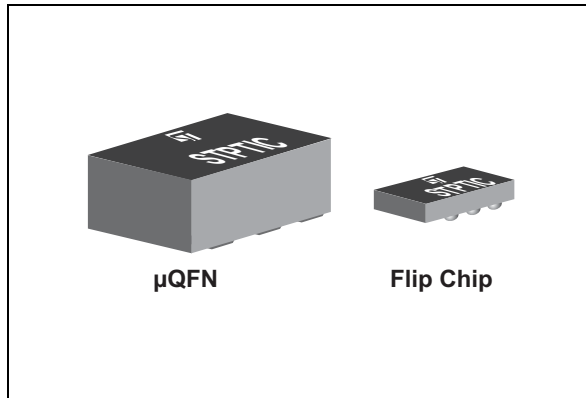


# Parascan™ tunable integrated capacitor

Datasheet - production data



## Features

- High power capability (+36 dBm)
- High tuning range (3.5/1)
- High quality factor (Q)
- High linearity device
- Low leakage current
- Capacitor bias is DC blocked
- Frequency of operation from DC to 3 GHz
- 8 values available: 1.2 pF, 2.7 pF, 3.3 pF, 3.9 pF, 4.7 pF, 5.6 pF, 6.8 pF and 8.2 pF
- Analog control voltage
- Compatible with high voltage control IC (STHVDAC series)
- Available in plastic molded package:
  - μQFN package 1.2 x 1.6 x 0.9 mm
  - Flip Chip 0.65 x 1.0 x 0.3 mm
  - Flip Chip 0.65 x 1.2 x 0.3 mm
- ECOPACK®2 compliant component

## Benefit

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

## Applications

- Cellular Antenna tunable matching network in multi-band GSM/WCDMA/LTE mobile phone
- Tunable RF filters
- Cellular tunable antenna
- LTE band tuning
- VSWR correction circuit

## 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 capacitances are tunable capacitances intended for use in mobile phone application, and dedicated to RF tunable applications. These tunable capacitances are controlled through a bias voltage ranging from 2 to 20 V. The use of BST tunable capacitance in mobile phones enables significant improvement in terms of radiated performances making the performance almost insensitive to the external environment.

TM: Parascan is a trade mark of Paratek microwave Inc.

