MLX90614 Single and Dual zone Infra Red thermometer Evaluation Board EVB90614 User Manual

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1 Introduction

The EVB90614 is designed to support MLX90614 infrared thermometer modules. The communication between PC and the evaluation board is accomplished by USB. The Demonstration Kit contains the following items:

1. FS USB demonstration board, pre-programmed with USB bootloader and demonstration firmware.
2. A standard USB cable for use in communicating with the board.
3. 1 pc. MLX90614AAA (single zone 5V)
4. 1 pc. MLX90614BAA (single zone 3V)
5. CD-ROM, containing the USB HID driver and EVB90614 software

The EVB90614 is designed to allow OEMs to configure the MLX 90614 IR thermometer for virtually any application quickly. OEMs can quickly experiment with temperature ranges, optics, etc. to find the best IR configuration to meet the application needs. Once the best configuration is established, low volume OEMs can easily configure IR modules for their own use. For high volume OEMs, Melexis can supply special configured modules, ready to install into the customer's application. Please contact IR Sales at Melexis for quotations.

The EVB90614 allows engineers to customize the MLX90614 for high accuracy IR measurements in an R&D or Laboratory setting.

2 Host computer requirements

To communicate with and program the EVB90614 evaluation board, the following hardware and software requirements must be met:
• PC-compatible system
• An available USB port
• CD-ROM drive (for use with the accompanying CD)
• Microsoft Windows 98, Second Edition (98SE), Windows 2000 Desktop or Windows XP

Note 1: EVB90614 is HID USB device and will require no drivers on PCs that support HID class USB devices (except Microsoft Windows 98, Second Edition (98SE)).
Check www.melexis.com for most recent release of the software.

3 Installing the software

As an USB device, the demonstration board requires very little effort to install. Most of the work is done by the operating system. The software is installed simply by running the file "setup.exe".
The software will be installed in a separate Melexis directory and can be accessed from Start/Programs/Melexis/ Mlx90614 Configurator.

Note 2: If your version of Windows does not support the HID USB devices you might need to install USB driver (check www.melexis.com for such driver).

4 Getting started with MLX90614 evaluation board

4.1 MLX90614 evaluation board overview
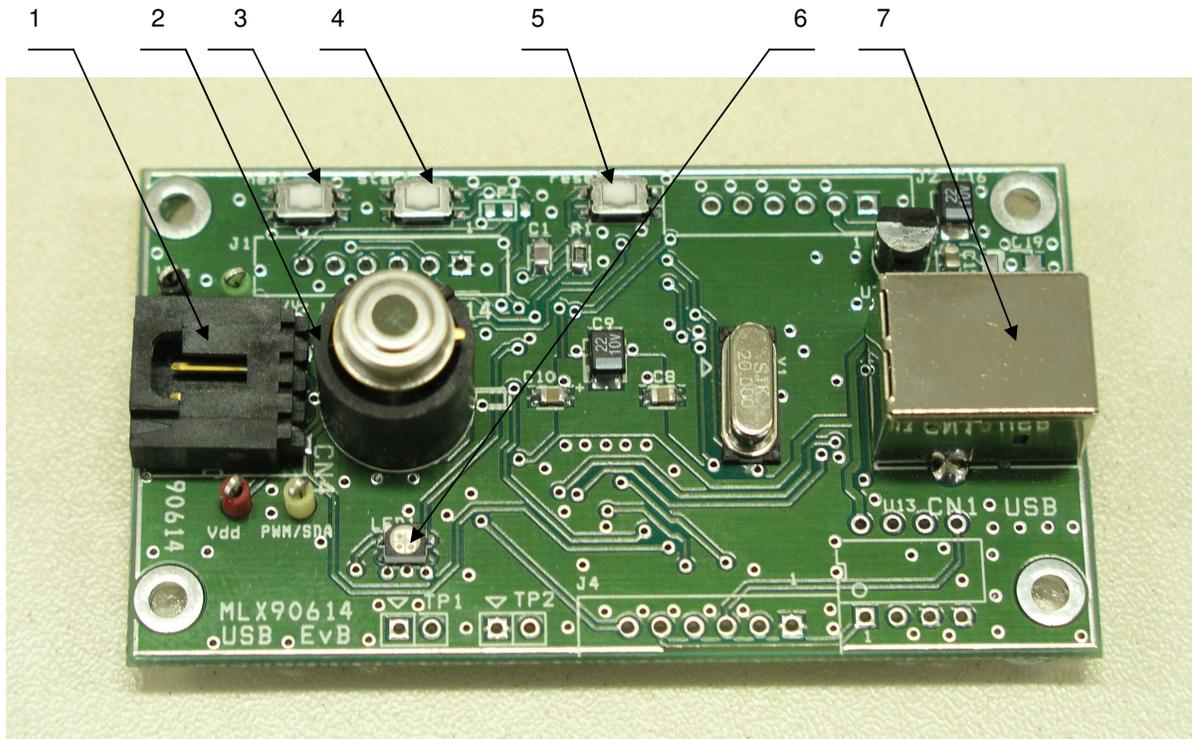
Fig.4.1

Top view of evaluation board is shown on Fig.4.1.The main elements include:

1. Extension connector (70553-0003 from www.molex.com) allowing additional MLX90614 modules to be connected to SMBus.

Connector pin description:

pin1 - SCL/Vz (*pin 1 is marked on the plastic body of the connector*)
pin2 - PWM/SDA
pin3 - Vdd
pin4 - Vss

2. ZIF socket for MLX90614
3. Button "next"
4. Button "start"
5. Button "reset"
6. RGB status LED
7. USB "B" Receptacles

The EVB90614 board receives its power supply only from the USB cable (Bus-Powered Device). External power supply source is not needed.

