MEG status

Marco Panareo

Lecce – 11/07/2014

Obiettivo dell'esperimento

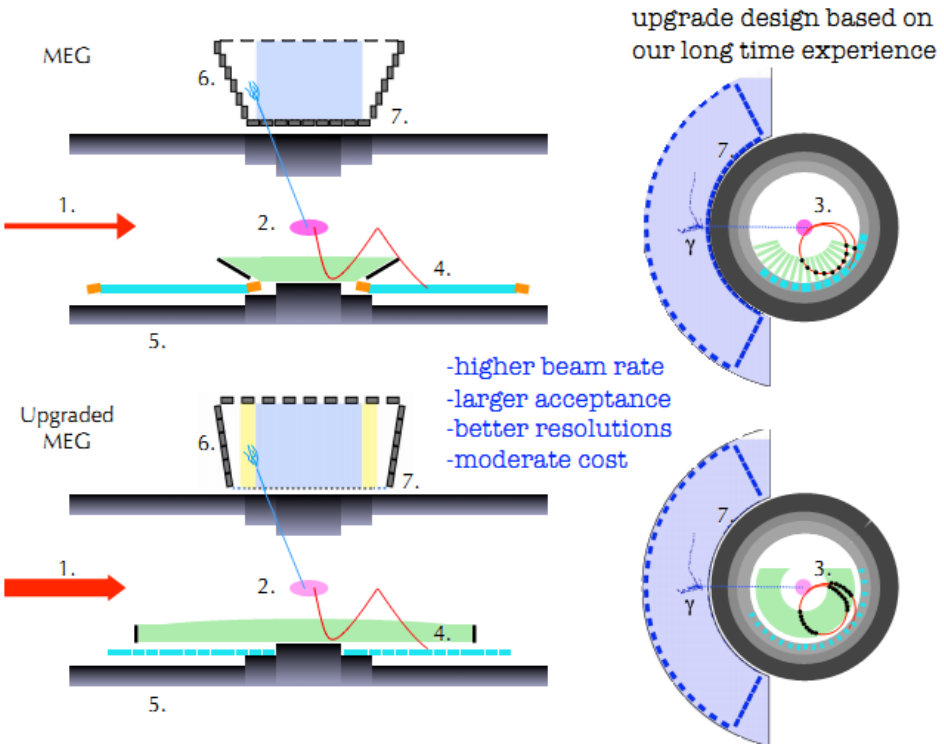
- L'esperimento MEG ha lo scopo di misurare il rapporto di decadimento

$$B=(\mu^+\rightarrow e^+\ \gamma\ )/(\mu^+\rightarrow tot)$$

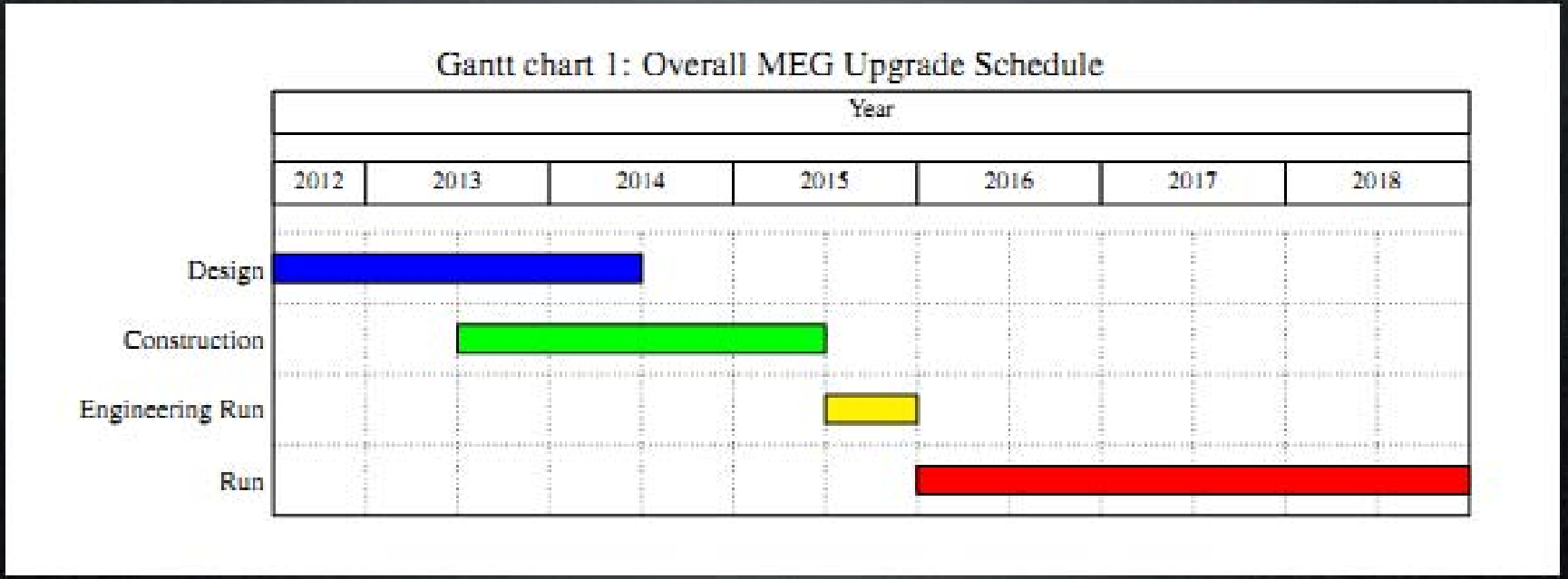
  al livello di circa 10^{-13} .
- Il modello standard prevede la conservazione del numero leptonico a tutti gli ordini. Anche includendo nel modello una massa dei neutrini diversa da zero, il nuovo modello prevede un rapporto *B* non accessibile sperimentalmente ($B < 10^{-40}$).
- Tuttavia alcune teorie di grande unificazione supersimmetrica prevedono un valore di *B* molto più grande ($10^{-14} \div 10^{-11}$). In questo senso MEG potrebbe fornire un utile contributo all'esplorazione della fisica oltre il modello standard.
- 3 anni di run (2009-2011) hanno permesso di migliorare di un fattore 5 il limite superiore sul decadimento cercato $[(\mu^+\rightarrow e^+\ \gamma\ )/(\mu^+\rightarrow e^+\ \nu\ \nu)]$ al 99% C.L.
  - 2009 → 9.6×10^{-12}
  - 2010 → 1.7×10^{-12}
  - 2009+2010 → 2.4×10^{-12}
- La presa dati della prima fase dell'esperimento è terminata nell'agosto 2013, con un raddoppio della statistica rispetto al campione utilizzato per l'ultimo risultato summenzionato. La sensibilità finale della prima fase dell'esperimento dovrebbe essere all'incirca di $4\div5\times10^{-13}$

Upgrade

- L'upgrade di MEG ha l'obiettivo di migliorare di un fattore 10 la sensibilità dello spettrometro.
- L'upgrade prevede
  - Sostituzione del tracciatore con una DC a volume continuo
  - Sostituzione dei PMT della faccia più interna del calorimetro LXe con SiPM (array di PMT da 1" quadrato), per migliorare la risoluzione nella posizione di arrivo del γ
  - Realizzazione di un bersaglio attivo con fibre scintillanti singolarmente accoppiate a una matrice di SiPM, per migliorare la risoluzione nella posizione di arresto/decadimento del μ
  - Uso di SiPM per la lettura degli scintillatori del TC (aumenta la risoluzione temporale, aumenta l'efficienza, riduce il pileup)



Time Line of Upgrade

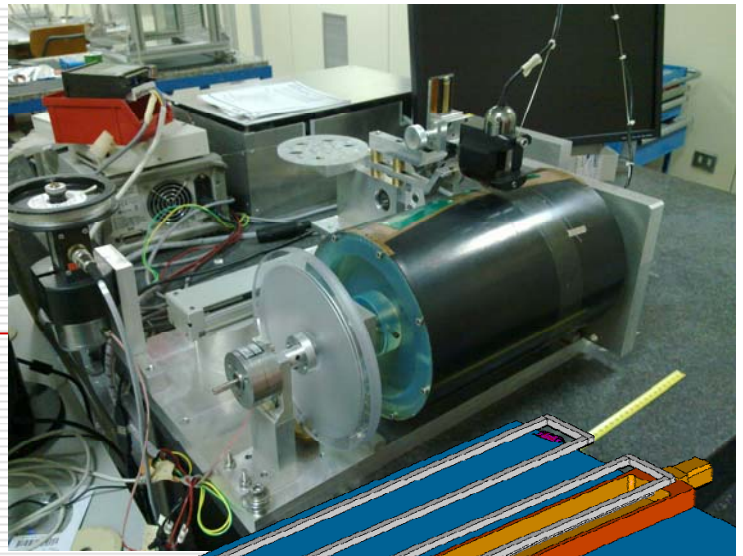


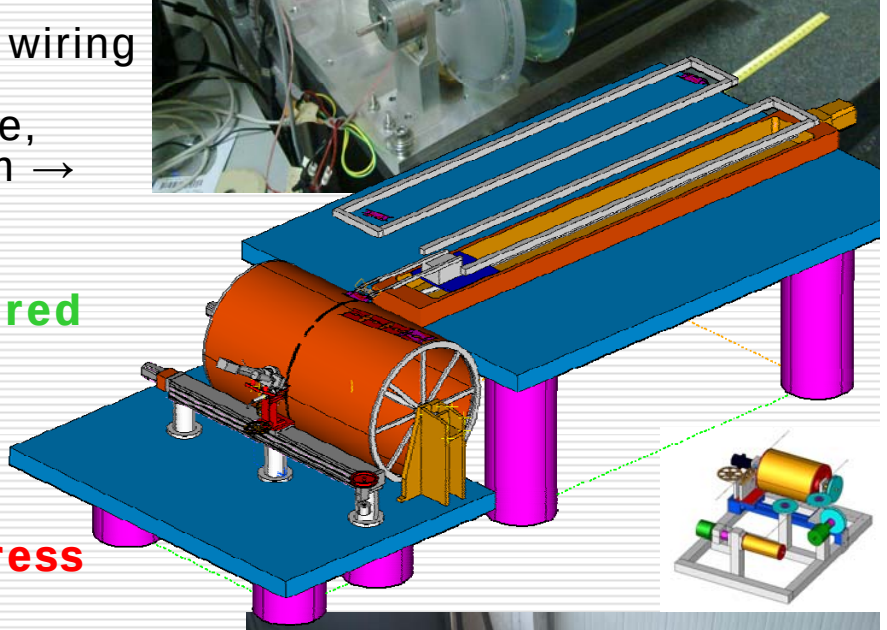
Updated schedule

- Il completamento del sistema di filatura è in un punto critico
- La milestone *Ready for assembly* è ritardata di circa 2 mesi:
  - L'inizio della filatura è previsto per la fine di Settembre
  - Trasferimento della camera a PSI per Agosto 2015

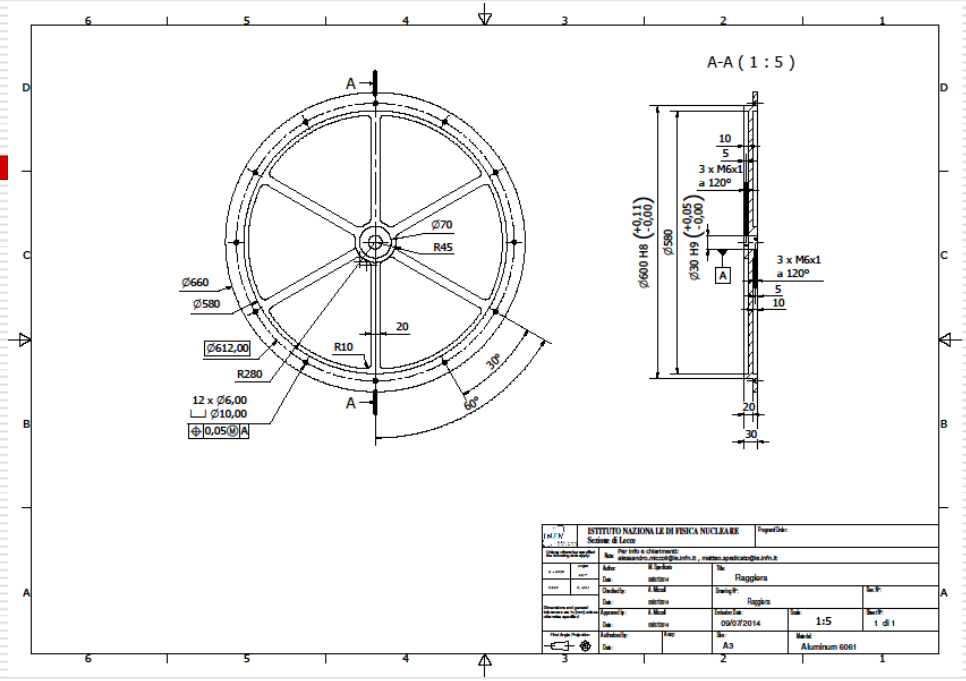
Wiring robot parts procurements

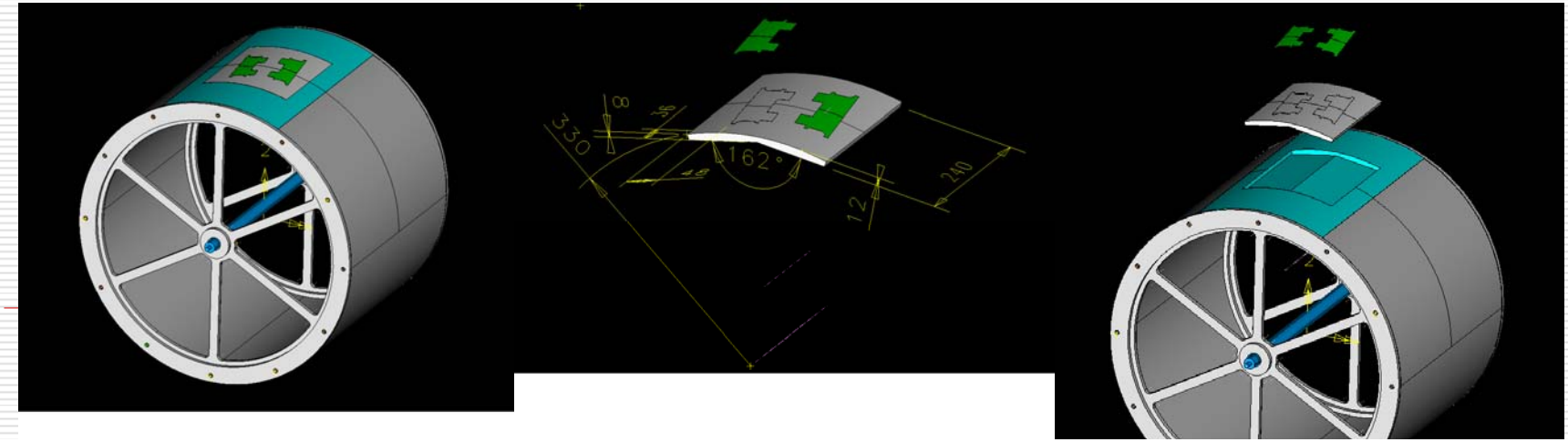
- Recycling parts from Mu2e prototype wiring robot: rotating axis, translation axis, torquemeter, e.m. friction, e.m. brake, digital microscope, monitoring system → **done**
- Table → **done, need to be machinered**
- Winding drum → **done, need to be machinered**
- Soldering system → **design in progress**
- Wire trays transport system → **design in progress**
- New mechanical supports → **done, need to be machinered**



