EVALST-3PHISOSD evaluation board

Introduction

The EVALST-3PHISOSD evaluation board implements a 3-phase AC/DC current meter that meets the requirements for motor control applications using low-cost, electromagnetic-immune shunt sensors and advanced galvanic-isolation technology.

The evaluation board is based on the high-accuracy ISOSD61 Isolated Sigma-Delta Converter front-end IC, with customizable firmware running on an STM32 microcontroller.

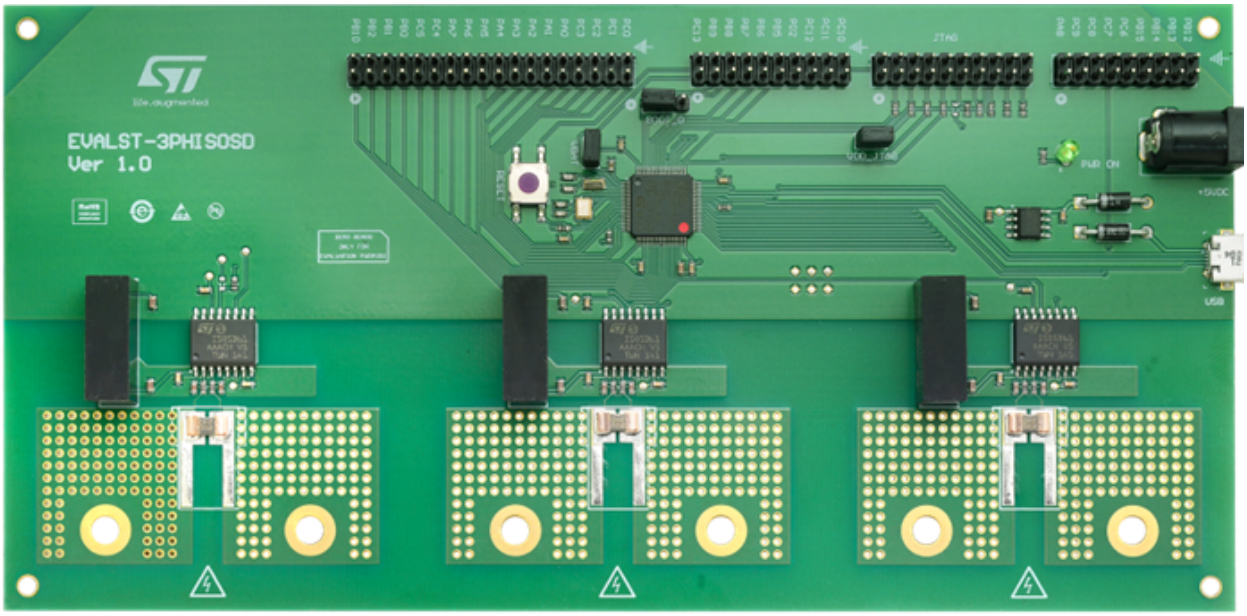
The ISOSD61, a single-channel second-order sigma-delta modulator, measures current for each phase through a shunt current sensor. It oversamples the signal using a synchronized clock distributed by the microcontroller and outputs the converted current sigma-delta bitstream. Three ISOSD61 are used in the 3-phase system to collect the current data from each phase.

Through an isolation barrier based on a thick-oxide technology, the internal digital transceiver transfers data between the isolated domains and guarantees 6 KV VIOTM and 1.2 KV VIORM between the phases.

The firmware implemented on the STPM32F413 uses digital filters for sigma-delta modulator (DFSDM) peripheral to convert modulated data into 24-bit current values and computes all data in real-time every 200 µs.

The firmware also implements a virtual COM port that provides access to internal parameters for reading data and calibrating the board.

