



VERSION 2.0

12-09-2022

OPTICAL ENCODER 13 BITS

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Translated by CT1BYM

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OPTICAL ENCODER

INTRODUCTION

The Encoder used is the 58-S8192GKD01 model from TWK Elektronik, which has a 13-bit digital output in gray code.



It can be found second hand on eBay at a reasonable price:

<https://www.ebay.es/itm/TWK-ELEKTRONIK-ROTARY-ENCODER-KBE-58-S8192-G-K-D01-FREE-SHIP/280952453283>

CONECTORS

Comes equipped with an 18-pin connector (can be male or female) from the manufacturer JST.

Model SMP-18V-BC

<https://es.rs-online.com/web/p/tira-de-zocalos-y-pines-para-pcb/3922515>

Pin SHF-001T-0.8BS

<https://es.rs-online.com/web/p/contactos-de-conectores-para-pcb/6881303/>



Model SMR-18V-B

<https://es.rs-online.com/web/p/tira-de-zocalos-y-pines-para-pcb/3922379>

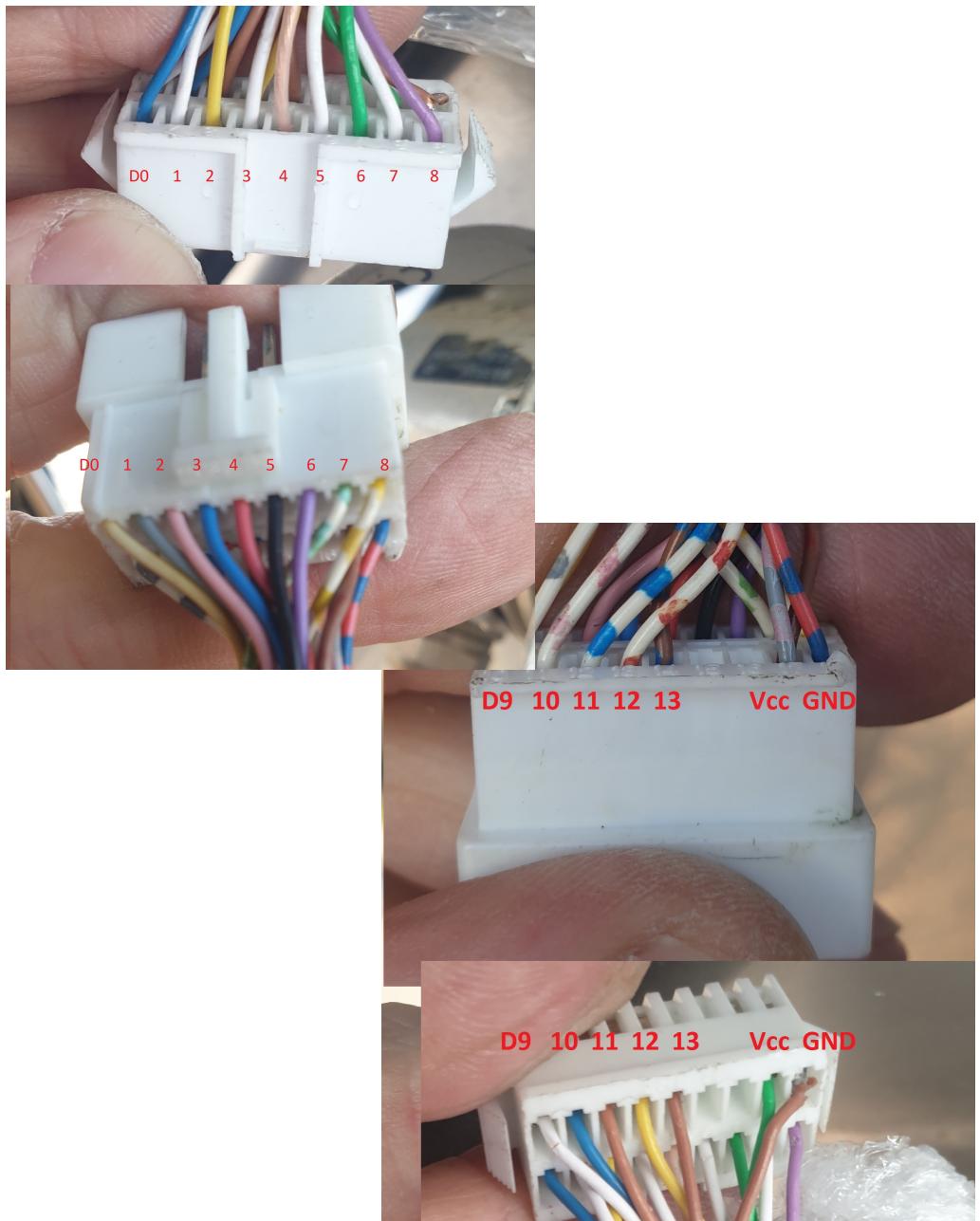
Pin SMY-001T-P0.6(N)

<https://www.digikey.es/product-detail/es/jst-sales-america-inc/SYM-001T-P0-6-N/455-1909-1-ND/1465028>



