Linx

T E C H N O L O G I E S

**HumDT™ 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 not have a frequency hopping protocol built in.

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.
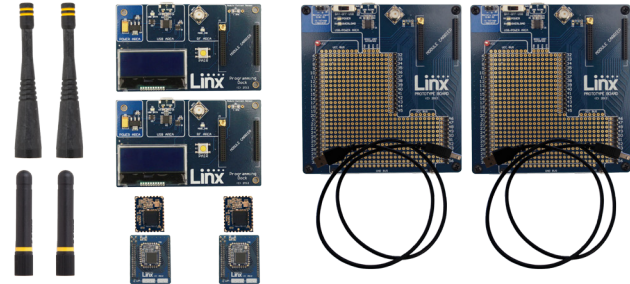
Table of Contents

Figure 1: HumDT™ Series Master Development System

Introduction

The Linx HumDT™ Series Remote Control Transceiver modules offer a simple, efficient and cost-effective method of adding remote control 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 HumDT™ 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 HumDT™ Series transceivers*, antennas, batteries and full documentation.

* One part is soldered to each Carrier Board

Ordering Information

Ordering Information	
Part Number	**Description**
MDEV-***-DT	HumDT™ Series Master Development System
HUM-***-DT	HumDT™ Series Transceiver
EVM-***-DT	HumDT™ Series Carrier Board
MDEV-PGDCK	Development System Programming Dock
MDEV-PROTO	Development System Prototype Board
CON-SOC-EVM	EVM Module Socket Kit
*** = Frequency; 868MHz, 900MHz	

Figure 2: Ordering Information

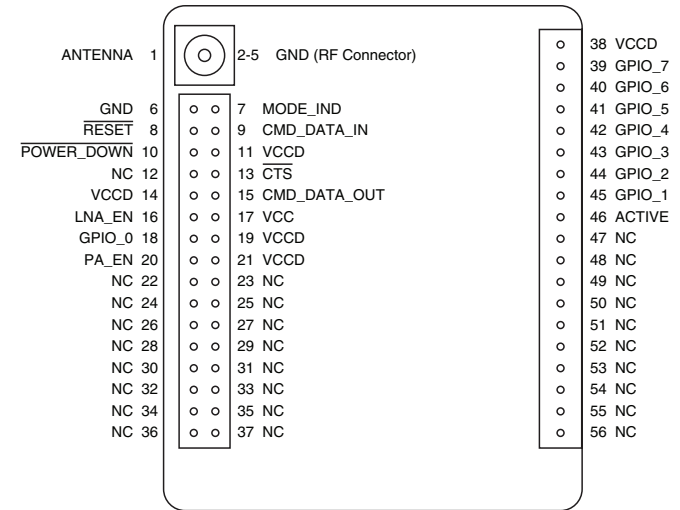## HumDT™ Series Carrier Board Pin Assignments

Figure 5: HumDT™ 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
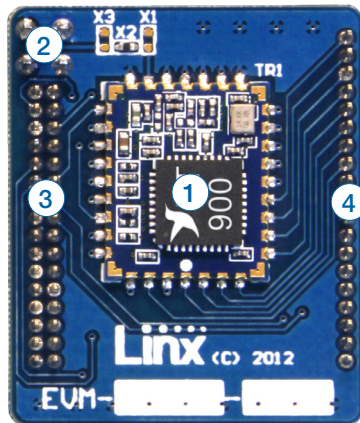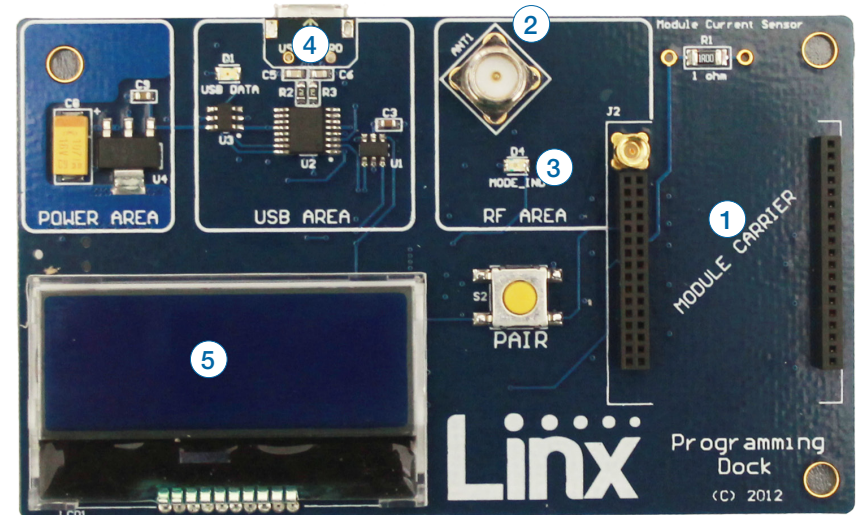
HumDT™ Series Transceiver Carrier Board

Figure 3: HumDT™ Series Transceiver Carrier Board

HumDT™ Series Transceiver Carrier Board Objects

1. HumDT™ Series Transceiver
2. MMCX RF Connector
3. Dual Row Header
4. Single Row Header
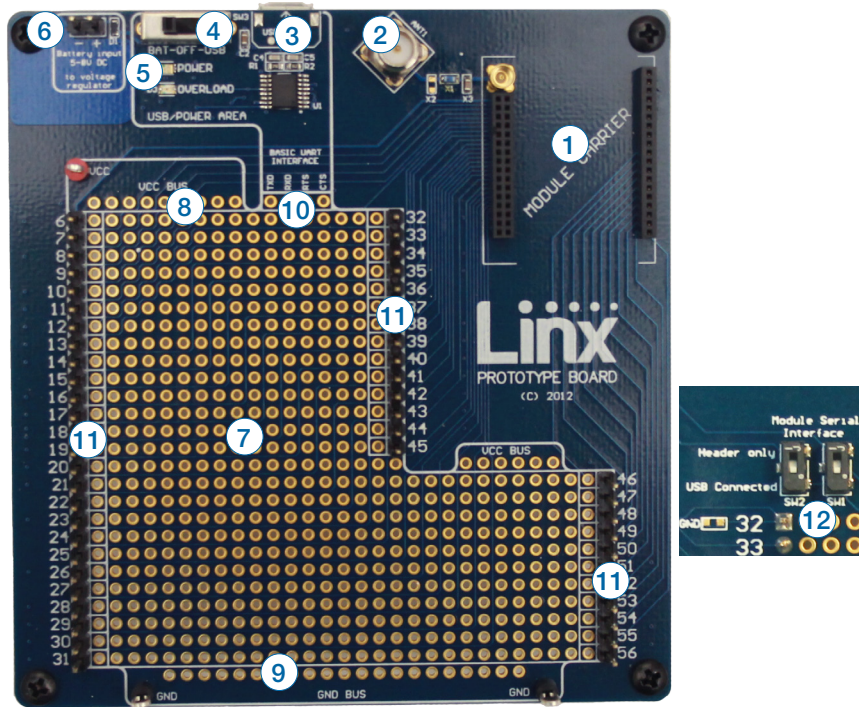
Prototype Board

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 HumDT™ 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.

> **Note:** The Prototype board uses a USB to UART chip to connect the module to the PC. This chip is powered from the 5V on the USB cable. It has an input line that detects the voltage on Vcc and sets the UART voltage levels to match as soon as power is applied to the chip.
>
> It is important that the power switch (SW3) be set appropriately before the USB cable is plugged in. If an external power supply is used and the switch is off when the cable is plugged in, then the UART output voltage may not be set correctly and could result in communication failures.
>
> Set the switch to BAT when using an external supply or to USB to use the USB bus to power the module. Then plug in the USB cable.

