

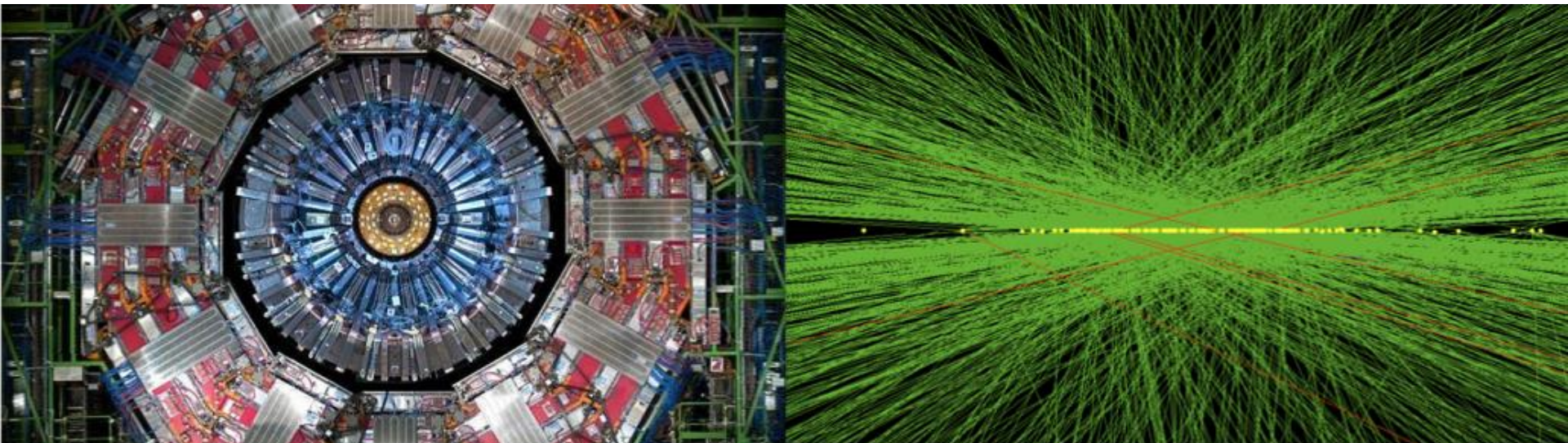


GE1/1 & GE2/1 Power System

Martina Ressegotti (Univ.&INFN Pavia) on behalf of the GEM Group

CMS GEM Workshop

October 3rd, 2019



Outline

- HV System
 - Overview
 - Status
 - Issues Debugging
- LV System
 - Overview
 - Status
 - Issues Debugging

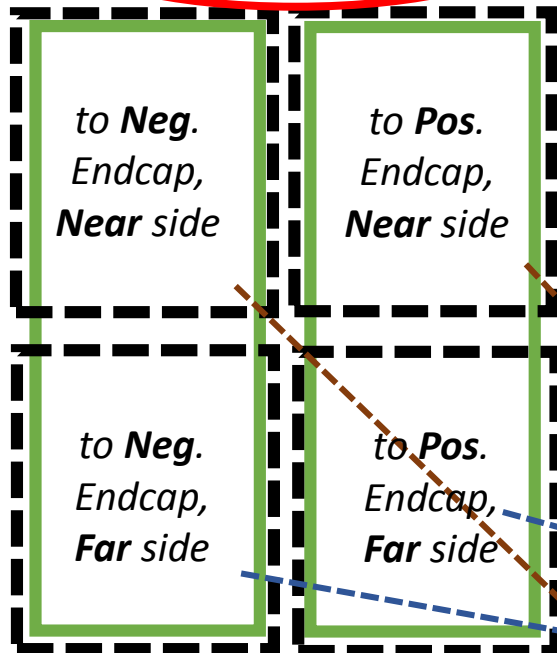
HV System

GE11 HV System Overview

USC

2 HV racks

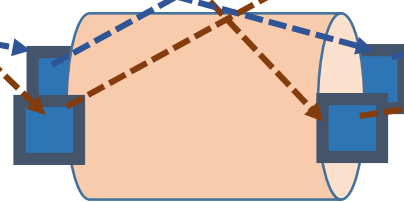
S1G12 *rearranged* S1F12



UXC

4 patch panels

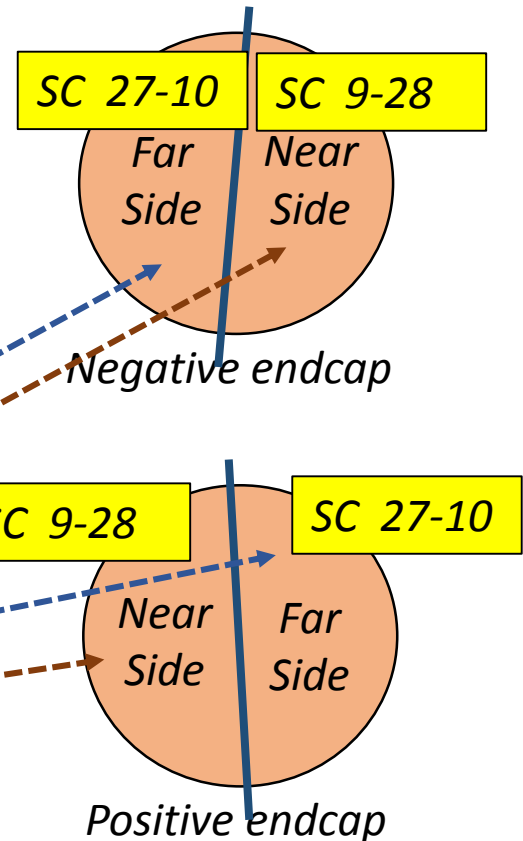
- Negative Endcap, Far Side
- Negative Endcap, Near Side
- Positive Endcap, Far Side
- Negative Endcap, Near Side



CMS

A test-box to check the correct connectivity of all HV cables in P5 is prepared

Detector

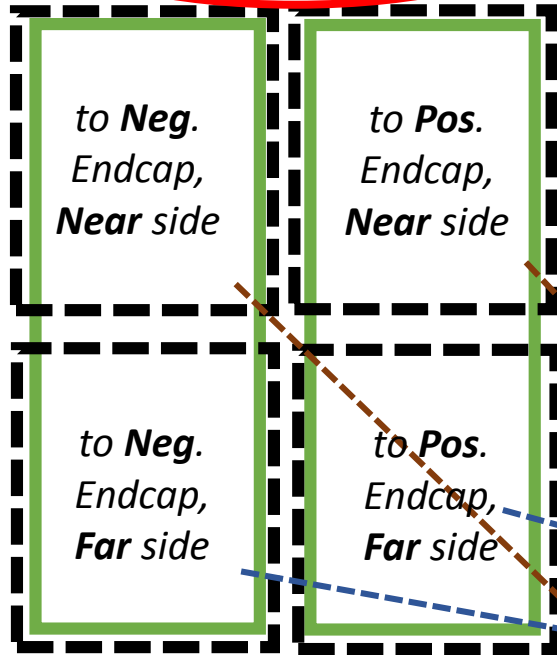


GE21 HV System Overview

USC

2 HV racks

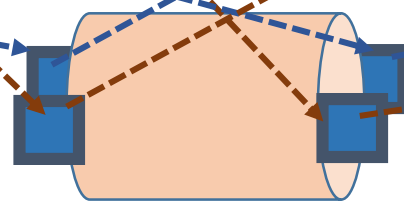
S1G13 *rearranged* S1F13



UXC

4 patch panels

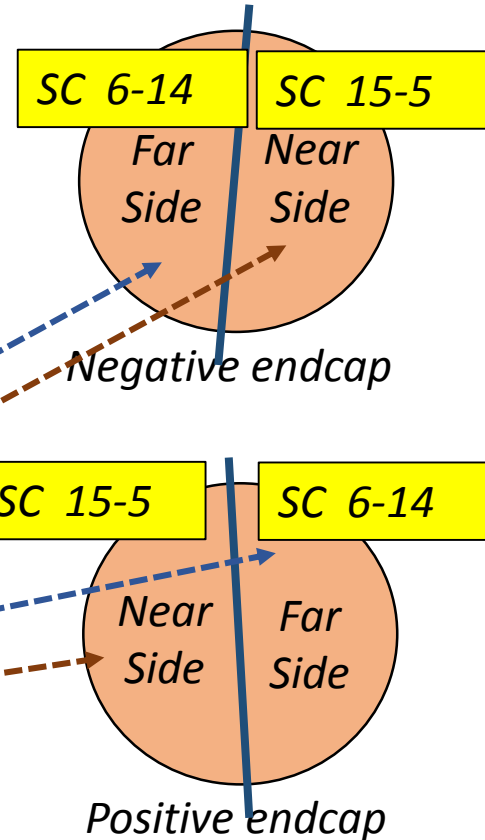
- Negative Endcap, Far Side
- Negative Endcap, Near Side
- Positive Endcap, Far Side
- Negative Endcap, Near Side



CMS

A test-box to check the correct connectivity of all HV cables in P5 is prepared

Detector



GE1/1-GE2/1 HV: CURRENT STATUS

X4-to-detectors cables

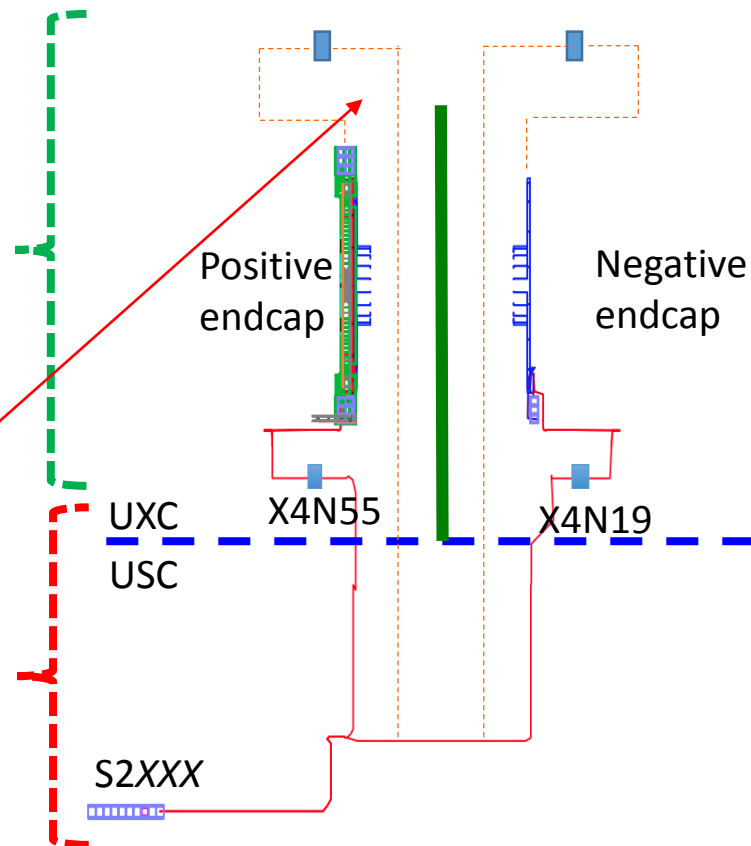
→ Cables through new cable chain

(-X4 near and far)

- ✓ **GE1/1 Negative Endcap DONE**
- GE1/1 Positive Endcap: TO DO for installing the same cables on the Positive Endcap we have to wait for the new cable chain installation
- ✓ **GE2/1 Negative Endcap DONE**

USC-UXC cables (~100 m): TO DO

- 36(GE1/1)+72(GE2/1)=**108** thick cables (4x10 conductors) to be routed
- waiting for the installation of new **trays** along the path for GEM HV cables



HV System Issues & Debugging

Problem: We have observed in laboratory that sometimes HV channels become *unplugged*.

- if the channel was ON it remains ON although it is not possible to control/monitor it anymore
- A simple *clear alarm* does not solve the problem since the faulty condition persists
- The solution that worked most of the times (but not always probably due to some capacity not fully discharged during the cycle) was to power cycle the mainframe
- So far the average cross section is about 1 channel in error every 6-7 months per board (anyway the frequency was not constant with time) → about 1 error every 6 days with 32 boards (GE1/1)

→ Possible explanation by CAEN:

the communication is based on the **50Hz frequency** of the 220V. If it's not very stable, the motherboard and the channels communication might mismatch. Hence the motherboard is no longer able to correctly interpret the packages coming from the channels → communication error between them (unplugged)

Current solution: Firmware 2.06 for A1515TG was released by CAEN in July, with 2 main changes:

1. Automatic procedure to recover unplugged channels without switching off the mainframe
→ **complemented from DCS** side to lock actions by the user during this procedure
 - The other 6 channels of the involved group are ramped down "normally"
 - The unplugged channel is killed and rebooted by cutting off its power for 10 seconds → this should restore the unplugged channel
2. In case of unplugged, the synchronization is reset

Firmware 2.06 used in all HV board in 904 lab **since 15 July** → **no more "unplugged" errors observed** until now

LV System

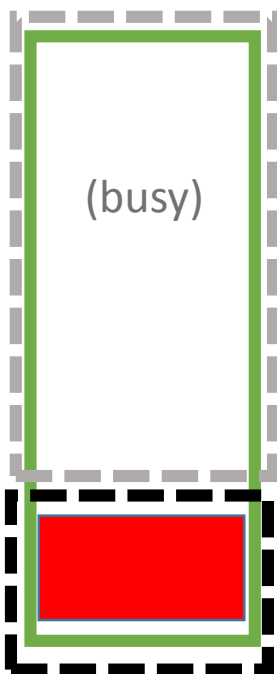
GE11 & GE21 LV System Overview

USC

1 LV rack

with 1 mainframe

S4F03



UXC

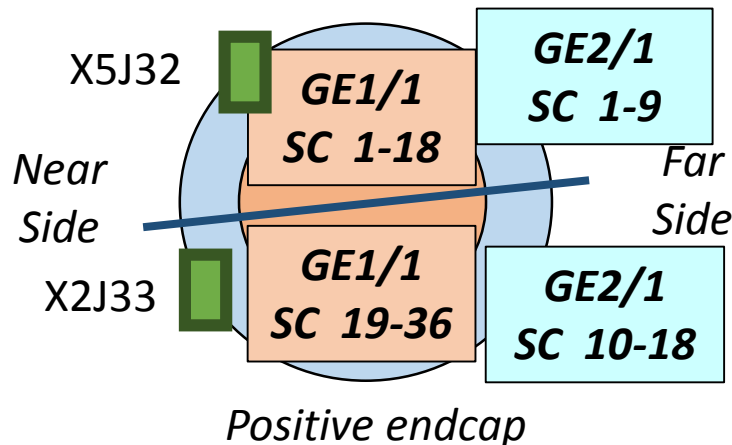
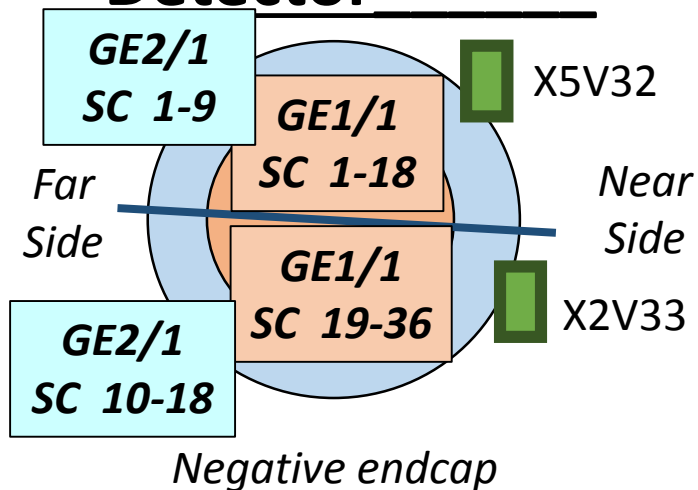
2 PATCH PANELS

- in rack X4N19 (Negative Endcap, Near Side)
- in rack X4N55 (Positive Endcap, Near Side)

4 LV racks

- X2V33 and X5V32 (Negative Endcap, Near Side)
- X2J33 and X5J32 (Positive Endcap, Near Side)

