NT Series Transceiver Wireless UART

Reference Guide RG-00102

Introduction

The NT Series transceiver's transparent data pipe is ideal for applications that use custom protocols or legacy protocols such as PWM that are not compatible with a standard transmission format. However, the NT Series also has an internal packet generator for applications that don't need a custom protocol and don't have the time or warrant the effort of creating a protocol.

The packet generator takes the data presented by the user and combines it with a preamble, SYNC word and a CRC value to create a packet. This packet is suitable for transmission in the noisy RF environment. On the receiving side, the packet generator validates the received packets and presents the received data to the user if the packets arrived intact.

The internal packet generator is accessed through the module's Command Data Interface (CDI). The CDI is a standard UART interface that is compatible with UARTs in a wide variety of off-the-shelf microcontrollers. The standard UART data structure is not robust enough for the noisy RF environment, so a protocol is required to protect the data and ensure that it is received correctly. The module's UART interface and internal packet generator combine to create a wireless UART and allow the designer to bypass protocol development.

Packet Mode Data Structure

Figure 1 shows the packet structure used by the NT Series.

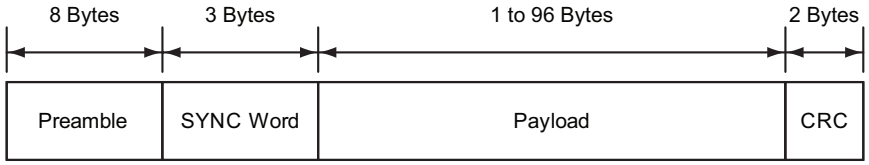

Figure 1: NT Series Transceiver Packet Mode Data Structure

The preamble is used to "clear the pipe." It is a repeating pattern (typically 101010) that can be distinguished from random noise. It allows the receiver circuitry to lock on to the signal and center itself without sacrificing any data.

The SYNC word is a fixed pattern of 3 bytes that identifies the packet as belonging to the system and allows the receiver to synchronize to the incoming data. It must match what is expected or the packet is rejected.

The payload is the data to be transferred. It can be from 1 to 96 bytes long depending on what the application needs.

The Cyclic Redundancy Check (CRC) is a data verification value that is calculated on the transmitted packet. The receiver performs the same calculation and if its result matches the value that was received in the packet then the packet is declared good.

Connecting the Command Data Interface

The Packet Mode interface uses eight lines (described in Figure 3) on the module (Figure 2).

NT Series Transceiver Pin Descriptions

Pin #	Name	Description
9	TRPT / $\overline{\text{PKT}}$[1]	Transparent/Packet data select. Pull high or float for Transparent Mode, pull low for Packet Mode. This line is checked once on power up.
19	BAUD0[1]	Baud Rate Select 0. This line and BAUD1 set over-the-air data rate and filter bandwidths.
20	BAUD1[1]	Baud Rate Select 1. This line and BAUD0 set over-the-air data rate and filter bandwidths.
15	$\overline{\text{READY}}$	Ready. This line is low when the transceiver is ready to communicate and high when it is busy. This line can be used for hardware flow control when using the Command Data Interface.
27	CMD_DATA_IN	Command Data In. This line is the input for command data to set up the module or packet data to be packetized and transmitted.
39	CMD_DATA_OUT	Command Data Out. This line outputs the command data to set up the module or packet data that has been received.
30	CMD_DATA_TYPE	Command Data Type. This line sets the data input through the Command Data Interface as either command data or packet data. Pull low for command data; pull high for packet data.
31	CMD_DATA_BAUD	Command Data Baud. This line sets the baud rate of the Command Data Interface. Pull low for 9,600bps; pull high for 57,600bps. This line is checked once on power up.

1- These lines have an internal 100kΩ pull-up resistor

Figure 3: NT Series Transceiver Pin Descriptions

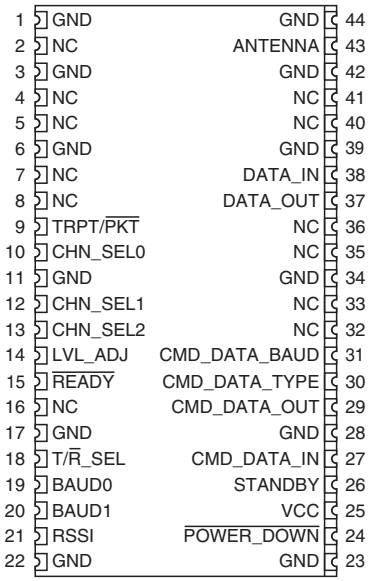

Figure 2: NT Series Transceiver Pinout (Top View)

Pulling the Transparent or Packet Select (TRPT/$\overline{\text{PKT}}$) line low on power up places the module into Packet Mode. The state of this line is checked once on power up. It can be hardwired to ground.

Pulling the Command Data Type (CMD_DATA_TYPE) line high tells the module that the data coming in on the UART should be sent to the packet generator. If this line is low, the data is interpreted as command data for configuring the module. Please see the Command Data Interface Reference Guide for information on the module's CDI. This line can be controlled by a microcontroller to switch between Packet Mode and configuration. The line is checked as soon as serial data is received on the CMD_DATA_IN line. The CMD_DATA_TYPE line should be set prior to sending serial data to the module and can be changed as soon as the $\overline{\text{READY}}$ line changes.

