



## Evaluation boards for Low-Power Dual-Mode Zero-IF 2.4GHz Transceiver IC

### Preliminary Technical Data

Eval-ADF7241DBZ1

#### ***Features***

**Frequency range (global ISM band)**

**2400 MHz to 2483.5 MHz**

**Programmable data rates and modulation**

**IEEE 802.15.4-2006-compatible (250 kbps)**

**Low power consumption**

**19 mA (typical) in receive mode**

**21.5 mA (typical) in transmit mode ( $P_o = 3$  dBm)**

**1.7  $\mu$ A, 32 kHz crystal oscillator wake-up mode**

**High sensitivity**

**Programmable output power**

**-20 dBm to +4.8 dBm in 2 dB steps**

**Excellent receiver selectivity and blocking resilience**

#### ***General description***

The ADF7241 is a highly integrated, low power, and high performance transceiver for operation in the global 2.4 GHz ISM band. It is designed with emphasis on flexibility, robustness, ease of use, and low current consumption. The IC supports the IEEE 802.15.4-2006 2.4 GHz PHY requirements in both packet and data streaming modes.

The ADF7241 ISM Band Transceiver Radio evaluation boards consist of a 4-layer PCB daughter board (Eval-ADF7241DB1Z) which plugs into a motherboard (Eval-ADF7xxxMB3Z).

**Rev. Pr A**

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## Hardware Overview

Schematics for the Eval-ADF7241DB1 daughter boards and the Eval-ADF7XXXMB3Z mother board are included in appendix 1.

The mother board may be powered via the USB cable. The 5V from the USB cable is regulated down to 3.3V for the Cypress EZ USB IC, the ADuC7020 microcontroller, and ADF7241 transceiver. Alternatively a battery may be used for the microcontroller and transceiver. A 3.6V battery is shipped with the boards.

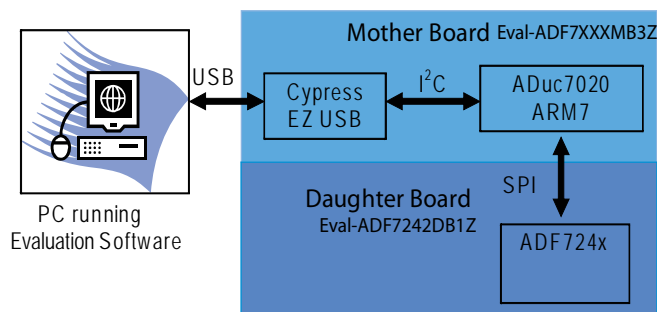


Figure 1: Hardware overview

## Evaluation Software Installation guide

The ADF7241 evaluation software and documentation can be installed from the Analog Devices ftp site. (<ftp://ftp.analog.com/pub/RFL/724x>). All previous ADF7241 software should be uninstalled before carrying out the installation. Download ADF7241\_Evaluation folder and unzip file ADF7241.zip. Execute set up file at ADF7241\setup.exe. If the default paths are used the install will place the relevant files in the folder C:\Program Files\Analog Devices BV \ ADF7241.

It will also create shortcuts on the start menu (Analog Devices->ADF7XXX->ADF7241). Refer to Installation section in the Appendix for further details.

Microsoft's .NET2.0 framework or later revision must be installed on any machine attempting to run this system. This is available for free download from Microsoft's web site. (This will be already installed on most PCs).

This software can run on Microsoft Windows XP, Windows 2000, Vista and Windows 7 (32bit and 64bit).

## Microcontroller Firmware

The motherboard includes an ADuC7020 micro. Updates to the microcontroller firmware can be loaded over the USB. Under the help button on the evaluation software tool bar there is an option to 'Check Firmware Revision'. The current revision is 02.00.00.00. To update the microcontroller firmware select *Disconnect USB* in the evaluation software. Then select Motherboard firmware updater under tools in the tool bar. If the default paths are used during the install the relevant Hex file will be in the folder C:\Program Files\Analog Devices BV\ ADF7xxxMB3z Firmware. The install will also create a shortcut on the start menu. On the GUI browse to the Hex file, click download and follow the instructions on the GUI.

## Using the evaluation board software

### Evaluation boards connect/disconnect:

The first time the mother board is connected to the PC drivers need to be installed. The installation process varies depending on whether the operating system is XP, Vista or Windows 7. Refer to section Installing USB drivers in the Appendix for further details.

If you wish to run two boards from one PC set switch S4 on one mother board to B1 (board 1) and to B2 (board 2 ) on the second mother board.

To launch software: If default installation path used then from the start menu select Start -> program files -> Analog Devices -> ADF7xxx -> ADF7241 -> ADF7241. If an alternative path used browse to ADF7241 in the alternative path used.

If two boards are connected to one PC launch 2 software GUIs and select board1 on one and board2 on the other. Figure 2 shows the software GUI.

1. A USB monitor window which displays data transmission over the USB may be enabled. When the board is connected to the PC ensure the board selected in the evaluation software matches the S4 switch setting on the motherboard and then select the *Connect USB* button. Select *Disconnect USB* before disconnecting the USB from the board.

