



**NT Series
Master Development System
User's Guide**

Wireless made simple[®]



A large-print version of this document is available at
www.linxtechnologies.com.

Table of Contents

1	Introduction
2	Ordering Information
2	NT Series Transceiver Development Board
2	Board Objects
3	Initial Setup
3	Troubleshooting
4	The Prototyping Area
5	The TX Power Select Switch
5	The Transceiver Area
6	The Power Area
6	The Evaluation Area
8	The Range Test Area
9	The PC Control Area
10	The PC Software
13	Using the Boards as a Design Reference
13	About Antennas
14	Board Control
14	Transmitter Output Power Selection
15	Transceiver Area
15	Header Section
16	Range Test Area
16	Power Area
17	Evaluation Area
17	LEDs
18	Signal Routing
19	Online Resources

NT Series Master Development System

User's Guide



Figure 1: NT Series Master Development System

Introduction

The Linx NT Series RF transceiver modules offer a simple, efficient and cost-effective method of adding wireless communication capabilities to any product. The Master Development System (Figure 1) provides a designer with all the tools necessary to correctly and legally incorporate the NT Series into an end product. The development boards serve several important functions:

- **Rapid Module Evaluation:** The boards allow the performance of the Linx NT Series modules to be evaluated quickly in a user's environment. Using the onboard transcoders, a pair of development boards can be used to evaluate the range performance of the modules.
- **Application Development:** An onboard prototyping area allows for the development of custom circuits directly on the development board. All signal lines are available on a header for easy access.
- **Software Development:** A PC interface allows for 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 two assembled development boards, four NT Series transceivers*, two CW Series antennas, two 9V batteries, four reverse polarity SMA connectors*, a USB interface board and full documentation.

* One part is soldered to each board

Ordering Information

Ordering Information	
Part Number	Description
MDEV-900-NT	NT Series Master Development System

Figure 2: Ordering Information

NT Series Transceiver Development Board

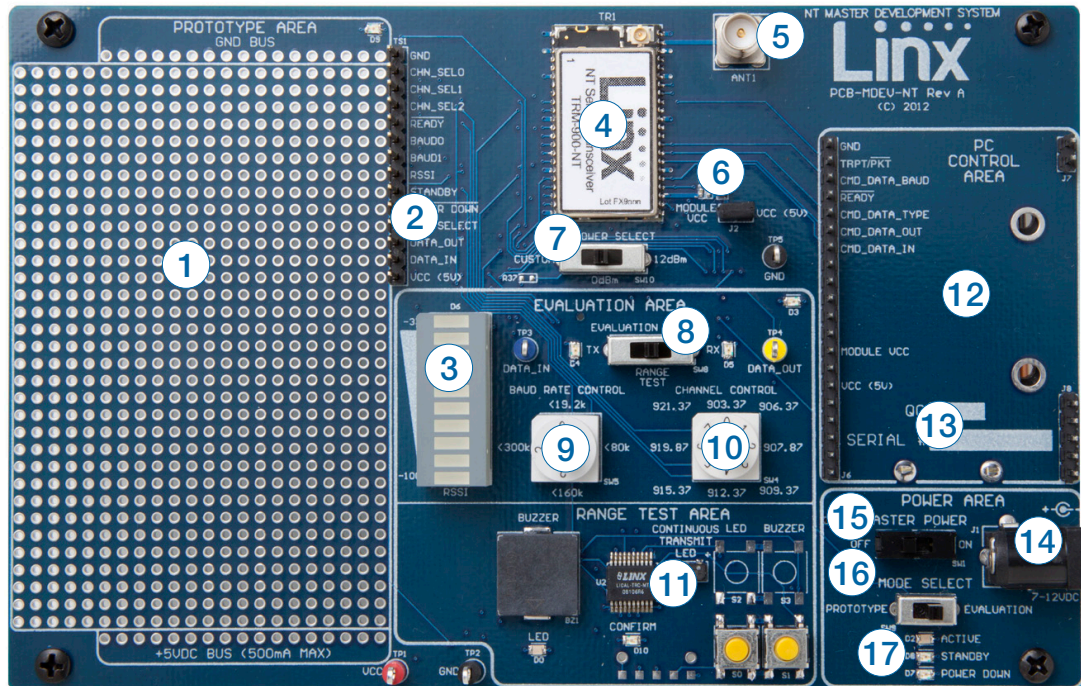


Figure 3: NT Series Transceiver Development Board

Board Objects

1. Prototype Area
2. Break-Out Header
3. RSSI Level
4. NT Series Transceiver
5. RP-SMA Antenna Connector
6. Module Power Header
7. Output Power Level Selection Switch
8. Evaluation Selection Switch
9. Baud Rate Selection Dial
10. Channel (Frequency) Selection Dial
11. Transcoder Range Test Area
12. PC Control Area
13. 9V Battery (on the back of the board)
14. DC Power Jack
15. Master Power Switch
16. Mode Selection Switch
17. Module Mode Indicator LEDs

Initial Setup

Unpack the development system, attach the antennas and install a 9V battery on each development board. The boards can be used in two different configurations: Prototype and Evaluation. The Mode Selection switch sets the configuration. By default, the boards are set to Range Test in the Evaluation configuration.

Evaluation Configuration

Setting the Mode Select switch to the EVALUATION (right) position enables the Evaluation Configuration. In this configuration, the module's signal lines are routed to the Evaluation Area for control. This enables the module to be configured by the controls on the board while allowing custom data to be sent over the link.

Range Test

The development boards feature an onboard Linx MT Series transcoder which facilitates range testing. Buttons on one board activate a light or buzzer on the other. A confirmation LED provides visual acknowledgment that a transmission was received across the wireless link.

Range Test is part of the Evaluation configuration and is the default configuration out of the box. To use the boards this way, place the Mode Select switch to Evaluation and the Evaluation Select switch to the RANGE TEST (middle) position. This routes the DATA_IN, DATA_OUT and T/R_SEL lines to the MT Series Transcoder.

Prototype Configuration

Setting the Mode Select switch to the PROTOTYPE (left) position enables the Prototype Configuration. In the Prototype configuration, the module's signal lines are routed to the break-out header next to the Prototype Area. This allows the module to be controlled with custom application circuitry.

Software Development

The kit includes one USB interface board for connection to a PC. Included software demonstrates use of the module's Command Data Interface (CDI).

Troubleshooting

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

- Make sure that the Master Power, Mode Select and Evaluation Select switches are in the correct positions. The Active LED should be on

- Make sure that the Baud Rate and Channel switches are set the same on both boards
- Check that the antennas are connected
- Make sure that a jumper is installed on the Module Power Header
- Make sure that the batteries are not dead

If all of these appear to be in order, please call +1 800 736 6677 or e-mail techsupport@linxtechnologies.com for technical support.

The Prototyping Area

In addition to its evaluation functions, the board may also be used for product development. It features a prototyping area to facilitate the addition of application-specific circuitry (Figure 4). 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.

