How to use the 16-channel high voltage pulser evaluation kit for ultrasound imaging applications

Introduction

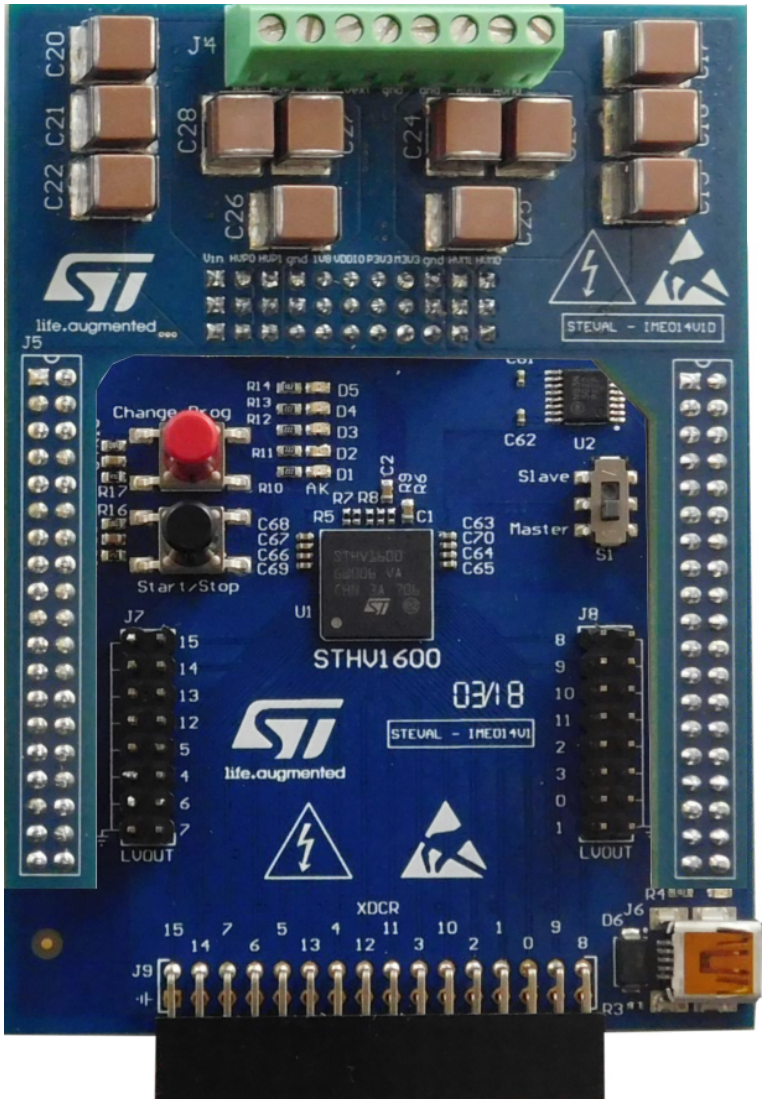
The STEVAL-IME014V1B evaluation kit, based on the STHV1600 16-channel high voltage pulser for ultrasound imaging applications, can be used to evaluate the characteristics and functionality of the HV as well as to understand the working methodology of the STHV1600 pulser digital interface, beamformer, waveform generator and register settings.

Four preset programs are available to test the pulser in typical conditions, and output waveforms can be displayed on an oscilloscope by connecting the scope probe to the relevant connectors.

A graphical user interface is available to change waveforms and configurations easily to best approximate the final application setups.

The evaluation kit is intended for a first and preliminary evaluation of the device in terms of performance and flexibility. It does not cover all the possible final application setups, especially the most stressing in terms of power dissipation, due to the evaluation board hardware limitations.

Figure 1. STEVAL-IME014V1B high voltage pulser evaluation kit



1 Safety recommendations

Attention: *The STEVAL-IME014V1B evaluation kit must be used by expert engineers only.*

Danger:
Due to the high voltage (±100 V_{DC}) present on the non-isolated parts, special care must be taken to avoid the risk of electric shocks and burns.

Caution: There are no protections against accidental human contact with high voltage components.

Caution: Never touch live board components when the board is connected or immediately after the board is disconnected, as the capacitors may still be charged.

Caution: Do not connect probes to any high voltage components if the board is not isolated from the mains supply, as this may cause damage to equipment.

Note:
STMicroelectronics assumes no responsibility for accidents or injury caused by improper use of this development tool.

2 STEVAL-IME014V1B specifications

- 16 channel high voltage outputs (XDCR): female strip connectors 2x16
  - typical load directly connected on XDCRs (100Ω // 270pF)
  - can disconnect load on XDCR by removing on-board solder bridges
- 16 channel low voltage outputs (LVOUT): male strip connectors 2x16
  - no load on LVOUT (by default)
- four preset programs
- USB connector to change programs and waveforms
- push button to build, select, start and stop the generation of waveforms
- push button to reset the device
- LEDs to monitor STHV1600 operation
- evaluation kit consists of three stacked boards:
  - STM32 Nucleo (NUCLEO-F401RE)
  - STHV1600 Module (STEVAL-IME014V1)
  - Power Supply Module (STEVAL-IME014V1D)
- possibility of connecting and synchronizing multiple STEVAL-IME014V1B kits in master and slave modes
- requires only two (3-level configuration) or four (5-level configuration) high voltage supplies and one low voltage supply (7-12 V)
- GUI interface to configure the evaluation kit

2.1 Programs, clock and modes

The STEVAL-IME014V1B can store up to four programs (this limitation is related to the STEVAL-IME014V1B firmware, not to the device), which can be accessed through the PB2 button.

The system clock is generated by the on-board PLL and the available CLKSYS frequencies are:

- 10 MHz
- 50 MHz
- 100 MHz
- 200 MHz

Note: The system may not function properly at 200 MHz because the STEVAL-IME014V1B operates with a CMOS interface and not in differential mode.

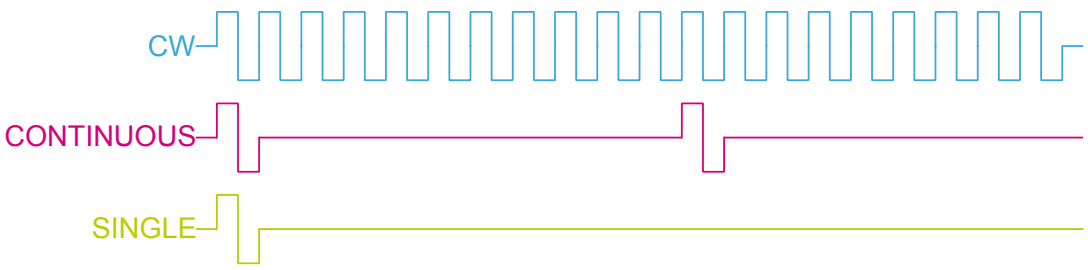
Note: The actual clock in case of 100 MHz selection is: f_{SYSCLK} = 98.7 MHz → T_{SYSCLK} = 10.13 ns

The available operating modes are:

- Single: a single trigger is provided to the pulser. Waveforms stored in each channel are generated only once.
- Continuous: multiple triggers are provided to the pulser with the desired Pulse Repetition Frequency.
- CW: waveforms stored in the pulser memory are continuously generated with no intermediate pause.

Note: In CW mode, it is recommended to limit the high voltage supplies to ±5 V, since the evaluation board is not designed for greater power dissipations.

Figure 2. STEVAL-IME014V1B operating modes



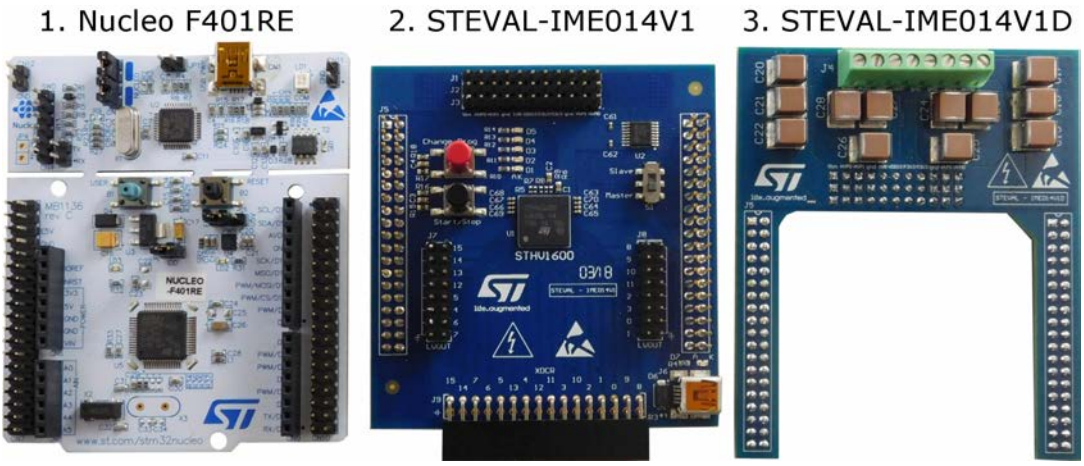
3 Hardware description

3.1 Evaluation kit overview

The STEVAL-IME014V1B evaluation kit consists of three stacked boards:

1. the NUCLEO-F401RE main board embedding an STM32 microcontroller, used to program and generate the correct signals for STHV1600
2. the STEVAL-IME014V1 board with embedded STHV1600 pulser, CLKSYS generator, connectors and buttons
3. the STEVAL-IME014V1D power supply module used to generate four on-board low voltage supplies and manage all power supplies

Figure 3. STEVAL-IME014V1B component boards



3.1.1 STEVAL-IME014V1D power supply module

The power supply module receives input power through an eight-pin connector for four high voltage lines that directly feed the device and one low voltage line to make on-board regulators generate adequate low voltage supplies for the pulser.

