2.3                             |                                 | $I_O = -4mA$              | 1.44                 |      |               | 1.44                         |               |         |
|           |                                   | 1.65                            |                                 | $I_O = -4mA$              | 1.5                  |      |               | 1.5                          |               |         |
|           |                                   | 1.4                             |                                 | $I_O = -2mA$              | 1.25                 |      |               | 1.25                         |               |         |
| $V_{OLB}$ | Low level output voltage (B3-B4)  | 1.4                             | <b>1.4 to 3.6V</b>              | $I_O = 100\mu A$          |                      |      | 0.1           |                              | 0.1           | V       |
|           |                                   | 1.8                             |                                 | $I_O = 100\mu A$          |                      |      | 0.2           |                              | 0.2           |         |
|           |                                   | 2.75                            |                                 | $I_O = 24mA$              |                      |      | 0.55          |                              | 0.55          |         |
|           |                                   | 2.75                            |                                 | $I_O = 18mA$              |                      |      | 0.35          |                              | 0.35          |         |
|           |                                   | 2.3                             |                                 | $I_O = 4mA$               |                      |      | 0.39          |                              | 0.39          |         |
|           |                                   | 1.65                            |                                 | $I_O = 4mA$               |                      |      | 0.20          |                              | 0.20          |         |
|           |                                   | 1.4                             |                                 | $I_O = 2mA$               |                      |      | 0.15          |                              | 0.15          |         |
| $I_{IB}$  | Input leakage current (B1-B2)     | 2.7                             | 3.6                             | $V_{IB} = V_{CCB}$ or GND |                      |      | $\pm 0.5$     |                              | $\pm 5$       | $\mu A$ |
|           |                                   | 1.4                             | 2.7                             | $V_{IB} = 3.6V$ or GND    |                      |      | $\pm 0.5$     |                              | $\pm 5$       | $\mu A$ |

Table 7. DC Specification for  $V_{CCB}$ 

| Symbol            | Parameter                                     | Test condition                  |                                 |  | Value                |      |           |              |          | Unit          |
|-------------------|---|---------------------------------|---------------------------------|--|----------------------|------|-----------|--------------|----------|---------------|
|                   |   | $V_{CCB}$<br>(V) <sup>(1)</sup> | $V_{CCA}$<br>(V) <sup>(1)</sup> |  | $T_A = 25\text{ °C}$ |      |           | -40 to 85 °C |          |               |
|                   |   |                                 |                                 |  | Min.                 | Typ. | Max.      | Min.         | Max.     |               |
| $I_{OFF}$         | Power off leakage current                     | 0                               | 0                               | $V_{IB} = \text{GND to } 3.6\text{V}$<br>$V_{OA} = \text{GND to } 3.6\text{V}$<br>$V_{IA} = \text{GND to } 3.6\text{V}$<br>$V_{OB} = \text{GND to } 3.6\text{V}$ |                      |      | $\pm 1.0$ |              | $\pm 10$ | $\mu\text{A}$ |
| $I_{CCIB}$        | Quiescent supply current                      | 1.4 to 3.6V                     | 1.4 to 3.6V                     | $V_{IA} = V_{CCA}$ or GND<br>$V_{IB} = V_{CCB}$ or GND   |                      |      | 0.5       |              | 5        | $\mu\text{A}$ |
| $\Delta I_{CCIB}$ | Maximum quiescent supply current / Input (Bn) | 2.7                             | 3.6                             | $V_{IB} = V_{CCB} - 0.6\text{V}$<br>$V_{IB} = V_{CCB}$ or GND<br>$V_{IB} = V_{CCA}$ or GND   |                      |      |           |              | 0.75     | mA            |
|                   |   | 1.95                            | 3.6                             |  |                      |      |           |              |          |               |
|                   |   | 1.95                            | 2.7                             |  |                      |      |           |              |          |               |

1.  $V_{CC}$  range =  $3.3 \pm 0.3$ ;  $2.5 \pm 0.2\text{V}$ ;  $1.8 \pm 0.15\text{V}$

