Waviot

RM141

Overview

Waviot modem is an energy efficient both software and hardware solution based on AXSEM AX8052F143 transceiver chip and proprietary firmware. The modem can be accessed and controlled from external IC via USART. There are some technical specifications. Additional specs can be found in AX8052F143 datasheet.

Weight: 20 g
Package: QFN40
Frequency range: 315, 433, 470, 500, 868, 915 MHz.
Supply range: 1.8 V – 3.6 V
Uplink sensitivity: -152 dBm @ 12 bps effective data rate
Downlink sensitivity: -148 dBm @ 12 bps effective data rate
Power consumption: 9.5 mA in active mode; 1.5 uA in sleep mode.
Battery life: approximately 20 years on AA battery.
Operating temperature: – 40. . . 85 °C

Contents

1 Interfacing with modem

1.1 USART settings

To access Waviot modem via USART you need to set 115200 8N1 profile: 115200 baudrate, 8 bit packet length, no parity, 1 stop bit.

1.2 Packet structure

Modem uses SLIP protocol to receive commands and response them. The packet structure is shown at the figure below.

START	COMMAND			STOP
0xDD	CMD	PAYLOAD	CRC	0xDE

CMD (1 byte) is the command code.
PAYLOAD (up to 256 bytes) is the sequence of command.
CRC (1 byte) is the checksum of PAYLOAD.

1.3 Calculating CRC

CRC checksum is calculated by function presented in the appendix B.

2 Commands

Byte in brackets represents the command code.

2.1 Echo (0x00)

Payload length can vary from 0 to 256 bytes. Modem responses with copy of payload.

2.2 Transmitting data (0x32)

Payload length can vary from 1 to 256 bytes. Modem responses with 0x00 if packet was successfully added in TX buffer and 0x04 if the TX buffer is overflowed. In the case of overflow the packet is ignored.

2.3 Getting number of packets in TX buffer (0x21)

There is no payload for this command. Modem responses 1 byte number of packets in the TX buffer.

2.4 Getting modem ID (0x09)

There is no payload for this command. Modem responses with 4 byte ID. Most significant byte is always first and equal 0x00.

2.5 Rebooting modem (0x20)

There is no payload for this command. Modem reboots.

2.6 Configuring modem (0x40)

Payload consists of 1-8 configuration bytes. Detailed description of configuration commands is placed in the next chapter.

2.7 Receiving data (0x10)

This command is transmitted from the modem to the host. Payload consists of 1-256 received data bytes.

3 Configuring modem

Here are described possible payloads for modem configure command (0x40).

3.1 TX and RX mode configuration

0	1	2	3	4	5	6
R/W	MODE	MACK	TX PHY	RX PHY	TX PWR	RETRY

R/W: **0x00** for read, **0x40** for write without confirmation, **0x80** for write with confirmation.

MODE: **0x01** receiver is active only after transmission, **0x02** receiver is always active. Default is **0x02**.

MACK: number of 8-bit packets that need delivery confirmation. Possible values: **0x00** (no ACK), **0x01, 0x02, 0x04, 0x08, 0x10, 0x20**. Default is **0x01**.

TX PHY: TX speed and protocol.
Modem can be connected both to base station and to another modem. This is shown in link type column.

Table 1: TX PHY modes

code	speed	link type
0x14	50bit/sec	modem-to-station
0x15	50bit/sec	modem-to-station
0x16	200bit/sec	modem-to-modem
0x17	400bit/sec	modem-to-station
0x18	400bit/sec	modem-to-station
0x19	500bit/sec	modem-to-modem
0x1A	3200bit/sec	modem-to-station
0x1B	5000bit/sec	modem-to-modem
0x1C	25600bit/sec	modem-to-station
0x1D	57600bit/sec	modem-to-modem

TX PWR: TX power, can be from 0 to 26. Default value is **26**.