The LDO voltage regulators and DC-DC converters generate VDDM, VDDP, DVDD and IOVDD voltages for the STHV1600 pulser from the low voltage line of the power supply connector (VEXT).

This module also hosts some decoupling capacitors.

Figure 4. STEVAL-IME014V1D connector pin assignment

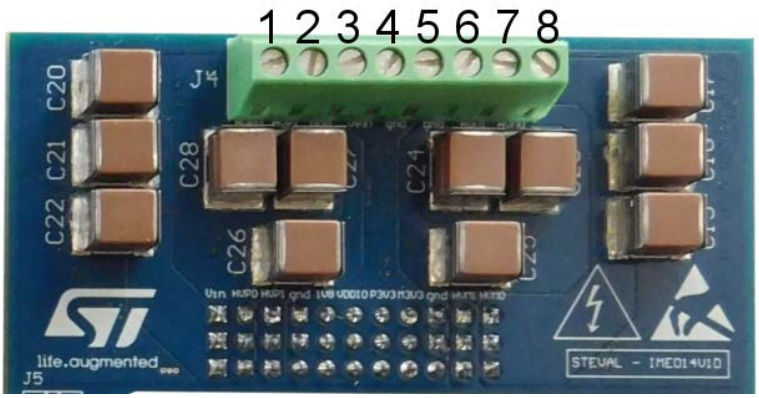


Table 1. Power supply connector pin descriptions

Pin	Signal	Description
1	HVP0	Positive high voltage TX0 supply
2	HVP1	Positive high voltage TX1 supply (in the 3-level configuration, it can be shorted to HVP0)
3	GND	Ground
4	VEXT	7 V to 12 V supply
5	GND	Ground
6	GND	Ground
7	HVM1	Negative high voltage TX1 supply (in the 3-level configuration, it can be shorted to HVM0)
8	HVM0	Negative high voltage TX0 supply

3.1.2 STEVAL-IME014V1 pulser module

The STEVAL-IME014V1 module includes the STHV1600 pulser, a clock generator for CLKSYS, a USB port and the button interface.

Figure 5. STEVAL-IME014V1 connectors, switches and buttons

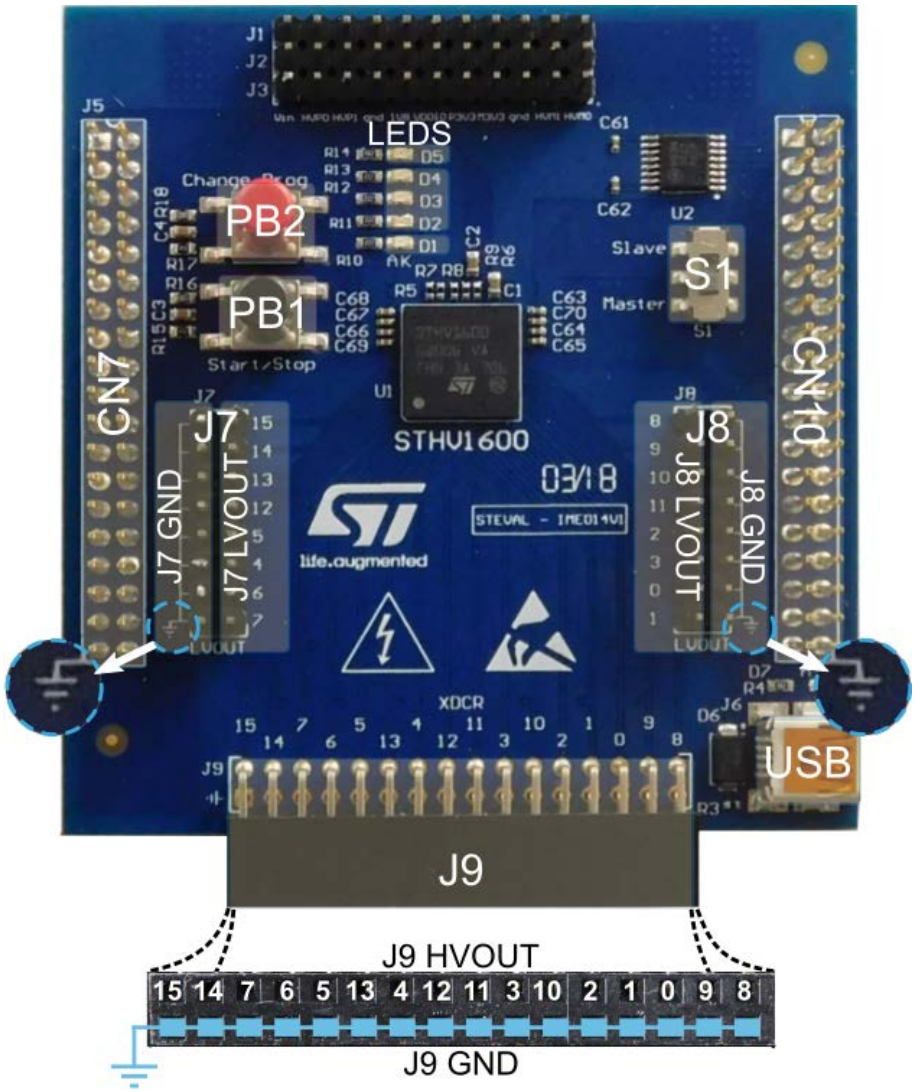


Table 2. STEVAL-IME014V1 connector, switch and button descriptions

Component	Description
PB1	Press once to Start waveform generation (Master mode trigger) Press again to Stop waveform generation (not needed in Single mode) Press and hold for 2 seconds to RESET the device
PB2	Press to change program Press and hold for 2 seconds to save programs in Flash memory
D1	Blinking: wave execution (or waiting for trigger in Slave mode trigger) Single flash: programs have been saved into Flash memory
D4, D3, D2	Selected program in binary code (D2 is the least significant bit)
D5	Lights red when an interrupt occurs
USB Port	Connect to a PC USB port to update the programs. Do not connect the cable to this port while pulsing.
J7	In Figure 5. STEVAL-IME014V1 connectors, switches and buttons: • J7LVOUT: STHV1600 LVOUTs output (pin numbers are inscribed) • J7 GND: ground net
J8	In Figure 5. STEVAL-IME014V1 connectors, switches and buttons: • J8LVOUT: STHV1600 LVOUTs output (pin numbers are inscribed) • J8 GND: ground net
S1	Master or slave selector
J9	In Figure 5. STEVAL-IME014V1 connectors, switches and buttons: • J9HVOUT: STHV1600 XDCR15 to XDCR0 high voltage output (pin numbers are inscribed) • JN GND: ground net