Table 8. Dynamic switching characteristics

| Symbol            | Parameter                             | Test condition          |                         |   | Value   |   |       |              |      | Unit |   |   |
|-------------------|---------------------------------------|-------------------------|-------------------------|---|---|---|-------|--------------|------|------|---|---|
|                   |                                       | V <sub>CCB</sub><br>(V) | V <sub>CCA</sub><br>(V) |   | T <sub>A</sub> = 25 °C  |   |       | -40 to 85 °C |      |      |   |   |
|                   |                                       |                         |                         |   | Min.  | Typ.  | Max.  | Min.         | Max. |      |   |   |
| V <sub>OLPA</sub> | Dynamic low level<br>Quiet An Output  | 1.4                     | 1.8                     | C <sub>L</sub> = 30pF<br>V <sub>ILB</sub> = 0V<br>V <sub>IHB</sub> = V <sub>CCB</sub> |   | 0.2   |       |              |      | V    |   |   |
|                   |                                       | 1.4-1.8                 | 2.5                     |   |   | 0.25  |       |              |      |      |   |   |
|                   |                                       | 1.8-2.5                 | 3.3                     |   |   | 0.35  |       |              |      |      |   |   |
| V <sub>OLVA</sub> | Dynamic low level<br>Quiet An Output  | 1.4                     | 1.8                     |   | C <sub>L</sub> = 30pF<br>V <sub>ILB</sub> = 0V<br>V <sub>IHB</sub> = V <sub>CCB</sub> |   | -0.2  |              |      |      | V |   |
|                   |                                       | 1.4-1.8                 | 2.5                     |   |   |   | -0.25 |              |      |      |   |   |
|                   |                                       | 1.8-2.5                 | 3.3                     |   |   |   | -0.35 |              |      |      |   |   |
| V <sub>OHVA</sub> | Dynamic high level<br>Quiet An Output | 1.4                     | 1.8                     |   |   | C <sub>L</sub> = 30pF<br>V <sub>ILB</sub> = 0V<br>V <sub>IHB</sub> = V <sub>CCB</sub> |       | 1.6          |      |      |   | V |
|                   |                                       | 1.4-1.8                 | 2.5                     |   |   |   |       | 2.1          |      |      |   |   |
|                   |                                       | 1.8-2.5                 | 3.3                     |   |   |   |       | 2.7          |      |      |   |   |
| V <sub>OLPB</sub> | Dynamic low level<br>Quiet Bn Output  | 1.4                     | 1.8-2.5                 | C <sub>L</sub> = 30pF<br>V <sub>ILA</sub> = 0V<br>V <sub>IHA</sub> = V <sub>CCA</sub> |   |   |       | 0.2          |      |      |   | V |
|                   |                                       | 1.8                     | 2.5-3.3                 |   |   |   |       | 0.25         |      |      |   |   |
|                   |                                       | 2.5                     | 3.3                     |   |   |   |       | 0.6          |      |      |   |   |
| V <sub>OLVB</sub> | Dynamic low level<br>Quiet Bn Output  | 1.4                     | 1.8-2.5                 |   | C <sub>L</sub> = 30pF<br>V <sub>ILA</sub> = 0V<br>V <sub>IHA</sub> = V <sub>CCA</sub> |   |       | -0.2         |      |      |   | V |
|                   |                                       | 1.8                     | 2.5-3.3                 |   |   |   |       | -0.25        |      |      |   |   |
|                   |                                       | 2.5                     | 3.3                     |   |   |   |       | -0.36        |      |      |   |   |
| V <sub>OHVB</sub> | Dynamic high level<br>Quiet Bn Output | 1.4                     | 1.8-2.5                 |   |   | C <sub>L</sub> = 30pF<br>V <sub>ILA</sub> = 0V<br>V <sub>IHA</sub> = V <sub>CCA</sub> |       | 1.2          |      |      |   | V |
|                   |                                       | 1.8                     | 2.5-3.3                 |   |   |   |       | 1.4          |      |      |   |   |
|                   |                                       | 2.5                     | 3.3                     |   |   |   |       | 1.9          |      |      |   |   |

