

Linac4 source Control system

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Outline

- Status
 - Control architecture (INCA)
 - WorkingSet (Knobs, Function Editor, Trim History)
 - OASIS
 - Logging Service
 - Specific Application
 - Logging Display
 - Timing editor
 - Synoptic : Vacuum and Gas delivery System
 - General Source control
- Resources needed to implement a magnetron source
- Conclusion/outlook

INjector Control Architecture

Based on 3-tier architecture

Top Tier

Control room

WorkingSet
Knobs, Function Editor, Trim History

OASIS
Viewer

Specific JAVA
Applications

Middle Tier

INCA (Applications Servers)

CONTROL CORE
LSA

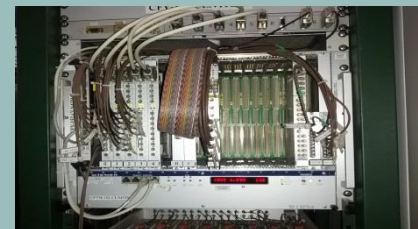
AcqCore

Configuration
Service

Logging
Service

Lower Tier

Front-End Computers



FESA

WorkingSet & Knobs

LN4:SRC_CONTROL-400 - LN4.USER.MD1 (on cs-ccr-dev1.cern.ch)

File Edit View References Commands Control Programs Help

30 Oct 2013 16:37:56 LN4 - 02 MD1 | olga_cycle_V1

Simple view

LTIM	Pulse	Delay	Train	AqnC	AqnCNano
L4X.SEJ	Enable	100000	10MHZ	275	275000000
L4X.STARTGAS	Enable	77000	10MHZ	273	273700000
L4X.STARTIGN	Enable	99300	10MHZ	275	275930000
L4X.STOPIGN	Enable	400	10MHZ	275	275970000
L4X.FWSRCRF	Enable	97000	10MHZ	275	275700000
L4X.RRF0NSRC	Enable	99000	10MHZ	275	275900000
L4X.W-H-DISCAP	Enable	70000	10MHZ	262	262000000
L4X.FW-H-DISCAP	Disable	520	1KHZ	-105	-105000000
L4X.S-H-DISCAP10	Enable	94000	10MHZ	275	275400000
L4X.S-H-DISCAP25	Enable	94000	10MHZ	275	275400000
L4X.S-H-DISCAP50	Enable	94000	10MHZ	275	275400000
L4X.A-H-DISCAP	Enable	102000	10MHZ	276	276200000

LTIM	Pulse	Delay	Train	AqnC
L4X.RFSTART	Enable	94200	10MHZ	275
L4X.RFSAQN	Enable	95000	10MHZ	275
L4X.RFREDAQN	Enable	300	1KHZ	565
L4X.RFLGTTST	Enable	99000	10MHZ	275

2 WorkingSets:

- Control:
- power supplies
 - RF
 - timings
 - beam stopper
 - faraday-cup

- Monitoring:
- pressures
 - temperatures
 - Waveforms

LN4:USER==MD1 - KnobsOpen (on cs-ccr-dev1.cern.ch)