Using the Prototype Board

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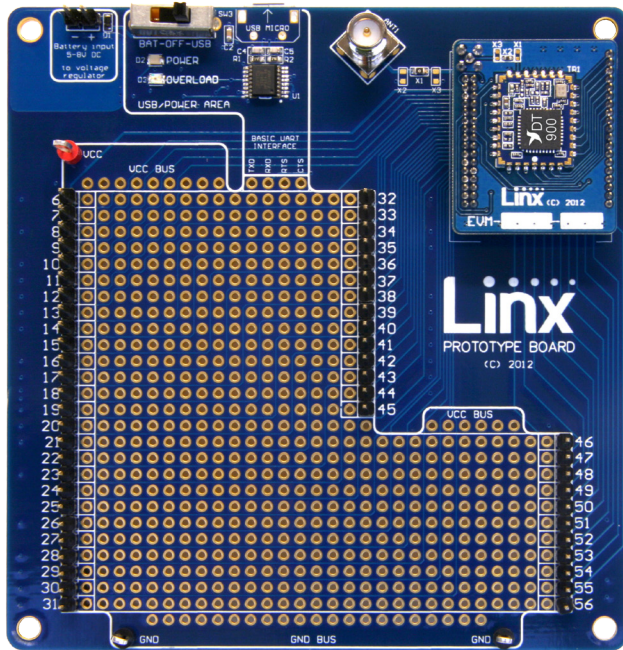

Figure 7: Prototype Board with a Carrier Board

Set the power switch (SW3) and 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 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.

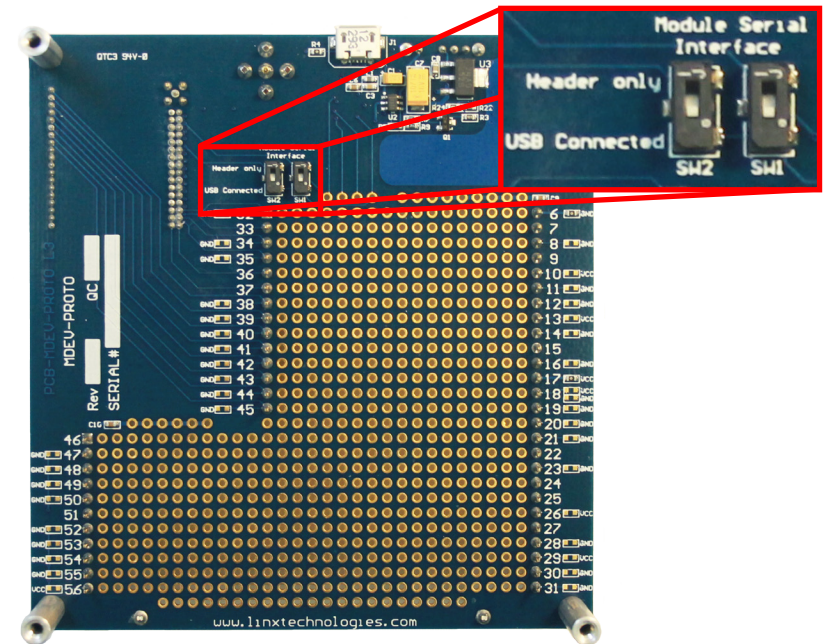Figure 8 shows the bottom of the board.

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.
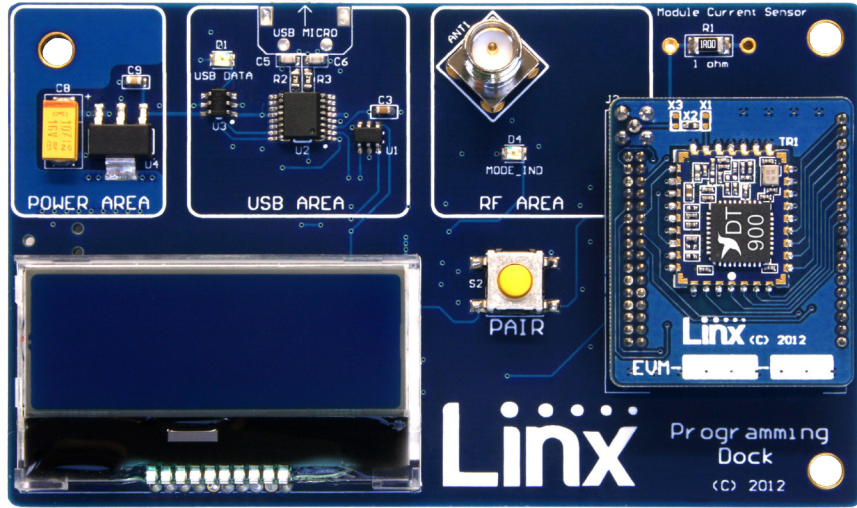

Figure 9: Programming Dock with a Carrier Board

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 HumDT™ 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 opened (Figure 10). This window configures the module's settings.
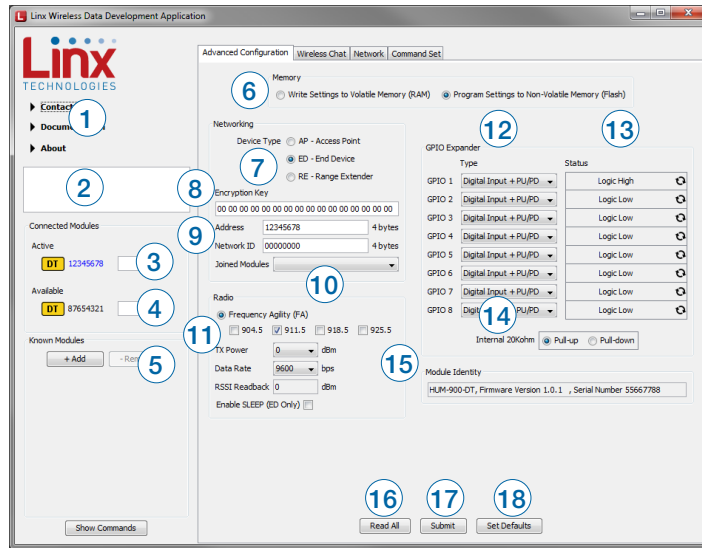

Figure 10: The Master Development System Software Advanced Configuration Tab

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 setting configures the software to read and write from either volatile memory or non-volatile memory.

7. The Device Type section configures the module as either an Access Point, End Device or Range Extender.

8. The Encryption Key box shows the module's 16 byte AES encryption

key. This can only be read from modules configured as an AP.

9. The Address box shows the module's current local address. The Network ID is the identifier of the network that the module is in. No other module with the same Network ID can have the same Address.

10. The Joined Modules list shows all of the modules that have joined with the current module. An ED and RE are only joined with an AP, so they have one entry. An AP can be joined to up to 50 other modules, including up to 4 REs.

11. The Radio section configures the radio functions. The checkboxes select which RF channels are used. The TX Power menu sets the transmitter output power. The data rate menu sets the serial UART data rate, which the module uses to configure the over-the-air data rate. The RSSI Readback shows the RSSI value of the last good packet that was received.

12. The GPIO Expander Type menus configure the eight GPIOs as digital inputs, digital outputs or analog inputs. The digital inputs are also configured to use internal pull-up or pull-down resistors, or set to high-impedance. High impedance deactivates the internal resistors.

