

SESAME

P.O. Box 7, Allan 19252, Jordan

www.sesame.org.jo

Magnets

SESAM

—Dipoles Po SR-PS-BM

Quadropo Focusing Q SRC01-PS-SRC01-PS-SRC02-PS-SRC02-PS-SRC03-PS-SRC03-PS-SRC04-PS-SRC04-PS-SRC05-PS-SRC05-PS-SRC06-PS-SRC06-PS-SRC07-PS-SRC07-PS-SRC08-PS-SRC08-PS-SRC09-PS-SRC09-PS-SRC10-PS-SRC10-PS-SRC11-PS-SRC11-PS-SRC12-PS-SRC12-PS-SRC13-PS-SRC13-PS-SRC14-PS-SRC14-PS-SRC15-PS-SRC15-PS-

SRC16-PS-0 SRC16-PS-0

Sextupole
 Focusing Se
 SR-PS-SF1
 SR-PS-SF2

Correctors

STRUCTURE AND DEVELOPMENT OF SESAME'S CONTROL SYSTEM CLIENT



Close

A. Al-Dalleh, A. Ismail, I. Saleh, SESAME, Allan, Jordan

Abstract

SESAME is a third-generation 2.5 GeV synchrotron-light source based in Allan, Jordan. The Pre-injector (Microtron) and Injector (Booster Ring) have been commissioned while the commission of the storage ring began in January 2017 and we expect machine operation in late 2017. The current components of the control systems software side are IOCs developed using EPICS software tools, graphical user interfaces (OPI) designed using Control System Studio (CSS) software tools, process variables archiving using CSS BEAUTY toolkit, alarm handling using CSS BEAST toolkit and tools to help in automation and reporting. This paper will present the current design of the client system which includes what was needed for the active commissioning period as well as upgrades that are under research including EPICS Qt framework as a client replacement for CSS and the pros and cons of this replacement and upgrading the archiver engine to a scalable and higher performance engine.

CONTROL SYSTEM CLIENT STRUCTURE		Main Menu - CS-Studio	- • ×	
\succ The main interface is divided based on the machine's stages, and each stage consists of its own subsystems	and each stage consists of its own subsystems			
Fine main interface is divided based on the machine's stages, and each stage consists of its own subsystems.	SESAME	Main Control System		
Magnets Power Supplies - CS-Studio				

