




# **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

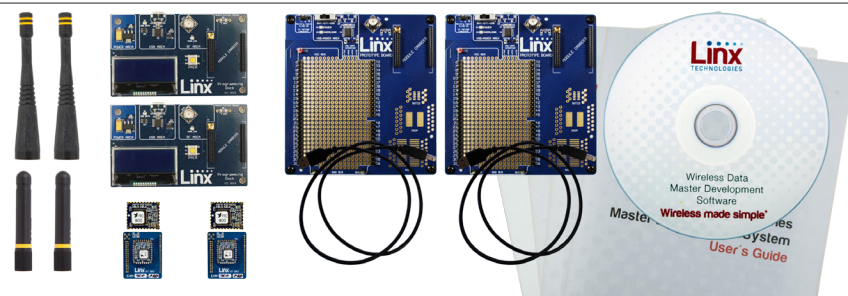


Figure 1: HumPRO™ Series Master Development System

### 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 regular or amplified 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
MDEV-A-900-PRO	Amplified HumPRO™ Series Master Development System
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
HUM-A-900-PRO-CAS	Amplified HumPRO™ Series High Power Data Transceiver with Castellated Connection
HUM-A-900-PRO-UFL	Amplified HumPRO™ Series High Power Data Transceiver with U.FL Connector
EVM-***-PRO	HumPRO™ Series Carrier Board
EVM-A-900-PRO-CAS	Amplified HumPRO™ Series Carrier Board, Castellated Connection with an edge-mount RP-SMA connector
EVM-A-900-PRO-UFL	Amplified HumPRO™ Series Carrier Board, U.FL Connector
MDEV-PGDOCK	Development System Programming Dock
MDEV-PROTO	Development System Prototype Board
CON-SOC-EVM	EVM Module Socket Kit

\*\*\* = Frequency; 868, 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

Amplified HumPRO™ Series Carrier Board

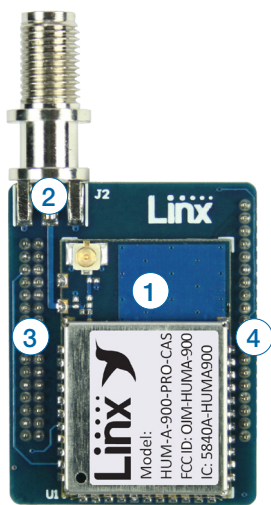


Figure 4: Amplified HumPRO™ Series Transceiver Carrier Board

Amplified HumPRO™ Series Carrier Board Objects

- 1. Amplified HumPRO™ Series Transceiver
- 2. Edge-mount RP-SMA RF Connector
- 3. Dual Row Header
- 4. Single Row Header

Programming Dock

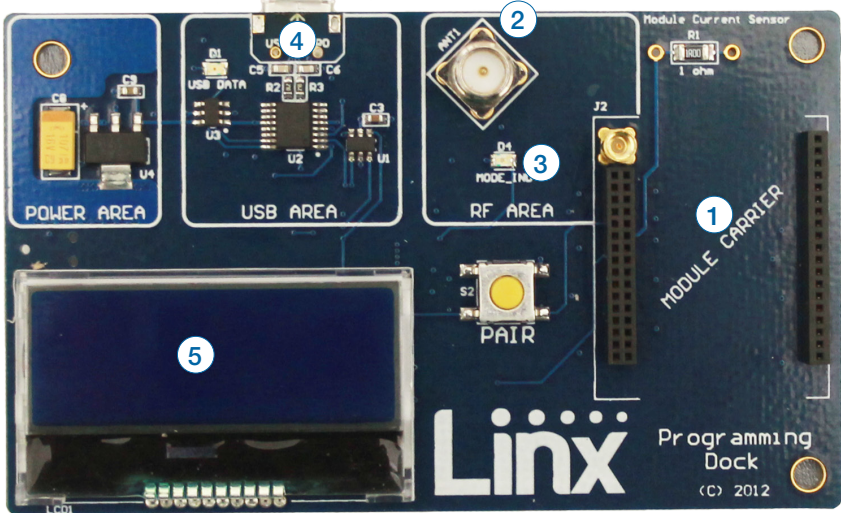


Figure 6: Programming Dock

Programming Dock Objects

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

HumPRO™ Series Carrier Board Pin Assignments

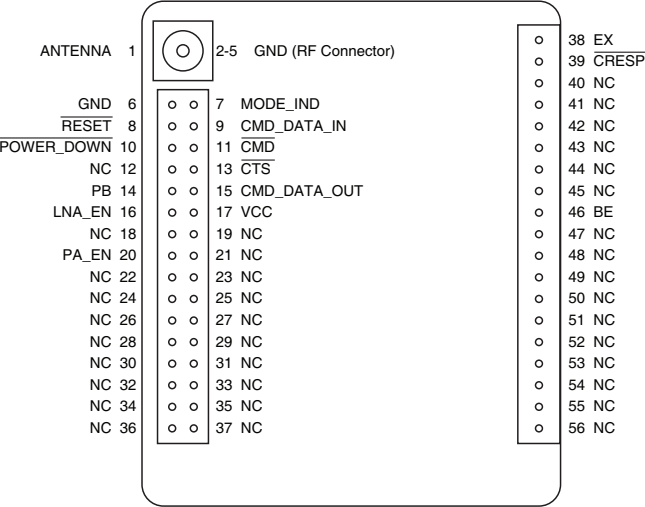


Figure 5: HumPRO™ Series Transceiver Carrier Board Pin Assignments (Top View)



## Prototype Board

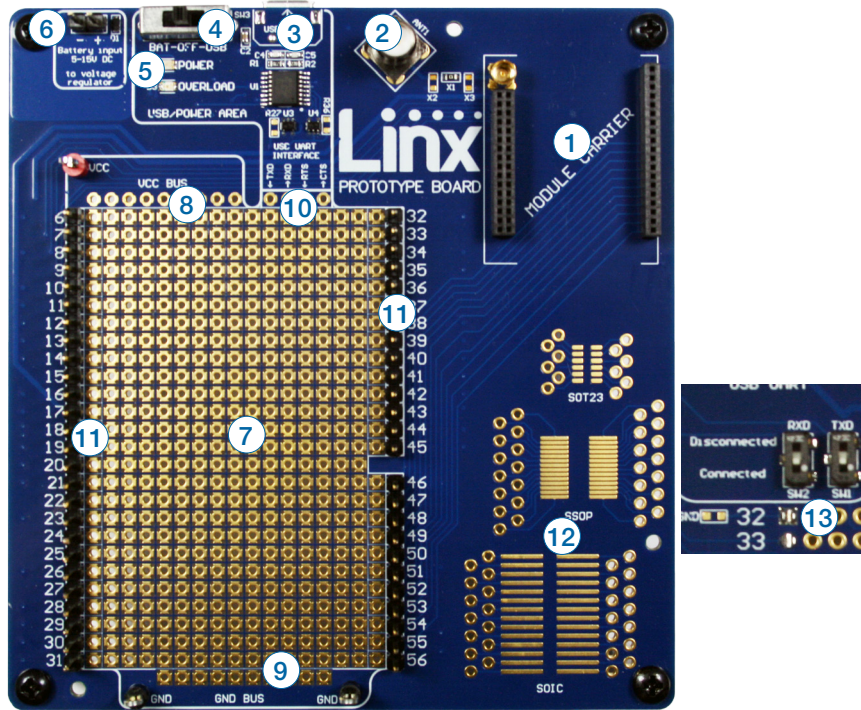


Figure 7: Prototype Board

### 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 UART Interface Lines
11. Module Interface Breakout Headers
12. Standard SMT Package Footprints
13. 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 7 and 10; 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 8.

