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Germanium 4 Fold Segmented SuperClover Detector N° 2 OPERATING MANUAL

Ind.	Rédigé par / Written by	Vérifié par / Verified by	Approuvé par / Approved by
A	Date / Date 12-Sep-01	Date / Date	Date / Date
	Nom / Name PASCAL QUIRIN	Nom / Name ERIC PACHOUD	Nom / Name DANIEL GUTKNECHT
	Visa / Visa	Visa / Visa	Visa / Visa

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**GERMANIUM 4 FOLD SEGMENTED SUPERCLOVER DETECTOR
OPERATING MANUAL**

HISTORIQUE DES MODIFICATIONS / MODIFICATIONS CHRONOLOGY			
Ind. Rev.	Date Date	Origine des modifications Modifications origin	Paragraphes concernés Related sections
A	12-Sep-01	Origin of the document	All

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1. PRELIMINARY.

CAUTION

EXAMINE THE SUPERCLOVER DETECTOR YOU HAVE RECEIVED.

***IN CASE OF OBVIOUS SHIPPING DAMAGE NOTIFY THE CARRIER
AND FILL IN A DAMAGE CLAIM.***

***KEEP CAREFULLY THE WOODEN TRANSPORTATION CASE SPECIALLY
DEVELOPED FOR AIRCRAFT SHIPMENT OF THE SUPERCLOVER DETECTOR.***

***NO DETECTOR WILL BE TAKEN UNDER WARRANTY
IF IT IS SENT BACK IN A DIFFERENT PACKING
AND AN ADDITIONAL ORIGINAL TRANSPORTATION CASE
WILL BE CHARGED IN THIS CASE.***

READ CAREFULLY THIS MANUAL BEFORE YOU SET UP THE SUPERCLOVER.

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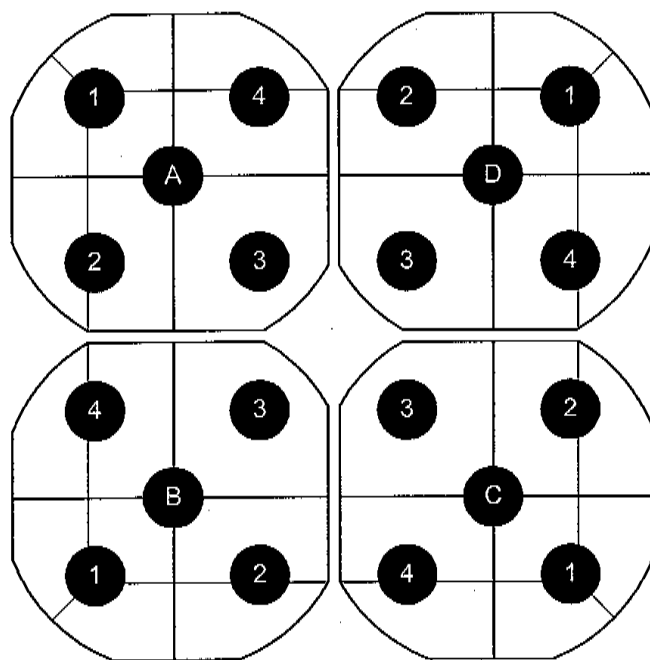
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2. ARRANGEMENT OF FOUR COAXIAL GERMANIUM DETECTORS.

The first CLOVER detector was developed by EURISYS MESURES in the frame of the EUROGAM collaboration.

It consists of four coaxial N-type Germanium detectors, arranged like a four leaf Clover.

For the segmented SuperClover the outer p-type contact of each of the crystals is segmented longitudinally to split the detector in four sectors. The segmentation planes are shown on the figure below. In addition to the four energy signals delivered from the inner contact by an AC coupled preamplifier, there are 16 position signals read-out individually by 16 DC coupled preamplifier.



Front view.

The starting dimension of each Germanium crystals is 70 mm diameter and 140 mm length.

Each crystal has a round section with four flat parts at 90°.

The gap between two adjacent crystals is 0.8 mm, with no material giving absorption above 20 keV. This allows a good transmission of the Compton Scattered photons from one crystal to its neighbour.

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The crystals are held only by the rear side. This reduces the amount of material around the detector and allows a high escape transmission to the anti-coincidence shielding.

The four crystals are mounted in a cryostat in a cap with a rectangular section.

Standard not segmented Clover :



(Not at scale)

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3. GETTING STARTED WITH YOUR SUPERCLOVER GERMANIUM DETECTOR.

Unpack and examine the SuperClover detector for any obvious shipping damage. If damage is evident, do not unpack it. Notify the carrier and file a damage claim. Contact your local EURISYS MESURES representative for assistance.

The EURISYS MESURES Germanium SuperClover detector is shipped in a special designed wooden box.

If the SuperClover detector is shipped at room temperature, cool it down by using the fill funnel delivered with, or by an automatic filling system. In case of manual cooling, the dewar, in a vertical position, must be filled 4 times. Filling way is as follows. Unscrew the dewar plug from the dewar fill opening. Insert the fill tube of the funnel into the dewar. The first liquid nitrogen poured inside, immediately boils off from the warm dewar. Continue to pour during 45 minutes till boiling decreases seriously. A second filling 30 minutes later is necessary to replace nitrogen which boils off rapidly during the initial period of cooling. Wait 4 hours and top off the dewar again. A 4th filling 12 hours later is important to fill the dewar again. If the SuperClover detector is often moved, fill the detector every 24 hours. Allow 48 hours after the first filling before steady conditions. The SuperClover in a static position has then about 42 hours holding time. A manual or automatic liquid nitrogen transfer system is available from EURISYS MESURES. Never block the dewar pop-off valve located at the rear side of the dewar to prevent the buildup of dangerous pressure. It is possible to vent the dewar, but in this case open the pressure valve delicately a few seconds. Never block it in an open position.

After 48 hours cooling connect only the preamplifier power supply cable in a first time. Doing that reheats the preamplifier rooms and avoids possible troubles which may be due to moisture. The preamplifier power cable supplies the four charge sensitive full volume preamplifiers, the 16 charge sensitive position preamplifiers and the alarm card: the power dissipated by these cards minimizes the risk of condensation inside the preamplifier room.

After proper cooling the SuperClover detector and waiting the necessary 48 hours time after the first filling, connect the complete system to external electronics. Check that the signals of the four energy preamplifiers and 16 position preamplifiers are present, before supplying the **POSITIVE** high voltage to each crystal. Verify that every high voltage unit is set to zero before connecting the SHV high voltage connectors. Apply high voltage by steps of 500 V maximum.

NOTE : it may be possible that without any high voltage applied to the four crystals, one (or more) position preamplifiers may be blocked. By applying some hundred volt, they have to operate.

The polarity of the high voltage is **POSITIVE** although the Germanium crystals are N type. The outer segmented surfaces are grounded through the position preamplifiers, so the inner contact of each crystal is polarized with positive high voltage. The signals are read out with a AC coupled preamplifier PSC 823 with a cooled FET.

