Prettl Elektronik
Radeberg GmbH

PER1220

User Manual

Project: ***Serial Port Bluetooth Module***

Phase: Approved

Author: ***Frank Hennig/EWG.***

Status: Released

Version: ***1.0***

Key Features

- RFCOMM Module
- Complete embedded Bluetooth-Stack up to RFCOMM
- Serial Port on chip Application
- Bluetooth V1.2 qualified
- Point to point or point to multipoint functionality
- Class 2 Bluetooth device, 4 dBm
- User payload data rate is up to 380 kbps over Bluetooth
- Module Interfacing over UART
- Temperature Range qualified: - 20 °C to + 70 °C
- Mechanical outline: 25.0 mm x 21.5 mm x 2.8 mm
- Power Supply: 3.3 V DC

Description

The PER1220 is a ready to market Class 2 Bluetooth Modul Solution. It can easy implemented in any electronical device to add Bluetooth connectivity. In standard configuration the module includes an 8 Mbit Flash, a radio solution, interfaces to antenna and application together with signalling at RFComm level. The Module supports both voice and data transmissions.
Since the PER1220 is already a qualified product according to Bluetooth Specification V1.2 the requested cost and time afford for qualification is kept to a minimum.
The standard software contains a full Bluetooth Protocol Stack up to RFComm and a serial port application. For example this on-chip-application can support your cable-replacement.

Table of Contents

Acronyms and Definitions

BC Module	BlueCore Module
CTS	Clear To Send
HCI	Host Controller Interface
LC	Link Controller
LM	Link Manager
MC	Microcontroller
MCU	Microcontroller Unit
RTS	Request To Send
RxD	Receive Data
TxD	Transmit Data
HCI	Host Controller Interface
SPP	Serial Port Profile
UART	Universal Asynchronous Receiver Transmitter
SPI	Serial Periphal Interface
PCM	Pulse Code Modulation
USB	Universal Serial Bus
PIO	Parallel In-/Output
AIO	Analogue In-/Output
XTAL	BlueCore Clock
Vin	Power Supply

1 General Information

The PER1220 Module (see figure 1) is based on a Bluetooth Single Chip from Cambridge Silicon Radio with a few external components. It has various interfaces to the target hardware / application: UART, SPI, PCM, USB, PIO and AIO.

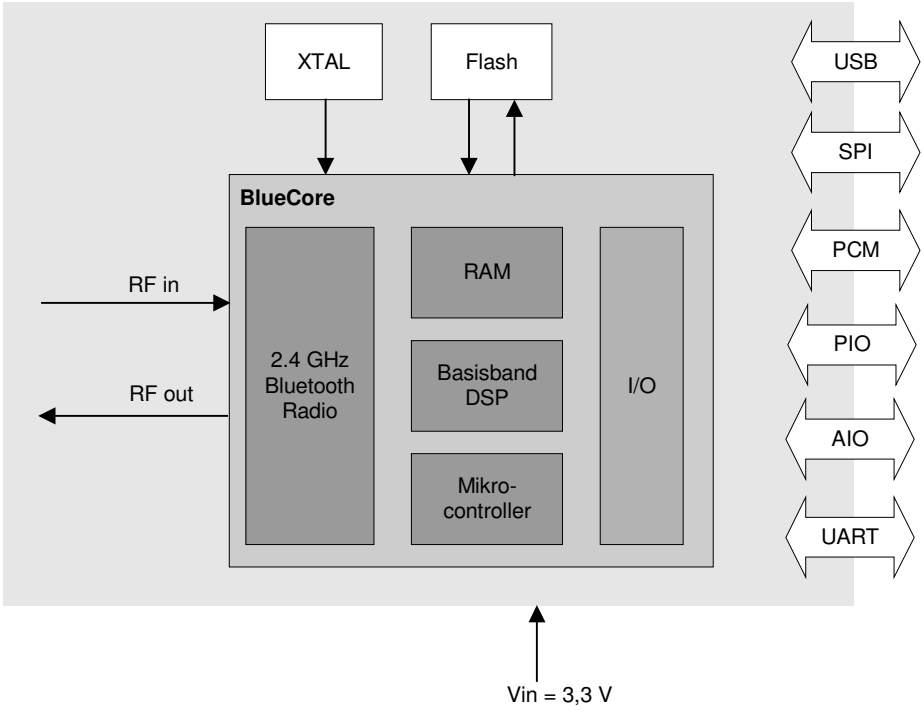


Figure 1: Overview PER1220

In standard configuration the PER1220 provides a complete Bluetooth protocol stack up to RFCOMM layer (see figure 2). It is possible to upgrade the firmware and to run an on-chip-application. This gives a true Bluetooth single chip solution (see also figure 2).

