Linx TECHNOLOGIES

250 Series Master Development System

User´s Guide

Wireless made simple®

Warning: Linx radio frequency ("RF") products may be used to control machinery or devices remotely, including machinery or devices that can cause death, bodily injuries, and/or property damage if improperly or inadvertently triggered, particularly in industrial settings or other applications implicating life-safety concerns. No Linx Technologies product is intended for use in any application without redundancies where the safety of life or property is at risk.

The customers and users of devices and machinery controlled with RF products must understand and must use all appropriate safety procedures in connection with the devices, including without limitation, using appropriate safety procedures to prevent inadvertent triggering by the user of the device and using appropriate security codes to prevent triggering of the remote controlled machine or device by users of other remote controllers.

Do not use this or any Linx product to trigger an action directly from the data line or RSSI lines without a protocol or encoder/ decoder to validate the data. Without validation, any signal from another unrelated transmitter in the environment received by the module could inadvertently trigger the action.

All RF products are susceptible to RF interference that can prevent communication. RF products without frequency agility or hopping implemented are more subject to interference. This module does have a frequency hopping protocol built in, but the developer should still be aware of the risk of interference.

Do not use any Linx product over the limits in this data guide. Excessive voltage or extended operation at the maximum voltage could cause product failure. Exceeding the reflow temperature profile could cause product failure which is not immediately evident.

Do not make any physical or electrical modifications to any Linx product. This will void the warranty and regulatory and UL certifications and may cause product failure which is not immediately evident.

Table of Contents

250 Series Master Development System

User´s Guide

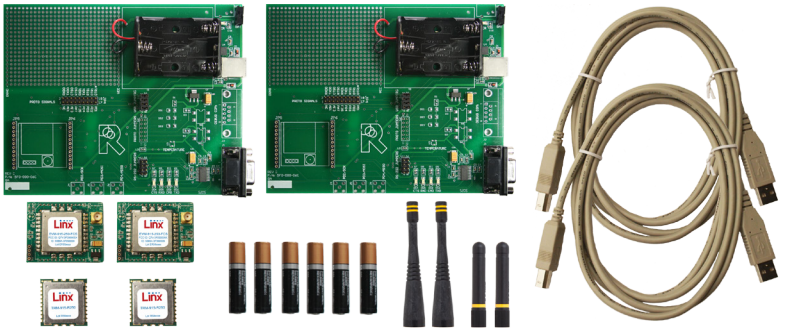


Figure 1: 250 Series Master Development System

Introduction

The Linx 250 Series RF modules offer a simple, efficient and cost-effective method of adding wireless communication capabilities to any product. The Master Development System gives a designer all the tools necessary to correctly and legally incorporate the 250 Series into an end product. The development boards serve several important functions:

- Rapid Module Evaluation: The boards allow the performance of the 250 Series modules to be quickly evaluated in a user's environment.
- Range Testing: Windows-based demonstration software is included, which allows for a variety of tests. A pair of development boards can be used to evaluate the range performance of the modules.
- Design Benchmark: The boards provide a known benchmark against which the performance of a custom design may be judged.
- Application Development: An onboard prototyping area allows for the development of custom circuits directly on the development board. All signal lines are available on a header for easy access.

The Master Development System includes two development boards, two 250 Series evaluation modules, two 250 Series transceivers, two CW Series antennas, two RH Series antennas, six AAA batteries, USB cables, demonstration software and full documentation.

Ordering Information

Ordering Information	
Part Number	**Description**
MDEV-915-250	250 Series Master Development System

Figure 2: Ordering Information

250 Series Transceiver Development Board

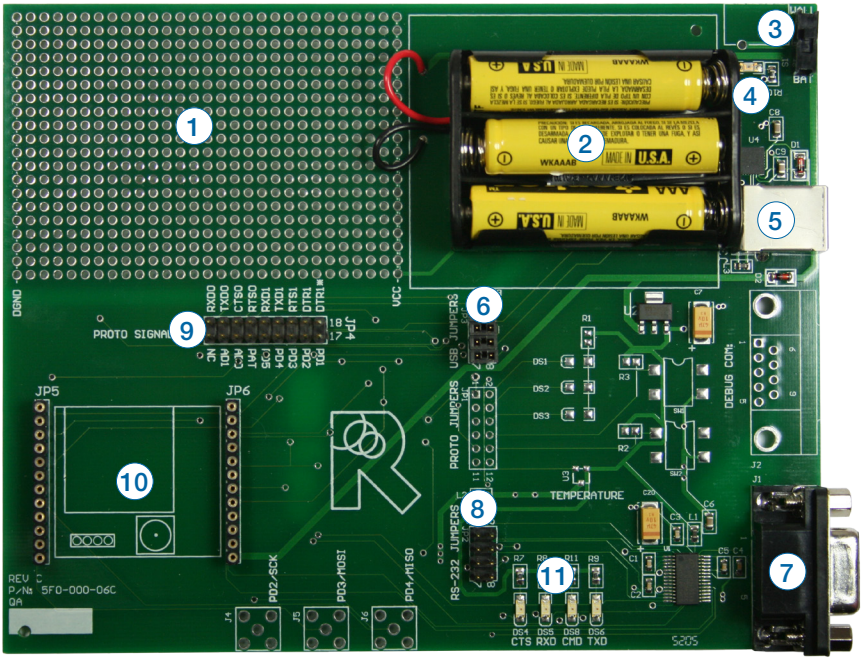


Figure 3: 250 Series Transceiver Development Board

1. Prototyping Area
2. Batteries (3xAAA)
3. On-Off Switch
4. Power LED
5. USB Connector
6. USB Jumpers
7. RS-232 Connector
8. RS-232 Jumpers
9. Breakout Header
10. EVM Module Socket
11. Serial Port Indicators

250 Series Transceiver Evaluation Module

Figure 4: 250 Series Transceiver Evaluation Module

Using the Development Boards

The development system provides a stable platform to test and evaluate the performance of the modules. Everything required for basic testing is included in the box.

The system includes two identical development boards and two evaluation modules. These are used to set up a bi-directional data link. The development boards have USB and RS-232 interfaces to connect to computers or peripheral devices. Windows-based software is included that is used to configure the modules and to establish a wireless chat that can send text between the modules.

Using the Development Boards

After unpacking the development system, the following steps are used to get started.

1. Insert an EVM module into the evaluation boards, observing the correct orientation. The antenna connector should be closest to the edge of the development board (Figure 5). Make sure it is seated fully and correctly.

