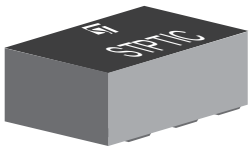
STPTIC-27L1

Parascan™ tunable integrated capacitor

Datasheet - production data



QFN

Features

- High power capability (+36 dBm)
- High tuning range (4/1)
- High linearity (IP3 up to +80dbm)
- High quality factor (Q)
- Low leakage current
- Compatible with high voltage control IC (STHVDAC series)
- Available in plastic molded package:
  – QFN package 1.2 x 1.6 x 0.9 mm
- ECOPACK®2 compliant component

Benefit

- RF tunable passive implementation in mobile phones to optimize antenna radiated performance.

Applications

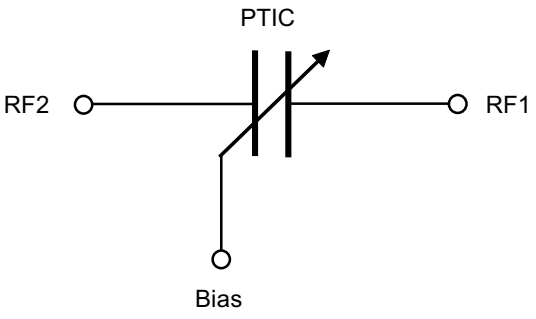
- Cellular antenna open loop tunable matching network in multi-band GSM/WCDMA/LTE mobile phone
- Tunable RF filters

Description

The ST integrated tunable capacitor offers excellent RF performance, low power consumption and high linearity required in adaptive RF tuning applications. The fundamental building block of PTIC is a tunable material called Parascan™, which is a version of barium strontium titanate (BST) developed by Paratek Microwave.

BST capacitors are tunable capacitors intended for use in mobile phone application and dedicated to RF tunable applications. These tunable capacitors are controlled through a bias voltage ranging from 1 to 22 V. The implementation of BST tunable capacitor in mobile phones enables significant improvement in terms of radiated performance making the performance almost insensitive to the external environment.

Figure 1. PTIC functional block diagram



TM: Parascan is a trademark of Paratek Microwave Inc.

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

1 Electrical characteristics

Table 1. Absolute maximum ratings (limiting values)

Symbol	Parameter	Rating	Unit
P_{IN}	Input peak power RF_{IN} (CW mode)/all RF ports	+39	dBm
$V_{ESD(HBM)}$	Human body model, JESD22-A114-B, all I/O	Class 1B(1)	V
$V_{ESD(MM)}$	Machine model, JESD22-A115-A, all I/O	100	V
T_{device}	Device temperature	+125	°C
T_{stg}	Storage temperature	-55 to +150	
V_x	Bias voltage	25	V

1. Class 1B defined as passing 500V, but fails after exposure to 1000V ESD pulse.

Table 2. Recommended operating conditions

Symbol	Parameter	Rating			Unit
		Min.	Typ.	Max.	
P_{IN}	RF input power	-	+33	+39	dBm
F_{OP}	Operating frequency	700	-	2700	MHz
T_{device}	Device temperature	-	-	+100	°C
T_{OP}	Operating temperature	-30	-	+85	
V_{BIAS}	Bias voltage	1	-	22	V

Table 3. Representative performance (T_{amb} = 25 °C otherwise specified)

Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
C_{1V}	capacitor at 1V bias	STPTIC-27L1	2.7	3.1	3.5	pF
C_{2V}	capacitor at 2V bias	STPTIC-27L1	2.43	2.7	2.97	pF
C_{22V}	capacitor at 22V bias	STPTIC-27L1	0.66	0.77	0.87	pF
ΔC	Tuning range	Ratio between C_{1V}/C_{22V} (1)	4/1	-	-	-
I_L	Leakage current	Measured with V_{bias} = 22 V	-	-	100	nA
Q_{LB}	Quality factor	Measured at 700 MHz at 2 V	50	60	-	-
Q_{HB}	Quality factor	Measured at 2700 MHz at 2 V	35	40	-	-
IP3	Third order intercept point	V_{bias} = 1 V (2)(4)	60	-	-	dBm
		V_{bias} = 22 V (2)(4)	80	-	-	
H2	Second harmonic	V_{bias} = 1 V (3)(4)	-	-	-65	dBm
		V_{bias} = 22 V (3)(4)	-	-	-75	
H3	Third harmonic	V_{bias} = 1 V (3)(4)	-	-	-50	dBm
		V_{bias} = 22 V (3)(4)	-	-	-70	
t_T	Transition time	From C_{min} to C_{max} (5)	-	-	90	µs
		From C_{max} to C_{min} (5)	-	-	90	