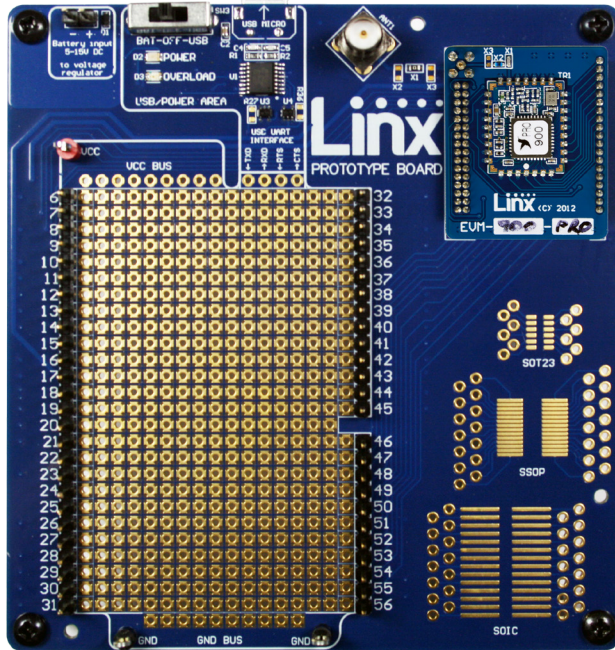


Figure 8: Prototype Board with a Carrier Board

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. Footprints for standard surface mount packages are also included to aid prototyping.

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 4 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 (60mA with the amplified PRO). 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 9 shows the bottom of the board.

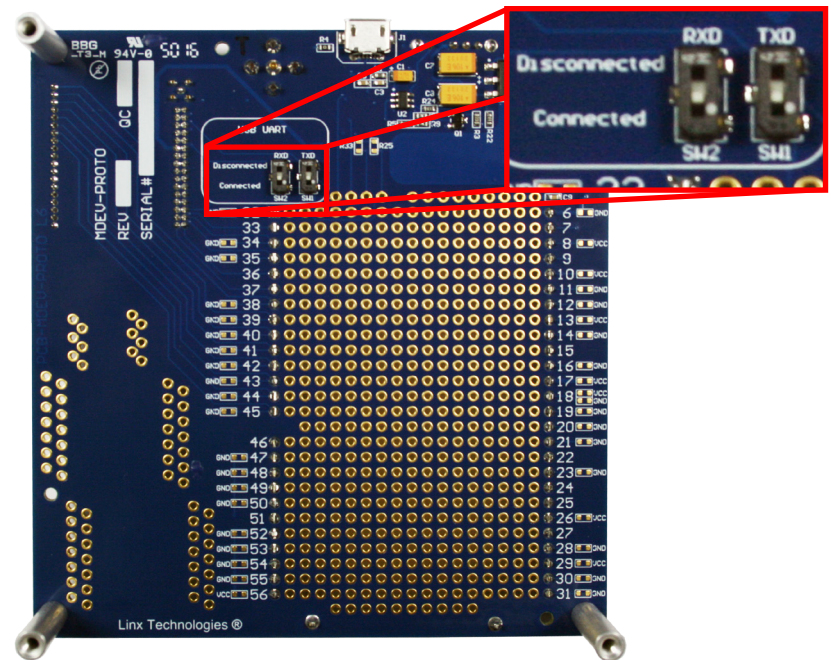


Figure 9: Prototype Board Bottom Side

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 10.

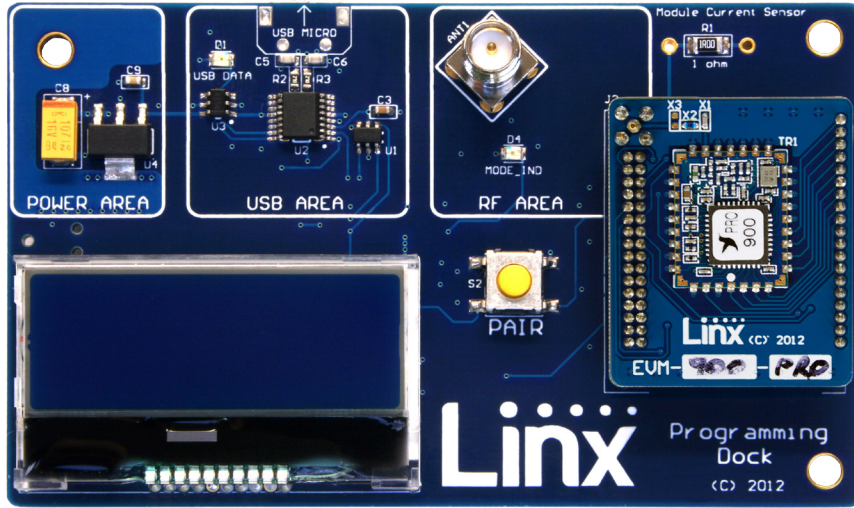


Figure 10: Programming Dock with a Carrier Board

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 11). This window configures the module's settings.

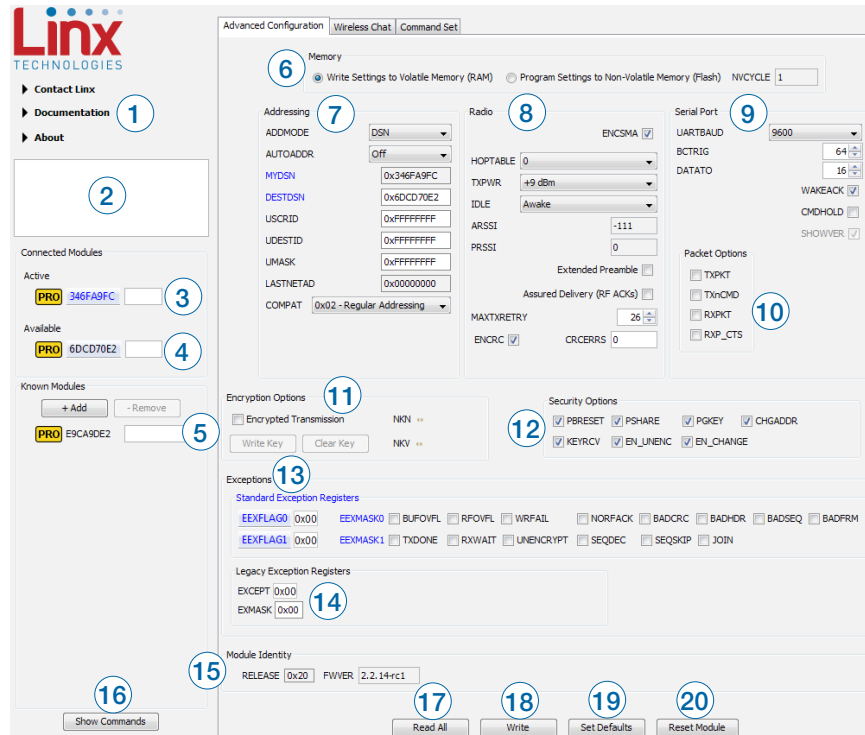


Figure 11: The Master Development System Software Advanced Configuration Tab

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 12.
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.

