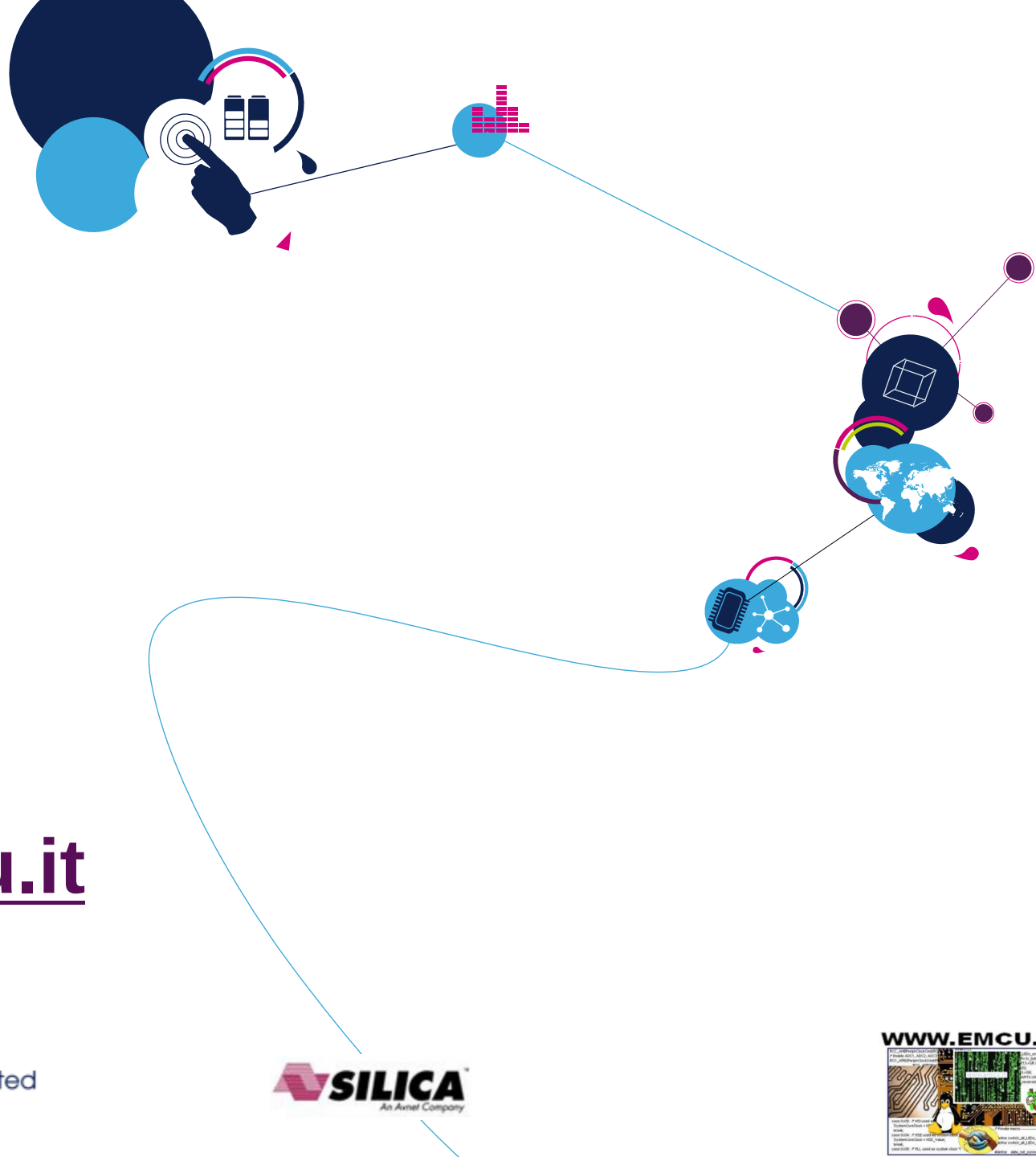
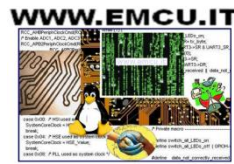


# WireLess

Apr. 2014

[www.emcu.it](http://www.emcu.it)





## Wireless Modules

# **SPWF01Sx WiFi & SPBT2632Cx Bluetooth**

See also here: <http://www.emcu.it/Wireless/Wireless.html>



# WiFi module SPWF01Sx.11

Module and turnkey solutions with embedded WiFi firmware and AT commands



<http://www.emcu.it/WiFi/WiFi.html>

# SPWF01Sx Modules

## Features

- **Radio.** 2.4 GHz IEEE 802.11b/g/n
- **Micro.** STM32 ARM Cortex-M3
- **Memory.** 64KB RAM, 1.5 MB Flash
- **Size (mm).** 26.92 x 15.24 x 2.35
- **Interfaces.**
  - Serial UART (ISPI Q4/14)
  - 16 GPIOs
  - JTAG
- **XTAL.** Integrated 32kHz to support low power modes
- Side pads **SMD**
- **Temperature.** Industrial temperature range
- **Antenna Options.** Integrated Antenna/U.fl. Connector
- **Certifications:**
  - FCC, IC and CE certified
  - ROHS Compliant