wer Supplies 🛿										E Star	tup Sequen	ce				
	Storag	e Ring DC Power Sup	pplies			Overview – Vac	cuum – CS–Studio		- • ×			Start	up/Shutdown Sec	uence		
State Vo ver Supply	oltage Current	Cycle Magnets	Open Loop Off	Waveform	🖾 Overview - Vacuum 🖾					I I						
On 196	0.195 152.450 152.45(Details)	PS Ramping State	Voltage Current		SESAME	Storage Ring V	acuum Overview			_ Mic	rotron —			nsfer Line (1) ———	
es Power Suppli adropoles	es 68.876	Defocusing Quadropole	s [15.499	9	IP1 IP2	IP3 IP4 IMG V1 V2	-Vacuum Cell 2				Operation	Actuating Mo	tors	ower Supplies	Vacuu	m
QF10n 3.01 QF20n 2.91	19 V 68.686 A 68.686 Details 11 V 68.500 A 68.501 Details	SRC01-PS-QDion SRC01-PS-QDion	0.467 V 24.628 A 24.628 0.466 V 25.431 A 25.432	8 Details 🔍 2 Details 🔍	CO1L 1.21E-9 1.55E-9	8.81E-10 3.153E-10	CO3L 4.86E-10 1.12E-9 4.88	3E-10 5.63E-10 3.328E-10		Po	wer Supplies	Analog Sign	als	ower supplies	vacuu	<u> </u>
QF10n 3.12 QF20n 3.04	22 V 68.795 A 68.793 Details	SRC02-PS-QDion	0.486 V 23.295 A 23.295 0.483 V 24.128 A 24.129	5 Details 🔍	C01B 3.09E-10 1.26E-10 C02S 1.61E-9 1.49E-9	2.74E-11 1.86E-10 9.437E-12 🥥 🥥	CO3B 1.41E-10 6.64E-11 1.67 CO4S 0E0 0E0	7E-11 1.58E-10 3.328E-10	• •							
QF10n 2.91	17 V 68.716 A 68.715 Details	SRC03-PS-QD On	0.456 V 25.462 A 25.462	2 Details	CO2B 3.24E-10 3.87E-10	2.94E-11 7.17E-10 8.281E-11	CO4B 5.99E-11 3.49E-11 1.30	5E-11 2.24E-10 7.502E-12		Boc	ster		— Tra	insfer Line (2)	
QF10n 2.77	77 V 68.493 A 68.496 Details	SRC04-PS-QDion	0.374 V 23.413 A 23.413 0.381 V 25.250 A 25.249	3 Details	Vacuum Cell 3		Vacuum Cell 4				Vacuum	RF				1
QF10n 2.95	54 V 68.569 A 68.569 Details	SRC05-PS-QDion	0.446 V 23.989 A 23.989 0.414 V 23.583 A 23.989	9 Details	CO5L 3.85E-10 8.19E-10 CO5B 1.66E-10 2.78E-11	2.07E-9 6.332E-11 1.05E-11 2.79E-10 3.887E-11	CO7L 3.09E-10 3.84E-10 1E- CO7B 3.49E-11 1.69E-11 1E-	11 1.438E-10 11 4.34E-11 1.237E-11		Bo	ver Supplies	Diagnostic		ower Supplies	Vacuu	m
QF10n 2.83	30 V 68.768 A 68.767 Details	SRC06-PS-QDIon	0.417 V 25.362 A 25.363 0.417 V 25.056 A 25.057	7 Details	CO6S 3.2E-10 1.73E-9 CO6B 9.68E-11 5.55E-11	1.96E-11 2.94E-10 2.148E-10	C08S 6.48E-11 7.88E-10 C08B 1E-11 7.55E-11 2.98	3E-11 8.11E-11 1.451E-11			wei Supplies		<u> </u>	Diagnostics	Coolin	ng
QF10n 2.69	52 V 68.692 A 68.692 Details	SRC07-PS-QDion	0.409 V 25.791 A 25.792 0.372 V 25.578 A 25.578	2 Details							C	ooling				
⊒F⊉On 2.67 ⊒F1On 2.77	74 V 68.348 A 68.348 Details 76 V 68.674 A 68.672 Details	SRC07-PS-QD.on SRC08-PS-QD.on	0.385 V 26.284 A 26.286 0.389 V 24.608 A 24.608	B Details	C09L 2.26E-10 6.55E-10	3.17E-9 1.209E-10	C11L 2.16E-10 6.47E-10 4.65	5E-9 1.428E-9		- Sto	rage Ring -			a System	- Tools -	
