LRP820
PASSIVE TAG
13.56 MHz TRANSCEIVER
THEORY of OPERATION

1.0 FUNCTIONAL DESCRIPTION

The Reader/Writer is comprised of six major blocks,

- Oscillators for 13.56MHz (carrier reference), 16.00 MHz (Controller), and 60.00 MHz (DSP).
- Controller (8051 type) to interpret commands
- DSP (TMS320C32) to implement Tag protocol.
- Transmitter AM modulator and power amplifier.
- Receiver (Rx) pre-selector filter, IF amplifier-filter, detector, and receiver Base Band (BB) amplifier/filter.
- Analog to digital converter.

2.0 READER/WRITER OPERATION

The transceiver data is communicated in with characteristic similar to standard half- duplex on one 13.56 MHz ISM band frequency.

2.1 Internal frequencies are supplied by standard Crystal Oscillators, or by digital division based upon one of the three Crystal Oscillators.

2.2 The Controller CPU interprets commands from RS232 or RS422. It can also interpret commands from a separate connector using the proprietary Mux-32 protocol (RS485 multidrop). This controller then interacts with the DSP to effect Tag communications and, upon completion, provides the response data in the appropriate format.

2.3 The TMS320C32 DSP and it's software implement the Tag communications protocol and support the timing and decoding necessary to implement the anti-collision algorithm.

2.4 The transmitter is a simple Class 'A' stage preceded by a driver and AM modulator. The output power to the antenna is less than or equal to 4 watts (36dBm). The transmitter output frequency is 13.56MHz and uses low level AM to encode the 100KHz BB data onto the transmitted carrier. The 13.56MHz reference frequency is used for RF carrier digital synchronization and is also supplied to the Modulator/Transmitter circuitry. The Modulator also has two digital inputs from the DSP. One to enable/disable the carrier, and another to provide the AM Modulation information. The modulated signal is bandpass filtered, and supplied to a temperature compensated Class 'A' output stage. This is followed by two traps to attenuate the second and third harmonics of the carrier. The Impedance at this point is 50 Ohms, which is the characteristic impedance of the cable connecting it to the antenna.

2.5 The receiver pre-selector filter, IF amplifier-filter, detector, and receiver Base Band (BB) amplifier/filter provide out of band rejection and selectivity to support the reception of tag data. The design does not use AGC amplifiers in the IF in order to allow the anti-collision to distinguish between two Tags, one close and one far, without an ACG circuit adjusting and eliminating the signal from a distant tag. The receiver uses an Amplitude Modulation (AM) detector to recover Base Band (BB) data. The received input frequency is at 13.984MHz with 26KHz data. The 423.8KHz signal is derived from the sub-carrier modulation of a "tag" on the 13.56MHz carrier. Only the upper side band at 13,983,750Hz is detected. The tag then modulates the sub-carrier with the 26KHz data signal.

2.6 The Analog to Digital converter is a low power, fast, 12 bit A-D used to convert the received and processed signal into the digital domain for further processing within the DSP.

3.0 FREQUENCIES

3.1 Receiver

The received frequency is product of the transmitted frequency and therefore controlled by the transmitter frequency stability.

Frequency, f_{in} (This is the upper side band)	13,983,750Hz
Bandwidth	200 ± 75KHz
Frequency, IF (sub-carrier)	423.75 ± 20KHz
Bandwidth	124 ± 50KHz
GAIN	
Gain, 423.75KHz	64 ± 10dB
Response, ripple	0 ± 1dB
DETECTION	
Rise and Fall Time	27 ± 1.5µs
BASE BAND	
Data Rate, Manchester encoded	26.5KHz

Phase with respect to received signal delay	In phase plus
BASE BAND AMPLIFIERS	
Gain BB	0 ± 1dB
Bandwidth	39 ± 2.2KHz
Roll off dB/octave minimum	-18
SENSITIVITY	
The following information is listed for reference only and is based on a complete working system.	
Amplitude, Analog to Digital Converter input U25	0.0 to 4.096V
Resolution	≤ 50mV
Noise	≤ 40mV
Tag at 0" with LRP08 Antenna clipped	4,000mVP
No-Tag Detected noise and or dc level maximum	500mV

3.2 Transmitter

FREQUENCY	
Carrier	13.56MHz ± 50PPM
RF BANDWIDTH	
Harmonics	-30dBc
Spurs at ≥20KHz <300KHz in 100Hz bandwidth	-60dBc

(reference information only)

Noise at ≥300KHz to 1MHz in 100Hz bandwidth -80dBc
(reference information only)

POWER

Carrier into 2:1 VSWR, 4watt P_o	36 ± 1.5dBm
Load without spectral breakup	∞ VSWR any angle
Impedance	50Ω nominal
Carrier disabled "high logic level" 5V	-45dBc minimum
Response time	5.0msec Maximum

3.3 Modulation

Pulsed Negative Amplitude (downward modulation)	10-30%
Manufacturing alignment	15±2% nominal
Rise and Fall Time	0.25-1.5μsec
Data Pulse Width	5.31μsec
Start Pulse Width	17.11μsec