Figure 1. EVALST-3PHISOSD



1 Safety and operating instructions

1.1 General terms

Warning: *During assembly, testing, and operation, the evaluation board poses inherent hazards due to high voltage.*

Danger: *There is danger of serious personal injury, property damage or death due to electrical shock if the kit or components are improperly used or installed incorrectly.*

The kit might be electrically connected to high-voltage supply AC/DC inputs. The evaluation board might be directly linked to the mains voltage. No barrier is present between the accessible parts and the high voltage. All measuring equipment must be isolated from the mains before powering the board. When using an oscilloscope with the demo, it must be isolated from the AC line. This prevents shock from occurring because of touching any single point in the circuit but does NOT prevent shock when touching two or more points in the circuit.

All operations involving transportation, installation, use, and maintenance must be performed by skilled technical personnel able to understand and implement national accident prevention regulations. For the purposes of these basic safety instructions, “skilled technical personnel” are suitably qualified people who are familiar with the installation, use, and maintenance of power electronic systems.

1.2 Intended use of evaluation board

The evaluation board is designed for demonstration purposes only. Technical data and information concerning the power supply conditions are detailed in the documentation and should be strictly observed.

1.3 Installing the evaluation board

The board contains electrostatically sensitive components that are prone to damage if used incorrectly. Do not mechanically damage or destroy the electrical components (potential health risks).

1.4 Operating the evaluation board

To properly operate the board, follow these safety rules.

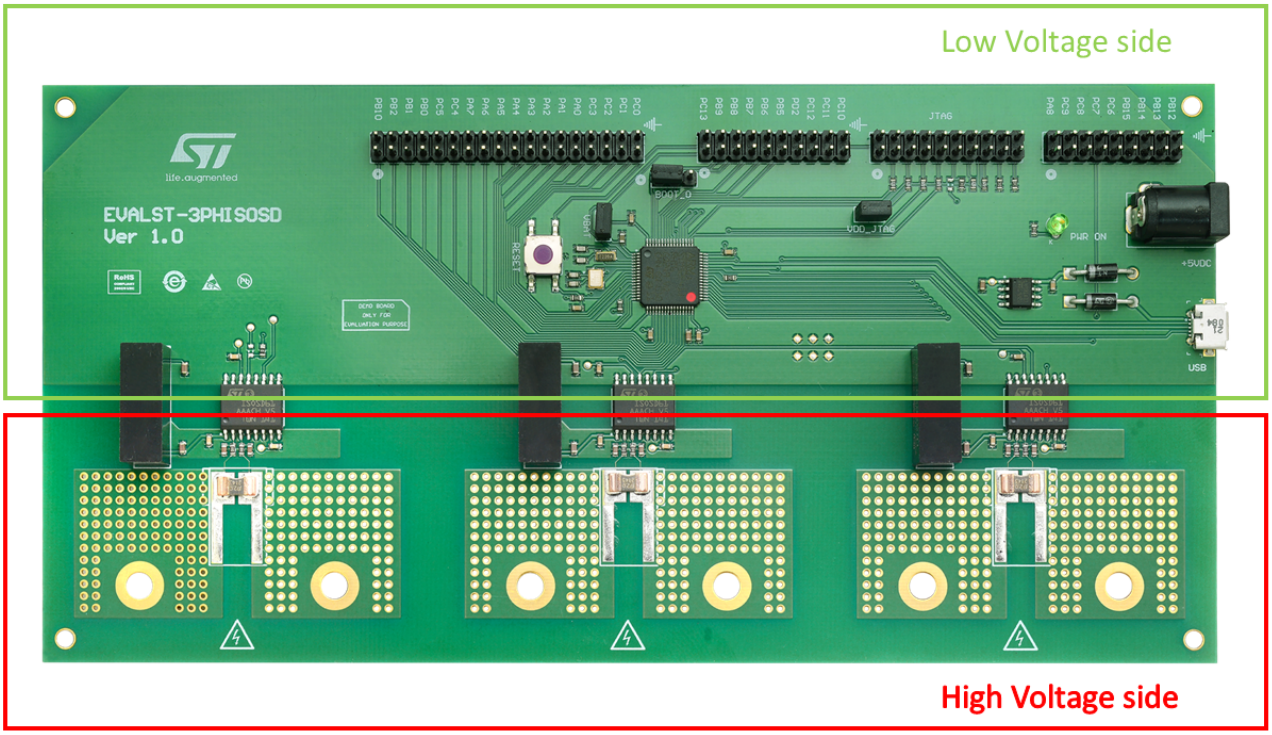
1. Work area safety:
   - The work area must be clean and tidy.
   - Do not work alone when boards are energized.
   - Protect against inadvertent access to the area where the board is energized using suitable barriers and signs.
   - A system architecture that supplies power to the evaluation board must be equipped with additional control and protective devices in accordance with the applicable safety requirements (that is, compliance with technical equipment and accident prevention rules).
   - Use a non-conductive and stable work surface.
   - Use adequately insulated clamps and wires to attach measurement probes and instruments.

