STEVAL-IFS017V1 multi device temperature
sensor and RTC demo

Introduction

This document explains the functioning of the multiple temperature sensors and RTC demo which is based on a motherboard and daughter card approach. The complete system consists of one motherboard having an STM32F102xx microcontroller and different daughter cards having a temperature sensor and RTC. The temperature sensors supported by this system are:
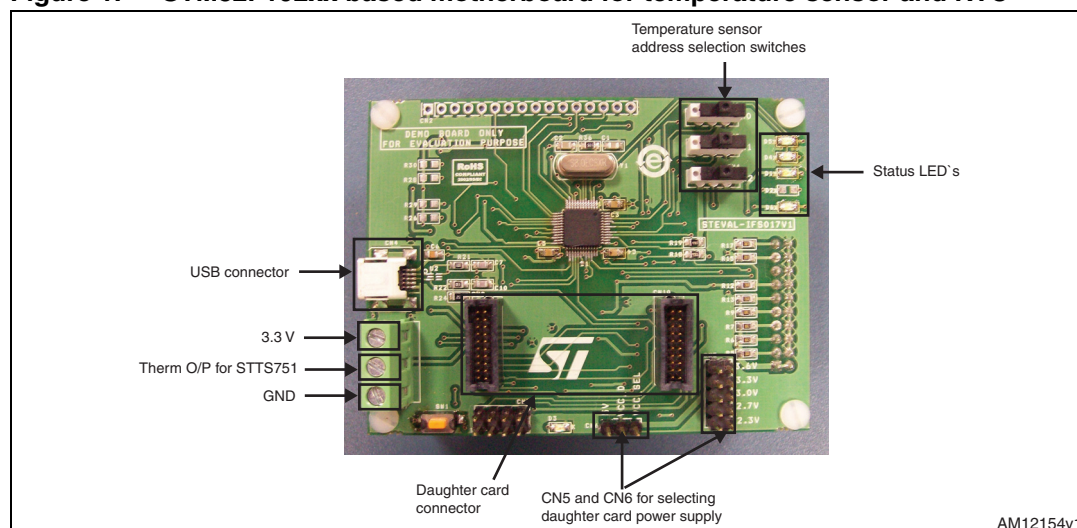
■ STLM20

■ STTS424E02

■ STTS75

■ STDS75

■ STLM75

■ STCN75

■ STTS751

■ STTS2002

RTCs supported by this system are:

■ M41T82SM6

■ M41T83SQA6

■ M41T83SMY6

This board operates in USB powered mode with a graphical user interface (GUI). The graphical user interface is used to access the registers and demonstrate the features of temperature sensors and RTCs.

Figure 1.   STM32F102xx based motherboard for temperature sensor and RTC

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1 Getting started

1.1 Package

The contents of the complete package are as follows:

1. Hardware content:
   – Demonstration board: STEVAL-IFS017V1
2. Documentation:
   – User manual (this document)
   – Schematics, Gerber files, BOM
3. Firmware:
   – Already programmed STM32F102xx device soldered on the demo board
4. GUI installation file.

1.2 System setup

The steps for starting the demo board are as follows:

1. Install the GUI .exe in the computer. The user should have administrator rights for the computer to install the GUI.
2. Connect the USB cable between the computer and USB connector on the STEVAL-IFS017V1 (CN4).
3. LED D3 should glow on the motherboard.
4. Opening the GUI shows the connected status in the bottom left corner of the window.

The daughter card power selection and feature demonstration is discussed in the following sections.

Figure 2. Temperature sensor GUI connected
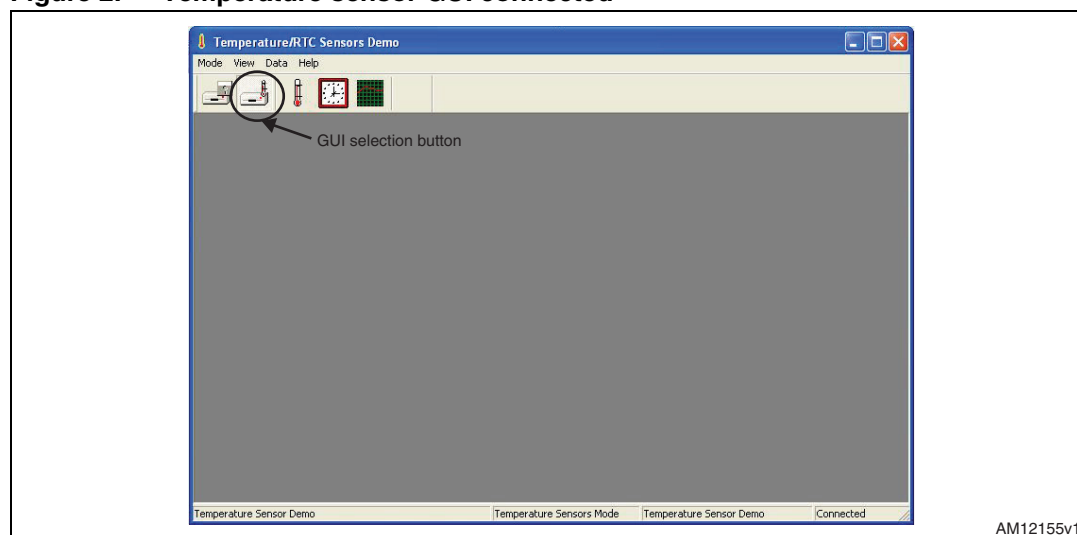
1.2.1 Power supply unit

There are two power sections in this system:

1. Power for motherboard.
2. Power for temperature sensor daughter cards.

1.2.2 Power for motherboard

The motherboard input power is 5 V from a USB connection. This 5 V is converted to 3.3 V using the LD39080DT33 voltage regulator. The STM32F102xx microcontroller is operated at 3.3 V.

1.2.3 Power for temperature sensor and RTC daughter cards

Connector CN5 and CN6 are used to configure the supply voltage for the daughter cards. *Table 1* shows the pin connections and their respective voltages generated for daughter cards.

Table 1.   Power selection for daughter cards

Connector CN5 on motherboard	Connector CN6 on motherboard	Daughter card supply voltage
Short Pin1(5 V) and Pin2(VDD_D)	DON'T CARE	5.0 V
Short Pin2(VDD_D) and Pin3(VCC_SEL)	Short Pin1 and Pin2 (2.3 V)	2.3 V
Short Pin2(VDD_D) and Pin3(VCC_SEL)	Short Pin3 and Pin4 (2.7 V)	2.7 V
Short Pin2(VDD_D) and Pin3(VCC_SEL)	Short Pin5 and Pin6 (3.0 V)	3.0 V
Short Pin2(VDD_D) and Pin3(VCC_SEL)	Short Pin7 and Pin8 (2.3 V)	3.3 V
Short Pin2(VDD_D) and Pin3(VCC_SEL)	Short Pin9 and Pin10 (2.3 V)	3.6 V

1.2.4 Address selection of sensor daughter cards

This demo board supports different temperature sensors and RTCs present on different daughter cards. For digital temperature sensors, the address lines are configured using the switches (SW2, SW3, and SW4) present on the motherboard. Logic level is assigned to the address line using the address selection switches. *Figure 3* shows the position of the switch and the respective logic level assigned by that switch.

Figure 3. Logic level and position of switch for address selection
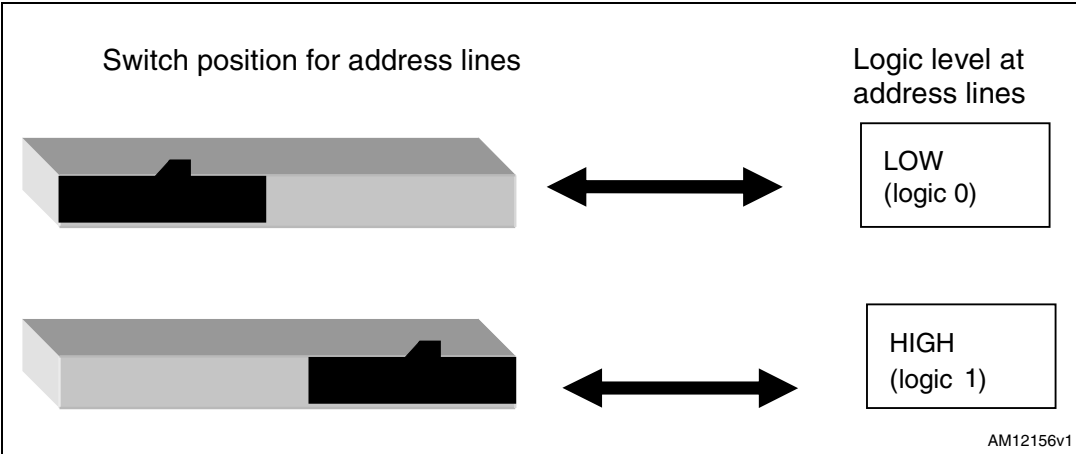
1.2.5 Address configuration for STTS75, STDS75, STLM75 and STCN75 temperature sensors

The STTS75, STDS75, STLM75 and STCN75 all are digital temperature sensors with 3 address lines. There are 8 possible addresses for these sensors. SW2 corresponds to A0, SW3 corresponds to A1 and SW4 corresponds to A2 address lines of the sensors. Below are the allowed addresses and their settings for STTS75, STDS75, STLM75 and STCN75:

● Address 1 = 0x90, => SW4 = 0, SW3 = 0, SW2 = 0
● Address 2 = 0x92, => SW4 = 0, SW3 = 0, SW2 = 1
● Address 3 = 0x94, => SW4 = 0, SW3 = 1, SW2 = 0
● Address 4 = 0x96, => SW4 = 0, SW3 = 1, SW2 = 1
● Address 5 = 0x98, => SW4 = 1, SW3 = 0, SW2 = 0
● Address 6 = 0x9A, => SW4 = 1, SW3 = 0, SW2 = 1
● Address 7 = 0x9C, => SW4 = 1, SW3 = 1, SW2 = 0
● Address 8 = 0x9E, => SW4 = 1, SW3 = 1, SW2 = 1

Table 2. Switch settings for selecting different addresses of STT75/STLM75/STDS75/STCN75 onboard

Address line	Address (0x9E)	Address (0x9C)	Address (0x9A)	Address (0x98)	Address (0x96)	Address (0x94)	Address (0x92)	Address (0x90)
SW2 (A0)								
SW3 (A1)								
SW4 (A2)								

1.2.6 Address configuration for STTS2002 and STTS424E02 temperature sensors

The STTS2002 and STTS424E02 are digital temperature sensors with 3 address lines. There are 8 possible addresses for these sensors. SW2 corresponds to A0, SW3 corresponds to A1 and SW4 corresponds to A2 address lines of the sensor.

Below are the allowed addresses and their settings for these sensors:
- Address 1 = 0x30, => SW4 = 0, SW3 = 0, SW2 = 0
- Address 2 = 0x32, => SW4 = 0, SW3 = 0, SW2 = 1
- Address 3 = 0x34, => SW4 = 0, SW3 = 1, SW2 = 0
- Address 4 = 0x36, => SW4 = 0, SW3 = 1, SW2 = 1
- Address 5 = 0x38, => SW4 = 1, SW3 = 0, SW2 = 0
- Address 6 = 0x3A, => SW4 = 1, SW3 = 0, SW2 = 1
- Address 7 = 0x3C, => SW4 = 1, SW3 = 1, SW2 = 0
- Address 8 = 0x3E, => SW4 = 1, SW3 = 1, SW2 = 1

Table 3.   Switch settings for selecting different addresses of the STTS424E02

Address line	Address (0x3E)	Address (0x3C)	Address (0x3A)	Address (0x38)	Address (0x36)	Address (0x34)	Address (0x32)	Address (0x30)
SW2 (A0)								
SW3 (A1)								
SW4 (A2)								

1.2.7 Address configuration for STLM20

The STLM20 is an analog temperature sensor with no address lines.

1.2.8 Address configuration for STTS751 temperature sensor

The STTS751 is available in 2 different device types:
1. STTS751-0
2. STTS751-1

Address selection for STTS751 sensor is not done by SW2/SW3/SW4 but is done using a jumper on the connector CN5 present on the daughter card itself.

Below is the table for selecting the address of the STTS751 temperature sensor:

Table 4.   Address selection for STTS751 sensor

Device type	Connector CN5 on daughter card	Sensor address
STTS751-0	Short Pin1 and Pin2	0x90
	Short Pin3 and Pin4	0x92
	Short Pin5 and Pin6	0x70
	Short Pin7 and Pin8	0x72
STTS751-1	Short Pin1 and Pin2	0x94
	Short Pin3 and Pin4	0x96
	Short Pin5 and Pin6	0x74
	Short Pin7 and Pin8	0x76

1.2.9   Temperature sensor features

The steps for starting with the temperature sensor daughter cards and the GUI are as follows:

1. Place the temperature sensor daughter card on the motherboard. Take note of the notch on the daughter card connector and motherboard connector.
2. Select the power supply of the daughter card as mentioned in *Section 1.2.3*.
3. Connect the USB cable to the computer and motherboard, LED D3 glows on the motherboard.
4. Open the GUI in the computer, the GUI window shows as connected in the bottom right corner, as shown in *Figure 2*.
5. Press the "Temperature Sensor Mode Select" button in the GUI, as shown in *Figure 2*.
6. The list of temperature sensors appears in the GUI, as shown in *Figure 4*. Select the sensor which is mounted on the motherboard. If the sensor selected in the GUI is not the one mounted on the motherboard, an error message pops up in the GUI. In the case of an error message, re-select the correct sensor in the GUI.
7. The GUI window for the sensor present on the motherboard opens.
8. A total of 5 sensors are supported by the demo:
●   STTS7/STDS75/STLM75/STCN75
●   STTS424E02
●   STLM20
●   STTS751
●   STTS2002.

