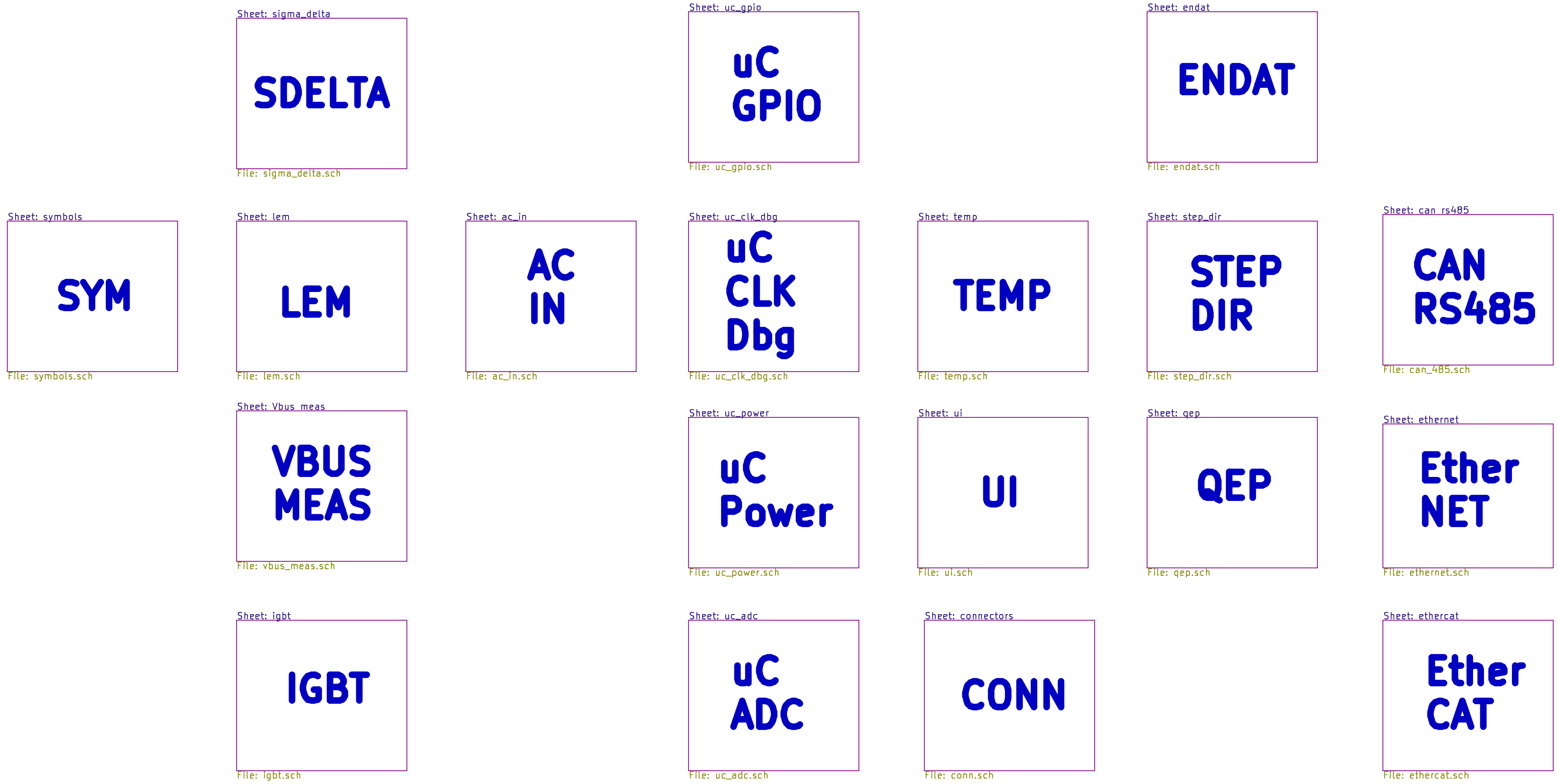
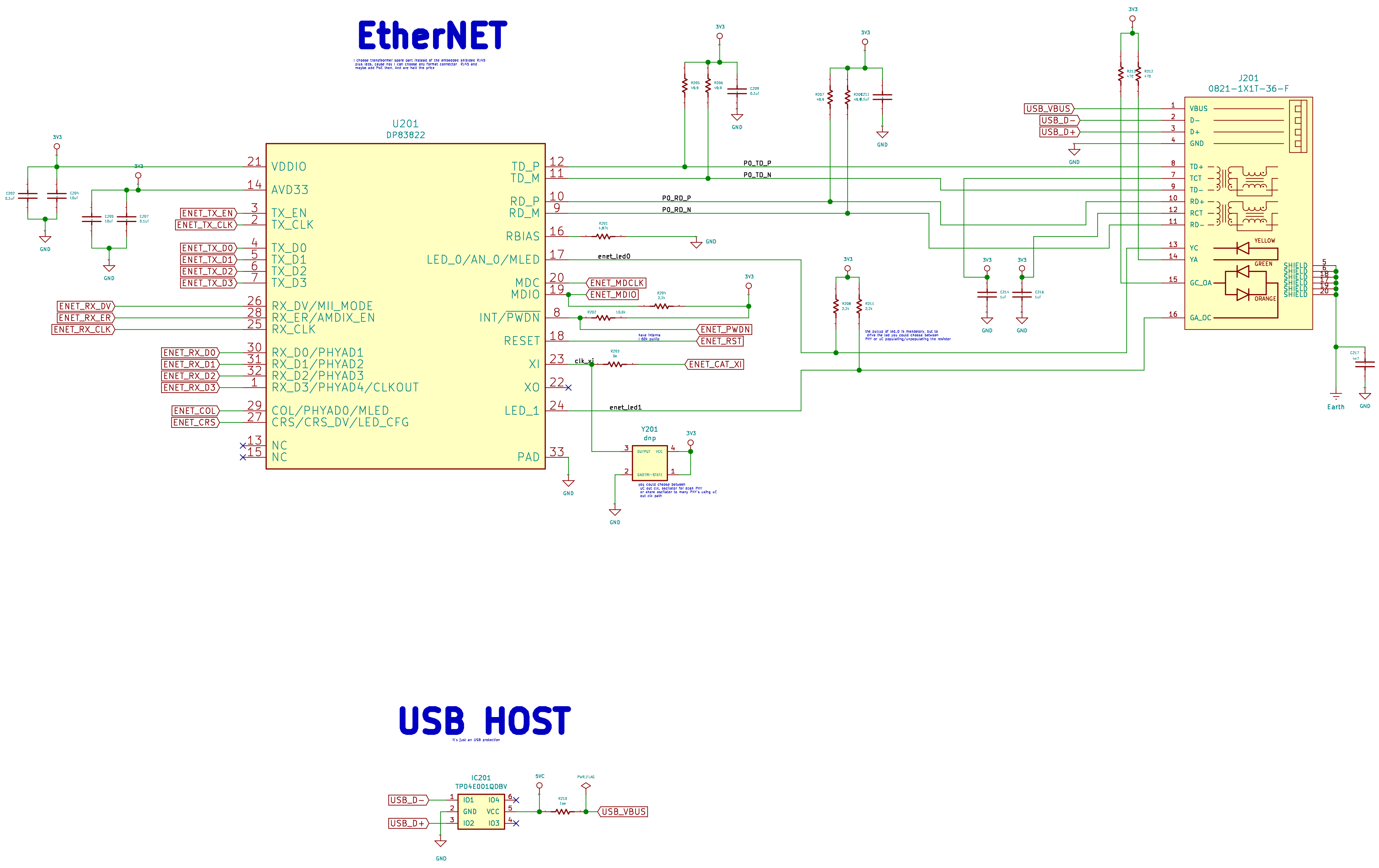
SERVO DRIVER BLOCKS

The project is divided in blocks. Each block join a group as signals and circuits depending on his function. The project is intended to have reinforced insulation using double simple isolation. For that reason, the uC circuitery is on a cold supply and the output logic is at hot supply. BUT take in account that HOT is not 220, is just a name indicating the first isolation stage



Pablo Slavkin
dcl

Sheet: /
File: servo.sch
Title: servo drive
Size: A3 | Date: 2020-01-09 | **Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1 | Id: 1/20