## Serial To WiFi Module

UART/SPI  
/I2C/GPIO

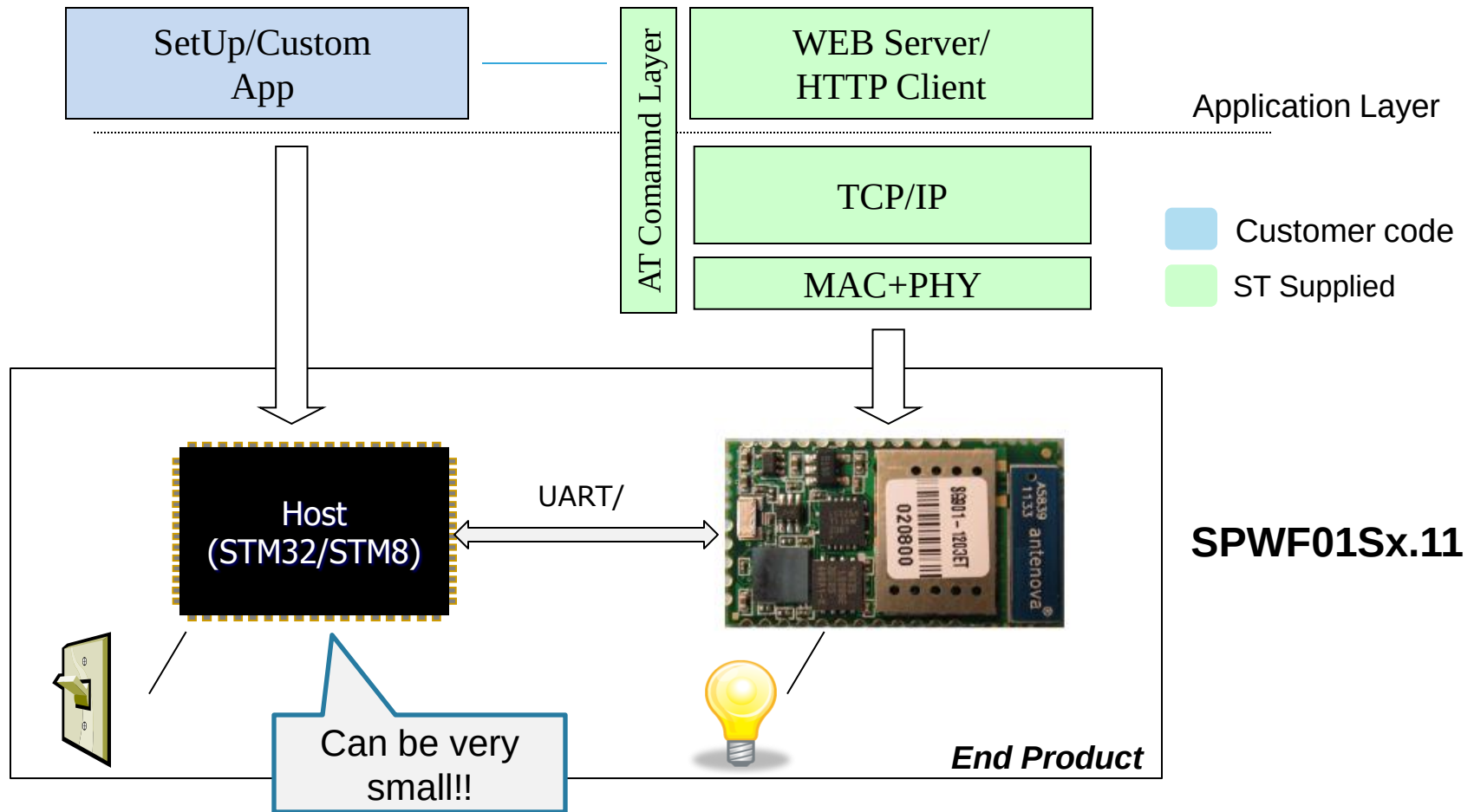


802.11  
b/g/n

| Part Number | Antenna Options | SW Library      |
|-------------|-----------------|-----------------|
| SPWF01SA.11 | Chip Antenna    | Full Stack (AT) |
| SPWF01SC.11 | U.FL            | Full Stack (AT) |

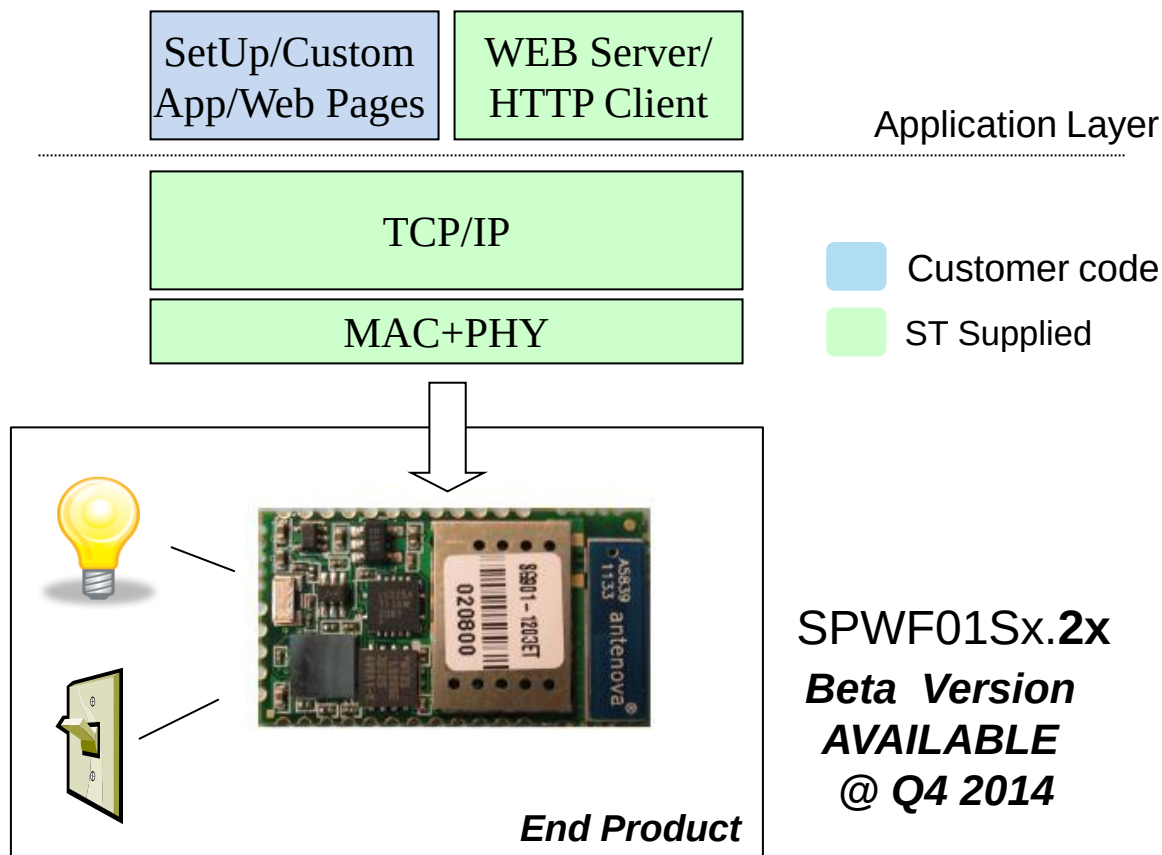
# AT Full Stack

*Enable the use of the module as a Network Coprocessor*



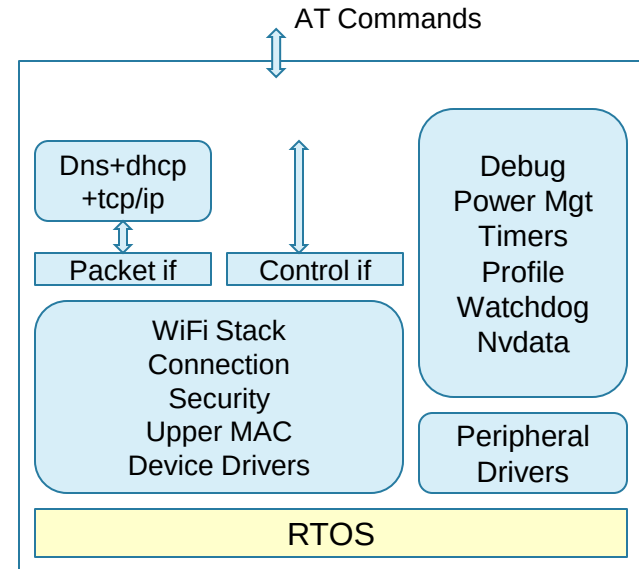
# STM WiFi (SPWF01Sx) SDK Full Stack – Q4/13

