

BasicPI PLC

Ethernet/GSM Module

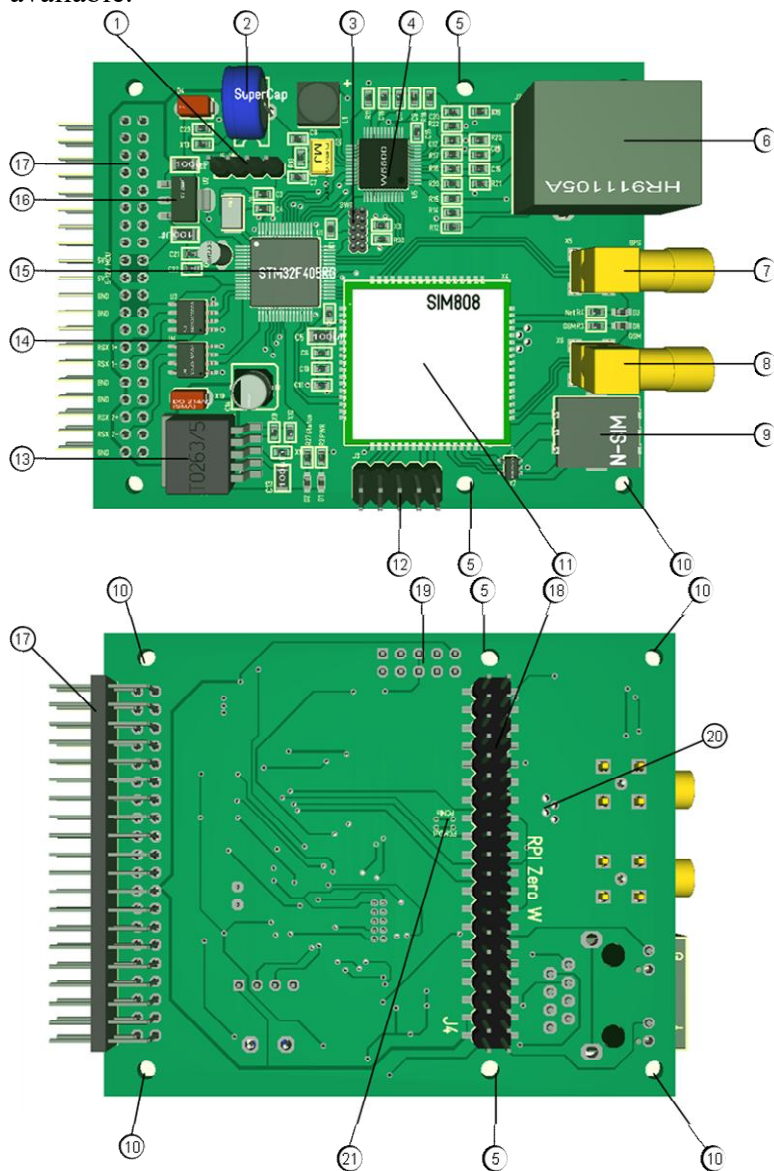
Annotated Schematics
Revision 1.0/31.jul.2017

Introduction

This document describe the PLC Ethernet/GSM module and provide sufficient documentation for understanding the schematics and programming the module.

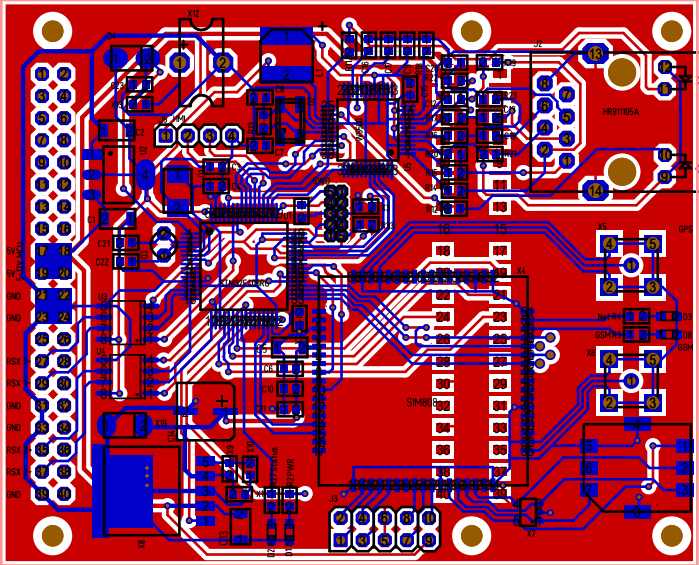
3D Model

The 3D model is generated by the EDA based on the PCB layout and serve the purpose of a visual review of the expected result. The model will be replaced with pictures once they are available.

