SPT97S3xx
“microSP” Transmitter
434,350 MHz

SPT97S3-xx

SPT97S3S-xx

Description

The SPT97S3xx series modules are RF data transmitters based on the STE proprietary and patented "microSP” technology (Patent WO20090119121A). **"microSP"** is a special and sophisticated PPM (Pulse Position Modulation) transmission in which the data message is converted into the time position of short (2µs) RF pulses. The pulse peak power is very high (+ 16dBm -40 mW) while the impulse stream has a very low duty cycle. Consequently during the transmission the average current consumption is very low and very low is also the transmitted average RF power (RF Power Density).

The SPT97S3 transmitter module is perfect for designing wireless sensors, wireless alarms and actuators or tags. These wireless devices, "microSP" equipped, can continuously transmit the life state (Hearthbeat) and measurements or commands at regular intervals or according to appropriate modalities. Powered by a small lithium battery, they can easily guarantee a life span of over 25 years.

For further explanations, with theoretical and practical insights on the "microSP" Technology, refer to the AN-901 Application Note in which, in addition to the "microSP" patent with description of the generation of the RF pulses, the concept of low "Duty cycle" PPM modulated transmission is explained and also its practical use in data transmission .

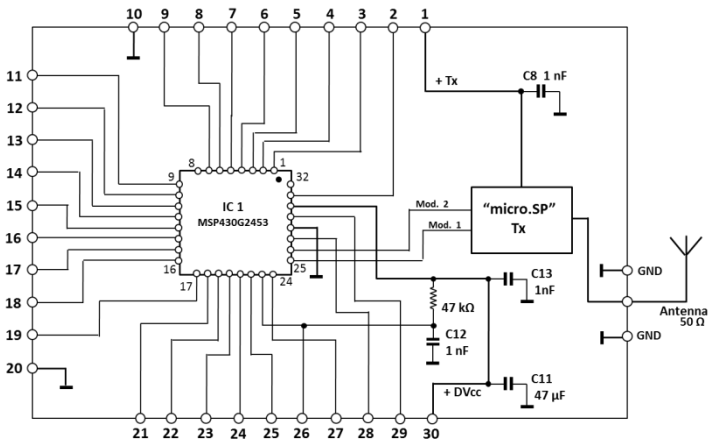


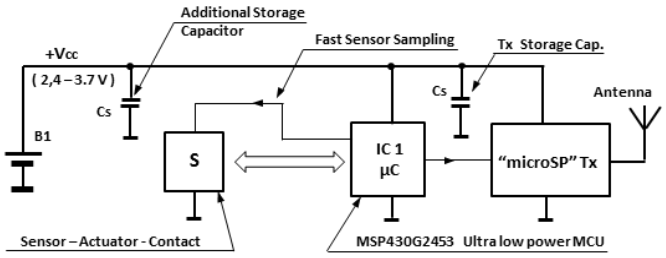
Fig. 1 - SPT97S3xx Block diagram

The SPT97S3 module includes a "microSP" transmitter circuit and an ultra-low power microcontroller MSP430G2453 (IC1). The µC implements pulse generation and the entire data string while generic input-output pins (GPIO) are available outside the module (refer to Fig.1 and Table 2) . A suitable "SW" will be responsible for carrying out sensor measurements and for generic control and generation of alarms or commands.

Wireless sensors or alarms must take into account a "Low-energy" design with appropriate timing and measurement sampling. Figure 2 shows the basic scheme of a typical wireless sensor device. Similar criteria can be used to carry out sampling of alarms, "Reed" or generic open/closed contacts, analog measurements, etc. Refer to the application note AN-901 for further details on the "Low-energy" design techniques.

Application in a wireless sensor or alarm

Fig. 2 - Diagram of a generic wireless sensor.



The "Low Energy" techniques are applied both to the "microSP" Tx part and to the circuit responsible for the data collection/measure with the related sampling.