# 1 Functional characteristics

Figure 1. PTIC functional block diagram

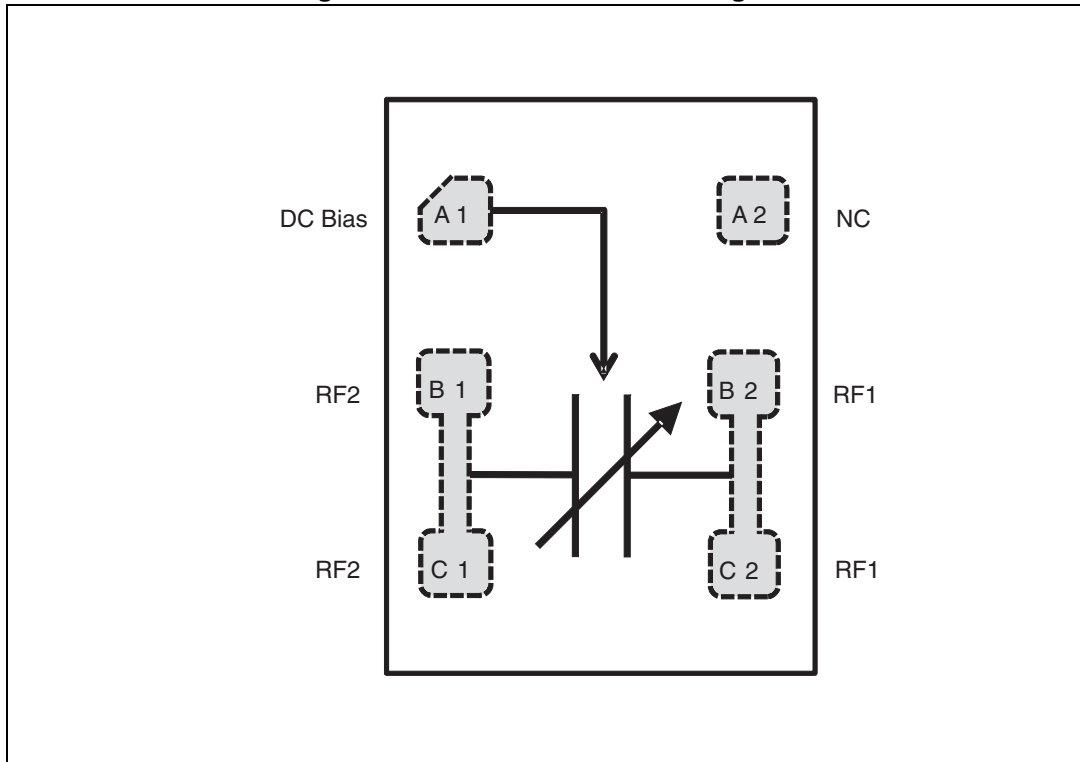


Table 1. Signal descriptions

Ball/Pad 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

## 2 Electrical characteristics

**Table 2. Absolute maximum ratings (limiting values)**

Symbol	Parameter	Rating	Unit
$P_{IN}$	Input peak power $RF_{IN}$ (CW mode)/all RF ports	+36	dBm
$V_{ESD(HBM)}$	Human body model, JESD22-A114-B, all I/O	STPTIC-12	500
		STPTIC-27	400 <sup>(1)</sup>
		STPTIC-33	400 <sup>(1)</sup>
		STPTIC-39	500
		STPTIC-47	500
		STPTIC-56	500
		STPTIC-68	500
$V_{ESD(MM)}$	Machine model, JESD22-A114-B, 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. Currently failing around 400 V, improvement on going to withstand 500 V on 2p7 and 3p3.

**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)			+35 +33	dBm
$F_{OP}$	Operating frequency	700		3000	MHz
$T_{device}$	Device temperature			+100	°C
$T_{OP}$	Operating temperature	-30		+85	
$V_x$	Bias voltage	2		20	V

Table 4. Representative performances ( $T_{amb} = 25\text{ °C}$ )

Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
$C_{2V}$	Capacitance at 2V bias	STPTIC-12	1.08	1.20	1.32	pF
		STPTIC-27	2.43	2.7	2.97	pF
		STPTIC-33	2.97	3.3	3.63	pF
		STPTIC-39	3.51	3.9	4.29	pF
		STPTIC-47	4.23	4.7	5.17	pF
		STPTIC-56	5.04	5.6	6.16	pF
		STPTIC-68	6.12	6.8	7.48	pF
	STPTIC-82	7.38	8.2	9.02		
$I_L$	Leakage current	Measured with $V_{bias} = 20\text{ V}$			100	nA
$\Delta C$	Tuning range	Ratio between $C_{2V}/C_{20V}$ measured at 100 kHz	3/1	3.5/1		
$Q_{LB}$	Quality factor	Measured at 900 MHz		65		
$Q_{HB}$	Quality factor	Measured at 1800 MHz		45		
IP3	Third order intercept point	$V_{bias} = 2\text{ V}^{(1)}$ and $^{(3)}$		60		dBm
		$V_{bias} = 20\text{ V}^{(1)}$ and $^{(3)}$		70		dBm
H2	Second harmonic	$V_{bias} = 2\text{ V}^{(2)}$ and $^{(3)}$		-65		dBm
		$V_{bias} = 20\text{ V}^{(2)}$ and $^{(3)}$		-65		dBm
H3	Third harmonic	$V_{bias} = 2\text{ V}^{(2)}$ and $^{(3)}$		-45		dBm
		$V_{bias} = 20\text{ V}^{(2)}$ and $^{(3)}$		-45		dBm
$t_T$	Transition time	From $C_{min}$ to $C_{max}^{(4)}$		135		$\mu\text{s}$
		From $C_{max}$ to $C_{min}^{(4)}$		100		$\mu\text{s}$

