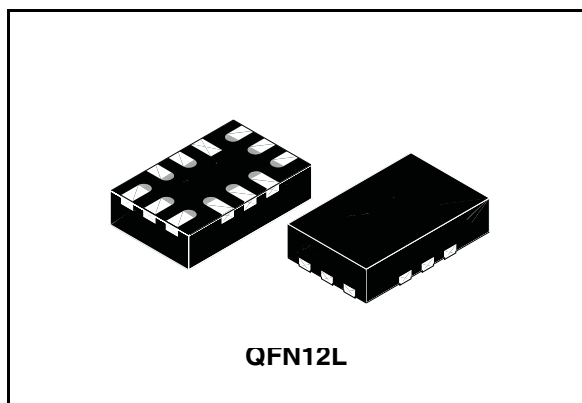


Low voltage 1.0 Ω max dual SP3T switch with break-before-make feature

Features

- High speed:
 - $t_{PD} = 0.3$ ns (typ.) at $V_{CC} = 3.0$ V
 - $t_{PD} = 0.4$ ns (typ.) at $V_{CC} = 2.3$ V
- Ultra low power dissipation:
 - $I_{CC} = 0.2$ μ A (max.) at $T_A = 85^\circ\text{C}$
- Low ON resistance $V_{IN} = 0$ V:
 - $R_{ON} = 1.0$ Ω (max. $T_A = 25^\circ\text{C}$) at $V_{CC} = 4.3$ V
 - $R_{ON} = 1.5$ Ω (max. $T_A = 25^\circ\text{C}$) at $V_{CC} = 3.0$ V
 - $R_{ON} = 1.8$ Ω (max. $T_A = 25^\circ\text{C}$) at $V_{CC} = 2.3$ V
- Wide operating voltage range:
 - V_{CC} (opr) = 1.65 V to 4.3 V single supply
- 4.3 V tolerant and 1.8 V compatible threshold on digital control input at $V_{CC} = 2.3$ to 4.3 V
- Latch-up performance exceeds 300 mA (JESD 17)
- ESD performance (analog channel vs. GND): HBM > 2 kV (MIL STD 883 method 3015)



Description

The STG3856 is a high-speed CMOS low voltage dual analog SP3T (single pole triple throw) switch or dual 3 : 1 multiplexer /demultiplexer switch fabricated in silicon gate C²MOS technology. It is designed to operate from 1.65 V to 4.3 V, making this device ideal for portable applications.

The device offers very low ON resistance (< 1.0 Ω) at $V_{CC} = 4.3$ V. The disabling and enabling of switches are done by setting the 1IN and 2IN control pins. Additional key features are fast switching speed, and ultra low power consumption. All inputs and outputs are equipped with protection circuits against static discharge, giving them ESD immunity and transient excess voltage.

Table 1. Device summary

| Order code | Temperature range | Package | Packaging |
|------------|-------------------|-----------------------|---------------|
| STG3856QTR | -40°C to +85°C | QFN12L (2.2 x 1.4 mm) | Tape and reel |

1 Summary description

1.1 Pin connections and description

Figure 1. Connection diagram (top through view)