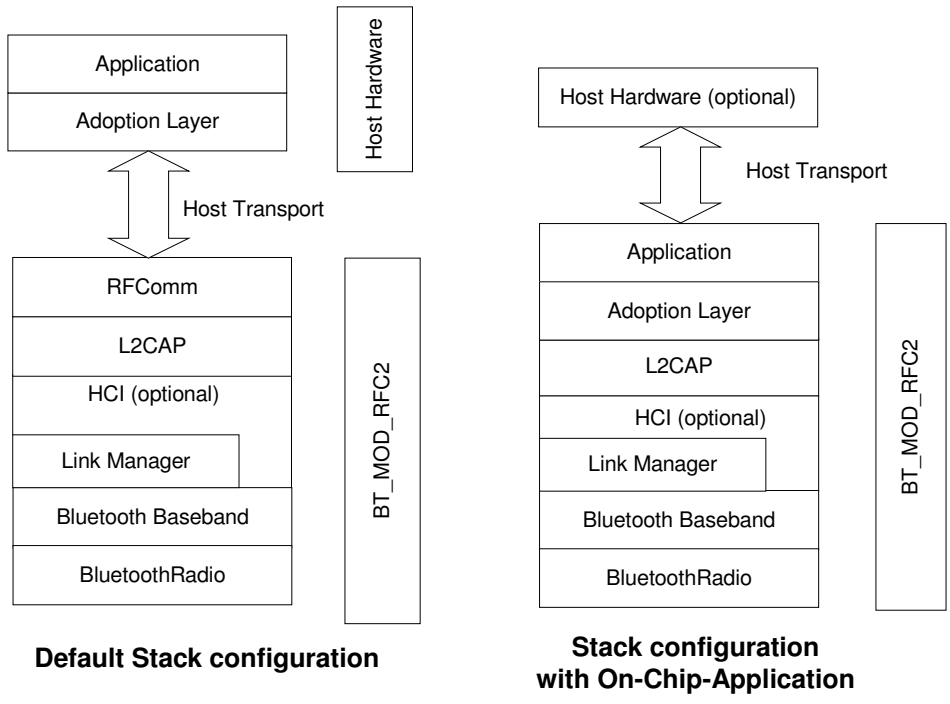


Figure 2: Firmware configurations

2 Module Pinout Diagramm

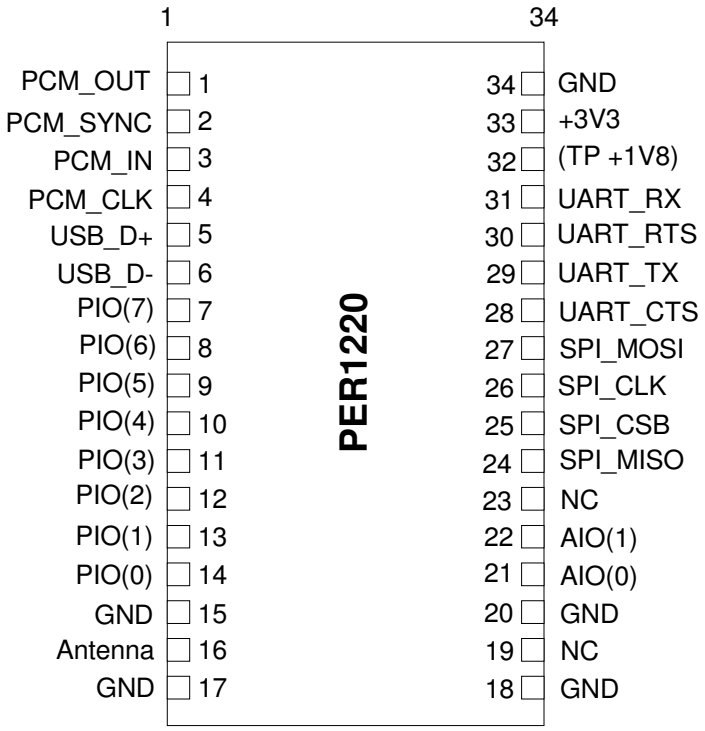


Figure 3: BT_MOD_RFC2 Pinout Diagramm

3 Device Terminal Functions

Radio and Power Supply	Pin	Padtype	Description
Antenna	16	Analogue, Z0 = 50 Ohm	RF IO
Power Supply	33	3V3	Positive power supply for PER1220

Testpoint	Pin	Padtype	Description
Testpoint	32	+1V8	VREG Testpoint

PCM Interface	Pin	Padtype	Description
PCM_Out	1	CMOS output, tristatable with weak internal pull-down	Synchronous data output
PCM_IN	3	CMOS input, tristatable with weak internal pull-down	Synchronous data input
PCM_SYNC	2	Bi-directional with weak internal pull-down	Synchronous data SYNC
PCM_CLK	4	Bi-directional with weak internal pull-down	Synchronous data clock

UART and USB	Pin	Padtype	Description
UART_TX	29	CMOS output	UART data output active high
UART_RX	31	CMOS input with weak internal pull-down	UART data input active high
UART_RTS	30	CMOS output, tristatable with weak internal pull-up	UART request to send active low
UART_CTS	28	CMOS input with internal weak pull-down	UART clear to send active low
USB_D+ (4)	5	Bi-directional	USB data plus
USB_D- (4)	6	Bi-directional	USB data minus

SPI	Pin	Padtype	Description
SPI_CSB	25	CMOS input with weak internal pull-up	Chip select for Serial Peripheral Interface active low
SPI_CLK	26	CMOS input with weak internal pull-down	Serial Peripheral Interface clock
SPI_MOSI	27	CMOS input with weak internal pull-down	Serial Peripheral Interface input
