STRAFT-P98L15

Antenna tuner for cellular application

Datasheet – production data

Features

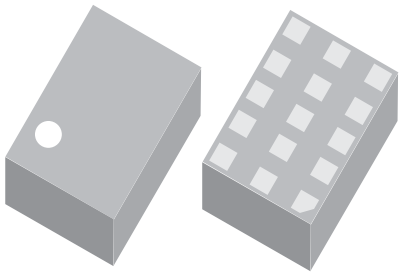
- 50 Ω nominal Input for a wide range of output impedances
- Wide operating frequency range (824 MHz to 2170 MHz)
- Specifically optimized to match single antenna cellular platforms
- RF tuner module controlled through an associated device (STHVDAC-303xF6) with three-wire serial interface
- LGA package
- Small footprint: 2.7 x 3.8 mm^2

Benefits

- Cellular antenna adaptive RF matching network
- Mobile phone TRP, TIS and current consumption optimization through antenna impedance control
- Ease of antenna design by actively adjusting the antenna impedances
- Enables the use of smaller / thinner antenna in mobile phones

Applications

- Multiband GSM/WCDMA mobile phone
- Cellular antenna tunable matching network
- Mobile phone TRP and TIS optimization and alignment to 3GPP requirements
- Open loop application



LGA package

Description

Building high performance multimode / multiband mobile phones requires antennae capable of working over a wide frequency range. Such antennas are very difficult to fit within the mobile phone package, requiring the antenna designer to balance the antenna performance to the required form factor constraints.

This RAFT tuner has been specifically designed to tune the antenna impedance, by controlling the matching network located between the front end module output and the antenna, relaxing the constraints related to antenna design.

An optimized matching of the antenna to the platform can then be guaranteed during mobile phone operation, enabling TRP and TIS requirement to be met and optimized according to network operators stringent requirements.

The RAFT is dedicated to single antenna platforms.

Tuners are designed to operate over wide frequency range to cover multimode / multiband mobile phones.

Thanks to the associated control IC (STHVDAC-303xF6) the RAFT antenna tuner module allows mobile handset RF performance to be tailored on a band-by-band basis.

This is information on a product in full production. www.st.com

1 Characteristics

Figure 1. Functional block diagram

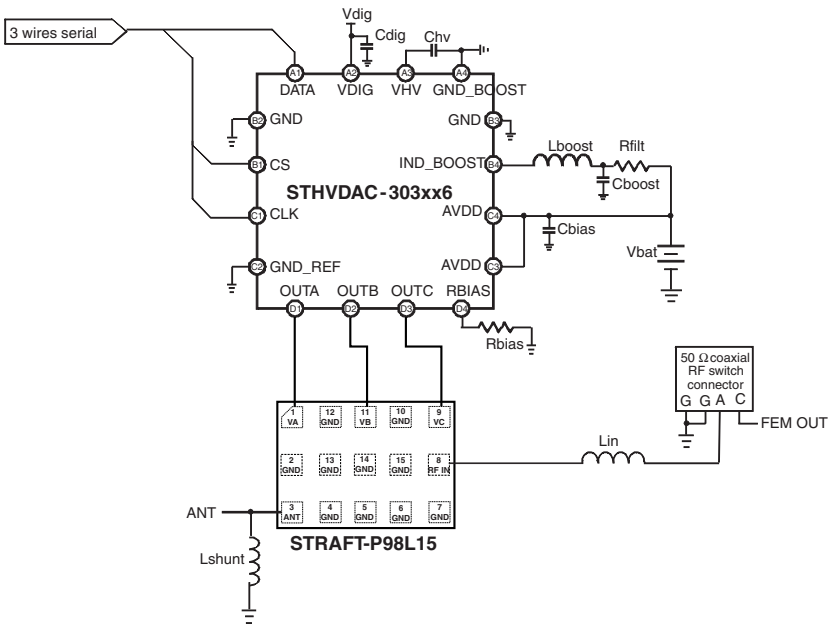


Table 1. Pinout description

Pin number	Pin name	Description
1	VA	Bias voltage A
2	GND	ground
3	ANT	Antenna Port
4	GND	ground
5	GND	ground
6	GND	ground
7	GND	ground
8	RFIN	RF input Port
9	VC	Bias voltage C
10	GND	ground
11	VB	Bias voltage B
12	GND	ground
13	GND	ground
14	GND	ground
15	GND	ground