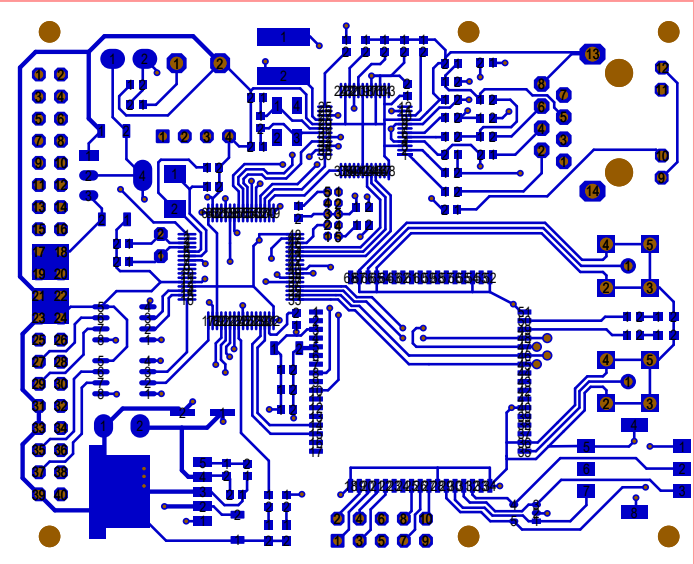


1. 4 pin HMI header.
2. Super capacitor for RTC.
3. SWD.
4. W5500
5. Raspberry PI Zero W mounting holes.
6. Ethernet RJ45
7. GPS Antenna
8. GSM/GPRS Antenna
9. Nano SIM Card holder.
10. Standard mounting holes. M2.5 in each corner.
11. SIM808 module
12. Analogue Audio/USB connector.
13. 4V PSU (MIC29302BU)
14. 2 x MAX3485 for RS485.
15. STM32F405RG
16. 3.3V PSU (LM1113)
17. 40 pin PLC backbone connector
18. 40 pin Raspberry PI 2/3/Zero W connector
19. Audio/USB available on back side. 5V + VBUS available here.
20. Test holes for PCM
21. Extra wiring to enable swapping of PCN In/Out

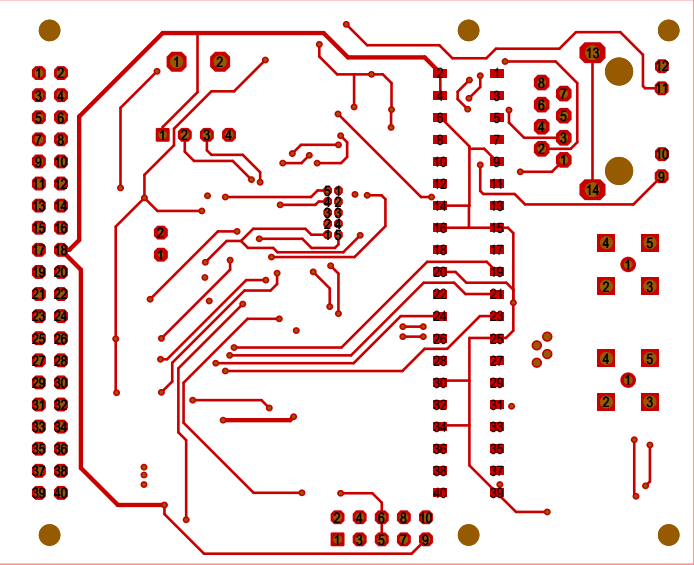
PCB



All layers including components and ground plane.

