SERVO DRIVER BLOCKS

The project is divided in blocks. Each block have a group os signals and circuits depending on its function. The project is intended to have reinforced insulation using double shield isolation for that reason. Each block have a name that ends with a number indicating the isolation level. Bear that in account that 0V0 is not GND is just a name indicating the first isolation stage

sigma_delta

SDELTA

sigma_delta.sch

uc_gpio

uC
GPIO

uc_gpio.sch

endat

ENDAT

endat.sch

lem

LEM

lem.sch

ac_in

AC
IN

ac_in.sch

uc_clk_dbg

uC
CLK
Dbg

uc_clk_dbg.sch

temp

TEMP

temp.sch

step_dir

STEP
DIR

step_dir.sch

can_rs485

CAN
RS485

can_485.sch

Vbus_meas

VBUS
MEAS

vbus_meas.sch

uc_power

uC
Power

uc_power.sch

ui

UI

ui.sch

qep

QEP

qep.sch

ethernet

Ether
NET

ethernet.sch

igbt

IGBT

igbt.sch

uc_adc

uC
ADC

uc_adc.sch

connectors

CONN

conn.sch

ethercat

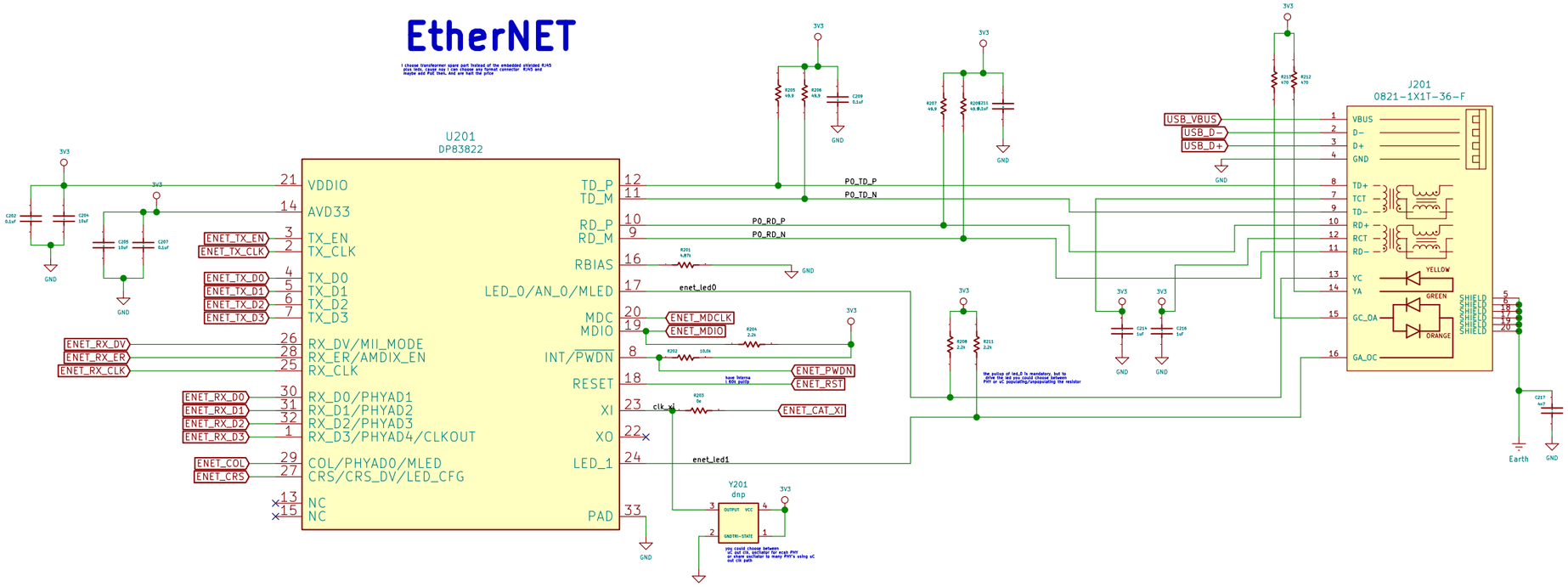
Ether
CAT

ethercat.sch

Pablo Slavkin		
dci		
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: 1/19

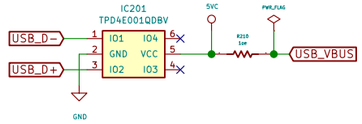
EtherNET

I chose transformer case part instead of the embedded shielded RJ45 pins here, since not I can change any human connector RJ45 and maybe add PoE then, and are had the price



USB HOST

It's just an USB protection



Pablo Slavkin		
dci		
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: 2/19

uC ADC PINS

Every interface to the ADC has the responsability to filter it's output before enter ADC pin. For that reason these page just connect to the uC without nothin in the middle

using the DAC out to manage audio or other multipurpose signals

TPD4E001QDBV IC301 3V3 GND
TPD4E001QDBV IC302 3V3 GND
TPD4E001QDBV IC303 3V3 GND
TPD4E001QDBV IC306 3V3 GND
TPD4E001QDBV IC304 3V3 GND
TPD4E001QDBV IC305 3V3 GND

LCD_AUDIO
DACB_DBG
NTC1_1_P
NTC1_1_N
NTC1_2_P
NTC1_2_N
LEM_B_U
LEM_B_V
LEM_B_ALL
LEM_B_W
VBUS2_P
VBUS2_N
NTC2_1_P
NTC2_1_N
NTC2_2_P
NTC2_2_N
LEM_A_U
LEM_A_V
LEM_A_ALL
LEM_A_W
VBUS1_P
VBUS1_N

Vin all have to be connected on positive pin of comparator (without being the internal DAC reference voltage) on the negative side only.

U1 ADCINA0/DACOUTA
T1 ADCINA1/DACOUTB
U2 ADCINA2/CMPIN1P
T2 ADCINA3/CMPIN1N
U3 ADCINA4/CMPIN2P
T3 ADCINA5/CMPIN2N
T4 ADCIN14/CMPIN4P
U4 ADCIN15/CMPIN4N
V2 ADCINB0
W2 ADCINB1
V3 ADCINB2/CMPIN3P
W3 ADCINB3/CMPIN3N
V4 ADCINB4
W4 ADCINB5
R3 ADCINC2/CMPIN6P
P3 ADCINC3/CMPIN6N
R4 ADCINC4/CMPIN5P
P4 ADCINC5/CMPIN5N
T5 ADCIND0/CMPIN7P
U5 ADCIND1/CMPIN7N
T6 ADCIND2/CMPIN8P
U6 ADCIND3/CMPIN8N
T7 ADCIND4
U7 ADCIND5

VREFHIA V1
VREFLOA R2
VREFHIB W5
VREFLOB V6
VREFHIC R1
VREFLOC P2
VREFHID V5
VREFLOD W6

U301A
TMS320F28388DZWTS

ADC_REFH
R301 1k
3V3A
C301 22uF
C302 1uF
R302 1k(dnp)
It's just for lower the reference of the ADC
C303 2.2uF
C304 0.1uF
GNDA

Pablo Slavkin		
dci		
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: 3/19

EtherCAT

I choose transformer spare part instead of the embedded stizided RJ45 plus 1ms, regue say I can choose any format connector RJ45 and maybe add PoE then. And we halt the price

The eeprom is mandatory in order to ESC read save some internal configuration.