Pablo Slavkin

dcl

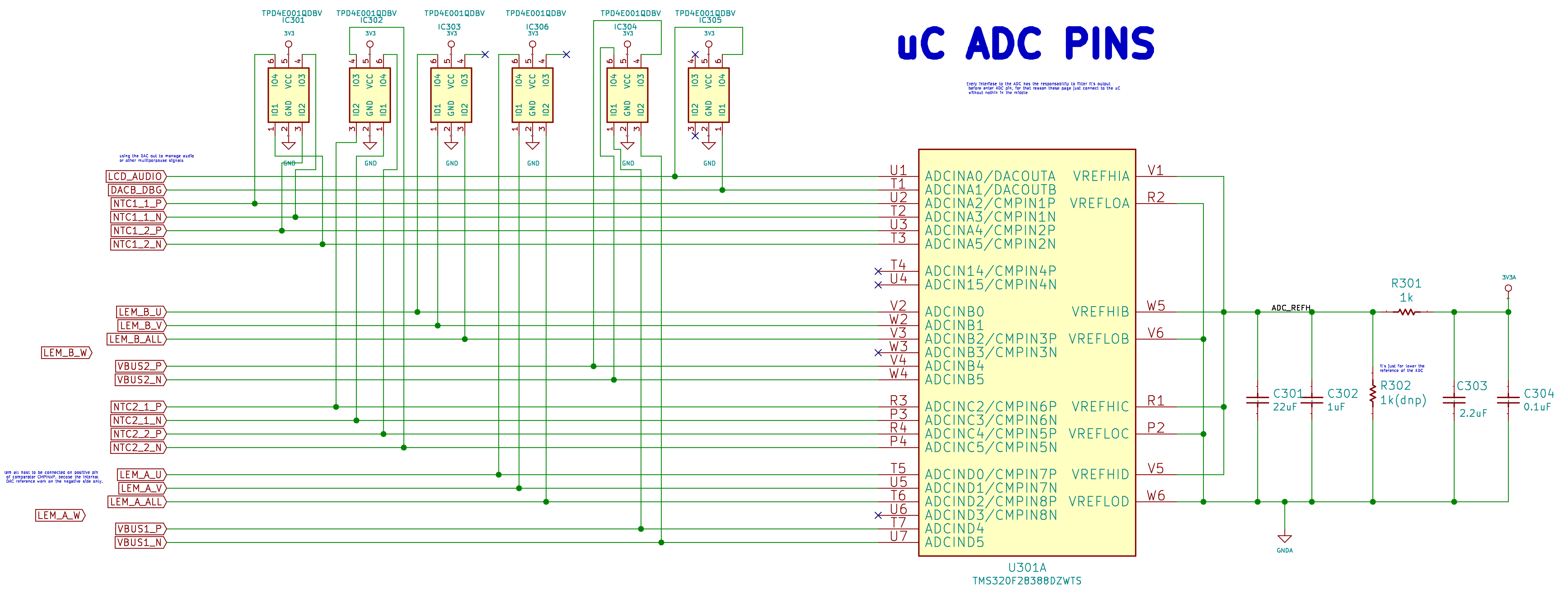
Sheet: /ethernet/

File: ethernet.sch

Title: ethernet

Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 2/20

uC ADC PINS



Pablo Slavkin

dcl

Sheet: /uc_adc/
File: uc_adc.sch

Title: ADC

Size: A3 | Date: 2020-01-09 | **Rev: 1.0**

KiCad E.D.A. kicad 5.0.2+dfsg1-1 | Id: 3/20

EtherCAT

I choose transformer spare part, instead of the embedded shielded RJ45 plus jack, saves cost, I can choose any format connector RJ45 and maybe add PoE later, and are halt the price

The program is mandatory in order to ESC read save source internal configuration.

Leds are optional, but the Port's has save pins used as a boostrap, so you have to respect that

EtherCAT P0

U402
DP83822

21	VDDIO	TD_P	12
14	AVD33	TD_M	11
ECAT0_TX_EN → 3	TX_EN	RD_P	10
ECAT0_TX_CLK → 2	TX_CLK	RD_M	9
ECAT0_TX_D0 → 4	TX_D0	RBIAS	16
ECAT0_TX_D1 → 5	TX_D1	LED_0/AN_0/MLED	17
ECAT0_TX_D2 → 6	TX_D2	MDC	20 ← ECAT_MDCLK
ECAT0_TX_D3 → 7	TX_D3	MDIO	19 ← ECAT_MDIO
ECAT0_RX_DV → 26	RX_DV/MII_MODE	INT/PWDN	8
ECAT0_RX_ER → 28	RX_ER/AMDIX_EN	RESET	18 ← ECAT_RST
ECAT0_RX_CLK → 25	RX_CLK	XI	23 ← ENET_CAT_XI
ECAT0_RX_D0 → 30	RX_D0/PHYAD1	XO	22
ECAT0_RX_D1 → 31	RX_D1/PHYAD2	LED_1	24
ECAT0_RX_D2 → 32	RX_D2/PHYAD3		
ECAT0_RX_D3 → 1	RX_D3/PHYAD4/CLKOUT	PAD	33
ecat0_col → 29	COL/PHYAD0/MLED		
ecat0_crs → 27	CRS/CRS_DV/LED_CFG		
13	NC		
15	NC		

P0_TD_P
P0_TD_N
P0_RD_P
P0_RD_N
ECAT0_RJ_LED0
ECAT0_RJ_LED1

Y401
dnp

EtherCAT P1

U403
DP83822

21	VDDIO	TD_P	12
14	AVD33	TD_M	11
ECAT1_TX_EN → 3	TX_EN	RD_P	10
ECAT1_TX_CLK → 2	TX_CLK	RD_M	9
ECAT1_TX_D0 → 4	TX_D0	RBIAS	16
ECAT1_TX_D1 → 5	TX_D1	LED_0/AN_0/MLED	17
ECAT1_TX_D2 → 6	TX_D2	MDC	20 ← ECAT_MDCLK
ECAT1_TX_D3 → 7	TX_D3	MDIO	19 ← ECAT_MDIO
ECAT1_RX_DV → 26	RX_DV/MII_MODE	INT/PWDN	8
ECAT1_RX_ER → 28	RX_ER/AMDIX_EN	RESET	18 ← ECAT_RST
ECAT1_RX_CLK → 25	RX_CLK	XI	23 ← ENET_CAT_XI
ECAT1_RX_D0 → 30	RX_D0/PHYAD1	XO	22
ECAT1_RX_D1 → 31	RX_D1/PHYAD2	LED_1	24
ECAT1_RX_D2 → 32	RX_D2/PHYAD3		
ECAT1_RX_D3 → 1	RX_D3/PHYAD4/CLKOUT	PAD	33
ecat1_col → 29	COL/PHYAD0/MLED		
ecat1_crs → 27	CRS/CRS_DV/LED_CFG		
13	NC		
15	NC		

