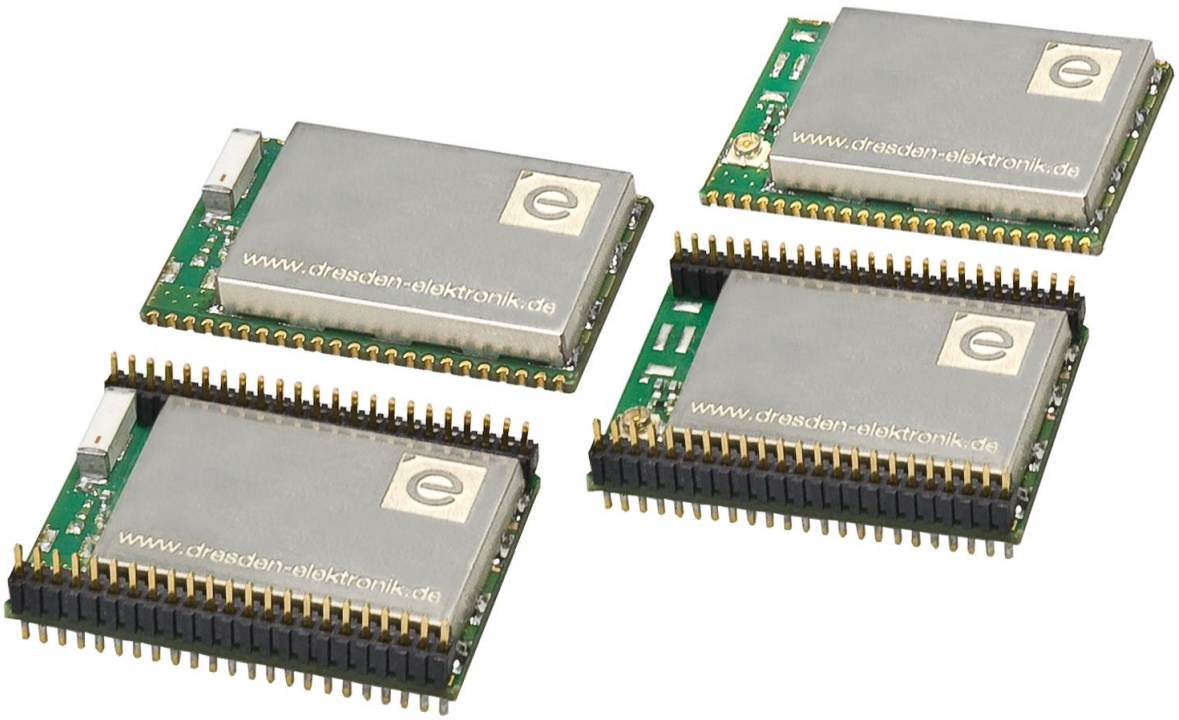
dresden elektronik

User Manual
Radio Modules

deRFmega128-22A00
deRFmega128-22A02
deRFmega128-22C00
deRFmega128-22C02



Document Version V1.4
2011-08-19

Table of contents

Document history

Date	Version	Description
2010-01-25	1.0	Initial version
2010-03-30	1.1	Addition of deRFmega128-22C00
2010-08-25	1.2	Updated deRFmega128-22A00 / -22A02 to Rev02 Addition of deRFmega128-22C02 New pin designation Updated footprint receptacles
2010-09-07	1.3	Updated Programming section
2011-08-19	1.4	Updated radio details Updated EEPROM Details Addition of PCB design Addition of clock details Addition of fuse settings Addition of programming options Addition of programming example Addition of performance test

Mailing list

Firm	Division / Name
DE	Dev. / A. Palm

Author / Check / Release

	Firm	Division / Name
Author	DE	Dev. / A. Palm
Check		
Release		

Abbreviations

Abbreviation	Description
ADC	**A**nalog to **D**igital **C**onverter
BOD	**B**rown**o**ut-**D**etection
CE	**C**onsumer **E**lectronics
FCC	**F**ederal **C**ommunications **C**ommission
GPIO	**G**enerals **P**urpose **I**nput **O**utput
JTAG	**J**oint **T**est **A**ction **G**roup
RF	**R**adio **F**requency
SPI	**S**erial **P**eripheral **I**nterface
TWI	**T**wo-**W**ire **I**nterface
UART	**U**niversal **A**synchronous **R**eceiver **T**ransmitter

1. Overview

The pluggable compact radio modules deRFmega128-22A00, deRFmega128-22A02 and the solderable radio module deRFmega128-22C00 and deRFmega128-22C02 include Atmel's Single-Chip ATmega128RFA1, which combines an 8-Bit AVR microcontroller with a 2.4GHz transceiver.

2. Application

The main applications for the radio modules are:

- 2.4GHz IEEE 802.15.4
- ZigBee® Pro
- ZigBee® RF4CE
- ZigBee® IP
- 6LoWPAN
- ISA SP100
- Wireless Sensor Networks (WSN)
- industrial and home controlling and monitoring

3. Features

The radio modules deRFmega128-22A00 and deRFmega128-22C00 offer the following features:

- Compact size: 30 x 22.7 mm (for 22A00) and 30 x 20.4 mm (for 22C00)
- Pluggable: 2 male connectors, 23 pins per row, 1.27mm pitch
- RF shielding
- Usable signals: power supply, peripheral, programming, debugging, tracing, ADC, GPIO
- Application interfaces: 2 x UART, 1 x TWI
- Debug/Programming interfaces: 1 x SPI, 1 x JTAG
- Onboard chip-antenna 2.4GHz
- Onboard EEPROM AT24C1024B for firmware update over-the-air and/or process data storing (1Mbit, serial, TWI, onboard Pull-ups on SDA an SCL)
- Onboard 32.768kHz (Deep-Sleep clock) and 16MHz (Transceiver clock) crystal oscillator
- Certification: CE, FCC

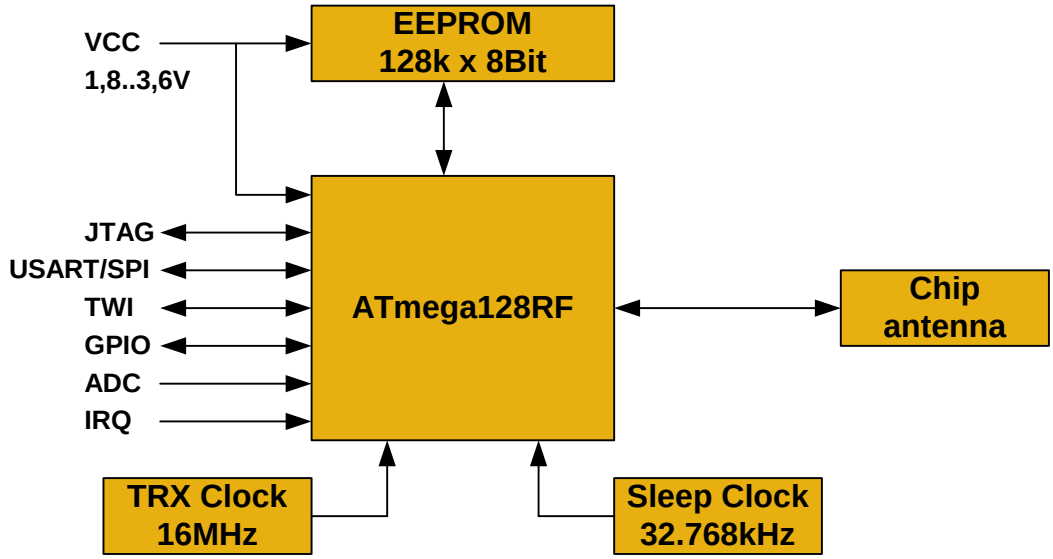


Figure 1: block diagram deRFmega128-22A00 / 22C00

The deRFmega128-22A02 and deRFmega128-22C02 offer the same features like the deRFmega128-22A00 except the chip antenna is replaced by a coaxial receptacle (U.FL) for connecting an external antenna.

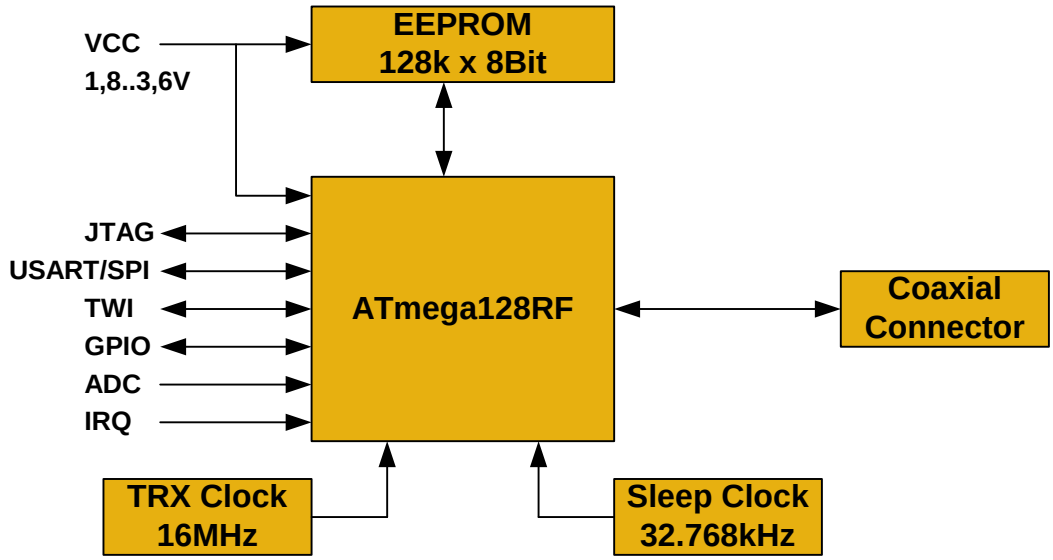


Figure 2: block diagram deRFmega128-22A02 / 22C02

4. Technical data

Table 1: Mechanical data

Mechanical	
Radio modules	
Size (L x W x H)	30 x 22.7 x 8.2 mm (for deRFmega128-22A00 / 22A02) 30 x 20.4 x 4.1 mm (for deRFmega128-22C00 / 22C02)
Connectors	
number of headers	2
pins per header	23
pitch	1.27 mm
pin length	3.05 mm
pin diameter	0.51 mm
Insulator (L x W x H)	29.2 x 2.5 x 2.5 mm
Pins	
pitch	1.27 mm

Table 2: Temperature range

Temperature range					
		Min	*Typ*	*Max*	*Unit*
Working range	T_work	-40		+85	°C

Table 3: Electrical data

Electrical (Vcc = 3,3VDC)					
	Parameter	*Min*	*Typ*	*Max*	*Unit*
Supply Voltage	VCC	1.8	3.3	3.6	VDC
Current consumption	I_TXon (TX_PWR = +3dBm)		18		mA
	I_RXon		19		mA
	I_Idle (Txoff, BOD on)		6.5		mA
	I_BODon		5		µA
	I_Sleep (depends on Sleep Mode)	0.5	1.0	5	µA

Table 4: RF data

Radio (Vcc = 3,3VDC)					
	Parameter	*Min*	*Typ*	*Max*	*Unit*
Transmit power conducted	TX_PWR = 0		+2.4		dBm

5. Mechanical size

5.1. Radio module (pluggable)

Used connectors: SAMTEC “TMS-123-02-L-S”

