Manual

ARC4 - Optical ARC Detector System 2.0

A4-2-SYS-00-X_D-X_I-X_T

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1. 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 and the recommended maintenance notes. Non-compliance can cause damages to the product as well as danger to personnel and equipment. Safety items should 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 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.

2. General 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)**

Fig. 2.1: Safety symbols

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

Fig. 2.2: Electrical symbols

Table 2.1: 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.

Attention

This electronic device is a safety class I equipment with an universal mains power supply 240 VAC, 50 Hz and 120 VAC, 60 Hz. All parts of the housing are connected electrically conductive, in order to provide a well-designed protective conductor system. However, the protective system is effective only, if the device is closed and the power supply is correctly installed, which is the normal case.

Do never open the device and remove the power supply module while the mains plug is still inserted in the mains socket. It will break the protective system and can cause personnel injury by electric shock!

3. Unpacking

Note

<u>Receiving Inspection</u>:
Please read and follow the instructions given in the paper "Instructions for Receiving Inspection" (AFT doc. no. P100211673) prior to unpacking 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.

This AFT products is delivered in 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 return shipment.
- Open the cardboard box carefully.
- Remove the sealing foil, packing material / foam.
- Check the device for visual shipping or handling damage.
- Never drop the device.
- To protect the device against damage, dust and particles all FSMA-connectors are protected with black caps. Keep the original covers and caps for further transportation, storage and use.
- Each ARC4 unit is supplied with a mains cable and connector kits for all electrical interfaces.
- Ordered arc accessories such as fiber optic cables and arc viewport may be packed in the ARC4 box.

4. Product Introduction

Arcs in high-power microwave systems

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 is exceeded because of dust, dirt, small particles, humidity or contamination or because of surface overheating, electrical breakdown in the form of arcing is possible. An arc is caused by a high electrical current ionizing the gas. Arcs appear in form of a lightning with an intense dazzling light and extreme temperatures. A plasma discharge maybe visible as a corona glow prior to an arc ignition. Due to the high temperature (>> 1000°C) arcs can melt metals and ceramics.

Arcing is not a local event limited to the source point of arcing. In case of arcing, part of the microwave energy is reflected and the arc travels back to the RF source. Thus, arcing can lead to severe damage of costly components or even the entire RF waveguide system including the RF tube. Not seldom: total damage! The energy transferred from the microwave to the arc decides about the damage an arc can cause: arc energy ~ RF power * time.

Arcs of lower energy do have a cleaning effect (“cleaning arcs”). Dust and small particles are burnt and evaporated prior to forming a destructive travelling arc. If the arc energy reaches values in the order of 5J or above, waveguide and microwave source might be subject to considerable damages and might even be completely destroyed. Thus, an RF device is best protected from arcing, if the first indication of arc light (glow) is detected with high sensitivity and fast response time.

AFT arc detectors cannot avoid arcing, but they are designed to effectively limit the energy of the arc by ultra-fast light detection and by providing a fast interlock signal to shut-down the RF source. 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. In this way, the use of an arc detector can prevent damage by arcing in best case, or at least reduce the risk of damage significantly.

AFT´s Arc Detectors Stand out for:

- Cutting edge light sensitivity
- Broadband light spectrum
- Ultra-fast response time.
- The detector electronics is locally separated from the high-power RF waveguide, leading to a high isolation of electronics from RF, radiation and heat.
- Fast, low-loss fiber optic transmission between arc viewport and arc detector.
- Arc viewports (FSMA) are easy to install to RF waveguide, easy retrofit and upgrade.
- High reliability.
- Modular upgradeability.
- Multiple systems interlocking with configurable logic.

ARC4 2.0 Product Information

The new generation ***ARC4 2.0*** *optical arc detector system* detects light produced by an arc with very *short response time*, using a *high-sensitivity, wide-spectrum* photodiode in the optical input stage. It is designed to effectively protect high-power RF equipment from damage due to unwanted electrical breakdown, corona discharge and arcing.

Arc Detector Modules (ADM): The modular system is available with up to 16 ADM cards cased in a 19" rack mountable chassis. Function keypads at the front panel as well as remote control interfaces allow testing, resetting and customizing of modules and system. Arc detection is signalled in three ways: (1) visually indicated by keypad LEDs, (2) via a digital output signal as TTL and Open Collector (OC), and (3) via a digital optical output signal. The output signals are used for interlock purpose in high-power RF systems. An analog output provides access to the photo voltage of each detector for monitoring and analyzing arc signal waveform among others. For safety reason the module comes with a power/system failure signal.

System Interface Modules (SIM): ARC4 can be complemented by up to two SIMs. These module cards allow customer programmable logical combinations of the electrical output signals provided by the arc detector modules. Two independent global arc output signals (GLBARC) are available on each interface module for interlocking two separate RF systems. Each GLBARC output signal can form a different configurable logic (AND/OR). These signals are available as TTL or O.C. With two SIMs one ARC4 system is capable of forming a total of four arc interlock signals (A, B, C, D) and thus to interlock up to four separate RF systems. The default logic for all GLBARCs is an OR combination of all 16 arc channels. This logic setting is typically used to combine multiple arc observation points to form a single arc interlock signal.
The coincidental arc detection scheme, realized by an AND connection of two arc signals at the same observation point, can increase the reliability of arc detection in a radiative environment. The time window for coincidental arc detection is given by the auto reset time.
There are two versions of SIM: *A4-2-SIM-00* allows remote test/ reset, while *A4-2-SIM-01* provides additional access to all 16 arc detector output signal as TTL (active low).

Optical Test Modules (OTM): OTM offers two independent FSMA optical test outputs driven by high-power CREE LEDs. Multiple test modules can be applied to precisely test the functionality of several optical arc detection loops, including photo detector, fiber optic cables, arc viewport, and arc test port. Optical test modules require the same card slots as the arc detector modules. The total number of detector modules plus optical test modules is 16.

USB Interface Access (Option): The USB option allows to set up a serial terminal connection using a telnet client. It enables an adjustment of light sensitivity (trigger threshold level) and auto-reset time for customized needs. An USB cable is part of the supply.

LAN Web Interface (Option): A web server provides computer access to ARC4 via a web browser using a local Ethernet or LAN connection. The web interface allows (1) complete system configuration and parameter settings, (2) scanning the system, component and signal status, (3) remote control of the system, (4) photo voltage monitoring as well as (5) alarm, event and status logging. USB interface access is included.

Given its modularity and flexibility, ARC4 provides a high degree of customizing and allows an easy system upgrade and replacement. The ARC4 2.0 system base unit comes with a CPU module and a power supply module as standards and can by configured with ADM, SIM and OTM modules, following an ordering code given in the ARC4 2.0 data sheet. A mains cable and connector kits for all electrical interfaces are supplied as standard accessories.

Low-loss fiber optic cables with FSMA connectors are used to transmit light from the arc viewports (observation points in RF components) to the ARC4 detectors and to send the optical test signals. Cables are available in different standard length as accessories.

