Manual
Evaluation-Board for
PAN4555 Wireless Module

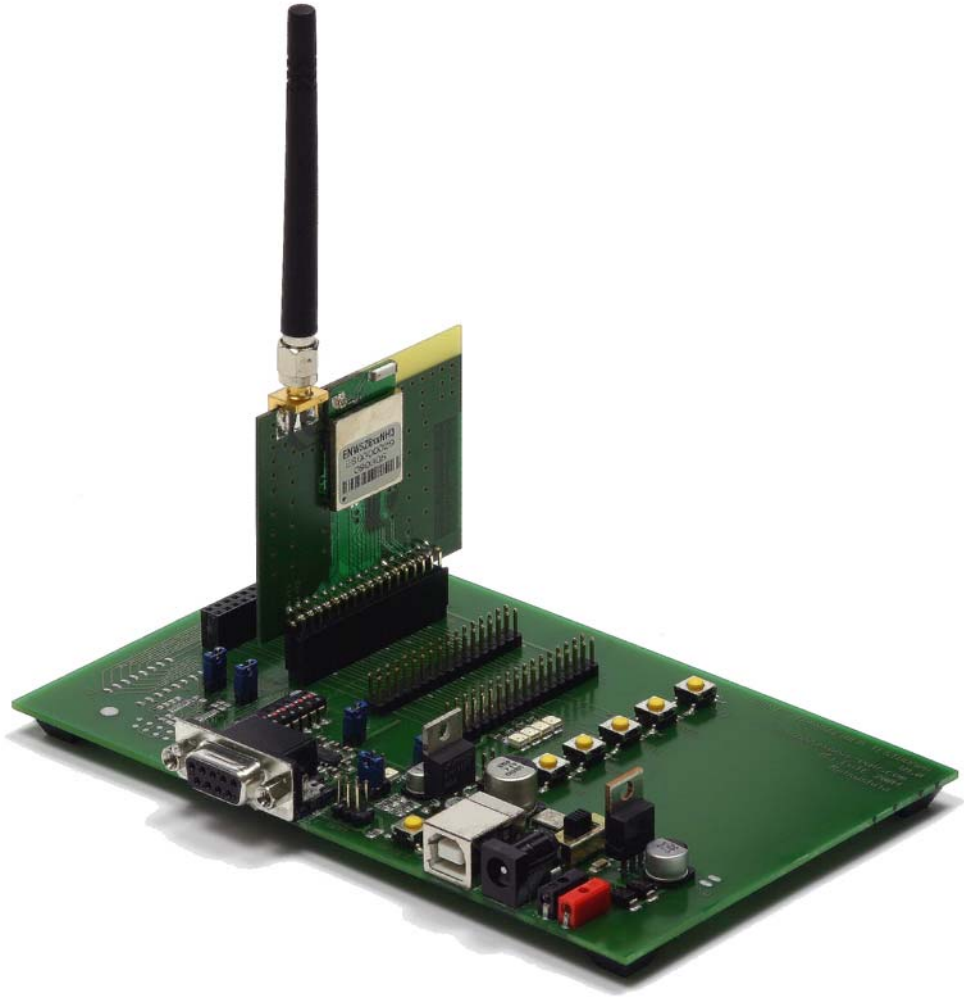

FIGURE 1 ISM RF TRANSCEIVER TESTBOARD WITH PAN4555 AND ANTENNA

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1. OVERVIEW

The EvalKit PAN4555 allows quick and versatile evaluation of the of the wireless module PAN4555. Currently the Embedded Bootloader plus test software from Freescale Inc. is provided for RF performance testing, as for example Packet Error Rate (PER). Testing requires installation of the GUI TestTool™ from Freescale Inc. on a computer with 2 COM ports.

Remark: ZigBee sample application software for this EvalKit is under preparation and will be provided with the next version of this CD.

1.1. CONTENTS OF THE EVALUATION KIT:

- 2 x ISM RF Transceiver Testboards
- 2 x PAN4555 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 ZigBee-Modem PAN4555 with software and documentation

1.2. HARDWARE NEEDED

- 12 x Batteries (AA size) or 2 supplies 6-9Vdc with 2mm plugs
- 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/) or at http://www.freescale.com/ZigBee)

1.3. SOFTWARE NEEDED

a) Freescale TestTool™ from Freescale Inc. as on the CD included, folder 132xxEVKCD\Install. The embedded bootloader is required for TestTool™ and already installed on PAN4555, for reinstalling it with USB HCS08/HCS12 Multilink adapter USB-ML-12 use the file in the folder \embedded_bootloader\embedded_bootloader_4555.s19.