Figure 4. List of temperature sensors in the GUI

AM12157v1
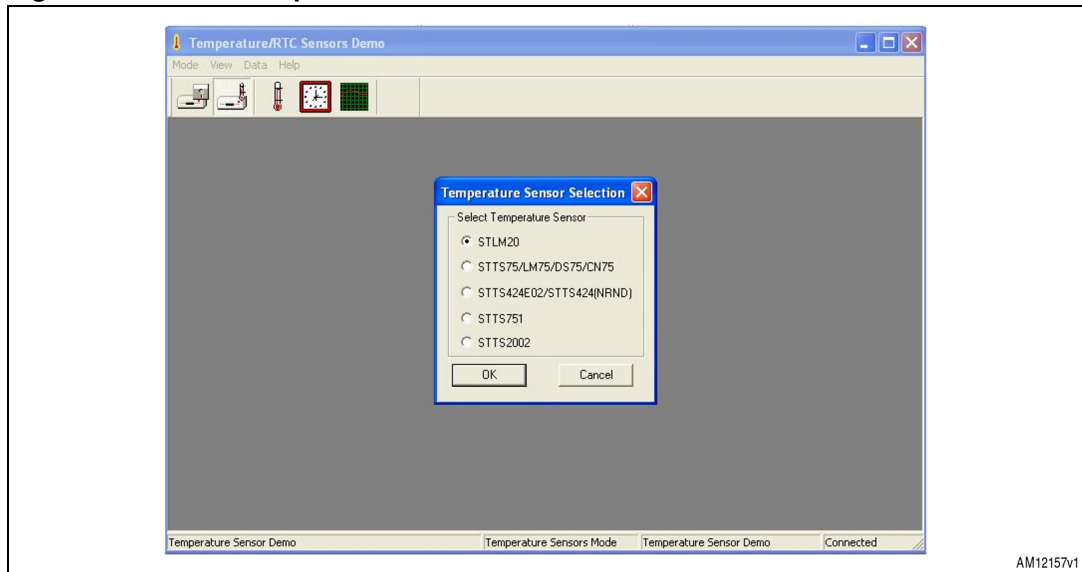
1.2.10 GUI window for STTS75, STDS75, STLM75 and STCN75 sensors

The STTS75, STLM75, STDS75, and STCN75 sensors are supported by a single GUI window, as shown in *Figure 5*. There are radio buttons for selecting one of four possible sensors (STTS75, STLM75, STDS75, and STCN75).

Below are the steps for operating these sensors using the GUI:

1. Select one of the radio buttons present in the "Select the temperature sensor" area in the GUI. This enables the GUI for one of the selected sensors (STTS75/STLM75/STDS75/STCN75).

2. Choose the address from the dropdown menu of the "Choose Address" block. If the address selected from the GUI is the same as configured onboard (as described in *Section 1.2.4*), the remaining part of the GUI is enabled; or else an error message appears in the GUI, as shown in *Figure 6*. In the case of an error message, check the correct address from the GUI.

3. Configure the different registers of the sensor and observe the behavior in the GUI and on the board. The bits of the configuration register can be selected in the GUI and can be written by pressing the 'Write' button.

4. The slider for over-limit and hysteresis can be used to select the values for oversaturation and hysteresis registers of the sensor.

5. The "Once" button is used to read the instantaneous value of the temperature value from the sensor.

6. The "Loop" button is used to continuously read the temperature value from the sensor and display the same in the GUI.

7. ALARMS is seen in the GUI only when the Once or Loop button is pressed. Pressing Once reads the instantaneous temperature value and latches the instantaneous ALARM condition in the GUI. Pressing the Loop button continuously monitors the temperature and the ALARM condition and displays the same in the GUI. Stopping the Loop button latches the last measured value of temperature and the last ALARM condition in the GUI. This alarm is used to indicate the behavior of the OS pin output of the temperature sensor.

a) Default state: alarm OFF

b) Temperature reaches above the over-limit temperature (Tos): alarm GLOWS

c) Temperature reaches below Thys: alarm OFF

On the motherboard there is an LED D5 which shows the alarm signal from the #ALERT pin of the temperature sensor. In the case of alert, D5 glows, and as soon as the alert signal goes OFF, D5 switches off.

8. There is a One-shot mode button present in the GUI which functions only for the STTS75 sensor. One-shot mode puts the sensor into Shutdown mode and then goes for a one-shot read of temperature. After One-shot mode, the shutdown pin of the configuration register sets to '1'. To bring the sensor to Normal mode, write the shutdown bit to '0'.

9. Frequency for I^{2}C communication between the sensor and microcontroller can be set either to 100 kHz or 400 kHz using the Radio button selection and Write button.

Figure 5.   GUI window for STTS75, STDS75, STLM75, STCN75 temperature sensors
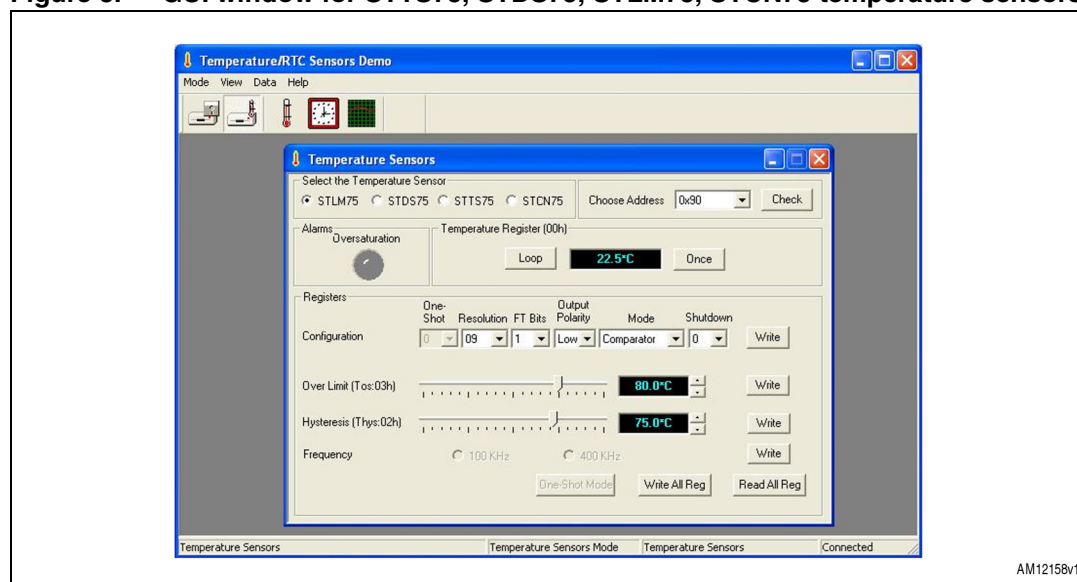
Figure 6. Wrong address message on GUI

AM12159v1
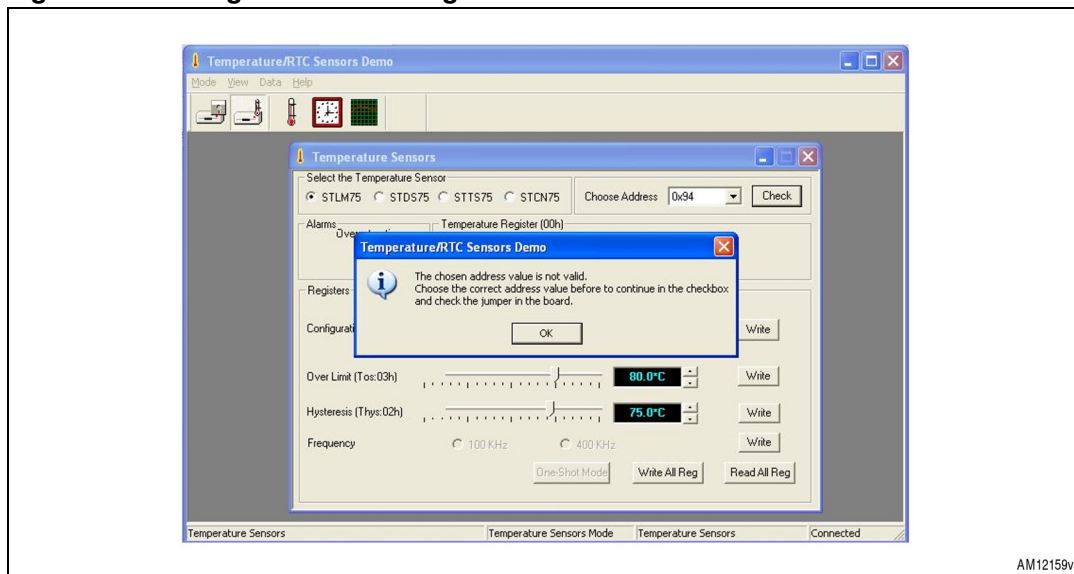
1.2.11 GUI window for STTS424E02 temperature sensor

The STTS424E02 is a simple digital temperature sensor with an on-chip 2 Kb EEPROM.

Below are the steps to operate the STTS424E02 sensor in GUI mode:

1. Plug the daughter card of the STTS424E02 on the motherboard.
2. Select the sensor option for the STTS424E02 from the GUI, as shown in *Figure 4*.
3. Select the STTS424E02 sensor Radio button from sensor options in the "Select the Temperature Sensor" area in the GUI. On selecting the STTS424E02 sensor, the "Edit EEPROM" option also gets enabled in the GUI.
4. Check the address from the "Choose Address" area. If the address configured on the board (explained in *Section 1.2.6*) is different from the address selected from the GUI, an error message appears on the GUI. In the case of an error, re-check the address with the correct option.
5. All the registers show the default readings at first selection.
6. Press the Loop button to continuously read the temperature in the GUI.
7. Configure the different registers through the GUI and observe the behavior of the sensor. The bits of the configuration register can be individually selected using the GUI.
8. Sliders for "Upper Temp Register", "Lower Temp Register" and "Critical Temp Register" can be used to separately configure the upper boundary, lower boundary and critical limit for temperatures. Press the Write button individually for all the three limits to write the value inside the sensor registers.
9. The Once button is used to read the instantaneous value of temperature value from the sensor.
10. The Loop button is used to continuously read the temperature value from the sensor and display the same in the GUI.
11. There are 3 different alarms supported by this sensor:
    a) Below alarm window (BAW):
       This alarm occurs when the measured temperature goes below the temperature setting performed in the alarm temperature lower boundary register (lower temp

register). This alarm glows as the BAW alarm in the GUI. As the measured temperature becomes greater than the BAW setting, the alarm switches off.

b) Above alarm window (AAW):

This alarm occurs when the measured temperature goes above the temperature setting performed in the alarm temperature upper boundary register (upper temp register). This alarm glows as the AAW alarm in the GUI. As the measured temperature becomes lower than the AAW setting, the alarm switches off.

c) Above critical temperature (ACI):

This alarm occurs when the measured temperature goes above the temperature setting performed in the critical temperature register. This alarm glows as the ACI alarm in the GUI. As the measured temperature becomes lower than the critical alarm setting, the alarm switches off.

The "Alarm" icon also glows in the GUI only when the O/P control bit is enabled in the configuration register and one of the above mentioned alarms has occurred, and then only the alarm LED onboard (D5) glows.

BAW, AAW, and ACI alarm statuses can be seen in the GUI either in Once or Loop mode. Pressing of the Once button shows the instantaneous alarm conditions and latches the same in the GUI. This condition is refreshed on again pressing the Once button. Pressing the Loop button continuously monitors the alarm conditions and displays them in the GUI. Stopping the Loop button latches the last alarm conditions in the GUI. These are refreshed either by again using the Once or Loop read buttons.

For the first time address check, the default state of the upper temp register, lower temp register and critical temp register, is 0x00, therefore alarm conditions for AAW and ACI are met and so these are seen as glowing in the GUI.

Figure 7. GUI window for STTS424E02 temperature sensor
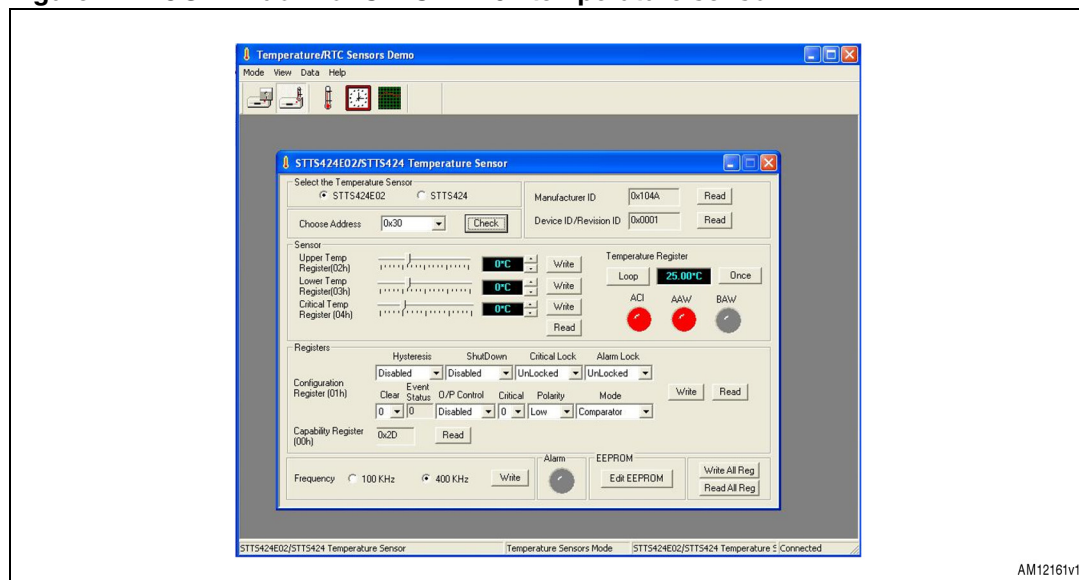
1.2.12 GUI window for EEPROM section of the STTS424E02 temperature sensor

The STTS424E02 sensor has an on-chip 2 Kb EEPROM. For the STTS424E02 sensor selected in the GUI, the "Edit EEPROM" button gets enabled. The EEPROM window opens on clicking this Edit EEPROM button.