P1_TD_P
P1_TD_N
P1_RD_P
P1_RD_N
ECAT1_RJ_LED1
ECAT1_RJ_LED0

Y402
dnp

U404
rj45x2

ECAT_MDIO

EtherCAT EEPROM

U401
CAT24C16WI

1	NC	VCC	8
2	NC	WP	7
3	NC	SCL	6
4	VSS	SDA	5

ECAT_EEPROM_SCL
ECAT_EEPROM_SDA

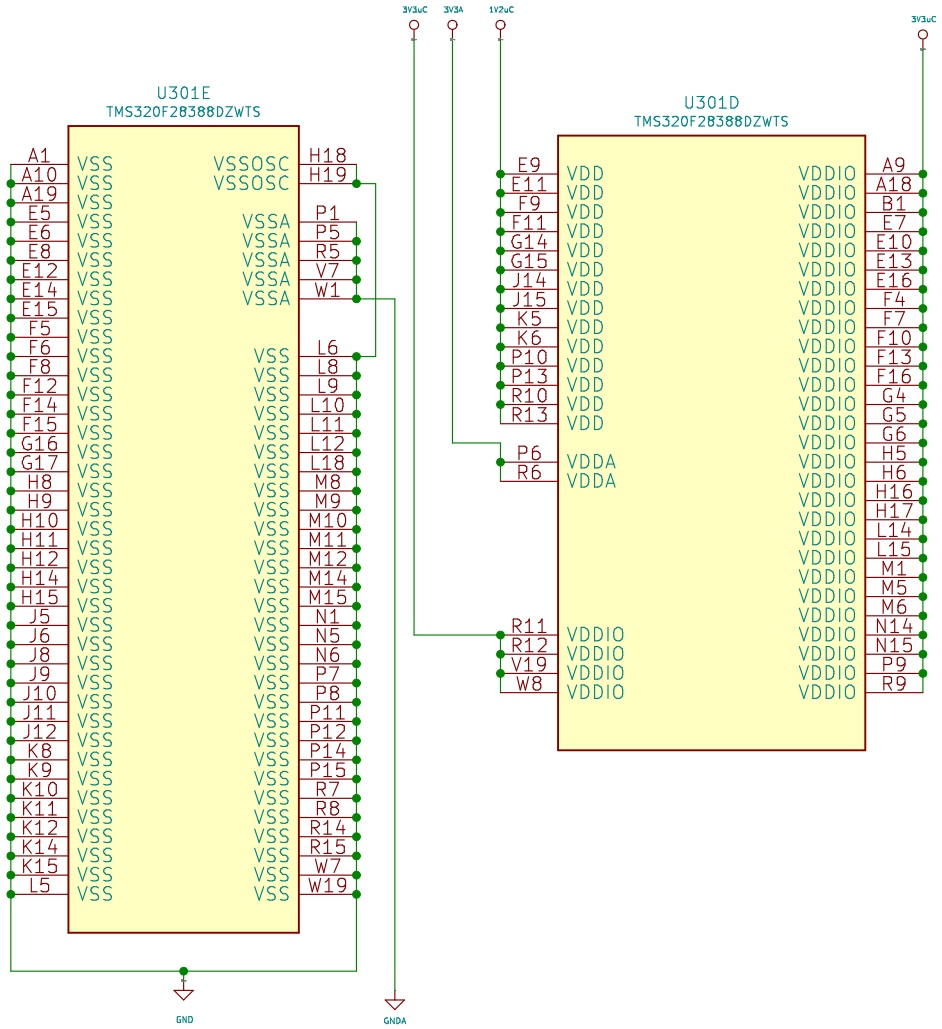
Run and Error LEDs

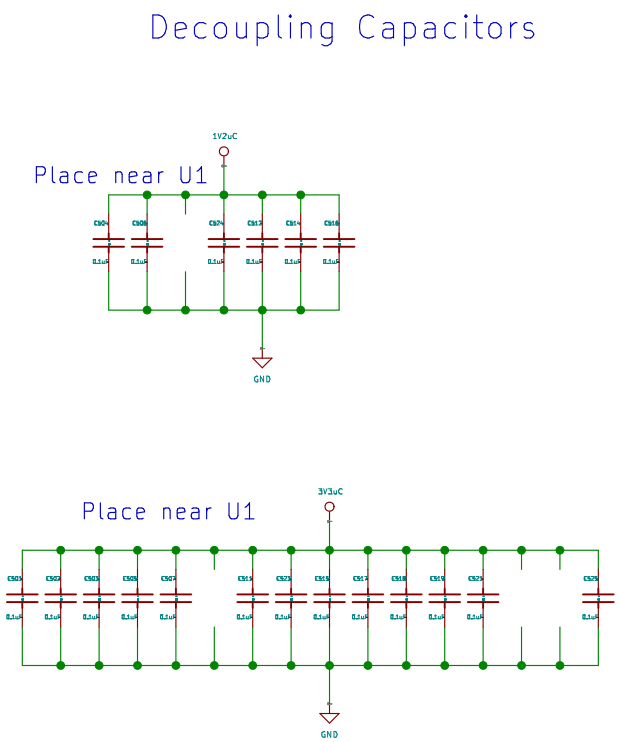
ECAT_LED_RUN
ECAT_LED_ERR

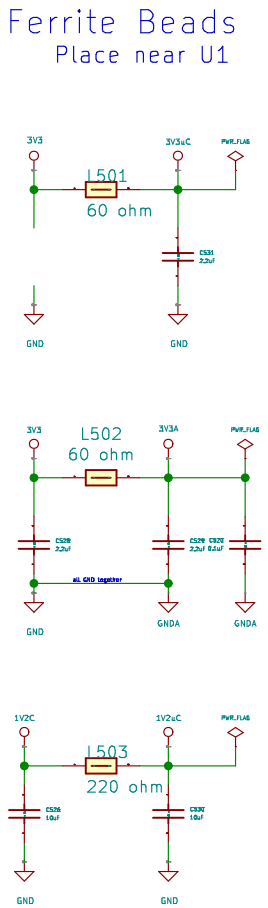
Pablo Slavkin
dci

Sheet: /ethercat/		
File: ethercat.sch		
Title: ethercat		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 4/20

DECOUPLING FILTERS

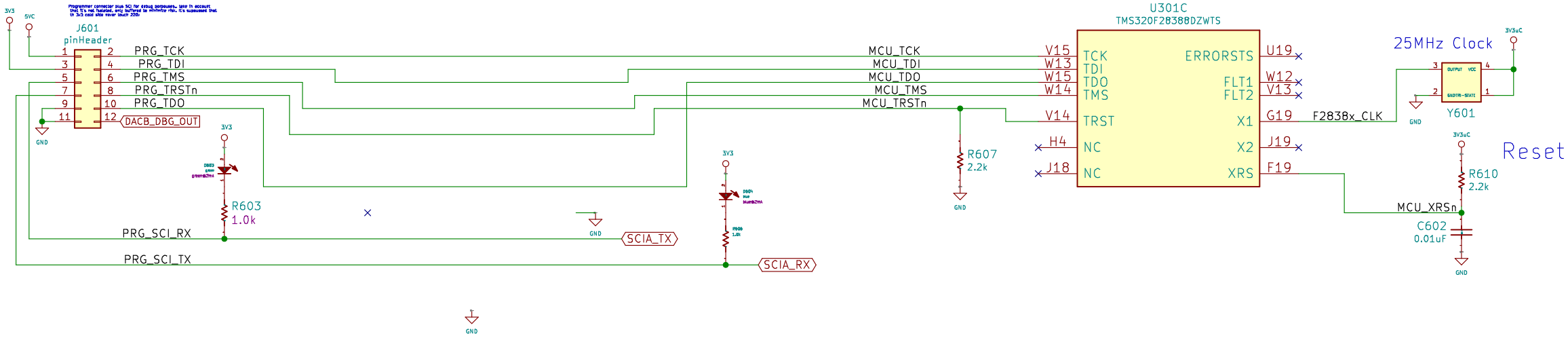




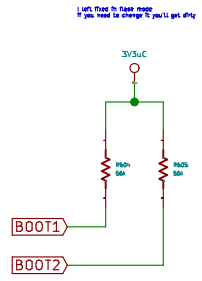


Pablo Slavkin		
dci		
Sheet: /uc_power/		
File: uc_power.sch		
Title: uC Power		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 5/20