Remark: All the files in the folder 132xxEVKCD are unchanged versions from Freescale Inc.. Because of different hardware platforms of freescale reference devices and PAN4555 they do NOT apply to PAN4555 directly. Check for updates of this folder at http://www.freescale.com/ZigBee)

b) Software Flash Utility; recommended is the P&E USB HCS08/HCS12 Multilink adapter USB- ML-12 available through http://www.pemicro.com/ . See also folder 132xxEVKCD\Drivers.

c) For the development of software based on ZigBee™, IEEE802.15.4 or SMAC™ the Integrated Development Environment (IDE) Metrowerks™ CodeWarrior IDE from www.metrowerks.com is required.

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

2. SETTING UP THE EVALBOARD

Plug a PAN4555 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 PAN4555 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 PAN4555 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 PAN4555 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 PAN4555 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

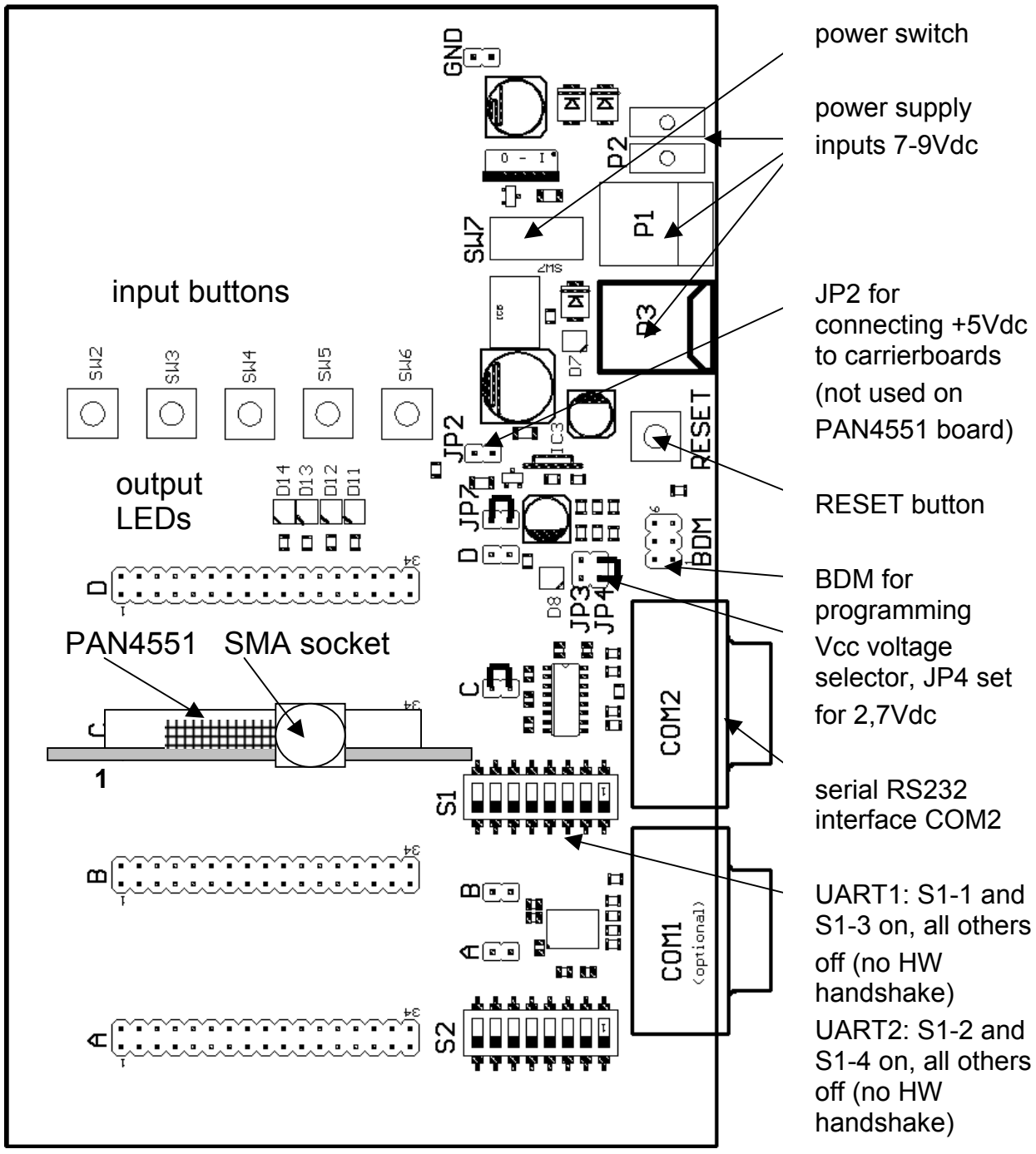


Figure 2 ISM RF Transceiver testboard with PAN4555 and antenna

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 PAN4555 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 PAN4555
JP3 only	3,4 Vdc	maximum for PAN4555
no jumpers	2,1 Vdc	minimum for PAN4555

(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)

Remark: For **PAN4555** only **UART1** is used, SW1-2 and SW1-4 are have to be set to OFF.

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 PAN4555 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 PAN4555 is a Motorola MC9S08GT60.

8.1. FLASHING AND SERIAL UPLOAD INSTRUCTIONS

Remark: Installation of the embedded bootloader and upload of the test software to PAN4555 is already done and only required for re-installation

1. Download and install the required Software for USB HCS08/HCS12 Multilink adapter USB-ML-12. See also folder 132xxEVKCD\Drivers\P&E USB device.
2. Plug the PAN4555 carrierboard on the testboard and switch the testboard power ON
3. Connect the USB HCS08/HCS12 Multilink adapter to the BDM connector on the testboard and via USB to the PC where the flash programming software is installed.
4. Start the HCS08 Flash Programmer and select as port the P&E HCS08/HCS12 Multilink
5. Select the 9S08GT60.S8P Algorithm to be used
