# Radiocrafts
## Embedded Wireless Solutions

# RC12X0HPDK

## RC12X0HPDK Demonstration Kit User Manual



### Table of contents

## Quick Start Guide

*How do I set up a simple link between the boards?*
To do a basic communication test, do like this for each of the Demonstration Boards:

- Attach the antenna to the SMA connector
- Connect the RS232 port to a PC
- Start a terminal program on the PC (like Microsoft HyperTerminal). Make sure to select the correct serial port, set data rate 19200, 1 start bit, no parity, 1 stop bit, no flow control.
- Connect the battery eliminator plug to the DC jack. Put the battery eliminator in the wall outlet socket.

The module will now be in idle mode listening for a valid data packet to arrive.

Now you can enter data in one terminal window and after approximately 2 seconds timeout, the ASCII string is transmitted to the other module and shown in the other terminal window if the transmission was successful.


*How do I go on and change the RF channel or any other parameter?*
To change configurable parameters, assert the CONFIG pin (pulling low by pressing CONFIG-button, see Figure 1), and send the command string using the same serial interface as for transmitting data. Parameters can be changed permanently and stored in non-volatile memory in the module. The details for this you should look up in the RC232 User Manual.

The best way to use the configuration interface of the module, is to use a terminal program that provides the possibility to send and receive binary / hexadecimal numbers, and not only ASCII characters.

## Introduction

The RC12X0HP RF modules with embedded protocol provide a very compact solution for a wide range of applications. The RC12X0HPDK Demonstration Kit is designed to make it easy for the user to evaluate the module and develop an application very quickly.

The Demonstration Kit includes two RC12X0HPDB Demonstration Boards. The Demonstration Boards contain the RC12X0HP module and associated support circuits. The board can easily be operated using a PC terminal emulator.

This User Manual describes how to use the Demonstration Kit and provides detailed documentation for the Demonstration Board.

The RC12X0HPDK Demonstration Kit includes what you need to evaluate the RF performance of the modules, develop your own application interfacing the modules, and can also be used to build a prototype of your application.

Your Demonstration Kit should contain the following items:

| Kit contents | |
| --- | --- |
| Item | *Number of articles* |
| Demonstration Board (RC12X0HPDB) | 2 |
| RF Module (RC12X0HP) | 2 |
| Antenna, 50Ω quarter-wave monopole, SMA male connector | 2 |
| SMA to BNC adapters | 2 |
| RS232 serial cable (1:1) | 2 |
| AC/DC battery eliminator 6VDC/1000mA | 2 |

## Demonstration Board

The Demonstration Board contains a serial port driver circuit for RS232 and the 9-pin D-Sub connector, buttons (CONFIG, TXEN, RXEN, RESET), voltage regulator, configuration jumpers and connectors to make it easy to interface the RC12X0HP with various test equipment or the host used in an application. Not all components are needed in an actual application. Please see the datasheet for a typical application circuit.