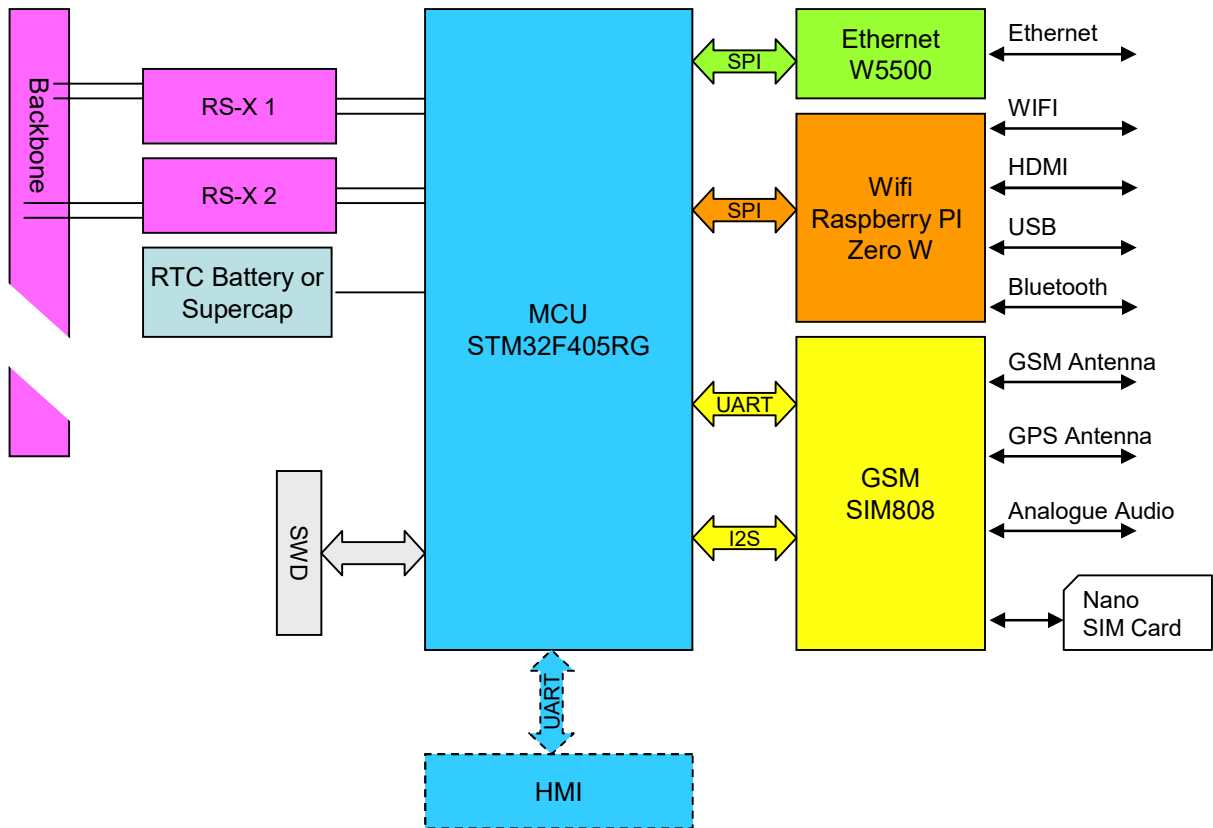


Top layer PCB layout



Bottom layer PCB layout.