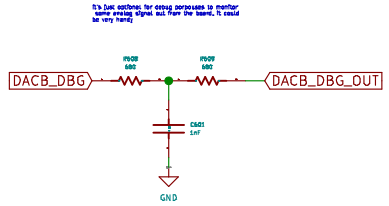
CLK + JTAG + SCI



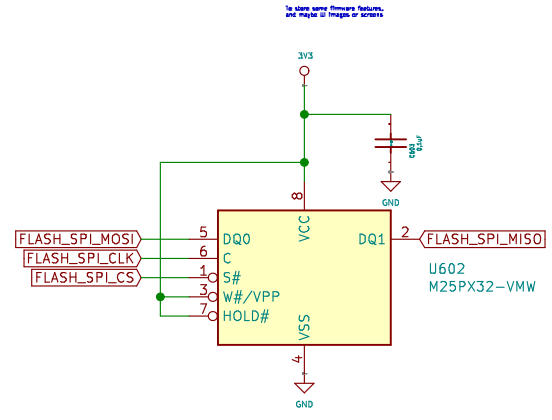
BOOTSRAP R's



ADC/DAC DBG OUT

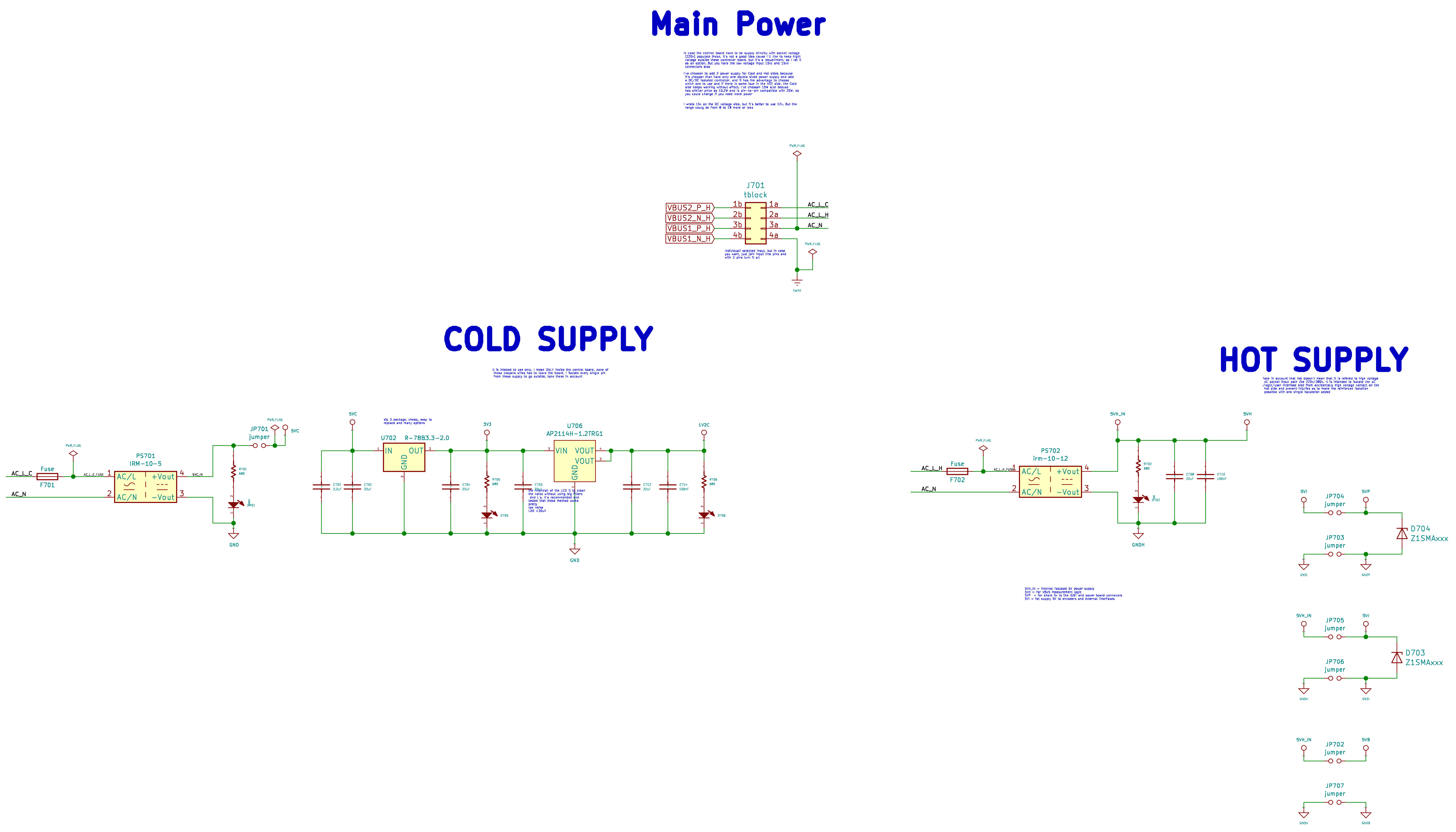


SPI FLASH



Pablo Slavkin
dcl

Sheet: /uc_clk_dbg/		
File: uc_clk_dbg.sch		
Title: clk		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 6/20



Pablo Slavkin

dcl

Sheet: /ac_in/

File: ac_in.sch

Title: AC Input

Size: A3	Date: 2020-01-09	Rev: 1.0
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 7/20

PWM OUT -> ISOLATOR -> BUFFER -> FILTER

these pins has isolation and a buffer. They could be directly connected to a IGBT module for test porpouses or to a power board and another isolation stage for production porpouses to have a reinforced isolation. In next stages of the development of the board, the buffers could be eliminated, but not the isolation Scmith trigger stage

I left other multiporpouse IN/OUT using the free pins on isolators

U801
SI8660BD

U802
SI8662BD

U813
SI8660BD

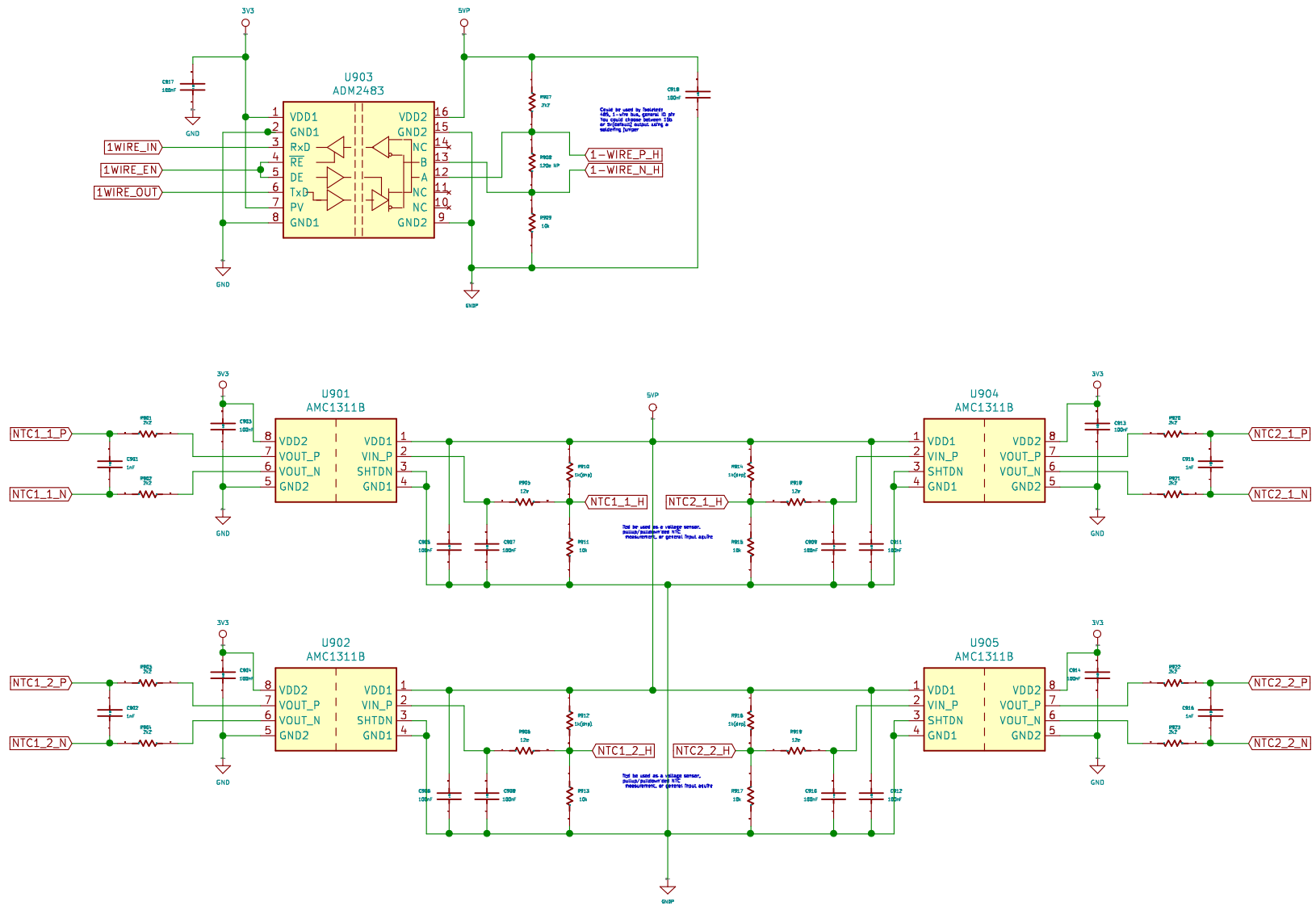
U814
SI8662BD

Pablo Slavkin	
dci	
Sheet: /igbt/	
File: igbt.sch	
Title: Igbt interface	
Size: A3	Date: 2020-01-09
KiCad E.D.A. kicad 5.0.2+dfsg1-1	**Rev: 1.0**
	Id: 8/20

2 isolated NTC interfase +
1 isolated 1-wire/485

I left 2 isolated analog input to measure until 2 NTC for each meter. If each meter has one faster the meter and other for IGBT dissipator.

If you need more precision or more sensors, I left also an isolated 1-wire/RS485 interface that could manage a lot of 18B20 on a bus network.