*Enable the module to host the whole target application*



# AT Full Stack Features

- **Rich AT command** set for RS-232
- Standards-compliant **802.11b/g/n** operation
- **Advanced Power Saving Modes**
- **Wireless security** (WEP, WPA/WPA2-PSK)
- Full IPv4 stack + TCP + UDP (including DHCP client and DNS Client)
- **Field update via WiFi and RS-232**
- TCP/UDP Sockets API
- Built-in application utilities:
  - **Mini A.P.**
  - **http client** (http get) (pull data mode)
  - **“http post via get”** (push data mode)



**SPWF01 First Config**

Insert the SSID:

Insert the PSK:

Choose Auth:

Choose Mode:

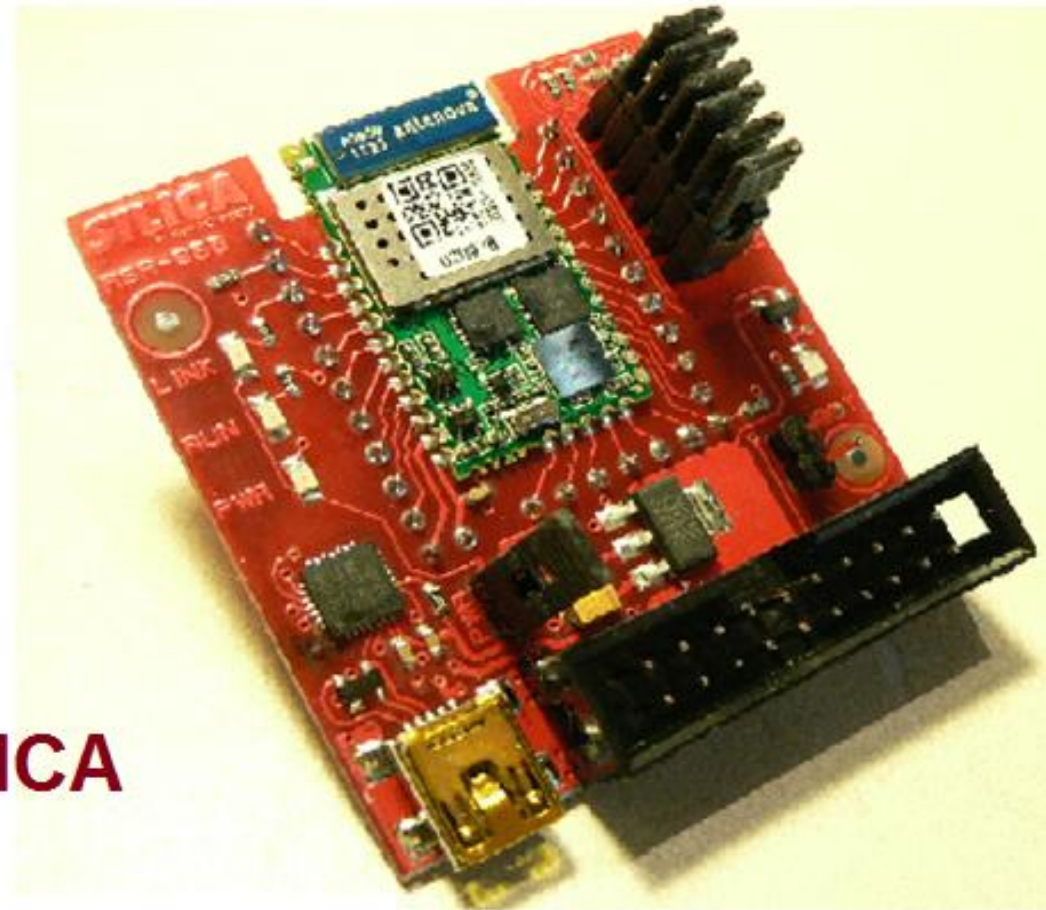


# Eva Board from SILICA

## Resources

- SPWF01Sx Datasheet
- SPWF01Sx.11 AT Command User Guide
- Tutorial
- SW Library
- EVK HW and User Guide

## Web Server from SILICA



SILICA STM WiFi EvaBoard: <http://www.emcu.it/WiFi/WiFi.html>



# Bluetooth® modules

Modules and turnkey solutions with embedded Bluetooth firmware and AT command



<http://www.emcu.it/Wireless/BT/BlueTooth.html>

# Blue Modules series

- The SPBT2532 and SPBT2632 micro-sized **Blue Modules** offer the most advanced Bluetooth® technology on a highly-reliable and affordable platform
- The series includes modules for short and long range (class 2 and class 1), with and without antenna, embedding different FW subsets to meet the requirements of a wide range of applications.

## Blue Modules series

### SPBT2632 Modules with antenna embedded

**SPBT2632C2A.AT 2** (Class 2 profile, enhanced FW\*)

**SPBT2632C1A.AT 2** (Class 1 profile, enhanced FW\*)



\* Supports communication with smartphones and Apple iOS Bluetooth enabled devices

# SPBT2632CyA.AT2 series - what's new

## Fully qualified

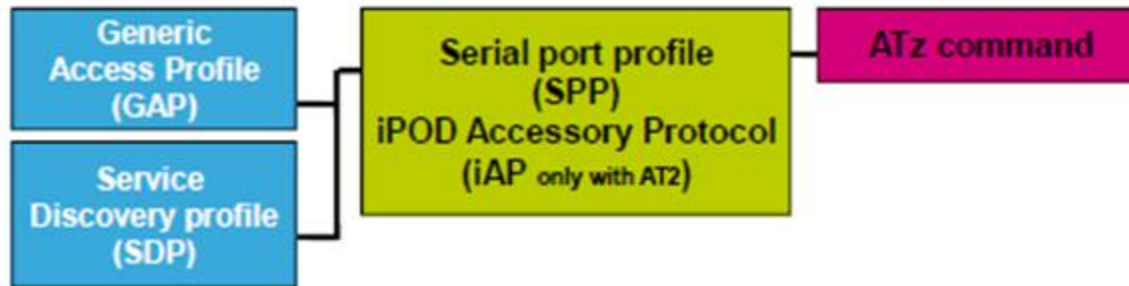
- SPBT2632 series is **BQB qualified and listed**. Ready to enable your end product Listing (EPL) at SIG website
- EPL enables use of Bluetooth logo in just a few clicks - **easy, fast and free of charge**
- SPBT2632 series is **modular approved FCC** qualified and **IC qualified**
- SPBT2632 series is **CE 1051 approved**

## Key features

- Based on STM32 ARM-Cortex-M3 microcontroller and STE *Bluetooth* Radio
- Compliant with *Bluetooth* 3.0
- Equipped with high speed UART, SPI, I<sup>2</sup>C and GPIOs
- FW upgradable via UART
- Integrated antenna
- Supporting low-power mode
- Implement cable replacement through SPP and AT2 command
- AT2 embedded FW enabling communication with most Bluetooth enabled devices (supporting SPP), Android smartphones and Apple iOS Bluetooth enabled devices. \*
- The smallest form factor

\* The external Apple authentication coprocessor and MFI certification are required.

