
# CERN experience with 12 GHz high power waveguide components

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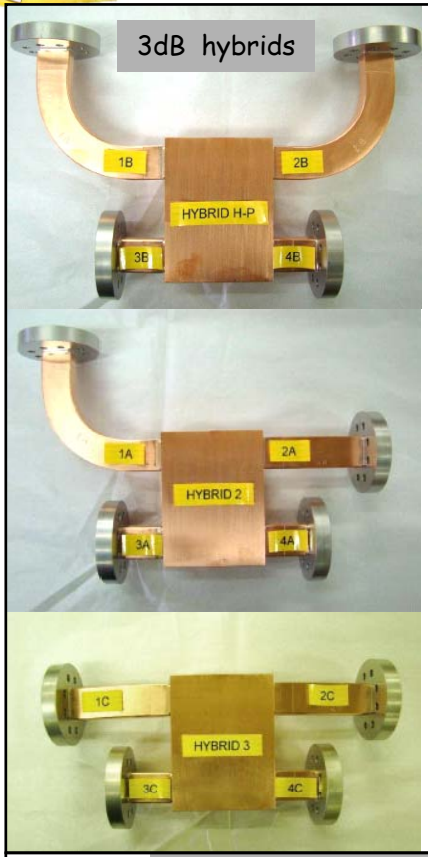
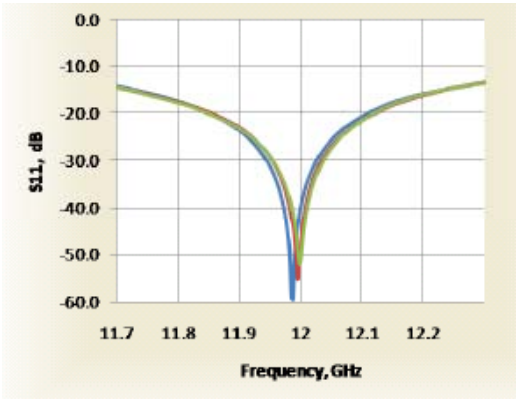
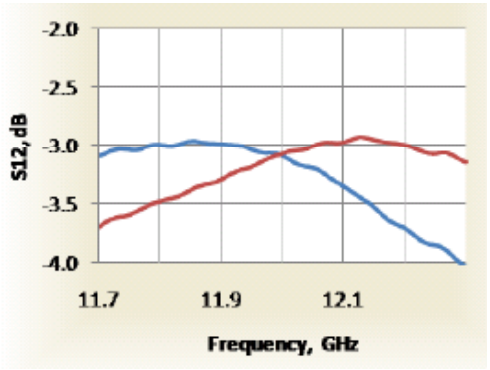
# THE BIG LIST of the X-band waveguide components

| Areas | Type | Design | Company | Received/ ordered |
|---|---|---|---|---|
| Conventional devices | 50 dB Directional coupler | GYCOM | GYCOM | 10/10 |
| | 3 dB hybrid | CERN | Cinel, IHEP | 3/3 + 1/1 |
| | 3 dB H-plane splitter | CERN | VDL | 1/10 |
| | Dry stainless steel RF load | CERN | VDL,Cinel, Heeze | 5/5+1/5+1/4 |
| | Waveguide E/H bends | CERN | CERN | many |
| | RF flanges (new design) | CERN | CERN | prototype |
| TBTS PETS Recirculation network | Attenuator/splitter(0 ->1) | GYCOM | GYCOM | 1/3 |
| | RF phase shifter (360$^0$) | GYCOM | GYCOM | 1/1 |
| Stand along power source | H10-> H01 mode converter | GYCOM/SLAC | both RF & mechanical designs exist | |
| | RF/vacuum valve (Grudiev type) | SLAC | 11.424 GHz version exists | |
| PETS ON/OFF | Variable reflector<br>Polarized circulator | CERN | concept and FR design will be presented by A. Cappelletti | |
| CLIC WG network | Choke mode flange | CERN | CERN | 2/2 |

