BNL-105859-2014-TECH
EP&S No. 143;BNL-105859-2014-IR

The electronics for the EPM

E. Beadle

January 1993

Collider Accelerator Department
Brookhaven National Laboratory

U.S. Department of Energy
USDOE Office of Science (SC)

DISCLAIMER

Alternating Gradient Synchrotron Department

BROOKHAVEN NATIONAL LABORATORY

Associated Universities Incorporated

Upton, New York 11973

Experimental Planning and Support Division Technical Note

AGS/EP&S Technical Note No. 143.

THE ELECTRONICS FOR THE EPM

E. Beadle

January 27, 1993

Alternating Gradient Synchrotron Department
BROOKHAVEN NATIONAL LABORATORY
Associated Universities Incorporated
Upton, New York 11973

Experimental Planning and Support Division Technical Note

AGS/EP&S Technical Note No. 143.

THE ELECTRONICS FOR THE EPM

E. Beadle
January 27, 1993

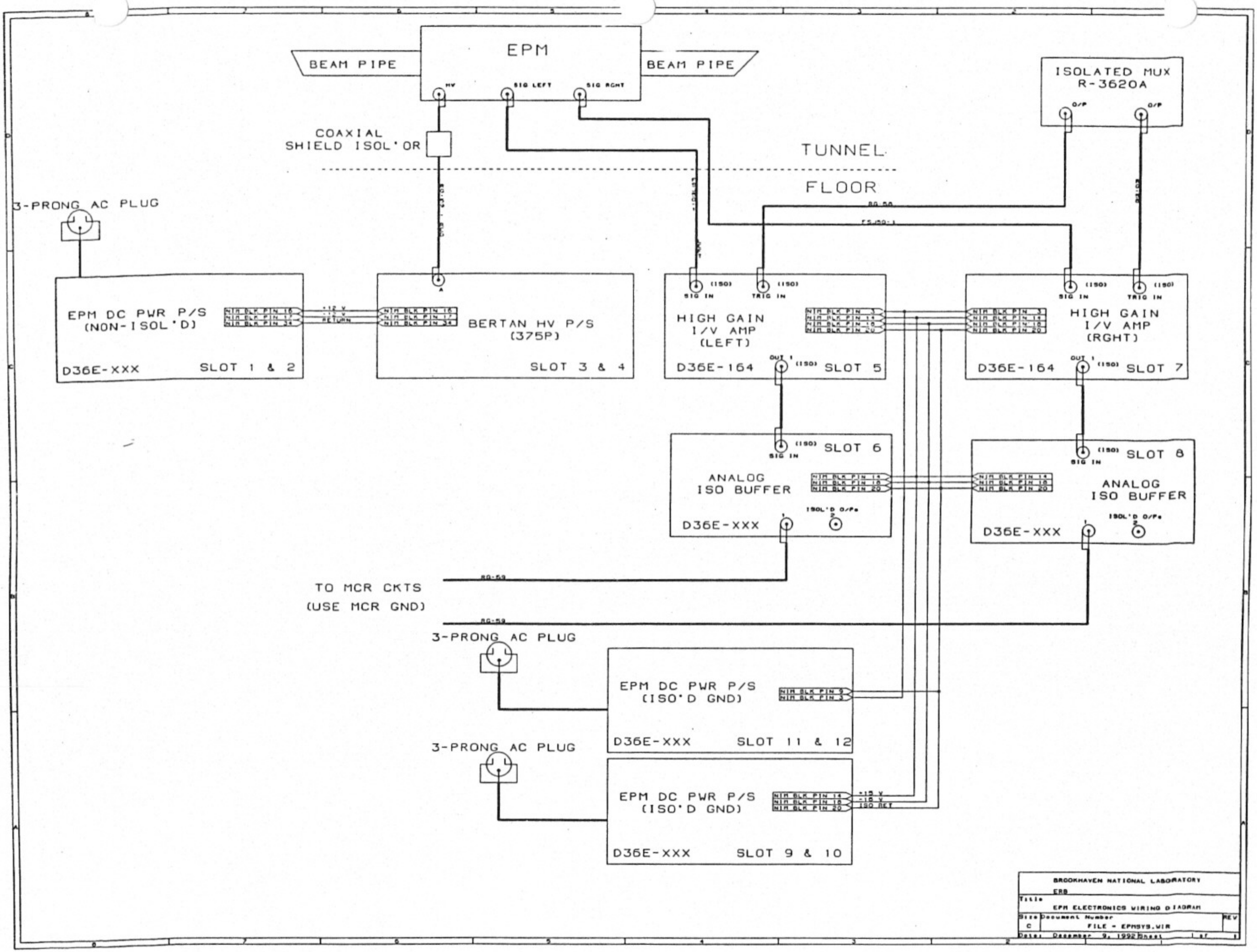
Introduction.

