

Single-Phase Energy Measurement Development Board

Introduction:

The Smart Samaan's Single-Phase Energy Measurement Development Board is a powerful and versatile solution for accurate energy monitoring in residential, commercial, and industrial settings. The key features of this board are:

- STM8S103F3 8-bit controller with 8K Flash, 1K RAM, and 640 Bytes EEPROM having 16MHz advanced processor core.
- Precisely measures energy consumption, instantaneous power, I RMS, and V RMS.
- Dedicated UART pins for communication with the PC via USB serial port (Requires an Isolated USB to Serial Converter).
- I2C port for serial interfacing of OLED displays (e.g., 0.96" or 1.3" OLED display or similar such as I2C-based character LCDs)
- Additional I/O pins for ADC and other purposes

The board includes HLW8012 8-pin metering IC that communicates with the STM8S103F3 to transfer the measured data to the microcontroller. The technical specifications of the HLW8012 are:

- High-frequency pulse CF, indicating active power, meets the accuracy of 50/60Hz IEC 687/1036 standards, in the range of 1000:1 to reach 0.2% accuracy.
- High-frequency pulse CF1 can be configured to output current or voltage RMS, in the range of 500:1 to reach 0.5% accuracy.
- Built-in power supply monitoring circuit, when the power supply voltage is low to 4V, the chip will be reset.
- Operating current is less than 3 mA.

Since there is an onboard microcontroller (STM8S103F3) available for communication with the HLW8012 metering engine, the board can directly be used after programming of STM8S103F3 (see "Default Connection" section for more information).

Measurement Specifications:

The Single-Phase Energy Measurement Development Board incorporates an onboard 1 mΩ shunt resistor to sample the current signal. Therefore, there is no need to connect any current transformer (CT) externally with this board. The maximum current that the board can measure is calculated as follows:

$$V_{peak} = \pm 43.75 \text{ mV}$$

$$I_{max} = \frac{V_{peak}}{R_{shunt}} = \frac{\pm 43.75 \text{ mV}}{1 \text{ m}\Omega} = \pm 43.75 \text{ A (peak)}$$

where, V_{peak} is the maximum voltage signal that can be applied on the current channel pins of the HLW8012. I_{max} is the maximum peak current that can be measured using this board.

The maximum voltage that the board can measure is given as,

$$V_{peak} = \pm 700mV (peak)$$

where, V_{peak} is the maximum voltage signal that can be applied on the current channel pins of the HLW8012. The resistive divider ratio on the voltage pin is 1/1201. Therefore,

$$V_{max} = 1201 \times 700mV \approx 840 V_{peak}$$

Applications:

- Can be used to measure the energy for any single-phase household appliances.
- Can be used to measure the electrical power parameters of industrial single-phase machines.
- Can be used for personal/hobby projects.
- Can be used as smart sockets, digital meters, smart streetlamps, etc.

Default Connection:

Since there is an onboard microcontroller (STM8S103F3) available for communication with the HLW8012 metering engine, the board can be directly used after the programming of STM8S103F3 (programming port using ST-Link v2 is shown in Figure 1), and the electrical parameters can be obtained on the displays as well as on the PC. The default connection diagram is shown in Figure 1. The programming pins and UART serial communication (requires an Isolated USB to Serial Converter which is available at Smart Samaan's Website) pins information is shown in Figure 2.

