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Manual

High-Power Isolator

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1. Product Introduction

The present document serves as a generic manual for AFT´s state-of-the-art ferrite isolators designed for high-power RF and microwaves.

A ferrite isolator is a non-reciprocal passive RF/microwave device with typically two connecting ports (input and output). Non-reciprocal means that the microwaves transmits through the device in one direction of propagation only. Isolation is given for the counter direction. The ferrite isolator is actually based on a ferrite circulator and load terminations at the isolated port(s). Non-reciprocity is achieved by a magnetically biased microwave ferrites in the core of the circulator. Fig.1.1 illustrates the set-up of a 3-port isolator. The energy enters at port 1 and the ferrites direct the energy to port 2 while port 3 is isolated. The reflected energy at port 2 is directed to port 3, where the energy is absorbed in the load, thus isolating the input port 1 from reflections. In case of a 4-port circulator a second load is connected to port 4.

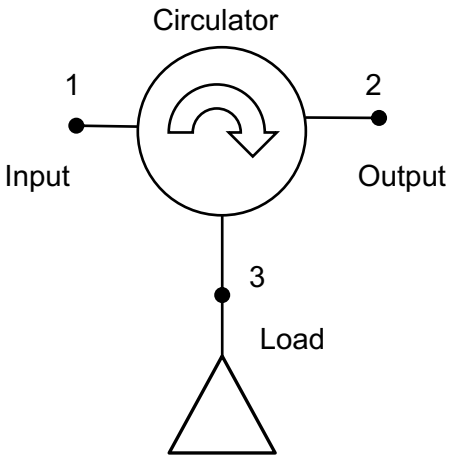

Fig. 1.1: 3-port isolator with 3-port circulator and load termination

Isolators are used to protect and stabilize high-power RF sources operated into highly reflective applicators, such as particle accelerator cavities, and industrial microwave ovens. In this way, they effectively contribute to improve performance, reliability and life-time of RF tubes, solid-state power amplifiers and complete RF systems.
AFT´s high-power ferrite isolators are robust and reliable devices designed to offer lowest loss, high isolation and excellent power capability. Most devices are capable to handle full forward power into a 100% reflective termination at the circulator output, covering all phase angles.
As a unique feature, AFT uses its own in-house ferrite materials with a stringent quality control.
All isolators are designed and manufactured to be compliant to the requirements of the directive 2011/65/EU of the European Union on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).
Depending on power level, AFT isolators are equipped with water cooling and high-power tuning options such as the magneto-static tuning or an electronic temperature compensating unit (TCU) with optional RF feedback control.
Complementary electronic equipment such, as AFT´s high-sensitivity arc detectors are strongly recommended to protect the circulator against permanent damage in case of unexpected arcing.

2. Preamble

Glossary of Terms

Customer

The customer is the organization, or entity that is using the product for its intended purpose and operation by its personnel.

User personnel

User personnel are those assigned by the customer for duties such as equipment, installation, operation, setting- up and maintenance including cleaning, troubleshooting and transportation.

Operational staff

Operational staff are personnel assigned by the customer for the operation of the system in which the product is installed.

Intended users of the manual

This manual addresses user personnel, who is in charge of the duties for installation, operation, maintenance and operational staff, which is responsible for the system operation.

The operating company has the obligation to:

- Supply and give access to this manual to user personnel and operational staff at any time.
- Train personnel concerning the use of AFT-products including safety notes.

This manual contains important information for customer about:

- Unpacking
- Installation
- Operation
- Maintenance

Intended operation

A precondition for the intended operation is the understanding of the manual. Non-compliance can cause damages to the product as well as danger to personnel and equipment. Safety items must not be disabled, or modified, or used contrary to their intended operation.

The customer is responsible for operating the product in its intended manner!

The product is intended to be operated in an industrial, scientific research laboratory or production company and should not be used in a way which can cause damage to personnel or installations.
The customer assumes responsibility for use of the product outside its intended operation or in disregarding the instructions of the manufacturer. The manufacturer will assume no responsibility for misuse of the product.
The intended operation is obtained when the product is operated according to this manual, the technical specification and any additional supplied document. The use of the product requires special knowledge. The customer is responsible to ensure that only operational staff and well trained personnel with appropriate capabilities are using this product.