Table 2. Absolute maximum ratings (limiting value)

Symbol	Parameter	Rating	Unit
P_{IN}	Input power RFIN (CW mode) / All RF ports	+36	dBm
$V_{ESD\ (HBM)}$	Human body model, JESD22-A114-B, all I/O	500	V
$V_{ESD\ (MM)}$	Machine model, JESD22-A115-A, all I/O	100	V
T_{device}	Maximum device temperature	+115	°C
T_{stg}	Storage temperature range	-55 to +150	°C
V_{bias}	Bias voltage range	-0.3, 20	V

Table 3. Recommended operating conditions

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
P_{IN}	RF Input Power (50% duty cycle mode) RF in (LB) RF in (HB) ANT (LB and HB)	-	-	 +33 +31.5 +13	dBm
VSWR	Ruggedness (reference to 50 Ω)	-	-	10:1	-
T_{OP}	Operating temperature	-25	-	+85	°C
V_X	Bias voltage	2	-	16	V

Table 4. Electrical characteristics

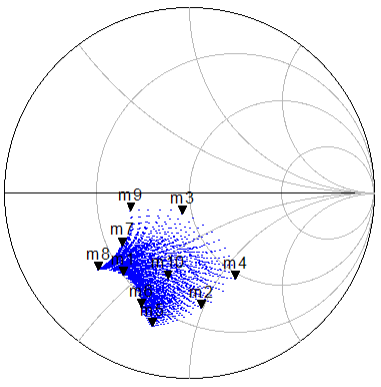
Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
I_{LVA}	Leakage current on VA bias pin, VA = 16 V	-	0.5	2	µA
I_{LVB}	Leakage current on VB bias pin, VB = 16 V	-	0.5	2	µA
I_{LVC}	Leakage current on VC bias pin, VB = 16 V	-	0.5	2	µA

Table 5. RF LB performance(1)

Symbol	Parameter	Conditions					Min.	Typ.	Max.	Unit
		index	VA	VB	VC	$Z_{ANT\_LB\_nom}$				
$VSWR_{LB}$	LB impedance mismatch at 915 MHz calculated according to design complex impedance target ($Z_{ANT\_LB\_nom}$)	m_1	16 V	2 V	16 V	0.39 -j 0.47	-	-	3:1	
		m_2	5 V	16 V	2 V	0.64 -j 1.16	-	-	3:1	
		m_3	2 V	8 V	2 V	1.19 -j 0.19	-	-	3:1	
		m_4	2 V	16 V	2 V	1.35 -j 1.36	-	-	3:1	
		m_5	16 V	16 V	2 V	0.29 -j 0.86	-	-	3:1	
		m_6	16 V	16 V	16 V	0.35 -j 0.70	-	-	3:1	
		m_7	16 V	2 V	2 V	0.44 -j 0.27			3:1	
		m_8	16 V	2 V	16 V	0.27 -j 0.38			3:1	
		m_9	2 V	2 V	2 V	0.57 -j 0.12			3:1	
		m_{10}	5 V	10 V	7 V	0.744 -j 0.63			3:1	
DL_{LB}	LB tuner nominal dissipative loss at 915 MHz	ANT port loaded with 50 Ω, for Va = 16 V, Vb = 2, V_c = 16 V					-	-0.5	-1(2)	dB
Hx_{LB}	Tuner output harmonics level	VA, VB, VC set to minimize S_{21}, 824 MHz < f0 < 915 MHz Harmonics from 1 GHz to 2.88 GHz, ANT port loaded by 50 Ω, L_{shunt} = 12 nH, and Ls = 2.2 nH					-	-	-30	dBm

1. Conditions: Freq from 824 MHz to 960 MHz, P_{in} = +33 dBm, T_{amb} = 25 °C, duty cycle 25%, RF IN and ANT ports loaded by 50 Ω, otherwise specified
2. Measured with tuner input/output loaded with 50 ohms. As the tuner output is not matched to 50 ohms, this parameter represent the dissipative loss {DL_{LB} = 20*log(S21) - 10*log(1-mag(S22)²)}

