Basic Configurations for Sending Data with the HumPRO™ Series RF Transceivers

Reference Guide RG-00106

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Introduction

The HumPRO™ Series transceiver module is designed for the reliable transfer of digital data. It offers many options and features that make it suitable for a wide range of applications. With all of these options it can leave a designer unsure of where to start. This document shows how to set the HumPRO™ Series transceivers up for simple data transfer. Additional functions and capabilities can be built upon this foundation.

Physical Setup

The most basic configuration for the HumPRO™ Series is shown in Figure 1.

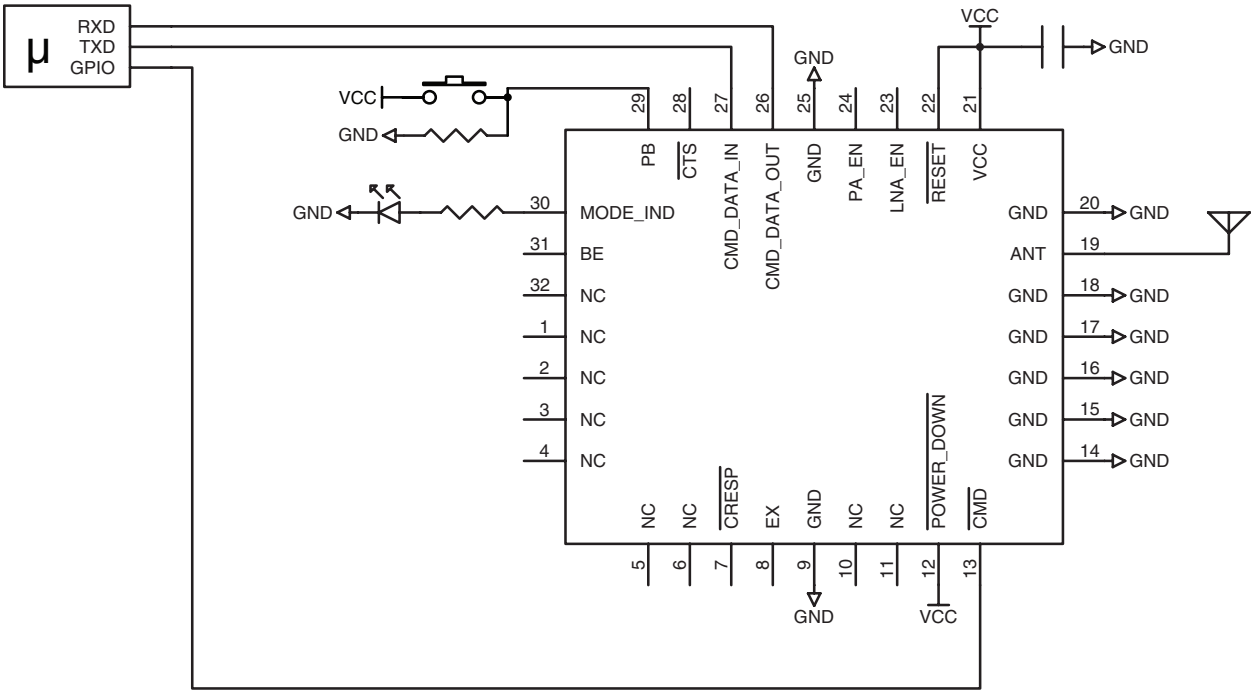

Figure 1: HumPRO™ Series Transceiver Basic Setup Schematic

Three lines are all that are really required to communicate with and control the module. CMD_DATA_IN and CMD_DATA_OUT are the UART interface lines. The state of the $\overline{\text{CMD}}$ line tells the module if the data on the UART is configuration data or data to be transmitted over the air.

This shows the module connected to a microcontroller, but it could also be any device with a UART interface. This includes RS-232 or USB converters.

Module Configuration

The module must be configured by serial commands before sending data with the HumPRO™ Series. All commands and command responses are in binary. The HumPRO™ has two types of configuration registers; volatile and non-volatile.

