Notes to Reef-PI HAT

Contents

Revision	Reason	Date
1.0	Original release for HAT v1.0	13 Aug 2018
1.1	Update table 6 for temperature sensor (tip and ring reversed) for HAT v1.0 (thanks to Speedstar) Reviewed and updated HAT.csv file (BOM including datasheets, potential supplier and Manufacturing Part Numbers) Added page numbers to this document Added list of items to update to this document Added revision history to this document	7 Nov 2018

Table 1: Revision history

Planned updates to this document:

	Planned addition or update
a)	Add photo's of complete assembled Reef-PI HAT
b)	Add "introduction" paragraph to describe purpose of the Reef-PI HAT
c)	Add "assembly instructions" paragraph
d)	Update "relays interface" paragraph: - Which ULN2803 can be left out if only 4 or 8 relays are required - How to connect relays boards with external power (e.g. 12V)
e)	Add "debugging" paragraph
f)	Add list of potential "updates to the Reef-PI HAT" design
g)	Update figure 11 for better description of temperature sensor cabling

Table 2: Things to do to this document

1. Main HAT board:

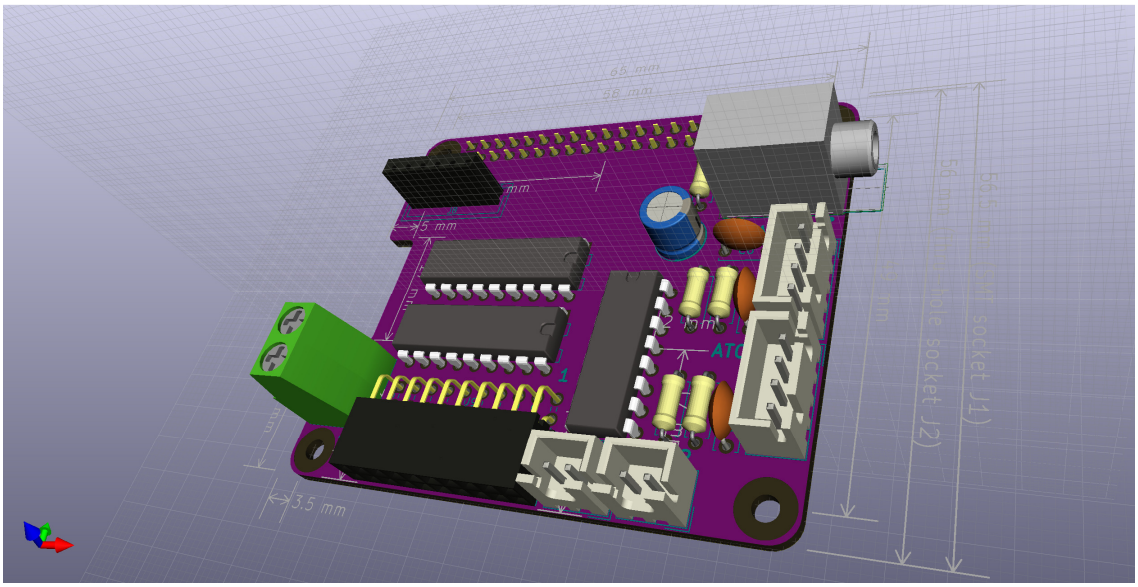

Figure 1: Top HAT board

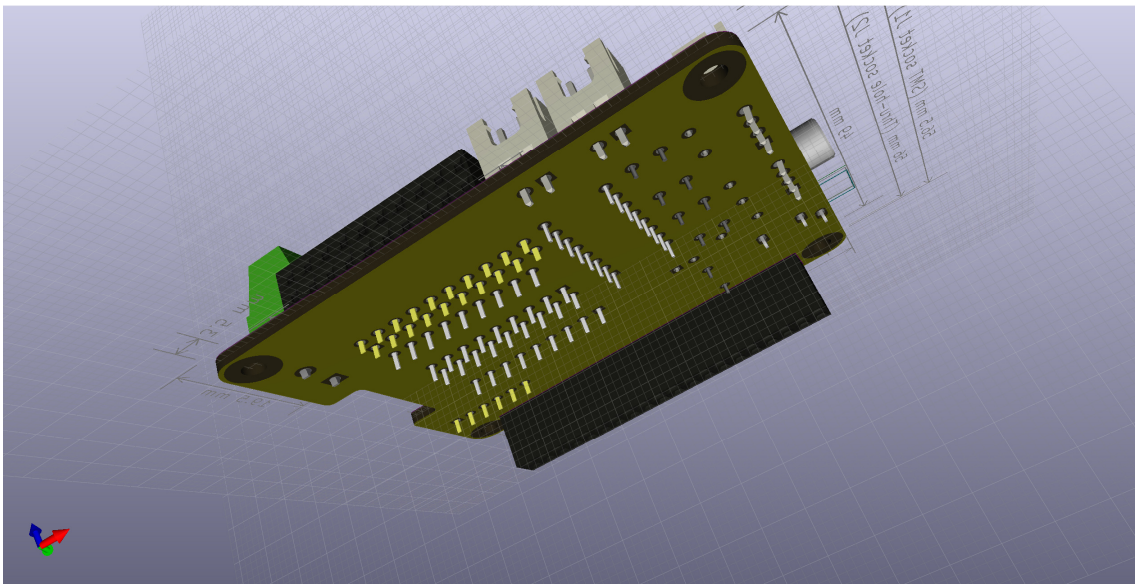

Figure 2: Bottom HAT board

2. Schematic:

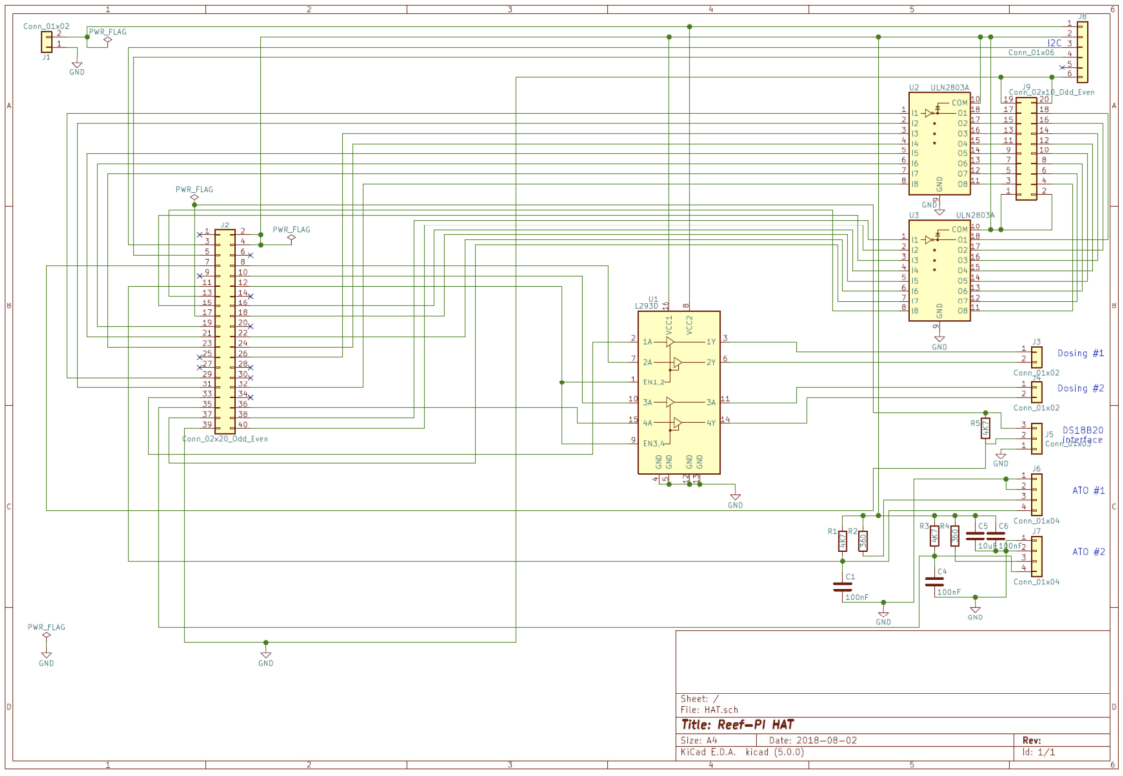

