



# Hall C High Voltage CAEN Test Results

Pablo Campero  
Detector Support Group  
August 7<sup>th</sup>, 2019

# Content

- Overview
  - HV CAEN SY4527 Systems
  - HV CAEN EPICS Test Station Setup
- Development of CSS-BOY screens
- Test Procedure
- Test Results
- Status and Upcoming Tasks
- Conclusions

# CAEN SY4527 Systems



CAEN SY4527 System Mainframe – Front view



CAEN SY4527 System Mainframe – Rear View

## CAEN Mainframe – Technical Specifications

Version	SY4527
Voltage range	100/240 VAC, 50/60 Hz
Max current	25 A; fuse 30 A 600 V screw cap
Max power	5500 W at 220 VAC 2750 W at 110 VAC
Max number of boards	16
Max number of PSU units per crate	4 (1 primary + 3 optional)
Max output power	4200 W at 220 V 1990 W at 110 V
Communication	Gigabit Ethernet, Wi-Fi (optional)
Software	Graphical Interface Control Software; OS Platforms : Windows, Linux HiVoCS tool
CPU	basic, advanced, and full
Additional features	OPC Server compatibility
Operating temperature	From 5 °C to 40 °C

# CAEN SY4527 Systems



CAEN- A1535



CAEN-A7435



CAEN-A7030TN

## Hall C CAEN HV Boards – Technical Specifications

System mainframe	Board model	Max voltage [V]	Max current [mA]	Max power [w]	Channels	Hall C system
SY4527	A1535SP/SN	+/- 3500	3	8	24	Hodo/Shower /Heavy Gas/ Noble Gas/ Aerogel
	A7435SN	+ 3500	3.5/0.35	9	24	
	A7030TN	+ 3000	1	1.5	36	

# HV CAEN EPICS Test Station - Overview

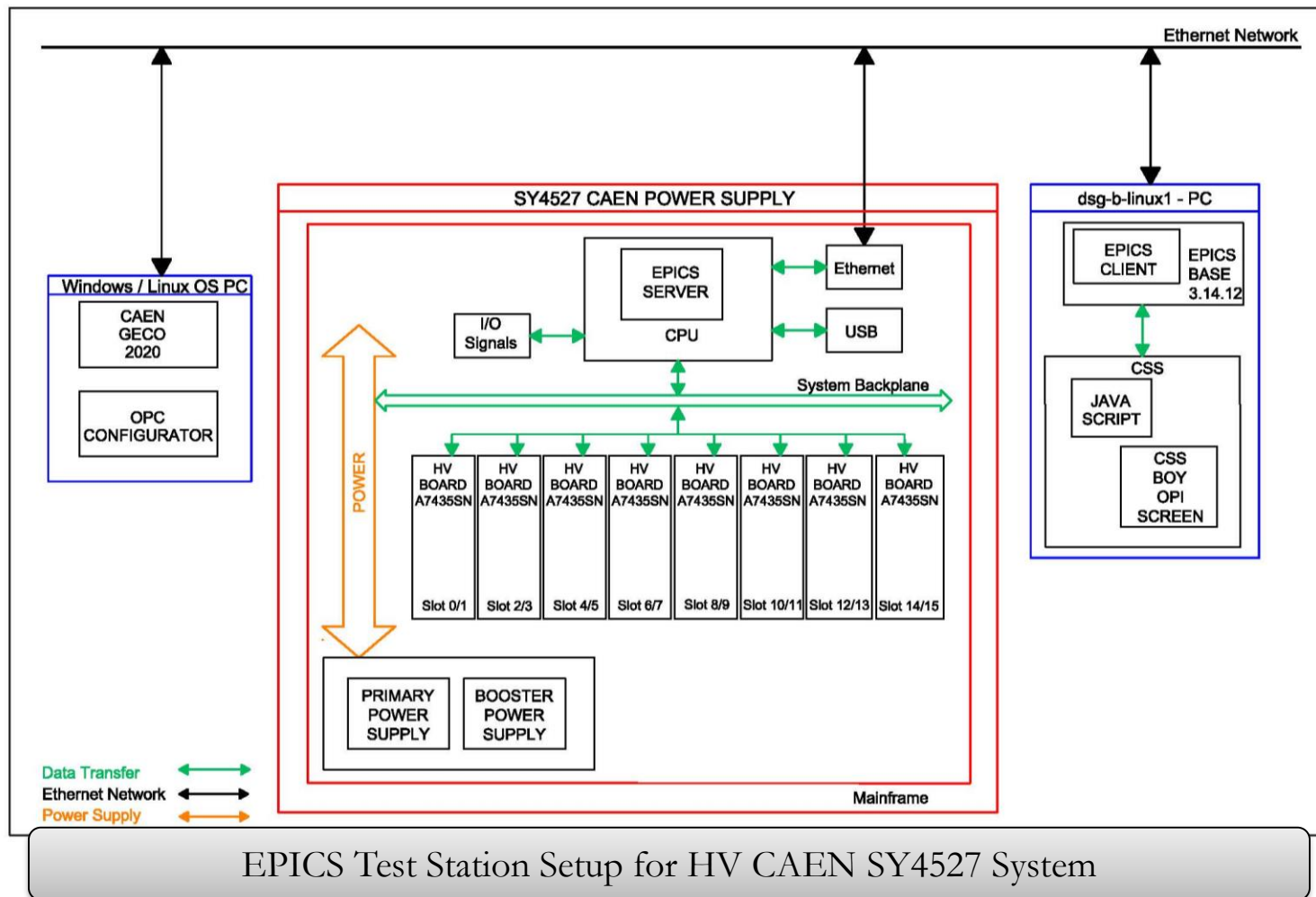
## • Hardware

- Linux/Windows PC
- CAEN SY4527 Mainframe
  - ✓ SY4527 basic CPU
    - Firmware 2.0.2
  - ✓ Booster A4532 - single PWS unit  
600 W
  - ✓ Primary PSU A4531- primary PWS  
unit 600 W
- HV Boards Tested
  - ✓ CAEN-A7434
  - ✓ CAEN-A1535
  - ✓ CAEN-A7030TN – firmware 1.05

## • Software

- CAEN GECO2020 Ver. 1.9.0
  - ✓ General control software for  
CAEN
- EPICS Base Ver. 3.14.12
- CSS Studio Ver. 4.5.0
  - ✓ EPICS-based software to  
developed GUI
- JAVA Ver. 8
  - ✓ Runs as part of CSS to control  
multiple channels at same time