The steps for using the EEPROM of the STTS424E02 sensor are as follows:

1. Check the address of the EEPROM. The last 3 bits of the EEPROM address are derived from the last 3 bits of the temperature sensor address.

2. For the correct address checked, the GUI for the EEPROM gets enabled with an editable area for 256 bytes.

3. To read the data byte at any specific location, select the location on the editable window and press the Read byte button; it reads the selected location data from the sensor EEPROM and displays it at the location in the editable area in the GUI.

4. The Read All button reads all 256 bytes from the sensor EEPROM and displays them in the editable area.

5. To write a single byte at a specific location, change the byte value and press the Enter button on the computer. Then press Write Byte to write the data into the EEPROM.

6. To write all 256 bytes of EEPROM, press the Write All button in the GUI. This writes the bytes as seen in the editable box. To change the bytes in the editable box, type the new value and press Enter, and then go to type a new value to another location. After all values are changed according to requirements, press Write All to program the values in the EEPROM.

7. Fill buffer is used to fill the area of the EEPROM with the same data byte. Type the memory location from where the data is to be written and also the destination memory location address. Then enter the data byte in the 'Fill With' area. Pressing the Fill Buffer button programs the EEPROM selected area with the selected data byte. This data byte can be seen in the GUI by pressing the Read All button.

8. Copy Block is used to copy the data from memory location 0x00 -0x7F to the location 0x80-0xFF. Therefore, both upper and lower 1 Kbit data is similar after the Copy Block command.

9. Settings for the EEPROM of the STTS424E02 sensor are shown in *Figure 8*.

Figure 8.   EEPROM GUI window for the STTS424E02
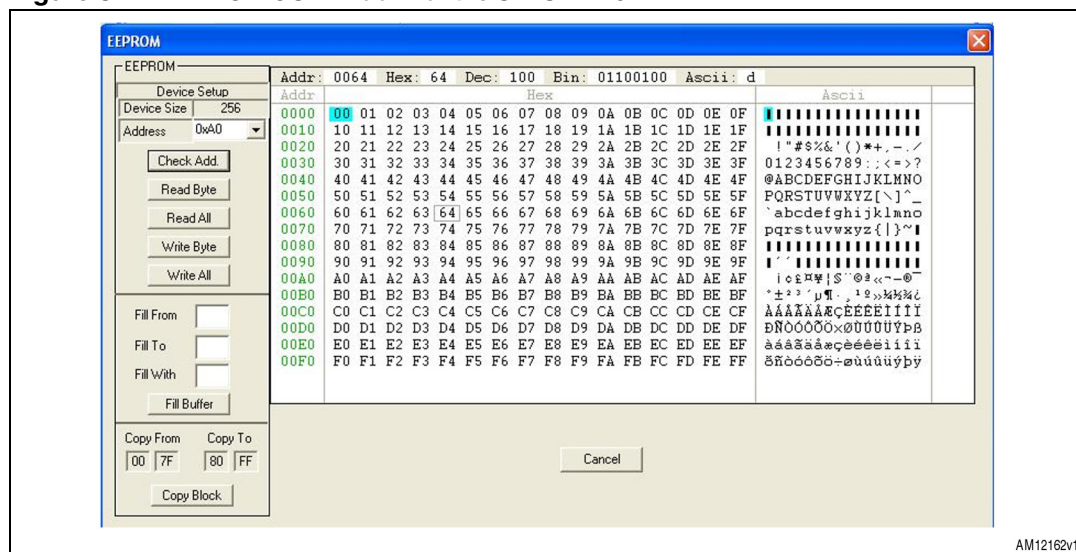
AM12162v1

1.2.13   GUI window for the STLM20 temperature sensor

The STLM20 is an analog temperature sensor. The steps for using the GUI for the STLM20 are as follows:

1.   Plug the STLM20 daughter card on the motherboard.

2.   Select the STLM20 sensor in the GUI and the GUI window for the STLM20 opens, as shown in *Figure 9*.

3.   The Read button reads the sensor value and voltage output value, at that moment, from the sensor.

4.   The Loop button continuously reads the temperature and voltage from the STLM20.

Figure 9.   GUI window for the STLM20 temperature sensor
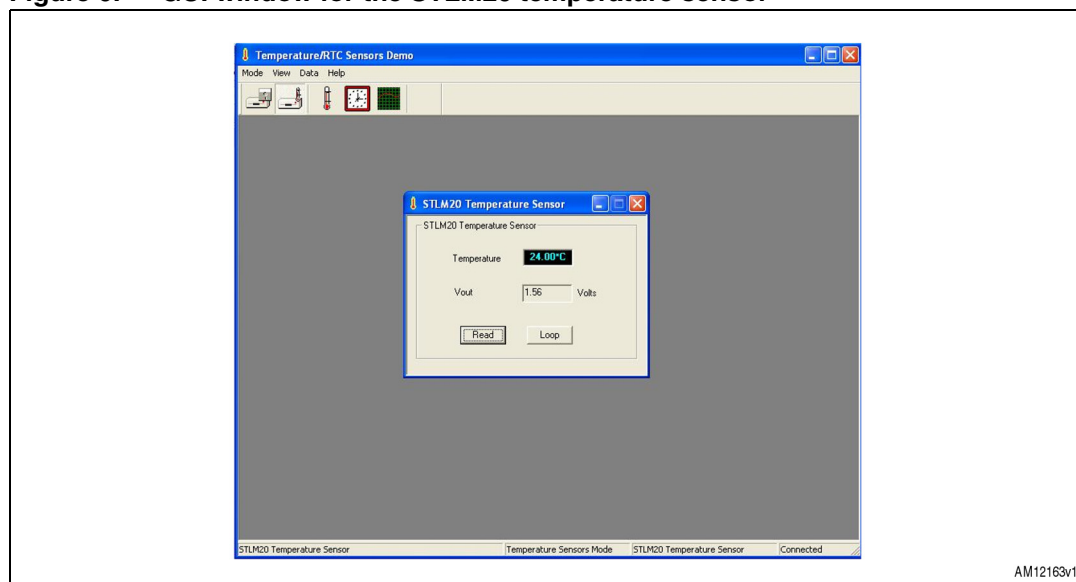
AM12163v1

1.2.14 GUI window for the STTS751 temperature sensor

The STTS751 temperature sensor is available in two versions:

● STTS751-0

● STTS751-1.

Address configuration for this sensor is done using the jumper CN5 present on the daughter card (explained in *Section 1.2.8*).

The steps to operate the STTS751 sensor in GUI mode are as follows:

1. Place the daughter card on the motherboard.

2. Select the address of the daughter card using CN6/CN5 on the daughter card (refer to *Section 1.2.8*), as shown in *Figure 10*.

3. Power up the motherboard using USB power.

4. Select the STTS751 sensor in the GUI and then select either STTS751-0 or STTS751-1 from the Radio button in the GUI, as shown in *Figure 11*. Then select the address from the dropdown menu of the GUI.

5. Configuration register bits can be individually configured using the GUI.

6. Sliders can be used to configure the values inside the upper temp register, lower temp register, therm limit, therm hysteresis and conversion rate registers. The Write button is to be used for each value to be written inside the sensor registers.

7. The Once button is used to read the instantaneous value of the temperature value from the sensor.

8. The Loop button is used to continuously read the temperature value from the sensor and display the same in the GUI.

9. There is one alarm output in the STTS751 by the name EVENT. When the temperature is above the value configured inside the upper temp register or is equal to or lower than the value inside the lower temp register, the EVENT signal is asserted and is seen as D5 LED glowing on the motherboard. In the GUI, the status of the EVENT pin is seen on pressing the One-shot or Loop button.

10. If the EVENT condition exists, then pressing the ARA button returns the sensor address.

11. One-shot write is used to read the temperature once when the sensor is in Standby mode and then again return the sensor in Standby mode.

12. SMBus timeout is used to demonstrate the timeout feature of the STTS751. Checking the "TimeOut Test Enable" checkbox enables the timeout feature of the STTS751 by writing inside the "SMBus timeout enable" register of the sensor. The slider can be used to select the timeout delay in milliseconds. If the delay is between 20-30 msec, the device does not time out and returns ACK to communication and is seen as ACK glowing in the GUI. For timeout delay greater than 30 msec, the device returns NACK to communication and is seen as NACK glowing in the GUI. This ACK and NACK is the response from the sensor to I^2C communication along with the delay in between.

13. The I^2C speed can be selected to be one of 100 kHz or 400 kHz using the Radio button and Write button.

Figure 10. STTS751 sensor address selection connector CN5

STTS751 sensor address selection
connector CN6
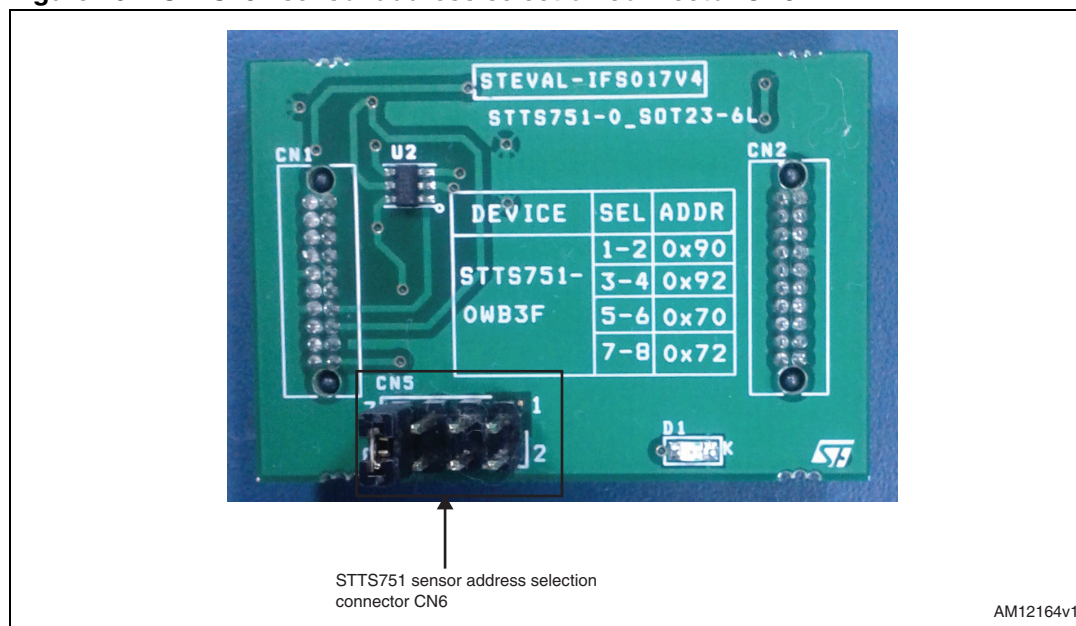
AM12164v1

Figure 11. GUI window for the STTS751
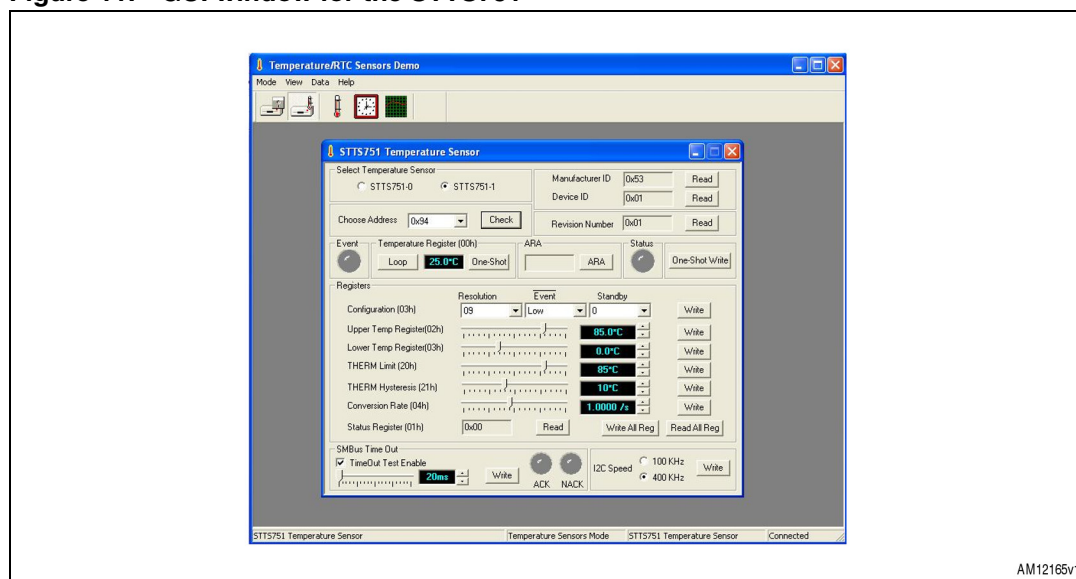
AM12165v1

1.2.15 GUI window for the STTS2002 temperature sensor

The STTS2002 is a digital temperature sensor with an on-chip 2 Kb EEPROM.

