OPTO-ELECTRONICS INC.

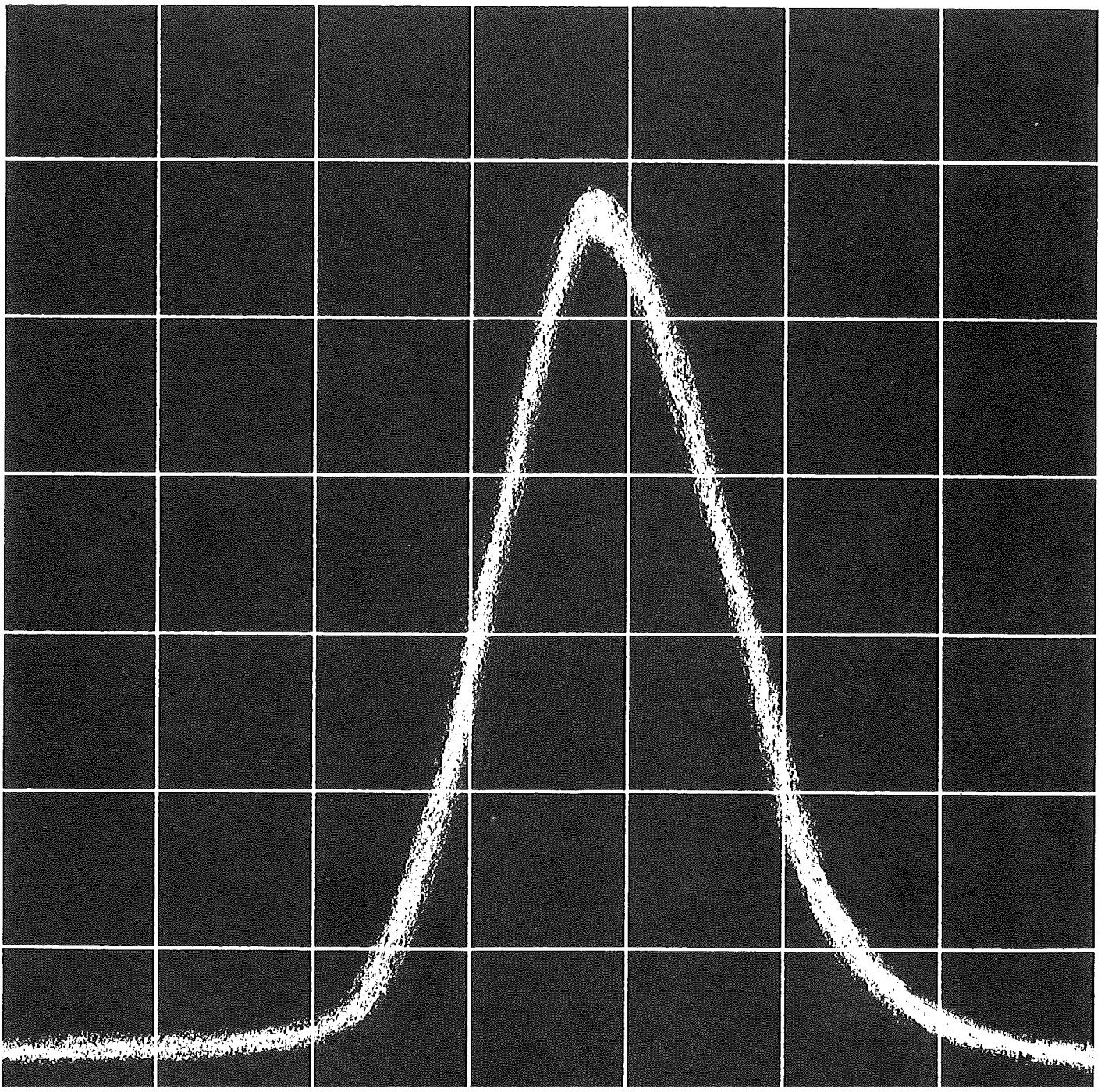
RESEARCH IN ELECTRO-OPTICS

RL201

OPERATING MANUAL

PICOSECOND FIBER OPTIC SYSTEM

(PFOS)



OPERATING MANUAL

PICOSECOND FIBER OPTIC SYSTEM

(PFOS)

OPTO-ELECTRONICS INC.

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Oakville, Canada
January, 1994

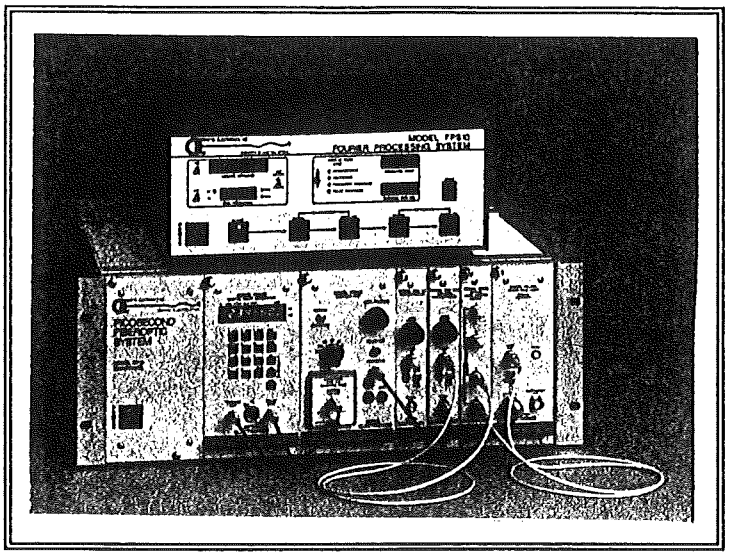
CONTENTS

The PFOS Manual consists of a combination of mini-manuals selected from the sections listed below. These sections are combined in numerical order, however, one or more of these sections may be omitted where the PFOS system does not contain the relevant module.

