Smart meter demonstration board with DLMS/COSEM using ST7570 S-FSK modem with STM32™ and SPEAr™

Introduction

The purpose of this user manual is to help the user to set up, run and evaluate a complete solution that demonstrates a smart metering system based on one or several electricity-meters, one data concentrator, and using the DLMS/COSEM application libraries (server and client) from ANDREA Informatique and hardware and firmware from STMicroelectronics™. The communication medium is based on power line communication (PLC) with a modulation technique used in IDIS (specifications) meters or in Linky G1 meters based on the IEC 61334-5-1 standard.

ANDREA Informatique and ST Microelectronics have agreed to promote an easy way to obtain DLMS/COSEM ready-to-use smart metering solutions.

With this demonstration setup it is possible to evaluate how easy it is to build a complete and robust system.

For instance, on this demonstration board the power, time and status of the breaker and other information stored in the power meter can be shown on an LCD display of the meter or sent to the data concentrator through a power line communication system.

The E-meter demonstration board is based on the STM32F103VE microcontroller, ST7570 PLM modem, ALTAIR04-900 power supply IC, and, optionally, STPMC1/S2 poly-phase energy metering ICs. It implements a PLM smart meter node which allows the final utility to monitor energy consumption and other electrical parameters on one or more phases.

The concentrator is based on the SPEAr microprocessor and the ST7570 power line modem (PLM).

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1 Description

Warning: **The boards must be used only by expert technicians. Due to the high voltage (220 VAC) special care should be taken with regard to human safety. There is no protection against accidental human contact with high voltages. After disconnection of the board from the mains, none of the live parts should be touched immediately because of the energized capacitors. It is mandatory to use a mains insulation transformer to perform any debugging/tests on the board in which debugging and test instruments like USB/JTAG dongles, spectrum analyzers, or oscilloscopes are used. Do not connect any oscilloscope probes to high voltage sections in order to avoid damaging instruments and demonstration tools. STMicroelectronics assumes no responsibility for any consequences which may result from the improper use of this tool.**

1.1 Introduction

In order to build a power line demonstration system, at least one concentrator and one meter are required. Optionally, the user can connect more meters (up to 8) and a network SPY (refer to the AN3213 application note), see *Figure 1*.

Figure 1. Application block diagram
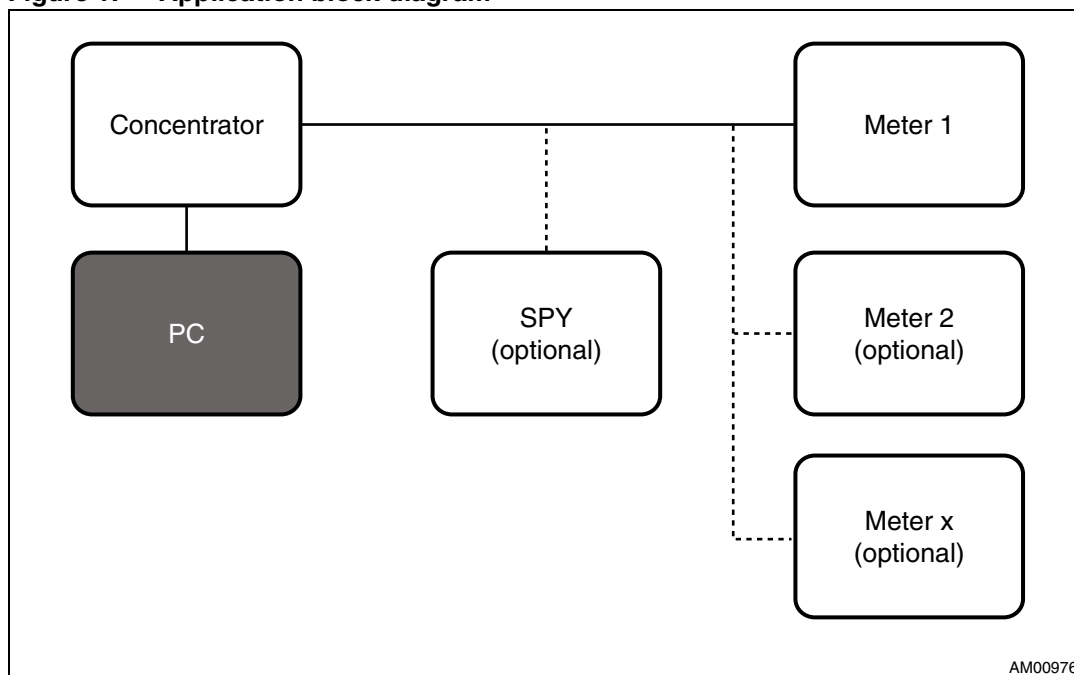
IEC 61334 (S-FSK), and IEC 62056 (DLMS/COSEM) are performed on:

● STEVAL-IPP002V1 (E-meter) and

● EVALSPEAr320HMI (concentrator).

The demonstration board, depicted in *Figure 2*, aims to demonstrate, to meter manufacturers, how easy it is to implement a complete smart meter solution using the STMicroelectronics HW and ANDREA Informatique SW (DLMS/COSEM stack).

The stack and user interface running on the concentrator, depicted in *Figure 3*, allows access to the remote E-meters. It is possible to work with the different data objects (DLMS/COSEM) in the E-meter through power line communication:

● The objects can provide different information and perform some actions, for instance, they are able to:

– read energy values

– read load profile, reading each 15 minutes over 2 days (stored in the memory of the E-meter)

– read the clock

– set the clock

– disconnect and reconnect the breaker

– send a message to the customer (to the E-meter display)

– change tariff

● The information and actions that objects provide can be interfaced through a web server/web pages:

– up to 8 meters can be accessed in one moment

– real-time indication about a number of the connected meters and their status

– graphical representation of the load profile

– bi-directional communication with the meter using buttons or text command window.

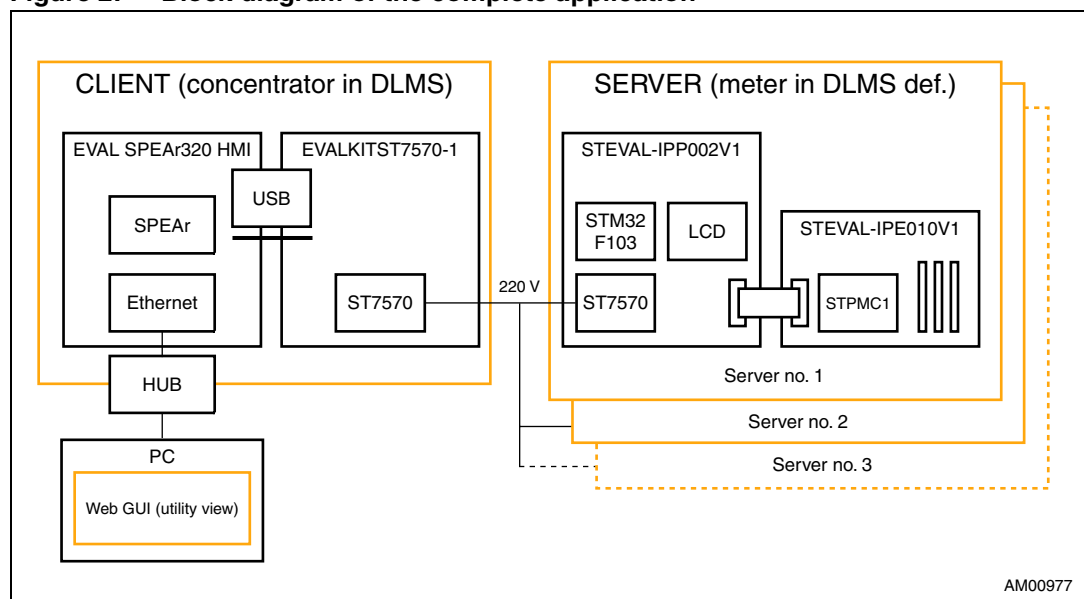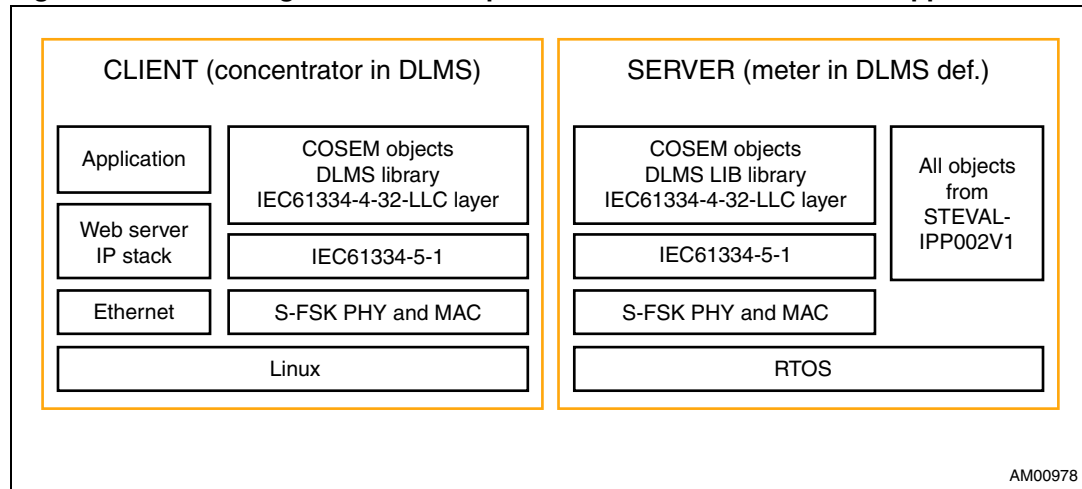**Figure 2.   Block diagram of the complete application**