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During the increase of bias, it is very important to observe the four central outputs after every 500 V step. At each step the preamplifiers block. After a short time the signal reappears. The big noise of the unbiased crystals should decrease when applying the high voltage. The base line of the amplifier connected to the four preamplifiers should be carefully observed for any increasing of noise or any oscillation. Stop increasing the high voltage if signal becomes noisy.

When the system reaches the recommended value of the four high voltages indicated in the specification sheet or on the labels, expose the crystals to a radioactive source.

Set the amplifier to 6 μ s (see data sheet) shaping time and adjust correctly the Pole/Zero. The full width at half maximum (FWHM) for each crystal is ≤ 2.6 keV for 1.33 MeV gamma ray of ⁶⁰Co. For 122 keV gamma ray from ⁵⁷Co source, the FWHM is ≤ 1.7 keV. The resolutions indicated in the data sheet are measured at a count rate of 1000 counts per second, with a number of counts in the photopeaks $\geq 10^5$.

The relative efficiency and the Peak to Compton ratio are measured at 25 cm from the center of the face of each crystal. The distance between the front surface of the Germanium detectors and the end cap is 8 mm. The four detectors have a minimum relative efficiency of 63%.

The FWHM energy resolution for 1.33 MeV gamma rays obtained from each of the 16 position signals is less than 5 keV (about 3 keV depending of the position). This measurement is performed with the ⁶⁰Co source placed on the central axis of each crystal.

4. TRANSPORT.

Never transport a cold SuperClover detector wrapped in insulating materials otherwise the cryostat will freeze. Use the special developed travel cases as EURISYS MESURES after the complete warm-up period (the red LED is flashing). Prevent excessive shock although it is carried in its original packing case.

Transportation case must be used for car or truck travel.

To travel it from one room to an other, do never use a kart. Travel and handle it by hand with two or more peoples.

To travel it from one building to another do not use a kart with "hard wheels". Use only a kart with air pressurized wheels and avoid chocks due to steps.

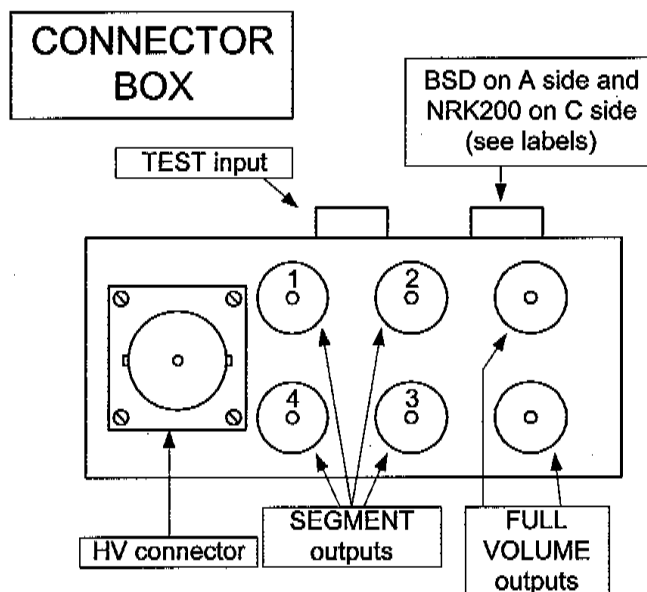
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5. ELECTRICAL CHARACTERISTICS.

The segmented SuperClover detector is equipped with 20 resistive charge sensitive preamplifiers PSC 823. Each central core preamplifier has two negative energy outputs with a sensitivity of about 300 mV/MeV, the DC offset is less than ± 50 mV and the time constant of the output is 50 μ second. The 16 position preamplifiers are also PSC 823 cards. Each position channel has one negative output with a sensitivity of about 300 mV/MeV.

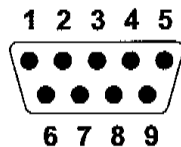


All the preamplifier outputs are SMA connectors (Female). The high voltage connectors are SHV type (Male). A test input, for each full volume preamplifier, is available on a SMA connector (Female). The preamplifier supply connector, match the standard NIM preamplifier power supply, as provided from an EURISYS MESURES spectroscopy amplifier.

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**Power supply 9 pin
male connector**

Layout :

- 1 : ground
- 2 : ground
- 3 : n.c.
- 4 : + 12 V
- 5 : bias shut down signal.
- 6 : - 24 V
- 7 : + 24 V
- 8 : n.c.
- 9 : - 12 V

A temperature sensor is located on the mount near the four crystals, within the cryostat. The alarm card is connected to the sensor and gives a EURISYS MESURES standard signal on a SMA connector, shutting down the high voltage supply when the temperature rises above a safe operating level. Verify that your high voltage units are compatible with the remote shut down level : high impedance (open circuit) if the SuperClover detector is cold and 0V (short circuit to ground) in case of alarm. Verify also that the four high voltage units are connected in parallel to the remote shut down signal.

The bias shut down signal is also available on the power supply connector, on pin 5.

A red light-emitting diode, mounted on a 30 cm cable on the cryostat, comes on steady when the detector temperature is too high and in this case the high voltages must be turned off, if not connected to the high voltage shut down.

This red LED flashes when the detector temperature is close to ambient temperature and indicates the end of a heating cycle. Never cool the cryostat before this red LED flashes. The cryostat can be cooled again only after this indication, when it has gone through a complete heat cycle.

6. ANNEALING.

The manufacturing of the Germanium SuperClover detector is such that it will accommodate several neutron damage repairs without any loss in detection efficiency.

Access to the cryostat vacuum is available, through a VOP10 operator so that simple in-cryostat repairs (e.g. following vacuum deterioration or neutron damage) can be carried out.

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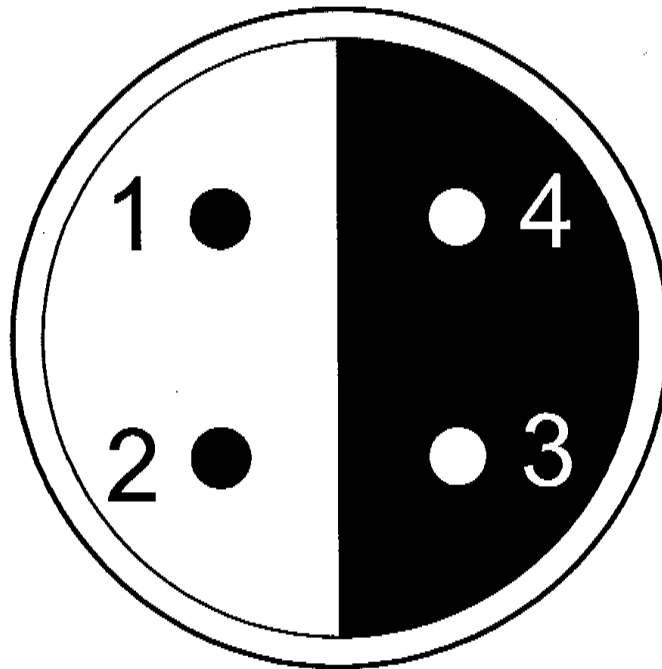
A special connector allows the monitoring of the annealing of the SuperClover detector. On this 4 pins LEMO 1S connector are available a heating resistance for reheating the inside of the cryostat and a temperature sensor (Pt100) for measuring the inner temperature. This temperature sensor can also be used to control the temperature of the SuperClover detector.