Figure 3: HAT schematics

3. Functional overview:

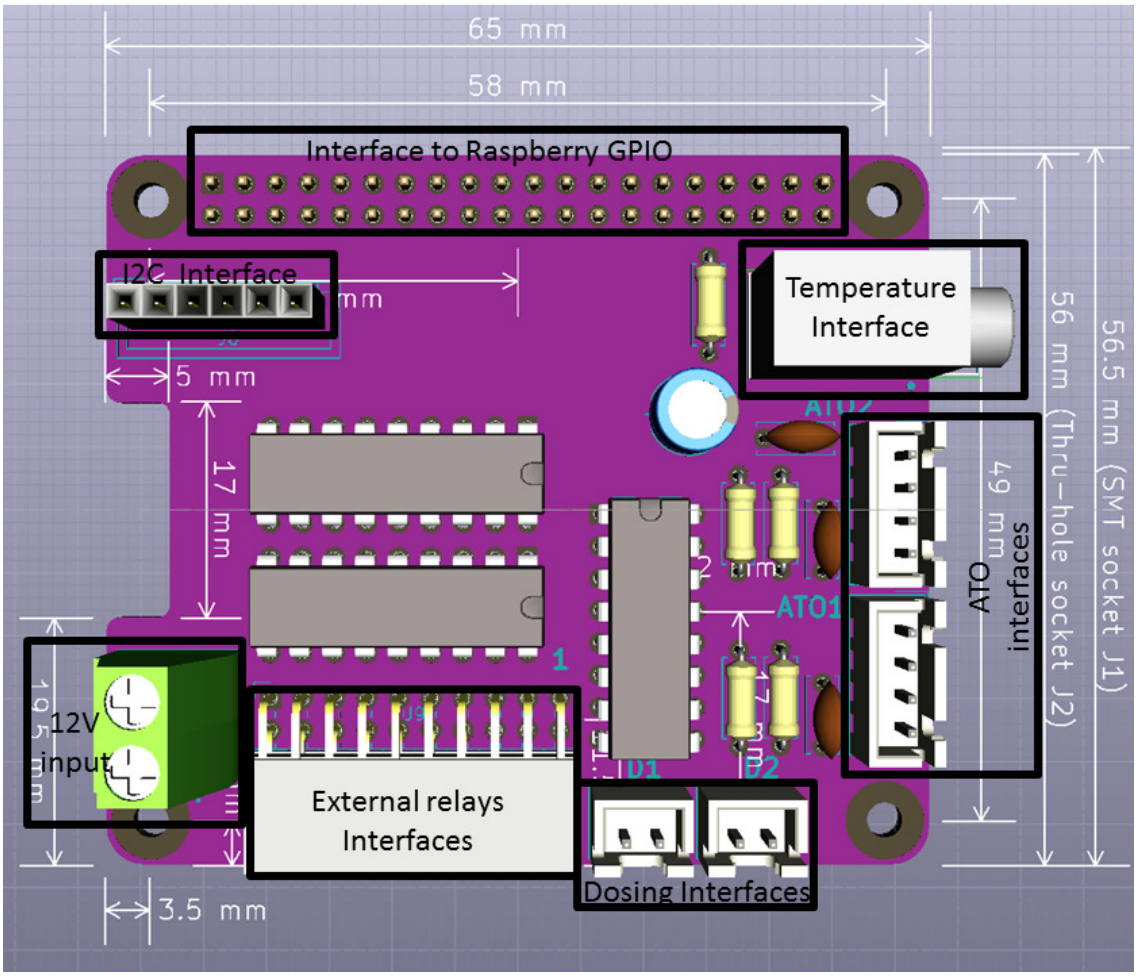

Figure 4: Overview HAT functions

4. BOM:

The proposed links are for easy finding, but most components can be found at various Internet sites at better prices such as Aliexpress, Banggood, eBay and Amazon. Purpose of this info is to provide as much as possible of information to find the required components.

The present KiCad files show D1, D2, ATO1 and ATO2 as straight connectors, you may choose to use 90 degree turned connectors for easier access in case additional Reef I2C boards (e.g. PWM module) are going to be added.

