User's Manual

78K0R-UD-STICK-EE

Demonstration Kit for Renesas Electronics µPD78F1146 Zigbee™ / RF4CE™ ready Wireless Network Evaluation Stick

Document No. R20UE0002ED0100
Date Published April 2010

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CE 0682

This equipment complies with directive 1999/5/EC

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EEDT-ST-004-10

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Revision History

Date	Revision	Chapter	Description
04-16-2010	V1.00	---	First release

Table of Contents

1. Introduction 11

1.1 Package contents 11
1.2 Features 11
1.3 System requirements 11
1.4 Trademarks 11

2. *Hardware* 12

2.1 Block diagram 12
2.2 SW1: Power supply selection 12
2.3 SW2: USB setting 13
2.4 LED1: Power LED 13
2.5 LED2-LED4 13
2.6 CN2 connector 15
2.6.1 Connection of 78K0R-UD-STICK-EE adapter board 15
2.7 USB programming and debugging interface 16
2.8 U1 Temperature sensor (S-8120CNB) 16
2.9 Power supply 16

3. *78K0R-UD-STICK-EE* installation and operation 17

3.1 Getting started 17
3.2 CD-ROM contents 17
3.3 Pre-programmed Demo-Application 17

4. Hardware installation 18

5. Software installation 19

5.1 IAR Systems Embedded Workbench for 78K installation 19
5.2 WriteEZ5 installation 21
5.3 Sample projects installation 21
5.4 USB Driver Installation 21
5.4.1 Installation on Windows 2000 21
5.4.2 Installation on Windows XP 24
5.5 Confirmation of USB Driver Installation 27

6. Flash Programmer WriteEZ5 28

6.1 Device Setup 28
6.2 Using WriteEZ5 30

7. Sample projects 31

7.1 RF-Test program 31
7.1.1 Opening the IAR Embedded Workbench workspace 31

7.1.2 Predefined project settings 32
7.1.3 Setting up the Transmitter 32
7.1.4 Setting up the Receiver 34
7.1.5 Setting up HyperTerminal for the transmitter 35
7.1.6 Transmit/Receive test 37
7.1.7 Channel selection 38
7.1.8 Output power adjustment 39
7.1.9 Further RF-Test modes and settings 40
7.1.9.1 PER test /receiver 40
7.1.9.2 Continuous TX / Pseudo Noise 40
7.1.9.3 Continuous TX / Raw Carrier 40
7.1.9.4 RX Mode 40
7.1.9.5 IDLE Mode 40
7.1.9.6 Standby Mode 41
7.1.9.7 Deep Sleep Mode 41
7.1.9.8 Power down mode 41
7.1.9.9 Resetting RF 41
7.2 MAC sample program: TextChat 41
7.2.1 Preparing the Hardware 41
7.2.2 Running the MAC sample program 41
7.2.2.1 Designation of the Coordinator 42
7.2.2.2 Designation of End Devices 43
7.2.2.3 Text Chat 44

8. BOM list 46

9. Schematics 48

List of Figures

Figure 1: 78K0R-UD-STICK-EE demonstration board (Top View) 12
Figure 2: 78K0R-UD-STICK-EE Block diagram 12
Figure 3: 78K0R-UD-STICK-EE LED1 (Top View) 13
Figure 4: 78K0R-UD-STICK-EE LED2-LED4 (Top View) 13
Figure 5: 78K0R-UD-STICK-EE CN2 Connector (Top View) 15
Figure 6: Connection 78K0R-UD-STICK-EE adapter board 15
Figure 7: *78K0R-UD-STICK-EE* CDROM autorun.exe 19
Figure 8: IAR Embedded Workbench installation screen 20
Figure 9: IAR Embedded Workbench License request and install 20
Figure 10: Found New Hardware Wizard (Windows 2000) 21
Figure 11: Search Method (Windows 2000) 22
Figure 12: Driver File Location (Windows 2000) 22
Figure 13: Address Specification 2 (Windows 2000) 23
Figure 14: Address Specification 3 (Windows 2000) 23
Figure 15: Driver File Search (Windows 2000) 24
Figure 16: USB Driver Installation Completion (Windows 2000) 24
Figure 17: Found New Hardware Wizard 1 (Windows XP) 24
Figure 18: Found New Hardware Wizard 2 (Windows XP) 25
Figure 19: Search Location Specification 1 (Windows XP) 25
Figure 20: Search Location Specification 2 (Windows XP) 26
Figure 21: Windows XP Logo Testing (Windows XP) 26
Figure 22: USB Driver Installation Completion (Windows XP) 27
Figure 23: Windows Device Manager 27
Figure 24: WriteEZ5 Startup 28
Figure 25: WriteEZ5 Device Setup Dialogue 28
Figure 26: WriteEZ5 Device Menu 30
Figure 27: IAR Embedded Workbench Startup screen 31
Figure 28: IAR Embedded Workbench IDE view 32
Figure 29: IAR Embedded Workbench RF-Test project configuration selection 33
Figure 30: IAR Embedded Workbench Debugger Settings 34
Figure 31: IAR C-SPY debugger window 35
Figure 32: HyperTerminal Connection Description 36
Figure 33: HyperTerminal COM Port selection 36
Figure 34: HyperTerminal COM Port properties 36
Figure 35: RF-Test project opening window 37
Figure 36: HyperTerminal RF-Test PER test 37
Figure 37: RF-Test PER test result 38
Figure 38: RF-Test Channel selection 38
Figure 39: RF-Test PER test Channel 23 39
Figure 40: RF-Test Output power adjustment 1 39
Figure 41: RF-Test PER test power adjusted 40
Figure 42: MAC sample program startup screen 42
Figure 43: MAC sample configuration 43
Figure 44: MAC sample End Device 43
Figure 45: MAC sample End Device associated short address 44
Figure 46: MAC sample sending text message 44
Figure 47: MAC sample received message 45

List of Tables

Table 1: Power Supply 13
Table 2: USB I/F setting 13
Table 3: Communication switch setting....13
Table 4: Application LEDs 13
Table 5: 78K0R-UD-STICK-EE CN2 Connector Pin Out 15
Table 6: *78K0R-UD-STICK-EE* CD-ROM directory structure 17
Table 7: WriteEZ5 action buttons 30
Table 8: Switch settings for flash programming 33
Table 9: Switch settings for serial communication 33
Table 10: Microsoft™ HyperTerminal COM port properties....42
Table 11: Bill of Materials 47

1. Introduction

1.1 Package contents

- 1 x 78K0R UD Stick
- 1 x Adapter board
- 1 x Battery case
- CD-ROM containing sample applications and an evaluation copy of the IAR Embedded Workbench for 78K with 16Kbyte code size limitation

Please verify that you have received all parts listed in the package contents list attached to the *78K0R-UD-STICK-EE* demonstration kit package. If any part is missing or seems to be damaged, please contact the dealer from whom you received your *78K0R-UD-STICK-EE* demonstration kit.

1.2 Features

- Zigbee™ / RF4CE™ communication
- Programming / On-chip debug supported
- UBEC UZ2400 Low Power 2.4 GHz Transceiver for IEEE 802.15.4 standard
- Easy to use RF4CE sample projects

1.3 System requirements

HOST PC	A PC supporting Windows 2000, Windows XP or Windows Vista is required for the IAR Systems Embedded Workbench demo-version. A Pentium processor with at least 1 GHz CPU performance, with at least 256 Mbytes of RAM, allowing you to fully utilize and take advantage of the product features. 500 Mbytes of free disk space and an additional 10 Mbytes of free disk space on the Windows system drive. A web browser and Adobe Acrobat Reader to be able to access all the product documentation.
Host interface	USB interface that enables communication based on USB (Ver1.1 or later)

Note: Updates of the IAR Embedded Workbench for 78K, documentation and/or utilities for the *78K0R-UD-STICK-EE* Demonstration Kit, if available, may be downloaded from the Renesas WEB page(s) at http://www.renesas.eu/78K0R-UD-STICK-EE

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2. *Hardware*

This chapter describes the specification of 78K0R UD Stick board delivered with the *78K0R-UD-STICK-EE* demonstration kit.

The *78K0R-UD-STICK-EE* demonstration kit is assembled with a µPD78F1146 16-bit microcontroller and an UBEC UZ2400 Low Power 2.4 GHz Transceiver for IEEE 802.15.4 (Zigbee™) standard.

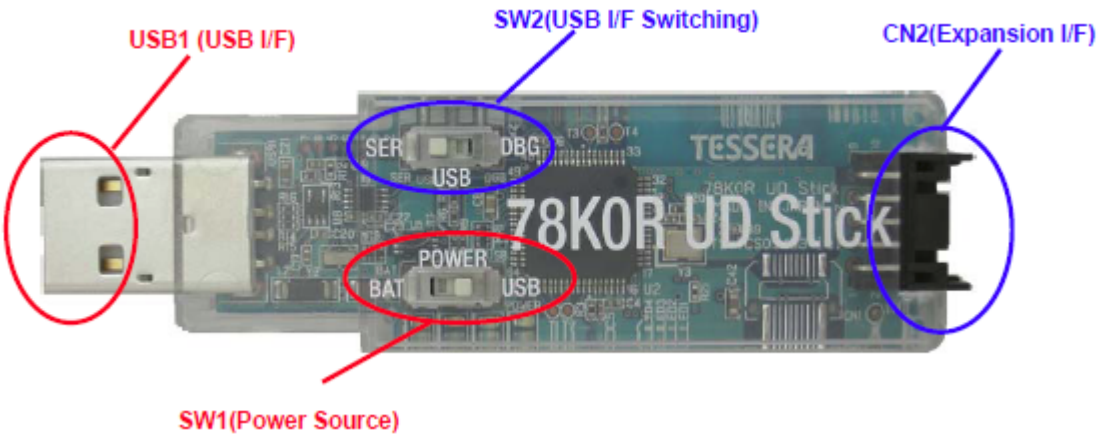

Figure 1: 78K0R-UD-STICK-EE demonstration board (Top View)

2.1 Block diagram

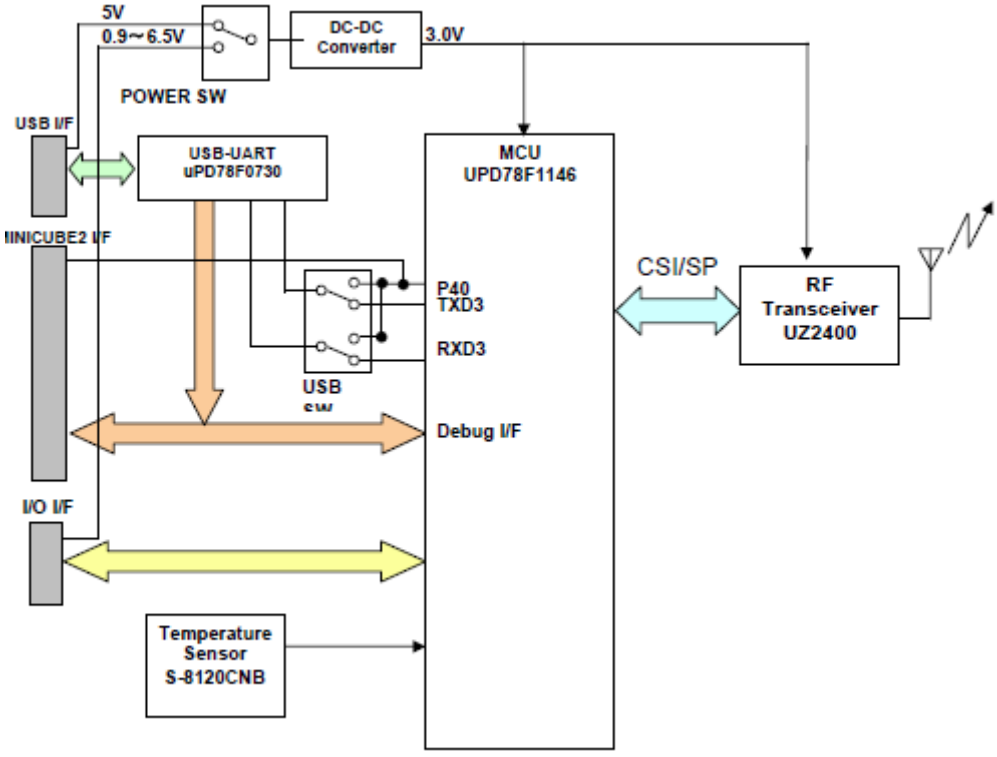

Figure 2: 78K0R-UD-STICK-EE Block diagram

2.2 SW1: Power supply selection

The *78K0R-UD-STICK-EE* can be powered either via USB or battery power connection, based on the SW1 setting.

Setting	Power supply
USB	USB power
BAT	CN2: Expansion I/F

Table 1: Power Supply

2.3 SW2: USB setting

SW2 is used to select the functionality of the USB I/F.

Setting	USB
SER	Normal mode (UART3 connection)
DBG	Debug mode

Table 2: USB I/F setting

2.4 LED1: Power LED

LED1 indicates the power supply status. LED1 can be turned off by setting P17 to Output High

Status	LED	
Power ON	On (green)	
Power ON	Off	P17 is Output High
Power OFF	Off	

Table 3: Communication switch setting

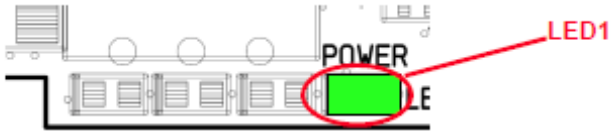

Figure 3: 78K0R-UD-STICK-EE LED1 (Top View)

2.5 LED2-LED4

These LEDs are assembled for application usage. They emit orange by setting the port output of P60, P61, or P62 of the µPD78F1146 to low, respectively.

