

Raspberry pi-4B extension board datasheet



Revision 1

October 2021



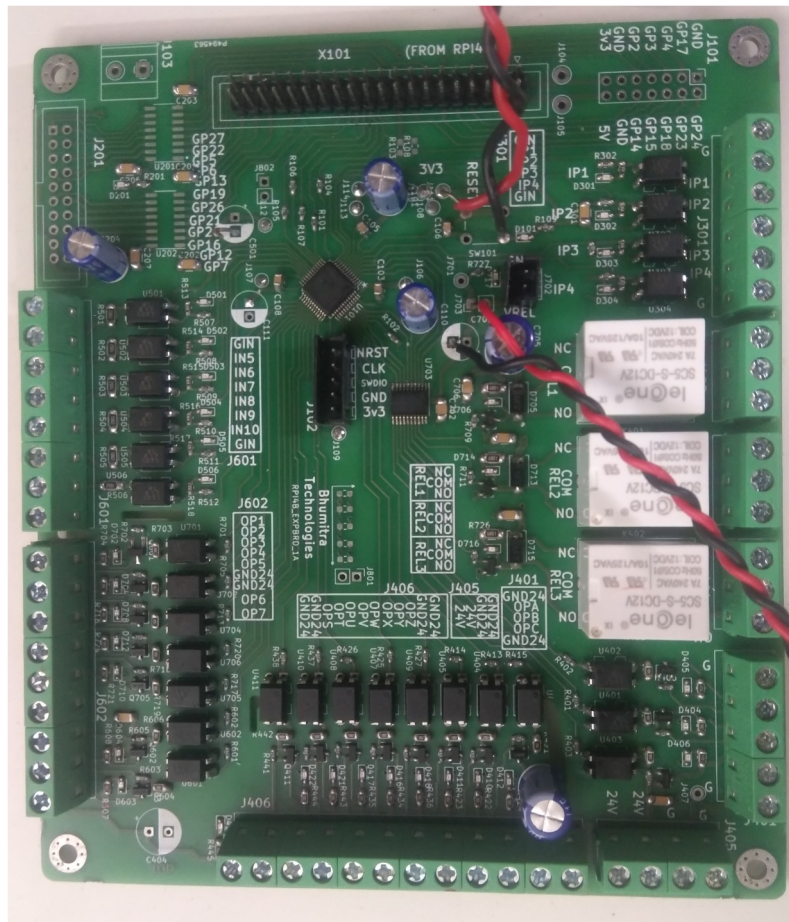
Contents

1 Introduction:.....	3
2 Features:.....	3
3 Board Description:.....	4
4 Electrical Specification:.....	5
Power requirements:.....	5
Power supply for zone PI:.....	5
Power supply for Output Zone 1:.....	5
Power supply for Output Zone 2:.....	5
Power supply for Relay Zone:.....	5
5 Peripherals :.....	6
Raspberry pi pins: Without ISOLATION.....	6
Raspberry pi pins: With ISOLATION.....	6
Output pins:.....	7
Connector J602:.....	7
Connector J401.....	7
Connector J406:.....	7
Relays:.....	7
Input pins:.....	8
Input zone 1:.....	8
Input zone 2:.....	8
40 Pin Connector: FROM RPI4B.....	8
6 Communication:.....	9
SPI on Raspberry pi:.....	9
Communication Protocol:.....	9
Data exchange:.....	9
Data sent by Master:.....	10
The first 8 bits:.....	10
The second 8 bits:.....	10
The third 8 bits:.....	10
Data sent by Slave:.....	10
The first 8 bits:.....	10
The second 8 bits:.....	10
The third 8 bits:.....	10
Example:.....	11
7 Board layout:.....	12



1 Introduction:

The RPI4B_EXPBRD_1A extension board for raspberry pi 4B comes with 31 complete isolated GPIO's, based on model the input voltage for relays, input zone may vary.



