VAJRUINO 4G IoT INDUSTRIAL GATEWAY BOARD

Features:

- ESP32 32 bit WiFi Controller
- SIMCOM A7672 4G LTE Module
- W5500 Ethernet Module
- RS485/RS232 with optional isolation
- Micro SD Card and Nano SIM slot
- Serial Port for code upload and monitoring
- On-board RTC and 32k EEPROM
- 4 Digital Isolated Inputs
- 2 Digital Outputs
- Protocols: MQTT(s), HTTP(s), DHCP, FTP, Modbus, SPI, I2C, etc
- FOTA (Firmware Update) support
- PCB Header for mounting RA-08 LoRa-WAN module
- Compact PCB size 130x105mm

Introduction: Vajravegha Mobility Pvt Ltd based in Mumbai is a full-scale solution provider in the field of IoT, DC Energy Measurement and Embedded Systems. We take immense pride in introducing **Vajruino**, an innovative and user-friendly IoT development board designed to simplify the world of Internet of Things (IoT). This compact and versatile board offers a wide range of features, making it an ideal choice for IoT enthusiasts, developers, and industry professionals seeking an all-in-one solution. With its exceptional functionality and affordable price point, Vajruino stands out as a game-changer in the industry. It is meticulously crafted with simplicity and user-friendliness in mind. It provides a hassle-free experience for both beginners and experienced developers. The board comes equipped with labelled pins and concise documentation, simplifying the process of connecting and integrating various peripherals. Whether you're a seasoned professional or just starting your IoT journey, Vajruino ensures a smooth and intuitive development experience.

Vajruino consolidates multiple functionalities into a single module, eliminating the need for additional components. It seamlessly integrates a 32-bit ESP32 controller, a 4G module (A7672), an Ethernet module (W5100), Wi-Fi and Bluetooth connectivity, RTC, 32KB EEPROM, RS232 or RS485 for Modbus, Micro SD card slot, Isolated digital inputs, digital outputs and a PCB header to solder LoRaWAN RA-08 module, if required. This all-in-one design saves time and effort in sourcing and assembling individual components, providing convenience without compromising performance.

Importance in the IoT Industry: In the fast-growing IoT industry, Vajruino holds immense significance. Its comprehensive feature set enables developers to quickly prototype and deploy IoT solutions for various applications. With this board, you can collect and transmit data from connected devices seamlessly, enabling remote monitoring, control, and automation. The board's versatility and compatibility with popular IoT platforms make it an invaluable asset for individuals and organizations driving innovation in the IoT space.

Affordability: Vajruino offers exceptional value for its price. Compared to existing products in the market, Vajruino stands out as a cost-effective solution without compromising on quality or performance. Its affordable price point makes it accessible to a wider range of users, empowering more individuals and organizations to embark on IoT projects without breaking the bank. Our board also proudly embodies the **"Make in India"** initiative, showcasing the country's capabilities in designing and manufacturing cutting-edge IoT solutions. By choosing Vajruino, you support local innovation and contribute to the growth of India's technology sector.

Applications:

Industrial Automation: The VAJRUINO module's support for Ethernet, Modbus, RS485, and RS232 protocols makes it suitable for industrial automation applications, including data acquisition, control systems, and monitoring.

Internet of Things (IoT): With built-in Wi-Fi, cellular connectivity, and support for various protocols, the module can be used in IoT projects for remote monitoring, data transmission, and control.

Data Logging and Time-keeping: The Micro SD card slot allows for data logging, making the module ideal for applications that require storage and analysis of large amounts of data. The accurate RTC ensures precise timekeeping for scheduling and synchronization in applications such as event triggering, data logging, and automation. The module also features a 32KB EEPROM for non-volatile storage of critical data, providing reliability and persistence across power cycles.

Protocol Support: Various protocols such as MQTT(s), HTTP(s), DHCP, FTP, Modbus, SPI, and I2C are supported, enabling easy integration with different systems.