3.2 STEVAL-IME014V1B power supply and ST morpho connectors

Figure 6. **Power supply and ST morpho connector pinouts**

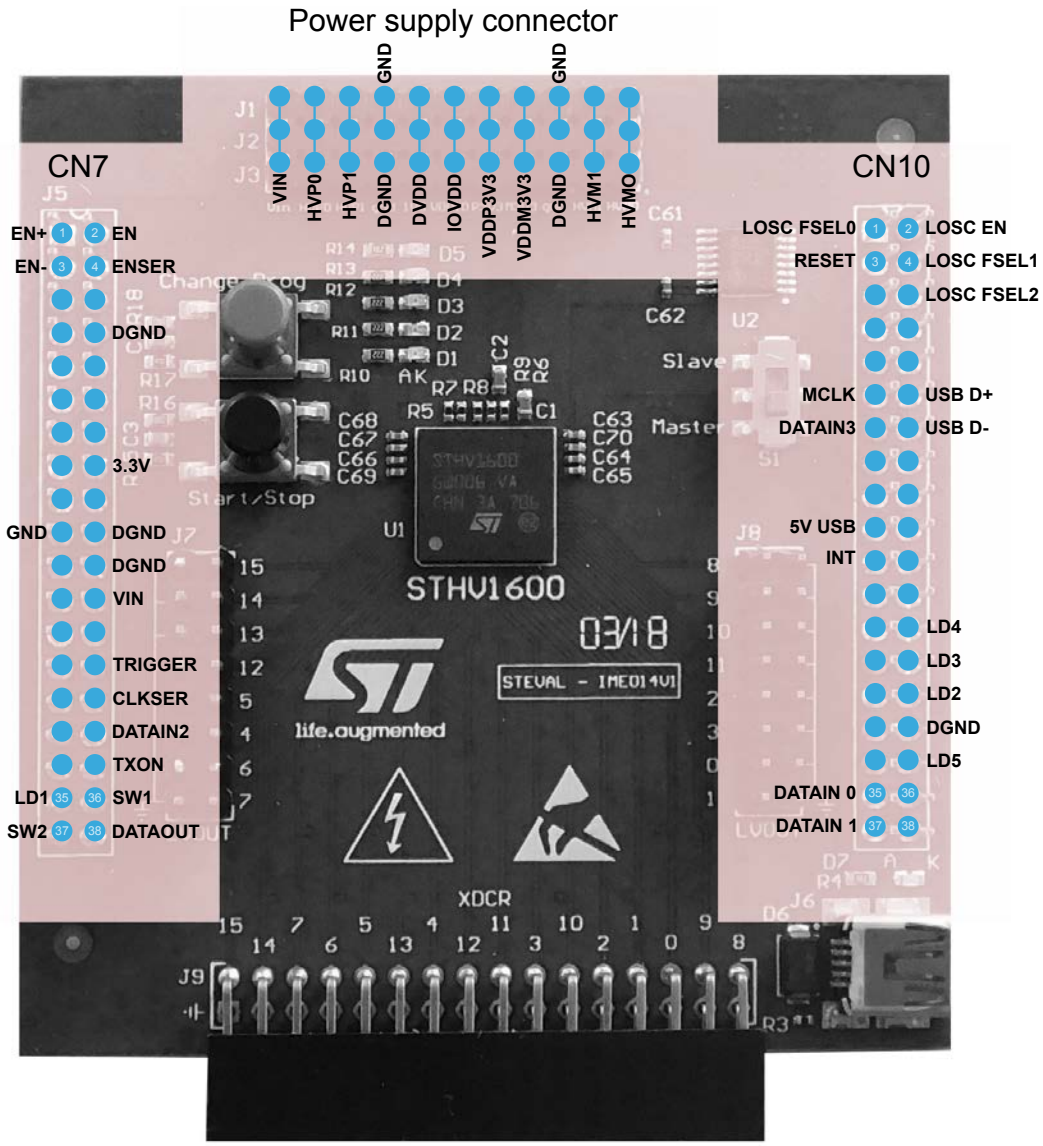


Table 3. **Output supply connector**

Pin Number	Signal Name	Function
1-2-3	VIN	Positive low voltage supply
4-5-6	HVP0	STHV1600 positive high voltage TX0 supply
7-8-9	HVP1	STHV1600 positive high voltage TX1 supply
10	DGND	STHV1600 Digital Ground (0V)
11-12	GND	STHV1600 Power Ground (0V)
13-14-15	DVDD	STHV1600 positive logic supply (1.8 V) → generated by Power supply Module
16-17-18	IOVDD	STHV1600 CMOS IO supply (3.3 V) → generated by Power supply Module

Pin Number	Signal Name	Function
19-20-21	VDDP3V3	STHV1600 positive low voltage supply (3.3V) → generated by Power supply Module
22-23-24	VDDP3M3	STHV1600 negative low voltage supply (-3.3 V) → generated by Power supply Module
25	DGND	STHV1600 Digital Ground (0V)
26-27	GND	STHV1600 Power Ground (0V)
28-29-30	HVM1	STHV1600 negative high voltage TX1 supply
31-32-33	HVM0	STHV1600 negative high voltage TX0 supply

Table 4. ST morpho CN7 connector

Pin Number	Signal Name	Function
1	EN +	Enable VDDP3V3 voltage regulator
2	EN	Enable DVDD and IOVDD voltage regulator
3	EN -	Enable VDDM3V3 voltage regulator
4	ENSER	STHV1600 ENSERP signal
8, 19, 20, 22	DGND	Digital ground
16	3.3V	3.3V supply
18	VIN	VIN supply
28	TRIGGER	STHV1600 TRIGGERP signal
30	CLKSER	STHV1600 CLKSERP signal
32	DATAIN2	STHV1600 DATA_INP[2] signal
34	TXON	STHV1600 TX_ON signal
35	LD1	LED D1 driving signal
36	SW1	Button PB1 logic state (start/stop)
37	SW2	Button PB2 logic state (change program, save program)
38	DATAOUT	STHV1600 DATA_OUT signal

Table 5. ST morpho CN10 connector

Pin Number	Signal Name	Function
1	LOSC_FSEL0	PLL frequency selection, bit 0
2	LOSC_EN	PLL enable
3	RESET	STHV1600 RESET signal
4	LOSC_FSEL1	PLL frequency selection, bit 1
6	LOSC_FSEL2	PLL frequency selection, bit 2
11	MCLK	PLL clock input signal (from Nucleo)
12	USB D+	USB data +
13	DATAIN3	STHV1600 DATA_INP[3] signal
14	USB D-	USB data -
35	DATAIN0	STHV1600 DATA_INP[0] signal
23	INT	STHV1600 INT signal
26	LD4	LED 4 driving signal

Pin Number	Signal Name	Function
28	LD3	LED 3 driving signal
30	LD2	LED 2 driving signal
34	LD5	LED 5 driving signal
35	DATAIN0	STHV1600 DATA_INP[0] signal
37	DATAIN1	STHV1600 DATA_INP[1] signal

4 How to connect the board and generate wavefoms

4.1 How to connect STEVAL-IME014V1B to your PC

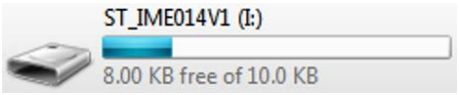
Step 1. Connect a type A to mini type B USB cable between the USB connector on the STEVAL-IME014V1 board and a USB port on your PC

Note: *Use the USB connector on the STEVAL-IME014V1 board, instead of the one on the Nucleo board.*
USB connection is also suitable to provide low voltage supply to the board, while connected.

Figure 7. USB connection

Step 2. A removable disk appears in the Computer Resources.
The name of the disk is ST_IME014V1, with a capacity of 10 KB.

Figure 8. ST_IME014V1 disk drive



1. If the USB device is not recognized, try a USB + charging port with the symbol.
2. If this doesn't work, provide suitable VEXT (pin 4) power supply and GND (pin 5) on the STEVAL-IME014V1D power supply module before connecting the USB cable.

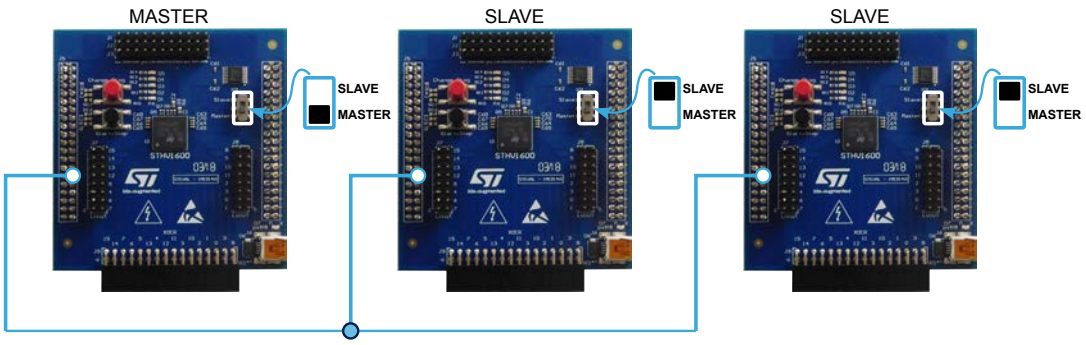
4.2 Multi-board mode

More than one STEVAL-IME014V1B can be chained in a multi-board configuration to simulate a multi-device system. In this mode, all the devices are synchronized to the same trigger event.

One STEVAL-IME014V1B kit must be set to MASTER and the rest set to SLAVE. The trigger is generated by the MASTER, while the SLAVE boards wait for an external trigger.

The external trigger can be provided by a simple wire that is usually connected to the output trigger of the MASTER (pin 28, CN7 connector).

Figure 9. Multiple STEVAL-IME014V1 boards in Master-Slave configuration



4.3 How to generate a waveform

The STEVAL-IME014V1B kit must have a valid .bin file loaded before waveform generation can begin.

Step 1. Connect the required supply voltages according to the specifications.
Disconnect the USB cable when connecting high voltage supplies.

Step 2. Connect the probes you need to evaluate high voltage waveforms and digital signals.

Step 3. Press the PB2 button to select the desired program.
Keep pressing the PB2 button to loop through the available waveform programs.
The currently selected program is indicated in binary format by LEDs D4, D3 and D2:
- D2 on, D3 off, D3 off: program 1 selected
- D2 off, D3 on, D4 off: program 2 selected
- D2 on, D3 on, D4 off: program 3 selected
- D2 off, D3 off, D4 on: program 4 selected

Step 4. Press PB1 to start the program.
In single mode, waveform generation stops automatically at the end of the program.

Step 5. Press PB1 to stop waveform generation in continuous and CW modes.

4.3.1 How to generate waveforms in Multi-board mode

Step 1. Configure each STEVAL-IME014V1 board with a bin file.

