BM innovations GmbH
incremental changes in thinking

BlueRobin™

Wireless Low-power Body Area Network

BM-MM5 Receiver Module with UART Interface

User Guide

Author: Richard Mayerhofer
Date: 19th of March 2009
Revision: 1.1

Interface Hardware

A UART interface is used to connect the receiver module to the host application. The baud rate and the format is defined with 9600 Baud, N-8-1. The signal level is positive TTL, max. VCC. The polarity is standard TTL, which means that 'high' refers to VCC, 'low' refers to 0 volts. The idle line is 'high'.

The size of the receiver module is 32.0 mm x 14.0 mm x 2.2 mm. All interface pins are arranged on one side of the module in a 2.54 mm grid, so standard connectors can be used. The position of the module should be chosen in a way so that no ground plane is located below or above the antenna part.

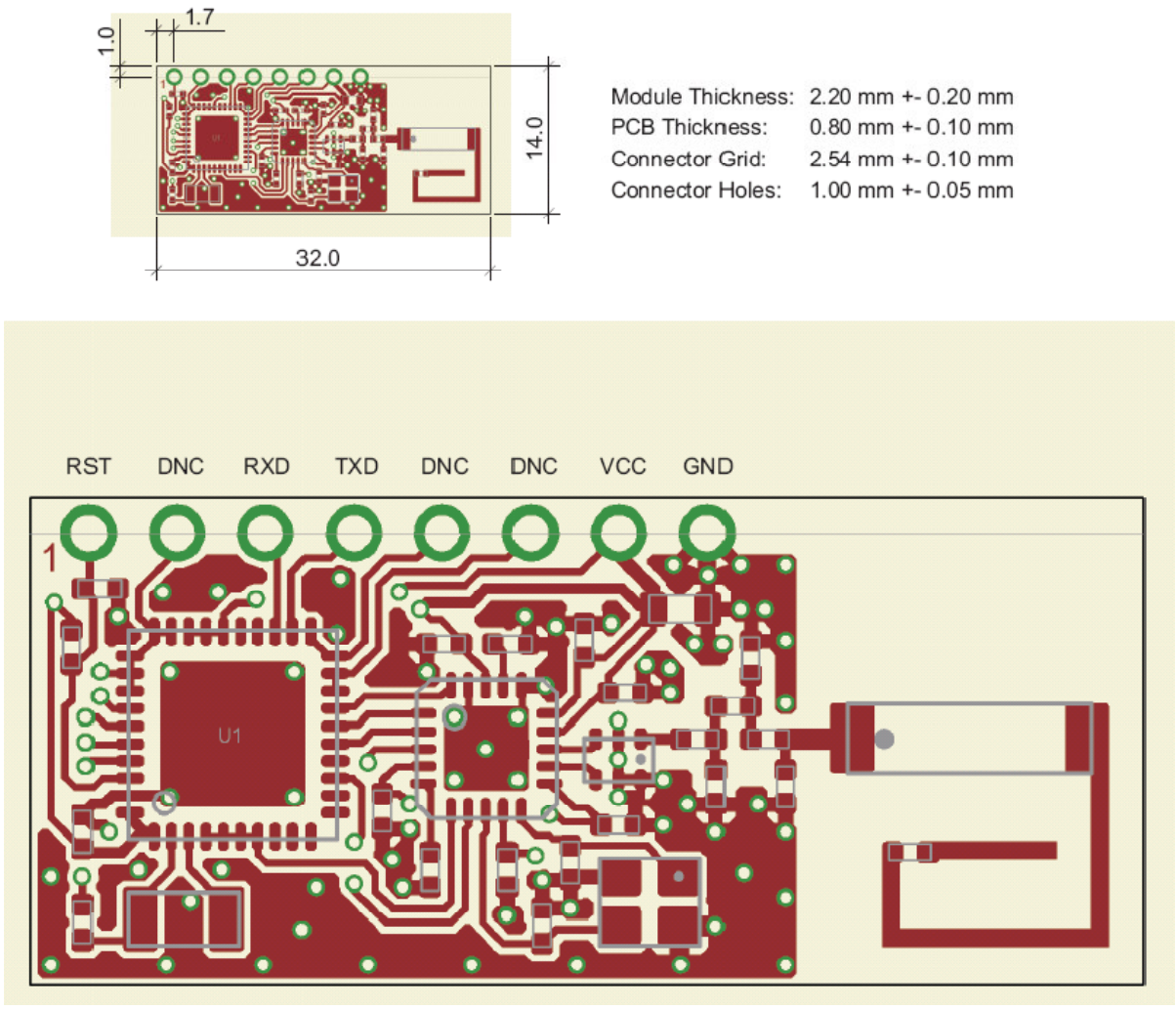

Fig. 1: Receiver module dimensions and connector assignment

The interface pins provide the following signals:

- PIN1: RST — Module reset input (47k pull-up, can be left open)
- PIN2: DNC — To be left open
- PIN3: RXD — Receive data input
- PIN4: TXD — Transmit data output
- PIN5: DNC — To be left open
- PIN6: DNC — To be left open
- PIN7: VCC — Supply voltage, positive terminal
- PIN8: GND — Supply voltage, negative terminal

Technical Data

Supply voltage:	2.8 V to 3.3 V
Current consumption in Search Mode:	max. 30 mA
Current consumption in Normal Mode:	typ. 50 uA in average, 25 mA peak
Current consumption in Standby Mode:	typ. 1.2 uA
Operating temperature:	10 °C bis +50 °C
Storage temperature:	-20 °C bis +80 °C
Data transmission:	***BlueRobin***™
Transmission frequency:	868 MHz ISM band with frequency hopping
Transmission distance:	min. 10 m free air, dependent on environment
Antenna:	chip antenna
Channels:	reception of 10 HR transmitters in parallel
Interface to host:	asynchronous, standard TTL (max. Vcc), polarity inverse in reference to V24
Baud rate:	9600 Baud, no parity, 8 data bits, 1 stop bit
Signal level:	Input Low <= 0.8 Volt Input High >= 2.0 Volt, <= VCC Output Low <= 0.8 Volt Output High >= 2.0 Volt (Rload >= 10kOhm)

The supply voltage has to be switched on in less than 10 ms (10% - 90 % level). Spikes may not be allowed. The receiver module needs a settling time of typ. 2 seconds after power on before communication with the host system can be started.

Command Structure

Each command and feedback sequence consists of 4 bytes with the following contents:

Command code, Argument1, Argument2, Checksum;

The byte order for parameters is big endian: first high byte, last low byte.

The checksum for each command is calculated as follows:

Checksum = 0xFF ^ Command code ^ Argument1 ^ Argument2;

If no arguments are needed for a command, these bytes have to be set to zero. Only the command NOP has no parameter and no checksum and initiates a reset of the protocol sequence. Thus the NOP can be used to resynchronize communication after an error was detected. The host should send 4 NOPs in sequence after a reset, after an error was detected or in case bytes have been lost. The response time for a module is typically not more than 20 ms after any host command.

Commands sending data automatically from the receiver unit to the host system contain the corresponding channel number in the lower 7 bits of the command code, the MSB of the command code is always set.

Communication Sequence

All commands sent from a host system to the receiver module will be answered with the same command code. In case data have been requested they will be passed in the arguments of the returned command. An exception to this is the NOP command used for (re)synchronization which can be only used on the host side and does not cause any answer from the receiver unit.

If a channel is not in powerdown mode its data and RSSI level will be sent automatically to the host system. No answer from the host system is required.

Commands available to be sent from a host system

Command Name	Code	Request Parameter	Reply Parameter	Notes
NOP	0	-	-	(re)synchronize communication, has to be sent 4 times
Error	*1*	*Channel, Error*	-	*error notification, sent instead of reply to command from host*
Reset	2	Channel, 0	0, 0	enter powerdown mode, channel settings to default values (ID to 0)
Start	3	Channel, 0	0, 0	start search for transmitter if not already in active mode
Stop	4	Channel, 0	0, 0	enter powerdown mode
SetID_Mid	7	Channel, ID	0, 0	set middle byte of ID, only available in powerdown mode; has to be used right before SetID_Low
SetID_Low	8	Channel, ID	0, 0	set low byte of ID, only available in powerdown mode;
GetID_Low_Mid	9	Channel, 0	ID	get lower and middle byte of ID
GetTimeoutCnt	12	Channel, 0	Counter	get counter for timeout to powerdown mode
SetID_High	13	Channel, ID	0, 0	set high byte of ID, only available in powerdown mode; has to be used right before SetID_Mid
SetPowerdownDelay	14	Delay	0, 0	set timeout for powerdown mode for all channels
GetID_High	15	Channel, 0	ID	get high byte of ID; has to be used right before GetID_Low_Mid
SetLearnSensitivity	16	Sensitivity	0, 0	set receiver sensitivity reduction for transmitter learn mode
GetSoftwareRevision	21	0, 0	Revision	get software revision
GetHardwareRevision	22	0, 0	Revision	get hardware revision

