CLEAVELAND/PRICE INC.

CP-RM001 User's Manual

User's Manual for Incorporating the CP-RM001 in Cleaveland/Price Products.

FCC ID: 2ATMU-CP-RM001

IC: 25561-CPRM001 HVIN 1.0

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com

CLEAVELAND/PRICE INC.

Table of Contents

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com

CLEAVELAND/PRICE INC.

Overview

Audience and Intent

This document is intended for Cleaveland/Price development engineers who are seeking to incorporate the CP-RM001 radio module into their products, and maintain the single modular FCC certification of the radio module. ***The CP-RM001 is not provided for sale outside of Cleaveland/Price, and the intended use case only includes Cleaveland/Price products.***

Description of CP-RM001

The Cleaveland/Price CP-RM001 radio module consists of an Anaren A1101R09C radio module (FCC ID: X7J-A10040601), which is a stand-alone module equipped with a u.FL antenna connector, certified for some number of external antennas. The CP-RM001 module (FCC ID: 2ATMU-CP-RM001) expands upon the A1101R09C's allowable configurations, allowing different antenna types and gains, modulation schemes, and data rates to be used.

The Anaren A1101R09C is a surface mount module, including an integrated crystal, internal voltage regulator, matching circuitry and filtering. It utilizes an external antenna through a U.FL connector on the module. The module operates in the US 902-928 MHz ISM band, and is based on TI's CC1101 RF Transceiver. Communications and control are handled via a serial data bus (SPI Interface), and the transceiver provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, and link quality indication. See the TI datasheet for information on how to control the module.

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com

CLEAVELAND/PRICE INC.

Theory of Operation

The CP-RM001 is intended for low power wireless applications in the US 902-928 MHz ISM Band. The devices can be used to implement a variety of networks, including point-to-point, point-to-multipoint, and mesh networks. The CP-RM001 interfaces to an application microcontroller via an SPI bus. Physical and MAC layer functionality are accessed via the SPI bus through addressable registers as well as execution commands. Data to be received or transmitted is also accessed through the SPI bus – the module implements a 64-byte FIFO buffer for both receive and transmit state machines.

To transmit, a frame of data is placed in the transmit FIFO – this information includes a destination address. Once the FIFO is loaded, a transmit command is given via the SPI bus to begin transmission. To receive data, a receive command is given via the SPI bus, which causes the module to "listen" for a transmission. When such a transmission occurs, it places the received frame in the FIFO. When transmit or receive are not required, the radio can enter an Idle mode for power consumption reduction. The radio can transition quickly from idle to receive or transmit modes – for more information, see the TI CC1101 User's Manual.

Below is a block diagram of the CP-RM001 radio module.

- Antenna
  - The antenna couples energy between the surrounding air and the radio module. The CP-RM001 is tested for compliance with a number of external antennas. Up to a 3dB right-hand circular polarized patch antenna, a 3dB 'salt shaker' vertical, linear polarized antenna, a 3dB dipole strip antenna, and a 14dBi Yagi directional antenna are compliant for use with the CP-RM001. Special care should be paid to the radiation pattern and application of a chosen antenna. Antenna selection is limited to C/P development engineering, as the application permits with use of the CP-RM001. For more antenna information, see the CP-RM001 FCC Modular Integration Instructions.
- Filtering
  - Filtering removes spurious signals to comply with regulatory intentional radiator requirements.
- Matching
  - Matching provides the correct loading of the transmit amplifier to achieve the highest output power, as well as the correct loading for the receive LNA to achieve the best sensitivity.
- Physical
  - The physical layer provides conversions between data, symbol and RF signal.
- MAC
  - The MAC layer is part of the Logical Link Layer and provides frame handling, addressing and medium access services.
- Microcontroller Interface
  - The microcontroller interface exposes registers and commands for the physical and MAC layers to a microcontroller.
- Power Management
  - Power management ensures a stable supply for the internal functions, as well as providing means for a low power sleep mode (in which case, most of the transceiver is power off).