# HV CAEN EPICS Test Station - Overview



# HV CAEN CSS-BOY Screens Developed

## SY4527 CAEN HV POWER SUPPLY - MAINFRAME STATUS

HV-Expert Controls

Select CAEN HV Slot

General Status			Front Panel - Input Status			Front Panel - Output Status			Reset System Configurations		
Signal Name	Status	Description	Signal Name	Status	Description	Signal Name	Status	Description	Description	Set	Status
GEN Enable	Green		Vsel	Green	0 = V0 / 1 = V1	OVC	Green	Over Current	Redesign Reset due to CPU failure	SET	Green
GEN Always ON	Green		Isel	Green	0 = I0 / 1 = I1	UNV	Green	Under Voltage	Always set to 1	SET	Green
ON due to OvV	Green	Over Voltage	Kill	Green		OVV	Green	Over Voltage	Redesign Reset due to front panel reset input signal	SET	Green
ON due to OvC	Green	Over Current	Interlock	Green		CHON	Green	Channel ON	CPU Reset due to front panel reset input signal	SET	Green
ON due to UnV	Green	Under Voltage	Remote Enable	Green		Bit 4 Don't care	Green		Always set to 1	SET	Green
ON due to TRIP	Green		Local Enable	Green		Bit 5 Don't care	Green		Always set to 1	SET	Green
Bit 6 Don't care	Green		TTL/NIM	Green	0 = TTL / 1 = NIM	Bit 6 Don't care	Green		Always set to 0	SET	Green
Bit 7 Don't care	Green		Bit 7 Don't care	Green		Bit 7 Don't care	Green		Always set to 0	SET	Green
Enable MASK	Green		Bit 8 Don't care	Green		Fan Failure	Green		Always set to 0	SET	Green
Always ON MASK	Green		Bit 9 Don't care	Green		OVT	Green		Always set to 0	SET	Green
ON due to OvV	Green	Over Voltage MASK	Bit 10 Don't care	Green		Bit 10 Don't care	Green		Always set to 0	SET	Green
ON due to OvC	Green	Over Current MASK	Bit 11 Don't care	Green		Bit 11 Don't care	Green		Always set to 0	SET	Green
ON due to UnV	Green	Under Voltage MASK	Bit VMon Don't care	Green		Bit VMon Don't care	Green		Always set to 0	SET	Green
ON due to TRIP MASK	Green		Bit 13 Don't care	Green		Bit 13 Don't care	Green		Always set to 0	SET	Green
Bit 14 Don't care	Green		Bit 14 Don't care	Green		Bit 14 Don't care	Green		Always set to 0	SET	Green
Bit 15 Don't care	Green		Bit 15 Don't care	Green		Bit 15 Don't care	Green		Always set to 0	SET	Green

HV Power Supply Module Status		Primary Power Supply Status			HV System Status			
Description	Status	Description	Set	Readback	Feature	Readback	Description	
Returns string with power supply module status Format : ACstatus : Primary : Add 0 : Add 1 : Add 2	1:1:A4532:0:0	Power Supply Voltage	0	0	System Mod. Name	SY4527	System model name	
AC status = -1 -> FAIL AC status = 1 -> GOOD Primary = -1 -> Module FAIL Primary = 1 -> Module GOOD Add X = -1 -> Addon Sup. FAIL Add X = 0 -> Addon Sup. NOT PRESENT Add X = 1 -> Addon Sup. GOOD		Power Supply Current	1.72A:6.60A:0.00A:1.10A:1.05A:0.00A:0.0		System firmware Ver.	2.0.2 - 0.08	Downloaded firmware	
		Network Status			Login Session	admin:admin:TCP/IP:Fri Aug 02 15:59:01		
		Description	Set	Readback	System Symbolic Name	SystemOne		
		IP ADDRESS	129.57.86.124	129.57.86.124	CPU Load	00.CPU1:00.CPU2:00.CPU3 01.36:01.31:01.33 CPU Average Used		
		IP NET MASK	255.255.255.0	255.255.255.0	Memory Status	TOTAL MEMORY : USED MEMORY : FREE MEMORY : BUFFER MEMORY 1968308:1807528: 39432: 5268		
		IP GATEWAY	129.57.86.1	129.57.86.1				
		HV Fan Status						
		Description	Status					
		FAIL = -1 GOOD = 1 Format : Status : Speed	Fan#1	Fan#2	Fan#3	Fan#4	Fan#5	Fan#6
			1:3432:1:3289:1:3361:1:3468:1:3218:1:33					

- Mainframe Status CSS-BOY screen
  - Allows remote controls and monitoring of CAEN mainframe system variables
  - Developed two screens, one for each system mainframe under test

CAEN SY4527 Mainframe Status CSS-BOY screen displays real time data from "hvcaentest2" mainframe