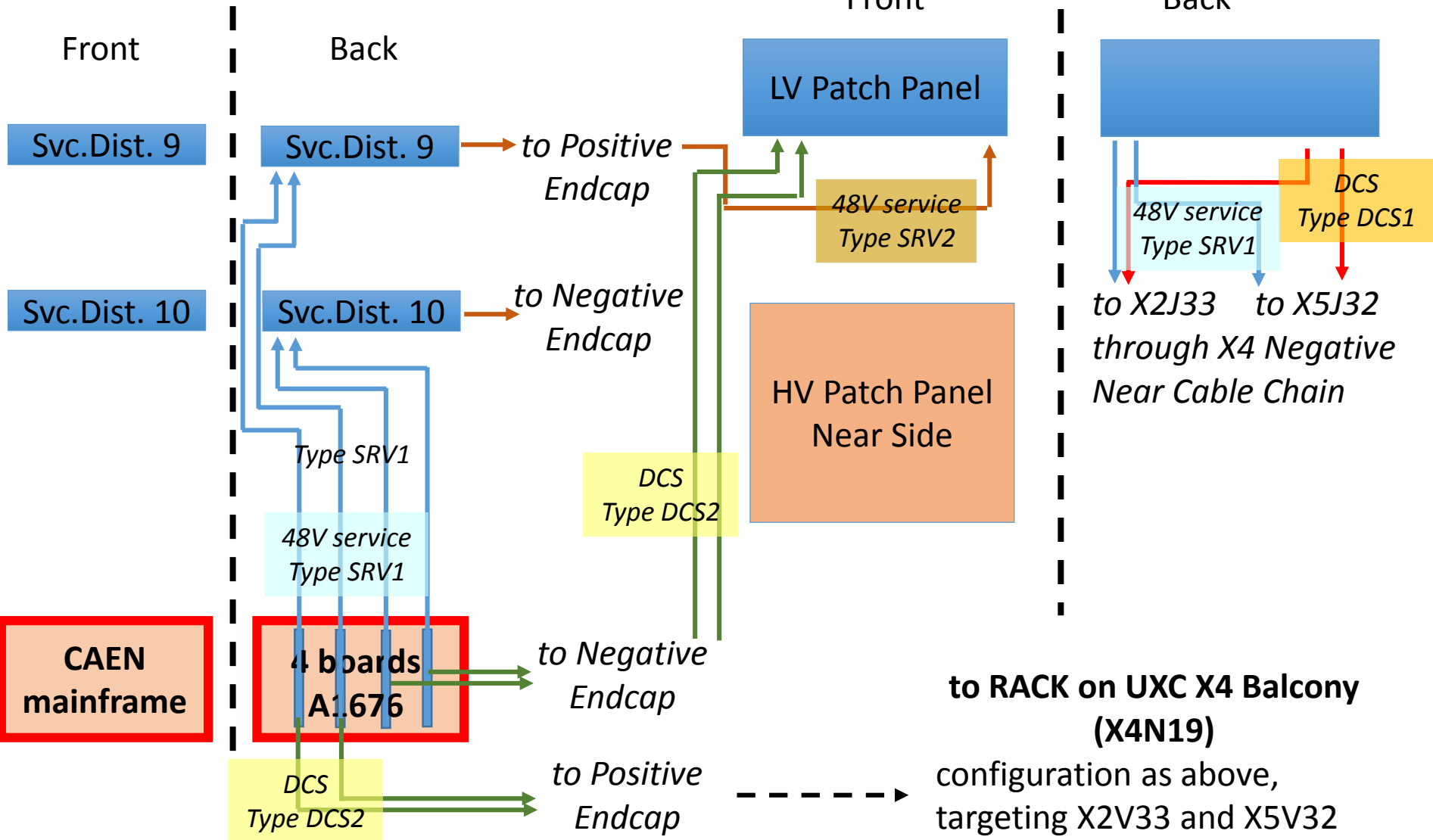
Detector



GE1/1 LV System – USC + PP

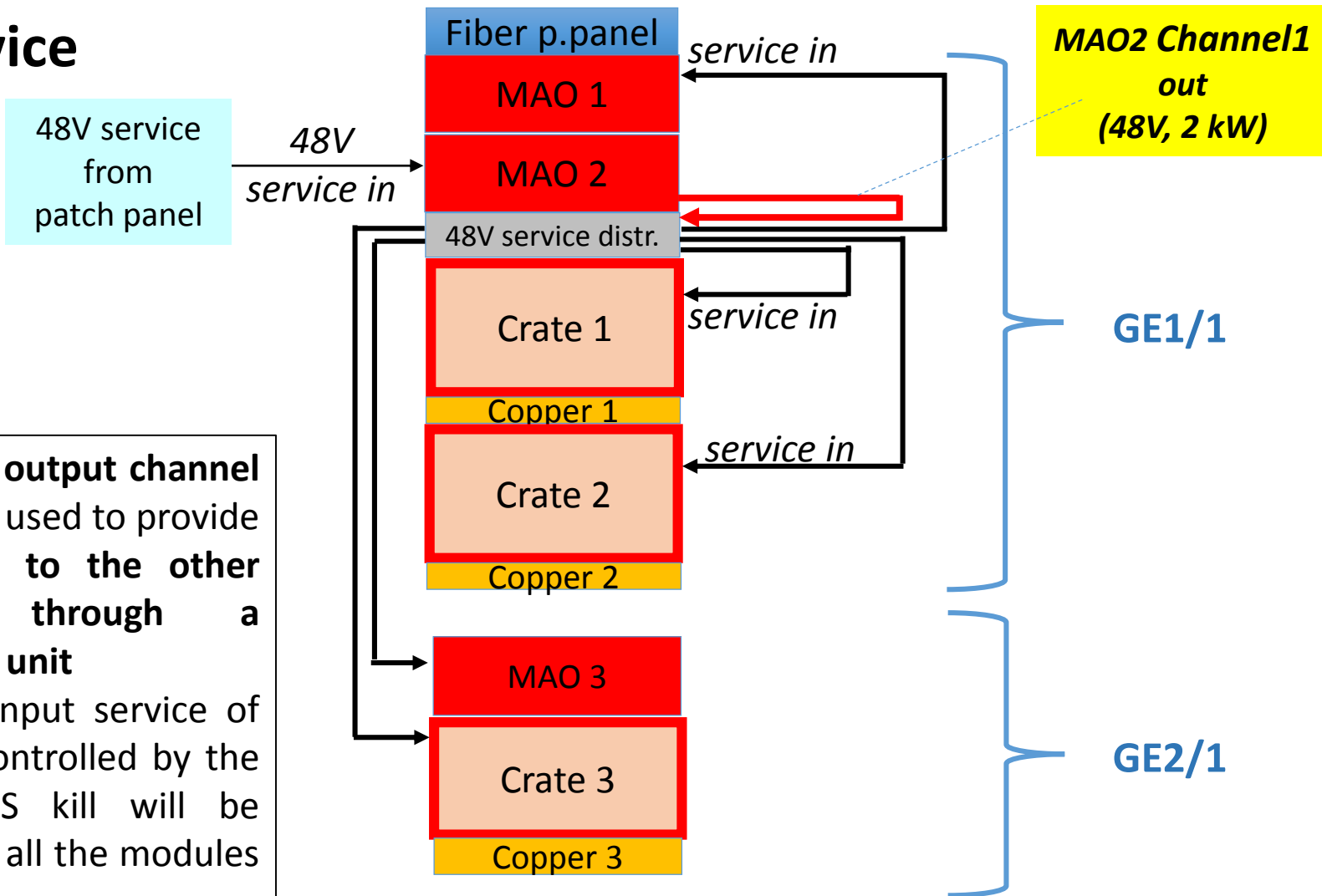
RACK in USC (S4F03)

RACK on UXC X4 Balcony (e.g. X4N55)



GE1/1-GE22/1 LV – UXC rack

48V service

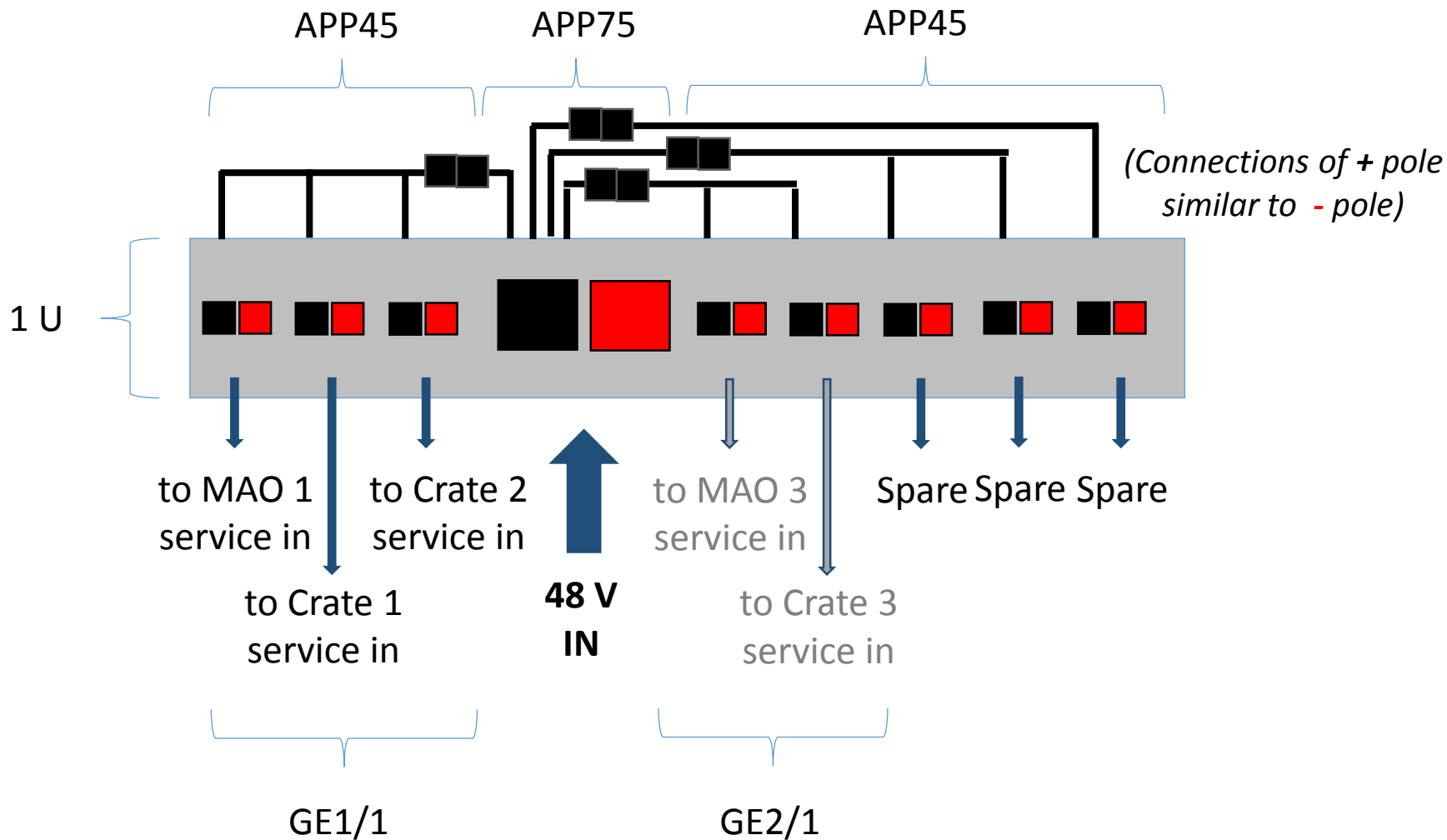


The **second output channel of MAO 2** is used to provide the **service to the other modules, through a distribution unit**

→ As the input service of MAO 2 is controlled by the DSS, a DSS kill will be effective on all the modules in the rack

GE1/1 LV System – UXC rack

48V Service Distr. Unit



GE1/1 LV System – UXC rack

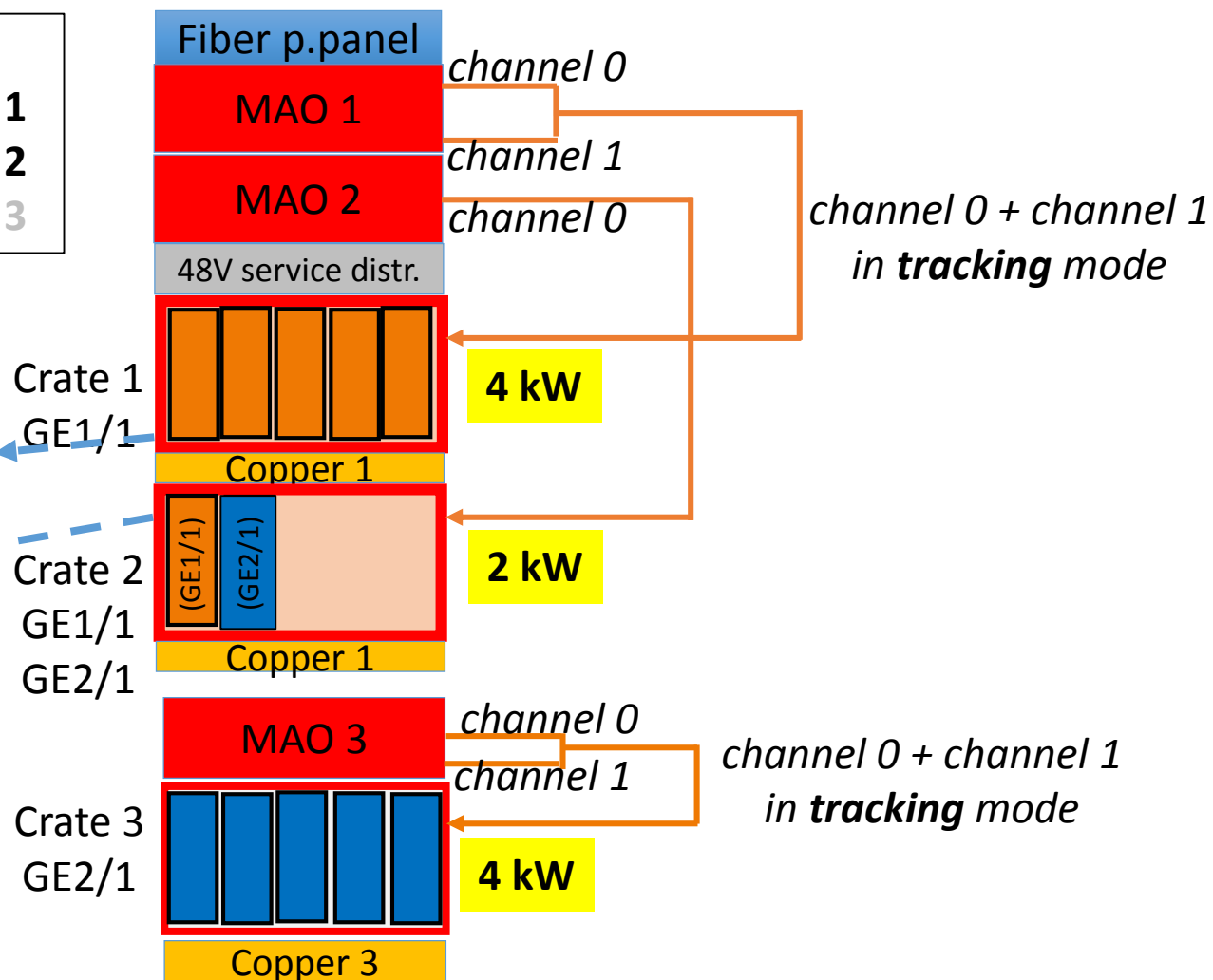
48 V power

Rule:

- **MAO 1** → supplies **Crate 1**
- **MAO 2** → supplies **Crate 2**
- **MAO 3** → supplies **Crate 3**

Expected power consumption:

- Crate 1 → 5 boards
→ $\approx 5 \times 400 \text{ W} = 2 \text{ kW}$ (50% of max)
- Crate 2 → 1 board
→ $\approx 0.4 \text{ kW}$ (20% of max)
- Crate 2 with GE2/1
→ 2 boards (A3016HP + A3009HP)
→ $\approx 400 \text{ W} + 600 \text{ W} = 1 \text{ kW}$ (50% of max)
- Crate 3 → 5 boards
→ $\approx 5 \times 600 \text{ W} = 3 \text{ kW}$ (75% of max)



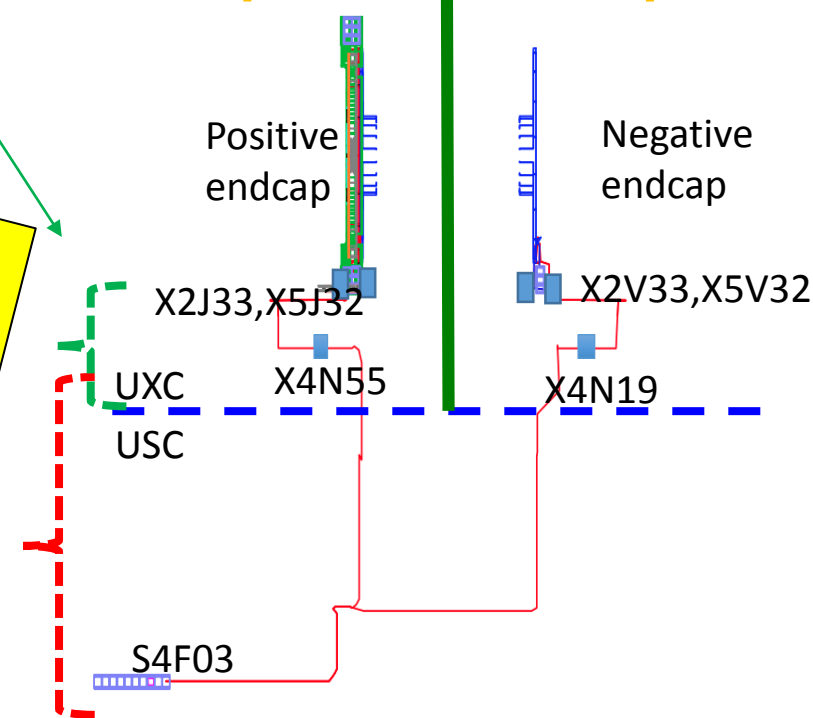
GE1/1-GE2/1 LV: CURRENT STATUS

X2/X5-to-detectors cables

Negative Endcap

- ✓ all 72 SC GE1/-1 LV cables in place
- ✓ all 144 SC GE2/-1 LV cables in place

- Installation of same cables on the positive endcap in 2020



USC-UXC cables routed for both endcaps, for both GE1/1 GE2/1

X4-to-X2/X5 cables (~30 m) Negative Endcap

→ Cables through new cable chain (-X4 near)

- ✓ 2x DCS (communication & control)
 - ✓ 2x 48V service power
 - ✓ 2x tri-phase 220V for rack power
- ½ targets X2V33, ½ targets X5V32
 - for installing the same cables on the positive endcap we have to wait for the new cable chain installation

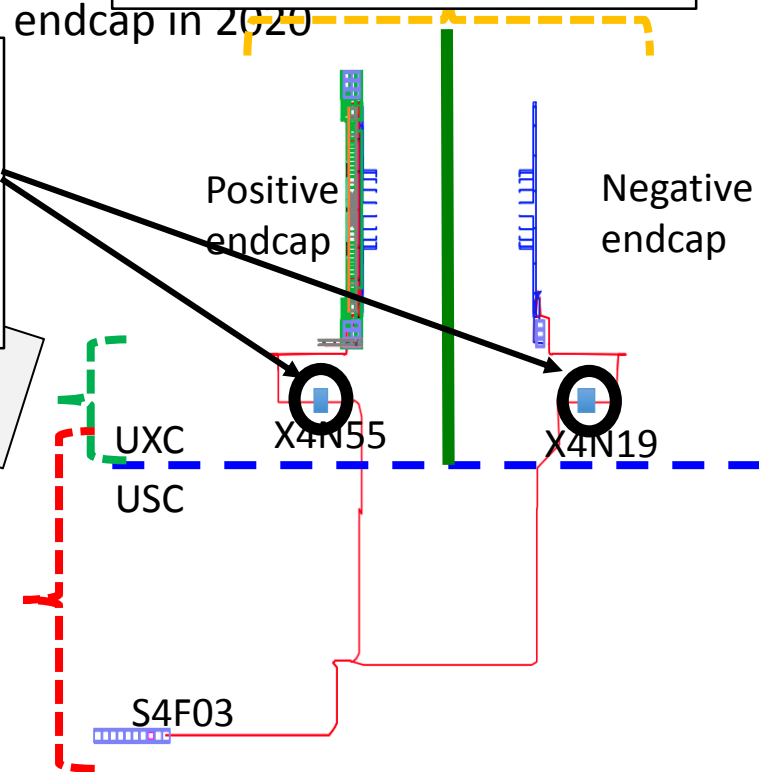
USC-UXC cables (~100 m)

- ✓ 4x DCS (communication & control)
 - ✓ 2x 48V service power (2 service power for GEM in each cable)
 - ✓ 4x tri-phase 220V for rack power
- all cables start in S4F03 rack
 - ½ targets X4N55, ½ targets X4N19

GE1/1-GE2/1 LV: CURRENT STATUS

X2/X5-to-detectors cables

- Negative endcap**
- TO DO:
- ✓ Connectorization of 72 cables on rack side in place
 - ✓ 144 (GE2/1) cables on rack side in
- Inst positive endcap in 2020



X4-to-X2/X5 cables (~30 m) Negative Endcap

- Cable through main cable chain (X4 rack)
- ✓ 2 TO DO:
 - Connectorization of cables on both ends
 - ✓ 2
 - ✓ 2x tri-phase 220V for rack power
- ½ targets X2V33, ½ targets X5V32

- TO DO:
- 2x Patch panels
 - to joint DCS, 48V service and 220V power cables in the two X4 racks
 - provided by S.Lusin

USC-UXC

- ✓ 4x DCS (communication & control)
 - ✓ 2x 48V service power
- (2 s)
- TO DO:
- Connectorization of cables on both ends
- all ca
- ½ targets X4N55, ½ targets X4N19

LV System Issues & Debugging

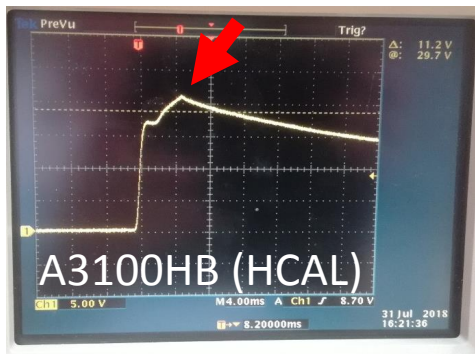
Summary of HCAL case:

In 2018 following a **power interruption** in CMS an HCAL power supply is suspected of having produced a voltage spike that killed the FEASTMP

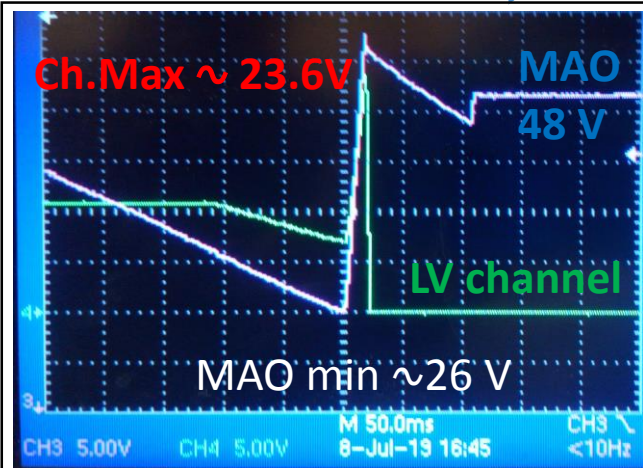
Could this happen also with A3016 boards?

