UM1747
User manual

Getting started with STEVAL-IME002Vx graphical user interface

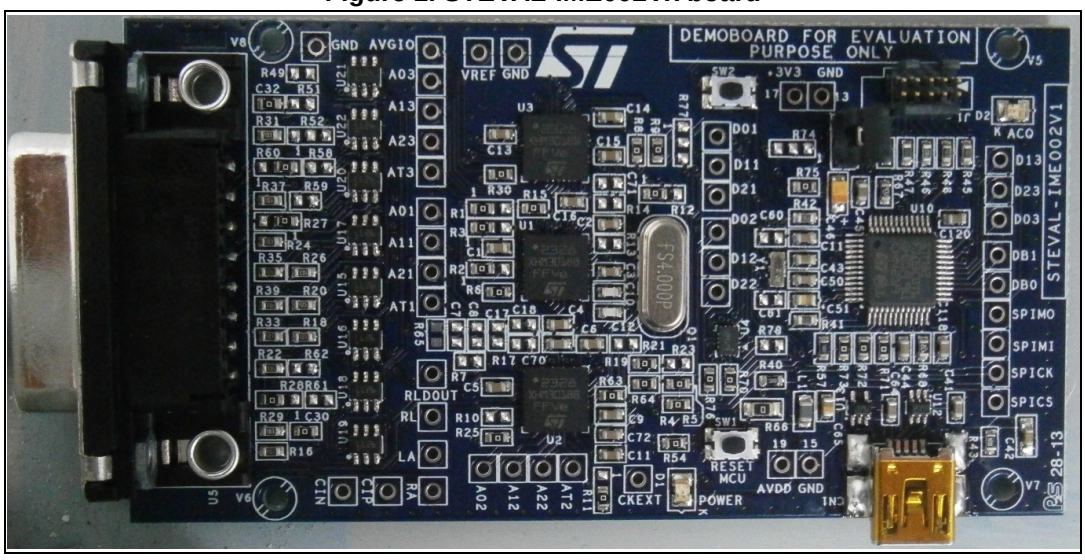
Introduction

This document describes the graphical user interface for the STEVAL-IME002Vx evaluation boards. There are two evaluation boards in the family: STEVAL-IME002V1 and STEVAL-IME002V2, designed to demonstrate the use of HM301D in multi-lead electrocardiogram (ECG) and single lead automated external defibrillator (AED) configurations respectively.

The graphical user interface described here is called the EDEN application.

Warning: **These boards must be used in laboratories and development environments. This product must be never be connected to a human body.**

Figure 1. STEVAL-IME002Vx board



Contents

1 Getting started

1.1 Package contents

After installation, the following items are found in the “Program Files” subfolder:

\STMicroelectronics\Eden application

(the exact folder name may be different on your computer)

This folder contains:

- The Eden.exe application and associated files.
- A subfolder with the STEVAL-IME002Vx board drivers for 32- or 64-bit Windows OS (x86 and x64 folders respectively).
- The STM32F103 firmware package subfolder.
- The Restrib subfolder with a Software Development Kit for advanced users to write their own PC applications.

1.2 EDEN installation

Run EDEN_Application_1.x.y_date.exe: the setup Wizard guides you through the installation of the EDEN application, the USB virtual com device drivers and the Firmware Package source code on your computer. Once installation has completed successfully, click the “Finish” button. You can then explore the full package contents (described in *Section 1.1*).

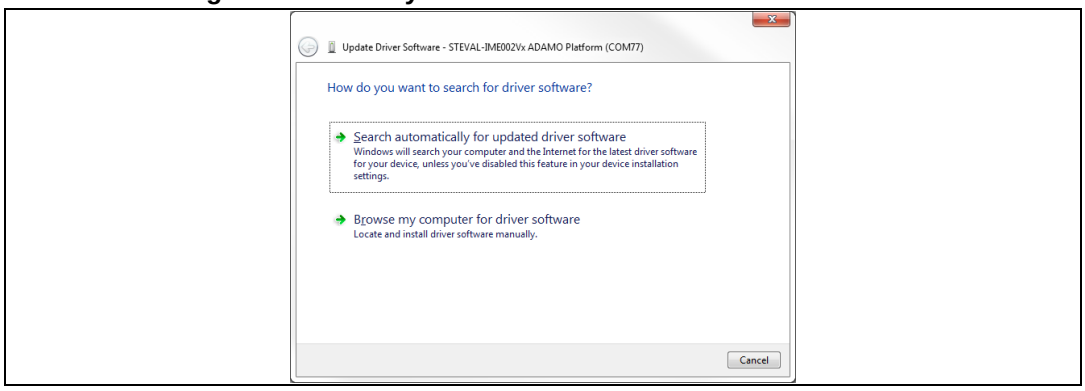
1.3 STEVAL-IME002Vx driver installation

As soon as the STEVAL-IME00Vx board is connected to a USB port on your PC, the “found new hardware wizard” starts, see *Figure 2*. Click the “Next” button.

Figure 2. device driver installation wizard

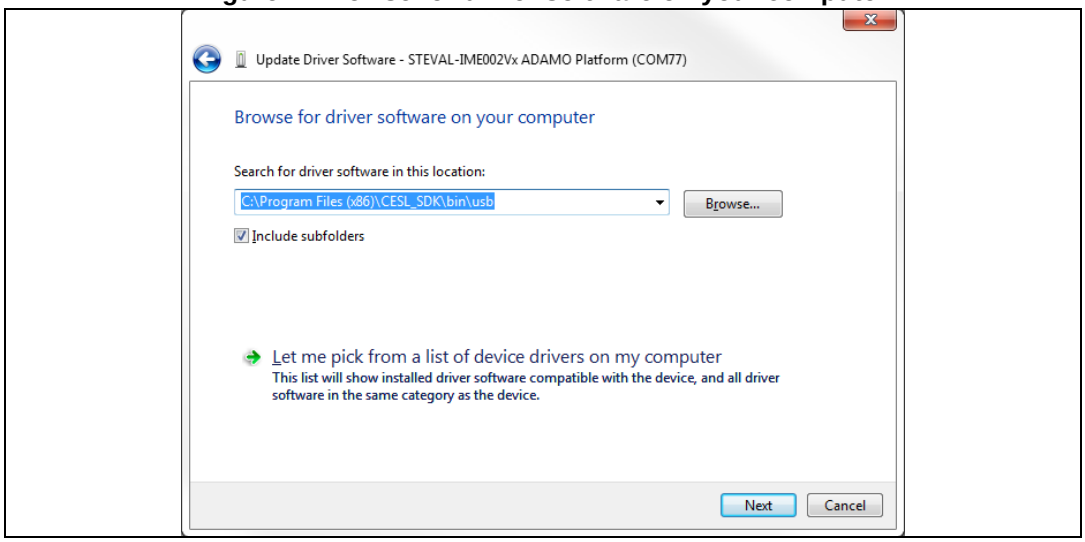
Select “Browse my computer for driver software” as shown in *Figure 3*.

Figure 3. How do you want to search for driver software?



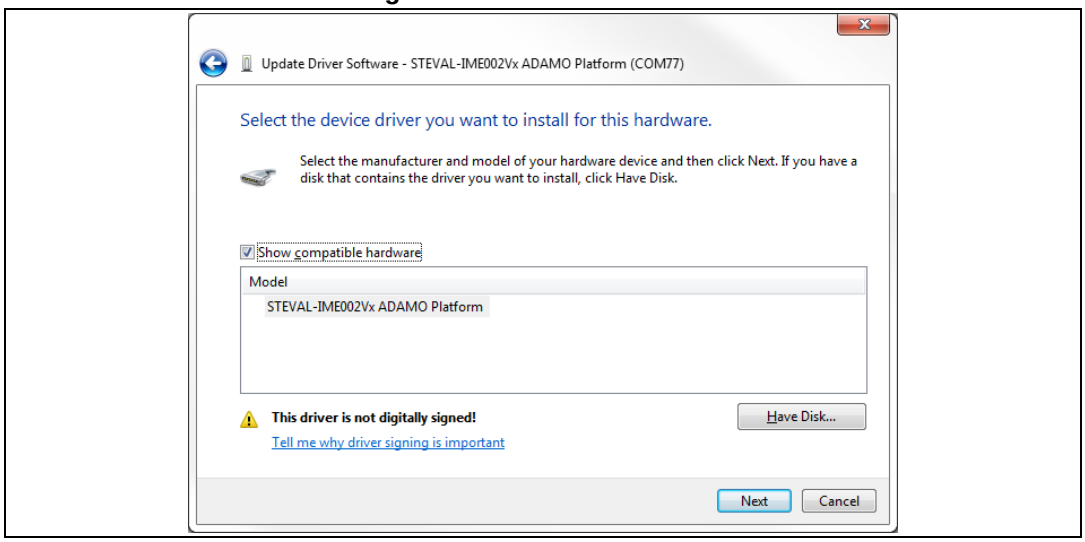
On next page, select “Let me pick from a list of device drivers on my computer” as per *Figure 4*.

