Manual
Evaluation-Board for
PAN4551 Wireless Module

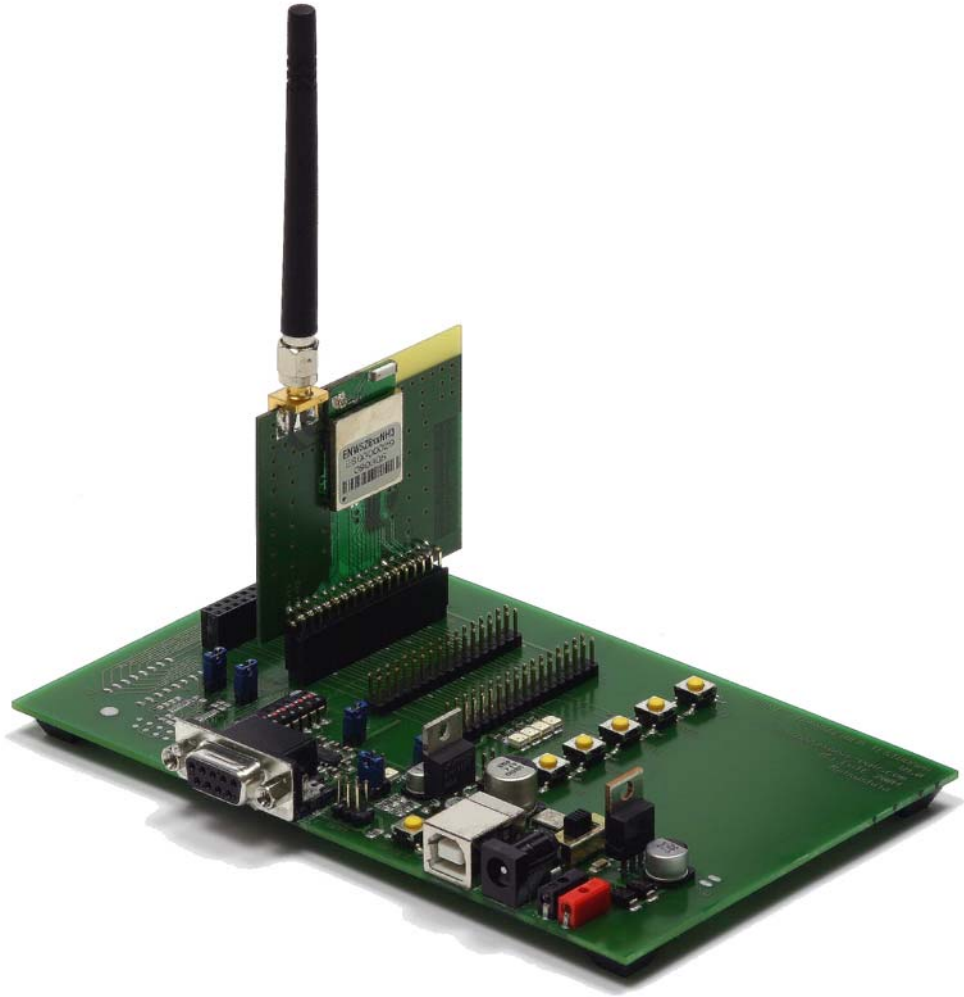

FIGURE 1 ISM RF TRANSCEIVER TESTBOARD WITH PAN4551 AND ANTENNA

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1. OVERVIEW

The EvalKit PAN4551 allows quick and versatile evaluations of the of the wireless module PAN4551. As a Z.Stack application example a serial cable replacement can easily be established by connecting the evalboards to the UART interfaces of your computers.

1.1. CONTENTS OF THE EVALUATION KIT:

- 2 x ISM RF Transceiver Testboards
- 2 x PAN4551 mounted on a carrierboard
- 2 x 2,45GHz antennas with male SMA plugs
- 2 x RS-232 cables
- 2 x battery adaptors with cable for d. c. power supply
- 1 x CD with software and documentation

1.2. HARDWARE NEEDED

- 12 x Batteries (AA size)
- PC with at least 1 (preferably 2) free COM Ports
- a Flashing Device for the MC9S08GT60 (Recommended: P&E USB HCS08/HCS12 Multilink adapter USB-ML-12 available through http://www.pemicro.com/)