13. The Status column shows the current status of all of the GPIO lines on the active module.

14. The Internal 20kohm radio button sets the internal resistors as either pull-up or pull-down.

15. The module identity box shows the active module's name, firmware version and serial number.

16. The Read All button reads all of the values.

17. The Submit button writes all changes to the active module.

18. The Set Defaults button restores all settings to the factory defaults.
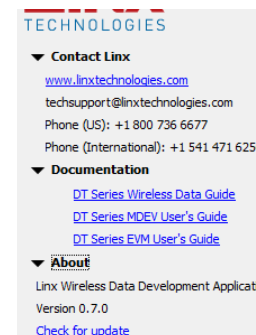

Figure 11: The Master Development System Software Additional Information

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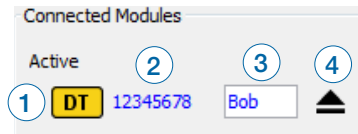

Figure 12: The Master Development System Software Module Identifiers

1. The type of module (HumDT™ 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: 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.
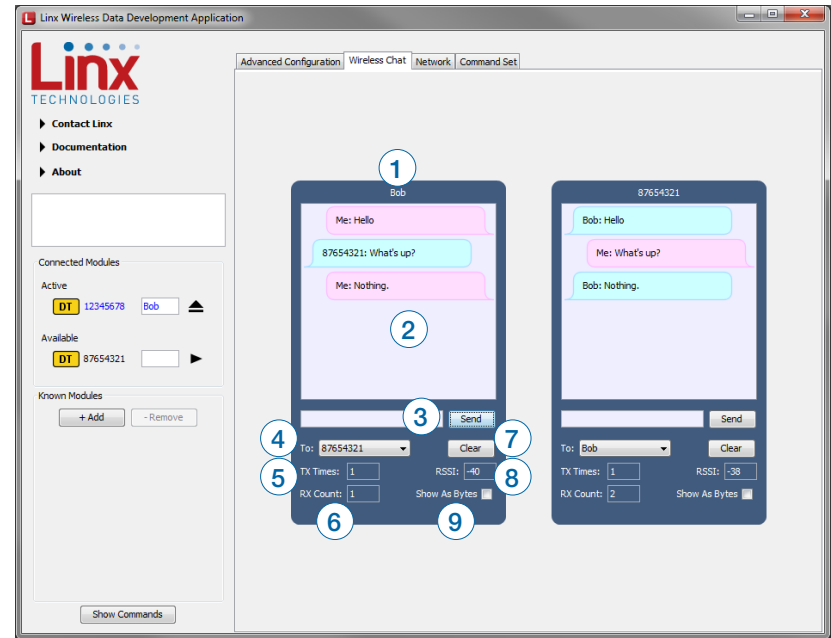
Figure 14: The Master Development System Software Wireless Chat Tab

1. The top of the window shows the address of the associated module.
2. The chat screen shows the chat messages that have been sent and received.
3. The Send box is where the message text is entered. The message is transmitted when the Send button is pressed.
4. The To menu selects the address of the connected module that is to receive the message (the destination address).
5. The TX Times box shows how many times the module has transmitted.
6. The RX Count box counts the number of messages that the module has received.
7. The Clear button clears all of the messages from the chat window.
8. The RSSI box indicates the signal strength of the last received message.
9. When the Show As Bytes box is selected the messages are shown as bytes in the chat window.

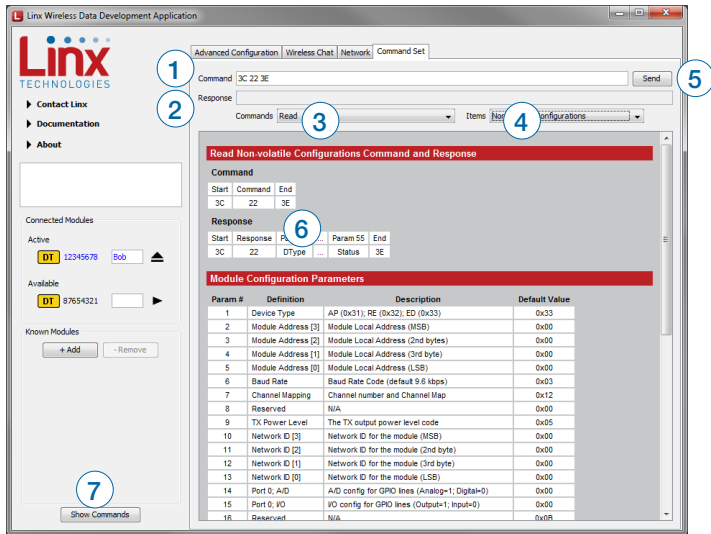The Command Set tab (Figure 15) allows specific commands to be written to the module.

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 the Send button 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 HumDT™ Series Transceiver Data Guide for definitions of each value.
7. The Show Commands button opens a window that shows all of the bytes sent to the module and the responses from the module.
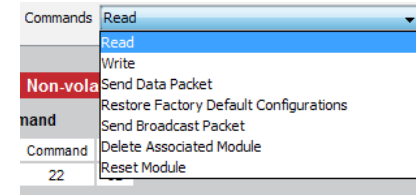
Figure 16: The Master Development System Software Command Set Tab Commands Menu
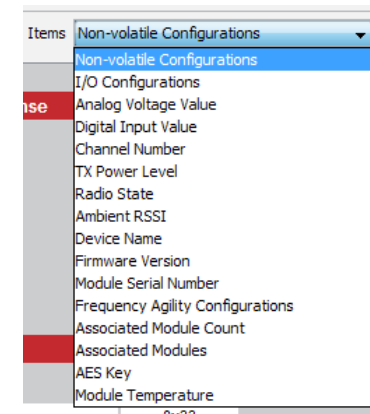

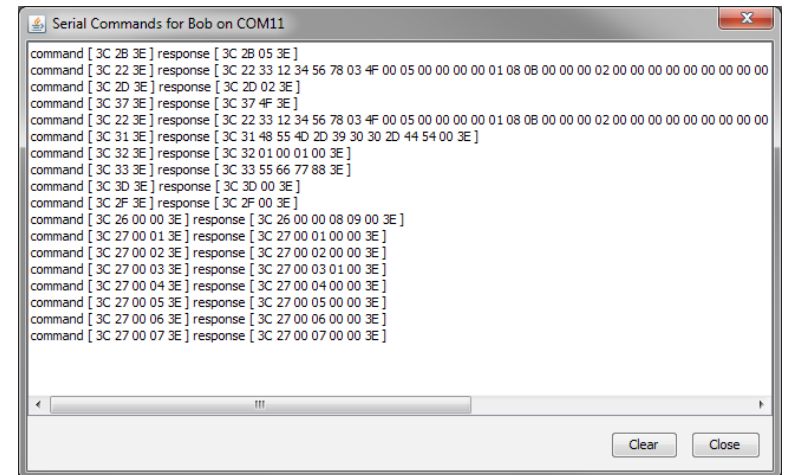Figure 17: The Master Development System Software Command Set Tab Items Menu

Figure 18: The Master Development System Software Show Commands Window

The Network tab shows the interaction of all of the connected modules on one screen. Figure 19 shows two modules on the screen, but up to 8 modules can fit at one time.
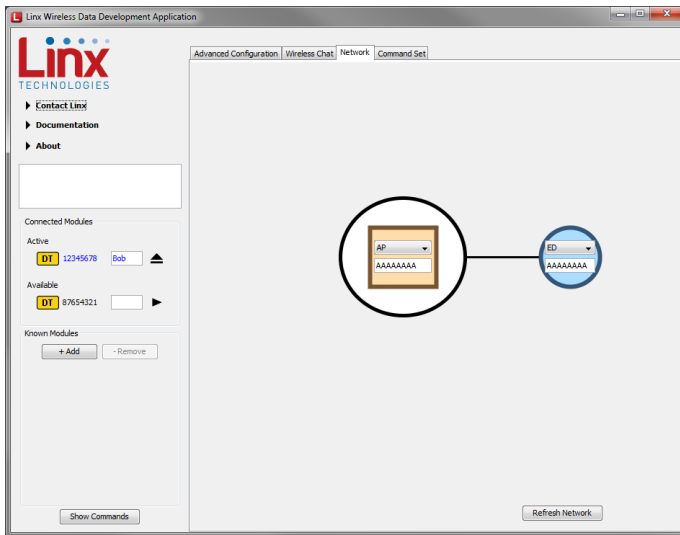

Figure 19: The Master Development System Software Network Tab

The screen shows the network configuration of all modules that are connected to the PC. The drop-down menu changes the module's device type and the text box has the module's network ID. This screen makes it easy to quickly set up the network and visually verify its configuration.