Step 2. Select the correct program on each board using PB2.

Step 3. Press the PB1 Start button on each SLAVE module.
LED D1 will blink.

Step 4. Press the PB1 Start button on the MASTER module.
Waveforms are generated on XDCR output pins

Step 5. To stop waveform generation:
- In continuous and CW modes, press the Stop button on the MASTER module and then on all the SLAVE modules.
- In single mode, just press the Stop button on the SLAVE modules.

4.4 How to troubleshoot interrupt events

LED D5 shows any interrupt event triggered by a fault, which stops the device if the related safe condition is enabled into STHV1600 registers. Use the procedure below to check the cause and restart the device, if needed.

Step 1. Press PB1 to stop waveform generation if the current operating mode is Continuous or CW.

Step 2. Check the STEVAL-IME014_log.txt log file written to the ST_IME014V1 drive.
Each line in the log file represents the hexadecimal address of a memory register and a corresponding status code. For example, the code strings returned below reveal the following information:

```
0x1028 0x0F00
```

where `0x1028` = STATUS register and `0x0F00` = all HV voltage references fail

Step 3. Press and hold PB1 for 2 seconds.
LED D5 will turn off and the device will reset.

4.5 Default waveforms

The STEVAL-IME014V1B can store up to four programs in the on-board Flash memory to demonstrate the performance of each pulser output. A default set of selectable patterns is already stored in the Flash memory in a file named prog_def.bin and ready to use.

Important:
It is not recommended to keep the USB connected to the PC while the evaluation kit is powered up with high voltage.

Important:
Before launching any default program, read carefully the behavior of each one. In particular, Program 2 is a CW mode demonstration and cannot be used with HVP1 and HVM1 greater than ±5 V.

4.5.1 Program 1

The first program is based on a 100 MHz CLKSYS and represents a typical 3-level PW mode. In this case, the device can be supplied with up to 100 V.

Odd outputs are all in phase and they are 180° phase-shifted with respect to the even outputs.

All channels are enabled in TX and RX.

Figure 10. Program 1 waveform

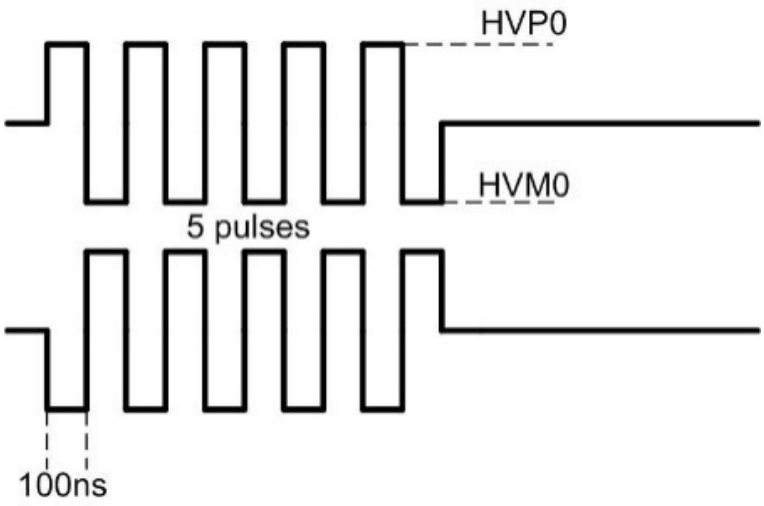


Table 6. Program 1 waveform output

Output	Mode	Frequency [MHz]	Number of pulses	Initial Pulse	PRF [µs]	H-Bridge
XDCR0	PW continuous	5	5	Positive	300	TX0
XDCR1	PW continuous	5	5	Negative	300	TX0
XDCR2	PW continuous	5	5	Positive	300	TX0
XDCR3	PW continuous	5	5	Negative	300	TX0
XDCR4	PW continuous	5	5	Positive	300	TX0
XDCR5	PW continuous	5	5	Negative	300	TX0
XDCR6	PW continuous	5	5	Positive	300	TX0
XDCR7	PW continuous	5	5	Negative	300	TX0
XDCR8	PW continuous	5	5	Positive	300	TX0
XDCR9	PW continuous	5	5	Negative	300	TX0
XDCR10	PW continuous	5	5	Positive	300	TX0
XDCR11	PW continuous	5	5	Negative	300	TX0
XDCR12	PW continuous	5	5	Positive	300	TX0
XDCR13	PW continuous	5	5	Negative	300	TX0

Output	Mode	Frequency [MHz]	Number of pulses	Initial Pulse	PRF [µs]	H-Bridge
XDCR14	PW continuous	5	5	Positive	300	TX0
XDCR15	PW continuous	5	5	Negative	300	TX0

Table 7. **Program 1 state sequence**

XDCR0, XDCR2, XDCR4, XDCR6, XDCR8, XDCR10, XDCR12, XDCR14		XDCR1, XDCR3, XDCR5, XDCR7, XDCR9, XDCR11, XDCR13, XDCR15	
CLAMP	200 t_{CLKSYS}	CLAMP	200 t_{CLKSYS}
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}
CLAMP	200 t_{CLKSYS}	CLAMP	200 t_{CLKSYS}
RX	295 µs	RX	295 µs

4.5.2 Program 2

The second program is based on a 100 MHz SYSCLK and represents a typical CW mode.
Odd outputs are in phase and they are 180° phase-shifted with respect to even outputs.
Only 4 channels run on this program.

Note: *A supply higher than 5 V in not recommended in CW mode due to power dissipation and the evaluation kit limitations.*

Figure 11. **Program 2 waveform**

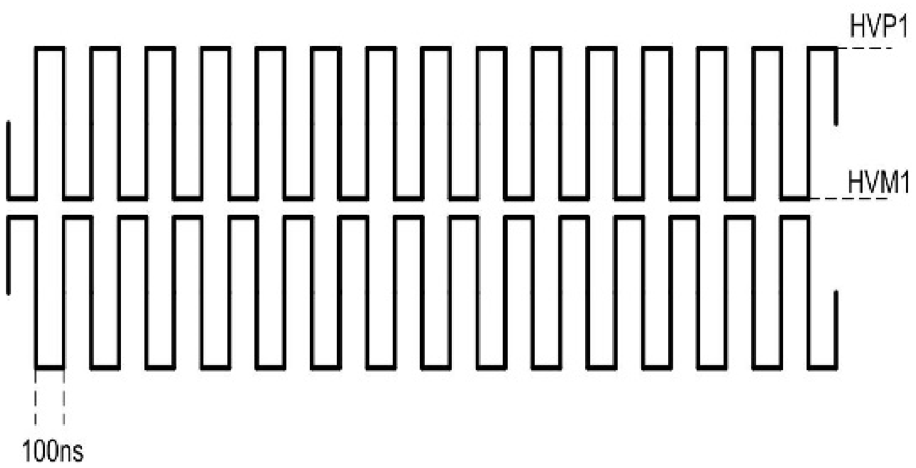


Table 8. **Program 2 waveform output**

Output	Mode	Frequency [MHz]	Initial Pulse	H-Bridge
XDCR0	CW	5	Positive	TX1
XDCR1	CW	5	Negative	TX1
XDCR2	CW	5	Positive	TX1
XDCR3	CW	5	Negative	TX1
XDCR4	NO TX – CLAMP	-	-	-
XDCR5	NO TX – CLAMP	-	-	-
XDCR6	NO TX – CLAMP	-	-	-
XDCR7	NO TX – CLAMP	-	-	-
XDCR8	NO TX – CLAMP	-	-	-
XDCR9	NO TX – CLAMP	-	-	-
XDCR10	NO TX – CLAMP	-	-	-
XDCR11	NO TX – CLAMP	-	-	-
XDCR12	NO TX – CLAMP	-	-	-
XDCR13	NO TX – CLAMP	-	-	-
XDCR14	NO TX – CLAMP	-	-	-
XDCR15	NO TX - CLAMP	-	-	-

Table 9. **Program 2 state sequence**

XDCR0, XDCR2		XDCR1, XDCR3	
HVP0	10 t_{CLKSYS}	HVM0	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}	HVP0	10 t_{CLKSYS}

4.5.3 Program 3

The third program is based on a 100 MHz SYSCLK and represents a 5-level PW mode, with basic beam-steering. Each output shows a 10 ns delay with respect to the previous one.
All channels are enabled in TX and RX.