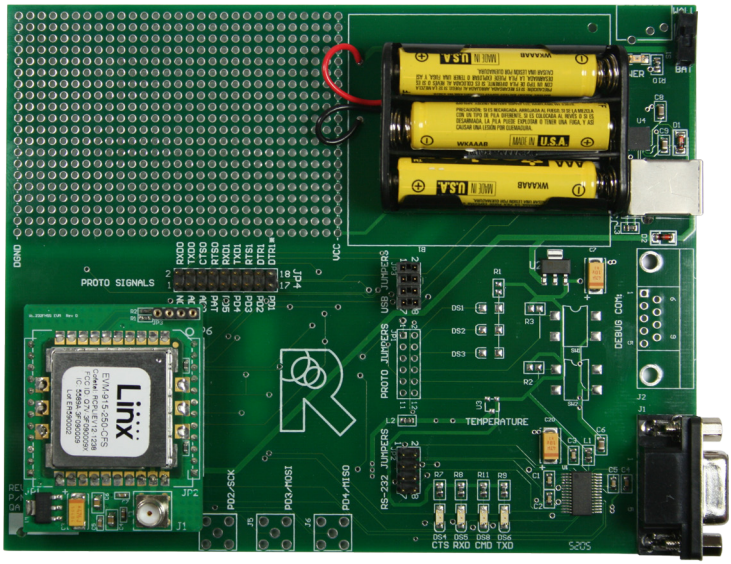


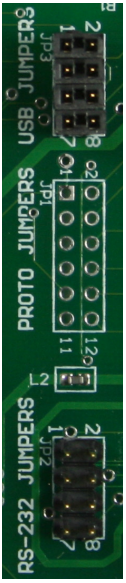
Figure 5: 250 Series Transceiver Evaluation Module on the Development Board

2. Screw an antenna onto each EVM board and install the AAA batteries.

3. Set the jumpers on the development boards. If using the USB interface then populate the USB jumpers and remove the RS-232 jumpers (Figure 6 A). If using the RS-232 interface then populate the RS-232 jumpers and remove the USB jumpers (Figure 6 B). Connecting both sets of jumpers at the same time could lead to short circuits and bit collisions, so only use one interface at a time.

4. Connect one of the development boards to a computer. USB drivers are included on the CD, so install them if using the USB interface and prompted by the computer. The latest drivers may be downloaded from Silicon Labs at http://www.silabs.com/products/interface/usbtouart/Pages/usb-to-uart-bridge.aspx

(A)



(B)

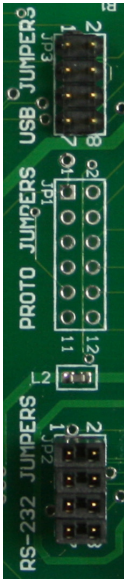
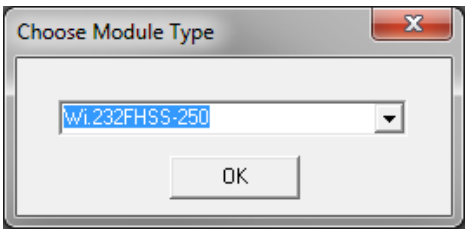


Figure 6: 250 Series Development Board Jumpers; (A) for USB Interface; (B) for RS-232 Interface

5. Insert the CD that is included with the kit into the computer and install the Windows software. If already installed, skip this step.

6. Run the software, select “Wi.232FHSS-250” and click “OK” (Figure 7 A). On the next screen select the appropriate COM port and 2400 baud operation Then click “OK” (Figure 7 B). Note that if the baud rate has been changed on the module, then the baud rate must be changed here as well.



(A)

(B)

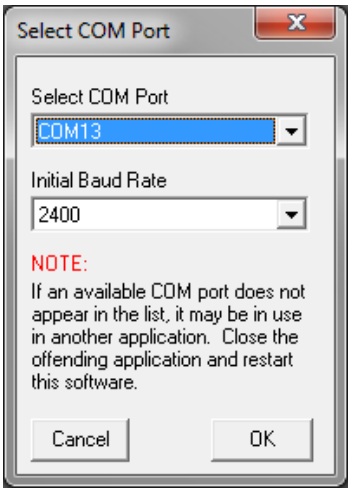


Figure 7: 250 Series Transceiver Development System Software Setup

7. The software opens on the Volatile Registers tab. Click on the “Wireless Chat” tab as shown in Figure 8.

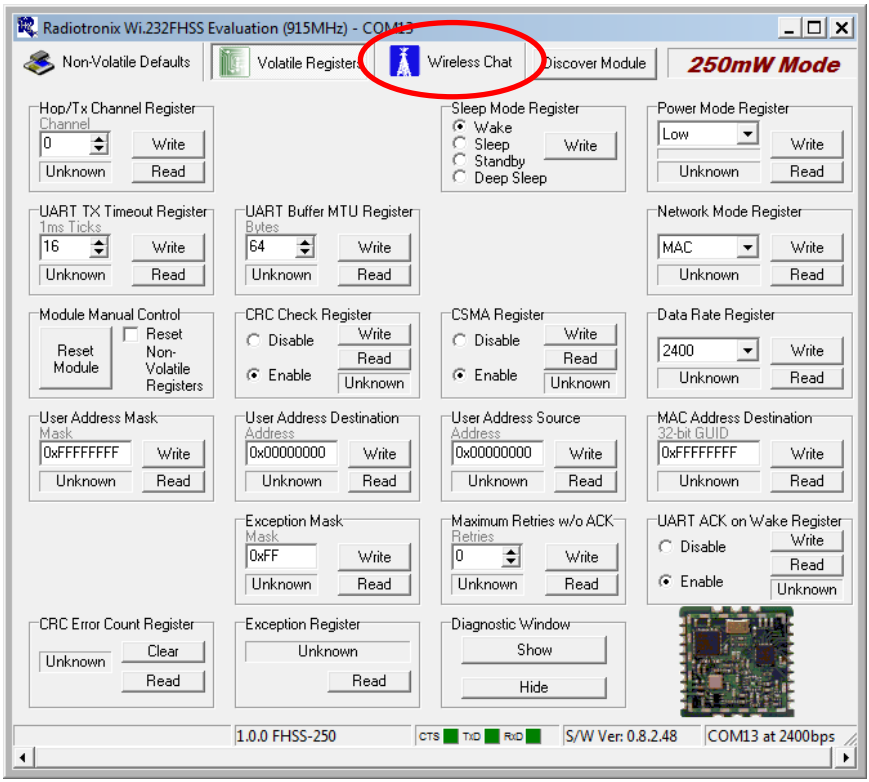


Figure 8: 250 Series Transceiver Development System Software Volatile Registers Tab

This opens the wireless chat window (Figure 9).