LED	MCU Pin	Port Level	LED Status
LED2	P62	Low	LED active
		High	LED off
LED3	P61	Low	LED active
		High	LED off
LED4	P60	Low	LED active
		High	LED off

Table 4: Application LEDs

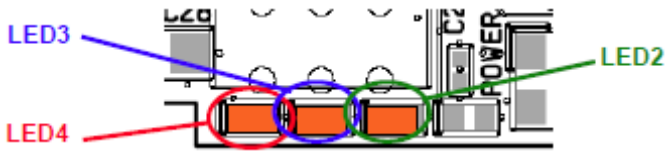

Figure 4: 78K0R-UD-STICK-EE LED2-LED4 (Top View)

2.6 CN2 connector

CN2 is an expansion connector (Hirose DF11-10DP-2DS).

Pin	Pin Name	µPD78F1146 connection	Notes
1	GND	GND	
2	Battery	Not connected	Battery supply
3	P12	P12/SO00/TxD0、P77/KR7/INTP11	
4	P11	P11/SI00/RxD0, P76/KR6/INTP10	
5	P141	P141/PCLBUZ1/INTP7, P05/TI05/TO05	
6	P10	P10/SCK00、P75/KR5/INTP9	
7	P25	P25/ANI5	
8	P23	P23/ANI3	
9	P24	P24/ANI4	
10	GND	GND	

Table 5: 78K0R-UD-STICK-EE CN2 Connector Pin Out

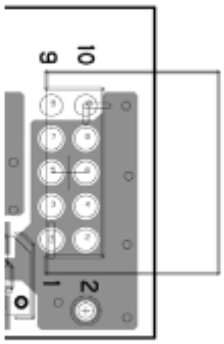

Figure 5: 78K0R-UD-STICK-EE CN2 Connector (Top View)

2.6.1 Connection of 78K0R-UD-STICK-EE adapter board

The *78K0R-UD-STICK-EE* Adapter board can be connected to the *78K0R-UD-STICK-EE* demonstration board via connector CN2.

Figure 6: Connection 78K0R-UD-STICK-EE adapter board

CN2 of the adapter board is the connector for the battery case. CN3 is a multi purpose connector.

2.7 USB programming and debugging interface

The *78K0R-UD-STICK-EE* evaluation board implements an on-board USB programming and debugging interface using the Renesas Electronics µPD78F0730 USB microcontroller. You can download code to the µPD78F1146 microcontroller from a host computer, and then proceed to debug that code (for information about debugging refer to the regarding chapter).

2.8 U1 Temperature sensor (S-8120CNB)

The temperature sensor “U1” (S-8120C from Seiko Instruments Inc.) is connected to the A/D converter input pin “P27/ANI7” of the µPD78F1146. For detailed information regarding the temperature to voltage ratio please refer to the temperature sensor data sheet (`432-01173-0-S-8110C-8120C_series.pdf`) in the directory “`\Doc`” of the demonstration kit CD-ROM.

2.9 Power supply

The *78K0R-UD-STICK-EE* can be powered by two different sources, USB or an AA battery via CN2 and the 78K0R UD Stick Adapter Board, based on the setting chosen by SW1.

If using the battery as power supply, please make sure to replace the battery if the voltage level goes below 0.9V, as below this voltage level the functions of the board can not be guaranteed. The battery voltage can be checked as follows.

26.4% of the battery output voltage is available at ANI6 (P26/ANI6). If the supply voltage falls below 1V, the signal of “P30/INTP3/RTC1HZ” will be LOW output. Use the internal pull-up resistor (PU3).

3. *78K0R-UD-STICK-EE* installation and operation

3.1 Getting started

It is necessary to have a valid IAR Embedded Workbench for 78K installation on the PC host system, to be able to compile and debug the available software samples provided with the *78K0R-UD-STICK-EE* demonstration kit. As communication interface between the PC host system and the *78K0R-UD-STICK-EE* evaluation board a standard USB interface line is needed. Before you can download and run a program, soft- and hardware have to be installed properly.

3.2 CD-ROM contents

The CD-ROM shows following directory structure:

78K0R-UD-STICK-EE	CD-ROM ROOT
Acrobat	- Acrobat Reader for 32Bit Windows OS
Doc	- Documentation
Driver	- *78K0R-UD-STICK-EE* USB driver files
IAR Systems Tools	- IAR Embedded Workbench for 78K
Sample projects	- Sample projects for the *78K0R-UD-STICK-EE* demonstration kit
WriteEZ5	- Flash Programmer WriteEZ5 incl. PRM file for µPD78F1146

Table 6: *78K0R-UD-STICK-EE* CD-ROM directory structure

3.3 Pre-programmed Demo-Application

The *TK-RF8058+SB-EE* demonstration kit is pre-programmed with the RF-Test software. For further information about this program please refer to chapter 7.1.

4. Hardware installation

After unpacking the *78K0R-UD-STICK-EE* demonstration kit, connect the board with your host computer. When connected, the USB driver needs to be installed on the host machine. Please refer to the following **Chapter 5 Software Installation**.

5. Software installation

The *78K0R-UD-STICK-EE* package comes with the following software packages:

- IAR Systems Embedded Workbench for 78K 16Kbyte code size limited, including C compiler, assembler, linker, librarian and IAR C-SPY debugger / simulator
- Sample project for the IAR Embedded Workbench for 78K
- WriteEZ5 flash programmer including the PRM file for µPD78F1146

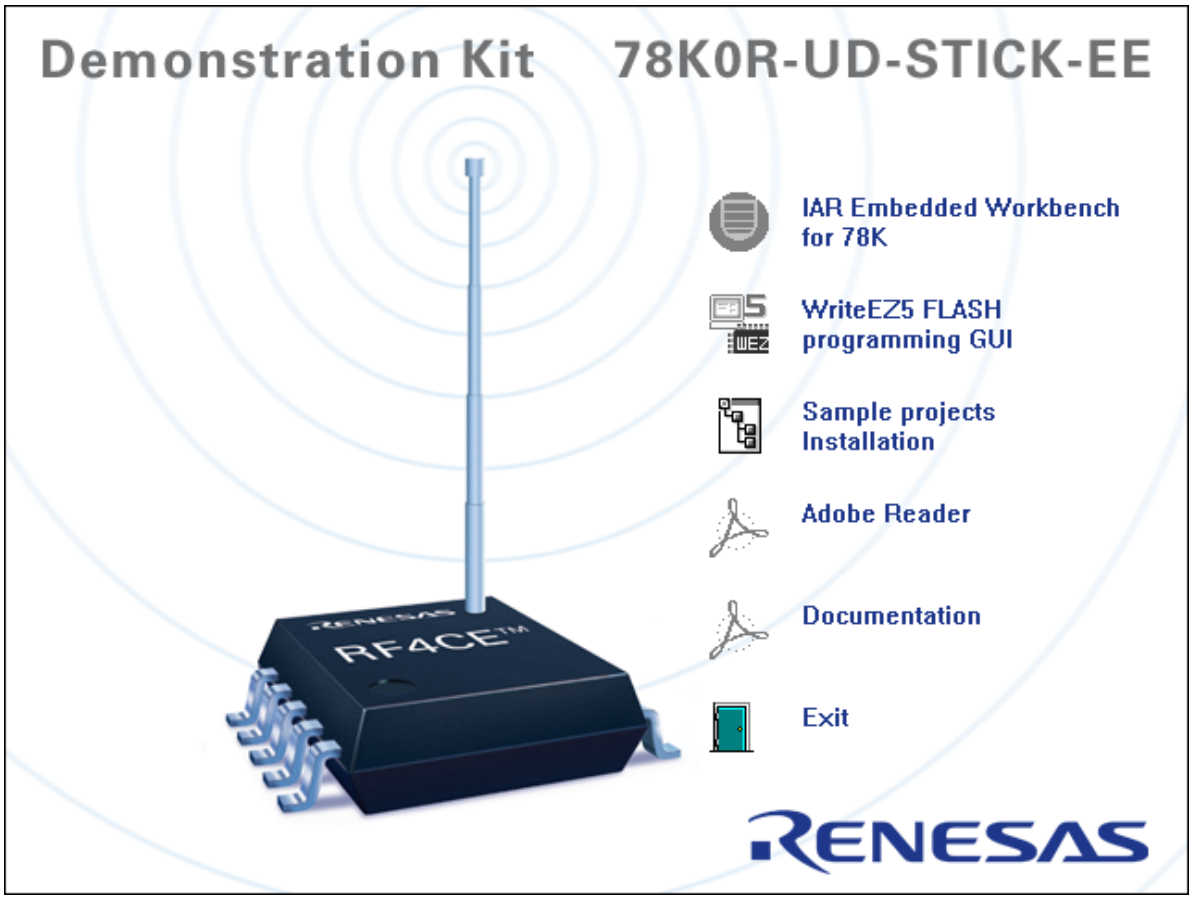

Figure 7: *78K0R-UD-STICK-EE* CDROM autorun.exe

5.1 IAR Systems Embedded Workbench for 78K installation

To install the IAR Systems Embedded Workbench for 78K including C-SPY debugger / simulator press the regarding button from the Autorun of the CD-ROM provided within the *78K0R-UD-STICK-EE* package. The installation can also be started by executing the `Autorun.exe` program in the directory "`\IAR Systems Tools\`" of the CD-ROM. The setup dialogues will guide you through the installation process.

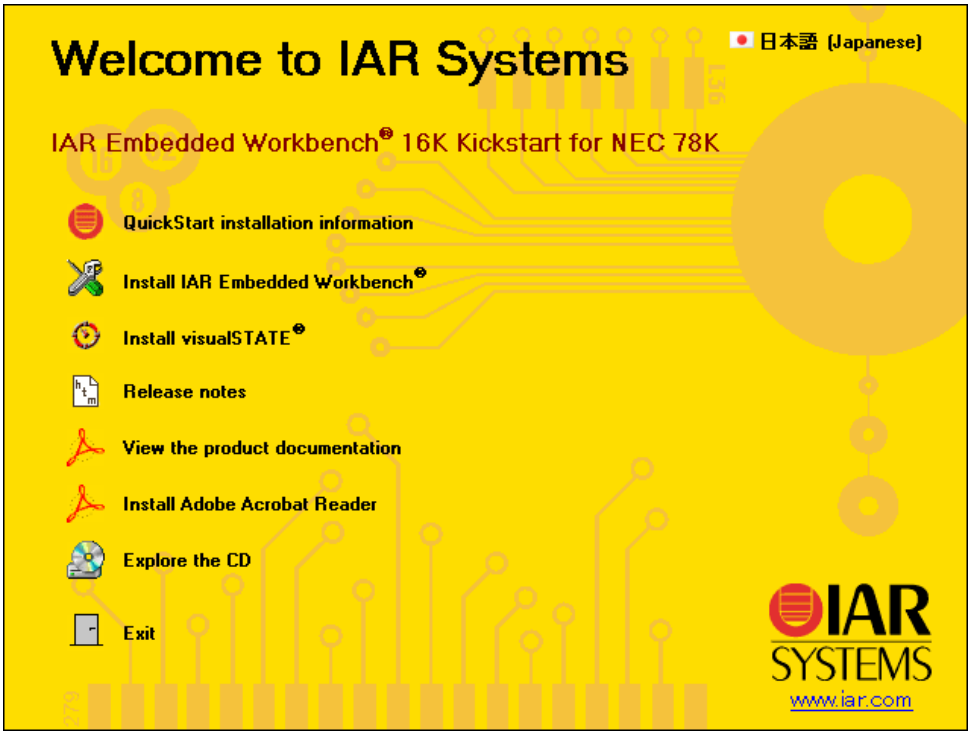

Figure 8: IAR Embedded Workbench installation screen

Note: To be able to install the IAR Embedded Workbench 16K Kickstart for 78K a License number and key have to be requested free of charge via an online registration.

Figure 9: IAR Embedded Workbench License request and install

For further information on the IAR Embedded Workbench installation refer to the `InstallationGuide.ENU.pdf` in the directory "`\IAR Systems Tools\doc\common\doc`" of the CD-ROM.

5.2 WriteEZ5 installation

To install WriteEZ5 just press the regarding button from the Autorun of the CD-ROM provided within the *78K0R-UD-STICK-EE* package. The setup dialogues will guide you through the installation process. The installation can also be started by executing the `WriteEZ5_V100_r3_EE.exe` in the directory `"\WRITEEZ5"` of the CD-ROM.

5.3 Sample projects installation

To copy the sample projects to the Host PC hard drive press the regarding button from the Autorun of the CD-ROM provided within the *78K0R-UD-STICK-EE* package. The setup dialogues will guide you through the copying process. The copy can also be started by executing the `78K0R-UD-STICK-EE_sample_projects.exe` in the directory `"\Sample projects"` of the CD-ROM.

5.4 USB Driver Installation

In order to use the *78K0R-UD-STICK-EE* evaluation board the USB driver needs to be installed on the host machine. Install the driver according to the following procedure:

Installation on Windows 2000 Page 21
Installation on Windows XP Page 24

5.4.1 Installation on Windows 2000

1. When the *78K0R-UD-STICK-EE* evaluation board is connected with the host machine, the board is recognized by <Plug and Play>, and the wizard for finding new hardware is started. Click Next>.

Figure 10: Found New Hardware Wizard (Windows 2000)

2. Following the window below is displayed. So, check that "Search for a suitable driver ..." is selected, then click Next>.

