8-channel In-Line Array

Product Manual

The PPAA8x0 system is an array in-line power monitor with analog and digital outputs.

The analog outputs consist of one (typically SMA) connector per channel which provides an output voltage that has a lognormal relationship to the input optical power (V=A log(P), with A typical 0.01, 1mV for each dBm).

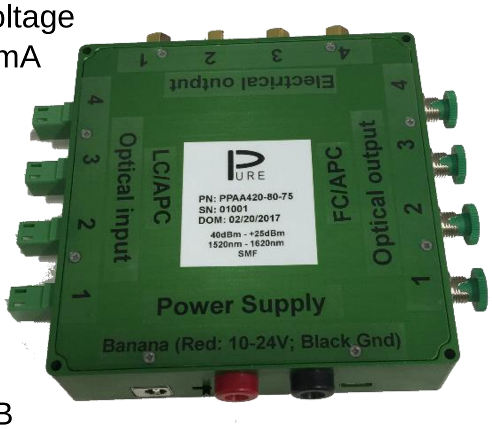
The digital output is a micro-USB connector that installs as a serial interface. The interface allows for reading device properties (serial#, manufacturer, power range) and for reading the output power for each channel.

Optionally the product can be configured with a VOA to vary the output power level or to stabilize the output power level (fixed attenuation or fixed output power mode).

Later versions of the product (serial number 1030 and onwards) have a built-in memory to collect the power information over an extended time-period (like a DAQ).

1. System description

The PPAA8x0 is a 6”x6”x1” box with inputs/outputs on its four sides. The labeling on the lid indicates these inputs/outputs. Looking at the device from the electrical inputs (with the micro-USB interface).



Front; the system is powered by a 10-24V voltage source. Current draw will be of the order of 50mA or less. The supply can be provided with a wall-plug power supply (barrel-plug input) or with banana-plugs. For the banana-plugs, the **black input needs to be connected to ground** and the **red input needs to be connected to the positive voltage**. The slide switch is used to turn the power supply on or off, in case only one supply is connected (recommended). The micro-USB interface connects to the internal micro-processor and can be directly connected to a computer. This USB input is powered by the system, so only after activation of the power, the USB input is detected by the computer. The interface will install as a serial interface.

Left; the optical inputs (connector types as indicated on the box). From the front to the back-side the channels are numbered 0 to 7.

Right; the optical outputs (connector types as indicated on the box). From the front to the back-side the channels are numbered 0 to 7.

Back; the electrical analog outputs. The voltage on these outputs have a lognormal relationship to the input power. The channels are numbered 0 to 7 from the optical input side to the optical output side.

2. Optical connections

The type of optical connections are indicated on the box. They can also be derived from the partnumber PPAA8x0-yy-zz, where yy are the input connectors' type and zz are the output connectors' type. The input/output can either be an adapter or a connectorized pigtail. The definition of x, yy and zz are defined to the right.

x	**Power range** 1: -50 - +15dBm 2: -40 - +25dBm
yy	**Input connector** 10: FC/ PC pigtail 15: FC/APC pigtail 30: SC pigtail 35: SC/APC pigtail 40: LC pigtail 45: LC/APC pigtail 70: FC/PC bulkhead 75: FC/APC bulkhead 80: LC/APC bulkhead 85: LC bulkhead 90: SC bulkhead 95: SC/APC bulkhead
zz	**Output connector** (see above)

Be sure not to mix angle polished and straight polished parts as damage may occur.

At all times, ensure cleanliness of the optical connector by using the appropriate cleaning equipment and by ensuring visual inspection of the connector face before inserting the connector. Never input a connector without verifying that it is clean. It is very difficult to clean the connector facets on the inside of the system, once they have been contaminated. Contamination will result in excess loss.

3. Analog Output

The analog outputs are SMA connectors and can be connected to any co-axial cable. The input impedance of each channel is 40 kOhm. We recommend to use a high impedance (>1 MΩ) detection method, otherwise the reading may be impacted by the sensing system.

The typical response of the analog output is 1mV per dBm. E.g. 0dBm is 0V, 10dBm is 10mV and -30dBm is -30mV. Upon request the device can be configured with a different relationship between voltage and power. This is not user-settable.

