



HumPRO™ Series
Master Development System
User's Guide

Wireless made simple®

 **Warning:** Some customers may want Linx radio frequency (“RF”) products 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 (“Life and Property Safety Situations”).

NO OEM LINX REMOTE CONTROL OR FUNCTION MODULE SHOULD EVER BE USED IN LIFE AND PROPERTY SAFETY SITUATIONS. No OEM Linx Remote Control or Function Module should be modified for Life and Property Safety Situations. Such modification cannot provide sufficient safety and will void the product’s regulatory certification and warranty.

Customers may use our (non-Function) Modules, Antenna and Connectors as part of other systems in Life Safety Situations, but only with necessary and industry appropriate redundancies and in compliance with applicable safety standards, including without limitation, ANSI and NFPA standards. It is solely the responsibility of any Linx customer who uses one or more of these products to incorporate appropriate redundancies and safety standards for the Life and Property Safety Situation application.

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.

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HumPRO™ Master Development System

User's Guide

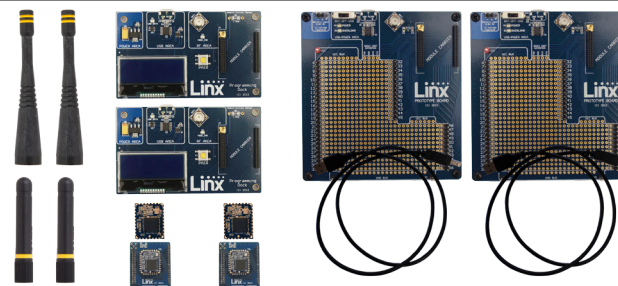


Figure 1: HumPRO™ Series Master Development System

Introduction

The Linx HumPRO™ Series data transceiver modules offer a simple, efficient and cost-effective method of adding wireless capabilities to any product. The Master Development System provides a designer with all the tools necessary to correctly and legally incorporate the module into an end product. The boards serve several important functions:

- **Rapid Module Evaluation:** The boards allow the performance of the Linx HumPRO™ Series modules to be evaluated quickly in a user's environment. The development boards can be used to evaluate the range performance of the modules.
- **Application Development:** A prototyping board allows the development of custom circuits directly on the board. All signal lines are available on headers for easy access.
- **Software Development:** A programming dock with a PC interface allows development and testing of custom software applications for control of the module.
- **Design Benchmark:** The boards provide a known benchmark against which the performance of a custom design may be judged.

The Master Development System includes 2 Carrier Boards, 2 Programming Dock Boards, 2 Prototype Boards 4 HumPRO™ Series transceivers*, antennas, batteries and full documentation.

* One part is soldered to each Carrier Board

Ordering Information

Ordering Information	
Part Number	Description
MDEV-***-PRO	HumPRO™ Series Master Development System
EVAL-***-PRO	HumPRO™ Series Basic Evaluation Kit
HUM-***-PRO	HumPRO™ Series Data Transceiver
HUM-***-PRO-CAS	HumPRO™ Series Data Transceiver with Castellated Connection
HUM-***-PRO-UFL	HumPRO™ Series Data Transceiver with u.FL Connector
EVM-***-PRO	HumPRO™ Series Carrier Board
MDEV-PGDCK	Development System Programming Dock
MDEV-PROTO	Development System Prototype Board
CON-SOC-EVM	EVM Module Socket Kit

*** = Frequency; 900MHz

Figure 2: Ordering Information

HumPRO™ Series Transceiver Carrier Board

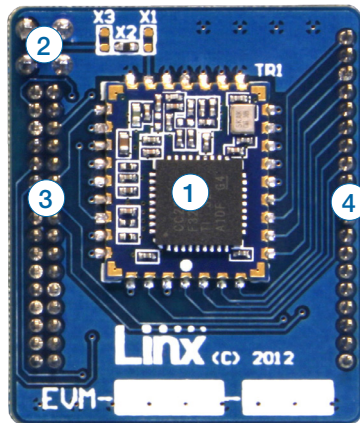


Figure 3: HumPRO™ Series Transceiver Carrier Board

HumPRO™ Series Transceiver Carrier Board Objects

1. HumPRO™ Series Transceiver
2. MMCX RF Connector
3. Dual Row Header
4. Single Row Header

HumPRO™ Series Carrier Board Pin Assignments

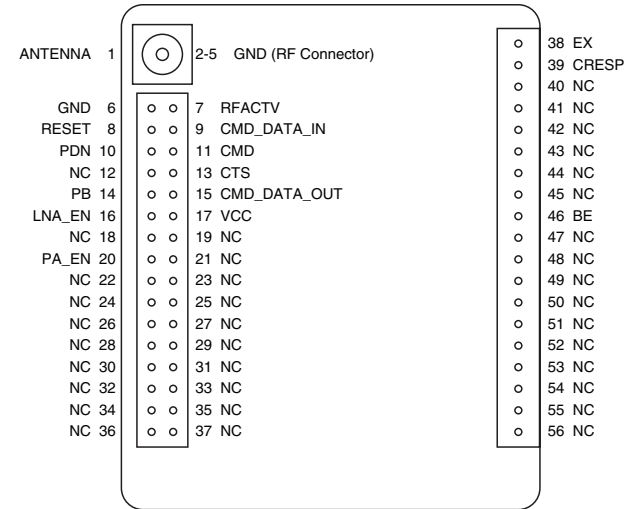


Figure 5: HumPRO™ Series Transceiver Carrier Board Pin Assignments (Top View)