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7. ANNEALING CONTROL CONNECTOR LAYOUT.

PIN 1 & PIN 2 (male pins) : heating resistor.
PIN 3 & PIN 4 (female pins) : temperature sensor Pt100.



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8. PT100 : TEMPERATURE VS RESISTANCE TABLE.

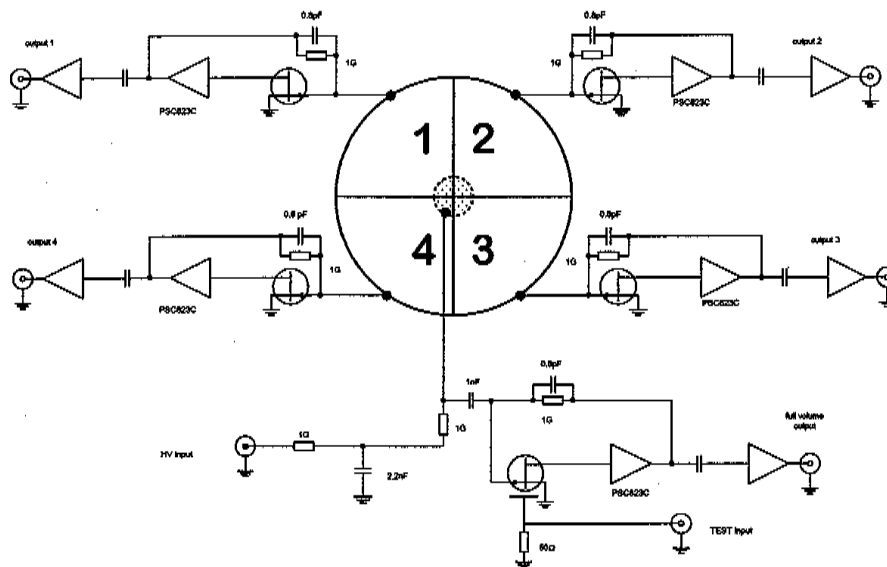
°C	Ohm	°C	Ohm	°C	Ohm	°C	Ohm	°C	Ohm	°C	Ohm
-220	10,41	-160	35,48	-100	60,20	-40	84,21	20	107,79	80	130,89
-219	10,81	-159	35,90	-99	60,61	-39	84,61	21	108,18	81	131,27
-218	11,20	-158	36,31	-98	61,01	-38	85,00	22	108,57	82	131,65
-217	11,60	-157	36,73	-97	61,42	-37	85,40	23	108,95	83	132,03
-216	11,99	-156	37,15	-96	61,82	-36	85,79	24	109,34	84	132,41
-215	12,39	-155	37,57	-95	62,23	-35	86,19	25	109,73	85	132,80
-214	12,78	-154	37,98	-94	62,63	-34	86,59	26	110,12	86	133,18
-213	13,18	-153	38,40	-93	63,04	-33	86,98	27	110,51	87	133,56
-212	13,57	-152	38,82	-92	63,44	-32	87,38	28	110,89	88	133,94
-211	13,97	-151	39,23	-91	63,85	-31	87,77	29	111,28	89	134,32
-210	14,36	-150	39,65	-90	64,25	-30	88,17	30	111,67	90	134,70
-209	14,78	-149	40,07	-89	64,65	-29	88,57	31	112,06	91	135,08
-208	15,19	-148	40,48	-88	65,06	-28	88,96	32	112,44	92	135,46
-207	15,61	-147	40,90	-87	65,46	-27	89,36	33	112,83	93	135,84
-206	16,03	-146	41,31	-86	65,86	-26	89,75	34	113,22	94	136,22
-205	16,45	-145	41,73	-85	66,27	-25	90,15	35	113,61	95	136,60
-204	16,86	-144	42,14	-84	66,67	-24	90,55	36	113,99	96	136,98
-203	17,28	-143	42,56	-83	67,07	-23	90,94	37	114,38	97	137,36
-202	17,70	-142	42,97	-82	67,47	-22	91,34	38	114,77	98	137,74
-201	18,11	-141	43,39	-81	67,88	-21	91,73	39	115,15	99	138,12
-200	18,53	-140	43,80	-80	68,28	-20	92,13	40	115,54	100	138,50
-199	18,96	-139	44,21	-79	68,68	-19	92,52	41	115,93	101	138,88
-198	19,38	-138	44,63	-78	69,08	-18	92,92	42	116,31	102	139,26
-197	19,81	-137	45,04	-77	69,48	-17	93,31	43	116,70	103	139,63
-196	20,23	-136	45,45	-76	69,88	-16	93,71	44	117,08	104	140,01
-195	20,66	-135	45,87	-75	70,29	-15	94,10	45	117,47	105	140,39
-194	21,08	-134	46,28	-74	70,69	-14	94,49	46	117,86	106	140,77
-193	21,51	-133	46,69	-73	71,09	-13	94,89	47	118,24	107	141,15
-192	21,93	-132	47,10	-72	71,49	-12	95,28	48	118,63	108	141,52
-191	22,36	-131	47,52	-71	71,89	-11	95,68	49	119,01	109	141,90
-190	22,78	-130	47,93	-70	72,29	-10	96,07	50	119,40	110	142,28
-189	23,21	-129	48,34	-69	72,69	-9	96,46	51	119,78	111	142,66
-188	23,63	-128	48,75	-68	73,09	-8	96,86	52	120,17	112	143,04
-187	24,06	-127	49,16	-67	73,49	-7	97,25	53	120,55	113	143,41
-186	24,49	-126	49,57	-66	73,89	-6	97,64	54	120,94	114	143,79
-185	24,92	-125	49,99	-65	74,29	-5	98,04	55	121,32	115	144,17
-184	25,34	-124	50,40	-64	74,68	-4	98,44	56	121,70	116	144,55
-183	25,77	-123	50,81	-63	75,08	-3	98,82	57	122,09	117	144,93
-182	26,20	-122	51,22	-62	75,48	-2	99,21	58	122,47	118	145,30
-181	26,62	-121	51,63	-61	75,88	-1	99,61	59	122,86	119	145,68
-180	27,05	-120	52,04	-60	76,28	0	100,00	60	123,24		
-179	27,47	-119	52,45	-59	76,68	1	100,39	61	123,62		
-178	27,90	-118	52,86	-58	77,07	2	100,78	62	124,01		
-177	28,32	-117	53,27	-57	77,47	3	101,17	63	124,39		
-176	28,74	-116	53,68	-56	77,87	4	101,56	64	124,77		
-175	29,17	-115	54,09	-55	78,27	5	101,95	65	125,16		
-174	29,59	-114	54,49	-54	78,66	6	102,34	66	125,54		
-173	30,01	-113	54,90	-53	79,06	7	102,73	67	125,92		
-172	30,43	-112	55,31	-52	79,46	8	103,12	68	126,30		
-171	30,86	-111	55,72	-51	79,85	9	103,51	69	126,69		
-170	31,28	-110	56,13	-50	80,25	10	103,90	70	127,07		
-169	31,70	-109	56,54	-49	80,65	11	104,29	71	127,45		
-168	32,12	-108	56,94	-48	81,04	12	104,68	72	127,83		
-167	32,54	-107	57,35	-47	81,44	13	105,07	73	128,22		
-166	32,96	-106	57,76	-46	81,83	14	105,46	74	128,60		
-165	33,38	-105	58,17	-45	82,23	15	105,85	75	128,98		
-164	33,80	-104	58,57	-44	82,63	16	106,23	76	129,36		
-163	34,22	-103	58,98	-43	83,02	17	106,62	77	129,74		
-162	34,64	-102	59,39	-42	83,42	18	107,01	78	130,13		
-161	35,06	-101	59,79	-41	83,81	19	107,40	79	130,51		