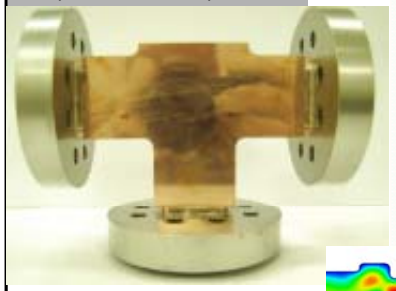

## 3dB hybrids

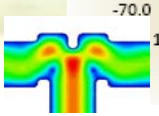


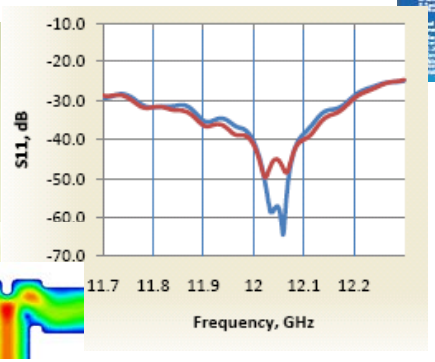




## H-plane 3dB splitter

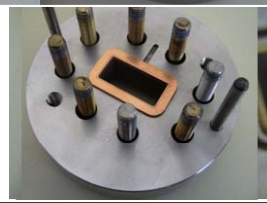






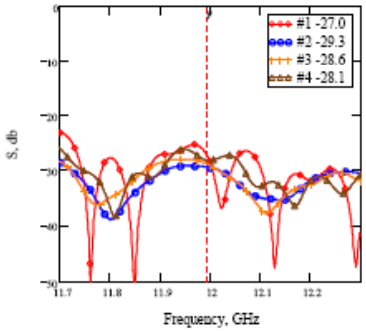


Unisex RF vacuum flange development at CERN

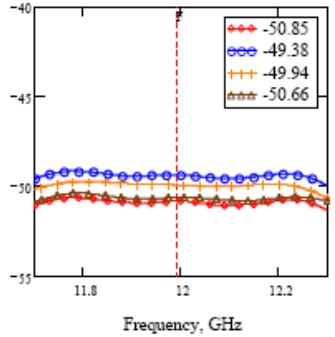


## 50 db directional couplers

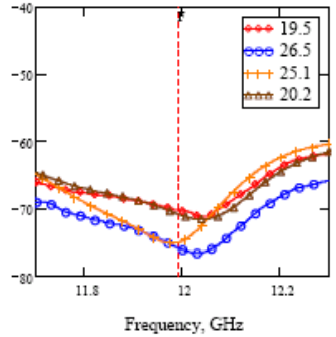
Matching




Coupling



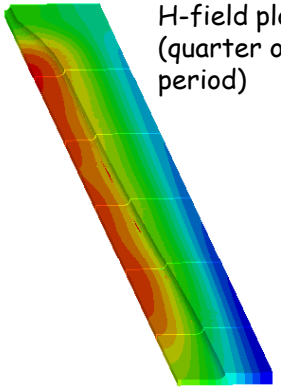

Directivity



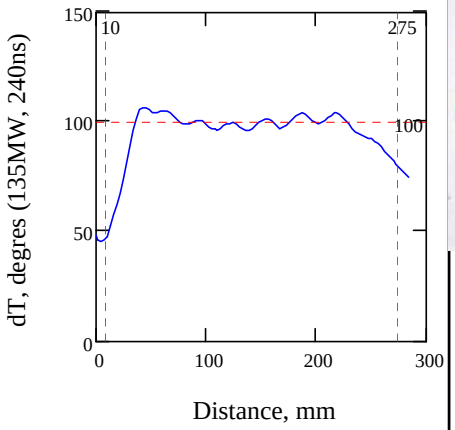
# Dry stainless steel RF load. High peak and high average power design.


