UM1614
User manual

STEVAL- IME002Vx demonstration boards based on the HM301D and STM32

Introduction

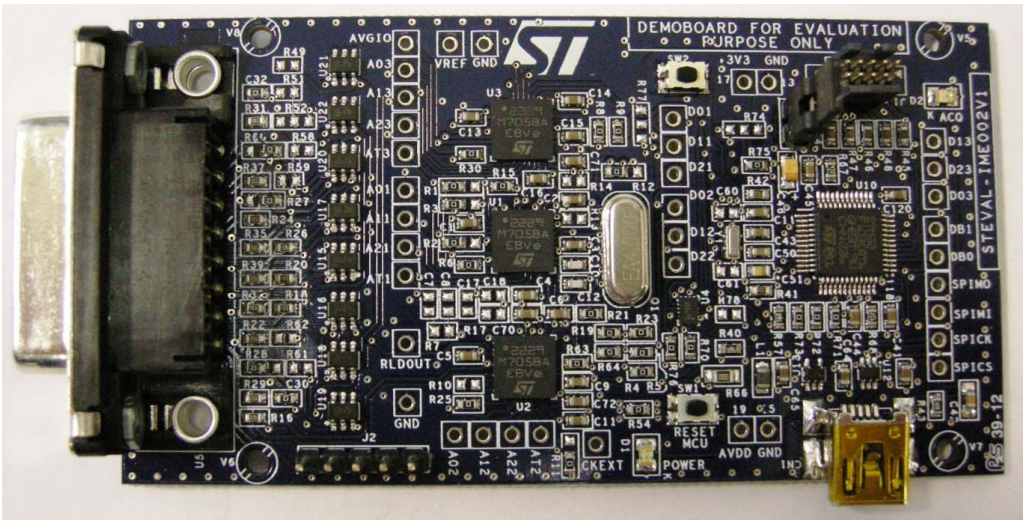
The STEVAL-IME002Vx represent the family of demonstration boards designed around the new HM301D diagnostic quality analog front-end device for bio-electric sensors and bio-impedance measurements.

This family of boards consists of two demonstration boards: STEVAL-IME002V1 and STEVAL-IME002V2 designed to demonstrate the use of the HM301D in, respectively, Electrocardiographs (ECGs) (or patient monitoring systems) and Automated External Defibrillator (AED) configurations.

The boards also host a 32-bit microcontroller of the STM32 family which manages the SPI protocol of the HM301D and the USB communication from/to the PC. Both boards can be easily used with a graphical user interface to demonstrate all the different configurations.

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

Figure 1. STEVAL-IME002Vx board



Contents

1 Overview

1.1 Features

- Two power supply options: USB connector and external power connector
- Up to three HM301D devices: 12-lead ECG with bio-impedance measurement
- STG3692 low-voltage high-bandwidth quad SPDT switch to manage the HM301D SPI
- STM32F103CBT6: low-power high-performance 32-bit microcontroller powered by ARM® Cortex™-M3
- ESDALCL6-2SC6 provides ESD protection with very low capacitance
- USB 2.0 full-speed connection
- SWD/JTAG connector to program the MCU
- 37 debug test points to interact electrically with the ICs mounted on the board
- Reset button
- User LED and pushbutton
- Graphical user interface to manage the HM301D and display data outputs
- Device Firmware Upgrade (DFU) procedure for easy upgrades of the STM32 firmware

1.2 Demonstration software

To facilitate user development and data analysis, the STEVAL-IME002Vx demonstration boards include a graphical user interface to display data outputs, as well as a firmware library for easy development of customized applications. The latest version of the firmware package and PC graphical user interface can be downloaded from the web page:

www.st.com/evalboards

2 Hardware layout and configuration

The STEVAL-IME002Vx demonstration boards have been designed to manage up to three HM301D devices in an SPI daisy chain. On the STEVAL-IME002V1, an STG3692 (low-voltage high-bandwidth quad SPDT switch) manages the switch between the three possible configurations of one, two or three devices entitled U1, U2, and U3 on the board. Only daisy chain configurations are possible, in other words, it is not possible to have U2 and U3 active without U1. The allowable sequences are U1, U1 and U2, U1 and U2 and U3 in this order.

Any HM301D input is protected by an ESD protection device, ESDALCL6-2SC6, compliant with the IEC61000-4-2 level 4 standard.

The hardware block diagram, in *Figure 2*, illustrates the logical connections between all the components on the board, while *Figure 4* shows the placement of components on the board. Specifically, the logic connection between the STM32F103CBT6 peripherals and the HM301Ds is shown in *Figure 3*, where the master of the SPI is the STM32F103CBT6 microcontroller that manages the SPI switch path (through STG3692), closing the SDO signals to the MCU. Further details on the SPI chain will be provided in *Section 2.2.2*.

Figure 2. Block diagram

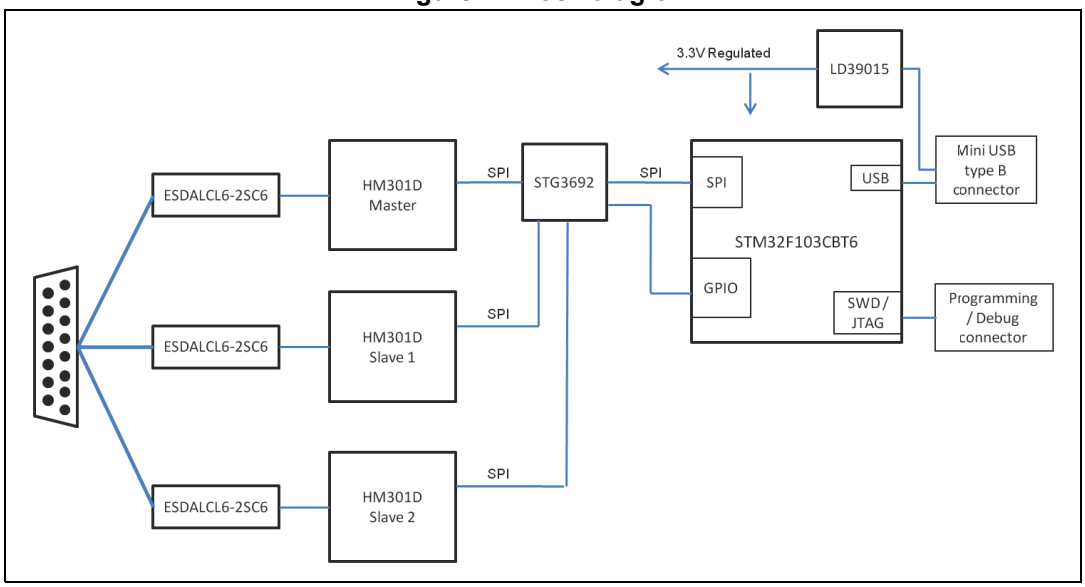


Figure 3. SPI daisy chain

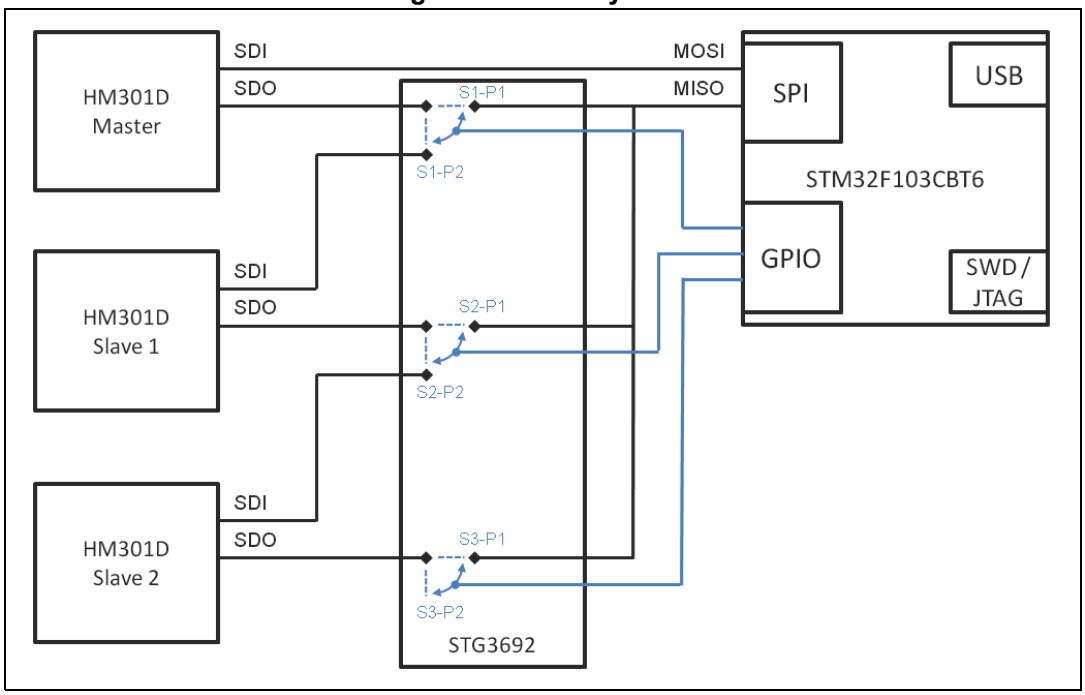
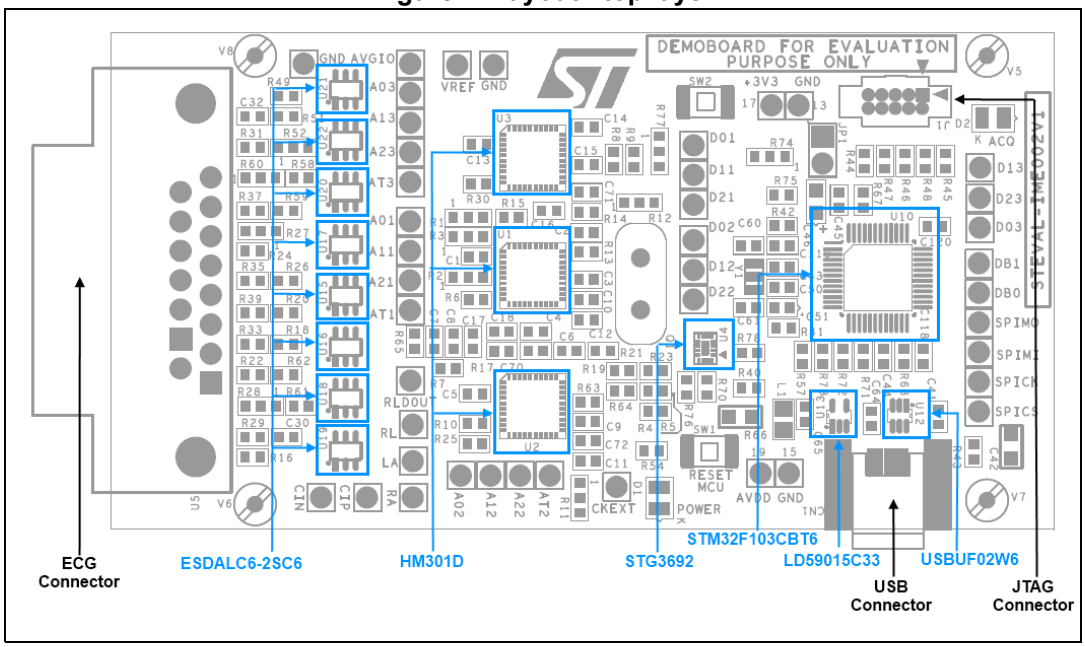


