



# (PS/SPD) HV System

ECAL Upgrade II Workshop

Orsay

12-14 December 2022

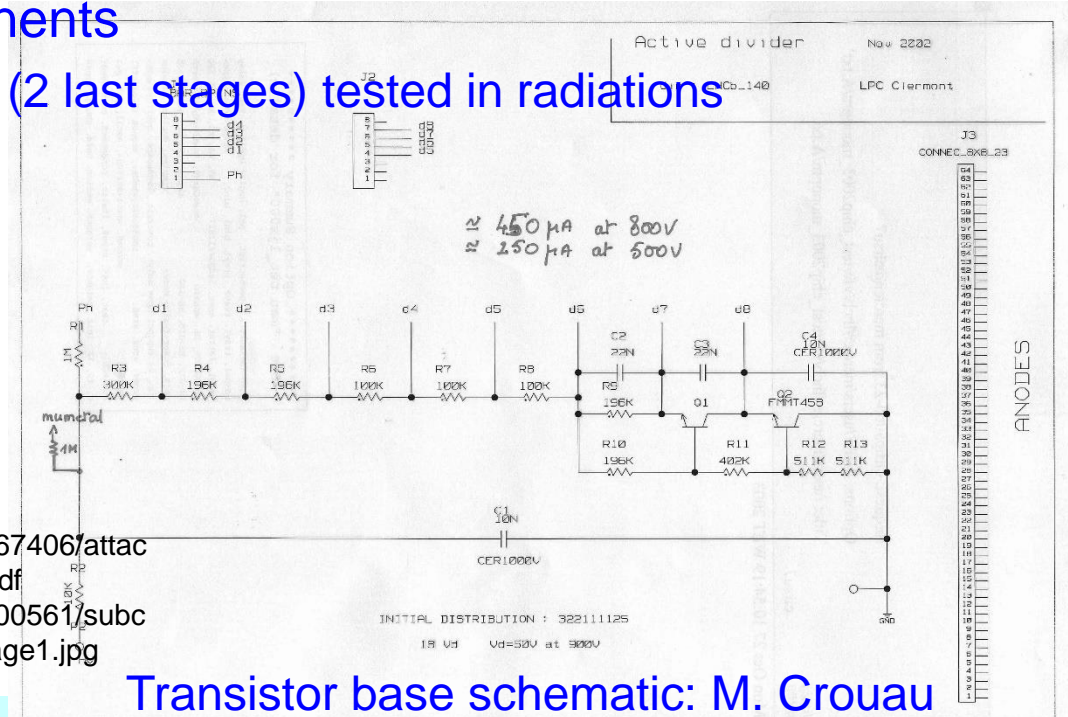
# PS/SPD MaPMT

## ◆ As a reminder:

- MaPMT (64-channels) located on top and bottom of the detector inside VFE boxes
  - 200 MaPMT for PS and SPD
- Multistage board:
  - PMT base, ASIC (analog part), connectors (signal, clock, LV, HV and temperature probes)
  - An active (transistor) base was chosen: the same for PS and SPD
  - Compact circuit few components
    - 1 resistor and 2 transistors (2 last stages) tested in radiations
  - Simplicity
  - HV between 500V to 900V



PS VFE board



<https://indico.cern.ch/event/410616/contributions/1867406/attachments/832022/1151064/MAPMThighcurrentbase.pdf>  
<https://indico.cern.ch/event/416146/contributions/1000561/subcontributions/80539/attachments/854825/1193198/page1.jpg>

