VOA Array Rack System

(net-ready, high precision, 70dB, high speed, SM/MM, broadband)

(US patent 8,666,218 and other patents pending)

The VOA Array Rack System is highly versatile that is cable of meeting performance requirements for all application scenarios. The system intergrades feedback minoring power taps to provide high-precision attenuation or output laser power control. Power control is lower in cost than attenuation control. Many types of VOAs can be selected. MEMS VOAs offer low cost and up to 70dB shut-off. Electro-optical NanoSpeed™ VOAs offer 800ns fast response and a high-speed laser power stabilization function that eliminates fluctuations and surges. Fiber-Fiber™ VOAs offer ultra-broadband covering from 200 to 2500nm with all types of fibers and ultra-low insertion loss.

The system is a modular pluggable design that accommodates any number of channels in a single system with various corresponding rack heights. Each standard plug-in contains up to 8 channels using compact LC connectors, and a 1U system can be configured to have 24 channels. Only the VOAs on the same plug-in module can be controlled simultaneously. There is a short time delay to control VOAs between modules. A special unit can be made in which all channels are controlled simultaneously. The same system can further integrate other modules, such as switches, power monitors, and dispersion compensators…. The standard control interface is ethernet. Other control methods may be available per request. A standard Web-based GUI is included.

Features

- Very Low Loss
- Highly Repeatable
- Latching
- High Resolution
- Large Attenuation

Applications

- Power Control
- Power Regulation
- Channel Balance
- Instrumentation

Specifications

Parameters	Min	Typical	Max	Unit
Operation Wavelength	300		2500	nm
Insertion Loss		0.3	0.5 [1]	dB
		1	1.5 [2]	dB
Polarization Dependent Loss		0.15	0.5	dB
Wavelength Dependence Loss		0.1	0.2	dB
Attenuation Range	20	60	78 [3]	dB
Attenuation Setting Repeatability			0.05	dB
Extinction Ratio (PM version only)	18	23	25	dB
Polarization Mode Dispersion (SM version only)		0.01	0.05	ps
Return Loss	45			dB
Response Time			100	ms
Optical Power handling (CW)		0.3	20 [4]	W
Operating Temperature	-20		75	°C
Storage Temperature	-40		85	°C
Electrical Power Input	100		230	VAC
Communication Interface (Ethernet)	SNMP	Telnet		

Notes:

[1]. Use Ultra-broad band Precision MEMS VOA with build-in position sensor. The loss is without the connectors. Each connector adds 0.1 to 0.3dB (https://agiltron.com/product/high-precision-optical-variable-attenuator/)

[2]. Conventional MEMS VOAs with tap monitor. It has a limited wavelength range due to coatings. The loss is without the connectors. Each connector adds 0.1 to 0.3dB depending on mating condition.

[3]. 60dB and 78dB uses special MEMS VOAs and Precision MEMS VOAs

[4]. 1W single mode and 3W multimode are only available with Precision MEMS VOAs (https://agiltron.com/product/high-precision-optical-variable-attenuator/)

Note: The specifications provided are for general applications with a cost-effective approach. If you need to narrow or expand the tolerance, coverage, limit, or qualifications, please [click this link]:

