Design of the test system

From nQPS Power Pack Tester
to
iQPS Power Block Tester
Open questions?

Z.Charifoulline, TE-MPE/PE

nQPS Power Pack: Technical Requirements

DO-26002/TE 5

Technical Specification for the Procurement of 950 Power Supply Modules for the Upgrade of the Superconducting Circuit Protection of the LHC Collider

4. TECHNICAL REQUIREMENTS

4.1 General Description

The function of the Power Pack is to supply and control four independent DC voltage outputs.

The main characteristics of these modules are:

- Single-phase AC/DC with four independently DC voltage outputs:
  - DC Output 1: +5.5V DC ±2%, 2.6A
  - DC Output 2: +5.5V DC ±2%, 2.6A
  - DC Output 3: +5.5 DC ±2%, 2.6 A
  - DC Output 4: -15V DC ±10%, 0.5A
- Closed housing to prevent environmental influences, e.g. dust water
- Natural convection air-cooled
- Galvanic isolation between mains input and low-voltage DC outputs
- Compact volume (340mm x 210mm x 175mm)
- Low weight (< 10 kg)

The Power Packs will be installed inside racks in the LHC tunnel under the main dipole magnets (not included in this Tender).

nQPS crate:
5xDQQBS
4xDQQDS
1xDQAMGS
3xDQQDE

iQPS Power Block: Technical Specifications

Equipment	+5.6 V isolated	+15 V isolated	-15 V isolated	+5.6 V common	+15 V common	-15 V common	Remark
DQQDL_A	100	50	50	0	0	0	
DQQDL_B	100	50	50	0	0	0	
DQAMC	0	0	0	250	100	100	
DQHSU fast	0	0	0	250	40	20	
DQHSU slow	0	0	0	0	0	0	Cancelled
DQCSU	0	0	0	250	20	10	Confirmed
SPARE_1	0	0	0	250	50	50	Optional
SPARE_2	0	0	0	250	50	50	Optional
	200	100	100	1250	260	230	
Request	500 mA	250 mA	250 mA	2000 mA	500 mA	500 mA	

From: Reiner Denz
Sent: 23 August 2012 17:43
To: Knud Dahlerup-Petersen; Joaquim Mourao
Cc: Vincent Froidbise; Jens Steckert
Subject: RE: The new Power Modules for DYPB.

iQPS Power Block versus nQPS Power Pack

Equipment	+5.6 V isolated	+15 V isolated	-15 V isolated	+5.6 V common	+15 V common	-15 V common	Remark
DQQDL_A	100	50	50	0	0	0	
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DQAMC	0	0	0	250	100	100	
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SPARE_2	0	0	0	250	50	50	Optional
	200	100	100	1250	260	230	
Request	500 mA	250 mA	250 mA	2000 mA	500 mA	500 mA	

