

DE LA RECHERCHE À L'INDUSTRIE

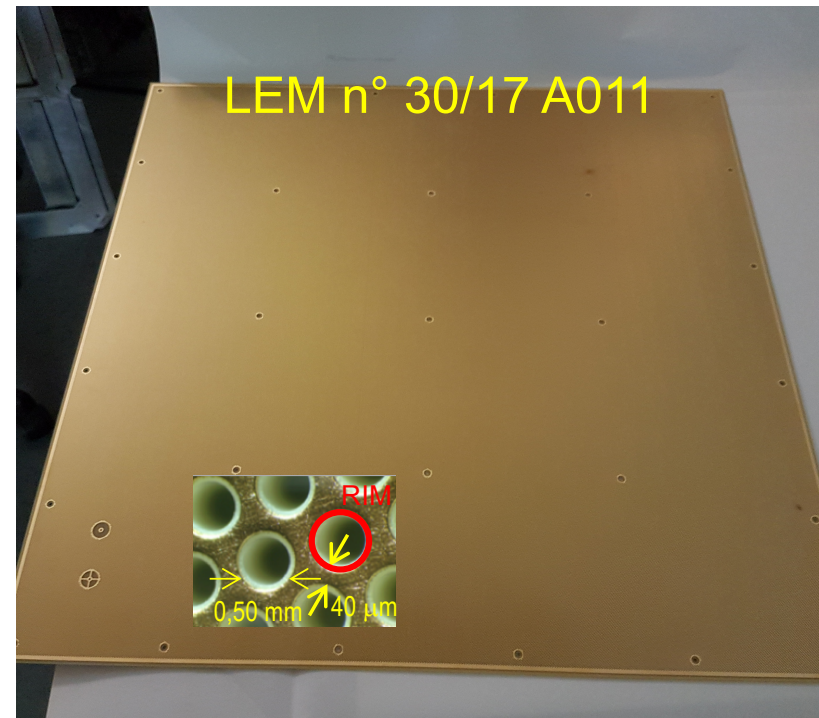


www.cea.fr



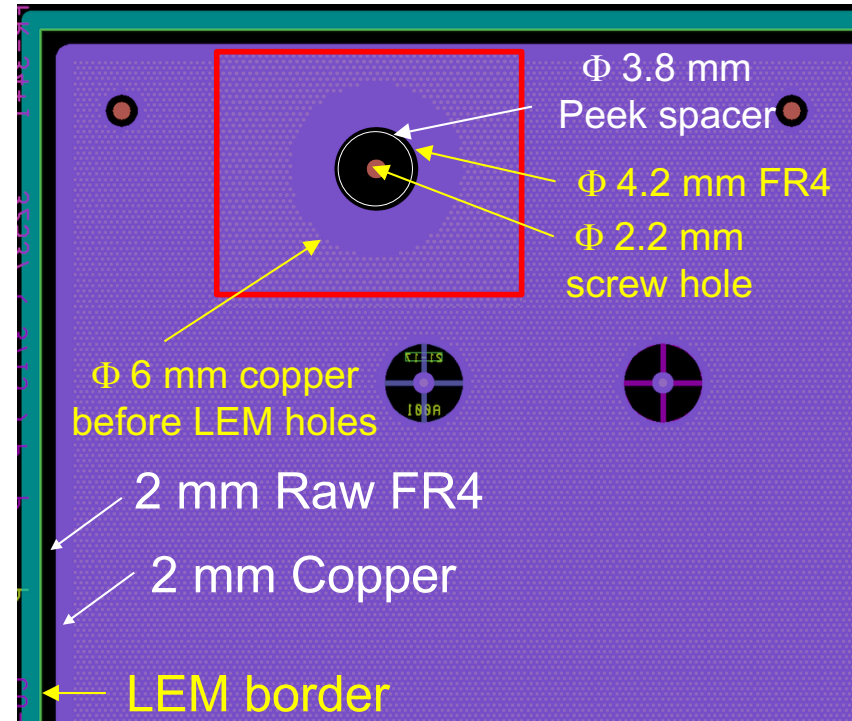
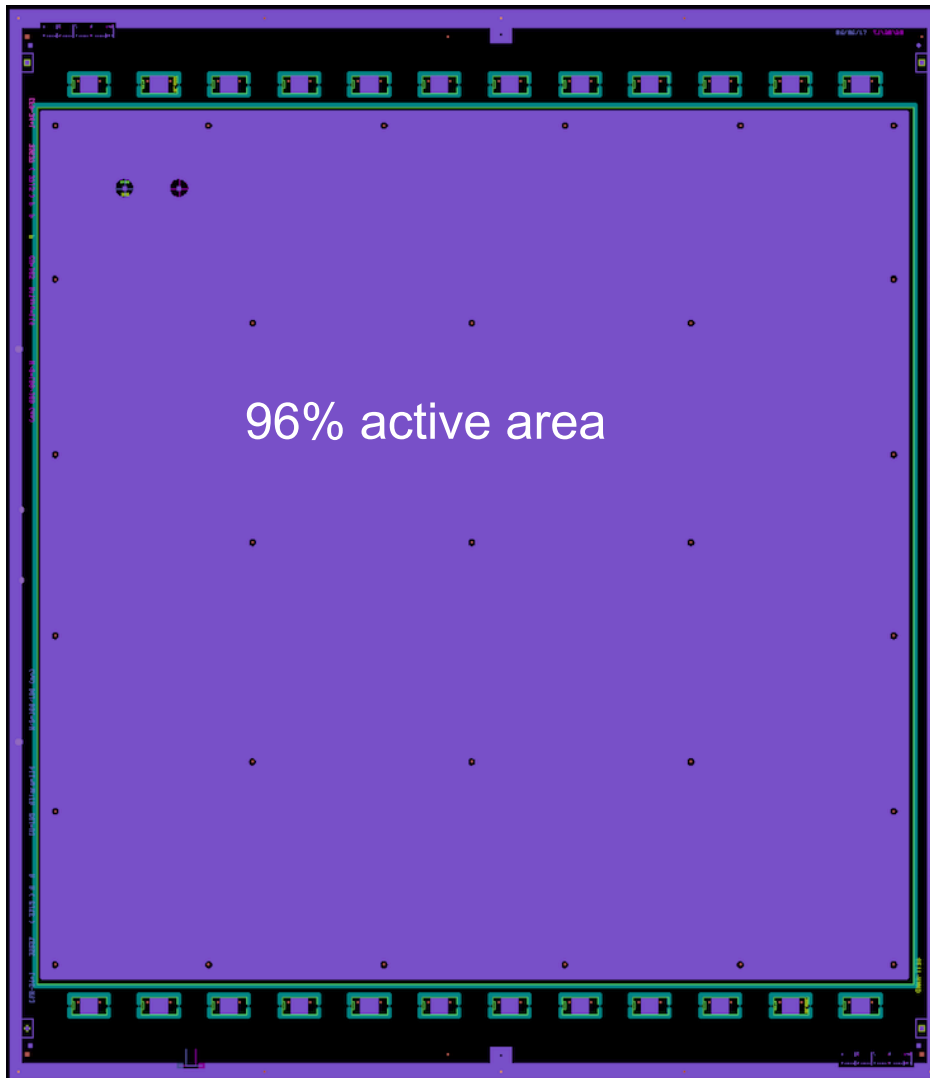
STATUS OF 6X6X6 m³ LEM PRODUCTION AND QA/QC PREPARATION FOR ANODE PROCUREMENT BY CEA/IRFU