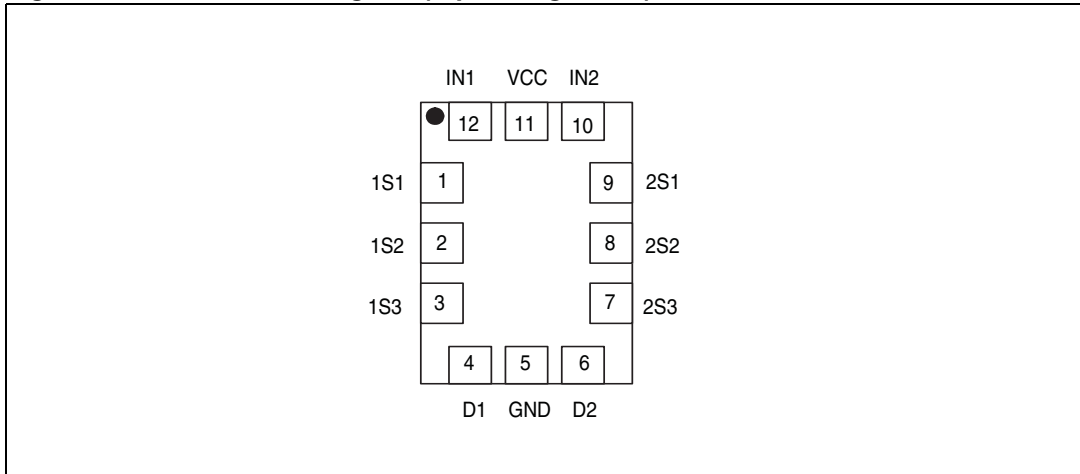


Table 2. Pin description

| Pin | Symbol | Name and function |
|--------------|------------------------------|-------------------------|
| 12, 10 | 1IN, 2IN | Controls |
| 1,2,3, 9,8,7 | 1S1, 1S2, 1S3, 2S1, 2S2, 2S3 | Independent channels |
| 4,6 | D1, D2 | Common channels |
| 11 | V _{CC} | Positive supply voltage |
| 5 | GND | Ground (0 V) |

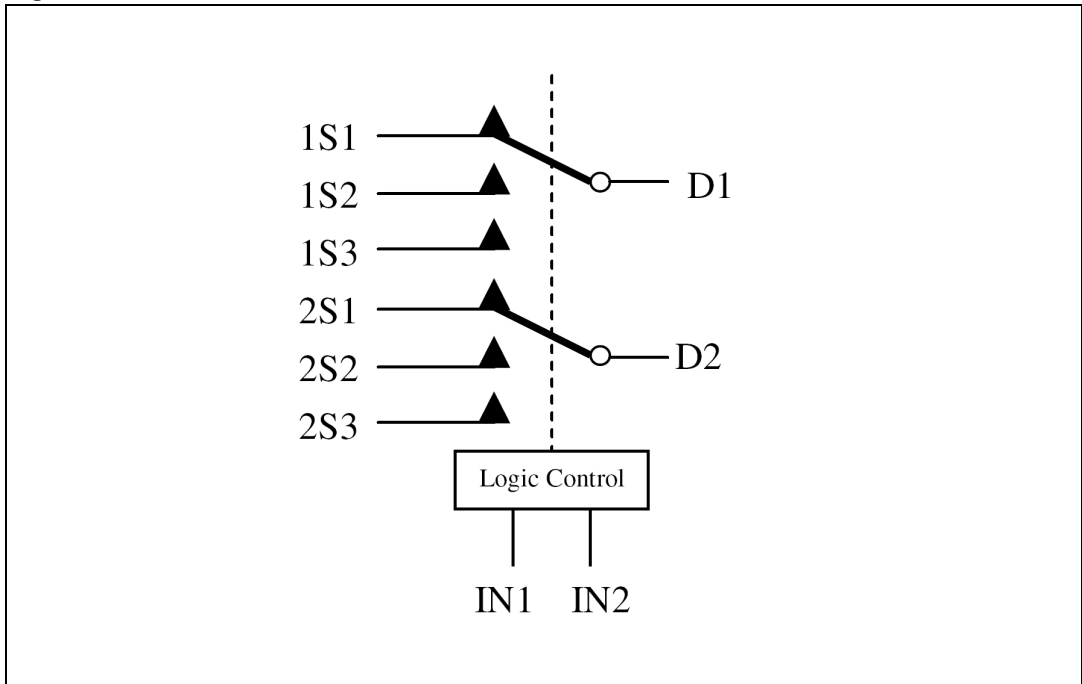
1.2 Truth table

Table 3. Truth table

| 1IN | 2IN | Switch state |
|-----|-----|----------------|
| L | L | High impedance |
| L | H | D1-1S1, D2-2S1 |
| H | L | D1-1S2, D2-2S2 |
| H | H | D1-1S3, D2-2S3 |