The module on the demonstration board is as default at power-up configured with a channel in the frequency band where high output power is allowed. For RC1280HP this is 869.400-869.650 MHz where max output power is 500 mW (+27 dBm). If configured for another channel, be sure to program the maximum allowed output power according to the datasheet, never exceeding +10 dBm outside the mentioned frequency band.
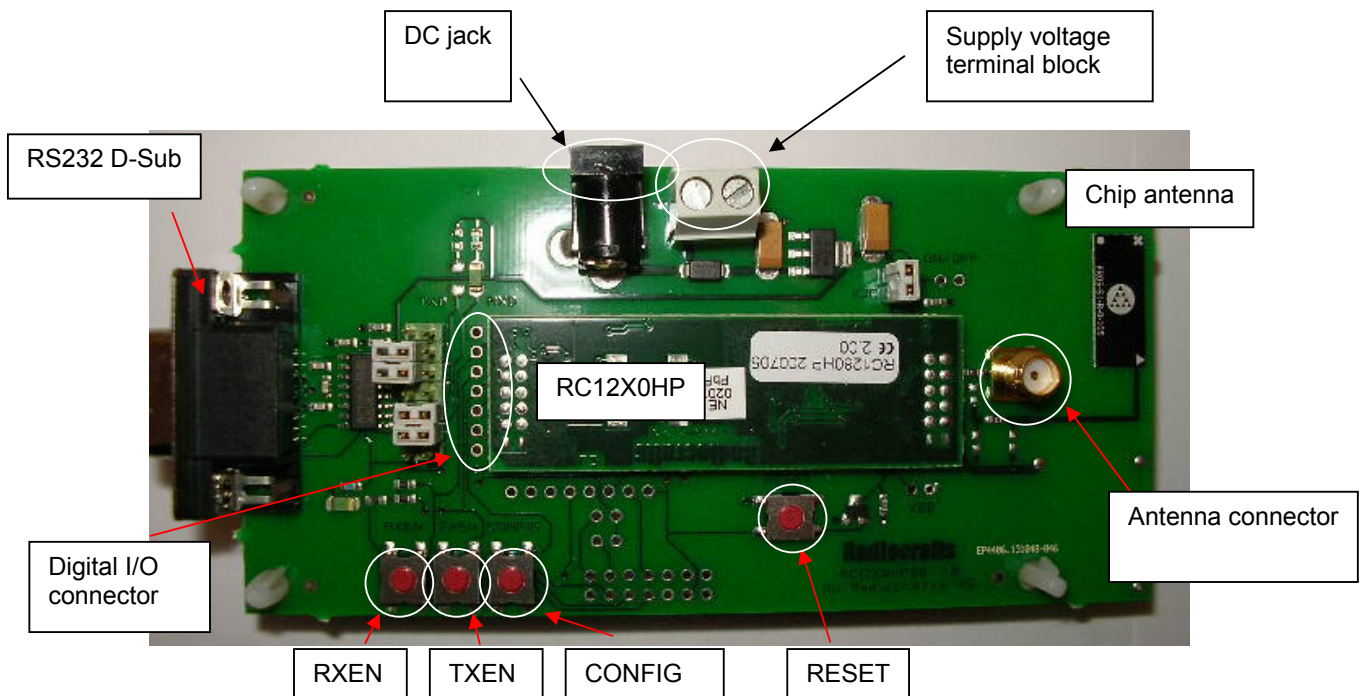


**Figure 1: RC12X0HP Demonstration Board**

NOTE: The RC12X0HP-module and RC1280HPDB are both designed to fulfil regulatives as given in the datasheet for the module. A maximum TX/RX-ratio of 10% applies for 500 mW operation. When operated in buffered mode (default) no special concern has to be taken except for the 10% TX/RX ratio.

When operated in testmode "1" or unbuffered mode (see RC232 User Manual) a maximum transmission period ("TX-time") of 3 seconds applies.

### Power supply section

The board contains a 3.3V fixed voltage regulator. You can choose between applying a 4.6-12V unregulated supply voltage at the DC jack (like the equipped battery eliminator), or the screw terminal where a battery pack or some other supply can be connected. The on-board regulator drops the voltage to 3.3V.

Input supply voltage range is 4.6 – 12 V. A series diode protects the circuit against wrong polarity.

An ampere meter can be connected in order to measure the DC current drawn by the module. Remove the strap on connector P14 and connect the ampere meter between the two pins as shown in the figure below.
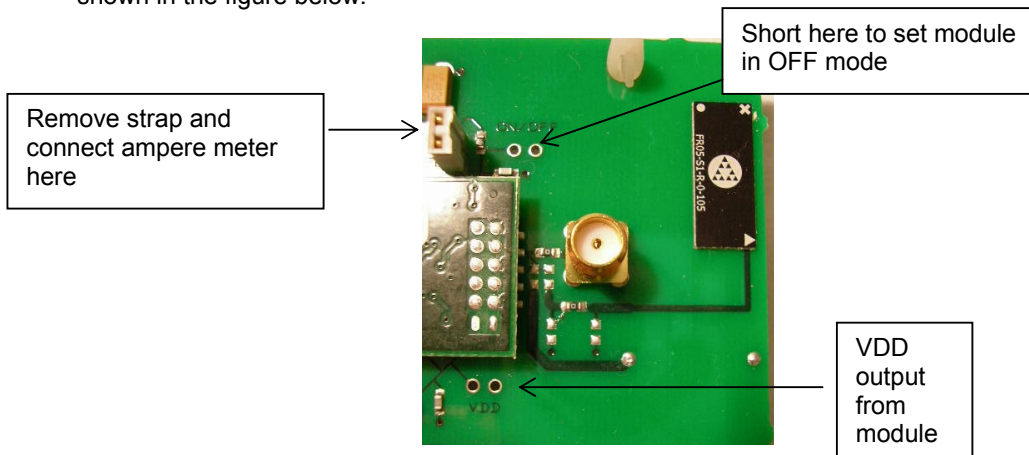


Short here to set module in OFF mode

Remove strap and connect ampere meter here

VDD output from module

**Figure 2. Module current consumption measurement**

As shown in the figure above there are also available connection points for setting the module in OFF mode and for VDD monitoring, both optional connections for test purposes.

