Making Light Work Lighter

General Photonics Corporation

PSM – 001

Miniature Microprocessor Controlled Fiber-Optic
Polarization Scrambler Card

Operation Manual

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Section 1. Specifications:

Physical Features:

Board Dimensions	101 mm (L) × 76 mm (W) × 20 mm (H)
Fiber Input/Output Connectors	FC/PC, FC/APC, SC/PC or SC/APC

Optical Characteristics:

Insertion Loss	< 0.05 dB (without connectors) < 0.6 dB (with connector)
Center operating wavelength	1260-1650 nm and 970-1260 nm standard
Operating wavelength range [1]	> 300 nm
Output degree of polarization	< 5% [2]
Average PMD	< 0.05 ps
Intrinsic PDL	< 0.05 dB
Optical return loss	> 65 dB (without connectors)
Optical power handling	> 1000 mW

Electrical Characteristics:

Power Supply	5.0-5.5V DC, 3 W max.
Power consumption	0.5-3 Watts, depending on scrambling rate
Scrambling frequencies (Hz)	User selectable, 10, 20, 50, 100, 200, 500 1 k, 2 k, 5 k, 10 k, 12 k, and 12.5 k

Environmental Requirements:

Operating Temperature	10 °C to 65 °C
Storage Temperature	-10 °C to 65 °C

Note:

1. Center wavelength ± 150 nm.
2. Per 1000-point average.

Section 2. Overview:

PSM-001 is a miniature polarization scrambler card that integrates General Photonics' Award winning PolaRite polarization controller, driver circuit, and a microprocessor based controlling electronic circuit on a single module, as shown in Figure 1. PSM-001 employs continuous fiber construction that results in extremely low optical insertion loss, polarization dependent loss, and polarization mode dispersion. It uses 5V DC power supply and has very low electric power consumption. The device can be operated with battery power supplies. PSM-001 is an ideal tool for hand-held optical instrument, frequency selectable polarization scrambling, device characterization, network conditioning, and other polarization related applications.

PSM-001 consists of a 3-axis electromechanical polarization controller, a micro-processor, and driving circuits that generate control signals to randomize the input polarization state. The operation of PSM-001 can be described as a multi-stage birefringent modulator in cascading. All birefringent modulators are set at random retardations that are independent to each other. The combination of these random polarization modulators creates a randomly oriented birefringent waveplate with random phase retardation. The driving voltage for each axis has been adjusted to achieve a near uniform polarization state distribution on Poincare sphere. External power supplies are required to operate the module.

Microprocessor control provides a greatly expanded capability for the PSM-001 module. PSM-001 can operate over a large temperature range and a wide wavelength band. Standard PSM-001 module can cover 1260-1650 nm fiber transmission window. Short wavelength PSM-001 module covers wavelength range from 970 nm to 1260 nm.

Figure 1. PSM-001 polarization scrambler module.

Section 3. Feature Descriptions:

Warning:

Avoid touching the heat sink because the temperature on the heat sink may reach over 60°C during normal operation.

3.1 Optical Features:

PSM-001 module has two fiber pigtails, one for the input and the other for the output. The input and output fiber pigtails are interchangeable unless user specifies special connector combinations for the input/output fiber pigtails.

Fiber connectors can either be FC/PC, SC/PC, or FC/APC per customer's specifications.

Before each connection, fiber connectors should be cleaned using industry standard fiber connector cleaning methods.

Fiber pigtails should be handled carefully. Excessive force on fiber pigtails may degrade scrambler performance or damage the device.

3.2 Electrical Features:

PSM-001 module has a compact circuit board size of 3"x4". The polarization controller and other electronic components are directly mounted on the board. PSM-001 is designed as either an equipment plug-in module or a stand-alone module for laboratory research and experiment. The operation of PSM-001 module requires a +5V DC power supply that is converted to +72V DC on the board. The location and pin assignment of the external power supply connectors will be discussed and illustrated in Section 3.2.1.

