Replacing the HP3 Series with the NT Series

Application Note AN-00154

Introduction

As the HP3 Series reaches the end of its life, Linx recommends the NT Series as a migration path. The NT Series is a transceiver module and the HP3 Series consists of separate transmitter and receiver modules. The NT has a number of options to optimize the module for different applications. This application note discusses the differences in the modules and the settings for the NT that enable it to operate with the HP3 Series.

Physical Difference

The HP3 Series has separate transmitter and receiver modules, each of which comes in a pinned or surface-mount package. These are shown in Figure 1.

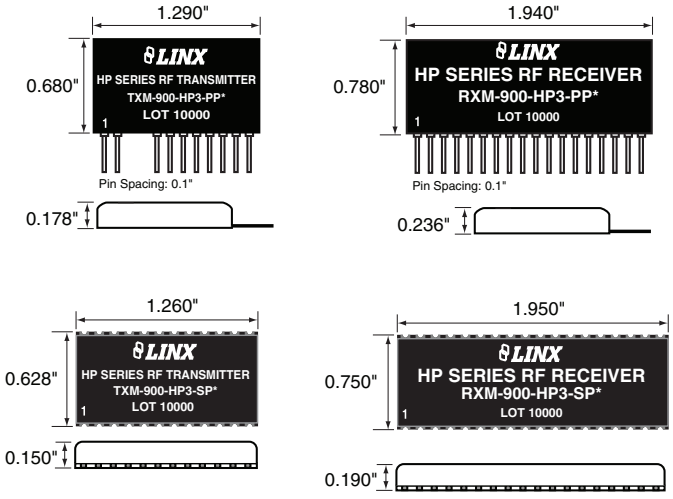

Figure 1: HP3 Transmitter and Receiver Dimensions

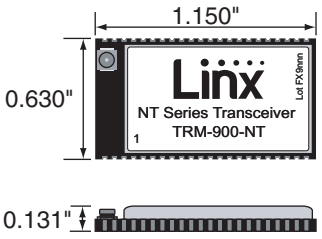

Figure 2: NT Series Transceiver Dimensions

The physical size of the modules is different, requiring a PC board change to accommodate the new module. In some cases, a daughter board can be made that will adapt the NT module to the HP3 footprint on an existing board. Linx can assist with this design on a case-by-case basis. Please contact technical support for more information.

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The footprints and pin-outs for the modules are shown in Figure 3 through Figure 8.