2. Electrical safety:
   - Proceed with the arrangement of measurement setup, wiring, or configuration paying attention to high voltage sections.
   - Remove power supply from the board and electrical loads before performing any electrical measurement on the high voltage sections of the board.
   - Once the setup is complete, energize the board.

   Parts of the kit are not electrically isolated from the AC/DC input. The USB interface, the JTAG connector and the strip line connector are in the low voltage side of the board, so they can be used to connect a host computer. Please refer to Figure 2.

3. Personal safety:
   - Always wear suitable personal protective equipment such as, insulating gloves and safety glasses.
   - Take adequate precautions and install the board in such a way to prevent accidental touch. Use protective shields such as, an insulating box with interlocks if necessary.

Figure 2. High and low voltage sides



2 Getting started

2.1 Hardware and software requirements

Using the EVALST-3PHISOSD evaluation board requires the following software and hardware:

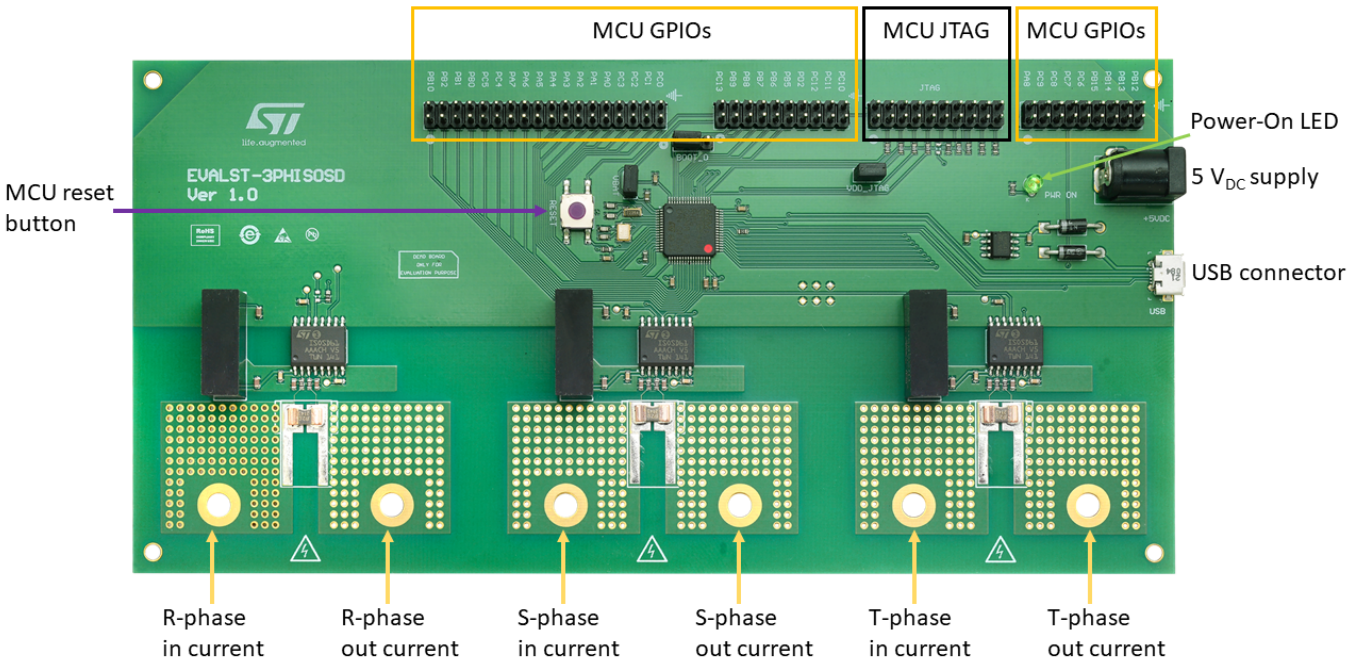
- A Windows PC (XP, Vista, Win 7, Win 8, Win 10) to eventually install the software package available on www.st.com or to communicate through the mini-shell.
- A 'USB type A to Micro-B' cable, used to power on the board (through USB connector CN1) from host PC and to allow communication with terminal or software GUI.
- JTAG Arm debugging probe (optional).
- 3-Ph AC power supply and 3-Ph load or a 3-Ph controlled motor system application.
- Reference ammeter (optional).