A. Delbart, Ph. Cotte, M. Karolak, E. Mazzucato, Y. Pénichot, Y. Piret,
M.Zito (Irfu), S. Murphy (ETHZ)



WA105 vidyo meeting, december 13th 2017

CFR-34 LEM production design (42 LEM produced under CEA 4000759184 order)



DC version (august 8 2017) of the CdcLEMWA105fr file

Female Deutch connector for HV cables are very difficult to procure : 400 were ordered by CEA/Irfu to FARNELL for an expected delivery **week 12** ETHZ placed an order in september to RS for an expected delivery end of february.

- 42 CFR-34 design LEMS were delivered (2 pre-series LEMs included).
- 37+2 passed the QA/QC tests in synthetic air and 5.7 Argon @ 3.3 bar absolute pressure.
- Production of LEMs was paused after sept 25th CERN meeting.
- ELTOS has 38 raw Panasonic FR4 R-1566W sheets for the remaining 36 LEM production of CEA contract and ordered a **new batch of 68 panels expected for delivery end of January.** ELTOS has 2 new 6 heads drilling machines that could help increase the production rate. One can be dedicated to LEM production. Up to 18 LEMS could be drilled at the same time.
- For a resuming of the production this week, 36 LEMs could be produced by february 12th

A. Delbart (CEA) / R. Pinamonti (CEA)
last update date 29 November 2017 by A. Delbart

Reminder : qualification of a batch (in HP vessel) of 6 LEMs requires 2-3 working days + ~60 h pumping

Batch#	LEM S/N	shipment to CEA	ELTOS QA/QC	QA/AC at saclay	delivered	qualified	Commercial comments
0	A001-A002	23 June 2017	26 June 2017	passed (08/04/2017)	2	2	6 paid
1	A003-A008	02 August 2017	04 August 2017	6 LEMs OK	6	6	Invoice and paiement issued
2	A009-A014	scheduled 28 august	28 August 2017	6 LEMs OK	6	6	A009 delivered on 7/11/201
3	A015-A020	11 September 2017	5 LEMs 11/09/2017	5 LEMs OK	5	5	to be delivered:A018,A025 --> these # are abandoned
4	A021-A026	11 September 2017	5 LEMs 11/09/17 & 1/11/17	4 LEMs OK	5	4	Delivered on 7/11/2017:A021&A026 A021 to be cleaned again &
5	A027-A032	19 September 2017	6 LEMs on 19/09	6 LEMs OK	6	6	
6	A033-A038	19 September 2017	5 LEMs on 19/09	6 LEMs OK	6	6	A033 delivered on 7/11/201
7	A039-A044	07 November 2017	6 LEMs on 07/11	6 LEMs OK	6	4	A042&A043 to be cleaned again & tested
8	A045-A050						Production STOPPED to deal with 3200 V HV limit (design CFR-35)
9	A051-A062						
10	A063-A080						A018 & A025 missing : total 2+40 LEMs delivered (7 batches) labels A018@A025 will not be produced LEM A045-A080 remaining to be produced within CEA contract
Total					42	39	