Figure 3.   Block diagram of the complete software stack used in the application

1.2   IEC 61334 (S-FSK)

IEC 61334-5-1 describes the requirements of the S-SFK (frequency shift keying modulation) in conjunction with the services provided by the physical layer entity and the MAC sub-layer. The transmission medium is assumed to be the distribution network. The MAC sub-layer described in this standard interfaces with the logical link control layer described in IEC 61334-4-32.

The 3-part modulation, physical layer and MAC sub-layer are embedded in the ST7570 so that the best cost/performance ratio may be achieved.

The profile described in this standard is one of several profiles (described in series IEC 61334-5) which are all designed for data transmission via the distribution network. Considering the ongoing technical development in this field, the profiles are published first as technical specifications with the intention to transform, into standards, those profiles which are successful in practice (IEC 61334-5-1).

IEC 61334-5-1 is used in the IDIS specifications or Linky G1.

IEC 61334-5-1 can bridge to the DLMS/COSEM communication standard through the convergence layer IEC 61334-4-32.

S-FSK modulation and ST7570 PLM

S-FSK modulation uses two tones for communication, one frequency for the "0" and one frequency for the "1". The two tones must be more that 10 kHz apart; when one tone is masked by a strong noise, the other one can be read in AM mode. This makes the system robust to narrow band noise. The ST7570 is a powerful power line networking system-on-chip. It combines a high-performance PHY processor core and a protocol controller core with a fully integrated analog front-end (AFE) and line driver. The ST7570 features allow the most cost-effective, single-chip power line communication solution based on the IEC 61334-5-1 S-FSK standard. It offers 1 Hz step programmable carriers up to 148.5 kHz.

The ST7570 embeds a full physical (PHY) and a medium access control (MAC) protocol layer and services compliant with the open standard IEC 61334-5-1, mainly developed for smart metering applications, but suitable also for other command and control applications and remote load management.

A local port (UART) is available for communication with an external host, exporting all the functions and services required to configure and control the device and its protocol stack. The protocol layers and functions embedded in the ST7570 are:

Physical layer: implemented in the PHY processor and exporting all the primitive functions listed in the international standard document IEC 61334-5-1, plus additional services for configuration, alarm management, signal and noise amplitude estimation, phase detection and statistical information.

MAC layer: implemented on the protocol controller and exporting all the primitive functions listed in the international standard document IEC 61334-5-1, plus additional services for configuration.

Management information base (MIB): an information database with all the data required for proper configuration of the system (at both PHY and MAC layer).

Host interface: all the services of the PHY, MAC and MIB are exported to an external host through the local UART port.

1.3 IEC 62056 (DLMS/COSEM)

IEC 62056 is a set of standards for electricity metering. The IEC 62056 standards are the international standard versions of the DLMS/COSEM specification. DLMS or "device language message specification" is the suite of standards developed and maintained by the DLMS User Association. The DLMS User Association (UA) has established a D Type liaison with IEC TC13 WG14, responsible for international standards for meter data exchange and establishing the IEC 62056 series.

The DLMS UA provides maintenance, registration and conformance testing services for IEC 62056 DLMS/COSEM. COSEM or "companion specification for energy metering", includes a set of specifications that defines the "transport and application layers" of the DLMS protocol. The DLMS User Association defines the protocols in a set of four specification documents, namely, Green Book, Yellow Book, Blue Book and White Book. The Blue Book describes the COSEM meter object model and the object identification system, the Green Book describes the architecture and protocols, the Yellow Book treats all the questions concerning conformance testing, the White Book contains the glossary of terms.

The standards included in this demonstration setup, on top of the IEC 61334, are:

– IEC 62056-4-32: Distribution automation using distribution line carrier systems - Part 4: Data communication protocols - Section 32: Data link layer - Logical link control (LLC)
– IEC 62056-53: COSEM application layer (this specification has now been withdrawn by IEC)
– IEC 62056-61: Object identification system (OBIS)
– IEC 62056-62: Interface classes.

Other standards, such as the ones below, are not covered by the demonstration setup and should be requested from ANDREA Informatique in order to comply with other requirements:

- IEC 62056-21: Direct local data exchange (3rd edition of IEC 61107) describes how to use COSEM over a local port (optical or current loop)
- IEC 62056-42: Physical layer services and procedures for connection-oriented asynchronous data exchange
- IEC 62056-46: Data link layer using HDLC protocol
- IEC 62056-47: COSEM transport layers for IPv4 networks.

DLMS/COSEM library

ANDREA Informatique has implemented both DLMS/COSEM libraries (client and server). The DLMS/COSEM libraries comply with the IEC 62056 series of standards. They have been written in C++ and the server library has been optimized for running in the STM32 microcontroller.

The main features of the libraries (client and server) are:

- Easy-to-use interface to integrate DLMS/COSEM objects
- Easy-to-use interface to integrate any modem: S-FSK, PRIME[a], GPRS[a], etc.
- Management of *Short and Logical Names*
- Short names: Read, Write and Information Report
- Logical names: Get, Set, Action and Event Notification
- COSEM security (AES128-GCM)[a]
- Authentication (LLS, HLS-*MDS, HLSSHA1, HLS-GMAC)[a]*.

For more information, please download relevant images and documentation at: www.cosemlibs.andrea.fr.

1.4 STEVAL-IPP002V1 smart meter demonstration board

The E-meter demonstration board (STEVAL-IPP002V1) is based on the STM32F103VE microcontroller, ST7570 PLM modem, and can be connected to the STPMC1/S2 poly-phase energy metering IC demonstration board. It implements a PLM smart meter node which allows the final utility to monitor energy consumption and other electrical parameters of the meter.

The voltage, current, power, power factor, THD, active and reactive energy, and other stored information can be shown on an LCD display locally, or sent to a PLM data concentrator through a power line communication network based on the IEC 61334-5-1 standard protocol and DLMS/COSEM application data objects.

1.4.1 Hardware

The application described in this document refers to the STEVAL-IPP002V1 demonstration board depicted in *Figure 4* (see www.st.com).

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a. Not demonstrated in this specific demonstration setup.

