



HumPRC™ 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.

Ordering Information

Ordering Information	
Part Number	Description
MDEV-***-PRC	HumPRC™ Series Master Development System
HUM-***-PRC	HumPRC™ Series Remote Control Transceiver, Castellation Interface, External Antenna Connection
HUM-***-PRC-CAS	HumPRC™ Series Remote Control Transceiver, Certified, Castellation Interface, External Antenna Connection
HUM-***-PRC-UFL	HumPRC™ Series Remote Control Transceiver, Certified, Castellation Interface, U.FL Connector
EVM-***-PRC	HumPRC™ Series Carrier Board, Not Certified, Through-Hole Pin Interface, MMCX Connector for the Development System
EVM-***-PRC-CAS	HumPRC™ Series Carrier Board, Certified, Through-Hole Pin Interface, RP-SMA Connector
EVM-***-PRC-UFL	HumPRC™ Series Carrier Board, Certified, Through-Hole Pin Interface, U.FL Connector
OTX-***-HH-LR8-PRC	HumPRC™ Long-Range Handheld Transmitter
MDEV-DEMO-RC-A	Development System Remote Control Demo Board, Type A
MDEV-DEMO-RC-B	Development System Remote Control Demo Board, Type B
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

Programming Dock

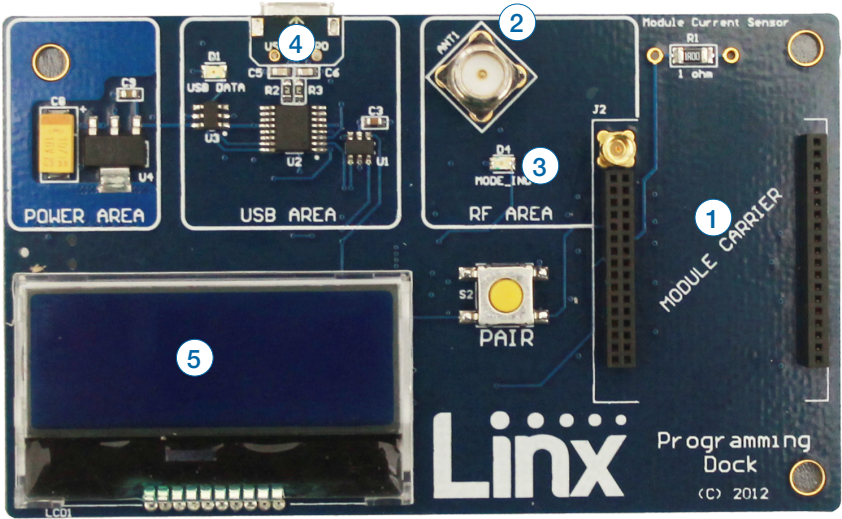


Figure 5: Programming Dock

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

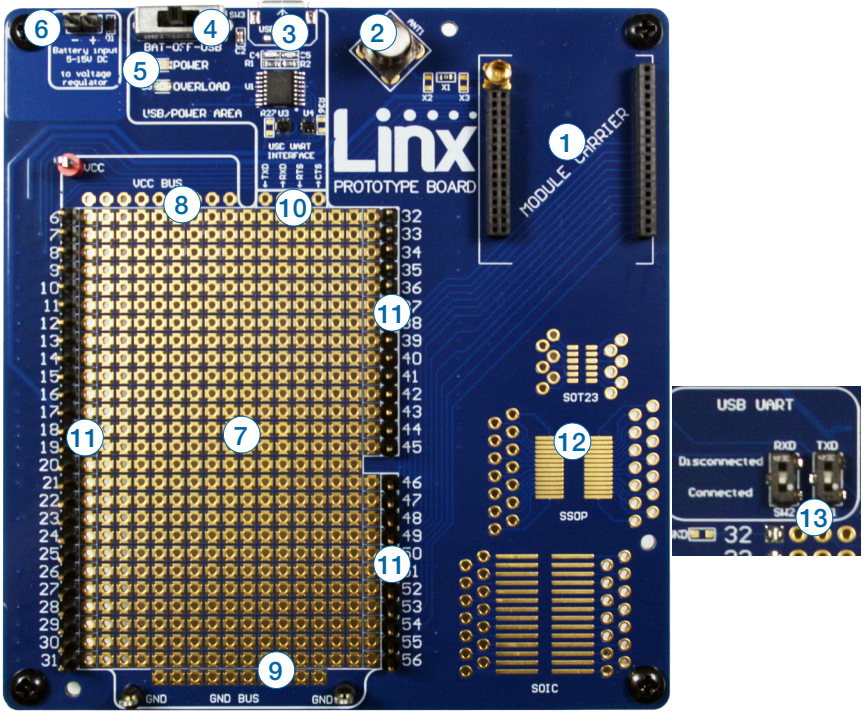


Figure 7: Prototype Board

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 Interface Lines
11. Module Interface Headers
12. Standard IC Package Footprints
13. Command Data Interface Routing Switches (on back)

Long-range Handheld Transmitter Button Assignments

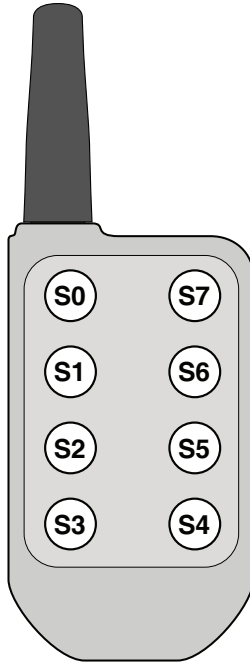


Figure 9: OTX-***-HH-LR8-PRC Button Assignments

Initial Setup

Several boards are included with the Development System that are intended for different use cases:

1. Two Remote Control Demo Boards for bi-directional operation and range testing
2. One Programming Dock to demonstrate use of the Command Data Interface with a PC.
3. One Prototype Board for use in developing a custom application
4. One Handheld transmitter and Handheld Transmitter Evaluation Board for one-way operation with a finished transmitter.