4. Digital Output

The digital micro-USB interface will install as a serial port. In case the interface does not automatically install as a serial port, the following driver should be downloaded: http://www.ftdichip.com/Drivers/CDM/CDM21224_Setup.zip at http://www.ftdichip.com/Drivers/VCP.htm.

The communication protocol is derived from a tunable laser standard (see http://www.oiforum.com/wp-content/uploads/OIF-ITLA-MSA-01.3.pdf) which writes and reads from registers. Note that it is the intend to also add SKIPPY support in the future.

Most registers are read-out as 16-bit integer values. Some registers are Automatic Extended Addressing, which allows the provision of more information in one single query (e.g. serial number). The following registers are defined:

Register	Name	Description	Details
0x00	NOP	Status register	R
0x01	DevType	System Type	R, AEA, PDARRAY
0x02	MFGR	Manufacturer	R, AEA, PurePh
0x03	Model	Model Identification	R, AEA, PPAA4x0-yy-zz
0x04	SerNo	Serial Number	R, AEA, PPAAxxxx
0x05	MFGDate	Manufacturing or latest calibration date	R, AEA, MM-DD-YYYY
0x06	Release	Firmware version	R, AEA, 7.x.x
0x50	OpsL	Lowest power level	R, units of 0.1dBm
0x51	OpsH	Highest power level	R, units of 0.1dBm
0x31	Channel	Channel identification	R/W, 0-3
0x35	FCF1	Frequency (THz part)	R/W, units of THz
0x36	FCF2	Frequency (MHZ part)	R/W, units of 0.1MHz
0x42	OOP	Power	R, units of 0.01dBm; signed integer
0x0D	IOCap	Communication definition	R/W, sets baudrate
0x14	DLConfig	Download configuration	R/W, allows firmware upgrade
0x0B	EA-EAR	AEA register	R, allows read of AEA registers
0x70		Power Direct	R, units of 0.01dBmp; provide desired channel in the data field.
0x71		VOA mode	R/W; 0 for fixed attenuation; 1 for fixed power
0x72		VOA absorption	R/W, units of 0.01dB; attenuation setpoint for fixed attenuation; reads 0 for fixed power

0x73		VOA power target	R/W; units of 0.01dB (signed); power target for fixed power;
0xA0		Collection Mode	R/W; trigger configuration
0xA1		Collection Rate	R/W; units of samples/sec
0xA2		Collection No of Samples	R/W; samples to collect
0xA3		Collection Read value	R; read single values or have the memory output in burst mode
0xA4		Switch configuration	ONLY ON SELECT HARDWARE Configuration of switch

Channel output power

To obtain the latest measured output power from each channel, first set the channel register to the correct value by writing the channel number to register 0x31 (so channel can be set to the values 0 – 7). Then read the output power for that channel from register 0x42. The output power is provided in units of 0.01dBm, the 16 bit value is a signed integer, so for values about 0x7fff, the value is calculated at value – 0x1000 (65536).

An averaged power value may be obtained (integration time approximately 1 second) by writing (0x0100+(channel)) to register 0x31 (equivalent to 256+(channel-1)).

The power may also be read directly by addressing register 0x70 and inserting the desired channel ID in the data field (available since February 2018)

Channel VOA mode

To set the VOA mode for each channel, first set the channel register to the correct value by writing the channel number to register 0x31 (so channel can be set to the values 0 – 3). Then set read or set the VOA mode by writing 0 (for constant attenuation mode) or 1 (for constant power mode) to register 0x71.

Channel VOA target

To set the VOA target value for each channel, first set the channel register to the correct value by writing the channel number to register 0x31 (so channel can be set to the values 0 – 3). Write the desired value to register 0x72

In constant attenuation mode, the target is an attenuation value in units of 0.01dB. Only positive numbers are allowed.

Channel power target

In constant power mode, the target is an output power value in units of 0.01dBm. The value is configured as a signed integer. The output power range is limited to the power capabilities of the unit.

Device information

The device information can be obtained through registers 0x01 through 0x06 and 0x50 and 0x51.

