

# WA105 PMT cables and flanges options

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# Cables options

I've checked all the 50ohm and High voltage cables at CERN store and also the cables used in other experiments.

The table bellow is a summary with the cables that better matches our requirements

	SCEM		Max V (KV)	Diam (mm)	Temp	Price €/m	Cap (pF/m)	Insulation	Bend radius	Att (dB/m)			Length for 3dB att @200MHz
										10MHz	100MHz	200MHz	
(Lemo)	<a href="#">04.61.11.145.5</a>	COAXIAL CABLE 50 OHM - TYPE C-50-2-1	2	2,85	-10 to 70	0,51	101	XL-PE (Cross-linked polyethylene)		0,095		0,42	7,142857
	<a href="#">04.61.11.010.9</a>	MINIATURE COAXIAL CABLE 50 OHM - POLYIMIDE	3	1,15	-200 to 200	8	125	Polyimide		25 (13MHz)			
HTC-50-3-2	<a href="#">04.31.51.750.1</a>	COAXIAL HIGH-VOLTAGE CABLE 8 kVdc - WITHOUT PARTIA	8	5,2	-10 to 70	0,92	101	XL-PE	25 to 50 mm	0,045	0,15	0,21	14,28571
HTC-50-2-1	<a href="#">04.31.51.760.9</a>	COAXIAL HIGH-VOLTAGE CABLE 9 kVdc (10) * - WITH PART.	9	4,6	-10 to 70	1,1	141	XL-PE	25 to 50 mm				
(Double-Chooz)		RG303/U	2,5	4,3	-65 to 165	8		FEP (Fluorinated ethyl)	25 to 50 mm		0,13	0,19	15,78947
(Icarus, MicroBooNe)		RG316/U	1,5	2,5	-65 to 165	3	97	FEP (Fluorinated ethyl)	15 to 37,5mm		0,25	0,4	7,5

Only one cable matches the temperature requirement but its attenuation is very high. This data could be wrong at the CERN store description, so, it could be 0.25 dB/m instead of 25 dB/m but it is high anyway (logical because is the thinner).

Two other cables are rated up to -65 °C (FEP insulation) and used in other experiments. They both can be plugged with SHV connectors and have low attenuation. The RG-303 has the lowest attenuation and is rated up to 2.5KV but is more expensive and the bend radius is bigger. The RG-316 is cheaper, has smaller bending radius but attenuation is double than RG-303 and depending on the manufacturer it's rated from 1KV to 1.5KV. I think these two cables are the most safe options for our experiment.

# RG-303 and RG-316



RG-303 attached to a Double-Chooz PMT  
(external diameter 4.3mm)



RG-316  
(external diameter 4.3mm)

# Flanges options

I see here two options:

- Use a commercial double side SHV feedthrough. The best I've found is from Allectra with three connectors on a CF-40 flange. They also sell the individual connectors to be soldered but there is not a big difference on price.
- Design a feedthrough to pass the cables through it without connector. We have this at Double-Chooz but it was not in vacuum on one side. This option is cheaper but requires design and tests