Transistor base schematic: M. Crouau

# Overview of HV system for PS/SPD

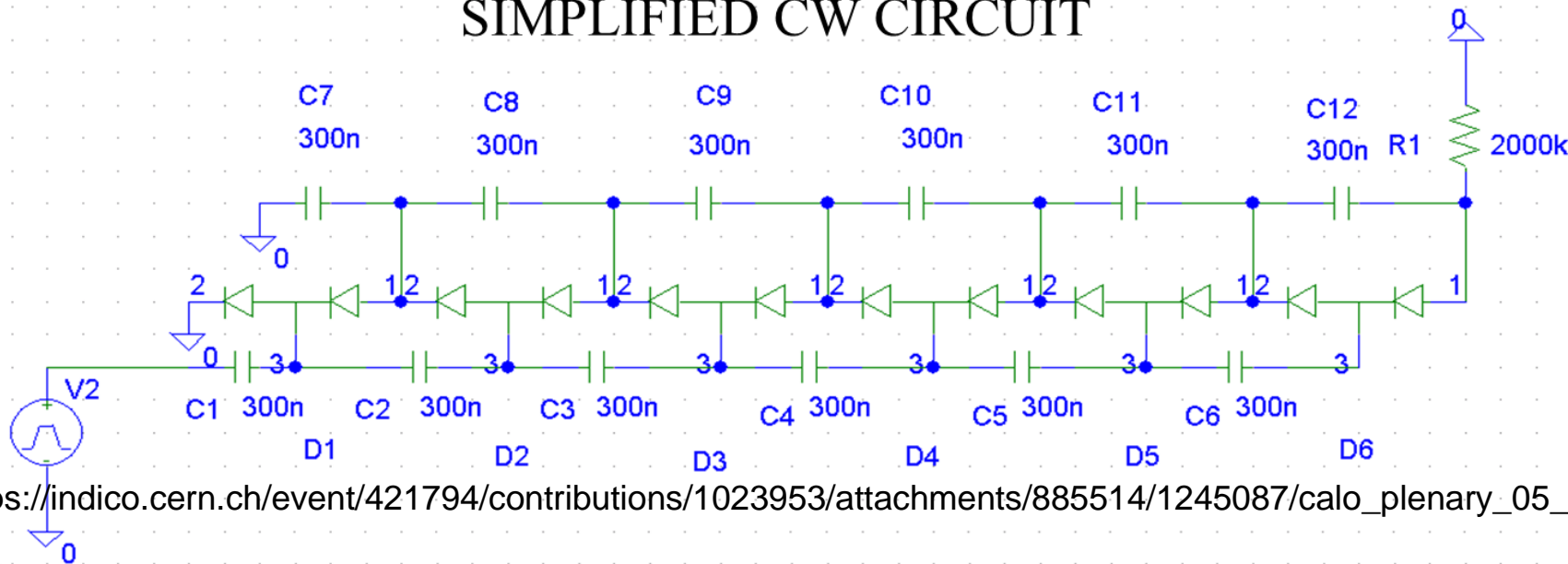
LHCb Plenary meeting 11/3/2005

## *HV system choice for SPD/PS*

- ✓ CW solution also adopted for SPD/PS HV system (-900 V)
- ✓ CW design based on ECAL/HCAL design (bigger capacitors)
- ✓ Control system based on ECAL/HCAL system
- ✓ CW located on 8 ch. HV board with 104 ch. in one crate (on ECAL platform)
- ✓ HV transmitted to classical transistor base on MaPMT
- ✓ prototype of CW HV system exists and lab tests successful
- to be fully validated on Clermont test-bench

- ✓ CW Designed made by Yuri Gilitsky (IHEP)
- ✓ Control signal distribution board derived from ECAL/HCAL HV control board by Anatoli Konoplyannikov