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

### 3 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](http://www.st.com). ECOPACK® is an ST trademark.

Figure 2. μQFN-6L package dimension

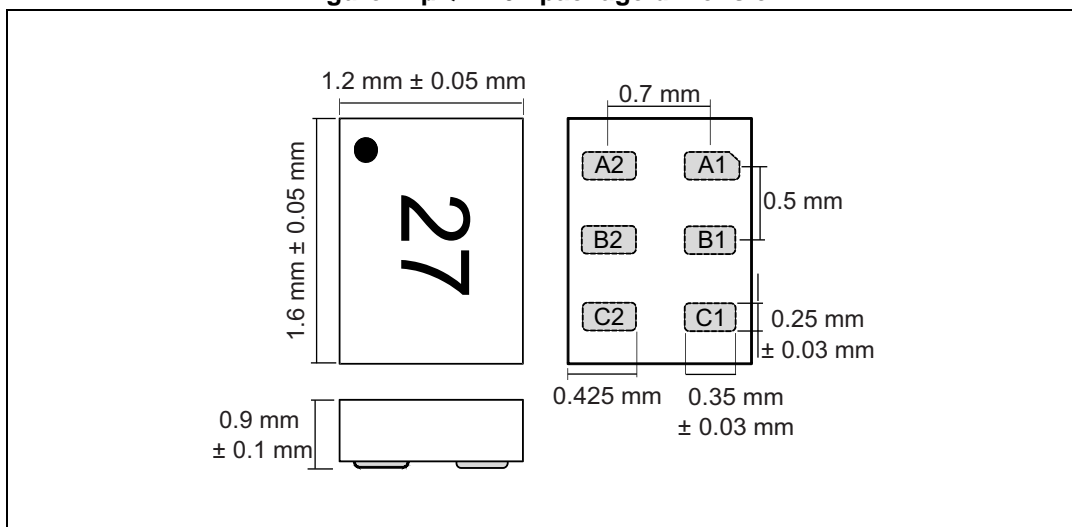
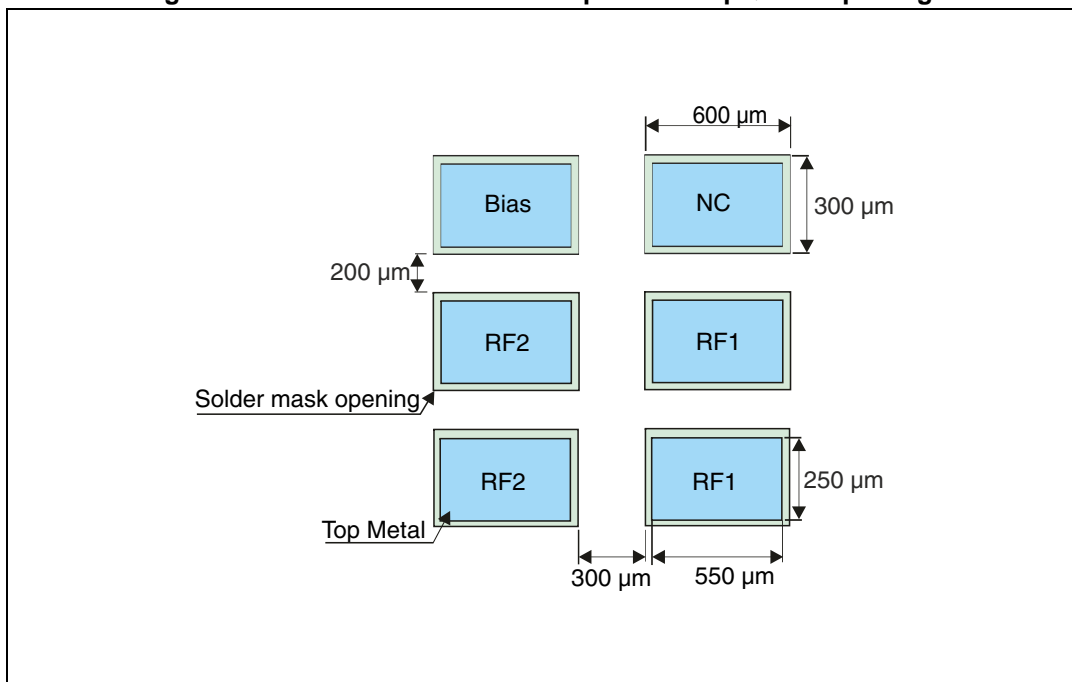
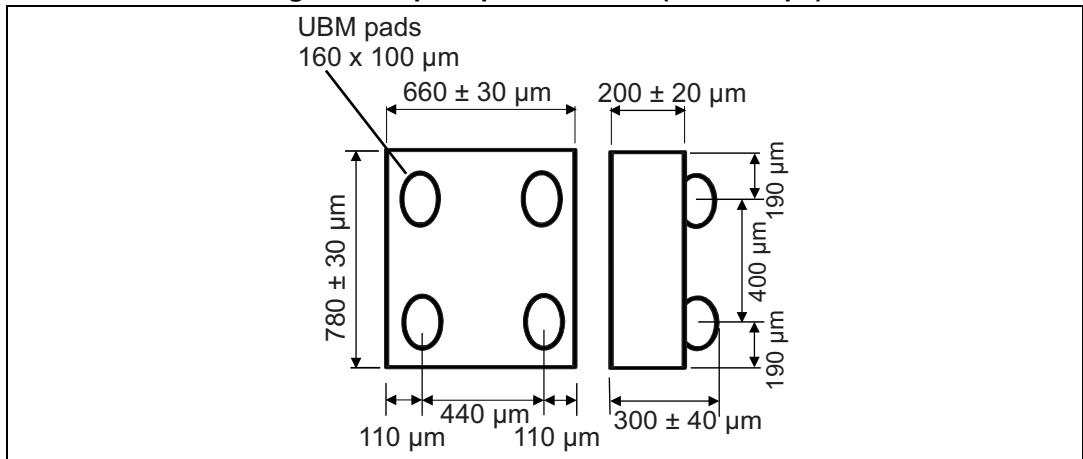