2. Clicking Flash LEDs will flash the LEDs on the board corresponding with that GUI.

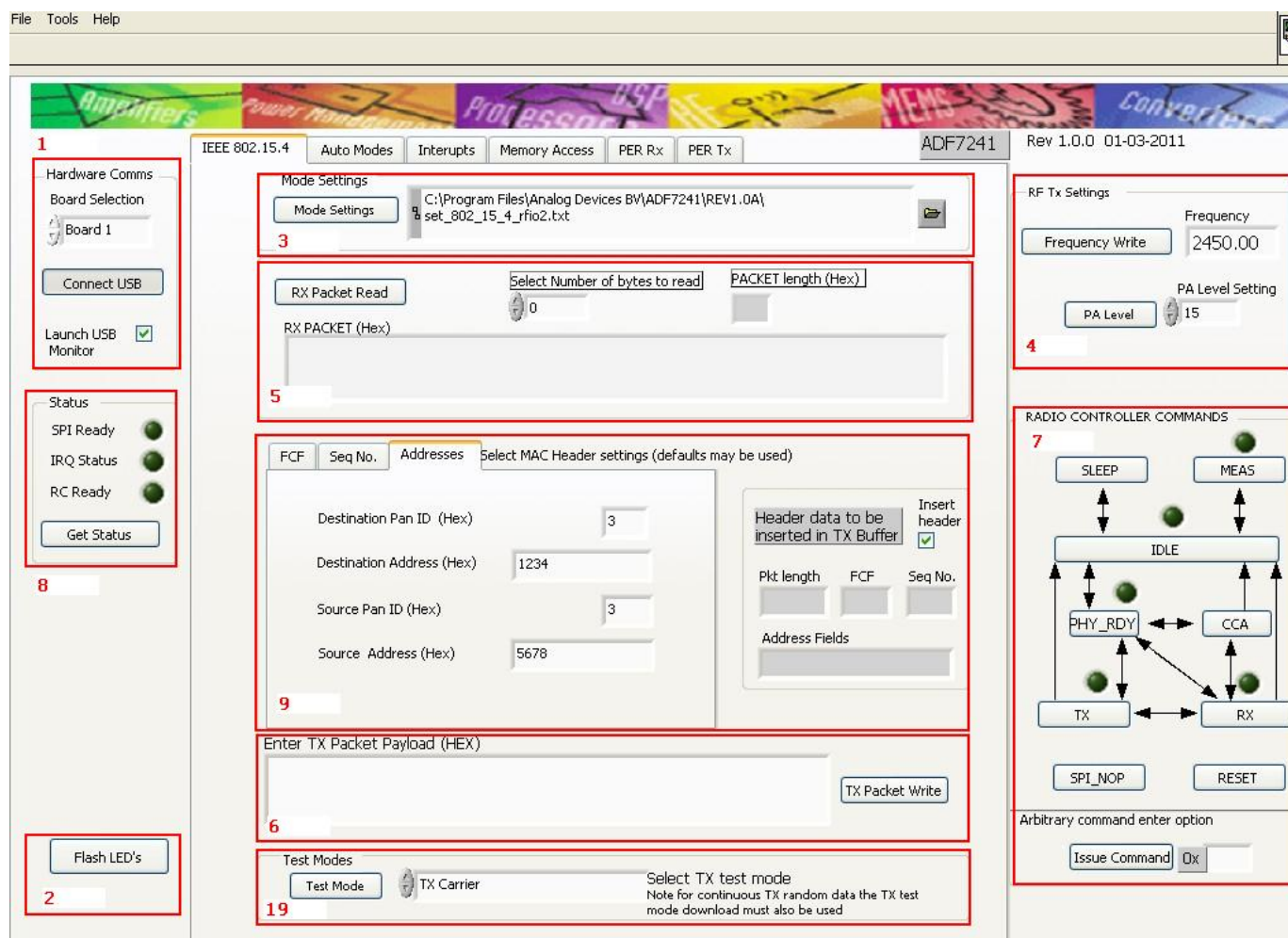


Figure 2: This screen shot shows the IEEE 802.15.4 tab.

## Configuring the ADF7241

The part will be in IDLE state on start up. Registers should be programmed in IDLE state.

3. Figure 2 shows the IEEE 802.15.4 tab.

A set of configuration files are included in the install. These contain the recommended register setting for different modes of operation. The file names indicate the mode to which they apply. Browse to select the desired configuration. Clicking on *Mode Settings* writes the selected file settings.

4. Similarly clicking on the *Frequency write* and *PA Level* buttons writes the selected frequency and PA power level.

5. Set number of RX buffer bytes you wish to read and select *RX Packet Read*.

6. TX packet data you wish to transmit may be written to the TX buffer. Select *TX Packet Write* to write the data you enter to the Buffer. If using the continuous transmit test mode it is

recommended to write 127 bytes to the TX Buffer.

## Changing states

7. Change states as required using the radio control command buttons. Arrows indicate allowed transition paths. For example from the IDLE state, click PHY\_RDY, then RX to enter RX state or Click PHY\_RDY, then TX to transmit data. Note in Packet modes the part automatically transitions back to PHY\_RDY after sending a packet unless a test mode is enabled.

There is also an option to enter any arbitrary command.

## Status Check

8. Click on *Get Status* to check what state the part is in. 'LEDs' will be updated indicating current state.

## IEEE 802.15.4 Automatic modes

A firmware download is available which enables frame filtering, automatic acknowledge and Automatic frame transmission using unslotted CSMA\_CA with automatic retries.

Please refer to **application note AN1082** for further details on these modes.

9. Header settings can be selected and inserted in the TX buffer in IEEE 802.15.4 mode.

10. To enable these modes the firmware should first be downloaded. This is selected under the Auto Modes tab shown in figure 3.