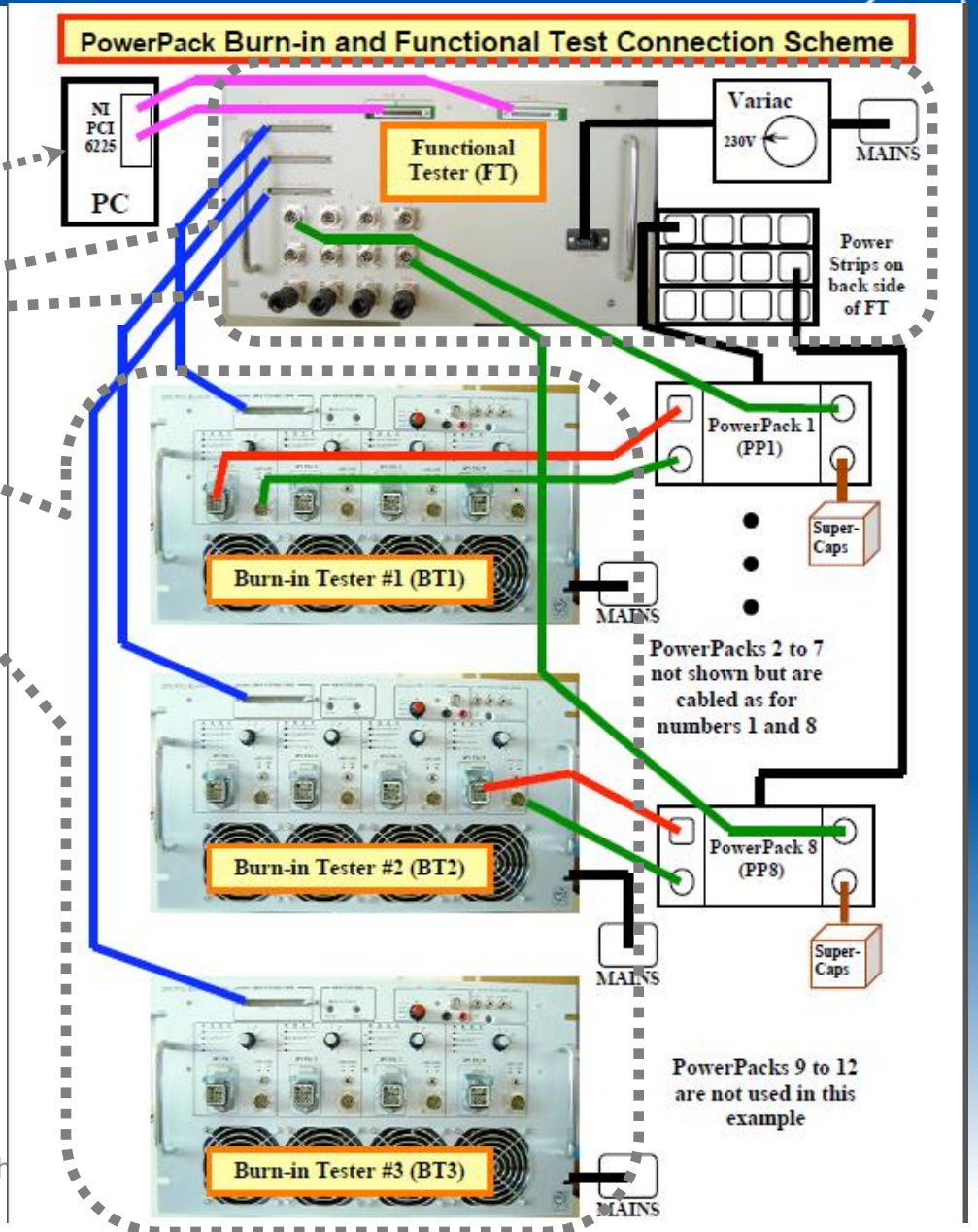
System	+5.6V	±15V	Σ outputs	Σ consumption	
nQPS	3	1	4	50W	
iQPS	2	4	**6**	36W	

nQPS Power Pack: Test System

Power Pack Test System:

- PC + LabView
- 1 NI PCI6225 (2x68pin)
- 1 Functional Tester
- 3 Burn-in Tester (4PP)
- 12PPs under the test

@Production time:
Two complete systems were installed at ELITE and One at CERN. Where are they now? b281?



nQPS Power Pack: Burn-in Tester (I)

nQPS Power Pack Burn-In Unit

Benoit Favre, Yves Thurel
TE-EPC-LPC, 2009

4 Power Packs burn-in tested in one go.
Memorization of faults during a burn-in sequence.
Initial and final check of some internal functions,
to ensure no degradation occurs during burn-in phase.
Burn-In Unit provides output voltage integrity check.
It creates different conditions using front panel push button or switches:
no load – full load step, action on Power Pack internal 5V6_xx relays.
It can be used in "remote" mode through a remote connector. In such a mode, Burn-In Unit is then used as a 2-state active load [0% - 100%] providing Power Pack D.U.T internal relays control, with all voltages and internal thermal sensors being accessed through a 50 flat pin cable remote connector.
Burn-In Unit is highly configurable.

- All
- Ea
- 2 c

o No

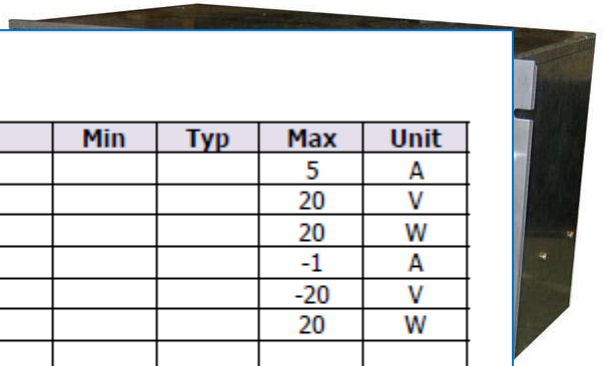
o AC Mains Loss conditions window: [4%..22%] - 7 steps (Mains loss test)

