SPR27S3x

“microSP” Receiver

434,350 MHz

Description

The SPR27S3xx series modules are RF data receivers based on the STE proprietary "microSP" Technology. The "microSP" is a type of Pulse Position Modulation (PPM) data transmission in which the message is converted into a frame of very short (2 µs) RF pulses. The SPR27S3 is a high dynamic range, direct amplification receiver (Patent WO2012150565A3). The receiver has a low noise front-end (LNA) for good 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 nanoseconds rise time pulses with a dynamic range of more than 75dB.

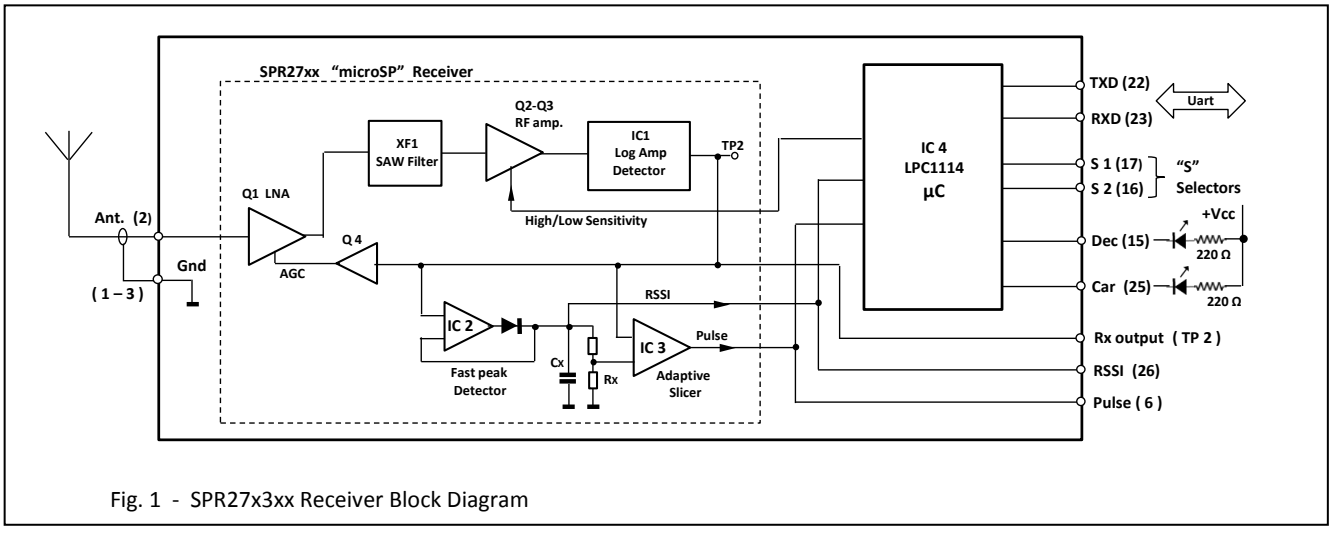


Fig. 1 - SPR27x3xx Receiver Block Diagram

The process of decoding the received signal depends on the Software programmed in the IC4 microcontroller. The µC continuously analyzes two signals: the averaged level at the output of the peak detector IC2 (RSSI) and the pulses at the output of the IC3 comparator (Pulse). The RSSI level is continuously sampled by IC4 and when a rising edge with characteristics compatible with a 2 µs RF pulse is detected, the decoding process is started. Interferences and noise pulses are immediately discarded until a valid message is detected and decoded. When validated, the data message is immediately sent to the UART and is available at Txd output.
The uC has two outputs designed to drive two LED indicators. "Car" Led (Carrier-pin25) indicates the reception of a generic RF signal, be it from a network device, or a disturbance. "Decode" Led (pin 15) indicates only the reception of a valid message. It is therefore possible to monitor the traffic status on the radio channel and the possible presence of disturbances or interferences and this can be very convenient both during the design phase and during installation and maintenance.

The SPR27S3xx and the IC4 Microcontroller .