The system could be run and evaluated in the following ways:

- Installing the software GUI. In this case, please refer to the related documentation.
- Connecting to a shell terminal on the host PC.
- Using a JTAG Arm debugging probe can be connected to JTAG connector for debugging and programming. For this purpose, it is necessary to install the IDE “IAR Embedded Workbench® for Arm” version 8.5.

2.1.1 Hardware description

Figure 3. EVALST-3PHISOSD boards function description



2.1.1.1 *Power supply*

The board can be supplied alternatively:

- Connecting a USB cable to the PC
- Providing 5 V DC by the coaxial jack

Each phase ISOSD61 is supplied by an independent integrated DC-DC power supply, providing the necessary 5 V to the device.

2.1.1.2 *Board ratings*

The maximum current rating of the board for each phase is 50 ARMS.

2.1.2 Running the built-in demonstration

The board comes with the demonstration firmware preloaded in the flash memory.

Before running your application, you should establish the connection with the board.

Follow the steps below to run it:

- Connect the board to a PC with a 'USB type A to Micro-B' cable through USB connector CN1 to power the board. Green LED (PWR ON) then lights up.
- Connect the board to a 3-phase generator and load as shown in Figure 4, or to the current branches of the motor (Figure 5), then power on the generator/motor supply:

Figure 4. Electric connections (3-phase source and 3-phase loads)