Fig. 4.1.: Front Panel View

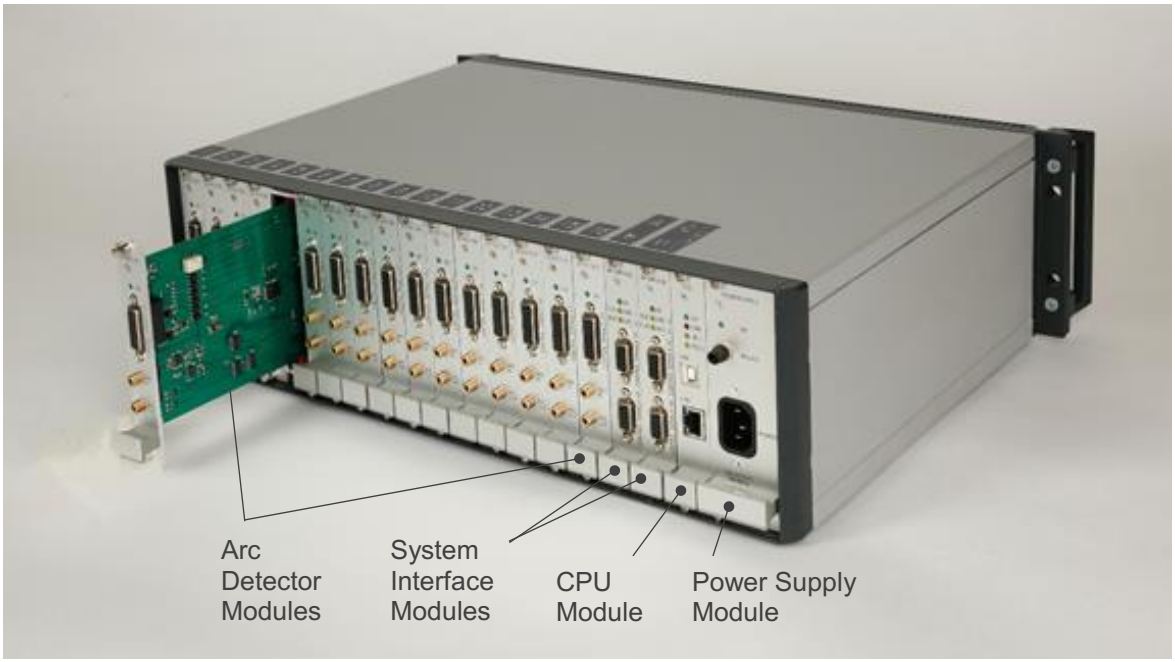
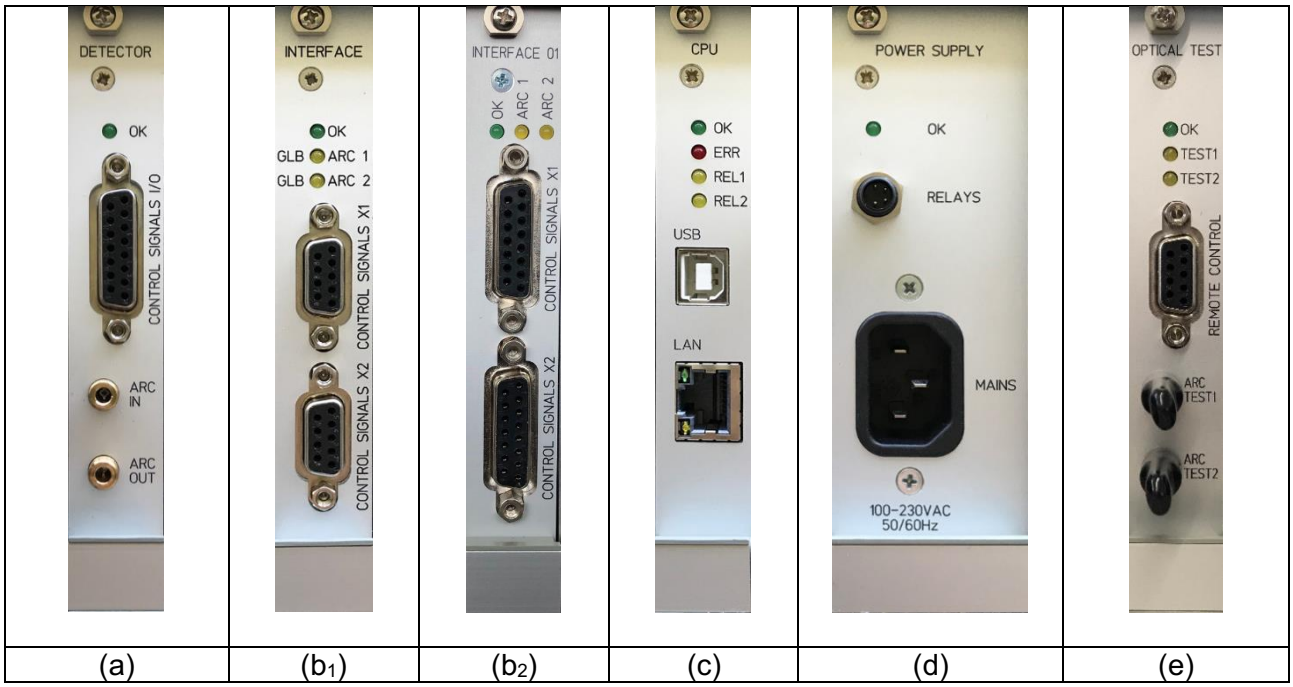


Fig. 4.2.: Back Panel View



(a)	(b_1)	(b_2)	(c)	(d)	(e)

Fig. 4.3: Interfaces and Signals at the backside of the ARC detector

(a) ARC Detector Module (ADM) with arc in/out (FSMA) and DB-15,
(b_1) System Interface Module SIM-00 with 2x DB-9,
(b_2) System Interface Module SIM-01 with 2x DB-15,
(c) CPU Module with USB and Ethernet (LAN) interface,
(d) Power Supply (PS) module with Mains connector,
(e) Optical Test Module (OTM) with 2x FSMA output and DB-9.

For details about connector pin assignment see ARC4 2.0 datasheet.

5. Front Panel Interface

The front panel of ARC4 2.0 is divided into functional fields, where multi-colored LEDs and highlighted buttons indicate current signal states or device status.

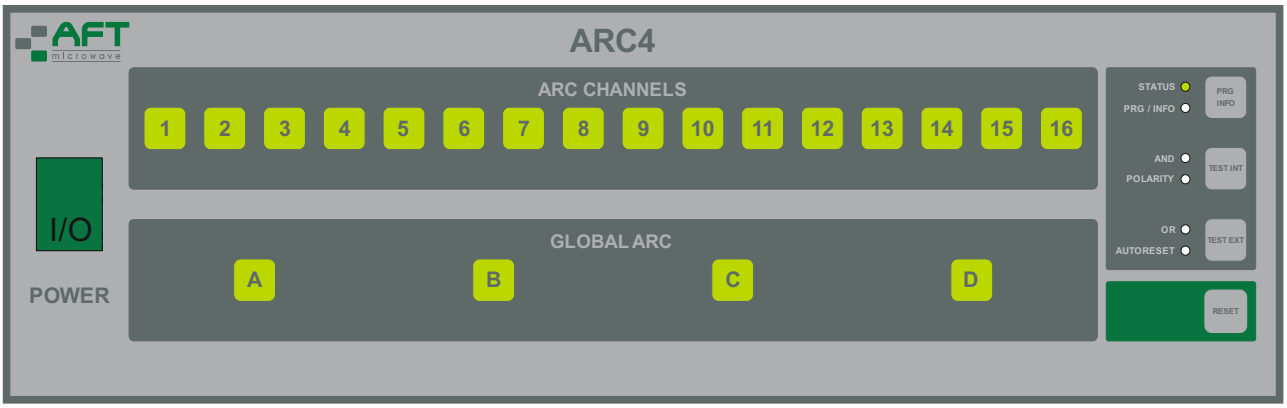
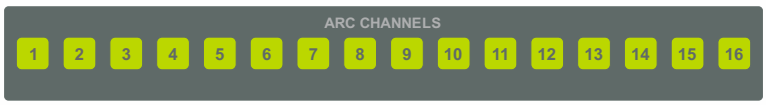
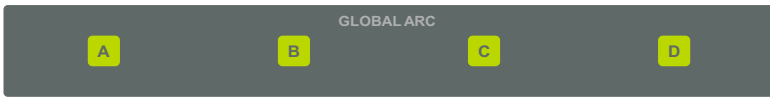
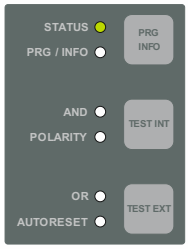


