

Manual AMB8425-M

Version 1.6

SW-V1.6

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Abbreviations

CS Checksum

PS Pin select Operating mode selection via pins

UI User interface Serial interface to the host

1 Summary

The wireless M-bus radio module AMB8425-M was designed as a subcomponent group for wireless reading of meters. It complies with the requirements of EN13757-4:2005 (wireless M-bus; see [1]) and can be used wherever such radio communication is needed.

The following operating modes are supported:

- S1 / S1-m / S2
- T1 / T2 (meter/ other)
- R2

A serial interface (UART, optionally SPI) whose data rate and format can be adjusted flexibly is available for the communication with the host system.

All transfer parameters listed in the standard (coding methods, chip rate, carrier frequency, preamble length, etc.) can be adjusted flexibly via the user interface.

The module is suitable for use in the meter, but can also be used in a repeater or concentrator.

2 Communication with the Customer Application

Both the transparent, buffered data transfer (with and without addition and evaluation of block 1) as well as the device configuration take place via the serial user interface.

2.1 Transparent, Buffered Data Transfer

2.1.1 Wireless Transmission of Data

In this mode, up to 128 bytes of payload data are transmitted to the radio module via the serial interface and initially buffered. A length byte must be placed in front of the actual payload data (see Figure 1).

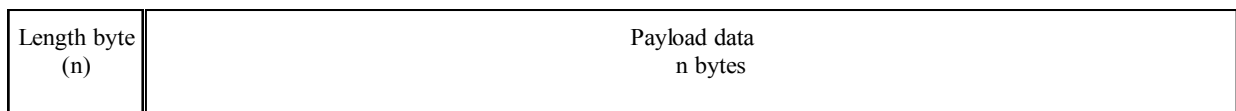


Figure 1: Reception of data to be sent via radio transmission with check of block 1

After all data have been received, the radio transmission takes place according to the operating mode configured according to [1]. Optionally, AMB8425-M can adopt the content of the first block (C-field, M-field, A-field) from the non-volatile memory and insert it in the radio telegram (see Figure 1); otherwise, the format according to Figure 2 is used (factory state; see parameter MBUS_B1_ADD_Disable).

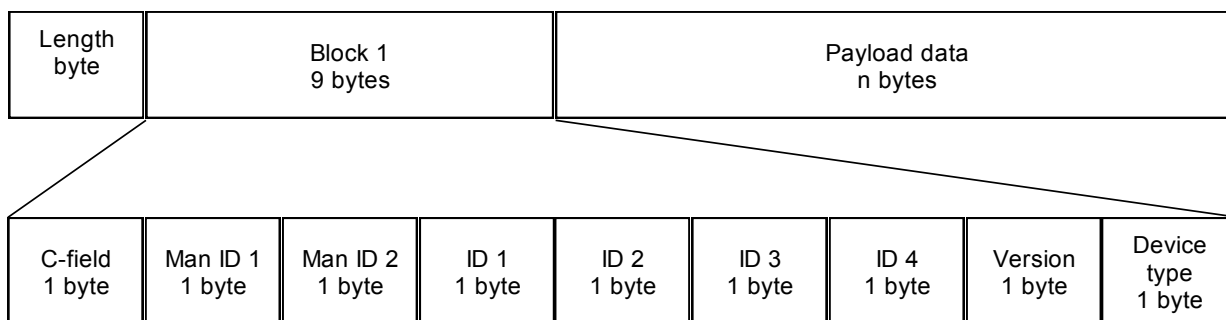


Figure 2: Reception of data to be sent via radio transmission including block 1

2.1.2 Wireless Reception of Data

The output of data also takes place with length information placed in front. Additionally, a measure for the connection quality can be made available in the form of a field strength value (see `RSSI_Enable`).

Optionally, the first block (M-field and A-field) can be compared with the parameters in the non-volatile memory (see `MBUS_B1_ADD_Disable`).

If the check is enabled, the received data will only be issued as shown in Figure 3 if the M-field and the A-field (see sections `MBUS_B1_ManID1`) correspond to the values stored in the radio module.

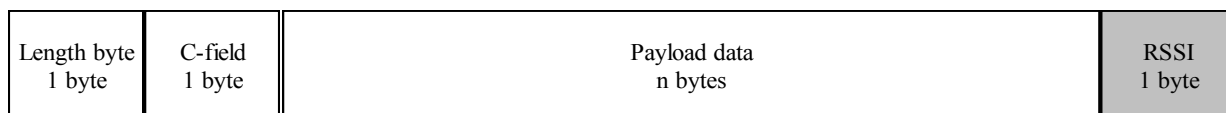


Figure 3: Output of data received via radio transmission with check of block 1

If the check is disabled, the received data will always be fully issued (see Figure 4).

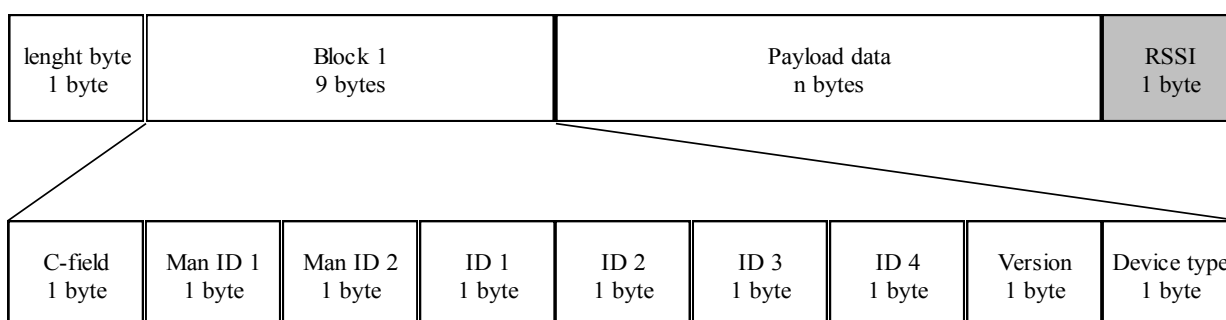


Figure 4: Output of data received via radio transmission without check of block 1

2.2 Command Mode

In this operating mode, the communication with the module is achieved by using predefined commands. For example, these commands can be used to set and read operating parameters and to execute special functions (e.g., software reset or reset of the operating parameters to the factory state).

The telegram consists of the start character (0xFFh) followed by a command byte and information about the length of the subsequent data. A checksum (XOR operation of all preceding characters) must be transmitted as the last byte.

Start character 0xFFh 1 byte	Command 1 byte	Length information(n) 1 byte	Data n bytes	Checksum 1 byte
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Figure 5: Serial interface in the command mode

Table 1 provides an overview of the valid commands.

Command	Value [hex]	Description
CMD_DATA_REQ 6.1.1	0x00	Send data
CMD_DATA_RETRY_REQ 6.1.2	0x02	Resend data previously sent to the module
CMD_DATA_IND 6.1.3	0x03	Received Data
CMD_RESET_REQ 6.1.4	0x05	Software reset
CMD_SET_CHANNEL_REQ 6.1.5	0x06	Select channel
CMD_SET_REQ 6.1.6	0x09	Write parameters of the non-volatile memory
CMD_GET_REQ 6.1.7	0x0A	Read parameters of the non-volatile memory
CMD_SERIALNO_REQ 6.1.8	0x0B	Read serial number
CMD_RSSI_REQ 6.1.9	0x0D	Read current RSSI value
CMD_SETUARTSPEED_REQ 6.1.11	0x10	Select transfer speed of the user interface
CMD_FACTORYRESET_REQ 6.1.12	0x11	Reset module to factory settings

Table 1: Overview of the commands

Every command of the type "request" is followed by an acknowledgement by the module in the form of a message of the type "confirm". For this purpose, the module adds the bit 0x80 to the respective command byte (e.g. "0x0D" becomes "0x8D", "0x11" becomes "0x91") and returns it along with the respective data or status information.