## Design specifics

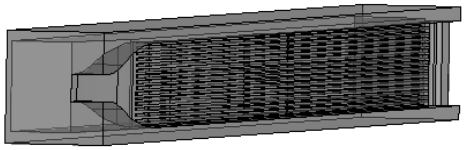
H-field plot (quarter of the period)



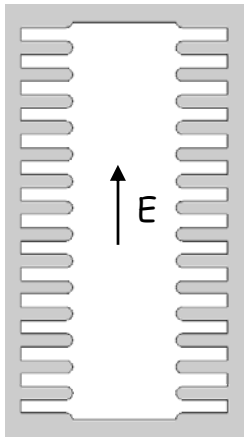
Pulsed heating distributions along the load:




The load half

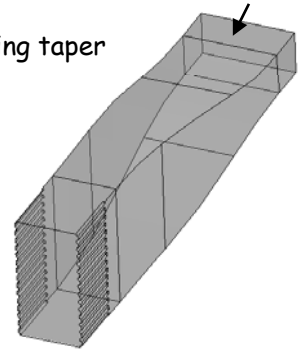


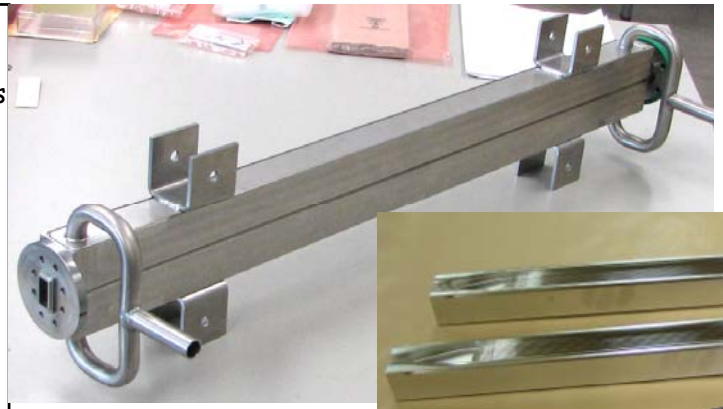
Load regular part cross section

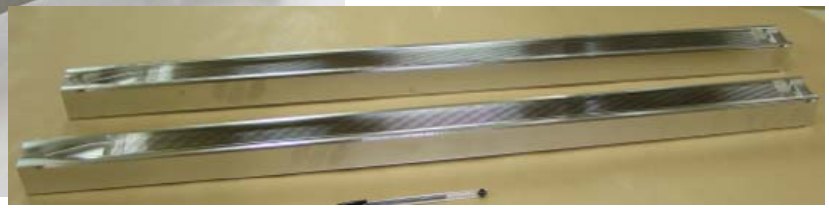


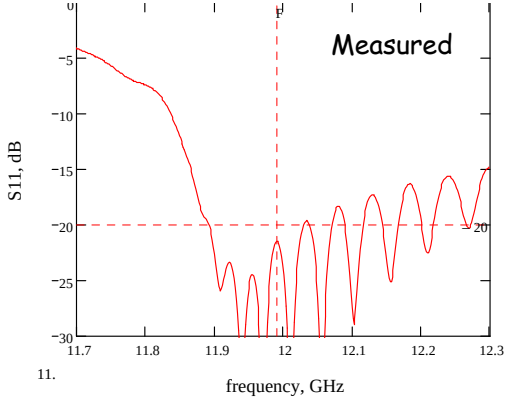

WR90

Matching taper

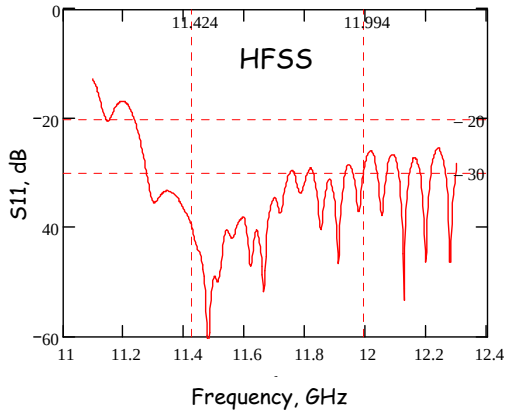






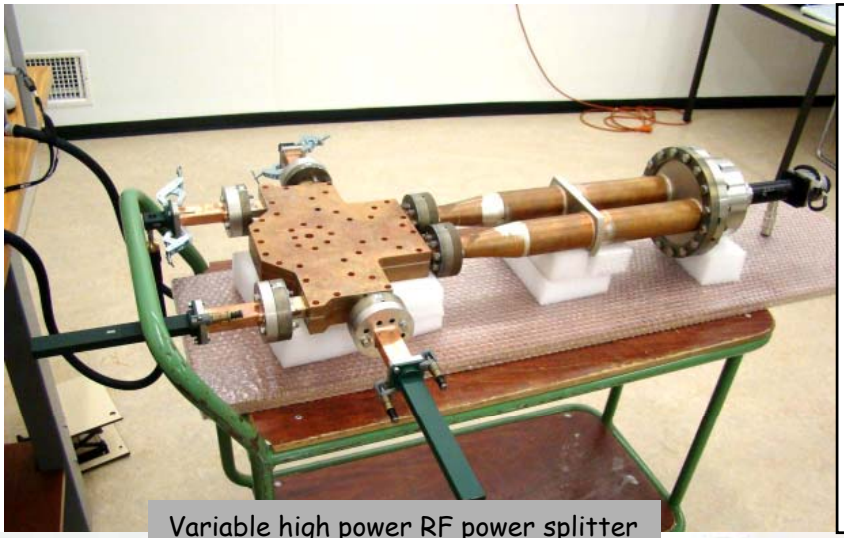



The 12 GHz load is made of the standard stainless steel S316 and is 0.8 m long.




The new, double-frequency load modification is made of the SS430 magnetic stainless steel and have the same length . The prototype arrived at CERN for the acceptance RF check.
The 2 loads will go to KEK and 2 to SLAC