CFR-34 LEM PRODUCTION STATUS

CEA CONTRACT 4000759184 FOR THE PRODUCTION OF 78 LEMS

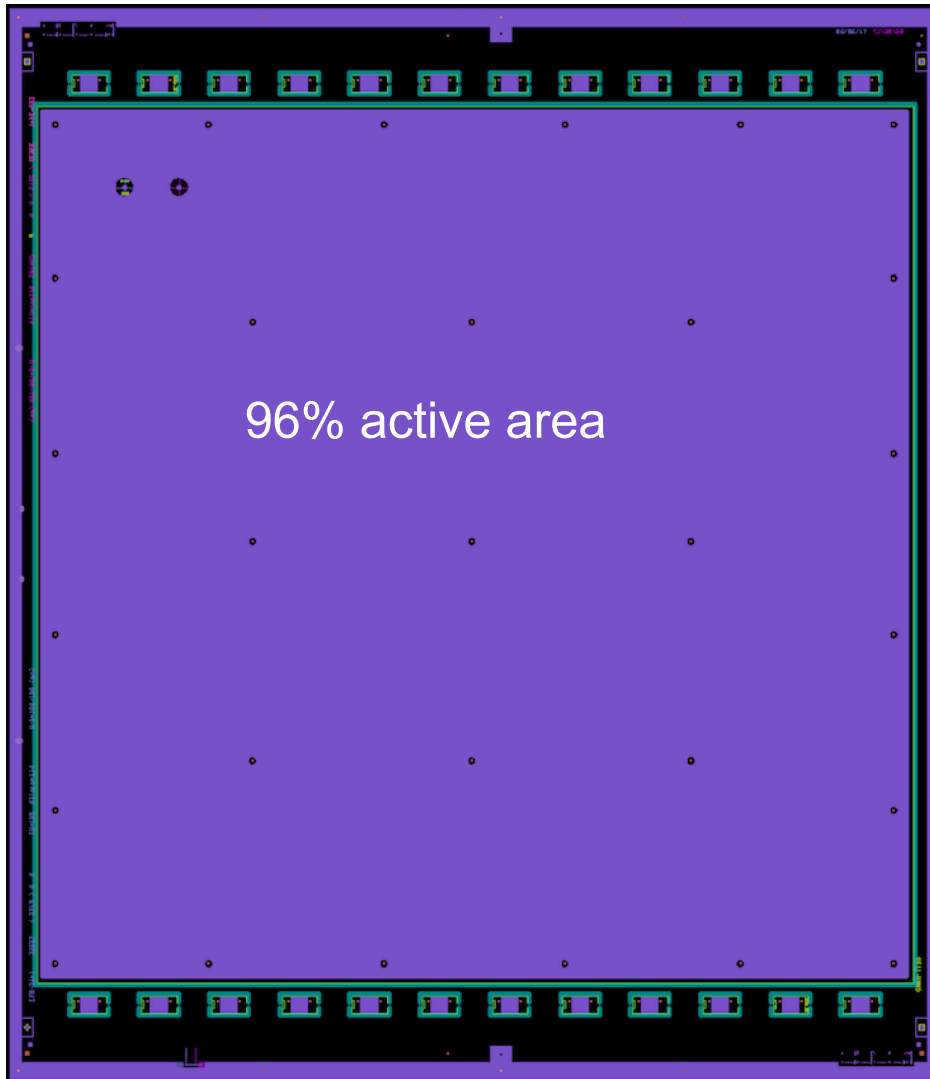
A. Delbart
last update 29 November 2017

LEM S/N	ELTOS QA/QC	CEA visual inspection before cleaning	CEA visual inspection After cleaning	4500V, I<2 nA	3200V, I<2 nA	Comments
				HV in synthetic air	HV in 3,3 bar Argon	
A001	23 June 2017	Passed	Passed	Passed	Passed	A001 was not polymerized at 160 °C. To polymerized at 180° for test
A002	23 June 2017	Passed	Passed	Passed	Passed	"dark" deposit. A second cleaning-drying-HV test was needed. Colle sur 1/2 soudure
A003	02 August 2017	Passed	Passed	Passed	passed	"dark deposit" cleaned. 2nd Test OK 19/09/2017
A004	02 August 2017	Passed	Passed	4100V / not passed	Passed	9 nA increasing current in synthetic air. OK in Argon
A005	02 August 2017	Passed	Passed	passed	Passed	
A006	02 August 2017	Passed	Passed	Passed	Passed	Same kind of "dark" deposit around Teflon supporting pillar as A002. Cleaned, HV test OK 08/09/2017
A007	02 August 2017	Passed	Passed	passed	Passed	
A008	02 August 2017	Passed	Passed	passed	passed	"dark deposit" cleaned. 2nd Test OK 19/09/2017
A009	28/08/2017/ Not passed 07/11/2017 repaired	Passed	Passed	Passed	passed (but difficult)	repaired at ELTOS (a rim is missing- hole filling with epoxy) delivered 11/06/2017
A010	28 August 2017	not Passed	Passed	passed	Passed	"suspicious" dark zones. Plus de traces après nettoyage
A011	28 August 2017	not Passed	remaining defects	passed	passed (but difficult)	a hole is partially filled. Dark stains and partially filled hole suppressed after cleaning. 2 dark spots remain
A012	28 August 2017	Passed	Passed	passed	Passed	some dark stains cleaned. A brown zone around a screw hole
A013	28 August 2017	not Passed	Passed	passed	Passed	"suspicious" dark zones. A suspicious mark (lack of copper ?) and a brown mark
A014	28 August 2017	not Passed	Passed	passed	Passed	some dark stains cleaned. A brown zone around a screw hole
A015	11 September 2017	Passed	20 September 2017	passed	Passed	
A016	11 September 2017	Passed	20 September 2017	passed	Passed	3,3 bar HV not passed the 2nd time BUT passed after pumping again (without dismount)
A017	11 September 2017	Passed	20 September 2017	passed	Passed	
A018						To be delivered
A019	11 September 2017	Passed	20 September 2017	passed	Passed	
A020	11 September 2017	Passed	20 September 2017	passed	Passed	
A021	07 november 2017	Passed	Passed	Passed	Not Passed	delivered 07/11/2017, tested nov 20 2017
A022	11 September 2017	Passed	20 September 2017	passed	Passed	
A023	11 September 2017	Passed		passed	Passed	
A024	11 September 2017	Passed		passed	Passed	
A025	19 september 2017					To be delivered
A026	07 november 2017	Passed	Passed	Passed	Passed	delivered 07/11/2017
A027	19 september 2017	Passed	Passed	passed	Passed	
A028	19 september 2017	Passed	Passed	passed	Passed	
A029	19 september 2017	Passed	Passed	4500V/55 nA	Passed	
A030	19 september 2017	Passed	Passed	passed	Passed	
A031	19 september 2017	Passed	Passed	passed	passed	
A032	19 september 2017	Passed	Passed	passed	passed	
A033	07 november 2017	Passed	Passed	Passed	Passed	delivered 07/11/2017
A034	19 september 2017	Passed	Passed	passed	passed	
A035	19 september 2017	Passed	Passed	passed	passed	
A036	19 september 2017	Passed	Passed	passed	passed	
A037	19 september 2017	Passed	Passed	passed	passed	
A038	19 september 2017	Passed	Passed	passed	passed	
A039	07 november 2017	Passed	Passed	passed	Passed	
A040	07 november 2017	Passed	Passed	passed	Passed	
A041	07 november 2017	Passed	Passed	passed	Passed	
A042	07 november 2017	Passed	Passed	Passed	Not Passed	
A043	07 november 2017	Passed	Passed	Passed	Not Passed	
A044	17 november 2017	Passed	Passed	passed	passed	
A045-A050	PRODUCTION PAUSED !					
A051-A062						
A063-A078						

