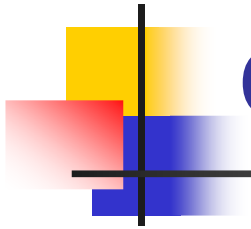
AGATA PROJECT

EMC STATUS SINCE JANUARY 2010

By : N. Karkour

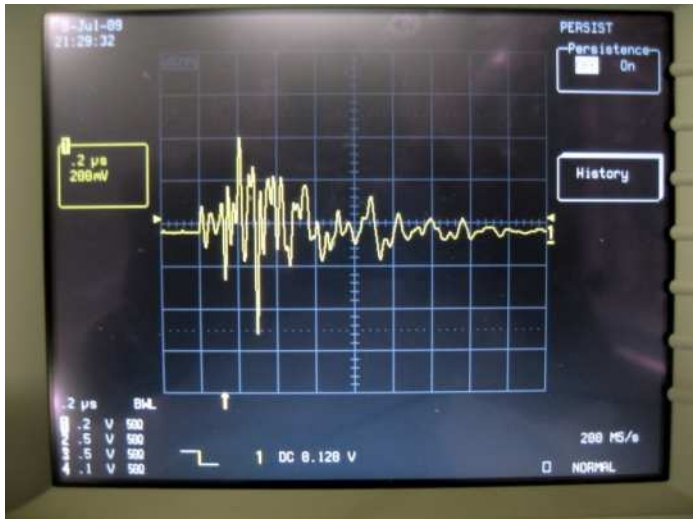


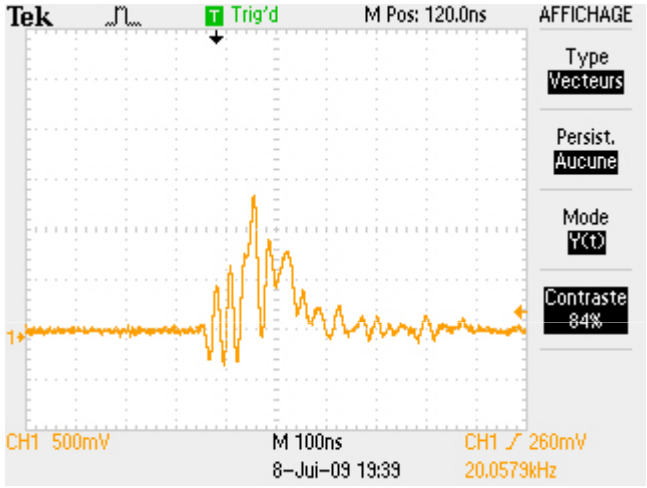
outline

- Few Remindings about 2 major grounding problems
- Actions TDB on ATC Crystal and MDR cable
- Preamplifier Motherboard
- MDR cable financial studies for modification and comparaison
- ATC5 qualification
- Conclusion

July 2009 Qualification results

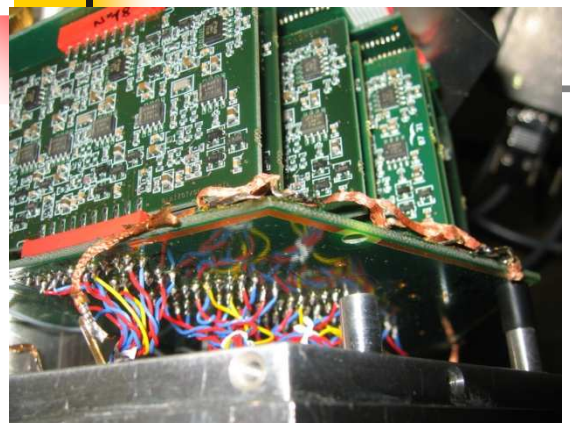
1.Spikes shown on the preamplifier signal by sending spikes on the Digitisers bay mechanics Direct injections

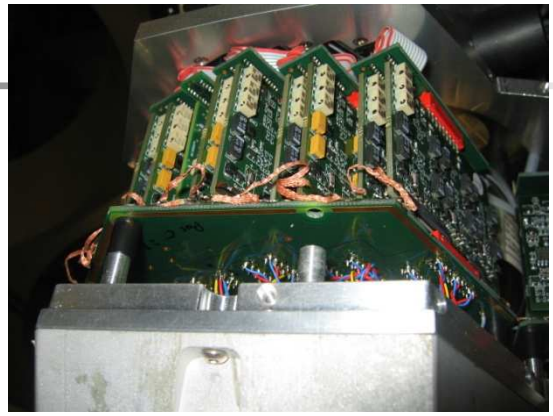




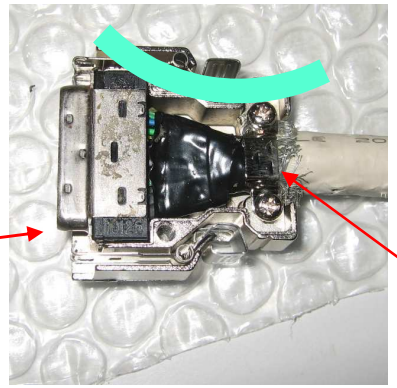
- **Results on the noise injected into the detector mechanics chassis**
- 1 V and 1.5 V of noise with only 500 V of injected noise
- The following measurements were made at the Analog inspection lines of the digitisers. They concern the core preamplifier signal for the 3 crystals