4.2 Connecting the EVB90614 evaluation board

To connect the evaluation board:

1. Unbox and unwrap the board, and set it on a non-conductive surface near the host system.

2. Connect the USB cable (supplied in the kit) to an open USB port on the host system or a USB hub connected to the host system, and to the USB connector on the board. The LED will shine in BLUE.

3. EVB90614 evaluation board is HID compliant device so a special USB device driver is not needed (*except when using Window 98 & 98SE).*

4. Check the board connection. This can be done from Start/Settings/Control Panel/ System/Hardware/Device Manager (Fig. 4.2).

Fig. 4.2

5 Getting started with MLX90614 Configurator

5.1 MLX90614 Configurator overview

The MLX90614 Configurator is a Windows-based software application designed to be used with the EVB90614 evaluation board for evaluating Melexis MLX90614 infrared thermometers. Using this software, features and performance of MLX90614 infrared thermometers can be evaluated. All basic configurations of MLX90614 are also supported in user-friendly format. Configuration is written in EEPROM of each MLX90614 and will be the POR default afterwards. This way the MLX90614 can be further used without EVB in target applications.

5.2 Working with MLX90614 Configurator

Insert a MLX90614 thermometer in the ZIF socket (see Fig. 4.1). Make sure that module benchmark coincides with the mark on the PCB.
The software can be launched from Start/Programs/Melexis/ MLX90614 Configurator.

The Configurator automatically recognizes the module type, address and voltage supply (Fig. 5.1). The status LED is shinning GREEN.

Fig. 5.1

If there is no thermometer module inserted on the EVB or the module is not a MLX90614, the user will be notified (Fig. 5.2). Click the button OK. The main panel looks as shown in Fig. 5.3.
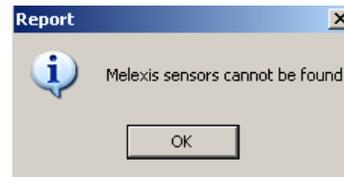
Fig. 5.2
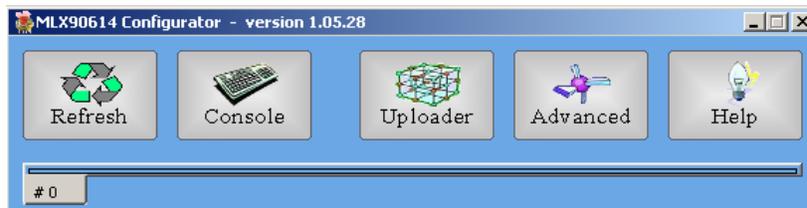
Fig. 5.3

IF a module is put incorrectly the user will be notified (Fig. 5.4).
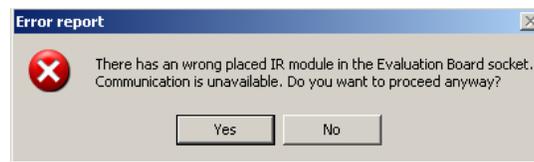
Fig. 5.4

Note that the buttons Power off and Refresh are alternating.
The MLX90614 Configurator gives the opportunity to connect a few MLX90614 modules in a network (Fig.5.5). Note that if in a network both 3V (MLX90614Bxx) and 5V (MLX90614Axx) modules are present, currently only the 3V modules will be available.

Fig. 5.5

Note 3: When more than one module is connected on the bus an error message (see Fig. 5.4) will be shown. Note that this doesn't mean mandatory that there is incorrectly put module but the user is encourages carefully to check the modules before click button Yes.
Note 4: If in a SMBus network there is a module with address zero it will be not reported. A module with SMBus address zero will be reported if it is the only one connected to board. Also modules with the same SMBus addresses connected to the network will cause conflict on the bus when operation reading is done.
Note 5: It is strongly recommended to save factory default EEPROM of every new MLX90614 before doing anything else with it (See below how to do that).
Note6: schematics for PCBs to attach multiple modules using connector 1 can be found on page 20.

Main panel description

Power off	Turn off module power supply.
Refresh	(Re-)start system to refresh information about the modules.
Console	Opens "Console Utility" window for manual sending of commands. See Appendix A for commands set.
Uploader	Opens "Configuration uploader" window for quick replication of MLX90614 infrared modules' configuration.
Advanced	Opens "Advanced" window from which user can upgrade EVB firmware, change measuring unit of the temperature scale and relocate the log file.
Help	Opens current EVB90614 User Manual. It is recommended to check www.melexis.com for updates and related documents.

Config	Opens "Configuration utility" window used for configuring MLX90614 infrared thermometers.
Measure	Opens "Measure utility" window for temperature measurements.
	Dual zone module identification picture.
	Single zone module identification picture.
	Cyclop module identification picture.
Type: Mlx90614AA Bus Adress 0x5A	Module type and SMBus slave address identification fields.
# 0 # 1	Show which EVB is active (more than one EVB can be connected to the one PC).

5.3 Configuration of MLX90614 modules

From the main panel push the button Config. *"Configuration utility"* window is opened (Fig. 5.6).