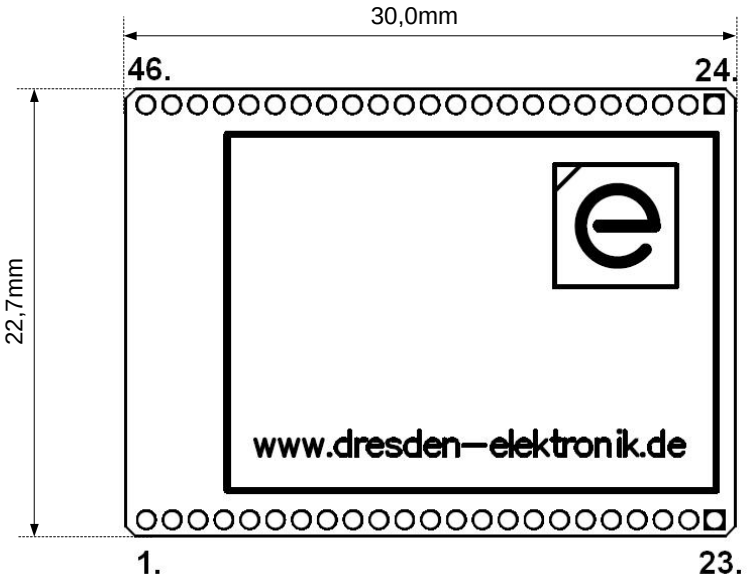


Figure 3: Size deRFmega128-22A00 and deRFmega128-22A02

5.2. Footprint receptacles

Used receptables: SAMTEC “SLM-123-01-L-S”

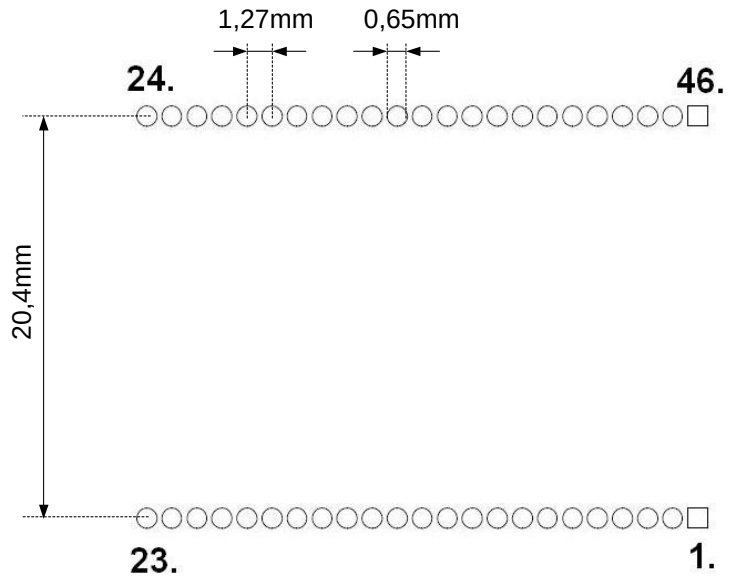


Figure 4: Footprint receptacles 1.27mm pitch

5.3. Radio module (solderable)

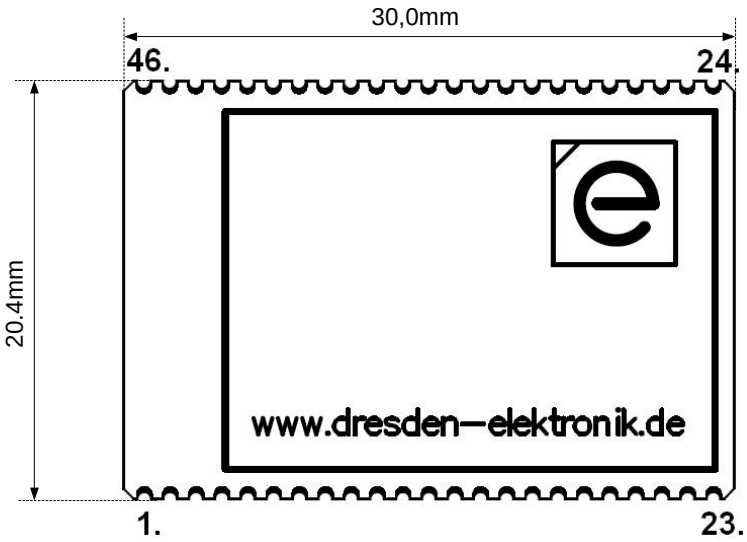


Figure 5: Size deRFmega128-22C00 and deRFmega128-22C02

5.4. Footprint Pads

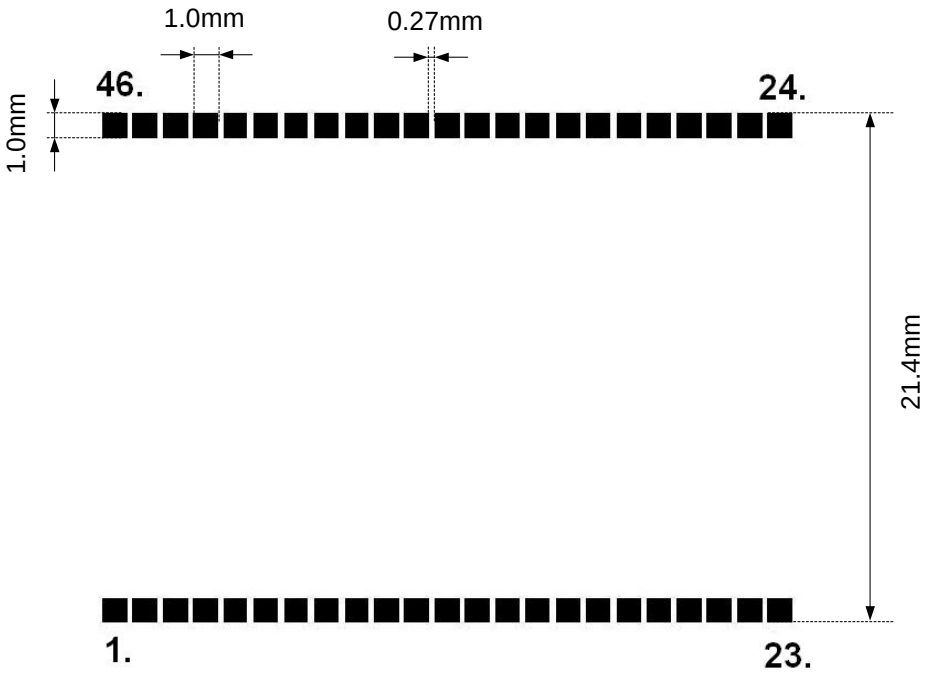
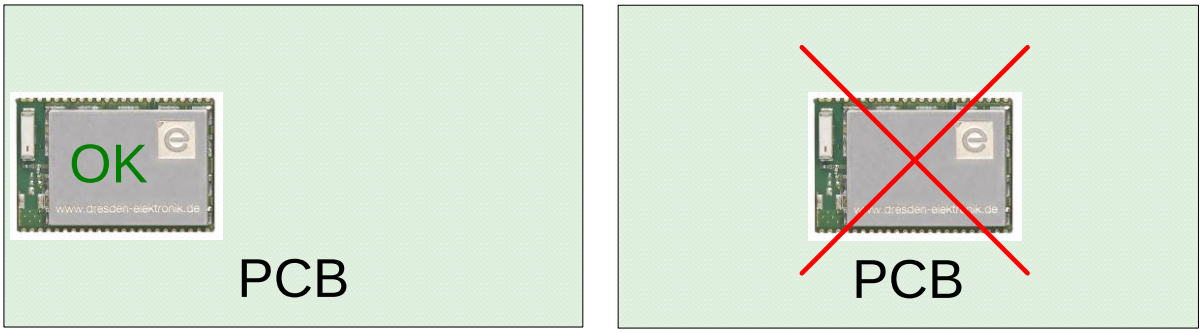


Figure 6: Footprint for deRFmega128-22C00 and deRFmega128-22C02

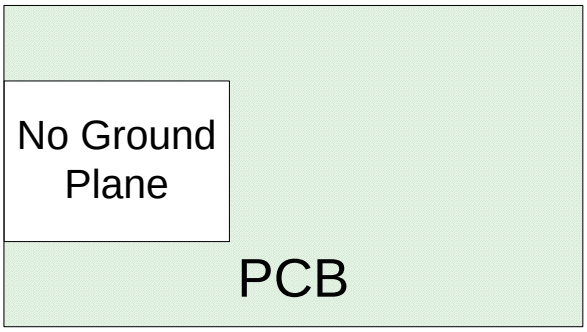
Do not place ground areas below the radio module and near the chip-antenna.

6. PCB Design

The PCB design of the radio module base board and placement affects the radio characteristic. The radio module should be placed at the edge or side of a base board. The chip antenna should be directed to PCB side.



Do not place ground areas below the radio module and near the chip-antenna.



If the base board with the radio module will be placed into a metal case, it is necessary to use the radio module variant with coaxial connector and an external antenna.

7. Soldering Profile of deRFmega128-22C00 and deRFmega128-22C02

Table 5 gives the soldering profile for the radio modules.

Table 5: Soldering Profile

Profile Feature	Values
Average-Ramp-up Rate (217°C to Peak)	3°C/sec max.
Preheat Temperature 175°C ±25°C	180 sec. max
Temperature Maintained Above 217°C	60 sec. to 150 sec.
Time within 5°C of Actual Peak Temperature	20 sec. to 40 sec.
Peak Temperature Range	260°
Ramp-down Rate	6°C/sec max.
Time 25°C to Peak Temperature	8 min. max.

Figure 7 shows a recorded soldering profile for a radio module. The blue colored line illustrates a temperature sensor placed next to the soldering-contacts of the radio module. The pink line shows the set temperatures depending on the zone within the reflow soldering machine.

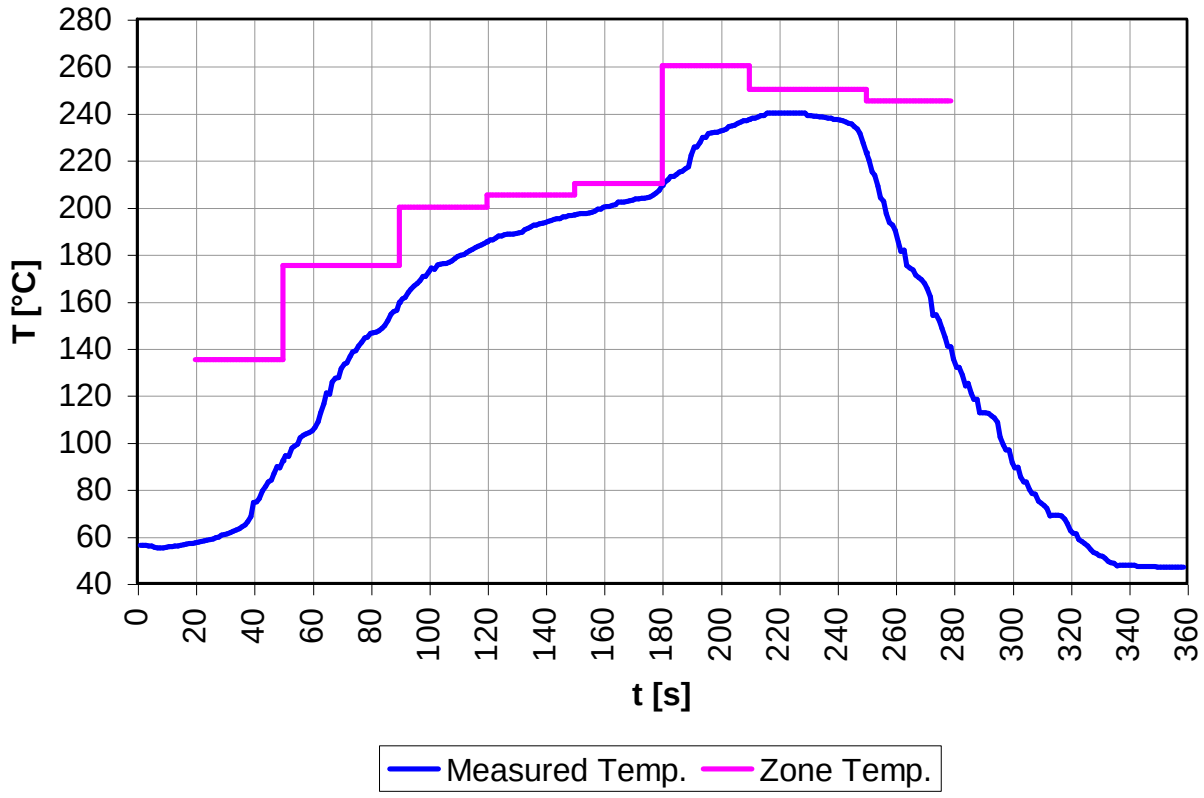


Figure 7: Recorded soldering profile

A solder process without supply of nitrogen causes a discoloration of the metal RF-shielding.