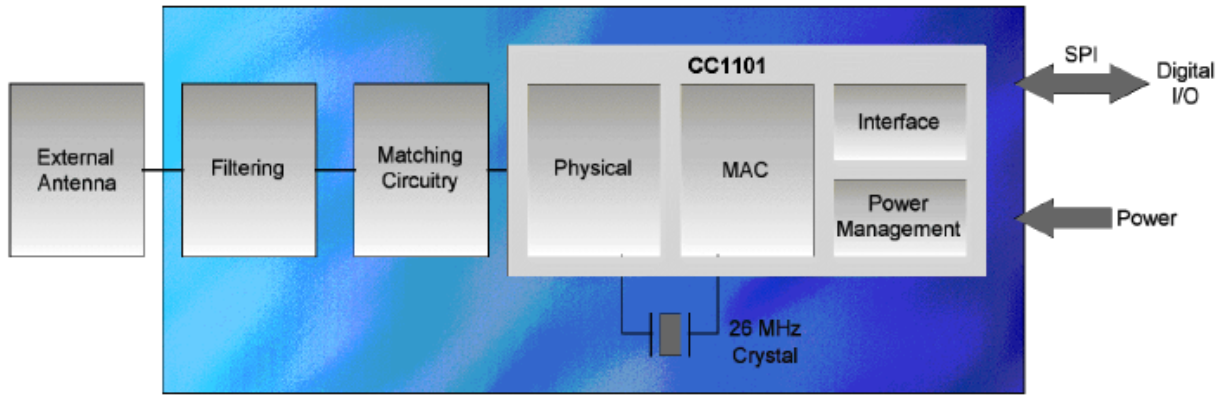

FIGURE 1: CP-RM001 HARDWARE STATE DIAGRAM

Product Approvals

Applicable FCC Rules

The CP-RM001 radio module, used with the antennas listed below, has been tested to comply with FCC Part 15 – specifically, 15.247 (combination of digital modulation and frequency hopping spread spectrum at 902-928 MHz). The device also meets the requirements for a single modular transmitter outlined in 15.212, and may be integrated into a finished product (following this guide) without obtaining subsequent FCC approvals. For specific references on each rule in 15.212, see the 'CP-RM001 FCC Modular Approval Letter' document.

Antenna	Manufacturer	Model Number	Gain (dBi)	Description	Connector Type
'Patch'	PCTEL	FMD9023-CP	3	RHCP Patch, Primary antenna used on CommBridge	Type N Female
'Strip'	PCTEL	IE9022-CP	3	Dipole adhesive-backed strip antenna	u.FL
'Standard Yagi'	RDA Solutions	RDA D900-10	10	7-element, welded Yagi antenna	Type N Female
'Large Yagi'	ZDA Communications	ZDADJ928-14YG	14	9-element Yagi Antenna, 900mm length	Type N Female

TABLE 1: APPROVED ANTENNAS

CLEAVELAND/PRICE INC.

RF Exposure Considerations

The following statement must be included as a CAUTION statement in manuals and OEM products to alert end users of FCC RF Exposure compliance:

> To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Labeling Requirements

The following label must be printed outside of the finished product on which the module is installed, or within the user manual for the product:

> Contains Transmitter Module FCC ID: 2ATMU-CP-RM001
>
> -or-
>
> Contains FCC ID: 2ATMU-CP-RM001
>
> This device complies with Part 15.247 of the FCC Rules.
>
> Operation is subject to the following two conditions:
>
> (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

IC/ISED Labeling Requirements

The following label must be printed outside of the finished product on which the module is installed, or within the user manual upon agreement with Industry Canada:

> Contains IC: 25561-CPRM001 HVIN 1.0
>
> **Notice**: This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
>
> **Avis**: Cet appareil est conforme avec Industrie Canada RSS standard exempts de licence (s). Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com

CLEAVELAND/PRICE INC.

Approved Usage

The CP-RM001 has been approved for use as a digitally modulated transmitter (DTS) device, for which it must have a minimum occupied bandwidth (6dB bandwidth) of 500 kHz. In addition, the spectral density may not exceed 8dBm/3kHz and the total output power, including antenna gain, may not exceed 1 Watt. 'Fc', as denoted below, is the center frequency of a given channel. In order to meet band edge requirements, the center frequency selection must be inside these bounds at a given modulation and datarate. Frequency hopping, when combined with DTS, is allowable when in compliance with FCC regulation (>50 channels per second).

Per FCC 15.21, changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Modulation	**Datarate (kB)**	6-dB Bandwidth	TX Power	Fc Min	Fc Max
MSK	600	665.6 kHz	+11dBm	903.149 MHz	926.582

TABLE 2: APPROVED CONFIGURATIONS WITH MAX OUTPUT POWER

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com

CLEAVELAND/PRICE INC.

ISED Requirements

Per RSS-Gen, Section 8.4 This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- l'appareil ne doit pas produire de brouillage;
- l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Per RSS-Gen, Radio apparatus shall comply with the requirements to include required notices or statements to the user of equipment with each unit of equipment model offered for sale.

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. **See Table 1, above, for the referenced antennas.**

Cleaveland/Price Inc.
14000 Rt. 993
Trafford, PA 15085
(724) 864-4177
www.cleavelandprice.com