Fig. 5.1: Front panel

Table 5.1: Front Panel Description

Keypad	Description
	**ARC CHANNELS** – indicate current channel state, enable induvidual testing and resetting
	**GLOBAL ARC (GLBARC)** – indicate current logical group status, enable testing and resetting of whole logical group
	**Control** – LEDs indicate current device status, show current configuration
	logic setting
	polarity
	autoreset
	**RESET** button – enables resetting all channels and groups

6. Status Indication

During startup the CPU verifies, if all previously registered modules are present in their slots or if any modules have been added into the chassis. Status of the given slot is shown by the corresponding button's color: constant green, constant white, blinking orange and blinking red.

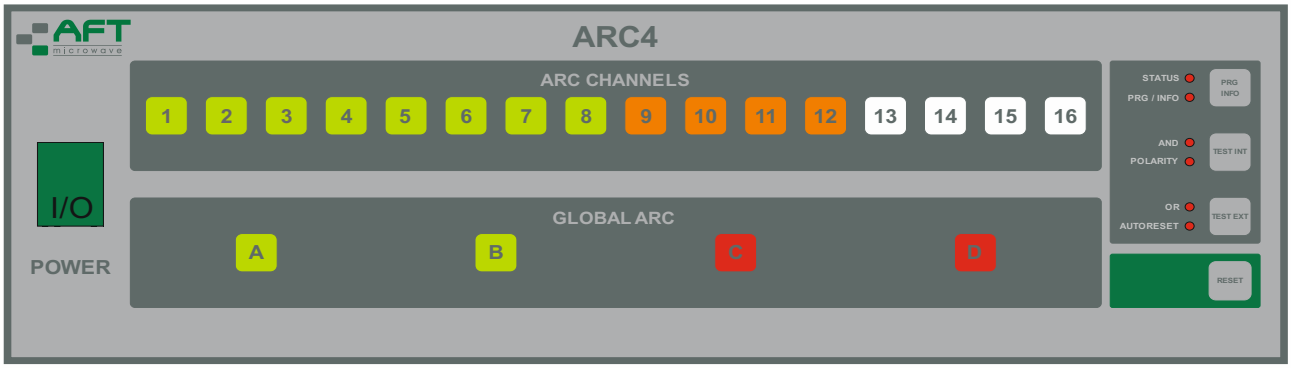
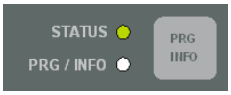


Fig. 6.1: Front panel showing module setup

Table: 6.1: LED showing status of the device

Keypad	Description
	**Green constant:** Modules at given slots are present and properly working.
	**White constant:** Modules at given slots are not present (as before)
	**Orange blinking:** Modules newly added into the chassis at given slots
	**Red blinking:** Modules at given slots newly removed from chassis or are not working properly.
	**Confirming new status:** By pressing the blinking button (orange or red) the newly changed status is confirmed by the user. The button will then turn accordingly green or white.
	**Saving new modules configuration:** By pressing the RESET button once the new modules configuration is saved by the user.

Table: 6.2: LED showing status of the device during operation

LED	Description
	Status OK
	Status alarm: in case of an error the STATUS LED changes from green to red. Possible causes: • CPU system data error • missing module • module data error • communication error between CPU and modules or display

During operation active alarms are shown as red color of corresponding buttons.

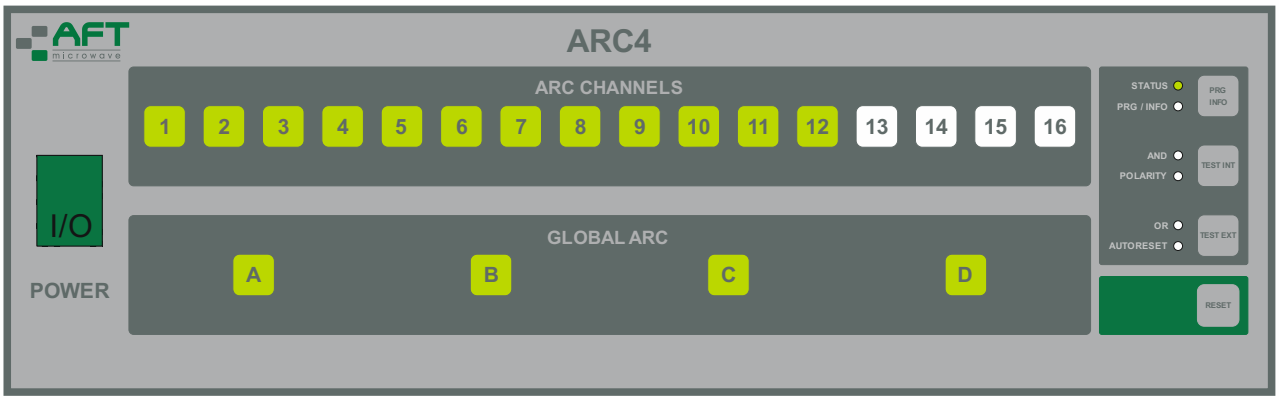


Fig. 6.2: Front panel status display example 1:
normal operation, no active alarms, slots 13 to 16 empty

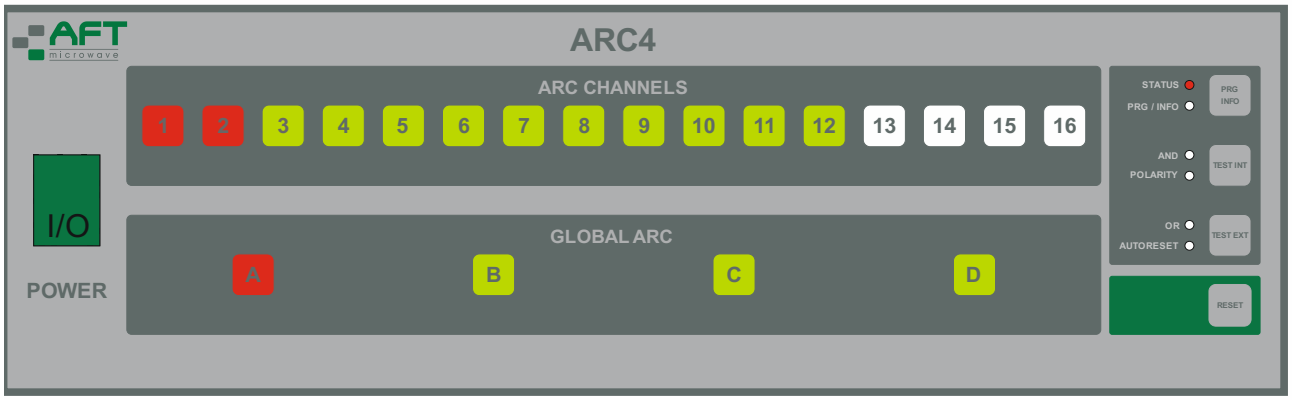
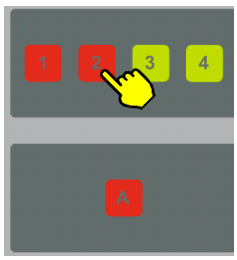


Fig. 6.3: Front panel status display example 2:
active alarms for ARC Channels 1 and 2, as well as Global ARC A

Table 6.3: Front panel status info

Keypad	Description
	Active arc alarms for ARC CHANNELS 1 and 2 as well as GLOBAL ARC A
	By pressing a button with active alarm the alarm for this particular channel or logical group is confirmed (resetted) and (unless the light is still seen by the detector) the button will turn back green If AUTORESET is ON, the alarm will remain active only for the set period
	Collective confirmation of all active alarms by pressing RESET button.