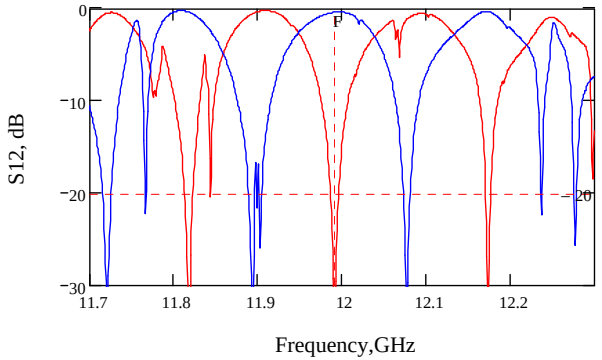
# TBTS PETS Recirculation network



Variable high power RF power splitter

Variable high power RF phase shifter

S parameters at the position of the max (blue) and min (red) coupling

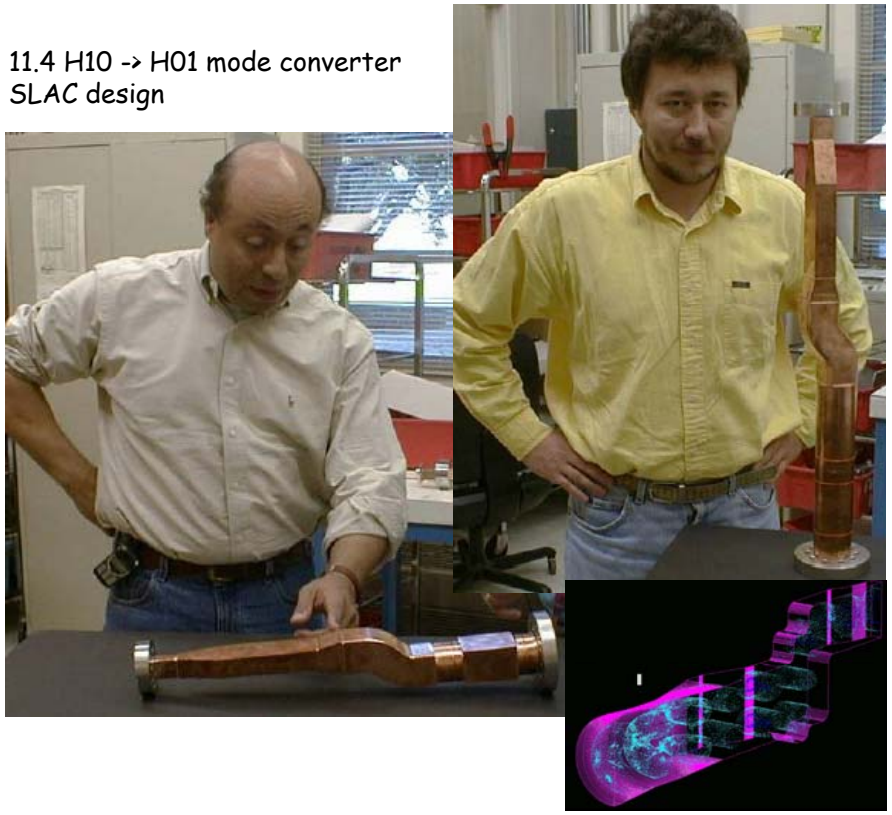


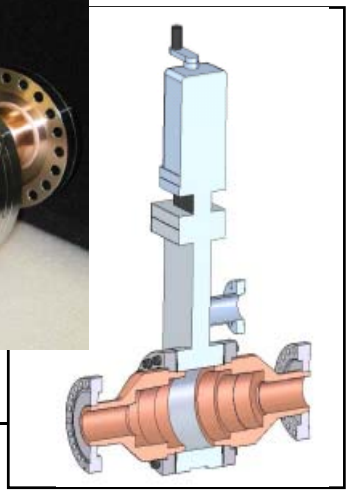

