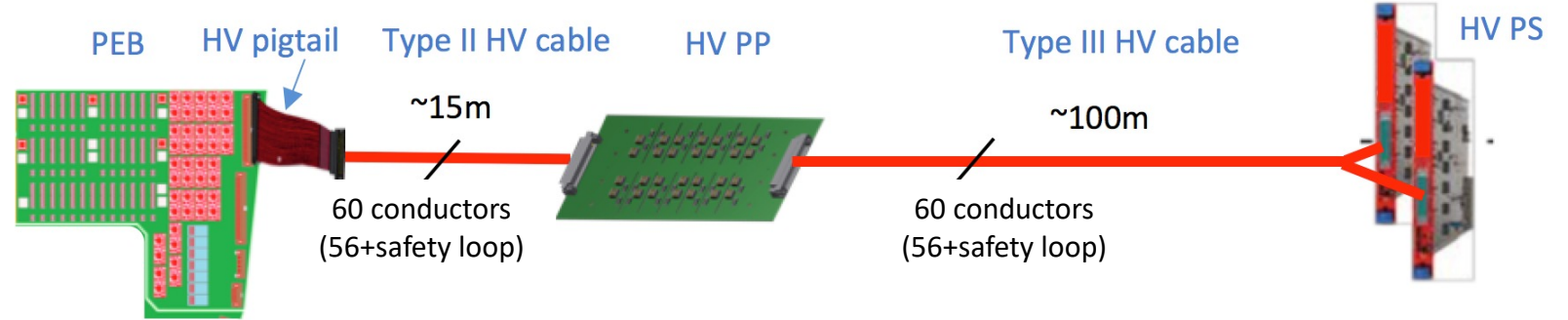


HGTD HV Connectors

R.Gonçalo (LIP/UC)

HV Cables



Long cables (Type III, 100m)

- **(A)** HVPS side (USA15):
 - 2 connectors/cable
 - Occasional access in service cavern
- **(B)** PP side:
 - 1 connector/cable
 - Low accessibility and frequent disconnections, so must be robust

Proximity cables (Type II, 15m)

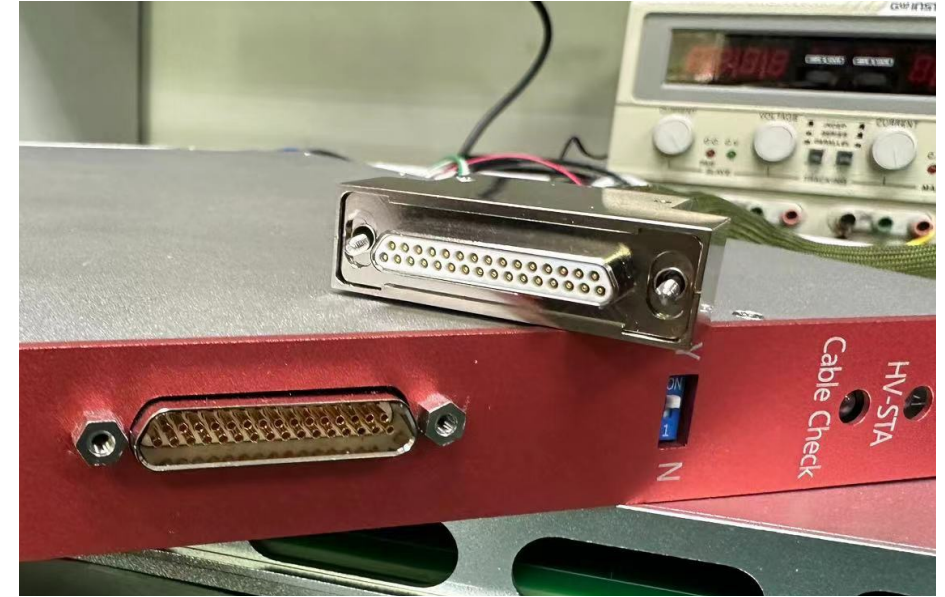
- **(C)** PP side:
 - 1 connector/cable
 - Occasional access once installed
- **(D)** Vessel side:
 - 1 connector/cable
 - Space restrictions
 - Occasional access once installed

Parameter	Value
Number of conductors	56, pairs laid up together
Conductor	Tinned copper 0.14 mm ² (AWG26)
Screening	Tinned copper braid Ø 0.15 mm, coverage ≥ 75%, <u>drain wire under screen</u>
Fire barrier	<u>Aluminium</u> - polyester
Linear resistance	140 Ohm/km max @ 20 °C
Rating voltage	≥ 1000 <u>Vdc</u>
Test voltage	3000 <u>Vdc</u>
Temperature range	(-20 ÷ +70) °C
Radiation resistance	Radiation index according to IEC 60544-4, <u>≥ 5.7</u>
Safety specifications	According to SSI-FS-2-1 and IS 41
Maximal outer diameter	16 mm
Sheath	Halogen free
Initial tensile strength	25 <u>MPa</u>

Smaller index needed for long cables from USA15

(A): Long cables HVPS side

- HVPS company plans to use connector JG J29A-31TJL-D
 - Bought easily in Chinese market
 - Price: 600 RMB per connector pair (77 EUR)
 - Connector manufacturer: <http://www.jiegaodz.cn/>
 - Questions (for Lei):
 - Ease of mounting?
 - What is normal operating voltage?
 - Can company use female connector on HVPS side?
- Previously Suen studied D-Sub connectors – see below
 - Seem useful for proximity cables