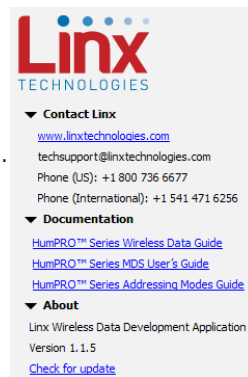


Figure 12: Additional Information

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 groups. The Addressing group configures the addressing features of the module.
  - The Addressing Mode (ADDMODE) menu sets the addressing mode used by the module; either DSN, User or Extended User.
  - The Auto Addressing (AUTOADDR) menu turns the automatic addressing feature on and off.
  - The MYDSN address is the module's local address. This is configured at the factory and cannot be changed.
  - The DSN Destination Address (DESTDSN) is the address of the desired destination module when DSN addressing mode is used.
  - User Source Address (USRCID) is the module's local address when User and Extended User modes are used.
  - User Destination Address (UDESTID) is the address of the destination module when User and Extended User addressing modes are used.
  - User ID Address Mask (UMASK) is the mask for screening incoming packets.
  - The LASTNETAD is the last address that the module assigned using the JOIN process. This is only used if encryption is used and the module is an administrator.
  - The Compatibility (COMPAT) setting allows communication with legacy products.
8. The Radio group configures the radio settings of the module.
  - For 900MHz units, checking the ENCSMA box enables the Carrier Sense Multiple Access feature.
  - The HOPTABLE menu selects the module's hopping pattern
  - The TXPWR menu sets the module's transmitter output power.
  - The IDLE menu sets the module's operating state as awake or asleep.
  - The ARSSI measurement is the ambient RSSI in the local environment on the current channel at the time when the read command is issued.
  - The PRSSI is the RSSI measurement of the last valid packet that was received.

- Checking the Extended Preamble box configures the module to send a long preamble at the beginning of every packet.
- Checking the Assured Delivery box enables RF acknowledgements and retries when an acknowledgement is not received.
- MAXTXRETRY sets the maximum number of times that the module will retry sending the packet before an exception is thrown.
- Checking the ENCRC 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 Serial Port group configures all of the UART serial port settings.
  - The UARTBAUD 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 (BCTRIG) sets the number of bytes that the UART receives before triggering the transmission of a packet.
  - The UART Data Timeout (DATATO) sets the number of milliseconds from the last character received on the UART before the module transmits the data in its buffer.
  - Selecting the WAKEACK box instructs the module to output the acknowledgement (0x06) on the UART when the module wakes from sleep or power cycle.
  - Selecting the CMDHOLD box instructs the module to buffer any received over-the-air data while processing configuration commands.
  - Selecting the SHOWER box instructs the module to output the firmware version information when the module starts up from a power cycle or reset.

- The Packet Options group configures the explicit packet transmission and reception, allowing the host microcontroller to control when packets are sent and how they are received. These are set in the PKTOPT register.
- The Encryption Options group configures the encryption settings.
  - Selecting the Encrypted Transmission box enables encryption.
  - Clicking the Write Key button opens a window where the 128-bit AES key can be entered (Figure 13).
  - Clicking the Clear Key button opens a window where the key can be cleared (Figure 13).

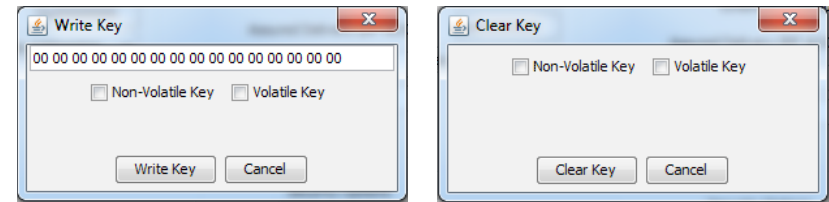


Figure 13: The Master Development System Software Write Key and Clear Key Windows

- The Security Options group corresponds to the SECOPT register. This configures the security options related to encryption and the Join Process for setting up networks.
- The Exceptions group configures the Extended Exception Flags and Extended Exception Mask.
  - Checking the boxes in the EEMASK0 and EEMASK1 rows sets which exception conditions trigger the exception flags
  - The EEXFLAG0 and EEXFLAG1 boxes show the current value for the flags. 0x00 means no exceptions were detected. A non-zero value means an exception flag is set. Clicking on the box opens a menu showing which flags are set. Clicking on the flag clears it (Figure 14).

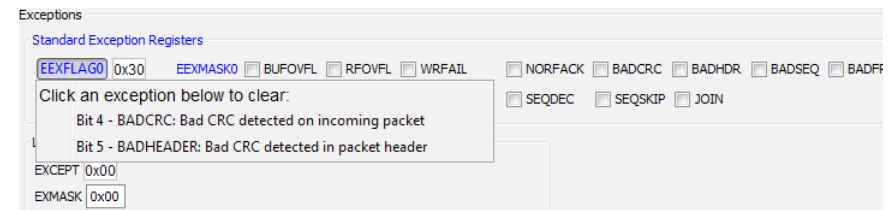


Figure 14: The Master Development System Software Exception Flags

- The Legacy Exception Registers group configures the Exception Mask and Exception Flags associated with the older 250 Series modules. These are included for backwards compatibility and are not recommended for new designs.
- The Module Identity group displays the RELEASE value and the firmware version.
- The Show Commands button opens a window that displays all of the commands sent to the module. This is useful for seeing the UART commands when developing and debugging firmware.
- The Read All button reads all of the values from the active module.
- The Write button writes all changes to the active module.
- The Set Defaults button restores all settings to the factory defaults.

20. The Reset Module button issues a command to restart the module.
21. When an 868MHz module is active, the ENCSMA becomes a drop-down menu that selects the LBT + AFA settings (Figure 15).

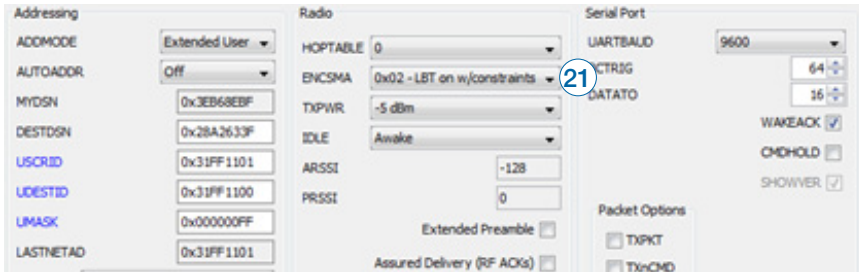


Figure 15: The Master Development System Software 868MHz Advanced Configuration Tab

The modules are shown with four identifiers as shown in Figure 16.

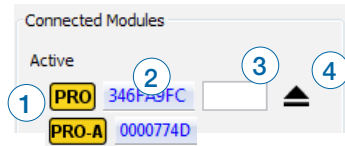


Figure 16: The Master Development System Software Module Identifiers

1. The type of module (HumPRO™ or Amplified 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 17).
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.



Figure 17: The Master Development System Programming Dock with Name and Address Displayed

The Wireless Chat tab (Figure 18) offers a demonstration of sending data between two modules. There is a window for each connected module.



Figure 18: 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.

9. When the Echo with RSSI box is checked, the software transmits any message it receives and appends the received RSSI to the end of the message.
10. The Join Status box shows the value in the JOINST register. This indicates the state of Join activity since the module was last reset. Clicking on the box opens a description of the value (Figure 19).

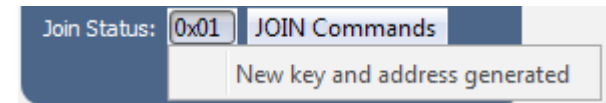


Figure 19: The Master Development System Software Join Status Register Description

11. The Join Commands button sets the Join Process Control options in the CMD register. Clicking on the button opens a menu of the Join commands. Clicking on one of the commands triggers that operation (Figure 20).