Figure 4. Layout - top layer



2.1 Power supply

The STEVAL-IME002Vx includes a low-noise voltage regulator (LD59015) to provide 3.3 V to the entire board.

The board can be powered by the USB cable, supplying +5 V provided by the PC. No other power supply is needed. When the USB port is connected, the +5 V is automatically supplied to the board and the LED D1 lights up.

The USB port (2.0 full-speed, 12 Mb/s) is protected by U12 (USBUF02W6) which is a monolithic application-specific device dedicated to ESD protection for the USB port. It guarantees compliance with the IEC 61000-4-2 level 4 standard (15 kV air discharge, 8 kV contact discharge).

The user can supply the HM301D by using an external power supply which can be useful to test the HM301D in the range 2.7 - 3.6 V, as indicated in the device datasheet.

In order to do this, two simple steps have to be followed:

1. Remove R66 (see *Figure 5*)
2. Connect the external power supply to AVDD (test pad 19) and GND test points

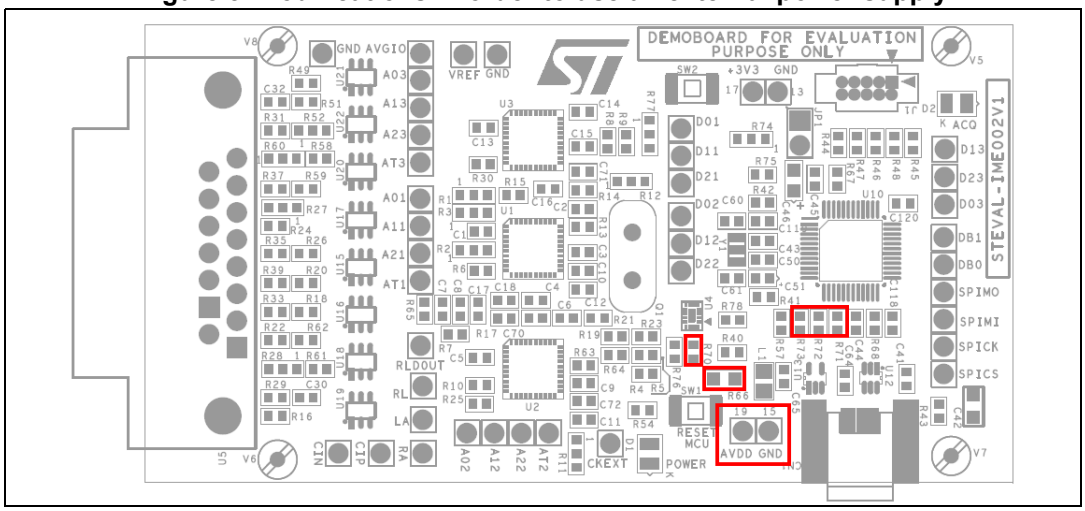
However, the user can test the HM301D over the entire supply voltage range (1.62 - 3.6 V), but without using the STM32 mounted on the board. To bypass the microcontroller, a further step is needed:

3. Remove R70, R71, R72 and R73 (see *Figure 5*)

In this way, the SPI communication channel between the STM32 and HM301D is interrupted and the HM301D devices have to be driven by external signals applied to the test pads 33, 34, 35 and 36.

Warning: The user must verify the voltage polarity as the circuit is not protected in case of reverse polarity applied to these pads (33, 34, 35, and 36).

Figure 5. Modifications in order to use an external power supply



Note: Do NOT use 3.3 V pad (test point 17) to apply an external power supply.

2.2 MCU

The STEVAL-IME002Vx demonstration board hosts an STM32F103CBT6.

This microcontroller is part of the STM32 medium-density device family, generically the STM32F103xx performance line family incorporates the high-performance ARM® Cortex™-M3 32-bit RISC core operating up to 72 MHz, high-speed embedded memories (Flash memory up to 1Mbytes and SRAM up to 80 kbytes), and an extensive range of enhanced I/Os and peripherals connected to two APB buses.

All devices offer three 12-bit ADCs, four general-purpose 16-bit timers plus one PWM timer, as well as standard and advanced communication interfaces: up to two I^2Cs, three SPIs, five USARTs, a USB and an SDIO.

The STM32F103xx performance line family operates from a 2.0 to 3.6 V power supply. It is available in both the -40 to +85 °C temperature range and the -40 to +105 °C extended temperature range. A comprehensive set of power-saving modes allows designing low-power applications.

The complete STM32F103xx performance line family includes devices in 5 different package types: from 36 pins to 100 pins. Please refer to the datasheet and reference manual for details.

The STM32F103CBT6 present on the board is a medium-density member of the STM32F103 product family, it embeds 128 kbyte of Flash and 20 kbyte of SRAM in a small LQFP48 package (7x7 mm).

2.2.1 Reset of MCU

To reset the STM32F103 two sources are available:

- Reset pushbutton SW1
- Debugging tool from SWD/JTAG connector J1

The jumper JP1 enables reset of the STM32F103CBT6 embedded JTAG TAP controller each time a system reset occurs. JP1 connects the TRST signal from the JTAG connection with the system reset signal RESET#. Default setting: not fitted.

2.2.2 SPI daisy chain

The SPI daisy chain illustrated in *Figure 3* is managed by the SPI peripheral of the STM32. To extract the ECG data with the maximum throughput, this peripheral is configured as follows:

- Clock rate at 9 MHz
- Transfer frame format selected at 16-bit
- Data order with MSB first
- Clock polarity set to high
- Clock phase set on second edge
- Reception buffer synchronized with internal DMA

The STM32 also manages the STG3692 switch to select the number of HM301D devices to be connected on the board (only for STEVAL-IME002V1).

The STG3692 pin connections and its internal diagram are depicted in *Figure 6*, the truth table is shown in *Table 1*. The two Selection pins 1-2SEL and 3-4SEL control Switch 1 and 2, and 3 and 4 respectively.

Table 1. Truth table of STG3692

SEL	Switch S1	Switch S2
H	ON	OFF
L	OFF	ON

Figure 6. Pin connections of STG3692

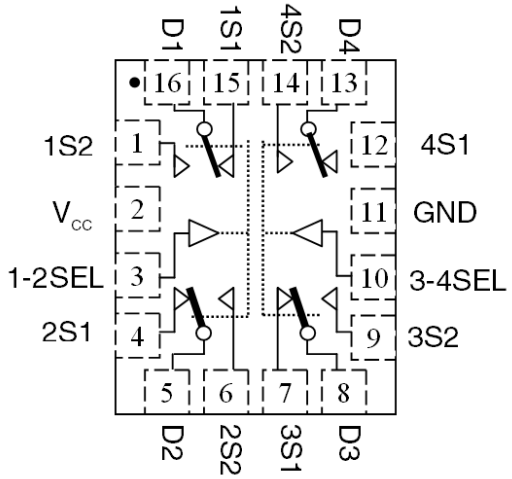


Figure 7 on page 9 illustrates the SPI routing between the STM32 and the HM301D. The SPI MOSI signal is connected directly from the STM32 to the HM301D master, while the SPI MISO is routed through the STG3692 SPDT switch. However, the SPI clock and SPI CS from the microcontroller are connected to the SPC and CS pins of each HM301D device. As in *Figure 7*, on the STEVAL-IME002V1 the four switches enable the three possible configurations: one HM301D, two HM301D (one master and one slave) or three HM301D (one master and two slaves). Only daisy chain configurations are possible. In other words with the three HM301D present on the board (U1, U2 and U3), it is not possible to have U2 and U3 active without U1. The allowed sequences are U1, U1 and U2, U1 and U2 and U3 in this order. Instead, on the STEVAL-IME002V2 only U1 is mounted and it is the only device to be addressed by STM32.

The STM32 selects one device by adopting these commands:

– ADAMO_STG3692_Set_SelectionON(STG3692_12_SEL)
– ADAMO_STG3692_Set_SelectionOFF(STG3692_34_SEL)

since it sets the 1-2SEL pin and resets the 3-4SEL. In this way, SDO of the HM301D master is connected to MISO of the STM32 and SDO of the HM301D slaves are inactive.