Preamplifier mother board and MDR preamplifier cables poor grounding





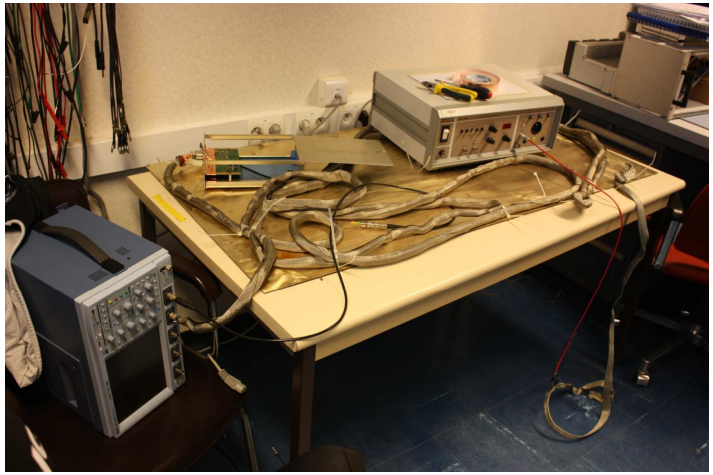
We can conclude that the preamplifier motherboard is susceptible to EMC noise. The photos below show the ground connections between the preamplifiers which are too long to act as low impedance bonds above 10 MHz frequencies. The improvement of the noise susceptibility is shown in the next test measurements on the preamplifier output.

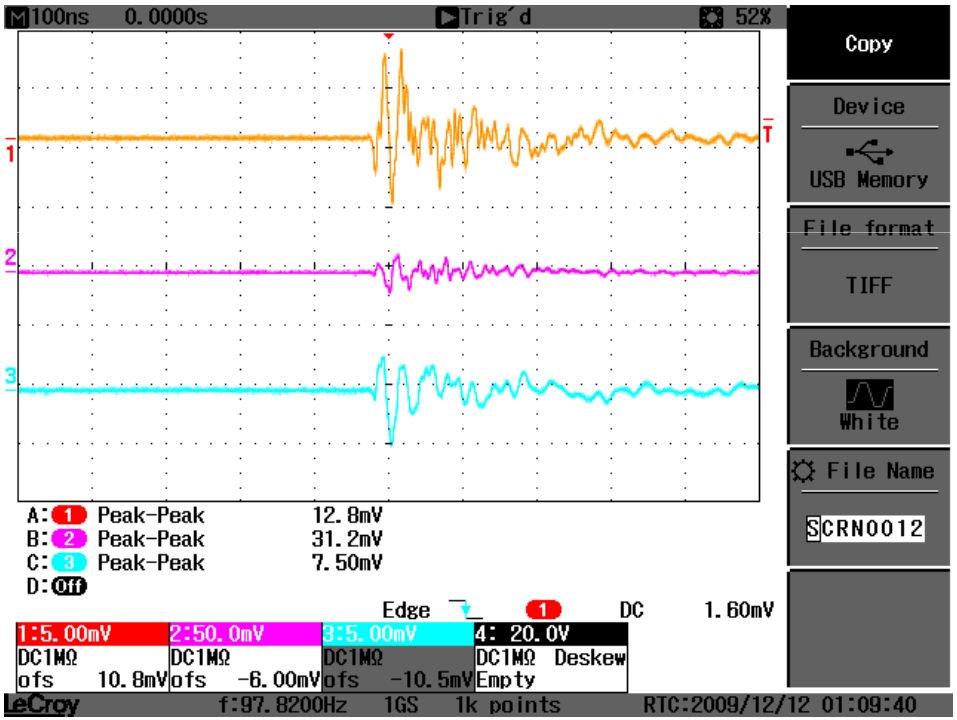


Connector Core not tightly connected to the shield

Cable shield tightly connected to the connector hoods but not core

Orsay MDR Cable Qualification





@1 kV Injected noise
MDR CABLE response Vpp < 6 mV
with scope intrinsic noise deduced

Conclusions from the Sit Down Meeting @ Legnaro on December 2009

- MDR cable must be surrounded by metallic sleeve from beginning to the end.
- Meeting to be held with GSI and DCDC manufacturer ISEG to improve HV Filter grounding
- Meeting with the cologne and CTT company to improve preamplifier mother board grounding
- Propositions to improve grounding connections to the digitisers bay from Legnaro people will be done somewhere in 2010.
- Grounding Meetings to plan the milestones for the actions defined.
- Creation of the grounding group in order information circulate to all the interested persons.