8. Pin assignment

Both pin headers respectively pin contacts provide the most important signals to the customer: power supply, peripheral, programming, debugging, tracing, analog measurement and free programmable ports. All provided signals except VCC, DGND, RSTN, RSTON, AREF and CLKI are free programmable port pins (GPIO).

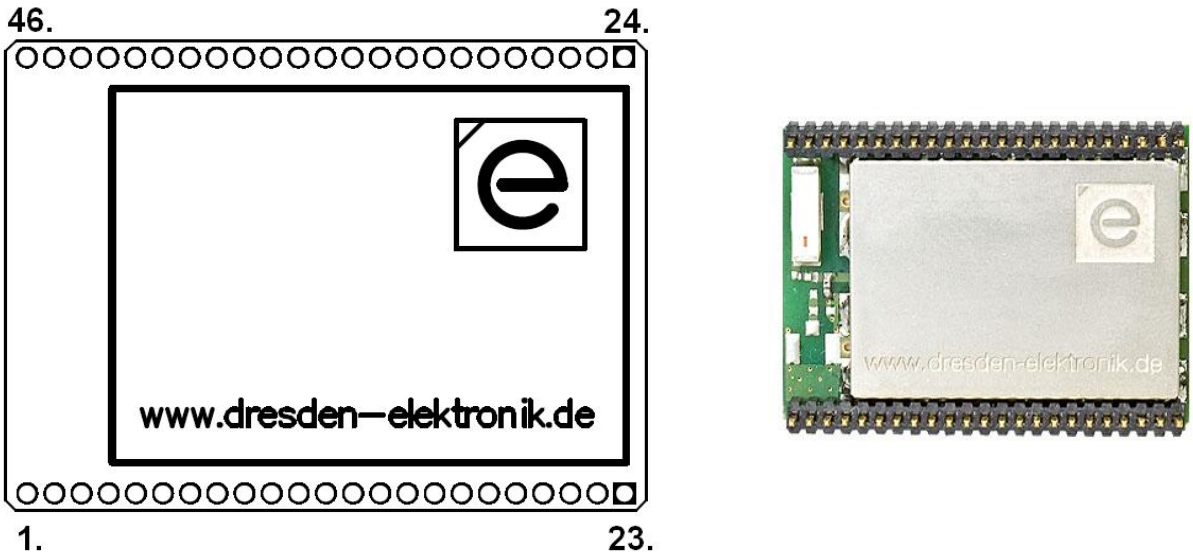


Figure 8: Top overlay deRFmega128-22A00

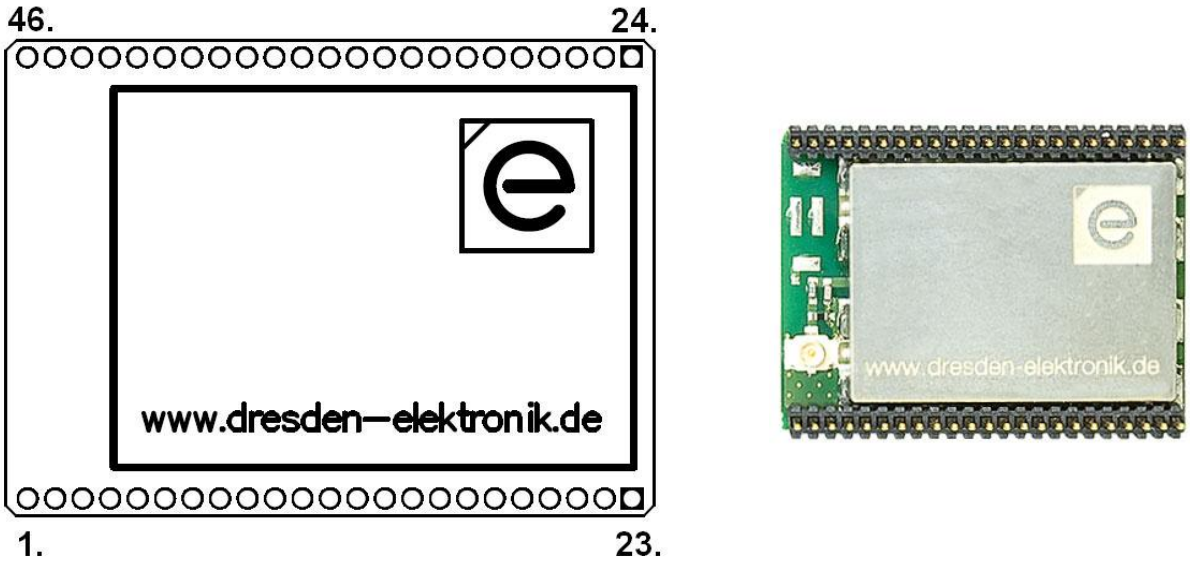


Figure 9: Top overlay deRFmega128-22A02

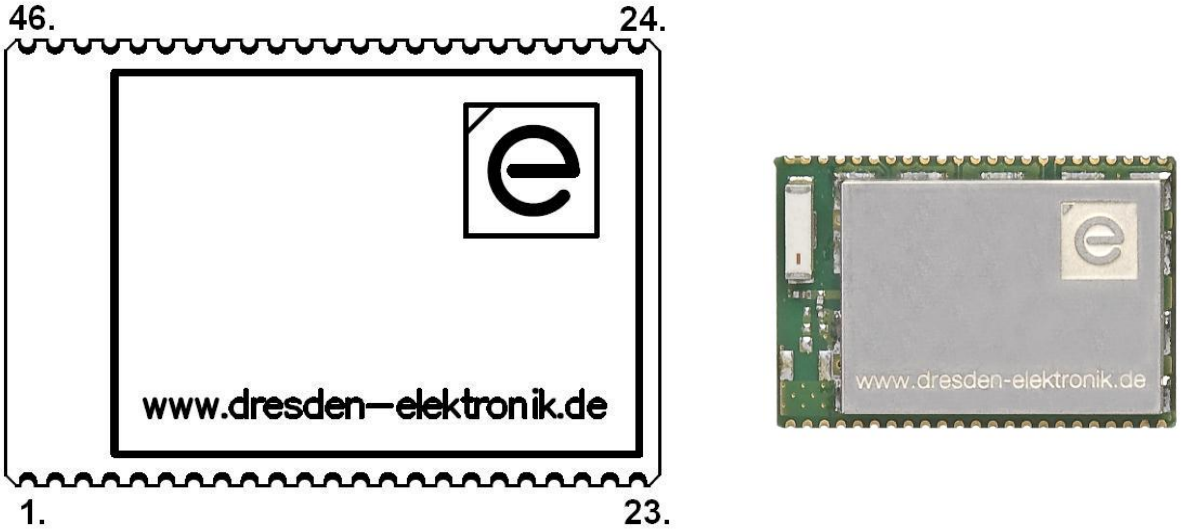


Figure 10: Top overlay deRFmega128-22C00

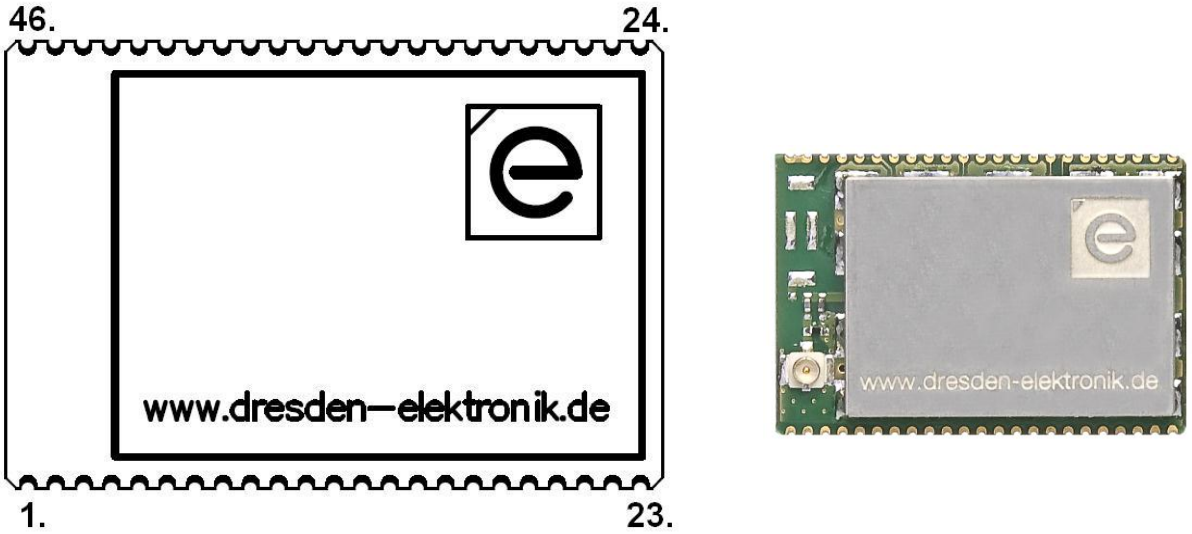


Figure 11: Top overlay deRFmega128-22C02

Table 6: Pin assignment of deRFmega128-22A00 / 22A02 / 22C00 / 22C02

Pin assignment			
Pin	*µC-Port*	*Pin*	*µC-Port*
1	VCC	24	VCC
2	DGND	25	DGND
3	AREF	26	PE0/RXD0/PCINT8
4	PG1/DI1	27	PD2/RXD1/INT2
5	RSTN	28	PE1/TXD0
6	PG2	29	PD6/T1
7	PD0/SCL/INT0	30	PE2/XCK0/AIN0
8	PG5/OC0B	31	PE3/OC3A/AIN1
9	PD1/SDA/INT1	32	PD4/ICP1
10	PD3/TXD1/INT3	33	PE4/OC3B/INT4
11	PD7/T0	34	PF0/ADC0
12	PD5/XCK1	35	PE5/OC3C/INT5
13	PB1/SCK/PCINT1	36	PF1/ADC1
14	CLKI	37	PE6/T3/INT6
15	PB2/MOSI/PCINT2/PDI	38	PF4/ADC4/TCK
16	PB0/SSN/PCINT0	39	PE7/ICP3/CLKO/INT7
17	PB3/MISO/PCINT3/PDO	40	PF5/ADC5/TMS
18	PB6/OC1B/PCINT6	41	PF2/ADC2
19	PB4/OC2/PCINT4	42	PF6/ADC6/TDO
20	PB7/OC0A/OC1C/PCINT7	43	RSTON
21	PB5/OC1A/PCINT5	44	PF7/ADC7/TDI
22	DGND	45	DGND
23	DGND	46	DGND

Be careful: with User Manual version 1.2 the pin designation was changed from X1 (1 to 23) and X2 (1 to 23) to an incremental pin numbering from 1 to 46, beginning in the bottom left corner and move counter-clockwise around the module at top view. There were no electrical changes made!

