MED-EKG
User Manual

Rev. 0.2

freescale
semiconductor

Table of Contents

1. Hardware Set

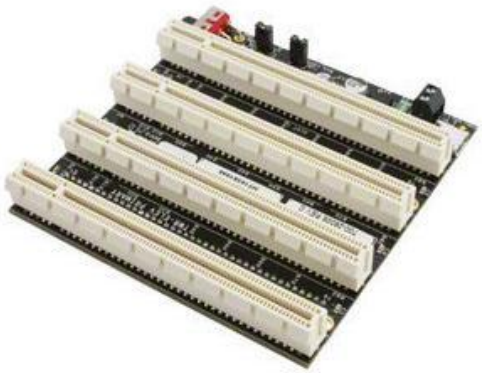
Following steps will guide you on how to set up your Tower System for use with the demo.

1.1. Required Elements

Following elements are required in order to assembly the demo.

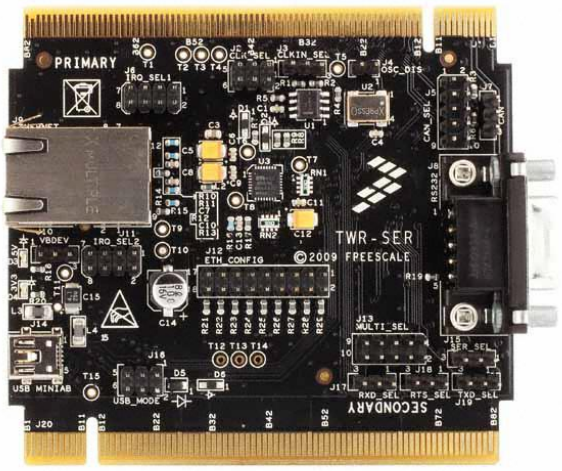
2xTWR-ELEV(1xPrimary and 1xSecondary)

TWR-ELEV
Secondary



TWR-ELEV
Primary

1xTWR-SER



1xController Module (TWR-K53N512, TWR-MCF51MM or TWR-S08MM128)

1xMED-EKG Board

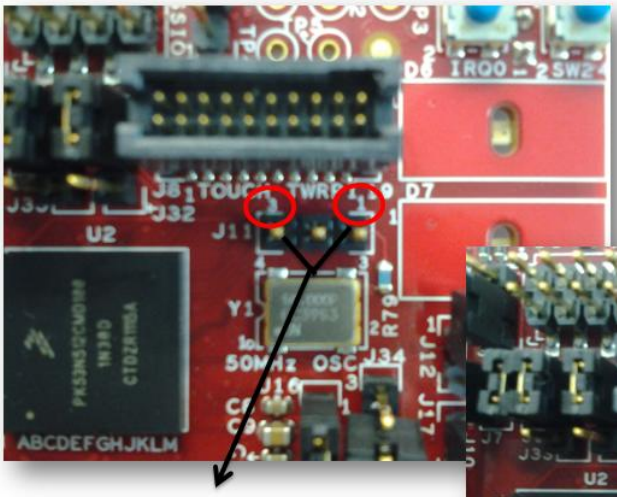
3xlead wires and 3xAgClAg EKG electrodes

2xUSB A to mini B cables

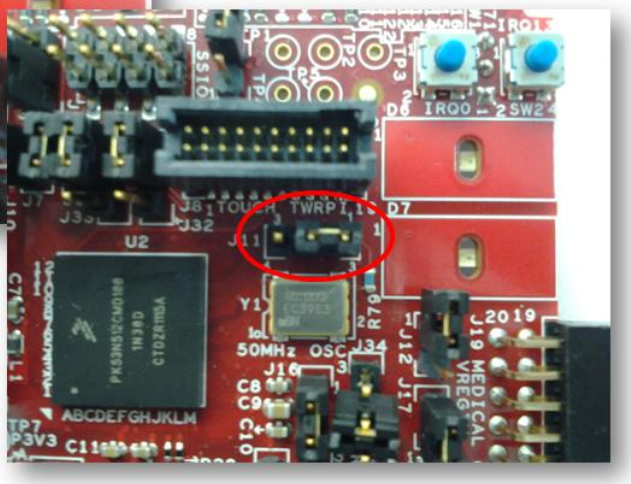
1.2. Jumper Configuration

⚠ Some of the boards mentioned before must be set according with the jumper configuration. If you use one or more of the boards below, set the respective jumper configuration according with the tables.

Jumpers must be removed and placed using pincers. Jumper pins on board are enumerated. To place a jumper, check the pin enumeration and place the jumper across the pins to create a shortcut. Open means no jumper must be placed. Connected means that only two pins exist and jumper must be placed across them.



Pin Enumeration



Jumper across
1-2

1.2.1. TWR-SER Jumper Configuration

Jumper	Position
J10	1 - 2
J16	3 -4
J2	1 - 2

1.2.2. TWR-S08MM128 Jumper Configuration

Jumper	Position
J1	Connected
J3	Open
J5	Open
J6	Connected
J7	Open
J8	Open
J10	2-3
J11	Connected
J12	Open
J18 1-2	Open
J18 3-4	Connected
J18 5-6	Connected
J18 7-8	Connected
J18 9-10	Open
J18 11-12	Open
J18 13-14	Open
J25 1-2	Open

1.2.3. TWR-MCF51MM Jumper Configuration

Jumper	Position
J1	Connected
J3	Open
J5	Open
J6	Connected
J7	Open
J8	Open
J10	2-3
J11	Connected
J12	Open
J18 1-2	Open
J18 3-4	Connected
J18 5-6	Connected
J18 7-8	Connected

J18 9-10	Open
J18 11-12	Open
J18 13-14	Open
J25 1-2	Open

1.2.4 TWR-K53N512 Jumper Configuration

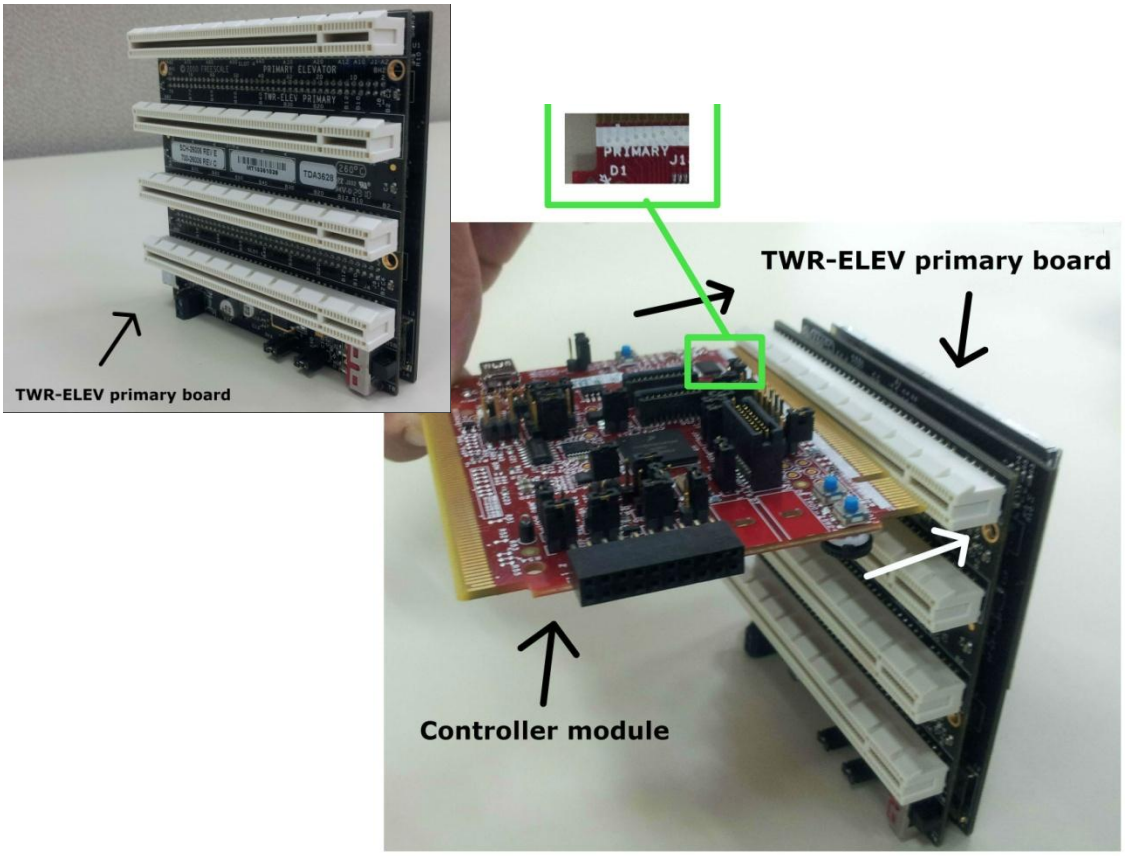
Jumper	Position
J1	Open
J3	Open
J4	2-3
J11	1-2
J15	Connected
J17	Connected
J18	Connected
J24	1-2
J28	Open
J34	Open

1.2.5 MED-EKG Jumper Configuration

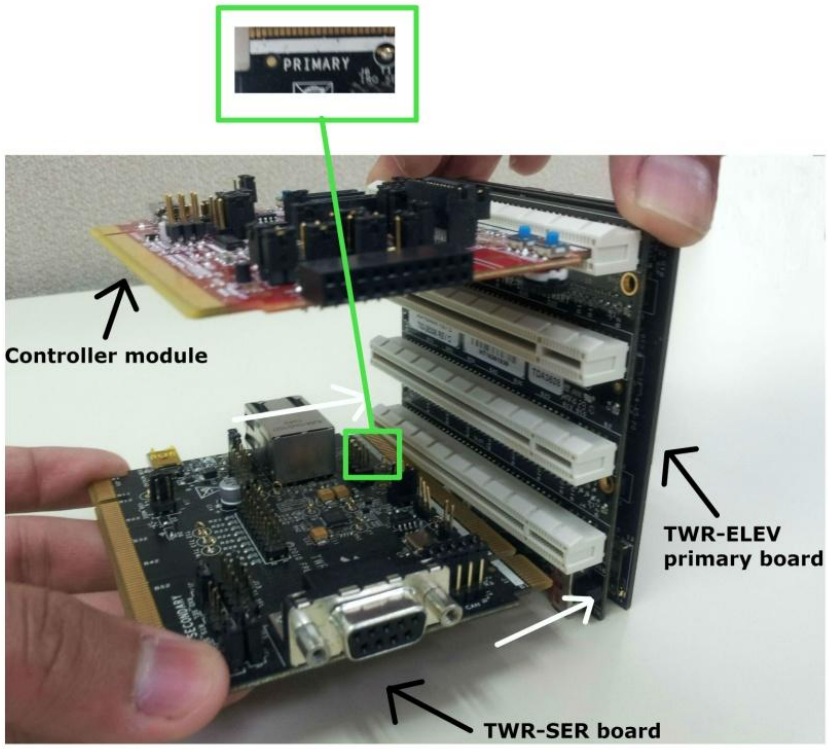
Jumper	Position
J2	1-2
J3	1-2
J4	1-2
J6	2-3
J7	2-3
J11	2-3

1.3. Assembling the demo

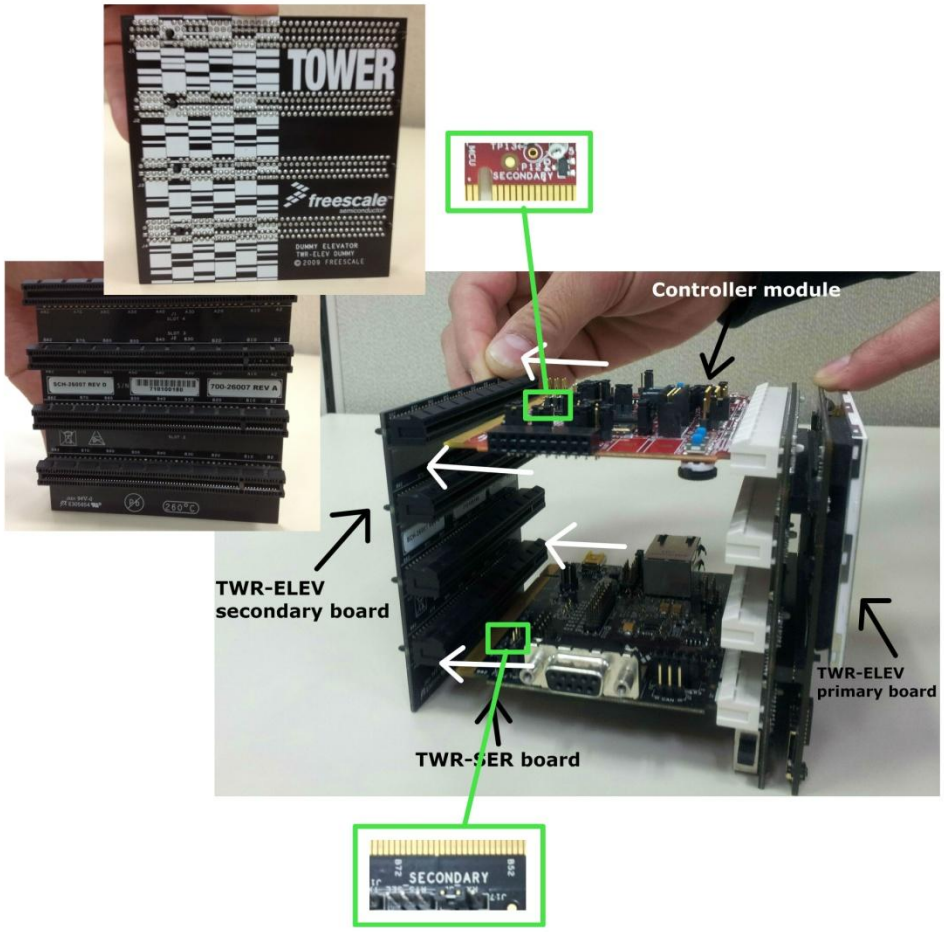
1. Take the controller module and the TWR-ELEV primary board. Connect the side of the controller module marked as “primary” to one of the slots on the TWR-ELEV primary board.



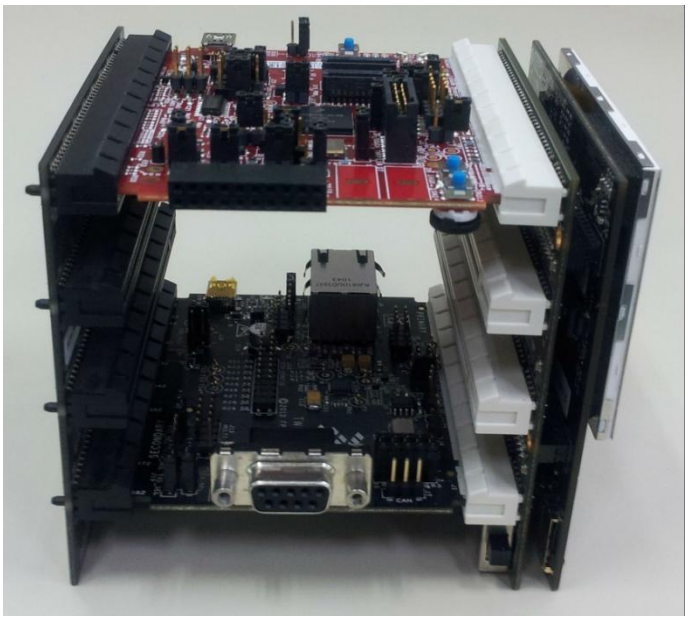
2. Take the TWR-SER board. Connect the side of the TWR-SER board marked as “primary” to one of the slots on the TWR-ELEV primary board.



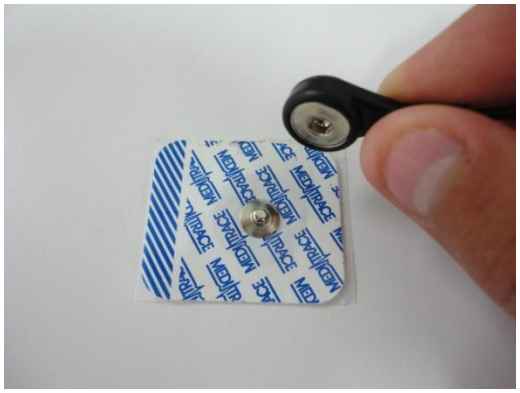
3. Take the TWR-ELEV secondary board. Connect the side on the controller module and TWR-SER board marked as “secondary” to the respective slot on the TWR-ELEV secondary board.