Leds are optional, but the PHY's has som pins used as a boostrap, so you have to respet that

EtherCAT P0

U402
DP83822

VDDIO
AVD33
TX_EN
TX_CLK
TX_D0
TX_D1
TX_D2
TX_D3
RX_DV/MII_MODE
RX_ER/AMDIX_EN
RX_CLK
RX_D0/PHYAD1
RX_D1/PHYAD2
RX_D2/PHYAD3
RX_D3/PHYAD4/CLKOUT
COL/PHYAD0/MLED
CRS/CRS_DV/LED_CFG
NC
NC
TD_P
TD_M
RD_P
RD_M
RBIAS
LED_0/AN_0/MLED
MDC
MDIO
INT/PWDN
RESET
XI
XO
LED_1
PAD

ECAT0_TX_EN
ECAT0_TX_CLK
ECAT0_TX_D0
ECAT0_TX_D1
ECAT0_TX_D2
ECAT0_TX_D3
ECAT0_RX_DV
ECAT0_RX_ER
ECAT0_RX_CLK
ECAT0_RX_D0
ECAT0_RX_D1
ECAT0_RX_D2
ECAT0_RX_D3
ecat0_col
ecat0_crs
P0_TD_P
P0_TD_N
P0_RD_P
P0_RD_N
ECAT_MDCLK
ECAT_MDIO
ECAT_RST
ENET_CAT_XI
ECAT0_RJ_LED0
ECAT0_RJ_LED1

Y401
dnp

U404
rj45x2

EtherCAT P1

U403
DP83822

ECAT1_TX_EN
ECAT1_TX_CLK
ECAT1_TX_D0
ECAT1_TX_D1
ECAT1_TX_D2
ECAT1_TX_D3
ECAT1_RX_DV
ECAT1_RX_ER
ECAT1_RX_CLK
ECAT1_RX_D0
ECAT1_RX_D1
ECAT1_RX_D2
ECAT1_RX_D3
ecat1_col
ecat1_crs
P1_TD_P
P1_TD_N
P1_RD_P
P1_RD_N
ECAT_MDCLK
ECAT_MDIO
ECAT_RST
ENET_CAT_XI
ECAT1_RJ_LED1
ECAT1_RJ_LED0

Y402
dnp

ECAT_MDIO

EtherCAT EEPROM

These IC is a 'must'.
Especified on the ethercat slave

U401
CAT24C16WI

NC
NC
NC
VSS
VCC
WP
SCL
SDA

ECAT_EEPROM_SCL
ECAT_EEPROM_SDA

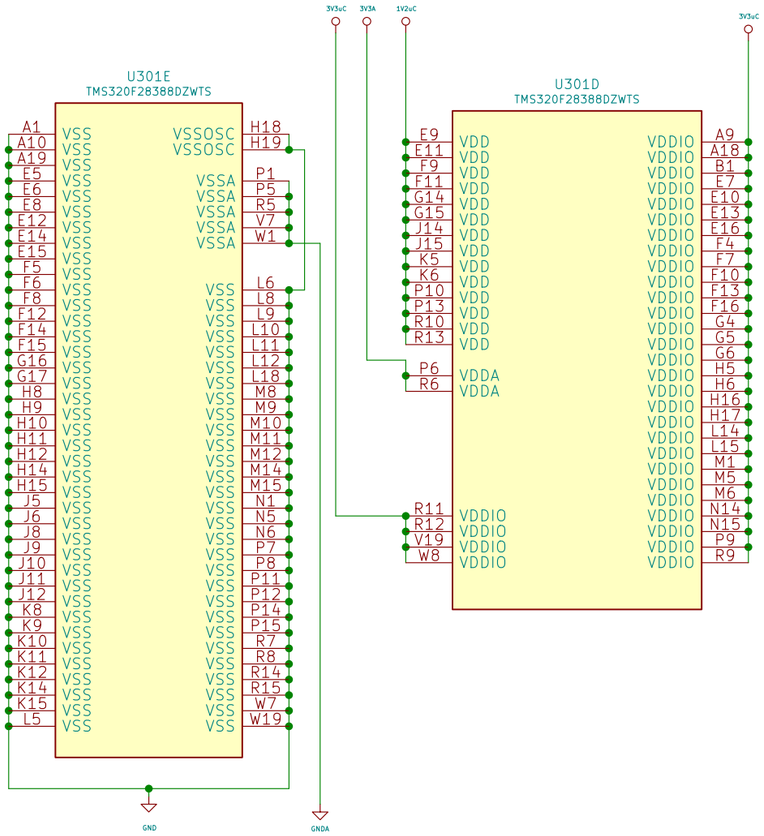
Run and Error LEDs

It's a good idea to have them on these MCU pins but could be throught away on real release.

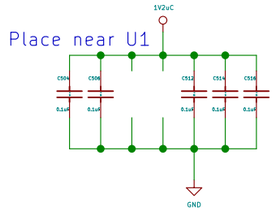
ECAT_LED_RUN
ECAT_LED_ERR

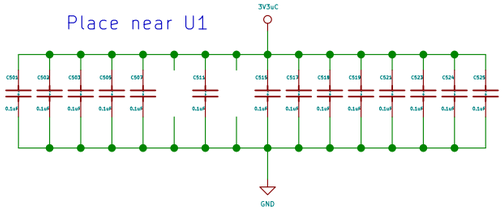
Pablo Slavkin		
dci		
Sheet: /ethercat/		
File: ethercat.sch		
Title: ethercat		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 4/19

