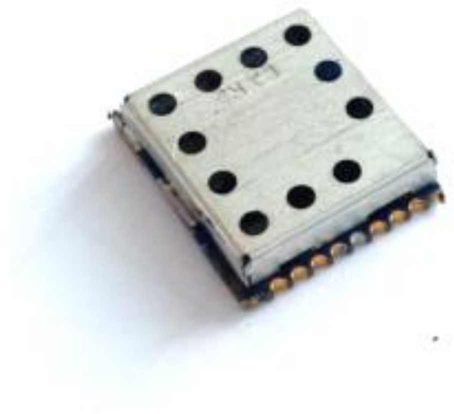
SPR97S3x

“microSP” Receiver

434,350 MHz



Description

The SPR97S3xx series modules are RF data receivers based on the STE proprietary "microSP" Technology. The "microSP" is a form of "PPM" Pulse Position Modulation data transmission in which the message is converted into a frame of very short (2 µs) RF pulses. The SPR27S3 is a direct amplification, high dynamic range, receiver (Patent WO2012150565A3) .
The receiver has a low noise front-end (LNA) for high sensitivity and a linear group delay response “SAW” filter for high selectivity. The IC1 integrated circuit (fig.1) is a Logarithmic Amplifier (Log Amp) followed by a fast peak detector stage (IC2) and by an accurate "Adaptive Data Slicer" (IC3) able to capture nanosecond rise time pulses with over 75 dB dynamic range.

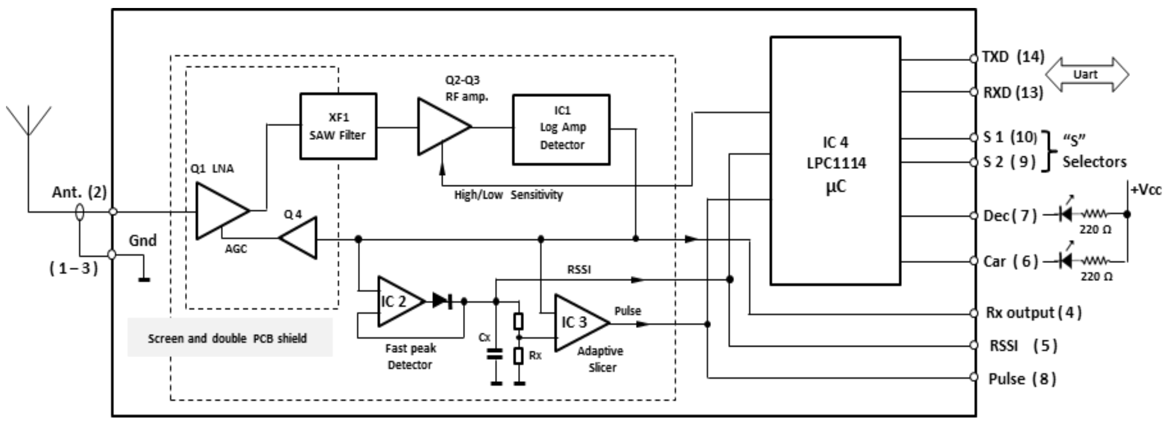


Fig. 1 - SPR97x3xx Receiver Block Diagram

The SPR97S3x is the SMT version of the SPR27x3x basic line of "microSP" receivers and is specifically designed for mass production.
It has a double EMI protection with an external shield and one inside the PCB to avoid interference and noise both radiated and generated locally by fast logic or switching regulators. Two outputs (Fig.1 - pin n.6 and n.7) are used to indicate the status of the radio channel and the decoding of a valid message. "Car" in particular, measures the presence of an "RF Carrier" or "Noise" on the radio channel and the two outputs can be of help for a first "on field" control of the reliability of the radio link. Two other pins are provided, n.9 and n.10, to be able to implement additional control or auxiliary functions. In the SPR97S3-D2 version, programmed with the D2 "Multiprotocol Software", the two pins are used to select (Fig. S1 and S2) the different format of the string and the output data protocol.

Pulse and data recovery.

