# I/O Frontend Processor

# *sat-nms* IO-FEP 2

# User Manual

Version 4.1.1


SatService Gesellschaft für Kommunikationssysteme mbH
Hardstrasse 9
D-78256 Steisslingen

satnms-support@satservicegmbh.de

www.satnms.com
www.satservicegmbh.de
Tel +49 7738 99791-10

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# sat-nms IO-FEP2 User Manual

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**Abstract**

> The ***sat-nms*** IO-FEP2 manufactured by SatService GmbH is a frontend-processor which is especially designed for satellite ground stations. It allows to supervise potential-free (alarm-) contacts, to switch external items, to measure different temperatures, to switch and control waveguide- or coaxial-switches, it is possible to assign the inhibit-contacts of the waveguide-switches to up to 10 connected HPAs and additionally it is possible to realize different independent 1 to n redundancy Systems. Comparing to the recent ***sat-nms*** IO-FEP and IO-FEP-E, the new ***sat-nms*** IO-FEP2 also provides the possibility to monitor current and voltage of up to 6 LNA/LNB power supplies as an option. These alarms can also be used to trigger a redundancy switchover.
>
> This document describes how to install, setup and operate this antenna controller.


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# 1 Introduction

The ***sat-nms*** IO-FEP2 is based on a hardware platform that provides up to 48 digital-inputs via optocoupler. Up to 4 different temperatures can be measured with external PT1000 sensors, with optional closed loop controller function e.g. heaters or air condition can be controlled. To switch external units, the ***sat-nms*** IO-FEP2 has 6 potential-free relay outputs and 10 photomos-relay outputs. 16 waveguide-switch interfaces control and monitor position and switching state of connected waveguide or coaxial switches. The ***sat-nms*** IO-FEP2 contains an inhibit matrix, that allows to allocate different inhibit signals of waveguide-switches on different HPAs. So it is possible to mute up to 10 HPAs controlled by up to 16 waveguide-switches. The ***sat-nms*** IO-FEP2 also contains a software-inhibit matrix. If connected waveguide-switches are not equipped with an inhibit-contact, nevertheless the connected HPA's can automatically be muted by software.

Although the new ***sat-nms*** IO-FEP2 provides more functionality, it needs 40% less space than the previous ***sat-nms*** IO-FEP-E. To ensure easy replacement, the new ***sat-nms*** IO-FEP2 is 100% pin compatible to ***sat-nms*** IO-FEP and IO-FEP-E.

The standard version contains following interfaces and functionalities:

- 16x digital input
- 6x digital output via relay contacts
- 10x digital output via photomos relay (for HPA mute)
- hardware and software HPA mute matrix
- 4x waveguide switch interface
- 4x PT1000 temperature measurement
- internal unit temperature measurement
- internal Clock/Calendar
- internal Alarm Log (saved on an USB-Stick)
- 2x NTP server interface
- Ethernet and RS232 interface

To adapt the ***sat-nms*** IO-FEP2 to your system, more functions can easily be installed via feature codes. So even a subsequent functionality upgrade of an already installed unit is possible without problems. Following packages are available:

- altogether 32x digital input
- altogether 48x digital input
- altogether 8x waveguide switch interface
- altogether 12x waveguide switch interface
- altogether 16x waveguide switch interface
- 1:1 and 2:1 redundancy controller
- closed loop temperature controller
- LNA/LNB power supply monitoring

The data output is provided by 2 different and parallel available interface types: a HTTP Web Interface via an internal Web Server, and a RS232 interface. The ***sat-nms*** IO-FEP2 is controlled remotely by a monitoring and control application through the TCP/IP interface. The ***sat-nms*** IO-FEP2 implements the protocols HTTP (for both, the user interface and for remote control), SNMP and Modbus. The ***sat-nms*** IO-FEP2 MIB may be downloaded from the ***sat-nms*** IO-FEP2 itself via its internal webpage.

This document is the user manual provided with the ***sat-nms*** IO-FEP2 It contains all necessary information how to install, setup and operate the processor. The user manual is available as a printed document and for online reading on the ***sat-nms*** IO-FEP2 itself as well.

The paragraphs below give a short overview to the contents of this manual.

- Installation : The installation chapter guides through the installation and setup of the ***sat-nms*** IO-FEP2. It describes the mechanical concept of the ***sat-nms*** IO-FEP2 box and assignment of connectors. Finally you learn in this chapter how to set the ***sat-nms*** IO-FEP2's IP address, which is a essential precondition to operate the ***sat-nms*** IO-FEP2 by means of a web browser. This section is available in the printed version only.
- Operation : The ***sat-nms*** IO-FEP2 is operated using a standard web browser like e.g. Internet-Explorer on MS Windows based computers. The user interface design is straight forward and clearly structured. Operating the ***sat-nms*** IO-FEP2 is mostly self-explanatory. Nevertheless, the 'Operation' chapter outlines the map of web pages which make up the ***sat-nms*** IO-FEP2 user interface and elaborately describes the meaning of each alterable

parameter.
- Remote Control : The ***sat-nms*** IO-FEP2 provides a versatile remote control interface. A monitoring & control software may fully operate the ***sat-nms*** IO-FEP2 either through a TCP/IP network connection or through the RS232 interface of the ***sat-nms*** IO-FEP2. This chapter describes the communication protocol used for remote control and lists all parameters accessible through the remote interface.
- Connector Reference : This chapter provides a comprehensive reference of the ***sat-nms*** IO-FEP2 input and output connectors.
- Specifications : At the end of the document, the specifications applicable to the ***sat-nms*** IO-FEP2 are summarized in this chapter.

**Support and Assistance**

If you need any assistance regarding your ***sat-nms*** IO-FEP2, don't hesitate to contact us. We would be pleased to help you by answering your questions.

satnms-support@satservicegmbh.de

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SatService GmbH
Hardstrasse 9
78256 Steisslingen
Germany
phone +49 7738 99791-10
www.satnms.com
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## 1.1 Compliances

The ***sat-nms*** IO-FEP2 fulfils all necessary requirements for CE conformity. Following chapters specify which standards have successful been tested. If required, SatService GmbH provides a declaration of conformity.

### 1.1.1 Safety compliance (CE)

This equipment has been tested and meets the specification of following safety standards:

- EN 60950
- EN 62368 To meet all safety requirements it is necessary to keep with the cabling requirements mentioned in the installation chapter.

### 1.1.2 EMC compliance (CE, FCC)

This equipment has been tested and meets the specification of following EMC standards:

- EN 55032
- EN 55024
- FCC, part 15B
- ICES003 To meet all EMC requirements it is necessary to keep with the cabling requirements mentioned in the installation chapter.

### 1.1.3 Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Note: To ensure EMC compliance, properly shielded cables for data, and I/O connections have to be used. These cables have to be shielded from end to end, ensuring a continuous shield. For Data connections use double shielded twisted pair cables. We recommend to use CAT7 S/FTP cable, e.g. DRAKA UC900 SS27 Cat.7 PUR.

# 2 Installation

This chapter describes how to install the ***sat-nms*** IO-FEP2. You find a guide how to connect, configure and mechanically mount the IO-FEP2 below.

Before you start, please first read the Safety Instructions chapter below. It contains some important recommendations to prevent damage from the IO-FEP2.

Then, we strongly recommend to do a first setup of the IO-FEP2 on a lab desk before installing it at it's final location. This is mainly for one reason:

1. To setup the processor's IP parameters, the PC used for configuring and the IO-FEP2 must either be connected to the same Ethernet hub or must be connected directly with a crossover cable.

Hence, the typical sequence of tasks when putting an ***sat-nms*** IO-FEP2 into operation is as follows:

1. Read the chapter Safety Instructions
2. Set the device's IP address
3. Mechanically mount the device.
4. Connect the IO-FEP2 at it's destination environment.

## 2.1 Safety Instructions

Failure to observe all Warnings and Cautions may result in personnel injury and/or equipment damage not covered by the warranty.

- **The equipment described in this manual is designed to be installed and used by properly trained personnel only!**
- Follow standard Electrostatic Discharge (ESD) procedures when handling a ***sat-nms*** IO-FEP2.
- Select and apply the appropriate 24V D/C voltage according to the data sheet and documentation **before** connecting power.
- The ***sat-nms*** IO-FEP2 can be damaged if the input voltage is higher than the specified maximum value. Take care that ratings are not exceeded.
- The DIN Rail, on which your ***sat-nms*** IO-FEP2 is installed, has to be permanently connected to a grounding point for save operation. Otherwise, the device could be damaged. Furthermore it might be possible not to meet all of the mentioned EMC requirements.
- Install suitable over-voltage protection to ensure that no over-voltage (such as that caused

by a bolt of lightning) or over-current can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
- Before connecting ***sat-nms*** IO-FEP2 to another unit, please make sure that the connected unit can handle the voltage provided by the ***sat-nms*** IO-FEP2.
- Before connecting the ***sat-nms*** IO-PEP2's output and input circuits, observe the maximum ratings mentioned on the datasheet. Exceeding these limits might damage your ***sat-nms*** IO-FEP2.
- Do not connect units that can be damaged by the output voltage of the ***sat-nms*** IO-FEP2.
- In case of a failure do not open the device, you will loose warranty, call SatService GmbH for an RMA number.
- Observe normal safety precautions when operating, servicing, and troubleshooting this equipment.
- Take standard safety precautions with hand and/or power tools.

## 2.2 Setting the IP Address

The IO-FEP2 permits to change its IP address through its Web-GUI. You need to be logged in as 'admin', then you can change the parameters IP address, subnet mask and standard gateway at the 'Info' page (click to 'Change IP Address' in the IP settings table). This opens a page in the webbrowser which lets you enter the IP address, the subnet mask and the gateway address. Clicking to 'OK' saves the entered values and reboots the IO-FEP2 with the new IP settings.

For the procedure described above you need to know the address of the IO-FEP2 and this address must be in the same subnet as the computer you want to use for this. There will be situations where this is not the case, perhaps you don't even know the address of the IO-FEP2. For this, the IO-FEP2 provides alternative ways to evaluate and to set the device's IP settings without connecting to it:

**Evaluating an IO-FEP2's IP Address**

If you don't know an IO-FEP2's IP address, you can get this information from the IO-FEP2's USB stick:

1. Ensure that the IO-FEP2 is switched off
2. Remove the USB stick from the IO-FEP2 and plug it into your computer
3. Open (double click) the file 'interfaces.txt'. The file contents should be something like shown below. The lines 'address', 'netmask' and 'gateway' contain the IP settings which actually apply to the IO-FEP2.
4. Unmount the USB stick and plug it back to the IO-FEP2.

Example content of an 'interfaces.txt' file:

```
auto lo

iface lo inet loopback

auto eth0
allow-hotplug eth0

iface eth0 inet static
    address 192.168.0.226
    netmask 255.255.255.0
    gateway 192.168.0.1
```

```
hwaddress ether FC:C2:3D:13:ED:32
```

If the IO-FEP2 is configured for DHCP, the file looks a little different, instead if listing 'address', 'netmask' and 'gateway' there is a single line `iface eth0 inet dhcp` . In DHCP mode the IO-FEP2 obtains its IP settings from your router.

Please note, that changing this file will **not** change the device's IP settings. The file 'interfaces.txt' is for information only and created by the IO-FEP2 on each start when it initializes its IP interface.

**Setting the IP Address With The USB Stick**

The USB stick at the IO-FEP2 can also be used to set the device's IP address. The procedure for this is similar to that one described above for evaluating the actual address, but it uses a different file name and a simpler file format:

1. Ensure that the IO-FEP2 is switched off
2. Remove the USB stick from the IO-FEP2 and plug it into your computer
3. Create a plain text file called 'IPRESCUE.TXT' on the USB stick which contains one line of text with the IP address, netmask and gateway to set, separated from each other by on space character. The line should look like this: `192.168.0.226 255.255.255.0 192.168.0.1` . In order to configure the IO-FEP2 for DHCP, the line should contain a single wird `dhcp` .
4. Unmount the USB stick and plug it back to the IO-FEP2.
5. Power on the IO-FEP2, the device boots with the IP settings as defined in the 'IPRESCUE.TXT' file.

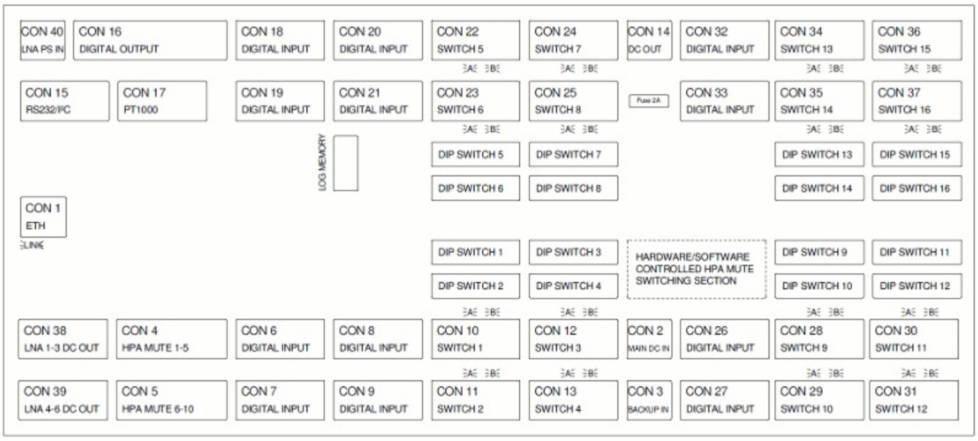
The IO-FEP2 automatically removes the 'IPRESCUE.TXT' file from the USB stick after the IP settings have been set. The new IP settings are stored permanently in the IO-FEP2, they however may be changed any time at the Web-GUI or by the procedure described above.

## 2.3 Connecting *sat-nms* IO-FEP2

**General Note:** To meet EMC requirements mentioned in chapter 1.1 Compliances , it is essential to use shielded cables for connecting external devices. Connect shield properly to PE to ensure best EMC performance. Take care that the DIN Rail, on which your ***sat-nms*** IO-FEP2 is installed, is permanently connected to the same grounding point than the shield of your cabling. For Data connections use double shielded twisted pair cables. We recommend to use CAT7 S/FTP cable, e.g. DRAKA UC900 SS27 Cat.7 PUR.

### 2.3.1 general overview

The following diagram shows the layout of the IO-FEP2's connectors.




- **CON1** is the Ethernet 100Base-T / RJ45 connector. Use a standard double shielded twisted pair network cable to connect the IO-FEP2 to an Ethernet hub. We recommend to use CAT7 S/FTP cable, e.g. DRAKA UC900 SS27 Cat.7 PUR. If your computer is not providing autosensing on the LAN port and you want to connect your computer and the IO-FEP2 directly without using a hub, you need a crossover cable for this with swapped RX/TX lines.
- **CON2** is to supply the ***sat-nms*** IO-FEP2 with power. You need two power supplies, one for 24V INT, and another for 24V EXT circuit.
- **CON3** is to realize a redundant power supply system. When you connect two other backup power supplies on this connector the ***sat-nms*** IO-FEP2 switches automatically to the other supply in case of power outage at CON2.
- **CON4 and CON5** are digital outputs via photomos-relays. The standard configuration is, that the outputs are connected to the inhibit matrix to mute the connected HPAs in the moment of switching a waveguide switch. You can use them also as normal digital outputs. Therefore you have to change the position of internal switches. On above shown layout, this section is mentioned 'HARDWARE/SOFTWARE CONTROLLED HPA MUTE SWITCHING SECTION'. How to do this is described in chapter 2.4.3 Photomos-relay digital outputs . In contrast to the former ***sat-nms*** IO-FEP(-E), the photomos-relay outputs at this new ***sat-nms*** IO-FEP2 are closed when IO-FEP2's power is off. So if the unit fails, your transmission will not be interrupted by this issue!
- **CON6, CON7, CON8 and CON9** are the connectors for digital inputs 1...16. They are only able to detect potential-free contacts. Never put Voltage to these pins, the ***sat-nms*** IO-FEP2 might be damaged in this case.
- **CON10, CON11, CON12 an CON13** connect waveguide- or coaxial-switches #1...4 that you want to control here. Pin allocation is the same on all of these switch interfaces.
- **CON14** is the spare power output. If you want to use 24V_EXT for other units, you can take the power from here. The maximum continuous current that can be taken from here is 500mA. Never exceed this limit, the IO-FEP2 might be damaged.
- **CON15** is the RS232 and the I2C-bus interface. If you need an adapter cable to connect the ***sat-nms*** IO-FEP2 via RS232 interface to your computer, call SatService GmbH support centre. The I²C-bus interface is actual not active and for special requirements only.
- **CON16** is the connector for digital outputs switched by relays. COM11-13 is switched by three relays to 11, 12 and 13. 14, 15 and 16 are single contacts without a common potential. The external voltage that has to be switched by the relays must not exceed 48V. Maximum possible continuous current to be switched is 1A.
- **CON17** up to 4 external sensors for measuring external temperatures have to be connected here. You can use any standard PT1000 type.
- **CON18, CON19, CON20 and CON21** are the connectors for digital inputs 17...32. They are

only able to detect potential-free contacts. Never put Voltage to these pins, the ***sat-nms*** IO-FEP2 might be damaged in this case. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.

