PRODUCTION STATUS OF ACCELERATOR COMPONENTS

WEP038

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Introductions

Mitsubishi Heavy Industries (MHI) has started manufacturing of accelerator components such as accelerating structures in 1960s. For example, in a field of normal conducting accelerator, in recent years, MHI had handled mass production of C-band choke-mode accelerating structures and SLED for Riken SACLA, production of DTL, SDTL (Separated DTL), ACS (Annular Coupled Structure) for JAEA/KEK J-PARC. In latest years, MHI manufactured over 120 S-band accelerating structures for PAL-XFEL and shipment has completed in March 2015. In addition, MHI has accepted order of C-band waveguide network prototype (CWNP) for SwissFEL project in June 2014 and has been already delivered to PSI in December 2014. MHI also has been accepted order of 26 C-band waveguide network series (CWNS) and the production of them is in progress now.

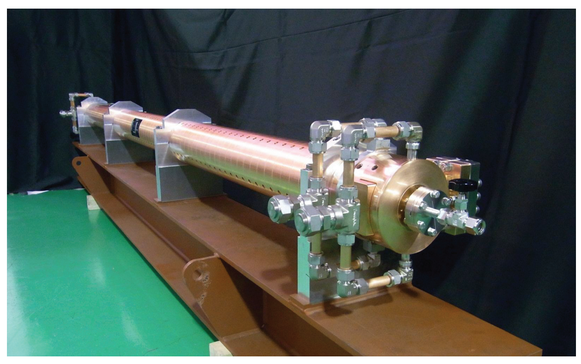
S-band accelerating structures for PAL-XFEL

- Mass-production of the S-band 3 m long accelerating structure started in June 2012 and finished at March 2015. Totally 120 structures has been delivered to PAL.
- Results of LLRF measurement after tuning shows excellent performance of production.

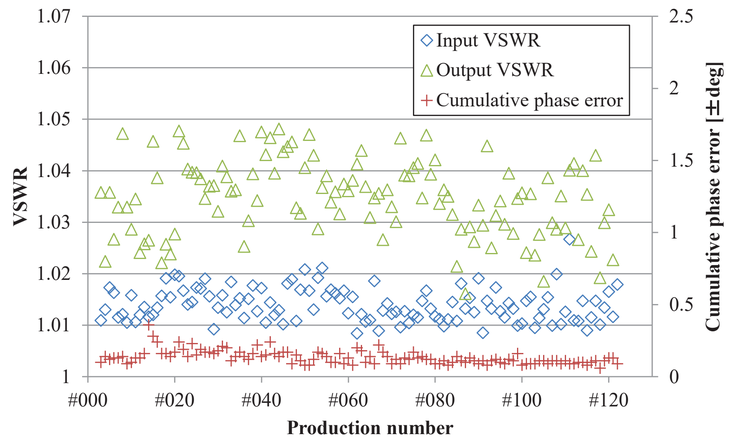
Main parameters

Frequency	2856 MHz
Accelerating Type	C.G.
Phase Shift per Cavity	2π/3
Unloaded Q	13000
Attenuation Constant	0.56
Input / Output VSWR	< 1.05
Phase error	< ±2.5 degree
Number of Cells	82 + 2 Coupler Cells
Filling Time	0.84 μs
Length	3 m
Coupler Type	Quasi-symmetrical type

