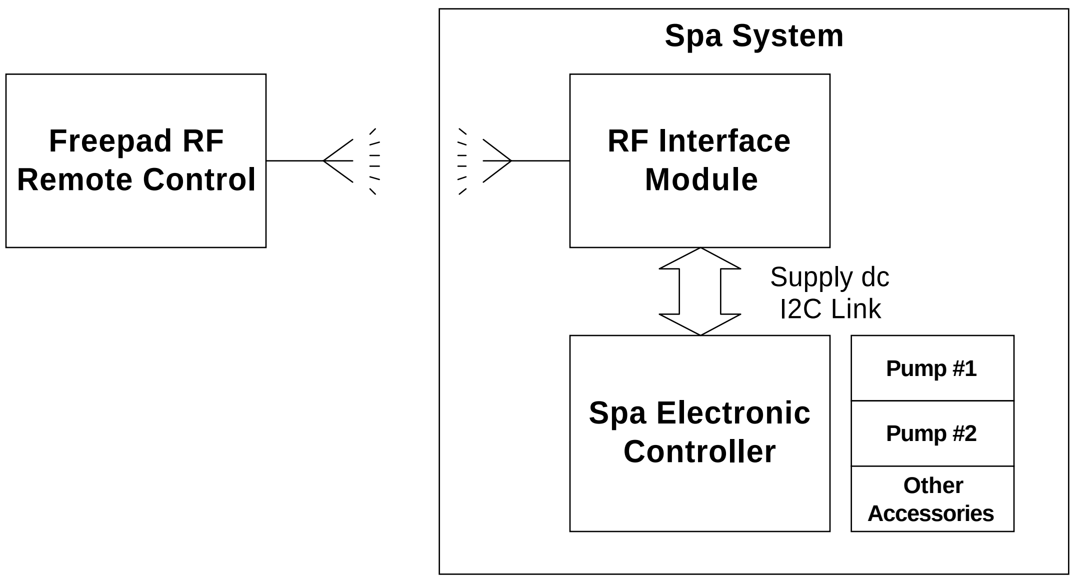
FreePad and Interface Module – Application General Circuit Description

The FreePad RF Remote Control and the RF Interface Module are part of a complete Spa System.

Spa Electronic Controller:

This Spa System uses a Spa Electronic Controller which is a black box located under the skirt of a spa. The Spa Electronic Controller provides power to all the pumps, heaters, blower, temperature probe and the like of the spa system. To do so, the Spa Electronic Controller has microcontroller based control circuits for timer, temperature regulation, pump and other control functions.



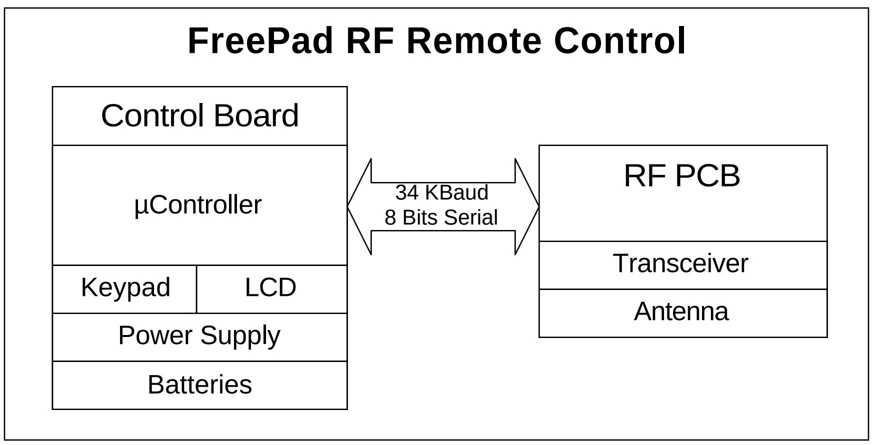
Spa system using the FreePad RF Remote Control and the RF Interface Module

FreePad RF Remote Control:

The FreePad RF Remote Control is the user interface that sends commands to the Spa Electronic Controller and that receives status information from the Spa Electronic Controller. It does so through RF Communication. The FreePad RF Remote Control electronic circuit is located inside a plastic housing. There is two separated Printed Circuit Boards (PCB) in this housing.

