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PSB BEAM CONTROL - TECHNICAL GUIDE

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Geneva, Switzerland
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Contents

Introduction

This guide is intended to the rf specialists of the PS complex. It should provide key data and documents describing the PSB low-level equipment. Nevertheless it will not explain the “raison d’être” of the different parts.

History

Since its running-in period in 1972, the PSB machine was subject to many improvements. The most perceptible in 1983 consisted in the introduction of a second harmonic cavity on each ring. The peak accelerated intensity levelled off from that time at about 3.4 10^{13} protons per pulse (ppp) with all four rings (1.1 10^{13} on ring 2). The introduction of a fast feedback on the cavities in 1985 consolidated the operation, but did not improve the record value.

During the first h=1 run in 1998, the operation was disturbed by the impedance of the vacuum flanges around the ring. The resonances of this flanges gave a total (integrated around the ring) longitudinal coupling impedance of 450 Ohms at 750 kHz [2] which is the rf frequency range at the beginning of the cycle. The return voltage generated by the beam current was coupling to different electronic devices which therefore had to be equipped with common mode rejection circuits. Some coupling between rings remained, implying adjustment of the radial position to avoid beating between cavities near the synchrotron frequency.
After some flanges have been short-circuited [2] during the 1998-99 shutdown the total impedance was lowered to about 200 Ohms (still higher than the maximum value for h=5 which was 130 Ohms). This allowed not considering the frequency beating from one ring to the other and also permitted to reach a new intensity record in September 99: 4.1 10^{13} ppp accelerated with 1.2 10^{13} in ring 2. New RF decoupling flanges were introduced in the 1999-2000 machine shut-down to further reduce the impedance down to less than 20 Ohms (in the working frequency range).

The transition to h=1 permitted to get rid of the coupled bunch mode instabilities (non-existent with a single bunch) and its complex feedback system, as well as Hereward damping system tackling quadrupolar bunch-shape oscillations. This last effect, not formally studied, could well be explained by a criterion given in [3,4] that relates the loss of Landau damping to the beam current. The current threshold, described as proportional to V_{rf}/h, has been improved by a factor 3.3 when moving from h=5 to h=1.
The absence of the quadrupolar loop indirectly permitted an increase of the h=2 versus h=1 voltage ratio limited to 50 % in the ancient system where beam amplitude detection was misled by double peaked bunches.
All these improvements certainly contributed to the record intensity increase.

Another improvement came from the C04 (h=2) cavities. These were obtained from the conversion of the older C08’s that were used as the main h=5 drive cavities. They have more voltage and power margin than the previous C16 cavities used at h=10 and thus run more reliably whenever the phase relationship between h=1 (C02) and h=2 (C04) is critical in terms of power demand from h=2.

In summary, the main advantages of the h=5 to h=1 conversion are:

- Increase of longitudinal acceptance (proportional to $\sqrt{\frac{V_{rf}}{h}}$)
- No need of coupled bunch mode feedback system
- Less longitudinal space charge effect $\Rightarrow$ no need for Hereward damping at present intensities

Cavities

The PSB is composed of four superimposed rings, each having three cavities described in table 1.

Cavity	Frequency range	Maximum voltage	Use (for protons)	Use (for ions)
C02	0.6 → 2 MHz	8 kV	Acceleration on h=1	Acceleration h=4 up to 1.8 MHz (Frev=450 kHz)
C04	1.2 → 3.9 MHz	8 kV	Bunch flattening Bunch splitting (h=1→2) at 1.4 GeV Acceleration on h=2	Acceleration on h=4 from 1.8 MHz (Frev=450 kHz) up to 3.86 MHz (Frev=965 kHz)
C16	5 → 16 MHz	6 kV	Controlled longitudinal blow-up (h=9) near 1.4GeV	None

Table 1: PSB cavities

Beam control typical layout

The present beam control was installed in 1998 within the framework of the harmonic change from h=5 to h=1 and/or 2. Its structure is based on one digital frequency synthesiser per cavity, each digital frequency word being directly derived from the main magnetic field measurement (B to f conversion).
The present architecture is represented in Figure 1.

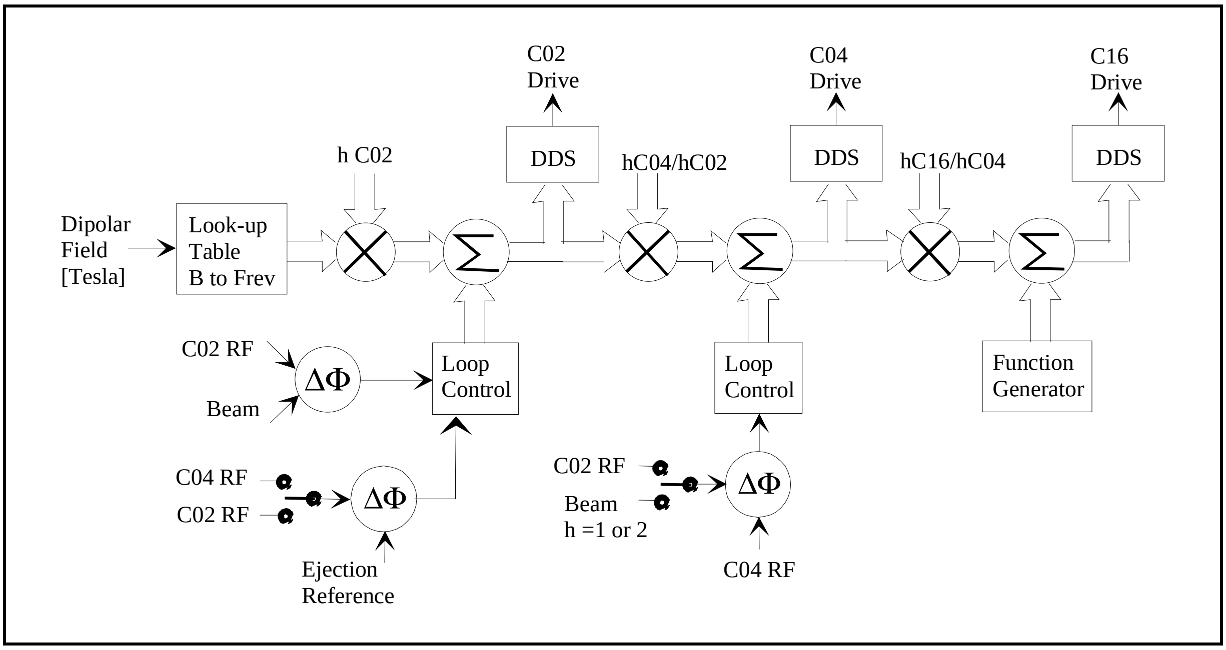


Figure 1 : PS Booster Beam Control basic layout for the acceleration of proton beams

Figure 1 shows that the measured value of the dipolar field ("B-train") is used for generating the frequency words feeding all three cavities.
The revolution frequency (F_{rev}) is obtained from a look-up table (typically a Read Only Memory) and multiplied by the harmonic number aimed for C02 (h=1 for LHC beams). The resulting frequency is summed with the loop (phase and synchronisation) error signals, so as to obtain the actual C02 rf value sent to the cavities via a digital synthesiser.

The same principle applies for C04 and C16 cavities. Moreover, depending on the user, C04 is operated in single or dual harmonic mode. In the former case C04 is working on its own at h=2 (for some proton beams) and in the latter case it is tracking the C02 (h=1) cavity so as to obtain particular bunch shapes to improve for example the bunching factor.

C16 is used as a "controlled blow-up" cavity and so is not used in any loop. Its frequency word is modulated by a function generator. The blow-up principle is similar to the one used in the PS or SPS [1] and consists of a phase modulation (at 3 f_S typ.) of a high harmonic signal (h=9).
It can be noted that when all loops are opened the frequencies are rigidly transmitted to the different cavities that are therefore naturally frequency locked.
This beam control structure has been foreseen for the current operations: h=1 acceleration, dual harmonic (h=1 and 2) acceleration, h=2 acceleration, bunch splitting (h=1 $\rightarrow$ h=2), h=1 with blow-up and finally h=4 (lead ions) acceleration with main drive take-over from C02 to C04.

The main advantages of the digital structure are:

- The look-up-table on the left-hand side of figure 1 sets the RF frequency so as to keep the beam on orbit for any magnetic field. This feature makes it possible to accelerate a beam with all loops open (albeit with some losses and instabilities). In the previous (analogue) version, only the radial loop could establish the required frequency to keep the beam centred but the position detectors were quite hard to run at low intensity beams (e.g. lead ions).

- All cavities are naturally locked in frequency even with loops open; this avoids the presence of an integrating type of corrector in the different phase loops (simplified correctors and more stability margins).

- In the old system, the loss of beam led to saturation of the different loops and erratic behaviour of the frequency and voltage programs necessitating security interlocks, quite heavy to handle, to protect the power equipment. In the new system the loops just need to act on a small frequency range and do not provoke cavity trips.

The actual beam control

Figure 1 was showing a typical architecture. The actual layout for both protons and lead ions beams is described in figures 2 and 3.

On the left end of figures 2 and 3, the main dipolar field is feeding a conversion table (field to revolution frequency). The field is sent in the form of two pulse trains (TBU0.1 and TBD0.1); each pulse representing a 0.1 Gauss increase (Up) or decrease (Down).

The “B Rate Multiplier” is then filtering the pulse train so as to keep only a Q/m (normalised charge over mass) fraction. For protons Q/m = 1.

The look-up table (Digital frequency Program) is converting the B train into a 23 bit frequency word representing the revolution frequency. For the Booster revolution, the weight of the MSB is 1.25 MHz. This value was chosen so as to obtain the best resolution for a maximum revolution frequency of $c/2\pi R$ = 1.91 MHz.

The revolution frequency word needs to be multiplied by the harmonic number “h” used for the C02 cavity (one for the protons, four for the lead ions). This multiplication used to be undertaken by a special unit (Digital Arithmetic Unit), but as the possible h values are power of two, the bits of the parallel word are simply shifted on the multi-wire cable. On the DDS (Direct Digital Synthesiser) the MSB is equal to 10 MHz, so as to perform the h=1 multiplication one has to make a three bit shift towards the LSB. (1.25 MHz/10 MHz = 2^{-3})

After multiplication the revolution word becomes a C02-rf word that is serialised in a “Serial Link”, multiplexed to the different rings and put back to parallel in another “serial Link” unit.

The rf word is then fed into a summing point (Digital Loop Processor) that will add the error signal from the phase, synchro and radial loop and also different possible offsets. The modified rf word is sent into the DDS of C02.
The same architecture is then applied to C04 and C16. C04 can act as a main h = 2 cavity (when C02 is not used) or as bunch-shaping cavity (protons) when used in conjunction with C02. In this mode (the dual harmonic mode) C04 is phase locked with either C02 or the first harmonic of the Beam signal. The first reference is used in the absence of bunched beam and the later when beam is present because it is the only stable position.

PSB low level location

Figure 4 shows the implementation of the PSB rf low-level racks in Building 361.
Figure 5 shows the global layout in a pair of racks used for one ring.
Figure 6 shows the detailed content of the two racks used for every single ring.