Table 9. AC electrical characteristics

| Symbol                              | Parameter                             | Test condition          |                         |  | Value        |      | Unit |
|-------------------------------------|---------------------------------------|-------------------------|-------------------------|--|--------------|------|------|
|                                     |                                       | V <sub>CCB</sub><br>(V) | V <sub>CCA</sub><br>(V) |  | -40 to 85 °C |      |      |
|                                     |                                       |                         |                         |  | Min.         | Max. |      |
| t <sub>PLH</sub> t <sub>PHL</sub>   | Propagation delay time Bn to An       | 2.3 to 3.6              | 1.4                     | C <sub>L</sub> = 10 pF                           | 2.0          | 6.5  | ns   |
|                                     |                                       | 1.4 to 1.95             | 1.4                     |  | 2.0          | 6.8  |      |
|                                     |                                       | 2.3 to 3.6              | 1.65 to 1.95            |  | 2.0          | 5.2  |      |
|                                     |                                       | 1.4 to 1.95             | 1.65 to 1.95            |  | 2.0          | 5.6  |      |
|                                     |                                       | 1.4 to 1.95             | 2.3 to 2.7              |  | 2.0          | 4.6  |      |
|                                     |                                       | 1.4 to 1.95             | 3.0 to 3.6              |  | 2.0          | 4.3  |      |
|                                     |                                       | 2.3 to 2.7              | 3.0 to 3.6              |  | 1.0          | 3.6  |      |
| t <sub>PLH</sub> t <sub>PHL</sub>   | Propagation delay time Bn to An       | 2.3 to 3.6              | 1.4                     | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω | 2.0          | 7.5  | ns   |
|                                     |                                       | 1.4 to 1.95             | 1.4                     |  | 2.0          | 7.5  |      |
|                                     |                                       | 2.3 to 3.6              | 1.65 to 1.95            |  | 2.0          | 6.5  |      |
|                                     |                                       | 1.4 to 1.95             | 1.65 to 1.95            |  | 2.0          | 6.7  |      |
|                                     |                                       | 1.4 to 1.95             | 2.3 to 2.7              |  | 2.0          | 5.9  |      |
|                                     |                                       | 1.4 to 1.95             | 3.0 to 3.6              |  | 2.0          | 5.7  |      |
|                                     |                                       | 2.3 to 2.7              | 3.0 to 3.6              |  | 1.0          | 4.9  |      |
| t <sub>PLH</sub> t <sub>PHL</sub>   | Propagation delay time An to Bn       | 2.3 to 3.6              | 1.4                     | C <sub>L</sub> = 10 pF                           | 2.0          | 5.5  | ns   |
|                                     |                                       | 1.4 to 1.95             | 1.4                     |  | 2.0          | 6.0  |      |
|                                     |                                       | 2.3 to 3.6              | 1.65 to 1.95            |  | 2.0          | 5.0  |      |
|                                     |                                       | 1.4 to 1.95             | 1.65 to 1.95            |  | 2.0          | 5.0  |      |
|                                     |                                       | 1.4 to 1.95             | 2.3 to 2.7              |  | 2.0          | 4.6  |      |
|                                     |                                       | 1.4 to 1.95             | 3.0 to 3.6              |  | 2.0          | 3.9  |      |
|                                     |                                       | 2.3 to 2.7              | 3.0 to 3.6              |  | 1.0          | 3.0  |      |
| t <sub>PLH</sub> t <sub>PHL</sub>   | Propagation delay time An to Bn       | 2.3 to 3.6              | 1.4                     | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω | 2.0          | 7.0  | ns   |
|                                     |                                       | 1.4 to 1.95             | 1.4                     |  | 2.0          | 7.5  |      |
|                                     |                                       | 2.3 to 3.6              | 1.65 to 1.95            |  | 2.0          | 6.0  |      |
|                                     |                                       | 1.4 to 1.95             | 1.65 to 1.95            |  | 2.0          | 6.0  |      |
|                                     |                                       | 1.4 to 1.95             | 2.3 to 2.7              |  | 2.0          | 5.6  |      |
|                                     |                                       | 1.4 to 1.95             | 3.0 to 3.6              |  | 2.0          | 4.6  |      |
|                                     |                                       | 2.3 to 2.7              | 3.0 to 3.6              |  | 1.0          | 4.0  |      |
| t <sub>OSLH</sub> t <sub>OSHL</sub> | Output to output skew time (note1, 2) | 1.8 ± 0.15              | 2.5 ± 0.2               | C <sub>L</sub> = 30 pF<br>R <sub>L</sub> = 500 Ω |              | 0.5  | ns   |
|                                     |                                       | 1.8 ± 0.15              | 3.3 ± 0.3               |  |              | 0.5  |      |
|                                     |                                       | 2.5 ± 0.2               | 3.3 ± 0.3               |  |              | 0.75 |      |