### SIMPLIFIED CW CIRCUIT



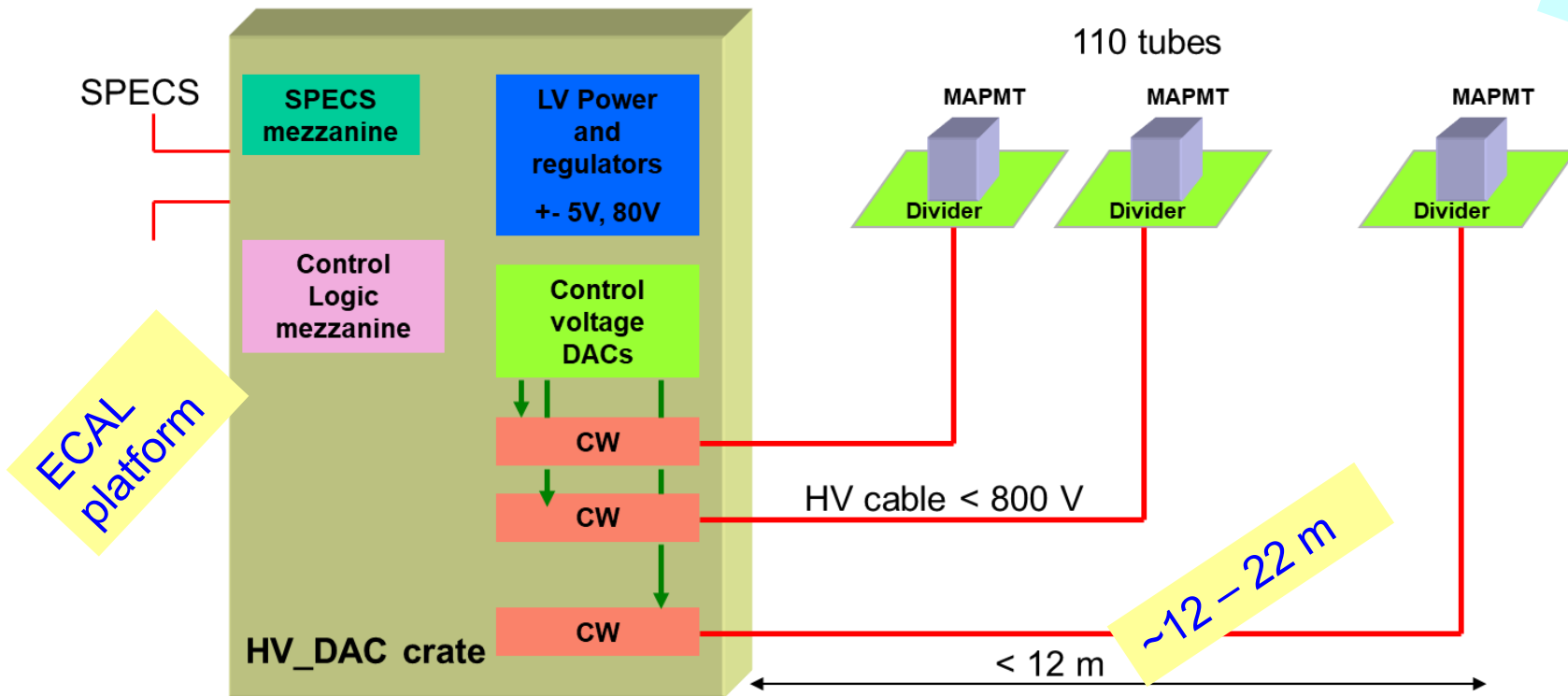
Yuri Guz has the final design

[https://indico.cern.ch/event/421794/contributions/1023953/attachments/885514/1245087/calor\\_plenary\\_05\\_03.ppt](https://indico.cern.ch/event/421794/contributions/1023953/attachments/885514/1245087/calor_plenary_05_03.ppt)

# Overview of HV system for PS/SPD



## Architecture of HV system for SPD/PS



LHCb CALO meeting  
08/06/2005  
Anatoli

### Details:

[https://indico.cern.ch/event/423632/contributions/1907431/subcontributions/171127/attachments/895616/1261810/hvSPD\\_PS.ppt](https://indico.cern.ch/event/423632/contributions/1907431/subcontributions/171127/attachments/895616/1261810/hvSPD_PS.ppt)

The MAPMTs of the SPD/PS are installed on the top and under detector and equipped with a transistor divider. Relatively low HV (< 800 V) feeds each divider through the HV cable.

The CW converters and board with the control voltage DAC ICs are housed into 6 U VME crate inserted into the rack on the electronics platform.