# HV CAEN CSS-BOY Screens Developed

TEST HV CAEN SLOT 0 - Novice							
Expert Control				ALL ON/OFF			
Ch#	Description	Pw	VMon	Imon	Status	Vset	Iset
00	CHANNEL00	ON	10.08 Volt	-0.034 microAm	ON	10.00 Volt	101.00 microAm
01	CHANNEL01	ON	9.96 Volt	-0.042 microAm	ON	10.00 Volt	101.00 microAm
02	CHANNEL02	ON	9.86 Volt	-0.136 microAm	ON	10.00 Volt	101.00 microAm
03	CHANNEL03	ON	9.97 Volt	-0.098 microAm	ON	10.00 Volt	101.00 microAm
04	CHANNEL04	ON	10.09 Volt	-0.122 microAm	ON	10.00 Volt	101.00 microAm
05	CHANNEL05	ON	9.88 Volt	-0.040 microAm	ON	10.00 Volt	101.00 microAm
06	CHANNEL06	ON	10.17 Volt	-0.068 microAm	ON	10.00 Volt	101.00 microAm
07	CHANNEL07	ON	9.52 Volt	-0.104 microAm	ON	10.00 Volt	101.00 microAm
08	CHANNEL08	ON	9.74 Volt	-0.140 microAm	ON	10.00 Volt	101.00 microAm
09	CHANNEL09	ON	10.13 Volt	-0.058 microAm	ON	10.00 Volt	101.00 microAm
10	CHANNEL10	ON	10.09 Volt	-0.074 microAm	ON	10.00 Volt	101.00 microAm
11	CHANNEL11	ON	9.52 Volt	-0.092 microAm	ON	10.00 Volt	101.00 microAm
12	CHANNEL12	ON	9.85 Volt	-0.120 microAm	ON	10.00 Volt	101.00 microAm
13	CHANNEL13	ON	9.82 Volt	-0.098 microAm	ON	10.00 Volt	101.00 microAm
14	CHANNEL14	ON	9.63 Volt	-0.054 microAm	ON	10.00 Volt	101.00 microAm
15	CHANNEL15	ON	9.93 Volt	-0.050 microAm	ON	10.00 Volt	101.00 microAm
16	CHANNEL16	ON	9.93 Volt	-0.048 microAm	ON	10.00 Volt	101.00 microAm
17	CHANNEL17	ON	9.71 Volt	-0.052 microAm	ON	10.00 Volt	80.00 microAm
18	CHANNEL18	ON	10.68 Volt	-0.076 microAm	ON	10.00 Volt	101.00 microAm
19	CHANNEL19	ON	10.07 Volt	-0.022 microAm	ON	10.00 Volt	101.00 microAm
20	CHANNEL20	ON	10.01 Volt	-0.052 microAm	ON	10.00 Volt	101.00 microAm
21	CHANNEL21	ON	10.04 Volt	0.002 microAm	ON	10.00 Volt	101.00 microAm
22	CHANNEL22	ON	9.74 Volt	-0.060 microAm	ON	10.00 Volt	101.00 microAm
23	CHANNEL23	ON	9.78 Volt	-0.088 microAm	ON	10.00 Volt	101.00 microAm
24	CHANNEL24	ON	1.64 Volt	-0.128 microAm	ON	0.00 Volt	101.00 microAm
25	CHANNEL25	ON	0.77 Volt	-0.046 microAm	ON	0.00 Volt	101.00 microAm
26	CHANNEL26	ON	0.00 Volt	-0.072 microAm	ON	0.00 Volt	101.00 microAm
27	CHANNEL27	ON	1.45 Volt	-0.014 microAm	ON	0.00 Volt	101.00 microAm
28	CHANNEL28	ON	1.42 Volt	0.026 microAm	ON	0.00 Volt	101.00 microAm
29	CHANNEL29	ON	1.51 Volt	-0.102 microAm	ON	0.00 Volt	101.00 microAm
30	CHANNEL30	ON	1.33 Volt	-0.086 microAm	ON	0.00 Volt	101.00 microAm
31	CHANNEL31	ON	0.35 Volt	-0.110 microAm	ON	0.00 Volt	101.00 microAm
32	CHANNEL32	ON	1.52 Volt	-0.072 microAm	ON	0.00 Volt	101.00 microAm
33	CHANNEL33	ON	0.93 Volt	-0.048 microAm	ON	0.00 Volt	101.00 microAm
34	CHANNEL34	ON	0.00 Volt	-0.130 microAm	ON	0.00 Volt	101.00 microAm
35	CHANNEL35	ON	1.22 Volt	-0.062 microAm	ON	0.00 Volt	101.00 microAm

- Novice CSS-BOY screen
  - Allows monitoring of main HV boards parameters
  - Only controls power on/off for each channel in the HV board

Example of HV CAEN Novice CSS-BOY screen for CAEN-A7030TN HV board



# HV CAEN CSS-BOY Screens Developed

## TEST HV CAEN - Expert Controls - Slot 1

Novice Board Model A7030TN - [S/N: 297] ALL ON/OFF

Ch#	Location	Click to Turn	Status	VMon [V]	Imon [uA]	Vset [V]		Iset [uA]		Vmax [V]		RUp [V/s]		RDwn [V/s]		Trip [s]	
						Readback	Set	Readback	Set	Readback	Set	Readback	Set	Readback	Set	Readback	Set
00	DSG-Lab	OFF	ON	1499.73	-0.016	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
01	DSG-Lab	OFF	ON	1499.88	0.006	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
02	DSG-Lab	OFF	ON	1499.89	-0.104	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
03	DSG-Lab	OFF	ON	1499.83	-0.042	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
04	DSG-Lab	OFF	ON	1499.75	-0.078	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
05	DSG-Lab	OFF	ON	1499.94	-0.032	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
06	DSG-Lab	OFF	ON	1499.85	2.976	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
07	DSG-Lab	OFF	ON	1499.89	-0.118	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
08	DSG-Lab	OFF	ON	1499.82	-0.034	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
09	DSG-Lab	OFF	ON	1499.89	-0.036	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
10	DSG-Lab	OFF	ON	1499.75	0.922	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
11	DSG-Lab	OFF	ON	1499.86	-0.028	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
12	DSG-Lab	OFF	ON	1499.86	-0.070	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
13	DSG-Lab	OFF	ON	1499.79	-0.124	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
14	DSG-Lab	OFF	ON	1499.90	-0.020	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
15	DSG-Lab	OFF	ON	1500.04	-0.036	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
16	DSG-Lab	OFF	ON	1499.78	-0.042	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
17	DSG-Lab	OFF	ON	1499.75	-0.020	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
18	DSG-Lab	OFF	ON	1499.89	-0.062	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
19	DSG-Lab	OFF	ON	1499.87	0.038	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
20	DSG-Lab	OFF	ON	1499.96	-0.010	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
21	DSG-Lab	OFF	ON	1499.72	-0.004	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
22	DSG-Lab	OFF	ON	1499.90	-0.030	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
23	DSG-Lab	OFF	ON	1499.93	-0.068	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
24	DSG-Lab	OFF	ON	1499.99	-0.020	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
25	DSG-Lab	OFF	ON	1499.93	-0.018	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
26	DSG-Lab	OFF	ON	1499.80	0.002	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
27	DSG-Lab	OFF	ON	1499.78	0.030	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
28	DSG-Lab	OFF	ON	1499.95	-0.006	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
29	DSG-Lab	OFF	ON	1499.68	-0.032	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
30	DSG-Lab	OFF	ON	1499.91	-0.040	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
31	DSG-Lab	OFF	ON	1499.68	-0.076	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
32	DSG-Lab	OFF	ON	1499.82	-0.018	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
33	DSG-Lab	OFF	ON	1499.76	-0.042	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
34	DSG-Lab	OFF	ON	1499.84	-0.062	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0
35	DSG-Lab	OFF	ON	1499.80	-0.034	1500.00	1500	1000.00	1000.00	1800	1800	25	25	25	25	3.0	3.0

HV- CAEN MAIN

Max Current Hwd 1108 microAm

Max Voltage Hwd 3156 Volt

Board Temperature 25 Celsius

I & V Plots

Ramp Up Test

Bd Status

- Power Fail
- Firmware Errors
- HV Max Cal
- Temp Cal
- Under-Temp
- Over-Temp

All Channels

VSet [V]	I Set [uA]	VMax [V]	Rup [V/s]	RDown[V/s]	Trip [s]
1500.0	1000.0	1800.0	25.0	25.0	3.0