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9. SUPERCLOVER DETECTOR FUNCTIONAL BLOCK DIAGRAM.

One crystal block diagram :

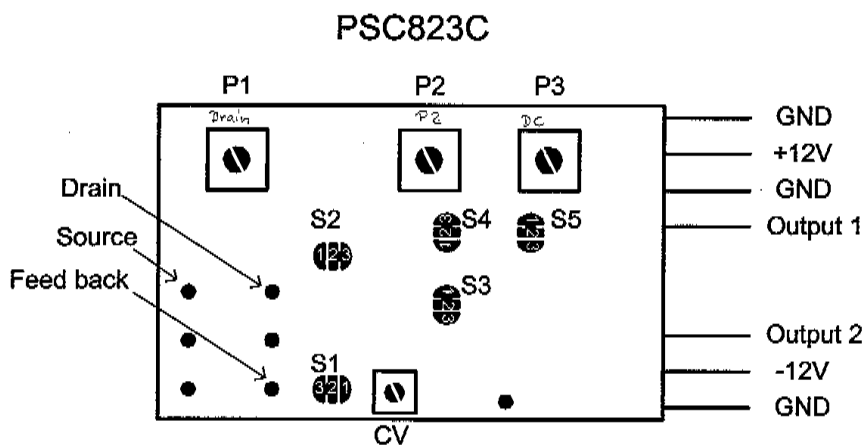


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10. PREAMPLIFIER PSC823C CARD.

10.1. PSC823C FULL VOLUME CARD.



Link	Default position	Remark :
S1	2-3	Non-inverting
S2	2-3	
S3	1-2	Standard p/z cancellation
S4	2-3	
S5	1-2	Normal count rate

10.2. PSC823C SEGMENT CARD.

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Link	Default position	Remark :
S1	1-2	inverting
S2	1-2	
S3	1-2	Standard p/z cancellation
S4	2-3	
S5	1-2	Normal count rate

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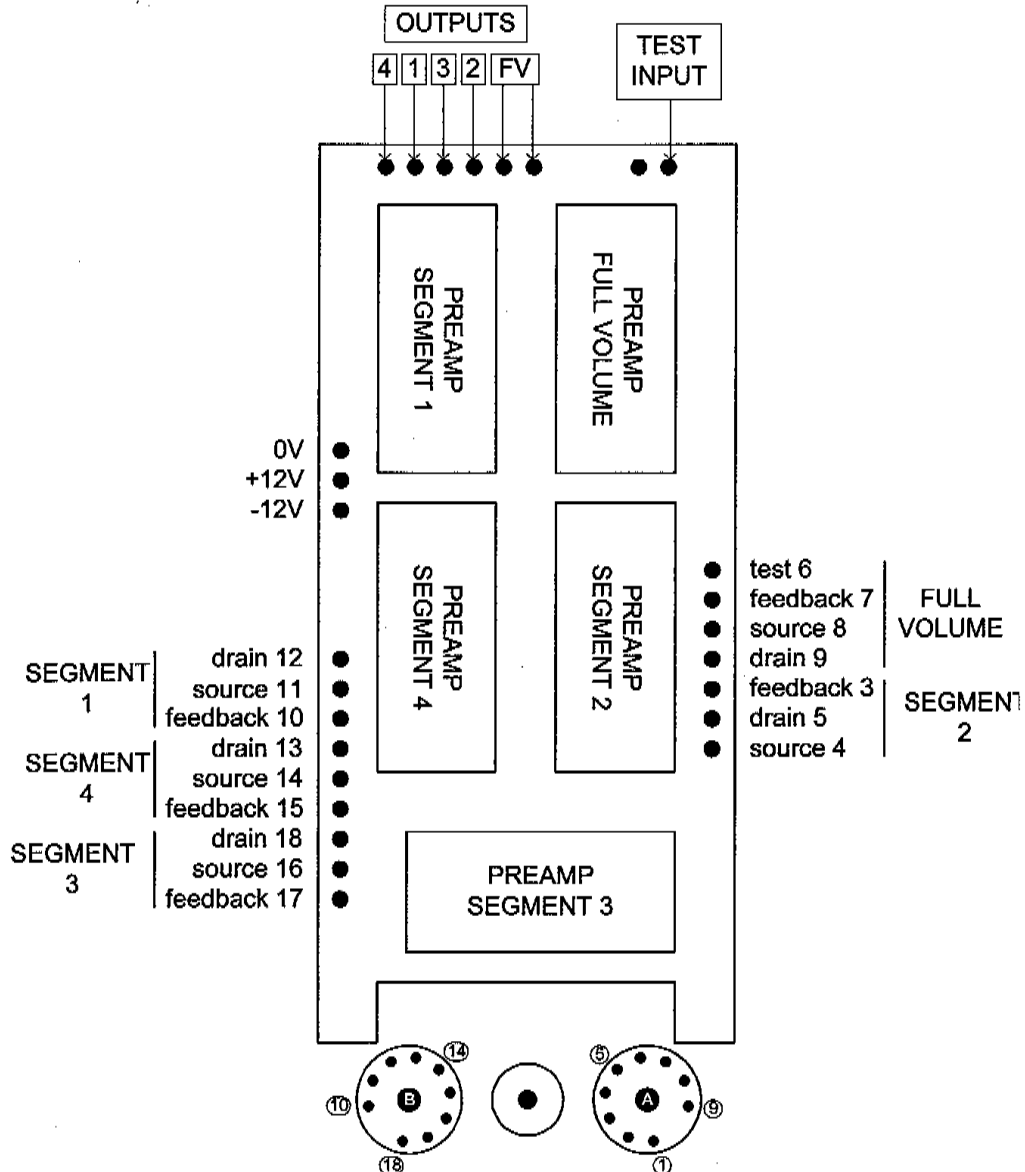
**GERMANIUM 4 FOLD SEGMENTED SUPERCLOVER DETECTOR
OPERATING MANUAL**