The SPR27S3x module includes the "microSP" receiver circuit (as described above - Figure 1) and an ARM Cortex-M0 LPC1114 microcontroller. The main purpose of the µC is to acquire and decode PPM data messages. In addition, the module has generic GPIOs that can be used for customer applications (refer to Fig. 2 and Table 2).
The SPR27S3-D2 version is programmed for simple message decoding only and is ideal for general applications as a simple data receiver from wireless “microSP” Sensors, Alarms or Tags. More informations are available on the AN-903 Application Note.

Table 1 - RF Performance Data	
Operating Frequency	434.35 MHz
Selectivity	500KHz
Sensitivity	-105dBm (Pulse modulation) -110dBm (AM 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

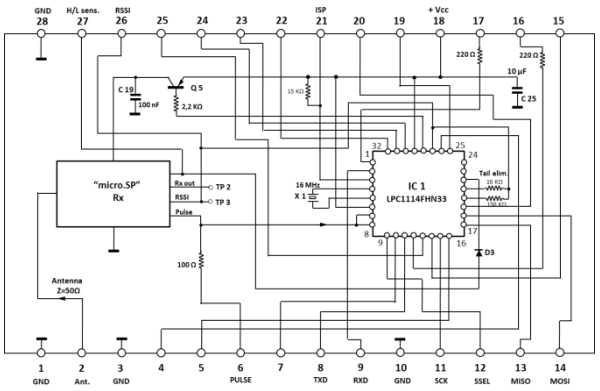


Fig. 2 - SPR27S3x Block diagram with simplified µC connections.

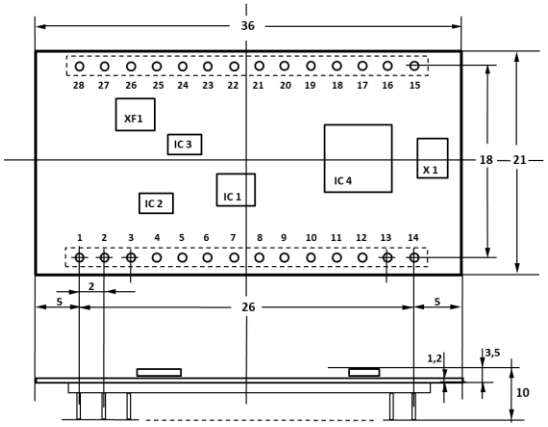


Fig. 3 - Mechanical dimensions

Table2– Terminal Functions – SPR27S3xx			
N°	Description	N°	Description
1	GND	15	Dec (LED 2 -Decode)
2	RF input (Z= 50 Ω)	16	µC pin 12 (P1.9)-S2 selector
3	GND	17	µC pin 1 (P2.0) - S1 selector
4	µC pin 26 (P1.4)	18	+Vcc (3,3 VDC ±5 %)
5	µC pin 16 (P1.7)	19	µC pin 25 (P1.3 - SWDIO)
6	Pulse	20	µC pin 19 (P0.10 - SWCLK)
7	µC pin 10 (P0.4 - SCL)	21	µC pin 3 (P0.1 - ISP)
8	µC pin 11 (P0.5 - SDA)	22	UART 0 - TXD (output)
9	µC pin 2 - RST (Reset)	23	UART 0 - RXD (input)
10	GND	24	µC pin 30 (P1.5)
11	µC pin 15 (P0.6 - SCK)	25	Car (LED 1 – Carrier)
12	µC pin 9 (P0.3 - SSEL)	26	RSSI (output)
13	µC pin 17 (P0.8 - MISO)	27	H / L sensitivity
14	µC pin 18 (P0.9 - MOSI)	28	GND

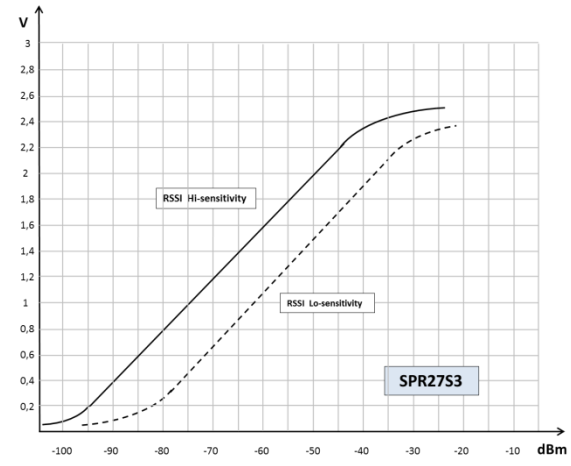


Fig. 4 - Received Signal Strength Indicator (pin 26).

