Functional Description

SIRIT Model INfinity 210 RFID Reader

The Sirit INfinity 210 is a RFID reader device that transmits and receives in the 900 MHz ISM band. The RFID tag to be read is energized off this reader via the +30 dBm antenna port RF power radiating out from the patch antenna. The reader sends out an amplitude shift key (ASK) modulated signal to poll the tag. The tag, in turn, generates a frequency shift key (FSK) modulated signal in response. The reader then downconverts and demodulates the received signal and decodes the received tag data. The reader hardware may be functionally divided into two sections: the Transmitter (TX) and the Receiver (RX) sections.

Transmitter

The TX transmits an ASK modulated signal at a selectable power level between +15 dBm and +30 dBm (maximum power) in 1 dB increments. The frequency of operation is between 902 to 928 MHz and is divided into 50 channels, with the lowest assigned channel at 902.75 MHz and the highest channel at 927.25 MHz. The frequency hopping sequence is pseudo random and is controlled by an on board microprocessor. The microprocessor sends serial data, the clock signal, and enable signal to program the operating channel of the RF synthesizer. The RF synthesizer contains an integrated VCO, and is phase locked to a 20 MHz reference oscillator. This low phase noise VCO is used by both the TX and RX sections. The output of the VCO is fed into a RF buffer amplifier. Since the VCO and buffer amplifier are not signal conditioned, a RF lowpass filter is used in the gain block to remove unwanted harmonics before the signal is split into 2 paths. This filtering will ensure spectral purity for both the RX and TX sections. The lowpass filter is followed by a 2-port 3 dB splitter. One of the splitter ports is routed to the RX section, the other to the TX section.

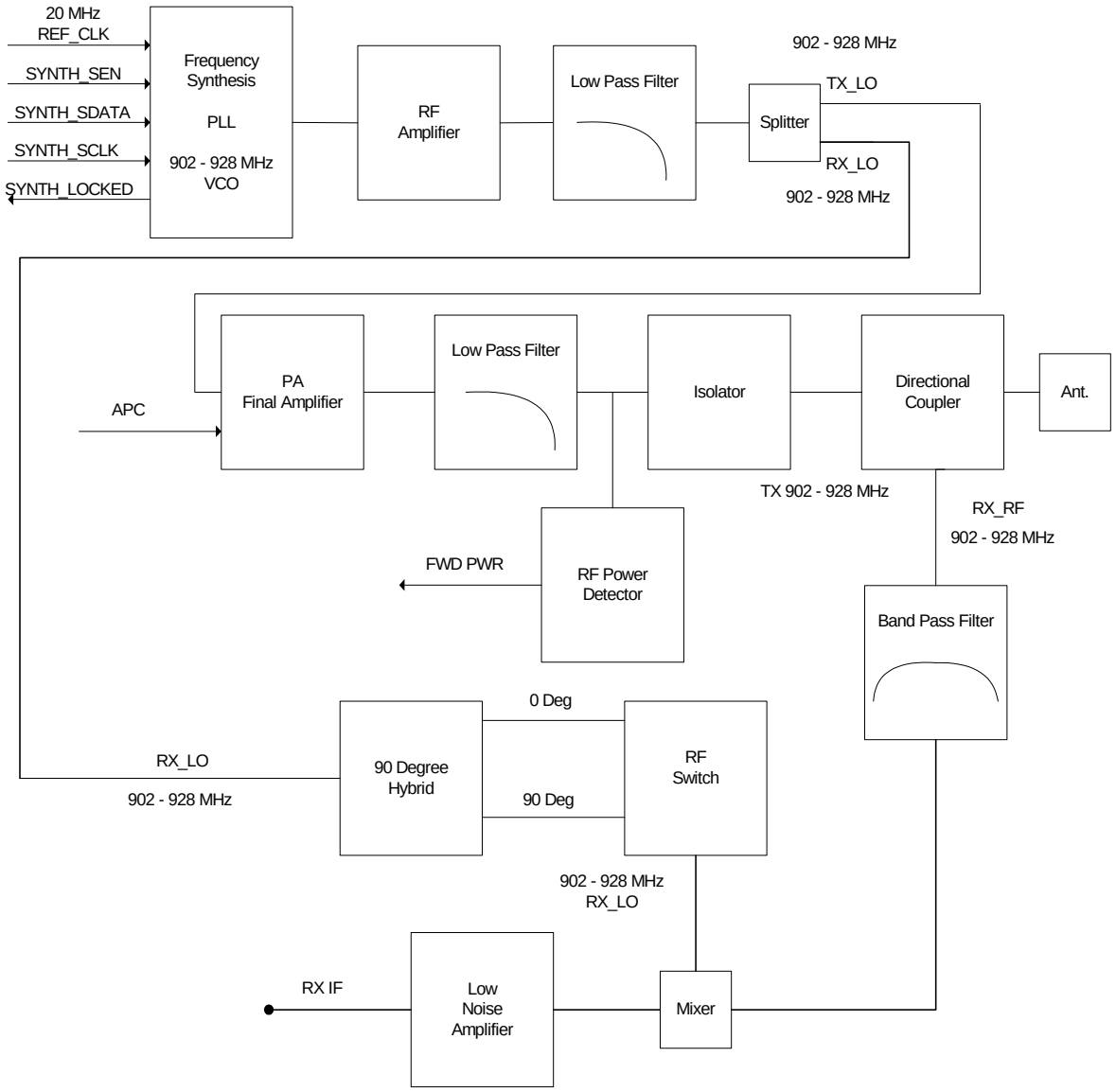
The 3 dB splitter's TX port output is connected to a RF power amplifier (PA) containing an integrated Analog Power Control (APC) pin.. The power amplifier is matched and optimized to work between 902 and 928 MHz with low harmonic levels. A RF lowpass filter follows the PA and is used to further reduce any harmonic emissions before transmission. The output power level of the power amplifier is controlled by the microprocessor via the APC pin on the power amplifier. The APC pin is also used to ASK modulate the RF carrier signal to send data to the RFID tag. The ASK modulation is shaped to produce a 20 dB occupied bandwidth transmit spectrum of less than 500 kHz. The firmware is also designed to limit the transmitter emission to less than 400 msec on any given channel. The high power RF level is connected to an isolator followed by a directional coupler before it is launched into the patch antenna.