# Blue Modules FW profile and application



## Generic Access Profile (GAP)

- Discovers and connects to other devices
- Security (authentication)
- idle mode procedure: inquiry
- linking, paging, connection

## Service Discovery Profile (SDP)

- Locates/describes services from/to other devices

## Serial Port Profile (SPP)

- Emulates legacy serial communication
- Cable replacement

## iPOD Accessory Protocol (iAP)

- Supports communication with Apple iOS Bluetooth enabled device\*

(\*) The external Apple Authentication coprocessor and MFI certification are required

| Key features                 | AT2 command |     |
|------------------------------|-------------|-----|
| Bluetooth version (**)       | 2.1 +EDR    | 3.0 |
| Point-to-point communication | ■           |     |
| Multipoint communication     | ■           |     |
|                              |             |     |
| SPP                          | ■           |     |
| iAP                          | ■           |     |
| Phone support                |             |     |
| BlackBerry                   | ■           |     |
| Android                      | ■           |     |
| iPhone                       | ■           |     |



# Blue Modules - Certifications

Blue Modules are **CE** and **Bluetooth®** certified. Radio type compliant for US and Canada.

|                 | BQB qualified design                                                                                                                                      | CE Statement of opinion*                                                                                                                                                    | FCC and IC                                                                                                                                               |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| SPBT2632C2A.AT2 | QD ID: <b>B019224</b><br>Product type: End Product<br>TGP Version: Core 3.0<br>Core Spec Version: 3.0<br>Product Description: Bluetooth Module, spec V3.0 | <b>0307-ARMJ00003</b><br>Measurements in accordance with :<br>EN 300 328 V 1.7.1 (2006-10)<br>EN 301 489-17 V 2.1.1 (2009)<br>EN 60950-1:2006 +A11:2009+A1:2010<br>CE 0051① | FCC ID: <b>X3ZBTMOD4</b><br>IC: <b>8828A-MOD4</b><br>In accordance with FCC part 15, the SPBT2632C2A.AT2 is listed above as a modular transmitter device |

\* Reports available on request

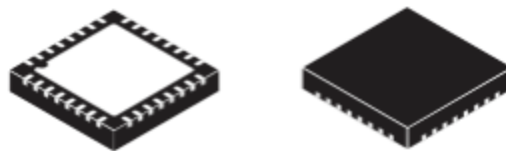




# BlueNRG

## Bluetooth® low energy wireless network processor

- The BlueNRG is a very **low power Bluetooth low energy (BLE)** single-mode network processor, compliant with Bluetooth specification v4.0 Smart, see here.
- The BlueNRG can act as **master** or **slave**.
- The entire **Bluetooth low energy stack runs on the embedded Cortex M0** core.
- The non-volatile Flash memory allows on-field stack upgrading.
- The BlueNRG allows applications to meet of the tight advisable peak current requirements imposed with the use of standard coin cell batteries.
- The **maximum peak current** is only **10 mA** at **1 dBm** of output power.
- Ultra low-power sleep modes and very short transition times between operating modes allow very low average current consumption**, resulting in longer battery life.
- The BlueNRG offers the option of **interfacing with external microcontrollers using SPI** transport layer.
- The **external Apple authentication coprocessor is NOT** request for B.T. 4.0

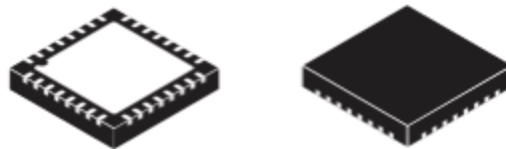
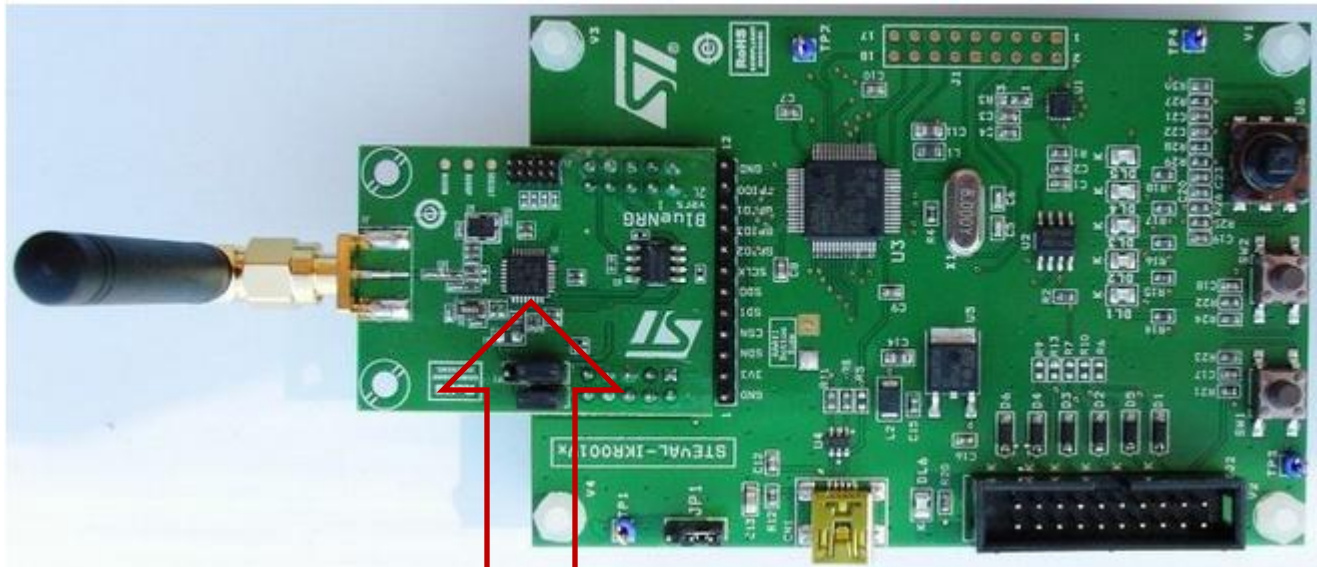


QFN32 (5 x 5 mm)



# BlueNRG

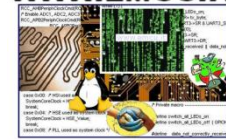
## STEVAL-IDB002V1



QFN32 (5 x 5 mm)



