POFA3 Operating Manual

(**P**lastic **O**ptical **F**iber **A**ttenuator **3**th generation)

Version 1.2, Date: 19.09.2012

Fig.1a: OEM module (Original Equipment Manufacturer) module

Fig.1b: Device version 19/2" 2U front connectors
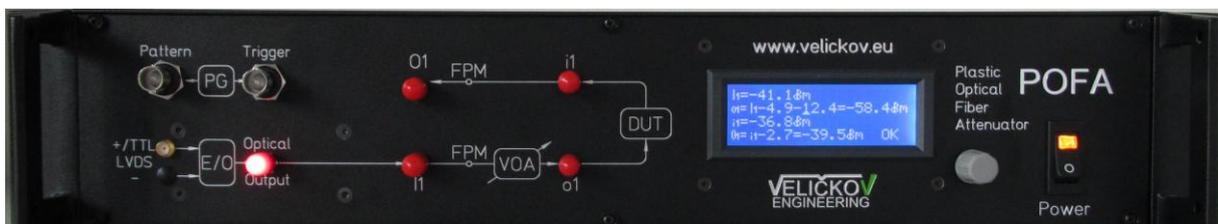
Fig.1c: Device version 19" front connectors version with PG and E/O

Contents

0. Declaration of Conformity

The manufacturer,

František VELIČKOV Engineering

Clermont-Ferrand-Allee 36

D-930 49 Regensburg, Germany

declares, that the measuring instrument, as described in operating manual, conforms with European standards as follows:

EMC: EN55022 (1991), Group 1, Class B

           EN50082-1 (1992) / IEC 801-4

The product herewith complies with the requirements of EMC Directive 89/336/EEC and CE markings have been affixed on the devices accordingly.

1. Safety

Attention!

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

Before applying power to your POFA system, make sure that the protective conductor of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet!

Improper grounding can cause electric shocks with damages to your health or even death!

2. Warranty

The producer warrants material and production of the measuring instrument modules for a period of 6 months starting with the date of shipment. During this warranty period the manufacturer will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to the producer. The customer will carry the shipping costs to the manufacturer, in case of warranty repairs the producer will carry the shipping costs back to the customer.
If no warranty repair is applicable the customer also has to carry the costs for back shipment.
In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

The producer warrants the hard- and software determined by the manufacturer for this unit to operate fault-free provided that they are handled according to our requirements. However, the producer does not warrant a fault- free and uninterrupted operation of the unit, to soft- or firmware for special applications nor this operation manual to be error free.

The manufacturer is not liable for consequential damages.

2.1 Restriction of warranty

The afore mentioned warranty does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modifications stated by us or unauthorised maintenance.

Further claims will not be consented to and will not be acknowledged. The manufacturer does explicitly not warrant the usability or the economical use for certain cases of application.

The producer reserves the right to change this operating manual or the technical data of the described unit at any time.

3. Introduction

This manual is provided as a help in operating the POFA (**P**lastic **O**ptical **F**iber **A**ttenuator) device. POFA is a stand-alone instrument that makes it possible to adjust light attenuation, to measure the light input power and to calculate the optical output power (Fig.2). The attenuation is set according to the calibration table. POFA can be controlled manually or by a remote interface (RS232).
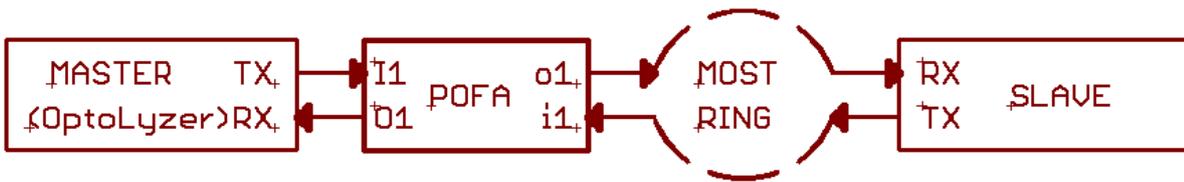
Figure 2: Application example

The optical connector must be clean! If you connect the fiber cable, please put the red protection cover on the holder on the rear panel (Fig.3.). After you disconnect the fiber cable, the connector should be protect with the saved protection cover!

Figure 3: Rear panel view to the cover holder

4. Function diagram

POFA3 is composed of the attenuator, a fiber power meter (FPM), a microcontroller and a power supply (Fig.4). The light goes from the input connector through FPM and attenuator to the output connector. The attenuator consists of a variable rotated filter and precise rotated actuator The interface unit (IU) attends to the user interface, the POFA control and the remote communications. The IU is composed of a LCD and a turn/push knob.
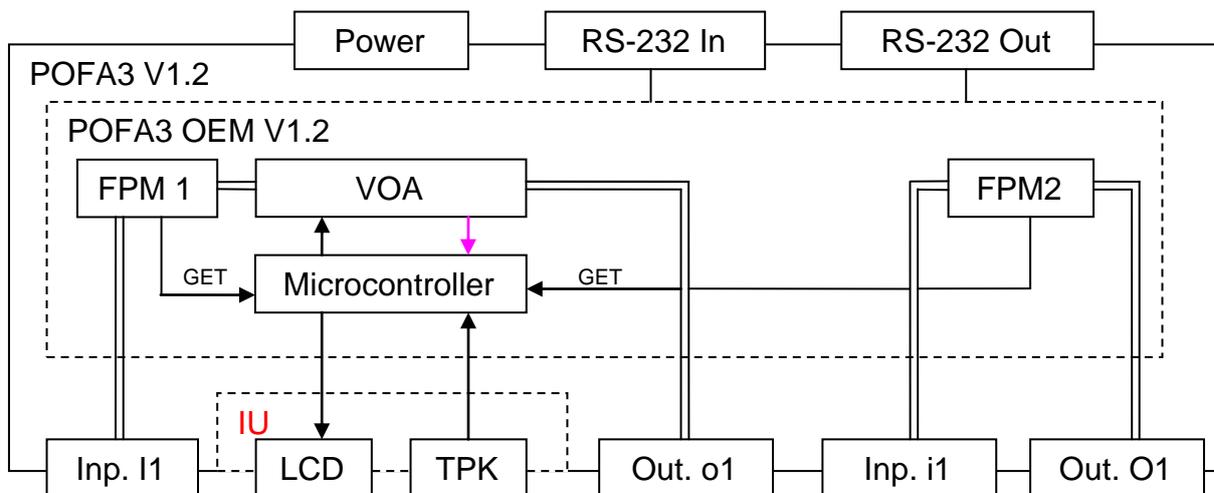

