

**HIGH VOLTAGE DISTRIBUTION SYSTEM
FOR THE
DRIFT CHAMBERS
OF
CLAS**

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February 8, 1996

Introduction:

The eighteen drift chambers of CLAS (CEBAF Large Acceptance Spectrometer) instrument the six sectors defined by the toroidal magnet. In the radial direction, three regions are defined by the location of the chambers with respect to the target and to the magnet. Region 1 drift chambers are the closest to the target. Region 2 chambers are in the magnetic field, between the cryostats. Region 3 chambers are located just beyond the outer coil of the toroidal magnet.

The CLAS drift chambers are designed to have their own independent power supplies. Each drift chamber consists of an axial superlayer and a stereo superlayer. Each superlayer consists of six layers of sense wires surrounded by six field wires in a hexagonal arrangement. A single row of guard wires surrounds each superlayer of each drift chamber.

Field wires are (electrically) connected in groups of sixteen. Field wire groups are formed on the endplate by daisy-chaining. Similarly, guard wires are connected. Sense wires are daisy-chained on the HVTBs in groups of sixteen. Each sixteen wire group forms a HV channel. Sense and guard wires are of a positive potential whereas field wires are at negative potential. Of the 528 HV channels per region 2 and region 3 drift chamber, only 102 HV channels are available from their respective HV power supply. A high voltage distribution system is needed to provide HV to all region 2 and all region 3 drift chamber wires.

Each region 3 drift chamber has 24 stereo and 24 axial high voltage translator boards (HVTBs); a total of 48 HVTBs. Each board is instrumented with a high voltage cable which has twelve conductors (7 field channel wires, 3 sense channel wires, 1 guard channel wire and 1 ground wire). HV channels are jumpered between adjacent boards of the same super-layer. Hence, there are 14 field, 6 sense and 2 guard HV channels per board pair; (a total of 528 HV channels) per region 3 drift chamber.

Region 2 drift chambers have 25 HVTBs (12 axial and 13 stereo). With the exception of the first board # 0 (which has 2 HV cables) all other stereo HVTBs have 4 HV cables each. Two of the four HV cables are jumpered from the stereo to the corresponding axial board, electrically providing two cables per region 2 HVTB. Every pair of region 2 HVTB has 14 field, 6 sense and 2 guard HV channels (a total of 528 HV channels) per region 2 drift chamber.

Each region 1 drift chamber has 6 HVTBs. These HVTBs span both the stereo and axial superlayers. The number of HV channels varies among region 1 HVTBs. Region 1 HV system design does not require a distribution system.

Connections between drift chambers and HV cables are made through solder terminations on the HVTBs. The opposite end of drift chamber HV cables are terminated by a special nine contact HV connector. Region 1 HV cables mount directly to the Lecroy power supplies through the special HV connector. Region 2 and region 3 HV cables mount to HV distribution boxes utilizing the same type HV connector.

1.0 High Voltage Cable

The high voltage cable consists of twelve color coded 22 AWG stranded conductors insulated in F.E.P. Teflon, shielded with a copper braid. The copper braided shielding over conductors is required to have 90% or more coverage to prevent voltage fluctuation due to induced noise. The whole assembly is encapsulated in a red PVC outer jacket. Seven of these fourteen conductors are allocated for negative voltages (field channels), four are for positive voltages (three sense and one guard channel) and the last conductor for ground. The average high voltage cable length is 60 feet.

2.0 High Voltage Distribution Enclosure

To minimize installation time, every HV enclosure is designed to be directly mountable to the front side of a 19 inch rack. For proper clearance between equipment and HV cables within the 19 inch rack, the enclosure depth is designed to be 4 inches (outside dimension). In order to fit eighteen HV distribution boxes in one rack, the enclosure is designed to be 3.5 inches high (outside dimension) (see figure 1).

The high voltage cables from region 2 and region 3 drift chambers are grouped into pairs. Each cable pair is terminated by three HV connectors. One HV connector is shared by the sense and guard wires

of each cable pair. The remaining connectors are dedicated to the field wires from each cable. A group of 8 cables (12 connectors) are assigned to one high voltage distribution box. Every enclosure is designed to house one row of twelve HV receptacle connectors on the front panel, and two HV receptacle connectors and a SHV receptacle on the back panel. All fanout connections are done inside the enclosure. All 7 field wires in a HV receptacle are jumpered together and connected to one LeCroy channel. Sense wires are jumpered in groups of 3 per LeCroy channel. All guard wires in a HV distribution box are connected to a SHV and then to one LeCroy channel. (see figure 2).

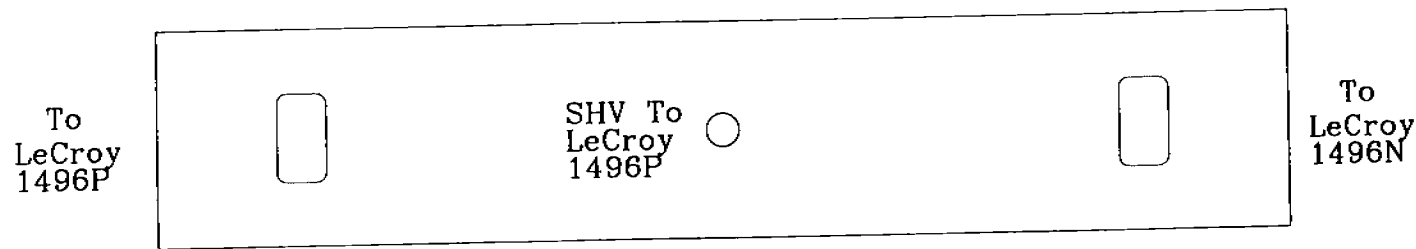
3.0 High Voltage DC Power Supply

The LeCroy 1469P and LeCroy 1469N power supply card has a maximum output of 3.5KV, 38 μ A per positive channel, 40 μ A per negative channel and mount directly in the LeCroy 1458 HV Mainframe which in-turn mounts directly to the front of a standard 19 inch rack. Each 1469 card has 24 HV channels. These 24 HV channels are divided into three 8 channel groups, each group is capable of a different voltage potential independent from the other groups. Each of the 8 HV channels can be turned on or off, within each group.