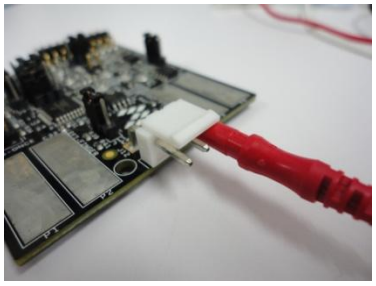
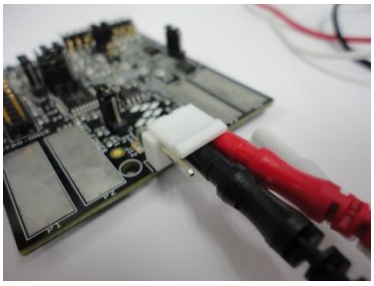
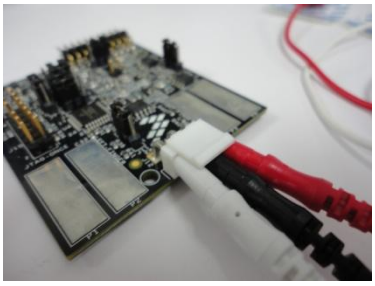
4. Once assembled, Tower System must look like the following image.



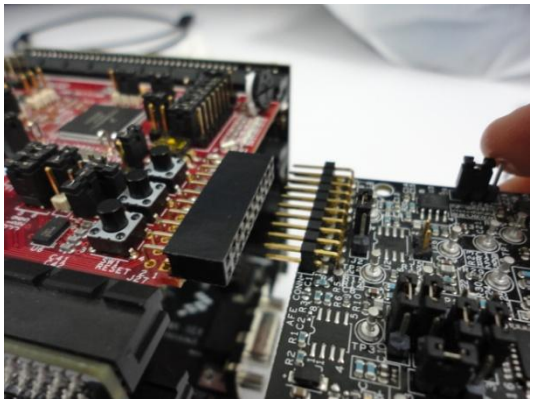
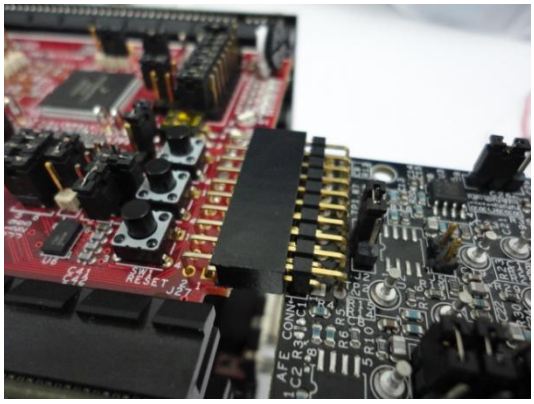
1. Attach the three leads to the three ekg electrodes, using the integrated connectors.



2. Connect the other endings of the wires to the external electrodes connector on the MED-EKG board (J12). Red wire connects to pin 3, black wire connects to pin 2 and white wire connects to pin 1.

3. Take the Analog Front End (AFE) board and connect it to the Medical Connector on the controller board. Medical connector pins enumeration must match with the AFE pin enumeration.

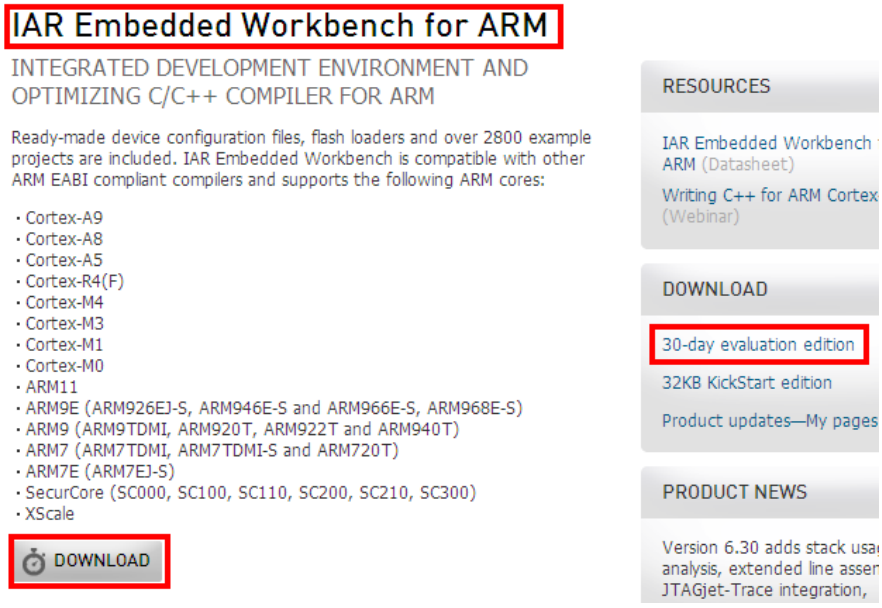
2. Loading Software

Following steps will guide you on how to load the microcontroller software. TWR-MK53N512 uses different compiler software than TWR-MCF51MM and TWR-S08MM128. Procedures for both cases will be explained below.

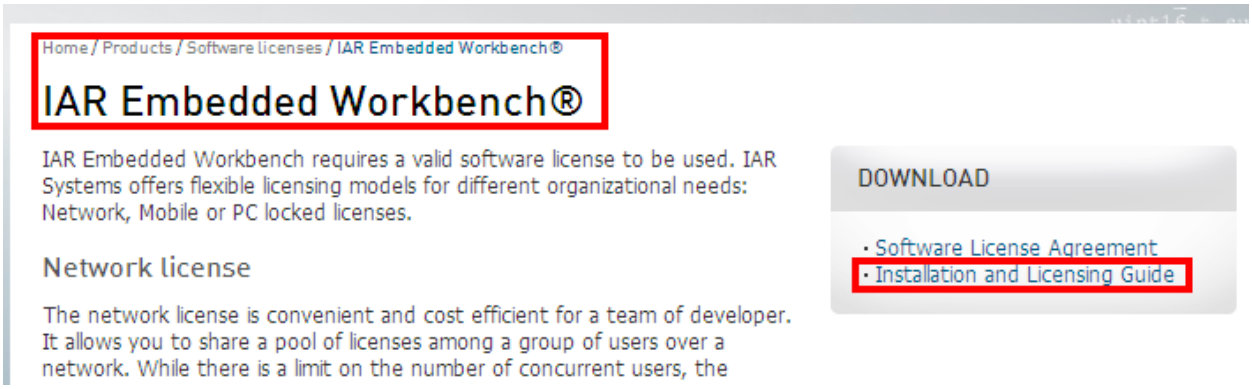
2.1. Installing IAR for Cortex M4 (TWR-MK53N512)

1. Go to IAR webpage www.iar.com

2. Search for **IAR Embedded Workbench for ARM®** and download version **6.2 or higher**. If you do not have an IAR license, you can download the 30 days trial version of the software.



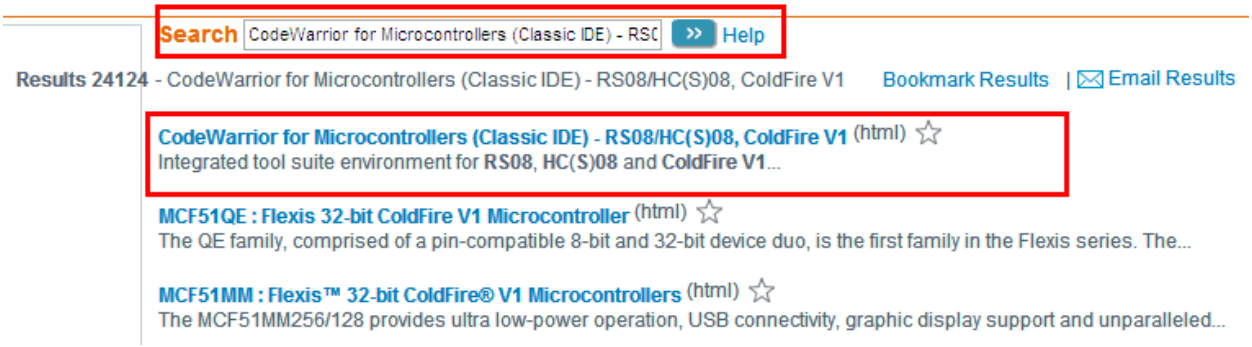
3. Install **IAR Embedded Workbench for ARM®** according with the **Installation and Licensing Guide for IAR Embedded Workbench®** that can be found on the IAR webpage.



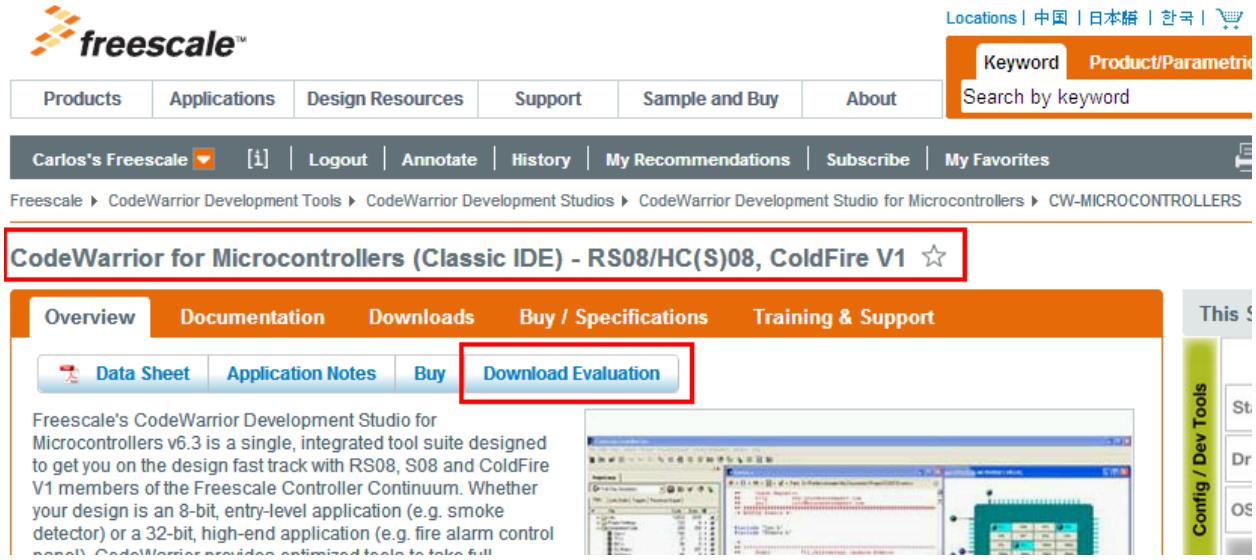
2.2. *Installing CodeWarrior and Patch for MM devices (TWR-MCF51MM and TWR-S08MM128)*

1. Go to Freescale webpage at www.freescale.com

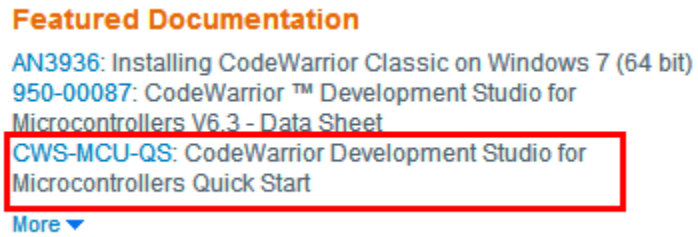
2. Search for **CodeWarrior for Microcontrollers (Classic IDE) - RS08/HC(S)08, ColdFire V1** and go to the web page.



3. Download **CodeWarrior V6.3** from webpage. If you do not count with a CodeWarrior license, you can download the 30 days Evaluation version.

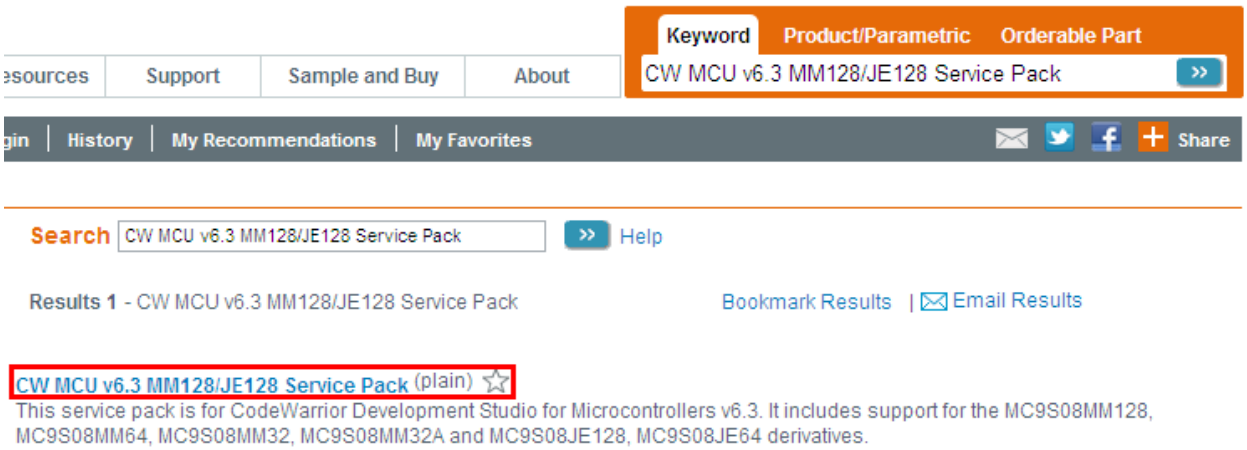


4. Install **CodeWarrior V6.3** as shown in the **CodeWarrior Development Studio for Microcontrollers V6.3 Quick Start** that can be found on the Freescale webpage.

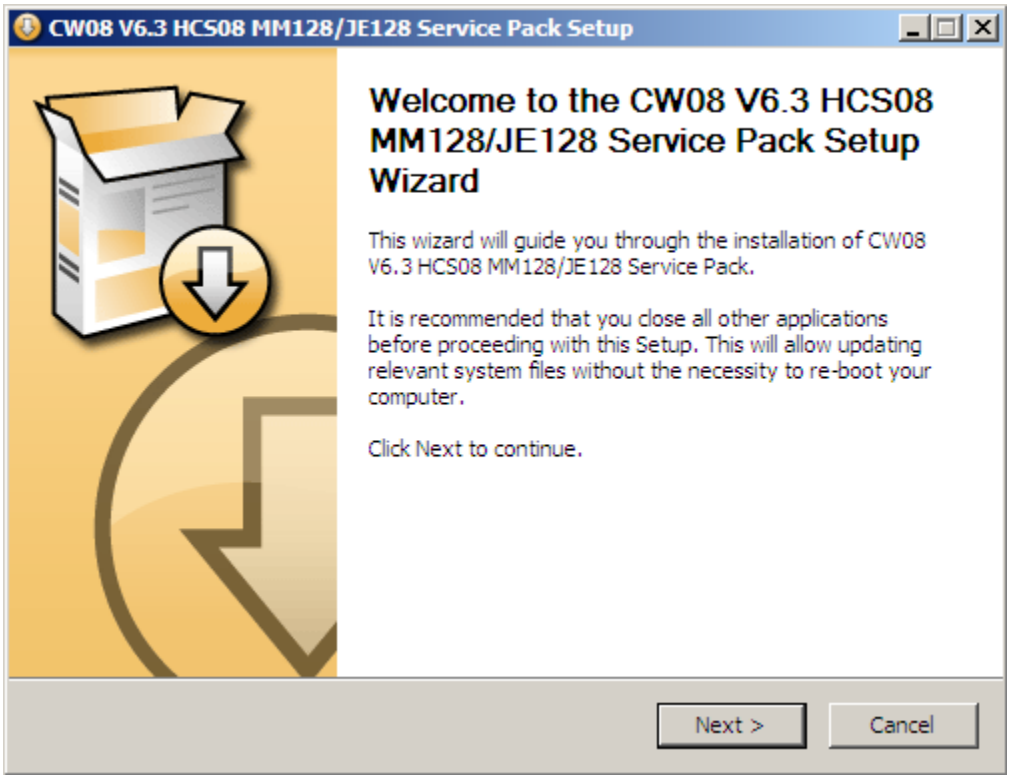


2.2.1. Installing CodeWarrior Patch for MM Devices

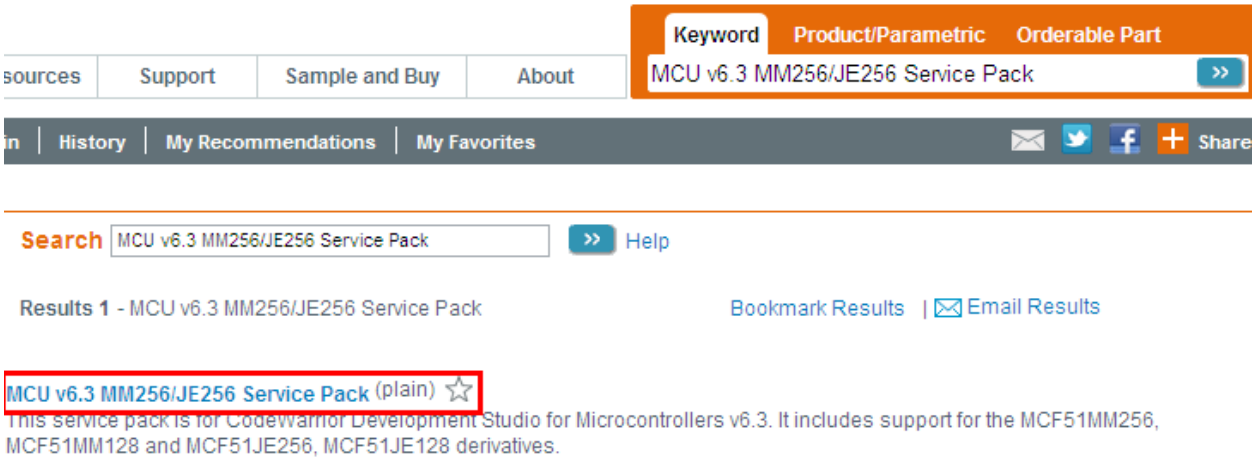
1. Go to Freescale webpage www.freescale.com and search for **CW MCU v6.3 MM128/JE128 Service Pack**



2. Download **CW MCU v6.3 MM128/JE128 Service Pack** and install clicking on the executable. Follow the on screen instructions to complete the installation.



