Hermes™ IoT Development Platform Remote User Interface

1   Introduction

The Hermes™ IoT Development Platform allows you to control the AMS Radon Reader to read sensor tags and send the results to a remote user through either a UART, TCP, CAN, I2C or SPI interface.

2   Hermes Remote User Interface Module

The Hermes Demo application implements a Remote User Interface (RUI) module which is composed of a generic interface class and specific classes for the UART, TCP, CAN, I2C, and SPI interfaces. Please see Figure 1 below for a depiction of the module. From the Demo application's main window, the user can select the Remote Operation option and then select the interface Hermes should listen through for commands. When the user presses the Start button, this in effect switches in the UART, TCP, CAN, I2C, or SPI data stream, and Hermes is ready to process commands. When those commands are processed, Hermes sends back responses through the same stream.
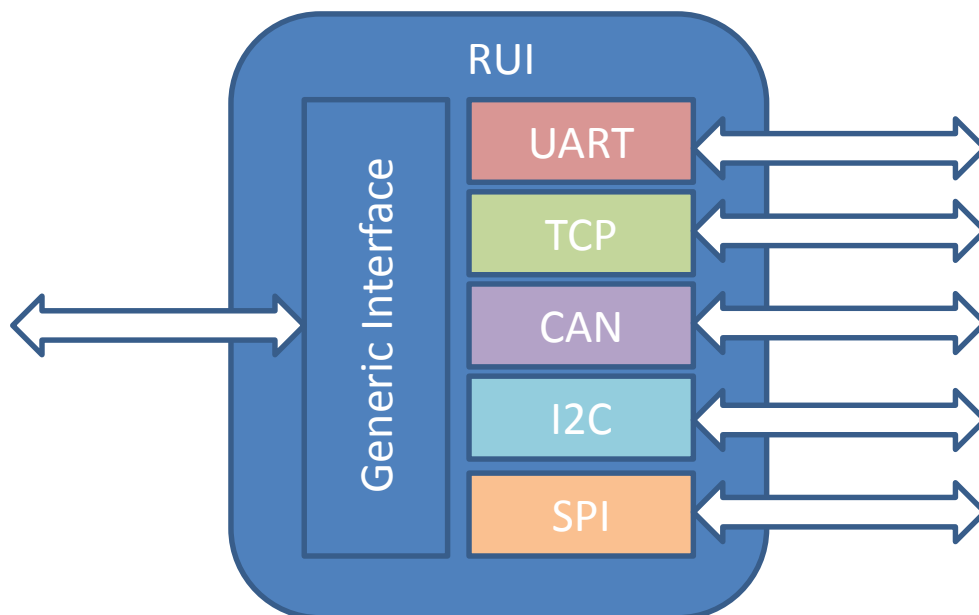

Figure 1. The Remote User Interface Module

3   Hermes Remote User Interface Protocol

Now that we have described the RUI module, we can move on to describing the protocol that flows through those interfaces. The protocol requires an external device connected through one of the interfaces to send a command to Hermes and Hermes to send a response back, at no set time, after it has received the command. The command consists of a header and a payload. Please see Figure 2 below for a depiction of the command and response format in terms of bytes sent across the interface.