Programming Dock

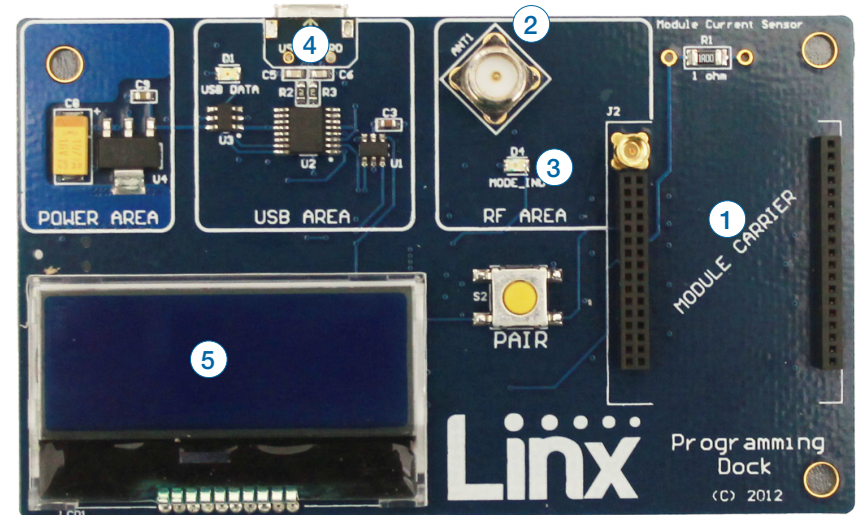


Figure 4: Programming Dock

Programming Dock Objects

1. Carrier Board Socket
2. RP-SMA Antenna Connector
3. MODE_IND LED
4. Micro USB Connector
5. LCD Display

Prototype Board

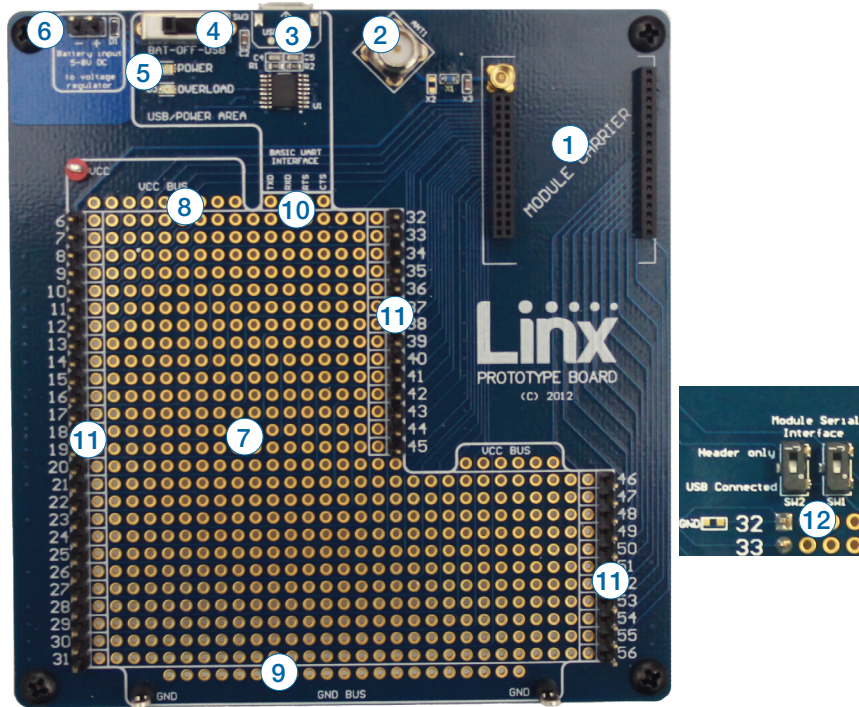


Figure 6: Prototype Board

Prototype Board Objects

1. Carrier Board Socket
2. RP-SMA Antenna Connector
3. Micro USB Connector
4. Power Switch
5. Power LED
6. External Battery Connection
7. Prototyping Area
8. 3.3V Supply Bus
9. Ground Bus
10. USB Interface Lines
11. Module Interface Headers
12. Command Data Interface Routing Switches (on back)

Initial Setup

There are several boards that are included with the Development System. The Carrier Boards have a HumPRO™ Series transceiver on a daughter board with headers. These boards snap into sockets on the other boards, enabling the modules to be easily moved among the test boards.

There are two Programming Docks that have a socket for a Carrier Board and a USB interface for connection to a PC. This is used with the demonstration software included with the kit to configure the module through its Command Data Interface.

There are two Prototype Boards that have a socket for a Carrier Board, a USB interface and a large area of plated through holes that can be used to develop custom circuitry. The board can be powered either from the USB connection or an external battery.

Warning: Installing or removing a Carrier Board while power is applied could cause permanent damage to the module. Either turn off power to the board or unplug the USB cable before installing or removing a Carrier Board

The development software supports Windows XP, Vista, 7, 8, and 8.1; OS X 10.6 'Snow Leopard' or later (including Lion, Mountain Lion, and Mavericks); any version of Linux with Java 1.6 or later.

Using the Prototype Board

Snap a Carrier Board onto the socket on the Prototype Board as shown in Figure 7.

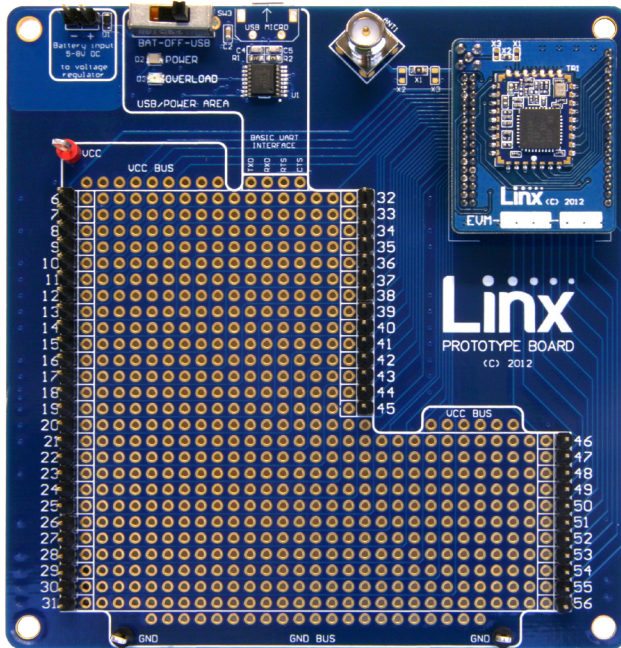


Figure 7: Prototype Board with a Carrier Board

Connect a micro USB cable into the connector at the top of the board. Plug the other end into a PC or any USB charger. The board is powered by the USB bus. This board features a prototyping area to facilitate the addition of application-specific circuitry. The prototyping area contains a large area of plated through-holes so that external circuitry can be placed on the board. The holes are set at 0.100" on center with a 0.040" diameter, accommodating most industry-standard SIP and DIP packages.

At the top of the prototyping area is a row connected to the 3.3V power supply and at the bottom is a row connected to ground. External circuitry can be interfaced to the transceiver through the breakout headers. The numbers next to the headers correspond to the pin numbers on the Carrier Board. Figure 5 shows the pin assignments for the Carrier Board.

The OVERLOAD LED indicates that too much current is being pulled from the USB bus. This is used to prevent damage to the parts or the bus. The overload condition is reset once the excess current draw is removed.

Supply for the module is connected through R17. This can be removed and replaced by another supply or used to measure the current consumption of the module.

Note: The onboard 3.3-volt regulator has approximately 400mA available for additional circuitry when plugged into a PC. If more current is required, the user must power the board from an external supply or a USB charger with more current capabilities, up to 1A.

Figure 8 shows the bottom of the board.

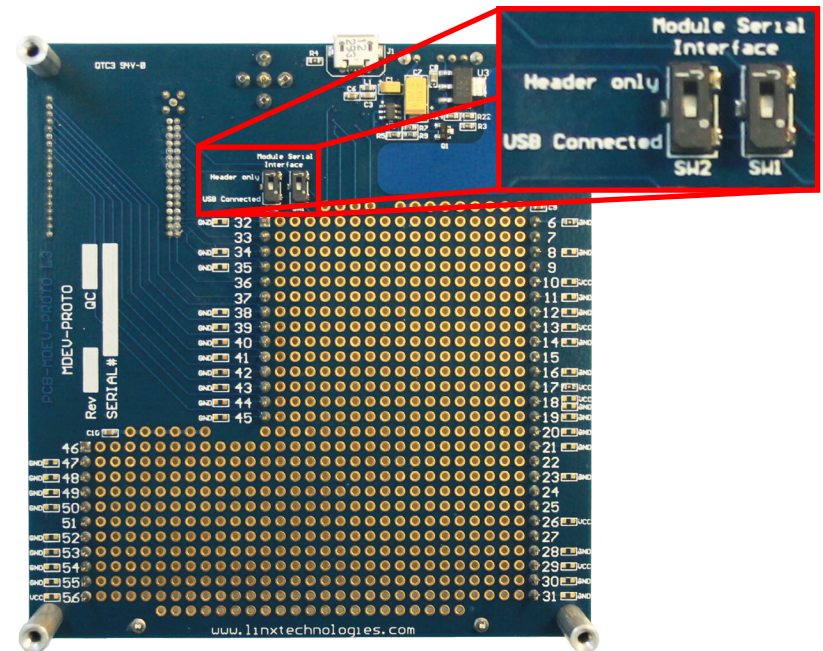


Figure 8: Prototype Board Bottom Side

SW1 and SW2 connect the USB interface to the Command Data Interface lines on the module. This allows the prototype board to be used with the development kit software or a custom application. When in the "USB Connected" position, the module is connected to the USB interface. The "Header Only" position connects the module to the header.

