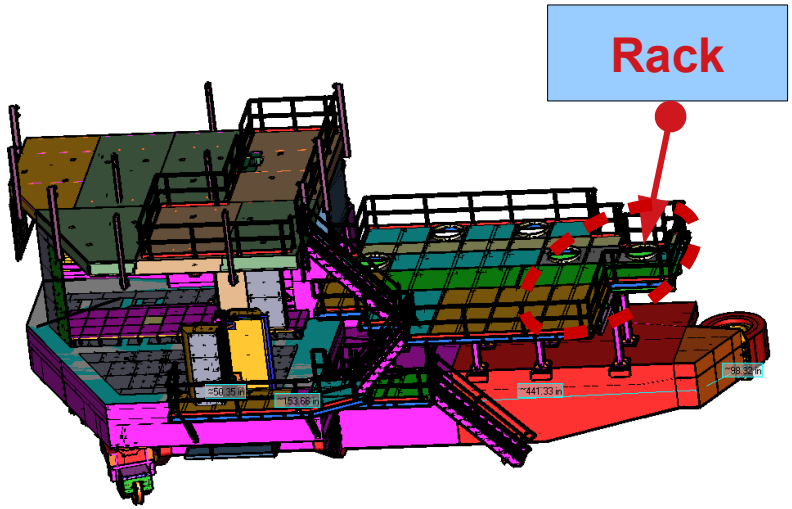
Signal/HV Cable Runs

- Plan is for a single 84” tall, 19” standard width rack to be placed near the pivot
  - → Planned to go on the upper, power supply deck



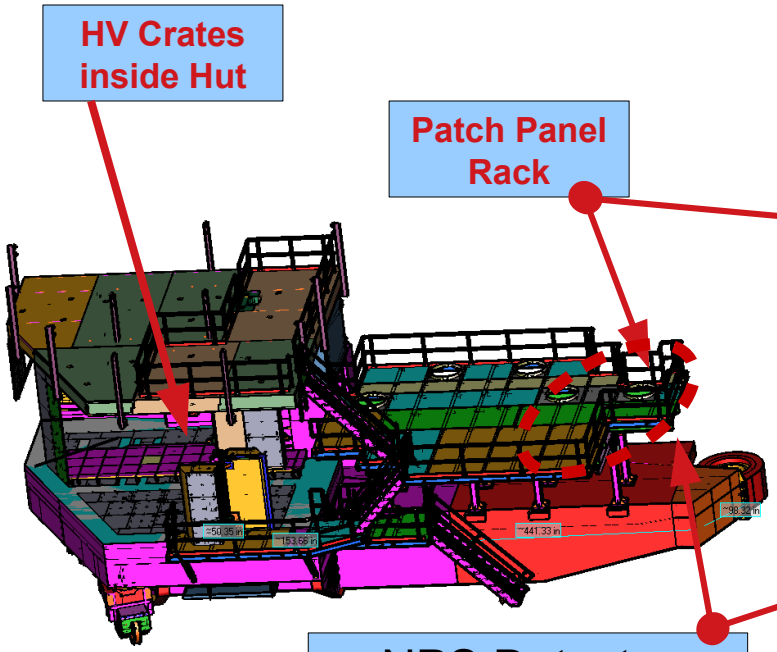
- The rack at the pivot will be “double sided”:
  - → One side will provide 1100 BNC connections
    - » BNC ↔ BNC feedthroughs
  - → The other side will provide 30+2 high-density HV connections
    - » "Radiall 52" connector
    - » 36 ch/connector

