Discussion Contribution to the design of the cathode-HV

Power supply

Connector

Cable

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Power Supply (I)

Estimate of power necessary: assuming U = 100 kV
and R = 1 GΩ for resistor chain → I = 100 µA → P = 10 W
(more realistic for triple GEM readout 280 V/cm · 225 cm + 2500 V = 65 500 V)

This should not be a problem because the power is very low.
Only question I could think of is the residual ripple.
If the we aim for a field homogeneity of 10^{-5}, probably also the HV should have a ripple as low as 10^{-5}?

Short internet research turned out some candidates:

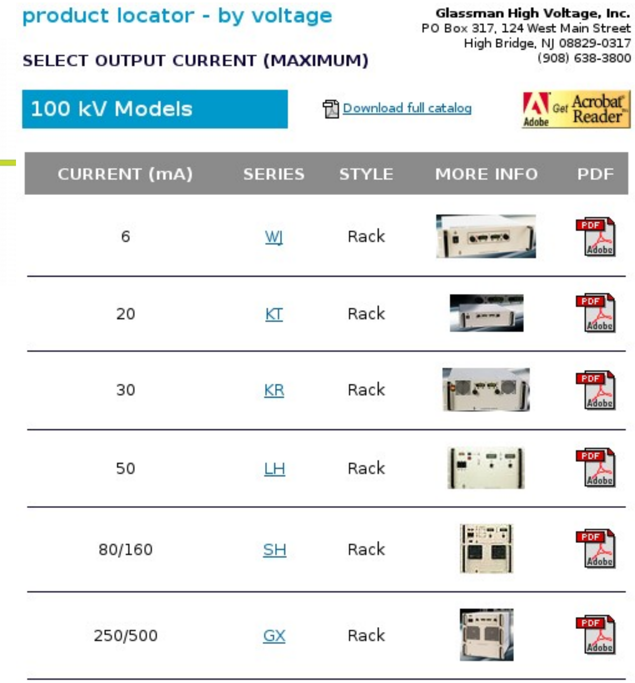
FuG – HCP series:

Setting resolution ±$1\cdot10^{-4}$
Residual ripple (0-10MHz)
< $1\cdot10^{-4}$pp + 50mVpp,
typ. $5\cdot10^{-5}$pp

Option lower ripple
On several series a lower ripple can be achieved by better smoothing.

Series	Vmax	Amax	Pmax	Width	Height	Depth	Weight
HCP 140-65000	65 kV	2 mA	140 W	443 mm	133 mm	450 mm	21 kg
HCP 350-65000	65 kV	5 mA	350 W	443 mm	266 mm	450 mm	45 kg
HCP 700-65000	65 kV	10 mA	700 W	443 mm	355 mm	550 mm	55 kg
HCP 1400-65000	65 kV	20 mA	1,4 kW	443 mm	399 mm	550 mm	70 kg
HCP 2800-65000	65 kV	40 mA	2,8 kW	443 mm	399 mm	550 mm	80 kg
HCP 140-100000	100 kV	1 mA	140 W	443 mm	221 mm	550 mm	50 kg
HCP 350-100000	100 kV	3 mA	350 W	443 mm	221 mm	550 mm	55 kg
HCP 700-100000	100 kV	6 mA	700 W	443 mm	355 mm	550 mm	73 kg
HCP 1400-100000	100 kV	12 mA	1,4 kW	443 mm	399 mm	550 mm	90 kg

Power Supply (II)


product locator - by voltage

Glassman High Voltage, Inc.
PO Box 317, 124 West Main Street
High Bridge, NJ 08829-0317
(908) 638-3800

SELECT OUTPUT CURRENT (MAXIMUM)

100 kV Models

Download full catalog

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CURRENT (mA)	SERIES	STYLE	MORE INFO	PDF
6	WJ	Rack		
20	KT	Rack		
30	KR	Rack		
50	LH	Rack		
80/160	SH	Rack		
250/500	GX	Rack		

Glassmann High Voltage Incorprated → KT series

Static Voltage Regulation: Better than ±0.005% for specified line variations and 0.01% for no load to full load variations.

Ripple: Better than 0.025% of rated voltage at full load (0.1% RMS for > 100kV).