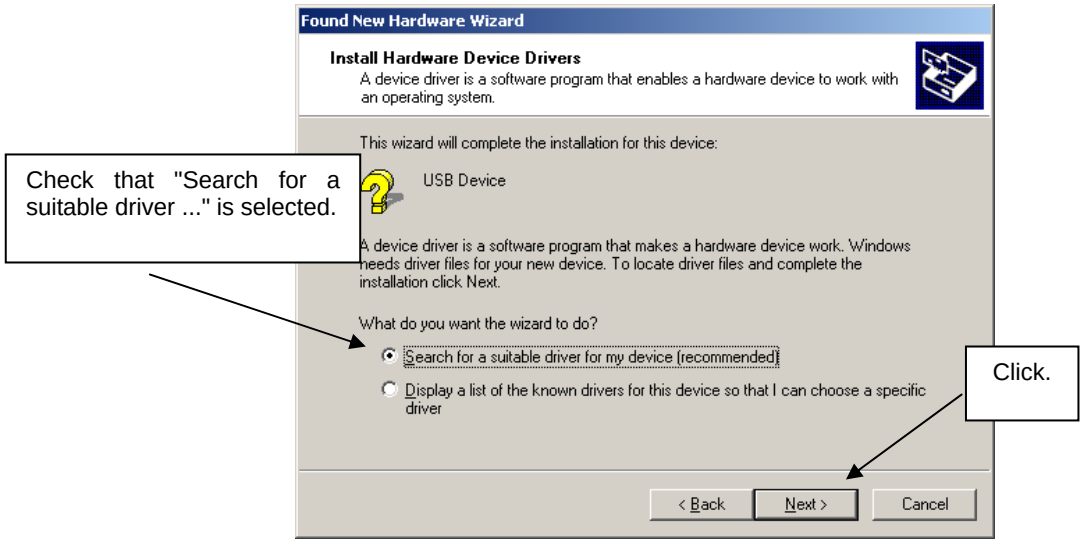

Figure 11: Search Method (Windows 2000)

3. Check the "Specify a location" check box only, then click Next>.

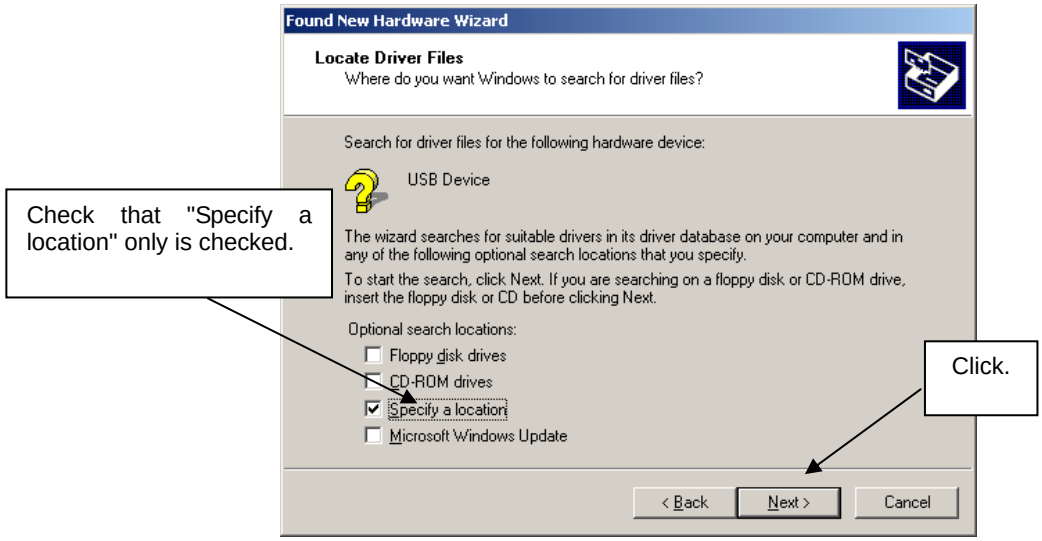

Figure 12: Driver File Location (Windows 2000)

4. Locate to the folder "CDROM:\Driver".

5. The setup information file “MQB2ALL.inf” is automatic selected, then click Open to proceed within driver installation.

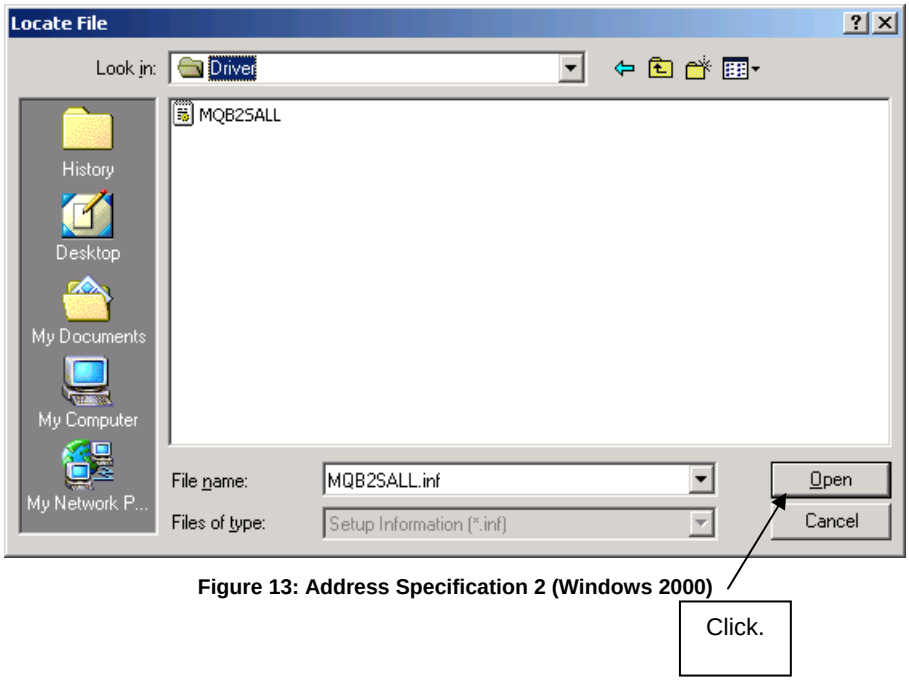

Figure 13: Address Specification 2 (Windows 2000)

6. After the location of the USB driver has been specified click OK to proceed.

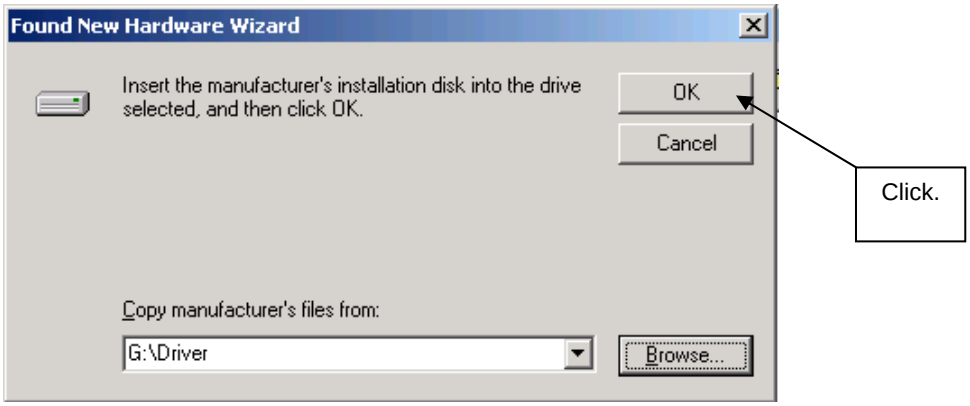

Figure 14: Address Specification 3 (Windows 2000)

7. Click Next>.

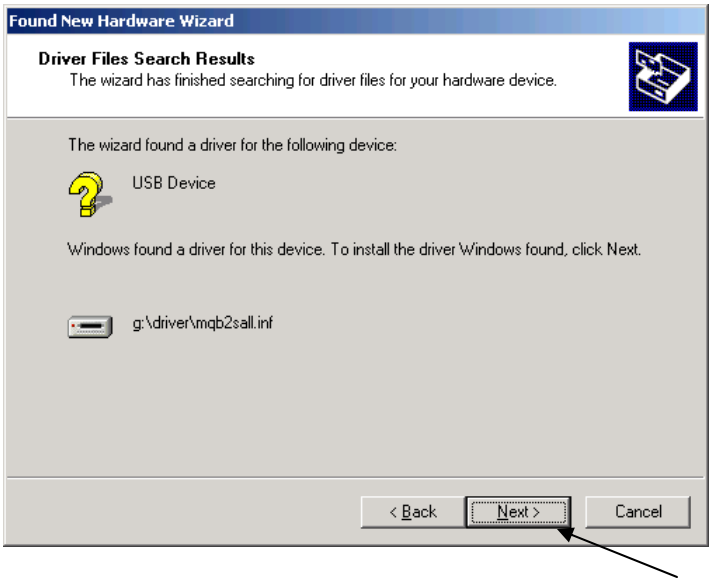

Figure 15: Driver File Search (Windows 2000)

Click.

8. Click Finish to complete the installation of the USB driver.

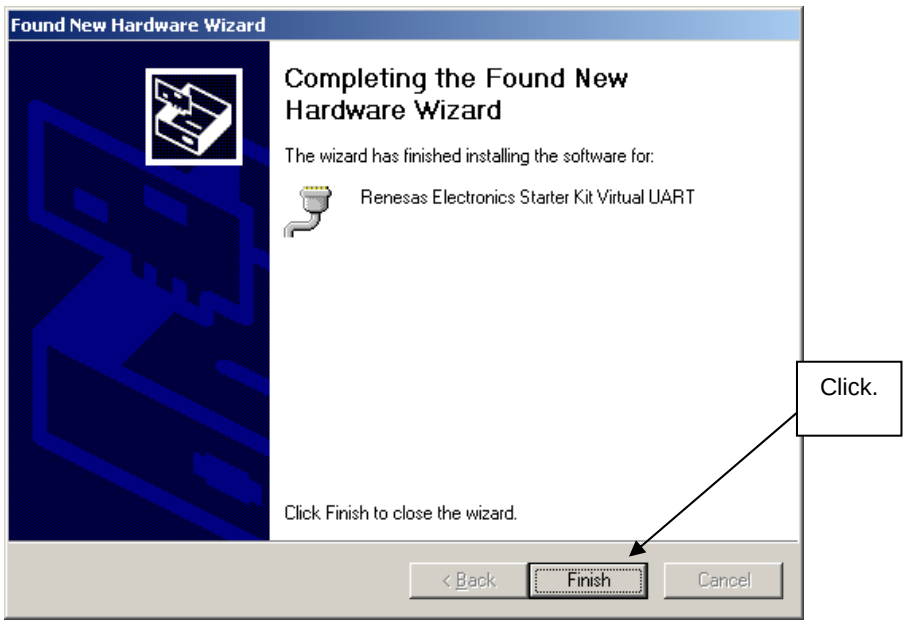

Figure 16: USB Driver Installation Completion (Windows 2000)

5.4.2 Installation on Windows XP

1. When the *78K0R-UD-STICK-EE* evaluation board is connected with the host machine, the board is recognized by Plug and Play, and the wizard for finding new hardware is started. At first the hardware wizard will ask if windows should search on the windows update web, check "No, not this time" and then click Next>.

Figure 17: Found New Hardware Wizard 1 (Windows XP)

2. Check that "Install from a list or specific location (Advanced)" is selected, then click Next>.

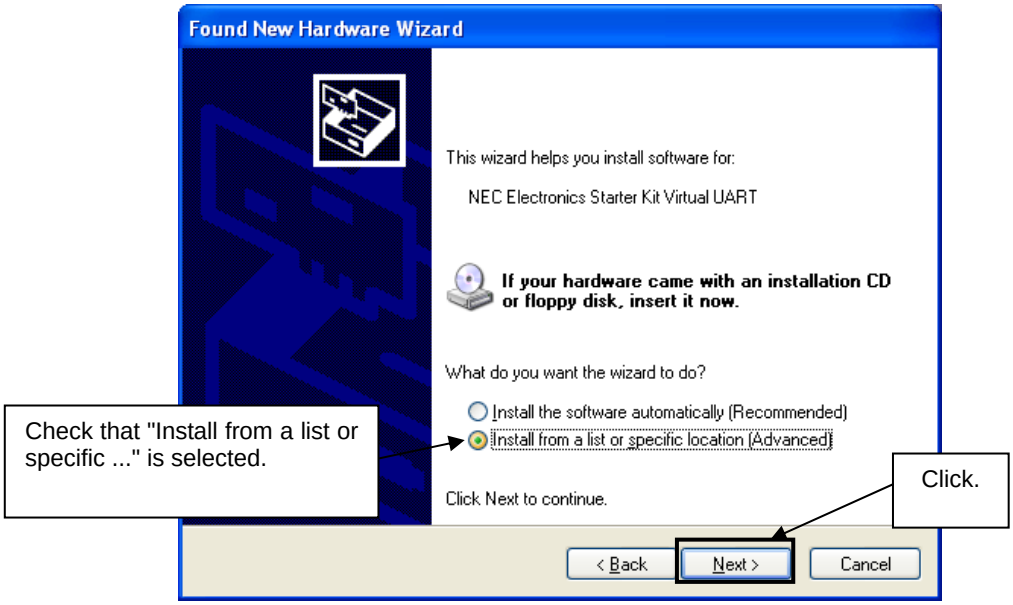

Figure 18: Found New Hardware Wizard 2 (Windows XP)

3. Check that "Search for the best driver in these locations." is selected. Select the "Include this location in the search:" check box and then click Browse.