When a wireless sensor is designed as described above, the microcontroller is used to generate PPM modulation and also to manage sensors or alarm data. This is the preferred solution both in terms of cost and energy optimization: in the vast majority of "IoT" applications of sensors or one-way wireless alarms, the need for a second µC is eliminated.

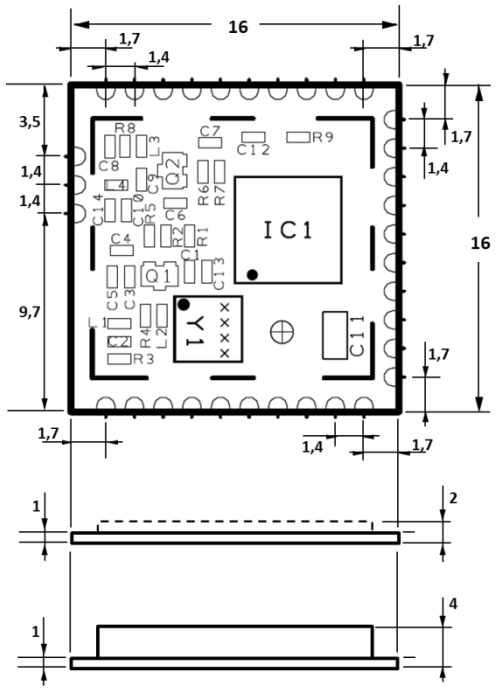
Table 1 - RF Performance Data

Frequency	434.35 MHz
RF Output Power	+16dBm (40 mW) (peak – conducted) (1) -20dBm/10kHz (typ. ERP Power Density)
Modulation	PPM (Pulse Position Modulation)
Emission BW (- 3 dB)	400 kHz
Supply Voltage	3 Vdc (2,4 -3,7 Vdc)
Current	1 – 2 µA (2)
RF output Impedance	50 Ω
Operating Temp.	-40 + 85 °C
Dimensions	16 x 16 mm
IC1 µController	MSP430G2453

Note (1) : "ERP" radiated power depends on the antenna "rad" efficiency.
Note (2) : 1–2 µA is the typical current absorption of a "microSP" sensor. Refer to AN-903 Application Note for a detailed analysis of the current consumption of the "microSP" technology.

The SPT97S3 module can be directly interfaced to a sensor and/or to external digital or analog inputs. In order to maintain a very low consumption, the measurements are opportunely sampled in a short time (<100us). By accurately managing these sampling times and the repetition time of the "Life state" transmission (Heartbeat), the total average current consumption can be reduced to less than 1-2 µA.
The current peaks of the transmission pulses and of the sampled measurements are absorbed by the Cs storage capacitors and the battery is in an excellent efficiency of use of its total mA/h capacity. Moreover, in the presence of such a low average current, the battery and especially the Lithium battery do not show a voltage drop with a relative reduction in its efficiency both at room temperature, but also above all even at very low temperatures (-25/-40 ° C).

