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FCC ID: PDVRFLAN

RF-LAN Module

User's Guide v1.01

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FCC WARNING STATEMENTS

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC.

Rules: These limits are designed to provide reasonable protection against harmful interference in a residential/office installation. The equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced Radio/TV technician for help.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC LABEL STATEMENT

This device complies with FCC Rules Part 15. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) This device must accept any interference that maybe received, including interference that may cause undesired operation.

INSTRUCTIONS TO THE INSTALLER & USER

Minimum Safe Distance:	0.14943 meters (5.9 inches)
Antenna Substitution:	Do not substitute any antenna for for the one supplied by the manufacturer. You may be exposing person(s) to harmful radiation. Contact supplier or the manufacturer for further instructions.

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Operational Overview

The purpose of the RF-LAN Module is to provide communication over the air to another similar unit or an RF-LAN Hub. The RF-LAN Module can be installed in different types of host electronic measurement, control, and data acquisition equipment, such as electric meters.

The following describes the general operation of the RF-LAN Module:

- The Module operates in ISM band (902 – 928 MHz) using the Frequency Hopping method.
- The Module can be installed in devices that provide a 5VDC power supply.
- Communication with the host device is accomplished through a 9600 baud serial interface.
- The Module adjusts output RF power according to reception of an acknowledgment signal.
- The Module can communicate with a similar Module located in other devices, such as a Gateway, and with low power RF transceivers located nearby inside devices like Water or Gas Meters.

Electrical Specifications

Operating Voltage:	5VDC +/- 5%
Consumed Current:	< 1A, peak
Effective Radiated Output RF Power with Tuned Antenna:	10, 15, 20, 25, 30 dBm, programmable
Frequency Range:	902 – 928 MHz
Number of Channels:	50, minimum
Data Rate:	1200, 2400, 4800, 9600, programmable
Receiver Sensitivity:	-105dBm, maximum
Adjacent Channel Rejection:	45dBc, min
Out of Band Signal Rejection:	60dBc, min
Frequency Synthesizer Steps:	500Hz, max
RF Input/Output Impedance:	50 Ohm
Receiver Saturation:	126 dBuV/m, min

Hardware Description

The main building blocks of the RF-LAN Module are the microcontroller, the RF transceiver, and the 1-Watt RF power amplifier, as shown in the following Figure 1: Block Diagram of RF-LAN Module.