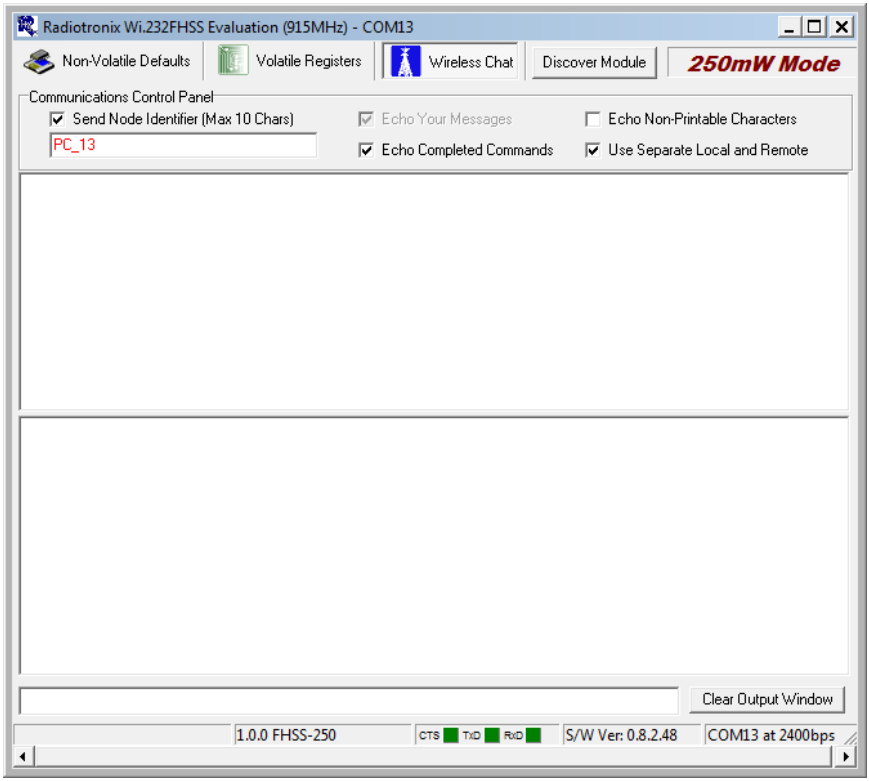


Figure 9: 250 Series Transceiver Development System Software Wireless Chat Tab

8. The second board can be connected to the same computer for bench top testing or to a second computer for range testing. Open a second instance of the software if using one computer. If two computers are used then repeat steps 4 through 7 for the second board on the second computer.

9. Power-On both development boards, verifying that the version / copyright information is displayed on the screen from both modules (Figure 10).

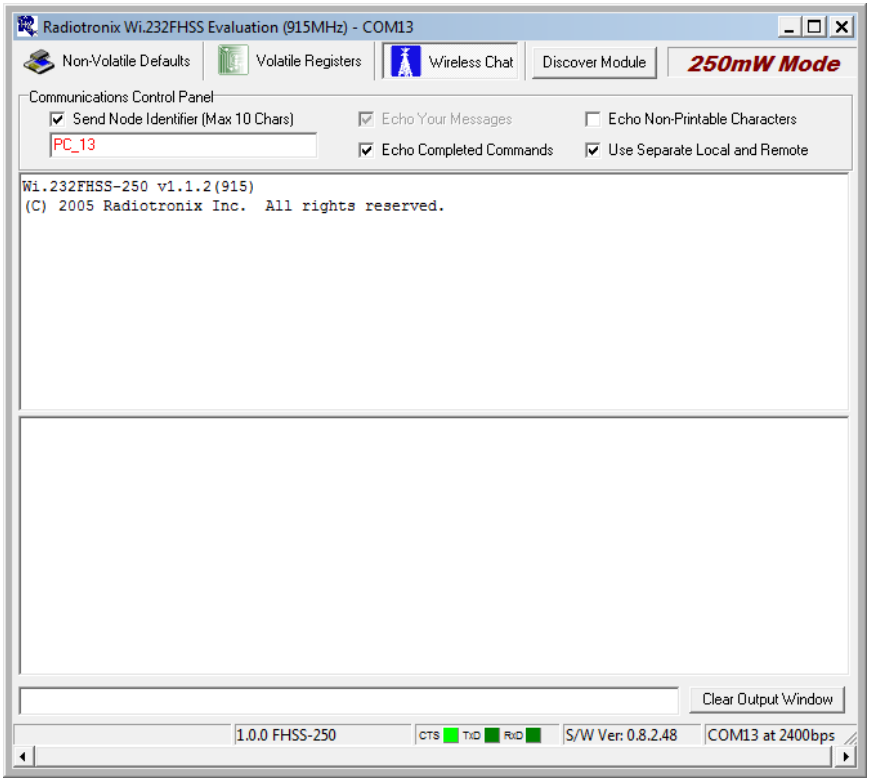


Figure 10: 250 Series Transceiver Development System Software Wireless Chat Tab with Module Information

10. Type a message into the bottom box in one of the windows.

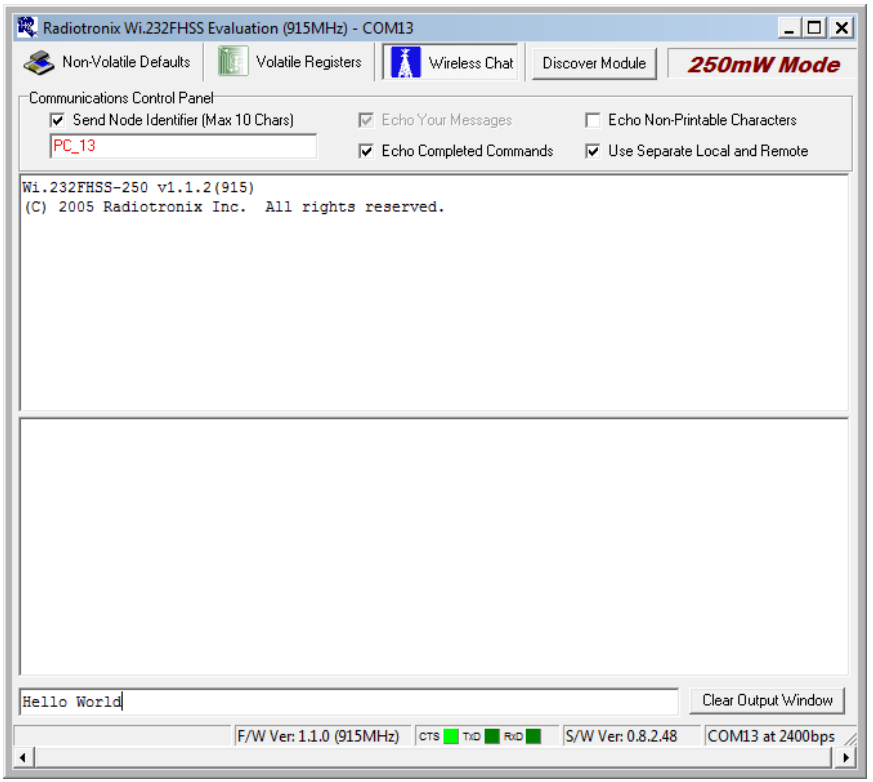
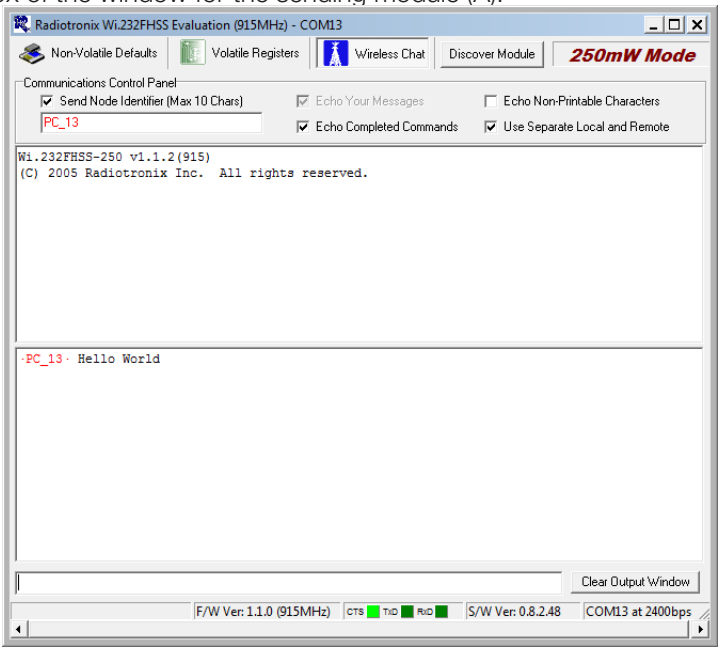


Figure 11: 250 Series Transceiver Development System Software Wireless Chat Tab

11. Press Enter and look for the message to appear in the top box of the window connected to the second module (B). It appears in the middle box of the window for the sending module (A).

