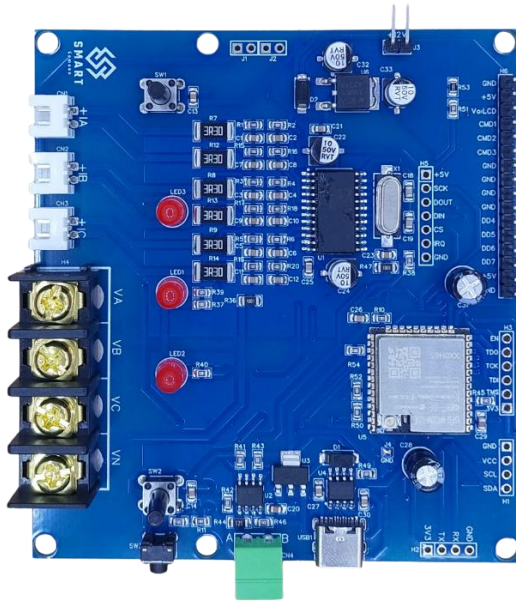# Smart IntelliMeter Pro: WiFi & Bluetooth Based Three-Phase Bidirectional Energy Metering Evaluation/Development Board

Introduction:

Smart IntelliMeter Pro SS-IP3BEM is an industrial grade WiFi MCU based 3-phase bidirectional energy metering development/evaluation board with an onboard ESP32-WROOM-32UE WiFi/Bluetooth controller incorporating a RS-485 communication port. The board has the capability to interface with a character LCD (16x2, 20x2, 16x4, or 20x4) in 4-bit mode as well as a serial I2C display. The on-chip flash memory of the controller is used to store the energy variables as well as calibration constants. The main features of the board are:

- ESP32-WROOM-32UE controller 4MB Flash, 448kB ROM, 536kB SRAM
- WiFi protocol: 802.11b/g/n, Bluetooth v4.2 +EDR, Class 1, 2 and 3
- USB Type-C port for serial communication between the board and PC to access measurement data on the PC as well as programming of the MCU.
- I2C port for serial interfacing of OLED displays (e.g., 0.96" or 1.3" OLED display or similar)
- 4-bit interface for character LCDs (e.g., 16x2, 20x2, 16x4, 20x4 or similar)
- A JTAG interface for programming of the MCU using ESP-IDF
- Two pushbuttons for custom navigation of LCD display windows
- RS-485 communication port for industrial grade communication with other devices

The board includes ADE7758 24-pin SOIC which can also communicate via SPI communication with any external microcontroller unit to get the energy measurements. The technical specifications of the ADE7758 are:

- Highly accurate; supports IEC 60687, IEC 61036, IEC 61268, IEC 62053-21, IEC 62053-22, and IEC 62053-23
- Compatible with 3-phase/3-wire, 3-phase/4-wire, and other 3-phase services
- Less than 0.1% active energy error over a dynamic range of 1000 to 1 at 25°C
- Supplies active/reactive/apparent energy, voltage RMS, current RMS, and sampled waveform data.
- Two pulse outputs, one for active power and the other selectable between reactive and apparent power with programmable frequency
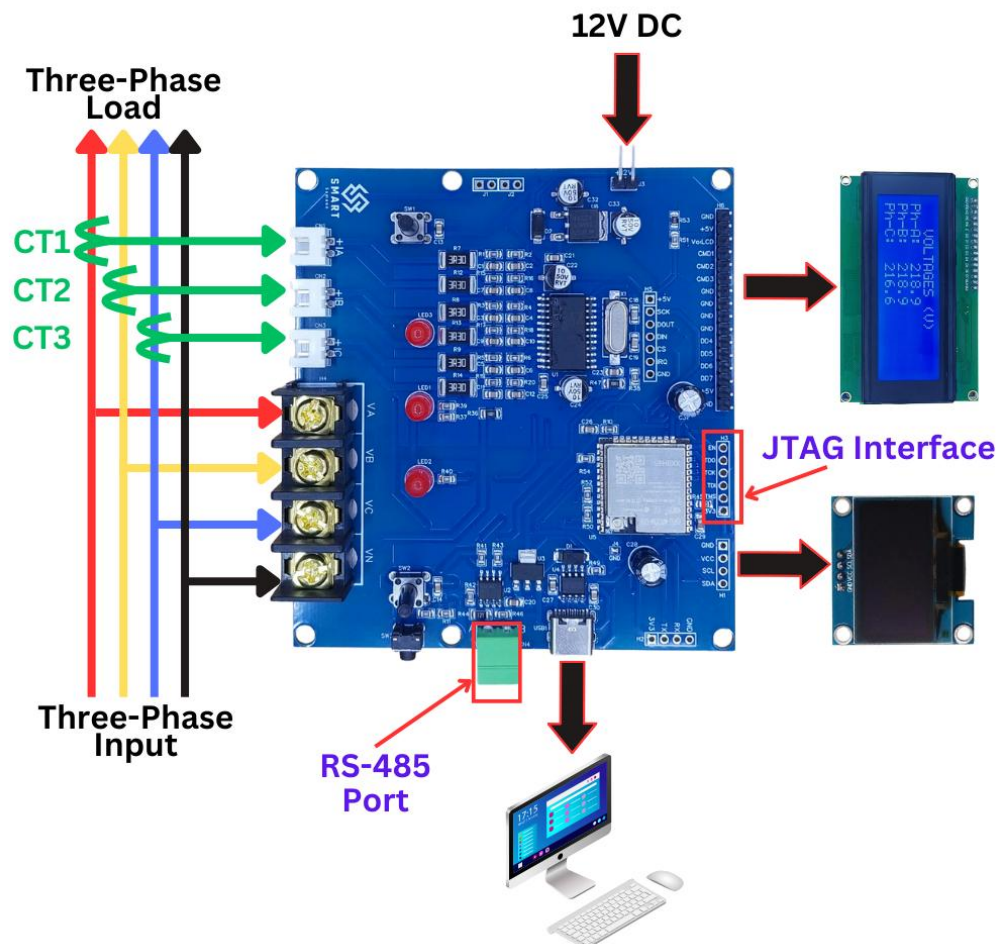
- Digital power, phase, and RMS offset calibration.
- On-chip, user-programmable thresholds for line voltage SAG and overvoltage detections
- An on-chip, digital integrator enables direct interface-to-current sensors with di/dt output.
- A PGA in the current channel allows a direct interface to current transformers.
- A SPI-compatible serial interface with IRQ
- 3-phase bidirectional energy measurement

Since there is an onboard MCU (ESP32) available for the communication with ADE7758 metering engine, the board can directly be used after programming of ESP32 (see "Default Connection" section for more information).

Connection Diagram:

Since there is an onboard microcontroller (ESP32) available for the communication with ADE7758 metering engine, the board can be directly used after the programming of ESP32 (via the USB Type-C port), and the electrical parameters can be obtained on the displays as well as on the PC. The connection diagram for this mode is shown in Figure 1.

Note: For factory programmed boards, select appropriate options while ordering.

Figure 1: Connection diagram.

Applications:

- Can be used to measure the energy for any three-phase household appliances.
- Can be used to measure the electrical power parameters of industrial machines.
- Can be used for personal/hobby projects.

SMPS Power Supply Unit Integration:

The R&D team of Smart Samaan has developed an EMC compliance-based switch mode power supply board which can be installed on the Smart IntelliMeter Pro board. In this way the Smart IntelliMeter Pro board can be powered internally from the Phase-A of the three-phase input connected to it. The connection diagram for this mode is shown in Figure 2.
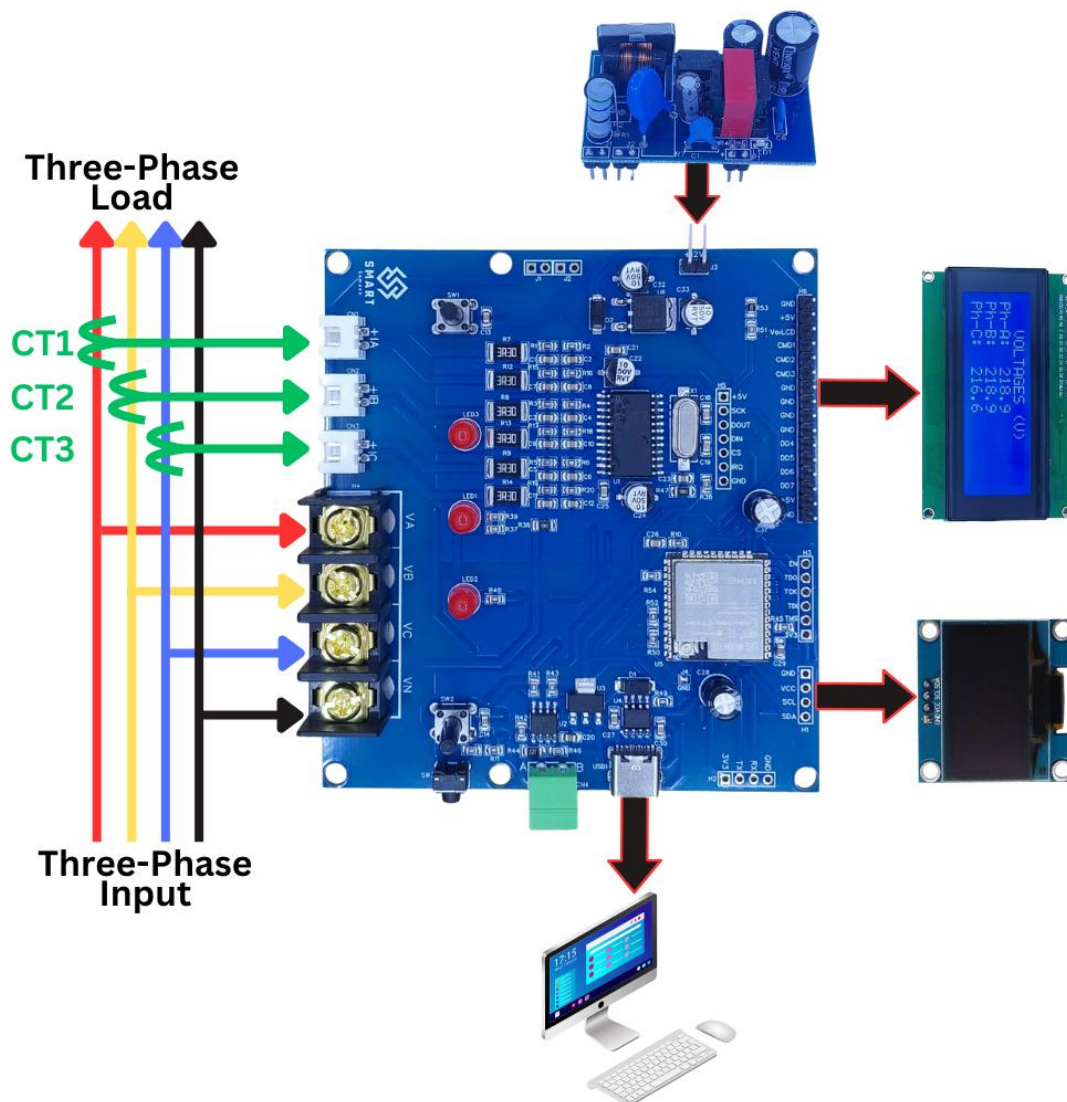

Figure 2: SMPS power supply integration diagram.

Sample Code and Library:

The sample C code and library for the Smart Intellimeter Pro development board with 20x4 character LCD is available at the following repository: https://github.com/SmartSamaan/SS-IP3BEM_Smart_IntelliMeter_Pro.

Disclaimer: Safety Precautions and Legal Notice

This product is intended for use by trained professionals only. Installation and operation of the Smart IntelliMeter Pro 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 Smart IntelliMeter Pro 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 Smart IntelliMeter Pro board. Users assume all risks associated with the installation and operation of this product.

Indemnification: By purchasing and using the Smart IntelliMeter Pro 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 Smart IntelliMeter Pro 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 Smart IntelliMeter Pro board comply with all applicable laws, regulations, and standards in their jurisdiction.

Safety Certification: The Smart IntelliMeter Pro 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.