# Sub-GigaHertz Transceiver **SPIRIT1** & **STS1TX**

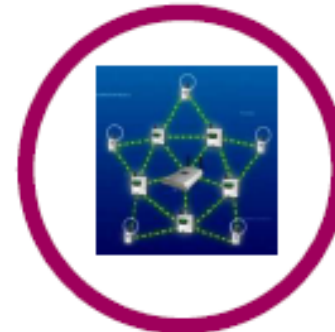


# WIDE APPLICATION COVERAGE

HOME/BUILDING AUTOMATION



SMART METERING



WIRELESS SENSOR NETWORKS



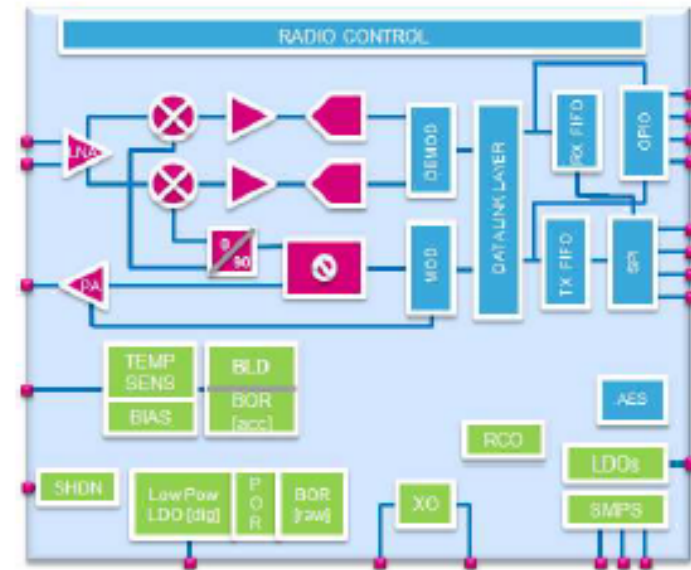
ALARM SYSTEMS



INDUSTRIAL MONITORING & CONTROL

# SPIRIT1 – Sub 1-GHz RF Transceiver

- Frequency bands: 150-174MHz, 300-348 MHz, 387-470 MHz, 779-956 MHz
- Modulation schemes: FSK, GFSK, MSK, OOK and ASK
- Air data rate from 1 to 500 kbps
- Programmable output power: from -30dBm to +16dBm (boost mode)
- RX sensitivity: -118dBm @1.2kbps
- Low current consumption
  - Shutdown: 2.5nA
  - Stand-by: 650nA
  - Sleep: 950nA
  - RX: 9mA
  - TX: 21 mA @+11dBm
- Programmable channel spacing (12.5 kHz min).
- Frequency Hopping Antenna diversity algorithm
- AES 128-bit encryption co-processor
- Automatic acknowledgement, retransmission, and timeout protocol engine
- Embedded packet handler
- Wireless M-BUS, 6LoWPAN, 
- EN 300 220, FCC CFR47 15 (15.205, 15.209, 15.231, 15.247, 15.249), and ARIB STD T-67, T-108 compliant



QFN20 4\*4

# SPIRIT1: key features

## Packet handler and Link Layer features

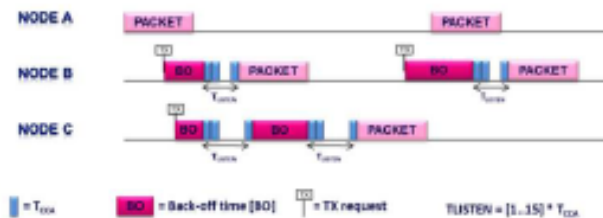
- Integrated **packet handler** supporting:
  - BASIC [general purpose/flexible packet format]
  - Wireless M-BUS
  - STack [ST proprietary stack]
- Support for **Automatic acknowledgment** of received packets, **retransmission** and **time-out** protocol.

## Peripherals & Support Functions

- AES 128-bit encryption co-processor** is available for secure data transfer
- Separate **96-byte RX/TX FIFOs**, accessible via the SPI interface for host processing
- Integrated temperature sensor**
- Battery indicator and low battery detector**

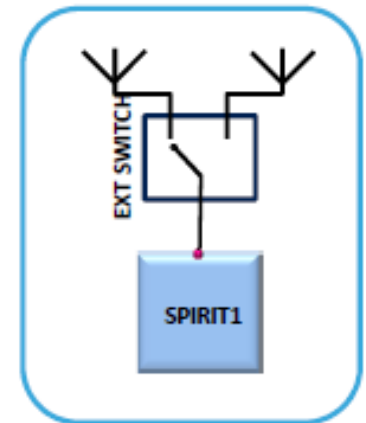
## CSMA/CA Engine

- The CSMA/CA engine is a **channel access** mechanism based on the rule of **sensing the channel before transmitting**. This avoids the simultaneous use of the channel by different transmitters.



## Antenna Diversity Algorithm

- An external switch is controlled to select the antenna with the highest RSSI
- While receiving the preamble, the antennas are repeatedly switched until the  $\text{RSSI} > \text{threshold}$ .
- The switch is then disabled and the selected antenna is used.



SPIRIT1 – Product presentation



# Available tools and support

- **Orderable EVAL KITS**

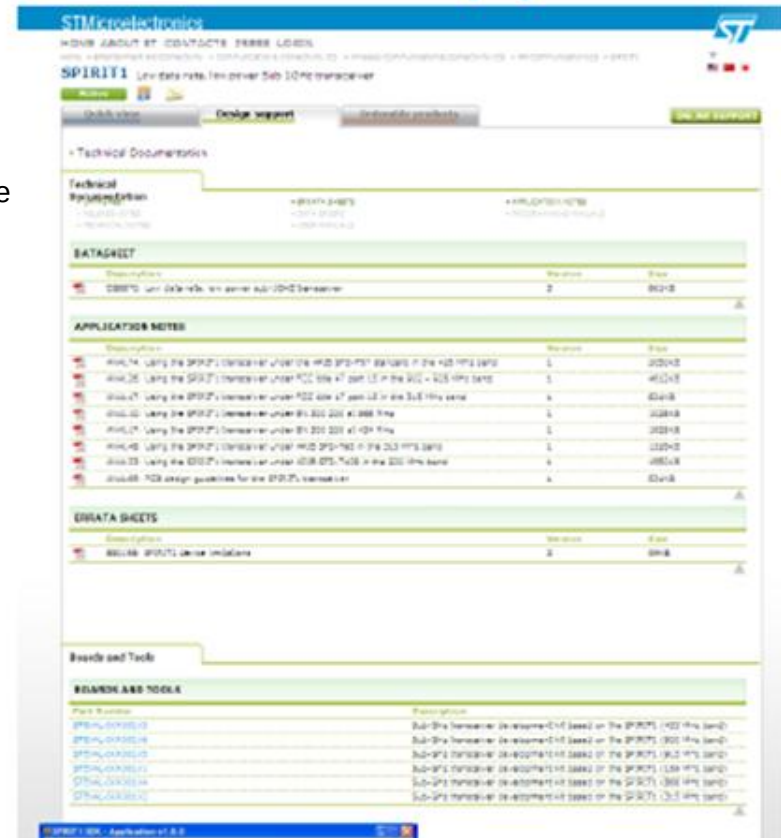
- STEVAL-IKR001V1** Sub-GHz transceiver development kit based on the SPIRIT1 (169 MHz band)
- STEVAL-IKR001V7D** Sub-GHz transceiver development kit based on the SPIRIT1 + PA (169 MHz band)
- STEVAL-IKR001V2** Sub-GHz transceiver development kit based on the SPIRIT1 (315 MHz band)
- STEVAL-IKR001V3** Sub-GHz transceiver development kit based on the SPIRIT1 (433 MHz band)
- STEVAL-IKR001V4** Sub-GHz transceiver development kit based on the SPIRIT1 (868 MHz band)
- STEVAL-IKR001V5** Sub-GHz transceiver development kit based on the SPIRIT1 (915 MHz band)
- STEVAL-IKR001V6** Sub-GHz transceiver development kit based on the SPIRIT1 (920 MHz band)