3 Radio Telegram

As mentioned in section 2.1.1, the content of the first block from the non-volatile memory is added to the payload data to be sent (this can be disabled). Moreover, the checksum—which is required by the standard—is computed for each block and added.

The fields marked in green are added or recomputed by the module.

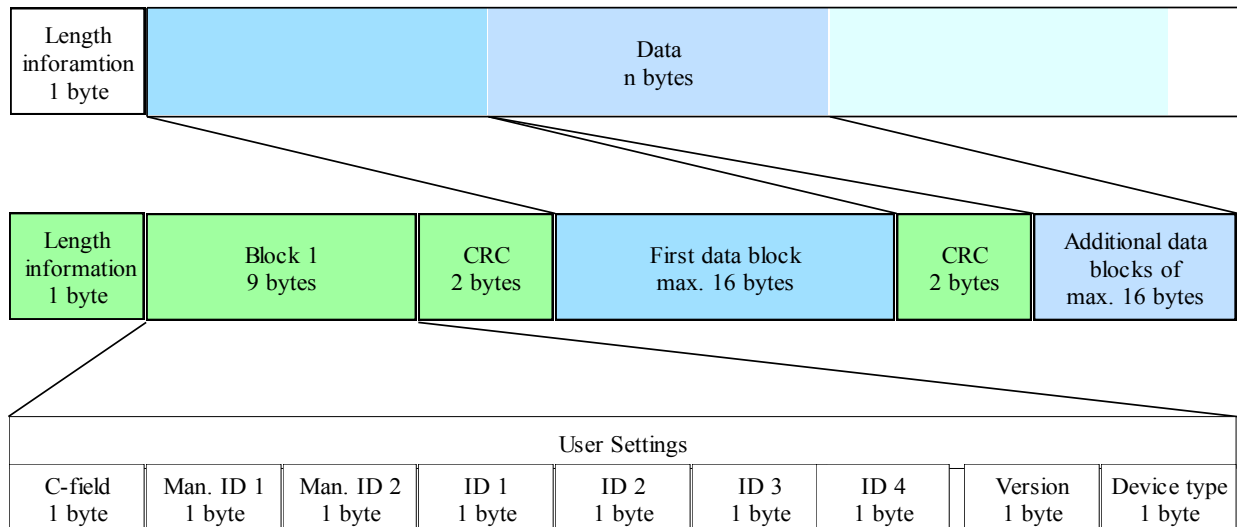


Figure 6: Radio telegram with adoption of the content for block 1 from the non-volatile memory

Content of block 1	Parameter in the non-volatile memory
C-field	MBUS_B1_Control 9.1.23
Man ID 1	MBUS_B1_ManID1 9.1.24
Man ID 2	MBUS_B1_ManID2 9.1.25
ID 1	MBUS_B1_ID1 9.1.26
ID 2	MBUS_B1_ID2 9.1.27
ID 3	MBUS_B1_ID3 9.1.28
ID 4	MBUS_B1_ID4 9.1.29
Version	MBUS_B1_Version 9.1.30
Device type	MBUS_B1_DevType 9.1.31

Table 2: Settings radio telegram block 1

4 Technical Parameters

4.1 Input Voltage

The input voltage of the module ranges from 2.2 to 3.6 V.

4.2 Power Consumption AMB8425-M

See data sheet [3].

4.3 Dimensions and Weight

See data sheet [3].

4.4 Pinout

See data sheet [3].

5 Serial User Interface

5.1 UART

5.1.1 Supported Data Rates

The data rate can be set by directly configuring the respective parameters in the module's non-volatile memory (see `UART_BR0`, `UART_BR1`, and `UART_MCTL` on page 19 ff) or using the command `CMD_SETUARTSPEED_REQ` (6.1.11).

As the UART speed is derived from the speed of the utilised clock quartz, there may be variations of up to 0.5%.

When using the PC program "ACC", the following data rates can be selected directly via drop-down menu:

110, 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 56000, 57600, and 115200 baud.

With this selection, the registers stated above are automatically set to the optimum value.

Moreover, the "ACC" program also provides a dialogue for calculating any needed baud rates.

The default baud rate of the module is 9600.

The output of characters on the serial interface takes place with secondary priority. For this reason, short interruptions may occur *between* the output of individual characters (e.g., in the event of an interrupt).

5.1.2 Supported Data Formats

The following data formats are supported:

- 8 bits
- No, even, or odd parity
- 1 or 2 stop bits

In ACC, the following data formats can be selected directly via drop-down menu:

8n1, 8o1, 8e1, 8n2, 8o2, 8e2.

The data format, too, can be set by directly configuring the respective microprocessor registers.

The default data format is 8 data bits, no parity, 1 stop bit ("8n1").

5.2 SPI Interface

Instead of the UART interface, the module also offers an SPI interface (separate firmware; in preparation).

6 The Command Interface

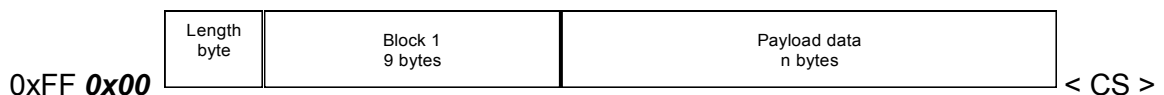
Below, the commands already mentioned in 2.2 are described in detail. All module settings specified in the document EN 13757-4:2005 can be adjusted via this interface.

6.1 Data Transfer in the Command Mode

6.1.1 CMD_DATA_REQ

This command serves the simple data transfer. Transmission takes place on the configured channel.

Format:



Return:

0xFF 0x80 0x01 < status > < CS >

Status:

0x00: data transmitted.

6.1.2 CMD_DATA_RETRY_REQ

This command relaunches the transmission of the data previously submitted to the module. Thus, the data do not need to be re-sent over the serial interface.

The buffered data are lost as soon as new data are sent via UART or data are received via wireless transmission.

Format:

0xFF 0x02 0x00 0xFD

Return:

0xFF 0x82 0x01 < status > < CS >

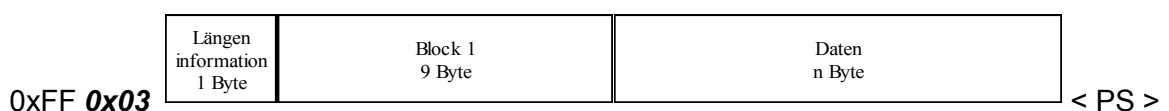
Status:

0x00: data sent

6.1.3 CMD_DATA_IND

This telegram indicates the reception of data bytes and represents the counterpart to the command CMD_DATA_REQ.

Format:



6.1.4 CMD_RESET_REQ

This command triggers a software reset of the module. The reset is performed after the acknowledgement is issued.

Format:

0xFF **0x05** 0x00 0xFA

Return:

0xFF **0x85** 0x01 < status > < CS >

Status:

0x00: success

6.1.5 CMD_SET_CHANNEL_REQ

This command is used to toggle the wireless channel. An overview of the channels is presented in section 0.