Byte 0 → Msg Type

Msg Length

Msg CRC

Byte 5 → Status

Payload Byte 1

Header

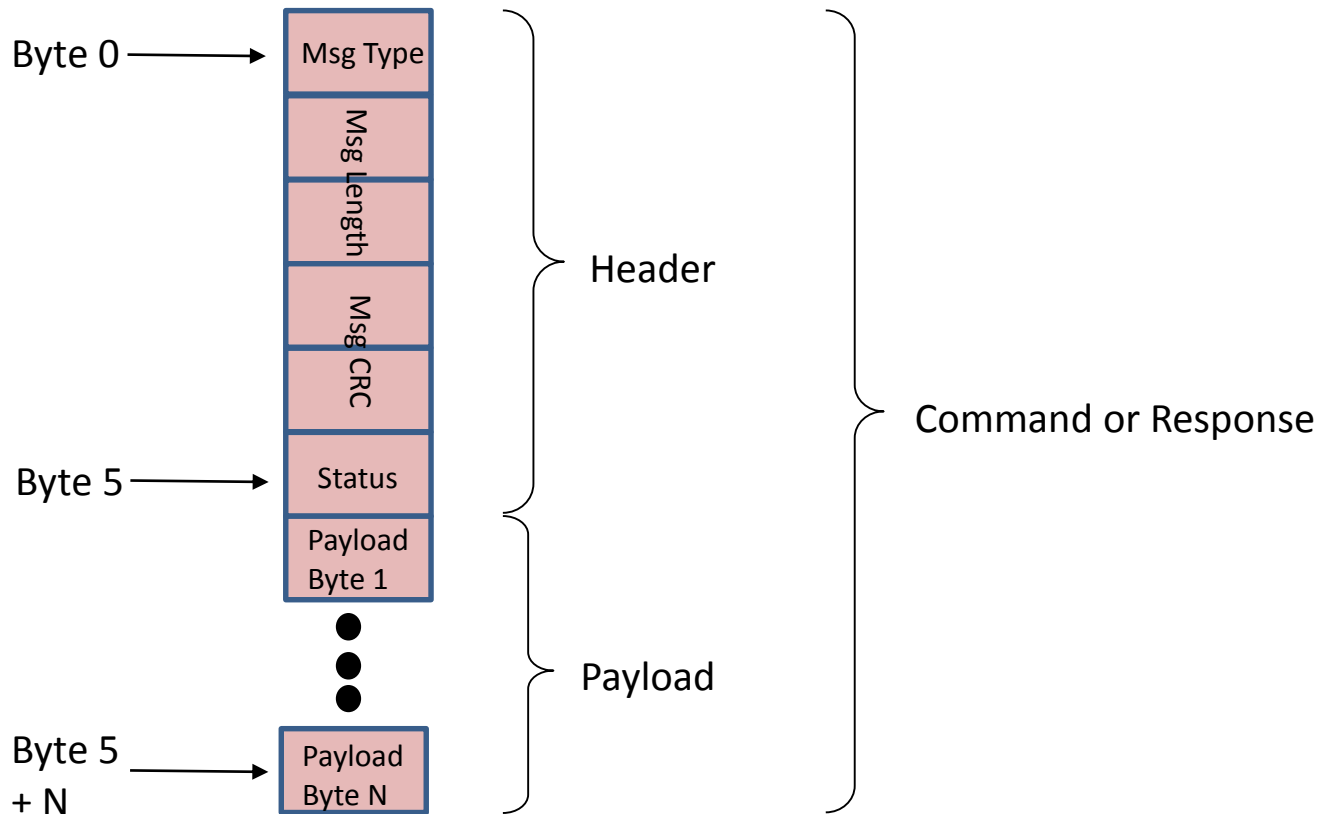Byte 5 + N → Payload Byte N

Payload

Command or Response

Figure 2. The Command and Response Format for the RUI Protocol

As you can see, the command and response are made up of a header and a payload. The header consists of a Message Type field one byte long, a Message Length field two bytes long, a Message CRC field two bytes long, a Status field one byte long, and a Payload field N bytes long. The Message Type field is used to specify the command being sent. Please see the next section for a list of commands available. The Message Length field contains the length of the entire command or response, header + payload. The Message CRC field contains the CRC-16 value calculated for the entire message, header + payload. The Status field is used in the response and contains the status or result of the operation performed per the command. Note that the Least Significant Byte of the Message Length is

put at the lower byte address and the Most Significant Byte at the higher byte address. The same is true for the Message CRC.