05 Nov 2013 15:37:58 LN4 - 04 MD1 | olga_cycle_V1

01 MD1 | olga_cycle_V1

L4X.S-H-DISCAP10

Pulse: Enable

Load: BIX.W10-CT

Delay: 94000 10MHZ

Ref: -

Init: 94000 10MHZ

Delay: 94000 10MHZ

L4LH-DISCAP10

Control: 0n

Status: 0n

CCV: 36000.00 V

Ref: -

Init: 36000.00 V

CCV: 36000.00 V

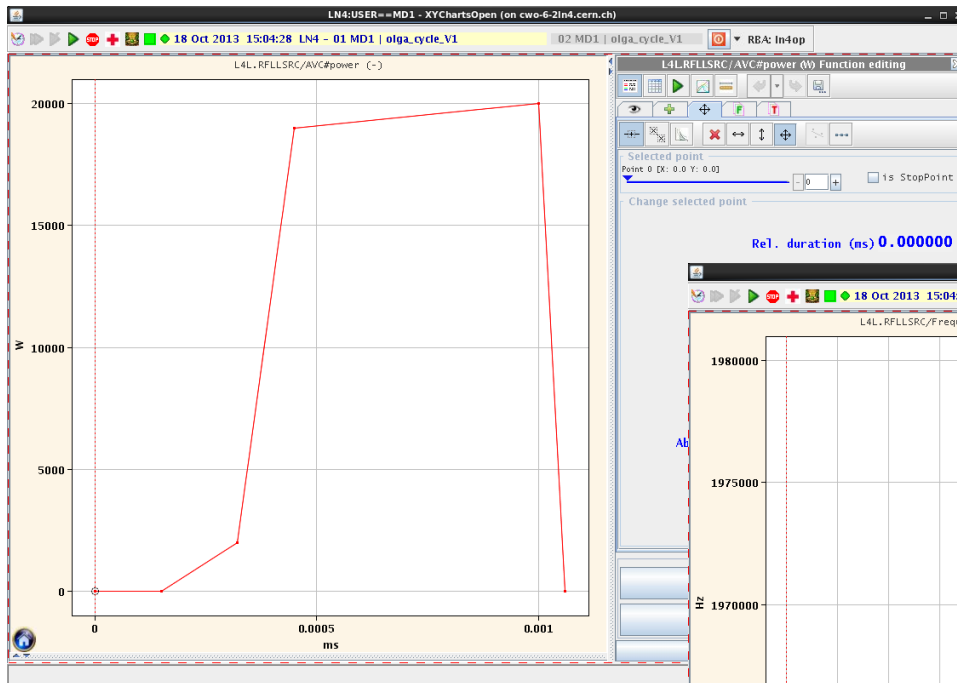
AQN: 34991.30 V

AQN1: 0.00 uA

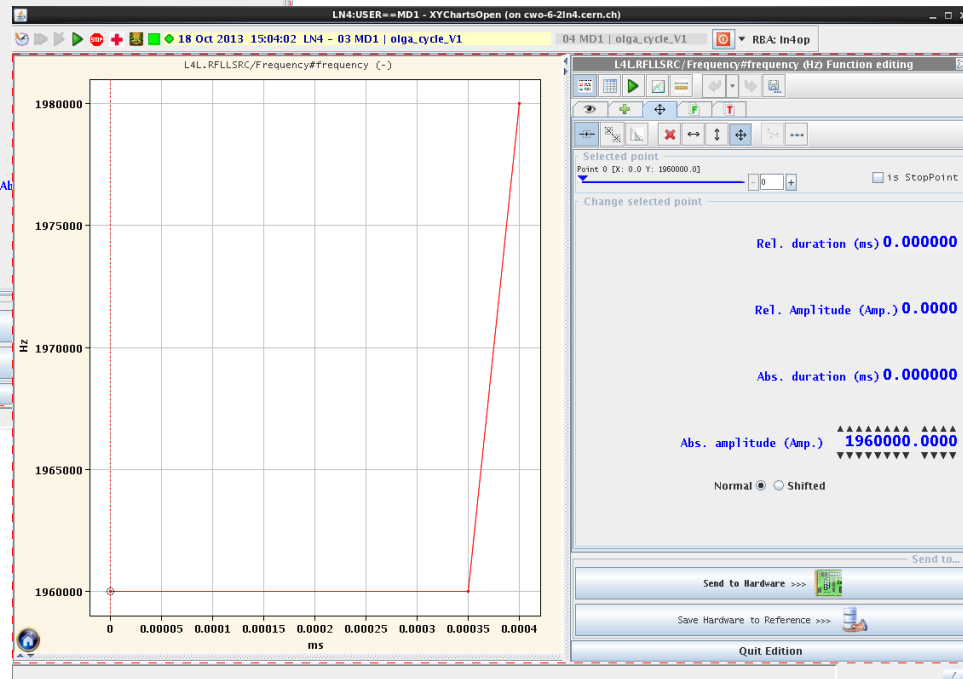
Function Editor

RF parameters

Power function



Frequency function



Trim History

PLS condition: LN4.USER.MD1 LSA Context: olga_cycle.V1 Select trim from history

Open Parameter selector Open Context selector 2013-09-19 10:46:22.362 null

Select param

TrimHistoryPanelOpenCmd_0 (on cs-ccr-dev1.cern.ch)