1 THE PICOSECOND FIBER OPTIC SYSTEM

1.1 DESCRIPTION

1.2 WARRANTY AND REPAIR



1.1 DESCRIPTION

The Picosecond Fiber Optic System (PFOS) is an instrument designed to perform a variety of fiberoptic related measurements in the picosecond time and gigahertz frequency domains. The capabilities and features of transmitters and receivers are similar to the Opto-Electronics stand-alone picosecond lasers and photodetectors, with the added convenience of all units being housed in a rack mountable mainframe. Additional modules provide for a variety of configurations and measurement possibilities. The PFOS instrument consists of the mainframe containing power supply circuitry and modules chosen from a wide variety to meet the users requirements. Supplemented with additional Processors the PFOS instrument can provide unprecedented accuracy and sensitivity to a variety of applications.

The Opto-Electronics PFOS system of readily interchangeable modules permits convenient, fast, and accurate measurements of pulse dispersion and bandwidth, OTDR testing, attenuation and measurements or experiments in optical communications and fiber optic sensing. The flexibility in utilizing the system along with the large choice in modules makes the system an excellent instructional aid where fiber optic courses are being taught.

A brief description of each module series is given below.

The Mainframe contains the main power supply and has been designed to accommodate a variety of modules which can be inserted into any one of the eleven bays. The mainframe can be rack mounted or placed conveniently on a bench.

The Diode Laser Sources are available over the wavelength range from 680 nm to 1550 nm. One series of picosecond pulsed diode lasers (PPL30K) operates at a 33 KHz repetition rate while a second operates at 50 MHz (PPL50M). There is an analog modulatable series (PAML10) and a digital modulatable series (PDML10). These can be externally modulated from 0.1 to 1 GHz and Gbit/s respectively and are available at most wavelengths. There is also a choice of a variety of narrow band multi-gigahertz modulatable diode lasers.

The Ultra Fast Photodetectors include a choice from Si, Ge, and InGaAs materials of the non-avalanche and avalanche variety tuned to be ultra fast. The avalanche type provide more gain at the expense of some speed. These detectors are DC coupled and operate to above 8 GHz.

The Fast Amplified Photodetectors are similar to the ultra fast type except that they are amplified to provide even more gain but again at the expense of some speed. These detectors are AC coupled and operate from 10 KHz to above 1 GHz.

The Fiber Optic Couplers are available to operate with all standard fiber core sizes, singlemode or multimode and are designed to fit the mainframe for convenience. These are generally 2 X 2 couplers with a 1:1 splitting ratio but other configurations are available.

The Digital Delay Generator runs at an automatically selected repetition rate which depends on the total delay, and provides a very low jitter delay signal to trigger the detection system. This has been specifically designed to operate with the Millimeter Resolution OTDR system or the Bandwidth measurement system but can be used in any application requiring a low jitter adjustable delay following a trigger signal.

The Sampling Unit has been designed to operate with the TDR or FPS series Processors. The sampling technique is required to follow the very fast electrical signals generated by the various detectors.

The Photon Counting Units provide the ultimate in sensitivity at both short (850 nm) and long (1300 & 1550 nm) wavelengths. Useful in both transmission and reflection configurations this unit is designed to operate with the TDR30 processor.

The Optical Attenuator is calibrated at one or more wavelengths (680 to 1550 nm) as required. This provides a quick accurate means for making loss measurements and a convenient method for controlling signal amplitude.

The PFOS system with the addition of the TDR series processor becomes the worlds highest resolution and most sensitive OTDR system. Minimum detectable signals 100 dB down can be realized.

With the addition of the FPS Processor the bandwidth of fiber runs can be measured in reflection or where both ends are available the bandwidth can be measured in transmission.

For a summary of applications ask for the "Millimeter Resolution OTDR System" booklet.

For PFOS system built in the OTDR configuration there is a Reference manual and a Training manual included with the system.

1.2 WARRANTY AND REPAIR

The PFOS Mainframe and Modules have been designed for a long life of trouble free operation. In the case of faulty assembly or materials Opto-Electronics provides a one year warranty on this product. This is intended to cover labour and parts and is valid up to one year from the date of shipment.

Do not attempt to repair or disassemble diode laser or photodetector heads as such attempts will almost certainly lead to irreparable damage and will invalidate any warranties.

In order to prevent unnecessary returns please read the operating instructions and consult the Data Sheet for the module in question. Also consult the troubleshooting section and read any relevant applications notes.

In the event that a return is necessary, please notify your nearest representative. Please, do not return instruments or parts before receiving an authorization number and return instructions. Improperly shipped goods will result in delays by Customs and increased handling costs.

PLEASE NOTE Opto-Electronics CAN NOT accept collect shipments. All shipments must be prepaid.

All returns for repair must be sent to the Canadian factory at the address listed below.

For return authorization contact your local representative or the appropriate number listed below.