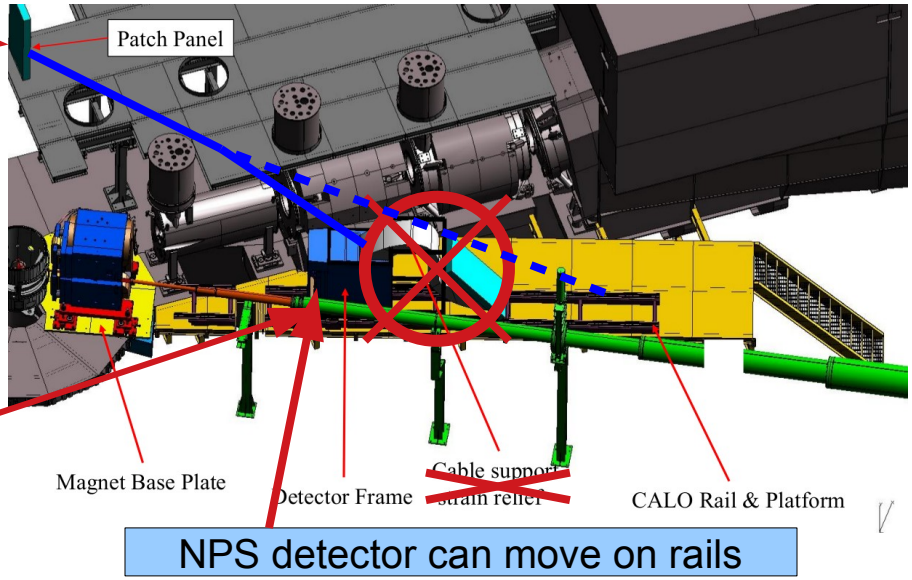
HV / Slow Controls / Cabling Overview

- High Voltage
  - → High Voltage (-1.6kV @ < 1 mA base draw)
    - » 30x CAEN 7030N Cards (36ch, 1mA max/ch)

- High Voltage Cables
  - → 2 cable runs:
    - » NPS roof patch → (~60-70 ' run) → Patch panel rack on SHMS carriage near pivot, and
    - » Patch panel rack → (~60-70' run) → SHMS detector hut (HV crates)

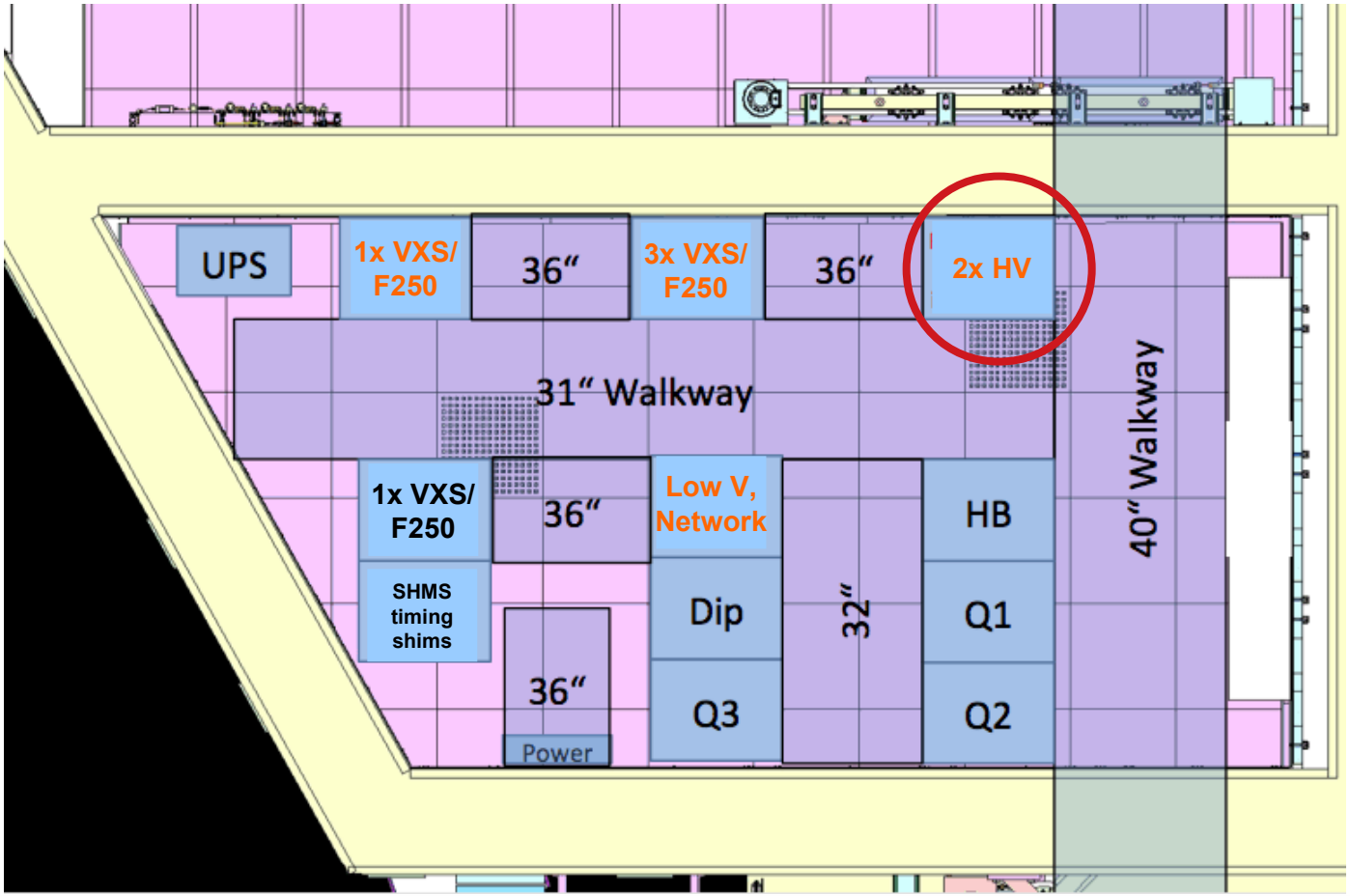
(Ignore the “Cable strain relief” concept below. It's being handled differently.)