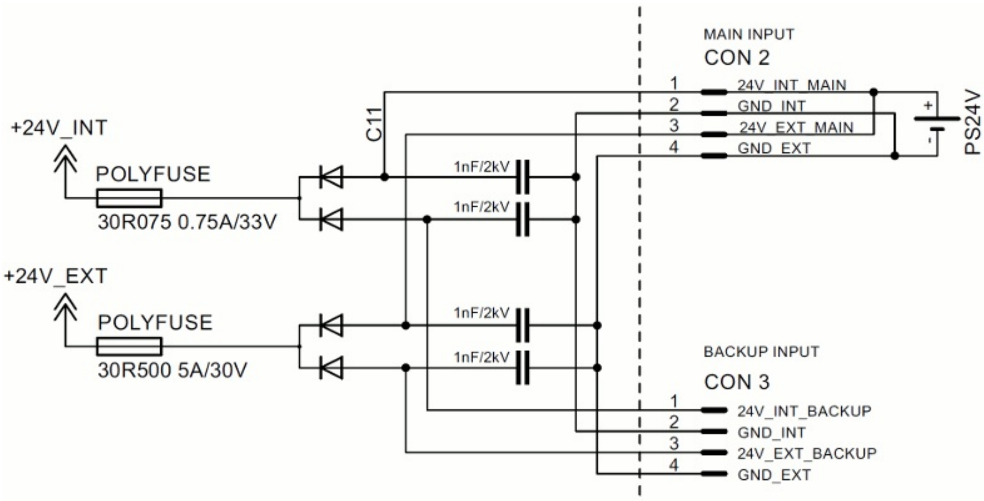
- **CON22, CON23, CON24 and CON25** connect the waveguide- or coaxial-switches 5...8 that you want to control here. Pin allocation is the same on all of these switch interfaces. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.
- **CON26, CON27** are connectors for digital inputs 33...40. They are only able to detect potential-free contacts. Never put Voltage to these pins, the ***sat-nms*** IO-FEP2 might be damaged in this case. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.
- **CON28, CON29, CON30 an CON31** connect the waveguide- or coaxial-switches 9...12 that you want to control here. Pin allocation is the same on all of these switch interfaces. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.
- **CON32, CON33** are connectors for digital inputs 41...48. In delivery configuration they are only able to detect potential-free contacts. Never put Voltage to these pins, the ***sat-nms*** IO-FEP2 might be damaged in this case. If you want to detect a 24V-Signal, have a look at chapter 2.4.4 Detect 24V DC signals with DIN41...18 to learn how to configure the digital inputs to be able to detect a 24V-Signal. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.
- **CON34, CON35, CON36 and CON37** connect the waveguide- or coaxial-switches 13...16 that you want to control here. Pin allocation is the same on all of these switch interfaces. These interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.
- **CON39 and CON39** connect LNA's/LNB's here that need to be monitored. It is possible to monitor current and voltage for each single LNA/LNB. Connected LNA's/LNB's are supplied by a power supply connected to CON40. Supply voltage has to be in the range of +15...+24VDC. Maximum current is 600mA per LNA/LNB. To protect your external Equipment, each output will separately be disabled upon a current above 1A. Monitoring of these interfaces is deactivated in standard delivery state. It can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code. Additionally +24V EXT and corresponding GND EXT is provided at pin 7 and 8 of these connectors. Maximum current at these interfaces is 300mA each. Take care not to connect a LNA/LNB here if you have a 15V Type, it might be damaged!

### 2.3.2 Power supply connection

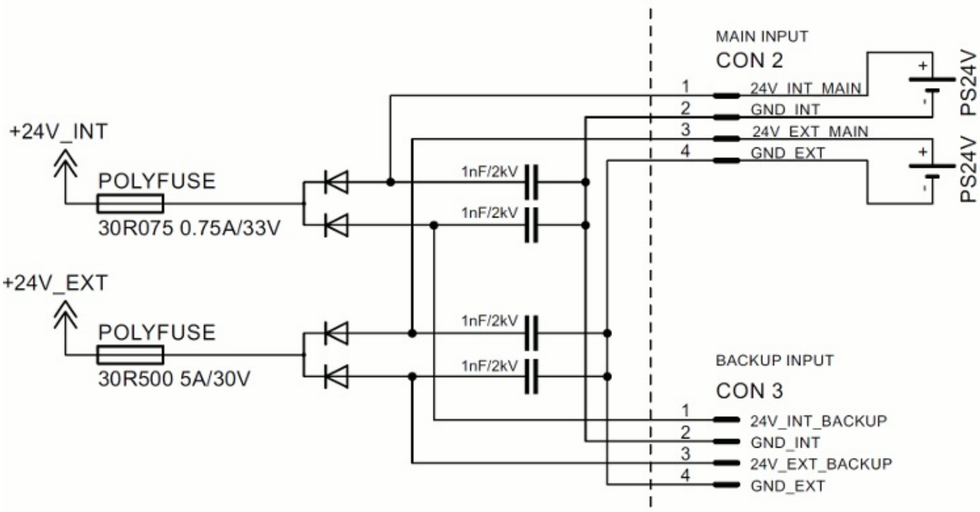
The ***sat-nms*** IO-FEP2 is prepared to use two different 24V DC power supplies: 24V INT is for controller and processor circuit. 24V EXT is used to supply digital outputs and waveguide or coaxial switches. The ***sat-nms*** IO-FEP2 is prepared for redundant power supplies. So it is possible to supply this unit with one, two or four power supplies. We strongly recommend to use minimum 2 power supplies to to ensure maximal system stability of the ***sat-nms*** IO-FEP2. Near by CON2 you find 2 green LEDs: One is marked with '3.3V ok'. If this LED is on, 24V INT is connected and internal 3.3V voltage is available. If this LED is off although 24V INT is connected, check Fuse near by CON14. The other LED is marked with '24 ok'. If this LED is on, 24V EXT is connected and available.

Following pictures show how to connect power supplies to the ***sat-nms*** IO-FEP2

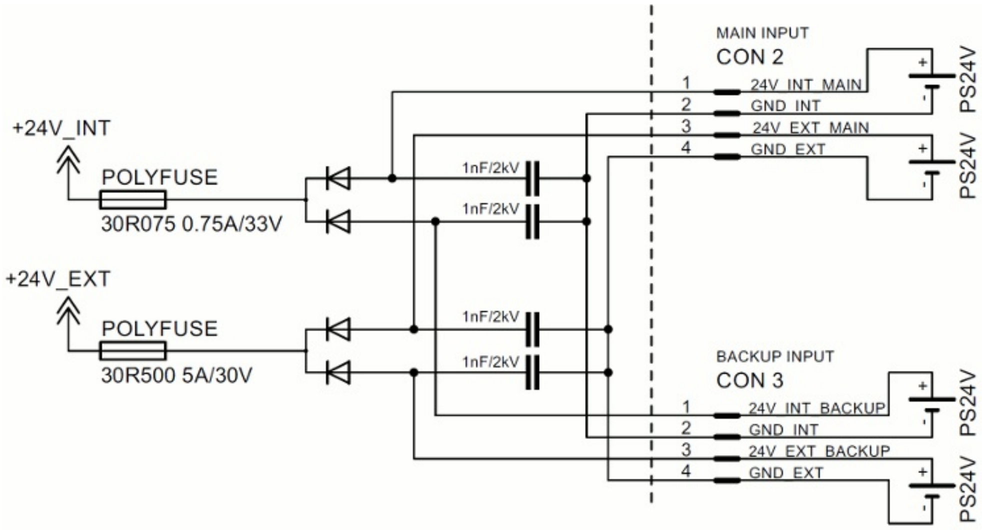
- **using only one power supply** We strongly recommend to use minimum 2 power supplies to ensure maximal operational availability of ***sat-nms*** IO-FEP2. Nevertheless it is possible to run ***sat-nms*** IO-FEP2 with only one single Power supply. In this case 24VDC and 24V_EXT have to be connected to one power supply as you can see in the following picture.




* **using two power supplies** Here one power supply is connected to the 24V INT input and the other one to 24V EXT input.




- **using four power supplies** If you like to set up a redundant power supply system for your ***sat-nms*** IO-FEP2 you have to use 4 different power supplies. Connect them to the ***sat-nms*** IO-FEP2 as you can see in the following picture. In case of failure of one power supply, ***sat-nms*** IO-FEP2 switches automatically to the other one and will be still running without any interrupt.




The power supply for 24V INT circuit has to have a minimum current load of 1A. The supply for 24V EXT circuit has to have a minimum current load of 1A plus current that will be taken from CON14 and peak current of the biggest waveguide or coaxial switch to be controlled. Do not exceed the current-limit, maximum peak-current for switching waveguide-switches is 5A.

24V EXT circuit is protected by a self-healing 5A Polyfuse, so maximum continuous current is 5A here.

The fuse for +24VDC circuit is near by CON14. In case of damage, only put in there delayed 2A types. Otherwise the ***sat-nms*** IO-FEP2 might be damaged. In the latest version, a Polyfuse is installed here. As it is self-healing, you do not have to take care about this fuse.

## 2.3.3 digital outputs

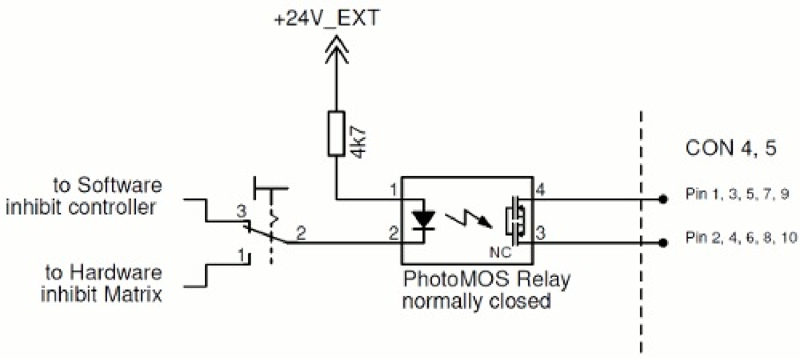
***sat-nms*** IO-FEP2 provides 2 different types of digital output circuits. 10 of them are realized with normally closed Photomos-Relays, the other 6 ones are usual normally open relay contacts.

### 2.3.3.1 Photomos digital outputs

These outputs are usually used for muting HPAs during switching cycle of an assigned waveguide switch. Nevertheless these outputs also can be used as simple digital outputs. Please refer to chapter 2.4.3 Photomos-relay digital outputs to learn how to define if these outputs are hardware controlled by inbit matrix or by software. In contrast to the former ***sat-nms*** IO-FEP(-E), photomos-relay outputs at this new ***sat-nms*** IO-FEP2 are closed when IO-FEP2's power is off. So if the unit fails, your transmission will not be interrupted by this issue! if you nevertheless need to have normally open contacts, please refer to chapter 2.6 Replacing an existing ***sat-nms*** IO-FEP(-E) by IO-FEP2 to learn how to solve this issue.

For each output there is one red LED available showing actual state. As these outputs usually are used to mute HPAs, corresponding red LED is ON, when contact is OPEN, so connected HPA is in mute state. If LED is OFF, corresponding output is CLOSED and connected HPA is transmitting.

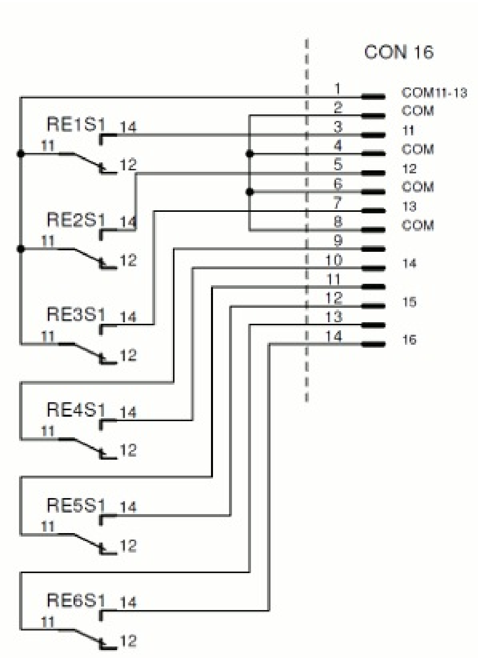
Take care not exceed ratings of these switches: maximum 48V/130mA is allowed. On-state resistance is 18Ohm typ. (25Ohm max.).




### 2.3.3.2 Relay digital outputs

Digital outputs provided at CON16 are usual normally open relay contacts. As soon as ***sat-nms*** IO-FEP2 is powered off, relay contacts are open. The external voltage that might be switched by this relays must not exceed 48V. Maximum possible continuous current to be switched is 1A. COM11-13 is switched by three relays to 11, 12 and 13. An additional COM allows easy cabling of e.g. relays, control lamps or something like that. 14, 15 and 16 are single contacts without a common potential.

For each output there is one green LED available showing actual state. In contrast to photomos outputs, corresponding green LED is ON, when contact is CLOSED. If LED is OFF, corresponding output is OPEN.



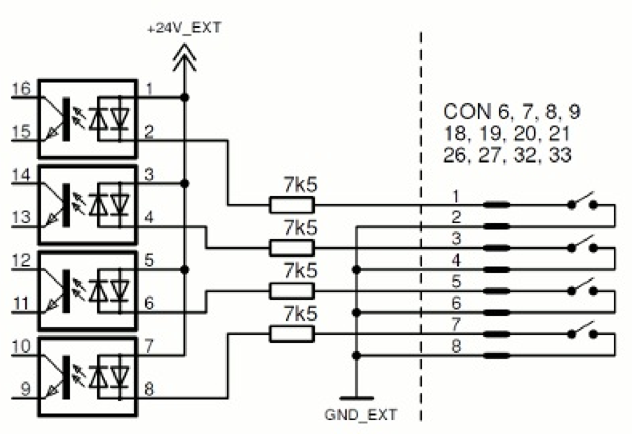

## 2.3.4 digital inputs

In standard configuration only digital inputs at CON 6, 7, 8 and 9 (digital input No. 1...16) are available. The other digital inputs are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.

The digital input interfaces are used to monitor potential-free contacts. Indication current provided by ***sat-nms*** IO-FEP2 is approx 3mA. Never put external Voltage to these pins, ***sat-nms*** IO-FEP2 might be damaged in this case. all of these interfaces have the same connector layout: Pin1 and Pin2 is one input, Pin3 and Pin4 is the next one and so on. Fox exact pin layout, please refer to chapter 5 Connector Reference .

For each input there is one green LED available showing actual state. LED is ON, when corresponding input is CLOSED. If LED is OFF, corresponding input is OPEN.

The digital inputs at CON32 and CON33 are configured as all the other inputs by default. The nevertheless might be configured to detect a 24V-Signal. Have a look at chapter 2.4.4 Detect 24V DC signals with DIN41...48 to learn how to configure these digital inputs to be able to detect a 24V-Signal.




### 2.3.5 waveguide/coaxial switch interface

In standard configuration only switch interfaces at CON 10, 11, 12 and 13 (switch No. 1...4) are available. The other switch interfaces are deactivated in standard delivery state. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation for further information. Call SatService GmbH sales team for purchasing a feature code.

Pin-layout is the same for all switch interfaces. By default, all interfaces use 24V EXT as switching signal and use GND EXT as common. If you have got switches installed in your system that use +24V as common and need GND to be switched, ***sat-nms*** IO-FEP2 provides a solution as well. Take a look at chapter 2.4.5 Change polarity of waveguide-switch interfaces and learn how to manage that.

For each interface there three LEDs available showing actual state. In the upper connector row, LEDs are located below corresponding connectors, in the lower row, LEDs are located above corresponding connector.

- green LED marked with 'A', in line with pin 4: if this LED is on, connected switch is in 'A' position.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A | set position A | DC out | |
| 2 | GND_EXT | com | DC | |

| | | | | |
|---|---|---|---|---|
| 2 | GND_EXT | com | out | |
| 3 | POS B | set position B | DC out | |
| 4 | IND A | indication position A | DC out | displayed by a green LED in line with this pin |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B | indication position B | DC out | displayed by an orange LED in line with this pin |
| 7 | INH | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC out | displayed by a green LED in line with this pin |

### 2.3.6 temperature sensors

For measuring external temperatures ***sat-nms*** IO-FEP2 provides 4 interfaces for external temperature Sensors. You can connect every standard sensor as long as it uses a PT1000 sensing element.

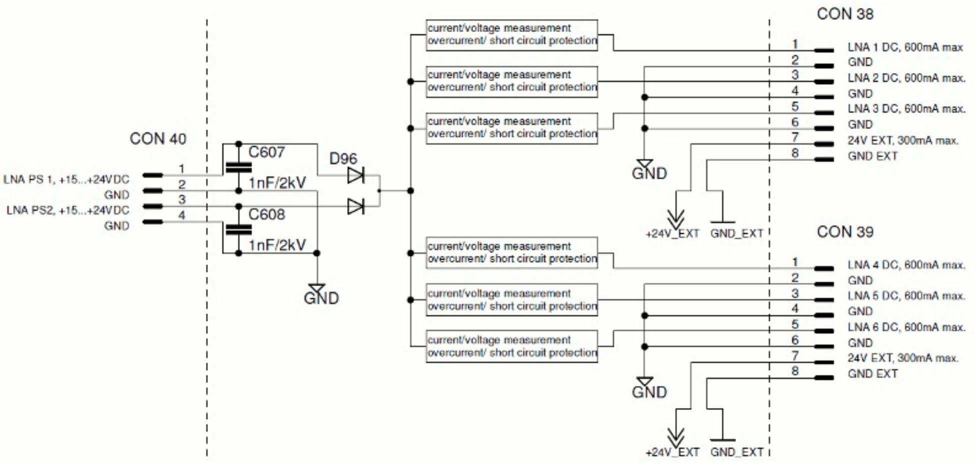
| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | SENS OUT1 | output to PT1000 | DC out | |
| 2 | SENS IN1 | input to PT1000 | DC in | |
| 3 | SENS OUT2 | output to PT1000 | DC out | |
| 4 | SENS IN2 | input to PT1000 | DC in | |
| 5 | SENS OUT3 | output to PT1000 | DC out | |
| 6 | SENS IN3 | input to PT1000 | DC in | |
| 7 | SENS OUT4 | output to PT1000 | DC out | |
| 8 | SENS IN4 | input to PT1000 | DC in | |

In standard configuration, your ***sat-nms*** IO-FEP2 is able to measure 4 external temperatures (additionally to the internal temperature of the unit) and to monitor a high and low alarm threshold for each sensor. If you like to setup a closed loop temperature controller, e.g. for controlling a heater or an air condition. This option can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature Codes for further information. Call SatService GmbH sales team for purchasing a feature code.