Mlx90614AB @ 0x5C - Configuration utility	
To max [°C]	119.85
To min [°C]	-20.15
Ta max [°C]	119.88
Ta min [°C]	-20.28
PWM / SMBus / Relay	SMBus
SMBus address	0x5C
PWM mode	Single
PWM struct	To1
PWM period repititions	0
PWM period [ms]	1.024
PWM pin configuration	Open-drain
F.I.R. filter [ms]	141.631
I.I.R. filter [%]	100
K-Emissivity	1.0000

Read / Write / Save file / Load file / View memory / Close

Fig. 5.6

Mlx90614AB @ 0x5C - Configuration utility	
Hysteresis [°C]	1
Threshold [°C]	26.00
Ta max [°C]	119.88
Ta min [°C]	-20.28
PWM / SMBus / Relay	Thermo relay
SMBus address	0x5C
PWM mode	Single
PWM struct	To1
PWM period repititions	0
PWM period [ms]	1.024
PWM pin configuration	Open-drain
F.I.R. filter [ms]	141.631
I.I.R. filter [%]	100
K-Emissivity	1.0000

Read / Write / Save file / Load file / View memory / Close

Fig. 5.7

From this window the user can configure the MLX90614 module. A short description of every setting field follows bellow. For a detailed description of the settings please refer to the MLX90614 datasheet. These settings are stored in MLX90614 EEPROM and will be the power-up default configuration.

●To max, To min - defines the temperature ranges for object temperature in PWM mode.

●Ta max, Ta min - defines temperature ranges for ambient temperature in PWM mode.

●PWM/SMBus/Relay - chooses between SMBus, PWM and Thermo Relay mode.

●PWM mode - defines single or extended PWM mode

●PWM struct - selects what data will be transmitted via the PWM.

●PWM period - defines the PWM period. A list of available settings as drop-down menu.

●PWM period repetitions - defines how many times each PWM period will be repeated. Any even number of repetitions from 0 to 62 is valid.

●PWM pin configuration - chooses between NMOS "open drain" and "push pull" PWM output.

●Sensor zone - defines the number IR sensors. This number is factory programmed and is recommended not to be altered.

●SMBus address - set SMBus slave address. All values between 0 and 127 are valid. All MLX90614 will accept communication with slave address 0. Therefore in SMBus network a slave address 0 will be useless.

●F.I.R filter- drop-down list of settling time available via embedded in MLX90614 digital filter. Slower settling comes with less noise.

●I.I.R filter [%] – drop-down list of available values for impulse limit. 100% passes all impulse, 50% cuts impulse magnitude in half via embedded in MLX90614 IIR filter. Note that the settling time depends on both FIR and IIR filters settings.

Some options are available from the drop-down menu while other must be typed by the user. For example to change the object temperature range double click on To min or To max field and type the new range.

To change between PWM and SMBus mode double click on PWM/SMBus/Relay field and select from the drop-down menu the desired option (Fig.5.8).
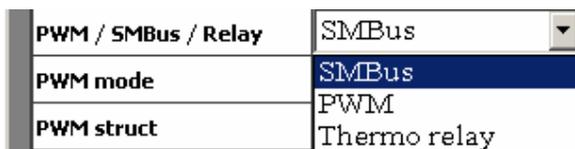
Fig. 5.8

Note that when the Thermo relay option is selected the fields To max and To min change in Hysteresis and Threshold respectively (Fig.5.7). Hysteresis adds to threshold on each side. Trip points will be Threshold+Hysteresis for rising temperature and Threshold-Hysteresis for decreasing temperature.

Tick [☐ View memory] to view the full EEPROM memory in hexadecimal view (Fig.5.9). Note that only highlighted cells are accessible by the user (see MLX90614 datasheet for more information and Note 7). All other EEPROM cells contain factory calibration values and are protected against erase and writes.
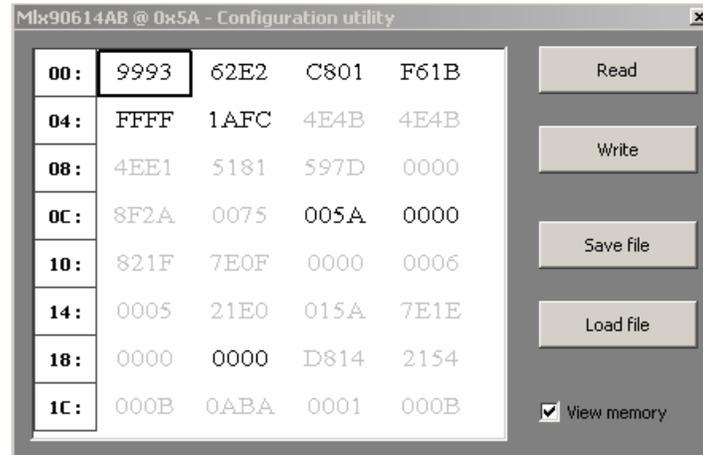
Fig. 5.9

Note 7: Bits <3>, <13:11> and <15> of ConfigRegister1 (EPROM address 0x05) can't be changed from this window because contains a specific information. They can be changed only using the command **we** *(see 5.4 Manual sending commands)*

Note 8: Do not write SMBus address 0x00 in any module when you make a sensor network because reading this module will cause all devices on the network to reply. This will result in confusion on the SMBus.

Click button Read to read the complete EEPROM memory. Starting the SW or clicking "Refresh" after "Power Off" will automatically read the EEPROM, too.

Click button Write to write changed EEPROM cells. Factory calibration values will not be altered. Writing EEPROM cell is automatically preceded by erasure.

