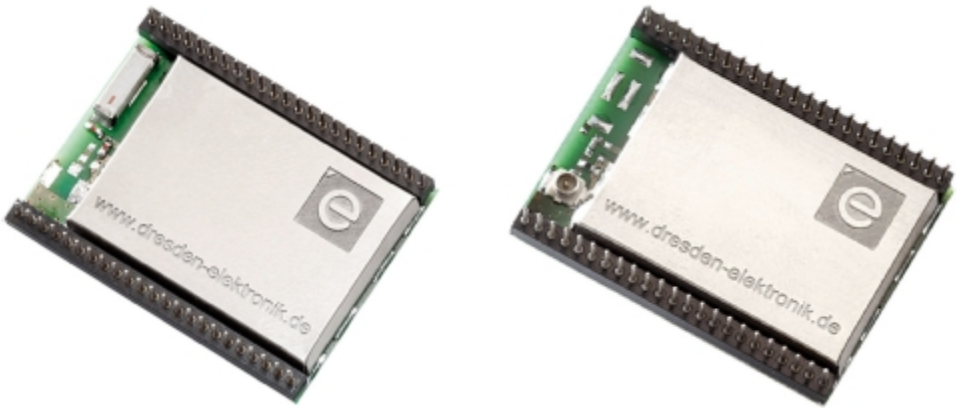
dresden elektronik

User Manual
deRFmega128-22A001
deRFmega128-22A021



Document Version V01.00

Table of contents

Document history

Date	Version	Description
2010-01-25	01.00	Initial version

Mailing list

Firm	Division / Name
DE	APA

Author / Check / Release

	Firm	Division / Name
Author	DE	Dev. / APA
Check		
release		

1. Overview

The pluggable compact radio modules deRFmega128-22A001 and deRFmega128-22A021 includes 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 module deRFmega128-22A001 are:

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

3. Features

The radio module deRFmega128-22A001 offers the following features:

- compact size: 30 x 22,7 mm
- 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 for firmware update over-the-air and/or process data storing (1Mbit, serial, TWI, onboard Pull-ups on SDA an SCL)
- Certification: CE, FCC

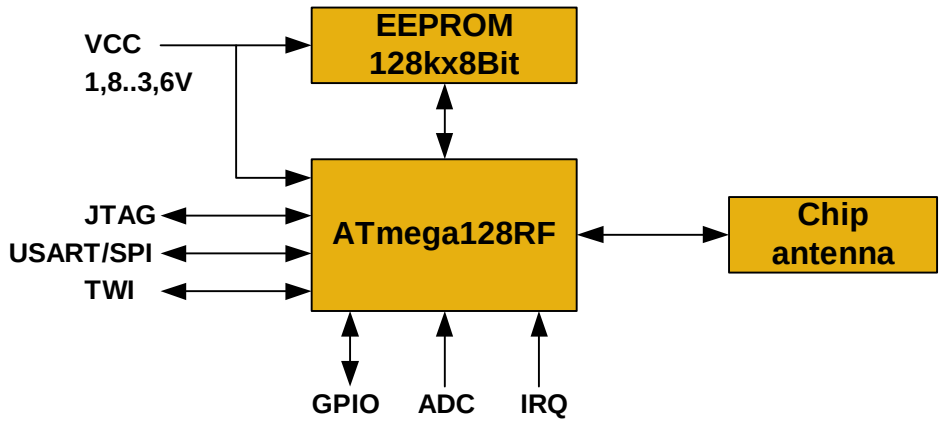


Figure 1: block diagram deRFmega128-22A001

The deRFmega128-22A021 offers the same features like the deRFmega128-22A001 except the chip antenna is replaced by a coaxial receptacle (U.FL) for connecting an external antenna.