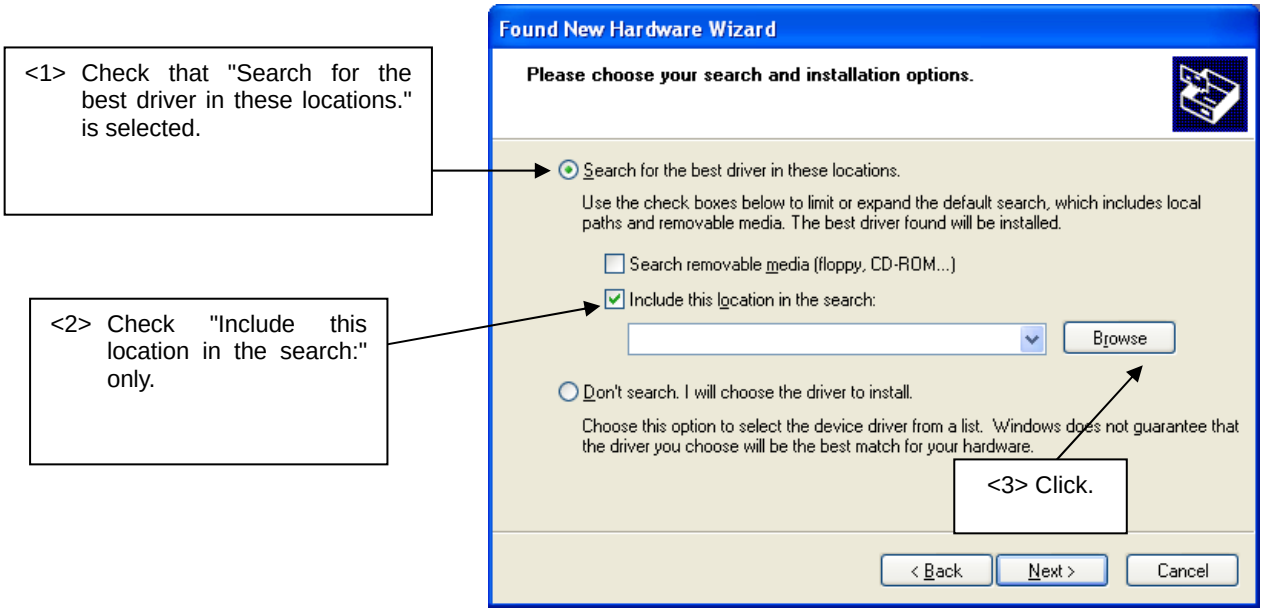

Figure 19: Search Location Specification 1 (Windows XP)

4. Locate the folder "**CDROM**:\Driver\" and click OK.

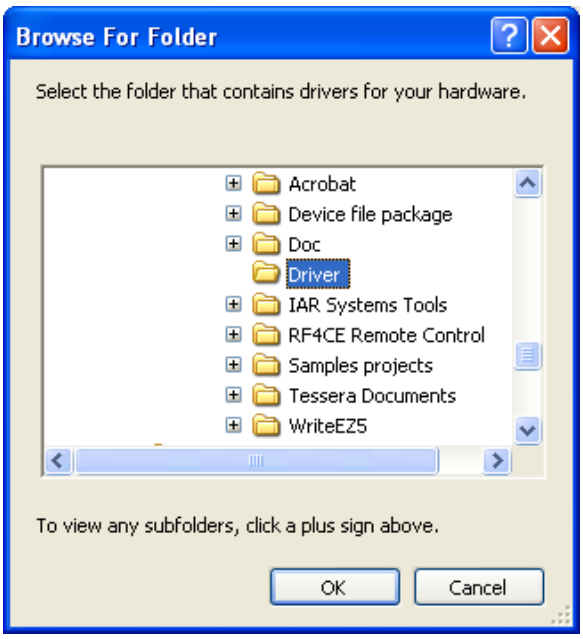

Figure 20: Search Location Specification 2 (Windows XP)

5. As shown below, "Renesas Electronics Starter Kit Virtual UART has not passed Windows Logo testing to verify its compatibility with Windows XP." is displayed. Click Continue Anyway.

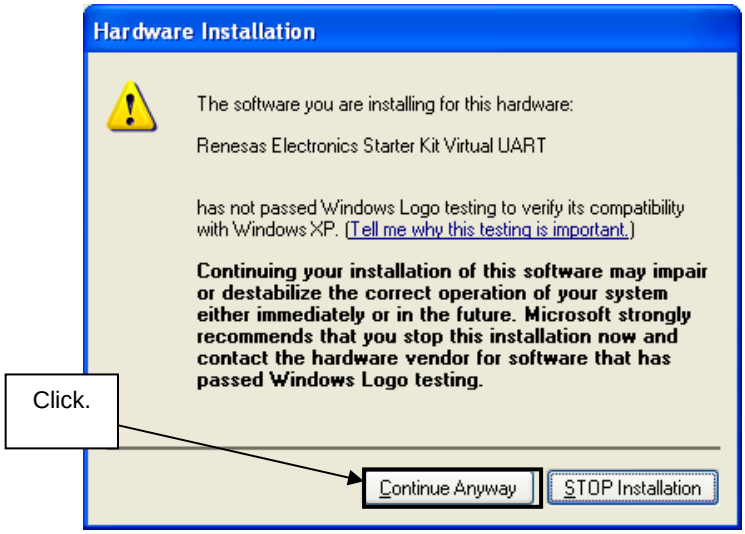

Figure 21: Windows XP Logo Testing (Windows XP)

6. After the installation of the USB driver is completed the window below is displayed. Click Finish to close the hardware wizard.

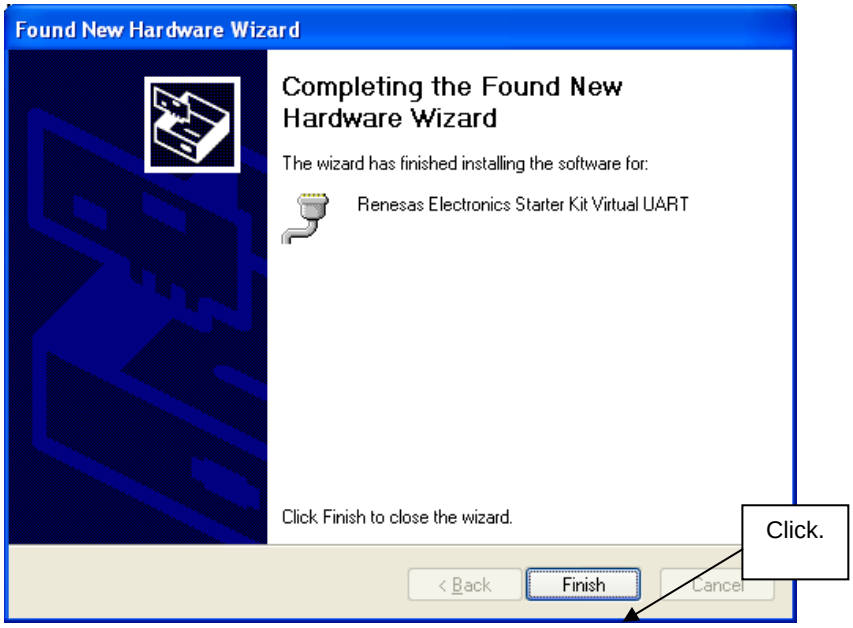

Figure 22: USB Driver Installation Completion (Windows XP)

5.5 Confirmation of USB Driver Installation

After installing the USB driver, check that the driver has been installed normally, according to the procedure below. When using the *78K0R-UD-STICK-EE* evaluation board the “Renesas Electronics Starter Kit Virtual UART” should be present like in the figure below.

Please check in the Windows "Device Manager" within the Windows Properties (“Hardware” tab), that the driver is installed normally.

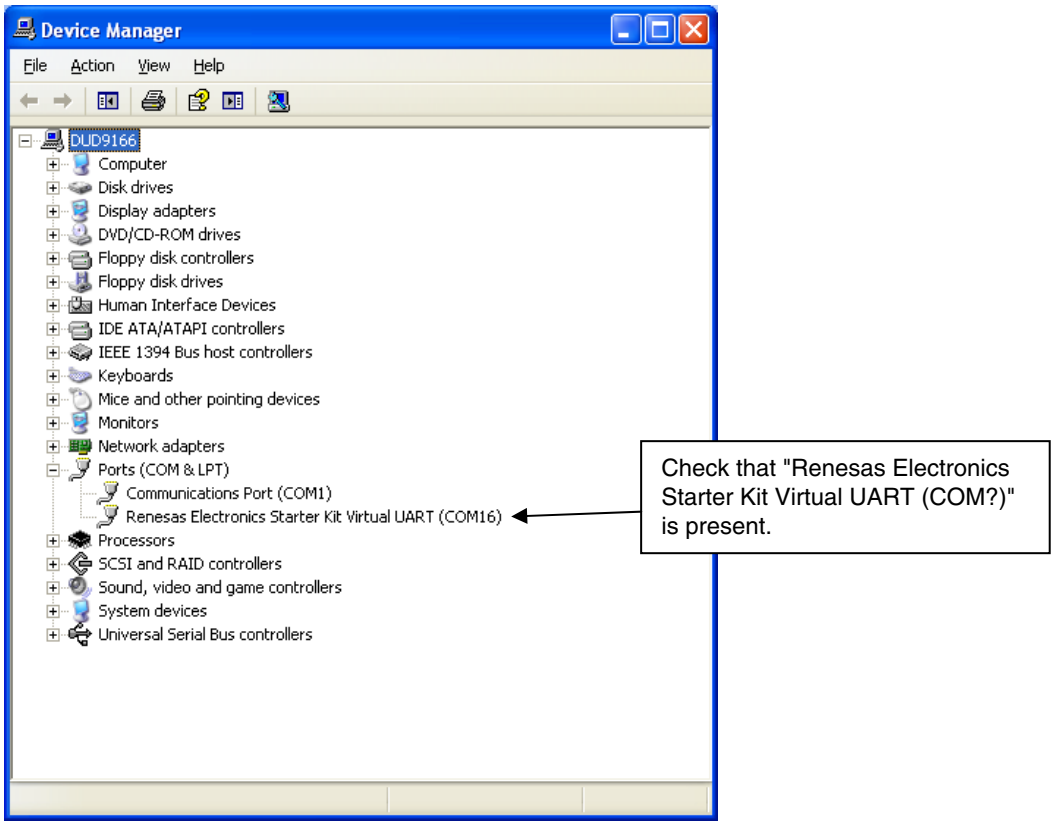

Figure 23: Windows Device Manager

6. Flash Programmer WriteEZ5

The WriteEZ5 is flash programming software to flash hex files to the related device. For installation information refer to the chapter WriteEZ5 installation.

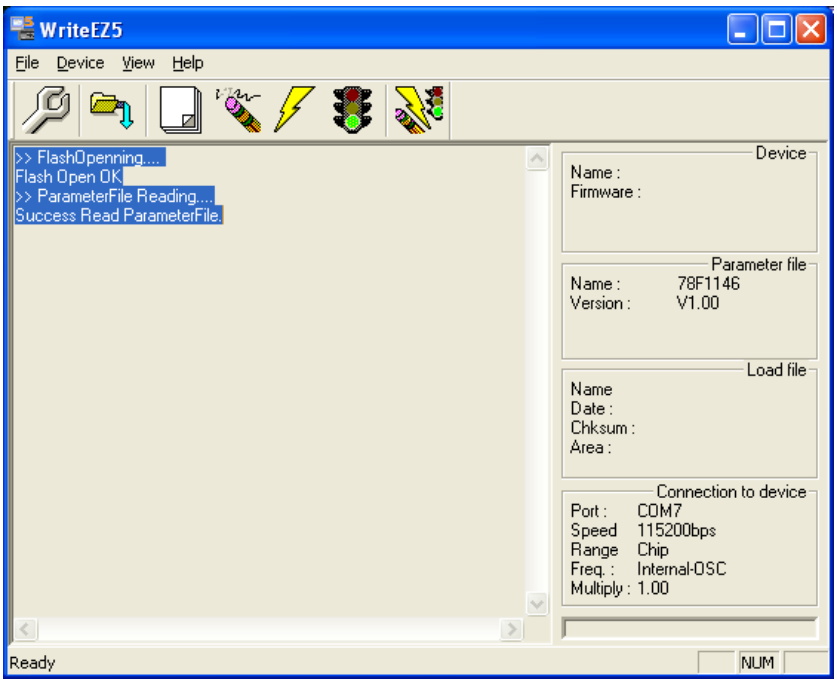

Figure 24: WriteEZ5 Startup

6.1 Device Setup

To provide all necessary information about the device to be programmed, only the corresponding flash parameter file must be loaded. The parameter file (*.prm) of the µPD78F1146 is located on the CDROM. It can be found in a subfolder of the WriteEZ5 setup file. Please use the menu **"Device → Setup…"** to open the following dialogue and the button **"PRM File Read"** to select the parameter file.

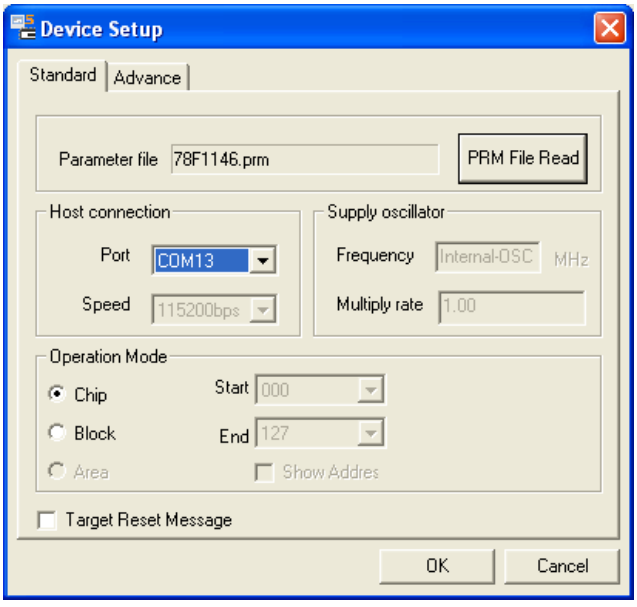

Figure 25: WriteEZ5 Device Setup Dialogue

Please check that the correct host communication port is selected. The used communication port can be seen in the Windows Device Manager.

6.2 Using WriteEZ5

After a successful device selection the internal flash memory can be blank-checked, erased, programmed and/or verified. WriteEZ5 can be controlled either by menu or by buttons.