This command and response format is valid for the UART, TCP, I2C, and SPI interfaces. For the CAN interface, the response format is different because of the way CAN sensors operate. In the CAN network, a sensor typically broadcasts periodic responses in frames containing an 8-byte data field the sensor can use to send data. In our Demo application, we use that field as depicted in Figure 3 below.

Msg Type	Tag #	Param Byte 1	Param Byte 2	Param Byte 3	Param Byte 4	Param Byte 5	Param Byte 6

The Message Type field is one byte long and it contains the response type or the command this response corresponds to. The Tag Number field is one byte long and it contains the Tag's number in the list of tags found generated as a result of a search for tags command.

4   Commands and Responses of the RUI

Now that we have defined the protocol that flows through the interfaces, we can define the specific commands and responses that make use of it. The commands available through the RUI are listed in Table 1 below.

Command/Response Message Types	ID
SEARCH_FOR_TEMP_TAGS	1
SEARCH_FOR_TEMP_TAGS_RESP	2
SEARCH_FOR_MOISTURE_TAGS	3
SEARCH_FOR_MOISTURE_TAGS_RESP	4
MEASURE_TEMP_TAGS	5
MEASURE_TEMP_TAGS_RESP	6
MEASURE_MOISTURE_TAGS	7
MEASURE_MOISTURE_TAGS_RESP	8
GET_TEMP_DEMO_SETTINGS	9
GET_TEMP_DEMO_SETTINGS_RESP	10
GET_MOISTURE_DEMO_SETTINGS	11
GET_MOISTURE_DEMO_SETTINGS_RESP	12
SET_TEMP_DEMO_SETTINGS	13
SET_TEMP_DEMO_SETTINGS_RESP	14
SET_MOISTURE_DEMO_SETTINGS	15
SET_MOISTURE_DEMO_SETTINGS_RESP	16

Table 1. Commands and Responses of the RUI

For the CAN interface, only commands to search and measure temperature and moisture tags are available. Also, the responses to those commands are different. Only certain parameters, as described later, are sent back and they are sent in frames with 8-byte data fields. Each frame has a Message Type field that is defined in Table 2 below.

Response Message Types for CAN	ID
EPC_LEN_RESP	1
EPC_RESP	2
TID_LEN_RESP	3
TID_RESP	4
TEMP_CAL_C1_RESP	5
TEMP_CAL_T1_RESP	6
TEMP_CAL_C2_RESP	7
TEMP_CAL_T2_RESP	8
CRCVALID_RESP	9
TEMP_VALUE_RESP	10
SENSOR_VALUE_RESP	11
ONCHIPRSSI_VALUE_RESP	12
DONE_RESP	13
EPC_LEN_RESP	14
EPC_RESP	15
TID_LEN_RESP	16

Table 2. Responses of the RUI Specific to the CAN Interface

4.1 Search for Temp Tags Command

The Search for Temp Tags Command allows the user to search for Temp tags in the area. The command is defined in Table 3 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 3. The Search for Temp Tags Command

4.2 Search for Temp Tags Response

The Search for Temp Tags Response is defined in Table 4 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Number of Tags Found	
7	Tag Number	
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)	
9	EPC Length	
10 + EPC Length – 1 (= N)	EPC	
N + 1	TID Length	
N + 1 + TID Length – 1 (= M)	TID	
M + 1	Temp Cal C1	
M + 2		
M + 3		
M + 4		
M + 5	Temp Cal T1	
M + 6		
M + 7		
M + 8		
M + 9	Temp Cal C2	
M + 10		
M + 11		
M + 12		
M + 13	Temp Cal T2	
M + 14		
M + 15		
M + 16		
M + 17	CRC Valid	

Repeats 'Number of Tags Found' times

Table 4. The Search for Temp Tags Response

4.3 Search for Temp Tags Response (CAN)

The Search for Temp Tags Response for CAN is define in Table 5 below.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
EPC_LEN_RESP	Tag Number	EPC Length				0	0
EPC_RESP	Tag Number	EPC Characters					
TID_LEN_RESP	Tag Number	TID Length				0	0
TID_RESP	Tag Number	TID Characters					
TEMP_CAL_C1_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_T1_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_C2_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_T2_RESP	Tag Number	EPC Length				0	0
CRCVALID_RESP	Tag Number	CRC Valid	0	0	0	0	0
DONE_RESP	0	0	0	0	0	0	0

Frames repeat until all characters sent.

