LIU BWS
Electronics status

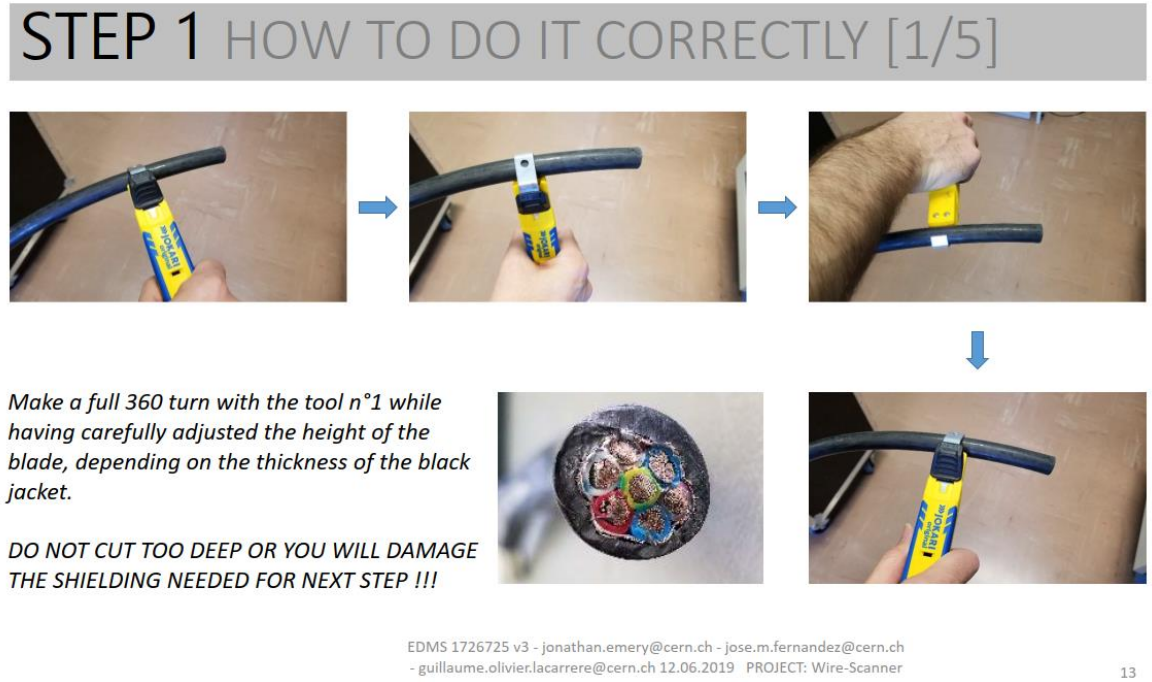
18.06.2019 J. Emery

Plan

- Electronics design
- BWSAIF: Latest validated parts
- Electronics production

New procedure revision for motor cable assembly

- EDMS 1726725 to instruct EN/EL and EN/EA on assembly
- New revision (V3) to simplify assembly (proposed by EN/EA) and for safety reasons (change in tooling)
- New revision will be signed by EN/EL, EN/EA and A-DSO BE (safety)
- Procedure revision 3 by Guillaume.



Electronics design

- Last 2 weeks good progress on BWSAIF HW&FW (see later)
- BWSMIB test procedure completed (Jose Maria)
- BWSMCU
  Cable harness assembled + validated (Guillaume)
  New fans part number (Guillaume)
- Next step:
  Assemble complete crate for complete test of the interaction between boards

- Design office jobs

  1) BWSAIF -> V4 to do
  2) BWSCPC -> V4 to check almost finished
  3) BWSADP -> V1
  Acquisition digitalisers protection
  new board + mechanical assembly design into 1U crate.

  To protect the input of the acquisition ADC against over voltage and maybe some signal conditioning…..

  4) BWSIDC (intelligent drive crate) V3 tbd
  5) BWSMCU (Motion control Unit) V3 tbd

Detailed electronics design status 18.06.2019

DESIGN							
EDA	Designation	Description	Current rev.	Nbr Part Number	completion	Status	next steps
EDA-03592	BWSCPC	BWS – Capacitor Power Charger	V3->V4	40	70%->80%	V4 done by design office	Finalise validation inside PROTO2
EDA-03519	BWSMIB	BWS – Motor Inverter Board	V2	64	80%	10 boards produced, 1 under tests	integration into PROTO2
EDA-03096	BWSAIF	BWS – Analog Interface FMC	V3->V4	95	60%->80%	2 proto tested	integration into PROTO2 + New PCB revision
EDA-03624	BWSFHE	BWS – FMC Height Extender	V2	1	90%	10 pcs ready for final test	integration into PROTO2
EDA-03698	BWSVPA	BWS – VME Power Adapter	V1	2	100%	12 pcs ready for final test	integration into PROTO2
EDA-03764	BWSPSA	BWS – Particle Shower Acquisition	V1	16	100%	Tested with beam - ready for serie production	order PCB + componants
EDA-03634	BWSIDC	BWS – Intelligent Drive Crate	V2	105	80%	Prototyping on-going	integration into PROTO2
		crate		1	100%	commercial product	integration into PROTO2
		custom mechanics		11		3 sets under construction (BE-BI)	integration into PROTO2
		Cables harness		30	70%	under prototyping with EN/EA	integration into PROTO2
EDA-03697	BWSMCU	BWS – Motion Control Unit	V2	57	80%	Prototyping on-going	
		crate		1	80%	production 25 units (PENTAIR)	integration into PROTO2
		custom mechanics		4		2 systemes under construction	integration into PROTO2
		Cables harness		9	80%->90%	Final validation on-going - New FAN selected	integration into PROTO2
tbd	BWSADP	BWS - Acquisition Digitalisers Protection	>>>> V1				
total				436			

Electronics tests design for the BWSMIB

- Procedure design completed (13 pages step-by-step)
  Hardware 50% done, all components done
  Software to do

  (By Jose Maria)

- LabVIEW will switch ON PSU2 [+HV]. Start monitoring PSU2 voltages and currents.
- Check that the CPLD is not activating any of the transistors. To do this, these DIGITAL INPUTS should be as follows:

DIGITAL IO	CONFIGURATION	STATUS
NI9403_22 to NI9403_27	INPUT	LOW [Transistors OFF]

- The transistors should be OFF. To check this, these ANALOG INPUTS should read these voltages:

ANALOG INPUT	CONFIGURATION	VOLTAGE
NI9221-2_5	INPUT	12.5V ~ 17.5V

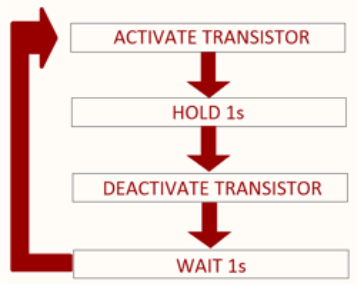
- ***Transistors (SHORT-CIRCUIT PROTECTION) & SPI INTERFACE***
  - In order to do this test, we need the SPI INTERFACE. For this interface we need to configure some DIOs as outputs:

DIGITAL IO	CONFIGURATION	STATUS
NI9403_7	OUTPUT	XX [SCLK]
NI9403_8	OUTPUT	XX [MOSI]
NI9403_10	OUTPUT	XX [SS]

  - Using the SPI INTERFACE, read the status of the FAULT SIGNALS. The status should be HIGH.
  - Connect the phases to PGND using the relays. To do this, these DIGITAL OUTPUTS should be as follows:

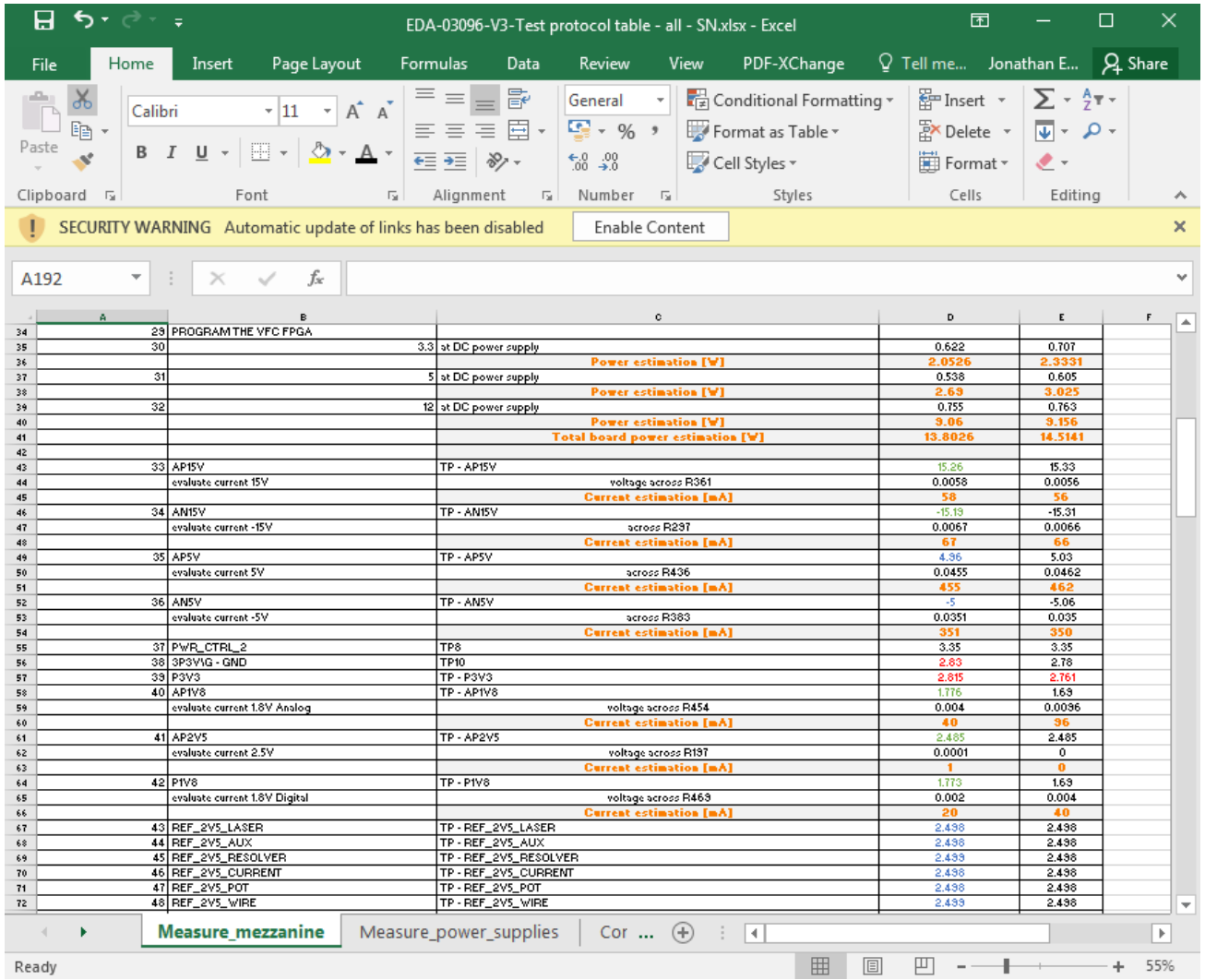
DIGITAL IO	CONFIGURATION	STATUS
NI9403_20	OUTPUT	HIGH
NI9403_21	OUTPUT	HIGH [Phases to GND]

  - Now, activate the HIGH SIDE TRANSISTORS, one by one. The procedure should be:

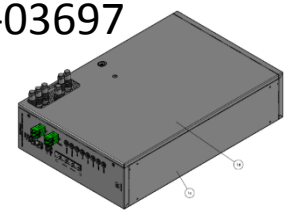


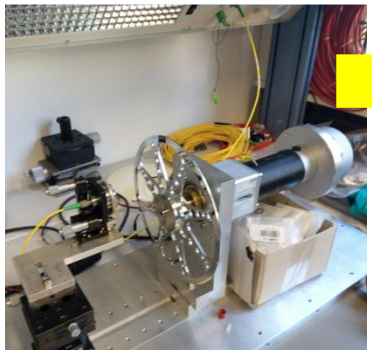
Electronics tests design for the BWSAIF

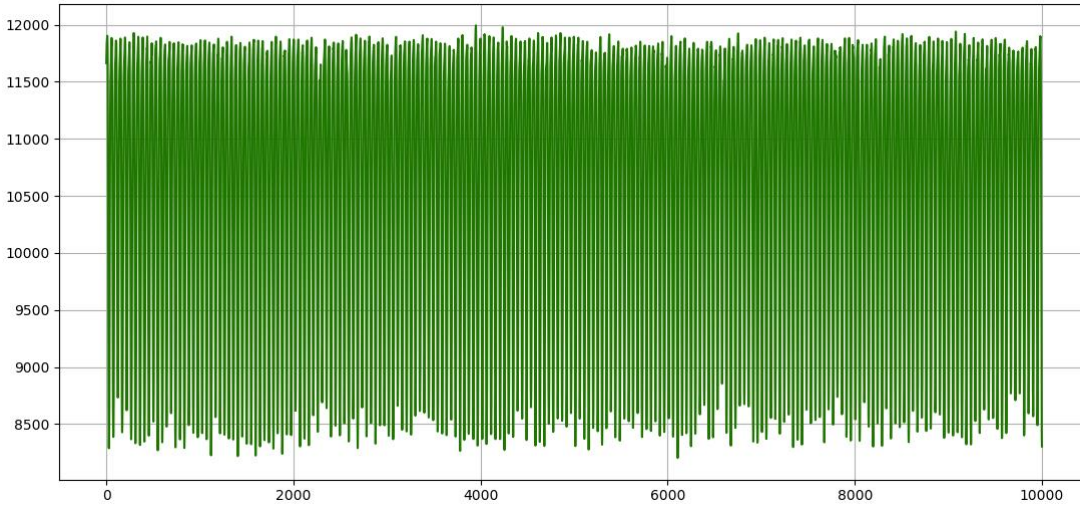
- Procedure design almost completed advancing with the validation of the board.
(by Jonathan)