We discovered **2 ways** to produce transients in laboratory on **3016(HP) boards**:

1. ON command to MAO channel already ON (with MAO firmware $\leq 2.4 \rightarrow$ problem fixed in next fw version)
2. Short "glitch" on the input power (220 V) of the MAO, obtained acting on the button (circuit breaker) of the 400/220 V transformer



A3016HP (GE1/1)



↕ 5 V



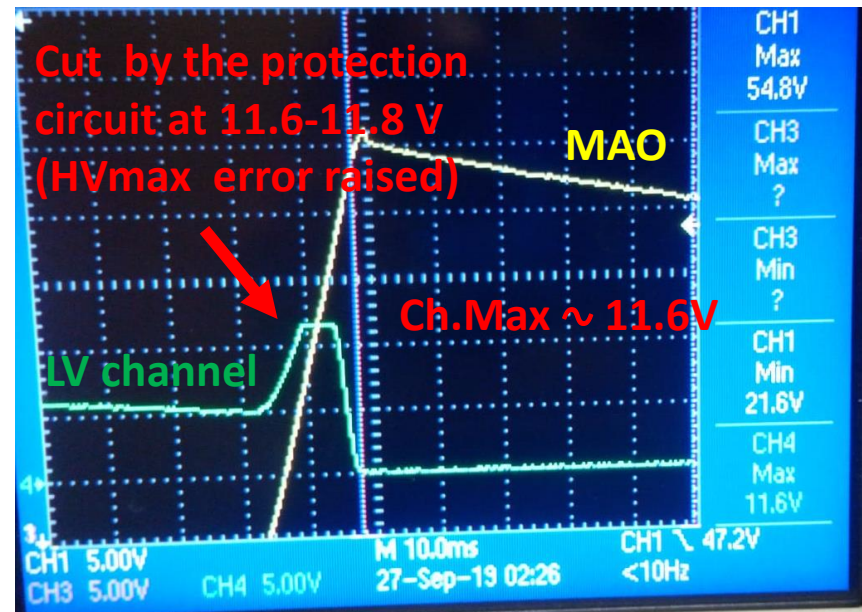
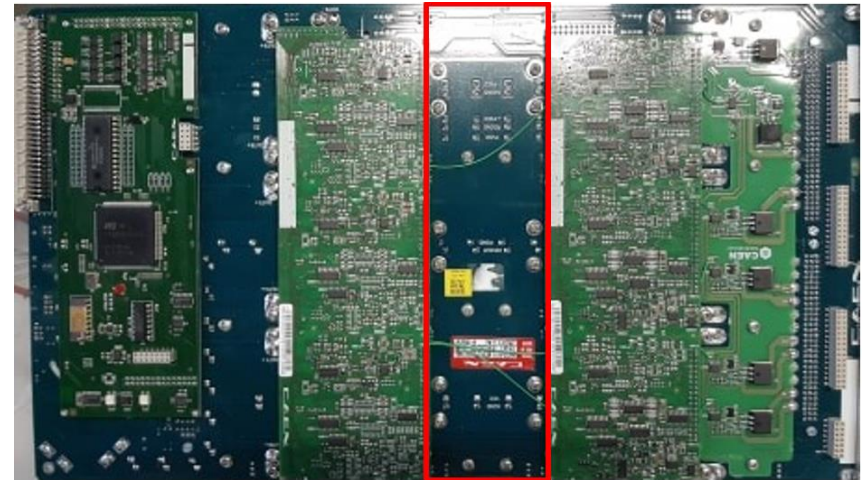
LV System Issues & Debugging

SOLUTION

- CAEN will provide an upgraded version of the LV boards with an additional protection circuit
 - It cuts the voltage above a fixed threshold
 - The threshold is determined by resistors in the protection circuit (→ can be modified by caen)

- 1st board (#175) declared with threshold of 11.8 V successfully tested in 904 lab
 - Verified that transients are cut at 11.6-11.8 V in all 6 channels
 - Verified that all FEASTMPs have survived (120 trials in total)

→ ALL BOARDS for P5 will be equipped with this protection circuit



Backup

GE1/1 HV System Mapping

e.g.:

HV Board (Slot)	SC Powered
0	SC 08 / SC 09
1	SC 06 / SC 07
2	SC 04 / SC 05
3	SC 02 / SC 03
4	SC 36 / SC 01
5	SC 34 / SC 35
6	SC 32 / SC 33
7	SC 30 / SC 31
8	SC 28 / SC 29
0	SC 10 / SC 11
1	SC 12 / SC 13
2	SC 14 / SC 15
3	SC 16 / SC 17
4	SC 18 / SC 19
5	SC 20 / SC 21
6	SC 22 / SC 23
7	SC 24 / SC 25
8	SC 26 / SC 27

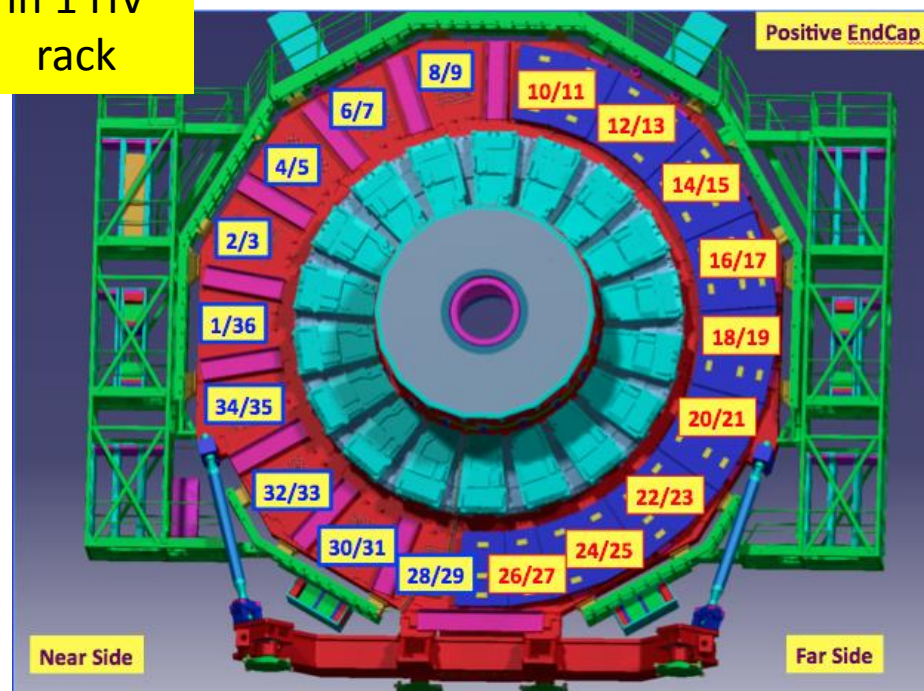
SC	Layer	Board channel
06	Ly 1 & Ly 2	Channel 0-6 ("group 1")
07	Ly 1 & Ly 2	Channel 7-13 ("group 2")

to Far Side

to Near Side

A test-box to check the **correct connectivity** of all HV cables in P5 is prepared

in 1 HV rack



* Same mapping for Positive and Negative Endcap

GE1/1 HV System Mapping

e.g.:

HV Board (Slot)	SC Powered
0	SC 08 / SC 09
1	SC 06 / SC 07
2	SC 04 / SC 05
3	SC 02 / SC 03
4	SC 36 / SC 01
5	SC 34 / SC 35
6	SC 32 / SC 33
7	SC 30 / SC 31
8	SC 28 / SC 29

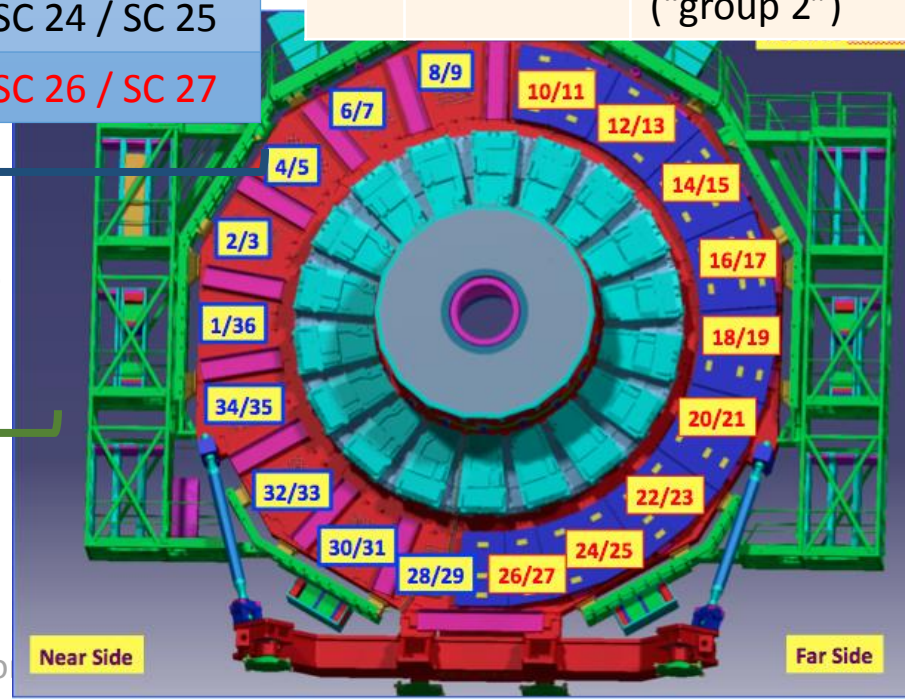
HV Board (Slot)	SC Powered
0	SC 10 / SC 11
1	SC 12 / SC 13
2	SC 14 / SC 15
3	SC 16 / SC 17
4	SC 18 / SC 19
5	SC 20 / SC 21
6	SC 22 / SC 23
7	SC 24 / SC 25
8	SC 26 / SC 27

SC	Layer	Board channel
12	Ly 1 & Ly 2	Channel 0-6 ("group 1")
13	Ly 1 & Ly 2	Channel 7-13 ("group 2")
SC	Layer	Board channel
36	Ly 1 & Ly 2	Channel 0-6 ("group 1")
01	Ly 1 & Ly 2	Channel 7-13 ("group 2")