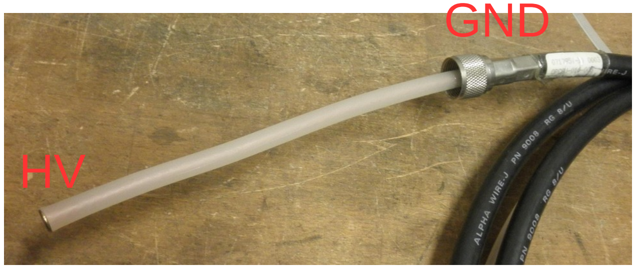
CPS High Voltage → Model 2600

Output voltage:	0 to 30 or 0 to 60 kVDC (full scale programmable)
Ripple at full output and load:	< 100 mVpeak-to-peak for 100 μA
	< 200 mV peak-to-peak for up to 500 μA
	< 1 V peak-to-peak for over 500 μA

CAEN or ISEG did not seem to have more than ~30 kV

Connector

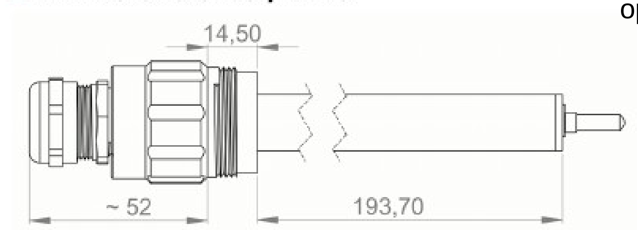
There are two sides:
1.) power supply: Usually given by power supply producer
Examples are

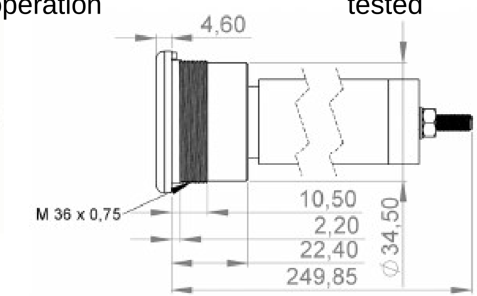


Hivolt (www.hivolts.de)

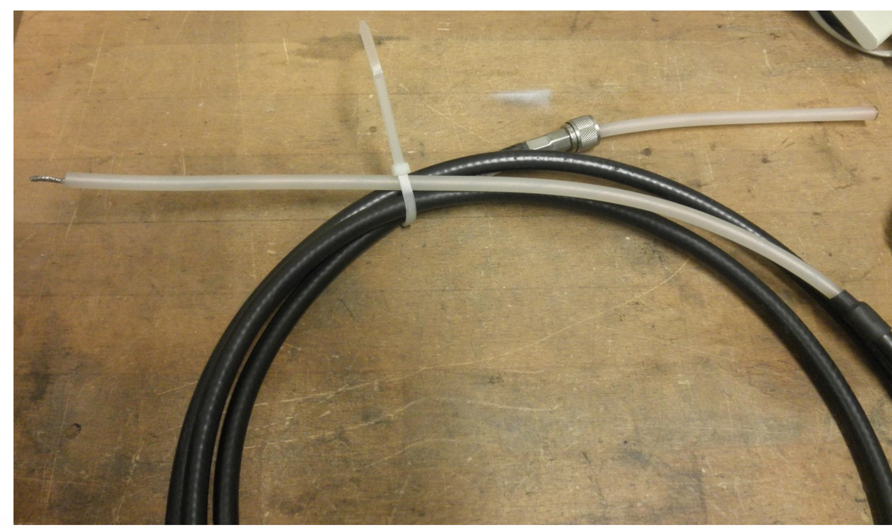
$V_{operation}$ = 60 kV, V_{tested} = 90 kV

- DIMENSIONS S165 / B165





2.) cathode: → HV expert at Bonn (ELSA accelerator) suggested:
Remove sufficient length of GND shielding and solder/clamp the HV line to the cathode.
If there is a connector, you still have to get from the connector to the membrane and fix it there, the problems stays the same or even increases.



Cable

Assuming same pitch as the LP for the ring electrodes of field cage: 2.8 mm
Length of detector: 225 cm (-1 cm for gating GEM)
→ 803 resistors

Assuming 1.25 MΩ between two strips
→ 1 GΩ total resistance
BUT it depends on the insulation resistance of the HV cable!