(B): Long cables PP side

- Difficult access
- Several disconnection cycles
- Need for mechanical robustness
- Around 130 EUR/connector (2021 price)
- <http://www.farnell.com/datasheets/2916873.pdf>

Specifications:

Insulator Material	Diallyl Phthalate, Thermoplastic Polyester or Polycarbonate UL 94V- 0
Color	Green or Grey
Contact Material	Copper Alloy
Contact Plating	Gold Plating over Nickel over entire contact
Current Rating	8.5 Amperes
Contact Resistance	10 milliohms maximum
Withstanding Voltage	2000 VAC rms at sea level
Insulation Resistance	5000 Megaohms minimum
Operating Temp	-40°C to +125°C (Diallyl Phthalate Only)
Operating Temp	-40°C to +105°C
Insertion & Withdrawal Force	2 to 16 Oz (0.56 to 4.45N) per contact position

516 SERIES

RACK AND PANEL CONNECTOR (PLUG AND RECEPTACLE)

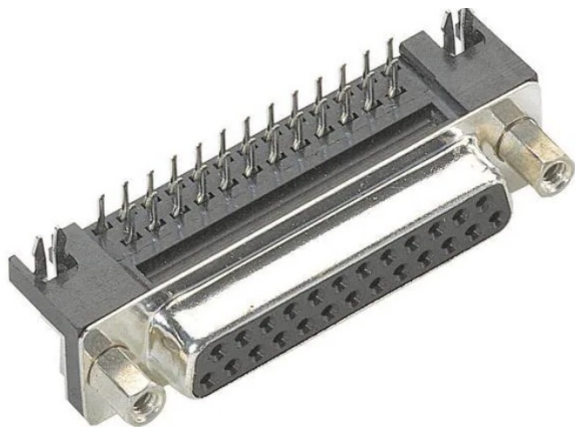
- **FEATURES:**
- .150" (3.81mm) Contact Spacing x .130" (3.30mm) or .150" (3.81mm) Row Spacing with staggered Grid
- Plug and Receptacle in 20, 38, 56, 90 and 120 Contact Sizes
- Edacon Hermaphroditic Contact Mating Design
- Contact Termination Options include Crimp, P.C. Tail, Wire Hole and Wire Wrap
- Mating and Unmating Simplified with use of Actuating Screws
- Optional Covers with Side or Top Entry Cable Clamp in Plastic or Metal material Available for all Connector Sizes
- Versatile Metal Cover Design permits Assembly or Disassembly After Cabling is Complete plus Cable Entry Style Flexibility
- Actuating Screws, Locknuts, Polarizing Hardware, Covers and Contacts Suitable for either Plug or Receptacle
- Polarizing Hardware Adjustable for 288 Mating Combinations
- Tools Available for Contact Installation, Removal and Crimping and Polarizing Changes
- RoHS Compliant & UL Certified

EDAC

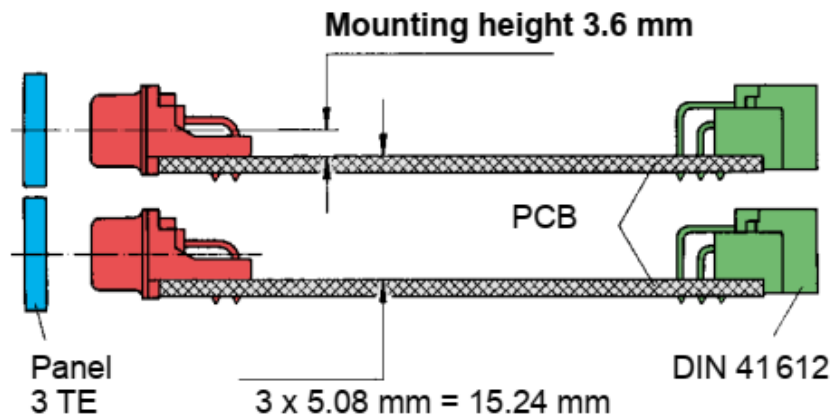


(C): Proximity cables PP side

- No frequent access needed
- D-SUB Previously studied by Suen with good results



27.03.24



HGTD Cable & Optical Services

Working current see current carrying capacity chart Turned contacts Stamped contacts	7.5 A max. 6.5 A max.
Test voltage $U_{r.m.s.}$	1 kV
Clearance and creepage	≥ 1.0 mm
Contact resistance Insulation resistance	≤ 10 m Ω $\geq 10^{10}$ Ω
Temperature range The higher temperature limit includes the local ambient and heating effect of the contacts under load	-55 °C ... +125 °C
Terminations	a) Solder pins \varnothing 0.6 mm for P.C.B. holes \varnothing 0.8/1 mm b) Solder pins, angled 90° \varnothing 0.6 mm for P.C.B. holes \varnothing 1 mm

(D): Proximity cables vessel side

- Space restrictions
- Nikomatic connectors identified by Sergei

ELECTRICAL

- All contacts 3 A max. @ 25°C
2.2 A max. @ 85°C
- Working voltage (sea level) Tested at 800 V DC
- Proof voltage Tested at 1 200 V DC
- Contact resistance (initially) max. 10 mΩ
- Insulation resistance 1 000 MΩ min.

