

BaBar Calorimeter DAQ Powering, Grounding & Shielding Plan

Version Control:	
	Uncontrolled copy. This means that this copy of the document may not be the latest version. You can download the latest version via the WWW from the BaBar Home Page-> Electronics->Calorimeter->System and Board Descriptions.
	Controlled copy issued to:

Author:	john.dowdell@rl.ac.uk		
File Name:	JohnD HD:BaBar:Write-Ups:P, G & S Plan:P, G & S Plan		
First Modified:	9-May-96	Last Modified:	13-Jan-97

CONTENTS

1. REVISION HISTORY.....	2
2. POWERING.....	4
2.1 PHOTODIODE BIAS VOLTAGE.....	4
2.2 POWER RAILS.....	4
2.3 REMOTE MONITORING.....	4
2.4 MAINS POWER.....	5
2.5 PHYSICAL PACKAGE.....	5
2.6 SAFETY/INTERLOCKS.....	6
3. POWER CABLES.....	7
3.1 SAFETY.....	7
3.2 BIAS SUPPLY.....	7
3.3 VREG, $\pm 5V$, INTERLOCK.....	7
3.4 QUANTITY.....	7
4. SHIELDING.....	8
4.1 SHIELDING OF THE PRE-AMPLIFIER.....	8
4.2 SHIELDING OF THE ADC BOARD.....	9
4.3 SHIELDING OF THE I/O BOARD.....	9
4.4 SHIELDING OF THE TRANSITION BOARD.....	9
4.5 SHIELDING OF THE ENVIRONMENTAL MONITORING BOARD.....	9
4.6 SHIELDING OF THE POWER SUPPLY CABLES.....	9
4.7 SHIELDING OF THE OTHER CABLES.....	9
5. GROUNDING.....	10
5.1 GROUNDING THE ADC AND I/O BOARDS.....	10
5.2 GROUNDING THE TRANSITION BOARDS.....	10
5.3 GROUNDING THE ENVIRONMENTAL MONITORING BOARDS.....	10

1. REVISION HISTORY

Date Issued	Description of Revisions
28-Aug-96	<ul style="list-style-type: none"> Description of DC power supplies expanded.
10-Oct-96	<ul style="list-style-type: none"> Regulator voltage changed to about 9.5V. 50% contingency on current consumption added.
19-Dec-96	<ul style="list-style-type: none"> Grounding of TRB and EMB Add spec for cable. Remove some options.
13-Jan-97	<ul style="list-style-type: none"> Update power consumption

2. POWERING

The scheme for powering the ADB and IOB is presented in the respective write-up.

Each barrel or end-cap IOB (and the ADBs and pre-amps that connect to it) is powered from its own power supply. Similarly the transition board is separately powered but for simplicity the same type of supply can be used for it. Therefore we need 110 supplies for the detector, plus spares. How the environmental monitoring board is powered needs to be clarified.

2.1 Photodiode Bias Voltage

The photodiodes require 60–80V to reverse bias them. Each diode will draw less than 20nA from this supply. The sum of the current drawn by all diodes will be about 300 μ A, worst case. Because the photodiode is at the very input to the signal chain (where we need a dynamic range of 18 bits) they are very sensitive to noise on the bias voltage.

This will be supplied by one (or a small number) of linear power supplies, situated in the electronics house. Each supply will be connected to the detector by one cable, which is daisy chained around the IOBs the supply connects to.

2.2 Power Rails

All three output rails are floating with respect to each other and to earth.

The current best estimate (including contingency) of the current drawn by a barrel IOB (and everything connected to it downstream, including pre-amps) is:

- From VREG (+10V) \pm 1%: 9A
- From the +5V \pm 1%: 9A
- From the -5V \pm 1%: 9A

Which implies a total power from the supply of approximately 180W.

Because of the nature of the analogue electronics the power supply ripple must be minimised, if possible it should be less than 10mV peak-to-peak.

All of these supplies will have remote sensing. The problem with this is that the voltage drop down 30m of 2mm² (14 AWG) cable at these currents could be 3V.

In the following a “supply” is the single unit that supplies VREG, \pm 5V to an IOB and a “regulator” is a device that supplies one of these voltages.

2.3 Remote Monitoring

We need to be able to read the voltage and current drawn from each regulator remotely. We may want to read temperature also? We will not want to set the voltage or current limits remotely. It is likely the monitoring will be performed using CAN bus.

We will have a single monitoring board in each power supply crate, connected to say 10 supplies. There is then only one CAN link per crate. The connection from supplies to monitoring board would then be differential sense lines via the backplane. The monitoring module would probably need to have its own power supply directly from the mains input.