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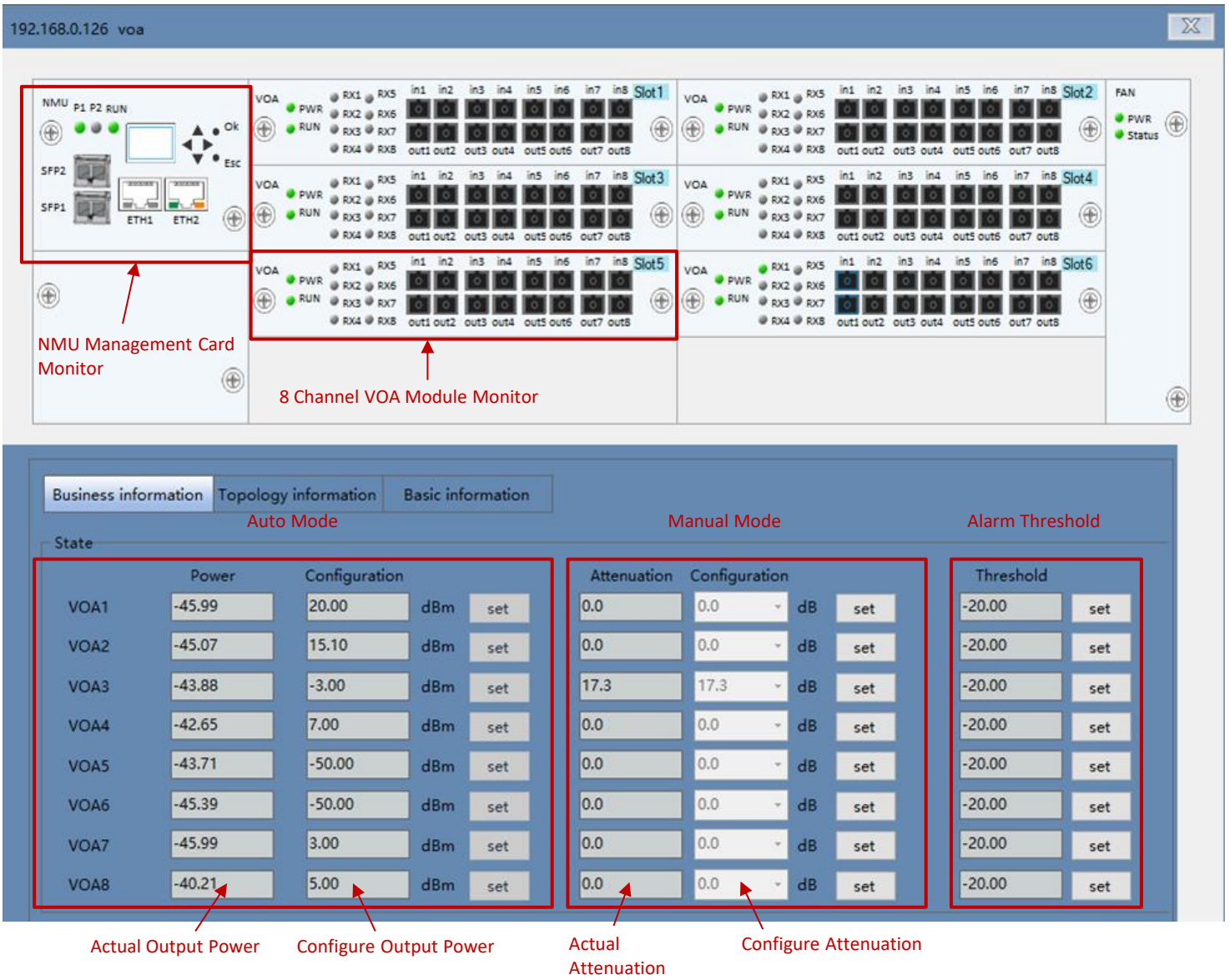
GUI Software

- The system contains tap monitor on each channel output providing attenuation and power control function.



We provide a command list for customers to write their control code, such as Python

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Mechanical Footprint Dimensions (mm)

19" rack. The unit will select the minimum height to accommodate the channel count and connector type

For 1U chassis

- Choose LC connectors up to 32 Channels; 4 pluggable cards
- Choose FC, SC, or ST connectors for up to 16 Channels; 2 pluggable cards

*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

Ordering Information

- ❑ The system includes a rack-mount box of from 1U up to 6U with multiple plug-in modules
- ❑ Pluggable module order information below, each module accommodate up to 8 channels power control with LC connectors