7. Parameters and Settings

Table 7.1: Operation Parameters and Settings

Parameter	Type	Value Range	Change via			Definition
			Buttons	USB	Web Interface	
Signal Polarity (ADM)	Qualitative	Normal / Inverted	✓	✓	✓	**Normal:** TTL-signal is low (0V) for no arc and high (5V) in case an arc is detected. OC stage is non conducting (hi-Ohm) for no arc and conducting (0 Ohm) if an arc is detected. **Inverted (default):** TTL signal is high (5V) for no arc and low (0V) in case an arc is detected. OC stage is conducting (0 Ohm) for no arc and non-conducting (hi-Ohm) if an arc is detected.
Signal Polarity (SIM)						
Auto Reset (ADM)	Qualitative	ON / OFF	✓	✓	✓	**ON:** after an arc is detected, if after a given time (auto reset time) arc is no more present, the alarm will automatically reset and be ready for next arc detection. **OFF (default):** after an arc is detected the alarm will remain active until it's manually reset (confirmed) by the user.
Auto Reset (SIM)						
Auto Reset Time (ADM)	Quantitative	0.1ms to 2000ms	x	✓	✓	Time period after which an arc detector will automatically reset if no more arcs are present. **Default: 0.1 ms**
Auto Reset Time (SIM)						
Sensitivity Threshold (ADM)	Quantitative	20mV to 500mV	x	✓	✓	Trigger threshold value of the photodetector voltage, at or above which an arc is being reported. Defines the detector's sensitivity. **Default: 20 mV**
GLBARC Logic (SIM)	Qualitative	OR / AND	✓	✓	✓	**OR:** two or more arc signals are combined in OR logic, the output signal will be true if any of the input signals (or both) is true. **Default** for all channels and logic groups **AND:** if two arc signals are combined in AND logic, the output signal is true only and only if both input signals are true.

Table 7.2: Default Factory Settings

Parameter		Default Setting
Signal Polarity	ADM	Inverted
	SIM	Inverted
Auto Reset	ADM	OFF
	SIM	OFF
Auto Reset Time	ADM	0.1 ms, if auto reset is activated
	SIM	0.1 ms, if auto reset is activated
Sensitivity Threshold	ADM	20 mV
GLBARC Logic	SIM	OR (16x) for all GLBARC groups (A, B, C, D)

The parameters *Signal Polarity*, *Auto Reset* and *Auto Rest Time* have to be set separately for each arc detector module (ADM) and for each GLBARC logical group of a System Interface Module (SIM).

Signal Polarity, *Auto Reset* and *GLBARC Logic* can be modified in the standard configuration of ARC 4 2.0 by using the keypad programming.

Auto Reset Time and *Sensitivity Threshold* can be modified by using the optional USB Interface Access 2.0 (A4-2-USB-00) or the LAN Web Sever Interface 2.0 (A4-2-LAN-00), only.

Note

If the AND logic is used for coincidental arc detection in a GLBARC channel, *Auto Reset* shall be activated (ON) while using the default *Auto Reset Time* of 0.1ms!

8. Installation and Initial Start

- Place the device in its intended position - the ARC4 2.0 can be used as a desktop device or installed in a 19" cabinet. Maintain environmental temperature and humidity conditions as specified in the data sheet.
- All optical FSMA ports (ARC IN and ARC OUT, ARC TEST) are covered with lightproof black protection caps. Remove the cap prior to connecting a fiber optic cable.

Note

All unused ports must remain covered to ensure correct operation of the device.

- Connect AFT fiber optic cables to optical ports ARC IN and ARC OUT and ARC TEST, if used.
- For accessing the DB-9 and DB-15 electrical connectors of ADM, SIM and OTM (CONTROL SIGNALS I/O and REMOTE CONTROL) make use of the supplied connector kits. The electrical interfaces allow access to all output signals including the photo-detector voltage monitors and to the remote control options (Test and Reset). See data sheet for pin assignment.
- Use any of the digital ARC output signals (TTL or OC) of a single ADM or the GLBARC output signal of a SIM for interlocking your RF source. The interlock signal shall be hard-wired to the RF source or system control unit.
- Make optional use of the System OK relay provided at the M8 connector of the power supply module for your extended system protection. The System OK relay contact is triggered in case of an ARC4 system failure or power outage. It can be used as an additional system interlock signal. The RELAYS connector M8 provides relay switches for System OK status and Arc Alarm indications. The relay status indication is as follows:

  System OK – relay is CLOSED when the status of ARC4 is OK. In case of a system failure, which covers power failure, CPU error and card error, or during booting sequence (temporary) the relay OPENS.

  Arc Alarm – relay is OPEN in case of no active alarms. Once an alarm occurs, that is arc detection or card error, and during booting sequence (temporary) the relay CLOSES. An alarm is acknowledged by the reset button or via Web browser (optional feature).
- Power failure output signals (OC) are also available at the CONTROL SIGNALS interfaces of all ADMs and SIMs.
- Connect the supplied AC mains cable or a cable adapted to your electrical socket. Switch on the device using the POWER switch on the front panel. During booting the device performs an internal test procedure. After booting the device is ready for operation, indicated by STATUS LED in green, ARC CHANNELS buttons in green for all installed ADMs and GLOBAL ARC buttons in green, if SIMs are installed.
- The USB and LAN interface connectors belong to extended system features that are not included in the standard set-up. For installation and operating instructions please refer to the specific manuals of the USB and the LAN Web interface.
- Prior to operation read safety notes in the following section.

9. Safety Notes for Operation of the Device

Notes

- The arc detector does not prevent arcing, but it effectively helps to limit the energy of arcs by sensitive light detection and by providing an output signal(s) within a few microseconds. The customer has to hard-wire the digital arc output(s) to the interlock of the RF source while providing a response time of about 10µs. Under these conditions permanent damage to costly RF equipment can be effectively avoided in most cases.
- Always operate in correct “OK” status indicated by “STATUS” LED in green and all respective arc/global arc channel buttons in green. Otherwise the device is not ready for arc triggering and does not allow safe system operation.
- Use AFT low-loss fiber optic cables only. The quality of the cables as well as proper positioning of the arc viewport at the RF waveguide significantly affect the effectiveness of arc detection.
- ARC4 2.0 can only deploy its full capability of fast arc detection, if the arc viewport (observation point) is spot most close to a critical location. Even though in many cases the high light sensitivity allows the coverage of more than just a single spot, we always recommend to provide a separate arc viewport for each critical area. This may include more than one viewport per component.
- Never disconnect a fiber optic cable while RF source is in operation.
- Regularly confirm technical functionality and safety of the product by checking the status LED, all cables and connectors.
- In the event of an obvious malfunction or visual damage immediately discontinue using the product and secure it against unwanted operation by third party. Disconnect AC power.
- In case of damage to the arc detector, do not attempt to repair on site. Please contact AFT for service and repair options.
- AFT does not accept any responsibility or liability for damage to RF equipment, even if the arc detector is operated properly.