1.3. SOFTWARE NEEDED

- Microsoft "Hyper Terminal" or any other terminal software
- Software Flash Utility (depending on Hardware Flasher; Recommended: Software for the P&E USB HCS08/HCS12 Multilink adapter USB-ML-12: progHCS08_install.exe on the Evalboard CD)
- Freescale TestTool from the Freescale ZigBee Evaluation Kit CD (available from http://www.freescale.com/ZigBee)

Important: To install and run the programs you need Administrator rights on the test PC

2. SETTING UP THE EVALBOARD

Plug a PAN4551 Carrierboard on one of the three 34-pins headers B,C or D as shown in Figures 1 and 2. Please take care that pin 1 of the Carrierboard connects to pin1 of the testboard according to the "1" marking on the PCBs.

Important: Only 1 PAN4551 carrierboard may be plugged on the testboard.

The other 34-pin headers/sockets are provided for demo application boards like sensors, actuators, etc. On slot A a socket is mounted instead of double pin rows for applications using a plug with pins. For details on the testboard see chapter 3 and the testboard schematic in chapter 10.

Mount the 50Ohms 2,4GHz antenna with SMA male plug on the PAN4551 SMA socket.

Set the +2,7Vdc supply jumper to the corresponding 2-pin header B-C-D.
Instead of a jumper an amperemeter for measuring the module current on VCC can be connected.

Remark: In case of inserting an amperemeter the voltage drop at the amperemeters internal resistor reduces the Vcc voltage applied to PAN4551 depending on the current drawn. Thus check if the amperemeter used has an internal resistance of sufficiently low value.

In addition to a default +2,7Vdc Vcc supply a +5Vdc regulated voltage is available on the headers (this does not apply to usage of USB as power supply) which could be useful for application boards needing a higher supply voltage (i.e. with white LEDs). +5Vdc on the headers must be activated by setting JP2.

Important: Do not connect the +5Vdc to PAN4551 directly.

The total available current from Vcc plus the current from +5Vdc is approximately 270mA maximum, provided that the power source voltage applied to P1-P2-P3 does not drop below approximately 6,6Vdc.

For the location of switches and jumpers on the Evaluation board see chapter 3.