The scrambling frequencies are set by a factory supplied program. Unless specified, the scrambling frequency can be changed from 10, 20, 50, 100, 200, 500, 1k, 2k, 5k, 10k, 12k, and 12.5k hertz. These frequencies can be selected with a push button on the print circuit board. The default initial frequency setting can be selected with a SDIP switch on the circuit board.

There are multiple jumpers set at factory for testing and tuning purpose. User should not remove these jumpers unless authorized by the manufacturer.

3.2.1 Scrambler board

An overview of the miniature polarization scrambler board is shown in Figure 2. The board consists of a PolaRite III polarization controller, driving electronics, power and

communication connector blocks. The external power supply needs to be connected to a 2-pin connector jumper block JPOW near upper right hand corner as shown in Figure 2 and 3, along with the pin assignment scheme for the JPOW connector.

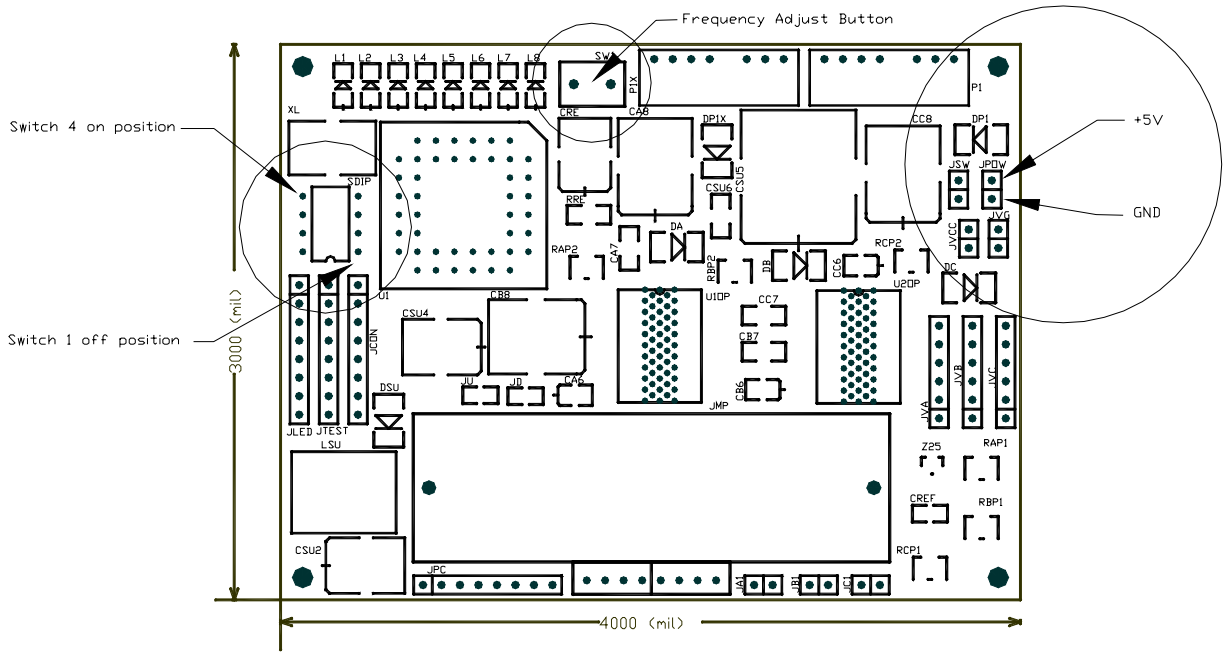

Figure 2. Circuit board layout showing the DC power connector location on the driver board (Top View).