- **Easy to use GUI gets users up and running fast**

- SPIRIT1 performance can be easily tested
- Packet transmission/reception test with PER evaluation
- AES engine encryption/decryption tests
- Register read/write and dump

- **W-MBUS protocol stack** 

- Reference design, Application notes, STM32 [Cortex M3] software libraries/drivers



# STS1TX Low data rate, low power sub-1GHz transmitter

Frequency bands: **150-174 MHz, 300-348 MHz, 387-470 MHz, 779-956 MHz**

Modulation schemes: **2-FSK, GFSK, MSK, GMSK, OOK, and ASK**

Air data rate from **1 to 500 kbps**

Very low power consumption (**21 mA TX at +11 dBm**)

Programmable channel spacing (**12.5 kHz min.**)

Programmable output power up to **+16 dBm**

Fast startup and frequency synthesizer settling time (**6  $\mu$ s**)

**Integrated temperature sensor**

**Battery indicator and low battery detector**

TX FIFO buffer (96 bytes each)

Configurability via **SPI** interface

**AES 128-bit** encryption co-processor

Fully integrated ultra low power **RC oscillator**

Wakeup on internal timer and on external event

Automatic **CRC** handling

**FEC with interleaving**

**WM-BUS, EN 300 220, FCC CFR47 15** (15.205, 15.209, 15.231, 15.247, 15.249),  
and **ARIB STD T-67, T93, T-108** compliant

QFN20 4x4 mm RoHS package

Operating temperature range from **-40 ° C to 85 ° C**

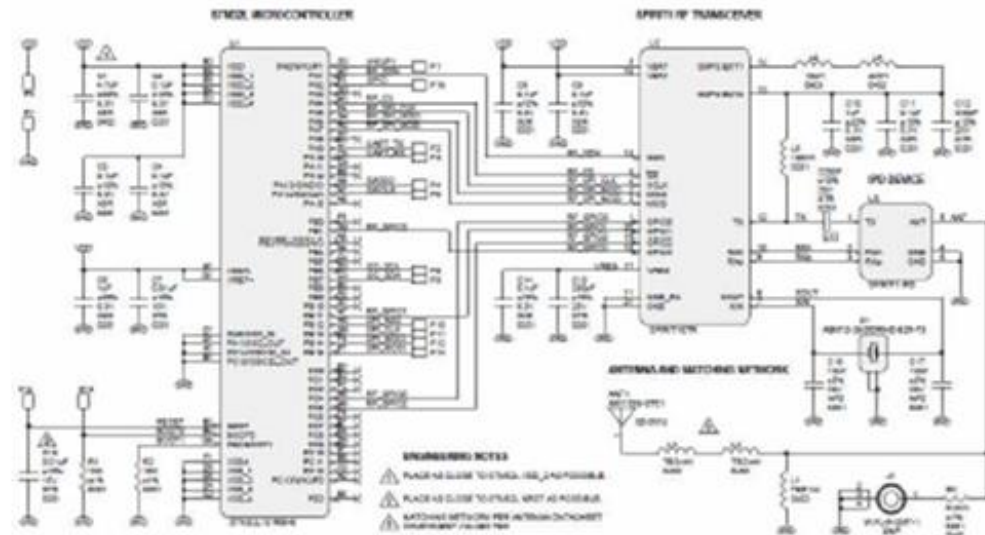
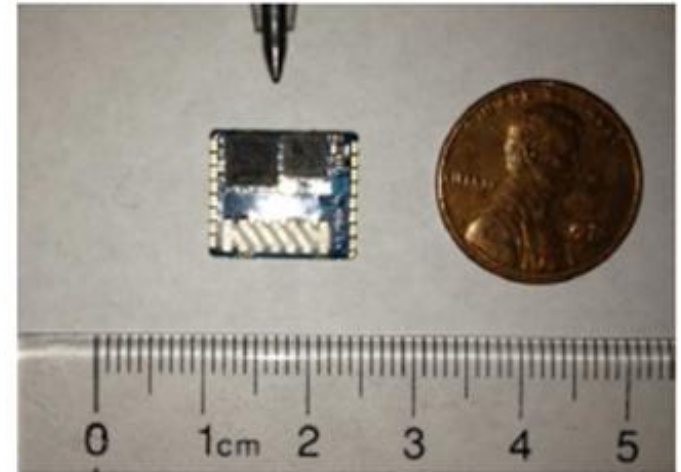


QFN20

# 868 and 915MHz SPIRIT1 based module

- SPIRIT1 based Module

- Supported bands 868MHz and 915MHz
- Using BALF-SPI-01D3 868/915MHz IPD balun and filter
- STM32L151RBH6 MCU on board
- Surface Mount antenna
- AT Command set interface via UART



# Wireless M-BUS suite description

- Key features:

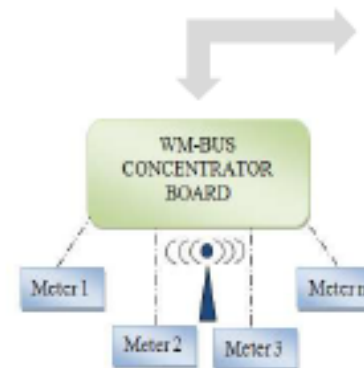
- EN 13757-4:2011
- Modes S1, S1-m, S2, T1, T2, R2, N easily configurable
- Device types supported: meter, collector/reader, both
- Supports AES-128 Encryption.