Figure 4. Browse for driver software on your computer



If you followed the steps in *Section 1.2*, you will already have the board driver installed on your PC and the “STEVAL-IME002Vx ADAMO Platform” driver will appear in the list of drivers (see *Figure 5*). Select it and click on “Next” button.

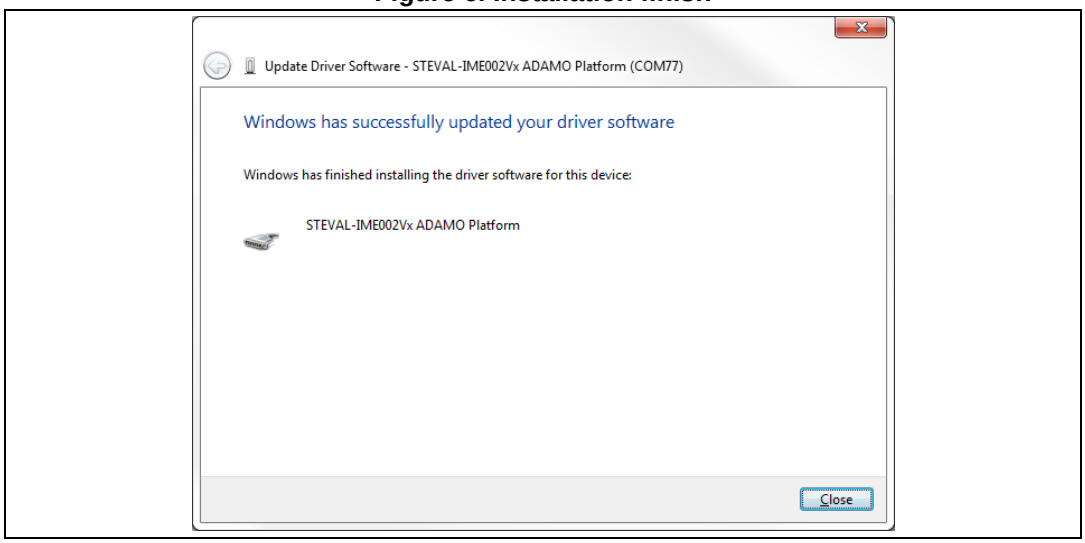
Figure 5. Driver selection list



The PC will automatically select the correct INF file. Before installing the driver, Windows will display a Warning dialog box indicating that the driver has not passed Windows logo testing, click “continue anyway” to continue.

Windows will eventually display a message indicating that the installation was successful. Click “Finish” to complete the installation (see *Figure 6*).

Figure 6. Installation finish



2 EDEN user interface description

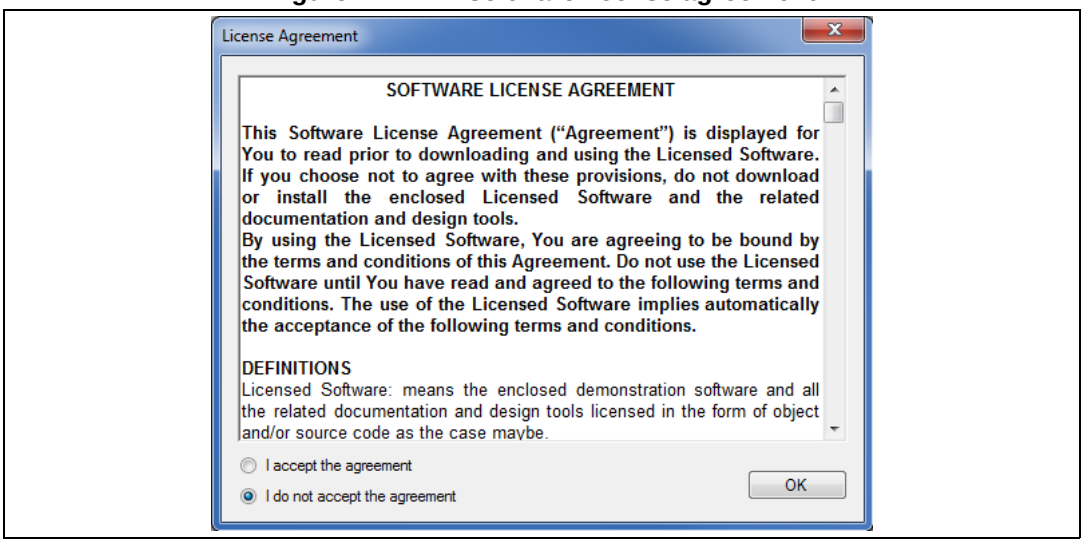
This section describes the user interface and explains how to use it to manage the STEVAL-IME002Vx and the embedded HM301D (diagnostic quality acquisition system for bio-electric sensors and bio-impedance measurements) to demonstrate the use in electrocardiogram (ECG) and automated external defibrillator (AED) configurations.

You can find the EDEN application in:

Start Menu -> All Programs -> STMicroelectronics -> Eden

Accept the software license agreement to start using the graphical user interface, see *Figure 7*.

Figure 7. EDEN software license agreement

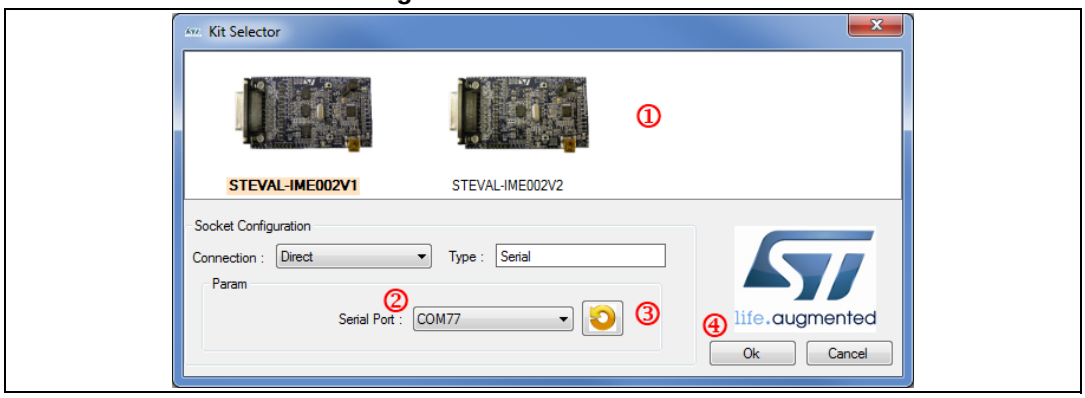


Select the correct evaluation board (*Figure 8*, Control 1):

- STEVAL-IME002V1, Multi lead electrocardiogram (ECG) and body impedance evaluation board
- STEVAL-IME002V2, Single lead electrocardiogram (ECG) and body impedance evaluation board

Then select the serial port from the list (*Figure 8*, Control 2); the GUI usually automatically selects the right port, but the user can click on the icon (*Figure 8*, Control 3) to refresh the serial port. Finally, proceed by clicking the "Ok" button (*Figure 8*, Control 4).

Figure 8. EDEN kit selector



2.1 EDEN main window

The EDEN graphical user interface (*Figure 9*) has a simple and robust design, so you do not need any special training to use it. The circled numbers in *Figure 9* correspond with the descriptions in *Table 1* for the different control areas in the EDEN Application.