1. Measured at 100kHz
2. F_1 = 894 MHz, F_2 = 849 MHz, P_1 = 20 dBm, P_2 = -15 dBm, $2f_1 - f_2$ = 939 MHz
3. 894 MHz, P_{in} = 34 dBm
4. IP3 and harmonics are measured in the shunt configuration in a 50 W environment
5. One or both of RF_{in} and RF_{out} must be connected to DC ground

Table 4. Representative performance (T_{amb} = 25 °C otherwise specified)

Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
IP3	Third order intercept point	V_{bias} = 2 V(1)(2)	70	-	-	dBm
		V_{bias} = 20 V(1)(2)	80	-	-	
H2	Second harmonic	V_{bias} = 2 V(3)(2)	-	-	-65	dBm
		V_{bias} = 20 V(3)(2)	-	-	-65	
H3	Third harmonic	V_{bias} = 2 V(3)(2)	-	-	-50	dBm
		V_{bias} = 20 V(3)(2)	-	-	-70	

1. P_1 = +25dBm, P_2 = +25dBm (see measurement data *Figure 6* with f1 = 894 MHz, f2 = 849 MHz, 2f1-f2 = 939 MHz)
2. iIP3 and harmonics are measured in shunt configuration in a 50 Ω environment
3. Pin = 34 dBm, CW (see measurement data *Figure 4* and *Figure 5*)

Figure 2. Capacitor variation versus bias voltage

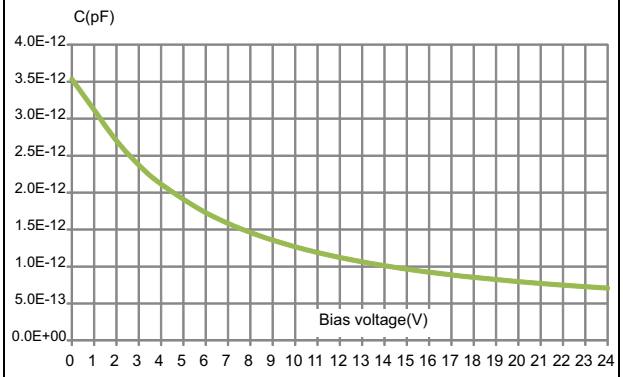


Figure 3. Quality factor versus frequency

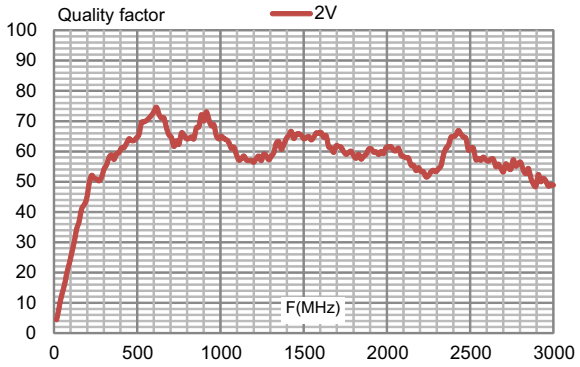


Figure 4. Harmonic power versus bias voltage (series)

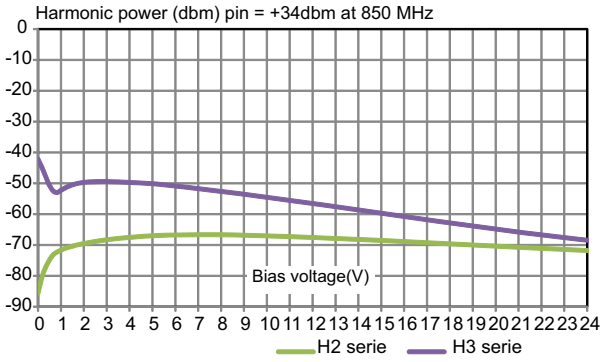


Figure 5. Harmonic power versus bias voltage (shunt)