Format:

0xFF **0x06** 0x01 < 1-byte channel > < CS >

Example (selection of channel 11):

0xFF 0x06 0x01 0x0B 0xF3

Return:

0xFF **0x86** 0x01 < new channel > < CS >

Return for above example:

0xFF 0x86 0x01 0x0B 0x73

6.1.6 CMD_SET_REQ

This command enables the direct manipulation of the parameters in the non-volatile memory of the module. The respective parameters are accessed via the memory position described in Table 6.

Individual or multiple consecutive parameters in the memory can be modified concurrently.

Caution: The validity of the specified parameters is not verified. Incorrect values can result in device malfunction!

**Caution: To save the parameters in the flash memory of the module, the particular memory segment must first be flushed entirely and then restored from the RAM. If a reset occurs during this procedure (e.g., due to supply voltage fluctuations), the entire memory area may be destroyed. In this case, the module may no longer be operable, which means that the firmware must be re-installed via "ACC".
Recommendation: First, verify the configuration of the module with CMD_GET_REQ; write only if necessary.**

Format:

0xFF **0x09** < number of bytes + 2 > < memory position > < number of bytes > < parameter > < CS >

Return:

0xFF **0x89** 0x01 < status > < CS >

Status:

0x00: success

0x01: verification failed

0x02: invalid memory position or invalid number of

bytes to be written (write access to unauthorised area > 127 / 0x7F)

Example 1: Change adding of block 1 (MBUS_B1_ADD_Disable; according to Table 6, memory position 0x2Dh):

0xFF **0x09** 0x03 0x2D 0x01 < parameter value > < CS >

Example 2: Setting the 3 registers for the baud rate configuration (UART_MCTL, UART_BR0, and UART_BR1). According to Table 6, UART_BR0 has the memory position 0x02h:

0xFF **0x09** 0x05 0x02 0x03 < UART_BR0 > < UART_BR1 > < UART_MCTL > < CS >

6.1.7 CMD_GET_REQ

This command can be used to query individual or multiple non-volatile parameters (see 9.1). The requested number of bytes from the specified memory position is returned.

Individual or multiple consecutive parameters in the memory can be queried concurrently.

Format:

0xFF **0x0A** 0x02 < memory position > < number of bytes > < CS >

Example (query of all parameters):

0xFF **0x0A** 0x02 0x00 0x80 0x77

Return:

0xFF **0x8A** < number of bytes + 2 [0x82]> < memory position[0x00] > < number of bytes[0x80] > < parameter > < CS >

The read access to the memory area behind the parameters documented in Table 6 is blocked. The memory position and the number of bytes are limited accordingly. Thus, the last memory position that can be read out is 127 (0x7F).

6.1.8 CMD_SERIALNO_REQ

This command can be used to query the individual serial number of the module.

Format:

0xFF **0x0B** 0x00 0xF4

Return:

0xFF **0x8B** 0x04 < 4-byte serial number > < CS >

The most significant byte is returned first (MSB first); this byte identifies the product ("product ID").

6.1.9 CMD_RSSI_REQ

This command delivers the current RX level determined by the transceiver IC in the form of a two's complement.

Format:

0xFF **0x0D** 0x00 0xF2

Return:

0xFF **0x8D** 0x01 < RX level > < CS >

The value obtained in this way delivers the RX level $RSSI_{dBm}$ in dBm as follows:

1. Conversion of the hexadecimal value to a decimal $RSSI_{dec}$
2. If $RSSI_{dec} \geq 128$: $RSSI_{dBm} = (RSSI_{dec} - 256) / 2 - RSSI_{Offset}$
3. Otherwise ($RSSI_{dec} < 128$): $RSSI_{dBm} = RSSI_{dec} / 2 - RSSI_{Offset}$

$RSSI_{Offset}$ is a data-rate-dependent correction factor according to Table 3 (AMB8425).

The relation between the calculated value and the physical RX level in dBm is not linear across the entire operating range and is displayed in Figure 7.

Data rate	RSSI offset
1.2 kbps	74
38.4 kbps	74
250 kbps	78

Table 3: Data-rate-dependent RSSI offset for AMB8425 (from [2])

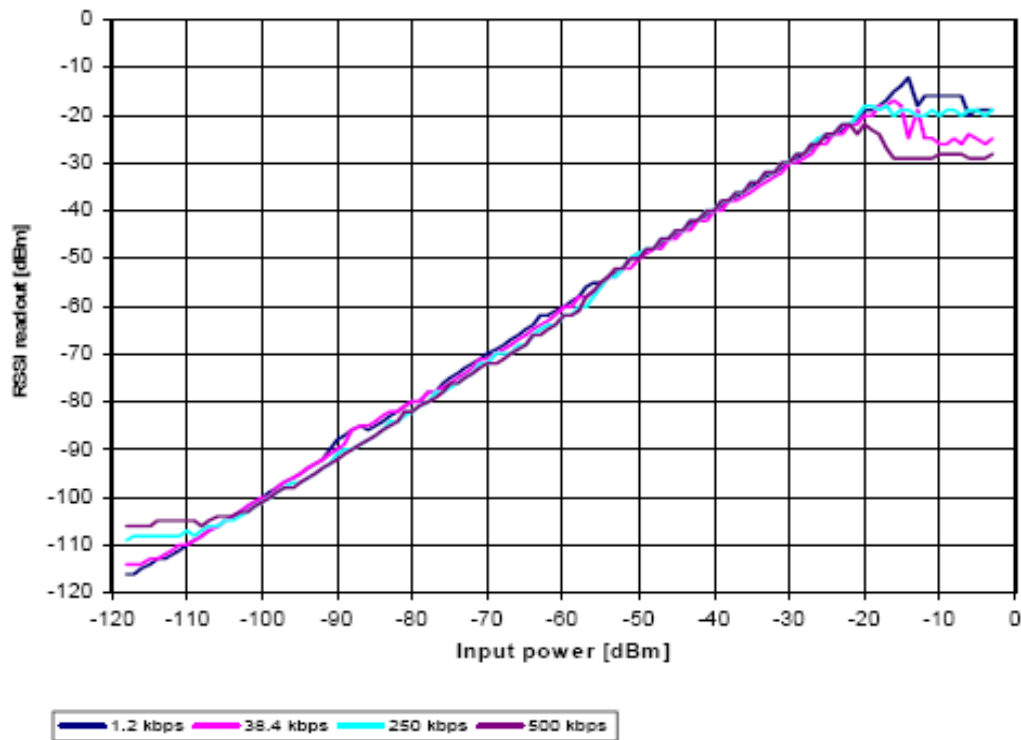


Figure 7

Relation between the RX level and the RSSI value read out for AMB8425 (from [2])

6.1.10 CMD_ERRORFLAGS_REQ

This command returns internal error states.

Format:

0xFF **0x0E** 0x00 0xF1

Return:

0xFF **0x8E** 0x02 < error flags MSB > < error flags LSB >< CS >

An error flag return value of "0" indicates that no error has occurred. The value is set back after the query and in the event of a reset.

The meaning of the error flags is not described in detail in this context.

6.1.11 CMD_SETUARTSPEED_REQ

This command changes the parameters of the serial user interface (UART_CTL0, UART_CTL1, UART_BR0, UART_BR1, UART_MCTL) to preset values for fixed transfer rates. The index of the transfer rate is indicated in Table 4.