Warranty and liability disclaimer

The contractually agreed warranty expires immediately, if:

- the product or any of its components (incl. water fittings) is / are disassembled or changed,
- the device is operated not according to the intended operation,
- the device is intentionally or negligently damaged.

The warranty does not apply to natural wear and tear.

Warranty or liability claims concerning personal injuries or installation damages are forfeit if one or more of the following causes are involved:

- Improper mounting, setting up, use or maintenance of the product.
- Use of the product with non-operational, improper or defective protection and safety equipment.
- Disregard of the notes in this manual concerning transportation, mounting, setting up, use and maintenance of the product.
- Non-approved modifications of the intended installation of the product.
- Mechanical damage from foreign objects or force majeure.
- Non-intended operation of the product.

3. Safety Notes

General introduction

AFT is continuously improving the products to provide the highest safety standards and technical up to date state. To maintain this condition and to ensure safe operation, the user should read and comply with all notes and warnings.

Symbols and safety labels

Observation of the Safety Notes is necessary to avoid injuries to personnel and damage to equipment. Therefore, it is necessary to carefully read and observe all following safety notes, before setting up the product. The described symbols and labels are generally used by AFT but do not all necessarily apply to this specific product.

				
Observe important notes & instructions (a)	**Danger of electric shock (b)**	**Danger of RF radiation (c)**	**Danger of heat (d)**	**Danger of magnetic field (e)**

Fig. 3.1: Safety symbols

			
Equipment ground conductor	**Grounding conductor**	**Ground**	**Components sensitive to electrostatic discharge**
(a)	(b)	(c)	(d)

Fig. 3.2: Electrical symbols

Table 3.1: Signal words

Signal Words	Meaning
Danger	Indicates a dangerous area with high-risk potential. Dangerous area can lead to death or serious injuries and severe damage to the product.
Warning	Indicates a dangerous area with medium risk potential. Dangerous area can lead to death or serious injuries and severe damage to the product.
Attention	Indicates a dangerous area with low risk potential. Dangerous area can lead to minor or to no injuries and damage to the product
Regard	Indicates a possibility for a misuse, which can cause damages to the product.
Note	Indicates circumstances, which have to be considered while using the product but does not cause damages.

Basic Safety Notes

Note

- Installation has to be done by qualified user personnel.
- The use of the product requires special knowledge and a high degree of concentration during use. Otherwise, a high degree of risk to personnel and installation exists. The customer should assign appropriate qualified personnel for the use of the product.
- Check prior to setting up of the product that all protective measures are installed in a proper way and are working. Use the product only if all safety and security measures are fully operational.
- Never remove a safety installation or other parts of the product while it is in use. Misuse can cause personnel injury and installation damage from heat, electrical shock or mechanical force.

- Please note that the device has a strong magnetic field that attracts all iron particles. Therefore, use non-magnetic tools only and keep away any magnetic sensitive devices e.g. cardiac pacemaker, credit cards or watches.

4. Unpacking

Note

Receiving Inspection:
Please read and follow the instructions given in the paper "Instructions for Receiving Inspections" (AFT doc. no. P100211673) prior to unpacking and installation of the device. The instruction paper can be found in the delivery note papers.

The scope of supply and the device serial number are documented in the accompanied delivery note papers.

AFT products are delivered in a wooden crate or a cardboard box**.** To unpack the product the following guidelines should be used:

- Never unpack a cold device due to the risk of condensation. The device should be warmed up to room temperature prior to unpacking.
- Unpack in clean and dry area only.
- Keep the original packaging including cover and caps for storage and future shipment.

In case of a wooden crate:

The wooden crate is not stackable if not otherwise noted.

- Ensure that the device is unpacked in an area where a crane is available.
- A series of marked screws attaches the cover to the box. Use a screwdriver to remove the screws.
- Lift the cover.
- In most cases the device in the crate is fixed against movement with additional crossbar(s). In this case remove the screws for the crossbars on the side of the crate. Remove the crossbar(s).
- Remove the sealing foil, packing material / foam and the desiccant bags. Dispose the desiccant bags, if applicable.