Grounding Group

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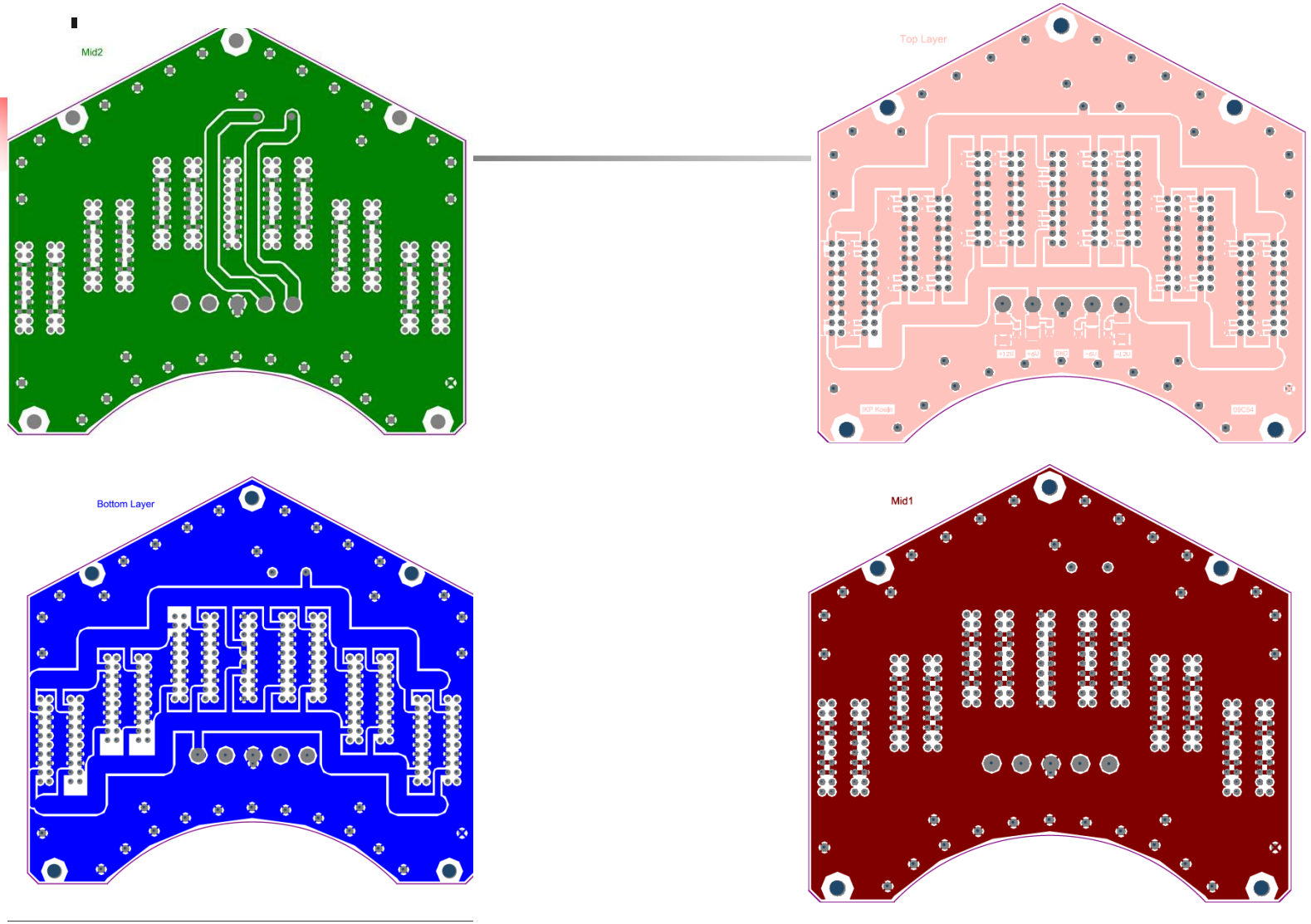
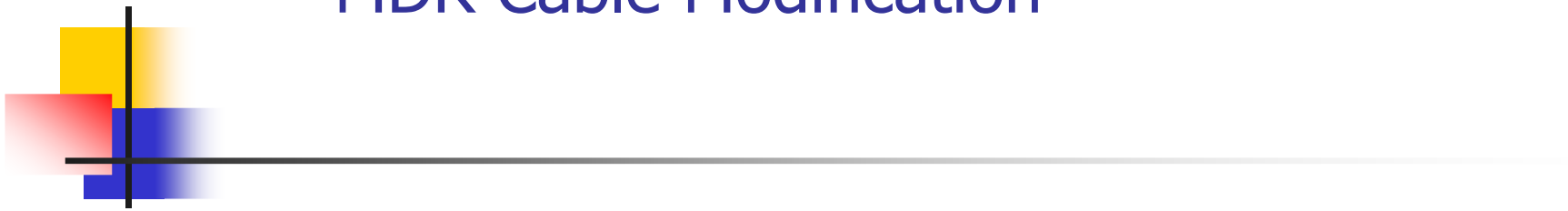
Preamplifier mother board modification



MDR Cable Modification



- 2 quotations for the new version of the MDR cable.
- The first version is to modify the existing cables by adding external shielding.
- Realise a cable harness for each Ge crystal containing 7 MDR cables.
- The TOTAL quotation is 3600 euro/crystal includes a harness of 7 MDR cables
- This solution increases significantly the size of the MDR cables.

- The second solution is to manufacture a double shielded twisted pair cables with 11 STP to manufacture the MDR cables by a subcontractor.
- The difficulty is the MDR connector hood which is to be modified because the cable diameter is 11 mm instead of 8 mm (for the single shielded version). The quotation for such a cable is 5250 Euros/crystal includes 7 MDR cables.
- Below are the new cable data sheet characteristics that Axon company can propose to fulfil the EMC specifications for AGATA preamplifier signal integrity.

IND	MODIFICATIONS	DES.	VERIF.	DATE
BA	CREATION	ARi	FD	18/03/10

COMPOSITION DU CABLE

1- 11 paires blindées E 2807 MA 2 constituées de :
- Conducteur en cuivre argenté
  - 7 brins de 0.127 mm
  - Diamètre : 0.381 mm nominal
  - Section : 0.089mm2
  - R ohmique : 20 ohms/100 m nom.
- Isolation PTFE
  - Diamètre d'un fil : 1.0 mm nominal
  - Diamètre d'une paire : 2.0 mm nominal
  - Couleurs : 2 couleurs à définir suivant std Axon'
- -Ruban en polyester aluminisé
  - Diamètre : 2.20 mm nominal