Volatile memory is used while the module is running, but any changes are lost when power is cycled. Non-volatile memory is retained when power is removed, but any changes require power to the module to be cycled in order for them to take effect. Volatile registers are set to associated non-volatile register values on reset.

If the module is configured by one device, such as the development kit, and then placed into a different circuit for testing, the non-volatile registers must be used. If it will stay in circuit and there are a number of configurations that will be adjusted to test results, then it is better to change the volatile registers.

The following simplified procedure assumes that the modules have the default factory configurations (as shipped). If not. restore the factory defaults as described in the module's data guide.

Data Rate

The first critical configuration is the data rate. The default data rate is 9,600bps with 1 start bit, 1 stop bit, 8 data bits and no parity. If a different data rate is desired then the UARTBAUD register must be changed.

Regardless of the final data rate, the first time the module is powered on the external device must be at 9,600bps. The module outputs a startup message when power is applied. This serves as a good test to ensure that the external UART is configured correctly. From this point the rate can be changed. The command to change the rate is shown in Figure 2. The $\overline{CMD}$ line must be pulled low before the commands are issued.

HumPRO™ Series UARTBAUD Configuration

Volatile Register Configuration

Header	Size	Address	Value
0xFF	0x02	0x4E	V

Non-Volatile Register Configuration

Header	Size	Address	Value
0xFF	0x02	0x03	V

Figure 2: HumPRO™ Series UART Baud Rate Command

0x4E is the address for the volatile register and 0x03 is the address for the non-volatile register. Value V is the code for the UART baud rate. These codes are shown in Figure 3.

HumPRO™ Series UARTBAUD Register Settings

V	Baud Rate (bps)	RF Data Rate (bps)
0x01	9,600	19,200
0x02	19,200	19,200
0x03	38,400	153,600
0x04	57,600	153,600
0x05	115,200	153,600
0x06	10,400*	153,600
0x07	31,250*	153,600

* These data rates are not supported by PC serial ports. Selection of these rates may cause the module to fail to respond to a PC, requiring a reset to factory defaults.

Figure 3: HumPRO™ Series UART Baud Rate Settings

If the volatile register is changed then the UART changes its rate immediately after sending an ACK byte. If the non-volatile register is changed then the power must be cycled before the change will be implemented.

Addressing

The HumPRO™ Series transceiver has 3 addressing modes that are suitable for different applications. The command to set the addressing mode is in Figure 4.

HumPRO™ Series ADDMODE Configuration

Volatile Register Configuration

Header	Size	Address	Value
0xFF	0x02	0x4F	V

Non-Volatile Register Configuration

Header	Size	Address	Value
0xFF	0x02	0x04	V

Figure 4: HumPRO™ Series Addressing Mode Command

0x4F is the address for the volatile register and 0x04 is the address for the non-volatile register. The simplest method is to use Extended User Addressing Mode (V = 0x07). This mode uses the values in the USRCID registers as the module's local address. By default these are all set to 0xFF. The values in registers UDESTID are used as the destination address for the transmitted messages. They are also 0xFF by default.

All of these can be left to the default values for demonstration purposes if no other modules are in range. It will generally be fine when testing two modules on the bench, but will get confusing with more than two modules. Deployed systems should use separate addresses for every module to identify the transmitter that sent the message and avoid interference with other systems.

This example assumes two modules creatively named Module 1 and Module 2. To keep things simple, the low address registers are changed to 0x01 for module 1 and 0x02 for module 2. The destination addresses are set as well. These commands are shown in Figure 5.

This can be extended to more modules in a system, but this is the simplest implementation.

The UMASK regsters are 0xFF by default. This is suitable for the purposes of getting started.

Testing

The modules are now ready to send data. Pull the CMD line high and write data to one of the modules. It is output on the UART of the remote module. The MODE_IND line goes high when data is transmitted or received, providing feedback of the operation.