11. Then configuration options must be selected.

12. Finally enable this firmware add\_on.

13. The CSMACA command enables transmission with unslotted CSMA\_CA.

14. An auto status readback may be performed.

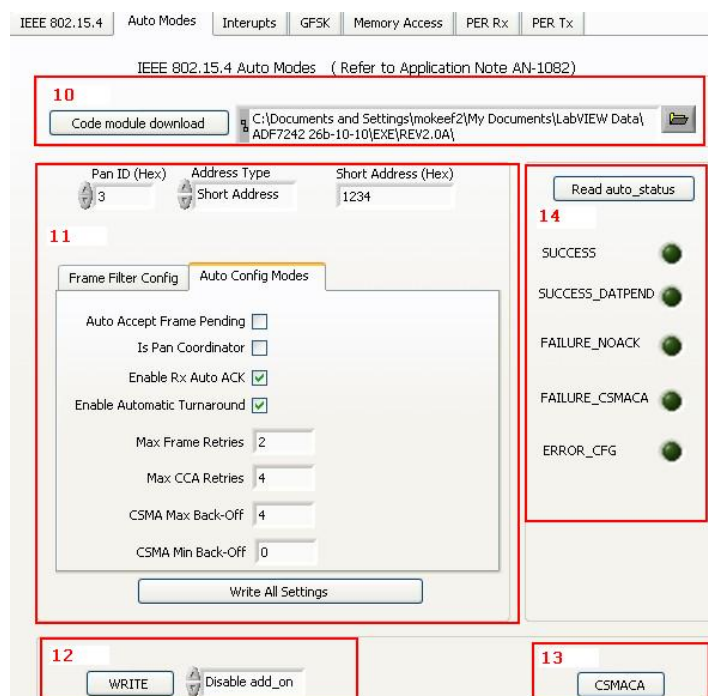


Figure 3 IEEE 802.15.4 Auto modes tab

## Interrupts

15. There are two IRQ pins on the ADF7241. The IRQ1 pin is used as the interrupt pin on the evaluation board. Figure 4 shows the interrupt tab.

- Select the desired interrupts to the pin and enable using *LOAD IRQ Settings*
- Read IRQ1 source register by selecting *Check IRQ Status*
- Clear IRQ1 source register by selecting *Reset IRQ*

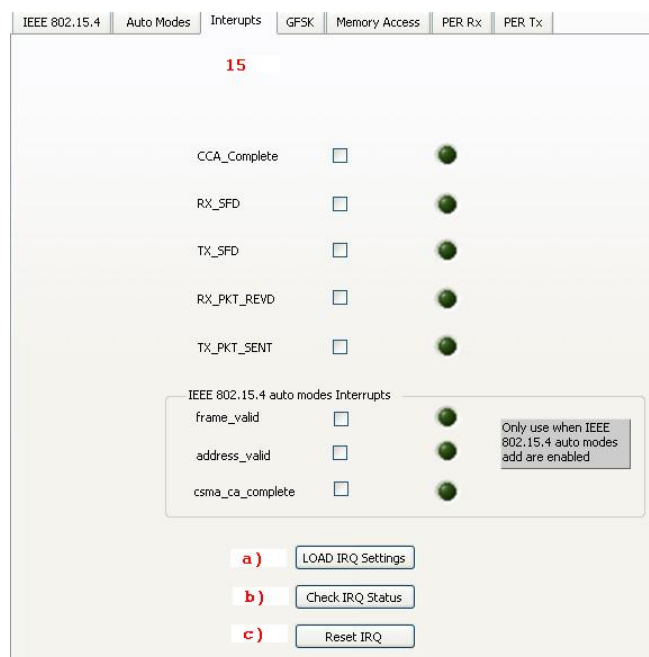


Figure 4 Interrupts tab

## Memory Access

16. Figure 5 shows the Memory access tab.

- All MCR and BBRAM registers may be read.
- Option to do single register writes to BBRAM or MCR registers.

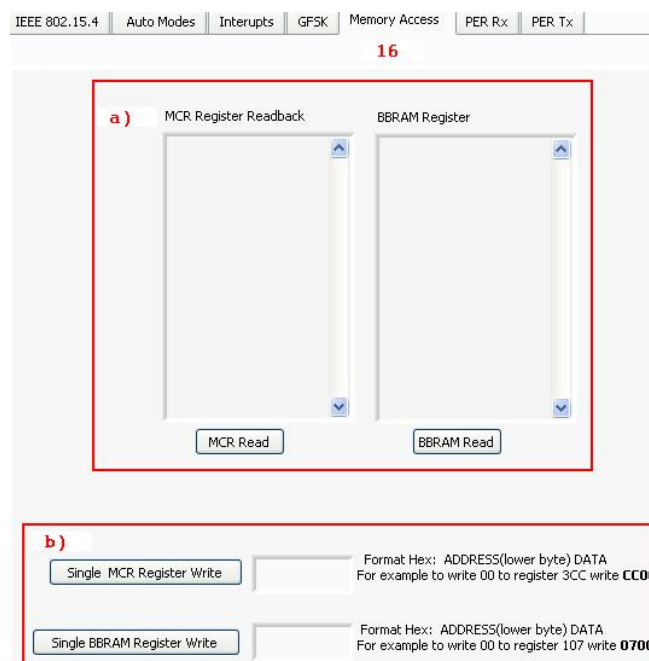
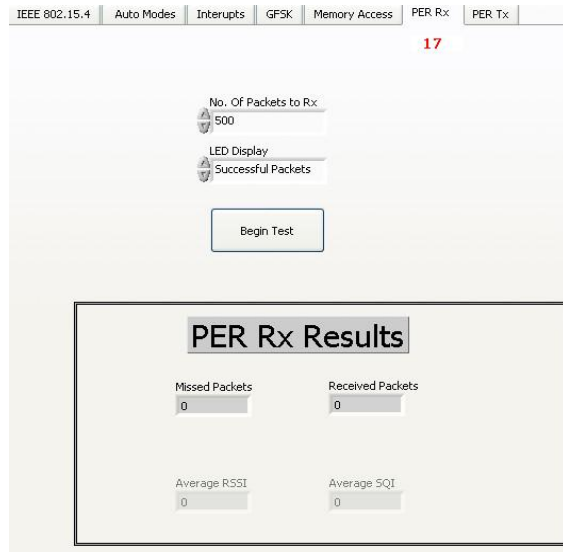