DECOUPLING FILTERS

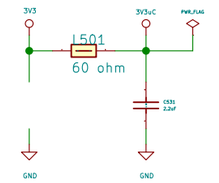


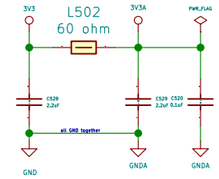
Decoupling Capacitors

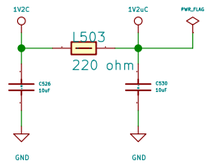




Ferrite Beads
Place near U1

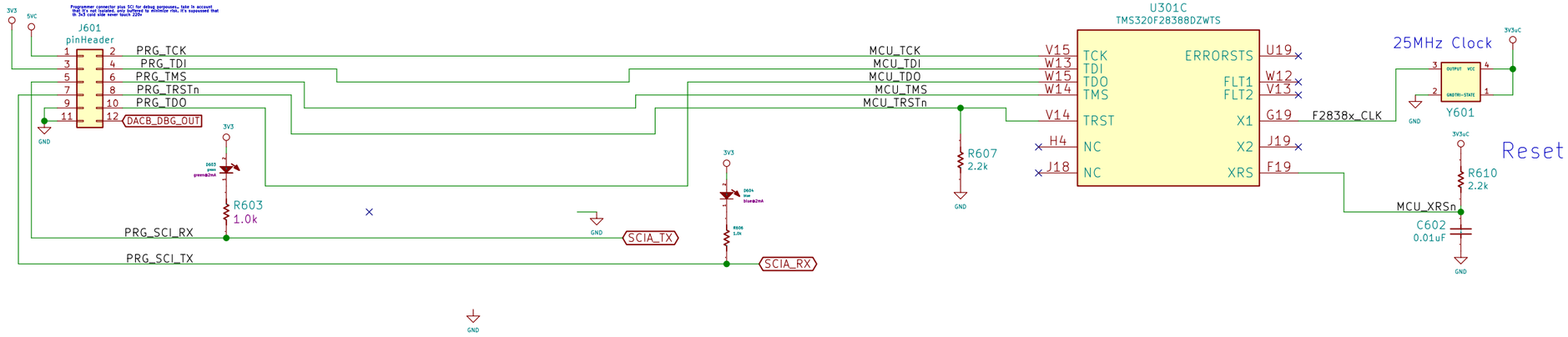




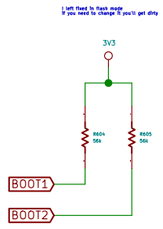


Pablo Slavkin		
dci		
Sheet: /uc_power/		
File: uc_power.sch		
Title: uC Power		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 5/19

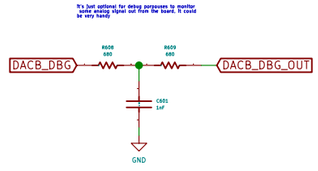
CLK + JTAG + SCI



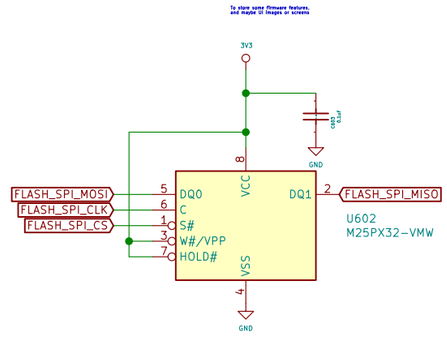
BOOTSRAP R's



ADC/DAC DBG OUT



SPI FLASH



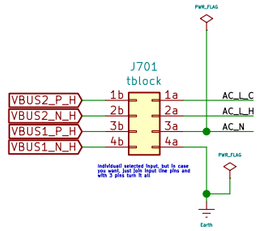
Pablo Slavkin		
dci		
Sheet: /uc_clk_dbg/		
File: uc_clk_dbg.sch		
Title: clk		
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 6/19

Main Power

In case the control board have to be supply directly with socket voltage (220v) provide there, it's not a good idea cause I'd like to keep high voltage outside these controller board, but it's a requirement, so I left it as an option, But you have the low voltage input 15Vac and 15vh connectors

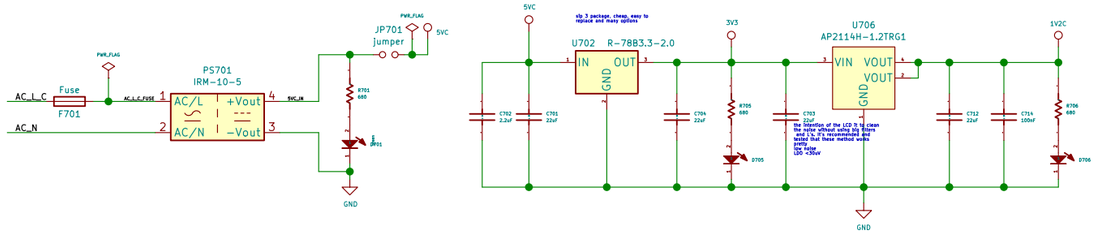
It's choosen to add 2 power supply for Cold and Hot sides because there are boards that have only one double sided power supply and add a DC/DC isolated controller, and it has the advantage to choose which one to use and if there is some issue on 5V or 3V3 side, the Cold side keep working, the selected one is mini Leon HV 20W, the Cold has similar price by 10,5€ and is pin-to-pin compatible with 20W, so you could change if you need more power

I wrote 15v on the DC voltage side, but it's better to use 12v. But the range could be from 0 to 20 more or less



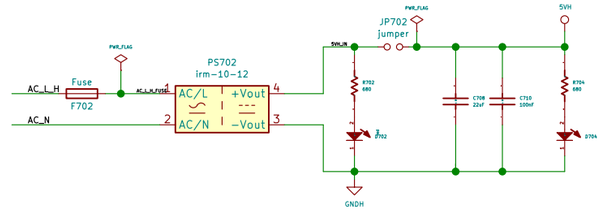
COLD SUPPLY

It is intended to use only, I mean ONLY builds the control board, none of these elements were has to leave the board. I builds every single pin from these supply to go outside, take these in account



HOT SUPPLY

Take in account that hot doesn't mean that it is refered to high voltage or dangerous voltage, it's refered to the fact that it's connected to the Logic/Low voltage side from accidentally high voltage contact on the hot side and prevent failures as to make the reinforced isolation possible with one single insulation added



Pablo Slavkin
dci

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: 7/19

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

IGBT1_WL
IGBT1_WH
IGBT1_VL
IGBT1_VH
IGBT1_UL
IGBT1_UH

FREE_OUT1_2
FREE_OUT1_1
BRK_MEC1
BRK_RES1
IGBT_ALARM1
FAN_RPM1

IGBT1_WL_H
IGBT1_WH_H
IGBT1_VL_H
IGBT1_VH_H
IGBT1_UL_H
IGBT1_UH_H
FREE_OUT1_2_H
FREE_OUT1_1_H
BRK_MEC1_H
BRK_RES1_H
IGBT_ALARM1_H
FAN_RPM1_H