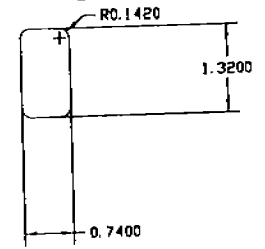
4.0 Safety Aspects

CEBAF's safety standards require HV cables to pass the CL2 rating from Article 725 of the NEC. Enclosure is require to be UL approved with a NEMA 1 rating so to prevent damage due to debris. The LeCroy HV power supply is UL approved.

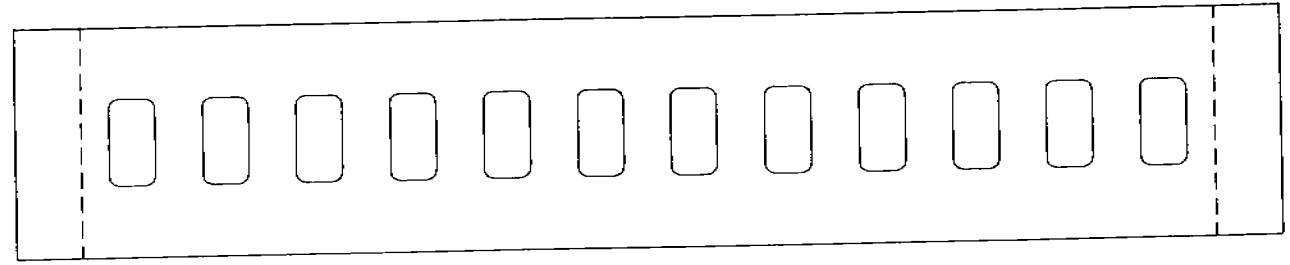
Back-side of HV Box



High Voltage Connector Panel Cut-Out Dimensions



Front-side of HV Box



From CLAS Drift Chambers

Figure 1

FROM
DRIFT CHAMBERS

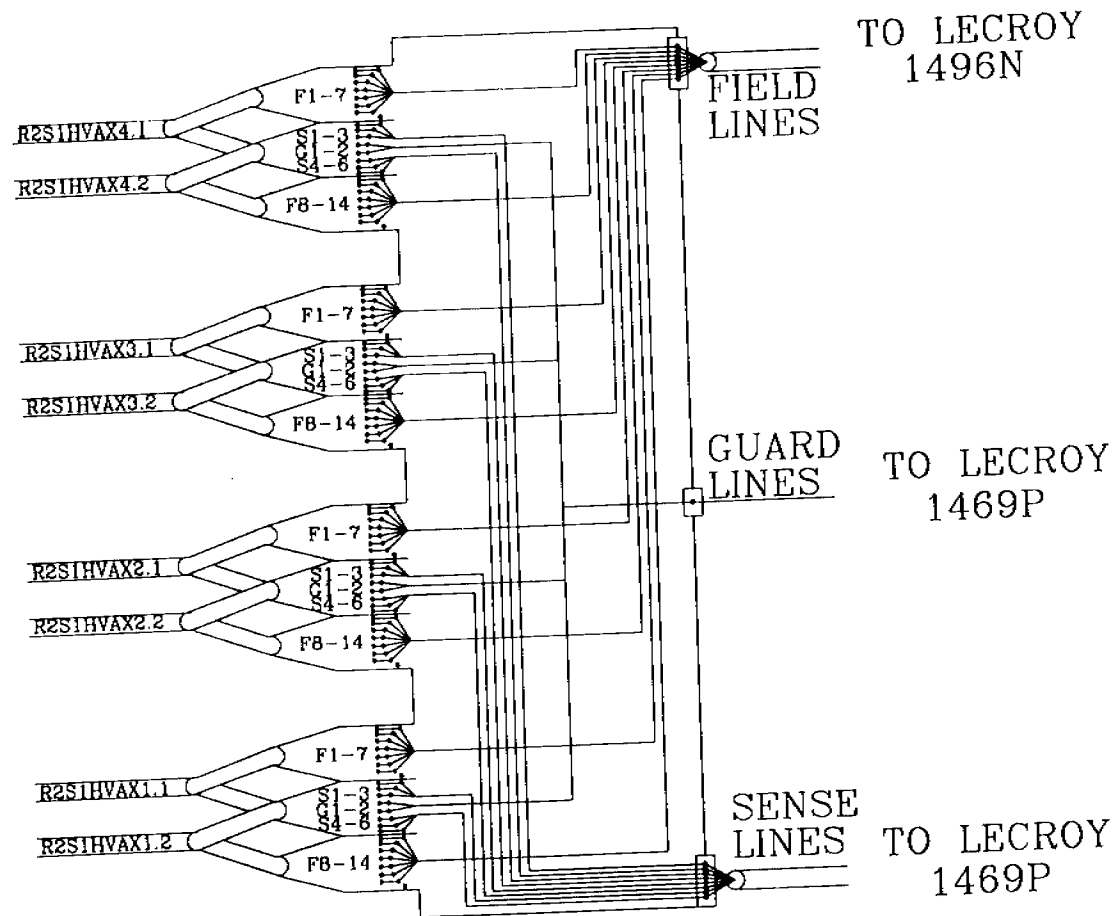


Figure 2