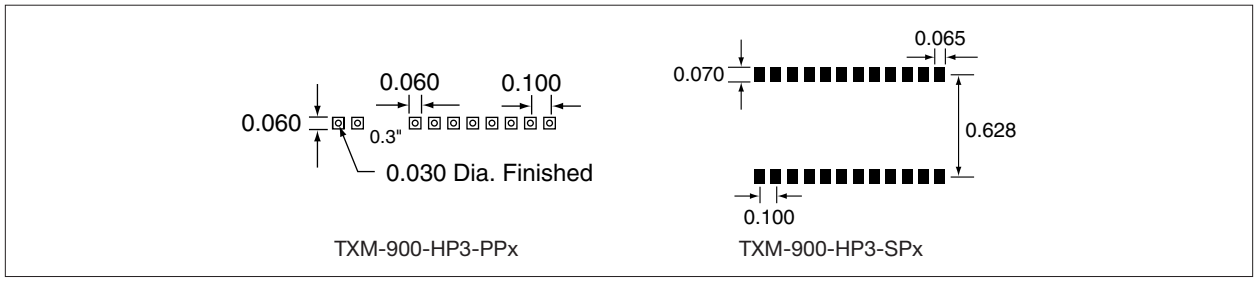


Figure 3: HP3 Series Transmitter Footprints

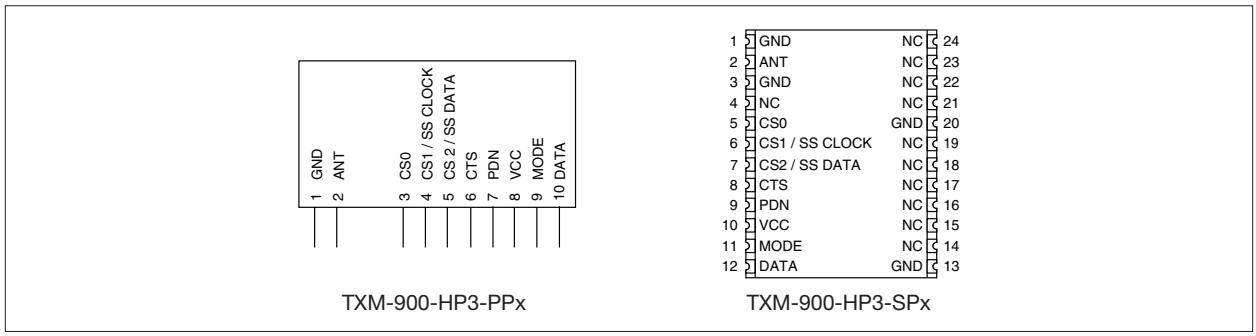


Figure 4: HP3 Series Transmitter Pinouts

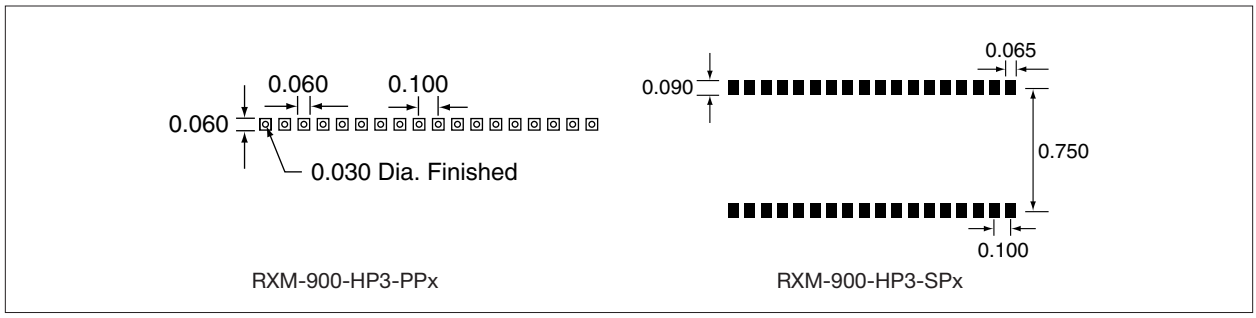


Figure 5: HP3 Series Receiver Footprints

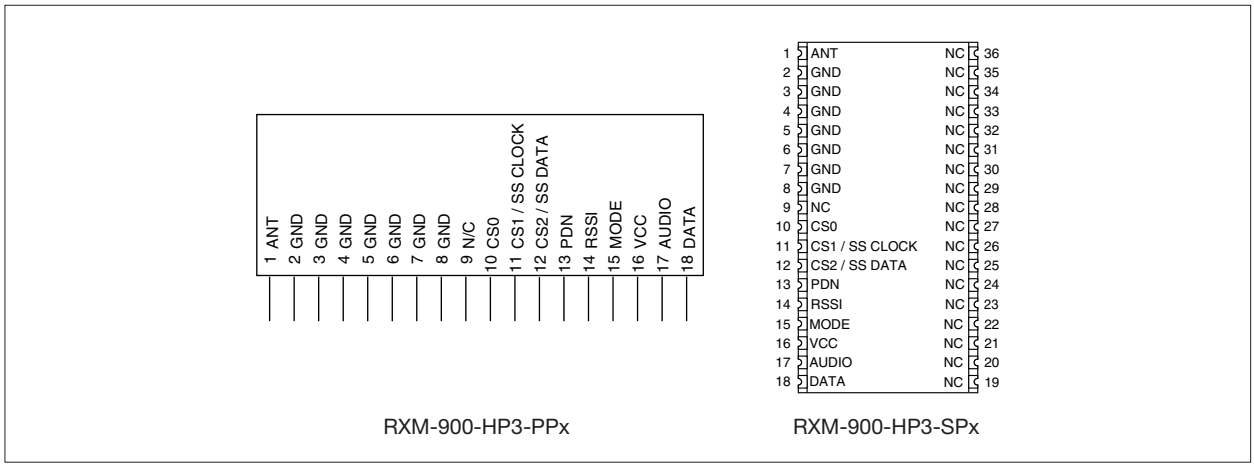


Figure 6: HP3 Series Receiver Pinouts

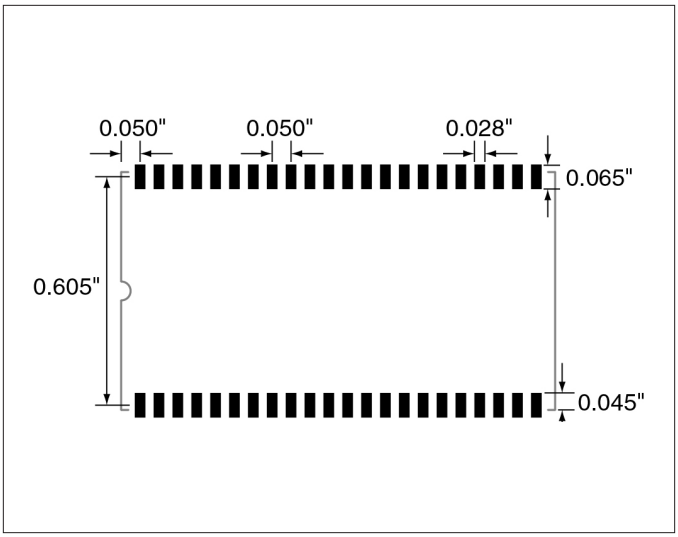


Figure 7: NT Series Transceiver Footprint

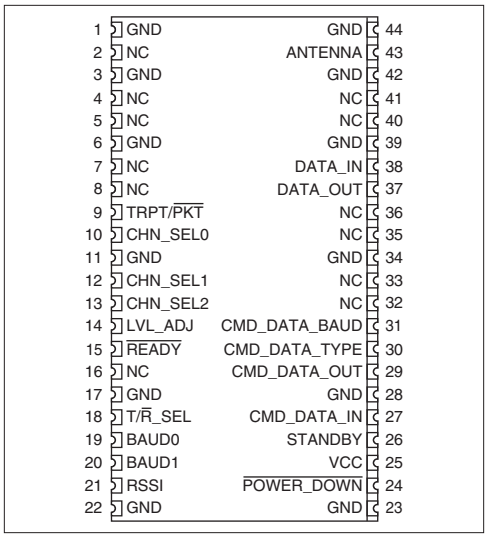


Figure 8: NT Series Transceiver Pinout

NT Settings - Parallel Interface

Applications using the HP3's parallel channel selection should configure the NT as follows.

For using the NT Series transceiver to replace an HP3 Series transmitter:

- Connect the TRPT/$\overline{\text{PKT}}$ line to V_{CC}.
- Set the Channel Select lines the same as for the HP3. The channel selection is identical between the two series.
- The LVL_ADJ line uses a resistor to ground to set the output power. An FCC test lab should determine the resistor value that sets the output power to the legal limit.
- Connect the T/$\overline{\text{R}}$_SEL line to V_{CC}.
- The NT should be set to Baud Band 2 when replacing a transmitter, so connect BAUD0 to V_{CC} and BAUD1 to GND.
- The $\overline{\text{POWER\_DOWN}}$ line is used the same as on the HP3. Pull it high to activate the module or low to place it into a low power state.
- Connect STANDBY, CMD_DATA_TYPE and CMD_DATA_BAUD to GND.
- Connect CMD_DATA_IN to V_{CC}.
- Leave CMD_DATA_OUT unconnected.
- Connect source data to the DATA_IN line.