U813
SI8660BD

U814
SI8662BD

IGBT2_UH_H
IGBT2_UL_H
IGBT2_VH_H
IGBT2_VL_H
IGBT2_WH_H
IGBT2_WL_H
BRK_MEC2_H
BRK_RES2_H
FREE_OUT2_1_H
FREE_OUT2_2_H
FAN_RPM2_H
IGBT_ALARM2_H

IGBT2_UH
IGBT2_UL
IGBT2_VH
IGBT2_VL
IGBT2_WH
IGBT2_WL

BRK_MEC2
BRK_RES2
FREE_OUT2_1
FREE_OUT2_2
FAN_RPM2
IGBT_ALARM2

Free to other users, if you choose another version of these IC that has some pins reverted to input, you could use these as an isolated general input also, just remember to bridge the output buffer or reverse it also

Choose a package pin-to-pin compatible whit TI ISO7760. But blades cost had the price as TI

Pablo Slavkin
dci

Sheet: /igbt/
File: igbt.sch

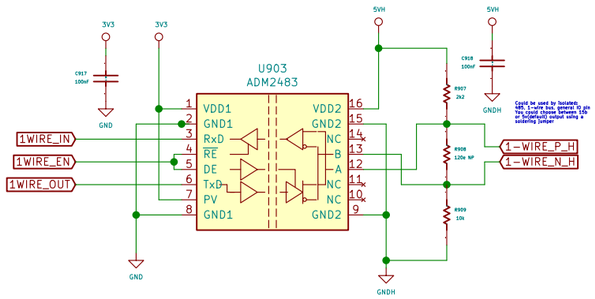
Title: Igbt interface

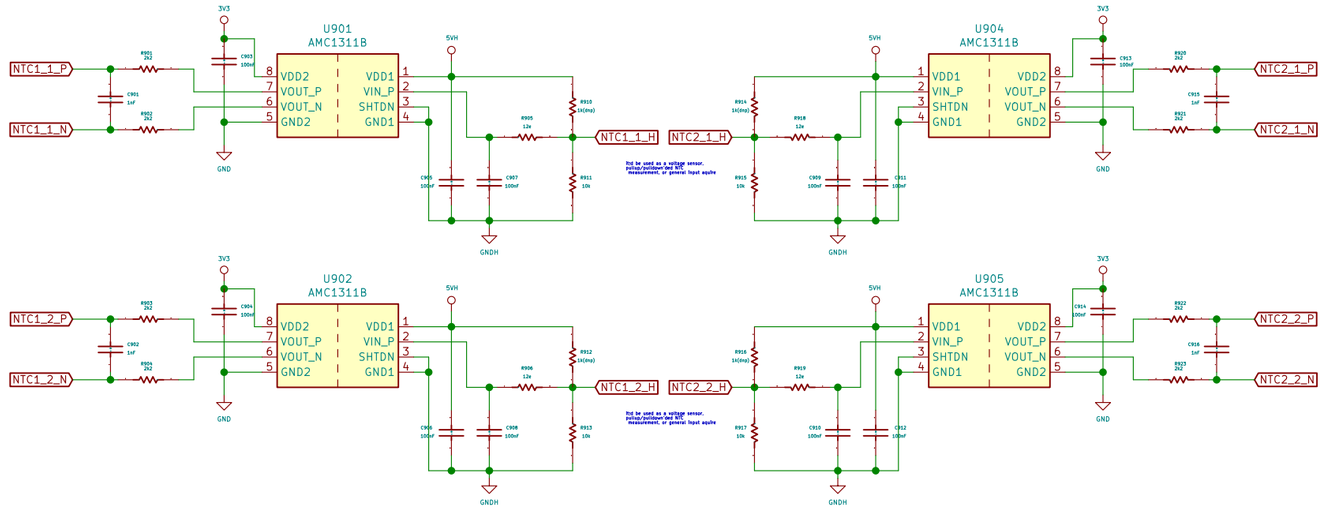
Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A.	kicad 5.0.2+dfsg1-1	Id: 8/19

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

I left 2 isolated analog input to measure with 2 NTC for each motor. If each motor has one inside the motor and other for IGBT divipator.

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.

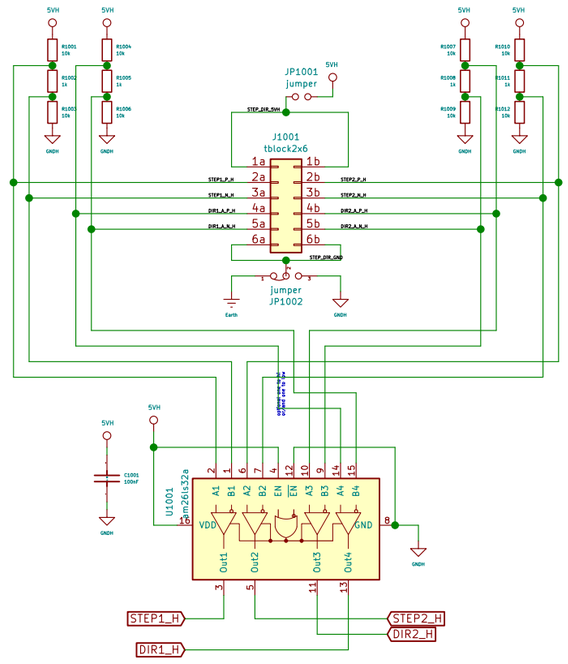




Pablo Slavkin **dci**		
Sheet: /temp/ File: temp.sch		
Title: gpio		
Size: B	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 9/19