1	2	3	4	5	6	7	8

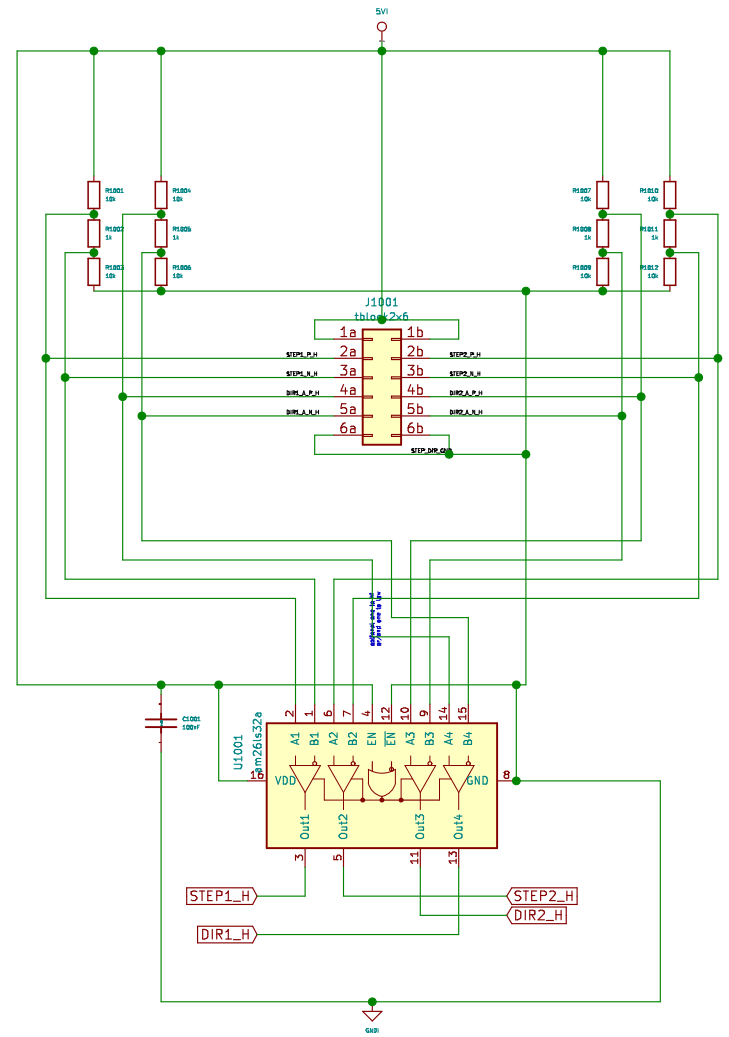
Pablo Slavkin
dcl
Sheet: /temp/
File: temp.sch

Title: gpio

Size: B	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 9/20

Differential STEP-DIR input HOT

The heatsitter part is shared with SEP



Pablo Slavkin

dcl

Sheet: /step_dir/

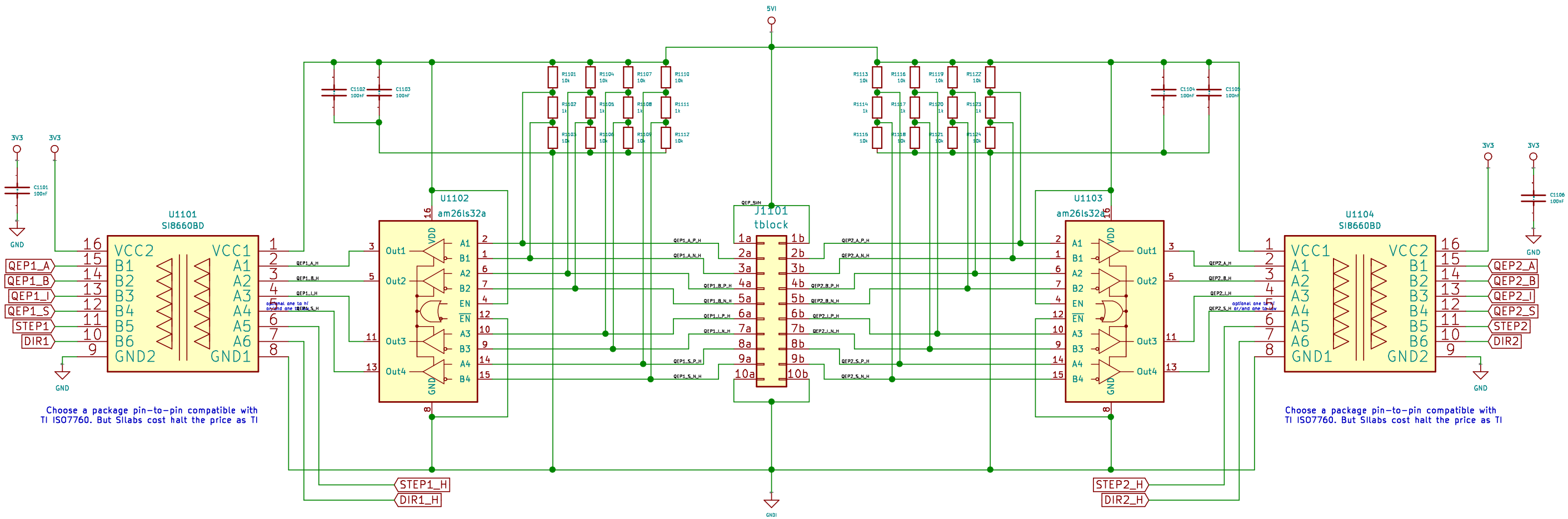
File: step_dir.sch

Title: ENDAT/BISS Interface

Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 10/20

2x Isolated Idifferential incremental encoder interfase
5v input A-B-I-S

I left the input for two isolated incremental encoders.
I left the 4 signals input plus two auxiliary output for any porpous plus
the ability to choose between 5 or 15vH



Pablo Slavkin		
dci		
Sheet: /qep/		
File: qep.sch		
Title: QEP encoder Interfase		
Size: A4	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 11/20

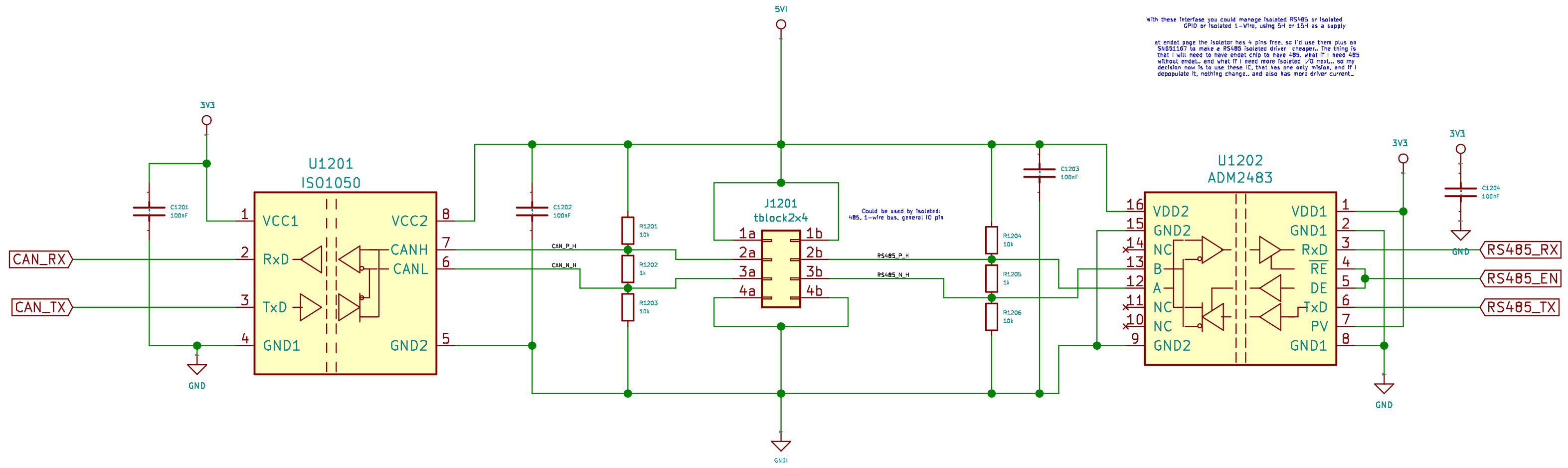
Isolated CAN interfase

A simple CAN driver. it also could be used as a RS485 driver in his speed.. the minimum for CAN is 40kbps, so in RS485 at 9600 could be fine

Isolated RS485

With these interfase you could manage isolated RS485 or isolated GPIO or isolated 1-Wire, using 5H or 15H as a supply

at endat page the isolator has 4 pins free. so I'd use them plus an SN651167 to make a RS485 isolated driver cheaper.. The thing is that I will need to have endat chip to have 485. what if I need 485 without endat.. and what if I need more isolated I/O next... so my decision now is to use these IC. that has one only mision. and if I depopulate it, nothing change.. and also has more driver current..