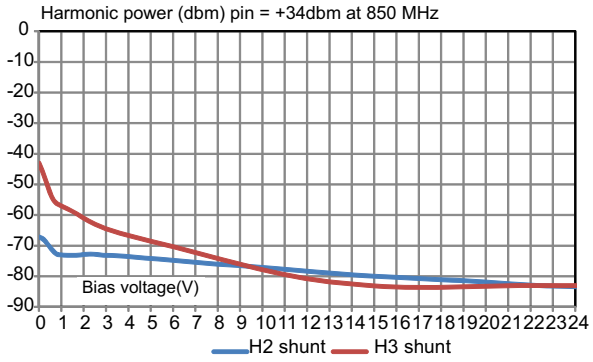
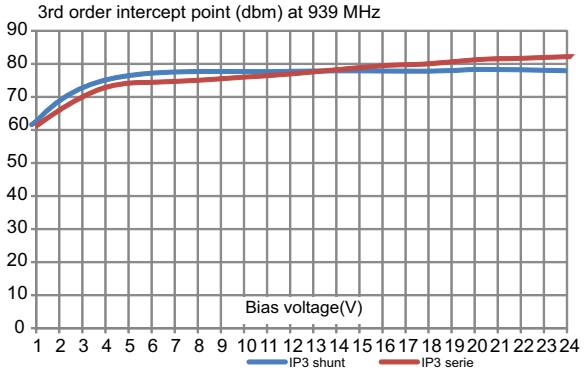


Figure 6. Third order intercept point (IP3)



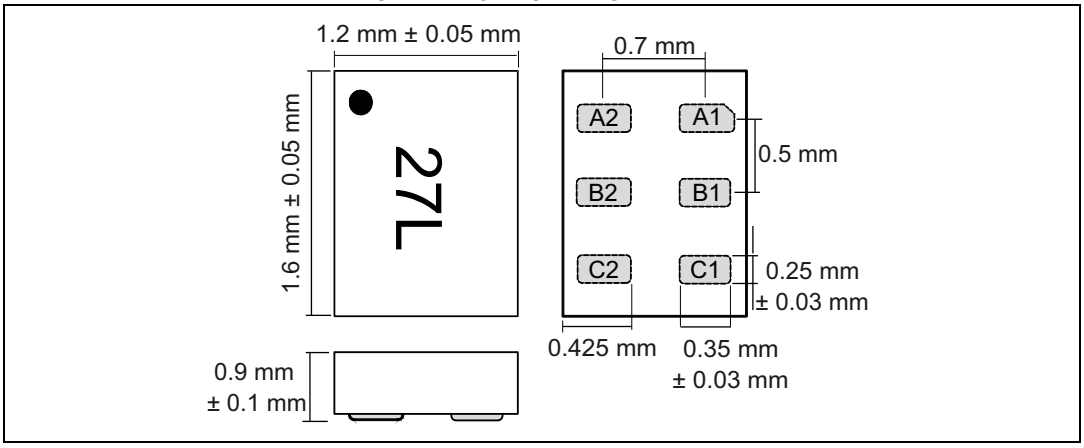
2 Package information

- Epoxy meets UL94, V0
- Lead-free package

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.

2.1 QFN package information

Figure 7. QFN package outline

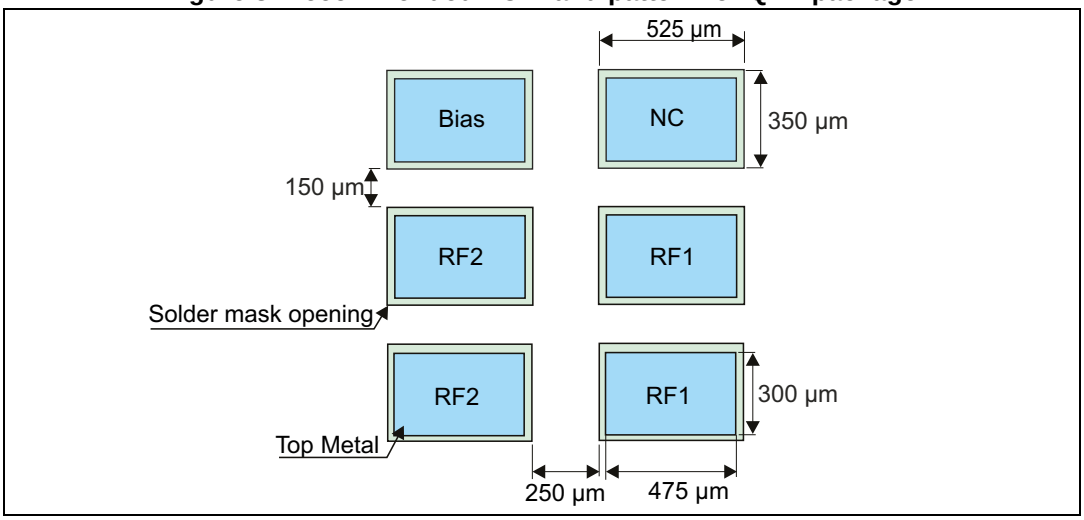


The land pattern below is recommended for soldering the device on PCB.

NC stands for No Connect, this pad must not be connected on application board. Please leave this pad floating.