The Carrier Boards have a HumPRC™ 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.

Using the Programming Dock

Snap a Carrier Board onto the socket on the Programming Dock as shown in Figure 10.

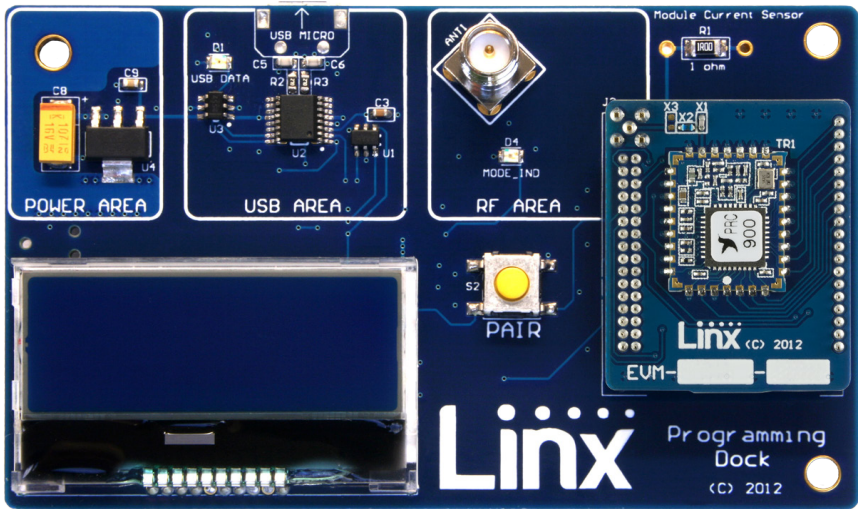


Figure 10: Programming Dock with a Carrier Board

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 HumPRC™ Series transceiver has a serial Command Data Interface that offers the option to configure the transceiver through software instead of through hardware. 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 Remote Control Demo Boards. To prepare the board for range testing, simply turn it on by switching the power switch to the ON position. Pressing a status line button on one board (the IU) activates an LED on the other board (the RU). The RU then sends an acknowledgement back to the IU, which turns on the CONFIRM LED. This indicates good bi-directional RF communications and lets the user set one board down and walk with the other board.

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, measure the receiver's RSSI voltage 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.

Note: The Remote Control Demo boards are designed for hardware configuration. If the modules are changed through software configuration then the boards may not operate as expected. A restore to default configuration can be used to reset the modules.

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 13 shows the bottom of the board.

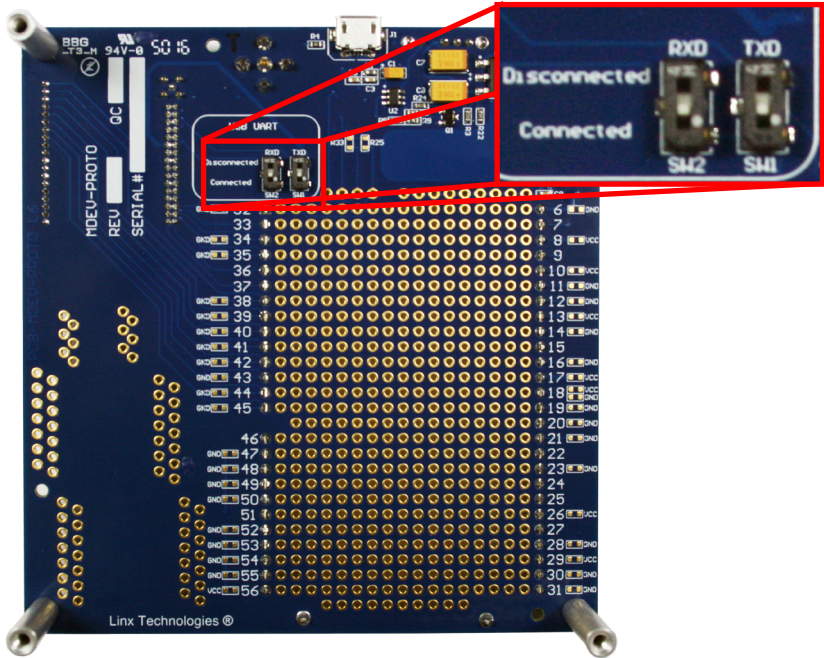


Figure 13: Prototype Board Bottom Side

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. The prototype board is shipped with the switches in the “Header Only” position.

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 Handheld Transmitter Evaluation Board

Snap a Carrier Board onto the socket on the Handheld Transmitter Evaluation Board and install the batteries and an antenna as shown in Figure.