This Tech Note summarizes the development of the electronics required to produce usable signals from the EPM. Figure 1 shows a diagram of the functional blocks and their interconnection. All of the blocks shown in the figure represent individual modules constructed to fit the single and dual width NIM formats. The EPM electronics package is a stand-alone crate requiring only the usual 60 Hz line voltage for power.

The Bertan Adjustable High Voltage Supply (Model 375P) is used to provide the EPM with an adjustable DC bias of several hundred volts. The Bertan supply requires a ±12 VDC input for operation, so an in-house designed AC-DC power supply has been used. The EPM output is a current from two individual plates, and each acts as a current source. Since the monitoring and display devices used are voltage oriented, the capability to convert the output current to usable voltage levels has been included. The current-to-voltage conversion is performed by the High Gain I-V Amp (D36-E164)[1]. Because of ground loop problems, the amplifier output is buffered by an isolated driver. Each driver provides two outputs, each with 100 mA drive capability. Additionally, the amplifiers and drivers are powered by in-house designed isolated DC supplies. The isolation of the DC power completes the three-port isolation necessary to guard against corrupting the EPM signals with noise produced by ground loops. A detailed discussion of the hardware follows below.

EPM Bias Voltage.

The bias voltage output by the Bertan DC Power Supply is brought to the EPM via a red RG-59 coaxial cable. At the EPM, the high voltage input coax shield is broken with a phenolic feedthru. This breaks the ground loop caused by the signal cable shields, high voltage shield, EPM case and chassis grounds.



EPM
BEAM PIPE
BEAM PIPE
HV
SIG LEFT
SIG RGHT
ISOLATED MUX
R-3620A
O/P
O/P
COAXIAL
SHIELD ISOL'OR
TUNNEL
FLOOR
RG-58
3-PRONG AC PLUG
EPM DC PWR P/S
(NON-ISOL'D)
D36E-XXX
SLOT 1 & 2
+12 V
RETURN
BERTAN HV P/S
(375P)
SLOT 3 & 4
SIG IN
TRIG IN
(ISO)
HIGH GAIN
I/V AMP
(LEFT)
D36E-164
SLOT 5
OUT 1
HIGH GAIN
I/V AMP
(RGHT)
D36E-164
SLOT 7
SLOT 6
ANALOG
ISO BUFFER
ISOL'D O/Ps
D36E-XXX
SLOT 8
ANALOG
ISO BUFFER
D36E-XXX
TO MCR CKTS
(USE MCR GND)
RG-59
3-PRONG AC PLUG
EPM DC PWR P/S
(ISO'D GND)
D36E-XXX
SLOT 11 & 12
3-PRONG AC PLUG
EPM DC PWR P/S
(ISO'D GND)
D36E-XXX
SLOT 9 & 10
+15 V
-15 V
ISO RET
BROOKHAVEN NATIONAL LABORATORY
ERB
Title
EPM ELECTRONICS WIRING DIAGRAM
Size
C
Document Number
FILE - EPMSYS.WIR
REV
Date: December 9, 1992
Sheet 1 of 1

FIGURE 1.

EPM Signal Conditioning.