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 20).
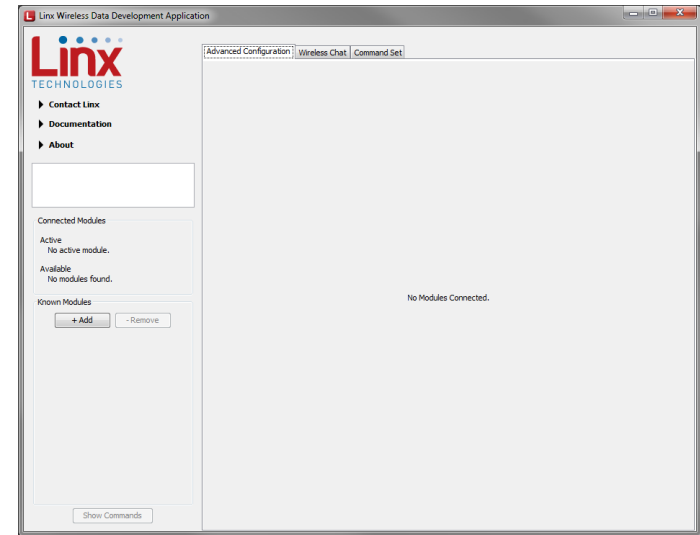
Figure 20: The Master Development System Software Advanced Configuration Tab at Start-up

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 21.
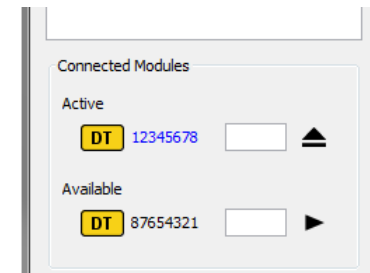

Figure 21: The Master Development System Software Connected Modules

Once the modules are detected by the software, the appropriate options are displayed on the Advanced Configurations tab and a Network tab appears. The module's documents appear under the Documentation link.
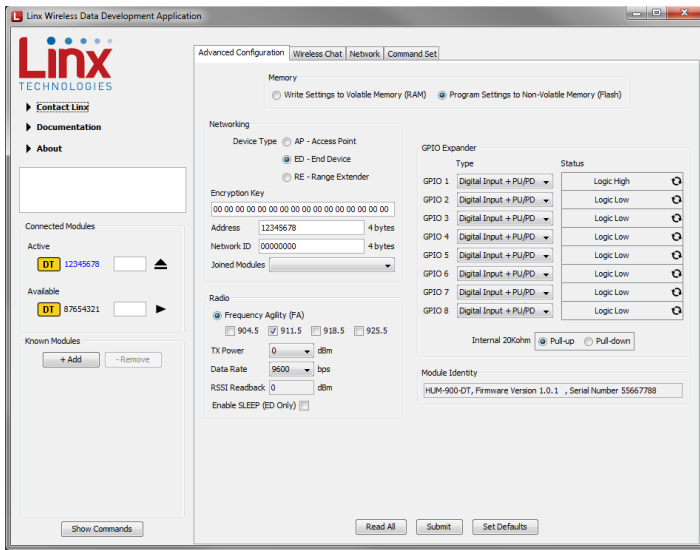
Figure 22: The Master Development System Software with Connected Modules

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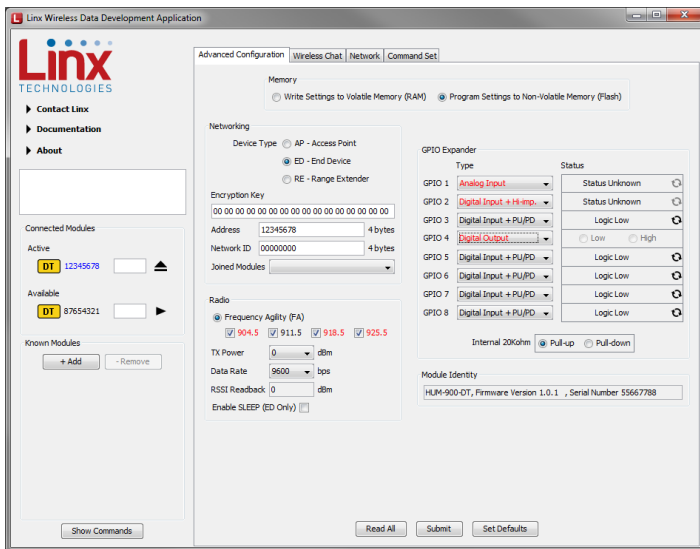

Figure 23: The Master Development System Software Advanced Configuration with Changes

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.
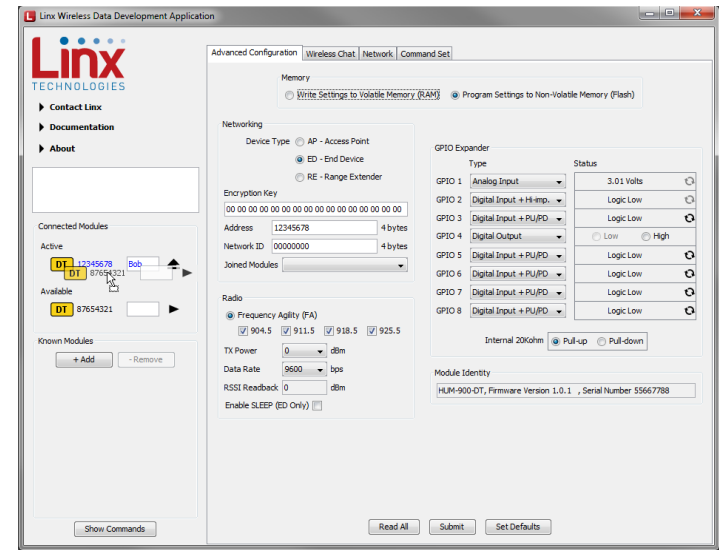
Figure 24: The Master Development System Software Dragging to Change the Active Module

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

• The Encryption Key must match on both modules. This can only be read out of an AP.

• Network ID must match on both devices.

• The UART Baud Rate is 9600.

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

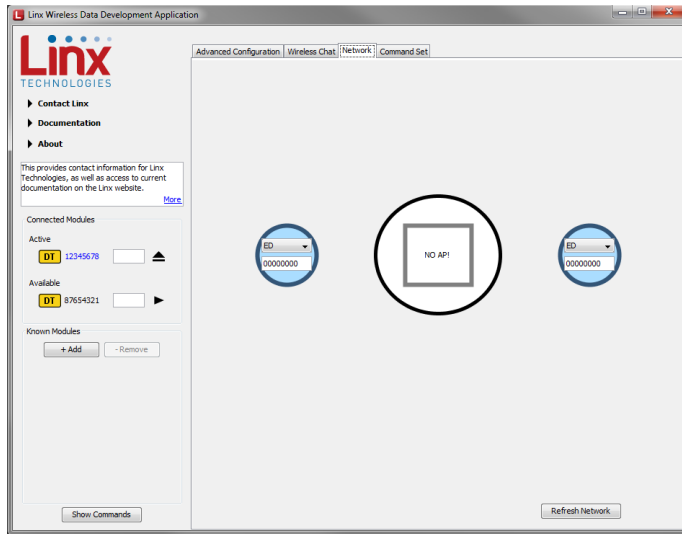Clicking on the Network tab shows the current state of all modules connected to the PC.