Block Diagram and Basic Schematic
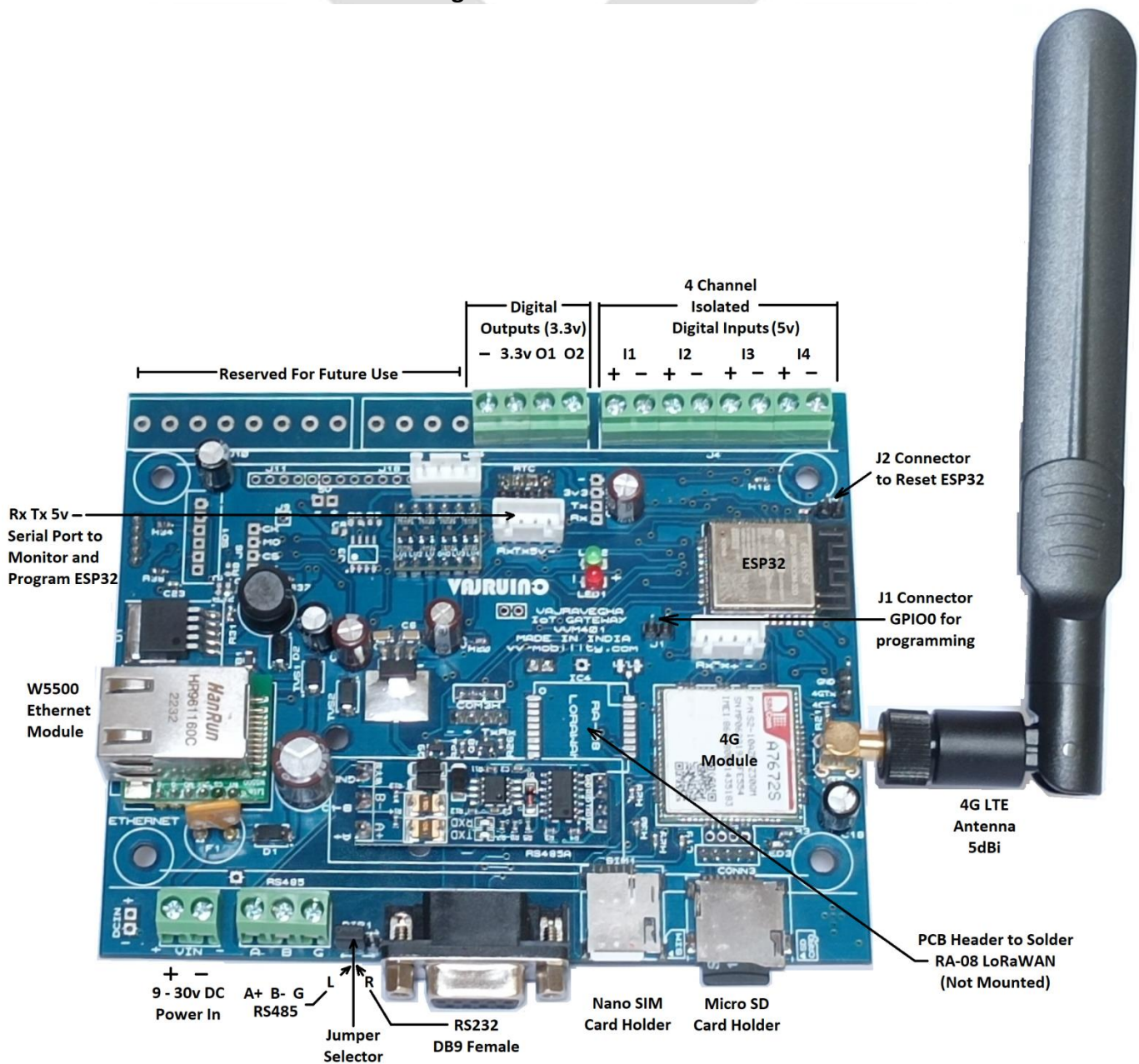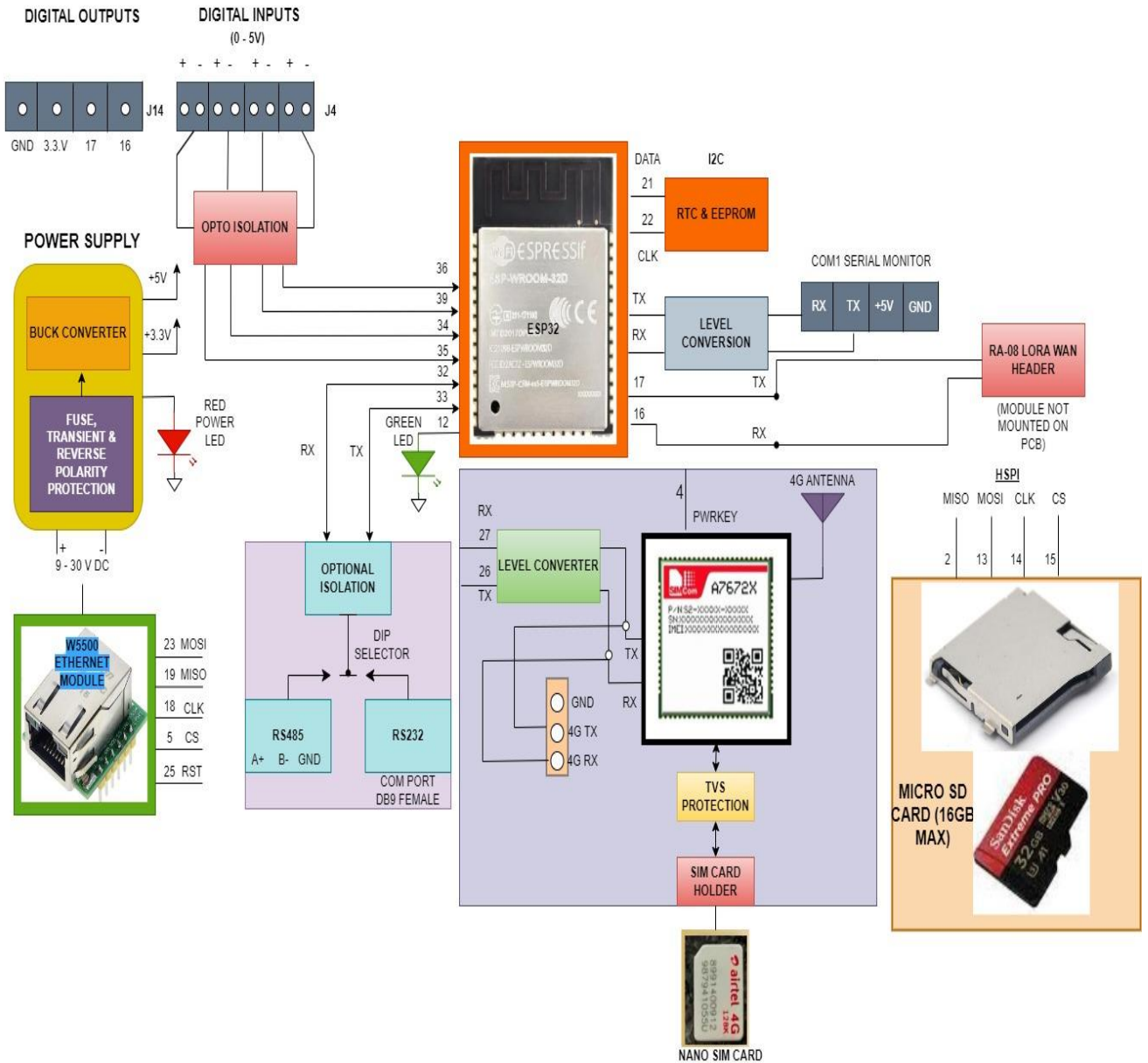
ESP32 GPIO Pin Mapping	
SIM7672 4G LTE Module (Serial Communication)	26(Tx) to Rx , 27(Rx) to Tx, 4 to Power Key respectively of 4G Module
Ethernet Module (SPI Communication)	23(MOSI), 19(MISO), 18(CLK), 5(CS), 25(RST) Regular SPI
SD Card (SPI Communication)	2(MISO), 13(MOSI), 14(CLK), 15(CS) Alternate HSPI
RS485 / RS 232 (Serial Communication)	33(Tx), 32(Rx) Select either RS485 or RS232 by the Jumper Selector
RTC (DS3231 based) and 32k EEPROM (I2C Communication)	22(SCL), 21(SDA)
Digital Inputs (All optically Isolated)	34, 35, 36, 39 (Active Low)
Digital Outputs	17, 16 (Non Isolated). These pins are also shared with Tx and Rx of RA-08 LoRaWAN module if you plan to solder them on-board.
Green LED	12, Used for Diagnosis to indicate network, data transmission, etc.