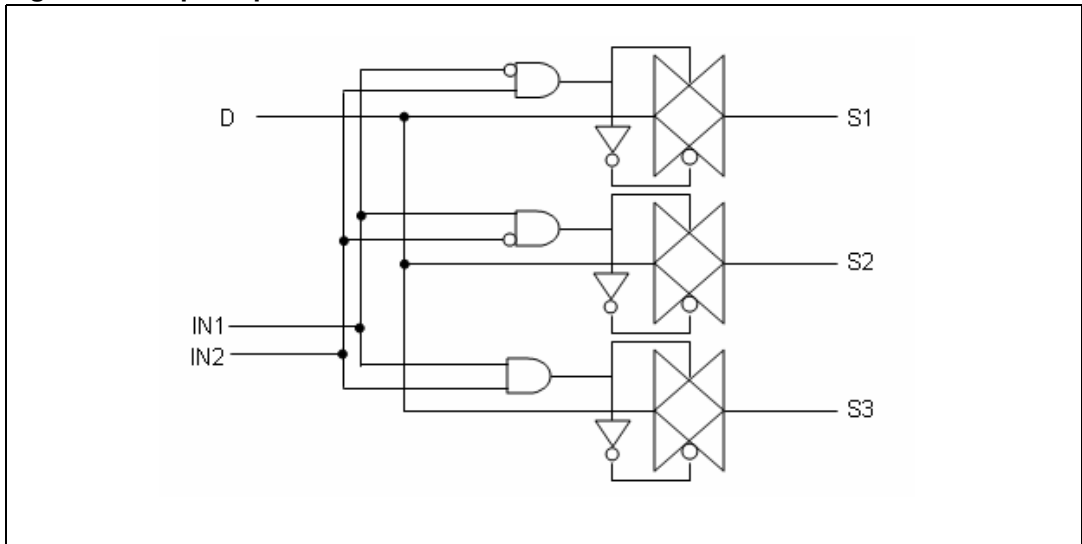
1.3 Internal schematic

Figure 2. Internal schematic



1.4 Input equivalent circuit

Figure 3. Input equivalent circuit



2 Maximum ratings

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.

Table 4. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|-----------------------|--|------------------------|------------------|
| V_{CC} | Supply voltage | -0.5 to 5.5 | V |
| V_I | DC Input voltage | -0.5 to $V_{CC} + 0.5$ | V |
| V_{IC} | DC Control input voltage | -0.5 to 5.5 | V |
| V_O | DC output voltage | -0.5 to $V_{CC} + 0.5$ | V |
| I_{IKC} | DC input diode current on control pin ($V_{IN} < 0$ V) | - 50 | mA |
| I_{IK} | DC input diode current ($V_{IN} < 0$ V) | ± 50 | mA |
| I_{OK} | DC output diode current | ± 20 | mA |
| I_O | DC output current | ± 150 | mA |
| I_{OP} | DC output current peak (pulse at 1 ms, 10% duty cycle) | ± 300 | mA |
| I_{CC} or I_{GND} | DC V_{CC} or ground current | ± 100 | mA |
| P_D | Power dissipation at $T_A = 70^\circ\text{C}$ ⁽¹⁾ | | mW |
| T_{STG} | Storage temperature | -65 to 150 | $^\circ\text{C}$ |
| T_L | Lead temperature (10 sec) | 300 | $^\circ\text{C}$ |

1. Derate above 70°C by 18.5mW/C.

3 Electrical characteristics

Table 5. Recommended operating conditions

| Symbol | Parameter | Value | Unit | |
|----------|--|--|---------|------|
| V_{CC} | Supply voltage ⁽¹⁾ | 1.4 to 4.3 | V | |
| V_I | Input voltage | 0 to V_{CC} | V | |
| V_{IC} | Control input voltage | 0 to V_{CC} | V | |
| V_O | Output voltage | 0 to V_{CC} | V | |
| T_{OP} | Operating temperature | -55 to 125 | °C | |
| dt/dv | Input rise and fall time control input | $V_{CC} = 1.65\text{ V to }2.7\text{ V}$ | 0 to 20 | ns/V |
| | | $V_{CC} = 3.0\text{ to }4.3\text{ V}$ | 0 to 10 | |

1. Truth table guaranteed: 1.2 V to 4.3 V.

3.1 DC electrical characteristics

Table 6. DC electrical 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 |
| V_{IH} | High level input voltage | 1.65 - 1.95 | | 0.65 V_{CC} | - | - | 0.65 V_{CC} | - | 0.65 V_{CC} | - | V |
| | | 2.3 - 2.5 | | 1.4 | - | - | 1.4 | - | 1.4 | - | |
| | | 2.7 - 3.0 | | 1.4 | - | - | 1.4 | - | 1.4 | - | |
| | | 3.3 - 4.3 | | 1.5 | - | - | 1.5 | - | 1.5 | - | |
| V_{IL} | Low level input voltage | 1.65 - 1.95 | | - | - | 0.40 | - | 0.40 | - | 0.40 | V |
| | | 2.3 - 2.5 | | - | - | 0.50 | - | 0.50 | - | 0.50 | |
| | | 2.7 - 3.0 | | - | - | 0.50 | - | 0.50 | - | 0.50 | |
| | | 3.3 - 4.3 | | - | - | 0.50 | - | 0.50 | - | 0.50 | |