PLS condition: LN4.USER.MD1 LSA Context: olga_cycle.V1 Select trim from history

Open Parameter selector Open Context selector

Select parameter names to be checked

- L4L.RFLLSRC/AVC#power
- L4L.RFLLSRC/Frequency#frequency
- L4L.RFLLSRC/Settings#enable

Select NONE Copy selected parameters

Revert to selected trim Edit trim Comment Show trim dependencies

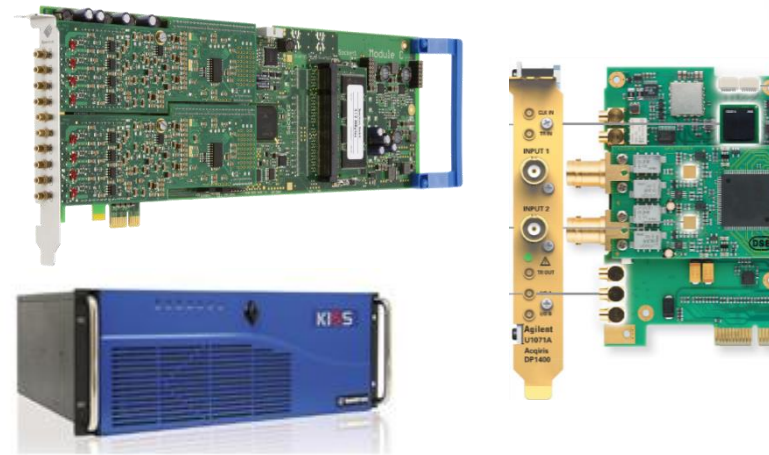
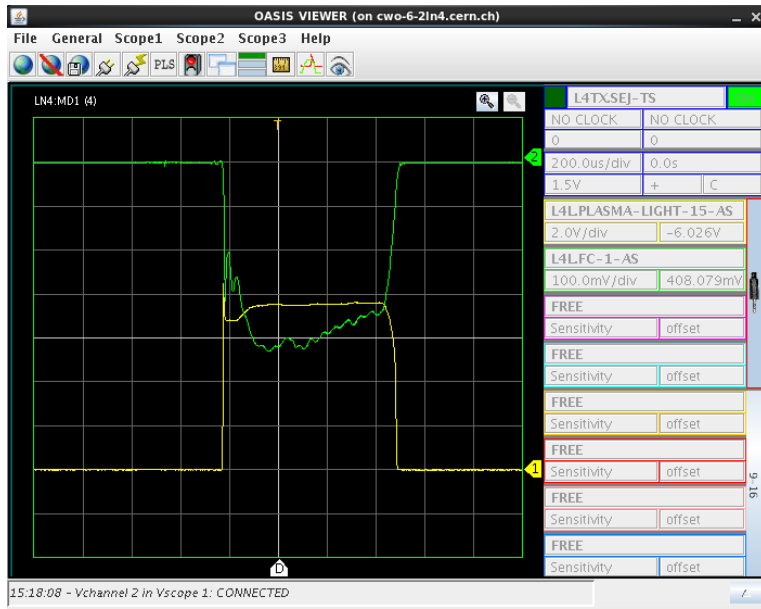
Select NONE

This chart does not contain any visible DataSource

Selected Trim headers date/time

13:32:37 - 3 parameter names added in 40 ms

Open Analogue Signal Information System



- System to acquire analogue signal from devices and display them in a graphical application. The signals are digitalized by oscilloscopes located in the front-end computers(FEC). The acquired data are sent through the Ethernet network , displayed on workstations running dedicated application and logged by the logging service
- 6 scopes in 2 FEC for linac4 and the same for the Test Stands.
- 48 signals are foreseen to be acquired by OASIS. (30% connected)

