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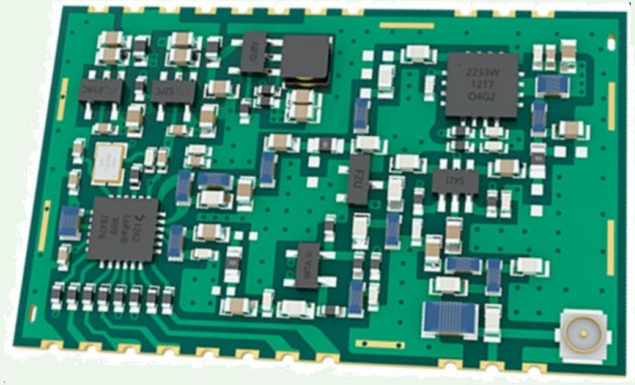
RRNode LoRa module Overview

EBYTE E22-400M33S - 433/470MHz 33dBm SX1268 wireless module. Working frequency range: 410~493MHz

- Transmitter power: up to ***33dBm (2W)***
- Size and weight:24x38.5mm, 4.9gr.
- Working voltage/current: 5VDC

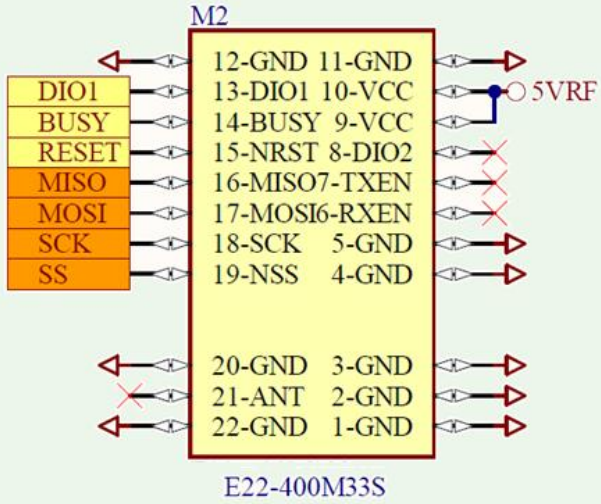
- 1200 mA/6W instantaneous at 33 dBm (2W) output power
- ≈1.5 mA/0,0075W on receive

- IPX antenna connector



NOTE: *In the place of the E22-400M33S* ***should be possible*** *to use E22-900M33S for a frequency range of 850 ~ 930MHz, because of the same pinout and footprint. But this is* ***UNTESTED and UNVERIFIED****.*

The module is controlled via a mixed SPI and I/O interface. It uses four SPI lines and three I/O lines, which must be properly set up in the RNode Firmware.
The pinout of the module is listed and explained shortly in the table below



The module contains the *Semtech SX1262* LoRa modem chip, a *Innotion YP3322W* broadband power amplifier, which is tamed to an ample but very stable 18dB of amplification gain, a *Psemi PE4259* transmit/receive switch, that connects the antenna to the receiver or power amplifier and is controlled internally by the SX1262, a full set of filters and a low noise amplifier (LNA) on the receive side, improving dynamic range and performance. It also contains a temperature stabilized oscillator for wide spreading factor working modes.
All the Radio Frequency (RF) circuitry is dealt with within the shielded module and the only RF component outside of it is the ***antenna***, which is attached trough a tiny IPEX *coaxial connector*.

Name	Function
DIO1	IRQ (Interrupt Request) from the SX1268 to the controller
RESET	When pulled low externally, it resets the SX1268 chip.
BUSY	When the radio holds this line low, it tells us, that it is ready to receive commands.
MISO	Master In, Slave Out or transmit serial line for SPI bus
MOSI	Master Out, Slave In or receive serial line for SPI bus
SCK	Serial Clock, timing for the SPI bust command transfers
SS	Serial Select for the SPI bus