Table 6. DC electrical characteristics (continued)

| 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 |
| R _{ON} | Switch ON resistance | 4.3 | V _S = 0 V to V _{CC} I _S = 100 mA | - | 0.6 | 1.0 | - | 1.2 | - | - | Ω |
| | | 3.0 | | - | 1.3 | 1.5 | - | 1.8 | - | - | |
| | | 2.7 | | - | 1.5 | 1.8 | - | 2.2 | - | - | |
| | | 2.3 | | - | 2.0 | 2.2 | - | 2.6 | - | - | |
| | | 1.8 | | - | 2.5 | 3.0 | - | 3.6 | - | - | |
| | | 1.65 | | - | 3.3 | 4.0 | - | 4.8 | - | - | |
| ΔR _{ON} | ON resistance match between channels | 2.7 | V _S at R _{ON} max I _S = 100 mA | - | 0.01 | - | - | - | - | - | Ω |
| R _{FLAT} | ON resistance flatness (1)(2) | 4.3 | V _S = 0 V to V _{CC} I _S = 100 mA | - | - | - | - | - | - | - | Ω |
| | | 3.0 | | - | - | - | - | - | - | - | |
| | | 2.7 | | - | 0.22 | 0.35 | - | 0.35 | - | - | |
| | | 2.3 | | - | - | - | - | - | - | - | |
| | | 1.65 | | - | - | - | - | - | - | - | |
| I _{OFF} | OFF state leakage current (nSN), (Dn) | 4.3 | V _S = 0.3 or 4 V | - | - | ± 20 | - | ±10 0 | - | - | nA |
| I _{IN} | Input leakage current | 0 - 4.3 | V _{IN} = 0 to 4.3 V | - | - | ± 0.1 | - | ± 1 | - | - | μA |
| I _{CC} | Quiescent supply current | 1.65 - 4.3 | V _{IN} = V _C or GND | - | - | ± 0.05 | - | ± 0.2 | - | ± 1 | μA |
| I _{CCLV} | Quiescent supply current low voltage driving | 4.3 | V _{IN1} , V _{IN2} = 1.65 V | - | ± 37 | ± 50 | - | ± 10 0 | - | - | μA |
| | | | V _{IN1} , V _{IN2} = 1.80V | - | ± 33 | ± 40 | - | ± 50 | - | - | |
| | | | V _{IN1} , V _{IN2} = 2.60V | - | ± 12 | ± 20 | - | ± 30 | - | - | |

1. ΔRon = max ImSN-nSNI, where m = 1 and n = 2, N = 1..3
 2. Flatness is defined as the difference between the maximum and minimum value of ON resistance as measured over the specified analog signal ranges.

3.2 AC electrical characteristics

Table 7. AC electrical characteristics ($C_L = 35 \text{ pF}$, $R_L = 50 \text{ } \Omega$, $t_r = t_f \leq 5 \text{ ns}$)

| 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 | 1.65 - 1.95 | | – | 0.45 | – | – | – | – | – | ns |
| | | 2.3 - 2.7 | | – | 0.40 | – | – | – | – | – | |
| | | 3.0 - 3.3 | | – | 0.30 | – | – | – | – | – | |
| | | 3.6 - 4.3 | | – | 0.30 | – | – | – | – | – | |
| t_{ON} | Turn-ON time | 1.65 - 1.95 | $V_S = 0.8 \text{ V}$ | – | 56 | – | – | – | – | – | ns |
| | | 2.3 - 2.7 | | – | 33 | 50 | – | 60 | – | – | |
| | | 3.0 - 3.3 | $V_S = 1.5 \text{ V}$ | – | 21 | 40 | – | 50 | – | – | |
| | | 3.6 - 4.3 | | – | 19 | 40 | – | 50 | – | – | |
| t_{OFF} | Turn-OFF time | 1.65 - 1.95 | $V_S = 0.8$ | – | 24 | – | – | – | – | – | ns |
| | | 2.3 - 2.7 | | – | 17 | 25 | – | 40 | – | – | |
| | | 3.0 - 3.3 | $V_S = 1.5 \text{ V}$ | – | 14 | 20 | – | 30 | – | – | |
| | | 3.6 - 4.3 | | – | 12 | 20 | – | 30 | – | – | |
| t_D | Break-before - make time delay | 1.65 - 1.95 | $V_S = 0.8$ | 10 | 31 | – | – | – | – | – | ns |
| | | 2.3 - 2.7 | | 10 | 22 | 40 | – | 50 | – | – | |
| | | 3.0 - 3.3 | $V_S = 1.5 \text{ V}$ | 10 | 18 | 30 | – | 40 | – | – | |
| | | 3.6 - 4.3 | | 10 | 7 | 25 | – | 35 | – | – | |
| Q | Charge injection | 1.65 - 1.95 | $C_L = 100 \text{ pF}$ | – | 25 | – | – | – | – | – | pC |
| | | 2.3 - 2.7 | $R_L = 1 \text{ MO}$ | – | 35 | – | – | – | – | – | |
| | | 3.0 - 3.3 | $V_{GEN} = 0 \text{ V}$ | – | 40 | – | – | – | – | – | |
| | | 3.6 - 4.3 | $R_{GEN} = 0 \text{ } \Omega$ | – | 55 | – | – | – | – | – | |