6. Wait for the Flashing Utility to become ready
7. Erase the PAN4555 flash memory
8. Select the \embedded_bootloader\embedded_bootloader_4555.s19 file from the CD
9. Choose "program" to flash it into the PAN4555
10. Wait for completion of the programming algorithm
11. After removing the BDM connector push RESET on the Testboard. The LEDs D13 and D14 should be lit permanently now.
12. Set the COM1 switch on the testboard to UART1, e. g. switch 1 and 3 ON and all others OFF. Connect the testboard via a serial cable to the PC. Start the Freescale TestTool
13. 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
14. Now select View / Embedded Bootloader and choose the COM Port you want to use Wait several seconds until a board type window appears. Select 13213-NCB and OK. From the Application files displayed select "EVK_PTC_Demo_w_Embedded_Bootloader_V202_13213_NCB" and "UPLOAD". The upload progress is shown on the display with the final the message "Firmware downloaded – resets system"
15. Close the Embedded Bootloader and open VIEW\ZigBee Radio Test
16. Check a "Device Ready", a "Ping" has to result in "Hello"
17. Now the devices are ready for a test as in part 9.2

9. FREESCALE ZIGBEE IMPLEMENTATION

9.1. DEVELOPMENT OF APPLICATIONS WITH FREESCALE BEESTACK™

PAN4555 is built around the MC13214 single package from Freescale Inc. which includes the freescale ZigBee codebase BeeStack™ (downscaled versions of PAN4555 with MC1321x suited for IEEE802.15.4 or SMAC only are available on demand as well).

The access to BeeStack™ is provided after registration and login at www.freescale.com/zigbee . After login the BEEKITDOWNLOADPACKAGE.zip can be downloaded. This package contains BeeStack™ , IEEE802.15.4 MAC and SMAC codebases. For PAN4555 PHY testing using TestTool™ the download of the latest 1321xEVK package is recommended.

After successful installation of Beekit on a PC open BeeKit. A ZigBee sample solution *.bksln can be created in a few steps.
Important: Before a solution may be exported for PAN4555 the MC1321x target settings have to be changed via the "User defined target editor". The required changes are:
1. Uncheck the "Use external Antenna Switch"
2. Adjust the port settings depending on your application, the PAN4555 datasheet and for use of the PAN4555 carrierboard the pinlist in chapter 10.3.

