Attachment 1

Description of Reader System & its Components

System Overview

The Tag-it™ system is comprised of a transponder (or tags), reader(s) and its antenna(s). The reader is controlled by a host system such as a PC, a larger computer, or some other kind of intelligent device (for example a ticket printer).

During a transaction, the transponder (tag) is permanently powered by the signal sent by the reader. This signal also provides the clock frequency to the transponder. It is amplitude modulated to transmit requests from the reader to the transponder (tag). In order to transmit responses to the reader, the transponder (tag) derives the operating energy and the clock from the reader's power signal to generate the sub-carrier frequencies. Modulation depth is 100% and is influenced by the coupling factor between the reader's antenna and the transponder, and thus by the distance between them. The emissions from transponders (tags) was not measureable and well above the regulated limit. The passive tag does not required to be FCC certified.

Tag-it Reader (TI PN RI-R00-320A)

A typical reader consists of three electronic boards (interface, digital CPU and analog RFM) and an antenna. The reader can be powered with 12 V_{DC} by either battery or DC source through the interface board. The interface board (TI PN RI-R00-232A) provides on/off switch, power and RS-232 data communication connections. The interface board has a built-in DC filter and voltage regulator. Interface board and digital CPU may not be required if the reader (analog RFM) is integrated into application peripheral such as a thermal demand printer or fixed-point identification system. The data is transmitted through the RS-232 port that is connected to its host (Application Processor) through a serial processor or a Local Area Network (LAN). It sends energy and commands to, and receives signals from the transponder through the antenna (aerial).

The basic reader includes a transmitter (with crystal oscillator), receiver and control components. The transmitter operates at a ISM frequency of 13.56 MHz with a defined bandwidth of ±7 kHz. A magnetic field is generated and supplies energy (100% ASK or full duplex) to the batteryless tag and maintains the data communication (FSK modulation) between transponder and reader. The data is transferred from the tag at 26.7 kBaud per second and 37.42 µsec bit length using two fixed side band sub-carrier frequencies of 13.56 MHz ± 423.75 kHz (high) and ± 484.29 kHz (low) through Manchester encoding.

The digital CPU module (TI PN RI-CTL-0320-00) routes communication instruction (serial protocol) set from the computer and processes the tag data through digital signal processor (DSP). CPU module has an on-board 5V DC regulation for its logic circuitry. The analog RFM (transmitter / receiver, TI PN RI-RFM-320) uses down-loadable firmware (TI PN RI-S00-320) to interrogate and respond to the tag through the protocol and energy from the antenna. The firmware can not change any system's output parameters affecting regulated emissions. The antenna module is attached to the reader by 50Ω coaxial cable. The antenna module (TI PN RI-A00-0315) includes a loop wire and matching circuit board (TI PN RI-A00-M50A). The matching circuit board allows 50Ω impedance at 13.56 MHz giving maximum output.

Attachment 1 (continue)