Figure 4: Function block diagram

FPM = Fibre Power Meter

IU = Interface Unit

LCD = Liquid Crystal Display

TPK = Turn Push Knob

VOA = Variable Optical Attenuator

5. Instrument attenuation offset definition

The instrument attenuation offset (IAO) includes all losses in the light pathway (Fig.5) for attenuation 0,0 dB of course.
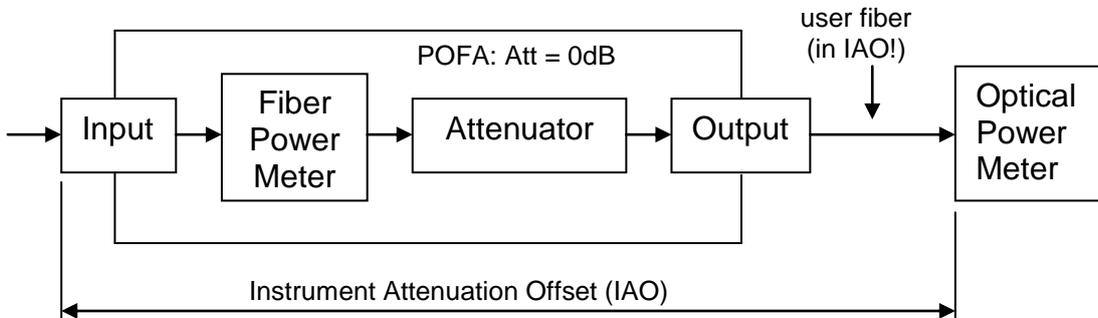
Figure 5: The instrument attenuation offset

The light looses are composed of the two connectors (Input, Output), FPM, Attenuator (att) and the user fiber.

In the application, it's important to know, how much light power is on the end of the fiber. This means that **the IAO value must include the user output fiber**. The IAO offset value should include the offset value of the user fiber (Fig.6). The value in the delivery device is pre-set by **BAUER Engineering**. An instrument offset for both channels can be set from 0 dB up to 25,5 dB.
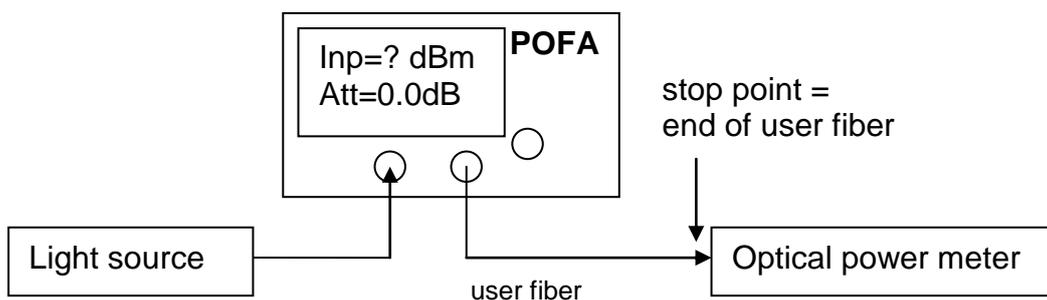
Figure 6: Measure of the IAO

For determination of the instrument attenuation offset you need to connect an LED light source to the POFA input connector and the optical power meter to the end

of the user fiber. Set the attenuation to 0 dB. The input light power is displayed on the display of POFA (Inp). The output light power is measured by the light power meter. The difference between output and input power is the IAO (Eq.5.1). Set this value to the POFA.

Calculation of the IAO

IAO1 [dB] = input power 1 (I1) [dBm] – Output power 1 (o1) [dBm], Att =0dB   (5.1)

IAO2 [dB] = input power 2 (i1) [dBm] – Output power 2 (O1) [dBm]   (5.2)

6. Calculation of optical output power

Attenuation can be set from 0 dB up to 40,0 dB and is always positive. The mean value of the input light power is read every half a second from the FPM.

6.1 Summary of symbols

Att [dB]	0.0 ~ +40.0	Attenuation (always positive)
IAO [dB]	0.0 ~ +25.5	Instrument Attenuation Offset (always positive)
I1 [dBm]	-20.0 ~ +10.0	Input Power for the channel 1
o1 [dBm]	see Eq.6.3	Output Power for the channel 1
i1 [dBm]	-30.0 ~ +10.0	Input Power for the channel 2
O1 [dBm]	see Eq.6.4	Output Power for the channel 2

6.2 Equations

The total attenuation consists of adjusted attenuation and calibrated offset.

$$\text{ATTENUATION [dB]} = \text{Att [dB]} + \text{IAO [dB]} \tag{6.1}$$

The maximal output power equals the sum of the input power and total attenuation.

$$\text{Output [dBm]} = \text{Input [dBm]} - \text{ATTENUATION [dB]} \tag{6.2}$$

Use equations (6.1) in equation (6.2).

$$\text{o1 [dBm]} = \text{I1 [dBm]} - (\text{Att [dB]} + \text{IAO1 [dB]}) \tag{6.3}$$

$$\text{O1 [dBm]} = \text{i1 [dBm]} - \text{IAO2 [dB]} \tag{6.4}$$

7. Manual control

After power on the firmware information device address and baud rate are displayed, comes the main window with the stored attenuation. All informations are displayed on the LCD (Fig.7) and are updated every half a second. The user can control the attenuation value according to the increment value <0,1;10,0> by turning the knob. After 1,5 seconds (Control time out) the desired attenuation set and "BUSY" message will be displayed. If the attenuation is reached, the "OK" message will be displayed.