- AC Mains Phase Loss simulation duration is configurable from [0..200ms]

QPS PSU Burn-in Unit is what it is called:

- QPS PSU Burn-in Unit is used for burn in purpose. It then test that the QPS PSU is able to deliver correct output voltages during a long period (12h).

nQPS Power Pack: Burn-in Tester (II)



Absolute Maximum Ratings

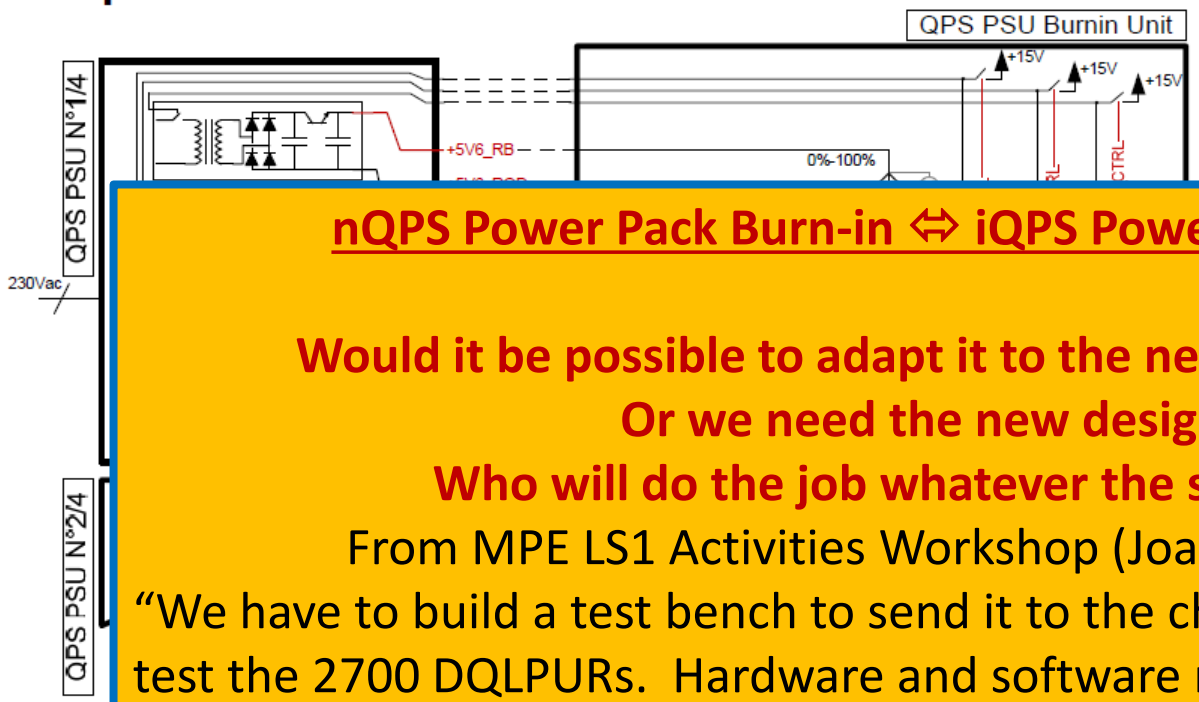
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{5V6_x}	Sink current / channel	Same limit for RB, RQD, DQAMG channel			5	A
V_{5V6_x}	Input Voltage / Channel	Same limit for RB, RQD, DQAMG channel			20	V
P_{5V6_x}	Input Power / Channel	Same limit for RB, RQD, DQAMG channel			20	W
I_{-15V_HDS}	Sink current / channel				-1	A
V_{-15V_HDS}	Input Voltage / Channel				-20	V
P_{-15V_HDS}	Input Power / Channel				20	W
I_{IN}	QPS PSU Burnin Unit Input Current	Current taken from main network		0.25	0.4	A
P_{IN}	QPS PSU Burnin Unit Input Power	Power taken from main network			40	W
V_{IN}	Continuous Input AC Voltage	50Hz Network	207	230	253	V_{RMS}
$V_{IN\ PEAK}$	Pulse Input Voltage phase Pulse Input Voltage phase / earth	T< 10ms up to 3 phases T< 0.2ms on 1 phase			300 1200	V_{RMS} V_{PEAK}
V	Isolation Voltage AC / DC or earth	t<1min – ensured by 50Hz transformer			2500	V_{RMS}