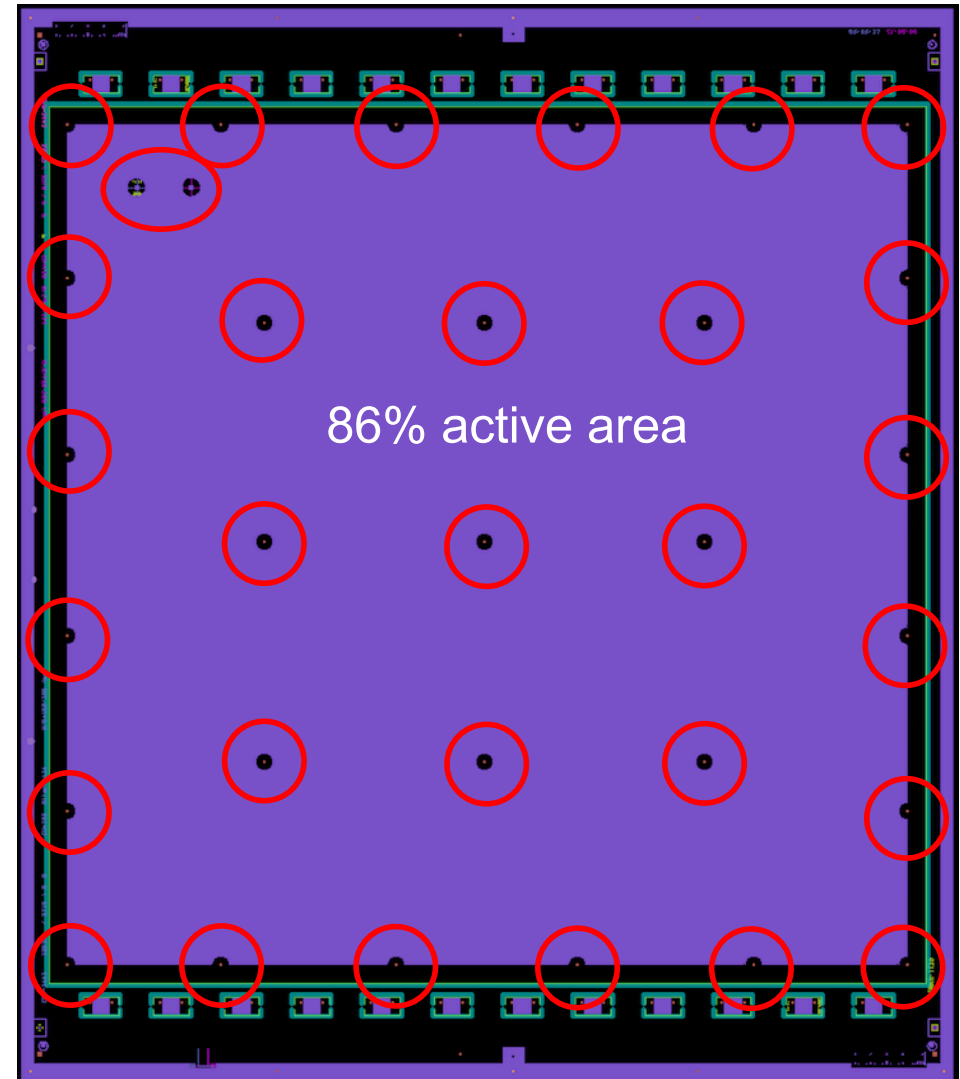
ELTOS QA/QC, CEA QA/QC, and this production status file are uploaded and regularly updated on the WA105 Integration CERNBox

42 delivered 39 qualified (A001 A002 included)
36 LEMs (A045-A080) left to be produced within CEA contract

CFR-34 (42 LEMs produced)

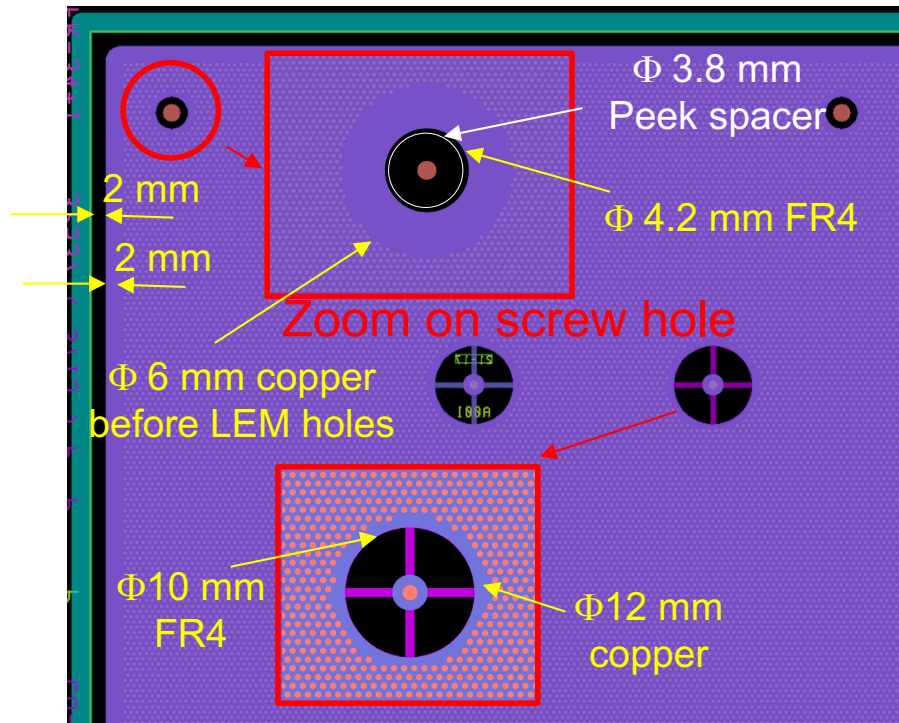


Modified version CFR-35 (2 prototypes)
Around screw holes, HV connections & LEM borders