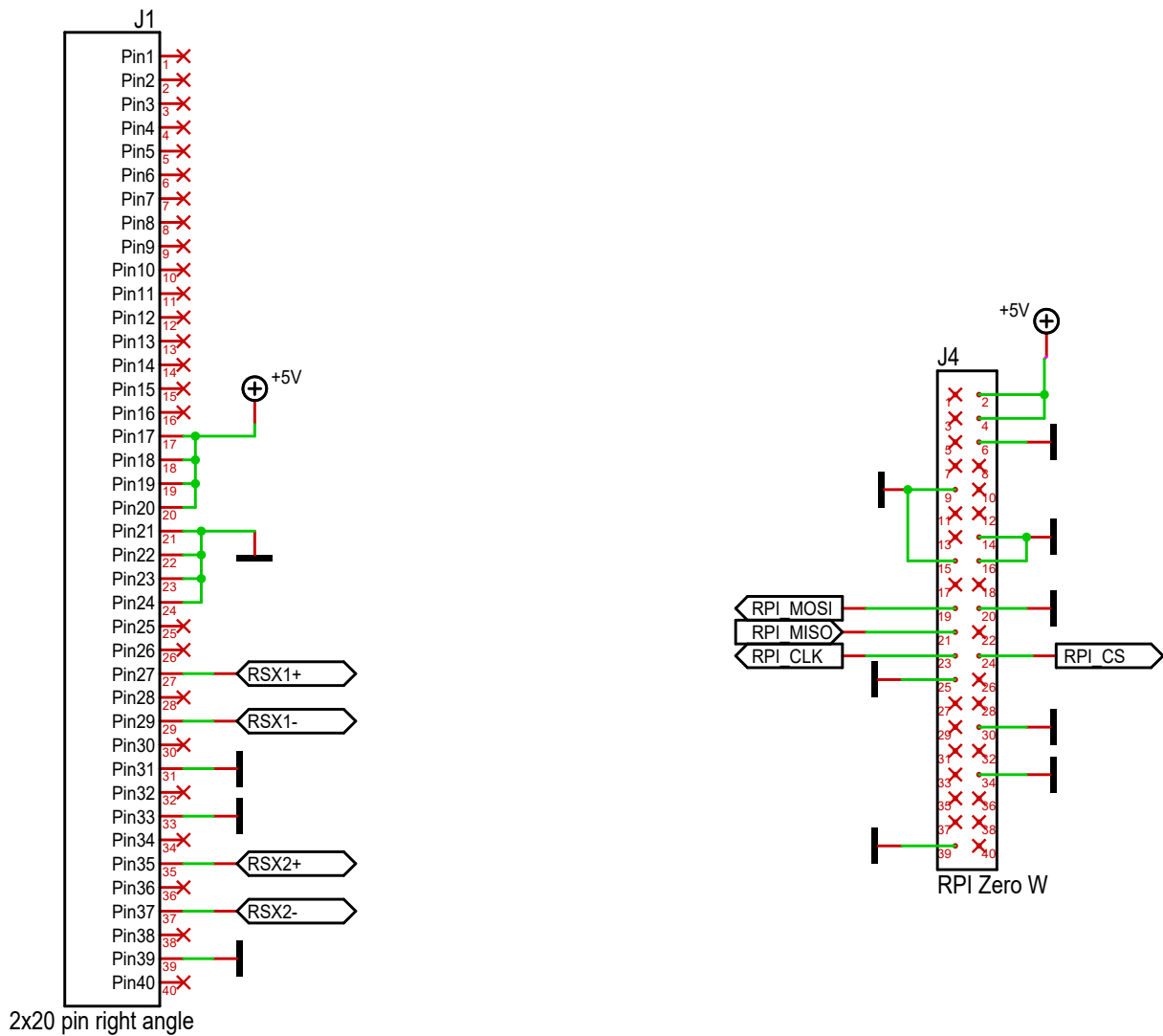
Block Diagram



This block diagram show the Ethernet/GSM module from a functional perspective.

MCU	STM32F405RG, 168Mhz, 32 bit ARM M4, 1Mb Flask, 196Kb SRAM.
RS-X1 / RS-X-2	Dual high speed (10Mbps) UART for backbone communication.
RTC Supercap	Supercap for preserving clock though power dips. Battery optional and can replace supercap.
SWD	Standard SWD connector.
Ethernet W5500	Hard wired Ethernet with 8 socket connections.
Raspberry PI Zero W	Raspberry PI Zero W with 1Ghz, 32bit ARM running Linux (Rasbian). 512Mb SRAM, 4++Gb SD Card, Wifi, Bluetooth, HDMI & USB.
SIM808	GSM/GPRS/GPS module.
HMI	Optional HMI using UART. A Nextion display can easily act as a phone display with buttons enabling calls.
Analogue Audio	Analogue Microphone/Speaker available on header pins.