The EPM signal outputs are brought back to the processing electronics crate via Andrews' Corporation 1/4" superflex cables (FSJ50-1). These cables were used because the solid shield offers the two main benefits of very low shield impedance and high shielding effectiveness. Both of these characteristics are superior to the braided shield or foil shield cables usually employed in this type of application.

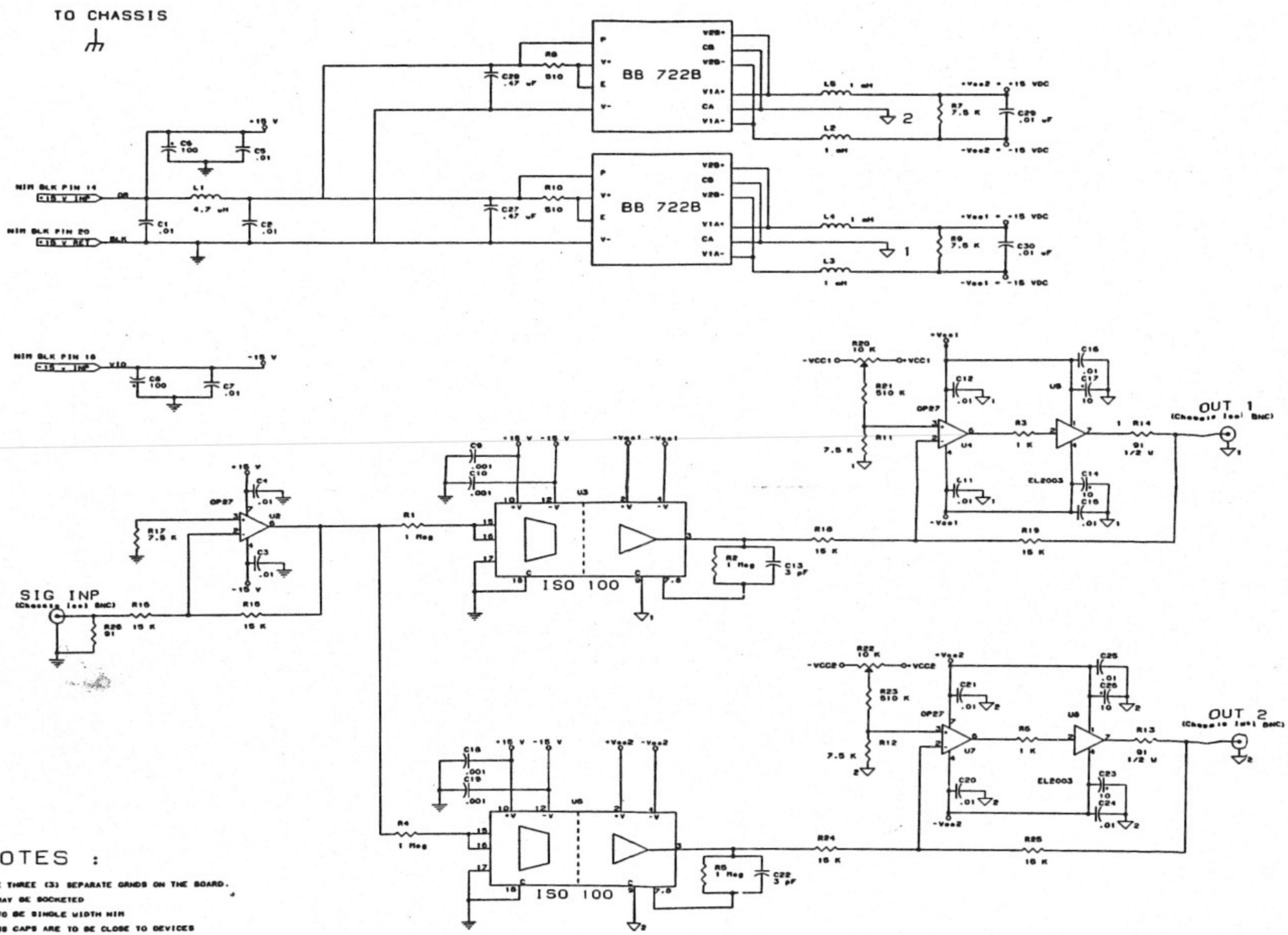
The output currents of the EPM are converted to voltages by the Booster High Gain I-V Amp. Briefly, the amplifier has selectable gains over the range of 100 kohm to 2 Gohm and a bandwidth of > 10 KHz. In addition it has an auto-zero feature that re-acquires the zero baseline every AGS cycle. The baseline correction is triggered by the AGS T_0 signal. The EPM electronics receives the trigger from an isolated multiplexer. The isolation of this port insures the possibility of ground loop contamination is minimized.