	□□	□	□	□	□□	□	□	□	□□
Prefix	**Channel**	**Speed**	**Configuration [1]**	**Test Wavelength**	**Fiber type**	**Attenuation**	**Connector**	**Interface[2]**	**Output Power[3]**
VOAS-	8 = A8 16 =16 24 =24 32 =32 ... 96 =96	MEMS 100ms = 1 NS 10µs/18dB = 2 NS 10µs/35dB = 3 NS 10µs/50dB = 5 NS 1µs/18dB = 6 NS 1µs/35dB = 7 NS 1µs/50dB = 8 Latching 100ms = L	Transparent Auto Output Control = 1 Transparent Auto Attenuation Control = 2 Opaque Auto Output Control = 7 Opaque Auto Attenuation Control = 5 5W NS Transparent/Auto Output Control = H MEMS Transparent Calibrated [4] = C Special = 0	1260-1620 = C 488 = 4 532 = 5 630 = 6 780 = 7 850 = 8 980 = 9 1060 = 1 1310 = 3 1550 = A 2000 = 2 Special = 0	Pick from the below table	35dB = 1 60 dB = 2 65 dB = 3 70 dB = 4	FC/PC = 2 FC/APC= 3 SC/PC = 4 SC/APC= 5 ST/PC = 6 LC/PC = 7 MTP = 9 LC/APC = A LC/UPC = U Special = 0	Ethernet = E RS232 = R 0-5V = A UART = U	N/A = NA 0.001W = A1 0.002W = A2 ... 0.01W = B1 0.02W = B2 ... 0.1W = C1 0.2W = C2 ... 1W = D1 2W = D2 ... 9W = D9 10W = 10 ... 20W = 20

[1]. **Transparent**: The device passes light without applying electrical voltage.
Opaque: The device blocks light without applying electrical voltage.
Auto Output Control: Using one output tap to feed-back control the output power.
Auto Attenuation Control: Using input and output taps to subtract feed-back control the attenuation

[2]. **A and U** are choice for NS type fast VOA only. Each channel has a dedicated connection on the front panel. UART is a digital control format that can also be converted into USB interface. A GUI is provided.

[3]. For the selection of auto output power control only. Since the VOA has a limited dynamic range, a maximum output power needs to be selected and the minimum controllable output power = max output setting – dynamic range-insertion loss.

[4]. This version has no feedback control but is curved fit for precision control

Fiber Type Selection Table:

01	**SMF-28**	34	**PM1550**	67	**OM1 (MMF 62.5/125µm)**
02	**SMF-28e**	35	**PM1950**	68	**OM2 (MMF 50/125µm)**
03	**Corning XB**	36	**PM1310**	69	**OM3 (MMF 50/125µm)**
04	**SM450**	37	**PM400**	70	**OM4 (MMF 50/125µm)**
05	**SM1950**	38	**PM480**	71	**GIF50 (GIF 50/125µm)**
06	**SM600**	39	**PM630**	72	**GIF625 (GIF 62.5/125µm)**
07	**Hi780**	40	**PM850**	73	**105/125um**
08	**SM800**	41	**PM980**	74	**FG105LCA**
09	**Hi980**	42		75	**FG50LGA**
10	**Hi1060**	43	**PM780**	76	
11	**Draka BBE**	44		77	
12		45		78	