RETRY: Number of attempts to transmit data if the transmission was unsuccessful. Can be from 0 to 128. Default value is **5**.

RX PHY: RX speed and protocol.

Table 2: RX PHY modes

code	speed
0x00	200bit/sec
0x01	500bit/sec
0x02	5000bit/sec
0x03	57600bit/sec

3.2 Handshake configuration

0	1	2
R/W	HNDSK	MACK

R/W: **0x01** for read, **0x41** for write without confirmation, **0x81** for write with confirmation.

HNDSK: handshake mode, necessity of ACK **0x01** receiver is active only after transmission, **0x02** receiver is always active. Default is **0x02**.

MACK: number of 8-bit packets that need delivery confirmation. Possible values: **0x00** (no ACK), **0x01, 0x02, 0x04, 0x08, 0x10, 0x20**. Default is **0x01**.

3.3 Chunking configuration

0	1
R/W	MAXLEN

R/W: **0x02** for read, **0x42** for write without confirmation, **0x82** for write with confirmation.

MAXLEN: chunk size in bytes for long packets. **8** by default.

3.4 TX frequency configuration

0	1 2 3 4
R/W	TXFREQ

R/W: **0x03** for read, **0x43** for write without confirmation, **0x83** for write with confirmation.

TXFREQ: TX frequency in Hz. The first bit is MSB.

3.5 RX frequency configuration

0	1	2	3	4
R/W	RXFREQ			

R/W: **0x04** for read, **0x44** for write without confirmation, **0x84** for write with confirmation.

RXFREQ: RX frequency in Hz. The first bit is MSB.

3.6 Antenna configuration

0	1	2	3
R/W	TX PWR	TX ANT	RX ANT

R/W: **0x05** for read, **0x45** for write without confirmation, **0x85** for write with confirmation.

TX PWR: TX power, can be from 0 to 26. Default value is **26**.

TX ANT: output of TX antenna, can be **0** or **1**. Default is **0**.

RX ANT: output of TX antenna, can be **0** or **1**. Default is **0**.

3.7 Downlink ID configuration

0	1	2	3
R/W	DL ID		

R/W: **0x06** for read, **0x46** for write without confirmation, **0x86** for write with confirmation.

DL ID: downlink ID, the first bit is LSB.

3.8 Heartbeat configuration

0	1	2	3
R/W	HB NUM	HB INT	

R/W: **0x07** for read, **0x47** for write without confirmation, **0x87** for write with confirmation.

HB NUM: number of heartbeat messages need to be transmitted. Can be from 0 to 255, where 255 is interpreted as infinity. Heartbeat message consists of battery voltage, RSSi, temperature, TX power.

HB INT: interval of heartbeat messages specified in minutes for MODE=0x01 or in seconds for MODE=0x02.

3.9 Firmware version

0	1 2 3 4 5 6
R/W	VERSION

R/W: **0x0A** for read.

VERSION: returned by modem. Represents firmware and hardware version.

3.10 Flags configuration

0	1
R/W	FLAG

R/W: **0x01** for read, **0x41** for write without confirmation, **0x81** for write with confirmation.