For lifting the device out of the box observe the following points:

- Lift a heavy device with a crane by using all provided crane eye bolts on top of the device, only.
- No personnel is allowed underneath a crane-lifted device!
- Never drop the device.
- Ensure that the product is kept in balance during movement.
- Never lift the device at the RF flanges.

In case of a cardboard box:

- Open the cardboard box carefully.
- Remove the sealing foil, packing material / foam and the desiccant bags, if applicable. Dispose the desiccant bags.

- Never lift the device at the RF flanges. Use the main body close to the center of gravity to grab the device.
- Never drop the device.

To protect the device against damage, dust and particles the RF flanges and all interface connectors (e.g. water connector, coil connector, sensor connector, arc viewport connector and the connectors for pressurization) are protected with covers and caps. Remove cover and caps in a clean area only for visual inspection or just before installation after the device has been moved to its final destination.. Keep the original covers and caps for further transportation and storage.

Check the device for visual shipping or handling damage.

Check for the undamaged cardboard box of the accompanying TCU, if applicable.

Transportation Locks:

AFT´s circulators are often equipped with a transportation lock for the ferrite cooling disks. Plastic plates support the cooling disks inside the circulator and stabilize it against each other and the circulator housing, see **Fig. 4.1**.
If applicable, carefully remove the transportation lock, after the device has been transported to its final mounting area. There are three plastic plates which are accessible via the RF ports of the circulator. First remove the screw nuts in the middle of the flange and remove the flange cover. Then remove all threaded rods with their corresponding plastic plates by pulling them out of the device. Circulator-specific transportation locks may require additional instructions. Please pay attention to additional documents sent with the device. Keep the original transport locks for a safe future storage, transport, and shipment of the device.

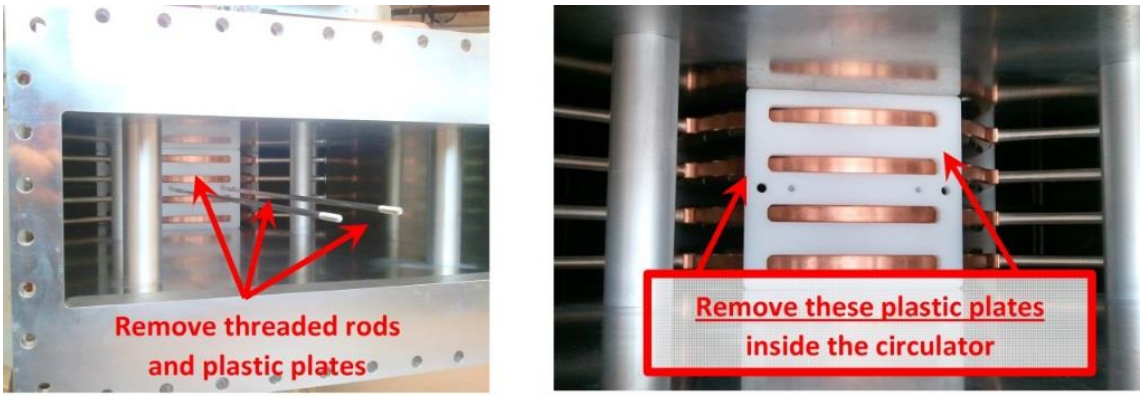

Fig. 4.1: Transportation lock of a waveguide circulator (example only)

In case of waveguide devices a visual inspection of the waveguide interior is mandatory, particularly after any transport and storage. Remove RF covers for visual inspection. Check for ferrite integrity and dust, dirt, moisture or any loose particles in the waveguide. Remove moisture or dust carefully by using a clean and dry cloth. In case of ferrite particles sticking in the magnetic field area, please contact AFT for instructions on cleaning.

5. Installation

Before operating the device under high-power microwaves, the following installation procedure shall be followed.

Mounting:

- Move the device to its final mounting position.
- Mount the device onto its support structure by using the provided mounting holes/ threads as shown in the footprint drawing. Use non-magnetic tools, only.
- The use of magnetic steel or any other kind of magnetic material is not allowed within a distance of 10cm from the envelope of the device.