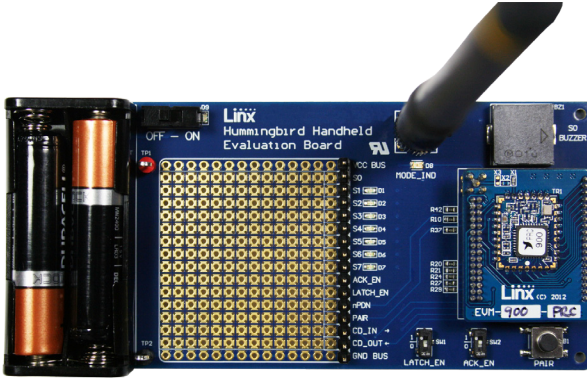


Figure 15: Assembled Handheld Transmitter Evaluation Board

The receiver board is powered by two AAA batteries. A Linx HumPRC™ Series transceiver is used for reception of the transmitted signal. This receiver provides exceptional sensitivity, allowing the transmitter and receiver to operate at distances of up to 0.8 mile (1,300m) depending on signal conditions. The data recovered by the transceiver is validated and if everything is correct, the status line outputs are updated to match the states of the buttons on the transmitter. To demonstrate this, one status line on the evaluation board is used to drive a buzzer while the other lines activate LEDs. The board also has a prototyping area with all of the transceiver lines brought out to a header.

Turn on the power to the board, and press a button on the handheld transmitter. When S0 is pressed, the buzzer sounds; when S1–S7 are pressed, the LEDs turn on. When any button (S0–S7) is pressed on the transmitter, the corresponding output (S0–S7) is active high (V_{CC}) on the prototyping header.

Simple range testing can be performed with the transmitter and Evaluation Board by placing the board in a stationary location and walking away with the transmitter. When in good signal range, as a button is pressed on the transmitter, the buzzer will sound or an LED will light up on the Evaluation Board. Also, the Acknowledgement LED will light up on the transmitter. When the Evaluation Board no longer activates and moving around a few feet does not restore operation, the maximum range in the operating environment has been reached.

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 RC Configuration tab when opened (Figure 18). This window offers basic configuration and demonstration of the module's functionality with the current configuration.

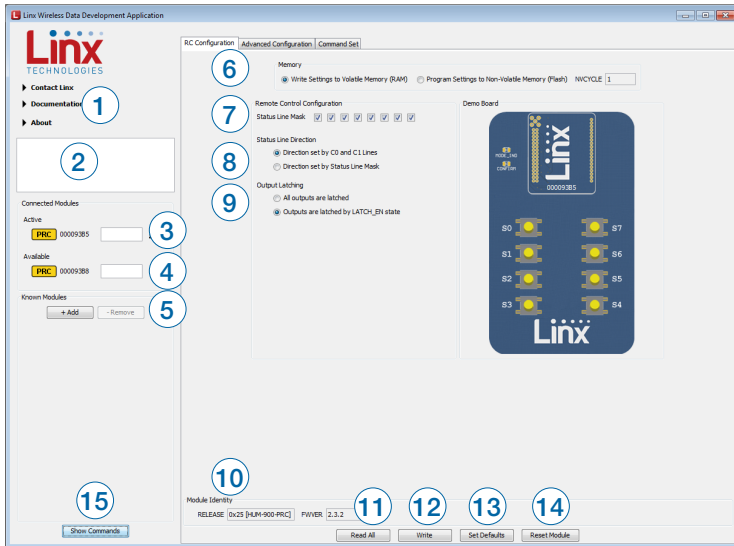


Figure 18: The Master Development System Software Demo and EZConfiguration Tab

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 19.
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 PC
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 if changes are written to volatile or non-volatile memory.

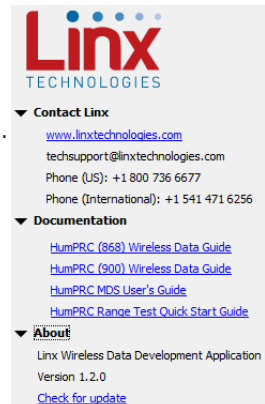


Figure 19: Additional Information

The Advanced Configuration tab (Figure 21) offers more detailed configuration options for the active module.

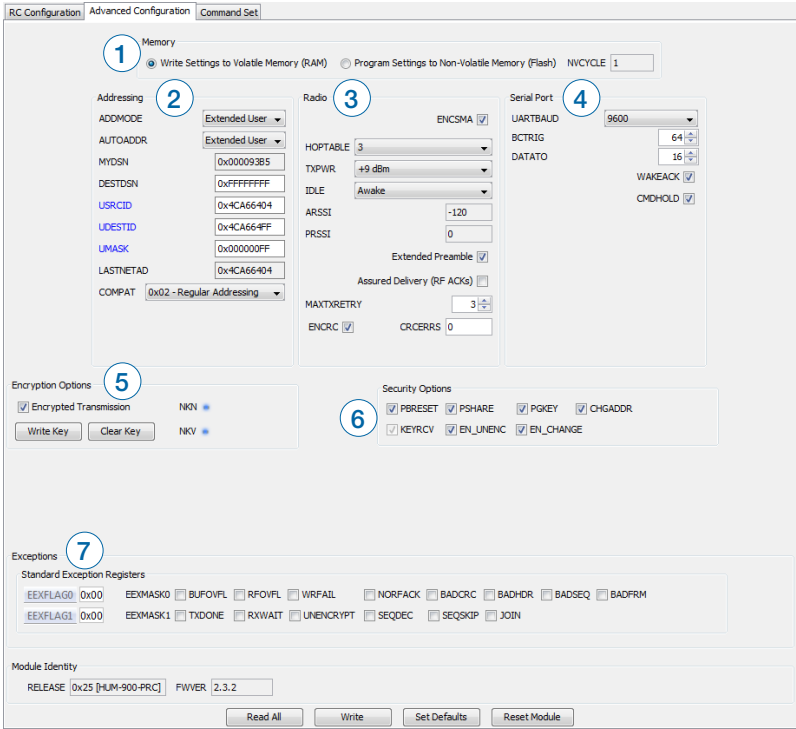


Figure 21: The Master Development System Software Advanced Configuration Tab

1. The Memory group selects if changes are written to volatile or non-volatile memory.
2. 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.