To change other values the user must select the desired setting item in the menu (Fig.8). In order to enter the menu click down the control knob. Turn the knob until the desired value is selected and click down to enter the selection.
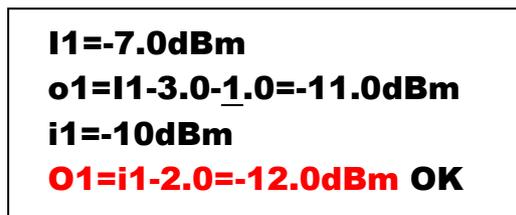
I1=-7.0dBm
o1=I1-3.0-1.0=-11.0dBm
i1=-10dBm
O1=i1-2.0=-12.0dBm OK

Fig.7: Main window
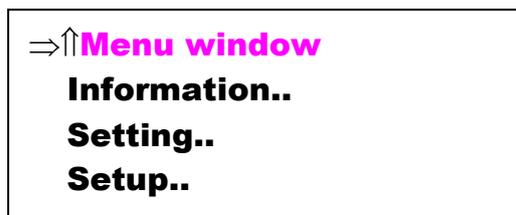
⇒⇑Menu window
Information..
Setting..
Setup..

Fig.8: Menu window

7.1 Menu flow diagram

For menu orientation see this flow diagram (Fig.9) below.
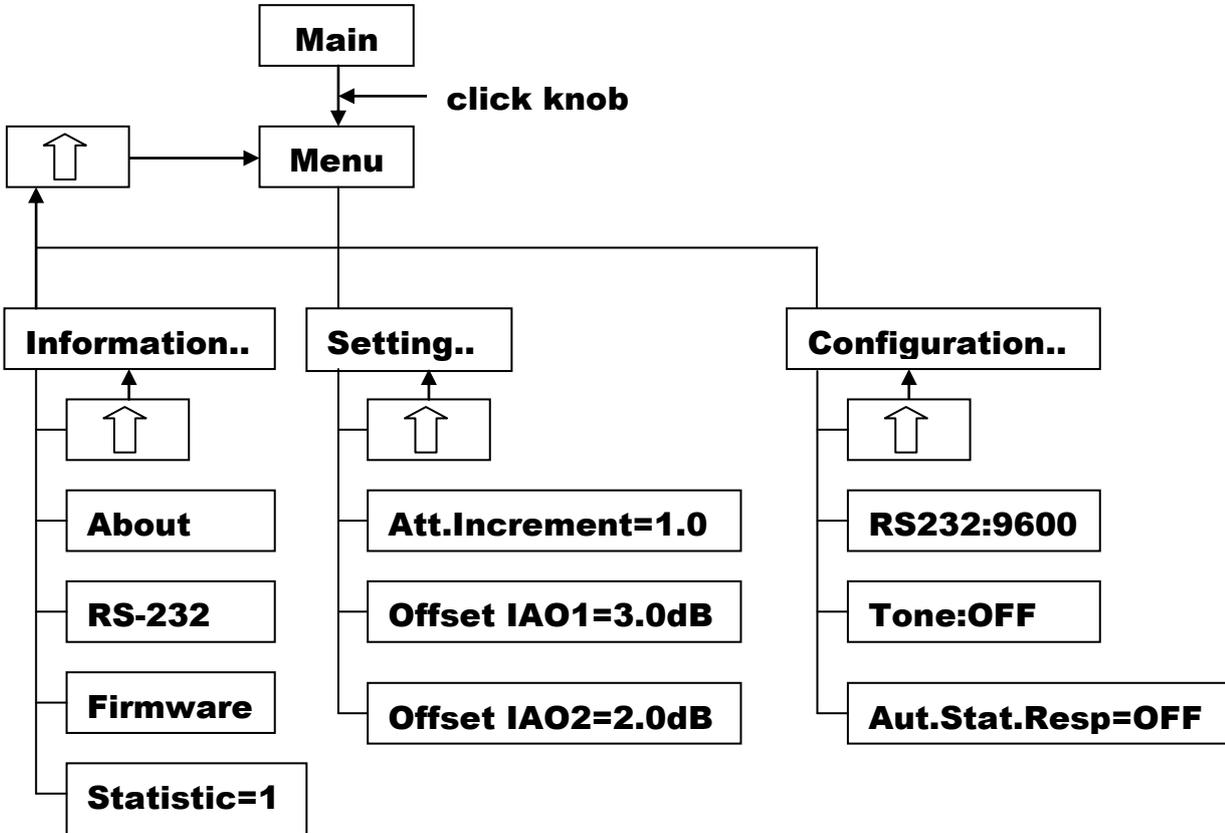
Figure 9: Flow diagram of the menu

8. RS232 communication

8.1 RS232 chain concept

The standard RS232 connection allows to connect one device to the personal computer (PC) COM port, only. The next device needs an additional COM port.

The chain concept makes it possible to connect more devices to a single COM port of the PC (Fig.10).

PC master	SubD cable	POFA ID = *	SubD cable	POFA ID = 1	SubD cable	POFA ID = z
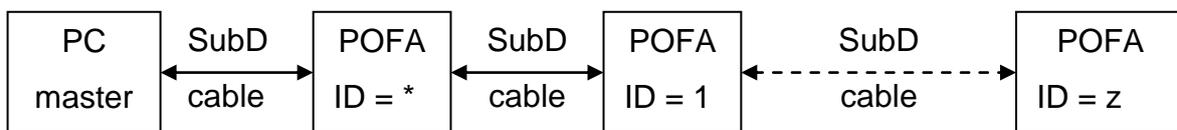
Figure 10: RS232 chain concept

Each device (POFA, FPM, Multiplexer, …) has its own identification address (ID) and two separated COM ports. All messages have recipient and transmitter addresses char. The ID Address char is adjustable in the service menu and displayed on the LCD after power on. The two COM ports functions as a repeater, if the message has a different recipient ID.