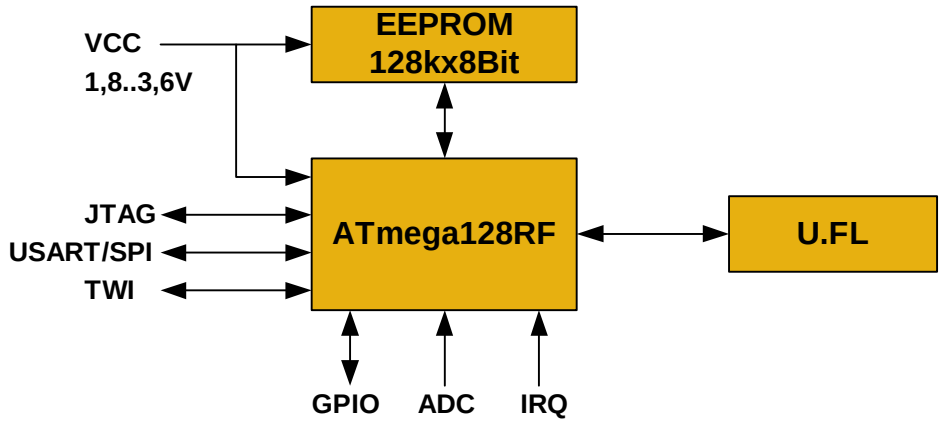


Figure 2: block diagram deRFmega128-22A021

4. Technical data

Table 1: Mechanical data

Mechanical	
Radio module	
Size (L x B)	30 x 22.7 mm
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 B x H)	29.2 x 2.5 x2.5 mm

Table 2: Temperature range

Temperature range					
		Min	*Typ*	*Max*	*Unit*
Working range	T_work	-40		+85	°C
Storage range	T_storage				°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_TXoff		5		mA
	I_Sleep		1	5	µA

Table 4: RF data

Radio (Vcc = 3,3VDC)					
	Parameter	*Min*	*Typ*	*Max*	*Unit*
Transmit power conducted	TX_PWR = 0		-0.9		dBm

5. Mechanical size

5.1. Radio module (pluggable)

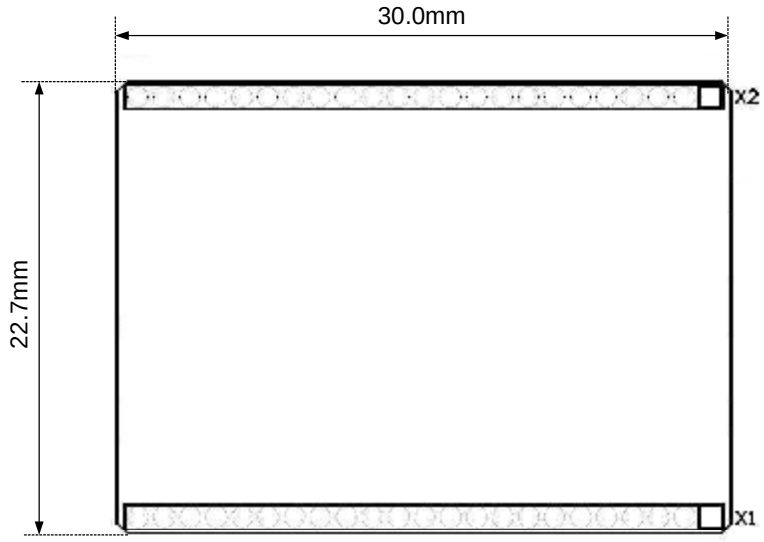


Figure 3: Size deRFmega128-22A001 and deRFmega128-22A021

5.2. Footprint receptacles

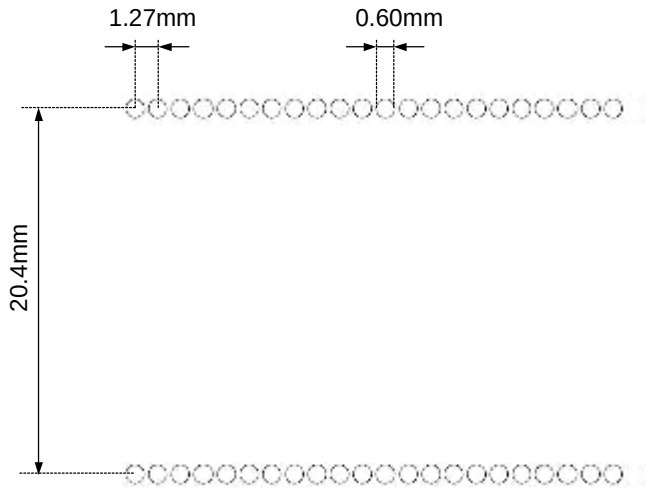


Figure 4: Footprint receptacles 1,27mm pitch

6. Pin assignment

Both pin headers provide the most important signals to the costumer: 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).