Footprints for 0603 size resistors are on most lines so that pull-ups or pull-downs can easily be added to the lines. The pads are connected to V_{CC} or GND based on the most common configuration for the module. The schematic at the end of this document shows how each line is connected.

Using the Programming Dock

Snap a Carrier Board onto the socket on the Programming Dock as shown in Figure 9.

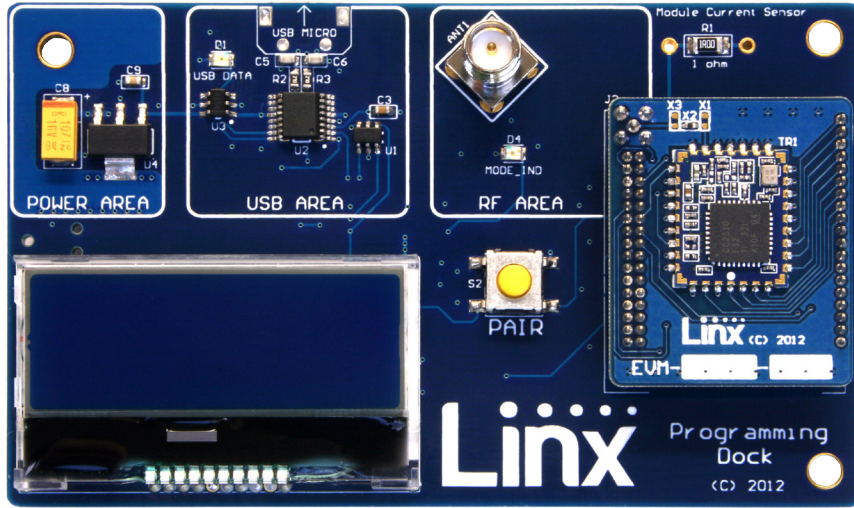


Figure 9: Programming Dock with a Carrier Board

Connect a micro USB cable into the connector at the top of the board. Plug the other end into a PC. The board is powered by the USB bus. The demonstration software included with the kit or custom application software can be used to configure the module through its Command Data Interface. The LCD is used to display information about the module. This includes the module's local address and a custom nickname. The nickname is entered using the development kit software and can be any name that helps distinguish the modules from one another. This is convenient when multiple programming docks are connected to the same computer. Please see the development kit software section for more information on the nicknames.

The HumPRO™ Series transceiver has a serial Command Data Interface that is used to configure and control the transceiver. This interface consists of a standard UART with a serial command set.

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 modules in the intended operational environment.

Range testing can be performed with the Programming Docks and / or the Prototype Boards. Data can be sent across the link using the included software or a custom microcontroller connected to the module. The RSSI is included with the output data messages, so this can be used to qualify the link.

As the maximum range of the link in the test area is approached, it is not uncommon for the signal to cut in and out as the radio moves. This is normal and can result from other interfering sources or fluctuating signal levels due to multipath effects. This 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 farther usually restores the signal. If the signal is not restored, then the maximum 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, check the ambient RSSI value with the transmitter turned off to determine if ambient interference is present. High RSSI readings while the transmitter off indicate there is interference. If this fails to resolve the issue, please contact Linx technical support.

The Development Kit Demonstration Software

The development kit includes software that is used to configure and control the module through the Programming Dock. The software defaults to the Advanced Configuration tab when modules are plugged in (Figure 10). This window configures the module's settings.



Figure 10: The Master Development System Software Advanced Configuration Tab

1. Clicking the Contact Linx, Documentation and About labels on the left side expands them to show additional information and links to the latest documentation. This is shown in Figure 11.
2. The Help window shows tips and comments about the software.
3. The active module is connected to the PC and being configured by the software.
4. Available modules are connected to the PC but are not currently being configured or controlled by the software.
5. Known Modules are not currently connected to the PC, but have either been connected to the software in the past or have been manually entered.
6. The Memory group selects whether configurations are written to volatile or non-volatile memory.
7. The configurations are divided into three columns. The Addressing



Figure 11: Additional Information

column configures the addressing features of the module.

- The Addressing Mode menu sets the addressing mode used by the module; either DSN, User or Extended User.
- Checking the ACKs box enables acknowledgements.
- The Auto Addressing menu turns the automatic addressing feature on and off.
- The DSN Source Address is the module's local address. This is configured at the factory and cannot be changed.
- The DSN Destination Address is the address of the desired destination module when DSN addressing mode is used.
- User Source Address is the module's local address when User and Extended User modes are used.
- User Destination Address is the address of the destination module when User and Extended User network addressing modes are used.
- User ID Address Mask is the mask for screening incoming packets.

8. The Radio column configures the radio settings of the module.

- Checking the CSMA box enables the Carrier Sense Multiple Access feature.
- The Hopping Pattern menu selects the module's hopping pattern
- The TX Power menu sets the module's transmitter output power.
- The Idle Mode menu sets the module's operating state as awake or asleep.
- Checking the CRC box enables the CRC checks on the incoming data. The CRC Errors box shows the number of errors since the last power cycle or the last time the count was reset.
- The Ambient RSSI measurement is the RSSI in the local environment on the current channel at the time when the read command is issued.
- The Last Packet RSSI is the RSSI measurement of the last valid packet that was received.

9. The Serial Port column configures all of the UART serial port settings.

- The UART Baud rate menu configures the serial port baud rate, which is used by the module to set the over-the-air RF data rate.
- The Byte Count Trigger sets the number of bytes that the UART receives before triggering the transmission of a packet.

- The UART Data Timeout sets the number of milliseconds from the last character received on the UART before the module transmits the data in its buffer.
 - The Retries Without ACK configuration sets the number of times the module will retransmit the data without receiving an acknowledgement from the remote side before it triggers an exception.
 - Selecting the UART Outputs ACK on Wake box instructs the module to output the acknowledgement (0x06) on the UART when the module wakes from sleep or power cycle.
 - Selecting the Hold RX Data When /CMD line is Low instructs the module to buffer any received over-the-air data while it is processing configuration commands.
 - Selecting the Module Version Output Enable box instructs the module to output the firmware version information when the module starts up from a power cycle or reset.
 - The Exception Output box shows the value of the Exception register and if any errors have occurred.
10. The Exception Handling section configures the Exception mask.
 11. The Module Identity group displays the customer ID value, the firmware version and the non-volatile cycle count.
 12. The Read All button reads all of the values from the module.
 13. The Submit button writes all changes to the active module.
 14. The Set Defaults button restores all settings to the factory defaults.
 15. The Show Commands button opens a window that displays all of the commands sent to the module.