Otherwise, the STM32 selects two devices by adopting these commands:

– ADAMO_STG3692_Set_SelectionOFF(STG3692_12_SEL);
– ADAMO_STG3692_Set_SelectionON(STG3692_34_SEL);

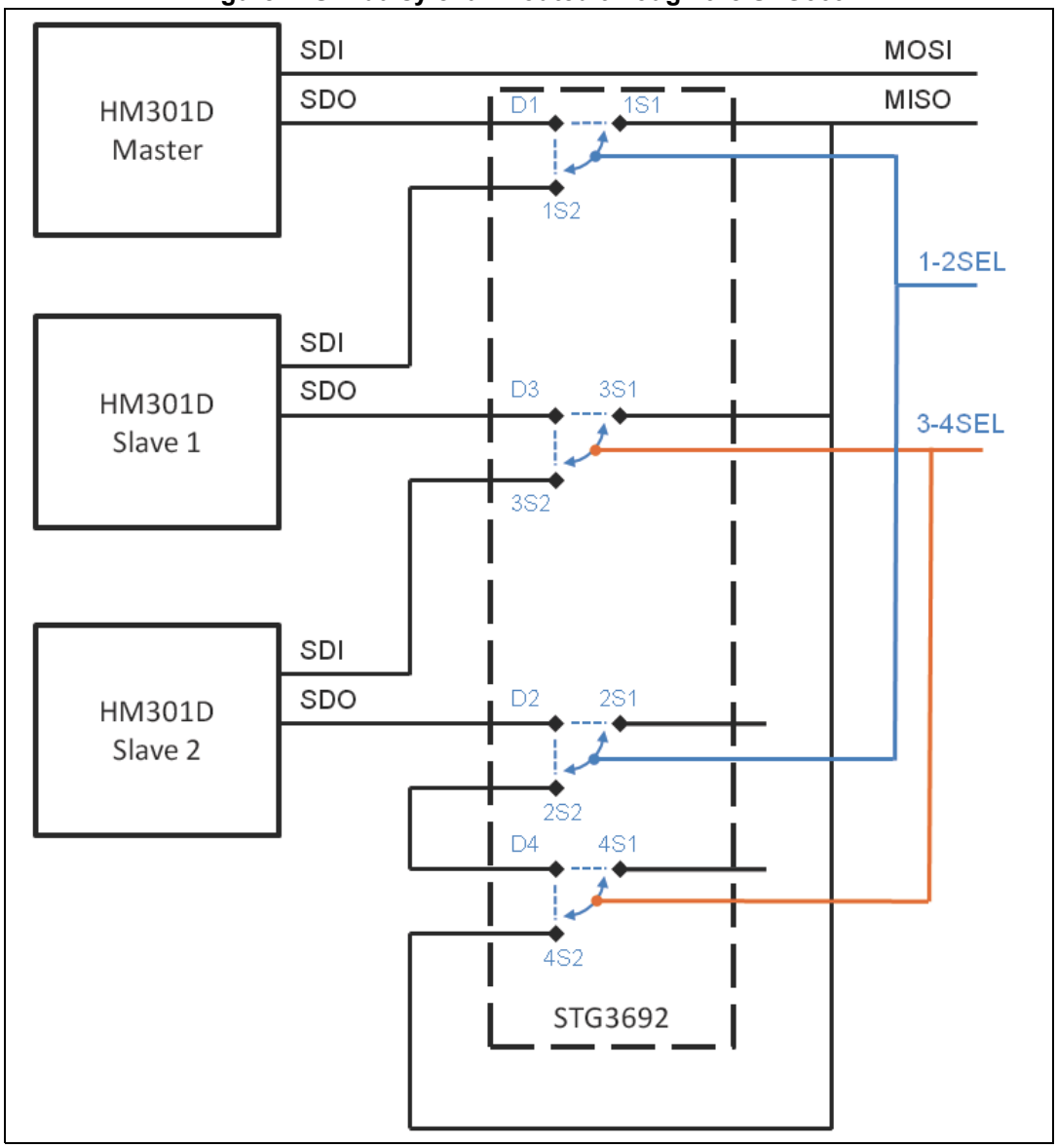
since it resets the 1-2SEL pin and sets the 3-4SEL. In this way, the SDO of the HM301D master is connected to the SDI of the first HM301D Slave and, its SDO is connected to the MISO of the STM32. HM301D Slave 2 is inactive.

Finally, the STM32 selects three devices by adopting these commands:

– ADAMO_STG3692_Set_SelectionOFF(STG3692_12_SEL);
– ADAMO_STG3692_Set_SelectionOFF(STG3692_34_SEL);

since it resets both the 1-2SEL and the 3-4SEL. In this way, the SDO of the HM301D master is connected to the SDI of the first HM301D slave, its SDO is connected to SDI of the second HM301D slave and, the latter SDI is connected to the MISO of the STM32.

Figure 7. SPI daisy chain routed through the STG3692



2.3 Electrodes connector and protection

The STEVAL-IME002Vx board can be connected to a Patient Simulator by using its standard female D-SUB 15 connector. The user can adopt the recommended ECG cable indicated in *Appendix CAppendix C*.

The schematic of the connection of the electrodes with the HM301Ds is illustrated in *Figure 8* and *9*. *Figure 8* shows the schematic of the ECG connector and filter while *Figure 9* shows the ESD protection. The 10 kohm series resistor limits the current flowing to the ESDALCL6-2SC6 in case of defibrillator discharge. However, the 10 kohm resistors are not sized to sustain a defibrillator shock, but their presence allows testing the performance of the HM301D as if it were protected equipment. After the resistors, the entire tracks are protected by a series of ESDALC6-2SC6 (U15, U16, U17, U18, U19, U20, U21 and U22). The ESD protection devices used are compliant with the IEC 61000-4-2 level 4 standard (15 kV air discharge, 8 kV contact discharge).

Figure 8. ECG connectors

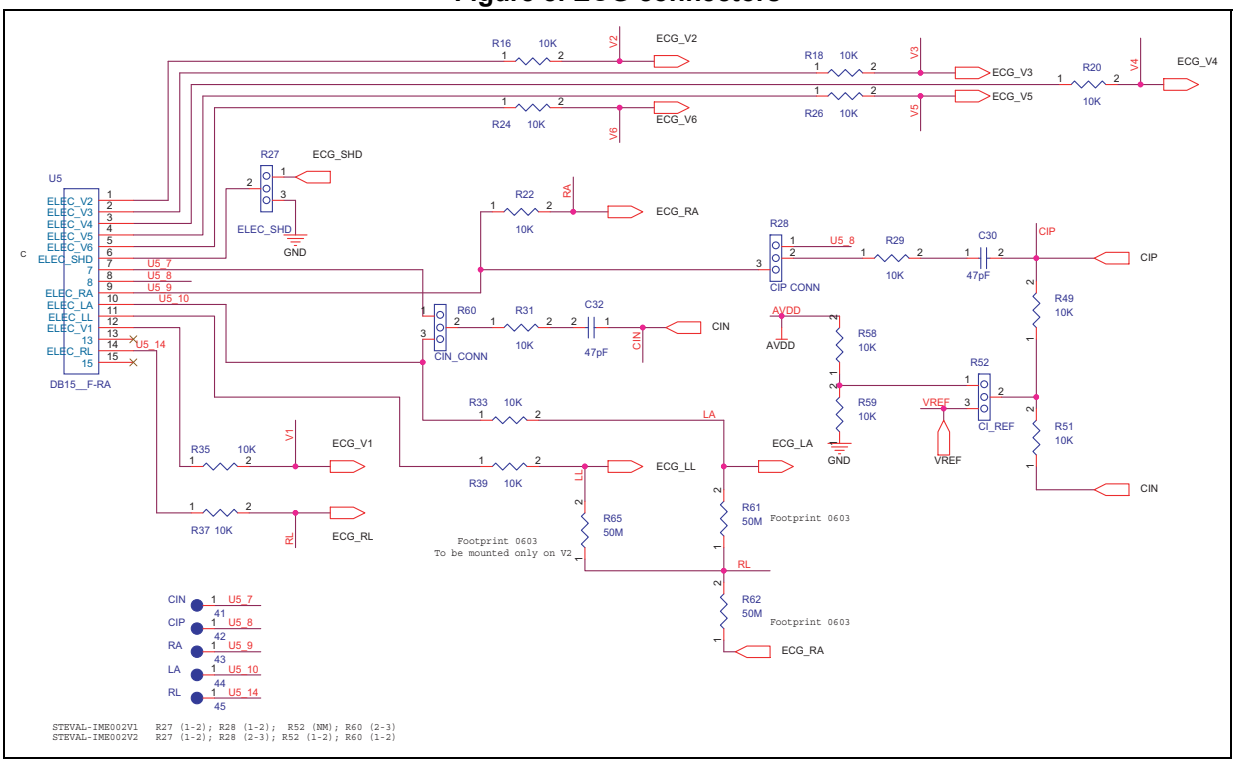
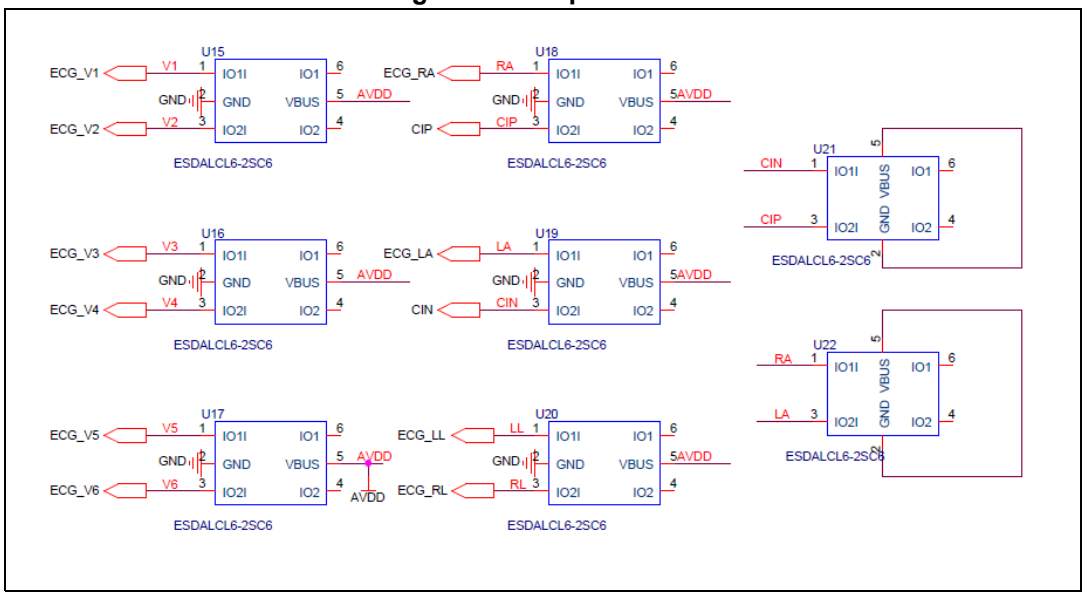


Figure 9. ESD protection



The connector section can be configured by changing the R0 positioning on the resistor pads indicated in *Table 2*.