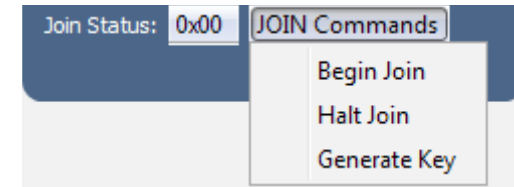


Figure 20: The Master Development System Software Join Commands



The Command Set tab (Figure 21) allows specific commands to be written to the module.

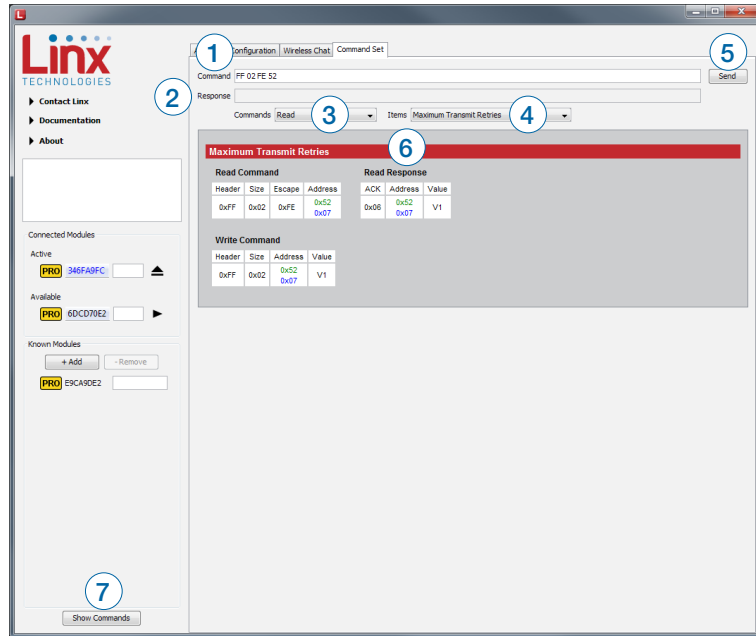


Figure 21: The Master Development System Software Command Set Tab

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 22). 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 23). 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 24).

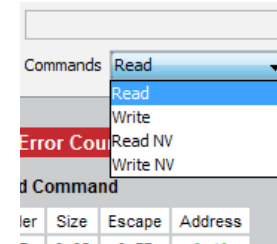


Figure 22: The Master Development System Software Command Set Tab Commands Menu

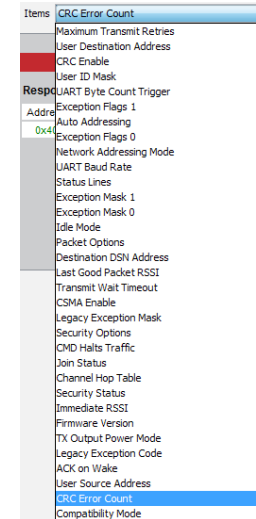


Figure 23: The Master Development System Software Command Set Tab Items Menu

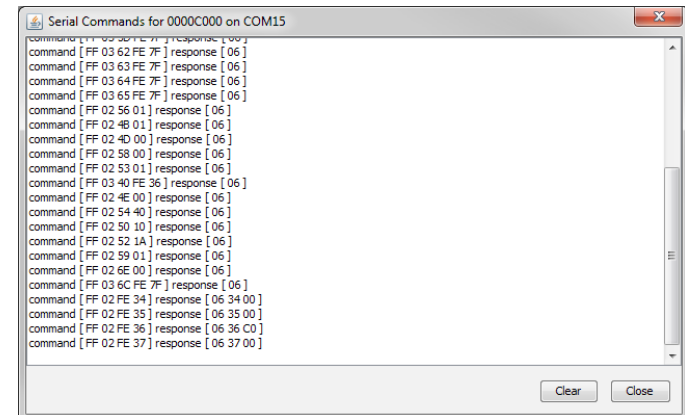


Figure 24: The Master Development System Software Show Commands Window

## 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 25).

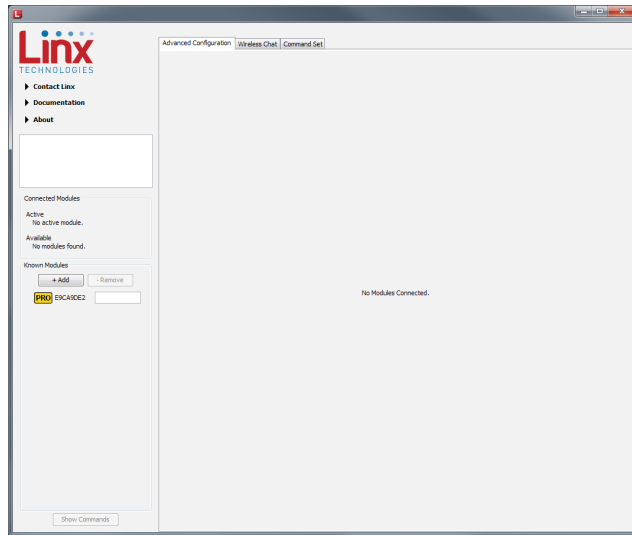


Figure 25: The Master Development System Software Advanced Configuration Tab at Start-up

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 26.

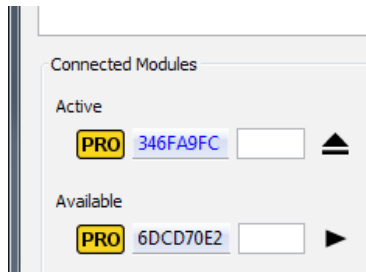


Figure 26: The Master Development System Software Connected Modules

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.