3.3 Analog switch

Table 8. Analog switch characteristics ($C_L = 5\text{ pF}$, $R_L = 50\ \Omega$, $T_A = 25^\circ\text{C}$)

| 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 |
| O _{IRR} | Off Isolation ⁽¹⁾ | 1.65 - 4.3 | V _S = 1 V _{RMS} f = 100 kHz | - | -82 | - | - | - | - | - | dB |
| X _{talk} | Crosstalk | 1.6 - 4.3 | V _S = 1 V _{RMS} f = 100 kHz | - | -84 | - | - | - | - | - | dB |
| T _{HD} | Total harmonic distortion | 2.3 - 4.3 | R _L = 600 Ω V _{IN} = 2 V _{PP} f = 20 Hz to 20 kHz | - | 0.03 | - | - | - | - | - | % |
| BW | -3dB bandwidth | 1.65 - 4.3 | R _L = 50 Ω | - | 100 | - | - | - | - | - | MHz |
| C _{IN} | Control pin input capacitance | | | - | 5 | - | - | - | - | - | pF |
| C _{Sn(OFF)} | Sn port OFF capacitance | 3.3 | f = 1 MHz | - | - | - | - | - | - | - | |
| C _{Sn(ON)} | Sn port ON capacitance | 3.3 | f = 1 MHz | - | - | - | - | - | - | - | |
| C _D | D port capacitance when switch is enabled | 3.3 | f = 1 MHz | - | - | - | - | - | - | - | |

1. OFF Isolation = 20 Log₁₀ (V_D/V_S), V_D = output, V_S = input at off switch

4 Package mechanical data

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Figure 4. QFN12L (2.2 x 1.4 mm) package outline