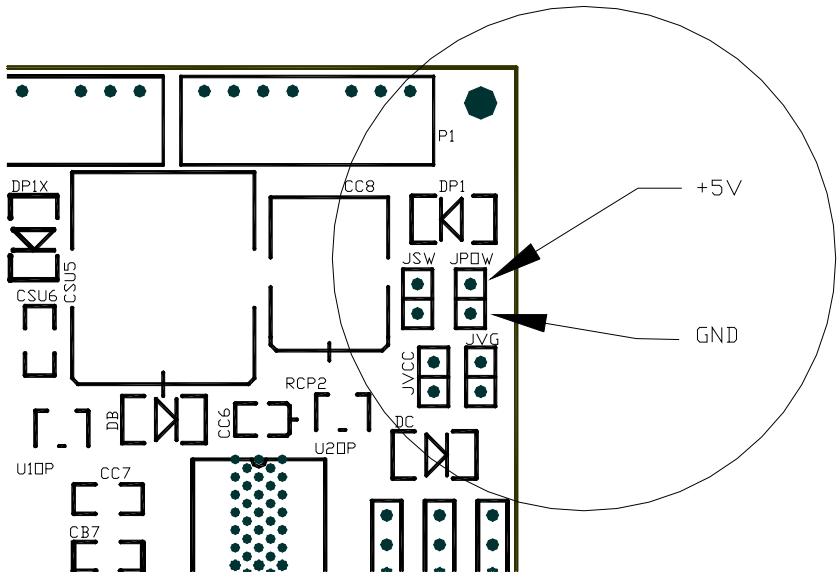

Figure 3. Magnified power connector area (Top View).

3.3 Environment Requirements:

PSM-001 board is designed for indoor use in an office or laboratory environment. Outdoor operation requires PSM-001 board to be packaged inside a weatherproof enclosure or other standard outdoor electronic packaging. If PSM-001 is placed inside an enclosure, it is best to have natural air or forced-air cooling when the scrambling rate is over 1 KHz.

The recommended operation temperature range is 10 - 65°C.

Section 4. Operation Instruction:

To operate PSM-001 as an individual laboratory instrument, electrical and optical connections are required during setting up. Follow the safety precautions when make electrical and optical connections.

Warning:
Never look at the fiber connector against the light exit direction when light source is connected. THE OUTPUT LIGHT FROM PSM-001 MODULE MAY BE HARMFUL TO HUMAN EYES.

4.1 Unpacking

Great care must be taken when unpacking PSM-001 module from its original shipment package.

The electronic circuit is sensitive to static discharge.

Inspect the module to check if any component becomes loose or disconnected during shipment.

Avoid applying any force to two optical fiber pigtails (blue color) and do not let any free-drop of fiber connectors occur at any time.

4.2 Getting Started

Follow the steps below to operate PSM-001 in a laboratory environment.

1. Set the power supply to the correct voltage before connecting the power cable. Turn off the power supply before plugging the cable to power jumper connector JPOW shown in Figure 2 and 3. The cable connector is unidirectional.

Warning: Avoid contacting the electronic components or metal leads, wires on the PSM-001 board. They may have a DC voltage up to 72 V.

2. Turn on the power supply after connecting power cable. The device will be operating at the initial scrambling frequency that is determined by the SDIP switch shown in Figure 2 and Figure 4.

   The initial scrambling frequency is user selectable using the DIP switch SDIP located at the left hand side of the board shown in Figure 2. The initial scrambling frequencies and the corresponding switch positions are listed in Table 1 where the digit 0 stands for OFF position and digit 1 stands for ON position. The factory setting is all OFF, that is, the 0000 setting corresponding to the highest scrambling frequency.

   The initial frequency setting switch is to minimize the frequency adjustment every time when the device is powered off. This feature is very useful for outdoor field service instruments operated on battery power. In order to save battery life, the power supply of this unit can be turned off when the instrument is not in use. When the unit is turned on again, it will be immediately operating at a desired scrambling frequency.

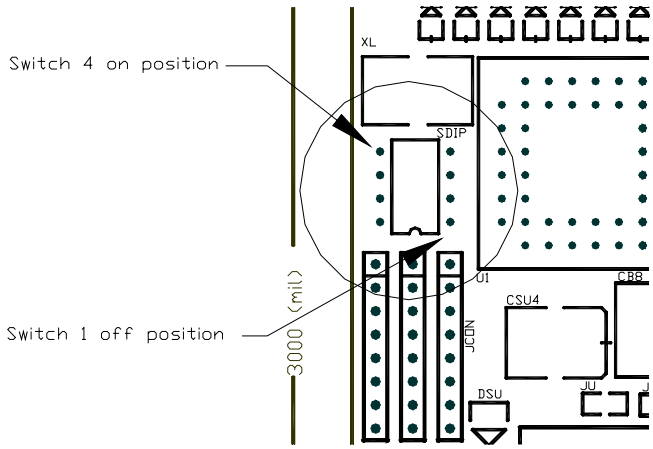

Figure 4 Initial scrambling frequency setting.