RF Connections:

- Remove RF connector covers or caps.
- Check RF connectors / waveguides for any damages before connecting.
- In case of flanges with sealing grooves used for pressurized devices:
  - Check all sealing grooves to be scratch-free and clean.
  - Insert the gaskets into the grooves and make sure they are evenly positioned in the groove. Use the gaskets supplied with the device, or select gaskets acc. to specification / data sheet.
- The connecting waveguides or coaxial transmission lines for all ports shall be of nominal size and longitudinally homogenous for an electrical length of at least $\lambda/4$. This ensures that there is no interaction between matching elements in the isolator and any discontinuities in the connecting waveguide / lines. It is key to obtain best performance from the isolator.
- Align the waveguides / coaxial lines for a stress-free connection.
- Do not force the flanges or coaxial connectors when installing the isolator.
- Connect the coaxial connectors / waveguide flanges properly to ensure good and low loss electrical contact and to avoid RF leakage. Tighten the flanges with appropriate screws, nuts and washers for all available flanges holes. It is important to tighten the screws evenly one after another in several tightening sequences. Choose a proper mounting torque according to the selected bolt size and material. Never overtighten the screws on the flanges, in order to avoid deformation.
- The isolator ports are typically labeled "**Port 1**" and "**Port 2**" or "**INPUT**" and "**OUTPUT**". The isolator sense of rotation is a RF power flow from Port 1 $\rightarrow$ Port 2 $\rightarrow$ Load. Usually, Port 1 is used as the input to connect the RF source and Port 2 is used as the output (applicator).

Water Cooling:

- The majority of AFT´s high-power devices are equipped with a water cooling system, in order to remove the power loss generated in ferrites and conductors.
- Usually, there are two water cooling loops with separate connectors for circulator and load, due to different requirement for water flow rate, temperature stability and others.
- The water inlet and outlet connectors are labeled explicitly. Please refer to the specified direction of water flow given by the labels "water in" and "water out". Usually, the water inlet connector is located at a lower vertical position than the output. This arrangement better avoids air bubbles remaining in the cooling channels. In case there is no distinction between water in and out, feel free to choose your own preference.
- Remove the protective covers and caps.

- Connect the water inlet and outlet pipes to the isolator and load, respectively. The connector types are given in the specification document. In case of a series connection of circulator and load, please ensure that the circulator is the first device in the line.
- Do not use PTFE pipe tape or hemp pack for sealing additional water connections. Residues contaminate the coolant and may harm the effectiveness of cooling. Use pipe sealant e.g. Loctite 576.
- Ensure that water quality, inlet temperature, flow, and inlet pressure are controlled carefully within the specified values. Exceeding the specified values can lead to damage to the device.
- For reason of protection, the device requires sensor technology with hard-wired RF interlocks for specified water inlet temperature range, max. water outlet temperature, minimum water flow, and maximum water inlet pressure. The corresponding sensor and interlock equipment is not part of the circulator delivery and has to be provided by the customer.
- We recommend to not exceed a water flow rate by more than 30% above the specified minimum flow rate in order to avoid too high pressure drop. An excessively high water flow rate could damage the cooling circuits.
- Use demineralized water only, if not otherwise specified, in order to avoid deposits of calcium carbonate and mineral salts in the cooling channels.
- Air bubbles in the cooling channel have to be avoided.
- Turn on the cooling water and check for water leaks at all connector, tube and hose locations.

Gas Pressurization:

- High-power devices with very high power density often require a pressurization of the RF waveguide with dielectric gases, such as dry air, Nitrogen or SF6, in order to withstand the E-field arising from high circulating power. Please refer to the device specification, if applicable.
- If gas pressurization is applicable to the device, the standard procedure requires to firstly evacuate and then backfill the device with the specified gas and operational pressurization. Use the prescribed pure gas only; never use a mixture of gases.
- Check for permanent pressure integrity in terms of gas purity and pressure. Too low gas pressure or a contaminated gas may lead to electrical breakdown. Too high pressurization may lead to permanent damage to the device body.
- For reason of protection, the device requires a pressure sensor with a hard-wired RF interlock for minimum and maximum allowed gas pressurization; see specification. If not otherwise specified, the device comes without a gas inlet connector, valve and pressure gauge.