Receiver

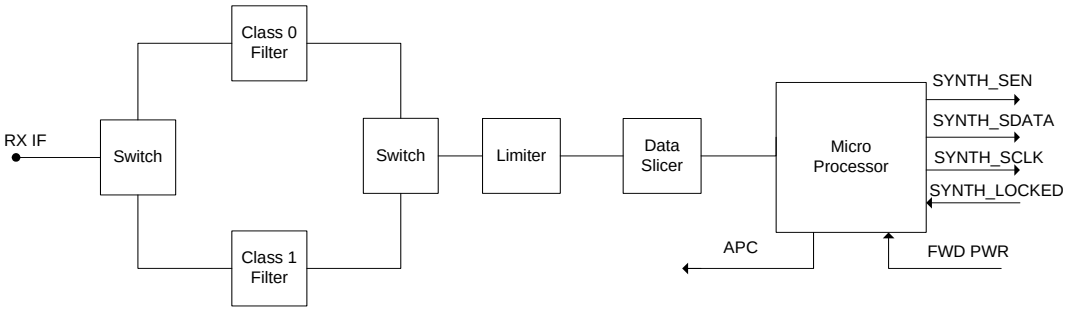
The 3 dB splitter's RX port output is connected to a 90 degree hybrid and port selection switch before connecting to the downconverting mixer. The RX signal from the patch antenna is routed through a directional coupler and conditioned with a 902-928 MHz bandpass filter before connecting to the mixer where it is down converted, using the same VCO frequency as the transmitter, to a baseband I or Q signal. The I or Q signal is individually selected by the 90 degree hybrid port selector switch. The baseband I or Q signal is then lownoise amplified before connecting to an analog switch that selects between the Class 1 and Class 0 IF processing chains.