Impédance entre les deux fils de la paire : 100 Ohms nominal

2- Jonc de remplissage

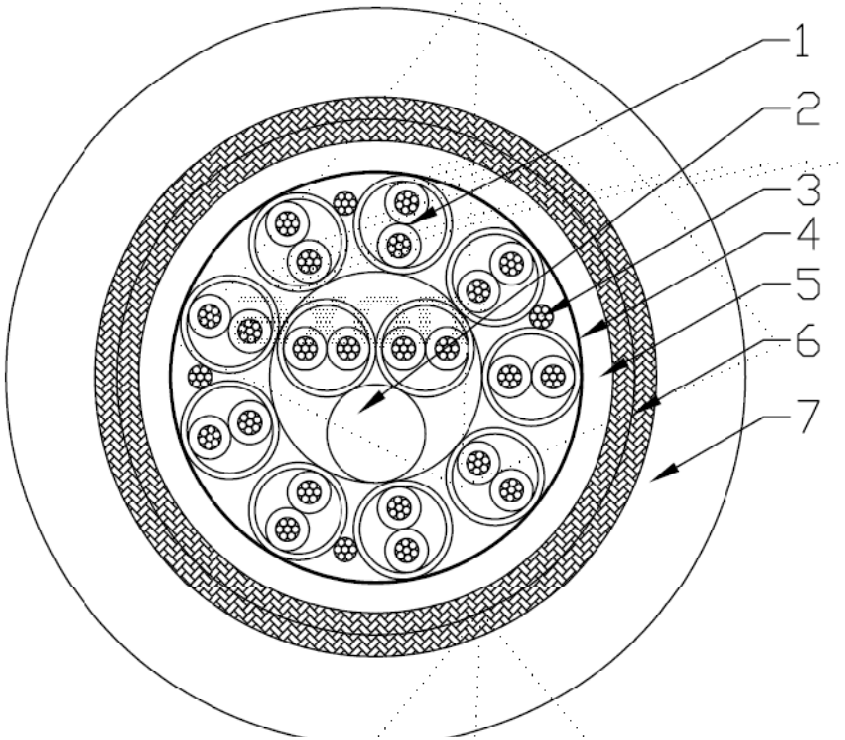
3- Drain de masse en cuivre étamé
- 7 brins de 0.127 mm
- Diamètre : 0.38 mm nominal
- Section : 0.09 mm2
- R ohmique : 20 ohms/100 m nom.

4- Ruban de maintien en polyester

5- Gaine en PVC
- -Diamètre : 9.8 mm nominal
- -Couleur : à définir suivant std Axon'

6- Double tresse de blindage en cuivre étamé

7- Gaine extérieure en PVC
- -Diamètre : 13 mm nominal
- -Couleur : noir

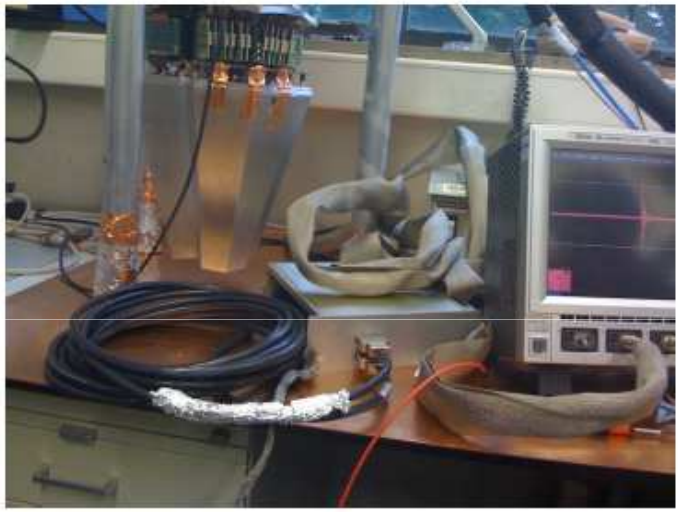


Fréquence	10 kHz	100 kHz	1 MHz	3 MHz	10 MHz	20 MHz	30 MHz	100 MHz	400 MHz
Impédance de transfert de la double tresse (en mΩ/m)	1.71	1.71	0.98	0.42	0.54	0.76	1.10	1.81	5.02
Efficacité de blindage sous 50 Ohms (en dB)	95	95	108	102	105	102	99	95	86

CARACTERISTIQUES GENERALES DU CORDON

Température d'utilisation : de -40 °c à +80 °c
Tension de service : 600 V AC
Masse approximative du câble: 282 g/m

New Honda MDR Cable



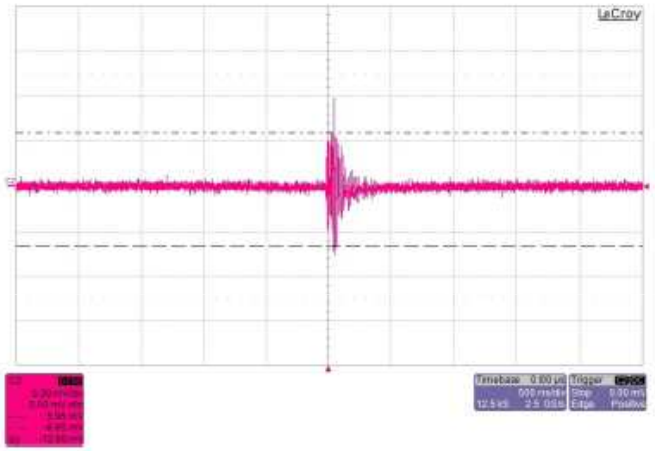


FIGURE41. Direct injection response for the Honda MDR cable

- Honda Cable shield is tighter than Agata MDR shield
- Price is 1000 euro/crystal includes 7

Results : Vp-p = 10 mV OK

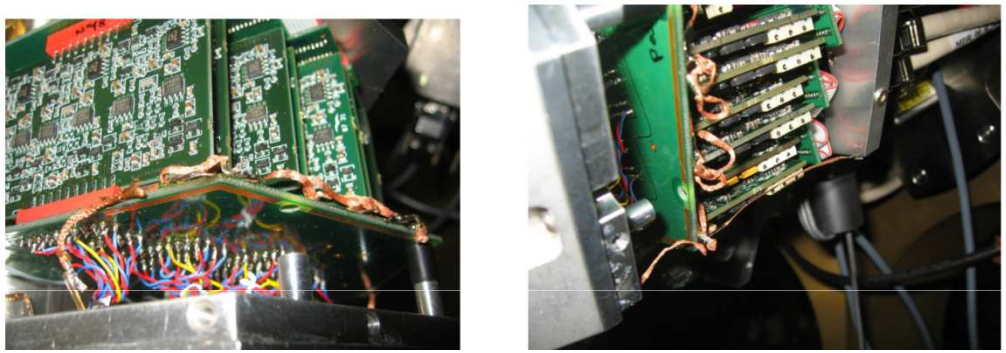
ATC 5 QUALIFICATION @ COLOGNE by NK and MT