Click button Save file to save EEPROM in a bin file. Refer to Fig.5.10.

Click button Load file to load a bin file. If the loaded bin file is to be written into MLX90614 EEPROM a "Write" must be clicked afterwards. Refer to Fig.5.11.
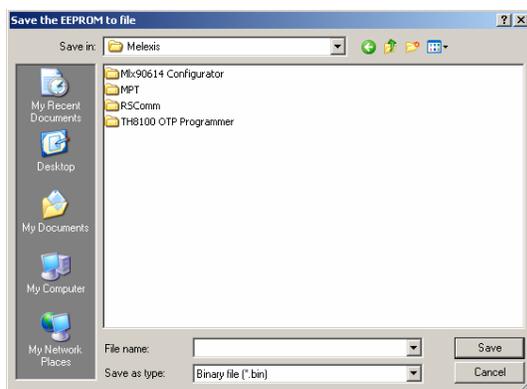
Fig. 5.10
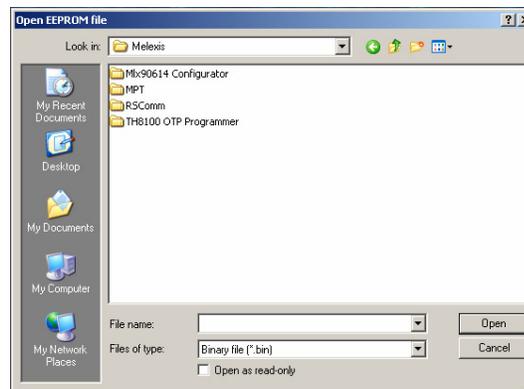
Fig. 5.11

5.4 Manual sending commands

From the main panel push the button Console. *"Console utility"* window is opened (Fig.5.12).
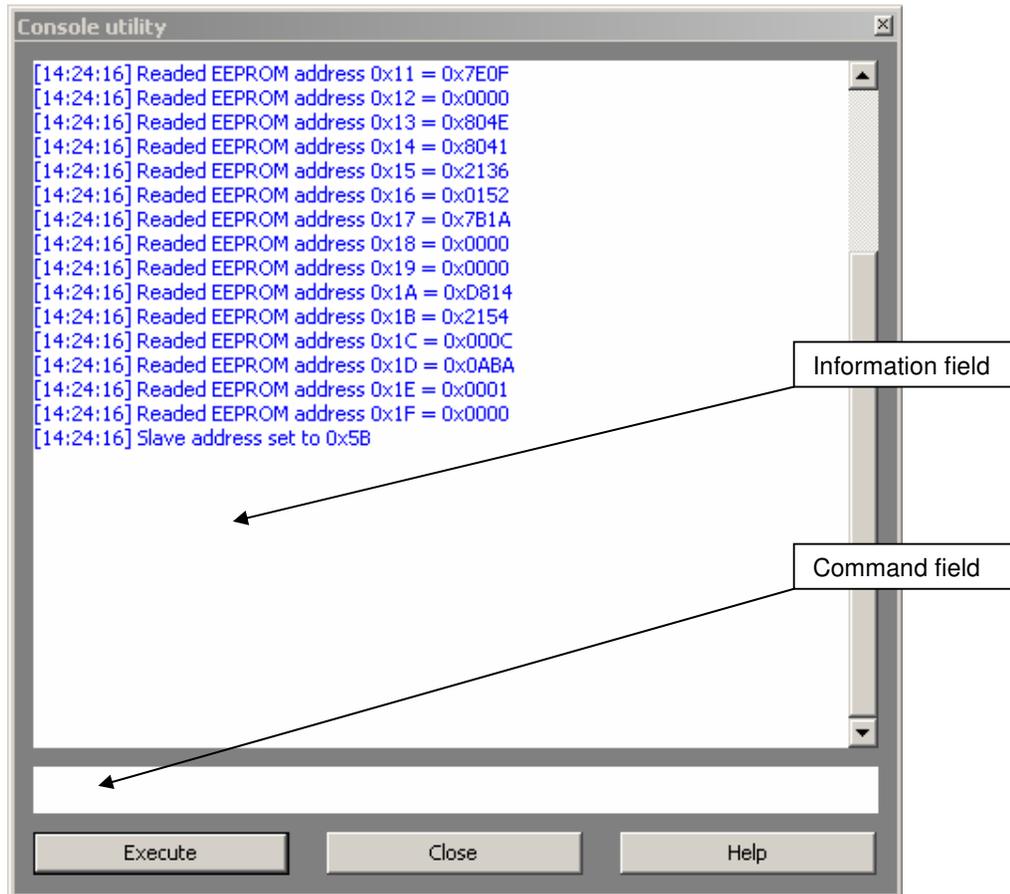
Fig. 5.12

Type a valid command in the Command field, push Execute (or button 'Enter' on the keyboard). The result will be reflected in the Information field. The supported commands are described in APPENDIX A. The console utility is provided for extended functionality. All read/configure/write as well as measure/log data operations can be done without this utility.