Transfer rate [baud]	Index [hex]
1200	0x00
2400	0x01

Transfer rate [baud]	Index [hex]
4800	0x02
9600	0x03
19200	0x04
38400	0x05
56000	0x06
115200	0x07

Table 4: Preconfigured transfer rate of the serial interface

Format:

0xFF **0x10** 0x00 < index > < CS >

Return:

0xFF **0x90** 0x01 < status > < CS >

Status:

0x00: success

6.1.12 CMD_FACTORYRESET_REQ

This command resets all parameters to the factory settings:

Format:

0xFF **0x11** 0x00 0xEE

Return:

0xFF **0x90** 0x01 < status > < CS >

Status:

0x00: success

7 Factoryreset

One option to perform a factory reset is the command `CMD_FACTORYRESET_REQ`. This command can be used as long as the UART settings are known and the module can be configured by the serial port.

Another way to make a factory reset is the Boot Up Factory Reset. To use this mechanism, Pin4.3 and Pin4.4 must be connected during a reset. Upon success Pin2.1 (RX_INDICATE) will toggle 3 times.

After a Factory Reset the speed of the serial interface is set back to 9600 8n1.

8 Toggling the Operating Mode via Pin

Moreover, the host can use a pin interface to toggle the preconfigured operating modes. If this interface is activated, the unit toggles between the preconfigured wireless M-bus operating modes. To activate this functionality, the parameter

Mode_Preselect is set to the value 0x0F, and the pins of the interface are connected according to the desired operating mode.

Pinout	Selected operating mode

Pinout		Selected operating mode
[1.5]	[1.4]	
0	0	None
0	1	S1
1	0	S1-m
1	1	S2
0	0	Reserved
0	1	T1 meter
1	0	T1 other
1	1	T2 meter
0	0	T2 other
0	1	Reserved
1	0	R2 meter
1	1	R2 other
0	0	Reserved
0	1	Reserved
1	0	Reserved
1	1	Not permitted

Table 5: Signals when toggling between the modes via pin interface

Caution: In the event of periodic toggling, the duration of the state for one operating type should be at least 2.5 ms, as otherwise the detection of a preamble cannot be guaranteed!

9 Configuration Parameters

9.1 Non-volatile Configuration Parameters

The non-volatile parameters listed in the following table can be modified by means of specific commands in the configuration mode (`CMD_SET_REQ`, see 6.1.6) of the module or by using the Windows software "AC". These parameters are stored permanently in the module's flash memory.

Caution: The validity of the specified parameters is not verified. Incorrect values can result in device malfunction!

Parameter	Description	Adr. [hex]	Permissible values [hex]	Default [hex]
UART_CTL0	Control register for UART data format	0x00	See Table 7	

Parameter	Description	Adr. [hex]	Permissible values [hex]	Default [hex]
UART_CTL1	Control register for UART	0x01	0x80	
UART_BR0	Prescaler for setting the baud rate (LSB)	0x02	Compute with ACC	
UART_BR1	Prescaler for setting the baud rate (MSB)	0x03	Compute with ACC	
UART_MCTL	Modulation control register UART	0x04	Compute with ACC	
UART_CMD_Out_Enable	Output from received frames in CMD format	0x05	0x00, 0x01	0x00
UART_DIDelay	Configurable output delay	0x06	0x0000 – 0xFFFF	0x0000
UART_Reserved3	Reserve	0x08		0xFF
UART_Reserved4	Reserve	0x09		0xFF
APP_MAXPacketLength	Maximum number of bytes to send/receive	0x0A	0x0A – 0xFF	0x80
APP_AES_Enable (in Preparation)	Enable encryption	0x0B	See Table 8	0x00
APP_AESX (in Preparation)	Key AES128 MSB	0x0C	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 1	0x0D	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 2	0x0E	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 3	0x0F	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 4	0x10	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 5	0x11	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 6	0x12	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 7	0x13	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 8	0x14	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 9	0x15	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 10	0x16	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 11	0x17	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 12	0x18	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 13	0x19	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 14	0x1A	0x00 – 0xFF	0x00
APP_AESX (in Preparation)	Key AES128 MSB – 15	0x1B	0x00 – 0xFF	0x00

Parameter	Description	Adr. [hex]	Permissible values [hex]	Default [hex]
Preparation)	or LSB			
APP_WOR_PeriodH	Period length in ms - high byte	0x1C	0x00 – 0xFF	0x00
APP_WOR_PeriodL	Period length in ms - low byte	0x1D	0x00 – 0xFF	0x32
APP_WOR_MultiplierH	Multiplier of the period length - high byte	0x1E	0x00 – 0xFF	0x00
APP_WOR_MultiplierL	Multiplier of the period length - low byte	0x1F	0x00 – 0xFF	0x02
APP_RX_Time	WOR time in ms during which the module remains in the RX mode	0x20	0x00 – 0xFF	0x14
APP_RX_After_RX (in Preparation)	Time that the module remains in the RX mode after the reception	0x21	0x00 – 0xFF	0x00
APP_Reserved0	Reserve	0x22		0xFF
APP_Reserved1	Reserve	0x23		0xFF
APP_Reserved2	Reserve	0x24		0xFF
APP_Reserved3	Reserve	0x25		0xFF
APP_Reserved4	Reserve	0x26		0xFF
MBUS_Coding	Coding method	0x27	See Table 9	0x01
MBUS_HeaderLengthH	Header length in bytes (high byte)	0x28	0x00 – 0xFF	0x00
MBUS_HeaderLengthL	Header length in bytes (low byte)	0x29	0x00 – 0xFF	0x04
MBUS_Synch	Synchronisation character	0x2A	See Table 10	0x00
MBUS_RXTimeout	Time in ms that the module remains in the RX mode after transmitting data	0x2B	0x00 – 0xFF	0x00
MBUS_Reserved1	Reserve	0x2C		0xFF
MBUS_Reserved2	Reserve	0x2D		0xFF
MBUS_Reserved3	Reserve	0x2E		0xFF
MBUS_Reserved4	Reserve	0x2F		0xFF
MBUS_B1_ADD_Disable	Disable adding of block 1	0x30	See Table 12	0x00
MBUS_B1_Control	C-field of block 1	0x31	0x00 – 0xFF	0x44
MBUS_B1_ManID1	M-field of block 1	0x32	0x00 – 0xFF	0x00
MBUS_B1_ManID2	M-field of block 1	0x33	0x00 – 0xFF	0x00
MBUS_B1_IDNr1	A-field of block 1	0x34	0x00 – 0xFF	0x00
MBUS_B1_IDNr2	A-field of block 1	0x35	0x00 – 0xFF	0x00
MBUS_B1_IDNr3	A-field of block 1	0x36	0x00 – 0xFF	0x00
MBUS_B1_IDNr4	A-field of block 1	0x37	0x00 – 0xFF	0x00
MBUS_B1_Version	A-field of block 1	0x38	0x00 – 0xFF	0x00
MBUS_B1_DevType	A-field of block 1	0x39	0x00 – 0xFF	0x00

Parameter	Description	Adr. [hex]	Permissible values [hex]	Default [hex]
MBUS_Reserved5	Reserve	0x3A		0xFF
MBUS_Reserved6	Reserve	0x3B		0xFF
RF_Channel	Radio channel	0x3C	See Table 13	0x0B
RF_Power	Transmission power	0x3D	See Table 14	0x05
RF_DataRate	Chip rate	0x3E	See Table 15	0x01
RF_AutoSleep	Sleep mode	0x3F	See Table 16	0x00
RF_Reserved0	Reserve	0x40		0xFF
RF_Reserved1	Reserve	0x41		0xFF
RF_Reserved2	Reserve	0x42		0xFF
RF_Reserved3	Reserve	0x43		0xFF
RF_Reserved4	Reserve	0x44		0xFF
RSSI_Enable	Enable RSSI value output	0x45	See Table 17	0x00
Mode_Preselect	Default settings for M-bus operating modes	0x46	See Table 18	0x03
Net_Mode	Modem, concentrator, or repeater mode	0x47	In preparation	0x00
Config_CRC_Disable	Take checksum into consideration in the configuration mode or not	0x48	See Table 19	0x00
Reserved0	Reserve	0x49		0xFF
Reserved1	Reserve	0x4A		0xFF
Reserved2	Reserve	0x4B		0xFF
Reserved3	Reserve	0x4C		0xFF
Reserved4	Reserve	0x4D		0xFF
Reserved5	Reserve	0x4E		0xFF
Reserved6	Reserve	0x4F		0xFF
CFG-Flags	Configuration flags	0x50	0x0000 – 0xFFFF	0x0000

Table 6: Non-volatile parameters

9.1.1 UART_CTL0

With the help of this register, the format of the serial interface can be adjusted.