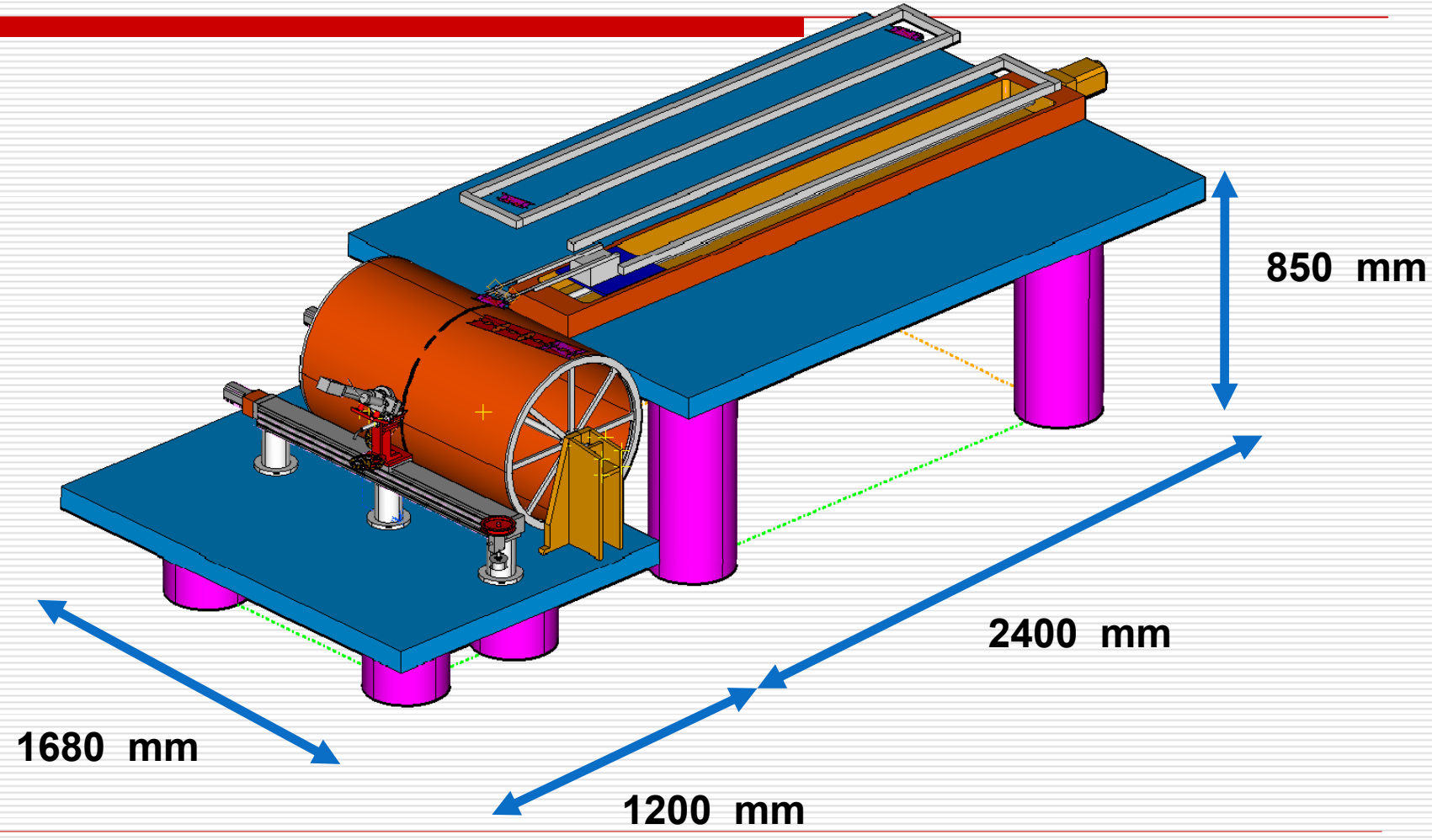


Winding drum

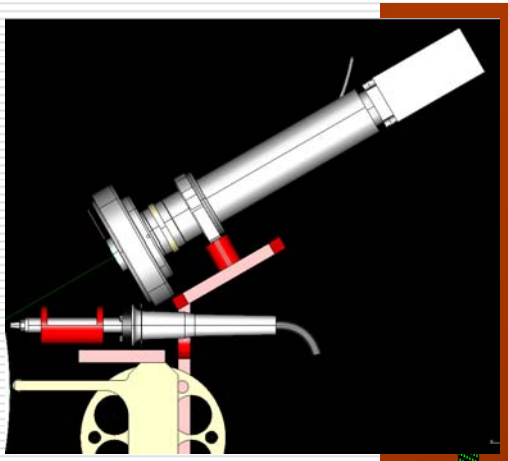


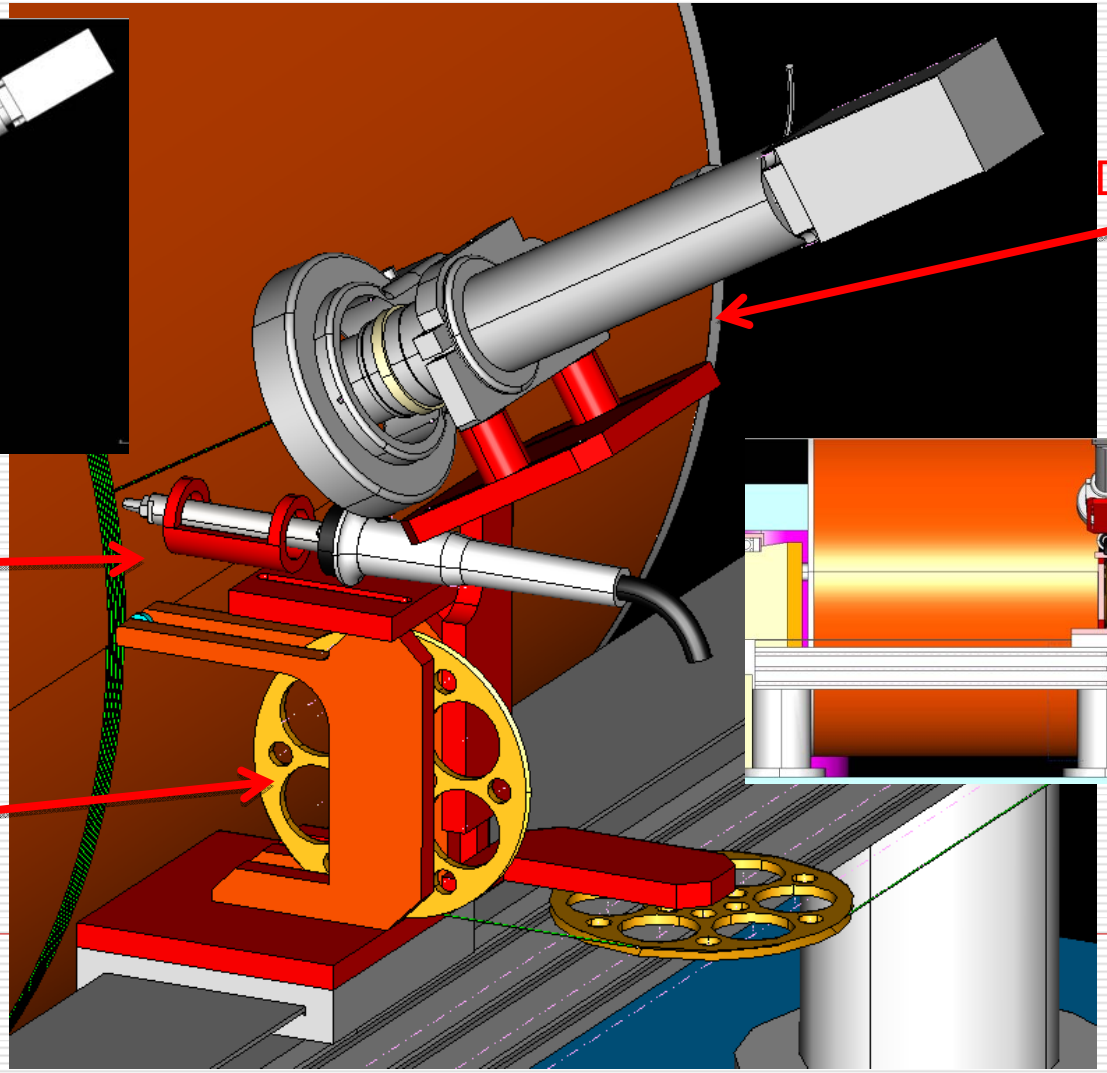


Isometric view



Glide for wiring and soldering

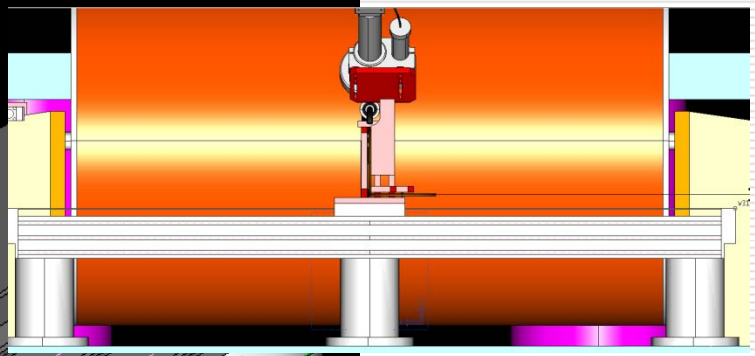




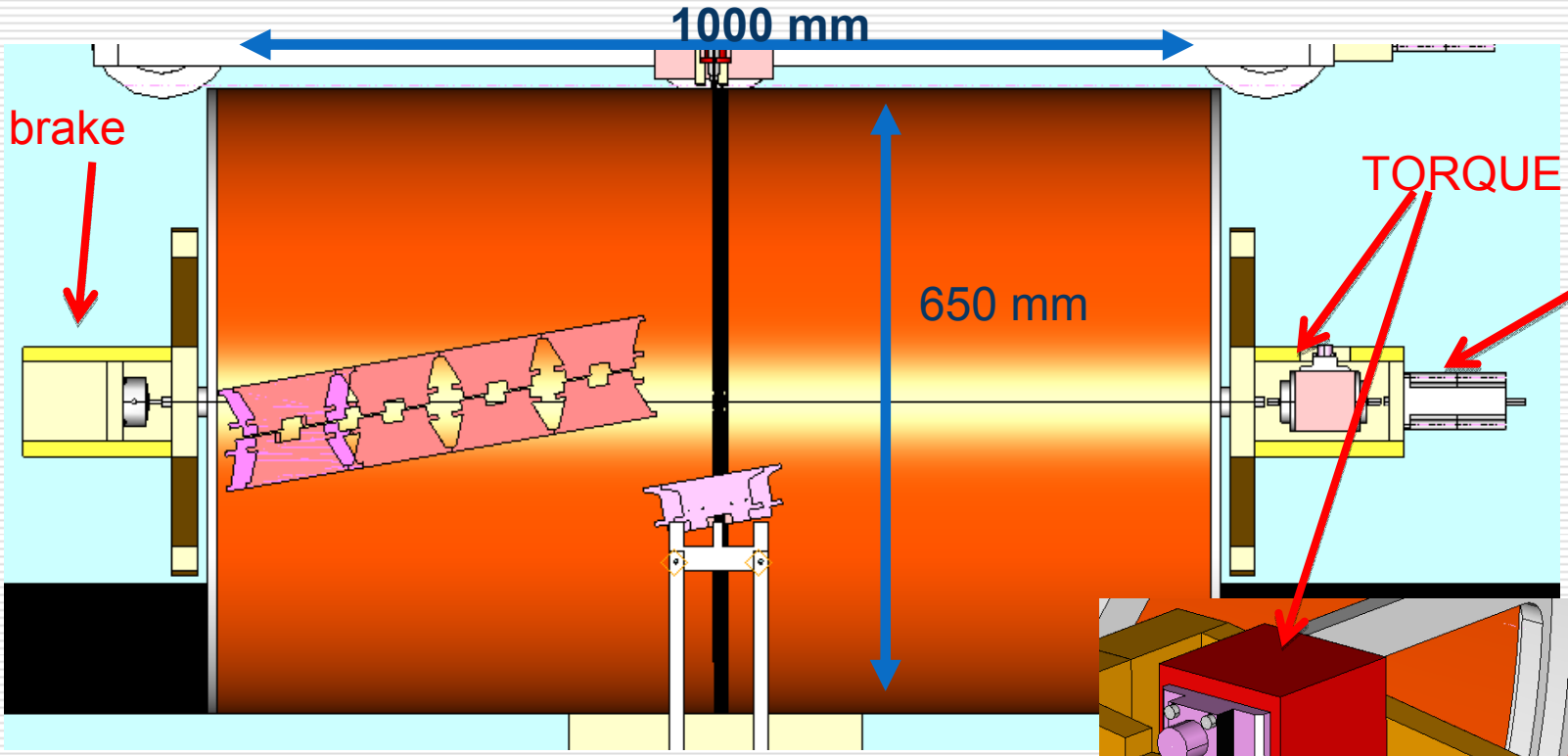
Digital Camera

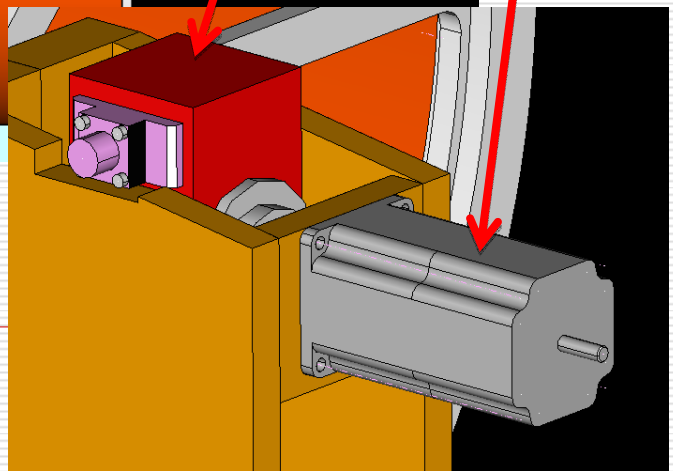
Hot Air Solder

Pulleyes



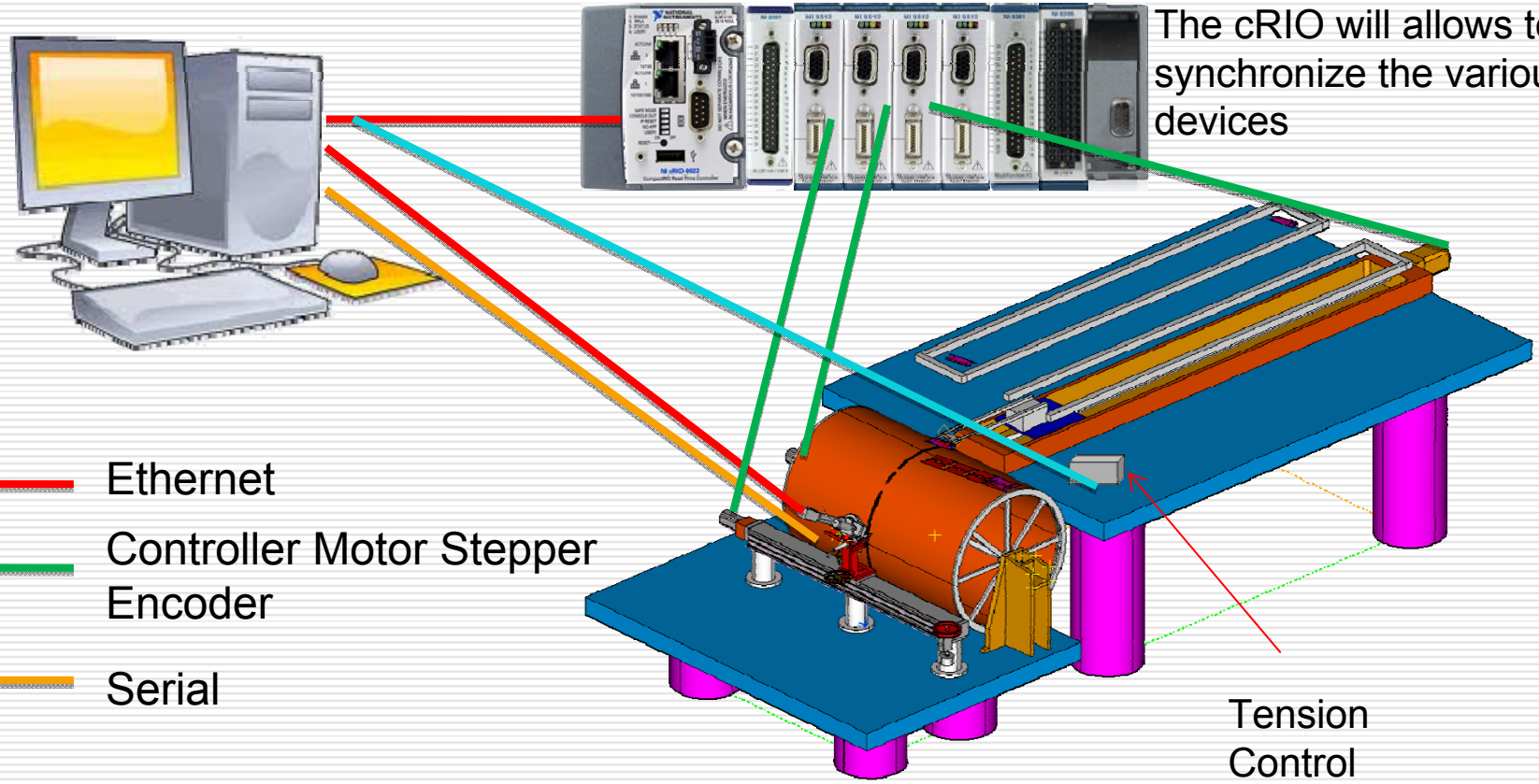
Wire drum control system





Connections

The cRIO is used for the control of the wiring machine because it can rely on the robust real-time system for the control of the operations.