SPI_MISO	24	CMOS output, tristatable with weak internal pull-down	Serial Peripheral Interface ouput

PIO Port [2]	Pin	Padtype	Description
PIO(0)	14	Bi-directional with programmable weak internal pull-up/down	Programmable input/output line
PIO(1)	13	Bi-directional with programmable weak internal pull-up/down	Programmable input/output line
PIO(2)/USB_PULL_UP [1]	12	Bi-directional with programmable weak internal pull-up/down	PIO or USB pull-up (via 1.5kΩ resistor to USB_D+)
PIO(3)/USB_WAKE_UP/RAM_CSB [1]	11	Bi-directional with programmable weak internal pull-up/down	PIO or output goes high to wake up PC when in USB mode or external RAM chip select
PIO(4)/USB_ON [1]	10	Bi-directional with programmable weak internal pull-up/down	PIO or USB on (input senses when VBUS is high, wake BlueCore02)
PIO(5)USB_DETACH [1]	9	Bi-directional with programmable weak internal pull-up/down	PIO line or chip detaches from USB when this input is high
PIO(6)/CLK_REQ	8	Bi-directional with programmable weak internal pull-up/down	PIO line or clock request output to enable external clock for ecternal clock line
PIO(7)	7	Bi-directional with programmable weak internal pull-up/down	Programmable input/output line[1]
AIO(0)	21	Bi-directional with programmable weak internal pull-up/down	Programmable input/output line [3]
AIO(1)	22	Bi-directional with programmable weak internal pull-up/down	Programmable input/output line [3]

Notes:

[1] USB functions can be software mapped to any PIO terminal

[2] All PIO's are configured as inputs with weak pull-downs at reset.