External circuitry can be easily interfaced to the NT transceiver through the breakout header (TS1) to the right of the prototyping area. The Mode Select switch should be set to the left position to enable the module's lines to be controlled from the prototyping area. At the bottom of the prototyping area is a row connected to the 5V power supply and at the top is a row connected to ground.

Note: The onboard 5-volt regulator has approximately 600mA available for additional circuitry. If more current is required, the user must add an additional regulator or power the board from an external supply.

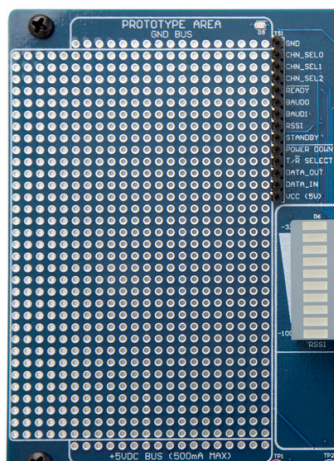


Figure 4: The Development Board Prototyping Area

The TX Power Select Switch

The board has a switch to select among three different transmitter output power levels (Figure 5). The right position sets the module to full power of about 12dBm. The center position sets the output power to about 0dBm, which is the legal limit for most applications. The left position uses resistor R37 to set the power. This position is an unpopulated 0603 size resistor location. A resistor can be placed here to set the output power to any available level. Please see the NT Series Data Guide for more information on resistor values. **A power cycle is required for changes to take effect.**

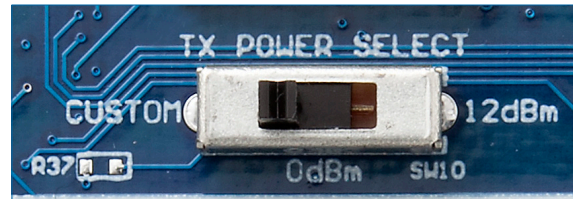


Figure 5: The Development Board TX Power Select Switch

The Transceiver Area

The transceiver section consists of the transceiver module and a reverse-polarity SMA connector as shown in Figure 6. The RP-SMA connector is FCC compliant and reverses the center pin and socket. RP-SMA connectors will mate with but not provide electrical connection to standard SMA connectors or SMA equipped antennas. A header next to the module disconnects the module's power from the main board power. This can be used for current measurements or to power the module alone from an external power source. A jumper must be installed to power the module from the board.

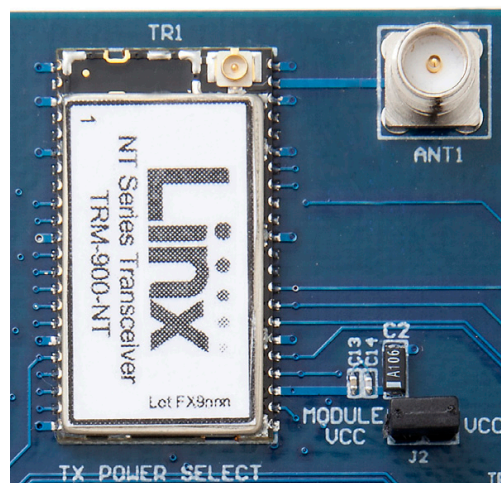


Figure 6: The Development Board Transceiver Area

The Power Area

The Power Area has two switches that control power to the board and the type of operation (Figure 7). The Master Power switch supplies power from the 9V battery or the power jack to the board. The power jack accepts a 2.5mm plug with the tip ground and the shell 7 to 12VDC.

The Mode Select switch configures the board for either Prototype operation (left position) or Evaluation operation (right position). In Prototype operation, the module's signal lines are routed to the header next to the Prototype Area. This allows custom circuits to easily interface with the module.

In Evaluation operation, the module's signal lines are routed to the Evaluation Area. The controls in this area allow the module to be operated without any other circuits, microcontrollers or a PC.

Three LEDs show the state of the module. Active shows the module is on and ready for operation. Standby and Power Down indicate that the low power modes have been entered and the module is not ready for operation.

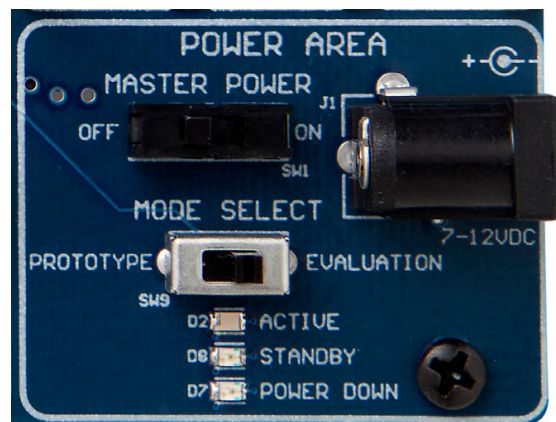


Figure 7: The Development Board Power Area

The Evaluation Area

The Evaluation Area is activated by setting the Mode Select switch to the right position. Figure 8 shows the Evaluation Area.

The Evaluation Select switch configures the area for different types of evaluation. The left position puts the module into transmit mode. The orange TX LED lights up and any data present on the blue DATA_IN test point is transmitted by the module.

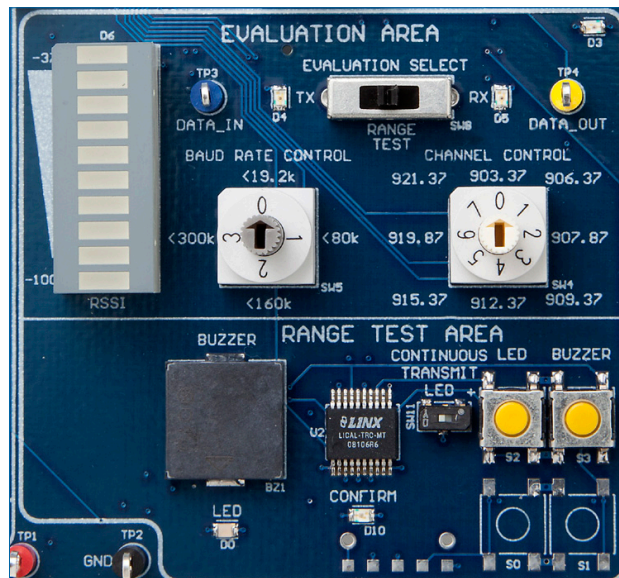


Figure 8: The Development Board Level Adjust Section

The right position puts the module into receive mode. The yellow RX LED lights up and data received by the module is output on the yellow DATA_OUT test point.

These two configurations allow the module to transmit and receive custom data while controlling the baud band and channel with the frequency dials on the board. It is similar to the Prototype Area, but requires less external circuitry to configure the module. The switches on the board are used for hardware configuration in this mode.

The Baud Rate Control dial sets the BAUD0 and BAUD1 lines to configure the module's baud band. This should be set the same on both boards for proper operation.

The Channel Control dial sets the CHAN_SEL0, CHAN_SEL1 and CHAN_SEL2 lines to configure the module's channel. This should be set the same on both boards for proper operation.