Table 7: Description of available I/O port pins

Description of available I/O port pins on header pins				
I/O port pin	*Alternate function (signal name)*			*Comments*
PB0	SSN		PCINT0	
PB1	SCK		PCINT1	
PB2	MOSI	PDI	PCINT2	
PB3	MISO	PDO	PCINT3	
PB4		OC2A	PCINT4	
PB5		OC1A	PCINT5	
PB6		OC1B	PCINT6	
PB7	OC0A	OC1C	PCINT7	
PD0	SCL	INT0		Onboard Pull-Up Resistor 4k7
PD1	SDA	INT1		Onboard Pull-Up Resistor 4k7
PD2	RXD1	INT2		
PD3	TXD1	INT3		
PD4		ICP1		
PD5		XCK1		
PD6		T1		
PD7		T0		
PE0	RXD0		PCINT8	
PE1	TXD0			
PE2	XCK0	AIN0		
PE3	OC3A	AIN1		
PE4	OC3B	INT4		
PE5	OC3C	INT5		
PE6	T3	INT6		
PE7	ICP3	INT7	CLKO	
PF0	ADC0			
PF1	ADC1			
PF2	ADC2	DIG2		
PF4	ADC4		TCK	
PF5	ADC5		TMS	
PF6	ADC6		TDO	
PF7	ADC7		TDI	
PG1		DIG1		
PG2	AMR			
PG3	TOSC2			
PG4	TOSC1			
PG5	OC0B			

Note: The I/O port pins PF3/ADC3/DIG4 and PG0/DIG3 are not available!
PG4/TOSC1 and PG3/TOSC2 are connected internal with a 32.768kHz crystal (see section 9).

Table 8: Signal description list

Signal name	Function	Type	Active Level	Comments
Power				
VCC	Voltage Regulator Power Supply Input	Power		1.8V to 3.6V
GND		Ground		
Clocks and Oscillators				
CLKI	External Clock Input	Input		
CLKO	Divided System Clock Output	Output		
JTAG				
TCK	Test Clock	Input		No pull-up resistor[1]
TDI	Test Data In	Input		No pull-up resistor
TDO	Test Data Out	Output		
TDM	Test Mode Select	Input		No pull-up resistor
Serial Programming				
PDI	Data Input	Input		
PDO	Data Output	Output		
SCK	Serial Clock	Input		
Reset				
RSTN	Microcontroller Reset	I/O	Low	Pull-Up resistor[2]
USART				
TXD0 – TXD1	Transmit Data			
RXD0 – RXD1	Receive Data			
XCK0 – XCK1	Serial Clock			
Timer/Counter and PWM Controller				
OC0A-OC3A	Output Compare and PWM Output A for Timer/Counter 0 to 3			
OC0B-OC3B	Output Compare and PWM Output B for Timer/Counter 0 to 3			
OC0C-OC3C	Output Compare and PWM Output C for Timer/Counter 0 to 3			
T0, T1, T3	Timer/Counter 0,1,3 Clock Input	Input		
ICP1 ICP3	Timer/Counter Input Capture Trigger 1 and 3	Input		
AMR	Automated Meter Reading	Input		
Interrupt				
PCINT0 - PCINT7	Pin Change Interrupt Source 0 to 7	Output		
INT0 – INT7	External Interrupt Input 0 to7	Input		
SPI				
MISO	SPI Master In/Slave Out	I/O		
MOSI	SPI Master Out/Slave In	I/O		
SCK	SPI Bus Serial Clock	I/O		
SSN	SPI Slave Port Select	I/O		

[1] Pull-up resistors on TCK, TDI and TDM are not assembled but needed for correct JTAG function
[2] Internal MCU Pull-up resistor

Signal description list (continued)

Signal name	Function	Type	Active Level	Comments
Two-Wire-Interface				
SDA	Two-Wire Serial Interface Data	I/O		Onboard 4k7 Resist.
SCL	Two-Wire Serial Interface Clock	I/O		Onboard 4k7 Resist.
Analog-to-Digital Converter				
ADC0 – ADC7	Analog to Digital Converter Channel 0 to 7	Analog		
AREF	Analog Reference	Analog		
Analog Comparator				
AIN0	Analog Comparator Positive Input	Analog		
AIN1	Analog Comparator Negative Input	Analog		
Radio Transceiver				
DIG1/DIG2	Antenna Diversity Control Output	Output		

9. Clock

The radio module family deRFmega128 contains an external onboard 32.768kHz and a 16MHz crystal oscillator, see Figure 12 and Figure 13. The 32kHz oscillator can be used for deep-sleep mode of the microcontroller. The 10ppm low tolerance 16MHz oscillator is used as transceiver clock and provides a higher performance than the available internal clock.

See section 10.4 for using the 32.768kHz oscillator.

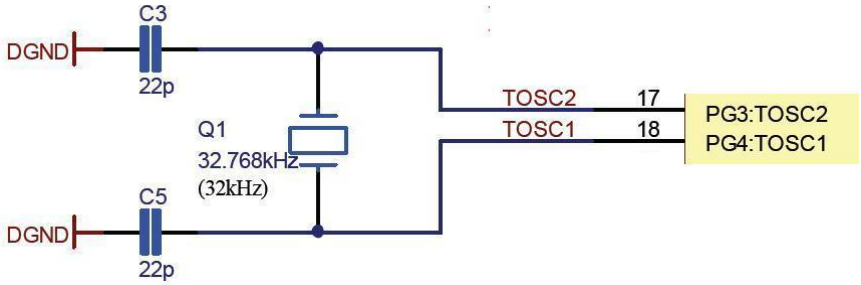


Figure 12: 32.768kHz crystal oscillator

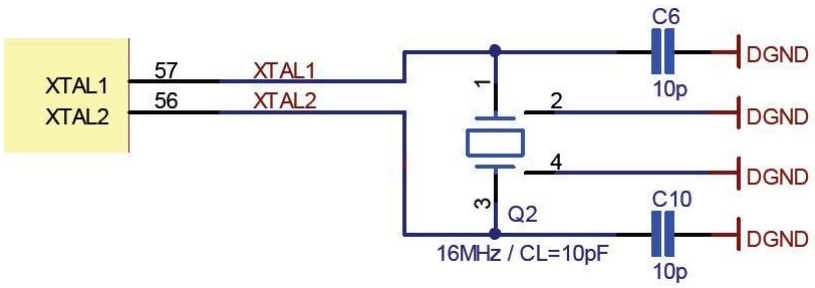


Figure 13: 16MHz crystal oscillator

10. Programming

10.1. Required Hardware

Various hardware setups are possible for a fast start-up of dresden elektronik radio modules:

1. Option
    - (A) deRFmega128-22A00 or deRFmega128-22A02
    - (B) deRFtoRCB
    - (C) Sensor Terminal Board
    - (D) JTAG-ICE mkII or similar programmer, e.g. AVR Dragon
    - (E) Level-Shifter for tracing

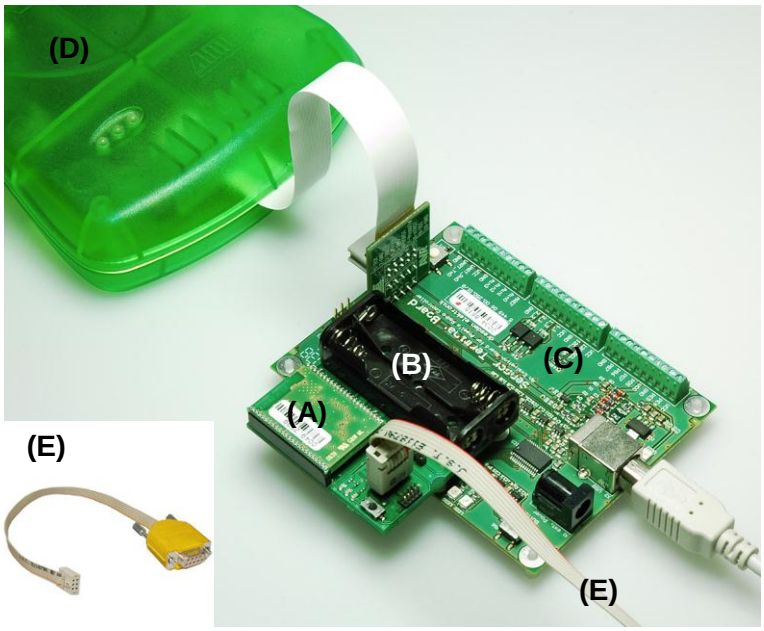


Figure 14: Programming option 1

2. Option
    - (A) deRFmega128-22A00 or deRFmega128-22A02
    - (B) deRFtoRCB
    - (C) JTAG-ICE mkII or similar programmer, e.g. AVR Dragon
    - (D) JTAG-ICE-Adapter (10 pins, pitch 1.27mm to 30 poles flat cable)
    - (E) Level-Shifter for tracing

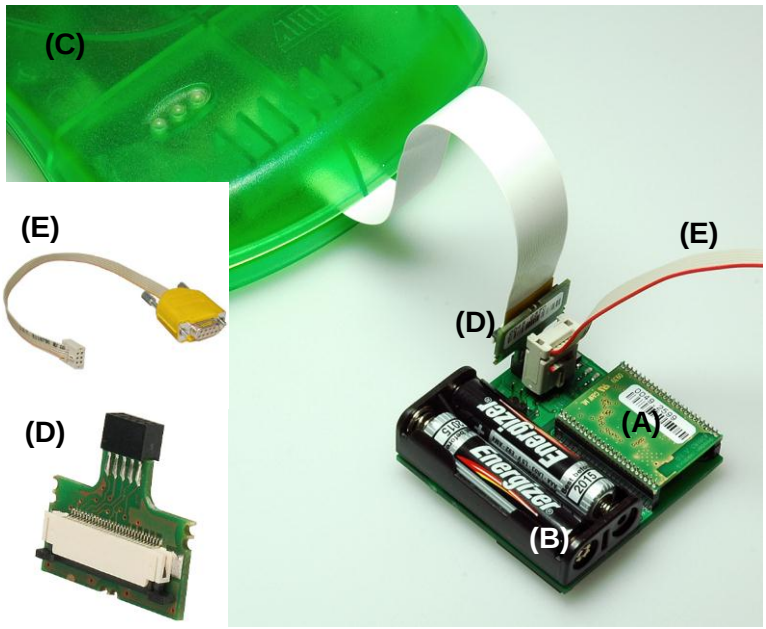


Figure 15: Programming option 2

3. Option
    - (A) deRFmega128-22A00 or deRFmega128-22A02
    - (B) deRFbreakoutBoard
    - (C) JTAG-ICE mkII or similar programmer, e.g. AVR Dragon
    - (D) Level-Shifter for tracing