Pablo Slavkin		
dcl		
Sheet: /can rs485/		
File: can_485.sch		
Title:		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 12/20

Symbols Slots fiducials, and others

I use these sheet to add all manufacturer component including fiducials, slotted holes and things like that

Case

Fiducials TOP

H1301 fiducials
H1303 fiducials
H1305 fiducials
H1307 fiducials

Fiducials Bottom

H1302 fiducials
H1304 fiducials
H1306 fiducials
H1308 fiducials

SLOT 'I' anyware

H1309 Slot
H1310 Slot
H1311 Slot
H1312 Slot
H1313 Slot
H1319 Slot
H1325 Slot
H1331 Slot
H1314 Slot
H1320 Slot
H1326 Slot
H1332 Slot
H1315 Slot
H1321 Slot
H1327 Slot
H1333 Slot
H1316 Slot
H1322 Slot
H1328 Slot
H1334 Slot
H1317 Slot
H1323 Slot
H1329 Slot
H1335 Slot
H1318 Slot
H1324 Slot
H1330 Slot
H1336 Slot
H1337 Slot
H1339 Slot
H1341 Slot
H1343 Slot
H1338 Slot
H1340 Slot
H1342 Slot
H1344 Slot
H1358 Slot
H1357 Slot

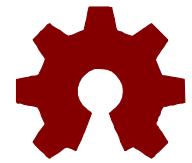
SLOT V LEMs

H1345 Slot
H1346 Slot
H1348 Slot
H1347 Slot
H1349 Slot
H1351 Slot
H1353 Slot
H1355 Slot
H1350 Slot
H1352 Slot
H1354 Slot
H1356 Slot

mounting holes

logo recycler
logo nanocut
logo klcad
logo pslavkin

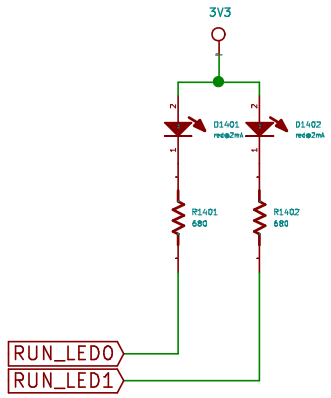
logo neurona



logo GNU

Pablo Slavkin **dci**		
Sheet: /symbols/ File: symbols.sch		
Title: gpio		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 13/20

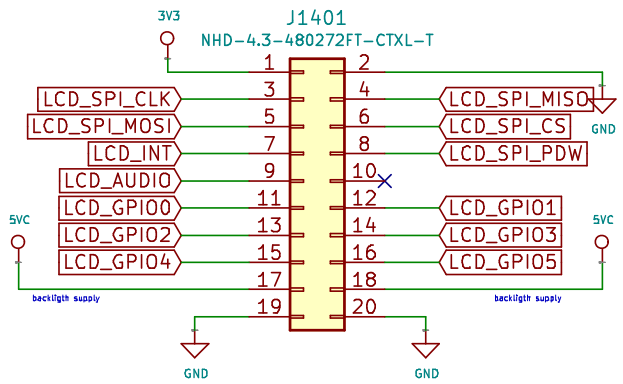
Multipropouse LEDs



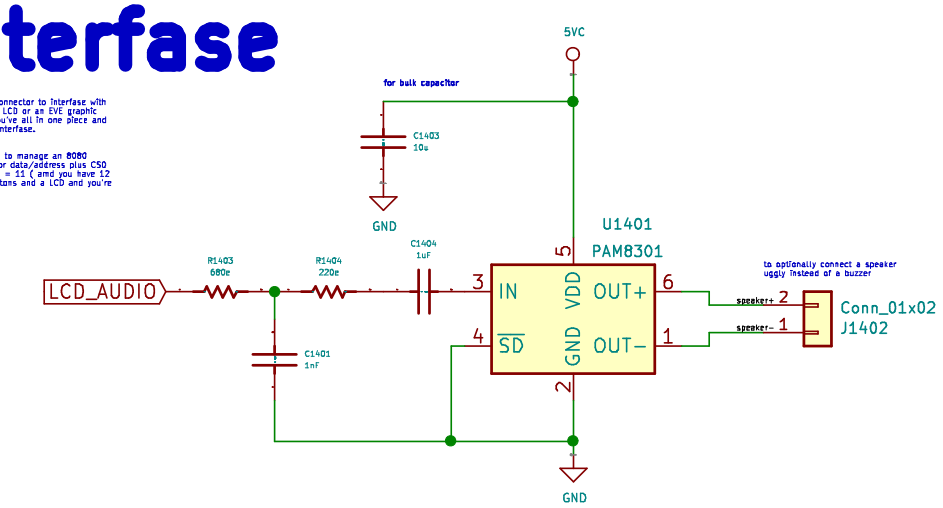
LCD UI interfase

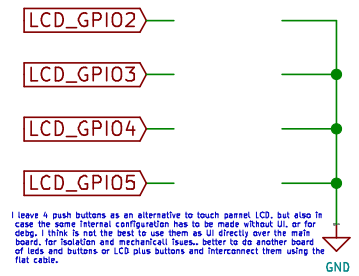
I leve a multi LCD/Touch/button 20 pins IDC connector to interfase with some UI, it could be simple leds,, a character LCD or an EVE graphic LCD as I recommend, 'cause for same price you've all in one piece and it's already done, clean, usefull and intuitive interfase.

I've added 2 more GPIO's 4 and 5 apart of LCD to manage an 8080 motorola LCD interfase as well, using 4 bits for data/address plus CS0 /CS1 plus R/W plus E = 7 bits plus 4 buttons = 11 (and you have 12 available) Just made another board with 4 buttons and a LCD and you're done



interfase directly using f20 wires flat cable for NHD-4.3-480272FT-CTXL-T newheaven LCD or hand wiring
EA eDIP128B-6LWTP
or using any paralel 8080 3v3 interfase bitbanging the SPI and GPIO pins





I leave 4 push buttons as an alternative to touch pannel LCD, but also in case the same internal configuration has to be made without UI, or for debg, I think is not the best to use them as UI directly over the main board, for isolation and mechanicall issues,, better to do another board of leds and buttons or LCD plus buttons and interconnect them using the flat cable.

Pablo Slavkin **dci**		
Sheet: /ui/ File: ui.sch		
Title: clk		
Size: A4	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 14/20

8 LEM's current measurement
U+V+W+ALL x 2

with 6 screw connector you could choose
3 range of current measurement 1x, 2x or 3x.
IN 1 BRIDGE 1-2-3 and 4-5-6 OUT 4 -------- X
IN 1 BRIDGE 1-2 and 3-5-6 OUT 4 -------- 2X
IN 1 BRIDGE 2-6 and 3-5 OUT 4 -------- 3X

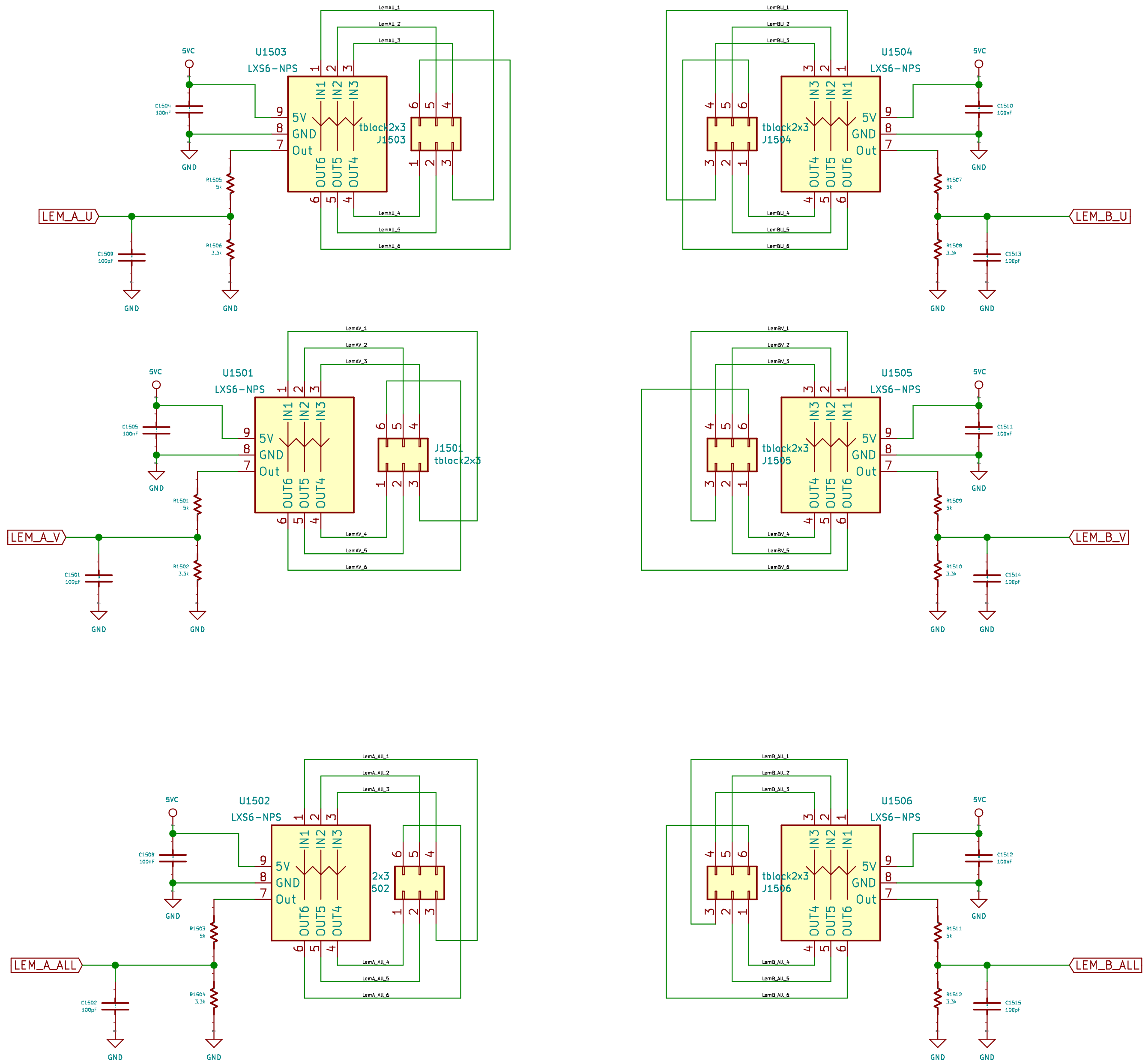
The intention of these lems is to have the capacity on the control board to measure all the current, without the need of the sigma delta chips on power board side. Why?? becouse I've study the two options carrefullty and I've conclude that there are very similar, and more or less buck per byck (a little expensive is SD) but the new generation LEM's I'm includin here has <0.5uSeg response time, and the SD has all the SD filter delay, so LEM is faster. The other advantage is that for same LEM I've choosen you could rearange the connection to multiply the preccision 1x,2x or 3x without touching nothing, and is pretty linear. In the case of SD you have to change the precission shunt, or puts more than one, that is costly and take some board space.
The disadvantage of LEM is that the output is single ended, so it could not travel across boards, for that reason I've put them on control board, but is completely isolated becouse of these phisics effect, and also becouse of that single ended I just use one ADC channel per current. I't not the only option, becous if you insist and wanna use SD, I'eft all the SD channels available as an inputs on SD schematic page.