Differential STEP-DIR input HOT

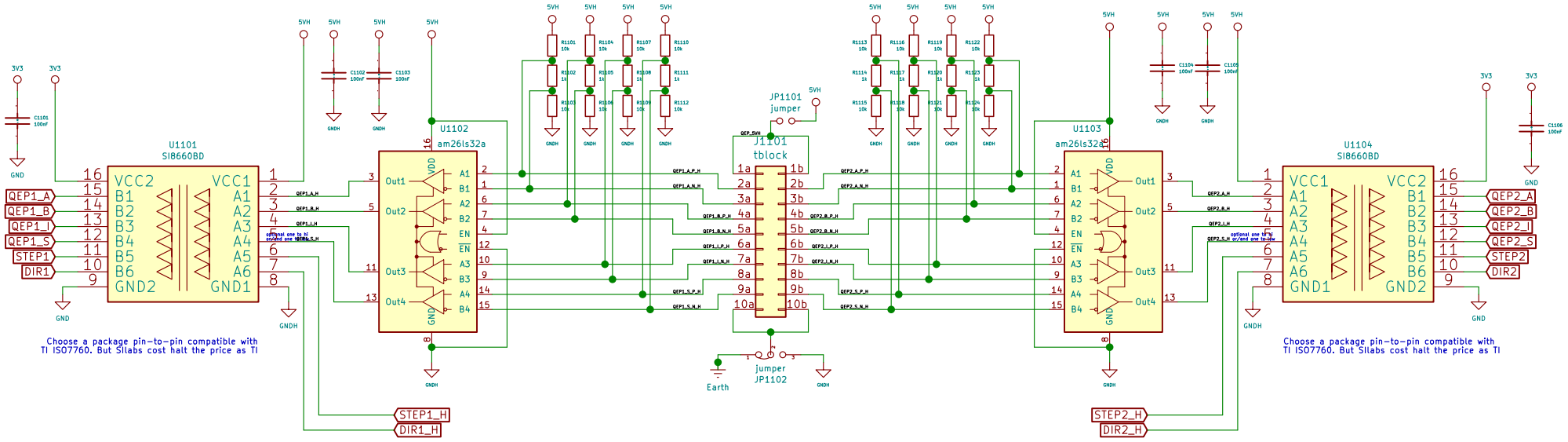
The isolation part is shared with QEP



Pablo Slavkin		
dci		
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: 10/19

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

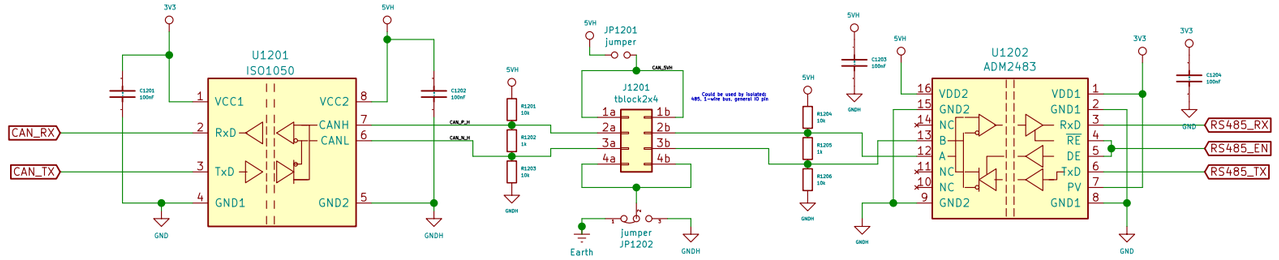
! left the input for two isolated incremental encoders.
! left the 4 signals input plus two auxiliary output for eny porpous plus the ability to choose between 5 or 15vH



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: 11/19

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 5V or 15V as a supply

or ended using the isolator has 4 pins free, so I'd use them plus an SN6501DR to make a RS485 isolated driver chipset, the thing is, that I'd need to have enough room to have both chips, I'd need to make a double sided PCB, and I'd need to think if it's worth the decision now to fit use these IC, that has one only mission, and if I decapsulate it, nothing changes, and also has more driver current.

Pablo Slavkin
dci

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: 12/19

uC GPIO's pins

I've spend hours to choose the GPIO's for each interface trying to not clash one to the other, just pay attention if you wanna move some pheres.
I've used global labels connector to go from one page to another because the off-page connector because it's more prone to errors. I know that's not too orthodox, but it's better and fastly for now