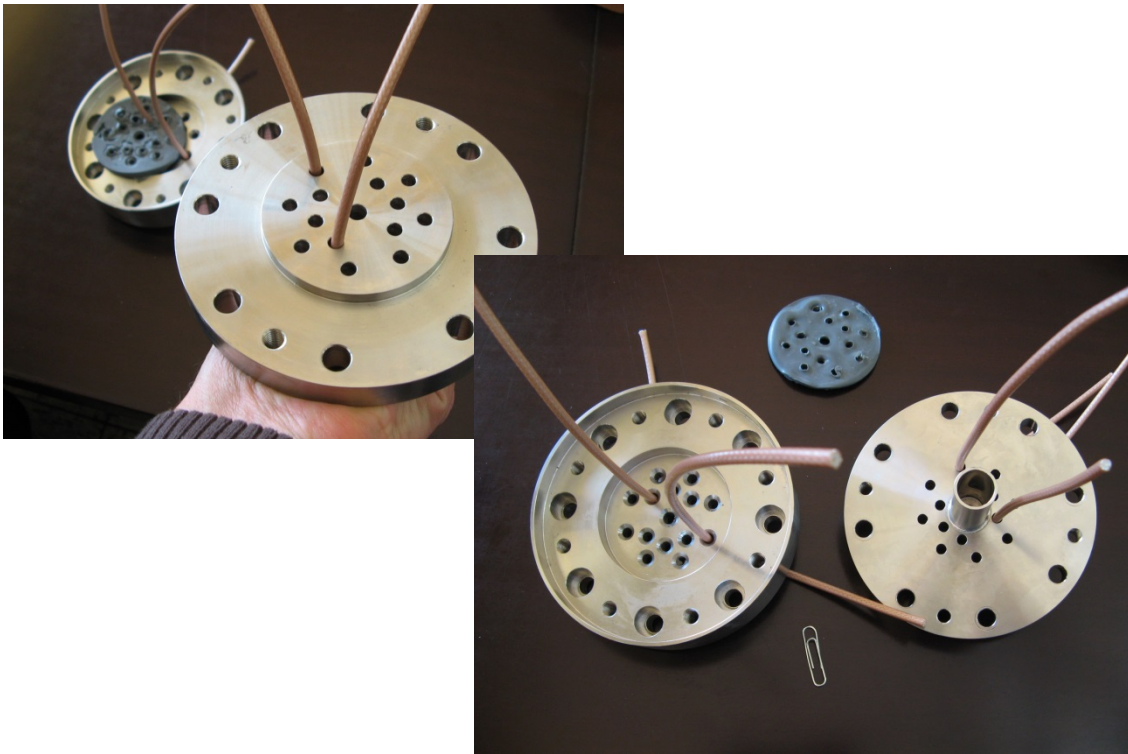
SHV-Feethroughs						Units	Price	Flange	Allectra code
SHV 50 Ohm, 6KV Coaxial DOUBLE SIDED versions - FLOATING SHIELD						3	1098	CF-40	242-SHVDF50-C40-3
Single						1	324	Weld	242-SHVDF50
SHV 50 Ohm, 6KV Coaxial DOUBLE SIDED versions - GROUNDED SHIELD						3	985	CF-40	242-SHVD50-C40-3
Single						1	283	Weld	242-SHVD50

There are two options in the commercial FT: to have the cable ground isolated or connected to the flange. I think it's better to keep it isolated so we will be able to choose later if the cable ground is connected to the detector ground or to the electronics ground.

# External cables

If we choose the SHV feedthrough, on the external side we can use the HV RG-58 cable (you can find its specs on first page). Price is about 1€/m

If we choose the custom feedthrough without connectors the internal and external cables will be the same.



Allectra double-sided SHV connector in CF-40 flange. We will use the version with three connectors per flange (maximum available). To be tested in Ar gas.

Feedthrough used in Double-Chooz for the RG-303 cables.  
It's externally sealed with epoxy when the cables are on their place.

# Costs estimation

Internal cable assuming 18m of RG-316 per PMT

Inner cables length (m)	18
Total (m for 36 cables)	648
Cable price (€/m)	3
<b>Total (€)</b>	<b>1944</b>

External cable assuming 15m of HV RG-58 per PMT and SHV connectors for both sides of the feedthrough

External cable (36*15)	540
SHV connectors (36 *2)	1584
<b>Total</b>	<b>2124</b>

Allectra double sided ground isolated SHV Feedthroughs (CF-40 and single versions)

	Units	Price
CF-40 Feedthroughs (36/3)	12	13176
Single SHV Feedthroughs	36	11664
CF-250 to 6 CF-40 adaptor	2 ?	
CF-250 cover with 18 single SHV FT	2 ?	
Custom	1 ?	

External cable assuming 15m of RG-316 and custom feedthrough without connectors

External cable (36*15*3)	1620
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## Summary

Option	Internal cable	Feedthroughs	External cable + connectors	Total
SHV feedthrough	1944	≈15000	2124	≈ 19000
Custom	1944	?	1620	≈ 5000 + work time

# Costs estimation for the external cables

## Feedthrough to splitter cable assuming 15m of RG-303 per PMT

36 SHV connectors	900€
540m RG-303 cable	3500€
Total	4400€

## Power supply to splitter cable

36 SHV connectors	900€
36x2.5m HTC-50-3-2 cable	100€
Total	1000€

## Splitter to front-end cable

36 SMA connectors	300€
36 x 2.5m RG-58 cable	100€
Total	400€