10. Test Functions

The ARC4 2.0 allows the user to test proper function of light detection by two means – internal and external test.

10.1. Test Internal

The internal test checks the proper function of detector itself and related electronics in all installed arc detector modules by introducing a short IR pulse from an internal IR LED through an additional bore directly into the detector input.
To activate internal test for all ARC channels, press TEST INT button once.

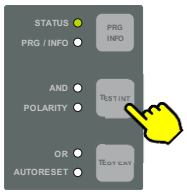


Fig. 10.1.: Starting internal test

All active Arc channels should change color to red. To resume normal operation press RESET button once.

Fig. 10.2: Resuming normal operation

Note

For ARC channels with auto reset ON the red color remains only for the defined auto reset time, then it goes back to green.

The ARC4 2.0 also allows the User to test proper function of light detection for individual ARC CHANNELS or GLOBAL ARC (GLBARC) logic groups. The principle is identical to global internal test, only limited to a chosen arc channel or GLBARC logic group.

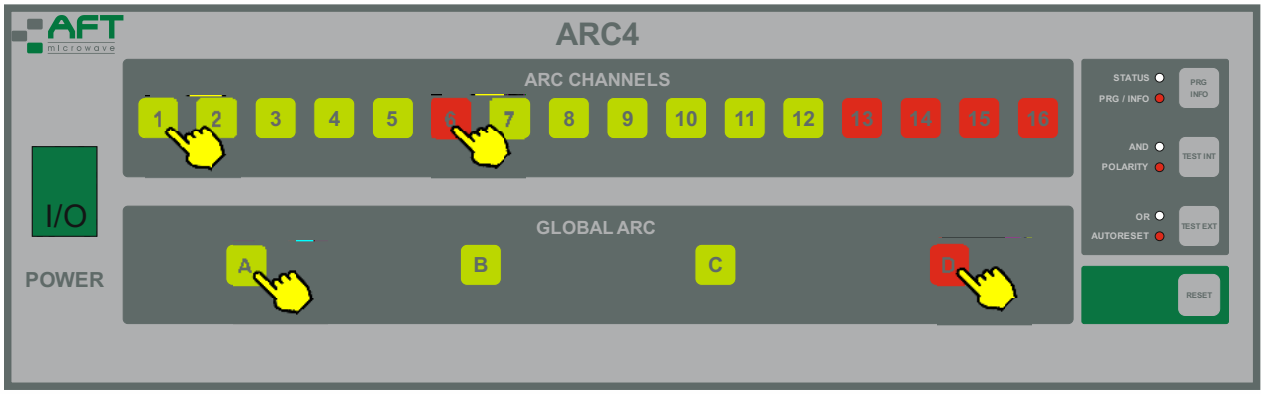


Fig. 10.3.: Running individual internal test

To run the test for an individual Arc channel simply press the corresponding button once. The button should turn red. To confirm/ reset the alarm press the button again.
If a GLBARC logic group button (A, B, C or D) is pressed, all logically programmed Arc channels for this group will be tested and should turn red. The group button should also turn red. To confirm/ reset the alarms either press the group button again or each individual Arc channel button. You can also use the RESET button.

10.2. Test External

The external test is intended to verify the whole optical section from the arc viewport in the waveguide up to the photo detector. This test can be performed by using:

- ARC4´s optical test modules (OTM), see section 10.3.
- an external light source can be installed as a test port to the arc viewport. For this purpose each arc detector module as well as system interface module has a potential-free relay output (Test external output) for triggering the external test-light source. See data sheet for pin assignments.

To activate the external test for all arc channels, press TEST EXT button once. The ARC Test signals of all installed OTMs and all external test relays in the ADMs and SIMs are triggered.

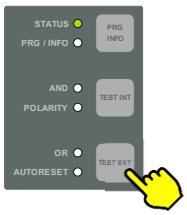


Fig. 10.4: Starting external test with TEST EXT buttom

Respective arc channels for which an external light source has been installed should change color to red. To resume normal operation press RESET button once.

Fig. 10.5.: Resuming normal operation with RESET button

Note

For ARC channels with auto reset ON the red color remains only for the defined auto reset time, then it goes back to green.

10.3. Optical Test Module

Multiple ARC4 Optical Test Modules (OTM) can be installed in any available slot for arc detector modules, that is slots 1-16, best starting from slot 16 and moving down. E.g., if two OTMs are to be installed, they should occupy slots 16 and 15.

The optional ARC4 Optical Test Module 2.0 is designed for precisely testing the functionality of up to two arc detector modules at a time along with connecting additional fiber optic cables. It enables the user to verify the full optical loop path of detection, from the arc viewport to the detector input. In this case the arc viewport has to be equipped with an additional FSMA test port, in such a way that the test port sends light into the arc viewport. The OTM has two independent FSMA optical outputs driven by high power CREE LEDs, that can be triggered in various ways:

- REMOTE CONTROL DB-9 interface on the card's back. You can trigger each output separately. For pin assignment see Arc4 2.0 data sheet.
- TEST EXT button on the device's front panel. It triggers the outputs of all test modules at once.
- Web Server interface

Each test LED emits one short (100us) pulse of visible light at 600nm.

11. INFO-Menu

The INFO-Menu serves as a quick check of current device settings, parameters and GLBARC logic, without the risk of making any unwanted changes.

To view (only) the device's current parameter settings, follow the steps given below:

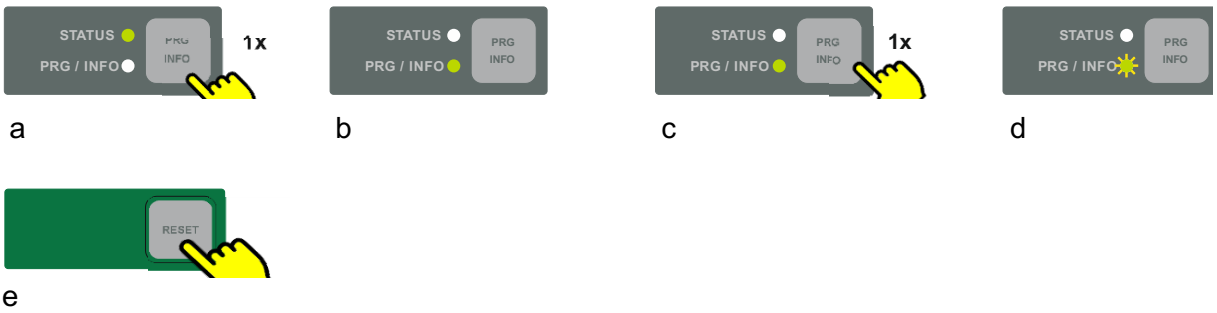


Fig. 11.1.: Entering the INFO-Menu

a. press PRG/INFO button once (1x) to view current parameters - polarity and auto reset

b. INFO-Menu for parameters is active - PRG/INFO LED constant green

c. press PRG/INFO button once more (1x) to view current GLBARC logic settings

d. INFO-Menu for logic settings is active - PRG/INFO LED blinking green

e. press RESET button once (1x) to exit INFO-Menu

Note

In this menu no changes can be made.

The first shown channel upon entering the menu is the last viewed or programmed ARC Channel. To change the channel or group for which the parameters should be shown, press the corresponding ARC CHANNELS or GLOBAL ARC button while in the INFO-Menu Parameters (PRG/INFO LED constant green).

