Installation Planning for BPM-HRM Booster DAQ Extension

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December 14, 2009

Revision 6

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I. Introduction

Currently the Beam Position Monitors (BPM's) in the Booster are digitized using Omnibyte 2 MHz "Comet" VME modules. The data from these modules is processed to provide turn by turn beam position plots for operations. It is desired to also be able to plot the BPM data in "Snap Shot" plots and "Fast Time" plots alongside other data such as beam losses, corrector magnet currents, etc..

We intend to accomplish this by teeing the BPM signals at the VME crates and additionally digitizing them using the HRM electronics. A proposal for this new cabling arrangement is shown in Figure 1. We are planning to mock-up the new cabling arrangement and test to see if there is any negative impact on the position signal or its digitized values.

The 64 channel HRM digitizer data is transmitted over a high speed serial link to a VME PMC carrier module with associated PMC Hotlink data link module and a VME power PC processor module. Both the HRM chassis and VME crates/power supplies will need to be installed.

We are also considering putting in new electronics for the Beam Loss Monitors (BLM's). In a few of the locations, we are going to be adding full size VME crates to accommodate this in addition to the BPM-HRM readouts.

The following pages provide information on the physical location and installation of the current BPM position demodulation and position data acquisition electronics.

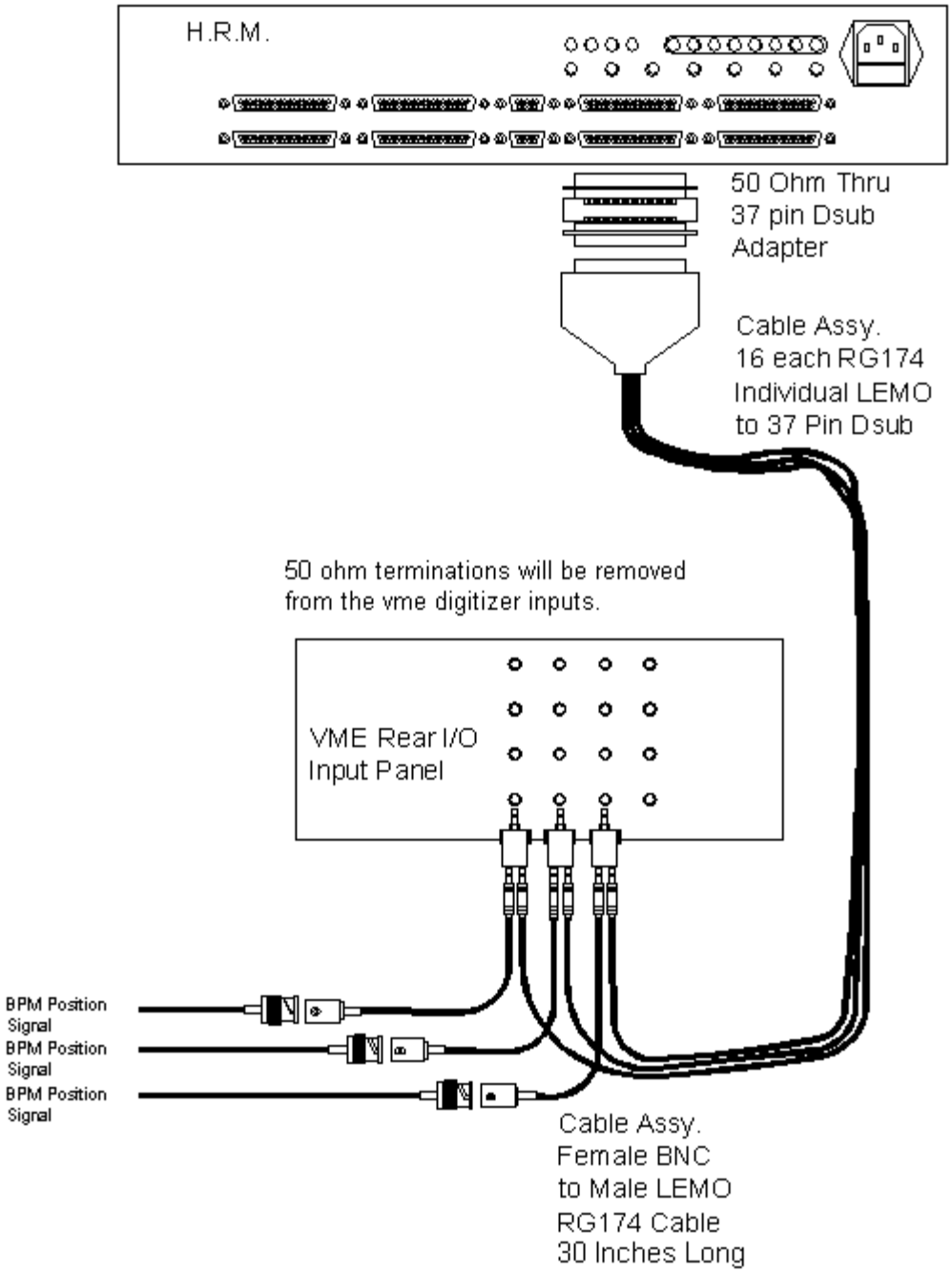


Figure I.1 Cabling modification for the BPM Position signals.

Adapter Cable Assembly Specification

Cable ==========
RG-174
Length = 30" +/- 0.5"

Connector 1 ==========
LEMO - FFA.00.250.CTAC29Z - RF/Coaxial Connector or equivalent.
Manufacturer: LEMO
Newark Part Number: 70C8241
Manufacturer Part No: FFA.00.250.CTAC29Z

Connector 2 ==========
AMPHENOL CONNEX - 112160 - RF/Coaxial Connector or equivalent.
Manufacturer: AMPHENOL CONNEX
Newark Part Number: 99H4294
Manufacturer Part No: 112160

Length Table for Individual Lemo to 37 Pin DSub Cable Assembly

Location	**Length**	**Comment**
G01-RR6-2	6 feet	This applies whether the HRM is in G01-RR6-2 or G01-RR6-1.
G21-RR5-2	6 feet	HRM in G21-RR5-2.
Period 18	6 feet	
G17-RR2	20 feet	Cable runs from VME crate in G17-RR2 to HRM in the bottom of G17-RR1-3.
G14-RR1	6 feet	
G11-RR6-1	8 feet	Cable runs from VME crate in G11-RR6-1 to HRM in G11-RR6-2.

II. Period 1 Racks

Status: Space Available

A 21-slot VME crate is installed in rack G01-RR6-3 that can be used for housing the VME processor for reading back the HRM data and for housing future Beam Loss Monitor Integrators. There appears to be plenty of space in rack G01-RR6-1 for mounting an HRM chassis.

Rack Numbers: G01-RR6-1, G01-RR6-2, G01-RR6-3.

BPM's Serviced Here:

VME Crate: BBPM24

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL24	24	G01-RR6-1	HP24L	0	0	HL24P	0	1,20
VL24	24	G01-RR6-1	VP24L	0	1	VL24P	1	2,21
HS24	24	G01-RR6-1	HP24S	0	2	HS24P	2	3,22
VS24	24	G01-RR6-1	VP24S	0	3	VS24P	3	4,23
HL1	1	G01-RR6-1	HP01L	1	0	HL01P	4	5,24
VL1	1	G01-RR6-1	VP01L	1	1	VL01P	5	6,25
HS1	1	G01-RR6-1	HP01S	1	2	HS01P	6	7,26
VS1	1	G01-RR6-1	VP01S	1	3	VS01P	7	8,27
HL2	2	G01-RR6-1	HP02L	2	0	HL02P	8	9,28
VL2	2	G01-RR6-1	VP02L	2	1	VL02P	9	10,29
HS2	2	G01-RR6-1	HP02S	2	2	HS02P	10	11,30
VS2	2	G01-RR6-1	VP02S	2	3	VS02P	11	12,31
HL3	3	G01-RR6-2	HP03L	3	0	HL03P	12	13,32
VL3	3	G01-RR6-2	VP03L	3	1	VL03P	13	14,33
HS3	3	G01-RR6-2	HP03S	3	2	HS03P	14	15,34
VS3	3	G01-RR6-2	VP03S	3	3	VS03P	15	16,35
HL4	4	G01-RR6-2	HP04L	4	0	HL04P	16	1,20
VL4	4	G01-RR6-2	VP04L	4	1	VL04P	17	2,21
HS4	4	G01-RR6-2	HP04S	4	2	HS04P	18	3,22
VS4	4	G01-RR6-2	VP04S	4	3	VS04P	19	4,23
HL5	5	G01-RR6-2	HP05L	5	0	HL05P	20	5,24
VL5	5	G01-RR6-2	VP05L	5	1	VL05P	21	6,25
HS5	5	G01-RR6-2	HP05S	5	2	HS05P	22	7,26
VS5	5	G01-RR6-2	VP05S	5	3	VS05P	23	8,27
HP03LU	3	G01-RR6-3	HP03LU	7	2	HL03UP	24	9,28
VP03LU	3	G01-RR6-3	VP03LU	7	3	VL03UP	25	10,29
HRM Patch Panel Connections								
		G01-RR6-1				Input 26	26	11,30
		G01-RR6-1				Input 27	27	12,31
		G01-RR6-1				Input 28	28	13,32
		G01-RR6-1				Input 29	29	14,33
		G01-RR6-1				Input 30	30	15,34
		G01-RR6-1				Input 31	31	16,35