The cRIO will allows to synchronize the various devices

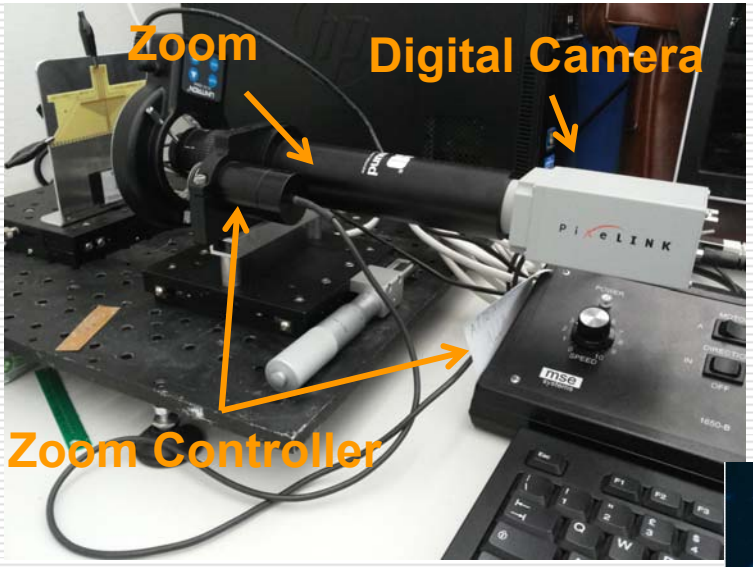
Ethernet

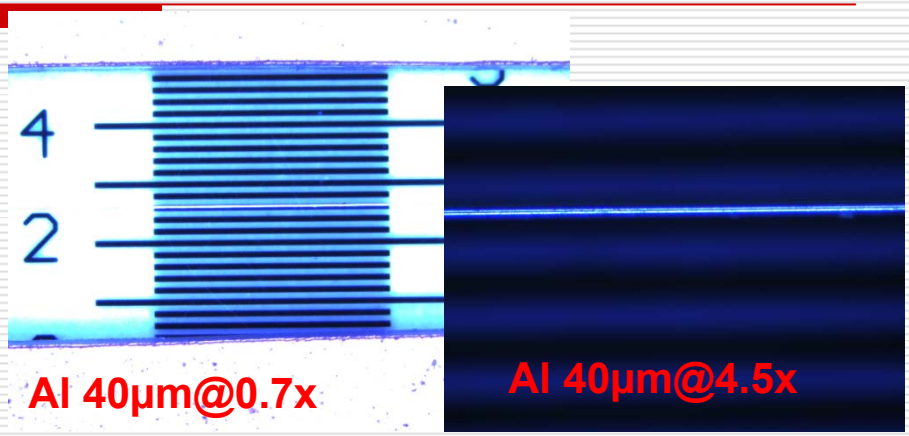
Controller Motor Stepper Encoder

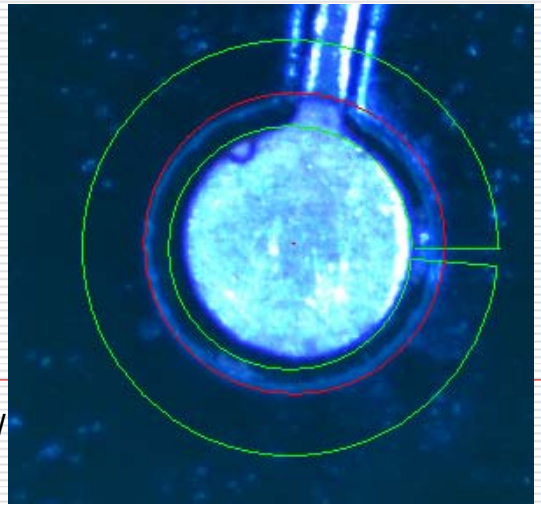
Serial

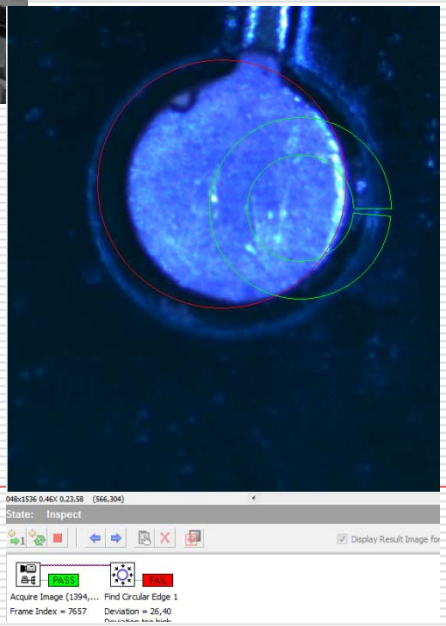
Tension Control

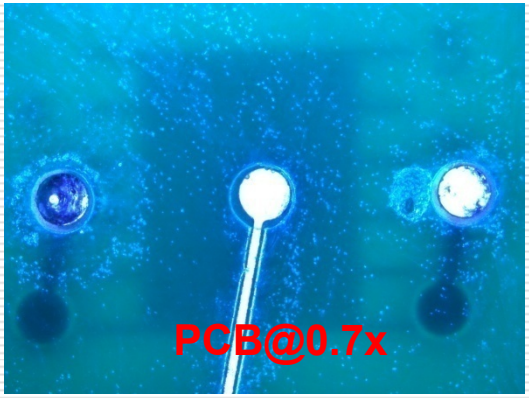
Test of the digital camera



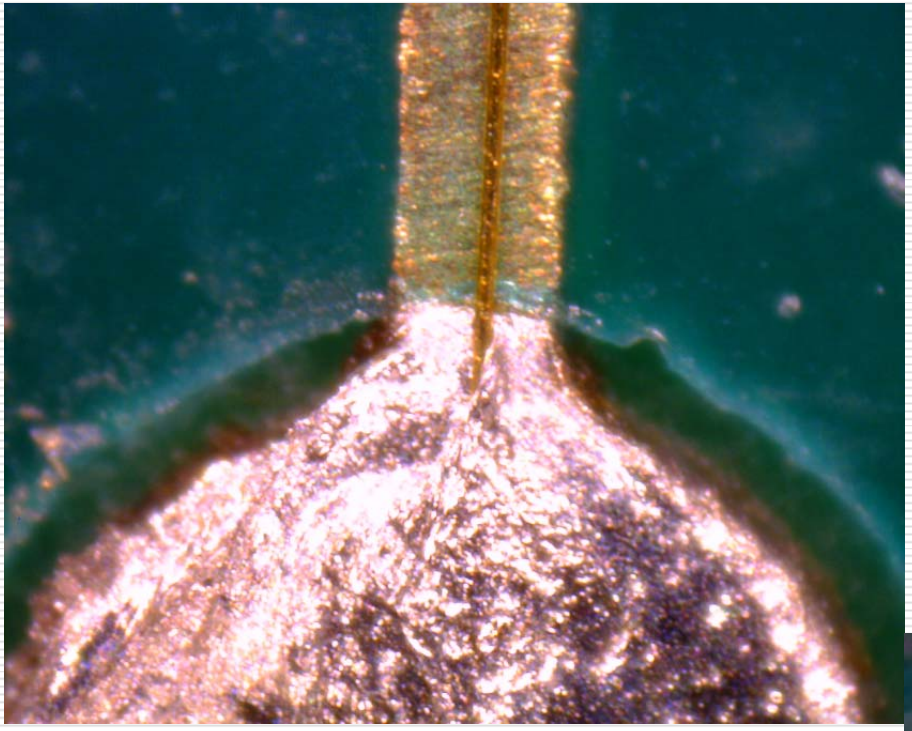


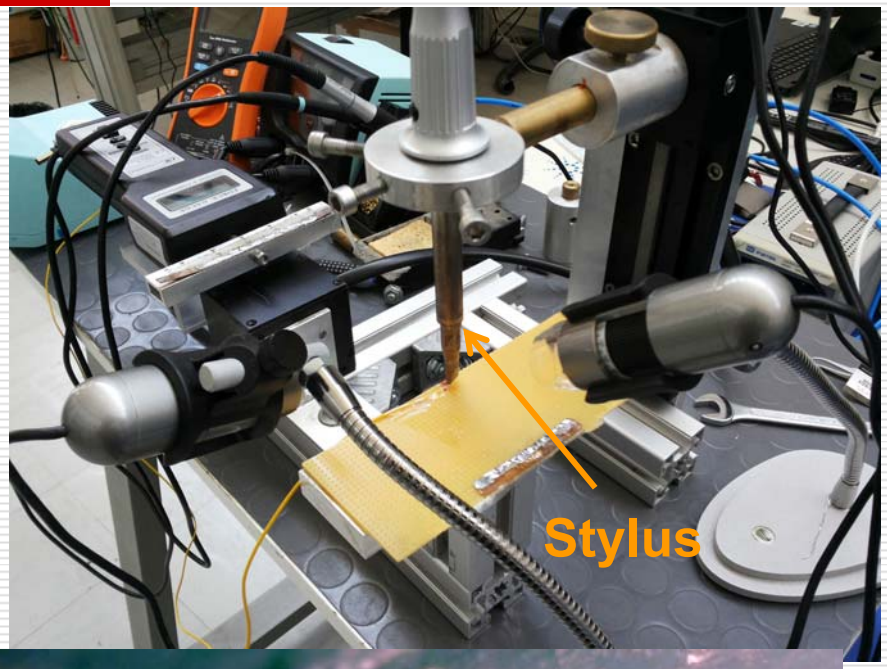






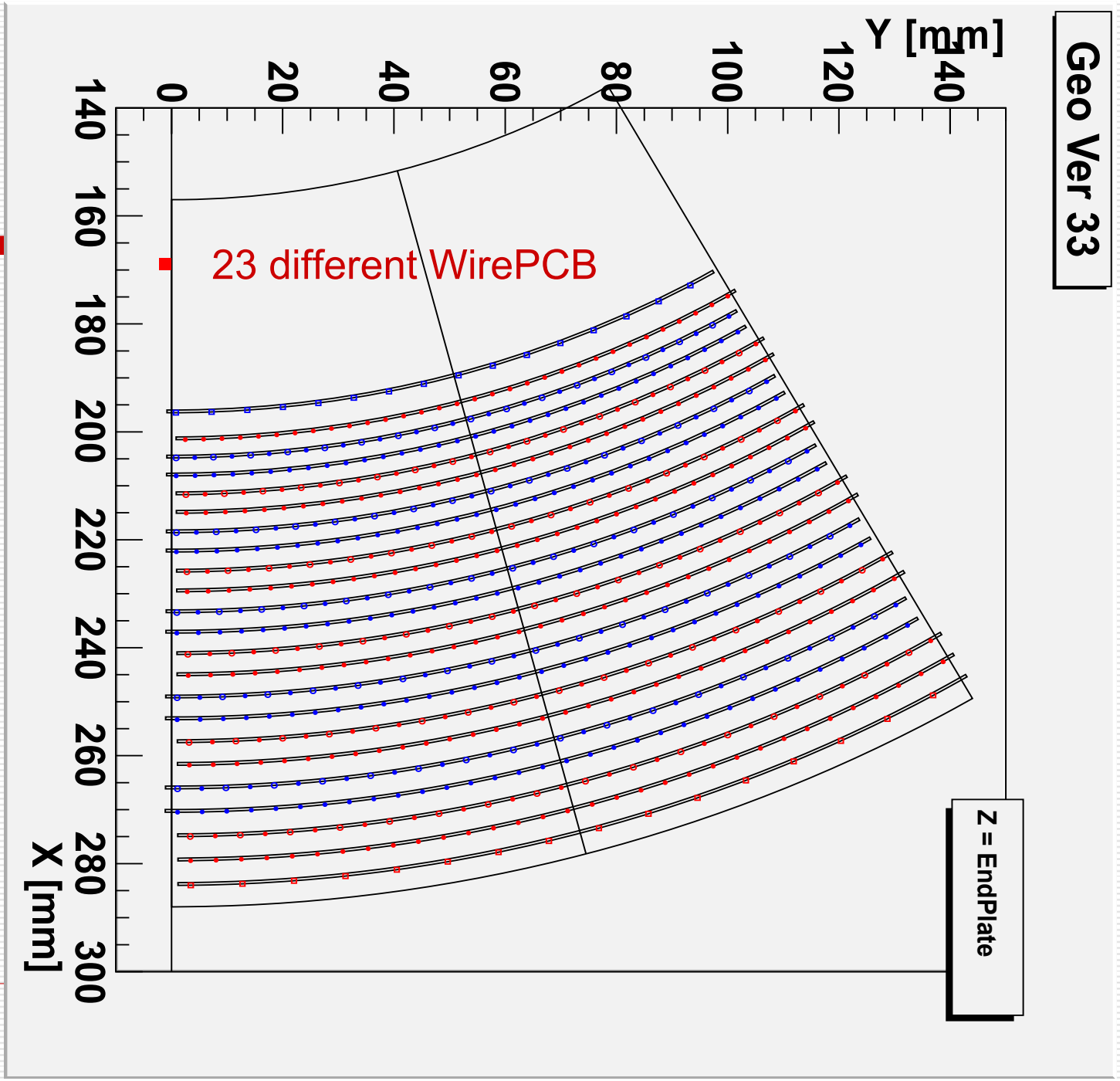
Test of the soldering system



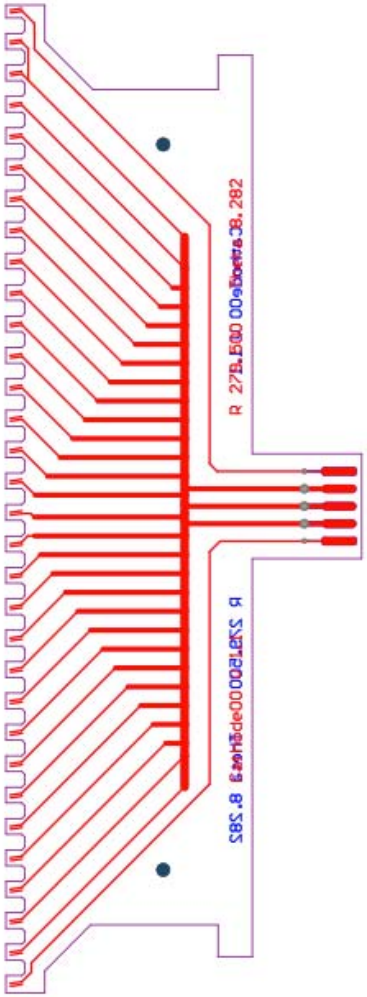


Welding performed at 5 mm
with a flow of hot air to 25% .

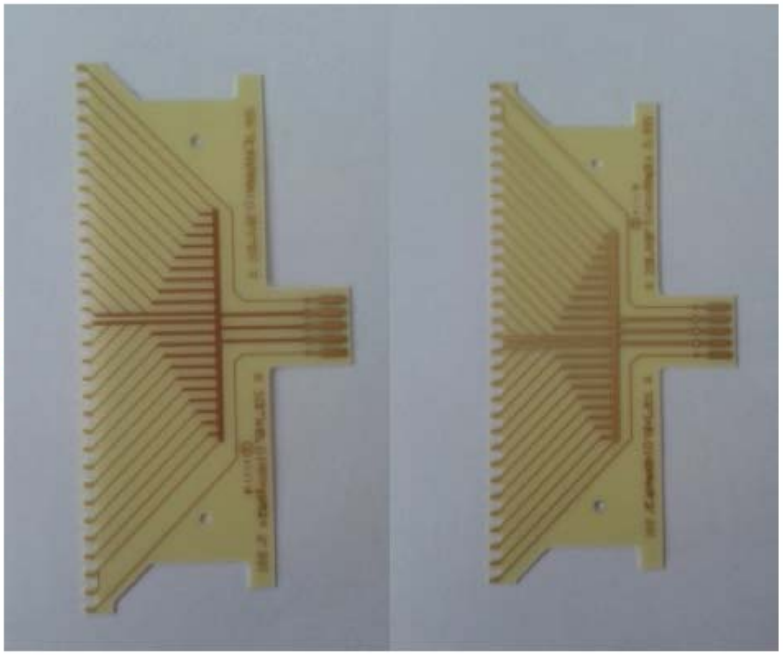
PCB


Geo Ver 33
Y [mm]
0
20
40
60
80
100
120
140
X [mm]
140
160
180
200
220
240
260
280
300