Bit no.	Description
0 (0x01)	Toggle between UART (0x00h) and USART (0x01h).
1 to 2 (0x02 – 0x04)	Reserved, must always be set to 0x00,
3 (0x08)	This bit selects the number of stop bits. If this bit is set, 2 stop bits will be used, if not, 1 will be used.
4 (0x10)	If this bit is set, the character length will be 7 bits, if not, it will be 8 bits.
5 (0x20)	If the MSB of a byte is the first thing to be sent, this bit must be set. Otherwise, it remains 0x00.

6 (0x40)	Even parity if the bit is set, otherwise odd parity
7 (0x80)	This bit enables the use of parity (if set).

Table 7: Parameter UART_CTL0

9.1.2 UART_CTL1

This register selects the source for generating the UART clock speed. Currently, the only permissible value is 0x80h.

9.1.3 UART_BR0

The ACC program should be used to compute this parameter.

9.1.4 UART_BR1

The ACC program should be used to compute this parameter.

9.1.5 UART_MCTL

The ACC program should be used to compute this parameter.

9.1.6 UART_CMD_Out_Enable

If this parameter contains the value 0x01h, received frames will send in cmd format over the UART. If the parameter contains 0x00h, the output format is transparent.

9.1.7 UART_DIDelay

This parameter determines the duration in milliseconds between the incoming radio signal data on the pin / DATA_INDICATION and the output of data via the UART. This delay can be used to prepare eg a "sleeping" host system to receive the data. Activated from SW version 1.6 with CFG flags

9.1.8 APP_MAXPacketLength

The maximum packet length can be set by means of this parameter. This limits the number of bytes issued via the serial interface in case the device after the module only has limited buffer space.

9.1.9 APP_AES_Enable (in Preparation)

If this parameter contains the value 0x00h, the AES128 encryption is disabled. If the value is 0x01h, the AES128 encryption key entered in the following 16 bytes is used.

Value	Description
0x00	Encryption disabled
0x01	Encryption enabled

Table 8: Parameter APP_AES_ENABLE

9.1.10 APP_AESX (in Preparation)

The 128-bit key for AES128 encryption is entered in these parameters. APP_AES0 contains the MS byte and APP_AESF the LS byte.

9.1.11 APP_WOR_PeriodH

This parameter contains the high byte for the length of the wake period in WOR operation. Together with the parameter

9.1.12 APP_WOR_PeriodL

the result is a parameter that determines the length of the wake period in ms. The parameters APP_WOR_MultiplierH and APP_WOR_MultiplierL can be used to enable WOR times of more than 65535 ms.

9.1.13 APP_WOR_MultiplierH

and

9.1.14 APP_WOR_MultiplierL

are multipliers for the length of the period of the module's WOR operation. Thus, the total interval between the wake times is:

$$\text{Wake time[ms]} = ((\text{APP_WOR_PeriodH} \times 255) + \text{APP_WOR_PeriodL}) \times ((\text{APP_WOR_MultiplierH} \times 255) + \text{APP_WOR_MultiplierL})$$

i.e., after every wake-up timeout, the module wakes up and "listens" to see whether a preamble is being received. If a preamble is being received, the module will look for a synchronisation character.

N.B.: Do not set this parameter to 0.

9.1.15 APP_RX_Time

By means of this parameter, the user can set the time period during which the module is to be in RX mode in WOR operation. Up to 255 ms can be set. The minimum time period should be 3 ms in order to make sure that the radio chip is ready. If a preamble is received during this time period, the module will remain in RX mode until a data set is received or the preamble aborts.

9.1.16 APP_RX_After_RX (in Preparation)

If the module is to remain in RX mode for a certain time period after receiving a data set in WOR mode, this parameter must contain this period in ms.

9.1.17 MBUS_Coding

The coding can be set by means of this parameter.

Value [hex]	Description
0x00	3-of-6 coding
0x01	Manchester coding

Table 9: Parameter MBUS_Coding

9.1.18 MBUS_HeaderLengthH

The high byte of the entire number of bytes before the synchronisation character is set in this parameter. Together with the parameter

9.1.19 MBUS_HeaderLengthL

this results in a 16-bit number that contains the number of header bytes. The number of (01) is computed as follows:

$$\text{Number}(01)\text{sequences} = ((\text{MBUS_HeaderLengthH} \times 255) + \text{MBUS_HeaderLengthL}) \times 4$$

Example: If the value contained in the high byte is 0x00h and the value contained in the low byte is 0x46, the total number of bytes is 0x0046h (70). Each byte consists of 4 (01) sequences. According to the formula, this means that there are 280 (01) sequences. Thus, it is sufficient to

set the high byte to 0x00h and the low byte to 0x46h in order to send a valid header length in the operating mode S1 (long message header).

The duration of the header can be determined by means of the following formula:

$$\text{Header duration}[s] = \frac{8 \times ((\text{HeaderLengthH} \times 255) + \text{HeaderLengthL})}{\text{chip rate}[Hz]}$$

9.1.20 MBUS_Synch

The value in this parameter is the index for the selection of the synchronisation character.

Value	Synchronisation character
0x00	000111011010010110
0x01	0000111101

Table 10: Parameter MBUS_Synch

The selection of the synchronisation character is effective for the transmission and for the reception.

9.1.21 MBUS_RXTimeout

By means of this parameter, it is possible to configure the time in ms for which the module is to remain in the RX mode after transmitting data before it enters the sleep mode. This parameter is effective in all operating modes. If the parameter contains the value 0x00h, no timeout is activated.

Value	Description
0x00	RX timeout disabled
> 0x00	RX timeout in ms

Table 11: Parameter MBUS_RXTimeout

9.1.22 MBUS_B1_ADD_Disable

The adding of the first block to be transferred can be disabled by means of this parameter. Thus, the host must transfer the content for the C-field, M-field, and A-field over the serial interface (Figure 8).

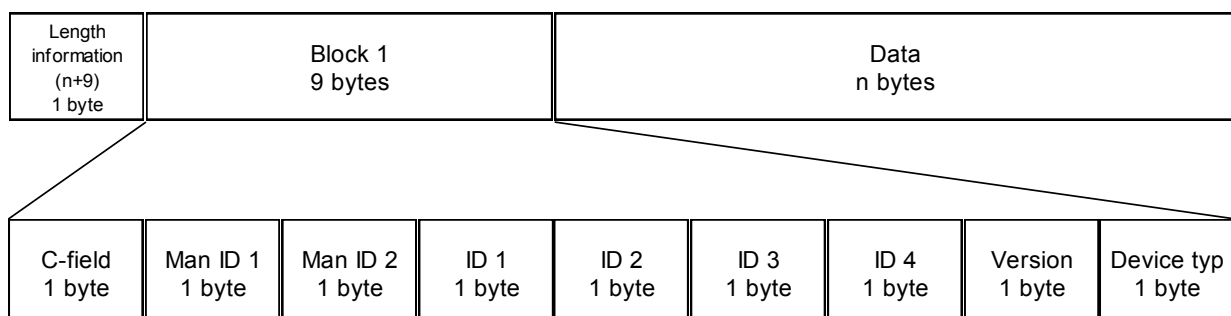


Figure 8: Adding of block 1 disabled

In this case, the values stored in the non-volatile memory will not be compared with the received values of the M-field and the A-field in block 1. The data are issued with optional field strength value (RSSI) (see Figure 9).