[3] Unused AIO pins may be left unconnected

[4] If unused USB_D+ and USB_D- should be connected to ground

4 Electrical Characteristics

Absolute Maximum Ratings		
Rating	**Min**	**Max**
Storage Temperature	-20 °C	+70 °C
Supply Voltage +3V3		

Recommended Operating Conditions		
Operating Condition	**Min**	**Max**
Operating Temperature Range	-20 °C	+ 70°C
Supply Voltage +3V3	3.0 V	3.6 V

Input/Output Terminal Characteristics				
Digital Terminals	**Min**	**Typ**	**Max**	**Unit**
Input Voltage				
V_{IL} input logic level low (VDD=3.0 V)	-0,4	-	+0.8	V
(VDD=1.8 V)	-0.4	-	+0.4	V
V_{IH} input logic level high	2.31	-	3.7	V
Output Voltage				
V_{OL} output logic level low, (Io=4.0mA), VDD =3.0 V	-	-	0.2	V
V_{OL} output logic level low, (Io=4.0mA), VDD =1.8 V	-	-	0.4	V
V_{OH} output logic level high, (Io=4.0mA), VDD =3.0 V	3.1	-	-	V
V_{OH} output logic level high, (Io=4.0mA), VDD =3.0 V	2.9	-	-	V
Input and Tristate Current with:				
Strong pull-up	+100	-20	-10	µA
Strong pull-down	+10	+20	+100	µA
Weak pull-up	-5	-1	0	µA
Weak pull-down	0	+1	+5	µA
I/O pad leakage current	-1	0	+1	µA
C Input Capacitance	2.5	-	10	pF

Input/Output Terminal Characteristics (Continued)				
USB Terminals	**Min**	**Typ**	**Max**	**Unit**
Input threshold				
V_{IL} input logic level low	-	-	1.32	V
V_{IH} input logic level high (VDD_PADS=3.46 V) (2)	2.31	-	-	V
Input leakage current				
$0 < V_{IN} < 3.3$ V (1)	-1	-	1	µA
C_I Input capacitance	2.5	-	10	pF
Output levels to correctly terminated USB Cable				
V_{OL} output logic level low	0	-	0.2	V
V_{OL} output logic level high	2.8	-	3.3	V

Notes:
Current drawn into a pin is defined as positive; current supplied output of a pin is defined as negative.
(1) Internal USB pull-up disabled.
(2) 3.46 V= 3.3 V + 5 %

Input/Output Terminal Characteristics (Continued)				
Auxillary DAC, 8-Bit Resolution	**Min**	**Typ**	**Max**	**Unit**
Resolution	-	-	8	Bits
Average Output step size (1)	12.5	14.5	17.0	mV
Ouput Voltage		monotonic(1)		
Voltage Range (Io=0)	0	-	VDD_PIO	V
Current Rage	-10	-	+0.1	mA
Minimum output voltage (Io=100 µA)	0	-	0.2	V
Maximum output voltage (Io=10 mA)	VDD_PIO-0.3	-	VDD_PIO	V
High Impedance Leakage Current	-1	-	+1	µA
Offset	-220	-	+120	mV
Integral non-linearity(1)	-2	-	+2	LSB
Starting time (50pF load)	-	-	10	µs
Setting time (50pF load)	-	-	5	µs

(1) Specified for an output voltage between 0.2 V and 1.6 V

Average Power Consumption [(1)]				
Temperature = +20 °C				
Mode	**Min**	**Average**	**Max (Peak)**	**Unit**
Inquiry Scan inquiry intervall = 1.28 s inquiry window = 11.25 ms	0.065	1.3	29.1	mA
ACL link (Slave), no data transfer, sniff intervall = 0.64 s Sniff attempt = 2.5 ms sniff timeout = 2.5 ms park intervall = 1.28 s	0.065	0.342	23.2	mA
ACL link (Slave), data transfer	1.7	22.6	38.5	mA
Standby, no radio activity, UART 115.5 kbit/s, Slave	0.065	0.088	1.5	mA

Deep Sleep Leakage Current [(1)]		
Supply Voltage = 3.3 V Temperature = +20 °C		
Mode	**Value**	**Unit**
Deep Sleep	65	µA

Notes:

(1) Power Consumption is the sum of both Bluetooth Single Chip and flash (see figure 4)

These results are only correctly with firmware v16.4.4 and the on-chip application “Serial Port Profile” Slave.