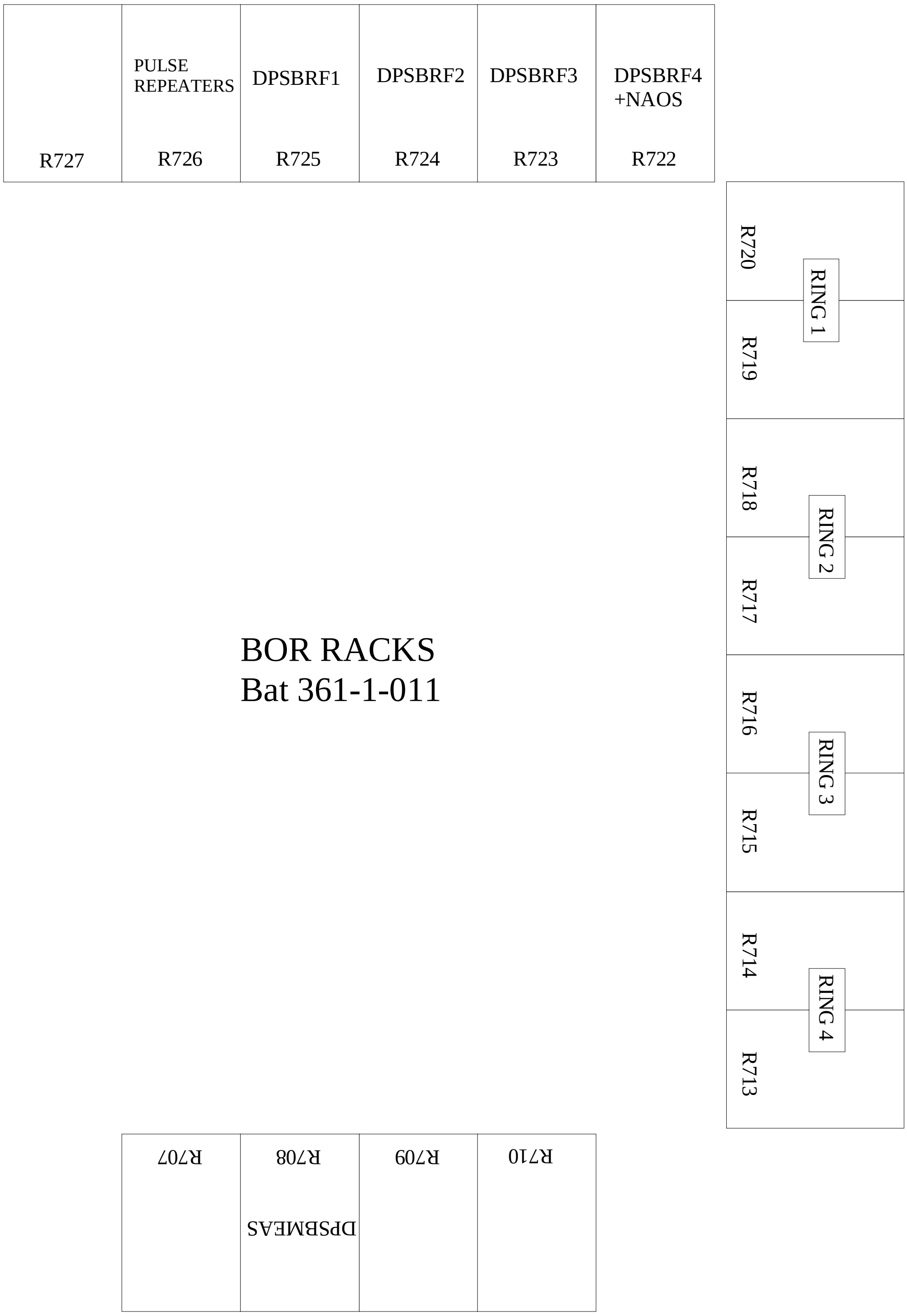


Figure 2 : PSB low-level rack implementation.

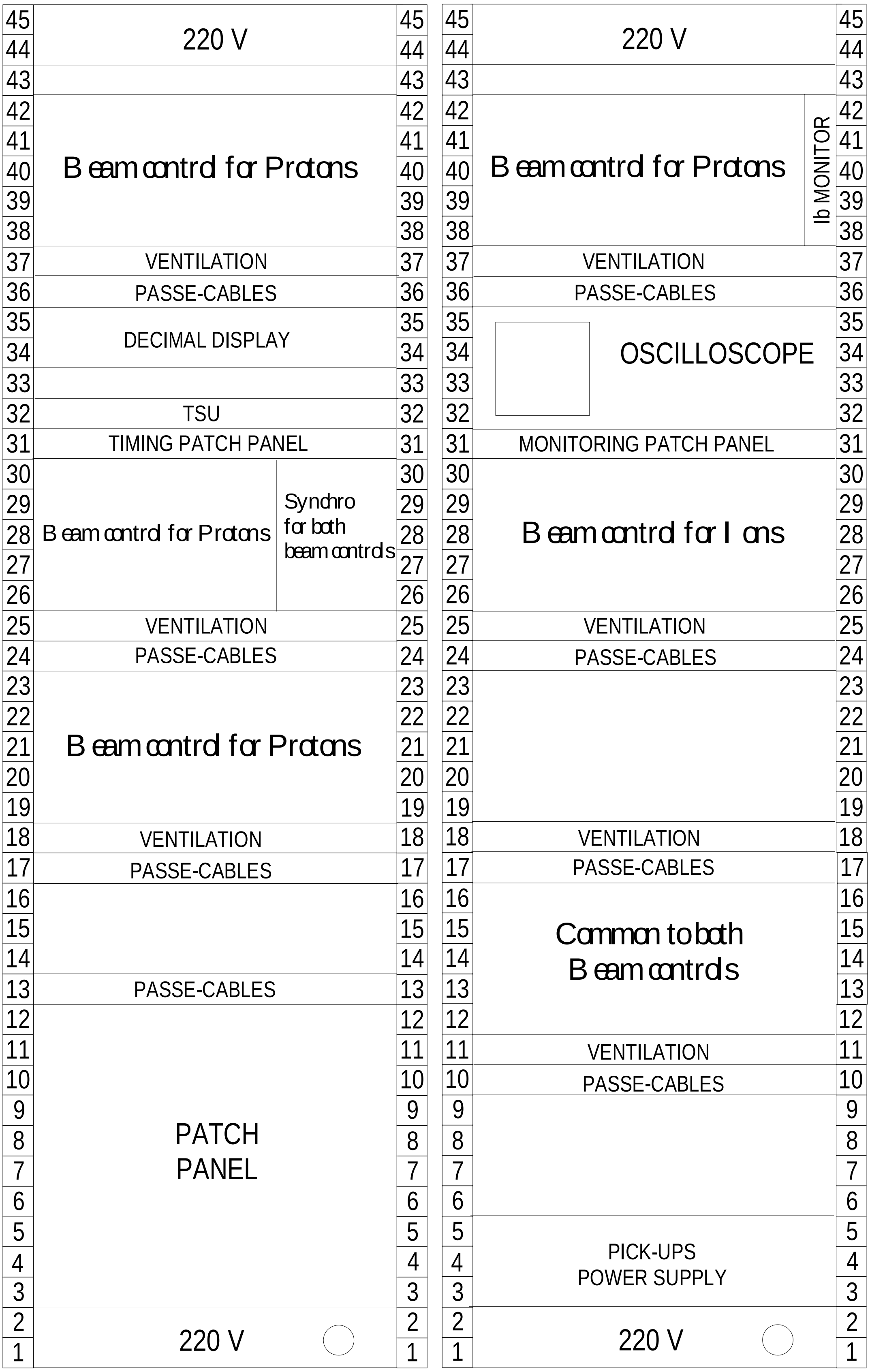


Figure 3 : Global layout of a pair of racks used for one PSB ring

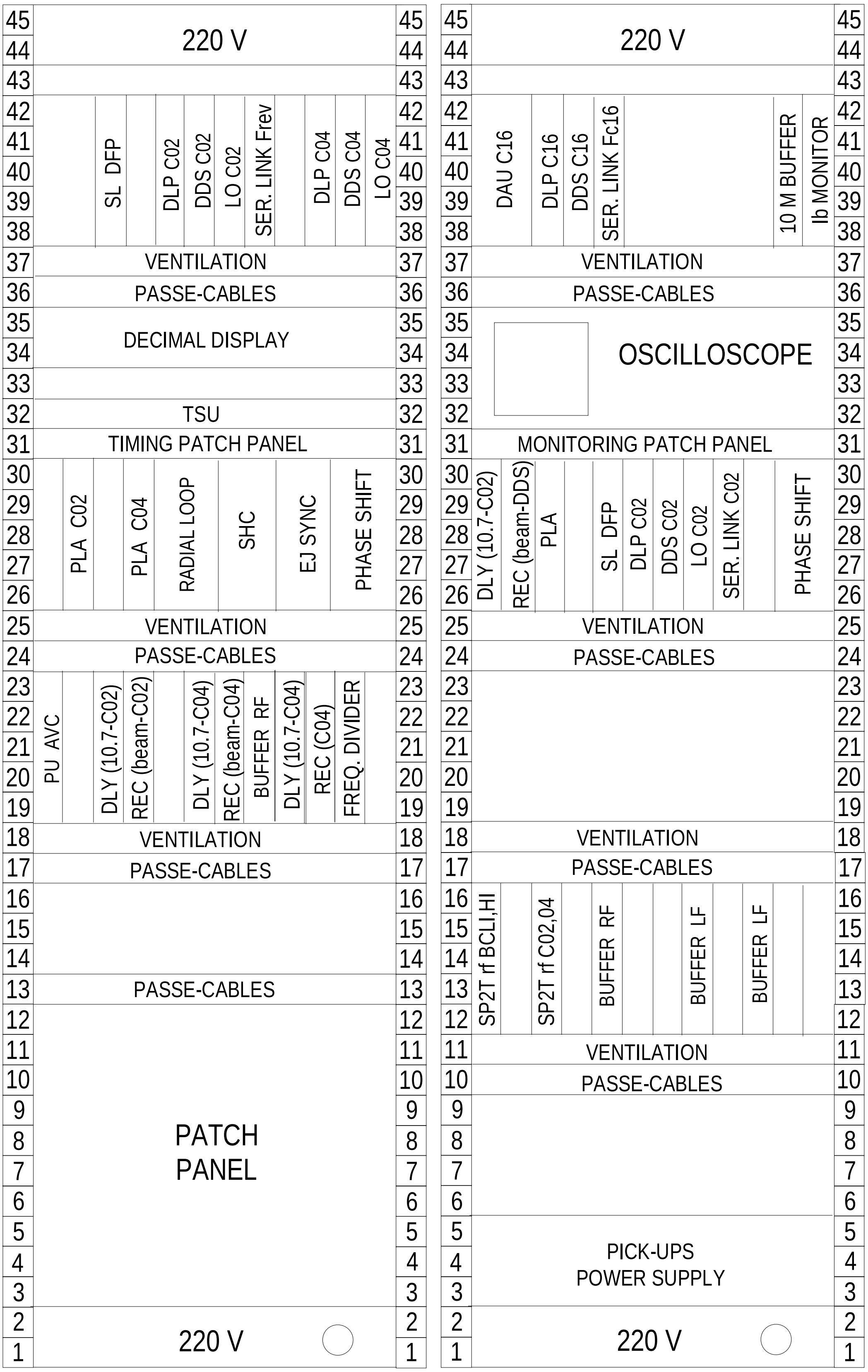


Figure 4 : Detailed layout of a pair of racks used for one PSB ring

Beam Control architecture

Glossary

SYNC: Synchro loop filter
PH SHIFT: Phase shifter
SP2T: Single port-double through
ATT: Attenuator
DEMOD: Delta/sigma demodulator (used to extract the radial position)
RADIAL LOOP: Radial loop filter
PLA: Phase loop amplifier (or filter)
REC: Receiver = mixer + phase discriminator
BRM: B rate multiplier
BTI: B train interface
DFP: Digital Frequency program
SL: Serial link
SPLIT: Digital multiplexer
DLP: Digital loop processor
DDS: Direct digital synthesiser
LO: Local oscillator
DWS: Digital word shifter
MIX: Mixer
DIV BY 2: Frequency divider
DAU: Digital arithmetic unit