5.5 Demonstration of SMBus and PWM temperature measuring

From the main panel push the button Measure. The "Measure utility" window is opened (Fig.5.13).
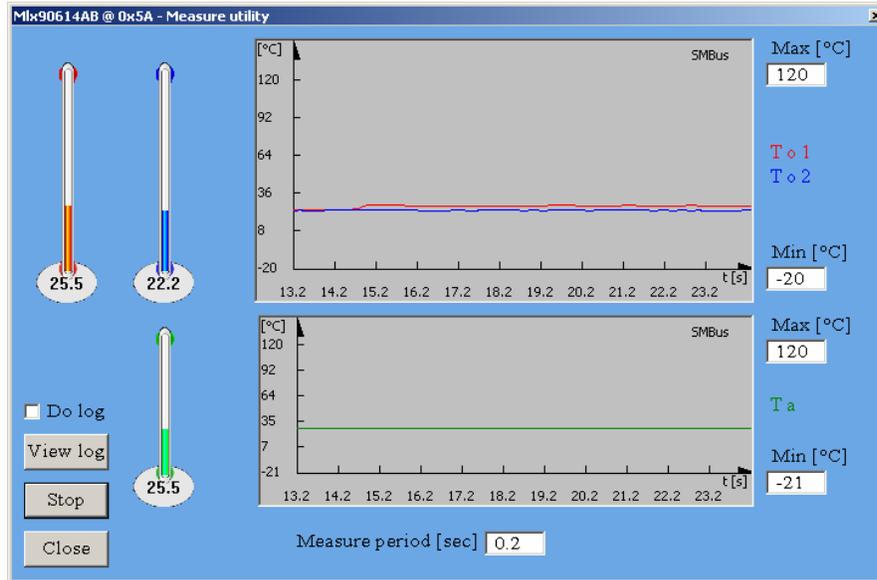
Fig. 5.13

Note 9: If the used module is single zone only two thermometers will be present on the screen (Fig.5.14).
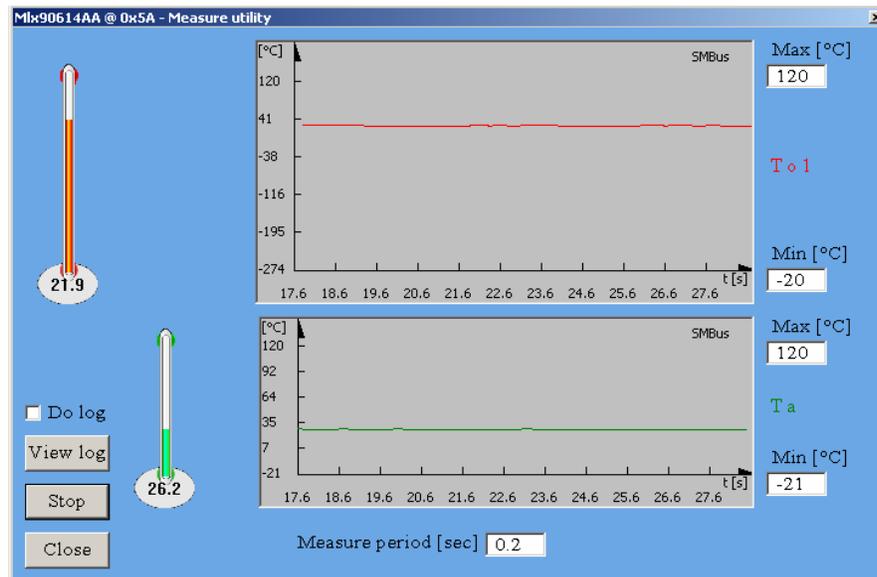
Fig. 5.14

Push the button Start to start temperature measurement. With the MLX90614 configured in PWM mode the PWM output depends on the ranges written in EEPROM. These ranges

are automatically read and filled in the Min/Max boxes on this screen. An example is shown on Fig.5.15.
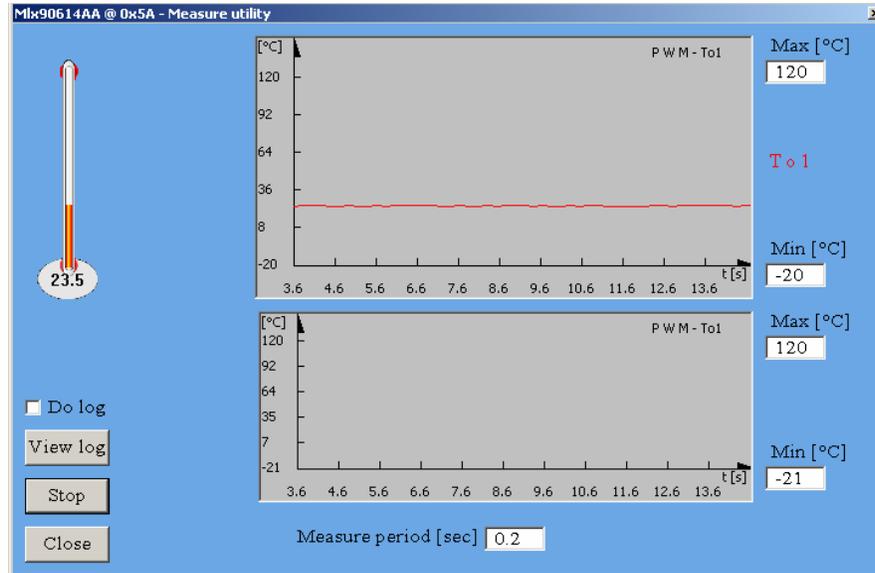
Fig. 5.15

In the field "Measure period" the user can make the measuring faster or slower. Max and Min fields permit user to change graphic scales.