Note: 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

Table 10. Capacitance characteristics

| Symbol          | Parameter                     | Test condition          |                         |         | Value                  |      |      |              |      | Unit |
|-----------------|-------------------------------|-------------------------|-------------------------|---------|------------------------|------|------|--------------|------|------|
|                 |                               | V <sub>CCB</sub><br>(V) | V <sub>CCA</sub><br>(V) |         | T <sub>A</sub> = 25 °C |      |      | -40 to 85 °C |      |      |
|                 |                               |                         |                         |         | Min.                   | Typ. | Max. | Min.         | Max. |      |
| C <sub>IN</sub> | Input capacitance             | open                    | open                    |         |                        | 6    |      |              |      | pF   |
| C <sub>O</sub>  | Output capacitance            | 1.8-2.5                 | 2.5-3.3                 |         |                        | 9    |      |              |      | pF   |
| C <sub>PD</sub> | Power dissipation capacitance | 2.5                     | 3.3                     | f=10MHz |                        | 50   |      |              |      | pF   |
|                 |                               | 1.8                     | 3.3                     |         |                        | 28   |      |              |      |      |
|                 |                               | 1.4                     | 2.5                     |         |                        | 22   |      |              |      |      |
|                 |                               | 1.4                     | 1.8                     |         |                        | 15   |      |              |      |      |
|                 |                               | 3.3                     | 1.8                     |         |                        | 28   |      |              |      |      |

Note: 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.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4$  (per circuit)

## 5 Test circuit

Figure 4. Test circuit

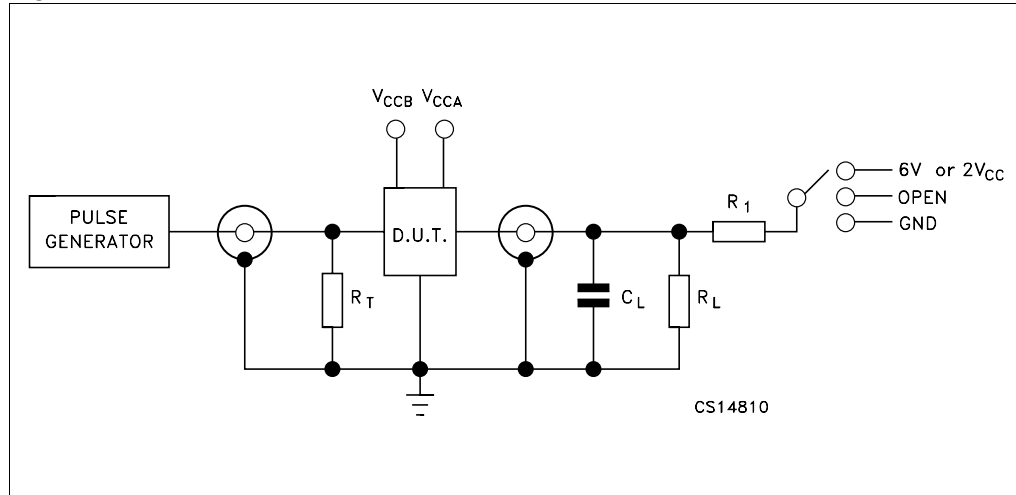


Table 11. Test circuit

| Test               | Switch |
|--------------------|--------|
| $t_{PLH}, t_{PHL}$ | Open   |

$C_L = 10/30pF$  or equivalent (includes jig and probe capacitance)