Figure 12. **Program 3 waveform**

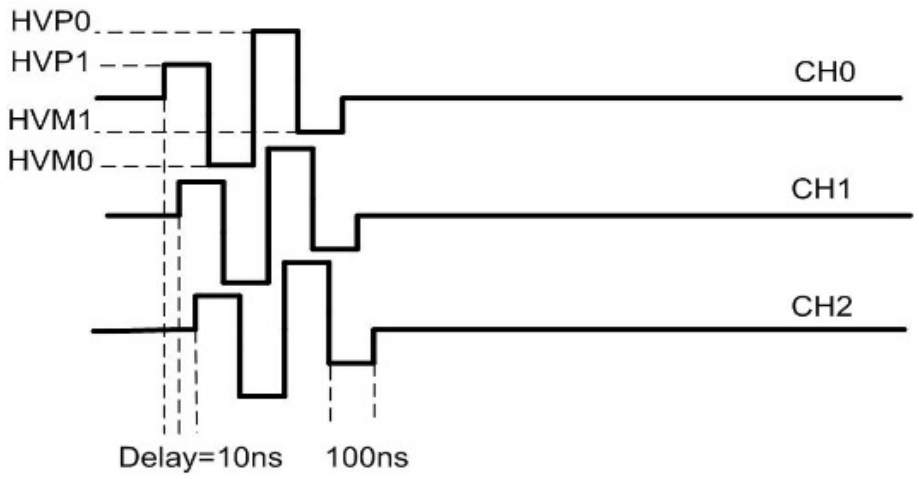


Table 10. **Program 3 waveform output**

Uotput	Mode	Frequency [MHz]	Delay [ns]	Number of pulses	Initial Pulse	PRF [us]	H-Bridge
XDCR0	PW continuous	5	0	2	Positive	300	TX0 and TX1
XDCR1	PW continuous	5	10	2	Positive	300	TX0 and TX1
XDCR2	PW continuous	5	20	2	Positive	300	TX0 and TX1
XDCR3	PW continuous	5	30	2	Positive	300	TX0 and TX1
XDCR4	PW continuous	5	40	2	Positive	300	TX0 and TX1
XDCR5	PW continuous	5	50	2	Positive	300	TX0 and TX1
XDCR6	PW continuous	5	60	2	Positive	300	TX0 and TX1
XDCR7	PW continuous	5	70	2	Positive	300	TX0 and TX1
XDCR8	PW continuous	5	80	2	Positive	300	TX0 and TX1
XDCR9	PW continuous	5	90	2	Positive	300	TX0 and TX1
XDCR10	PW continuous	5	100	2	Positive	300	TX0 and TX1
XDCR11	PW continuous	5	110	2	Positive	300	TX0 and TX1
XDCR12	PW continuous	5	120	2	Positive	300	TX0 and TX1
XDCR13	PW continuous	5	130	2	Positive	300	TX0 and TX1
XDCR14	PW continuous	5	140	2	Positive	300	TX0 and TX1
XDCR15	PW continuous	5	150	2	Positive	300	TX0 and TX1

Table 11. **Program 3 state sequence**

All XDCRs	
CLAMP	200 t_{CLKSYS}
HVP1	10 t_{CLKSYS}
HVM0	10 t_{CLKSYS}
HVP0	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}
CLAMP	200 t_{CLKSYS}
RX	295.5 µs

4.5.4 Program 4

The fourth program is based on a 100 MHz SYSCLK and represents another use of 5-level PW mode.
Odd outputs are in phase and 180° phase-shifted with respect to even outputs.
All channels are enabled both in TX and RX.

Figure 13. **Program 4 waveform**

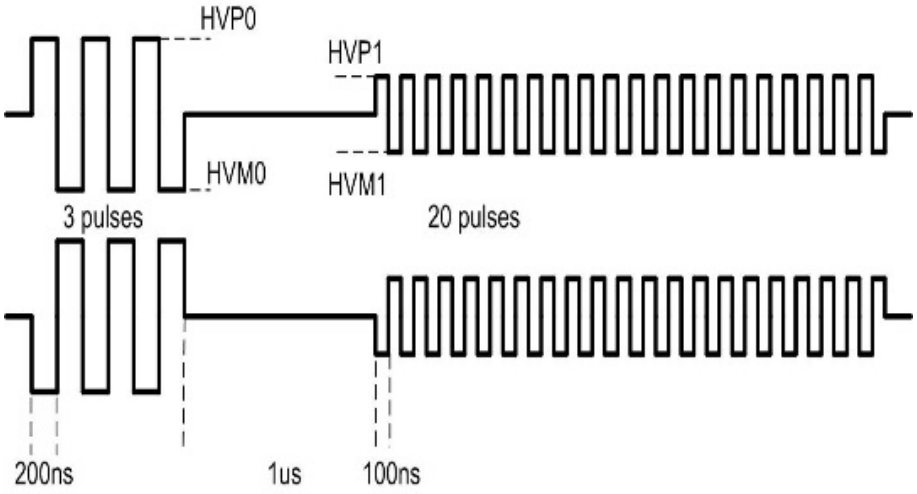


Table 12. **Program 4 waveform output**

Output	Mode	Frequency [MHz]	Number of pulses	Initial Pulse	PRF [µs]	H-Bridge
XDCR0	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR1	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR2	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR3	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR4	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR5	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR6	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR7	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR8	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR9	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR10	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR11	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR12	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR13	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1
XDCR14	PW continuous	2.5 - 5	3 – 20	Positive	300	TX0 – TX1
XDCR15	PW continuous	2.5 - 5	3 – 20	Negative	300	TX0 – TX1

Table 13. **Program 4 state sequence**

XDCR0, XDCR2, XDCR4, XDCR6, XDCR8, XDCR10, XDCR12, XDCR14		XDCR1, XDCR3, XDCR5, XDCR7, XDCR9, XDCR11, XDCR13, XDCR15	
CLAMP	200 t_{CLKSYS}	CLAMP	200 t_{CLKSYS}
HVP0	20 t_{CLKSYS}	HVM0	20 t_{CLKSYS}
HVM0	20 t_{CLKSYS}	HVP0	20 t_{CLKSYS}
HVP0	20 t_{CLKSYS}	HVM0	20 t_{CLKSYS}

XDCR0, XDCR2, XDCR4, XDCR6, XDCR8, XDCR10, XDCR12, XDCR14		XDCR1, XDCR3, XDCR5, XDCR7, XDCR9, XDCR11, XDCR13, XDCR15	
HVM0	20 t_{CLKSYS}	HVP0	20 t_{CLKSYS}
HVP0	20 t_{CLKSYS}	HVM0	20 t_{CLKSYS}
HVM0	20 t_{CLKSYS}	HVP0	20 t_{CLKSYS}
CLAMP	100 t_{CLKSYS}	CLAMP	100 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}

XDCR0, XDCR2, XDCR4, XDCR6, XDCR8, XDCR10, XDCR12, XDCR14		XDCR1, XDCR3, XDCR5, XDCR7, XDCR9, XDCR11, XDCR13, XDCR15	
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
HVP1	10 t_{CLKSYS}	HVM1	10 t_{CLKSYS}
HVM1	10 t_{CLKSYS}	HVP1	10 t_{CLKSYS}
CLAMP	200 t_{CLKSYS}	CLAMP	200 t_{CLKSYS}
RX	295 µs	RX	295 µs

4.6 How to store new waveforms

You can change the default waveforms stored on the STEVAL-IME014V1B by loading new bin files with custom waveforms and configuration setup information.

Step 1. Connect the STEVAL-IME014V1 module to your PC via USB cable.

Step 2. Double click on the Mass Storage drive to open it.

Step 3. Delete any *.bin files on the drive and save a copy of the default programs (prog_def.bin) for future reference.

Step 4. Copy and paste new custom *.bin file (either downloaded from ST website or locally edited with the PC GUI)
The file is now temporarily stored in the RAM.

Step 5. To store the file in the on-board Flash memory, press and hold PB2 for few seconds, until LED D1 flashes, while the USB cable is still connected to the PC

Important: *Do not connect the USB to the PC while the evaluation kit is powered up with high voltage.*

RELATED LINKS

4.1 How to connect STEVAL-IME014V1B to your PC on page 10
GUI documentation on www.st.com
Firmware documentation on www.st.com