International:

Your Local Representative or
The Canadian factory at ...

Opto-Electronics Inc.
Tel (905) 827-6214
Fax (905) 827-6216

USA:

Your Local Representative or
The Canadian numbers above or
The Buffalo, NY number at ...

Opto-Electronics Inc.
Tel (716) 856-1322

ALL returns must be sent to ...

Opto-Electronics Inc.
Customer Service Department
Unit 9, 2538 Speers Road,
Oakville, Ontario, L6L 5K9,
Canada

2 PFOS MAINFRAME

MF20

2.1 DESCRIPTION

The rack mountable mainframe is the main power supply for the PFOS system. With this modular system, versatility is the key descriptive feature. Consider the following:

- Over forty different modules from which to choose; more to come.
- Any module fits any bay.
- Eleven bays in each mainframe.
- New modules can easily be added as requirements change.
- Should all the bays become occupied, additional modules can be stored on a nearby shelf and easily exchanged as required or an additional Mainframe can be used.

2.2 SPECIFICATIONS

CHARACTERISTIC	VALUE	UNITS
Line Voltage	110/120	VAC
Line Frequency	50/60	Hz
Power Consumption	80	W (Max)
Size (H x W x D)	7 x 19 x 14	in
	18 x 48 x 41	cm
Weight	15	lb
	6.8	kg

The Mainframes is mountable in a standard 19 inch rack. It contains 11 bays from which any of the modules can be powered. most of the modules are a single bay wide, a few are two bays wide and several are three bays wide. The Mainframe can accommodate all the modules requried for a comlete OTDR or bandwidth measurement system.

2.3 OPERATION

Insure that the correct voltage is supplied to the Mainframe. The correct operating voltage has been factory set for the country of destination or as customer specified. If the operating voltage must be changed consult the factory for instructions.

Operation requires only that the power switch is turned on. When ON (Pressed in) all modules are automatically powered and the Mainframe cooling fan should just be audible.

> CAUTION
> THE MAINFRAME POWER MUST BE OFF WHEN INSERTING OR REMOVING MODULES. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE MODULE AND WILL NULLIFY ANY PERTINENT WARRANTY.

2.4 TROUBLESHOOTING

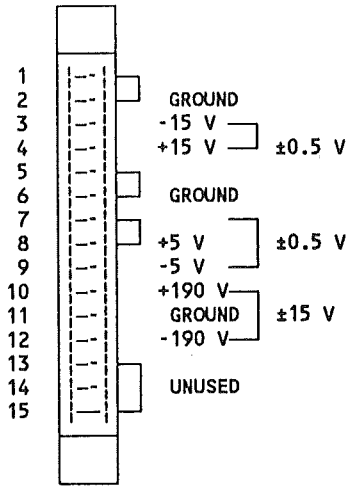
If none of the modules will operate and it is felt that the fault lies with the Mainframe check the following:

1) Check that the proper voltage is being supplied.

2) Check the mainframe fuse located at the rear beside the power cord. Fuse values are:
   1.5 A for 110 V units
   0.75 A for 220 V units

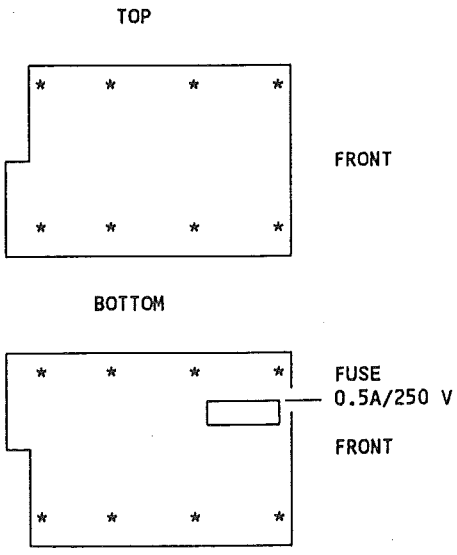
3) If the Mainframe power supply is operating correctly, the voltages listed below should be present at the 11 plug-in connectors inside the mainframe.

MAINFRAME PLUG-IN CONNECTOR



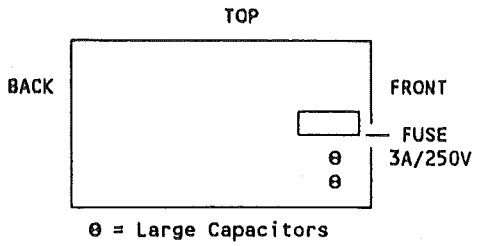
4) If the +190 V only is absent, check the fuse inside the power module. To do this proceed as follows.
   a) Power down.
   b) Remove the upper screw and the lower screw from the front panel of the power module. Now pull the power module out of the Mainframe.
   c) Remove the eight screws from the power module PCB screen plate as shown to the right. There is no need to disconnect any of the wires.

POWER MODULE SIDE VIEW



If the fuse was mechanically damaged, the unit should operate with a new fuse. If the fuse was blown the cause should be ascertained and any faults should be repaired before attempting to use the power supply again.

5) If the ±15 V and the ±5 V are absent, The fuse on the main PCB of the power supply should be checked. This can be accessed by following the procedure outlined in step 4 above, except that this fuse is located as shown to the right. With the PCB screen plate off, look into the module at the main PCB.



If the fuse was mechanically damaged, the unit should operate with a new fuse. If the fuse was blown the cause should be ascertained and any faults should be repaired before attempting to use the power supply again.