When the measurement is started and Do log field is ticked data will be acquired in a log.csv file. If the SMBus mode is selected the following RAM registers will be logged in the log.csv file (See MLX90614 datasheet for more information):

● Ambient sensor data - SMBus RAM address=0x03h

● IR sensor 1 data - SMBus RAM address= 0x04h

● IR sensor 2 data - SMBus RAM address= 0x05h

● Linearized ambient temperature Ta - SMBus RAM address =0x06h

●Linearized object temperature (IR1) T_{OBJ1} - SMBus RAM address= 0x07h

●Linearized object temperature (IR2) T_{OBJ2} - SMBus RAM address = 0x08h

If PWM mode is selected logged data will depend on the chosen PWM structure.

Every time a measurement is started the log file is continued, with the entire EEPROM saved as new heading row.

*Note 10: In Regional and Language Options (available from Start/Settings/Control panel) **list separator** need to be "**,**" and **decimal symbol** – "**.**" in order to get the CSV log file opened in an easy to use form in EXCEL.*

Note 11: Note that the CSV log file is the same for all measurements, there is not a separate file for every module that is measured.

To change the temperature measuring unit (°C, °F or K) and to relocate the log.csv file:

1. Click the button Advanced from main panel

2. Click the button Options available in *"Advanced"* window.

3. From *"Software settings"* window choose the desired settings (Fig. 5.16).
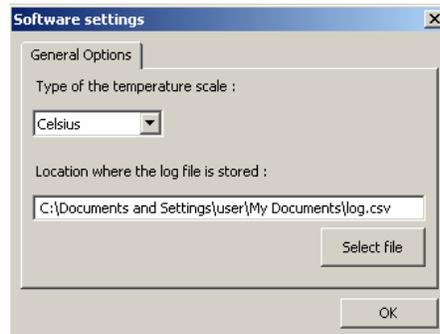
Fig. 5.16

Thermo Relay option can be simulated with MLX90614 Configurator. For example let choose Thermo Relay option in the "Config" window and set the following parameters: Threshold=27ºC, Hysteresis=1ºC. Let open "Measure utility" window (Fig. 5.17) and press the button Start. The Thermo Relay output should be in logical "0" if the object temperature is bellow 26ºC how it is shown on the Fig. 5.17.When the object temperature become above 28ºC the Thermo Relay output is switching over in logical "1" (Fig. 5.18). Min and Max fields show min and max temperature threshold by which the Thermo Relay output will switch over in logical "0" and "1" respectively. Note that the module is indeed in SMBus mode by SMBus Request command and the shown below pictures show how the real Thermo Relay output should keep itself.
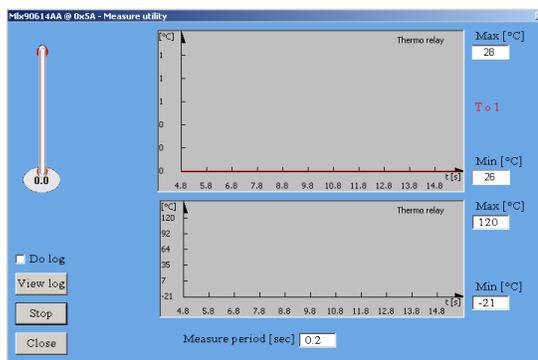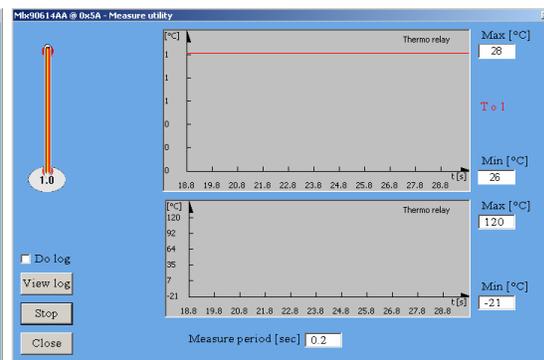
Fig. 5.17   Fig. 5.18

To use EVB90614 with modules with fixed PWM output (no SMBus access is available) the following option can be used:

1. Click the button Advanced from main panel

4. Click the button PWM-M available in *"Advanced"* window.

The window "PWM detached measurement module" is opened (Fig. 5.19).
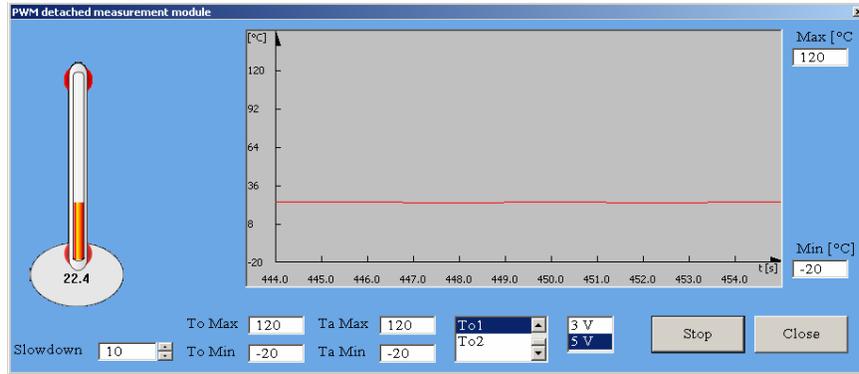
Fig. 5.19

All settings must be entered manually by the user. In Slowdown field user can write value between 0 and 100. Bigger value in this field will make the thermometer readings slower and easier.