Note: The 100k pull-up resistor R2 will draw approximately 27 uA in OFF mode if not removed. The pull-up resistor is used to keep the module in ON mode for normal use. In a real application this pin could be controlled by a digital output, and (the pull-up) R2 could be omitted, and hence the very low OFF mode current consumption could be achieved.

## RS-232 interface

The Demonstration Board provides a RS232 driver circuit. The serial port is configured as a data modem and a 1:1 cable should be used to connect the board to the PC.

The RTS/CTS handshaking pair is also provided, so that hardware handshaking may be used on this port, but this is not enabled in the default configuration from the factory. Handshaking can be enabled by changing the configuration in permanent memory (see RC232 User Manual) and doing the following hardware changes:

- R7 must be removed to enable CTS. Otherwise it will act as a voltage divider together with the internal series resistor in the module reducing the signal swing.
- Insert jumpers at P13 to connect CTS and RTS to the RS232 driver

P13 is used to set jumpers to connect the module UART interface to the RS232 PHY driver. Normally the jumpers connecting RXD and TXD are installed, and provide UART communication with a PC without handshaking. With the jumpers removed the modules RXD and TXD can easily be connected to a host, for instance a microcontroller or external development board. The table below shows the pinout and signals at P13.

| Pin no. | | Signal | Note |
|---|---|---|---|
| 1 | 2 | GND | |
| 3 | 4 | CTS | Install jumper when using hardware handshake |
| 5 | 6 | RTS | Install jumper when using hardware handshake |
| 7 | 8 | CONFIG | |
| 9 | 10 | TXD | Jumper installed from factory |
| 11 | 12 | RXD | Jumper installed from factory |
| 13 | 14 | GND | |

*Note*: The module CTS is set up during the first stop bit sent from to module when the buffer is full, and the host should then halt further character transmissions to prevent character loss. If the host can not detect the CTS quickly enough during hardware handshake, it should be configured for two stop bits.

## Connectors

The Demonstration Board is furnished with many connectors for easy access to all module signals:

P5 (and P13) bring out all the digital data and control lines used to interface the module.

P14 carries supply voltage VCC and P12 connects to the ON/OFF signal and GND. A 2.54 mm pitch pin-row can be mounted at P12 if convenient.

P6 brings out digital I/O for future use and custom specific applications. A 2.54 mm pitch pin-row can be mounted at P6 if convenient.

P8, P10 and P11 are for factory test only and not equipped on the PCB.

## Push buttons

The Demonstration Board is furnished with four push buttons connected to the control signals:

S1: RXEN. Pressing this button will activate RX when using un-buffered mode.
S2: TXEN. Pressing this button will activate TX when using un-buffered mode.
S3: CONFIG. Pressing this button will activate configuration mode.
S4: RESET. Pressing this button will activate the main RESET of the module.

## Using the Demonstration Kit
The Demonstration Kit is useful for providing hands-on experience with the RC12X0HP for both software and hardware developers.

Follow the Quick Start Guide instructions to hook up the kit.

The RC232 User Manual together with the Data Sheet for each specific module provide information on how to change the configurations of the modules.

**Important:** *The use of radio transceivers is regulated by international and national rules. Radiocrafts' modules meet the regulations in EU and US/Canada for different frequency variants. Make sure the local regulative are according to these rules. Your local telecommunication authorities can provide more information on use of un-licensed radio transmitter in your country.*

## Antenna Selection
The choice of antenna is cruicial for the achieved range for any radio system. RC12X0HPDB has three onboard possible antenna solutions:

1. SMA-connector for connection to a whip antenna. This is the default configuration and a 0-Ohm series resistor R1 is connecting the SMA to the RF module. The whip antennas following the kit have a quarterwave length. When connected to the RC12X0HPDB a range of more than 5 km Line-Of-Sight can be expected. For increased range and more omnidirectional radiation an antenna with a more optimum ground plane should be used. See RC12X0HP Data Sheet for guidelines.
2. Fractus chip antenna. With this antenna a range of more than 3.5 km Line-Of-Sight can be expected. For reference designs and more information about the antenna contact Fractus at www.fractus.com . For the Fractus antenna, no matching other than the transmission line widths recommended by Fractus is required, as implemented on the RC1280HPDB.
3. 1.0 mm hole for connection and evaluation of various customer-selected antennas like for instance helical constructions.