Figure 5: Memory Access tab

## Receiver PER test

17. One board may be configured as the receiver and the other as the transmitter. First set up the receiver: under the RX PER tab select the number of packets to include in the PER test. Then select Begin test. The RX PER tab is shown in figure 6.



**Figure 6 RX PER tab**

18. Then set the second board as the transmitter: under the TXPER tab as shown in figure 7 select the same number of packets as selected on the RX board. Select the interval between packets. Then select *Begin test*.

The result will be reported on the RX board GUI. Note clicking on the stop button on the RX end will end the PER test and report the results as far as it has proceeded. This may be required if the final packet is missed by the receiver.



**Figure 7 TX PER tab**

## TX Test Modes:

19. There are TX test mode options selectable under the IEEE 802.15.4 tab.

A test mode to select a carrier transmission may be selected.

Also a test mode in which random data is continuously transmitted may be selected. To use this mode, in addition to selecting this mode under the TEST MODE options the rom\_ram\_7242\_2\_0\_tx\_testmodes.dat module must be downloaded. This download may be selected under the Auto Modes tab. Write *enable add\_on*.

Alternatively data written to the TX Buffer can be continuously transmitted. One of the packet mode configuration files should be written. Note that the transmitter momentarily transmits an RF carrier between packets due to a finite delay from when the packet handler finishes transmitting a packet in TX\_BUFFER and going back to transmit the start of TX\_BUFFER again.

For all test tx modes the required frequency and power should be written. Then issue the PHY\_RDY and TX commands. To exit TX issue command RC\_PHY\_RDY. The test mode must be rewritten to the device before reissuing Command RC\_TX. To revert back to normal operation select normal mode under the TX test modes.

## Appendix 1

### Board Schematics

#### Eval\_ADF7241DB1Z Bill of Material:

Qty	Name	Value	Tolerance	PCB decal	Manufacturing Part No.
3	C1, C15, C18	220nF	10%	0402	LMK105BJ224KV-F
8	C2, C3, C12, C13, C14, C16, C17, C21, C23, C25	27pF	5%	0402	ECJ-0EC1H270J
4	C4, C6, C8, C10	1pF	10%	0402	GRM1555C1H1R0BZ01D
4	C5, C7, C9, C11	10nF	10%	0402	GRM155R71H103KA88D
2	C19, C20	18pF	5%	0402	GRM1555C1H180JZ01D
3	C22, C24, C28	0.1μF	10%	0402	GRM155R71C104KA88D
2	C26, C27	8pF	0.5pF	0402	GRM1555C1H8R0DZ01D
2	L1, L3	2.4nH		0402	Coilcraft 0402CS-2N4X_LU
2	L4, L6	2.7nH		0402	Coilcraft 0402CS-2N7X_LU
1	L5	9.5nH		0402	Coilcraft 0402CS-9N5X_LU
2	R1, R2, R10	100 kohm	1%	0402	MCR01MZPF1003
1	R3	27 kohm	1%	0402	MCR01MZPF2702
2	R4, R5, R11, R12, R13	0 ohm	1%	0402	MCR01MZPJ000
	C29, C30, C31, L2, R6, R7, R8, R9,	DNI <sup>1</sup>			
1	U1	2.45GHz		5mmx5mm	ADF7241
1	U2	2.45GHz		0603	LFL182G45TC1A208
1	Y1	26 MHz			NX3225SA-26.000000MHZ-G2
1	Y2	32 KHz			ABS07-32.768KHZ-7-T