$R_L = R_1 = 500\Omega$  or equivalent

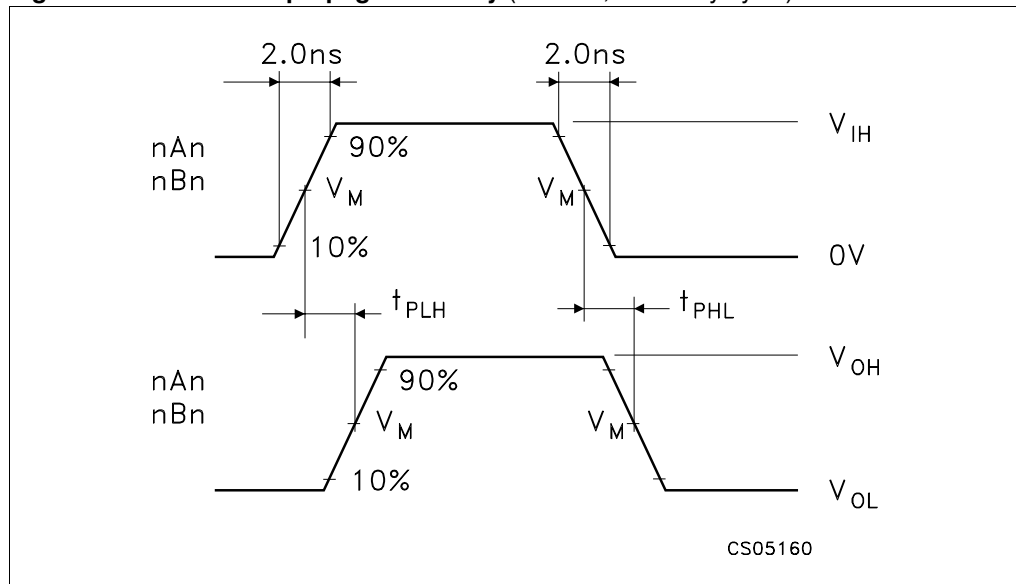
$R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

## 6 Waveforms

**Table 12. Waveform symbol value**

| Symbol          | V <sub>CC</sub>        |                         |                         |
|-----------------|------------------------|-------------------------|-------------------------|
|                 | 3.0 to 3.6V            | 2.3 to 2.7V             | 1.65 to 1.95V           |
| V <sub>IH</sub> | V <sub>CC</sub>        | V <sub>CC</sub>         | V <sub>CC</sub>         |
| V <sub>M</sub>  | 1.5V                   | V <sub>CC</sub> /2      | V <sub>CC</sub> /2      |
| V <sub>X</sub>  | V <sub>OL</sub> + 0.3V | V <sub>OL</sub> + 0.15V | V <sub>OL</sub> + 0.15V |
| V <sub>Y</sub>  | V <sub>OL</sub> - 0.3V | V <sub>OL</sub> - 0.15V | V <sub>OL</sub> - 0.15V |

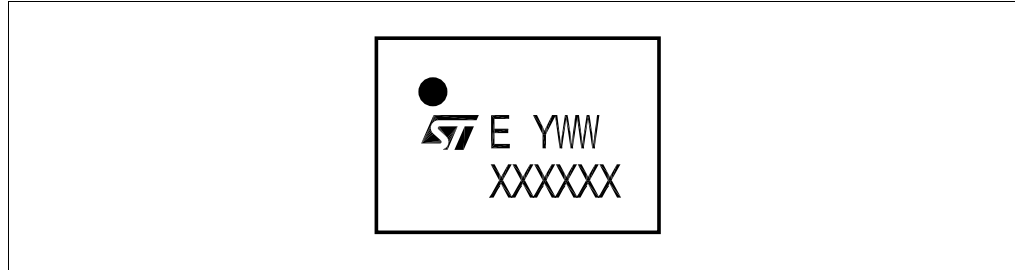
**Figure 5. Waveform - propagation delay (f=1MHz; 50% duty cycle)**



## 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)



**Figure 6. Marking**

*Note:* E = Eco Level; Y = Assy Year; WW = Assy Week; X = Marking Area; Marking Code 9521