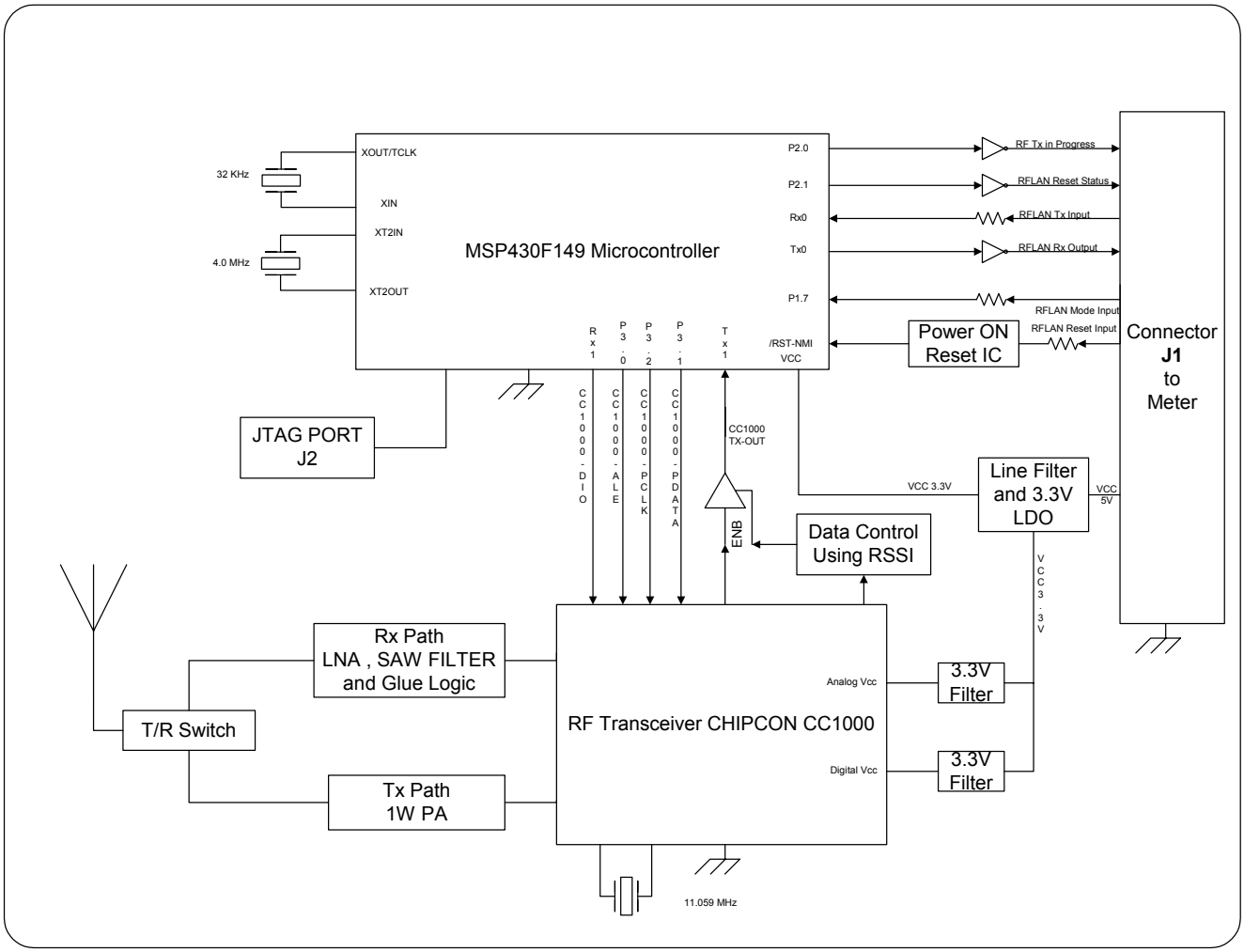

Figure 1: Block Diagram of RF-LAN Module

J1 is the I/O connector to interface to the host device.

J2 is the MSP430 programming header.

The MSP430 controller is the heart of the circuit, which interfaces with the host device via the J1 port, and to the RF section through the CC1000 chip. The firmware program resides in the internal flash of MSP430. MSP430 has two crystals, Y1 is 32.768 KHz and Y2 is 4.0MHz. Y1 is basically used to work with a JTAG emulator for debug purposes, Y2 is used for normal operation. When the RF LAN Module is connected to a host device, the host device controls the way the RF LAN Module will work through the serial port, J1.5 (Reset), and J1.6 (Command/Data).

MSP430 controls all of the functions on the RF-LAN Module, it talks to the host device via Serial port 0. The mode of RF-LAN is set by the signal level at J1.6. When the signal level is high it is in command mode, when the signal level is low it is in data mode. MSP430 appropriately handles the data by polling the J1.6.

MSP430 talks to the CC1000 via port bits and sends/receives RF data using serial port 1. MSP430 initializes CC1000 by toggling port bits (simulated synchronous serial bus), P3.2 (PCLK), P3.1 (PDATA IO), and P3.0 (PALE), as provided by the CC1000 data sheets.

The CC1000 is a single chip RF transceiver, used for wireless application in the ISM band 300-1000MHz frequency ranges. The analog and digital supply to CC1000 is well filtered by using a PI filter to suppress noise. An 11.059 MHz crystal is connected to CC1000 as a reference for the data rate and for other internal functions.

On the receive path, the RF input signal from the antenna goes through a saw filter, an LNA, and a 50-ohm impedance matching network, before feeding the RF input of CC1000. Great care is taken to design the traces on these paths to match for 50-ohm traces in order to reduce loss.

On the transmit path, the RF2131 IC is connected to the RF output of CC1000 to provide a 1-Watt RF power output. The MSP430 controller does the on-off control of the PA.