U301B
TMS320F28388DZWTS

IGBT1_UH	C8	GPIO0/EPWM1A	GPIO84	A11	BOOT2
IGBT1_UL	D8	GPIO1/EPWM1A	GPIO85	B11	LCD_GPIO3
IGBT1_VH	A7	GPIO2/EPWM2A	GPIO86	C11	LCD_GPIO2
IGBT1_VL	B7	GPIO3/EPWM2B	GPIO87	D11	LCD_GPIO1
IGBT1_WH	C7	GPIO4/EPWM3A	GPIO88	C6	LCD_GPIO0
IGBT1_WL	D7	GPIO5/EPWM3B	GPIO89	D6	LCD_SPI_PDW
IGBT2_UH	A6	GPIO6/EPWM4A	GPIO90	A5	LCD_INT
IGBT2_UL	B6	GPIO7/EPWM4B	GPIO91/SPID_SIMO	B5	LCD_SPI_MOSI
IGBT2_VH	G2	GPIO8/EPWM5A	GPIO92/SPID_SOMI	A4	LCD_SPI_MISO
IGBT2_VL	G3	GPIO9/EPWM5B	GPIO93/SPID_CLK	B4	LCD_SPI_CLK
IGBT2_WH	B2	GPIO10/EPWM6A	GPIO94/SPID_STEn	A3	LCD_SPI_CS
IGBT2_WL	C1	GPIO11/EPWM6B	GPIO95	B3	LCD_GPIO4
BRK_RES1	C2	GPIO12/EPWM7A	GPIO96	C3	LCD_GPIO5
BRK_RES2	D1	GPIO13/EPWM7B	GPIO97	A2	
ENDAT1_N_SKEW_CLK	D2	GPIO14/EPWM8A	GPIO98	F1	
ENDAT1_Y_SKEW_CLK	D3	GPIO15/EPWM8B	GPIO99	G1	
SD_CLK_OUT	E1	GPIO16/EPWM9A	GPIO100/SPIC_SIMO	H1	FLASH_SPI_MOSI
SD_CLK_IN1	E2	GPIO17/SD1_C1	GPIO101/SPIC_SOMI	H2	FLASH_SPI_MISO
ENDAT2_N_SKEW_CLK	E3	GPIO18/EPWM10A	GPIO102/SPIC_CLK	H3	FLASH_SPI_CLK
ENDAT2_Y_SKEW_CLK	E4	GPIO19/EPWM10B	GPIO103/SPIC_STEn	J1	FLASH_SPI_CS
QEP1_A	F2	GPIO20/EQEP1_A	GPIO104	J2	
QEP1_B	F3	GPIO21/EQEP1_B	GPIO105	J3	ENET_MDCLK
QEP1_S	J4	GPIO22/EQEP1_STROBE	GPIO106	L2	ENET_MDIO
QEP1_I	K4	GPIO23/EQEP1_INDEX	GPIO107	L3	
QEP2_A	K3	GPIO24/EQEP2_A	GPIO108	L4	
QEP2_B	K2	GPIO25/EQEP2_B	GPIO109	N2	ENET_PWDN
QEP2_I	K1	GPIO26/EQEP2_INDEX	GPIO110	M2	ENET_CRS
QEP2_S	L1	GPIO27/EQEP2_STROBE	GPIO111	M4	ENET_COL
SCIA_RX	V11	GPIO28/SCIA_RX	GPIO112	M3	ENET_RX_CLK
SCIA_TX	W11	GPIO29/SCIA_TX	GPIO113	N4	ENET_RX_DV
CAN_RX	T11	GPIO30/CANA_RX	GPIO114	N3	ENET_RX_ER
CAN_TX	U11	GPIO31/CANA_TX	GPIO115	V12	ENET_RX_D0
BRK_MEC1	U13	GPIO32	GPIO116	W10	ENET_RX_D1
BRK_MEC2	T13	GPIO33	GPIO117	U12	ENET_RX_D2
RUN_LED0	U14	GPIO34	GPIO118	T12	ENET_RX_D3
RUN_LED1	T14	GPIO35	GPIO119	T15	ENET_TX_EN
SD1_U	V16	GPIO36/SD1_D1	GPIO120	U15	ENET_RST
SD1_V	U16	GPIO37/SD1_D2	GPIO121	W16	ENET_TX_CLK
SD1_W	T16	GPIO38/SD1_D3	GPIO122	T8	ENET_TX_D0
SD1_A	W17	GPIO39/SD1_D4	GPIO123	U8	ENET_TX_D1
FREE_OUT1_1	V17	GPIO40	GPIO124	V8	ENET_TX_D2
FREE_OUT1_2	U17	GPIO41	GPIO125	T9	ENET_TX_D3
USB_D-	D19	GPIO42/USB0DM	GPIO126	U9	
USB_D+	C19	GPIO43/USB0DP	GPIO127	V9	
FAN_RPM1	K18	GPIO44	GPIO128	W9	
IGBT_ALARM1	K19	GPIO45	GPIO129	T10	ECAT1_TX_EN
FREE_OUT2_1	E19	GPIO46	GPIO130	U10	ECAT1_TX_CLK
FREE_OUT2_2	E18	GPIO47	GPIO131	V10	ECAT1_TX_D0
FAN_RPM2	R16	GPIO48	GPIO132	W18	ECAT1_TX_D1
SD2_U	R17	GPIO49/SD2_D1	GPIO133	G18	
SD2_V	R18	GPIO50/SD2_D2	GPIO134	V18	ECAT1_TX_D2
SD2_W	R19	GPIO51/SD2_D3	GPIO135	U18	ECAT1_TX_D3
SD2_A	P16	GPIO52/SD2_D4	GPIO136	T17	ECAT1_RX_DV
IGBT_ALARM2	P17	GPIO53	GPIO137	T18	ECAT1_RX_CLK
RS485_TX	P18	GPIO54/SCIB_TX	GPIO138	T19	ECAT1_RX_ER
RS485_RX	P19	GPIO55/SCIB_RX	GPIO139	N19	ECAT1_RX_D0
RS485_EN	N16	GPIO56	GPIO140	M19	ECAT1_RX_D1
SD_CLK_IN2	N18	GPIO57/SD2_C1	GPIO141	M18	ECAT1_RX_D2
ENDAT1_MOSI	N17	GPIO58/SPIA_SIMO	GPIO142	L19	ECAT1_RX_D3
ENDAT1_MISO	M16	GPIO59/SPIA_SOMI	GPIO143/ESC_LED_LINK0_ACTIVE	F18	ECAT0_RJ_LED0
ENDAT1_CLK	M17	GPIO60/SPIA_CLK	GPIO144/ESC_LED_LINK1_ACTIVE	F17	ECAT1_RJ_LED0
ENDAT1_CS	L16	GPIO61/SPIA_STEn	GPIO145/ESC_LED_ERR	E17	ECAT_LED_ERR
	J17	GPIO62	GPIO146/ESC_LED_RUN	D18	ECAT_LED_RUN
	J16	GPIO63/SPIB_SIMO	GPIO147	D17	
ENDAT2_MOSI	L17	GPIO64/SPIB_SOMI	GPIO148/ESC_PHY0_LINKSTATUS	D14	ECAT0_RJ_LED1
ENDAT2_MISO	K16	GPIO65/SPIB_CLK	GPIO149/ESC_PHY1_LINKSTATUS	A13	ECAT1_RJ_LED1
ENDAT2_CLK	K17	GPIO66/SPIB_STEn	GPIO150/ESC_I2C_SDA	B13	ECAT_EEPROM_SDA
ENDAT2_CS	B19	GPIO67	GPIO151/ESC_I2C_SCL	C13	ECAT_EEPROM_SCL
STEP1	C18	GPIO68	GPIO152/ESC_MDIO_CLK	D13	ECAT_MDCLK
DIR1	B18	GPIO69	GPIO153/ESC_MDIO_DATA	A12	ECAT_MDIO
STEP2	A17	GPIO70	GPIO154/ESC_PHY_CLK	B12	ENET_CAT_XI
DIR2	B17	GPIO71	GPIO155/ESC_PHY_RESETn	C12	ECAT_RST
BOOT1	B16	GPIO72	GPIO156/ESC_TX0_ENA	D12	ECAT0_TX_EN
	A16	GPIO73	GPIO157/ESC_TX0_CLK	B10	ECAT0_TX_CLK
	C17	GPIO74	GPIO158/ESC_TX0_DATA0	C10	ECAT0_TX_D0
	D16	GPIO75	GPIO159/ESC_TX0_DATA1	D10	ECAT0_TX_D1
	C16	GPIO76	GPIO160/ESC_TX0_DATA2	B9	ECAT0_TX_D2
	A15	GPIO77	GPIO161/ESC_TX0_DATA3	C9	ECAT0_TX_D3
	B15	GPIO78	GPIO162/ESC_RX0_DV	D9	ECAT0_RX_DV
	C15	GPIO79	GPIO163/ESC_RX0_CLK	A8	ECAT0_RX_CLK
	D15	GPIO80	GPIO164/ESC_RX0_ERR	B8	ECAT0_RX_ER
	A14	GPIO81	GPIO165/ESC_RX0_DATA0	C5	ECAT0_RX_D0
1WIRE_IN	B14	GPIO82	GPIO166/ESC_RX0_DATA1	D5	ECAT0_RX_D1
1WIRE_EN	C14	GPIO83	GPIO167/ESC_RX0_DATA2	C4	ECAT0_RX_D2
1WIRE_OUT			GPIO168/ESC_RX0_DATA3	D4	ECAT0_RX_D3