23 different WirePCB
Z = EndPlate

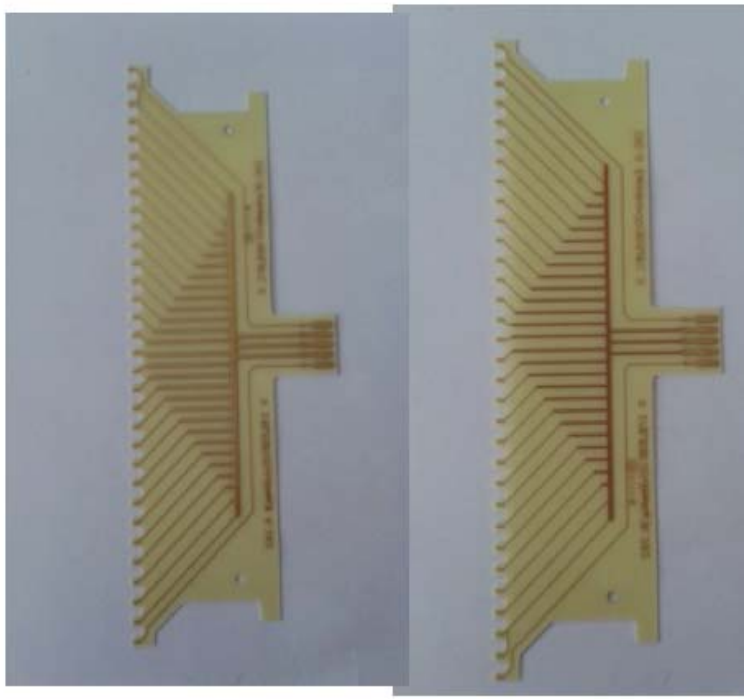
PCB Catodes



cathode 00

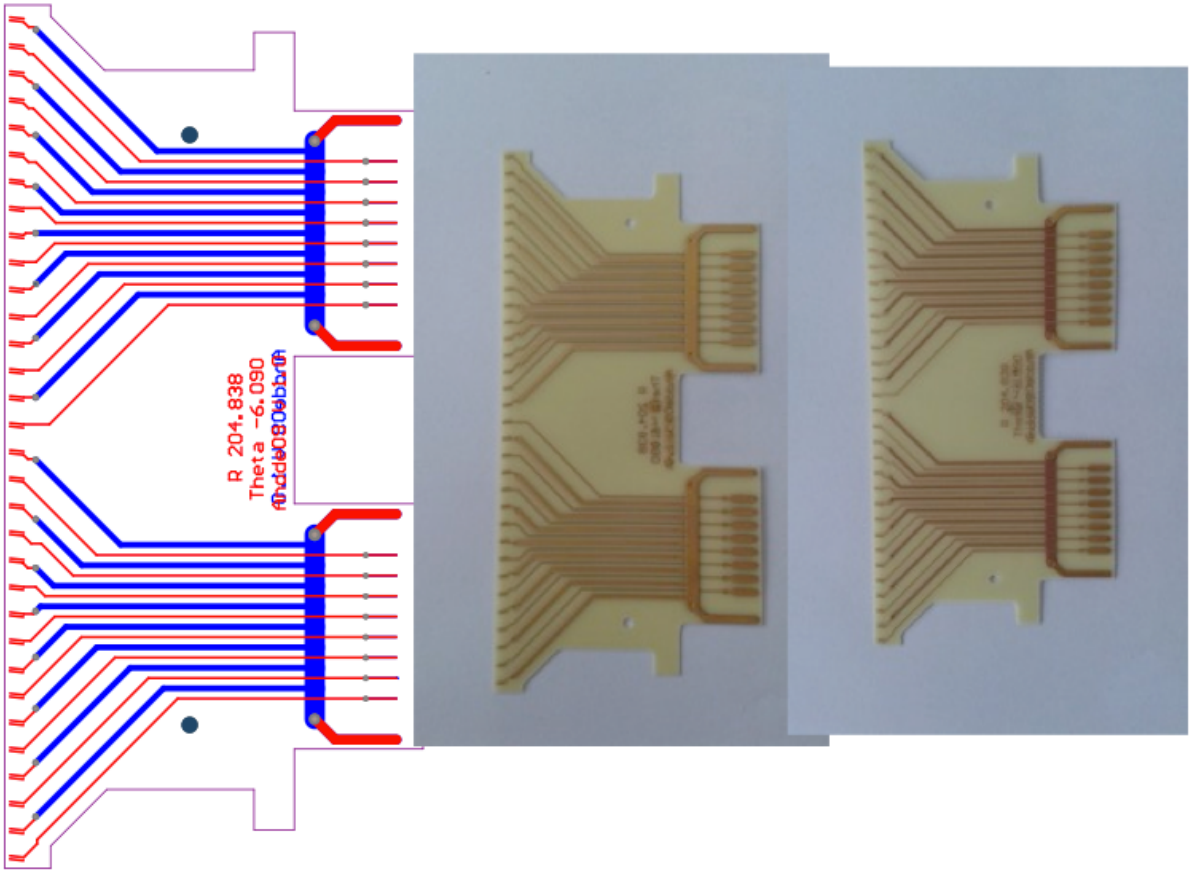


cathode 10

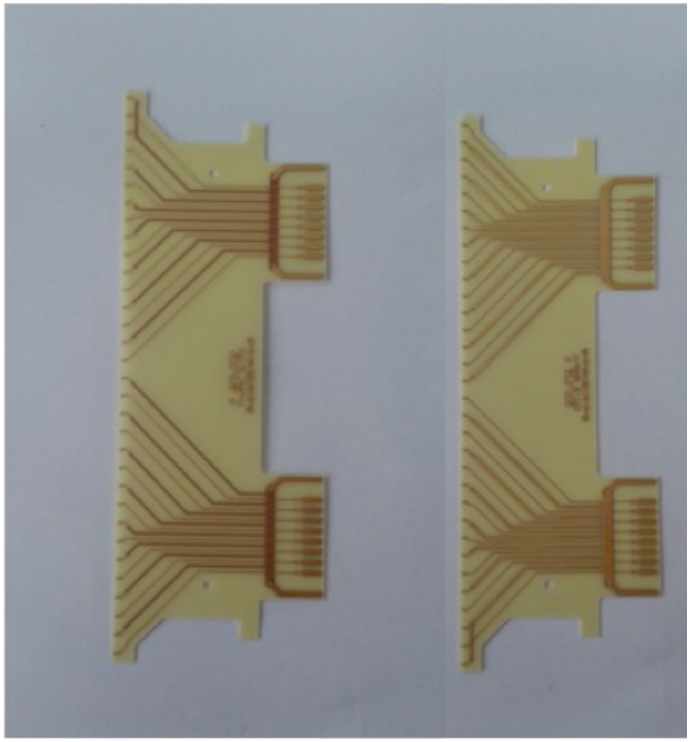


PCB Anodes

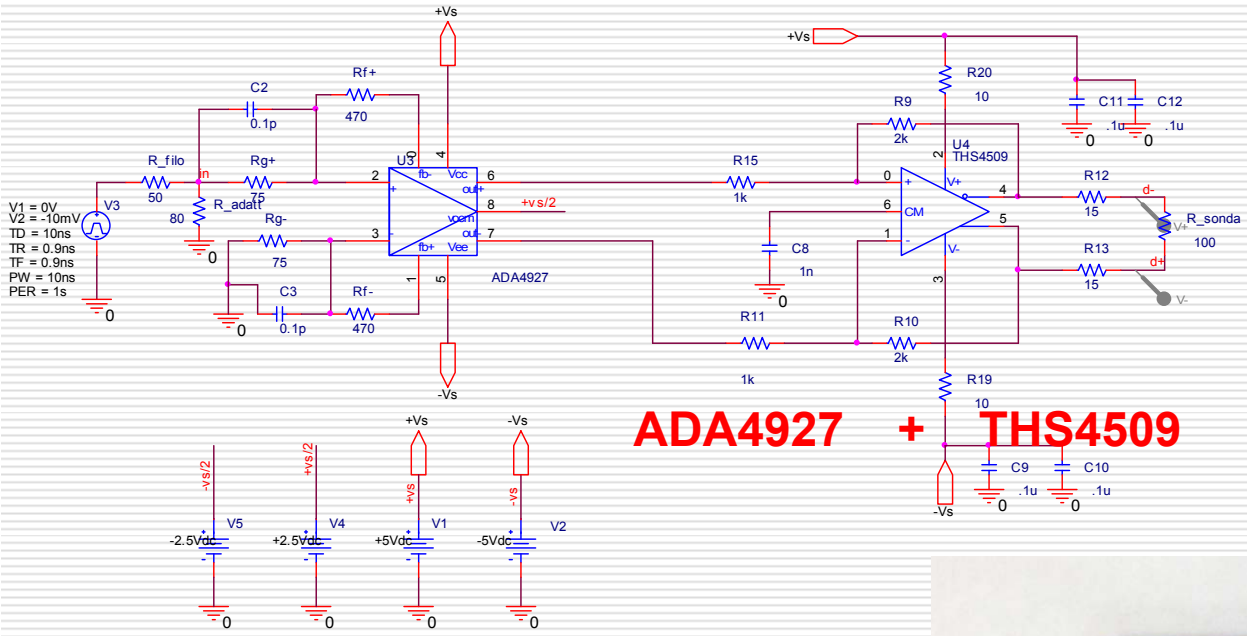
anode 00



anode 09



Front End Electronics



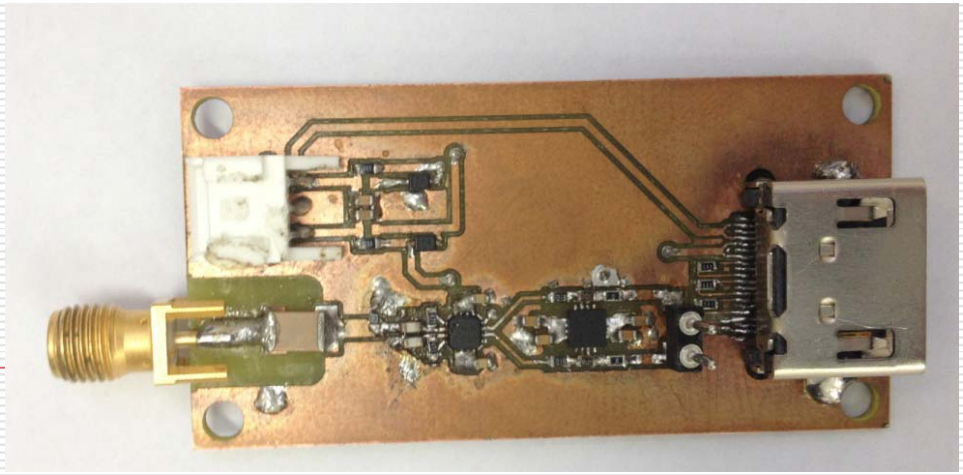
ADA4927 + THS4509

- **ADA4927 - Ultralow Distortion Current Feedback Differential ADC Driver**
  - **−3 dB bandwidth of 2.3 GHz**
  - **0.1 dB gain flatness: 150 MHz**
  - **Slew rate: 5000 V/µs, 25% to 75%**
  - **Fast 0.1% settling time: 10 ns**
- **THS4509 - Wideband, Low-Noise, Low-Distortion, Fully-Differential Amplifier**
  - **−3 dB bandwidth of 1.9 GHz**
  - **Slew rate: 6600 V/µs**
  - **1% Settling Time: 2 ns**