Figure 4.   STEVAL-IPP002V1 smart meter demonstration board
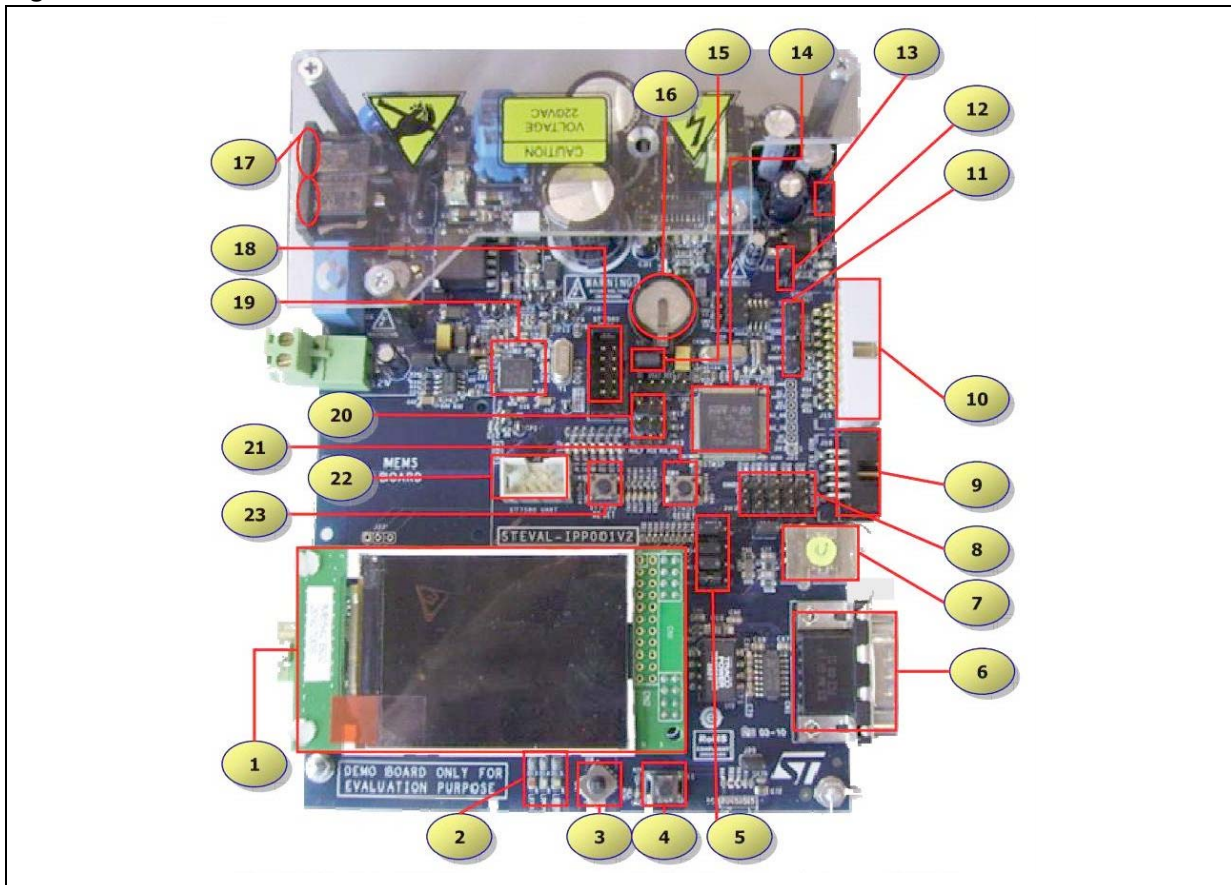
1. TFT LCD color display 320 x 240

2. General purpose application red, green, yellow LEDs

3. General purpose application joystick, switch meter user data

4. General purpose application button, switches the phase view on the LCD display from 3, R, S, T

5. Energy meter configuration jumper (SW10) to use SPI-MISO or SPI-MOSI for data line, LCD display configuration jumpers (SW16, SW17, SW18) to control the LCD display via SPI of GPIO

6. RS232 USART connector

7. USB connector

8. General purpose application configuration jumpers (SW19, SW20, SW21, SW22, SW23)

9. Energy meter external board connector (e.g. STEVAL-IPE010V2)

10. STM32 JTAG 20-pin connector

6. RS232 USART connector

11. Boot configuration jumpers (SW7, SW9)

12. Enable/disable DL2 LED

13. Enable/disable DL1 LED

14. STM32F103VET6 32-bit high density microcontroller

15. Battery enabled/disabled configuration jumper

16. Battery for STM32 V_{BAT} supply

17. 85 - 256 V board power supply. Suggested 110 - 220 V AC

18. ST7570 JTAG 10-pin connector

19. ST7570 power line modem IC

20. RTC calibration/normal mode configuration jumpers

21. STM32 microcontroller reset button

22. ST7570 PLM IC UART connection connector

23. ST7570 PLM IC reset button

The E-meter demonstration board can be used as a guideline to design a typical energy meter board for smart metering applications. It is designed to include advanced features as well as to fit the requirements for next generation energy meters. These extra features can be added to the board by modules for easy customizing. The board includes the following functions shown in the block diagram in *Figure 5*:

● Energy measurement by an external metrology board

● Power line communication up to 2.4 Kbps

● LCD display to show energy consumption information

● USB and RS232/IrDA connectivity

● Optional ZigBee® communication capability

● Optional MEMS module support.

Figure 5. STEVAL-IPP002V1 smart meter demonstration board block diagram
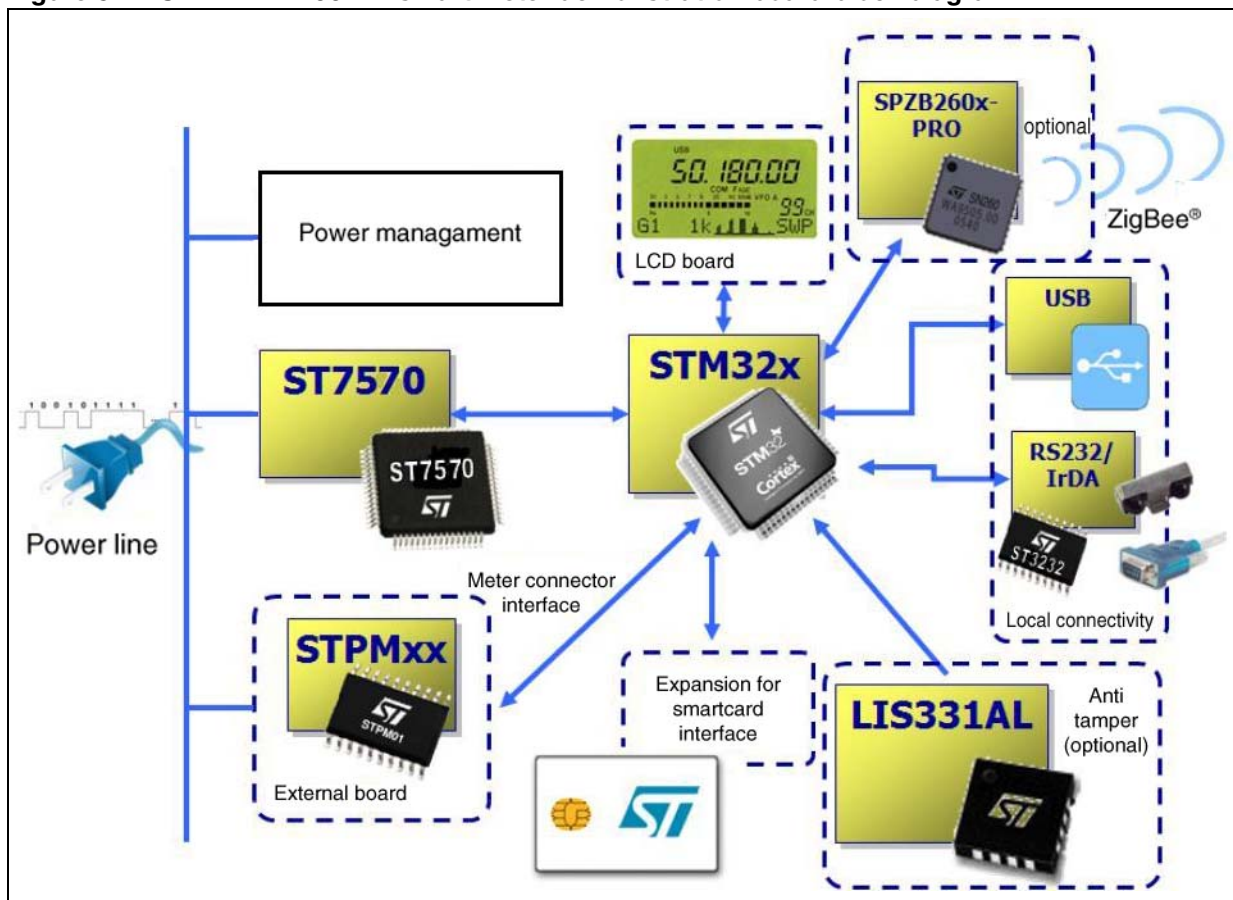
Main hardware components