5 STEVAL-IME014V1B schematics

Figure 14. **STEVAL-IME014V1 schematic 1**

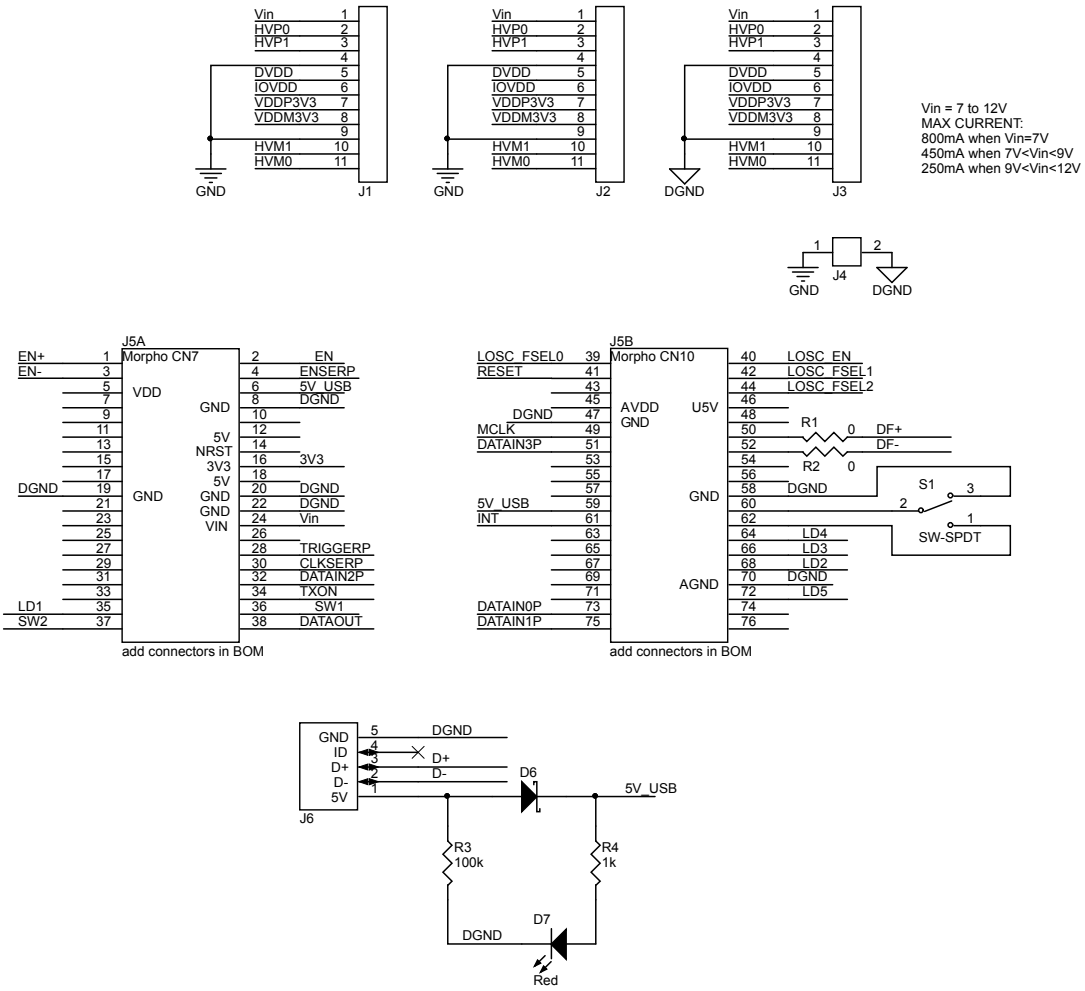


Figure 15. **STEVAL-IME014V1 schematic 2**

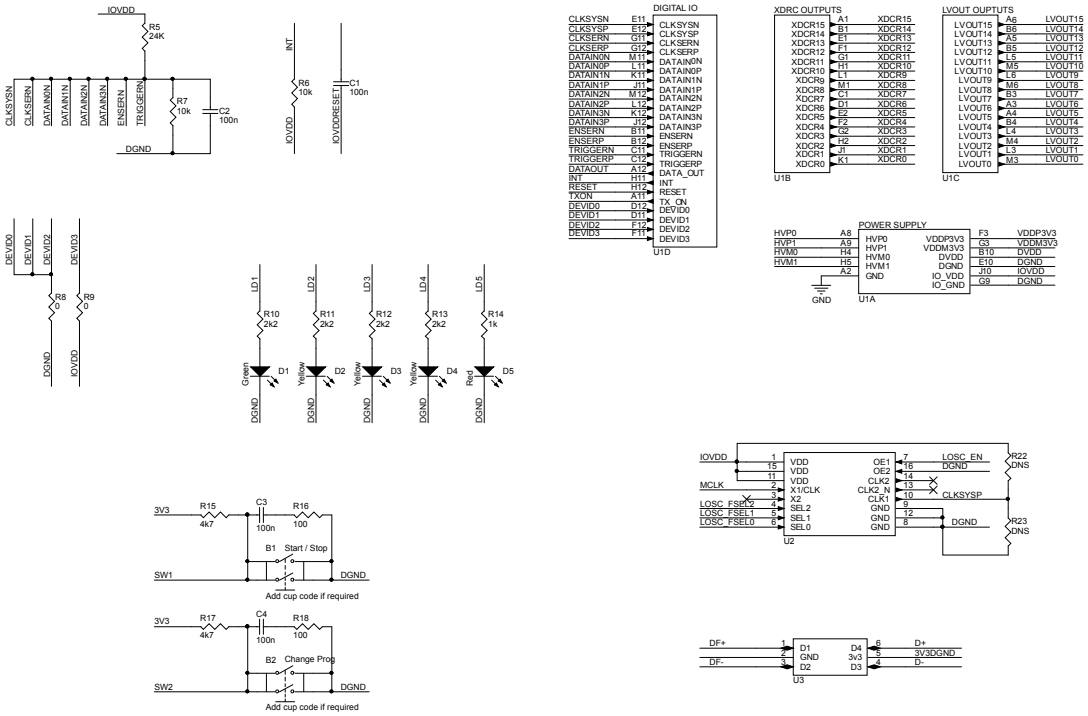


Figure 16. **STEVAL-IME014V1 schematic 3**

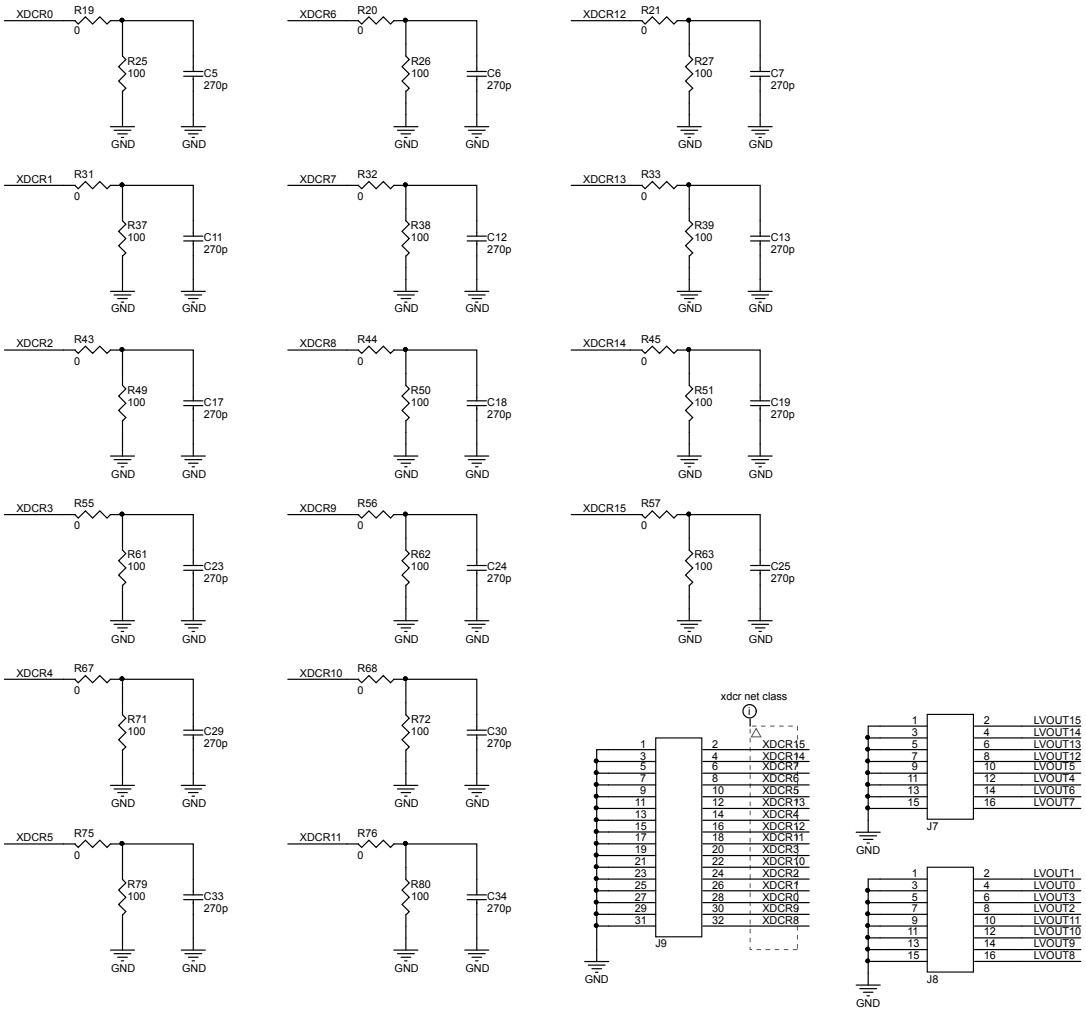


Figure 17. **STEVAL-IME014V1 schematic 4**

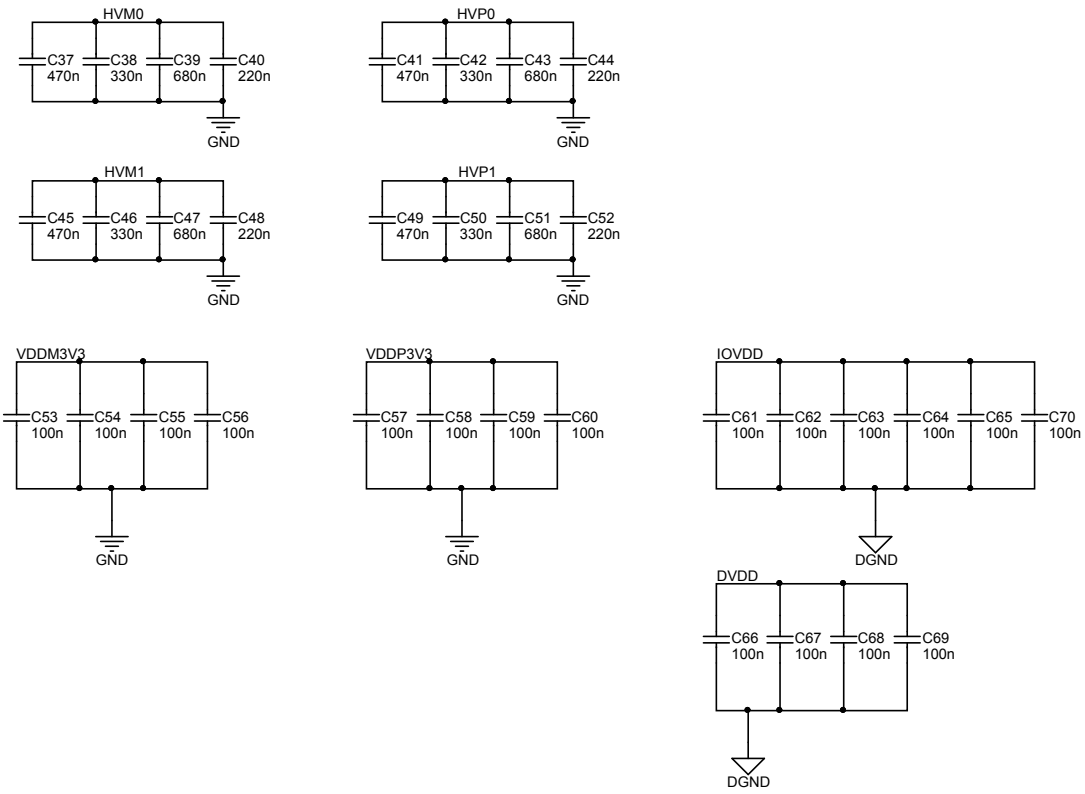
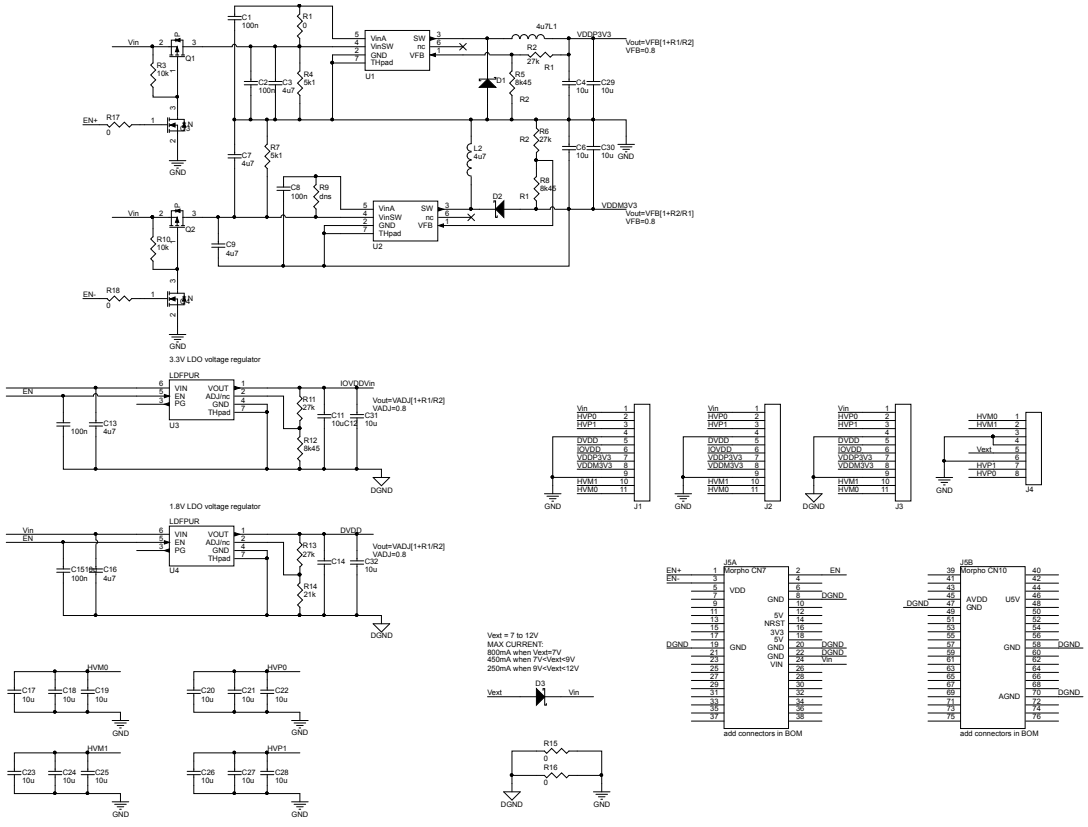


Figure 18. **STEVAL-IME014V1D schematic**



6 Bill of materials

Table 14. **STEVAL-IME014V1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	B1	-	SWITCH TACTILE SPST-NO 0.05A 12V	E-Switch	TL3301SPF260QG
2	1	B1_CUP	-	CUP for button 6x6. RED	E-Switch	-
3	1	B2	-	SWITCH TACTILE SPST-NO 0.05A 12V	E-Switch	TL3301SPF260QG
4	1	B2_CUP	-	CUP for button 6x6. BLACK	E-Switch	-
5	1	C1	100nF 16V	Capacitor not polarized	Any	-
6	1	C11	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
7	1	C12	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
8	1	C13	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
9	1	C17	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
10	1	C18	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
11	1	C19	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
12	1	C2	100nF 16V	Capacitor not polarized	Any	-
13	1	C23	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
14	1	C24	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
15	1	C25	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
16	1	C29	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
17	1	C3	100nF 16V	Capacitor not polarized	Any	-
18	1	C30	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
19	1	C33	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
20	1	C34	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
21	1	C37	470nF 100V ±10%	Capacitor not polarized	Murata	-
22	1	C38	330nF 100V ±10%	Capacitor not polarized	Murata	-
23	1	C39	680nF 100V ±10%	Capacitor not polarized	Murata	-
24	1	C4	100nF 16V	Capacitor not polarized	Any	-
25	1	C40	220nF ±10%	Capacitor not polarized	Murata	GRM21AR72A224KAC5L
26	1	C41	470nF 100V ±10%	Capacitor not polarized	Murata	-
27	1	C42	330nF 100V ±10%	Capacitor not polarized	Murata	-
28	1	C43	680nF 100V ±10%	Capacitor not polarized	Murata	-