3. Go to Freescale webpage www.freescale.com and search for **MCU v6.3 MM256/JE256 Service Pack**

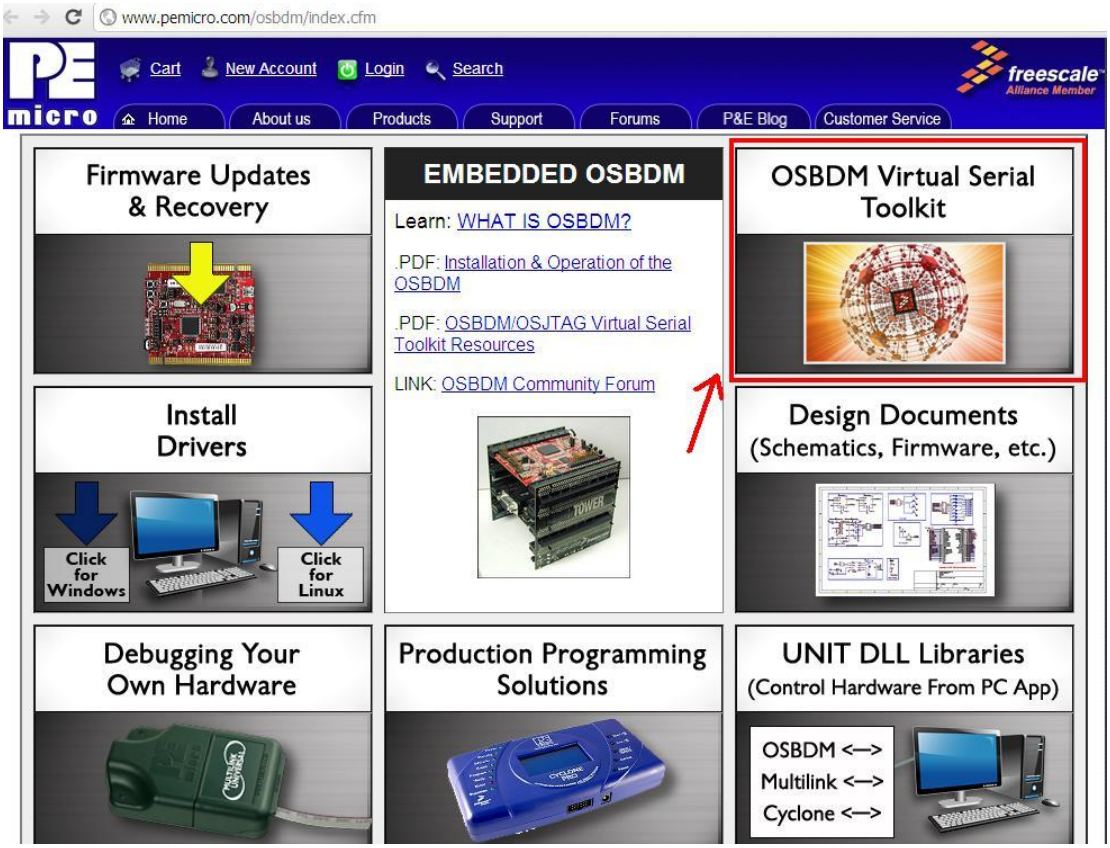


4. Download **MCU v6.3 MM256/JE256 Service Pack** and install clicking on the executable. Follow the on screen instructions to complete the installation.

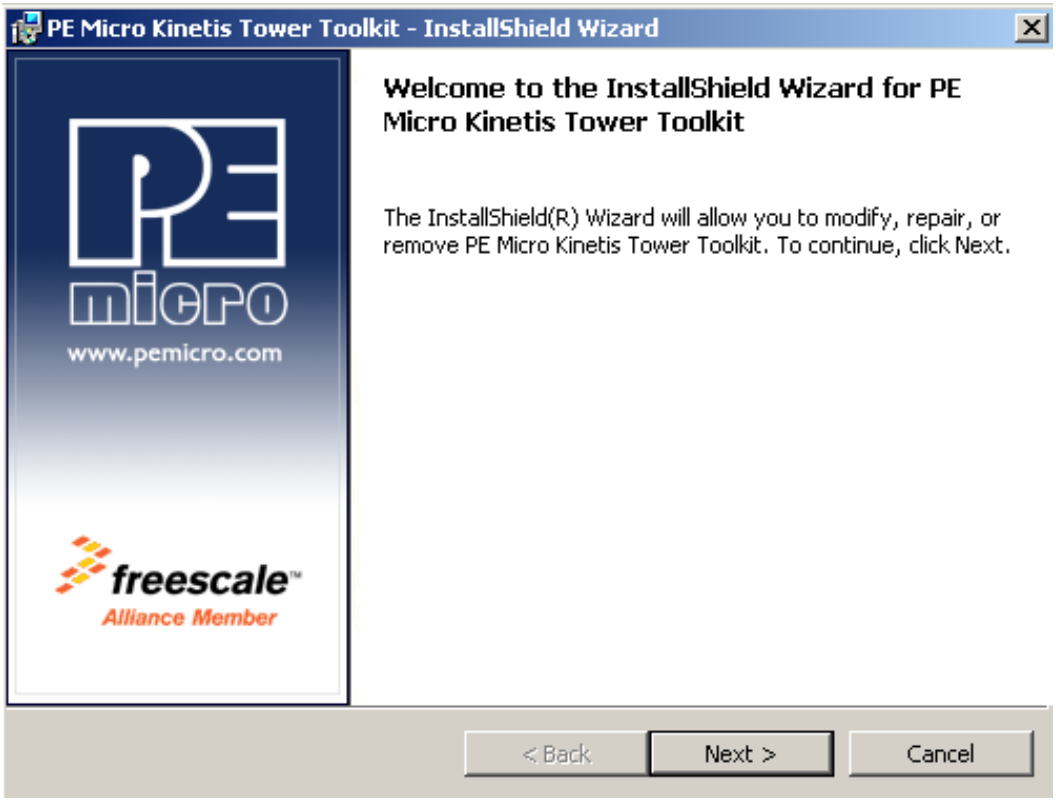
2.3 Installing JM60 driver

2.3.1. Installing JM60 driver for TWR-MK53N512

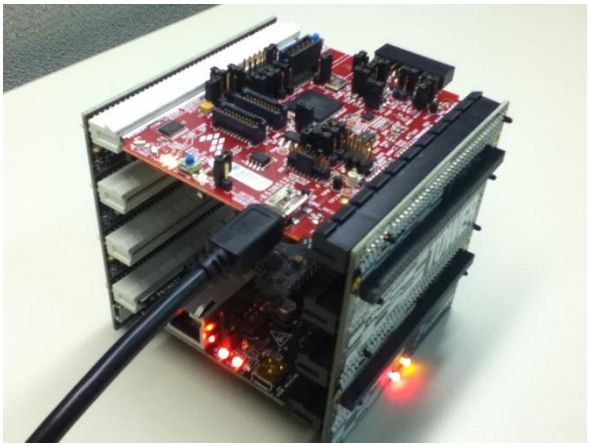
1. Go to http://www.pemicro.com/osbdm/index.cfm and download OSBDM Virtual Serial Toolkit software.



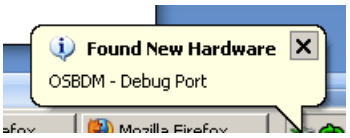
2. Install **P&E Micro Kinetis Tower Toolkit** by clicking on the executable. Follow the on screen instructions to complete the installation.



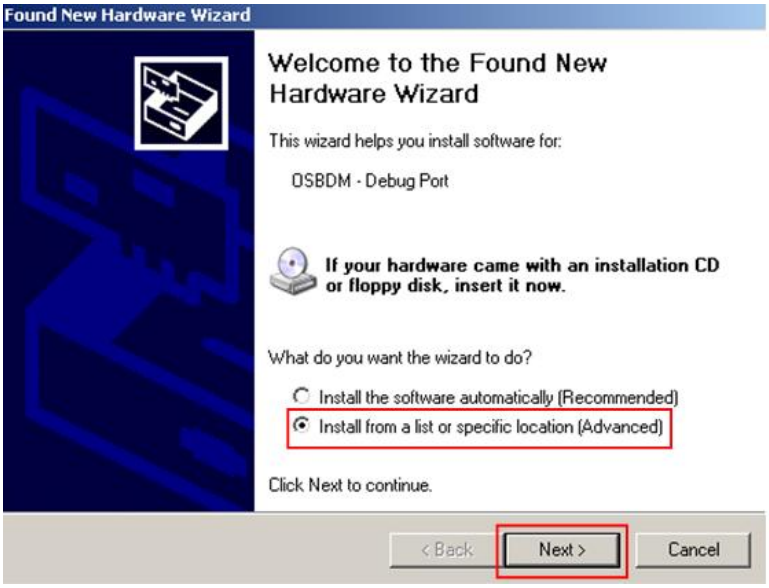
1. Connect the TWR-MK53N512 module of the Tower system to the computer using a Mini USB to USB cable.



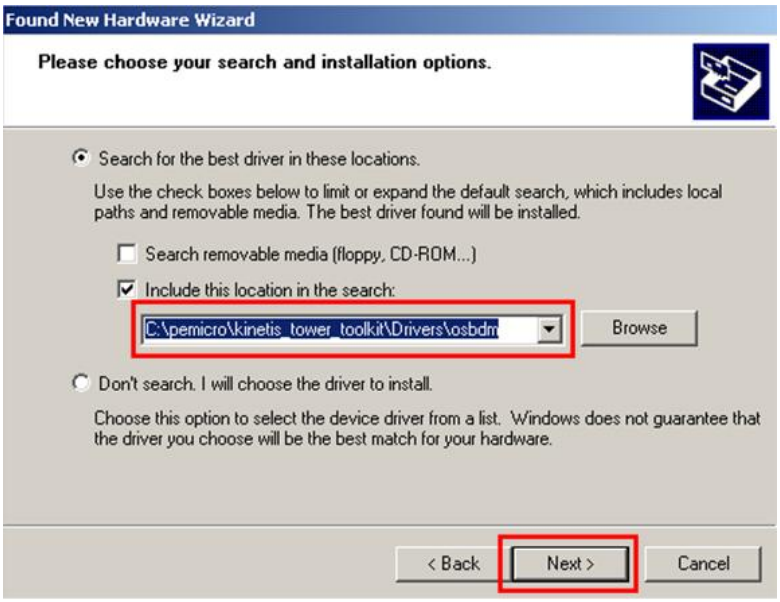
2. The TWR is recognized as an “OSBDM – Debug Port”:



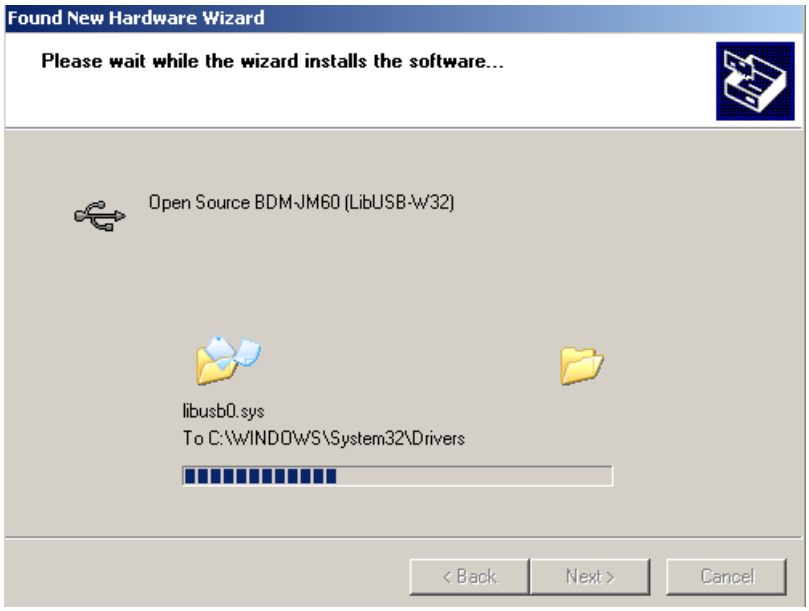
3. At the “Found New Hardware Wizard” screen, select “Install from a list or specific location (Advanced)” then click “Next”.



4. In the next window, click “Browse” and select the following folder: C:\pemicro\kinetis_tower_toolkit\Drivers\osbdm. Then click “Next”.

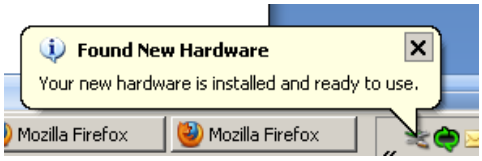


5. Wait while the driver is being installed.



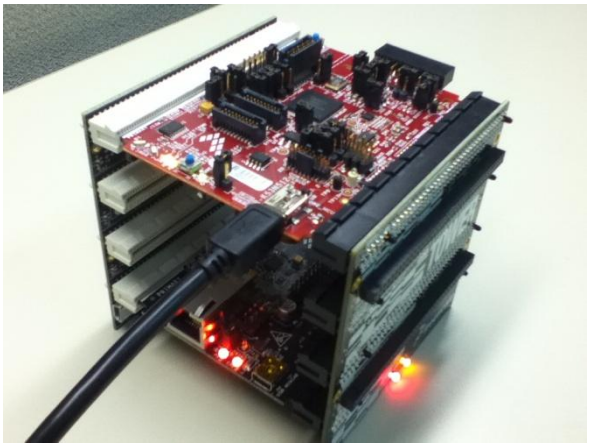
6. The “Open Source BDM-JM60” driver is installed, now click “Finish”.