The Class 1 IF chain consists of a bandpass filter (BW = 280 kHz, corresponding to the received Class 1 tag signal) The Class 0 IF chain consists of a bandpass filter (BW = 480 kHz, corresponding to the received Class 0 tag signal). The output of each IF chain is connected through an analog selector switch to a common limiting IF amplifier that removes amplitude variation from the selected IF signal. The limited FSK IF data is DC level shifted by a data slicer circuit and then sent to the microprocessor for decoding. The received signal strength is also derived from the limiting IF amplifier. Depending on the class of operation, the microprocessor selects the proper IF switch setting to allow the different RFID tag types to be properly filtered before decoding.

Block Diagram



Block Diagram (Cont.)



Frequency Hopping Algorithm

The INfinity 210 RFID reader polls for tags only under command from the Host computer (external to the RFID reader module), and is inactive otherwise. The Host computer sends requests to the reader for various tag functions, such as reading a tag ID or programming a new ID into a tag. The reader receives the request and carries out the requested function. Each requested function is executed on a new hop channel as shown in the Hop Count column in the table below. The firmware chooses a new Hop Count (or channel) each time a new reader function is issued from the Host. The firmware is also designed to limit the transmitter emission to less than 400 msec on any given channel. The hopping algorithm sequentially increments through the frequency hopping table, with the hop count incremented after each tag function request. The initial starting hop count is randomly determined after INfinity 210 power up, before the first tag function request is processed. The hop count is rolled over to 1 after a count of 50 is reached. The INfinity 210 is not synchronized to other readers and does not have synchronization functionality built in to the reader hardware or software.

Frequency Hopping Table

Hop Count	Frequency (MHz)	Hop Count	Frequency (MHz)		Frequency (MHz)
1	920.75	21	919.75	41	903.75
2	911.25	22	922.25	42	911.75
3	926.75	23	906.75	43	918.75
4	909.75	24	924.25	44	908.25
5	917.75	25	905.25	45	902.75
6	927.25	26	913.75	46	906.25
7	915.75	27	913.25	47	921.75
8	904.75	28	921.25	48	910.25
9	909.25	29	904.25	49	916.25
10	912.75	30	907.25	50	923.75
11	925.75	31	912.25		
12	916.75	32	924.75		
13	926.25	33	920.25		
14	923.25	34	914.25		
15	914.75	35	908.75		
16	919.25	36	903.25		
17	917.25	37	905.75		
18	915.25	38	907.75		
19	918.25	39	910.75		
20	922.75	40	925.25		