The pulses that make up the "PPM" message are detectable at the n.8 pin (Fig.1 and Fig.). The pulses are then sent to IC2, a "peak detector" which has a decay time constant determined by Cx and Rx . The result at IC2 output is the "RSSI" signal as shown in Fig….. and its average level is a function of the signal at the receiver input expressed in dBm (Fig……). After the peak detector the IC3 Comparator, an "Adaptive Slicer", compares the pulse peak with the RSSI signal decreased by about 6 dB and reconstructs the frame of the original message ("Pulse", see Fig…..). With an "Adaptive Slicer" which dynamically regulates its own intervention threshold 6dB below the peak value of the pulses, a high co-channel rejection is established. Interferences and fast transients at a level from 10 to 15 dB lower are practically ignored.

PPM messages decoding

The decoding process of the received signal depends on the software programmed in the IC4 Microcontroller. The µC continuously analyzes two signals: the average level at the output of the IC2 Peak-detector (RSSI) and the pulses at the output of the IC3 Comparator (Pulse). The output from the receiver (Rx out), normally composed of broadband noise plus interferences and various transient signals, is averaged to the peak level by IC2 and sampled by IC4 and when a rising edge is detected with characteristics compatible with a 2 µs RF pulse, it is started the decoding process. Interference and noise pulses are immediately discarded until a valid message is detected and decoded. Once validated, the data message is immediately sent to the UART and is available at the TXD output. The monitoring function of valid or interfering signals can be detected on pin 6 (Carrier) while pin 7 (Decode) only indicates the decoding of a valid message. Both outputs are active low and can drive a LED indicator.

Table 1 - RF Performance Data	
Operating Frequency	434.35 MHz
Selectivity	300KHz
Sensitivity	-106dBm (Pulse modulation)
Modulation	PPM / ASK / OOK
Supply Voltage	3.3V DC ±5%
Current consumption	16 mA
RF Input Impedance	50 Ω
Data rate	150 cps – 1 Mcps
Operating Temp.	-40 + 85 °C
Size	36 x 21 x 3,5 mm

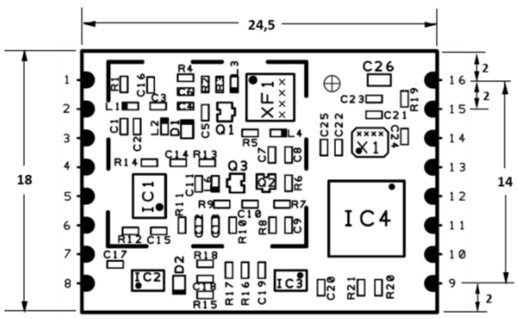


Fig. 2 - Mechanical dimensions

Table2– Terminal Functions – SPR97x3			
N°	**Description**	**N°**	**Description**
1	GND	9	µC pin 12 (P1.9) - S2 selector
2	RF input (Z= 50 Ω)	10	µC pin 1 (P2.0) - S1 selector
3	GND	11	µC pin 19 (P0.10 - SWCLK)
4	Rx output	12	µC pin 25 (P1.3 - SWDIO)
5	RSSI output	13	UART 0 - RXD (input)
6	Pulse output	14	UART 0 - TXD (output)
7	Car (LED 1 – Carrier)	15	RST (Reset) - µC pin 2
8	Dec (LED 2 -Decode)	16	+Vcc (3,3 VDC ±5 %)

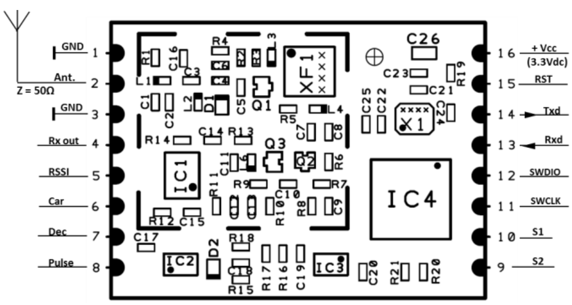


Fig. 3 - SPR97x3x Terminal Description

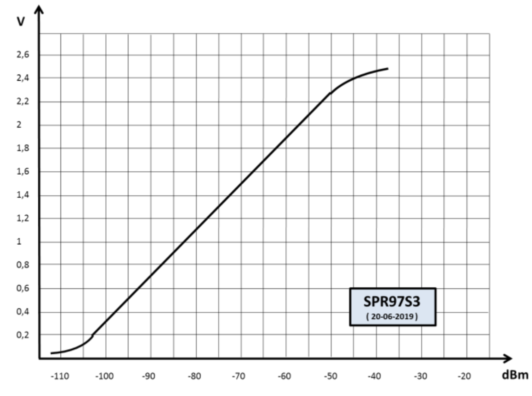


Fig. 4 - Received Signal Strength Indicator (n. 8).