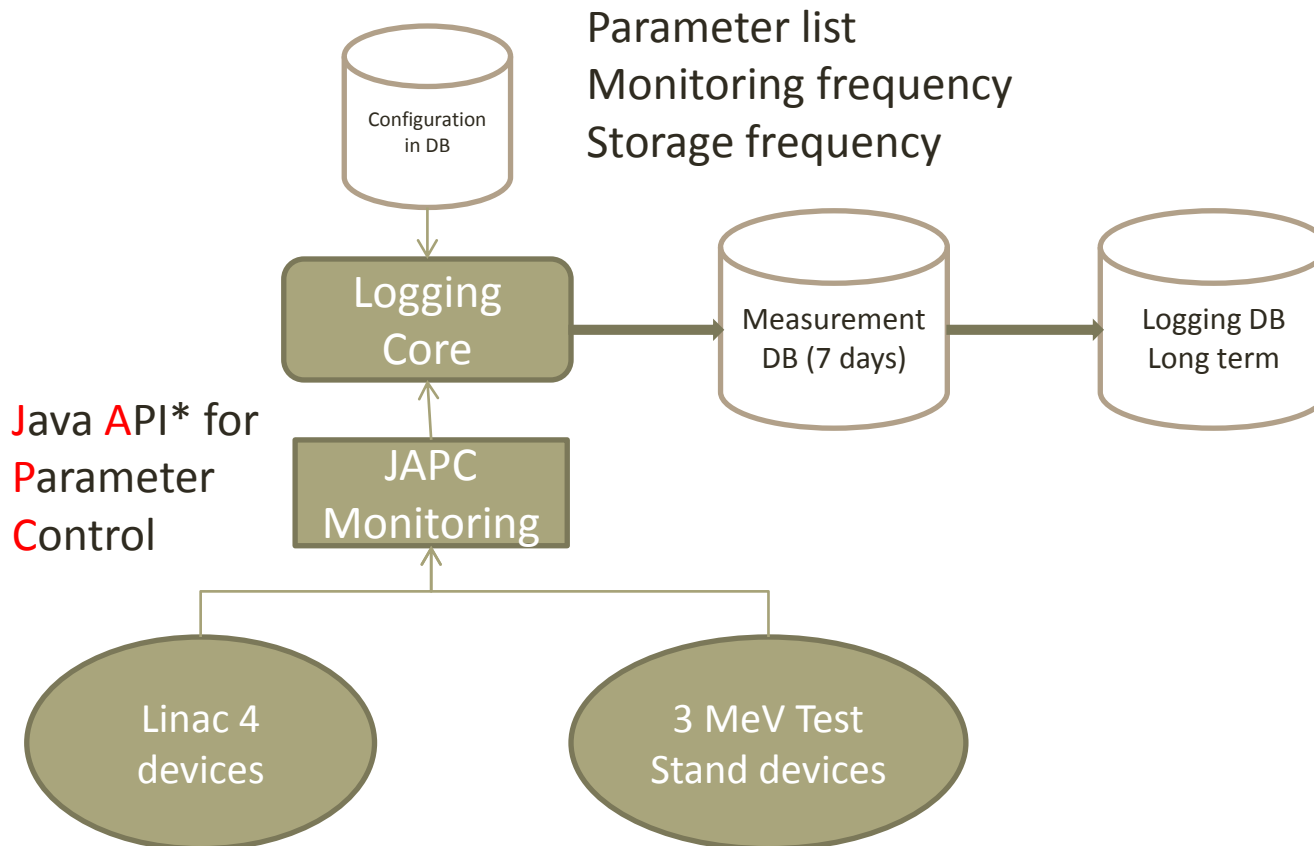
List of signals

Linac 4 Tunel	3MeV Test Stand	Description
L4L.SOL-ANTENA-I-AS	L4LT.SOL-ANTENA-I-AS	RF antenna current
L4L.COLLAR-I-AS	L4LT.COLLAR-I-AS	Collar electrode current, SF 10, A
L4L.COLLAR-V-AS	L4LT.COLLAR-V-AS	Collar electrode voltage, SF 100
L4L.FC-1-AS	L4LT.FC-1-AS	Faraday cup 1 current, SF 0.1, A
L4L.PLASMA-LIGHT-0-AS	L4LT.PLASMA-LIGHT-0-AS	Ignition chamber light signal 0°
L4L.PLASMA-LIGHT-15-AS	L4LT.PLASMA-LIGHT-15-AS	Ignition chamber light signal 15°
L4L.PLASMA-LIGHT-30-AS	L4LT.PLASMA-LIGHT-30-AS	Ignition chamber light signal 30°
L4L.RF-P-REFL-AS	L4LT.RF-P-REFL-AS	RF reflected power
L4L.RF-P-FW-AS	L4LT.RF-P-FW-AS	RF forward power
L4L.GAS-PIEZO-V-AS	L4LT.GAS-PIEZO-V-AS	Piezo valve voltage, SF 100
L4L.IGN-V-AS	L4LT.IGN-V-AS	Ignition pulser voltage, SF 1000
L4L.IGN-I-AS	L4LT.IGN-I-AS	Ignition pulser current, SF 20, A
L4L.SOURCE-V-AS	L4LT.SOURCE-V-AS	HT power supply voltage
L4L.SOURCE-I-AS	L4LT.SOURCE-I-AS	HT power supply current
L4L.PULLER-V-AS	L4LT.PULLER-V-AS	Puller HT power supply voltage
L4L.PULLER-I-AS	L4LT.PULLER-I-AS	Puller HT power supply current