10.3. PSC823C POTENTIOMETERS:

Potentiometer	Function
P1	Drain current
P2	Pole zero
P3	DC offset
CV	Band width adjust

**GERMANIUM 4 FOLD SEGMENTED SUPERCLOVER DETECTOR
OPERATING MANUAL**

10.4. PSC823C MOTHER CARD:



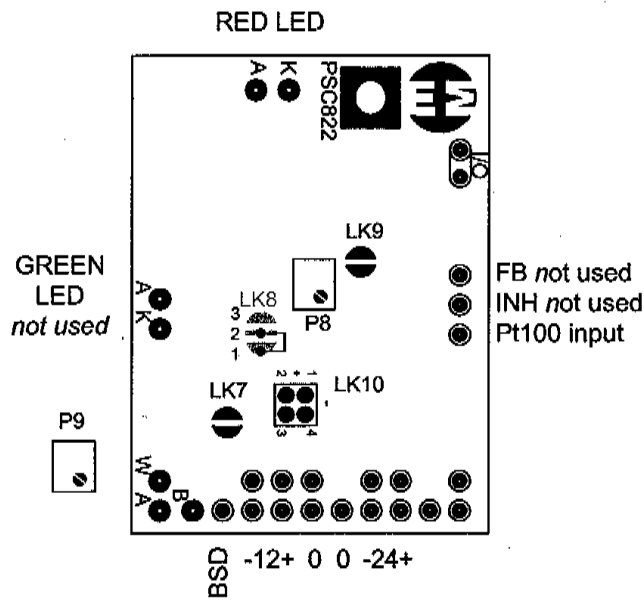
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Type NT	Emetteur 010	Code Article OC115402	Indice A	Format 4	Page 19 / 22
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OPERATING MANUAL**

11. PSC822 ALARM CARD.

11.1. ALARM CARD LAYOUT :



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OPERATING MANUAL**

11.2. ALARM CARD LINKS AND POTENTIOMETER.

Link	Function	Position
LK7	High voltage remote shut down standard	No alarm : Open (high impedance)
LK8		Alarm : Position 1-2 : (0V)
LK9	Green LED threshold	Not used
LK10	INHIBITION signal polarity	Not used

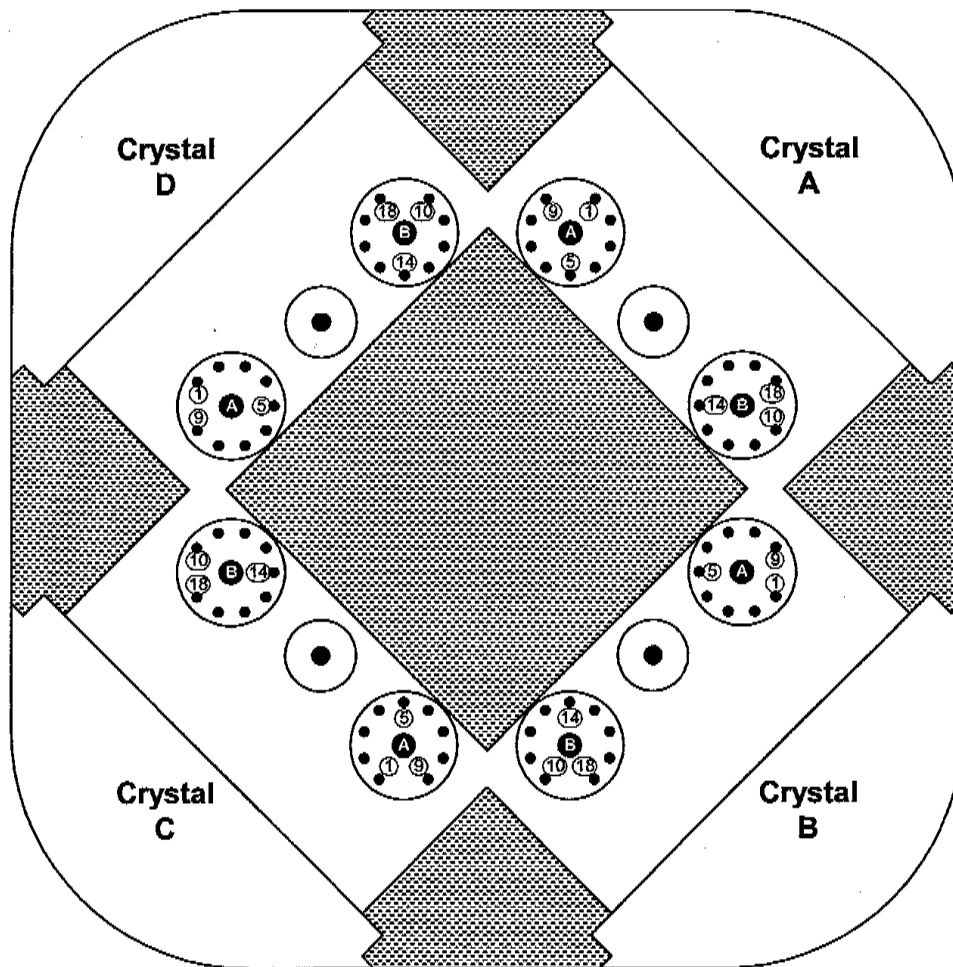
Potentiometer	Function	Remark
P8	Temperature alarm threshold	
P9	Inhibition time	Not used

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12. SIGNAL FEEDTHROUGH.