MECHANICAL

- Mechanical operations Up to 2500 cycles
- Contact insertion and withdrawal force 2 N max. / 0.2 N min. per contact
- Contact retention in insulator 10 N min.
- Contact replacement in insulator 3 cycles (Crimp contacts only)

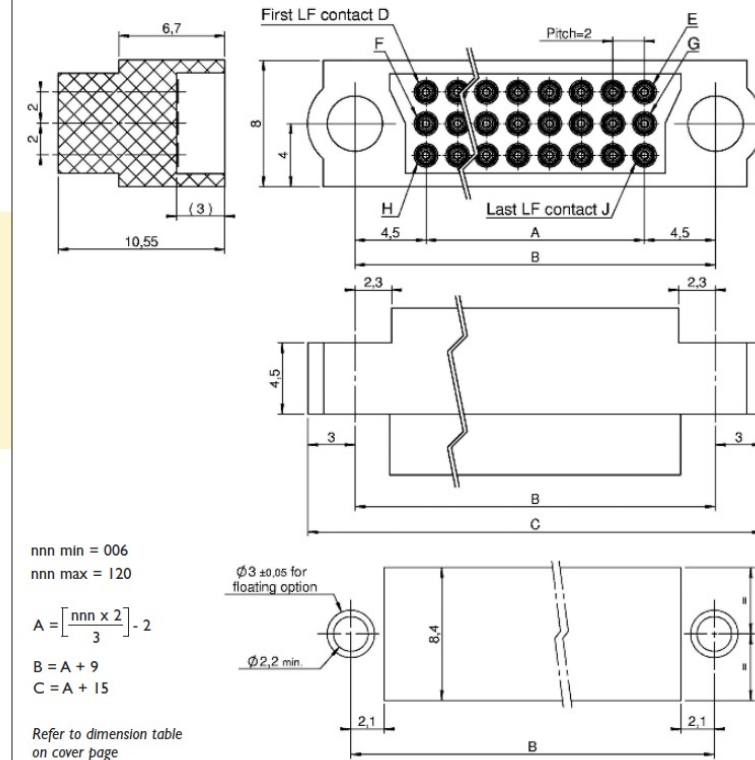
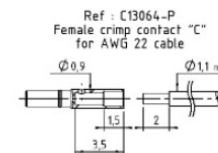
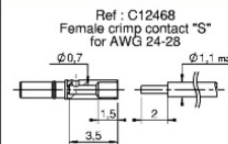
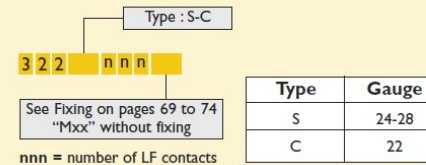
ENVIRONMENTAL

- Temperature range From - 60°C to + 260°C
Reflow solder process compatible (+260°C)

CRIMP FOR LF CONTACTS ONLY



Part numbering :



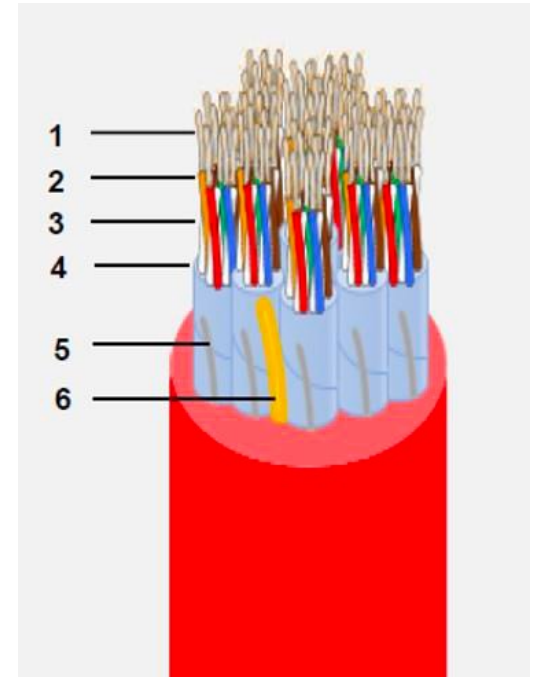
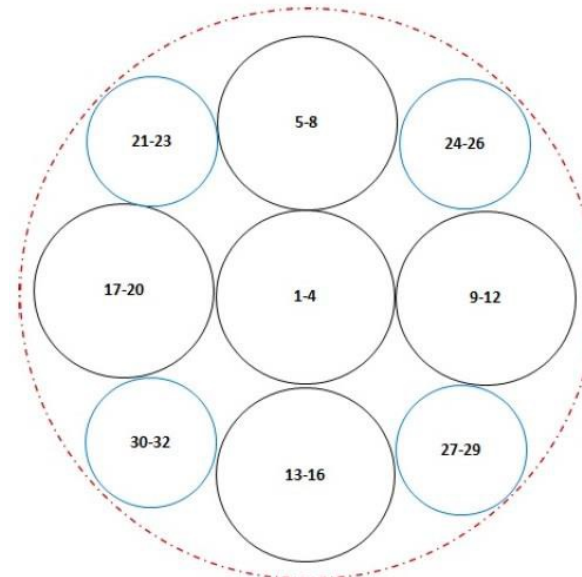
Action Items