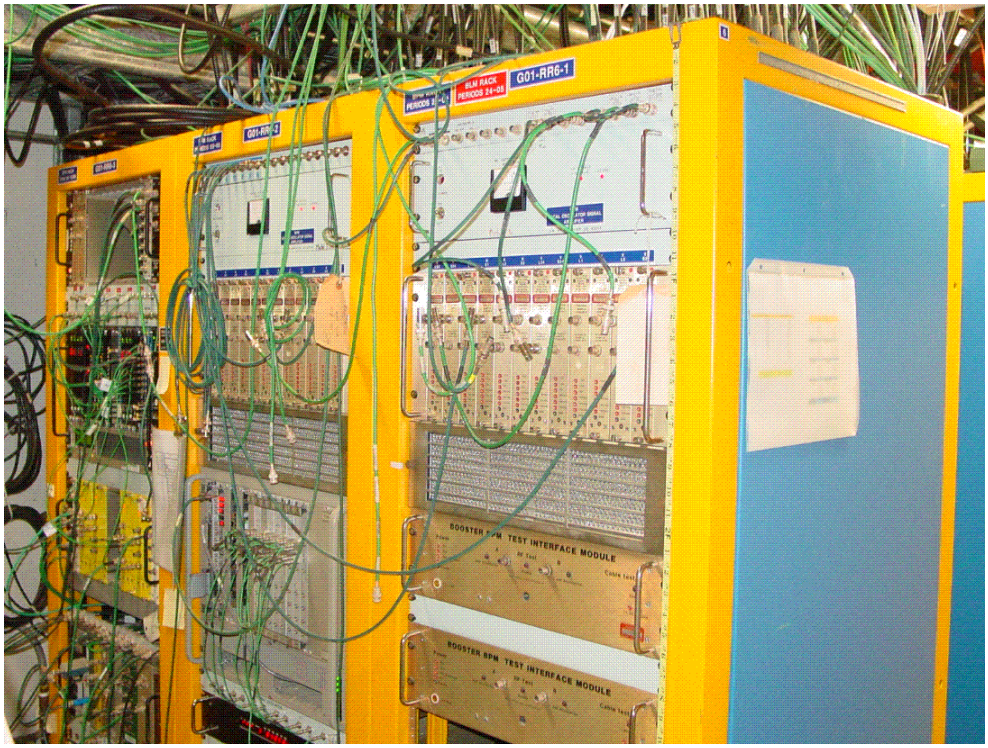


Figure II.1 G01-RR5 racks (front, top).

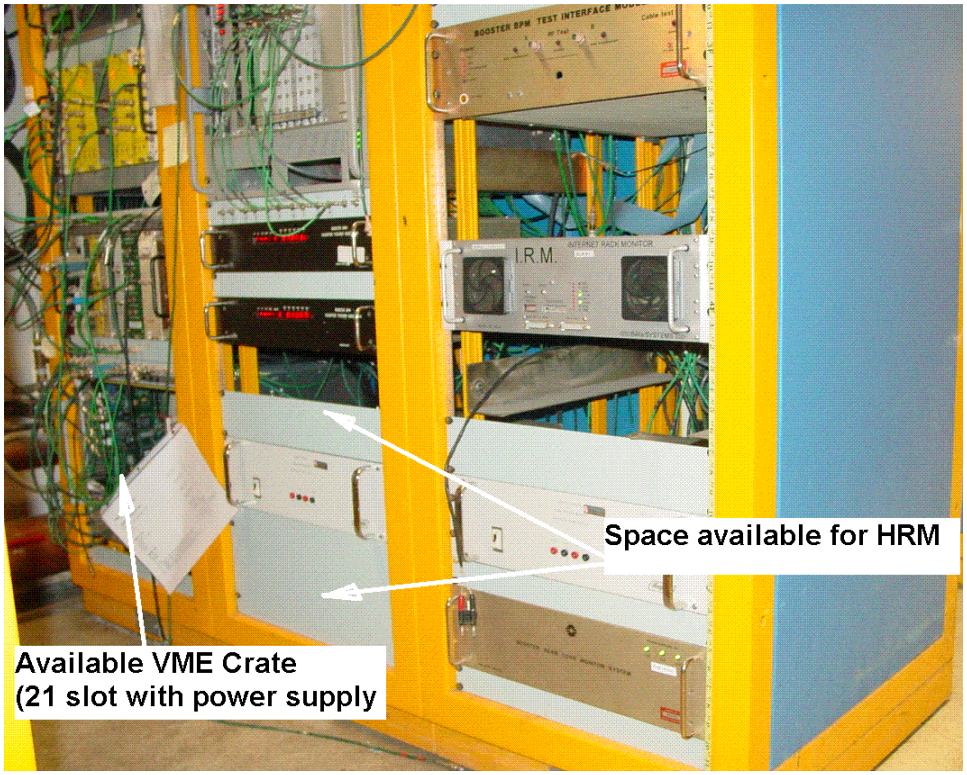


Figure II.2 G01-RR5 racks (front, bottom).

Figure II.3 G01-RR5 Digitizer VME crate (rear).

Period 1 -- TODO

1. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
2. Build Lemo to 37 pin Dsub cable assembly.
3. Install HRM into rack G01-RR6-2.
4. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Attach to each signal cable a new Lemo Tee and reconnect to the VME IO panel in the correct port.
    c. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly in the rack.
    d. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    e. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    f. Connect the cable assembly with adapter to the HRM.
5. Monitor the Turn-By-Turn and HRM data to ensure proper connections

III. Period 21 Racks

Status: Consider removing old corrector power supplies.

Once the old sextupole magnet power supplies are removed from Rack G21-RR5-1 there will be more than enough room for a VME crate at the location. A 5 slot VME crate and an HRM could be fit into G21-RR5-2 regardless of whether the old corrector power supplies are removed, however. The VME processor here could receive data from an HRM located here at period 21 and an HRM down the hall in the North-West corner of the Booster Gallery.

Rack Numbers: G21-RR5-1, G21-RR5-2, G21-RR5-3.

BPM's Serviced Here:

VME Crate: BBPM21

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL21	21	G21-RR5-2	HP21L	0	0	HL21P	0	1,20
VL21	21	G21-RR5-2	VP21L	0	1	VL21P	1	2,21
HS21	21	G21-RR5-2	HP21S	0	2	HS21P	2	3,22
VS21	21	G21-RR5-2	VP21S	0	3	VS21P	3	4,23
HL22	21	G21-RR5-2	HP22L	1	0	HL22P	4	5,24
VL22	21	G21-RR5-2	VP22L	1	1	VL22P	5	6,25
HS22	21	G21-RR5-2	HP22S	1	2	HS22P	6	7,26
VS22	21	G21-RR5-2	VP22S	1	3	VS22P	7	8,27
HL23	21	G21-RR5-2	HP23L	2	0	HL23P	8	9,28
VL23	21	G21-RR5-2	VP23L	2	1	VL23P	9	10,29
HS23	21	G21-RR5-2	HP23S	2	2	HS23P	10	11,30
VS23	21	G21-RR5-2	VP23S	2	3	VS23P	11	12,31

Figure III.1 G21-RR5 racks (front).