Electrical Connections to TCU:

- If the isolator, more precisely the circulator, needs to be operated in connection with an electronic *Temperature Compensating Unit (TCU)*, the device is equipped with an electro-magnet coil for re-tuning the magnetic bias field for the ferrites. Moreover, the device incorporates temperature sensors for water inlet and outlet temperature as well as ambient temperature. A connector box provides access to the connectors for coil current and temperature sensors.
- When equipped with the optional *RF feedback control* option, the isolator includes a directional RF coupler at its input port 1 in order to measure the input reflected power.
- Isolator and TCU are shipped as matched pair. Check that the S/N´s of isolator and TCU are a correct matching set, as given in the test protocols of isolator and TCU.
- Electrical cabling is required between isolator and TCU for coil current and sensors signal. All required cables are part of the TCU package.

- Please follow the installation procedure described in the owner's manual of the TCU in order to install and operate the TCU.
- For reason of protection, the TCU operation requires the installation of a hard-wired RF interlock, making use of the TCU status and error signals. See TCU manual for details.

ARC Detector:

- In most cases, AFT high-power devices are equipped with one or more arc detector viewport connector(s) of FSMA-type. The viewports allow the connection of an AFT arc detector system via low-loss fiber optical cables.
- The use of at least one arc viewport in connection with a proper arc detector system is recommended or even mandatory (see specification document) for a safe operation of the device. The viewport located at the output arm should be used primarily, as the highest electrical fields are encountered here, usually. Not used arc viewports have to be covered by a lightproof protective cap (e.g. the caps AFT used during transport).
- See the corresponding arc detector manual for instructions on the installation and operation of the used arc detector system.
- The device itself is not protected against arcing that can occur as a consequence of 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.

6. Operation

6.1. Low-Power Test

Prior to any high-power operation we advise our customers to perform a low-power S-parameter test as described below. This is to verify that the device has not been affected by transport and handling. If the test data deviate from the factory results please refer to section 8 "Trouble Shooting and Corrective Actions" or call AFT.

A low-power S-parameter test of the tuned isolator is performed in the AFT factory prior to shipment. The test set-up usually consists of a calibrated 2-port, 3-port or 4-port vector network analyzer, coaxial RF test cables, and waveguide-to-coaxial transitions (if applicable). Usually, the reference planes of calibration are set directly to the isolator ports by using proper calibration standards in coaxial or waveguide technology. In case of coaxial isolators, the calibration is done with N-connector calibration standards, only. For testing isolators with larger size coaxial connectors well-matched coaxial transitions are added to the isolator at each port while the reference plane remains at the N-connectors.

The measurements are conducted at the optimum water inlet temperature and within the specified water temperature range. Water is supplied by a well-controlled thermostat. The ambient temperature is 22°C ± 3°C. The data are recorded in thermal equilibrium after about 2h dwell time, if not otherwise specified.

Tab. 6.1: Isolator S-parameters in low-power test.

Parameter	Description
$\|S_{xx}\|$	Return Loss at Port x
$\|S_{yx}\|$	Insertion Loss from Port x to Port y
$\|S_{xy}\|$	Isolation between Port x and Port y

If specified, the reported low-power data may also include results of phase measurements or coupling coefficients of RF couplers among others.

The low-power S-parameter test protocol with reference to the corresponding serial number of the isolator and corresponding TCU (if applicable) is attached to this document.

6.2. High-Power Safety Issues

The ferrite isolator is a rugged passive device and requires virtually no special care. However, specific start and safety issues must be addressed.
Microwave devices and systems working in high-power area may quickly build up extremely high electric field strength. If the disruptive strength of the air or the dielectric gas filled in the device exceeds the limit, electrical breakdown in the form of arcing is possible. Typical reasons for arcing are:

- overheated surfaces by insufficient or missing water cooling,
- insufficient or missing gas pressurization or impure gas,
- humidity, e.g. by condensation or water leaks,
- contamination by dust, dirt or small particles.

In this case, part of the microwave energy is reflected and the arc travels back to the source. If the arc burns long enough, its energy reaches such high values, that ferrites, waveguide and microwave source might be subject to considerable damage and might even be completely destroyed. The use of an arc detector can reduce the risk of permanent, costly damage by arcing significantly. 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.