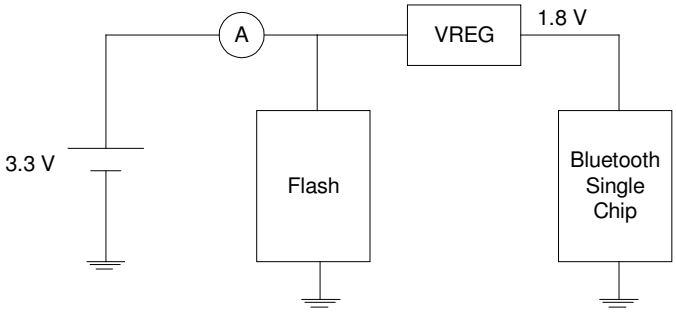


Figure 4: Power Consumption Measurement Setup

5 Radio Characteristics

The PER1220 Bluetooth Module is qualified according to Bluetooth Specification V 1.2. So its radio characteristics are equal or better as requested in the specification.

Please contact PRETTL support staff for more detailed information.

6 PER1220 Bluetooth Software Stack

PER1220 comes with a Bluetooth stack firmware running in the internal RISC microcontroller. This is compliant to the Bluetooth Specification V1.2

The Bluetooth Module software architecture includes an on chip “Serial Port Profile” application. This eliminates the need for host-side software and processing time. Therefore it is easy to implement the PER1220 in a legacy application.

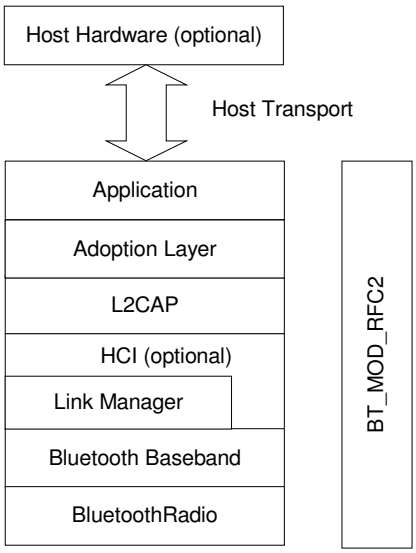


Figure 5: Stack configuration with On-Chip Application

This firmware requires no host processor. All software layers, including application software, run on the internal RISC processor in a protected user software execution code environment.

6.1 Key Features

Interfaces to Host

- RFCOMM, an RS-232 serial cable emulation protocol
- SDP, a service database look-up protocol

Connectivity

- Maximum number of active slaves: 3
- Maximum number of simultaneous active ACL connections: 3
- Maximum number of simultaneous active SCO connections: 3

- Data Rate up to 380 kbit/s

Security
- Full support for all Bluetooth security features up to and including strong (128-bit) encryption

Power Saving
- Full support for all Bluetooth power saving modes (Park, Sniff and Hold)
- System Power saving modes (Deep Sleep, Shallow Sleep)

Data Integrity
- Channel Quality Driven Data Rate (CQDDR) increases the effective data rate in noisy environments
- Receiver Signal Strength Indicator (RSSI) used to minimise interference to other radio using ISM band

7 Device Terminal Description

7.1 Antenna

- 2.4 GHz Antenna (Z_0 = 50 Ohm)
- Min. 100 MHz Bandwidth
- Temperature range: -20 °C to + 70 °C
- A ceramic antenna requires a copper free area in all PCB layers
- Antenna gain: 0 dBi (If your antenna uses another antenna gain, you must do your own FCC approval)

This antenna gain is mandatory for the FCC limited modular approval. See Chapter 12 “Regulatory Statements”.

7.2 UART Interface

PER1220 Universal Asynchronous Receiver Transmitter (UART) interface provides a simple mechanism for communicating with other serial devices using the RS232 Standard [(1)].

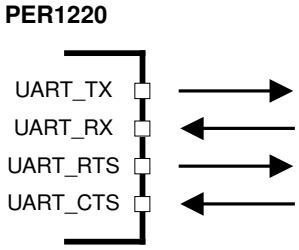


Figure 6: Universal Asynchronous Receiver Transmitter

Four signals are used to implement the UART Function as shown in figure 6. When PER1220 is connected to another digital device UART_RX and UART_TX transfer data between the two devices. The remaining two signals UART_CTS and UART_RTS can be used to implement RS232 hardware flow control. Where both are active low indicators. All UART connections are implemented using CMOS technology and have signalling levels of 0 V and 3.3 V.