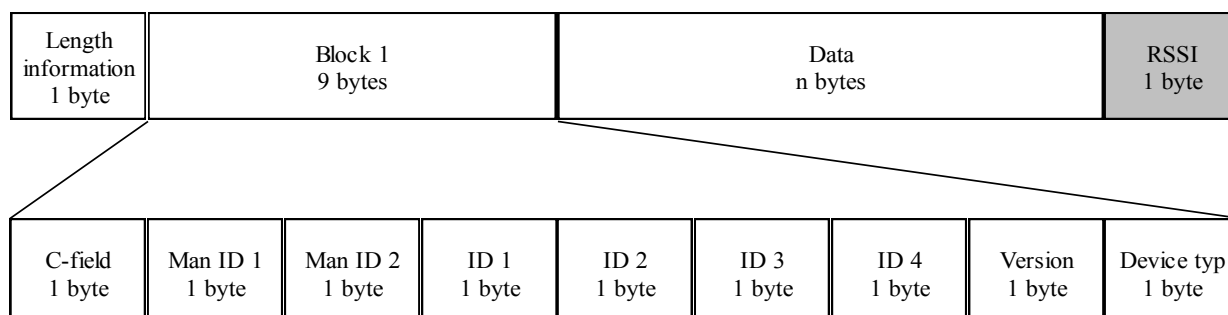


Figure 9: Output of received data if adding of block 1 is disabled

Value	Description
0x00	The address is evaluated and block 1 is added in the module.
0x01	Block 1 is not evaluated and added in the module.

Table 12: Parameter MBUS_BI_ADD_Disable

9.1.23 MBUS_B1_Control

This byte contains the value of the C-field in the first block of the data to be sent.

9.1.24 MBUS_B1_ManID1

This byte contains the value of the first byte of the M-field in the first block of the data to be sent.

9.1.25 MBUS_B1_ManID2

This byte contains the value of the second byte of the M-field in the first block of the data to be sent.

9.1.26 MBUS_B1_IDNr1

This byte contains the value of the first byte of the A-field in the first block of the data to be sent.

9.1.27 MBUS_B1_IDNr2

This byte contains the value of the second byte of the A-field in the first block of the data to be sent.

9.1.28 MBUS_B1_IDNr3

This byte contains the value of the third byte of the A-field in the first block of the data to be sent.

9.1.29 MBUS_B1_IDNr4

This byte contains the value of the fourth byte of the A-field in the first block of the data to be sent.

9.1.30 MBUS_B1_Version

This byte contains the value of the fifth byte of the A-field in the first block of the data to be sent. (Version)

9.1.31 MBUS_B1_DevType

This byte contains the value of the sixth byte of the A-field in the first block of the data to be sent. (Device type)

9.1.32 RF_Channel

The desired TX/RX channel can be selected by means of this parameter.

Channel	Value	Frequency [MHz]	Operating mode
1	0x01	868.03	R2
2	0x02	868.09	R2
3	0x03	868.15	R2
4	0x04	868.21	R2
5	0x05	868.27	R2
6	0x06	868.33	R2
7	0x07	868.39	R2
8	0x08	868.45	R2
9	0x09	868.51	R2
10	0x0A	868.57	R2

11	0x0B	868.30	S1, S1-m, S2, T2
12	0x0C	868.95	T1, T2

Table 13: Parameter RF_Channel

All changes to these parameters are adopted *without* reset.

9.1.33 RF_Power

Enables the adjustment of the transmission power.

Power [dBm]	Value
-5	0x01
0	0x02
+5	0x03
+7	0x04
+10	0x05

Table 14: Parameter RF_Power

9.1.34 RF_DataRate

The various chip rates can be selected by means of this parameter.

Chip rate [kcps]	Value	Operating mode
4.8	0x00	R2
32.768	0x01	S1, S1-m, S2, T2
100.0	0x02	T1, T2

Table 15: Parameter RF_DataRate

9.1.35 RF_AutoSleep

The parameter RF_AutoSleep supports 3 different settings. First, AutoSleep can be disabled. In this case, the module will be in the RX mode permanently. If the parameter is set to WOR, the radio chip will wake up at the configured intervals and enter the RX mode. If the parameter is set to sleep, the entire module will go to sleep. In this case, it can only be waked up via the user interface (data or command mode).

Value [hex]	Description
0x00	Between the transmissions, the module is permanently in RX mode
0x01	The module wakes up according to the settings of the parameters APP WOR PeriodH , APP WOR PeriodL , APP WOR MultiplierH , and APP WOR MultiplierL and listens for the time set in the parameter APP RX Time in order to see whether it receives a preamble.

0x02	Between the transmissions, the module is always in the sleep mode (and cannot receive anything).
------	--

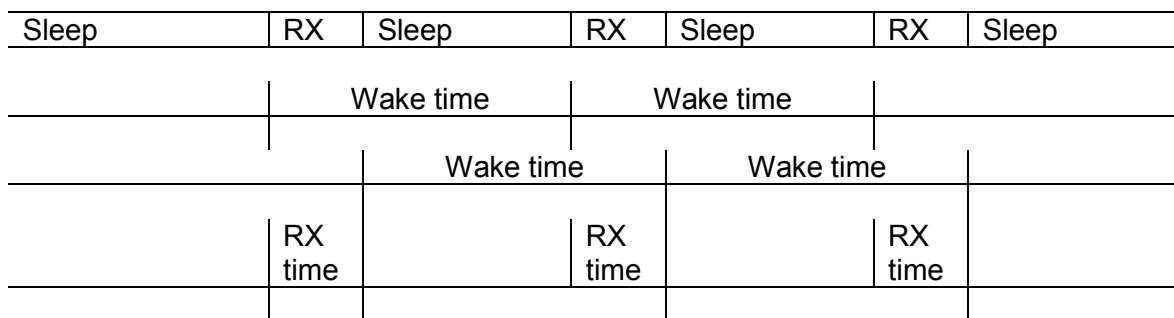
Table 16: Parameter RF_AutoSleep

- **RX:**

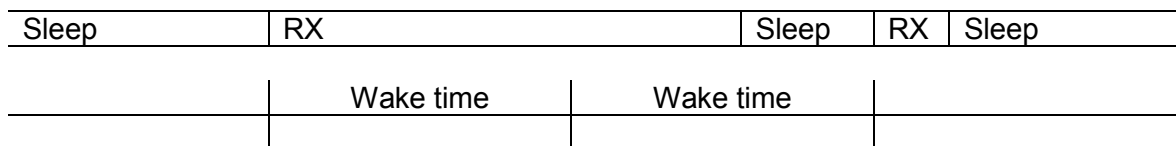
The module is permanently in RX mode. Data can be received at all times.

- **WOR :**

If the module is set to WOR operation (parameter RF_AutoSleep = 0x01), a timer that counts the time defined by means of the parameters APP_WOR_PeriodH, APP_WOR_PeriodL, APP_WOR_MultiplierH, and APP_WOR_MultiplierL is started in order to wake up the module.