Below are the steps to operate the STTS2002 sensor in GUI mode:

1. Plug the daughter card of the STTS2002 on the motherboard.
2. Select the sensor option for the STTS2002 from the GUI, as shown in *Figure 12*.
3. Check the address from the "Choose Address" area. If the address configured onboard (explained in *Section 1.2.5*) is different from the address selected from the GUI, an

error message appears in the GUI. In the case of an error, re-check the address with the correct option.

4. All the registers show the default readings at first selection.

5. Press the Loop button to continuously read the temperature in the GUI.

6. Configure the different registers through the GUI and observe the behavior of the sensor. The bits of the configuration register can be individually selected using the GUI.

7. Sliders for "Alarm Temp Upper Boundary", "Alarm Temp Lower Boundary" and "Critical Temp Register" can be used to separately configure the upper boundary, lower boundary and critical limit for temperatures. Press the Write button individually for all three limits to write the value inside the sensor registers.

8. The Once button is used to read the instantaneous value of the temperature value from the sensor.

9. The Loop button is used to continuously read the temperature value from the sensor and display the same in the GUI.

10. There are 3 different alarms supported by this sensor:

    a) Below alarm window (BAW):

        This alarm occurs when the measured temperature goes below the temperature setting performed in the alarm temperature lower boundary register (lower temp register). This alarm glows as BAW alarm in the GUI. As the measured temperature becomes greater than the below alarm window setting, the alarm switches off.

    b) Above alarm window(AAW):

        This alarm occurs when the measured temperature goes above the temperature setting performed in the alarm temperature upper boundary register (upper temp register). This alarm glows as AAW alarm in the GUI. As the measured temperature becomes lower than the above alarm window setting, the alarm switches off.

    c) Above critical temperature(ACI):

        This alarm occurs when the measured temperature goes above the temperature setting performed in the critical temperature register. This alarm glows as ACI alarm in the GUI. As the measured temperature becomes lower than the critical alarm setting, the alarm switches off.

The Alarm icon also glows in the GUI only when the O/P control bit is enabled in the configuration register and one of the above mentioned alarms has occurred, and then only the alarm LED onboard (D5) also glows.

The BAW, AAW, ACI alarm statuses can be seen in the GUI either in Once or Loop mode. Pressing the Once button shows the instantaneous alarm conditions and latches the same in the GUI. This condition is refreshed on again pressing the Once button. The Loop button, pressed continuously, monitors the alarm conditions and displays them in the GUI. Stopping the Loop button latches the last conditions of alarms in the GUI. These are refreshed either by again using the Loop or Once read button.

For the first time address check, the default state of the upper temp register, lower temp register and critical temp register is 0x00, therefore alarm conditions for AAW and ACI are met and so these are seen as glowing in the GUI.

11. SMBus timeout is used to demonstrate the timeout feature of the STTS2002. Checking the "TimeOut Test Enable" checkbox enables the slider for entering the timeout delay. The slider can be used to select the timeout delay in milliseconds. If the delay is between 20-29 msec, the device does not time out and returns ACK to communication

and is seen as ACK glowing in the GUI. For timeout delay greater than 29 milliseconds, the device returns NACK to communication and is seen as NACK glowing in the GUI. This ACK and NACK is the response from the sensor to the I^{2}C communication along with the delay in between.

12. I^{2}C speed can be selected to be either 100 kHz or 400 kHz using the Radio buttons and Write button.

Figure 12. GUI Window for STTS2002
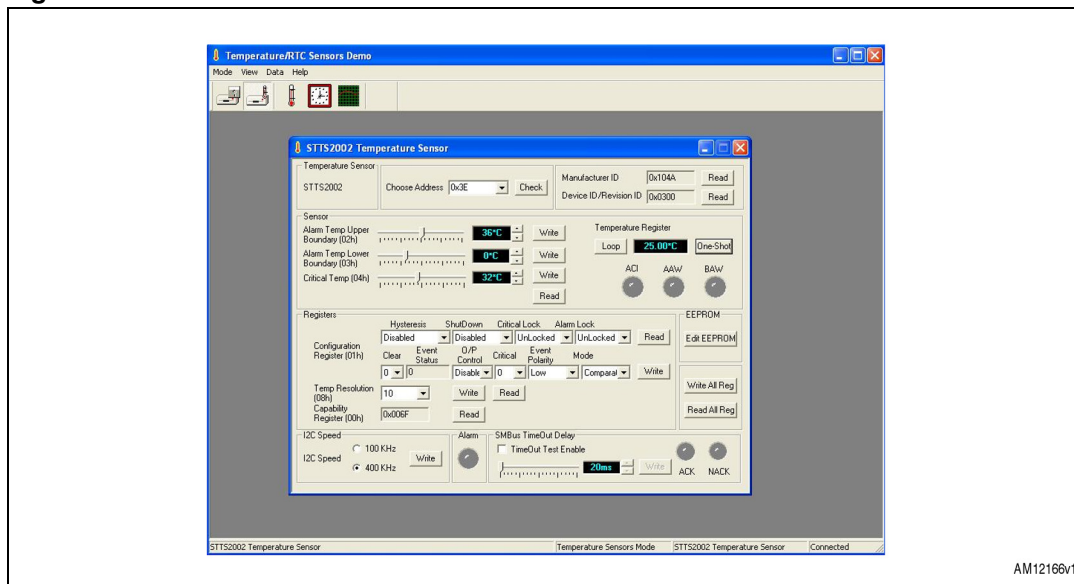
1.2.16 GUI window for STTS2002 temperature sensor EEPROM

The STTS2002 sensor has an on-chip 2 Kb EEPROM. For the STTS2002 sensor selected in the GUI, the "Edit EEPROM" button gets enabled. The EEPROM window opens on clicking this Edit EEPROM button.

The steps for using the EEPROM of the STTS2002 sensor are as follows:

1. Check the address of the EEPROM. The last 3 bits of the EEPROM address are derived from the last 3 bits of the temperature sensor address.

2. For the correct address checked, the GUI for the EEPROM gets enabled with editable area for 256 bytes.

3. The EEPROM area of the STTS2002 is divided into 2 sections:

   a) Lower half between 0x00 - 0x7F (first 128 bytes)

   b) Upper half between 0x80 - 0XFF (last 128 bytes)

   The EEPROM supports permanent write protection for the data written inside the lower half of memory using the PSWP command. The EEPROM window has a READ PSWP

button which returns the status of the memory being protected or not. Writing PSWP permanently protects the memory for read and write.

Once the memory is permanently write protected then neither read nor write is possible for the lower half memory area.

4. To read the data byte at any specific location, select the location in the editable window and press the Read Byte button, it reads the selected location data from the sensor EEPROM and displays at the location in the editable area in the GUI.

5. The Read All button reads all the 256 bytes from the sensor EEPROM and displays it in the editable area.

6. To write a single byte at a specific location, change the byte value and press the Enter button on the computer. Then press Write Byte to write the data in the EEPROM.

7. To write all the 256 bytes of EEPROM, press the Write All button in the GUI. This writes the bytes as seen in the editable box. To change the bytes at the memory location, type the new value at that memory location and press Enter. To modify another memory location, go to that location, type the bytes and then press Enter.

    After all values are changed according to requirements, press Write All to program the values in the EEPROM.

8. Fill Buffer is used to fill the area of EEPROM with the same data byte. Type the memory location from where the data is to be written and also the destination memory location address. Then enter the data byte in the Fill With area. Pressing the Fill Buffer button programs the EEPROM selected area with selected data byte. This data byte can be seen in the GUI by pressing the Read All button.

9. Copy Block is used to copy the data from memory location 0x00-0x7F to the location 0x80-0xFF. Therefore both upper and lower 1 Kbit data is similar after the Copy Block command.

10. The settings for the EEPROM of the STTS424E02 sensor are shown in *Figure 13*.

Figure 13.   GUI window for EEPROM section of STTS2002 temperature sensor
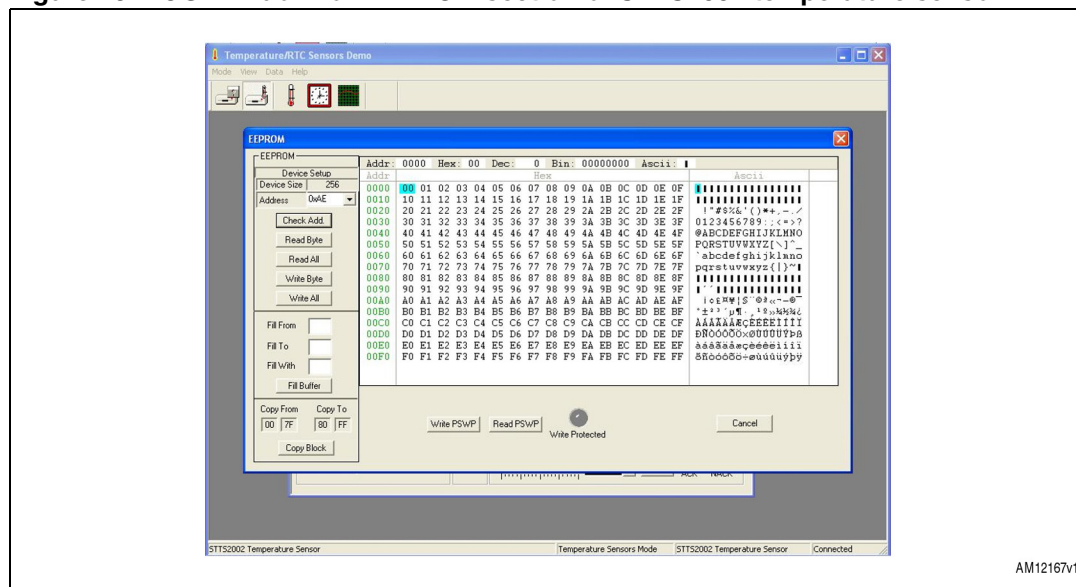
Figure 14. PSWP for permanent write protection
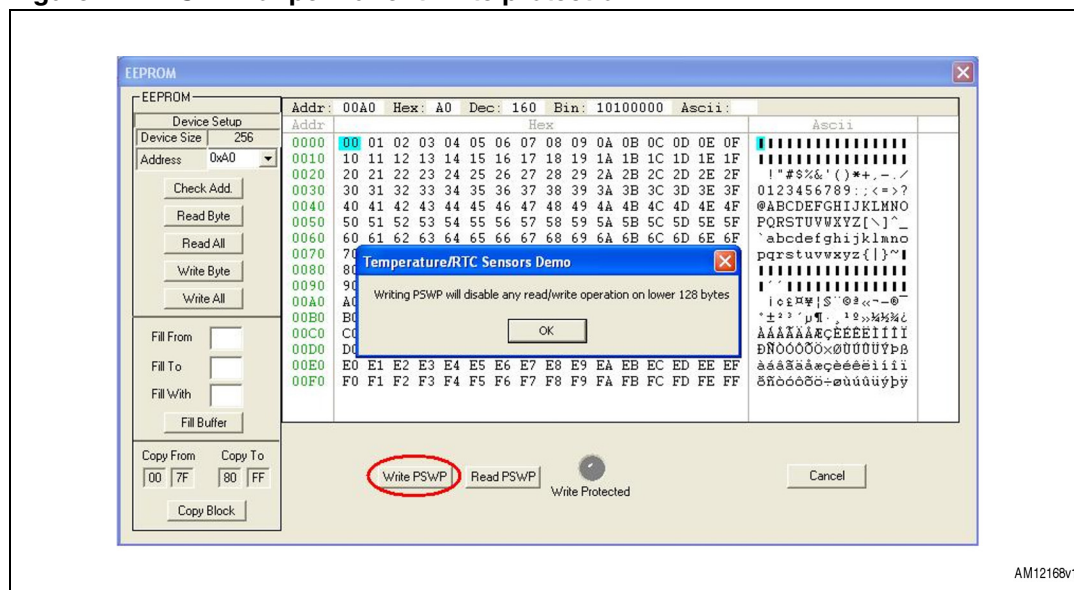
AM12168v1

1.2.17 RTC features

The GUI supports the demonstration of three RTCs:

1. M41T82 RTC mounted on separate daughter card.
2. M41T83 (QFN package) mounted on separate daughter card.
3. M41T83 (SOX18 package) mounted on separate daughter card.

RTC mode of the GUI is selected through the RTC selection icon in the GUI. Pressing the RTC selection icon shows the selection menu for the RTC, as shown in *Figure 15*.