(A)



(B)

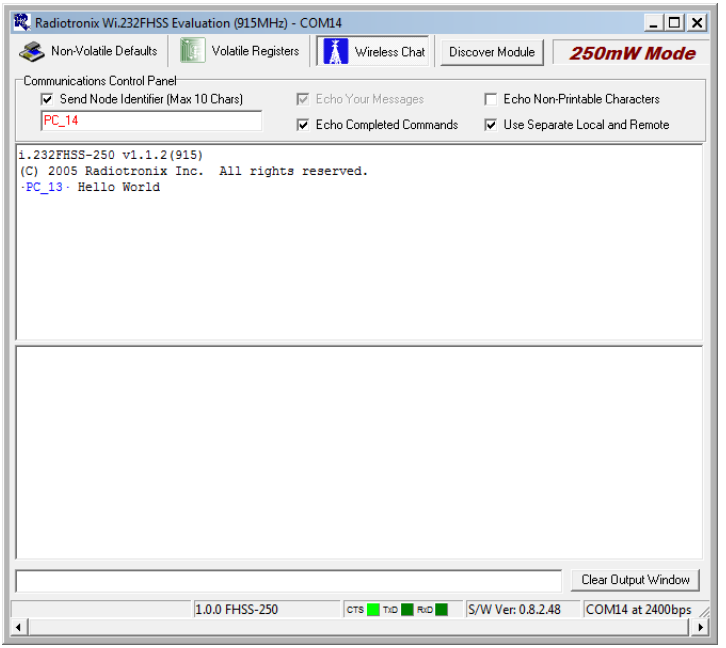
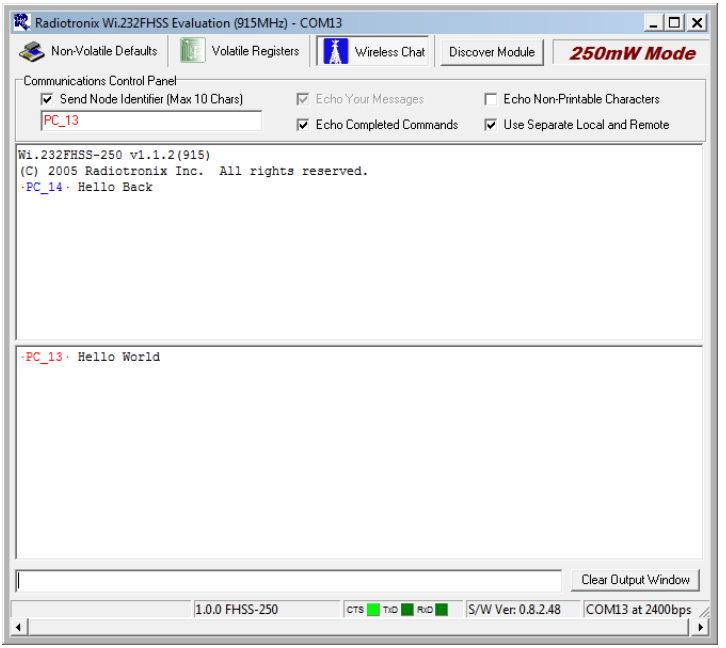


Figure 12: 250 Series Transceiver Development System Software Wireless Chat Tab; (A) Sent; (B) Received

12. Chat back and forth between evaluation boards, verifying that serial and RF communications are successful.

(A)



(B)

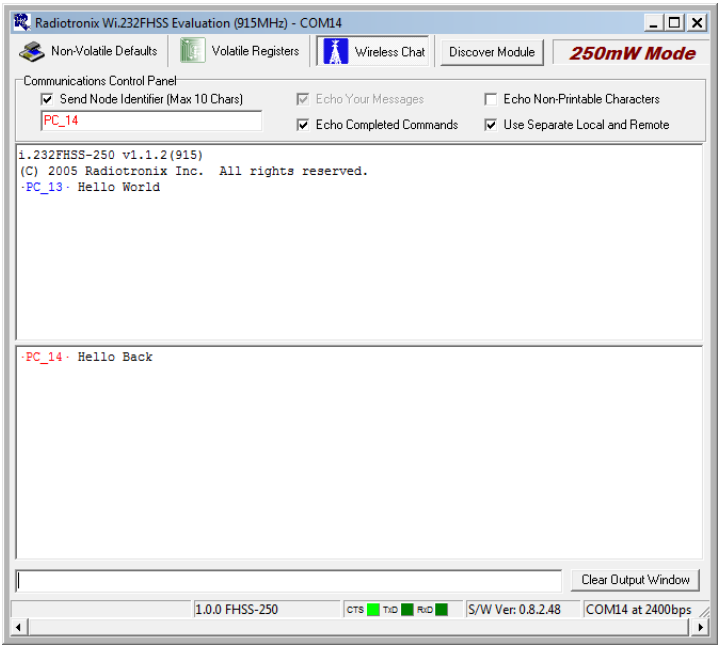


Figure 13: 250 Series Development System Software Wireless Chat Tab; Response (A) Received; (B) Sent

Troubleshooting

If the boards fail to work out of the box, then try the following:

- Check the batteries to make sure they are not dead.
- Make sure that the antennas are connected.
- Make sure that the jumpers are set correctly.
- Ensure that the latest USB drivers are installed.
- Test additional baud rates.

If all of these appear to be in order, then you can call 800-736-6677 or e-mail techsupport@linxtechnologies.com.

The Prototyping Area

In addition to their evaluation functions, the boards may also be used for actual product development. They feature a prototyping area for the addition of application-specific circuitry. The prototyping area is the same on both boards and contains a large area of plated through-holes so that external circuitry can be placed on the board. The holes are set at 0.1" on center with a 0.05" diameter, making it easy to add most industry-standard SIP and DIP packages to the board. This circuitry can be interfaced with the transceiver through the breakout header at the bottom. On the right of this area is a row connected to the 3.3V power supply and on the left is a row connected to ground.

Note: The on-board 3.3-volt regulator has approximately 50mA of headroom available for additional circuitry. If added circuitry requires a higher current, the user must power the board from an external supply.