- 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.
5. 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 22).
 - Clicking the Clear Key button opens a window where the key can be cleared (Figure 22).

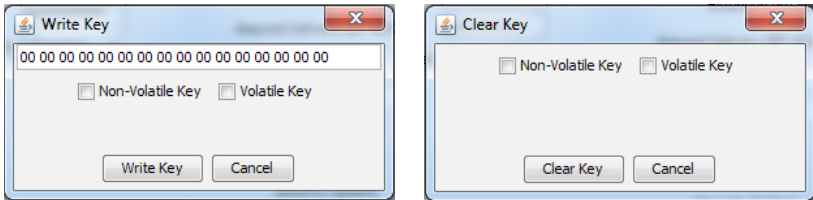


Figure 22: The Master Development System Software Write Key and Clear Key Windows

6. 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.
7. 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 23).

- The Items drop down menu displays all of the items that are available for the active module (Figure 26). Selecting one of the items from this menu automatically fills in the Command box. The values can be adjusted by typing in the box.

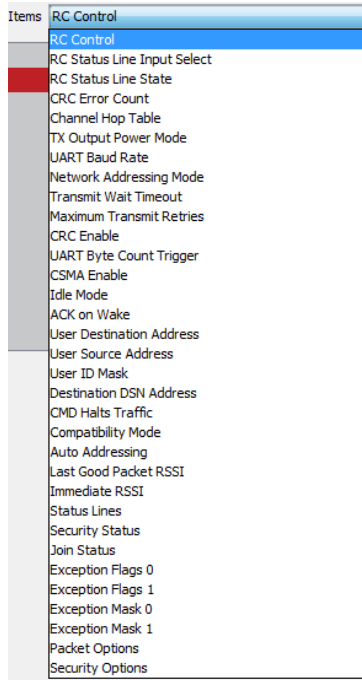


Figure 26: The Master Development System Software Command Set Tab Items Menu

- Clicking the Send button writes the values in the Command box to the module.
- The structure of the selected command and its response is shown in the main window. Please see the HumPRC™ Series Transceiver Data Guide for definitions of each value.

To change the status line directions, first change the Status Line Direction option to “Direction set by Status Line Mask.” The change is highlighted in red (Figure 29). Click the Write button to write the change to the module.

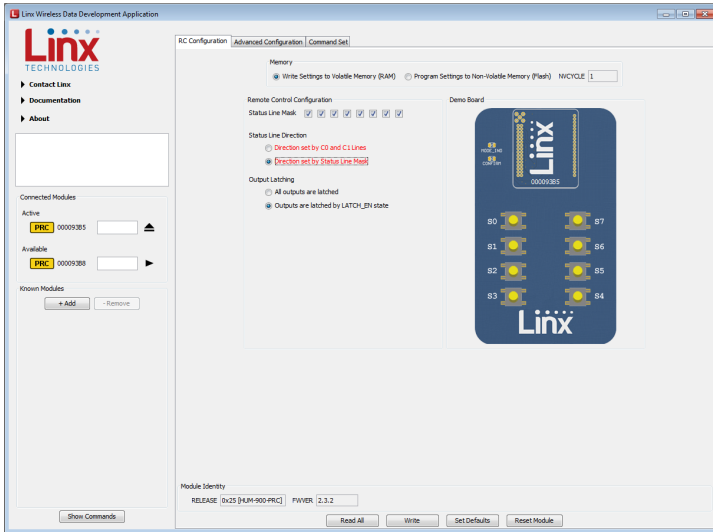


Figure 29: The Master Development System Changed Status Line Direction

Then change the Status Line Mask as desired. Checked boxes are set as inputs for buttons (Figure 30).

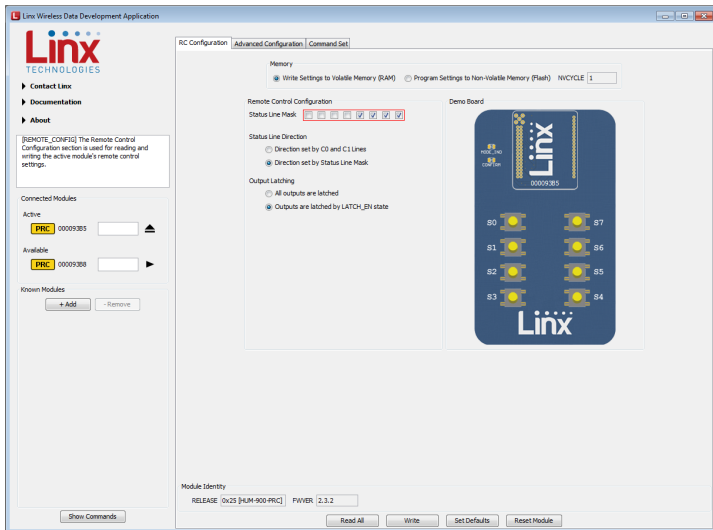


Figure 30: The Master Development System Changed Status Line Mask

When the latched configuration is written to the module, the symbol next to the LEDs changes to reflect the operation (Figure 33).