in Mainframe to Near Side

in Mainframe to Far Side

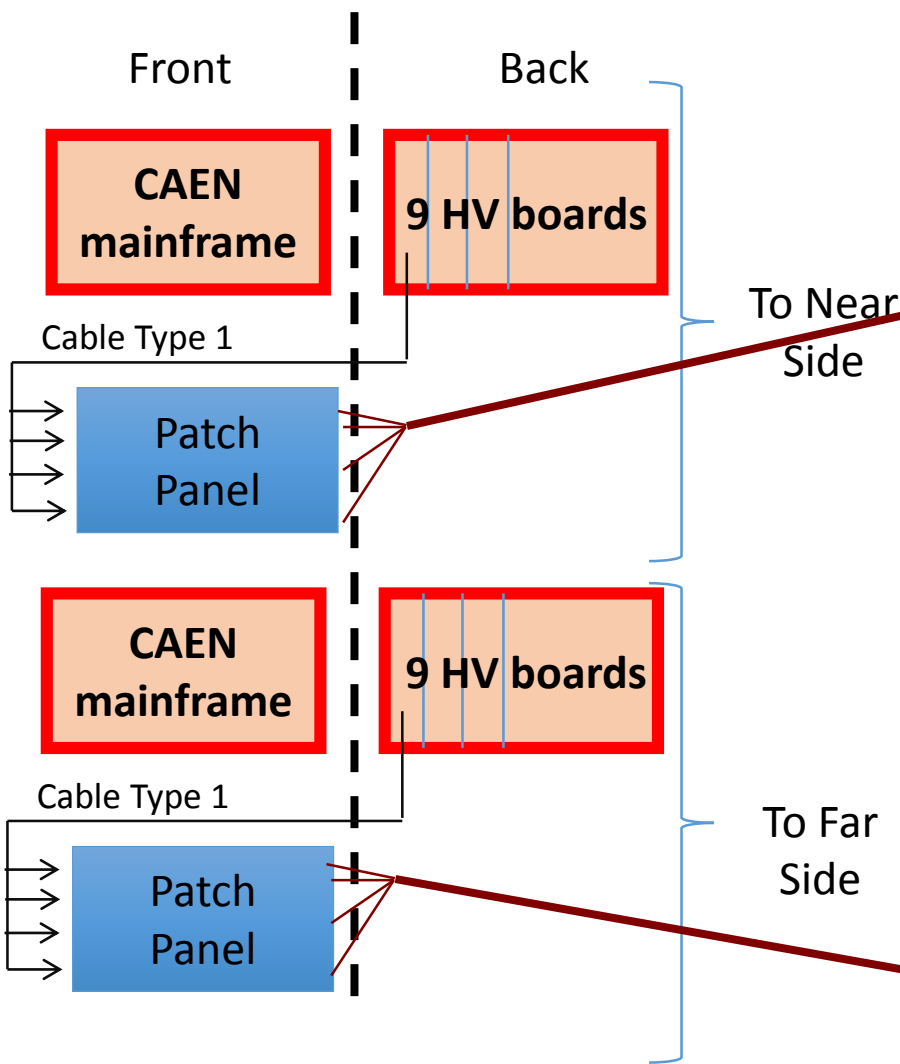
in 1 HV rack



* Same mapping for Positive and Negative Endcap

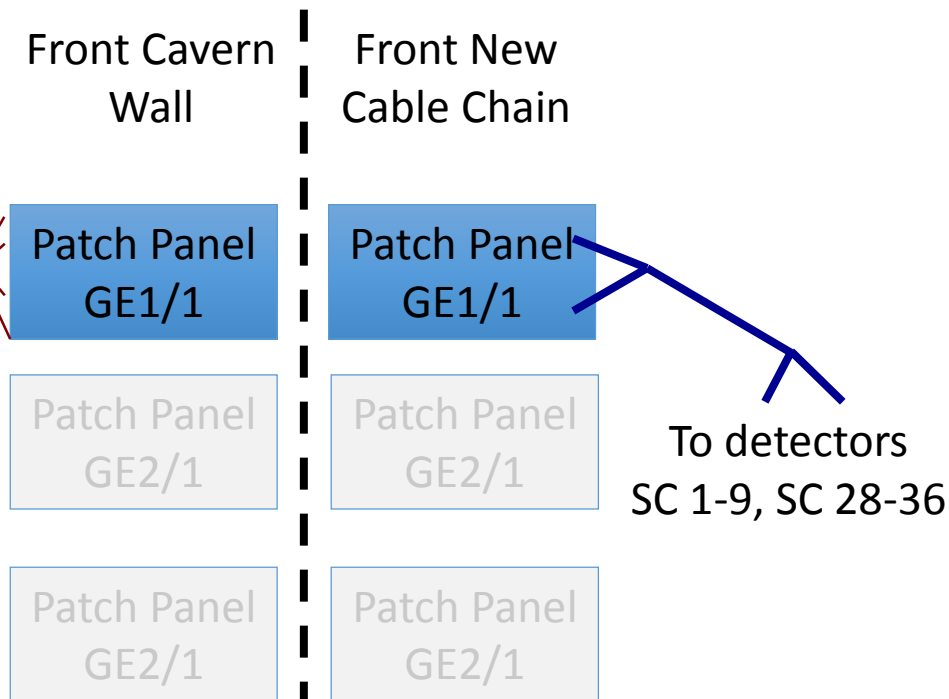
GE1/1 HV System for 1 endcap

RACK in USC



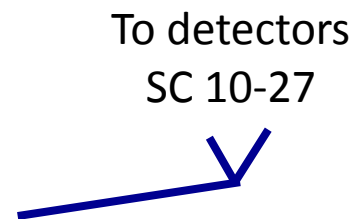
RACK on cavern balcony

Near Side

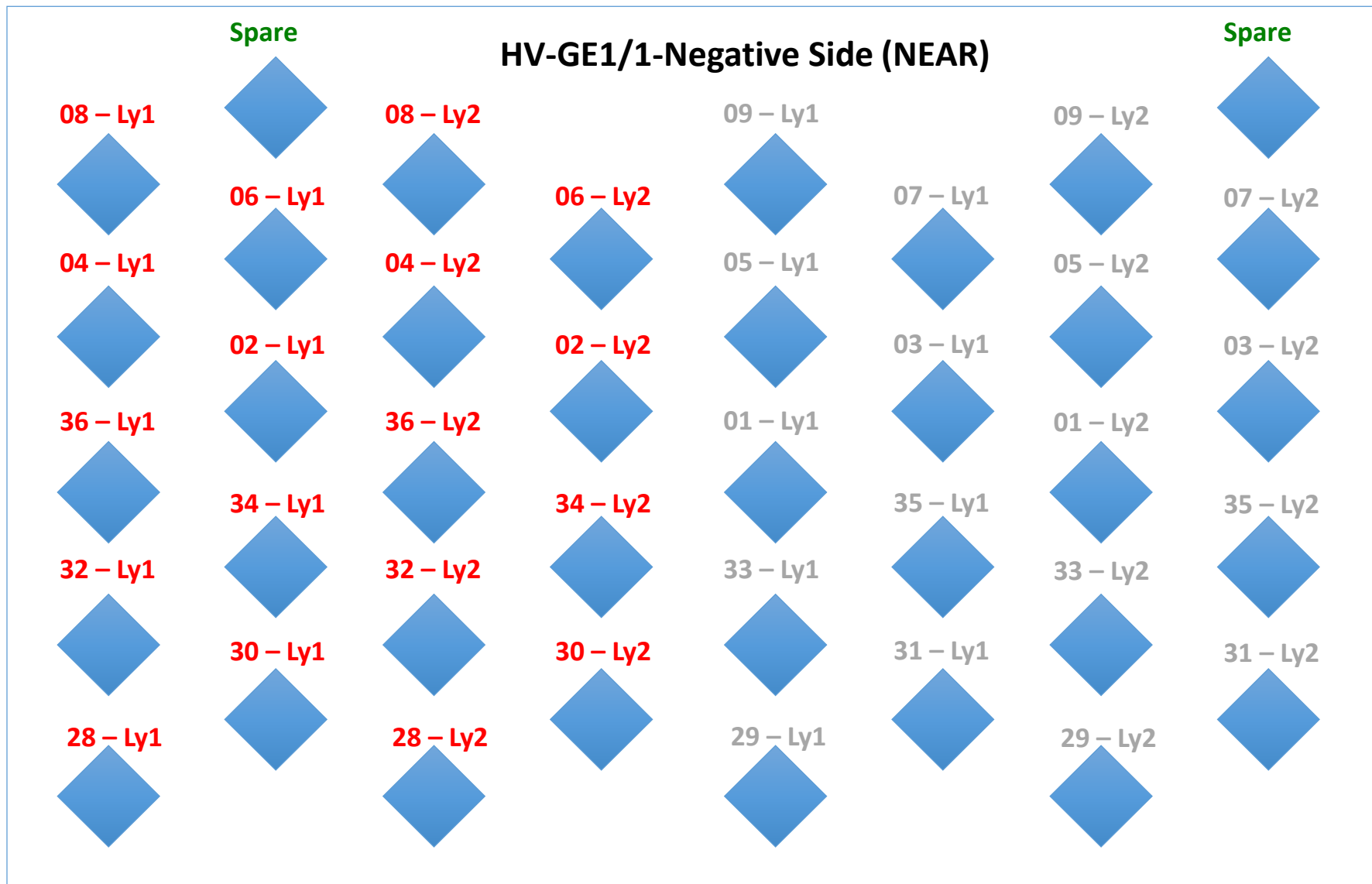


RACK on cavern balcony

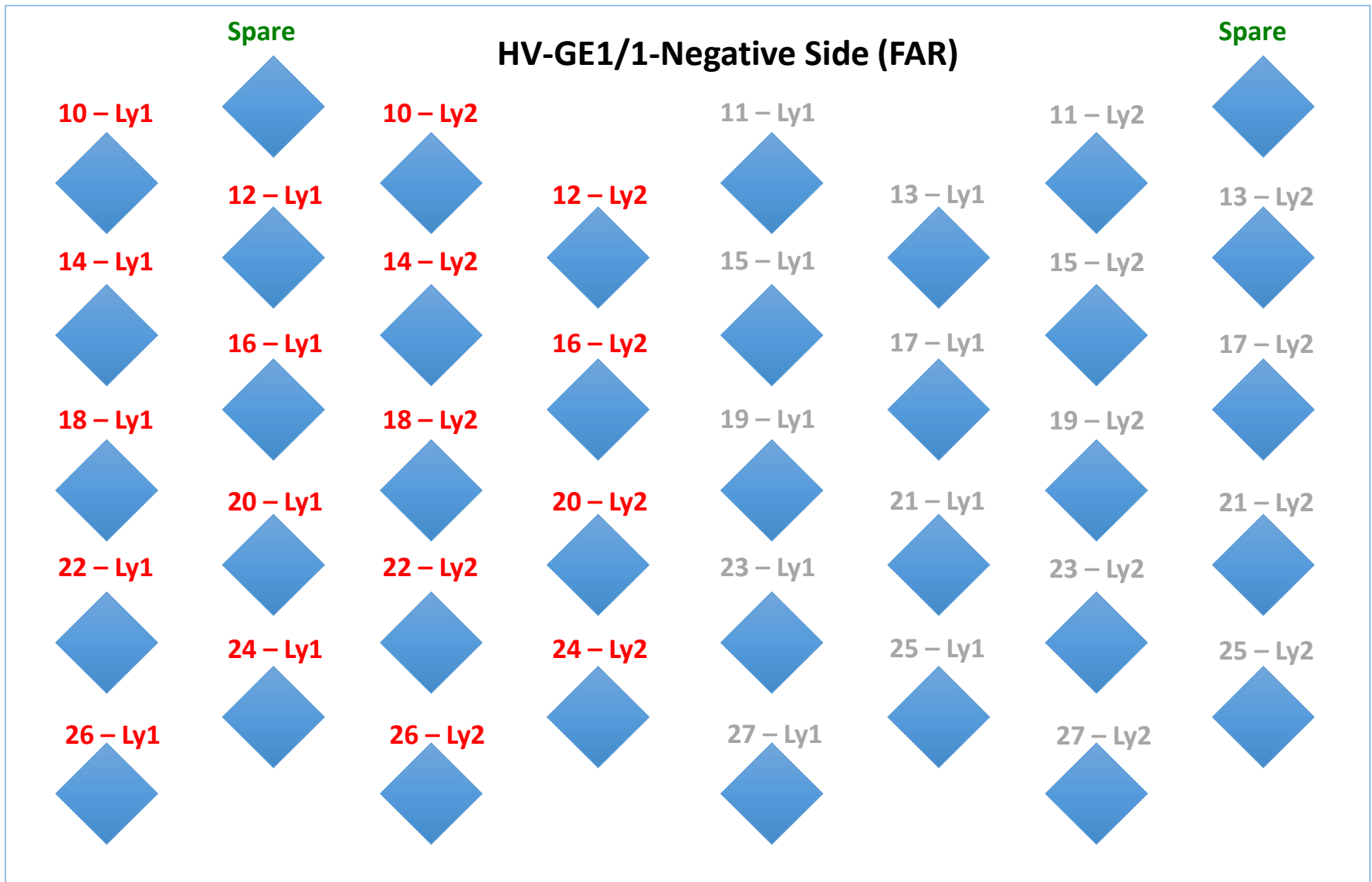
Far Side *similar*



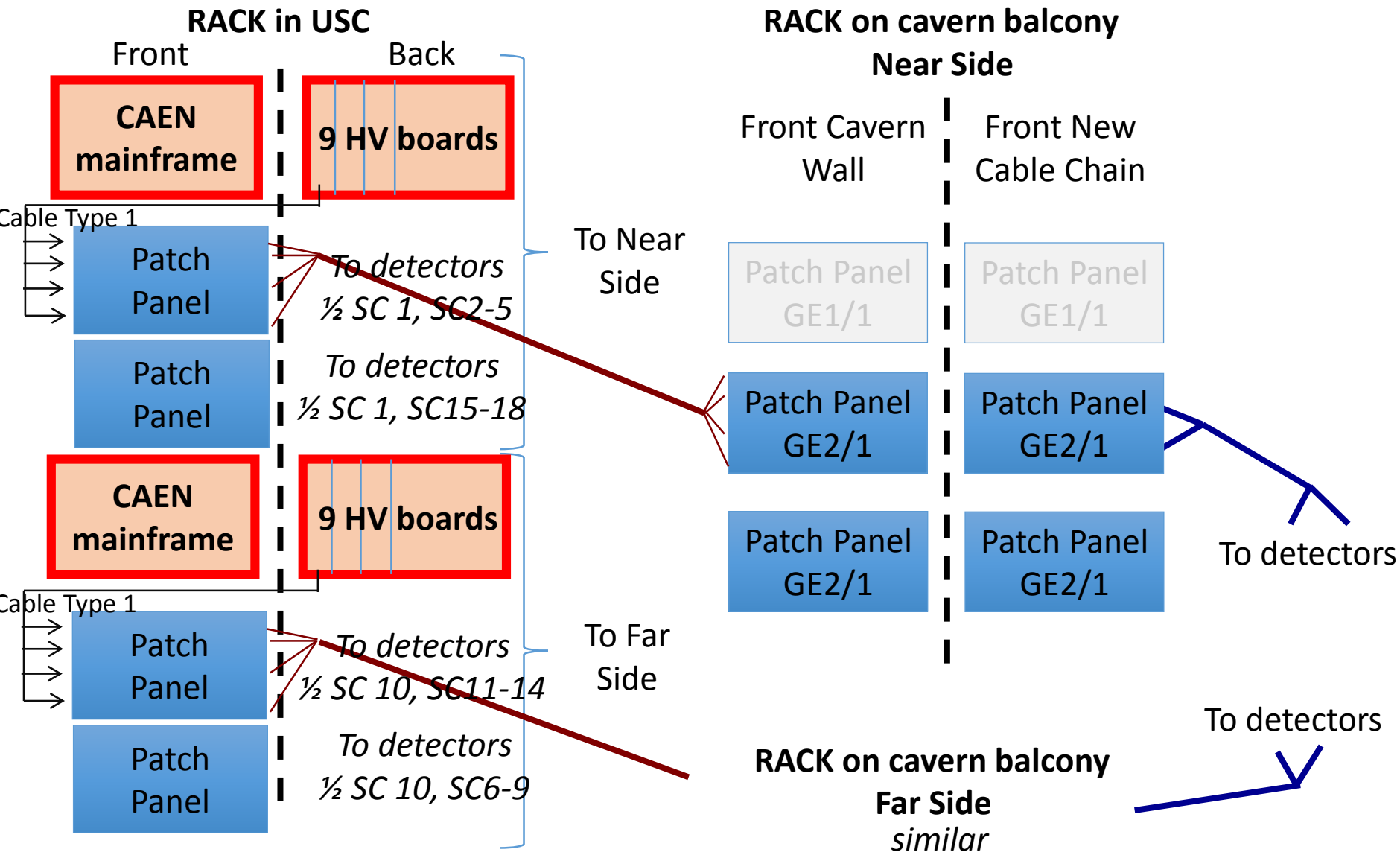
HV patch panel (USC)



HV patch panel (USC)

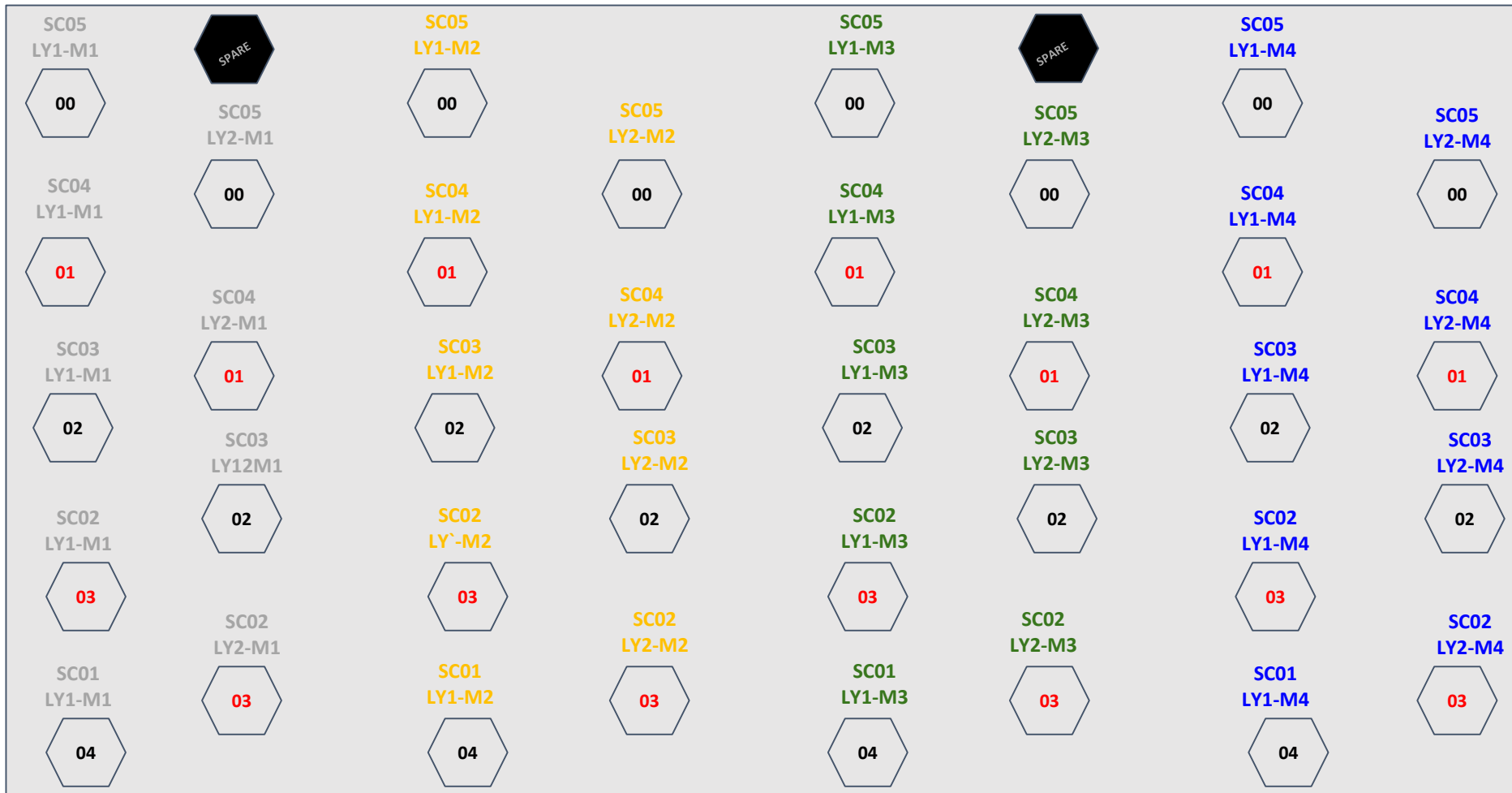


GE2/1 HV System for 1 endcap



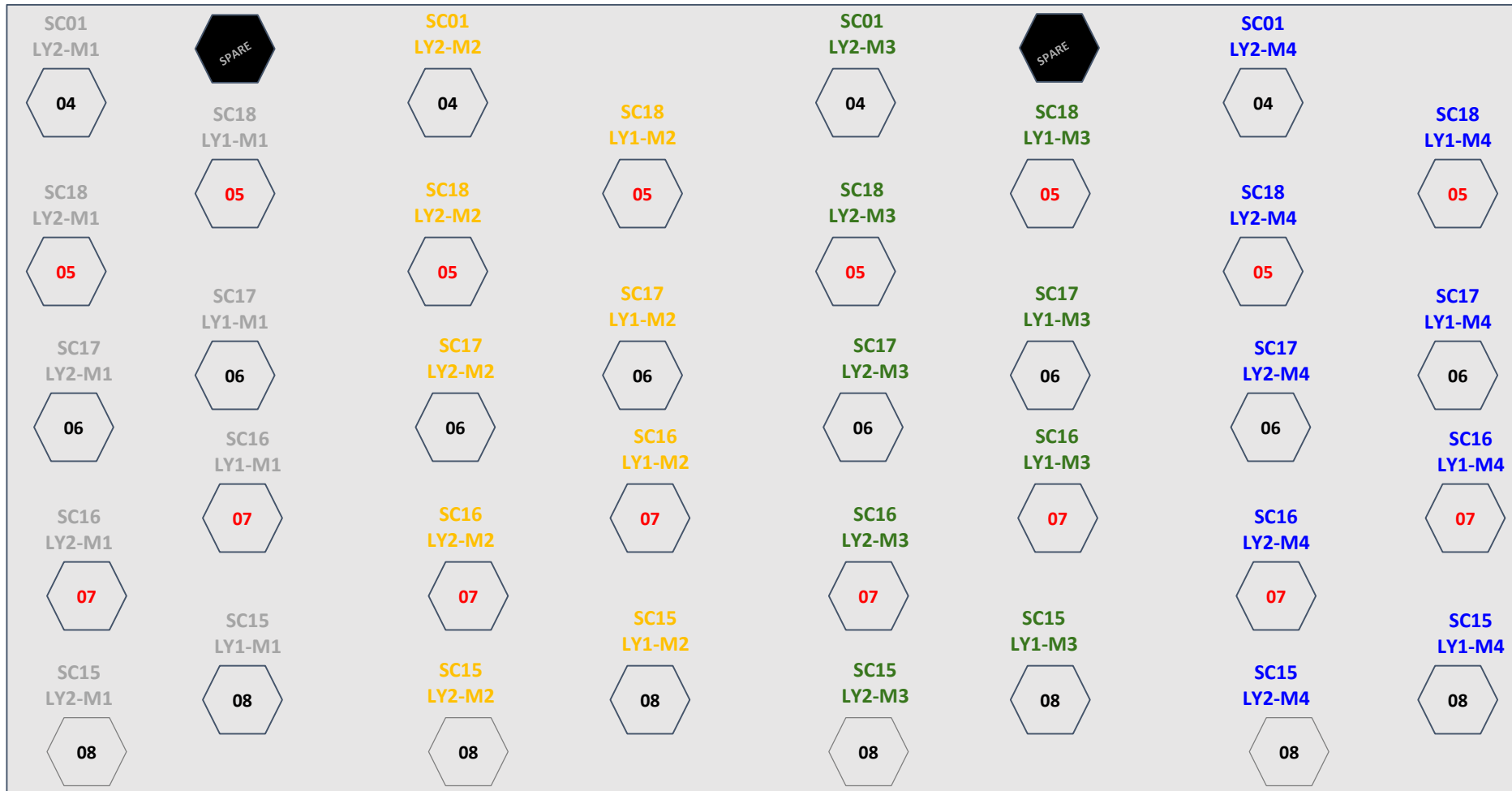
GE2/1 HV patch panel-1

“Near” side (USC)



GE2/1 HV patch panel-2

“Near” side (USC)



GE2/1 HV patch panel-1

“Far” side (USC)



GE2/1 HV patch panel-2

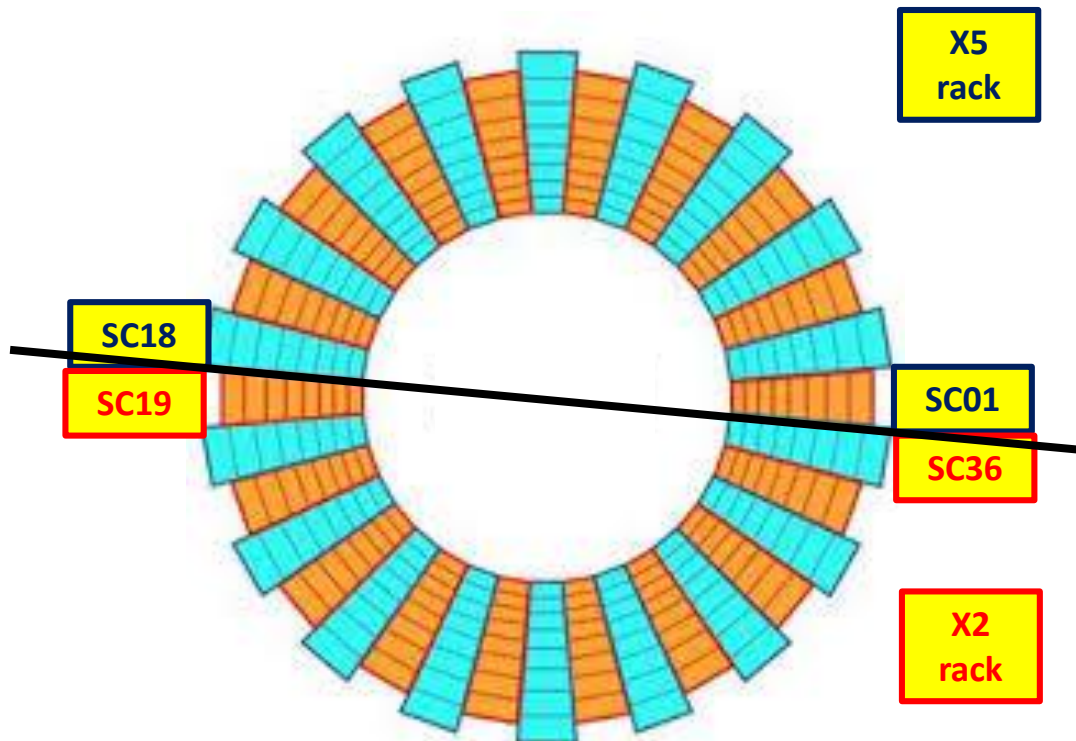
“Far” side (USC)



LV System Mapping - USC

Board (A1676 Slot *)	Target Endcap	Target Rack in UXC	SC Powered
2	Positive	X5J32	SC 01 to SC 18
5	Positive	X2J33	SC 19 to SC 36
8	Negative	X5V32	SC 01 to SC 18
11	Negative	X2V33	SC 19 to SC 36