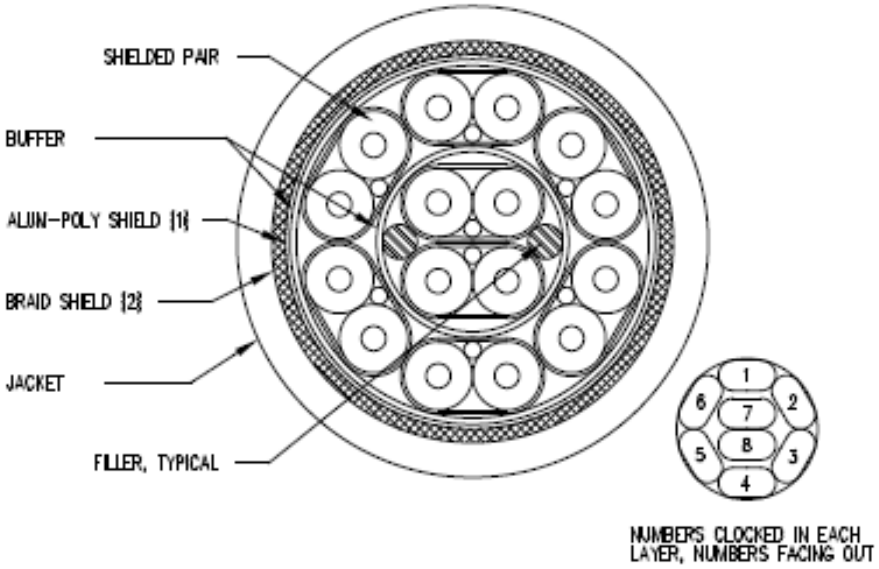
Power: 50mA @ ± 2.0V

Total power ~ 380W

Single channel prototype (used to test bandwidth and HDMI / Amphenol SS-SC connector/cable)

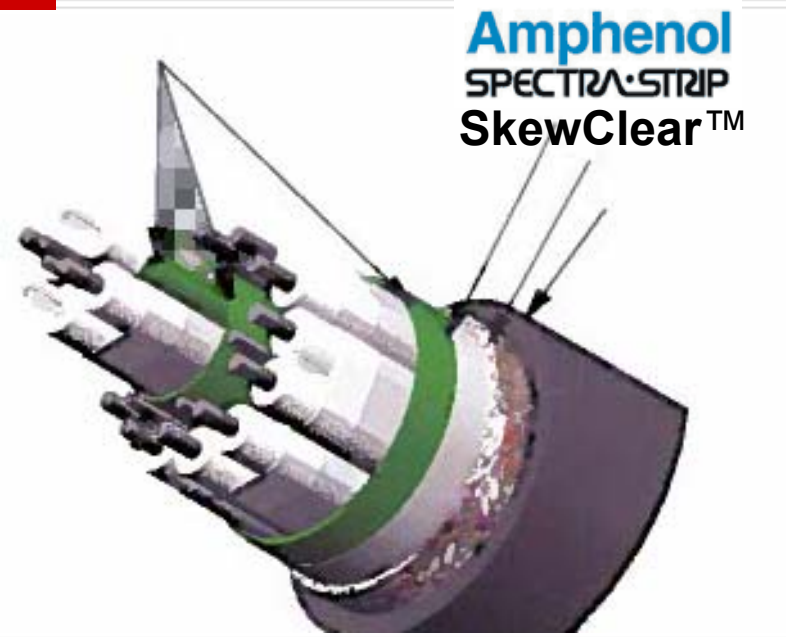


Output cable

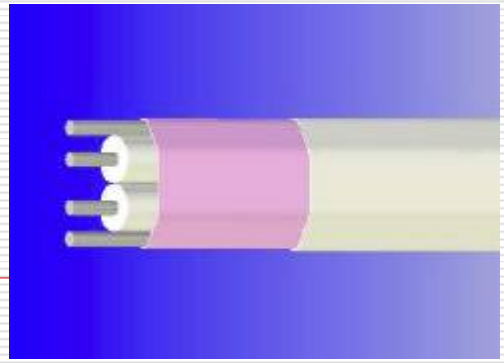


ELECTRICAL

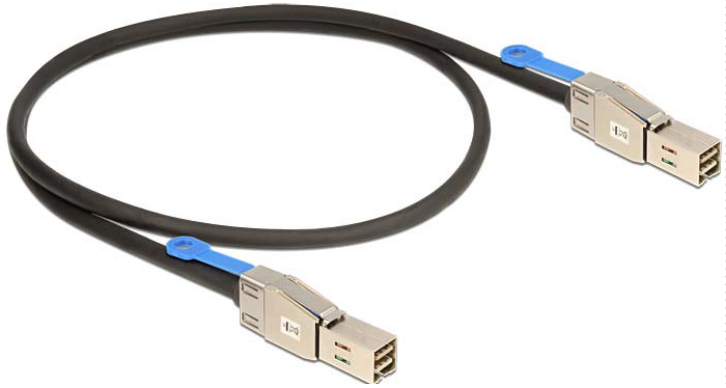
IMPEDANCE:	100 ± 5 Ω (DIFFERENTIAL TDR)
CAPACITANCE:	42 pF / M NOMINAL
PROP DELAY:	4.25 ns / M NOMINAL
SKEW (WITHIN PAIR):	≤ 100 ps / 10 M (TDT METHOD, DRAIN GROUNDED) (DIFFERENTIAL 50%-50%, TEKTRONIX TDS-8000 OR 11801)
SKEW (PAIR/PAIR):	≤ 400 ps / 10 M (TDT METHOD, DRAINS GROUNDED) (DIFFERENTIAL 50%-50%, TEKTRONIX TDS-8000 OR 11801)
ATTENUATION (MAXIMUM):	0.61 dB / M @ 625 MHz (0.57 dB TYPICAL) 0.91 dB / M @ 1250 MHz (0.84 dB TYPICAL) 1.37 dB / M @ 2500 MHz (1.24 dB TYPICAL) 2.20 dB / M @ 5000 MHz (1.96 dB TYPICAL)
SHIELD ISOLATION:	OVERALL SHIELDS ISOLATED FROM PAIR SHIELDS



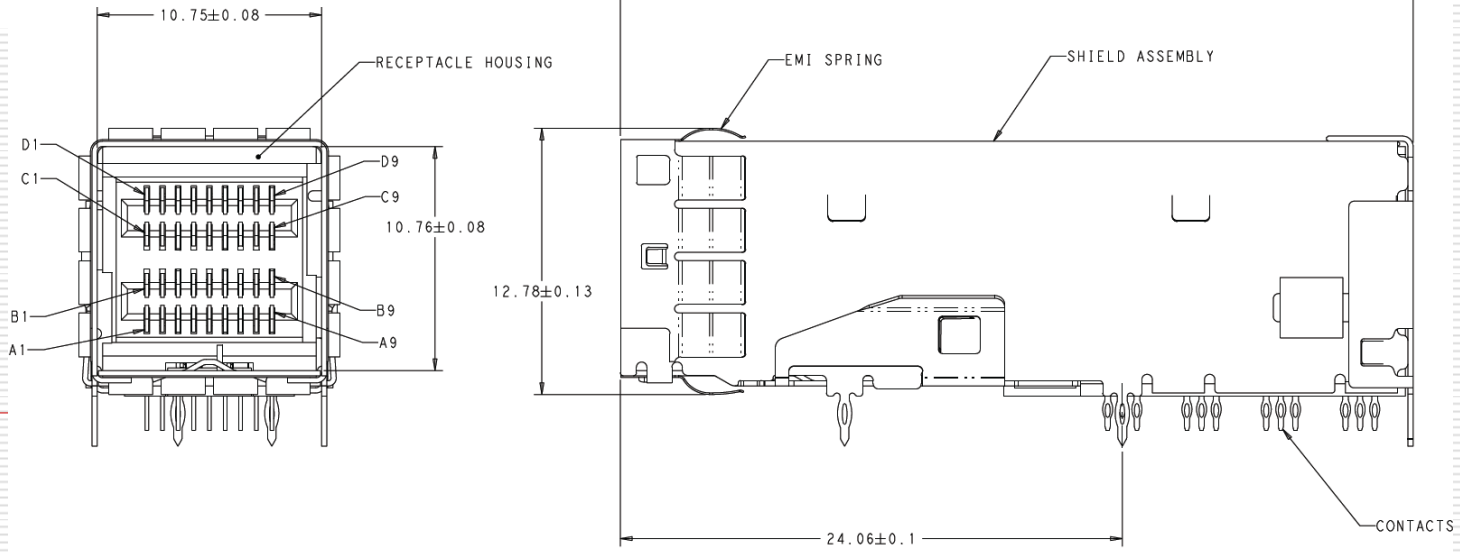
- each pair is individually shielded
- Overall ground jacket is also present



Cable assembly: miniSAS HD

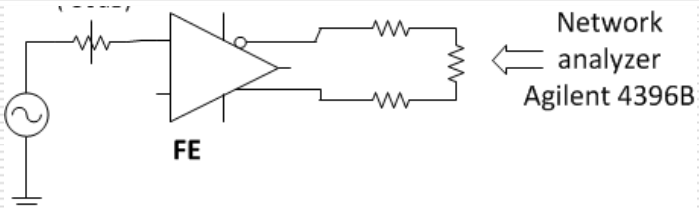


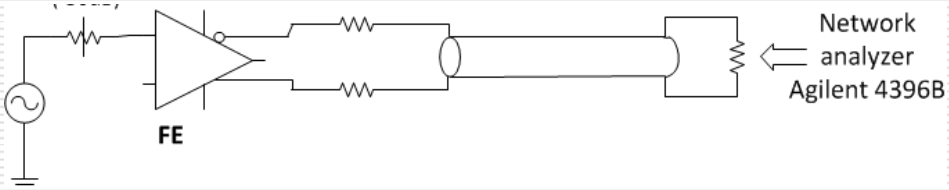
Farnell 2368899 -
3m,
173,14€ (> 50 units)