Figure 9. EDEN main window

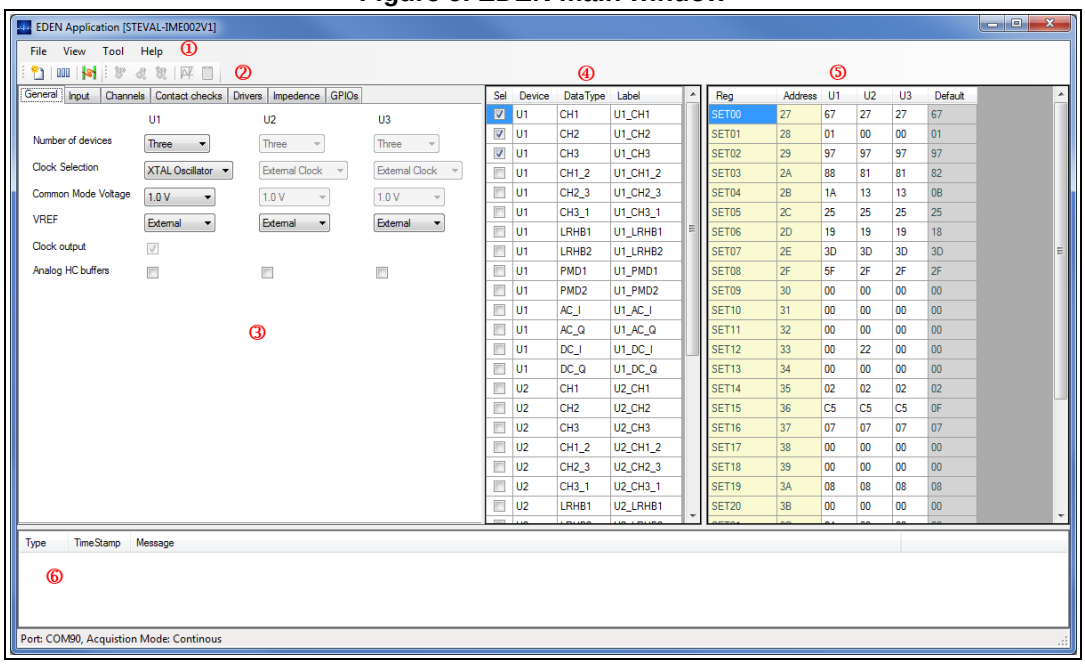


Table 1. EDEN main window description

Control	Description
1	Menu bar
2	Toolbar
3	Board configuration setting section
4	Plot selection window
5	HM301D register window
6	Message log window

2.1.1 EDEN Menu

This is where you can access the various menu items. Some of the commands accessible from this location have a shortcut in the Toolbar.

The structure of the main menu is:

- File
  - New
  - Load CFG…
  - Save CFG…
  - Save Log…
  - Exit
- View
  - Log bar
  - Device setting
  - Plot window
  - Data log
- Tool
  - Link sensor values
  - Read all registers
  - Write all registers
  - Write and verify registers
  - Communication
    - Connect
    - Trace
    - Firmware upgrade…
- Help
  - Contents
  - About
  - Register list help

File

Provides access to open and save configuration files. These options are similar to other document programs.

New

This allows you to create a new, default project. This command re-opens the kit selector dialog box (see *Figure 8*) to select a new board type or a new connection port.

Note: This command does not restore the default register settings of the HM301D.

Load CFG…

This allows you to open an existing configuration file containing a set of register values for the HM301D mounted on the board.

Note: The register values are not written to the HM301D devices. In fact, the HM301D Register Window shows dark pink colored cells to indicate this.

Save CFG…

This command saves a configuration file with the current register values and workspace settings.

Save Log…

Saves the logged messages (control 6 in *Figure 9*) to a specified file.

Exit

Exits the EDEN application. You will be prompted to save your changes if you have not already done so.

View

These commands change the way the workspace is presented.

Log Bar

Hides/shows the message log window, control 6 in *Figure 9*.

Device setting

Hides/shows the HM301D register window, control 5 in *Figure 9*.

Plot Window

When the board is connected, this command shows the plot window.

Data Log

When board is connected, this command shows the device data log window.

Tool

Contains a set of basic commands to communicate with STEVAL-IME002Vx boards.

Link sensors value

Lock/Unlock the configuration value for each HM301D; this facilitates setting identical register values in the different HM301Ds on the board.

Read all registers

Reads all the HM301D registers and updates the HM301D register window (control 5 in *Figure 9*) with these values.

Write all registers

Writes the data in HM301D register window to all the HM301D registers.

Write and verify registers

Writes to all HM301D registers and subsequently reads them back to check the value of all the writable registers.

Communication

- **Connect.** Connect/disconnect the board from the application.
- **Trace.** Shows a log message dialog with the message returned by the STM32 microcontroller on the board (this features has to be operated by the firmware).
- **Firmware upgrade...** Allows the user to upgrade the firmware from a binary file (.hex).

Help

Provides quick access to help documentation, information about the authors and the board firmware version.

Contents

Shows the online help for the EDEN application

About

Shows a dialog box with information about the connected board, including the firmware version.

Register list help

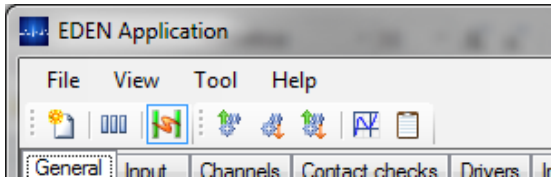
Shows a dialog with the description of all registers and their fields.

2.1.2 EDEN Toolbar

The Toolbar provides shortcuts to the most common EDEN Menu commands, see *Figure 10*. From left to right, the icons represent:

- File -> New
- Tool -> Link sensor values
- Tool -> Read all registers
- Tool -> Write all registers
- Tool -> Write and verify all registers
- View -> Show plot window
- View -> Data log window

Figure 10. EDEN Toolbar



For further information on these commands, please refer to *Section 2.1.1*

2.1.3 Board configuration

Board configuration is the core section of the graphical user interface; it permits you to set all the features of the STEVAL-IME002Vx board and to set the parameters of the HM301Ds on it. For further details on the HM301D settings, refer to the relevant datasheet on www.st.com.

The settings are arranged in different tabs:

- General
- Input
- Channels
- Contact checks
- Drivers
- Impedance
- GPIOs
- Each tab is detailed in the following sub-sections

General tab

This tab offers the basic settings for the STEVAL-IME002Vx board, see *Figure 11*.

- Number of devices: you can choose to use one, two or all the three HM301D devices on the board (not applicable for the STEVAL-IME002V2 board).
- Clock selection: in order to enable a chain of three HM301Ds, you can choose how to propagate the clock from the master to the slave devices; there are three options:
  - Ring oscillator; the propagated clock is generated by the internal oscillator of the master HM301D.
  - XTAL oscillator; the propagated clock is dictated by the external quartz (Q1) on the board.
  - External clock; the propagated clock is generated by an external clock via the CKEXT test pin.
- Common mode voltage: You can select the instrumentation amplifier common mode voltage between
  - 0.7 V
  - 1 V
- VREF: select the internal or external voltage reference.
- Clock Output: enable or disable the clock output from the HM301D master; this option can only be edited on the STEVAL-IME002V2.
- Analog HC buffer: enable the differential to single-ended block of ALL health channels. In this way the analog signal is available at the pins ANAx_OUT (x=[1,2 or 3]) of the HM301D. You can identify these analog pins on the board by the notation indicated in *Table 2*. The output voltage of the differential to single-ended block equals:

$$DIFF2SE\_OUT = \frac{V_{INxP} - V_{INxN}}{2} + V_{REF}$$

where V_{REF} is 0.8V.

Figure 11. General tab

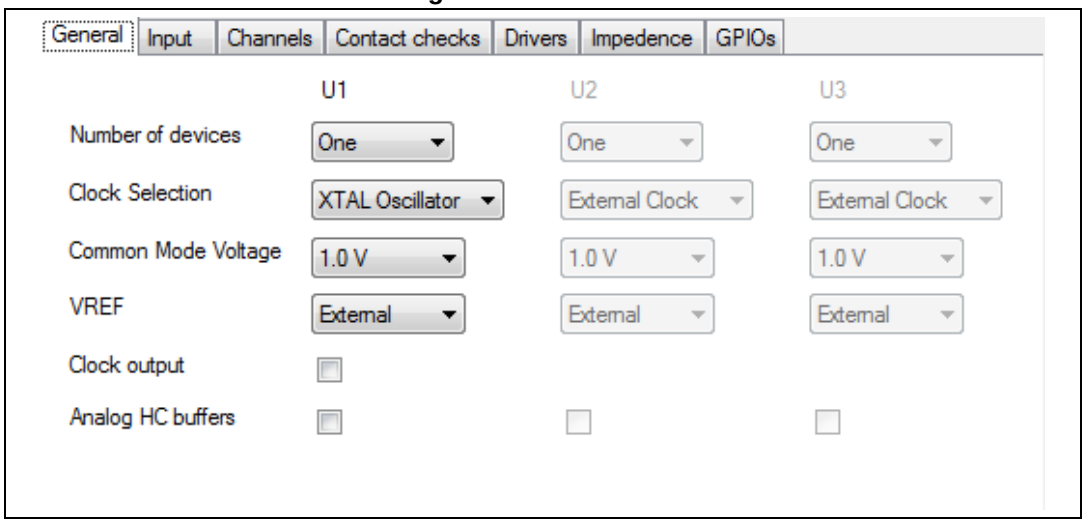


Table 2. HM301D channels analog output and how to identify on the board

Silk screen label	Description
A01	HM301D Master: channel 1 single ended analog output
A11	HM301D Master: channel 2 single ended analog output
A21	HM301D Master: channel 3 single ended analog output
A02	HM301D first Slave: channel 1 single ended analog output
A12	HM301D first Slave: channel 2 single ended analog output
A22	HM301D first Slave: channel 3 single ended analog output
A03	HM301D second Slave: channel 1 single ended analog output
A13	HM301D second Slave: channel 2 single ended analog output
A23	HM301D second Slave: channel 3 single ended analog output