Setting baud rate

The baud rate can be set to 4 values (0=9600Baud; 1=19200Baud; 2=38400Baud; 3=57600Baud; 4=115200Baud). The baudrate is stored in bits 4-7 of register 0x0D. The baudrate can be set by multiplying the value by 16 (e.g. 16 x 4 = 64 for 115200 Baud) and writing it to the register. The current value can be read as bits 4-7 of the response package (note that the interface is already at the right baudrate if communication is possible). The default baudrate is 9600 Baud.

Collection configuration

The unit, when hardware equipped, can collect data over a selected period of time at a selected data rate. The registers 0xA0 to 0xA3 are used to set this feature.

Register 0xA0 is used to set the collection mode. Bit 0 is used for software trigger and writing 1 to this bit will start the collection. Bit 1 is for hardware trigger and when set to 1 will start the collection on a trigger on the hardware line (if equipped). Bit 2 is for a latched hardware trigger. After a trigger is received bits 1 and 2 are set back to 0. When the collection is in progress, all writes to this register except 0x00 are rejected. Writing 0x00 to this register will stop any collection and set the register to 0. Doing so may corrupt the data. Reading this register will provide a 1 in bit 1 if the module is waiting for a hardware trigger. Bit 15 is 1 if the module is collecting.

Registers 0xA1 is used to set the collection rate in samples per second. 1 sample includes a reading of each channel. The minimum read time per channel is 200us and the minimum read time per sample is 200us x number of channels. For each channel the internal switches are set and the remainder of the time per channel is used for settling of the signal. The actual measurement is taken at the end of the interval, just before the switch is set to a new channel. As such, the collection is not truly simultaneous. A settling time of 10us is the maximum required for each channel. Note, that the bandwidth of the log conversion and associated electronics, which is dependent on the input power and the device configuration is not related to the channel settling time and collection beyond the bandwidth of the full system may not be helpful.

Register 0xA2 is used to set the number of samples that are being collected. For a 1 shot measurement the value can be set to 1.

Register 0xA3 is used to read the collection data. The value in this register read provides the sample ID (e.g. 2 channels system, channel 2, point 30 is (30-1)*2+(2-1)). When writing 0xFFFF to register 0xA3, the unit will go into a data-dump mode. It will continuously write all samples, starting at sample ID 0 and cycling through each channel (i.e. sequence is e.g. Sample0;Ch0 – Sample0; Ch1 – Sample0;Ch0 - Sample1;Ch1 – etc.). It will continue this until the number of samples in register 0xA2 is reached or until a command is received from the user. In the data dump mode the reading of e.g. 1000 samples on 2 channels will take 0.3 seconds at 115200 baudrate. In the standard mode (with all overheads) this would take at least 1.5 seconds.

Uploading new firmware

Firmware upload is a sensitive process and has the potential to make the digital interface of the device non-operational. The new ray-file needs to be obtained from the manufacturer and uploaded to the device.

Please note that the underlying interface to communicate with the micro-processor is RS-232. RS-232 has some different features than USB and the USB interface is typically not configured optimally. **It is required to go into the device manager and change the latency time for the USB interface to 1ms and the packet size to 64.** Please refer to the application note of firmware upgrade for an example.

The upgrade procedure should be done through the Command Line Interface. This program is available at http://www.pure-photonics.com/downloads1/. The following procedure should be followed:

- it.connect(x,9600)   #x is the COM port number
- it.baudrate(115200)
- it.upgrade('application',r'c:\.....ray')   #with the location of the ray file on the system

The firmware upgrade process takes about 2-3 minutes in most cases, but can take up to 15 minutes for slower systems. **Do not disrupt the power supply during the firmware upgrade process.**

5. Software support

Graphical User Interface

Pure Photonics makes a GUI available on its website. It contains a program ‘PP GUI – Analog Array Detection.bat’. After entering the com port on which the micro-USB is installed, this GUI will connect to the device and continuously update the measured output power on each channel.

Command Line Interface

Pure photonics makes a CLI available for communication with the device. The interface is established by typing it.connect(x,9600) where x is the COM port number. The program allows to read the different registers (e.g. it.channel(3) to set the channel to 3 and it.channel() to read the channel). The autocomplete structure allows easy access to all registers. Note that the CLI does contain several commands that are not applicable to this system.