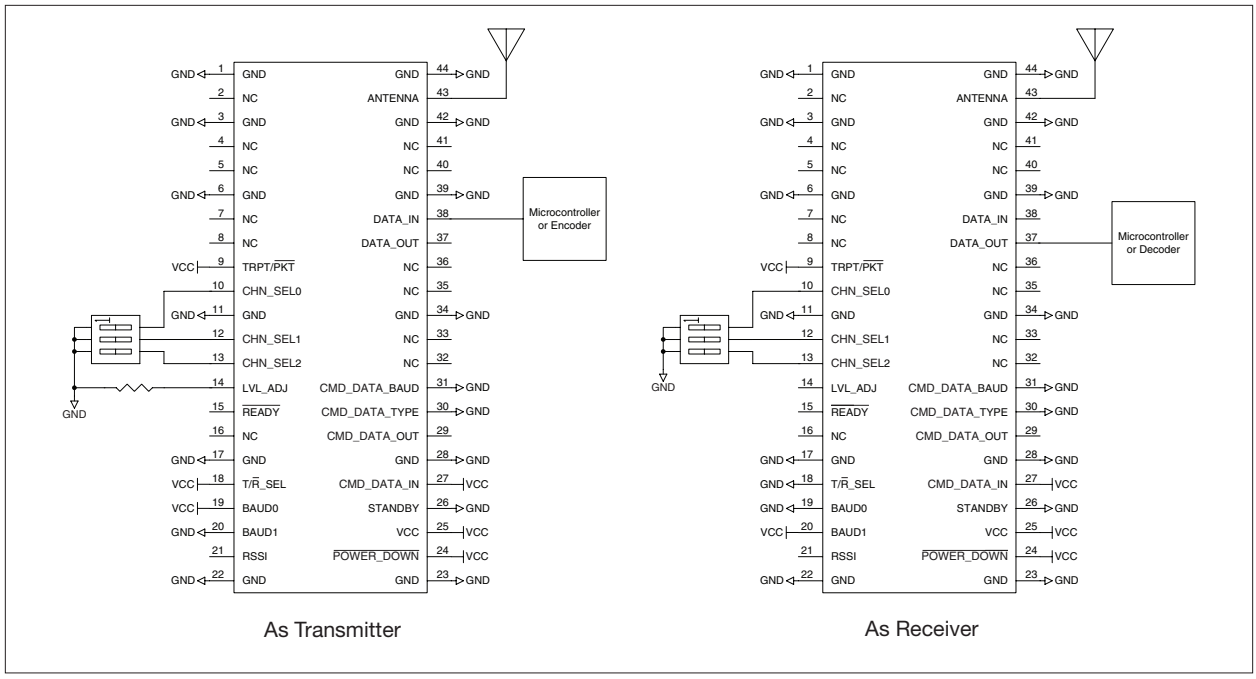


Figure 9: NT Series Transceiver Settings for Replacing an HP3 Transmitter and Receiver - Parallel Channel Selection

For using the NT Series transceiver to replace an HP3 Series receiver:

- Connect the TRPT/$\overline{\text{PKT}}$ line to V_{CC}.
- Set the Channel Select lines the same as for the HP3. The channel selection is identical between the two series.
- The LADJ line is not used on the receiver, so it can be left unconnected.
- Connect the T/$\overline{\text{R}}$_SEL line to GND.
- The NT should be set to Baud Band 3 when replacing a receiver, so connect BAUD0 to GND and BAUD1 to V_{CC}.
- The RSSI line operates the same as with the HP3 except that in the NT the output voltage will swing from GND to V_{CC} instead of GND to 3.0V with the HP3.
- The $\overline{\text{POWER\_DOWN}}$ line is used the same as on the HP3. Pull it high to activate the module or low to place it into a low power state.
- Connect STANDBY, CMD_DATA_TYPE and CMD_DATA_BAUD to GND.
- Connect CMD_DATA_IN to V_{CC}.
- Leave CMD_DATA_OUT unconnected.
- Connect the DATA_OUT line to the data sink.

NT Settings - Serial Interface

The NT's serial interface is different from the HP3's interface. The HP3 uses a single line for data input and a second line for a clock. The NT uses a standard UART that is compatible with those common in most off-the-shelf microcontrollers. This difference needs to be addressed when making the change to the NT Series. More information is in the Serial Interface section.