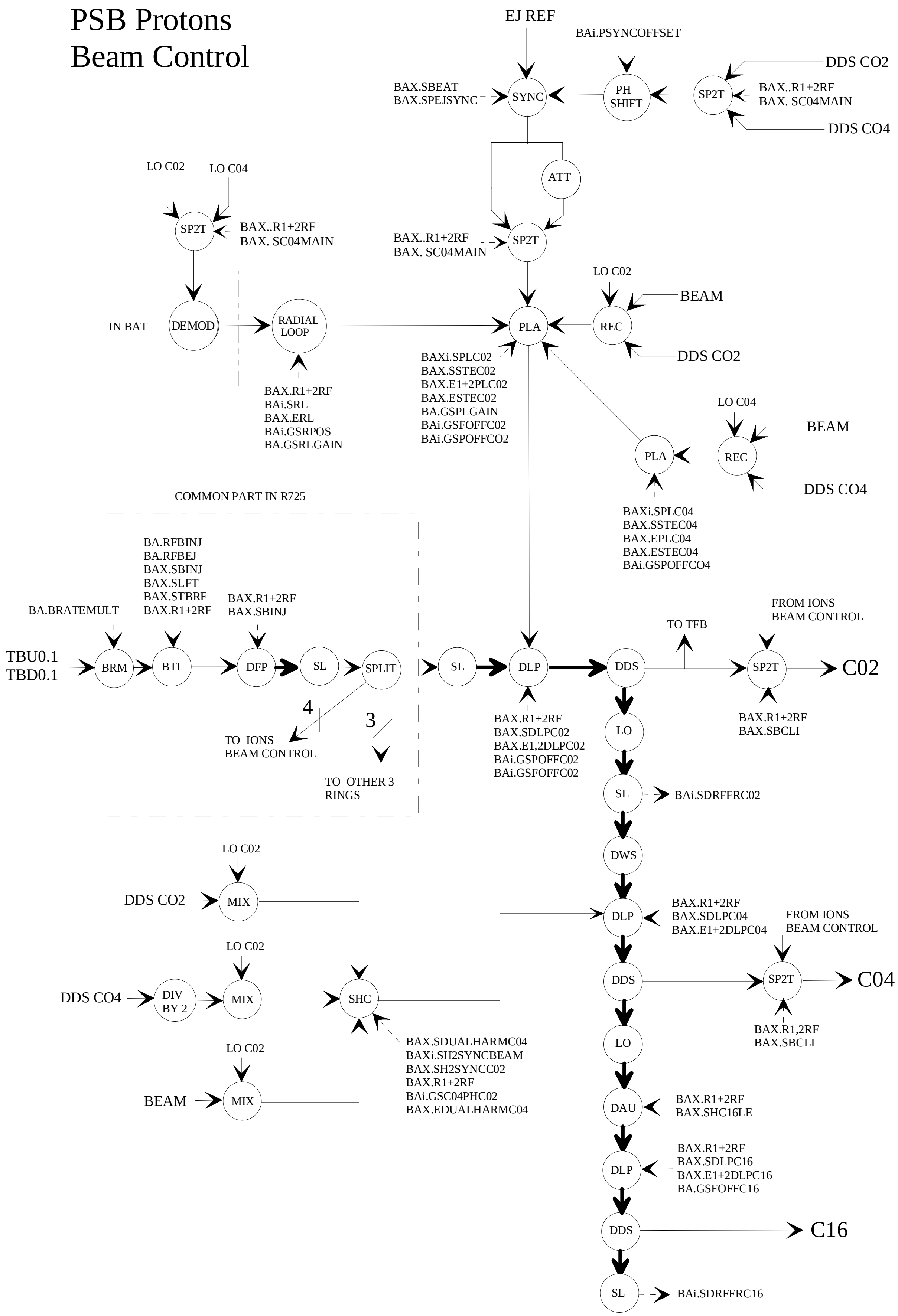


Figure 5 : Actual PSB protons Beam Control

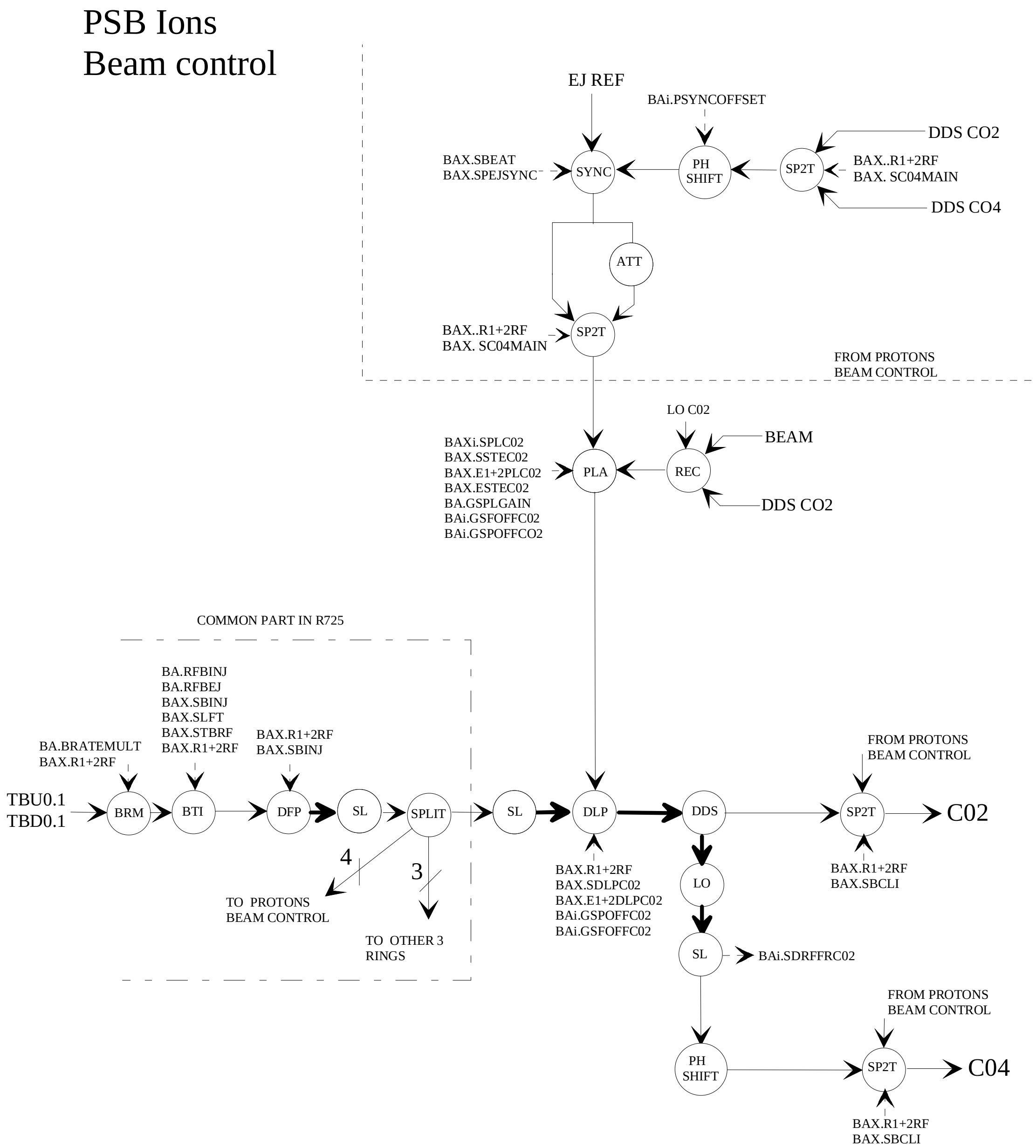
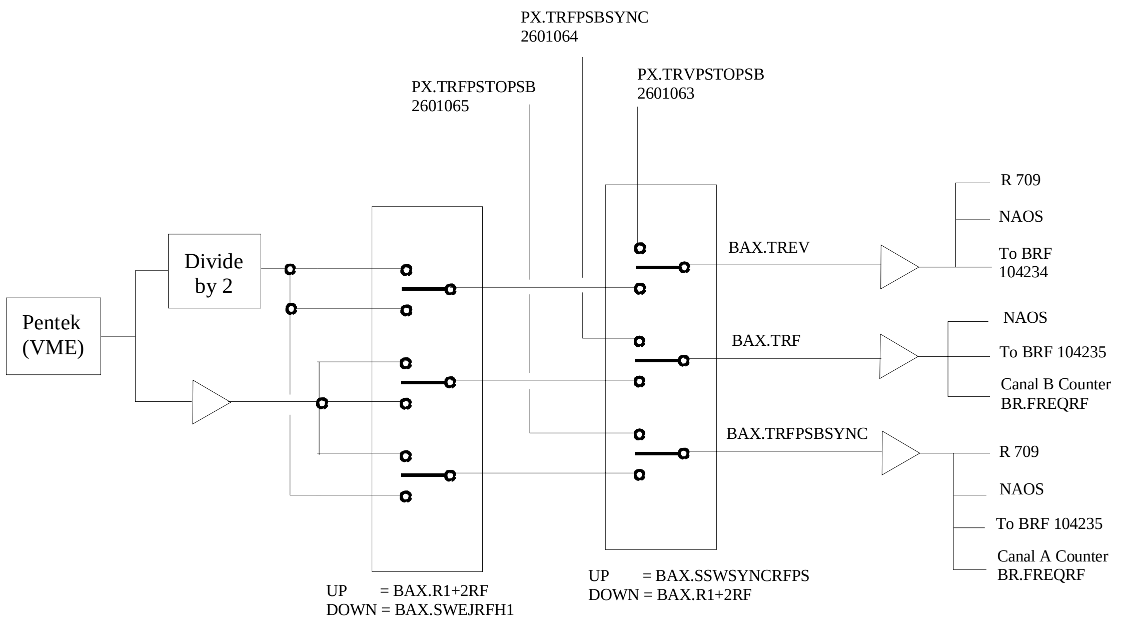
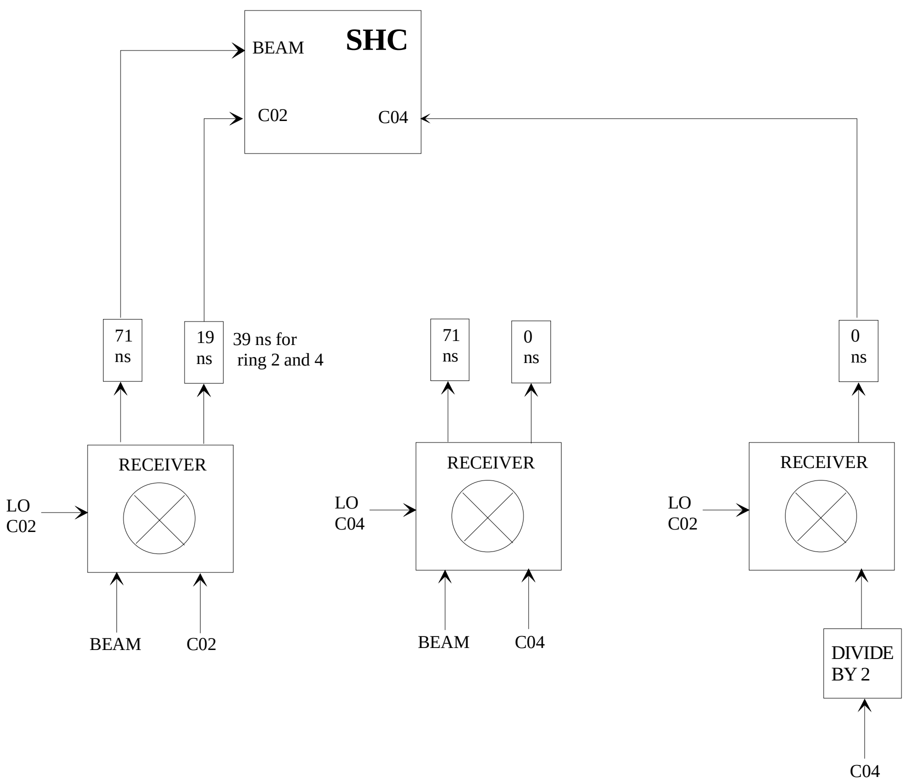