ATC5 experimental setup infrastructure @ arrival

ATC 5 QUALIFICATION @ COLOGNE by NK and MT

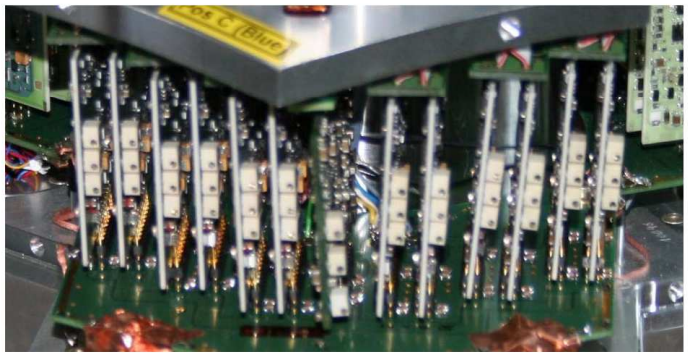
A. OLD ATC ground connections

The enhancements made on the preamplifier pcb from are old version to the new version are significant. Here copper braids were added on the motherboard.

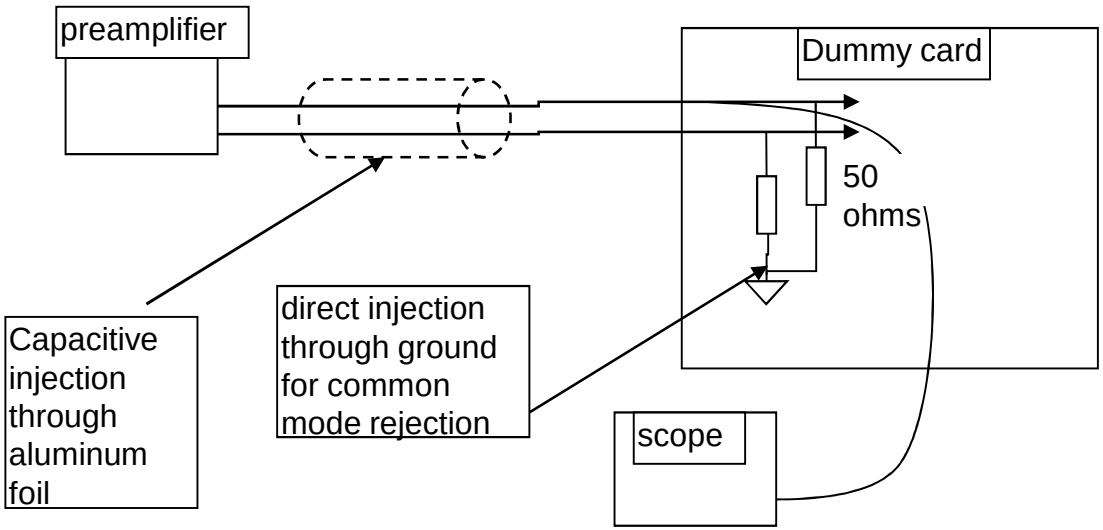


B. New ATC ground connections

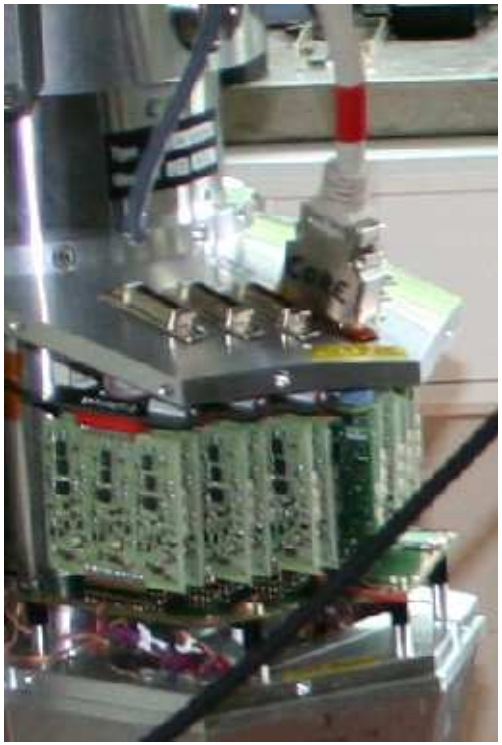
The enhancements made on the preamplifier pcb from are old version to the new version are significant. No copper braids were added on the motherboard.