### 2.3.7 LNA power supply monitoring

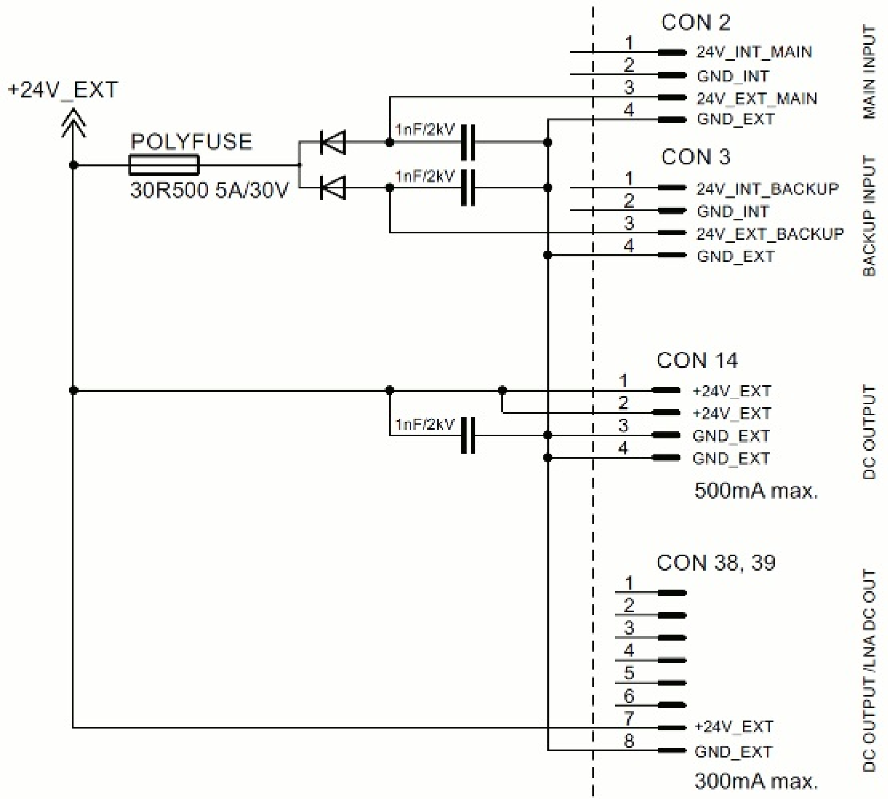
As a new feature, ***sat-nms*** IO-FEP2 provides the possibility to monitor current and voltage for up to 6 LNAs/LNBs. Connected LNAs/LNBs are supplied by one or two power supplies connected to CON40. Supply voltage has to be in range of +15...+24VDC. Maximum current is 600mA per LNA/LNB. To protect your external equipment, each output will separately be disabled upon a current above 1A. Monitoring of these interfaces is deactivated in standard delivery state. It can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature codes activation for further information. Call SatService GmbH sales team for purchasing a feature code. Nevertheless, over-current and short circuit protection is active even without activating above mentioned monitoring option! Additionally +24V EXT and corresponding GND EXT is provided at pin 7 and 8 of these connectors. Maximum current at these interfaces is 300mA each. **Take care not to connect a LNA/LNB here if you have a 15V Type, it might be damaged!**

It is possible to connect 2 independent power supplies to increase availability of connected LNAs/LNBs. If you do use only one power supply for connected LNAs/LNBs, it is up to you whether to supply at Pin 1/2 or Pin3/4 of CON40. A green LED below CON40 displays if LNA/LNB supply voltage is connected to CON40.




## 2.3.8 24V EXT power output

Your ***sat-nms*** IO-FEP2 provides different possibilities to supply units with low power consumption like relays, sensors, small signalling lights or something like that. As you can see on the following schematic, there is not forseen a fuse for each output. So you have to make sure by yourself, not to exceed mentioned current limits. Your ***sat-nms*** IO-FEP2 might be damaged in this case.




## 2.4 Configuring the *sat-nms* IO-FEP2

This chapter gives a short overview about some configuration parameters you want to set after you have installed the ***sat-nms*** IO-FEP2. A complete reference of all available setup parameters is given in chapter 3.4 Installation Parameters .

### 2.4.1 Feature code activation

A number of features of the IO-FEP2 have to be ordered separately, for example protection switching, LNA power supply monitoring or higher numbers of inputs or waveguide switches than the base version of the IO-FEP2 contains.

These features are enabled by entering feature codes at the IO-FEP2 Web-GUI. Please call the SatService GmbH sales team for purchasing a feature code for a function you want to add to the IO-FEP2. Feature codes are unique to every single IO-FEP2 unit, you cannot use the code purchased for a certain unit with another one.

To add a new feature code to the IO-FEP2, go to the 'Info' page of the Web-GUI. The section 'Licensed Functions' shows which features of the IO-FEP2 have already be licensed. To license a new feature, click to 'Enter License Key' to the right of the description of the feature to add (you have to be logged on as 'admin' for this)

This opens a new page with an input field to enter the key. Enter the key exactly as shown in the purchase, with the hyphens between the groups of characters. By clicking 'OK' the key is stored permanently in the IO-FEP2 and the licensed function is enabled. Please note, that entered keys cannot be removed from an IO-FEP2.

If the IO-FEP2 rejects the key, please recheck that the key is entered correctly character by character and that the serial number the IO-FEP2 matches the serial number you purchased the the function for.

### 2.4.2 Setting the HPA-mute-matrix

When connected waveguide switches are equipped with inhibit contacts, it is possible to mute different connected HPA`s while a corresponding waveguide-switch is switching.

For configuring this HPA-mute-matrix, 16 DIP switches are located on the top-board of your ***sat-nms*** IO-FEP2. You can check actual settings through little windows in the top cover of your ***sat-nms*** IO-FEP2's housing. For changing configuration, you have to remove this top cover by releasing 3 screws: 2 screws on top left around RJ45 LAN connector (one above and one below this connector) and one screw on very right side of the top cover. Each of all DIP-switches represents one waveguide switch 1...16. The DIP switches position on the board correlates to the position of each switch interface connector on the mainboard. Additionally each switch is marked with its function on the board, e.g. 'HPA MUTE BY WG-SWITCH 1'. Numbers written on every DIP-switch belong to the numbers of the corresponding HPA. When a switch is in position "on", the corresponding HPA mutes, during switchover of corresponding waveguide switch.

An example: You want to mute HPA 1 or 4 or 8 when waveguide switch 2 changes its condition.

Then you have to configure on the DIP-switch marked with 'HPA MUTE BY WG-SWITCH 2' the switches 1 and 4 and 8 into the "on"-position. All the others have to remain in 'off'-position.

Another example: You want to mute HPA 1 when waveguide switch 2 or 9 or 16 changes its condition. Then you have to configure on each of following DIP-switch switch 1 to 'on'-position: 'HPA MUTE BY WG-SWITCH 2', 'HPA MUTE BY WG-SWITCH 9', and 'HPA MUTE BY WG-SWITCH 16' All the others have to remain in 'off'-position.

This hardware HPA-mute-matrix is always enabled for all 16 waveguide-switch interfaces regardless the quantity of enabled waveguide-switch interfaces by feature codes.

If connected waveguide-switches are not equipped with inhibit-contacts, your ***sat-nms*** IO-FEP2 nevertheless provides the possibility to mute connected HPA(s) during switchover triggered by software. Therefore you have to open top cover of ***sat-nms*** IO-FEP2 and switch a slide-switch with corresponding number of the HPA to 'SOFTWARE CONTROLLED HPA MUTE' position. These switches are set to 'HARDWARE CONTROLLED HPA MUTE' by factory default. They are located between the DIP switches and are marked with 'HPA 1'...'HPA 10'. This clarifies correlation to the HPA mute outputs. Afterwards you have to configure the software-muting-matrix. How to do this is described in chapter 3.4 Installation Parameters .

Setting of these switches is also displayed on the ***sat-nms*** IO-FEP2's webpage: Setup/WG switches right half of the first line shows 'Inhibit' and the numbers of each HPA mute output. When 'HARDWARE CONTROLLED HPA MUTE' is selected, a 'HW' is shown here. If nothing is displayed here, corresponding output is configured to 'SOFTWARE CONTROLLED HPA MUTE'.

This option is only available for waveguide-switch interfaces enabled by feature codes, see chapter 2.4.1 Feature code activation for further information.

A mixed configuration of hardware and software muting is possible. You have to take into account that you have to select per HPA whether to switch by hardware or by software matrix. So it is not possible to mute one HPA with a mixed configuration of hardware and software muting.

If you nevertheless have this challenge to solve, there is a solution available as well: Therefore you have to connect 2 HPA mute outputs as series connection, one triggered by software, the other one triggered by hardware.

### 2.4.3 Photomos-relay digital outputs

If you don't have some HPA's to mute or don't need all the mute-outputs, you can use them as digital outputs as well. Therefore you have to open the top cover of ***sat-nms*** IO-FEP2's housing and put all the switches of corresponding outputs that you want to use this way, in the 'SOFTWARE CONTROLLED HPA MUTE' position. These switches are located between the DIP switches and are marked with 'HPA 1'...'HPA 10'. Don't exceed continuous current limit of 130mA and continuous voltage of 48V DC. Otherwise your ***sat-nms*** IO-FEP2 might be damaged. If you want to switch inductive loads, don`t forget to add a clamp diode to limit the spike voltages in the switching moment. Configuration of these outputs is described in chapter 3.4 Installation Parameters .

### 2.4.4 Detect 24V DC signals with DIN41...48

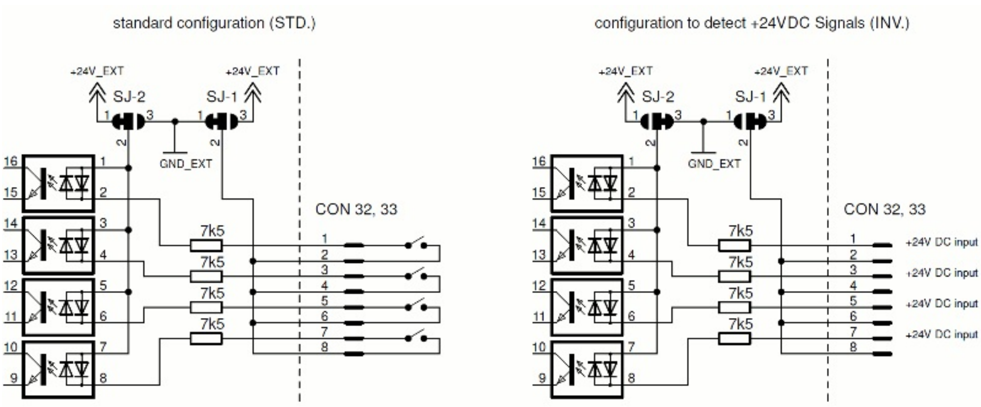
On these digital inputs you can select, if you like to detect potential- free on/off-contacts or if you want to detect a 24V DC Voltage. Factory setting is detecting potential-free contacts, like all the other digital-inputs. If you want to detect 24V DC signals, you have to observe following procedure:

**Attention: this configuration should be carried out by well trained personnel only!**

**Never do this during operation. *sat-nms* IO-FEP2 has to be switched off and all connectors have to be disconnected for this modification!**

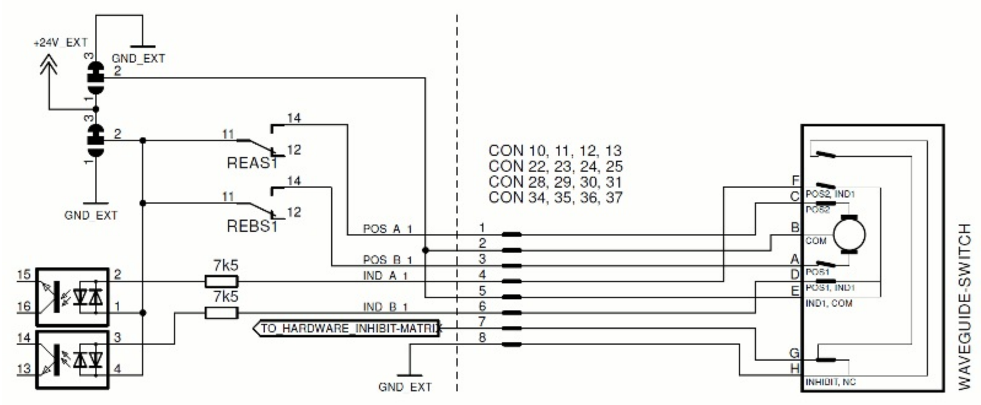
- Open ***sat-nms*** IO-FEP2's housing: Remove top cover (3 screws) and the upper side-rail (4 screws).
- Now take out the PCBs of the unit vertical up.
- flip PCB over. between CON32 and CON33 you find 2 solder jumpers. The one nearer to pin 1 of CON32 and CON33 is SJ-1 the one nearer to the middle of CON32 and CON33 is SJ2.
- As factory default, middle and outer pads (near by CON32) are connected to enable standard configuration. This position is marked with 'STD.' on the PCB. To configure these inputs for detecting 24V DC, change the position of both solder jumpers. Now middle and inner pads (near by CON33) have to be connected. This position is marked with 'INV.' on the PCB.
- Put PCB back into its housing and screw everything together in reverse order.

Following picture shows how to connect the digital inputs #41...48 in both ways of configuration, and how it works internally.




### 2.4.5 Change polarity of waveguide-switch interfaces

Your ***sat-nms*** IO-FEP2 is by factory default configured in that way most of usually used waveguide-switch work: it provides a 24V DC pulse to trigger a switchover of connected waveguide switch. GND is COM in this case. There are some waveguide switches available that work exactly contrary: They need a GND 'pulse' and have 24V DC as COM. Therefore ***sat-nms*** IO-FEP2 also provides a solution: It is possible to change polarity of waveguide-switch interfaces in blocks of 4. By that it is possible to e.g. connect 12 'normal' ones and 4 switches with changed polarity. Following picture shows the schematic of a switch interface in standard configuration:

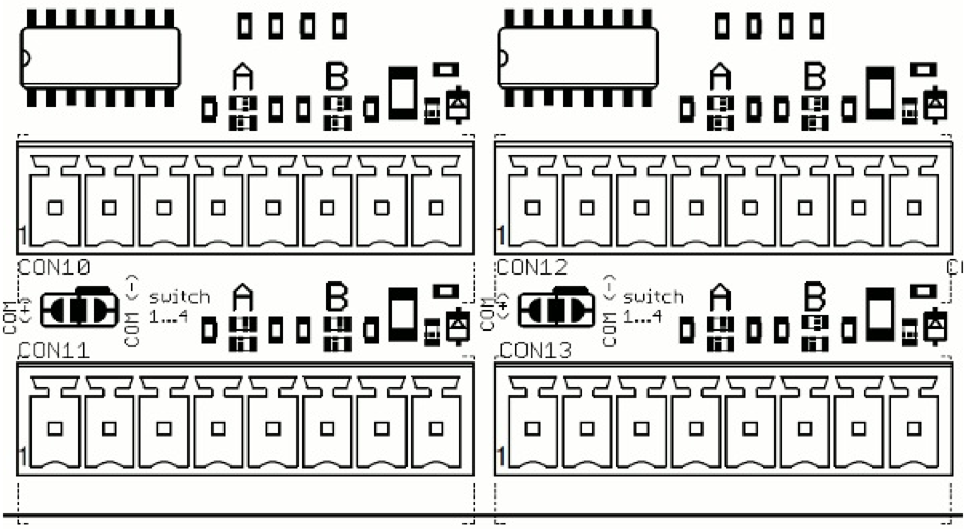



Reconfiguration of polarity will be explained exemplary with the first block of switch interfaces No. 1...4. This correlates to CON10...CON13. Configuration is done by changing solder jumpers.

**take care that *sat-nms* IO-FEP2 is switched off during this modification!**

**This modification should be carried out by well trained personnel only!**

Both solder jumpers are located between CON10/11 and CON12/13. you can easily see this on following picture. We strongly recommend to unplug affected connectors in order to get enough space for working with a soldering-iron.




Standard configuration is marked with a little line besides the pads that have to be connected. As you can see on the picture, both jumpers are marked with 'COM (-)' here. A little 'switch 1...4' is marked here too, in order to clarify correlation to affected switch interfaces. To change polarity, you have to connect left and middle pad marked with 'COM (+)' on **both** jumpers. By this, 24V EXT is connected as COM, GND EXT will be pulse switched to trigger a switchover. It is essentially, that both solder jumpers are always in same configuration, otherwise this interface does not work. Now, switch interfaces #1...#4 are configured with inverted polarity. All others work in 'normal' way if solder jumpers have not been changed here. If you like to connect more waveguide switches with inverted polarity, go ahead comparable to this example. Each 4 interfaces act as one block that might be configured. Following table shows which switch belongs to which block and location of each solder jumper.

| switch-interface No. | location of solder jumper |
|---|---|
| 1, 2, 3, 4 | between CON10/11 and CON 12/13 |
| 5, 6, 7, 8 | between CON22/23 and CON 24/25 |
| 9, 10, 11, 12 | between CON28/29 and CON 30/31 |
| 13, 14, 15, 16 | between CON34/35 and CON 36/37 |

## 2.5 Mechanical installation

The ***sat-nms*** IO-FEP2 enclosure is DIN rail mountable. Hence simply snap the ***sat-nms*** IO-FEP2 on to the rail to fix it. For plain wall mount, fix a minimum 100 mm piece of DIN rail at the wall with at least two screws and lock the ***sat-nms*** IO-FEP2 on this. For 19inch rack-mount, SatService GmbH offers a mounting plate. Call our sales team for more informations.

When planning the mechanical installation of the ***sat-nms*** IO-FEP2, please consider that cables to the ***sat-nms*** IO-FEP2 have to be fixed on the upper and the under side. So you need some space and something to fix the cables.

Take care, that the DIN rail, on which you mount your ***sat-nms*** IO-FEP2, is properly connected to PE potential. This is necessary to meet EMC compliances mentioned in chapter 1.1 Compliances .

## 2.6 Replacing an existing *sat-nms* IO-FEP(-E) by IO-FEP2

To ensure easy replacement of an existing ***sat-nms*** IO-FEP or IO-FEP-E, the new ***sat-nms*** IO-FEP2 is designed 100% pin- and connector compatible. By this it is possible to use existing cabling including connectors, so you have a plug-and play scenario.

There are only some things that need to be considered when installing a new ***sat-nms*** IO-FEP2 instead of an old ***sat-nms*** IO-FEP or IO-FEP-E:

- Make sure that you have enabled enough interfaces. ***sat-nms*** IO-FEP2 is available in only one hardware version, definition of enabled interfaces is done with license codes. To learn more about that, please refer to chapter {h2410 2.4.1 Feature code activation}.
- Although extreme compact design, the new ***sat-nms*** IO-FEP2 is a bit longer than formerly IO-FEP. Compared to ***sat-nms*** IO-FEP-E, the new ***sat-nms*** IO-FEP2 is a lot more compact and saves approximately 40% space. You have to consider that if you plan to replace an existing ***sat-nms*** IO-FEP.