Input tab

This panel (see *Figure 12*) allows the user to:

- configure the front-end MUX for each channel by connecting input pads INxy (x=1,2,3 y=P/N) with health channel inputs.
- connect input AVG buffer[1,2,3] to any of the 6 input pads INxy (x=1,2,3 y=P/N).
- connect the RLD output to any of the inputs pads INxy (x=1,2,3; y=P/N).

Figure 12. Input tab

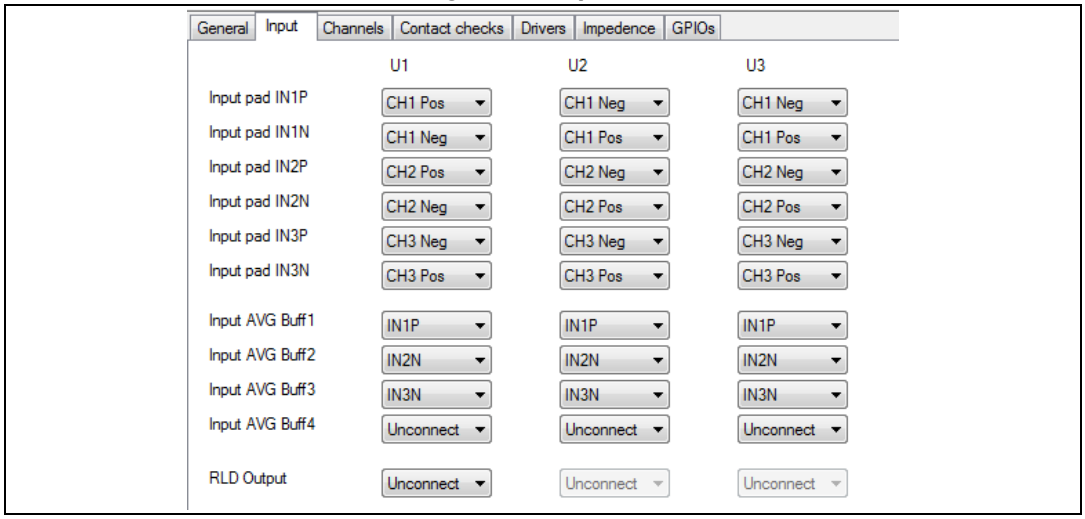


Figure 13. AVG buffers

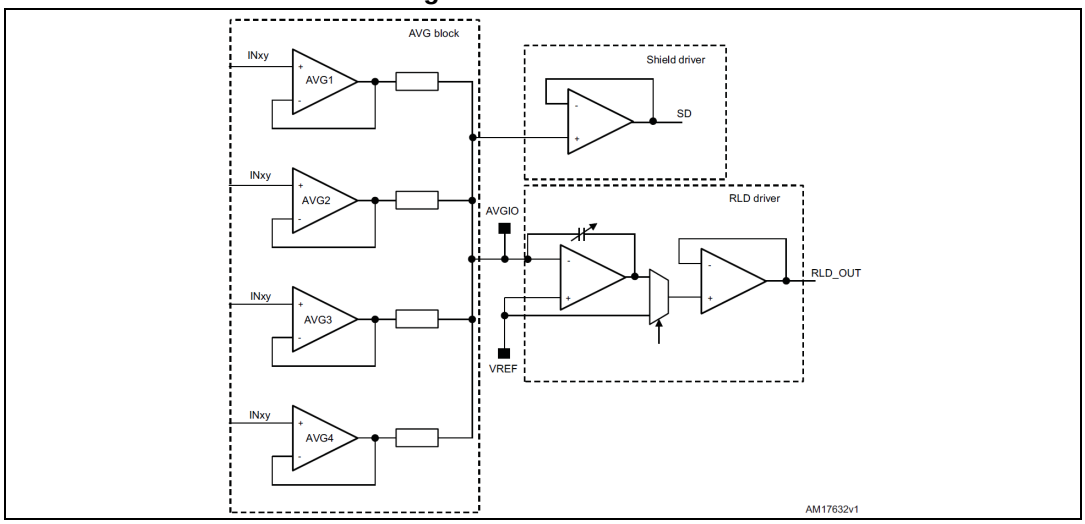


Figure 12 shows an example in which only the AVG buffers produce the average value of IN1P, IN2N and IN3N. The output of the AVG buffers is fed to the shield driver and RLD driver.

Through the RLD output control, we can disconnect the input of the RLD driver from the output of the AVG buffers and connect it to any of the input pads INxN/P (for x=1,2,3).

Channels tab

This panel (see *Figure 14*) allows the user to set up all the parameters of the bio potential channels (see *Figure 15*); each channel can be switched on or off.

The user can:

- Enable/disable digital filtering.
- Set the PGA and INA gain, their respective values can be: 4, 2, 4/3, 1 and 16, 8 to obtain a final gain between 8 and 64.
- Enable the healthcare channels.
- Set the HPF and LPF cutoff frequency for both the ECG (HRLB) and pace maker (LRHB) channels. The HPF is only available when Recovery Mode is ON, while the LPF for LRHB is only available with one HM301D. All the available values are described in *Table 3*.
- Set the fast recovery mode parameters. The first parameter is the overflow mask Time to select the blanking time for overflow detection (in the range 2.5 ÷ 37.5 ms or OFF). The other two parameters select the switching time for the first and second cutoff frequencies (200 ms ÷ 1 s).
- For each healthcare channel, the digital HPF and analog HPF is available when the overflow mask time is OFF. In this case, the user can select the digital and analog HP cutoff frequency for HCx (x= 1, 2 or 3).
- LRHB threshold (0-511); you can select the pacemaker detection threshold by inserting a value in the range 0 ÷ 511. The effects of this setting can be appreciated in the plot window by checking Ux_PMDy (for x=1,2,3 and y=1,2).