PINOUT

Pin	Value
1	D0
2	D1
3	D2
4	D3
5	D4
6	D5
7	D6
8	D7
9	D8
10	D9
11	D10
12	D11
13	D12
14	D13 (no use)
15	NC
16	NC
17	VCC 12V
18	GND

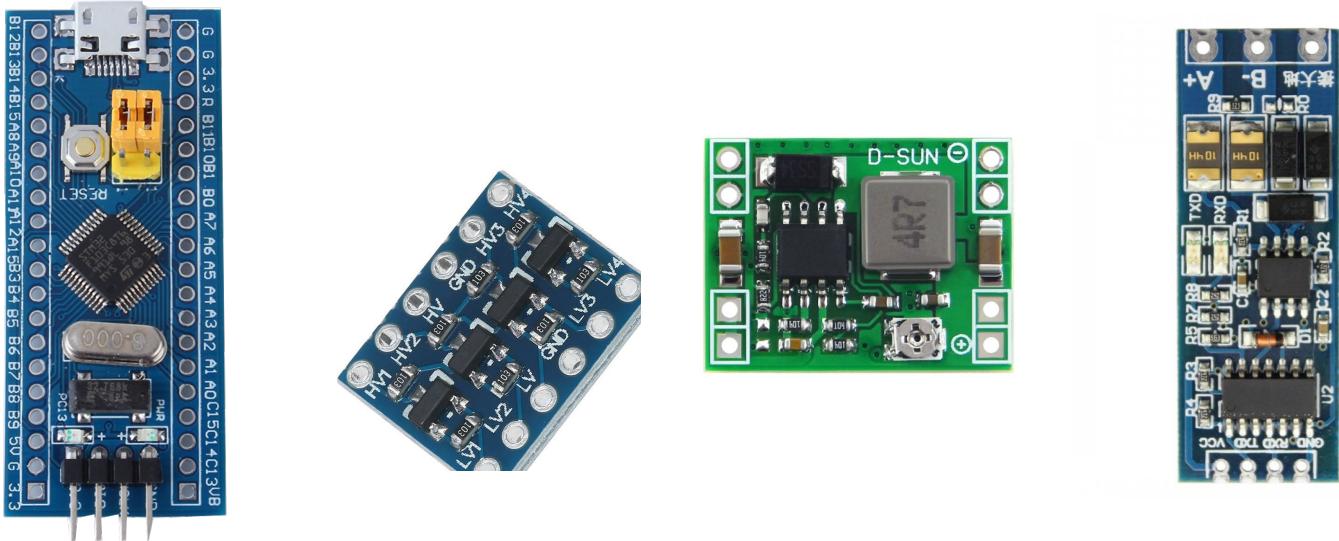


CONVERTER PARALEL TO MODBUS-RTU RS485

INTRODUCTION

Handling 13 parallel bits is quite cumbersome and it is more standard to use the MODBUS-RTU protocol to manage the position of the Encoder.

The circuit consists of a blue pill stm32f03 module, a voltage reducer module from 12V to 3.3V, four shifter level modules to adapt the 12v from the Encoder outputs to the 3.3V of the micro, and a TTL232 to RS485 module.



ONLINE SHOPPING LINKS

<a href="https://es.aliexpress.com/item/1005001707231287.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtcp=&albtt=Google 7 shopping&aff_platform=google&aff_short_key=UneMJZVf&gclsrc=aw.ds&&albag=8888888&&ds_e_adid=475827849334&ds_e_matchtype=&ds_e_device=c&ds_e_network=u&ds_e_product_group_id=855473407372&ds_e_product_id=es1005001707231287&ds_e_product_merchant_id=106535957&ds_e_product_country=ES&ds_e_product_language=es&ds_e_product_channel=online&ds_e_product_store_id=&ds_url_v=2&ds_dest_url=https://es.aliexpress.com/item/1005001707231287.html?&albcpc=11489913537&albag=114956049489&isSmbAutoCall=false&needSmbHouyi=false&gclid=Cj0KCQjwrsGCBhD1ARIsAlLILByPbLBt4mhgn2-FVbdts4jtXmJoTz84gTirCBMg5SMJrtmPF71AyKlaAqOnEALw wcB

<a href="https://es.aliexpress.com/item/32216841860.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtcp=&albtt=Google 7 shopping&aff platform=google&aff short key=UneMJZVf&gclsrc=aw.ds&&albagn=8888888&&ds e adid=473728314619&ds e matchtype=&ds e device=c&ds e network=u&ds e product group id=536572975094&ds e product id=es32216841860&ds e product merchant id=107330331&ds e product country=ES&ds e product language=es&ds e product channel=online&ds e product store id=&ds url v=2&ds dest url=https://es.aliexpress.com/item/32216841860.html?&albcp=11405488241&albag=115612532150&isSmbAutoCall=false&needSmbHouyi=false&gclid=CiOKCQiwrsGCBhD1ARIsALILBYpa7bA7in7MHgsckeNU3xYREUIJ8EQp3E8c-hGAxKnnk94K-ic-4waAkN5EALw wcb