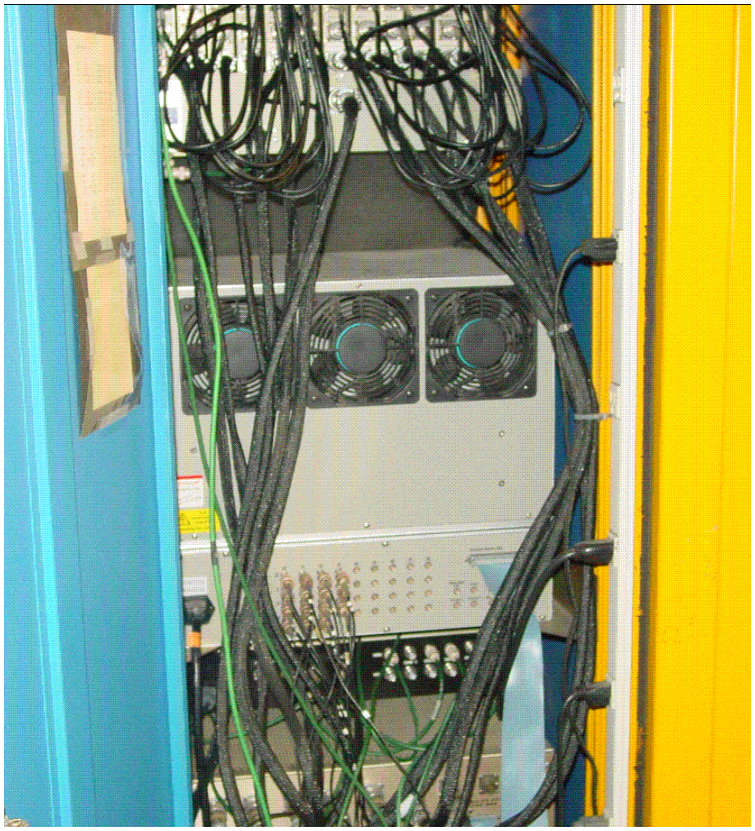


Figure III.2 G21-RR5-2 Digitizer VME crate (rear).

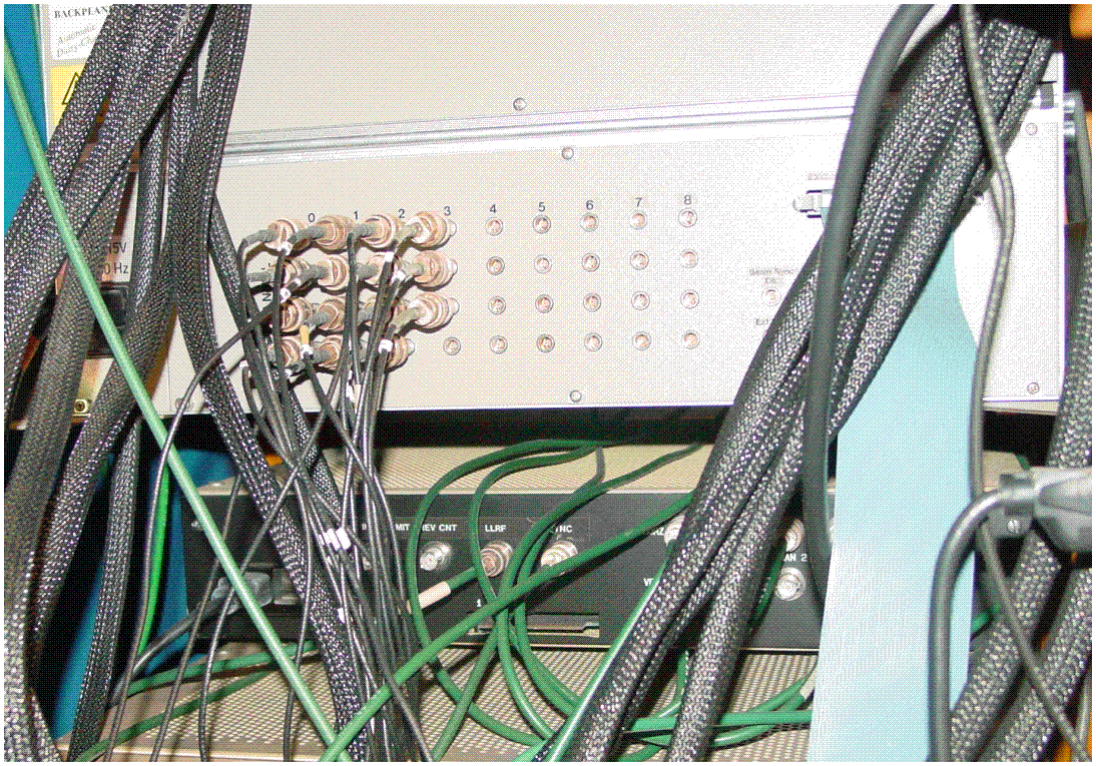


Figure III.3 G21-RR5-2 Digitizer VME crate close-up.

Period 21 -- TODO

1. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
2. Build Lemo to 37 pin Dsub cable assembly.
3. Install HRM and 5 Slot VME Crate into rack G21-RR5-2. The BPM RF Module Power Supply will need to be move upward or downward in the rack to make room.
4. Run Hotlink cable from G21-RR5-2 down to the HRM in the Period 18 rack.
5. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Remove existing BNC to Lemo adapter.
    c. Attach to each signal cable the new BNC to Lemo cable and Lemo Tee and reconnect to the VME IO panel in the correct port.
    d. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly in the rack.
    e. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    f. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    g. Connect the cable assembly with adapter to the HRM.
6. Monitor the Turn-By-Turn and HRM data to ensure proper connections

IV. Period 18 Rack (BGW-North Corner)

Status: Difficult, limited space. Run Hotlink to VME at period 21.

This is a difficult location. We would need to squeeze in the HRM chassis and run the Hotlink data link down the hall to period 21 where the processor there would handle the data from both this HRM at period 18 and the HRM at period 21. The cable length for the Hotlink would be just under the 30 meter limit. The figures below indicate how we would squeeze in the HRM.

Rack Numbers: Period 18 - 20.

BPM's Serviced Here:

VME Crate: BBPM18

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL18	18	P. 18-20 (BGW-North)	HP18L	0	0	HL18P	0	1,20
VL18	18	P. 18-20 (BGW-North)	VP18L	0	1	VL18P	1	2,21
HS18	18	P. 18-20 (BGW-North)	HP18S	0	2	HS18P	2	3,22
VS18	18	P. 18-20 (BGW-North)	VP18S	0	3	VS18P	3	4,23
HL19	18	P. 18-20 (BGW-North)	HP19L	1	0	HL19P	4	5,24
VL19	18	P. 18-20 (BGW-North)	VP19L	1	1	VL19P	5	6,25
HS19	18	P. 18-20 (BGW-North)	HP19S	1	2	HS19P	6	7,26
VS19	18	P. 18-20 (BGW-North)	VP19S	1	3	VS19P	7	8,27
HL20	18	P. 18-20 (BGW-North)	HP20L	2	0	HL20P	8	9,28
VL20	18	P. 18-20 (BGW-North)	VP20L	2	1	VL20P	9	10,29
HS20	18	P. 18-20 (BGW-North)	HP20S	2	2	HS20P	10	11,30
VS20	18	P. 18-20 (BGW-North)	VP20S	2	3	VS20P	11	12,31

