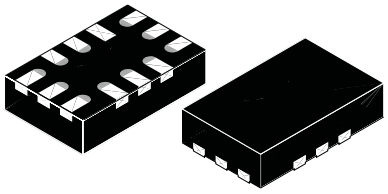
STG3856

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 µA (max.) at T_A = 85°C
- Low ON resistance V_{IN} = 0 V:
  - R_{ON} = 1.0 Ω (max. T_A = 25°C) at V_{CC} = 4.3 V
  - R_{ON} = 1.5 Ω (max. T_A = 25°C) at V_{CC} = 3.0 V
  - R_{ON} = 1.8 Ω (max. T_A = 25°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)



QFN12L

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 C^2MOS 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)

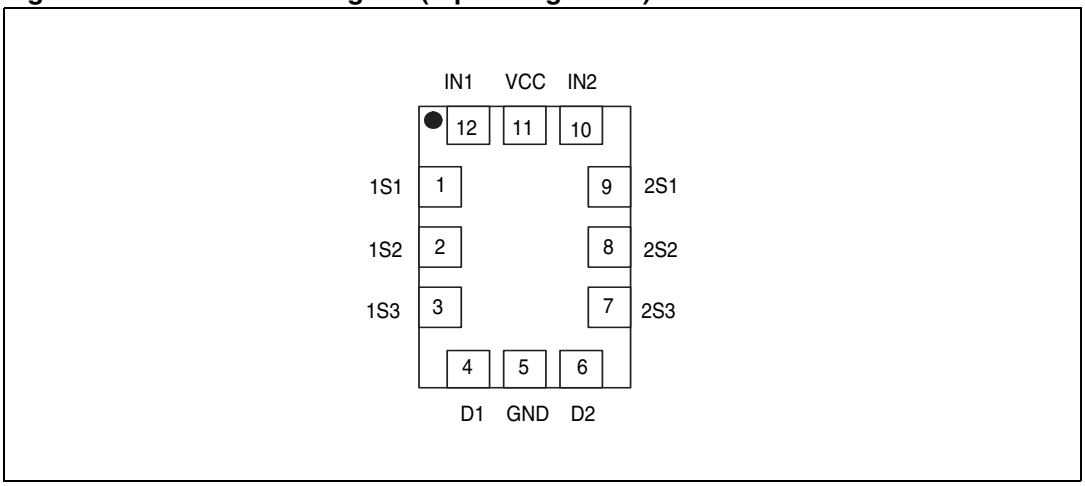


Table 2. Pin description

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)