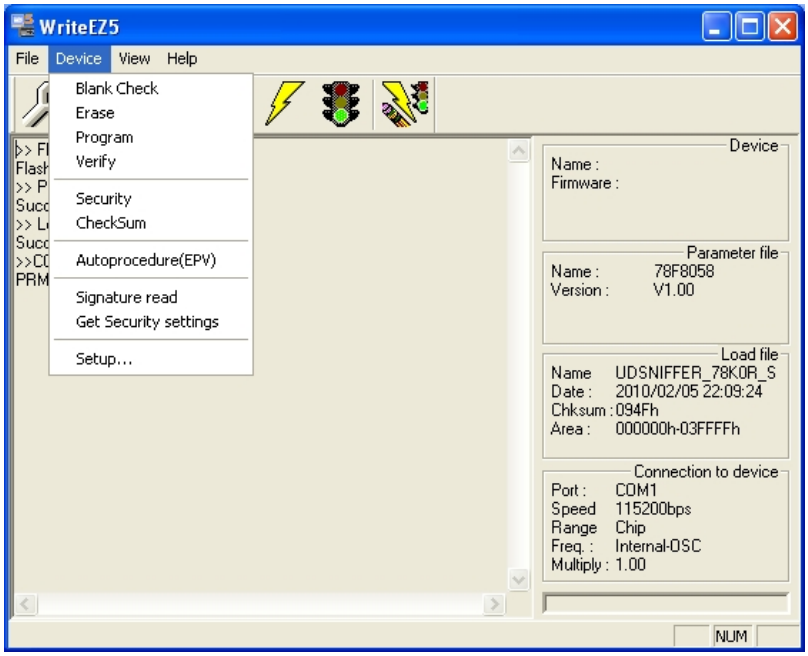

Figure 26: WriteEZ5 Device Menu

	device setup button
	load file button
	blank check button
	erase button
	program button
	verity button
	erase / program / verify button

Table 7: WriteEZ5 action buttons

WriteEZ5 supports Intel-Hex and Motorola S-record file formats as input file.

7. Sample projects

The *78K0R-UD-STICK-EE* demonstration kit comes with two sample applications, a RF-Test program, which is provided as an IAR Embedded Workbench project, and a simple MAC application utilizing an IEEE 802.15.4 PHY/MAC standard star network, provided as hex file. To be able to run these projects please run the Sample projects installation to copy the files to your Host PC.

To be able to run the RF-Test application, make sure that the IAR Embedded Workbench and the WriteEZ5 are installed correctly on your Host PC. For functional testing of these sample projects it is necessary to have at least two *78K0R-UD-STICK-EE* demonstration kits.

7.1 RF-Test program

To run this sample application with all possible tests, it is mandatory that you have at least two *78K0R-UD-STICK-EE* demonstration kits. Furthermore you need an identical number of PCs or one PC with more than one USB interface. Hereinafter, the first 78K0R-UD-STICK-EE demonstration kit is called "**transmitter**" and the other one with USB interface to the second PC or USB Port for debugging is called "**receiver**", which send back the test result to the **transmitter**.

7.1.1 Opening the IAR Embedded Workbench workspace

To start the IAR Embedded Workbench 16K Kickstart for 78K click **Start → All Programs → IAR Systems → IAR Embedded Workbench for 78K 4.62 Kickstart → IAR Embedded Workbench**.

The Embedded Workbench Startup screen comes up. To open the sample project workspace press the **Open existing workspace** button and locate the **TK78K0R.eww** file in the "`RF-Test_IAR`" sub-folder, of your Sample projects installation.

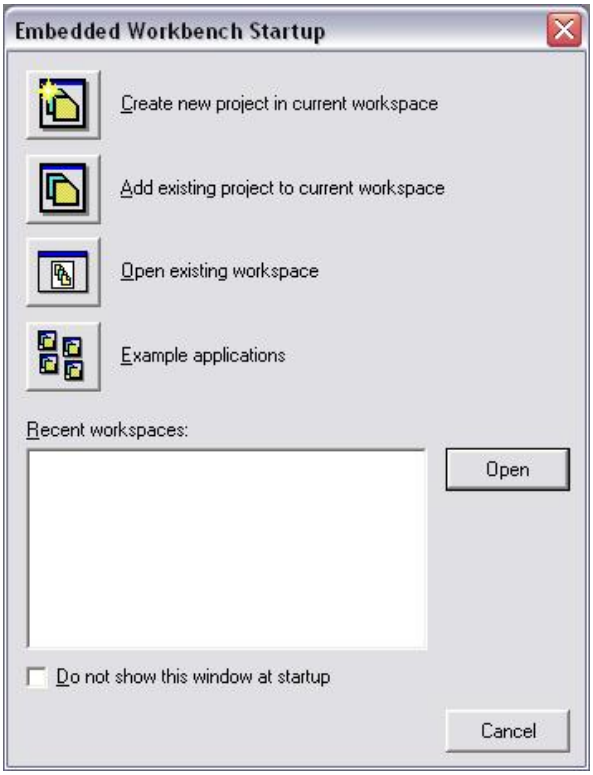

Figure 27: IAR Embedded Workbench Startup screen

The project shall show up on the left side of the IAR Embedded Workbench window in the Workspace view.

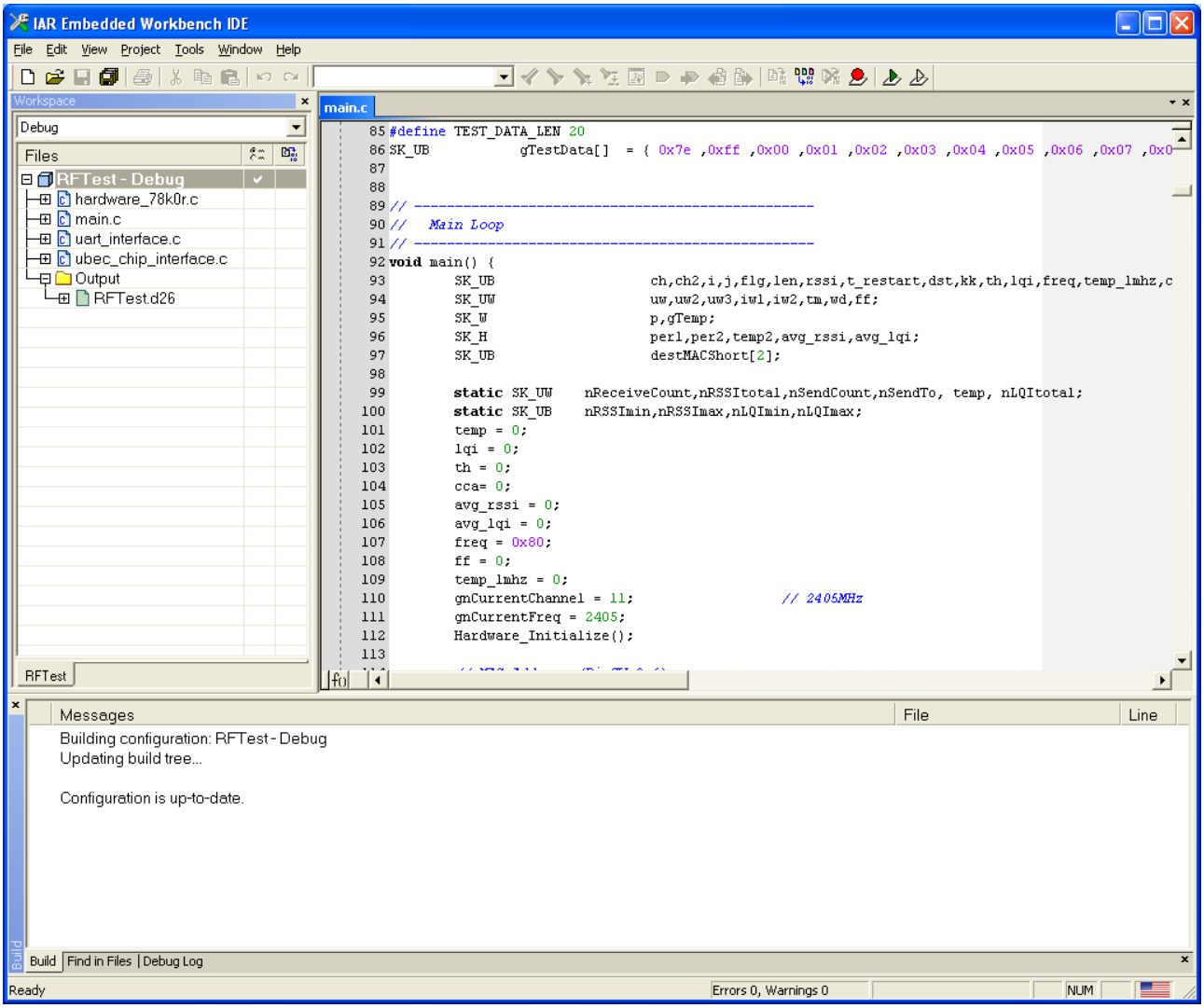

Figure 28: IAR Embedded Workbench IDE view

7.1.2 Predefined project settings

The RF-Test project contains 3 predefined project settings, two release settings only differing in the short address (MAC_ADDR) 0x0001 and 0x0002, which is used to identify the *78K0R-UD-STICK-EE* in the network, and a debug configuration with a predefined short address (MAC_ADDR) of 0x0002 and a fixed setting as **receiver**. The debug configuration generates an IAR C-SPY specific output format and the release versions are generating .hex files that can be flashed with the WriteEZ5 software.

7.1.3 Setting up the Transmitter

To set up the transmitter please select the predefined project configuration “Release 0001” from the drop-down menu in the upper side of the Workspace window and rebuild the project (Project → Make). Now you will find the file “`RFTEST_0001.hex`” in the subfolder “`\Release 0001\exe`” of the RF-Test project.

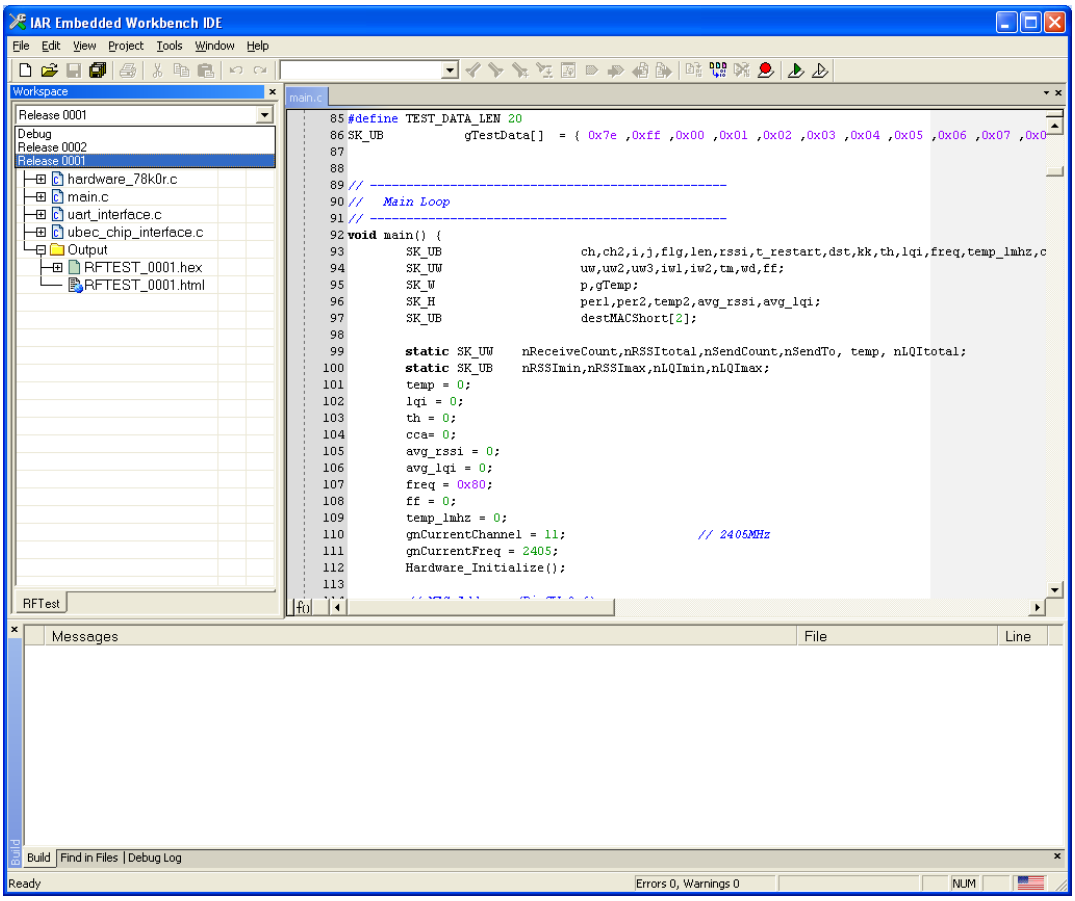

Figure 29: IAR Embedded Workbench RF-Test project configuration selection

To download the program to the **transmitter** has to be set up with the following setting.

Switch	Position
SW1	DBG
SW2	USB

Table 8: Switch settings for flash programming

Note: Make sure to disconnect the transmitter is not connected to the Host PC while making hardware setting changes.

When the hardware is set up with the above shown configuration please use the WriteEZ5 software to program the hex file of the **transmitter**.

After a successful download of the program close WriteEZ5, disconnect the **transmitter** from your Host PC to change the **SW2** setting from **DBG** to **SER** and connect it to the Host PC again.

Switch	Position
SW1	SER
SW2	USB

Table 9: Switch settings for serial communication

7.1.4 Setting up the Receiver

To set up the receiver please select the predefined debug configuration of the IAR project. Make sure that the MINICUBE is selected as debugger driver (Project → Options → Debugger → Driver → MINICUBE) as shown below.

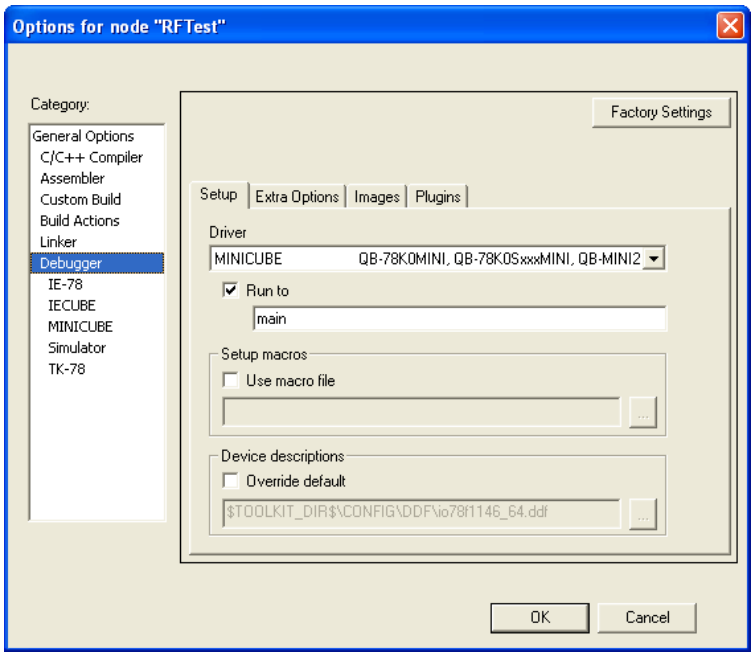

Figure 30: IAR Embedded Workbench Debugger Settings

Before connecting the **receiver** to the Host PC, make sure that the switch setting described in Table 8 is chosen.