An LED bar is used to provide a general indication of the RF signal strength. The closer the active LED is to the top, the stronger the received signal level. The receiver must be active for at least one second for the RSSI level to update.

The center position on the Evaluation Select switch activates the Range Test Area, allowing the link's range to be evaluated. This area is described in detail in the Range Test Area section of this user's guide.

The Range Test Area

The board features an MT Series remote control transcoder with two push buttons, a buzzer and an LED. The two boards in the kit are populated differently so that the button inputs on one board are outputs on the other board. Figure 9 shows the differences.

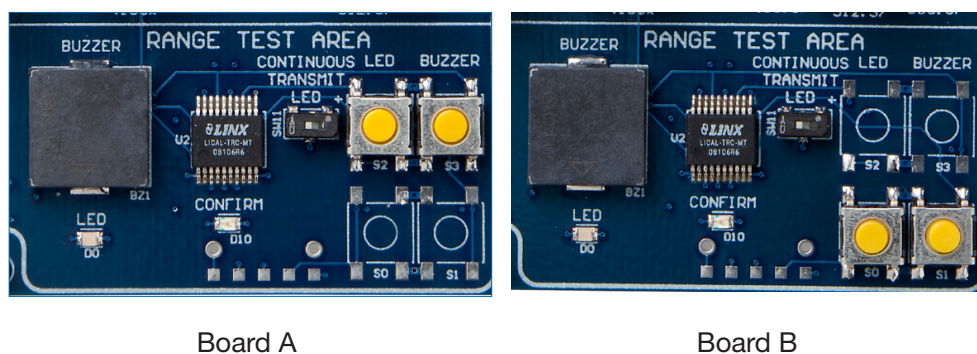


Figure 9: The Development Board Range Test Section

When a button is pressed on one board, the status of both buttons is captured, encoded into a data stream, and transmitted. The data recovered by the receiving board is decoded and the transcoder's data lines are set to replicate the states of the buttons, driving either the buzzer or the LED. A confirmation packet is then sent to the transmitting board activating the Confirm LED.

To activate this area of the board, the module's DATA and T/ \bar{R} _SEL lines must be routed to the transcoder. This is accomplished by setting the Mode Select switch to the right position and the Evaluation Select switch to the middle position.

After the boards have been configured, place Board A on a flat surface and turn it on. Turn on Board B and press button S1. The buzzer on Board A will sound and the Confirm LED on Board B will light up. The usable range of the link in your environment can be ascertained by carrying Board B away from Board A. Switch SW11 has been provided to continuously transmit the LED activation without having to hold down a button.

As you near the maximum range of the link in your area, it is common for the signal to cut in and out as you move. This is normal and can result from other interfering sources or fluctuating signal levels due to multipath effects. The areas in which this occurs are commonly called "nulls" and simply walking a little farther will often restore the signal.

To achieve maximum range, keep objects such as your hand away from the antennas and ensure that the antennas on the boards have an unobstructed line-of-sight path to each other. 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, TX output power setting and antenna connection. Check the range performance on different channels. Next, measure the receiver's RSSI voltage with the transmitter turned off to determine if ambient interference is present. If this fails to resolve the issue, please contact Linx technical support.

The PC Control Area

The PC Control Area is used with a daughter board to connect the module's Command Data Interface to a PC. This advanced feature is a serial data interface for configuration and data transfer. One USB interface board is included with the development kit. Additional USB interface boards or an RS-232 interface board can be purchased separately.

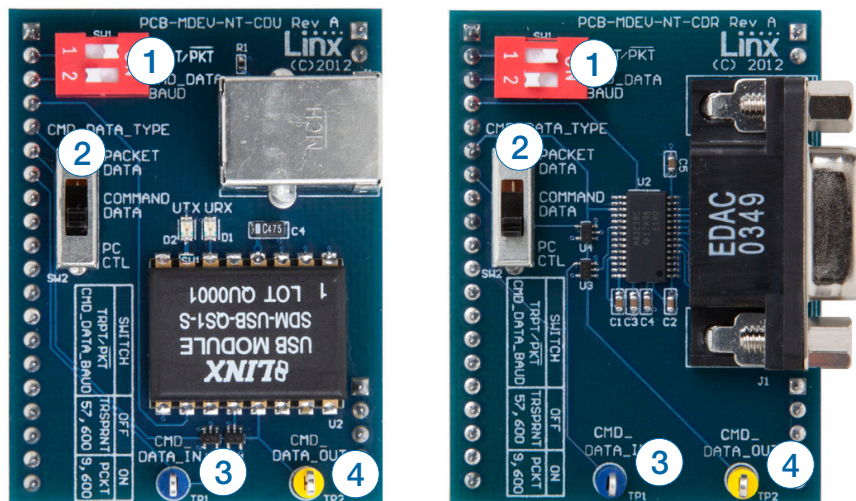


Figure 10: PC Interface Boards

The top DIP switch (1) controls the TRPT/ $\overline{\text{PKT}}$ line on the module. This line selects between transparent data transmission and packet data transmission. Slide it to the left for transparent data and to the right for packet data.

The bottom DIP switch (1) controls the CMD_DATA_BAUD line on the module. This is the data rate for the CDI and has no effect on the over-the-air data rate. Slide to the left for 57,600bps and to the right for 9,600bps.

The three position slide switch (2) controls the CMD_DATA_TYPE line. This line tells the module that the data coming in on the CDI is either command data for configuring the module (middle position) or packet data to be transmitted over the air (top position). The bottom position connects this line to the DTR line on the USB or RS-232 interface. This allows the PC software to control the line, giving it the ability to configure the module and send data.

Test points for CMD_DATA_IN (3) and CMD_DATA_OUT (4) are provided so that the communications can be monitored.

The PC Software

The kit includes PC software that can be used to configure the module through the PC interface daughter board. Figure 11 shows the software.

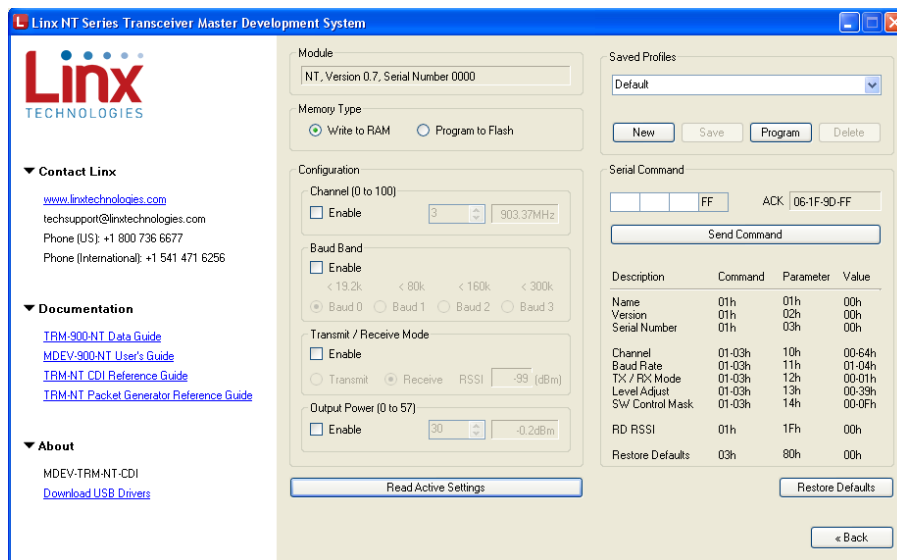


Figure 11: Development Kit PC Software

The left side of the window contains labels that expand to show links to useful information (Figure 12). This includes the Linx Technologies contact information and links to the website for the latest product documentation and software updates. Clicking on these links opens the page in the computer's default web browser.