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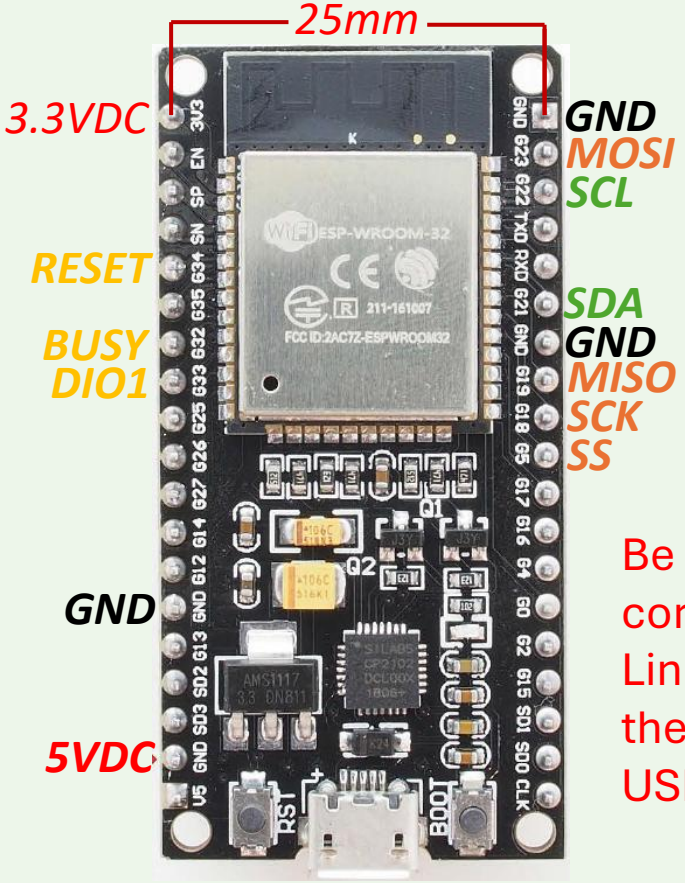
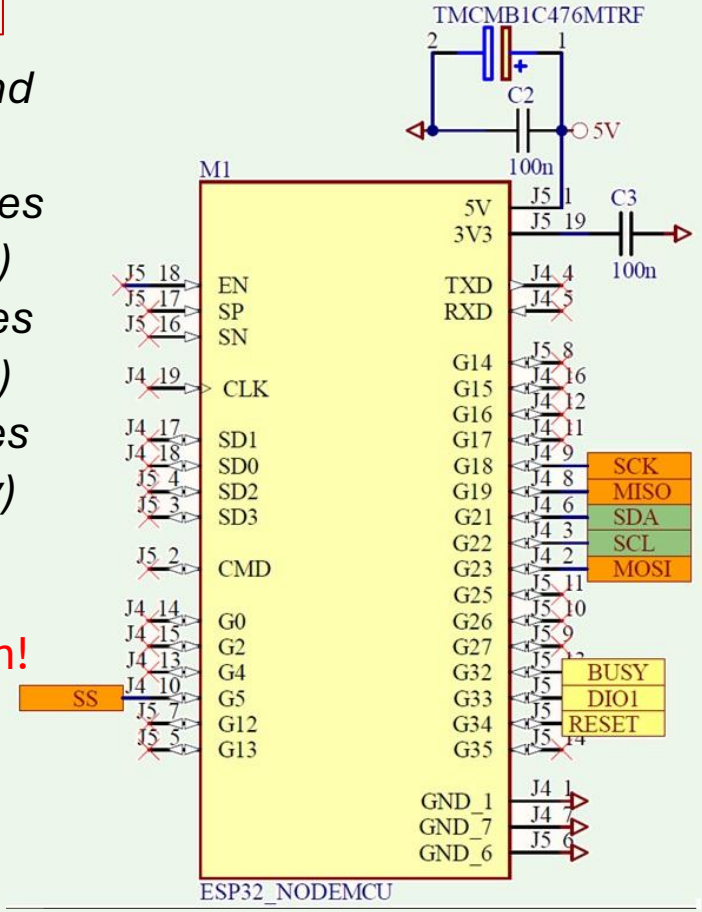
RRNode ESP32 module

AZ Delivery ***ESP32 MCUNode***
Low power SoC (system on chip), based on ***Tensillica Extensa LX6*** microcontroller, paired with a ***Silabs CP2102*** USB/UART bridge and an ***Advanced Monolithic Systems AMS1117*** 3.3V/1A linear regulator. It has a wide range of I/O options and has been proven as a stable and widely available platform for many years now, making it a plausible choice for an RNode deployment.



Pin mapping and Connection
Orange – SPI lines (LoRa module)
Yellow – I/O lines (LoRa module)
Green – I²C lines (OLED Display)

Be sure to get the correct ESP32 version! Links are provided in the BOM file! Micro USB is mandatory!