Table 2. Filter configuration options

	STEVAL-IME002V1		STEVAL-IME002V2	
R27 ELEC_SHD	1-2 (default)	To connect the cable shield to pin 13 (SD - driver output of the shield cable) of the HM301D master device.	1-2 (default)	To connect the cable shield to pin 13 (SD - driver output of the shield cable) of the HM301D master device.
	2-3	To connect the cable shield to ground.	2-3	To connect the cable shield to ground.
R28 CIP_CONN	1-2	To connect the current injection positive pin to pin 8 of the ECG connector	1-2 (default)	To connect the current injection positive pin to pin 8 of the ECG connector
	2-3 (default)	To connect the current injection positive pin to the right arm pin of the ECG connector	2-3	To connect the current injection positive pin to the right arm pin of the ECG connector
R52 CI_REF	1-2	Not mounted	1-2 (default)	CI reference set at AVDD / 2
	2-3	Not mounted	2-3	CI reference set at VREF
R60 CIN_CONN	1-2	To connect the current injection negative pin to the shield pin of the ECG connector	1-2 (default)	To connect the current injection negative pin to the shield pin of the ECG connector
	2-3 (default)	To connect the current injection negative pin to the left arm pin of the ECG connector	2-3	To connect the current injection negative pin to the left arm pin of the ECG connector

2.4 HM301D devices and their configuration

The STEVAL-IME002Vx boards have been designed around the HM301D in order to allow the evaluation of the characteristics of the HM301D for their use in ECG/AED systems. The STEVAL-IME002V1 has been created to work with one, two or three HM301D devices. In multi-chip configurations the SPI will be configured as a daisy chain SPI, connecting the data output of any device to the data input of the following device, as explained in *Section 2.2.2*.

To address a broad range of applications, some channels of the three HM301Ds can be connected to the electrodes as bipolar configuration and some as unipolar. At the output of the channel, the bipolar configuration gives the voltage difference between 2 electrodes. Otherwise, the unipolar configuration reads the difference between the single electrode and the WCT reference voltage.

To evaluate the different modes of operation of the HM301D devices, the demonstration boards allow connecting the first HM301D (U1) in bipolar or unipolar configuration, while the other HM301Ds (U2 and U3) are always connected in unipolar mode.

Specifically on the STEVAL-IME002V1, U1 is configured to acquire the Einthoven equilateral triangle. Its vertices's are LA (left arm), RA (right arm), and LL (left leg) and are directly connected to U1. Moreover, the RL (right leg) is used as a reference electrode for potential and is connected to pin 9 of U1. In this arrangement, the electrocardiographic frontal limb leads could be easily retrieved. In fact, lead I is the potential difference between LA and RA, lead II is the potential difference between LL and RA and, lead III is the potential difference between LL and LA. The connection is controlled by the resistors R1, R2 and R3, see *Table 3*.

Most of the traditional clinical ECG machines use a single channel amplifier and recording system with a multi-position switch to select the desired lead connection. The HM301Ds on the STEVAL-IME002V1 permit the recording of all lead connections (I, II, III, V1, V2, V3, V4, V5, and V6) and apply it to the bio-potential amplifier through the parameter setting of a Graphical User Interface. The ECG leads can be also recorded on the user's PC.

If present, the electrodes V1, V2 and V3 are connected to the U2 in unipolar mode and, the electrodes V4, V5 and V6 to the U3 in unipolar mode. All the connections of the U2 and U3 devices are unipolar and are referred to the WCT signal of the master (U1) device.

Specifically on the STEVAL-IME002V2, only U1 is mounted on the board and it is configured to acquire only lead I, the potential difference between LA and RA.

Table 3. Input configuration of first HM301D

	STEVAL-IME002Vx configuration		Result
R1 U1 - IN1	1-2 (default in V1)	Unipolar mode	WCT shorted with IN1_P
	2-3 (default in V2)	Bipolar mode	LA shorted with IN1_P
R2 U1 - IN2	1-2 (default in V1, not mounted in V2)	Unipolar mode	WCT shorted with IN2_P
	2-3	Bipolar mode	LL shorted with IN2_P

Table 3. Input configuration of first HM301D (continued)

	STEVAL-IME002Vx configuration		Result
R3 U1 - IN3	1-2 (default in V1, not mounted in V2)	Unipolar mode	WCT shorted with IN3_P
	2-3	Bipolar Mode	RA shorted with IN3_P
R15	R0 in V1, not mounted in V2		LA shorted with IN2_N

To synchronize the three devices, an external crystal oscillator is used. The Q1 quartz is soldered on the board and connected to the master device (U1). The clock is generated in U1 and delivered to the other devices.

All the common ECG configurations listed in *Table 4* can be achieved with the STEVAL-IME002Vx demonstration boards.

Table 4. STEVAL-IME002Vx common ECG configurations

Application	Electrodes	Connection	Channels	Devices	Board
– Standard 12-lead ECG	9 + RL	2 bipolar + 6 unipolar	8	3 x HM301D	STEVAL-IME002V1
– Standard 12-lead ECG	9 + RL	9 unipolar	9	3 x HM301D	STEVAL-IME002V1
– Interpolated 12-lead using a 6-wire cable	5 + RL	2 bipolar + 2 unipolar	4	2 x HM301D	STEVAL-IME002V1
– Interpolated 12-lead using a 6-wire cable	5 + RL	5 unipolar	5	2 x HM301D	STEVAL-IME002V1
– 5-lead wire /EASI	4 + RL	2 bipolar + 1 unipolar	3	1 x HM301D	STEVAL-IME002V1
– 5-lead wire / EASI	4 + RL	4 unipolar	4	2 x HM301D	STEVAL-IME002V1
– Einthoven's Triangle	3 + RL	2 bipolar	2	1 x HM301D	STEVAL-IME002V1
– Einthoven's Triangle	3 + RL	3 unipolar	2	1 x HM301D	STEVAL-IME002V1
– Rhythm	2	1 bipolar	1	1 x HM301D	STEVAL-IME002V2
– Automated External Defibrillator	2	1 bipolar	1	1 x HM301D	STEVAL-IME002V2

The STEVAL-IME002Vx and the HM301D offer a further functional mode to be configured through the TM pins (see Section 6.7 of the HM301D datasheet), the two modes available are:

- Operating mode with internally generated POR
- Operating mode with external Enable

As shown in *Figure 8 on page 10*, to obtain these settings, R11 and R12 resistors can be placed as indicated in *Table 5*.

Table 5. TM configuration

	Resistor	Default		Optional	
TM0	R12	2-3	Operating mode with Enable provided by STM32	2-3	Operating mode with internally generated POR
TM1	R11	1-2		2-3	

Note: It is recommended to not change this configuration on the STEVAL-IME002Vx board, the STM32F103CBT6 is programmed to generate the POR signal.

3 Board connectors

3.1 USB

The STEVAL-IME002Vx are provided with USB 2.0 compliant full-speed communication via a USB type mini-B receptacle connector (CN1), with dedicated EMI filter and line termination through USBUF02W6 (U5). The PA10 pin of the STM32F103 is used for the software connection/disconnection of the USB cable. The MCU pins shall be configured in output push-pull mode: when high, the USB communication is enabled, when low, it is disabled.

Figure 10. USB mini-B connector (CN1) and schematics

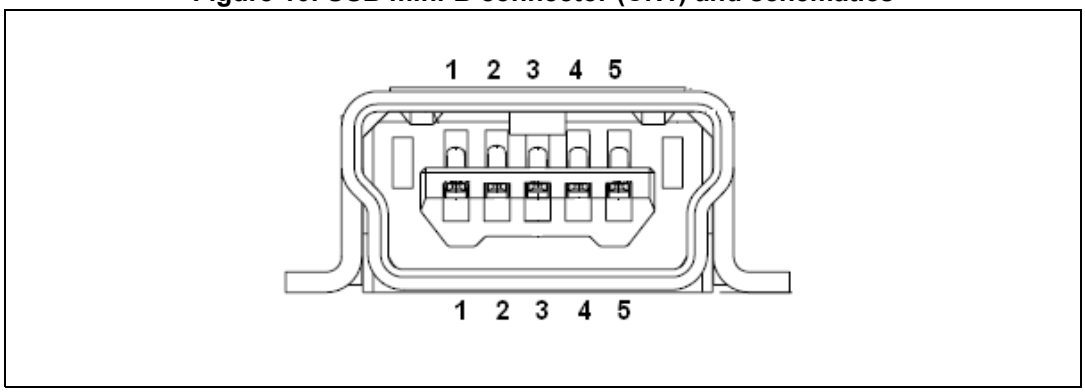


Table 6. USB mini-B connector pinout

Pin number	Description
1	Vbus (power)
2	DM (PA11)
3	DP(PA12)
4	N.C.
5	Ground

3.2 User LED and button

In the STEVAL-IME002Vx demonstration board, one LED D2 and one pushbutton SW2 are available for the user's application. The embedded firmware uses the LED to indicate the Acquisition phase to the user, while the pushbutton is used only to exploit the embedded Device Firmware Upgrade (refer to AN4267 available from *www.st.com*).

Table 7. User LED and GPIO button

Device	MCU GPIO
D2	PA3
SW2	PB0

3.3 STM32 SWD connector

The STM32F103CBT6 can be programmed through the J1 connector, its pinout is described in *Figure 11* and *Table 8*.