Figure 15. RTC selection window
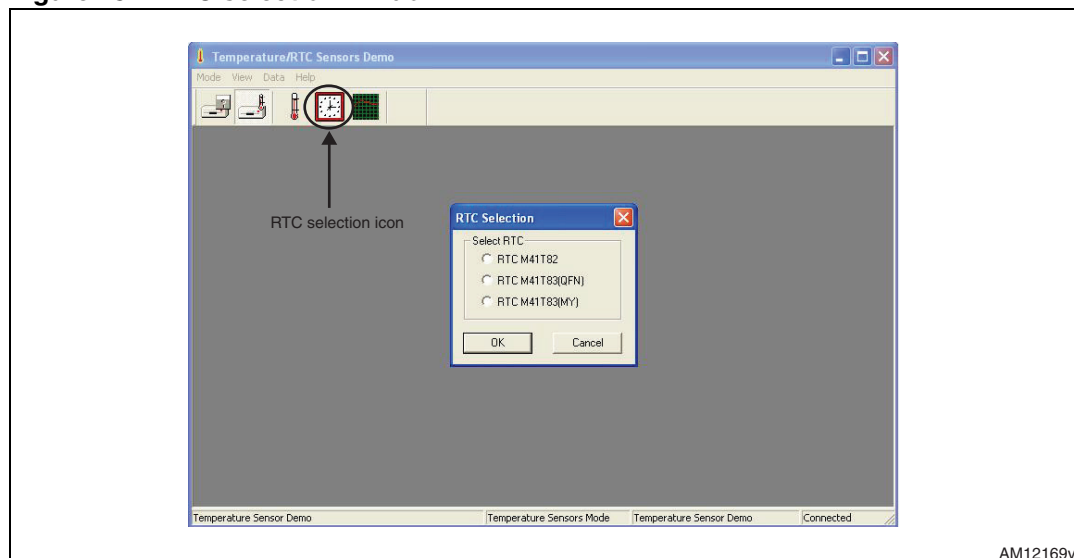
AM12169v1

1.2.18 GUI window for M41T82SM6 RTC

M41T82 RTC is available in SO8 package and is mounted on a separate daughter card.

The steps for selecting the M41T82 RTC are as follows:

1. Select the supply for the RTC daughter card using jumper CN5 and CN6 on the motherboard. Refer to *Section 1.2.3*.
2. Plug in the M41T82 RTC daughter card on the motherboard (take note of the notch on the daughter card connector for mounting).
3. Power up the motherboard using the USB cable.
4. Open the GUI and select the RTC selection icon, as shown in *Figure 15*.
5. Select M41T82 RTC from the menu and press OK.
6. The M41T82 RTC window opens, as shown in *Figure 16*.
7. On powering up the board, the RTC clock is seen as halted showing the time on which external power was removed from the RTC. The clock starts running only after resetting the HT bit in the RTC GUI window.

Figure 16. GUI Window for M41T82 RTC
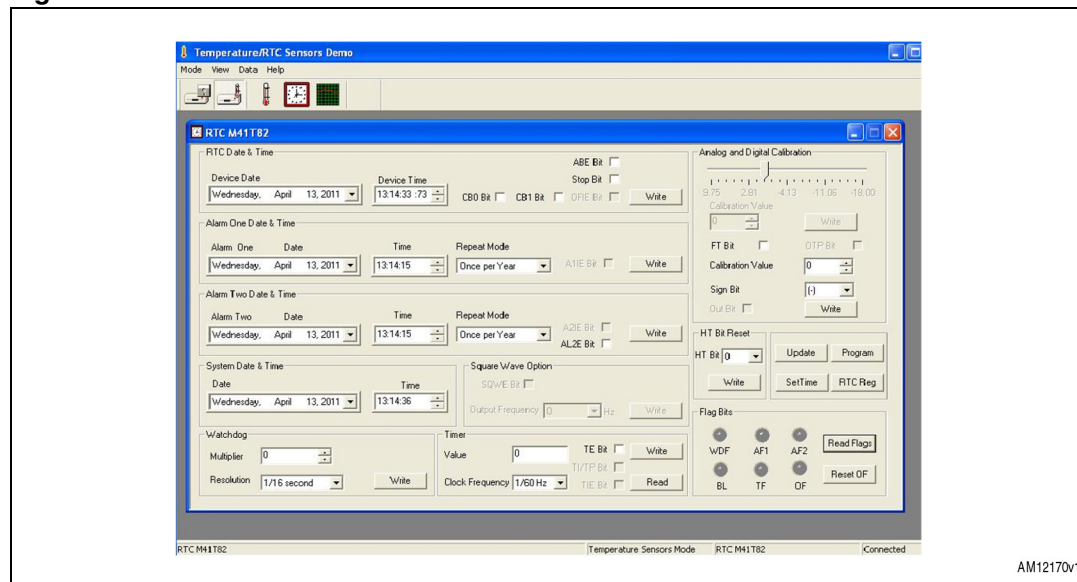
1.2.19 M41T82 RTC date and time setting

1. Click on the RTC selection icon in the toolbar of the GUI. RTC selection Radio button appears in the GUI, as shown in *Figure 15*.

2. Select for RTC M41T82, it opens the RTC GUI window for the M41T82, as shown in *Figure 16*.

3. Press the Update button to enable the configuration of RTC. Pressing the Update button enables the GUI window for RTC configuration. It also reads the RTC registers and displays the same in the GUI.

4. After pressing the Update button, reset the HT bit to see the clock ticking on the display.

5. Configure the RTC date and time by clicking on the Set Time button in the GUI. It programs the onboard RTC with the system date and time.

6. CB0, CB1, Stop bit, and OFIE bit are checkboxes to enable or disable the respective bit in RTC. Checking the box and then pressing the Write button sets the bits and un-checking them and clicking on the Write button resets the bits.

7. The Program button configures the RTC with the current settings visible in the GUI.

8. The RTC Reg button shows the RTC registers and the values present in those registers.

9. Device time in the GUI also reads the milliseconds from RTC and displays them in the GUI.

1.2.20 M41T82 RTC alarm setting

M41T82 RTC has two alarm functions:

● Alarm one

● Alarm two

    a) Alarm one

1. Set the alarm date and time using the alarm one date and time section of the RTC GUI window.

2. There is no alarm output pin in M41T82 RTC. As the alarm time is matched, the AF1 flag is set inside the flag status register. This can be seen in the GUI by pressing the Read Flags button.

3. The alarm status can be seen in the GUI by pressing the Read Flags button. Pressing this button again clears the alarm register of RTC and its new status is shown in the GUI.

4. The Reset OF button is used to reset the OF bit in the alarm register and, correspondingly, the oscillator bit alarm is also cleared by resetting the OF button.

    b) Alarm two:

1. Set the alarm date and time using the alarm two date and time section of the RTC GUI window.

2. Checking the AL2E bit and writing it using the Write button enables this alarm. On the matching of the RTC clock time and date with the alarm two time and date, the AF2 flag is set inside the flag status register.

3. Alarm status can be seen in the GUI by pressing the Read Flags button. Pressing the read flags again clears the alarm register of RTC and its new status is shown in the GUI.

4. The Reset OF button is used to reset the OF bit in the alarm register and, correspondingly, the oscillator bit alarm is also cleared by the Reset button.

1.2.21 M41T82 RTC watchdog configuration

1. The watchdog of RTC is enabled by configuring the multiplier and resolution settings and pressing the Write button.
2. The time period for watchdog is calculated by the resolution x multiplier value. This value is in seconds.
3. The watchdog alarm occurs when the time set in the watchdog register has lapsed.
4. The status of the watchdog alarm can be seen only by pressing the Read Flags button. Pressing again clears the WDG flag in the alarm register of RTC and its status is shown in the GUI. The watchdog status on the motherboard (D6 LED) is cleared by writing the watchdog register. Writing zero disables the watchdog.

1.2.22 M41T82 RTC timer configuration

1. M41T82 RTC has an 8-bit countdown timer. This timer counts down from the user configured value to 1 and then again reloads the timer countdown value.
2. Enter any value between 1 and 255 inside the value bracket of the timer.
3. Select the timer ticking clock from the clock frequency dropdown menu of the timer.
4. Enable the checkbox for the TE bit, this enables the timer. If the TE bit is not enabled, the timer does not start the counting.
5. Press the Write button to enter the timer configuration values in the timer section of M41T82 RTC.
6. As soon as the timer rolls over from 1 to the timer countdown value, the timer flag (TF) is set inside the flag status register of RTC. This flag is cleared only by reading the flag register. Pressing the Read Flag button shows the status of this flag in the GUI.

1.2.23 M41T82 RTC digital calibration configuration

1. Enter the calibration value between 0-31 in the calibration register.
2. Select the positive or negative calibration by selecting the sign in the sign bit dropdown menu.
3. Press the Write button to configure the RTC calibration register with the selected settings.

1.2.24 M41T82 RTC analog calibration configuration

1. Check the FT bit checkbox.
2. The slider for analog calibration gets enabled and LED D6 glows on the motherboard. This disables the remaining RTC window.
3. Enter the calibration value using the slider and press the Write button to configure the value inside RTC.
4. After the value is configured, remove the check from the FT bit checkbox.

1.2.25 M41T82 RTC HT bit configuration

At every power-down, the HT bit is set. To start the display of clock on consecutive powering, the HT bit should be reset each time.

1. HT bit set and reset option is selected from the dropdown menu.

2. Setting the HT bit halts the clock display of RTC.

3. Resetting the HT bit resumes the clock display of RTC.

1.2.26 M41T82 RTC FT bit configuration

The FT bit is a checkbox; if none of the RTC interrupt functions (alarm/WDG/SQW) are selected, checking this box selects the frequency test function of RTC and D3 LED on the motherboard lights up. Resetting the bit switches off the frequency test function.

1.2.27 GUI window for M41T83SQA6E(QFN) RTC

M41T83SQA63 RTC is a QFN package and is mounted on a separate daughter card.

The steps for selecting the M41T83 RTC are as follows:

1. Select the power supply for the RTC daughter card using CN6 on the motherboard. Select 5 V supply for RTC.

2. Plug in the M41T83 (QFN package) RTC daughter card on the motherboard (take note of the notch on the daughter card connector for mounting).

3. Power up the motherboard using a USB cable.

4. Open the GUI and select the RTC selection icon, as shown in *Figure 15*.

5. Select M41T83 (QFN) RTC from the menu and press OK.

6. M41T83 RTC window opens, as shown in *Figure 17*.

7. On powering up the board, the RTC clock is seen as halted showing the time at which the power was put down. The clock starts running only after resetting the HT bit on the RTC GUI window.

Figure 17. GUI window for M41T83_QFN RTC
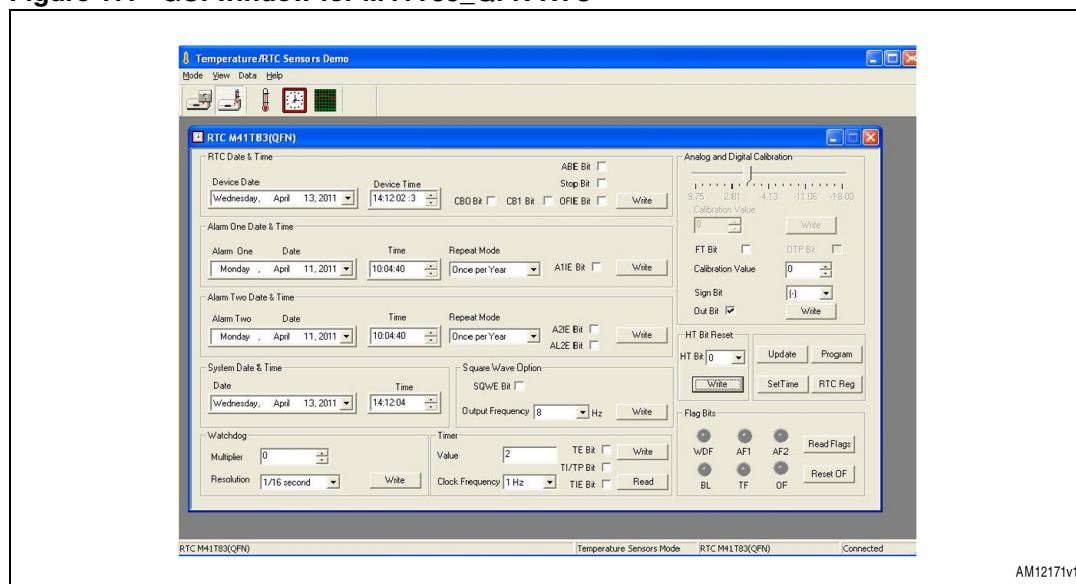
1.2.28   M41T83_QFN date and time setting

1.   Click on the RTC Selection icon in the toolbar of the GUI. the RTC selection Radio button appears in the GUI, as shown in *Figure 15*.

2.   Select RTC M41T83 (QFN) and the RTC child window opens, as shown in *Figure 17*.

3.   Press the Update button to enable the configuration of RTC. Pressing the Update button enables the GUI window for RTC configuration. It also reads the RTC registers from the onboard RTC and displays the same in the GUI.

4.   After pressing the Update button, reset the HT bit to see the clock ticking on the display.

5.   Configure the RTC date and time by clicking on the Set Time button in the GUI. It programs the onboard RTC with the system date and time.

6.   CB0, CB1, Stop bit, and OFIE bit are checkboxes to enable or disable the respective bit in RTC. Checking the box and then pressing the Write button sets the bits and un-checking them and clicking on the Write button resets the bits.

7.   The Program button configures the RTC with the current settings visible in the GUI.

8.   The RTC Reg button shows the RTC registers and the values present in those registers.

9.   Device time in the GUI also reads the milliseconds from RTC and displays them in the GUI.

1.2.29   M41T83_QFN RTC alarm setting

M41T83_QFN RTC has two alarm functions:

●   Alarm one

●   Alarm two

    a)   Alarm one

1.   Set the alarm date and time using the alarm one date and time section on the RTC GUI window.

2.   Check the A1IE checkbox to see the alarm status on the interrupt output pin of RTC. This is seen as an LED glowing on the motherboard whenever the alarm match occurs.