To connect to option 2 and 3, the 0-Ohm series resistor R1 must be moved to position R4 and R5 respectively. See the assembly drawing for reference.
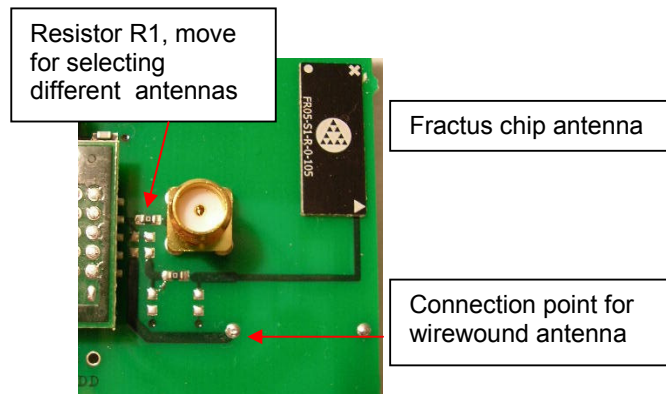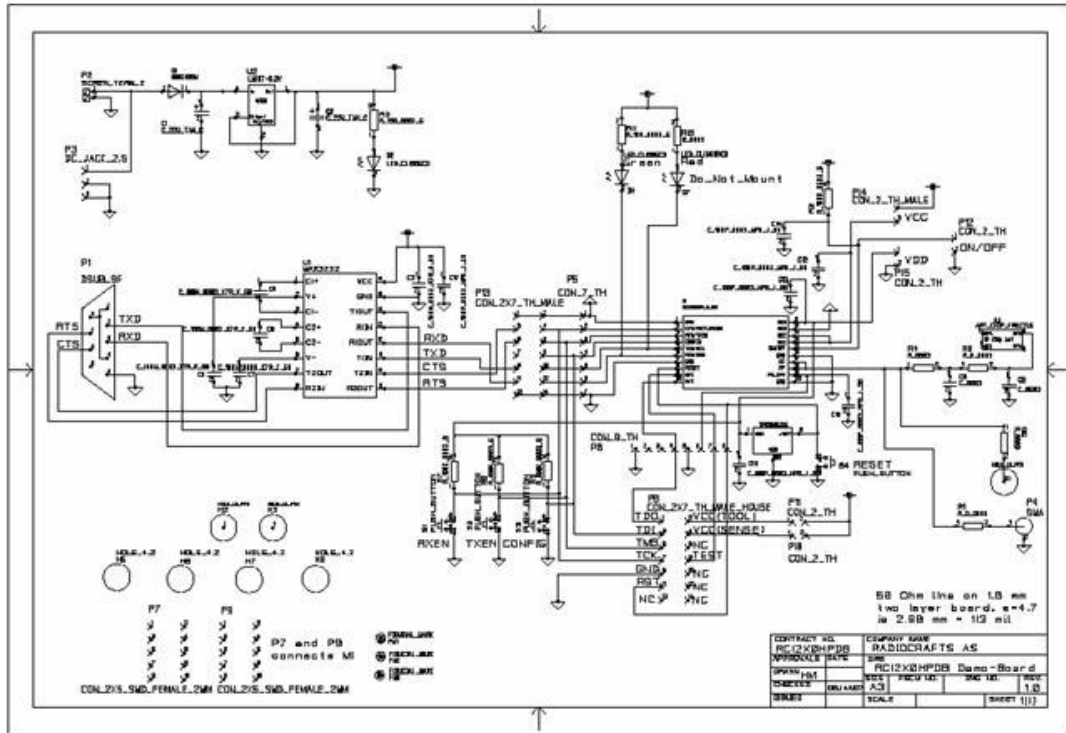


**Figure 3. Antenna selection by moving resistor**

## Circuit Diagram

The circuit diagram is shown below. A full resolution schematic is found in RC12x0HPDB_1_0.zip available from Radiocrafts' webpage.