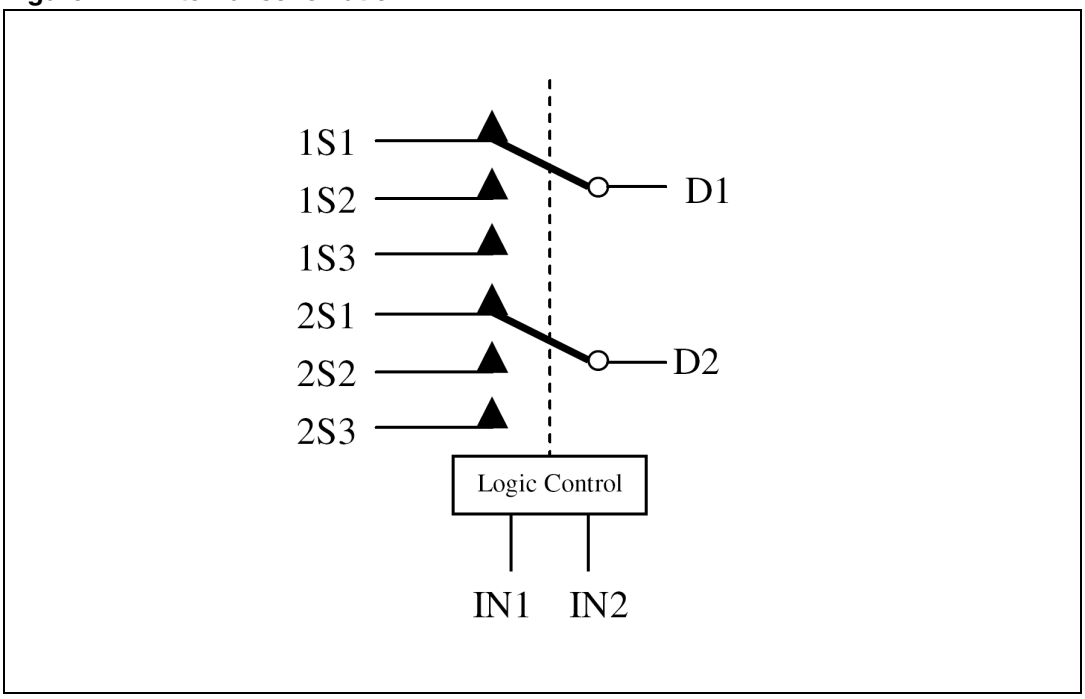
1.2 Truth table

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

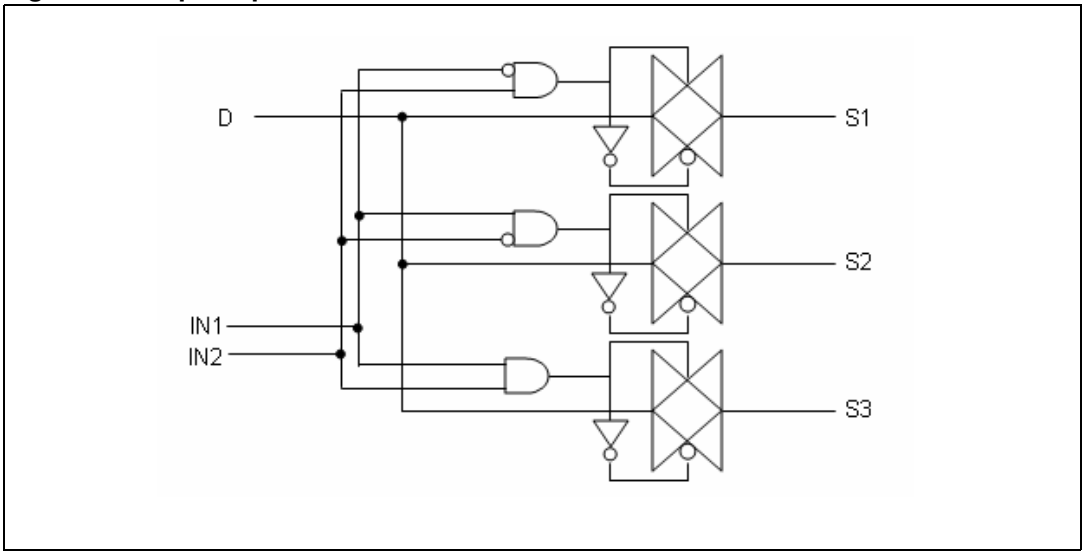
1.3 Internal schematic

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 = 70ºC (1)		mW
T_{STG}	Storage temperature	-65 to 150	°C
T_L	Lead temperature (10 sec)	300	°C

1. Derate above 70ºC 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 V to 2.7 V	0 to 20	ns/V
		V_{CC} = 3.0 to 4.3 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°C			-40 to 85°C		-55 to 125°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	–	±100	–	–	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_{CC} 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	–	± 100	–	–	µA
			V_{IN1}, V_{IN2} = 1.80V	–	± 33	± 40	–	± 50	–	–	
			V_{IN1}, V_{IN2} = 2.60V	–	± 12	± 20	–	± 30	–	–	

1. ΔRon = max |mSN-nSN|, 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 pF, R_L = 50 Ω, $t_r = t_f \leq 5$ ns)