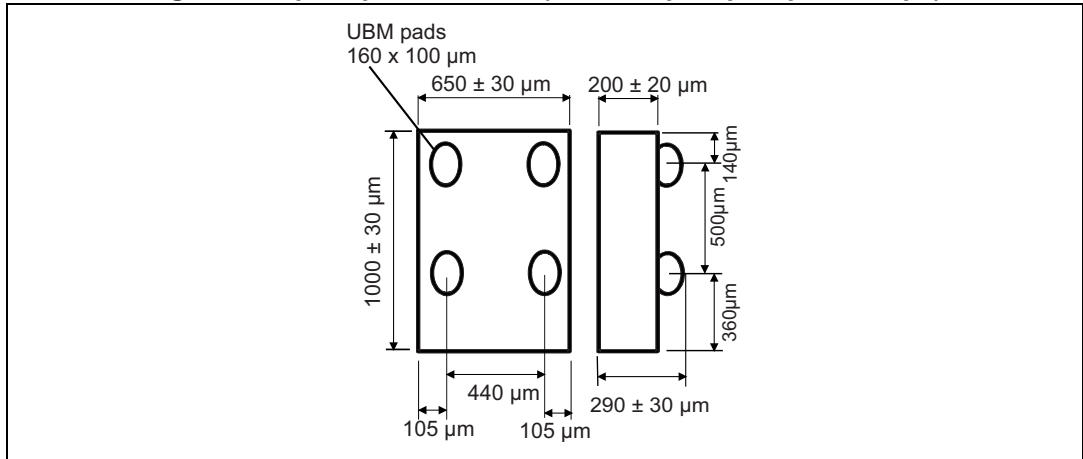
Figure 3. Recommended PCB land pattern for μQFN-6L package



**Figure 4. Flip Chip dimensions (size for 1p5)**



**Figure 5. Flip Chip dimensions (size for 2p7, 3p3, 3p9, and 4p7)**



**Figure 6. Flip Chip dimensions (size for 5p6, 6p8, 8p2)**

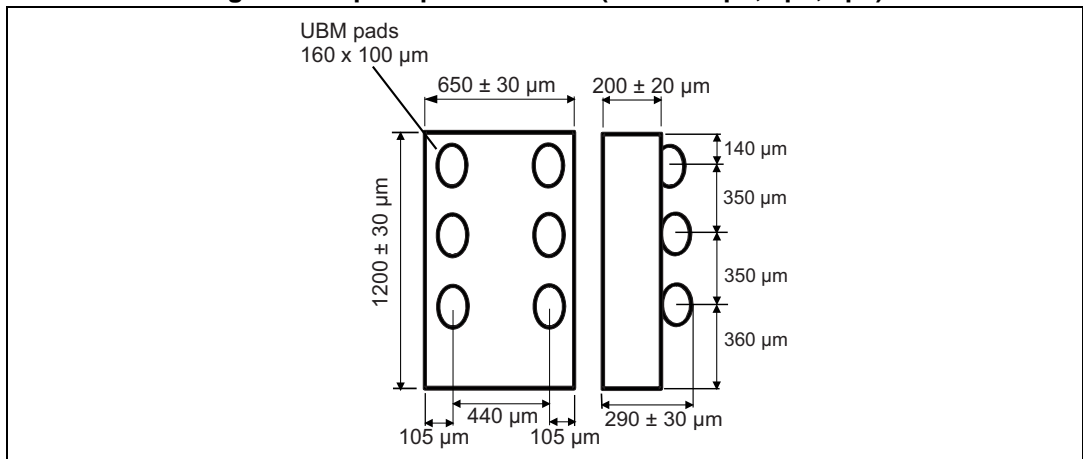


Figure 7. Recommended PCB land pattern for Flip Chip package (metal defined pads, solder mask 25 µm larger)