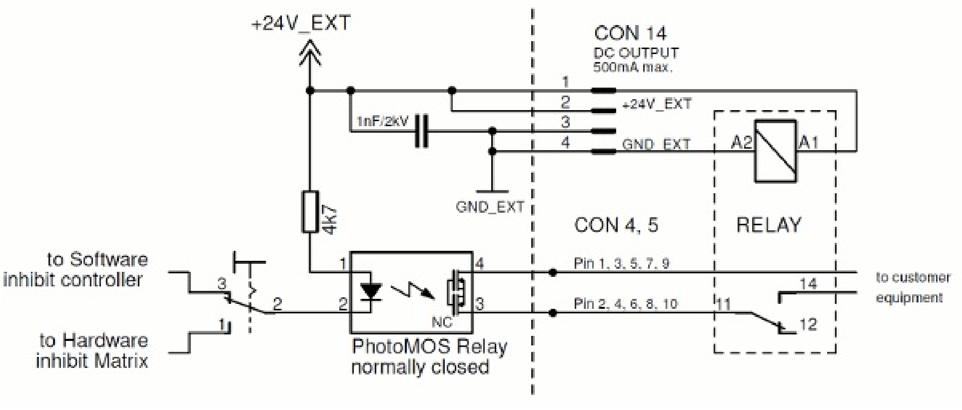
Following table compares mechanical dimensions of all 3 models:

| Type | length | width | height |
|---|---|---|---|
| IO-FEP | 264mm | 165mm | 60mm |
| IO-FEP-E | 434mm | 165mm | 60mm |
| IO-FEP2 | 307mm | 139mm | 60mm |

- Assignment of waveguide-switch interface number 5...8 and corresponding connector number have changed. Pin assignment is the same, so you only have to connect existing cables in new order. Following table shows new assignment:

| switch interface no. | IO-FEP(-E) | IO-FEP2 |
|---|---|---|
| switch 5 | CON 23 | CON22 |
| switch 6 | CON 22 | CON23 |
| switch 7 | CON 25 | CON24 |
| switch 8 | CON 24 | CON25 |

- In contrast to ***sat-nms*** IO-FEP(-E), the new ***sat-nms*** IO-FEP2 contains new photomos relay types. These ones are normally closed, so contact is closed when power is off. This ensures that connected HPAs are not muted in case ***sat-nms*** IO-FEP2 fails. If you use one or more of these outputs for controlling an external device, e.g. a heater, this function might be a problem. If possible, we recommend to use digital outputs 11-16. These are implemented as normally open relay contacts, so they will remain open upon power interrupt. If you nevertheless need to ensure photomos digital output interfaces with normally open function, we recommend to use an external relay connected to 24V EXT. Its contact needs to be connected in line to the photomos digital output. As soon as 24V EXT voltage disappears, contact will open. Following schematic shows how to connect this external relay:




## 2.7 Updating The IO-FEP2 Firmware

The IO-FEP2 provides tqo ways to update the device's firmware. One is via the Web-UI, the other uses SFTP and SSH from the command line.

**Updating the firmware using the Web-UI**

At the web page 'Info' there is a link 'Update Software' which leads to the firmware update page. You need to log in as 'admin' for this. Loading the firmware update page may take some seconds.

Then the IOFEP2 presents a Web page where the file to upload can be selected and the checksum of the file must be entered. With the update the file gets uploaded to the IO-FEP2 and unpacked, but the IOFEP2 does **not** automatcally reboot. You should do this as the next step.

**Updating the firmware using SFTP and SSH**

Using the Unix/Linux command line tools *sftp* and *ssh*, the process of updating the IO-FEP2 firmware may be automated with shell scripts. As a prerequisite you need the IO-FEP2 firmware update archive (something like iofep2-update-x-y-z.tar.gz, preferably in yout actual working directory) and the checksum for this file (a 32 digit hexadecimal number).

The firmware update is a 2-step procedure. With the first step the IO-FEP2 firmware update archive gets copied to the IO-FEP2's /tmp directory:

```
sftp iofep2-update-5.6.7.tar.gz root@10.10.1.1:/tmp/UPDATE.TGZ
```

The example above assumes that the IO-FEP2's IP address is 10.10.1.1 and that iofep2-update-5.6.7.tar.gz ist the file to upload. Enter 'satnms' when *sftp* asks for a password. Be sure to select */tmp/UPDATE.TGZ* als the file destination, otherwise the update will fail.

For the second step you log onto the IO-FEP2 using ssh and call the script install-update:

```
ssh root@10.10.1.1
```

Again, this assumes that the IO-FEP2's IP address is 10.10.1.1, enter 'satnms' when *ssh* asks for a password.

Finally, at the IO-FEP2's cli prompt enter

```
install-update checksum
```

checksum should be replaced with the 32 digit hexadecimal checksum you received with the firmware update. The IO-FEP2 installs the firmware update and automatically reboots to run the updated background programs. The *ssh* session gets closed by this (some *ssh* clients stay connected until the IO-FEP2 has finished its reboot).

# 3 Operation

The ***sat-nms*** IO-FEP2 is designed to be controlled over a network link using a standard web browser. This means in practice, that the user interface to the ***sat-nms*** IO-FEP2 appears in your browser window after you type in the ***sat-nms*** IO-FEP2's IP address in the address field of your browser program.

Operating the ***sat-nms*** IO-FEP2 is mostly self-explanatory.

## 3.1 The Web-based User Interface

After having connected the ***sat-nms*** IO-FEP2 to a power supply and set ***sat-nms*** IO-FEP2's IP address, you can access ***sat-nms*** IO-FEP2's user interface. To do this, start your favourite web browser program (Internet Explorer, Mozilla Firefox, Opera or what else program you prefer). At the address field, where you normally enter the URL of a web page you want to see, type in the IP address of the ***sat-nms*** IO-FEP2 you want to control.

The ***sat-nms*** IO-FEP2 shows a web page consisting of a navigation bar at the left side of the browser window and the actual state display of the ***sat-nms*** IO-FEP2 in the main part of the window. The readings automatically refresh once a second in standard configuration.

The navigation bar at the left contains a couple buttons which build the ***sat-nms*** IO-FEP2's main menu:

- State --- This button switches back to the IO-FEP2s main page you already see when you connect to the IO-FEP2. This page displays the actual state of the IO-FEP2.
- Settings --- By clicking to this button you switch to the 'Settings' page where you can change the position of the wageguide switches connected to the IO-FEP2 as well as the state of the outputs which are available for general purpose.
- Setup --- Clicking this button expands the navigation bar, making the submenu buttons visible which give access to the several sections of the installation / setup dialog. A second click to the 'Setup' button folds the navigation bar to it's original state.
- Event Log --- This button shows the IO-FEP2's event log in the main display area (the most recent 25 entries). The IO-FEP2 records all input port changes and all switch actuations with a time stamp.
- Info --- After a mouse click to this button, the IO-FEP2 shows a table with information like the serial number of the device or the revision ID and compilation date of the software.
- Help --- Clicking to this button shows the on-line version of this user manual

## 3.2 Displayed State

The 'State' page is the main page of the IO-FEP2 which shows the actual state of all inputs and outputs. The page automatically refreshes every second (the refresh interval is configurable at the Setup / General page).

The page shows a 5-column table containing all information about the input / output states, temperature readings and faults. The page is read-only, to change an output or waveguide switch position go to the Settings page.

**Output Circuits**

The output circuits column shows the current state of all outputs which are configured to work as operator controlled outputs. The outputs 1 to 10 are the photo-MOS output circuits which also may be used as HPA inhibit outputs. The lines 11 to 16 refer to the relay output circuits provided by the IO-FEP2. The following applies to all output states:

- The displayed state ON/OFF is the *logical* state of the output. By default ON represents a closed contact, however, each individual output may be configured to the inverse function at the Setup / Output Circuits page.
- Outputs configured as 'UNUSED' neither show a circuit name nor an ON/OFF state.
- Outputs configured to act as a HPA inhibit circuits are displayed with a dimmed name, without a circuit state.

**WG Switches**

The second column displays the state of the waveguide switches controlled by the IO-FEP2. The standard version provides I/O circuits for 4 switches, it can be upgraded to up to 16 switches. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation .

Each switch may show one of the states 'A', 'B' or 'FLT'. The states are determined from the switches' position indication circuits, 'FLT' is shown if both circuits have the same state (unknown position). Table row referring to switches configured as 'UNUSED' are left empty

**Input Circuits**

The table columns 3..5 show the state of the input circuits provided by the IO-FEP2. Depending on the quantity of licensed inputs, some input circuits remain dimmed. The dimmed inputs are not licensed. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation

- Inputs configured as 'INPUT' show the states ON or OFF.
- Inputs configured as 'ALARM' show the states OK or FLT.
- Rows referring to 'UNUSED' inputs are left empty.
- The displayed state is the *logical* state of each input. By default ON/FLT stands for a closed contact, however, each individual input may be configured to the inverse function at the Setup / Input Circuits page.
- The displayed state also takes into account the delay time configured for each individual input. (This probably will not be visible for short delay times)

**Temperature Readings**

The IO-FEP2 displays the internal temperature and the reading of up to four external temperature sensors at the table field below the output circuits. For each sensor the sensor name, the temperature and an OK/FLT state is shown. A temperature value is considered 'OK' if the value is inside the limits configured at the Temperature Sensors page.

**Protection Switch State**

The IO-FEP2 provides up to 16 instances of automatic 1:1 protection / redundancy switching units. Each protection switch controls the waveguide switch with the same number. Up to 5 alarm inputs may be assigned to each side of a protection switch at the Setup / Protection page. Two consecutive protection switches can be coupled to build a 2:1 redundancy circuit.

The following state information is provided for each protection switch unit (unconfigured protection switches are shown as empty fields, DISABLED instances show the text **DISABLED** ):

- The operation mode 1:1-SW-ONCE/1:1-SW-ALWAYS/2:1-SW-ONCE (see Protection for details)
- The chain A fault state (green for OK, red for FAULT)
- The switch Position A/B
- The chain B fault state (green for OK, red for FAULT)
- The SWITCHED flag. This flag is set once the protection switch has actuated the WG switch due to a fault in the active chain. In 1:1-SW-ONCE mode this prevents the protection switch from further switching.
- 2:1 protection switches show the use of the redundant chain (CHAIN-1, CHAIN-2 or NONE) in place of the switch setting. The fault state of the the redundant chain is shown below this.

Unavailable instances of protection switches are shown shaded with dark background.

## 3.3 Output Circuit / WG Switch Operation

The page 'Settings' provides a 2-column table which is used to operate output circuits of the IO-FEP2 and the waveguide switch connected to it. Like the State page, the table shows the actual position of the outputs / switches. The display isn't updated automatically, so the displayed state may be outdated if the page is left open.

Clicking to the state of an output / waveguide switch opens a dialog which provides buttons to change the switch position. This dialog is password protected, you are required to login in order to change the position of waveguide switches or output circuits.

Protection switch parameters are shown in the third table column. Each protection switch may be set to ENABLED or DISABLED. ENABLED means that protection switch is 'hot', it will switch if a fault happens in the actually selected signal chain. The protection switch may be temporarily DISABLED, e.g. to perform maintenance tasks at the equipment without triggering the protection switch. For 2:1 protection switches the enabled state is coupled for both chains.

The function RESET resets the SWITCHED flag of the protection switch (only available if the SWITCHED flag of the particular protection switch is set).

2:1 protection switches show their location setting at the rightmost column. Clicking this lets you set the redundant chain use explicitly to NONE, CHAIN-1 or CHAIN-2. Note, that while enabled, the 2:1 protection switch does not allow to activate a chain if there is an error pending on it.

Please note: The 'Settings' page isn't updated automatically, so the displayed state may be outdated if the page is left open. Don't use your browser's 'reload' button to update the page as this will re-execute your last command with some browsers. Instead, use the 'REFRESH PAGE' link below the table.

## 3.4 Installation Parameters

The pages accessible through the 'Setup' menu items contain the IO-FEP2's installation parameters. Installation parameters are protected by an administrator password, without a successful login as administrator you may view the configuration settings but you may not change them.

Due to the large number of configuration settings, they are divided into several pages:

- General Setup --- Contains general configuration parameters like communication interface settings, passwords etc.
- Output Circuits --- The usage of the output circuits of the IO-FEP2 is configured on this page
- WG Switches --- The control of the waveguide switches connected to the IO-FEP2 is configured on this page.
- Input Circuits --- The usage of the input circuits is configured at this page
- Temperature Sensors --- The temperature sensors connected to the IO-FEP2 are configured in this page.
- LNA Supply --- LNA power supply monitoring parameters
- Protection --- Protection switch configuration

## 3.5 General Setup

The general setup page provides some general installation settings (section 'General') and the settings of the IO-FEP2's SNMP agent (section 'SNMP Configuration'). The settings are in particular:

**General**

- Display Title --- The title entered here is displayed on all pages of the IO-FEP2 user interface. For compatibility with older software versions, "State" is treated as an empty title. To remove an entered title, either enter "State" or a single space character.
- Date & Time --- Click to 'Set Time' in order to set the actual date / time at theIO-FEP2's real time clock. Enter the actual date / time in *xactly* the format *YYYY-MM-DD HH:MM:SS* .
- NTP Time Server 1 IP --- To make the IO-FEP2 sync it's internal clock to a NTP time server, set this to the IP address (aaa.bbb.ccc.ddd) of the NTP server. Setting this to 0.0.0.0 disables the NTP synchronisation (even if time server 2 IP is set).
- NTP Time Server 2 IP --- You may define a second (backup) time server IP address with this field. The backup time server is queries if the first server is not available. The setting 0.0.0.0 disables the backup time server interrogation.
- NTP Time Zone Offset --- NTP servers deliver their time stamps in UTC. By setting an offset in this field, you can tweak the IO-FEP2 clock to display local time, even if synced to a NTP server. Entering "01:00" for example adjusts the clock to CET (Central European Time), "-04:30" to VET (Venezuelan Standard Time). Beside the the HH:MM notation, the software also accepts arbitrary values in minutes. The examples above then would read as "60" (CET) or "-270" (VET). Entering "0" or "00:00" clears the offset, returning the clock to UTC, the same happens if the offset cannot be parsed by the software.After changing the time zone, you should clear the event log because old log entries are not affected by the time zone change.
- State Page Refresh Rate --- The state page by default refreshes automatically every second The refresh rate may be slowed down, setting it to zero disables the automatic refresh completely.
- Point & Click Operation --- Setting this to YES enables small buttons at the main status page which permit to change output settings and switch positions with a single mouse click to one of the buttons.
- Use USB Stick --- Setting this to YES lets the IO-FEP2 write its log files to the stick instead of storeing them in RAM. This makes the log persistent when the IO-FEP2 ist switched off. For obvious reasons this requires an USB stick to be plugged to IO-FEP. Setting this to NO

unmounts the USB Stick allows the safe removal of the stick.
- Max. Concurrent WG-Switch Actuations --- The IO-FEP2 is capable to queue / delay waveguide switch actuations in order to protect weak power supplies from overload. While this is not important if the IO-FEP2 is exclusively controlled through the web interface, a monitoring & control computer is capable to command actuations for all waveguide switches at a time. Set the parameter to the max. available supply current divided by the current drawn by a single waveguide switch. Setting the parameter to zero disables the switch actuation queuing.
- Serial I/O Address --- The serial interface may be operated either with the MOD-95 / Miteq protocol, using a device address 'A' to 'G' or with a simple ASCII / terminal protocol (setting 'NONE'). See chapter 4.3 The RS232 remote control interface for details.
- User Password --- Defines the user password (default 'user'), which is required to actuate switches or to set output circuits of the IO-FEP2. An empty password disables the password prompting.
- Administrator Password --- Defines the administrator password (default 'admin'), which is required to change any configuration settings. An empty password disables the password prompting.
- Reboot Device --- Clicking to REBOOT forces a power up reboot of the IO-FEP2 (after an inquiry dialog). Please note, that rebooting the IO-FEP2 interrupts all operation including redundancy switching for about 30 seconds.

**SNMP Configuration**

- Read Community --- Sets the SNMP community string expected for read access. The default is 'public'.
- Write Community --- Sets the SNMP community string expected for write access. The default is 'public'.
- Trap Community --- Sets the SNMP community string sent with traps. The default is 'public'.
- Trap Destination IP 1 --- Enter the trap destination IP address (dotted quad notation) to make the IO-FEP2 sending traps by UDP to this host. Setting the parameter to 0.0.0.0 disables the trap generation.
- Trap Destination IP 2 --- Enter the trap destination IP address (dotted quad notation) to make the IO-FEP2 sending traps by UDP to this host. Setting the parameter to 0.0.0.0 disables the trap generation.
- Trap Destination IP 3 --- Enter the trap destination IP address (dotted quad notation) to make the IO-FEP2 sending traps by UDP to this host. Setting the parameter to 0.0.0.0 disables the trap generation.
- Trap Destination IP 4 --- Enter the trap destination IP address (dotted quad notation) to make the IO-FEP2 sending traps by UDP to this host. Setting the parameter to 0.0.0.0 disables the trap generation.
- System Location --- The IO-FEP2 replies to MIB-II sysLocation requests with the text entered at this place.
- System Contact --- The IO-FEP2 replies to MIB-II sysContact requests with the text entered at this place.

**File Up & Downloads**

- Download MIB File --- Clicking to DOWNLOAD downloads the IO-FEP2 MIB file from the device to your computer. Depending on the configuration of your webbrowser the file is stored as 'IO-FEP.MIB' in the default download folder or a file save dialog appears to select the place where to store the file.
- Download Configuration --- Clicking to DOWNLOAD downloads the SETUP.TXT file which

contains all configuration setting of the IO-FEP2 from the device to your computer. Depending on the configuration of your webbrowser the file is stored in the default download folder or a file save dialog appears to select the place where to store the file.

- Upload Configuration --- Clicking to UPLOAD (you must be logged in as 'admin' for this) shows a dialog to select a SETUP.TXT file which shall be applied to the device. After selecting the file it gets uploaded to the IO-FEP2 and the settings in the file are applied immediately. No reboot is required. For convenience, the IP settings (address, netmask and gateway) are not changed with this. IP settings in the SETUP.TXT file are ignored. This lets you easily copy complete setups from one IO-FEP2 to another without messing up the IP settings of the destination device.It is not necessary that the Setup file is named 'SETUP.TXT.' It might also be possible to upload a Setup-file thats name is e.g. 'STATION_1_IO-FEP2_SETTINGS.TXT'. By this it is easy to handle backup files from different IO-FEP2.
- Upload Configuration (incl. IP Parameters) --- This second config file upload works the same way than the one above, but it updates also the IP parameters with the values (IP address etc.) stated in the uploaded file. Please note, that the new IP parameter do not become effectove immediately after the upload. To set the changed IP address it is required to reboot the IO-FEP2.