The modules are shown with four identifiers as shown in Figure 12.

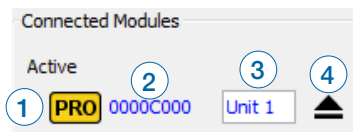


Figure 12: The Master Development System Software Module Identifiers

1. The type of module (HumPRO™ Series)
2. The module's local address.
3. A custom name that can be given to the module. Type a name into

the box and press Enter to apply it. This name is shown on the LCD display on the programming dock (Figure 13).



Figure 13: The Master Development System Programming Dock with Name and Address Displayed

4. The active module has an eject symbol that disconnects the software from that module when clicked. The Available modules have a play symbol that makes that module active when clicked.

The Wireless Chat tab (Figure 14) offers a demonstration of sending data between two modules. There is a window for each connected module.

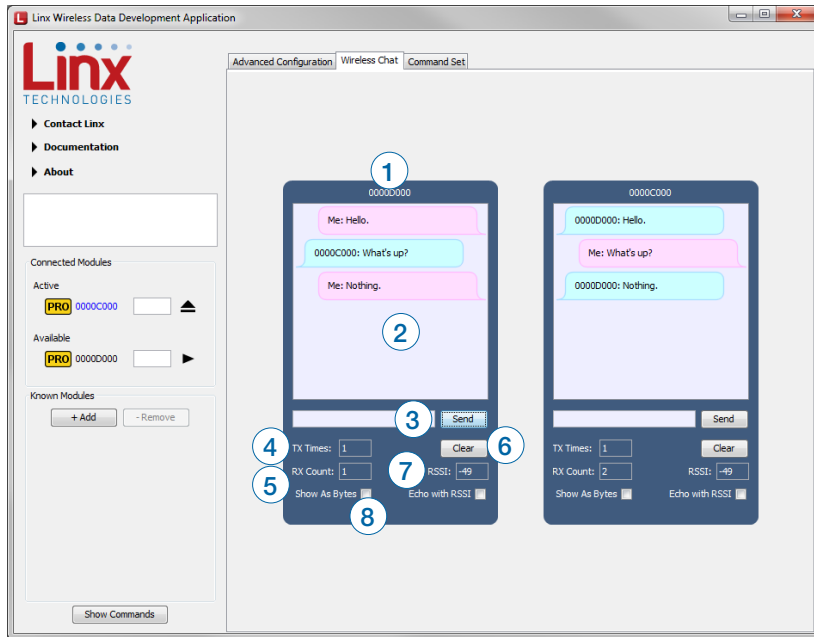


Figure 14: The Master Development System Software Wireless Chat Tab

1. The top of the window shows the address or nickname of the associated module.
2. The chat screen shows the chat messages that have been sent and received. Transmitted messages are in pink, received are in blue.
3. The Send box is where the message text is entered. The message is transmitted when the Send button is clicked.
4. The TX Times box shows how many times the module has transmitted.
5. The RX Count box counts the number of messages that the module has received.
6. The Clear button clears all of the messages from the chat window.
7. The RSSI box indicates the signal strength of the last received message.
8. When the Show As Bytes box is selected the messages are shown as bytes in the chat window.

The Command Set tab (Figure 15) allows specific commands to be written to the module.

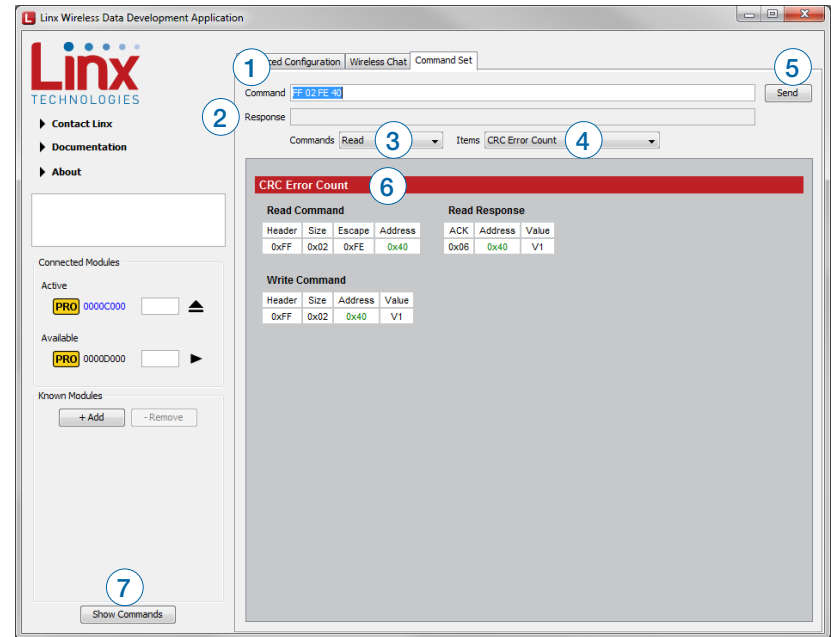


Figure 15: The Master Development System Software Command Set Tab

1. The Command box shows the hexadecimal values that are written to the module. Values can be typed into the box or a command can be selected from the Commands menu.
2. The Response box shows the hexadecimal values that are returned from the module in response to a command.
3. The Commands drop-down menu shows all of the commands that are available for the active module (Figure 16). Selecting one of the commands from this menu automatically fills in the Command box. The values can be adjusted by typing in the box.
4. The Items drop down menu displays all of the items that are available for the active module (Figure 17). Selecting one of the items from this menu automatically fills in the Command box. The values can be adjusted by typing in the box.
5. Clicking Send writes the values in the Command box to the module.
6. The structure of the selected command and its response is shown in the main window. Please see the HumPRO™ Series Transceiver Data Guide for definitions of each value.
7. The Show Commands button opens a window that shows the bytes sent to the module and the responses from the module (Figure 18).