8.1.1 Devices connection

Connection is realised with a 1:1 female : male SubD-9pin cable (see Fig.11).

PC COM	SubD cable	POFA RS232 Input RS232 Output	SubD cable	POFA RS232 Input RS232 Output
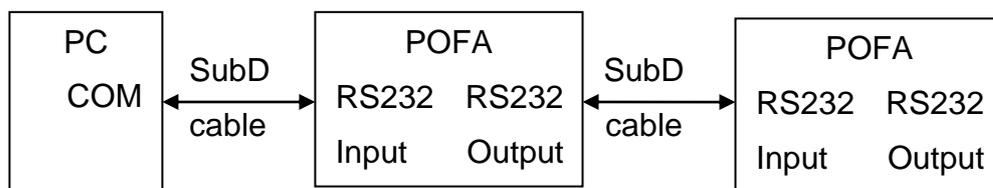
Figure 11: POFA connection

8.1.2 OEM connection

Connection between the PC and the first module is realised with a SubD cable (Fig.12).
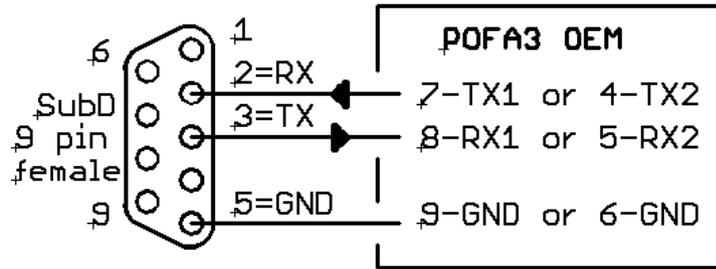
Figure 12: SubD Cable

Connection between two POF modules (POFA3 OEM) is realised with a null modem cable (Fig.13).
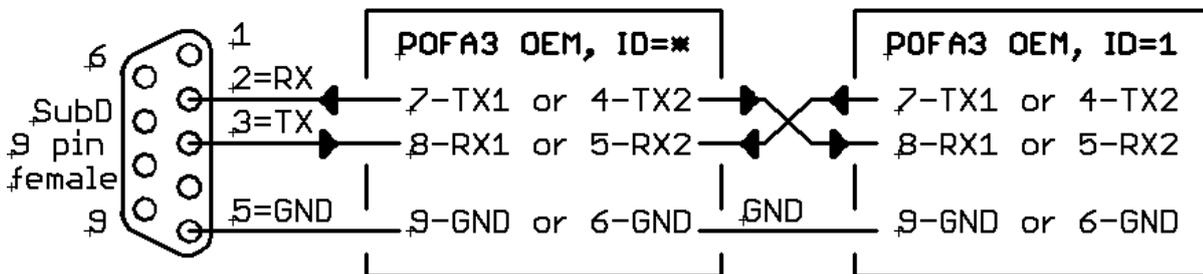
Figure 13: Null modem cable

8.2 RS232 settings

Baud rate: 9600 or 38400

Stop bit: 1

Data bits: 8

Parity: no

Handshake: no

Cable: 1:1

For the communication the Hyperterminal program could be used, which is integrated in the Windows operation system. See the correct port setting on figure 14 and the ASCII settings on figure 15.
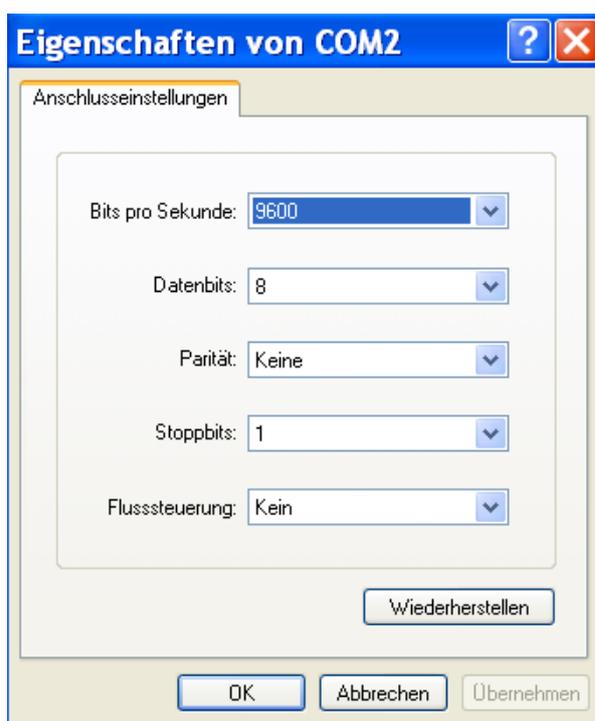
Figure 14: Port configuration
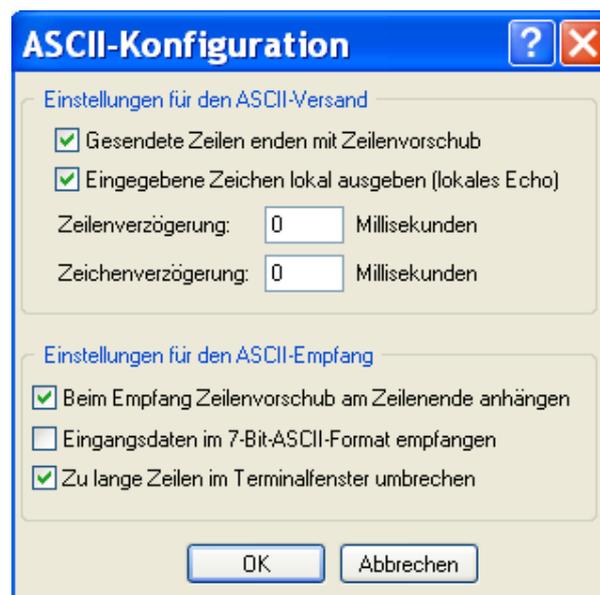
Figure 15: ASCII configuration

8.3 RS232 command structure

The previous version V1.1 is full compatible with this version V1.2.