When used in shunt configuration, it is recommended to connect RF2 to GND

Figure 8. Recommended PCB land pattern for QFN package



2.2 Packing information

Figure 9. QFN tape and reel outline

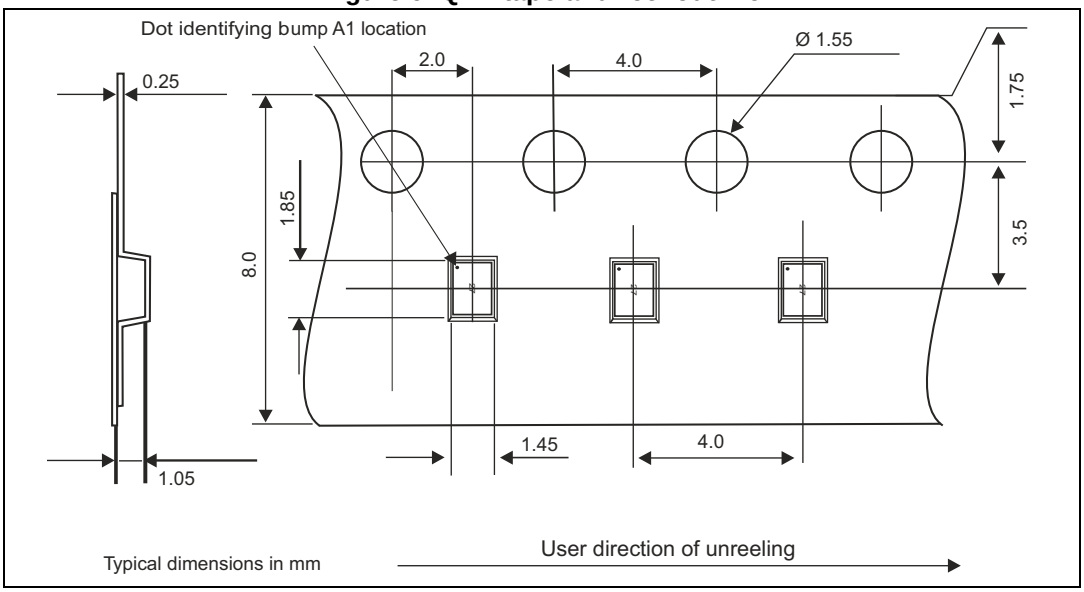


Figure 10. QFN marking

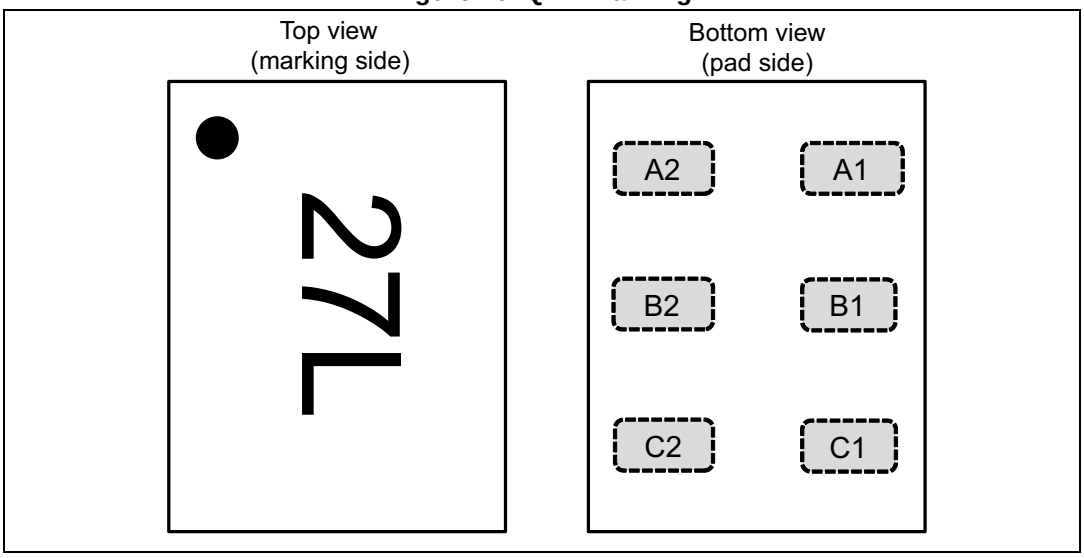
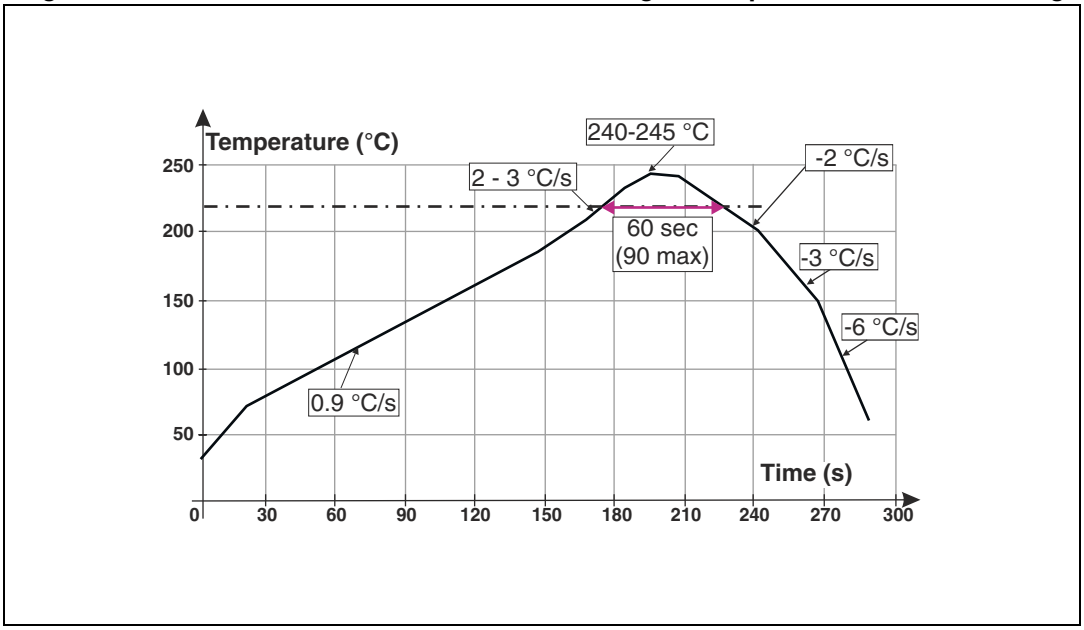