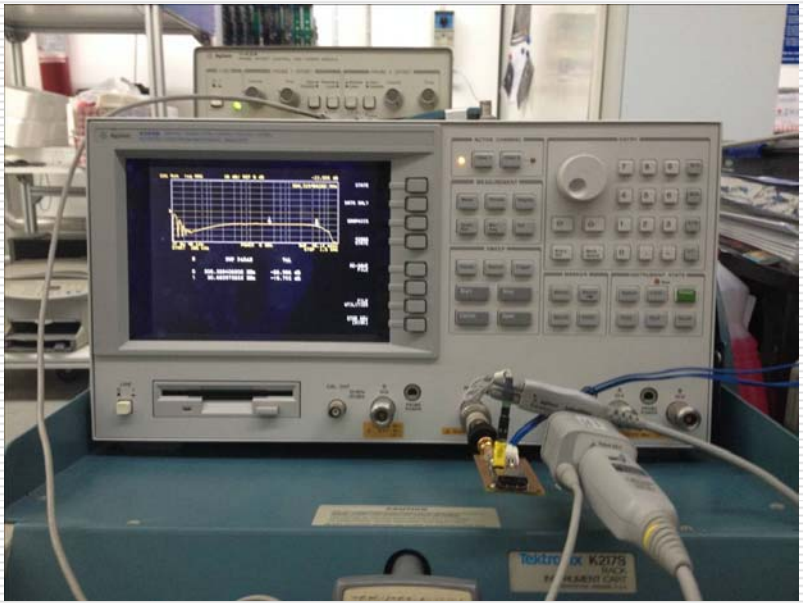


10/07/2014

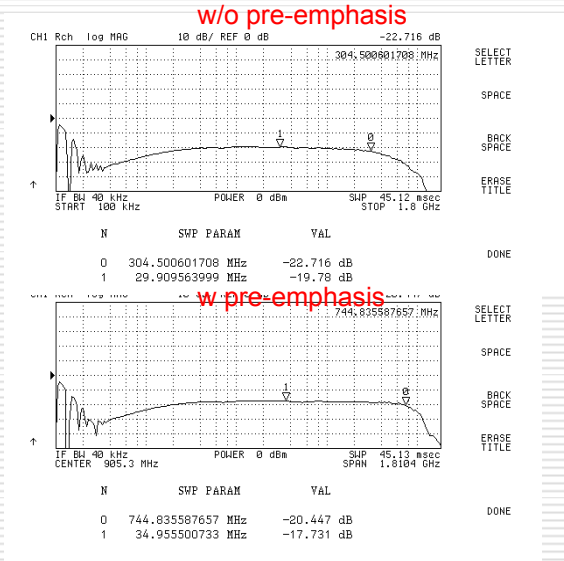
FE measurement setups

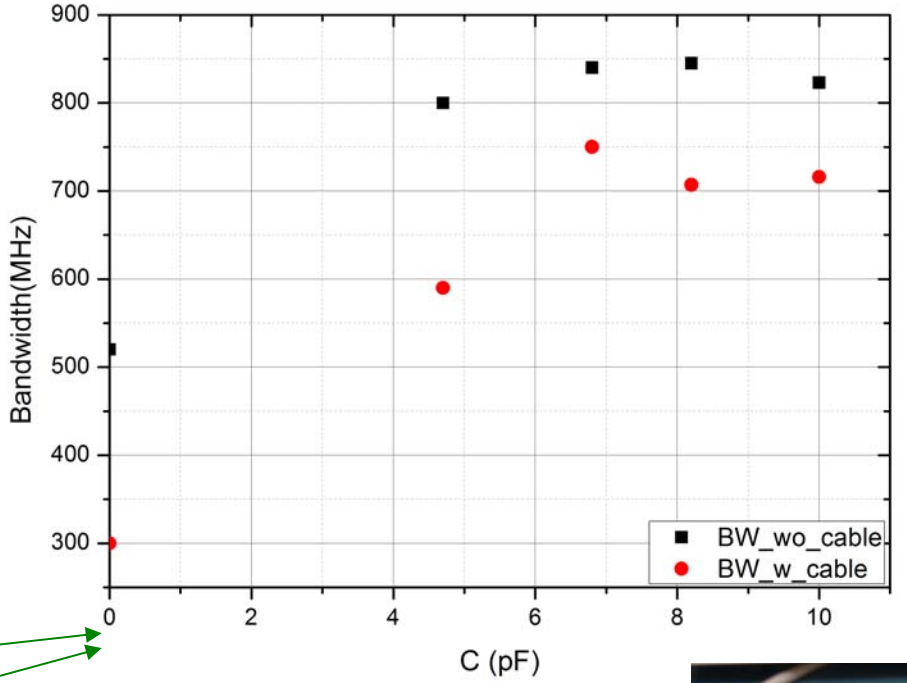


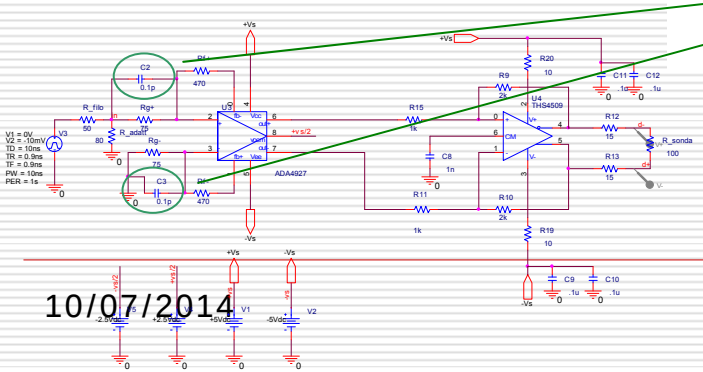




Pre-emphasis implemented

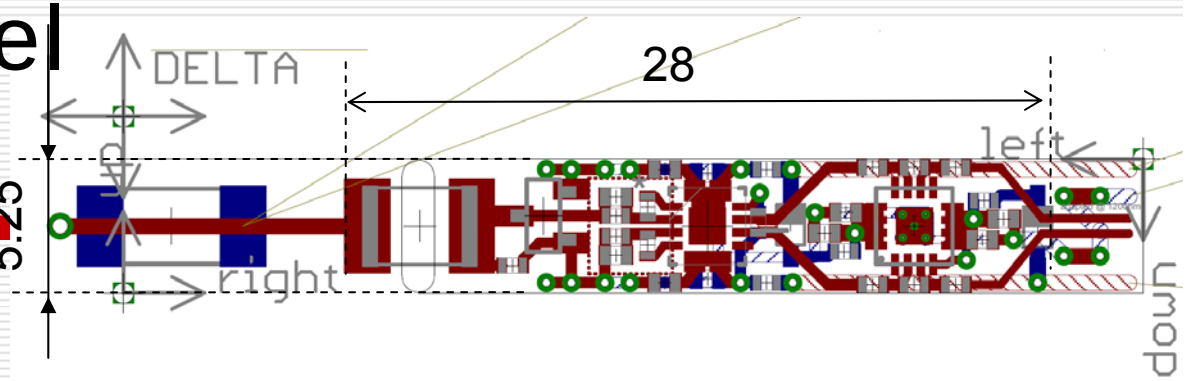


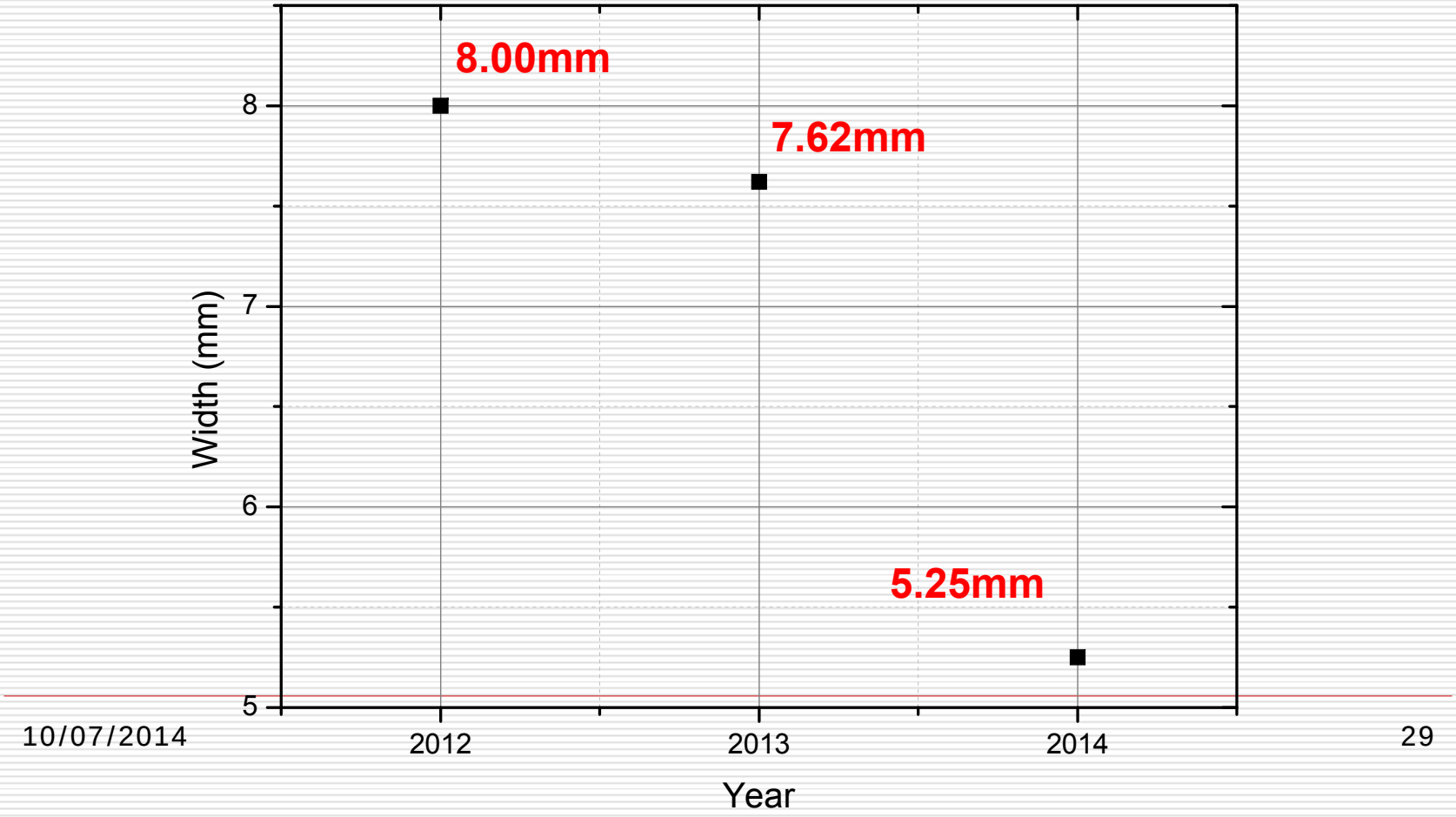




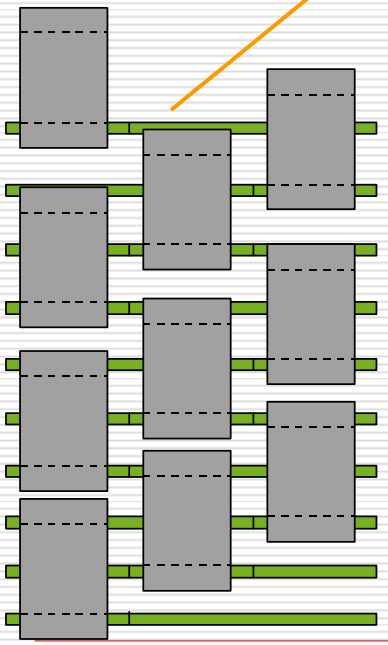
- Improper output connection
- Better with the right connector

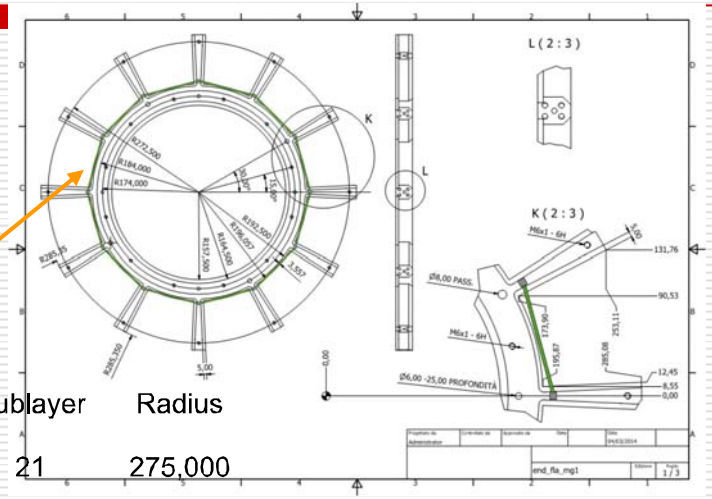
Single channel width on pcb





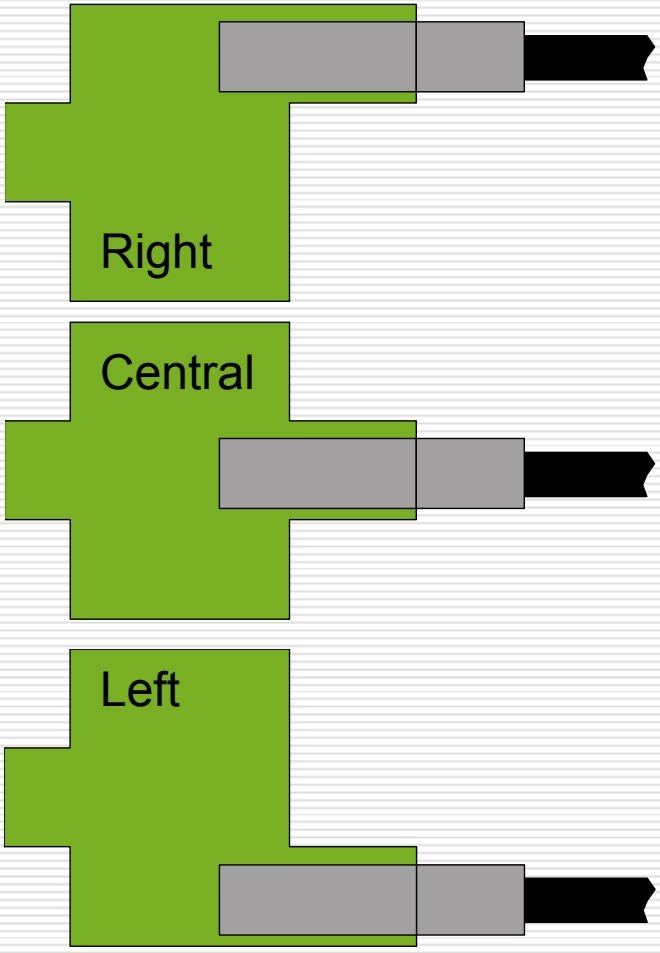
Layout and card size



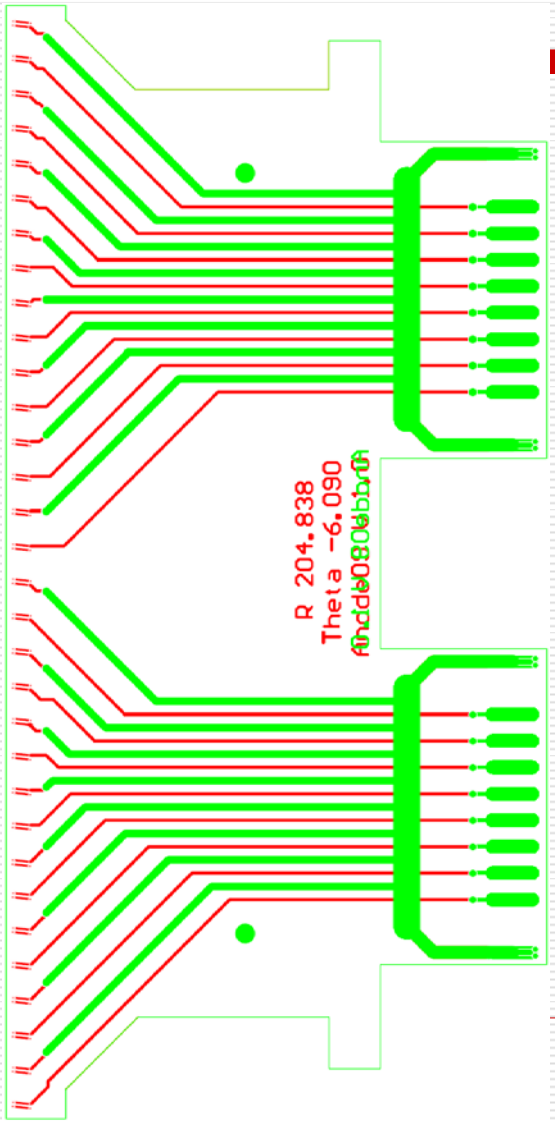


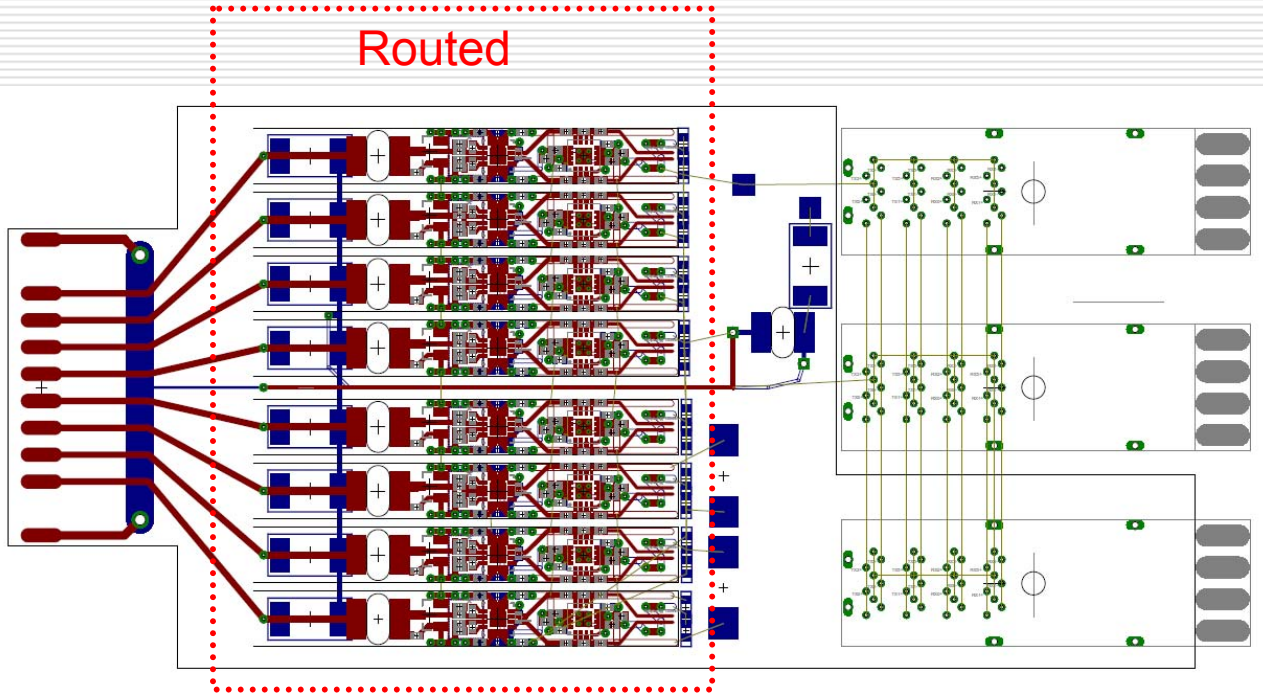
Sublayer	Radius
21	275,000
19	266,146
17	257,576
15	249,283
13	241,256
11	233,488
9	225,970
7	218,695
5	211,653
3	204,838