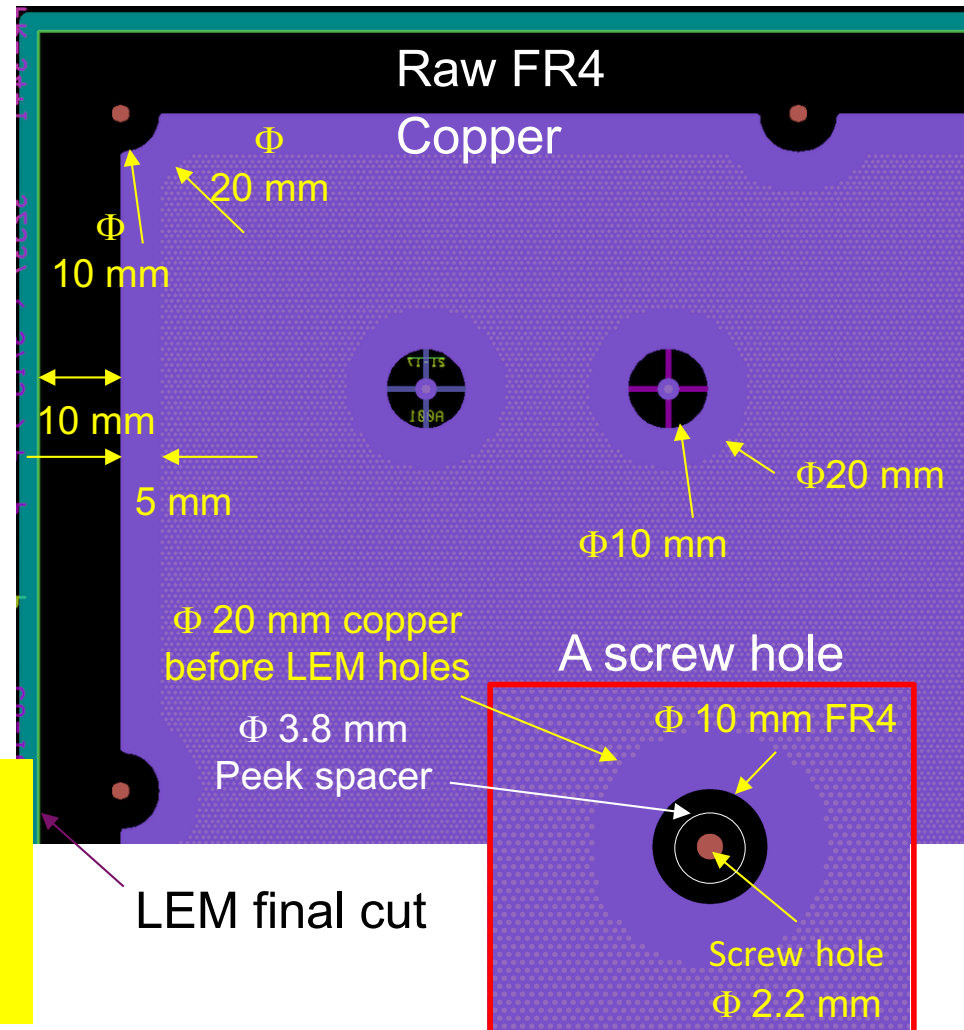


- 2 mm FR4 + 2 mm plain copper borders increased to 10 mm FR4 + 5 mm plain copper
- $\Phi 10$ mm FR4 + $\Phi 20$ mm copper around screw holes and HV connections

CFR-34 LEM production design



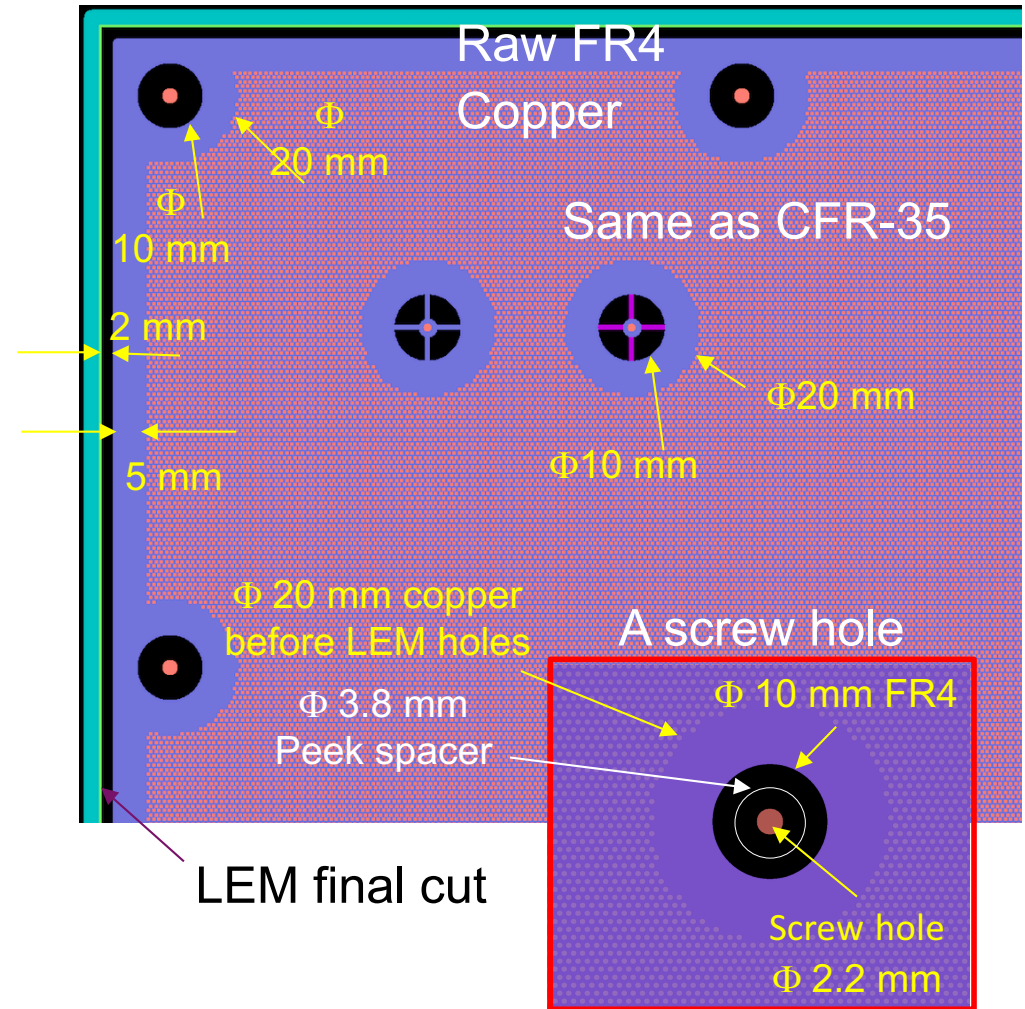
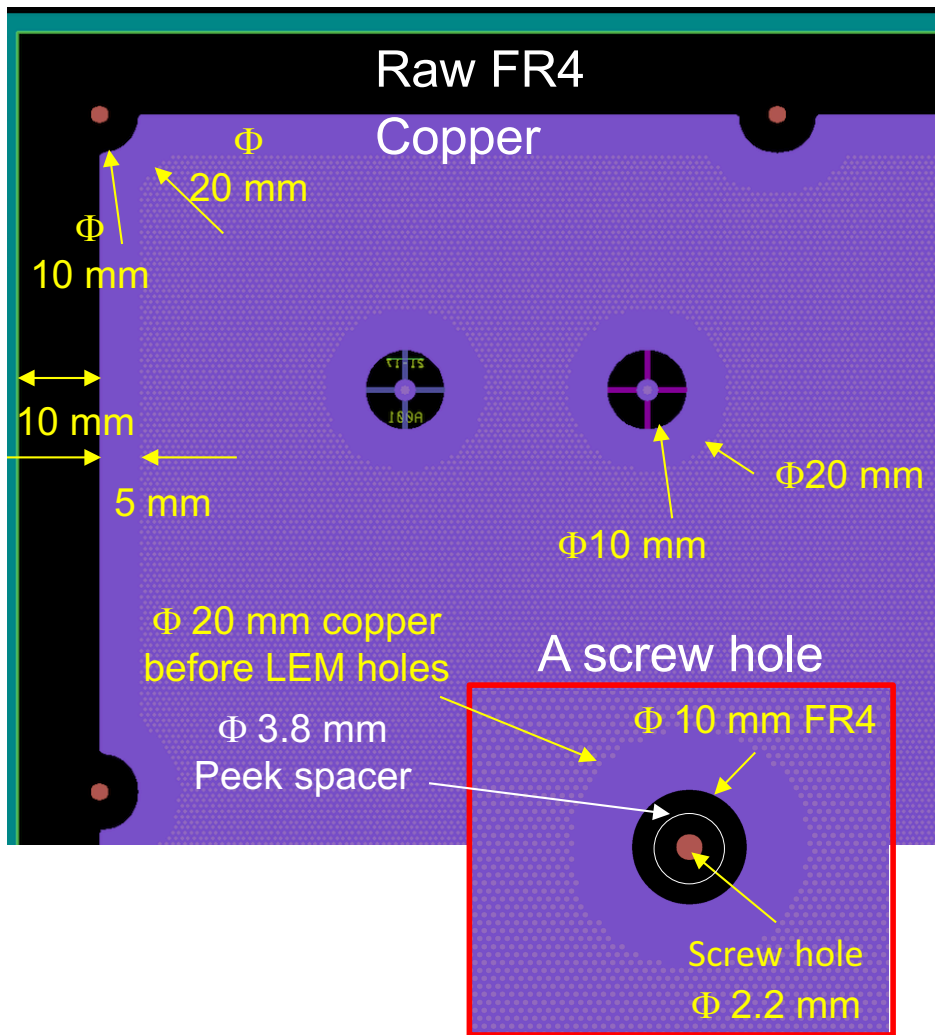
« conservative » design CFR-35