Single-Phase Energy Measurement Board

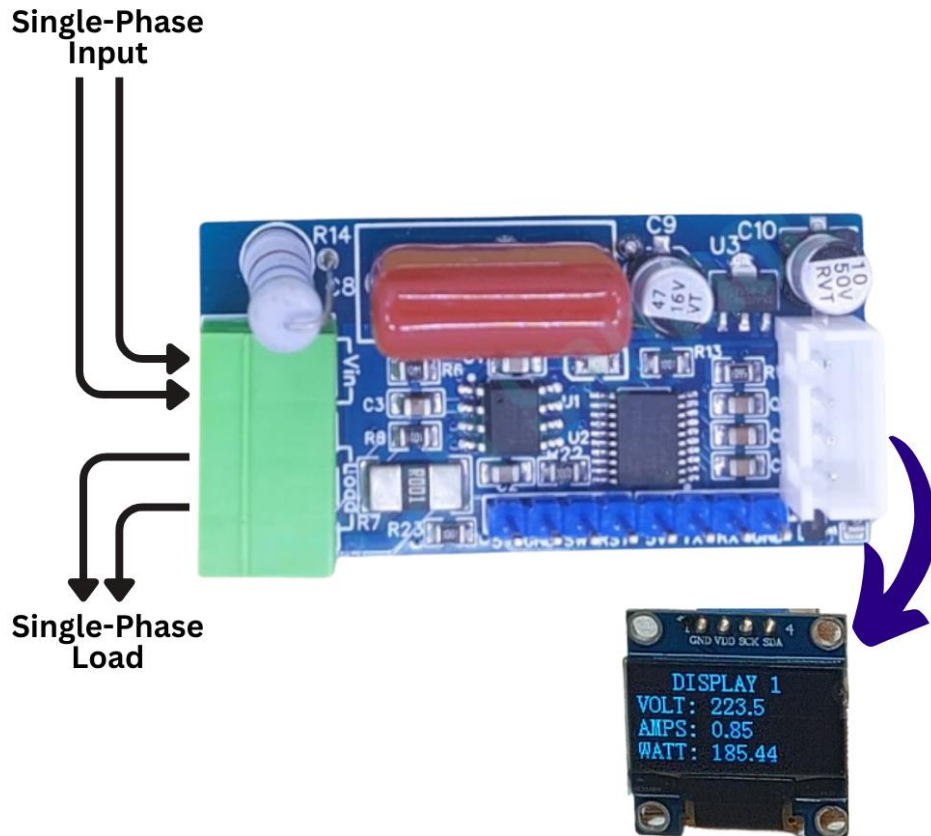
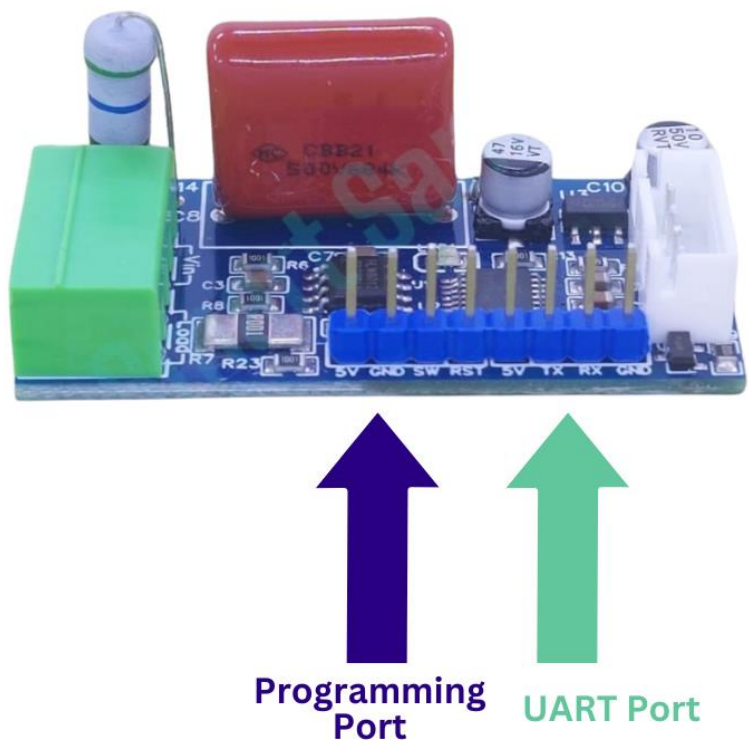


Figure 1: Default connection diagram.



Board Pins	External Connection	Purpose
5V, GND, SW, RST	ST-Link V2	Programming of STM8S103F3
5V, TX, RX, GND	USB-to-TTL Converter	USB Serial Communication with PC

Figure 2: Programming and Serial communication connection diagram.

Sample Code and Library:

The sample C code and library for the Single-Phase Energy Measurement Development with 0.96" OLED display is available at the following repository: <https://github.com/SmartSamaan/Single-Phase-Energy-Measurement-Development-Board>.

Disclaimer: Safety Precautions and Legal Notice

This product is intended for use by trained professionals only. Installation and operation of the Single-Phase Energy Measurement Development Board should be conducted by individuals with the appropriate technical expertise and understanding of electrical systems. It is imperative to adhere to all safety precautions outlined in the provided documentation, including but not limited to, the proper handling of high-voltage components and compliance with relevant electrical codes and regulations.

Warning: The Single-Phase Energy Measurement Development Board is designed to operate with high-voltage electricity. Improper installation, handling, or operation of the board may result in electric shock, serious injury, or even death. Extreme caution must be exercised during all phases of installation, testing, and maintenance to avoid contact with live electrical components.

Limitation of Liability: Smart Samaan and its affiliates shall not be held liable for any damages, losses, or injuries resulting from the use, misuse, or inability to use the Single-Phase Energy Measurement Development Board. Users assume all risks associated with the installation and operation of this product.

Indemnification: By purchasing and using the Single-Phase Energy Measurement Development Board, the user agrees to indemnify and hold harmless Smart Samaan, its officers, employees, and agents against any and all claims, damages, liabilities, costs, and expenses arising from the use or misuse of the product.

Product Modification: Any modification, alteration, or tampering with the Single-Phase Energy Measurement Development Board, including but not limited to, removing safety features or bypassing recommended procedures, voids any warranty and may result in increased risk of injury or damage.

Legal Compliance: Users are responsible for ensuring that the installation and operation of the Single-Phase Energy Measurement Development Board comply with all applicable laws, regulations, and standards in their jurisdiction.

Safety Certification: The Single-Phase Energy Measurement Development Board may not have undergone formal safety certification. Users are advised to verify compliance with relevant safety standards and regulations before deployment.

For Professional Use Only: This product is intended for use by professionals trained in electrical engineering or a related field. It is not suitable for use by unqualified individuals or in residential settings without proper supervision and expertise.

Contact Information: For inquiries regarding safety, installation, or technical support, please contact Smart Samaan at info@smartsamaan.com.