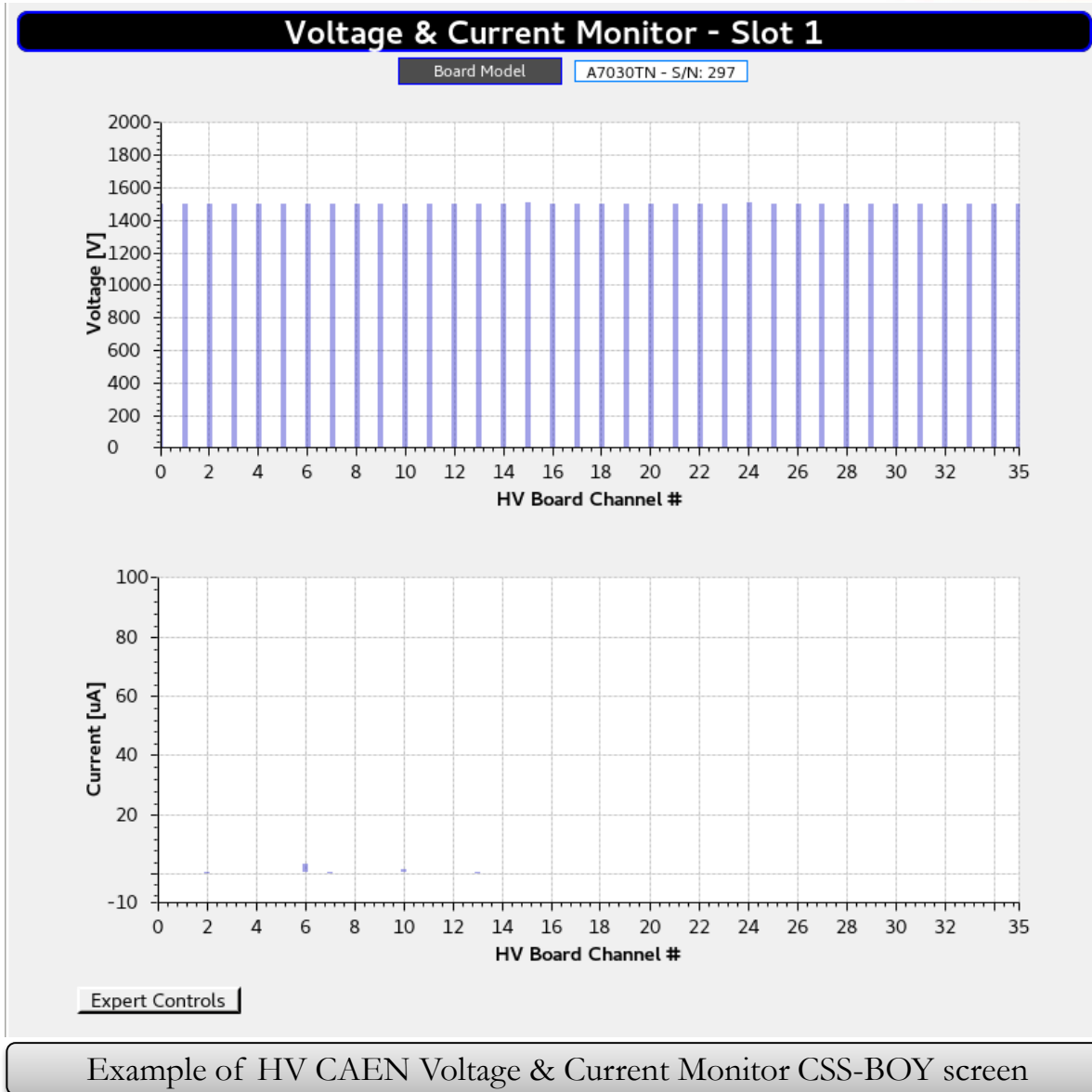
Next Slot >

< Previous Slot

- HV CAEN Expert Controls CSS-BOY screen
  - Allows controls and monitoring of HV board at expert level
  - Runs 8 Java scripts to control the powering on/off and setting up of 6 variables at one time
    - ✓ Power on/off
    - ✓ Voltage set -  $VSet$
    - ✓ Maximum Voltage -  $VMax$
    - ✓ Max current -  $ISet$
    - ✓ Voltage ramp up -  $RUp$
    - ✓ Voltage ramp down -  $RDwn$
    - ✓ Trip time

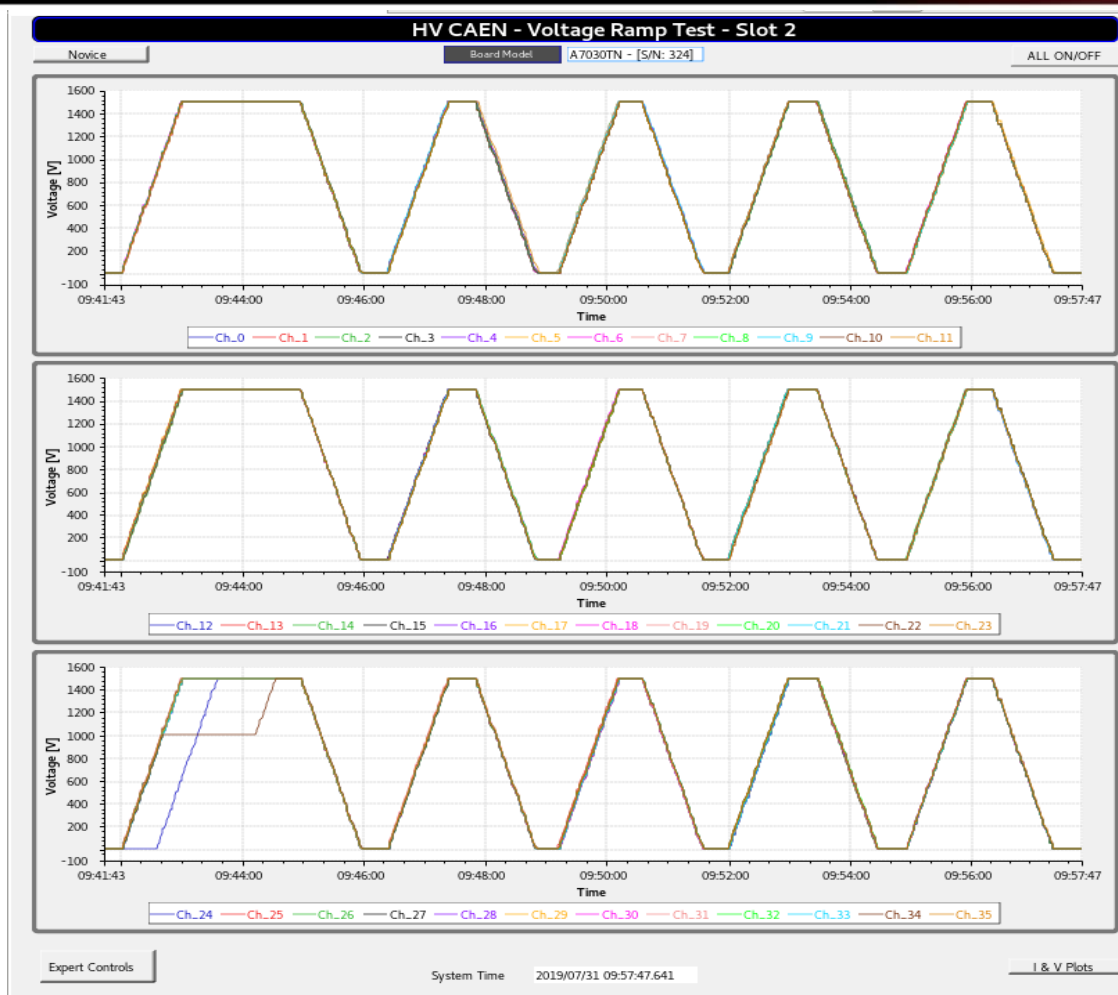
Example of HV CAEN Expert Controls CSS-BOY screen developed for CAEN-A7030TN board located in slot 1 of "hvcaentest1" mainframe