- Wireless M-BUS suite :

- 169MHZ / 868 MHz W M-BUS stacks [binary]
- Application examples
- GUI



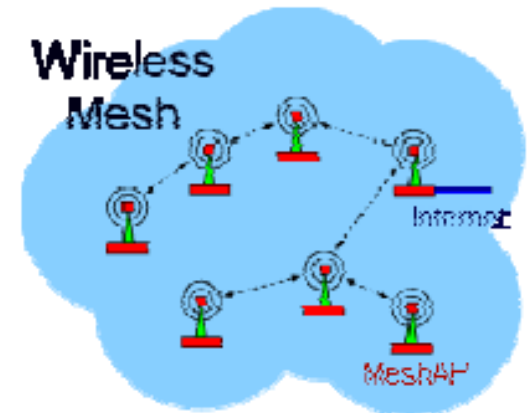
WM-BUS SOFTWARE  
APPLICATION





# 6LoWPAN and Internet of Things

- Spirit1 + STM32L based platform
  - Availability: March 2013
- Developed and provided by Thingsquare
  - A pioneering provider of open-source software
- To connect SPIRIT1 to Internet or any other IP network
  - Adapting the packet size of the two networks
  - Adaptation layer for interoperability and packet form
  - Mesh Routing in the personal area network
  - ...
- Open source based on Contiki OS
  - Modest resources requirements
  - Over-the-air secure software updates





# SUMMARY

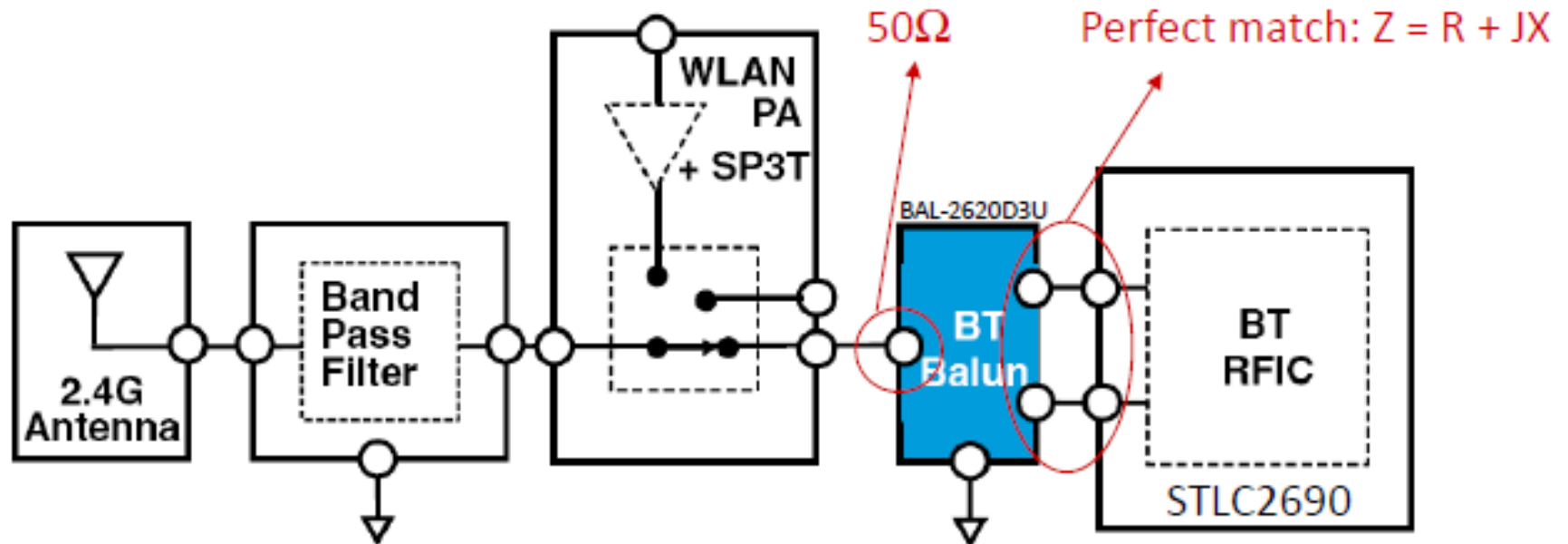
- Best in class solution power consumption without sacrificing RF performances
- Allows long range, reliable and robust RF communication links
- FCC, ETSI, ARIB compliant
- Sub-1GHz Proprietary radio Roadmap
- W-MBUS protocol stack provided
- 6LoWPAN protocol available
- Large availability of development tools and support



# BALF-xxx

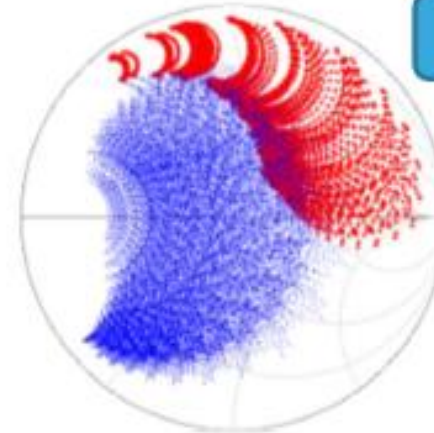
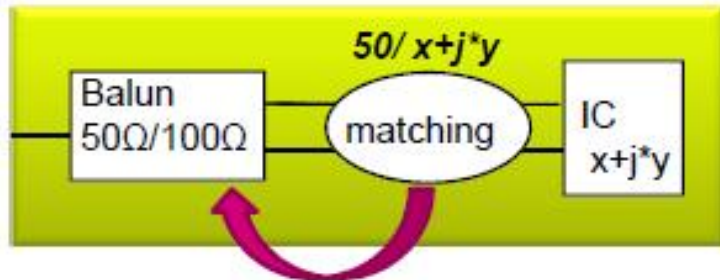
## Balun and filters

# Balun example



- ▶ BAL-2690D3U has been designed to **fit with FM/BT combo STLC2690 output impedance**
- ▶ It is **used when both WLAN and BT are coexisting**