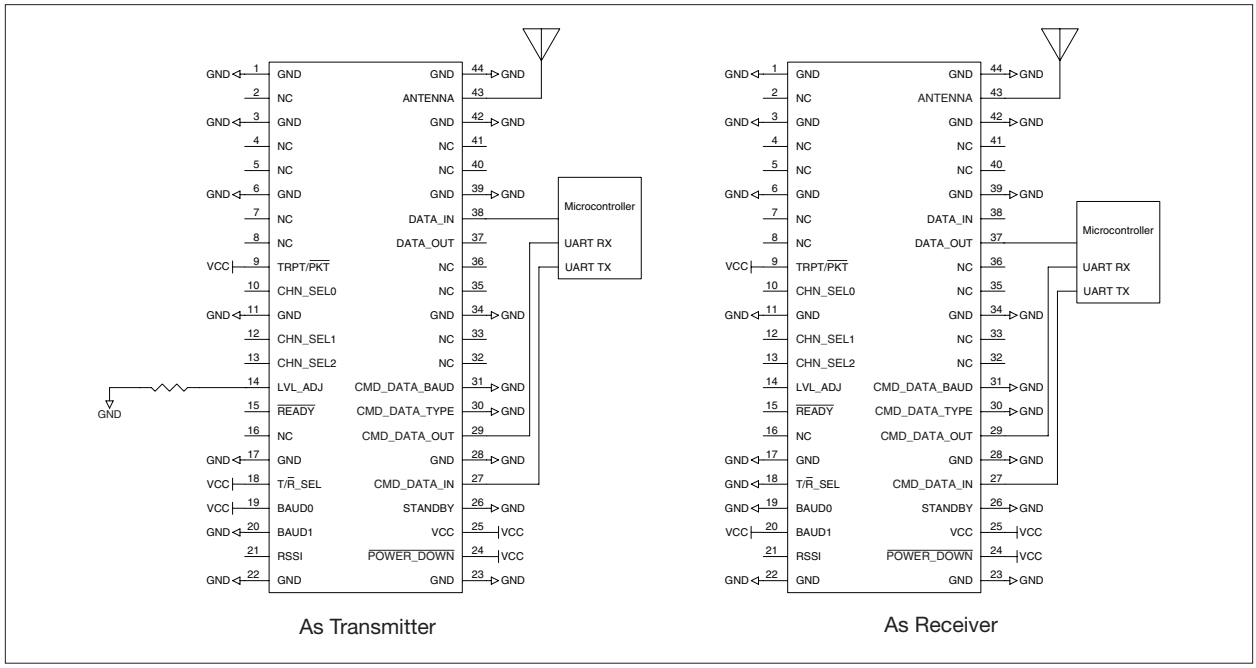


Figure 10: NT Series Transceiver Settings for Replacing an HP3 Transmitter and Receiver - Serial Channel Selection

Applications using the HP3's serial interface for channel selection should have the NT configured as follows.

For using the NT Series transceiver to replace an HP3 Series transmitter:

- Connect the TRPT/$\overline{\text{PKT}}$ line to V_{CC}.
- The Channel Select lines are not used, so they can be disconnected.
- The LVL_ADJ line uses a resistor to ground to set the output power. An FCC test lab should determine the resistor value that sets the output power to the legal limit.
- Connect the T/$\overline{\text{R}}$_SEL line to V_{CC}.
- The NT should be set to Baud Band 2 when a transmitter, so connect BAUD0 to V_{CC} and BAUD1 to GND.
- The $\overline{\text{POWER\_DOWN}}$ line is used the same as on the HP3. Pull it high to activate the module or low to place it into a low power state.
- Connect STANDBY, CMD_DATA_TYPE and CMD_DATA_BAUD to GND.
- Connect CMD_DATA_IN to a microcontroller's UART TX line and CMD_DATA_OUT to the UART RX line.
- Connect source data to the DATA_IN line.