2.5 WARRANTY AND REPAIR

For warranty and repair information refer to Section 1.2.

3 PFOS DIODE LASER SOURCES

PPL30K

3.1 DESCRIPTION

The PPL30K module has been designed to slide into any position on the PFOS mainframe. The source is a diode laser in a microwave circuit of proprietary design. The laser source can be triggered internally at a fixed repetition rate or externally at a variable repetition rate. In either mode a pretrigger pulse is provided for triggering an oscilloscope or other equipment. The laser is thermally controlled for superb stability.

The standard multimode optical output is via an ST style connector fitted with any of the standard multimode fibers as requested. The standard singlemode optical output is via the appropriate singlemode fiber for the wavelength chosen. Other connectors and fiber options can be custom fitted.

3.2 SPECIFICATIONS

NOMINAL WAVELENGTH (nm)	WAVELENGTH TOLERANCE (nm)	SPECTRAL WIDTH (nm)	RISETIME (ps)	FWHM (ps)	PEAK POWER (mW)	
					MM	SM
680	10	4	<30	<50	>20	n/a
785	10	4	<30	<50	>20	>7
810	10	4	<55	<75	>20	>7
820	10	4	<55	<75	>150	>50
850	10	4	<55	<75	>150	>50
900	10	4	<55	<75	>200	>50
1060	20	10	<95	<140	>5	>2
1300	25	10	<55	<75	>30	>10
1550	30	15	<95	<140	>5	>2

CHARACTERISTIC	VALUE	UNITS
Pulse Repetition Rate		
Internal	33	kHz
External	0 - 33	kHz
Pretrigger		
Risetime	1	ns
Peak voltage	600	mV
Precedes Optical Pulse	80	ns
External Trigger Requirement	TTL	
Thermal Control	± 0.5	deg C
Operational Temperature Range	0 - 50	deg C

NOTE:
PPL30K modules designed to operate in the Opto-Electronics High Resolution OTDR system may have a FWHM in excess of the numbers specified above. This increases the power output at the expense of pulse width to provide more energy per pulse. This has very little effect on the OTDR system resolution but enhances the signal to noise ratio significantly, and hence improves the system performance.

3.3 OPERATION

> CAUTION
> THE MF20 POWER MUST BE OFF WHEN INSERTING OR REMOVING MODULES. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE MODULE AND WILL NULLIFY ANY PERTINENT WARRANTY.

With the mainframe power off, plug the module into any convenient unused part of the mainframe and tighten into place with the thumbscrew. To power the module, turn the mainframe power on. The LED on the PPL30K front panel serves notice that the diode laser is at operating temperature. This may take seconds if the ambient temperature is near 23 degrees Celsius or minutes if the ambient temperature is extreme.

3.3.1 INTERNAL TRIGGERING

With the PPL30K trigger mode switch set to "INTERNAL" the source will send stable optical pulses as soon as the LED lights. The internal repetition rate is set to 33 kHz and cannot be varied.

3.3.2 EXTERNAL TRIGGERING

With the PPL30K trigger mode switch set to "EXTERNAL" the source can be triggered from single shot to a 33 kHz repetition rate. A TTL level trigger pulse must be supplied via the indicated BNC connector.

3.3.3 PRETRIGGER OUT

The pretrigger out provides a low jitter trigger pulse which precedes the optical pulse by approximately 80 ns. This is to provide ample delay so that the optical pulse can be detected and displayed by a standard sampling oscilloscope.

3.3.4 OPTICAL CONNECTIONS

Care should be taken with the optical connectors. While they are quite robust it must be remembered that the optical path is quite small so that even a tiny speck of dust can severely reduce transmission through a connector. Dry clean air works well to keep the connectors dust free. Capping when not in use is strongly recommended. Alcohol used with a Q-tip can also be used on the open end. The connector on the inside of the module is not very accessible thus preventive hygiene is preferable to disassembly. Grit should be avoided at all cost as one grain can permanently damage the glass surface of the fiber in the connector. If this happens the only recourse is to reconnectorize.

3.4 TROUBLESHOOTING

This troubleshooting guide is designed to assist the user to identify the general area of a problem. It describes some simple checks to isolate the fault. In the event of failure the factory will be glad to assist with the troubleshooting, or to complete the repairs.

1. If the "READY" light does not come on, there may be a fault with the temperature control circuit or the heater/cooler. This cannot be repaired in the field. The unit must be returned to the factory for repair. However, to be certain, Check the mainframe power supply as described in Section 2-4. If the mainframe is supplying the correct power, check the electrical connections by trying the module in a different bay. Remember to power down before removal or insertion of modules.

2. If the "READY" light does come on, but there are problems finding a pulse, the diode laser can be checked as follows. Trigger the source internally and view the output with an IR viewer or camera, as required for the particular wavelength of the source. For short wavelengths (750 to 900 nm) the source should appear very bright with an IR viewer or IR camera. For long wavelengths (1300 to 1550 nm) the source may not be visible with an IR viewer (certainly not at 1550 nm) but should appear reasonably bright on the IR camera. If no light is apparent or it is very dim the module must be returned to the factory for recalibration or repair.