3. TESTBOARD LAYOUT

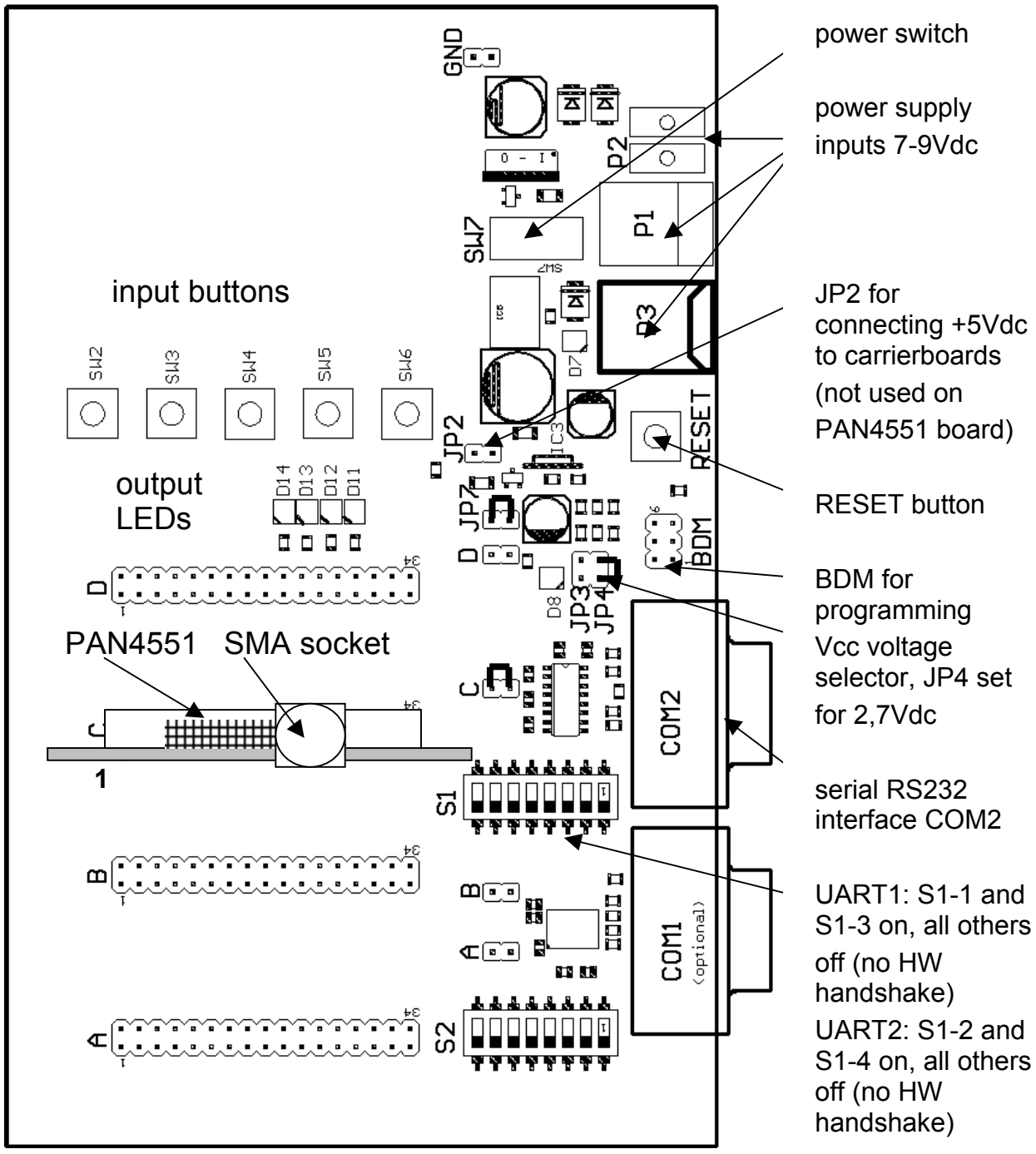


Figure 2 ISM RF Transceiver testboard with PAN4551 and antenna

4. OPERATION OF THE TESTBOARD

If not already done please follow the basic setting up instructions as in Chapter 2

Check if the jumper plugs are set as indicated in Figure 2. The functions of the jumpers are as follows:

jumper name	function	to set as in Figure 2
A	Vcc for module in Slot A*	do not care
B	Vcc for module in Slot B*	do not care
C	Vcc for module in Slot C*	yes
D	Vcc for module in Slot D*	do not care
JP2	5Vdc feed to Slots A, B, C, D**	no
JP3	Vcc setting 2.1-2.7-3.4V; see Table 2	no for Vcc=2.7Vdc default
JP4	Vcc setting 2.1-2.7-3.4V; see Table 2	yes for Vcc=2.7Vdc default
JP7	Vcc regulator output feed to A, B, C, D	yes

(Table 1)

* An amperemeter for measuring module current can be inserted instead of the jumper
** +5Vdc supply (independent on JP3 and JP4 settings) option is provided for application demos. It is not used on PAN4551 carrierboard.

Check if the port switches S1 near to the COM2 connector for RS232 are all set to off position except the selected UART as noted in Figure 2/Table 3.

5. POWER SUPPLY

5.1. D.C. POWER FROM A POWER SUPPLY

Set the power switch SW7 to the position 2 = off.
Connect a power supply with 7-9VDC to one of the power inputs (P1 or P2).

In case of P1 use a plug with 5,5mm diameter and the positive terminal at the centre contact.

For use of the P2, 2mm contacts the black socket P2-X1 is the negative/ground contact and the red socket P2-X2 is the positive terminal.

A linear regulator on the testboard regulates the input voltage down to the +5V DC board supply. A second linear regulator regulates the +5V DC down to the module VCC supply of 2,1/2,7/3,4Vdc

5.2. D.C. POWER FROM A USB DEVICE:

In case no dedicated supply is available, DC supply can be taken from an USB connection. The +5V DC from the USB feeds the linear regulator for the modules VCC supply of 2,1/2,7/3,4Vdc (see table 1).

Please note that communication via the USB connector is **not** possible.

Please take into account that when using the +5V DC feed to the 34-pin-headers in combination with USB power supply the voltage is not +5V but unregulated 4.3 V DC due to the voltage drop at a protection diode connected in series on the testboard.

Warning: Do not overload the USB power source. Check for the current available from your USB device in order to avoid malfunction of or damage to your USB power source.