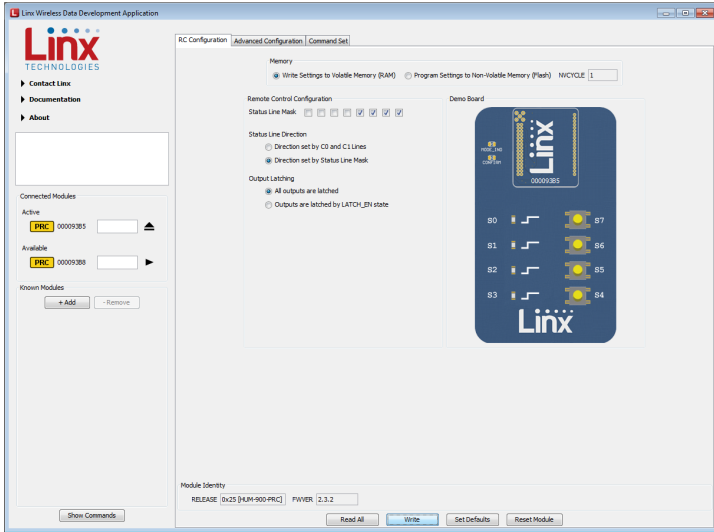


Figure 33: The Master Development System Software Configured Module

Figure 34 shows the latching and momentary symbols.



Figure 34: The Master Development System Software Latching (1) and Momentary (2) Symbols

The software continuously polls the module checking the state of its outputs. When it detects that the module has taken a line high, this is reflected in the software as an active LED (Figure 35).

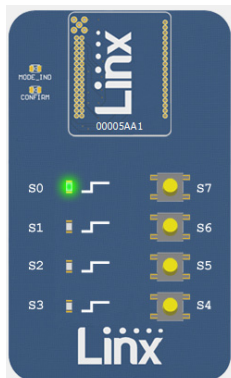


Figure 35: The Master Development System Software Activated Module

The Join Process selects a random 3-byte number that is used as a network address. This is placed in the upper 3 bytes of the module's local source address (USRCID) and the destination address (UDESTID). In this example, the number is 0x4CA664. The last byte in the USRCID field is the module's unique address, in this case 0x03 and 0x04 for the two modules.

The UMASK value is 0x000000FF. This divides the address into two groups. All of the address bits in a received message represented by the '0's must match the local USRCID exactly in order for the message to be accepted. In this case, the UDESTID address in a received packet must be 0x4CA664 or the packet is rejected.

The bits in a received packet represented by the 0xFF in the mask must match exactly or be all '1's in order for the message to be accepted. In this case, the low byte of the received UDESTID must match the last byte of the local USRCID or be 0xFF in order for the received packet to be accepted. Since all modules will accept a 0xFF, this is the network broadcast address.

The HumPRC™ Join Process automatically sets the lower byte UDESTID to 0xFF, so all modules broadcast to the entire network. This means all modules can control all other modules in the network. This is limited by the status line input / output configurations as a line set as an input cannot be activated. Only lines set as outputs can be activated.

For more information on the addressing modes and join process, please see RG-00105, the HumPRO™ Series Addressing Mode Reference Guide and RG-00107, The HumPRO™ Series Join Process Reference Guide.

Remote Control Demo Board Schematic

Note: The Remote Control Demo boards are designed to accept carrier boards for multiple module families. Some circuitry is not applicable for some modules.