one PWM channel for all 3 SD

SD C2/3/4 goes directly inside of epwm and MUST C1 resolve

Safetest gpio's for mCU boot, don't move

SD C2/3/4 goes directly inside of epwm and MUST C1 resolve

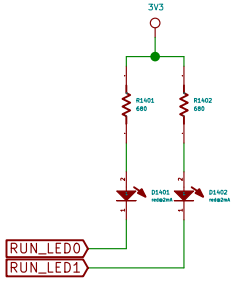
Pablo Slavkin
dci

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: 13/19

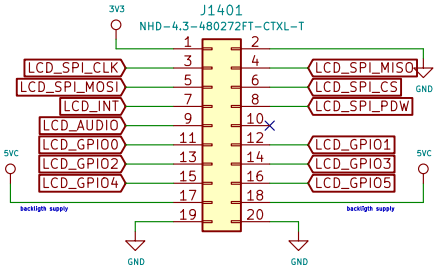
Multipropouse LEDs



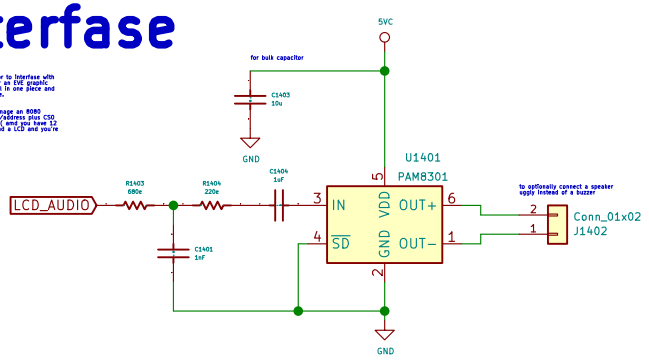
LCD UI interfase

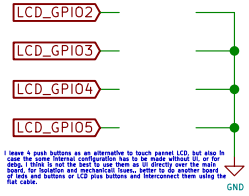
I leve a multf LCD/Touch/button 20 pins IDC connector to interfase with some UI, it could be simple leds, a character LCD or an EVE graphic LCD as I recommend. 'cause for some price you've all in one piece and it's already done. clean, usefull and intuitive interfase.

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 (4 + 7 pins 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 some interse configuration has to be made (wheel UI or for example a LCD with 4 buttons) I made them to be mounted on the other board, for isolation and mechanical 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: 14/19

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

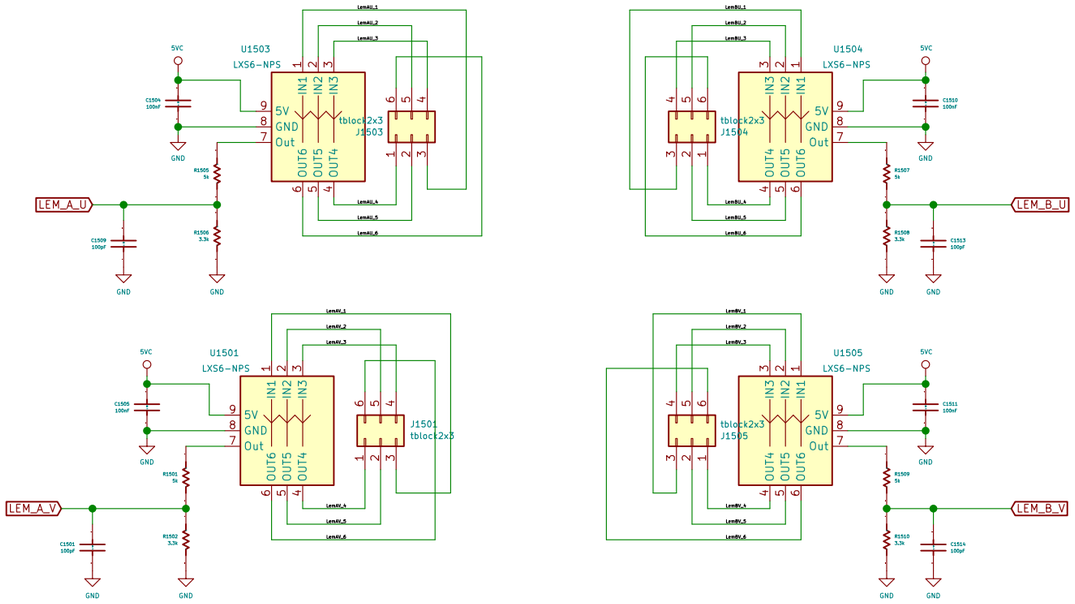
The intention of these lems is to have the capacity on the control board to measure all three phases in relation to each of the higher delta chips to measure and to identify/ compare the readings from the LEM's carefully and I've conclude that there are very similar. and more or less hold per turn (4 little especially in 50) but the new generation LXS 25-NP is more linear than the LTS 25-NP and also has a little less than all the 2U filter delay, so LXS is faster. The other advantage is that for same LEM I've chosen you could rearrange the connection to multiply the current by 2 or by 3 and the measurement will be more or less still linear. In the case of 3D you have to change the precision shunt, or add more than one, that is costly and take some board space. Unfortunately the LXS 25-NP has only 3 SPI CS pins (SS), so I could not travel across boards, for that reason I've put them on control board, but to completely isolated because of these pinouts effect, and also because I've put a buffer on the SPI bus to drive the LEM's supply current. I'll put the only option, because if you tested and wanna use SD, I left all the SD channels available on 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 use an opamp because 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 want to measure 2 LEM in line you use the soldering link…because they connetor is 2 terminal, not 6

<antagoli> I've decided to return to a 2x3 terminal block output 'cause it match the size of the LEM