Receiver ID char	Sender ID char	Command char	Operator char	Data string	Unit string	End of message char
'*'	'P' or '1'	'a'..'w'	':', '?', '='	'10.5'	'dB'	CR

Receiver ID char = this char indicates the receiver device address

> '*' = POFA3 **device** (compatibility with POFA2)

> '1' = POFA3 **OEM**

**Sender char = 'P':** this char indicates who send the message (for example 'P'**)**

Command char: the command char identifies the command (Command summary)

Operator: the operator indicates whether the selected value

- has to be written (':', followed by data)

- has to be read ('?', without data)

- is an answer on a read command ('=', with data)

Data: this field is filled with a data string, formatted accordingly to the command

End of message: CR is carriage return (=13 dec = 0D hex)

The minimal delay between two sender messages is 50 ms!

8.4 RS232 command summary

Description	Cmd char	Parameter	Operator char	Data (Range)	Units string
Attenuation	a	None	?, =, :	<0;40.0>	dB
Baud Rate	b	None	?, =, :	9600, 38400	
Service configuration	c	c = power check	?, =, :	0 = off (disable) 1 = on (enable)	
Echo	e	None	:	0 = off, 1 = on	
Light power	I	i = Input (I1) o = Output (o1) m = Monitor inp.(i1) O = Monitor out(O1)	?, =		dBm
Serial number	n	None	?, =		
Offset (IAO1)	o	None	?, =, :	<0;25.5>	dB
Offset (IAO2)	O	None	?, =, :	<0;25.5>	dB
Status	s	a = Automatic response[1] t = Tell	?, =, : ?, =	0 = OFF 1 = ON 'BUSY', 'OK' or <00;255>[2]	
Statistic[3]	t	None	?, =		
Temperature[4]	T	none	?, =	<10.00;50.00>	°C
Identify	IDN	None	?	Firmware string	
Reset[5]	RST	None	None	None	

Remarks

1. If a = 1 and the attenuation is reached, the status message 'OK' is sent automatically.
2. If an error occurs, the error stack (see Error Table) is popped and sent.
3. Statistic of attenuator switchings
4. Temperature measurement option.
5. Hardware reset , device is reset after 0.8 second!

8.5 RS232 examples of commands

Attenuation

Get or set the attenuation.

Set syntax	* P a : 10.1 dB CR
Response	No response

Get syntax	* P a ? CR
Response	P * a = 10.1dB CR

Echo

Set or clear echo. If echo on, POFA sends characters back.

Set syntax	* P e : 1 CR
Response	No response

Get syntax	* P e : 0 CR
Response	No response

Light power

Get light power from input or output. The output power is the power on the output connector calculated according to the equation (6.3).

Get syntax	* P l i ? CR
Response	P * l i = -10.1 dBm CR

Serial Number

Get serial number.

Get syntax	* P n ? CR
Response	P * n = POF0510007 CR

Offset 1 (IAO1)

Get or set the offset 1 (IAO1).

Set syntax	* P o : 3.5 dB CR

Response	No response

Get syntax	* P o ? CR
Response	P * o = 3.5 dB CR

Offset 2 (IAO2)

Get or set the offset 2 (IAO2).

Set syntax	* P O : 2.5 dB CR
Response	No response

Get syntax	* P O ? CR
Response	P * O = 2.5 dB CR

Status

Get status.

Get syntax	* P s t ? CR
Response	P * s t = BUSY CR

Set automatic status if the attenuation is reached.

Set syntax	* P s a : 1 CR

Response if the attenuation is reached.

Response	P * s t = OK CR

Statistic of attenuator switchings

Get the statistic of attenuator switchings.

Get syntax	* P s ? CR
Response	P * s = 123456 CR

Identify

Device identify. POFA sends firmware version

Set syntax	* P IDN ? CR
Response	P * POFA3 V1.2

Reset

Device remote reset.

Set syntax	* P RST CR
Response	No response

9. I2C Communication (for OEM)

9.1 I2C Specifications

Clock:	100 kHz
POFA3 address:	'1' = 0x31 (Read = 0x62, Write = 0x63)
Data string:	ASCII characters with end char (CR=0x0d)
Data length:	maximum 11 bytes

9.2 I2C message format

Address Bit 1..7	R\W Bit 0	Cmd Char	Parameter Char	Data string	End Char
0x62,3	<0;1>	'a'..'s'	'i'	'105'	CR

9.3 I2C communication format

Master to Slave

Slave to Master

Write to the slave (POFA3)

START	Addr+ R	ACK	Cmd	ACK	Par	ACK	Data	ACK	CR	ACK	STOP

Read from the slave (POFA3)

START	Address+ R	ACK	Cmd	ACK	Par	ACK	CR	ACK

START	Address+ W	ACK	Data	ACK	…	ACK	CR	ACK	STOP

9.4 I2C command summary

Description	Read Write	Cmd Char	Parameter	Data (Range)
Attenuation	R, W	'a'	none	$<0;400>_1$
Light Power	R	'l'	i = input (I1) o = output (o1) m = monitor inp. (i1) O = monitor out (O1)	$<-500;100>_1$
Offset (IAO1)	R, W	'o'	none	$<0;255>_1$
Offset (IAO2)	R, W	'O'	none	$<0;255>_1$
Status	R	's'	t = tell	'BUSY', 'OK' or $<0;255>$
Identify (Firmware)	R	'IDN'	none	'POFA3 V1.0'
Reset	W	'RST'	none	$<1>_2$

Remark:

1. Data: -200 = -20.0

2. All write commands have a number char on the end of a message (before CR).

10. Table of error codes

The microcontroller operating software checks the system and if anything is out of order, an error code is displayed.