Note: Before the first use of the IAR C-SPY debugger please make sure to erase the flash memory using WriteEZ5.

When the *78K0R-UD-STICK-EE* evaluation board is connected correctly to the Host PC, the flash is erased and MINICUBE is selected as Debugger driver you shall be able to build, download and debug the sample project. Therefore just press the **Download and Debug** button ( ) or click **Project → Download and Debug**. After downloading the sample project to the target device the IAR C-SPY debugger shows up and the program execution shall be stopped at the beginning of the **main()** function.

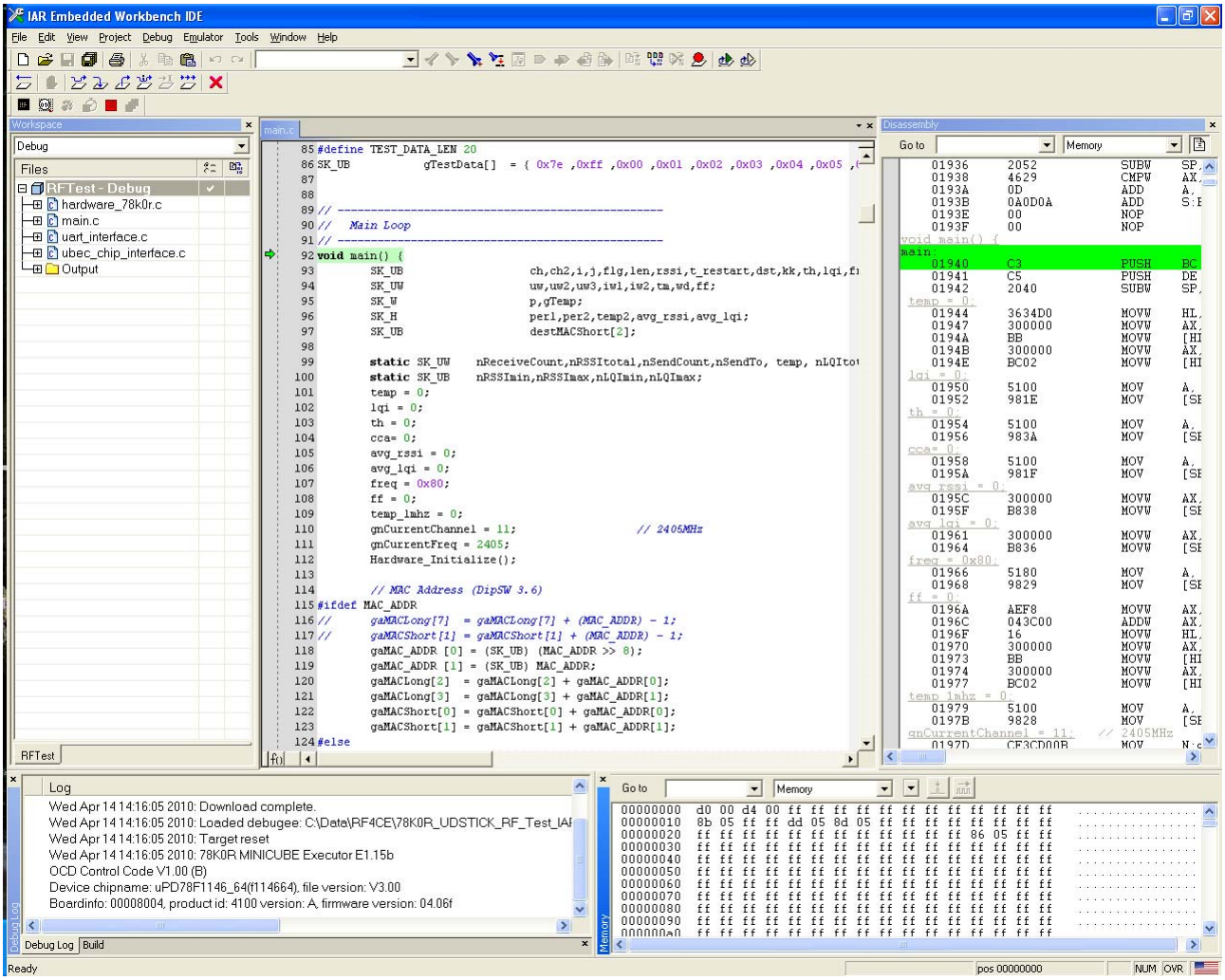

Figure 31: IAR C-SPY debugger window

To run the application press the **Run** button. After pressing the run button the **receiver** is in the reception mode.

7.1.5 Setting up HyperTerminal for the transmitter

When the software is flashed into the **transmitter** device and the switches are set up correctly the software can be tested by using a terminal program.

In this document the Microsoft™ HyperTerminal is used, but in fact any kind of other terminal tool should be sufficient, too.

To open Microsoft™ HyperTerminal please press Start → All Programs → Accessories → Communication → HyperTerminal from your Microsft™ Windows.

First of all a new connection has to be configured as follows.

1. Insert a Name of the new configuration (for example: “transmitter”)

Figure 32: HyperTerminal Connection Description

2. Select the correct COM Port. If you are not sure about the COM port number, click Start → Settings → Control Panel → System → Hardware → Device Manager and check the number at “Renesas Electronics Starter Kit Virtual UART" under "Ports (COM & LPT)".

Figure 33: HyperTerminal COM Port selection

3. Setting the COM properties as follows

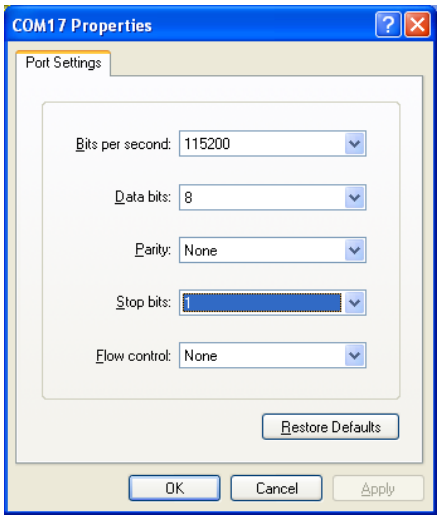

Figure 34: HyperTerminal COM Port properties

After pressing “ENTER” on the keyboard the opening menu will show up in the HyperTerminal window.

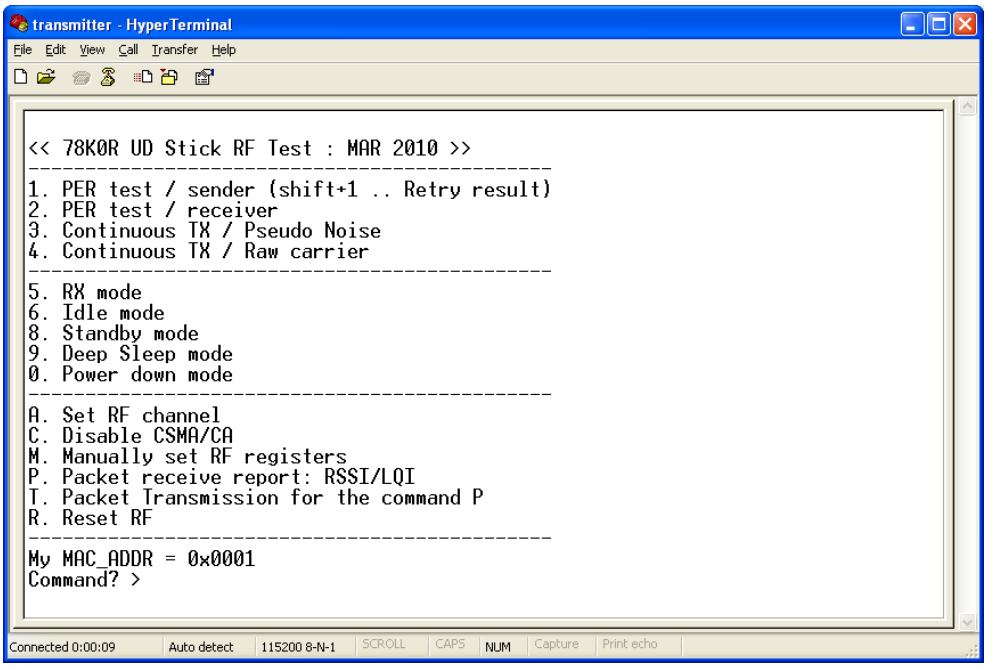

Figure 35: RF-Test project opening window

If the opening window is not displayed after pressing “ENTER” please check the following. Set SW1 of the **transmitter** from **USB** to **BAT** and back to **USB** once.

7.1.6 Transmit/Receive test

The sample software provides a so called PER (Packet Error Rate) test. To start this test, insert 1 in the HyperTerminal. You will see the [MyProfile] and will be asked to insert the Short Address (MAC_ADDR) of the destination. Make sure that the r**eceiver** is running at this time in the IAR C-SPY debugger. The **receiver** address is 0x0002. So please insert 0002 in the HyperTerminal. Now you are asked how many packets you want to send to the **receiver** in this test. 1000 is a sufficient amount of packets. As last information you have to insert the interval time of the packets to send to the **receiver** in msec. Here a time between 3-10 msec is sufficient.

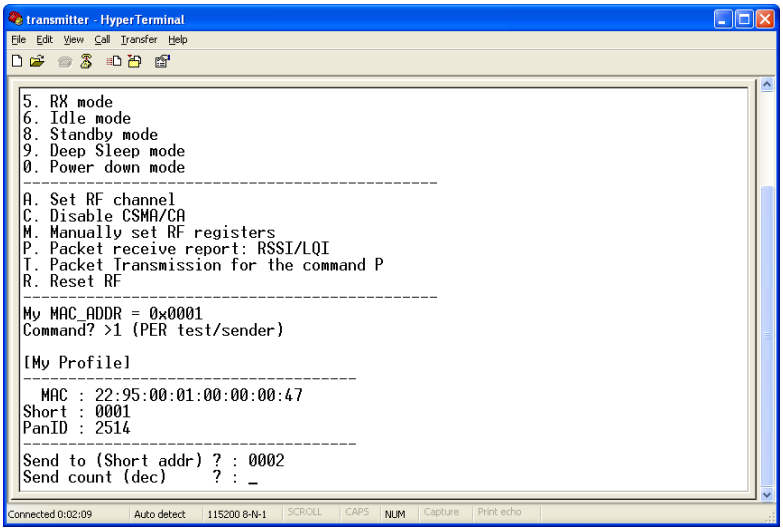

Figure 36: HyperTerminal RF-Test PER test

After a short time you will get the result displayed in the HyperTerminal window of the **transmitter**.

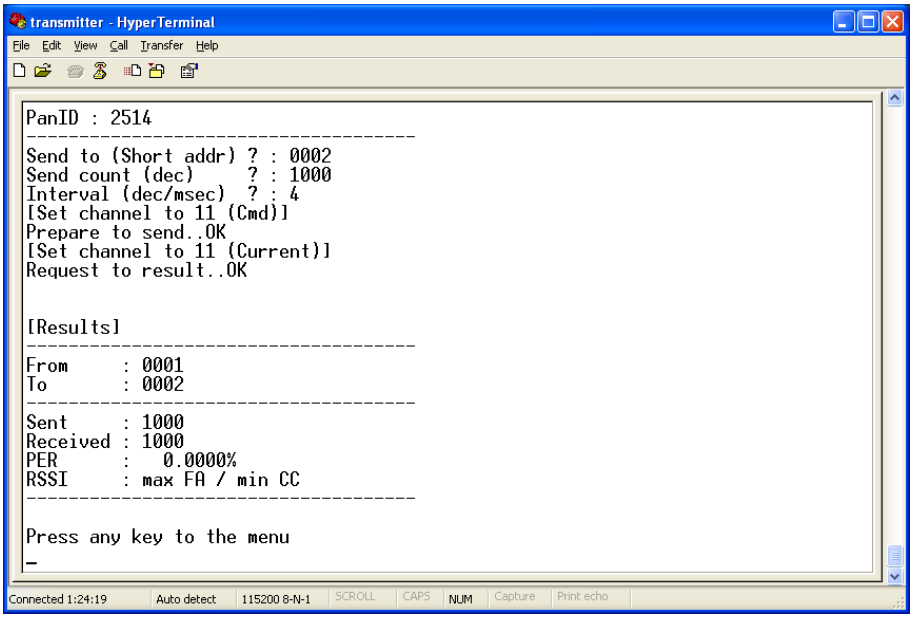

Figure 37: RF-Test PER test result

The result is shown as a list of Sent, Received, PER and RSSI (Received Signal Strength Indication).

RSSI is expressed in a hexadecimal value of 256 levels, which indicates the signal strength in the received signal. For more details of the RSSI value, please refer to the datasheet of the UZ2400 RF chip. Please note the PER and the RSSI are measured at the receiver side. The receiver does not send back the test packets, but only the test result.

7.1.7 Channel selection

In the previous example, you may have also found the RF channel used in this test is the Channel 11. The channel is specified by the IEEE 802.15.4 specification. Channel 11 is assigned at 2405 MHz. You can change the channel used for the PER test in 5MHz steps to the maximum channel of 26th at 2480 MHz. To do so, please press “A” in the HyperTerminal when you are in the opening window. Then, please choose the channel by “+”, “-“, “A”, “B”, or “C”. In the example below, the channel 23th, 2465 MHz, was selected.