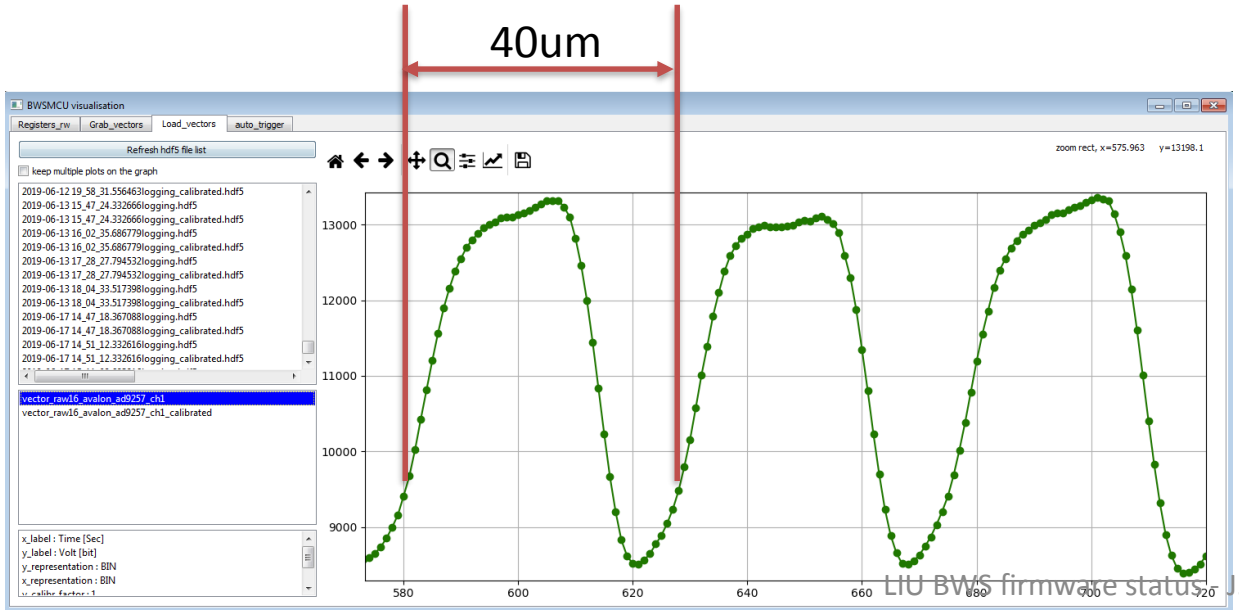


Motion Control Unit (MCU) – IOPS Digitalisation





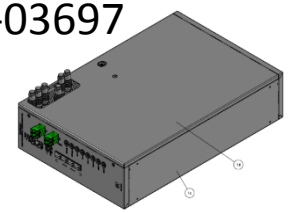




Measures:
48pt/40 um @ 80 rad => 1.2 pt/um

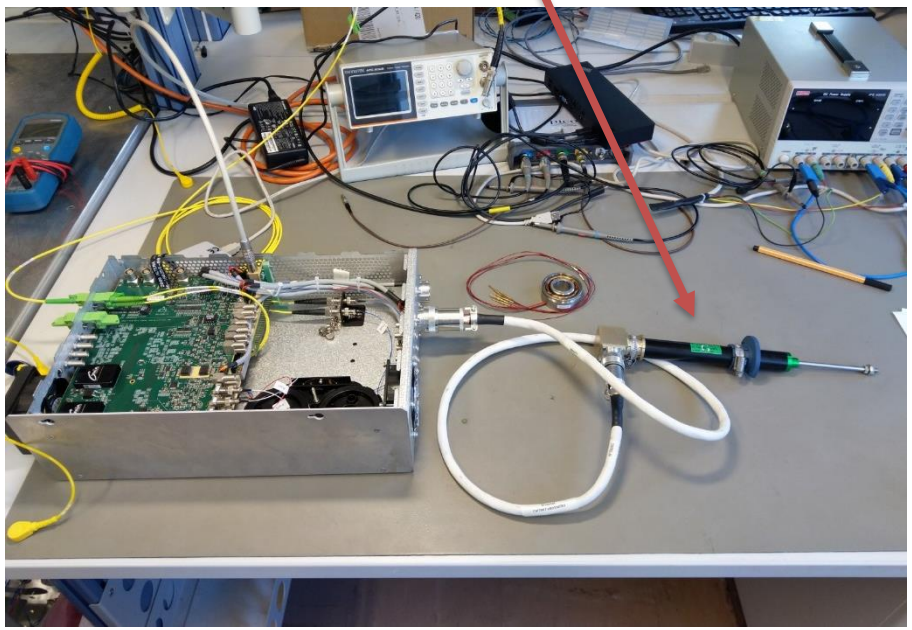
Worst case estimation:
29 pt/40um @ 133 rad/s (PSB) => 0.725 pt/um

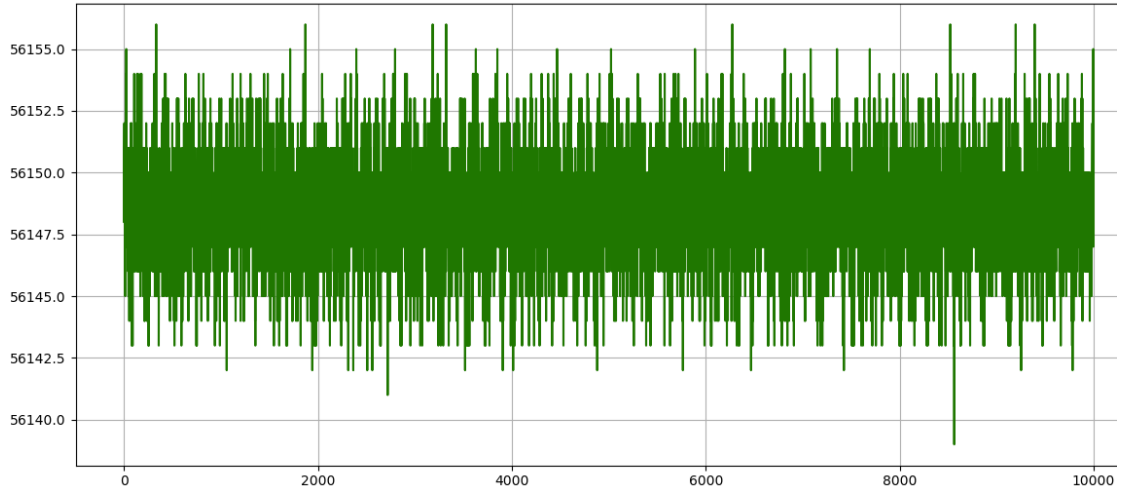
EDA-03697



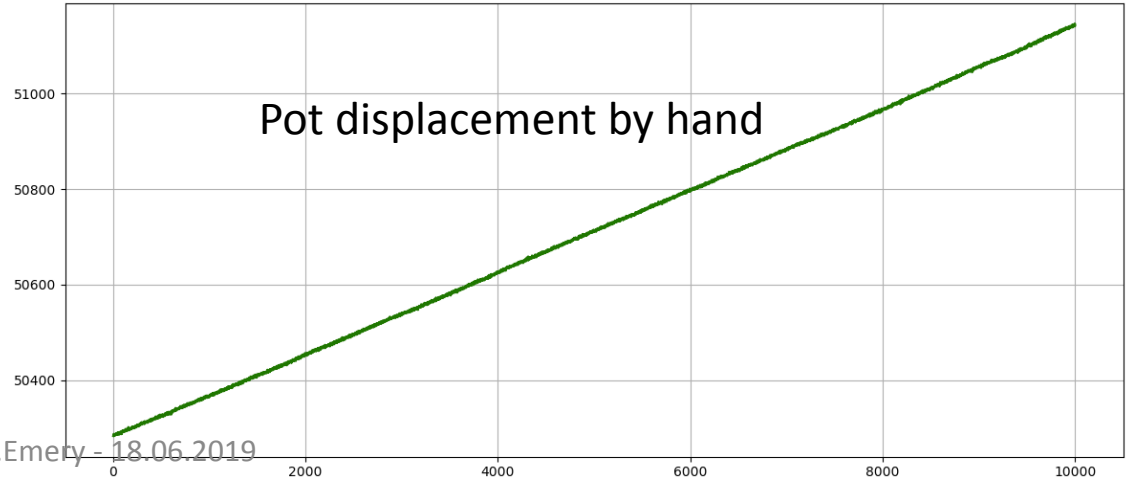
Motion Control Unit (MCU) – LHC potentiometer