3.   Press the Write button to program the alarm one date and time in the RTC.

4.   As the Alarm time is matched, the AF1 flag sets inside the flag status register and if A1IE is also checked, the D4 LED glows on the motherboard. This alarm can be seen in the GUI by pressing the Read Flag button, the AF1 flag glows and is cleared on a second pressing of read flags.

5.   The D6 LED shows the status of the #IRQ1 pin of the RTC.

    a)   Alarm two

1.   Set the alarm date and time using the alarm two date and time section on the RTC GUI window.

2.   Check the AL2E bit to enable the alarm two function. The A2IE bit is used to enable the alarm match status output on the #IRQ2 pin of RTC.

3.   Press the Write button to program the alarm two configuration in RTC.

4.   On the matching of RTC clock date and time with the alarm two date and time, the AF2 flag is set inside the flag status register and, if the A2IE bit is checked, then the alarm match status is also seen on the motherboard as the glow of the D1 LED. The D1 LED goes off on pressing the Read Flags button.

5. The alarm status can be seen in the GUI by pressing the Read Flags button. Pressing read flags again clears the alarm register of RTC and its new status is shown in the GUI.

6. The Reset OF button is used to reset the OF bit in the alarm register and, correspondingly, the Oscillator bit alarm is also cleared by the Reset button.

1.2.30 M41T83_QFN RTC watchdog configuration

1. The watchdog of RTC is enabled by configuring the multiplier and resolution settings and pressing the Write button.

2. The time period for watchdog is calculated by the resolution x multiplier value. This value is in seconds.

3. The watchdog alarm occurs when the time set in the watchdog register has lapsed.

4. The status of the watchdog alarm can be seen only by pressing read flags, and on the motherboard this status is shown by the glow of the D6 LED. Pressing again the Read Alarm button clears the WDG flag in the alarm register of RTC and its status is shown in the GUI. On the motherboard the D6 LED goes off only by writing the watchdog register. Writing 0 in the watchdog register disables the watchdog function.

1.2.31 M41T83_QFN RTC timer configuration

1. M41T83 RTC has an 8-bit countdown timer. This timer counts down from the user configured value to 1 and then again reloads the timer countdown value.

2. Enter any value between 1 and 255 inside the value area of the timer.

3. Select the timer ticking clock from the clock frequency dropdown menu of the timer.

4. Enable the checkbox for the TE bit, this enables the timer. If the TE bit is not enabled, the timer does not start the counting. The TI/TP checkbox selects the mode of the timer.

5. The TIE bit is used to output the timer rollover interrupt on the #IRQ1 interrupt pin of RTC. Whenever the timer rollover occurs, the TF flag is set and the D6 LED glows on the motherboard. The LED goes off by reading the flag register using Read Flag button.

6. Press the Write button to enter the timer configuration values in the timer section of M41T83_QFN RTC.

7. As soon as the timer rolls over from 1 to the timer countdown value, the timer flag (TF) is set inside the flag status register of RTC. This flag is cleared only by reading the flag register. Pressing the Read Flag button shows the status of this flag in the GUI. A second read clears the flag from the GUI.

1.2.32 M41T83_QFN RTC digital calibration configuration

1. Enter the calibration value between 0-31 in the calibration register.

2. Select the positive or negative calibration by selecting the sign in the sign bit dropdown menu.

3. Press the Write button to configure the RTC calibration register with the selected settings.

1.2.33 M41T83_QFN RTC analog calibration configuration

1. Check the FT bit checkbox.
2. The slider for analog calibration gets enabled and LED D6 glows on the motherboard. This disables the remaining RTC window.
3. Enter the calibration value using the slider and press the Write button to configure the value inside the RTC registers.
4. After the value is configured, remove the check from the FT bit checkbox and then the remaining GUI window gets enabled.

1.2.34 M41T83_QFN RTC HT bit configuration

At every power-down the HT bit is set. To start the display of the clock on consecutive powering, the HT bit should be reset each time.

1. The HT bit set and reset option is selected from the dropdown menu.
2. Setting the HT bit halts the clock display of RTC.
3. Resetting the HT bit resumes the clock display of RTC.

1.2.35 M41T83_QFN RTC FT bit configuration

The FT bit is a checkbox; if none of the RTC interrupt functions (Alarm/WDG/SQW) are selected then checking this box selects the frequency test function of RTC and it is displayed as a glow on the D3 LED. Resetting the bit switches off the frequency test function. Checking of the FT bit disables the GUI window except for the analog calibration section.

1.2.36 M41T83_QFN RTC square wave configuration

M41T83_QFN RTC has a square wave output option.

1. Select the square wave output frequency from the output frequency dropdown menu.
2. Check the enable square wave output checkbox to enable the square wave function.
3. D5 LED blinks on the motherboard to show the status of the square wave output of RTC.

1.2.37 GUI window for M41T83SMY6E(SOX18 package) RTC

M41T83SMY6E RTC is an SOX18 package and is mounted on a separate daughter card. This RTC has one silicon crystal and therefore needs no external crystal for operation.

Below are the steps for selecting the M41T83_MX RTC:

1. Plug in the M41T83(SOX18 package) RTC daughter card on the motherboard (take note of the notch on the daughter card connector for mounting).
2. Power up the motherboard using USB cable.
3. Open the GUI and select the RTC selection icon, as shown in *Figure 15*.
4. Select M41T83(SOX18) RTC from the menu and press OK.
5. M41T83 (SOX18) RTC window opens, as shown in *Figure 18*.
6. On powering up the board, the RTC clock is seen as halted showing the time at which the power was put down. The clock starts running only after resetting the HT bit in the RTC GUI window.

Figure 18.   GUI window for M41T83_SOX18 RTC
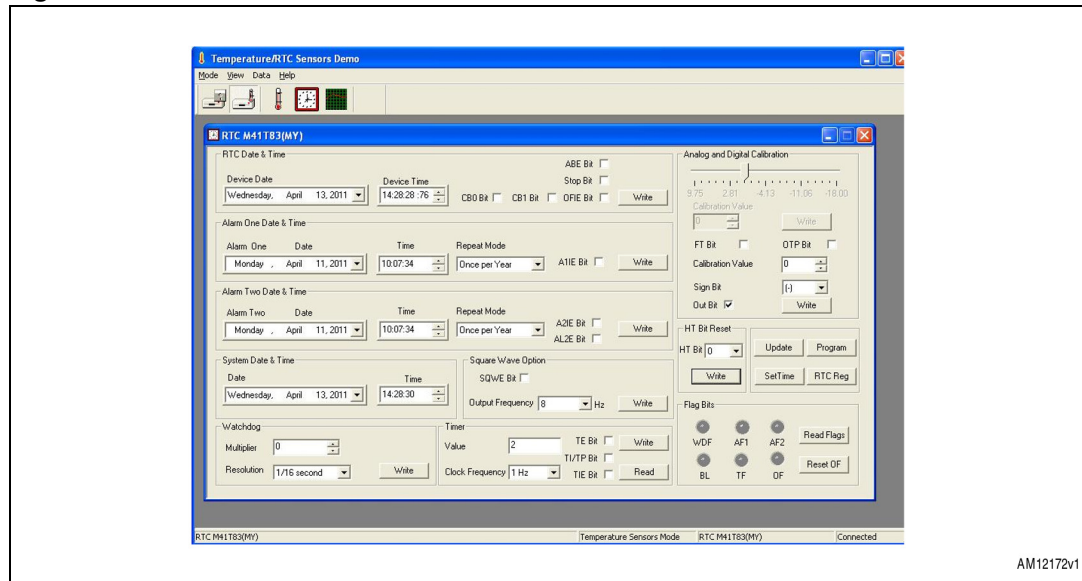
AM12172v1

1.2.38   M41T83_SOX18 RTC date and time setting

1.   Click on the RTC Selection icon in the toolbar of the GUI. The RTC selection Radio button appears in the GUI, as shown in *Figure 15*.

2.   Select RTC M41T83 and the RTC child window opens, as shown in *Figure 18*.

3.   Press the Update button to enable the configuration of RTC. Pressing the Update button enables the GUI window for RTC configuration. It also reads the RTC registers from the onboard RTC and displays the same in the GUI.

4.   After pressing the Update button, reset the HT bit to see the clock ticking on the display.

5.   Configure the RTC date and time by clicking on the Set Time button in the GUI. It programs the onboard RTC with the system date and time.

6.   CB0, CB1, Stop bit, and OFIE bit are checkboxes to enable or disable the respective bit in RTC. Checking the box and then pressing the Write button sets the bits and un-checking them and clicking on the Write button resets the bits.

7.   The Program button configures the RTC with the current settings visible in the GUI.

8.   The RTC Reg button shows the RTC registers and the values present in those registers.

9.   The device time in the GUI also reads the milliseconds from RTC and displays them in the GUI.

1.2.39 M41T83_SOX18 RTC alarm settings

M41T83_SOX18 RTC has two alarm functions:

● Alarm one
● Alarm two

a) Alarm one:

1. Set the alarm date and time using the alarm one date and time section on the RTC GUI window.
2. Check the A1IE checkbox to see the alarm status on the interrupt output pin of RTC. This is seen as a D6 LED glowing on the motherboard whenever the alarm match occurs.
3. Press the Write button to program the alarm one date and time in the RTC.
4. As the Alarm time is matched, the AF1 flag sets inside the flag status register and if A1IE is also checked, the D6 LED glows on the motherboard. This alarm can be seen in the GUI by pressing the Read Flag button, the AF1 flag glows and is cleared on a second press of read flags.
5. D6 LED shows the status of the #IRQ1 pin of the RTC.

b) Alarm two:

1. Set the alarm date and time using the alarm two date and time section on the RTC GUI window.
2. Check the AL2E bit to enable the alarm two function. The A2IE bit is used to enable the alarm match status output on the #IRQ2 pin of RTC.
3. Press the Write button to program the alarm two configuration in RTC.
4. On the matching of RTC clock date and time with the alarm two date and time, the AF2 flag is set inside the flag status register and, if the A2IE bit is checked, then the alarm match status is also seen on the motherboard as the glow of D1 LED. D1 LED goes off on pressing the Read Alarm button.
5. The alarm status can be seen in the GUI by pressing the Read Flags button. Pressing read flags again clears the alarm register of RTC and its new status is shown in the GUI.
6. The Reset OF button is used to reset the OF bit in the alarm register and, correspondingly, the oscillator bit alarm is also cleared by the Reset button.

1.2.40 M41T83_SOX18 RTC watchdog configuration

1. The watchdog of RTC is enabled by configuring the multiplier and resolution settings and pressing the Write button.
2. The time period for watchdog is calculated by the resolution x multiplier value. This value is in seconds.
3. The watchdog alarm occurs when the time set in the watchdog register has lapsed.
4. The status of the watchdog alarm can be seen only by pressing the Read Flags button and, on the motherboard, this status is shown by the glow of the D6 LED. Pressing again the Read Alarm button clears the WDG flag in the alarm register of RTC and its status is shown in the GUI. On the motherboard the D6 LED goes off only by writing the watchdog register. Writing 0 in the watchdog register disables the watchdog function.

1.2.41 M41T83_SOX18 RTC timer configuration

1. M41T83 RTC has an 8-bit countdown timer. This timer counts down from the user configured value (timer countdown value) to 1 and then again reloads the timer countdown value.
2. Enter any value between 1 and 255 inside the value area of the timer.
3. Select the timer ticking clock from the clock frequency dropdown menu of the timer.
4. Enable the checkbox for the TE bit, this enables the timer. If the TE bit is not enabled, the timer does not start the counting. The TI/TP bit is used for mode selection of the timer.
5. The TIE bit is used to output the timer rollover interrupt on the #IRQ1 interrupt pin of RTC. Whenever the timer rollover occurs, the TF flag is set and the D6 LED glows on the motherboard. The LED goes off by reading the flag register using the Read Flag button.
6. Press the Write button to enter the timer configuration values in the timer section of the M41T83_SOX18 RTC.
7. As soon as the timer rolls over from 1 to the timer countdown value, the timer flag (TF) is set inside the flag status register of RTC. This flag is cleared only by reading the flag register. Pressing the Read Flag button shows the status of this flag in the GUI. A second read clears the flag from the GUI.

1.2.42 M41T83_SOX18 RTC digital calibration configuration

1. Enter the calibration value between 0-31 in the calibration register.
2. Select the positive or negative calibration by selecting the sign in the sign bit dropdown menu.
3. Press the Write button to configure the RTC calibration register with the selected settings.

1.2.43 M41T83_SOX18 RTC analog calibration configuration

1. Check the FT bit checkbox.
2. The slider for analog calibration gets enabled and LED D6 glows on the motherboard. This disables the remaining RTC window.
3. Enter the calibration value using the slider and press the Write button to configure the value inside RTC.

    After the value is configured, remove the check from the FT bit checkbox.

Note: *The frequency test function (FT) works only when all the other interrupt functions are disabled. If any of the interrupt functions are enabled then the frequency test function is disabled.*

1.2.44 M41T83_SOX18 RTC HT bit configuration

At every power-down the HT bit is set. To start the display of the clock on consecutive powering, the HT bit should be reset each time.

1. HT bit set and reset option is selected from the dropdown menu.
2. Setting the HT bit halts the clock display of RTC.
3. Resetting the HT bit resumes the clock display of RTC.

1.2.45 M41T83_SOX18 RTC FT bit configuration

The FT bit is a checkbox; if none of RTC interrupt functions (Alarm/WDG/SQW) are selected, then checking this box selects the frequency test function of RTC and it is displayed as a glow on D6 LED. Resetting the bit switches off the frequency test function.