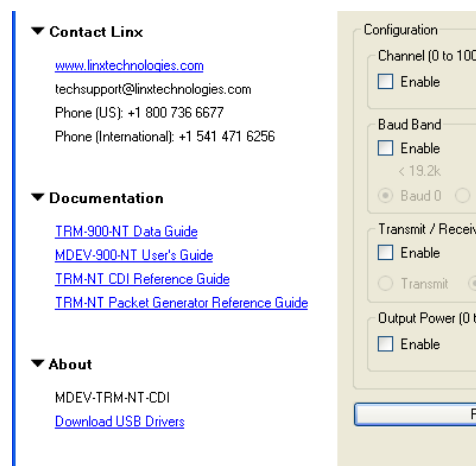


Figure 12: Development Kit PC Software

The command portion of the window starts in the middle of the window (Figure 13). At the top is a box that states the product name, firmware version and serial number.

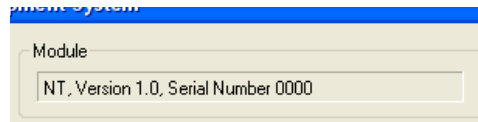


Figure 13: Development Kit PC Software

Below this is a selection that determines how the module is configured (Figure 14). Writing to RAM is faster, but the settings are lost when power is cycled to the module. Programming to flash takes a bit longer (5ms/byte), but the settings are retained when power is cycled to the module.

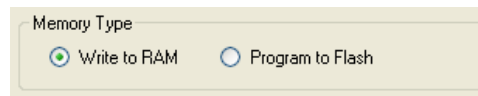


Figure 14: Development Kit PC Software

Below this are the configuration settings (Figure 15). These allow the software to change the channel, baud band, transmit and receive mode and the output power. By default the module looks to its hardware pins for these configuration settings, so software control must be enabled for it to take control. This is done by checking the Enable checkbox in each section.

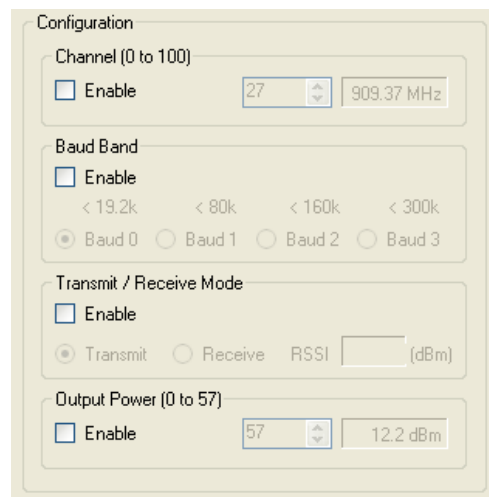


Figure 15: Development Kit PC Software

The Channel configuration allows the user to select from among all 101 channels offered by the module rather than just the eight available with the hardware lines. A selection box shows the channel and a text box shows the channel's frequency.

The Baud Band setting adjusts internal filters and other settings to set the transceiver's maximum over-the-air data rate. The Baud Band section allows for the selection from among the four baud bands.

The Transmit/Receive Mode selection activates the transceiver's transmitter or receiver. When the receiver is active the measured RSSI level is shown in the text box.

The Output Power section allows the module's transmitter output power level to be adjusted. The NT Series has 57 power levels that drop the power in approximately 0.5dB increments. The adjacent text box shows the approximate power. This is not a measured value, but an approximate value based on characterization of the modules.

The “Read Active Settings” button at the bottom (Figure 16) reads the existing configuration settings from the module and adjusts the values in the configuration sections based on the module’s current configuration.

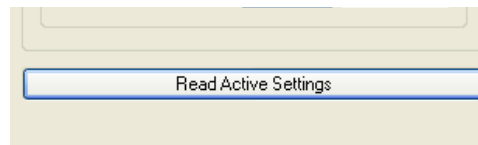


Figure 16: Development Kit PC Software

The right column in the window starts with the Profile section (Figure 17). Specific configuration settings can be saved as a profile and loaded into a connected module. This allows the software to be used in small-scale production lines for products that provide connection to the CDI.

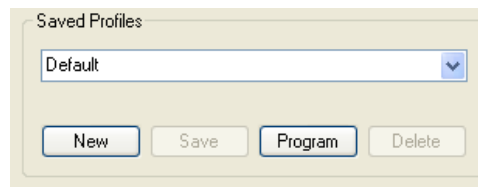


Figure 17: Development Kit PC Software

Select the “New” button to create a new profile and give it a name. Set the configuration controls as desired and click the “Save” button to save the profile. Click the “Program” button to send the profile to the module. All of the profiles saved on the PC can be viewed in the drop down menu and sent to the module with the “Program” button. The “Delete” button removes the selected profile from the computer.

The Serial Command section (Figure 18) provides the ability to send a specific packet to the module. Byte values are typed into the boxes to create the packet and the “Send Command” button sends the packet to the module. The ACK text box displays the module’s response. The possible values for each byte are shown in the table below the “Send Command” button.

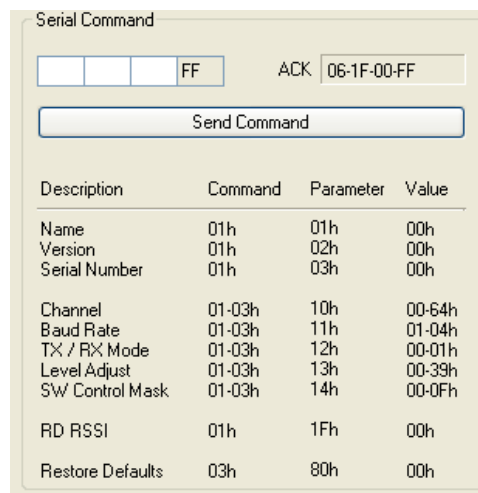


Figure 18: Development Kit PC Software

The “Restore Defaults” button (Figure 19) writes the factory default values to the transceiver. This is an easy way to restore the module to a known configuration.