L4L.DUMP-V-AS	L4LT.DUMP-V-AS	Dump HT power supply voltage
L4L.DUMP-I-AS	L4LT.DUMP-I-AS	Dump HT power supply current
L4L.EINZEL-V-AS	L4LT.EINZEL-V-AS	Einzel HT power supply voltage
L4L.EINZEL-I-AS	L4LT.EINZEL-I-AS	Einzel HT power supply current
L4L.SRC-PRES-1-AS	L4LT.SRC-PRES-1-AS	Source Pressure
L4L.SRC-PRES-2-AS	L4LT.SRC-PRES-2-AS	Source Pressure
L4L.EINZ-PRES-AS	L4LT.EINZ-PRES-AS	Einzel pressure
L4L.LEBT-PRES-AS	L4LT.LEBT-PRES-AS	LEBT Pressure

LOGGING Service

Operational on the whole CERN accelerator

Aim : to capture and store any relevant accelerator data



* API = Application Programming Interface

List of parameter logged

- Description of the working source (Type, Name, Polarity,...)
- 48 waveforms 5000pts(time window 1ms).
 - Settings : sampling rate, cursors.
 - Average, Standard Deviation
- Others relevant parameter (Power Supplies acquisition, Pressures, Temperatures).
- Monitoring frequency : 0.83Hz.
- Storage frequency : every cycle in the short DB and on change in the long term database.

Exception: Waveforms every hour in the long term database.