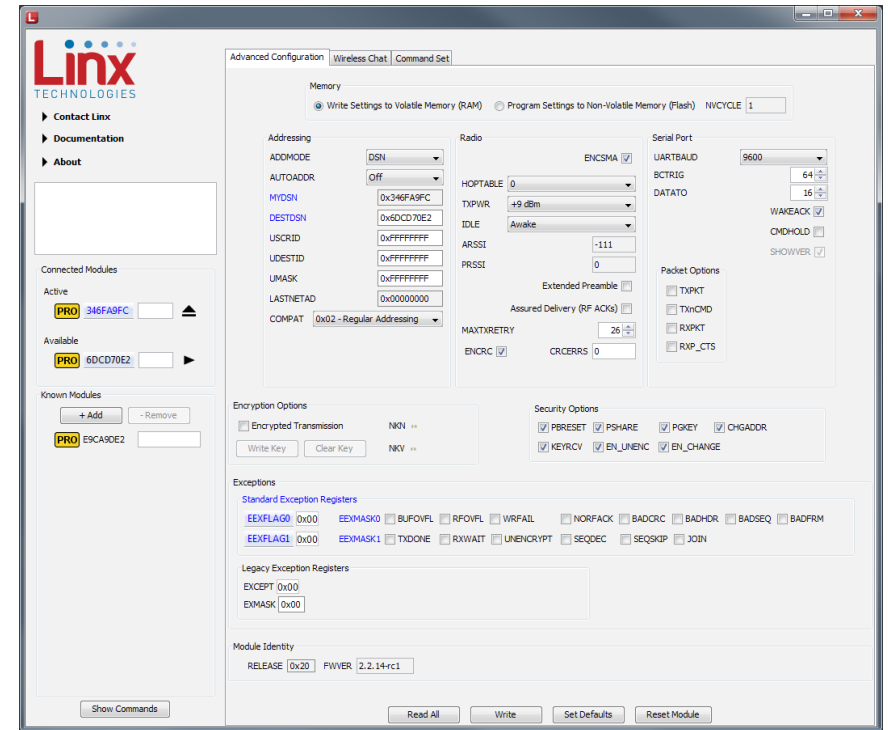


Figure 27: The Master Development System Software with Connected Modules

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

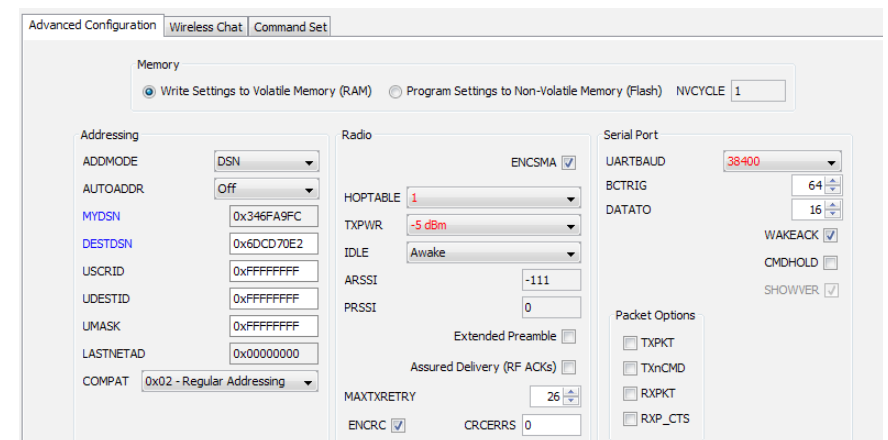


Figure 28: The Master Development System Software Advanced Configuration with Changes

Changing the active module is accomplished by clicking the play symbol next to the desired module. Changes can now be made to this 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 346FA9FC DSN Source Address has the DSN Destination Address of 6DCD70E2 and vice versa.
- The Hopping Pattern is 1.
- The UART Baud Rate is 38400.

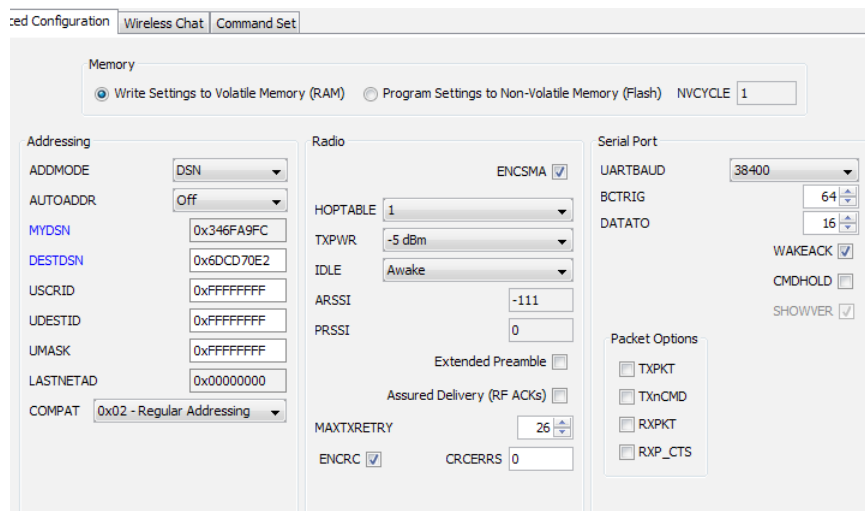


Figure 29: The Master Development System Software Advanced Configuration with Changes Written

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.

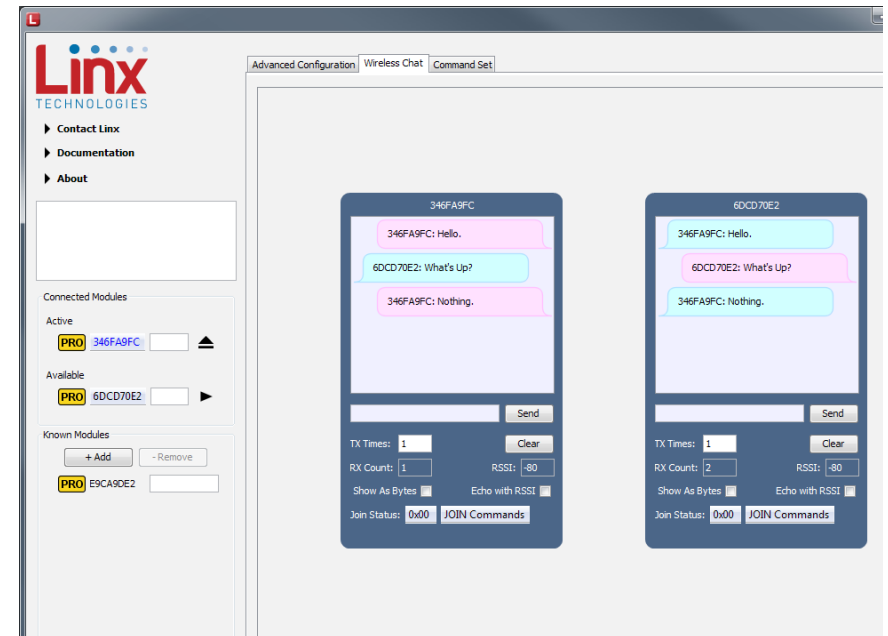


Figure 30: The Master Development System Software Wireless Chat Tab

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.