Environment Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T	Operating Temperature	3x [14W / 5V6_x] + 1x [10W/-15V_HDS]	10		40	°C
	Humidity				90	%
	Radiation	Not suitable for radioactive appl.				
	Conducted Emissions	IEC478 Level C				
	Radiated Emissions	N.A.				
I	Main Fuse Rating	Located in AC Power Plug		0.4T		A
Icc	Main Fuse	Shall be connected to low Icc main network		NA		kA
	Cooling Environment	No obstruction to cooling air path required front and rear side of the Unit				

nQPS Power Pack: Burn-in Tester (III)

Principle Schematics



nQPS Power Pack Burn-in ⇔ iQPS Power Block Burn-in

Would it be possible to adapt it to the new requirements?
Or we need the new design?
Who will do the job whatever the solution is?

From MPE LS1 Activities Workshop (Joaquim Mourao):
"We have to build a test bench to send it to the chosen company for the test the 2700 DQLPURs. Hardware and software required

- Zinur Charifoulline (for software), **Mathieu Favre (hardware)" ???**

nQPS Power Pack Burn-in Tester
4 x { 3x**(+5.6V)** + 1x**(-15V)** }
or
12x**(+5.6V)** + 4x**(-15V)**

???

iQPS Power Block Burn-in Tester
2 x { 2x**(+5.6V)** + 2x**(-15V)** + 2x**(+15V)** }
Internal relays control? Connectors?

nQPS Power Pack: Test System

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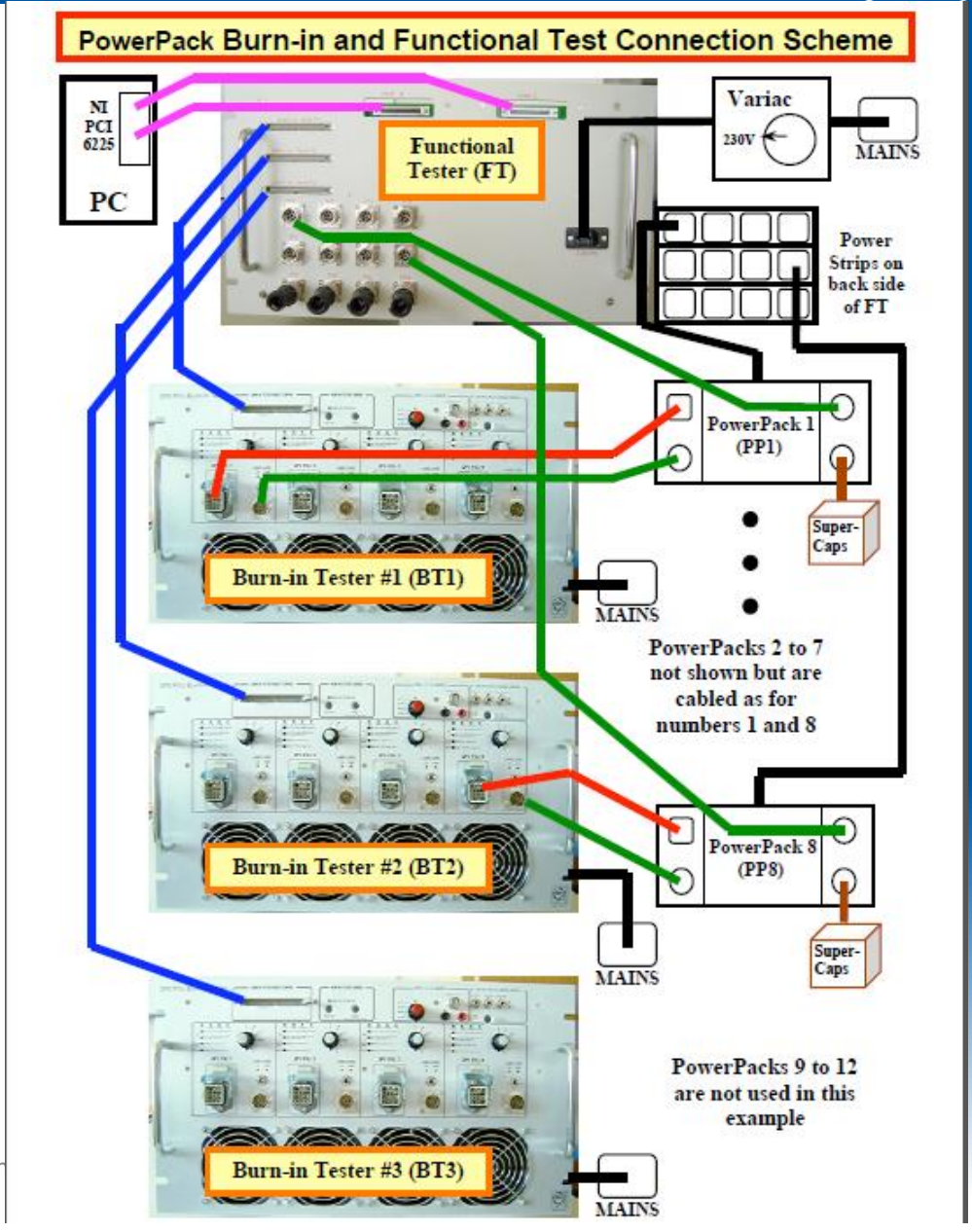