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Description: ESP32 is used as the main controller on this board. It has a 32 bit dual-core microprocessor running at 240MHz, 4MB Flash memory and 520kB SRAM. It is a power house equipped with multiple GPIOs, SPI, I2C, UART, PWM and ADCs. and supports protocol stacks for WiFi and Bluetooth. All the peripheral devices for communication and data sensing is connected to GPIOs of ESP32. Primary Internet connectivity is provided by SIMCOM A7672S 4G LTE Module and W5500 Ethernet Module.

Setup: Connect the 4G Antenna and gently insert a Nano SIM card having valid 4G subscription service in the spring type SIM Card holder. Insert a micro SD Card (16GB max) in the SD card holder. SD Card is optional and required only if Data Logging or Data Storage is required. On devices having LAN Module, connect an Ethernet cable from this board to the Ethernet. Create a Mobile / Wireless Router Hotspot with the following credentials: **SSID: iotgateway Password: iot@1234** Connect a good quality regulated SMPS (9v to 30v range, 2A) to the Power Input Connector of the board, ensuring proper polarity. Set the communication for either RS485 or RS232 using the jumper selector. Default code is already present in ESP32. Refer our github page **http://www.github.com/vajravegha/vajruino** This default code (**LTE_WiFi_Eth_MQTT.ino**) is OTA enabled.

This board doesn't have an on-board USB to TTL convertor, so an external USB to TTL Convertor must be used for Serial Monitoring and uploading the code manually. Make the connection between USB-TTL Module and Vajruino as shown in the right. Connect USB to PC/Laptop, open Serial Monitor in Arduino IDE and set Baud Rate to 115200.

USB to TTL Module

GND to –
TXD to Rx
RXD to Tx
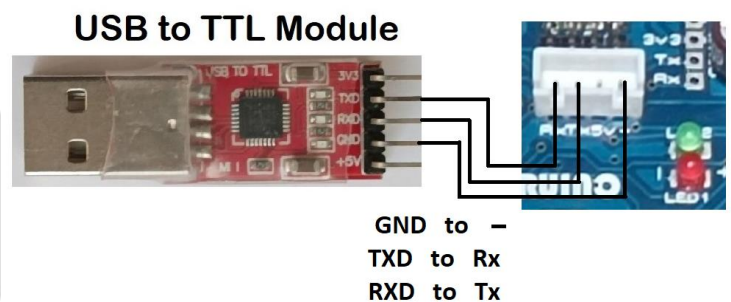
Operation: Turn ON the power supply. Red LED1 (Power LED) lights up first and in a few moments the tiny red LED3 lights up, and later starts blinking if the module is connected to the Cellular Network. ESP32 connects to the WiFi hotspot created earlier, checks for Internet on WiFi, Ethernet and 4G and transmits temperature readings via MQTT messages to HiveMQ public MQTT broker. Refer github source code for detailed explanation of default code and other sample codes. Open HiveMQ broker (https://www.hivemq.com/public-mqtt-broker/), click on MQTT Browser Client, click on Connect and subscribe to the following topic VAJRUINO/TEST. Published MQTT messages will be displayed here with Unix Timestamp as well. Additionally these messages will also be logged in the SD Card. Arduino Serial Monitor displays the ongoing process.

In the code we have used Async Elegant OTA library for uploading new code into ESP32 via WiFi. To upload new code manually from Arduino IDE, ensure Vajruino and USB-TTL Module is firmly connected. Short connectors J1(GPIO0) and J2(RESET) on the board using jumpers provided. After clicking on upload icon in Arduino IDE, when "Connecting....._____.....____" message appears remove the J2(reset) jumper and code begins to upload. After Code is Done Uploading, remove J1(GPIO0) Jumper. Once again, short and remove J2 jumper momentarily to restart ESP32. If code fails to upload, remove SD card and try again.

Working: On power on, ESP32 checks for all peripherals like SD Card, RTC, etc. It then searches for Wireless network, Ethernet and Cellular network. Once the device is registered within these networks, it reads temperature data from the sensor, reads the Digital Input states, reads the current time from RTC, parses it into json format and transmits the data to the broker, and then saves the same data into SD Card.

Digital Inputs: 4 Isolated Digital Inputs have been provided: I1, I2, I3 and I4. On connecting external 5v to +ve and –ve of these terminals, the corresponding pins on ESP32 will go LOW (Active Low Logic).