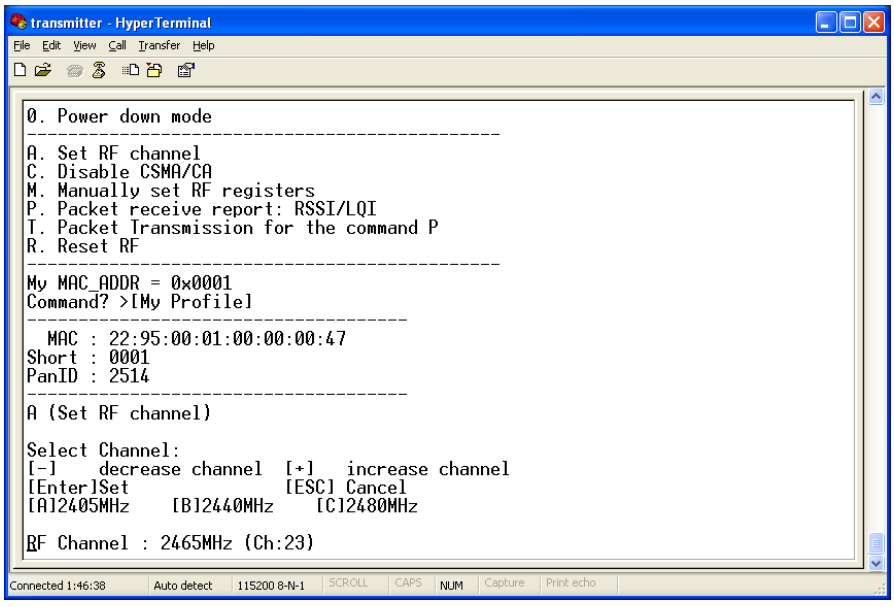

Figure 38: RF-Test Channel selection

To start a PER test at channel 23 now, press “ENTER” on your keyboard to get back to the Opening window and press “1” once more. To run the test insert the receiver short address, the amount of packets to send and the interval time again. Please check that the correct channel is selected for communication, shown in the **transmitter** window.

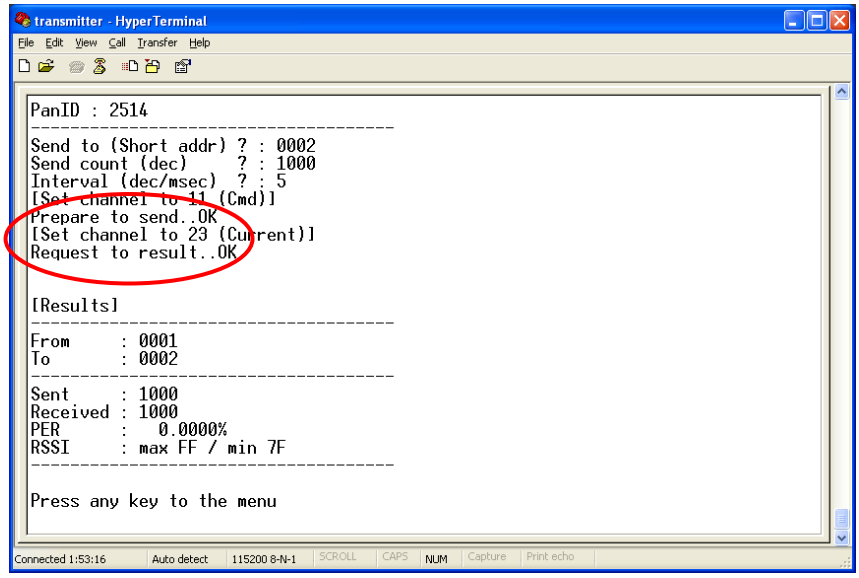

Figure 39: RF-Test PER test Channel 23

7.1.8 Output power adjustment

The RF-Test project also provides the functionality to adjust the used output power. To do this press “M”, when being the opening window.

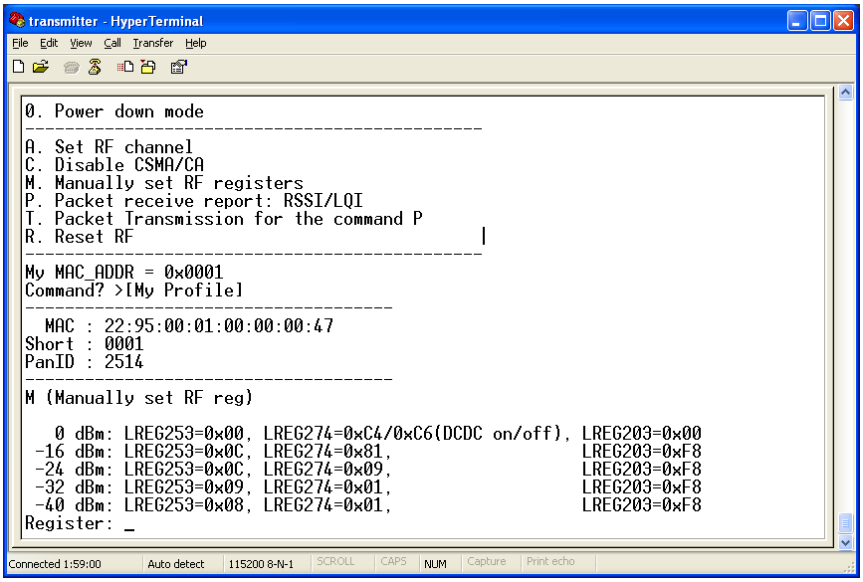

Figure 40: RF-Test Output power adjustment 1

You will be asked to insert the register ID. Please input “**274**”. Then you will see, “LREG[274] : C4 >”.
It means the current value at the register [274] is 0xC4h, which means 0 dB. 0xC4h is the reset default.

LREG[274]: [7:6] -> large scale tuning
- C4: 0 dB
- 81: -8 dB
- 09: -16 dB
- 01: -24 dB

LREG[203]: [7:3] -> small scale tuning
- 000000: 0 dB
- 000001: -0.1dB
- |
- 111111: -8.00 dB

So if you wish, for instance, a power adjustment of -8dB, please insert “81”. Then start the PER test again and insert the receiver short address, packet count and interval time.

You may find a larger PER and a smaller RSSI value in this case.

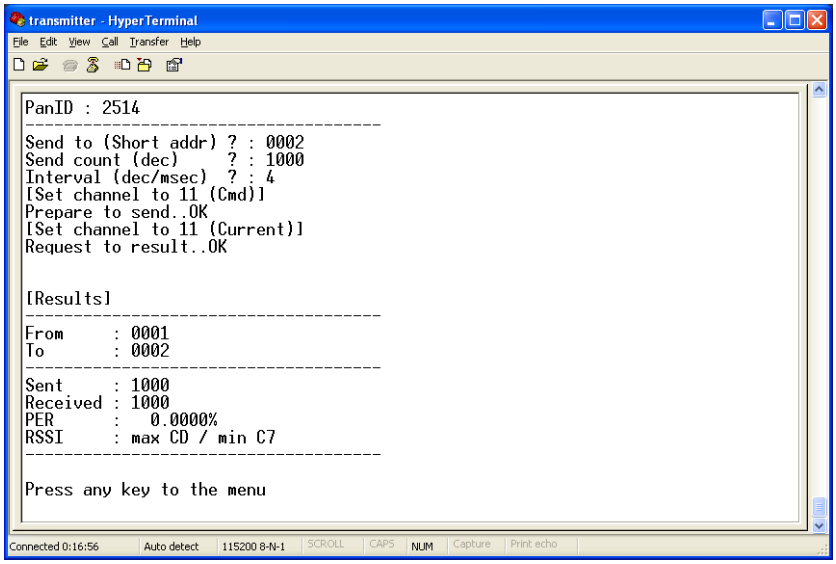

Figure 41: RF-Test PER test power adjusted

Note: Only the transmitter output power is adjusted. The receiver always sends back the result with a 0db adjusted output power.

7.1.9 Further RF-Test modes and settings

7.1.9.1 PER test /receiver

Pressing “2” in the opening window sets the 78K0R-UD-STICK-EE demonstration kit in the receiver mode of the PER test. In fact this is the mode, in which the **receiver** is set to, in the predefined debug configuration for the IAR C-SPY debugger.

7.1.9.2 Continuous TX / Pseudo Noise

Pressing “3” in the opening window initiates a modulated RF transmission. The data carried are pseudo random numbers. You can define the channel using the menu “A” from the opening window, and the output power using the menu “M”.

7.1.9.3 Continuous TX / Raw Carrier

Pressing “4” in the opening window initiates the carrier transmission. The output power is not 0 dB as a reset default. You can define the channel using the menu “A”.

7.1.9.4 RX Mode

Pressing “5” in the opening window initiates the receiver mode.

7.1.9.5 IDLE Mode

Pressing “6” in the opening window sets the UZ2400 into the IDLE mode.

7.1.9.6 Standby Mode

Pressing “8” in the opening window sets the UZ2400 into the Standby mode.

7.1.9.7 Deep Sleep Mode

Pressing “9” in the opening window sets the UZ2400 into the Deep Sleep mode.

7.1.9.8 Power down mode

Pressing “0” in the opening window sets the UZ2400 into the Power down mode.

7.1.9.9 Resetting RF

Pressing “R” in the opening window allows you to reset the UZ2400 registers.

7.2 MAC sample program: TextChat

The MAC Sample program is developed to provide a simple example to construct a star network utilizing the IEEE 802.15.4 PHY/MAC standard. It supports a text chat for one **coordinator** and up to four **End Devices**.

The MAC Sample Program offers,

1. Designation of a network **coordinator** in a star configuration
2. A Text chat between a End Devices and an **End Device**

To use the MAC Sample Program, you need to prepare at least two PC with a USB interface or one PC with more than one USB interface, and two 78K0R-UD-STICK-EE demonstration kits. The program is provided as hex files with different short address settings. You will find these hex files after a successful installation of the sample projects in the subfolder “`MAC_sample_project`”.

7.2.1 Preparing the Hardware

To be able to chat, at least 2 *78K0R-UD-STICK-EE* demonstration kits, with different short addresses, have to be prepared. One *78K0R-UD-STICK-EE* demonstration kit will be used as **Coordinator** and up to four *78K0R-UD-STICK-EE* demonstration kits can be used as **End Devices**. Basically the same sample project is used for **Coordinator** and **End Devices**, the only thing to take care for is that any module needs an independent short address.

To program the software please set the switches of the *78K0R-UD-STICK-EE* demonstration kit to the flash programming setting and use the WriteEZ5 flash programming tool.

After a successful download, please disconnect the *78K0R-UD-STICK-EE* demonstration kit from the Host PC and change the switch setting to the serial communication setting. Now you can connect the *78K0R-UD-STICK-EE* demonstration kit to the Host PC again.

7.2.2 Running the MAC sample program

To run the the MAC sample program a terminal program is needed. In this document the Microsoft™ HyperTerminal is used, but in fact any kind of other terminal tool should be sufficient, too.

To open Microsoft™ HyperTerminal please press Start → All Programs → Accessories → Communication → HyperTerminal from your Microsft™ Windows.

Please select following settings when configuring the connection using the HyperTerminal.

COM port properties	Setting
Bits per second	115200
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None

Table 10: Microsoft™ HyperTerminal COM port properties

For further information regarding the HyperTerminal configuration please refer to Chapter 7.1.5. To start the application set SW1 from **USB** to **BAT** and back once. Now the startup screen shall occur.

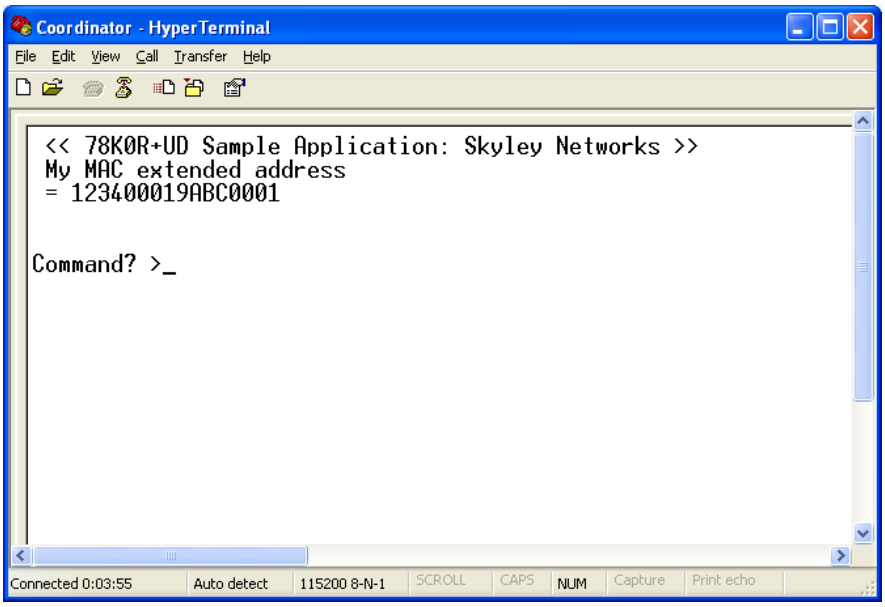

Figure 42: MAC sample program startup screen

In the same way, connect the other *78K0R-UD-STICK-EE* demonstration kits to PC, and start HyperTerminal. If the PC has more than one USB port, you can connect more than one *78K0R-UD-STICK-EE* demonstration kits and start more than one HyperTerminal on this PC. Only the COM ports of each *78K0R-UD-STICK-EE* demonstration kits have to be set up correctly.

7.2.2.1 Designation of the Coordinator

Now you have to decide which *78K0R-UD-STICK-EE* demonstration kits shall be used as **coordinator**. To do so open the regarding HyperTerminal window and press Enter.