- Ricardo & Luis:
 - Ask Agostinho Gomes for procedure to get Technical Coordination approval for TileCal proposed Sub-D connector
 - Send samples of TileCal proposed Sub-D connector to Suen and Lei for testing
 - Get updated quotation for EDAC 516 connector from company
- Suen:
 - Send samples of Sub-D connector to Lei and Ricardo for testing
- Lei:
 - Find what is normal operating voltage for JG J29A-31TJL-D connector
 - Ask company if they can use female connector on HVPS

Backup

Cables: from TileCal (General Cable)

- Last version not good in fire test – needed to change insulation thickness
- Two new prototypes are being produced – to be done this week or next
- Circular section, unlike last one
- Expected diameter 13.5– 14 mm



Connectors

REF:516-120-000-101 REF:516-056-000-301 REF:516-120-000-402 REF:516-056-000-402 REF:516-230-512 REF:516 230-556

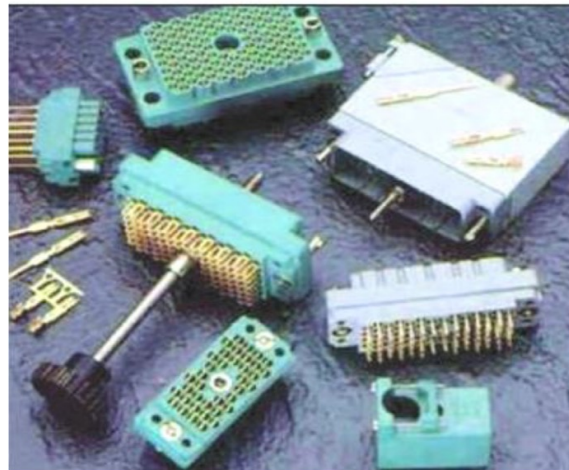
- We have been using this one for Patch Panel development:
 - <http://www.farnell.com/datasheets/2916873.pdf>
 - Unit price (120 pins, small quant.): 53 € plug; 45 € pins; 26 € conector (old price)
 - Good mechanical stability

- Looks good for long-cable to Patch Panel conneciton



516 SERIES

RACK AND PANEL CONNECTOR (PLUG AND RECEPTACLE)

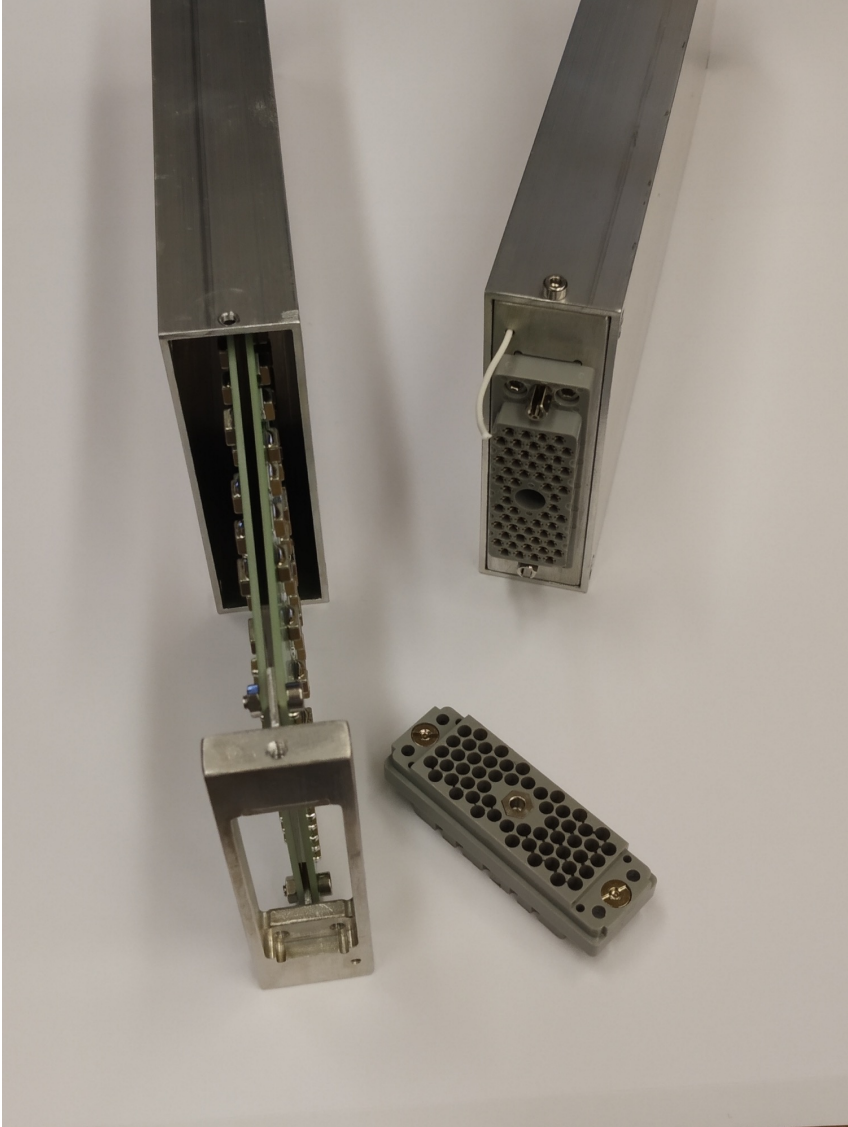


FEATURES:

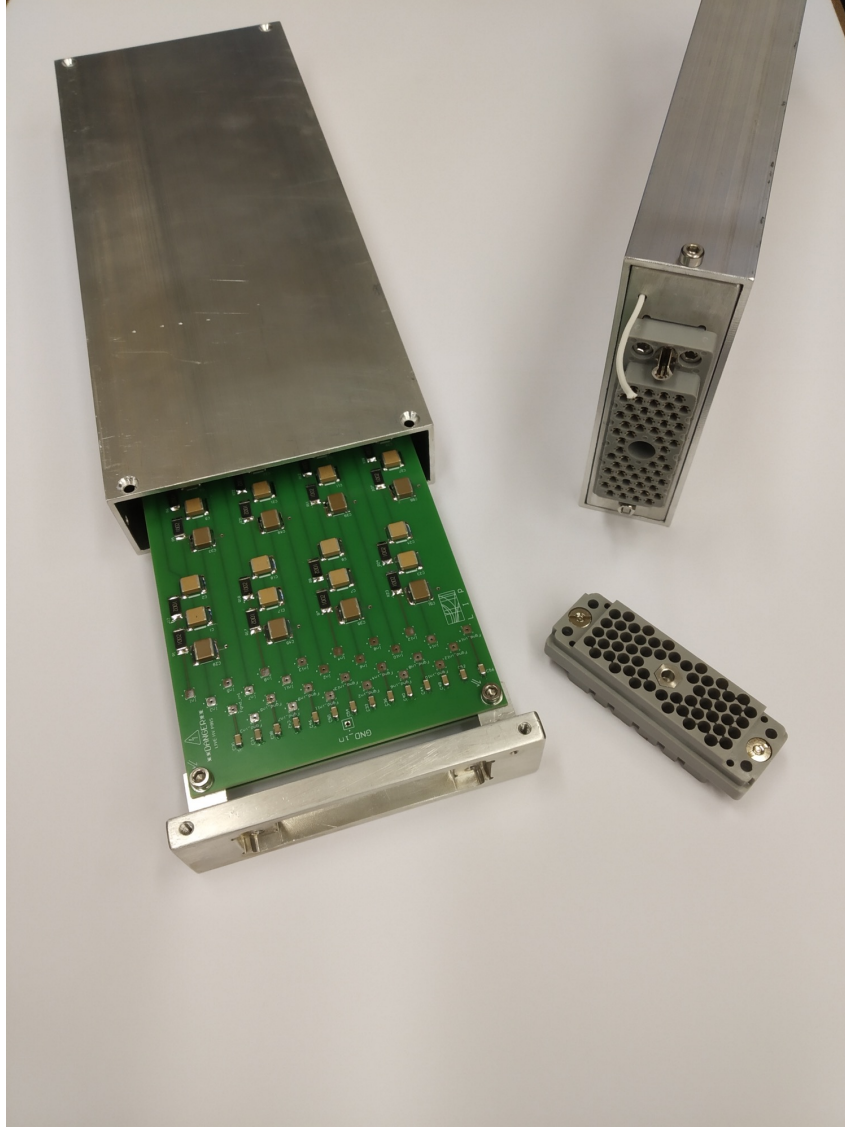
- .150" (3.81mm) Contact Spacing x .130" (3.30mm) or .150" (3.81mm) Row Spacing with staggered Grid
- Plug and Receptacle in 20, 38, 56, 90 and 120 Contact Sizes
- Edacon Hermaphroditic Contact Mating Design
- Contact Termination Options include Crimp, P.C. Tail, Wire Hole and Wire Wrap
- Mating and Unmating Simplified with use of Actuating Screws
- Optional Covers with Side or Top Entry Cable Clamp in Plastic or Metal material Available for all Connector Sizes
- Versatile Metal Cover Design permits Assembly or Disassembly After Cabling is Complete plus Cable Entry Style Flexibility
- Actuating Screws, Locknuts, Polarizing Hardware, Covers and Contacts Suitable for either Plug or Receptacle
- Polarizing Hardware Adjustable for 288 Mating Combinations
- Tools Available for Contact Installation, Removal and Crimping and Polarizing Changes
- RoHS Compliant & UL Certified

Specifications:

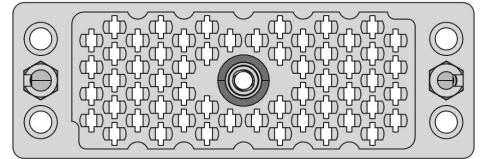
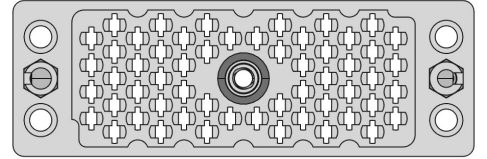
Insulator Material	Diallyl Phthalate, Thermoplastic Polyester or Polycarbonate UL 94V-0
Color	Green or Grey
Contact Material	Copper Alloy
Contact Plating	Gold Plating over Nickel over entire contact
Current Rating	8.5 Amperes
Contact Resistance	10 milliohms maximum
Withstanding Voltage	2000 VAC rms at sea level
Insulation Resistance	5000 Megaohms minimum
Operating Temp	-40°C to +125°C (Diallyl Phthalate Only)
Operating Temp	-40°C to +105°C
Insertion & Withdrawal Force	2 to 16 Oz (0.56 to 4.45N) per contact position