Rackspace in SHMS hut

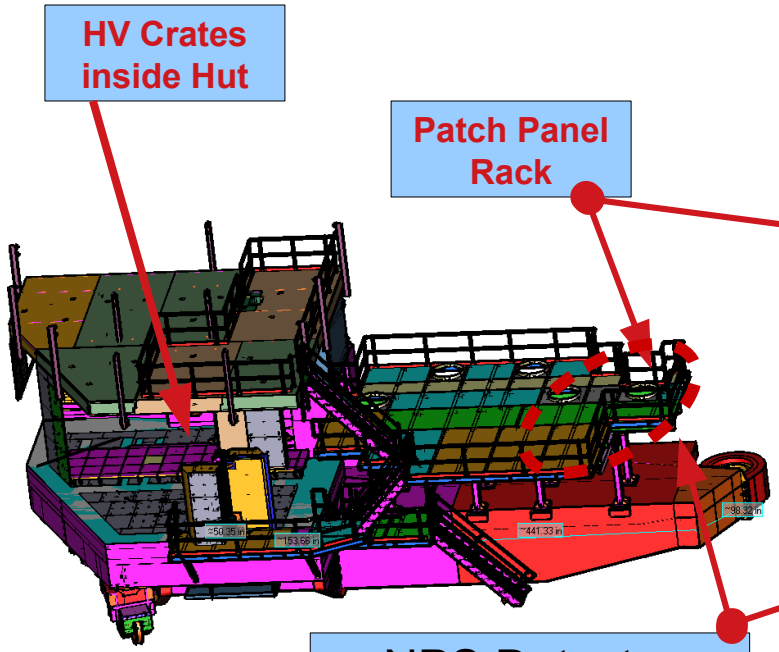
- 4+1 VXS crates + 2 High Voltage crates
  - → It's pretty snug, but it'll fit…
  - → Cables flow into crates via cable trays running above racks