5.3. POWER ON

Set SW7 to the position 1 = on. (With power from USB position 1 is off and position 2 is on). D7 should be lit indicating that +5Vdc supply is available on the testboard. D8 should be lit indicating that the regulated Vcc module supply is available.

The dc regulator output voltage is set with a jumper on JP3 or JP4 as follows:

jumper on 2-pin header	regulator output voltage VCC	remarks
JP4 only	2,7 Vdc	typical for PAN4551
JP3 only	3,4 Vdc	maximum for PAN4551
no jumpers	2,1 Vdc	minimum for PAN4551

(Table 2)

6. SERIAL PORTS

The evalboard is equipped with a serial port connector (COM2). The COM port can be linked to either UART1 (SCI1) or UART2 (SCI2) on the module. This is done with the S1 switch, which has to be set as follows:

UART1 active	1	2	3	4	5	6	7	8
SW1 settings	**on**	off	**on**	off	off	off	off	off
UART2 active	1	2	3	4	5	6	7	8
SW1 settings	off	**on**	off	**on**	off	off	off	off

(Table 3)

7. RESET

Reset of the testboard and the boards at A,B,C or D can be done with the button named "RESET" next to the USB socket.

8. BDM CONNECTOR

Reprogramming of PAN4551 can be done via the on-board BDM connector.
For programming, the P&E USB HCS08/HCS12 Multilink adapter USB-ML-12 available through http://www.pemicro.com/ is recommended, but any programmer capable of flashing the MC9S08GT60 Controller on the Module can be used.
The 6-pin BDM header has the same pinning as the Multilink adapter cable and is located between the reset switch and the COM2 Connector.
Please make sure that pin1 of the plug connects to pin1 of the header. The correct device selection for PAN4551 is a Motorola MC9S08GT60.

8.1. FLASHING INSTRUCTIONS

1. Download and install the required Software (see chapter 1.3)
2. Connect the flashing Device to the EvalBoard (see chapter 8)
3. Check the UART selection (1 or 2) on the Board, depending on the Software you are going to use (as described in Table 3)
4. Power on the Board with the programming Device attached to it
5. Start the HCS08 Flash Programmer (or a similar Flash Utility)
6. If you use the HCS08 Flash Programmer choose the Interface and the Port the P&E USB HCS08/HCS12 Multilink adapter are plugged in
7. Select the 9S08GT60.S8P Algorithm to be used
8. wait for the Flashing Utility to become ready
9. Erase the PAN4551 memories
10. Select the "embedded_bootloader.s19" file from the Evalboard CD
11. Choose "program" to flash it into the PAN4551
12. Wait for completion of the programming algorithm
13. After removing the BDM connector reset the Testboard. All LEDs should be lit now
14. Start the Freescale TestTool
15. Select Tools / Communication Settings / Add Internal with the COM Port you have the Board connected to and as Baudrate choose 19200, then close the Window
16. Now select View / Embedded Bootloader and choose the COM Port you want to use
17. Select the Software you want to test and press the Upload Button to flash it to the Board
18. wait for the Upload / Flashing to be finished
19. Reset the Board
20. The Board is now ready to be tested with the programmed Software

9. FREESCALE ZIGBEE IMPLEMENTATION

9.1. DEVELOPMENT OF APPLICATIONS WITH Z-STACK

For ZigBee™ applications the latest Zigbee Stack (Z-Stack) is available from our partner Freescale Inc. by registration at www.freescale.com/zigbee . The upcoming version 1.0 of Z-Stack is offered as a 90-days evaluation version. After this period the use of Z-Stack requires a fee paid to Freescale Inc.. The shipping of products which use ZigBee™ technology requires a membership of the ZigBee™ Alliance (www.zigbee.org), at least as an adopter member, and is mandatory for the ZigBee™ product certification procedure and use of the ZigBee™ Logo.

As Integrated Development Environment (IDE) the Metrowerks™ CodeWarrior IDE from www.metrowerks.com is required.

As device flash programmer the USB HCS08/HCS12 Multilink from www.pemicro.com is recommended.

Important: PAN4551 is based on the the freescale evaluation board MC13192(3)-EVB design, but includes some modifications for optimized RF performance. For compatibility with PAN4551 the Z-Stack and the applications have to be compiled for the freescale DIG-536 target.