## Bill of materials

| Reference | Quantity | Part number | Description |
|---|---|---|---|
| A3 | 1 | Fractus FR05-S1-R-0-105 | Chip antenna 868 MHz |
| C12-17 | 6 | C_100P_0603_NP0_J_50 | Capacitor, 0603 |
| C3-7 | 5 | C_100N_0603_X7R_K_50 | Capacitor, 0603 |
| C1-C2 | 1 | C_22U_TAN_C | Capacitor, tantal, C-size |
| D1 | 1 | 10MQ100N | Diode, Si |
| D2 | 1 | LED_CL150GCD | Green LED |
| M1 | 1 | RC12X0HP | RF Module |
| P1 | 1 | DSUB_9F | D-Sub, 9 pin, female |
| P2 | 1 | SCREW_TERM_2 | 2 pin terminal, screw |
| P3 | 1 | DC_JACK_2.5 | DC jack, 2.5mm center pin |
| P4 | 1 | SMA | SMA connector, straight |
| P7;P9 | 2 | CLT-105-02-L-D-A-TR | Samtec 2x5 SMD female, 2.0 mm |
| P13 | 1 | CON_2X7_TH_MALE | Connector 14 pins, pin header |
| R1; R6 | 2 | R_0_0603 | Resistor, 0603 |
| R2;R7-9 | 4 | R_100K_0603_G | Resistor, 0603 |
| R3; R11 | 1 | R_150_0603_G | Resistor, 0603 |
| S1-4 | 4 | PUSH_BUTTON | Push button, SMD |
| U1 | 1 | MAX3232 | RS-232 Transceiver, SO-16 |
| U2 | 1 | LM1117-3.3V | 3.3V low drop-out regulator, 800 mA |
| U6 | 1 | TPS3809J25 | Voltage supervisor, 2.5V, SOT-23 |

## PCB layout

The PCB is a simple 2-layer board where the bottom layer is used as ground plane. The laminate used is standard FR-4 board material. The PCB is 1.6mm thick. Full resolution layout and assembly drawing are found in RC12X0HPDB_2_0.zip.
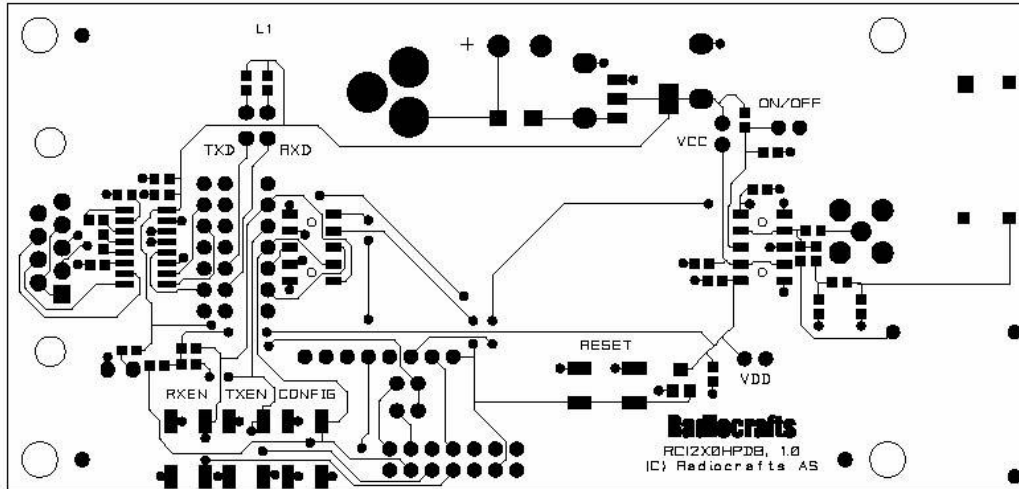