<sup>1</sup> DNI: do not insert

## Eval\_ADF7241DB1Z Schematic:

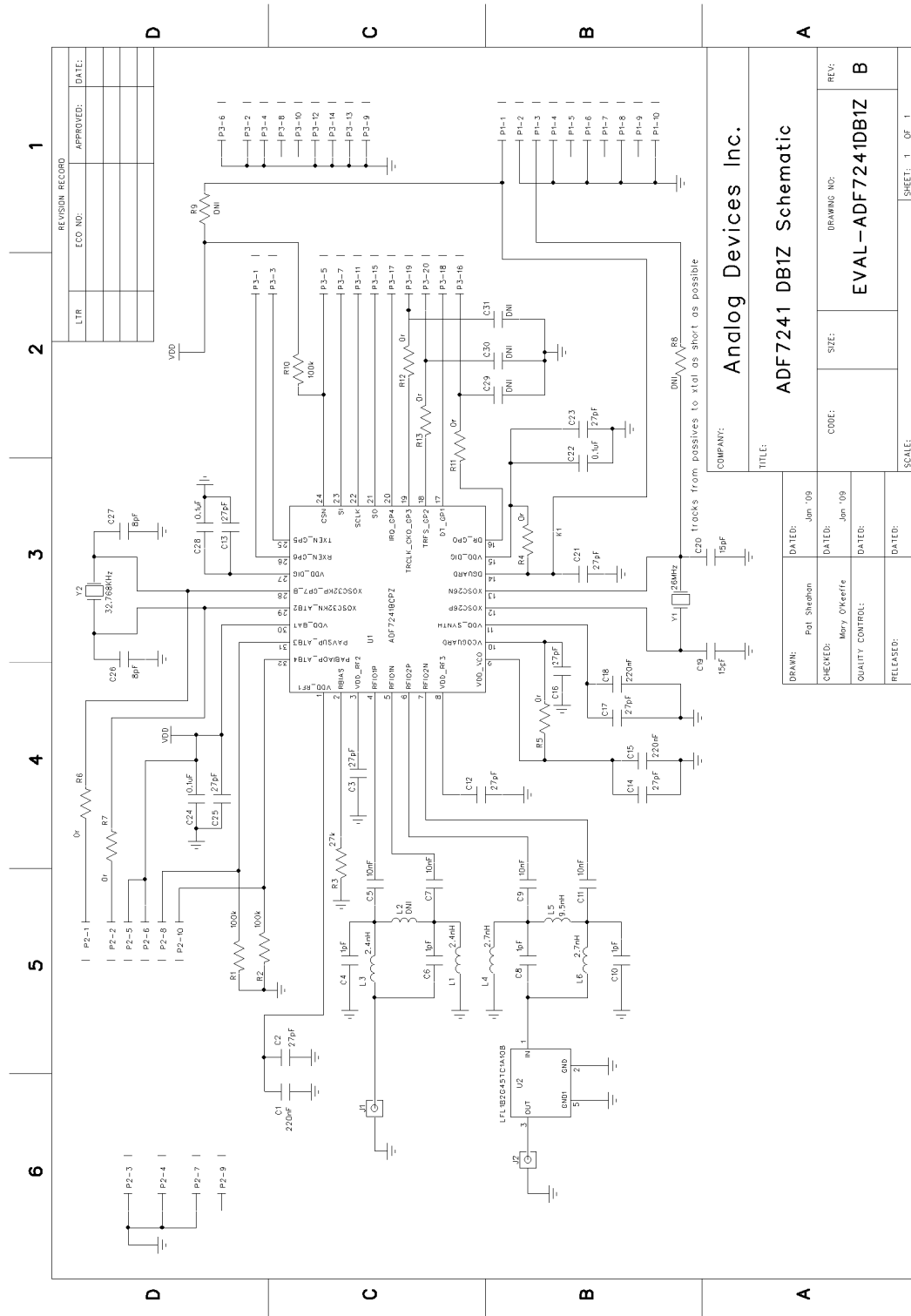


Figure 8 ADF7241DB1 Daughter board schematic



## Eval\_ADF7XXXMB3Z Schematics:

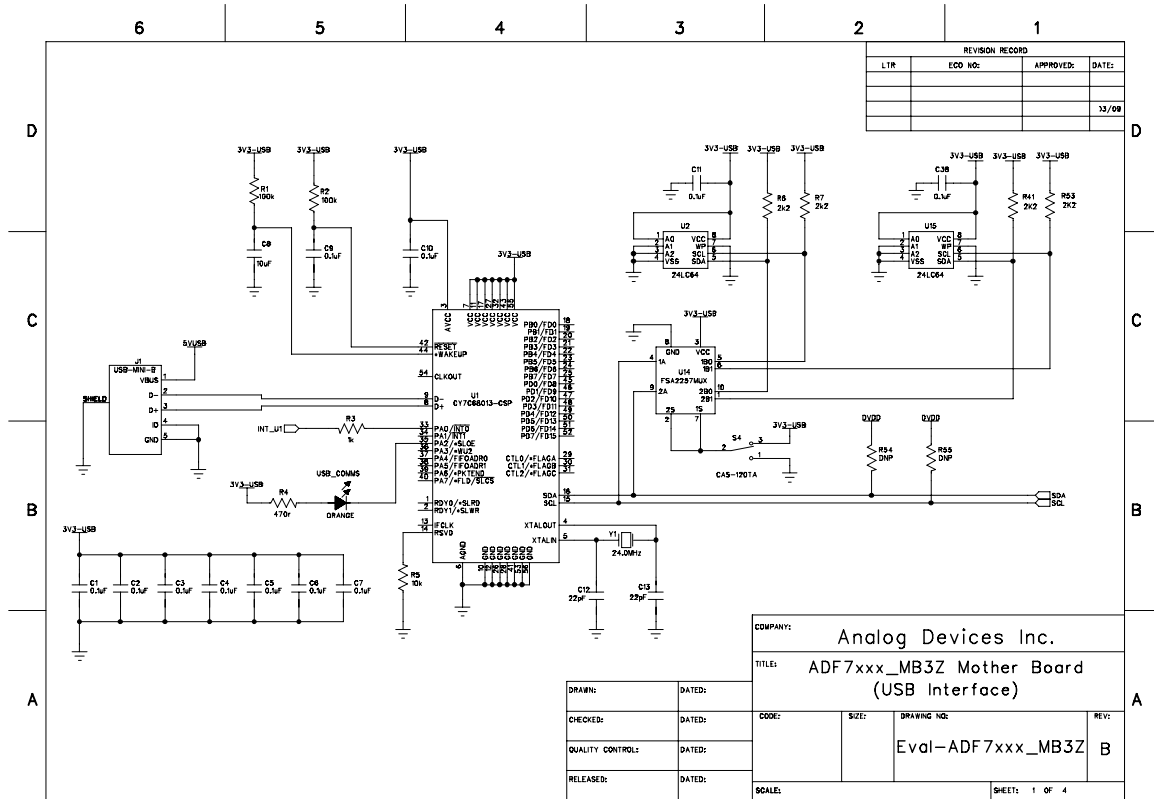


Figure 9 ADF7XXXMB3Z mother board schematic, page 1

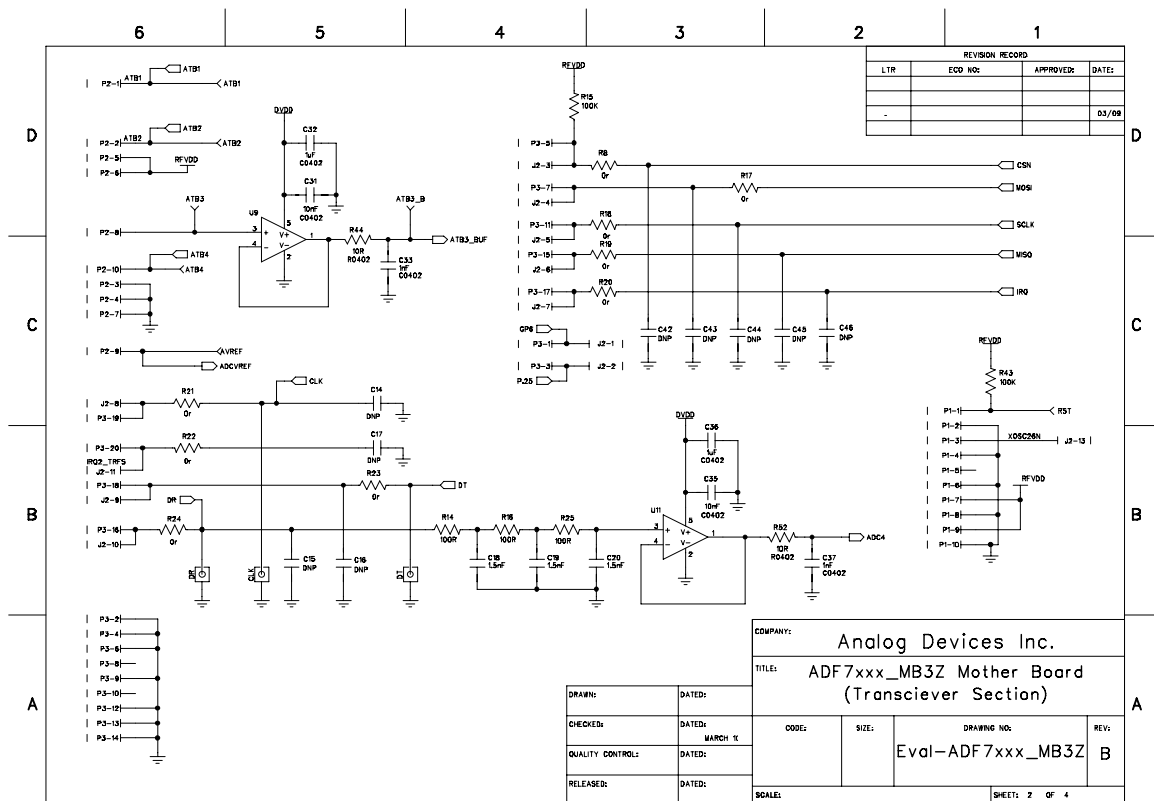
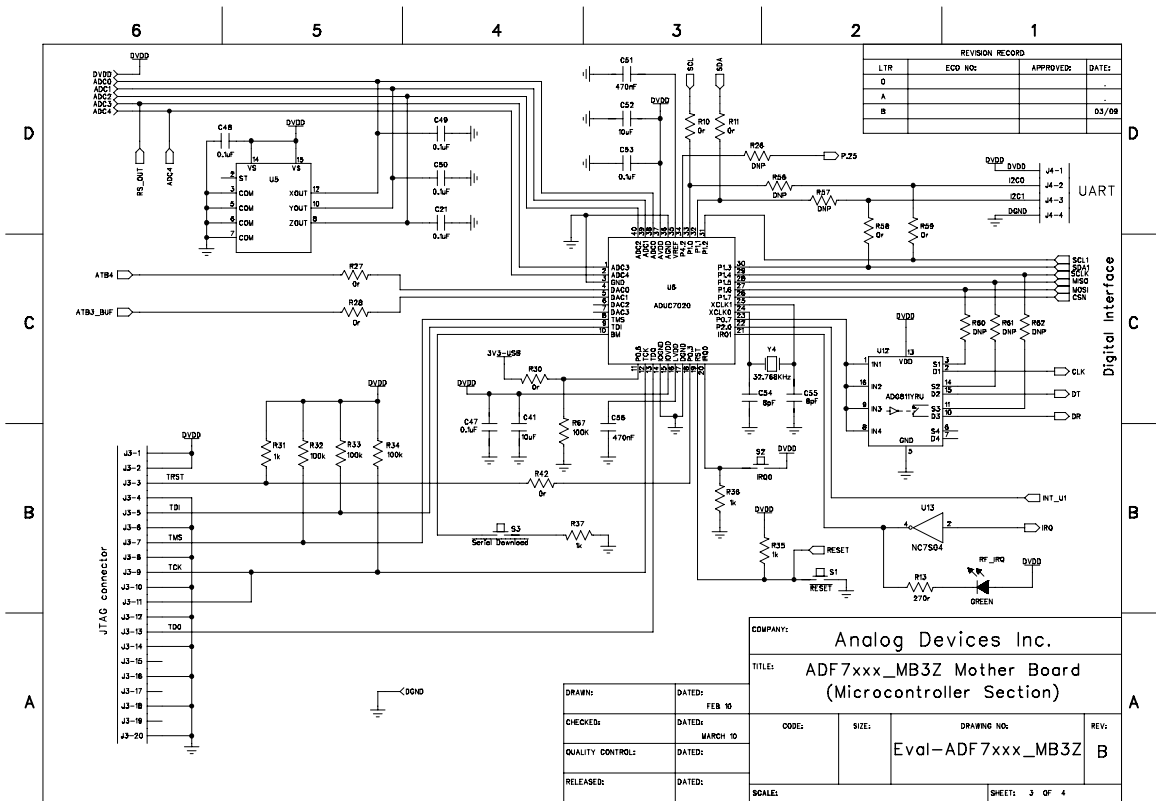