The inputs are processed such that they are isolated from the local chassis and rack grounds to prevent ground loops. Only the beam pipe is used as the return path and ground reference. Thus the EPM DC Power Supplies were designed to provide the DC power required for the amplifier and drivers as well as the necessary isolation from the rack grounds.

Analog Signal Isolation Buffer.

This device provides a 1:2 fanout/buffer function. But in addition to the buffering, the outputs are isolated from the inputs. Therefore systems monitoring the EPM can be located in any remote grounding system without corrupting the local instrumentation grounds. Further enhancing the flexibility of the system is the provision for the fanout of two independent outputs. Each output channel is completely isolated from the other for both power and drive circuitry. Therefore two completely independent loads may be connected to each EPM channel. Finally, the drivers were designed to drive 93 ohm cables by providing > 100 mA of output drive for each output. However, to preserve the maximum signal swing of > $\pm$ 12 V and unity gain for the module, a high impedance load is recommended. If a high impedance load is impractical, the internal back terminator can be removed. The paragraph below details the design of the module.

The module design is shown in Fig. 2. The input is terminated by a 93 ohm resistor and the AD707 is used as a high impedance voltage follower/buffer. The output is split into two channels. The Burr-Brown ISO100s are used as the input-output isolation device. The gain for the isolation unit is set at unity. In this configuration a 3 pF feedback capacitor is required to avoid excessive gain peaking in the feedback response of the device. To reduce loading on the ISO100 outputs and provide the necessary cable drive, the output amplifiers are the traditional current-boosted opamp circuit. The 91 ohm resistor shown in the output stage is for back terminating a transmission line.



NOTES :

1. THERE ARE THREE (3) SEPARATE GRNDS ON THE BOARD.
2. ALL ICs MAY BE SOCKETED
3. CARD IS TO BE SINGLE WIDTH NIM
4. ALL BYPASS CAPS ARE TO BE CLOSE TO DEVICES
5. ALL CAPACITORS, RESISTORS AND INDUCTORS ARE IN uF, OHMS AND uH UNLESS OTHERWISE NOTED

BROOKHAVEN NATIONAL LABORATORY ERB		
Title C10 AMP & EPR SERVO ISOLATED BUFFER/DRIVER		
Size C	Document Number FILE - C1010AMP.SCH	REV A
Date: March 9, 1993	Sheet 1 of 1	

The power for the output circuitry is supplied by Burr-Brown 722B DC/DC converters, and the outputs of the converters are paralleled to increase the available current from the supply to 128 mA (nom) per output. The 722's were used because the switching frequency of 1 MHz is well beyond the passband of the ISO100s passband (60 KHz). Lower frequency switching supplies were tested in this circuit, but the supply ripple from the switchers appears on the output. This is because above a few kilohertz the ISO100s have very little power supply rejection capability.

EPM DC Power Supplies.

This design is an AC/DC converter, based on the Calex AC/DC supplies. In the ± 15V supply the Calex units have been paralleled to increase the available load current. The provision for optional output regulators has been included. At this time only the non-isolated + 12 V output supply is regulated. Additionally, each power supply unit has a front panel fuse to limit potentially damaging fault currents, and LEDs to indicate the condition of the outputs. Also, there are front panel test points so that the output voltages can be monitored. Finally, there is the capability to internally jumper the isolated power commons to the chassis ground, which is useful in bench tests.

References

1. C10 SEC Preamplifier, AGS/EP&S/Tech. Note 139, E. Beadle, January 21, 1992.