UART configuration parameters, such baud rate and packet format, can optionally set

Note:
(1) Uses RS232 Protocol, but voltage levels are 0 V to 3.3 V (requires external RS232 transceiver IC)

Parameter		Possible Values
Baud Rate	Minimum	1200 Baud (<= 2% Error)
		9600 Baud (<= 1% Error)
	Maximum	1.5 Mbaud (<= 1% Error)
Flow Control		RTS/CTS or none
Parity		None, odd, even
Stop Bit		1 or 2
Bits per channel		8

The UART interface is cabable of resetting the PER1220 upon reception of a break signal (see figure 8). A break is identified by a continuos logic low on the RX terminal, as shown in figure. If t_{brk} is longer than the value, defined as manufacture setting, a reset will occur.

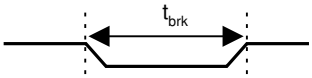


Figure 8: UART Break Signal

7.3 USB Interface

PER1220 contain a full speed (12 Mbit/s) USB interface, capable of driving a USB cable directly. No external USB transceiver is required. The device operates as a USB peripheral, responding to requests from a master host controller such a PC. Both the OHCI and the UHCI standards are supported. The set of USB endpoints implemented behave as a specified in the USB section of the Bluetooth Specification V1.2, part H2.

As USB is a master-slave oriented system, PER1220 only supports USB slave operation.

For more details, please contact PRETTL® Support.

7.4 Serial Peripheral Interface

PER1220 holds the firmware and the persistent store in a flash. It can be read/write by the SPI. Normally, this will be done by PRETTL®. Ask for more details

7.5 PCM

Pulse Code Modulation (PCM) is the standard method used to digitise human voice patterns for transmission over digital communication channels. Through it's PCM interface, PER1220 has hardware support for continual transmission and reception of PCM data, thus reducing processor overhead for wireless headset applications. PER1220 offers a bi-directional digital audio interface that routes directly into the Baseband layer to the on-chip firmware. It does not pass through the HCI protocol layer.

Hardware on PER1220 allows the data to be sent and received from a SCO connection.

Up to three SCO connections can be supported by the PCM interface at any one time. (1)

PER1220 can operate as the PCM interface Master generating an output clock of 128, 256 or 512 kHz. When configured as PCM interface slave it can operate with an input clock up to 2048 kHz. PER1220 is compatible with a variety of clock formats, including Long Frame Sync, Short Frame Sync and GCI timing environments.

It support 13- or 16-bit-linear, 8-bit-µ-law or A-law companded sample formats at 8 ksamples/s and can receive and transmit on any selection of three of the first four slots following PCM_SYNC. The PCM configuration options are enabled by setting a Persistent Store Key.

PER1220 interfaces directly to PCM devices includes the following:

- Qualcomm MSM 3000 series and MSM 5000 series CDMA Baseband devices
- OKI MSM7705 four channel A-law and µ-law CODEC
- Motorola MC145481 8-bit-A-law and µ-law CODEC
- Motorola MC145483 13-bit-A-law and µ-law CODEC

PER1220 is also compatible with Motorola SSi™ Interface

Ask for PER1220 that includes the Audio CODEC.

Note:
(1) Subject to firmware support, contact PRETTL for details

7.6 PIO

The Parallel Input Output (PIO) Port is a general purpose I/O interface to PER1220. The port consists of 8 programmable, bi-directional lines, PIO[7,0]

Programmable I/O lines can be accessed either via an embedded application running on PER1220 or via private channel.

8 Typical Radio Performance

The PER1220 Bluetooth Module operates according to the Bluetooth Specification Version 1.2.

Please contact PRETTL support staff for more information.

9 Recommended Solder Profile

Detailed handling requirements for manufacturing: see IPC A 610 class 2.

Required soldering profile:

For any application the pre-qualified module PER1220 should be surface mounted to any kind of a solid motherboard.