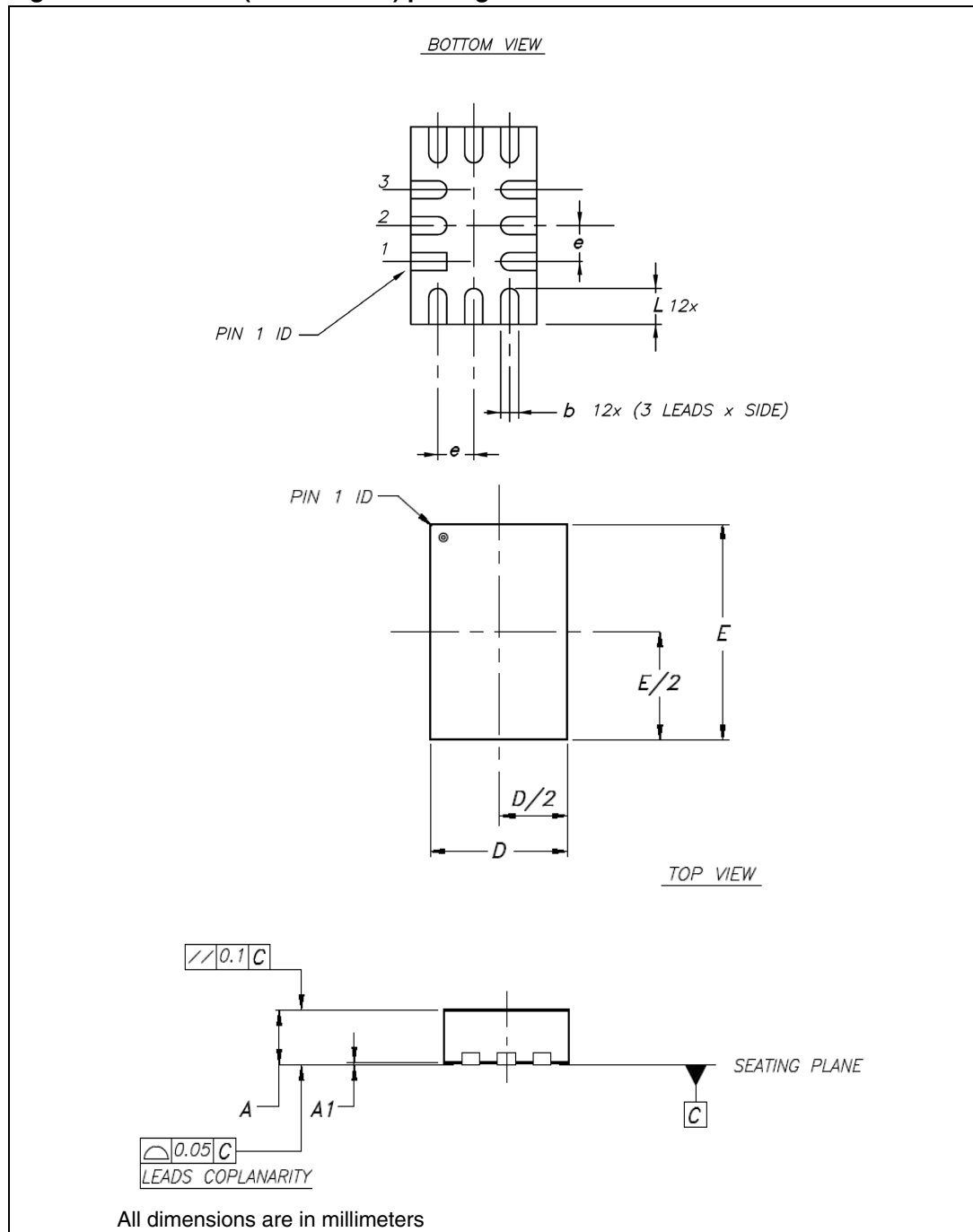


Table 9. FN12L (2.2 x 1.4 mm) mechanical data

| Symbol | Millimeters | | | Inches | | |
|--------|-------------|------|------|--------|-------|-------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.50 | 0.55 | 0.60 | 0.019 | 0.021 | 0.023 |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.001 | 0.002 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.007 | 0.010 |
| D | 1.30 | 1.40 | 1.50 | 0.051 | 0.055 | 0.059 |
| E | 2.10 | 2.20 | 2.30 | 0.082 | 0.086 | 0.090 |
| e | | 0.40 | | | 0.015 | |
| L | 0.35 | 0.40 | 0.45 | 0.013 | 0.015 | 0.017 |