3. There is only one way to check the pulsed operation of the diode laser. The pulse must be detected and displayed. This can be done by connecting the diode laser directly to a photodetector. There are many possibilities here, depending upon the system. One of the biggest difficulties is looking for the pulse in the correct time frame. If the pulse is found then there is probably no problem with the diode laser source. If no pulse can be found, consult the factory for suggestions. The unit may have to be returned.

4. External triggering at high repetition rate (to 33 kHz) will also cause the output to be "visible" with an IR viewer or camera. However, at very low repetition rates one should not expect to see the output due to the very low average energy.

3.5 WARRANTY AND REPAIR

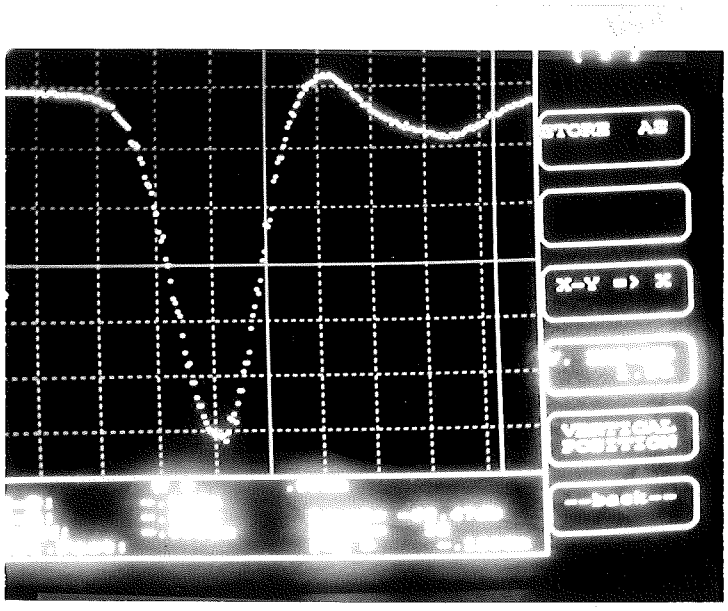
For warranty and repair information refer to Section 1.2.

3.6 DATA SHEET

MODEL NUMBER PPL 30K SERIAL NUMBER 250

PFOS _____ for _____

LASER WAVELENGTH 1300 nm FIBER TYPE SM 9/125



FWHM

OBSERVED 85 ps

SYSTEM 73 ps

SOURCE 44 ps

PEAK POWER 17 mW

NOTES:

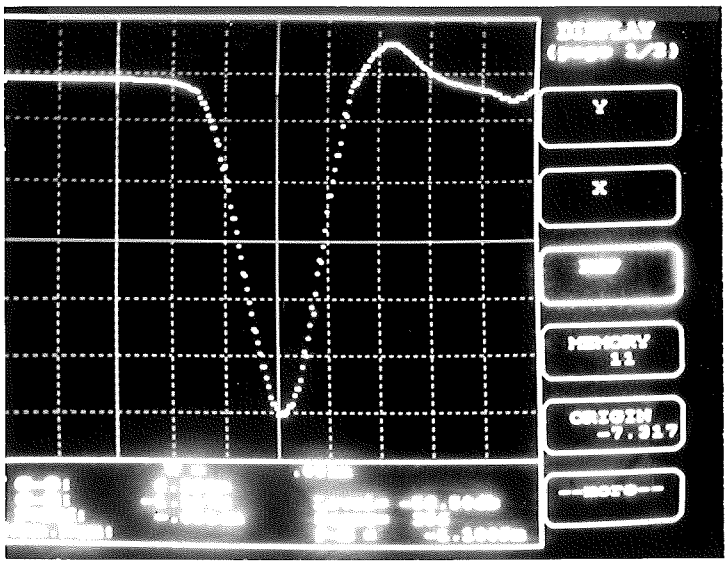
Completed by DJA Date 2 APR 96

3.6 DATA SHEET

MODEL NUMBER PPL30K SERIAL NUMBER 250

PFOS 191 for SAIEN

LASER WAVELENGTH 1300 nm FIBER TYPE 9/125



FWHM		
OBSERVED	80	ps
SYSTEM	93	ps
SOURCE	33	ps
PEAK POWER	75	mW

NOTES:

Completed by DJB Date 30 NOV 95

5 PFOS FAST AMPLIFIED PHOTODETECTORS

PAD230, PAD240,

5.1 DESCRIPTION

The PAD module have been designed to slide into any position in the PFOS mainframe from which it obtains its electrical power. The detector itself is an fast avalanche photodiode in a microwave circuit of proprietary design. The photodetector is specifically designed to resolve ultra short light pulses, or to monitor high frequency modulation of light sources. Optical input is via a 100/140 μm diameter core/cladding, graded-index, multimode fiber with a numerical aperture of 0.3. Connection is made with an ST style optical connector located on the front panel. The 50 ohm SMA style electrical connector is also on the panel front.