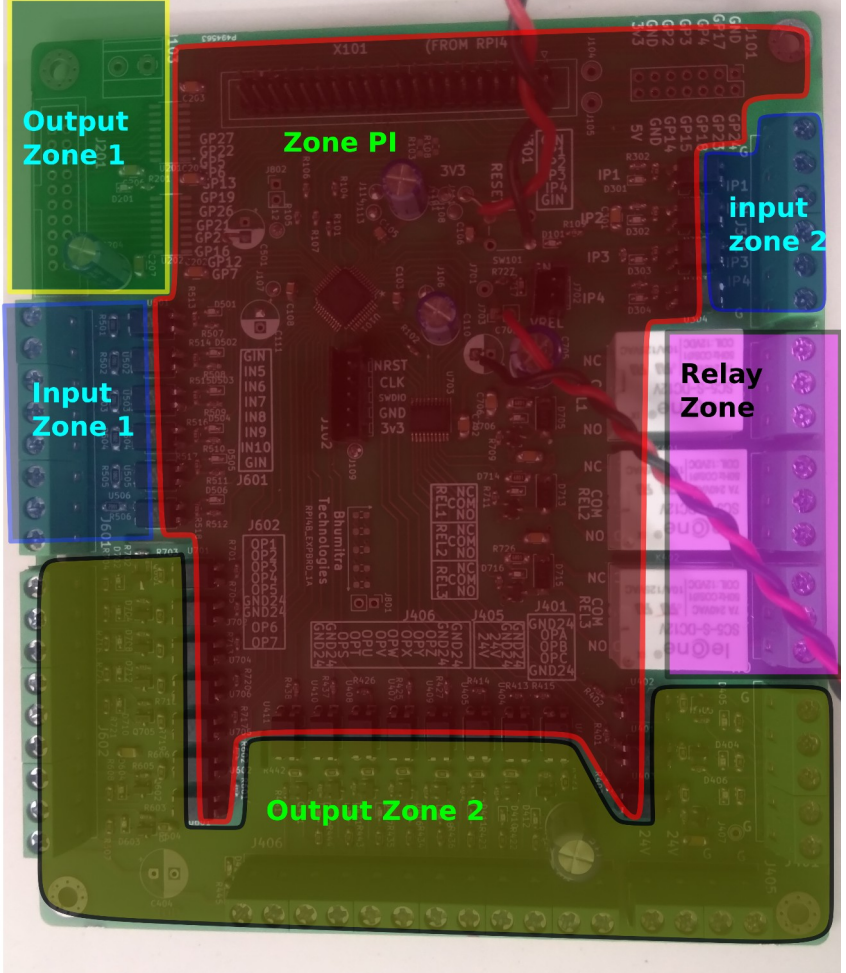
Model No. RPI4B_EXPBRD_1A

2 Features:

- 10 input pins with isolation.
- 18 output pins can switch upto 0.1A load with isolation.
- 3 output pins control 3 relays.
- SPI transmission can goes up to 6.25MHz.

3 Board Description:

Board is divided into 5 zones based on different grounds.

Zone PI: The ground present in this zone and Raspberry pi 4B are same. The 40 pin connector present in this zone. Some of the pins from 40pin connector comes out through J101 connector without isolation.	
Output Zone 1: Some of the pins from 40pin connector comes out through J201 connector with isolation provided by Fast isolators.	
Output Zone 2: 18 outputs share a common ground isolated from RPI-4B. User can access 18 outputs through connectors J602,J406,J401.	
Relay Zone: 3 Relays present in this zone. The 3 relay outputs can be access through J402,J403,J404 repectively.	
Input zone 1: 6 isolated inputs present in input zone 1.	
Input zone 2: 4 isolated inputs present in input zone 2.	

4 Electrical Specification:

The board is divided into five zones based on different grounds.

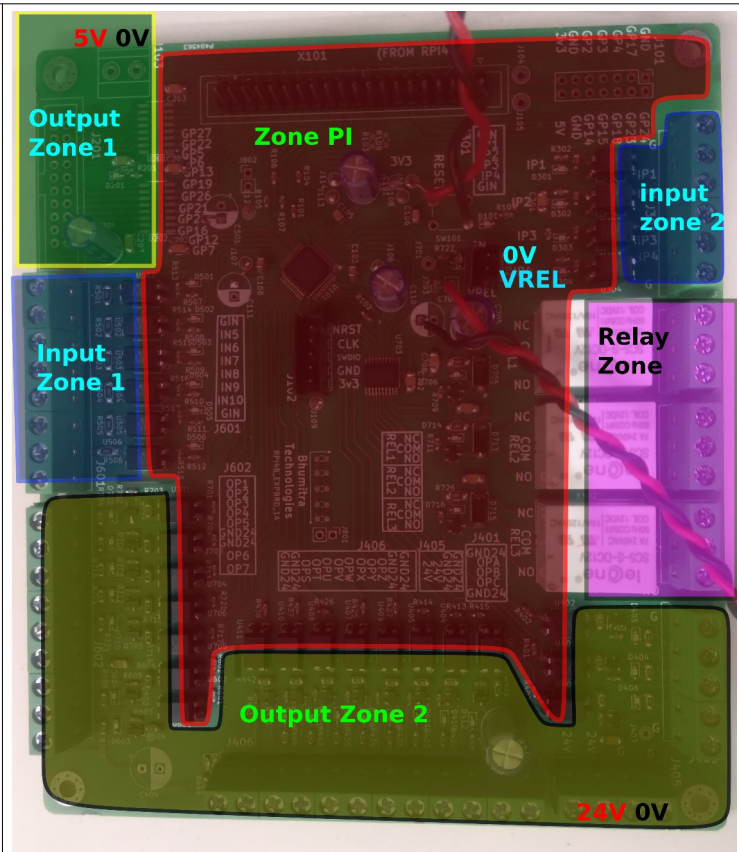
Power requirements:

Power supply for zone PI:

Microcontroller is present in this zone, the ground present in this zone is connected to RPI-4B through ground pin in the 40 pin connector. The power supply for this zone 3.3V and 5V is taken from the 40 pin connector. So no need to connect the external power supply to this zone while board is connected to 40 pin connector of RPI-4B.

Power supply for Output Zone 1:

Some unused pins from the raspberry pi connector comes out to the user with isolation. To use these pins user must give 5V supply to connector J103 as shown in the adjacent picture.



Power supply for Output Zone 2:

This is output Zone, total 18 outputs shares a common ground. The 4 pin connector J405 is the power supply connector for all the 18 outputs. Apply 24V to the positive terminal and 0V to the negative terminal.

Power supply for Relay Zone:

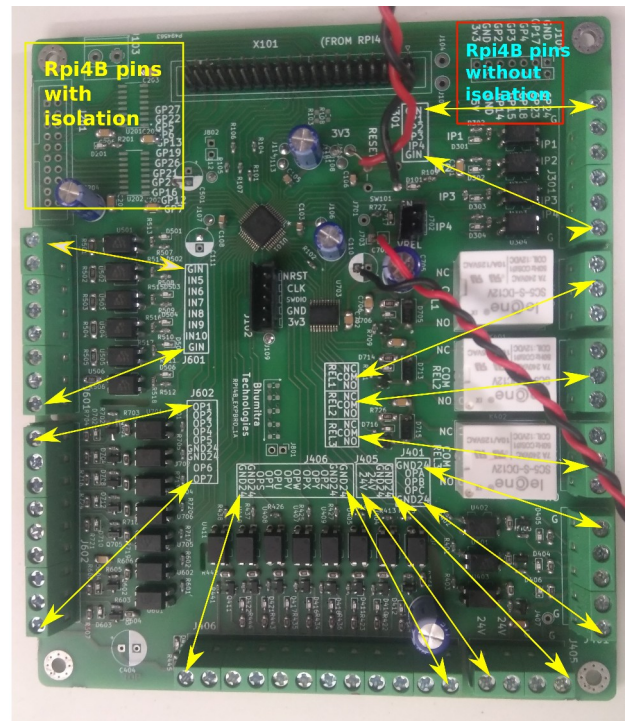
To power up the relay circuit user need to give VREL to the J702, after that relays can be controlled by user. The female RMC connector will be given with the board and its a unipolar pluggable connector. VREL voltage vary with the relay used on the board. For this model it is 12V.

5 Peripherals :

Raspberry pi pins: Without ISOLATION

User can access through J101 connecter

Rpi4B pin	J101		Rpi4B pin
GND	1	2	GP24
GP17	3	4	GP23
GP4	5	6	GP16
GP3	7	8	GP15
GP2	9	10	GP14
GND	11	12	GND
3v3	13	14	5V
	J101		



Raspberry pi pins: With ISOLATION

RPI-4B pins	J201		RPI-4B pins
GP27	1	2	GP22
	3	4	GP5
	5	6	GP6
GP19	7	8	GP13
	9	10	
GP26	11	12	GP21
	13	14	GP20
	15	16	GP16
	17	18	GP12
	19	20	GP7
	J201		



Output pins:

There are 18 isolated outputs in 3 different connectors.

To power up all the outputs, user need to give 24V to J405 connector.

Connector J602:

J602(pin)	Signal
1	OP1
2	OP2
3	OP3
4	OP4
5	OP5
6	GND24
7	GND24
8	OP6
9	OP7

Connector J401

J401(pin)	Signal
1	GND24
2	OPA
3	OPB
4	OPC
5	GND24

Connector J406:

J406(pin)	Signal
1	GND24
2	GND24
3	OPS
4	OPT
5	OPU
6	OPV
7	OPW
8	OPX
9	OPY
10	OPZ
11	GND24
12	GND24

Relays:

There are 3 relays on the board.

signal	Connector No.	Pins
REL1	J402	NC
		COM
		NO
REL2	J403	NC
		COM
		NO
REL3	J404	NC
		COM
		NO

When relay is OFF, pins COM and NC will be connected, NO and COM will be open.