Command Data In (CMD_DATA_IN) and Command Data Out (CMD_DATA_OUT) are the serial interface lines. The data format follows standard UART conventions of 8 data bits, 1 start bit, 1 stop bit and no parity. The UART voltage levels are mark (1) = VCC and space (0) = 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). This line is checked on power up and can be hardwired.

In Packet Mode, the states of the BAUD0 and BAUD1 lines set the over-the-air baud rate as shown in Figure 4. This does not affect the baud rate of the CDI serial interface. Using a lower baud rate results in better range. This can be configured through the CDI or hardwired.

NT Series Transceiver Packet Mode Baud Selection

Baud Band	BAUD1	BAUD0	Baud Rate (kbps)
1	0	0	19.2
2	0	1	57.6
3	1	0	153.6
4	1	1	300

Figure 4: NT Series Transceiver Packet Mode Baud Selection

The Ready output ($\overline{\text{READY}}$) can be used for simple hardware flow control similar to the Clear To Send (CTS) line in traditional serial interfaces. This output is logic low when the module is ready for use and logic high when it's busy. In Packet Mode, it goes high when the internal buffer reaches 96 bytes, indicating that the host application should stop the data stream. This makes it straightforward to send streaming data. The line can be ignored to send bursts of data that are less than 96 bytes each while waiting enough time for the NT to transfer the data over the air and be ready for more serial data. This time can be measured using the $\overline{\text{READY}}$ pin.

Operation

When Packet Mode is enabled, the transceiver is in Receive Mode looking for data until data is received into the UART. Once the transceiver has buffered 96 bytes of data from the UART, $\overline{\text{READY}}$ goes high. At this point an additional 22 bytes can be buffered while the host application prepares to halt serial data transfer. Once the maximum amount of serial data is buffered, additional data is accepted and ignored. After serial data has been halted for more than 2.4ms, the buffered data is sent to the packet generator and the over-the-air packet is created. The transceiver goes into Transmit Mode and the packet is transmitted. The packets are sent once with no retries or forward error correction. After transmitting the packet, the module sets $\overline{\text{READY}}$ low and checks for more data from the UART. If there is more data, then it repeats the cycle. If no data is present, it returns to Receive Mode.

When a packet is received over the air, the transceiver automatically checks the SYNC word, CRC and other items and presents the data in the payload on the CMD_DATA_OUT line. If any check fails, the packet is ignored.

A generic protocol structure is used that may be similar to other systems, so it is recommended to include some form of validation or check within the data payload so that the receiving device can confirm that the received data is from an authorized device. This can be as simple as a value that is in a specific place in every packet sent by every device in the system. If the correct value is not present in the correct location, the received data is ignored.

When in Packet Mode, the DATA_IN, DATA_OUT and T/$\overline{R}$_SEL lines are ignored. The CDI command to change the TX/RX Mode is also ignored. The serial interface is available for use when the transceiver is not in Power Down or Standby modes.

Typical Applications

Figure 5 shows a typical application using Packet Mode. The TRPT/$\overline{PKT}$ line is pulled low, placing the module into Packet Mode.

CMD_DATA_IN and CMD_DATA_OUT are connected to the TX and RX lines of the UART in the microcontroller.

The microcontroller controls the CMD_DATA_TYPE line to toggle between Command Data for changing the module's settings and Packet Data for transmission and reception.

The microcontroller controls $\overline{POWER\_DOWN}$ and STANDBY for power conservation, though these lines can be hardwired if power conservation is not required by the application.

The microcontroller monitors the $\overline{READY}$ line for flow control and to monitor the status of the module.

CMD_DATA_BAUD is hardwired to the high data rate (57,600bps).

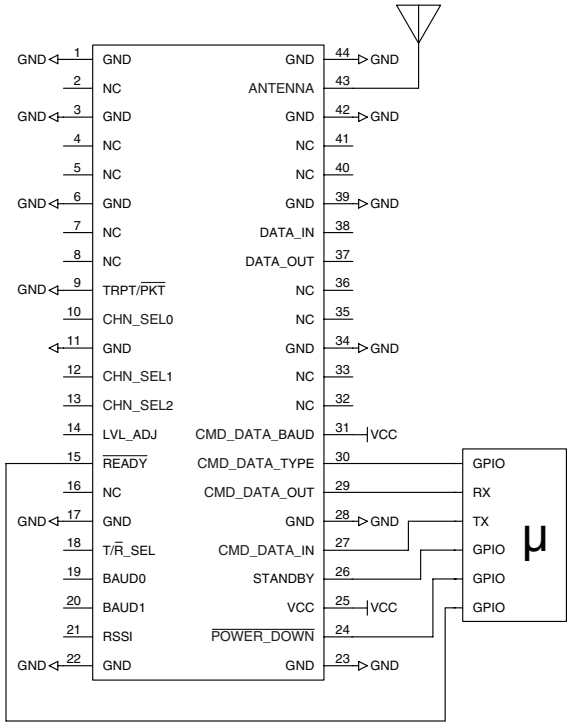

Figure 5: NT Series Transceiver Typical Application Circuit - Packet Mode

The channel, power level and baud band are controlled by the microcontroller through the CDI rather than by the hardware lines. The microcontroller also reads the RSSI level through the CDI.

Please see the Command Data Interface Reference Guide for more information on the NT's Command Data Interface.

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