12.1. REAR OUTSIDE VIEW.



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OPERATING MANUAL**

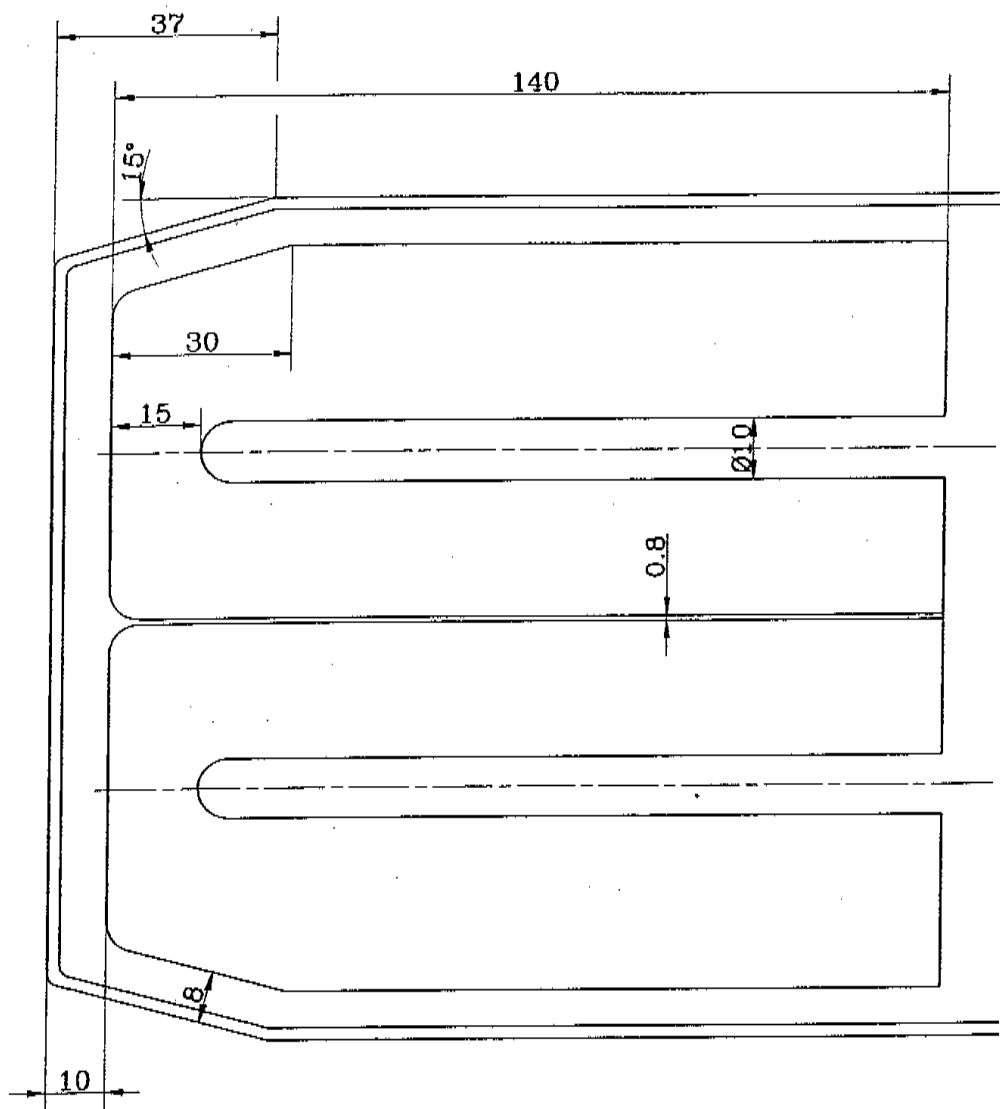
12.2. PIN ASSIGNMENT:

Each preamplifier room has a high-voltage feedthrough and 2 signal feedthroughs:

SIGNAL FEEDTHROUGH	PIN	ASSIGNMENT	
A	1	Pt100, outgassing resistor or nothing	
	2		
	3	Feedback	Segment 2
	4	Source	
	5	Drain	
	6	Test	Full volume
	7	Feedback	
	8	Source	
	9	Drain	
B	10	Feedback	Segment 1
	11	Source	
	12	Drain	
	13	Drain	Segment 4
	14	Source	
	15	Feedback	Segment 3
	16	Source	
	17	Feedback	
18	Drain		

13. DRAWINGS AND SPECIFICATION SHEETS.

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A	12.02.01	Première émission			
Indice	Date	Origine des modifications	SCHLEIFER	GUTNECHT	SAND
			Dessiné	Vérifié	Approuvé

	Echelle : 1:1	Poids : /
	Tolérances générales : ± 5	

Client :

Réf :

OP DA

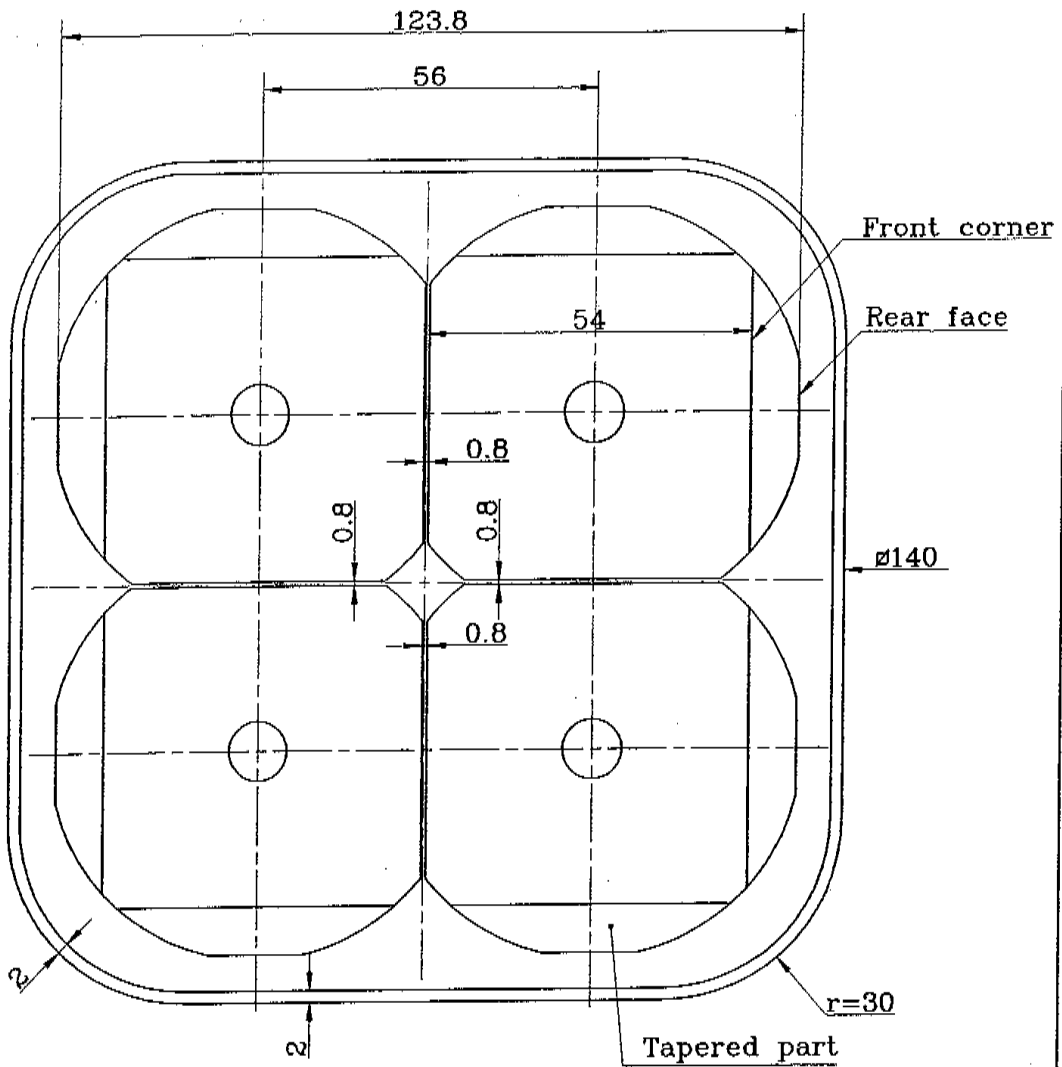
~~SCHLEIFER~~ ~~GUTNECHT~~ ~~SAND~~

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Detector location (Side view)
CLOVER 70-140 SEG16