When relay is ON, pins COM and NC will be open, NO and COM will be connected.



Input pins:

There are 10 isolated inputs in 2 different connectors.

Input zone 1:

Connector J601

J601(pin)	Signal
1	GIN
2	IN5
3	IN6
4	IN7
5	IN8
6	IN9
7	IN10
8	GIN

Input zone 2:

Connector J301

J301(pin)	Signal
1	GIN
2	IN5
3	IN6
4	IN7
5	IN8
6	GIN

The voltage between 5.8V to 24V is considered as high when applied to input pin. Anything less than 5.8V is considered as low.

40 Pin Connector: FROM RPI4B

functionality	X101		functionality
►	1	2	
	3	4	
	5	6	
	7	8	
	9	10	
	11	12	
	13	14	
	15	16	
	17	18	
	19	20	
	21	22	GP_INPUT
	23	24	SPI_CS
	25	26	
	27	28	
	29	30	
	31	32	
	33	34	
	35	36	
	37	38	
	39	40	
	X101		

► this symbol points the 1st pin on the board.

The extension board uses these 5 pins for communicate with Raspberry pi 4B.

The functionality of these pins are fixed.



6 Communication:

SPI on Raspberry pi:

The spi on the Raspberry pi should be configured as follow.

- Configure the GPIO pins as spi pins shown in the 40 pin connector table.
- SPI as Full Duplex Master.
- By default SPI_CLK should be low.
- Data size must be 8bits.
- MSB first(both transmitting and receiving) .
- Data change must be on falling edge.
- Data reading on raising edge.

Communication Protocol:

Steps to communicate:

1. Make pin number 22 in the 40pin connector high(which is GPIO25 in RPI4B) .
2. Wait for 20us.
3. Start the communication.
4. Start sending 3 8bits and simultaneously receive 3 8bits data.
5. You can make pin number 22 in the 40 pin connector low, whenever you want but to start communicate with the slave device you must make this pin high and wait for 20us.

Data exchange:

In order to control 21 outputs on the extension board, Master has to send all 21 pins data even if there is no need to change still master has to send all the ouput pins data whenever master initiated transmission.

The outputs are arranged in an order that user can understand easily. The 21 outputs are divided into 3bytes like as shown below.



Data sent by Master:

The first 8 bits:

X	OP1	OP2	OP3	OP4	OP5	OP6	OP7
MSB							LSB

These 8bits data will appear on the J602 connector, slave ignores the 8th bit.

*whenever master sending data, first 8bits should be like this.

The second 8 bits:

OPZ	OPY	OPX	OPW	OPV	OPU	OPT	OPS
MSB							LSB

These 8bits data will appear on the J406 connector on extension board.

*whenever master sending data second 8bits should be like this.

The third 8 bits:

X	X	REL1	REL2	REL3	OPA	OPB	OPC
MSB							LSB

The slave ignores the 8th, 7th bits.

*whenever master sending data third 8bits should be like this.

Data sent by Slave:

The first 8 bits:

X	X	IN5	IN6	IN7	IN8	IN9	IN10
MSB							LSB

This 8bits data Was read from the connector J601 from input zone 1.

*master has to ignore the don't cares.

The second 8 bits:

X	X	X	X	IN1	IN2	IN3	IN4
---	---	---	---	-----	-----	-----	-----

This 8 bits data was read from the connector J301 from input zone 2.

The third 8 bits:

X	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

This is just the dummy data, by the way slave will send all 1's .master will receive 11111111.



Example:

Lets assume master wants to make OP1,OP3,OP4,OP7,OPX,OPY,OPZ,REL1,REL2,OPA high and read inputs(assume IN1,IN2,IN4,IN5,IN7,IN8 are high and remaining pins are low).

Solution:

The first 8bits to be sent:

Pattern	X	OP1	OP2	OP3	OP4	OP5	OP6	OP7
Data	0	1	U_S	1	1	U_S	U_S	1

U_S = Unchanged State of the respective pin.

X = don't care(simply send 0).

*remember every time master have to send unchanged state too.

The second 8bits to be sent:

Pattern	OPZ	OPY	OPX	OPW	OPV	OPU	OPT	OPS
Data	1	1	1	U_S	U_S	U_S	U_S	U_S

U_S = Unchanged State of the respective pin.

*remember every time master have to send unchanged state too.