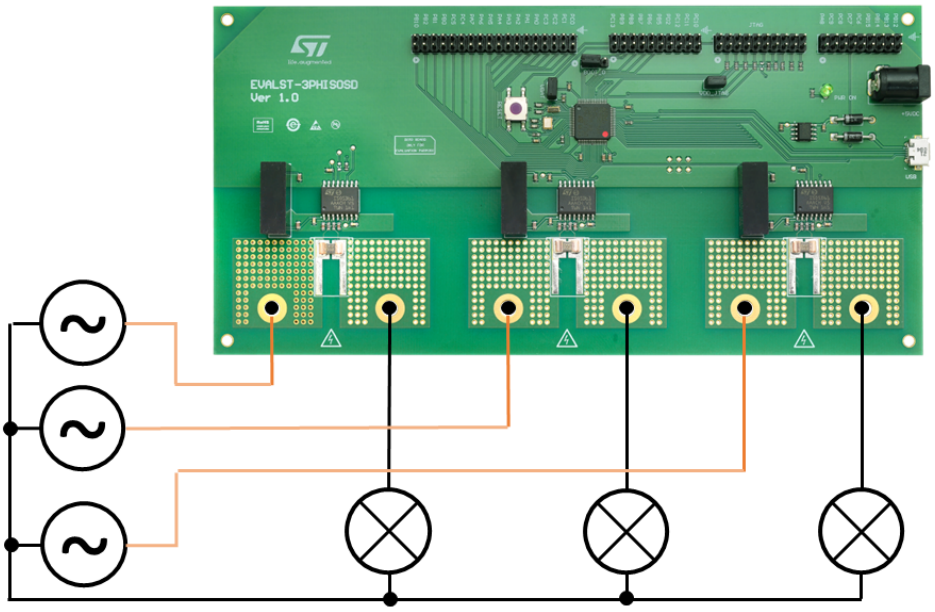
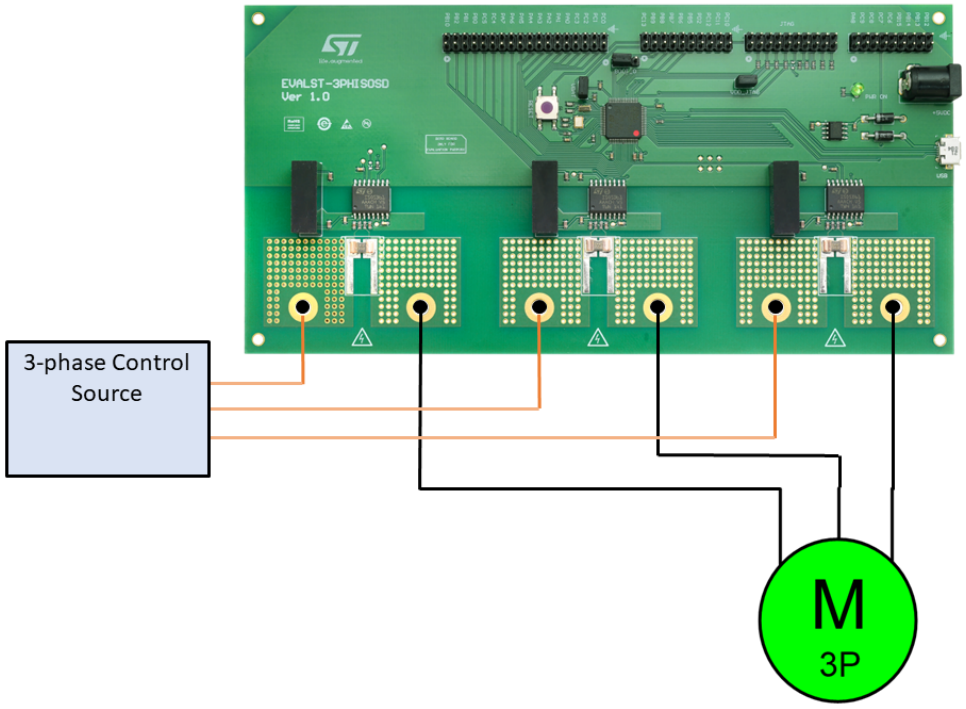


Figure 5. **Electric connections (3-phase controlled motor)**



- Connect a shell terminal to the board virtual COM port as specified in section 4.1 below.
- Alternatively, use the software GUI to read data. For more details on the GUI refer to its User manual.
- For application development and debug, connect the JTAG probe and open the “IAR Embedded Workbench for Arm” IDE. For FW details, refer to related User manual.

2.2 Register access through mini-shell

It is possible to access the calibration and samples data by connecting to the virtual serial COM port associated to the board with the following settings:

- Baud rate: 115200
- Handshake: Request to send
- Parity: None
- Data bits: 8
- Stop bits: 1.

To communicate with the board, use the command set in Table 1, where:

- <phase> could be 1, 2 or 3;
- <address> is the address or the register to read, as in the second column of the registers' map in Table 2;
- <n> is the number of registers to read, the maximum is 70. Consider that some of the registers are unused, they are not listed in Table 2 but are actually present in the memory structure. It is necessary to take them into account when requesting a read or write access on several registers.

Table 1. Minishell commands

Command	Data received
met metro 5 1 <phase> 1	Current sample
met metro 22 1 <phase>	Current samples buffer
met metro 23 1	DFSDM peripheral settings
met rd <phase> <address> <Nb>	Read < Nb > registers starting from <address>
met wr <phase> <address> <Nb> <data1> <data2> … <dataNb>	Write < Nb > registers starting from <address> ; <datax> is the 32 bit register value to write

Table 2. Register map

	Address	(R)ead (W)rite (L)atch	31:28	27:24	23:20	19:16	15:12	11:8	7:4	3:0	Name	Default value
5	0A	RW						CHC [11:0]			DSPCTRL6	00000800
7	0E	RW	Padding		OFFC [23:0]						DSPCTRL8	00000000
25	32	RL	Padding		CSample [23:0]						DSP_REG3	00000000

2.3 Accuracy results

Some of the accuracy test results after calibration are reported below.