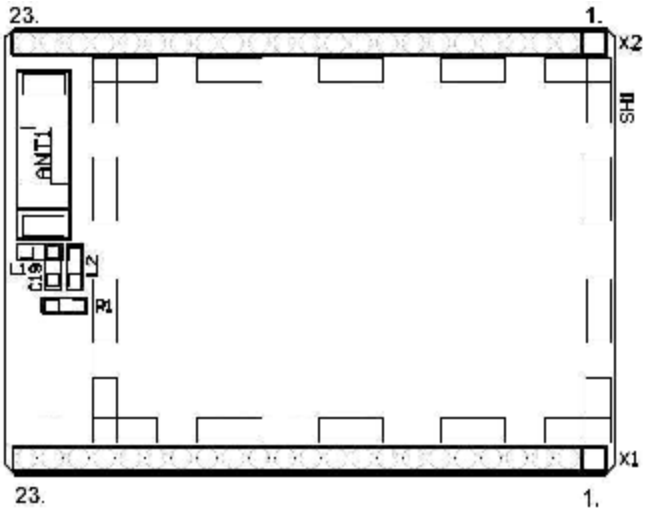


Figure 5: Top overlay deRFmega128-22A001

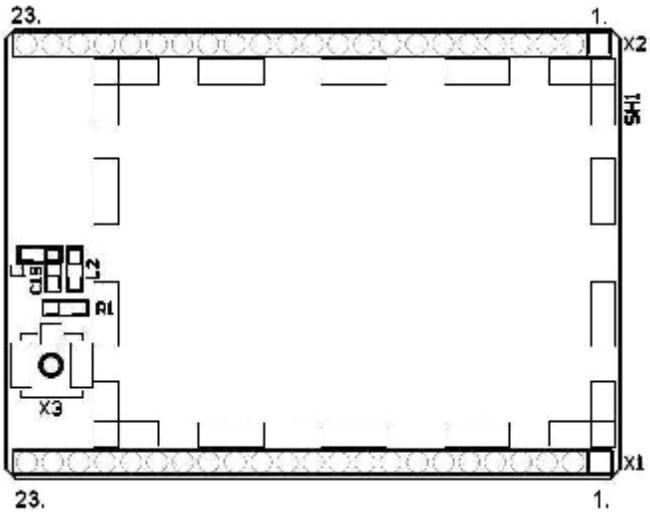


Figure 6: Top overlay deRFmega128-22A021

Table 5: Pin assignment of deRFmega128-22A001 and deRFmega128-22A021

X1		**X2**	
Pin	*µC-Port*	*Pin*	*µC-Port*
1	DGND	1	VCC
2	DGND	2	DGND
3	PB5	3	PE0
4	PB7	4	PD2
5	PB4	5	PE1
6	PB6	6	PD6
7	PB3	7	PE2
8	PB0	8	PE3
9	PB2	9	PD4
10	CLKI	10	PE4
11	PB1	11	PF0
12	PD5	12	PE5
13	PD7	13	PF1
14	PD3	14	PE6
15	PD1	15	PF4
16	PG5	16	PE7
17	PD0	17	PF5
18	PG2	18	PF2
19	RSTN	19	PF6
20	PG1	20	RSTON
21	AREF	21	PF7
22	DGND	22	DGND
23	VCC	23	DGND

Table 6: 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			

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.

Table 7: 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
TDI	Test Data In	Input		No pull-up resistor
TDO	Test Data Out	Output		
TDM	Test Mode Select	Input		No pull-up resistor
SPI Serial Programming				
PDI	Data Input			
PDO	Data Output			
Reset				
RSTN	Microcontroller Reset	I/O	Low	Pull-Up resistor
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		
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.

Signal description list (continued)

Signal name	Function	Type	Active Level	Comments
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		

7. Programming

7.1. JTAG interface

The deRFmega128-22A001 and deRFmega128-22A021 could be programmed over JTAG interface (TDI, TDO, TCK, TMS). If the JTAG-ICE mkII programmer will be used, no external pull-up resistors are necessary.