Figure 11. SWD (J1)

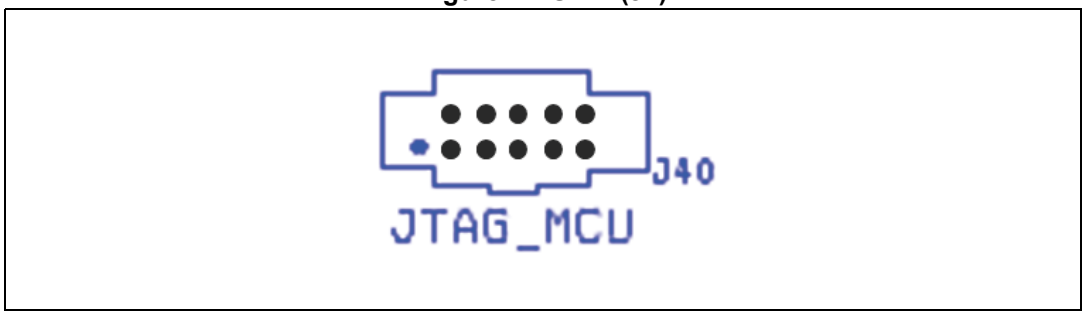


Table 8. JTAG/SWD connector pinout

Pin number	Description
1	MCU_3V3
2	JTMS
3	GND
4	JTCK
5	GND
6	JTDO
7	GND
8	JTDI
9	GND
10	RESET#

3.4 ECG connector

The STEVAL-IME002Vx demonstration boards can be connected to a Patient Simulator through a DB15 connector, its pinout is described in *Figure 12* and *Table 9*.

Figure 12. ECG connector

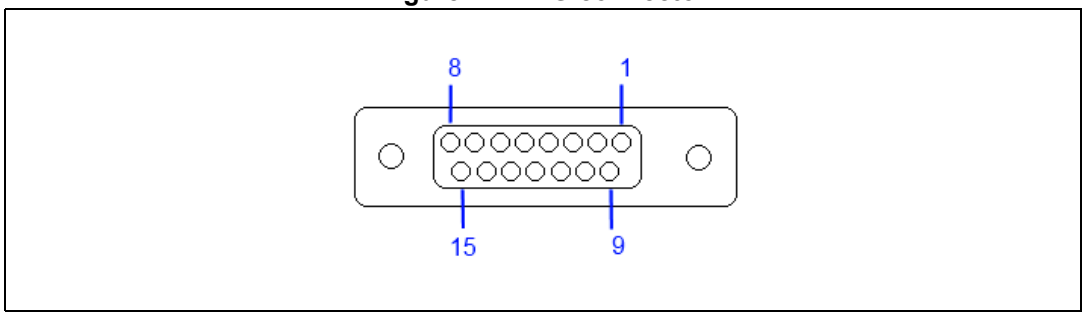


Table 9. ECG connector pinout

Pin Number	STEVAL-IME002Vx Connection	IEC Code 1 (usually European)	IEC Code 2 (usually American)	Position on Body
1	ECG_V2	C2	V2	Fourth intercostal space at right border of sternum
2	ECG_V3	C3	V3	Fifth rib between C2/V2 and C4/V4
3	ECG_V4	C4	V4	Fifth intercostal space on left midclavicular line
4	ECG_V5	C5	V5	Left anterior axillary line at the horizontal level of C4
5	ECG_V6	C6	V6	Left midaxillary line at the horizontal level of C4
6	ELEC_SHIELD			
7	CIN			
8	CIP			
9		R	RA	Right arm
10		L	LA	Left arm
11		F	LL	Left leg
12		C1	V1	Single movable chest electrode
13	Not Connected			
14		N	RL	Right leg (neutral electrode)
15	Not Connected			

3.5 Extra connector

In order to facilitate the connection of the user's own Patient Simulator, five extra connection pins have been provided on the board, see *Figure 13* and *Table 10*.

Figure 13. Extra connection pins

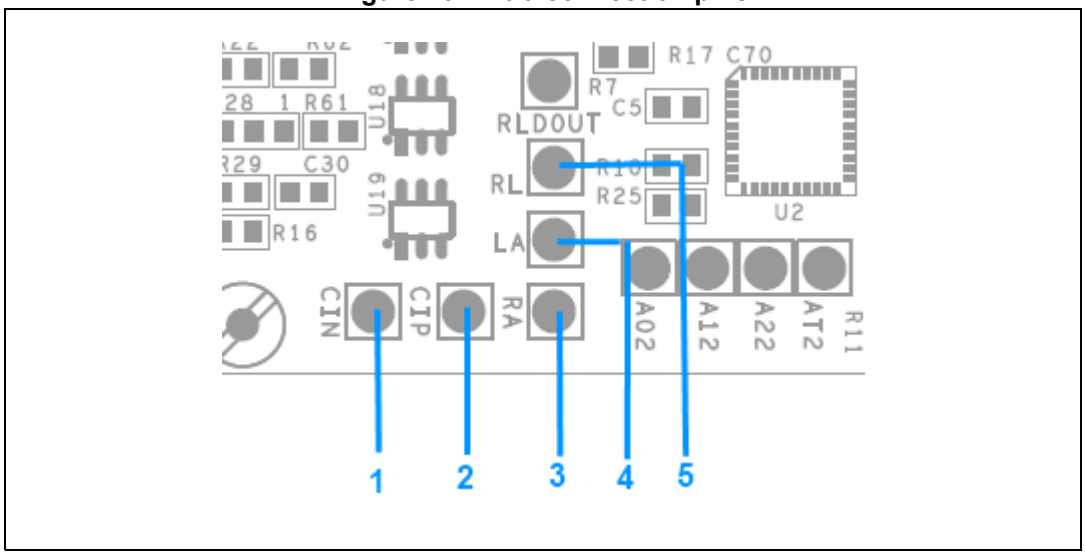


Table 10. Extra connection pinout

Pin number	Description
1	CIN
2	CIP
3	RA
4	LA
5	RL

Note: These pins are mutually exclusive with the ECG connector. Avoid plugging signals into these pins and the ECG connector at the same time, or use these pins only to show signals on an oscilloscope.