Figure 14. Channel tab

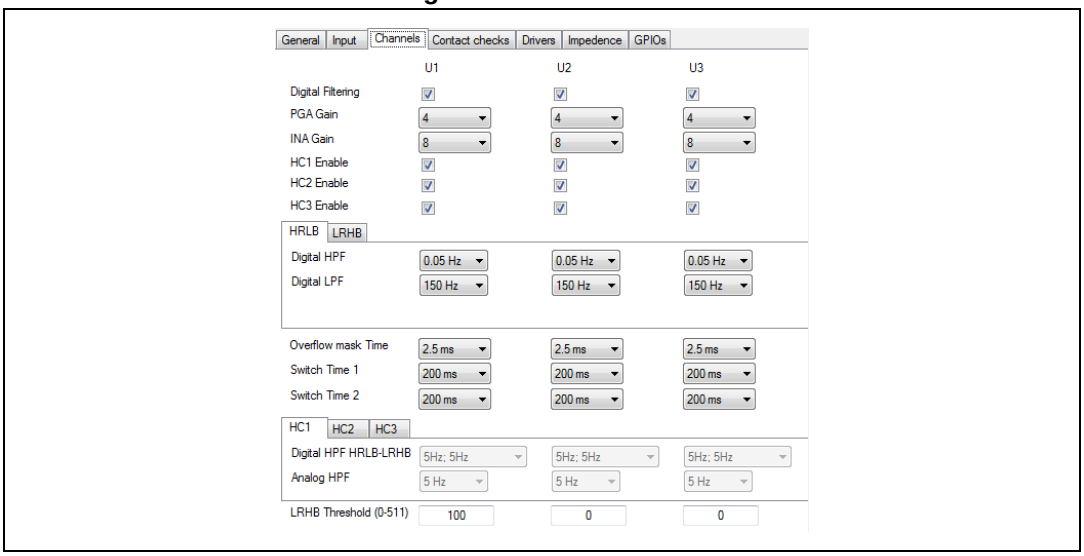


Figure 15. Bio potential channel block schematic

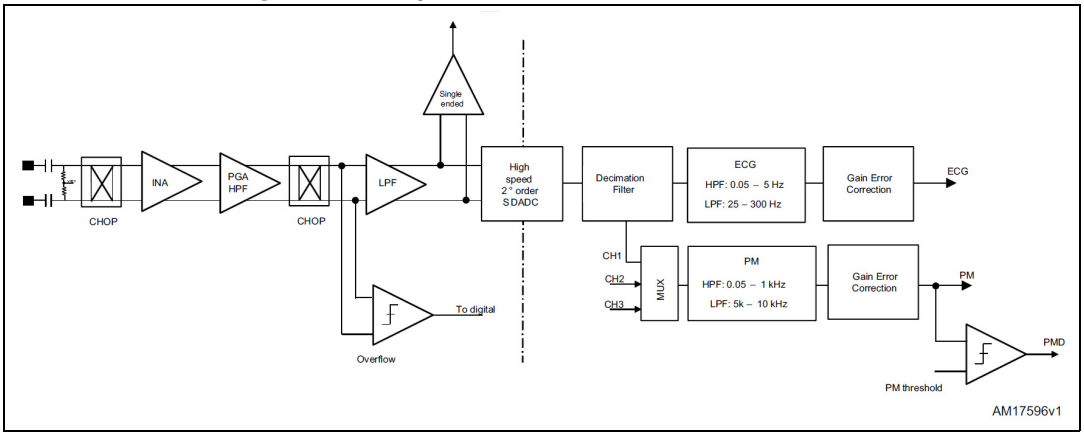


Table 3. HPF and LPF setting for ECG (HRLB) and pace maker (LRHB) channels

High pass filter		Low pass filter	
HRLB	**LRHB**	**HRLB**	**LRHB**
0.05 Hz	0.05 Hz		
0.1 Hz	0.7 Hz	37.5 Hz	10 kHz
0.5 Hz	1 Hz	50 Hz	
0.7 Hz	5 Hz	75 Hz	
1 Hz	1 kHz	100 Hz	
2 Hz		150 Hz	
5 Hz		200 Hz	
		300 Hz	
		600 Hz	

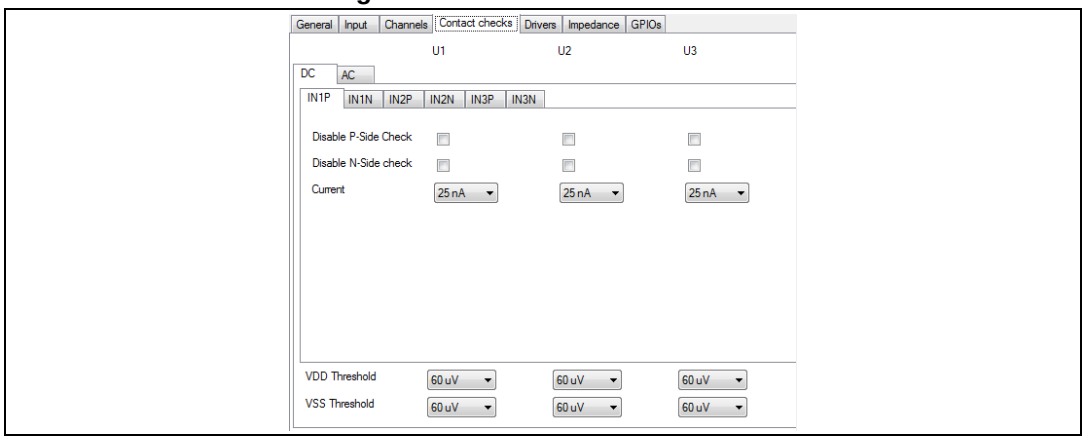
Contact check tab

This panel is organized in two sub-tabs: one dedicated to DC contact checks (see *Figure 16*) and the other dedicated to AC contact checks (*Figure 17*).

In the DC contact checks tab, the user can:

- Disable P-Side and N-Side checks for all the INxy input pads (x=1,2,3 y=P/N) of each HM301D mounted on the board.
- Select the current (25 / 50 / 100 / 200 nA) of each contact check connected to INxy input pads (x=1,2,3 y=P/N).

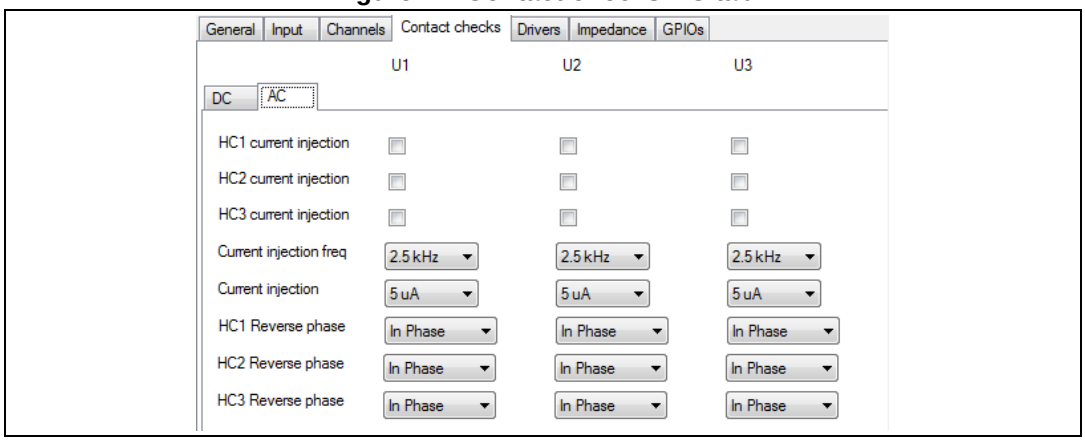
Figure 16. Contact checks DC tab



In the AC contact checks tab, the user can:

- Enable or disable the health channel x (x=1,2 or 3) current injection.
- Select the current injection frequency (2.5 kHz or 5 kHz) for all the health channels of each HM301D.
- Select the current injection value (5 uA, 10 uA or 20 uA) to provide to all health channels.
- Reverse the phase of the injection frequency of the health channels. This is used in unipolar measurements.

Figure 17. Contact checks AC tab

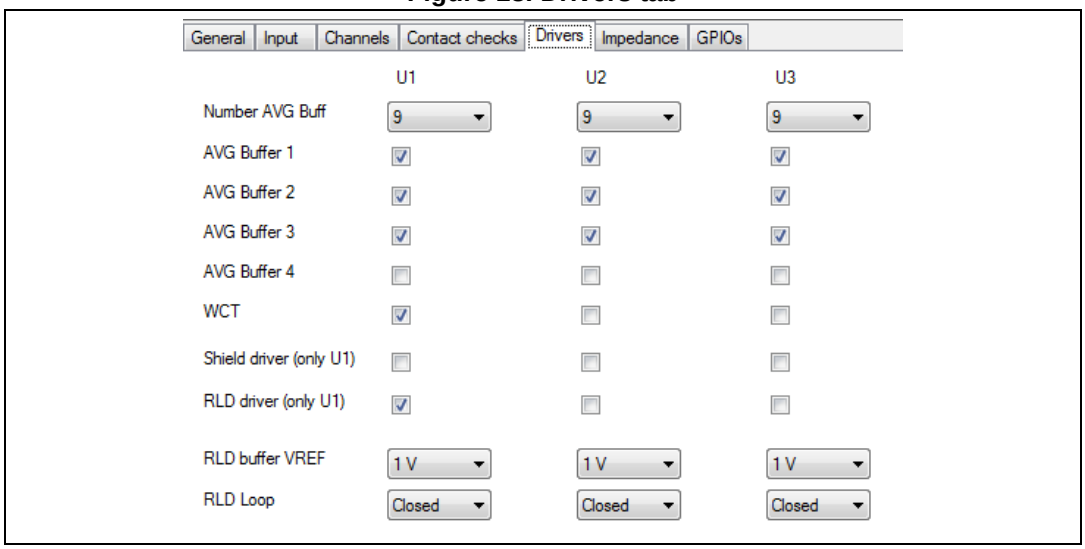


Drivers tab

This panel (see *Figure 18* has all the setting related to the driver section of the HM301D, see also *Figure 13* for reference. It allows the user to:

- Select the number of AVG buffers to be used in the system (0 ÷ 15).
- Enable or disable the single AVG buffers.
- Enable or disable the WCT (wilson common terminal).
- Enable or disable the shield driver.
- Enable or disable the right leg driver (RLD).
- Select the voltage reference for RLD buffer (0.7 V, 1 V or 1.49 V).
- Open or close the RLD Loop.