Figure 2. STRAFT-P98L15 smith chart coverage at 915 MHz (Port 2 conjugate)



m1
VPTIC3=16
VPTIC1=16 VPTIC2=8
impedance = Z0 * (0.334 - j0.435)

m2
VPTIC3=2
VPTIC1=5 VPTIC2=16
impedance = Z0 * (0.485 - j0.990)

m3
VPTIC3=2
VPTIC1=2 VPTIC2=7
impedance = Z0 * (0.906 - j0.208)

m4
VPTIC3=2
VPTIC1=2 VPTIC2=16
impedance = Z0 * (0.925 - j1.194)

m5
VPTIC3=2
VPTIC1=16 VPTIC2=16
impedance = Z0 * (0.227 - j0.735)

m6
VPTIC3=16
VPTIC1=16 VPTIC2=16
impedance = Z0 * (0.282 - j0.629)

m7
VPTIC3=2
VPTIC1=16 VPTIC2=2
impedance = Z0 * (0.407 - j0.294)

m8
VPTIC3=16
VPTIC1=16 VPTIC2=2
impedance = Z0 * (0.244 - j0.346)

m9
VPTIC3=2
VPTIC1=2 VPTIC2=2
impedance = Z0 * (0.512 - j0.109)

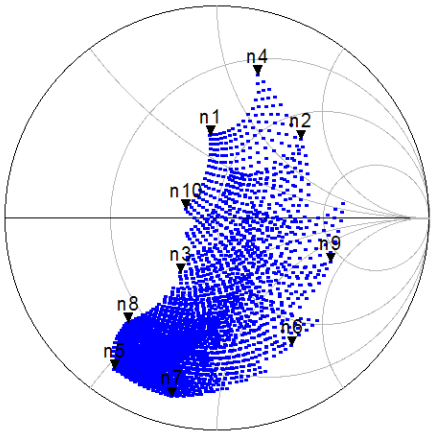
m10
VPTIC3=5
VPTIC1=8 VPTIC2=10
impedance = Z0 * (0.531 - j0.635)

Table 6. RF HB performance(1)

Symbol	Parameter	Conditions					Min.	Typ.	Max.	Unit
		index	VA	VB	VC	$Z_{ANT\_HB\_nom}$				
$VSWR_{HB}$	HB impedance mismatch at 1980 MHz calculated according to design Complex Impedance target ($Z_{ANT\_HB\_nom}$)	n_1	2 V	2 V	16 V	0.52 +j 0.91	-	-	3:1	
		n_2	3 V	2 V	2 V	1.82 +j 2.42	-	-	3:1	
		n_3	5 V	16 V	16 V	0.83 -j 0.47	-	-	3:1	
		n_4	2 V	12 V	2 V	0.57 +j 1.56	-	-	3:1	
		n_5	16 V	16 V	2 V	0.12 -j 0.60	-	-	3:1	
		n_6	7 V	2 V	2 V	0.64 -j 1.78	-	-	3:1	
		n_7	16 V	2 V	2 V	0.14 -j 0.89	-	-	3:1	
		n_8	16 V	16 V	16 V	0.32 -j 0.52	-	-	3:1	
		n_9	5 V	2 V	2 V	2.63 -j 2.69	-	-	3:1	
		n_{10}	2 V	16 V	16 V	1.0 +j 0.24	-	-	3:1	
DL_{HB}	HB Tuner nominal dissipative loss at 1980 MHz	ANT port loaded with 50 Ω, for Va = 16 V, Vb = 16 V, V_c = 16 V					-	-0.7	-1(2)	dB
Hx_{HB}	Tuner output harmonics level	VA, VB, VC set to minimize S_{21}, 1710 MHz < f0 < 2110 MHz Harmonics from 1 GHz to 6.51 GHz, ANT port loaded by 50 Ω, L_{shunt} = 12 nH, and Ls = 2.2 nH					-	-	-30	dBm
$IMD3_{HB}$	Tuner Intermodulation Level	VA, VB, VC set to minimize S_{21}, ANT port loaded by 50 Ω, $T_{xsignal}$: +20 dBm@1950 MHz, Blocker Signal: -15dBm@1760 MHz, IMD3 measured @ 2140 MHz L_{shunt} = 12 nH, and Ls = 2.2 nH					-	-	-105	dBm

1. Conditions: Freq from 1710 MHz to 2170 MHz, Pin = +31.5 dBm, duty cycle 25%, T_{amb} = 25 °C, RF IN and ANT ports loaded by 50 , Otherwise specified
2. Measured with tuner input/output loaded with 50 ohms. As the tuner output is not matched to 50 ohms, this parameter represents the dissipative loss {DL_{HB}=20*log(S_{21})-10*log(1-mag(S_{22})²)}