Appendix A Schematics

Figure 14. HM301D section

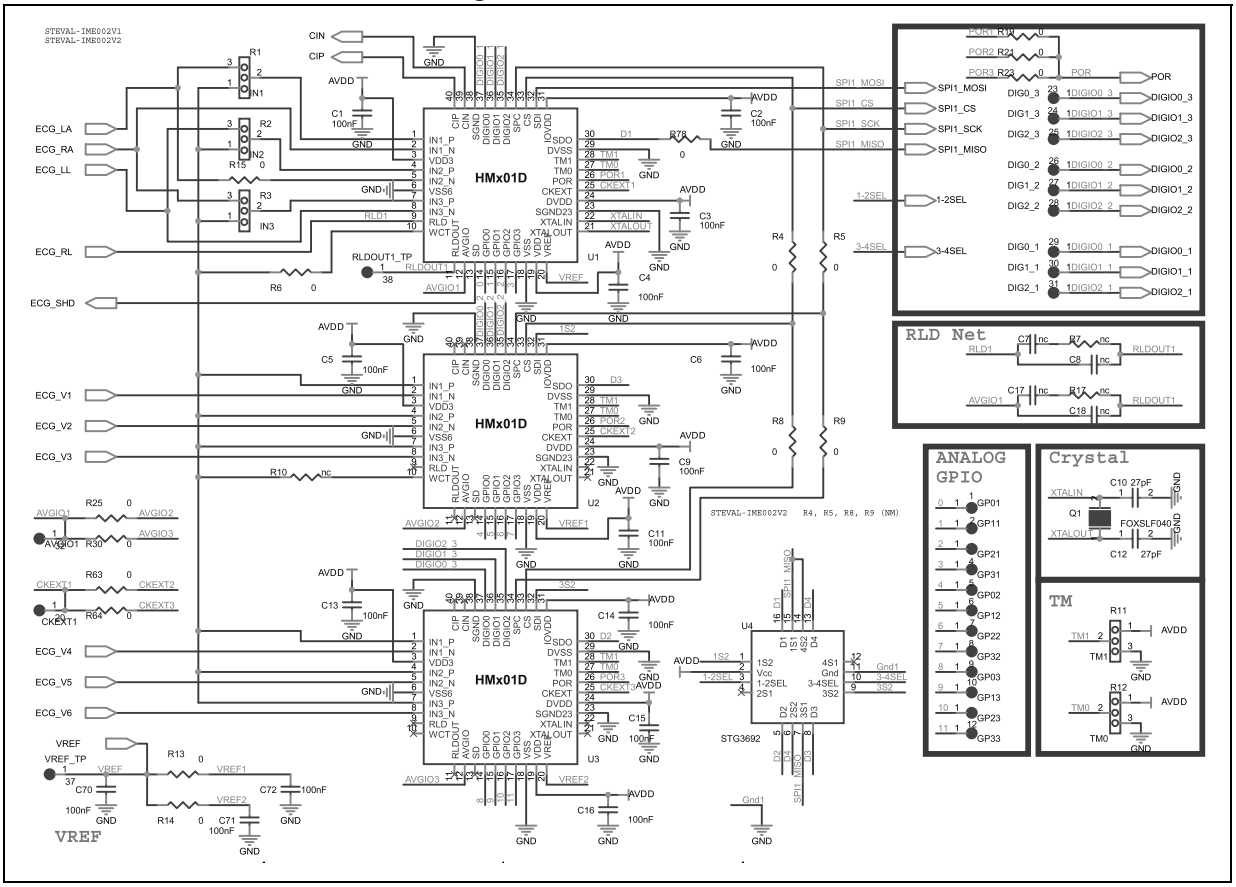


Figure 15. ECG connectors

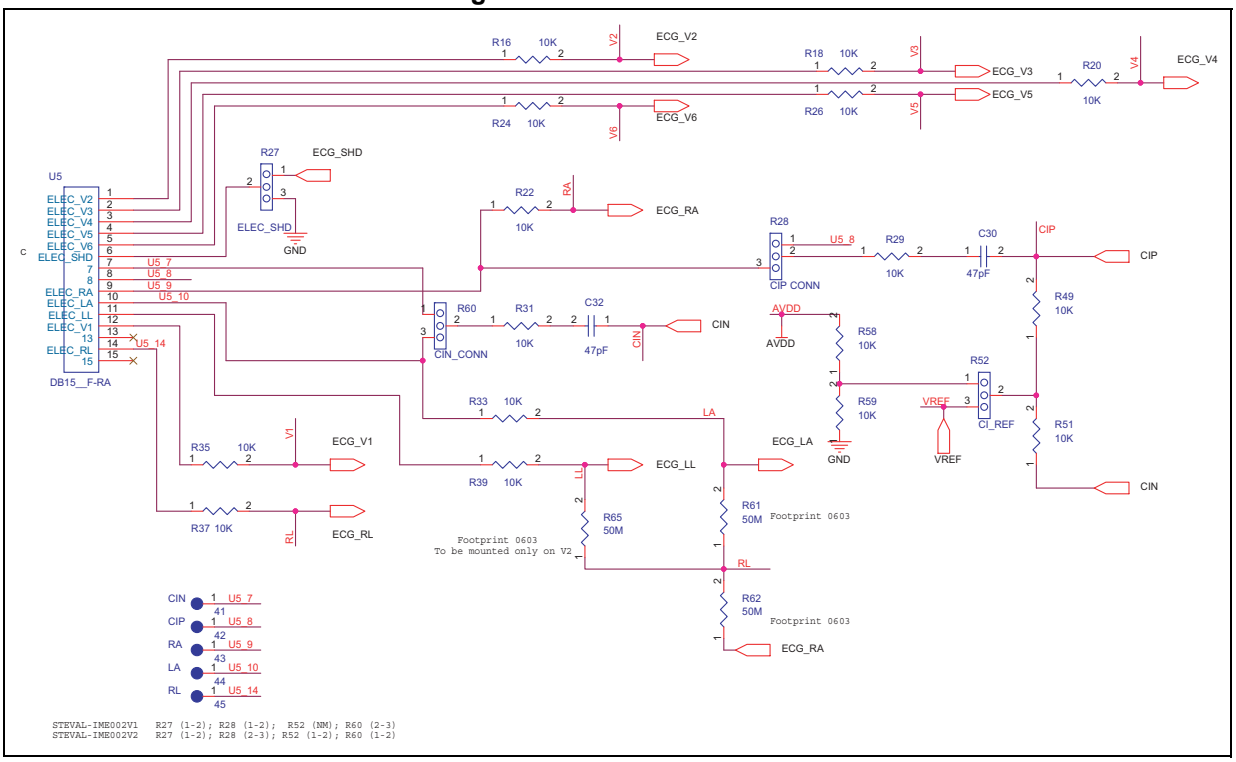


Figure 16. ESD protection

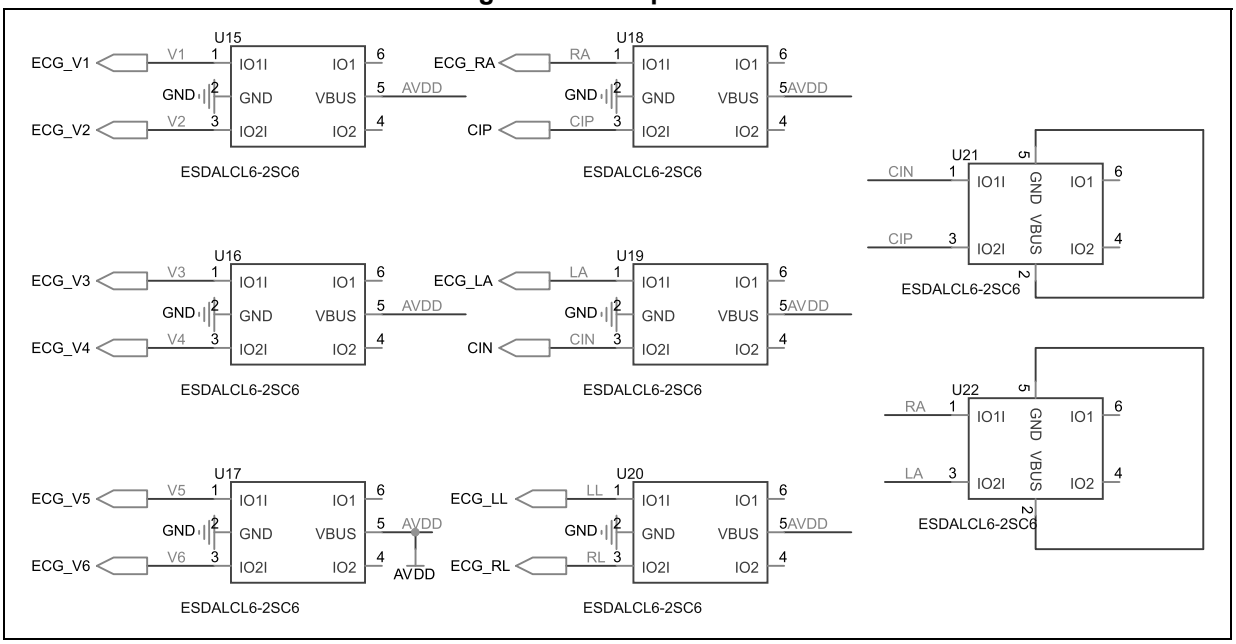


Figure 17. Connectors and buttons

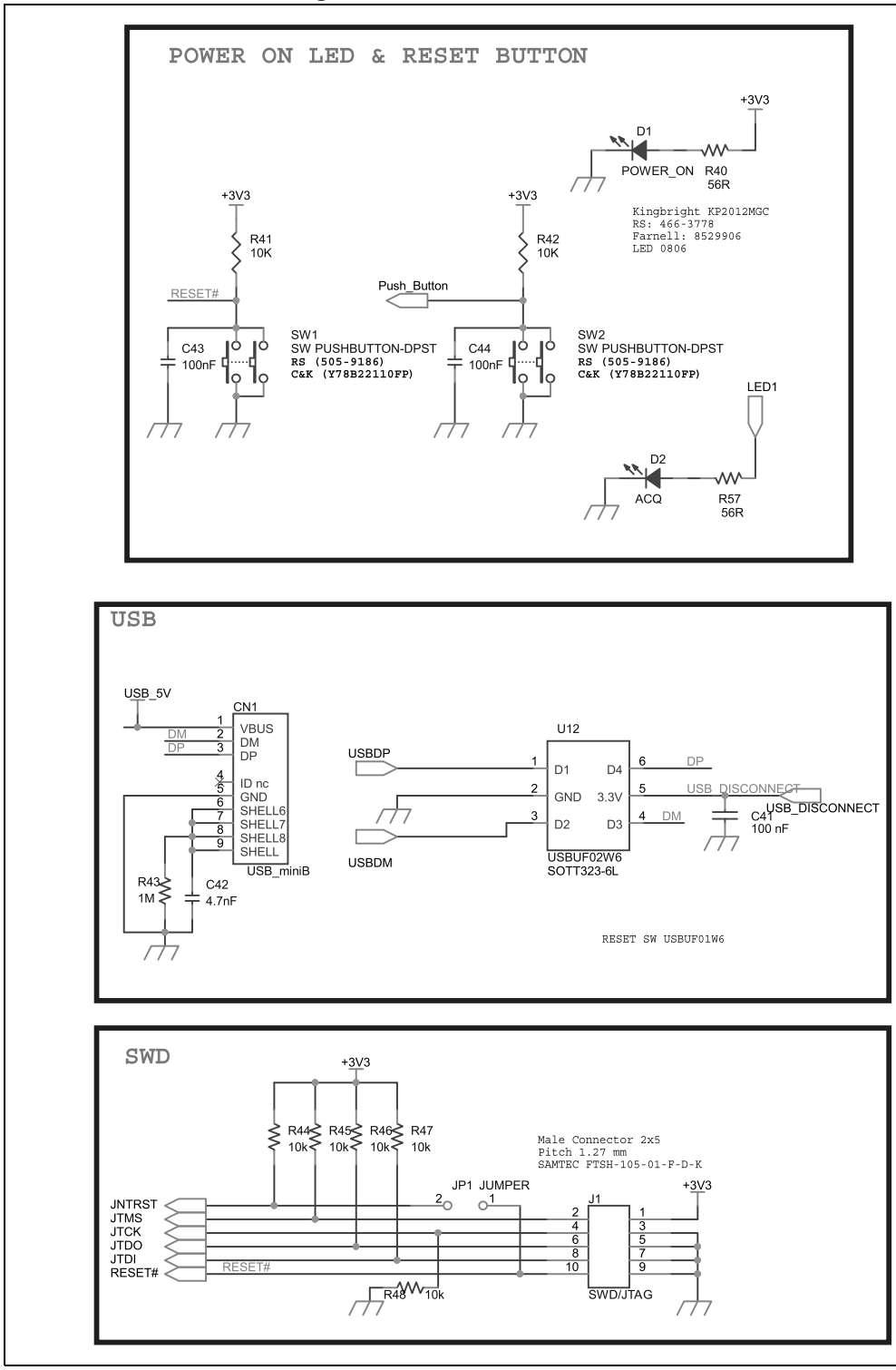


Figure 18. Microcontroller

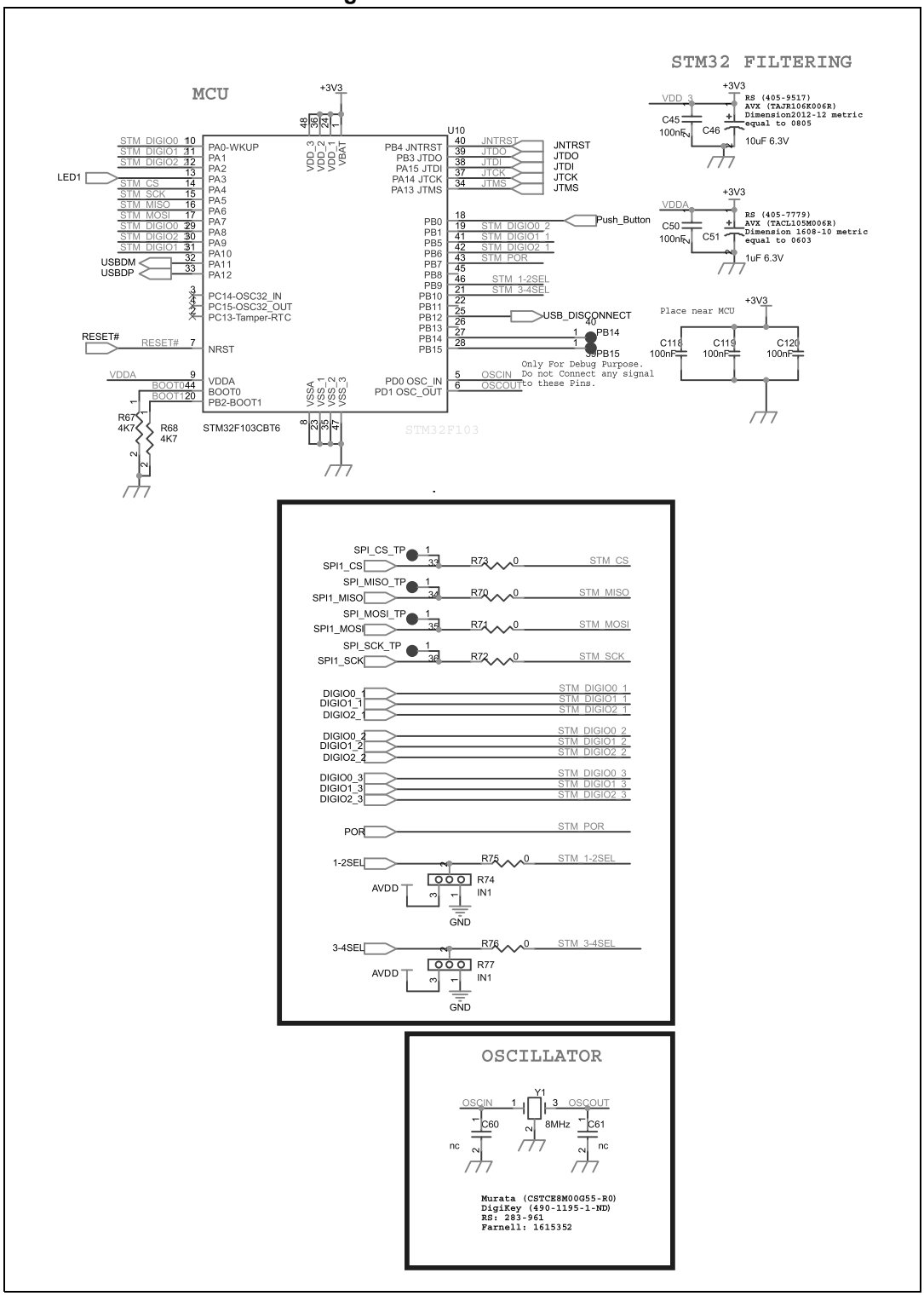
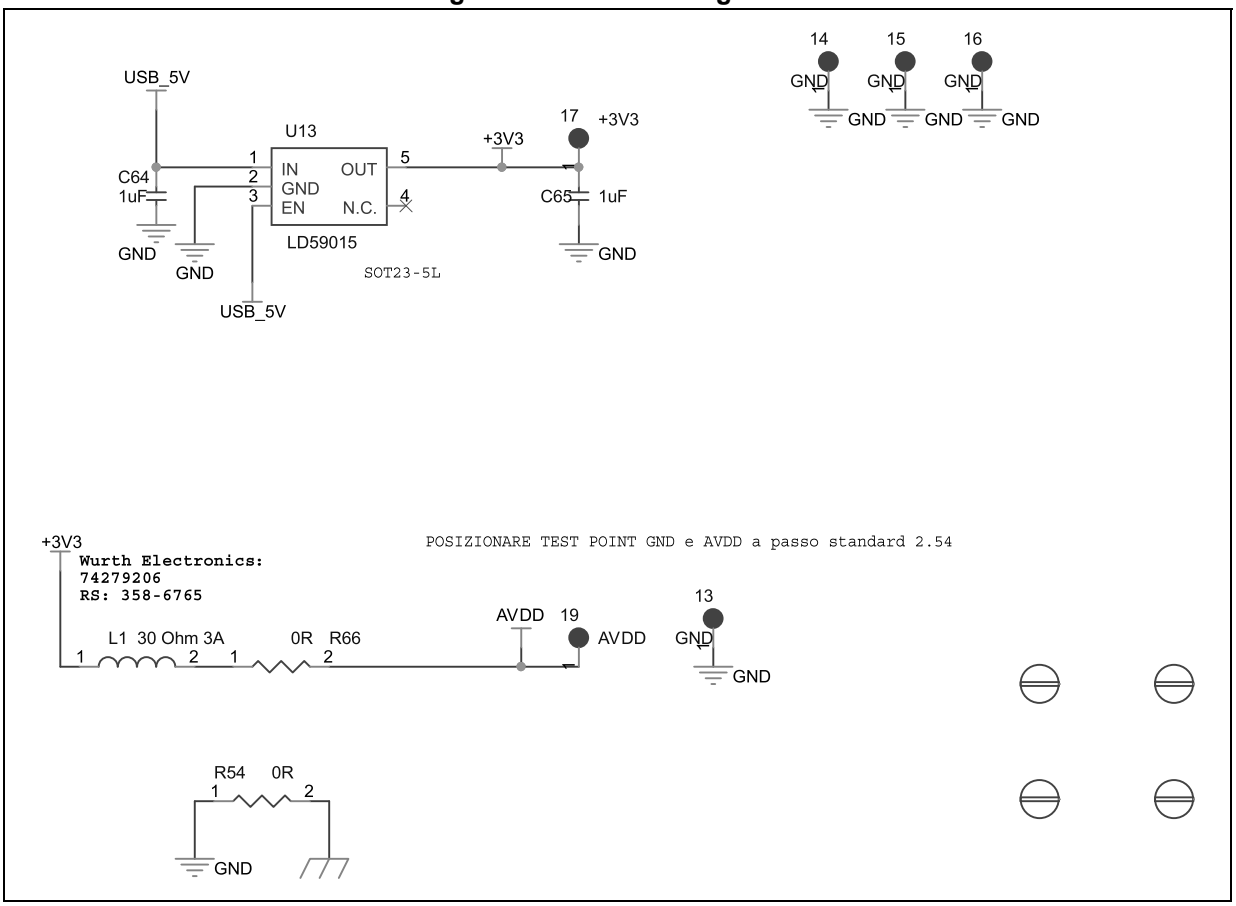


Figure 19. Power management



Appendix B Bill of material

Table 11. STEVAL-IME002V1

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
ADAMO demonstration board								
1	1	CN1	USB_miniB		Molex	54819-0572	RS	RS: 515-1995
2	23	C1, C2, C3, C4, C5, C6, C9, C11, C13, C14, C15, C16, C41, C43, C44, C45, C50, C70, C72, C118, C119, C120, C121	100nF	SMD 0603	MURATA	GRM188R71H104KA93D	RS	RS: 624-2480
3	23	R7, R10, R13, R14, R17, R21, R23, R49, R51, R52, R58, R59, R61, R62, R65, R78, C7, C8, C17, C18, C60, C61, C71	N.M.	SMD 0603	N.M.		N.M.	
4	2	C10, C12	27pF	SMD 0603	MURATA	GQM1885C1H270JB01D	RS	RS:647-7349
5	2	C30, C32	0	SMD 0603	Any		Any	
6	1	C42	4.7nF	SMD 0603	MURATA	GRM188R71H472KA01D	RS	RS: 204-0741
7	1	C46	10µF 6.3V	SMD 0805	AVX	TAJR106K006R	RS	RS: 405-9517
8	1	C64	1µF 10V	SMD 0603	MURATA	GRM188F51A105ZA01D	RS	RS:545-4317
9	2	C51, C65	1µF 6.3V	SMD 0603	AVX	TACL105M006R	RS	RS: 405-7779
10	1	D1	POWER_ON	LED 0806	Kingbright	KP2012MGC	RS / Farnell	RS: 466-3778 Farnell: 8529906

Table 11. STEVAL-IME002V1 (continued)

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
11	1	D2	ACQ	LED 0806	Kingbright	KP2012MGC	RS / Farnell	RS: 466-3778 Farnell: 8529906