7. The new hardware is installed and ready to use.

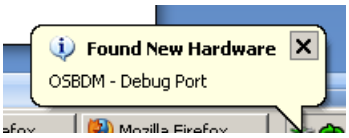


2.3.2 Installing JM60 driver for TWR-MCF51MM and TWR-S08MM128

1. Connect the TWR-MCF51MM or TWR-S08MM128 module of the Tower system to the computer using a Mini USB to USB cable.

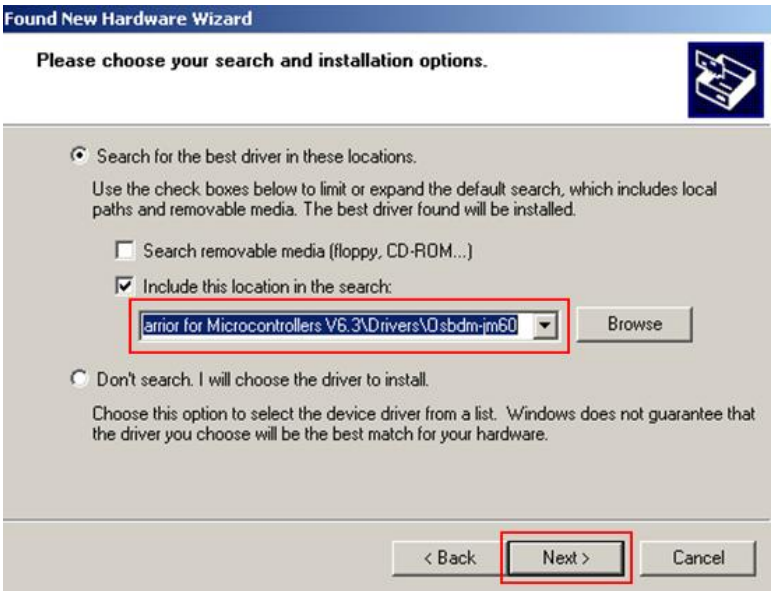


2. The TWR is recognized as an “OSBDM – Debug Port”:

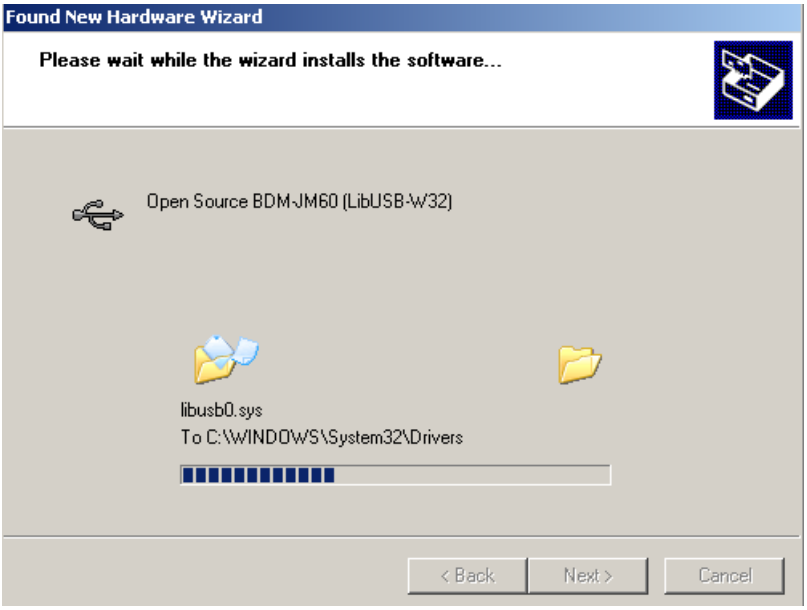


3. At the “Found New Hardware Wizard” screen, select “Install from a list or specific location (Advance)” then click “Next”.

4. In the next window, click “Browse” and select the following folder: C:\Program Files\Freescale\CodeWarrior for Microcontrollers V6.3\Drivers\Osbdm-jm60. Then click “Next”.

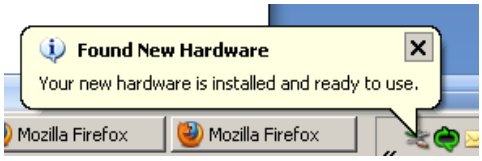


5. Wait while the driver is being installed.



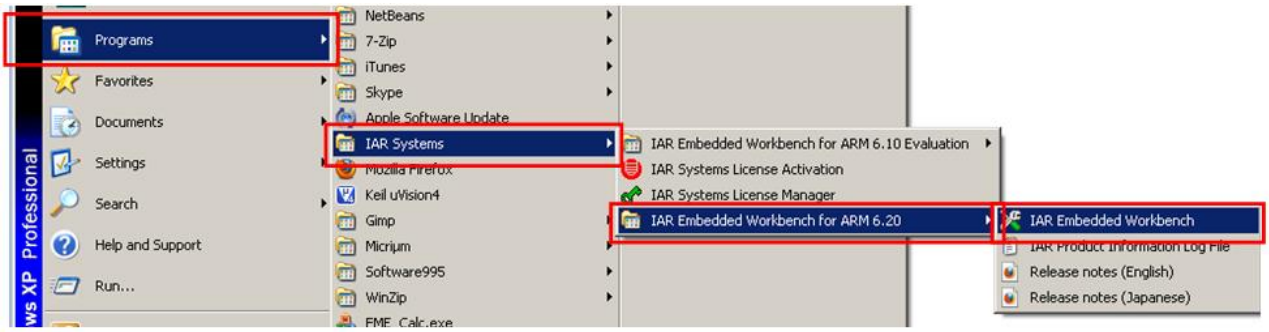
6. The “Open Source BDM-JM60” driver is installed, now click “Finish”.

7. The new hardware is installed and ready to use.

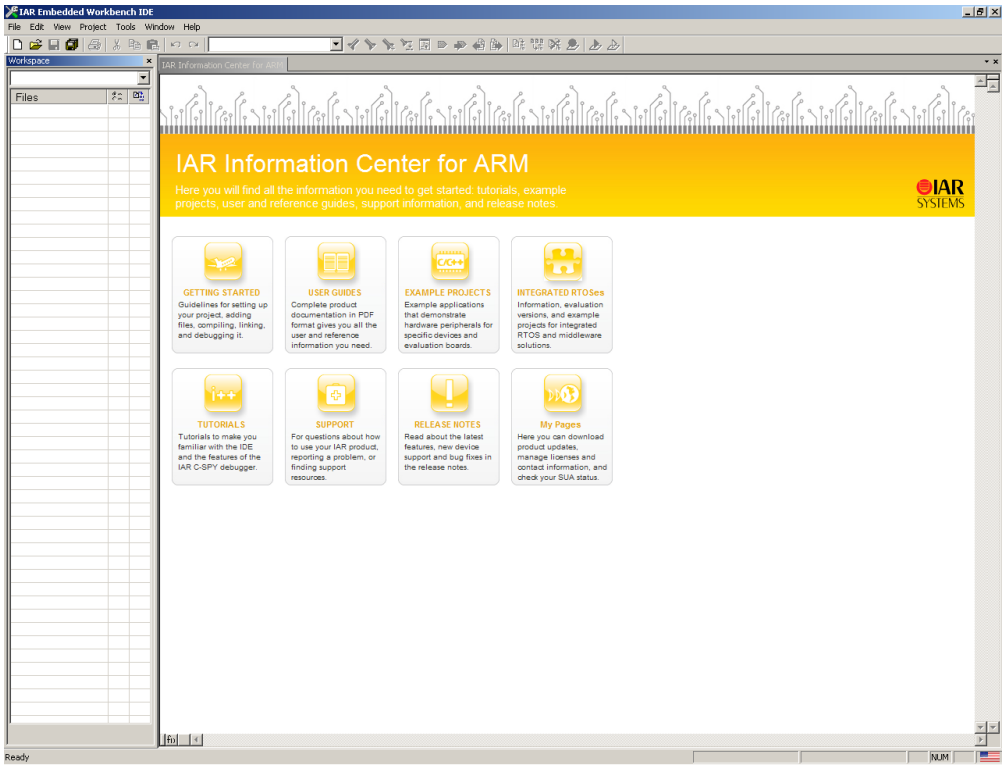


2.4 Loading software for TWR-MK53N512 with IAR for Cortex M4

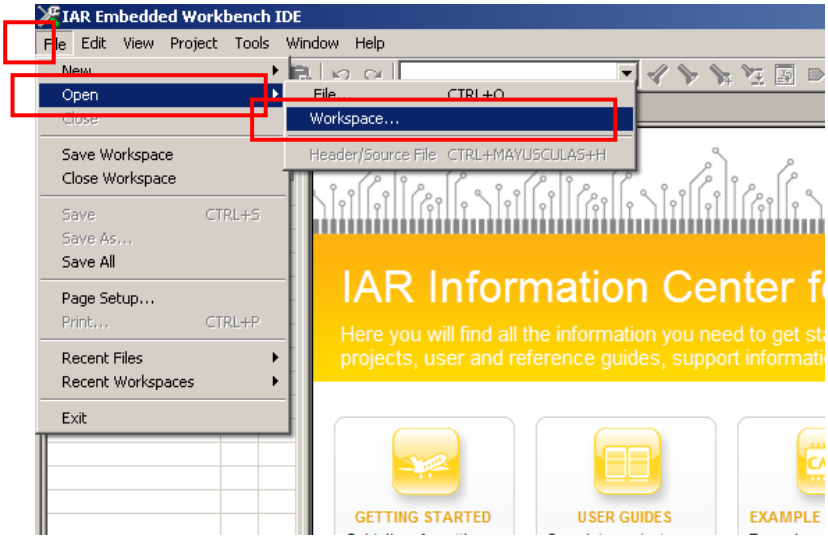
1. Open the IAR Embedded Workbench software.



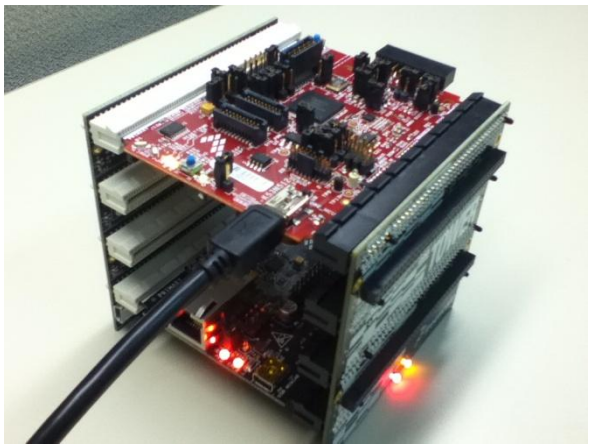
2. Following image shows the program window when it has been recently opened.



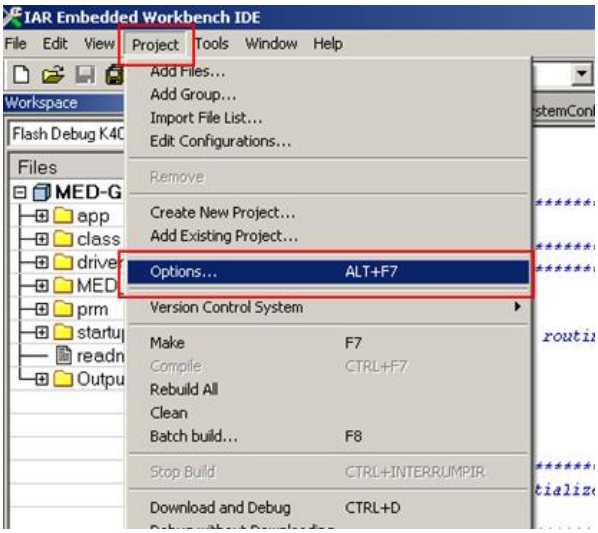
3. Go to Menu->File/Open/Workspace… and open the workspace file for the MED-EKG project “MED-EKG K53.eww”. It can be found on the folder “MED-EKG” uncompressing the file “AN4323SW.zip” downloaded from Freescale webpage. Workspace is in the path “MED-EKG\MED-EKG K53\app\cdc\iar_ew\kinetis\MED-EKG K53.eww”.



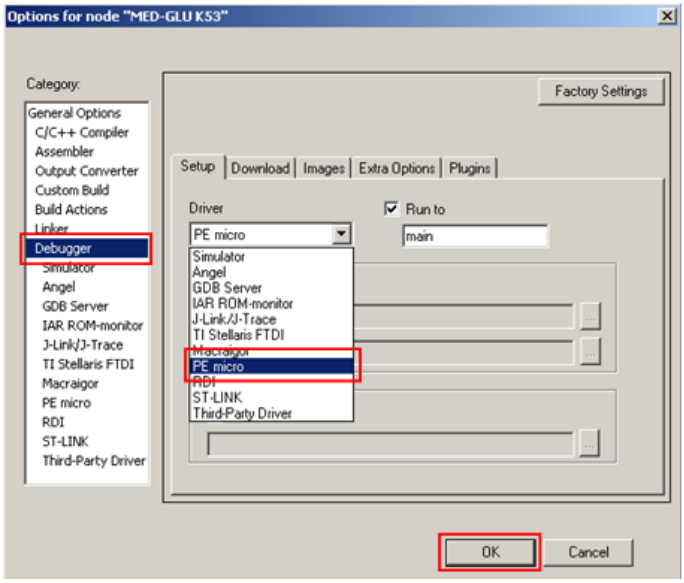
4. Connect the TWR-MK53N512 module of the Tower system to the computer using a Mini USB to USB cable.



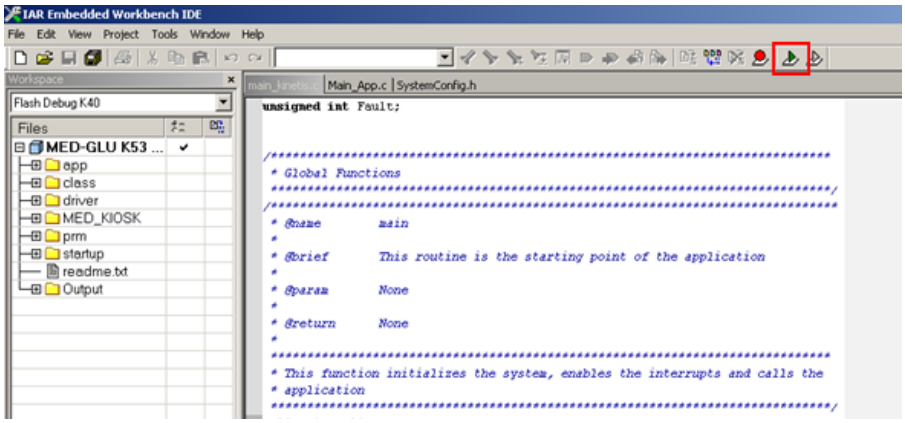
5. Make sure the debugger in the project options panel is PE micro. To do that, click on Menu Project/Options.



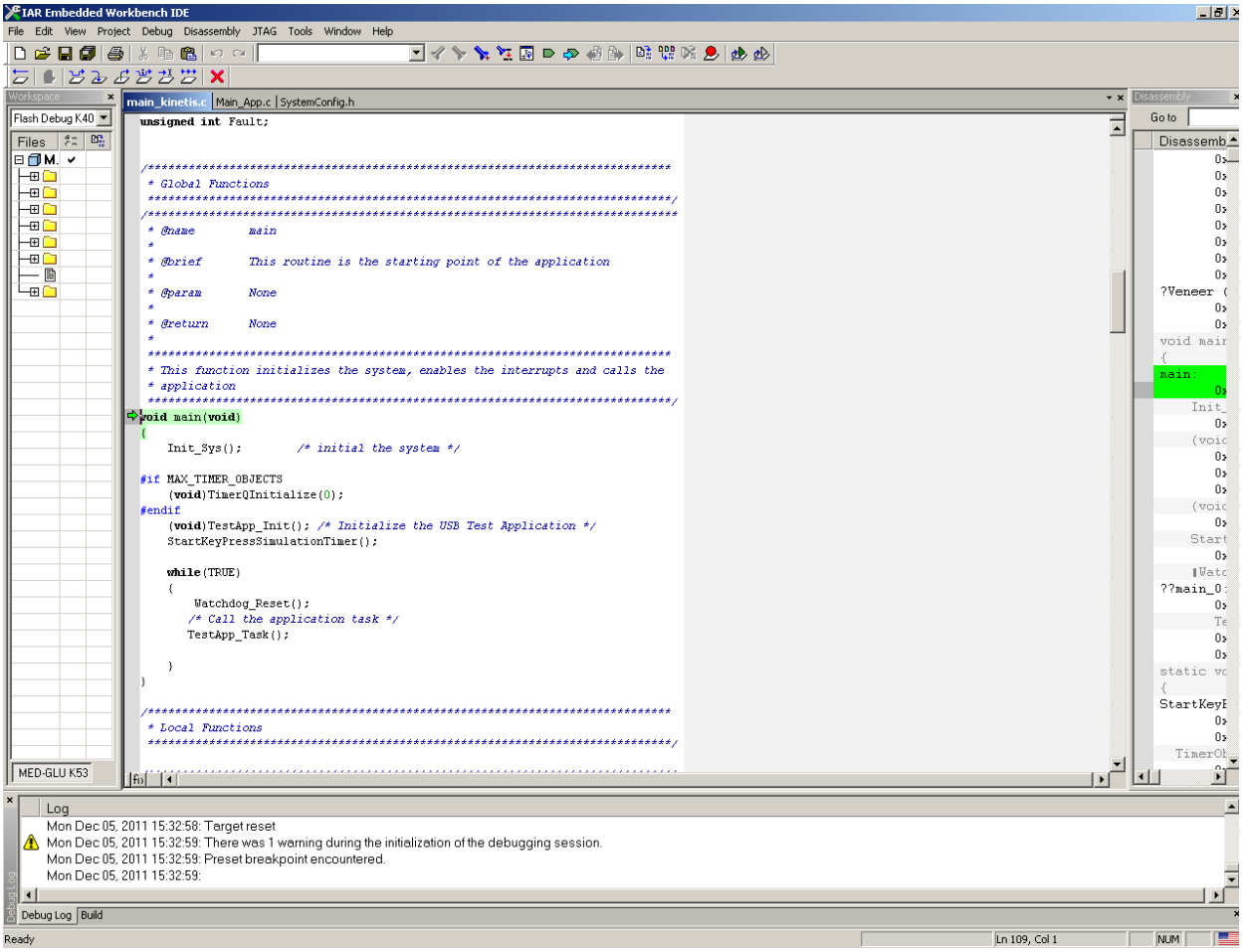
6. Select the category Debugger and check that PE micro is selected as shown in figure below.