Table 13. Flip-Chip11 Mechical data

| Dim. | mm    |       |       | inch |      |      |
|------|-------|-------|-------|------|------|------|
|      | Min   | Typ   | Max   | Min  | Typ  | Max  |
| A    | 0.585 | 0.65  | 0.715 | 23.0 | 25.6 | 28.1 |
| A1   | 0.21  | 0.25  | 0.29  | 8.3  | 9.8  | 11.4 |
| A2   |       | 0.40  |       |      | 15.7 |      |
| b    | 0.265 | 0.315 | 0.365 | 10.4 | 12.4 | 14.4 |
| D    | 1.99  | 2.04  | 2.09  | 78.3 | 80.3 | 82.3 |
| D1   |       | 1.5   |       |      | 59.1 |      |
| E    | 1.36  | 1.41  | 1.46  | 53.5 | 55.5 | 57.5 |
| E1   |       | 0.866 |       |      | 34.1 |      |
| eD   | 0.2   | 0.25  | 0.30  | 7.9  | 9.8  | 11.8 |
| eE   | 0.383 | 0.433 | 0.483 | 15.1 | 17.0 | 19.0 |
| fD   |       | 0.270 |       |      | 10.6 |      |
| fE   |       | 0.272 |       |      | 10.7 |      |
| ccc  |       | 0.080 |       |      | 3.1  |      |

Figure 7. Package dimension

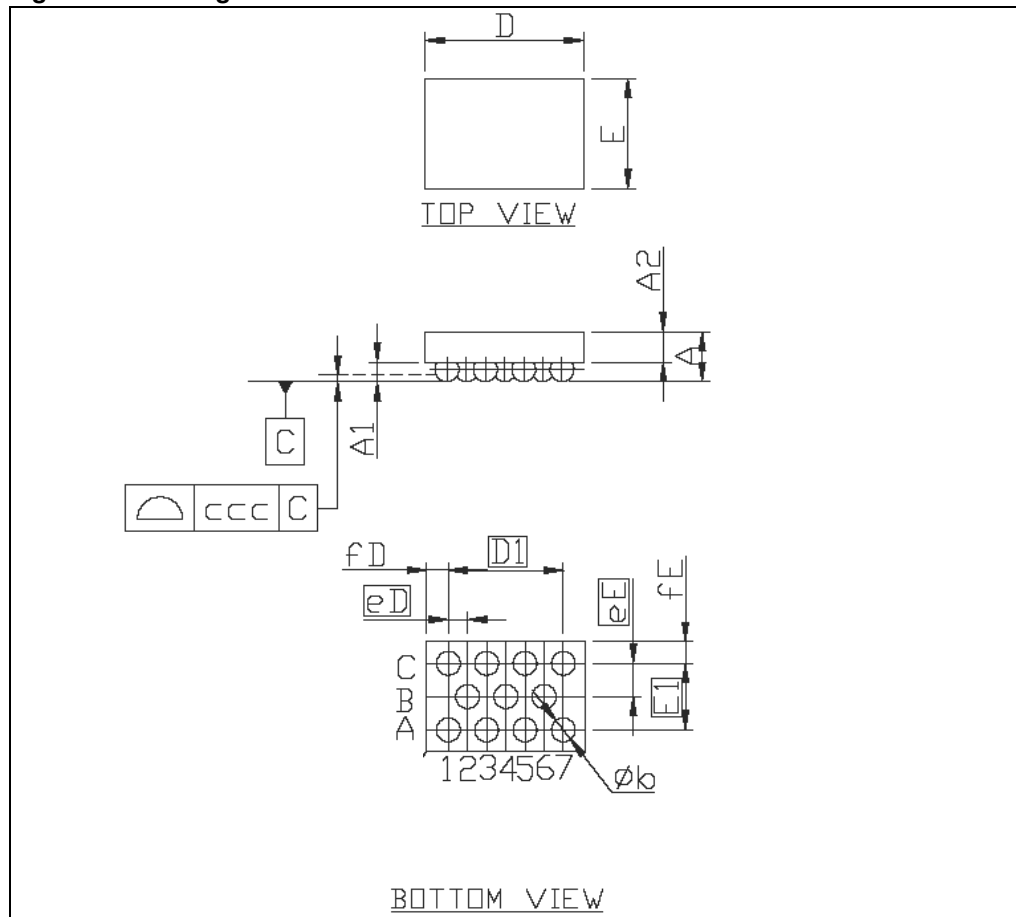
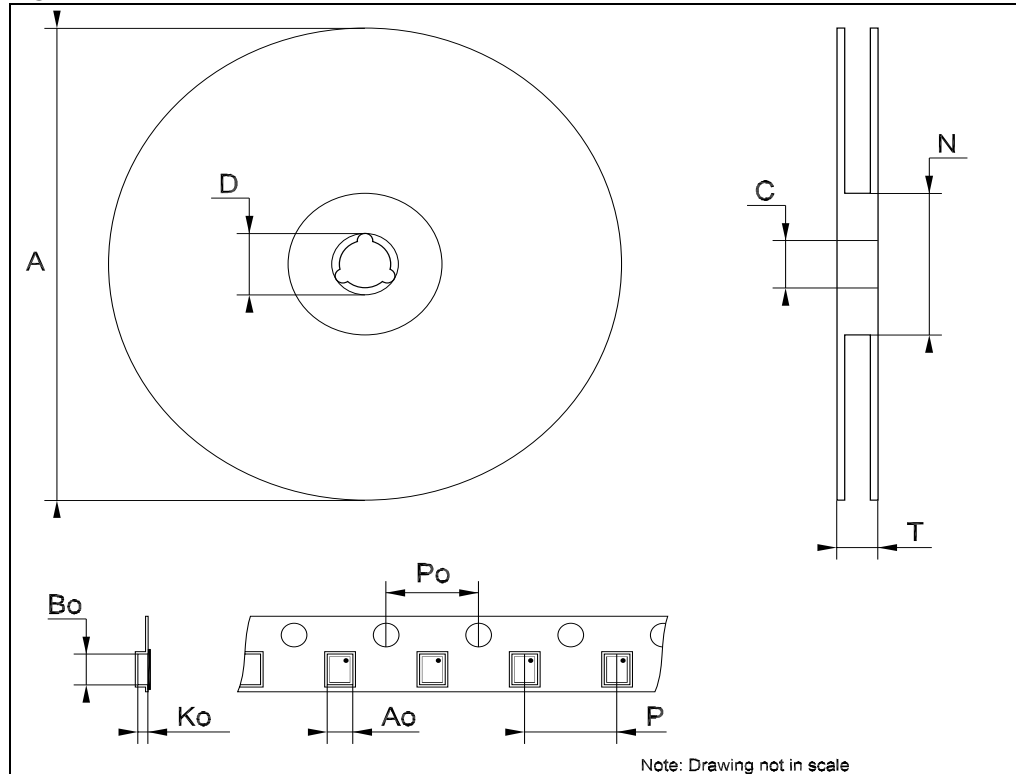