7.2. ISP interface

The deRFmega128-22A001 and deRFmega128-22A021 could be programmed over ISP interface (PDI, PDO).

7.3. Required Hardware

Dresden elektronik ingenieurtechnik gmbh offers the hardware components for a fast start-up in the Webshop. The following hardware setups are possible:

1. Option
   - (A) deRFmega128-22A001 or deRFmega128-22A021
   - (B) deRFtoRCB
   - (C) Sensor Terminal Board
   - (D) JTAG-ICE mkII or similar programmer, e.g. AVR Dragon
   - (E) RS232 Level-Shifter for debugging

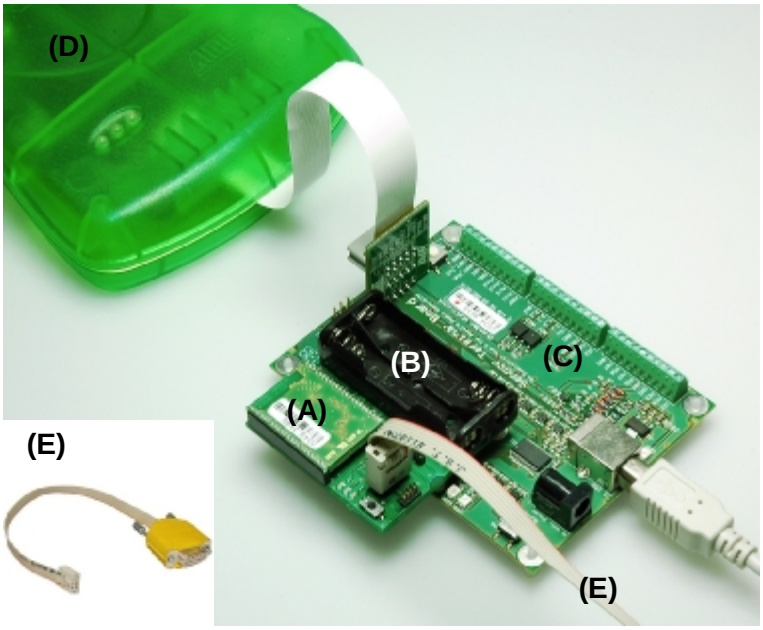


Figure 7: Programming option 1

2. option
    - (A) deRFmega128-22A001 or deRFmega128-22A021
    - (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) RS232 Level-Shifter for debugging

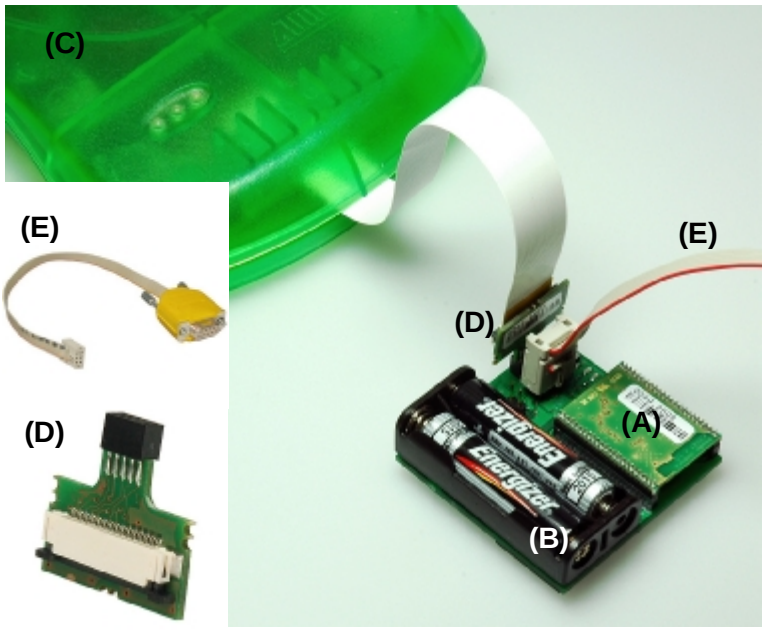


Figure 8: Programming option 2

8. Debugging and Tracing

Debugging and tracing of the radio module is possible with the deRFtoRCB adapter and the RS232-Level-Shifter. Both components were offered in the dresden elektronik ingenieurtechnik gmbh Webshop.