Table 1 Initial scrambling frequency setting and corresponding SDIP position

SW 4	SW 3	SW 2	SW 1	Scrambling Frequency (Typical)
0	0	0	0	12.5 (kHz)
0	0	0	1	12 (kHz)
0	0	1	0	10 (kHz)
0	0	1	1	5 (kHz)
0	1	0	0	2 (kHz)
0	1	0	1	1 (kHz)
0	1	1	0	500 (Hz)
0	1	1	1	200 (Hz)
1	0	0	0	100 (Hz)
1	0	0	1	50 (Hz)
1	0	1	0	20 (Hz)
1	0	1	1	10 (Hz)
1	1	0	0	Channel A only
1	1	0	1	Channel B only
1	1	1	0	Channel C only
1	1	1	1	Disable

3. Scrambling frequency selection/changing during normal operation: Pressing switch SW1 shown in Figure 2 and Figure 5 will increase the scrambling frequency sequentially according to the order in Table 1. Once the maximum scrambling frequency is achieved, pressing SW1 again will switch the scrambling frequency to the lowest frequency (10 Hz) setting. The operation of SW1 results in a cyclic frequency settings.

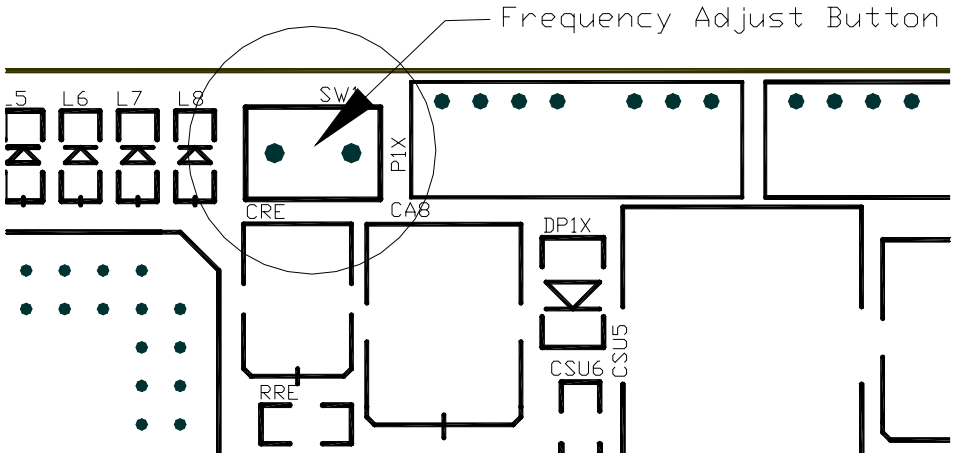

Figure 5 Location of frequency adjustment button SW1 (Top View)

4. Connect the input/output fiber connectors to the appropriate optical lines.

5. To turn off scrambler, the user needs to turn off power supply to the board.

4.3 Testing and Characterization:

PSM-001 can be serviced only by manufacturer authorized personnel. No user serviceable components in this module.

User can test the performance of PSM-001 with available polarization analysis instruments or other established methods. Note that the DOP specification for PSM-001 is calculated using 1000 discrete sampling points that are sampled at a slower rate than the scrambling rate.

4.4 Remote control and programming:

Remote control of PSM-001 requires hardware and software modifications. There is no user interface (such as RS 232) available for the current hardware version. However, the flexibility of the microprocessor and extra input/output lines allow us to modify the device for remote applications. If any user is interested in the remote operation of PSM-001, please contact General Photonics at the address listed in the cover page of this Manual.

Section 5. Technical Support

General Photonics is committed to high quality standard and customer satisfaction for its products. If there is any question regarding the quality and the use of PSM-001 board, please feel free to contact General Photonics Corporation at (909)-590-5473 or info@generalphotonics.com.