For using the NT Series transceiver to replace an HP3 Series receiver:

- Connect the TRPT/$\overline{\text{PKT}}$ line to V_{CC}.
- The Channel Select lines are not used so they can be disconnected.
- The LVL_ADJ line is not used on the receiver so it can be left unconnected.
- Connect the T/$\overline{\text{R}}$_SEL line to GND.
- The NT should be set to Baud Band 3 when a receiver, so connect BAUD0 to GND and BAUD1 to V_{CC}.
- The RSSI line is used the same as with the HP3 except that in the NT the output voltage will swing from GND to VCC instead of GND to 3.0V as with the HP3.
- The $\overline{\text{POWER\_DOWN}}$ line is used the same as on the HP3. Pull it high to activate the module or low to place it into a low-power state.
- Connect STANDBY, CMD_DATA_TYPE and CMD_DATA_BAUD to GND.
- Connect CMD_DATA_IN to a microcontroller's UART TX line and CMD_DATA_OUT to the UART RX line.
- Connect the DATA_OUT line to the data sink.

Note: The NT's serial interface (also called the Command Data Interface or CDI) temperature specification is 0°C to +60°C.

Operational Differences

With the settings described above, data transfers with the NT Series are the same as with the HP3 Series. The most significant difference is that the NT Series is a digital-only device and cannot transmit analog or audio signals. An external CODEC is required for analog transmissions.

Certification

Because the NT Series module is a different radio, the product will need to be re-tested for regulatory compliance. This is the case for all countries in which certifications are sought. Linx has partnered with a test lab that offers discounts for Linx customers. Contact Linx technical support for more information on certification and the lab's contact information.

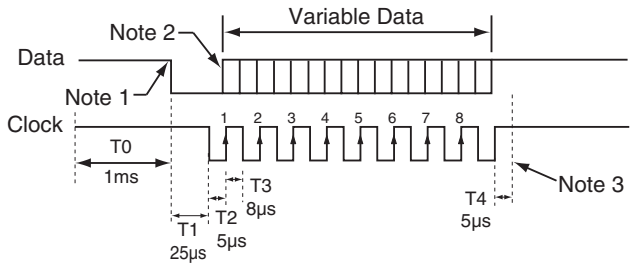
The Serial Interface

Both the NT and the HP3 have a serial interface that can be used to configure the modules. The interface on the HP3 is used to set the module's channel. The NT offers this and several other configuration options, but this application note only focuses on the channel selection.

The HP3's Serial Mode is entered when the MODE line is left open or held high. In this condition, CS1 and CS2 become a synchronous serial port, with CS1 serving as the clock line and CS2 as the data line. The module is programmed by sending and latching the binary number (0 to 100) of the desired channel.

Minimum timings and bit order must be followed. Loading is initiated by taking the clock line high and the data line low as shown in the figure below. The eight-bit channel number is then clocked-in one bit at a time, with the LSB first.

There is no maximum time for this process, only the minimum times that must be observed. After the eighth bit, both the clock and data lines should be taken high to trigger the automatic data latch.



HP3 Series Serial Data Timing		
(T0)	Time between packets or prior to data startup	1mS min
(T1)	Data-LO / Clock-HI to Data-LO / Clock-LO	25µS min
(T2)	Clock-LO to Clock-HI	5µS min
(T3)	Clock-HI to Clock-LO	8µS min
(T4)	Data-HI / Clock-HI	5µS min
Total Packet Time		157µS min

Figure 11: HP3 Series Serial Data Timing

The NT Series transceiver has a Command Data Interface (CDI) that offers the option to configure the transceiver through software instead of through hardware. It uses Command Data In (CMD_DATA_IN) and Command Data Out (CMD_DATA_OUT) as a serial port. The data format follows standard UART conventions of 8 data bits, 1 stop bit and no parity. The UART voltage levels follow digital logic as mark = V_{CC} and space = GND. The Command Data Baud (CMD_DATA_BAUD) line sets the baud rate of the serial interface to either 9,600bps (low) or 57,600bps (high).

The serial interface is available for use as long as the transceiver is not in power down or standby modes. The Ready output ($\overline{\text{READY}}$) can be used for simple hardware flow control similar to CTS. This output is logic low as long as the transceiver is able to receive command data. If the $\overline{\text{READY}}$ output is logic high, the transceiver cannot receive commands.

The serial data structure consists of four bytes: the Command, the Parameter, the data Value, and a Terminator.