Figure 6. AC accuracy

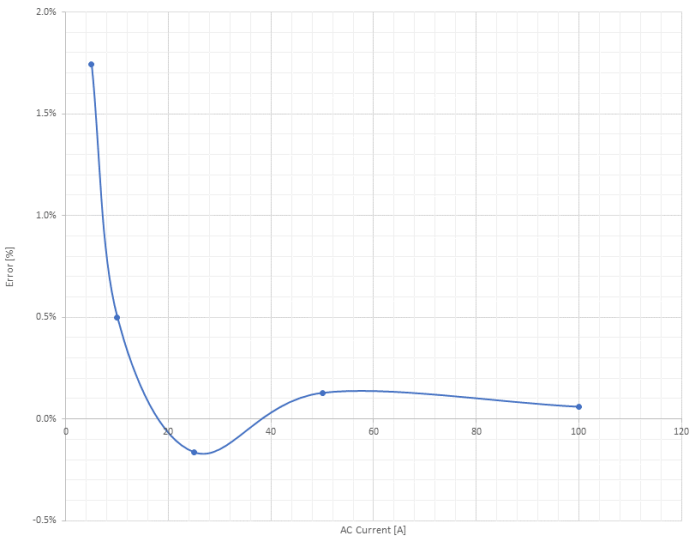
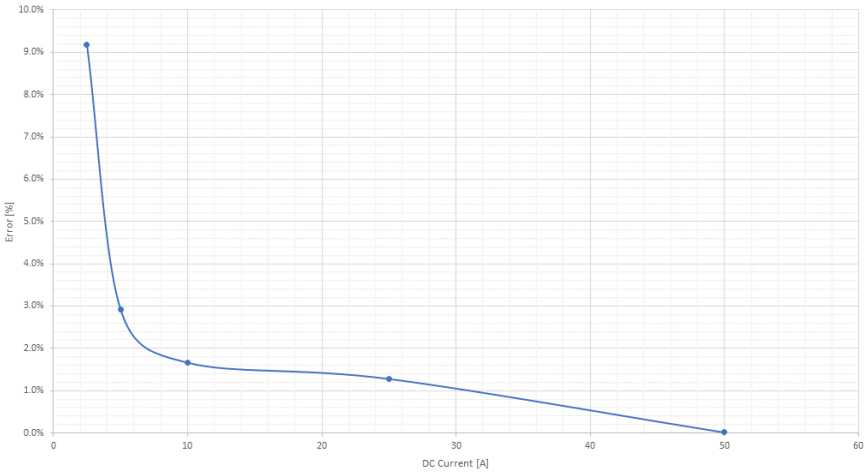


Figure 7. DC accuracy



- **Revision history**

Table 3. Document revision history

Date	Version	Changes
16-Nov-2022	1	Initial release.
24-Nov-2022	2	Minor text change.

Contents

1 **Safety and operating instructions** **2**
1.1 General terms 2
1.2 Intended use of evaluation board 2
1.3 Installing the evaluation board 2
1.4 Operating the evaluation board 2
2 **Getting started** **4**
2.1 Hardware and software requirements 4
2.1.1 Hardware description 4
2.1.2 Running the built-in demonstration 5
2.2 Register access through mini-shell 6
2.3 Accuracy results 7

List of tables

Table 1. Minishell commands 7
Table 2. Register map 7
Table 3. Document revision history 9

List of figures

Figure 1. EVALST-3PHISOSD 1
Figure 2. High and low voltage sides 3
Figure 3. EVALST-3PHISOSD boards function description 4
Figure 4. Electric connections (3-phase source and 3-phase loads) 5
Figure 5. Electric connections (3-phase controlled motor) 6
Figure 6. AC accuracy 7
Figure 7. DC accuracy 8