* Slots are numbered from slot 0



LV System Mapping – UXC X2 Level

Crate	LV Board (Slot)	LV channel	SC Powered	Crate	LV Board (Slot)	LV channel	SC Powered	
1 (EasyCrate2 in DCS)	1	0	SC 19 – Ly 1	1 (EasyCrate2 in DCS)	13	0	SC 28 – Ly 1	
		1	SC 19 – Ly 2			1	SC 28 – Ly 2	
		2	SC 20 – Ly 1			2	SC 29 – Ly 1	
		3	SC 20 – Ly 2			3	SC 29 – Ly 2	
		4	SC 21 – Ly 1			4	SC 30 – Ly 1	
		5	SC 21 – Ly 2			5	SC 30 – Ly 2	
	5	0	SC 22 – Ly 1			17	0	SC 31 – Ly 1
		1	SC 22 – Ly 2				1	SC 31 – Ly 2
		2	SC 23 – Ly 1				2	SC 32 – Ly 1
		3	SC 23 – Ly 2				3	SC 32 – Ly 2
		4	SC 24 – Ly 1				4	SC 33 – Ly 1
		5	SC 24 – Ly 2				5	SC 33 – Ly 2
	9	0	SC 25 – Ly 1				2 (EasyCrate3 in DCS)	1
		1	SC 25 – Ly 2	1	SC 34 – Ly 2			
		2	SC 26 – Ly 1	2	SC 35 – Ly 1			
		3	SC 26 – Ly 2	3	SC 35 – Ly 2			
		4	SC 27 – Ly 1	4	SC 36 – Ly 1			
		5	SC 27 – Ly 2	5	SC 36 – Ly 2			

in 1 UXC LV rack

* Same mapping for Positive and Negative Endcap

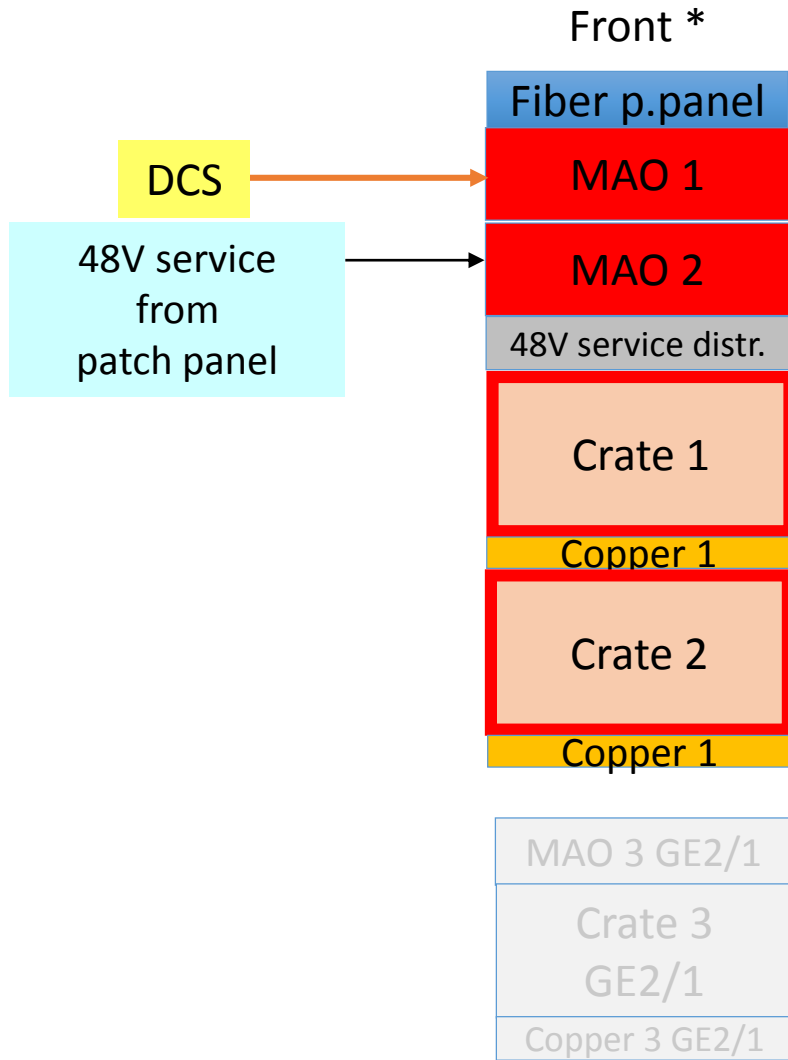
LV System Mapping – UXC X5 Level

Crate	LV Board (Slot)	LV channel	SC Powered	Crate	LV Board (Slot)	LV channel	SC Powered		
1 (EasyCrate2 in DCS)	1	0	SC 01 – Ly 1	1 (EasyCrate2 in DCS)	13	0	SC 10 – Ly 1		
		1	SC 01 – Ly 2			1	SC 10 – Ly 2		
		2	SC 02 – Ly 1			2	SC 11 – Ly 1		
		3	SC 02 – Ly 2			3	SC 11 – Ly 2		
		4	SC 03 – Ly 1			4	SC 12 – Ly 1		
		5	SC 03 – Ly 2			5	SC 12 – Ly 2		
	5	0	SC 04 – Ly 1			17	0	SC 13 – Ly 1	
		1	SC 04 – Ly 2				1	SC 13 – Ly 2	
		2	SC 05 – Ly 1				2	SC 14 – Ly 1	
		3	SC 05 – Ly 2				3	SC 14 – Ly 2	
		4	SC 06 – Ly 1				4	SC 15 – Ly 1	
		5	SC 06 – Ly 2		5		SC 15 – Ly 2		
	9	0	SC 07 – Ly 1		2 (EasyCrate3 in DCS)		1	0	SC 16 – Ly 1
		1	SC 07 – Ly 2					1	SC 16 – Ly 2
		2	SC 08 – Ly 1					2	SC 17 – Ly 1
		3	SC 08 – Ly 2					3	SC 17 – Ly 2
		4	SC 09 – Ly 1					4	SC 18 – Ly 1
		5	SC 09 – Ly 2			5		SC 18 – Ly 2	

in 1 UXC LV rack

* Same mapping for Positive and Negative Endcap

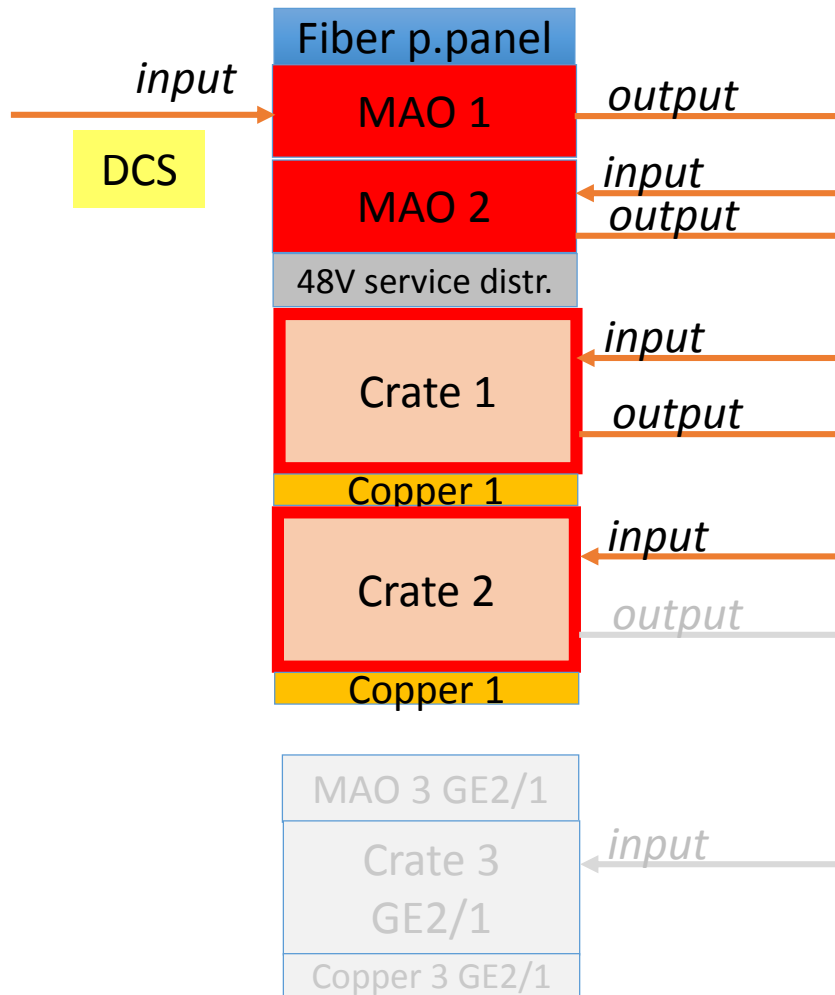
GE1/1 LV System – UXC rack



** All modules in the rack need to be accessed only from the front*

GE1/1 LV System – UXC rack

DCS



Unplugged Procedure

Procedure to be implemented in the new firmware of the HV boards to recover unplugged channels:

Step		Error in DCS	Error in ssh / GECO / ...
1	Channel X becomes unplugged	Unplugged	Unplugged
2	The other 6 channels are switched off “normally” (i.e. with the rDwn set, following the offOrder if in GEM mode)	Unplugged	Unplugged
3	The unplugged channel is killed by cutting off the power of the channel for 10 seconds <ul style="list-style-type: none"> During this 10 s the rDown depends on the impedance of the line 	PwrFail	PwrFail
4	After this 10 s power is repristinated and the output is put to ground <ul style="list-style-type: none"> the rDown depends on the load The microcontroller of the channel at this point is rebooted, and hopefully with a working communication with the microcontroller of the base	Unplugged + PwrFail	Unplugged
5	All 7 channels are now OFF	Unplugged + PwrFail	Unplugged
6	It is necessary to acknowledge the problem by clearing the alarm before powering the channel group		

Setup

MAO:

- ch0 → 48V power
- ch1 → 48V service

400/220V transformer

MAO A3486LS

splitter

A3016HP

CON

“upgraded” board with new CAEN protection circuit

Cable length:
~3.7 m from LV board to GEB

Electronic load

Scope:

- ch1 → 48V power
- ch4 → LV channel

Scope

ch1

ch4

GEB:

- Old version GEB
- «rejected» FEASTMPs used, as they could be damaged in the test
- 8 of 9 FEASTMP with correct output voltage
- only feast FQC “wrong” value (1V instead of 1.2V)

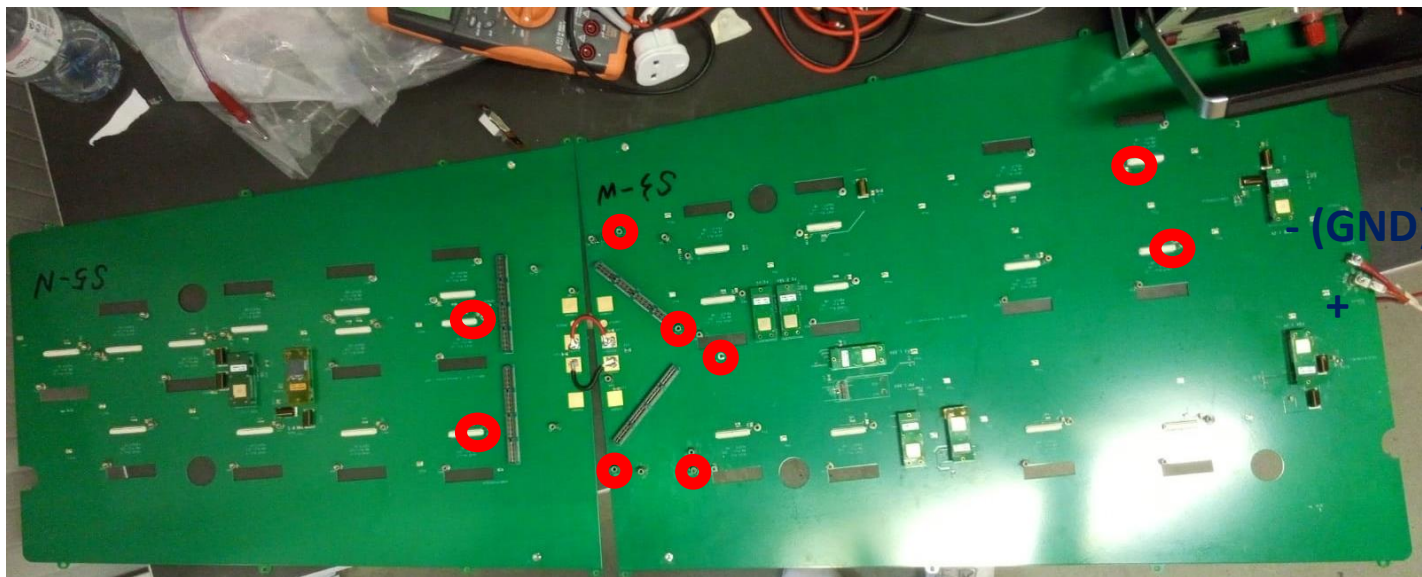
→ Anyway we suppose that the right output voltage of the FEASTMP has no influence on the test (no electronics powered)

V_{GEB}

No sense wire used, V_{GEB} measured here with voltmeter

The load (in parallel) is necessary to produce transients
 → Not able to produce them with $I_{mon}=0$
 → More easily produced at higher load

Test if FEASTMPs are ALIVE



“Health” of all 9 FEASTMPs verified by measuring with the voltmeter if there is voltage on the following 9 points (w.r.t. GEB ground):

- **VFAT pos 15** (or similar powered by FEAST QA)
- **VFAT pos 23** (or similar by FEAST QB)
- **VFAT pos 3** (or similar by FEAST QC)
- **VFAT pos 11** (or similar by FEAST QD)
- **OH1**
- **OH2**
- **OH3**
- **OH5**
- **OH6**

Unplugged Procedure

Remarks

- The user should not try to switch on channels or clear alarms while they're rebooting
→ locking all 7 channels and the clear alarm command could be implemented on DCS side
- In the DCS the presence of the errors “unplugged + pwrFail + unplugged” in a predeterminate sequence indicates that the micro was rebooted because the unplugged error appeared

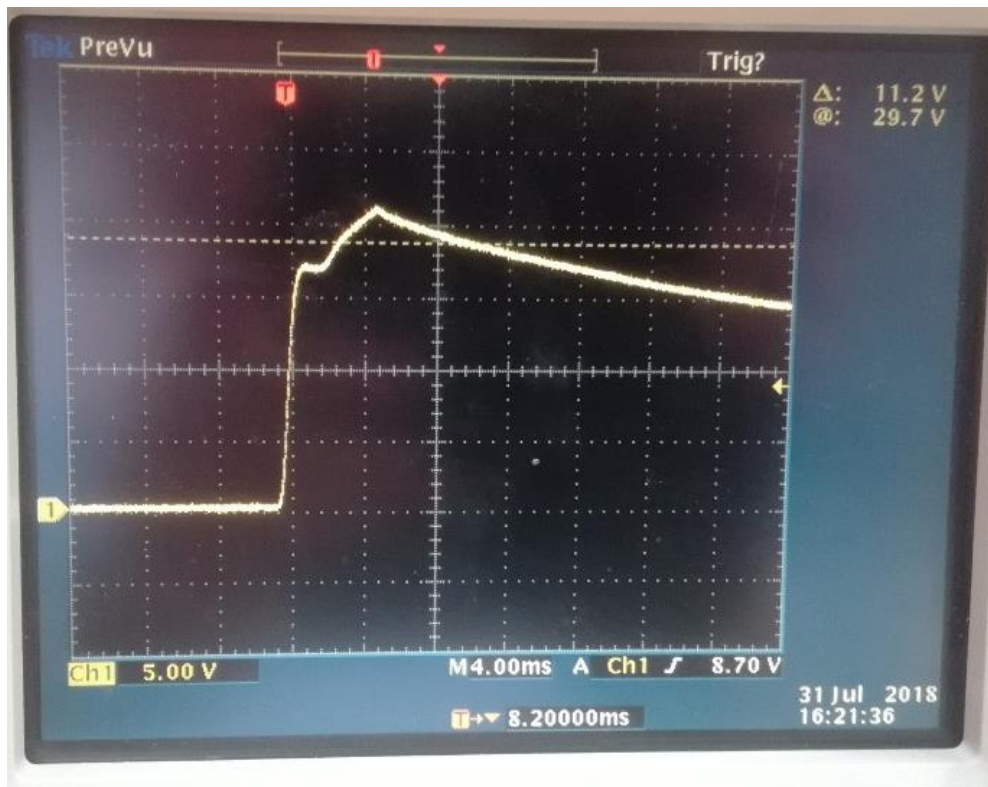
Summary of HCAL case (1/2)

On June 30th, following a **power interruption** in CMS the power supply (#130) **A3100HB** [One channel $8 \div 14$ V, 600 W]

- was failing to switch on due to **OvHVMax** errors
- showed **Cal-Error** error [= error detected in reading the Eprom that contains all the calibration parameters], that could be **cleared** allowing to switch the channel on again (appeared a few times also later in the lab tests)
- Despite replacing the module, there was no communication with ngFEC, so the affected **HEM sectors were lost**.
- In next slide is what **killed** them (notably the **FEASTMPs**) ...

Summary of HCAL case (2/2)

Both CAEN and HCAL (German) were able to reproduce the issue:



- When the channel was switched on, a **transient of 20V** was produced before the OverHVMax trip turned off the channel
- The length of the transient over 15V with a load of 2A was around **10 ms**
- Reproducing the issue is not systematic, it is necessary to repeat a test many times to see the event (about **few times over 100** tests as reported by German)

LV System Issues & Debugging

Two possible solutions to protect against voltage transients:

1. **CAEN** has developed a protection circuit to be installed on LV boards that kills the output ($V_{con}=0$) whenever the V_{con} overcomes a fixed threshold V_{max}

2 prototypes of A3100HBP with CAEN protection circuit produced
 → they are **currently under test** in collaboration with German (HCAL)
 → It can be implemented also on A3016HP boards once “approved”

Prototype A3100HBP #140



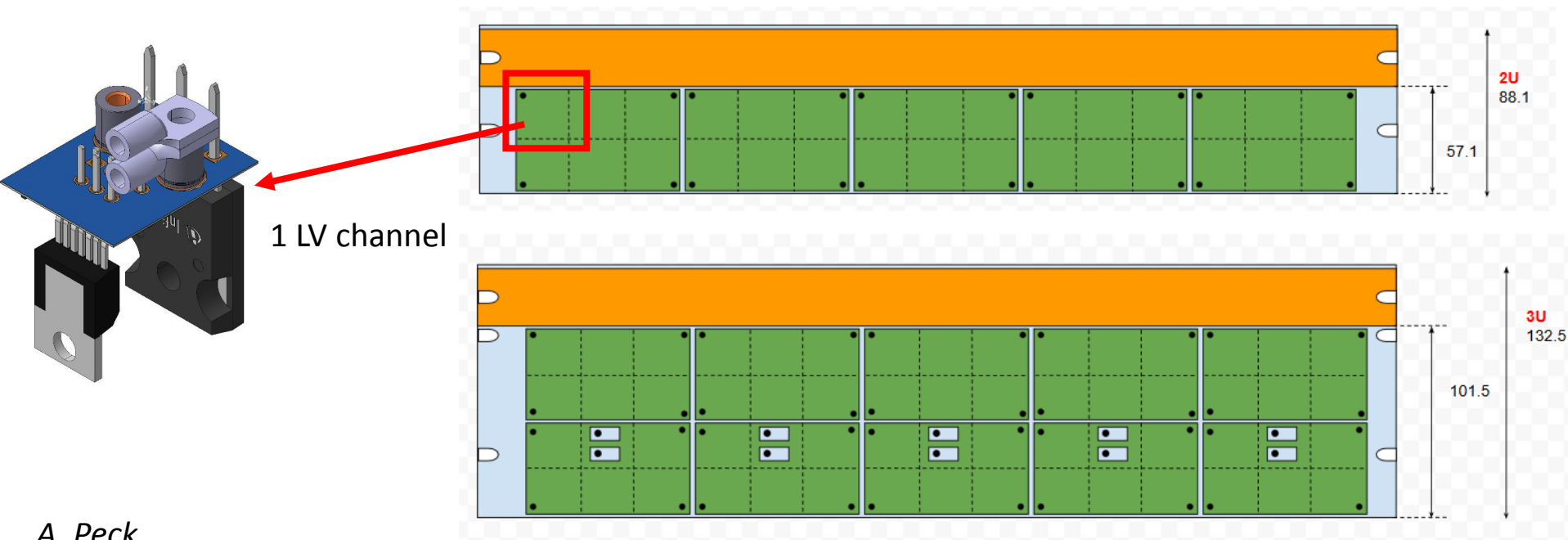
2. **HCAL** (German) has developed an external protection circuit