Figure 25: The Master Development System Software Network Tab

Both modules are set as End Devices. There must be at least one Access Point in every network, so one module must be changed. This is accomplished by clicking the drop-down menu on one of the modules and selecting AP.
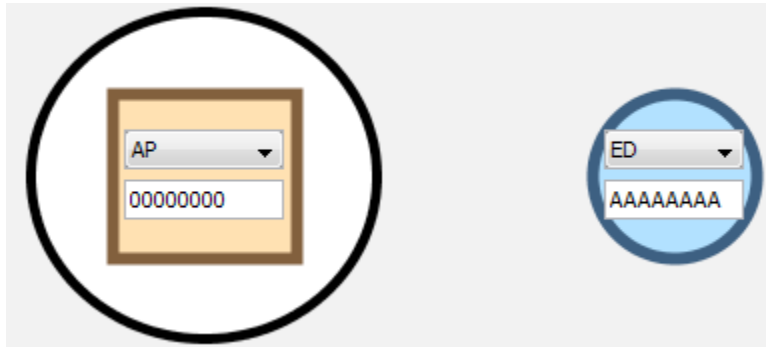

Figure 26: The Master Development System Software Network Tab

Both modules must have the same Network ID, so change the ID number in one or both of the boxes to match.
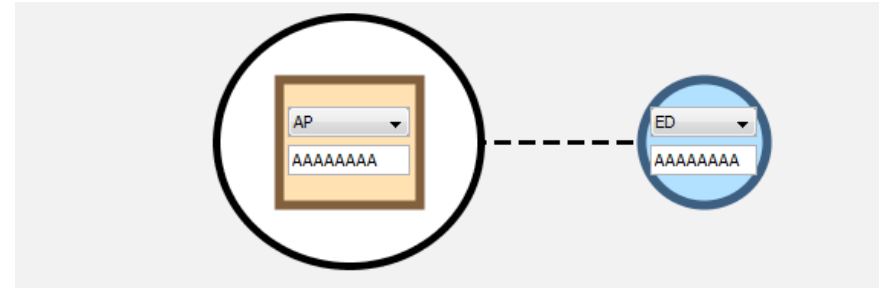
Figure 27: The Master Development System Software Network Tab

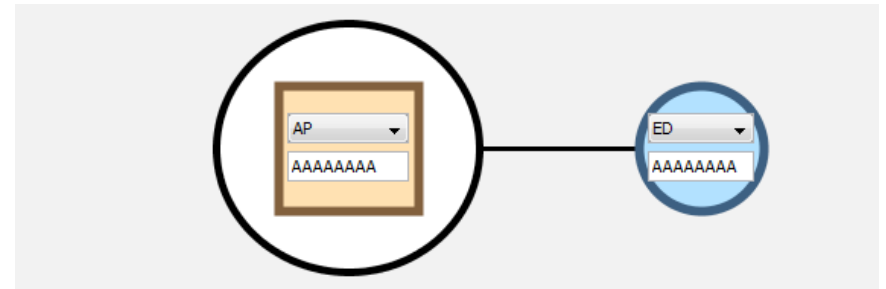A dotted line appears between the modules indicating that they are joining the network.

Figure 28: The Master Development System Software Network Tab

A solid line appears between the modules when they are joined and ready to communicate. The Wireless Chat tab can now be used to send data between the modules.
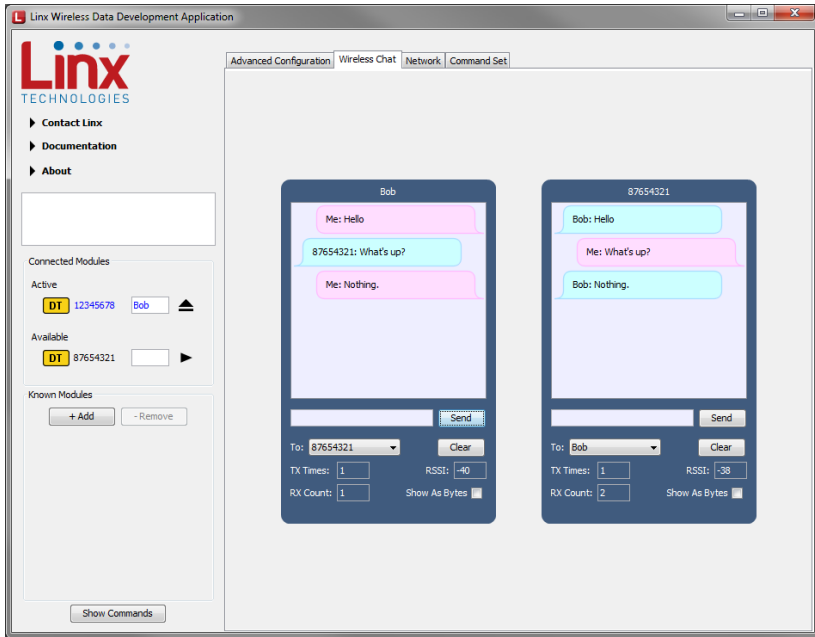
Figure 29: The Master Development System Software Wireless Chat Tab
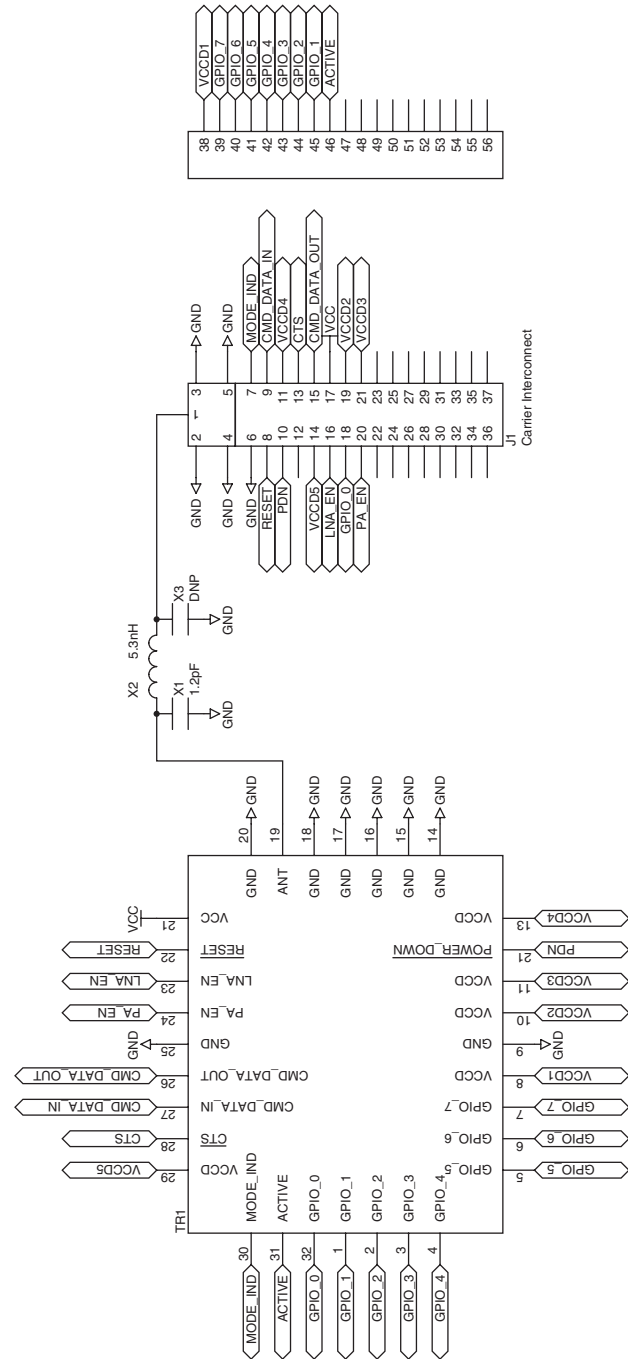
Carrier Board Schematic