Infinity 210 Photographics

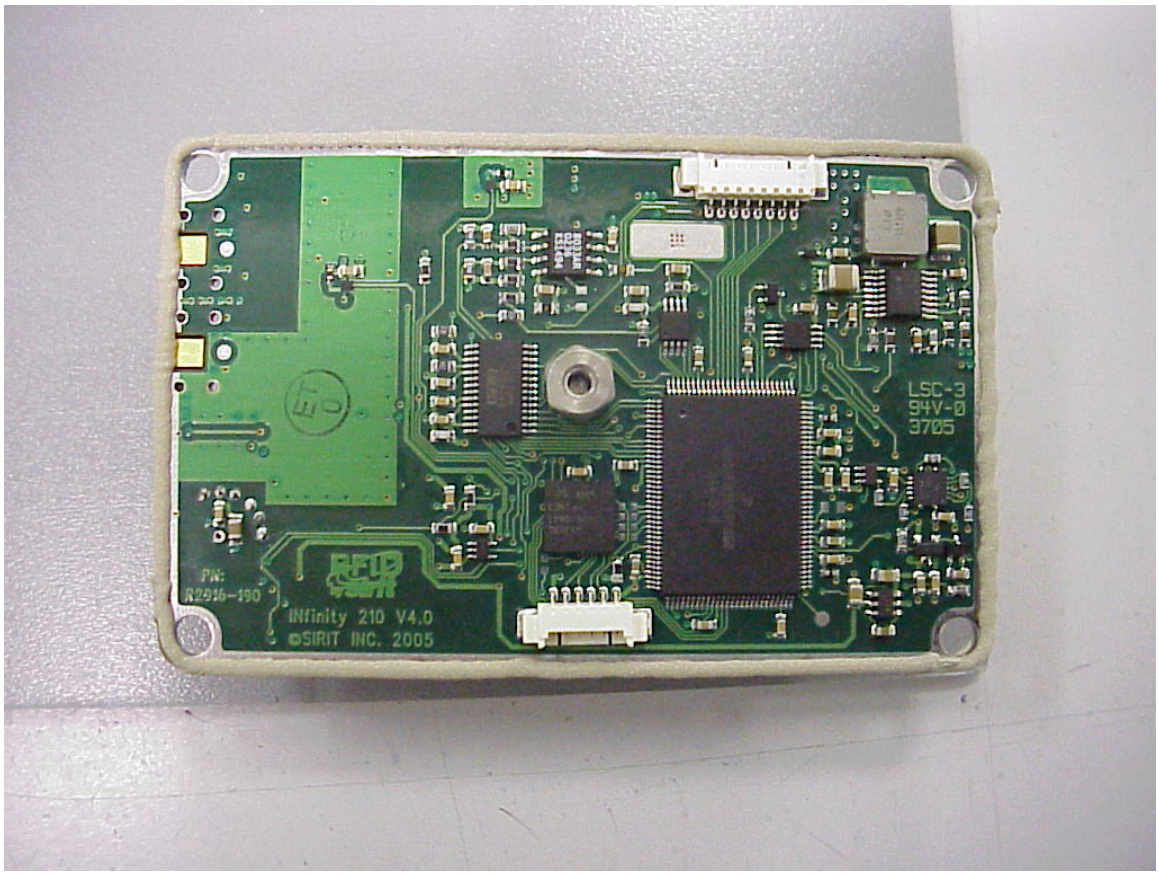


Figure 1 – Bottom of Infinity 210 circuit board

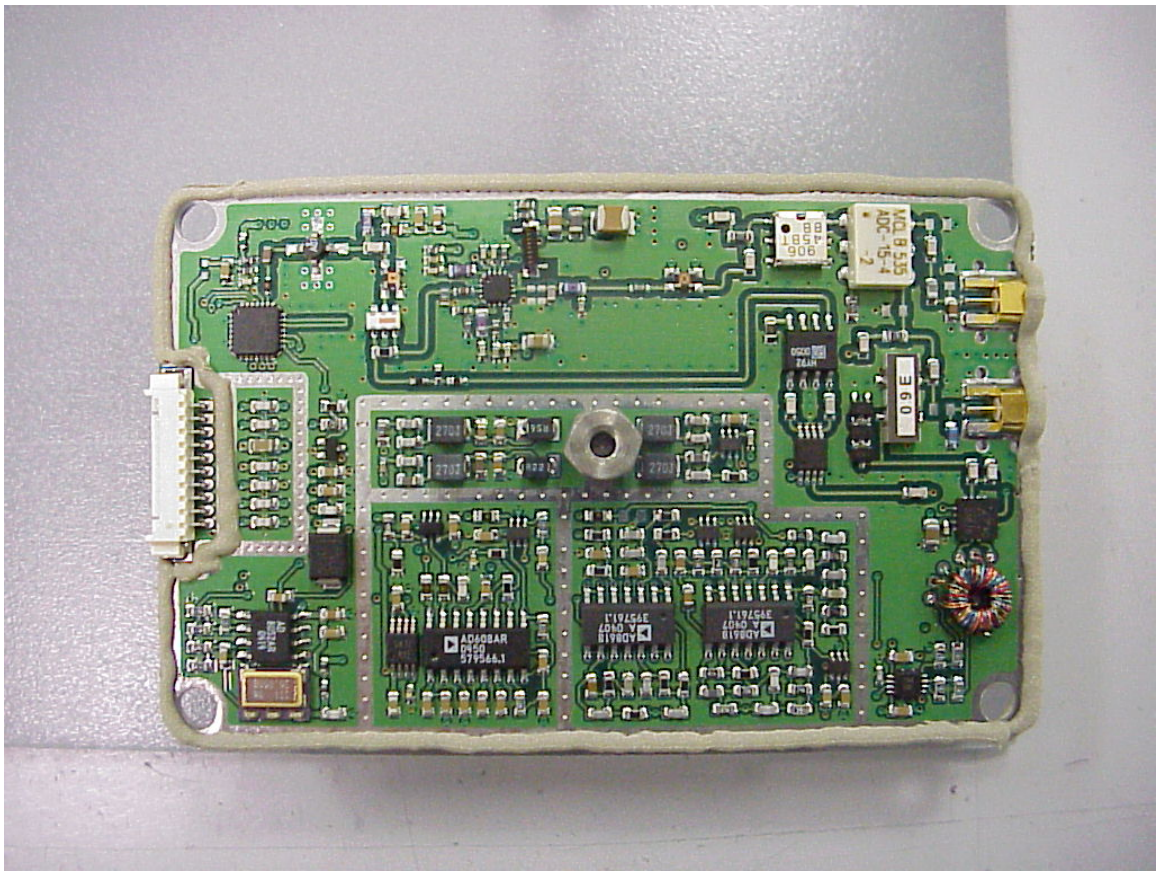