The E-meter demonstration board (STEVAL-IPP002V1) main hardware components are:

● An STM32F103VE microcontroller running the application firmware

● An external optional STPMC1 multiphase energy metering IC; the external STEVAL-IPE010V1 demonstration board based on STPMC1 and STPMS2 has been used in this firmware release

● An MB542B-01 320x240 color TFT LCD display module; used to show data locally

● An ST7570 power line modem; used to provide PLC connectivity to the system

● 3 status LEDs; 1 green, 1 yellow, 1 red LED for application status scope

● 1 I^{2}C expansion connector for dual interface EEPROM connection (J8)

● 5 configuration jumpers (SW19, 20, 21, 22, and 23); used for software configuration scope

● 1 user button (S1) and 1 joystick (U8); used for user application scope

● 1 microcontroller reset button (SW4); used to force an MCU reset

● 1 modem reset button (SW1); used to force an ST7580 reset.

Detailed information about the smart meter demonstration board hardware and its setup can be found in *Section 2: References* (STEVAL-IPP002V1).

1.4.2 Firmware

The demonstration board can be programmed by the included JTAG connector using any JTAG programming tool for STM32. The ST-LINK tool is the one delivered by STMicroelectronics, for more information on how to get it, refer to www.st.com/internet/evalboard/product/251168.jsp.

It is necessary to program the STEVAL-IPP002V1 board before connection to the STEVAL-IPE010V1, in order to keep the insulation from the mains; in fact the STEVAL-IPP002V1 is insulated by default, but as soon as it is connected to the metrology board the insulation is lost due to the not insulated topology of the STEVAL-IPE010V1.

There are two ways to program FW into the STEVAL-IPP002V1:

Using IAR™ programming environment

The advantage of using this approach is that the user can add its tasks, modify the firmware code and debug the code. The user unpacks the project archive to the new folder, finds the main project file with *.eww extension and opens this project file in IAR programming environment. Clicking the "download and debug" button downloads the firmware into the STM32 Flash through J-Link, JTAG tool, ST-LINK or any of those supported in the project option - debugger.

IAR programming environment can optionally generate a binary output suitable for later flash programming of the microcontroller. This option can be found in the converter section of the IAR project option. The binary outputs that IAR may generate are:

● BIN file with *.bin extension
● Intel® HEX file with *.hex extension
● Motorola S-record file *.srec extension.

Using STM32 ST-LINK utility

The advantage of using ST-LINK utility is the simplicity of the flashing of the firmware and the cost. The user does not need to compile a whole project or have source files. The setup of the complex programming environment is not necessary. ST-LINK utility is very simple to use.

The user clicks on the button "open file" and chooses the binary file to flash with one of the following extensions that the ST-LINK utility supports:

● BIN file with *.bin extension
● Intel HEX file with *.hex extension
● Motorola S-record file *.srec extension.

The "Program" button, that is immediately offered by the utility or can be found later in the main menu, programs the microcontroller flash with the chosen binary file via the connected ST-LINK adaptor.

Once the 3-phase system is put in place according to the previous description and the system is powered on, the Smart E-meter application shows the following view on the LCD display (see *Figure 6*).

Figure 6.   E-meter application running on STEVAL-IPP002V1
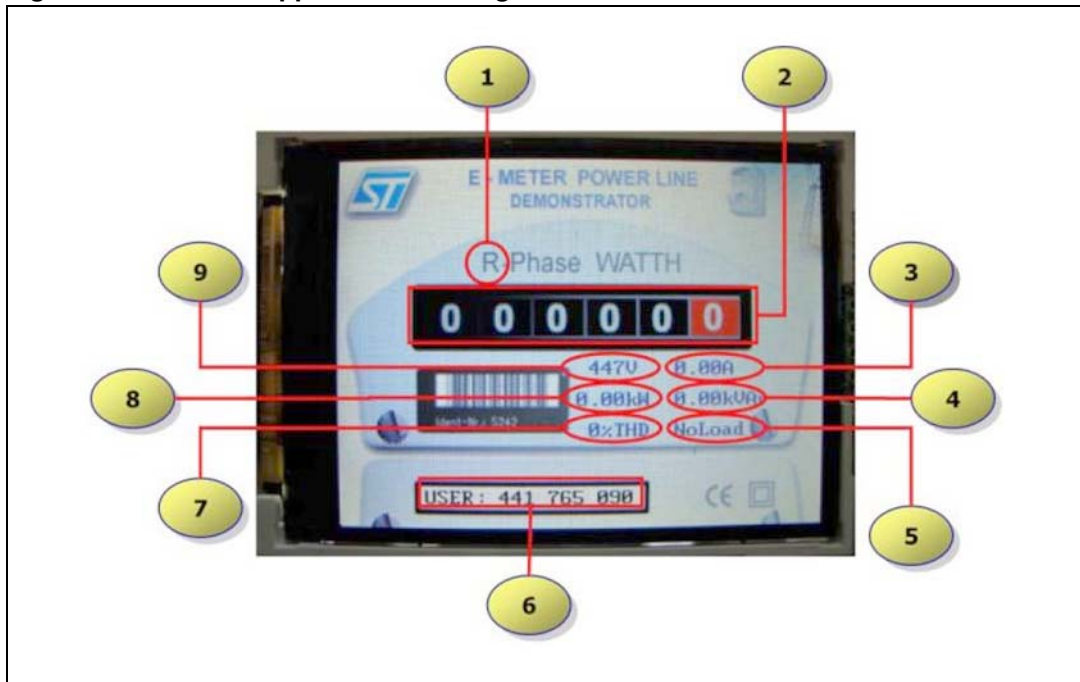
1. Phase identification (3, R, S, T).

2. Energy counter in kilowatt hour. Red digit represents tenths kWh.

3. Phase current in Amperes.

4. Phase reactive energy in kVAr.

5. Power factor or "No Load" if no load condition is detected.

6. Meter user data. Use joystick to move shown data.

7. Phase THD parameter in percentage.

9. Phase voltage in Volts.

If the application is running without problem, the LED (LED1) is seen blinking. During counter moving the red LED (LED0) blinks every time the red number (tenth Watt-hours) moves to the next step. To move from a phase view to the next phase view, it's necessary to press user button S1. Joystick U8 allows user data to be moved.

In order to keep the connection to the power measurement board (STPMxx) optional, the power information is simulated.

