MKRU519 FREQUENCY HOPPING AND MODULATION

The MKRU519 scanner uses frequency hopping as a method of meeting the FCC requirement for spread spectrum operation. The frequency hopping is completely independent of the modulation used to communicate with the RF ID labels. Both functions are described below.

Frequency Hopping

The RF frequency is generated using a phase locked loop (PLL) and a voltage controlled oscillator (VCO). At power up the microprocessor begins sending the PLL integrated circuit (National Semiconductor's LMX2325TM) the serial information to the set frequency. The PLL uses a 20 MHz crystal oscillator as a reference frequency. The PLL generates a voltage for the voltage controlled oscillator (VCO). The VCO generates the RF signal, which is then fed back to the PLL. The PLL divides this signal down, and compares it to the 20 MHz reference. In the closed control loop, the PLL's output voltage is adjusted to precisely maintain the set frequency.

The frequency hopping timing is maintained by the microprocessor in the MKRU519. When it is time to hop, the microprocessor sends serial data to the PLL to change the frequency. There are 50 hopping channels with center frequencies located at 0.5 MHz intervals starting at 903 MHz and continuing to 927.5 MHz. The hopping dwell time is 300msec. The frequencies - numbered 1 through 50 - are chosen pseudorandomly. The frequency number is modulo 50 of the contents of a 7 bit maximum length feedback shift register. The linear feedback shift register (counter) operates continuously as soon as power is switched on. However, power is not applied to the final amplifier (to begin transmitting) until a command is received by the scanner from the operator via the host computer. The time at which the transmit command occurs will generally be uniformly distributed across the 50 channels. The shift register (counter) continues to operate which should guarantee a uniform distribution of restart frequencies.

Modulation

The MKRU519 Transceiver uses an RF on/off modulation scheme. The RF signal powers the ID tag in the field, and then communicates with the tag by briefly turning off the RF power at the proper time. The waveform timing and duty cycle depend on the transmitted symbol. There are 3 transmitter waveforms. The transceiver is either sending just a clock, sending a logic "0", or sending a logic "1". Figure 1 shows the timing for each of these waveforms. The range of time for the next frame of data or clock varies as a function of the interrupt latency of the microprocessor. The modulation either has the RF at full strength in the "on" state, or attenuated by at least 20 dB in the "off" state. Any time the scanner is normally operating, the RF signal is continuously being modulated. The commands being sent and the frequency of these commands is user dependant. The system is operating unmodulated only when the transceiver is instructed to operate as such, via operator command. Even when not modulated, the scanner is still frequency hopping at 300 ms intervals. The sequence of clock, logic "0" and logic "1" information being transmitted is completely dependent on the commands issued by the processor, and by the tag responses.

The modulation of the signal is controlled with a digital pulse sequence from the FPGA. This signal is RC filtered to limit the transmission bandwidth, and then is sent to the analog gain control of an RF amplifier. The RF amplifier attenuates the RF signal by a minimum of 20 dB when in the "off" state.

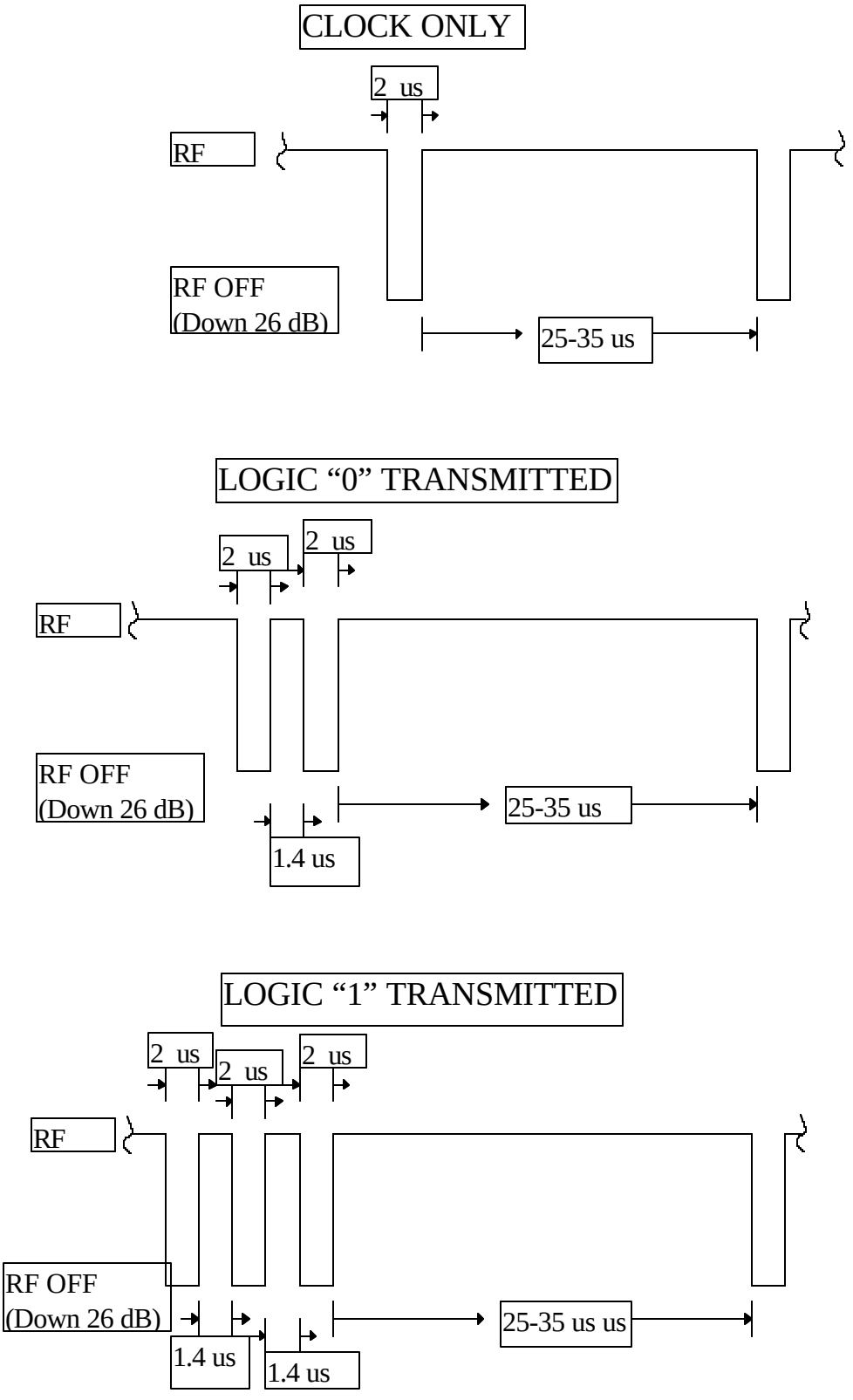

Figure 1 Modulation Modes of the MKRU519 Transceiver