## Carrier Board Schematic

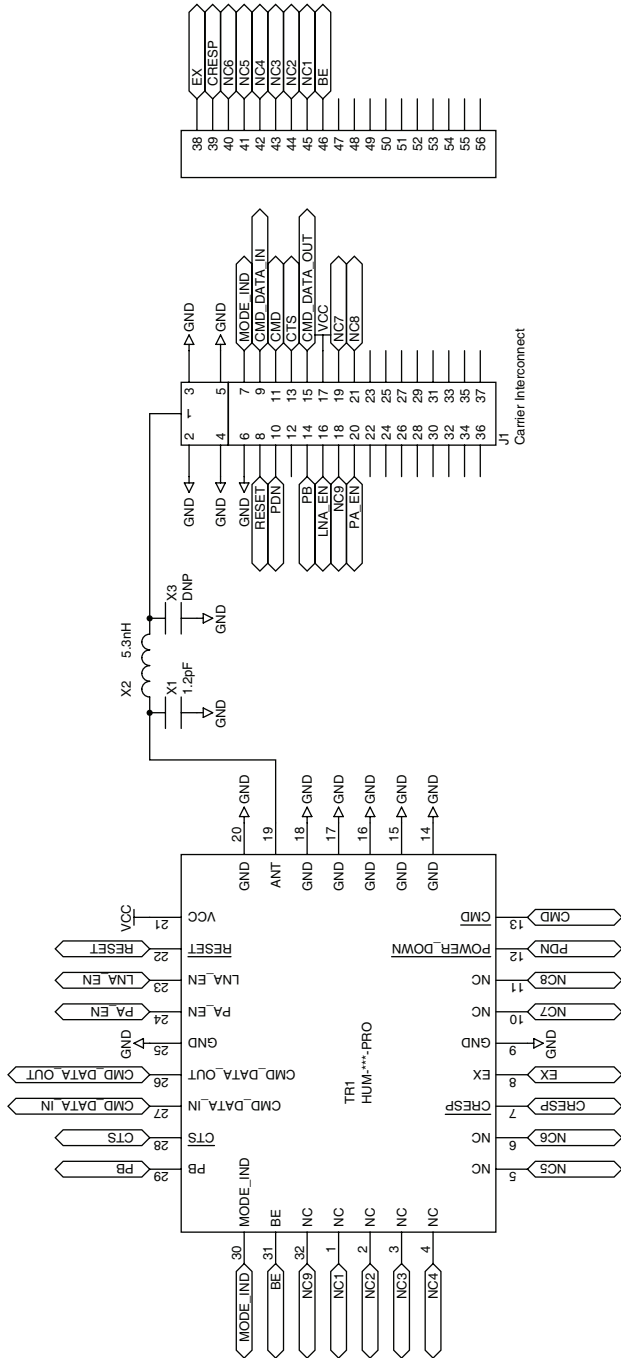
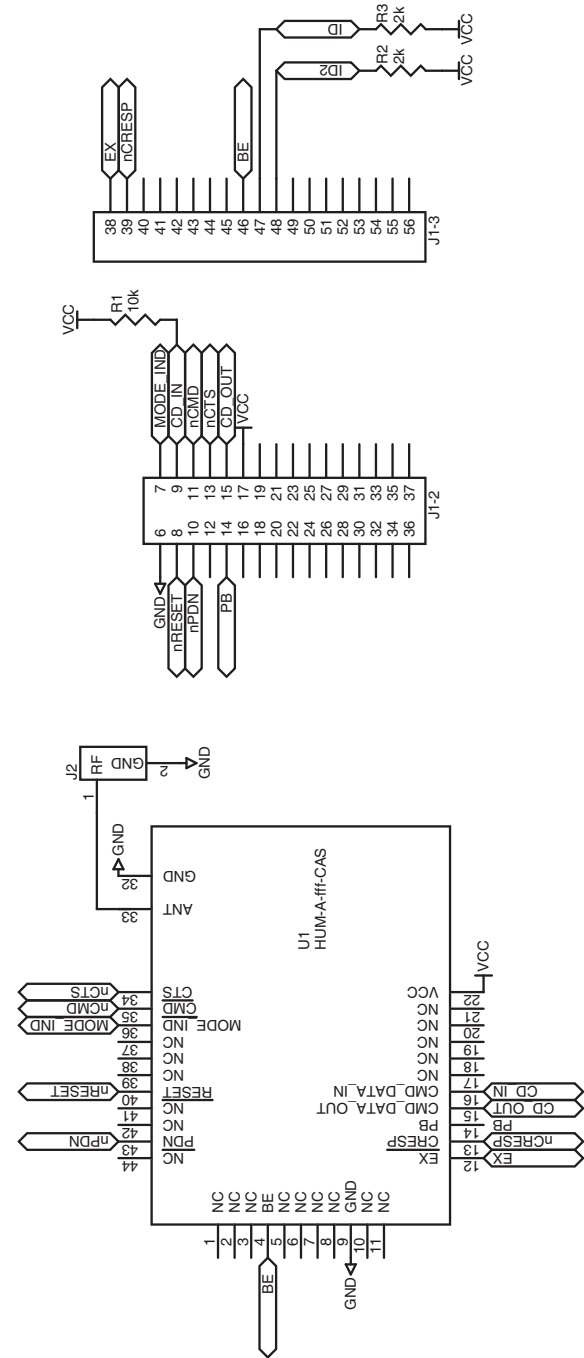