Title	Reef-PI HAT		
Revision	1		
Date	8/2/2018		
Generated	11/7/2018 8:25		
Company			
Comment 1			
Comment 2			
Comment 3			
Comment 4			
Total Parts	21		
Total Unique	13		
Ref	Qty	Value	Footprint
C1 C4 C6	3	100nF	Capacitors_THT:C_Disc_D6.0mm_W2.5mm_P5.00mm
C5	1	10uF	Capacitors_THT:CP_Radial_D6.3mm_P2.50mm
J1	1	Conn_01x02	Pin_Headers:Pin_Header_Straight_1x02_Pitch2.54mm
J2	1	Conn_02x20_Odd_Even	Pin_Headers:Pin_Header_Straight_2x20_Pitch2.54mm
J3 J4	2	Conn_01x02	Pin_Headers:Pin_Header_Straight_1x02_Pitch2.54mm
J5	1	Conn_01x03	SJ1-3533NG:CUI_SJ1-3533NG
J6 J7	2	Conn_01x04	Pin_Headers:Pin_Header_Straight_1x04_Pitch2.54mm
J8	1	Conn_01x06	Pin_Headers:Pin_Header_Straight_1x06_Pitch2.54mm
J9	1	Conn_02x10_Odd_Even	Socket_Strips:Socket_Strip_Angled_2x10_Pitch2.54mm
R1 R3 R5	3	4K7	Resistors_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
R2 R4	2	360	Resistors_THT:R_Axial_DIN0207_L6.3mm_D2.5mm_P7.62mm_Horizontal
U1	1	L293D	Housings_DIP:DIP-16_W7.62mm
U2 U3	2	ULN2803A	Housings_DIP:DIP-18_W7.62mm
BOM made with KICAD_BOM_WIZARD (https://github.com/HashDefineElectronics/KiCad_BOM_Wizard.git)			
Generated 11/7/2018 8:25:58 AM			

Table 3: BOM with values and footprints

Ref	Qty	Value	Datasheet
C1 C4 C6	3	100nF	https://www.mouser.com/datasheet/2/212/F3294_MMK-1101858.pdf
C5	1	10uF	https://www.mouser.com/datasheet/2/88/RSS_series-553040.pdf
J1	1	Conn_01x02	https://www.mouser.com/datasheet/2/324/ItemDetail_1715022-929342.pdf
J2	1	Conn_02x20_Odd_Even	
J3 J4	2	Conn_01x02	http://www.jst-mfg.com/product/pdf/eng/eXH.pdf
J5	1	Conn_01x03	https://www.cui.com/product/resource/sj1-353xng.pdf
J6 J7	2	Conn_01x04	http://www.jst-mfg.com/product/pdf/eng/eXH.pdf
J8	1	Conn_01x06	https://www.mouser.at/datasheet/2/181/M20-782-1220556.pdf
J9	1	Conn_02x10_Odd_Even	https://drawings-pdf.s3.amazonaws.com/10494.pdf
R1 R3 R5	3	4K7	https://www.mouser.at/datasheet/2/447/Yageo%20LR_MFR_2013-467719.pdf
R2 R4	2	360	https://www.mouser.at/datasheet/2/447/Yageo%20LR_MFR_2013-467719.pdf
U1	1	L293D	http://www.ti.com/lit/gpn/l293d
U2 U3	2	ULN2803A	https://www.mouser.com/datasheet/2/389/uln2801a-957494.pdf

Table 4: BOM with datasheets

Ref	Available
C1 C4 C6	https://www.mouser.com/ProductDetail/KEMET/MMK5104J50J01TR18L165TR18?qs=sGAEpiMZZMv1cc3ydrPrF5x3WQ3kgUjq2n7LI2iOtYY%3d
C5	https://www.mouser.com/ProductDetail/Illinois-Capacitor-CDE/106RSS050M?qs=sGAEpiMZZMtZ1n0r9vR22fPWwtj8kO8a58s44%2fdFKj09plvQeLN9jQ%3d%3d
J1	https://www.mouser.com/ProductDetail/Phoenix-Contact/1715022?qs=sGAEpiMZZMv8kkll404QlQ5JHVXTAtUD
J2	https://www.mouser.at/ProductDetail/Adafruit/2222?qs=sGAEpiMZZMsMyYRRhGMFNhmPBiclXg21QVJnSoTyCdM%3d
J3 J4	Best to buy JST XH kit at Aliexpress Banggood or eBay. Not available at Mouser (best is 90 degree turned for easier connection)
J5	https://www.mouser.com/ProductDetail/CUI/SJ1-3533NG?qs=%2fha2pyFadugIOW6%2fGHaxFTtDzgX5jy4lT1DvwLSs%2f4zg9whX7S1hBg%3d%3d
J6 J7	Best to buy JST XH kit at Aliexpress Banggood or eBay. Not available at Mouser (best is 90 degree turned for easier connection)
J8	https://www.mouser.at/ProductDetail/Harwin/M20-7820646?qs=sGAEpiMZZMs%252bGHln7q6pmzlZUuX%2f53qjd9Ri%252bf2usQ4%3d
J9	search at Aliexpress Banggod eBay or Amazon for MPN description
R1 R3 R5	https://www.mouser.com/ProductDetail/Yageo/CFR-25JT-52-4K7?qs=sGAEpiMZZMukHu%252bjC5l7YY9Rw%2foCMY%252bkAa5MYwSus5A%3d
R2 R4	https://www.mouser.com/ProductDetail/Yageo/MFR-25FTE52-360R?qs=sGAEpiMZZMukHu%252bjC5l7YSmb5PYXOMoV%2f%252bs02PAm%252bVQ%3d
U1	https://www.mouser.com/ProductDetail/Texas-Instruments/L293DNE?qs=sGAEpiMZZMtYFXwiBRPs0wSafWlCmJbc
U2 U3	https://www.mouser.com/ProductDetail/STMicroelectronics/ULN2803A?qs=sGAEpiMZZMvAvBNgSS9LqpP7ived4CP2