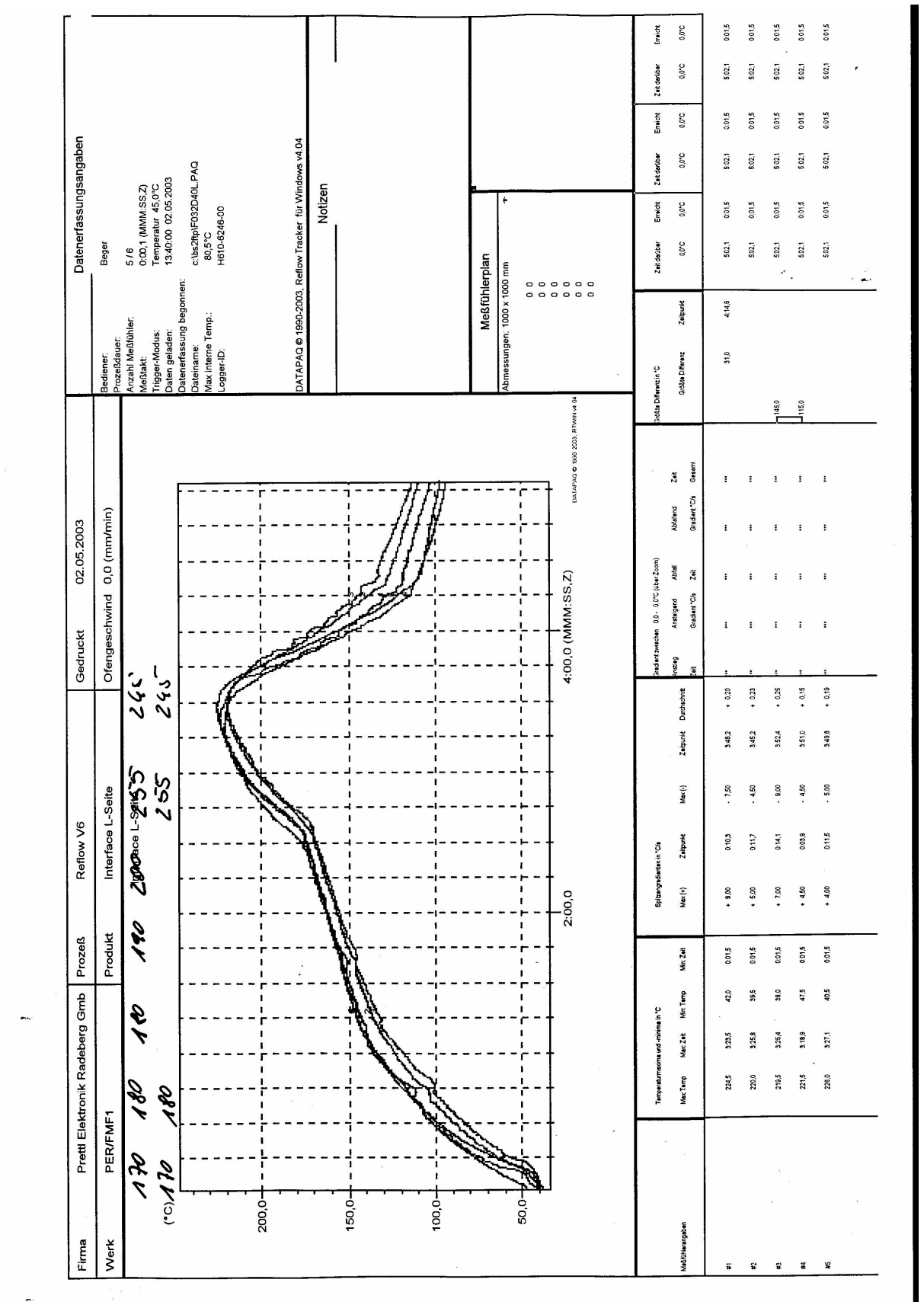
The pinout of the module is optimized for a standard FR4 pcb with NiAu plating.

Profile specification in case of manual soldering:

- Nominal temperature: 340°C
- Heat duration per pin: 6s (max)
- solder: Sn 60 Pb 38 Cu Typ C 3,5%

Profile specification in case of double reflow soldering:

- The reflow process has to be compliant to our process specification **Reflow V6** (parameters see below)**.**



10 Installation

This guide describes the installation of the PER1220 in a target PCB. They are mandatory to be conform to the FCC limited modular approval.