Figure 18. Drivers tab

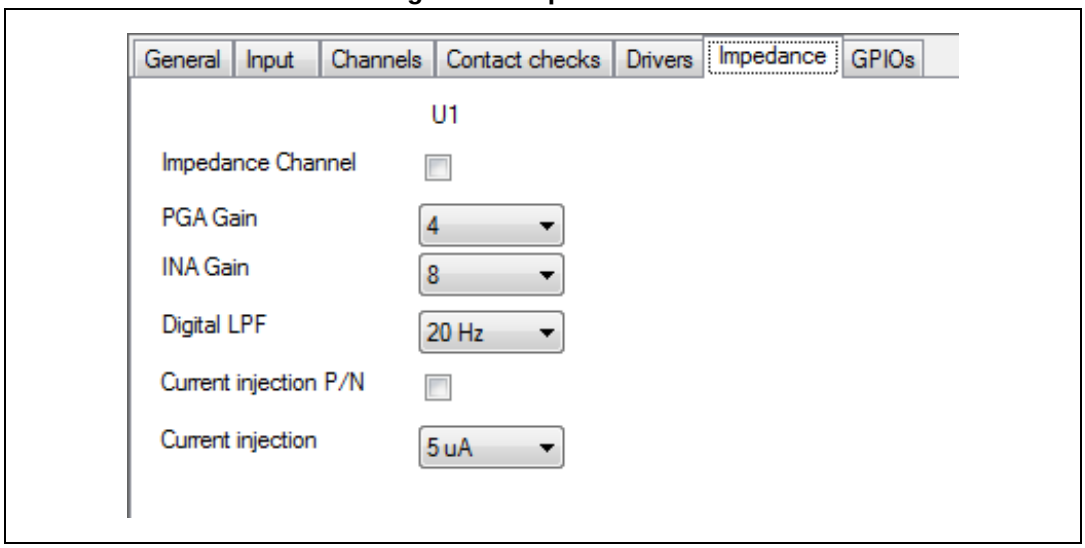


Impedance tab

This panel (see *Figure 19*) collects all the settings related to the impedance channel; it only acts on the first HM301D. The user can:

- Enable or disable the impedance channel.
- Select the PGA and INA gain for the impedance channel, their respective values can be: 4, 2, 4/3, 1 and 16, 8 in order to obtain a final gain between 8 and 64.
- Select the cutoff frequency of the digital LPF (1 and 20 Hz).
- Enable the impedance current injection (CIP and CIN current generators).
- Select the value of the current injection (5 uA, 10 uA or 20 uA).

Figure 19. Impedance tab



GPIOs tab

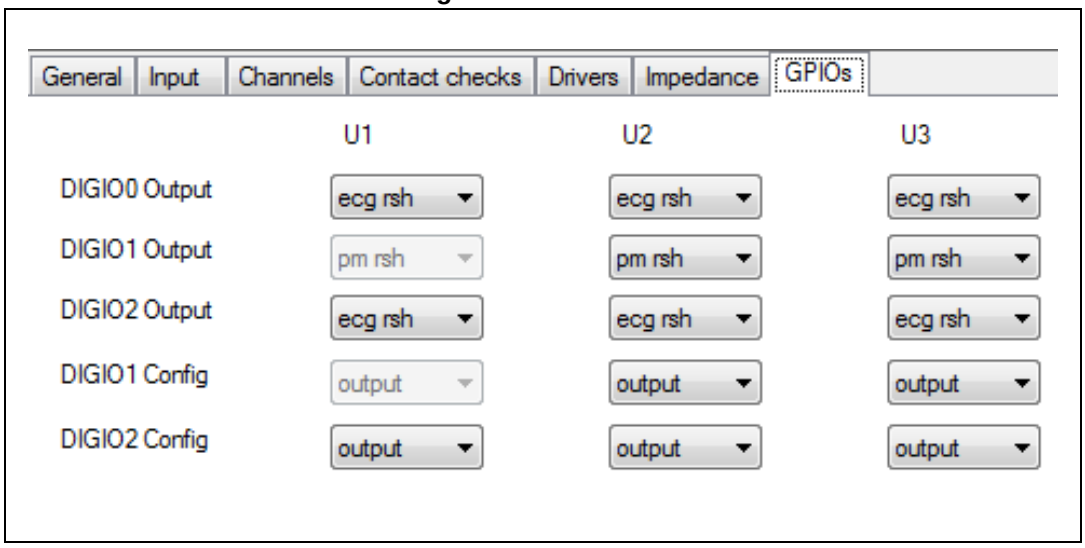
This panel (see *Figure 20*) allows the user to capture the HM301D signals on DGIO pins. It is possible to capture:

- pm_rsh: data refresh of the LRHB signal path inside the HM301D.
- clk: oscillator output.
- PMD1 and PMD2: the output of the signal amplitude detection of the LRHB signal.
- adc_pdmx (for x=1 or 2): first or second bit of the ΔΣ stream of the ADC of the impedance channel.
- fchop: chopping signal for the input amplifiers and the signal for the AC contact check current injection.
- por: power on reset signal.
- ecg_rsh: data refresh of the HRLB signal path inside the HM301D.
- z_rsh: data refresh of the impedance channel.
- prefilt_rsh: data refresh of the pre-filtered signals.
- out_flag_x (for x= 1..6): contact check flags go high when the comparator threshold is crossed.
- hcx_overflow_o (for x=1, 2 or 3): overflow signals of the three acquisition channels.
- imp_overflow_o: overflow signals of the impedance channel.

For further details, please refer to the HM301D datasheet.

Note: The DIGIO1 of the first HM301D is fixed to pm_rsh to synchronize the STM32 readings.

Figure 20. GPIOs tab



2.1.4 Plot selection window

This is where the user can select what to show in the Plot Window. For each HM301D device (named U1, U2 and U3), it is possible to select (see *Figure 21*):

- the bio-potential channels (CHy with y=1, 2 or 3);
- the LRHB channels (LRHB1 and LRHB2);
- the elaborate HRLB channels (CH1_2, CH2_3 and CH3_1):