Activité	Type	Format	Code Article	Indice	Folios
10	PC	4	66689	-A	/



A	12.02.01	Première émission	 SCHLEPPER GUTKNECHT SAND	
édice	Date	Origine des modifications	Dessiné	Vérifié / Approuvé

Echelle : 1:1 Poids : /
 Tolérances générales : ± 5

EURISYS MESURES

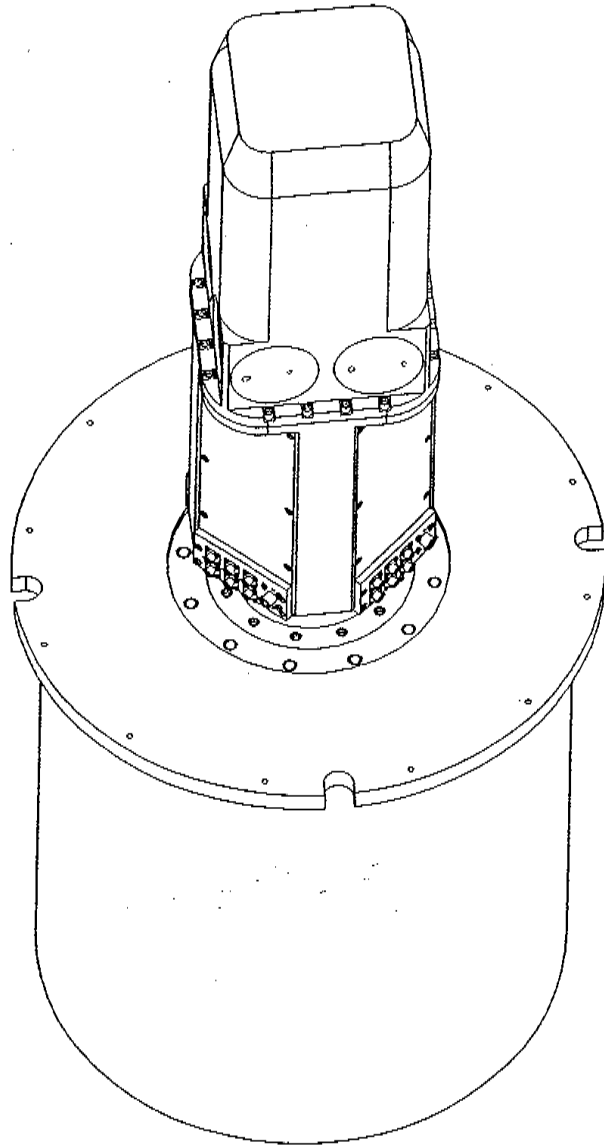
Client :

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Réf :

Detector location (top view)
 CLOVER 70/140 SEG 16

Activité	Type	Format	Code Article	Indices	Folios
10	PC	4	66687	-A	/



A	12.02.01	Première émission			
Indice	Date	Origine des modifications	SCHÖTTER/GOTTSBECHT	SAND	
			Dessiné	Véifié	Approuvé

	Echelle : /	Poids : /
	Tolérances générales : ±0.1	

Matière :

Traitement :

Finition :

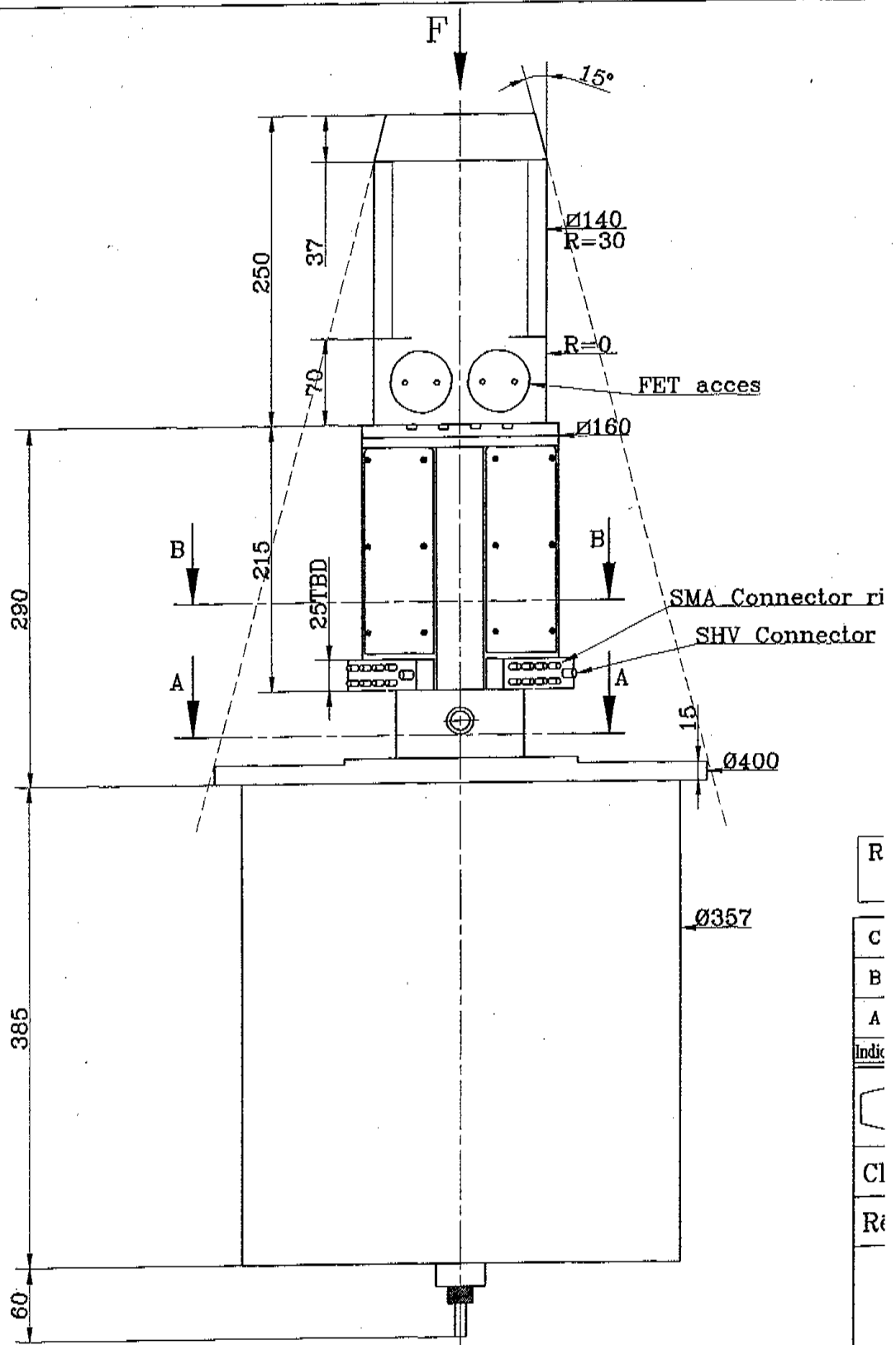
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Vue générale