The number of RF components: directional couplers, loads variable splitter and phase shifter have been installed and now under operation in the TBTS, CLEX at CERN

# 12 GHz Stand along power source

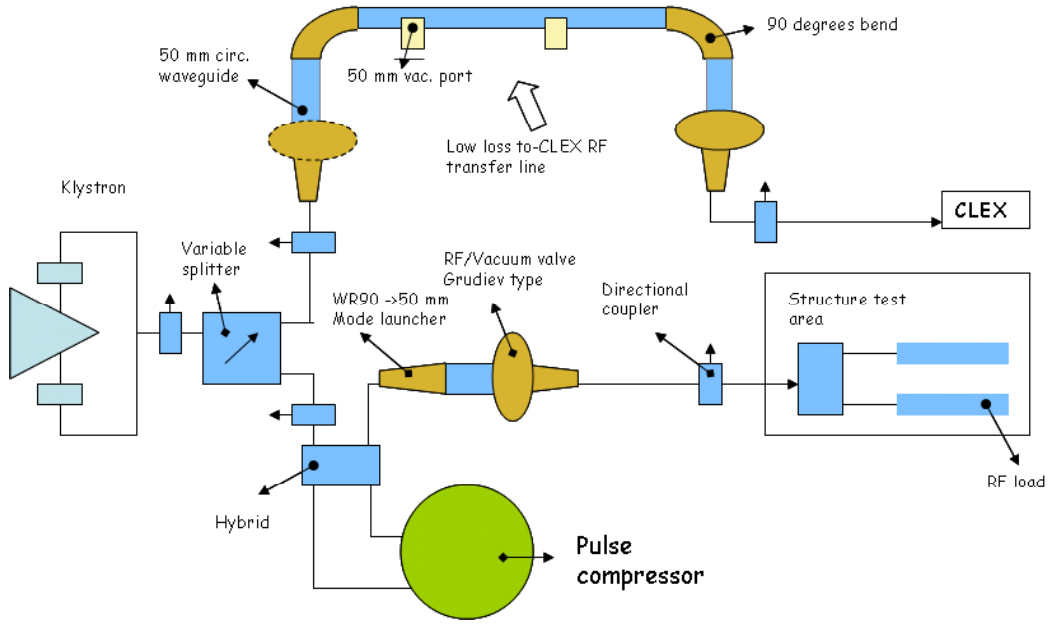

Normally the overmoded component should be used in the complicated and long waveguide networks to allow efficient and reliable operation.