$$\mathrm{CH1\_2} = \frac{\mathrm{CH1}\_HRLB + \mathrm{CH2}\_HRLB}{2}$$

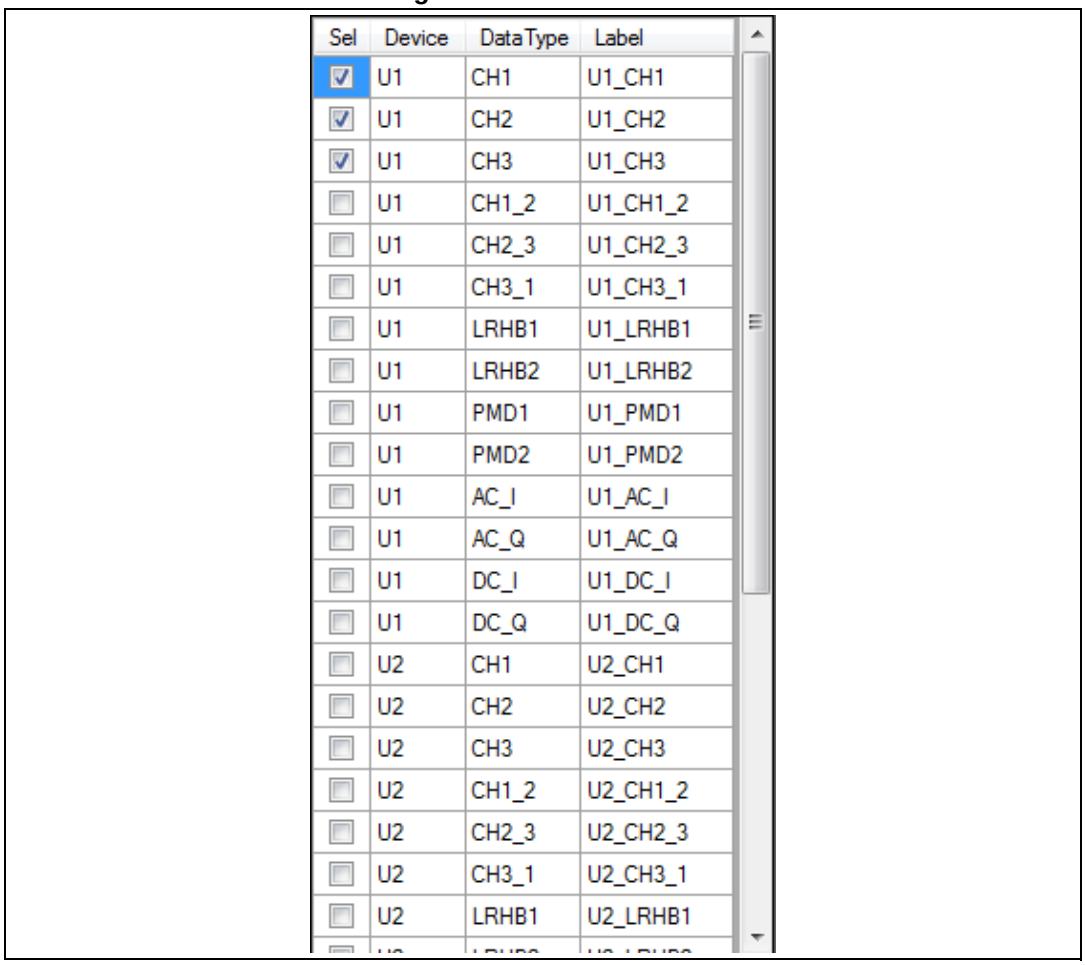
$$\mathrm{CH2\_3} = \frac{\mathrm{CH2}\_HRLB + \mathrm{CH3}\_HRLB}{2}$$

$$\mathbf{CH3\_1} = \frac{\mathbf{CH3}\_\boldsymbol{HRLB} + \mathbf{CH1}\_\boldsymbol{HRLB}}{\mathbf{2}}$$

- the pacemaker detection signals (PMD1 and PMD2);
- the average value and modulated impedance channel outputs as real and imaginary parts.

The user can also edit the Label for each plot simply by double clicking the label rectangle.

Figure 21. Plot selection



It is recommended to not select more than 7-8 plots (depends on PC CPU speed and available memory) because each channel generates significant quantities of data.

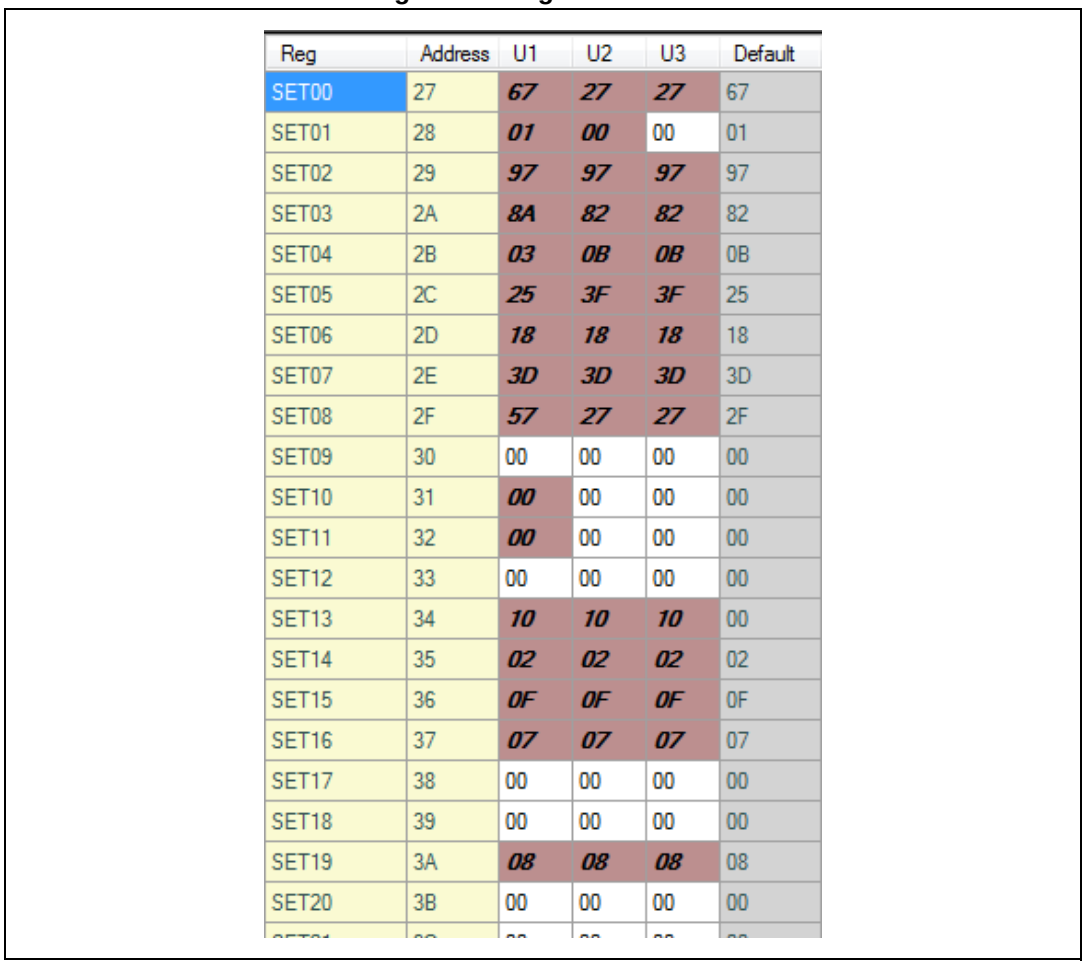
2.1.5 HM301D Register window

This section shows the values of all the internal registers of the HM301D mounted on STEVAL-IME002Vx boards; see *Figure 22* and refer to the HM301D datasheet for further information. This is a read-only area reflecting all the modifications made to the board configuration settings.

For each register, the user can find:

- the address of the register
- its default value
- the actual value; it is shown in dark pink when it is not yet written in the HM301D registers