2 prototypes of a new design (CFR-36) with the FR4 border back to 2 mm wide and 92% active area were ordered to ELTOS (production time 3 weeks)

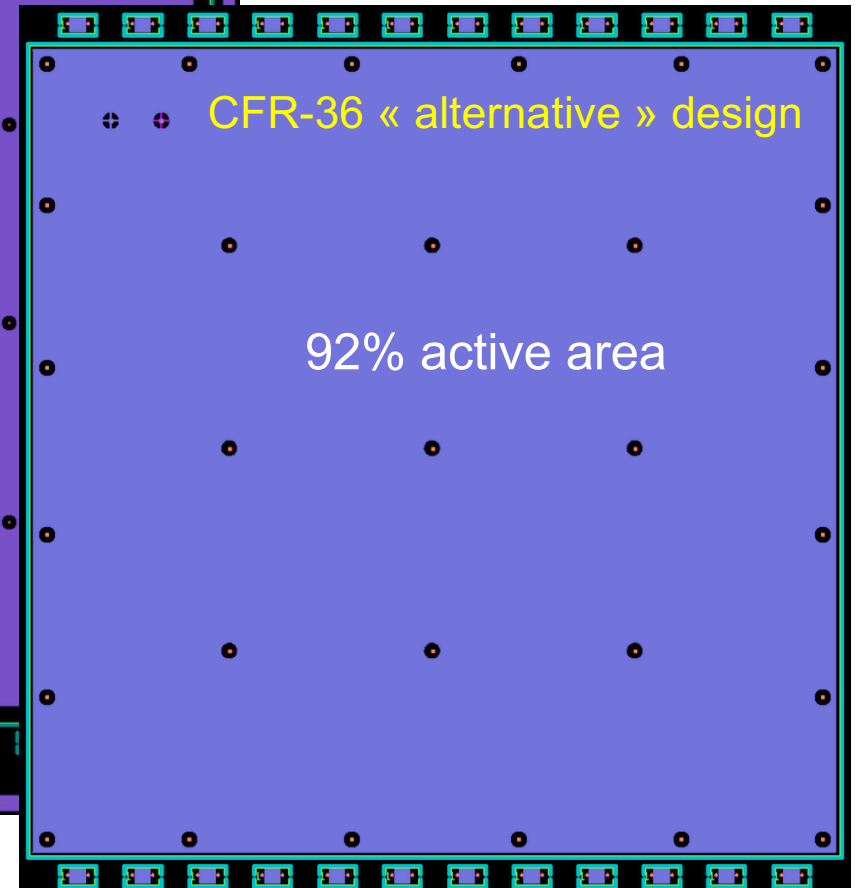
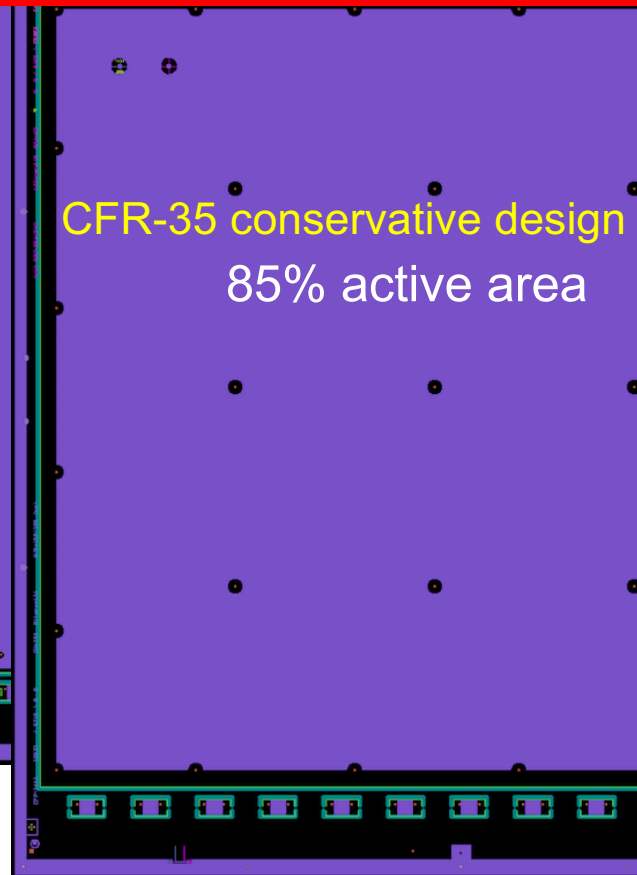
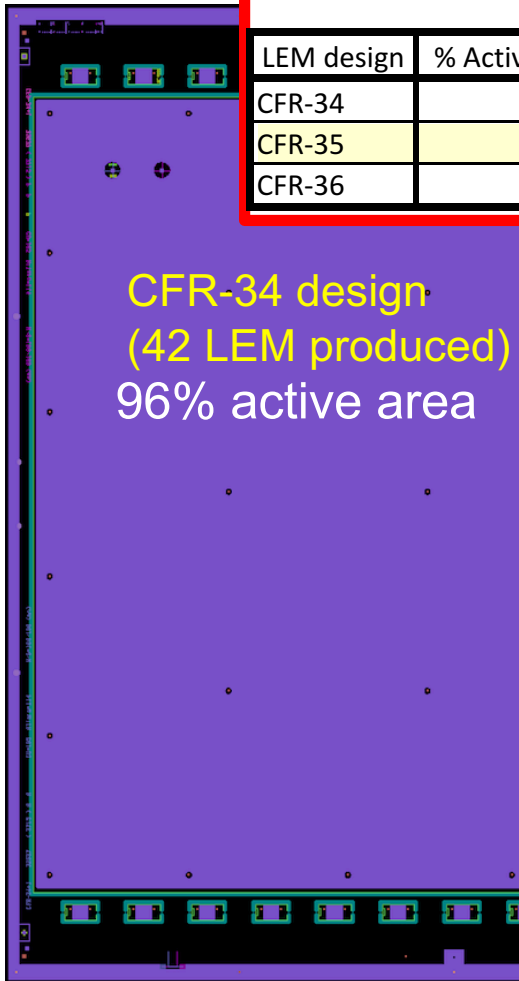
« conservative » design CFR-35