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https://es.aliexpress.com/item/32707755990.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtcp=&albtt=Google_7_shopping&aff_platform=google&aff_short_key=UneMJZVf&gclsrc=aw.ds&&albagn=8888888&&ds e adid=475827849334&ds e matchtype=&ds e device=c&ds e network=u&ds e product group_id=855473407372&ds e product_id=es32707755990&ds e product_merchant_id=107407105&ds e product_country=ES&&ds e product_language=es&ds e product_channel=online&ds e product_store_id=&ds url_v=2&ds dest_url=https://es.aliexpress.com/item/32707755990.html?&albcn=11489913537&albag=114956049489&isSmbAutoCall=false&needSmbHouyi=false&gclid=CiOKCQiwrsGCBhD1ARIsALILBYrQz8ac3gJ9uLeXPPGlhVVi6a_5ILdgH--lhWLW_ciD0QVMxz2G5kaAsyVEALw_wcB

https://www.amazon.es/3-81mm-pernos-Staight-Bloques-Conectores/dp/B01EZZMXTG/ref=sr_1_14?__mk_es_ES=%C3%85M%C3%85%C5%BD%C3%95%C3%91&dchild=1&keywords=pi_tch+3.81&qid=1615983833&sr=8-14



https://www.amazon.es/dp/B07Z2TXSCW>tag=amz-mkt-chr-es-21&ascsubtag=1ba00-01000-org00-win10-other-nomod-es000-pcomp-feature-rscomp-wm-5&ref=aa_rscomp

https://www.amazon.es/DealMux-AC300V-asiento-terminales-Conector/dp/B071GYHYYL/ref=sr_1_4?__mk_es_ES=%C3%85M%C3%85%C5%BD%C3%95%C3%91&dchild=1&keywords=3.81mm+15P&m=A25HL4JIED5BM8&qid=1615983632&s=merchant-items&sr=1-4

https://www.amazon.es/dp/B07Q1XBGFB>tag=amz-mkt-chr-es-21&ascsubtag=1ba00-01000-org00-win10-other-nomod-es000-pcomp-feature-scomp-wm-5&ref=aa_scomp



MODBUS-RTU PROTOCOL

This functions are supported: function 3 reading and 6 writing.

FUNCTION 3 READING

Master sends:

Slave Nº
Operation Code: 0x03
Registry address
No. of data to be read: 0x01
CRC(16): H L

Encoder responds:

Slave Nº
Operation Code: 0x03
Number of bytes read: 0x01
Data Value
CRC(16): H L

Encoder position reading example

Sent: 01 03 00 00 00 01 84 0A

Received: 01 03 04 04 D2 DA D8

FUNCTION 6 WRITING

Master sends:

Slave Nº
Operation Code: 0x06
Registry address
Data Value
CRC(16): H L

Encoder responds:

Slave Nº
Operation Code: 0x06
Registry address
Data Value
CRC(16): H L

Example: change direction to 2

Sent: 01 06 00 04 00 02 49 CA

Received: 01 06 00 04 00 02 49 CA

ENCODER REGISTRY

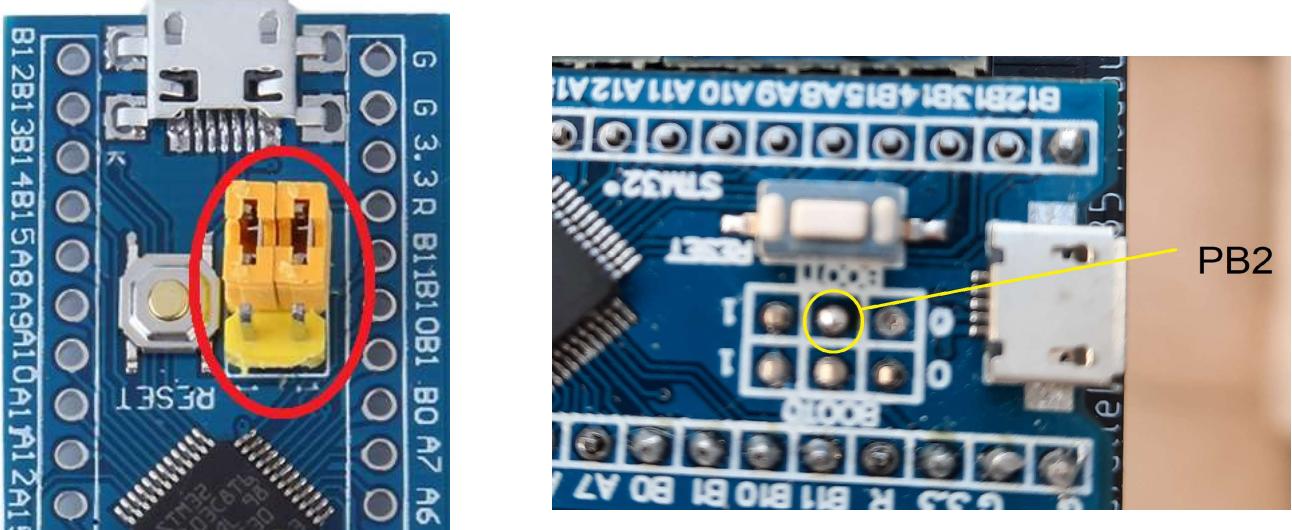
Registry	Description	Value range	Functions	Notes
0x00	Position	0x00÷2 ^{bit number}	0x03	Encoder position
0x04	Dirección Encoder	0x00÷0xFF	0x03-0x06	0x01 default
0x05	Velocidad bps	0x00÷0x04	0x03-0x06	0x00 9600 bps 0x01 19200 bps 0x02 38400 bps 0x03 57600 bps 0x04 115200 bps
0x06	Número de bits	0x00÷0x10	0x03-0x06	Hardware to 13 bits
0x08	Código grey	0x00÷0x01	0x03-0x06	0x00 binary code 0x01 grey code
0x09	Dirección conteo	0x00÷0x01	0x03-0x06	0x00 CW 0x01 CCW

