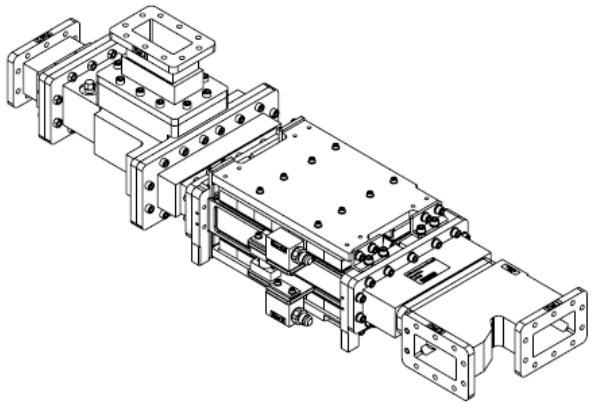

- 4-port ferrite phase shifter circulator
- Low insertion loss
- High isolation
- Extended peak power capability using a Magic-T design in WR340, covering operation into a short circuit at any phase
- Robust and reliable design
- RoHS compliant
- Designed for S-band LINACs

| Parameter | Value | | |
|---|---|---|---|
| **Footprint Drawing No.** | FP-10073658 | | |
| **Product Type** | Circulator | | |
| **Configuration** | 4-port ferrite phase shifter circulator | | |
| **Orientation of Rotation** | see footprint drawing for port labeling | | |
| **Center Frequency $f_0$** | 2998 MHz | | |
| **Bandwidth BW** | ± 10 MHz | | |
| **Forward Power** | **Options:** | **Xp = 1** | **Xp = 2** |
| **Forward Peak Power** | | 25 MW | 35 MW |
| **Forward Average Power** | | 15 kW | 15 kW |
| **Reverse Power** | 100% at any phase | | |
| **Insertion Loss** | ≤ 0.15 dB | | |
| **Return Loss** | ≥ 30 dB | | |
| **Isolation** | ≥ 30 dB | | |
| **RF Waveguide** | WR284 | | |
| **RF Flanges / Connectors** | CPR284F flat | | |
| **Cooling System** | demineralized water | | |
| **Water Tube Materials** | Copper or Stainless steel only | | |
| **Water Connectors** | 2x ½ hose barb fittings, stainless steel | | |
| **Water Inlet Temperature (nominal)** | selectable between 20°C and 40°C | | |
| **Water Inlet Temperature Range** | ± 5°C | | |
| **Water Flow Rate** | ≥ 400 l/h | | |
| **Water Pressure Drop** | ≤ 2 bar | | |
| **Water Inlet Pressure** | ≤ 10 bar | | |
| **Water Leak Test Pressure** | 15 bar for 10min | | |

| | | |
|---|---|---|
| **Waveguide Dielectric Filling Gas** | SF6 | |
| **Gas Pressure** | nominal: | 3 bar absolute |
| | maximum | 4 bar absolute |
| **Gas Leak Rate (Helium)** | < $5 \cdot 10^{-4}$ mbar l/s, | |
| | device pressurized with He gas at 2.5 bar gauge | |
| **Ambient Temperature** | operating : | 10°C to 40°C |
| | storage : | 0°C to 60°C |
| **Relative Humidity** | < 80%, non-condensing | |
| **Magnetic Stray Field** | < 5 G in 1m distance,<br>No magnetic material is allowed within a distance of 10cm from the envelope of the device. The device must not be exposed to magnetic stray radiation of >5G. | |
| **Body Material** | Aluminium | |
| **Surface Finish** | none | |
| **Dimensions** | see footprint drawing | |
| **Weight** | t.b.d. kg ± 10% | |
| **Mounting Orientation** | any | |
| **Mounting and Lifting** | mounting brackets, see footprint drawing | |
| **Arc Viewport Connector** | 1x FSMA ¼"-36 UNS-2A, male thread | |

## Ordering Code

**C4-WR284-04-2998 - Xp - Xw**

| Variable | Description | Value Options | |
|---|---|---|---|
| **Xp** | Forward Power Option | **1** : 25 MW / 15 kW | **2** : 35 MW / 15 kW |
| **Xw** | Water Inlet Temp. [°C] | **20 .. 40** | |

## Notes:

1 Circulator Characteristic Power Capability: The circulator is designed to operate above ferromagnetic resonance to offer lowest loss and highest peak power capability. The device is designed to handle full forward power into a 100% reflective short-circuit at port 2, covering all phase angles, without breakdown. The isolated port 3 of the circulator must be terminated with a reliable dummy load. The same applies to port 4, in case of a 4-port device. The return loss of the dummy loads is required to maintain a match of ≥ 30 dB over the full power range. Under these conditions the peak power capability of the device can be expressed by a "characteristic" power of about Pc = 4x forward peak power.

2 Electrical Parameters: The specified values for insertion loss, return loss and isolation are valid for the circulator terminated with well-matched loads on all ports. The input reflection coefficient of the circulator terminated with a short circuit at port 2 and a dummy load at port 3 (and port 4) may differ from these values, depending on the superposing vectors of (1) circulator return loss, (2) circulator isolation and (3) load match.

3 Arc Detector Viewport: The device is equipped with one or more arc detector viewport connector(s) that allow(s) the connection of an AFT arc detector device via a low-loss fiber optical cable.
The device itself is not protected against arcing that can occur as a consequence moisture or contamination inside the waveguide or under abnormal operating conditions. However, the use of an arc detector can reduce the risk of permanent damage by arcing significantly. The use of at least one arc viewport in connection with a proper arc detector system is *recommended* for a safe operation of the present device and the entire RF system.
AFT´s high-sensitivity arc detector systems detect light and provide an interlock output signal within a very short response time of a few microseconds. The interlock signal must be hard wired to the RF source in such a way that the RF source can be shut down within about 10µs.

4 Water Cooling: There is a water cooling circuit with a designated water inlet and outlet connector. Water quality, temperature, flow, and input pressure need to be controlled carefully according to the specified values. Air bubbles in the cooling channel have to be avoided.
The requirement for demineralized water is based on the exclusion of deposition and agglomeration of mineral salts, calcium carbonate or rust in the cooling channels. There are no specific requirements for the water resistivity.
The cooling channels must not be contaminated by sealants such as PTFE tape or hemp fibers. These can decrease cooling significantly or even block cooling channels.
For reason of protection, the device requires sensorics with RF interlocks for specified water temperature, water flow, and water inlet pressure. The corresponding equipment is to be provided by the customer.
Note: Water has to be carefully drained from the cooling circuit before transport and storage, in order to avoid possible damage by freezing of water.

5 Low-Power Factory Tests: The following tests will be performed at the AFT factory before shipment:
(1) small-signal network analyzer measurements of insertion loss, isolation, and return loss vs. frequency at the nominal water inlet temperature and at an ambient room temperature of 22°C ± 4°C, for all ports and signal paths.
(2) Water pressure and leak test.
(3) Visual inspection.
(4) Helium gas leak rate test.

6 Documentation: An owner´s manual is supplied for providing information on the installation, operation and maintenance of the device. The documentation will also include specification, footprint drawing, an inspection report, and the RF test results as viewgraphs of S-parameters vs. frequency.

| Rev. | Remark | Date | Name |
|---|---|---|---|
| 00 | Initial | 26.05.2018 | C. Weil |
| | Footprint drawing no. | 13.06.2018 | C. Weil |
| | New logo, notes | 19.02.2024 | C. Weil |