**Real Time Clock battery backup**

The IO-FEP2's real time clock is backed up by a goldcap capacitor. The goldcap supplies the RTC chip with power for several days if the main power is missing. This is the preferred mode of RTC backup for stationary installations of the IO-FEP2.

For applications where the IO-FEP2 is powered up only occasionally, a lithium cell may be connected inside the IO-FEP2 housing in order to provide a permanent buffering of the clock.

**NTP time synchronisation**

The IO-FEP2 may be configured to use one or two NTP time servers as reference for it's internal clock. To enable NTP time synchronisation, set the NTP server's IP address at the general setup page.

With NTP time synchronisation enabled, the IO-FEP2 sets the internal clock from the NTP time once after power on and then every 3 hours. This ensures correct time stamps for IO-FEP2's event log.

With the first successful NTP sync after power on, the IO-FEP2 also sets the on-board RTC chip to the NTP time. If later on the NTP server becomes unavailable, the IO-FEP2 automatically uses the RTC chip as a backup for synchronisation. The actual state of time synchronisation is continuously displayed at the bottom of the main page of the IO-FEP2's Web-GUI.

If the time server address 2 is configured as well, the IO-FEP2 queries this server if the first one is not available (times out). The date / time status line at the primary IO-FEP2 web page always states which time server was used for synchronization recently and if this was successful.

## 3.6 Output Circuits

This page configures the usage of the output circuits provided by the IO-FEP2. Outputs 1 .. 10 refer to the photo-MOS outputs, normally dedicated to the WG switch - HPA muting circuitry. Outputs 11 .. 16 are the general purpose relay outputs of the IO-FEP2.

Following properties may be configured for each output:

- Type --- Defines the main purpose / type of the output:
    - UNUSED --- The output is not connected / not used
    - SW-INHIBIT --- The output is controlled by the software as a HPA mute output. It is not accessible for general purpose. (only available for the outputs 1..10)
    - HW-INHIBIT --- The output is controlled directly by the hardware HPA mute logic, not under software control. (only available for the outputs 1..10)
    - OUTPUT --- The output is configured as general purpose output, it's state may be controlled at the web interface or through one of the M&C interfaces.
    - TEMP-CTRL --- The output is configured as an output for a temperature control loop. The "State" page shows the actual state of this output like for a normal output, but the output cannot be controlled manually. The temperature control loop setup only offers outputs which are configured as TEMP-CTRL.
- Name --- When you activate an output at the 'Type' setting, the IO-FEP2 names this output as 'Oxx'. You may name the output in a more meaningful way by entering a circuit name at this place.

- Polarity --- 'NORMAL' polarity closes the contact for the output setting 'ON', 'INVERTED' polarity reverses this behaviour. The INVERTED setting frequently is used together with the software controlled inhibit logic in order to *open* the inhibit circuit while the switch moves. The polarity setting is not available if a photo-MOS output is configured as 'SW-INHIBIT'.

Please note, that the function of the outputs 1 ..10 first and foremost is controlled by the HW/SW control switch settings inside the IO-FEP2. Outputs which are selected as hardware controlled HPA mute outputs (the factory setting for all of these outputs) are not under software control and are automatically configured as HW-INHIBIT.

## 3.7 WG Switches

This page configures the waveguide switches controlled by the IO-FEP2. The standard version provides I/O circuits for 4 switches, it can be upgraded to up to 16 switches. They can easily be enabled by entering the corresponding feature code. See chapter 2.4.1 Feature code activation .

The following properties may be configured for each waveguide switch:

- Type --- Defines actuation mode for the switch:
    - UNUSED --- The switch is not connected / not used. te .ns FIXED-PULSEThe switch is actuated with a pule of a fixed width. After the actuation pulse the position is checked and a fault is raised if the switch position is not signalled as expected.
    - AUTO-PULSE --- With AUTO-PULSE the IO-FEP2 releases the switch actuation as soon as the switch signals that it reached it's target position. The pulse width given for this switch in this mode acts as a maximum time / timeout: if the switch does not reach it's target position within this time, a fault is raised.
    - READ-ONLY --- The IO-FEP2 does not produce any actuation for a READ-ONLY switch, it simply displays name and position of this switch at the status page.
    - TOGGLE --- Use this configuration to control a waveguide- or coaxial switch with needs a toggle command. An actuation pulse of 'pulse width' milliseconds is applied to **both** actuation outputs, if a position is commanded which differs from the actual one.
    - SLAVE-TO-SWITCH-n --- Slave switches are automatically actuated when the configured master switch is set. Internally the switch uses it's individual actuation pulse timing, raises faults if the position indication inputs read unexpected states.

- Name --- When you activate switch at the 'Type' setting, the IO-FEP2 names this switch as 'Sxx'. You may name the switch in a more meaningful way by entering a circuit name at this place.
- Pulse Width --- The actuation pulse width (FIXED-PULSE) or the switch actuation timeout (AUTO-PULSE) in milliseconds.
- Inhibit --- Set a check mark at a particular column to activate the software controlled HPA muting for this switch and the selected output. Multiple HPA muting outputs may be selected to be activiated from a single switch. An output must be configured to 'SW-INHIBIT' mode before it can be selected at this place.

**FIXED vs. AUTO pulse width**

You will find the AUTO-PULSE mode very handy in most cases: The actuation pulse width is as short as possible, making 'queued' switching sequences running much faster. The AUTO-PULSE however requires that the switch signals it's target position not before the switch mechanics has reached a stable position where it does not 'snap back' if the actuation is switched off.

Additionally bouncing of the switch may be another problem in AUTO-PULSE mode. If a connected switch is prone to bouncing (you see this when the waveguide switch reached its position and nevertheless a fault is displayed) we recommend using FIXED-PULSE configuration.

You should therefore test each switch in AUTO-PULSE mode carefully if it operates reliably when controlled by the IO-FEP2 before you apply RF power to it.

**READ-ONLY switches**

The READ-ONLY mode is meant to be used for switches which have their actuation circuits wired in parallel to another switch, or do not provide any electrical actuation at all. The IO-FEP2 simply reads and displays the position decoded from the position indication inputs. However, the IO-FEP2 does no position fault checking with switches marked as READ-ONLY. This is because it neither knows the nominal position of such a switch nor when it gets switched and therefore may cause an 'indifferent position' state for a short moment.

**SLAVE switches**

SLAVE switches change their position any time the configured master switch is set. This is done by copying the switch position request from the master switch to all its slaves. Internally the slave switches are treated as individual switches, each switch controls its activation pulse timing and checks its position indicating inputs individually. Each slave uses its individual pulse width setting, it however inherits the AUTO/FIXED pulse mode from it's master.

As slave switches are commanded simultaneously with their master, but processed individually, they are subject to the IO-FEP2's switch action queuing. For details see the correspondent paragraph below.

**Software controlled HPA muting**

The IO-FEP2 provides software controlled HPA muting during switch actuations for situations where the waveguide switches do not provide inhibit circuits or where such circuits are not usable for some reason. To use this feature, you have to configure the IO-FEP2 as follows:

1. Select a number of PhotoMOS outputs to be used as software controlled HPA muting circuits. Open the IO-FEP2 and set the switches for these outputs to position 'Software controlled'.

2. At the Setup / Output Circuits configure these outputs as 'SW-INIHIBIT'. To make the output *open* to mute the HPA, set output polarity to 'INVERTED'.
3. At the Setup / WG Switches page configure the waveguide switches to activate the mute outputs in accordance to the RF signal flow.

The IO-FEP2 mutes the HPA(s) before the switch motor is actuated and unmutes it after the switch has reached it's target position. Multiple waveguide switches may activate the same muting output, the IO-FEP2 combines such requests with a logical 'or'. Each waveguide switch may activate multiple muting outputs.

When using the software controlled HPA muting, you should consider the following:

- Although the IO-FEP2 continuously monitors the position indication circuits of the switches and by this means recognizes manual switch actuations, you never should move such a switch manually. It may take up to 20 msecs until the IO-FEP2 mutes the HPA, with high RF power applied this may be enough to damage HPA and / or the switch.
- It is not possible to mix hardware and software controlled HPA muting internally in the IO-FEP2. If your system setup requires such a mix, you have to configure the software controlled inhibits and the hardware controlled ones separately, to different output circuits. You may combine these externally, e.g. by wiring the circuits in series.

**Switch actuation queuing**

The IO-FEP2 is capable to queue / delay waveguide switch actuations in order to protect weak power supplies from overload. This in particular is valuable if the IO-FEP2 is operated by monitoring & control computer, as a M&C is capable to command actuations for all waveguide switches at a time. The IO-FEP2 takes care that no more switch actuation outputs than configured are active at a time. Commanded switch actuation are delayed for this, switches commanded in parallel are processed in the order of their switch number.

The maximum number of the parallel switch actuation is configured at the General Setup page.

## 3.8 Input Circuits

This page configures the usage of the input circuits provided by IO-FEP2. The IO-FEP2 monitors up to 48 general purpose inputs. Each input may be configured as a simple state monitor, signalling it's state as ON/OFF, or as alarm input signalling its state as OK/FLT.

The following properties may be set for each individual input:

- Type --- Defines the main purpose / type of the input:
    - UNUSED --- The input is not connected / not used. te .ns INPUTThe input is used for general purpose state monitoring. It reports it's state as ON/ OFF.
    - ALARM --- The input is used for alarm monitoring. It reports it's state as OK / FLT.
- Name --- When you activate an input at the 'Type' setting, the IO-FEP2 names this input as 'Ixx'. You may name the input in a more meaningful way by entering a circuit name at this place.

- Polarity --- 'NORMAL' polarity signals 'ON' or 'FLT' for a closed contact, 'INVERTED' polarity reverses this behaviour.

- Delay --- If this parameter is set to a non-zero value, the IO-FEP2 requires the input signal to be stable for at least the given time before a new state is signalled. You may use the delay to prevent short fault 'spikes' from being signalled.

## 3.9 Temperature Sensors

This page configures the temperature sensors. The IO-FEP2 contains an internal temperature sensor measuring the temperature on the circuit board. Additionally the IO-FEP2 offers inputs for up to four external (Pt-1000) temperature sensors which may be used to monitor the temperature of the equipment shelter, the antenna feed box or other locations. The IO-FEP2's temperature measurement-circuit is calibrated before delivery, That's the reason why the offset sometimes is not set to 0,0°C in delivery state.

The following properties may be configured for each temperature sensor.

- Enable --- Setting this parameter to 'ENABLED' activates the monitoring for this sensor.
- Name --- You may enter a descriptive name for the temperature value measured with this sensor. The name appears at the main ('State') page.
- Offset --- Pt-1000 temperature sensors are very precise and do not require an individual calibration for simple monitoring applications. Nevertheless, a temperature offset may be defined for each sensor, e.g. to compensate for the cable resistance to the sensor. The displayed value is the sensor reading + the offset defined in this column. The IO-FEP2's temperature measurement-circuit is calibrated before delivery. That's the reason why the offset sometimes is not set to 0,0°C in delivery state.
- Low/High Limit --- You may define temperature limits for each sensor. The IO-FEP2 signals a fault if a temperature is outside the given limits. To disable the limit checking, set the limits to values like -100 / +300.
- Closed Loop --- Configures the IO-FEP2 to do perform closed loop temperature control with this sensor. This feature may be activated for the external sensors 2-5 and only if a sensor is activated. The following options may be set:
  - NONE: No temperature control is done
  - HEAT: The IO-FEP2 switches the configured output ON if the temperature drops below *T_target - T_hyst/2* , it switches the output OFF if the temperature raises above *T_target + T_hyst/2*
  - COOL: The IO-FEP2 switches the configured output ON if the temperature raises above *T_target + T_hyst/2* , it switches the output OFF if the temperature drops below *T_target - T_hyst/2*
- Target Temp --- The target temperature for the closed loop temperature control. (T_target)
- Hysteresis --- The control loop hysteresis (T_hyst)
- Control Output --- The output port used for the temperature control. Only outputs configured as TEMP-CTRL outputs may be used, you must configure the output before you can reference it in the temperature control.
- Inhibit Input --- You may define an inhibit input which disables the control loop (forces the output to OFF) if active. All NORMAL or ALARM inputs may be used as inhibit input. Select 'none' if there shall be no input defined to inhibit the control loop.

The internal temperature sensor of the IO-FEP2 cannot be disabled, it's name is fixed to 'Board' and it's offset is fixed to '0.0'.

## 3.10 Protection/ Redundancy definition

The IO-FEP2 provides up to 16 instances of automatic 1:1 protection / redundancy switching units. Each protection switch controls the waveguide switch with the same number. With this page the operation mode of each protection switch and it's alarm input assignment is configured.

**Operation Mode**

Each protection switch may be configured to one of the following operation modes:

- UNUSED --- The protection switch is not configured
- 1:1-SW-ONCE --- The protection switch is configured for '1:1 switch once' mode
- 1:1-SW-ALWAYS --- The protection switch is configured for '1:1 switch always' mode
- 2:1-SW-ONCE --- The protection switch (and it's neighbour) are coupled and used to build a switch once 2:1 chain redundancy circuit.

To configure a protection switch it's required, first to configure the waveguide switch controlled by this protection switch instance at the Setup / WG Switches page. Protection switches belonging to "UNUSED" waveguide switches are marked with "n/a" and cannot be configured.

**Input Assignment**

For each protection switch configured as 1:1-SW-ONCE/1:1-SW-ALWAYS up to 5 alarm inputs for chain A and up to 5 alarm inputs for chain B may be assigned. It is not required to configure all 5 fault inputs for a chain, unused inputs are marked with "none". Obviously, at least one alarm input for each chain must be configured to make the 1:1 protection work.

Chain A is defined as the equipment chain which is selected while the waveguide switch is in position A, chain A faults are fault signals originated by equipment in chain A, hence causing the protection switch to switch over to position B. How fault inputs are assigned for 2:1 protection switches, see below.

Only inputs configured as ALARM inputs may be selected as a fault input signal for a protection switch. Hence, the inputs must be configured at the Setup / Input Circuits page before they can be used in a protection switch.

**1:1-SW-ONCE vs. 1:1-SW-ALWAYS Operation**

A protection switch toggles it's position if there is no fault at the actually redundant chain and there is at least one fault at the actually selected chain. Thereby the software honours any signal inversion or delay configured for each individual input. Switching to the redundant chain causes the protection switch to set the SWITCHED flag as an indication that a switchover took place. In 1:1-SW-ONCE mode, this prevents the protection switch from switching back to the original position until the SWITCHED flag has been reset by the operator. In 1:1-SW-ALWAYS mode the protection may switch back if the switching condition appears laterally reversed.

**2:1-SW-ONCE 2:1 Chain Operation**

This mode lets you couple two consecutive protection switch units to build one 2:1 chain redundancy switch. If you select this mode, the following assignments / prerequisites apply:

1. Each switch controls one operational chain with switch position A meaning "the chain is in use". Position B switches the redundant chain in place. This means switch positions A/A describe the normal operation mode, A/B or B/A appear if the redundant chain has been

switched in place of one of the operational chains. The switch combination B/B usually makes no sense.

2. The chain A fault inputs of each switch are to receive faults from the corresponding operational chain. All chain B fault inputs are combined (logical OR), receiving faults from the redundant chain.
3. A 2:1 redundancy unit switches the redundant chain in place of an operational chain if it is enabled, if there is no fault pending for the redundant chain. A 2:1 redundancy is only active in "NONE" position, therefore acts in a "switch once" manner.

## 3.11 LNA/LNB power supply monitoring

The IO-FEP2 provides 6 power supply circuits for LNAs / LNBs with short circuit protection and monitoring capabilities for voltage and current. This page controls the voltage and current limits for each individual supply circuit.

- Enable --- Enables or disables monitoring for this particular supply circuit. When enabled, voltage and current are measured and compared to the limits defined for this circuit. Measurement values and the comparison results are displayed at the main status page. When disabled, these fields remain empty. The short circuit protection remains active, even if monitoring is disabled.
- Name --- You may define a descriptive name for the LNA supplied by this circuit.
- VoltageLowLimit --- The voltage limit (V). If the supply voltage drops below this value, a fault is raised an a message is written to the event log.
- CurrentLowLimit --- The current low limit (mA). If the supply current drops below this value, a fault is raised an a message is written to the event log.
- CurrentHighLimit --- The current high limit (mA). If the supply current raises above this value, a fault is raised an a message is written to the event log.
- calc --- Clicking to this link lets you enter a percentage value for the low/high current limits. The IO-FEP2 takes the actual current reading and sets the limits the given number of percent points below and above it.

**Remarks**

LNA/LNB power supply monitoring is only available, if this feature is licensed.

In case of a short circuit the voltage will drop to zero due to the protection circuit built into the IO-FEP2.

## 3.12 Event Log

The IO-FEP2 provides an internal event log which records all changes at input circuits, waveguide switch or output circuit actuations and temperature / supply limit alarms. Each event is stored with a time stamp read from the IO-FEP2's real time clock.

The event log is organized as a set of eight files which are written in a round-robin manner. Every time the IO-FEP2 boots or after 24 hours a new file is started. If a USB stick is plugged into the IO-FEP2 and 'Use USB Stick' at the 'Setup-General' page is set to YES, the event log is permanently stored on this device. Otherwise the files are stored in volatile memory and are lost when the IO-FEP2 is switched off.

By default, the event log page shows the contents of the recent. file, starting with the latest event Clicking to 'NEWEST' refreshes. this display. The buttons '-1' to '-7' let you inspect the older event log files.

**Search**

Entering a search pattern to the search field on top of the right sidebar and clicking to 'SEARCH' searches the *complete* event log for entries containing the pattern entered. The search pattern is interpreted as a regular expression, permitting to specify complex search conditions.

**Download**

Clicking to the 'DO IT' button in the 'Download' section of the right sidebar downloads the complete event log as a single text file. Unlike the web application which shows recent events fist, the downloaded file contains recent events at the very end.

**Clear**

Clicking the 'CLEAR' button at the right sidebar deletes all events from the log.

## 3.13 USB interface

The IO-FEP2 provides an USB socket for an external USB stick / storage device. The IO-FEP2 comes with a miniature USB stick which protrudes only a few millimeters from the IO-FEP2's housing.