Figure 30: HumDT™ Series Transceiver Carrier Board Module Schematic

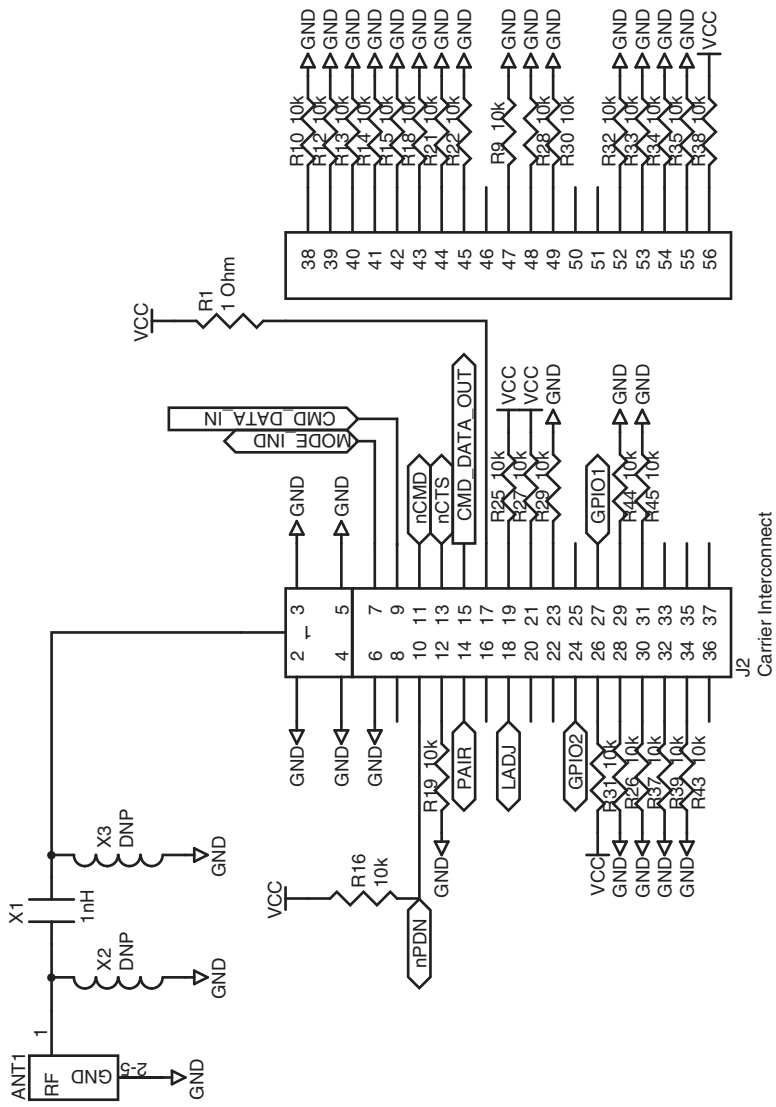# Programming Dock Board Schematic

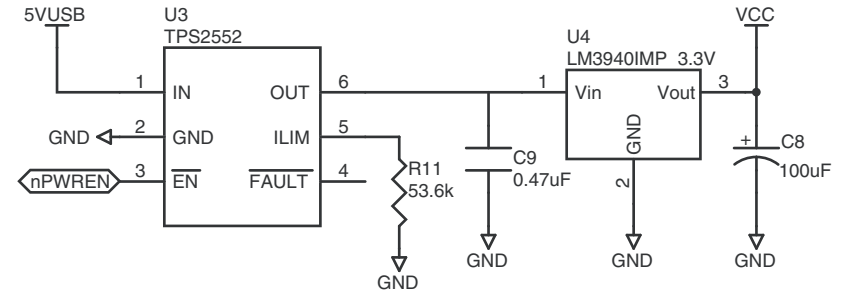Figure 31: Programming Dock Board RF Carrier Area Schematic

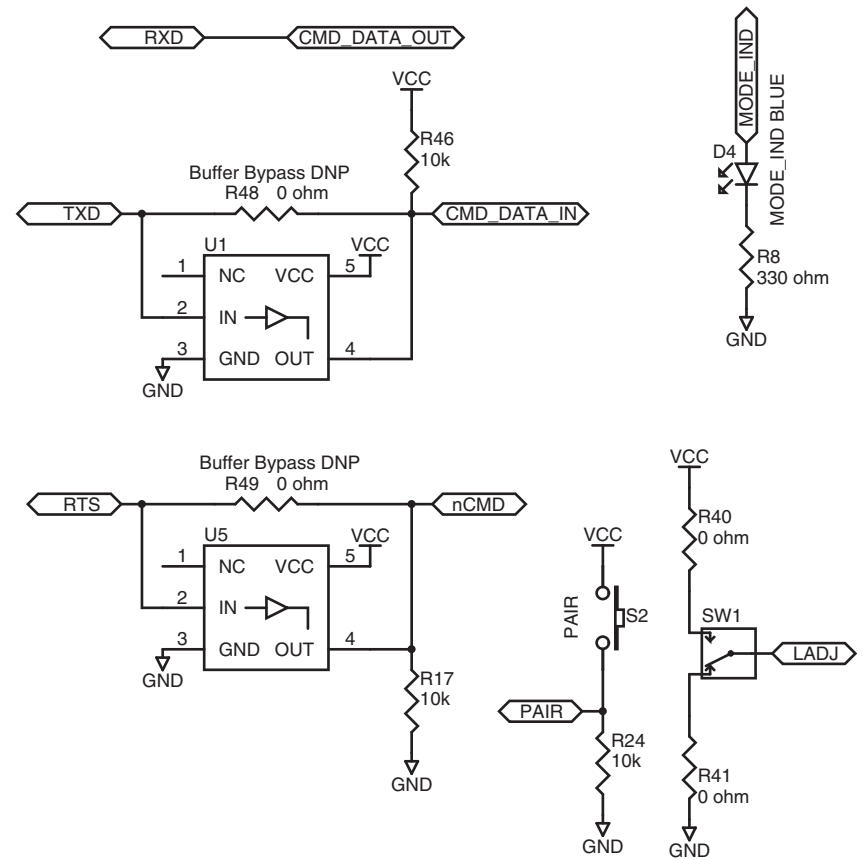Figure 32: Programming Dock Board Power Supply Area Schematic