Table 5. Pinout description

Pad / Ball number	Pin name	Description
A1	DC bias	DC bias voltage
B1	RF2	RF input / output
C1	RF2	RF input / output
A2	NC	Not connected
B2	RF1	RF input / output
C2	RF1	RF input / output

3 Reflow profile

Figure 11. ST ECOPACK® recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement.

Table 6. Recommended values for soldering reflow

Profile	Value	
	Typical	Max.
Temperature gradient in preheat (T = 70-180 °C)	0.9 °C/s	3 °C/s
Temperature gradient (T = 200-225 °C)	2 °C/s	3 °C/s
Peak temperature in reflow	240-245 °C	260 °C
Time above 220 °C	60 s	90 s
Temperature gradient in cooling	-2 to -3 °C/s	-6 °C/s
Time from 50 to 220 °C	160 to 220 s	

4 Ordering information

Figure 12. Ordering information scheme

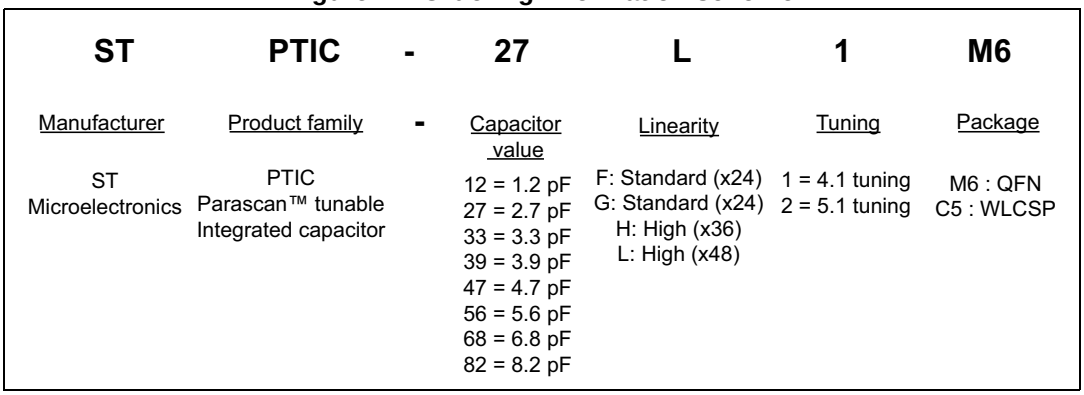


Table 7. Ordering information

Part Number	Marking	Base Qty	Delivery Mode
STPTIC-27L1M6	27L	3000	Tape and reel

5 Revision history

Table 8. Document revision history

Date	Revision	Changes
20-Jul-2015	1	Initial release.