5.2 SPECIFICATIONS

CHARACTERISTICS	UNITS	PAD230	PAD240
Material	-	Si	Ge
Diode Type	-	APD	APD
Risetime (max)	ps	300	300
FWHM (max)	ps	500	500
Freq Bandwidth (3dB Pt)	GHz	1.0	1.0
Dynamic Range	-	200:1	200:1
Peak Responsivity	mA/mW	15	15
Peak Resp (into 50 n)	mV/mW	750	750
Min Det Signal (into 50n)	μW	6	6
Max Aug Input Power	mW	5	5
Max Peak Input Power	W	1	1
Output Impedance	ohms	50	50

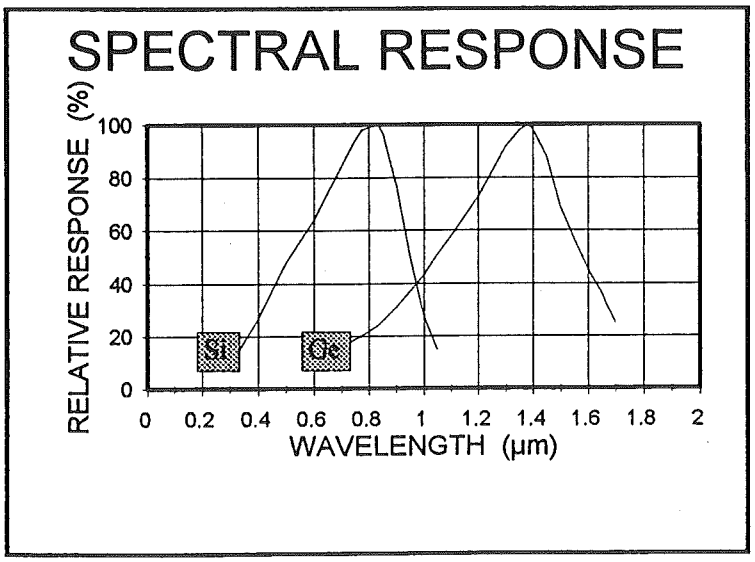


Figure 1

5.3 OPERATION

> CAUTION
> THE MF20 POWER MUST BE OFF WHEN INSERTING OR REMOVING MODULES. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE MODULE AND WILL NULLIFY ANY PERTINENT WARRANTY.

With the mainframe power off, plug the module into any convenient unused part of the mainframe and tighten into place with the thumbscrew. Insure that the GAIN switch is in the LOW GAIN position. To power the module, turn the mainframe power on. The amplified avalanche detector is now ready to use.

5.3.1 LOW GAIN OPERATION With the GAIN switch in the low gain position, the photodetector can be operated as a pn type diode with no avalanching. Low gain provides a bias voltage of approximately 1/3 V_B for the PAD230 and 1/2 V_B for the PAD240 where V_B is the photodiode breakdown voltage. The breakdown voltage is defined as the voltage at which the dark current is 100 uA. Note that the voltage adjust control has no effect on the bias voltage in the low gain setting.

5.3.2 HIGH GAIN OPERATION With the gain switch in the HIGH GAIN position, the photodiode avalanches and the gain can be varied smoothly from V_B to approximately 0.85 V_B. This allows the gain to be varied from maximum back close to unity. The unit should not be operated at or above V_B. In this region the amplifiers may oscillate or the current limiting circuit may operate to protect the diode. Current limiting is indicated by a lighted LED next to the gain switch.

5.3.3 OPTICAL CONNECTIONS Care should be taken with the optical connectors. While they are quite robust it must be remembered that the optical path is quite small so that even a tiny speck of dust can severely reduce transmission through a connector. Dry clean air works well to keep the connectors dust free. Capping when not in use is strongly recommended. Alcohol used with a Q-tip can also be used on the open end. The connector on the inside of the module is accessible so that it can be readily dissembled and cleaned if required. Grit should be avoided at all cost as one grain can permanently damage the glass surface of the fiber in the connector. If this happens the only recourse is to reconnectorize.

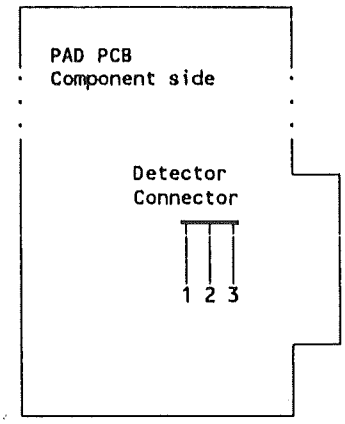
5.3.4 ELECTRICAL OUTPUT The electrical output can be monitored from the 50 ohm SMA connector. Care must be taken to use 50 ohm high frequency cable and connectors when monitoring very short pulses.

5.4 TROUBLESHOOTING

In the event that there is difficulty obtaining a signal from the detector, the following items should be checked.

1. Remove the module to be checked, and the module to its right from the mainframe. Disconnect the detector bias voltage cable from the connector. Connect the test probes from a dc voltmeter to the connector PIN 1 as shown in Figure 2 below. Replace the module, turn the mainframe ON and check the voltage. The detector should be receiving the voltage

indicated. Check both the LOW GAIN and HIGH GAIN position as well as the VOLTAGE ADJUST. Note that VOLTAGE ADJUST has no effect when the gain switch is in the LOW GAIN position. The maximum voltage is factory set for each diode, thus the indicated values are only approximate. If the voltage is incorrect, check the mainframe section; if OK, proceed.



PIN	V_B	MODEL
1	LG: - 45 V HG: -110 to -135 V	PAD230
	LG: -15 V HG: -25 to -30 V	PAD240
	(These voltages are approximate as the bias voltage V_B is diode dependent.)	
2	Ground	All
3	+ 15 V	All

Figure 2

2. In a similar manner to the above, check Pin 3. This supplies + 15 V to the detector amplifiers.

3. Remove the module and check the detector as follows. Remove the detector bias voltage cable from the connector and with an ohmmeter, measure the detector resistance in both directions. (ie. reverse ohmmeter leads.) The measurements should indicate the characteristics of a diode; that is, high impedance in one direction, low impedance in the other. A short in both directions or high impedance in both directions indicates a defective diode. This necessitates returning the module for repair. If OK, proceed.