Linear LHC pot





Noise std ~3 [bit] => ENOB 14bits => 133mm stroke => 8um resolution before processing



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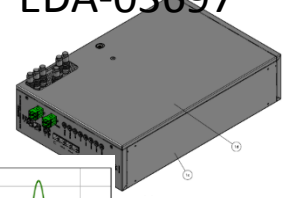
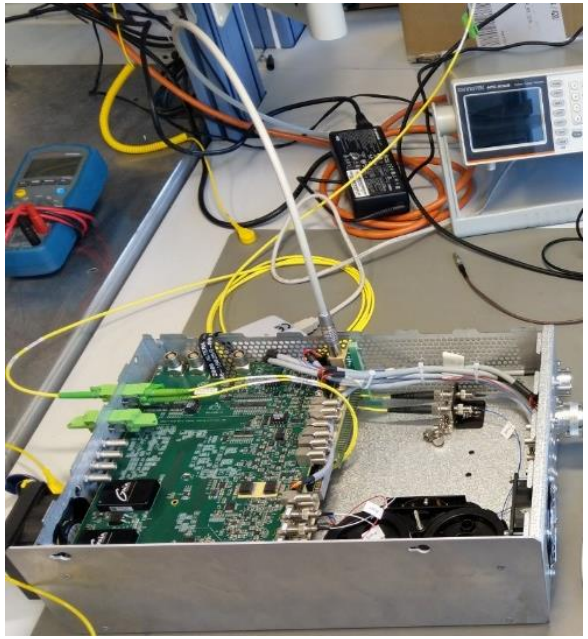
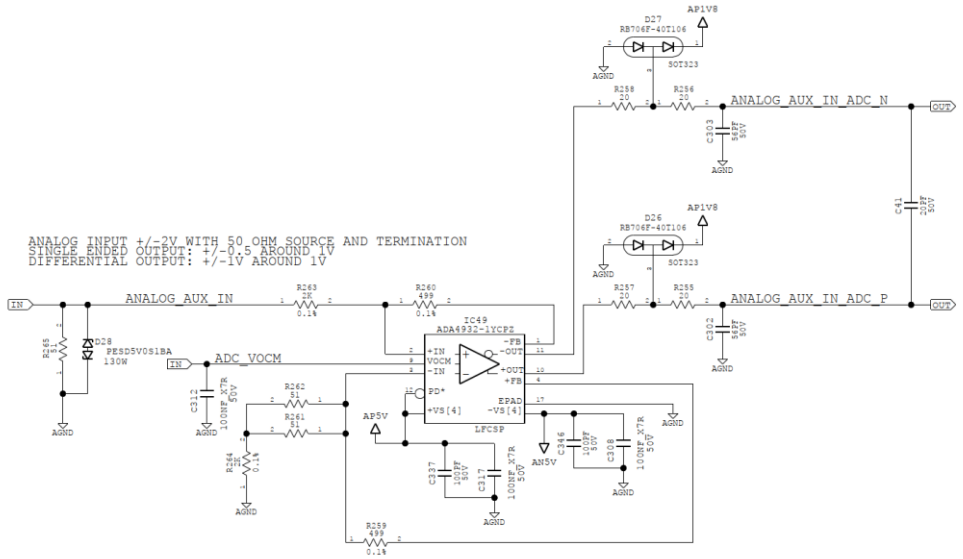
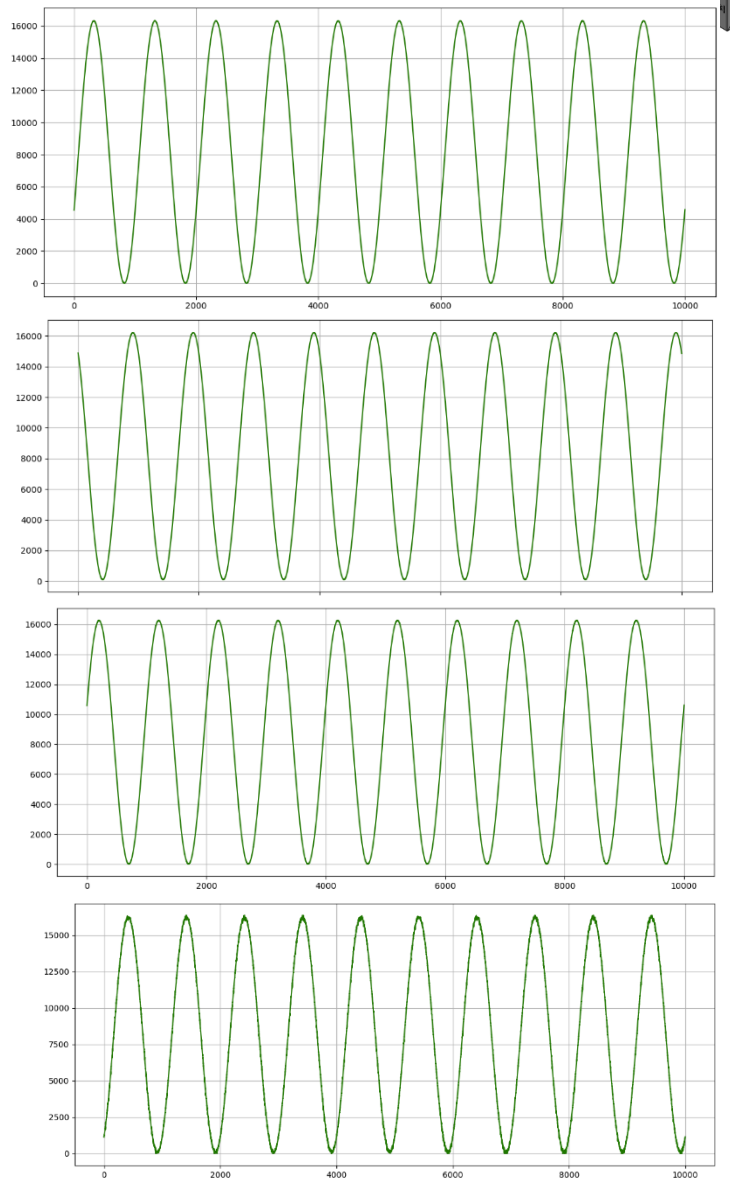


Motion Control Unit (MCU) – 4x AUX INPUTS







4 auxiliary analog inputs 14 bits @ 10MHz
(later upgrade possible at faster speed)
+- 4 Vpp inputs

To think of:
Maybe usable temporarily in the PSB if the ADC board are late?