Connectors



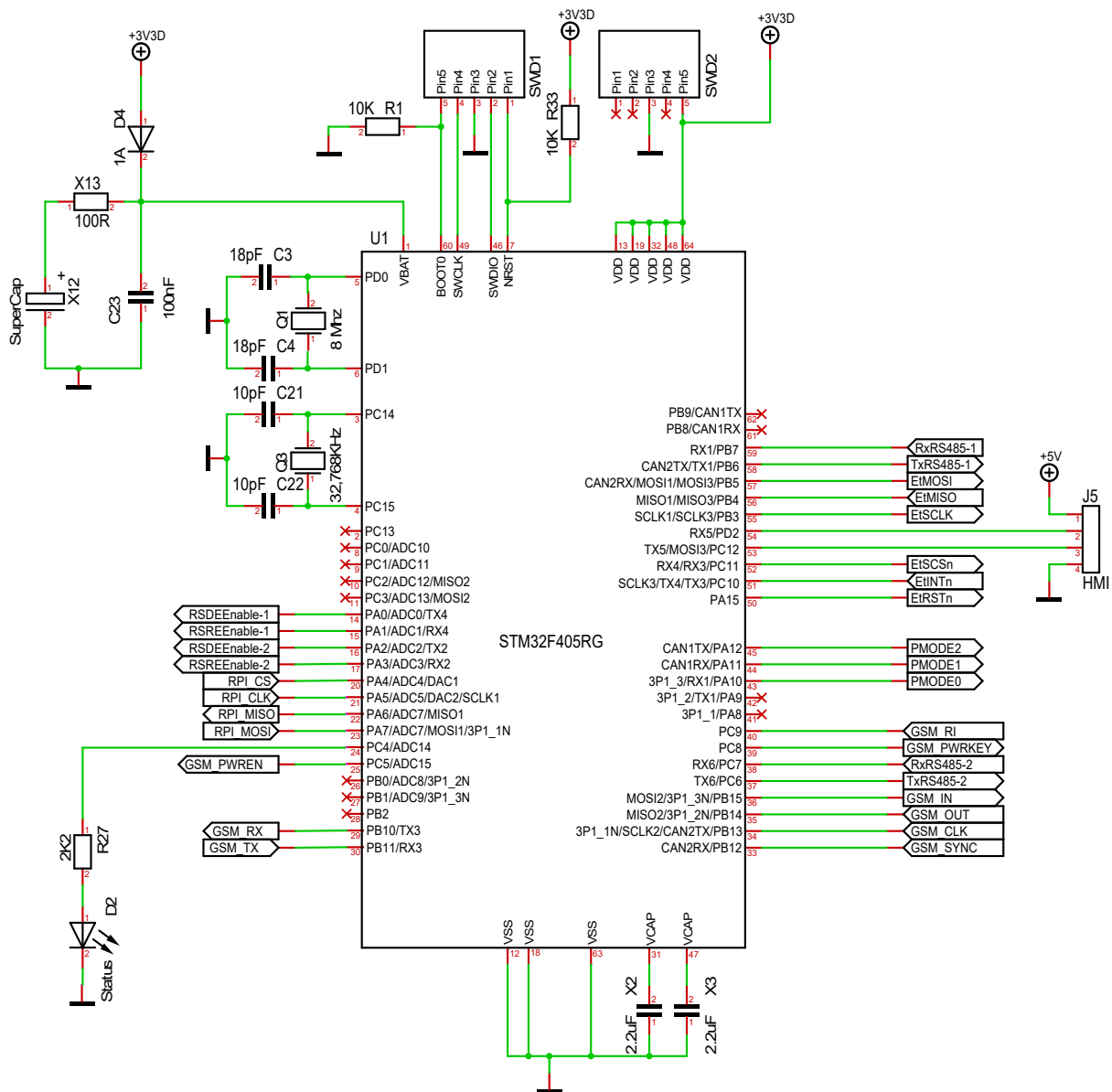
J1 is the backbone connector. In this case we only use 5V and RSX1 & RSX2. Layout of RSX on this connector

J4 is the Raspberry PI 40 pin connector that can be used for the Raspberry PI Zero W add on module. This module will behave like a Hat with address 1. Additional Hat's can be added on the back with address 2-8. Pin 15 & 16 is shorted to ground due to PCB layout support for GSM antenna.