Note 1: "RSSI" is the peak measure of the received RF signal level .
Pin 26 is a high impedance output (10 MΩ maximum load).

PPM messages decoding and data recovery.

The pulses that make up the "PPM" message are detectable at the TP2 test point (Fig.5). The pulses are then sent to IC2, a "peak detector" which has a decay time constant determined by Cx and Rx (Fig.1). The result at IC2 output is the "RSSI" signal as shown in Fig.6 and its average level is a function of the signal at the receiver input expressed in dBm (Fig.4). At the end of a valid and decoded frame, the falling edge is truncated ("Tail eliminator") to allow the receiver to detect and decode an immediately following signal. After the peak detector, the comparator IC3, 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.6).

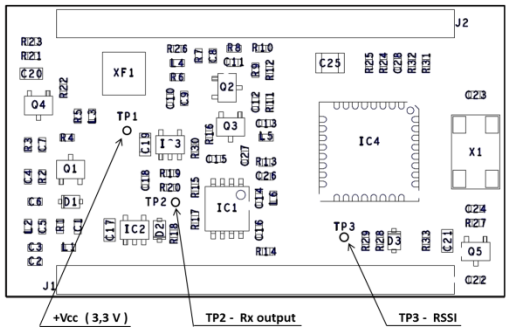


Fig.5 - Components layout and "Test Points"

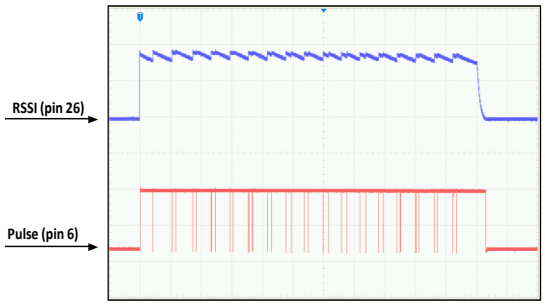


Fig.6 - "RSSI" and "Pulse" output Waveforms

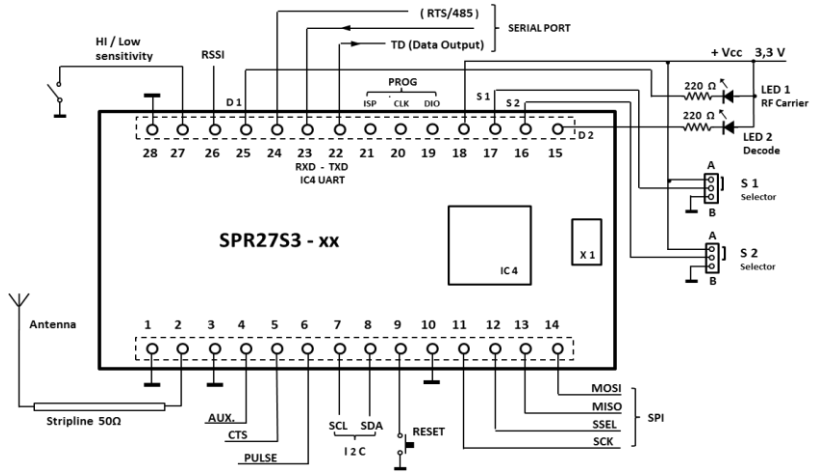


Fig. 7 - SPR27S3xx Typical Application Circuit

The SPR27S3xx is the receiver in its basic version, designed to receive "PPM" encoded data from "microSP" transmitters. In particular, it is programmed to receive messages from sensors or wireless alarms equipped with Tx modules of the SPT17S3x or SPT97S3x series. Once validated, the message is sent to the Td output of the UART (pin 22 – 38400,N,8,1).