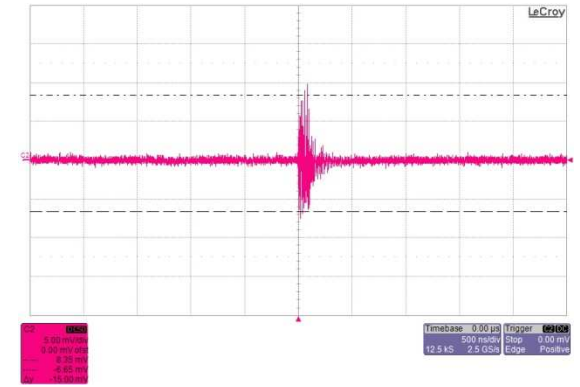


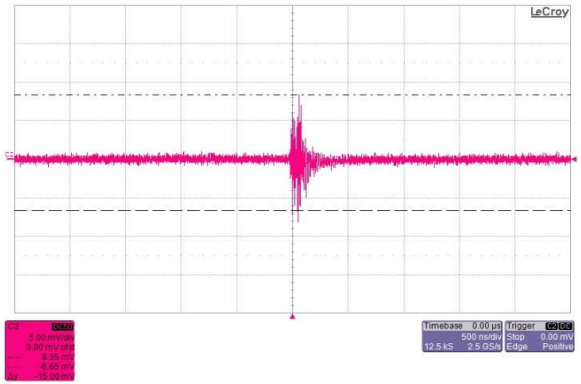
Cabling scheme for the qualification



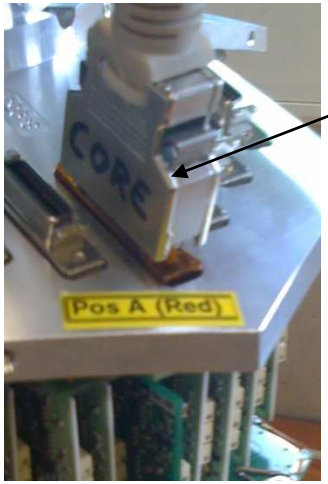
Segment qualification results



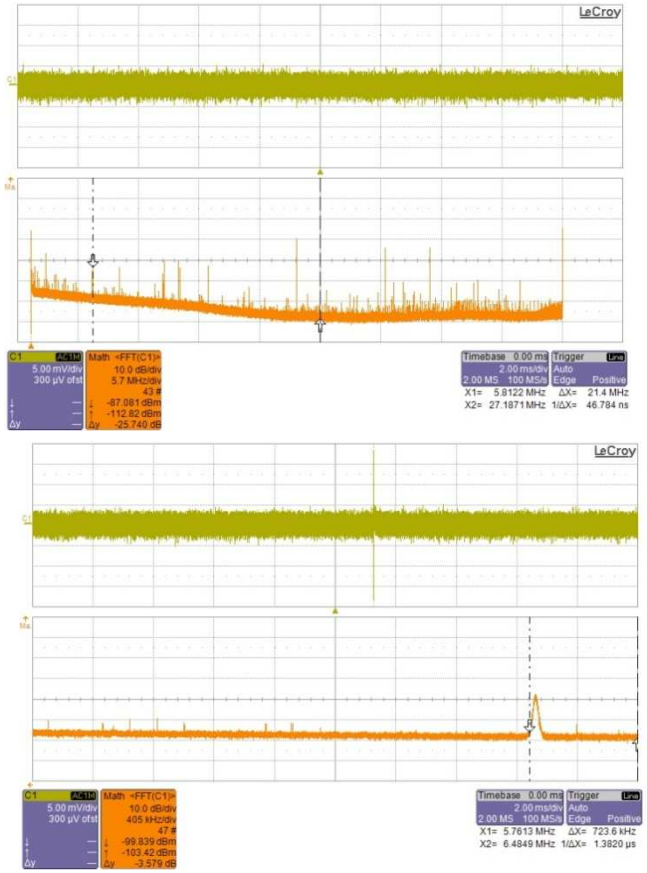




Core qualification results



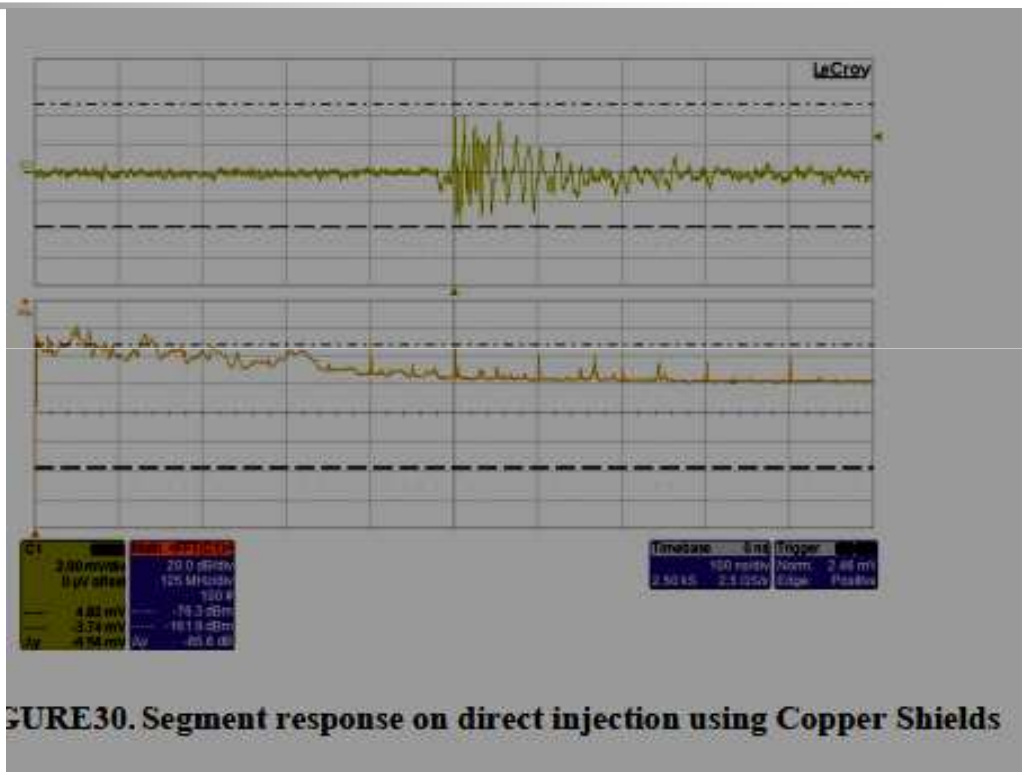
Isolated tape surrounding the MDR connector