# HV CAEN CSS-BOY Screens Developed



- Voltage and Current Monitor CSS-BOY screen
  - Shows graph bars for voltage vs time and current vs time for all channels in HV board
  - Facilitates visual monitoring of any voltage drop or increment for any HV channel

# HV CAEN CSS-BOY Screens Developed



- Voltage Ramp Up/Down Test CSS-BOY screen
  - Monitors voltage ramp up/down of all 24/36 channels simultaneously in real time
  - Works in conjunction with Expert Control screen

Example of developed HV CAEN Voltage Ramp Test CSS-BOY screen used to test HV board A7030TN -S/N 324. Bottom panel shows an overvoltage condition, VSet value changed from 1500 V to 0 V for no reason (changes on GECO-2020 and PV)

# HV CAEN – Summary

- Summary of CSS-BOY screens developed with aim to test all HV boards and mainframe simultaneously

<b>CAEN High Voltage Boards CSS-BOY Screens</b>						
Board model	Max # of boards connected in mainframe	Novice	Expert controls	Voltage and current monitoring	Voltage ramp test	Total screens
A7435	8	8	8	8	8	32
A1535	8	8	8	8	8	32
A7030TN	16	16	16	16	16	64
<b>CAEN High Voltage Mainframe CSS-BOY Screens</b>						
Mainframe model	HV mainframe status		HV mainframe - expert		Total screens	
SY4527	2		2		4	
Total developed CSS screens					132	

# Testing Procedure

## 1. Communication Test

- Performed to ensure correct transfer of PVs between EPICS server and EPICS/CSS screens (EPICS Client)
  - ✓ 1. Ping HV CAEN system host name/IP address (129.57.86.124/38) from host Linux PC — **Verified and correct**
  - ✓ 2. Used EPICS base commands such as camonitor, caget, cainfo and caput to read/write PVs — **Expected response to set and read PVs**
  - ✓ 3. Performed visual inspection of CSS widgets used for PVs reading/writing in CSS-BOY screens — **No pink color, meaning proper communication between CSS-BOY screens (EPICS client) and CAEN EPICS Server**

# Testing Procedure

## 2. Opened and ran developed HVCAEN Power Supply – Mainframe Status CSS-BOY screen

- Ensured that system mainframe operates under CAEN specifications
  - ✓ Interlock status – Clear
  - ✓ System variables – Ok
  - ✓ Firmware version : Latest recommended version for tested CPU is 2.0.2
  - ✓ Front panel input/front panel output status – No overcurrent/overvoltage conditions, clear status

# Testing Procedure

3. Opened and ran developed HVCAEN— Expert Control CSS-BOY
  - Set each channel of HV board to values shown in table below
  - Ensured that opened CSS screen corresponds to HV board under test (board serial number, model, number of channels)
  - Entered values in “All Channels” windows on Expert Controls CSS screen to set all 24/36 channels (depending on board been tested) to same value

<b>Set Voltage</b>	<b>1500 V</b>
<b>Set ramp up/down rate</b>	25 V/s
<b>Load</b>	0 $\Omega$
<b><i>IMon</i></b>	0 $\mu$ A
<b><i>ISet</i></b>	3000 $\mu$ A
<b><i>VMax</i></b>	1800 V
<b>Trip time</b>	3 s

Example table used for CAEN-A1535 HV boards tested

# Testing Procedure

4. Compared all PVs shown in Expert Controls CSS screen with values for same parameter in GECO2020 software
  - This step ensures that set PVs in CSS screens matched parameters in actual HV board (hardware)
5. Took screenshots of initial data and set parameters on GECO and CSS screens
6. Executed “All On/Off” button on Expert Controls screen
7. Opened and ran developed HVCAEN-Voltage ramp test CSS-BOY



# Testing Procedure

8. Monitored that all channels ramped at 25 V/s to set voltage
  - Kept voltage at set point for  $>10$  s
  - Turned all channels off to ramp, then to 0 V, kept at 0 V for  $> 10$  s
9. Performed 3 to 5 ramp up/down per each test
10. Repeated steps 3 to 9 for all HV board tested
11. Recorded data and plots, made note of failures and documented