4. The output signal should be positive. In the event that it is inverted, one of the amplifiers is faulty. The unit must then be returned to the factory for repair

5. The output impedance should be 50 ohms. If the above items all check out, then the detector is almost certain to be operational. This indicates that the difficulties lie elsewhere. In particular, check the following.

6. Verify that the fiber connectors are all clean as small particles of dirt in the connector can reduce the light input substantially.

7. Improper triggering delays can result in searching for the output on the oscilloscope in the wrong time frame.

5.5 WARRANTY AND REPAIR

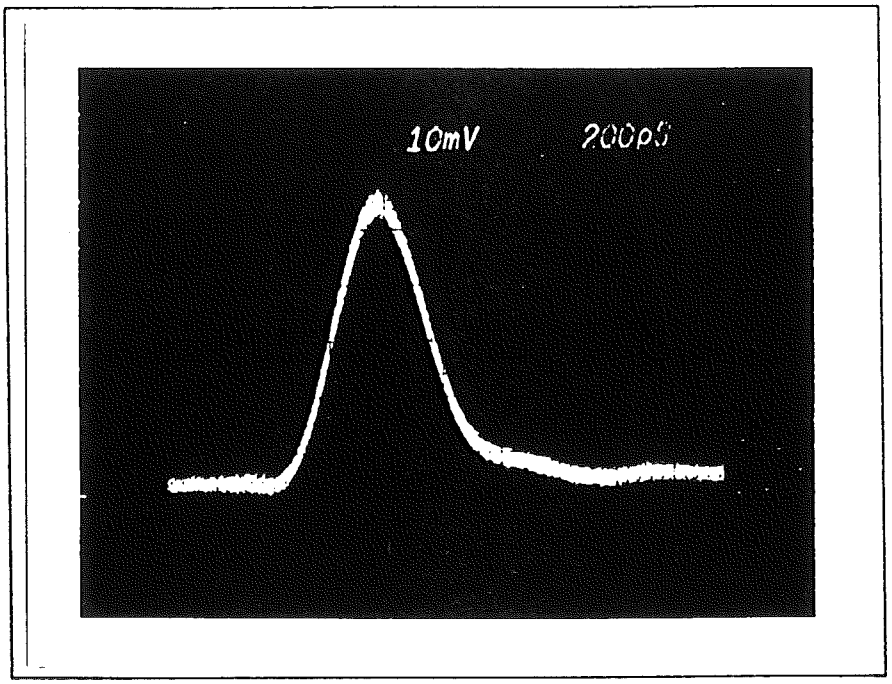
For warranty and repair information refer to Section 1.2.

5-6 DATA SHEET

PFOS 191 for SAVEN DATE 95/12/13

MODEL NUMBER PAD240 SERIAL NUMBER 074

FIBER CORE DIA. 100 µm



TEMPORAL RESPONSE

GAIN = 8.0

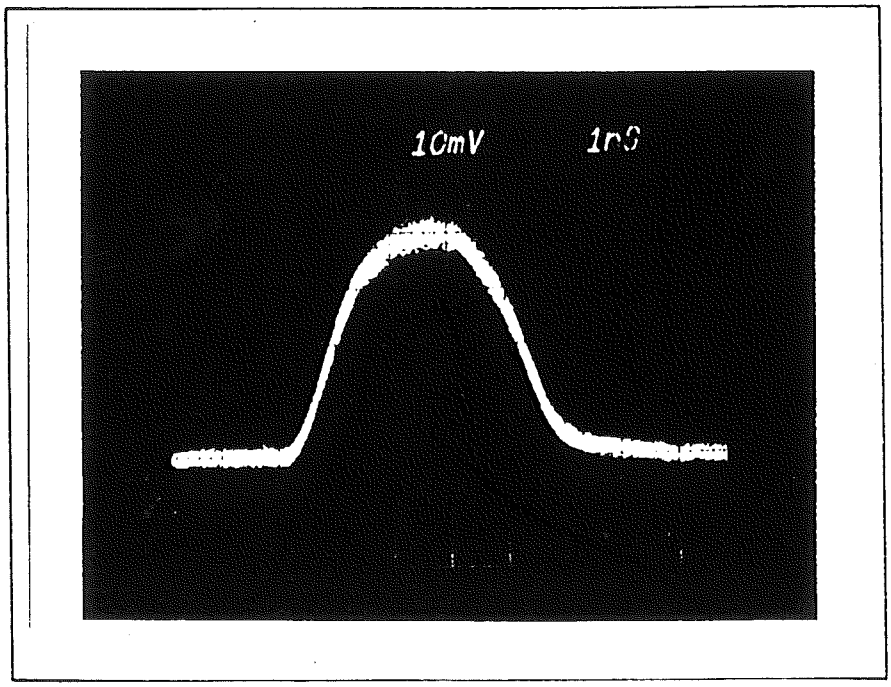
FWHM 345 ps

RISETIME 200 ps

TEST SOURCE

WAVELENGTH 1300 nm

FWHM 32 ps



RESPONSIVITY

SOURCE

WAVELENGTH 1321 nm

FWHM 3200 ps

POWER* 3.7 µW

* This is the optical power hitting the phoodiode.