CMRR-60 dB

Qualification results using copper shield

FIGURE29. Copper shields for the ATC5

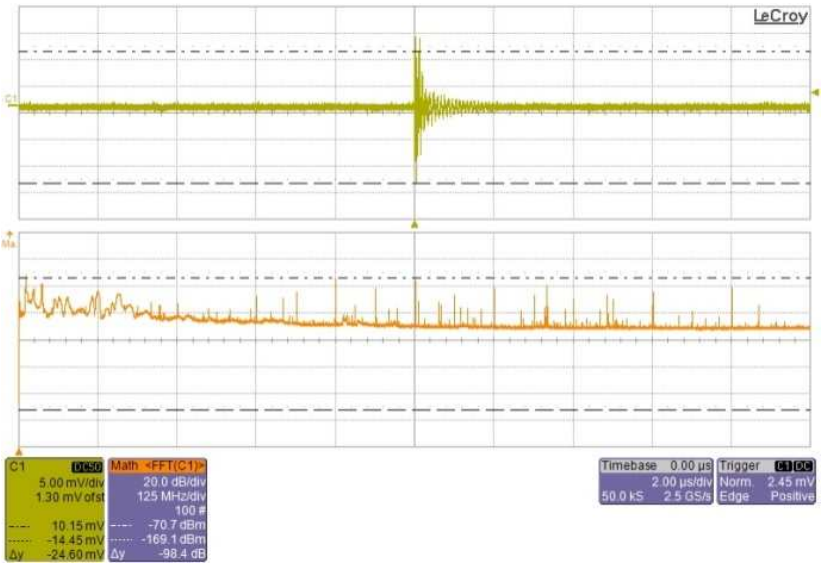


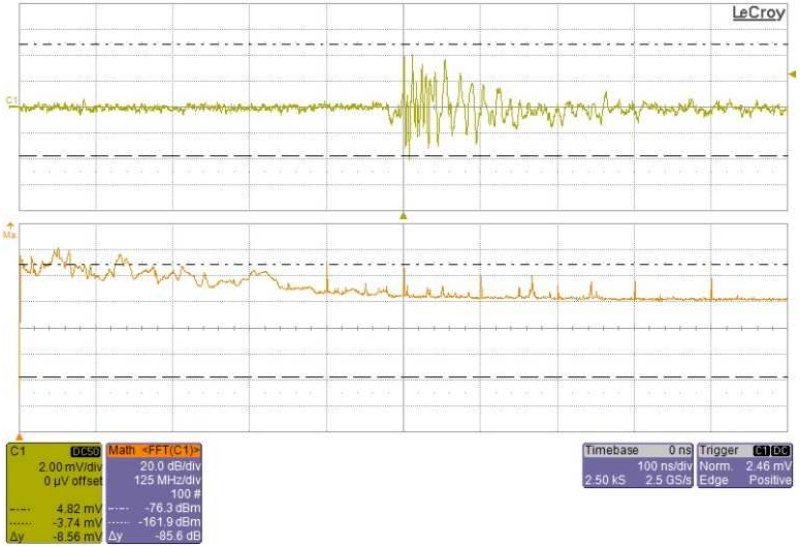
GURE30. Segment response on direct injection using Copper Shields