HARDWARE

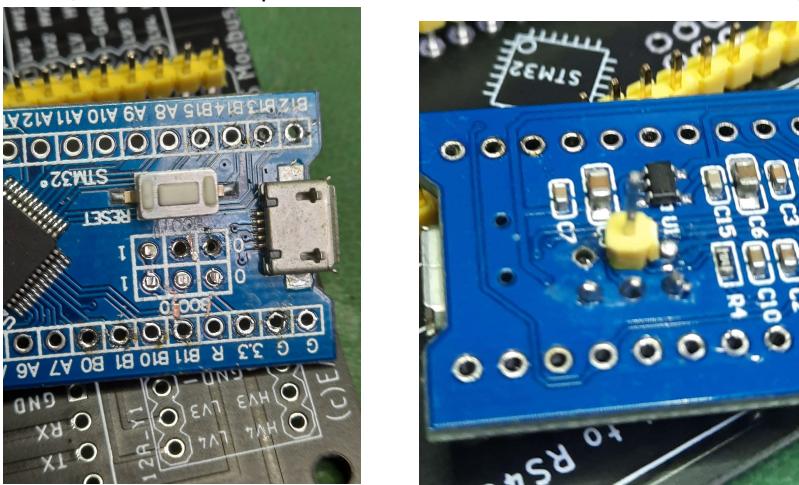
PREPARATION

The stm32f103 module is modified to access the PB2 pin, which is not accessible normally.

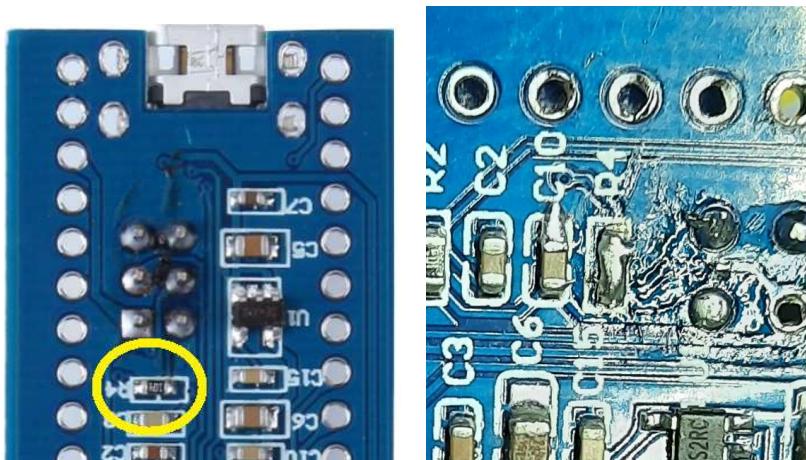
We first we remove the pins that are used for boot selection.



Then, we mount the pin down in the same side as the connection pins.