To stabilize the operation and to protect the device against damage the following general instructions must be followed before applying high-power.

- Check for clean and dry device.
- Check for properly connected RF Flanges to avoid RF leakage.
- It is recommended to cool the device with a water temperature well above ambient temperature; thus to prevent condensation. Condensation promotes arcing and corrosion.
- The device should be warmed up with cooling water until a thermal steady state is reached. This settling time is usually 1 to 2 hours. Never switch on high-power immediately after starting the water supply.
- Check if specified water flow is applied (if applicable).
- Check if specified gas pressurization is applied (if applicable).
- Check for a properly installed and operational TCU (if applicable).
- Check for properly installed and operational arc detector system.
- Check for properly installed RF interlocks.
- Strictly limit the RF input power to the max. peak and average values specified for the device.

Regard

Monitoring and RF interlocking is mandatory for:
- **max. water outlet temp., min. water flow & max. water inlet pressure**
- **minimum and max. gas pressure**
- **ARC detection and TCU status**

Missing safety interlocks can lead to severe damage to the device.

Attention

The surface of high-power devices may heat up to temperatures above 50°C. There is a risk of getting burnt when touching the waveguide surface.

Warning

Inadequately connected or bad RF flanges and connectors may lead to significant radiation of RF energy under high-power operation and thus may irradiate personal.

Warning

If any arcing occurs switch off RF immediately (best done with an arc-detector). Do not proceed with high-power operation in order to avoid or limit permanent damage to the device. Please contact AFT microwave.

6.3. High-Power Operation

Even if the isolator/circulator is designed for minimum losses and good temperature stability, very high-power circulators might be detuned by a temperature increase of the ferrites, which is dependent on the heat dissipation in the ferrites. In this case, the minimum return loss and isolation will be shifted to a somewhat higher frequency compared to the low-power condition.
The heat dissipation depends on the forward power as well as on the reverse power entering the circulator. The reverse power can vary from very low contributions, when the circulator output is operated into a matched load termination, up to 100% reflection, when operated into a short circuit or a detuned resonant cavity. Please note that the dissipation in the ferrites is not only dependent on the magnitude but also on the phase of the reflection coefficient connected to port 2 of the circulator.
The thermal drift of the ferrites under high-power can be compensated by retuning the magneto-static bias of the ferrites. By this means, the circulator return loss at center frequency, i.e. the reflected power to the RF generator, can be minimized again.

AFT offers two solutions for optimizing the circulator performance in high-power operation.

(1) Temperature Compensation Unit (TCU)

Circulators with an average power beyond 50kW are usually operated in connection with an electronic temperature compensating unit (TCU). The TCU actively compensates for variations of the water inlet temperature and high-power induced temperature drift by retuning the coil current of the circulator bias magnetic system. The circulator is equipped with temperature sensors for water inlet and outlet as well as ambient temperature.
For high-power optimization a manual tuning is required via a weighting potentiometer on the TCU front panel. This is a one-time tuning, typically performed at the initial circulator high-power test. Once the TCU is tuned for optimal performance, the circulator operates at a single set of correction settings without manual operator interaction.
Often, the TCU is assisted by a RF feedback control (RF sensor card option) to improve the response time of the temperature compensation.
Detailed instructions on TCU setting and high-power testing can be found in the TCU manual and corresponding AFT technical note papers.

(2) Magneto-static tuning

Circulators with moderate average power or thermally well stabilized device are normally operated without an electronic assistance. In many cases the circulator is equipped with a magneto-static tuning capability. This is based on a manual change of the static magnetic field biasing the microwave ferrites in order to obtain optimum S-parameters for the nominal forward power and the nominal reverse power. It is achieved by either creating small gaps in the magnetic return path or by applying parallel shunts for the magnetic flux in terms of iron sheet plates. Both means reduce the magnetic bias in the ferrites. Vice versa, the bias can be increased again by reducing the gaps or removing iron sheet plates.
This is a one-time tuning procedure, typically performed at the initial circulator high-power test. It probably does not provide optimum performance for any operating condition.
Prior to apply high-power to the circulator it is important to follow the detailed instructions on the magneto-static tuning procedure under high-power. The device-specific instructions are given in a corresponding technical note paper attached to this manual (if applicable).