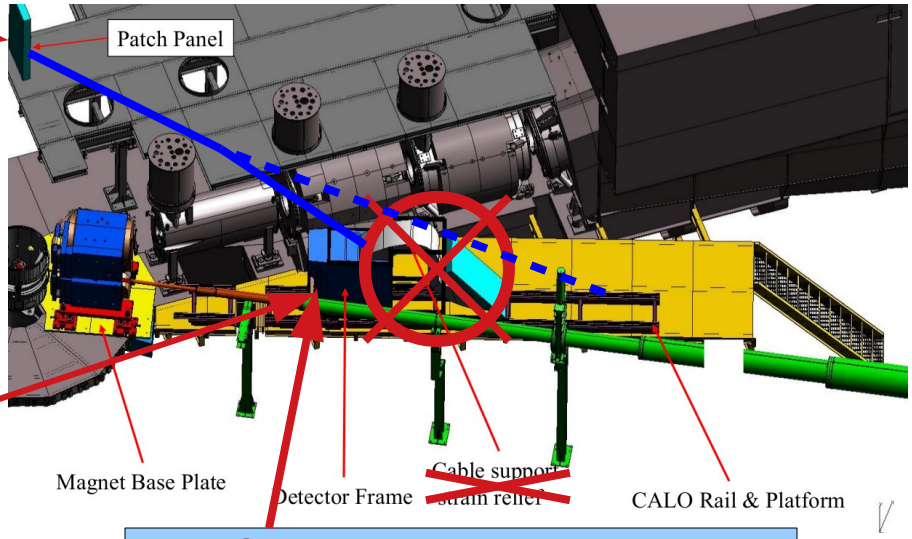


HV / Slow Controls / Cabling Overview

- High Voltage
  - → High Voltage (-1.6kV @ < 1 mA base draw)
    - » 30x CAEN 7030N Cards (36ch, 1mA max/ch)

- High Voltage Cables
  - → IF Radiall 52 F-F feedthroughs exist for the patch panel, then one set of cables would work:
    - » 60+4 identical 70' cables (M:R52 ↔ M:R52)
  - → Else hardwire cable to panel-mount (F) Radiall 52 at patch panel, and have second set from PP→NPS
    - » 30+2 70' cables (M:R52 → panel)
    - » 30+2 70' cables (M:R52 ↔ M:R52 [NPS])





NPS High Voltage Supply

- High Voltage Requirements
  - → 1100 channels
  - → -1.6kV @ < 1 mA base draw
- Supplied by 2 CAEN SY4527 HV Chasses w/ Booster
  - →16x CAEN 7030TN Cards each
    - » Each card: 36ch, 1mA max/ch (matches 36 crystal columns)
  - →576 ch/crate; 1152 ch total
- Procurement in progress:
  - →1 Crate + 17 cards ordered Feb/19
  - →2nd duplicate order pending ($90k)

HV Patch Notes

- HV patch panel will accept a 'Radiall 52' male connector
  - → The connector has common ground for 48 independent channels (of which we use 36)
  - → The connector ground must be isolated from the rack
- Other end will plug into CAEN 7030 cards
  - → Connector map follows CAEN pinout as shown on left (from CAEN 7030 manual)
- Cables 'reversible' and reusable
- Multi-conductor cable identified
  - → Teledyne Reynolds in Torrance, CA.
    - » Part# 178-5790
- HV patch panel components TBP

https://www.datasheets360.com/pdf/8778225758601965736

https://www.caen.it/products/a996/

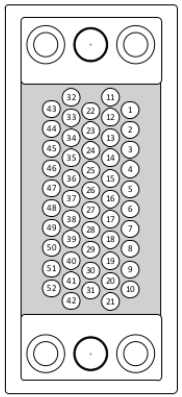
https://userweb.jlab.org/~brads/Manuals/Hardware/CAEN/A730_HV_Boards-Apr2016.pdf