Specific Application

GCS_LINAC4
L4 Ion Source - Production System

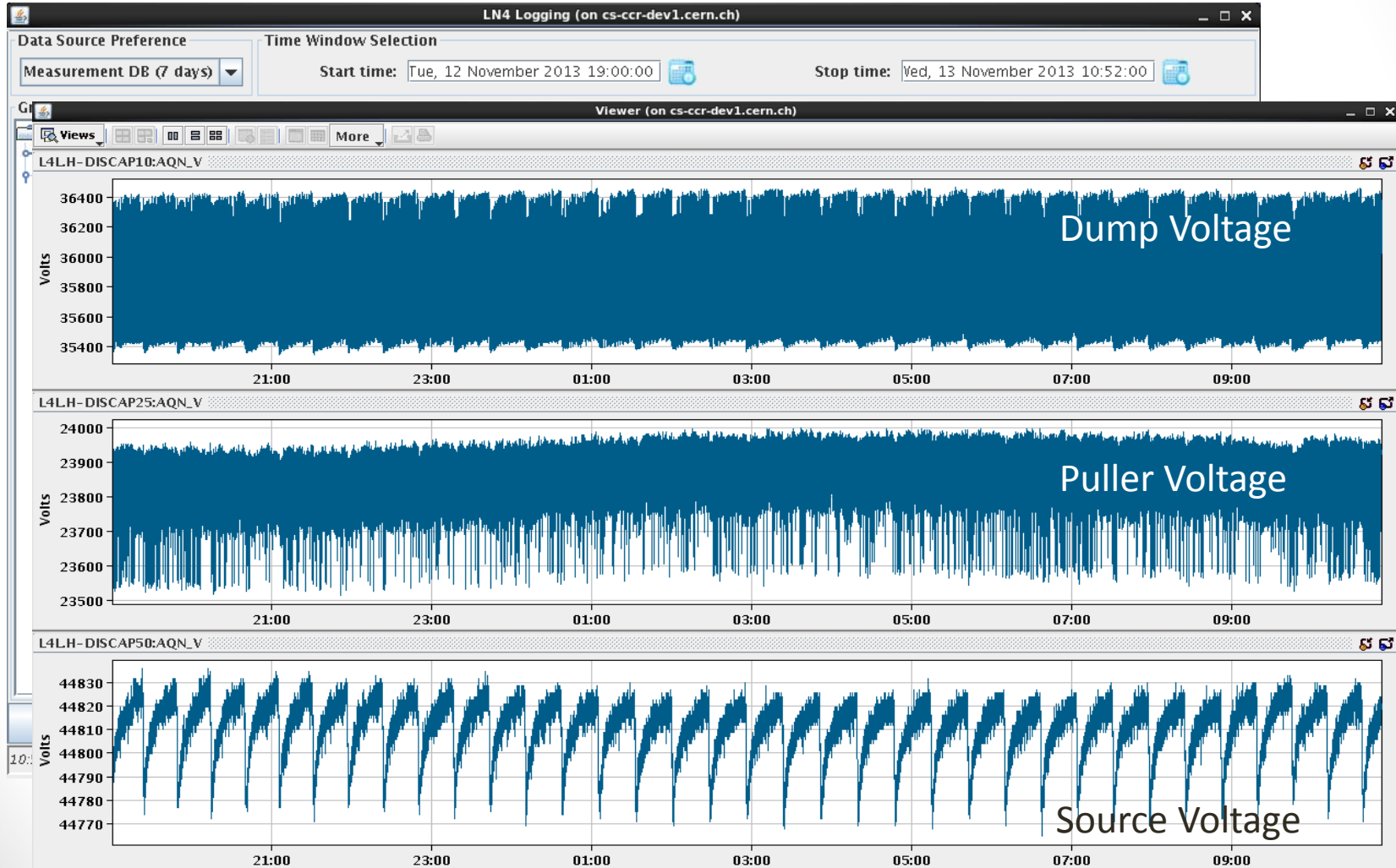
Ion Source Controls (on cw0-6-2ln4.cern.ch)
MD1 - 01
Type: IS01
Piezo Name: Volume01
Piezo Command: On
PiezoStatus: On
Polarity: Hminus
Collar Location: Linac4_400
Collar Command: Off
CollarStatus: Off
CollarV: 5.00V
IonTrapV: 10.00V
zoFeedBackLoop: 6.55
eAqn: 6.58

LN4 Logging (on cs-ccr-dev1.cern.ch)
Measurement DB (7 days)
Start time: Thu, 24 October 2013 15:27:00
Stop time: Thu, 24 October 2013 16:27:00

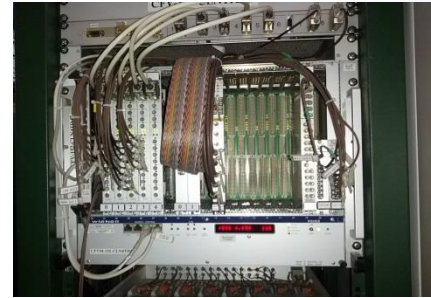
Variable Name	Description	Unit	Datatype
L4LH-DISCAP10:AQN_I	Dump current	A	NUMERIC
L4LH-DISCAP25:AQN_I	Puller current	A	NUMERIC
L4LH-DISCAP50:AQN_I	Source current	A	NUMERIC
L4LNSRCGEN:COLLAR_I	Collar Current	A	NUMERIC
L4LNSRCGEN:COLLAR_V	Collar Voltage	V	NUMERIC
L4LNSRCGEN:FIBER_T...	FiberTX status		NUMERIC
L4LNSRCGEN:IGNITIO...	Ignition Current	A	NUMERIC
L4LNSRCGEN:IGNITIO...	Ignition Status		NUMERIC
L4LNSRCGEN:IGNITIO...	Ignition Voltage	V	NUMERIC
L4LNSRCGEN:ION_TR...	Ion Trap Status		NUMERIC
L4LNSRCGEN:ION_TR...	Ion Trap Voltage	V	NUMERIC
L4LNSRCGEN:LEBT_V...	LEBT Vacuum pressure		NUMERIC
L4LNSRCGEN:LEBT_V...	LEBT Calculated Vacuu...		NUMERIC
L4LNSRCGEN:LEBT_V...	LEBT Vacuum Voltage	V	NUMERIC
L4LNSRCGEN:LIGHT1	Light 1		NUMERIC
L4LNSRCGEN:LIGHT2	Light 2		NUMERIC
L4LNSRCGEN:PIEZO_F...	Piezo FeedBack loop s...		NUMERIC
L4LNSRCGEN:PIEZO_S...	Piezo Status		NUMERIC
L4LNSRCGEN:PIEZO_V	Piezo Voltage	V	NUMERIC
L4LNSRCGEN:VACUU...	Source Vacuum averag...		NUMERIC
L4LNSRCGEN:VACUU...	Source Vacuum Voltage	V	NUMERIC