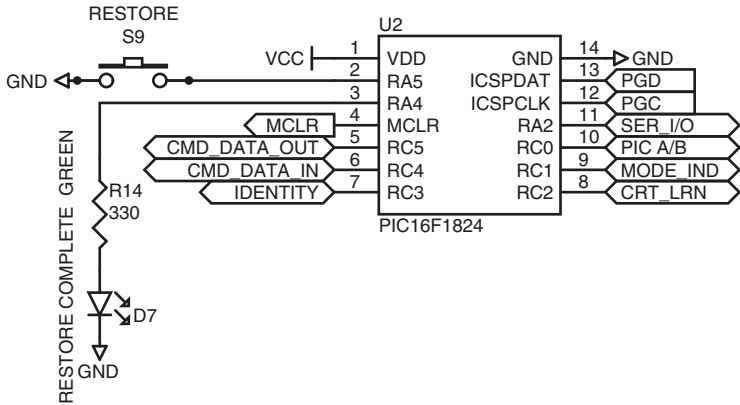


Figure 39: Remote Control Demo Board Microcontroller Area Schematic

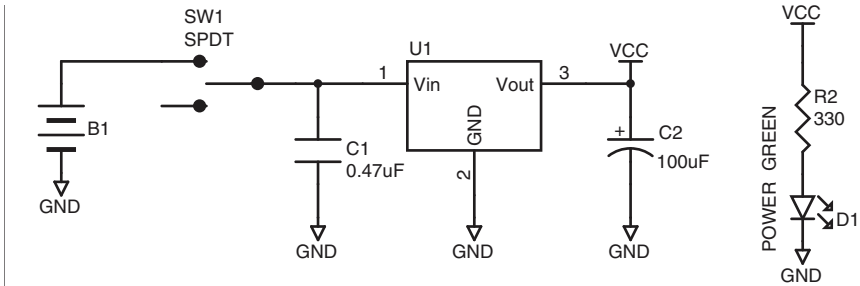


Figure 40: Remote Control Demo Board Power Supply Area Schematic

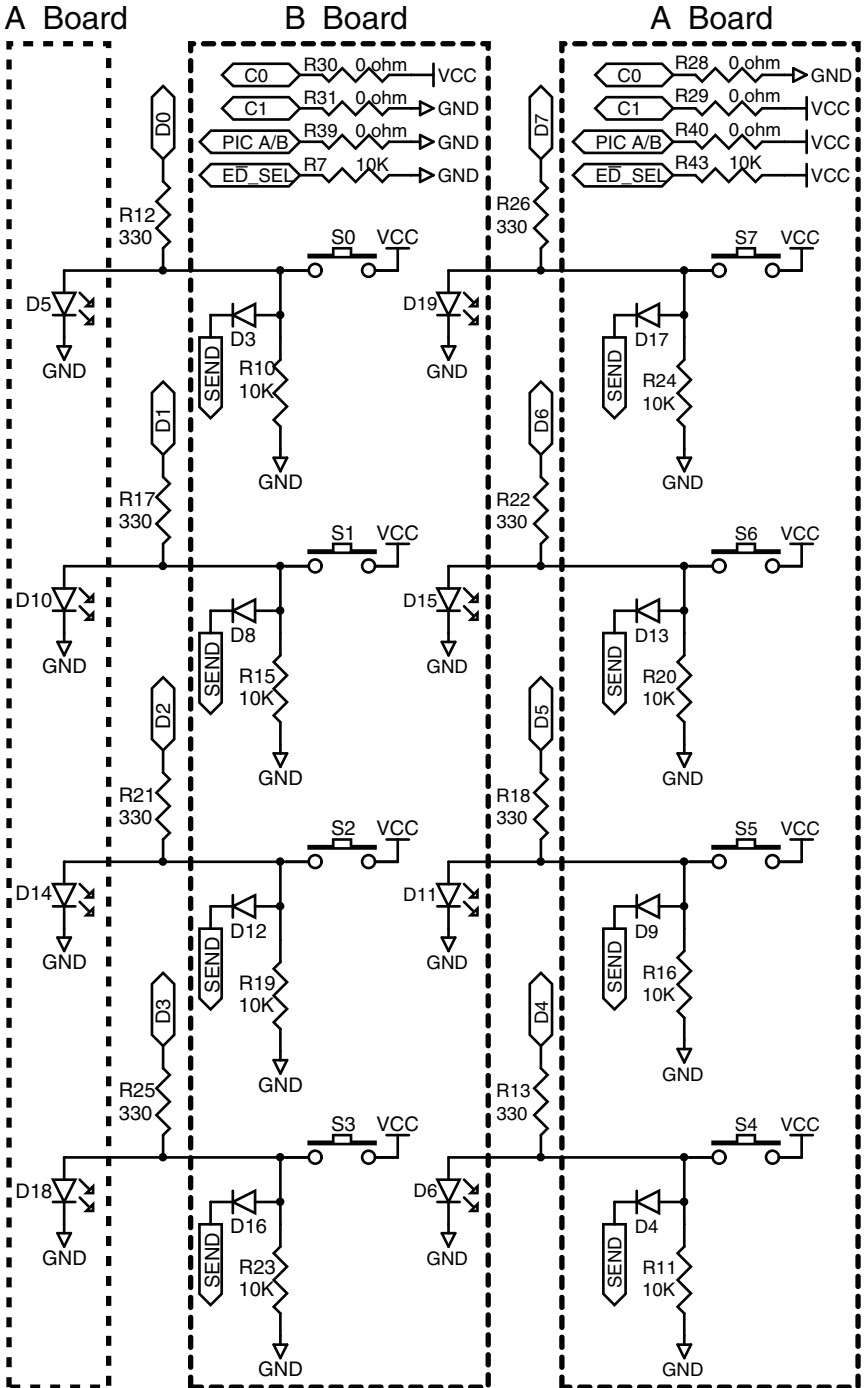


Figure 42: Remote Control Demo Board Remote Control Area Schematic