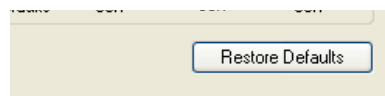


Figure 19: Development Kit PC Software

Using the Boards as a Design Reference

From a layout perspective, the master development boards included in this kit are quite simple, yet they illustrate some important techniques that can be incorporated into a design. The module's mounting pads extend slightly past the edge of the part. This eases hand assembly and allows for better heat conduction under the part if rework is necessary. The use of a full ground plane fill on the lower side of the board serves three important purposes.

First, since a $\frac{1}{4}$ -wave antenna is employed, the ground plane is critical to serve as a counterpoise. Application Note AN-00500 and AN-00501 provide additional details on how a ground plane affects antenna function.

Second, a ground plane suppresses the transfer of noise between stages of a product as well as unintentional radiation of noise into free space.

Third, a ground plane allows for the implementation of a microstrip feed to the antenna. The term microstrip refers to a PCB trace running over a ground plane that is designed to serve as a 50-ohm transmission line between the module and the antenna. A microstrip is implemented on this evaluation board. The module's data guide and a calculator available on the Linx Technologies website provide more information on the microstrip implementation and calculations.

About Antennas

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

Board Control

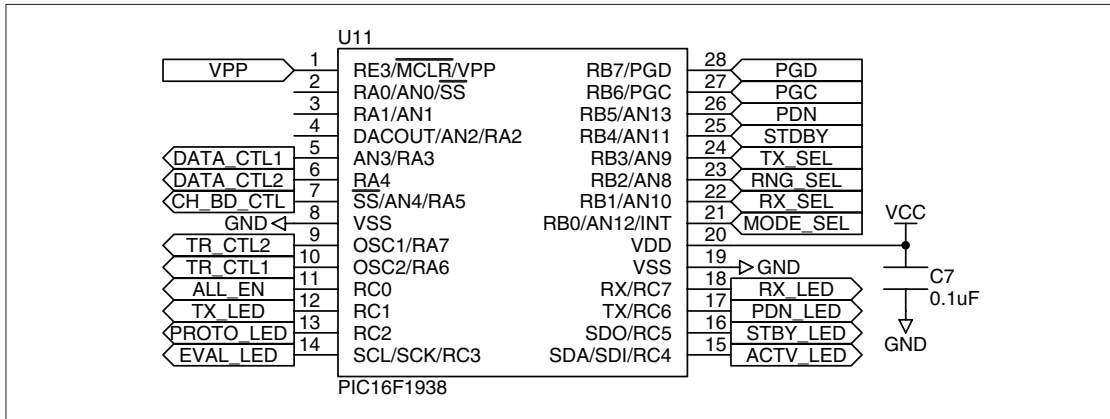


Figure 20: Board Control

Transmitter Output Power Selection

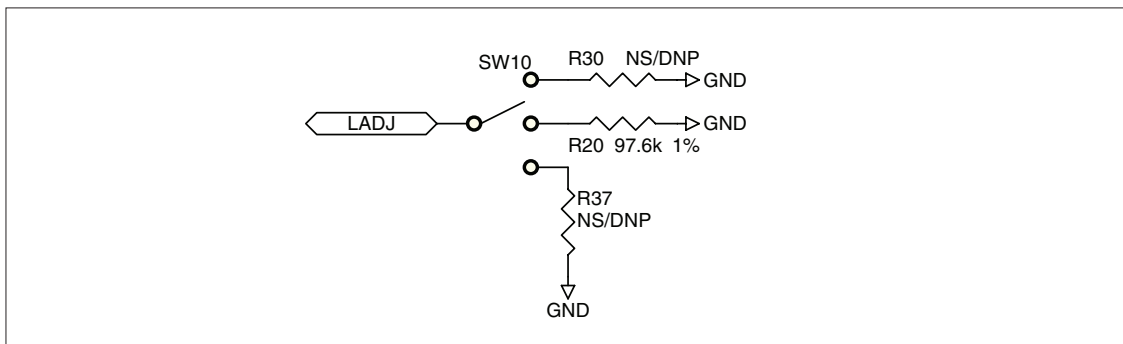


Figure 21: Transmitter Output Power Selection

Transceiver Area

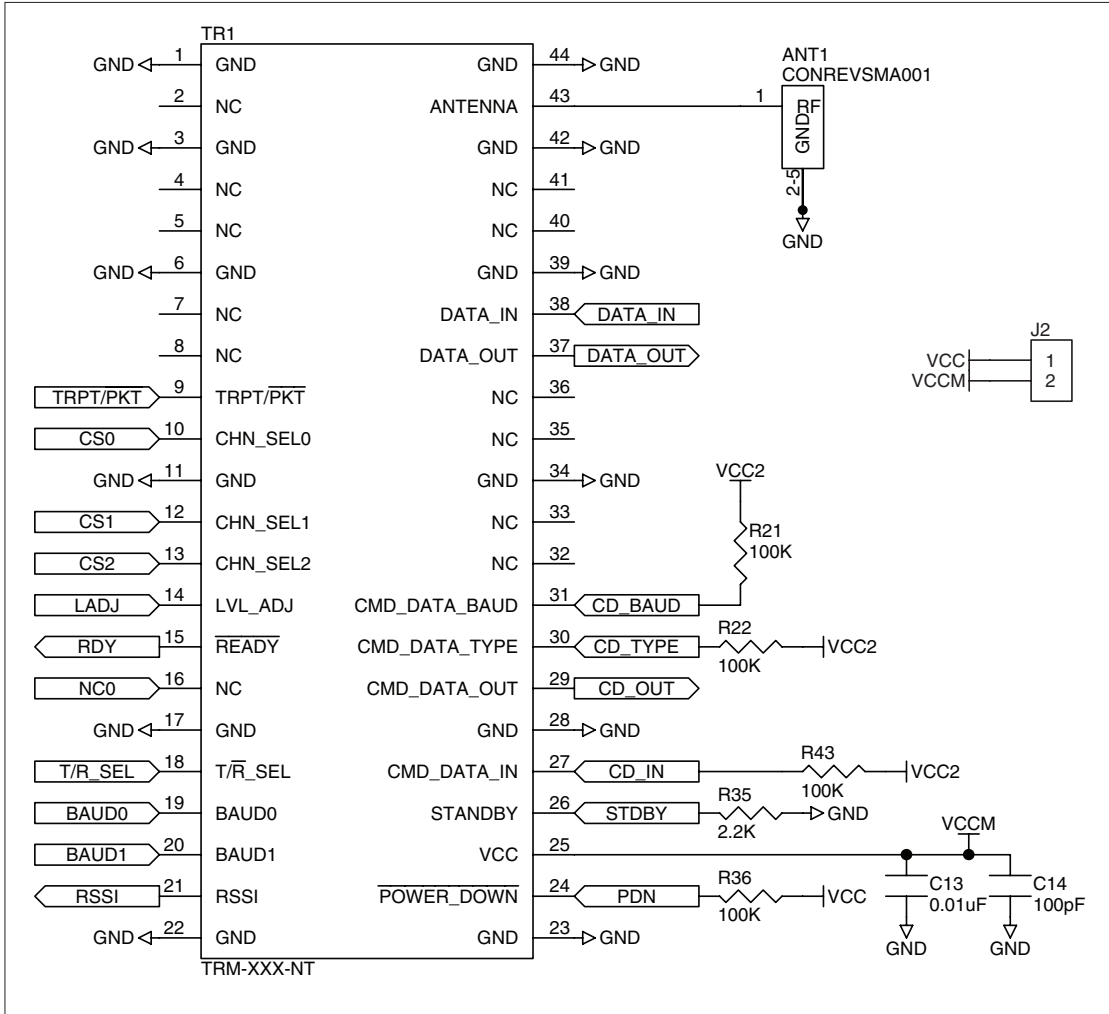


Figure 22: Transceiver Area

Header Section

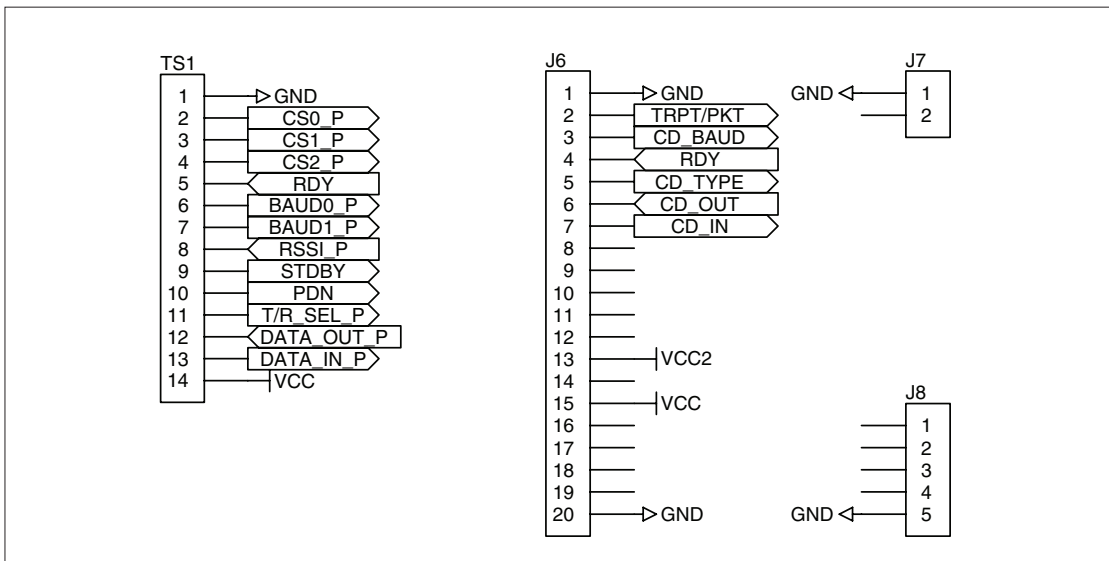


Figure 23: Header Section

Range Test Area

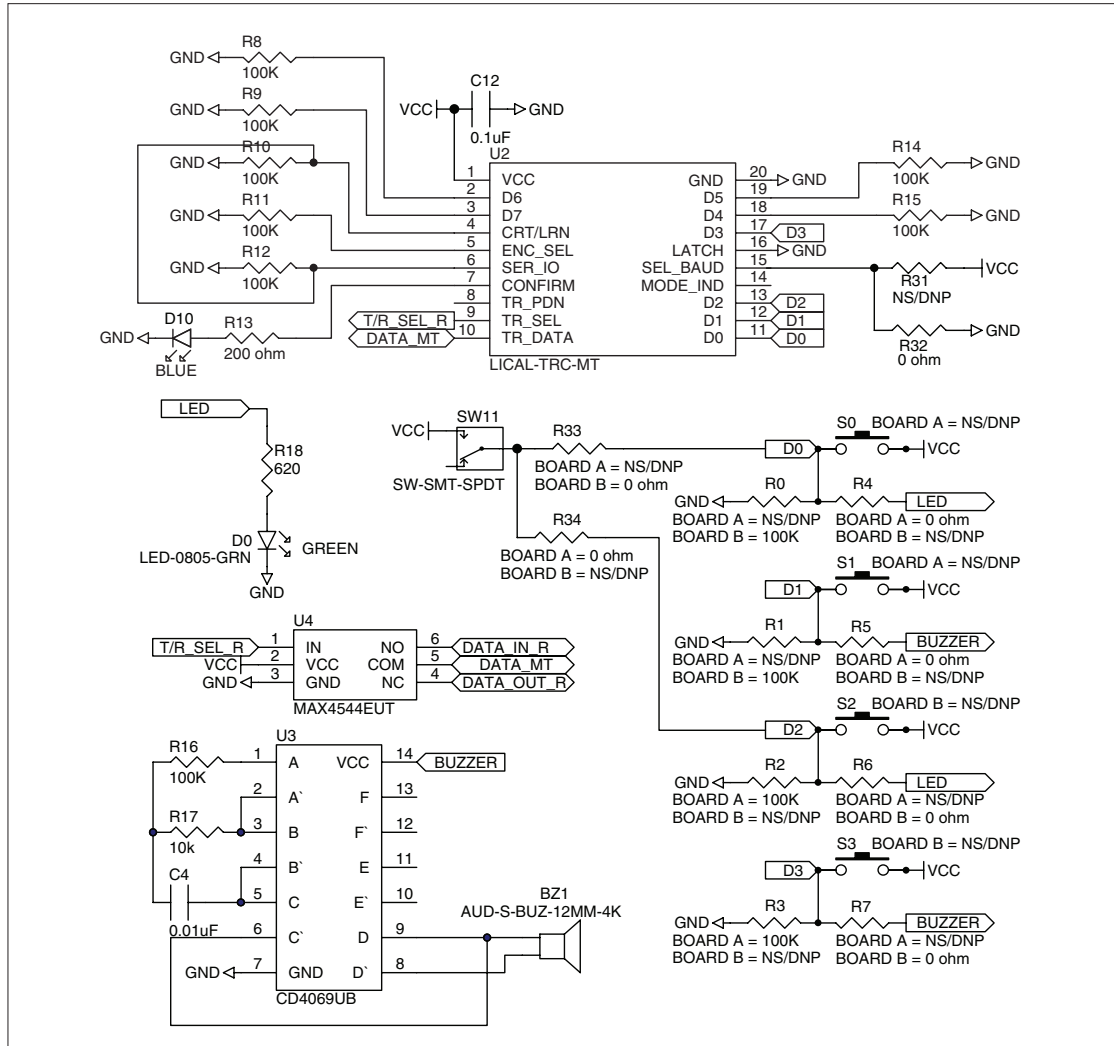


Figure 24: Range Test Area

Power Area

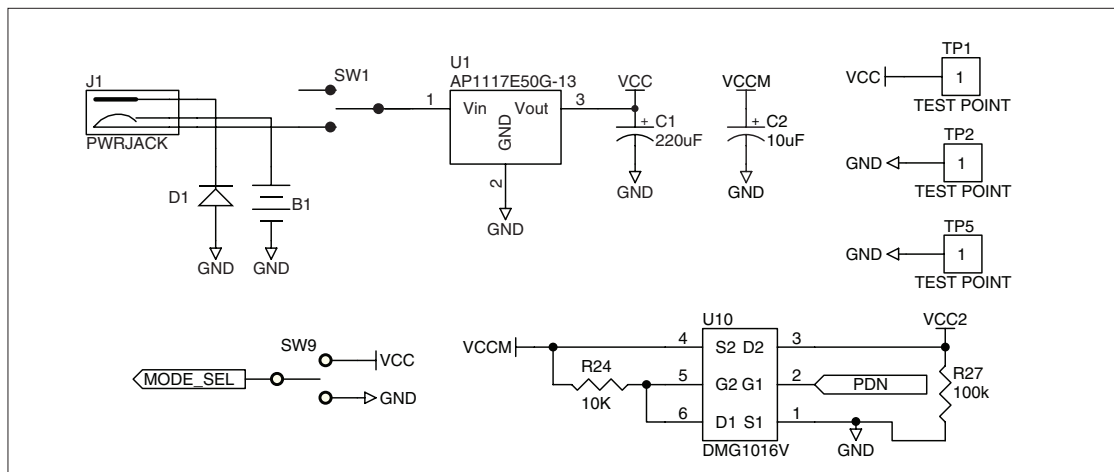


Figure 25: Power Area

Evaluation Area

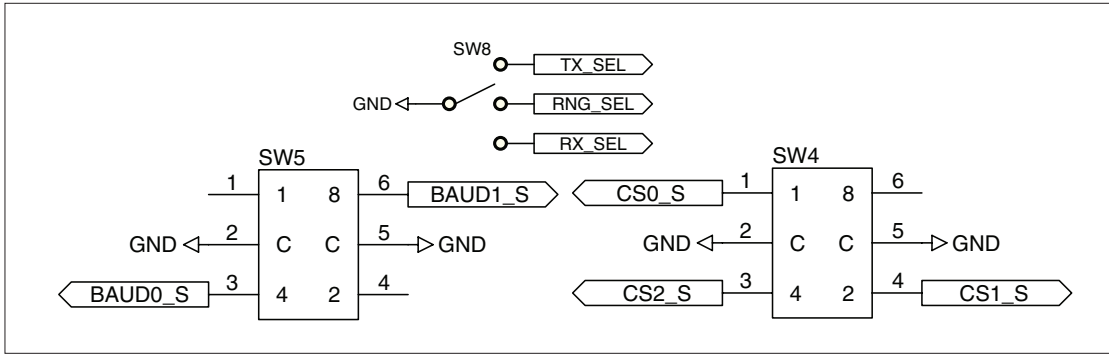


Figure 26: Evaluation Area

LEDs

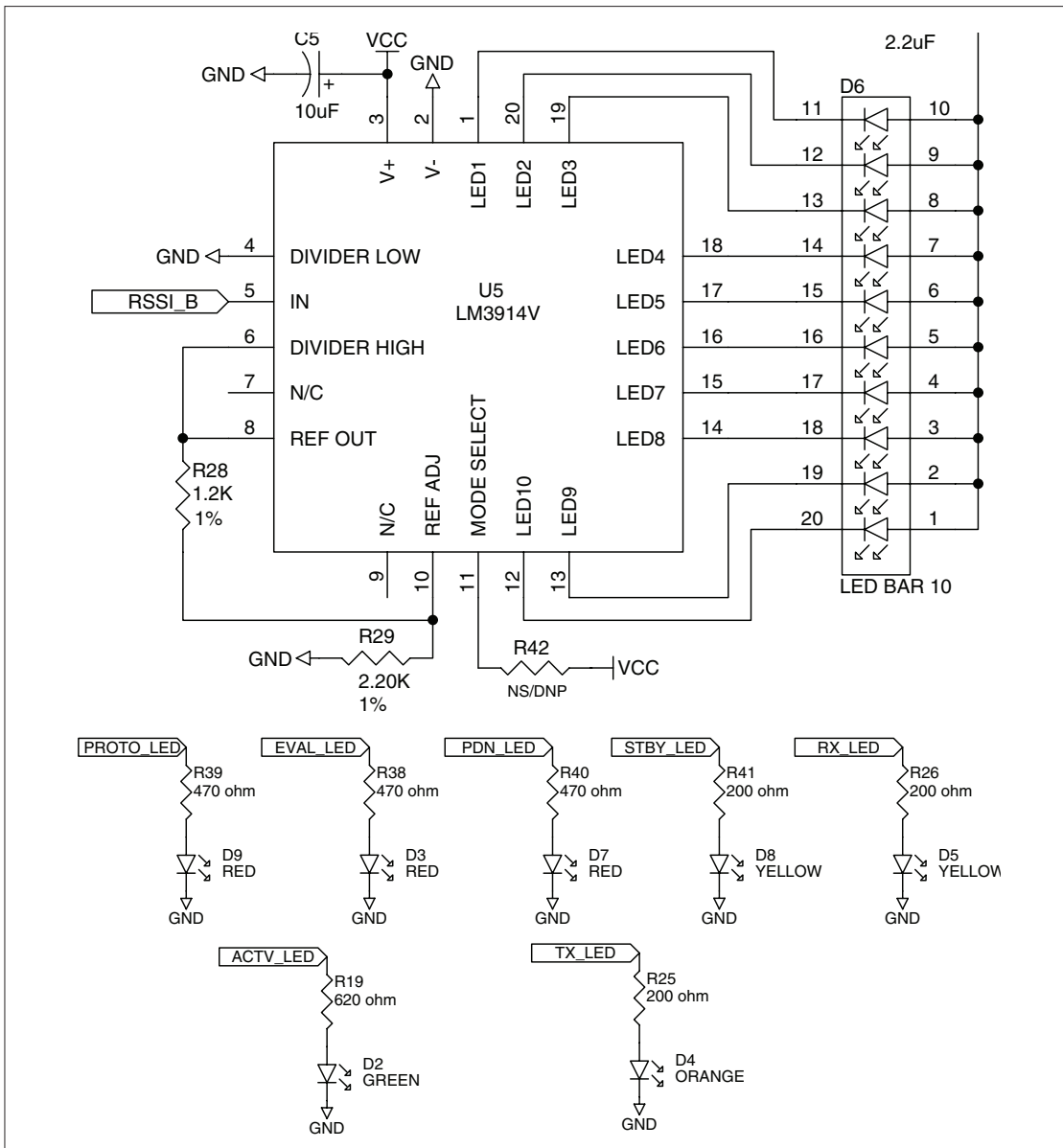


Figure 27: LEDs

Single Routing

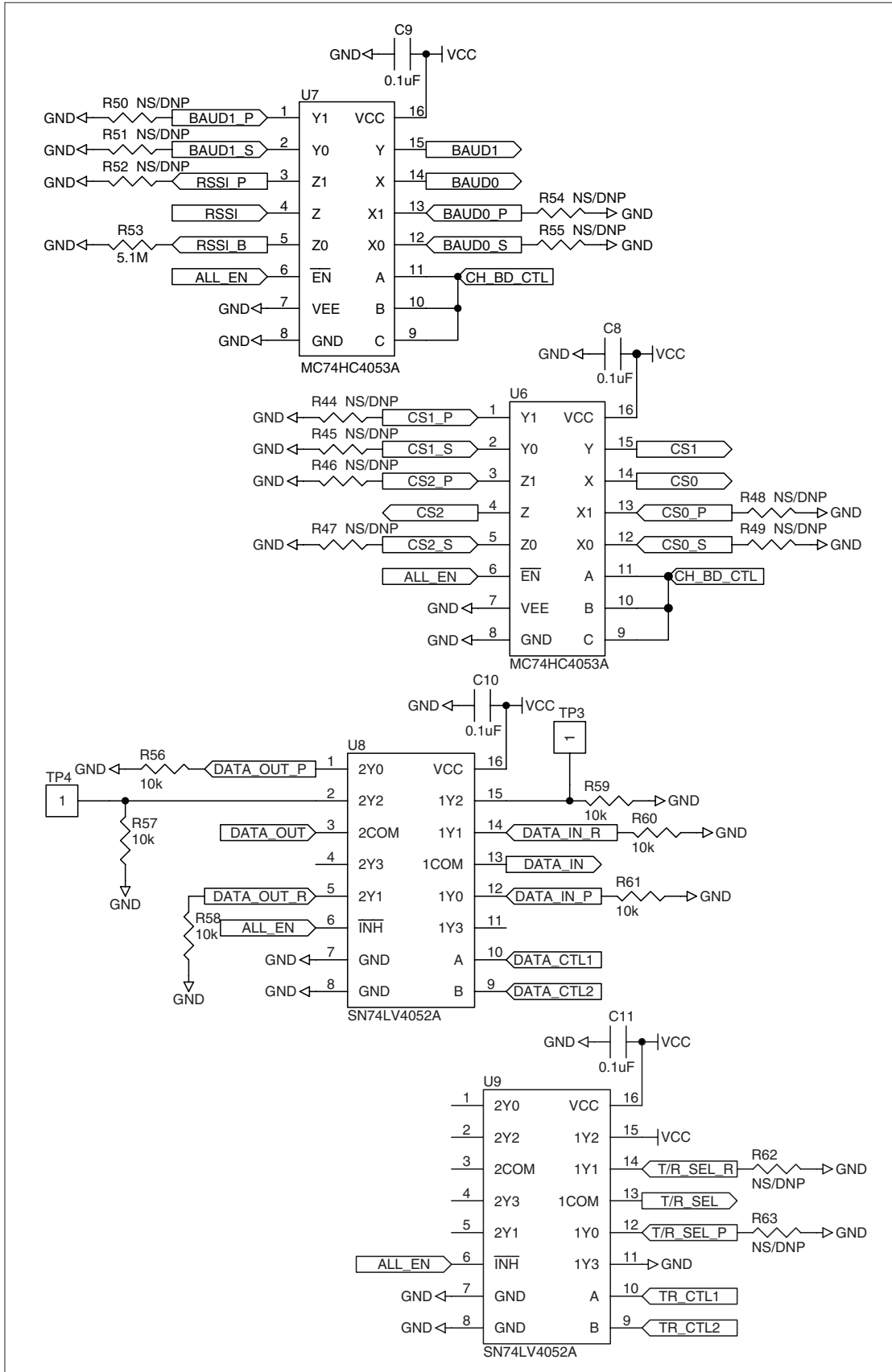


Figure 28: Single Routing

Online Resources

www.linxtechnologies.com

If you have questions regarding any Linx product and have Internet access, make www.linxtechnologies.com your first stop. Day or night, the Linx website gives you instant access to the latest information regarding the products and services of Linx. It's all here, including:

- **Manual and Software Updates**
- **Latest News**
- **Data Guides**
- **Application Notes**
- **Knowledgebase**
- **FCC Information**

And much more. Be sure to visit often!