The RF transmit and receive paths are connected to the antenna via a T/R switch. MSP430 controls which signal to pass by controlling the T/R switch, using port bits.

When CC1000 is programmed in receive mode, the data to the MSP430 is allowed only when RSSI (Receiver Signal Strength Indicate) is better than –105 DBm, using RSSI signal and glue logic.

MAX825SEUK (U5) provides the power on reset to the RF-LAN Module.

Software Description

At power-on, MSP430 initializes all port pins and initializes the CC1000. MSP430 sets the mode of operations by looking at J1 connector mode input (J1.6). The host device initializes all the RF-LAN registers at power-on in command mode.

When J1.6 is in data mode, MSP430 initializes the CC1000 in Rx mode. When a valid data packet is received, MSP430 checks for the valid CRC. If valid, it checks to see if it is addressed to this RF-LAN Module. If addressed correctly, the data packet is sent to the host device.

In data mode, data received on the serial port is buffered and packetized with the header, initialized with the CC1000 in the transmit mode, setting the T/R switch to the transmit path, and sends the data to the CC1000 to transmit the data over the air. Once the data is sent, the CC1000 is switched to the receive mode, waiting for the acknowledge packet for the data just sent. The frequency-hopping algorithm is implemented to send/receive data on various frequency channels. The frequency-hopping tables are residing in the flash of MSP430.

Commands To RF-LAN Module

The following are the commands between the host device and the RF-LAN Module.

Command Name	Description
Reset	Resets the RF-LAN Module firmware
Clear Reset Status	Sets the Reset Status pin of the RF-LAN Module to a non-default state
Sleep	Puts the RF-LAN Module into low power mode
Wakeup	Removes the RF-LAN Module from low power mode
Abort Tx	Aborts any transmission in progress
Read Register	Returns value of requested RF-LAN Module Register(s) xxxx = # of bytes to read (xxxx = 0 is invalid) Register # follows the command byte
Write Register	Writes value(s) into requested RF-LAN Module Register(s) xxxx = # of bytes to write (xxxx = 0 invalid) Register # follows the command byte
SOH	Reserved – Indicates start of message

Connector Details

J1 Connector

The J1 connector is designed so it can be used either as a 12 Pin 1x12 0.1" header or a 12 Position edge connector with a pitch of 0.1". The signal definition is as follows.

Pin #	Pin Name	Pin Description	MTC Signal Direction	Voltage Level
1	MTC – Tx In Progress	RF Tx in Progress o/p from RF-LAN (+5V = Tx in Progress, 0 = Tx Idle)	Input	0V DC
2	MTC – RF Reset Status	Indicates the reset status of the LAN o/p from RF-LAN Module. RF module (+5V = reset has occurred)	Input	+5V DC
3	MTC – Tx	MTC Transmit Signal to RF-LAN Module	Output	+5V DC
4	MTC – Rx	MTC Receive Signal from RF-LAN Module	Input	+5V DC
5	MTC – Reset	MTC reset signal to RF-LAN Module (signal is active low)	Output	+5V DC
6	MTC – Cmd Mode	RF-LAN Module Data/Command Mode Pin. (+5V = Cmd Mode, 0V = Data Mode)	Output	0V DC
7	MTC – RESERVED	DO NOT CONNECT	N/A	N/A
8	MTC – RESERVED	DO NOT CONNECT	N/A	N/A
9-10	+5V DC	MTC Power Output	Power	N/A
11-12	GND	Ground	Ground	N/A

J2 Connector

The J2 connector is a 10 position 2x5 0.1" header, used for programming of the MSP430F149 microcontroller. The signal definition is as follows. (Please refer to Texas Instruments documentation for a detailed description of the JTAG interface.)

Pin #	Pin Name
1	TDI/TDO
3	TDI
4	+3.3 V Supply
5	TMS
6	TCLK
7	TCK
9	GND
2,8,10,12,13,14	NC

J3 Connector

The J3 connector is a SMT SMA connector, for connecting to the antenna.

Pin #	Pin Name
1, 3	GND
2	RF Signal