CAEN Electronic Instrumentation

Multipin connector pin assignment

Table 2 – 52 pin connector assignment

A/AG7030 – 7030T (CH36..47 N.C. on A7030T & AG7030T)



#	function	#	function	#	function	#	function	#	function
1	CH02	11	RETURN	22	CH01	32	RETURN	43	CH00
2	CH07	12	CH04	23	CH06	33	CH03	44	CH05
3	CH12	13	CH09	24	CH11	34	CH08	45	CH10
4	CH17	14	CH14	25	CH16	35	CH13	46	CH15
5	CH22	15	CH19	26	CH21	36	CH18	47	CH20
6	CH27	16	CH24	27	CH26	37	CH23	48	CH25
7	CH32	17	CH29	28	CH31	38	CH28	49	CH30
8	CH37	18	CH34	29	CH36	39	CH33	50	CH35
9	CH42	19	CH39	30	CH41	40	CH38	51	CH40
10	CH47	20	CH44	31	CH46	41	CH43	52	CH45
		21	RETURN			42	SAFETY LOOP		

Radiall HV Connector

HIGH VOLTAGE MULTIPIN CONNECTORS

- ❑ High voltage connectors (breakdown voltage 12,5 kVdc).
- ❑ High density rectangular connectors for 23 or 52 high voltage contacts.
- ❑ Braid to braid electrical continuity achieved once plug & receptacle are mated.
- ❑ Rear release, rear removable size 23 crimp contacts.
- ❑ Interlock contacts.

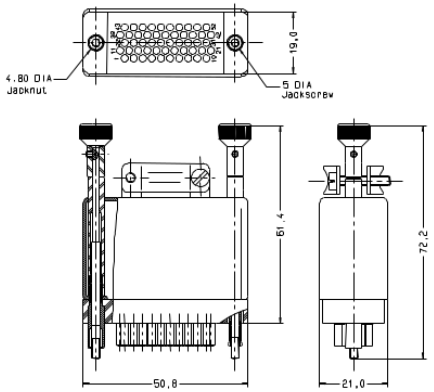
These connectors have been designed for high voltage applications on four CERN experiments (ATLAS, CMS, ALICE, LHC-B) of the LHC (Large Hadron Collider) particle accelerator. For connectors with 23 or 52 contacts (size 23 crimp), there are five configurations available (see table on reverse side). The connectors can be fitted with two interlock pin contacts that switch off the power supply before unmating the standard contacts . Both interlock and standard contacts are rear release rear removable crimp contacts. The electrical continuity between the plug and the receptacle is provided by the connector pin guides.

TECHNICAL CHARACTERISTICS :

• Material insulator :	Thermoplastic UL94V0 - halogen free - tensile strenght reduction does not exceed 6% after a cumulative exposition to 5 10^5Gy at a rate of 1 to 2 Gy / h.
• Backshell & shroud :	Aluminium alloy nickel plated.
• Locking device :	Stainless steel and nickel plated copper alloy.
• Contacts :	Copper alloy gold over nickel plated.
• Breakdown voltage :	12,5 kV dc.

ISO 9001 APPROVED

DIMENSIONS :
The drawing below shows the dimensions (mm) of the plug for cable and for 52 socket contacts.



CERN / RADIALL CROSS REFERENCES :