Figure 3. STRAFT-P98L15 smith chart coverage at 1980 MHz (Port 2 conjugate)



n1
VPTIC3=16
VPTIC1=2 VPTIC2=2
impedance = Z0 * (0.697 + j0.645)

n2
VPTIC3=2
VPTIC1=3 VPTIC2=2
impedance = Z0 * (1.400 + j1.480)

n3
VPTIC3=16
VPTIC1=5 VPTIC2=16
impedance = Z0 * (0.631 - j0.357)

n4
VPTIC3=2
VPTIC1=2 VPTIC2=2
impedance = Z0 * (0.456 + j1.222)

n5
VPTIC3=2
VPTIC1=16 VPTIC2=16
impedance = Z0 * (0.097 - j0.526)

n6
VPTIC3=2
VPTIC1=7 VPTIC2=2
impedance = Z0 * (0.657 - j1.543)

n7
VPTIC3=2
VPTIC1=16 VPTIC2=2
impedance = Z0 * (0.114 - j0.773)

n8
VPTIC3=16
VPTIC1=16 VPTIC2=16
impedance = Z0 * (0.260 - j0.436)

n9
VPTIC3=2
VPTIC1=5 VPTIC2=2
impedance = Z0 * (2.598 - j1.612)

n10
VPTIC3=16
VPTIC1=2 VPTIC2=16
impedance = Z0 * (0.743 + j0.066)

2 Application information

Figure 4. Application schematic

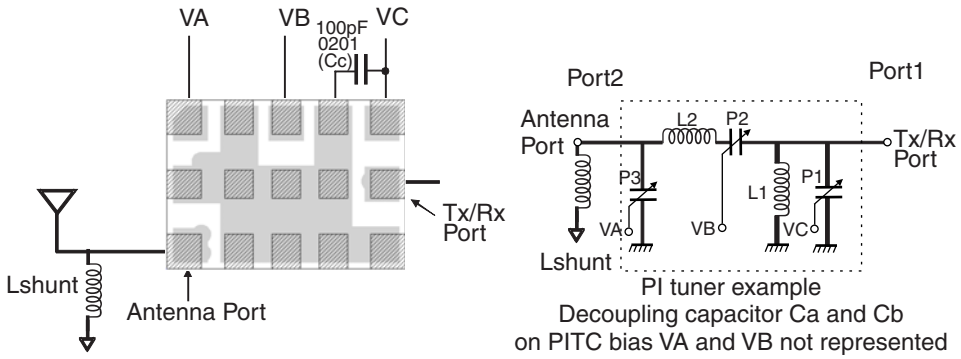
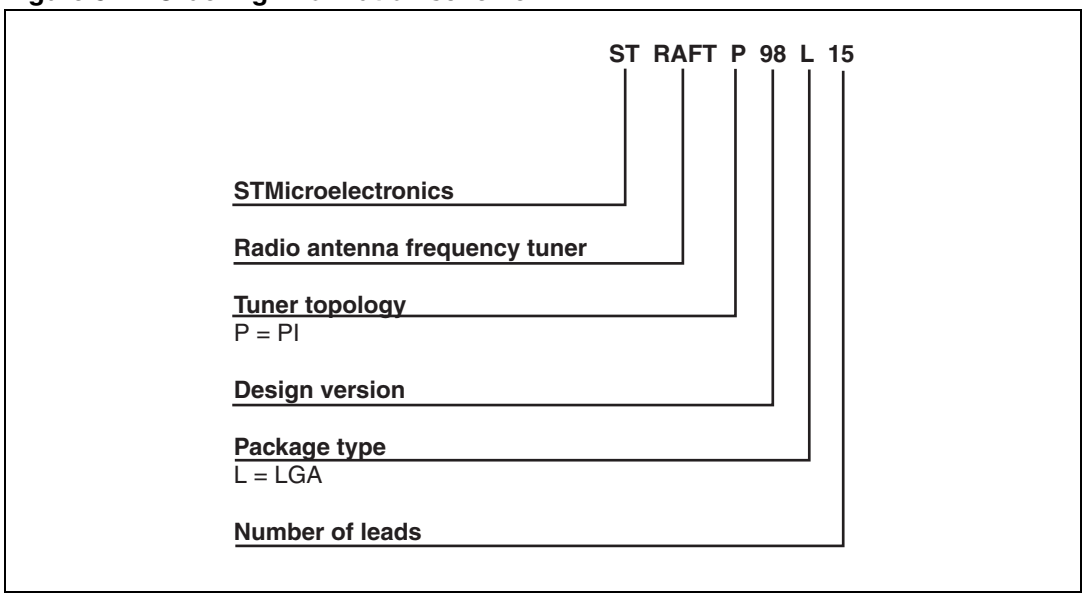