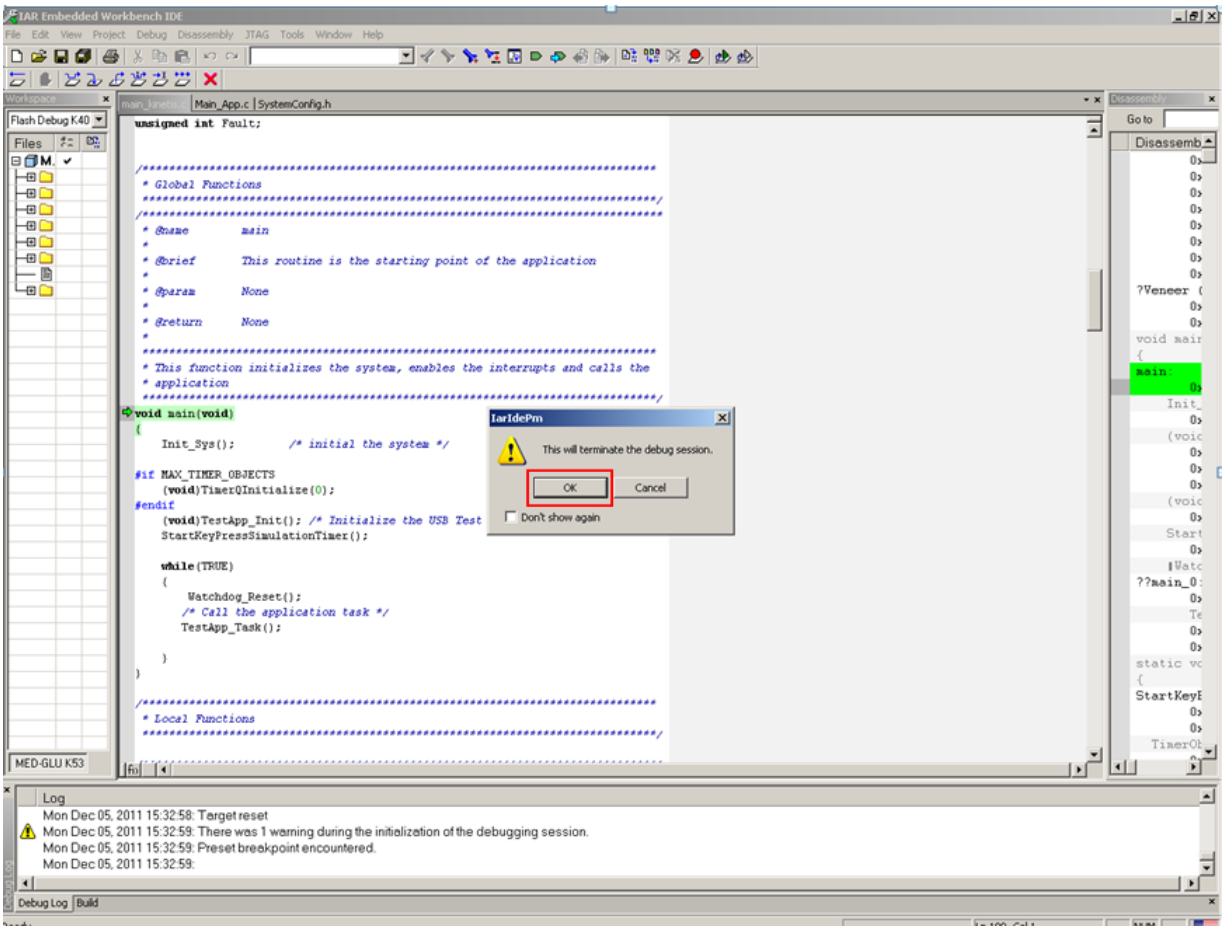
7. Click on the DEBUG button, and the project will be loaded into the MCU.



8. The project will compile automatically and load into the MCU. The debugging session will start, like is shown in the image below.

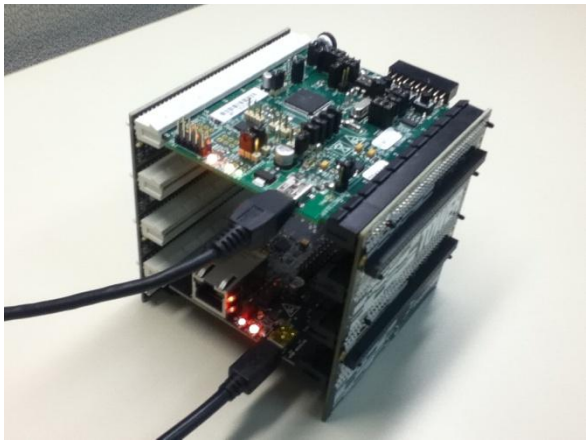


9. Disconnect the USB cable from the TWR-K53N512 board and close “IAR Embedded Workbench IDE”. A window showing “This will terminate the debug session” will appear, click “OK”.

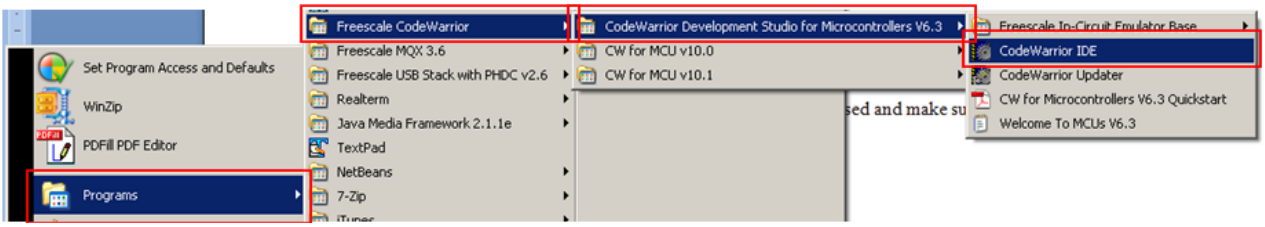


2.5 Loading software for TWR-MCF51MM and TWR-S08MM128 with CodeWarrior

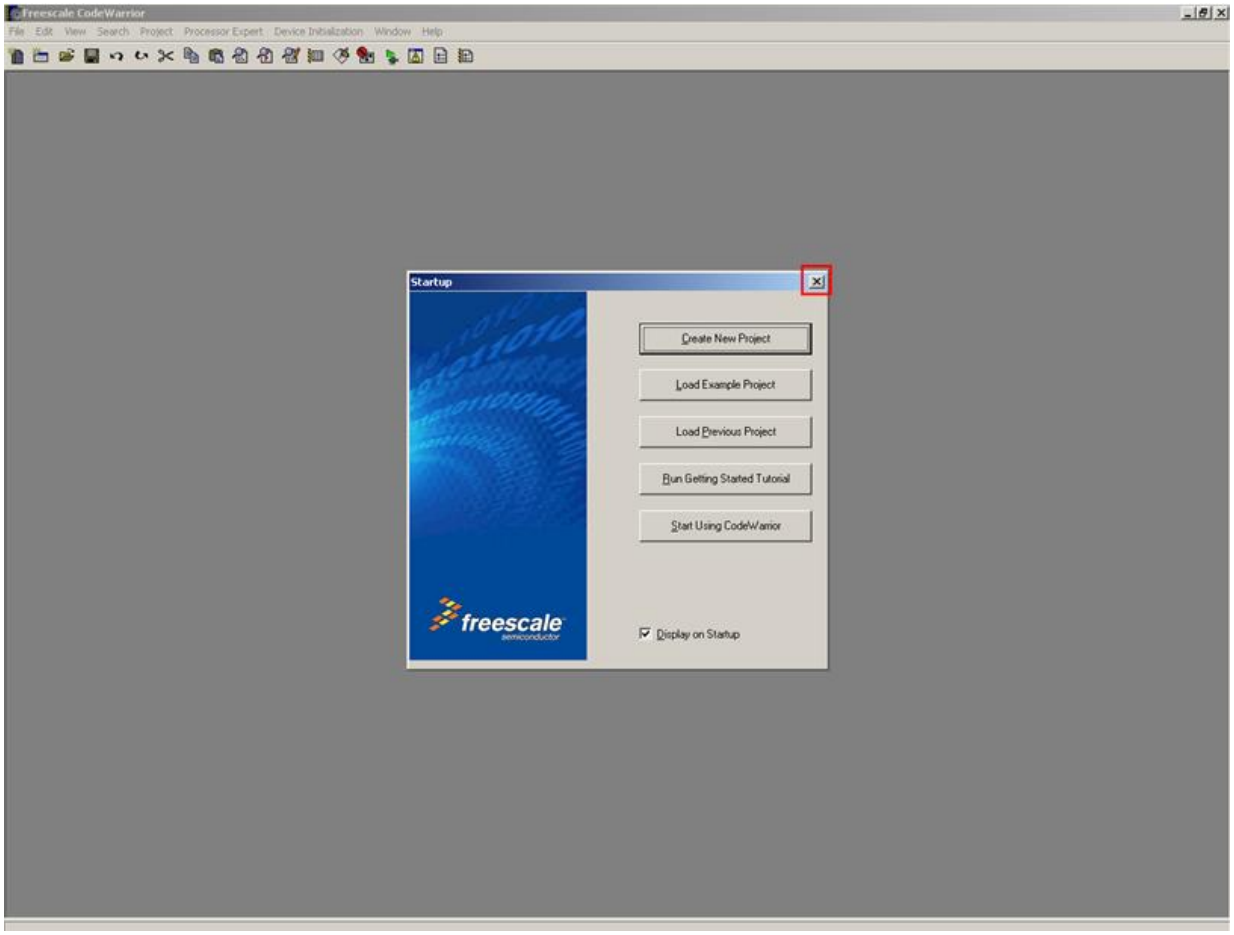
1. Connect an USB cable to the TWR-SER board to turn it on and an USB cable to the TWR-MM Module.



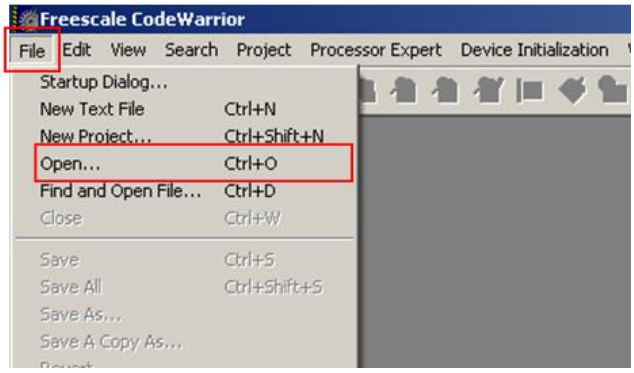
2. Open “CodeWarrior Development Studio Microcontrollers V6.3”.



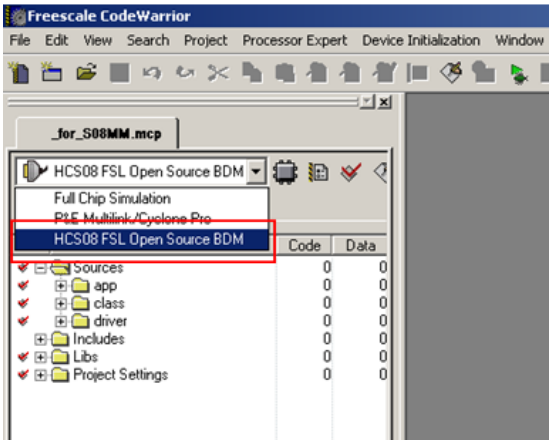
3. Close the Startup window.



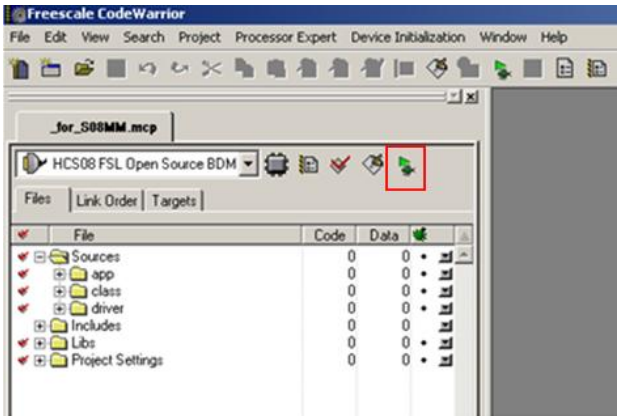
4. Go to Menu->File/Open and open the project file for the MED-EKG board with file extension .mcp. It can be found on the folder “MED-EKG” after uncompressing the file “AN4323SW.zip” downloaded from Freescale webpage. Project for MC9S08MM128 is in the path “MED-EKG\SW for MM devices with FIR\ECG for S08MM\Ecg for S08MM.mcp” and for MCF51MM256 in “MED-EKG\SW for MM devices with FIR\ECG for MCF51MM\Ecg for MCF51MM.mcp”.



5. Make sure the option Open Source BDM is selected for debugging.



6. Press the debug button to automatically compile and load the program into the MCU.



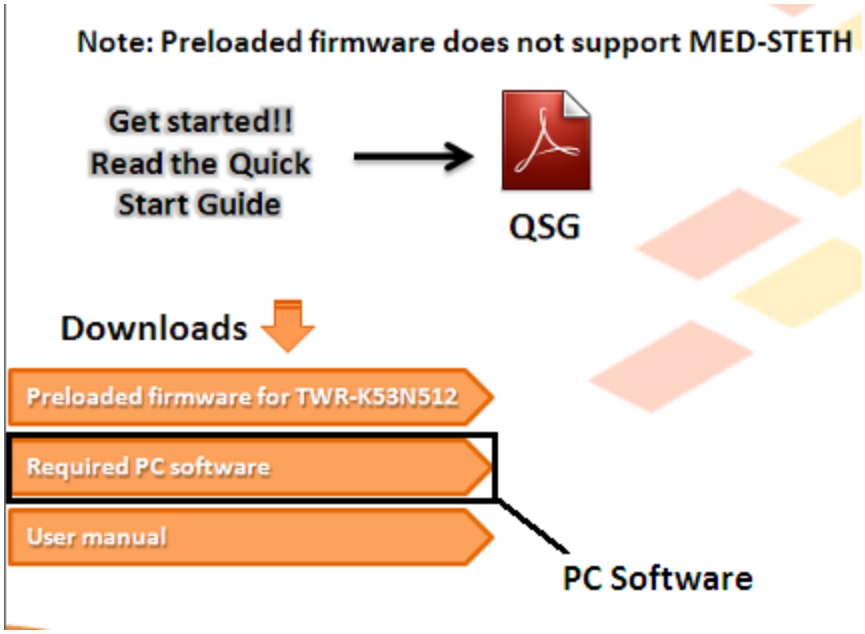
7. If a warning like in the following image appears, mark “Do not display this message anymore for this project” then click “OK”.

8. When the program has loaded successfully into the MCU, close the “True-Time Simulator & Real-Time Debugger”, “Freescale CodeWarrior” and disconnect the USB cable from both the TWR-SER and MM board.