The Functional Tester:

- 3 power strips each with 4 AC OUT outlet sockets to provide power for the 12 Power Packs
- 12 8-pin Burndy connectors for relay monitor signals from each Power Pack
- 3 …

the …

- 2 …

One …

2 D…

test …

nQPS Power Pack Burn-in ⇔ iQPS Power Block Burn-in

NI PCI-6225 card limit:

1 Vin + 6 Vout x 11 + 1 Temp x 11 = 78 analog channels (80 max)

So maximum 11 Power Blocks can be tested,

but if keep 3 Burn-in unit configuration it wil be 3x3=9

61 analog input channels (+19 free)

10 digital I/O channels (+14 free)

1 DAC output channel (+1 free)

They are:

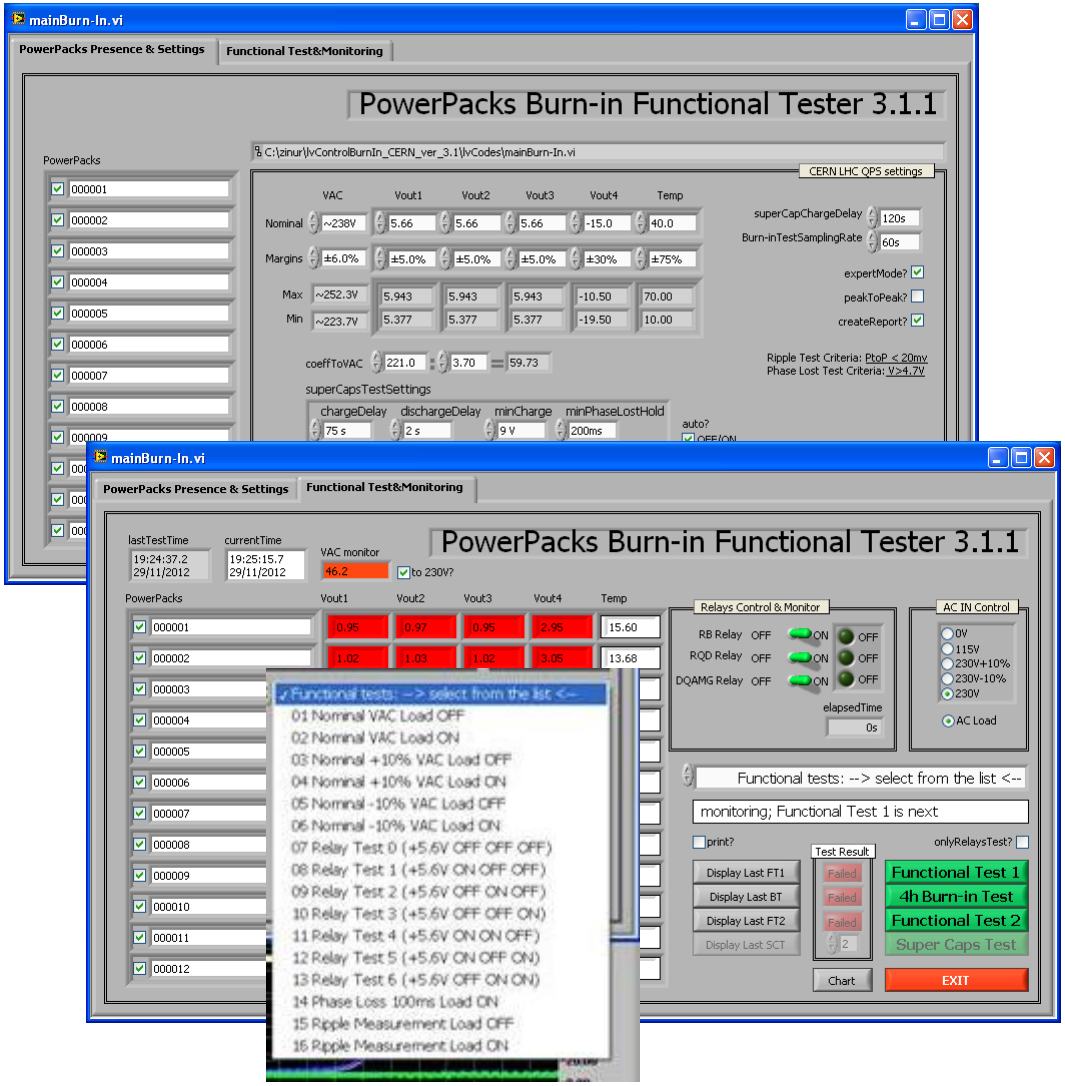
1 Vin + 4 Vout * 12 + 1 Temp * 12 = 61 analog channels