QF2On 2.82 QF1On 2.75	20 V 68.425 A 68.422 Details 51 V 68.988 A 68.987 Details	SRC08-PS-QD10n SRC09-PS-QD10n	0.438 V 26.325 A 26.325 0.371 V 24.436 A 24.436	5 Details 6 Details	C09B 6.79E-11 4.09E-11 C10S 1.45E-10 1.23E-9	. 1.22E-11 1.35E-10 8.661E-12	C11B 5.29E-10 2.43E-10 6.13 C12S 1.91E-10 1.25E-9	1E-11 1.91E-10 1.116E-9	• •	510	rage ning		1 -		10013	
QF2On 2.66 QF1On 2.71	69 V 69.153 A 69.152 Details 14 V 68.895 A 68.896 Details	SRC09-PS-QD10n SRC10-PS-QD10n	0.474 V 22.016 A 22.016 0.374 V 24.265 A 24.267	5 Details 7 Details	C10B 5.86E-11 4.07E-11	1.68E-11 1.57E-10 2.807E-11	C12B 1.1E-10 7.13E-11 5.47	7E-11 3.18E-10 3.919E-11			Vacuum		Eve	it Generator	Arch	niver
QF2On 2.75 QF1On 2.87	58 V 68.516 A 68.515 Details 70 V 68.960 A 68.959 Details	SRC10-PS-QD1on SRC11-PS-QD1on	0.392 V 24.346 A 24.347 0.452 V 25.938 A 25.936	7 Details 5 Details	Vacuum Cell 7		Vacuum Cell 8			Po	wer Supplies	Diagnostic	s Eve	nt Receiver 1		
QF2On 2.91 QF1On 2.97	19 V 68.621 A 68.622 Details 71 V 68.635 A 68.635 Details	SRC11-PS-QD10n SRC12-PS-QD10n	0.464 V 25.786 A 25.785 0.454 V 23.863 A 23.864	5 Details 🔍 4 Details 🔍	C13L 2.22E-10 6.79E-10 C13B 1.2E-10 6.14E-11	9.75E-9 1.791E-10 2.09E-11 1.34E-10 6.495E-11	C15L 3.4E-10 6.88E-10 6.47 C15B 8.18E-11 4.96E-11 2.24	7E-10 2.026E-10 4E-11 2E-10 4.427E-11			C	ooling	Eve	nt Receiver 2	Alarm F	landler
QF2 <mark>On 3.03</mark> QF1On 3.14	37 V 68.544 A 68.543 <u>Details</u> (*) 45 V 68.882 A 68.882 <u>Details</u> (*)	SRC12-PS-QDion SRC13-PS-QDion	0.496 V 25.198 A 25.197 0.548 V 26.079 A 26.080	7 <u>Details</u> Details	C14S 1.72E-10 1.6E-9 C14B 1.4E-10 8.36E-11	1 1.17E-11 3.2E-10 3.413E-10	C165 2.61E-10 1E-11 C16B 1.26E-10 5.82E-11 3.09	9E-11 4.61E-10 1.802E-10								
QF2On 3.06 QF1On 3.03	62 V 68.605 A 68.604 Details () 32 V 68.990 A 68.990 Details ()	SRC13-PS-QDion SRC14-PS-QDion	0.531V 26.448 A 26.447 0.504V 25.816 A 25.816	7 <u>Details</u> 5 Details								1				
QF2On 2.95 QF1On 2.88	50 V 68.849 A 68.849 Details 81 V 68.805 A 68.804 Details	SRC14-PS-QDIon SRC15-PS-QDIon	0.495 V 26.702 A 26.702 0.452 V 25.613 A 25.612	2 Details 🔍 2 Details 🔍	Schematic Vavles Inter	locks Heat Absorbers			Close	Mad	hines Manager	Profile	es D	ССТ		Close
QF2On 2.81 QF1On 2.77	17 V 68.745 A 68.746 Details 71 V 68.330 A 68.332 Details	SRC15-PS-QDIon SRC16-PS-QDIon	0.422 V 25.635 A 25.635 0.363 V 23.049 A 23.048	5 Details 🔍 8 Details 🔍												
QF2On 2.73	37 V 68.485 A 68.485 Details 🔍	SRC16-PS-QD	0.367 V 23.847 A 23.848	8 Details 🗶		Figure 2: Storage	e-Ring Vacuum OPI				Figu	re 3: Main In	terface for th	e Control Sv	stem Clien [®]	t