SPT97S3-xx

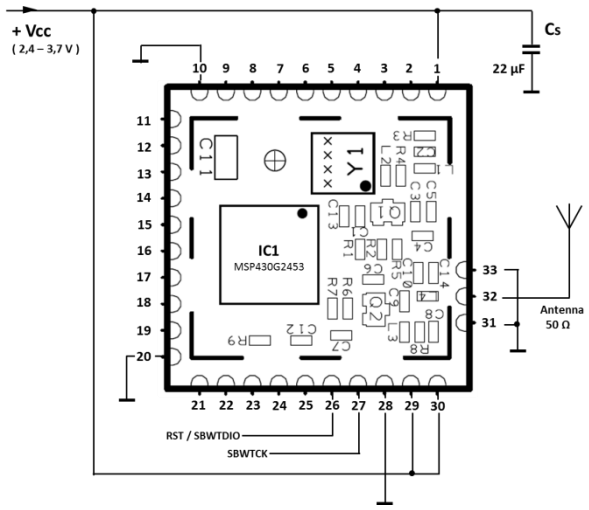


SPT97S3S-xx
Shielded version

Fig. 3 - Mechanical dimensions

Table 2 - SPT97S3-x Terminal Functions			
N°	Description	N°	Description
1	+ Vcc TX	16	µC pin 14 (P3.4)
2	µC pin 31 (P1.0)	17	µC pin 15 (P2.3)
3	µC pin 1 (P1.1)	18	µC pin 16 (P2.4)
4	µC pin 2 (P1.2)	19	µC pin 17 (P2.5)
5	µC pin 3 (P1.3)	20	GND
6	µC pin 4 (P1.4)	21	µC pin 18 (P3.5)
7	µC pin 5 (P1.5)	22	µC pin 19 (P3.6)
8	µC pin 6 (P3.1)	23	µC pin 20 (P3.7)
9	µC pin 7 (P3.0)	24	µC pin 21 (P1.6/SCL)
10	GND	25	µC pin 22 (P1.7/SDA)
11	µC pin 9 (P2.0)	26	µC pin 23 (RST-SBWTDIO)
12	µC pin 10 (P2.1)	27	µC pin 24 (SBWTCK)
13	µC pin 11 (P2.2)	28	ANAL. GND - µC pin 27 (AVSS)
14	µC pin 12 (P3.2)	29	ANAL. VCC - µC pin 29 (AVCC)
15	µC pin 13 (P3.3)	30	DIG. VCC - µC pin 30 (DVCC)

Fig. 4 - SPT97S3 - Layout, pin-out and main wiring.



A storage capacitor (essential for a correct current averaging) is provided on the module (C11 – Fig.1). An external Cs capacitor is suggested especially in the case of low capacity batteries and/or heavy current peaks during sensor sampling.

A typical implementation of a wireless “microSP” Sensor.

Vibration/Shock and Temperature (10-bit resolution) .

Fig.5 shows the practical realization of a wireless temperature and vibration sensor using the SPT97S3. For a detailed description refer to the AR-S905 Application Report. The code of this module is SPT97S3-VT001 (Firmware SW-3137VT001). The VT001 version provides for the activation of a "Test Mode" to facilitate the installation and to allow complete control of the RF transmission and the level and reliability of the received signal. Up to eight different measurement sampling and transmission times can be selected.
For schematics on other types of wireless sensor or alarm, refer to the “AR-S9xx Application Reports” and consult the Factory.