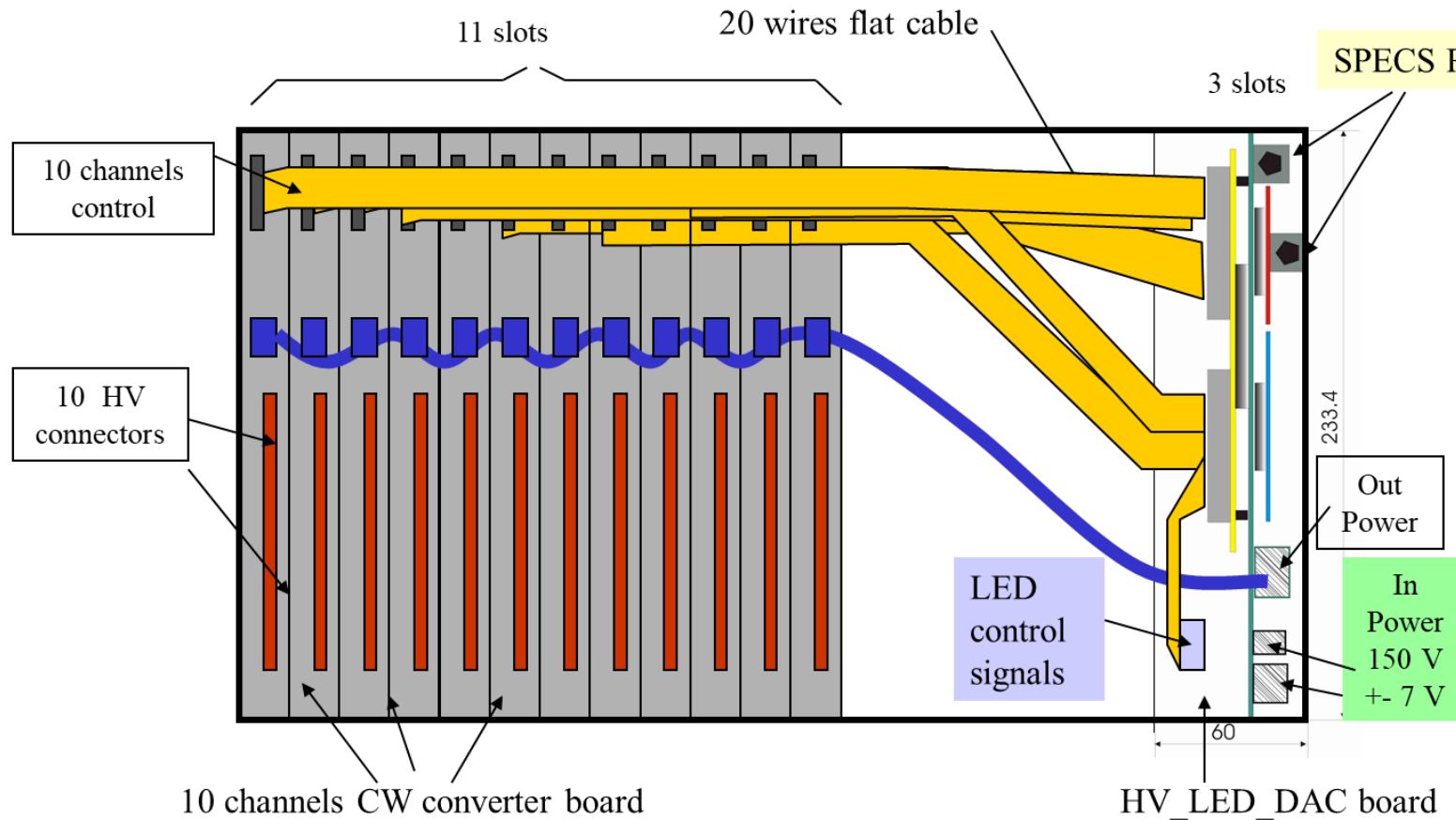
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Calorimeters

# Overview of HV system for PS/SPD



## SPD/PS HV system (proposal)

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Sketch of the front view of the 6 U VME crate with 110 HV channels and 10 LED control signals

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# Overview of HV system for PS/SPD

From PP Agilent: 150V -18V

Final design



## HV system for SPD/PS

6 U VME crate without backplane will house eleven one slot 10 channels CW boards and one three slots HV\_LED\_DAC control signal distribution board. The functionality of the HV\_LED\_DAC board is the same as for ECAL/HCAL one. 10 channels CW board is offered, due to the following reasons:

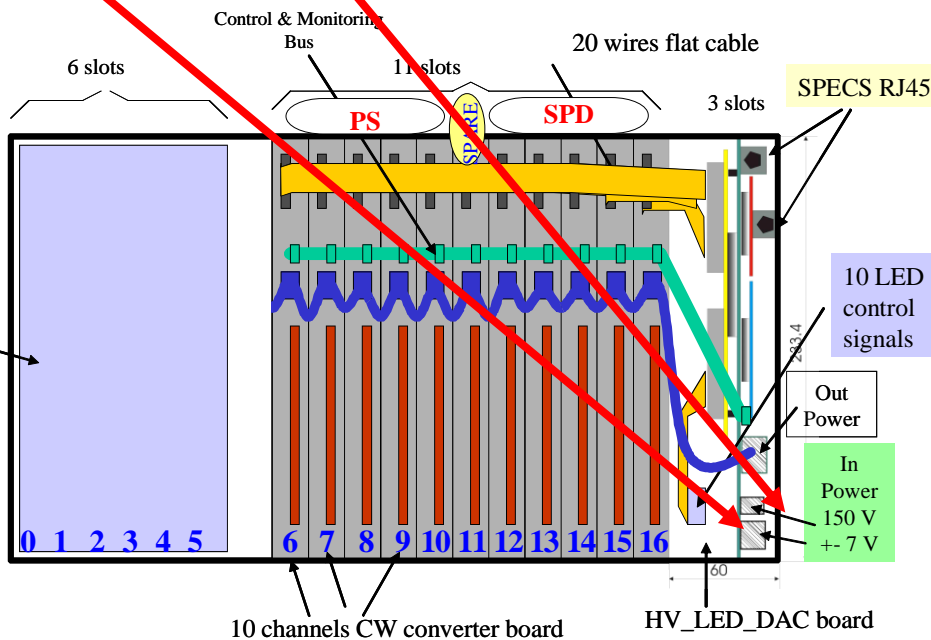
- natural connection with HV mezzanine (ECAL/HCAL HV mezzanine board has two of 20 channel connectors and it is easy to split on two flat cables);
- the miniature HV (with isolation 1.5 kV) MOLEX Mini-Fit connector could be used for powering individual MAPMT. It has small size, relatively low price and satisfied the CERN requirements. 10 connectors are well fitted on a one slot front panel.

The control of the 110 HV channels and 10 LED channels is managed by the control signal distribution board equipped with the same mezzanines as ECAL/HCAL one.

- three HV mezzanines with DACs;
- one Control mezzanine;
- one SPECS mezzanine.

Only the mother board has to be redesigned.

Maraton L3B01 (11) :+-7volts



<700V  
30 meters  
Cables x15  
TK24-U

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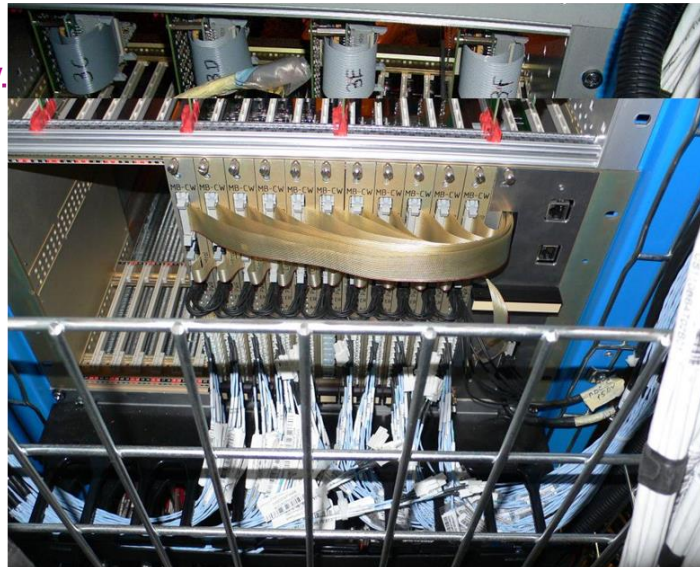
# Overview of HV system for PS/SPD