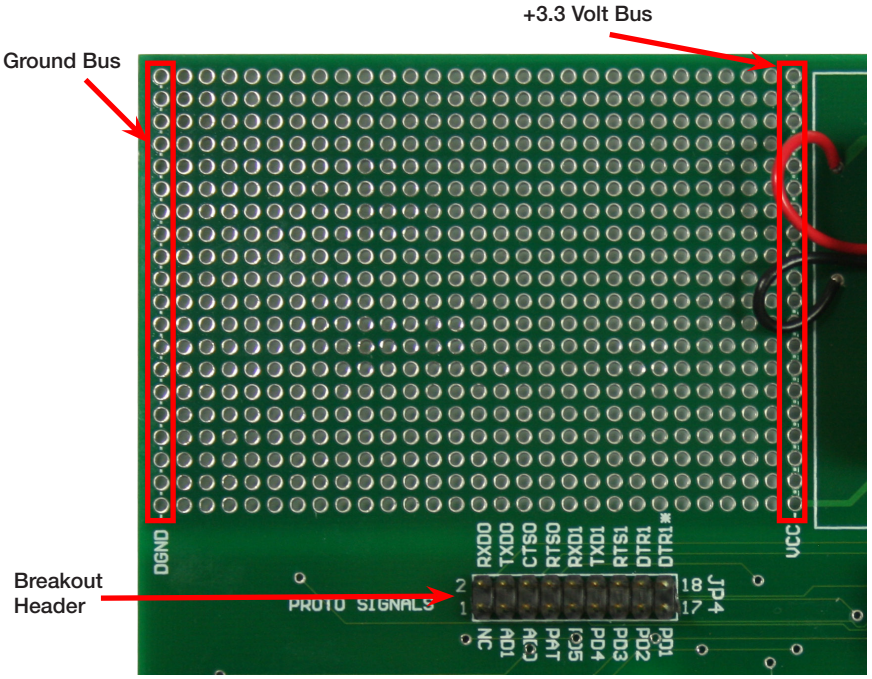


Figure 14: The Development Board Prototyping Area

Range Testing

Several complex mathematical models exist for determining path loss in many environments. These models vary as the transmitter and receiver are moved from indoor operation to outdoor operation. Although these models can provide an estimation of range performance in the field, the most reliable method is to simply perform range tests using the transmitter and receiver in the intended operational environment.

Simple range testing can be done with the development boards. Connect one board to a computer and set the software into Wireless Chat. Remove all jumpers from the other board and place one between the RXD0 and TXD0 pins on the breakout header as shown in Figure 15. This routs data received by the module back into its transmit buffer to be sent back to the first unit. In this way one board stays connected to a computer and the other board is moved away to test the effective range of the link.

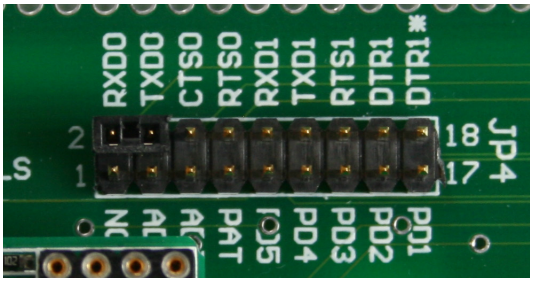


Figure 15: The Development Board Prototyping Area

As the maximum range of the link in an area is approached, it is not uncommon for the signal to cut in and out as the transmitter moves. This is normal and can result from other interfering sources or fluctuating signal levels due to multipath. Multipath results in cancellation of the transmitted signal as direct and reflected signals arrive at the receiver at differing times and phases. The areas in which this occurs are commonly called “nulls” and simply walking a little further usually restores the signal. If this does not restore the signal, then the maximum effective range of the link has been reached.

To achieve maximum range, keep objects such as your hand away from the antenna and ensure that the antenna on the transmitter has a clear and unobstructed line-of-sight path to the receiver board. Range performance is determined by many interdependent factors. If the range you are able to achieve is significantly less than specified by Linx for the products you are

testing, then there is likely a problem with either the board or the ambient RF environment in which the board is operating. First, check the battery, switch positions, and antenna connection. Next, measure the receiver's RSSI voltage with the transmitter turned off to determine if ambient interference is present. If this fails to resolve the issue, please contact Linx technical support.

Master Development Software

The development system is supplied with Windows-based software that facilitates communication with the development boards through either a USB or RS-232 connection. The software allows for configuration of the modules and sends text characters in a chat format.

The development system can be used with HyperTerminal to receive and transmit RS-232 data and send files using file transfer protocols such as ZMODEM. HyperTerminal and many other terminal programs assert RTS by default. On the evaluation board, the RTS line is tied to the $\overline{\text{CMD}}$ line on the module. When the $\overline{\text{CMD}}$ line is held low (RTS line is asserted), the module is placed in command mode.

In command mode, all UART data sent to the module is interpreted as commands and is NOT sent to the RF engine for transmission. Additionally, if a development board is switched on in the presence of an asserted RTS line, it performs a full hardware and flash reset to the factory defaults.

To use the evaluation board with HyperTerminal or other terminal programs, first remove the jumpers from between pins 7 and 8 of JP2, if using the RS-232 interface, or JP3, if using the USB interface. Removing this jumper disconnects the RTS line from the $\overline{\text{CMD}}$ line on the module, allowing normal operation.

The development software has three tabs for configuring and using the mdoule: Volatile Registers, Non-Volatile Registers and Wireless Chat. The Volatile Registers and Non-Volatile Registers tabs are used to configure the operation of the module. The Wireless Chat tab is a demonstration using the module.

The Volatile Registers Tab

The Volatile Registers tab tab displays all of the items that can be configured in volatile memory. Values programmed into these registers are lost on power-down, but have an immediate effect on module operation. If the Data Rate register is changed here, then the software needs to be restarted and the new baud rate selected. Please see the 250 Series Transceiver Data Guide for details on the register settings.

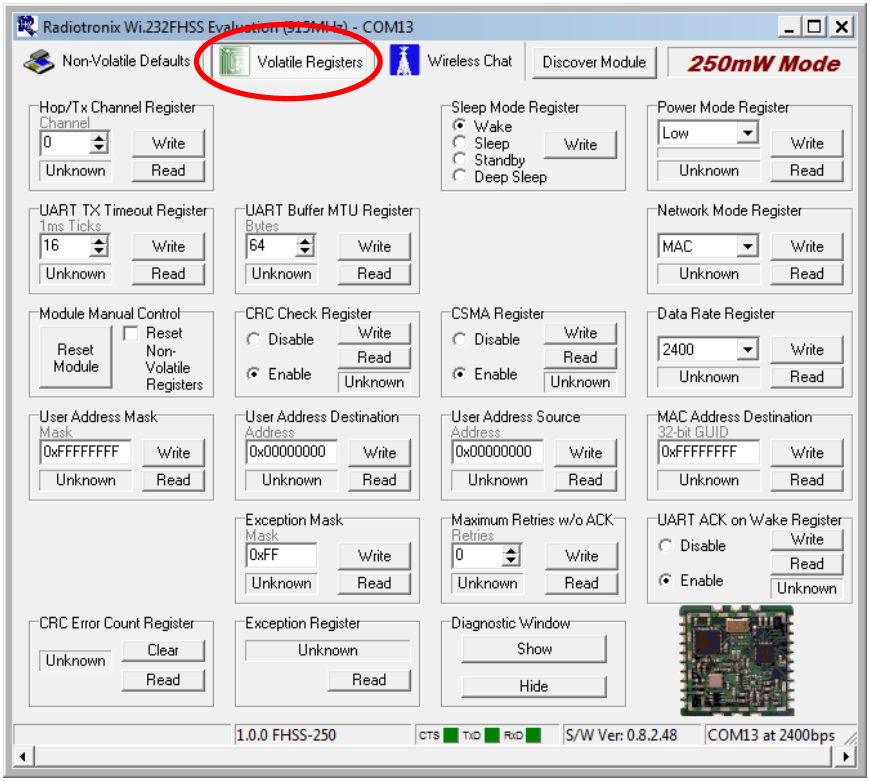


Figure 16: 250 Series Transceiver Development System Software Volatile Registers Tab

The Non-Volatile Registers Tab

The Non-Volatile Registers tab allows the configuration of the non-volatile registers. These are the default values that are loaded when the module powers on and are retained when power is removed from the module. Please see the 250 Series Transceiver Data Guide for details on the register settings.