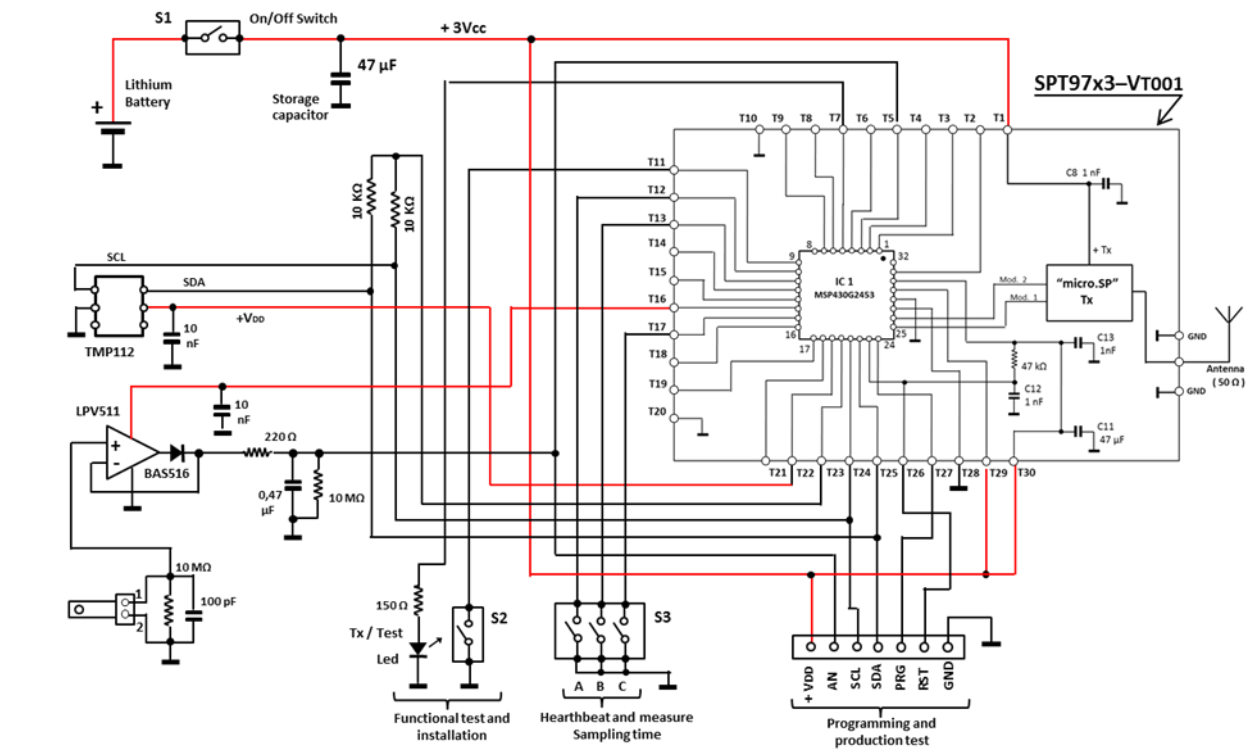


Fig. 5 - SPT97S3-VT001 "microSP" wireless Sensor (Vibration - Temperature)

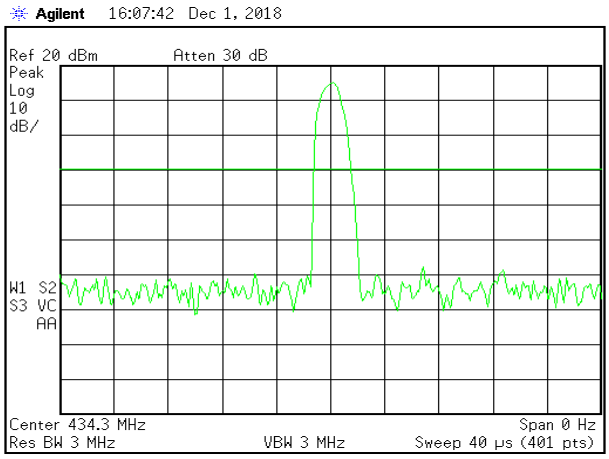


Fig.6 - The RF pulse as generated by a "microSP" Tx .

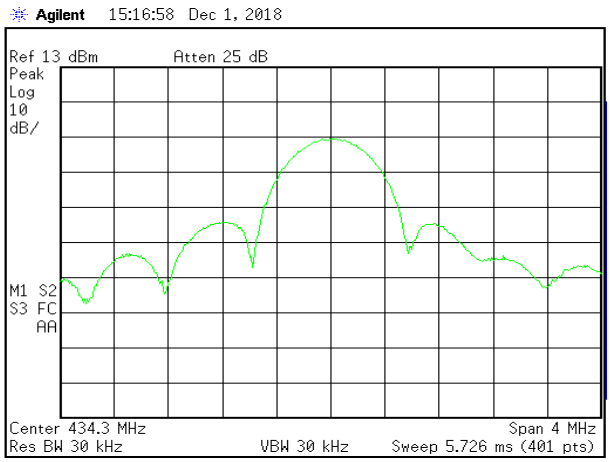


Fig.7 - The RF spectrum of a 96 bit message transmission.

In Fig.7 the RF spectrum of a 96-bit message transmission with 2µs RF pulses and "PPM" modulation. The "Gaussian" shape of the pulses (Fig.6) is necessary to limit the "Occupied Bandwidth" as required by the International Normative (FCC - Part 15 and ETSI - EN 300 220). Apart from the Normative, the reduced bandwidth allows employing a narrower selectivity on the receiver side increasing the signal to noise (S/N) ratio and reducing the interferences from other electronics or RF devices emissions.