CERN P/N	RADIALL P/N	Designation
09.41.34.700.2	691802002	Plug for cable and for 52 socket contacts
09.41.34.720.8	691802004	Plug for cable and for 52 pin contacts
09.41.34.705.7	691803002	Receptacle for cable and for 52 pin contacts
09.41.34.710.0	691803004	Receptacle for front panel and for 52 pin contacts
09.41.34.730.6	691803006	Receptacle for front panel and for 52 socket contacts
09.41.34.500.8	691802003	Plug for cable and for 23 socket contacts
09.41.34.520.4	691802005	Plug for cable and for 23 pin contacts
09.41.34.505.3	691803003	Receptacle for cable and for 23 pin contacts
09.41.34.510.6	691803005	Receptacle for front panel and for 23 pin contacts
09.41.34.530.2	691803007	Receptacle for front panel and for 23 socket contacts
09.41.33.840.5	691804200	Size 23 pin contact for 0,12mm² cross section cable
09.41.33.820.9	691804201	Size 23 pin contact for 0,02mm² cross section cable
09.41.33.830.7	691804300	Size 23 socket contact for 0,12mm² cross section cable
09.41.33.810.1	691804301	Size 23 socket contact for 0,02mm² cross section cable
09.41.33.890.5	691804230	Size 23 interlock pin contact for 0,12mm² cross section cable
09.41.33.880.7	691804231	Size 23 interlock pin contact for 0,02mm² cross section cable
T.B.D	282281	Crimping tool
T.B.D	282585001	Positioner
T.B.D	282549024	Insertion / extraction tool

For further information please contact your nearest Radiall representative :

radiall.com

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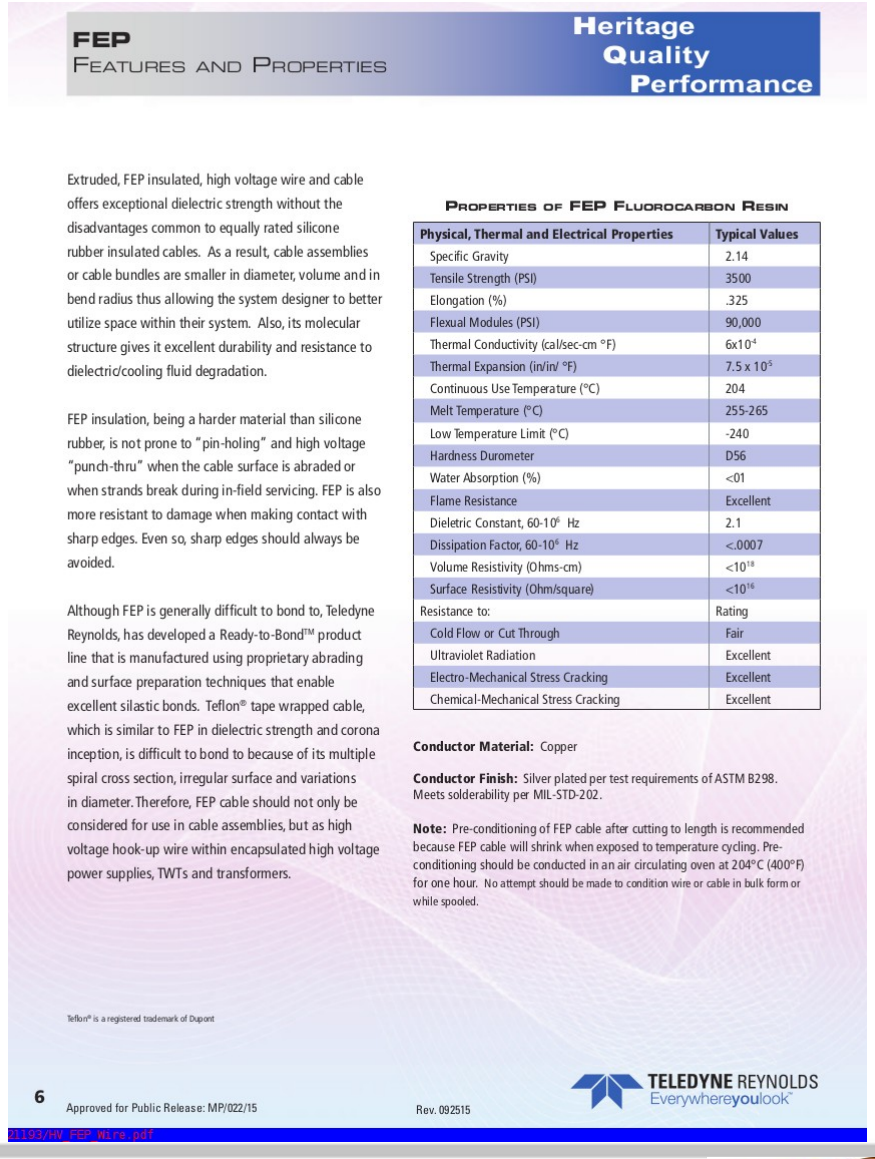
https://www.caen.it/products/a996/