Results : Vp-p = 5 mV OK

CMRR-70 dB

Qualification using Copper shields direct and capacitive injection on segment





•Segment response on Capacitive injection using Copper Shields

Results : Vp-p = 20 mV NOK

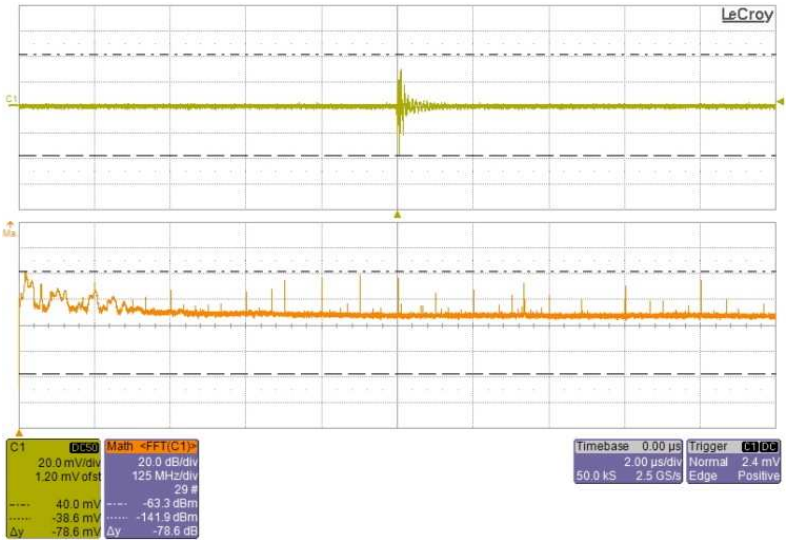
CMRR-40 dB

•Segment response on direct injection using Copper Shields

Results : Vp-p = 5 mV OK

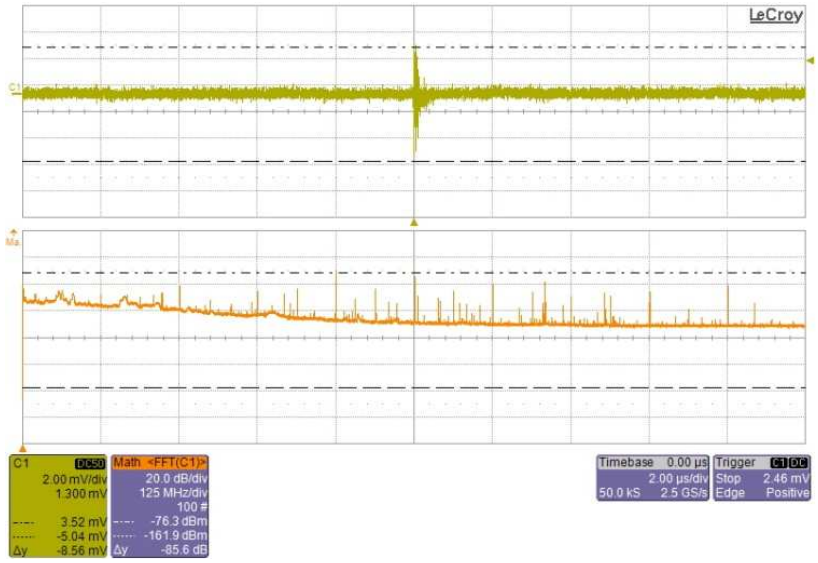
CMRR-65 dB

Qualification using Copper shields direct and capacitive injection on Core



Results : Vp-p = 45 mV NOK

•Core response on capacitive injection using Copper Shields



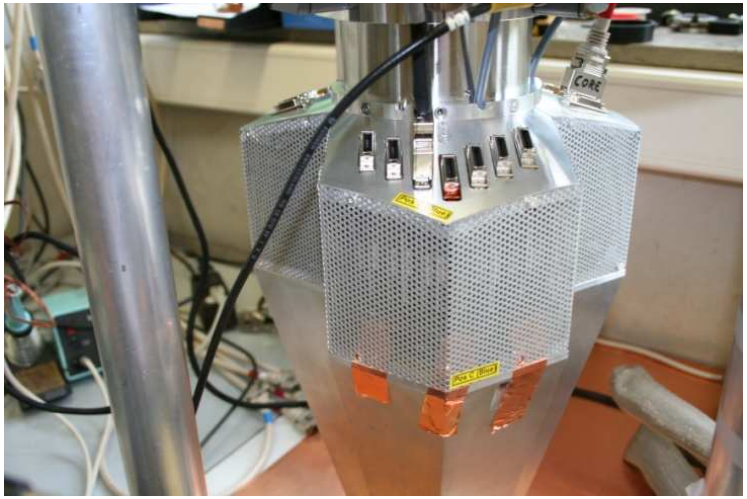
Results : Vp-p = 9 mV OK

•Core response on direct injection using Copper Shields

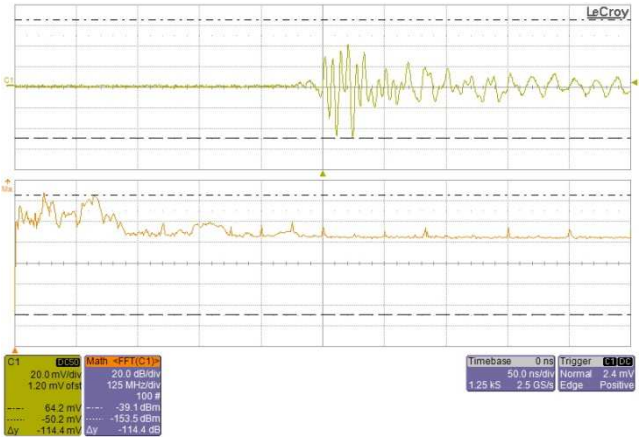
CMRR-45 dB

CMRR-50 dB

Qualification using Grid shields



Qualification using Grid shields direct injection on segment

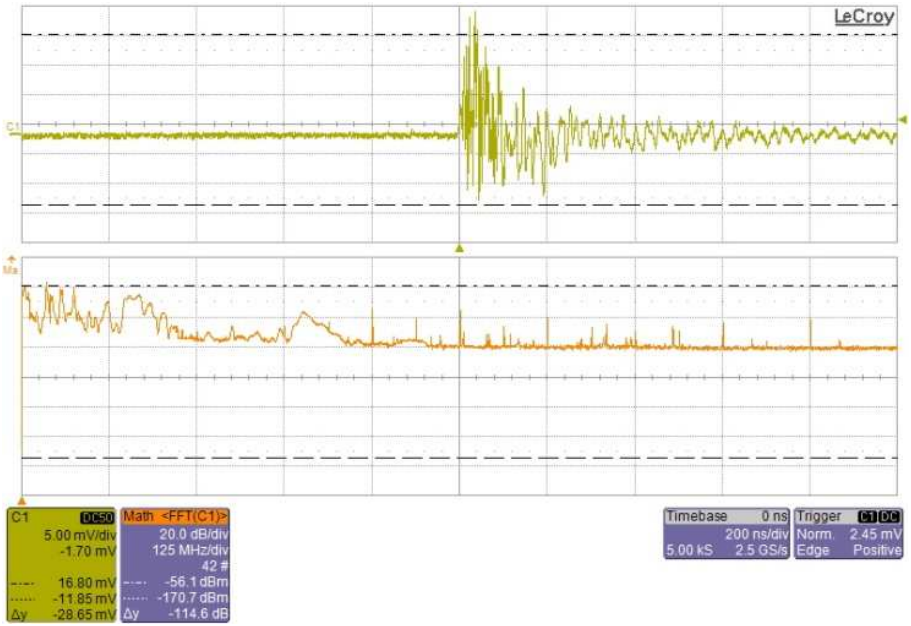


•**Segment response on Capacitive injection using Grid Shields**

Results : Vp-p = 9 mV OK

CMRR-50 dB

Qualification using Grid shields direct injection on core



•**Core response on direct injection using grid Shields**
Results : Vp-p = 25 mV NOK

CMRR-46 dB

•**Core response on capacitive injection using Grid Shields**
Results : Vp-p = 85 mV NOK

CMRR-36 dB

Recommendations

- The motherboard pcb support is glued on the Ge capsule mechanics, solution to screw the pcb support inside the Capsules mechanics instead of gluing them.
- The motherboard should have metallic rings large enough to make tight ground connections to fixing screws.
-
- MDR core connector: The core connector is isolated with tape, and the baseline signal was seen to be a bit noisy, and also the common mode rejection is not so high in order to be immune to noise. A recommendation is to connect the core connector to ground as the segment connectors.

Conclusions

- EMC qualification Tests are satisfactory on ATC5
- The motherboard modification has excellent results on EMC
- This modification is to be made on other TCs after the LNL campagne
- The MDR cable from Honda seems to have good rejection to direct and capacitive noise.
- Special Thanks to cologne staff and CTT collaboration.