The first PCB is the RF PCB. This is where all RF communication functions are located. The RF PCB is mounted over a second PCB, which is the Control Board.

This control board comprises batteries, keypad, LCD and a µController. It is this Control Board that controls the power supply, the keypad, the LCD and that manages the input/output data exchange between the µController and RF PCB. These exchanges of input/output data are done through a 34 Kbaud, 8bits serial link.

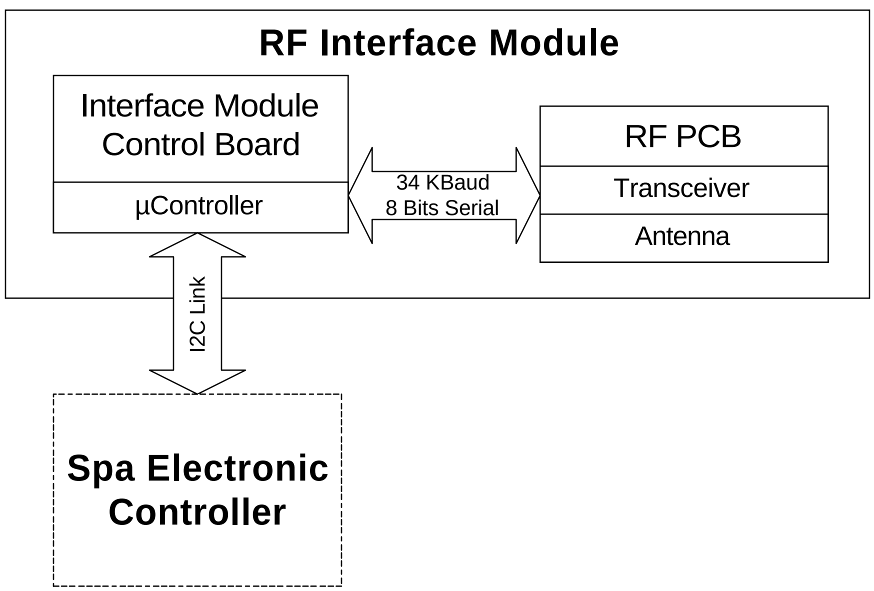


The RF Interface Module:

The RF Interface Module is the electronic circuitry that translates the RF communication data stream (from/to the FreePad RF Remote Control) to a low frequency digital data stream from/to the Spa Electronic Controller. The RF Interface Module is located inside a plastic box. This plastic box is connected to the Spa Electronic Controller through a 4 wire cable that provide a +5Vdc supply and the I^2C serial communication link. There is two separated Printed Circuit Boards in this RF Interface Module housing.

The first PCB is the RF PCB. This is where all RF communication functions are located. This is the exact same RF PCB as with the FreePad RF Remote Control. It has the same PCB, same layout, same components and same onboard antenna. As with the FreePad, the RF PCB is mounted over a second PCB, which is the Interface Module Control Board.

This Interface Module Control Board has only one function. It communicates with the RF PCB through the 34 Kbaud, 8bits serial link and translates this data stream to the I^2C serial communication link that connects to the Spa Electronic Controller.



The RF PCB:

The RF PCB uses a transceiver. This transceiver is a monolithic integrated circuit used as a low cost FM transceiver. It is the RF2095 from RF Micro Devices, Inc. (Greensboro, NC27409). This device is provided in 7mmx7mm, 48-lead plastic LQFP packaging and is designed to provide a fully functional FM transceiver. The chip is intended for digital FSK applications in the North American 915MHz ISM band. The integrated VCO, dual modulus/dual divide 128 prescaler, and reference oscillator require only the addition of a external crystals to provide a complete phase-locked oscillator. The crystals that are used are 7.07549MHz, 7.15909 MHZ and 10.7MHz

The RF PCB specification are as following:

Voltage of Operation:	5V dc
Power Consumption:	Rx mode: 8 mA typ. Tx mode: 25 mA typ.
Frequency of operation :	916 MHz
Typical Transmission power:	1mW
Transmission Type:	25 to 100 ms digital packets. Encoding: Manchester Digital data rate: 34.7 K bauds
Operating Temperature:	0 to 70 °C (32 to 160 °F)