The above graph demonstrates the periodic switch between RX and sleep if the module does not receive any preamble during the RX period. If the module receives a preamble and a data set, the wake time will continue periodically.



- Sleep:

In this mode, the module has the lowest power consumption, as the radio chip and μC are in the low-power state. In this mode, the power consumption is $<1 \mu\text{A}$. By way of the UART, the module can be waked up at all times for transmitting data or for configuration purposes.

9.1.36 RSSI_Enable

If this parameter contains the value 1, the RSSI value will not be appended to the payload data as shown in Figure 3/Figure 4.

RSSI	Value
Disabled	0x00
Enabled	0x01

Table 17: Parameter RSSI_Enable

9.1.37 Mode_Preselect

Default settings of the operating modes specified in [1] can be selected by means of this parameter.

Operating mode	Value	Direction(s)	Header length [(01) toggle]	Synchronisation character [Index]	Channel [Index]	Chip rate [Index]	Coding	Auto-sleep [Index]
UI	0x00	2	UI	UI	UI	UI	UI	UI
S1	0x01	TX	280	0	11	1	1	2
S1-m	0x02	TX	16	0	11	1	1	2
S2	0x03	2	UI	0	11	1	1	UI
Reserved	0x04							
T1 meter	0x05	TX	20	1	12	2	0	2
T1 other	0x06	TX	16	0	11	1	1	2
T2 meter	0x07	TX	20	1	12	2	0	UI
		RX		0	11	1	1	UI
T2 other	0x08	TX	16	0	11	1	1	UI
		RX		1	12	2	0	UI
Reserved	0x09							
R2 meter	0x0A	TX	40	0	UI	0	1	UI
		RX		0	6	0	1	UI

Operating mode	Value	Direction(s)	Header length [(01) toggle]	Synchronisation character [Index]	Channel [Index]	Chip rate [Index]	Coding	Auto-sleep [Index]
R2 other	0x0B	TX	40	0	6	0	1	UI
		RX		0	UI	0	1	UI
Reserved	0x0C							
Reserved	0x0D							
Reserved	0x0E							
Toggle mode	0x0F	PS	PS	PS	PS	PS	PS	UI

Table 18: Parameter Mode_Preselect

The transmission power is always determined by the value of the parameter `RF_Power`. Therefore, it must also be configured for the preconfigured modes.

- If the parameter contains the value 0x00h (no default settings), all parameters will be adopted from the non-volatile memory.
- If the module is connected to a meter that is supposed to transmit the meter level to a stationary concentrator at certain intervals and that does not expect any feedback, the operating mode S1 can be selected, thereby setting the parameter `Mode_Preselect` to the value 0x01h.
- If the concentrator is not battery-operated and therefore does not need an extended preamble, you can also select the operating mode S1-m. For this, the parameter `Mode_Preselect` can be set to the value 0x02h.
- In the previous two cases, the concentrator that collects the meter data should run in the operating mode S2 (0x03h), as this mode also comprises the reception of data. The preamble length must be set by means of the parameters `MBUS_HeaderLengthH` and `MBUS_HeaderLengthL`. Just as the behaviour of the module in the stand-by mode (AutoSleep).
- If a meter is to send its data in the form of short data blocks—e.g., in order to enable drive-by reading of these data—the module can be run in the mode T1 meter (`Mode_Preselect` = 0x05h).
- The setting 0x06h, which selects the operating mode T1 other, sets the same parameter as the operating mode S1-m.
- If the meter is also to be able to receive data (drive-by reading and wireless configuration of the meter), the module should run in the operating mode T2 meter (0x07h).
- In the receiving device, which can also configure the meter, the module would have to run in the operating mode T2 other (0x08h) in order to be able to communicate with the meter in the operating mode T1 meter or T2 meter.
- If data are to be transmitted frequently and this is to take place over a long radio distance, the parameter `Mode_Preselect` can be set to the value 0x0Ah (meter) or 0x0Bh (other), and the module operates in the wireless M-bus [1] operating mode R2. Here too, the stand-by behaviour corresponds to the configured parameter `RF_AutoSleep`.

- For quick toggling between the operating modes, the parameter should be set to the value 0x0Fh. In this way, the toggling between the preconfigured wireless M-bus [1] operating modes via pins (see 8) is activated.

9.1.38 Net_Mode

Reserved, must be set to 0x00h.

9.1.39 Config_CRC_Disable

By means of this parameter, the checksum check can be disabled when transmitting commands in the configuration mode. If the value of the parameter is 0x00h, the checksum will be taken into consideration. Otherwise, the checksum will not be checked and will be processed without being checked for correct transfer.

Value [hex]	Description
0x00	CRC required
0x01	CRC not required

Table 19: Parameter Config_CRC_Disable

9.1.40 CFG-Flags

This 2 byte large parameter provides the ability to carry out different configurations. It serves e.g. to activate various pin functions. All pin functions are disabled in the factory setting, so that the normal pin configuration is compatible with previous modules. A description of the flags, see Table 20. During the configuration of this parameter it is important to ensure that the LSB is transmitted always first. All settings will take effect only after a hardware reset of the module.

Bit Nr.	Description
0 (0x0001)	If set, this bit activates the function of the pin /RTS . After a reset of the module /RTS function is then available on pin P4.3. This pin will always symbolize whether the internal buffer is currently occupied (assigned = high).
1 (0x0002)	If set, this bit activates the function of the pin /CTS . After the reset of the module, the /CTS function is then available on pin P4.4. This pin will be queried before each byte to be output via the UART (low = data will be send).
2 (0x0004)	If set, this bit activates the function of the pin /DataIndication . After the reset of the module /DataIndication function is available on pin P4.5. This pin will indicate whether data is ready for output via UART. It can be used, for example, to awaken a host processor. A delay between the display at the pin and output on the UART can be done using the parameter UART_DIDelay .
3 bis 15 (0xFFFF)	Reserved

Table 20 Configurationflags

Examples:

Activated Pins: / RTS + / CTS + /DataIndication

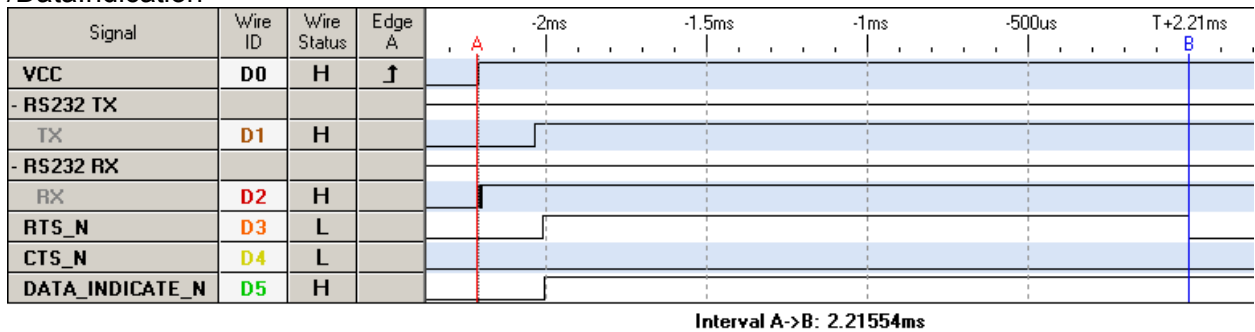


Figure 9-10 Turn-on

On turn-On the /RTS pin, signalize when the module can receive data via the UART (B signals). This time may vary.