10.1 Antenna

- The antenna must be mounted on a cupper area as you can see in figure 1
- A 50 Ohm microstrip wire is used for connecting it to the PER1220
- Antenna type: Phycomp 4313-115-00245 (Multilayer Ceramic Antenna)
  Characteristics:

Description	Value
Center frequency	2.45, 260 and 2,70 GHz
Bandwith	100 MHz
Gain	0 dBi max.
VSWR	2 max.
Polarization	Linear
Azimuth beamwidth	Omni-directional
Impedance	50 Ohm
Power dissipation	1 W
Operatin temperature	-55 to + 125 °C
Terminations	NiSn
Resistance to soldering heat	260 °C for 10s
Weight	0.16 g

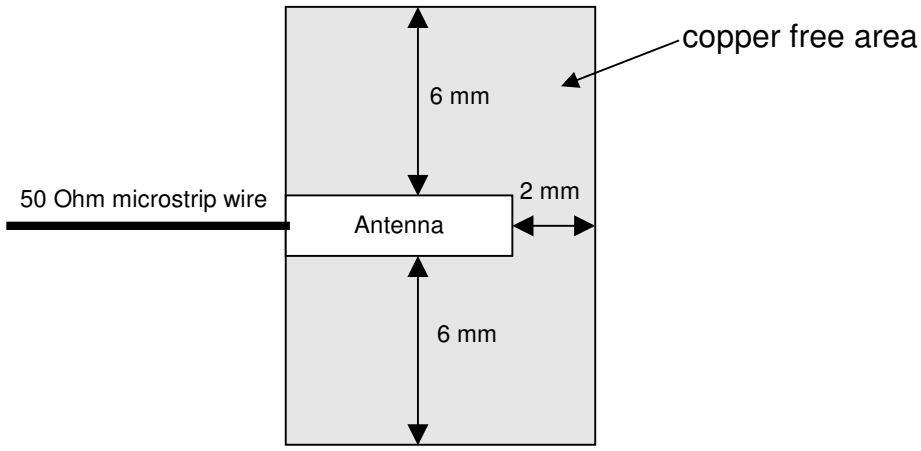


Figure 1: Mounting the antenna on the PCB

10.2 Power Supply

PER1220 needs an external power supply:

- stabilized 3.3 Volt DC (± 10%)
- max. current consumption 100 mA, peak: 120 mA
-

There are two different voltage rails inside the PER1220. One section of the module is directly powered with 3.3 Volt input voltage. The other section is powered with 1.8 Volt. Therefore the PER1220 includes a 1.8 V voltage regulator.

10.3 Interfaces

- The PER1220 uses 3.3 Volt CMOS Logic.

10.4 FCC Conformance

- The FCC conformance is achieved with these instructions.
- The endproduct must be labeled with the following information.
  - FCC-ID
  - FCC Logo
- This label must be displayed outside of the end product.

11 Ordering and Contact Information

Order code: tbd

Prettl Elektronik Radeberg GmbH
Customer Support CST 2
Robert-Bosch-Strasse 10
D-01454 Radeberg
Germany

info.prettl-elektronik@prettl.com
www.prettl-elektronik.de

12 Regulatory Statements

The PER1220 Bluetooth module has to be implemented and used according to technical description/specification provided by PRETTL®.
This Bluetooth module is intended to use in all States where the Bluetooth™ technology and the used frequency band is released.

The PER1220 Bluetooth module is conform to the following specifications/standards:

Parts of:

- FCC Part 15
- EN 300 328-1

Bluetooth Qualification Test Report (foto einfügen):

12.1 FCC Statements

The PER1220 is certified according FCC Part 15. This is a limited modular approval. Therefore you must comply with the following instructions. If not, you have to do your own FCC approval for your endproduct.

The chapter “Installation” describes these instructions.

RF Exposure

This device and its antenna must not be co-located or operating in conjunction with any other antenna or transmitter.

Label requirements

The modular transmitter is 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: „Contains Transmitter Module FCC ID: TJXPER1220“ or „Contains FCC ID: TJXPER1220.”

Statement according to FCC part 15.19

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.

Statement according to FCC part 15.21

Modifications not expressly approved by this company could void the user's authority to operate the equipment.

For a Class A digital device

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.

13 Document References

- Bluetooth Specification Version 1.2
- Universal Serial Bus Specification Version 1.1 (September 1998)

14 Record of Changes

Date	Version	Reason for Change
2005-07-29	1.0	- first issue