Figure 6 : Actual PSB ions beam control

PSB Synchro



Phase matching at mixers level



Cable lengths

Lengths in [ns]	C02 RING 1	C02 RING 2	C02 RING 3	C02 RING 4	C04 RING 1	C04 RING 2	C04 RING 3	C04 RING 4	C16 RING 1	C16 RING 2	C16 RING 3	C16 RING 4
DDS -> SP2T	16	16	16	16	16	16	16	16				
SP2T -> Patch BOR	10	10	10	10	10	10	10	10				
DDS -> Patch BOR									16	16	16	16
Patch BOR -> Patch BRF	148	148	148	148	156	156	156	165	266	266	258	254
Cable number	2708 499	2708 515	2708 542	2708 546	1088 31	1088 32	1088 33	1088 34	1157 47	1157 57	1157 67	1157 77
Patch BRF -> rf distrib.	51	51	51	51	32	32	32	32	36	36	36	36
rf distri -> AVC	4	4	4	4	4	4	4	4	4	4	4	4
AVC -> Ampli	10	10	10	10								
Ampli -> Patch	51	51	51	51								
AVC -> Filter					10	10	10	10	4	4	4	4
Filter -> Ampli					4	4	4	4	12	12	12	12
Ampli -> Filter					4	4	4	4	4	4	4	4
Filter -> Patch					32	32	32	32	24	24	24	24
Estimated delay in modules	30	30	30	30	40	40	40	40	30	30	30	30
Patch BRF -> Cavity	233	351	233	351	97	97	97	97	148	148	148	148
Cable number	2708 509	2708 525	2708 540	2708 556	1158 95	1159 01	1159 07	1158 63	1054 18	1054 20	1054 22	1054 24
Total DDS -> Cav	553	671	553	671	405	405	405	414	544	544	536	532
Cable to add to equilibrate drives	118	0	118	0	266	266	266	257	127	127	135	139
DDS -> Cav after compensation	671	671	671	671	671	671	671	671	671	671	671	671

Lengths in [ns]	C02 RING 1	C02 RING 2	C02 RING 3	C02 RING 4	C04 RING 1	C04 RING 2	C04 RING 3	C04 RING 4	C16 RING 1	C16 RING 2	C16 RING 3	C16 RING 4
Cav -> Pach BRF	233	351	233	351	97	97	97	97	148	148	148	148
Cable number	2708 505	2708 521	2708 536	2708 552	1158 96	1159 02	1159 08	1159 09	1054 10	1054 12	1054 14	1054 16
Patch BRF -> 4 Way Split	52	52	52	52	32	32	32	32	32	32	32	32
4 WS ->Quad 2 Way Split	8	8	8	8	10	10	10	10	10	10	10	10
Quad 2 Way Split -> AVC	4	4	4	4	4	4	4	4	4	4	4	4
AVC -> Patch BRF	52	52	52	52	32	32	32	32	32	32	32	32
Estimated delay in modules	30	30	30	30	30	30	30	30	30	30	30	30
Patch BRF -> Patch BOR	148	148	148	148	156	148	148	148	266	266	258	254
Cable number	2708 503	2708 519	2708 534	2708 550	2708 501	2708 517	2708 532	2708 548	1157 41	1157 51	1157 61	1157 71
Total Cav -> BOR patch	527	645	527	645	361	353	353	353	522	522	514	510
Cable to add to equilibrate return	118	0	118	0	284	292	292	292	123	123	131	135
Cav -> BOR after compensation	645	645	645	645	645	645	645	645	645	645	645	645
Total DDS -> Cav -> BOR	1316	1316	1316	1316	1316	1316	1316	1316	1316	1316	1316	1316
Beam Pick-ups cable length [ns]	275	275	275	275	275	275	275	275	275	275	275	275
Cable to add to PU to equilibrate	370	370	370	370	370	370	370	370	370	370	370	370
Wideband PU cable length	211	211	211	211	211	211	211	211	211	211	211	211

Key elements positioning

Element	Position in ring	Phase lag w.r.t. injection point (1L1)	Delay at 10.7 MHz to obtain the phase lag
C02 ring 1 and 3	10L1	225^o	58 ns
C02 ring 2 and 4	7L1	157.5^o	41 ns
C04	13L1	292.5^o	76 ns
C16	5L1	112.5^o	29 ns
Wide Band PU	8L1	180^o	47 ns
Active X1 PU	5L1	112.5^o	29 ns
Active X1 PU (spare)	14L4	330^o	86 ns
Active X10 PU	8L1	180^o	47 ns
Passive PU	1L5	18.75^o	5 ns
Passive PU	11L2	255^0	66 ns

RF working sets

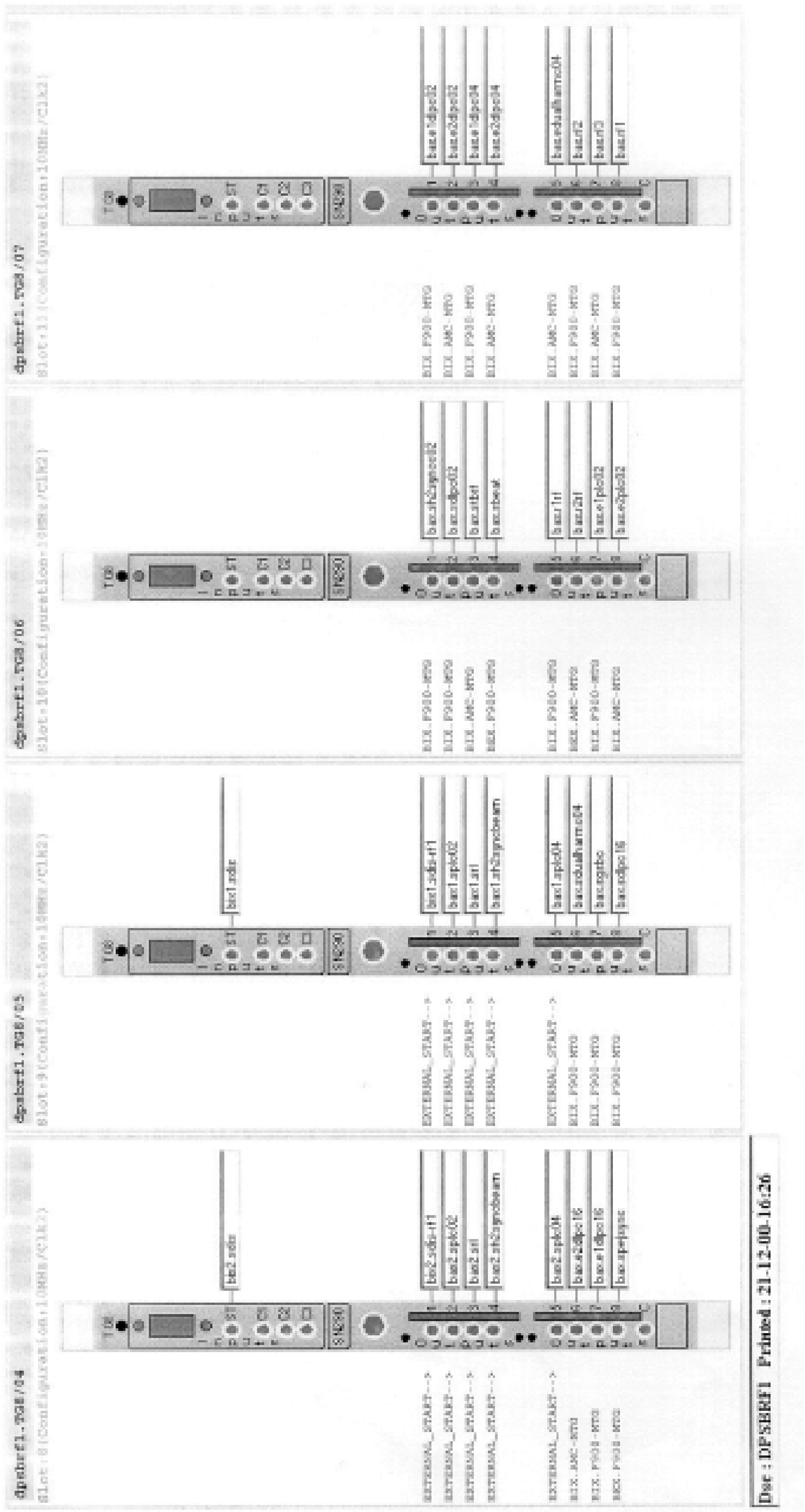
RF GLOBAL CONTROL	Comments
BA.GSRLGAIN	Radial loop gain
BA.GSFOFFC16	Frequency offset C16
BA.GSPLGAIN	C02 Phase loop gain
BA.GSMFS	Synchrotron frequency times m program used by ‘mode analyser’
BA.GSMFS20K	Synchrotron frequency times m + 20 kHz program used by ‘mode analyser’
BA.GSSTABLEP	Stable Phase used by PLA C02 and 2^{nd} harmonic corrector
BA.BRATEMULT	Gives the Q/m value referenced to protons
BAX.R1RF	Resets the beam control at the beginning of the cycle
BAX.R2RF	Resets the beam control after the end of the cycle
BAX.SBCLI	Start Beam Control Low Intensity
BAX.SHC16LE	Start Harmonic number for C16 when used at Low energy
BAX.SHGAIN	Start High Gain , sets the pick-up amplifier gain to the high value (used for low intensities)
BAX.SBINJ	Start to send dummy B train INJection value to beam control, used by BTI unit
BAX.STBRF	Start to send measured B Train to beam control (when beam captured)
BAX.SH2SYNCC02	Start to SYNChronise H2 cavity (C04) with C02 signal (DDS or Gap)
BAX.E1DLPC02	Disables any correction on the C02 frequency program (C02 in open loop mode). For use in the first part of the cycle.
BAX.E2DLPC02	Disables any correction on the C02 frequency program (C02 in open loop mode). For use after BAX.E1DLPC02
BAX.E1DLPC04	Disables any correction on the C04 frequency program (C02 in open loop mode). For use in the first part of the cycle.
BAX.E2DLPC04	Disables any correction on the C04 frequency program (C02 in open loop mode). For use after BAX.E1DLPC04
BAX.E1DLPC16	Disables any correction on the C16 frequency program (C02 in open loop mode). For use in the first part of the cycle.