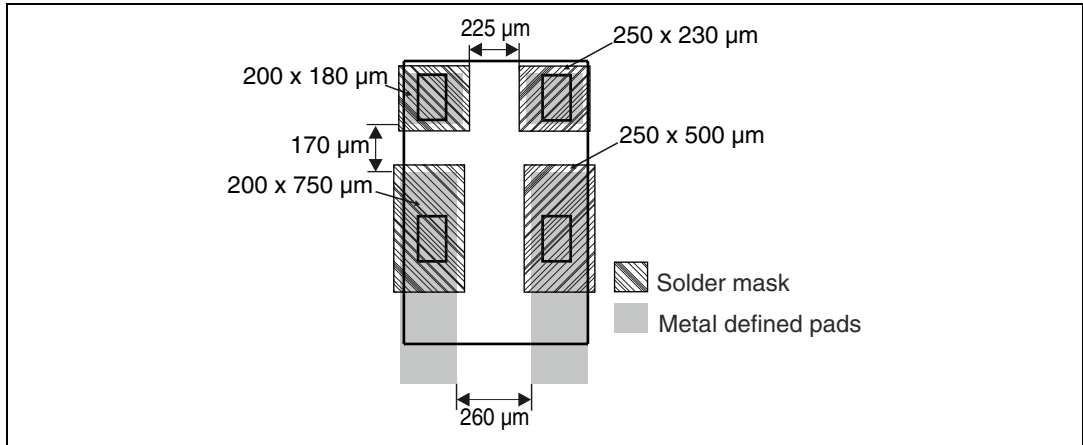
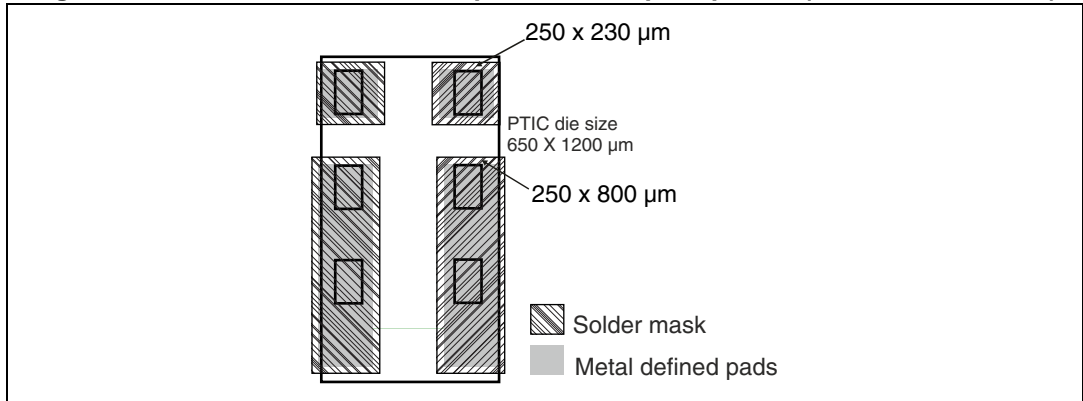
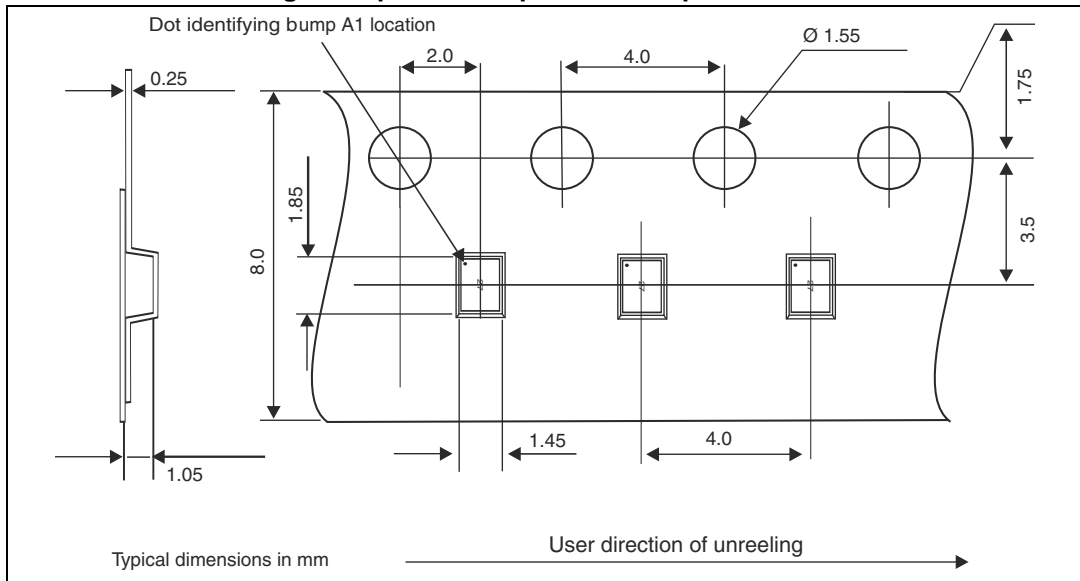