7. Maintenance and Storage

7.1. Maintenance

The passive device is basically free of maintenance and wear parts.
During maintenance periods of your system or after long non-operational periods, we recommend checking the device for moisture, contamination or corrosion. In case of abnormalities or problems please contact AFT.

7.2. Storage

The following instructions shall be followed for a safe transport and storage of the device after uninstallation.

- Drain the water cooling system completely and blow out the pipes with compressed air. This is essential to prevent freezing of residual water during cold storage. That could lead to damage to the device.
- Clean the device and remove any moisture; in particular in the interior, if required.
- Reinstall the original transportation locks for the circulator cooling plates, if applicable.
- Repack the device by making use of the original AFT packaging, including protective covers, connector caps and box/ container. The device must be properly protected from outside humidity, dust and dirt.
- The storage shall take place in a clean and dry environment. See product specification or data sheet for storage conditions.

Special care should be taken after long non-operational periods and storage to prevent cold water (below ambient) to enter the device. Contamination, moisture and condensed water have to be removed carefully from the waveguide interior by drying before restart of operation.

Regard

Inappropriate preparation for storage and improper storage conditions can lead to long-term damage to the device.

8. Trouble Shooting and Corrective Actions

Tab. 8.1: Trouble shooting of potential problems

Problem	Corrective Action
Low-power measurement data differs from factory results	Check for: • visual damage of the device after shipment • calibration of the applied test equipment • coolant inlet temperature • ambient temperature • gas pressurization • TCU connection
The device does not operate satisfactory under nominal high power	Check for: • visual damages at the device • calibration of applied test equipment (e.g. directional couplers) • coolant inlet temperature and water flow • ambient temperature • particles or dirt inside the waveguide • moisture or condensation inside the waveguide • if applicable: • TCU connection and setting • check the pressurization with the specified dielectric gas • replace dielectric gas after arcing since the gas may have decomposed.
Arcing occurs	Do not proceed with high-power operation. Contact AFT microwave.
Dust or particle inside waveguide	• contact AFT microwave for information on cleaning procedure, if applicable

We do not recommend any customer repair action on site. Please contact AFT in case of problems. A problem report or measurements data, sent by email, may be helpful for analyzing and troubleshooting.

9. Help and Service Request

For open questions on the use of the product, or the understanding of the Manual or for trouble shooting assistance or service please contact our sales department.

Contact address:

AFT microwave GmbH
Donaustrasse 18
71522 Backnang

Phone: +49 7191 9659 0
Fax: +49 7191 9659 200
E-mail: sales@aft-microwave.com
Website: www.aft-microwave.com

Procedure Return Shipment

1 First of all send a non-conformity or problem report.
2 Please contact AFT customer service center for RMA prior to any return shipment.
Note: Return shipments without RMA will not be accepted by AFT.
3 Packing:
Follow the instructions in section 7.2 to condition the device for packing and transport. For warranty reasons always use the original AFT packaging with box / container.
For details about “Packaging / repackaging of AFT High-Power products in wooden crates” see AFT document P100278833, available on request.
4 Please include a final non-conformity or problem report in hardcopy form.

10. Appendix

- Specification or Data sheet
- Footprint Drawing
- Low-Power RF Test Report (S-Parameter viewgraphs)
- Factory Acceptance Test Protocol (if agreed)
- Technical Notes (if applicable)

Revision History:

Rev.	Date	Description
1.0	11.08.2016	initial
1.1	16.09.2016	Chap.4 Title and document number corrected
1.2	29.11.2016	Chap. 5 Arc detector completed
1.21	11.04.2017	Typos corrected
1.22	17.04.2017	Chap. 4 Unpacking corrected
1.23	13.12.2017	Warning symbol magnetic field added, trouble shooting corrected
1.24	26.02.2018	Chap. 4 Unpacking corrected.
1.3	18.02.2020	Safety Notes and warranty information completed
1.4	07.04.2020	Layout changed
1.5	26.06.2020	Warning labels updated
1.6	28.07.2020	Note on RF connections, email contact changed to sales@aft-microwave.com
1.7	04.03.2022	Formal change