- Needs three type of cards:



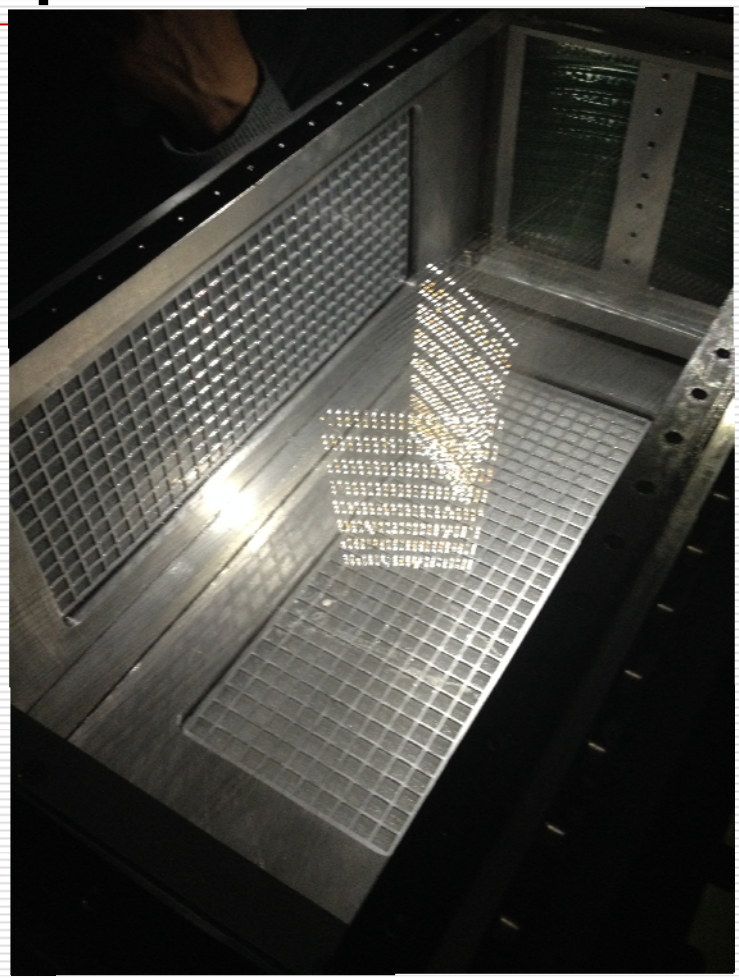
Steps toward the FE pcb



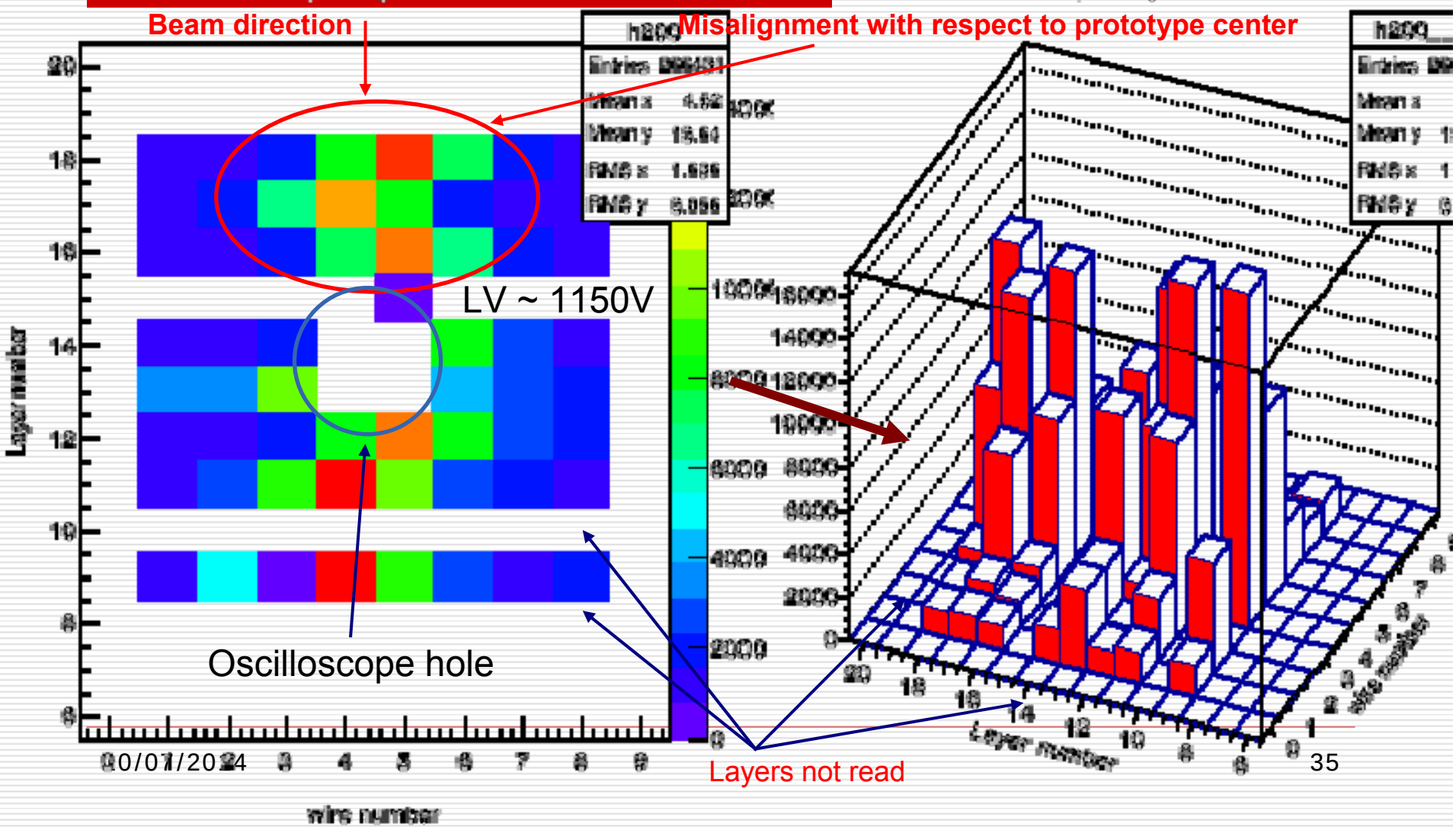


Mu2e – MEG prototype

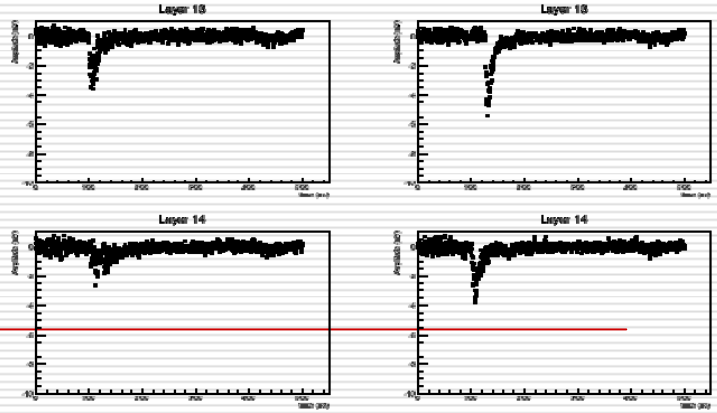
- Layout
  - Length:62.5 cm
  - Nr of layers: 15
  - Radius: 42.7 ÷ 52.3 cm
  - Cell Width: 6.58 ÷ 8.04 mm
  - Sense wire: 0.020 mm W
  - Field wire: 0.040 mm Al
  - Stereo angle: ± 0.20 rad
  - Nr of Sense wire: 10 (8 readed)
- Data Acquired
  - 2 gas mixtures are been tested
  - different positions respect to x, y and z axisis



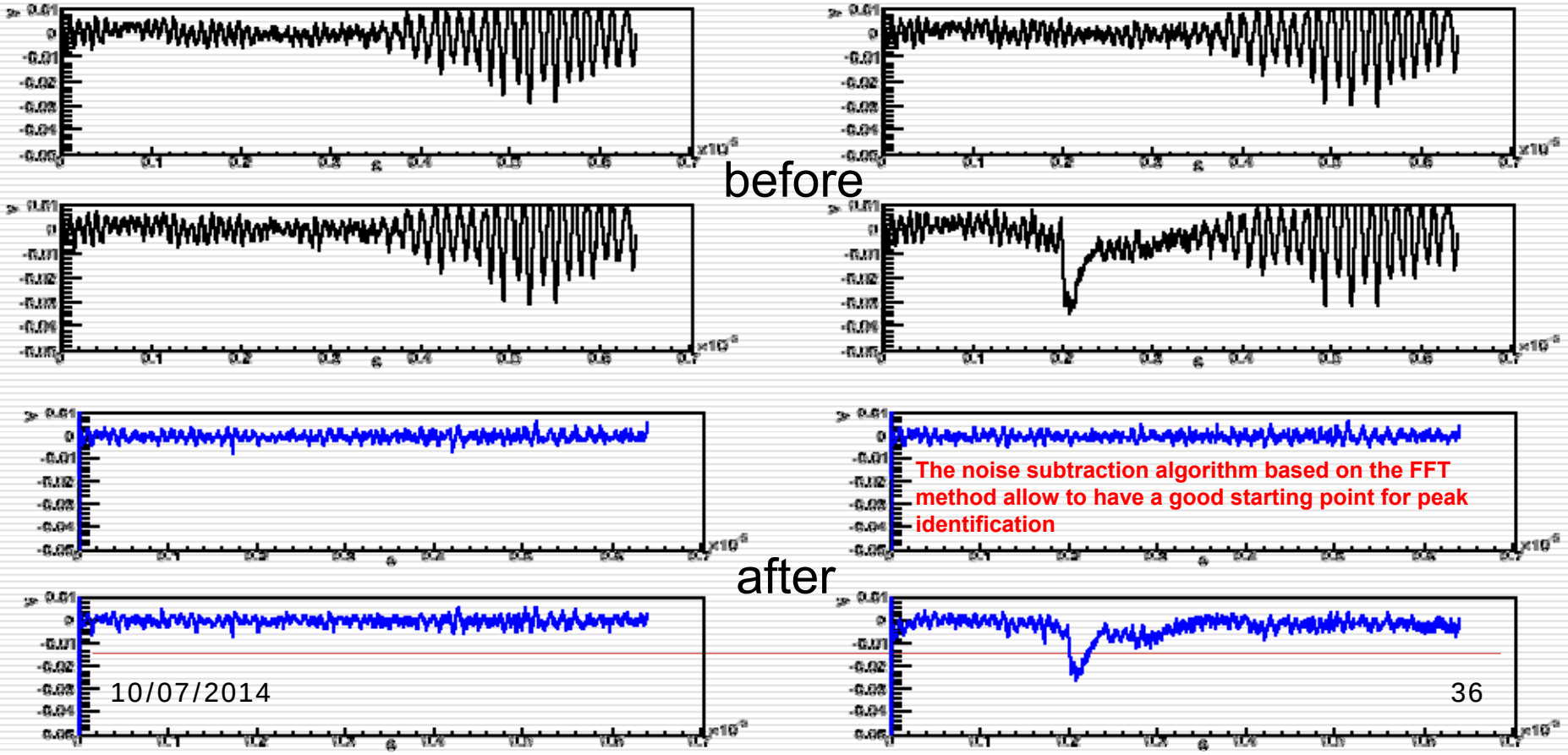
Beam alignment with respect to the prototype



Typical oscilloscope waveform



- Noise Level: sigma = ~ 0.3mV
- Signal Amplitude > 3 mV

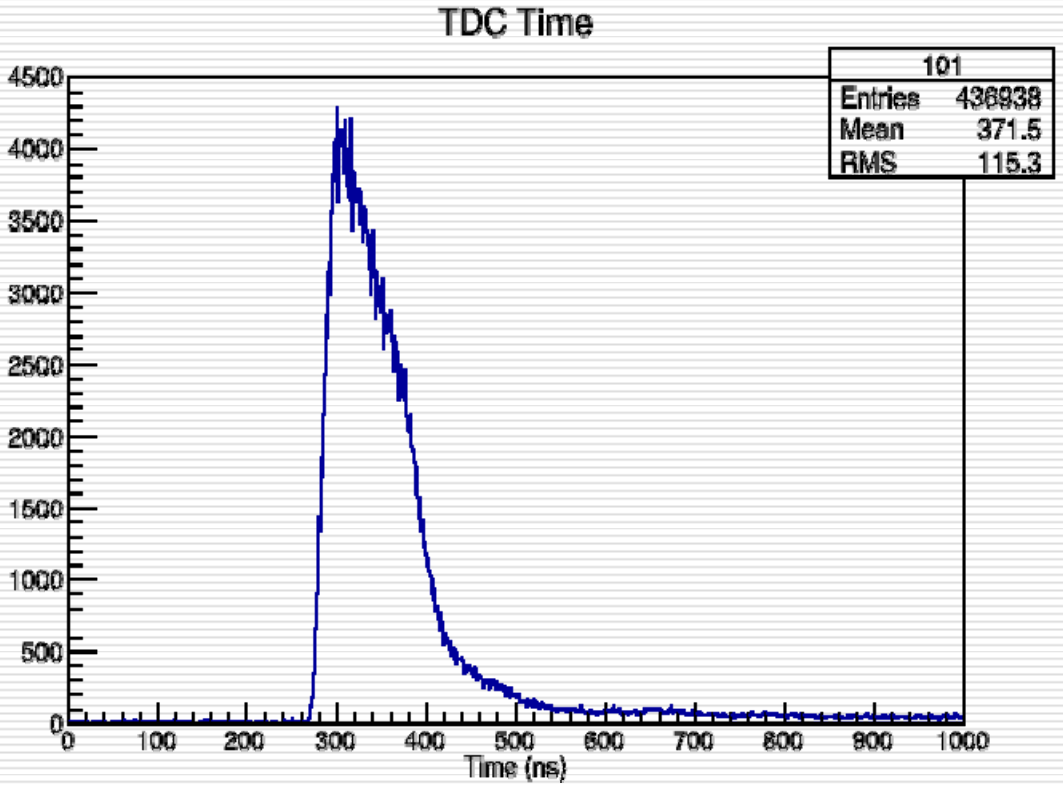


Space-Time relations

- A procedure to obtain space-time relations is developing
- Works in progress are:
  - Tracks reconstruction
  - Peaks identification for cluster timing/counting technique