# Test Results – CAEN A1535 Board

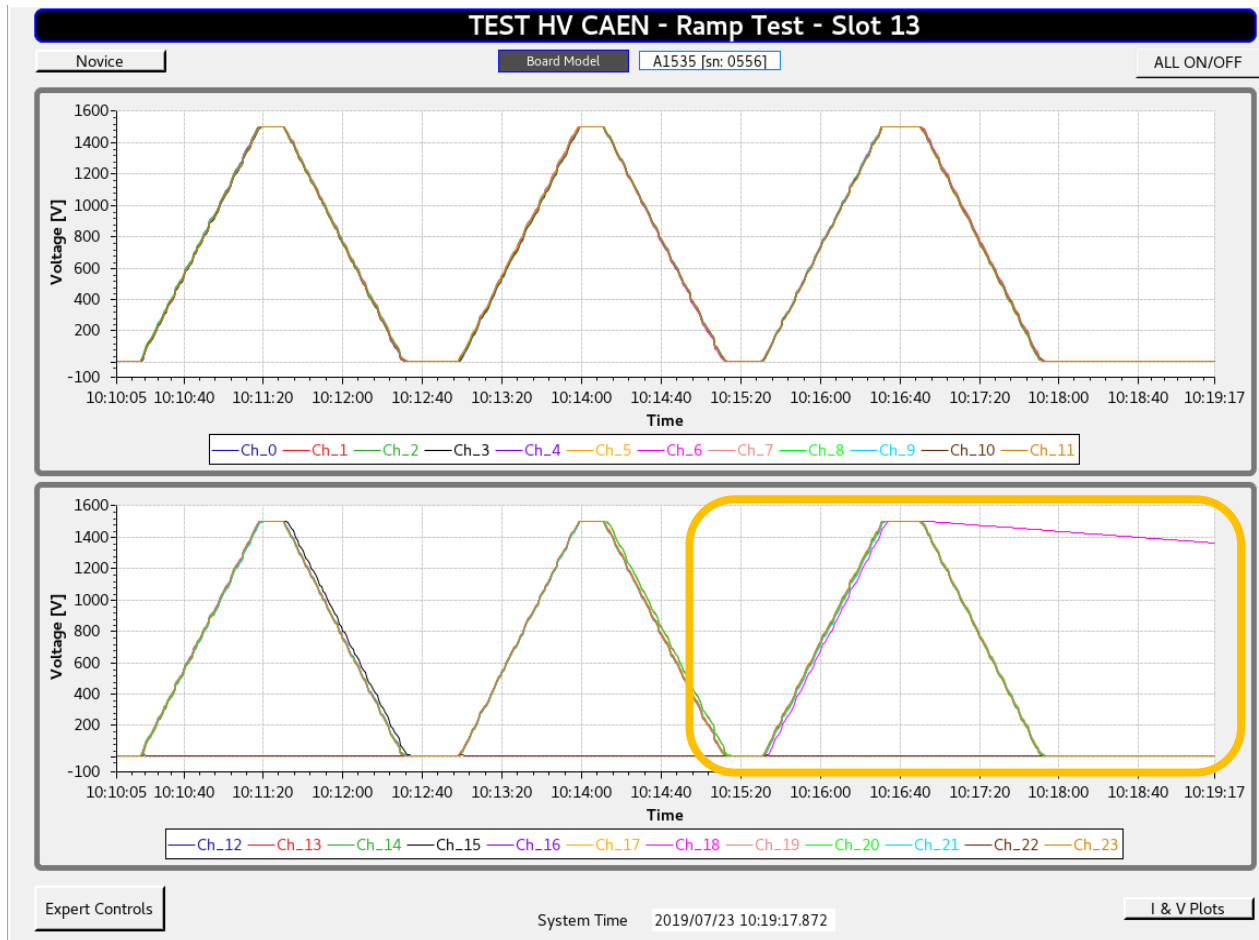
System main frame service name	Serial Number	Hardware Issue	Software Issue	Comments
hvcaentest2	775		X	<p>For some channels, <math>VSet</math> stuck at different value than pre-set value during test. One channel tripped because <math>ISet</math> value changed from its set value during test.</p> <p>Discrepancies between GECO-2020 values and EPICS PVs values for <math>IMon</math>.</p> <p>All affected channels ramped to desired set value after set values were re-entered and power On/Off reset.</p> <p>For recovery of some channels, reset of built-in CAEN EPICS Server was required.</p>
	776		X	<p>For some channels, <math>VSet</math> value changed from its pre-set value.</p> <p>For <math>VMon</math>, found discrepancies between GECO-2020 values and EPICS PVs values.</p> <p>All affected channels ramped to desired set value after set values were re-entered and channels were reset.</p>
	556	X	X	<p>Set values for <math>VSet</math>, <math>RDwn</math> and <math>VMax</math> changed (PVs and value in GECO-2020) from its pre-set values during test.</p> <p>Re-entering values for <math>VSet</math>, <math>RDwn</math> and <math>VMax</math>, then resetting power On/Off allowed ramp up all channels to desired set voltage except for <b>channel 22, which did not ramp up.</b></p>

Table shows the results/findings summary for A1535 boards

# Test Results – CAEN A1535 Board

System mainframe service name	hvcaentest2
Mainframe S/N	400
Board model	A-1535
Boards S/N	775,776,556
Slot # selected for test	13
Total #of tests/board	9
Total # of ramp up/down per board	27/27

Set voltage	1500 V
Set ramp up/down rate	25 V/s
Load	0 $\Omega$
<i>IMon</i>	0 $\mu$ A
<i>ISet</i>	3000 $\mu$ A
<i>VMax</i>	1800 V
Trip time	3 s



Example of developed HVCAEN-Voltage Ramp Test CSS-BOY screen used to test HV board A1535-S/N 556. Bottom panel in screen shows that channel 22 never ramped up to set voltage 1500 V and channel 18 *RD<sub>wn</sub>* value changed for no reason from set 25 V/s to 1 V/s.

# Test Results – CAEN-A7030TN Board

System main frame service name	Slot	Serial number	Hardware issue	Software issue	Comments
hvcaentest2	0	304		X	<p>For some channels' parameters (<i>VSet</i>, <i>VMax</i>, <i>ISet</i>, <i>RU<sub>p</sub></i>, and <i>RD<sub>wn</sub></i>), arbitrarily changed from its set values at test time to random different values. Changes occurred in GECO2020 and PVs.</p> <p>Discrepancies between GECO-2020 values and EPICS PVs values for <i>VMon</i>.</p> <p>All affected channels ramped to desired set value after set values were re-entered and power On/Off reset.</p>
	1	297		X	<p>For some channels' parameters (<i>VSet</i>, <i>VMax</i>, <i>ISet</i>, and <i>RU<sub>p</sub></i>), arbitrarily changed from its set values at test time to random different values. Changes occurred in GECO2020 and PVs.</p> <p>Discrepancies between GECO-2020 values and EPICS PVs values for <i>RU<sub>p</sub></i>.</p> <p>All affected channels ramped to desired set value after set values were re-entered and power On/Off reset.</p>
	2	324			X

Table shows the results/findings summary for A7030TN board

# Test Results – CAEN A7030TN Board

- Discrepancies between GECO2020 and PVs generated in CAEN EPICS Server— Software issue