1.5   EVALSPEAr320HMI data concentrator

The data concentrator consists of the EVALSPEAr320HMI expansion board connected to the EVALST7570-1 power line mode evaluation kit, as depicted in *Figure 2 on page 5*.
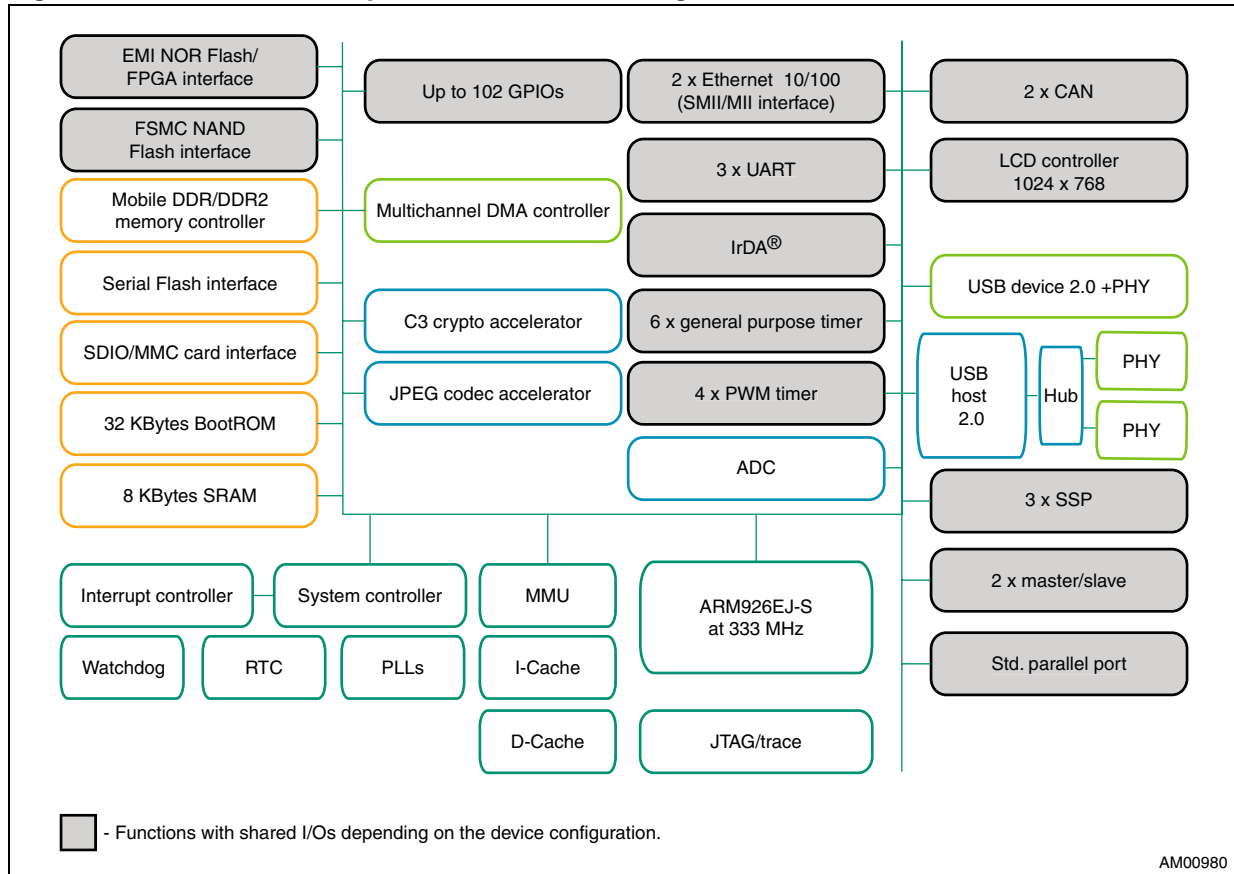
The EVALSPEAr320HMI expansion board hosts the SPEAr320 MPU:

● The SPEAr320 is a member of the SPEAr family of embedded MPUs, optimized for industrial automation and consumer applications. It is based on the powerful ARM926EJ-S processor (up to 333 MHz), widely used in applications where high computation performance is required.

In addition, the SPEAr320 has an MMU that allows virtual memory management - making the system compliant with the Linux operating system. It also offers 16 KB of data cache, 16 KB of instruction cache, JTAG and ETM™ (Embedded Trace Macrocell™) for debug operations.

A full set of peripherals allows the system to be used in many applications, some typical applications being factory automation, printer and consumer applications, see *Figure 7*.

Figure 7. SPEAr320 microprocessor unit block diagram

1.5.1 Hardware

The EVALSPEAr320HMI expansion board contains the following peripherals available to use (see *Figure 8*):

● 1 x Ethernet RJ45 connector (ST802RT1A)

● 1 x LCD display interface for 5.7" 640 x 480 EDT screen (ET057010DHU)

● 1 x unified LCD display interface (EDT displays with unified interface)

● 1 x resistive touchscreen interface (STMPE811)

● 2 x CAN DB9 plug connectors

● 3 x RS232 DB9 plug connectors (ST3232EBTR)

● Onboard temperature sensor and potentiometer (STMPE811)

● 64-Kbit dual interface EEPROM: ISO 15693 and ISO 18000-3 mode 1 compliant

● Contactless interface + I^2C (M24LR64)

● 4-Gb NAND Flash memory

● PWM mono audio output

● Analog extension connector featuring 8 ADC lines

● General purpose extension connector with GPIOs and I^2C functionality

● Unified power line modem (PLM) connector

● Raisonance Primer2 extension board interface connector

● DC-DC converter L7986A (+24 V/+5 V)

● Micro SD Card™ socket

● 4 LEDs

● 2 general purpose buttons

● System reset button.

Figure 8.   EVALSPEAr320HMI - block diagram
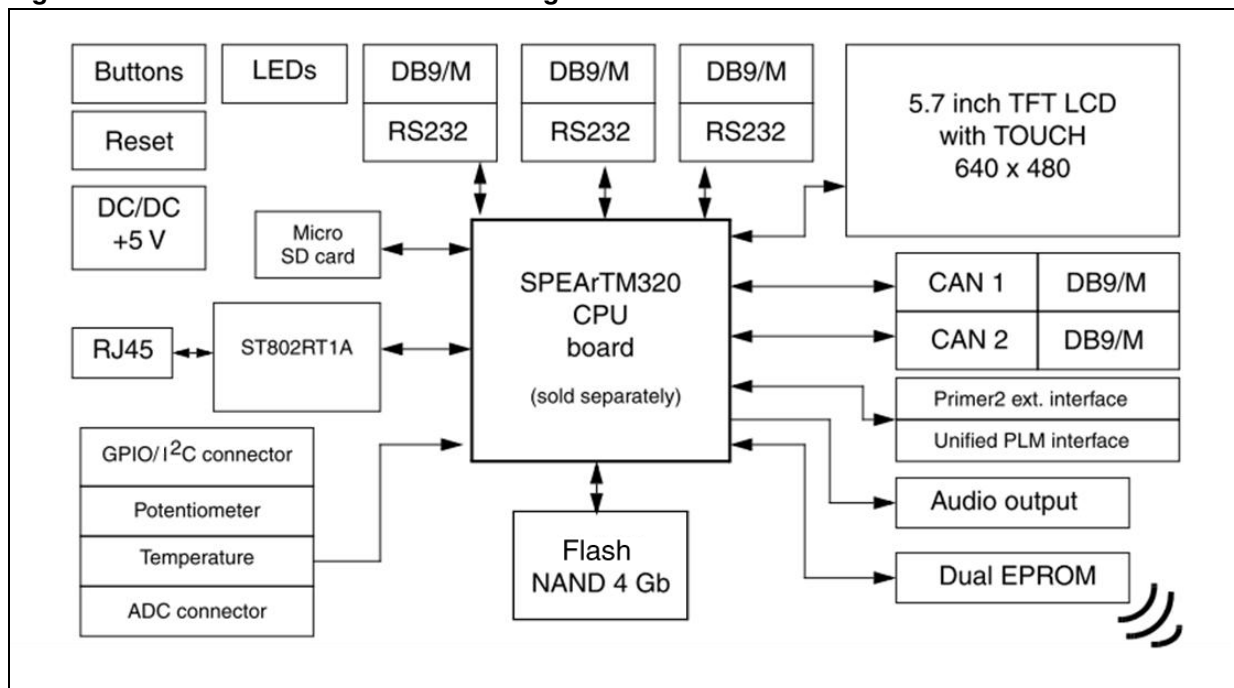
Detailed information about the EVALSPEAr320HMI expansion board and the SPEAr MPU can be found in *Section 2: References* (EVALSPEAr320HMI). The UM1045 user manual, rev. 3, should be read first.