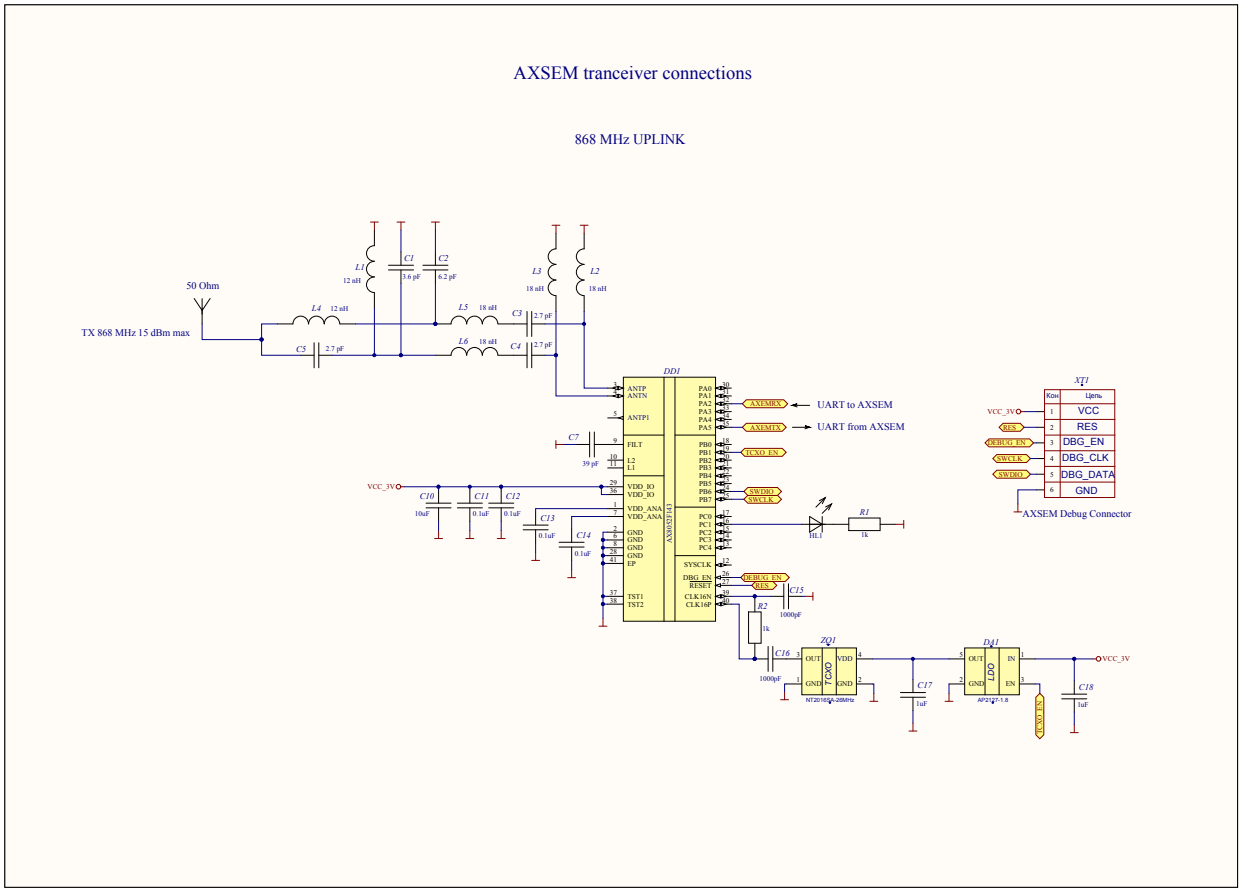
HNDSK: handshake mode, necessity of ACK **0x01** receiver is active only after transmission, **0x02** receiver is always active. Default is **0x02**.

MACK: number of 8-bit packets that need delivery confirmation. Possible values: **0x00** (no ACK), **0x01, 0x02, 0x04, 0x08, 0x10, 0x20**. Default is **0x01**.