The main purpose for the USB interface is the permanent storage of the IO-FEP2's event log. If an USB stick is plugged into the IO-FEP2 and the setup parameter 'Use USB Stick' is set to YES, the software permanently stores the event log on this stick. Otherwise the software stores the event log in volatile memory, the log files are lost when powered off in this case.

For more information about the IO-FEP2 event log, see chapter '3.6 Event Log'

**USB stick monitoring**

While 'Use USB Stick' is set to YES, the IO-FEP2 permanently monitors the presence of the USB stick. If the IO-FEP2 misses the stick, it shows a fault message at the bottom of the main status page.

Please note: You never should remove the USB stick while the IO-FEP2 is running with 'Use USB Stick' set to YES. First set 'Use USB Stick' to NO, then remove the USB stick. This unmounts the USB Stick allowing its safe removal. Otherwise you risk damaging the USB stick if it is written while removing.

After you have plugged the USB Stick back to the IO-FEP2, set the 'Use USB Stick' setting back to YES. The IO-FEP will add the events stored in the volatile memory to the data on the USB stick.

**Other USB stick functions**

You can use the USB stick to evaluate the IO-FEP2's IP address when it is switched off and to set / initialize the device's IP settings. See chapter '2.2 Setting the IP address' for more detail on this.

If you store a IO-FEP2 setup file on the USB stick, you can make the IO-FEP2 read this setup on power up. This can be used to easily copy the setup of one IO-FEP2 to another device:

1. Download the setup from the first IO-FEP2 as described in chapter 3.4.1 General Setup -- File Upload/Download

2. Rename the file to SETUPRESCUE.TXT if you want the second IO-FEP2 to skip the IP address when reading the file or to SETUPIPRESCUE.TXT if you want all parameter to be taken from the file, including the IP address.
3. Power down the second IO-FEP2
4. Copy the renamed setup file to the IO-FEP2's USB stick.
5. Plug the USB stick into the IO-FEP2 again and power ist on.

The IO-FEP3 will update its setup from the file found on the USB stick. The file will be deleted automatically after it has been read in order to make this happen only once and not with every reboot.

You should use only one of the power on initializazion files IPRESCUE.TXT, SETUPRESCUE.TXT or SETUPIPRESCUE.TXT at a time. Having them together on the USB stick may give confusing results if these files contain different settings.

# 4 Remote Control

The ***sat-nms*** IO-FEP2 offers multiple ways to control it from a remote site. It may be controlled remotely by Modbus/TCP, SNMP, a text based protocol based on HTTP or through a serial RS232 interface.

The Modbus/TCP interface gives complete control over the IO-FEP2, including all setup / installation parameters. It is recommended to use this interface for new applications. The SNMP, HTTP and RS232 remote interfaces only provide a subset of parameters which covers all operational settings and status values, but implements no setup parameters.

The SNMP, HTTP and RS232 remote interfaces are legacy interfaces which provide full backward compatibility to previous versions of the ***sat-nms*** IO-FEP and IO-FEP-E.

## 4.1 RS232/HTTP command syntax

The IO-FEP2 knows a number of parameters, each identified by a parameter name. To set a certain parameter to a new value, a message:

**name=value**

has to be sent to the IO-FEP2. The IO-FEP2 interprets this command, checks the range of *value* , sets the internal parameter and then answers:

**name=value**

The *value* in the reply is the value actually recognized by the IO-FEP2. For instance, if the requested value was out of range, the replied (and internally used) value is limited to the applicable minimum or maximum.

To read a parameter from the IO-FEP2, instead of a new parameter value a question mark is sent:

**name=?**

The IO-FEP2 replies the actual value in a complete message:

**name=value**

A complete list of the parameter the IO-FEP2 knows is shown later in this document in chapter Parameter list . Below, some common rules applying to the remote control message syntax are summarized.

- Parameter names always are of lower case letters, most of them are four characters long.
- Non-numeric parameter values always are written in upper case.
- Numeric (floating point) values may be specified with an arbitrary precision, however the device will reply only a fixed number of places. The IO-FEP2 recognizes a decimal point ('.'), numbers must not contain any commas.
- There must not be any space character in front or after the '=' in a message.
- If the command/query is not of the form **name=value** or **name=?** , the IO-FEP2 replies the message **?SYNTAX** .
- If the message syntax is OK, but contains an unknown parameter name is used, the reply is **?UNKNOWN**
- Numeric parameters are cut to the limits defined for this particular parameter.
- Misspelled choice values cause the IO-FEP2 to set the first value of the choice list.
- Assigning a value to a read-only parameter will cause no fault, however the IO-FEP2 will overwrite this parameter immediately or some seconds later with the actual value.

## 4.2 Parameter list

The table below shows the complete list of M&C parameters the IO-FEP2 knows. For each parameter the valid range and a short description is given. The list applies to the HTTP and RS232 remote interfaces and in some way also to the SNMP interface as the latter uses OIDs which resemble these parameters one by one.

| ***name*** | | ***description*** |
|---|---|---|
| *time* | r/o | Delivers date / time, format YYY-MM-DD HH:MM:SS |
| *stim* | r/w | Sets date / time, format YYY-MM-DD HH:MM:SS |
| *sver* | r/o | Software version |
| *srno* | r/o | Device serial no |
| *caps* | r/o | Software capabilities, coded as bits in a decimal number: |
| | | 2^0 = IO-FEP-E version |
| | | 2^1 = protection / redundancy switching installed |
| | | 2^2 = power supply monitoring installed |
| | | 2^3 = NTP time synchronization installed |
| *tmp0* | r/o | Board temperature (°C) |
| *tmp1* | r/o | Temperature sensor 1 (°C) |
| *tmp2* | r/o | Temperature sensor 2 (°C) |
| *tmp3* | r/o | Temperature sensor 3 (°C) |
| *tmp4* | r/o | Temperature sensor 4 (°C) |
| *outp* | r/w | Digital outputs |

| | | |
|---|---|---|
| *wgsw* | r/w | Waveguide switch actuation |
| *prsw* | r/w | Protection switch monitoring and control |
| *stat* | r/o | I/O state |
| *psua* | r/o | Power supply alarms (4 digits 0/1 for 24V, 24VEXT, 24V-RED and 24VEXT-RED) 0 states OK, 1 states fault |
| *tsya* | r/o | Time synchronisation alarm, 0 = NTP sync OK or disabled, 1 = NTP sync failed, 2 = NTP1 sync failed, but NTP2 sync was successful. |
| *lsyn* | r/o | Delivers a text describing the date/time and source of the recent clock synchronisation |
| *lnas* | r/o | Delivers a string containing the voltage and current readings of all 6 LNA power supply monitoring units. The readings are ordered 'voltage 1' 'current 1' .. 'voltage 6' 'current 6'. Voltages are in V, currents in mA. Values are separated by one space character. |
| *lnaa* | r/o | Delivers a string 6 characters long which reports the LNA power supply monitoring alarms. Each character may be either '0' (OK) or '1' (Alarm), the first character refers to the LNA 1 power supply monitoring unit. |

**I/O state monitoring**

The command 'stat=?' returns a 32 character string which contains the complete I/O state of the IO-FEP2, coded in 5 hexadecimal numbers. Example:

```
000000000010 0400 00000006 00 00
          |   |          |  |  |
          |   |          |  |  no hi temperature faults
          |   |          |  no low temperature faults
          |   |          S01=B, S02=A
          |   Output 11 is ON
          Input 5 is on
```

- *Inputs* --- The first number (12 characters, 48 bits) reports the state of the IO-FEP2 input circuits. Each bit of the hexadecimal number corresponds to one input. The least significant bit corresponds to input 1. A bit set to '1' reports an 'ON' or 'FLT' input, inputs which are 'OK' or 'OFF' read '0'. The reported port states are logical states, they already include the polarity inversion and filtering delay as defined in the setup for each individual port. Unused ports always read '0'.
- *Outputs* --- The second number (4 characters, 16 bits) reports the actual state of the output ports in a similar way. The contents of this is exactly the same as the reply to 'outp=?': bit 0 corresponds to the state of PhotoMOS output 1, bit 15 to the state of the relay 6. A bit set to 1 tells that the output is 'ON' as displayed at the user interface. A software polling the 'stat=?' variable frequently may parse the output state from here rather from 'outp=?', thus saving some protocol overhead.
- *WG Switch Positions* --- The third number (8 characters, 32 bits) reports the actual wave guide switch position. Each switch encodes it's state in two bits of the number, WG switch 1 uses the least significant bits. The bits reflect the state of the position indication circuits of each switch: '01' tells that the switch is in position 'A', '10' signals position 'B'. The bit combinations '00' and '11' both signal invalid states, a software monitoring the IO-FEP2 should decode this and report it to the operator. The switch positions reported here are pre-

processed by the IO-FEP2, not the raw position indication readings. If a switch is commanded to position 'X', this position is reported immediately, even if the switch did not yet reach this position. After the switch process has completed (or timed out) the real position is reported. This behaviour nis necessary to hide the delayed / queued switching performed by the IO-FEP2 from a M&C computer which expectes the IO-FEP2 to be a 'dumb PLC'. Unused waveguide switches always report '00'

- *Temperature Faults* --- The words 4 (low temperature faults) and 5 (high temperature faults) encode the limit faults for the temperature sensors of the IO-FEP2. The least significant bit corresponds to the internal board temperature sensor, bit 1 to the external temperature sensor 1 and so on.

**Waveguide switch actuation**

The command 'wgsw=xxxxxxxx' actuates one or more waveguide switches. Switch positions are coded the same way as in the 'stat=?' reply described above: two bits for each switch, the least significant two bits for switch 1. A bit combination '01' commands position 'A', '10' commands position 'B'. The combinations '00' and '11' are ignored, the switch position remains unchanged. If multiple switch movements are commanded at the same time, the switches move contemporaneously unless the number of parallel switch actuations has been limited in the setup.

A computer controlling the IO-FEP2 may use the 'wgsw' command like it would control the actuation motors directly: switching on a motor and switching it off a few hundred milliseconds later. This is for compatibility with software that expects a dumb switching unit to control the waveguide switches. In fact there are no timing constraints with the 'wgsw', the IO-FEP2 control the actuation timing off the switches internally.

**Output control**

The command 'outp=?' returns a 4 digit, 16 bit hexadecimal number showing the actual state of all outputs of the IO-FEP2. Bit 0 corresponds to the state of PhotoMOS output 1, bit 15 to the state of the relay 6. A bit set to 1 tells that the output is 'ON' as displayed at the user interface.

Writing a 'outp=xxxx' sets all outputs of the IO-FEP2. To set or clear a single output, you have to read the actual state, set/clear the appropriate bit and send the number back to the IO-FEP2.

Outputs which are not configured as type 'OUTPUT' always read '0'. Setting these outputs has no effect, the IO-FEP2 silently ignores commands to outputs which are not configured to act as a general purpose output.

**Protection switch control**

The command 'prsw=?' returns a 32 digit hexadecimal string showing the state of up to 16 protection switch units in the IO-FEP2. The bit positions 0..7 (the rightmost two digits) refer to protection switch #1, bits 8..15 to protection switch #2 and so on. The status bit definitions for one protection switch are as follows:

- 0 (lsb) --- 1 = WG-Switch fault or instance not configured
- 1 --- 0 = 1:1-SW-ONCE, 1 = 1:1-SW-ALWAYS
- 2 --- 0 = DISABLED, 1 = ENABLED
- 3 --- 0 = 1:1, 1 = 2:1 redundancy (bit 1 doesn't care in this case)
- 4 --- 1 = fault in chain A
- 5 --- 1 = fault in chain B
- 6 --- 1 = SWITCHED
- 7 (msb) --- 0 = chain A selected, 1 = chain B selected

The same parameter is used to send commands to a protection switch unit in the IO-FEP2. The format is different to the status report described above. One command changes one parameter of a particular protection switch:

prsw= *xy* applies the command *x* (a one digit number 1..8) to the switch *y* (1..16). The command codes for *x* are defined as follows:

- 1 --- Set the protection switch to UNUSED
- 2 --- Set the protection switch to 1:1-SW-ONCE
- 3 --- Set the protection switch to 1:1-SW-ALWAYS
- 4 --- Set the protection switch to DISABLED
- 5 --- Set the protection switch to ENABLED
- 6 --- Set the protection switch to position A
- 7 --- Set the protection switch to position B
- 8 --- Reset the SWITCHED flag of the protection switch
- 9 --- Set the protection switch to SW-2TO1

Example: 'prsw=312' sets the protection 12 switch to SW-ALWAYS.

For 2:1 protection switches, you have to command the position of both switches involved in order to set the redundant chain destination to CHAIN-A (B/A), CHAIN-B (A/B) or none (A/A).

## 4.3 The HTTP remote control interface

Controlling the IO-FEP2 through the network is done by means of HTTP GET requests. Setting parameter values or querying readings or settings, all is done by requesting HTTP documents from the IO-FEP2. The message *to* the IO-FEP2 thereby is coded into the URL as a CGI form parameter. The IO-FEP2 replies a one line document of the MIME type 'text/plain'.

The document name for remote control is **/rmt** , hence (assuming the IO-FEP2 is listening to the IP address 10.0.0.1), requesting a document with the URL

`http://10.0.0.1/rmt?tmp0=?`

will let the IO-FEP2 reply the actual level in a one line text document:

**tmp0=36.3**

This way all parameters may be queried or set, you may use your favourite web browser to try out the remote control of the IO-FEP2 manually.

## 4.4 The RS232 remote control interface

Beside the network interface, the IO-FEP2 also provides an RS232 serial port which can be used to control the device remotely. Depending on the device address set, the IO-FEP2 either runs framed protocol with start/stop characters and checksum or it provides a dumb terminal interface. The RS232 interface always operates at 9600 baud, no parity, 8 data bits, one stop bit.

If an address 'A' .. 'G' is selected, the IO-FEP2 expects each message it receives to be packed into a frame as described below.

| ***char #*** | ***example*** | ***description*** |
|---|---|---|

| | | |
|---|---|---|
| 1 | { | start character, always ' {' |
| 2 | A | device address (A..G) |
| 3 | t | first character of the message body |
| . | m | message body ... |
| . | p | .. |
| . | 0 | .. |
| . | = | .. |
| n-1 | ? | last character of the message body |
| n .tc} | end character, always '} ' | |
| n+1 | . | checksum |

The checksum byte is calculated using an algorithm as implemented by the following formula:

$$\text{sum} = 32 + \left(\sum_{i=1}^{n} (\text{byte}[i] - 32)\right) \text{ modulo } 95$$

This protocol type is known as *MOD95-* or *Miteq protocol* . The IO-FEP2 also packs it's reply in a protocol frame as described above. incomplete frames, checksum errors or address mismatches let the IO-FEP2 ignore the message. The time between the characters of a message must be less than 5 seconds or the IO-FEP2 will treat the message as incomplete.

If the IO-FEP2 is set to the device address 'NONE', it uses a simple line protocol instead of the framed protocol described above. Messages sent to the IO-FEP2 have to be terminated with a carriage return character (ASCII 13), the IO-FEP2 terminates replies with a CR/LF pair (ASCII 13/10). There is no echo for characters entered, hence this protocol easily may be used for computer based remote control.

## 4.5 SNMP remote control interface

The IO-FEP2 contains an SNMP agent listening at UDP port 161. The SNMP agent provides a common subset of the MIB-II system / interface parameters and gives full access to the remote control capabilities of the IO-FEP2 with a number of MIB objects placed in the private.enterprises tree.

The actual MIB file defining the IO-FEP2's private MIB may be downloaded from the IO-FEP2 istelf by FTP (user 'service', password 'service'). The file 'IO.FEP.MIB' contains all necessary information

## 4.6 Modbus remote control interface

In addition to the legacy remote interfaces described above, the ***sat-nms*** IO-FEP2 offers Modbus/TCP as its recommended remote control interface.

Modbus is a very efficient protocol which has been developed to control industrial devices in real time. It offers functions which set or read single parameters or larger sets of parameters in one single transaction.

Unlike the legacy remote interfaces of the ***sat-nms*** IO-FEP and IO-FEP-E which are limited to the operational parameters of the device, the Modbus/TCP interface gives access to all parameters, including the installation/setup parameters of the device.

### 4.6.1 Modbus/TCP Implementation

The IO-FEP2 Modbus interface maps all parameters to 16 bit Modbus registers. Read-only parameters like states of digital inputs or switch positions are reported by 'input registers', accessible through the Modbus function 04H 'Read Input Registers'. Read-Write parameters are located in 'holding registers', may be read using Modbus function 03H 'Read Holding Registers' and set by functions 06H 'Preset Single Register' or 10H 'Preset Multiple Registers'.

**Single Bit Parameters**

Parameters like digital input states are encoded bitwise. Bit 0 correspond to the least significant bit in a register and addresses the lowest numbered input or output

**Numeric Parameters**

Numeric Parameters may be integer numbers (e.g. a delay time in milliseconds), an enumerated value (e.g. a configuration state DISABLED/ENABLED) or a floating point number. The latter ones are always encodes as scaled integers (e.g. a temperature value in 1/100 centigrades).

**Character Strings**

The Modbus specifies no means to transport character strings. The IO-FEP2 uses multiple, consecutive 16 bit registers for this purpose:

- Each register contains two characters, the least significant byte in the register contains the the first one.
- The character string may be either exactly two times the reserved number of registers long or shorter. If it is shorter, the string must be terminated by a 0-byte. All characters beginning with this byte up to the end are ignored.

**Register Addressing**

Register addresses in the following chapters all are written in decimal notation, zero-based.