Table 14. Flip-Chip11 tape and reel information

| Dim. | mm.  |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | Min  | Typ  | Max  | Min   | Typ   | Max   |
| A    |      |      | 178  |       |       | 6.926 |
| C    | 12.8 |      | 13.2 | 0.504 |       | 0.519 |
| D    | 20.2 |      |      | 0.795 |       |       |
| N    | 49   | 50   | 51   | 1.929 | 1.969 | 2.008 |
| T    |      |      | 12.4 |       |       | 0.488 |
| Ao   | 2.29 | 2.34 | 2.39 | 0.090 | 0.092 | 0.094 |
| Bo   | 1.65 | 1.70 | 1.75 | 0.065 | 0.067 | 0.069 |
| Ko   | 0.76 | 0.81 | 0.86 | 0.030 | 0.032 | 0.034 |
| Po   | 3.9  | 4    | 4.1  | 0.153 | 0.157 | 0.161 |
| P    | 3.9  | 4    | 4.1  | 0.153 | 0.157 | 0.161 |

Figure 8. Reel dimensions



## 8 Revision history

Table 15. Revision history

| Date        | Revision | Changes   |
|-------------|----------|---|
| 14-Oct-2004 | 1        | First release.  |
| 26-Oct-2004 | 2        | Mechanical Data has been updated.                             |
| 11-Feb-2005 | 3        | Add Tape & Reel and Figure 6.                                 |
| 18-Feb-2005 | 4        | Table 1 has been updated from 4000 to 5000 parts per Reel.    |
| 30-Mar-2005 | 5        | Add Features ==> Max Data Rates.                              |
| 09-May-2005 | 6        | Table 9 and Table 10 have been updated.                       |
| 14-Jun-2007 | 7        | Document reformatted, typo <a href="#">Figure 2 on page 3</a> |

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