For importing, compiling and debugging of the BeeKit™ solution the Integrated Development Environment (IDE) Metrowerks™ CodeWarrior from www.metrowerks.com is required.
As device flash programmer the USB HCS08/HCS12 Multilink from www.pemicro.com is recommended.

Important: PAN4555 is a single rf port design with MC13214, refer also to AN3248.
The Freescale reference boards 13213-NCB and 13213-SRB are dual port designs, software for these boards will not run.

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.

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. BeeStack™: 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. RF TESTING OF PAN4555

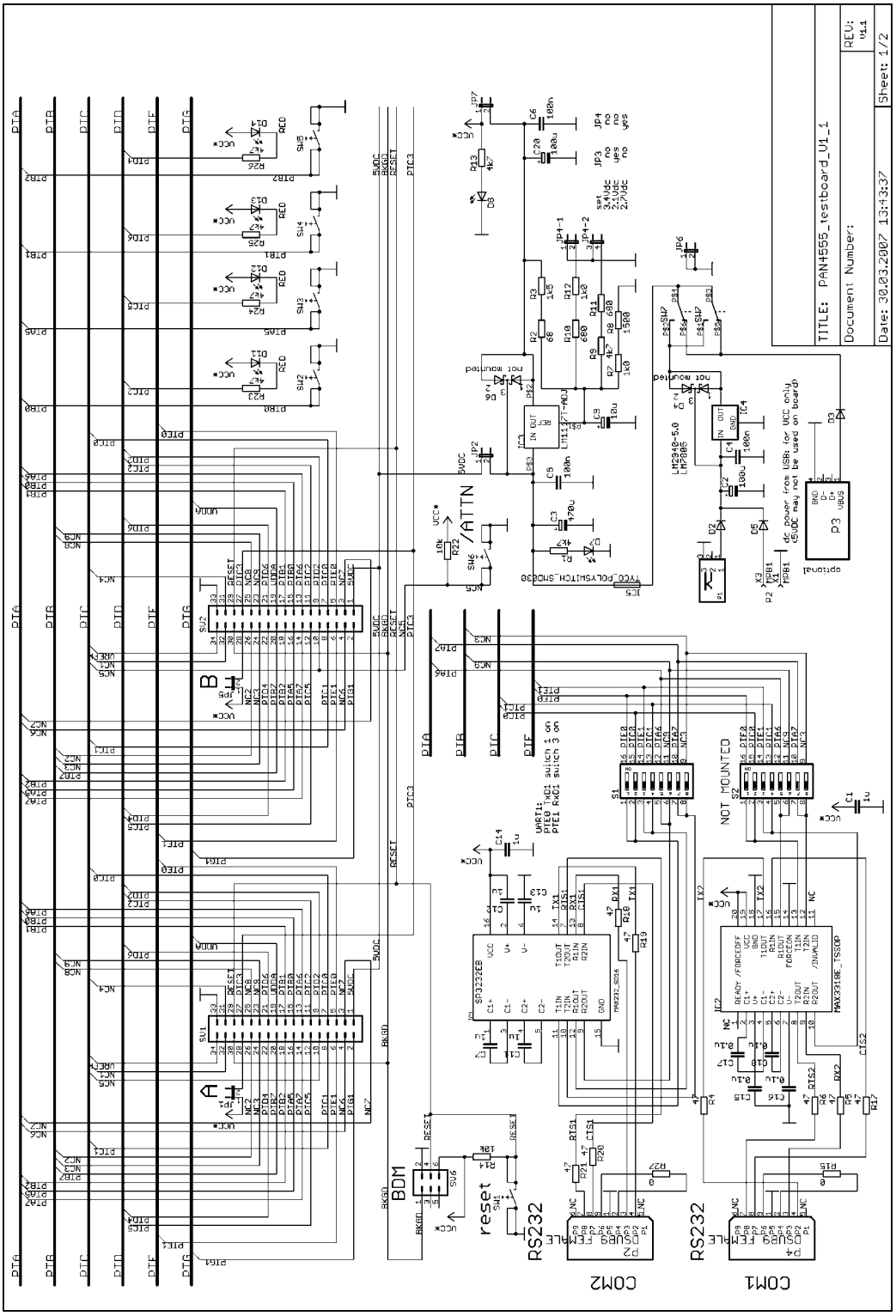
refer also to: freescale\documentation\13213EVKUG.pdf on the CD