The third 8bits to be sent:

Pattern	X	X	REL1	REL2	REL3	OPA	OPB	OPC
Data	0	0	1	1	U_S	1	U_S	U_S

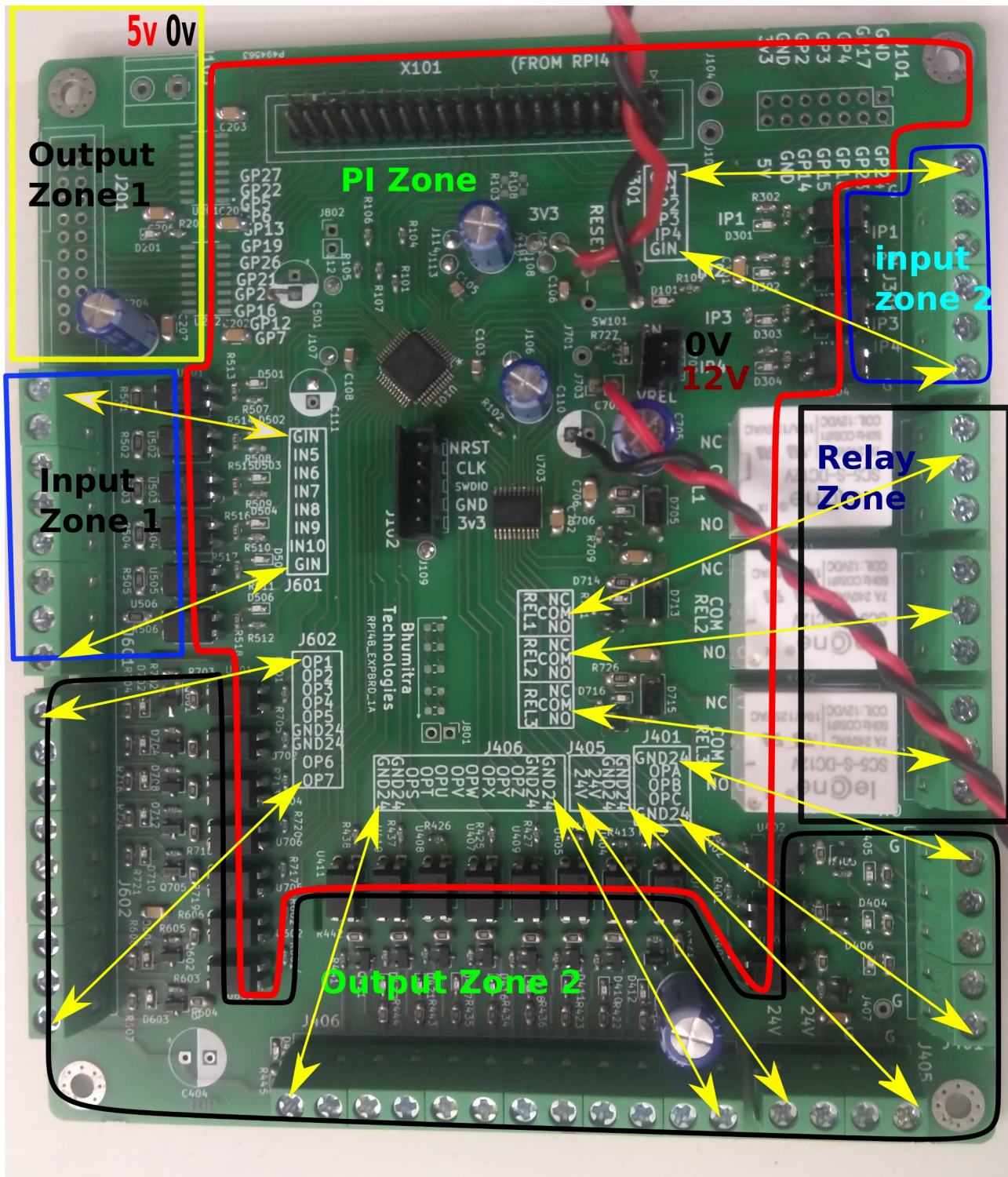
Receiving Data will be:

Data	0	0	1	0	1	1	0	0
Pattern	X	X	IN5	IN6	IN7	IN8	IN9	IN10

Data	0	0	0	0	1	1	0	1
Pattern	X	X	X	X	IN1	IN2	IN3	IN4

Data	1	1	1	1	1	1	1	1
Pattern	X	X	X	X	X	X	X	X

7 Board layout:





Bhumitra Technologies.

RPI4B_EXPBRD_1A