Figure 9-11 Send data (transparent mode))

When sending data, the / RTS pin indicates the date from the buffer is occupied for the transmission process (rising edge / RTS) and when the UART is receiving again (falling edge / RTS).

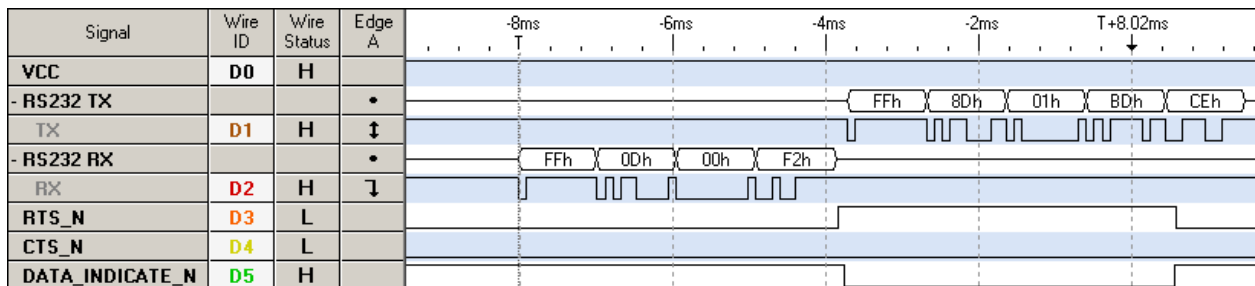


Figure 9-12 RSSI Command Request (UART_DIDelay = 0x0000)

At a command, the / RTS pin indicates the dates when the buffer is occupied. /DataIndication Indicates that the UART has Data to send.

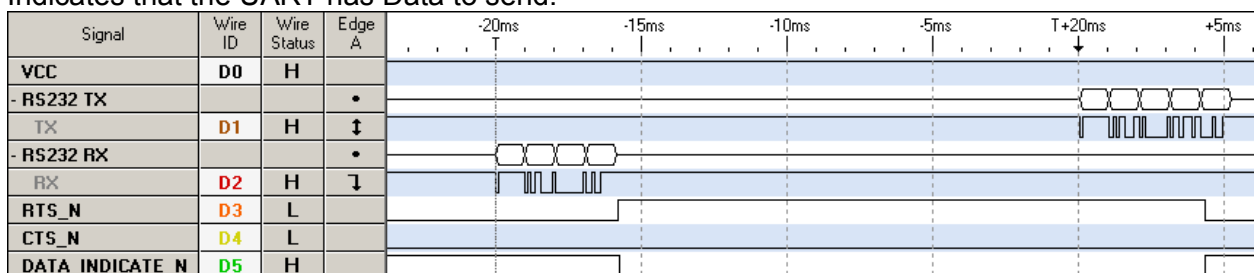


Figure 9-13 RSSI Command Request (UART_DIDelay = 0x0010)

10 Using the Module

10.1 Minimal Configuration

In the factory state, the modules are immediately ready for operation; the following pins are required in the minimal configuration: VCC, GND, UTXD, and URXD.

If the module is to be connected to a PC, a level converter (TTL to RS232) must be used.

10.2 Transfer of Large Amounts of Data

When transmitting larger amounts of data, the limited buffer size in the module must be taken into consideration. The data can only be transmitted packet by packet.

10.3 Use of the Low-Power Functionality

In this case, we recommend using the parameter `RF_AutoSleep`. If this parameter is set to sleep (0x02h), the module will be in the sleep mode except during transmission. During this time, it is not possible to receive data. If the reception/listening is controlled from the host, the module can be set to the RX mode by reconfiguring this parameter to RX (0x00h). If a message is received during this time, the module will forward it to the host and can subsequently go back to sleep.

If the module is to operate autonomously in such a WOR (wake on radio) mode, this can be activated by means of the parameter `RF_AutoSleep = 0x01h` and configured via the parameters `APP_WOR_PeriodH`, `APP_WOR_PeriodL`, `APP_WOR_MultiplierH`, `APP_WOR_MultiplierL`, and `APP_RX_Time`.

11 Firmware Update

The firmware of the module can be updated with the PC utility "ACC" from version 2.5 over the serial interface. If the module is not connected to a PC, the UART of the module should be made accessible, e.g. by means of suitable connectors. Only the UTXD and URXD signals are needed for this procedure.

A level converter (TTL to RS232) is required for the PC connection.

11.1 Firmware Version History

Version 1.0

- First release

Version 1.1

- Error flags

Version 1.2

- Bugfix

Version 1.3

- Addition command `CMD_DataReq`

Version 1.4

- Addition command `CMD_Data_IND`
- Bugfix
- Boot Up Factory Reset

Version 1.5

- Bugfix

Version 1.6

- Added support for hardware handshake

12 References

[1] Specification wireless M-Bus EN 13757-4:2005

[2] "CC1101 Single-Chip Low-Cost Low-Power RF Transceiver (Rev. B)", Texas Instruments

[3] "AMB8425-M Data Sheet", AMBER wireless GmbH

13 Regulatory compliance information

13.1 Important notice

The use of RF frequencies is limited by national regulations. The AMB8425-M has been designed to comply with the R&TTE directive 1999/5/EC of the European Union (EU).

The AMB8425-M can be operated without notification and free of charge in the area of the European Union. However, according to the R&TTE directive, restrictions (e.g. in terms of duty cycle or maximum allowed RF power) may apply.

Conformity assessment of the final product

The AMB8425-M is a subassembly. It is designed to be embedded into other products (products incorporating the AMB8425-M are henceforward referred to as "final products").

It is the responsibility of the manufacturer of the final product to ensure that the final product is in compliance with the essential requirements of the European Union's Radio & Telecommunications Terminal Equipment (R&TTE) directive.

The conformity assessment of the subassembly AMB8425-M carried out by AMBER wireless GmbH does not replace the required conformity assessment of the final product in accordance to the R&TTE directive!

Exemption clause

Relevant regulation requirements are subject to change. AMBER wireless GmbH does not guarantee the accuracy of the before mentioned information. Directives, technical standards, procedural descriptions and the like may be interpreted differently by the national authorities. Equally, the national laws and restrictions may vary with the country. In case of doubt or uncertainty, we recommend that you consult with the authorities or official certification organizations of the relevant countries. AMBER wireless GmbH is exempt from any responsibilities or liabilities related to regulatory compliance.

13.2 Declaration of Conformity



DECLARATION OF CONFORMITY Directive 1999/5/EC (R&TTE)

The manufacturer: AMBER wireless GmbH
Albin-Köbis-Straße 18
51147 Köln
Tel. +49-2203-699195-0

declares on its sole responsibility, that the following product:

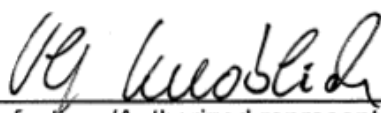
Type-designation: **AMB8425**

Intended purpose: 868MHz transceiver module
Transfer of digital messages

satisfies all the technical regulations applicable to the product within the scope of council directives 1999/5/EC, 2004/108/EC and 2006/95/EC if used for its intended purpose and in accordance with the manufacturers operating instructions and that the following norms, standards or documents have been applied:

EN 300 220-1 V2.1.1 (2006-04)
EN 300 220-2 V2.1.2 (2007-06)
EN 301 489-1 V1.8.1 (2008-04)
EN 301 489-3 V1.4.1 (2002-08)
EN 60950-1 (2001 + A11 + corrigendum 2004)
EN 50371 (2002)

Köln, 24th of September 2009
Place and date of issue



Manufacturer/Authorized representative
Ulf Knoblich

14 Important notes

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