The following errors will be detected automatically on the receiver module side and sent back as an error command instead of the normal answer to a command:

- 0x00 reserved
- 0x01 wrong checksum
- 0x02 reserved
- 0x04 invalid parameter
- 0x08 command not allowed
- 0x10 unknown command
- 0x20 wrong channel index
- 0x40 reserved
- 0x80 reserved

Commands (Information) sent automatically from the receiver module

Command Name	Code	Parameter	Notes
Data	Channel	RSSI level, Data	an RSSI level of 0 indicates a lost data packet if Data is set to 0 and a lost transmitter if Data is set to 1

For automatically sent information the MSB of the command code is always set, the channel number is contained in the remaining 7 bits of the command code.

As soon as new data have been received on a channel the “Data” command is used to pass these data to a host system together with the corresponding RSSI level.

If a data packet for an active channel has been missed it will be indicated with an RSSI level set to 0 and Data also set to 0. If the transmitter has been lost it will be indicated with an RSSI level set to 0 and Data set to 1. In that case an automatic search for the lost transmitter will be started on the corresponding channel.

Command Description

NOP

This command does not cause any operation or return value. It can be used to (re)synchronize the communication between host application and receiver module. Four NOPs should be sent in a row to ensure proper resynchronisation in any case.

Reset

To reset a channel to its default state this command has to be sent to the module It results in the following default settings:

State of HR channel: powerdown mode
ID of HR channel: 0 (learn mode when starting the channel)

Start

To start the search for a HR transmitter on a channel this command has to be used. If the channel is already in search or active state, the command will not be executed.

If the ID for the channel is set to 0 any HR transmitter will be accepted. As soon as a transmitter could be found the channel state changes to “active” and the ID of the found transmitter can be read. In this so called learn mode the receiver sensitivity can be reduced with the SetLearnSensitivity command to be able to only get transmitters close to the receiver application. As soon as a HR transmitter could be found the corresponding channel sensitivity will be set back automatically to its maximum value.

If the ID is set to any value except 0 only a HR transmitter having exactly this ID will be accepted. A preset ID always causes maximum channel sensitivity.

Stop

While searching for a HR transmitter or if a channel is in active mode it can be stopped respectively set to powerdown mode with this command. If the channel already is in powerdown mode this command does not have any effect.

SetID_High, SetID_Mid, SetID_Low

Setting the ID of a channel to a value not equal to zero causes the channel to only search for HR transmitters having this ID. An ID set to 0 results in searching for a HR transmitter with any ID. The ID can only be changed if the channel is in powerdown mode.

GetID_High, GetID_Low_Mid

These commands return the ID (either set or found during learn mode) for a channel.

GetTimeoutCnt

Returns the number of lost packets in a row on the channel. Reset whenever a valid packet could be received.

SetPowerdownDelay

This command sets the number of consecutive lost data packets after which an active channel will be switched automatically to powerdown mode. The actual number of lost packets in a row for an active channel, represented by its powerdown counter, can be determined using the GetChannelState command. Valid range is 1 to 200.

SetSearchTimeout

The time for trying to find a transmitter when starting a channel in both learn and normal search mode can be set with this command. It is specified in seconds. If the transmitter could be found within this time the channel changes from search to active mode, otherwise it switches back to powerdown mode. Setting the timeout value to 0 results in an infinite search and an automatic search start if a transmitter gets lost. Beside 0 the valid range is 3 to 20.

SetLearnSensitivity

This command has to be used to reduce the receiver sensitivity for a channel in learn mode to be able to only get transmitters close to the receiver module. As soon as a transmitter could be found the sensitivity of the corresponding channel will be set back automatically to its maximum value. Valid range is 0 to 40.

Change Log

Revision	Content	Made by	Date
1.0	Initial revision	Richard Mayerhofer	04.02.2009
1.1	Reduced transmission distance and changed module thickness	Richard Mayerhofer	19.03.2009