these LEM's version doesn't need a buffer,
it's one already included inside LEM

LXS6 is LTS and CAS pin to pin compatible, but LXS is a little better. I don't usa an opamp becous with the external conection I have x,2x and 3x amplifier option without any component

I've decided to make the loop over the LEM on board and if you wanna change it you have to use the soldering iron...becouse the connetor is 2 terminal, not 6

chanlog1: I've decided to return to a 2x3 terminal block output 'cause it match the size of the LEM



LEM_A_W LEM_B_W

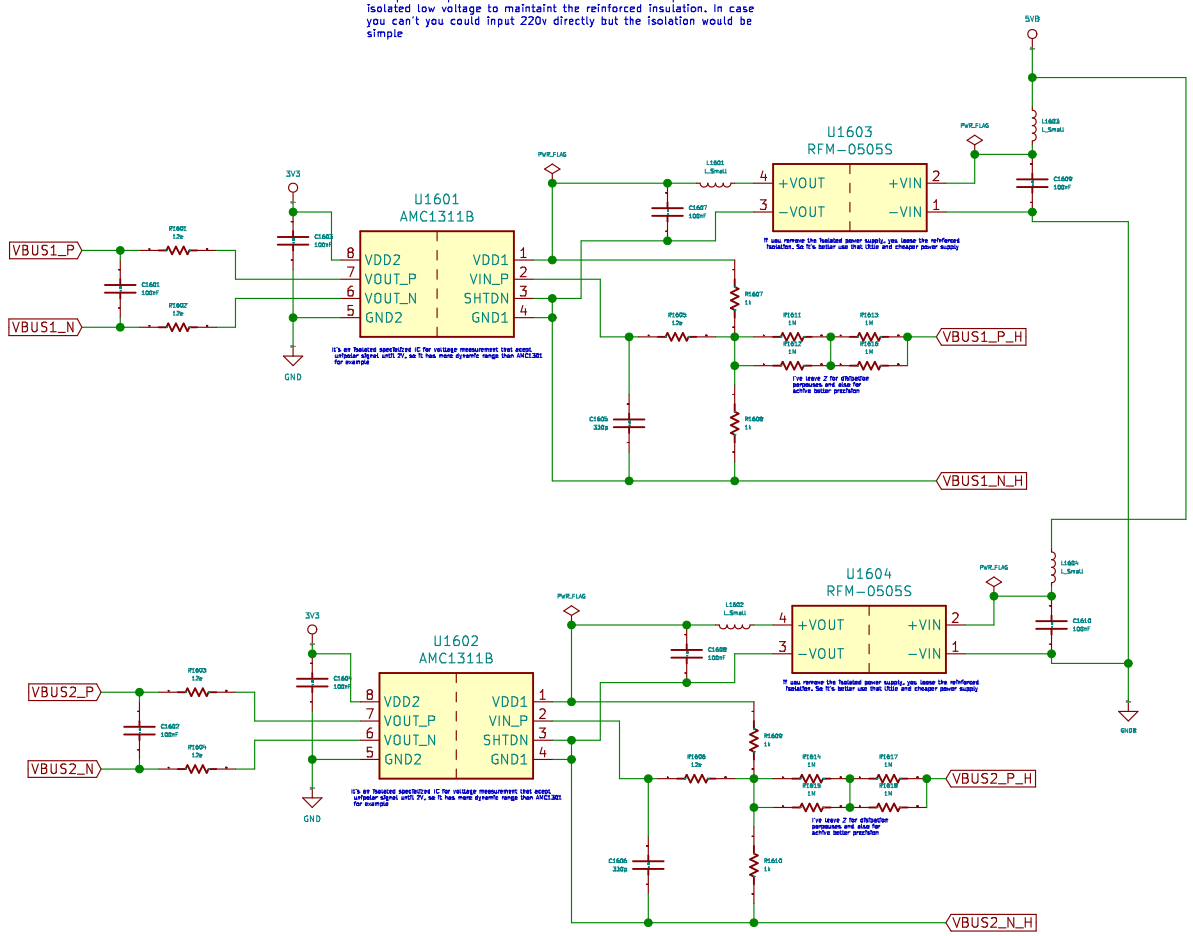
I've decided to eliminate 1 LEM, you could use 3 in line measurement, or 2 in line plus one for all. De reason is size of board and complexity

Pablo Slavkin
dcl
Sheet: /lem/
File: lem.sch
Title: LEM currente measurement
Size: A3 | Date: 2020-01-09 | **Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1 | Id: 15/20

VBUS -> R divider -> ISO ADC -> uC

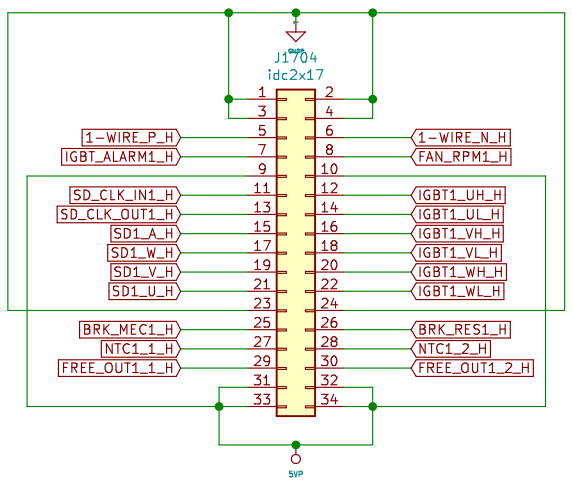
It's intended to measure the Vbus, one per motor, but they coild be joined if both motor share same VBus. The Vbus informatio will be used by the control algorith and to drive the break resistor PWM to protect the rise of the Vbus more than a threshold

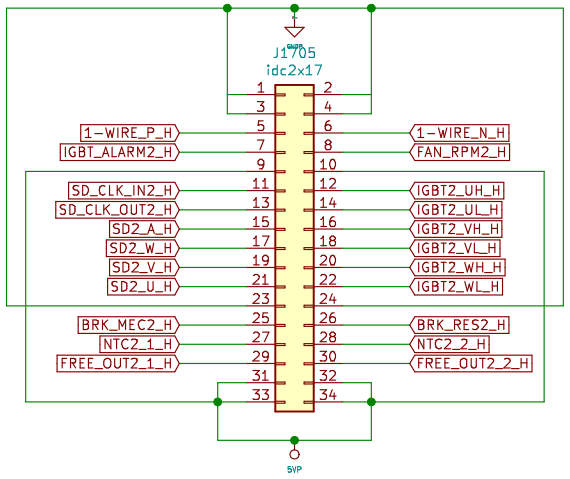
The input is expected not to be 220v or 380v. It's supoused to be a isolated low voltage to maintaint the reinforced insulation. In case you can't you could input 220v directly but the isolation would be simple