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	
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 V	–	56	–	–	–	–	–	ns
		2.3 - 2.7	V_S = 1.5 V	–	33	50	–	60	–	–	
		3.0 - 3.3		–	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	V_S = 1.5 V	–	17	25	–	40	–	–	
		3.0 - 3.3		–	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	V_S = 1.5 V	10	22	40	–	50	–	–	
		3.0 - 3.3		10	18	30	–	40	–	–	
		3.6 - 4.3		10	7	25	–	35	–	–	
Q	Charge injection	1.65 - 1.95	C_L=100pF R_L=1MO V_{GEN}=0V R_{GEN}=0Ω	–	25	–	–	–	–	–	pC
		2.3 - 2.7		–	35	–	–	–	–	–	
		3.0 - 3.3		–	40	–	–	–	–	–	
		3.6 - 4.3		–	55	–	–	–	–	–	

3.3 Analog switch

Table 8. Analog switch characteristics (C_L = 5p F, R_L = 50 Ω, T_A = 25°C)

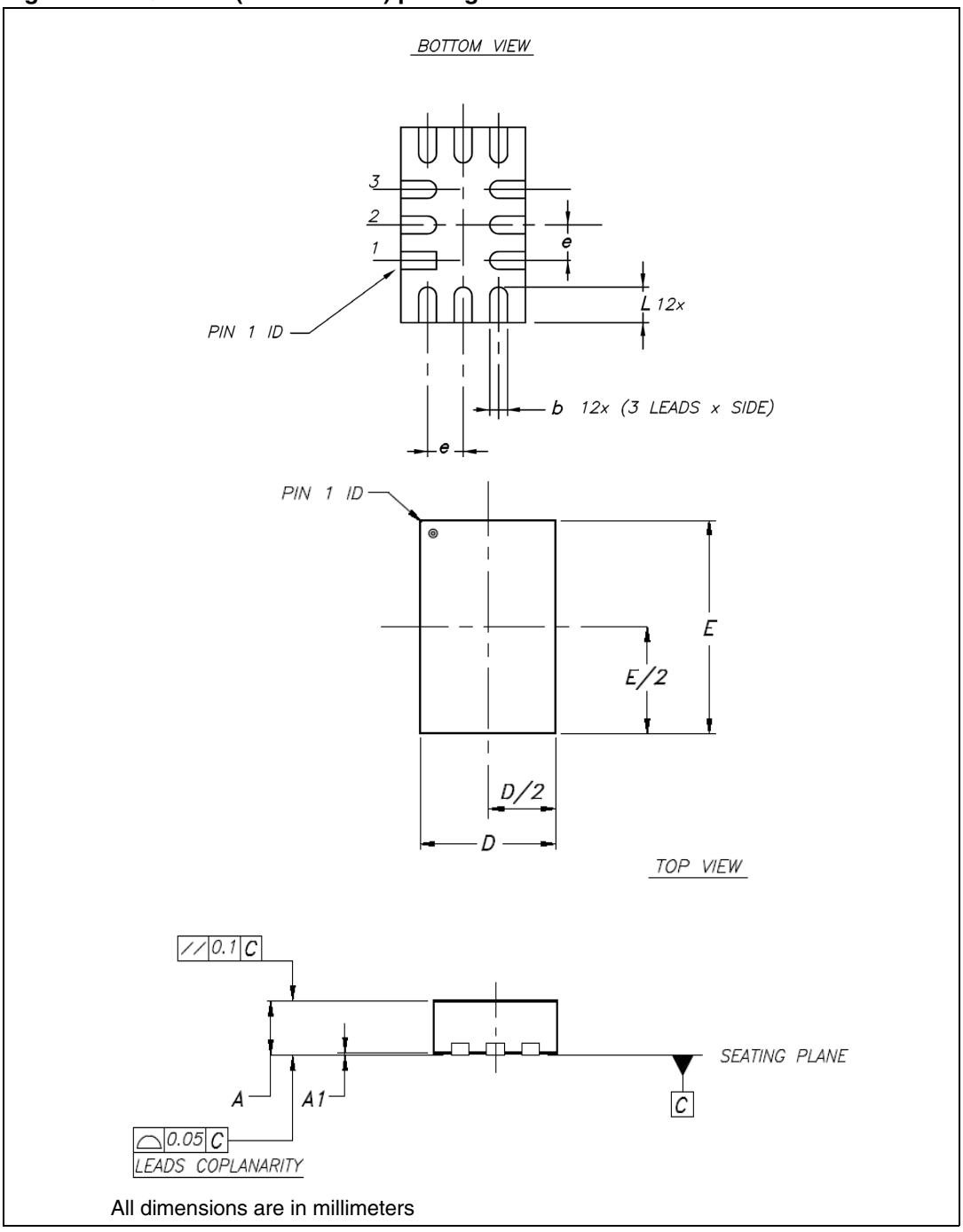
Symbol	Parameter	Test condition		Value							Unit
		V_{CC} (V)		T_A = 25°C			-40 to 85°C		-55 to 125°C		
				Min	Typ	Max	Min	Max	Min	Max	
O_{IRR}	Off Isolation (1)	1.65 - 4.3	V_S = 1V_{RMS} f = 100 kHz	–	-82	–	–	–	–	–	dB
X_{talk}	Crosstalk	1.6 - 4.3	V_S = 1 V_{RMS} f = 100 kHz	–	-84	–	–	–	–	–	dB
T_{HD}	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 Log_{10} (V_D/V_S), V_D = output, V_S = input at off switch