Table 7. Bill of materials

Components	Description	Nominal value	Package	Recommended P/N
P1	Tunable Capacitor (PTIC)	3.3 pF	die	NA
P2	Tunable Capacitor (PTIC)	5.6 pF	die	NA
P3	Tunable Capacitor (PTIC)	3.3 pF	die	NA
L1	Inductor	33 nH	0402	MURATA LQW15AN39NC00 series
L2	Inductor	6.2 nH	0402	MURATA LQW15AN8N2C00 series
L_{shunt}	Inductor	3.9 nH	0402	MURATA LQW15AN3N9C00 series
C1	VC decoupling capacitor	100 pF	0201	MURATA GRM0335C1Exxx series

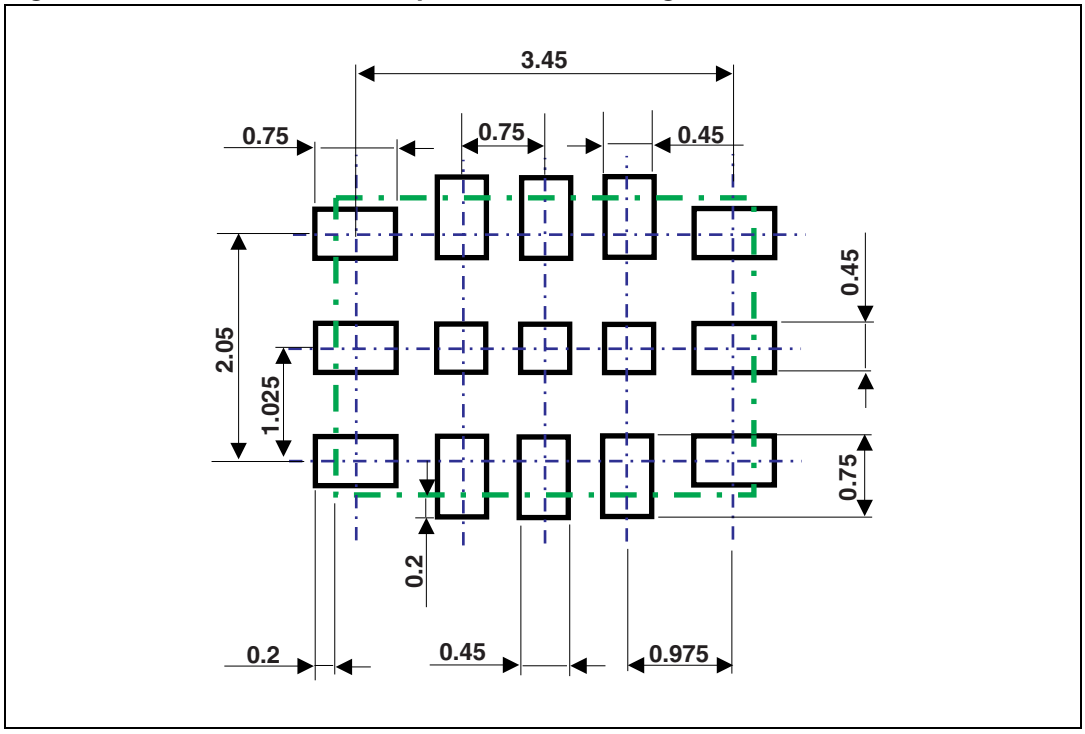
3 Ordering information scheme

Figure 5. Ordering information scheme



4 Recommendation on PCB assembly

Figure 6. Recommended land pattern for soldering the device on PCB



5 Package information

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 dimensions (reference definitions)

