PZEM-004T with PCBcubid Glyph C6 Board:

1. Introduction

The PZEM-004T is an energy monitoring module designed for measuring voltage, current, active power, energy, frequency, and power factor. This module is commonly used in IoT-based energy monitoring systems. In this project, the PZEM-004T is interfaced with the PCBcubid Glyph C6 board, which is based on the ESP32 microcontroller, enabling wireless data transmission and integration with a gateway using ESP-NOW and MQTT protocols.

2. PZEM-004T Module Overview

The PZEM-004T communicates over a UART interface using the Modbus-RTU protocol. Key features include:
- Voltage Measurement: 80–260V AC
- Current Measurement: 0–100A (with external CT sensor)
- Frequency Range: 45–65Hz
- Active Power: Calculated in real-time
- Energy Consumption: Stored in internal memory
- Power Factor: Indicates electrical efficiency

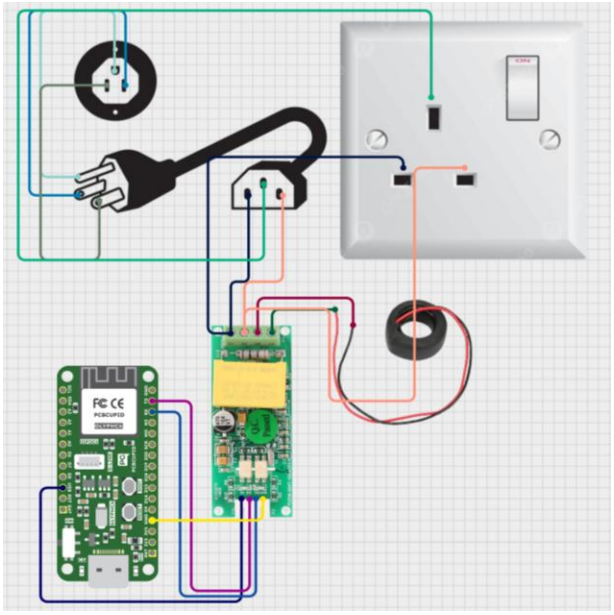
It is ideal for smart energy metering applications.

3. Integration with PCBcubid Glyph C6 Board

The PCBcubid Glyph C6 is based on the ESP32 module and includes sufficient GPIOs for UART communication and sensor interfacing. Integration involves serial communication using HardwareSerial, powered by a regulated 5V supply.

4. Wiring Diagram

Below is a typical wiring configuration between PZEM-004T and the PCBcubid Glyph C6 board:
- PZEM VCC to 5V (from Glyph C6)
- PZEM GND to GND
- PZEM TX to GPIO16 (RX2)
- PZEM RX to GPIO17 (TX2)



5. Software and Communication Protocols

The ESP32 reads the data from the PZEM-004T via UART using the PZEM004Tv30 library in Arduino IDE. The ESP-NOW protocol is used to wirelessly transmit this data to a gateway ESP32 module. The gateway then relays the data to an MQTT broker using the PubSubClient library

6. Software and Communication Protocols

To enable real-time monitoring and remote data access, the PZEM-004T module is integrated into a sensor node that communicates wirelessly with a central gateway. The Glyph C6 board, which features an ESP32 microcontroller, acts as the core processing and communication unit of the sensor node.

6.1 Sensor Node Features

The sensor node comprises the following key features:

• Measurement Capabilities: Accurately measures voltage, current, power, frequency, energy, and power factor using the PZEM-004T module.

• Wireless Communication: Utilizes ESP-NOW protocol to transmit data wirelessly to a nearby gateway ESP32 module.

• Real-Time Data Acquisition: Reads electrical parameters in real-time and sends them periodically

• Lightweight Communication: Ensures low-power operation and efficient data transfer through compact, structured payloads.

• Modularity: Easily expandable to include additional sensors like temperature, vibration, or RPM modules.

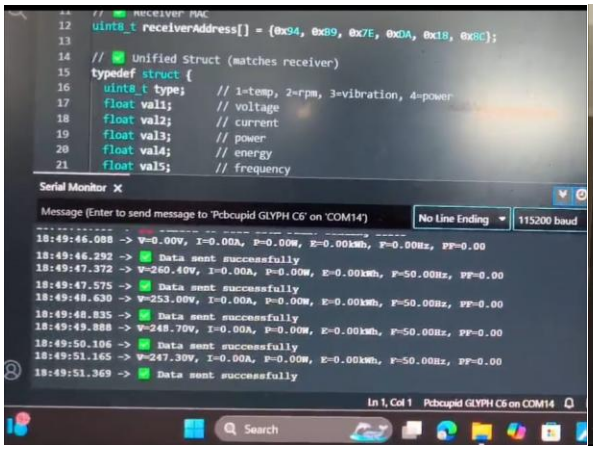
6.2 Gateway Integration

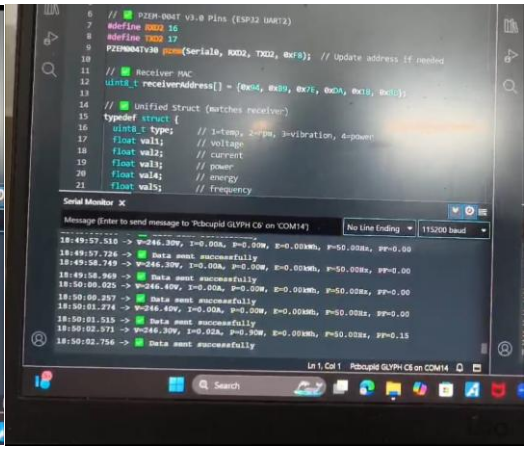
The gateway ESP32 module acts as a receiver and MQTT client. It collects sensor data transmitted via ESP-NOW, then formats the data as a JSON payload and publishes it to an MQTT broker. This design supports scalable and real-time monitoring for applications such as industrial equipment monitoring, smart energy meters, or home automation.

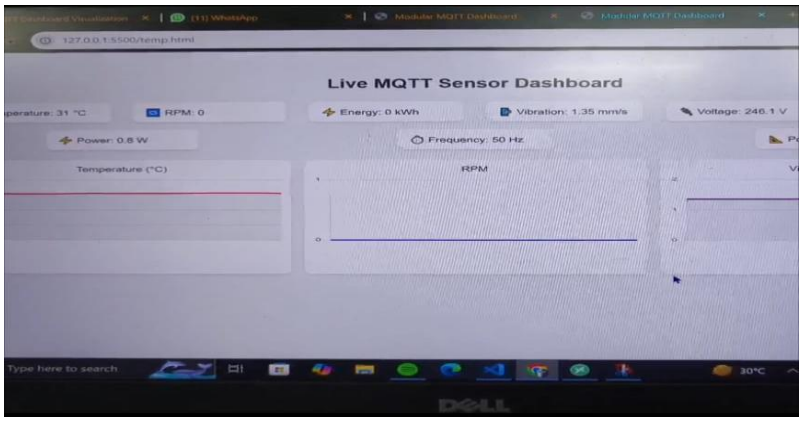
Example JSON Payload:

```
{
 "voltage": 229.5,
 "current": 0.56,
 "power": 128.3,
 "energy": 1.12,
 "frequency": 50.0,
 "power_factor": 0.95
}
```

7. Output:







8. Applications and Use Cases

- Home energy monitoring systems
- Industrial machine power monitoring
- Real-time IoT dashboards for smart grids
- Solar power consumption tracking

This module, when paired with ESP32, becomes a powerful IoT solution for power analytics and alert-based systems.