VERSION 2.0

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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

https://es.aliexpress.com/item/1005001707231287.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtctp=&albbt=Google_7_shopping&aff_platform=google&aff_short_key=UneMJZVf&gclsrc=aw.ds&&albagn=888888&&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?&albcp=11489913537&albag=114956049489&isSmbAutoCall=false&needSmbHouyi=false&gclid=Cj0KCQjwrsGCBhD1ARIsALILBYpbLBT4mhgn2-FVbdtS4jtXmJoTZ84gTirCBMg5SMJrtmPF71AyKlIaAqOnEALw_wcB

https://es.aliexpress.com/item/32216841860.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtctp=&albbt=Google_7_shopping&aff_platform=google&aff_short_key=UneMJZVf&gclsrc=aw.ds&&albagn=888888&&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=Cj0KCQjwrsGCBhD1ARIsALILBYpa7bA7in7MHgsckeNFU3xYREUjJ8EQp3E8c-hGAxKnnk94K-jc-4waAkN5EALw_wcB

https://es.aliexpress.com/item/33010669409.html?gps-id=pcDetail404&scm=1007.16891.96945.0&scm_id=1007.16891.96945.0&scm-url=1007.16891.96945.0&pvid=d1365083-42d5-4be8-853b-e442a5407e02&_t=gps-id:pcDetail404,scm-url:1007.16891.96945.0,pvid:d1365083-42d5-4be8-853b-e442a5407e02,tpp_buckets:668%230%23131923%230_668%230%23131923%230_668%23888%233325%233_668%23888%233325%233_668%232846%238111%231996_668%232717%237566%23844__668%233374%2315176%23857_668%232846%238111%231996_668%232717%237566%23844_668%233164%239976%23667_668%233374%2315176%23857

https://es.aliexpress.com/item/32707755990.html?src=google&albch=shopping&acnt=439-079-4345&isdl=y&slnk=&plac=&mtctp=&albbt=Google_7_shopping&aff_platform=google&aff_short_key=UneMJZVf&gclsrc=aw.ds&&albagn=888888&&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?&albcp=11489913537&albag=114956049489&isSmbAutoCall=false&needSmbHouyi=false&gclid=Cj0KCQjwrsGCBhD1ARIsALILBYrQz8ac3gJ9uLeXPPGlhVvi6a_5lLdqH--IhWLW_ciD0QVMxzt2G5kaAsyVEALw_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=pitch+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

Recieved: 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

Recieved: 01 06 00 04 00 02 49 CA

ENCODER REGISTRY

Registry	Description	Value range	Functions	Notes
0x00	Position	$0x00 \div 2^{\text{bit number}}$	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.12010612.8148356.38.6c588517MIxJLl

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=2%40dis%21EUR%21%2135.56%21%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

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.

70.00
31.00
Ø5.00
M3.00
M3.00
Ø42.00
Ø30.00
Ø8.00
31.00
60.00
M3.00
Ø5.00
M3.00