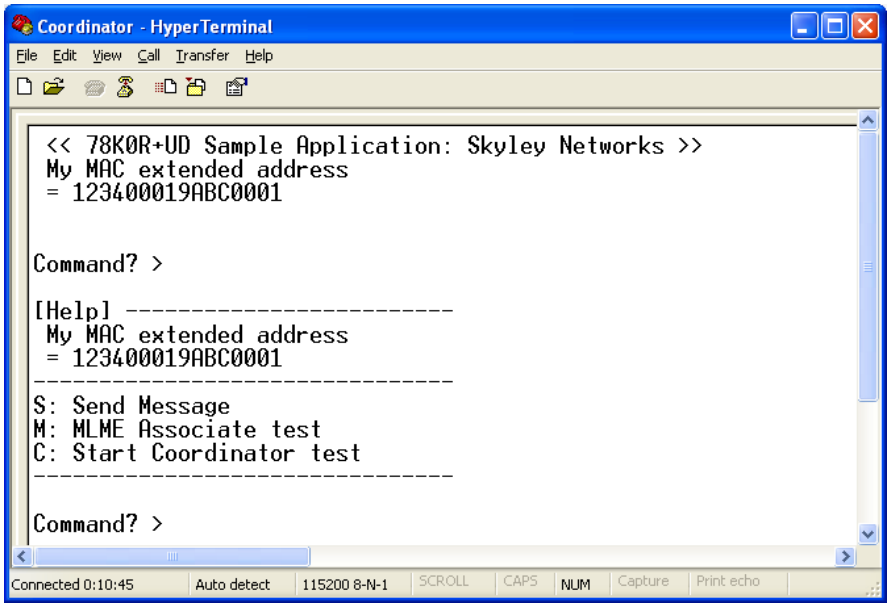

Figure 43: MAC sample configuration

Press “C” to start the **coordinator**.

7.2.2.2 Designation of End Devices

All other attached *78K0R-UD-STICK-EE* demonstration kits (up to 4) have to be set up as **End Devices**. Therefore press “Enter” from the startup screen and then “M”.

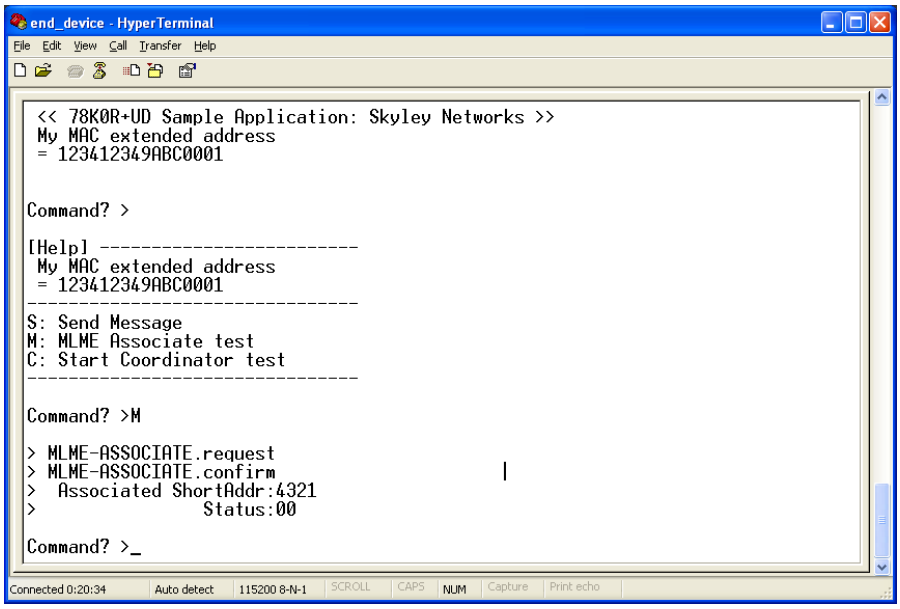

Figure 44: MAC sample End Device

On the **coordinator** side you will find the following message. In this message you will find the associated short address which is needed for the text chat later on.

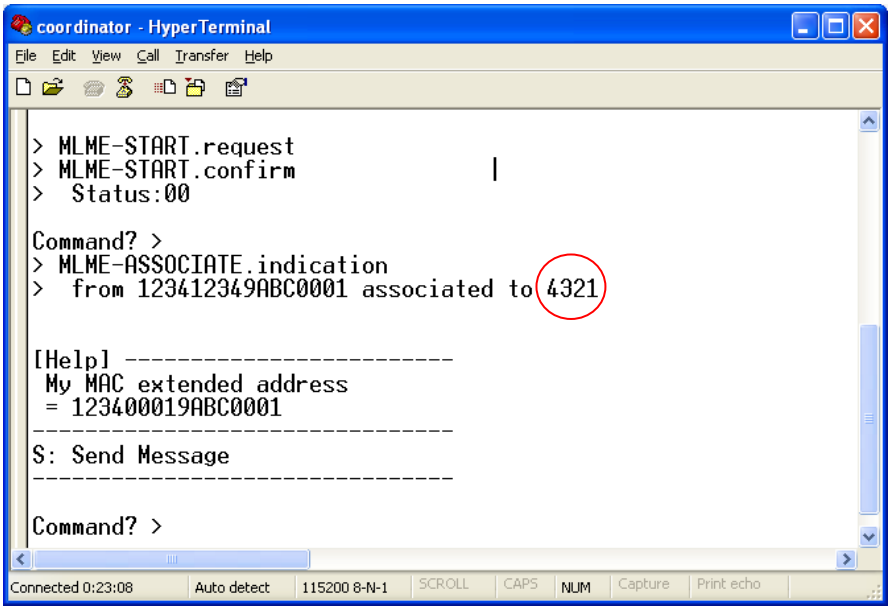

Figure 45: MAC sample End Device associated short address

7.2.2.3 Text Chat

Now the network is prepared to start a text chat between an **End Device** and the coordinator. At first, you may start with the **coordinator**. Press “S”, then input the short address of an **End Device**, 4321 in this example and input your text message, which can be up to 102 bytes per text block.

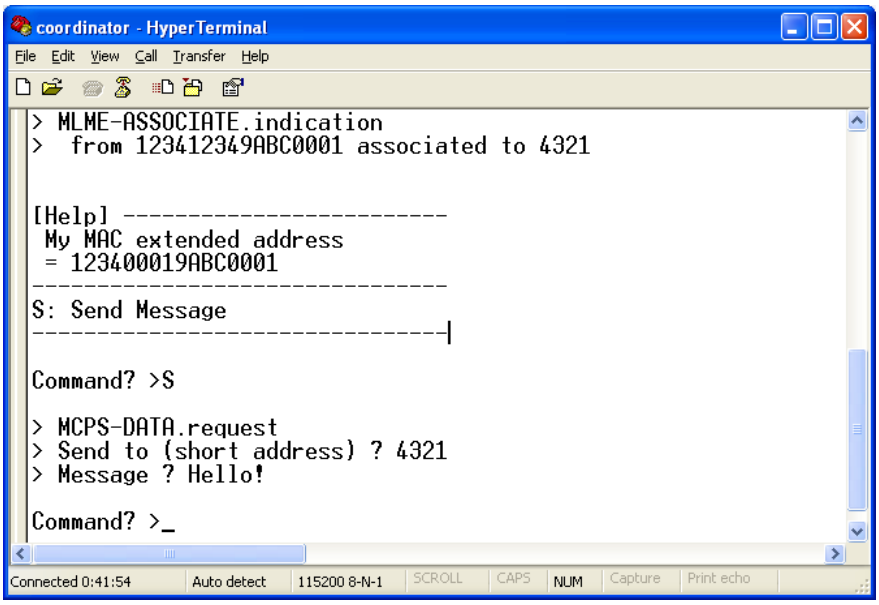

Figure 46: MAC sample sending text message

On the **End Device** you will find the received text message and the information from whom it was received.

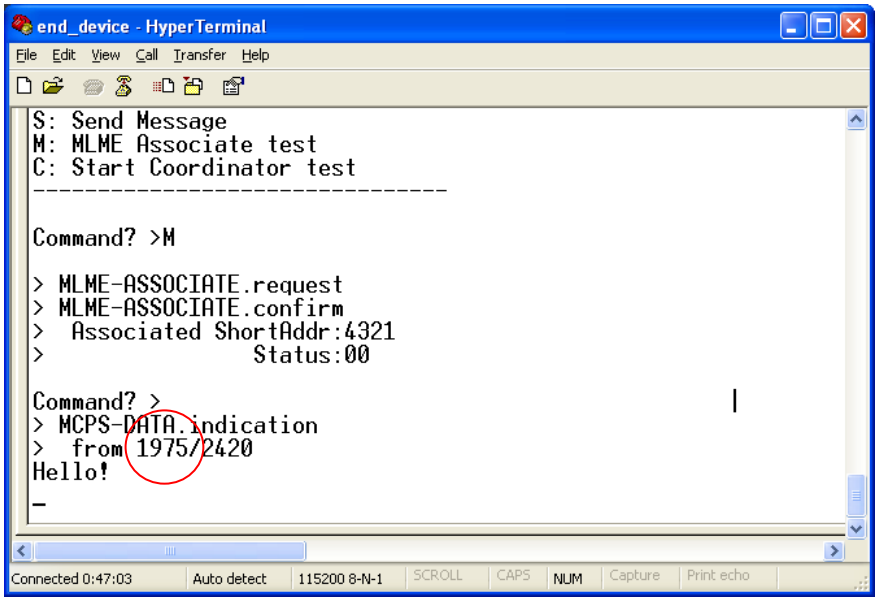

Figure 47: MAC sample received message

As you now know the short address of the **coordinator** you can send back a message from the **End Device** by inputting “S”, the **coordinator** short address (i. e. “1975” in this sample) and the reply text message. You will find the received text message on the **coordinator** HyperTerminal window.

8. BOM list

No.	Mount Quantity	Mount Parts Reference	Unmount Parts Reference	Type	Parts No	Manufacturer
1	0		CN1	Connecter	SICA2P20S	TET
2	1	CN2		Connecter	DF11-10DP-2DS(24)	Hirose
3	0		CN3	Patern anntena	-	
4	1	CN4		Connecter	MS-156C	Hirose
5	12	C1,C4,C6,C7, C13,C14,C18, C19,C20,C22, C23,C38		Chip ceramic cap	0.1uF	
6	2	C2,C3		Chip ceramic cap	18pF	
7	3	C5,C15,C17		Chip ceramic cap	0.47uF	
8	1	C8		Chip ceramic cap	2.2uF	
9	1	C9		Chip tantal cap	F931A476MCC	Nichicon
10	2	C16,C10		Chip ceramic cap	4.7uF/16V	
11	1	C11		Chip ceramic cap	10uF/16V	
12	1	C21		Chip ceramic cap	0.1uF	
13	3	C24,C26,C40		Chip ceramic cap	10pF	
14	4	C25,C30,C34, C44		Chip ceramic cap	0.01uF	
15	5	C27,C29,C31, C33,C39		Chip ceramic cap	47pF	
16	2	C41,C28		Chip ceramic cap	1uF	
17	1	C32		Chip ceramic cap	39pF	
18	2	R4,C35		Chip resister	0	
19	0		C36	Chip ceramic cap		
20	0		C37	Chip ceramic cap		
21	1	C42		Chip ceramic cap	4.7uF/10V	
22	1	C43		Chip ceramic cap	10uF/10V	
23	1	F1		Chip inductor	LDB212G4020C-001	Murata
24	1	IC1		IC	UZ2400V4.1	UBEC
25	1	LED1		LED	PG1111C	Stanly
26	3	LED2,LED3, LED4		LED	AA1111C	Stanly
27	1	L1		inductor	VLCF4020T-6R8N1R0	TDK
28	1	L2		Filter	BLM41PG750S	Murata
29	1	L3		Chip inductor	HK10052N7S-T	Taiyo Yuden
30	0		L5	Chip inductor		
31	1	L6		Chip inductor	HK10055N6S-T	Taiyo Yuden
32	1	L7		inductor	LQH2MCN8R2M02	Murata
33	2	MR3,MR1		resister module	CN1E4K-105J	KOA
34	1	MR2		resister module	CN1E4K-122J	KOA
35	1	R1		Chip resister	100	
36	6	R2,R3,R5, R11,R12, R21		Chip resister	10K	
37	2	R6,R8		Chip resister	390K	
38	1	R7		Chip resister	1M,1%	
39	1	R9		Chip resister	360K,1%	
40	1	R10		Chip resister	4.7K	
41	3	R13,R16,R22		Chip resister	1.5K	
42	2	R15,R14		Chip resister	27	
43	3	R17,R18,R19		Chip resister	100K	
44	1	R20		Chip resister	1M	
45	2	SW2,SW1		Switch	SSSS222700	ALPS
46	8	TPU1, TPU2, TPU3, TPU4,		Pad	TPU	

No.	Mount Quantity	Mount Parts Reference	Unmount Parts Reference	Type	Parts No	Manufacturer
		TPU5, TPU6, TPU7, TPU8				
47	1	TP1		Pad	PAD	
48	4	T1,T2,T3,T4		Pad	T	
49	1	USB1		Connecter	UAR10-4W5J00	Hirose
50	1	U1		IC	S-8120CNB	Seiko
51	1	U2		IC	uPD78F1146AGB-GAH-AX	NECEL
52	3	U3,U6,U8		IC	SN74LVC1G125DCK	TI
53	1	U4		IC	TPS61024DRC	TI
54	1	U5		IC	SN74LVC2G125DCU	TI
55	1	U7		IC	UPD78F0730MC	NECEL
56	1	U9		IC	SN74LVC2T45DCU	TI
57	1	Y1		Resonator	FC-135(32.768KHz)	Epson
58	1	Y2		Resonator	CSTCE16M0VH3L99-R0	Murata
59	1	Y3		Resonator	NX3225SA-32.000M-STD-CSR-3	NDK
60	1	L4		Chip ceramic cap	UVK105CH020BW-F	Taiyo Yuden
61	1	C45		Chip ceramic cap	UVK105CH1R3BW-F	Taiyo Yuden

Table 11: Bill of Materials

9. Schematics

Please find the schematics attached to this document. To open the attachments view in the Adobe Reader press the paper clip in the lower left corner of the window. To open the attachment double click the `78K0R-UD-STICK-EE_schematics.pdf`.

[MEMO]