Appearance of the structure



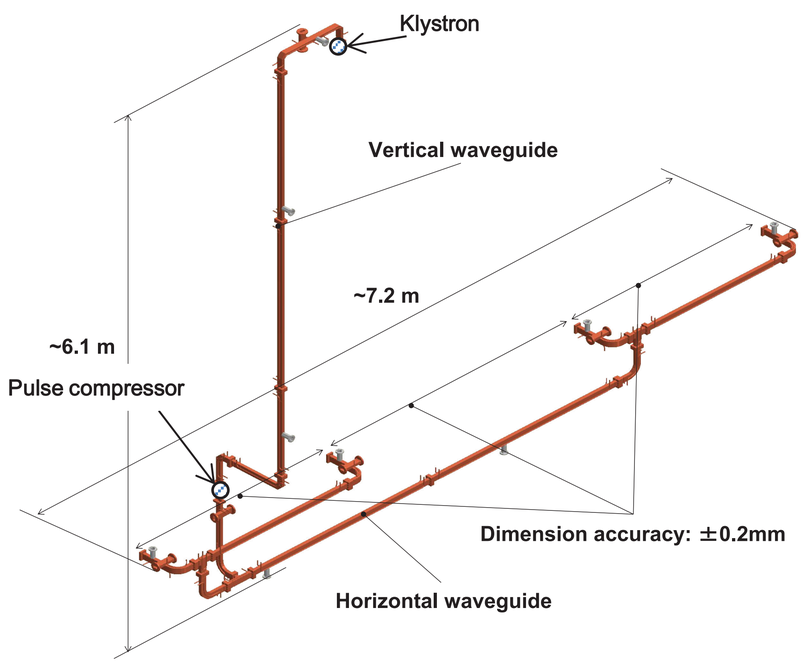
Result of LLRF measurement



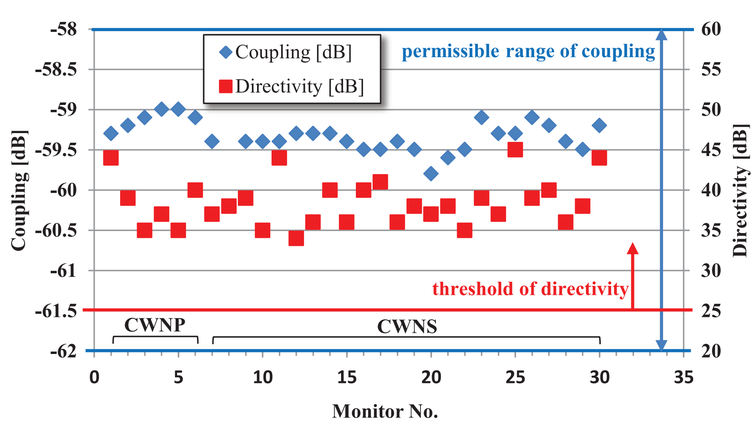
C-band waveguide network for SwissFEL

- One waveguide network provides RF power from one klystron to four accelerating structure.
- Six directional couplers for RF monitor, three RF splitters and nine vacuum ports are included in one unit.
- In order to precisely fit to input flange of each accelerator structure, dimension accuracy between four interface flanges are ±0.2 mm
- CWNP had been already installed in the test facility and high power test of the CWNP by PSI is planned.
- Production of CWNS (approximately 500 waveguides) has been started. First 4 units of the CWNS have been already delivered to PSI in August 2015.

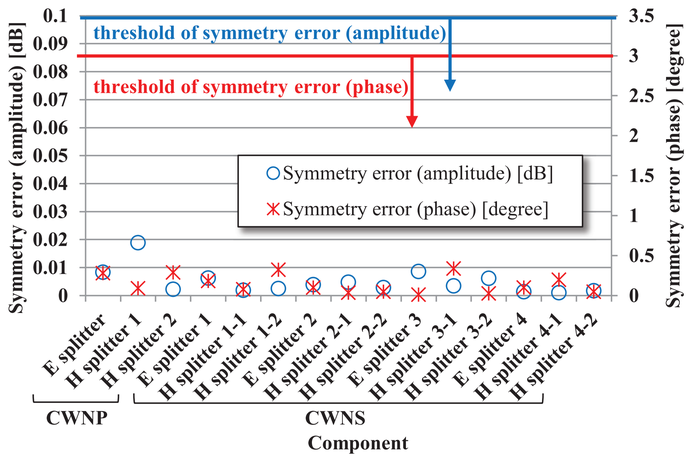
Overview of the waveguide network (series production for LINAC 1)