This RF2905 has been implemented in a 15GHz silicon bipolar process technology that allows low-power transceiver operation in a variety of commercial wireless products. In its basic form, the RF2905 can implement a two-way half duplex FSK transceiver with the addition of some crystals, filters, and passive components. There are two reference crystals that allow for the transmit carrier and the receiver LO to be independently generated with a common PLL and VCO. The receiver IF section is optimized to interface with low cost 10.7MHz ceramic filters but has a -3 dB bandwidth of 25MHz and can still be used (with lower gain) at higher frequency with the other type of filters. The PA output and LNA input are available on separate pins and are designed to be connected together through a DC blocking capacitor.

In the Transmit mode, the PA will have a 50Ω impedance and the LNA will be a high impedance. In Receive mode, the LNA will have a 50Ω interface and the PA will have a high impedance. This eliminates the need for a TX/RX switch and allows a single RF filter to be used in transmit and receive modes. Separate access to the PA and LNA allow the RF2905 to interface with external component such as higher power PA's, lower NF LNA's, up converters, and down converters for a variety of implementations.

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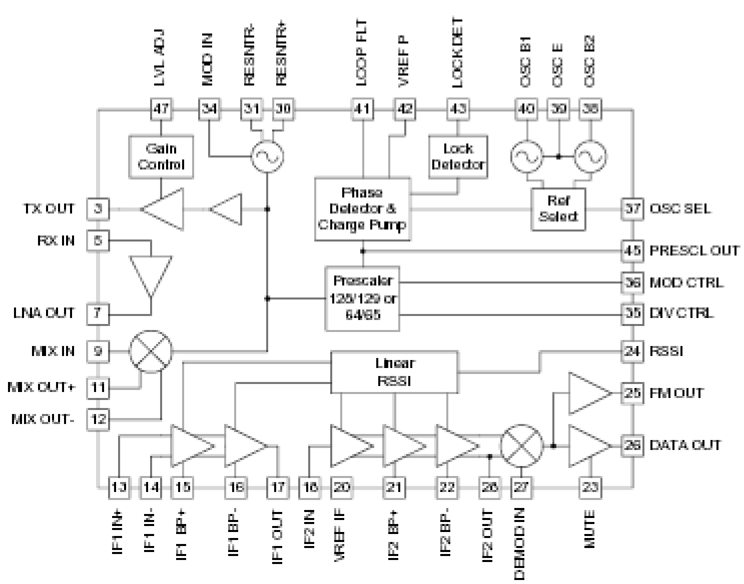
The MOD IN pin drives an internal varactor for modulating the VCO. This pin is driven with a voltage level needed to generate the desired deviation. A resistor divider network referenced to Vcc divides down logic level signals to the appropriate level for the desired deviation in FSK systems. On the receiver demod, two outputs are available, an analog FM output and a digital FSK output. The FM output is a buffered signal coming off of the quadrature demodulator. The digital output is generated by a data slicer that is DC coupled differentially to the demodulator.

An on-chip 1.6MHz RC filter is provided at the demodulator output to filter the undesired 2xIF product. This balanced data slicer has a speed advantage over a conventional adaptive data slicer where a large capacitor is used to provide DC reference for bit decision. Since the balanced data slicer does not have to charge a large capacitor, the RF2905 exhibits a very fast response time. For best operation of the on-chip data slicer, FM deviation needs to exceed the carrier frequency error anticipated between the receiver and transmitter with margin.

The data slicer itself is a transconductance amp and the DATA OUT pin is capable of driving rail to rail output only into a very high impedance and small capacitance. The amount of capacitance determine the bandwidth of the DATA OUT. At a 3pF load, the bandwidth is in excess of 500kHz. The rail to rail output of the data slicer is also limited by the frequency deviation and bandwidth of the IF filters.

For FSK modulation, an internal varactor is used to directly modulate the VCO with the baseband data. The lower frequency components are generated by long strings of 1's or 0's in the data stream. By limiting the number of consecutive, same bits, the lower frequency component is set. In addition, the data stream is balanced to minimize distortion. Manchester coding pattern such as Manchester is used to optimize system performance.



RF2905 Block Diagram