1 Vac * 3 dig_out + 3 relay cntrl dig_out + 3 relay dig_in + 1 load cntrl dig_out = 10 I/O ch

A.Honma, F.Formenti

nQPS Power Pack: NI PCI-6225 + LabView

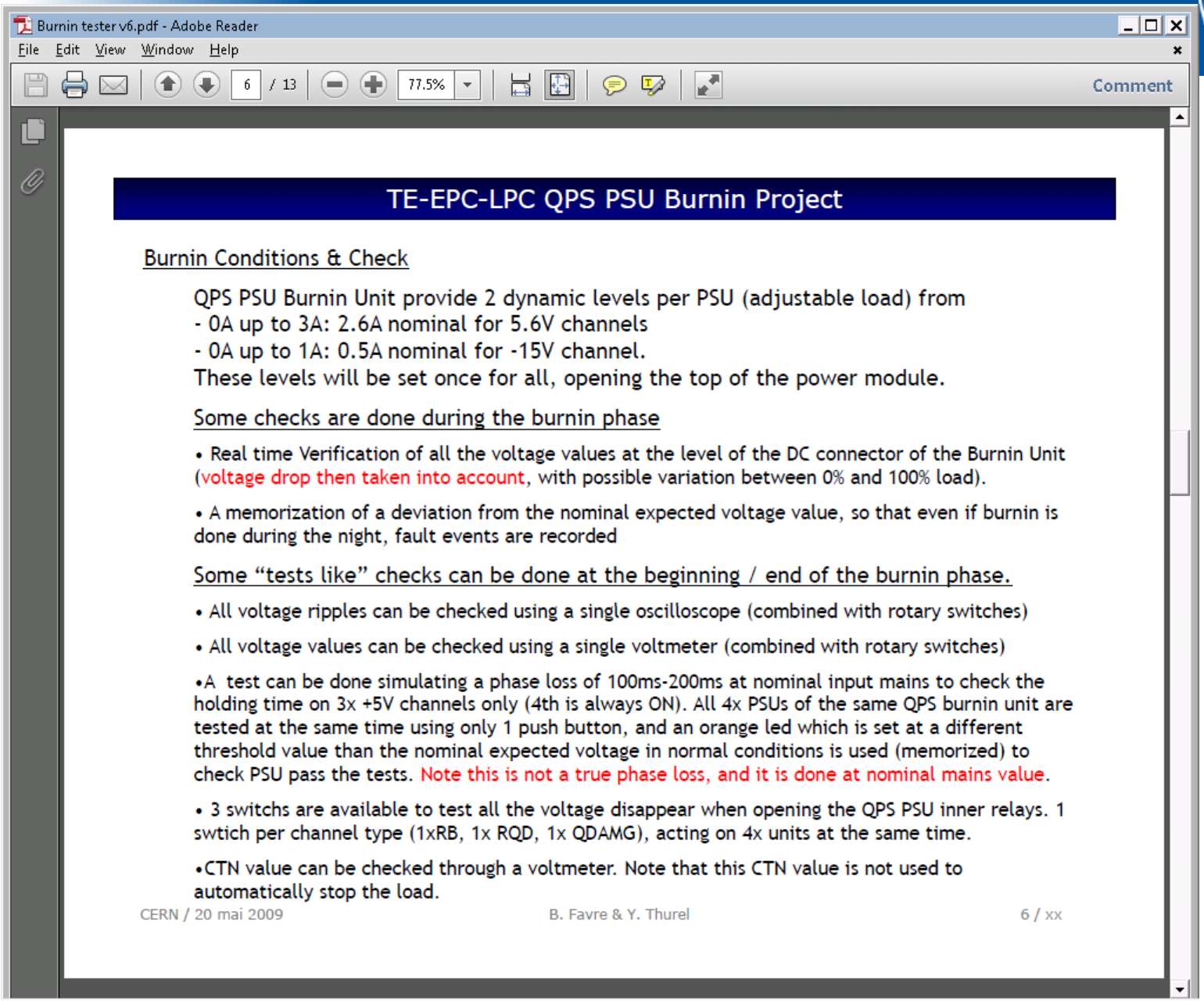
The automated control of the tests, analysis and reporting the test results were done by Labview code through NI PCI-6225 I/O card. All units are passed the Burn-in test with two series of 16 functional tests, before and after the burn-in. During the production two complete test systems (2x12PP) were installed in *Elite* and one at CERN.