27.03.24

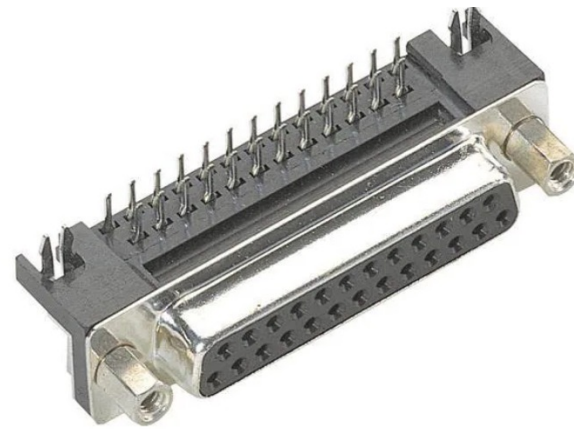


HGTD Cable & Optical Services

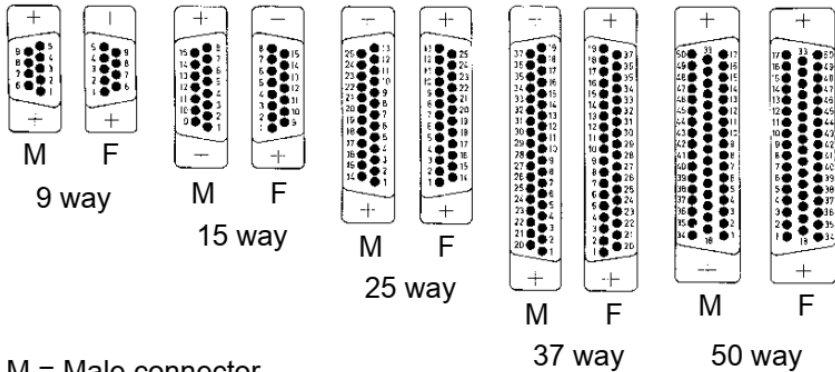


11

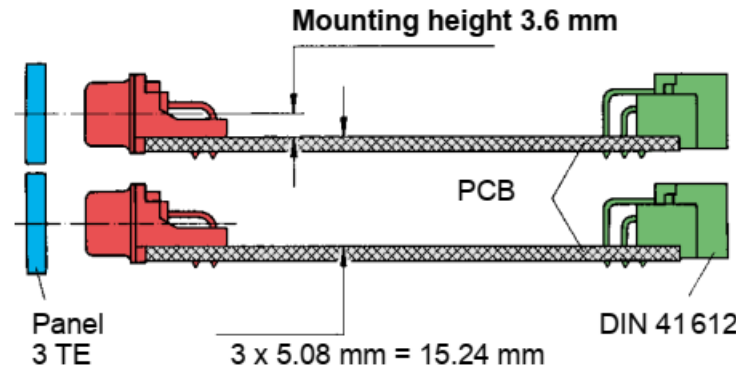
• D-SUB connector



Contact arrangement View from termination side



M = Male connector
F = Female connector



Working current see current carrying capacity chart Turned contacts Stamped contacts	7.5 A max. 6.5 A max.
Test voltage $U_{r.m.s.}$	1 kV
Clearance and creepage	≥ 1.0 mm
Contact resistance Insulation resistance	≤ 10 m Ω $\geq 10^{10}$ Ω
Temperature range	-55 °C ... +125 °C The higher temperature limit includes the local ambient and heating effect of the contacts under load
Terminations	a) Solder pins \varnothing 0.6 mm for P.C.B. holes \varnothing 0.8/1 mm b) Solder pins, angled 90° \varnothing 0.6 mm for P.C.B. holes \varnothing 1 mm

Professor Hou recommended a D-SUB high-voltage connector, Most parameters meet the requirement of 900V.

Some D-SUB type can be soldered onto PCBs and the size is fine.

Very cheap!

Previous HVPS side connector

1 Specification

Plug: BYS240-32TKL-A-X01 (1000PF/0.2)

Socket: BYS240-32ZJWP

2 Technical parameter

2.1 Electrical parameters

- Rated current: 3A
- Contact resistance: $\leq 18\text{m}\Omega$
- Insulation resistance: $\geq 5000\text{M}\Omega$
- Withstand voltage: 3000V (DC) 1 minute without breakdown or flashover

2.2 Mechanical parameters

- Mechanical life: 1000 times
- Vibration: 10~2000Hz 147m/s²
- Impact test: 980 m²/s

2.3 Other parameters

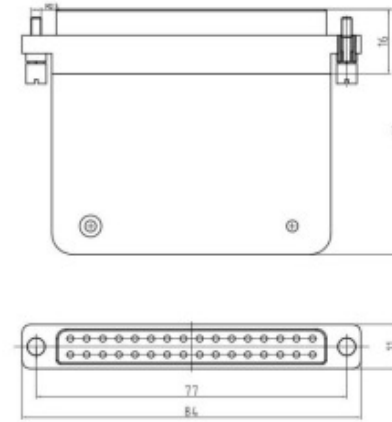
- Ambient temperature: -55℃~+125℃
- Supporting conductor: Cross-sectional area of conductor core 0.2mm²