Figure 10: ADF7XXXMB3Z mother board schematic, page 2



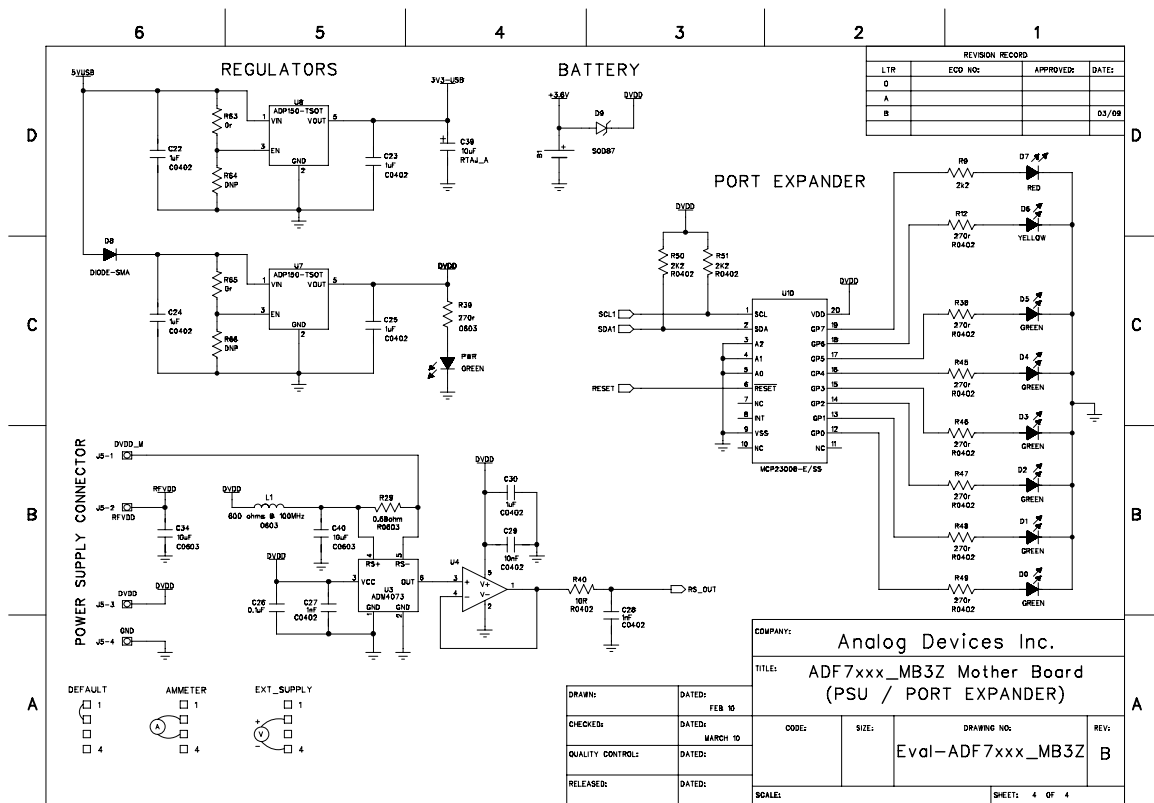
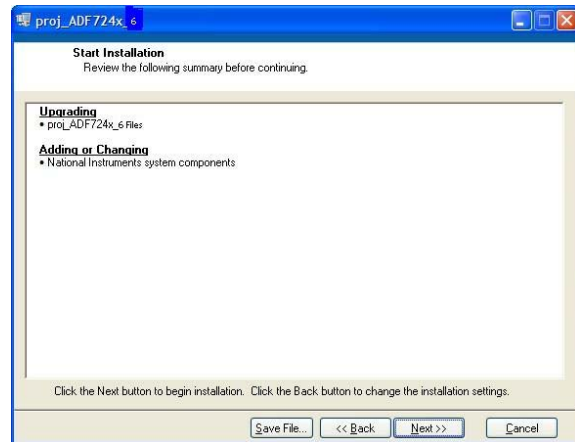