Figure 8. Recommended PCB land pattern for Flip Chip PTIC (die size 650 x 1200)



**Figure 9.  $\mu$ QFN-6L tape and reel specification**



**Figure 10. Flip Chip tape and reel specification**

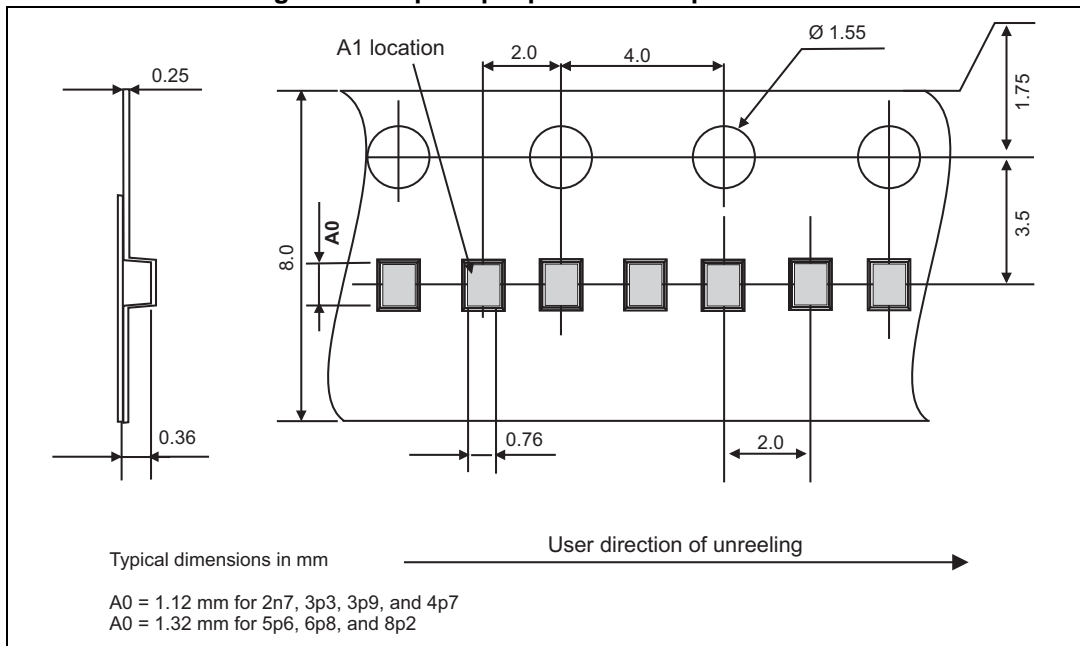




Figure 11.  $\mu$ QFN marking

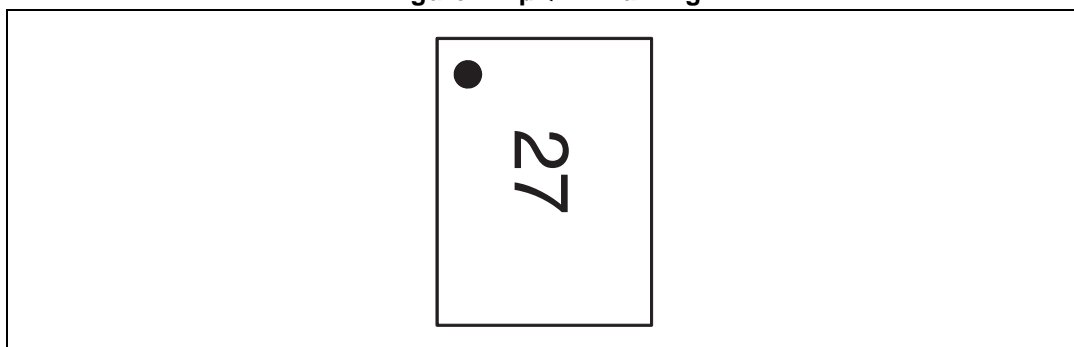
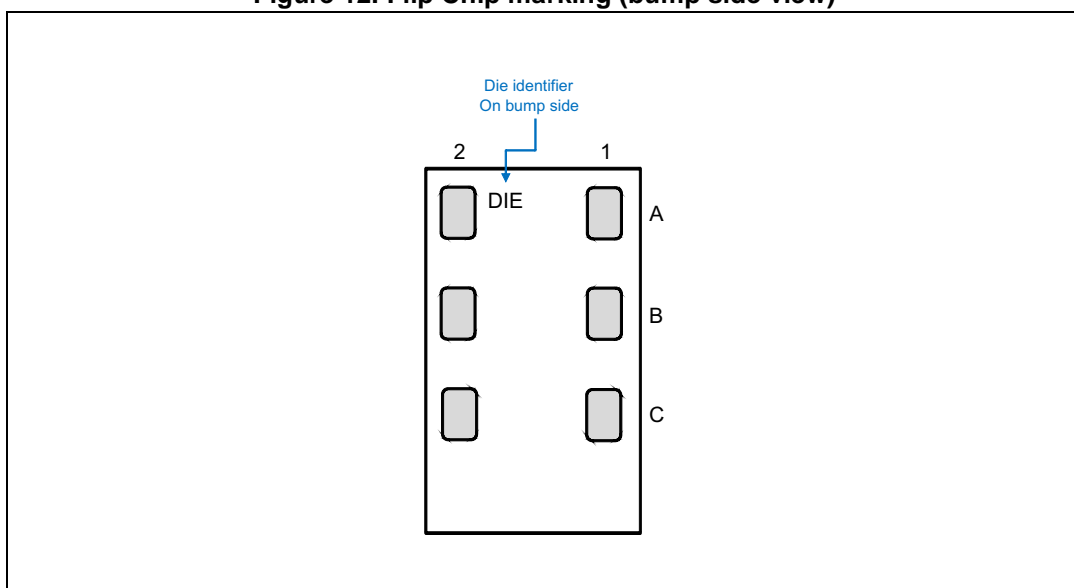
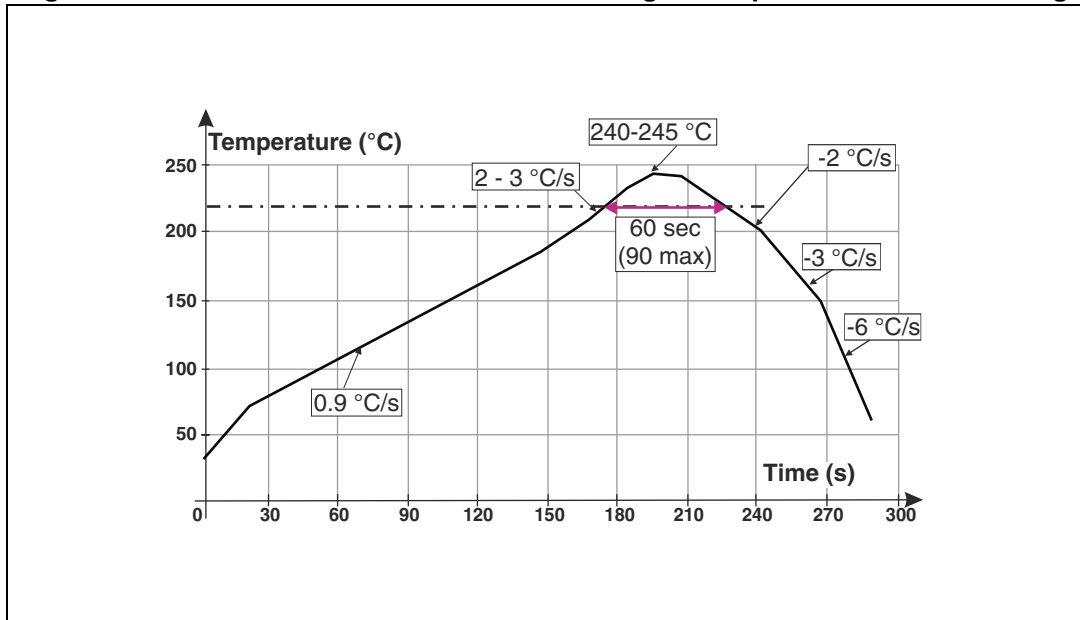