1.2.46 M41T83_SOX18 RTC square wave configuration

M41T83_SOX18 RTC has a square wave output option.

1. Select the square wave output frequency from the output frequency dropdown menu.
2. Check the enable square wave output checkbox to enable the square wave function.
3. D5 LED blinks on the motherboard to show the status of square wave output of RTC.

1.2.47 Plotter window

The GUI supports the plotting of the temperature value against time for each sensor.

The steps to be followed to plot the graph are as follows:

1. Select the temperature sensor and check the address.
2. Select the Graph Selector button on the GUI toolbar, as shown in *Figure 19*. This opens the Plotter window, as shown in *Figure 20*.
3. Select for the desired frequency (200 millisecond/500milisecond/1 second /10 second) from the "Time Interval" dropdown menu. This frequency denotes the timing interval after which the next reading is taken and plotted on the graph.
4. Click on the plotter Start button in the toolbar. It opens the plotter and starts plotting the graph, as shown in *Figure 19*.
5. To stop the plotting, click on the Stop button placed in the toolbar, shown in *Figure 20*.
6. Use the toolbar present in the graph window to expand or compress the scale on the graph.
7. To store the image of the graph on computer, click on the Save Plot window icon in the toolbar of the plotter window. It stores the graph as .tsg format. Refer to *Figure 21*.
8. To store the graph data as text format in an Excel$^{®}$ sheet, click on the Excel sheet icon in the toolbar. It saves the temperature readings in Excel format.
9. In order to see the previously stored graphs, click on the Display The Saved File icon in the toolbar and open the .tsg file to see the previously stored graph. Refer to *Figure 21*.
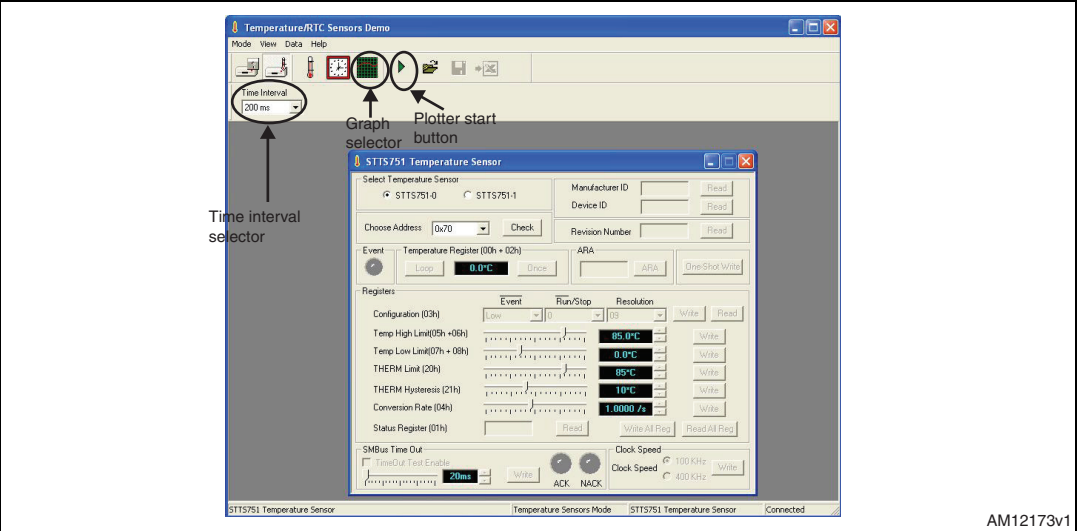
Figure 19.   Plotter selection window

AM12173v1

Figure 20.   Plotter window for STDS75 temperature sensor

AM12174v1
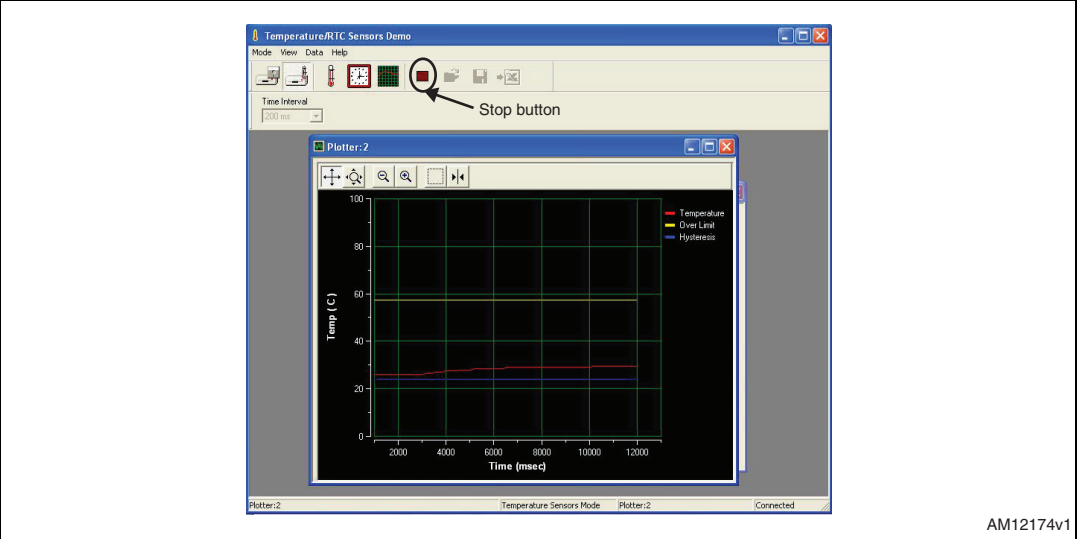
Figure 21.   Tool bar of plotter window
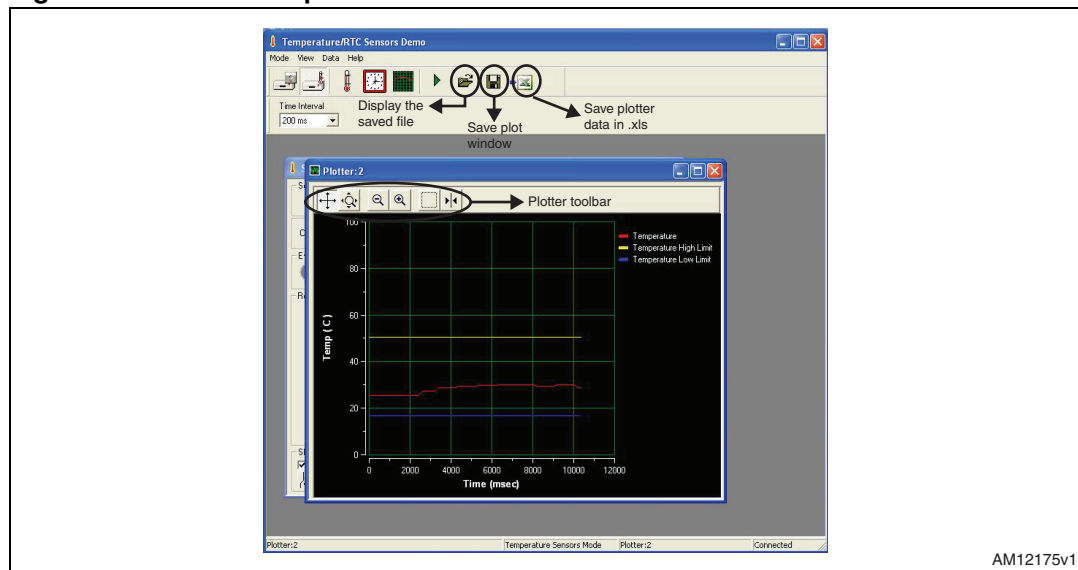
1.2.48   Application LEDs

There are 4 application specific LEDs on the board:

1. I^2C LED: This is a green LED (D4) which blinks whenever there is an I^2C communication occurring in the application.

2. RQ1 LED: This is a green LED (D6) which glows in accordance to the signal status on the #IRQ1 pin of M41T83 RTC.

3. RQ2 LED: This is a red LED (D1) which glows in accordance to the signal status on the #IRQ2 pin of M41T83 RTC.

4. Alarm/EVENT LED: This is a red LED (D5) which glows in accordance with the ALARM output signal of temperature sensors or for the SQW output option of M41T83 RTC.

5. Power LED: This is a red LED (D3) which glows as soon as the USB cable is plugged in.

2 System overview

This demo is a generic system for evaluating the family of temperature sensors and RTC from ST. This demo has 2 main blocks:

1. STM32F102xx microcontroller based motherboard.
2. Temperature sensors and RTC based daughter cards.

2.1 Hardware design description

Figure 22. Block diagram
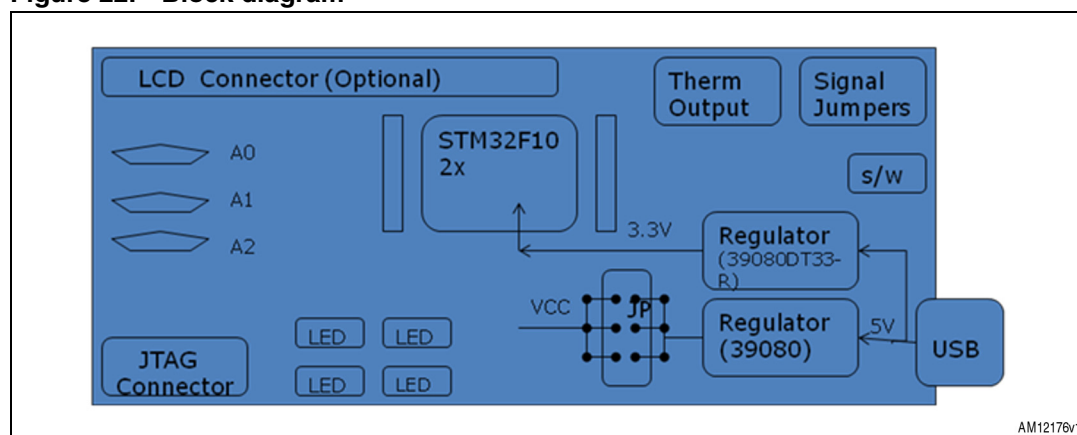
- JP: jumper for selecting one VCC (daughter card supply) out of 2.3 V/ 2.7 V/ 3.0 V/ 3.3 V/ 3/6 V
- S/W: reset switch
- A0;A1;A2: address selection switches for temp sensors.

2.1.1 STEVAL-IFS017V1-STM32F102xx based motherboard

The main components present on the motherboard are:

1. STM32F102C6T6 microcontroller.
2. LD39080DT33-R voltage regulator.
3. LD39080PT-R adjustable voltage regulator.
4. SPDT switches for address configuration of temperature sensors.
5. Connectors for mounting the daughter cards.

2.2 Hardware layout

Figure 23 and *24* below show the component layout to help the user to locate different components / sections on the board.

Figure 23. Hardware layout: motherboard top
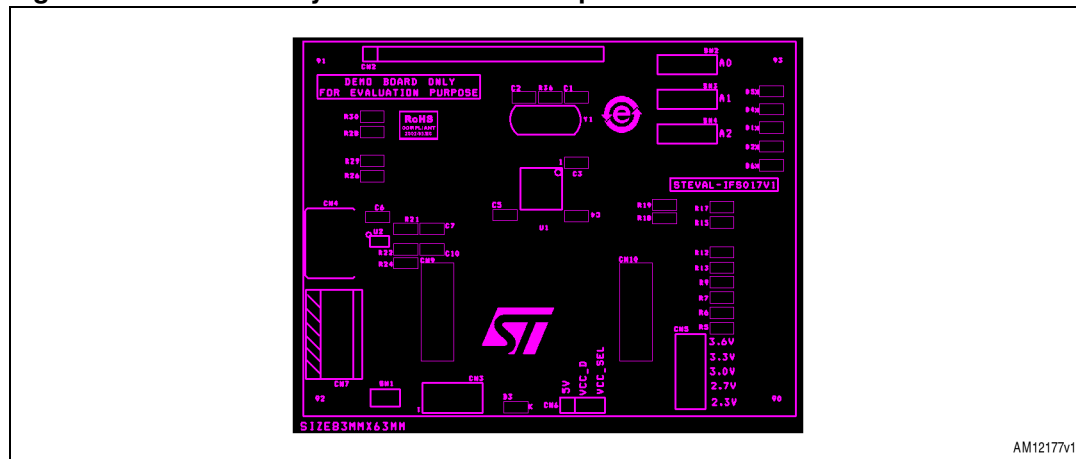
Figure 24. Hardware layout: motherboard bottom

3 Hardware schematics

Figure 25. Schematics (part 1)