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05/06/2007

## PS/SPD HV Status

### System specification:

- ◆ HV output voltage is in range 100V – 800 V.
- ◆ LED intensity control signal is in range from 0 to 5 V. Setting precision is 12 bits.
- ◆ LV input power voltages: + 6.5 V ( current ~ 600 mA for crate), - 6.5 V (current ~ 500 mA for crate).
- ◆ Current from 150 V power supply is about 550 mA per crate.
- ◆ Over current protection:
  - for 150 V : individual for each ch;
  - for LV: individual for a board (10ch)
- ◆ Monitoring parameters:
  - HV and LED control voltages
  - Over current protection status;
  - 150 V and LV power supplies settings



Power supplies, HV cables to be connected

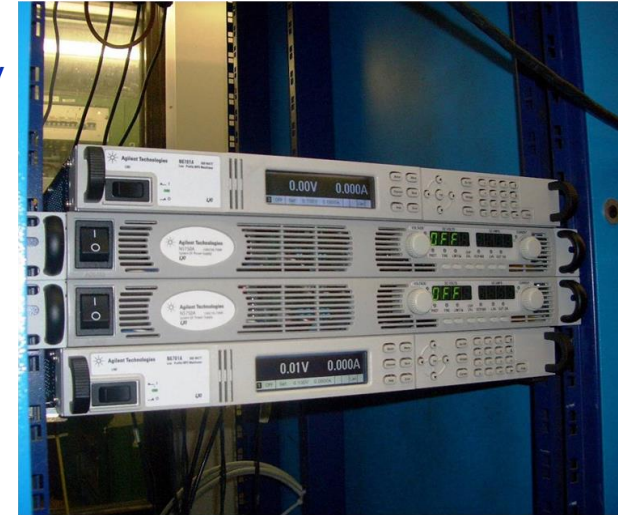
- Production of the PS/SPD HV system is finished.
- QC tests of the PS/SPD HV system have been done. Result is OK.
- One PRS HV (side C) crate has been installed.

05/06/2007

Pascal Perret - LPC Clermont

## PS/SPD HV Status (cont')

- ◆ Agilent power supplies are the part of the calorimeter HV system. They produce the 100 V power for CW bases.
- ◆ The power supplies are connected to LHCb ECS control system.
- ◆ Preproduction software has been developed for integration to LHCb ECS system. (cf Xavier)
- ◆ Control/monitoring will be installed on psdaqhvc01w PC



05/06/2007

Pascal Perret - LPC Clermont

[https://indico.cern.ch/event/16379/contributions/242632/attachments/194859/273339/PS-SPD\\_PP-070605c.pdf](https://indico.cern.ch/event/16379/contributions/242632/attachments/194859/273339/PS-SPD_PP-070605c.pdf)

# Overview of HV system for PS/SPD

## ◆ Connectors HV boards



### FEATURES AND SPECIFICATIONS

#### Features and Benefits

- Peg-mounted for increased board retention
- Low profile for space constraints
- Positive housing locks
- Fully isolated terminals to protect contacts from damage

#### Reference Information

Product Specification: PS-5556-0001  
 Packaging: Tray or bag  
 UL File No.: E29179  
 CSA File No.: LR19980  
 TÜV License No.: R75142  
 Metals With: **5557** dual row connectors

#### Electrical

Voltage: 600V  
 Current: (Used with 16 AWG)

Circuits	2-3	4-6	7-10	12-24
Amperes-Jr.	9	8	7	6
Amperes-HCS	12	11	10	9

Contact Resistance: 10mΩ max.  
 Dielectric Withstanding Voltage: 1500V  
 Insulation Resistance: 1000 MΩ min.

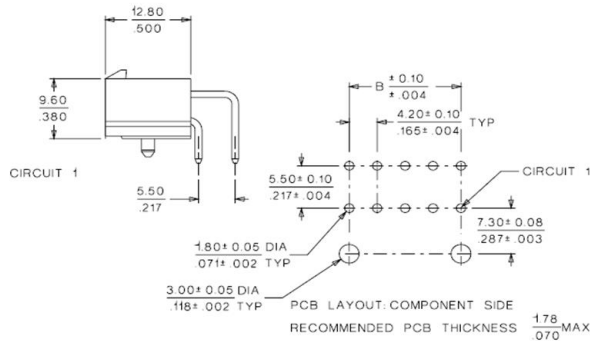
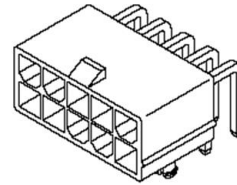
#### Mechanical