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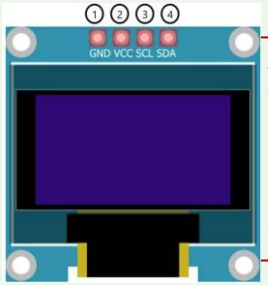
RRNode PCB Design Overview

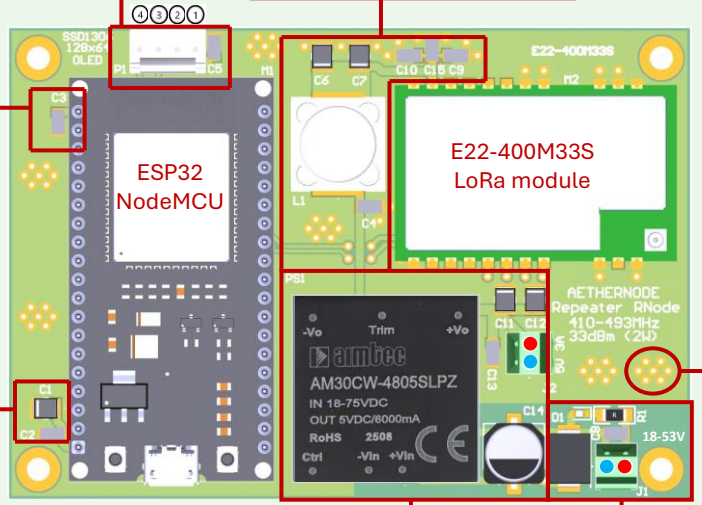


An I²C port allows a standard and widespread 0.96" SSD1306 based OLED display to be connected to the node for *observing and controlling the node flashing process*. The connector has the same pin order of the display, so it can be easily interfaced with 4-wire ribbon cable.

An LC filter network separates the 5V rail for the radio module and the rest of the system, guaranteeing no stray RF currents walk along unwanted paths, causing signal integrity issues.

A filtering capacitor for the internal 3.3VDC power supply for the ESP32 module. This supply should not be used to power anything external to the ESP32 module.

A filtering set of capacitors for the ESP32 NodeMCU. They provide very good, low-impedance power input, which ensures stability and independence from other loads on the 5V rail, like the LoRa, or the bit further down the line powered SBC. This is called power decoupling, a critical technique for assuring, that loads on the same power rail do not interfere with each other.



The PCB has two copper layers, a top and bottom one. Here both are utilized for tracks, but the rest, the free space, not containing signals and power, is always filled or poured with a ***ground plane layer***. This layer is critical for signal integrity reasons. On every PCB there are *sources of energy and loads*, and energy is transferred from one to the other, and in most cases ***the circuit is closed trough the common connection***, called Ground (GND). Having this one cover all unused area as a ground plane, helps these currents take the shortest paths, stabilizing the work of the circuit. And connecting well all ground planes on all layers of a PCB is very important. And these 7-***via*** (a connection between PCB layers) connection flowers do exactly this. There are more of these beneath the modules themselves.

A 30W, *wide input voltage range* power converter, which will supply a very well regulated, low noise ***5VDC at up to 6A of current*** for the system. The input capacitor ***C14***, having a sufficient capacity to provide short-term *power glitch* stability for the converter. On the output side we find a set of filter capacitors, that assure proper stabilization of the 5V rail and a buffer reservoir for energy. Capacitor ***C13*** serves to calm converter output noise, and the set of ***C11/C12***, having a total capacitance of 94uF, provide the buffer capacity. Those are a *wide-temperature, extended stability* Tantalum types. Connector ***J2*** provides a power connection for the SBC, in this case an Orange Pi Zero LTE.

Power supply input section. The LED will indicate voltage presence.
It takes ***from 18VDC to 53VDC***, being designed for the nominal Power Over Ethernet(PoE) voltage of ***48VDC***.
The protection diode (*Transil©*) ***D1*** will be invisible to the circuit up to 55VDC, over which it will start to conduct and *safely clamp* the voltage to a maximum of 77VDC, well within the maximum input handling capacity of the Aimtec DC/DC power converter, which can withstand up to 100VDC. This allows for any variations / emergency situations on the power supply side, which is expected be fused / current limited itself.