PLC Backbone bus Pin Layout

GND PSU Pin1	● ●	Pin2 GND PSU
GND PSU Pin3	● ●	Pin4 GND PSU
48V PSU Pin5	○ ○	Pin6 48V PSU
48V PSU Pin7	○ ○	Pin8 48V PSU
24V PSU Pin9	● ●	Pin10 24V PSU
24V PSU Pin11	● ●	Pin12 24V PSU
12V PSU Pin13	○ ○	Pin14 12V PSU
12V PSU Pin15	○ ○	Pin16 12V PSU
5V Pin17	● ●	Pin18 5V
5V Pin19	● ●	Pin20 5V
GND 5V Pin21	● ●	Pin22 GND 5V
GND 5V Pin23	● ●	Pin24 GND 5V
Spare Pin25	○ ○	Pin26 Spare
RSX 1 + Pin27	● ○	Pin28 Spare
RSX 1 - Pin29	● ○	Pin30 Spare
GND Pin31	● ○	Pin32 Spare
GND Pin33	● ○	Pin34 spare
RSX 2 + Pin35	● ○	Pin36 spare
RSX 2 - Pin37	● ○	Pin38 spare
GND Pin39	● ○	Pin40 spare

MCU



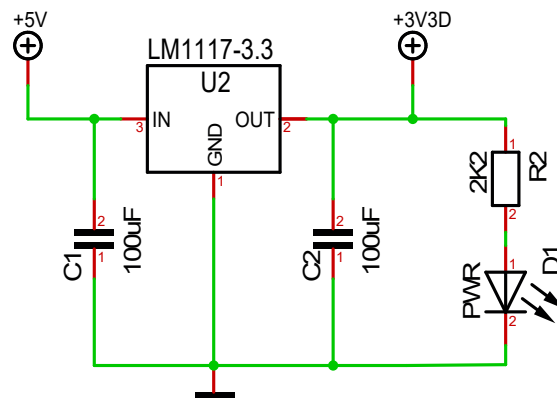
MCU is STM32F405RG. This is a 64pin LQFP64 package with a 32 bit M4 ARM ticking at 168Mhz and contains 1Mb Flash, 196Kb SRAM and a large list of IO features.

1	VBAT	Connected to supercap or battery.
3,4	PC14/PC15	RTC 32.768Khz crystal
5/6	PD0/PD1	HSE 8Mhz crystal
7,46,49,60	SWD/BOOT0/NRST	SWD Connector
14,15,58,59	USART1	RSX 1 on USART1 10Mbps
16,17,37,38	USART6	RSX 2 on USART6 10Mbps
20,21,22,23	SPI1	RPI Connector, 42Mbps SPI
24	PC4	Status Led
12,18,63	VSS/Ground	Ground
31,47	VCAP	2.2uF cap to ground on F405.
33,34,35,36	I2S	PCM Interface to SIM808
29,30	UART	GSM UART interface for control.

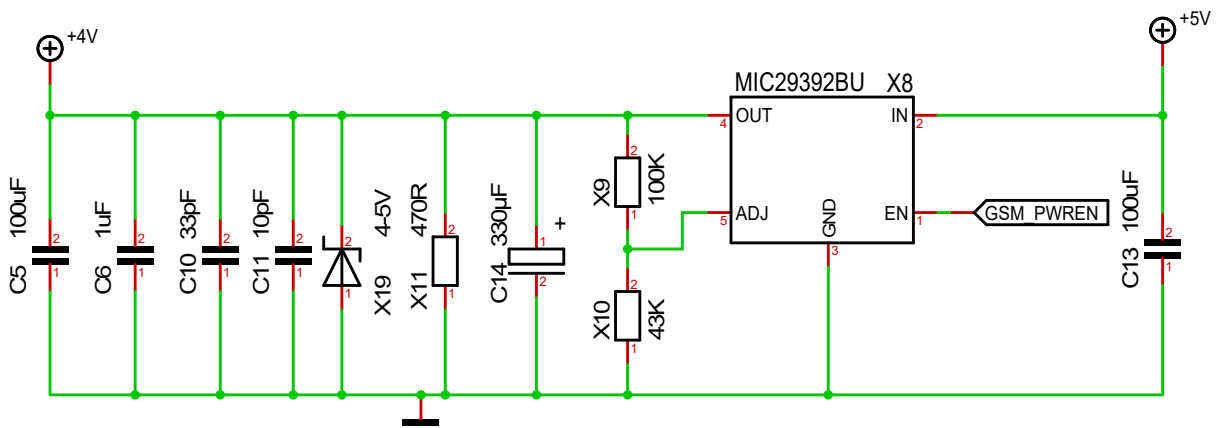
39	PC8	GSM_PWRKEY. Hold down 1 sec to switch on/off.
43,44,45,50,41,52,55,56,57	SPI3	Ethernet W5500 Interface
53,54	UART	HMI interface

PSU

The board use 5V as it's only PSU. The Raspberry PI module is supplied with 5V directly. The SIM808 is supplied with 4V/2A from MIC2939, while 3.3V is supplied from LM1117. Only linear regulators are used due to the low voltage drop.