AM12179v1
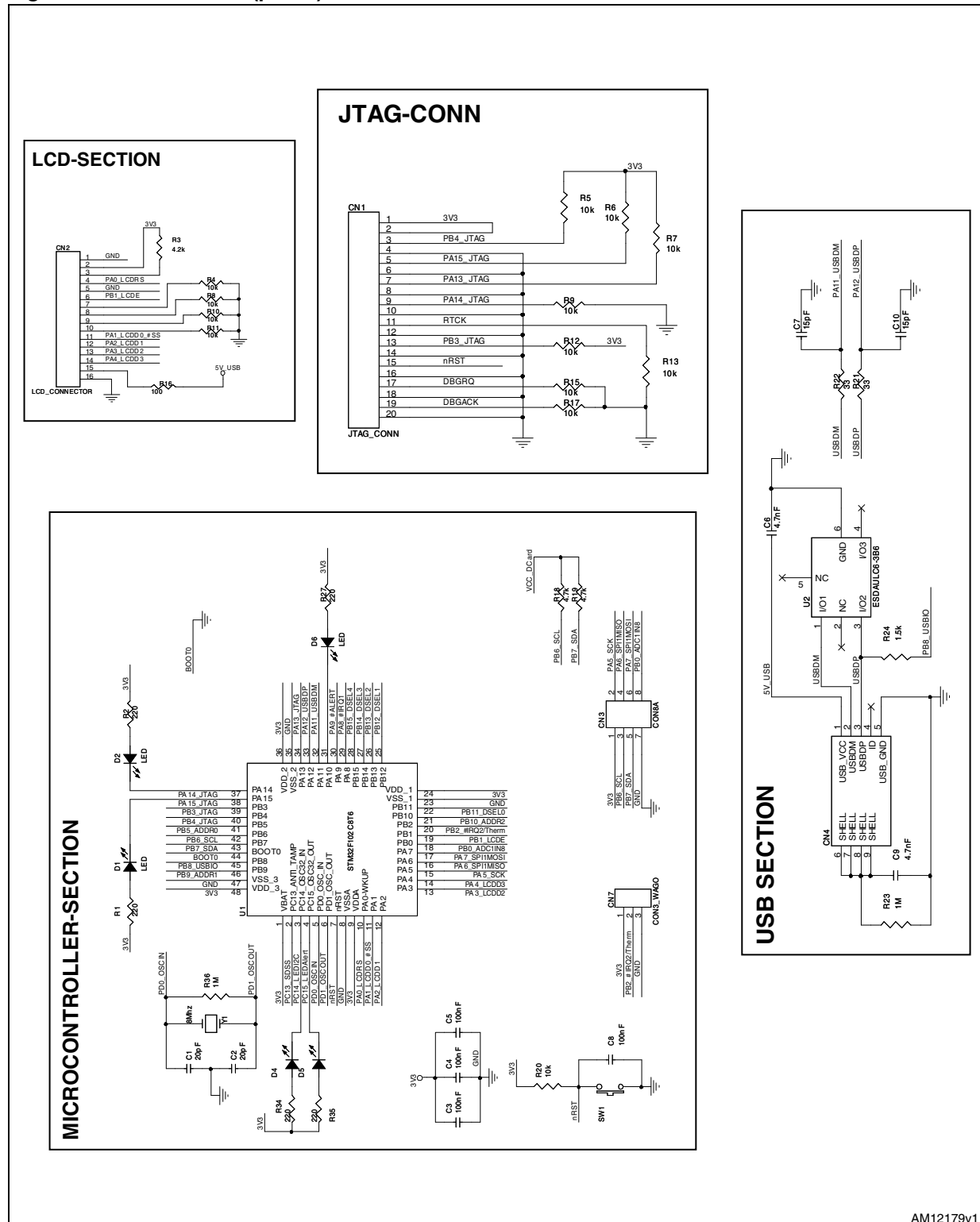
Figure 26. Schematics (part 2)

AM12180v1
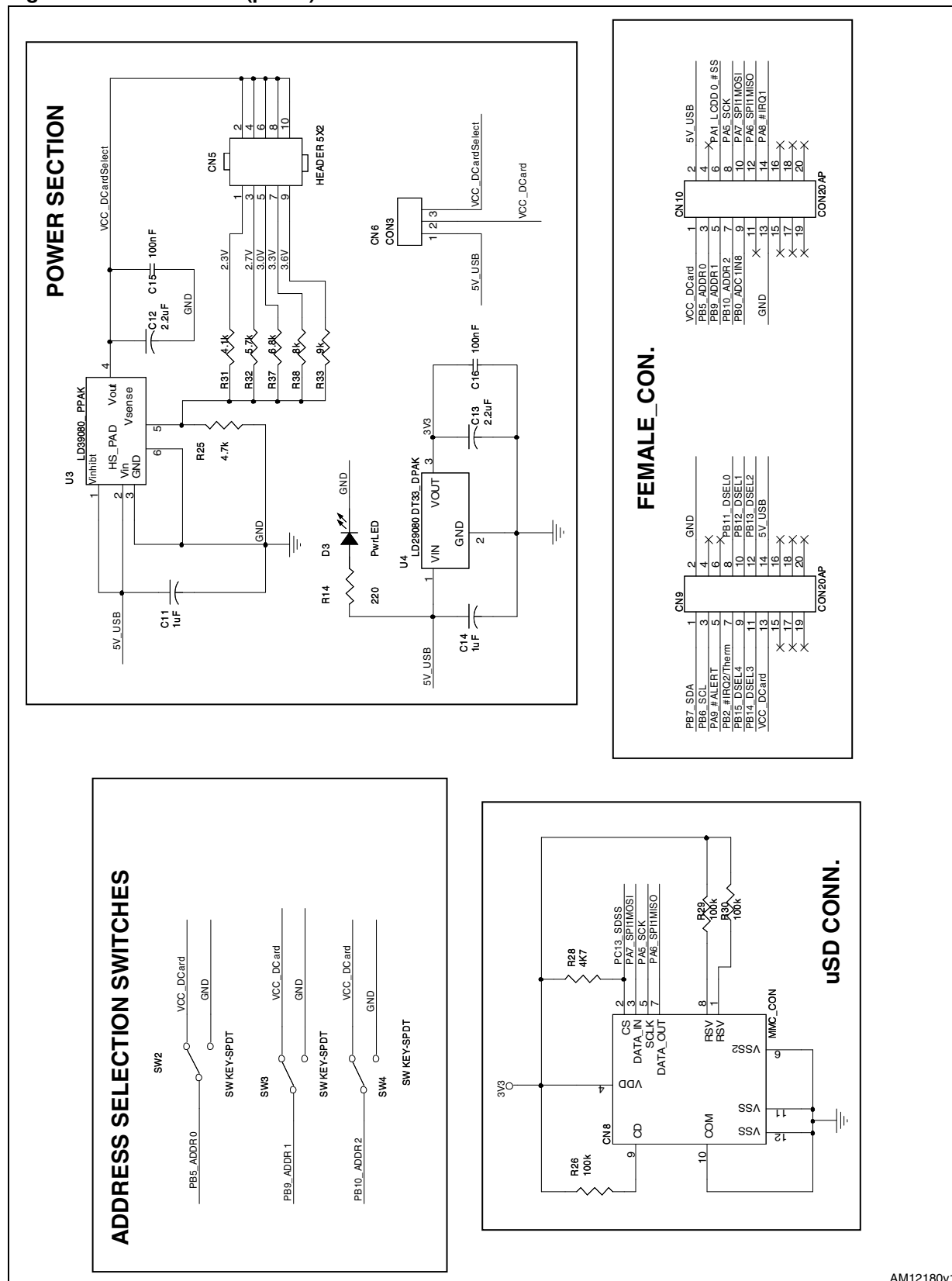
4 Bill of materials

Table 5.   BOM

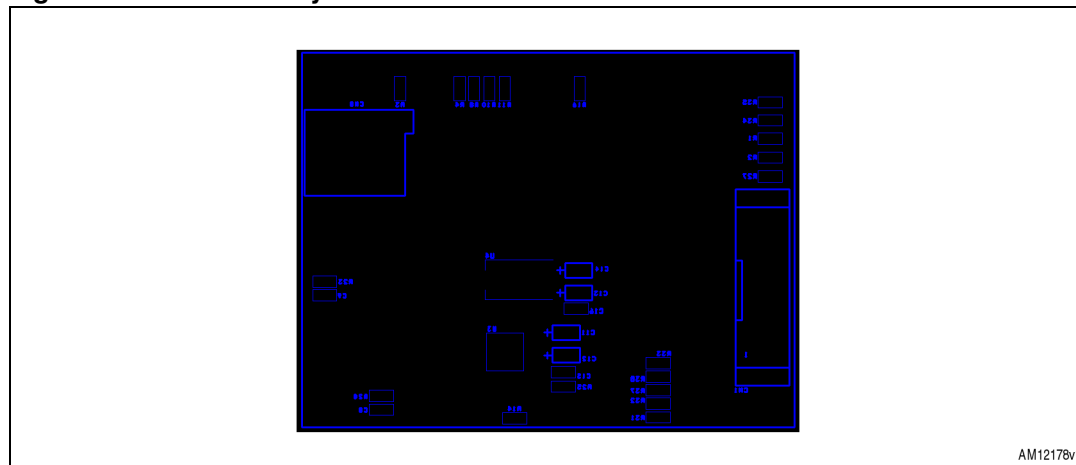| Category	Reference designator	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Supplier	Supplier ordering code
ST devices	U1	Microcontroller	LQFP48	ST	STM32F102C8T6		
	U2	USB protection device	SOT-666	ST	ESDAULC6-3BP6		
	U3	Adjustable voltage regulator	PPAK	ST	LD39080PT-R		
	U4	Voltage regulator	DPAK	ST	LD29080DT33		
Connectors	CN1	JTAG connector	10 x 2 header	3M Electronic Solutions Division	30320-6002HB	Mouser	517-30320-6002
	CN2,CN3, CN5,CN6	Bergstrip	4x1 pin Bergstrip	Any		Samtec	TSW-104-23-G-S
	CN4	Mini USB connector	SMD	Molex or equivalent	67503-1020	Mouser	538-67503-1020
	CN7	Screw type connector	Through hole	Phoenix contact or equivalent	1729131	Mouser	651-1729131
	CN8	MMC card connector	SMD	Proconn Technology	MSPN09-X0-1000		
	CN9,CN10	Daughter card connector	Through hole	Sametec	TFC110X1-L-D	Integrated Electronics	TFC110X1-L-D

Table 5.   BOM (continued)

Category	Reference designator	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Supplier	Supplier ordering code
Capacitors	C1,C2	20 pF	SMD0805	AVX Corporation or equivalent	08051A200JAT2A	Digi-Key	478-3735-1-ND
	C3,C4,C5, C8,C15,C16	100 nF	SMD0805	Panasonic - ECG or equivalent	ECJ-2VB1E104K or equivalent	Digi-Key	PCC1828CT-ND
	C6,C9	4.7 nF	SMD0805	Panasonic - ECG or equivalent	ECJ-2VB1H472K	Digi-Key	PCC472BNTR-ND
Capacitors	C7,C10	15 pF	SMD0805	AVX Corporation or equivalent	08055A150JAT2A	Digi-Key	478-1306-1-ND
	C11,C14	1 µF	SMD0805	Vishay/Sprague	298D105X0050P2T	Digi-Key	718-1720-1-ND
	C12,C13	2.2 µF	SMD0805	TAJ or equivalent	TAJR225M004RNJ	Digi-Key	478-3053-1-ND
LEDs	D1,D3,D5	LED, red color	SMD0805	Lite-On Inc	LTST-C170CKT	Digi-Key	160-1176-1-ND
	D6,D4	LED, green color	SMD0805	Lite-On Inc	LTST-C170KGKT	Digi-Key	160-1414-1-ND

Table 5. **BOM (continued)**

Category	Reference designator	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Supplier	Supplier ordering code
Resistors	R1,R2,R14, R27,R34,R 35	220 Ω	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ221V	Digi-Key	P220ACT-ND
	R3	4.2 kΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6ENF4221V	Digi-Key	P4.22KCTR-ND
	R4,R5,R6, R7,R8,R9, R10,R11,R 12,R13,R1 5,R17,R20, R33	10 kΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ103V	Digi-Key	P10KACT-ND
	R16	100 Ω	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ101V	Digi-Key	P100ATR-ND
	R18,R19,R 25,R28	4.7 kΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ472V	Digi-Key	P4.7KATR-ND
	R21,R22	33 Ω	SMD0805	Panasonic - ECG or equivalent	ERJ-6ENF33R0V	Digi-Key	P33.0CCT-ND
	R23,R36	1 MΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ105V	Digi-Key	P1.0MATR-ND
	R24	1.5 kΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ152V	Digi-Key	P1.5KATR-ND
	R26,R29,R 30	100 kΩ	SMD0805	Panasonic - ECG or equivalent	ERJ-6GEYJ104V	Digi-Key	P100KACT-ND

Table 5.   BOM (continued)

Category	Reference designator	Component description	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Supplier	Supplier ordering code
Resistors	R31	3.9 kΩ	SMD0805	Susumu or equivalent	RR1220P-392-D	Digi-Key	RR12P3.9KDCT-ND
	R32	5.6 kΩ	SMD0805	Susumu or equivalent	RR1220P-562-D	Digi-Key	RR12P5.6KDCT-ND
	R37	6.8 kΩ	SMD0805	Susumu or equivalent	RG2012P-682-B-T5	Digi-Key	RR12P6.8KDTR-ND
	R38	8.2 kΩ	SMD0805	Susumu or equivalent	RR1220P-822-D	Digi-Key	RR12P8.2KDCT-ND
Switches	SW2,SW3, SW4	SPDT switches	Through hole	EAO	09-03290-01	Farnell	674345
	SW1	Pushbutton	SMD	MULTICOMP	DTSM-32S-B	Farnell	9471898
Crystal	Y1	8 MHz	XTAL-3	Fox	FOXSLF/080-20	Mouser	559-FOXS080-20-LF

Appendix A   Definitions

Table 6.   **Definitions for acronyms**

Acronym	Definition
I2C	Inter integrated circuit
JTAG	Joint test action group
RTC	Real-time clock
ARA	Alert response address

Revision history

Table 7.   Document revision history

Date	Revision	Changes
16-Nov-2012	1	Initial release.

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