HumPRO™ Series Module 1 Commands

Volatile Register Configuration

Set USRCID0

Header	Size	Address	Value
0xFF	0x02	0x61	0x01

Set UDESTID0

Header	Size	Address	Value
0xFF	0x02	0x5D	0x02

Non-Volatile Register Configuration

Set USRCID0

Header	Size	Address	Value
0xFF	0x02	0x16	0x01

Set UDESTID0

Header	Size	Address	Value
0xFF	0x02	0x12	0x02

HumPRO™ Series Module 2 Commands

Volatile Register Configuration

Set USRCID0

Header	Size	Address	Value
0xFF	0x02	0x61	0x02

Set UDESTID0

Header	Size	Address	Value
0xFF	0x02	0x5D	0x01

Non-Volatile Register Configuration

Set USRCID0

Header	Size	Address	Value
0xFF	0x02	0x16	0x02

Set UDESTID0

Header	Size	Address	Value
0xFF	0x02	0x12	0x01

Figure 5: HumPRO™ Series User Source Address Registers

Moving On

Now that basic data transfer is operational, there are some other commands that can be explored. The following commands represent some of the more common features that are used in systems.

Hop Table

The module supports 6 channel hop sequences that allow different systems to operate in the same area at the same time. The HOPTABLE register sets which sequence is used. Modules only output messages sent by transmitters using the same hop sequence.

TX Output Power

The module's transmitter output power can be adjusted to suit different needs. It can be set to the highest level to get the most range. It can be lowered to reduce current consumption and potential interference at shorter ranges. The TXPWR register sets the transmitter output power.

Data Time Out and Byte Count Trigger

These values determine when a packet is sent. The Data Time Out configuration (DATATO register) sets the amount of time to wait for more UART data before sending a packet. If no more bytes are received on the UART within this time, then the module sends what it has.

The Byte Count Trigger (BCTRIG) sets the number of bytes to receive on the UART to trigger a transmission. Once this many bytes are received, the module sends the packet.

These values can be adjusted to make the module more responsive to the particular application. This can reduce the lag time between when the data is input to the module and when it is actually transmitted. This can be important if the modules need to sleep to conserve battery power.

Using the $\overline{\text{CRESP}}$ Line

The CRESP line indicates whether the data coming out of the module is data that was received over the air or a response to a command. If the end product is going to issue commands to the module while at the same time potentially receiving data, then it is a good idea to have the external micro monitor this line.

Sleeping and Sleep Cycling

Power consumption is a critical parameter for battery-powered devices. The HumPRO™ modules support placing the modules into a low-power sleep mode. This is done in one of two ways. Pulling the $\overline{\text{POWER\_DOWN}}$ line low or configuring the IDLE register.

The $\overline{\text{POWER\_DOWN}}$ line is a hardware configuration that can take less code and fewer UART transactions, but does require another GPIO from an external microcontroller. The IDLE register requires a bit more code, but does not require any additional hardware connections.

Pulling the $\overline{\text{POWER\_DOWN}}$ line high or a transition on the CMD_DATA_IN line wakes the module from sleep.

Exceptions

The module incorporates an exception engine that can inform the external micro to a number of events. These can include errors, such as no acknowledgement received from the remote end, or when there is received data ready to be output on the UART. Monitoring some of the exceptions can provide information about how the system is operating. These use the EXMASK, EXCEPT, EEXFLAG and EEXMASK registers as well as the EX line.

Explicit Packet Transfer

The module supports functions that give explicit control over when packets are transmitted. This can be important in systems that want to make sure all of the data is sent in the same packet or for timing constraints. These options are configured using the PKTOPT register.

Encryption

The module supports AES-128 encryption implemented in CCM mode. There are a number of features associated with the encryption that can be used. The modules can generate their own random encryption key as well as automatically set up addressing and distribute the key among system components. Likewise keys and addresses can be written into the modules if the designer wishes to set up the system explicitly. Reference Guide RG-00107 has more details about the encryption in the HumPRO™ Series.

Conclusion

There are many features and options available on the HumPRO™ Series transceiver modules. These represent the most common ones that are used in deployed systems, but many more possibilities await the creative designer.

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