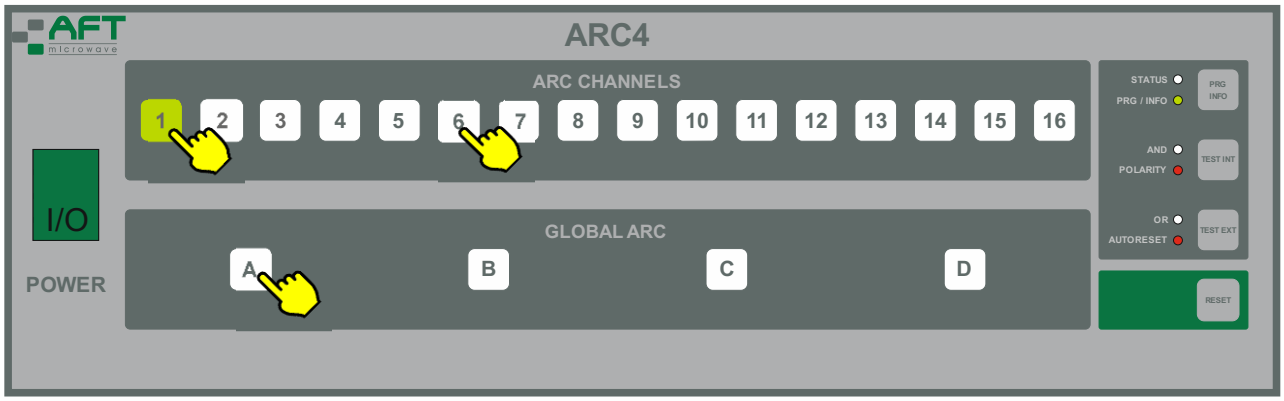
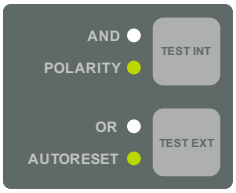


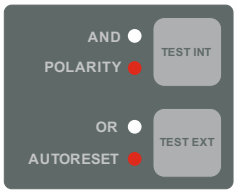
Fig.11.2: Front panel after entering INFO-Menu

Current setting of polarity and autoreset for a particular channel or group is shown by color of the according LED



Polarity = normal

Autoreset = ON



Polarity = inverted (default)

Autorest = OFF (default)

Fig. 11.3.: Status information for polarity and Autoreset

GLBARC logic settings are visualized by a three color scheme. OR combined arc channels are indicated by green color, see **Fig. 11.4**. AND combined channel pairs are indicated by orange and red, see **Fig. 11.5**. Inactive channels appear white.
For instructions about GLBARC logic programming and basics of logic opportunities see sections 12.2 and 12.3.

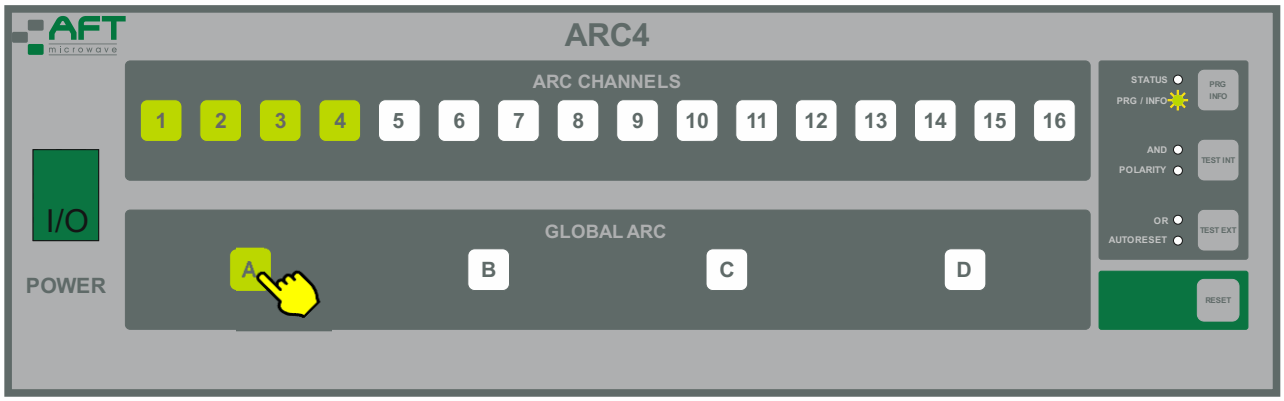


Fig. 11.4: Example 1: Front panel showing GLBARC group A defined as an **OR** combination of arc channels CH1, CH2, CH3, CH4. All other arc channels are inactive within GLBARC A.

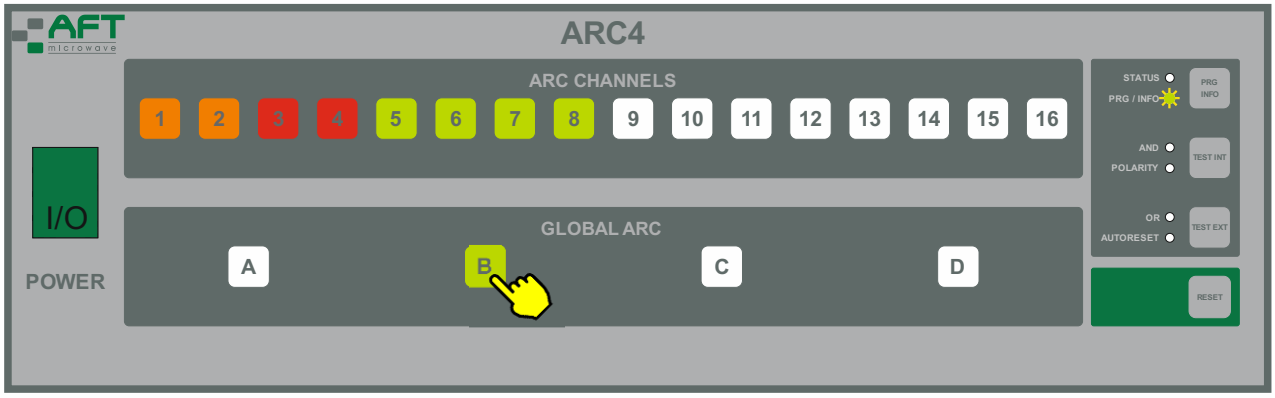


Fig. 11.5: Example 2: Front panel showing GLBARC group B consisting of CH1 to CH8 with a logic combination as: (CH1 **AND** ARC2) **OR** (CH3 **AND** CH4) **OR** CH5 **OR** CH6 **OR** CH7 **OR** CH8. All other arc channels are not active within GLBARC B.

Note

Only consecutive pairs of arc channels can be combined in an AND logic. To better distinguish the AND pairs the two colors orange and red are used in Fig. 11.5.

12. PRG-Menu

The PRG-Menu lets the user quickly change and save the device´s parameters or GLBARC logic connections between channels.

To enter the menu where you can change the settings, please follow the steps below.

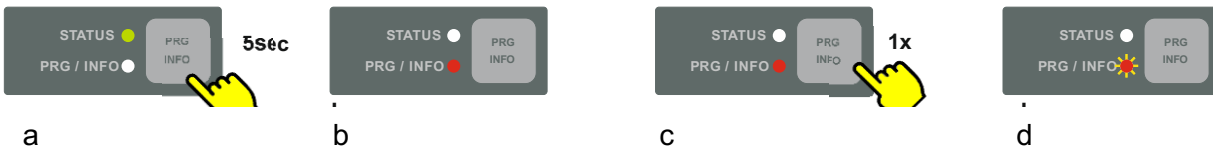


Fig. 12.1.: Steps to enter the PRG-Menu

a press and hold PRG/INFO button for 5 seconds to change polarity and auto reset settings

b PRG/INFO LED constant red → PRG-Menu for parameters is active

c press PRG/INFO button once to be able to change logic settings

d PRG/INFO LED blinking red → PRG-Menu for logic settings is active

To save your changes:

Fig. 12.2.: Steps to save changes:

a press and hold PRG/INFO button for 5 seconds
b the changes have been saved, PRG-Menu has been exited

Fig. 12.3.: to EXIT WITHOUT SAVING press the RESET button once.