2.4 Mains Power

The power supplies will be used in both the USA (in the system) and the UK (test rigs). There are several ways we can accommodate this:

- 1) Have autoranging, universal input supplies that couldn't care less what the input voltage/frequency is. These may (or may not) be pricey.
- 2) Have jumper selectable universal input supplies. The problem with this is that someone is bound to set the jumper to the wrong position at some point.
- 3) Have USA only input and use transformers for units used in the UK.

Currently all options are being investigated and when quotes are available it will be decided how to proceed.

2.5 Physical Package

Probably a fully shielded 6U height module (depth negotiable). Ideally it would be the width of two VME modules so we can fit 10 units in a standard crate with one slot spare for monitoring. This would require about 12 crates for the whole system.

In order to reach such a width we will need at least forced air cooling (one fan tray per crate). Preferably also heat exchangers per crate.

The output connector will probably be a 15 pin DIN41612 H-type. Mains will probably come in on one of these also.

2.6 Safety/Interlocks

The regulators should be shut off in the case of over current, over voltage or over temperature condition. Possibly “shut off” can mean “shut down” or “current limit”. However, in order to protect the front-end electronics, if any one regulator shuts off then all three in that supply should shut off together, but once you shut the whole supply down, how do you know which output tripped?

This might be achieved as follows:

- There is a TTL “DC OK” signal from each supply. This means that all three regulators are producing the set voltage. If any regulator shuts down either because of over current or over temperature conditions then the DC OK signal will be deasserted.
- There is a TTL “REMOTE ON/OFF” input for each supply. This remotely turns the regulators on and off.
- Both of these signals are connected to a SIAM module, which implements logic that turns the supply on and off under software control. In addition it will turn the supply off if the DC OK signal is deasserted OR the bimetallic switch on detector indicates the electronics is too hot.

3. POWER CABLES

3.1 Safety

All of the following power cables must meet at least one of the following standards for halogen free, low smoke and fume:

1. NFPA 262 (UL 910) "Modified Steiner Tunnel Test".
2. Factory Mutual Standard 3972, Group 1
3. CERN, Safety Instruction, IS 23, Rev 2
4. ASTM E 1354, ISO 560

3.2 Bias Supply

This is a two core (0.15mm² area, tinned copper), shielded cable. The current carried by the cable is much less than a milliamp.

This is a separate shielded cable because the front-end is very sensitive to noise on this supply and this voltage is generated separately from the other ones.

3.3 VREG, ±5V, Interlock

The power supplies are carried on three individual, identical, cables. Each cable contains a pair of current carrying conductors (2mm² area, 14 AWG, tinned copper), a shielded pair of sense conductors (0.15 mm² area, tinned copper) and a shielded pair of uncommitted conductors (0.15 mm² area, tinned copper). The cable has an overall braided shield.

Three cables of this type are required per IOB to carry the following supplies/signals:

1. VREG + sense
2. +5V + sense, interlock
3. -5V + sense

Where 'interlock' is a pair of wires connected to a temperature activated switch on the IOB that opens above a rated temperature to shut down the supplies.

In the case of cables (1) and (3) the uncommitted pair is unused. All three supply conductors will carry up to 9A.

3.4 Quantity

The exact length of the cables is not well known, it is expected to be 30m. We require 125 cables, including spares. Therefore we require $30 \times 125 \times 3 = 11.25$ km in total.

4. SHIELDING

The barrel and end-cap calorimeters both have a double shield around them — referred to as the inner and outer shields of the detector. As well as enclosing the calorimeter these shields run down the inside and outside of the barrel bulkhead respectively. In the end-cap they run down the inside and outside of the end-cap fan-out board. We will include several resistors between the two shields on the prototype barrel bulkhead and end-cap fan-out boards.

At least one of these shields will have to be connected to detector earth in at least one place.

Options for connecting the shields together include:

- don't connect them together, just connect them both to detector earth
- connect them together using the resistors on the bulkhead/FOB
- connect them both together with wire links in place of the resistors

Exactly how these shields are connected to each other and to earth is not yet decided.