s xtupoles	62 410	Defocusing Sextupoles	96 700	3		RF SSA Current - CS-Studio	;	×		• 			•	,		
On 7.83	36 V 18.840 A 18.840 Details	SR-PS-SD1 On SR-PS-SD2 On	12.568 V 30.047 A 30.046	<u>Details</u>	RF SSA Current 🕺							CS-Studio			-	o x
					SESAME	Storage Ring RF Solid-State Ampli	fier 1 Current and Power)
Power Supplies	Gateways Health Ge	eneral Control Pulsed	d Elements Reset All	Close	DIS 01 DIS 02	DIS 03 DIS 04 DIS 05 DIS 06 DIS 07 DIS 08 D	IS 09 DIS 10		🖀 libera_B+_main.opi 🖇	3						
Figu	ura 1. Staraga Ding		upplies ODI		Module 01 0.485 A 0.48 A 0.593 A 0.57 A	0.615 A 0.525 A 0.452 A 0.44 A 0.457 A 0.61 A 0.5 0.519 A 0.519 A 0.429 A 0.44 A 0.457 A 0.514 A 0.514 A 0.457 A 0.514	Pre-Driver 255 A 0.491 A 0.452 A Forward Amplifier Power (Kw)		A			ci Di	<u> </u>			
Figu	ire 1. Storage-King	g DC Power S	upplies OPI		Module O2 0.502 A 0.542 A 0.615 A 0.615 A 0.615 A	0.497 A 0.514 A 0.474 A 0.519 A 0.452 A 0.519 A 0.5 0.468 A 0.542 A 0.423 A 0.497 A 0.44 A 0.519 A 0.5	255A 0.463A 20 40 60		SESAME			Storage Rin	g Control System			
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Cell\$(BM	cell) Cell \$(cell) BM O	Cell \$(cell) BM 🕘 🍽	Cell \$(cell) BM 💿 🌑		Module 04 0.514 A 0.525 A 0.497 A 0.508 A	0.508 A 0.519 A 0.452 A 0.452 A 0.423 A 0.463 A 0.6 0.519 A 0.519 A 0.468 A 0.457 A 0.514 A 0.542 A 0.7	332 A 0.502 A 331 A 0.435 A Reflected Amplifier Power (Kw)									
QF1 QF2	QF1 0 QF2 0	QF1 • • • QF2 • •	QF1 • • • • • • • • • • • • • • • • • • •		Module 05 0.468 A 0.536 A 0.508 A 0.497 A	0.463 A 0.548 A 0.491 A 0.446 A 0.48 A 0.485 A 0.4 0.48 A 0.474 A 0.463 A 0.452 A 0.378 A 0.531 A 0.5	10 20 0.44 A 10 20 0.48 A 0 10 10 30			IP CPU Loa	d Uptime	Free Memory Load	I Avg			
QD2 SF1	QD2 0 SF1 0	QD2 • •	QD2 O SF1		Module 07 0.474 0.491A	0.491 A 0.548 A 0.463 A 0.389 A 0.406 A 0.559 A 0.5 0.468 A 0.508 A 0.395 A 0.418 A 0.485 A 0.604 A 0.4	519 A 0.446 A 229 A 0.44 A		Libera					1		1
SF2 SD1	SF2 SD1 SD2	SF2 SD1 SD2	SF2 SD1 SD2 SD2 SD2 SD2 SD2 SD2 SD2 SD2		0.514 A 0.502 A Module 08 0.446 A 0.502 A	0.593 A 0.565 A 0.48 A 0.406 A 0.452 A 0.514 A 0.5 0.519 A 0.446 A 0.463 A 0.429 A 0.519 A 0.429 A </td <td>502 A 0.452 A 515 A 0.525 A Forward Power 1.228 kW</td> <td></td> <td>SR-DI-LBR1 10.</td> <td>2.4.31 0.93%</td> <td>7 20:12</td> <td>1743638528 0.37 0</td> <td>.19 0.16 BPMs</td> <td></td> <td>Fans EVR</td> <td></td>	502 A 0.452 A 515 A 0.525 A Forward Power 1.228 kW		SR-DI-LBR1 10.	2.4.31 0.93%	7 20:12	1743638528 0.37 0	.19 0.16 BPMs		Fans EVR	
Cell \$(cell) Cell \$(cell)	- Cell \$(cell) -	Cell \$(cell)		0.474 A 0.502 A P.I. 1 0.02 0.025	0.468 A 0.423 A 0.452 A 0.474 A 0.497 A 0.519 A 0.5 0.02 0.016 0.013 0.012 0.023 0.028 0.0	0.491A Relfected Power 0.063 kW 028 0.018		SR-DI-LBR2 10.	2.4.32 0.73%	7 20:12	1744416768 0.020	.04 0.06 BPMs		Fans EVR	