Figure 5. Footprint recommendation

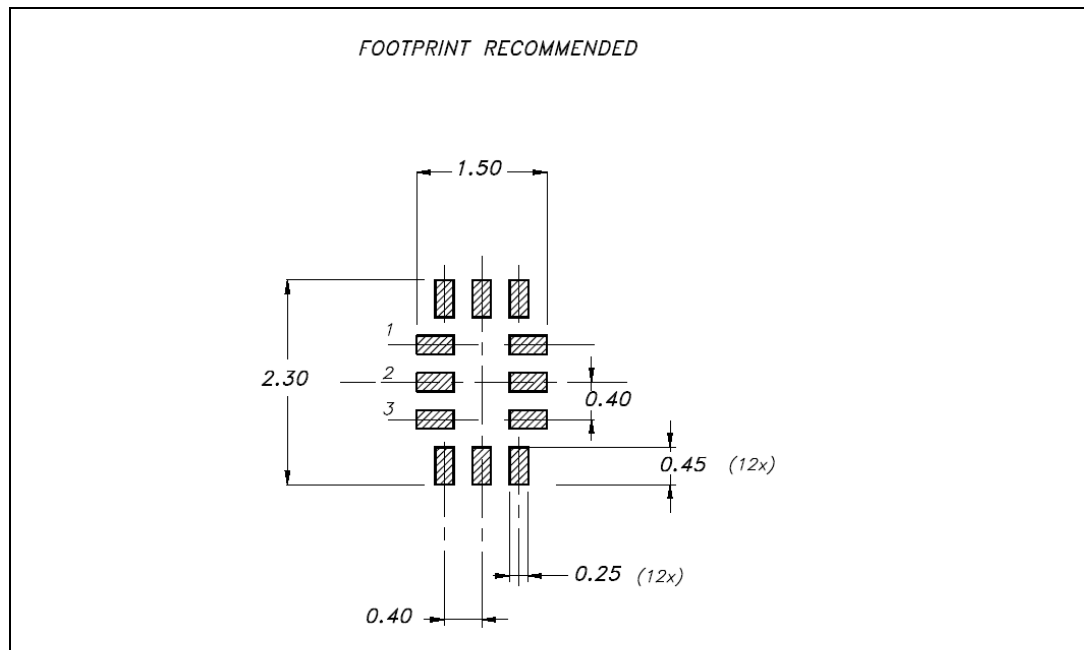


Figure 6. QFN12L (2.2 x 1.4 mm) reel for carrier tape information

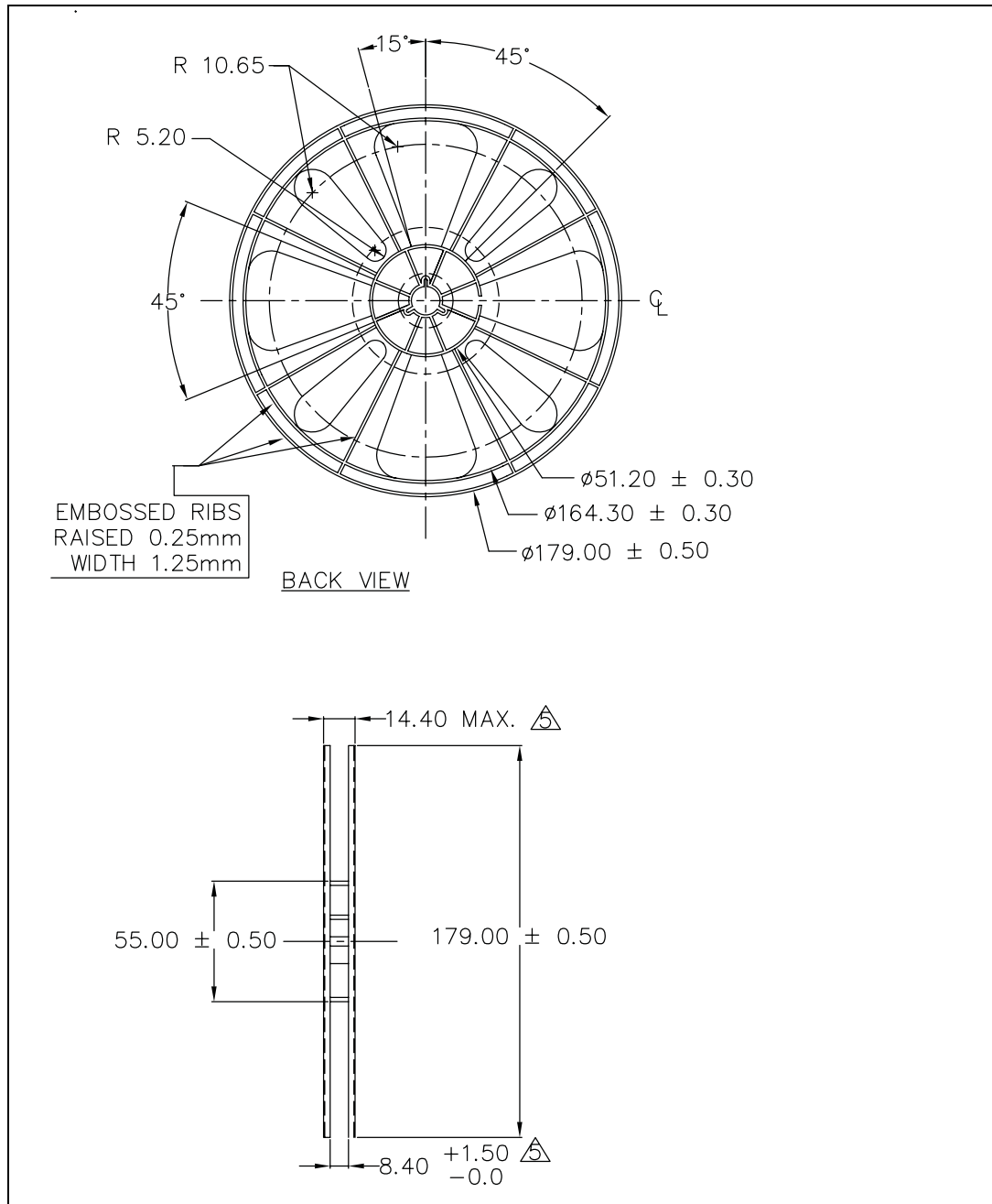
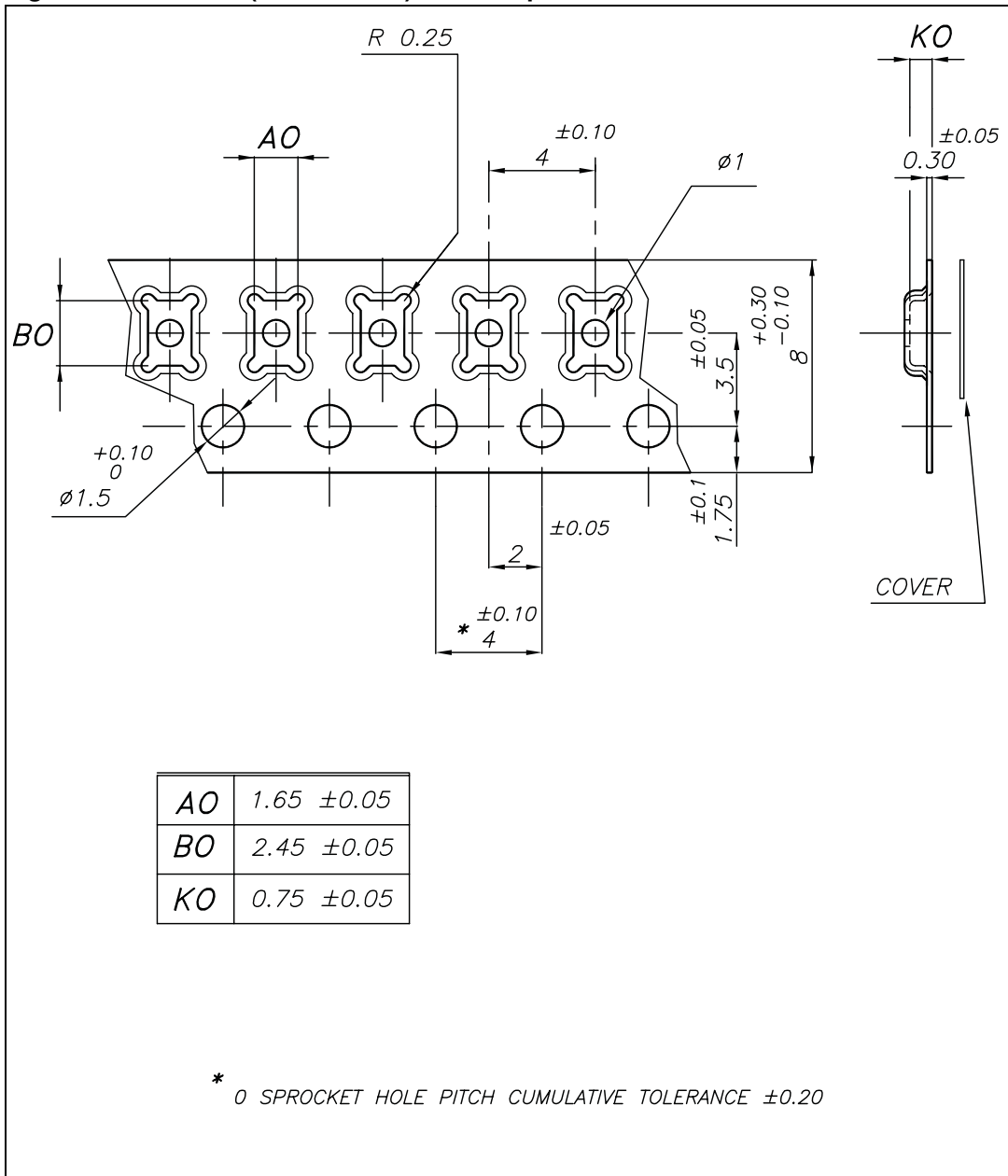


Figure 8. QFN12L (2.2 x 1.4 mm) carrier tape information



5 Revision history

Table 10. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 22-Dec-2005 | 1 | First draft. |
| 23-Dec-2005 | 2 | Few changes. |
| 15-Mar-2010 | 3 | The document has been reformatted, added tape and reel information. |

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