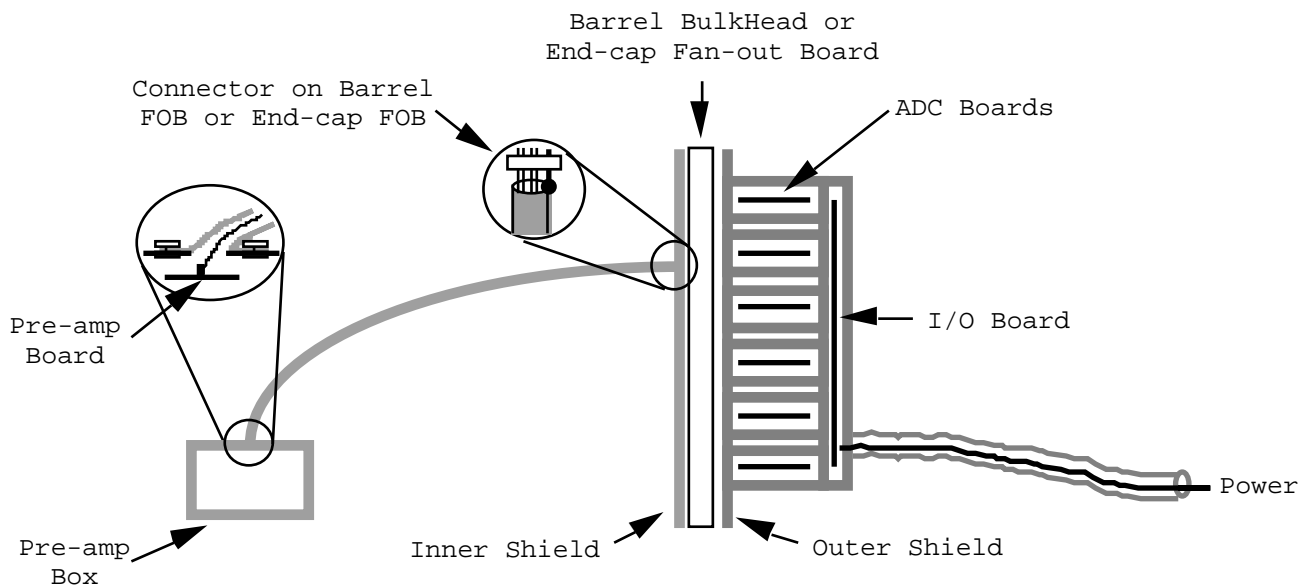


Figure 1 — Shielding Plan

Figure 1 shows the shielding plan, note the shields on each side of the bulkhead.

4.1 Shielding of the pre-amplifier

The pre-amplifiers are each in a shielding box. All shielding boxes are electrically isolated from each other.

The pre-amp is connected to the fanout board via a 20 way shielded cable. The outside of the cable shield is insulated so the shields are isolated from each other.

At the fanout board we foresee a connector with more than 20 pins so that the shield is connected via a drain wire to the unused pins on the connector and thence to the inner shield of the detector.

At the pre-amp box the shield is split into two and clamped onto the lid of the box to make electrical contact. This also performs the function of strain relief if the shield is an integral part of the cable. The preamp box is isolated from the pre-amp board.

4.2 Shielding of the ADC Board

The high density connectors from the bulkhead/FOB to the ADC board have shields around them, this shield is connected to the outer shield of the detector.

Both sides of the ADC board are shielded by screen cans. The construction of these cans will be such that they also shield the CARE chips from the formatters. These screen cans are connected to the shield of the high density connector and therefore to the outer shield of the detector.

The shielding of the ADC board is isolated from its power ground.

4.3 Shielding of the I/O Board

The inner face of the I/O board will be covered (hopefully completely) by a screen. There will be a screen can over the components on the outer face of the board.

Both shields will be connected to the outer shield of the detector. This will be via pins on the connector between the ADC and I/O boards.

4.4 Shielding of the Transition Board

The transition board will be enclosed in a shielded box, which will be connected to the outer shield of the detector via the shielded cables to each I/O board (carrying the CLINK and DLINK).

4.5 Shielding of the Environmental Monitoring Board

This will be the same as that of the transition board.

4.6 Shielding of the Power Supply Cables

The power supply cables will have an outer shield, which will be connected to the outer shield of the detector at the detector end. The shield will not be connected at the power supply end.

4.7 Shielding of the Other Cables

The other shielded cables from the IOB to the transition board and EMB will have their shields connected to the outer shield of the detector as soon as they reach it (for example they will connect to the backplate of the end-cap). The cables will then continue on and connect to unshielded connectors on the IOB.

5. GROUNDING

All power supplies are floating with respect to earth and to each other. This will minimise the problem of ground loops. At higher frequencies the isolation may be defeated by capacitive coupling, if this is a problem we could filter each supply cable using ferrites.

5.1 Grounding the ADC and I/O Boards

On each bulk-head (in the barrel) or fan-out board (in the end-cap) the power ground of the ADC boards will be connected to the outer shield.

On the prototype we will make this connection through a resistor, so we have the option of either not connecting or shorting with a wire link.

5.2 Grounding the Transition Boards

The 0V of the supplies are tied via a resistor to the shielding box.

5.3 Grounding the Environmental Monitoring Boards

The 0V of the supplies are tied via a resistor to the shielding box.