QF1 QF2	BM 0F1 0F2	QF1 G	QF1 G		P.R. 1 0.0 0.0 P.I. 2 0.016 0.013	0.0 0.004 0.005 0.0 0.002 0.0 0.0 0.017 0.011 0.012 0.008 0.015 0.003 0.0	0.0 Statistics 0.08 0.02 Minimum Current 0.339 A		SR-DI-LBR4 10.	2.4.34 0.98 %	7 20:11	1741660160 0.05 0	.10 0.12 BPMs		Fans EVR	$\frac{1}{2}$
QD1 QD2	QD1 QD2	QD1	QD1 O QD2 O		P.R. 2 0.0 0.006		0.003 Maximum Current 0.429 A		SR-DI-LBR5 10.	0.86%	7 20:11	1724350464 0.14 0	.09 0.10 BPMs	ІСВ	Fans EVR	2
SF1 SF2 SD1	SF1 SF1 SF2 SD1 SD1	SF1 🔮 🍯 SF2 🕘 🔮 SD1 曼 🖨	SF1 0 0 SF2 0 0 SD1 0 0		Module 09 0.429 A 0.474 A 0.477 A	0.57 A 0.514 A 0.497 A 0.502 A 0.355 A 0.474 A 0.4 0.44 A 0.485 A 0.435 A 0.474 A 0.474 A 0.476 A 0.47	Average Current 0.447 A Average Current 0.429 A Total PI Power 0.326 kW		SR-DI-LBR6 10.	2.4.36 0.88 %	7 20:11	1753264128 0.08 0	.05 0.06 BPMs	ICB	Fans EVR	2
SD2	SD2	SD2 🕘 🍯	SD2		Module 10 0.477 A 0.48 A 0.474 A 0.531 A	0.553 A 0.559 A 0.372 A 0.463 A 0.474 A 0.423 A 0.423 A 0.5 0.48 A 0.565 A 0.468 A 0.468 A 0.412 A 0.423 A 0.4	0.418 A Total PR Power 0.041 kW 855 A 0.401 A		SR-DI-LBR7 10.	2.4.37 1.13 %	7 20:11	1742524416 0.06 0	.08 0.09 BPMs		Fans EVR	
BM QF1	BM OF1	BM OF1	BM O		Module 11 0.412 A 0.525 A 0.463 A 0.429 A	0.429 A 0.553 A 0.457 A 0.435 A 0.406 A 0.485 A 0.4 0.48 A 0.463 A 0.491 A 0.531 A 0.35 A 0.423 A 0.4	Inlet Water Flow 211.9 L/M I35 A 0.435 A Outlet Water Flow 188.4 L/M		SR-DI-LBR8 10.	2.4.38 0.65%	7 20:11	1752256512 0.06 0	.07 0.06 BPMs		Fans EVR	
QF2 QD1	QF2 QD1 0	QF2 OC	QF2 O		Module 12 0.463 A 0.355 A 0.361 A 0.514 A	0.44 A 0.446 A 0.48 A 0.497 A 0.367 A 0.429 A 0.4 0.593 A 0.497 A 0.457 A 0.452 A 0.355 A 0.463 A 0.4	06 A 0.446 A Mains		SR-DI-LBR10 10	2.4.40 6.65%	7 20:11	870670336 0.010	.04 0.05 BPMs		Fans EVR	2
SF1 SF2	QD2 SF1 SF2 SF2 SF2	SF1 SF2	SF1 0 0 SF2 0 0		Module 13 0.378 A 0.502 A 0.446 A 0.463 A	0.519 A 0.542 A 0.457 A 0.401 A 0.423 A 0.48 A 0.4 0.497 A 0.497 A 0.423 A 0.468 A 0.406 A 0.452 A 0.4	146 A 0.361 A Start Stop Interlock •		SR-DI-LBR11 10.	2.4.41 0.75%	7 20:12	1722003456 0.12 0	.14 0.11 BPMs		Fans EVR	2
SD1 SD2	SD1 0 0 SD2 0 0	SD1 🔮 🔮 SD2 🍯 🍯	SD1 0 0 SD2 0 0		Module 14 0.452 A 0.418 A 0.474 A	0.491 A 0.497 A 0.429 A 0.435 A 0.361 A 0.468 A 0.4 0.542 A 0.508 A 0.44 A 0.514 A 0.423 A 0.485 A 0.4	135 A 0.435 A 197 A 0.406 A		SR-DI-LBR12 10.	2.4.42 0.70%	7 20:13	1742057472 0.11 0	.08 0.06 BPMs	ICB	Fans EVR	2
Cell \$(cell) — Cell \$(cell) —	Cell \$(cell)	Cell \$(cell)		Module 15 0.485 A 0.452 A 0.453 A	0.519 A 0.446 A 0.44 A 0.548 A 0.491 A 0.457 A 0.4	135 A 0.406 A									