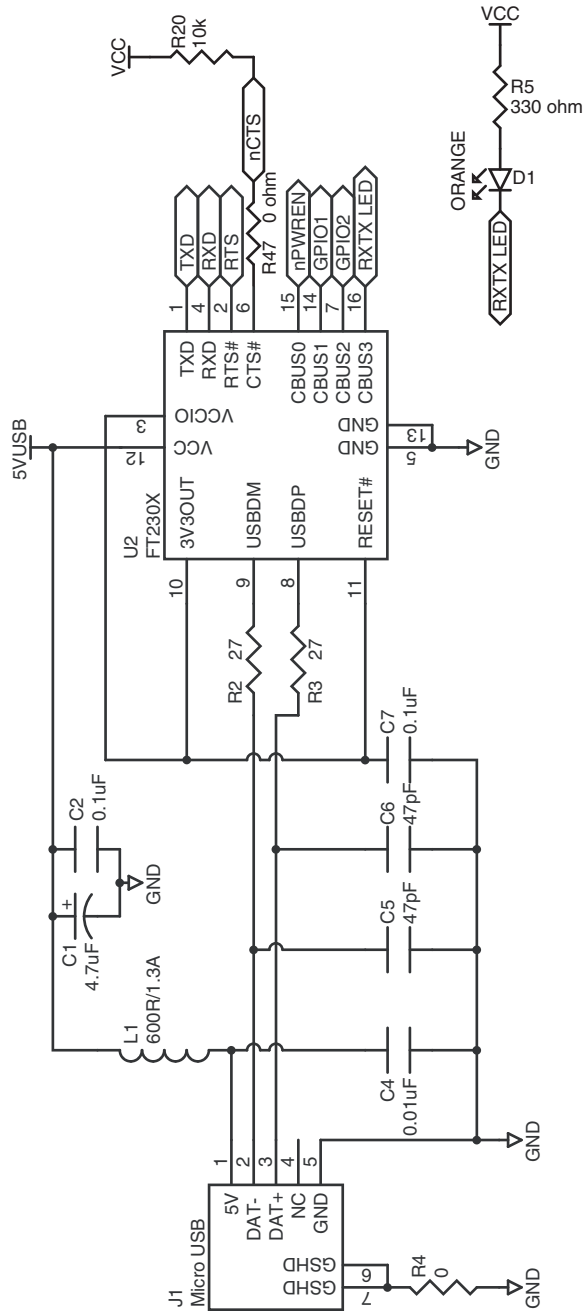Figure 33: Programming Dock Board Signal Routing Schematic

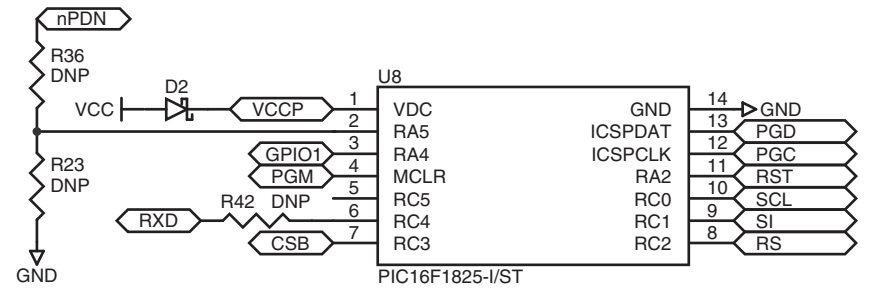Figure 34: Programming Dock Board USB Area Schematic

VCC

R20
10k

VCC

nCTS

R47 0 ohm
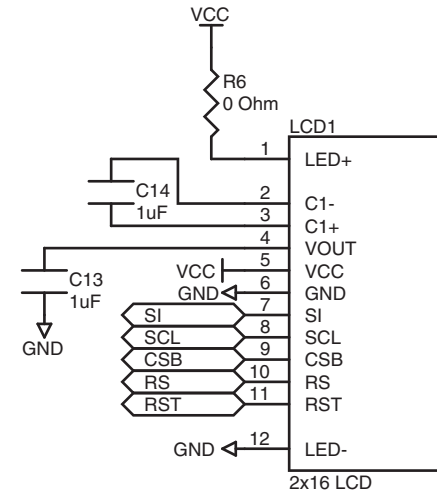
TXD RXD RTS nPWREN GPIO1 GPIO2 RXTX LED