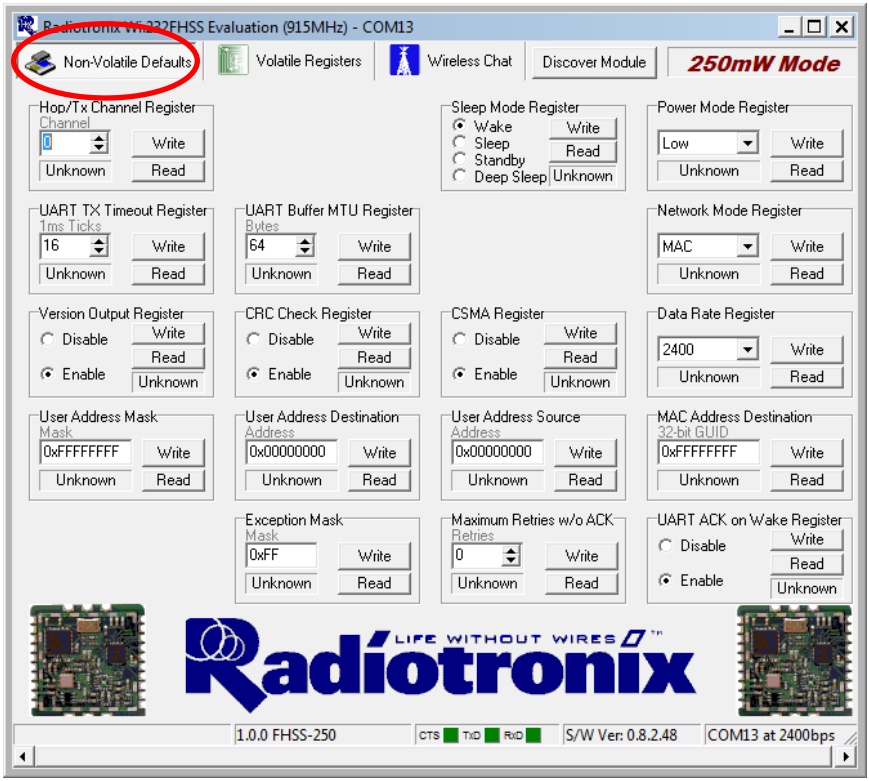


Figure 17: 250 Series Transceiver Development System Software Non-Volatile Registers Tab

The Wireless Chat Tab

The wireless chat tab demonstrates the capability of the 250 Series transceiver to be used as a wireless communications link. Text typed into the lower box is transmitted to a remote module. Text received from another module is displayed in the top box. In this way two development boards can be set up for wireless chat.

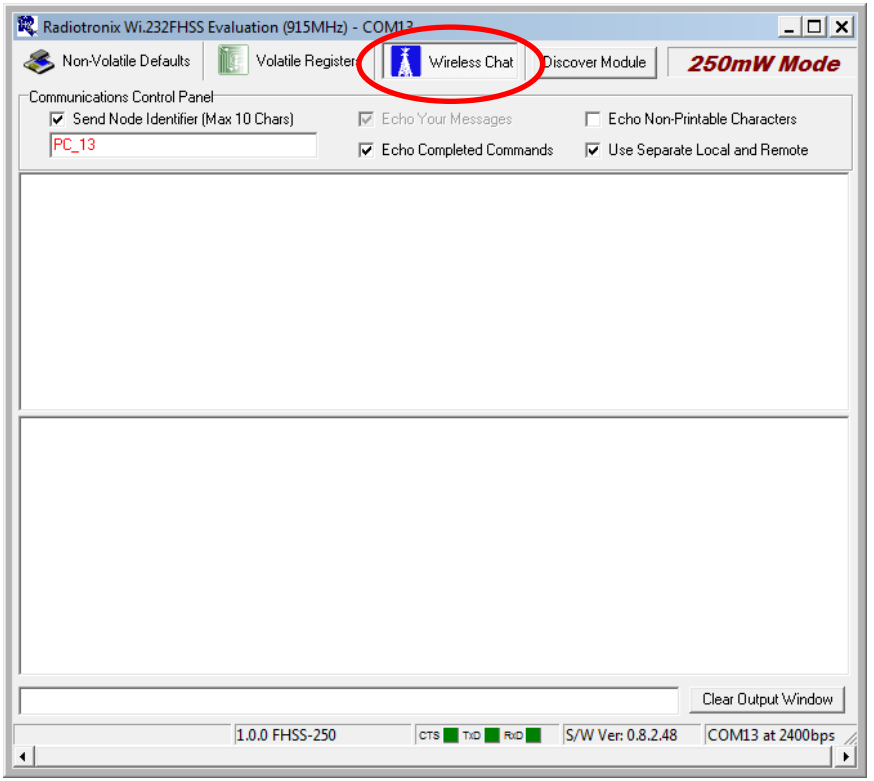


Figure 18: 250 Series Transceiver Development System Software Wireless Chat Tab

The text is prefixed with the Node identifier in the text box at the top. This makes it easy to know who sent the text. Uncheck the Send Node Identifier box to disable this.

If the Echo Completed Commands box is checked the middle window displays the commands and text sent to the connected module by the software.

The Clear Output Window button at the bottom clears the screens.

Diagnostic Command Modes

The Volatile Registers tab has a selection at the bottom to show the Diagnostic Command window.

Figure 19: Diagnostic Window Controls on the Volatile Registers Tab

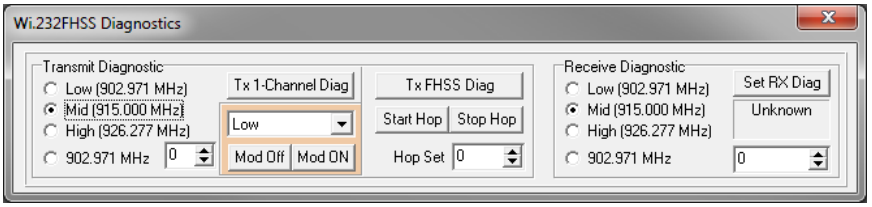


Figure 20: 250 Series Transceiver Development System Software Diagnostics Window

These commands place the module into special diagnostic modes that can be used to test the module's performance, or to activate the transmitter for RF testing purposes. Once a module executes a diagnostic command, it should be reset or have the power cycled to return to normal operation.

Transmit Diagnostic consists of the controls located in the "Transmit Diagnostic" group. The transmit diagnostic group is broken into two smaller sub-groups.