EPICS camonitor command shows PV updates

```
campero@dsg-b-linux1:~
File Edit View Search Terminal Help
^C
[campero@dsg-b-linux1 ~]$
[campero@dsg-b-linux1 ~]$ camonitor SY4527:01:027:RUp
SY4527:01:027:RUp      2019-07-31 03:49:59.320780 0 DISABLE NO_ALARM
SY4527:01:027:RUp      2019-07-31 04:08:39.458224 25
SY4527:01:027:RUp      2019-07-31 04:08:39.458224 0 DISABLE NO_ALARM
SY4527:01:027:RUp      2019-07-31 04:08:43.561951 25
SY4527:01:027:RUp      2019-07-31 04:08:43.561951 0 DISABLE NO_ALARM
SY4527:01:027:RUp      2019-07-31 04:08:52.171941 25
SY4527:01:027:RUp      2019-07-31 04:08:52.171941 25 DISABLE NO_ALARM
```

CSS Expert Control screen shows ch-27  $RU_p$  value at 0 V/s

Channel	Status	Setpoint	Actual	Rate	Limit	...
27 CHANNEL27	ON	OFF	217.21	-0.088	1500.00	1500.00
29 CHANNEL29	ON	OFF	217.62	-0.110	1500.00	1500.00
30 CHANNEL30	ON	OFF	218.85	-0.118	1500.00	1500.00
31 CHANNEL31	ON	OFF	207.20	-0.162	1500.00	1500.00
32 CHANNEL32	ON	OFF	206.28	-0.142	1500.00	1500.00
33 CHANNEL33	ON	OFF	205.98	-0.152	1500.00	1500.00
34 CHANNEL34	ON	OFF	220.80	-0.142	1500.00	1500.00
35 CHANNEL35	ON	OFF	237.81	-0.152	1500.00	1500.00

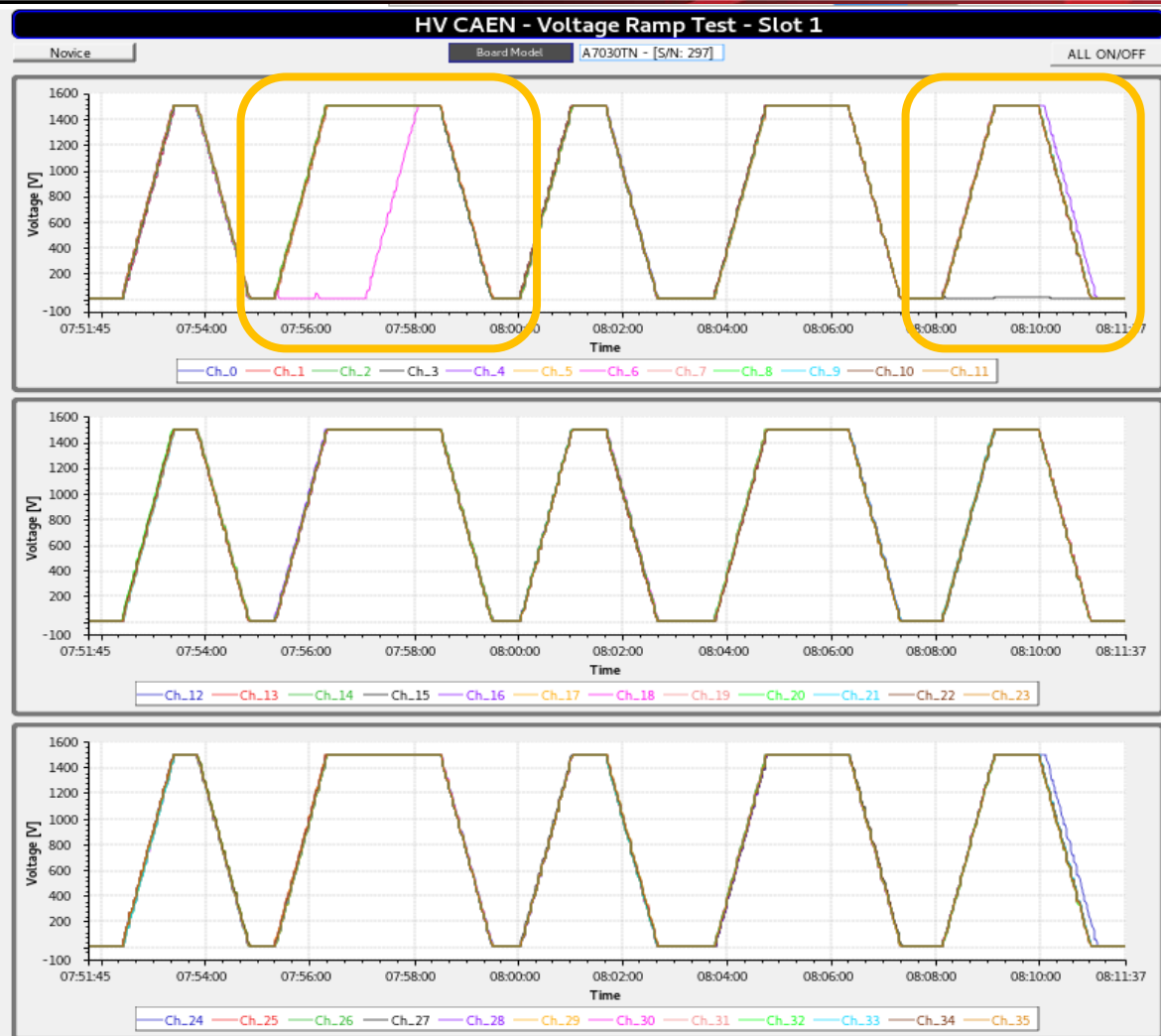
GECO2020 shows ch-27  $RU_p$  value at 25 V/s

ID	Channel	Current	Voltage	Rate	Limit	Status	...
01.026	CHANNEL26	1000.00 uA	1500.00 V	0.020 uA	1499.84 V	On	25 Vps
01.027	CHANNEL27	1000.00 uA	1500.00 V	0.056 uA	1499.82 V	On	25 Vps
01.028	CHANNEL28	1000.00 uA	1500.00 V	0.016 uA	1499.96 V	On	25 Vps
01.029	CHANNEL29	1000.00 uA	1500.00 V	0.010 uA	1499.71 V	On	25 Vps
01.030	CHANNEL30	1000.00 uA	1500.00 V	0.000 uA	1499.92 V	On	25 Vps

# Test Results – CAEN A7030TN Board

System mainframe service name	hvcaentest2
Mainframe S/N	400
Board model	A7030TN
Boards S/N	304,297,324
Slot # selected for test	0,1,2
Total # of tests/board	3
Total # of ramp up/down per board	15/15

Set voltage	1500 V
Set ramp up/down rate	25 V/s
Load	0 $\Omega$
<i>IMon</i>	0 $\mu$ A
<i>ISet</i>	1000 $\mu$ A
<i>VMax</i>	1800 V
Trip time	3 s



Example of developed HVCAEN-Voltage Ramp Test CSS-BOY screen used to test HV board A7030-S/N 297. Upper panel in screen shows *ISet* value for ch-3 and ch-6 changed from 1000  $\mu$ A to 0  $\mu$ A for no reason. Channel tripped.