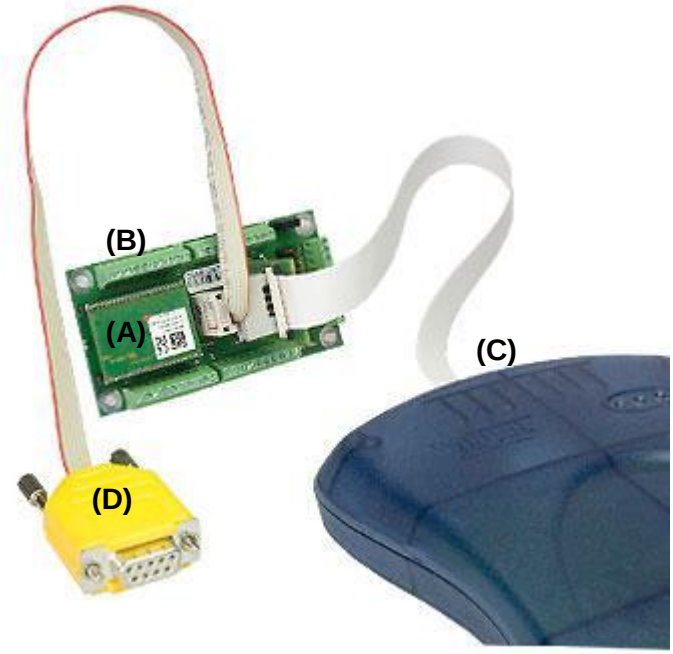


Figure 16: Programming option 3

Figure 17: deRFbreakoutBoard

4. Option
    - (A) deRFmega128-22A00 or deRFmega128-22A02
    - (B) deRFnode
    - (C) JTAG-ICE mkII or similar programmer, e.g. AVR Dragon
    - (D) Level-Shifter for tracing (not pictured)

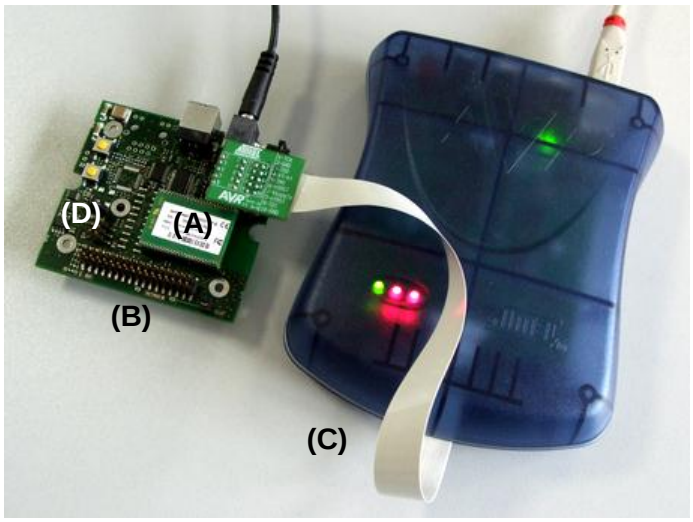


Figure 18: Programming option 4

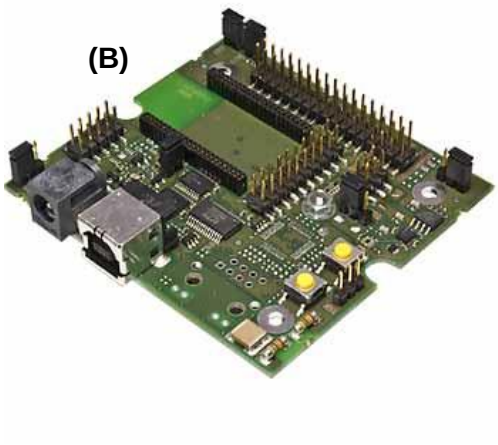


Figure 19: deRFnode

10.2. JTAG interface

The deRFmega128-22A00 / 22A02 / 22C00 / 22C02 are programmable over JTAG interface (TDI, TDO, TCK, TMS). If the JTAG-ICE mkII programmer will be used, no external pull-up resistors are necessary. Use the pin connection shown in Figure 20 to connect the radio module to a suitable JTAG programmer, for example the JTAG-ICE mkII.

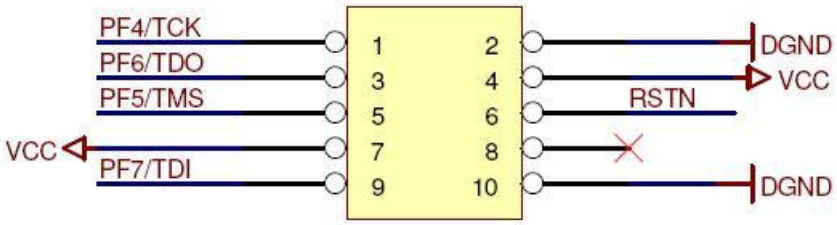


Figure 20: JTAG connector

It is necessary to use the latest version of AVR Studio (min. V4.18 + Service Pack 1 & 2 & 3) and to upgrade the JTAG-ICE mkII programmer firmware (min. V06.06; 06.06).

10.3. Programming Example

The following section describes the programming of a deRFmega128 radio module with AVR Studio version 4.18.700 and AVR Dragon programmer.

First of all, install AVR Studio and the AVR Dragon or a suitable programmer. Connect the programmer with deRFmega128 and power up the module. Start AVR Studio (see Figure 21) and select the used AVR programmer (see Figure 22).

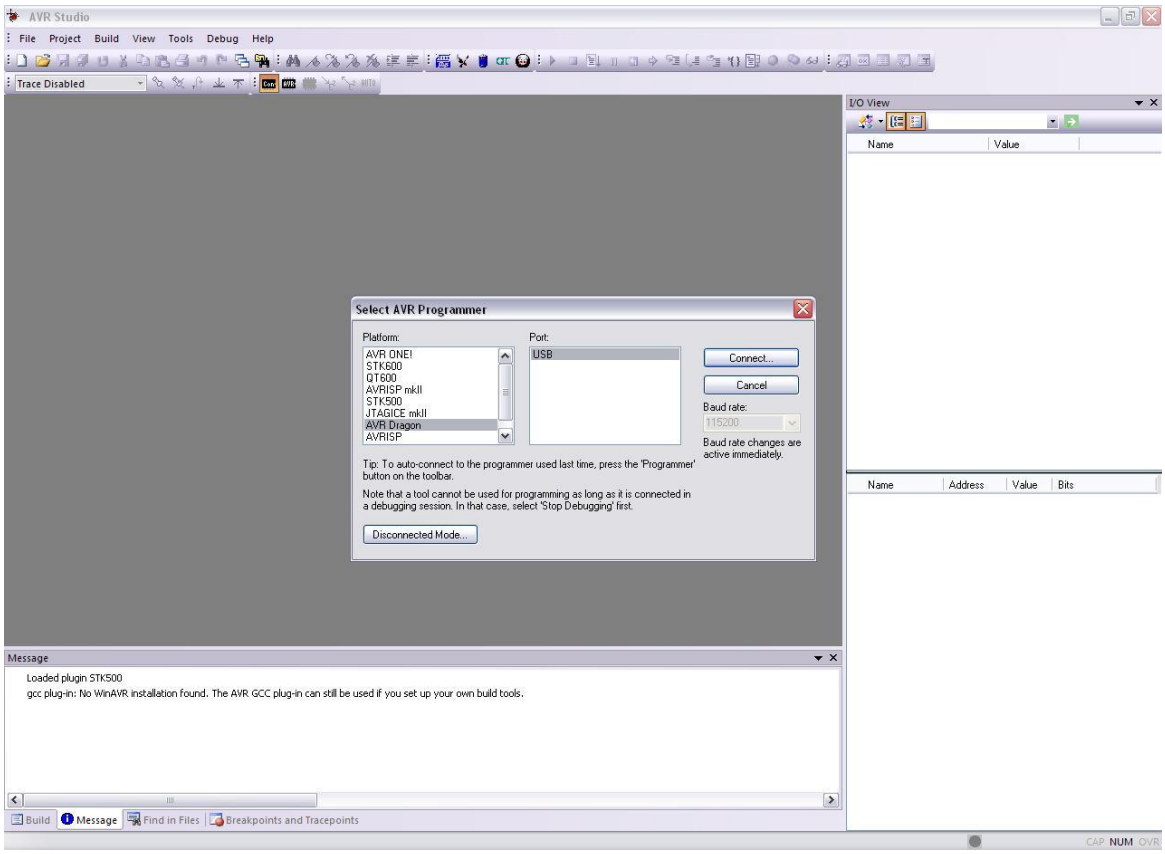


Figure 21: AVR Studio main window

The AVR Dragon communicates over USB. Select the applicable items and push ‘Connect’ (see Figure 22).

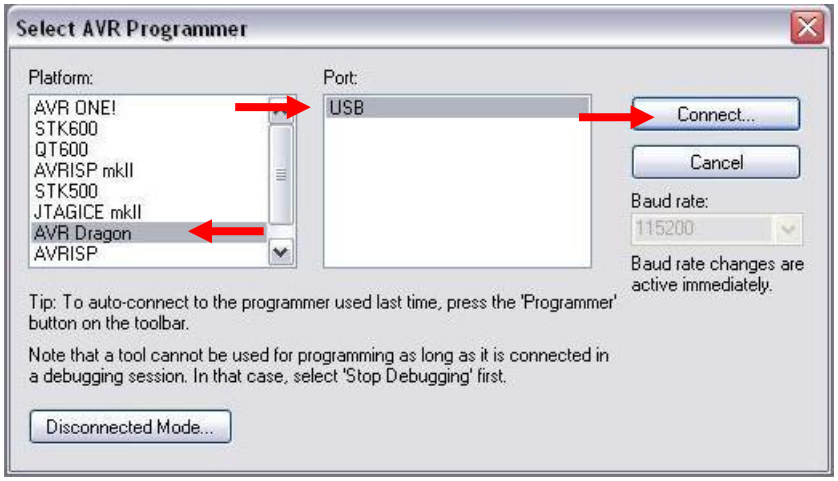


Figure 22: Select AVR programmer

After the connection was established, a new window will be open (see Figure 23). Select the correct microprocessor and push ‘Read Signature’. For this example ‘ATmega128RFA1’ is the correct value. A dialog appears, if the signature matches the selected device.