Figure 2 – Top of Infinity 210 circuit board

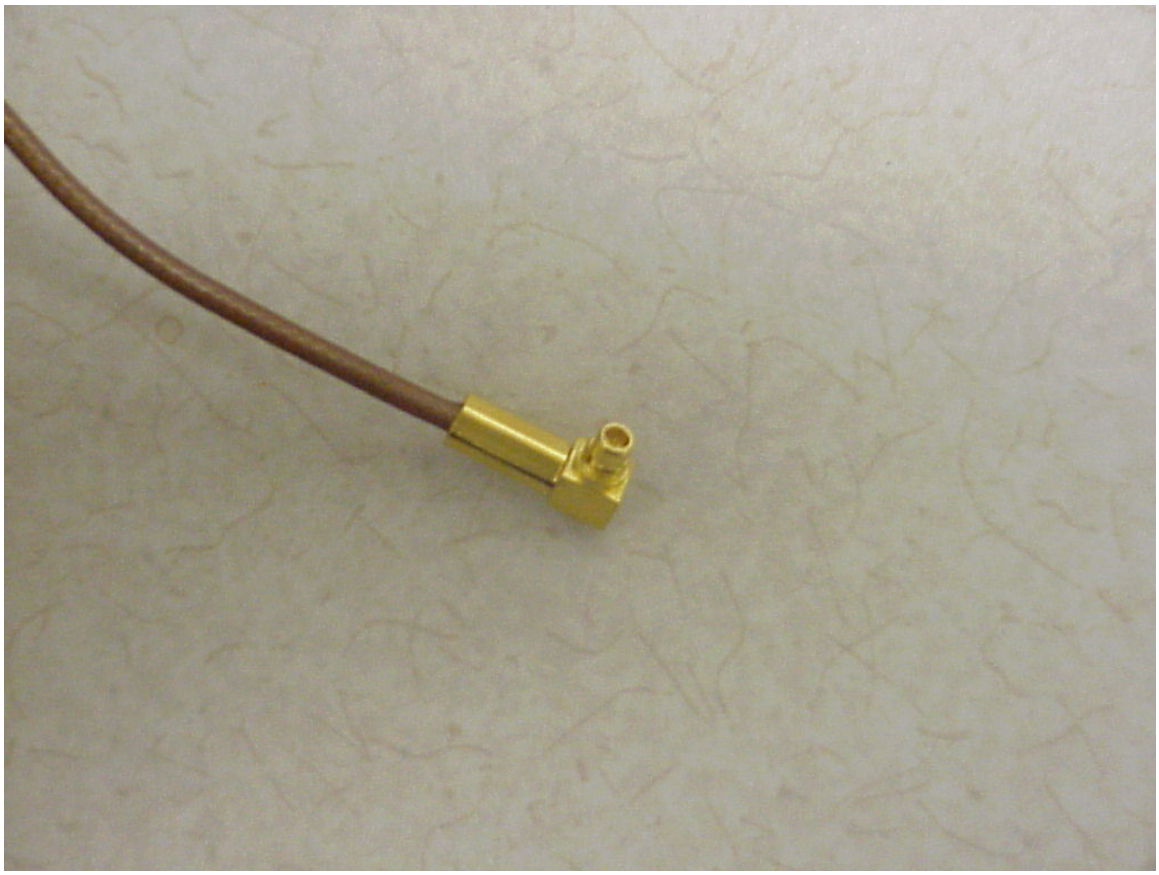


Figure 3 – MMCX Antenna Connector