Programming Dock Board Schematic

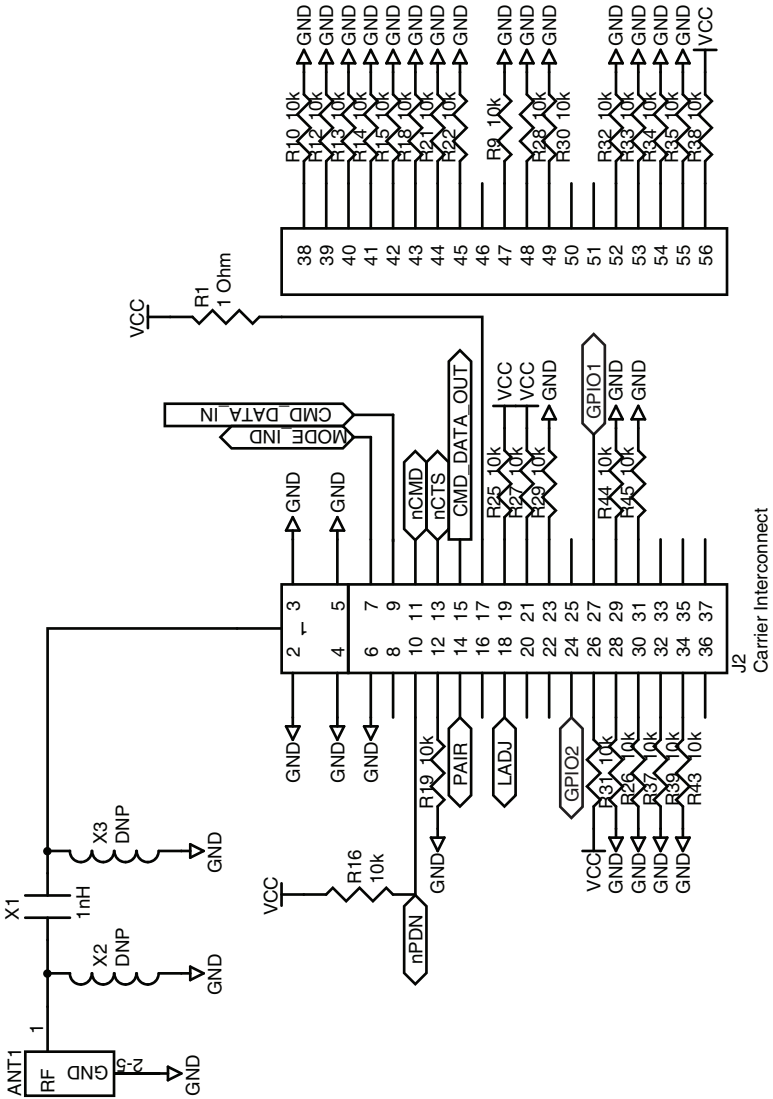


Figure 44: Programming Dock Board RF Carrier Area Schematic

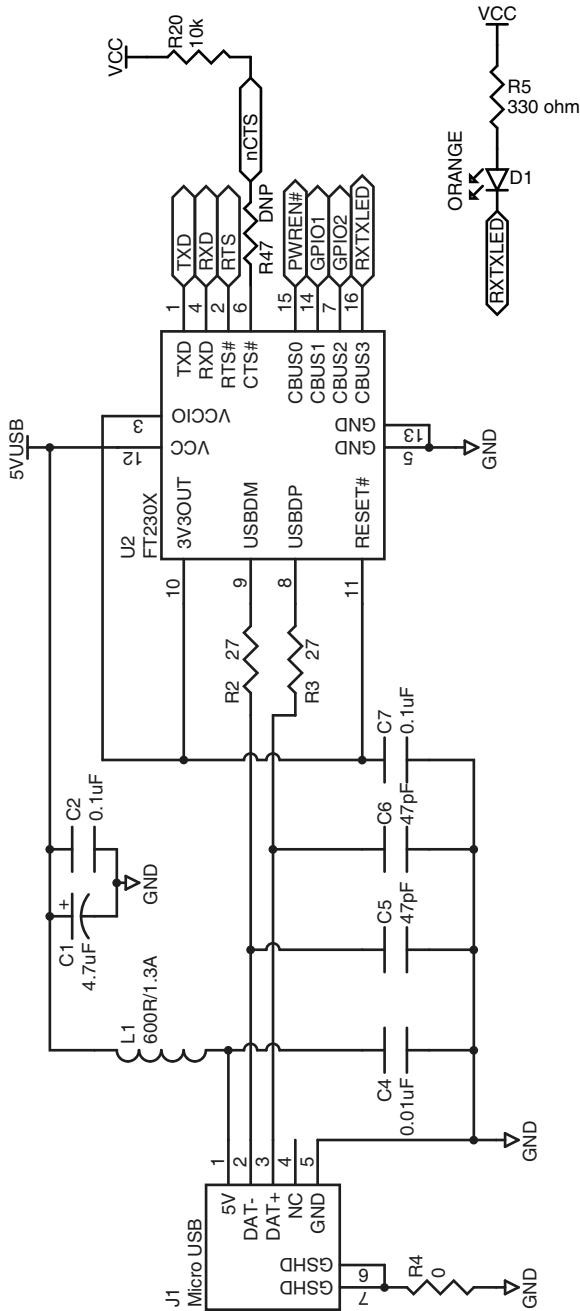


Figure 47: Programming Dock Board USB Area Schematic

Prototype Board Schematic

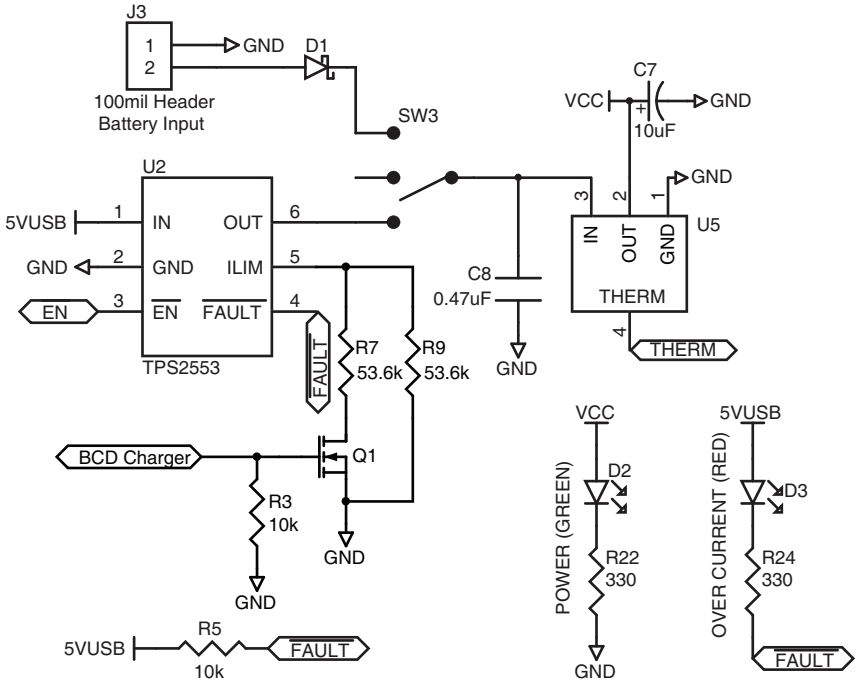