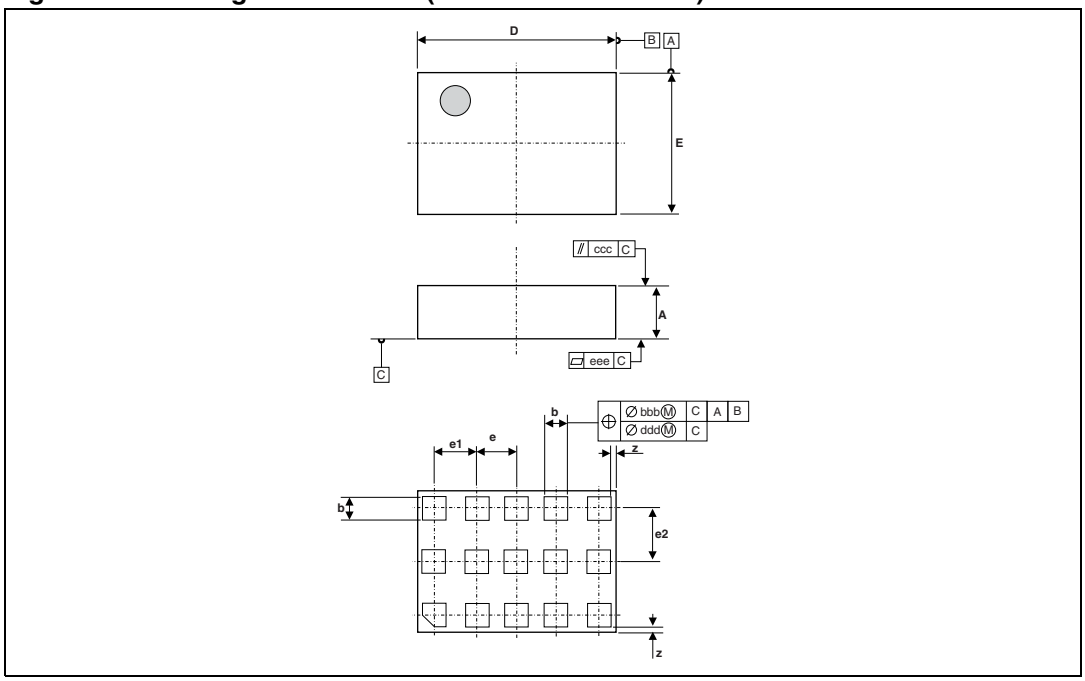
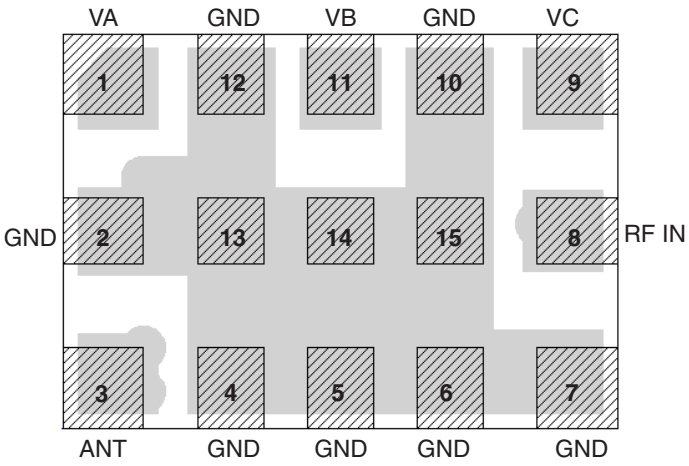


Table 8. Package dimensions (values)

Reference	Dimensions (mm)		
	Min.	Typ.	Max.
A	1.00	1.05	1.10
b	0.42	0.45	0.48
D	3.7	3.8	3.9
E	2.6	2.7	2.8
e	-	0.75	-
e1	-	0.825	-
e2	-	1.025	-
z	-	0.1	-
bbb	-	0.1	-
ccc	-	0.1	-
ddd	-	0.05	-
eee	-	0.05	-

Figure 8. Package footprint



Module size and footprint are standard for different type of tuner. Tee or PI tuner have the same size and footprint so that the tuner topology and Smith chart coverage can be adjusted without mobile phone PCB re-design.