Figure 31: HumPRO™ Series Transceiver Carrier Board Schematic

## Amplified Carrier Board Schematic





## Programming Dock Board Schematic

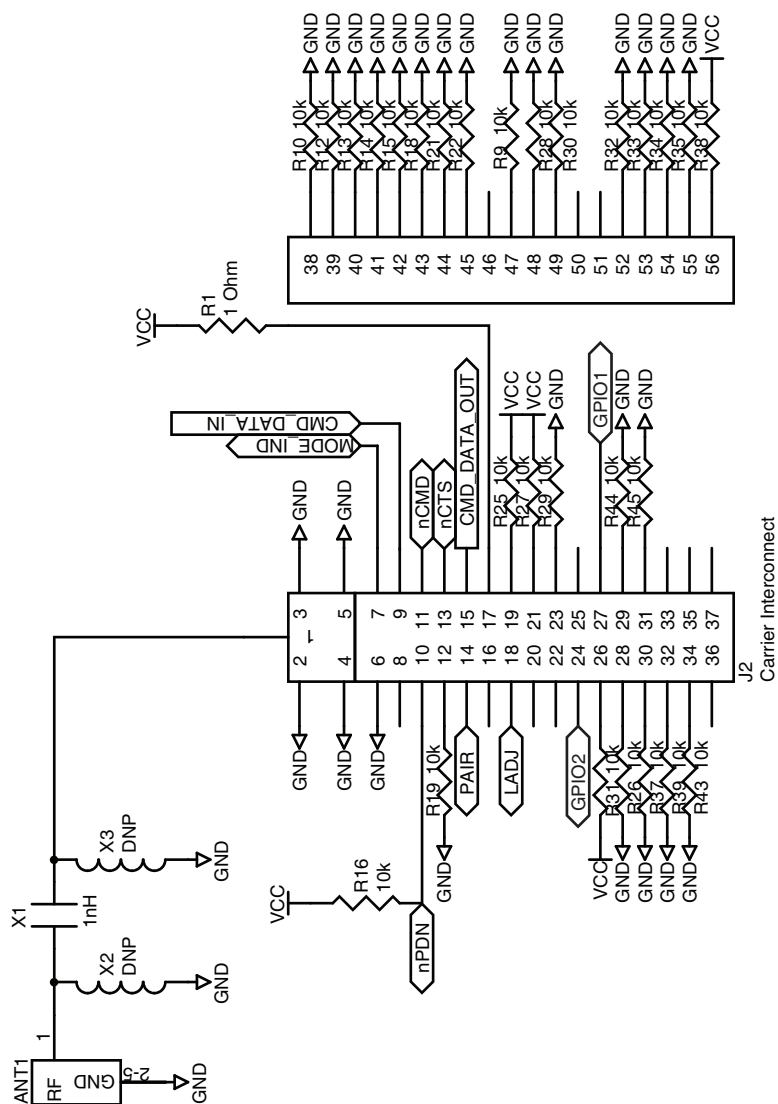


Figure 33: Programming Dock Board RF Carrier Area Schematic

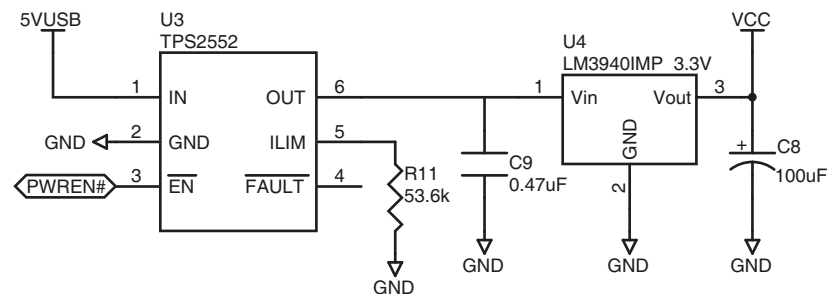


Figure 34: Programming Dock Board Power Supply Area Schematic

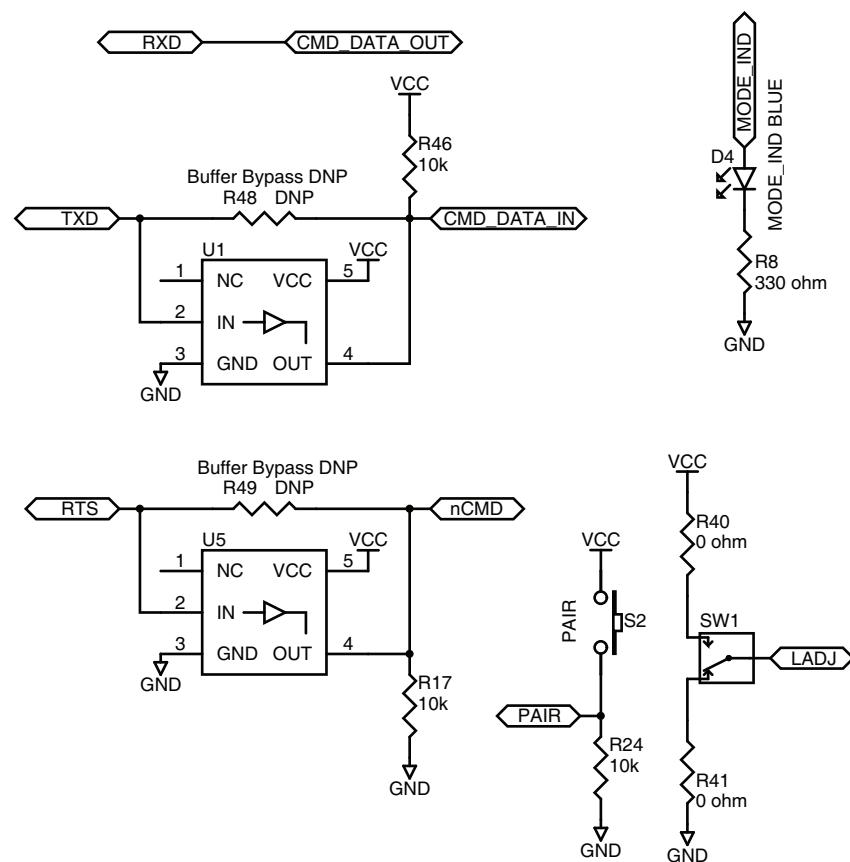


Figure 35: Programming Dock Board Signal Routing Schematic

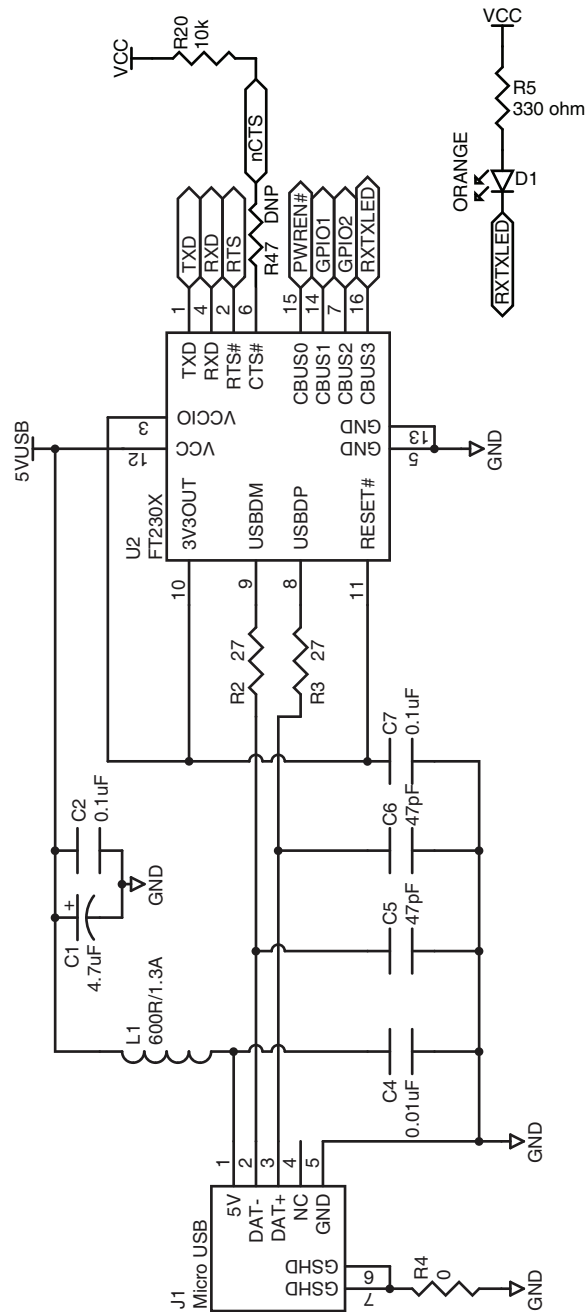


Figure 36: Programming Dock Board USB Area Schematic

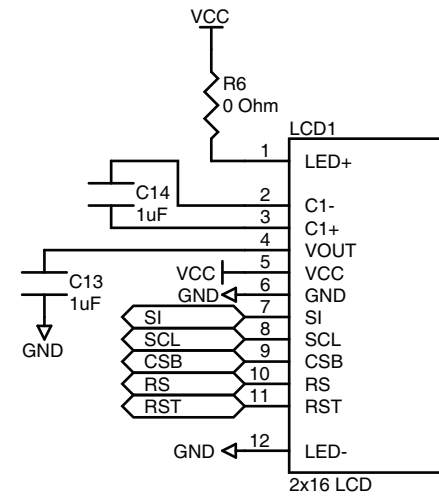
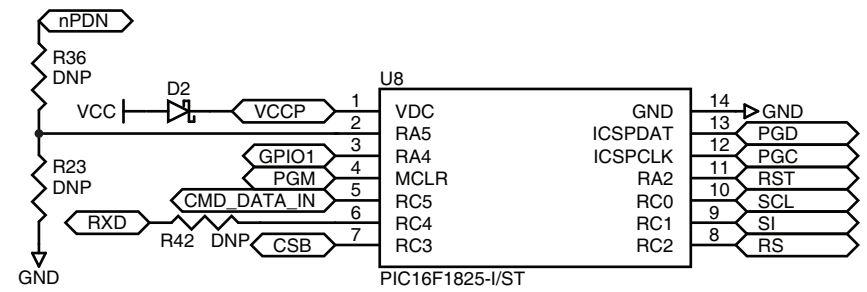