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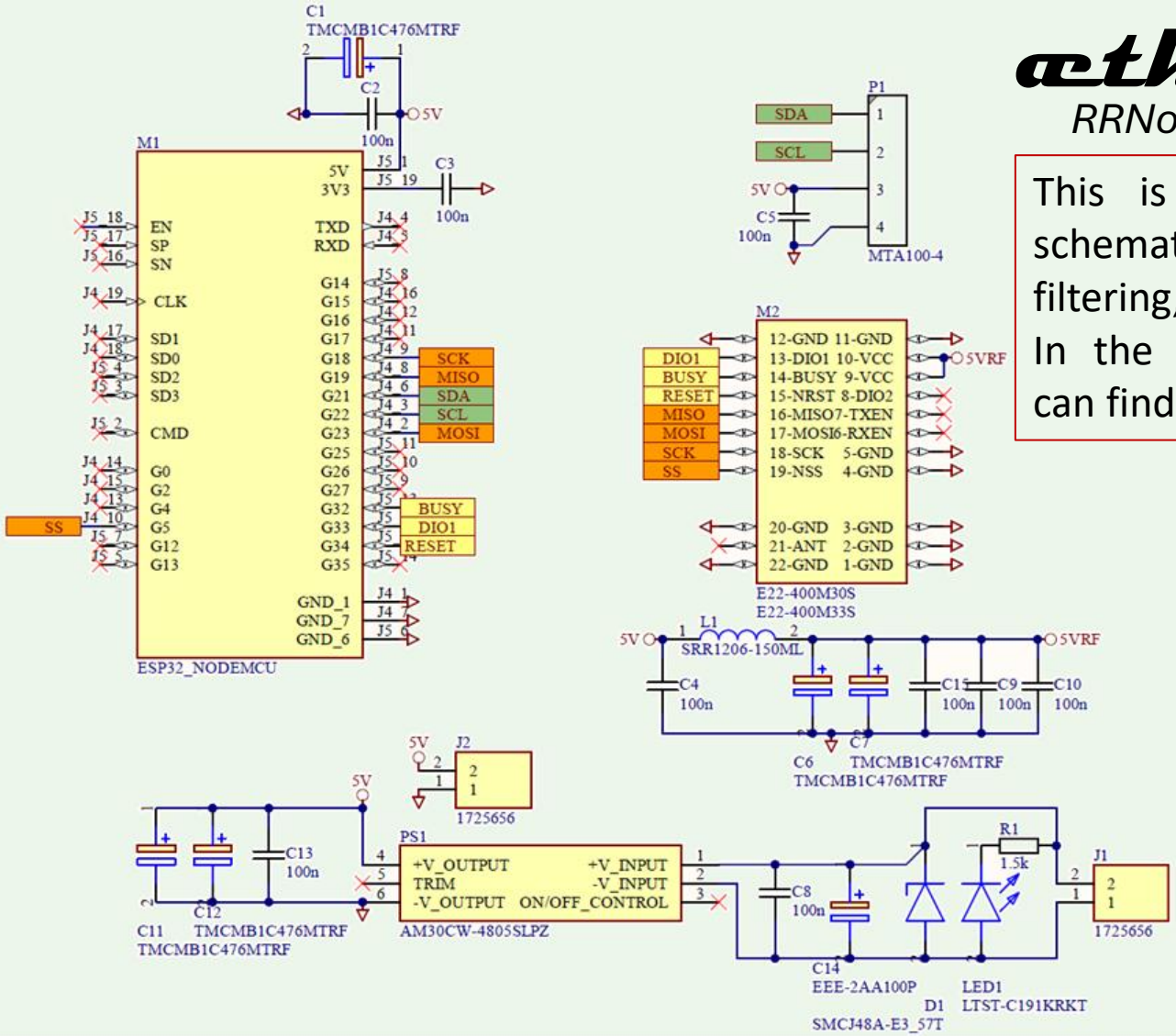
RRNode full schematic

This is the full RRNode schematic, including power, filtering, I²C and power.
In the project folder you can find all design files.