Pablo Slavkin		
dci		
Sheet: /Vbus meas/		
File: vbus_meas.sch		
Title: Shunt Isolated		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 16/20

Common Connections





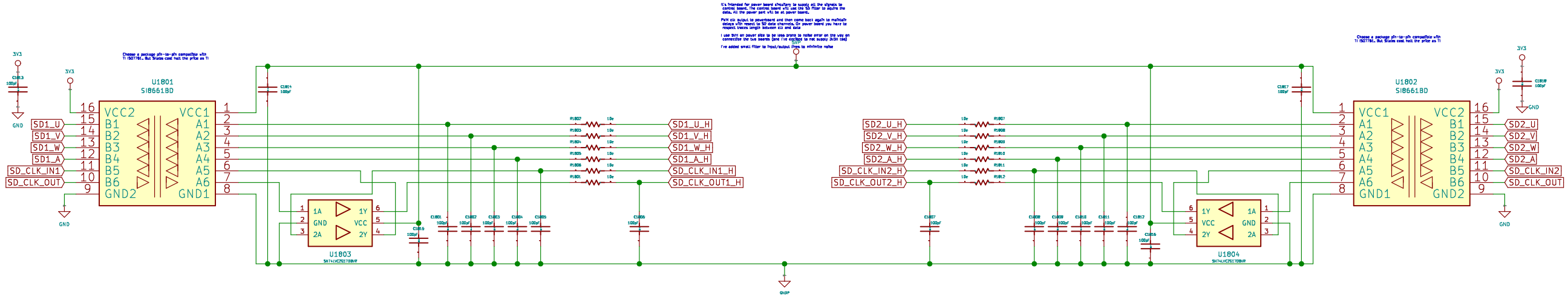
Pablo Slavkin
dcl

Sheet: /connectors/
File: conn.sch

Title: Common connections

Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 17/20

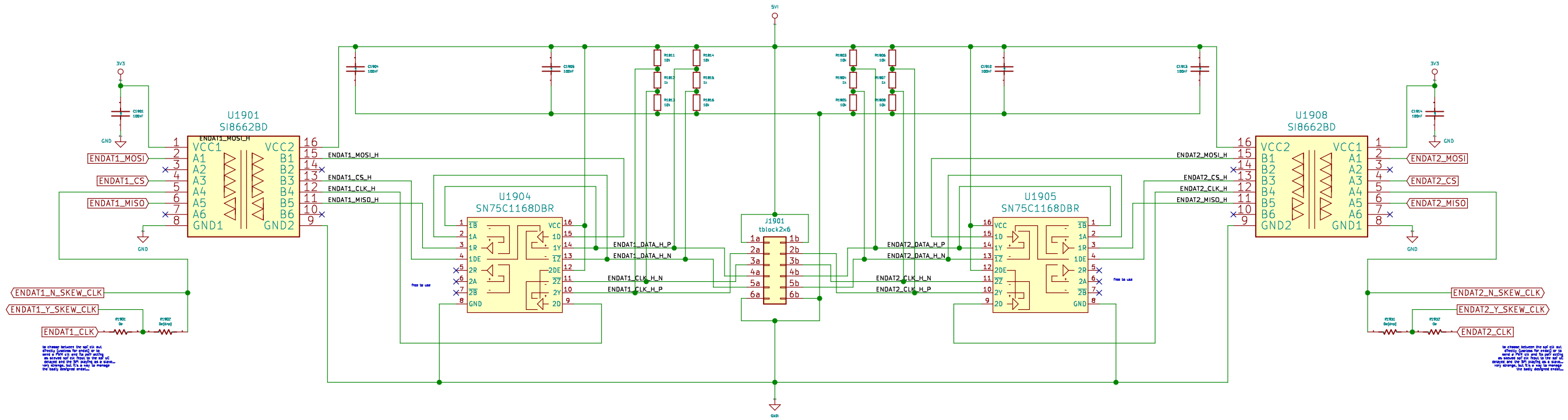
Isolated sigma delta ADC



Pablo Slavkin
dcl

Sheet: /sigma_delta/		
File: sigma_delta.sch		
Title: Shunt Sigma Delta Isolated		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 18/20

2X Isolated diferential ENDAT interface



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dci

Sheet: /endat/

File: endat.sch

Title: ENDAT/BISS Interface

Size: A3	Date: 2020-01-09	**Rev: 1.0**
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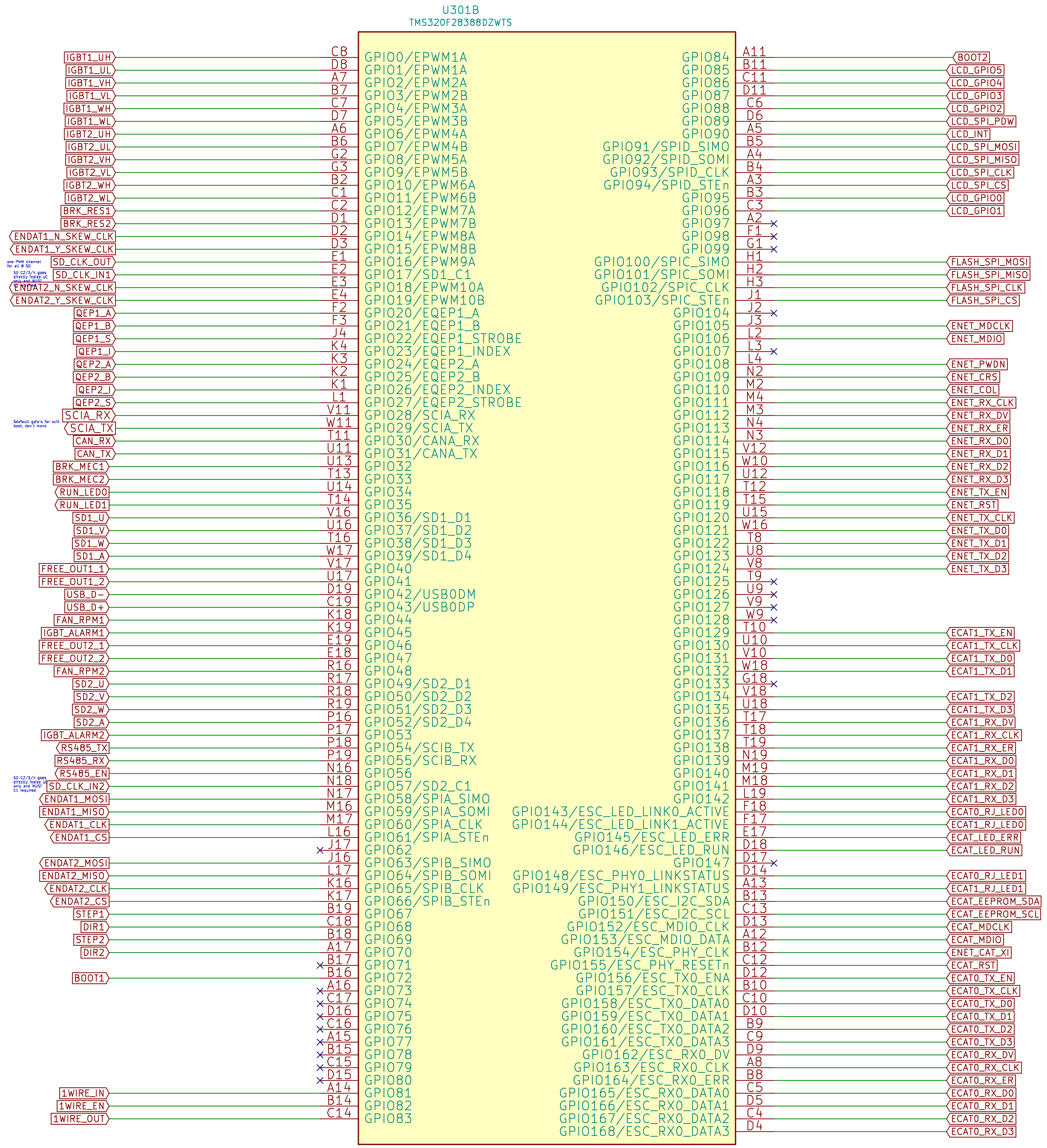
uC GPIO's pins



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dcl
Sheet: /uc_gpio/
File: uc_gpio.sch
Title: gpio
Size: A3 | Date: 2020-01-09 | **Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1 | Id: 20/20