# Assisted Solar System – S-Block Inverter Data Monitoring

**Project Progress Report**

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## 1. Requirements

The components and tools required for this project are:

### 1. TTGO SIM7600E-H LTE CAT-4 Module with ESP32-WROVER-B Chip

- Built-in GSM/LTE module (SIM7600E-H) for mobile data communication
- ESP32-WROVER-B microcontroller for processing and connectivity
- Integrated Wi-Fi and Bluetooth support
- CP2104 USB-to-UART chip for programming and debugging
- 18650 battery holder and solar charging support for standalone operation
- Product Link: https://rarecomponents.com/store/ttgo-sim7600e-h?utm_source=chatgpt.com
- **Detailed explanation about TTGO SIM7600E-H LTE CAT-4 Module with ESP32-WROVER-B**

  This is a multi-functional development board that combines both computing and communication features in one device. It removes the need to use separate boards for processing and internet connectivity.
  **Key Features:**

  **ESP32-WROVER-B Microcontroller**:
  - Acts as the “brain” of the system.
  - Reads data from the inverter and processes it before sending.
  - Built-in Wi-Fi and Bluetooth for additional connectivity options.
  - Supports programming via Arduino IDE or PlatformIO

  **SIM7600E-H LTE CAT-4 Module:**
  - A high-speed 4G LTE modem that allows the device to connect to the internet using a SIM card.
  - Supports GSM, GPRS, EDGE, WCDMA, and LTE networks.
  - Ensures that inverter data can be sent to a cloud database even without local Wi-Fi.

**CP2104 USB-to-UART Chip:**

- Used for programming and debugging through USB.
- 18650 Battery Support with Solar Charging:
- Allows the board to be powered even during power cuts.
- Can be connected directly to a small solar panel for backup.

**Why We Chose This Module:**

- Instead of buying a separate ESP32 board and a separate GSM module, this single device does both jobs, saving space, reducing wiring complexity, and improving reliability.

## 2. RS-485 Module

- To interface with the Blueplanet 50.0 TL3 M1 inverter
- Required for Modbus RTU communication to retrieve inverter data
- **Detailed explanation about RS-485 to TTL Adapter Module**

The RS-485 interface is the communication standard used by the Blueplanet inverter to share data. Since the ESP32 works on TTL (Transistor-Transistor Logic) levels, an RS-485 to TTL adapter is required to bridge the two.
**Key Features**:

**RS-485 Communication Support:**

- Allows long-distance, noise-resistant communication between the inverter and our device.
- Supports Modbus RTU protocol, which is used to read parameters like voltage, current, and power generation.

**TTL Output:**

- Converts the RS-485 signals from the inverter into a format the ESP32 can understand.

**Stable and Low-Power Design:**

- Works reliably in outdoor/industrial conditions.

**Why We Chose This Adapter:**

- Without it, the ESP32 would not be able to directly read the inverter's data. This small, low-cost module is the essential link between the inverter and the microcontroller.

## 2. Problem Statement

The S-Block in our college is equipped with a Blueplanet 50.0 TL3 M1 solar inverter. Currently, there is no system in place to monitor or visualize the solar energy data generated by this inverter on a central platform.

In contrast, other newly installed blocks (GCC and Mech, Drawing Hall, AD Block) already have third-party systems that collect inverter data and display it on a website with graphs and analytics.

Our goal is to replicate a similar setup for the S-Block by:

Collecting real-time inverter data (units generated, voltage, yield, etc.) via RS-485 communication

Sending this data to a cloud database using GSM/LTE connectivity

Displaying the stored data on a website dashboard in a graphical format

## 3. Approach

Initially, the plan was to use ESP32 and GSM module as two separate devices:

ESP32 for data processing

GSM module for cloud communication

However, after research, we decided to use the TTGO SIM7600E-H LTE CAT-4 Module, which already integrates ESP32 + GSM/LTE modem in a single board.

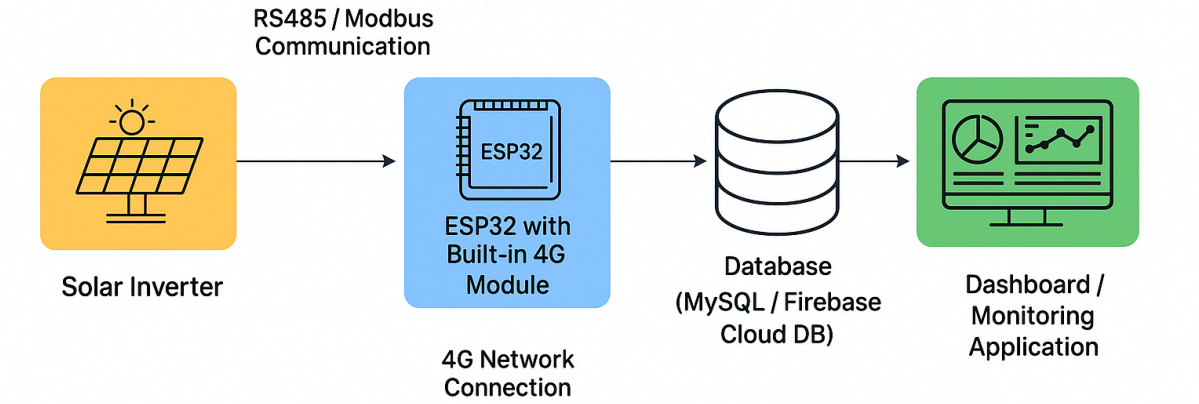
This revised approach offers the following benefits:

Reduced wiring and complexity

Lower power consumption

Compact form factor for easier installation near the inverter

Built-in support for both Wi-Fi and mobile networks




Flow chart of solar inverter data monitoring

## 4. Progress Made

So far, we have:

Researched the Blueplanet 50.0 TL3 M1 inverter's communication methods (Modbus RTU over RS-485)

Identified the hardware requirements (TTGO SIM7600E-H LTE CAT-4 Module + RS-485 module)

Finalized the communication flow from inverter → RS-485 → ESP32 (TTGO) → GSM/LTE → Cloud → Website

Understood the advantages of an integrated GSM + ESP32 module compared to separate devices

## 5. Current Stage

The current stage of the project is:

Ordering the TTGO SIM7600E-H LTE CAT-4 Module with ESP32-WROVER-B

Procuring the RS-485 module for communication with the inverter

Once these components arrive, they will be connected together for hardware testing.

## 6. Next Steps

After receiving and assembling the hardware:

1. Hardware Connection

- Connect RS-485 module to the TTGO SIM7600E-H board
- Connect RS-485 A/B lines to the inverter's RS-485 terminals

2. Software Development

- Write an ESP32 firmware to read inverter data via Modbus RTU
- Parse and format the collected data (voltage, current, units generated, yield)

3. Cloud Integration

- Use the SIM7600E-H LTE modem to send data to a cloud database (e.g., Firebase, MySQL server)
- Set up cloud APIs to store and retrieve the data

4. Website Dashboard

- Build a web interface to display stored data in graphs, tables, and daily reports
- Ensure mobile and desktop compatibility

## 7. Expected Outcome

By the end of the project, we expect to have a fully functional solar monitoring system for the S-Block, which will:

Collect real-time data from the Blueplanet 50.0 TL3 M1 inverter via RS-485

Upload data automatically to the cloud using GSM/LTE connectivity

Present the data in a web dashboard with visual analytics such as daily generation charts, monthly reports, and real-time status

Enable remote monitoring without relying on LAN or campus Wi-Fi infrastructure

This system will bring the S-Block's monitoring capabilities on par with the other new blocks, while being cost-effective and scalable for future installations.