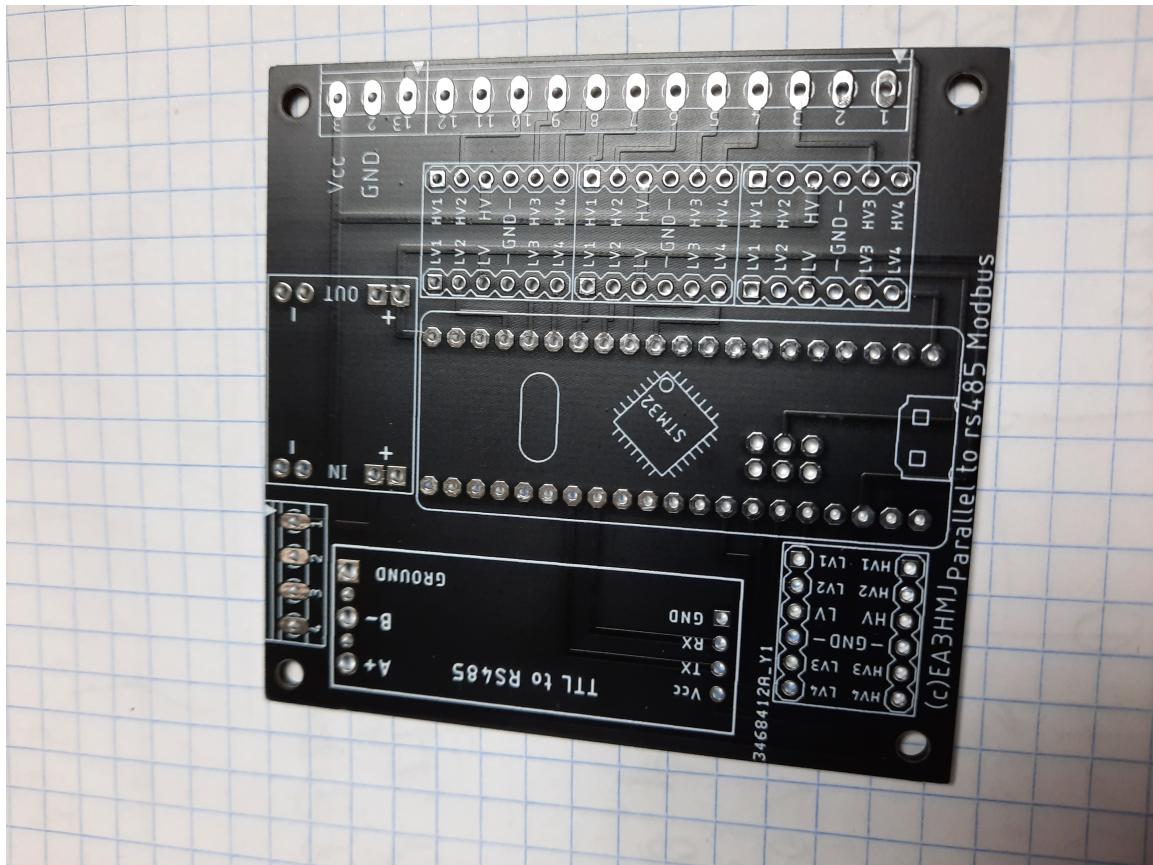


We remove R4 and solder a shunt across the terminals, on the bottom side.