« alternative » design CFR-36



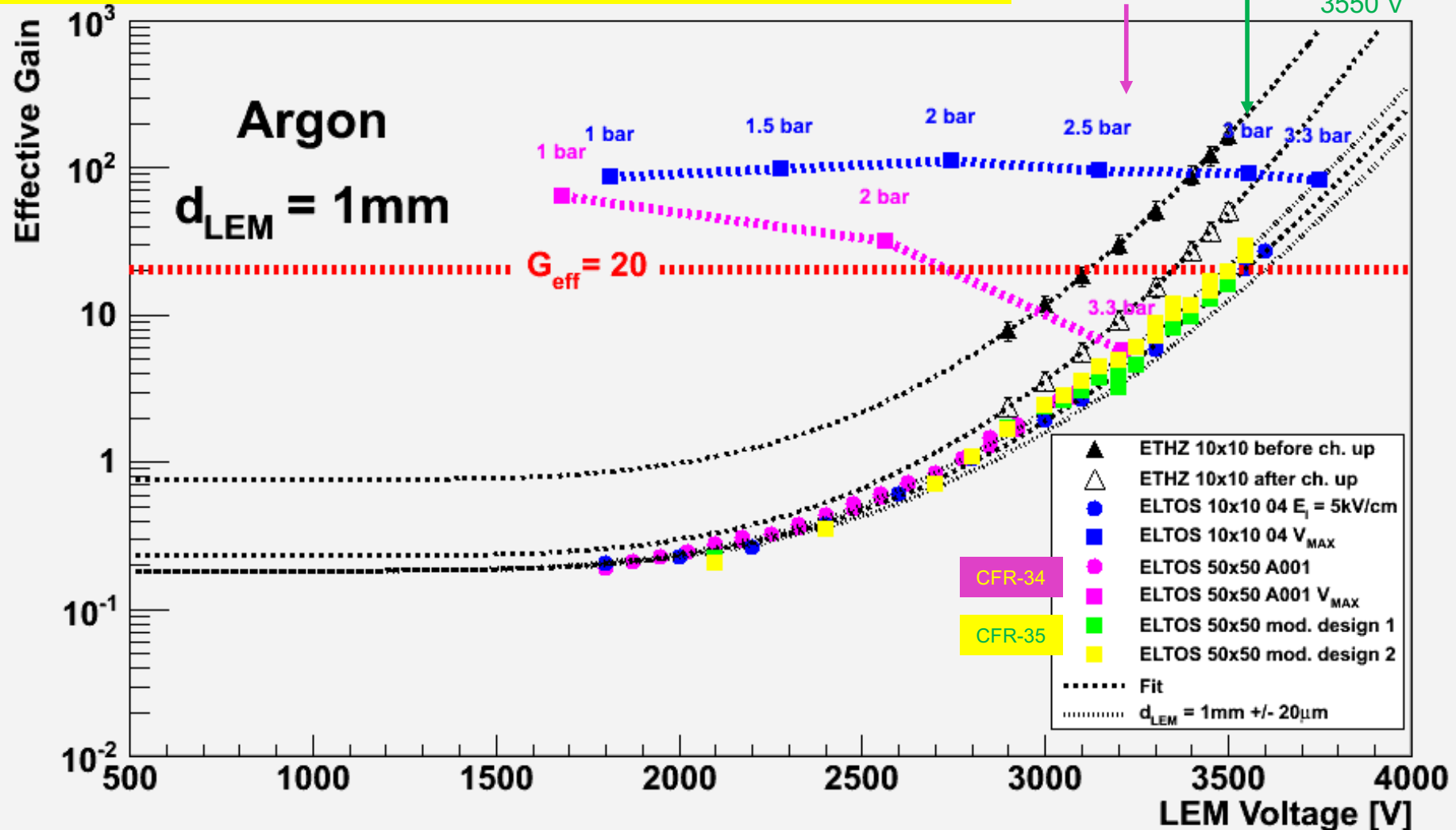
Same as CFR-35

LEM design	% Active area	LEM borders		Screw holes		HV connections	
		FR4	copper guard ring	FR4 ring Φ	copper guard ring Φ	FR4 ring Φ	copper guard ring Φ
CFR-34	96.2	2 mm	2 mm	4.2 mm	6 mm	10 mm	12 mm
CFR-35	85.8	10 mm	5 mm	10 mm	20 mm	10 mm	20 mm
CFR-36	92.1	2 mm	5 mm	10 mm	20 mm	10 mm	20 mm