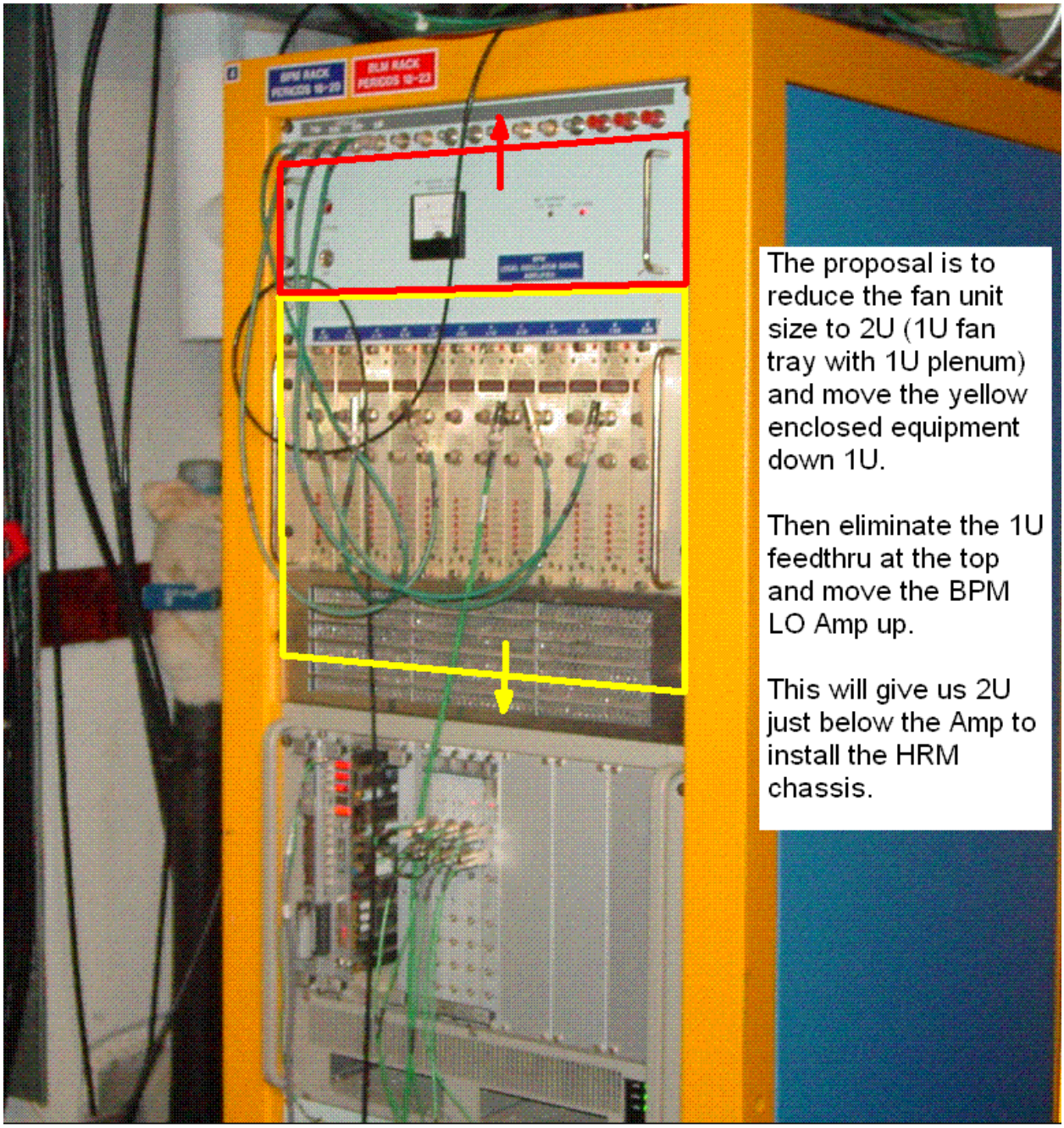


Figure IV.1. Period 18 rack (front) with modification proposal.

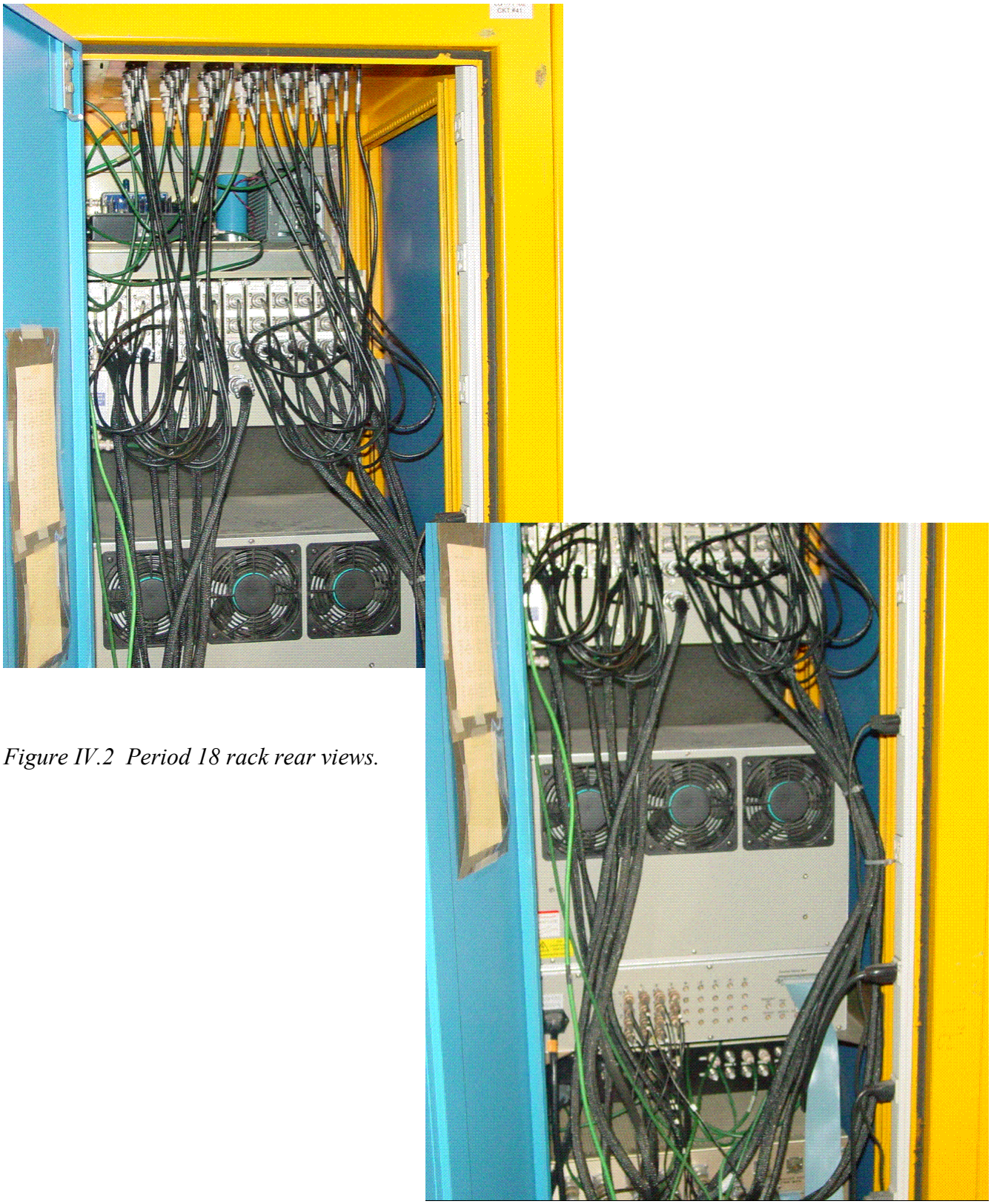


Figure IV.2 Period 18 rack rear views.

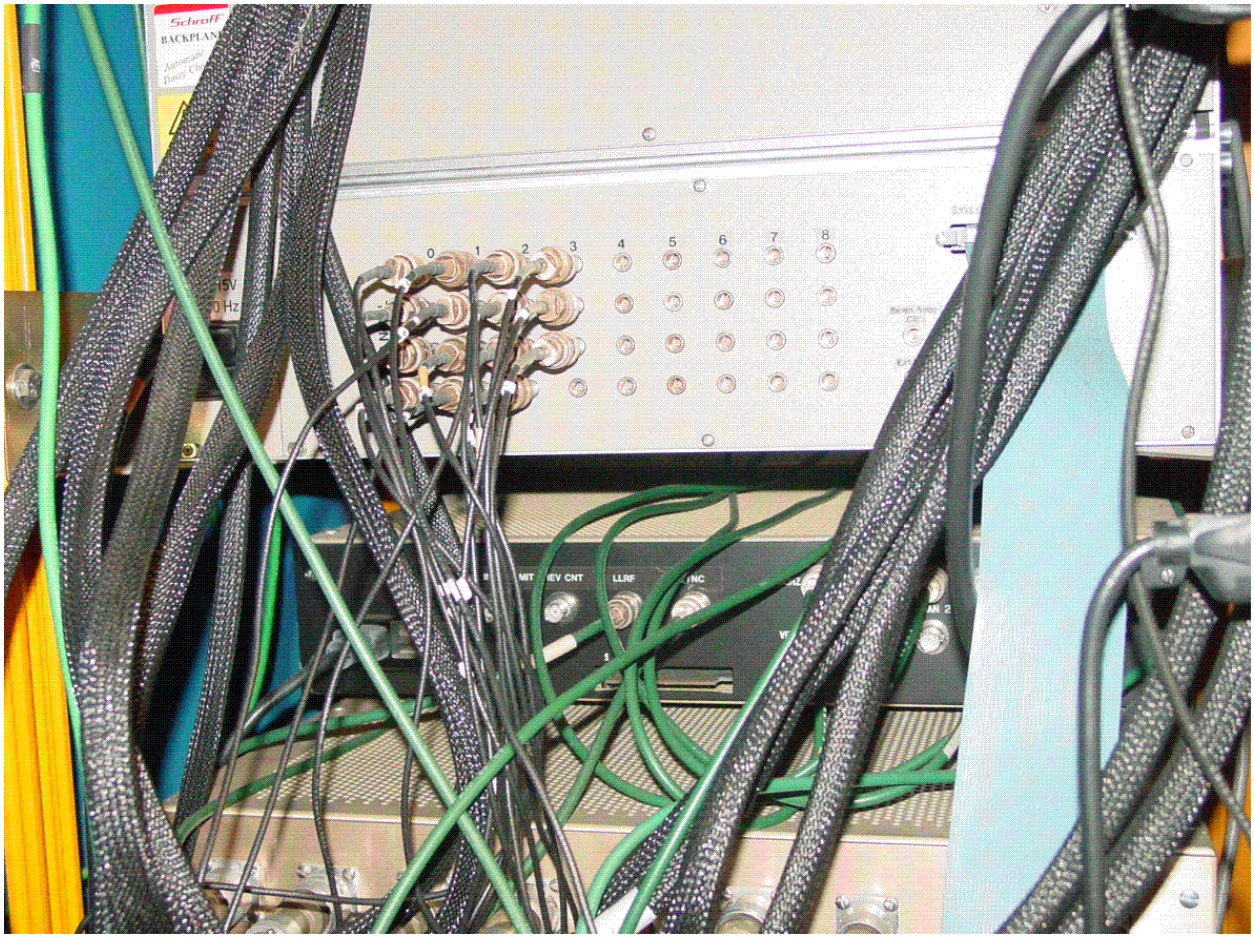


Figure IV.3 Period 18 Digitizer VME crate close-up.