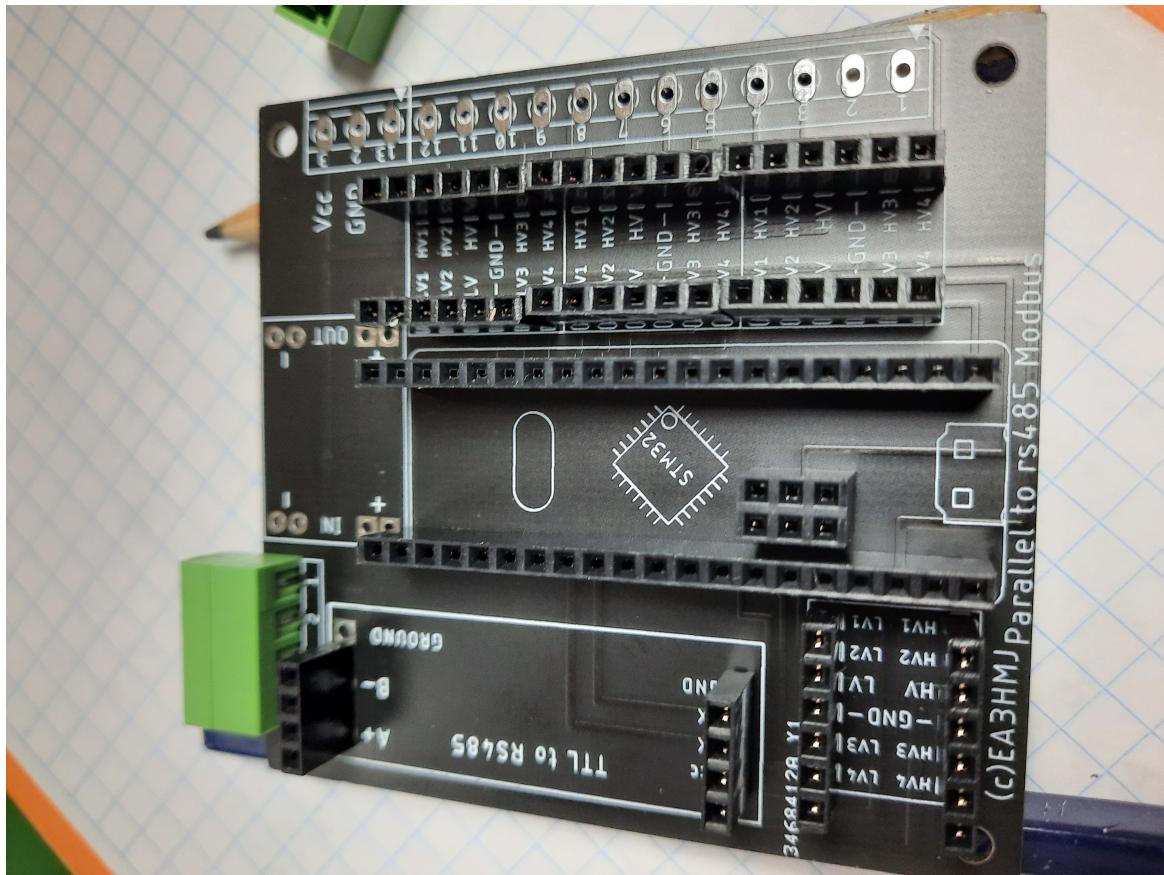


ASSEMBLY

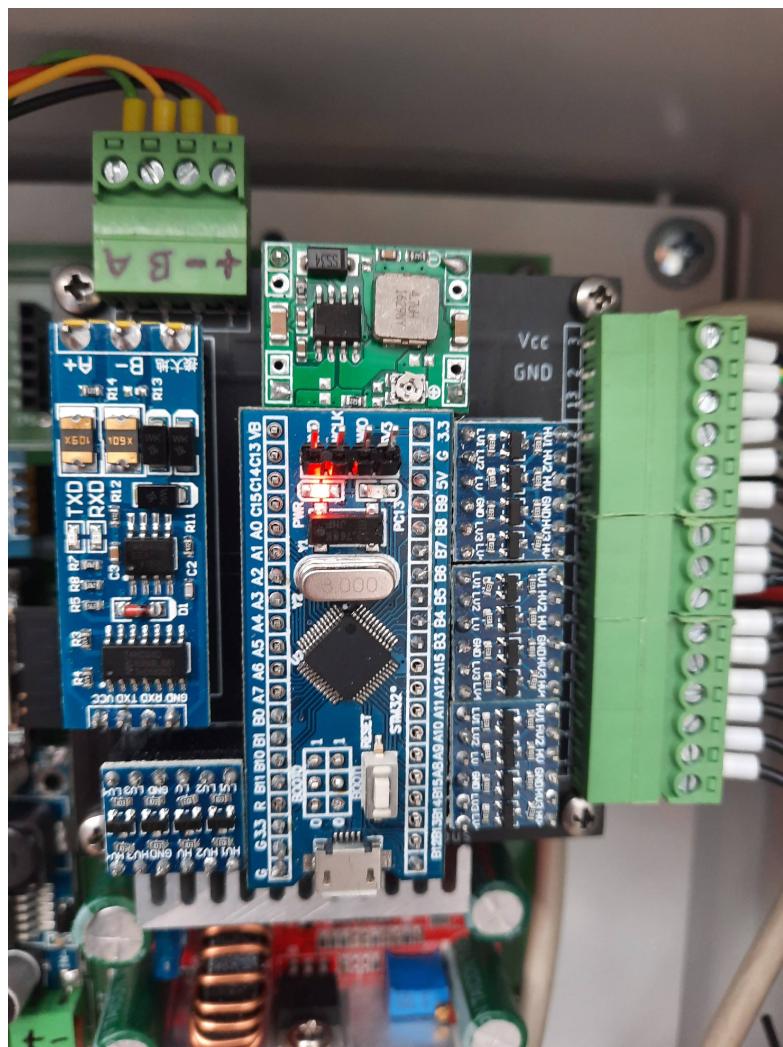
The pcb is based on a modular system and the modules are plugged into their respective places.



We solder the support pins.



We can now click the modules on the pins and we have the assembly ready.



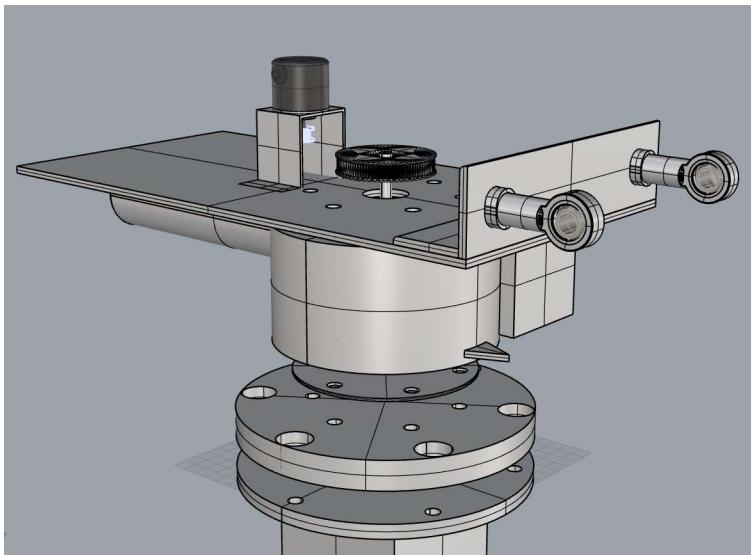
The system connections are very simple and are made through a 4-way connector (power supply and rs485) and a 15-way connector (power supply and 13-bit Encoder)

The power supply is 12V DC.

RESOLUTION INCREASE

There are two techniques to increase the encoder resolution, both mechanical.

The first will be through gears and belt.



This option allows us to achieve any multiplication depending on the gears teeth relation.

In the attached table the multiplications and the resolution achieved are given, a reduction of 6 is a good value.

Multiplication		2	3	4	5	6	7	8
bit increment		1		2				4
bit number		13	14		15			16
Resolutions (degrees)	0,0439	0,022	0,0146	0,011	0,0088	0,0073	0,0063	0,0055

The implementation is very simple as can be seen in the photo.