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

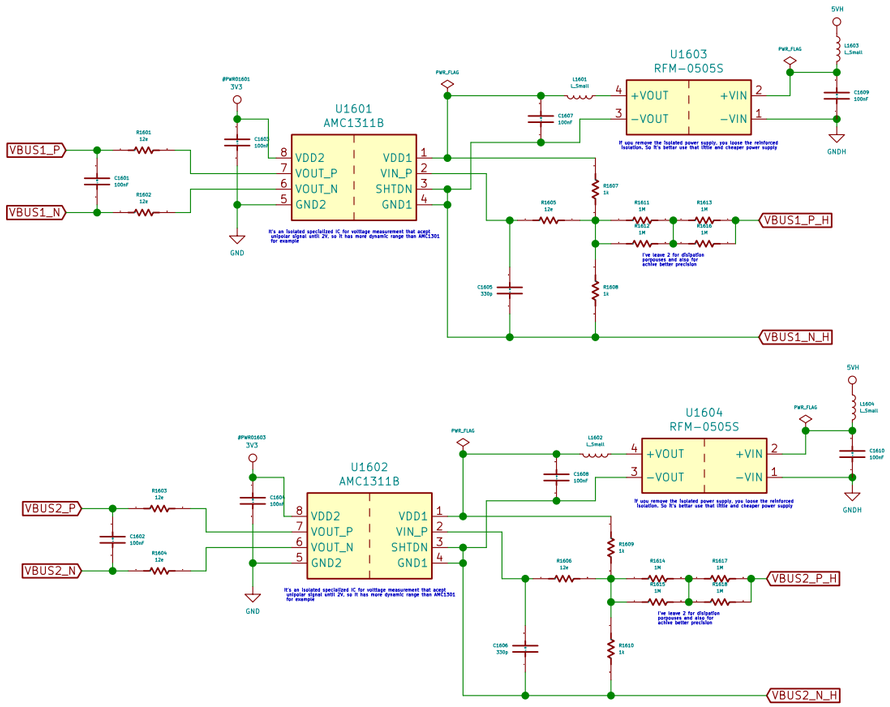
Pablo Slavkin
dci

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: 15/19

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

It's intended to measure the Vbus, one per motor, but they cold 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



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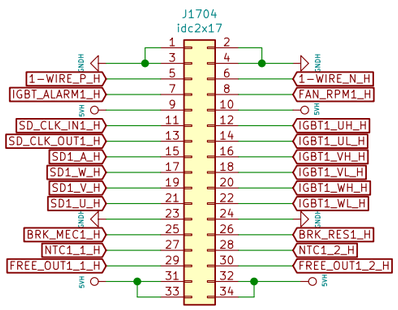
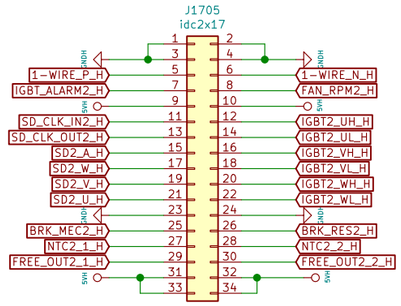
Sheet: /Vbus meas/
File: vbus_meas.sch

Title: Shunt isolated

Size: A3	Date: 2020-01-09	**Rev: 1.0**
KiCad E.D.A. kicad 5.0.2+dfsg1-1		Id: 16/19

Common Connections





Pablo Slavkin
dci

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: 17/19

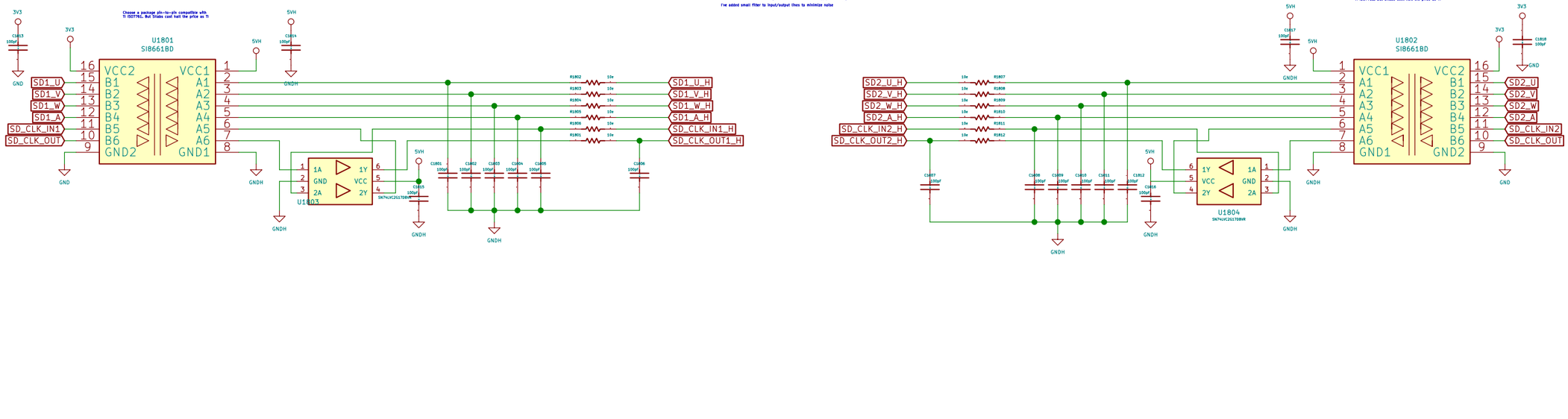
Isolated sigma delta ADC

It's intended for power board circuitery to supply all the signals to control board. The control board will use the SD filter to aquire the input. All the power part will be at power board.

PWM clk output to powerboard and then come back again to maintain the phase. Because of the PWM generation in the power board you have to respect traces length between clk and data

I use 5VH on power side to be less prone to value error on the way on connection the two boards (and I've decided to not supply 3v3H too)

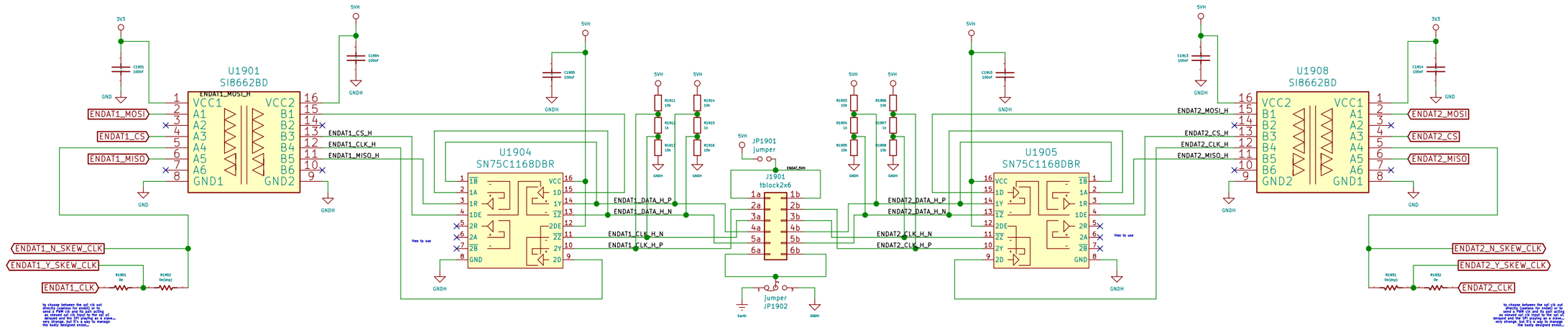
I've added small filter to input/output lines to minimize noise



Pablo Slavkin
dci

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: 18/19

2X Isolated diferential ENDAT interface



Pablo Slavkin

dci

Sheet: /endat/

File: endat.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: 19/19