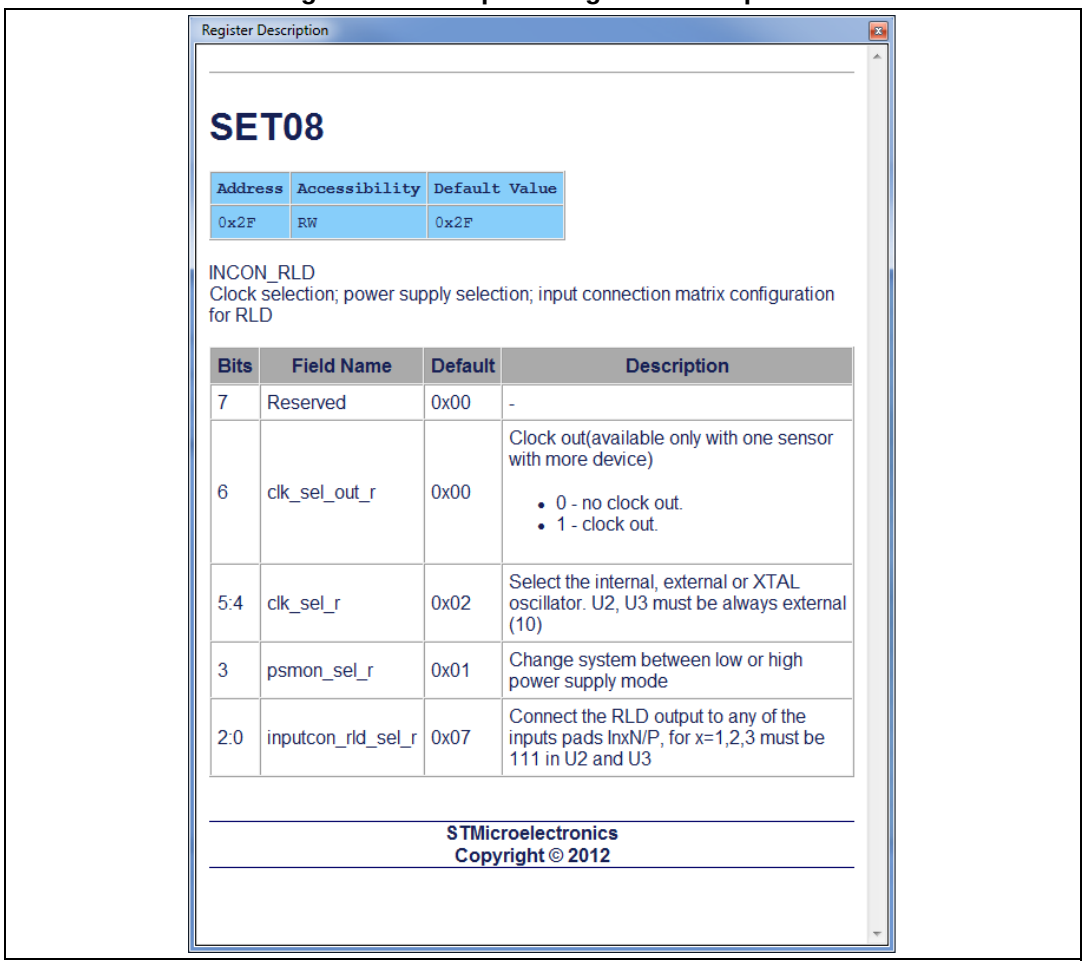
Figure 22. Register window



Reg	Address	U1	U2	U3	Default
SET00	27	67	27	27	67
SET01	28	01	00	00	01
SET02	29	97	97	97	97
SET03	2A	8A	82	82	82
SET04	2B	03	0B	0B	0B
SET05	2C	25	3F	3F	25
SET06	2D	18	18	18	18
SET07	2E	3D	3D	3D	3D
SET08	2F	57	27	27	2F
SET09	30	00	00	00	00
SET10	31	00	00	00	00
SET11	32	00	00	00	00
SET12	33	00	00	00	00
SET13	34	10	10	10	00
SET14	35	02	02	02	02
SET15	36	0F	0F	0F	0F
SET16	37	07	07	07	07
SET17	38	00	00	00	00
SET18	39	00	00	00	00
SET19	3A	08	08	08	08
SET20	3B	00	00	00	00

By double clicking on a single register label, it is possible see the register bit values (see *Figure 23*) with all the related details. Please refer to the HM301D datasheet for further information.

Figure 23. Example of register description



2.2 EDEN plot window

By clicking on the relative icon on the taskbar (see *Figure 10*), the Plot Window appears (see *Figure 24*). The numbers in *Figure 24* refer to the descriptions in *Table 4*, which lists the available control sections in this window.

Figure 24. EDEN plot window

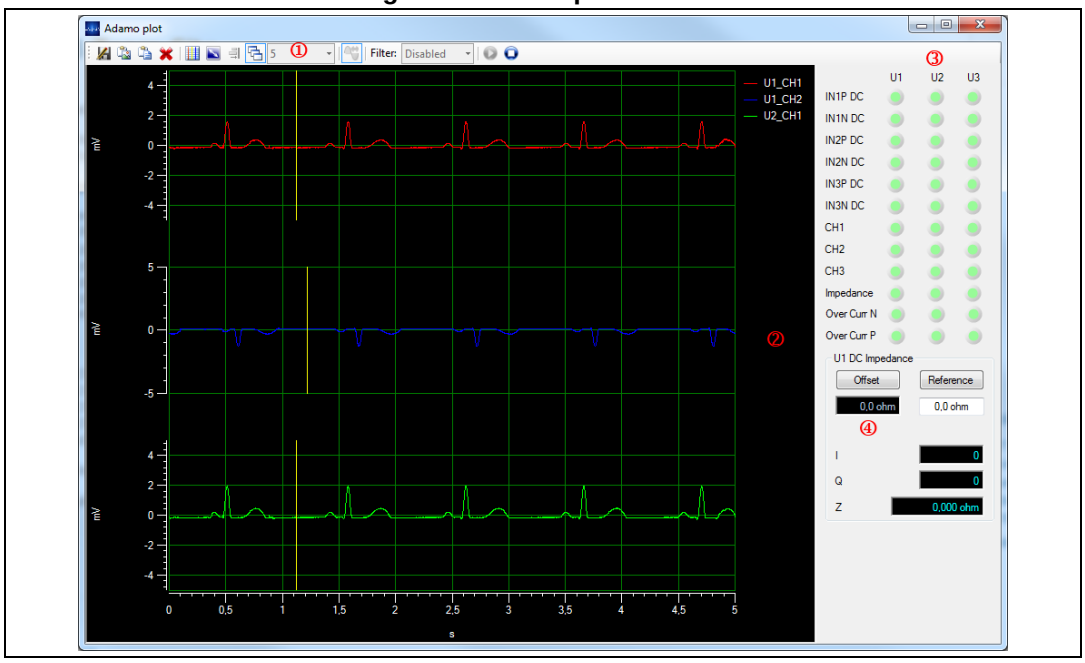


Table 4. plot window parts

Control	Description
1	Toolbar
2	Plot section
3	Output flag section
4	Impedance section

2.2.1 Toolbar in the plot window

Through this toolbar the user can:

- save all the logged data (see *Section 2.3*)
- copy the image to the clipboard
- copy data to the clipboard
- clear the plot
- show or hide the cursors (the cursors function as they would in a traditional oscilloscope); the user can manipulate them to study the X and Y values
- zoom the channel data to fit in the graphical window
- follow channel tracking, this option can be used when trace plot mode is enabled
- enable or disable a 50 or 60 Hz filter on acquired data
- start or stop data acquisition from the board

2.2.2 Plot section window

Here the user can view plots of the data acquired by the HM301Ds for parameters chosen in the plot selection window (see *Figure 21*). The user can manipulate the plot by:

- Zooming the single axis in and out via the left mouse button and the Ctrl button simultaneously.
- Moving the cursors left and right.
- Changing other settings (line width, color, …) in the context menu.

2.2.3 Output flags

Certain HM301D events during operation are signaled by onscreen LEDs on the Plot Window which change from green to red when events occur.

Up to thirty-six different events can be captured by the HM301Ds; for further details see *Table 5* and the HM301D datasheet.

Table 5. Output flags

Label	U1	U2	U3	Description
INxP DC	✓	✓*	✓*	DC contact check for the specific input
INxN DC	✓	✓*	✓*	DC contact check for the specific input
CHx	✓	✓*	✓*	Channel overflow
Impedance	✓	✓*	✓*	Impedance channel overflow
Over Curr N	✓	✓*	✓*	Over current on N input
Over Curr P	✓	✓*	✓*	Over current on P input

*Note: * Available only on STEVAL-IME002V1.*

2.2.4 Impedance section

The impedance channel of HM301D is used to measure the impedance of the body and measure its variation due to respiration.

It is important remember that the HM301D mounted on the STEVAL-IME002Vx board also measures the in-series resistance created by the protection mechanisms and the board itself. It is therefore advisable to use the CIN and CIP test points on the board to evaluate the level of impedance.

The operation of the impedance section is linked to the impedance tab (see *Figure 19*), as the user has to enable the impedance channel through this tab.

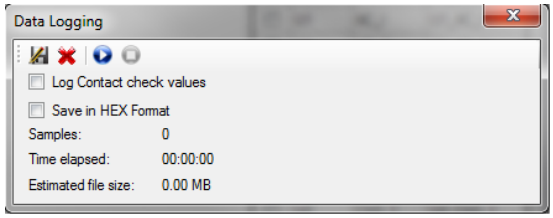
The user can easily set the offset and the reference of the impedance formula by adding some nominal resistances to the board connector and inserting the relative value in the text box of the dialog box.

2.3 EDEN data logging window

In order to permit users to save the acquired data for post-processing and elaboration in other software environments (i.e., Mathworks Matlab), all the selected data can be saved through the data log window in the toolbar (see *Figure 9* and *Figure 10*). Once the dialog box appears (see *Figure 25*), the user can:

- Save the logged data; a filename prompt appears.
- Clear all the logged data.
- Start and stop the data acquisition; this is an alternative to the plot function in order to avoid overloading the PC during this phase.
- Add the contact check values to the saved data (see HM301D datasheet for further details).
- Save the data in HEX format instead of adl (Adamo devices data log), which is an ASCII format file.

Figure 25. EDEN data logging window



Example:

In order to export the AC_I and AC_Q data, the user selects these two components in the plot selection window (*Figure 21*) and then clicks on data log window icon (*Figure 10*); the data logging window will appear as in *Figure 25*. The user then begins acquisition by clicking on the start button.

3 Revision history

Table 6. Document revision history

Date	Revision	Changes
09-Dec-2014	1	Initial release.