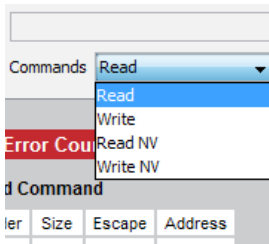


Figure 16: The Master Development System Software Command Set Tab Commands Menu

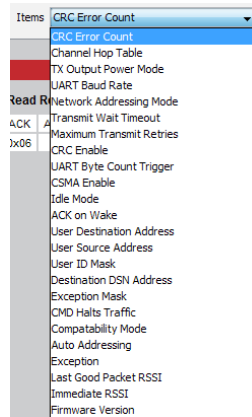


Figure 17: The Master Development System Software Command Set Tab Items Menu

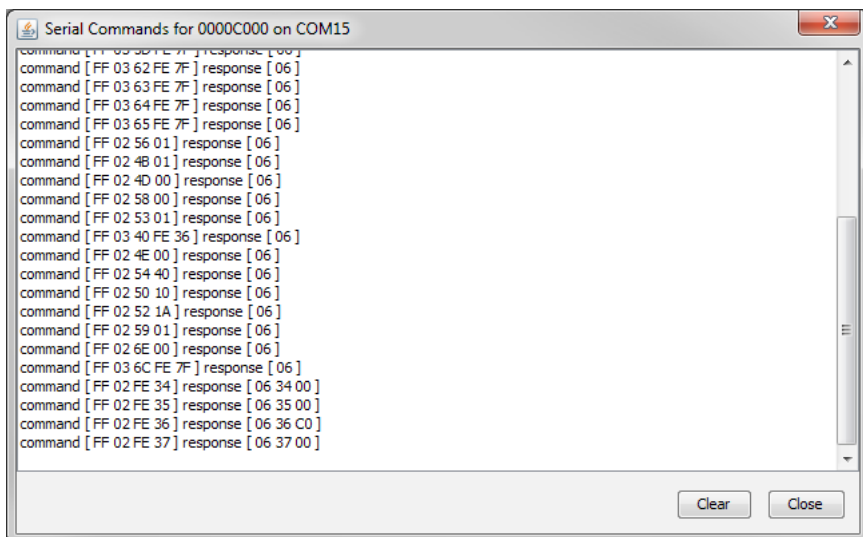


Figure 18: The Master Development System Software Show Commands Window

Development Kit Demonstration Software Example

This example shows how to configure two modules to work with each other. The software defaults to the Advanced Configuration tab when opened (Figure 19).

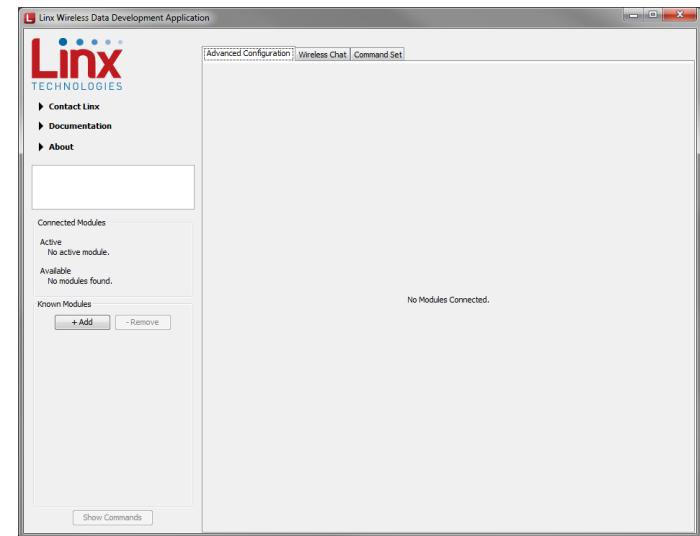


Figure 19: The Master Development System Software Advanced Configuration Tab at Start-up

Install Carrier Boards onto the Programming Docks and plug a USB cable between the Programming Docks and the PC. The software automatically detects attached devices. The first module that is identified appears under the Active label. This is the module that is actively controlled by the software. Subsequent modules are listed under the Available label as shown in Figure 20.

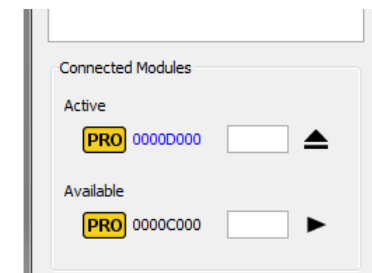


Figure 20: The Master Development System Software Connected Modules

Once the modules are detected by the software, the appropriate options are displayed on the Advanced Configurations tab. The module's documents appear under the Documentation link.

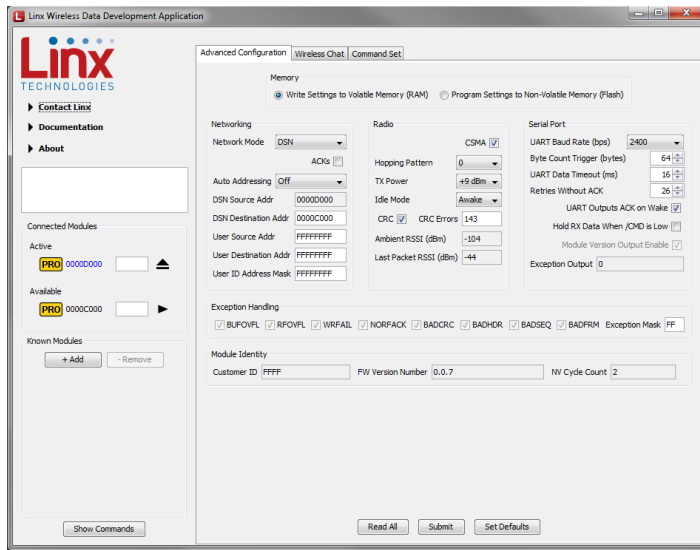


Figure 21: The Master Development System Software with Connected Modules

Any changes to the current configurations are shown in red. These changes are not written to the module until the Submit button is clicked.

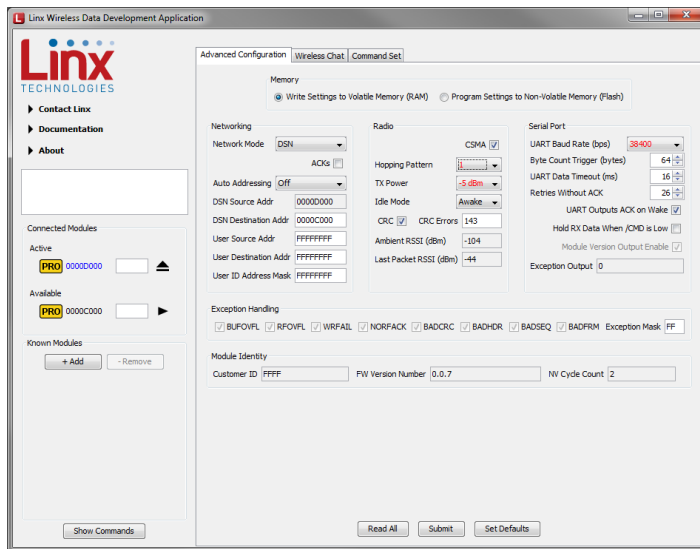


Figure 22: The Master Development System Software Advanced Configuration with Changes

Changing the active module is accomplished by either clicking the play symbol next to the desired module or dragging it from the Available list to the Active spot. Changes can now be made to this module.

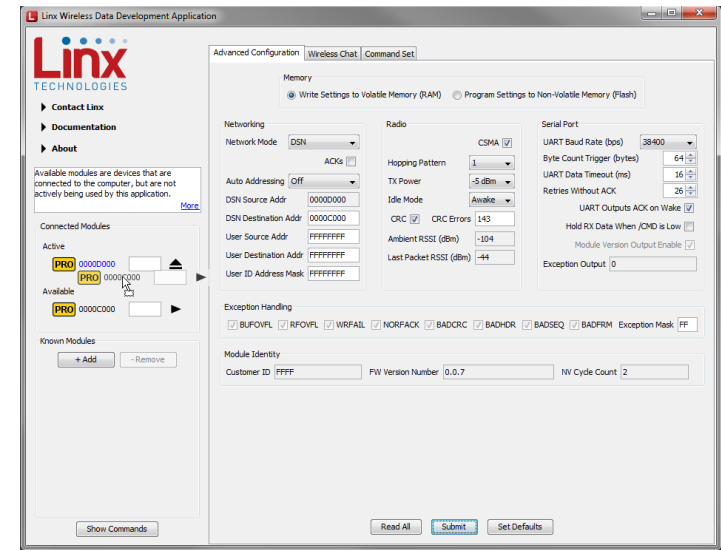


Figure 23: The Master Development System Software Dragging to Change the Active Module

There are several settings that must match in order for the modules to be able to communicate. This example uses the following settings.