Digital Outputs: Pins 17 and 16 of ESP32 are taken out to O1 and O2 terminals. These pins can be used as digital outputs. For example, the ESP32 can subscribe to an topic and switch these pin states depending on the logic. Kindly note that these output pins are not isolated and are 3.3v logic only. Do not connect relays or heavy loads here directly. Connect them via a buffer.

Additional Info:

Optional LoRa Module: If using the optional LoRWAN RA-08H module, carefully solder it into the designated PCB Header slot. Use pins 16 and 17 for sending and receiving AT commands from ESP32 to RA-08. This module by Ai-Thinker comes in 2 variants, RA-08 (410MHz - 525MHz) and RA-08H (803MHz - 930MHz license free in India). Adhere to relevant regulations and license free frequency bands specific to your region.

Scan this QR Code for github link
http://www.github.com/vajravegha/vajruino
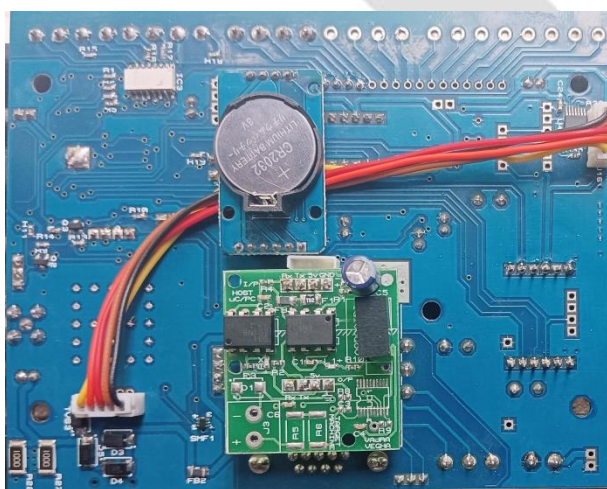
On boards provided with isolation, the RS485/RS232 communication section is optically isolated from the remaining section. Isolation: 1.5kV
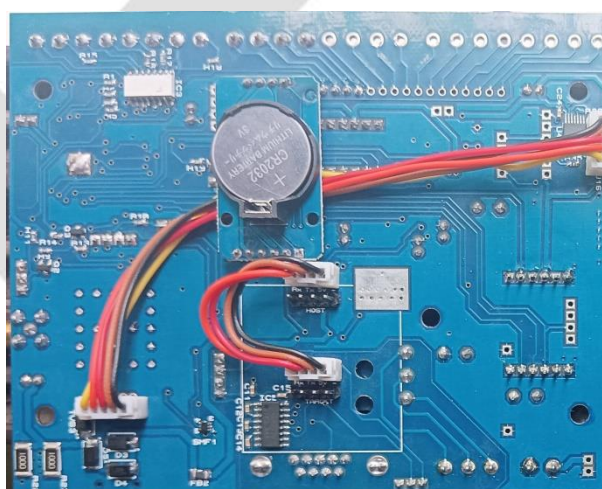
On boards without isolation, the communication section is part of the main board. For isolation, users can disconnect the short 4 pin wires and use our VVM481 TTL UART Isolator.

PRECAUTIONS :

Supply: Ensure that the module is powered using a stable and appropriate power supply within the specified voltage range (9v to 30v). Take necessary precautions to prevent electrostatic discharge (ESD) when handling the module to avoid damage. Follow the pinout and connection guidelines provided in the user manual diagram to prevent incorrect wiring, which may lead to malfunction or damage. Ensure proper grounding to minimize the risk of electrical noise and interference, which can affect the module's performance.

Environment and Handling: Avoid exposing the module to extreme temperatures, humidity, or other adverse environmental conditions that could affect its performance and longevity. Refer to the user manual and documentation provided by the module manufacturer for detailed guidelines, pinout diagrams, and programming instructions (given in our GitHub repository).

Security and Integration: Implement appropriate security measures to protect the module's firmware from unauthorized access or tampering. When integrating the module into a larger system, ensure compatibility and proper communication protocols between the module and other components.

Technical Support: If encountering any issues or difficulties, consult the manufacturer's technical support (**info@vv-mobility.com**) for assistance.

-Vajravegha Mobility Pvt Ltd
www.vv-mobility.com