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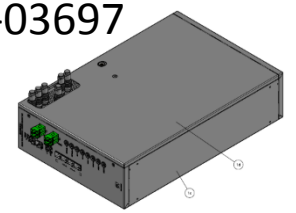
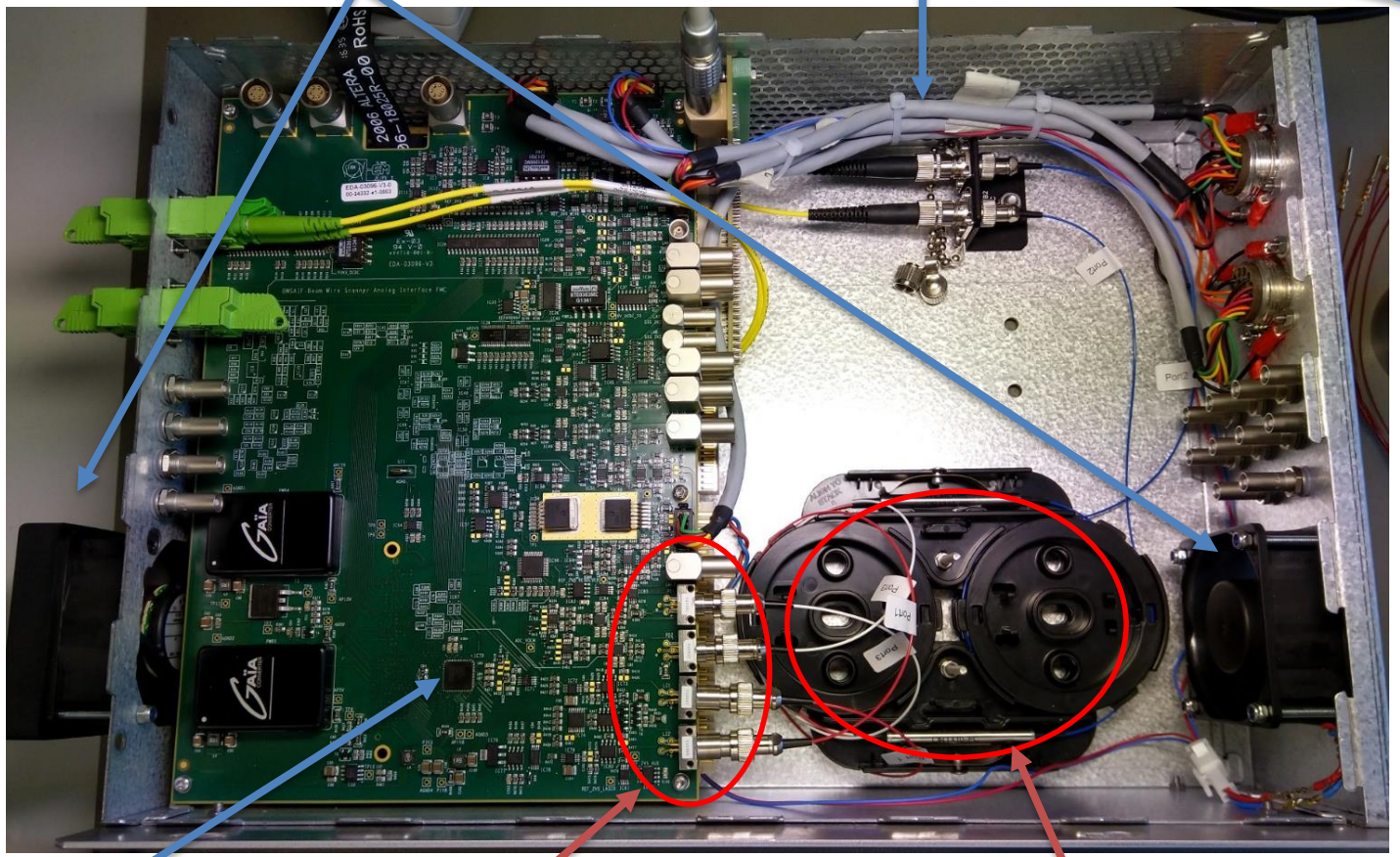


Motion Control Unit (MCU)

New FANS for cooling
VFC + MEZZANINE

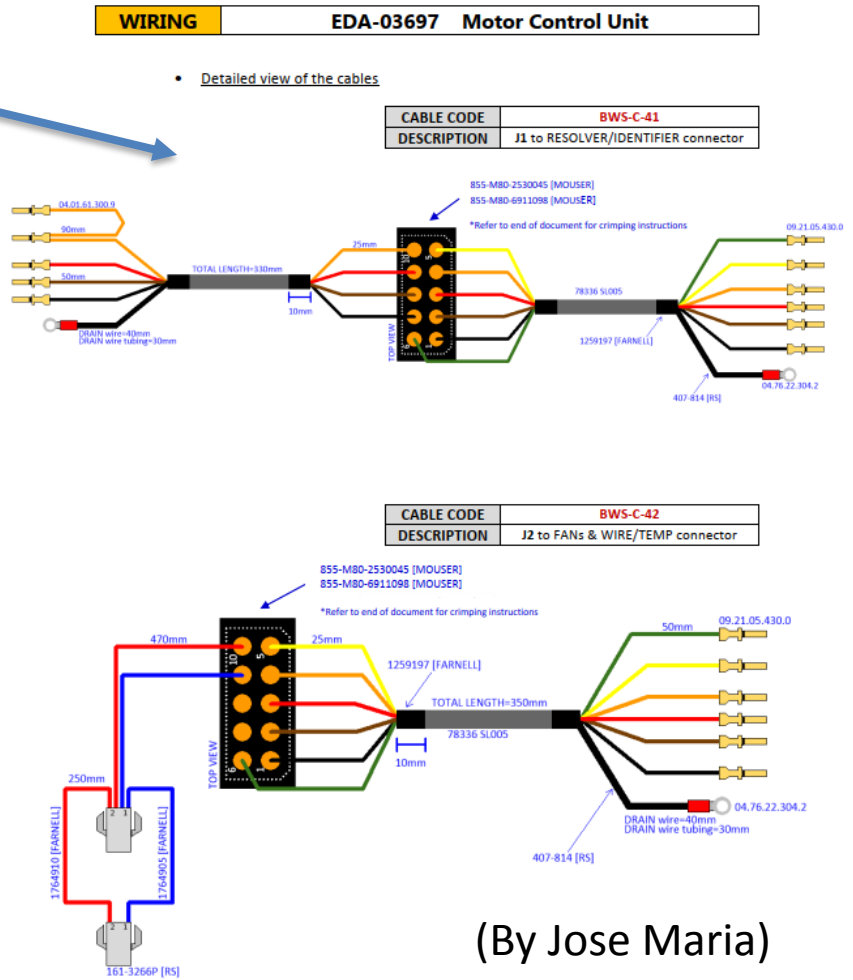
Cable harness



10MHz ADC

To order for ~27kCHF
(Laser components)

To order for ~29kCHF
(Thorlabs components)



(By Jose Maria)

Production - Procurement

- Standard components procurement for the PCB on-going (Guillaume)
- PCB production waiting for complete crate test
- Crate assembly starts next week
- 5x BWSPSA assemble by Jose Sirvent

Critical component procurements:

<u>Above 100k:</u>

- 30x ADC boards cost below 200kCHF
- Price Enquiry on-going
- First company has contacted us for technical questions

<u>Above 10k limit:</u>

- 62x
  Circulators for the optical encoder 393.31 Euro/pc => 24385.22 Euro => ~29kCHF
- 50x
  Laserdiode for the optical encoder 118.63 Euro/pc => 11863 Euro => ~14kCHF
- 50x
  Photodiode for the optical encoder 104.85 Euro/pc => 10845 Euro => ~13kCHF