Table 5: BOM with potential suppliers

For better readability refer to the HAT.csv file

5. Connectors:

5.1.12V input:

Required 12V power supply to drive the dosing motors. Plus and minus are indicated on the board.

5.2.External relays interfaces:

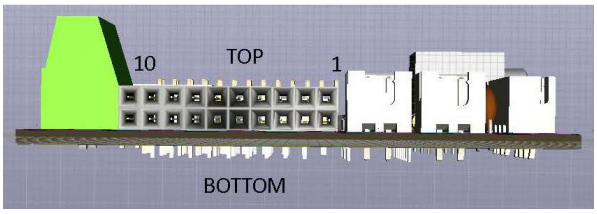

Figure 5: Relays interface

Top 10 pin connect relays:

Connector HAT	Relays	GPIO/Power
1	-	GND
2	1	5
3	2	6
4	3	7
5	4	8
6	5	9
7	6	10
8	7	11
9	8	12
10	-	5V

Table 6: Top 10 connections

Bottom 10 pin connector relays:

Connector HAT	Relays	GPIO/Power
11	-	GND
12	1	20
13	2	21
14	3	22

15	4	23
16	5	24
17	6	25
18	7	26
19	8	27
20	-	5v

Table 7: Bottom 10 connections

Connector HAT: The pin positions as shown in picture Figure 5: Relays interface
Relays: Usual external relays numbers when connected with 1-1 cable
GPIO: Shows under which GPIO ports the relays can be switched On/Off

Intended external relay module:

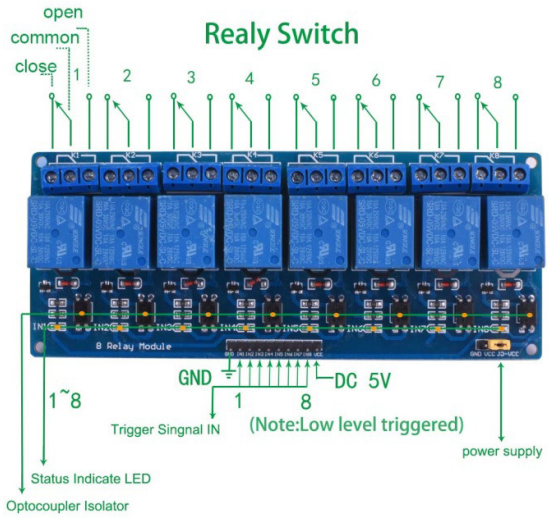

Figure 6: Intended external relays board

Also a smaller (4 channel) relay module can be used, but then a 10 to 6 pin adapter cable will be required. No external power supply is required. A total of 2 8 channel relays can be supported to have a total of 16 I/O interfaces.

5.3.Dosing interfaces:

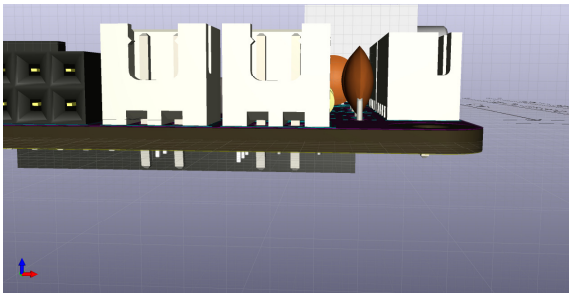

Figure 7: Dosing interfaces

Dosing motors are indicated on the HAT as D1 (left) and D2 (right)

In order for the dosing motors to function, the l293D must be enabled via GPIO port 18. Connectors are JST-XH (other will work as well, but since the optical ATO sensor has a 4pin JST-XH connector, the same 2 pin type has been selected).