2.4 Material and surface treatment

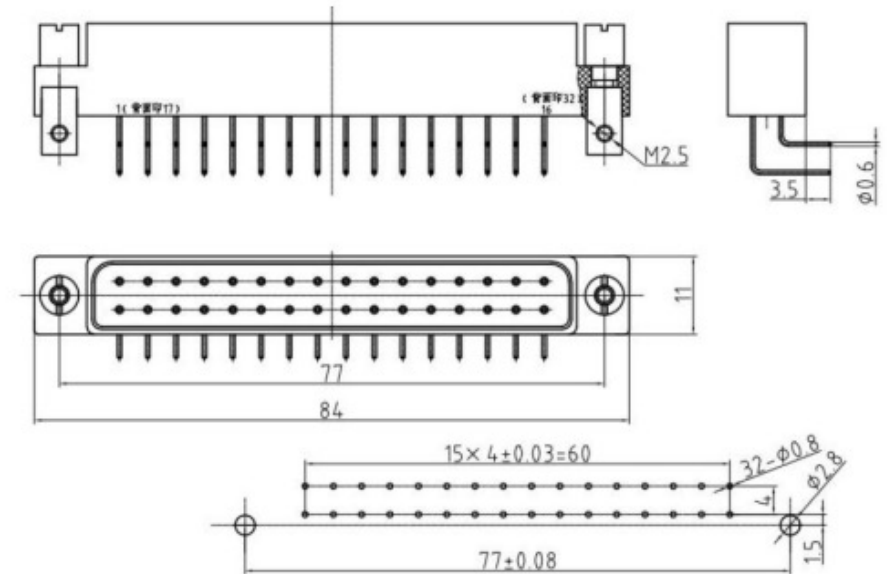
- Base and clamp: Polyphenylene sulfide (PPS)
- Pinhole: Gold plating on copper alloy
- Others: Stainless steel passivation

3 Outline dimension drawing

3.1 Plug BYS240-32TKL-A-X01 (1000PF/0.2)



3.2 Socket BYS240-32ZJWP



IDC Connectors – from Agostinho Gomes

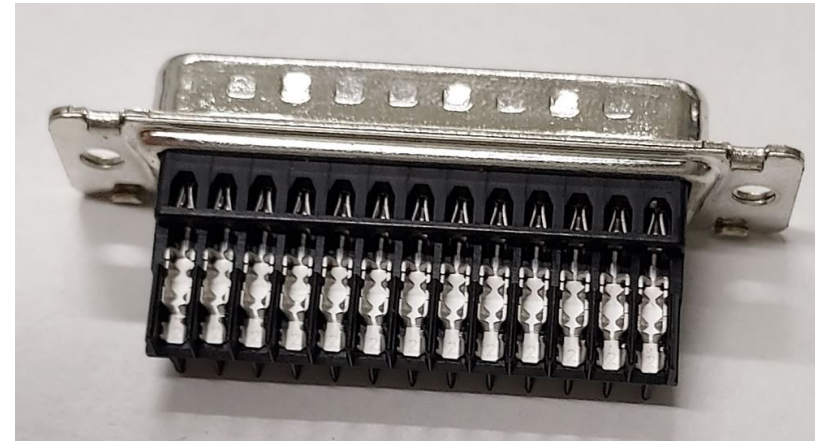
CERN BE-EA Cabling Team suggested Insulation Displacement Crimping Connectors (IDC)

Found IDC connectors from TE suited for solid copper wires: <https://pt.farnell.com/amp-te-connectivity/1-745495-8/socket-idc-d-metal-25way/dp/1098474?CMP=GRHB-OCTOPART>
<https://www.farnell.com/datasheets/1639165.pdf>

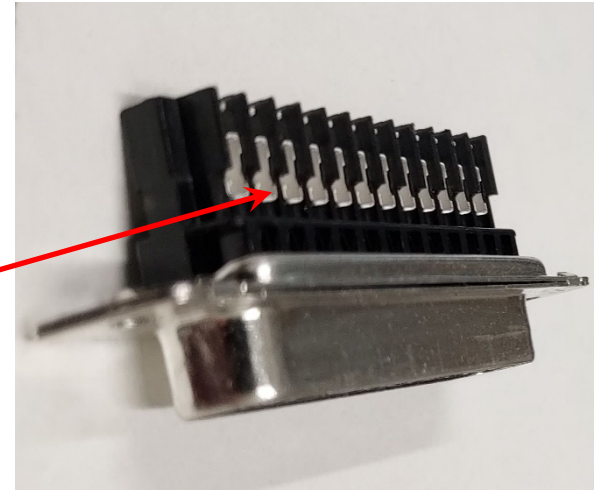
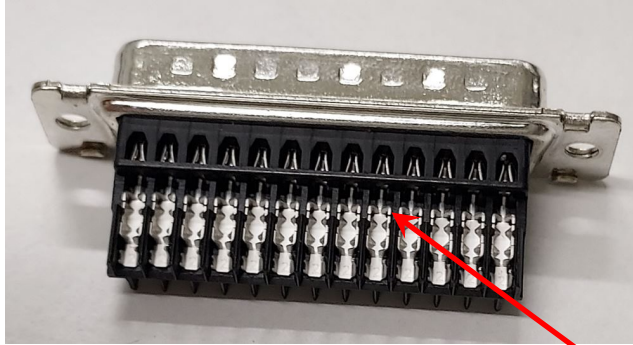
Tested the connectors

From the shelf their voltage limitation is low: sparks appear around 1.6 kV in any of the 2 rows, but not inter rows

Is it a problem? Neither for ground pins nor for HV pins (max voltage difference is 360 V), **but it is a problem for pin 13** (drain wire) that has a neighbour at HV.