Input message:

Command + Parameter + Value + Terminator (0xFF)

A response is returned when a command is entered. If the command is correct, the response message is an ACKnowledgement (Command = 0x06) with the Parameter that was received and either the Value that was received for a write Command or the Value that was queried for a read Command. If the Command is incorrect, the response message is a Negative ACKnowledgement (Command byte = 0x15) with the Parameter that was received and an error code in the Value byte. Every message must have a Terminator byte (0xFF) that identifies the end of the message.

Reply Message:

ACK: Command (0x06) + Parameter Received + Value Received + Terminator (0xFF)
NACK: Command (0x15) + Parameter Received + Error Code + Terminator (0xFF)

The serial command set uses the Command byte to distinguish between three different actions.

When Command is 0x01, the module reads the current parameter settings. This is useful to poll the module for its current operating status. The Value byte is not used on a read input message so is set to 0x00. This byte will contain the appropriate value on the output message.

When Command is 0x02, the module writes the parameter into temporary memory. Once power is removed from the module, these settings are lost and the default settings are restored on power up. This allows the module to be controlled through software while allowing a return to the factory default state on a power cycle. This is also useful in frequency hopping algorithms where the channel can be changed quickly without having to wait the required time for writing to non-volatile memory

When Command is 0x03, the module programs the parameter into non-volatile memory. These settings are used after the module has been turned off instead of the factory default settings. They can be used as a one-time setup through software or as custom default settings when power is cycled to the module.

Figure 12 shows the NT Series CDI command set. The command set uses binary data and not ASCII data.

Please see Application Note AN-00158 for more information on the NT Series module's CDI.

Command Data Structure				
Input Message	Command + Parameter + Value + Terminator (0xFF)			
ACK Reply Message	Cmd (0x06) + Rcvd Parameter + Value + Terminator (0xFF)			
NoACK Reply Message	Cmd (0x15) + Rcvd Parameter + Error Code + Terminator (0xFF)			
Function	**Cmd**	**Parameter**	**Value**	**Description**
Channel	01 – 03h	10h	00 – 64h	Channel (0 – 100)
Baud Band	01 – 03h	11h	01 – 04h	Baud Band (1 – 4)
TX / RX Mode	01 – 03h	12h	00 – 01h	Transmit / Receive (0 – 1)
Level Adjust Value	01 – 03h	13h	00 – 39h	TX output power (0 – 57)
Pin Override Mask	01 – 03h	14h	00 – 0Fh	Software override of hardware settings
Read Only				
Device Name	01h	01h	00h	Returns the 2 character name (NT)
Firmware Version	01h	02h	00h	Returns the 2 byte firmware version
Serial Number	01h	03h	00h	Returns the 4 byte serial number
Get RSSI Value	01h	1Fh	00h	Returns the RSSI value
Write Only				
Return to Default	03h	80h	00h	Return to factory default
Error Codes				
ERR_CMD	15h		F1h	Invalid Command
ERR_CHAN	15h		F2h	Channel value is out of range
ERR_BAUD	15h		F3h	Baud band value is out of range
ERR_RXTX	15h		F4h	RX / TX value is out of range
ERR_LVL_ADJ	15h		F5h	Level Adjust value is out of range
ERR_MASK	15h		F6h	Command is not enabled by the mask

Figure 12: NT Series Transceiver Command Data Interface Command Set

NT Series Serial Command Examples

To use the serial channels, first instruct the module to ignore the hardware channel select pins and use the serial interface for channel selection.

0x02 + 0x14 + 0x01 + 0xFF

The following command reads the NT's current channel.

0x01 + 0x10 + 0x00 + 0xFF

The following command writes a new channel number to temporary RAM.

0x02 + 0x10 + 0x(00h – 64h) + 0xFF

The following command programs a channel to non-volatile memory and makes it the new default on power-up.

0x03 + 0x10 + 0x(00h – 64h) + 0xFF

The value of 00 to 64 in hexadecimal equate to decimal channel numbers 0 to 100. Insert the desired channel number into the Value byte to activate that channel.

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159 Ort Lane, Merlin, OR 97532
Phone: +1 541 471 6256
Fax: +1 541 471 6251
www.linxtechnologies.com