Figure 49: Prototype Board Power Supply Area Schematic

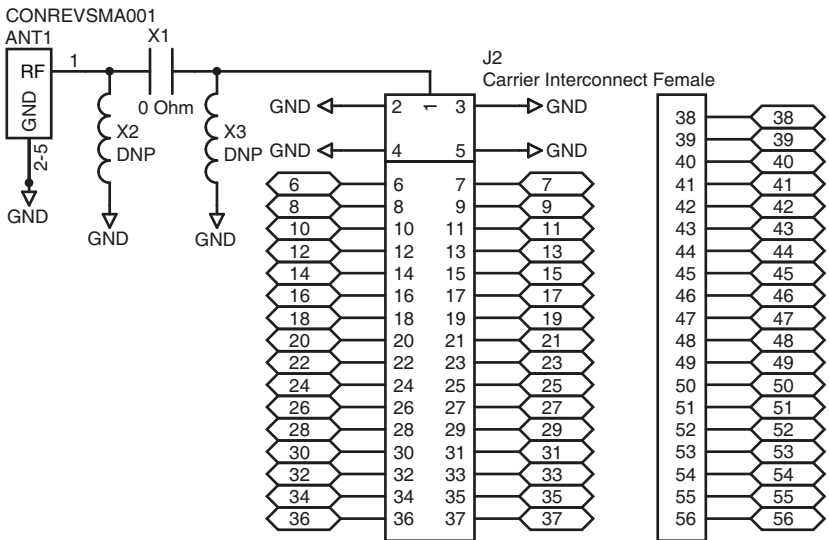


Figure 50: Prototype Board RF Carrier Area Schematic

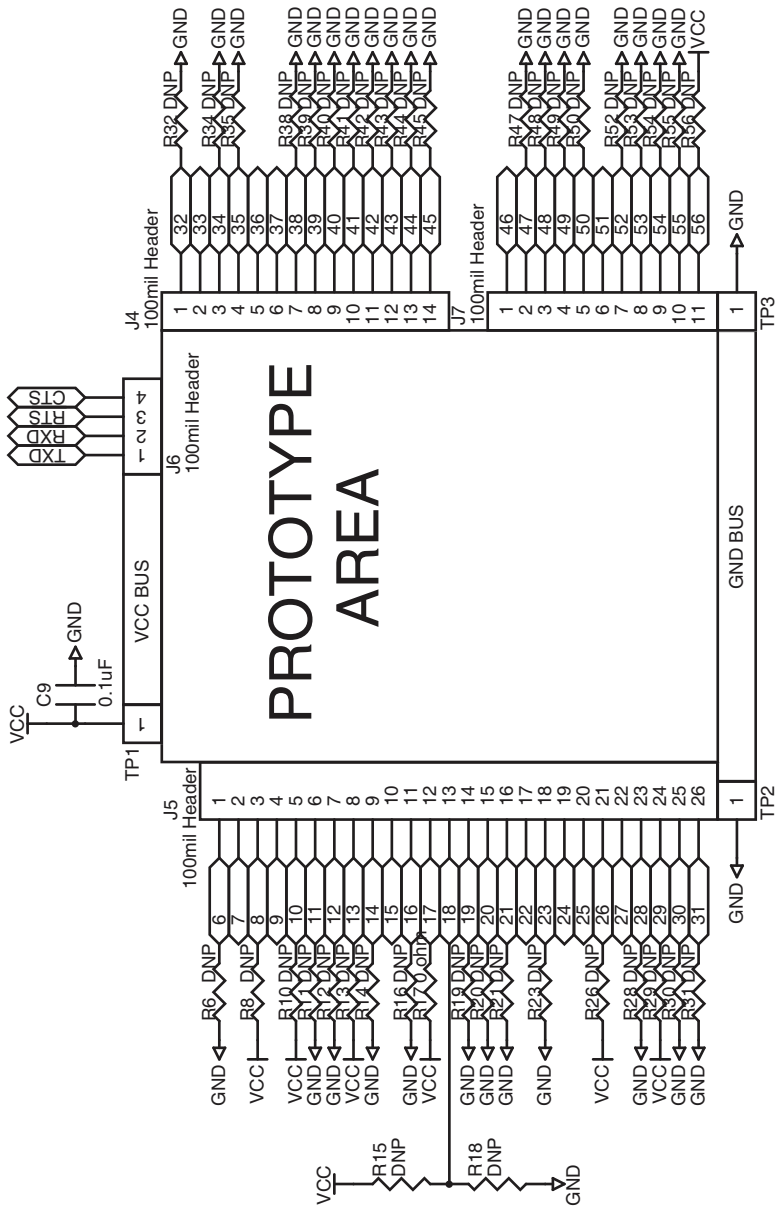


Figure 52: Prototype Board Prototype Area Schematic



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