Part symbols:

I2C = Inter Integrated Circuit (IIC => I^2C)

MOT = Motor (Servo)

OP_SYS = Operation System

RS232 = Recommended Standard 232

Error	Part	Error description
20	I2C	Arbitration lost
21	I2C	Arbitration lost in SLA+R/W as master
22	I2C	Arbitration lost in SLA+R/W
23	I2C	Command char out of range
24	I2C	Operation char out of range
25	I2C	Command parameter out of range
50	RS232	Port number out of range
51	RS232	Command character out of range
52	RS232	Operation character out of range
53	RS232	Command parameter out of range
54	RS232	Data out of range
55	RS232	Buffer overflow
60	OP-SYS	Calibration data out of range
61	OP-SYS	Operation mode out of range
62	OP-SYS	Menu buffer overflow
63	OP_SYS	LCD time out
80_1	MOTOR	Position out of range
81	MOTOR	Power supply low, < 4.8V
82	MOTOR	Power supply high, > 6.0V

83	MOTOR	Digital potentiometer out of range

Remarks

1. If this error offers please adjust the servo or improve the tolerance difference.

   Details find in the service instruction chapter.

11. Specification

Control: rotate/pushed knob

IAO (Instrument Attenuation Offset):   ≤ 4.0 dB (FPM1 + ATT + POF&connectors loss)

Interface: 2x RS-232 (9600 or 38400 bps, 8 data, 1 stop, no parity)

Connector loss: ≤ 1.0 dB

Set time: < 1 seconds

Specification are subject to change without notice.

11.1 Attenuator specification

Attenuation principle: grey filter

Attenuation range: IAO + 0.0 ~ 40.0 dB

Insertion loss: ≤ 2.0 dB

Resolution: 0.1 dB

Accuracy: ± 0.4 dB

11.2 FPM specification

Measure range: FPM1: 0 ~ -20.0 dBm

                         FPM2: 0 ~ -30.0 dBm

Insertion loss: FPM1: ≤ 1.0 dB

                         FPM2: ≤ 2.0 dB

Resolution: 0.1 dB

Accuracy: ± 0.2 dB (= ± 5% in Watt)

11.3 Additional options

Options below are possible only for device with width19".

- integration of OptoLyzer4MOST

- PG = Pattern Generator with Trigger output (TTL)

- EOC = EO Converter (modulated LED source)

- SW = optical Switch for duplicating of optical I/O

- MPX = optical multiplexer (scanner) for multiply of optical I/O

- another customised electronics

11.4 Calibration

Recalibration is recommended after **1 year** or after **200 000 attenuator settings**.

12. Technical data

12.1 Device technical data

Connectors:

Input 1, 2:	FSMA (optional ST or BAUER MOST inserts)
Output 1,2:	FSMA (optional ST or BAUER MOST inserts)

Dimension: 19/2": 235 x 135 x 370 mm

19": 455 x 135 x 370 mm

Fiber: Toray, NA = 0.5, index = step

1.0 mm POF: PFDU-CD 1001-23ABD or

0.5 mm POF: CWKG-501-10E (other specification!)

Operating   temperature: 23±5°C, humidity: 50±30%

Power supply: 100 ~ 240 VAC / 2A, 50 / 60 Hz

Weight: 4 kg

12.2 OEM technical data

Dimensions: 80 x 75 x 45 mm

Fiber: POF 980 / 1000 / 1520 µm (AMP/Tyco pigtail)

Power supply: $12 \pm 0,1$ V / 100 mA or $24 \pm 0,2$ V / 100 mA

Operating   temperature: 23±5°C, humidity: 50±30%

Weight: 150 g

12.3 OEM interface pinning

Interface (Fig.16) HE14 12 pin male (Farnell 281 695-3, female 428-648).

1. I2C/SDA	4. RS232/TX2	7. RS232/TX1	10. IU power/+5V/0.05A
2. I2C/SCL	5. RS232/RX2	8. RS232/RX1	11. Power/+12V/0.1A
3. I2C/GND	6. RS232/GND	9. RS232/GND	12. Power/GND
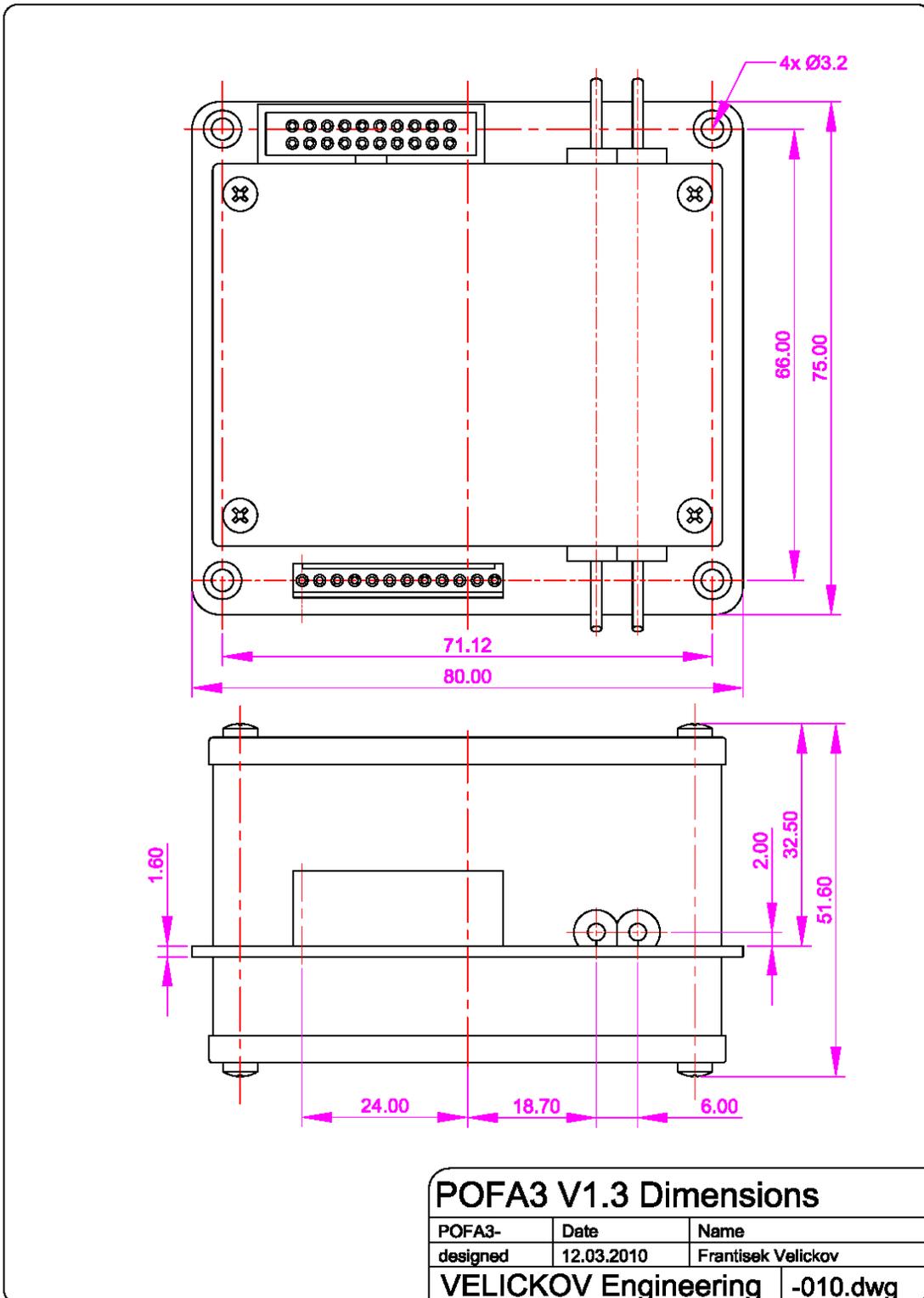
Fig. 16: Mechanical drawing