<u>Above 5k limit:</u>

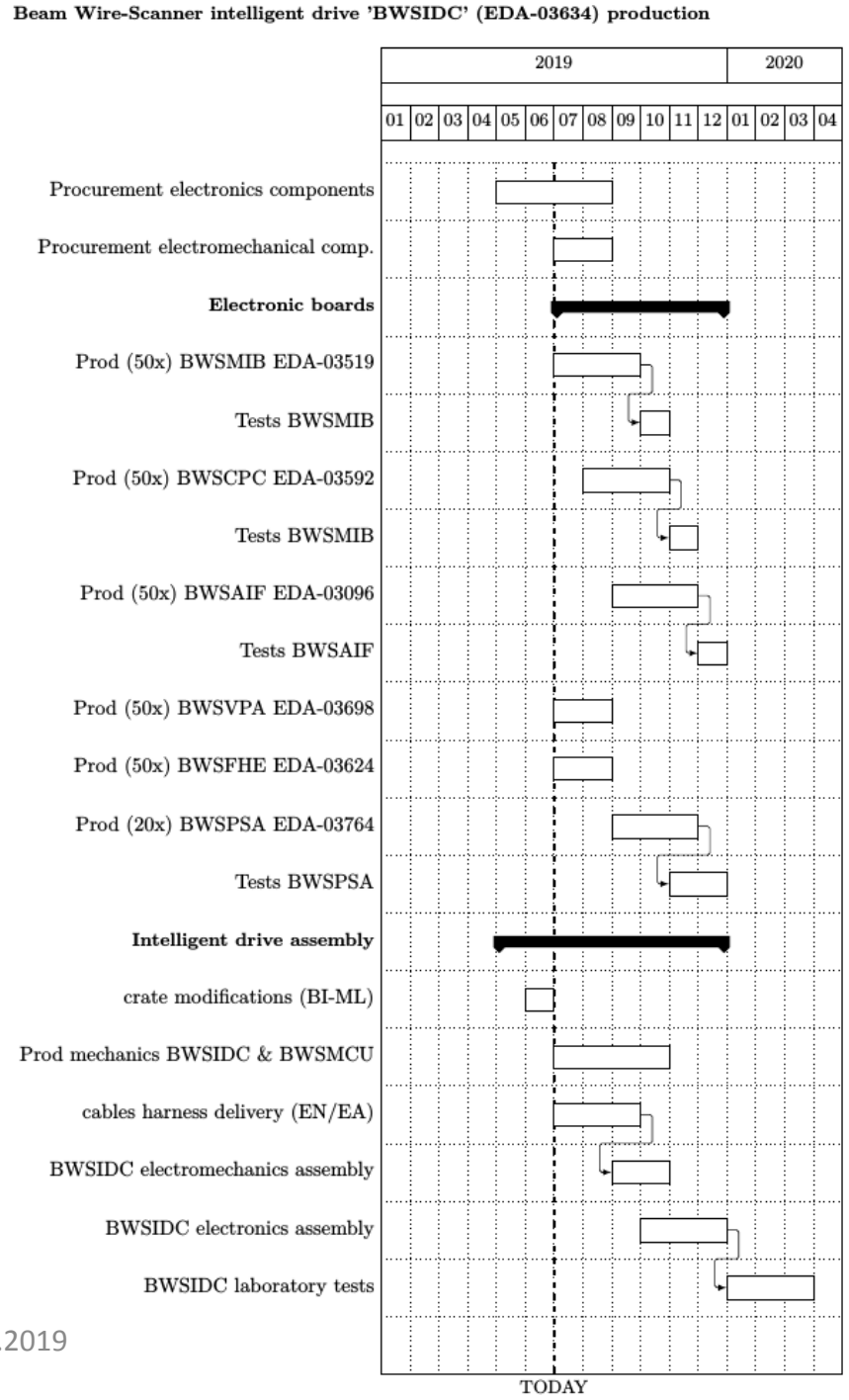
- 27xSinus Filter: 297.75 CHF/pc => 8039.25 CHF

Detailed electronics production status 18.06.2019

PRODUCTION							
EDA	Designation	Description	Current rev.	Nbr Part Number	Components ordering status	Status	next steps
EDA-03592	BWSCPC	BWS – Capacitor Power Charger	V3->V4	40	50%	ordering components	launch PCB
EDA-03519	BWSMIB	BWS – Motor Inverter Board	V2	64	90%	ordering components	launch PCB
EDA-03096	BWSAIF	BWS – Analog Interface FMC	V3->V4	95	0%	ordering components	launch PCB
EDA-03624	BWSFHE	BWS – FMC Height Extender	V2	1	100%	ordering components	launch PCB
EDA-03698	BWSVPA	BWS – VME Power Adapter	V1	2	100%	ordering components	launch PCB
EDA-03764	BWSPSA	BWS – Particle Shower Acquisition	V1	16		5 PCB ready for tests - 4 prototypes	launch PCB
EDA-03634	BWSIDC	BWS – Intelligent Drive Crate	V2	105		Preparing orders above 5k	order components
		crate		1	88%	29 pcs ready	order missing pcs
		custom mechanics		11	0%	Prototyping	
		Cables harness		30	0%	Prototyping	launch production by EN/EA
EDA-03697	BWSMCU	BWS – Motion Control Unit	V2	57	0%	Preparing orders above 10k	order components
		crate		1	50%	waiting for tests results	order missing pcs
		custom mechanics		4		Prototyping	
		Cables harness		9	0%	Changing FAN part number	launch production by EN/EA
total				436			

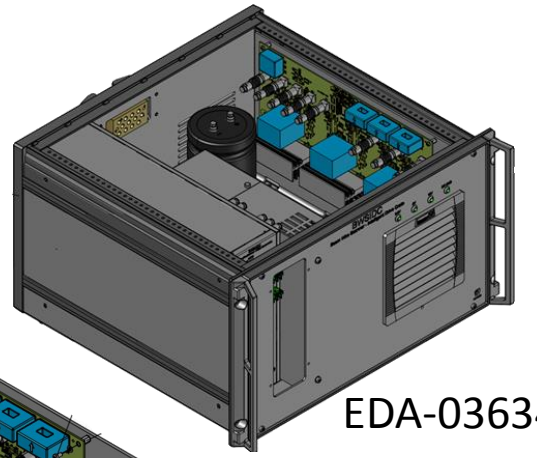
Production Schedule

- PCB Production waiting for final tests of the boards.
- Optimistic validation during July
- If we still want to finalize production by end of the year, we need to
  - Launch PCB production by the end of the month (before final validation!)
  - The risk is to have to reproduce some board (loss of money)
  - Assembly should start by August.
- If we accept a delay in the production for other machines than PSB, we could delay the production by 1 month?



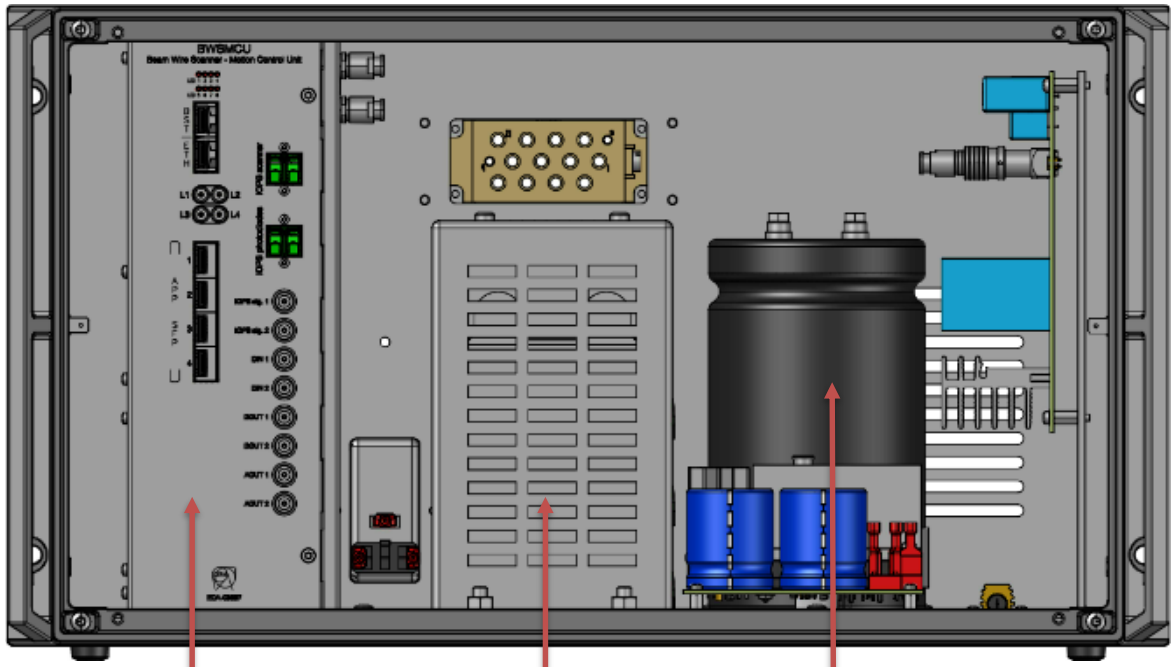
ADDITIONAL SLIDES

Intelligent Drive Crate (IDC)