12	1	JP1	Jumper	THR (spacing 2.54)	Any		Any	
13	1	J1	SWD/JTAG (male connector 10-pin 2x5)	THR (spacing 1.27)	SAMTEC	FTSH-105-01-F-D-K	Any	
14	1	L1	30 Ohm 3A	30 Ohm 3A	SMD 0805	Wurth Electronics 74279206	RS	RS: 358-6765
15	1	Q1	FOXSLF040	See datasheet		FOXSLF040	RS	RS: 547-6171
16	1	R1 (IN1: pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
17	1	R2 (IN2: pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
18	1	R3 (IN3: pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
19	2	R74, R77	SEL	SMD 0603	Not mounted		Not mounted	
20	18	R4, R5, R6, R8, R9, R15, R19, R25, R30, R54, R63, R64, R70, R71, R72, R73, R75, R76	0 Ohm	SMD 0603	Any		Any	
21	1	R66	0 Ohm	SMD 0805	Any		Any	
22	1	R11 (TM1: pos. 2-3)	0 Ohm	SMD 0603	Any		Any	
23	1	R12 (TM1: pos. 1-2)	0 Ohm	SMD 0603	Any		Any	

Table 11. STEVAL-IME002V1 (continued)

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
24	19	R16, R18, R20, R22, R24, R26, R29, R31, R33, R35, R37, R39, R41, R42, R44, R45, R46, R47, R48	10k	SMD 0603	Any		Any	
25	1	R27 (ELEC_SHD pos.1-2)	0 Ohm	SMD 0603	Any		Any	
26	1	R28 (CIP_CONN pos. 2-3)	0 Ohm	SMD 0603	Any		Any	
27	1	R60 (CIN_CONN pos. 2-3)	0 Ohm	SMD 0603	Any		Any	
28	2	R40, R57	56R	SMD 0603	Any		Any	
29	1	R43	1M	SMD 0603	Any		Any	
30	2	R67, R68	4k7	SMD 0603	Any		Any	
31	2	SW1, SW2	SW PUSHBUTTON-DPST		C&K	Y78B22110FP	RS	RS: 505-9186
32	3	U1,U2,U3	HM301D	See datasheet	ST		ST	
33	1	U4	STG3692	See datasheet	ST		ST	
34	1	U5	DB15__F-RA		TE		DIGIKEY	A32076-ND
35	1	U10	STM32F103CBT6	See datasheet	ST	STM32F103CBT6	ST	
36	1	U12	USBUF02W6	See datasheet	ST		ST	
37	1	U13	LD59015C33R	See datasheet	ST		ST	