DEPLOYING THE EPICS ARCHIVER APPLIANCE

- We are using the CSS RDB Archiver which archives data to a PostgreSQL database. The archiver is running on a virtual server with 32GB RAM and 1TB of storage
- Currently we have around 12000 input process variable for the machine with 1200 are actively archived, the currently archived process variables are consuming around 23GB/week of storage which fills up the allowed storage very quickly.
- > The other problem was data retrieval within the CSS which might take hours depending on the requested time interval.
- The EPICS Archiver aims to archive millions of PVs using a clustered design approach with focus on data retrieval performance.
- The Archiver Appliance is designed in Java and deployed in terms of Tomcat webapps. It consists of 4 Tomcat instances: Engine for archiving and clustering, ETL for storage management, retrieval for client data retrieval and management for the web interface.
- > The Archiver Appliance stores the archived samples in a custom file format in the storage, based on the software design the sample size will take around 22 KB per 1 second sample, averaging around 600 MB per year per sample.
- > Taking the previous machine statistics into account, it would take less than 15 GB per week for the entire machine and that is assuming active and continuous operation.



CLIENT DESIGN USING EPICS Qt

> Based on the popular Qt Creator framework and EPICS, EPICS Qt provides a high-level framework for faster prototyping and deployment of control system client.

Being very popular and built on top of Qt and flexible UI design, EPICS Qt can be considered a good replacement for existing control system clients such as Control System Studio, EDM, etc.
 The concept is still under research before officially replacing CSS.

UI design is kept the same as CSS so nothing feels different for the operators.

Qt's flexibility will allow for more things to be implemented using the framework itself instead of relying on external scripts and commands for example.