Figure 12. Flip Chip marking (bump side view)



## 4 Reflow profile

Figure 13. ST ECOPACK® recommended soldering reflow profile for PCB mounting



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

Table 5. 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	

## 5 Ordering information

Figure 14. Ordering information scheme

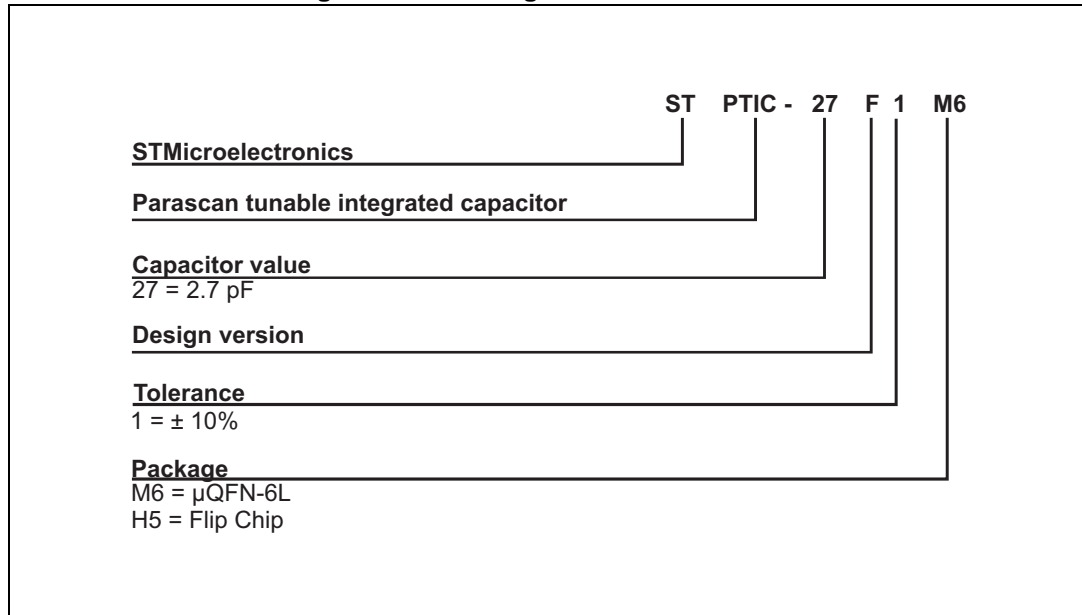


Table 6. Ordering information

Part Number	Marking	Weight	Base Qty	Delivery Mode
STPTIC-12F1M6	12	4.8 mg	3000	Tape and reel
STPTIC-27F1M6	27	4.8 mg	3000	Tape and reel
STPTIC-33F1M6	33	4.8 mg	3000	Tape and reel
STPTIC-39F1M6	39	4.8 mg	3000	Tape and reel
STPTIC-47F1M6	47	4.8 mg	3000	Tape and reel
STPTIC-56F1M6	56	4.8 mg	3000	Tape and reel
STPTIC-68F1M6	68	4.8 mg	3000	Tape and reel
STPTIC-82F1M6	82	4.8 mg	3000	Tape and reel
STPTIC-12G1H5	TBD	0.7 mg	15000	Tape and reel
STPTIC-27G1H5	I1x	0.7 mg	15000	Tape and reel
STPTIC-33G1H5	I3x	0.7 mg	15000	Tape and reel
STPTIC-39G1H5	I2x	0.7 mg	15000	Tape and reel
STPTIC-47G1H5	I5x	0.7 mg	15000	Tape and reel
STPTIC-56G1H5	I4x	0.7 mg	15000	Tape and reel
STPTIC-68G1H5	I7x	0.7 mg	15000	Tape and reel
STPTIC-82G1H5	I6x	0.7 mg	15000	Tape and reel

## 6 Revision history

**Table 7. Document revision history**

Date	Revision	Changes
02-Nov-2012	1	Initial release.
03-Jul-2013	2	Removed 6-pad 650 x 1000 Flip-Chip package.
10-Jan-2014	3	updated: <a href="#">Features</a> , <a href="#">Table 2</a> , <a href="#">Table 4</a> , <a href="#">Table 6</a> and added new <a href="#">Figure 4</a> .

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENVIRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER'S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR "AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL" INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)