16:27:21 - Registering JAPC Executor JMX Interface

LOGGING display software



Timings editor



Linac4 (Bldg. 400)

Dev Name	Description	Ref Name	Value	Acquisition
L4X.STARTGAS	Start gas pulse	L4X.SEJ	-2.300 ms	-2.3 ms
L4X.STARTIGN	Start ignition source	L4X.SEJ	-0.070 ms	-0.07 ms
L4X.STOPIGN	Stop ignition source	L4X.STARTIGN	0.040 ms	0.04 ms
L4X.RRFONSRC	Ready source RF ON	L4X.SEJ	-0.100 ms	-0.1 ms
L4X.FWSRCRF	Forewarning source RF	L4X.SEJ	-0.300 ms	-0.3 ms
L4X.FW-H-DISCAP	Forewarning for H-DISCAP	L4X.SEJ	-380.000 ms	-380 ms

LN4:USER==MD1 - KnobsOpen (on cs-ccr-dev1.cern.ch)

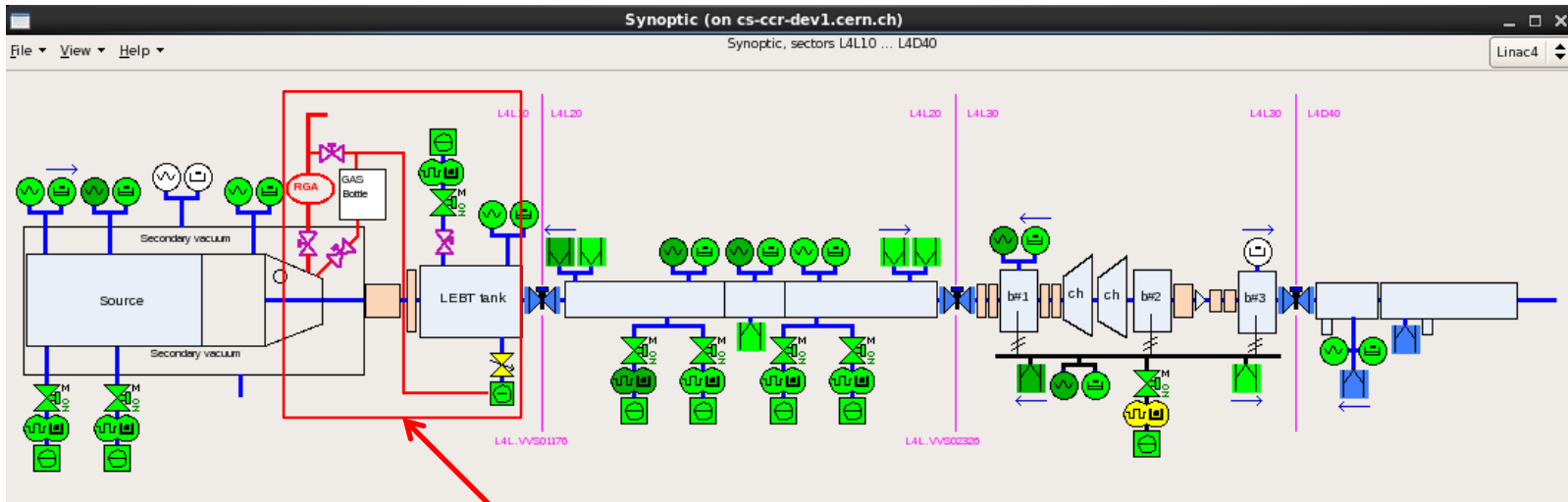
07 Nov 2013 16:15:58 LN4 - 04 MD1 | olga_cycle_V1