EDA-03634

6U, ≈ 22Kg



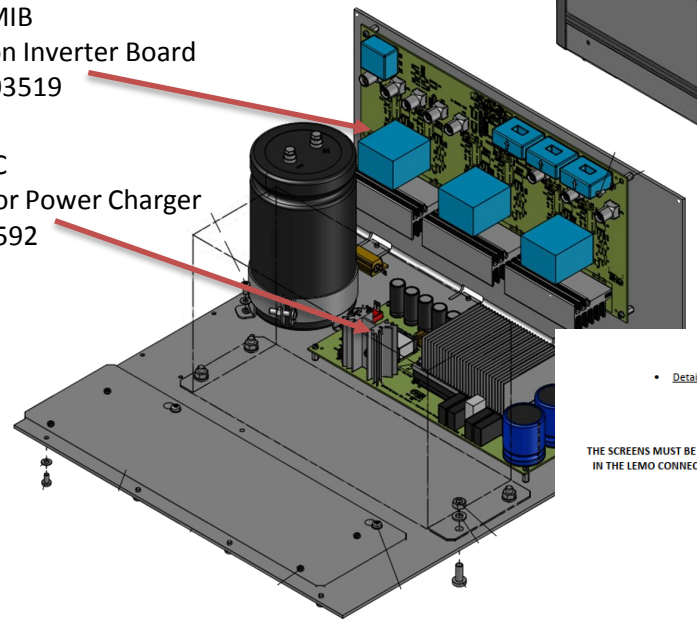
BWSMCU
Motion Control Unit
EDA-03697

Output filter “sinus”

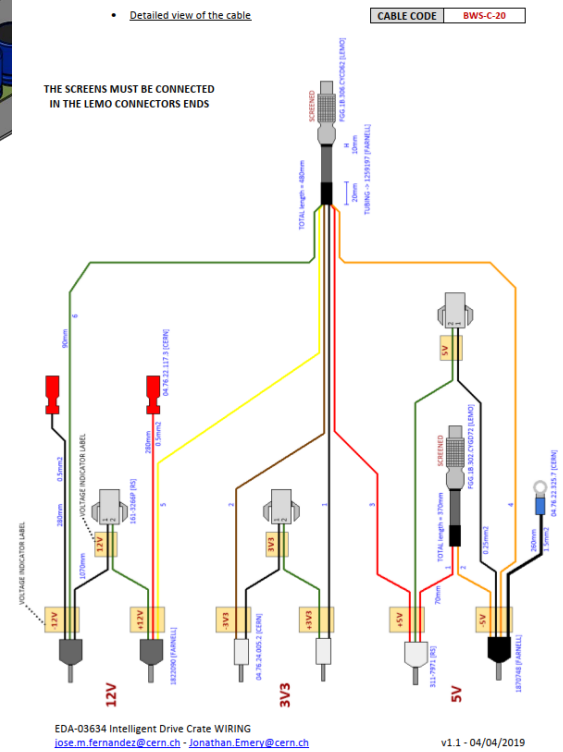
DC-BUS Capacitor

BWSMIB
Motion Inverter Board
EDA-03519

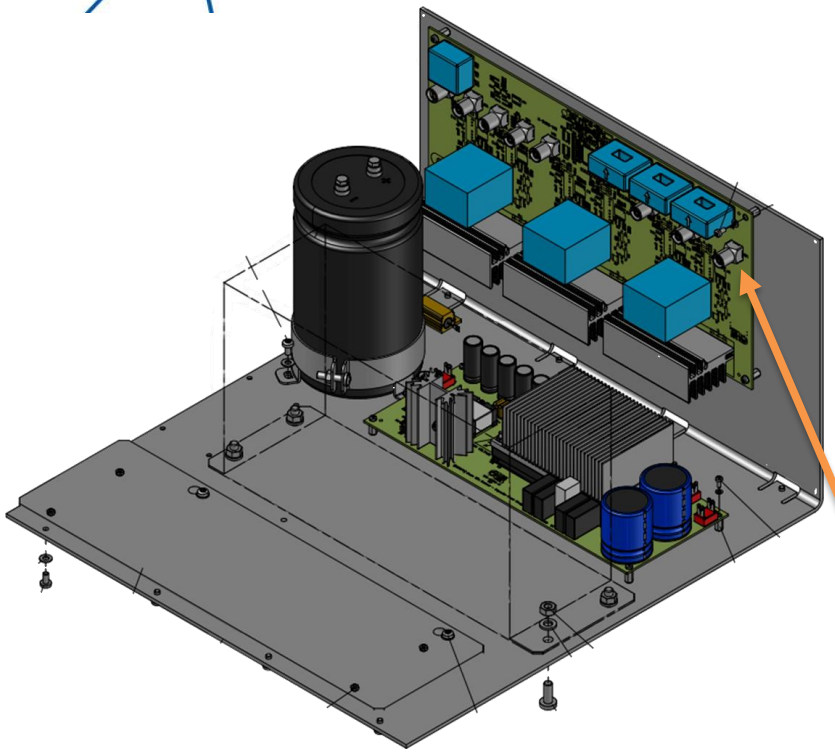
BWSCPC
Capacitor Power Charger
EDA-03592



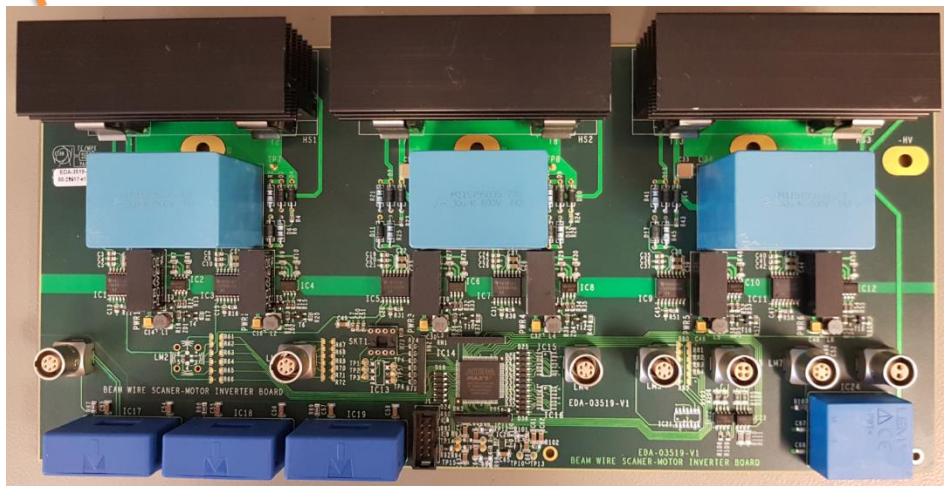
Cable harness
(30 references)!