1.5.2 Firmware

The EVALSPEAr320HMI board can boot a Linux kernel pre-installed in the parallel NAND Flash memory. At power-on, the serial port outputs a brief header message with some U-Boot information (U-Boot version, SDK version, and some internal hardware information). At this point the user can choose to:

● Stop the system directly in U-Boot: Before the boot delay time expires (default is 3 seconds), press the spacebar on the host computer's keyboard.

● Boot Linux: The system boot is finished when the login prompt appears in the console.

● Boot Linux: The system boot is finished when the login prompt appears in the console.

The default login user name for super user is 'root'; no password is required.

Basic procedure for demonstration firmware update (all users)

In order to update the uImage of the Linux firmware and boot parameters, the user can do so under SPEAr board loader uboot (prerequisites are: any TFTP server running on any PC and under any operational system). Uboot commands should follow this order:

```
> tftp 0 uImage
> nand erase 180000 220000
> nand write.jffs2 0 180000 220000
> setenv bootcmd nand read.jffs2 0x0 0x180000 0x220000\; bootm 0x0
> setenv bootargs console=tty0 mem=128M root=/dev/mtdblock7
rootfstype=yaffs2 ro init=/sbin/init
> saveenv
```

File system update can be performed via booting from another FS (an nfs boot is presented here, but USB can be used as well):

```
> setenv bootargs console=ttyS0 mem=128M root=/dev/nfs init=/sbin/init
nfsroot={serverip}:/tftpboot/fs ip=:::::SPEAr320::on
> boot
```

After the new image is downloaded into the SPEAr board, the user must put these commands in order to install the new file system from the new image in the SPEAr board Linux command line:

```
# mount -t yaffs2 /dev/mtdblock7 /mnt/nand
# cd /mnt/nand
# rm * -R
# tar xvf /home//meetering_fs.tar.bz2
# vi /etc/init.d/rcS
: at the eof switch virtual FTDI ports of metering daemons /dev/ttyUSB1 <->
/dev/ttyUSB0
```

After the new file-system is downloaded, installed in the board and is funtional, the last fix to the Apache server must be performed. In order to do this, boot the board, login as a 'root' and put the following commands:

```
# mount -o remount,rw /
# chmod +x /
```

Advanced procedure for demonstration firmware update (expert users only)

Choose Boot Linux and follow the 14 points to configure the system and run the DLMS/ COSEM demonstration board:

1. Compile the demonstration board set on a Linux host, equipped with SPEAr tool chain:
   cd /xxxxxxxx/metering
   make

2. Take a brand new, out-of-the-box, EVALSPEAr320HMI board, with NAND Flash file system. The flashed kernel should be the following version:
   Linux version 2.6.27_stm23_004-SPEAr320 (root@troll) (gcc version 4.2.4 (STMicroelectronics/Linux Base 4.2.4-70)) #4 PREEMPT Tue Apr 19 16:21:41 CEST 2011

3. Put the following directories on a USB key, from the delivered archive:
   – apache
   – metering

4. Insert the USB key into the EVALSPEAr320HMI board, and mount it (mount -t vfat /dev/sda1 /mnt)

5. Remount the SPEAr filesystem in read write:
   mount -o remount,rw /

6. Copy the directories in the following destinations
   cp -ar /mnt/apache /usr/
   cp -ar /mnt/metering/wwwapache /usr/
   cp -ar /mnt/metering /usr/local/bin

7. Unmount the USB key and remove it (umount/mnt)

8. Insmod the USB drivers:
   insmod /usr/local/bin/metering/usbdrivers/usbserial.ko
   insmod /usr/local/bin/metering/usbdrivers/ftdi_sio.ko

9. Create the device nodes:
   mknod /dev/ttyUSB0 c 188 0

10. It is now ready: plug in the USB cable attached to the modem. Beware, if there are more USB devices, the insertion order is important: the first cable is attached to ttyUSB0 and the second one to ttyUSB1 and so on.
    Remember the insertion order. The user can still check the connections with the dmesg command.

Note: *The PLM demonstration board consists of the following elements:*

- *A web server: apache*

- *A web site: www.apache directory*

- *A local PLM server that can connect to the PLM through virtual UART: server. It is listening on an IP port: the port is fixed in the client application. 12000 is used by the DLMS demonstration board set.*

- *A client application connects to the server through local host (127.0.0.1), and allows communication with the PLM. They are used by the CGI scripts of the web pages.*

11. Start the web server: make sure that ALL the directory structures from/to /usr/wwwapache have the +x rights.
    /usr/bin/apache/bin/apachectl -k start

12. Start the PLM servers:
    ifconfig lo 127.0.0.1 up
    export LD_LIBRARY_PATH=/usr/local/libs:/usr/apache/lib
    /usr/local/bin/metering/server 12000 /dev/ttyUSB0 &
    Remember where the USB cables are attached, to use the correct ttyUSB on the command line!

13. Check the correct behavior of the clients:
    /usr/wwwapache/cgi-bin/getdatacosem 1

14. The demonstration board should run. Once an E-meter is found, the following screen information should be shown (see *Figure 9*).

Figure 9. EVALSPEAr320HMI - board running, screen capture

For additional information about the SPEAr and all the tools, please refer to *Section 2: References*.

1.5.3 Web interface

Even though a lot of data may be seen on the display of the EVALSPEAr320HMI board, the web access to the data was prepared in order to view and access the data easily and more remotely.

The network parameters of the EVALSPEAr320HMI set in the previous chapter are:

IP: 192.168.100.250

MASK: 255.255.255.0

GW: 192.168.100.252

Interconnect the SPEAr board with the computer via an Ethernet cable and apply the following settings:

IP: 192.168.100.200

MASK: 255.255.255.0

GW: 192.168.100.250

In the case of connection with an Ethernet router, the following settings must be applied:
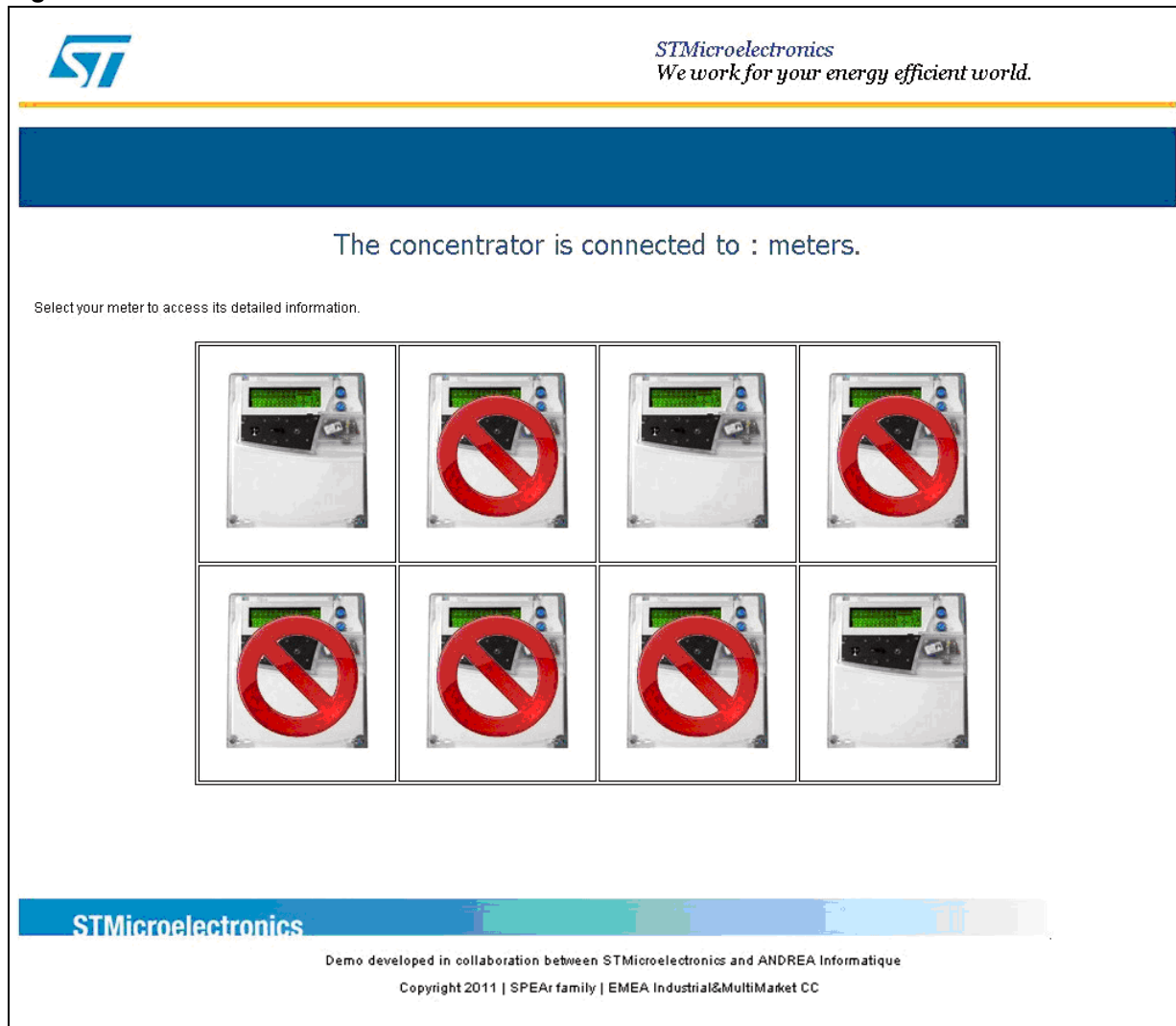
IP: 192.168.100.252