Compiled versions of the available Z-Stack applications ready for flash programming of the modules are included on the CD in the Z-Stack_V0.92/Binaries folder. Furthermore, if you want to compile new applications with the 0.92 Z-Stack you have to exchange two files to establish compatibility. Please see the the document "Porting_to_Pan4551.pdf" on the Evalkit CD in the Documentation folder for details on this modification. Please note that for the upcoming 1.0 Z-Stack no modifications will be necessary.

The prices and fees as known from today are as follows:

1. IDE CodeWarrior order number CWS-H08-C64K-CX from www.metrowerks.com : US$ 995,-.

2. USB HCS08/HCS12 Multilink (www.pemicro.com), orderable at www.freescale.com/zigbee

   with the ID USBMULTILINKBDM: US$ 99,-
3. Z-Stack: The support fee after a 30 days period free of charge required by Freescale Inc. is US$ 999,-.

4. Companies selling products using ZigBee™ technology have to be a member of the ZigBee™ Alliance (www.zigbee.org). The minimum fee per year for a membership as adopter is US$ 3500,-.

5. For adopter members the fee for listing the first product at (www.zigbee.org) is US$ 1000,-.

6. The cost of a ZigBee™ product certification at a testhouse (TÜV Rheinland) ranges from approximately US$ 4000,- to US$ 8000,-, depending on the implemented software.

9.2. Z-STACK WIRELESS UART DEMO

The default program flashed onto the PAN4551 is "wireless UART", an application available within the Z-Stack from Freescale. Details for the operation of the wireless UART demo are described in the document *Z-Stack SerialApp Programmer's Guide* in the *Figure8Wireless* documentation Folder. In short the following steps have to be done:

1. Make sure **UART1** is selected on the Evalboards as described in Table 3 (S1-SW1 and S1-SW3 ON, others off)
2. Per default the corresponding S19-Files are already flashed into the modules. *If not*, you can find them in the Z_Stack/Binaries/SerialApp folder on the Evalboard CD. Please flash them into two modules, one with Coordinator, one with Router functionality. (as described in chapter 8.1)
3. After Powerup:
4. If D11 is lit on either device, the extended address has to be set by pressing SW4 twice. This step can be skipped, if D13 is already lit.
5. D13 should now be lit on both devices. Now press SW3 (Auto-Bind request) on both devices. This establishes a connection between both devices.
6. D14 should be lit on both devices after a few seconds to indicate successful binding.
7. Set the COM ports on the PCs to 38400 Baud, 8n1, hardware handshake off
8. All serial data is now tunneled through a Zigbee-link between both PCs.