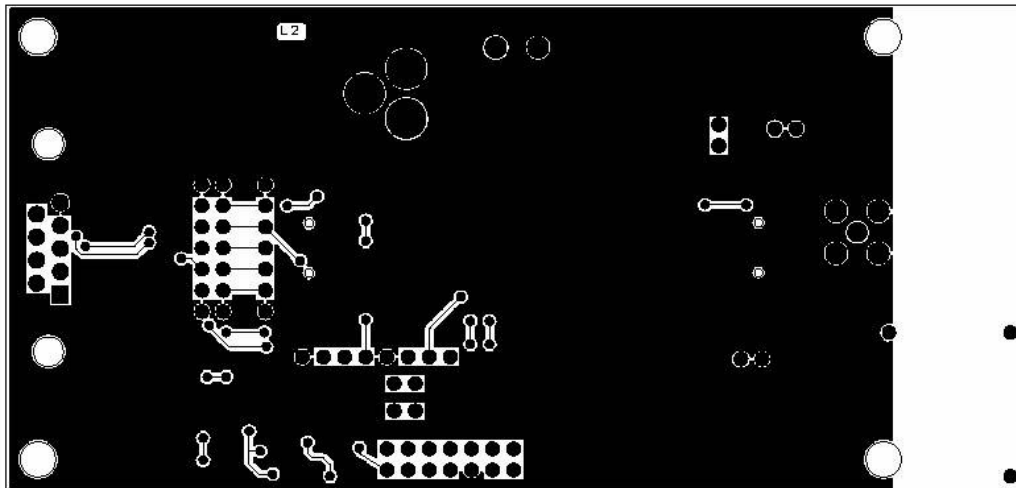**Figure 4: RC12X0HPDB PCB layout, top layer (1)**
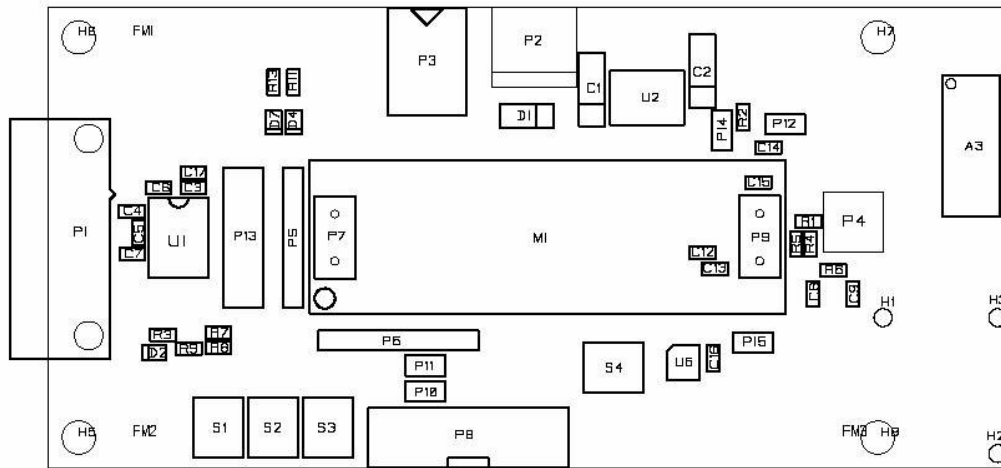


**Figure 5: RC12X0HPDB PCB layout, bottom layer (2)**

**Figure 6: RC12X0HPDB PCB component placement, top side**

## Troubleshooting

*It doesn't work*

- Is the battery eliminator plugged into the wall socket?

- Do you have the correct power source? Check that it can deliver 800 mA minimum. If you use an AC/DC battery eliminator check also if it has the correct AC-voltage rating for your outlet (220V or 110V).

- Measure the supply voltage at P14. Should be 3.3V and a strap or ampere meter must connect the two pins.

- Is the supply voltage correctly polarized? If not, the protection diode will prevent any current from flowing. + and – are indicated on the PCB, on the DC jack, the tip is + and the ring is –.

*I cannot communicate with the RC12X0HP UART through the serial port*

- Make sure that the RXD and TXD jumpers are inserted.

- Set up your terminal program according to the instructions in the Quick Start Guide. Remember to select the correct COM-port and connect to this port.

- Make sure that you are using a correctly wired 1:1 cable (as the one provided with the kit).

- Entering configuration mode (by press CONFIG button) the command prompt (">") should be displayed on the terminal window. Make sure to exit the command mode using the exit command (capital "X").

*I cannot communicate between two modules in buffered mode*

- Make sure that the address mode and CRC mode is the same in both modules (set using the "M" Memory configuration command, refer to the RC232 User Manual)

- Make sure the destination address is the same as the other modules Unique ID if addressing is used (set using the "T" Destination address command, refer to the RC232 User Manual).

- Make sure to exit from command mode using capital "X".

- The present configuration can be listed to the terminal using the test command "0" (zero).

*The module consumes more than the rated current in OFF mode*

- Note that the ON/OFF signal pull up resistor R2 (100 kΩ) draws approximately 27 uA. Remove this resistor when measuring the module current in OFF mode.

## Document Revision History

| Document Revision | Changes |
|---|---|
| 1.0 | First release |

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