www.antennafactor.com

The Antenna Factor division of Linx offers a diverse array of antenna styles (Figure 29), many of which are optimized for use with our RF modules. From innovative embeddable antennas to low-cost whips, domes to Yagis, and even GPS, Antenna Factor likely has an antenna for you, or can design one to meet your requirements.



Figure 29: Antenna Factor Antennas



Linx Technologies
159 Ort Lane
Merlin, OR, US 97532

3090 Sterling Circle, Suite 200
Boulder, CO 80301

Phone: +1 541 471 6256
Fax: +1 541 471 6251
www.linxtechnologies.com

Disclaimer

Linx Technologies is continually striving to improve the quality and function of its products. For this reason, we reserve the right to make changes to our products without notice. The information contained in this Data Guide is believed to be accurate as of the time of publication. Specifications are based on representative lot samples. Values may vary from lot-to-lot and are not guaranteed. "Typical" parameters can and do vary over lots and application. Linx Technologies makes no guarantee, warranty, or representation regarding the suitability of any product for use in any specific application. It is Customer's responsibility to verify the suitability of the part for the intended application. At Customer's request, Linx Technologies may provide advice and assistance in designing systems and remote control devices that employ Linx Technologies RF products, but responsibility for the ultimate design and use of any such systems and devices remains entirely with Customer and/or user of the RF products.