M	lainScreen – 🗆 🗙	Storage Ring RF Solid-State Amplifier Current and Power	_ _ ×	Storage RingVaucuum Overview _ □
Profiles		Storage Ring RF Solid-State Amplifier 1 Current and Power	Pre-Driver	Storage Ring Vaucuum Overview
SESAME SESAM	E Control System	Module 01 0.836 A 0.881 A 1.056 A 0.847 A 0.774 A 0.853 A 0.678 A 0.983 A 0.926 A 0.819 A Module 01 0.858 A 0.824 A 0.966 A 0.887 A 0.791 A 0.802 A 0.791 A 1.011 A 0.915 A 0.847 A Module 02 0.904 A 0.915 A 0.847 A 0.898 A 0.796 A 0.92 A 0.802 A 0.881 A 0.802 A 0.881 A 0.892 A 0.802 A	- Forward Amplifier Power (KW) - 40 50 30	Vacuum Cell 1 IP1 IP2 IP3 IP4 IMG V1 V2 IP1 IP2 IP3 IP4 IMG V1 C01L 2.79e-09 2.61e-09 1.2e-09 3.168e-10 C03L 9.32e-10 1.63e-09 9.92e-10 5.62e-10
Startup / S	Shutdown Sequence	Module 03 0.983 A 1.011 A 0.807 A 0.892 A 0.734 A 0.875 A 0.819 A 0.836 A 1.011 A 0.988 A Module 03 0.909 A 0.96 A 0.853 A 0.898 A 0.909 A 0.960 A 0.853 A 0.898 A 0.909 A 0.802 A 1.011 A 0.932 A Module 04 0.892 A 0.964 A 0.802 A 0.937 A 0.847 A 0.728 A 0.836 A 0.841 A 0.92 A 0.847 A 0.847 A 0.943 A 0.864 A 0.875 A 0.807 A 0.779 A 1.033 A 0.875 A	$- 10^{-1} 10$	C01B 6.08e-10 2.38e-10 5.41e-11 3.69e-10 7.564e-11 6.03B 1.08e-09 3.05e-10 1.17e-10 2.7e-11 7.241e-10 C02S 3.92e-09 3.4e-09 3.4e-09 1.04e-10 1.39e-09 1.825e-10 C04S 0
Operation Actuating Motors	Power Supplies Vaccuum	Module 05 0.858 A 0.92 A 0.875 A 0.898 A 0.802 A 0.802 A 0.853 A 0.898 A 0.892 A 0.768 A Module 06 0.824 A 0.943 A 0.807 A 0.932 A 0.819 A 0.802 A 0.853 A 0.898 A 0.892 A 0.766 A Module 06 0.881 A 0.87 A 0.824 A 0.87 A 0.824 A 0.87 A 0.875 A 0.875 A 0.875 A 0.877 A 0.875 A 0.864 A 0.943 A 0.751 A 0.717 A 0.909 A 0.875 A 0.862 A	 Reflected Amplifier Power (KW) 40 50 	Vacuum Cell 3 Vacuum Cell 4 C05L 6.49e-10 1.69e-09 5.29e-09 1.743e-10 C07L 5.21e-10 7.34e-10 1e-11
Power Supplies Analog Signals Booster Control System	Transfer Line 2 Control System	Module 07 0.898 A 0.898 A 0.824 A 0.897 A 0.711 A 0.711 A 0.836 A 1.022 A 0.708 A 0.779 A Module 08 0.807 A 0.898 A 0.824 A 0.966 A0.802 A 0.711 A 0.824 A 0.92 A 0.864 A 0.779 A Module 08 0.807 A 0.898 A 0.881 A 0.785 A0.802 A 0.774 A 0.915 A 0.774 A 0.977 A 0.943 A 0.836 A 0.92 A 0.824 A 0.779 A0.779 A 0.841 A 0.904 A 0.864 A 0.878 A 0.898 A	- 20 - 70 - 10 - 80	C05B 3.6e-10 6.13e-11 3.24e-11 5.52e-10 9.842e-11 • C07B 5.49e-11 2.69e-11 1.46e-11 9.17e-11 2.075e-11 C06S 5.74e-10 3.95e-09 • • C08S 1.21e-10 1.76e-09 C06B 1.94e-10 9.88e-11 3.91e-11 5.59e-10 2.091e-10 C08B 1e-11 1.22e-10 8.09e-11 2.08e-10 6.434e-11