We would need only very low currents (I = 100 µA). So the cable core can be thin (diameter 0.75 mm² → I = 15 A)

Example: LEMO cable 201 340, price 7.54 €/m,

$R_{conductor}$ = 56.1 Ω/km, $R_{insulator}$ = 1 GΩ/km, conductor diameter 0.75 mm

$V_{operating}$ = 50 kV, V_{tested} = 75 kV, outer diameter 7.25 mm

Cable (II)

HVP (http://www.hvproducts.de)

VOLTAGE		PART	CONDUCTOR SIZE				SEMICON	DIELECTRIC		SHIELD				JACKET	OUTSIDE	IMPEDANCE	CAPACITANCE	MIN BEND	MIN AMBIENT	MAX CONDUCTOR	WEIGHT
DC	AC	NUMBER	AWG	STRANDS	mm2	DIA (mm)	DIA (mm)	MATERIAL	DIA (mm)	CONSTRUCTION	AWG	Coverage	SEMICON	MATERIAL	DIAMETER (mm)	(ohms)	(pf/Mtr)	RADIUS (mm)	TEMP C	TEMP C	KG/MTR
(kV)	(kV)										(equiv)	(%)									
60	20	2024S_J	12	19/25SPC	3.31	2.30	3.40	SILICONE	9.10	34 TC BRAID	15	82	ink & tape		13.34	39	187	25	-65	200	0.232
60	20	2149SVJ	18	19/30TC	0.83	1.30	2.00	LDHMW PE	5.80	34 TC BRAID	17	86	N/A	PVC	8.51	50	121	64	-51	60	0.075
60	20	2240-R2	12	19/25SPC	3.35	2.40	3.60	EPR	10.20	34 TC BRAID	14	95	extruded	polyurethane	17.02	45	157	152	-51	130	0.373
75	25	2110SUJ	2	133/23TC	33.62	6.60	8.10	EPR	14.50	30 TC BRAID	4	95	N/A	polyurethane	20.07	19	387	102	-51	71	0.730
100	30	2062S_J	8	133/29SPC	8.37	4.20	5.60	SILICONE	16.50	34 TC BRAID	16	82	ink & tape		20.57	41	164	140	-65	200	0.596
100		2124	16	19/29TC	1.31	1.50	2.50	LDHMW PE	9.40	34 TC BRAID	13	90	N/A	PVC	11.18	61	98	152	-51	60	0.149
100		2125	12	19/25TC	3.31	2.30	3.30	LDHMW PE	9.40	34 TC BRAID	13	90	N/A	PVC	11.18	48	121	152	-51	60	0.149
100	30	2242	10	19/23TC	4.92	2.90	4.80	EPR	15.70	34 TC BRAID	14	90	extruded	polyurethane	21.59	48	141	127	-51	130	0.596

Conductor: A = 1.31 mm², 1.5 mm diameter
Dielectric: 9.4 mm diameter, material LDHMW PE
Outside diameter: 11.18 mm, min. bending radius 152 mm, weight 149 g/m
Capacitance: 96 pF/m

No information on $R_{insulator}$

HIVOLT (http://www.hivolt.de)

Conductor: A = 1.2 mm²
1.5 mm diameter
Impedance 61 Ω
Dielectric: material LDHMW PE
Outside diameter: 11.2 mm
Capacitance: 98 pF/m

RATED VOLTAGE		TYPE	CONDUCTOR SIZE		DIELECTRIC MATERIAL	JACKET MATERIAL	OUTER DIA	NOTES	STA-TUS
[kV_DC]	[kV_AC]		[AWG]	[mm²]			[mm]		*1
60	20	2024SVJ	12	3.1	SILICONE	PVC	12.7		P
60		2149SVJ	18	0.96	LDHMW PE	PVC	8.6		P
60	20	HSC-60-1PSUA-2	18	0.96	LDHMW PE	TPE-U	7.7		P
60		HXC-60-1EA-8	14	2	EPR (black)	PVC	11.1		P
100	30	2062SVJ	8	8.5	SILICONE	PVC	20.8		P
100		2124	16	1.2	LDHMW PE	PVC	11.2		P
100		2125	12	3.1	LDHMW PE	PVC	11.2		S
100	30	HSC-100-1PSUA-2	16	1.2	LDHMW PE	TPE-U	13.2		E