Period 18 -- TODO

7. Procure components for the new 2U fan unit.
    a. Panel Chasis, 1.75” High x 8” Deep x 17” Wide, Newark # 52F6474.
    b. Slotted Ventilation Panel, 1U High, Newark # 94B8070.
    c. AC Fan Tray, three fans, 1.75” High x 7.5” Deep x 17” Wide, Newark# 93B7361.
8. Assemble fan unit components.
9. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
10. Build Lemo to 37 pin Dsub cable assembly.
11. Submit shutdown work request for powering down the rack and moving the chassis.
12. Make rack modifications.
    a. Remove existing fan, filter and plenum.
    b. Install 90 degree shelf brackets for supporting the crate in the new position.
    c. Lower the NIM crate into the new position.
    d. Install new fan unit below the NIM crate.
    e. Install new signal feedthru above the IRM chassis.
    f. Move IRM signals from the top feedthru panel to the new panel.
    g. Remove the top feedthru panel.
    h. Move the BPM LO Amplifier up 1U.
13. Install HRM into the new 2U opening.
    **** Power can be returned to rack at this point and shutdown can end.
14. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Remove existing BNC to Lemo adapter.
    c. Attach to each signal cable the new BNC to Lemo cable and Lemo Tee and reconnect to the VME IO panel in the correct port.
    d. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly in the rack.
    e. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    f. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    g. Connect the cable assembly with adapter to the HRM.
15. Monitor the Turn-By-Turn and HRM data to ensure proper connections

V. Period 17 Racks

Status: Consider removing old corrector power supplies in rack G17-RR1-1.

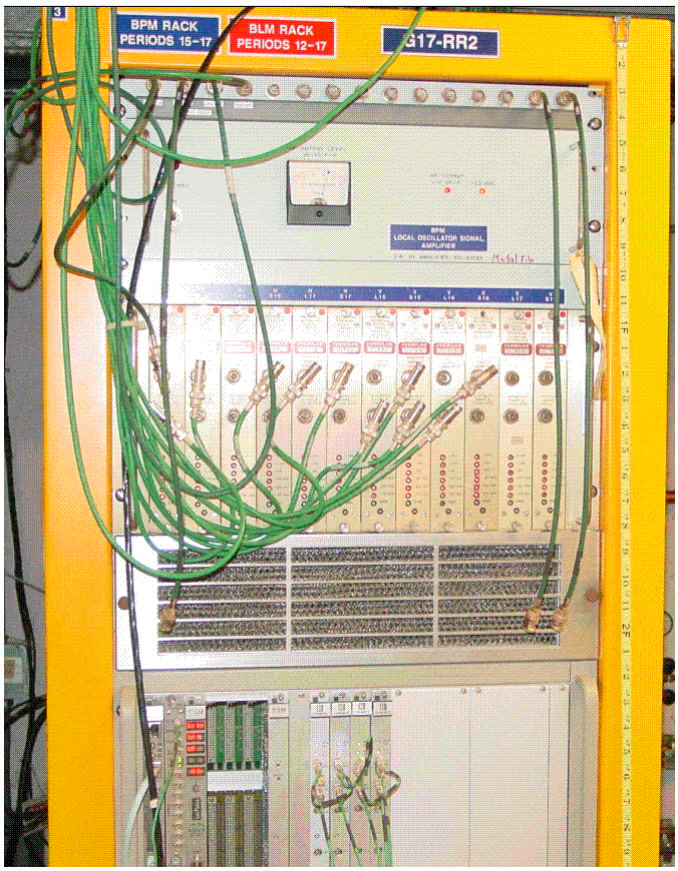
The nearby rack G17-RR1-3 can be used to house both the VME crate, VME processor and the HRM chassis. With the HRM chassis in G17-RR1-3 a longer cable assembly with the analog BPM signals would have to be run over from G17-RR2.

Rack Numbers: G17-RR2, G17-RR1-3.

BPM's Serviced Here:

VME Crate: BBPM15

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL15	17	G17-RR2	HP15L	0	0	HL15P	0	1,20
VL15	17	G17-RR2	VP15L	0	1	VL15P	1	2,21
HS15	17	G17-RR2	HP15S	0	2	HS15P	2	3,22
VS15	17	G17-RR2	VP15S	0	3	VS15P	3	4,23
HL16	17	G17-RR2	HP16L	1	0	HL16P	4	5,24
VL16	17	G17-RR2	VP16L	1	1	VL16P	5	6,25
HS16	17	G17-RR2	HP16S	1	2	HS16P	6	7,26
VS16	17	G17-RR2	VP16S	1	3	VS16P	7	8,27
HL17	17	G17-RR2	HP17L	2	0	HL17P	8	9,28
VL17	17	G17-RR2	VP17L	2	1	VL17P	9	10,29
HS17	17	G17-RR2	HP17S	2	2	HS17P	10	11,30
VS17	17	G17-RR2	VP17S	2	3	VS17P	11	12,31



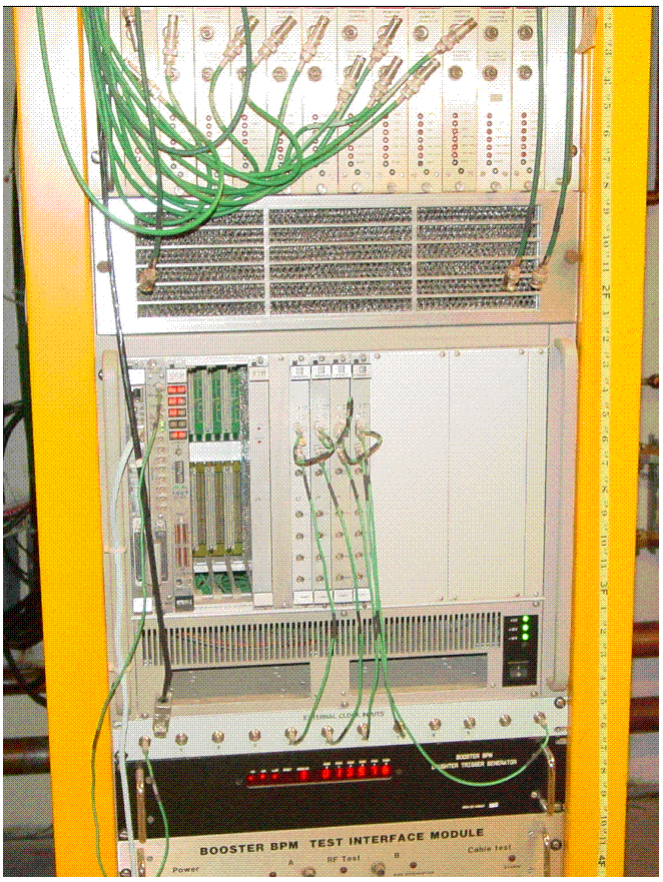


Figure V.1 G17-RR2 rack front views.