MASK: 255.255.255.0

If the user would like to access the concentrator pages now, write the following address to a web browser:

www:192.168.100.250/

After that, the screen depicted in *Figure 10* should appear (in this case three meters are connected).

Figure 10. User interface - evidence of the connected E-meters

Clicking on one of the meters that is active (no red sign in front of the image of the meter) shows detailed information about the meter status, as depicted in *Figure 11*.

Figure 11. User interface - detailed information about the chosen E-meter
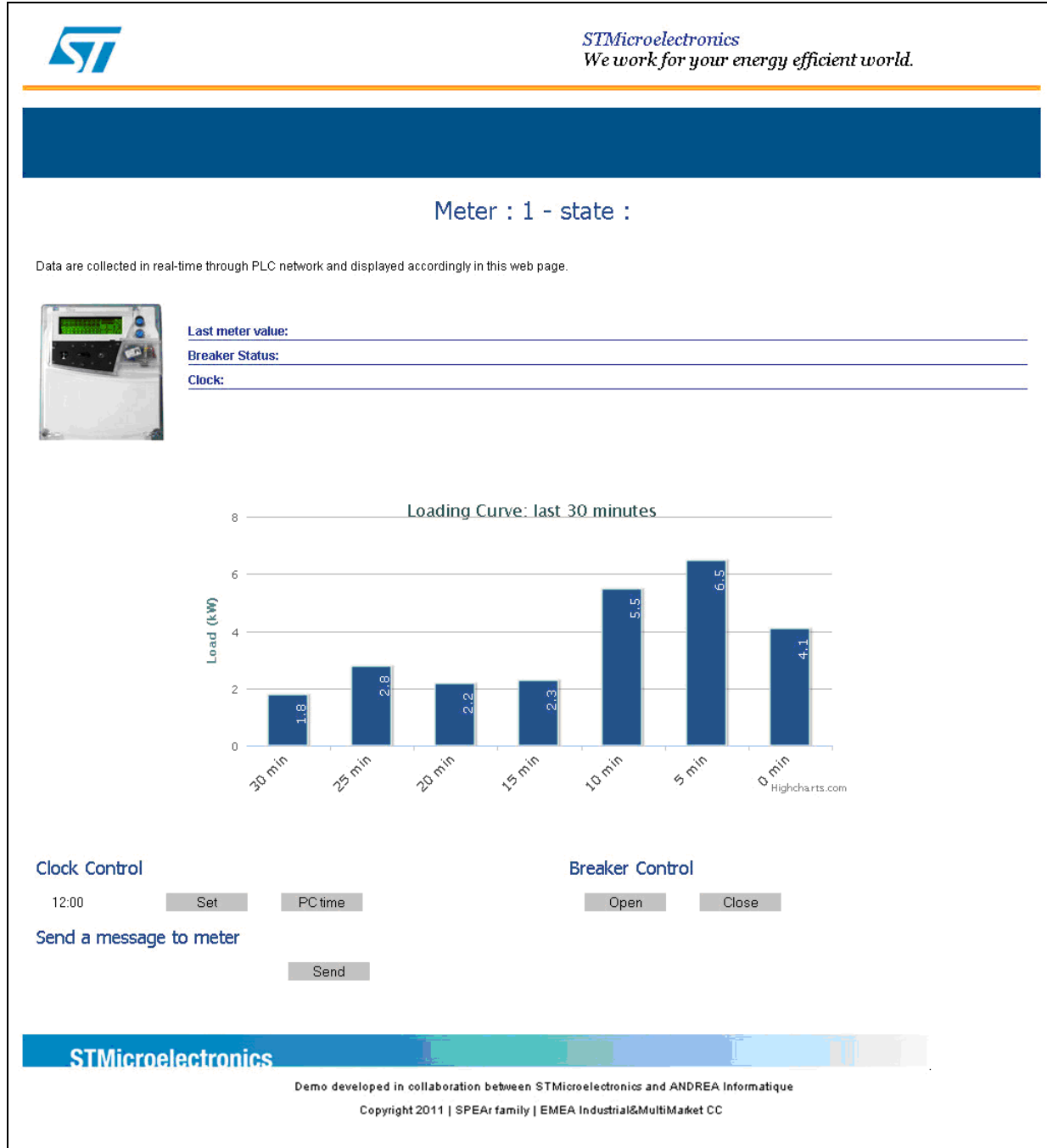
Clicking on the action buttons (Breaker Control: Open, Close, for example) performs the requested action.