LINX TECHNOLOGIES DISCLAIMS ANY AND ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL LINX TECHNOLOGIES BE LIABLE FOR ANY CUSTOMER'S OR USER'S INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR RELATED TO THE DESIGN OR USE OF A REMOTE CONTROL SYSTEM OR DEVICE EMPLOYING LINX TECHNOLOGIES RF PRODUCTS OR FOR ANY OTHER BREACH OF CONTRACT BY LINX TECHNOLOGIES. CUSTOMER AND/OR USER ASSUME ALL RISKS OF DEATH, BODILY INJURIES, OR PROPERTY DAMAGE ARISING OUT OF OR RELATED TO THE USE OF LINX TECHNOLOGIES RF PRODUCTS, INCLUDING WITH RESPECT TO ANY SERVICES PROVIDED BY LINX RELATED TO THE USE OF LINX TECHNOLOGIES RF PRODUCTS. LINX TECHNOLOGIES SHALL NOT BE LIABLE UNDER ANY CIRCUMSTANCES FOR A CUSTOMER'S, USER'S, OR OTHER PERSON'S DEATH, BODILY INJURY, OR PROPERTY DAMAGE ARISING OUT OF OR RELATED TO THE DESIGN OR USE OF A REMOTE CONTROL SYSTEM OR DEVICE EMPLOYING LINX TECHNOLOGIES RF PRODUCTS.

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. 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.

All rights reserved. ©2012 Linx Technologies

The stylized Linx logo, Wireless Made Simple, CipherLinx, WiSE and the stylized CL logo are trademarks of Linx Technologies.