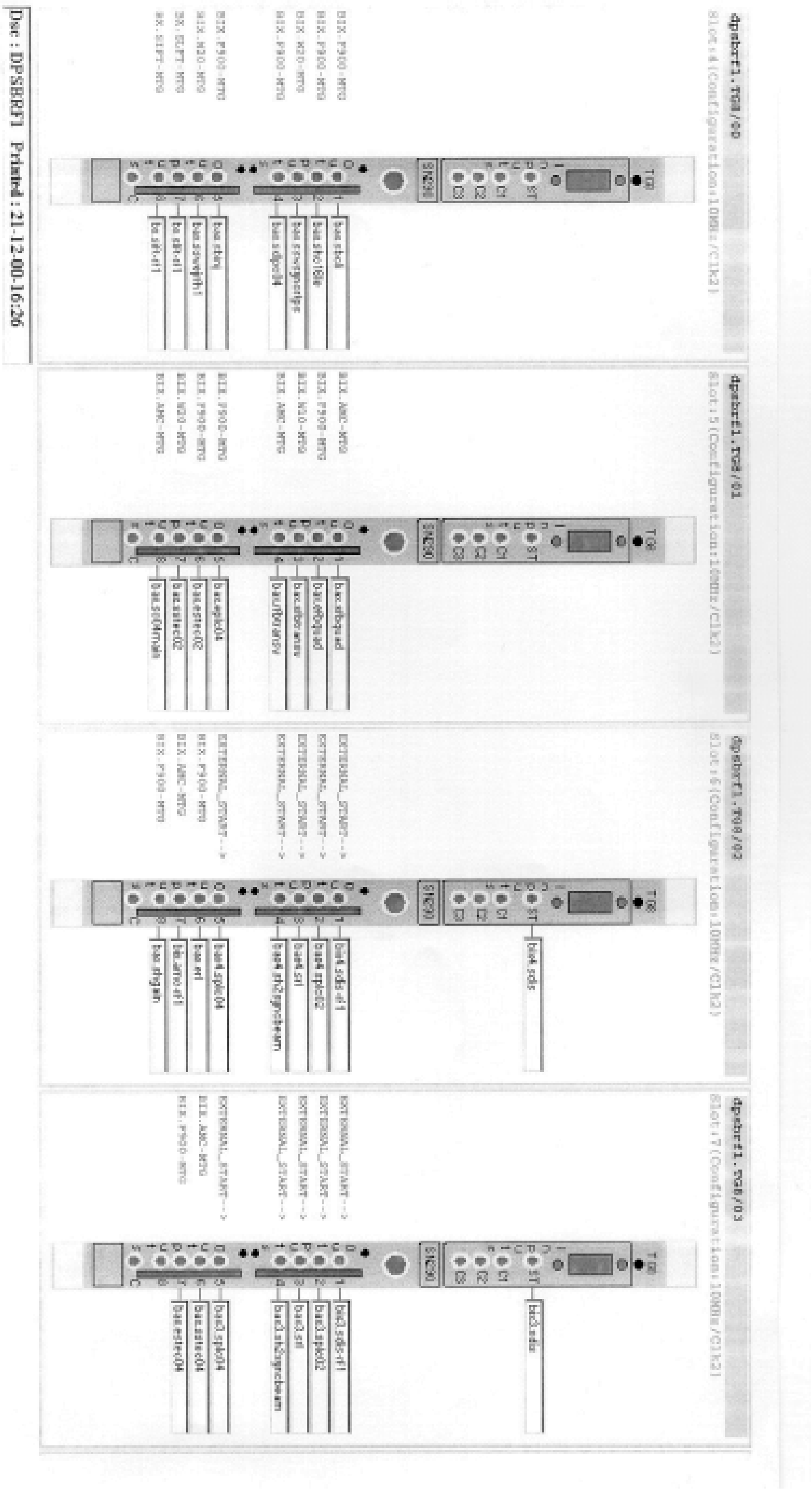
BAX.E2DLPC16	Disables any correction on the C16 frequency program (C02 in open loop mode). For use after BAX.E1DLPC04
BAX.SDLPC02	Start DLP of C02. Enables the action the different loops and frequency offsets on C02
BAX.SDLPC04	Start DLP of C04. Enables the action the different loops and frequency offsets on C04
BAX.SDLPC16	Start DLP of C16. Enables the action the different loops and frequency offsets on C16
BAX.E1PLC02	End Phase Loop C02
BAX.E2PLC02	End Phase Loop C02, to be used after BAX.E1PLC02
EPLC04	End Phase Loop C04
ESTEC02	End STEering input for C02; disables, at the PLA level, the radial loop, BAi.GSFOFFC02 and the output of the PLA for C04.
SSTEC02	Start STEering input for C02; enables, at the PLA level, the radial loop, BAi.GSFOFFC02 and the output of the PLA for C04.
ESTEC04	End STEering input for C04; disables, at the PLA level, the steering inputs (not used at the moment.
SSTEC04	Start STEering input for C04; enables, at the PLA level, the steering inputs (not used at the moment).
BAX.ERL	End Radial Loop
BAX.EDUALHARMC04	End DUAL HARMonic mode for C04. Disables the output of the SHC progressively (1ms rise time)
BAX.SDUALHARMC04	Start DUAL HARMonic mode for C04. Enables the output of the SHC progressively (1ms rise time)
BAX.EFBQUAD	End QUADripolar FeedBack (not used yet)
BAX.SFBQUAD	Start QUADripolar FeedBack (not used yet)
BAX.RFBTRANSV	Reset TRANSverse FeedBack
BAX.SFBTRANSV	Start TRANSverse FeedBack
BAX.SGSBC	Start GFAS Beam Control
BAX.SC04MAIN	Start C04 as the MAIN cavity (in mono mode operation). Switches the rf source on the synchro loop and on the Radial PU from C02 to C04.
BX.SCY-RF1	Start Cycle. Corresponds to the C0 timing
BIX.AMC-RF1	
BX.SIFT-RF1	Start Intermediate Flat Top (no such cycle used yet)
BX.SLFT-RF1	Start Last Flat Top
BX.EGS-RF2	End GFAS
BAX.RF1	Spare pulse
BAX.RF2	Spare pulse
BAX.RF3	Spare pulse

RF RING i	Comments
BIXi.SDIS-RF1	Start DIStributor (corresponds to the injection in the selected ring)
BAXi.SH2SYNCBEAM	Start SYNChronise H2 with respect to BEAM. Has to be set as soon as the beam starts to be bunched during capture
BAXi.SPLC02	Start Phase Loop C02. . Has to be set as soon as the beam starts to be bunched during capture
BAXi.SPLC04	Start Phase Loop C04. Has to be set as soon as the beam starts to be bunched during capture with C04 in mono mode operation.
BAXi.SRL	Start Radial Loop. Should come when bucket area is bigger than bunch area to allow acceleration and bucket reduction.
BAi.GSVRFC02	RF Voltage program for C02
BAi.GSVRFC04	RF Voltage program for C04
BAi.GSVRFC16	RF Voltage program for C16
BAi.GSPOFFC02	Phase OFFset for C02 (critical when switching phase loop ON or OFF)
BAi.GSPOFFC04	Phase OFFset for C04 (critical when switching phase loop ON or OFF)
BAi.GSC04PHC02	PHase program of C04 with respect to C02
BAi.GSRPOS	Radial POSition offset
BAI.GSFOFFC02	Frequency OFFset for C02

RF Synchro	Comments
BAi.PSYNCOFFSET	SYNChro Phase OFFSET acts on a phase shifter and shifts the beam with respect to extraction reference
BA.EJREFFREQ	EJection REFerence FREQuency acts on a VME frequency synthesiser (Pentek) and gives the local h = 2 reference
BR.FREQRF	Measures the frequency of the rf sent to the extraction timing (EJTIMRF) and of the rf sent to the beam control (EJRFREF)
BAX.SSWEJRFH1	Start SWitch EJection RF H1. Feeds the local ejection reference with the h=1 signal.
BAX.SBEAT	Starts the BEATing process prior to enable synchronisation
BAX.SPEJSYNC	Start Phase EJection SYNChro.
BAX.SSWSYNCRFPS	Start SWitch SYNChro RF PS. Allows the PS signals to be the references for extraction.
BAX.SHGAIN	Start High GAIN. Allows the amplification of the pick-up signal for low intensity beams.

TG8's (Timing source)




dpsbrf1.TG8/00
Slot:4(Configuration:10MHz/Clk2)
dpsbrf1.TG8/01
Slot:5(Configuration:10MHz/Clk2)
dpsbrf1.TG8/02
Slot:6(Configuration:10MHz/Clk2)
dpsbrf1.TG8/03
Slot:7(Configuration:10MHz/Clk2)
Dsc : DPSBRF1 Printed : 21-12-00-16:26

GFAS

GFAS NAME	VME Slots	START	STOP	EV START	EV STOP	DSC
BA1.GSVRFC02	4 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSVRFC02	4 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSVRFC02	12 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSVRFC02	12 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSVRFC04	5 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSVRFC04	5 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSVRFC04	13 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSVRFC04	13 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSVRFC16	6 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSVRFC16	6 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSVRFC16	14 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSVRFC16	14 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSPOFFC02	7 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSPOFFC02	7 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSPOFFC02	15 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSPOFFC02	15 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSPOFFC04	8 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSPOFFC04	8 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSPOFFC04	16 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSPOFFC04	16 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSC04PHC02	9 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA2.GSC04PHC02	9 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA3.GSC04PHC02	17 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA4.GSC04PHC02	17 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSRPOS	10 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA1.GSRPOS	10 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2
BA1.GSRPOS	18 Top	BAX.SGSBC	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA1.GSRPOS	18 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA1.GSFOFFC02	11 Top	BAX.SGSBC	BAX.R1+2RF	BAX1.SDIS		DPSBRF2
BA1.GSFOFFC02	11 Bottom	BAX.SGSBC	BAX.R1+2RF	BAX2.SDIS		DPSBRF2

BA1.GSFOFFC02	19 Top	BAX.SGSB C	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA1.GSFOFFC02	19 Bottom	BAX.SGSB C	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA.GSRLGAIN	20 Top	BAX.SGSB C	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA.GSFOFFC16	20 Bottom	BAX.SGSB C	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA.GSPLGAIN	21 Top	BAX.SGSB C	BAX.R1+2RF	BAX3.SDIS		DPSBRF2
BA.GSSTABLEP	21 Bottom	BAX.SGSB C	BAX.R1+2RF	BAX4.SDIS		DPSBRF2
BA.GSMFS		BAX.SGSB C		BIX.AMC-MEAS		DPSBMEAS
BA.GSMFS20K		BAX.SGSB C		BIX.AMC-MEAS		DPSBMEAS