To Td string in addition to the data transmitted by remote wireless devices are also added other measures useful to allow control and monitoring of the wireless network. In particular the measures of the "RSSI" level of the decoded signal and the "Noise" level present on the radio channel. This "Noise" can be a broadband noise or EMI and interferences from other electronic or wireless devices and the measure is taken at the time immediately before the decoding.

Pins 16 and 17 have been designed to facilitate the installation, maintenance and monitoring of the wireless sensor network. Two LEDs (Fig.6) can be activated by these pins: Led1 indicates the reception of a generic RF carrier (Noise/Interference), Led2 indicates the decoding of a valid message. Pins 16 and 17 are inputs through which various ways of encoding and presenting data strings coming from the UART can be selected.

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

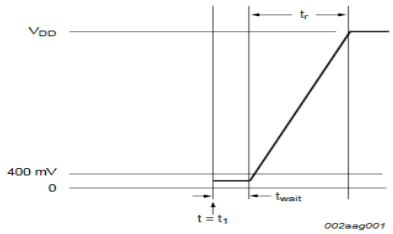


Fig. 8 - Vcc ramp at Power-on

The SPR27S3-D2 "Multiprotocol" and "Demo" version .

SPR27S3-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" SP2 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".

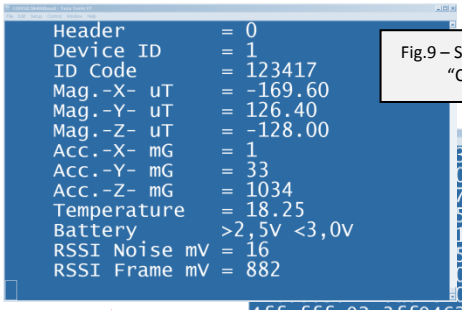


Fig.9 – S1 Jumper in "B" "Clear" format

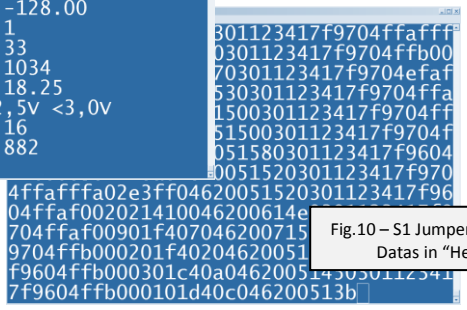
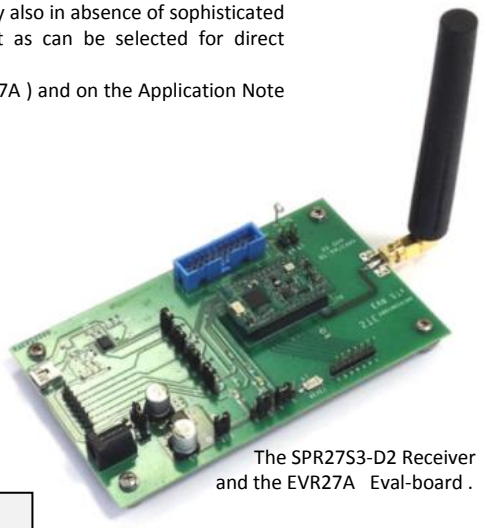


Fig.10 – S1 Jumper in "A" Datas in "Hex" format


The SPR27S3-D2 Receiver and the EVR27A Eval-board .

Data in Fig.9 are transmitted by a SPS207 Wireless Sensor (Temperature/Magnetometer/Accelerometer).

The EVR27A Eval-board allows to evaluate the performance of a "Wireless Network" based on "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 RF signal situation on the radio channel and to measure the S/N ratio and therefore the radio link reliability. The waveform to the side shows the signal at the "Rx out" test point (TP2) where a string of RF pulses is visible in the presence of disturbing signals.