### 4.6.2 Modbus Status Registers

Starting at Modbus Register 00001 the IO-FEP2 offers a compact block of registers containing all volatile status information. An M&C application may acquire these effectively with a block read command.

```
Register    Purpose              Remarks

00000       reserved             for internal use

00001       inputs 1..16         see 'Input Port Status
00002       inputs 17..32        Encoding' below.
00003       inputs 33..48
00004       inputs 49..64

00005       wg-sw 1..8 state     see 'WG Switch Status Encoding'
00006       wg-sw 9..16 state    below.
00007       wg-sw 17..24 state
```

```
00008       wg-sw 25..32 state

00009       wg-sw 1..8 alarm      see 'WG Switch Alarm Encoding'
00010       wg-sw 9..16 alarm     below.
00011       wg-sw 17..24 alarm
00012       wg-sw 25..32 alarm

00013       power supply alarm    bit 0: redundant 24V ext fault
                                  bit 1: redundant 24V fault
                                  bit 2: primary 24V ext fault
                                  bit 3: primary 24V fault
                                  bit 4: LNA supply 1 fault
                                  bit 5: LNA supply 2 fault
                                  bit 6: 5V fault
                                  bit 7: 3.3V fault
                                  bit 8: USB stick fault

00014       temperature alarm     bit 0: 1 = board temp. high
                                  bit 1: 1 = sensor 1 high
                                  bit 2: 1 = sensor 2 high
                                  bit 3: 1 = sensor 3 high
                                  bit 4: 1 = sensor 4 high
                                  bit 8: 1 = board temp. low
                                  bit 9: 1 = sensor 1 low
                                  bit 10: 1 = sensor 2 low
                                  bit 11: 1 = sensor 3 low
                                  bit 12: 1 = sensor 4 low

00015       prot-sw 1 state       see 'Protection Switch Status
00016       prot-sw 2 state       Encoding' below
...         ...
00045       prot-sw 31 state
00046       prot-sw 32 state

00047       lna 1 voltage         6 measured LNA supply voltages,
...         ...                   unsigned integer in steps
00052       lna 6 voltage         of 0.01V

00053       lna 1 current         6 measured LNS supply currents,
...         ...                   unsigned integer in steps
00058       lna 6 current         of 0.1mA

00059       lna 1 faults          6 sets of LNA monitoring faults
...         ...                   see 'LNA Monitoring Faults'
00064       lna 6 faults          below

00065       board temperature     Temperature values are reported
00066       temp. sensor 1        as 16 bit signed integers,
00067       temp. sensor 2        scaled to 1/10 centigrades. A
00068       temp. sensor 3        value of '-125' reports a
00069       temp. sensor 4        temperature reading '-12.5°C'

00070       time sync alarms      enumerated integer:
                                  0 = sync ok or disabled
                                  1 = time not synced, fault.
                                  2 = synced to secondary NTP
                                      server, primary failed.

00071       time sync source      enumerated integer:
```

```
                                    0 = RTC
                                    1 = first NTP server
                                    2 = backup NTP server

00072       last time sync          time stamp of the latest clock
...                                 synchronisation. 19 characters,
00081                               YYYY-MM-DD HH:MM:SS format,
                                    0-terminated
```

**Input Port Status Encoding** The registers '1'..'4' report the state of the 64 configurable inputs of the IO-FEP2. The least significant bit of register '0' corresponds to input 1. A bit set to '1' reports an 'ON' or 'FLT' input, inputs which are 'OK' or 'OFF' read '0'.

The reported port states are logical states, they already include the polarity inversion and filtering delay as defined in the setup for each individual port. Unused ports and port which are not licensed always read '0'.

**WG Switch Status Encoding** Each switch encodes it's state in two bits of the number, WG switch 1 uses the least significant bits. The bits reflect the state of the position indication circuits of each switch:

'01' tells that the switch is in position 'A', '10' signals position 'B'. The bit combinations '00' and '11' both signal invalid states, a software monitoring the IO-FEP2 should decode this and report it to the operator.

The switch positions reported here are pre-processed by the IO-FEP2, not the raw position indication readings. If a switch is commanded to position 'X', this position is reported immediately, even if the switch did not yet reach this position. After the switch process has completed (or timed out) the real position is reported. This behaviour is necessary to hide the delayed / queued switching performed by the IO-FEP2 from a M&C computer which expects the IO-FEP2 to be a 'dumb PLC'. Unused waveguide switches and switches which are not licensed always report '00'.

**WG Switch Fault Encoding** Each WG switch reports two fault bits, one register contains the fault bits for 8 switches. Switch 1 reports its fault with the least significant bits.

The lower significant bit for a switch is set if there is an 'indication fault', if either both indication inputs read the same level.

The higher significant bit for a switch is set if there is an 'actuation fault', if the switch has been commanded and does not reach the commanded position within the pulse duration.

**Protection Switch Status Encoding** The protection switch units in the IO-FEP2 report their state as a bit combination in one register for each protection switch unit.

For each protection switch eight status bits are defined:

```
bit 0 (lsb)   1 = WG-Switch fault or instance not configured
bit 1         0 = 1:1-SW-ONCE, 1 = 1:1-SW-ALWAYS
bit 2         0 = DISABLED, 1 = ENABLED
bit 3         0 = 1:1, 1 = 2:1 redundancy (bit 1 doesn't care in
              this case)
bit 4         1 = fault in chain A
bit 5         1 = fault in chain B
bit 6         1 = SWITCHED
bit 7         0 = chain A selected, 1 = chain B selected
bit 8         bits 8 .. 15 are reserved for future use
```

```
...
bit 15 (msb)
```

Unused protection switches report all bits set to 0. If protection switching is not licensed, all protection switches report 0 here.

**LNA Monitoring Faults**

There is one register for each LNA power supply monitoring channel which reports the fault states for this channel as a combination of the following bit definitions:

```
bit 0 (lsb)   1 = voltage too low (shortcut or supply input
                  missing)
bit 1         1 = current too low (cable broken or LNA defective)
bit 2         1 = current too high (shortcut or LNA defective)
bit 3         bits 3 to 15 are reserved for future use, actually
..            all read 0
bit 15 (msb)
```

If LNA power supply monitoring is not licensed, all fault bits read 0, also all measurement readings are clamped to 0

## 4.6.3 Modbus Info Registers

Modbus Info Registers starting at 00091 report some invariant information about the IO-FEP2 like the device serial number. M&C device drivers usually read these registers only once when the communication to the device has been established.

```
Register    Purpose               Remarks

00091       device serial number  ascii string, 0-terminated
00101       software version      ascii string, 0-terminated
00111       software capabilities bitmask, see below
00112       licensed features     bitmask, see below
```

**Software Capabilities Encoding**

The software capabilities register reports which software functions are available with this IO-FEP2. This information is included for compatibility reasons, the ***sat-nms*** IO-FEP2 device driver uses this to enable the particular functions

```
bit 0 (lsb)   1 = extension board installed. always reads 1.
bit 1         1 = protection switching. reads 1 if this feature is
                  licensed.
bit 2         1 = power supply alarms are detected.
                  reads always 1.
bit 3         1 = ntp clock synchronisation support.
                  reads always 1.
...           bits 4 to 15 are reserved for future use. they
bit 15 (msb)  actually read 0.
```

**Licensed Features Encoding**

Some functions in the IO-FEP2 require license key to be enabled. This register reports which of these functions are licensed with this IO-FEP2.

```
bit 0 (lsb)   1 = inputs 17..32 are licensed
bit 1         1 = inputs 33..48 are licensed
bit 2         1 = wave guide switches 5..8 are licensed
bit 3         1 = wave guide switches 9..12 are licensed
bit 4         1 = wave guide switches 13..16 are licensed
bit 5         1 = protection switching is licensed
bit 6         1 = temperature control loops are licensed
bit 7         1 = LNA supply monitoring is licensed
...           bits 8 to 15 are reserved for future use. They
bit 15 (msb)  actually read 0.
```

### 4.6.4 Modbus Settings Registers

Modbus Settings Registers starting at 00121 control the IOFEPs outputs, command switch positions and protection switch modes.

```
Register    Purpose              Remarks

00121       outputs 1..16        The lsb in this word controls
                                 output 1, the msb output 16
00122       outputs 17..32       Reserved for future use
00123       wg switch 1..8       See 'WG Switch Actuation' below
            commands
...
00126       wgswitch 29..32
            commands
00127       protection switch 1  See 'Protection Switch Control'
            command              below
...
00158       protection switch 32
            command
```

**WG Switch Actuation**

Commands for WG switch actuation are encoded in two bits per switch, the least significant two bits for switch 1. A bit combination '01' commands position 'A', '10' commands position 'B'. The combinations '00' and '11' are ignored, the switch position remains unchanged. If multiple switch movements are commanded at the same time, the switches move contemporaneously unless the number of parallel switch actuations has been limited in the setup.

A computer controlling the IO-FEP2 may use the actuation registers like it would control the actuation motors directly: switching on a motor and switching it off a few hundred milliseconds later. This is for compatibility with software that expects a dumb switching unit to control the waveguide switches. In fact there are no timing constraints with writing to these registers, the IO-FEP2 controls the actuation timing off the switches internally.

Controlling wave guide switches which either are not configured or not licensed at all, has no effect.

**Protection Switch Control**

There is one control register for each protection switch unit. These registers are 'command-only', reading them back always returns 0.

For each protection switch the following commands are defined:

```
0   NOP, do not change the protection switch
1   Set the protection switch to UNUSED
2   Set the protection switch to 1:1-SW-ONCE
3   Set the protection switch to 1:1-SW-ALWAYS
4   Set the protection switch to DISABLED
5   Set the protection switch to ENABLED
6   Set the protection switch to position A
7   Set the protection switch to position B
8   Reset the SWITCHED flag of the protection switch
9   Set the protection switch to SW-2TO1
```

Protection switch commands 1..5 and 9 alter the protection switch setup data, cause the setup.txt file to be written to sd-card.

### 4.6.5 Modbus General Setup Registers

Registers in this block control general setup parameters of the IO-FEP2. They are stored in the SETUP.TXT file on sd-card. Most of the parameters are character strings which must be 0-terminated.

Unused IP address parameters (e.g. for NTP or trap destinations) must be set to '0.0.0.0'. The same value the IO-FEP2 assigns if an IP address string cannot be parsed.

```
Register    Purpose                 Remarks

00201       IP address
00211       netmask
00221       gateway
00231       user password           hashed, not readable
00241       admin password          hashed, not readable
00251       ntp server 1 IP
00261       ntp server 2 IP
00271       snmp read community
00281       snmp write community
00291       snmp trap community
00301       trap destination ip 1
00311       trap destination ip 2
00321       trap destination ip 3
00331       trap destination ip 4
00341       snmp location string
00351       snmp contact string
00361       web gui title string
00376       ntp time offset         minutes, added to UTC to
                                    achieve local time
00377       web gui refresh         seconds
00378       RS232 remote address    65 ('A') .. 71 ('G') = Miteq
                                    style protocol address
                                    78 ('N') = No address, plain
                                    text protocol
00379       number of parallel      0 = no limitation
            switch actuations       1 .. 16 number of switch
                                    actuations that may be active
                                    concurrently
00380       psu alarm enable        1 enables alarms for the
                                    redundant psu
00381       point & click           1 enables point & click
                                    operation at the main page
```

### 4.6.6 Modbus License Key Registers

Registers starting address 00401 contain the license keys which enable particular functions of the IO-FEP2. The license key appear as character strings as entered at the web GUI. A license key is exactly 39 characters long, containing the 128 bit key as a hexadecimal string with '-' characters every 4 digits for better readability. Including the 0-termination each key covers 20 registers.

Unlike other setup configuration data, license keys are stored in a file KEYS.TXT rather in SETUP.TXT.

```
Register    Purpose

00401       license key 32 inputs
00421       license key 48 inputs
00441       license key 8 wg switches
00461       license key 12 wg switches
00481       license key 16 wg switches
00501       license key protection switching
00521       license key temperature control
00541       license key lna supply monitoring
```

### 4.6.7 Modbus Input Setup Registers

Configuration of the IO-FEP2 inputs starts at register 01001. The setup data for each input covers 20 registers, meaning that the setup configuration for input 2 starts at 01021, for input 3 at 01041 and so on. Setup of input 48 starts at address 01941 and ends with and including 01958.

Inputs which are not licensed are forced to "not used" by the. IO-FEP2 Configuring them to an active state has no effect.

The register definitions for input 1 are:

```
Register    Purpose              Remarks

01001       input 1 type         0 = not used
            definition           1 = normal input
                                 2 = alarm input
01002       input 1 name         up to 29 characters +
                                 0-termination in 15
                                 registers
01017       input 1 invert       0 = not inverting, current flow
                                     causes a '1' bit.
                                 1 = inverting, missing current
                                     causes a '1' bit
01018       input 1 delay        msecs
```

### 4.6.8 Modbus Output Setup Registers

Configuration of the IO-FEP2 outputs starts at register 03001. The setup data for each output covers 20 registers, meaning that the setup configuration for output 2 starts at 03021, for output 3 at 03041 and so on. Setup of output 32 starts at address 03621 and ends with and including 03637.

The register definitions for output 1 are:

```
Register    Purpose              Remarks

03001       output 1 type        0 = not used
            definition           1 = normal output
                                 2 = temperature control loop
                                     output
                                 3 = software controlled WG switch
                                     muting output
                                 4 = hardware controlled WG switch
                                     muting output
03002       output 1 name        up to 29 characters +
                                 0-termination in 15
                                 registers
03017       output 1 invert      0 = not inverting, '1' in the
                                     output register closes
                                     circuit
                                 1 = inverting, '1' in the output
                                     register opens circuit
```

**Remarks:**

1. Output type 2 (temperature control loop output) only can be set if temperature control loops are licensed. Without license, the output type will fall back to 0 (not used) when configured to this state.
2. Output type 4 (hardware controlled WG switch muting output) cannot be set explicitly. This state is detected from the IO-FEP2 hardware, if the DIP switch for an output is set to (hardware controlled WG switch muting, this register becomes read-only and always reports 4

### 4.6.9 Modbus WG Switch Setup Registers

WG switch setup data starts at register 04001, each WG switch covers 30 registers for its setup data. This means that WG switch 2 starts at register 04031, WG switch 3 at 04061 and so on. WG switch 32 (there physically only 16 WG switches available, but the Modbus address space is reserved for a future expansion to 32 switches) starts with address 04931 up to and including address 04957.

The register definitions for WG switch 1 are:

```
Register    Purpose                  Remarks

04001       wg-switch 1 type         See 'WG Switch Types'
            definition               below.
04002       wg-switch 1 name         up to 29 characters +
                                     0-termination in 15
                                     registers
04017       wg-switch 1 pulse width  actuation pulse width
                                     (msecs)
04018       wg-switch 1 mute out 1   See 'WG Switch Muting'
..                                   below
04027       wg-switch 1 mute out 10
```

**WG Switch Types**

The type definition register of a WG switch may contain one of the following values:

0: Not used. This value also is forced if the WG switch with this index is not licensed with this IO-FEP2

1: Fixed pulse width actuation. When switching, an actuation pulse of fixed duration ('pulse width' msecs) is applied, after this the software checks if the switch is now in the desired position

2: Auto pulse width actuation. When switching, an actuation pulse is applied until the position indication circuit states the commanded position of the switch. The pulse is applied for at 'pulse width' milliseconds at maximum, if the commanded position is not reached within this time, a fault is raised.

3: The switch is configured read-only, no actuation pulses are generated but the switch position is reported according to the position indication circuits.

4: The switch is configured as a toggle switch. An actuation pulse of 'pulse width' milliseconds is applied to both actuation outputs, if a position is commanded which differed from the actual one. Operated a ball pen like switch.

5: and subsequent values. The switch is configured as slave to WG switch (n-4). Every time the master switch is operated, this switch is operated in the same way.

Configuring switches which are not licensed has no effect, the switch automatically falls back to 'unused'.

**WG Switch Muting**

Setting a 'mute out' register to 1, lets the software open the corresponding output 1..10 while the WG switch actuation pulse is active. This requires, that the referenced output is configured as 'Software inhibit output'.

### 4.6.10 Modbus Protection Switch Setup Registers

Protection switch setup data starts at register 05001, each protection switch covers 20 registers for its setup data. This means that protection switch 2 starts at register 05021, protection switch 3 at 05041 and so on. protection switch 32 (there physically only 16 switches available, but the Modbus address space is reserved for a future expansion to 32 switches) starts with address 05621 up to and including address 05633.

The register definitions for protection switch 1 are:

```
Register    Purpose                   Remarks

05001       protection switch 1       0 = unused / off
            operation mode            1 = 1:1 protection
                                      2 = 2:1 protection
05002       protection switch 1       1 = protection enable
            enable
05003       chain A fault input 1     See 'Chain Fault Linking'
05004       chain A fault input 2     below
05005       chain A fault input 3
05006       chain A fault input 4
05007       chain A fault input 5
05008       chain B fault input 1
05009       chain B fault input 2
```

```
05010       chain B fault input 3
05011       chain B fault input 4
05012       chain B fault input 5
```

Configuring switches which are not licensed has no effect, the switch automatically falls back to 'unused'.

**Chain Fault Linking**

Each protection switch has 5 fault link registers for each switch direction protection switching takes place if the fault condition of at least one of them becomes true.

A fault link register containing '-1' is inactive, number 0..63 refer to the inputs 1..64 and 100..105 to the LNA supply monitors 1..6

### 4.6.11 Modbus Temperature Sensors Setup Registers

Temperature sensor setup registers start at register 6001, each sensor covers 30 registers for its setup data. This means that temperature sensor 2 starts at register 06031, temperature sensor 3 at 06061 and so on.

Temperature sensor 1 measures the board temperature, sensors 2..5 may be connected to external PT1000 sensors. Sensor 1 therefore is limited to temperature monitoring, no closed loop temperature control may be defined for this sensor. Beside this, the name of this sensor is fixed to 'board temperature'.

The register definitions for sensor 1 are:

```
Register    Purpose              Remarks

06001       sensor 1 enable      1 = show readings, check limits
06002       sensor 1 name        always reads 'board temperature'
06017       sensor 1 cal. offset
06018       sensor 1 low limit
06019       sensor 1 high limits

The register definitions for sensor 2 are:

Register    Purpose              Remarks

06031       sensor 2 enable      1 = show readings, check limits
06032       sensor 2 name        up to 29 characters +
                                 0-termination in 15 registers
06047       sendor 2 cal. offset
06048       sensor 2 low limit
06049       sensor 2 high limits
06050       sensor 2 control loop 0 = no control loop
            mode                 1 = heating
                                 2 = cooling
06051       control loop output  0..15 referring to output
                                 number 1..16. the referenced
                                 output must be configured as
                                 TCTRL_OUTPUT
06052       control loop inhibit input number 0..47 or -1 to
            input                to select no input
06053       target temperature
06054       hysteresis
```

All temperature values are signed integers scaled to 1/10 centigrades. Temperature control loop parameters only are available if this feature is licensed.

### 4.6.12 Modbus LNA Power Supply Monitoring Setup Registers

LNA supply monitoring setup registers start at register 6201, each channel covers 20 registers for its setup data. This means that channel 2 starts at register 06221, channel 3 at 06241 and so on.

LNA supply monitoring parameter are only available if this feature is licensed. Without license, all channels remain disabled.