Total Frames = EPC Length / 6

OR

TID Length / 6

Table 5. The Search for Temp Tags Response (CAN)

4.4 Search for Moisture Tags Command

The Search for Moisture Tags Command allows the user to search for Moisture tags in the area. The command is defined in Table 6 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 6. The Search for Moisture Tags Command

4.5 Search for Moisture Tags Response

The Search for Moisture Tags response is defined in Table 7 below.

Byte	Message Field	Field Value	
0	Message Type		
1	Message Length		
2			
3	Message CRC		
4			
5	Status		
6	Number of Tags Found		
7	Tag Number		Repeats 'Number of Tags Found' times
8	Tag's Data Length		
9	EPC Length		
10 + EPC Length – 1 (= N)	EPC		
N + 1	TID Length		
N + 1 + TID Length – 1 (= M)	TID		
M + 1	Temp Cal C1		
M + 2			
M + 3			
M + 4			
M + 5	Temp Cal T1		
M + 6			
M + 7			
M + 8			
M + 9	Temp Cal C2		
M + 10			
M + 11			
M + 12			
M + 13	Temp Cal T2		
M + 14			
M + 15			
M + 16			
M + 17	CRC Valid		

Table 7. The Search for Moisture Tags Response

4.6 Search for Moisture Tags Response (CAN)

The Search for Moisture Tags response for CAN is defined per Table 8 below.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
EPC_LEN_RESP	Tag Number	EPC Length				0	0
EPC_RESP	Tag Number	EPC Characters					
TID_LEN_RESP	Tag Number	TID Length				0	0
TID_RESP	Tag Number	TID Characters					
TEMP_CAL_C1_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_T1_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_C2_RESP	Tag Number	EPC Length				0	0
TEMP_CAL_T2_RESP	Tag Number	EPC Length				0	0
CRCVALID_RESP	Tag Number	CRC Valid	0	0	0	0	0
DONE_RESP	0	0	0	0	0	0	0

Frames repeat until all characters sent.

Total Frames = EPC Length / 6

OR

TID Length / 6

Table 8. The Search for Moisture Tags Response (CAN)

4.7 Measure Temp Tags Command

The Measure Temp Tags Command allows the user to the tag's On-Chip RSSI code and Temp code. The command is defined in Table 9 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 9. The Measure Temp Tags Command

4.8   Measure Temp Tags Response

The Measure Temp Tags Response is defined in Table 10 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Number of Tags Found	
7	Tag Number	
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)	
9		
10	Frequency	
11		
12		
13		
14	On-Chip RSSI Code	
15		
16		
17		
18	Temp Code	
19		
20		
21		

Repeats 'Number of Tags Found' times

Table 10. The Measure Temp Tags Response

4.9   Measure Temp Tags Response (CAN)

The Measure Temp Tags Response for CAN is defined in Table 11 below.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
TEMP_VALUE_RESP	Tag Number	Temp Value				0	0
ONCHIPRSSI_VALUE_RESP	Tag Number	On-Chip RSSI Value				0	0
DONE_RESP	0	0	0	0	0	0	0

Table 11. The Measure Temp Tags Response (CAN)

4.10 Measure Moisture Tags Command

The Measure Moisture Tags Command allows the user to read a tag's On-Chip RSSI code and Sensor code. The command is defined in Table 12 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 12. The Measure Moisture Tags Command