Clicking the "TX 1-Channel Diag" button stops the module from hopping frequencies. The radio buttons on the left allow quick selection of the transmitter's frequency. Once activated, a "…1010101010101…" bit pattern is transmitted for bit error testing or RF carrier analysis. This single-channel transmit diagnostic mode can be used with the receive diagnostic.

In the middle, the light-orange colored box controls the power and modulation characteristics of the transmitter. There are four power settings of increasing intensity: Low, Mid-Low, Mid-High, and High. The "Mod Off" and "Mod On" buttons switch the carrier's modulation off and on, respectively.

The right side is used to observe dynamic transmitter characteristics. Dynamic transmitter operation allows the module to hop frequencies as it transmits. The “Hop Set” radio button selects the hop sequence (values are 0-5) to be used when hopping. Dynamic transmitter mode cannot be used to provide a carrier for the Receive Diagnostic. Clicking the “Tx FHSS Diag” button sends the new hopping sequence value to the module and activates the transmitter. The “Start Hop” and “Stop Hop” buttons start and stop the diagnostic hopping, respectively.

Receive Diagnostic consists of four radio buttons which allow the selection of frequency, the “Set RX Diag” button which activates the module’s receiver and begins a bit error test, and the result box, which shows the number of bit errors recorded in the last test.

The “Set RX Diag” button switches on the receiver using the channel and mode selected in the channel selector and transceiver mode controls. The module stops hopping and stays on a single frequency. It waits for a “10101010...” bit pattern at the RF interface. If one is not received, the module could remain in an infinite loop waiting for this start condition. If this happens, simply cycle the power to return the module to normal operation.

If a “…1010101010101…” bit pattern is received, the BER test returns the number and percent of bit errors. This information is displayed in the panel below the “Set RX Diag” button.

The Receive Diagnostic mode can be used in conjunction with another module operating in “Tx 1-Channel Diag” mode. Both transmitting and receiving modules must be on the same frequency and have the same baud rate selected for proper operation of the bit error test.

About Antennas

The choice of antennas is one of the most critical and often overlooked design considerations. The range, performance, and legality of an RF link are critically dependent upon the type of antenna employed. Linx offers a variety of antenna styles that can be considered for a design. Included with the kit is a Linx CW Series connectorized whip antenna that should be connected prior to using the kit. Despite the fact that the antenna is not centered on the board's ground plane, it exhibits a VSWR of <1.7 and suitably demonstrates the module's best practical performance.

In Closing

Here at Linx, "Wireless Made Simple" is more than just our motto, it is our commitment. A commitment to the highest caliber of product, service, and support. That is why, should you have questions or encounter any difficulties using the evaluation kit, you'll be glad to know many resources are available to assist you. First, check carefully for the obvious, then visit our website at www.linxtechnologies.com or call +1 541 471 6256 between 8AM and 4PM Pacific Time to speak with an application engineer.

Legal Notice: All Linx kits and modules are designed in keeping with high engineering standards; however, it is the responsibility of the user to ensure that the products are operated in a legal and appropriate manner. The purchaser understands that legal operation may require additional permits, approvals, or certifications prior to use, depending on the country of operation.

250 Series Master Development Board Schematic

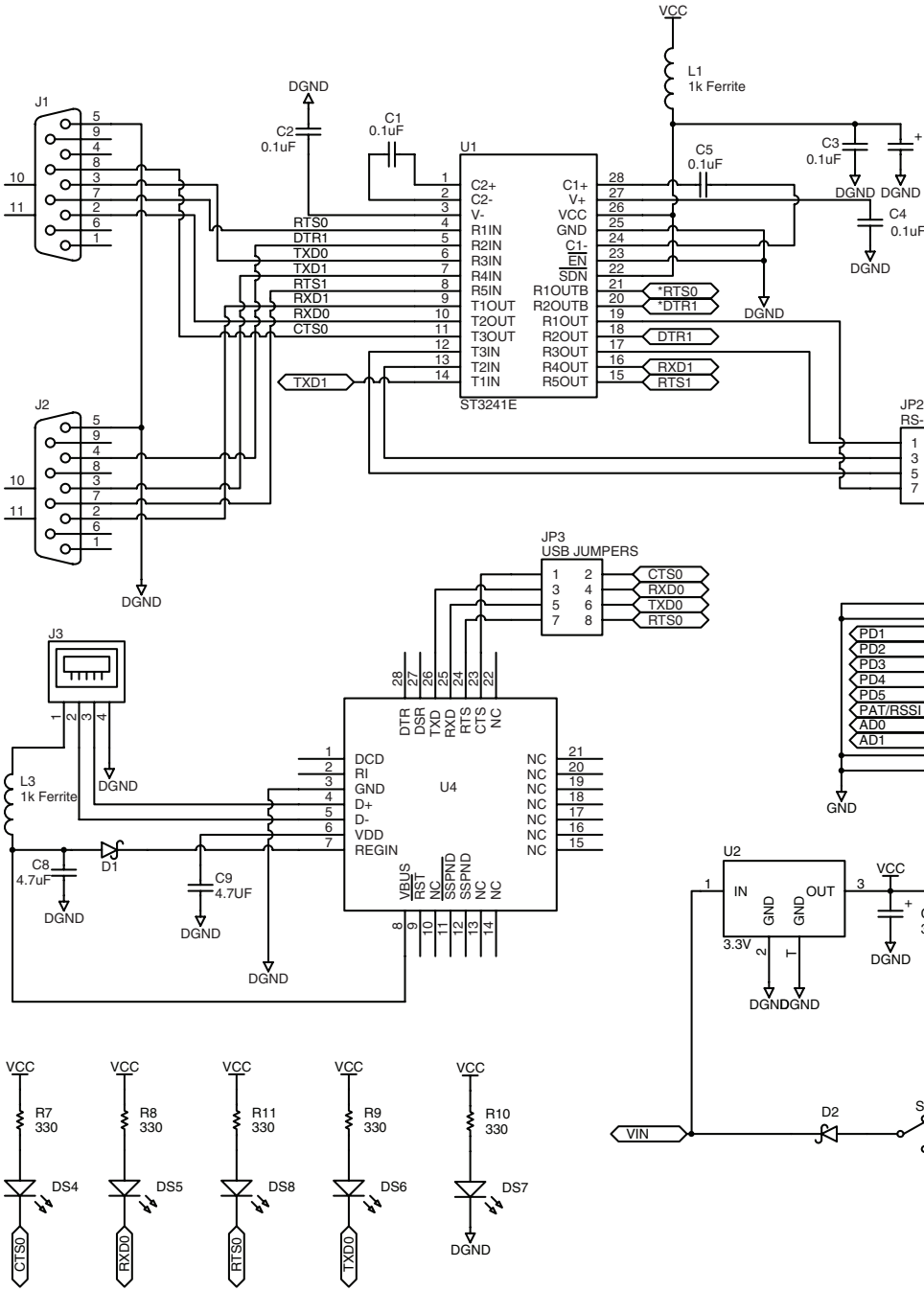
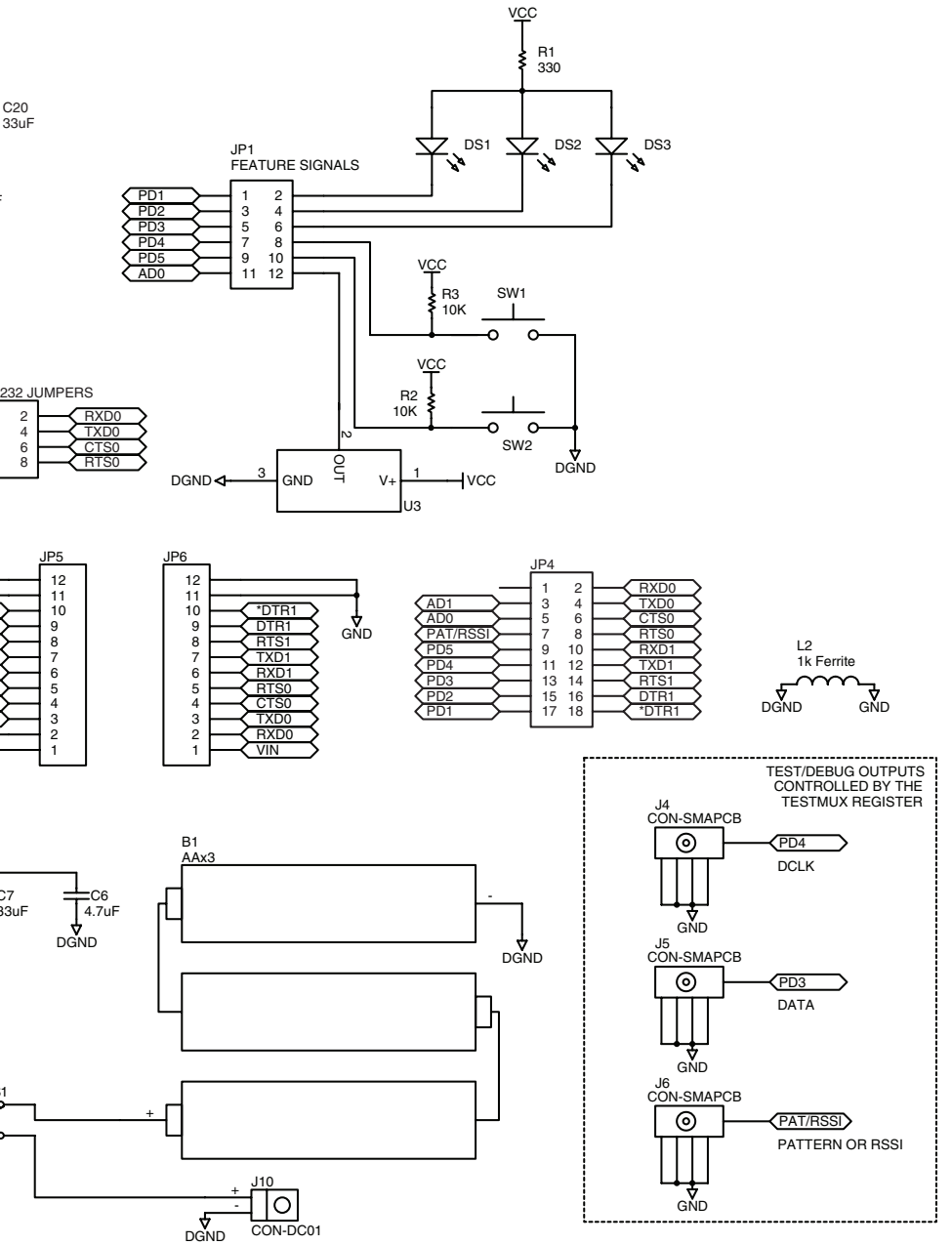