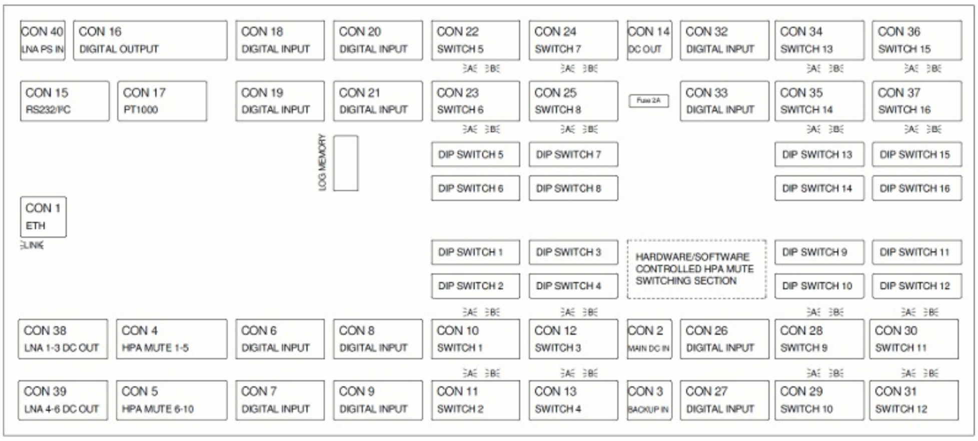
The register definitions for channel 1 are:

```
Register    Purpose              Remarks

06201       channel 1 enable     1 = show readings, check limits
06202       channel 2 name       up to 29 characters +
                                 0-termination in 15 registers
06217       minimum voltage     unsigned integer value in steps
                                 of 0.01V
06218       minimum current      unsigned integer value in steps
                                 of 0.1mA
06219       maximum current      unsigned integer value in steps
                                 of 0.1mA
```

# 5 Connector Reference

**Connector layout *sat-nms* IO-FEP2:**




**CON1 LAN**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | TX+ | default Ethernet cabling (10Base-T) | OUT | |
| 2 | TX- | | OUT | |
| 3 | RX+ | | IN | |

| | | | | |
|---|---|---|---|---|
| 4 | | | | |
| 5 | | | | |
| 6 | RX- | | IN | |
| 7 | | | | |
| 8 | | | | |

**CON2 main power input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | 24V INT | voltage input for IO-FEP2 | DC in | |
| 2 | GND INT | | DC in | |
| 3 | 24V EXT | voltage input for WG Switches etc. | DC in | |
| 4 | GND EXT | | DC in | |

**CON3 backup power input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | 24V INT | voltage input for IO-FEP2 | DC in | |
| 2 | GND INT | | DC in | |
| 3 | 24V EXT | voltage input for WG Switches etc. | DC in | |
| 4 | GND EXT | | DC in | |

**CON4 HPA mute**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | MUT IN1 | HPA 1 mute in | DC in | |
| 2 | MUT OUT1 | HPA 1 mute out | DC out | |
| 3 | MUT IN2 | HPA 2 mute in | DC in | |
| 4 | MUT OUT2 | HPA 2 mute out | DC out | |
| 5 | MUT IN3 | HPA 3 mute in | DC in | |
| 6 | MUT OUT3 | HPA 3 mute out | DC out | |
| 7 | MUT IN4 | HPA 4 mute in | DC in | |
| 8 | MUT OUT4 | HPA 4 mute out | DC out | |
| 9 | MUT IN5 | HPA 5 mute in | DC in | |
| 10 | MUT OUT5 | HPA 5 mute out | DC out | |

**CON5 HPA mute**

| Pin | Identifier | Description | Type | Remark |
|---|---|---|---|---|
| 1 | MUT IN1 | HPA 6 mute in | DC in | |
| 2 | MUT OUT1 | HPA 6 mute out | DC out | |
| 3 | MUT IN2 | HPA 7 mute in | DC in | |
| 4 | MUT OUT2 | HPA 7 mute out | DC out | |
| 5 | MUT IN3 | HPA 8 mute in | DC in | |
| 6 | MUT OUT3 | HPA 8 mute out | DC out | |
| 7 | MUT IN4 | HPA 9 mute in | DC in | |
| 8 | MUT OUT4 | HPA 9 mute out | DC out | |
| 9 | MUT IN5 | HPA 10 mute in | DC in | |
| 10 | MUT OUT5 | HPA 10 mute out | DC out | |

**CON6 digital input**

| Pin | Identifier | Description | Type | Remark |
|---|---|---|---|---|
| 1 | DIN 1 | digital input | input | |
| 2 | GND | refenece voltage | DC out | |
| 3 | DIN 2 | digital input | input | |
| 4 | GND | refenece voltage | DC out | |
| 5 | DIN 3 | digital input | input | |
| 6 | GND | refenece voltage | DC out | |
| 7 | DIN 4 | digital input | input | |
| 8 | GND | refenece voltage | DC out | |

**CON7 digital input**

| Pin | Identifier | Description | Type | Remark |
|---|---|---|---|---|
| 1 | DIN 5 | digital input | input | |
| 2 | GND | refenece voltage | DC out | |
| 3 | DIN 6 | digital input | input | |
| 4 | GND | refenece voltage | DC out | |
| 5 | DIN 7 | digital input | input | |
| 6 | GND | refenece voltage | DC out | |
| 7 | DIN 8 | digital input | input | |
| 8 | GND | refenece voltage | DC out | |

**CON8 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 9 | digital input | input | |
| 2 | GND | refenece voltage | DC out | |
| 3 | DIN 10 | digital input | input | |
| 4 | GND | refenece voltage | DC out | |
| 5 | DIN 11 | digital input | input | |
| 6 | GND | refenece voltage | DC out | |
| 7 | DIN 12 | digital input | input | |
| 8 | GND | refenece voltage | DC out | |

**CON9 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 13 | digital input | input | |
| 2 | GND | refenece voltage | DC out | |
| 3 | DIN 14 | digital input | input | |
| 4 | GND | refenece voltage | DC out | |
| 5 | DIN 15 | digital input | input | |
| 6 | GND | refenece voltage | DC out | |
| 7 | DIN 16 | digital input | input | |
| 8 | GND | refenece voltage | DC out | |

**CON10 waveguideswitch 1**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 1 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 1 | set position B | DC out | |
| 4 | IND A 1 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 1 | indication position B | DC out | |
| 7 | INH 1 | inhibit | DC out | |

| | | | | |
|---|---|---|---|---|
| 8 | GND_EXT | inhibit | DC in | |

**CON11 waveguideswitch 2**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | POS A 2 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 2 | set position B | DC out | |
| 4 | IND A 2 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 2 | indication position B | DC out | |
| 7 | INH 2 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON12 waveguideswitch 3**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | POS A 3 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 3 | set position B | DC out | |
| 4 | IND A 3 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 3 | indication position B | DC out | |
| 7 | INH 3 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON13 waveguideswitch 4**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | POS A 4 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |

| | | | | |
|---|---|---|---|---|
| 3 | POS B 4 | set position B | DC out | |
| 4 | IND A 4 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 4 | indication position B | DC out | |
| 7 | INH 4 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON14_Power_output**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | 24V EXT | spare output | DC out | |
| 2 | 24V EXT | spare output | DC out | |
| 3 | GND EXT | | DC out | |
| 4 | GND EXT | | DC out | |

**CON15 RS232 I2C**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | RS232 0 TX | RS232 access 0 | output | |
| 2 | RS232 0 RX | | input | |
| 3 | GND INT | | DC out | |
| 4 | RS232 1 TX | RS232 access 1 | output | |
| 5 | RS232 1 RX | | input | |
| 6 | I2C SDA | I²C data | in-/output | inactive |
| 7 | I2C SCL | I²C clock | output | inactive |
| 8 | GND INT | | DC out | |

**CON16 digital out**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | COM 11-13 | | input | |
| 2 | COM | | input | |
| 3 | 11 | switched COM11-13 | output | |
| 4 | COM | | output | |
| 5 | 12 | switched COM11-13 | output | |
| 6 | COM | | output | |
| 7 | 13 | switched COM11-13 | output | |

| | | | | |
|---|---|---|---|---|
| 8 | COM | | output | |
| 9 | | input 14 | input | |
| 10 | 14 | switched input 14 | output | |
| 11 | | input 15 | input | |
| 12 | 15 | switched input 15 | output | |
| 13 | | input 16 | input | |
| 14 | 16 | switched input 16 | output | |

**CON17 external temperature sensors**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | SENS OUT1 | output to PT1000 | DC out | |
| 2 | SENS IN1 | input to PT1000 | DC in | |
| 3 | SENS OUT2 | output to PT1000 | DC out | |
| 4 | SENS IN2 | input to PT1000 | DC in | |
| 5 | SENS OUT3 | output to PT1000 | DC out | |
| 6 | SENS IN3 | input to PT1000 | DC in | |
| 7 | SENS OUT4 | output to PT1000 | DC out | |
| 8 | SENS IN4 | input to PT1000 | DC in | |

**CON18 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 17 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 18 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 19 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 20 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON19 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 21 | digital input | input | |

| | | | | |
|---|---|---|---|---|
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 22 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 23 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 24 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON20 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 25 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 26 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 27 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 28 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON21 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 29 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 30 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 31 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 32 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON22 waveguideswitch 5**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | POS A 5 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 5 | set position B | DC out | |
| 4 | IND A 5 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 6 | indication position B | DC out | |
| 7 | INH 5 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON23 waveguideswitch 6**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 6 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 6 | set position B | DC out | |
| 4 | IND A 6 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 6 | indication position B | DC out | |
| 7 | INH 6 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON24 waveguideswitch 7**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 7 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 7 | set position B | DC out | |
| 4 | IND A 7 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 7 | indication position B | DC out | |
| 7 | INH 7 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON25 waveguideswitch 8**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 8 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 8 | set position B | DC out | |
| 4 | IND A 8 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 8 | indication position B | DC out | |
| 7 | INH 8 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON26 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 33 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 34 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 35 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 36 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON27 digital input**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | DIN 37 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 38 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 39 | digital input | input | |
| 6 | GND | reference voltage | DC out | |

| | | | | |
|---|---|---|---|---|
| 7 | DIN 40 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON28 waveguideswitch 9**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 9 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 9 | set position B | DC out | |
| 4 | IND A 9 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 9 | indication position B | DC out | |
| 7 | INH 9 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON29 waveguideswitch 10**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 10 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 10 | set position B | DC out | |
| 4 | IND A 10 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 10 | indication position B | DC out | |
| 7 | INH 10 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON30 waveguideswitch 11**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 11 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |

| | | | | |
|---|---|---|---|---|
| 3 | POS B 11 | set position B | DC out | |
| 4 | IND A 11 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 11 | indication position B | DC out | |
| 7 | INH 11 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON31 waveguideswitch 12**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | POS A 12 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 12 | set position B | DC out | |
| 4 | IND A 12 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 12 | indication position B | DC out | |
| 7 | INH 12 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON32 digital input**

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|
| 1 | DIN 41 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 42 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 43 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 44 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON33 digital input**

| ***Pin*** | ***Identifier*** | ***Description*** | ***Type*** | ***Remark*** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | DIN 45 | digital input | input | |
| 2 | GND | reference voltage | DC out | |
| 3 | DIN 46 | digital input | input | |
| 4 | GND | reference voltage | DC out | |
| 5 | DIN 47 | digital input | input | |
| 6 | GND | reference voltage | DC out | |
| 7 | DIN 48 | digital input | input | |
| 8 | GND | reference voltage | DC out | |

**CON34 waveguideswitch 13**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 13 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 13 | set position B | DC out | |
| 4 | IND A 13 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 13 | indication position B | DC out | |
| 7 | INH 13 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON35 waveguideswitch 14**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 14 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 14 | set position B | DC out | |
| 4 | IND A 14 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 14 | indication position B | DC out | |
| 7 | INH 14 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON36 waveguideswitch 15**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 15 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 15 | set position B | DC out | |
| 4 | IND A 15 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 15 | indication position B | DC out | |
| 7 | INH 15 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON37 waveguideswitch 16**

Following table shows interface with standard configuration! Refer to chapter 2.4.5 Change polarity of waveguide-switch interfaces if you need inverse actuation.

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | POS A 16 | set position A | DC out | |
| 2 | GND_EXT | com | DC out | |
| 3 | POS B 16 | set position B | DC out | |
| 4 | IND A 16 | indication position A | DC out | |
| 5 | GND_EXT | com | DC out | |
| 6 | IND B 16 | indication position B | DC out | |
| 7 | INH 16 | inhibit | DC out | |
| 8 | GND_EXT | inhibit | DC in | |

**CON38 LNA DC out 1-3 / 24V EXT out**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | LNA 1 DC | LNA/LNB 1 DC output | DC out | |
| 2 | GND | LNA/LNB COM | DC out | |
| 3 | LNA 2 DC | LNA/LNB 2 DC output | DC out | |
| 4 | GND | LNA/LNB COM | DC out | |
| 5 | LNS 3 DC | LNA/LNB 3 DC output | DC out | |

| | | | | |
|---|---|---|---|---|
| 6 | GND | LNA/LNB COM | DC out | |
| 7 | 24V EXT | spare output | DC out | |
| 8 | GND_EXT | | DC in | |

**CON39 LNA DC out 4-6 / 24V EXT out**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | LNA 4 DC | LNA/LNB 4 DC output | DC out | |
| 2 | GND | LNA/LNB COM | DC out | |
| 3 | LNA 5 DC | LNA/LNB 5 DC output | DC out | |
| 4 | GND | LNA/LNB COM | DC out | |
| 5 | LNS 6 DC | LNA/LNB 6 DC output | DC out | |
| 6 | GND | LNA/LNB COM | DC out | |
| 7 | 24V EXT | spare output | DC out | |
| 8 | GND_EXT | | DC in | |

**CON40 LNA PS in**

| *Pin* | *Identifier* | *Description* | *Type* | *Remark* |
|---|---|---|---|---|
| 1 | LNA PS 1 | LNA/LNB PS 1 DC input 15...24V DC | DC in | |
| 2 | GND | LNA/LNB COM | DC in | |
| 3 | LNA PS 2 | LNA/LNB PS 2 DC input 15...24V DC | DC in | |
| 4 | GND | LNA/LNB COM | DC in | |

# 6 Specification

| **General Interfaces** | **qty standard license** | **up to (via license code)** | **Connector No.** | **remark** |
|---|---|---|---|---|
| System Interfaces | | | | All interfaces (except the Ethernet-interface) have to be connected via Mini Combicon MCV1,5/XX-G-3,5 |
| external Temperature measurement | 4 | | 17 | via external PT1000 sensors, accuracy +/- 3°C, range: -40 to +60°C, alarm threshold, digital outputs can be assigned to setup up to 4 temperature controllers (heater or cooling) |

| | | | | |
|---|---|---|---|---|
| | | | | as an option |
| internal Temperature measurement | 1 | | --- | via internal on-chip-sensor, accuracy +/-3°C, Alarm threshold |
| internal clock/ calendar | 1 | | --- | Real-time clock/ calendar. If power supply is missing, a goldcap capacitor keeps the clock running for min. 7 days |
| LNA/LNB power supply monitoring | | 6 | 38, 39 | Monitoring of current and voltage of each LNA/LNB. Alarms can be used to trigger a redundancy switchover. External Power supply 1524VDC needed. Max. 600mA per LNA/LNB |
| digital input | 16 | 48 | 6, 7, 8, 9, 18, 19, 20, 21, 26, 27, 32, 33 | via optocoupler, indication current: ~3mA @ 24V DC |
| digital output | 6 | | 16 | relay contacts, max. continuous current: 1A, max continuous voltage: 48V DC |
| HPA-muting/ digital output | 10 | | 4, 5 | Photomos-relays, per relay max. continuous current: 130mA, max. continuous voltage: 48V, on-state-resistance typ. 18Ohm, max. 25Ohm |
| HPA-muting/ RF-inhibit matrix | 10x16 | | | software HPA-muting or DIP-switches for hardware-HPA-muting |
| waveguide-switching | 4 | 16 | 10, 11, 12, 13, 22, 23, 24, 25, 28, 29, 30, 31, 34, 35, 36, 37 | maximum peak switching current: 5A |
| waveguide-indication | 4 | 16 | see above. | via optocoupler, indication current: ~3mA @ 24V DC |
| weveguide inhibit-indication | 16 | | see above. | indication current ~5mA @ 24V DC |
| Redundancy switching 1:1, | | 16 | --- | 1:1 and 2:1 can be used at the same time in any combination. Maximum quantity is limited by |

| | | | | |
|---|---|---|---|---|
| up to | | | | quantity of enabled waveguide Switch Interfaces! |
| Redundancy switching 2:1, up to | | 8 | --- | 1:1 and 2:1 can be used at the same time in any combination. Maximum quantity is limited by quantity of enabled waveguide Switch Interfaces! |
| NTP time server interface | 2 | | --- | Interface for master and redundant NTP server |
| power output | 3 | | 14, 38, 39 | 24V DC, max 500mA (CON14), max 300mA (CON38, 39) |
| Ethernet | 1 | | 1 | RJ45, 10/100-Base-T, for controlling the ***sat-nms*** IO-FEP2 via HTTP GET, SNMP, Modbus or any Web-browser |
| RS232 | 1 | | 15 | for remote controlling the ***sat-nms*** IO-FEP2 |
| I²C | | | 15 | for special requirements, only usable with customized Software, inactive by default |

| **M&C Interface Specification** | **description** |
|---|---|
| interface for M&C and user | 10/ 100-Base-T, Via HTTP GET requests, RS232, SNMP, Modbus |

| **Electrical and Mechanical Specification, Environmental conditions** | **Connector No.** | **description** |
|---|---|---|
| Supply Voltage | 2 (main), 3 (backup) | 24 V DC, +5%/-10% |
| Power consumption 24V INT | 2, 3 | max. 100mA |
| Power consumption 24V EXT | 2, 3 | max. 750mA (excluding power output at CON14/38/39 and switching current of waveguide switches) |
| LNA/LNB supply voltage | 38, 39 | 15...24V DC, max. 600mA per LNA/LNB |
| Temperature range | | 5° to 40° C |
| Humidity | | up to 90% non condensing |
| DIN rail module | | 307 x 139 x 60 mm |
| Weight | | 1.3 kg |