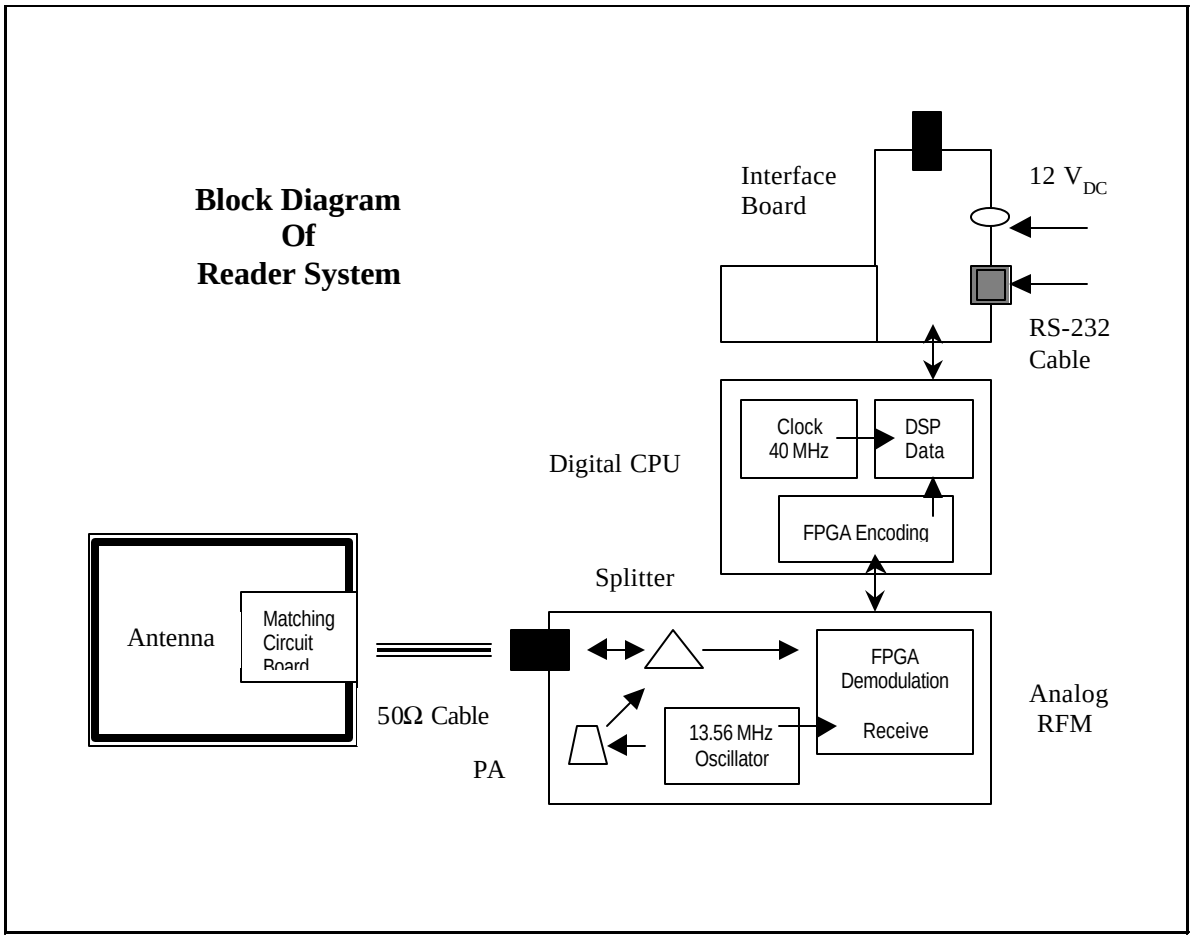

Figure 1: Block Diagram of Reader System

The front-end circuitry uses a power-splitter followed by a crystal filter in the receiving path and crystal based sinus wave oscillator. Transmitter generates a RF power output of 20.78 dBm at an impedance of 50Ω.

Attachment 1 (continue)

Transponder (Tag)

A Tag-it transponder (tag inlay) comprises a flexible foil antenna, a resonance capacitor and an integrated circuit. The tag inlay can be packaged in different formats such as pressure sensitive labels and plastic cards. The transponder's IC is powered by the electromagnetic field generated by the reader's antenna, this is generally described as a passive transponder.

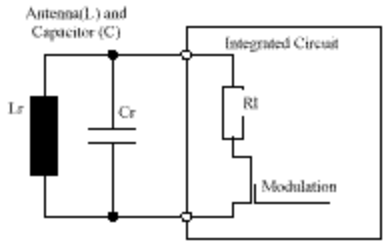

Figure 3: Block Diagram of the Transponder

The IC is flip chip mounted onto the antenna. The electrical parameters of the components: the antenna (including its inductance) and the resonance capacitor; and the layout of the antenna loops all have an effect on the transponder's performance. The L_r/C_r resonance circuit is trimmed to the required target frequency to achieve optimal performance.

The tag uses two sub-carrier AM modulation frequencies for sending its data to the Reader (up-link). The data are encoded in Manchester code by alternating between both sub-carrier frequencies, such generating an FSK modulation scheme. The emissions from transponders (tags) was not measurable and well above the regulated limit. The passive tag does not required to be FCC certified.