29	1	C44	220nF ±10%	Capacitor not polarized	Murata	GRM21AR72A224KAC5L
30	1	C45	470nF 100V ±10%	Capacitor not polarized	Murata	-
31	1	C46	330nF 100V ±10%	Capacitor not polarized	Murata	-
32	1	C47	680nF 100V ±10%	Capacitor not polarized	Murata	-
33	1	C48	220nF ±10%	Capacitor not polarized	Murata	GRM21AR72A224KAC5L
34	1	C49	470nF 100V ±10%	Capacitor not polarized	Murata	-
35	1	C5	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
36	1	C50	330nF 100V ±10%	Capacitor not polarized	Murata	-
37	1	C51	680nF 100V ±10%	Capacitor not polarized	Murata	-
38	1	C52	220nF ±10%	Capacitor not polarized	Murata	GRM21AR72A224KAC5L
39	1	C53	100nF 16V	Capacitor not polarized	Any	-
40	1	C54	100nF 16V	Capacitor not polarized	Any	-
41	1	C55	100nF 16V	Capacitor not polarized	Any	-
42	1	C56	100nF 16V	Capacitor not polarized	Any	-

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
43	1	C57	100nF 16V	Capacitor not polarized	Any	-
44	1	C58	100nF 16V	Capacitor not polarized	Any	-
45	1	C59	100nF 16V	Capacitor not polarized	Any	-
46	1	C6	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
47	1	C60	100nF 16V	Capacitor not polarized	Any	-
48	1	C61	100nF 16V	Capacitor not polarized	Any	-
49	1	C62	100nF 16V	Capacitor not polarized	Any	-
50	1	C63	100nF 16V	Capacitor not polarized	Any	-
51	1	C64	100nF 16V	Capacitor not polarized	Any	-
52	1	C65	100nF 16V	Capacitor not polarized	Any	-
53	1	C66	100nF 16V	Capacitor not polarized	Any	-
54	1	C67	100nF 16V	Capacitor not polarized	Any	-
55	1	C68	100nF 16V	Capacitor not polarized	Any	-
56	1	C69	100nF 16V	Capacitor not polarized	Any	-
57	1	C7	270pF 200V	Capacitor not polarized	Murata Electronics North America	GRM21A5C2D271JW01D
58	1	C70	100nF 16V	Capacitor not polarized	Any	-
59	1	D1	-	LED GREEN	Vishay / Lite-On	LTST-C191KGKT
60	1	D2	-	LED YELLOW	Lite-On Inc.	LTST-C191KSKT
61	1	D3	-	LED YELLOW	Lite-On Inc.	LTST-C191KSKT
62	1	D4	-	LED YELLOW	Lite-On Inc.	LTST-C191KSKT
63	1	D5	-	LED RED	Lite-On Inc.	LTST-C191KRKT
64	1	D6	-	Schottky Diode	ST	STPS2L30A
65	1	D7	-	LED RED	Lite-On Inc.	LTST-C191KRKT
66	1	J1	-	Header, 2.54mm, Male	Any	-
67	1	J2	-	Header, 2.54mm, Male	Any	-
68	1	J3	-	Header, 2.54mm, Male	Any	-
69	1	J4	-	-	Any	-
70	2	J5	-	-	SAMTEC	SSQ-119-23-G-D