These are the links to purchase:

Pulley GT2 T20, 6mm or 8mm for encoder

<https://es.aliexpress.com/item/32642429070.html?spm=a219c.12010612.8148356.6.5d8f66feFRFHbG>

Multiplication x4

Pulley GT2 T80, 8 mm, Fit Width 6mm

<https://es.aliexpress.com/item/32808804964.html?spm=a219c.12057483.0.0.47b4352dc3QenR>

Strap GT2, 6mm, 252GT2

<https://es.aliexpress.com/item/32590979879.html?spm=a219c.12010612.8148356.4.4fe229ddeplCgQ>

Multiplication x5

Pulley GT2 T100, 8 mm, Fit Width 6mm

<https://es.aliexpress.com/item/33011649388.html?spm=a219c.12010612.8148356.1.52e966feQf7fcu>

Strap GT2, 6mm, 280GT2

<https://es.aliexpress.com/item/32356427477.html?spm=a219c.12010612.8148356.4.208229ddUBW1Sy>

Multiplication x6

Pulley GT2 T120, 8 mm, Fit Width 6mm

<https://es.aliexpress.com/item/33014158442.html?spm=a219c.12057483.0.0.176837e299Ue9z>

Strap GT2, 6mm, 302GT2

<https://es.aliexpress.com/item/32739215128.html?spm=a219c.12010612.8148356.1.175929ddASLkiG>

Multiplication x8

Pulley 20T MXL, 6mm (Big Hub), For belt width 6mm

<https://es.aliexpress.com/item/871134110.html?spm=a219c.12010612.8148356.1.7ca66a1eXC4HC5>

Pulley 160T MXL, 8mm, For belt width 6mm

<https://es.aliexpress.com/item/32988615762.html?spm=a219c.12010612.8148356.19.b4c33613VRiz47>

Strap B177MXL025, Teeth 177

<https://es.aliexpress.com/item/568775215.html?spm=a219c.12010612.8148356.38.6c588517MlxJLI>

I have recently tried a more compact solution with a NEMA17 reducer.



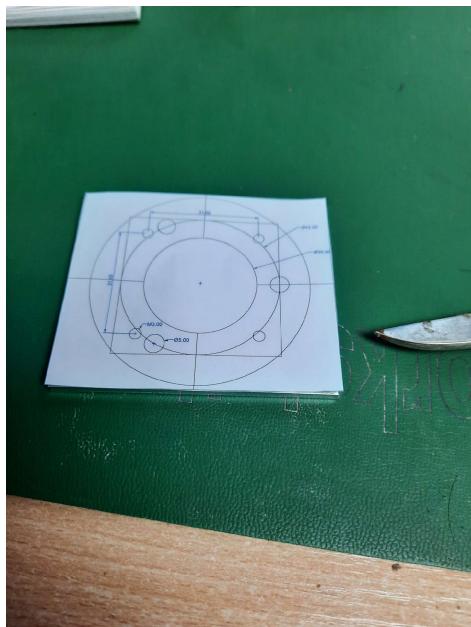
These reducers are found in different ratios, but the most logical options are 5:1 or 10:1.

We can find them in this link

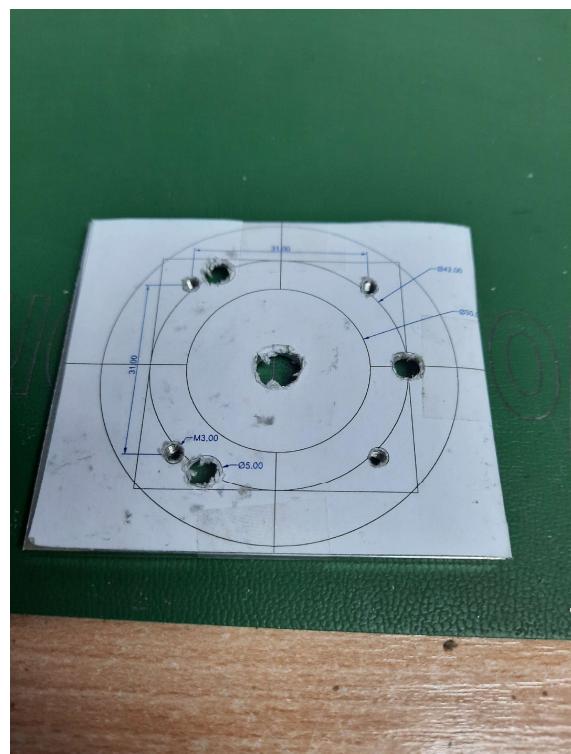
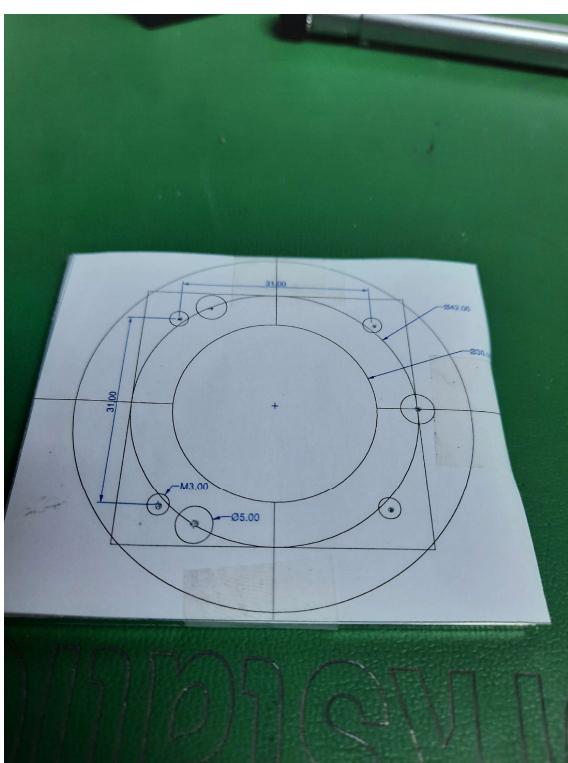
https://es.aliexpress.com/item/1005003499502668.html?spm=a2g0o.productlist.0.0.7e7727acr9Cs51&algo_pvid=43dc43b8-ff61-4ed5-a649-c6ce8355fb99&algo_exp_id=43dc43b8-ff61-4ed5-a649-c6ce8355fb99-3&pdp_ext_f=%7B%22sku_id%22%3A%2212000026069962062%22%7D&pdp_npi=%240dis%21EUR%21%2135.56%21%21%21%21%402100bb4c16569194145297471e5bb4%2112000026069962062%21sea