Patch panel layout

LOCATION	CABLE	FUNCTION	ORIGIN	DESTINATION	Comments
R714/P1/1	#115793	VRFD_C02_R4	BRF1/801		
R714/P1/2	#115792	VRFD_C04_R4	BRF1/801		
R714/P1/3	#115774	VRFD_C16_R4	BRF2/910		
R714/P1/4	#2708607	GRID_PH_CO2_R4	BRF1/801		
R714/P1/5	#2708608	GRID_PH_CO4_R4	BRF1/801		
R714/P1/6	#115772	GRID_PH_C16_R4	BRF2/910		
R714/P1/7	#2708545	Ik_C02_R4	BRF1/801		
R714/P1/8	#115794	Ik_C04_R4	BRF1/801		
R714/P1/9	#115773	Ik_C16_R4	BRF2/910		
R714/P1/10	#2708549	C02_RF_GAP_R4	BRF1/801		
R714/P1/11	#2708551	C04_RF_GAP_R4	BRF1/801		
R714/P1/12	#115778	C16_RF_GAP_R4	BRF2/910		
R714/P1/13	#2708550	C02_RF_GAP_AVC_R4	BRF1/801		0 ns added
R714/P1/14	#2708548	C04_RF_GAP_AVC_R4	BRF1/801		290 ns added
R714/P1/15	#115771	C16_RF_GAP_AVC_R4	BRF2/910		130 ns added
R714/P1/16	#2708547	C02_VRF_R4		BRF1/801	
R714/P1/17	#108840	C04_VRF_R4		BRF1/801	
R714/P1/18	#115776	C16_VRF_R4		BRF2/910	
R714/P1/19	#2708546	C02_RF_DRIVE_R4		BRF1/801	0 ns added
R714/P1/20	#108834	C04_RF_DRIVE_R4		BRF1/801	260 ns added
R714/P1/21	#115777	C16_RF_DRIVE_R4		BRF2/910	130 ns added
R714/P1/22					
R714/P1/23	Lemo 00	BA4.VRFDC02_NAOS		R722/P4/1	
R714/P1/24	Lemo 00	BA4.VRFDC04_NAOS		R722/P4/2	
R714/P1/25	Lemo 00	BA4.VRFDC16_NAOS		R722/P4/3	
R714/P1/26	Lemo 00	BA4.C02PHBEAM_NAOS		R722/P4/4	
R714/P1/27	Lemo 00	BA4.C04PHBEAM_NAOS		R722/P4/5	
R714/P1/28	Lemo 00	BA4.C04PHC02_NAOS		R722/P4/6	
R714/P1/29	Lemo 00	BA4.BEAMPHSYREF_NAOS		R722/P4/7	
R714/P1/30	Lemo 00	BA4.RPOS_NAOS		R722/P4/8	
R714/P1/31	Lemo 00	BA4.FBQUADERROR_NAOS		R722/P4/9	
R714/P1/32	Lemo 00	BA4.FREV_NAOS		R722/P4/10	
R714/P1/33	Lemo 00	BA4.CO2PHGRID_NAOS		R722/P4/11	
R714/P1/34	Lemo 00	BA4.CO4PHGRID_NAOS		R722/P4/12	
R714/P1/35	Lemo 00	BA4.C16PHGRID_NAOS		R722/P4/13	
R714/P1/36	Lemo 00	BA4.IKC02_NAOS		R722/P4/14	
R714/P1/37	Lemo 00	BA4.IKC04_NAOS		R722/P4/15	
R714/P1/38	Lemo 00	BA4.IKC16_NAOS		R722/P4/16	
R714/P1/39					
R714/P1/40					
R714/P1/41	Lemo 00	BA4.GSVRFC02			
R714/P1/42	Lemo 00	BA4.GSVRFC04	R723/GFAS		
R714/P1/43	Lemo 00	BA4.GSVRFC16	R723/GFAS		
R714/P1/44	Lemo 00	BA4.GSPOFFC02	R723/GFAS		
R714/P1/45	Lemo 00	BA4.GSPOFFC04	R723/GFAS		
R714/P1/46	Lemo 00	BA4.GSC04PHC02			
R714/P1/47	Lemo 00	BA4.GSFOFFC02			
R714/P1/48	Lemo 00	BA4.GSFOFFC16			
R714/P1/49					
R714/P1/50					
R714/P1/51					
R714/P1/52					
R714/P1/53					
R714/P1/54	Lemo 00	BAX.R1+2+INH_RF	R725 / PR		
R714/P1/55	Lemo 00	BAX.SBCLI	R725 / PR		
R714/P1/56	Lemo 00	BAX.SHC16LE	R725 / PR		
R714/P1/57	Lemo 00	BAX.SC04MAIN	R725 / PR		
R714/P1/58	Lemo 00	BAX.SHGAIN	R725 / PR		
R714/P1/59	Lemo 00		R725 / PR		
R714/P1/60	Lemo 00	BIX4.SDIS-RF1	R725 / PR		
R714/P1/61	Lemo 00	BAX.SH2SYNCC02	R725 / PR		
R714/P1/62	Lemo 00	BAX4.SH2SYNCBEAM	R725 / PR		
R714/P1/63	Lemo 00	BAX.E1+2DLPC02	R725 / PR		
R714/P1/64	Lemo 00	BAX.SDLPC02	R725 / PR		
R714/P1/65	Lemo 00	BAX.E1+2DLPC04	R725 / PR		
R714/P1/66	Lemo 00	BAX.SDLPC04	R725 / PR		

R714/P1/67	Lemo 00	BAX.E1+2PLC02	R725 / PR		
R714/P1/68	Lemo 00	BAX4.SPLC02	R725 / PR		
R714/P1/69	Lemo 00	BAX.EPLC04	R725 / PR		
R714/P1/70	Lemo 00	BAX4.SPLC04	R725 / PR		
R714/P1/71	Lemo 00	BAX.ESTEC02	R725 / PR		
R714/P1/72	Lemo 00	BAX.SSTEC02	R725 / PR		
R714/P1/73	Lemo 00	BAX.ESTEC04	R725 / PR		
R714/P1/74	Lemo 00	BAX.SSTEC04	R725 / PR		
R714/P1/75	Lemo 00	BAX.ERL	R725 / PR		
R714/P1/76	Lemo 00	BAX4.SRL	R725 / PR		
R714/P1/77	Lemo 00	BAX.E1+2DLPC16	R725 / PR		
R714/P1/78	Lemo 00	BAX.SDLPC16	R725 / PR		
R714/P1/79	Lemo 00	BAX.EDUALHARMC04	R725 / PR		
R714/P1/80	Lemo 00	BAX.SDUALHARMC04	R725 / PR		
R714/P1/81	Lemo 00	BAX.SBEAT	R725 / PR		
R714/P1/82	Lemo 00	BAX.SPEJSYNC	R725 / PR		
R714/P1/83	Lemo 00	BAX.EFBQUAD	R725 / PR		
R714/P1/84	Lemo 00	BAX.SFBQUAD	R725 / PR		
R714/P1/85	Lemo 00	BX.SLFT-RF1	R725 / PR		for monitoring
R714/P1/86	Lemo 00	BX.SIFT-RF1	R725 / PR		for monitoring
R714/P1/87	Lemo 00		R725 / PR		
R714/P1/88	Lemo 00	BEX.SEJ	R725 / PR		for monitoring
R714/P1/89	Lemo 00	BAX.RF1	R725 / PR		For test
R714/P1/90	Lemo 00	BAX.RF2	R725 / PR		For test
R714/P1/91	Lemo 00	BAX.RF3	R725 / PR		For test
R714/P1/92					
R714/P1/93					
R714/P1/94					
R714/P1/95					
R714/P1/96					
R714/P1/97	#104653	RAD_POS_4_R4	BAT21/P1/37		in A (7) RAD. LOOP
R714/P1/98	#104669	RAD_POS_6_R4	BAT31/P1/37		in B (8) RAD. LOOP
R714/P1/99	#104687	RAD_POS_12_R4	BAT65/P1/37		in C (9) RAD. LOOP
R714/P1/100	#104703	RAD_POS_14_R4	BCR533/P1/3 7		in D (10) RAD. LOOP
R714/P1/101	#104652	PU_SYGMA_4_R4	BAT21/P1/33		
R714/P1/102	#104670	PU_SYGMA_6_R4	BAT31/P1/33		
R714/P1/103	#104686	PU_SYGMA_12_R4	BAT65/P1/33		
R714/P1/104	#104655	LO_RF_R4		BAT21/P1/29	
R714/P1/105	#104671	LO_RF_R4		BAT31/P1/29	
R714/P1/106	#104689	LO_RF_R4		BAT65/P1/29	
R714/P1/107	#104705	LO_RF_R4		BCR533/P1/29	
R714/P1/108					
R714/P1/109	Lemo 00	REV_RF_R4		R709/P2/28	
R714/P1/110	Lemo 00	RF_C02_R4		R709/P2/15	
R714/P1/111	Lemo 00	RF_C04_R4		R709/P2/19	
R714/P1/112	Lemo 00	RF_C16_R4		R709/P2/23	
R714/P1/113					
R714/P1/114					
R714/P1/115					
R714/P1/116	Lemo 00	10 MHz	R 724		
R714/P1/117	Lemo 00	RF_REF_EJ	R723/P2/14		
R714/P1/118					
R714/P1/119					
R714/P1/120	Lemo 00	REV_RF_R4		BAT via R725	Transv. FB
R714/P1/121					

LOCATION	CABLE	FUNCTION	ORIGIN	DESTINATION	Comments
R716/P1/1	#115789	VRFD_C02_R3	BRF1/801		
R716/P1/2	#115788	VRFD_C04_R3	BRF1/801		
R716/P1/3	#115764	VRFD_C16_R3	BRF2/910		
R716/P1/4	#2708605	GRID_PH_CO2_R3	BRF1/801		
R716/P1/5	#2708606	GRID_PH_CO4_R3	BRF1/801		
R716/P1/6	#115762	GRID_PH_C16_R3	BRF2/910		
R716/P1/7	#2708530	Ik_C02_R3	BRF1/801		
R716/P1/8	#115790	Ik_C04_R3	BRF1/801		
R716/P1/9	#115763	Ik_C16_R3	BRF2/910		
R716/P1/10	#2708533	C02_RF_GAP_R3	BRF1/801		
R716/P1/11	#2708535	C04_RF_GAP_R3	BRF1/801		
R716/P1/12	#115768	C16_RF_GAP_R3	BRF2/910		
R716/P1/13	#2708534	C02_RF_GAP_AVC_R3	BRF1/801		120 ns added
R716/P1/14	#2708532	C04_RF_GAP_AVC_R3	BRF1/801		290 ns added
R716/P1/15	#115761	C16_RF_GAP_AVC_R3	BRF2/910		130 ns added
R716/P1/16	#2708531	C02_VRF_R3		BRF1/801	
R716/P1/17	#108841	C04_VRF_R3		BRF1/801	
R716/P1/18	#115766	C16_VRF_R3		BRF2/910	
R716/P1/19	#2708542	C02_RF_DRIVE_R3		BRF1/801	120 ns added
R716/P1/20	#108833	C04_RF_DRIVE_R3		BRF1/801	260 ns added
R716/P1/21	#115767	C16_RF_DRIVE_R3		BRF2/910	130 ns added
R716/P1/22					
R716/P1/23	Lemo 00	BA3.VRFDC02_NAOS		R722/P3/1	
R716/P1/24	Lemo 00	BA3.VRFDC04_NAOS		R722/P3/2	
R716/P1/25	Lemo 00	BA3.VRFDC16_NAOS		R722/P3/3	
R716/P1/26	Lemo 00	BA3.C02PHBEAM_NAOS		R722/P3/4	
R716/P1/27	Lemo 00	BA3.C04PHBEAM_NAOS		R722/P3/5	
R716/P1/28	Lemo 00	BA3.C04PHC02_NAOS		R722/P3/6	
R716/P1/29	Lemo 00	BA3.BEAMPHSYREF_NAOS		R722/P3/7	
R716/P1/30	Lemo 00	BA3.RPOS_NAOS		R722/P3/8	
R716/P1/31	Lemo 00	BA3.FBQUADERROR_NAOS		R722/P3/9	
R716/P1/32	Lemo 00	BA3.FREV_NAOS		R722/P3/10	
R716/P1/33	Lemo 00	BA3.CO2PHGRID_NAOS		R722/P3/11	
R716/P1/34	Lemo 00	BA3.CO4PHGRID_NAOS		R722/P3/12	
R716/P1/35	Lemo 00	BA3.C16PHGRID_NAOS		R722/P3/13	
R716/P1/36	Lemo 00	BA3.IKC02_NAOS		R722/P3/14	
R716/P1/37	Lemo 00	BA3.IKC04_NAOS		R722/P3/15	
R716/P1/38	Lemo 00	BA3.IKC16_NAOS		R722/P3/16	
R716/P1/39					
R716/P1/40					
R716/P1/41	Lemo 00	BA3.GSVRFC02			
R716/P1/42	Lemo 00	BA3.GSVRFC04	R723/GFAS		
R716/P1/43	Lemo 00	BA3.GSVRFC16	R723/GFAS		
R716/P1/44	Lemo 00	BA3.GSPOFFC02	R723/GFAS		
R716/P1/45	Lemo 00	BA3.GSPOFFC04	R723/GFAS		
R716/P1/46	Lemo 00	BA3.GSC04PHC02			
R716/P1/47	Lemo 00	BA3.GSFOFFC02			
R716/P1/48	Lemo 00	BA3.GSFOFFC16			
R716/P1/49					
R716/P1/50					
R716/P1/51					
R716/P1/52					
R716/P1/53					
R716/P1/54	Lemo 00	BAX.R1+2+INH_RF	R725/PR		
R716/P1/55	Lemo 00	BAX.SBCLI	R725/PR		
R716/P1/56	Lemo 00	BAX.SHC16LE	R725/PR		
R716/P1/57	Lemo 00	BAX.SC04MAIN	R725/PR		
R716/P1/58	Lemo 00	BAX.SHGAIN	R725/PR		
R716/P1/59	Lemo 00		R725/PR		
R716/P1/60	Lemo 00	BIX3.SDIS-RF1	R725/PR		
R716/P1/61	Lemo 00	BAX.SH2SYNCC02	R725/PR		
R716/P1/62	Lemo 00	BAX3.SH2SYNCBEAM	R725/PR		
R716/P1/63	Lemo 00	BAX.E1+2DLPC02	R725/PR		
R716/P1/64	Lemo 00	BAX.SDLPC02	R725/PR		
R716/P1/65	Lemo 00	BAX.E1+2DLPC04	R725/PR		
R716/P1/66	Lemo 00	BAX.SDLPC04	R725/PR		