9. Onboard EEPROM

The deRFmega128-22A001 and deRFmega128-22A021 contains a Serial-TWI-EEPROM with a memory size of 128k x 8Bit.

The EEPROM power supply and the pull-ups will be switch on with a LOW on port pin PD6/T1. It is necessary to wait with communication on the data bus (PD1 and PD0) till the TWI interface is initialized on the ATmega128RFA1.

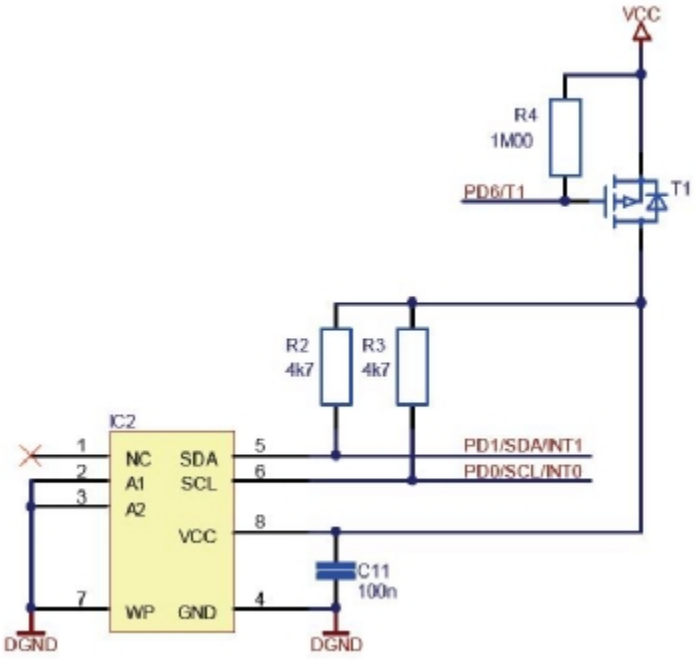


Figure 9: Schematic of EEPROM

10. RF components

10.1. deRFmega128-22A001

The chip antenna on the deRFmega128-22A001 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
  - **è** mismatching of the antenna
  - **è** decreased transmit-range
- place the module at the edge of a device

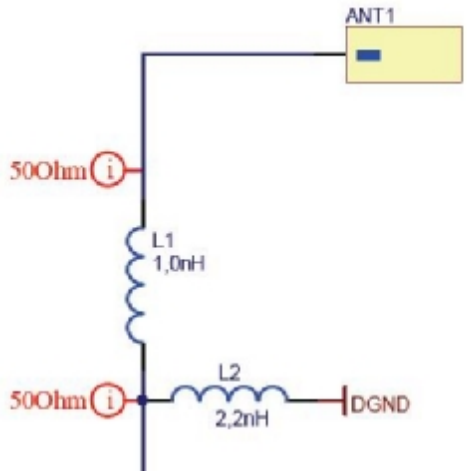


Figure 10: Matching circuit with chip-antenna

10.2. deRFmega128-22A021

The U.FL coaxial connector on the deRFmega128-22A021 is matched with:

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

The deRFmega128-22A021 is suitable for applications in plastic or metal cases.

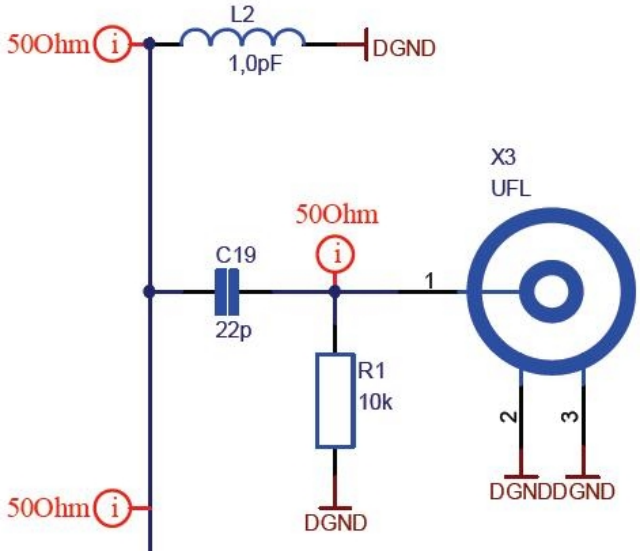


Figure 11: Matching circuit with U.FL-coaxial-connector

11. Radio Certification

11.1. United States (FCC)

The deRFmega128-22A001 and deRFmega128-22A021 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 labelled 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 deRFmega128-22A001:

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 deRFmega128-22A021:

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.