Note

If there is no button action for 30 seconds, the device will exit the PRG- or INFO-menu automatically WITHOUT SAVING.

12.1. PRG Parameters

The first shown channel upon entering the menu is the last viewed or programmed ARC CHANNEL. To change the channel or group for which the parameters should be changed, press the corresponding ARC CHANNELS or GLOBAL ARC button while in the PRG-Menu Parameters (PRG/INFO LED constant red).

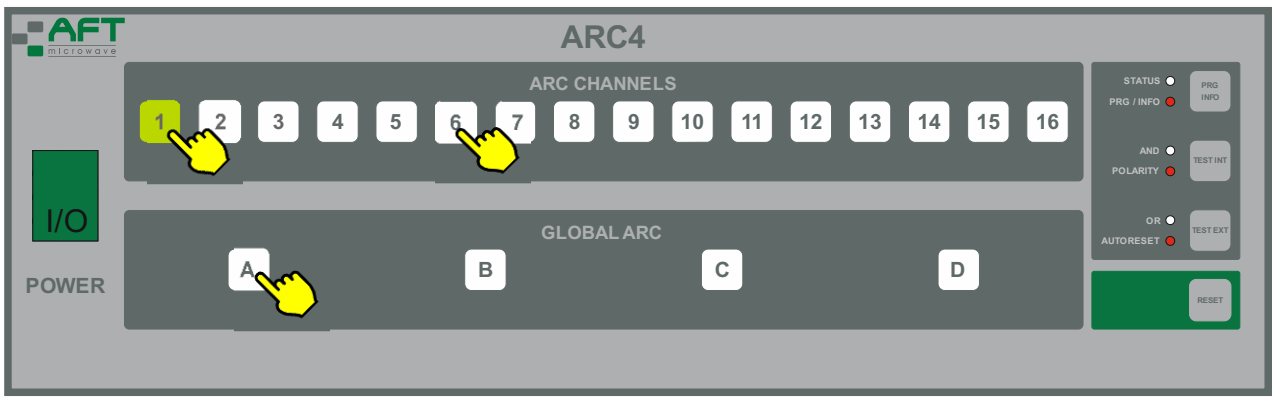


Fig. 12.4.: Front panel after entering PRG-Menu

The current setting of polarity and auto reset for a particular channel or group is shown by the color of the corresponding LED.

Fig. 12.5.: Status of polarity and auto reset

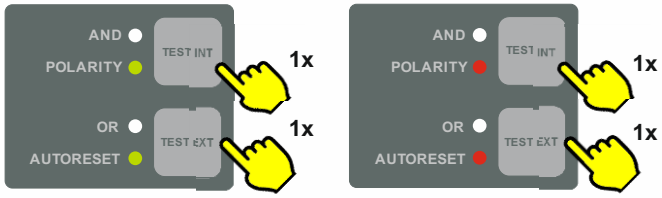


Fig. 12.6.: Changing the desired parameter by pressing the corresponding button once
→ the color of the LED will change

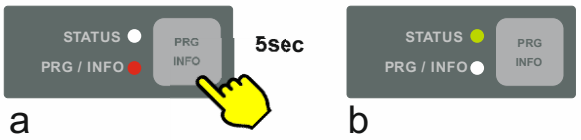


Fig. 12.7.: Exit the menu by pressing PRG/INFO for 5 seconds
→ the color of the LEDs will change

12.2. PRG GLBARC Logic

Upon entering the menu ARC CHANNEL 1 will be highlighted. To set up the GLBARC logic, first choose the desired GLBARC group (A, B, C or D) by pressing its corresponding button while in the PRG-Menu Logic (PRG/INFO LED constant red).

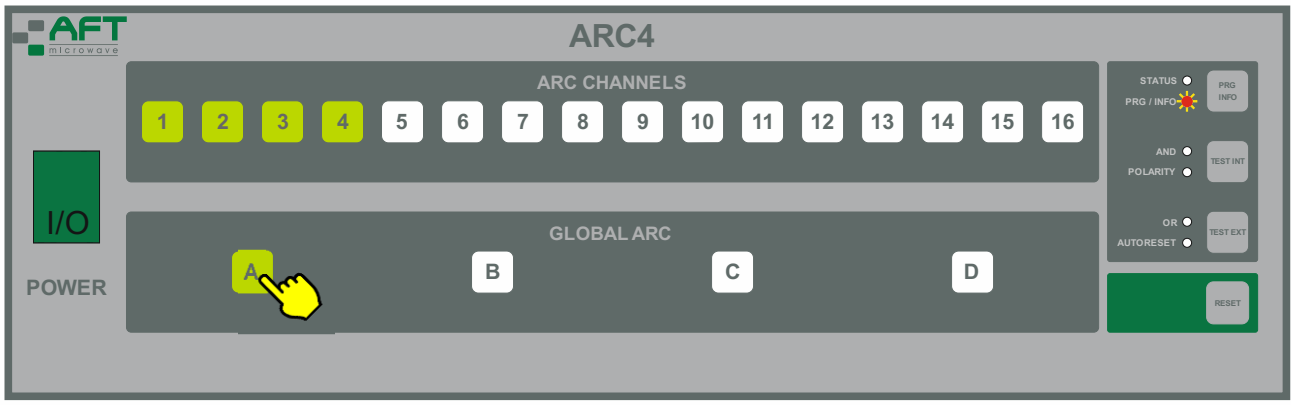


Fig. 12.8.: Front panel after entering PRG-Menu GLBARC Logic

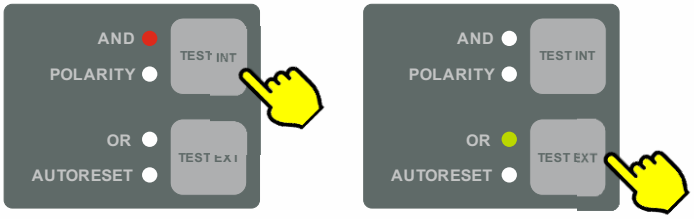


Fig. 12.9.: Changing the GLBARC logic function

To choose the desired logic function, press the corresponding control button once and then choose the desired arc channels to be logically combined by pressing their corresponding buttons once. By pressing for the second time you will DEACTIVATE the given channel from the logic combination for this particular group.

Fig. 12.10: For saving of the changes press and hold the PRG/INFO button for 5 seconds → you will exit the menu, LED colors will change.

As shown in **Fig. 11.4** and **11.5** OR combined arc channels appear green and AND combined pairs are indicated orange and red. Only two consecutive arc channels are allowed as AND pairs.

Repeat the procedure for programming other GLBARC groups, if applicable.

Note

Prior to operate a logic setting read section 12.3 for basic information of the ARC4 2.0 logic options.

12.3. Basics of GLBARC Logic

Basically, ARC4 2.0 system interface modules offers two combinational logic schemes for a GLBARC group (A, B, C, D): an OR combination of selected arc channels and a pairwise AND combination of arc channels. Each GLBARC group can be programmed and used independently from each other.

OR Logic

The combinational logic of a group can be set as an OR function of up to 16 arc channels, e.g.:

GLBARC_A = (CH1) **OR** (CH2) **OR** (CH3) **OR** … **OR** (CH16)

This is the default factory setting for all GLBARC groups.