BWSMIB - Motion Inverter Board - EDA-03519

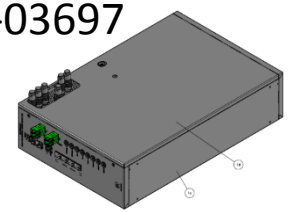


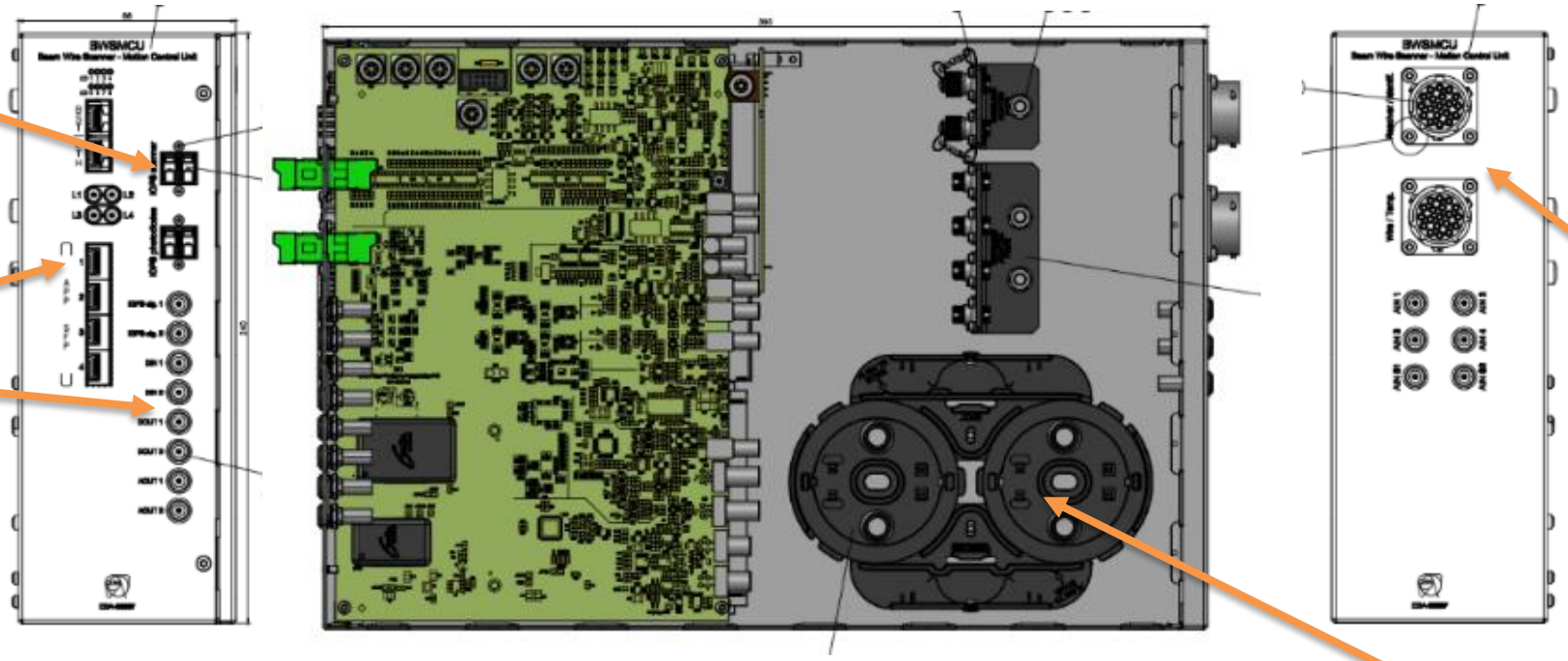
- Motor phases powering by chopping the DC-BUS (PWM control)
- Design for the wire-scanner repetition rate (~every few sec.)
  To reduce size by 3 compared to off the shelf inverter
- CPLD based digital interface and controls
- Also replace DC-BUS control and measure card
- SPI based interface, IGBT protection, faults signalisation, PWM generation (tbc)
- Version 2 to the design office mid-February 2018

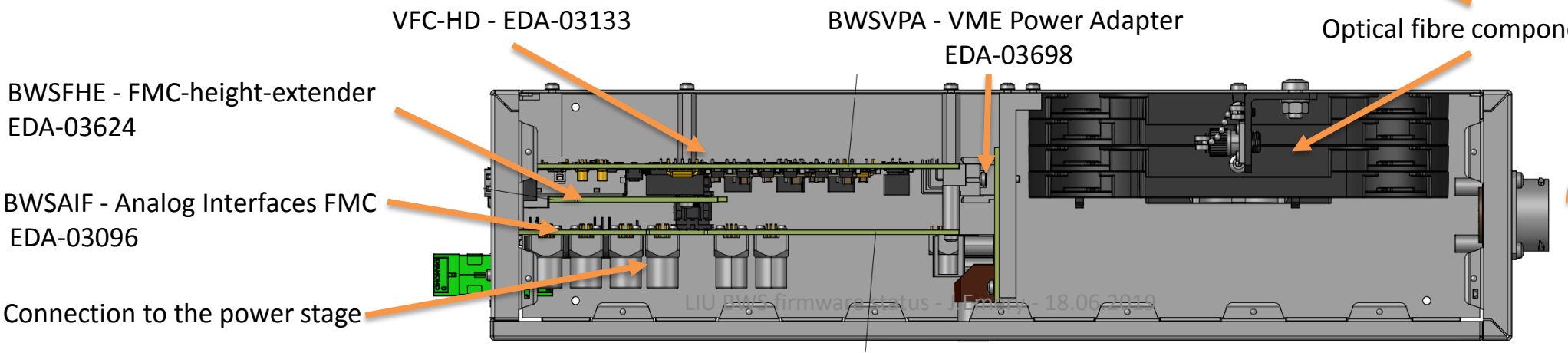


Motion Control Unit (MCU)

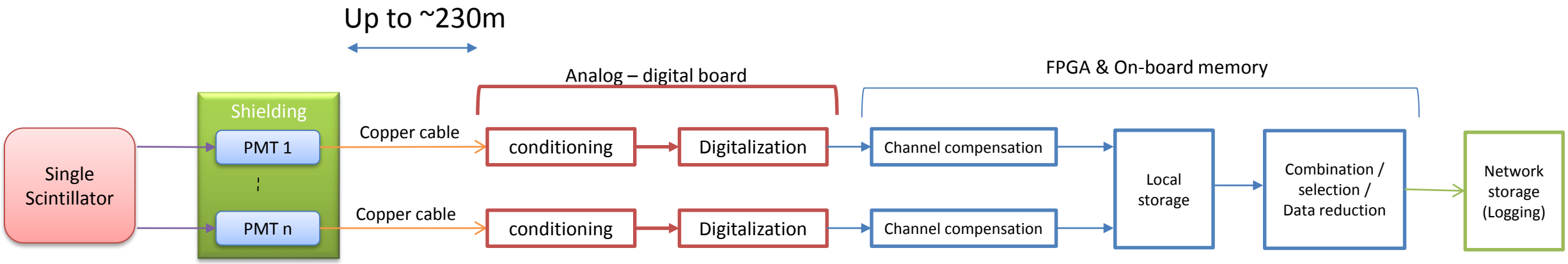
EDA-03697







BWS Secondary shower sensing acquisition chain using fast digitalizers



- Similar sensor as today: Scintillator + PMT
- Moving filters replaced by fixed filter and 4 PMTs
- Signal digitalization at the surface using direct digitalization on VFC
- Channel compensation, sensors combination and data reduction to be developed this year using field measurement (starting with scopes)
- Take advantage of the FBCT experience with similar architecture