To be used with the deRFmega128-22A021 module, the external antenna have been tested and approved which is specified in here below. The deRFmega128-22A021 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).

11.2. European Union (ETSI)

The deRFmega128-22A001 and deRFmega128-22A021 Modules has been certified for use in European Union countries.

If the deRFmega128-22A001 and deRFmega128-22A021 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 deRFmega128-22A001 and deRFmega128-22A021 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.

11.3. Approved antennas

The deRFmega128-22A001 has an integrated chip antenna. The design is fully compliant with all regulations.

The deRFmega128-22A021 has 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 8: Approved antenna(s) and accessory

Approved antenna(s) and accessory				
Part number	*Description*	*Manufacturer*	*Gain [dBi]*	*Min. Separation [cm]*
23768	Dual-band antenna (2.45GHz and 5.8GHz) with Reverse-SMA-Connector, ¼ wave	Antenna Factor	+4,7	20
23769	U.FL-to-SMA-Reverse pigtail, 10 cm	Hirose / Profineon	-0,37	

12. Ordering Information

The product name includes the following information:

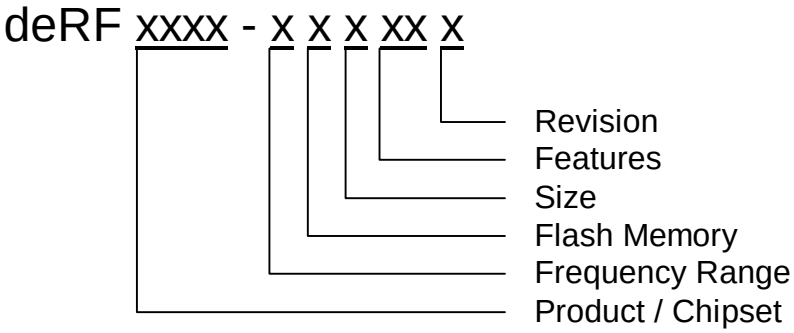


Table 9: product name code

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 mm	pluggable
Features	00	chip antenna	onboard
	02	coaxial connector	onboard U.FL
Revision	*<blank>*	Rev 0	
	1	Rev 1	

Table 10: ordering information

Ordering information		
Part number	*Product name*	*Comments*
28182	deRFmega128-22A001	pluggable radio module with onboard chip antenna
28498	deRFmega128-22A021	pluggable radio module with onboard U.FL coaxial connector

dresden elektronik ingenieurtechnik gmbh
Enno-Heidebroek-Straße 12
D-01237 Dresden

Tel. +49 351 - 31 85 00 | Fax +49 351 - 318 50 10
E-Mail wireless@dresden-elektronik.de
General manager: Dipl.-Ing. L. Pietschmann
Commercial Registry: HRB 749 Dresden Municipal Court
Tax number: 201/107/00726
Sales tax identification number: DE 140125678

Trademarks and acknowledgements

• ZigBee® is a registered trademark of the ZigBee Alliance.
• 802.15.4™ is a trademark of the Institute of Electrical and Electronics Engineers (IEEE).
These trademarks are registered by their respective owners in certain countries only. Other brands and their products are trademarks or registered trademarks of their respective holders and should be noted as such.

Disclaimer

This note is provided as-is and is subject to change without notice. Except to the extent prohibited by law, dresden elektronik ingenieurtechnik gmbh makes no express or implied warranty of any kind with regard to this guide, and specifically disclaims the implied warranties and conditions of merchantability and fitness for a particular purpose. dresden elektronik ingenieurtechnik gmbh shall not be liable for any errors or incidental or consequential damage in connection with the furnishing, performance or use of this guide.
No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use, without the written permission of dresden elektronik ingenieurtechnik gmbh.

Copyright © 2010, dresden elektronik ingenieurtechnik gmbh All rights reserved