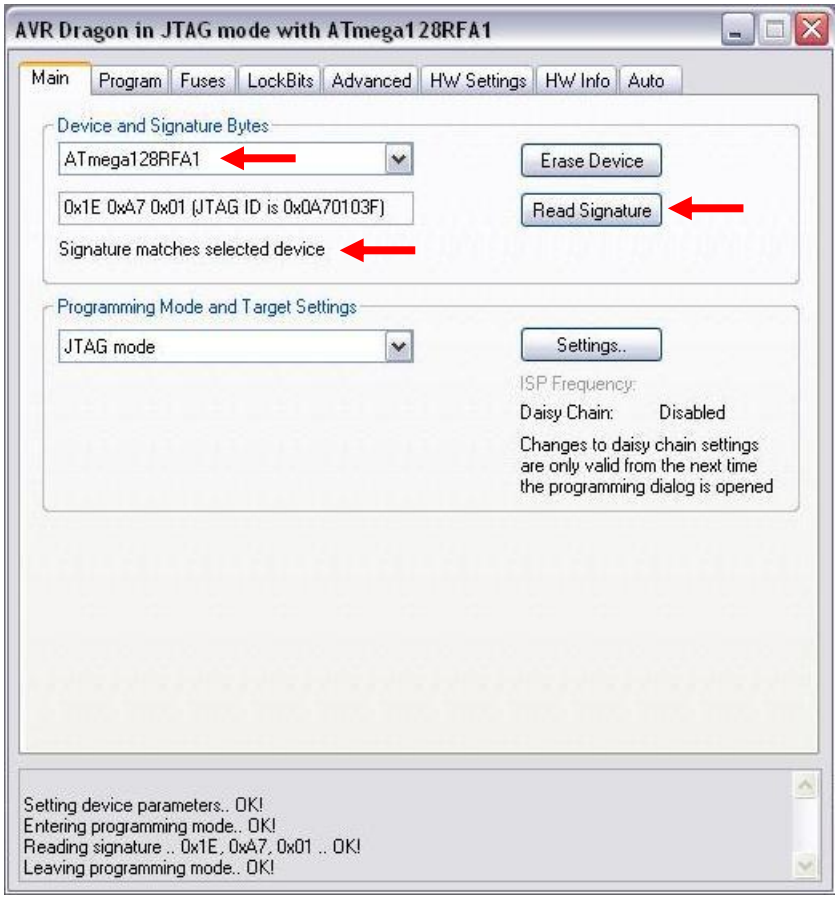


Figure 23: Select the device

The internal flash of the ATmega128RFA1 must be programmed with a HEX file. Select ‘Erase device before flash programming’ and ‘Verify device after programming’. Then select the path, where the file is located and push ‘Program’. A dialog will appear if programming and verifying is correct (see Figure 24).

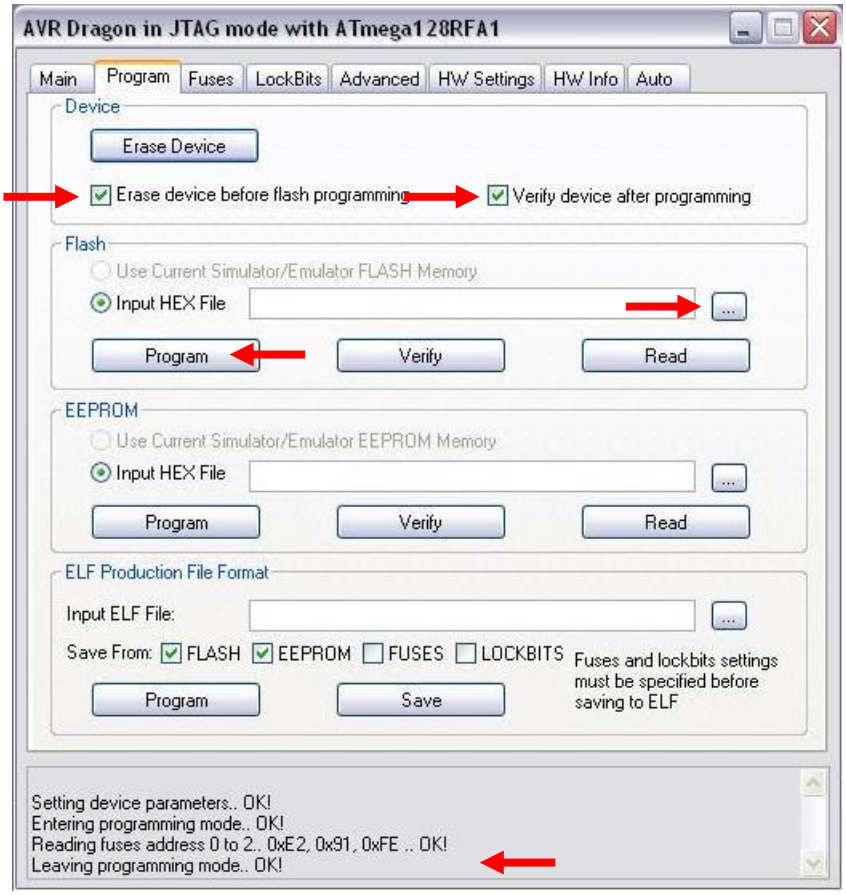


Figure 24: Programming

AVR Studio can now be closed.

10.4. Fuse Settings

A detailed description of the fuse settings can be found in the appropriate microcontroller datasheets. The fuse settings can be changed with AVR Studio. Follow the first steps described in section 10.3 and push the ‘Fuses’ tab. Depending on the selected device, not all fuses may be changeable.

Push ‘Read’ to read out the actual settings. Fuse changes can be saved with pushing ‘Program’.

It is recommended to select the fuses shown in Figure 25 for deRFmega128 radio modules. If the correct fuses are selected, the fuse setting must be HIGH = 0x91 and LOW = 0xE2.

Attention: **Be careful with deactivating the ‘JTAGEN’ fuse. This action disables the JTAG programming interface of the radio module! Reprogramming and fuse changes cannot be done over JTAG! The ‘JTAGEN’ fuse can only be reactivated over SPI if the ‘SPIEN’ fuse is activated! A suitable SPI programmer and the interface access is required for this action.**

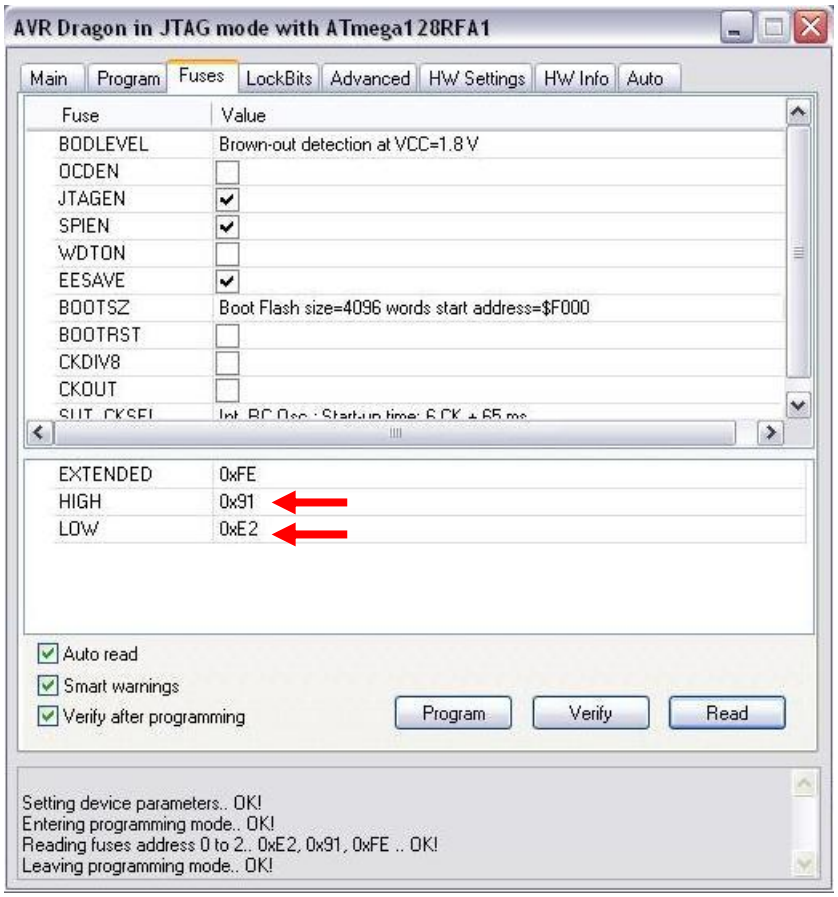


Figure 25: Fuse settings

For using the external 32.768kHz oscillator clock, the fuse ‘SUT_CKSEL’ have to be changed to ‘Ext. Clock’ (see Figure 26).

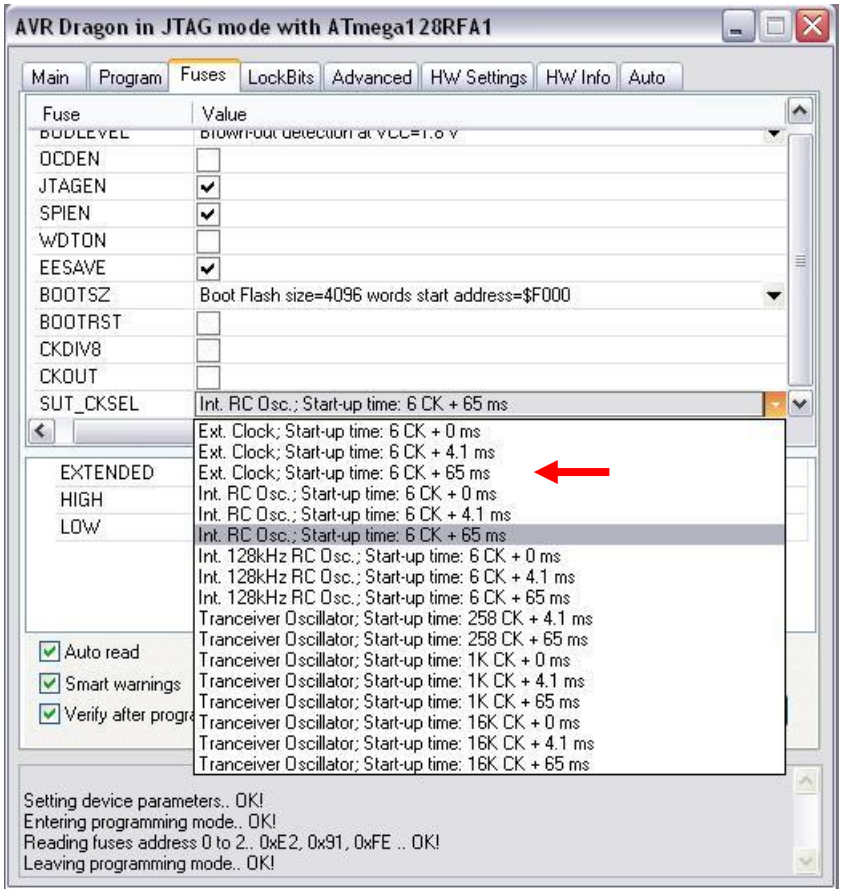


Figure 26: Fuse settings clock

11. Debugging and Tracing

Debugging and tracing of the radio module is possible with the deRFtoRCB adapter and the RS232-Level-Shifter or USB-Level-Shifter. These components were offered by dresden elektronik ingenieurtechnik gmbh. The used pin connection is shown in Figure 27 to connect the radio module to a suitable debug and trace hardware.

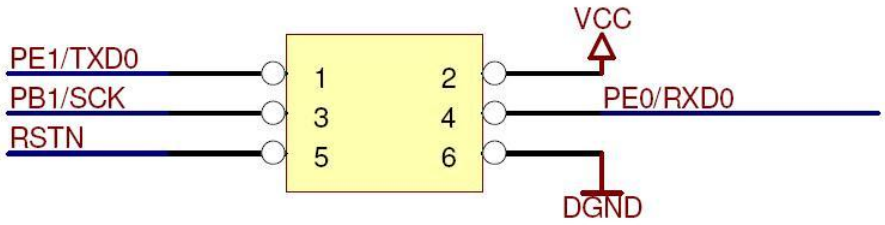


Figure 27: Debug interface

12. Onboard EEPROM

The deRFmega128-22A00 / 22A02 / 22C00 / 22C02 contain the Serial-TWI-EEPROM AT24C1024B by Atmel with a memory size of 128k x 8Bit.