Conclusion:

- ✓ The nQPS Power Pack Production Tester, 3xBurn-in Tester + Functional Tester + NI PCI-6225 I/O +Labview, was extremely effective and reliable testing tool in the very strict time frame conditions. It is very well documented!
- ✓ In my opinion, It can be used as a prototype for the Test System of the new iQPS Power Blocks.
- ✓ But, the existing Burn-in Tester and Functional Tester need to be adapted to the new requirements. Either the new type of testers need to be designed and produced.
- ✓ NI PCI-6225 card can handle a testing of 9 iQPS Power Block units in parallel.
- ✓ The LabView code can be easily upgraded to the new configuration. I can make it operational and provide the necessary help to the person who will be responsible for the next support.

Appendix


Burnin tester v6.pdf - Adobe Reader
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Comment
TE-EPC-LPC QPS PSU Burnin Project
Burnin Conditions & Check
QPS PSU Burnin Unit provide 2 dynamic levels per PSU (adjustable load) from
- 0A up to 3A: 2.6A nominal for 5.6V channels
- 0A up to 1A: 0.5A nominal for -15V channel.
These levels will be set once for all, opening the top of the power module.
Some checks are done during the burnin phase
• Real time Verification of all the voltage values at the level of the DC connector of the Burnin Unit (voltage drop then taken into account, with possible variation between 0% and 100% load).
• A memorization of a deviation from the nominal expected voltage value, so that even if burnin is done during the night, fault events are recorded
Some "tests like" checks can be done at the beginning / end of the burnin phase.
• All voltage ripples can be checked using a single oscilloscope (combined with rotary switches)
• All voltage values can be checked using a single voltmeter (combined with rotary switches)
•A test can be done simulating a phase loss of 100ms-200ms at nominal input mains to check the holding time on 3x +5V channels only (4th is always ON). All 4x PSUs of the same QPS burnin unit are tested at the same time using only 1 push button, and an orange led which is set at a different threshold value than the nominal expected voltage in normal conditions is used (memorized) to check PSU pass the tests. Note this is not a true phase loss, and it is done at nominal mains value.