- Addressing mode is DSN
- The DSN Destination Address is the DSN address of the other module. In this example, the module with the 0000C000 DSN Source Address has the DSN Destination Address of 0000D000 and vice versa.
- The Hopping Pattern is 1.
- The UART Baud Rate is 38400.

Other settings can be used as long as they match on both modules. Once the settings are changed and submitted to both modules, the Wireless Chat tab can be used to transfer data.

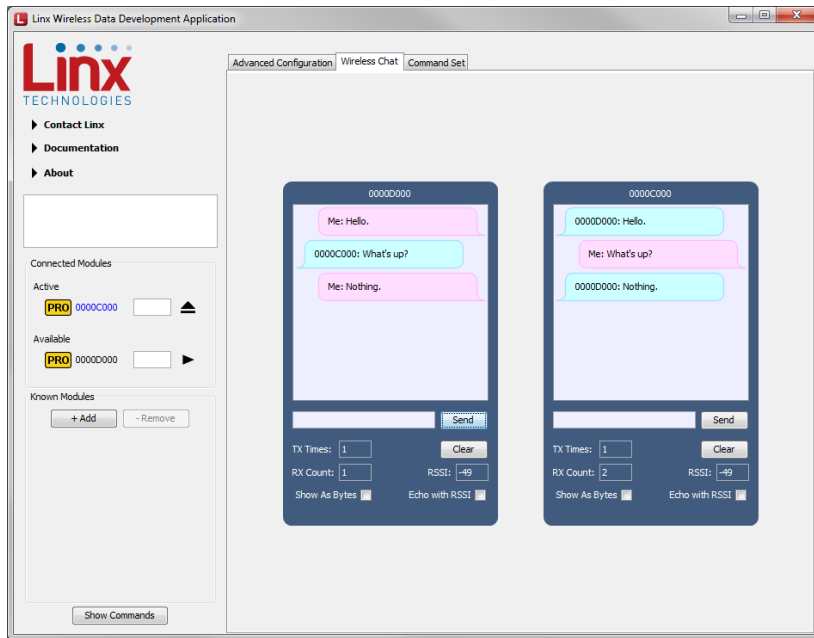


Figure 24: The Master Development System Software Wireless Chat Tab

Text can be entered into the box. Once the Send button is clicked, the text is transmitted to the other module. The RX Times, TX Times and RSSI boxes display data that can be used to qualify the integrity of the link.

The modules can be used with two computers for range testing. Install the Master Development System software on both computers. Connect both modules to both computers so that the software learns them. Now one module can be used with each computer to form a link.

When using both modules in close proximity to each other, such as when both are connected to one computer for testing, it is a good idea to set the transmitter output power to a low level. At short ranges and high output power levels the receivers can become saturated and miss packets.