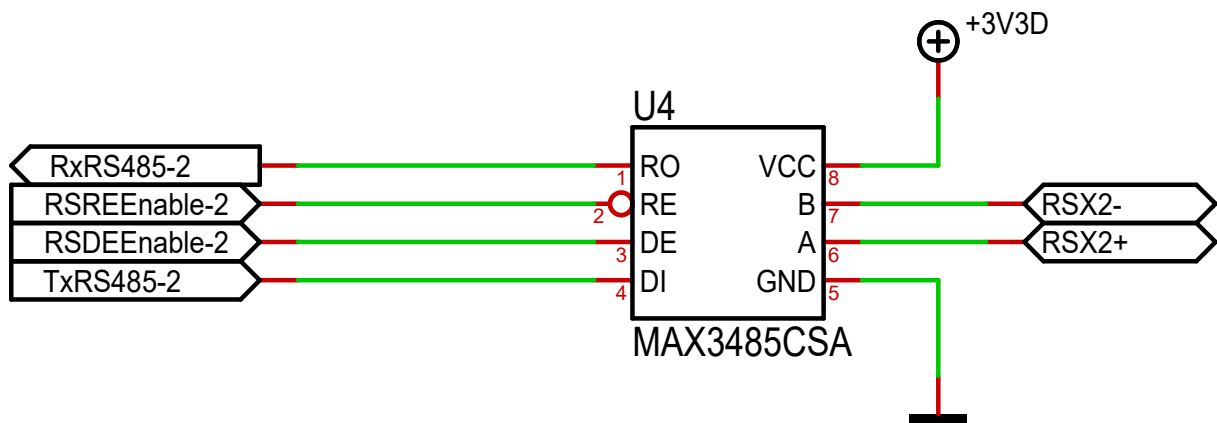
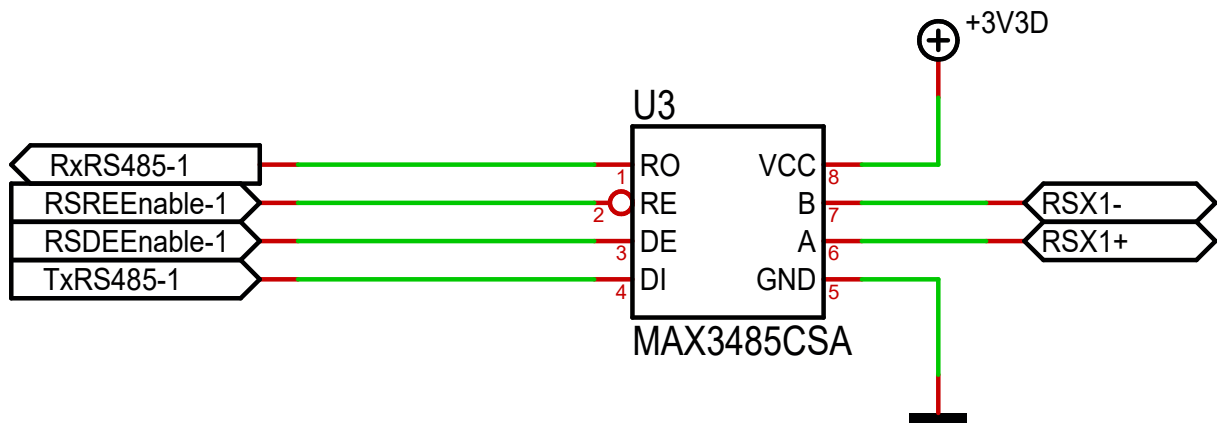