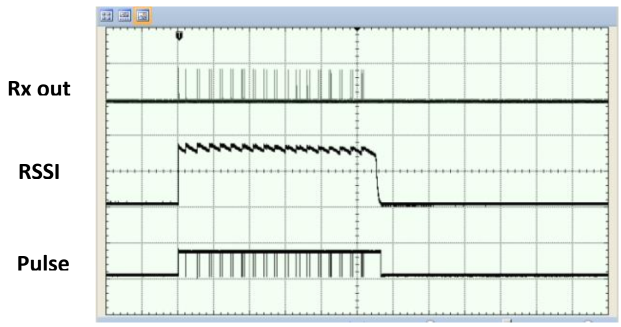


Fig.5 - Rx out – RSSI – Pulse output waveforms

Note 1 : "RSSI" is the peak value of the received signal and n.5 is an high impedance output (1 MOhm max. load)

The RF pulse strings, i.e. the "PPM" coded messages, as received by the SPR97S3x, are visible on the #4 terminal (Fig.2). The pulses are sent to a "Peak Detector" (IC2) which has a decay time constant determined by Cx and Rx. The signal resulting from the acquisition of the peak and its integration ("RSSI"-term. 26) is shown in fig.5. At the end of a valid and decoded frame, the falling edge (the "Tail") is truncated to allow the receiver to decode an immediately following signal ("Tail Eliminator"). After the peak detector, the IC5 Comparator, the "Adaptive Slicer", takes the peak of the pulse, compares it with the RSSI signal decreased by about 6 dB and reconstructs the message frame ("Pulse"-pin6- negative logic level) .

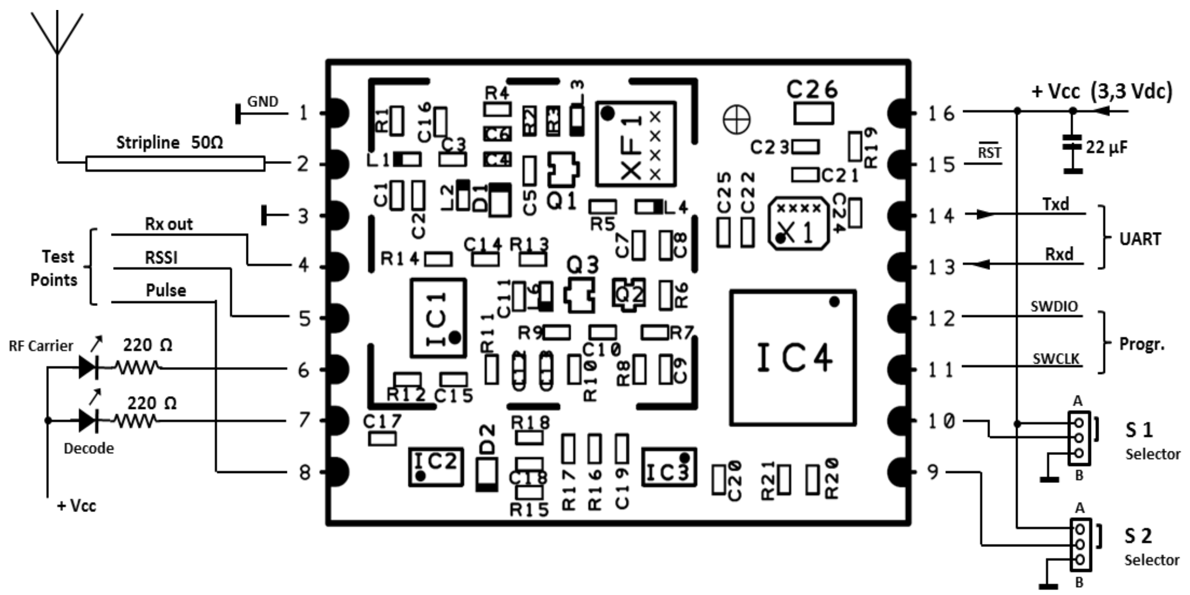


Fig. 6 - SPR97x3-D2 Typical Application Circuit

Latch-up prevention at power on .