Figure 25: HumPRO™ Series Transceiver Carrier Board Module Schematic



Figure 26: Programming Dock Board RF Carrier Area Schematic



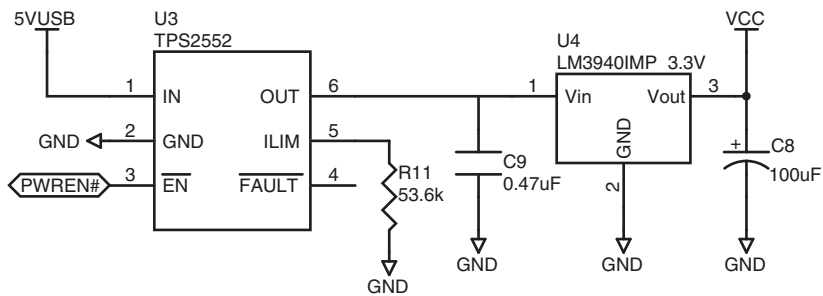


Figure 27: Programming Dock Board Power Supply Area Schematic

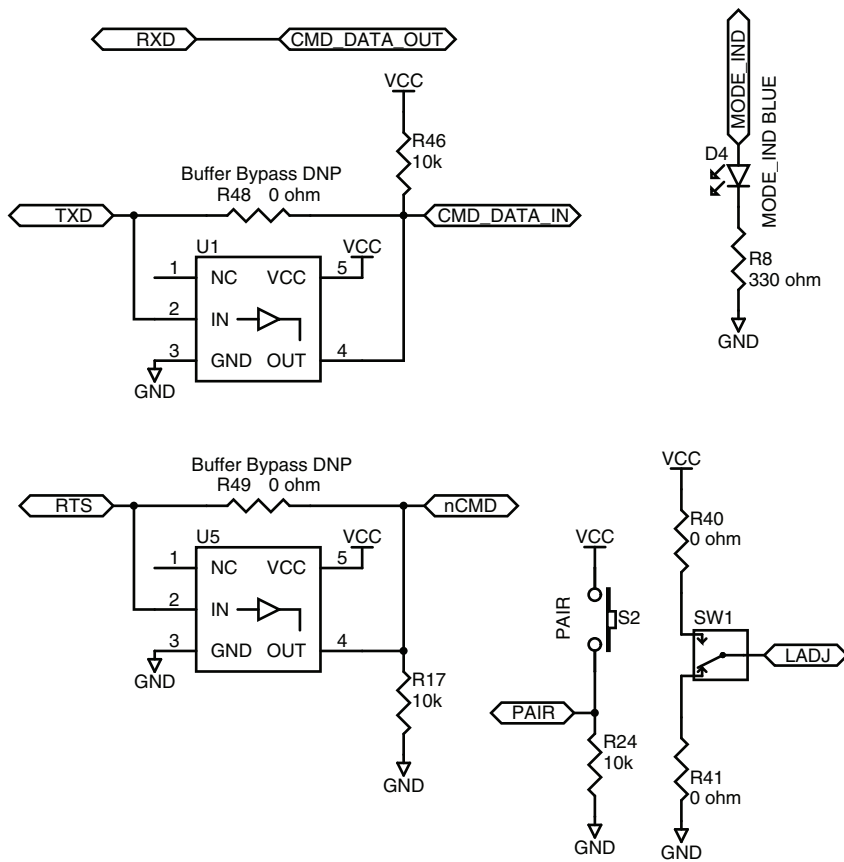


Figure 28: Programming Dock Board Signal Routing Schematic

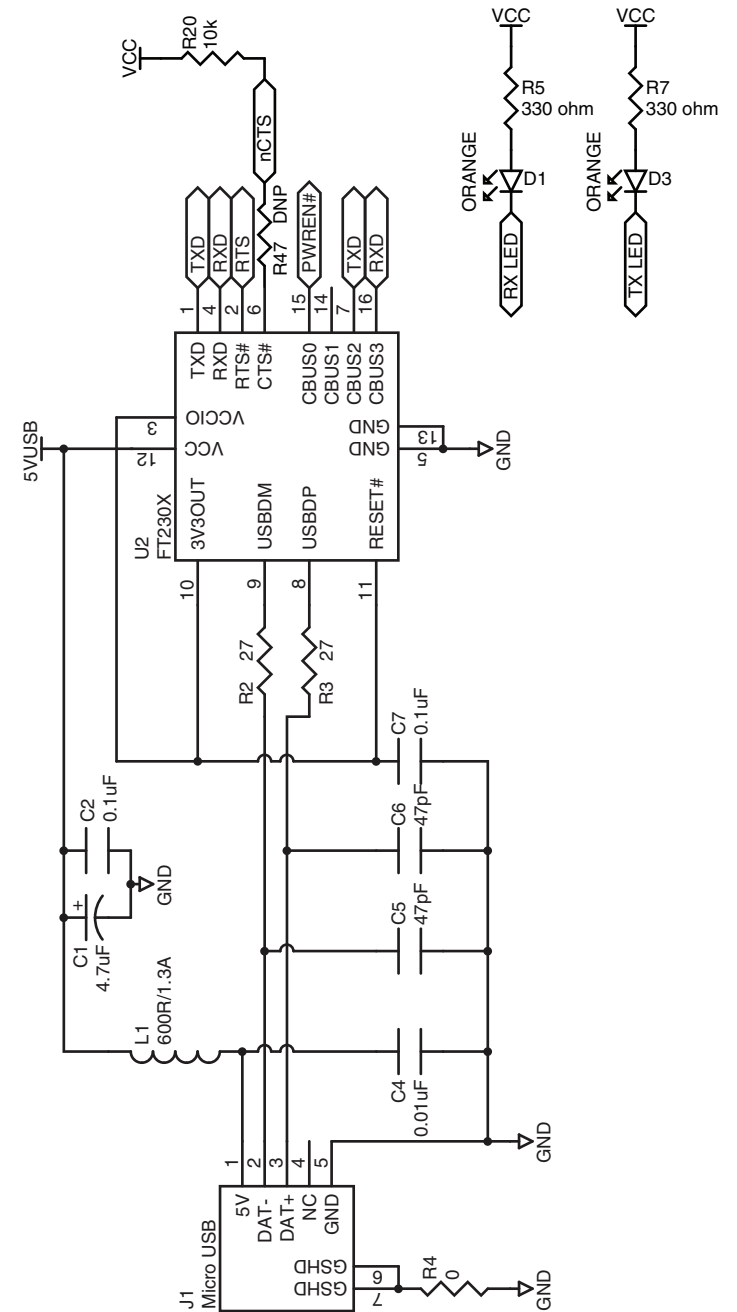


Figure 29: Programming Dock Board USB Area Schematic

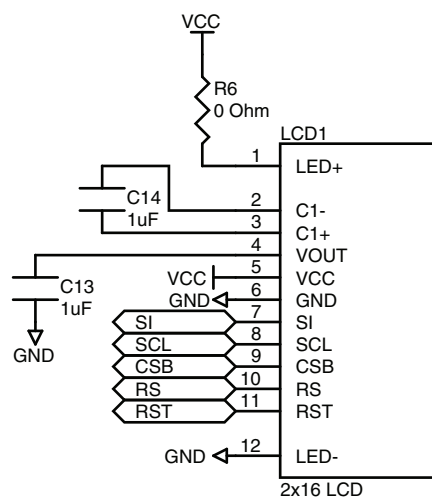
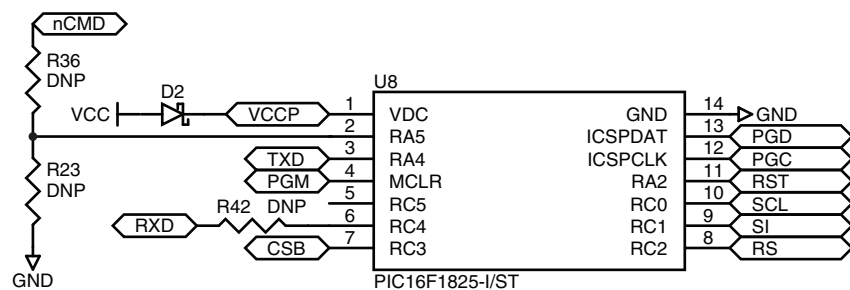