The EEPROM power supply and the pull-ups will be switched on with a LOW-Signal on port pin PD6/T1. It is necessary to wait until the TWI interface on the ATmega128RFA1 is initialized before the communication on the data bus (PD1 and PD0) can be started. The TWI address is set by pins A1 and A2 of the EEPROM. Both pins are set to ground.

Please check the Atmel homepage for further details and the EEPROM datasheet.

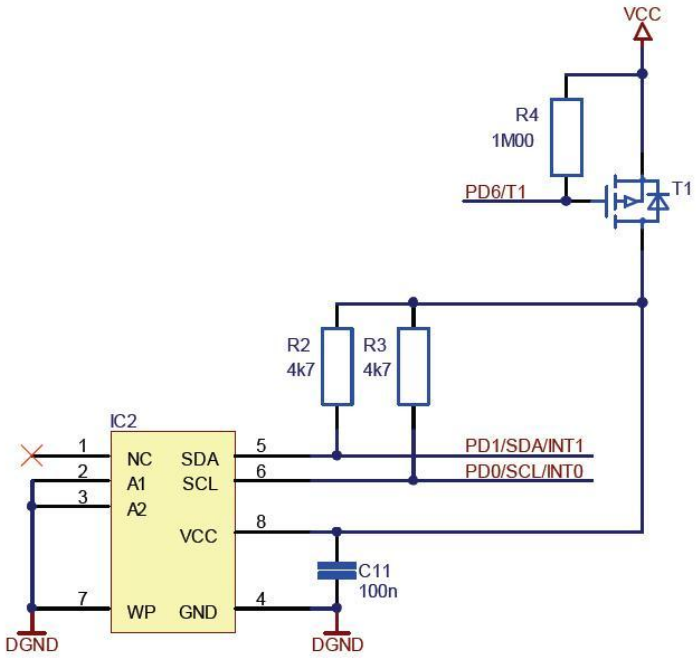


Figure 28: Schematic of the EEPROM AT24C1024B

13. Performance

This section shows the performance of the deRFmega128 radio modules. The test results are summarized in Figure 29, Figure 30, Figure 31 and Figure 32.

Test setup:

Two deRFmega128-22A00 radio modules are used. Each of them are plugged on a deRFnode development board by dresden elektronik. The modules are flashed with the “performance test software” which is an integral part of the deRFdevelopmentKit software package. The performance test based on Atmel MAC stack, but it does not use a specific MAC header. The modules are placed 0.5 meters away from each other. The modules transmit and receive in channel 20 (2.45 GHz). The number of transmitted packets is 10000. All available datarate modes are tested with varied payload and error correction functions. The error correction is part of the used transceiver and must be activated by writing the suitable register bits described in the MCU user manual.

Test cases:

- Data rate mode 250kBit/sec (channel page 0)
- Data rate mode 500kBit/sec (channel page 2)
- Data rate mode 1000kBit/sec (channel page 16)
- Data rate mode 2000kBit/sec (channel page 17)
- Auto Acknowledgement switched ON and OFF (ACK)
- CSMA/CA switched ON and OFF (CSMA)
- Auto frame retry switched ON and OFF (FR)
- Payload varied from 11 Byte to 127 Byte (PSDU)

Results:

- Netto datarate in kBit/sec

Be careful: The shown results are only valid for this type of performance test based on Atmel MAC stack without MAC header. The addition of packet overhead caused from the use of another radio protocol (for example ZigBee PRO) or the use of multihop systems decrease the netto datarate of the radio modules.