The most common practical use of the OR logic is (1) monitoring different high-power components, e.g. circulator, load, cavity, etc. or (2) improving the coverage of a single component, where more arc viewports oversee different and independent areas.

AND Logic

The second option for a GLBARC logic is an AND function of up to 8 consecutive, neighboring arc channel pairs. The pairs are always logically combined to one another using an OR logic, e.g.:

GLBARC_B = [(CH1) **AND** (CH2)] **OR** [(CH3) **AND** (CH4)] **OR** … **OR** [(CH15) **AND** (CH16)]

This logic function is specifically used for **coincidental arc detection** and requires two adjacent viewports per pair with overlapping fields of view, focused on the same spot and event. This method finds application where high EM noise or gamma or X-ray radiation in vicinity of the detector is present, potentially leading to a statistical spurious trip of one of the channels. Experience has shown that it is very unlikely that both detectors give random false tripping at the same time.

The time window for coincidental arc detection is given by the (auto) reset time. Timing diagrams for OR and AND logic are shown in **Fig. 12.11** (auto reset OFF) and **12.12** (auto reset ON), polarity “normal”.

Note

While using AND logic for coincidental arc detection in a GLBARC channel, ensure that:

1) **Both viewports in pair observe the same spot or area.**
2) **Auto reset for the corresponding GLBARC channel is ON.**
3) **The auto-reset time T_R is set to the minimum of 0.1ms (default).**

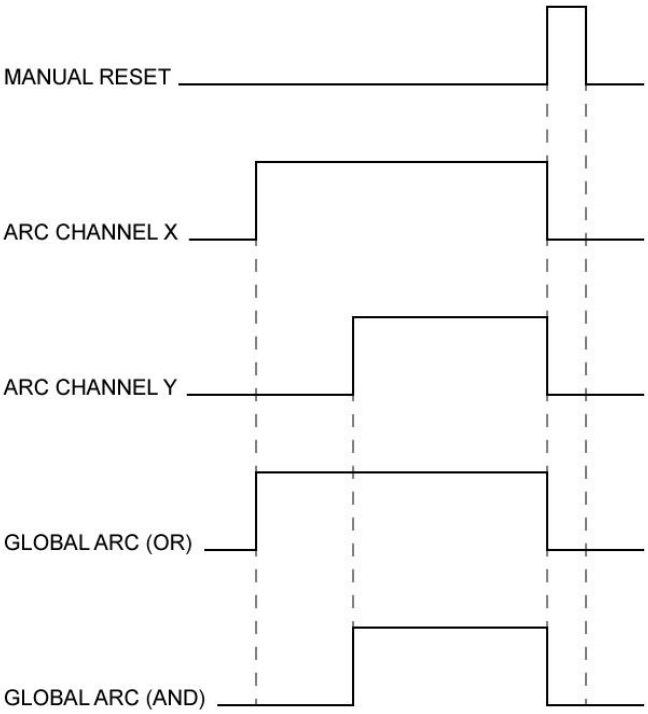


Fig. 12.11.: Timing diagram for GLBARC OR and AND logic with auto reset OFF (polarity = normal)

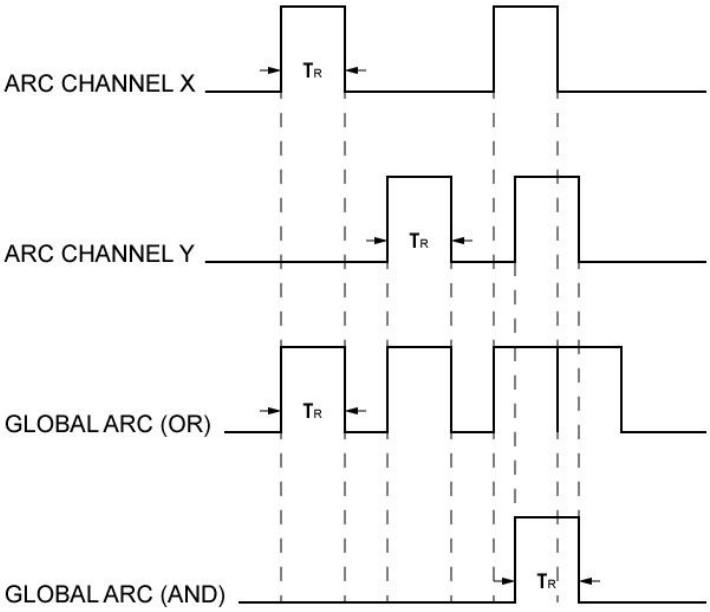


Fig. 12.12.: Timing diagram for GLBARC OR and AND logic with auto reset ON. (T_R = auto reset time, polarity = normal)

13. Maintenance, Storage and Modular Upgrade

13.1. Maintenance

The device is basically free of maintenance and wear parts. In case of abnormalities or problems please contact AFT.

13.2. Storage

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

- 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.
- The storage shall take place in a clean and dry environment. See product specification or data sheet for storage conditions.

Regard

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

13.3. Modular System Upgrade

ARC4 2.0 can be upgraded with additional arc detector modules (ADM), optical test modules (OTM) and system interface modules (SIM) up to the max. number of card slots. ADMs and OTMs use card slots 1 to 16. The SIM models SIM-00 and SIM-01 use the dedicated slots 17 and 18 only.

For adding a new card, switch off the mains power, dismount the blind cover plate of a free slot by unlocking the screws, insert the new card module and lock the card by the screws.
Prior to change the card setup follow the safety notes below.

Regard

Switch off the main power switch of the device before removing or installing a plug-in card or module, in order to avoid possible damage to the equipment.

Lock all cards by the dedicated screws of the cover plate.

Attention

ARC4 2.0 is a safety class I equipment with an universal mains power supply for 240 VAC, 50 Hz and 120 VAC, 60 Hz. All parts of the housing are connected electrically conductive, in order to provide a well-designed protective conductor system. However, the protective system is effective only, if the power supply module is screwed to the ARC4 housing, which is the normal case.

Do never remove the power supply module while the mains plug is still inserted in the socket. It will open the protective system and can cause personnel injury by electric shock!

14. Help and Service Request

For open questions on the use of the product, understanding of this manual, trouble shooting assistance or repair service options please contact our factory.

Contact address:

AFT microwave GmbH
Donaustrasse 18
71522 Backnang, Germany

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 3 to condition the device for packing and transport.
For safety reasons use the original AFT package or a similar proper packaging.
4 Please include a final non-conformity or problem report in hardcopy form.

15. Conformity

We confirm that the product

A4-2-SYS-00-X_D-X_I-X_T ARC4 – Optical Arc Detector System 2.0

fulfill the following requirements and directives of the EC:

2014/35/EU	Low Voltage
2014/30/EU	EMC
2011/65/EU with 2015/863 (EU)	RoHS

The following harmonized standards have been applied:

EN 61010-Part 1	Safety requirements
EN 61326-Parts	EMC

CE declarations of conformity are available as a separate documents

16. Appendix

- Data Sheet A4-2-SYS-00-X_D-X_I-X_T

Revision History:

Revision	Date	Description
1.0	29.08.2018	initial
1.1	12.09.2018	Optical Test Module added
1.2	20.09.2018	Update product introduction
1.3	22.11.2018	Details about auto reset time
1.4	18.02.2019	USB Interface Access
1.5	17.02.2020	Safety notes revised, chapter 13.3 modular system upgrade
1.6	16.02.2021	System Interface Module SIM-01 added, RoHS 2015/863 (EU), product introduction updated
1.7	22.03.2021	Support contact updated
1.8	04.03.2022	Formal change