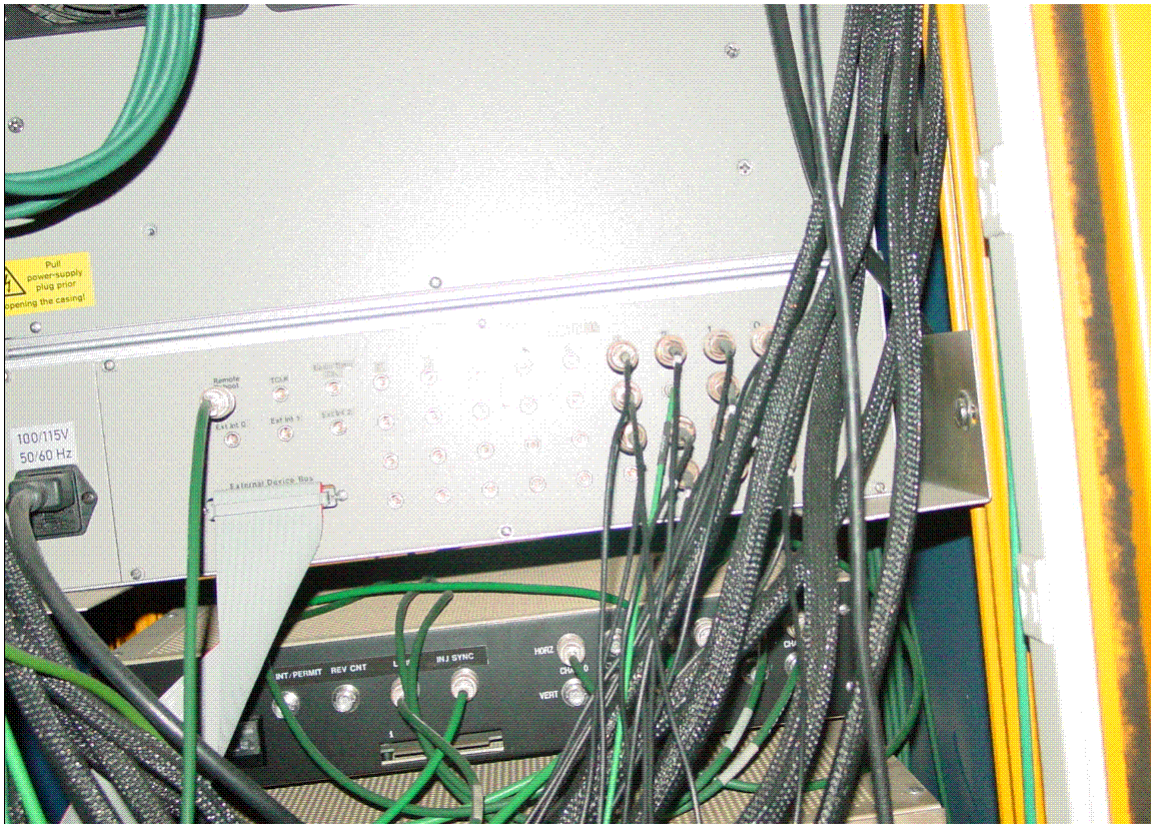


Figure V.2 G17-RR2 Digitizer VME crate close-up.

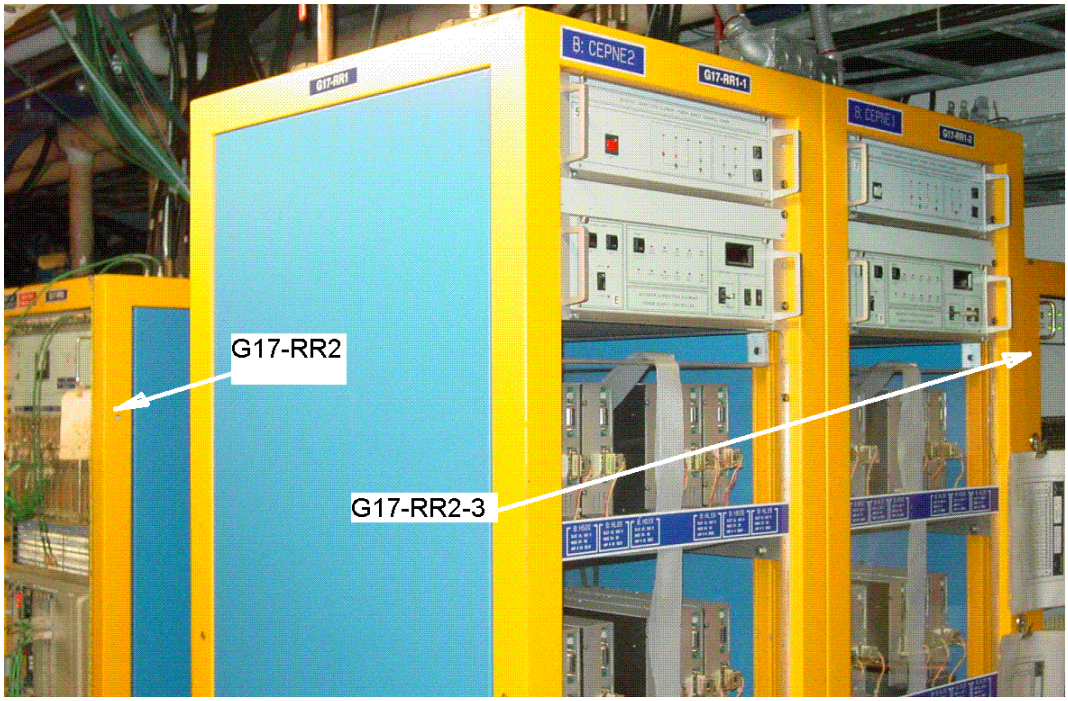


Figure V.3 G17-RR1-1 rack. Possible location of the HRM and VME Crate

Figure V.4 G17-RR1-3 rack front views.

Period 17 -- TODO

1. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
2. Build Lemo to 37 pin Dsub cable assembly.
3. Install HRM and 5 Slot VME Crate into rack G17-RR1-3. The BPM RF Module Power Supply will need to be move upward or downward in the rack to make room.
4. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Remove existing BNC to Lemo adapter.
    c. Attach to each signal cable the new BNC to Lemo cable and Lemo Tee and reconnect to the VME IO panel in the correct port.
    d. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly from rack G15-RR2 to G17-RR1-3.
    e. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    f. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    g. Connect the cable assembly with adapter to the HRM.
5. Monitor the Turn-By-Turn and HRM data to ensure proper connections

VI. Period 14 Racks

Status: Space available.

HRM and VME Equipment can go in the bottom portion of G14-RR1.

Rack Numbers: G14-RR1.

BPM's Serviced Here:

VME Crate: BBPM12

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL12	14	G14-RR1	HP12L	0	0	HL12P	0	1,20
VL12	14	G14-RR1	VP12L	0	1	VL12P	1	2,21
HS12	14	G14-RR1	HP12S	0	2	HS12P	2	3,22
VS12	14	G14-RR1	VP12S	0	3	VS12P	3	4,23
HL13	14	G14-RR1	HP13L	1	0	HL13P	4	5,24
VL13	14	G14-RR1	VP13L	1	1	VL13P	5	6,25
HS13	14	G14-RR1	HP13S	1	2	HS13P	6	7,26
VS13	14	G14-RR1	VP13S	1	3	VS13P	7	8,27
HL14	14	G14-RR1	HP14L	2	0	HL14P	8	9,28
VL14	14	G14-RR1	VP14L	2	1	VL14P	9	10,29
HS14	14	G14-RR1	HP14S	2	2	HS14P	10	11,30
VS14	14	G14-RR1	VP14S	2	3	VS14P	11	12,31

Figure VI.1 G14-RR2 rack (front).

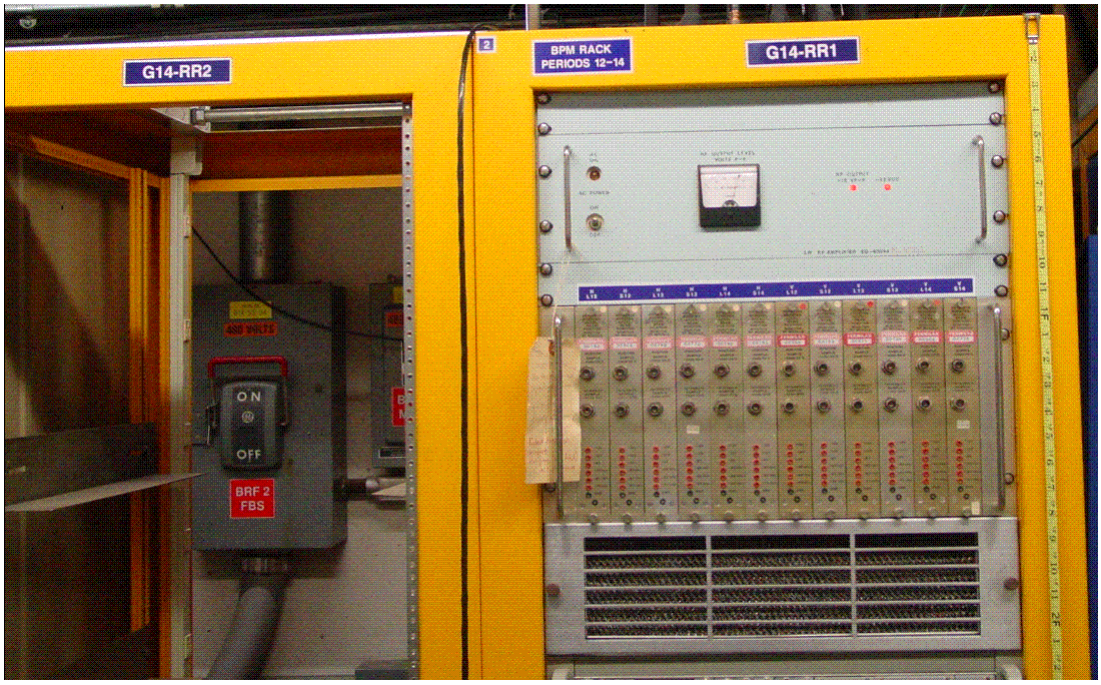


Figure VI.2 G14-RR1 rack (top, front).