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
71	1	J6	-	USB mini connector	Any	-
72	1	J7	-	-	Any	-
73	1	J8	-	-	Any	-
74	1	J9	-	-	Any	-
75	1	R1	0	Resistor	Any	-
76	1	R10	2k2	Resistor	Any	-
77	1	R11	2k2	Resistor	Any	-
78	1	R12	2k2	Resistor	Any	-
79	1	R13	2k2	Resistor	Any	-
80	1	R14	1k	Resistor	Any	-
81	1	R15	4k7	Resistor	Any	-
82	1	R16	100	Resistor	Any	-
83	1	R17	4k7	Resistor	Any	-
84	1	R18	100	Resistor	Any	-
85	1	R19	0	Resistor	Any	-
86	1	R2	0	Resistor	Any	-
87	1	R20	0	Resistor	Any	-
88	1	R21	0	Resistor	Any	-
89	1	R22	DNS	Resistor	Any	-
90	1	R23	DNS	Resistor	Any	-
91	1	R25	100	Resistor	Any	-
92	1	R26	100	Resistor	Any	-
93	1	R27	100	Resistor	Any	-
94	1	R3	100k	Resistor	Any	-
95	1	R31	0	Resistor	Any	-
96	1	R32	0	Resistor	Any	-
97	1	R33	0	Resistor	Any	-
98	1	R37	100	Resistor	Any	-
99	1	R38	100	Resistor	Any	-
100	1	R39	100	Resistor	Any	-
101	1	R4	1k	Resistor	Any	-
102	1	R43	0	Resistor	Any	-
103	1	R44	0	Resistor	Any	-
104	1	R45	0	Resistor	Any	-
105	1	R49	100	Resistor	Any	-
106	1	R5	24K	Resistor	Any	-
107	1	R50	100	Resistor	Any	-
108	1	R51	100	Resistor	Any	-
109	1	R55	0	Resistor	Any	-
110	1	R56	0	Resistor	Any	-

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
111	1	R57	0	Resistor	Any	-
112	1	R6	10k	Resistor	Any	-
113	1	R61	100	Resistor	Any	-
114	1	R62	100	Resistor	Any	-
115	1	R63	100	Resistor	Any	-
116	1	R67	0	Resistor	Any	-
117	1	R68	0	Resistor	Any	-
118	1	R7	10k	Resistor	Any	-
119	1	R71	100	Resistor	Any	-
120	1	R72	100	Resistor	Any	-
121	1	R75	0	Resistor	Any	-
122	1	R76	0	Resistor	Any	-
123	1	R79	100	Resistor	Any	-
124	1	R8	0	Resistor	Any	-
125	1	R80	100	Resistor	Any	-
126	1	R9	0	Resistor	Any	-
127	1	S1	-	SPDT Subminiature Toggle Switch, Right Angle Mounting, Vertical Actuation	Any	-
128	1	U1	-	STHV1600	ST	STHV1600
129	1	U2	-	3.3 V, LVPECL/ LVCMOS Clock Multiplier	ON Semiconductor	NB3N3020DTG
130	1	U3	-	USB filter	ST	USBUF01W6

Table 15. STEVAL-IME014V1D bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	D1	-	Schottky Diode	ST	STPS2L30A
2	1	D2	-	Schottky Diode	ST	STPS2L30A
3	1	D3	-	Schottky Diode	ST	STPS2L30A
4	1	J1	-	Header, 2.54mm	Any	-
5	1	J2	-	Header, 2.54mm	Any	-
6	1	J3	-	Header, 2.54mm	Any	-
7	1	J4	-	-	Phoenix Contact	1751303
8	2	J5	-	-	SAMTEC	SSQ-119-21-G-D
9	1	Q1	-	-	ST	STR2P3LLH6
10	1	Q2	-	-	ST	STR2P3LLH6
11	1	Q3	-	-	ST	STR2N2VH5
12	1	Q4	-	-	ST	STR2N2VH5

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
13	1	U1	-	1.5 A, 1.5 MHz adjustable, step-down switching regulator	ST	ST1S03PUR
14	1	U2	-	1.5 A, 1.5 MHz adjustable, step-down switching regulator	ST	ST1S03PUR
15	1	U3	-	LDO adjustable	ST	LDFPUR
16	1	U4	-	LDO adjustable	ST	LDFPUR
17	1	R1	0	Resistor	Any	-
18	1	R9	dns	Resistor	Any	-
19	1	R15	0	Resistor	Any	-
20	1	R16	0	Resistor	Any	-
21	1	R17	0	Resistor	Any	-
22	1	R18	0	Resistor	Any	-
23	1	C1	100nF 16V	Capacitor not polarized	Any	-
24	1	C2	100nF 16V	Capacitor not polarized	Any	-
25	1	C8	100nF 16V	Capacitor not polarized	Any	-
26	1	C12	100nF 16V	Capacitor not polarized	Any	-
27	1	C15	100nF 16V	Capacitor not polarized	Any	-
28	1	R3	10kΩ	Resistor	Any	-
29	1	R10	10kΩ	Resistor	Any	-
30	1	C4	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
31	1	C6	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
32	1	C11	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
33	1	C14	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
34	1	C17	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
35	1	C18	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
36	1	C19	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
37	1	C20	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
38	1	C21	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
39	1	C22	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
40	1	C23	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
41	1	C24	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
42	1	C25	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
43	1	C26	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
44	1	C27	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
45	1	C28	10µF 100V ±20%	Capacitor not polarized	TDK	CKG57NX7R2A106M500JH
46	1	C29	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
47	1	C30	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
48	1	C31	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
49	1	C32	10µF 10V ±10 %	Capacitor not polarized	Murata	GRM21BR71A106KE51L
50	1	R14	21kΩ ±0.1%	Resistor	TE Connectivity (Tyco Electronics)	RP73PF1J21kΩBTDF
51	1	R2	27kΩ ±0.1%	Resistor	Panasonic / Panasonic ECG	ERA-3AEB273V
52	1	R6	27kΩ ±0.1%	Resistor	Panasonic / Panasonic ECG	ERA-3AEB273V
53	1	R11	27kΩ ±0.1%	Resistor	Panasonic / Panasonic ECG	ERA-3AEB273V
54	1	R13	27kΩ ±0.1%	Resistor	Panasonic / Panasonic ECG	ERA-3AEB273V
55	1	C3	4u7 16V ±10%	Capacitor not polarized	Murata	GRM21BR71C475KA73L
56	1	C7	4u7 16V ±10%	Capacitor not polarized	Murata	GRM21BR71C475KA73L
57	1	C9	4u7 16V ±10%	Capacitor not polarized	Murata	GRM21BR71C475KA73L
58	1	C13	4u7 16V ±10%	Capacitor not polarized	Murata	GRM21BR71C475KA73L
59	1	C16	4u7 16V ±10%	Capacitor not polarized	Murata	GRM21BR71C475KA73L
60	1	L1	4u7 ±20%	Inductor	Vishay / Dale	IHLP2525CZER4R7M01
61	1	L2	4u7 ±20%	Inductor	Vishay / Dale	IHLP2525CZER4R7M01
62	1	R4	5k1	Resistor	Any	-
63	1	R7	5k1	Resistor	Any	-
64	1	R5	8k45 ±0.1%	Resistor	TE Connectivity Passive Product	CPF0603B8K45E1
65	1	R8	8k45 ±0.1%	Resistor	TE Connectivity Passive Product	CPF0603B8K45E2

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
66	1	R12	8k45 ±0.1%	Resistor	TE Connectivity Passive Product	CPF0603B8K45E3

Revision history

Table 16. **Document revision history**

Date	Version	Changes
09-May-2018	1	Initial release.
17-Jan-2020	2	Updated Introduction, Section 2 STEVAL-IME014V1B specifications, Section 2.1 Programs, clock and modes, Section 3.1 Evaluation kit overview, Section 3.1.1 STEVAL-IME014V1D power supply module, Section 3.1.2 STEVAL-IME014V1 pulser module, Table 3. Output supply connector, Section 4.4 How to troubleshoot interrupt events, Section 4.5 Default waveforms, Section 4.5.1 Program 1, Section 4.5.2 Program 2, Section 4.5.3 Program 3 and Section 4.6 How to store new waveforms.

Contents

List of figures

List of tables