Vacuum Radio Frequency Power Supplies Diagnostics	Power Supplies Vacuum	P.I 1 0.074 0.077 0.067 0.061 0.052 0.055 0.068 0.074 0.078 0.065 P.R 1 0.004 0.004 0.001 0.008 0.006 0.003 0.008 0.008 0.006 0.001 P.I 2 0.054 0.057 0.066 0.054 0.048 0.048 0.046 0.038 0.044 0.061 P.R 2 0.002 0.016 0.012 0.004 0.016 0.006 0 0.009 0 0.011	0 0.081 90 Forward Power 2.214 KW	Vacuum Cell 5 Vacuum Cell 6 C09L 3.57e-10 1.59e-09 8.15e-09 1.194e-10 C11L 3.33e-10 1.51e-09 1.15e-08 1.675e-09
Cooling	Diagnostics Cooling	Module 09 0.796 A 0.864 A 0.983 A 0.847 A 0.853 A 0.683 A 0.638 A 0.836 A 0.751 A 0.728 A Module 10 0.779 A 0.74 A 0.745 A 0.824 A 0.717 A 0.802 A 0.638 A 0.638 A 0.836 A 0.757 A 0.768 A 0.757 A Module 10 0.779 A 0.74 A 0.745 A 0.898 A 0.632 A 0.779 A 0.745 A 0.898 A 0.632 A 0.779 A 0.745 A 0.74 A	Reflected Power 0.079 KW Statistics Minimum Current 1.056	C09B 1.43e-10 7.44e-11 2.48e-11 3.17e-10 6.053e-11 • C11B 8.14e-10 4.07e-10 1.12e-10 3.76e-10 1.64e-09 C10B 1.24e-10 7.22e-10 3.79e-11 3.08e-10 6.399e-11 C12B 2.24e-10 1.5e-10 1.13e-10 6.15e-10 8.736e-11
Storage Ring Control System Vacuum Radio Frequency	Event Generator Archiver	Module 11 0.807 A 0.909 A 0.807 A 0.937 A 0.807 A 0.768 A 0.706 A 0.74 A 0.779 A 0.683 A 0.751 A 0.898 A 0.757 A 0.943 A 0.774 A 0.785 A 0.694 A 0.802 A 0.723 A 0.813 A 0.74 A 0.802 A 0.791 A 0.836 A 0.87 A 0.638 A 0.779 A 0.723 A 0.819 A 0.661 A 0.751 A 0.791 A 0.824 A 0.836 A 0.683 A 0.723 A 0.785 A	 Maximum Current 0.621 Average Current 0.82239: Total PI Power 1.187 KW Total PR Power 0.125 KW 	Vacuum Cell 7 Vacuum Cell 8
Power Supplies Diagnostics Cooling	Event Receiver 1 Event Receiver 2	Module 13 0.661 A 0.904 A 0.943 A 0.847 A 0.802 A 0.785 A 0.655 A 0.785 A 0.785 A 0.661 A 0.621 A Module 14 0.672 A 0.898 A 0.898 A 0.909 A 0.841 A 0.757 A 0.717 A 0.802 A 0.762 A 0.627 A Module 14 0.751 A 0.813 A 0.864 A 0.841 A 0.74 A 0.755 A 0.678 A 0.74 A 0.802 A 0.74 A 0.762 A 0.853 A 0.833 A 0.847 A 0.734 A 0.751 A 0.649 A 0.779 A 0.779 A 0.779 A Module 15 0.762 A 0.813 A 0.875 A 0.819 A 0.757 A 0.824 A 0.785 A 0.785 A 0.836 A 0.723 A	 Inlet Water Flow 216.1 L/M Outet Water Flow 189.6 L/M Mains Start Stop Interlock 	C13L 3.67e-10 1.59e-09 7.99e-09 3.767e-10 5.4e-10 1.54e-09 1.47e-09 2.247e-10 C13B 3.25e-10 1.65e-10 5.72e-11 3.11e-10 3.693e-10 1.86e-10 9.87e-11 5e-11 4.77e-10 1.147e-10 C14S 3.62e-10 4.17e-09 2.79e-11 5.98e-10 4.706e-10 C16S 5.79e-10 1e-11 2.62e-10 1.31e-10 7.27e-11 8.06e-10 2.115e-10
	Close	Module 16 0.847 A 0.796 A 0.864 A 0.745 A 0.745 A 0.892 A 0.802 A 0.768 A 0.745 A 0.728 A Module 16 0.649 A 0.824 A 0.904 A 0.779 A 0.824 A 0.745 A 0.785 A 0.751 A 0.785 A 0.627 A 0.864 A 0.915 A 0.904 A 0.796 A 0.796 A 0.7774 A 0.796 A 0.7774 A 0.757 A 0.774 A 0.757 A 0.75	Close	Schematic Valves Interlocks Heat Absorbers Close
Figure 8: Qt Design f	or the main screen.	Figure 9: Qt Design for the storage-rin	J g RF.	Figure 10: Qt Design for the storage-ring vacuum overview.