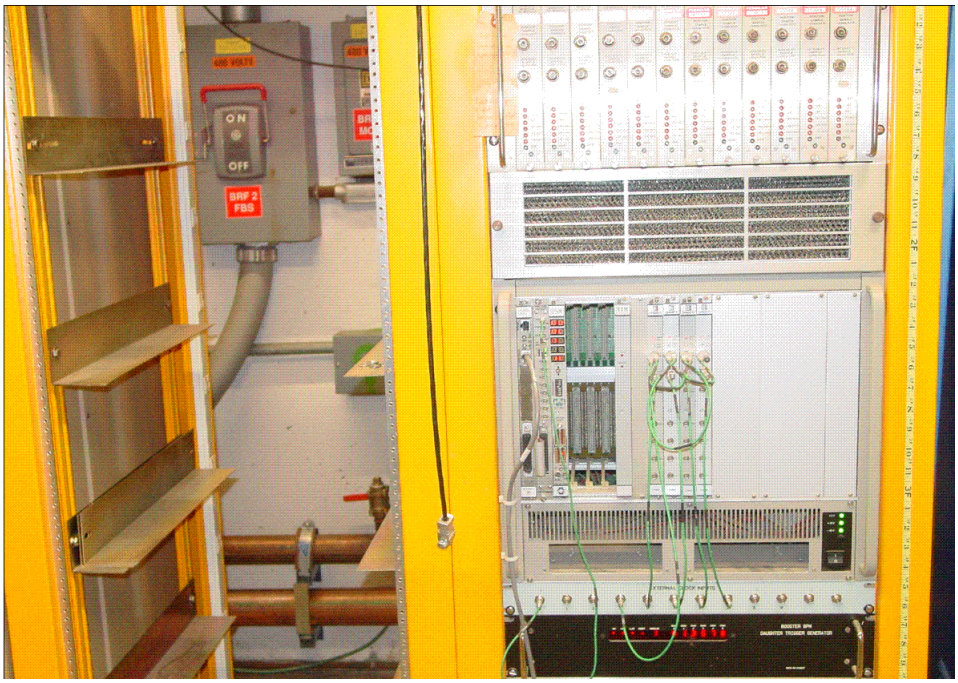


Figure VI.3 G14-RR1 rack (mid, front).

Figure VI.4 G14-RR1 rack (bottom, front).

Period 14 -- TODO

1. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
2. Build Lemo to 37 pin Dsub cable assembly.
3. Install HRM and 5 Slot VME Crate into bottom portion of rack G14-RR1. The BPM RF Module Power Supply will need to be move upward or downward in the rack to make room.
4. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Remove existing BNC to Lemo adapter.
    c. Attach to each signal cable the new BNC to Lemo cable and Lemo Tee and reconnect to the VME IO panel in the correct port.
    d. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly in the rack.
    e. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    f. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    g. Connect the cable assembly with adapter to the HRM.
5. Monitor the Turn-By-Turn and HRM data to ensure proper connections

VII. Period 11 Racks

Status: Space available for HRM, VME crate already installed.

The BPM racks at Period 11 have plenty of space for an HRM and the VME crate is already installed.

Rack Numbers: G11-RR6-1, G11-RR6-2, G11-RR6-3.

BPM's Serviced Here:

VME Crate: BBPM06

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL6	11	G11-RR6-2	HP06L	0	0	HL06P	0	1,20
VL6	11	G11-RR6-2	VP06L	0	1	VL06P	1	2,21
HS6	11	G11-RR6-2	HP06S	0	2	HS06P	2	3,22
VS6	11	G11-RR6-2	VP06S	0	3	VS06P	3	4,23
HL7	11	G11-RR6-2	HP07L	1	0	HL07P	4	5,24
VL7	11	G11-RR6-2	VP07L	1	1	VL07P	5	6,25
HS7	11	G11-RR6-2	HP07S	1	2	HS07P	6	7,26
VS7	11	G11-RR6-2	VP07S	1	3	VS07P	7	8,27
HL8	11	G11-RR6-2	HP08L	2	0	HL08P	8	9,28
VL8	11	G11-RR6-2	VP08L	2	1	VL08P	9	10,29
HS8	11	G11-RR6-2	HP08S	2	2	HS08P	10	11,30
VS8	11	G11-RR6-2	VP08S	2	3	VS08P	11	12,31
HL9	11	G11-RR6-1	HP09L	3	0	HL09P	12	13,32
VL9	11	G11-RR6-1	VP09L	3	1	VL09P	13	14,33
HS9	11	G11-RR6-1	HP09S	3	2	HS09P	14	15,34
VS9	11	G11-RR6-1	VP09S	3	3	VS09P	15	16,35
HL10	11	G11-RR6-1	HP10L	4	0	HL10P	16	1,20
VL10	11	G11-RR6-1	VP10L	4	1	VL10P	17	2,21
HS10	11	G11-RR6-1	HP10S	4	2	HS10P	18	3,22
VS10	11	G11-RR6-1	VP10S	4	3	VS10P	19	4,23
HL11	11	G11-RR6-1	HP11L	5	0	HL11P	20	5,24
VL11	11	G11-RR6-1	VP11L	5	1	VL11P	21	6,25
HS11	11	G11-RR6-1	HP11S	5	2	HS11P	22	7,26
VS11	11	G11-RR6-1	VP11S	5	3	VS11P	23	8,27
HUL6	11	G11-RR6-3	HP06LU	7	0	HL06UP	24	9,28
VUL6	11	G11-RR6-3	VP06LU	7	1	VL06UP	25	10,29
HUL7	11	G11-RR6-3	HP07LU	7	2	HL07UP	26	11,30
VUL7	11	G11-RR6-3	VP07LU	7	3	VL07UP	27	12,31

Figure VII.1 G11-RR5 racks (top, front).

Figure VII.1 G11-RR5 racks (bottom, front).

Period 11 -- TODO

1. Procure components for the Lemo to 37 pin Dsub cable assembly. *See length chart for cable length requirements*.
2. Build Lemo to 37 pin Dsub cable assembly.
3. Install HRM and 5 Slot VME Crate into bottom portion of rack G11-RR5-2. The BPM RF Module Power Supply will need to be move upward or downward in the rack to make room.
4. Make BPM position signal cable modifications.
    a. Label existing BPM position signal cables at the VME IO panel if necessary.
    b. Remove existing BNC to Lemo adapter.
    c. Attach to each signal cable the new BNC to Lemo cable and Lemo Tee and reconnect to the VME IO panel in the correct port.
    d. Run the multi-RG174 Lemo to 37 pin Dsub cable assembly in the rack.
    e. Connect the cable for the assigned HRM channel to the appropriate position signal Lemo Tee.
    f. Connect the 37 pin Dsub end of the assembly to the 50 Ohm connector adapter.
    g. Connect the cable assembly with adapter to the HRM.
5. Monitor the Turn-By-Turn and HRM data to ensure proper connections