ZigBee radio testing can be done using the "Test Tool" on a PC. Operation and some often used functions are described below:

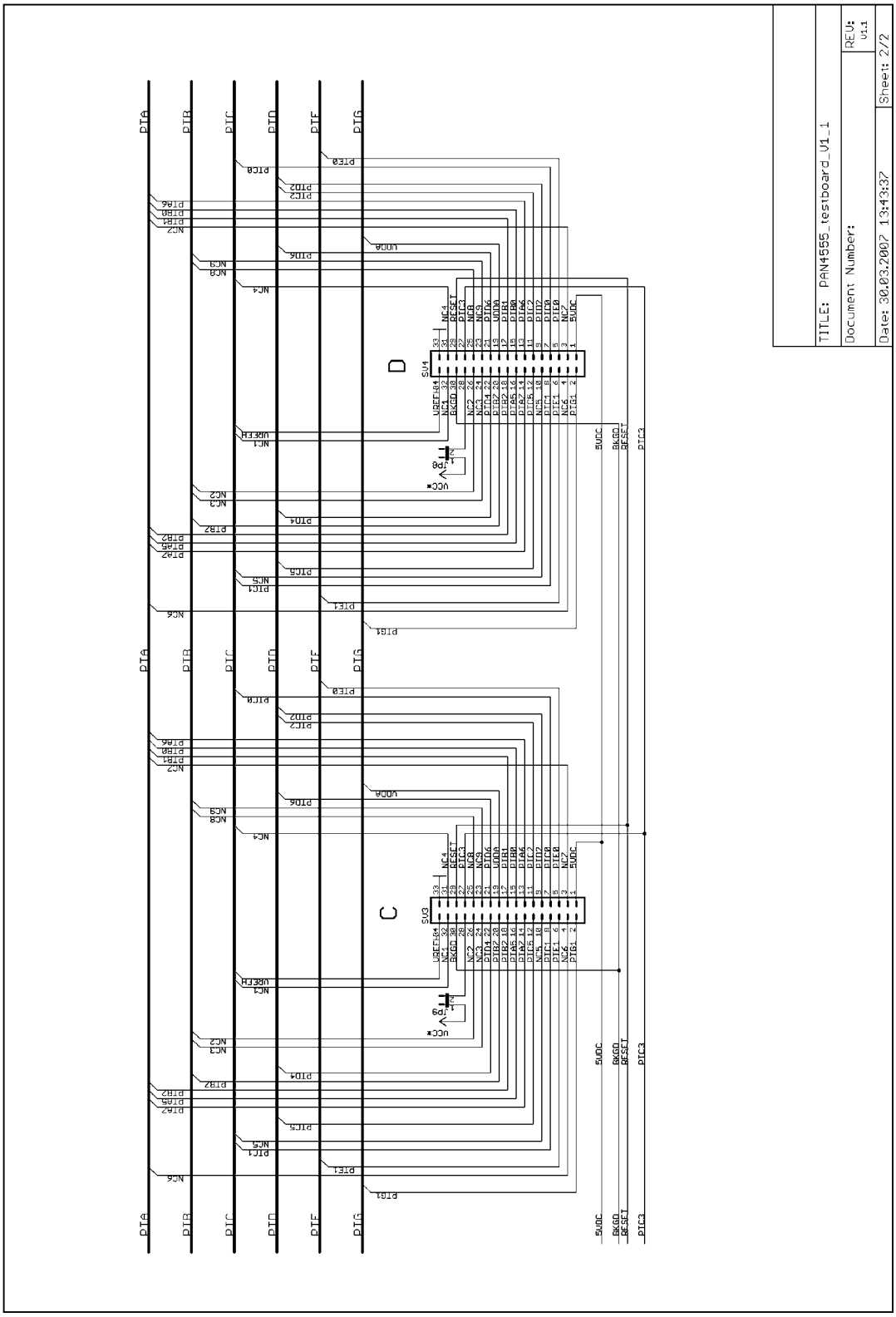
1. Install TestTool (from folder 132xxEVKCD on CD) on a PC with a free COM port.
2. Set the Testboard COM port to UART1 and connect it to the PC
3. If needed (for example for PER measurements within ZigBee Radio Test of TestTool) connect the second Testboard (set to UART1 too) to a second free COM port of the PC. If your PC does not provide enough serial ports, a USB to COM converter cable could help.
4. *This step is only required for reprogramming:*
   Flash program the embedded_bootloader_4555.s19 via the BDM and upload the EVK_PTC_Demo_w_Embedded_Bootloader_V202_13213_NCB via the serial cable to PAN4555 as described in 8.1.
5. Push RESET on the testboard and open TestTool\View\ZigBee Radio Test.
6. Open TestTool™ and Push "PING" and "HOOK" for a device firmware test.
7. **Important:** In section "SPI Registers" read modem **control_b register address x07**, the result is **0x4ca0**. This content means dual port mode as for 13213-NCB devices. Change this setting by writing **0x5ca0** to register x07, enabling the MC13214 internal Rx/Tx switch for single port operation.
   Remark: in case of missing rf input/output while testing with TestTool readout this register in order to check if it is still set to **0x5ca0** .
8. RF Testing Tx mode
   " Set Continuous TX" with the result "Succeeded". PAN4555 is set to a continuous unmodulated carrier for testing of wanted and unwanted (e.g. harmonics) output power or carrier frequency accuracy.
   The related settings are:
   - "Channel", write for example 0x0b for the lowest frequency at 2405MHz or 0x1a for the highest frequency at 2480MHz.
   - "Xtal Trim", the readout value is 0x7e. For series production this value might be adjusted for PAN4555
   - "Spi Register 12"
     The default readout 0xbc sets PAN4555 to a power of approximately –3dBm. In order to check the harmonics power, write 0xff for maximum power of approximately +1dBm at the carrier frequency.
9. RF Testing Rx mode
   The most important parameter for Rx mode is the sensitivity determined by increasing the path loss between transmitter and receiver until the Packet Error Rate inrceases from 0 to 1% (with 20 bytes payload according to the IEEE802.15.4 requirements). For detailed information on how to run PER measurements refer to the freescale documentation.
   Remark: Make shure that both Transmitter and Receiver are set to single port mode as described under point 7.