4.11 Measure Moisture Tags Response

The Measure Moisture Tags Response is defined in Table 13 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Number of Tags Found	
7	Tag Number	
8	Tag's Data Length (Number of bytes that follow contain the data for this tag)	
9		
10	Frequency	
11		
12		
13		
14	On-Chip RSSI Code	
15		
16		
17		
18	Sensor Code	
19		
20		
21		

Table 13. The Measure Moisture Tags Command

4.12 Measure Moisture Tags Response (CAN)

The Measure Moisture Tags Response for CAN is defined in Table 14 below.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
SENSOR_VALUE_RESP	Tag Number	Sensor Value				0	0
ONCHIPRSSI_VALUE_RESP	Tag Number	On-Chip RSSI Value				0	0
DONE_RESP	0	0	0	0	0	0	0

Table 14. The Measure Moisture Tags Response (CAN)

4.13 Get Temp Demo Settings Command

The Get Temp Demo Settings commands allows the user to get the current setting for the Temperature Demo. The command is defined in Table 15 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 15. The Get Temp Demo Settings Command

4.14 Get Temp Demo Settings Response

The Get Temp Demo Settings Response is defined in Table 16 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	
7		
8		
9		
10	Temp Auto Power	
11	Temp Max Power	
12	Temp Target On-Chip RSSI Min	
13		
14		
15		
16	Temp Target On-Chip RSSI Max	
17		
18		
19		
20	Temp Min Samples per Measurement	
21		
22		
23		

Table 16. The Get Temp Demo Settings Response

4.15 Get Moisture Demo Settings Command

The Get Moisture Demo Settings Command allows the user to get the current settings for the Moisture Demo. The command is defined in Table 17 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	

Table 17. The Get Moisture Demo Settings Command

4.16 Get Moisture Demo Settings Response

The Get Moisture Demo Settings Response is defined in Table 18 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	
7		
8		
9		
10	Moisture Auto Power	
11	Moisture Max Power	
12	Moisture Target On-Chip RSSI Min	
13		
14		
15		
16	Moisture Target On-Chip RSSI Max	
17		
18		
19		
20	Moisture Min Samples per Measurement	
21		
22		
23		

Table 18. The Get Moisture Demo Settings Response

4.17 Set Temp Demo Settings Command

The Set Temp Demo Settings Command allows the user to set the settings for the Temp Demo. The command is defined in Table 19 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	0 - 5
7		
8		
9		
10	Temp Auto Power	0 or 1
11	Temp Max Power	18 - 30
12	Temp Target On-Chip RSSI Min	0 – 31, Min < Max
13		
14		
15		
16	Temp Target On-Chip RSSI Max	0 – 31, Min < Max
17		
18		
19		
20	Temp Min Samples per Measurement	2, 5, 10, 20
21		
22		
23		

Table 19. The Set Temp Demo Settings Command

4.18 Set Temp Demo Settings Response

The Set Temp Demo Settings Response is defined in Table 20 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	0 = Success

Table 20. The Set Temp Demo Settings Response

4.19 Set Moisture Demo Settings Command

The Set Moisture Demo Settings Command allows the user to set the settings for the Moisture Demo. The command is defined in Table 21 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	
6	Current Frequency Band	0 - 5
7		
8		
9		
10	Moisture Auto Power	0 or 1
11	Moisture Max Power	18 - 30
12	Moisture Target On-Chip RSSI Min	0 – 31, Min < Max
13		
14		
15		
16	Moisture Target On-Chip RSSI Max	0 – 31, Min < Max
17		
18		
19		
20	Moisture Min Samples per Measurement	2, 5, 10, 20
21		
22		
23		

Table 21. The Set Moisture Demo Settings Command

4.20 Set Moisture Demo Settings Response

The Set Moisture Demo Settings Response is defined in Table 22 below.

Byte	Message Field	Field Value
0	Message Type	
1	Message Length	
2		
3	Message CRC	
4		
5	Status	0 = Success

Table 22. The Set Moisture Demo Settings Response

5 Notices