The specification is subject to change without notice.

13. Switch option

13.1 Local control

The position of the switch (A or B) is displayed on the LCD (Fig.17). The local control of the switch is implemented into the menu (Fig.18).

```
I1=-7.0dBm
o1=I1-3.0-1.0=-11.0dBm
i1=-10dBm            SW:A
O1=i1-2.0=-12.0dBm OK
```

```
   Information..
   Setting..
   Setup..
⇒Switch Position: A
```

Figure 17: Main window   Figure 18: : Menu window

13.2 Remote control (command)

Description	Cmd char	Parameter	Operator char	Data (Range)	Units string
Digital I/O	'd'	None	'?', '=', ':'	1 = Position A 0 = Position B	None

13.3 Examples

Digital I/O

Change the switch position from A (default) to the B.

Set syntax	* P d : B CR
Response	No response

Get syntax	* P d ? CR
Response	* d = B CR

14. Power meter option

The second fiber power meter (FPM2) could be optional configured as power meter (PM2) (Fig.19).
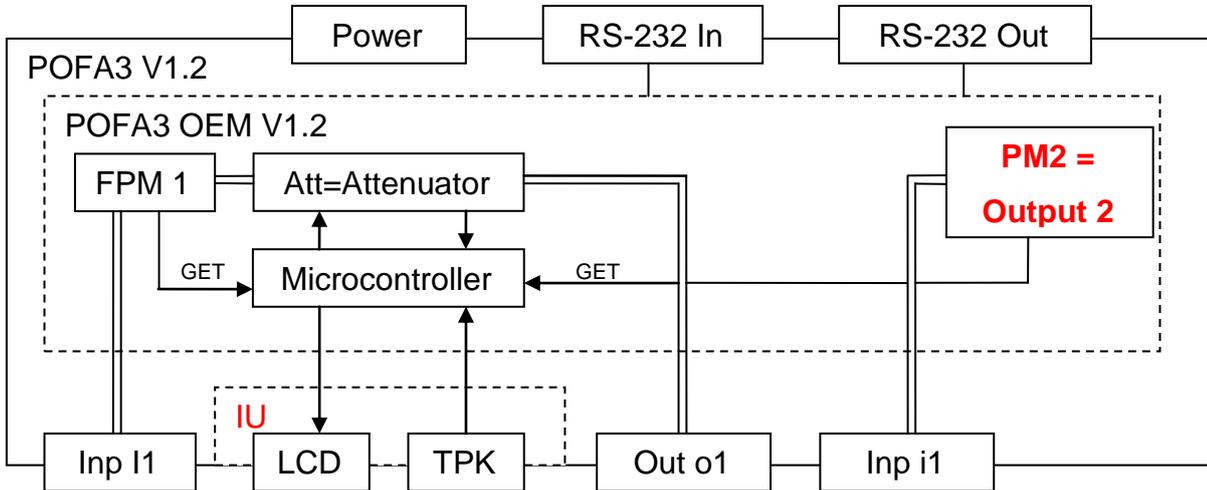

Figure 19: Function block diagram with PM

The attenuation offset (IAO2) in this configuration made it possible to adjust the input light power (I2) (14.1).

Calculation of input light power

$$\text{i1 [dBm] = O1 [dBm] + IAO2 [dB]} \qquad \text{(14.1)}$$

Second channel information (I2, O2) on the LCD are changed (Fig.20).

```
I1=-7.0dBm
o1=I1-3.0-1.0=-11.0dBm
i1=O1+2.0=-8.0dBm
O1=-10dBm            OK
```
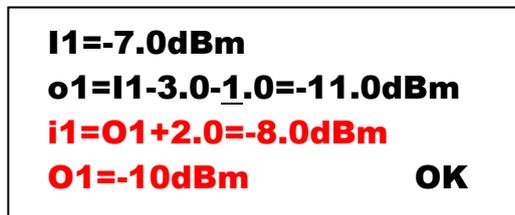
Fig.20: Main window

15. Service instructions

This part deals with configuration possibilities of POFA device.