- The choice of the components defines the threshold voltage v_{Max} (e.g. 12 V) and the reset voltage (e.g. 10 V)
- If $V_{con} > v_{Max}$ a large current (200 A) flows in the circuit (*not* at the load) and causes the module to trip after the $tripTime$
- The proper operation is restored when the voltage gets below the reset voltage

GEM community also designed a similar (to HCAL) solution. Due to the fact that A3016HP when operated with CAEN MAO system doesn't suffer of spike problems, implementation is staged

Design of protection circuit #1

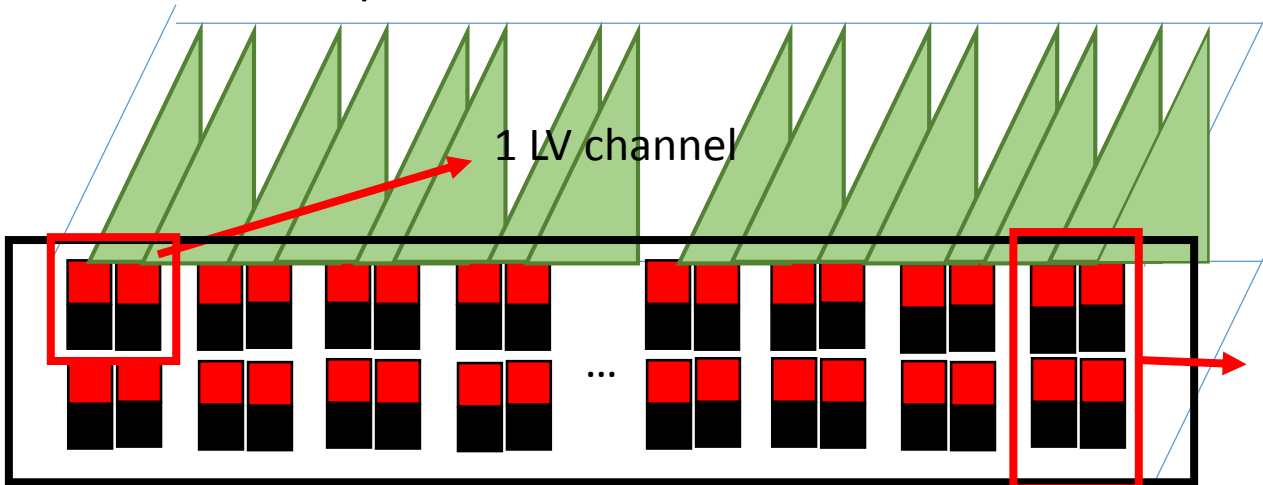
- Panel for **rack mounting**, based on (86 x 47.75) mm PCB with a matrix of 3x2 protection circuits ? (in figure: merged with copper bar for grounding, to save space)
- 2U panels for GE11 and GE21, 3U panels for MEO (2x number of LV channels)
- Difficult implementation for complexity of realization and space → the space for such panels was initially not foreseen in the racks



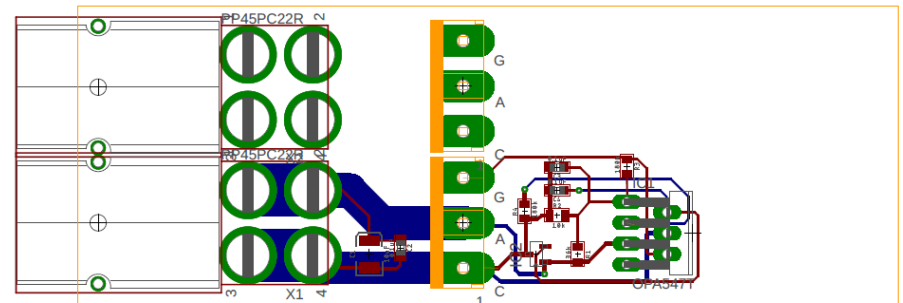
A. Peck

Design of protection circuit #2

- Panel for **rack mounting**
- The circuits are inside the rack, perpendicular to the front panel
- On the front panel there are 4x APP45 connectors for each LV channel



Front view (not to scale)



Side view

Z. Szillasi

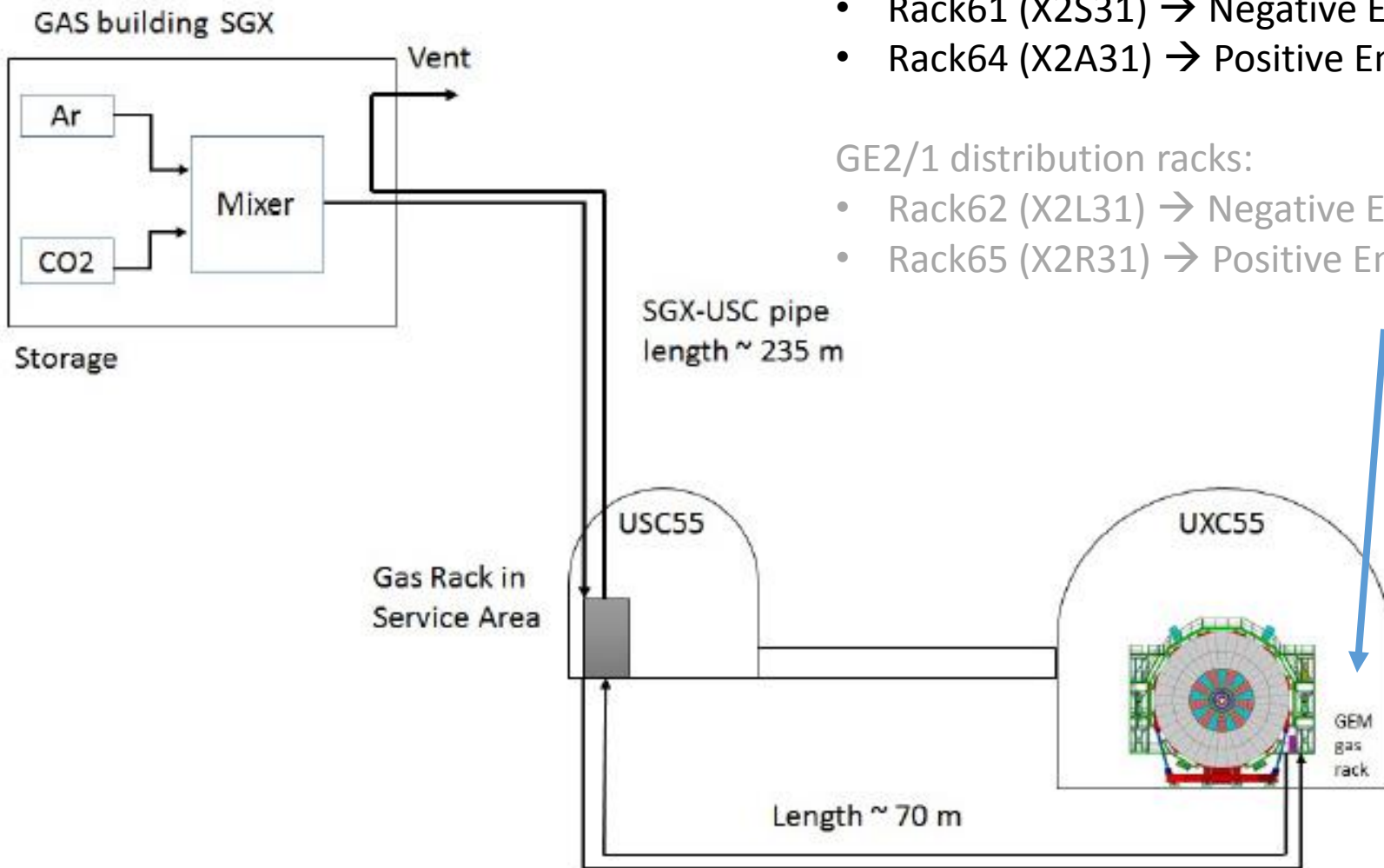
Gas System

GE1/1 distribution racks:

- Rack61 (X2S31) → Negative Endcap
- Rack64 (X2A31) → Positive Endcap

GE2/1 distribution racks:

- Rack62 (X2L31) → Negative Endcap
- Rack65 (X2R31) → Positive Endcap

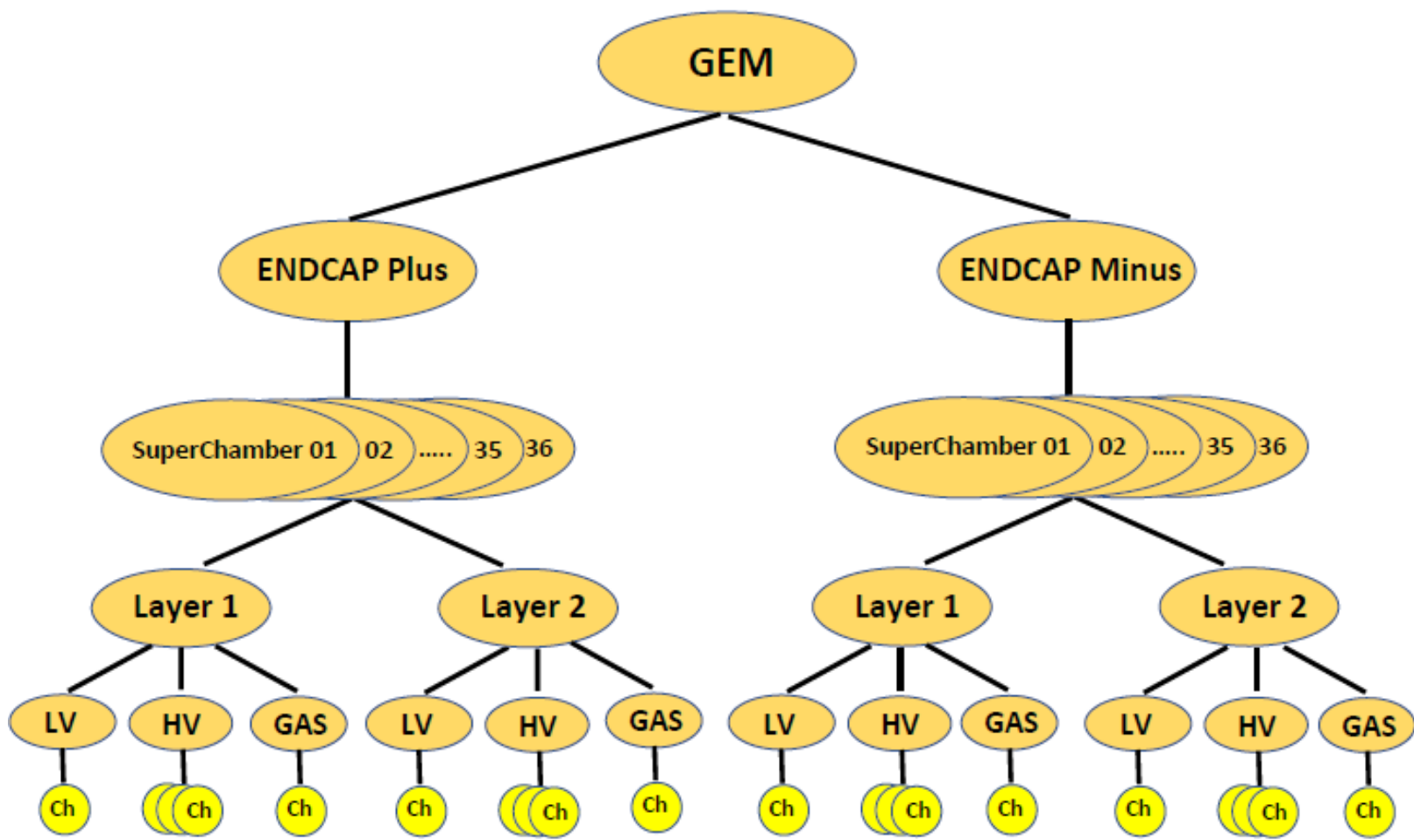


Gas System Mapping

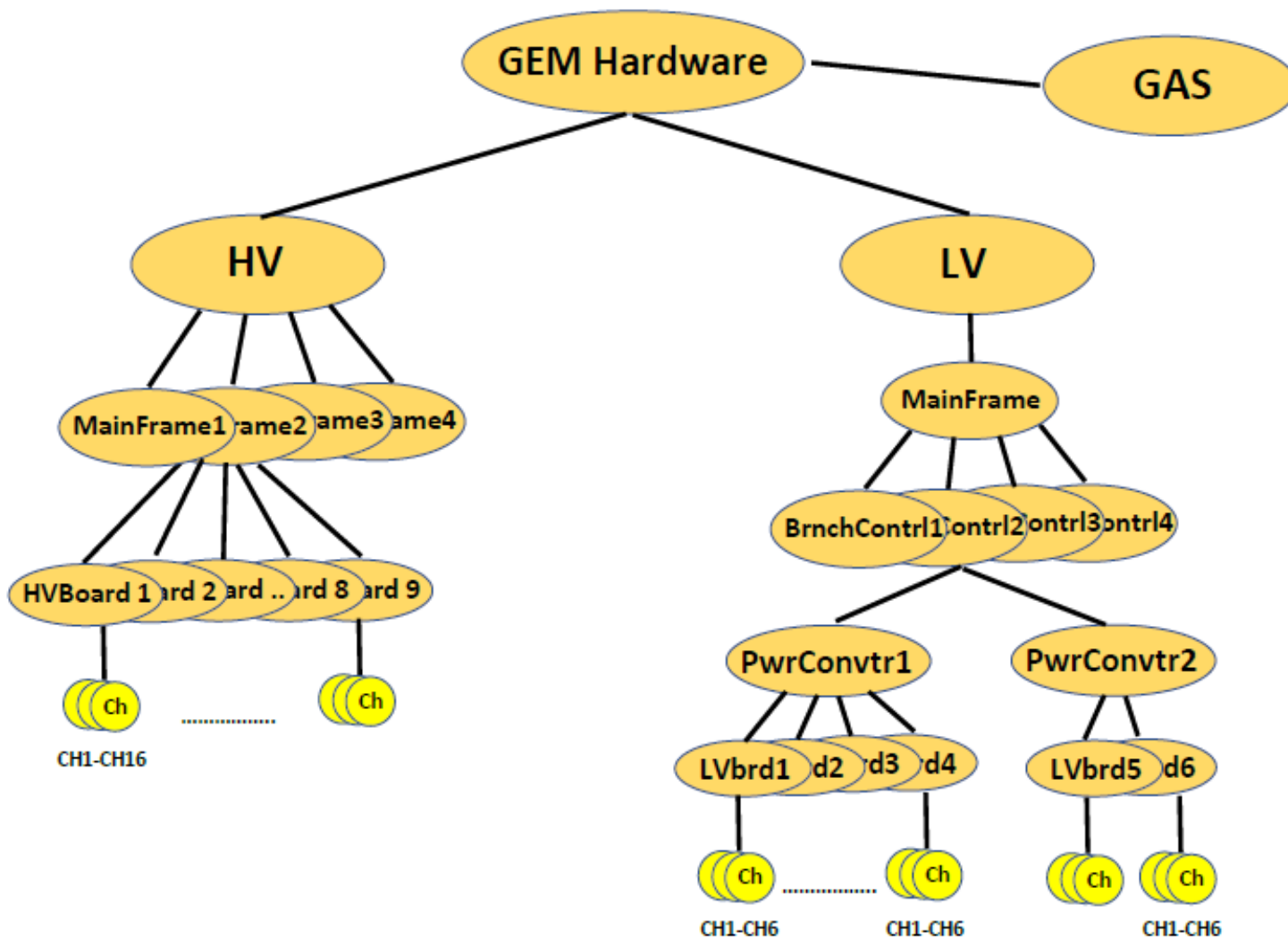
- Each gas rack hosts 13 (12 used) gas channels
- 1 gas channel supplies 6 (single) layers of different SCs (to minimize coverage holes in case of failures)

Negative Endcap	
SC 4 to 9 – Ly 1	SC 22 to 27 – Ly 1
SC 4 to 9 – Ly 2	SC 22 to 27 – Ly 2
SC 10 to 15 – Ly 1	SC 28 to 33 – Ly 1
SC 10 to 15 – Ly 2	SC 28 to 33 – Ly 2
SC 16 to 21 – Ly 1	SC 34 to 3 – Ly 1
SC 16 to 21 – Ly 2	SC 34 to 3 – Ly 2

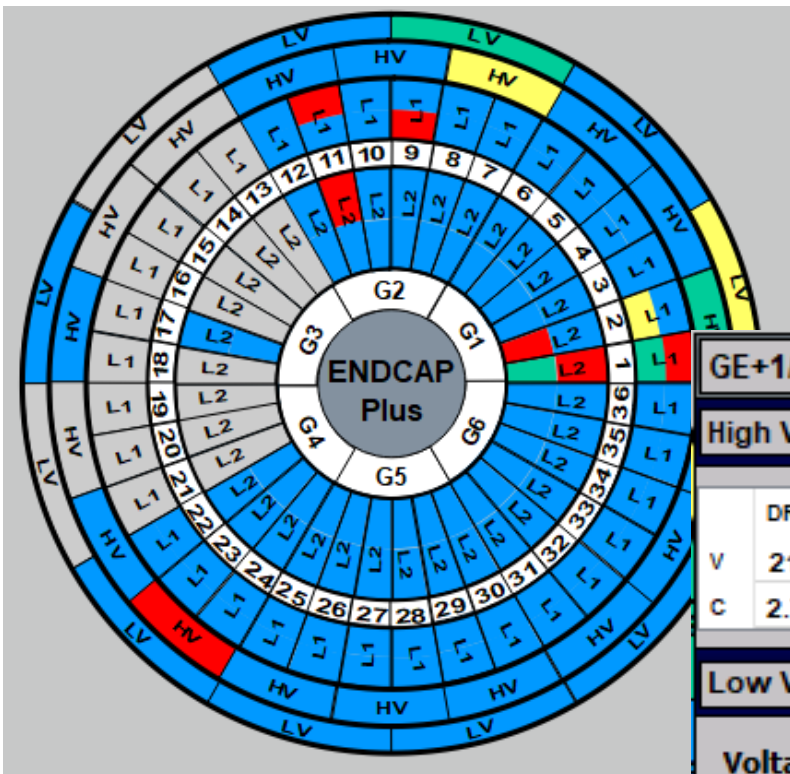
FSM – Detector View



FSM – Hardware View



Chamber Status Popup Panel



GE+1/1/01/1 ERROR [Change Settings](#)

High Voltage (HV) ERROR Last Updated
2018.10.03 14:53

	DRIFT	G1TOP	G1BOT	G2TOP	G2BOT	G3TOP	G3BOT
V	2145	891	854	412	256	338	200
C	2.711	2.656	2.200	1.756	1.244	0.844	0.300

Low Voltage (LV) ON Last Updated
2018.10.17 11:45

Voltage **Current**

Temperature Last Updated
2018.08.15 14:23

1	2	3	4	5	6
loading	loading	loading	loading	loading	loading

Status Monitor
Show Trends
Alarm Screen

Chamber Status Monitor Panel

Monitor (dist_1 - gem1; #1)