# Test Results – CAEN A7030TN Board

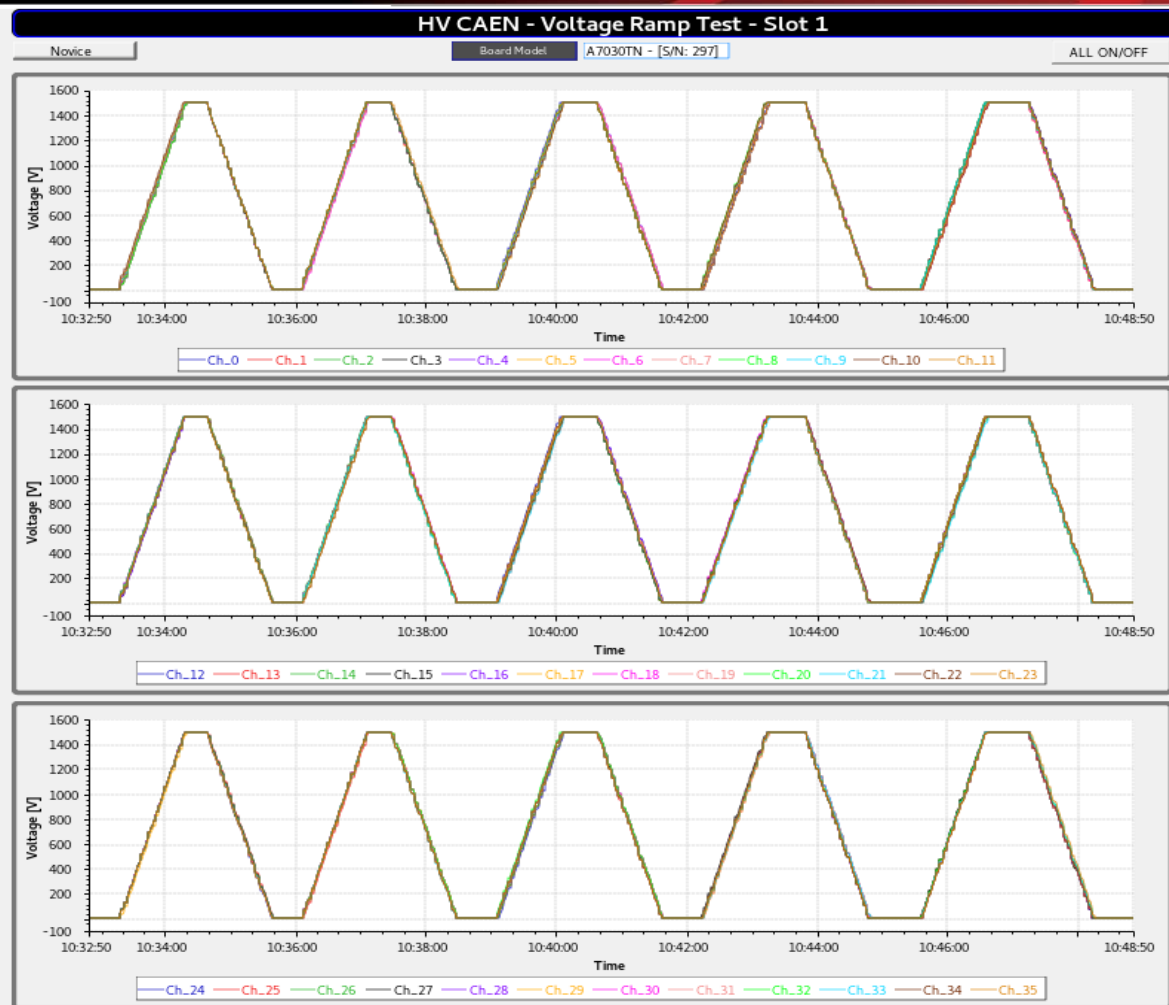
- A7030TN boards re-tested on different system mainframe
  - No channels failed for three tests performed

System main frame service name	Board #	Board model	Serial number	Comments
hvcaentest1	1	A7030TN	304	No Issues
	2		297	No issues
	3		324	No issues

# Test Results – CAEN-A7030TN Board

System mainframe service name	hvcaentest1
Mainframe S/N	-
Board model	A7030TN
Boards S/N	304,297,324
Slot # selected for test	0,1,2
Total # of tests/board	3
Total # of ramp up/down	15/15

Set voltage	1500 V
Set ramp up/down rate	25 V/s
Load	0 $\Omega$
<i>I</i> <sub>mon</sub>	0 $\mu$ A
<i>I</i> <sub>max</sub>	1000 $\mu$ A
<i>V</i> <sub>max</sub>	1800 V
Trip time	3 s



Example of developed HVCAEN-Voltage Ramp Test CSS-BOY screen used to test HV board A7030TN installed on hvcaentes1. Plots show all channels ramped up/down to set voltage with **no issues**.



# Status and Upcoming Tasks

- Developing java script to set fundamental parameters (On/Off,  $V_{Max}$ ,  $V_{Set}$ ,  $I_{Set}$ ,  $R_{Dwn}$ ,  $R_{Up}$ , Trip time) for all channels on boards installed in mainframe (x16 slots) — **In progress**
  - Goal: test showcase immediately bad channels in boards
- Calculating resistor values to be connected in HV board and enable testing of readout current (maximum and half levels) — **In progress**
- Testing HV mainframe + boards with GECO2020 isolating EPICS server — **In progress**
- Develop script to automate voltage and current test for each channel on HV boards — Not started
  - Implement CSS Scan System tool

# Conclusions

- CSS-BOY EPICS screens successfully developed to test CAEN HV boards and systems mainframes
- From tests performed found that
  - Three A1535 boards installed and running in SY4527 mainframe (hvcaentest2) presented CAEN software issues and one has hardware issue as well
  - Three A7030TN boards tested in SY4527 hvcaentes2 mainframe presented software issues, however same boards tested in hvcaentes1 mainframe did not fail.

THANK YOU