R716/P1/67	Lemo 00	BAX.E1+2PLC02	R725/PR		
R716/P1/68	Lemo 00	BAX4.SPLC02	R725/PR		
R716/P1/69	Lemo 00	BAX.EPLC04	R725/PR		
R716/P1/70	Lemo 00	BAX3.SPLC04	R725/PR		
R716/P1/71	Lemo 00	BAX.ESTEC02	R725/PR		
R716/P1/72	Lemo 00	BAX.SSTEC02	R725/PR		
R716/P1/73	Lemo 00	BAX.ESTEC04	R725/PR		
R716/P1/74	Lemo 00	BAX.SSTEC04	R725/PR		
R716/P1/75	Lemo 00	BAX.ERL	R725/PR		
R716/P1/76	Lemo 00	BAX3.SRL	R725/PR		
R716/P1/77	Lemo 00	BAX.E1+2DLPC16	R725/PR		
R716/P1/78	Lemo 00	BAX.SDLPC16	R725/PR		
R716/P1/79	Lemo 00	BAX.EDUALHARMC04	R725/PR		
R716/P1/80	Lemo 00	BAX.SDUALHARMC04	R725/PR		
R716/P1/81	Lemo 00	BAX.SBEAT	R725/PR		
R716/P1/82	Lemo 00	BAX.SPEJSYNC	R725/PR		
R716/P1/83	Lemo 00	BAX.EFBQUAD	R725/PR		
R716/P1/84	Lemo 00	BAX.SFBQUAD	R725/PR		
R716/P1/85	Lemo 00	BX.SLFT-RF1	R725/PR		for monitoring
R716/P1/86	Lemo 00	BX.SIFT-RF1	R725/PR		for monitoring
R716/P1/87	Lemo 00		R725/PR		
R716/P1/88	Lemo 00	BEX.SEJ	R725/PR		for monitoring
R716/P1/89	Lemo 00	BAX.RF1	R725/PR		For test
R716/P1/90	Lemo 00	BAX.RF2	R725/PR		For test
R716/P1/91	Lemo 00	BAX.RF3	R725/PR		For test
R716/P1/92					
R716/P1/93					
R716/P1/94					
R716/P1/95					
R716/P1/96					
R716/P1/97	#104649	RAD_POS_4_R3	BAT21/P1/37		in A (7) RAD. LOOP
R716/P1/98	#104665	RAD_POS_6_R3	BAT31/P1/37		in B (8) RAD. LOOP
R716/P1/99	#104683	RAD_POS_12_R3	BAT65/P1/37		in C (9) RAD. LOOP
R716/P1/100	#104699	RAD_POS_14_R3	BCR533/P1/37		in D (10) RAD. LOOP
R716/P1/101	#104648	PU_SYGMA_4_R3	BAT21/P1/33		
R716/P1/102	#104666	PU_SYGMA_6_R3	BAT31/P1/33		
R716/P1/103	#104682	PU_SYGMA_12_R3	BAT65/P1/33		
R716/P1/104	#104651	LO_RF_R3		BAT21/P1/29	
R716/P1/105	#104667	LO_RF_R3		BAT31/P1/29	
R716/P1/106	#104685	LO_RF_R3		BAT65/P1/29	
R716/P1/107	#104701	LO_RF_R3		BCR533/P1/29	
R716/P1/108					
R716/P1/109	Lemo 00	REV_RF_R3		R709/P2/28	
R716/P1/110	Lemo 00	RF_C02_R3		R709/P2/15	
R716/P1/111	Lemo 00	RF_C04_R3		R709/P2/19	
R716/P1/112	Lemo 00	RF_C16_R3		R709/P2/23	
R716/P1/113		C02_VPRD_R3			
R716/P1/114		C04_VPRD_R3			
R716/P1/115		C16_VPRD_R3			
R716/P1/116	Lemo 00	10 MHz			
R716/P1/117	Lemo 00	RF_REF_EJ	R723		
R716/P1/118					
R716/P1/119					
R716/P1/120	Lemo 00	REV_RF_R3		BAT via R725	Transv. FB
R716/P1/121					

LOCATION	CABLE	FUNCTION	ORIGIN	DESTINATION	Comments
R718/P1/1	#115785	VRFD_C02_R2	BRF1/801		
R718/P1/2	#115787	VRFD_C04_R2	BRF1/801		
R718/P1/3	#115754	VRFD_C16_R2	BRF2/910		
R718/P1/4	#2708603	GRID_PH_CO2_R2	BRF1/801		
R718/P1/5	#2708604	GRID_PH_CO4_R2	BRF1/801		
R718/P1/6	#115752	GRID_PH_C16_R2	BRF2/910		
R718/P1/7	#2708514	Ik_C02_R2	BRF1/801		
R718/P1/8	#115786	Ik_C04_R2	BRF1/801		
R718/P1/9	#115753	Ik_C16_R2	BRF2/910		
R718/P1/10	#2708518	C02_RF_GAP_R2	BRF1/801		
R718/P1/11	#2708520	C04_RF_GAP_R2	BRF1/801		
R718/P1/12	#115758	C16_RF_GAP_R2	BRF2/910		
R718/P1/13	#2708519	C02_RF_GAP_AVC_R2	BRF1/801		0 ns added
R718/P1/14	#2708517	C04_RF_GAP_AVC_R2	BRF1/801		290 ns added
R718/P1/15	#115759	C16_RF_GAP_AVC_R2	BRF2/910		130 ns added
R718/P1/16	#2708516	C02_VRF_R2		BRF1/801	
R718/P1/17	#108842	C04_VRF_R2		BRF1/801	
R718/P1/18	#115756	C16_VRF_R2		BRF2/910	
R718/P1/19	#2708515	C02_RF_DRIVE_R2		BRF1/801	0 ns added
R718/P1/20	#108832	C04_RF_DRIVE_R2		BRF1/801	260 ns added
R718/P1/21	#115757	C16_RF_DRIVE_R2		BRF2/910	130 ns added
R718/P1/22					
R718/P1/23	Lemo 00	BA2.VRFDC02_NAOS		R722/P2/1	
R718/P1/24	Lemo 00	BA2.VRFDC04_NAOS		R722/P2/2	
R718/P1/25	Lemo 00	BA2.VRFDC16_NAOS		R722/P2/3	
R718/P1/26	Lemo 00	BA2.C02PHBEAM_NAOS		R722/P2/4	
R718/P1/27	Lemo 00	BA2.C04PHBEAM_NAOS		R722/P2/5	
R718/P1/28	Lemo 00	BA2.C04PHC02_NAOS		R722/P2/6	
R718/P1/29	Lemo 00	BA2.BEAMPHSYREF_NAOS		R722/P2/7	
R718/P1/30	Lemo 00	BA2.RPOS_NAOS		R722/P2/8	
R718/P1/31	Lemo 00	BA2.FBQUADERROR_NAOS		R722/P2/9	
R718/P1/32	Lemo 00	BA2.FREV_NAOS		R722/P2/10	
R718/P1/33	Lemo 00	BA2.CO2PHGRID_NAOS		R722/P2/11	
R718/P1/34	Lemo 00	BA2.CO4PHGRID_NAOS		R722/P2/12	
R718/P1/35	Lemo 00	BA2.C16PHGRID_NAOS		R722/P2/13	
R718/P1/36	Lemo 00	BA2.IKC02_NAOS		R722/P2/14	
R718/P1/37	Lemo 00	BA2.IKC04_NAOS		R722/P2/15	
R718/P1/38	Lemo 00	BA2.IKC16_NAOS		R722/P2/16	
R718/P1/39					
R718/P1/40					
R718/P1/41	Lemo 00	BA2.GSVRFC02			
R718/P1/42	Lemo 00	BA2.GSVRFC04	R723/GFAS		
R718/P1/43	Lemo 00	BA2.GSVRFC16	R723/GFAS		
R718/P1/44	Lemo 00	BA2.GSPOFFC02	R723/GFAS		
R718/P1/45	Lemo 00	BA2.GSPOFFC04	R723/GFAS		
R718/P1/46	Lemo 00	BA2.GSC04PHC02			
R718/P1/47	Lemo 00	BA2.GSFOFFC02			
R718/P1/48	Lemo 00	BA2.GSFOFFC16			
R718/P1/49					
R718/P1/50					
R718/P1/51					
R718/P1/52					
R718/P1/53					
R718/P1/54	Lemo 00	BAX.R1+2+INH_RF	R725 / PR		
R718/P1/55	Lemo 00	BAX.SBCLI	R725 / PR		
R718/P1/56	Lemo 00	BAX.SHC16LE	R725 / PR		
R718/P1/57	Lemo 00	BAX.SC04MAIN	R725 / PR		
R718/P1/58	Lemo 00	BAX.SHGAIN	R725 / PR		
R718/P1/59	Lemo 00		R725 / PR		
R718/P1/60	Lemo 00	BIX2.SDIS-RF1	R725 / PR		
R718/P1/61	Lemo 00	BAX.SH2SYNCC02	R725 / PR		
R718/P1/62	Lemo 00	BAX2.SH2SYNCBEAM	R725 / PR		
R718/P1/63	Lemo 00	BAX.E1+2DLPC02	R725 / PR		
R718/P1/64	Lemo 00	BAX.SDLPC02	R725 / PR		
R718/P1/65	Lemo 00	BAX.E1+2DLPC04	R725 / PR		
R718/P1/66	Lemo 00	BAX.SDLPC04	R725 / PR		