MONITORING Chamber Name: ON OFF/ STANDBY RAMPING ERROR EXCLUDED Settings Close

HV Board Status

HV Board ID: **GE+1/1 HVBrd01**

UnderTemp OverTemp

Show Trendpage

OpMode: FALSE BdStatus: 2 ramping up

readback setting OpMode = FALSE = Free
OpMode = TRUE = GEM

Board Dp: CAEN/GEM_CAEN_HV_01/board00

	OvC	OvV	UnV	Trip	Status
Drfit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1 on
G1Top	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	16 overvoltage
G1Bot	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8 overcurrent
G2Top	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4 ramping down
G2Bot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0 standby/off
G3Top	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	32 undervoltage
G3Bot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1024 calibration error

STATUS

Status	Meaning
0	off
1	on
2	ramping up
4	ramping down
8	overcurrent
16	overvoltage
32	undervoltage
64	external trip
128	max v
256	external disable
512	internal trip
1024	calibration error
2048	unplugged

Show Trendpage

IMonRange = FALSE = High
ZCAdjust = FALSE = Dis
ZCDetect = FALSE = Off
OpMode = FALSE = Free

UNITS

Dimension or parameter	Unit
Voltage	V
Current	uA
Ramp up/down	V/s
TripTime	s

	V0	ID	Vmon	Imon	OnOff readBack	OnOff Actual	V1	I1	RUP	RDWN	TripTime	onOrder	offOrder	iM Range	ZC Adjust	ZC Detect	vMax SoftValue	iMon Det	iMon Real	Temp	
Drfit	0.0	0.00	2145.2	2.71	Off	On	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	Drfit
G1Top	0.0	0.00	891.2	2.66	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	G1Top
G1Bot	0.0	0.00	854.2	2.20	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	G1Bot
G2Top	0.0	0.00	412.3	1.76	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	G2Top
G2Bot	0.0	0.00	256.1	1.24	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	G2Bot
G3Top	0.0	0.00	338.3	0.84	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0	G3Top
G3Bot	300.0	0.26	200.0	0.30	On	Off	0.0	0.00	0	0	0	0	0	TRUE	FALSE	FALSE	0	0	0	0	G3Bot

readback setting actual readback setting actual

LV Board Status

LV Board ID: **GE+1/1 LVBrd01**

BdStatus: 1 on Show Trendpage

Board Dp: CAEN/GEM_CAEN_LV/branchController00/easyCrate0/easyBoard00

LV Channel	V0	ID	Vcon	Vmon	Imon	OnOff readBack	OnOff Actual	V1	I1	TripTime	vMax SoftValue
LV Channel	0.000	0.000	0.000	5.236	0.500	On	On	0.000	0.000	0	0

readback setting actual readback setting

LV Channel	OvC	OvV	UnV	Trip	Status
LV Channel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1 on

Move Cursor Over "Drift", "G1Top", etc. to See the Corresponding Channel Dp

❖ Using this panel, user can monitor,

- ❖ LV and HV channel DP values connected to the selected chamber
- ❖ LV and HV channel status
- ❖ LV and HV channel error status
- ❖ Relevant LV and HV Board status
- ❖ LV and HV Board trend pages
- ❖ Channel trend page

Chamber Settings Panel

Settings (dist_1 - gem1; #1)

CHANGE SETTINGS Chamber Name: Chamber ID: Status Monitor

Settings - Common Settings - More

BOARD settings

Operating Mode Board Dp:

Click "Apply" to apply settings

Channel settings

	OnOff	V0	V1	I0	I1	RUP	RDWN	TripTime	Vmon	Imon	IO readBack
Drfit	Off	0.0	0.0	0.000	0.000	0	0	0	2145.2	2.7111	0.000
G1Top	Off	0.0	0.0	0.000	0.000	0	0	0	891.2	2.6555	0.000
G1Bot	Off	0.0	0.0	0.000	0.000	0	0	0	854.2	2.2000	0.000
G2Top	Off	0.0	0.0	0.000	0.000	0	0	0	412.3	1.7555	0.000
G2Bot	Off	0.0	0.0	0.000	0.000	0	0	0	256.1	1.2444	0.000
G3Top	Off	0.0	0.0	0.000	0.000	0	0	0	338.3	0.8444	0.000
G3Bot	On	300.0	0.0	0.255	0.000	0	0	0	200.0	0.3000	0.255
Sum		300.0	(V)	(uA)	(uA)	(V/s)	(V/s)	(s)	5097.2	11.7110	Sum
		(V)							(V)	(uA)	

SWITCH ALL ON (uA) (uA)
 SWITCH ALL OFF (V) (V)
 Save current settings to...
 Load settings from file
 Load default values
 Set Divider Current to ALL
 Set Divider Voltage to ALL
 0.255 (uA)
 Set i0 to ALL
 Apply

Click "Apply" to apply settings

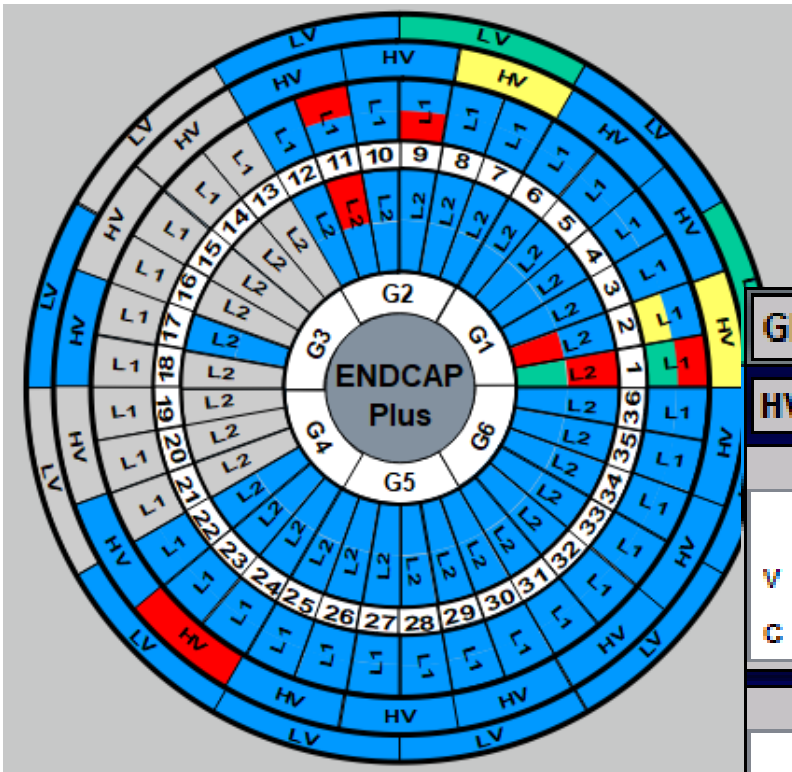
Move Cursor Over "Drift", "G1Top", etc. to See the Corresponding Channel Dp

ON OFF/STANDBY RAMPING ERROR EXCLUDED

❖ Using this panel, experts or operators can change,

- ❖ HV channel DP values connected to the selected chamber
- ❖ Relevant HV Board operating mode
- ❖ Can save current settings, load settings and load default settings
- ❖ Can set divider current and voltages by clicking a single button

HV Board Status Popup Panel



GE+1/1 HVBrd1
ON
Change Settings

HV Board Status
RAMPING
Last Updated
2018.10.17 13:04

Super Chamber No 1 , Layer1 & Layer2

	Ch 0	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6
V	200	338	256	412	854	891	2145
C	0.300	0.844	1.244	1.756	2.200	2.656	2.711

Super Chamber No 2 , Layer1 & Layer2

	Ch 7	Ch 8	Ch 9	Ch 10	Ch 11	Ch 12	Ch 13
V	0	0	0	0	0	0	0
C	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Status Monitor
Show Trends
Alarm Screen

HV Board Status Monitor Panel

Monitor (dist_1 - gem1; #1)

MONITORING Connected Chambers: **+GEMINI 5 & +GEMINI 6** ON OFF/ STANDBY RAMPING ERROR EXCLUDED Settings Close

HV Board ID: GE+1/1 HVBrd3

BOARD settings

Show Trendpage UnderTemp OverTemp

OpMode **FALSE** Bd Status **0 standby/off**

readback setting OpMode = FALSE = Free
OpMode = TRUE = GEM

Board Dp: CAEN/GEM_CAEN_HV_01/board02

Channel	OvC	OvV	UnV	Trip	Status
Channel 0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off

Channel	V0	ID	Vmon	Imon	OnOff readBack	OnOff Actual	V1	I1	RUP	RDWN	TripTime	onOrder	offOrder	iM Range	ZC Adjust	ZC Detect	vMax SoftValue	iMon Det	iMon Real	Temp
Channel 0	0.0	0.00	0.0	0.14	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 1	0.0	0.00	0.0	0.19	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 2	0.0	0.00	0.0	0.23	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 3	0.0	0.00	0.0	0.38	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 4	0.0	0.00	0.0	0.58	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 5	0.0	0.00	0.0	0.72	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 6	0.0	0.00	0.0	0.81	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 7	0.0	0.00	0.0	0.13	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 8	0.0	0.00	0.0	0.26	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 9	0.0	0.00	0.0	0.39	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 10	0.0	0.00	0.0	0.53	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 11	0.0	0.00	0.0	0.66	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 12	0.0	0.00	0.0	0.71	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0
Channel 13	0.0	0.00	0.0	0.88	Off	Off	0.0	0.00	0	0	0	0	0	FALSE	FALSE	FALSE	0	0	0	0

readback setting actual readback setting actual

Move Cursor Over "Channel 0", "Channel 1", etc. to See the Corresponding Channel Dp

❖ Using this panel, user can monitor,

- ❖ HV Board status
- ❖ HV channel DP values of selected HV board
- ❖ HV channel status
- ❖ HV channel error status
- ❖ Board and Channel trend pages

HV Board Settings Panel

Settings (dist_1 - gem1; #1)

CHANGE HV SETTINGS Connected Chambers: **GEMINI 1 & +GEMINI 2** HV Board ID: **GE+1/1 HVBrd1** Status Monitor

Settings - Common Settings - More

BOARD settings

Operating Mode: **GEM** Board Dp: **CAEN/GEM_CAEN_HV_01/board00**

Click "Apply" to apply settings

Channel settings

	OnOff	V0	V1	I0	I1	RUP	RDWN	TripTime	Vmon	Imon	IDreadBack
Channel 0	On	300.0	0.0	0.255	0.000	0	0	0	200.0	0.3000	0.255
Channel 1	Off	0.0	0.0	0.000	0.000	0	0	0	338.3	0.8444	0.000
Channel 2	Off	0.0	0.0	0.000	0.000	0	0	0	256.1	1.2444	0.000
Channel 3	Off	0.0	0.0	0.000	0.000	0	0	0	412.3	1.7555	0.000
Channel 4	Off	0.0	0.0	0.000	0.000	0	0	0	854.2	2.2000	0.000
Channel 5	Off	0.0	0.0	0.000	0.000	0	0	0	891.2	2.6555	0.000
Channel 6	Off	0.0	0.0	0.000	0.000	0	0	0	2145.2	2.7111	0.000
Sum	(V)	300.0	(V)	(uA)	(uA)	(V/s)	(V/s)	(s)	5097.2	11.7110	(uA)
Channel 7	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 8	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 9	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 10	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 11	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 12	Off	0.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Channel 13	Off	200.0	0.0	0.000	0.000	0	0	0	0.0	0.0000	0.000
Sum	(V)	200.0	(V)	(uA)	(uA)	(V/s)	(V/s)	(s)	0.0	0.0000	(uA)

(uA)
 (V)
 (uA)

 Click "Apply" to apply settings

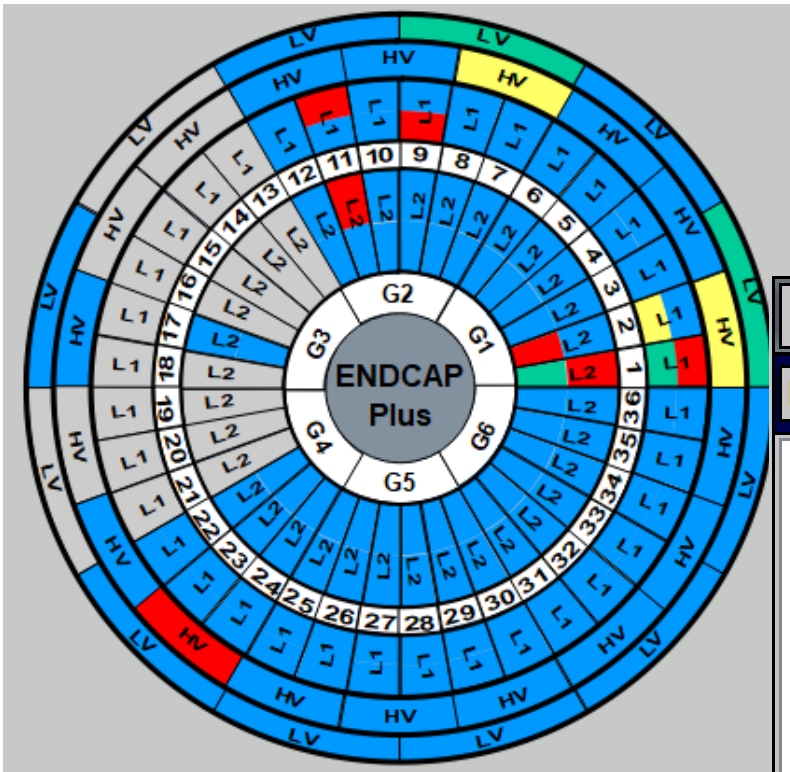
Move Cursor Over "Drift", "G1Top", etc. to See the Corresponding Channel Dp

ON OFF/STANDBY RAMPING ERROR EXCLUDED

❖ Using this panel, experts can change,

- ❖ All HV channel DP values of selected HV board
- ❖ HV Board operating mode
- ❖ Other features are same as Chamber Setting panel
- ❖ It will popup a message when user is going to apply changes, if relevant LV channel is off

LV Board Status Popup Panel



GE+1/1 LVBrd1
OFF
Change Settings

LV Board Status
ON
Last Updated
2018.10.17 12:34

Channel	Voltage	Current	\$Chmbtr Name	Layer
Channel 0	5.236	0.500	GE+1/1 C1	Layer 1
Channel 1	0.000	0.278	GE+1/1 C1	Layer 2
Channel 2	0.000	0.000	GE+1/1 C2	Layer 1
Channel 3	0.000	0.000	GE+1/1 C2	Layer 2
Channel 4	0.000	0.000	GE+1/1 C3	Layer 1
Channel 5	0.000	0.000	GE+1/1 C3	Layer 2

Status Monitor
Show Trends
Alarm Screen

LV Board Status Monitor Panel

Monitor (dist_1 - gem1; #1)

LV MONITORING Connected Chambers: **+GEMINI 1 , +GEMINI 2 , +GEMINI 3** Settings Close

BOARD settings

LV Board ID: **GE+1/1 LVBrd1**

BdStatus: **1** **on** Show Trendpage

Board Dp: **CAEN/GEM_CAEN_LV/branchController00/easyCrate0/easyBoard00**

UNITS

Dimension or parameter	Unit
Voltage	V
Current	uA
Ramp up/down	V/s
Triptime	s

iMonRange = FALSE = High
 ZCAadjust = FALSE = Dis
 ZCDetect = FALSE = Off
 OpMode = FALSE = Fret

Show Trendpage

Channel	OvC	OvV	UnV	Trip	Status
Channel 0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1 on
Channel 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	1 on
Channel 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	3
Channel 3	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	9
Channel 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off
Channel 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	0 standby/off

STATUS

Status	Meaning
0	off
1	on
2	ramping up
4	ramping down
8	overcurrent
16	overvoltage
32	undervoltage
64	external trip
128	max v
256	external disable
512	internal trip
1024	calibration error
2048	unplugged

Channel	Chamber Name	V0	I0	Vcon	Vmon	Imon	OnOff readBack	OnOff Actual	V1	I1	TripTime	vMax SoftValue	Channel
Channel 0	GE+1/1/01/1	0.000	0.000	0.000	5.236	0.500	On	On	0.000	0.000	0	0	Channel 0
Channel 1	GE+1/1/01/2	0.000	0.000	0.000	0.000	0.278	Off	Off	0.000	0.000	0	0	Channel 1
Channel 2	GE+1/1/02/1	0.000	0.000	0.000	0.000	0.000	Off	Off	0.000	0.000	0	0	Channel 2
Channel 3	GE+1/1/02/2	0.000	0.000	0.000	0.000	0.000	Off	Off	0.000	0.000	0	0	Channel 3
Channel 4	GE+1/1/03/1	0.000	0.000	0.000	0.000	0.000	Off	Off	0.000	0.000	0	0	Channel 4
Channel 5	GE+1/1/03/2	0.000	0.000	0.000	0.000	0.000	Off	Off	0.000	0.000	0	0	Channel 5

readback setting actual readback setting

Move Cursor Over "Channel 0", "Channel 1", etc. to See the Corresponding Channel Dp

ON **OFF/STANDBY** **RAMPING** **ERROR** **EXCLUDED**

❖ **Using this panel, user can monitor,**

- ❖ LV Board status
- ❖ LV channel DP values of selected LV board
- ❖ LV channel status
- ❖ LV channel error status
- ❖ Board and Channel trend pages

HV Board Settings Panel

Settings (dist_1 - gem1; #1)

CHANGE LV SETTINGS Connected Chambers: **+GEMINI 1 , +GEMINI 2 , +GEMINI 3** LV Board ID: **GE+1/1 LVBrd1** Status Monitor

BOARD settings

BdStatus: **1** **on** Board Dp: **CAEN/GEM_CAEN_LV/branchController00/easyCrate0/easyBoard00** Close

Channel settings

Channel	Chamber Name	OnOff	vMax					Vmon	Imon	IO readBack	
			V0	V1	IO	I1	TripTime SoftValue				
Channel 0	GE+1/1/01/1	On	0.000	0.000	0.000	0.000	0	0.000	5.236	0.500	0.000
Channel 1	GE+1/1/01/2	Off	0.000	0.000	0.000	0.000	0	0.000	0.000	0.278	0.000
Channel 2	GE+1/1/02/1	Off	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000
Channel 3	GE+1/1/02/2	Off	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000
Channel 4	GE+1/1/03/1	Off	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000
Channel 5	GE+1/1/03/2	Off	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000

(V) Set This Voltage to ALL V0 (A) Set i0 to ALL Apply Click "Apply" to apply settings

Save current settings to... Load settings from file Save current settings as default Load default values

