

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

Phase with respect to received signal delay	In phase plus
---	---------------

BASE BAND AMPLIFIERS

Gain BB	$0 \pm 1\text{dB}$
Bandwidth	$39 \pm 2.2\text{KHz}$
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	$\leq 50\text{mV}$
Noise	$\leq 40\text{mV}$
Tag at 0" with LRP08 Antenna clipped	4,000mVP
No-Tag Detected noise and or dc level maximum	500mV

3.2 Transmitter

FREQUENCY

Carrier 50PPM	$13.56\text{MHz} \pm$
------------------	-----------------------

RF BANDWIDTH

Harmonics	-30dBc
Spurs at $\geq 20\text{KHz}$ <300KHz in 100Hz bandwidth	-60dBc

(reference information only)

Noise at $\geq 300\text{KHz}$ to 1MHz in 100Hz bandwidth -80dBc
(reference information only)

POWER

Carrier into 2:1 VSWR, 4watt P_o $36 \pm 1.5\text{dBm}$

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 $15 \pm 2\%$ nominal

Rise and Fall Time 0.25-1.5 μsec

Data Pulse Width 5.31 μsec

Start Pulse Width 17.11 μsec