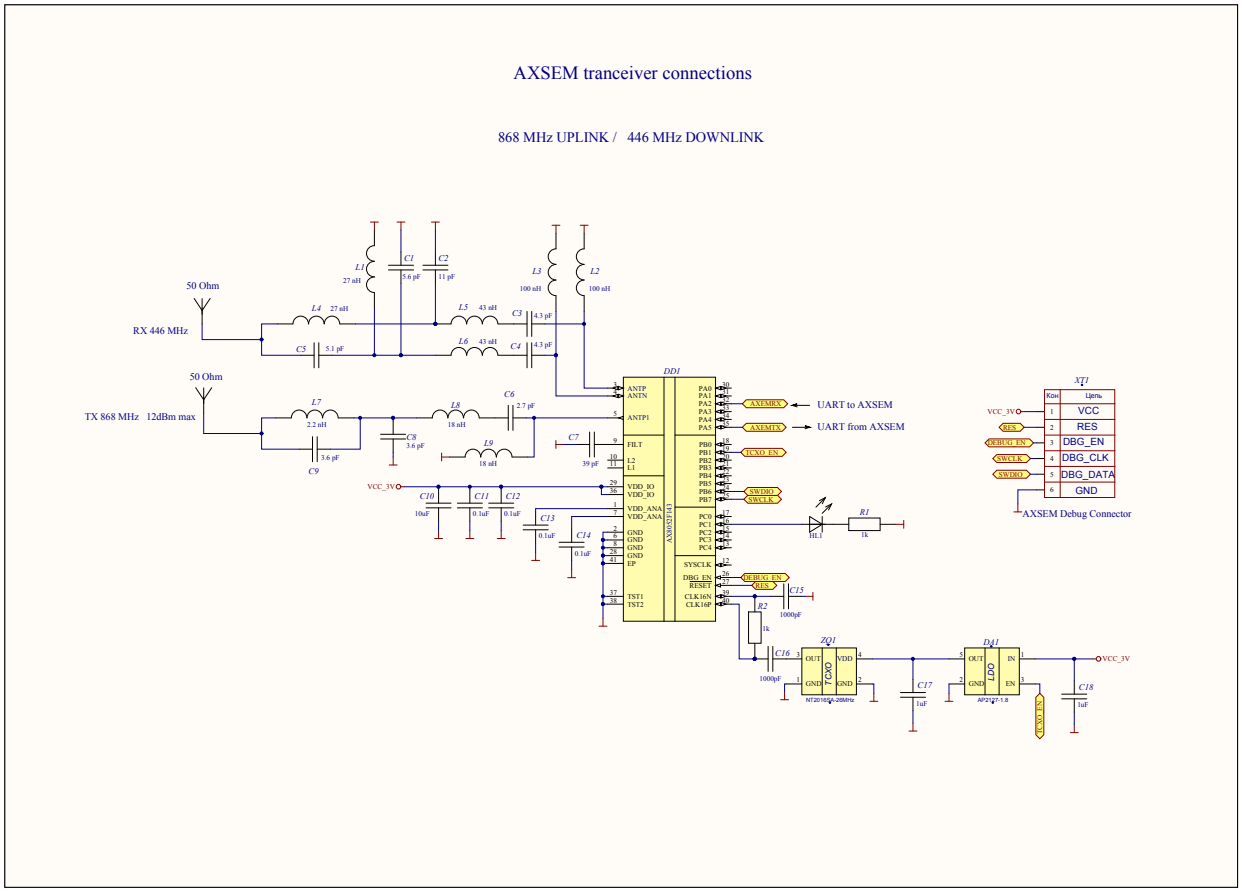
4 RF physical layer

A Design reference

A.1 Half-duplex modem schematic



A.2 Full-duplex modem schematic



A.3 Antenna design recommendations

B CRC reference

Here are listed C functions that calculate CRC of single byte and CRC of byte sequence.

```
uint8_t CRC8byte(uint8_t data)
{
        uint8_t crc = 0;
        if(data & 1) crc ^= 0x5e;
        if(data & 2) crc ^= 0xbc;
        if(data & 4) crc ^= 0x61;
        if(data & 8) crc ^= 0xc2;
        if(data & 0x10) crc ^= 0x9d;
        if(data & 0x20) crc ^= 0x23;
        if(data & 0x40) crc ^= 0x46;
        if(data & 0x80) crc ^= 0x8c;
        return crc;
}

uint8_t CRC8(uint8_t * data, uint8_t len)
{
uint8_t crc = 0;
        for(uint8_t i = 0; i < len; i++)
        {
                crc = CRC8byte(data[i] ^ crc);
        }
        return crc;
}
```