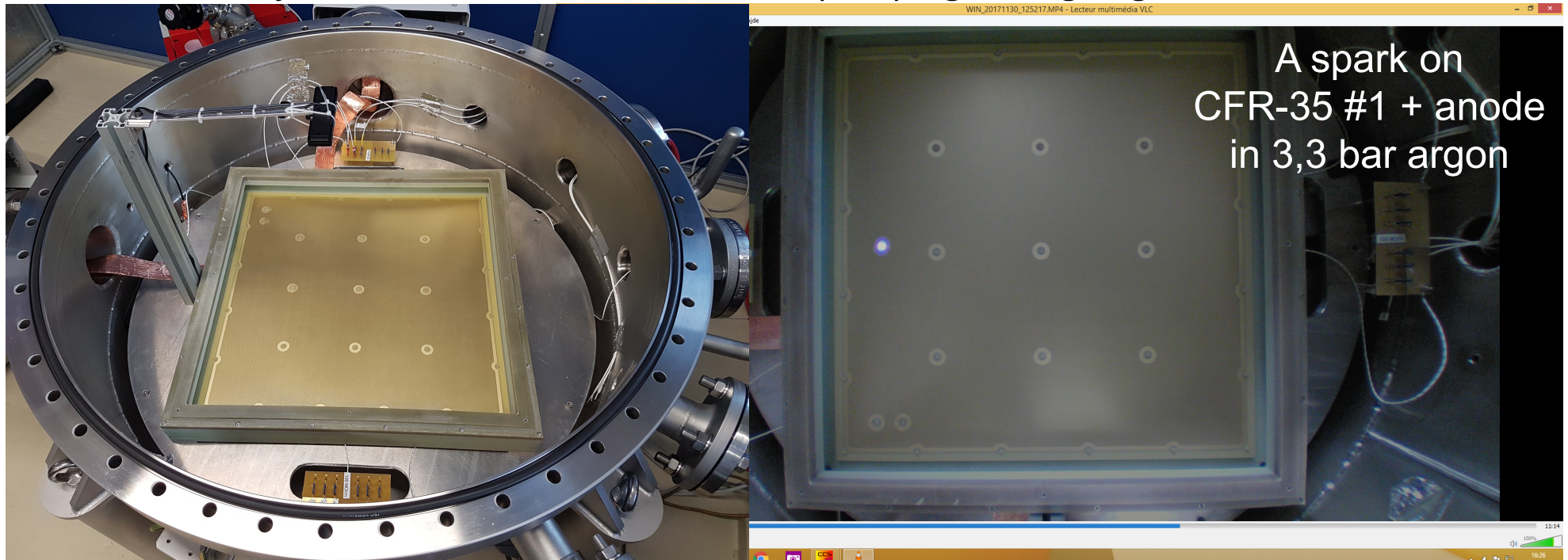


@3200 V: CFR-34 barely maintains HV (few minutes)
 + Anode CFR-35 #1 was operated during 24h with 30 sparks

CFR-34 max HV 3200 V
 CFR-35 max HV 3550 V



- A wide angle webcam was installed inside the vessel. A feedthrough for the USB cabling of the camera was made.
- The camera was successfully operated in dry air at NTP and in argon at 3.3 bar. But the USB cable feedthrough had a tiny leak which needed to be fixed. A new version of the feedthrough was made and passed the leak tests.
- The setup is ready for recording of the location of sparks in pure argon at 3.3 bar for a CFR-34 production LEM and a CFR-35 “conservative” design LEM mounted on an anode. CFR-34 LEM A002 was just mounted into the vessel and pumping is on-going.



- Anode gerber files (CERN-1359) were validated in June 2017 for the order by ETHZ of 80 anodes to ELTOS. Technical specifications (gerber files, PCB stack, QA/QC) were fixed to cope with both ELTOS and ELVIA requirements. CEA/Irfu ordered 2 Anode PCB to ELVIA in March 2017. Quality of these 2 ELVIA anodes is similar to the ELTOS anodes.
- The cost for 72 Anodes is close to the 25 k€ threshold (≈ 350 €/PCB) demanded by CEA to by a call for tender at CEA. Under this threshold, CEA/Irfu will be authorized to proceed with a simplified procedure based on the selection of the manufacturer among 3 quotations (ELTOS, ELVIA, OUESTRONIC are foreseen). A two weeks administrative delay will be required to place the order.
- Production delay for 80 anodes is 46 working days (ELVIA July 2017 quotation). Updated quotations were asked and the order should be placed by January 11th (beginning of a 2 weeks closing of the CEA order procedures for yearly maintenance).
- Soldering of the KEL connectors requires a large enough oven for global soldering. This kind of oven is rare on the market and the cost of the soldering of 20 KEL connectors of 1 anode is 120-150 € (ELTOS-ELVIA). The OUESTRONIC company offers an alternative method using a vapor phase oven for 58€/anode. This method still needs to be tested.
- Q/C by the manufacturer are standard ones driven by the IPC standards (A.O.I). Q/C of KEL soldering connections is done by WA105 thanks to the test bench provided by CEA/Irfu.

- 37 CFR-34 LEMs are ready to be shipped to CERN for mounting on anode + CRP
- ELTOS production quality is good (no delivered LEM rejected up to now) but 8 LEMs over 42 needed a second cleaning/drying to pass the QA/QC HV tests.
- 2 CFR-35 "conservative" design prototype LEMs were tested. Both presents the same gain in pure argon at 3.3 bar and room temperature up to 3500 ($G \sim 20$).
- The HP vessel is equipped with a camera. Recording of the sparking locations in pure argon @ 3,3 bar for a CFR-34 Vs a CFR-35 LEMs designs is on-going.
- ELTOS is prepared to resume the production of the remaining 36 LEMS under the CEA contract and waits for our decision (which LEM design).
- Critical path for LEM is probably the 3,3 bar QA/QC at Saclay for which it is today difficult to go faster than 6 LEMs per week without the support of 1 technician from the collaboration.
- Order(s) for the production (PCB & KEL connector soldering) of 80 anodes by CEA/Irfu should be made by january 11th in order to instrument 4 CRP by may 2018.