REDUCER MOUNT

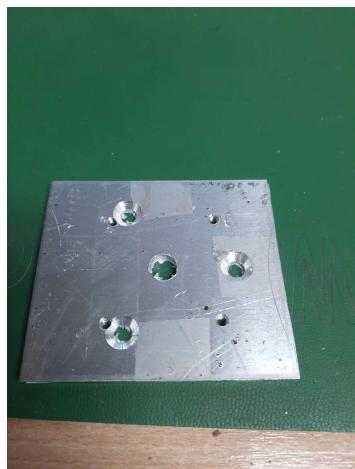
To be able to use the set we need an adaptation plate that we must machine from a 60x70x3 aluminum plate. We cut out the plan that is attached at the end of the document and print it at a 1:1 scale to use as a template



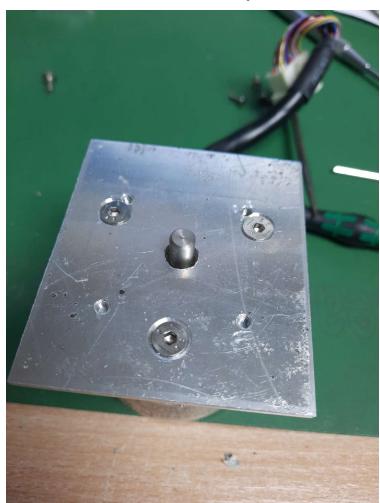
We mark the centers and drill



Now we make a chamfer for the screws that will support the encoder and we will do an M3 thread to the 2.5 holes made to hold the reducer.



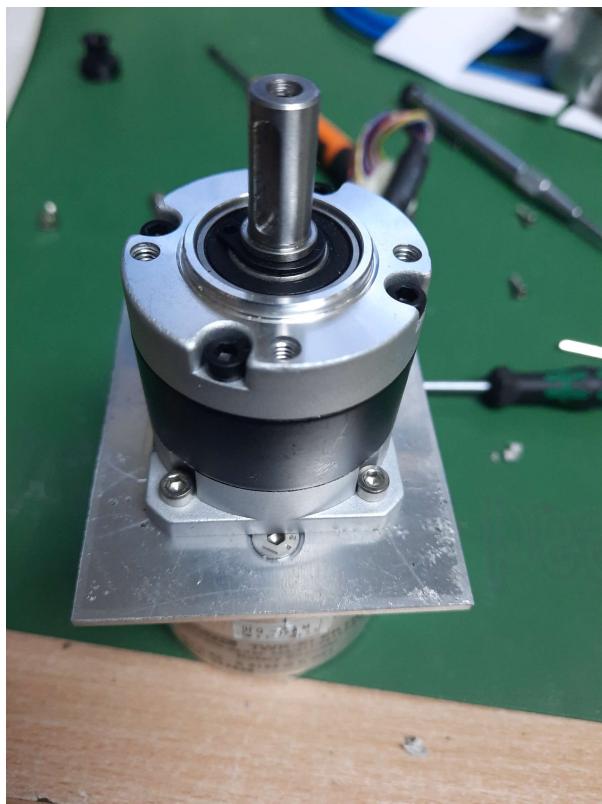
Now we mount the plate to the encoder through 3x M4x10 DIN7991 screws



We must rework the hole where the encoder is fixed with a 6mm drill bit, well at 5 mm. To do this we fix it with an M3x30 screw, replacing the original fastening screw, so that it does not turn.



Now we position the reducer and screw it to the plate using 4x M3x8 DIN912 screws.



And finally we tighten the union flange with the encoder shaft with a 2.5 Allen key.



There are two screws at 180 degrees.

And now we have our multiplier ready.

TEMPLATE