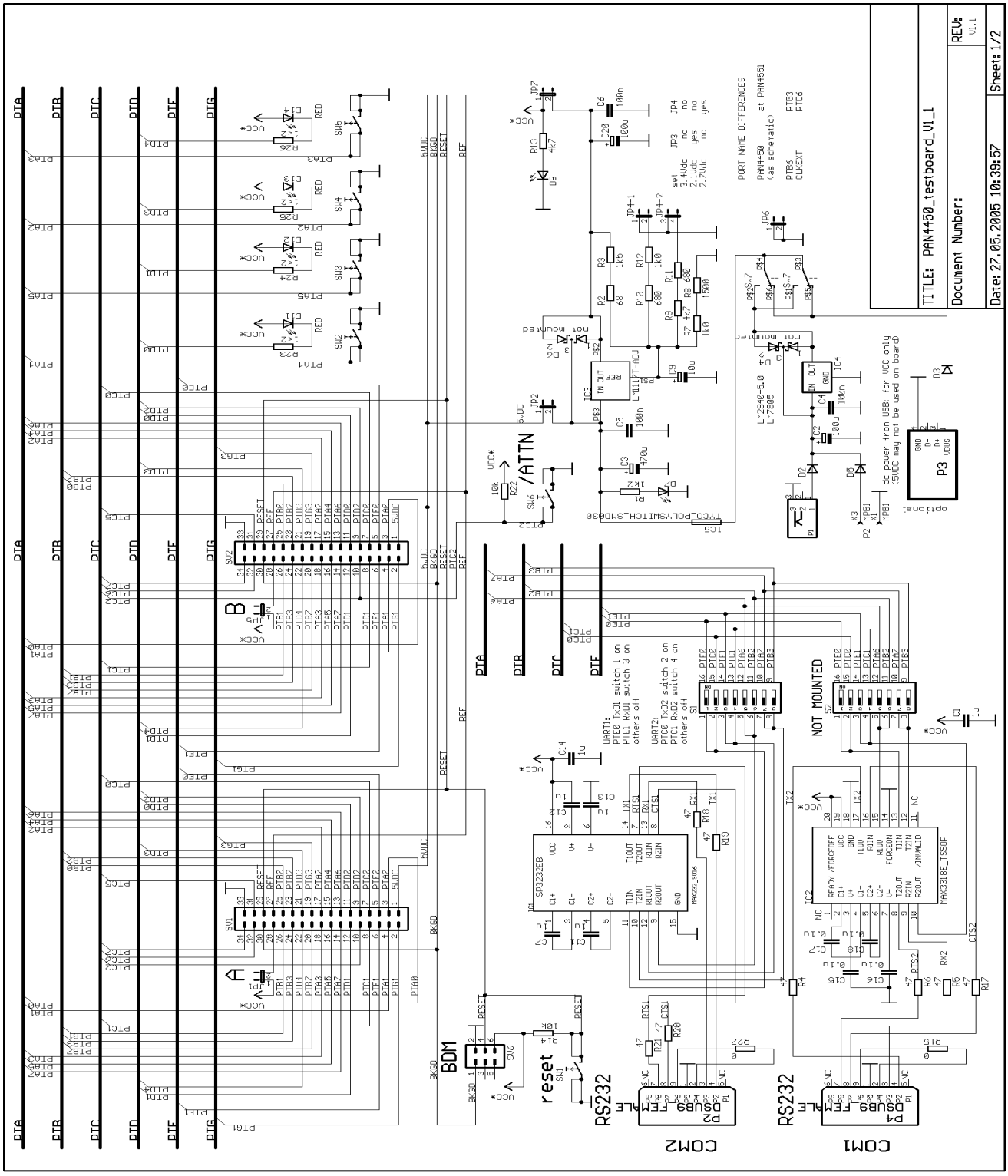
9.3. RF TESTING OF PAN4551

ZigBee radio testing can easily be done using the "Test Tool" PC. In short the following steps have to be done:

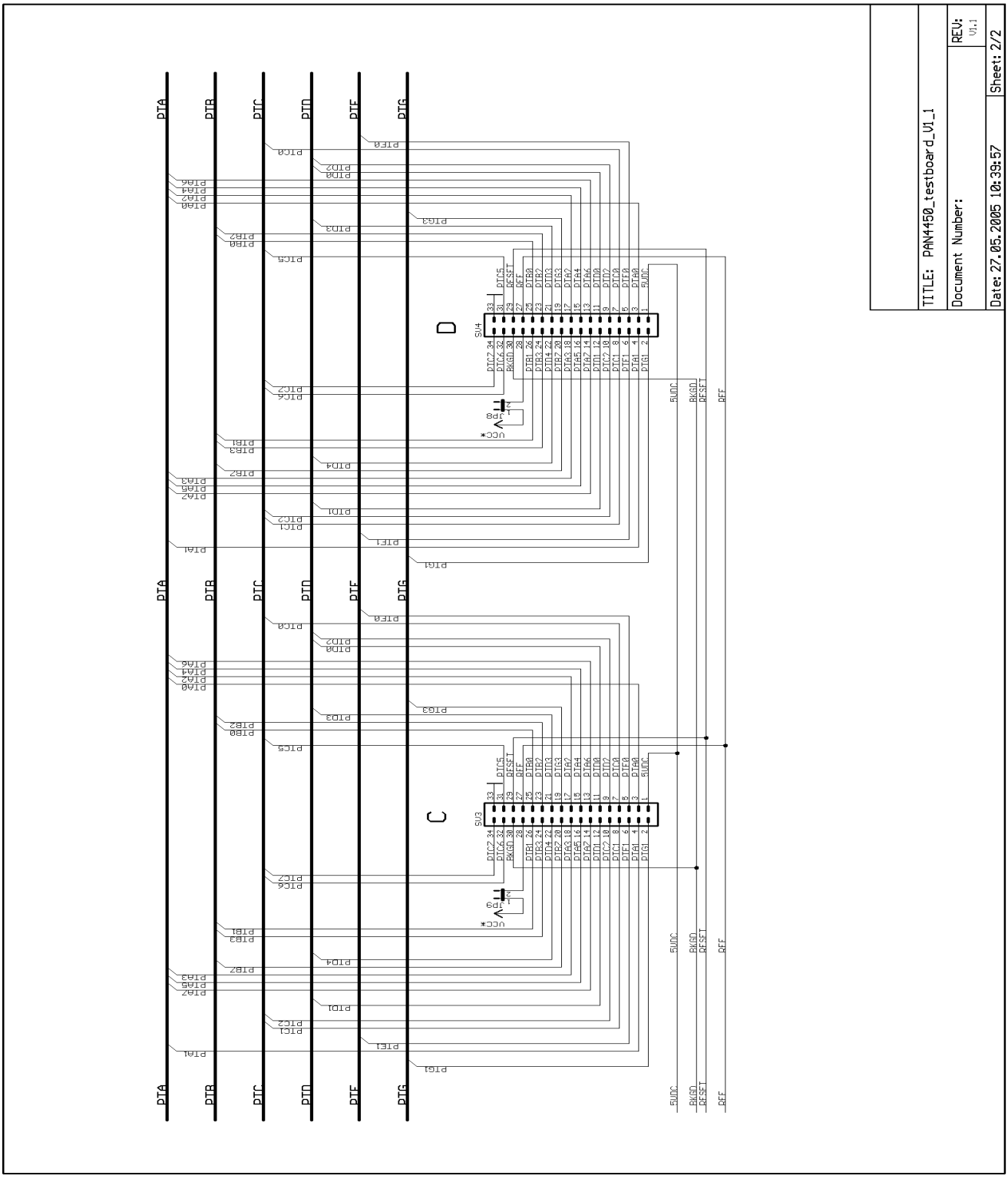
1. Install TestTool on a PC with a free COM port, as described in [4]
2. Set the Testboard COM port to **UART2** and connect it to the PC
3. If needed (for example for PER measurements within ZigBee Radio Test of TestTool) connect the second Testboard (set to UART2 too) to a second free COM port of the PC. If your PC does not provide enough serial ports, a USB to COM converter cable could help.
4. Erase and flash the PAN4551 memories with the embedded_bootloader.s19 file (the same as for the Freescale DIG-536-2,DIG-528-2 devices) via the BDM.
5. After removing the BDM connector reset the Testboard . All LEDs should be lit now.
6. Open TestTool and add the devices under Tools\Communication Settings.
7. Select View\Embedded Bootloader and upload the EVK_PTC_Demo_w_Embedded_Bootloader_V105c_EB501 to PAN4551.
8. After Reset of the Testboard(s) open TestTool\View\ZigBee Radio Test. The ZigBee Radio Test allows for direct reading/writing of the RF transceiver registers and direct control of the main RxTx parameters.

10. SCHEMATIC OF THE ISM RF TRANSCEIVER TESTBOARD

10.1. SHEET 1



10.2. SHEET 2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D
C
SU4
SU3
PTA
PTB
PTC
PTD
PTE
PTG
5VDC
BKGD
RESET
OFF

11. RELATED DOCUMENTS

[1] Data sheet PAN4551 DS-4551-2400-102-04 22/06/2005
[2] Data Sheet Freescale MC13192/13193 Transceiver Version Rev. 2.8 04/2005
[3] Data Sheet Freescale MC9S08GT60 Microcontroller Version 2.3 12/2004
[4] Freescale 13193 Evaluation Board Development kit, 13193EVBUG, Rev 0.0 06/2005

12. DOCUMENT STATUS

This information is preliminary.

13. HISTORY FOR THIS DOCUMENT

Revision Version	Date Datum	Modification / Remarks Änderungen / Bemerkungen
A	11.03.2005	Initial version
B	16.03.2005	Description updates and details added
C	01.04.2005	Addition to chapter 9.2 Wireless UART Demo step 7: no hw handshake
D	27.05.2005	Figure 1 update to PAN4551, testboard schematic update to V1.1
E	23.06.05	Added chapter 9
F	18.08.2005	Added chapter 1.1, 1.2, 1.3, 8.1, 9.3, minor Layout changes

14. GENERAL INFORMATION

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