Figure 30: Programming Dock Board Microcontroller Area Schematic

Prototype Board Schematic

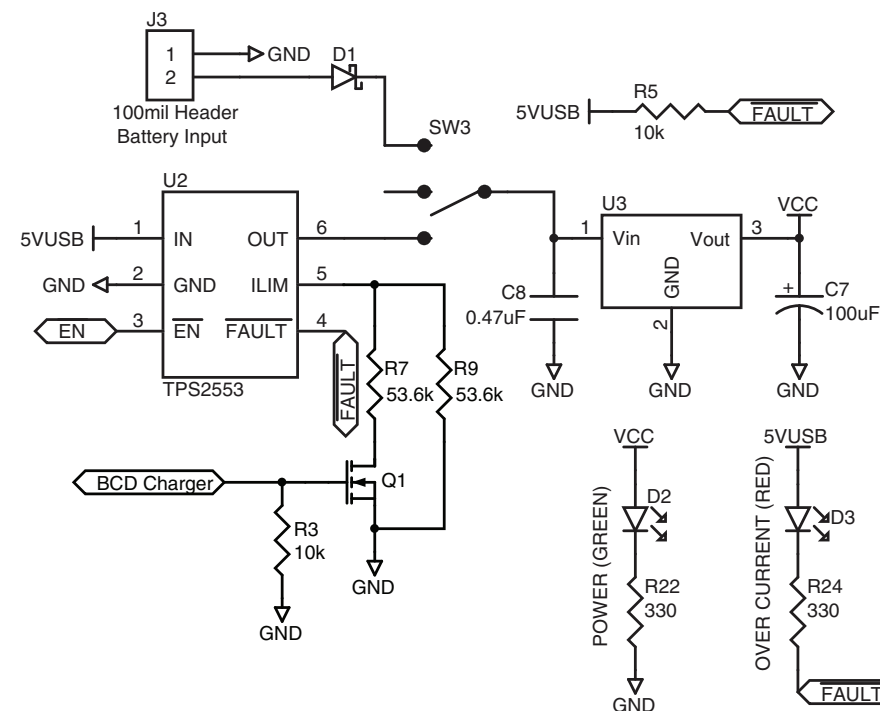


Figure 31: Prototype Board Power Supply Area Schematic

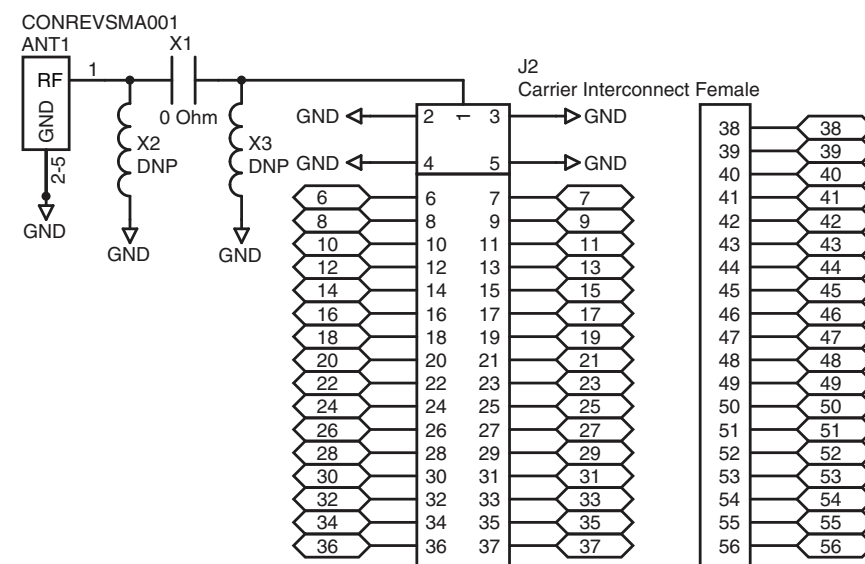


Figure 32: Prototype Board RF Carrier Area Schematic

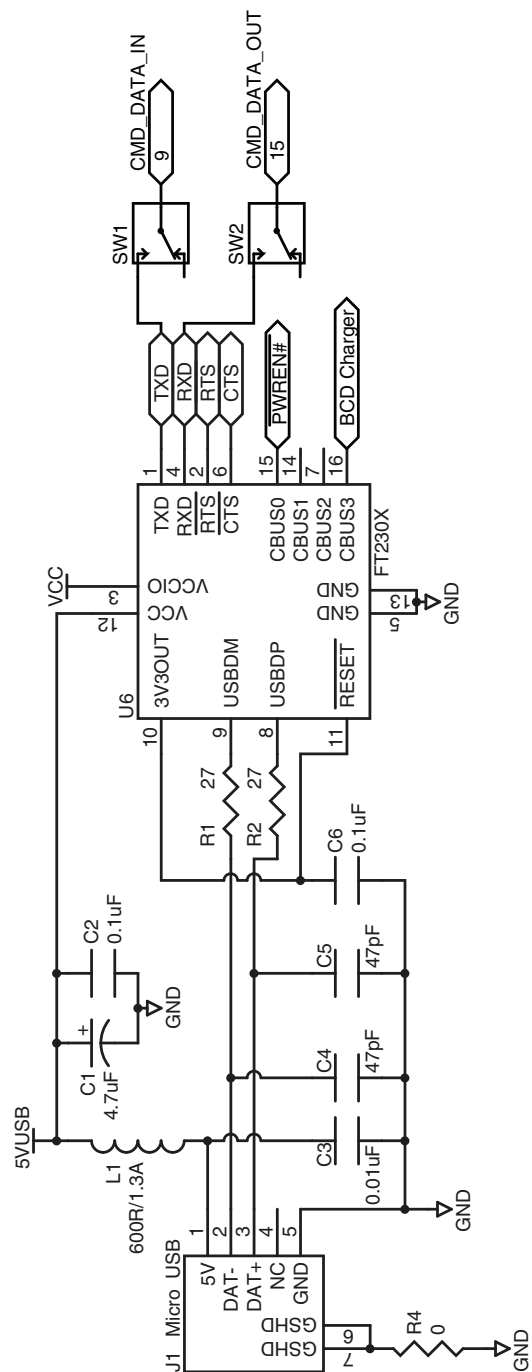


Figure 33: Prototype Board USB Area Schematic

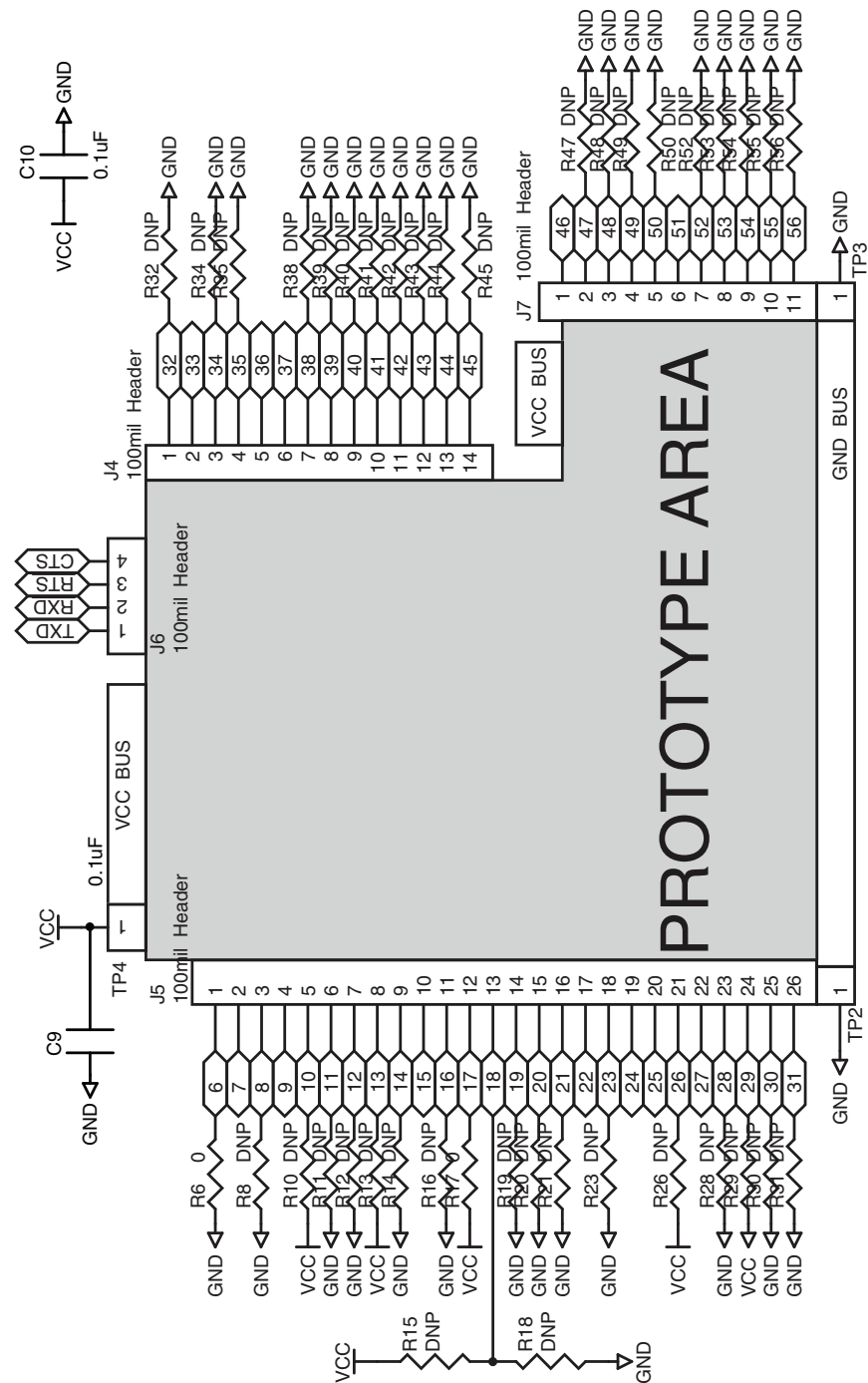


Figure 34: Prototype Board Prototype Area Schematic



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