11.4 H10 -> H01 mode converter
SLAC design



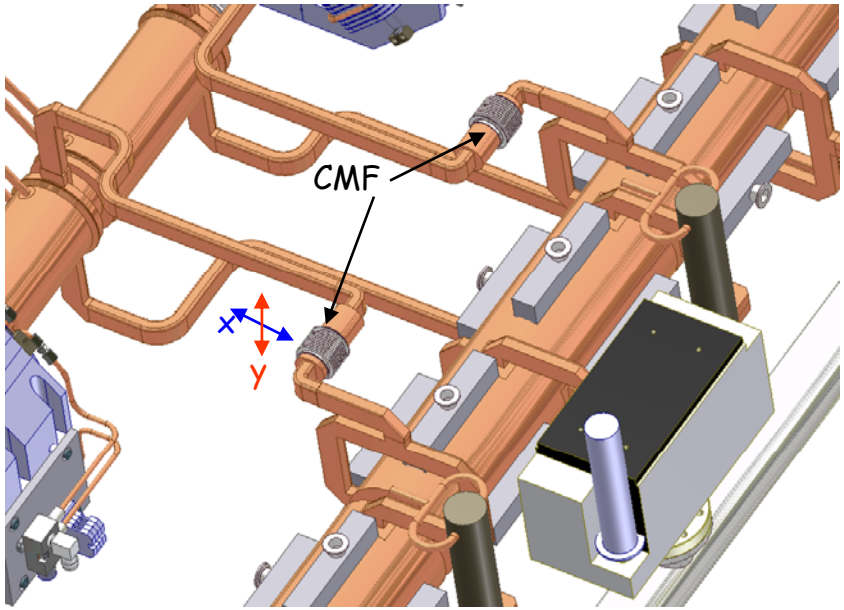



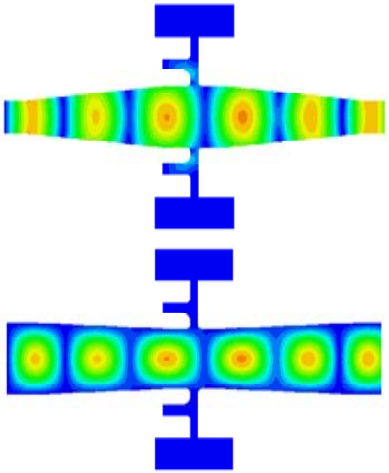
12 GHz stand along RF power source waveguide network layout.




-The 12 GHz version of the SLAC mode converter is already being designed as a part of the 12 GHz klystron window. We a planning to establish joint SLAC/CERN order to the industry.
- The 12 GHz gate valve is now being rescaled from its 11.4 GHz brother

To allow the independent transverse alignment of the two linacs in CLIC, the special, contact-free choke mode flanges (CMF) are planned to be used



Dynamic range for the accepted performance (S11< -45 dB)

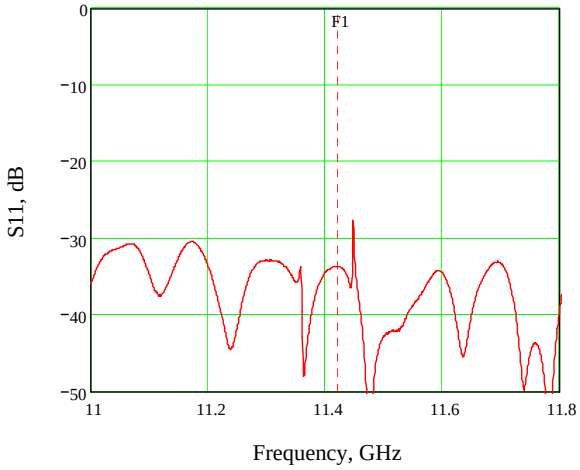
X - shift: ± 0.25 mm

Y - shift: ± 0.5 mm

Z - shift: ± 0.5 mm

Twist: < $5^0$

11.424 GHz choke mode flange prototype




# SUMMARY

- Since the CLIC frequency change in 2007, the extensive program of the X-band RF waveguides components development have been established in CERN. To date, we have designed, fabricated and received all the components necessary to start the high RF power operation of the TBTS and the first stage of the TBL. The number of them are already installed and are in operation.
- Recently, in Europe, the X-band activity has significantly grown. The number of Lab have expressed their interests in using the X-band technology for their needs. We are welcoming any requests to share our experience in terms of development and fabrication of the devices, even with customized specification. Also the design of the new types of the RF components can be done on the collaborative bases. Do not forget, the high power RF components is rather expensive business !