GPIO port	Function
13	0/12V interface to motor #1
14	0/12V interface to motor #1
15	0/12V interface to motor #2
16	0/12V interface to motor #2
18	Enable both dosing interfaces

Table 8: Overview GPIO ports to control dosing interfaces

GPIO 18	GPIO 13	GPIO 14	GPIO 15	GPIO 16	Motor #1	Motor #2
OFF	-	-	-	-	OFF	OFF
ON	OFF	OFF	OFF	OFF	OFF	OFF
ON	ON	OFF	-	-	Direction 1	-
ON	ON	ON	-	-	OFF	-
ON	OFF	ON	-	-	Direction 2	-
ON	-	-	ON	OFF	-	Direction 1
ON	-	-	ON	ON	-	OFF
ON	-	-	OFF	ON	-	Direction 2

Table 9: Overview motor directions

5.4.ATO interface:

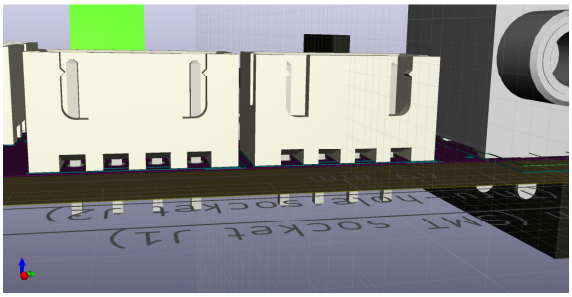

Figure 8: 4 pin dosing interfaces

The ATO1 (Left) and ATO2 (right are marked on the PCB. The interfaces connect to this type of probe

Figure 9: Intended optical water sensor

The values can be read out via GPIO ports 17 and 19

GPIO Port	Description
17	Read out ATO1
19	Read out ATO2

Table 10: ATO read out ports

5.5.Temperature sensor interface:

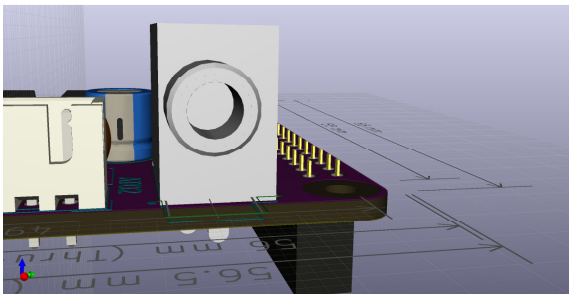

Figure 10: 3 pin DS18B20 interface

Multiple DS18B20 can be connected to the same interface alike this

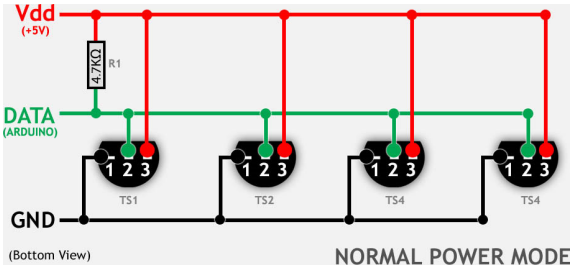

Figure 11: Mounting multiple DS18B20 sensors

It should be noted that the power supply is 3V3 and not 5V! The connection is done via a stereo audio plug alike this

Figure 12: Intended 3.5mm stereo jack connector

Connections used are:

Pin	Connection
Tip (left)	Connects to GPIO 7 (DATA)
Middle	3V3 power supply to GPIO 17 (VDD)
Right	GND to GPIO39 (GND)

Table 11: Connector pin out

5.6.Raspberry PI interface:

Female 2x20 pin strip to connect directly to the Raspberry PI 2 or 3

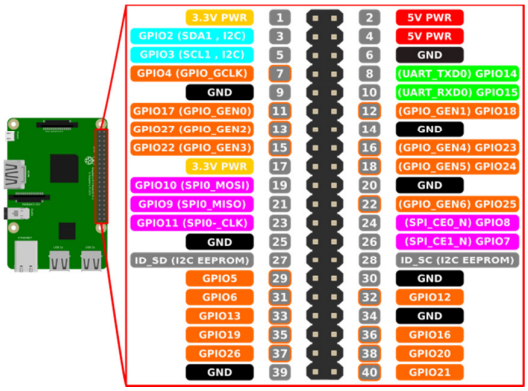

Figure 13: Raspberry GPIO pin overview

Only pins 27 and 28 (I2C EEPROM) are not used.

5.7.I2C interface:

Interface to external I2C boards (under development or existing). The interface provides signals

Pin	Signal
1	12V
2	5V
3	SDA

4	SCL
5	Not connected
6	GND

Table 12: I2C interface pin out