Insertion Force to PCB: 5.0kg max.  
 e: 0.7kg (1.54 lb) max.  
 x: 0.35kg (0.7 lb) min.  
 e: 200g min.  
 0 cycles

1/6 nylon, UL 94V-2 or 94V-0  
 SS  
 select Gold or overall Gold  
 temperature: -40 to +105°C

**molex** 4.20mm (.165") Pitch  
**Mini-Fit, Jr.™**  
**Header**

**5569**  
**Right Angle, Dual Row**  
**With Pegs**



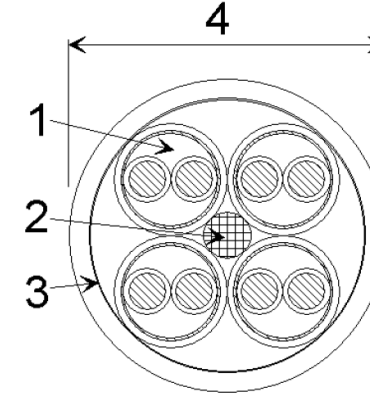
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LHCb CALO meeting 8.06.05

Anatoli Konoplyannikov

## ◆ Cables

Draka-Fileca TK24-U 4845-0001A F 4811P002



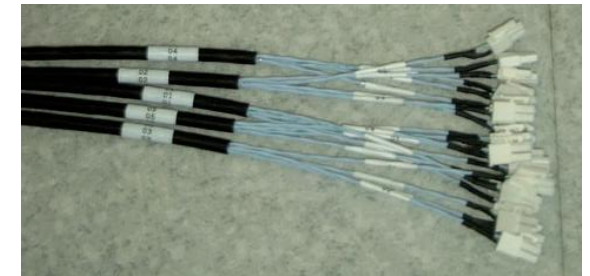
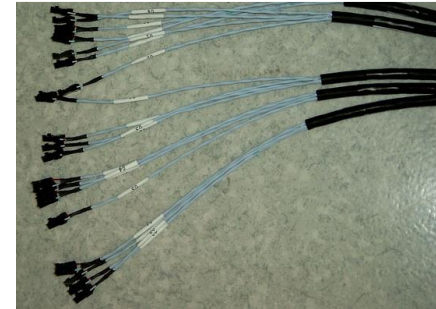
Diameter: 7.2 mm

#### Descriptif :

- 1 - 4 Paires blindées gainées AWG24 : réf TK24-U (éléments bleu pâle + rouge et gaine bleue Ø2.30mm maxi)
- 2 - Fausse branche silionne
- 3 - Ruban d'assemblage Ppolyester
- 4 - Gaine 0 Hal, Ø = 7.2 0 +/-0.30mm - couleur = noire

#### Caractéristiques principales :

- Tension de service = 900V DC
- Les paires blindées gainées sont homologuées suivants les spécifications aéronautiques ASN E0272TK
- Poids 48 kg/km
- Rayon de courbure 45mm



Connectors:  
 Antelec FA-S1-03

Molex 3901-2025



# HV system for ECAL

- A similar system could be used to provide HV to ECAL PMT
  - It was very robust: 1 single channel broken
- The main challenge is the number of channels and to find a place for its location
  - PS/SPD HV system:
    - 6U board, 10 channels/board + control system, 1 crate/side hosting 11 boards + control system + LED
    - Power supplies: 7V from a Maraton shared with LED system + 100V from Agilent PS in the barracks
  - We could have ~18-20 channels/board (given by the connector dimensions) if connections with the control board is on the backplane. A 9U board could be used if more convenient?
  - Few numbers for 30208 channels:
    - If 20 boards/crate and 20 channels/board  $\Rightarrow$  38 crates/side (42 for 18 channels!)
      - + xx Maraton
    - 3776 cables (with 4 cables in one) per side to distribute HV to PMT
- How to reduce the size of the system?:
  - Could we use part of the current CW HV system for shashlik modules (or a fraction)?
  - Could we deal with a common HV for few channels to reduce the size of the system?
- A lot to be studied!