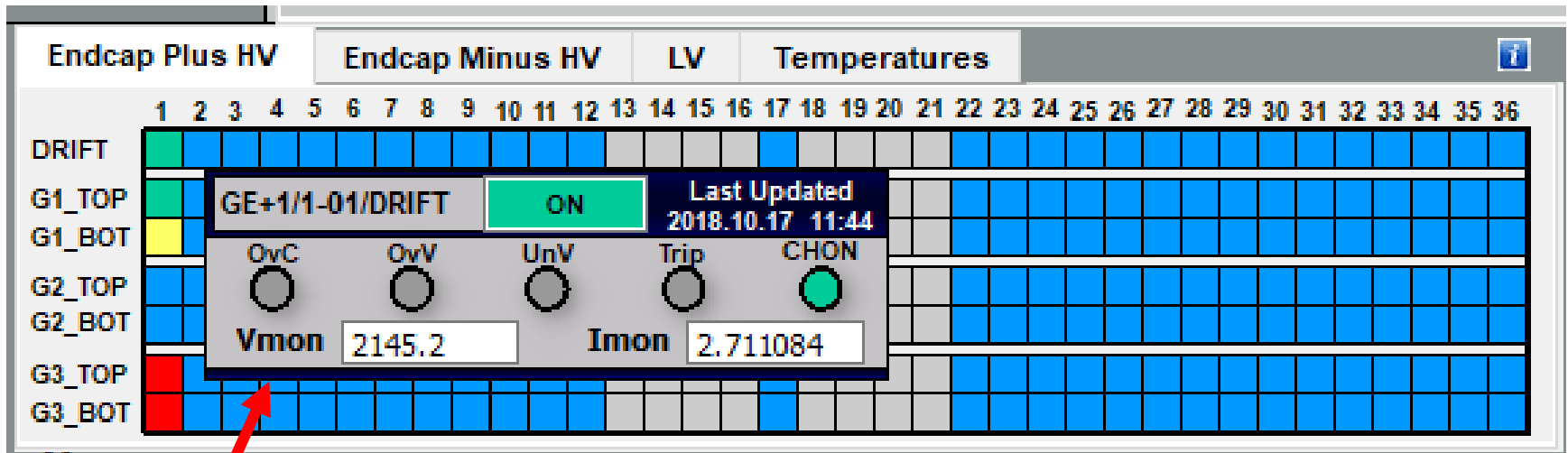
SWITCH ALL ON SWITCH ALL OFF

Move Cursor Over "Drift", "G1Top", etc. to See the Corresponding Channel Dp ON OFF/ STANDBY RAMPING ERROR EXCLUDED

❖ **Using this panel, experts can change,**

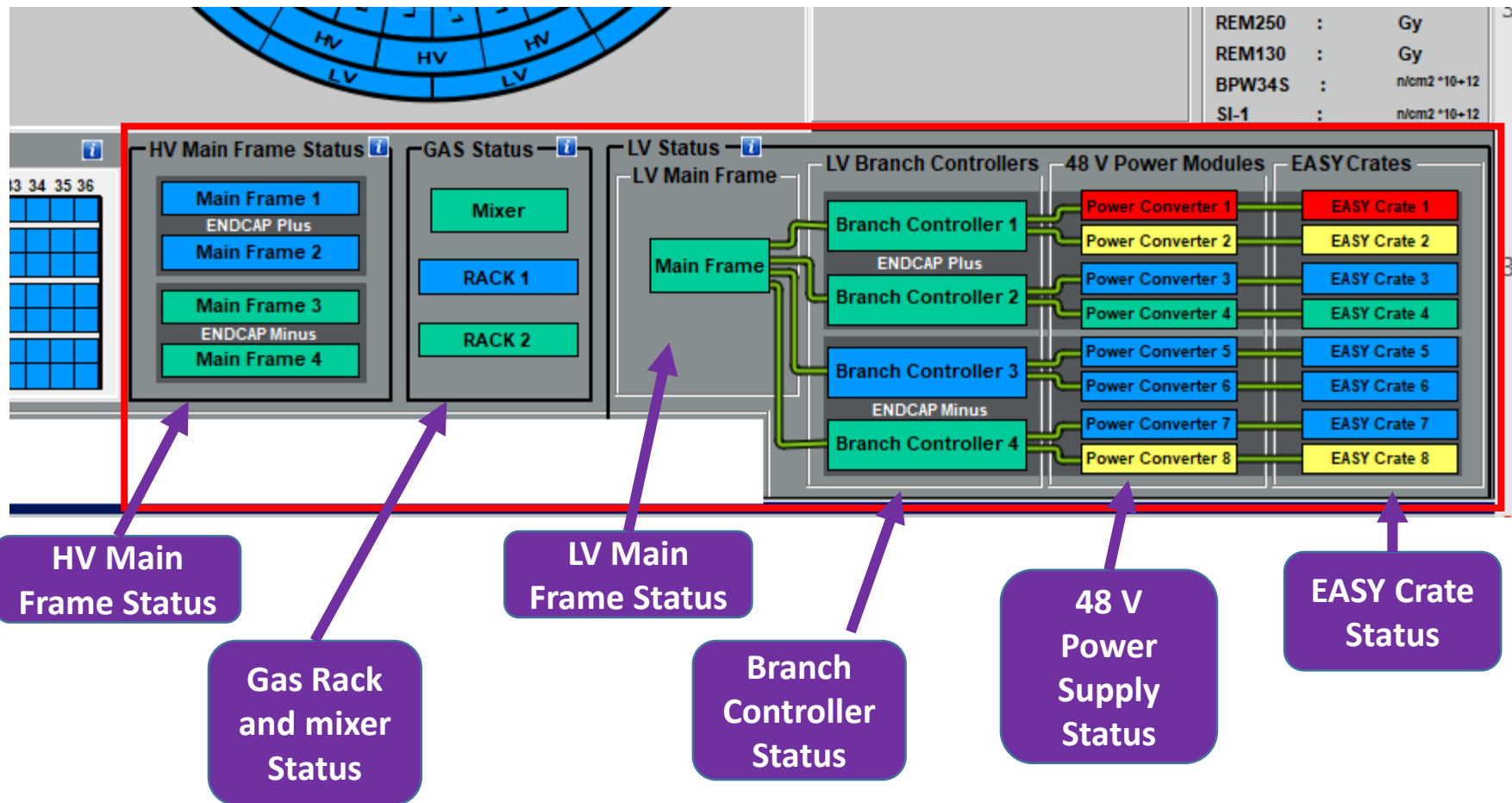
- ❖ All LV channel DP values of selected LV board
- ❖ Other features are same as Chamber Setting panel

Gem Foil HV Status



GEM Foil status

Main Frame, MAO and Crate Status



Chamber Include/ Exclude Panel

ChamberSettings (dist_1 - gem1; #1)

ENDCAP Plus ENDCAP Minus

Supper Chamber	Layer	Status	Enable/ Disable <input type="checkbox"/> Select All
GEMINI 1	Layer 1	Included	Exclude
	Layer 2	Included	Exclude
GEMINI 2	Layer 1	Excluded	Include
	Layer 2	Included	Exclude
GEMINI 3	Layer 1	Excluded	Include
	Layer 2	Included	Exclude
GEMINI 4	Layer 1	Included	Exclude
	Layer 2	Included	Exclude
GEMINI 5	Layer 1	Included	Exclude
	Layer 2	Included	Exclude
GEMINI 6	Layer 1	Included	Exclude
	Layer 2	Included	Exclude
GEMINI 7	Layer 1	Included	Exclude
	Layer 2	Included	Exclude

Apply Changes

Clear Selection

■ Included
■ Excluded

Close

Main Panel

The screenshot shows the CMS Main Panel interface. At the top, there are buttons for 'Kill', 'Save/ Load Recipe', and 'Detector'. Below these are tabs for 'Status', 'GAS', 'LHC Info', and 'Mag'. The main area is divided into a left sidebar with control buttons and a large circular detector status diagram on the right.

Control Buttons (Left Sidebar):

- Alarms:** Alarms, CLR LV Alarm, CLR HV Alarm
- Power Cycle:** Power Cycle LV
- SCAN:** LV Scan, HV Scan

Detector Status Diagram (Right):

The diagram is a circular layout representing the detector's sectors. It is divided into concentric rings labeled LV (Low Voltage) and HV (High Voltage). The sectors are numbered 1 through 27. The diagram shows various status indicators, including 'ENDC' and 'Plu' in the center, and labels G2, G3, G4, G5 around the perimeter. Some sectors are highlighted in red, indicating specific status or alarms.

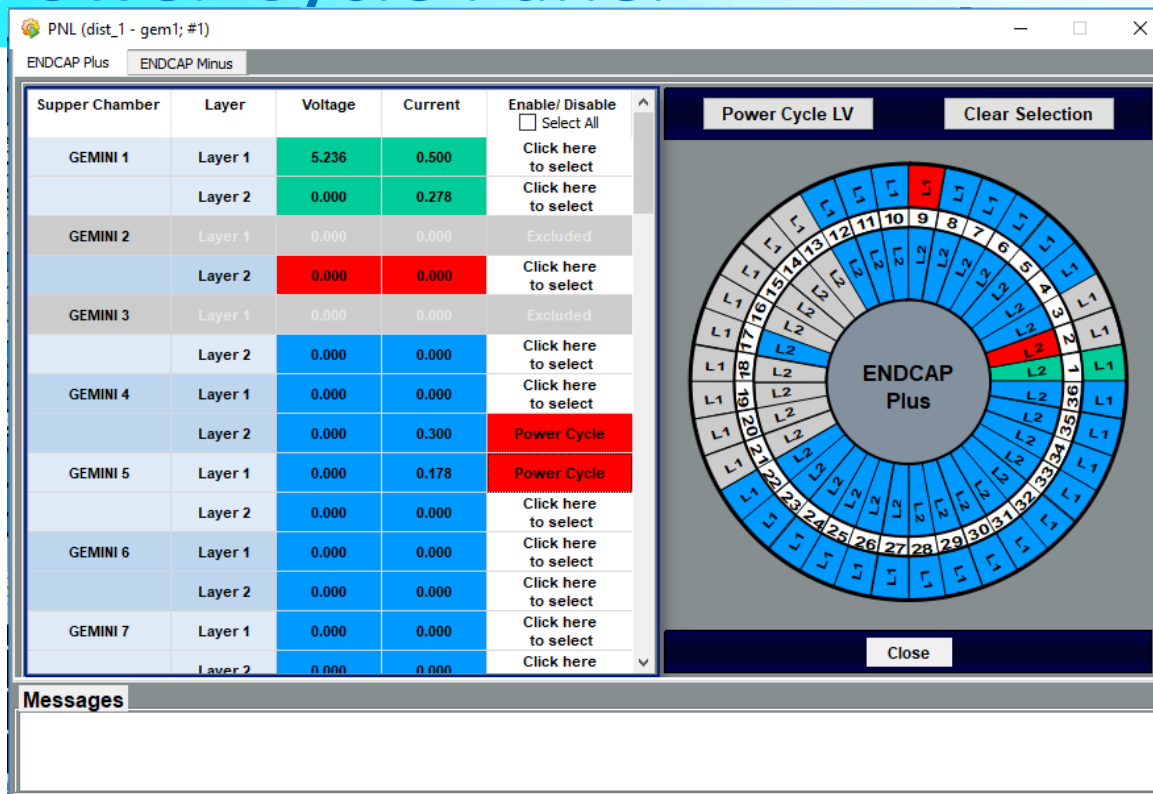
❖ Alarms →

❖ Power Cycle LV →

❖ Low Voltage Scan →

❖ High Voltage Scan →

LV Power Cycle Panel

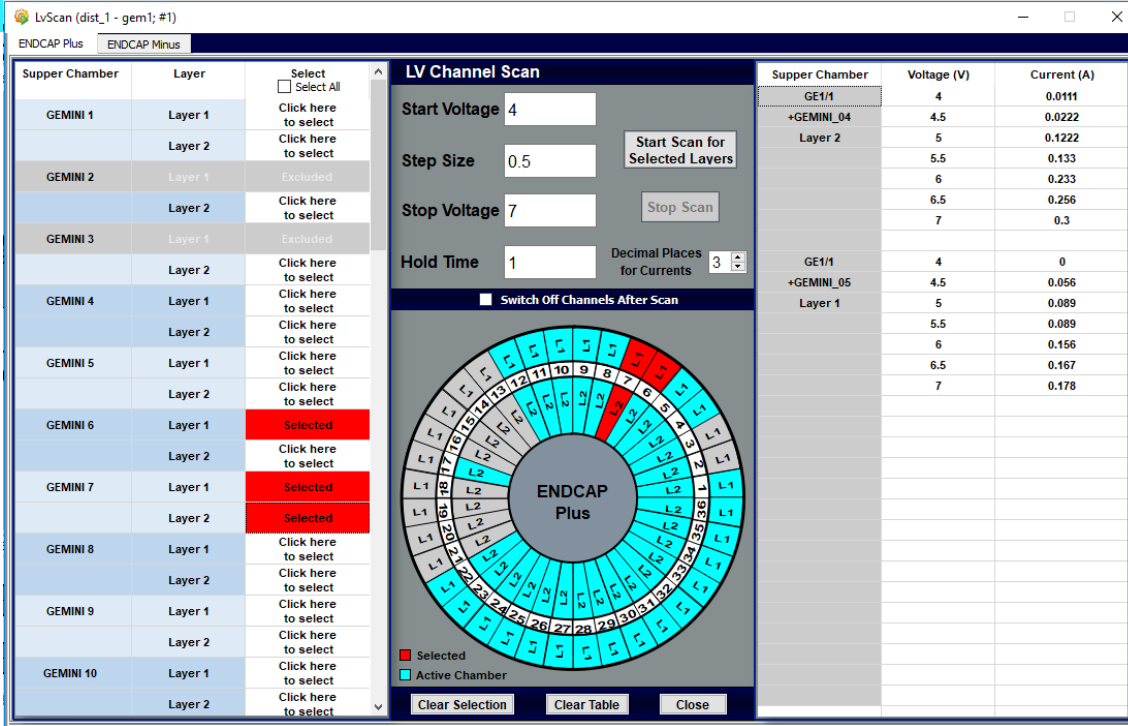


Supper Chamber	Layer	Voltage	Current	Enable/ Disable
GEMINI 1	Layer 1	5.236	0.500	Click here to select
	Layer 2	0.000	0.278	Click here to select
GEMINI 2	Layer 1	0.000	0.000	Excluded
	Layer 2	0.000	0.000	Click here to select
GEMINI 3	Layer 1	0.000	0.000	Excluded
	Layer 2	0.000	0.000	Click here to select
GEMINI 4	Layer 1	0.000	0.000	Click here to select
	Layer 2	0.000	0.300	Power Cycle
GEMINI 5	Layer 1	0.000	0.178	Power Cycle
	Layer 2	0.000	0.000	Click here to select
GEMINI 6	Layer 1	0.000	0.000	Click here to select
	Layer 2	0.000	0.000	Click here to select
GEMINI 7	Layer 1	0.000	0.000	Click here to select
	Layer 2	0.000	0.000	Click here to select

❖ Features :-

- ❖ User can select multiple chambers at once
- ❖ Selections will be highlighted in red color
- ❖ Displays the current voltage, current and state on the table and graphical area
- ❖ Two separate tabs for ENDCAP Plus and Minus
- ❖ When “Power Cycle LV” is clicked, selected chambers will be power cycled one by one
- ❖ **Power cycling status for each chamber will be shown in “Messages” area**

LV Scan Panel



The screenshot shows the LV Scan Panel software interface. It features a table on the left for selecting chambers and layers, a central circular diagram of the detector layout, and a table on the right showing scan results. The interface includes controls for setting scan parameters like start voltage, step size, and stop voltage, as well as buttons for starting and stopping the scan.

Supper Chamber	Layer	Select
GEMINI 1	Layer 1	Click here to select
	Layer 2	Click here to select
GEMINI 2	Layer 1	Excluded
	Layer 2	Click here to select
GEMINI 3	Layer 1	Excluded
	Layer 2	Click here to select
GEMINI 4	Layer 1	Click here to select
	Layer 2	Click here to select
GEMINI 5	Layer 1	Click here to select
	Layer 2	Click here to select
GEMINI 6	Layer 1	Selected
	Layer 2	Click here to select
GEMINI 7	Layer 1	Selected
	Layer 2	Selected
GEMINI 8	Layer 1	Click here to select
	Layer 2	Click here to select
GEMINI 9	Layer 1	Click here to select
	Layer 2	Click here to select
GEMINI 10	Layer 1	Click here to select
	Layer 2	Click here to select

Supper Chamber	Voltage (V)	Current (A)
GE1/1	4	0.0111
+GEMINI_04	4.5	0.0222
Layer 2	5	0.1222
	5.5	0.133
	6	0.233
	6.5	0.256
	7	0.3
GE1/1	4	0
+GEMINI_05	4.5	0.056
Layer 1	5	0.089
	5.5	0.089
	6	0.156
	6.5	0.167
	7	0.178

❖ Features :-

- ❖ User can select multiple chambers at once
- ❖ Selections will be highlighted in red color in both table and graphical area
- ❖ User should set start and stop voltages, step size and hold time
- ❖ When “Start Scan” button is clicked, selected chambers will be scanned one by one
- ❖ User can abort the scan by clicking “Stop Scan” button

HV Scan Panel

HvScan (dist_1 - gem1; #1)

ENDCAP Plus ENDCAP Minus

Supper Chamber	Layer	Select
GEMINI 1	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 2	Layer 1	Excluded
	Layer 2	<input type="checkbox"/>
GEMINI 3	Layer 1	Excluded
	Layer 2	<input type="checkbox"/>
GEMINI 4	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 5	Layer 1	Selected
	Layer 2	Selected
GEMINI 6	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 7	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 8	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 9	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>
GEMINI 10	Layer 1	<input type="checkbox"/>
	Layer 2	<input type="checkbox"/>

HV Channel Scan

Start Voltage:

Step Size:

Stop Voltage:

Hold Time: Decimal Places for Currents:

Switch Off Channels After Scan

Legend: ■ Selected, ■ Active Chamber

Buttons: Clear Selection, Clear Table, Close

Supper Chamber	Drift Voltage (V)	Drift Current (uA)	G1_Top Voltage (V)	G1_Top Current (uA)	G1_Bot Voltage (V)	G1_Bot Current (uA)	G2_Top Voltage (V)	G2_Top Current (uA)	G2_Bot Voltage (V)	G2_Bot Current (uA)	G3_Top Voltage (V)	G3_Top Current (uA)	G3_Bot Voltage (V)	G3_Bot Current (uA)
GE1/1	100	0.1	100	0.6444	100	1.0222	100	1.4555	100	1.9555	100	2.4555	100	2.4555
+GEMINI_04	150	0.1889	150	0.6778	150	1.0778	150	1.5222	150	2	150	2.5222	150	2.5222
Layer 1	200	0.2778	200	0.7444	200	1.0889	200	1.5555	200	2.0666	200	2.5222	200	2.5222
	250	0.3111	250	0.8	250	1.1444	250	1.6	250	2.1444	250	2.6	250	2.6
	300	0.3889	300	0.8667	300	1.2333	300	1.7	300	2.1778	300	2.6222	300	2.6222
	350	0.4778	350	0.9111	350	1.2555	350	1.7333	350	2.2222	350	2.6222	350	2.6222
	400	0.4778	400	0.9111	400	1.3555	400	1.8111	400	2.3111	400	2.6555	400	2.6555
	450	0.4778	450	0.9222	450	1.3555	450	1.8111	450	2.3333	450	2.7333	450	2.7333
	500	0.5778	500	0.9667	500	1.3667	500	1.8889	500	2.4111	500	2.8	500	2.8
GE1/1	100	0.0778	100	0.6222	100	1.2222	100	1.7555	100	2.3111	100	2.7666	100	2.7666
+GEMINI_04	150	0.1444	150	0.6889	150	1.3222	150	1.7555	150	2.3222	150	2.8555	150	2.8555
Layer 2	200	0.2444	200	0.7222	200	1.3889	200	1.8444	200	2.3333	200	2.8666	200	2.8666
	250	0.2778	250	0.8111	250	1.4555	250	1.8889	250	2.4222	250	2.9222	250	2.9222
	300	0.2778	300	0.9	300	1.5	300	1.9333	300	2.4222	300	2.9889	300	2.9889
	350	0.3333	350	0.9333	350	1.5444	350	1.9666	350	2.4555	350	3.0111	350	3.0111
	400	0.4	400	1.0111	400	1.6444	400	2.0555	400	2.5222	400	3.0777	400	3.0777
	450	0.4444	450	1.1111	450	1.6778	450	2.1333	450	2.6111	450	3.1444	450	3.1444
	500	0.5333	500	1.2111	500	1.7	500	2.2333	500	2.7	500	3.2444	500	3.2444

❖ Features :-

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