15.1 Service menu

Enter the service menu by pushing the control knob for more than 5 seconds

**The bold entries are the default settings.**

⇒⇑Service menu
  RS232 setup..
  Configuration..
  FiberPowerMeter..
  Servo setup..
  Temperature…
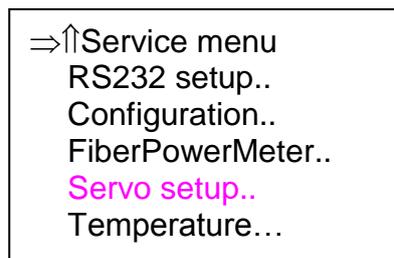
Figure 21: Service menu window with default setting

RS232 Setup = RS-232 communication setup

Device Address = Device address ID char (see chap. Remote commands) = **'*'**

Sender ID char = **ON (POFA3 mode)** / OFF (POFA2 mode)

Configuration = System configuration

Displ. Pos = Display Calibration Position (for internal needs) = **OFF** / ON

Opt.Switch = Optical Switch (see chapter Switch update) = **OFF** / ON

Power check = Power OFF check for the statistic feature = **ON** / OFF

Displ. FPM2 = Display FPM2 values (I2=…, O2=…) = **ON** / OFF

Fiber Power Meter = Fiber Power Meter setting

Reflex correction = Input 1 light power reflex correction from the attenuator

I1-0.1 by Att < ?.? = attenuation break point for I1 – 0.1dB correction

I1-0.2 by Att < ?.? = attenuation break point for I1 – 0.2dB correction

I1-0.3 by Att < ?.? = attenuation break point for I1 – 0.3dB correction

I1-0.4 by Att < ?.? = attenuation break point for I1 – 0.4dB correction

FPM1 Gain = 128

FPM1 Offset = 128

FPM2 Gain = 128

FPM2 Offset = 128

Servo setup = Servo setup

Servo Adjust = Servo potentiometer feedback adjustment

Start Adjust = Start servo potentiometer gain and offset adjustment

Servo Adjust = number of adjust cycles

LoPos= Low position = 1800, **HiPos** = High position = 4100

LoDif = Low Difference , **HiDif** = High Difference

Gain = servo position gain, **Ofst** = servo position offset

Calibrate = Calibrate the servo potentiometer gain and offset setting

Calibrate = number of calibrate cycles

Set = Set PWMvalue, **Get** = Get PWM value

Dif = Difference = Get – Set, **MaxDif** = Maximal difference

Stop = Stop cause = Move difference / Time out

AdjRangeOffset = Adjust range offset = 200

Cal.Increment = Calibration increment = +50

RS Adj/Cal List = RS232 adjustment/calibration listing

Servo Control = Servo control setting

PWM Minimum = Pulse Width Modulation minimum = 1600

PWM Maximum = Pulse Width Modulation maximum = 4300

SideMoveOffset = Side move offset = 20

Servo Position = Servo position test tool

Gain = servo position gain

Offset = servo position offset

PwmSet = PWM set

PwmGet = PWM get, **Dif** = PWM difference

Servo Wear = Servo Wear

ToleranceDif = Tolerance difference = 120

Maximal Diff = Maximal difference

VccVoltCheck = Vcc voltage check = ON/**OFF**

Movings Stat = Moving statistic

Temperature = Temperature inside the module

Minimum = Minimal temperature = ??.??°C

Last = Last (running) temperature = ??.??°C

Actual = Actual temperature = ??.??°C

Maximum = Maximal temperature = ??.??°C

For menu orientation see the diagram below.
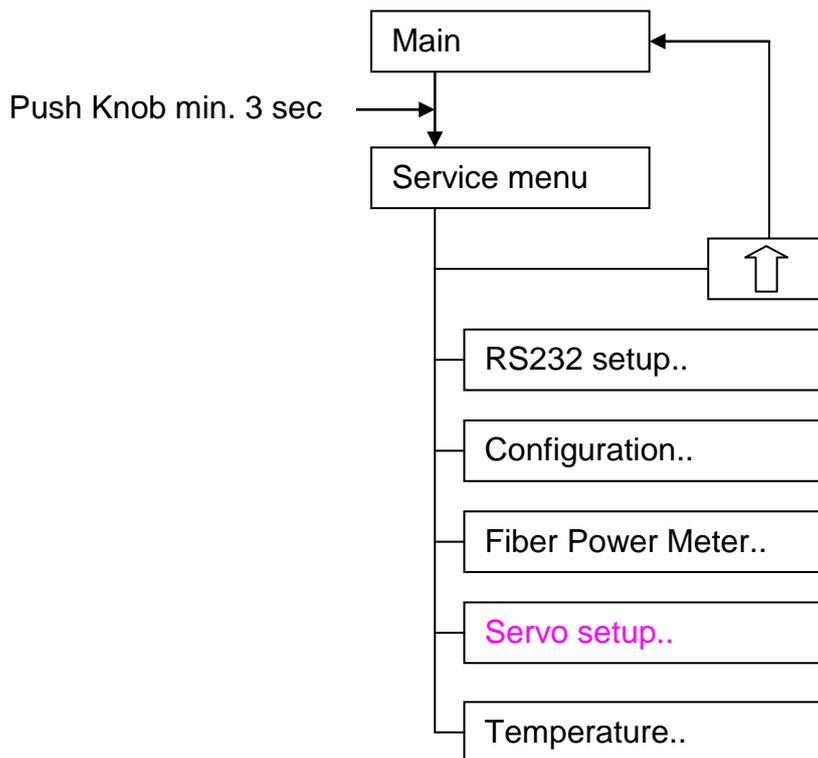
Figure 22: Service menu diagram

16. Trouble shooting

Trouble shooting	Problem	Solution
POFA device doesn't answer.	Address (receiver ID char)	POFA device = '*', please check the setting in service menu. OEM = '1'
	Sender ID setting	Communication mode POFA3/2.
	Baud rate	Check the baud rate setting
	Cable	1:1, female : male
On the LCD "Power OFF" occur	Low power supply or power supply noise	Set the Power check in the service configuration to the OFF.
Not described trouble shooting.		Please contact the manufacturer **VELICKOV Engineering**