Assisted Solar System - S-Block Inverter Data Monitoring

By Sai Prakash, Prudhvi, Manohar, Kiran, Narendra, Bhaskar, Abhilash, Mahesh

Components Used And It's Estimated Cost:

Sl.No	Component Name	Specification	Cost Per Unit	Quantity	Total Cost
1.	MAX485	RS-485 Transceiver Module	Rs. 25 – Rs. 30	1	Rs. 25 – Rs. 30
2.	TTGO SIM7600E-H	LTE CAT-4 Module with ESP32-WROVER-B Chip	Rs. 6500 - Rs. 6900	1	Rs. 6500 - Rs. 6900
3.	Resistor	120 Ω	Rs. 5	1	Rs. 5
4.	Capacitor	100 µF	Rs. 5	1	Rs. 5
5.	Jumper Wires	Set of 10-15 Male-to-Male/Female-to-Male wires	Rs. 50 per set	1 Set	Rs. 50
	Total:-				**Rs. 6585 - Rs. 6995**

Component Estimated Cost is in between Rs.6,583 - Rs.6,983

Product Links:

Sl.No	Component Name	Product link
1.	MAX485	https://robu.in/product/max485-ttl-rs485/?gad_source=1&gad_campaignid=21296336107
2.	TTGO SIM7600E-H	https://hubtronics.in/ttgo-sim7600e-h-q210
3.	Resistor	Offline Store
4.	Capacitor	Offline Store
5.	Jumper Wires	Offline Store

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TTGO SIM7600E-H

The **TTGO T-Call SIM7600E-H** is a compact development board combining the ESP32 microcontroller with the SIMCom SIM7600E-H LTE Cat-4 module. This integration enables both Wi-Fi/Bluetooth and 4G LTE cellular connectivity, making it ideal for IoT applications where internet access via cellular networks is essential. The board supports LTE, 3G, and 2G networks along with multiple GNSS systems (GPS, GLONASS, BeiDou, Galileo), allowing for location tracking and mobile data transfer without relying on external Wi-Fi sources.

With its dual-core ESP32 processor running up to 240 MHz, the TTGO SIM7600E-H can handle sensor data collection, processing, and direct cloud communication. The board features a nano-SIM slot, dedicated LTE and GPS antenna connectors, and a microSD card slot for data logging. Communication with the SIM7600E-H module is done via UART using AT commands, allowing HTTP, MQTT, FTP, and TCP/UDP data transfers. It can be powered through USB-C, a Li-ion battery, or an external 5 V source, with onboard charging support.

This board is widely used in applications such as remote monitoring, solar inverter data uploading, asset tracking, smart agriculture, and industrial IoT systems. Its design makes it easy to connect additional sensors and peripherals via GPIO, I²C, or SPI interfaces. A common use case is reading data from RS485/Modbus devices through a MAX485 converter, processing it in the ESP32, and sending it to cloud servers over 4G. GPS data can also be integrated for location-based services.

Power efficiency is an important consideration, as the LTE module can draw bursts of up to 2 A during transmission. For battery-powered projects, developers often use ESP32 deep sleep modes and control the SIM7600E-H power state to extend runtime. With the right power supply, antenna placement, and firmware, the TTGO SIM7600E-H offers a reliable and versatile solution for long-range, always-connected IoT deployments.

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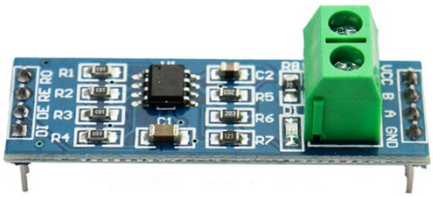
MAX485



The **MAX485 module** is a compact, low-power transceiver designed for RS-485 communication, widely used for long-distance and reliable serial data transmission in industrial environments. Built around the Maxim Integrated MAX485 IC, it allows microcontrollers to communicate with RS-485 devices using a single differential pair of wires. RS-485 supports multi-drop configurations, enabling multiple devices to share the same bus over distances of up to 1,200 meters while maintaining high noise immunity.

The MAX485 operates at a low supply voltage of 5 V and consumes minimal power, making it ideal for energy-efficient systems. It supports half-duplex communication, meaning the same pair of wires is used for both transmitting and receiving data, controlled via two enable pins (DE for driver enable, RE for receiver enable). Data is interfaced to the microcontroller through TTL-level UART pins (RO for receive output, DI for data input). This makes it easy to connect to controllers like Arduino, ESP32, or STM32 for Modbus, DMX, and other RS-485 protocols.

In practical IoT and industrial projects, the MAX485 is often used to connect microcontrollers to devices such as PLCs, energy meters, solar inverters, and environmental sensors. For example, in a solar monitoring setup, the MAX485 can read data from an RS-485 Modbus inverter and pass it to an ESP32 or similar MCU, which then sends the data to the cloud over Wi-Fi, Ethernet, or LTE. Its differential signaling allows it to work reliably in electrically noisy environments like factories or outdoor installations.

To ensure optimal performance, the RS-485 bus should have termination resistors (typically 120 Ω) at both ends to reduce signal reflections. The module should also be connected with twisted-pair cables to improve noise rejection. Proper handling of DE and RE control lines is essential for switching between transmit and receive modes without data collision. With its simplicity, low cost, and reliability, the MAX485 module remains one of the most popular choices for RS-485 communication in embedded and industrial systems.