Figure 9. Tape dimensions

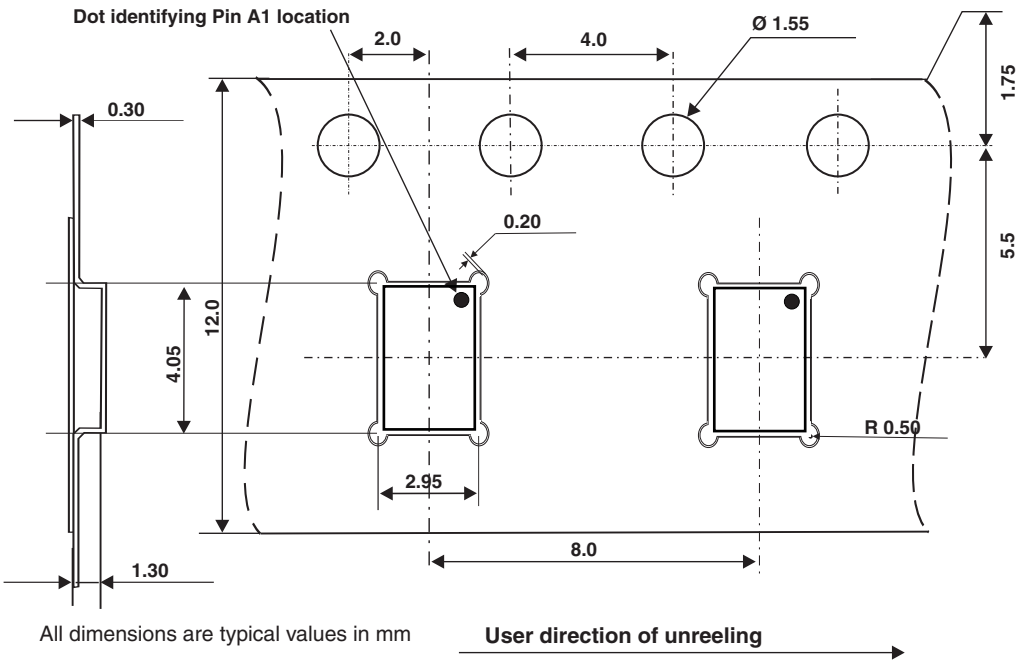


Figure 10. Reel dimensions (reference definitions)

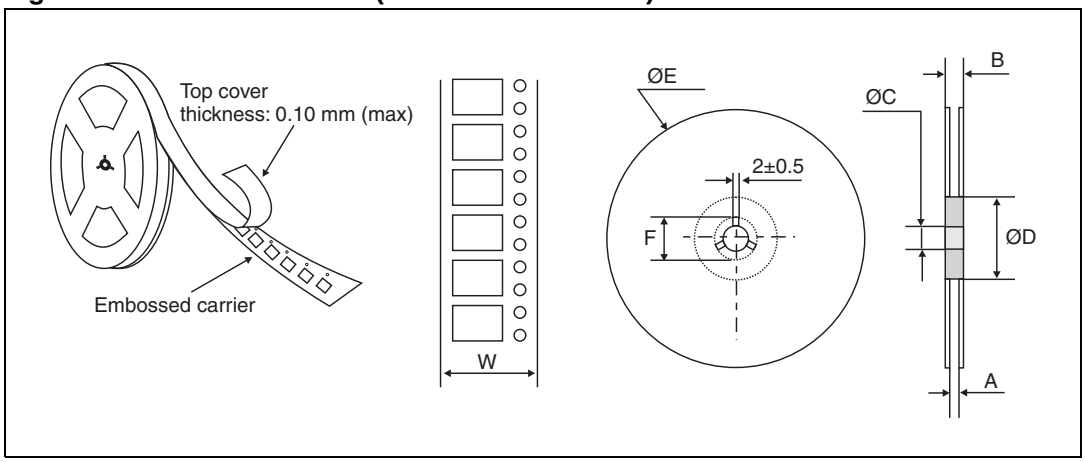


Table 9. Reel dimensions (values)

Package	Base qty.	Carrier tape width	Reel dimensions					
		W	A	B (max)	C	D (min)	E (max)	F (min)
LGA 2.7x3.8 15L	5000	12	12.4	18.4	13	50	330	20.2

6 Ordering information

Table 10. Ordering information scheme

Ordering code	Marking	Base Qty	Delivery Mode
STRAFT-P98L15	RAFTP98	5000	13’ Tape and reel

7 Revision history

Table 11. Document revision history

Date	Revision	Changes
02-Nov-2012	1	Initial release.

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