6 PFOS FIBEROPTIC COUPLERS

PFC6, PFC10, PFC15, PFC50, PFC62, PFC100, PFC200, PFC400

6.1 DESCRIPTION

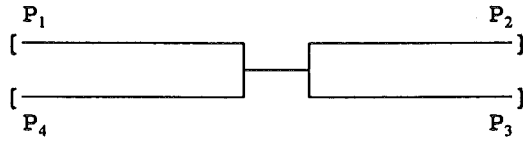
The PFC series Fiber Couplers are low loss, four port devices designed to slide into any free position in the PFOS mainframe. While the electrical connector is used for positioning, the couplers do not require electrical power. The couplers are packaged securely within a single module and are connectorized with a standard ST style optical connector. The convenient location of the coupler alongside the sources and detectors make it very easy to adapt the system for a large variety of measurements.

6.2 SPECIFICATIONS

CHARACTERISTICS	UNITS	MODEL NUMBER						
		PFC6	PFC10	PFC50	PFC62	PFC100	PFC200	PFC400
Core Dia.	μm	4	9	50	62.5	100	200	400
Cladding Dia.	μm	125	125	125	125	140	230	430
Excess Loss (max)	dB	1	1	1	1	1	2	2
Directivity (max)	dB	40	40	30	30	30	25	25
Nominal splitting Ratio	1:1	1:1	1:1	1:1	1:1	1:1	1:1	10
Ratio Tolerance	±%Rn	10	10	10	10	10	10	3 or 4
Ports	-	4	4	4	4	4	3 or 4	

Rn = Nominal Splitting Ratio

DEFINITIONS



Excess Loss $-10\log\{(P_2+P_3)/P_1\}$

Directivity $-10\log(P_4/P_1)$

Splitting Ratio P_3/P_2

NOTE: The three port devices do not have port P_3. In these units port P_3 has been eliminated leaving a single output port P_2. In OTDR applications Ports P_1 and P_4 are connected to the source and detector respectively.

6.3 OPERATION

The PFC does not require power for operation but is located in the MF20 mainframe for convenience.

6.3.1 OPERATION AS A COUPLER To operate the PFC as a coupler, connect the two light sources to ports P_1 and P_4. The coupled signals can then be observed from ports P_2 and/or P_3 (Port P_2 only, for the three port couplers). The four port couplers are symmetrical, hence will work in the reverse direction as well.

6.3.2 OPERATION AS A SPLITTER To operate the PFC as a splitter, couple a single light source into port P_1 or into port P_4. The light will then be split into the specified ratio at ports P_2 and P_3. The four port devices are symmetric and can be used in the reverse direction as well. (The three port splitters must be configured; in - P_2, out P_1 and P_4.) For the PFC to give the stated splitting ratio, it is necessary to completely fill the fiber. (i.e. all propagation modes must be filled.) The correct splitting ratio will not be obtained, for example, if a 50 μm core fiber is connected to a 100 μm core splitter. The lack of mode mixing has further ramifications when attempting bandwidth or optical time domain reflectometry measurements.

6.3.3 OPTICAL CONNECTORS It is a good practice to keep the plastic caps on the connectors and over the adaptors when they are not in use, even for short periods of time. It takes only a small particle of dirt to cause large losses. A small grain of sand ground into the glass face can cause irreparable damage.

6.3.4 MISMATCHED FIBER CORE SIZES In certain applications (OTDR for example) it can be advantageous to run a pigtailed source with a smaller core into a splitter with a larger core. If only the lower modes of the splitter fiber are excited then the light will pass through one arm of the splitter with very little loss. This arm can be used to inject the light into the test fiber. On the return trip all the fiber modes will probably be excited so that the splitter will now operate as designed. The result is a lower excess loss than would normally be expected. This will not affect distance measurements but will cause erroneous loss measurements.

6.4 TROUBLESHOOTING

There is very little to malfunction with the PFC Series Couplers as they are passive devices. However the following items can be checked.

1. If signals are unexpectedly weak, check the optical connectors to insure that they are clean and undamaged. The smallest speck of dust can greatly increase the losses.

2. It is possible to check for breakage simply by shining a bright light into port P_2 and observing the outputs of ports P_1 and P_4. Port P_3 (Four port devices only) can be illuminated next to check its integrity.

If the PFC Series Coupler is damaged, it must be returned to the factory for repair as it cannot be repaired in the field.

6.5 WARRANTY AND REPAIR

For warranty and repair information refer to section 1.2.

6.6 DATA SHEET

MODEL NUMBER PFC 10 SERIAL NUMBER 073

PFOS 191 for SAVEN

FIBER TYPE 9/125 µm

EXCESS LOSS < 0.7 dB

SPLITTING RATIO ~ 1:1

NOTES:

1. The above splitting ratio is correct whenever the input fiber has been fully filled with light and all modes are stabilized. In certain instances, with the OTDR system this is not the case, so that the splitting ratio will appear to be different from that stated above. Usually, this has no adverse effect and can sometimes even be turned into an advantage.

2. The excess loss is that loss measured at time of manufacture and does not take into account connector losses, which can be considerable. For use in the OTDR system excess loss is measured differently such that the results can be checked directly. For details see the DOCUMENTATION section in the OTDR manual.

Completed by J.L. Date 95/12/14