5.6 Quick customization of MLX90614 thermometers

Push the button Uploader on the main panel. *The "Configuration uploader"* window is opened (Fig. 5.20).
This window is very similar to *"Configuration utility"* window but here the user cannot change the EEPROM.
Click the button "Select EEPROM" to open the window *"Open EEPROM file"* (See Fig. 5.11). Browse to select the desired EEPROM configuration file and click the button "Open".

The chosen EEPROM configuration is loaded (Fig. 5.21). Tick [View memory] to view the full EEPROM memory in hexadecimal view if desired.
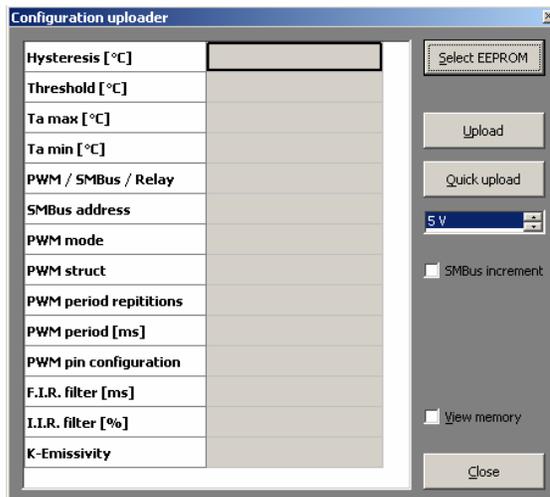
Fig. 5.20
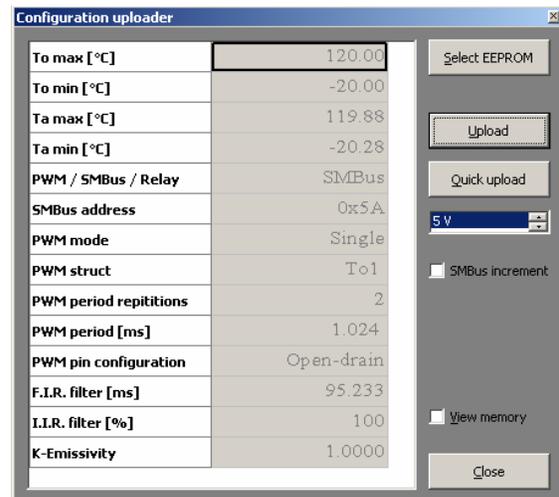
Fig. 5.21

The user has two choices to load an EEPROM configuration in a MLX90614 module:
● Upload
● Quick upload
        When the Upload button is pushed the software automatically checks the module power supply before writing the EEPROM memory of the module. This process takes some time. This option is useful when the user wants to configure MLX90614 modules of different versions. It is recommended to use this option as it provides additional safety (a 3V module would not be subjected to overvoltage stress unintentionally).
        When long series of MLX90614 modules need to be configured with the same configuration the Quick upload option might be preferred. In this case the user must initially choose the module voltage supply manually in the field below the button Quick upload (See Fig. 5.18 or Fig. 5.19) and push the button Quick upload. In this case the software does not make module power supply verification so the time of module configuration is reduced. Tick SMBus increment field if you want the SMBus address field to be incremented automatically.

        Note that in both cases the users cannot enter the SMBus device address. And indeed this is not necessary because the software automatically uses address 0x00 which is universal address for all MLX90614 devices. The users must realize also that when using the *"Configuration uploader"* window only one MLX90614 device should be present or all devices in the network are changed. If you work in a network and want to change the configuration of a specific module in the network use"*Configuration utility"* window (see 5.3 Configuration of MLX90614 modules).

5.7 Updating EVB90614 firmware

For possible future upgrades of the EVB FW a bootloader is programmed into the EVB MCU. This makes possible for the user to load updates into the EVB using the same software.

This can be done by two ways:

Updating EVB90614 firmware – method 1

1. Start MLX90614 Configurator
2. Push the button Advanced from the main panel. *"Advanced"* window is opened (Fig. 5.22).

Fig. 5.22

3. Push the button Upload HEX. A warning message appears (Fig. 5.23).
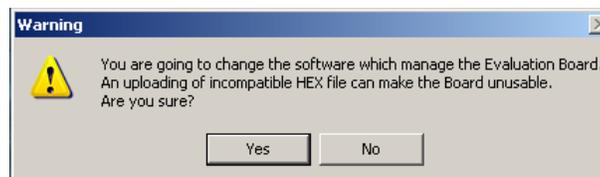
Fig. 5.23

4. Click Yes and in a new browse window to find the firmware file will appear, select the correct file and click button Open (Fig. 5.24).
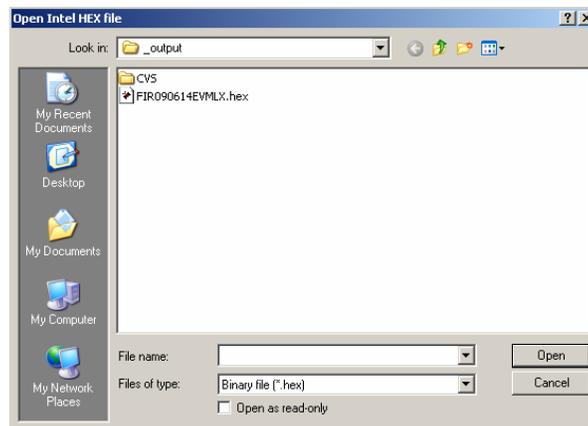
Fig. 5.24

Wait until a message box appears (Fig. 5.25).