VIII. BPM Listing

VME Crate: BBPM24

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL24	24	G01-RR6-1	HP24L	0	0	HL24P	0	1,20
VL24	24	G01-RR6-1	VP24L	0	1	VL24P	1	2,21
HS24	24	G01-RR6-1	HP24S	0	2	HS24P	2	3,22
VS24	24	G01-RR6-1	VP24S	0	3	VS24P	3	4,23
HL1	1	G01-RR6-1	HP01L	1	0	HL01P	4	5,24
VL1	1	G01-RR6-1	VP01L	1	1	VL01P	5	6,25
HS1	1	G01-RR6-1	HP01S	1	2	HS01P	6	7,26
VS1	1	G01-RR6-1	VP01S	1	3	VS01P	7	8,27
HL2	2	G01-RR6-1	HP02L	2	0	HL02P	8	9,28
VL2	2	G01-RR6-1	VP02L	2	1	VL02P	9	10,29
HS2	2	G01-RR6-1	HP02S	2	2	HS02P	10	11,30
VS2	2	G01-RR6-1	VP02S	2	3	VS02P	11	12,31
HL3	3	G01-RR6-2	HP03L	3	0	HL03P	12	13,32
VL3	3	G01-RR6-2	VP03L	3	1	VL03P	13	14,33
HS3	3	G01-RR6-2	HP03S	3	2	HS03P	14	15,34
VS3	3	G01-RR6-2	VP03S	3	3	VS03P	15	16,35
HL4	4	G01-RR6-2	HP04L	4	0	HL04P	16	1,20
VL4	4	G01-RR6-2	VP04L	4	1	VL04P	17	2,21
HS4	4	G01-RR6-2	HP04S	4	2	HS04P	18	3,22
VS4	4	G01-RR6-2	VP04S	4	3	VS04P	19	4,23
HL5	5	G01-RR6-2	HP05L	5	0	HL05P	20	5,24
VL5	5	G01-RR6-2	VP05L	5	1	VL05P	21	6,25
HS5	5	G01-RR6-2	HP05S	5	2	HS05P	22	7,26
VS5	5	G01-RR6-2	VP05S	5	3	VS05P	23	8,27
HP03LU	3	G01-RR6-3	HP03LU	7	2	HL03UP	24	9,28
VP03LU	3	G01-RR6-3	VP03LU	7	3	VL03UP	25	10,29
HRM Patch Panel Connections								
		G01-RR6-1				Input 26	26	11,30
		G01-RR6-1				Input 27	27	12,31
		G01-RR6-1				Input 28	28	13,32

		G01-RR6-1				Input 29	29	14,33
		G01-RR6-1				Input 30	30	15,34
		G01-RR6-1				Input 31	31	16,35

VME Crate: BBPM21

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL21	21	G21-RR5-2	HP21L	0	0	HL21P	0	1,20
VL21	21	G21-RR5-2	VP21L	0	1	VL21P	1	2,21
HS21	21	G21-RR5-2	HP21S	0	2	HS21P	2	3,22
VS21	21	G21-RR5-2	VP21S	0	3	VS21P	3	4,23
HL22	21	G21-RR5-2	HP22L	1	0	HL22P	4	5,24
VL22	21	G21-RR5-2	VP22L	1	1	VL22P	5	6,25
HS22	21	G21-RR5-2	HP22S	1	2	HS22P	6	7,26
VS22	21	G21-RR5-2	VP22S	1	3	VS22P	7	8,27
HL23	21	G21-RR5-2	HP23L	2	0	HL23P	8	9,28
VL23	21	G21-RR5-2	VP23L	2	1	VL23P	9	10,29
HS23	21	G21-RR5-2	HP23S	2	2	HS23P	10	11,30
VS23	21	G21-RR5-2	VP23S	2	3	VS23P	11	12,31

VME Crate: BBPM18

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL18	18	P. 18-20 (BGW-North)	HP18L	0	0	HL18P	0	1,20
VL18	18	P. 18-20 (BGW-North)	VP18L	0	1	VL18P	1	2,21
HS18	18	P. 18-20 (BGW-North)	HP18S	0	2	HS18P	2	3,22
VS18	18	P. 18-20 (BGW-North)	VP18S	0	3	VS18P	3	4,23
HL19	18	P. 18-20 (BGW-North)	HP19L	1	0	HL19P	4	5,24
VL19	18	P. 18-20 (BGW-North)	VP19L	1	1	VL19P	5	6,25
HS19	18	P. 18-20 (BGW-North)	HP19S	1	2	HS19P	6	7,26
VS19	18	P. 18-20 (BGW-North)	VP19S	1	3	VS19P	7	8,27

HL20	18	P. 18-20 (BGW-North)	HP20L	2	0	HL20P	8	9,28
VL20	18	P. 18-20 (BGW-North)	VP20L	2	1	VL20P	9	10,29
HS20	18	P. 18-20 (BGW-North)	HP20S	2	2	HS20P	10	11,30
VS20	18	P. 18-20 (BGW-North)	VP20S	2	3	VS20P	11	12,31

VME Crate: BBPM15

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL15	17	G17-RR2	HP15L	0	0	HL15P	0	1,20
VL15	17	G17-RR2	VP15L	0	1	VL15P	1	2,21
HS15	17	G17-RR2	HP15S	0	2	HS15P	2	3,22
VS15	17	G17-RR2	VP15S	0	3	VS15P	3	4,23
HL16	17	G17-RR2	HP16L	1	0	HL16P	4	5,24
VL16	17	G17-RR2	VP16L	1	1	VL16P	5	6,25
HS16	17	G17-RR2	HP16S	1	2	HS16P	6	7,26
VS16	17	G17-RR2	VP16S	1	3	VS16P	7	8,27
HL17	17	G17-RR2	HP17L	2	0	HL17P	8	9,28
VL17	17	G17-RR2	VP17L	2	1	VL17P	9	10,29
HS17	17	G17-RR2	HP17S	2	2	HS17P	10	11,30
VS17	17	G17-RR2	VP17S	2	3	VS17P	11	12,31

VME Crate: BBPM12

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL12	14	G14-RR1	HP12L	0	0	HL12P	0	1,20
VL12	14	G14-RR1	VP12L	0	1	VL12P	1	2,21
HS12	14	G14-RR1	HP12S	0	2	HS12P	2	3,22
VS12	14	G14-RR1	VP12S	0	3	VS12P	3	4,23
HL13	14	G14-RR1	HP13L	1	0	HL13P	4	5,24
VL13	14	G14-RR1	VP13L	1	1	VL13P	5	6,25
HS13	14	G14-RR1	HP13S	1	2	HS13P	6	7,26
VS13	14	G14-RR1	VP13S	1	3	VS13P	7	8,27
HL14	14	G14-RR1	HP14L	2	0	HL14P	8	9,28
VL14	14	G14-RR1	VP14L	2	1	VL14P	9	10,29

HS14	14	G14-RR1	HP14S	2	2	HS14P	10	11,30
VS14	14	G14-RR1	VP14S	2	3	VS14P	11	12,31

VME Crate: BBPM06

Name	Period	Demod Rack #	VME alias	VME MOD	VME CHAN	HRM alias	HRM CHAN	HRM PIN
HL6	11	G11-RR6-2	HP06L	0	0	HL06P	0	1,20
VL6	11	G11-RR6-2	VP06L	0	1	VL06P	1	2,21
HS6	11	G11-RR6-2	HP06S	0	2	HS06P	2	3,22
VS6	11	G11-RR6-2	VP06S	0	3	VS06P	3	4,23
HL7	11	G11-RR6-2	HP07L	1	0	HL07P	4	5,24
VL7	11	G11-RR6-2	VP07L	1	1	VL07P	5	6,25
HS7	11	G11-RR6-2	HP07S	1	2	HS07P	6	7,26
VS7	11	G11-RR6-2	VP07S	1	3	VS07P	7	8,27
HL8	11	G11-RR6-2	HP08L	2	0	HL08P	8	9,28
VL8	11	G11-RR6-2	VP08L	2	1	VL08P	9	10,29
HS8	11	G11-RR6-2	HP08S	2	2	HS08P	10	11,30
VS8	11	G11-RR6-2	VP08S	2	3	VS08P	11	12,31
HL9	11	G11-RR6-1	HP09L	3	0	HL09P	12	13,32
VL9	11	G11-RR6-1	VP09L	3	1	VL09P	13	14,33
HS9	11	G11-RR6-1	HP09S	3	2	HS09P	14	15,34
VS9	11	G11-RR6-1	VP09S	3	3	VS09P	15	16,35
HL10	11	G11-RR6-1	HP10L	4	0	HL10P	16	1,20
VL10	11	G11-RR6-1	VP10L	4	1	VL10P	17	2,21
HS10	11	G11-RR6-1	HP10S	4	2	HS10P	18	3,22
VS10	11	G11-RR6-1	VP10S	4	3	VS10P	19	4,23
HL11	11	G11-RR6-1	HP11L	5	0	HL11P	20	5,24
VL11	11	G11-RR6-1	VP11L	5	1	VL11P	21	6,25
HS11	11	G11-RR6-1	HP11S	5	2	HS11P	22	7,26
VS11	11	G11-RR6-1	VP11S	5	3	VS11P	23	8,27
HUL6	11	G11-RR6-3	HP06LU	7	0	HL06UP	24	9,28
VUL6	11	G11-RR6-3	VP06LU	7	1	VL06UP	25	10,29
HUL7	11	G11-RR6-3	HP07LU	7	2	HL07UP	26	11,30
VUL7	11	G11-RR6-3	VP07LU	7	3	VL07UP	27	12,31