Figure 37: Programming Dock Board Microcontroller Area Schematic

## Prototype Board Schematic

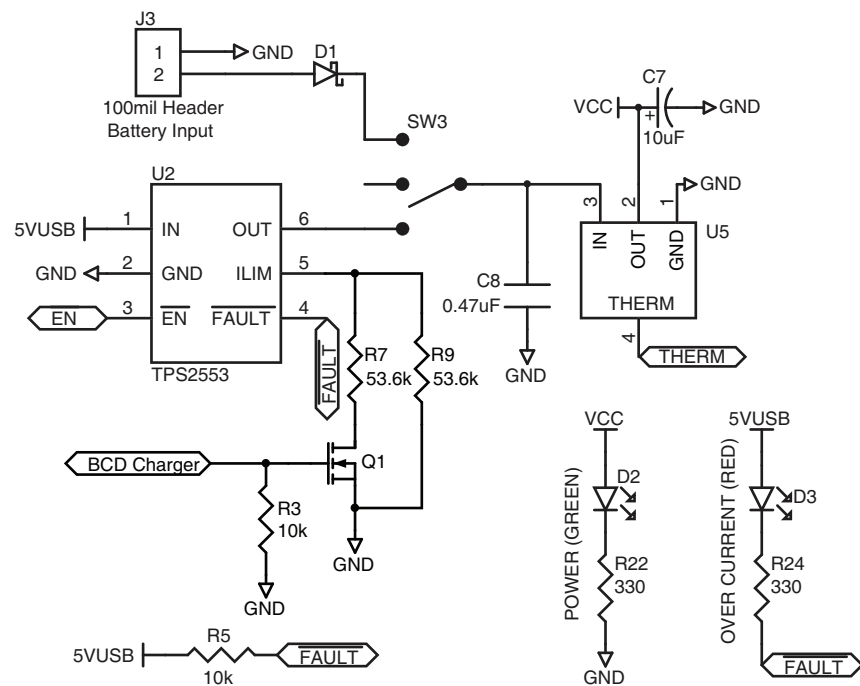


Figure 38: Prototype Board Power Supply Area Schematic

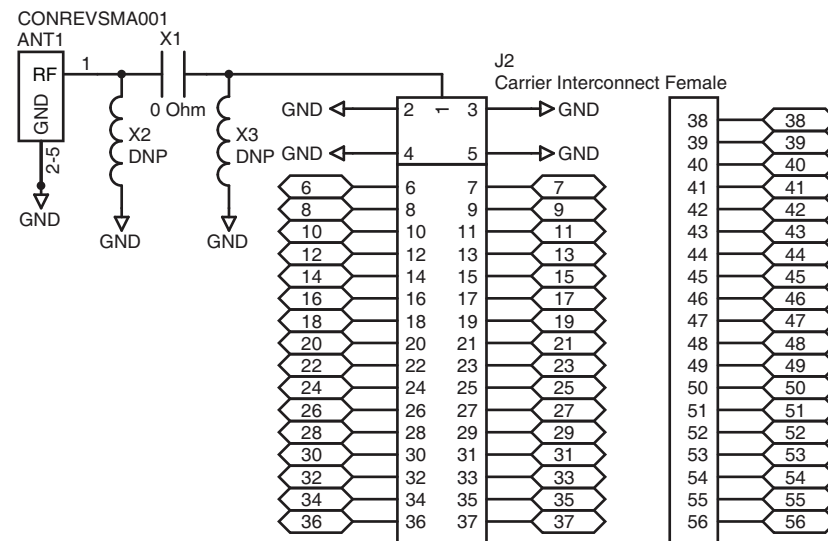


Figure 39: Prototype Board RF Carrier Area Schematic

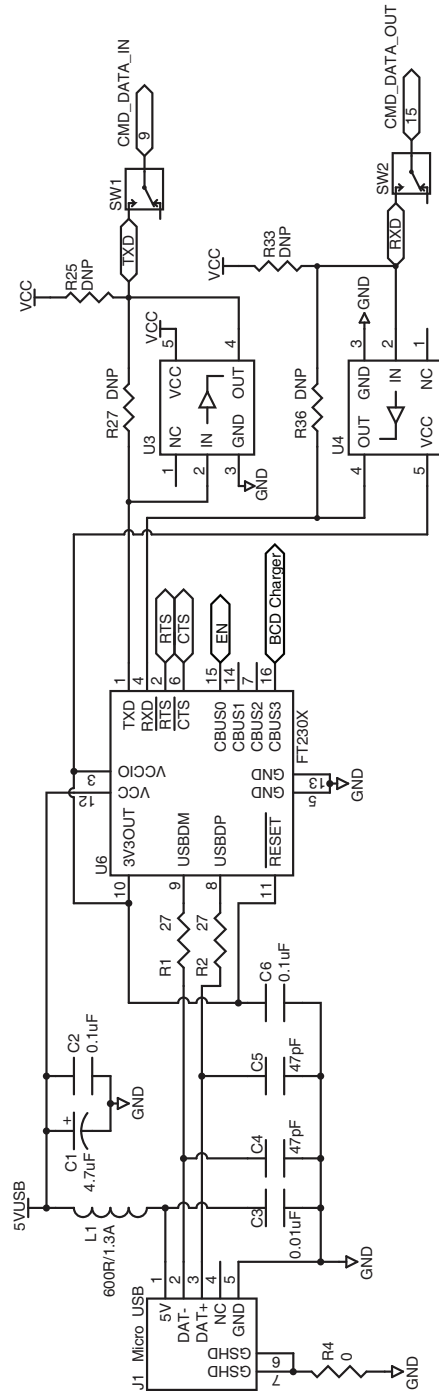


Figure 40: Prototype Board USB Area Schematic

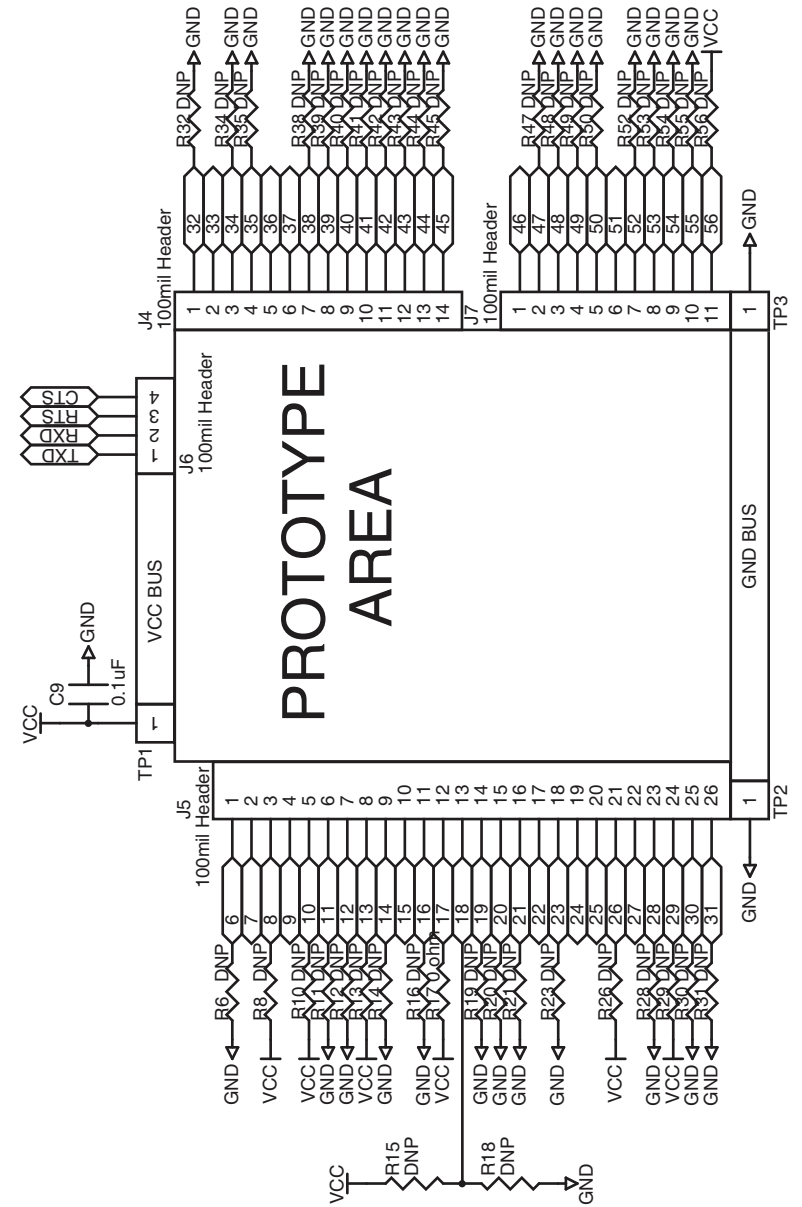


Figure 41: Prototype Board Prototype Area Schematic





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