1.5.4 Real hardware demonstration setup

The complete application according to the block diagram depicted in *Figure 2 on page 5* can be seen in *Figure 12* and *Figure 13*.
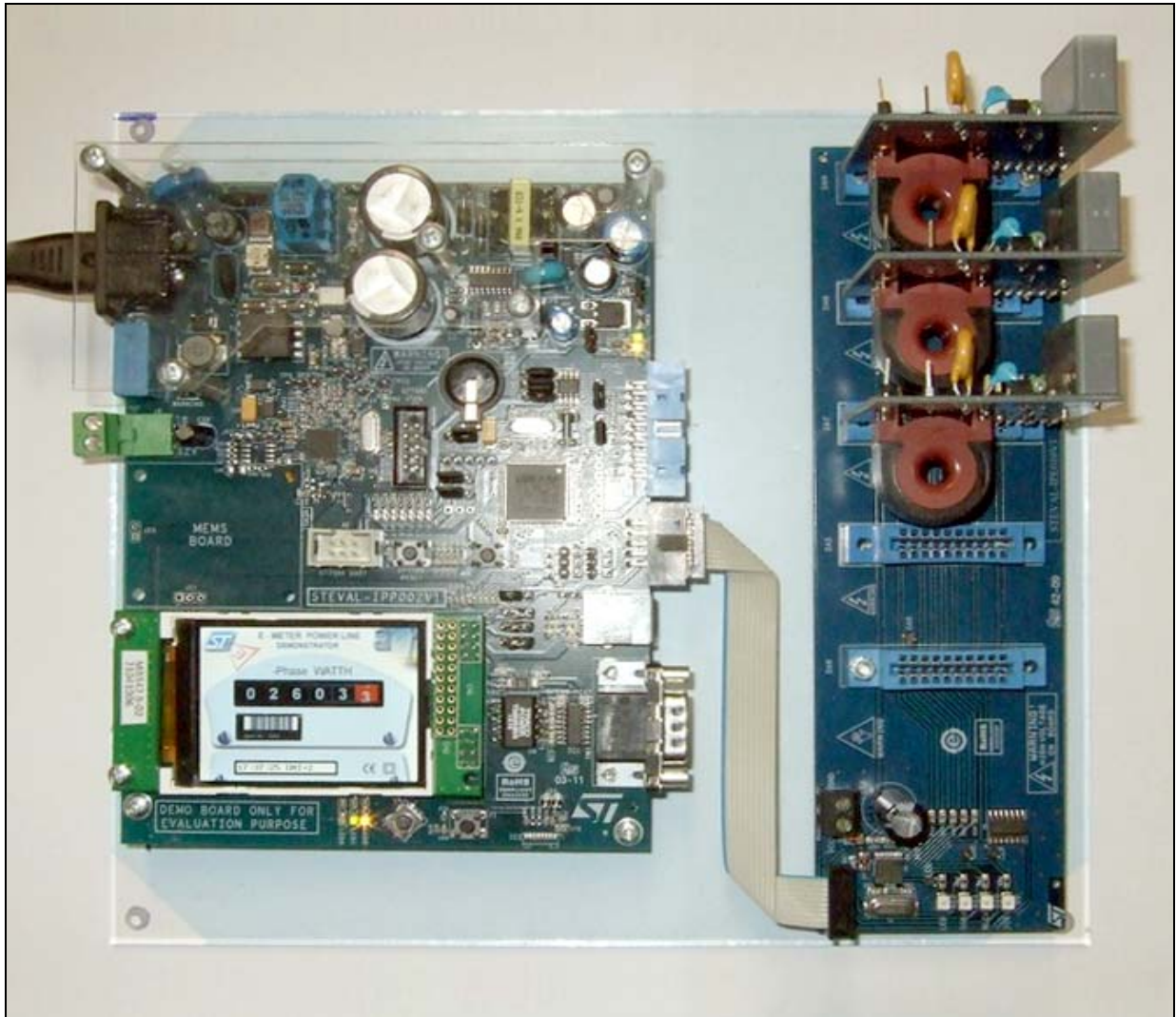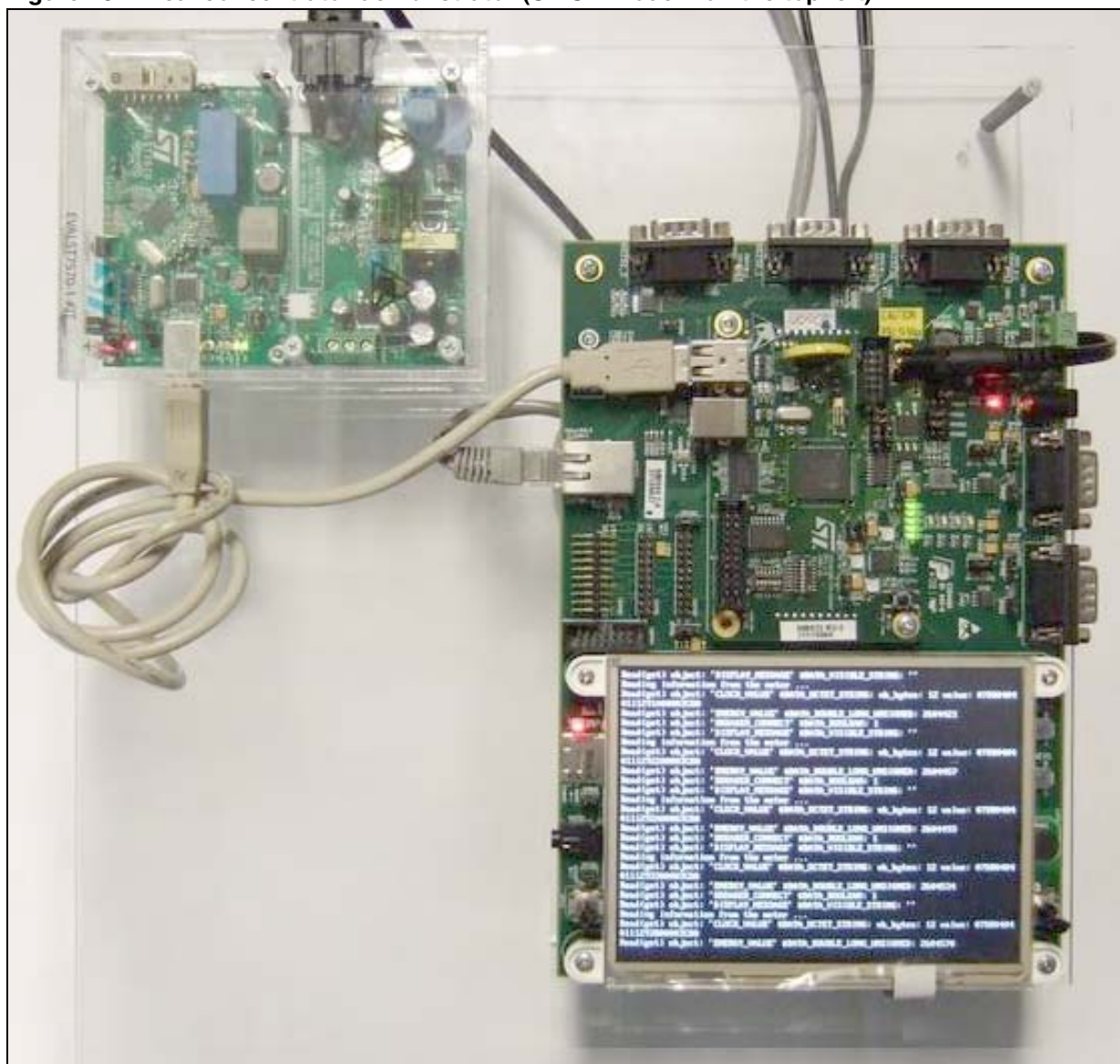
Figure 12. Real E-meter demonstrator

Figure 13.   Real concentrator demonstrator (S-FSK modem on the top left)

2 References

- DLMS:
  - www.dlms.com
- ANDREA Informatique (DLMS/COSEM libraries)
  - www.andrea.fr
- EVALSPEAr320HMI:
  - User manual UM1045 EVALSPEAr320HMI SPEAr320 board for HMI applications
  - SPEAr:
    www.st.com/internet/mcu/subclass/1156.jsp
  - ST7570:
    - EVALKITST7570-1 data brief
    - AN3213 application note
    - UM1008 user manual
- STEVAL-IPP002V1:
  - STEVAL-IPP002V1 - IEC 61334-5-1 compliant smart meter system for AMI applications based on STM32, ST7570 PLM, and STPMC1/STPMS1 chipset
  - FreeRTOS:
    www.freertos.org
  - STM23F10xxx:
    - STM32F10xxx datasheets
    - STM32F10xxx reference manuals
    - *STM32F10xFWLib 3.1.2*
  - Metering:
    - UM0746 user manual
    - STPMC1 datasheet
- Product information
  - ST7570, refer to www.st.com\powerline
  - STM32, refer to www.st.com/mcu
  - STPMxx, refer to www.st.com\metering
  - ALTAIR, refer to www.st.com\metering.

3 Acronyms

Table 1. List of acronyms

Abbreviation	Description
PLM	Power line modem
PLC	Power line communication
FSK	Frequency shift keying
S-FSK	Spread FSK
HMI	Human machine interface
STPMC1	ST power meter calculator type 1
STPMS2	STPM sensor type 2
DVP	Digital visualization panel
DLMS	Device language message specification
COSEM	Companion specification for energy metering

4 Revision history

Table 2. Document revision history

Date	Revision	Changes
30-Jul-2012	1	Initial release.

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