Multiconductor HV Cable

- Multiconductor cable recommendation
  - → Teledyne Reynolds
    - – Part# 178-5790
      - » Ph: (310) 823.5491
      - » Em: tr_sales@teledyne.com
  - → Used by CERN, CAEN



FEP
FEATURES AND PROPERTIES

Heritage
Quality
Performance

Extruded, FEP insulated, high voltage wire and cable offers exceptional dielectric strength without the disadvantages common to equally rated silicone rubber insulated cables. As a result, cable assemblies or cable bundles are smaller in diameter, volume and in bend radius thus allowing the system designer to better utilize space within their system. Also, its molecular structure gives it excellent durability and resistance to dielectric/cooling fluid degradation.

FEP insulation, being a harder material than silicone rubber, is not prone to "pin-holing" and high voltage "punch-thru" when the cable surface is abraded or when strands break during in-field servicing. FEP is also more resistant to damage when making contact with sharp edges. Even so, sharp edges should always be avoided.

Although FEP is generally difficult to bond to, Teledyne Reynolds, has developed a Ready-to-Bond™ product line that is manufactured using proprietary abrading and surface preparation techniques that enable excellent silastic bonds. Teflon® tape wrapped cable, which is similar to FEP in dielectric strength and corona inception, is difficult to bond to because of its multiple spiral cross section, irregular surface and variations in diameter. Therefore, FEP cable should not only be considered for use in cable assemblies, but as high voltage hook-up wire within encapsulated high voltage power supplies, TWTs and transformers.

Teflon® is a registered trademark of Dupont

PROPERTIES OF FEP FLUOROCARBON RESIN

Physical, Thermal and Electrical Properties	Typical Values
Specific Gravity	2.14
Tensile Strength (PSI)	3500
Elongation (%)	.325
Flexual Modules (PSI)	90,000
Thermal Conductivity (cal/sec-cm °F)	$6x10^{-4}$
Thermal Expansion (in/in/ °F)	7.5×10^{-5}
Continuous Use Temperature (°C)	204
Melt Temperature (°C)	255-265
Low Temperature Limit (°C)	-240
Hardness Durometer	D56
Water Absorption (%)	<01
Flame Resistance	Excellent
Dieletric Constant, 60-10^6 Hz	2.1
Dissipation Factor, 60-10^6 Hz	<.0007
Volume Resistivity (Ohms-cm)	$<10^{18}$
Surface Resistivity (Ohm/square)	$<10^{16}$
Resistance to:	Rating
Cold Flow or Cut Through	Fair
Ultraviolet Radiation	Excellent
Electro-Mechanical Stress Cracking	Excellent
Chemical-Mechanical Stress Cracking	Excellent

Conductor Material: Copper

Conductor Finish: Silver plated per test requirements of ASTM B298. Meets solderability per MIL-STD-202.

Note: Pre-conditioning of FEP cable after cutting to length is recommended because FEP cable will shrink when exposed to temperature cycling. Pre-conditioning should be conducted in an air circulating oven at 204°C (400°F) for one hour. No attempt should be made to condition wire or cable in bulk form or while spooled.

6

Approved for Public Release: MP/022/15

Rev. 092515

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21193/HV FEP Wire.pdf

SHMS Carriage w/ Distance Annot.