From S — T relations

$$t_{measured} = t_0 + t_{flight} + t_{drift}$$



Cleaning room

Conclusion

- La milestone *Ready for assembly* è stata posposta di 2 mesi
- Si stima un completamento della macchina di filatura per la fine di settembre
- Da quella data iniziano I primi test di filatura che stimiamo si completino in circa un mese, seguirà la filatura definitiva e la trasmissione degli array di fili a Pisa
- Il montaggio si completa per Agosto 2015 quando la camera verrà trasferita da Pisa al PSI
- L'ordine dell'elettronica e dei cavi di trasmissione FE-DRS sarà completato entro l'anno

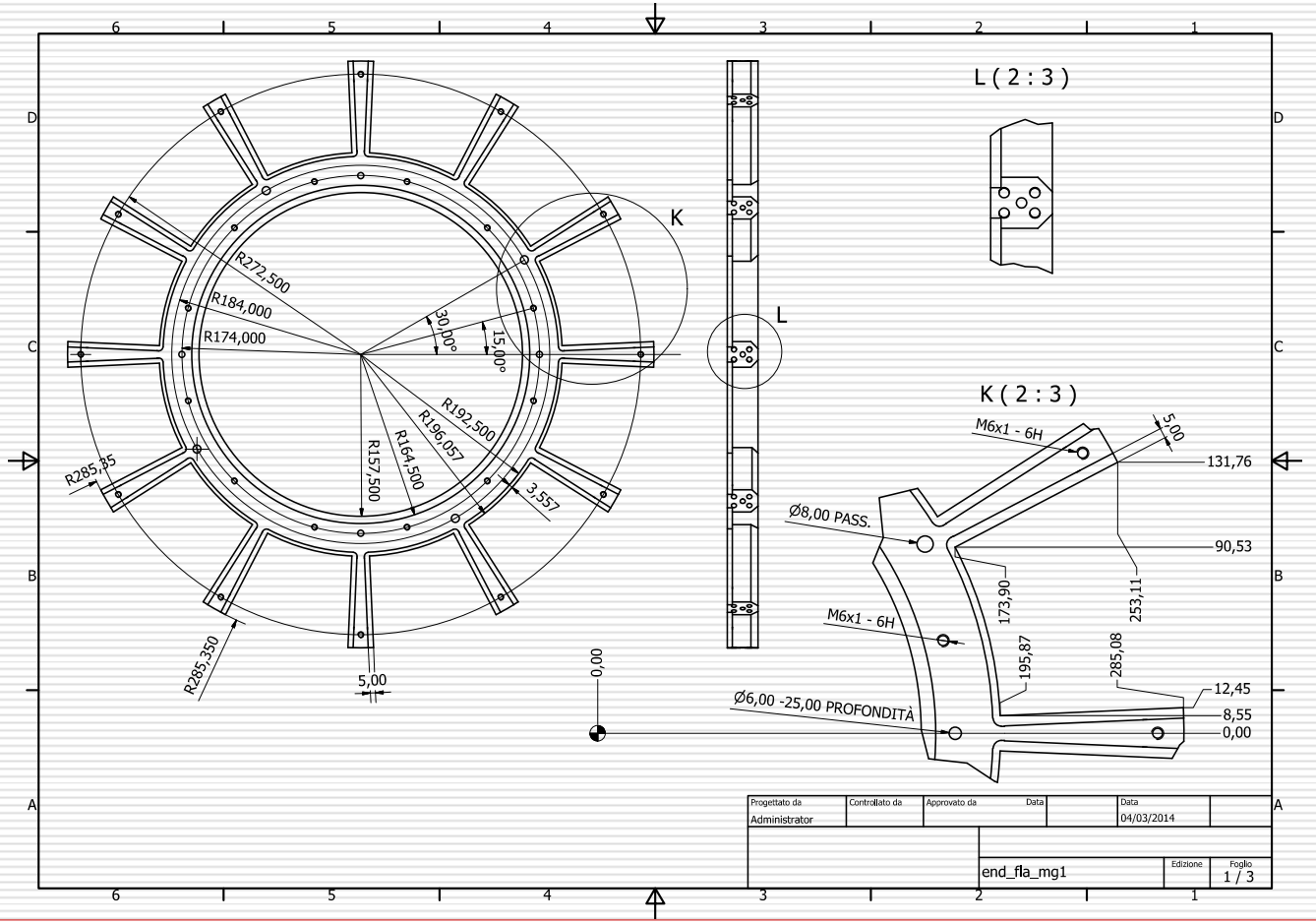
Lecce people

		MEG	FIRB
Chiarello Gianluigi	Dott	100	
Chiri Claudio	AssRic	100	
Grancagnolo Francesco	Ric	50	25
Maffezzoli Alfonso	PO	20	
Panareo Marco	PA	70	30
Pepino Aurora	Dott	100	
Tassielli Gianfranco	Ric	0	100
Zavarise Giorgio	PO	20	
TOT		**560**	
Primiceri Patrizio	CTech	100	
TOT		**100**	

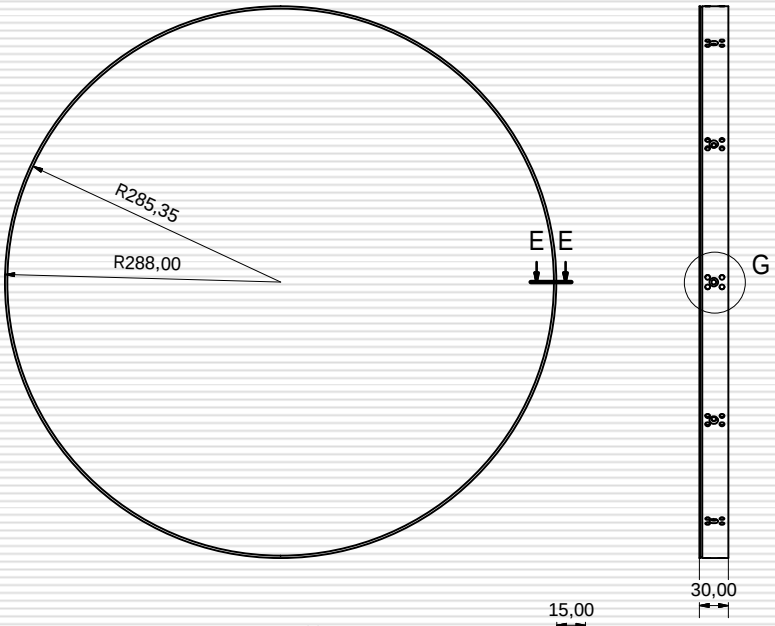
1 Laureando

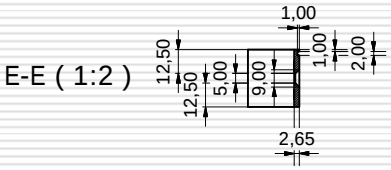

That's all Folks!

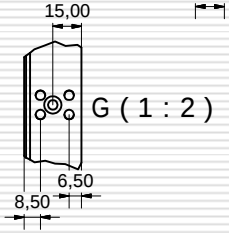
EndPlates


L (2 : 3)
K (2 : 3)
R272,500
R184,000
R174,000
30,00°
15,00°
R192,500
R196,057
R164,500
R157,500
3,557
R285,35
R285,350
5,00
0,00
M6x1 - 6H
5,00
131,76
Ø8,00 PASS.
90,53
173,90
253,11
M6x1 - 6H
195,87
285,08
12,45
Ø6,00 -25,00 PROFONDITÀ
8,55
0,00
Progettato da
Administrator
Controllato da
Approvato da
Data
Data
04/03/2014
end_fla_mg1
Edizione
Foglio
1 / 3

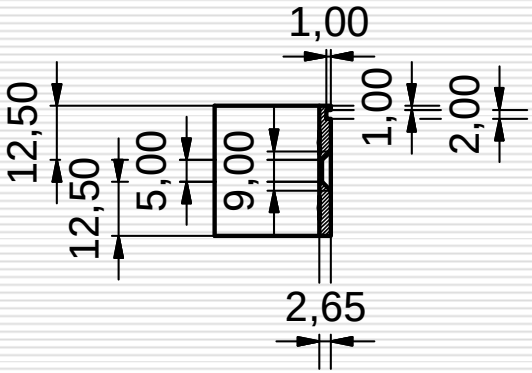
External rings





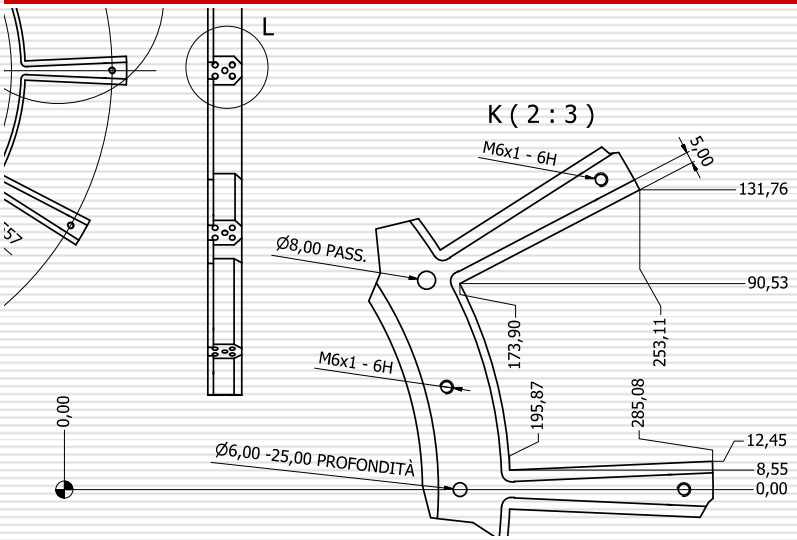


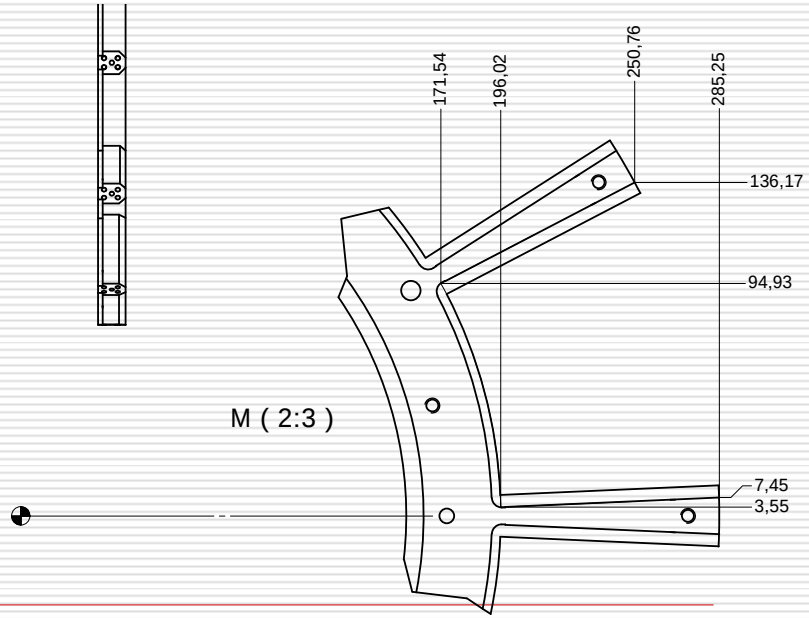
E-E (1:2)



- Volume sealing:
  - Sealant in the small groove facing the carbon fibre support structure

Details

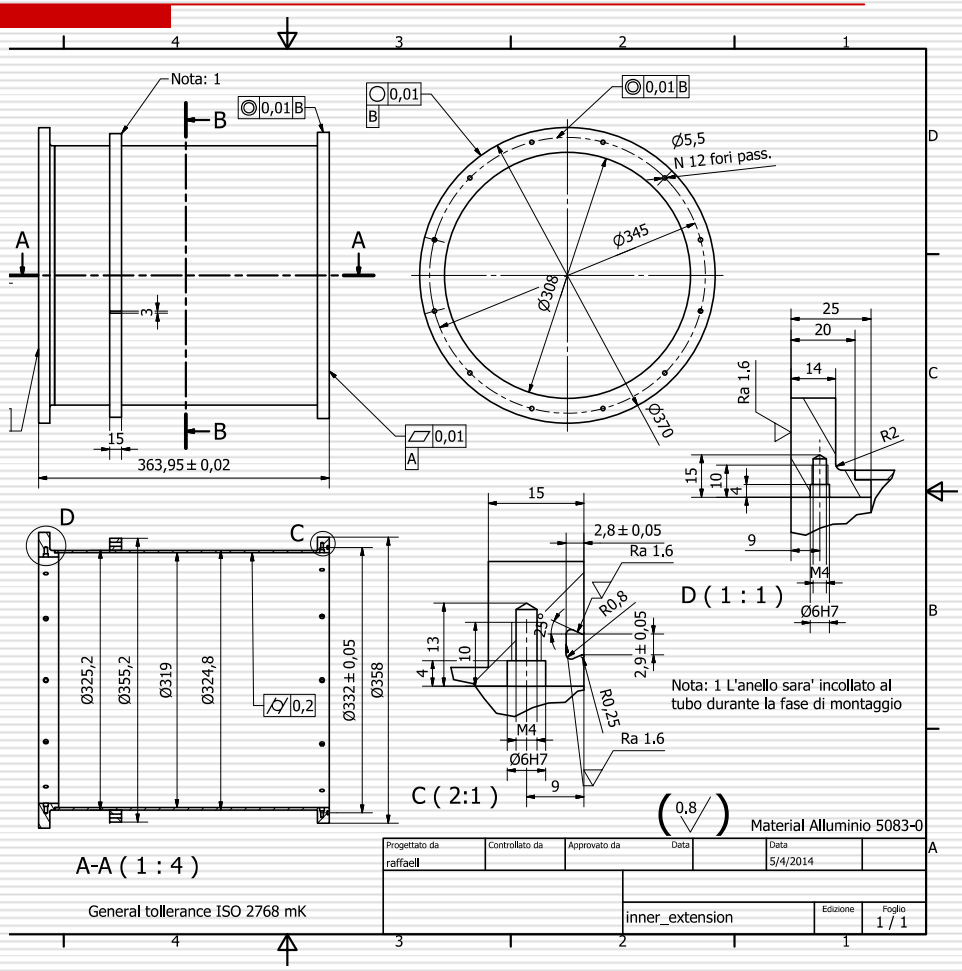




- Details
  - Material: Al 5083-0
  - Inner round off: 7x7 mm
  - Anchor round off: 5x5 mm
  - Thickness: 30 mm
  - Gas inlet/outlet: 4 holes of 8mm for different gas diffusers

US inner extension

- Design modified accordingly to PSI requests
- Active volume length unchanged
- Total chamber length further reduced by 14 mm



DS inner extension

- much simpler design