CLOVER 70-140 SEG16

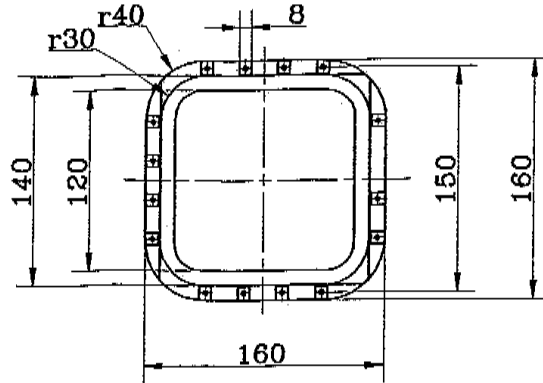
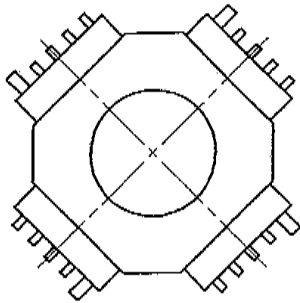
Activité	Type	Format	Code Article	Indice	Folios
10	PD	4	66688	A	/



R
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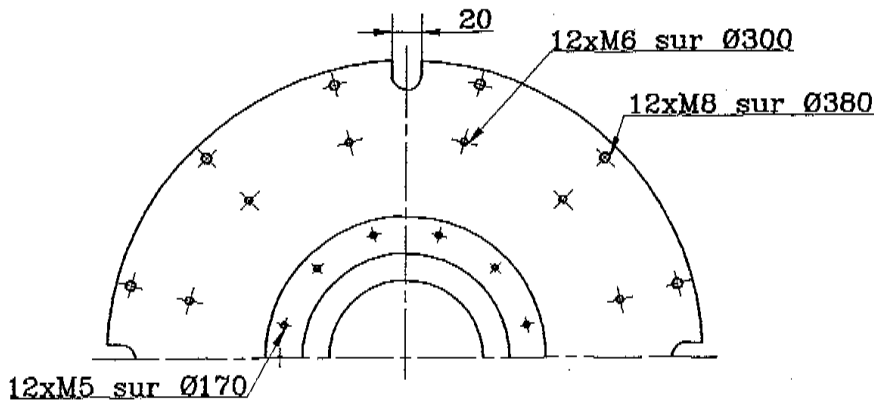
B - B

View in direction of arrow F
Cowl only



A - A

ing



Remark: Cap lenght is 10 mm longer
Total lenght of the cryostat is unchanged

12.02.01	Mise à jour	SCHLOTTER	GUTKNECHT	SAND
14.02.00	Mise à jour	SCHLOTTER	GUTKNECHT	SAND
28.01.00	Première émission	SCHLOTTER	GUTKNECHT	SAND
Date	Origine des modifications	Déssiné	Vérifié	Approuvé

	Echelle : 1:4		Poids :
	Tolérances générales : ± 2		

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ient :

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5f :

VEGA Clover 70/140

16 Segments

Activité	Type	Format	Code Article	Indice	Folios
10	PC	3	62619	-C	

EURISYS MESURES

Parc des Tanneries
1, Chemin de la Roseraie
67383 LINGOLSHEIM CEDEX - FRANCE

GERMANIUM DEPARTMENT
Telephone : (33) 03 88 77 43 50
Fax : (33) 03 88 78 68 22

For Mail :
B.P. 311
F 67834 TANNERIES CEDEX

SPECIFICATION SHEET FOR 4 FOLD SEGMENTED SUPERCLOVER GERMANIUM DETECTOR.

Serial number N°002

FULL VOLUME SPECIFICATIONS		A	B	C	D
Crystal serial number:		73559	73345	73346	73492
Measurement:	Expected values	Measured values			
Recommended high-voltage:		+4000 V	+4000 V	+4000 V	+4000 V
FWHM at 1.33 MeV at 6 μ s:	$\leq 2,6$ keV	2.16 2.23	2.40 2.44	2.31 2.55	2.51 2.55
FWTM/FWHM:		1.87	1.88	1.98	1.85
FWFM/FWHM:		2.60	2.56	2.89	2.49
Relative efficiency at 1.33 MeV: (Source 25cm from crystal)	≥ 63 %	69.4	68.7	68.3	68.1
Peak to Compton at 1.33 MeV:		69.1	61.5	61.1	55.1
FWHM at 122 keV at 6 μ s:	≤ 1.7 keV	1.32	1.42	1.33	1.70
FWHM with test pulser at 6 μ s:		1.20	1.32	1.31	1.57

Segment Specifications	A				B				C				D			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
FWHM at 1.33 MeV 6 μ s	2.70	3.18	2.64	4.07	2.65	3.06	2.80	4.08	2.82	3.24	2.97	3.93	2.69	2.97	2.68	2.16
FWHM at 122 keV 6 μ s	2.18	2.53	2.10	3.41	1.92	2.43	2.08	3.08	2.06	2.54	2.22	3.26	2.00	2.17	2.06	3.49

Measurement conditions : Amplifier 7245, gaussian shaping time.
Count rate : ≤ 1000 coups per second,
ADC 7602 with 8192 channels.

Verified by : Maël Carrée
Date : 12/09/01

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Parc des Tanneries
1, Chemin de la Roseaie
67383 LINGOLSHEIM CEDEX - FRANCE

GERMANIUM DEPARTMENT
Telephone : (33) 03 88 77 43 50
Fax : (33) 03 88 78 68 22

For Mail :
B.P. 311
F 67834 TANNERIES CEDEX

CRYOSTAT SPECIFICATION SHEET

Portable cryostat model :

SBF 00 PA11

4 Fold Segmented Super Clover detector : N° 002

Cooling time from room temperature : 48 hours

Number of fillings required to fully cool the detector : 4

- 1st filling : t = During 45*
- 2nd filling : t + 2 hours*
- 3rd filling : t + 4 hours*
- 4th filling : t + 12 hours*

Holding time : 42 hours

Liquid nitrogen capacity : 11 liters

Warm-up time from end of holding time up to room temperature : 4 days

Preamplifier type: PSC 823

Equipment :

- High voltage protection**
- Cold temperature indication**
- Room temperature indication**
- Annealing resistor-Pt100 output for NRK200**