Figure 12: ADF7XXXMB3Z mother board schematic, page 4

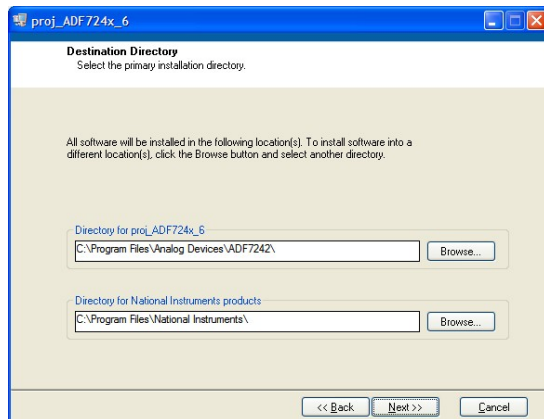
## Appendix 2

### Installation of Evaluation software:

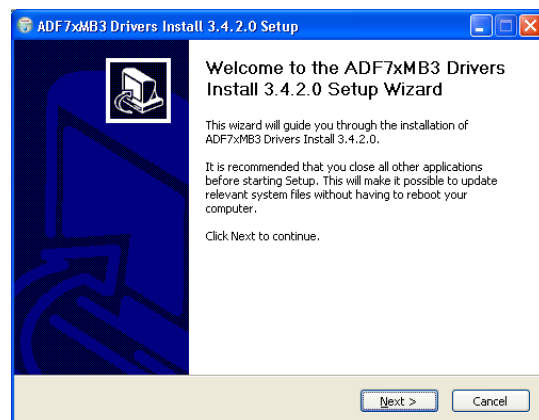
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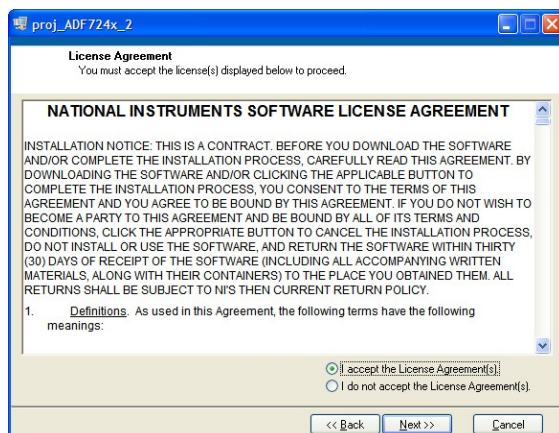
Next



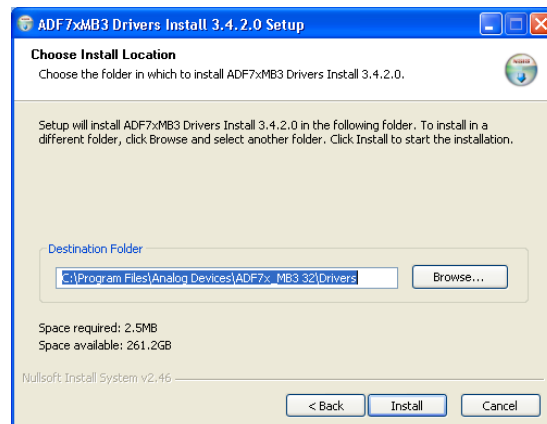
Recommend using default installation paths.



Click next



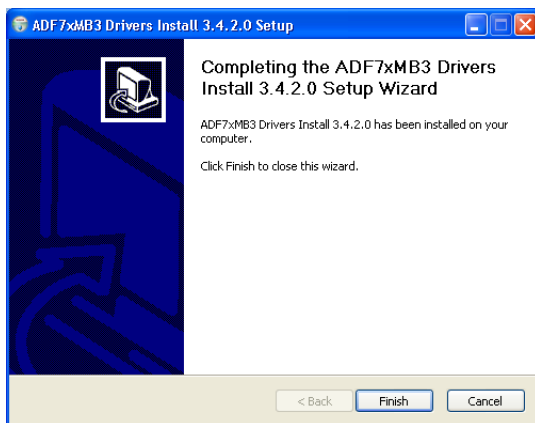
Accept license agreement required to proceed.  
Then next.



Click next



If this window appears select Continue Anyway



Finish

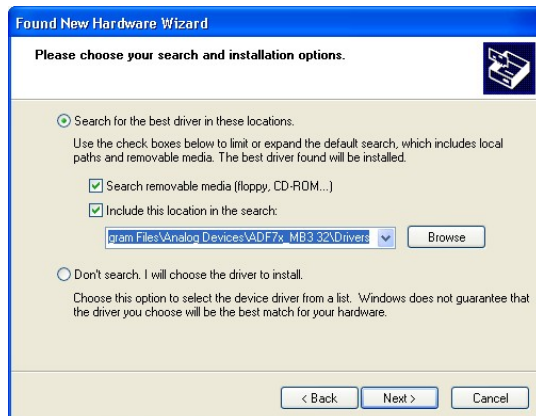
## Initial connection of hardware

On initial connection of the board to a PC USB port, a found new hardware wizard is launched. Depending on the operating system the install process varies.

For XP



Select install from a specific location



Browse to Program Files\Analog Devices\  
ADF7x\_MB3 32 \Drivers



If this window appears select Continue Anyway



When second found new hardware wizard appears repeat this procedure.

For Windows 7 this installation occurs automatically.