1 4 2 6 15 14 7 16

TXD RXD RTS# CTS# CBUS0 CBUS1 CBUS2 CBUS3

U2
FT230X

VCCIO
VCC

3
12

3V3OUT USBDM USBDP RESET#

10 9 8 11

GND GND

13 5

GND

5VUSB

R2 27
R3 27

C2 0.1uF

GND

C1 4.7uF

L1 600R/1.3A

C7 0.1uF

C6 47pF

C5 47pF

C4 0.01uF

GND

GND

J1
Micro USB

5V DAT- DAT+ NC GND

1 2 3 4 5

GSHD
GSHD

6 7

R4 0

GND

VCC

R5 330 ohm

ORANGE

D1

RXTX LED

Figure 35: Programming Dock Board Microcontroller Area Schematic

nPDN

R36
DNP

VCC

R23
DNP

GND

D2

VCCP

RXD

R42 DNP

CSB

U8

VDC RA5 RA4 MCLR RC5 RC4 RC3

1 2 3 4 5 6 7

GND ICSPDAT ICSPCLK RA2 RC0 RC1 RC2

14 13 12 11 10 9 8

GND PGD PGC RST SCL SI RS

PIC16F1825-I/ST

GPIO1
PGM

VCC

R6
0 Ohm

LCD1

LED+ C1- C1+ VOUT VCC GND SI SCL CSB RS RST LED-

1 2 3 4 5 6 7 8 9 10 11 12

C14 1uF

C13 1uF

GND

VCC
GND

SI
SCL
CSB
RS
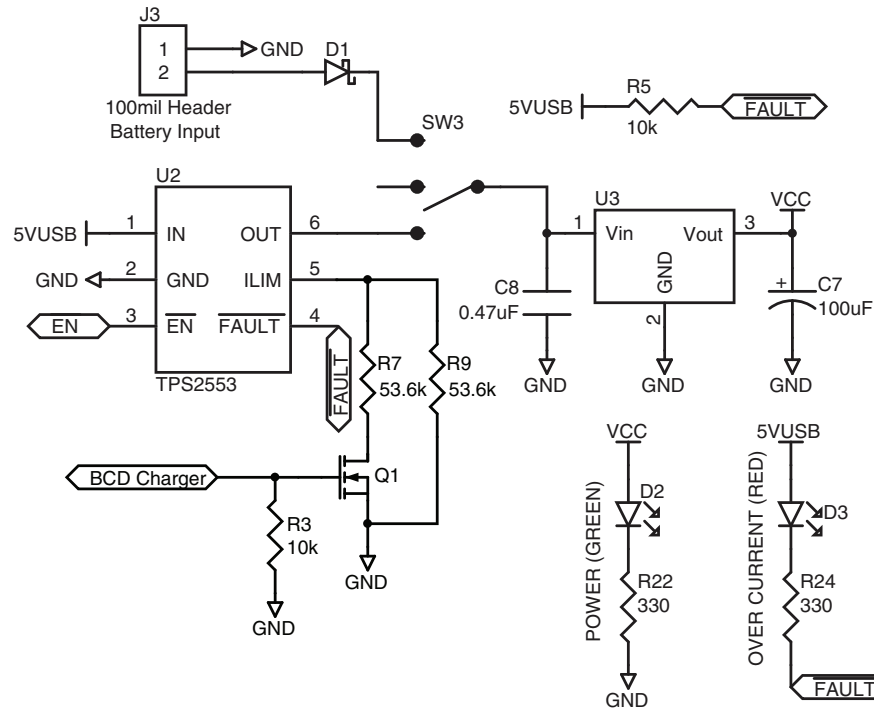RST

GND

2x16 LCD

Prototype Board Schematic
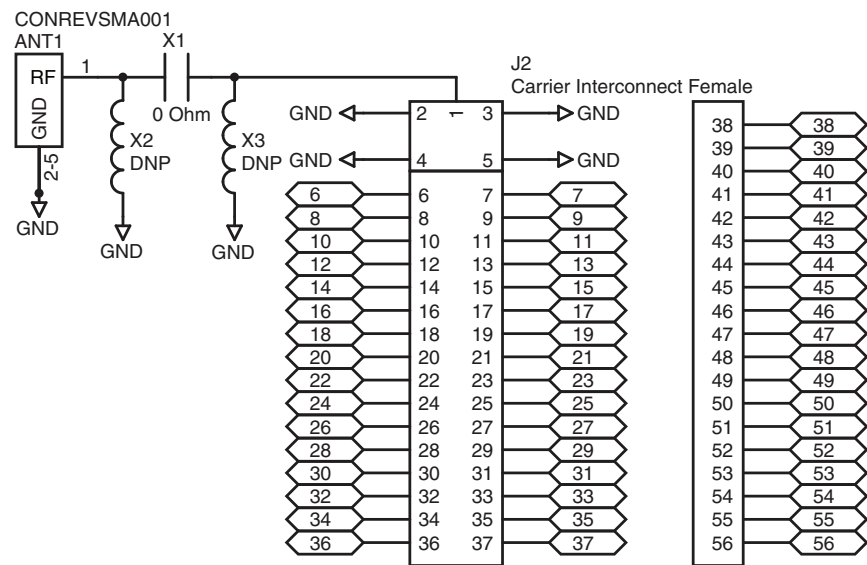

Figure 36: Prototype Board Power Supply Area Schematic
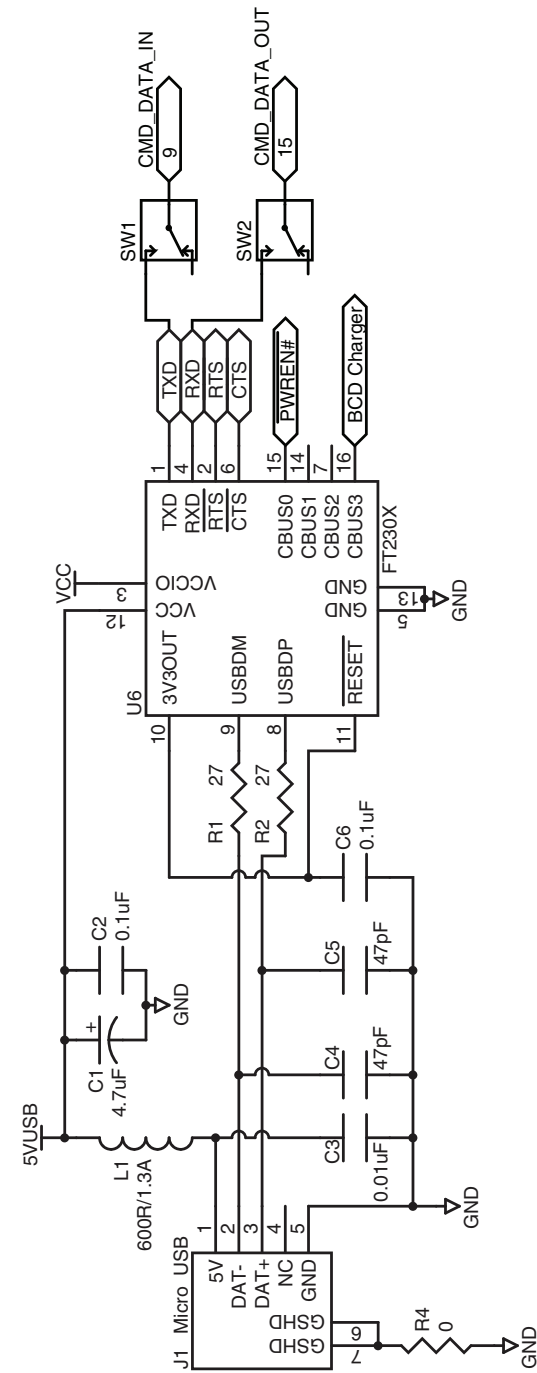

Figure 37: Prototype Board RF Carrier Area Schematic

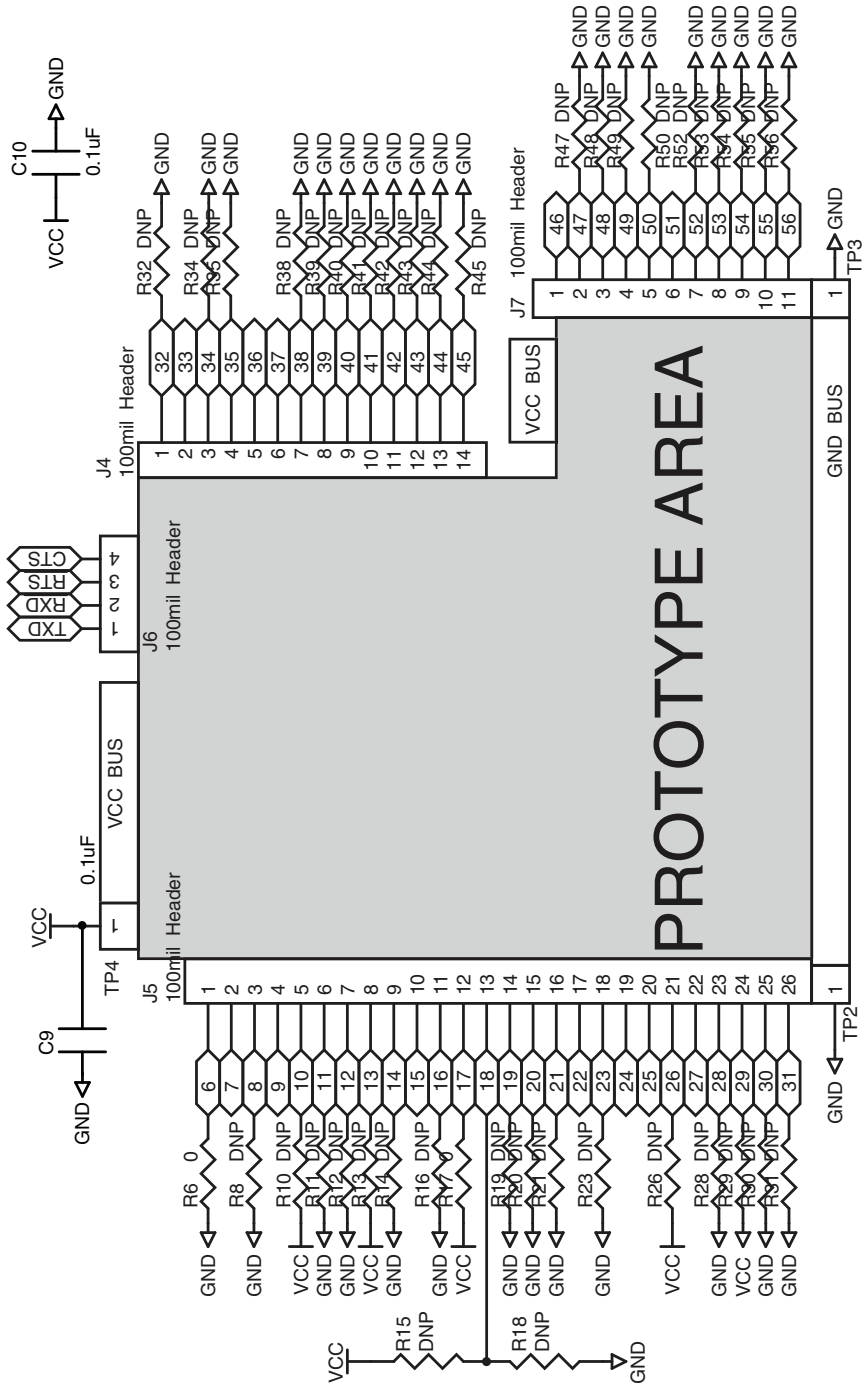Figure 38: Prototype Board USB Area Schematic

Figure 39: Prototype Board Prototype Area Schematic

Linx Technologies
159 Ort Lane
Merlin, OR, US 97532

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.