10. SCHEMATIC OF THE TESTBOARD AND PAN4555 PINLIST

10.1. SHEET 1



10.2. SHEET 2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REV: V1.1
Document Number:
Date: 30.03.2007 13:43:37
Sheet: 2/2
D
C
SW1
SW3
5VDC
BKGD
RESET
PTC3

10.3. PAN4555 PINLIST

The table below shows the connections provided via the PAN4555 carrierboard.

header pin	testboard_V1_1, headers B-D	PAN4555	used on testboard as
1	5VDC	not connected	
2	PTG1	PTG1	
3	NC7	not connected	
4	NC6	not connected	
5	PTE0	PTE0	TxD via S1
6	PTE1	PTE1	RxD via S1
7	PTC0	PTC0	
8	PTC1	PTC1	
9	PTD2	PTD2	
10	NC5	not connected	
11	PTC2	PTC2	D11
12	PTC5	PTC5	D12
13	PTA6	PTA6	
14	PTA7	PTA7	
15	PTB0	PTB0	SW2
16	PTA5	PTA5	SW3
17	PTB1	PTB1	SW4
18	PTB2	PTB2	SW5
19	VDDA	VDDA	
20	PTB7	PTB7	
21	PTD6	PTD6	D13
22	PTD4	PTD4	D14
23	NC9	not connected	
24	NC3	not connected	
25	NC8	not connected	
26	NC2	not connected	
27	PTC3	PTC3	
28	VCC	VCC	VCC
29	RESET	RESET	RESET
30	BKGD	BKGD	BKGD
31	NC4	not connected	
32	NC1	not connected	
33	GND	GND	
34	VREFH	VREFH	

11. RELATED DOCUMENTS

[1] Data sheet PAN4555 *currently not available, under preparation,*
see also PAN4555 flyer Web_PAN4555-B.pdf on the CD
[2] Data Sheet Freescale MC1321xDS - MC1320x 2.4 GHz Low Power Transceiver.pdf
[3] Data Sheet Freescale MC9S08GT60 Microcontroller

12. DOCUMENT STATUS

This information is preliminary.

13. HISTORY FOR THIS DOCUMENT

Revision Version	Date Datum	Modification / Remarks Änderungen / Bemerkungen
01	30.03.2005	preliminary version

14. GENERAL INFORMATION

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