Table 11. STEVAL-IME002V1 (continued)

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
38	8	U15, U16, U17, U18, U19, U20, U21, U22	ESDALCL6-2SC6	See datasheet	ST		ST	
39	1	Y1	8 MHz		Murata	CSTCE8M0G55-R0	RS / Digikey / Farnell	RS: 283-961, DigiKey: 490-1195-1-ND, Farnell: 1615352

Table 12. STEVAL-IME002V2

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
ADAMO demonstration board								
1	1	CN1	USB_miniB		Molex	54819-0572	RS	RS: 515-1995
2	13	C1, C2, C3, C4, C41, C43, C44, C45, C50, C70, C118, C119, C120	100 nF	SMD 0603	MURATA	GRM188R71H104KA93D	RS	RS: 624-2480
3	36	R4, R5, R7, R8, R9, R10, R13, R14, R15, R16, R17, R18, R20, R24, R25, R26, R30, R35, R63, R64, C5, C6, C7, C8, C9, C11, C13, C14, C15, C16, C17, C18, C60, C61, C71, C72	N.M.	SMD 0603	N.M.	N.M.	N.M.	
4	2	C10, C12	27 pF	SMD 0603	MURATA	GQM1885C1H270JB01D	RS	RS:647-7349

Table 12. STEVAL-IME002V2 (continued)

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
5	2	C30, C32	47 pF	SMD 0603	MURATA	GRM1885C1H470JA01D	RS	RS: 545-4121
6	1	C42	4.7 nF	SMD 0603	MURATA	GRM188R71H472KA01D	RS	RS: 204-0741
7	1	C46	10 µF 6.3 V	SMD 0805	AVX	TAJR106K006R	RS	RS: 405-9517
8	1	C64	1 µF 10 V	SMD 0603	MURATA	GRM188F51A105ZA01D	RS	RS:545-4317
9	2	C51, C65	1 µF 6.3 V	SMD 0603	AVX	TACL105M006R	RS	RS: 405-7779
10	1	D1	POWER_ON	LED 0806	Kingbright	KP2012MGC	RS / Farnell	RS: 466-3778 Farnell: 8529906
11	1	D2	ACQ	LED 0806	Kingbright	KP2012MGC	RS / Farnell	RS: 466-3778 Farnell: 8529906
12	1	JP1	JUMPER	THR (spacing 2.54)	Any		Any	
13	1	J1	SWD/JTAG (male connector 10-pin 2x5)	THR (spacing 1.27)	SAMTEC	FTSH-105-01-F-D-K	Any	
14	1	L1	30 Ohm 3 A	30 Ohm 3A	SMD 0805	Wurth Electronics 74279206	RS	RS: 358-6765
15	1	Q1	FOXSLF040	See datasheet		FOXSLF040	RS	RS: 547-6171
16	1	R1 (IN1 pos. 2-3)	0 Ohm	SMD 0603	Any		Any	
17	1	R2	N.M.	SMD 0603	N.M.		N.M.	
18	1	R3	N.M.	SMD 0603	N.M.		N.M.	
19	2	R74, R77	N.M.	SMD 0603	N.M.			
20	12	R6, R19, R21, R23, R54, R70, R71, R72, R73, R75, R76, R78	0 Ohm	SMD 0603	Any		Any	
21	1	R66	0 Ohm	SMD 0805	Any		Any	

Table 12. STEVAL-IME002V2 (continued)

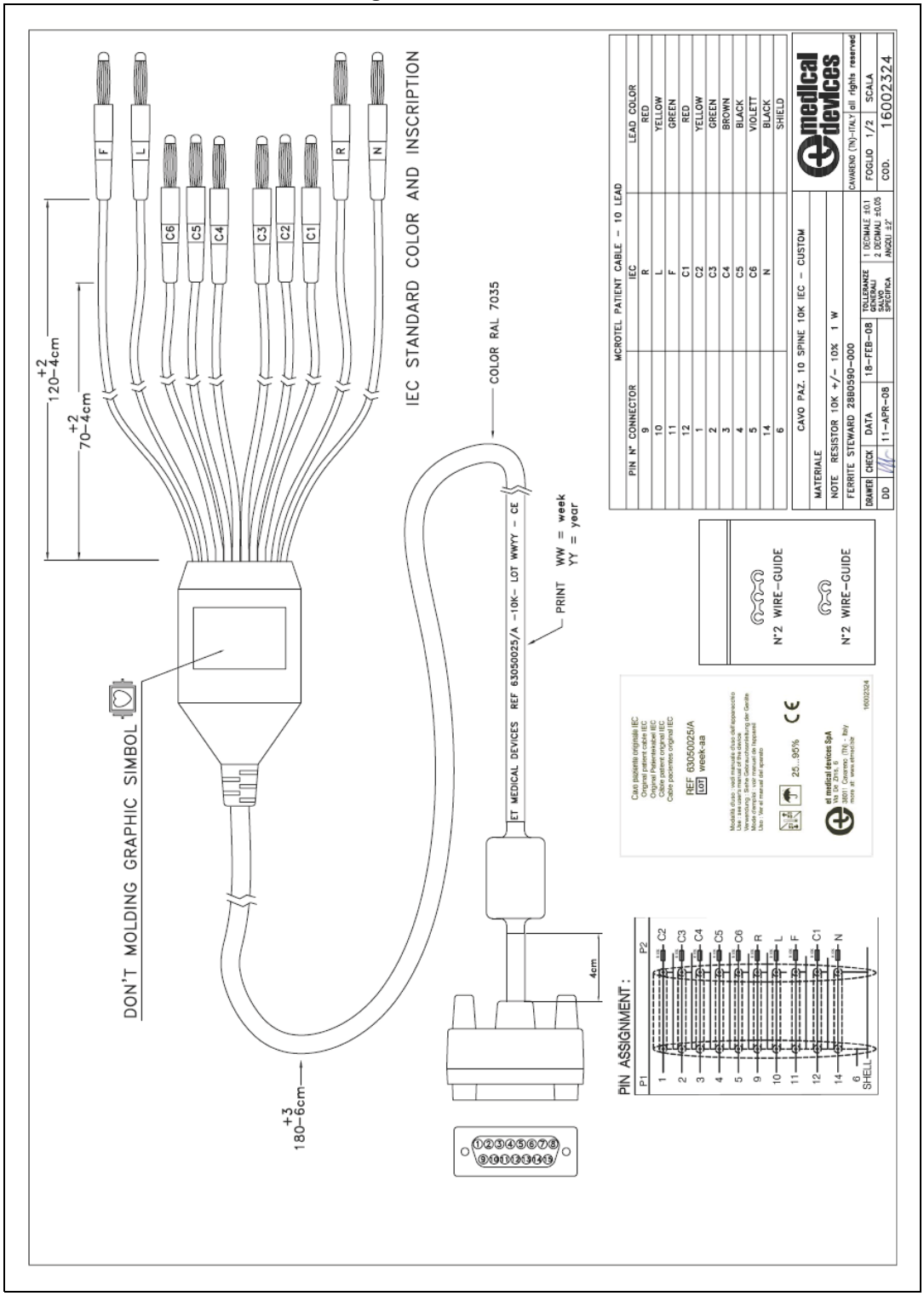
Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
22	1	R11 (TM1 pos. 2-3)	TM1	SMD 0603	Any		Any	
23	1	R12 (TM0 pos. 1-2)	TM0	SMD 0603	Any		Any	
24	17	R22, R29, R31, R33, R37, R39, R41, R42, R44, R45, R46, R47, R48, R49, R51, R58, R59	10 k	SMD 0603	Any		Any	
25	1	R27 (ELEC_SHD pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
26	1	R28 (CIP_CONN pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
27	1	R52 (CI_REF pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
28	1	R60 (CIN_CONN pos. 1-2)	0 Ohm	SMD 0603	Any		Any	
29	2	R40, R57	56R	SMD 0603	Any		Any	
30	1	R43	1 M	SMD 0603	Any		Any	
31	3	R61, R62, R65	50 M	SMD 0603	Any		Any	
32	2	R67, R68	4k7	SMD0603	Any		Any	
33	2	SW1, SW2	SW PUSHBUTTON-DPST		C&K	Y78B22110FP	RS	RS: 505-9186
34	1	U1	HM301D	See datasheet	ST		ST	
35	2	U2, U3	HM301D	N.M.		N.M.	N.M.	
36	1	U4	STG3692	N.M.		N.M.	N.M.	
37	1	U5	DB15__F-RA		TE		DIGIKEY	A32076-ND
38	1	U10	STM32F103CBT6	See datasheet	ST	STM32F103CBT6	ST	

Table 12. STEVAL-IME002V2 (continued)

Item	Qty	Reference	Part / Value	Package	Manu-facturer	Manufacturer's ordering code / orderable part number	Supplier	Supplier's ordering code
39	1	U12	USBUF02W6	See datasheet	ST		ST	
40	1	U13	LD59015C33R	See datasheet	ST		ST	
41	5	U18, U19, U20, U21, U22	ESDALCL6-2SC6	See datasheet	ST		ST	
42	3	U15, U16, U17	ESDALCL6-2SC6	N.M.	N.M.		N.M.	
43	1	Y1	8 MHz		Murata	CSTCE8M0G55-R0	RS / Digikey / Farnell	RS: 283-961, DigiKey: 490-1195-1-ND, Farnell: 1615352

Appendix C ECG cable

Figure 20. ECG cable



4 Revision history

Table 13. Document revision history

Date	Revision	Changes
08-May-2014	1	Initial release.

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