R718/P1/67	Lemo 00	BAX.E1+2PLC02	R725 / PR		
R718/P1/68	Lemo 00	BAX2.SPLC02	R725 / PR		
R718/P1/69	Lemo 00	BAX.EPLC04	R725 / PR		
R718/P1/70	Lemo 00	BAX2.SPLC04	R725 / PR		
R718/P1/71	Lemo 00	BAX.ESTEC02	R725 / PR		
R718/P1/72	Lemo 00	BAX.SSTEC02	R725 / PR		
R718/P1/73	Lemo 00	BAX.ESTEC04	R725 / PR		
R718/P1/74	Lemo 00	BAX.SSTEC04	R725 / PR		
R718/P1/75	Lemo 00	BAX.ERL	R725 / PR		
R718/P1/76	Lemo 00	BAX2.SRL	R725 / PR		
R718/P1/77	Lemo 00	BAX.E1+2DLPC16	R725 / PR		
R718/P1/78	Lemo 00	BAX.SDLPC16	R725 / PR		
R718/P1/79	Lemo 00	BAX.EDUALHARMC04	R725 / PR		
R718/P1/80	Lemo 00	BAX.SDUALHARMC04	R725 / PR		
R718/P1/81	Lemo 00	BAX.SBEAT	R725 / PR		
R718/P1/82	Lemo 00	BAX.SPEJSYNC	R725 / PR		
R718/P1/83	Lemo 00	BAX.EFBQUAD	R725 / PR		
R718/P1/84	Lemo 00	BAX.SFBQUAD	R725 / PR		
R718/P1/85	Lemo 00	BX.SLFT-RF1	R725 / PR		for monitoring
R718/P1/86	Lemo 00	BX.SIFT-RF1	R725 / PR		for monitoring
R718/P1/87	Lemo 00		R725 / PR		
R718/P1/88	Lemo 00	BEX.SEJ	R725 / PR		for monitoring
R718/P1/89	Lemo 00	BAX.RF1	R725 / PR		For test
R718/P1/90	Lemo 00	BAX.RF2	R725 / PR		For test
R718/P1/91	Lemo 00	BAX.RF3	R725 / PR		For test
R718/P1/92					
R718/P1/93					
R718/P1/94					
R718/P1/95					
R718/P1/96					
R718/P1/97	#104645	RAD_POS_4_R2	BAT21/P1/37		in A (7) RAD. LOOP
R718/P1/98	#104661	RAD_POS_6_R2	BAT31/P1/37		in B (8) RAD. LOOP
R718/P1/99	#104679	RAD_POS_12_R2	BAT65/P1/37		in C (9) RAD. LOOP
R718/P1/100	#104695	RAD_POS_14_R2	BCR533/P1/3 7		in D (10) RAD. LOOP
R718/P1/101	#104644	PU_SYGMA_4_R2	BAT21/P1/33		
R718/P1/102	#104662	PU_SYGMA_6_R2	BAT31/P1/33		
R718/P1/103	#104678	PU_SYGMA_12_R2	BAT65/P1/33		
R718/P1/104	#104647	LO_RF_R2		BAT21/P1/29	
R718/P1/105	#104663	LO_RF_R2		BAT31/P1/29	
R718/P1/106	#104681	LO_RF_R2		BAT65/P1/29	
R718/P1/107	#104697	LO_RF_R2		BCR533/P1/29	
R718/P1/108					
R718/P1/109	Lemo 00	REV_RF_R2		R709	
R718/P1/110	Lemo 00	RF_C02_R2		R709	
R718/P1/111	Lemo 00	RF_C04_R2		R709	
R718/P1/112	Lemo 00	RF_C16_R2		R709	
R718/P1/113		C02_VPRD_R2			
R718/P1/114		C04_VPRD_R2			
R718/P1/115		C16_VPRD_R2			
R718/P1/116	Lemo 00	10 MHz	R 724		
R718/P1/117	Lemo 00	RF_REF_EJ	R723		
R718/P1/118					
R718/P1/119					
R718/P1/120	Lemo 00	REV_RF_R2		BAT via R725	Transv. FB
R718/P1/121					

LOCATION	CABLE	FUNCTION	ORIGIN	DESTINATION	Comments
R720/P1/1	#115781	VRFD_C02_R1	BRF1/801		
R720/P1/2	#115783	VRFD_C04_R1	BRF1/801		
R720/P1/3	#115744	VRFD_C16_R1	BRF2/910		
R720/P1/4	#2708601	GRID_PH_CO2_R1	BRF1/801		
R720/P1/5	#2708602	GRID_PH_CO4_R1	BRF1/801		
R720/P1/6	#115742	GRID_PH_C16_R1	BRF2/910		
R720/P1/7	#2708498	Ik_C02_R1	BRF1/801		
R720/P1/8	#115782	Ik_C04_R1	BRF1/801		
R720/P1/9	#115743	Ik_C16_R1	BRF2/910		
R720/P1/10	#2708502	C02_RF_GAP_R1	BRF1/801		
R720/P1/11	#2708504	C04_RF_GAP_R1	BRF1/801		
R720/P1/12	#115748	C16_RF_GAP_R1	BRF2/910		
R720/P1/13	#2708503	C02_RF_GAP_AVC_R1	BRF1/801		120 ns added
R720/P1/14	#2708501	C04_RF_GAP_AVC_R1	BRF1/801		290 ns added
R720/P1/15	#115741	C16_RF_GAP_AVC_R1	BRF2/910		130 ns added
R720/P1/16	#2708500	C02_VRF_R1		BRF1/801	
R720/P1/17	#108843	C04_VRF_R1		BRF1/801	
R720/P1/18	#115746	C16_VRF_R1		BRF2/910	
R720/P1/19	#2708499	C02_RF_DRIVE_R1		BRF1/801	120 ns added
R720/P1/20	#108831	C04_RF_DRIVE_R1		BRF1/801	260 ns added
R720/P1/21	#115747	C16_RF_DRIVE_R1		BRF2/910	130 ns added
R720/P1/22					
R720/P1/23	Lemo 00	BA1.VRFDC02_NAOS		R722/P1/1	
R720/P1/24	Lemo 00	BA1.VRFDC04_NAOS		R722/P1/2	
R720/P1/25	Lemo 00	BA1.VRFDC16_NAOS		R722/P1/3	
R720/P1/26	Lemo 00	BA1.C02PHBEAM_NAOS		R722/P1/4	
R720/P1/27	Lemo 00	BA1.C04PHBEAM_NAOS		R722/P1/5	
R720/P1/28	Lemo 00	BA1.C04PHC02_NAOS		R722/P1/6	
R720/P1/29	Lemo 00	BA1.BEAMPHSYREF_NAO S		R722/P1/7	
R720/P1/30	Lemo 00	BA1.RPOS_NAOS		R722/P1/8	
R720/P1/31	Lemo 00	BA1.FBQUADERROR_NAO S		R722/P1/9	
R720/P1/32	Lemo 00	BA1.FREV_NAOS		R722/P1/10	
R720/P1/33	Lemo 00	BA1.CO2PHGRID_NAOS		R722/P1/11	
R720/P1/34	Lemo 00	BA1.CO4PHGRID_NAOS		R722/P1/12	
R720/P1/35	Lemo 00	BA1.C16PHGRID_NAOS		R722/P1/13	
R720/P1/36	Lemo 00	BA1.IKC02_NAOS		R722/P1/14	
R720/P1/37	Lemo 00	BA1.IKC04_NAOS		R722/P1/15	
R720/P1/38	Lemo 00	BA1.IKC16_NAOS		R722/P1/16	
R720/P1/39					
R720/P1/40					
R720/P1/41	Lemo 00	BA1.GSVRFC02			
R720/P1/42	Lemo 00	BA1.GSVRFC04	R723/GFAS		
R720/P1/43	Lemo 00	BA1.GSVRFC16	R723/GFAS		
R720/P1/44	Lemo 00	BA1.GSPOFFC02	R723/GFAS		
R720/P1/45	Lemo 00	BA1.GSPOFFC04	R723/GFAS		
R720/P1/46	Lemo 00	BA1.GSC04PHC02			
R720/P1/47	Lemo 00	BA1.GSFOFFC02			
R720/P1/48	Lemo 00	BA1.GSFOFFC16			
R720/P1/49					
R720/P1/50					
R720/P1/51					
R720/P1/52					
R720/P1/53					
R720/P1/54	Lemo 00	BAX.R1+2+INH_RF	R725 /PR		
R720/P1/55	Lemo 00	BAX.SBCLI	R725/PR		
R720/P1/56	Lemo 00	BAX.SHC16LE	R725/PR		
R720/P1/57	Lemo 00	BAX.SC04MAIN	R725/PR		
R720/P1/58	Lemo 00	BAX.SHGAIN	R725/PR		
R720/P1/59	Lemo 00		R725/PR		
R720/P1/60	Lemo 00	BIX2.SDIS-RF1	R725/PR		
R720/P1/61	Lemo 00	BAX.SH2SYNCC02	R725/PR		
R720/P1/62	Lemo 00	BAX1.SH2SYNCBEAM	R725/PR		
R720/P1/63	Lemo 00	BAX.E1+2DLPC02	R725/PR		
R720/P1/64	Lemo 00	BAX.SDLPC02	R725/PR		
R720/P1/65	Lemo 00	BAX.E1+2DLPC04	R725/PR		
R720/P1/66	Lemo 00	BAX.SDLPC04	R725/PR7.8		

R720/P1/67	Lemo 00	BAX.E1+2PLC02	R725/PR		
R720/P1/68	Lemo 00	BAX1.SPLC02	R725/PR		
R720/P1/69	Lemo 00	BAX.EPLC04	R725/PR		
R720/P1/70	Lemo 00	BAX1.SPLC04	R725/PR		
R720/P1/71	Lemo 00	BAX.ESTEC02	R725/PR		
R720/P1/72	Lemo 00	BAX.SSTEC02	R725/PR		
R720/P1/73	Lemo 00	BAX.ESTEC04	R725/PR		
R720/P1/74	Lemo 00	BAX.SSTEC04	R725/PR		
R720/P1/75	Lemo 00	BAX.ERL	R725/PR		
R720/P1/76	Lemo 00	BAX2.SRL	R725/PR		
R720/P1/77	Lemo 00	BAX.E1+2DLPC16	R725/PR		
R720/P1/78	Lemo 00	BAX.SDLPC16	R725/PR		
R720/P1/79	Lemo 00	BAX.EDUALHARMC04	R725/PR		
R720/P1/80	Lemo 00	BAX.SDUALHARMC04	R725/PR		
R720/P1/81	Lemo 00	BAX.SBEAT	R725/PR		
R720/P1/82	Lemo 00	BAX.SPEJSYNC	R725/PR		
R720/P1/83	Lemo 00	BAX.EFBQUAD	R725/PR		
R720/P1/84	Lemo 00	BAX.SFBQUAD	R725/PR		
R720/P1/85	Lemo 00	BX.SLFT-RF1	R725/PR		for monitoring
R720/P1/86	Lemo 00	BX.SIFT-RF1	R725/PR		for monitoring
R720/P1/87	Lemo 00		R725/PR		
R720/P1/88	Lemo 00	BEX.SEJ	R725/PR		for monitoring
R720/P1/89	Lemo 00	BAX.RF1	R725/PR		For test
R720/P1/90	Lemo 00	BAX.RF2	R725/PR		For test
R720/P1/91	Lemo 00	BAX.RF3	R725/PR		For test
R720/P1/92					
R720/P1/93					
R720/P1/94					
R720/P1/95					
R720/P1/96					
R720/P1/97	#104641	RAD_POS_4_R1	BAT21/P1/37		in A (7) RAD. LOOP
R720/P1/98	#104657	RAD_POS_6_R1	BAT31/P1/37		in B (8) RAD. LOOP
R720/P1/99	#104675	RAD_POS_12_R1	BAT65/P1/37		in C (9) RAD. LOOP
R720/P1/100	#104691	RAD_POS_14_R1	BCR533/P1/3 7		in D (10) RAD. LOOP
R720/P1/101	#104640	PU_SYGMA_4_R1	BAT21/P1/33		
R720/P1/102	#104658	PU_SYGMA_6_R1	BAT31/P1/33		
R720/P1/103	#104674	PU_SYGMA_12_R1	BAT65/P1/33		
R720/P1/104	#104643	LO_RF_R1		BAT21/P1/29	
R720/P1/105	#104659	LO_RF_R1		BAT31/P1/29	
R720/P1/106	#104677	LO_RF_R1		BAT65/P1/29	
R720/P1/107	#104693	LO_RF_R1		BCR533/P1/29	
R720/P1/108					
R720/P1/109	Lemo 00	REV_RF_R1		R709/P2/28	
R720/P1/110	Lemo 00	RF_C02_R1		R709/P2/15	
R720/P1/111	Lemo 00	RF_C04_R1		R709/P2/19	
R720/P1/112	Lemo 00	RF_C16_R1		R709/P2/23	
R720/P1/113		C02_VPRD_R1			
R720/P1/114		C04_VPRD_R1			
R720/P1/115		C16_VPRD_R1			
R720/P1/116	Lemo 00	10MHz	R724		
R720/P1/117	Lemo 00	RF_REF_EJ	R723		
R720/P1/118					
R720/P1/119					
R720/P1/120		REV_RF_R1		BAT	Transv. FB
R720/P1/121					

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