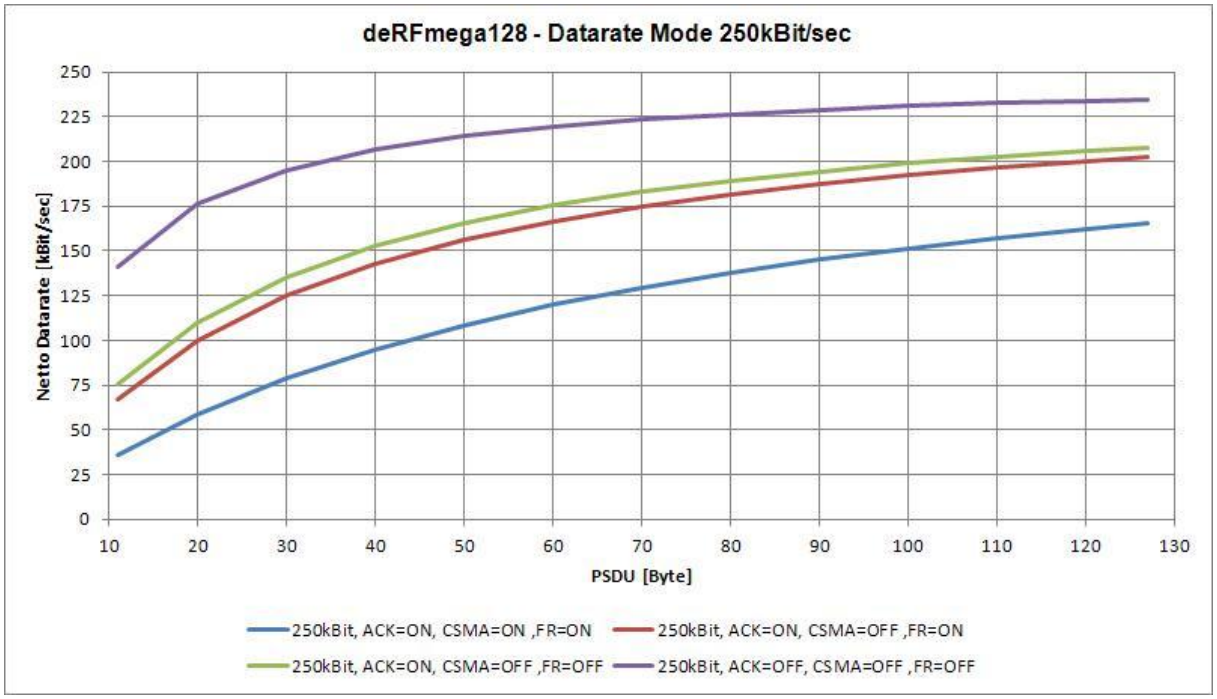


Figure 29: result datarate mode 250kBit/sec

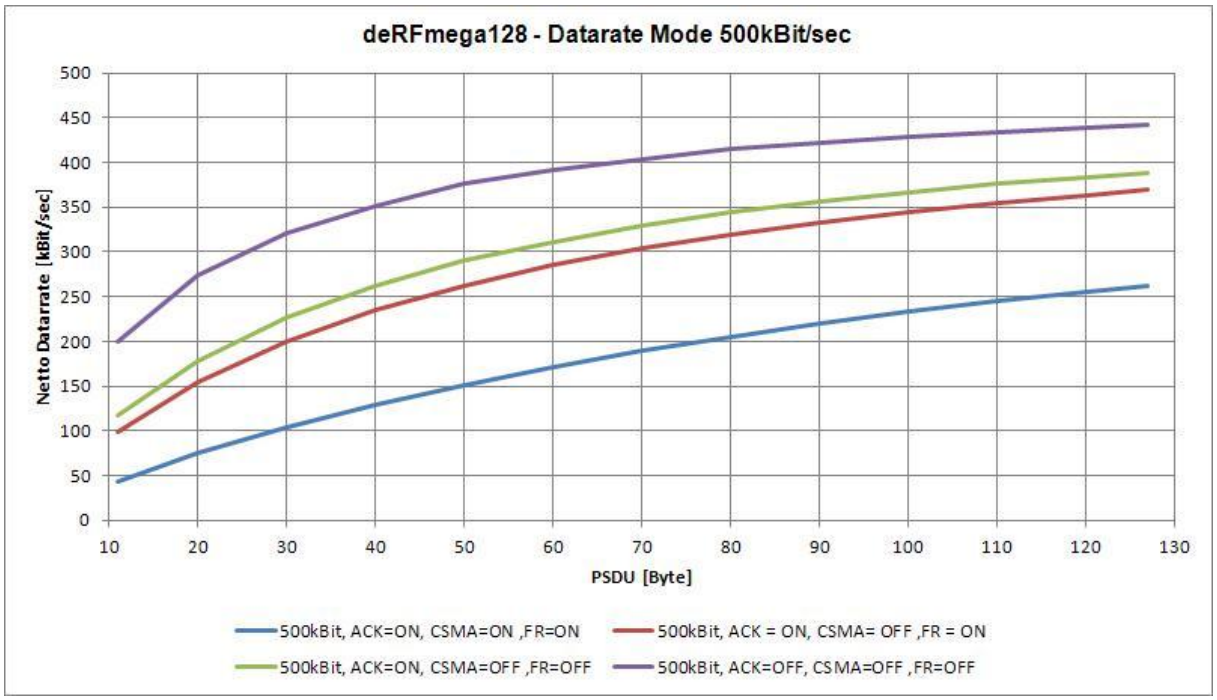


Figure 30: result datarate mode 500kBit/sec

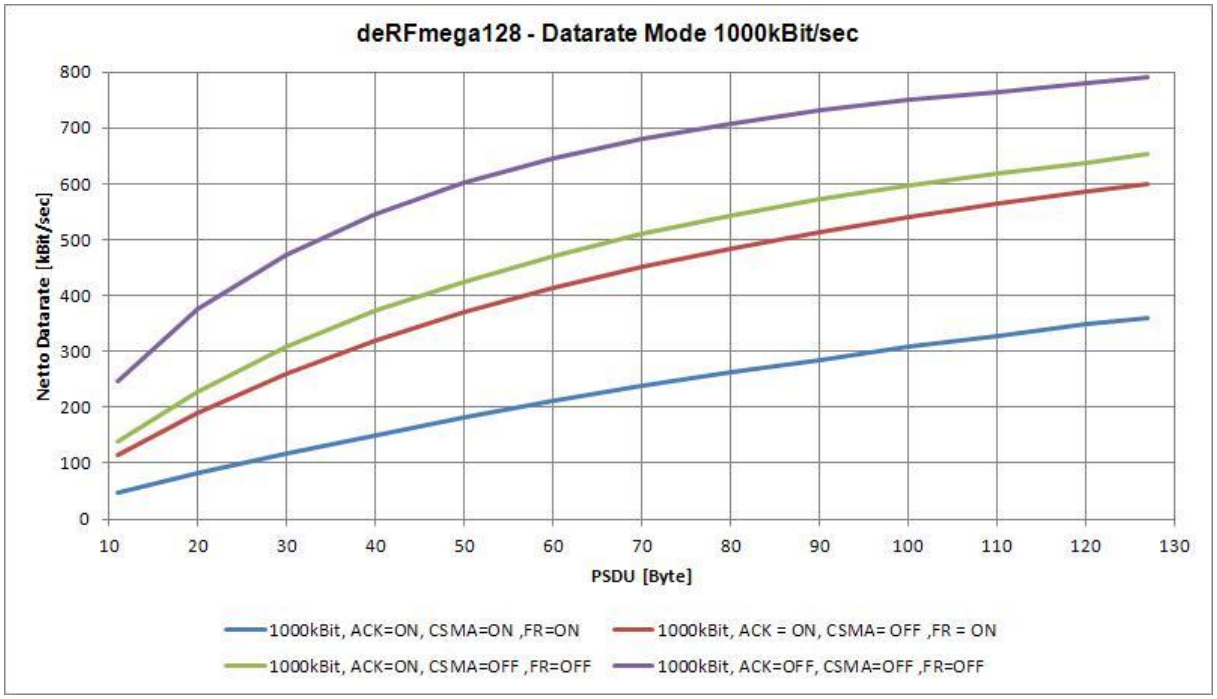


Figure 31: result datarate mode 1000kBit/sec

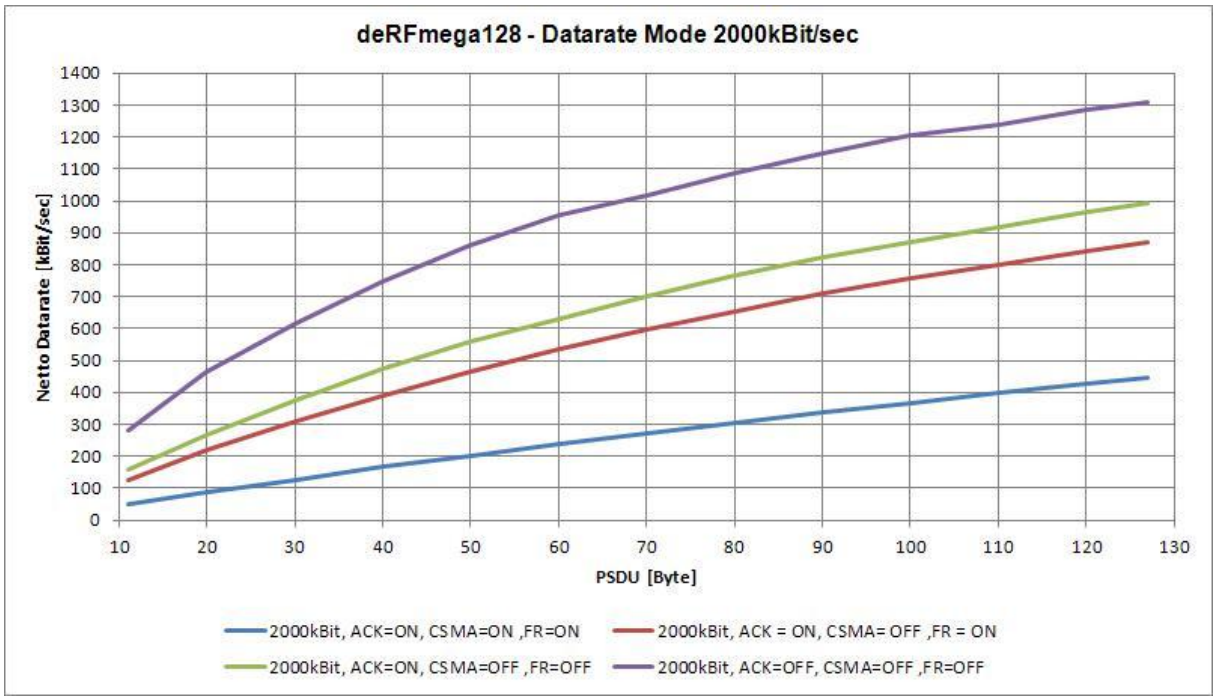


Figure 32: result datarate mode 2000kBit/sec

14. RF components

14.1. deRFmega128-22A00 / 22C00

The chip antenna on the deRFmega128-22A00 / 22C00 is matched with:

- L1 = 1,0nH (0402)
- L2 = 2,2nH (0402)

Some hints for the positioning of the radio module:

- avoid metallized environments in the near
  - ➔ mismatching of the antenna
  - ➔ decreased transmit-range
- place the module at the edge of a device

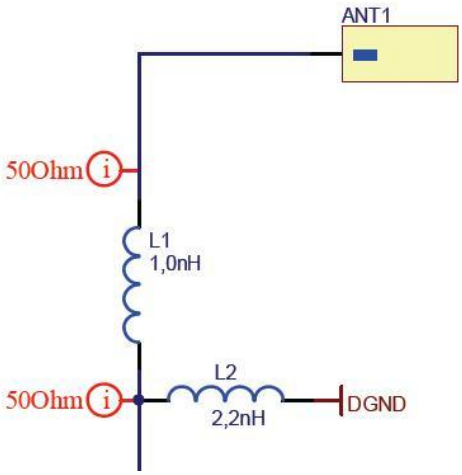


Figure 33: Matching circuit with chip-antenna

14.2. deRFmega128-22A02 / 22C02

The U.FL coaxial connector on the deRFmega128-22A02 / 22C02 is matched with:

- L2 = 1,0pF (0402)
- C19 = 22pF (0402)
- R1 = 10k (0402)

The deRFmega128-22A02 / 22C02 are suitable for applications in plastic or metal cases.

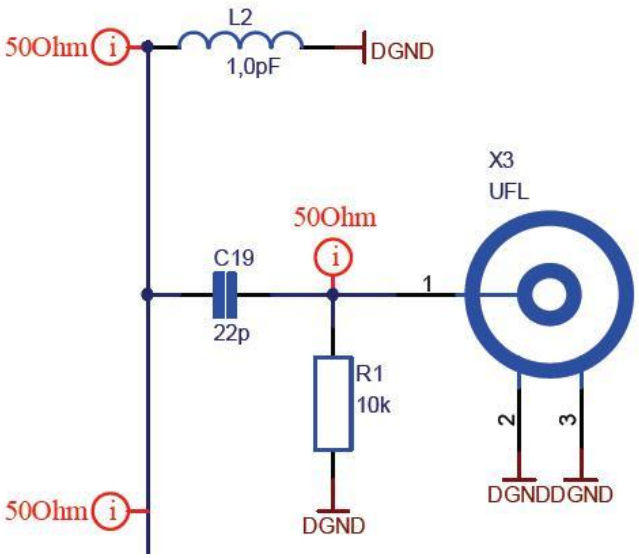


Figure 34: Matching circuit with U.FL-coaxial-connector

15. Radio Certification

15.1. United States (FCC)

The deRFmega128-22A00, deRFmega128-22C00, deRFmega128-22A02 and deRFmega128-22C02 complies with the requirements of FCC part 15.

To fulfill FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

The modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.

This exterior label can use wording such as the following. Any similar wording that expresses the same meaning may be used.

Sample label for radio module deRFmega128-22A00 and deRFmega128-22C00:

FCC-ID: XVV-MEGA22A00
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Sample label for radio module deRFmega128-22A02 and deRFmega128-22C02:

FCC-ID: XVV-MEGA22A02
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: The radio modules deRFmega-22C00 and deRFmega-22C02 fulfill a Permissive Change Class 1 regarding to FCC Section 2.1043 and complies with the requirements of FCC part 15.

To be used with the deRFmega128-22A02 module, the external antenna have been tested and approved which is specified in here below. The deRFmega128-22A02 Module may be integrated with other custom design antennas which OEM installer must authorize following the FCC 15.21 requirements.

The Original Equipment Manufacturer (OEM) must ensure that the OEM modular transmitter must be labeled with its own FCC ID number. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown below. If the FCC ID is not visible when the equipment is installed inside another device, then the outside of the device into which the equipment is installed must also display a label referring to the enclosed equipment.

This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation (FCC 15.19). The internal / external antenna(s) used for this mobile transmitter must provide

a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance. This device is approved as a mobile device with respect to RF exposure compliance, and may only be marketed to OEM installers. Use in portable exposure conditions (FCC 2.1093) requires separate equipment authorization.

Modifications not expressly approved by this company could void the user's authority to operate this equipment (FCC section 15.21).

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense (FCC section 15.105).

15.2. European Union (ETSI)

The deRFmega128-22A00, deRFmega128-22C00, deRFmega128-22A02 and deRFmega128-22C02 modules are conform for use in European Union countries.

If the deRFmega128-22A00, deRFmega128-22C00, deRFmega128-22A02 and deRFmega128-22C02 modules are incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

The manufacturer must maintain a copy of the deRFmega128-22A00, deRFmega128-22C00, deRFmega128-22A02 and deRFmega128-22C02 modules documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

The “CE“ marking must be affixed to a visible location on the OEM product. The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus
- The CE marking must be affixed visibly, legibly, and indelibly.

More detailed information about CE marking requirements you can find at "DIRECTIVE 1999/5/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" on 9 March 1999 at section 12.

15.3. Approved antennas

The deRFmega128-22A00 and deRFmega128-22C00 have an integrated chip antenna. The design is fully compliant with all regulations.

The deRFmega128-22A02 and deRFmega128-22C02 have been tested and approved for use with the antenna listed below. The module may be integrated with other custom design antennas which OEM installer must authorize with respective regulatory agencies. The used antenna was connected to the radio module with a 10cm “U.FL-to-SMA-Reverse pigtail”.

Table 9: Approved antenna(s) and accessory

Approved antenna(s) and accessory				
Part number	*Description*	*Manufacturer*	*Gain [dBi]*	*Min. Separation [cm]*
BN-023768	Dual-band antenna (2.45GHz and 5.8GHz) with Reverse-SMA-Connector, ¼ wave	Antenna Factor	+4,7	20
BN-023769	U.FL-to-SMA-Reverse pigtail, 10 cm	Hirose / Profineon	-0,37	

16. Ordering Information

The product name includes the following information:

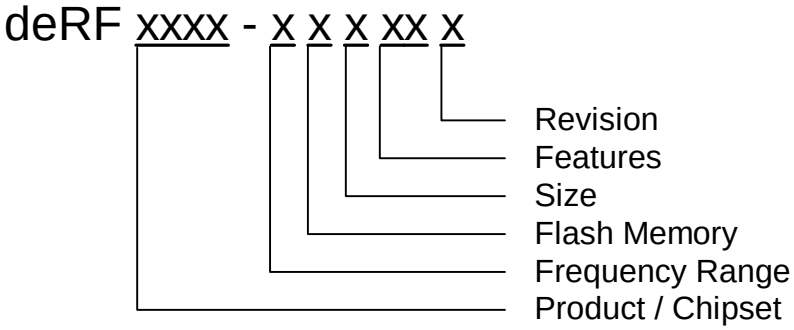


Table 10: Product name code

Product name code			
Information	*Code*	*Explanation*	*Comments*
Product / Chipset	mega128	ATmega128RFA1	radio module
Frequency range	1	780/868/915 MHz	
	2	2.4 GHz	
Flash memory	2	128 kByte	
Size	A	30 x 22.7 x 8.2 mm	pluggable
	C	30 x 20.4 x 4.1 mm	solderable
Features	00	chip antenna	onboard
	02	coaxial connector	onboard U.FL
Revision	*<blank>*	Rev 0	
	1	Rev 1	
	2	Rev 2	

Table 11: Ordering information

Ordering information		
Part number	*Product name*	*Comments*
BN-028182	deRFmega128-22A00	pluggable radio module with onboard chip antenna
BN-028498	deRFmega128-22A02	pluggable radio module with onboard U.FL coaxial connector
BN-028986	deRFmega128-22C00	solderable radio module with onboard chip antenna
BN-028987	deRFmega128-22C02	solderable radio module with onboard U.FL coaxial connector

17. Errata

17.1. Serial TWI EEPROM

Affected devices:

deRFmega128-22A001
deRFmega128-22A021

Problem:
Because of a hardware error the EEPROM, Transistor and Pull-up resistors are not assembled.

Workaround:
Fixed in revision 2.

Note:
The concerned signals PD0, PD1, PD6 can be used without problems.

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