IDC Connectors fix using Araldite epoxy



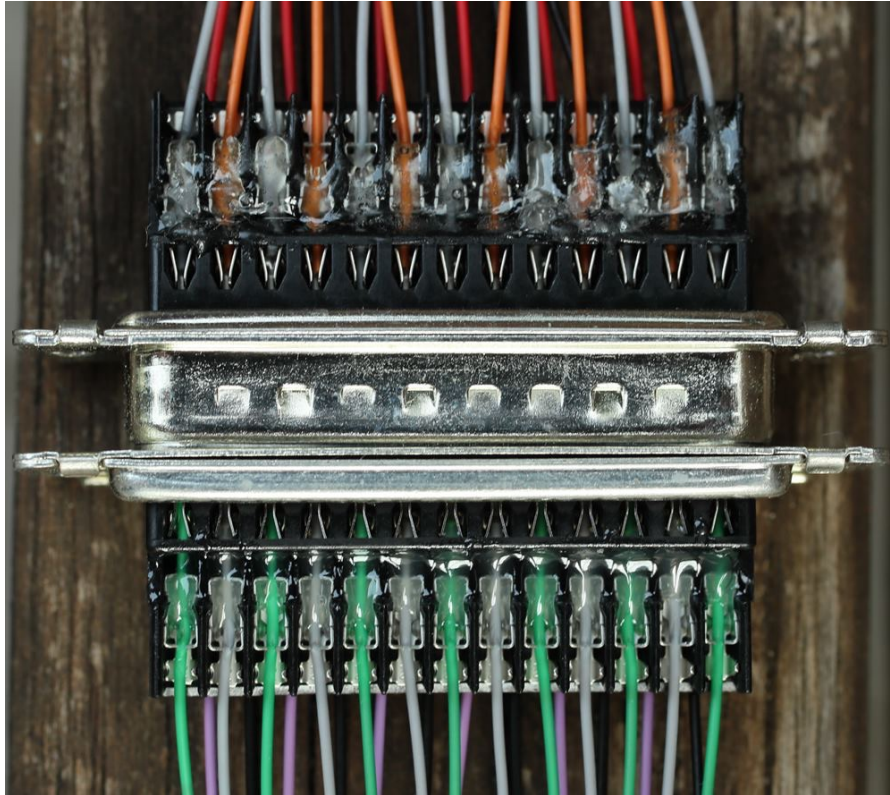
Weak point is a ~ 1 mm wide line where the pin to pin lateral insulation is cut/missing

Distance between sharp metallic contacts of the order of 0.5 mm, prone to generate sparks above 1.5 kV

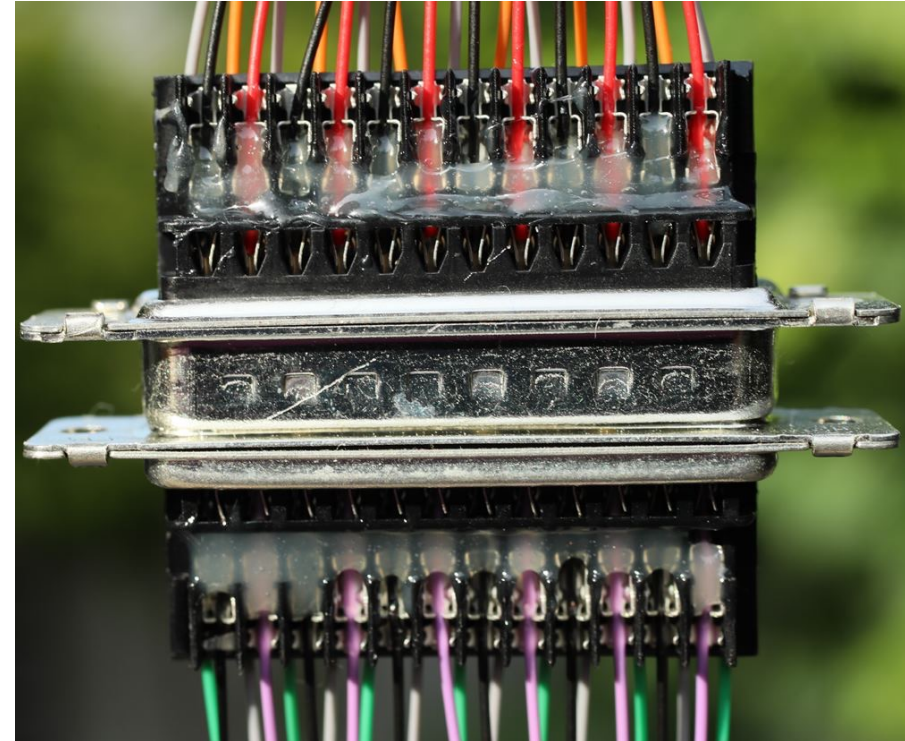
After insertion of the wires, covering the contacts with Araldite epoxy provides excellent insulation between adjacent pins

Limit for sparks in the connector jumps to ~ 2.7 kV

First test with a “slow” epoxy



First test with a “5 min” fast araldite epoxy, only a thin transparent layer of epoxy



Araldite epoxy, thick layers after 2 applications
As a bonus, the epoxy strengthens the wire connections