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



All dimensions are in millimeters

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

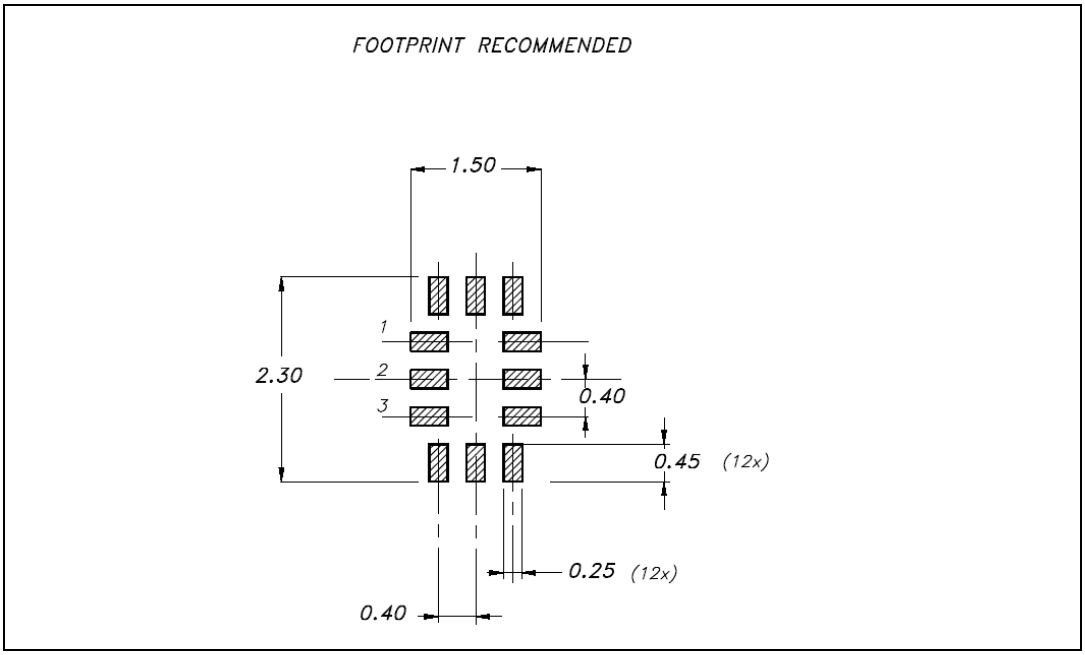


Figure 6. QFN12L (2.2 x 1.4 mm) reel for carrier tape information

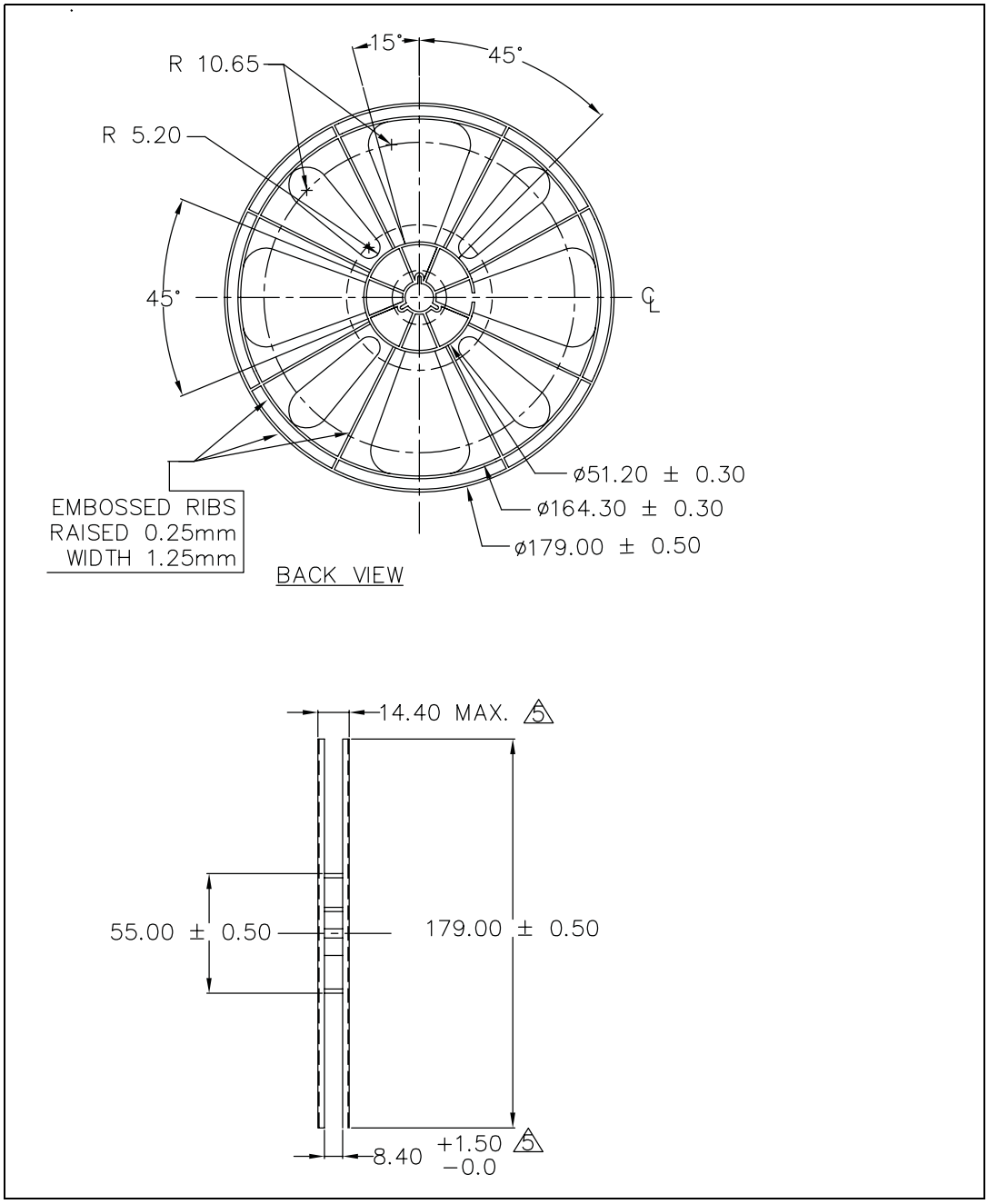


Figure 7. QFN12L (2.2 x 1.4 