Knob	Enable	Load	Ref	Init	Delay
L4X.SEJ	Enable	BIX.W10-CT	-	100000 10MHZ	100000 10MHZ
L4X.STARTGAS	Enable	BIX.W10-CT	-	77000 10MHZ	77000 10MHZ
L4X.RRFONSRC	Enable	BIX.W10-CT	-	99000 10MHZ	99000 10MHZ
L4X.FW-H-DISCAP	Disable	BIX.F900-CT	-	520 1KHZ	520 1KHZ

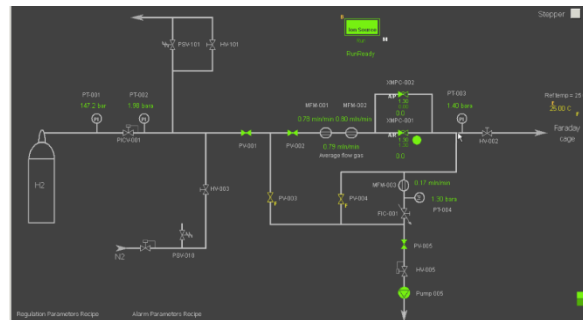
16:15:15 - Opening knob: L4X.FW-H-DISCAP...done

Synoptic:

Vacuum



Red circuit/lines controlled by the Gas Delivery System
Source and LEBT



General Source Control

Ion Source Controls (on cwo-6-2In4.cern.ch)

16 Oct 2013 15:16:46 LN4 - MD1, 04 MD1 - 01

Controls Other acquisitions

Source Description
 Type: IS01 Name: Volume01 Polarity: Hminus Location: Linac4_400

Piezo Piezo Command: On PiezoStatus : On PiezoVdc: 6.00V PiezoVAqn: 85.07		Collar Collar Command: Off CollarStatus : Off CollarV: 5.00V CollarVAqn: 1.50 CollarIAqn: 0.06	
Ignition Ignition Command: Off IgnitionStatus : Off IgnitionV: 500.00V IgnitionVAqn: 0.00 IgnitionIAqn: -0.52		IonTrap Ion Trap Command: Off IonTrapStatus : Off IonTrapV: 10.00V IonTrapVAqn: 0.00	
PressureLEBTP PressureLEBTP: 5.80 VacuumLEBTVaqn: 5.74 VacuumLEBTPAqn : 1.95E-06 VacuumLEBTPCaTc: 0.00		PiezoFeedBackLoop PFBL Command: Off PiezoFeedBackLoopStatus : Off PiezoFeedBackLoop: 6.55 VacuumSourceVAqn: 6.58 VacuumSourceVFBLAverageAqn: 6.55	
Plasma Light Light1Aqn: 7.49 Light2Aqn: 0.03		FiberTX Reset FiberTXStatus: ON	

Resources needed to implement a magnetron source

- Hardware (25kCHF, 0.5FTE)
 - Timing card
 - Cabling
 - PLC
 - Buffer cards
 - Oscilloscope for OASIS
- Software adaptation (0.5FTE)
 - Timing editor
 - General source control applications
 - FESA classes
 - Logging Service

Conclusion/outlook

- The control system of the Ion Source is based on existing components and systems developed for the LHC and injectors accelerators (LSA, INCA, WS, Knobs, OASIS and Logging Service). BE-CO is responsible of the maintenance and the configuration is done by BE/OP
- Java Operational applications will be maintain by BE-OP and BE-ABP
- PH-DT and TE-VSC groups are responsible of their Specific application
- Finalize the connection of the missing signal to OASIS + Logging settings 0.5FTE
- 1FTE and 25kCHF are needed to implement the Magnetron source in the current control system.