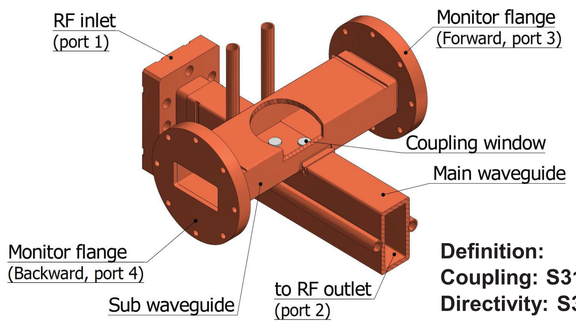
Coupling and directivity of RF monitors



Symmetry error of splitters

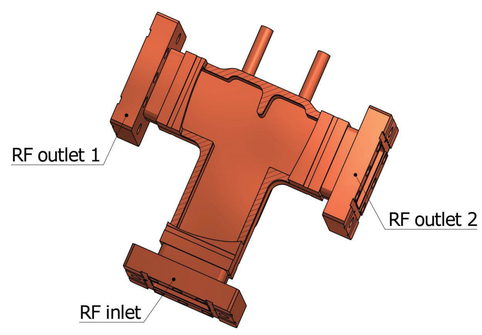


Schematic of RF monitor



Definition:
Coupling: S31 (-60 ±2 dB)
Directivity: S31 - S32 (> 25 dB)

Schematic of H-plane splitter

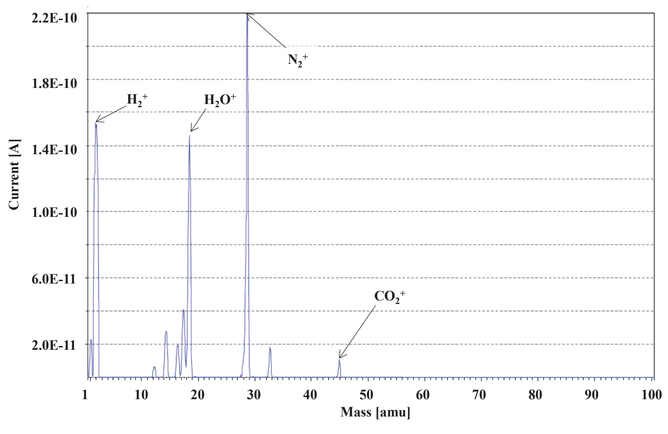


Main parameters

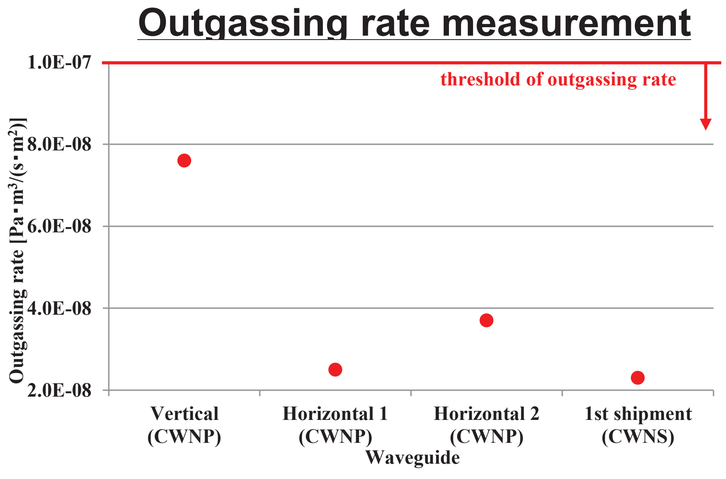
Bandwidth	5712 ± 20 MHz
Peak power	320 MW*
Average power	15 kW
Pulse repetition rate	1-100 Hz
VSWR	< 1.04
Operating pressure	$< 1 \times 10^{-6}$ Pa
Waveguide size	WR187
Flange type	C-band A-DESY
Coupling of the RF monitor	-60 ± 2 dB (5712 ± 3 MHz)
Directivity of the RF monitor	> 25 dB (5712 ± 20 MHz)
RF symmetry error of splitters	< 0.1 dB in amplitude < 3° in phase
RF leak to vacuum manifold	< -85 dB
Residual gas analysis (RGA)	The RGA spectrum must show no evidence of hydro carbons and the peaks > 40 Amu (excluding peak 44) should be ≦ 0.1%
Outgassing rate	$< 1.0 \times 10^{-7}$ Pa・m³/(s・m²)

*Maximum power in between the pulse compressor and the 1st splitter

Residual gas analysis (RGA)



Outgassing rate measurement



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