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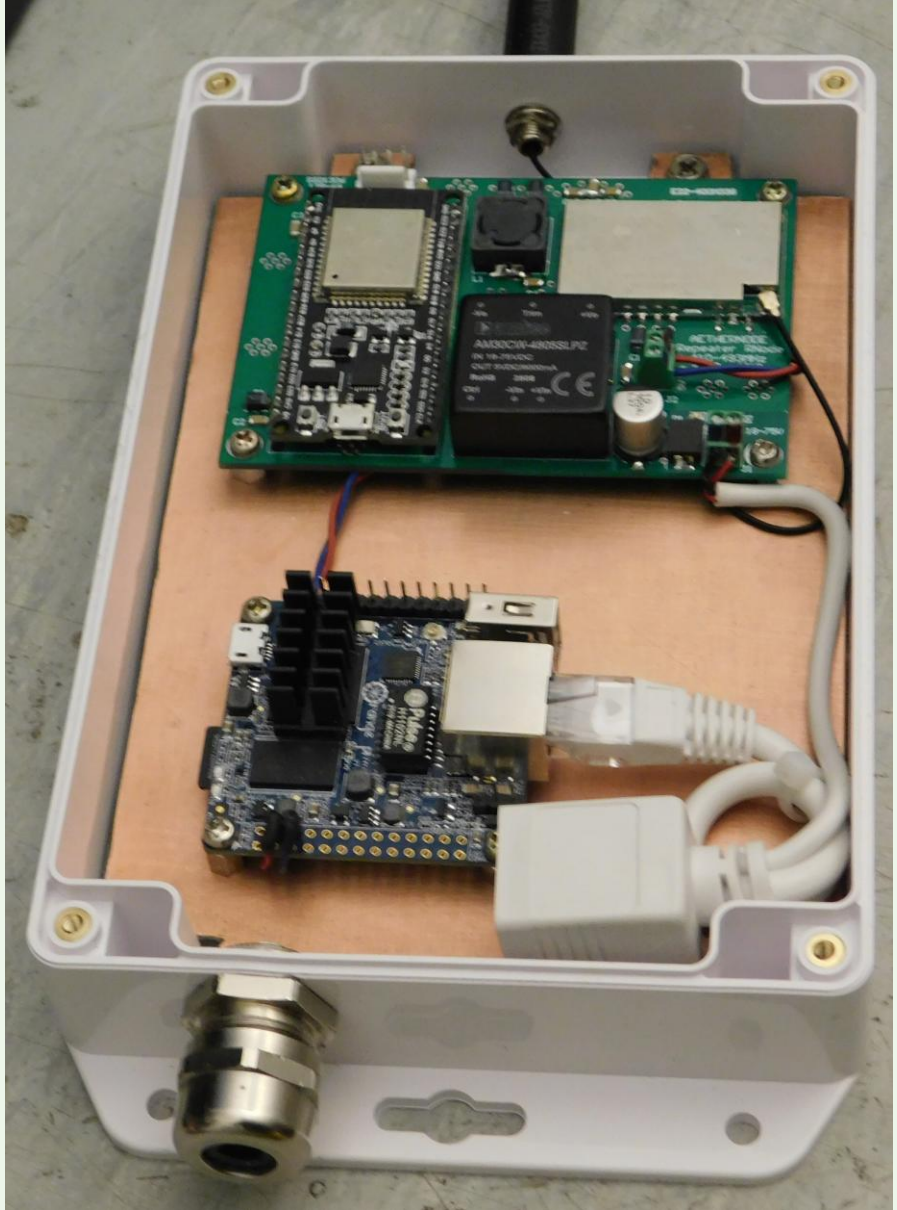
RRNode Design files

- ***Datasheets*** – a folder, containing all the datasheets of used major components.
- ***aethernode_v1.0_gerbers.zip*** – standard *Gerber* production file archive, including all PCB layers and a drill file. This can be directly loaded to websites like JlcPCB, PcbWAY, etc. so the boards can be easily ordered.
- ***aethernode_schematic_v1.0.pdf*** – the schematic in PDF format.
- ***aethernode_v1.0.pdf*** – a PDF 3D export from Altium Designer PCB, very convenient for explanations and demonstrations of the design.
- ***aethernode_v1.0.step*** – a 3D model STEP file, PCB exported as Single Part, very convenient if one wants to model own enclosure in CAD.
- ***aethernode_v1.0.xlsx*** – a BOM file – Bill Of Materials, export from Altium Designer + modules added. It contains purchasing links.
- ***base plate_v1.0.fpd*** – a Front Panel Designer (FPD) project file for the base plate, that the whole setup mounts to in the box. One can use it to modify the plate.
- ***base plate _v1.0.dxf*** – a DXF CAD file, that can be used to produce the plate.



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RRNode Assembled

This is how the assembled RRNode looks. Or at least before the USB cable was added… ☺

Because of the low profile of the box a normal cable gland was chosen, and the LAN cable RJ45 should be crimped upon installation. If mounted in a deeper box, an RJ45 watertight trough-panel coupler can be used, allowing for a quick disconnect option.