mm) reel for carrier tape information

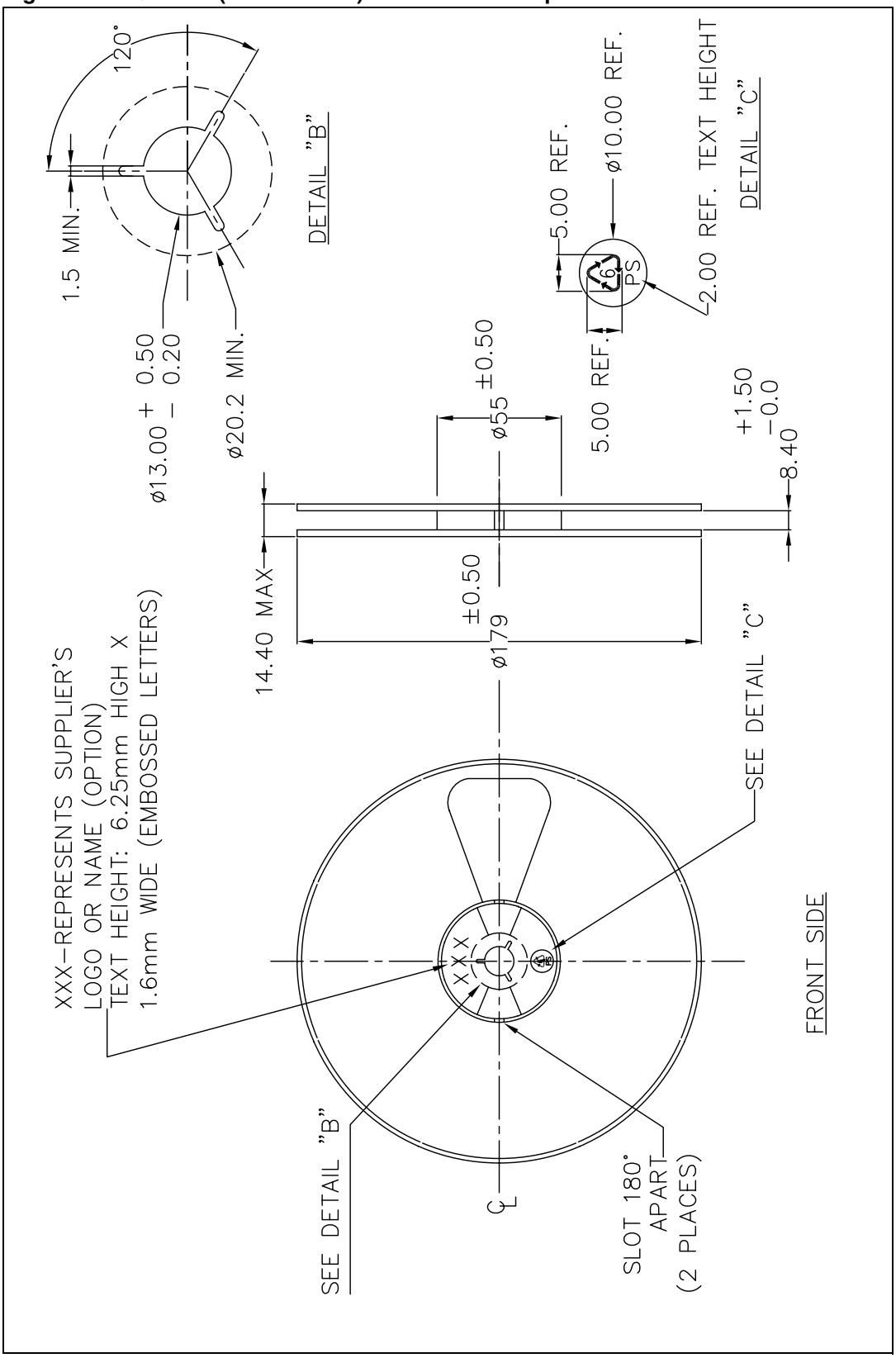
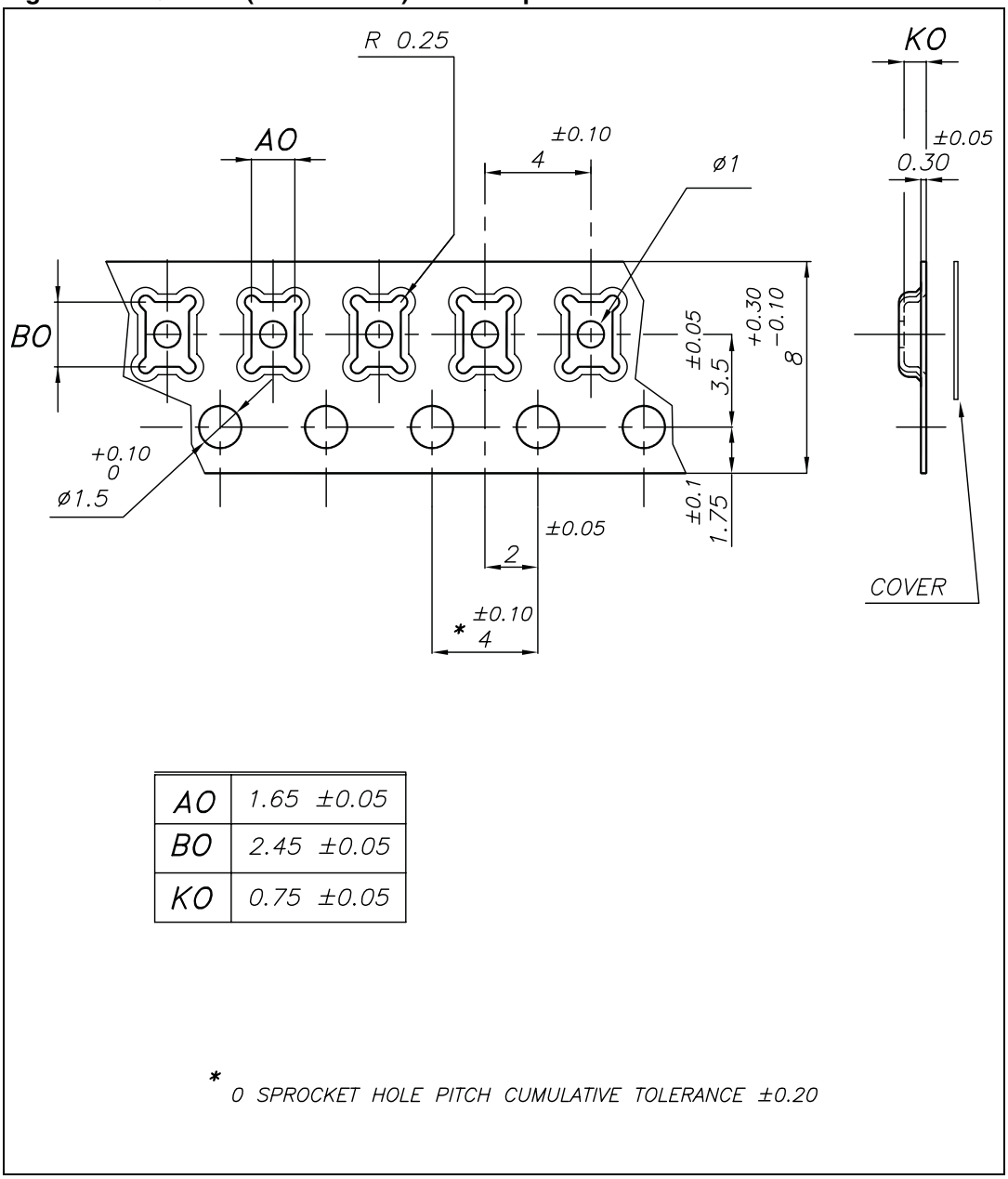


Figure 8. QFN12L (2.2 x 1.4 mm) carrier tape information



AO	1.65 ±0.05
BO	2.45 ±0.05
KO	0.75 ±0.05

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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