Figure 21: 250 Series Master Development Board Schematic


VCC
R1
330
C20
33uF
JP1
FEATURE SIGNALS
DS1
DS2
DS3
PD1
PD2
PD3
PD4
PD5
AD0
1 2
3 4
5 6
7 8
9 10
11 12
VCC
R3
10K
SW1
VCC
R2
10K
SW2
DGND
232 JUMPERS
RXD0
TXD0
CTS0
RTS0
DGND
3
GND
OUT
2
V+
1
VCC
U3
JP5
JP6
*DTR1
DTR1
RTS1
TXD1
RXD1
RTS0
CTS0
TXD0
RXD0
VIN
GND
JP4
AD1
AD0
PAT/RSSI
PD5
PD4
PD3
PD2
PD1
RXD0
TXD0
CTS0
RTS0
RXD1
TXD1
RTS1
DTR1
*DTR1
L2
1k Ferrite
DGND
GND
TEST/DEBUG OUTPUTS
CONTROLLED BY THE
TESTMUX REGISTER
J4
CON-SMAPCB
PD4
DCLK
GND
J5
CON-SMAPCB
PD3
DATA
GND
J6
CON-SMAPCB
PAT/RSSI
PATTERN OR RSSI
GND
B1
AAx3
C7
33uF
C6
4.7uF
DGND
DGND
J10
CON-DC01
DGND

Linx Technologies
159 Ort Lane
Merlin, OR, US 97532

3090 Sterling Circle Suite 200
Boulder, CO 80301

Phone: +1 541 471 6256
Fax: +1 541 471 6251

www.linxtechnologies.com

Disclaimer

Linx Technologies is continually striving to improve the quality and function of its products. For this reason, we reserve the right to make changes to our products without notice. The information contained in this Data Guide is believed to be accurate as of the time of publication. Specifications are based on representative lot samples. Values may vary from lot-to-lot and are not guaranteed. "Typical" parameters can and do vary over lots and application. Linx Technologies makes no guarantee, warranty, or representation regarding the suitability of any product for use in any specific application. It is the customer's responsibility to verify the suitability of the part for the intended application. NO LINX PRODUCT IS INTENDED FOR USE IN ANY APPLICATION WHERE THE SAFETY OF LIFE OR PROPERTY IS AT RISK.

Linx Technologies DISCLAIMS ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL LINX TECHNOLOGIES BE LIABLE FOR ANY OF CUSTOMER'S INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING IN ANY WAY FROM ANY DEFECTIVE OR NON-CONFORMING PRODUCTS OR FOR ANY OTHER BREACH OF CONTRACT BY LINX TECHNOLOGIES. The limitations on Linx Technologies' liability are applicable to any and all claims or theories of recovery asserted by Customer, including, without limitation, breach of contract, breach of warranty, strict liability, or negligence. Customer assumes all liability (including, without limitation, liability for injury to person or property, economic loss, or business interruption) for all claims, including claims from third parties, arising from the use of the Products. The Customer will indemnify, defend, protect, and hold harmless Linx Technologies and its officers, employees, subsidiaries, affiliates, distributors, and representatives from and against all claims, damages, actions, suits, proceedings, demands, assessments, adjustments, costs, and expenses incurred by Linx Technologies as a result of or arising from any Products sold by Linx Technologies to Customer. Under no conditions will Linx Technologies be responsible for losses arising from the use or failure of the device in any application, other than the repair, replacement, or refund limited to the original product purchase price. Devices described in this publication may contain proprietary, patented, or copyrighted techniques, components, or materials. Under no circumstances shall any user be conveyed any license or right to the use or ownership of such items.