The "Power up" conditions must be respected to allow a correct start-up of the microcontroller IC4. To avoid "Latch-up" problems, especially in the presence of a "On/Off/On" sequence, at power on the ramp must start from Vdd <400mV. Further informations on the NXP LPC1114 Technical Documentation .

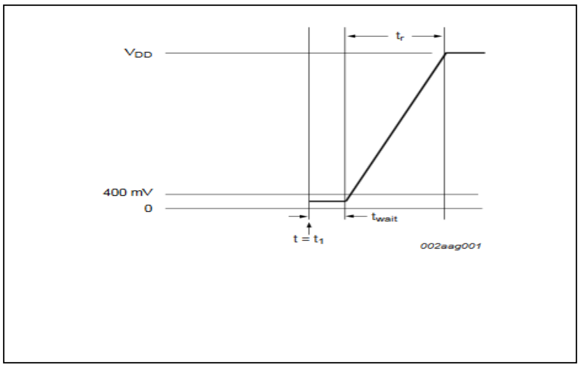
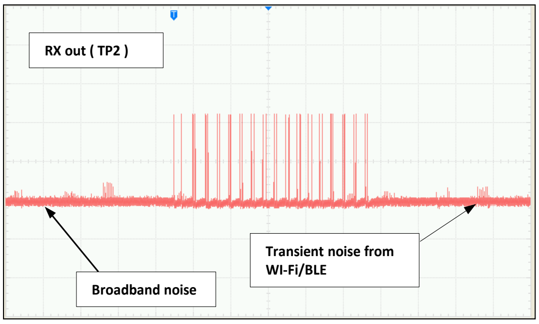


Table 2 - Power on conditions

Symbol	Parameter	Limits
t_r	rise time	0 – 500ms max
t_{wait}	wait time	12 µs min.
V_{input}	input voltage	0 – 400 mV

The SPR97S3-D2 “Multiprotocol” version .

SPR29S3-D2 is the "Multiprotocol" and “Demo” version of the receiver, designed to receive, decode and display most of the messaging data from Sensors, Alarms and Tags made with the "microSP" D2 Protocol. The receiver mounted on the Eval-board EVR27A is the ideal tool for demonstrations and studies on the "microSP" Technology also in absence of sophisticated RF Strumentation. In the examples of Fig.8 and 9, two different data strings format as can be selected for direct visualization at the USB port output of the Eval-board .
Further information on the Datasheets DS-013 and DS-014 (Eval-board EVT17S3 and EVR27A) and on the Application Note AN-904 "Test and Measurements with the Evaluation Boards".



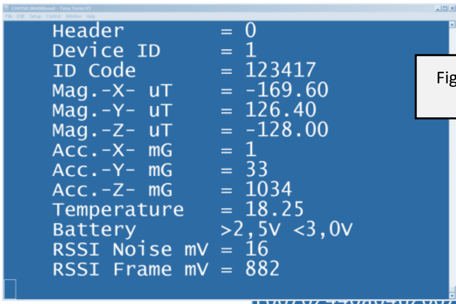


Fig.9 – S1 Jumper in “A”
Datas in Hex format

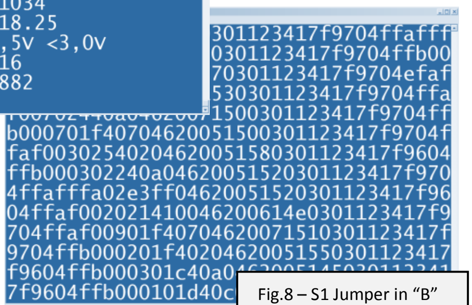


Fig.8 – S1 Jumper in “B”
“Clear” format

The EVR27A Evaluation Board allows to evaluate the performance of a "WSN" based on the "microSP" Technology, to carry out propagation tests and to study various types of antenna systems both on the RX side and on the Tx side. It also allows you to view the situation of the RF signal on the radio channel and to evaluate its S/N ratio and therefore its reliability. In Fig.10 the signal from "Rx out" (TP2) where a string of RF pulses is visible in the presence of disturbing signals.

Data in Fig.8 are transmitted by a SPS207 Wireless Sensor (Temperature/Magnetometer/Accelerometer).