# Balun with integrated matching

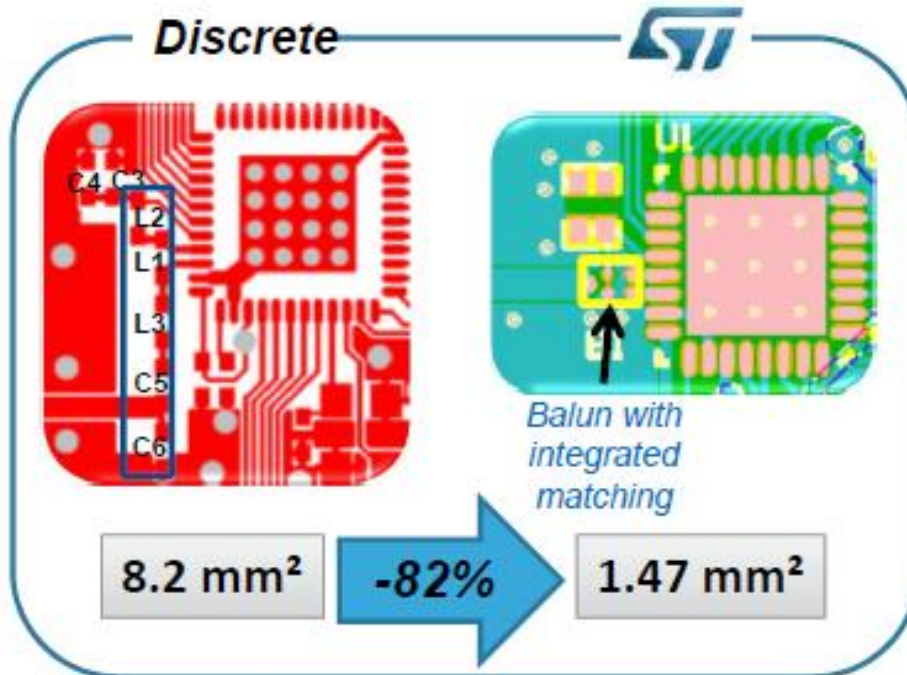


Perfect Match

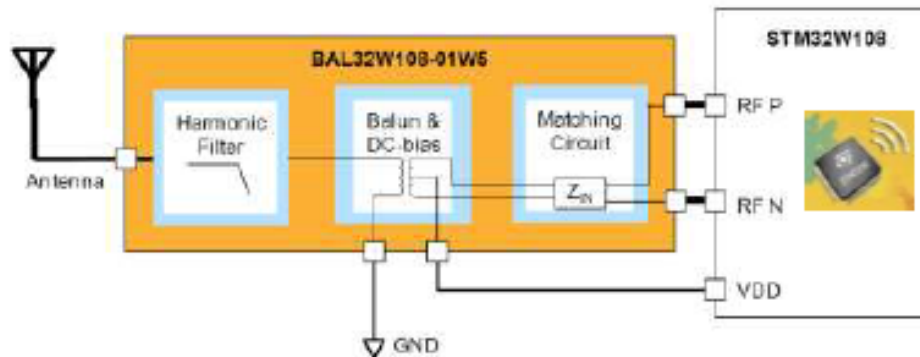
Continuous Impedance Matching



**ST Balun**  
= zero SMD components



# BAL32W108-01E3: one-slide benefits



## • FEATURES (target data)

Direct connection to STM32W  
1 device integrating 6 discretes

Insertion Loss < 3.1dB max

Coated Glass Die  
(Ceramic-like soldering)

PCB footprint area: 2.7 mm<sup>2</sup>

## • BENEFITS

**EASIER DESIGN:** faster time to market  
**LOWER BOM:** less assembly cost

**HIGHER Rx SENSITIVITY:**  
lower power consumption

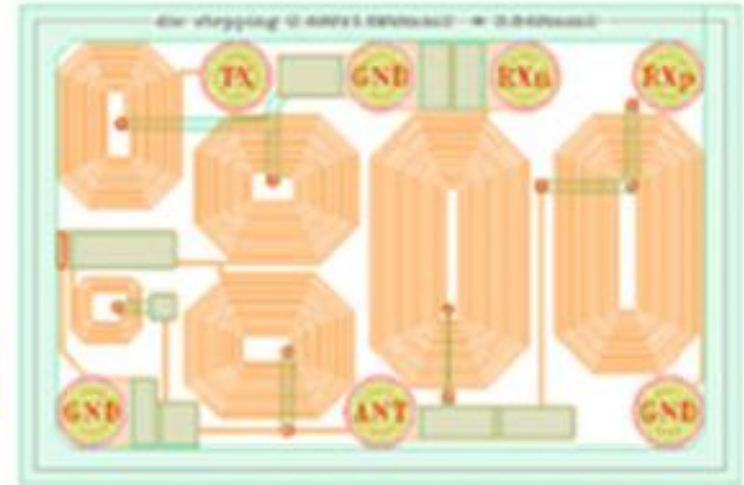
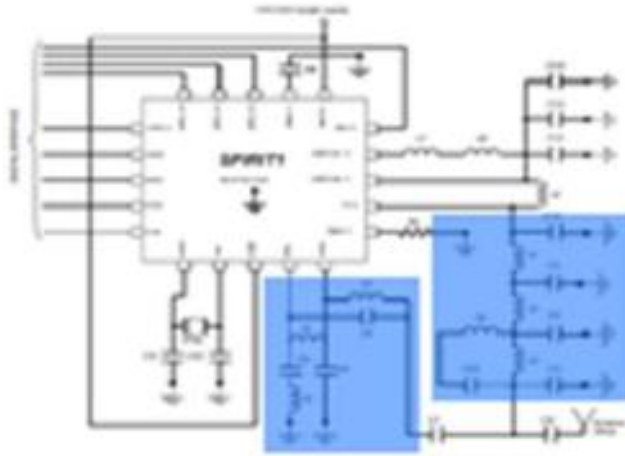
**HIGHER RELIABILITY**  
5 solder joints vs 20 in discrete

**LOWER PCB AREA**  
- 75% vs discrete



# BALF-SPI868-01D3

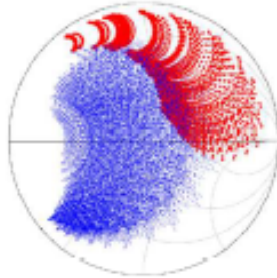
## SPIRIT1 companion chip



Design : September 2012  
Demo board : March 2013  
MAT 30: March 2013

Balun + Filter into 1 die

- ST IPD **technology on glass** : already in use by main RF players
- Cover all ETSI, FCC & ARIB recommendation : **868 to 920MHz** frequency range
- 3mm<sup>2</sup> : Reduce **size** (up to 70% vs discrete solution) and **cost** (-60% from BOM + PCB)
- Dedicated companion chip : No validation needed at customer for **faster design** time.
  - Will be validated in SPIRIT1 evaluation board
- No components dispersion or temperature dispersion : **function is guaranteed**
- Integrated solution : Higher **reliability**, better **performances** (IL) thanks to no parasitic elements, greatly **reduce PCB sensibility**



# Standalone Matched Balun

Production

Sampling

Development

Investigation

169-915MHz



BALF-SPIxxxE3



2.45GHz



BAL-2690D3



TEXAS INSTRUMENTS

BAL-C2531-01D3



BAL-NRF01-D3



TEXAS INSTRUMENTS

BAL-C2540-01D3



BALF-2690-01D3



BAL-32W108-01E3

2,1GHz

2,1GHz

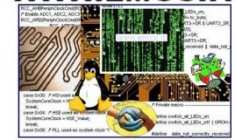
Transfer Jet

4.48GHz

SONY

BAL-4480-01D3

*No limitation on frequency range and impedance  
Can work with all ICs makers*



**For more info contact:**  
**enrico.marinoni@silica.com FAE**  
**roberto.rossetti@silica.com BDM**