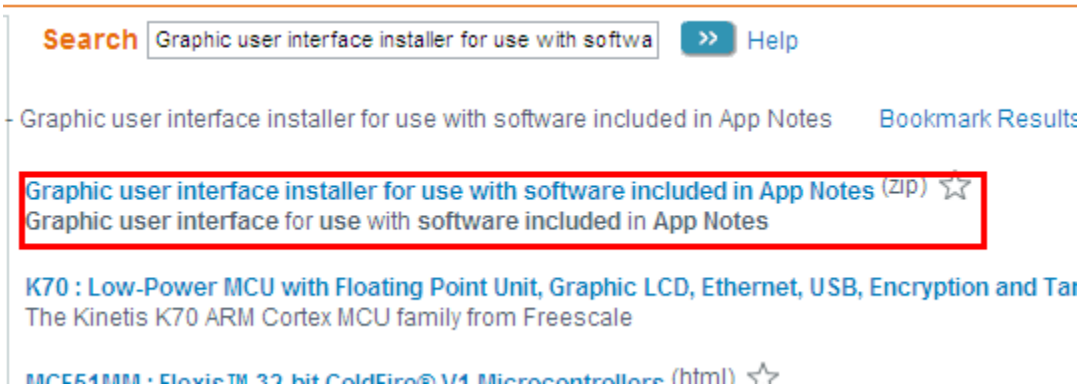
2.6. Installing Graphical User Interface (GUI)

Next steps must be followed in order to install the Medical GUI on your computer:

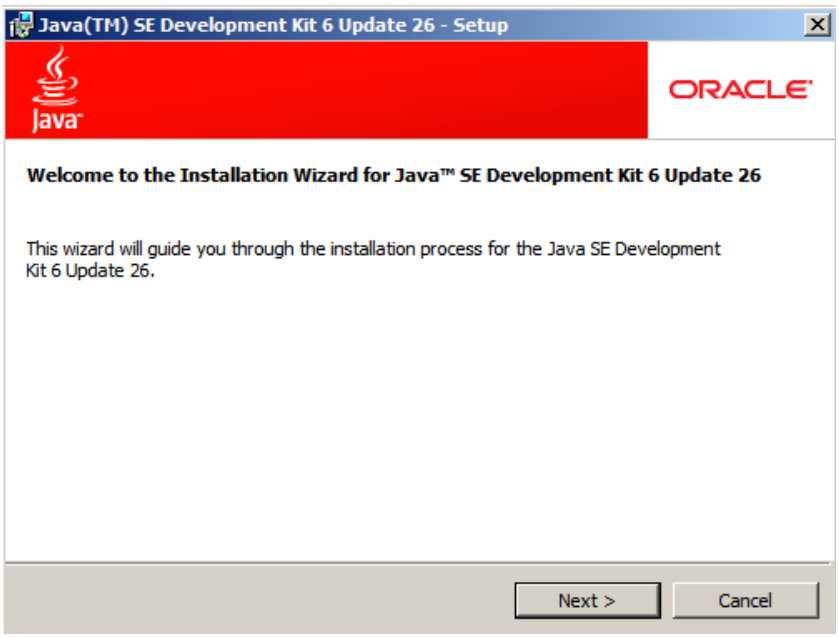
Note: All the required software described below can be also found on the Required PC Software section on the suitcase DVD.



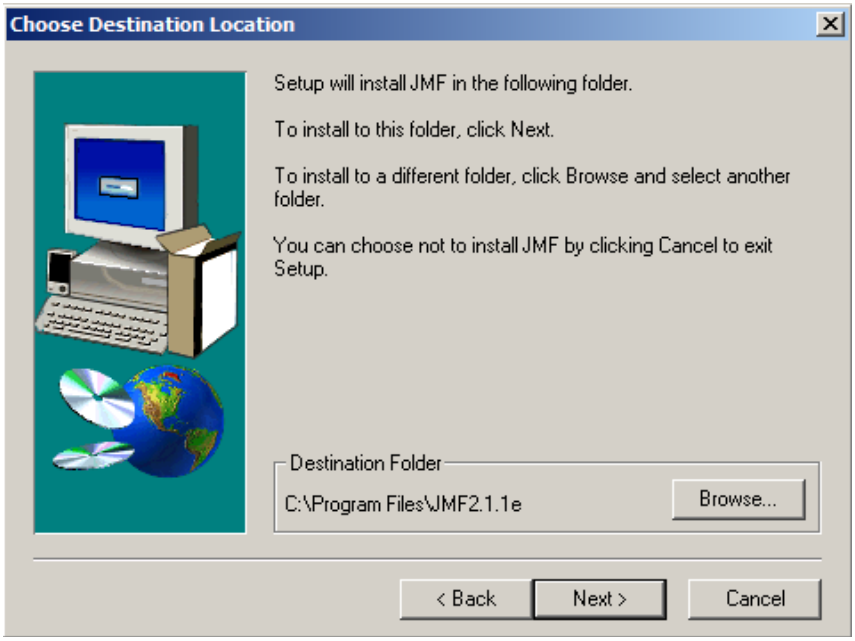
1. Download the Medical GUI from the Freescale website. It can be found searching for “Graphic user interface installer for use with software included in App Notes”

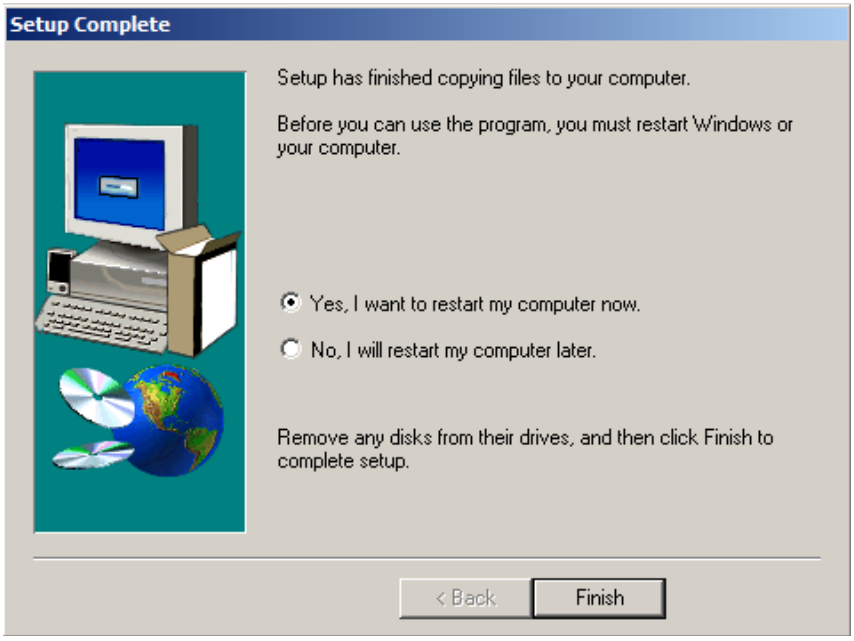


2. Download and install the latest version of Java JDK on your computer. It can be downloaded from Oracle® Web Page.

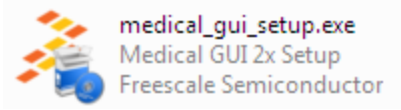


3. Download and install the latest version of Java JMF on your computer. Again, it can be downloaded from Oracle® Web Page.

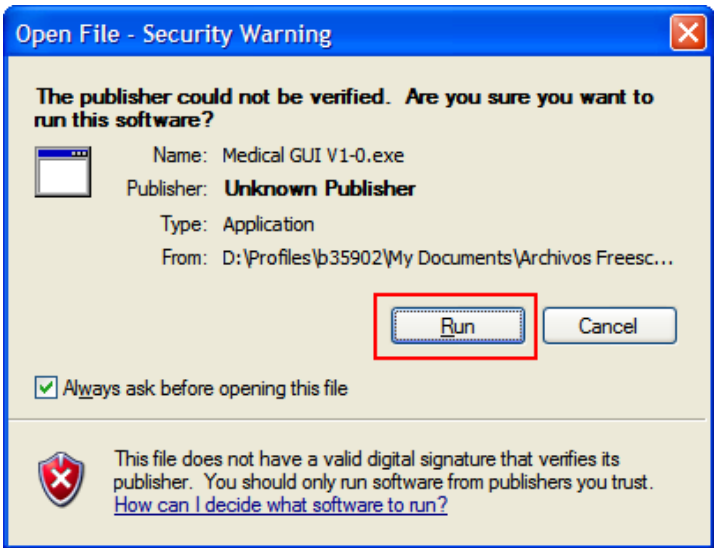




4. Execute medical_gui_setup.exe.

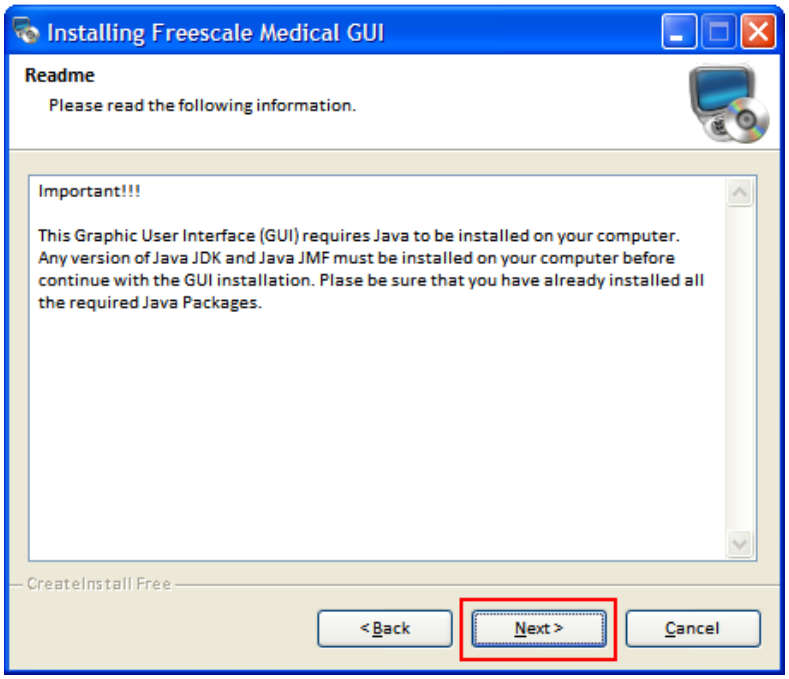


5. If a security warning like the one shown below appears, just click on “Run”.

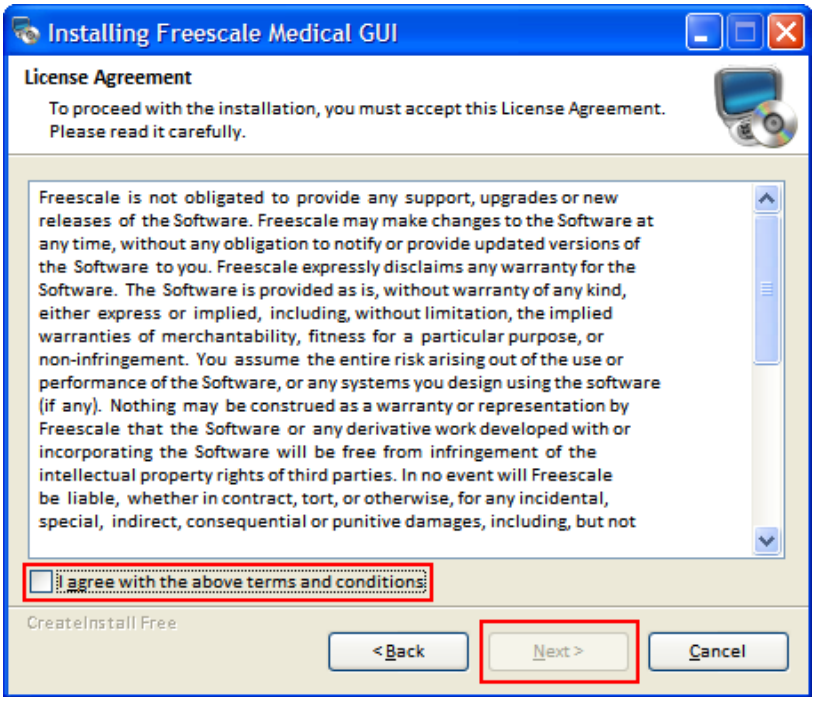


6. In the first screen of the installation process, click on “Next”.

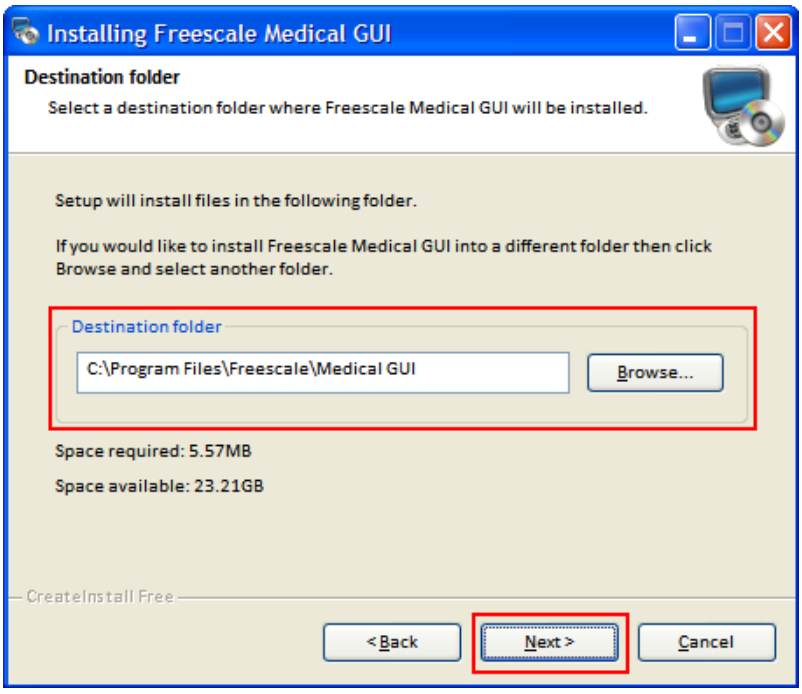
7. If you already installed Java JDK and Java JMF, ignore the Readme screen and click on “Next”. Otherwise cancel the installation and refer to steps 2 and 3.



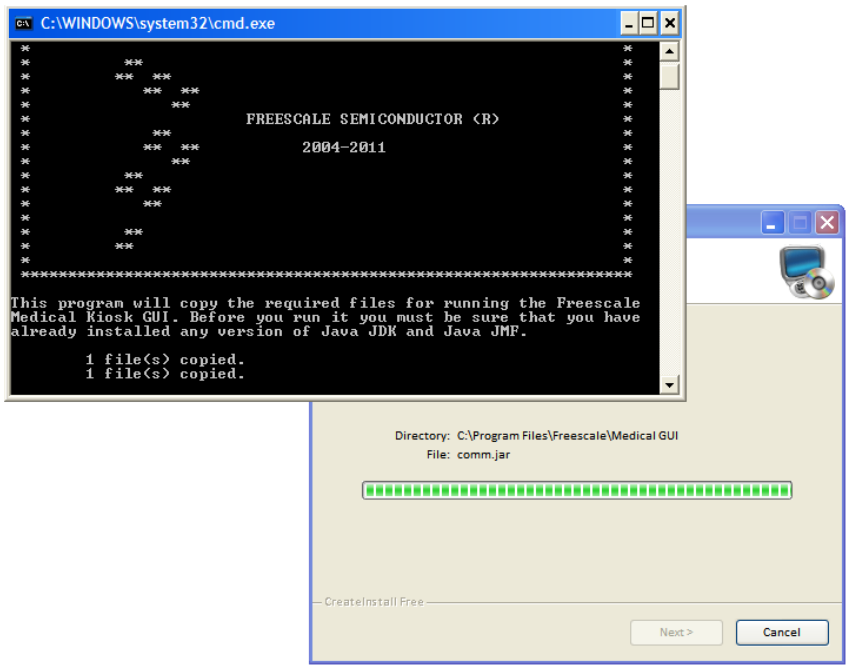
8. Take your time to read the license agreement in the next screen. If you accept all the terms exposed, select “I agree with the above terms and conditions” and click on “Next”.