• 3 switchs are available to test all the voltage disappear when opening the QPS PSU inner relays. 1 swtich per channel type (1xRB, 1x RQD, 1x QDAMG), acting on 4x units at the same time.
•CTN value can be checked through a voltmeter. Note that this CTN value is not used to automatically stop the load.
CERN / 20 mai 2009
B. Favre & Y. Thurel
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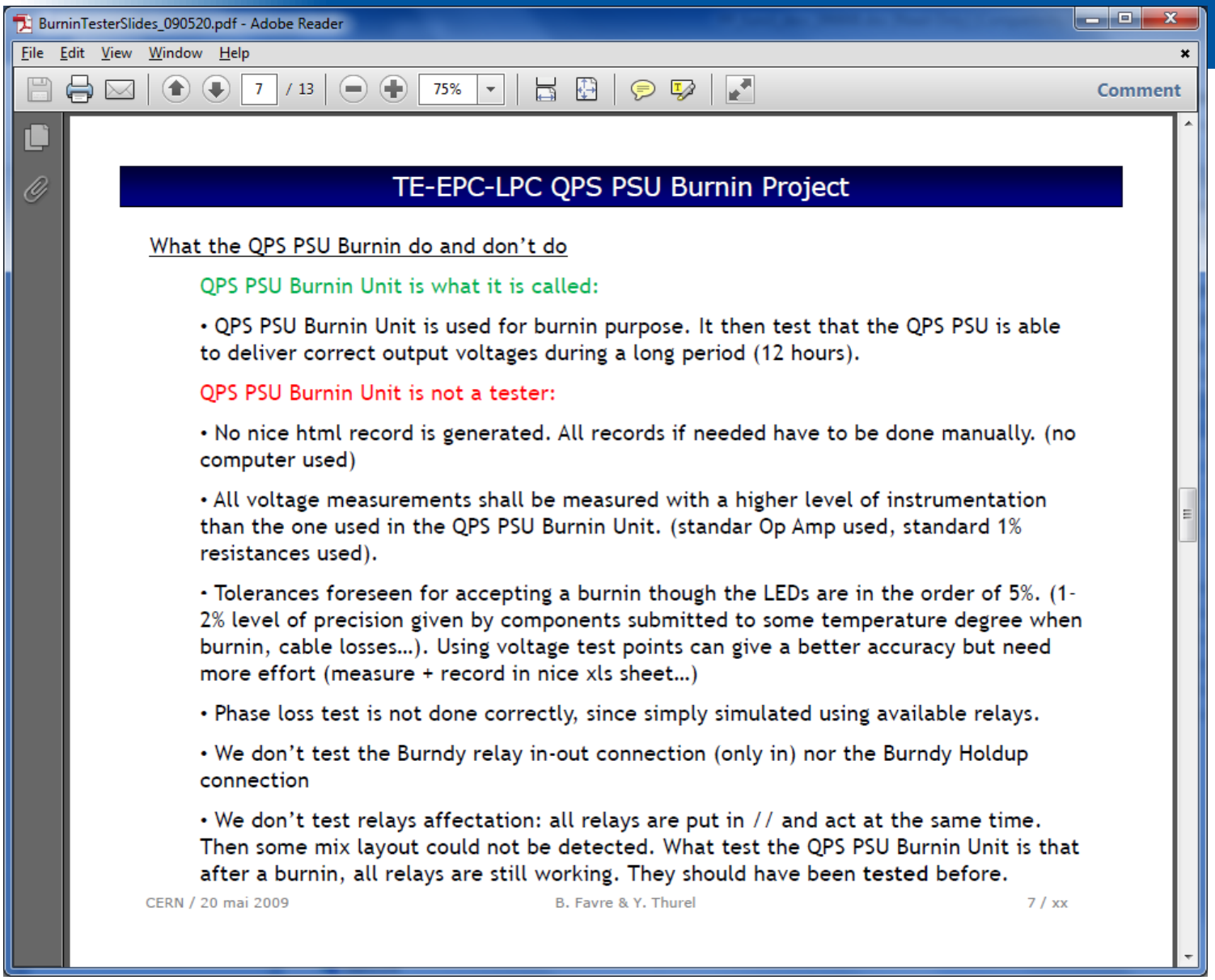
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TE-EPC-LPC QPS PSU Burnin Project
What the QPS PSU Burnin do and don't do
QPS PSU Burnin Unit is what it is called:
• QPS PSU Burnin Unit is used for burnin purpose. It then test that the QPS PSU is able to deliver correct output voltages during a long period (12 hours).
QPS PSU Burnin Unit is not a tester:
• No nice html record is generated. All records if needed have to be done manually. (no computer used)
• All voltage measurements shall be measured with a higher level of instrumentation than the one used in the QPS PSU Burnin Unit. (standar Op Amp used, standard 1% resistances used).
• Tolerances foreseen for accepting a burnin though the LEDs are in the order of 5%. (1-2% level of precision given by components submitted to some temperature degree when burnin, cable losses...). Using voltage test points can give a better accuracy but need more effort (measure + record in nice xls sheet...)
• Phase loss test is not done correctly, since simply simulated using available relays.
• We don't test the Burndy relay in-out connection (only in) nor the Burndy Holdup connection
• We don't test relays affectation: all relays are put in // and act at the same time. Then some mix layout could not be detected. What test the QPS PSU Burnin Unit is that after a burnin, all relays are still working. They should have been tested before.
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