Fig. 5.25

Close this window. The EVB90614 board is updated and ready for work.

If an incompatible file is loaded warning messages will appear.

Follow these messages to load a compatible file.

Updating EVB90614 firmware – method 2

 1. Close MLX90614 Configurator
 2. Press and hold the button *start* on the board
 3. Press and release the button *reset* on the board
 4. Release the button *start*

After these steps the board is manually entered in bootloader mode. The LED is turned off.

5. Start MLX90614 Configurator. The following message appears (Fig. 5.25).
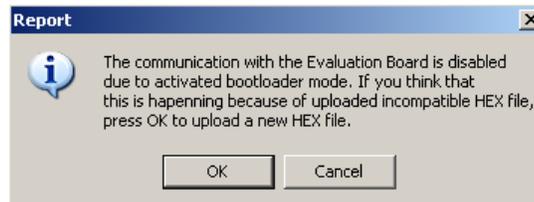
Fig. 5.25

6. Click OK and follow step 4 in method 1

5.8 Automatic emissivity compensation

This option allows automatic emissivity compensation in a MLX90614 when an object with emissivity lower than 1 is measured. Most materials have an emissivity close to 1 and a correction is not needed.

This routine can also be used to compensate for IR windows or IR lenses one wants to place between the object and the sensor in order to protect the sensor or make changes in the FOV. This can only be successful if one takes care to keep the window or lens at the same temperature as the sensor. The emissivity compensation will be active for all ambient and object temperatures measurable by the thermometer, but will have the highest accuracy at the object and ambient temperatures used during the "calibration".
.
To determine the emissivity it is necessary to know the object temperature accurately. This can be done by either using a contact thermometer or by painting part of the object black with thin layer of high temperature paint. The real temperature can then be measured with the MLX90614 pointing at the painted area and the emissivity can be determined with the MLX90614 pointing at the unpainted area.

It is assumed that the MLX90614 sensor has the same temperature as the area surrounding the object and sensor. The calculation of the emissivity correction is highly sensitive to this temperature. The EVB can heat up the sensor 1-2degrees. For this specific measurement it is advised to mount the sensor away from the EVB and make the SMBus interface using connector 1) on the EVB (see figure 4.1).

The emissivity coefficient is calculated using the formula:

$$Ke = \frac{Tomeas^4 - Ta^4}{Toreal^4 - Ta^4}$$

Where:
Tomeas - the object temperature measured from MLX90614
Ta   - the ambient temperature measured from MLX90614
Toreal   - the real object temperature

The automatic emissivity correction option is available from **Advanced** ->**Emissivity**.
The "*K-Emissivity correction*" window appears (Fig. 5.27) inviting the user to enter the real temperature Toreal of the object. Push OK button to start the measurement of Tomeas and Ta and the calculation of Ke. The sensor must be looking at the object at that moment.

Fig. 5.27

After the measurement finishes the following window appears:
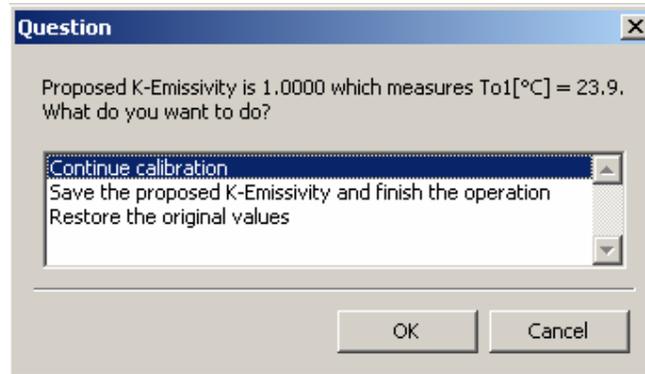
Fig. 5.28

Choose one of the proposed options.

If the temperature difference between Ta and Toreal is lower than 5 °C a warning appears (Fig. 5.29).

Fig5.29

6 Troubleshooting

If the USB communication with EVB90614 fails or the MLX90614 Configurator hangs, close the program, push the button reset on the board (the LED must shines BLUE) and launch the program again.

7 Disclaimer

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♦APPENDIX A – EVB90614 commands set

1. Read MLX90614 RAM address

   Syntax: rr   address

   Operands: 0(0x0) ≤ address ≤31(0x1F)

2. Read MLX90614 EEPROM address

   Syntax: re   address

   Operands: 0(0x0) ≤ address ≤31(0x1F)

3. Write MLX90614 EEPROM address

   Syntax: we   address value

   Operands: 0(0x0) ≤ address ≤31(0x1F)

                0(0x0) ≤   value ≤65535(0xFFFF)

4. Restart MLX90614 (turn off-turn on module power supply)

   Syntax: rt

   Operands: no operands

5. Send Request (switch to SMBus mode)

   Syntax: rq

   Operands: no operands

6. Capture PWM

   Syntax: cp

   Operands: no operands

♦ APPENDIX B – EVB90614 schematics

Note that the components marked "Optional" are not populated. They are assumed to give the user the option to develop his own applications with the board.

Note: If user decides to add own firmware using EVB90614 he must use program memory above 0x4000 (see PIC18F4550 datasheet). Also EEPROM memory addresses between 0x40 and 0x43 must be maintained 0x00 or 0xFF otherwise the EVB90614 will not be recognized from the host when it is in bootloader mode. For the latest information about this opportunity check www.melexis.com .