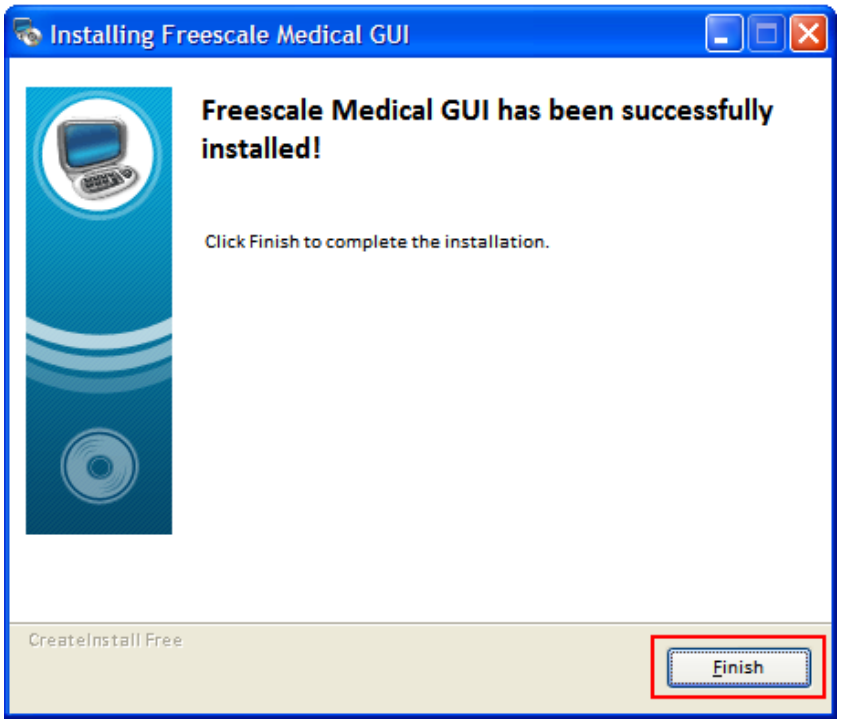
9. Select the desired destination folder or leave the default path and click on “Next”.



10. The software will be installed immediately to the computer.



11. After the installation is complete, click “Finish” on the last screen.

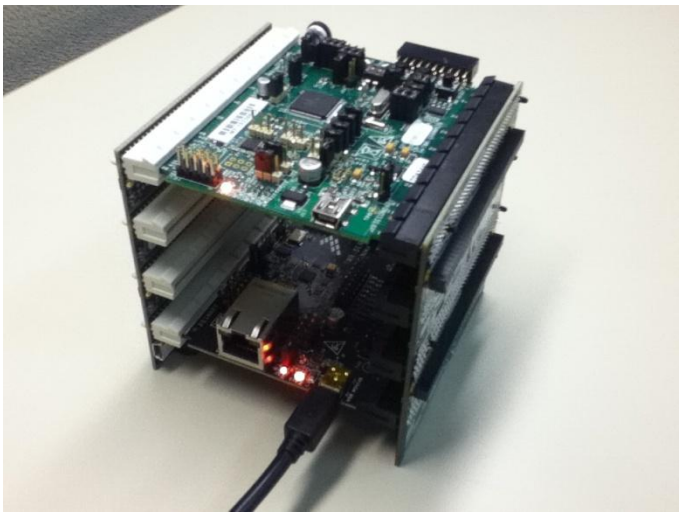


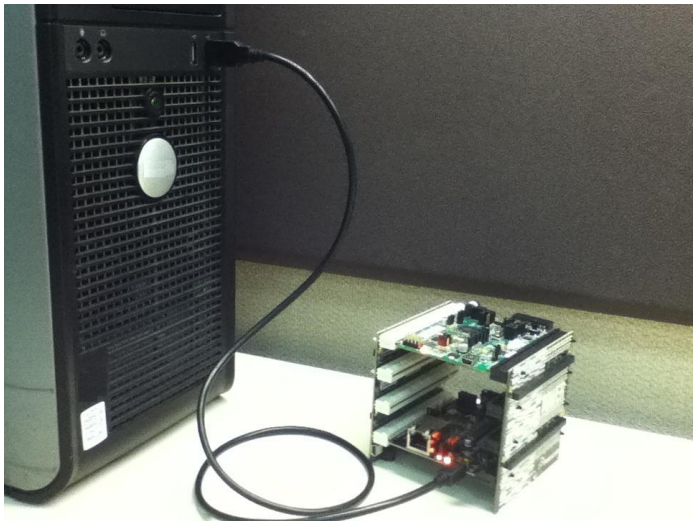
12. A shortcut must appear in the Desktop and the menu programs.

2.7. Installing Virtual Com Port Driver

Once the GUI has been installed and software downloaded to the microcontroller, the Tower System Medical Demo is ready to be connected.

Connect the TWR-SER to the host computer as follows:

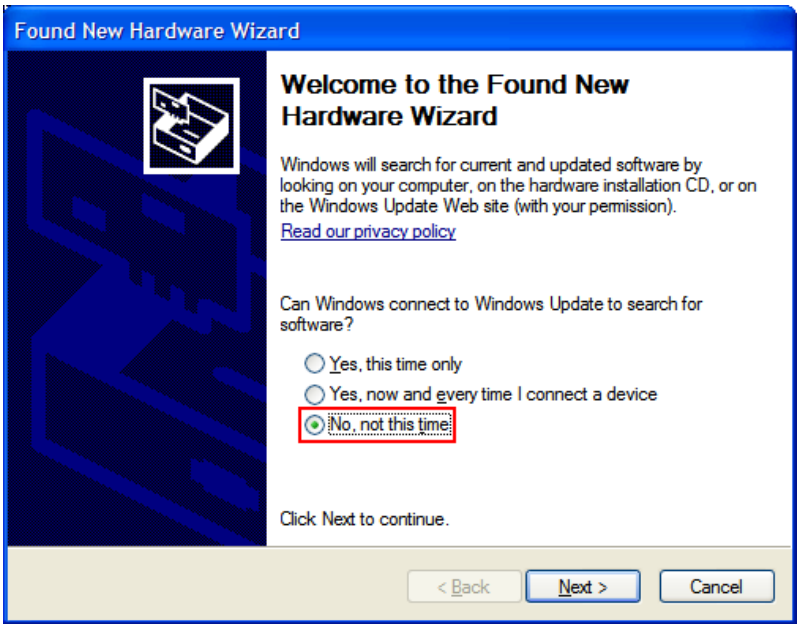




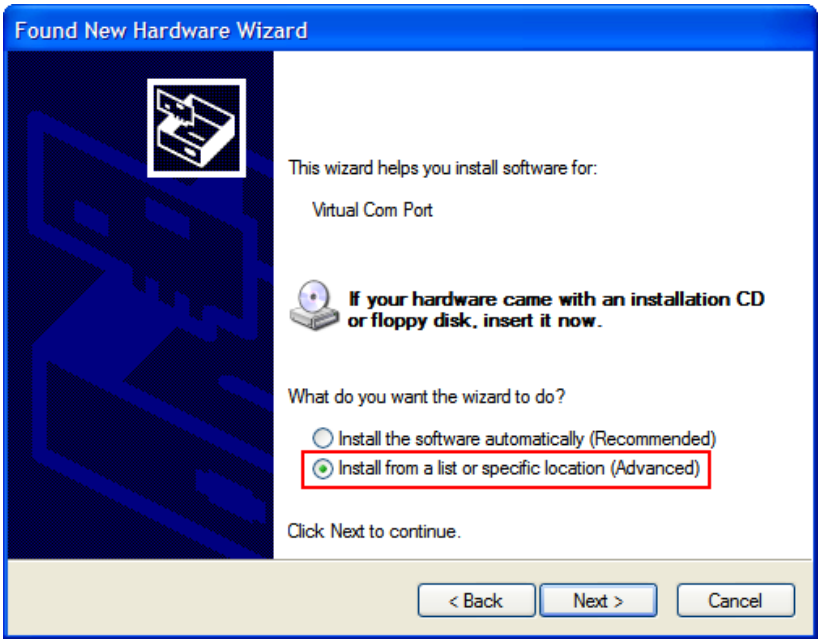
The demo is recognized as a Virtual Com Port:

The driver must be installed following next steps:

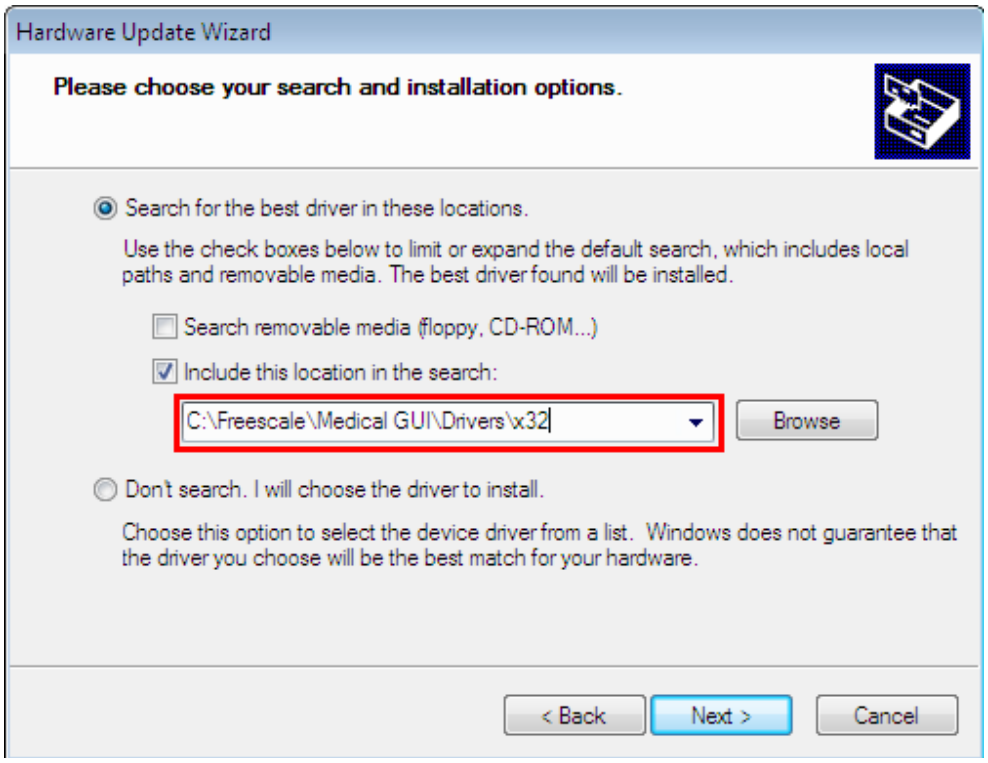
At the “Found New Hardware Wizard” screen, select “No, not this time”, and click “Next”.



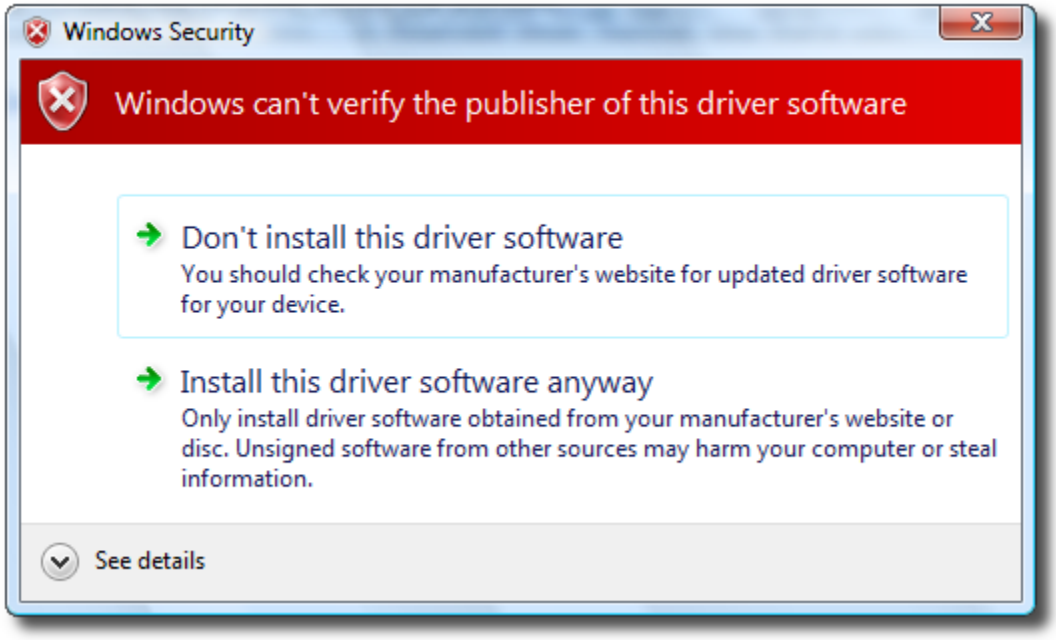
When asked “What do you want the wizard to do?” click “Install from a list or specific location”.



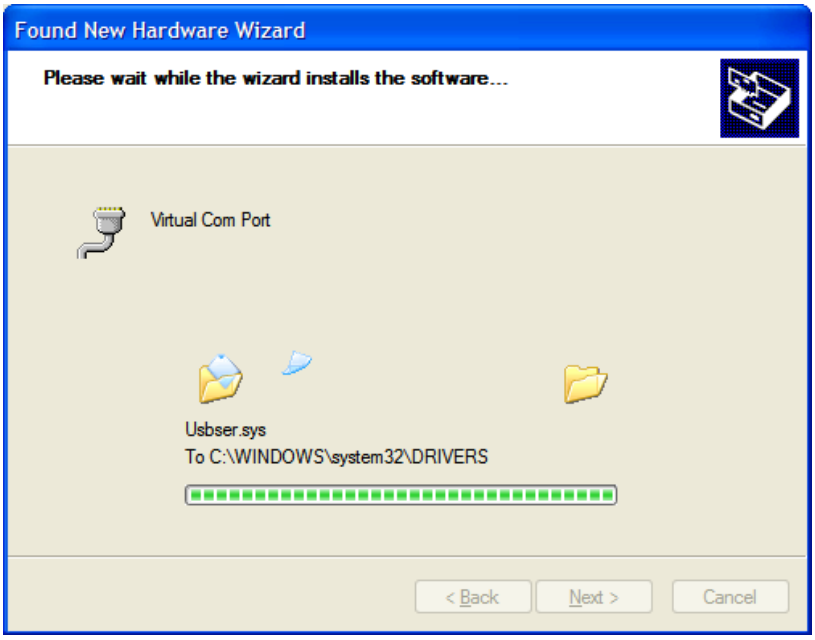
In the next window, click “Browse” and select the following folder: C:\Freescale\Medical GUI\Drivers\x32 or x64 depending on your Windows OS.



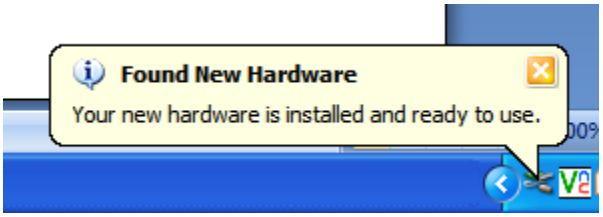
If you see the following dialog box, click “Install this driver software anyway”.



The computer installs the proper driver:

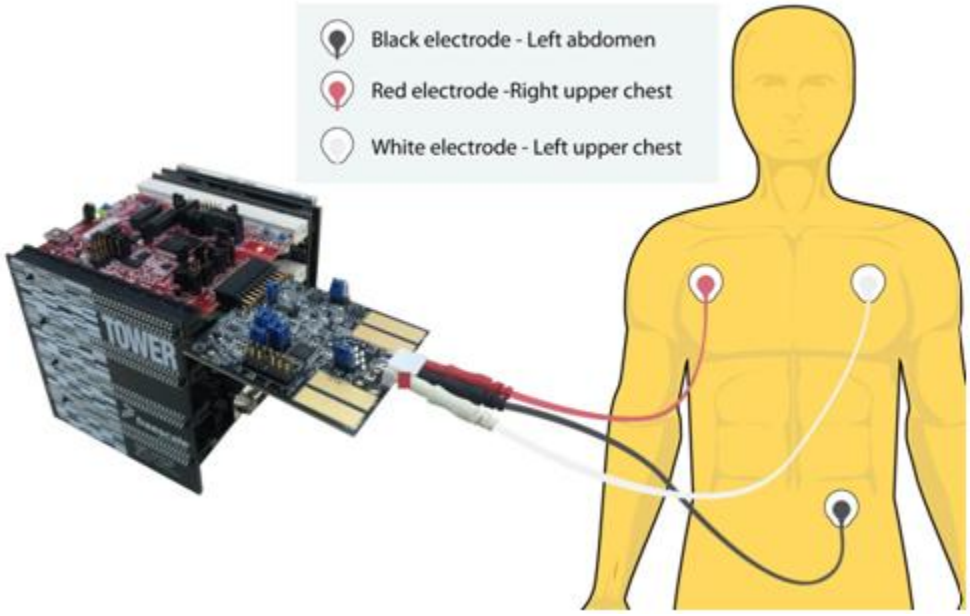


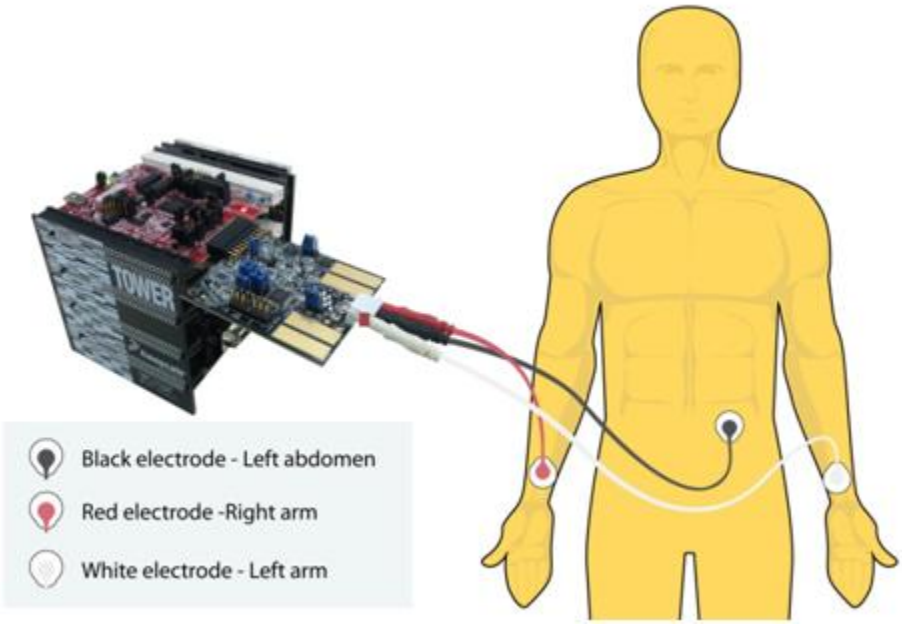
Click “Finish” to complete the installation. The next message will appear:



3. Running the demo

1. Once the microcontroller is programmed and the TWR-SER module is connected to the computer via USB, the next step is to connect the electrodes. In this case, we use the Welch Allyn® ECG Lead Wires, although it is possible to use the embedded electrodes or build your own leads, as mentioned before.

