RF Circuit Description (ref. ASH Tranceiver Block Diagram)

This circuit is the DR3000, 916.50 MHz amplifier-sequenced hybrid (ASH) transceiver module, manufactured by RF Monolithics. This description, and the block diagram, are based on the information provided by RF Monolithics in their "ASH Tranceiver Designer's Guide". The diagram and description have been modified to show the manner in which Maximum Inc. is using the DR3000 module.

Antenna – The antenna is a quarter-wave whip made from 14AWG copper wire.

Receiver chain - the SAW RF filter has a nominal insertion loss of 3.5 dB,a 3 dB band-width of 600 kHz, and an ultimate rejection of 55 dB. The output of the SAW filter drives amplifier RFA1. ON/OFF control to RFA1 (and RFA2) is generated by the Pulse Generator & RF Amp Bias function. The output of RFA1 drives the low-loss SAW delay line, which has a nominal delay of 0.5 µs, an insertion loss of 6 dB, and an ultimate rejection of 50 dB.

The second amplifier, RFA2, provides 51 dB of gain below saturation. The output of RFA2 drives a full-wave (rectifier) detector with 19 dB of threshold gain. The onset of saturation in each section of RFA2 is detected and summed to provide a logarithmic response. This is added to the output of the full-wave detector to produce an overall detector response that is square law for low signal levels, and transitions into a log response for high signal levels.

The detector output drives a gyrator filter. The filter provides a three-pole, 0.05 degree equiripple low-pass response with excellent group delay flatness and minimal pulse ringing. The 3 dB bandwidth of the filter is set to 4.5 kHz.

The filter is followed by a baseband amplifier which boosts the detected signal to the BBOUT pin. The BBOUT signal changes about 10 mV/dB, with a peak-to-peak signal level of up to 685 mV. The detected signal is riding on a 1.1 Vdc level that varies somewhat with supply voltage, temperature, etc. BBOUT is coupled to the CMPIN pin by a series capacitor.

Data Slicers - The CMPIN pin drives two data slicers, which convert the analog signal from BBOUT back into a digital stream. Data slicer DS1 is a capacitor-coupled comparator with provisions for an adjustable threshold. The threshold, or squelch, offsets the comparator's slicing level from 0 to 90 mV, and is set with a resistor between the RREF and THLD1 pins. This threshold allows a trade-off between receiver sensitivity and output noise density in the no-signal condition. DS2 is disabled.

AGC Control - AGC operation is disabled.

Receiver pulse generator and RF amplifier bias - The receiver amplifier-sequence operation is controlled by the Pulse Generator & RF Amplifier Bias module, which in turn is controlled by the PRATE and PWIDTH input pins, and the Power Down Control Signal from the Modulation & Bias Control function.

The interval between the falling edge of one RFA1 ON pulse to the rising edge of the next RFA1 ON pulse is set by a resistor between the PRATE pin and ground. The PWIDTH pin is connected to Vcc through a resistor, the RF amplifiers operate at a nominal 50%-50% duty cycle.

Both receiver RF amplifiers are turned off by the Power Down Control Signal, which is invoked in the power-down and transmit modes.

Transmitter chain - the transmitter chain consists of a SAW delay line oscillator followed by a modulated buffer amplifier. The SAW filter suppresses transmitter harmonics to the antenna. Note that the same SAW devices used in the amplifier-sequenced receiver are reused in the transmit modes.

Transmitter operation uses on-off keyed (OOK) modulation, the transmitter output turns completely off between “1” data pulses.

The delay line oscillator amplifier TXA1 and the output buffer amplifier TXA2 are turned off when the voltage to the TXMOD input falls below 220 mV.

The transmitter RF output power is proportional to the input current to the TXMOD pin. A resistor in series with the TXMOD pin is used to adjust the peak transmitter output power.

The transceiver operating modes, receive, transmit, and power-down (“sleep”), are controlled by the Modulation & Bias Control function, and are selected with the CNTRL1 and CNTRL0 control pins.