3.3V PSU



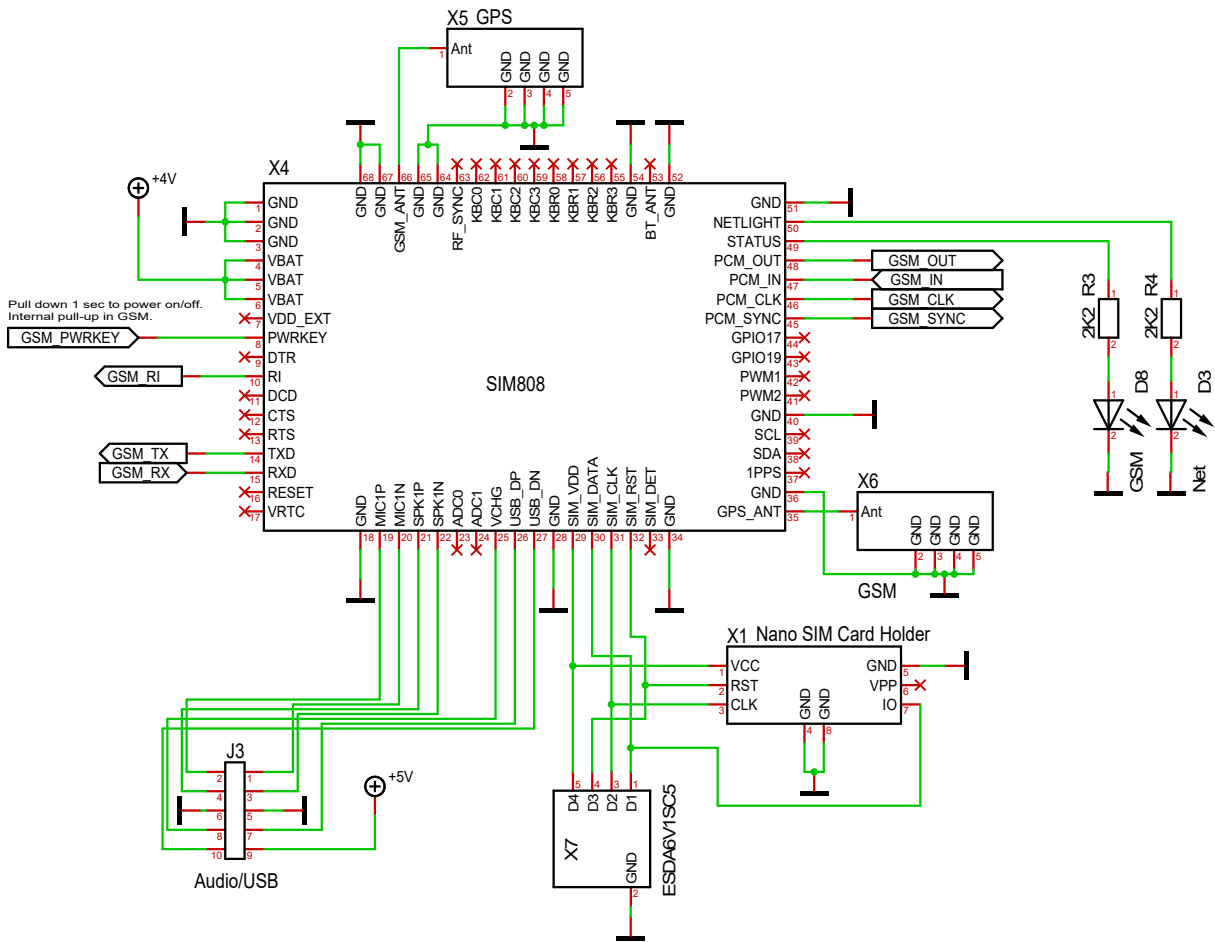
4V PSU for the GSM module. C5,C6,C10,C11 are placed close to VBAT on SIM808.

RS-X



Two separate RS485 based RS-X circuits form the backbone bus. These both operate at 10Mbps that is available on USART1 and USART6. No extra circuitry is provided on the MAX3485's as bias/terminator will be added to the backbone.

GSM/GPRS/GPS



GSM, GPRS and GPS connection is achieved by using a SIM808 module from SIMCOM. This is a small breakout with CE/FCC approval. The module is controlled through UART with AT commands. PCM audio is routed to SPI2 configured as I2S. Analogue Audio and USB is available on J3. GSM and GPS antenna is supported. Bluetooth is not supported since this is available through Raspberry PI.