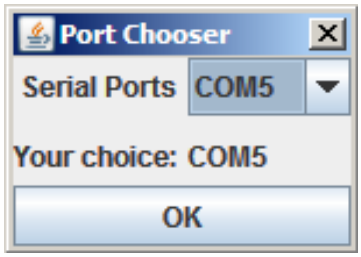




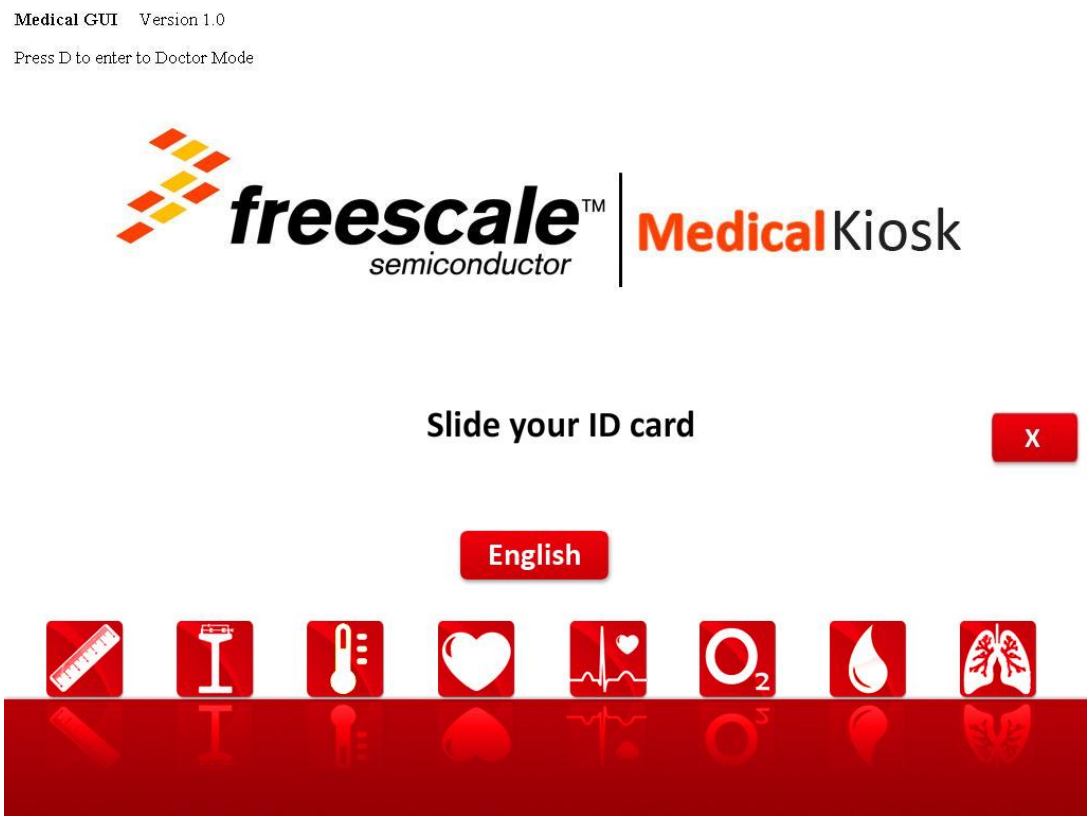
2. Press the reset button on the microcontroller board. When the demo is used for the first time, you have to install the driver for the USB CDC Virtual COM. The default path for the driver is: c:\Program Files\Freescale\MED-EKG\Driver\.

3. Open the Windows Device Manager and search for the port assigned to the USB CDC virtual com. This information is requested by the GUI.

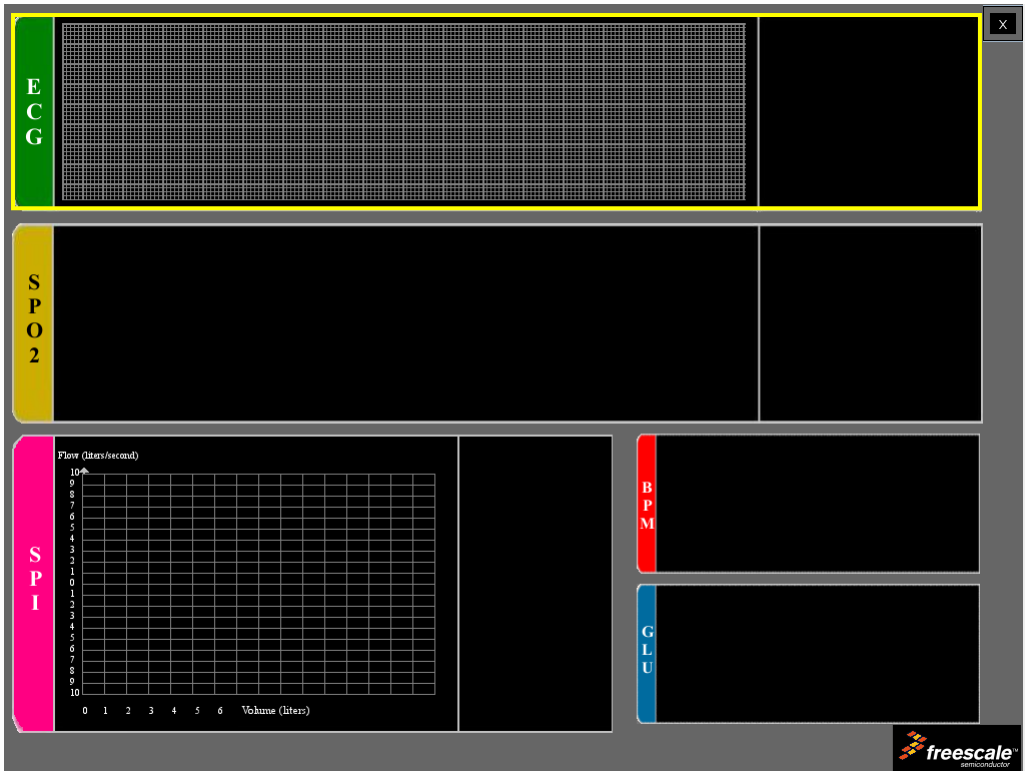
4. Open the graphical user interface (GUI). It will ask for a port number, obtained in step 3. Select the correct port and click on the OK icon.



5. The main screen of the GUI appears. Make sure that Caps Lock key is not activated on your keyboard and press Shift + D. This will start the GUI doctor mode.

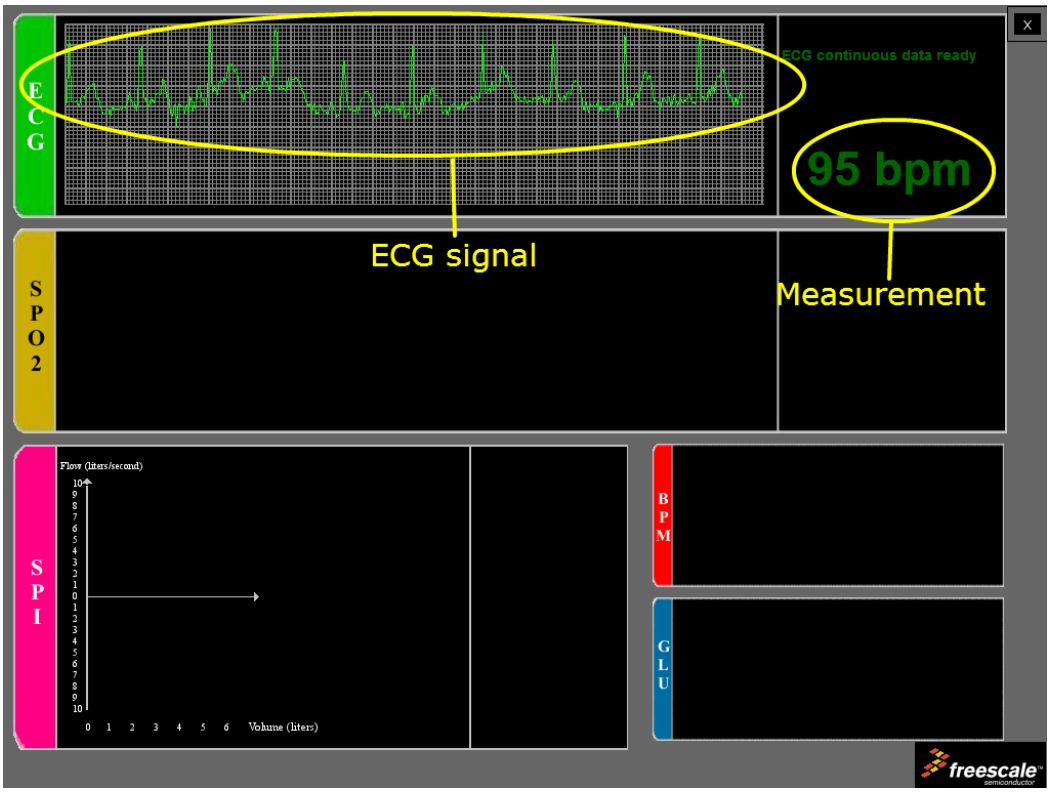


6. In the doctor mode screen, select the ECG option.



7. Press the “ECG” area. The ECG signal will start being displayed. Wait for the signal to stabilize. You can see the electrocardiogram signal and the heart rate as well.

8. The ECG parameters and the graph are shown on the GUI. The following figure is an example of the results of a ECG test.



IMPORTANT: The results of the test cannot be used with diagnostic purposes. This is only a demonstration of Freescale products and platforms, and the results must be interpreted by a healthcare professional. For medical assistance please visit your regular doctor.

Appendix A. Frequently Asked Questions (FAQs)

1- **Where can I find the necessary software for the MED-EKG demo?**
The software can be downloaded from the Freescale Webpage.

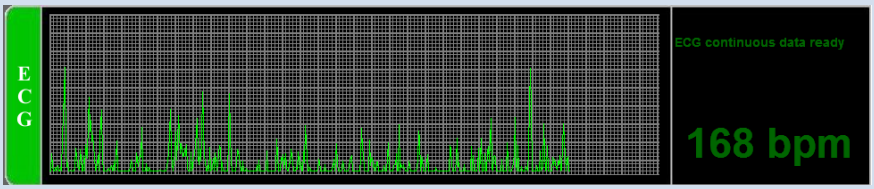
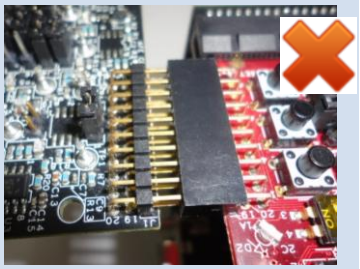
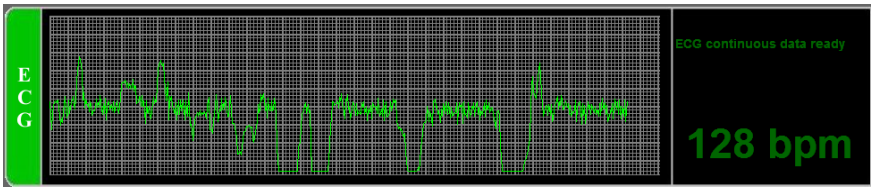
2- **Can I use the MED-EKG demo to diagnose heart diseases?**
No, the results of the tests are not to be used on diagnosis. You have to consult a professional healthcare provider.

3- **What can I do if I don't have EKG electrodes?**
You can use the embedded electrodes integrated on the MED-EKG board. Refer to MED-EKG User Guide for instructions on how to do that.

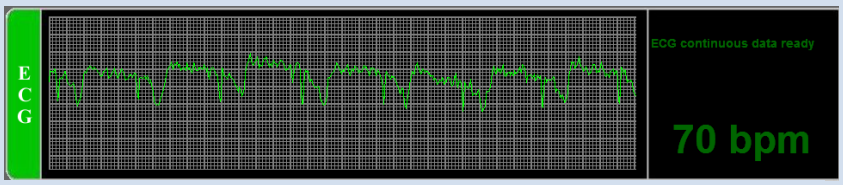
4- **Is it possible to sell this product with my own brand?**
No, you have to make some changes to the demo in order to obtain clearance from federal institutions such as FDA to sell this.

5- **Are there any gerbers, schematics and Bill of Materials available?**
Yes, the files can be used for designing your own prototype.

Appendix B. Common issues

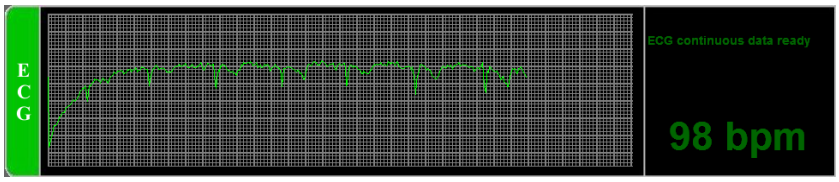
Error	Possible Solutions
Signal appears on the bottom of the GUI and without heartbeat pulses 	1. The AFE board has a deficient connection with the MCU board. Make sure that the headers have a secure connection. 
Signal is unstable on the GUI and it doesn't have a baseline 	1. The system is very sensitive to movements, causing the signal to move up and down. Keep quiet and do not move during the test.

Signal appears upside down on the GUI



1. The electrodes are not connected in the correct order to your body. Electrode with black wire must be connected to your abdomen. (See section 1.1, step 6)
2. The wires are not connected in the correct order to the MED-EKG board. Black lead must be connected to the middle pin. (See section 3, steps 5, 6 and 7)

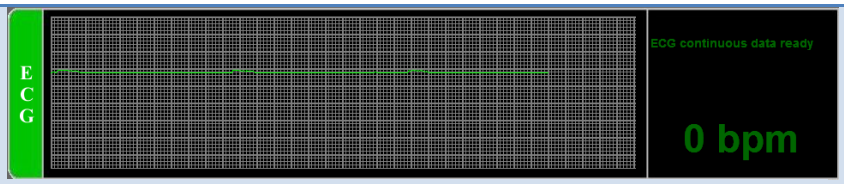
The signal is very small



1. The signal starts with low amplitude and the demo adjusts the gain automatically. Wait a few seconds for the signal's amplitude to increase.
2. Your body/skin might have very high impedance. Try changing red and white electrodes to your chest.

The GUI shows only a horizontal line

1. One or more of the electrodes are not connected. Make sure that the three electrodes are



connected.

2. The electrodes have not a good contact with the skin. You might need to replace the electrodes if the glue is insufficient.

3. One or more of the leads are not in contact with the connector on the MED-EKG board. Make sure all the wires are properly connected.

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For information on Freescale's Environmental Products program, go to http://www.freescale.com/epp.