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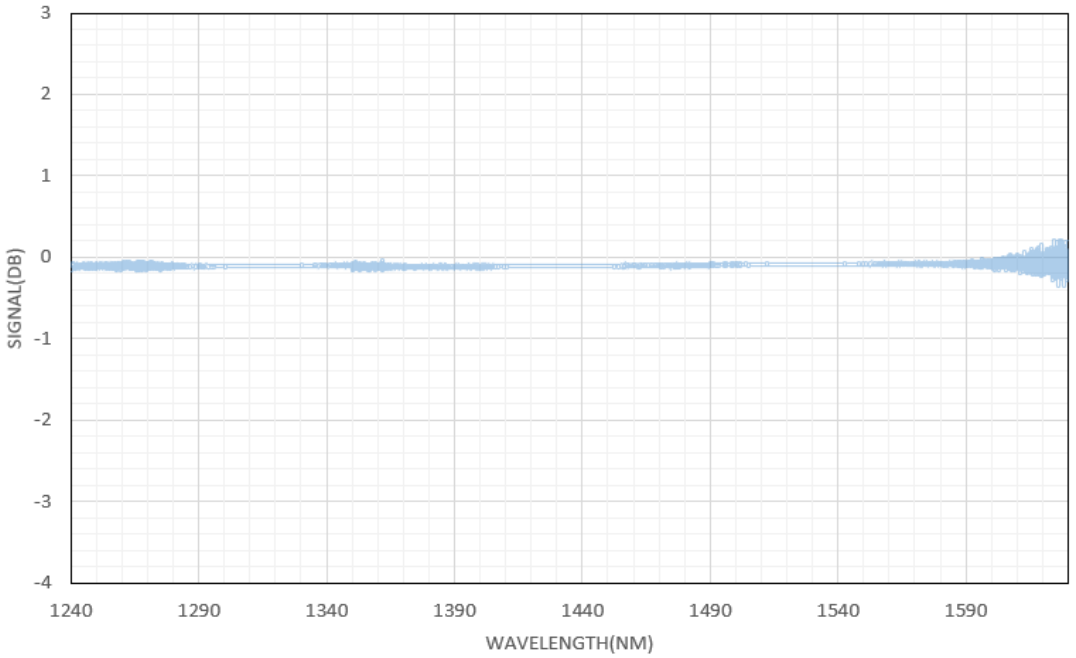
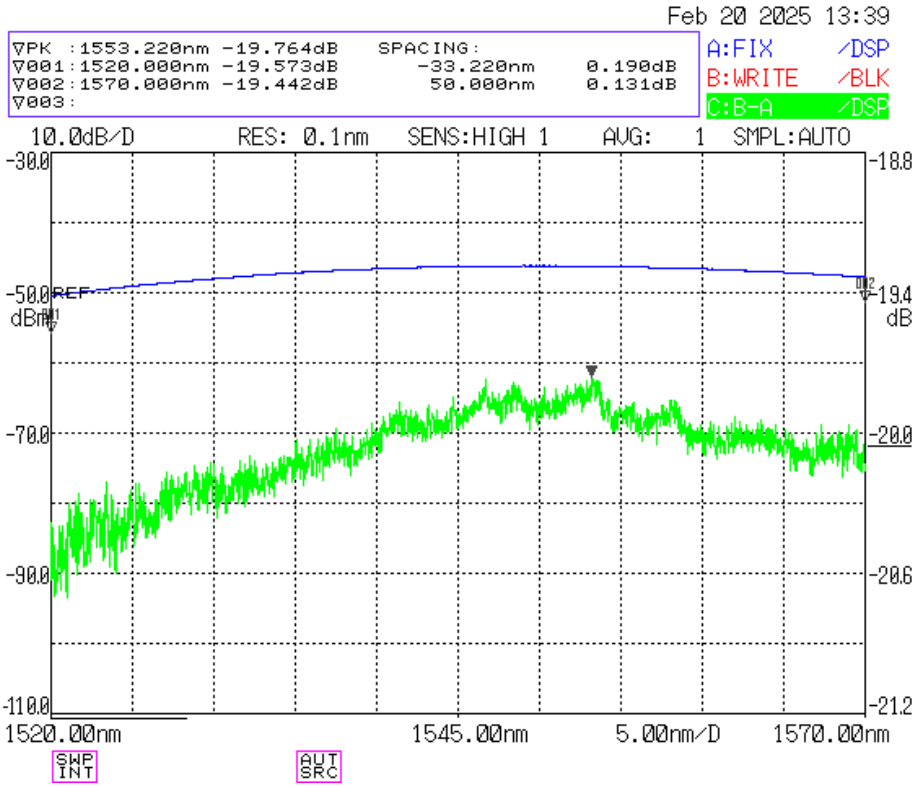
Typical Insertion Loss vs Wavelength (1240-1630nm)



Typical Wavelength Dependence @20dB Attenuation



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Application Notes

Fiber Core Alignment
Note that the minimum attenuation for these devices depends on excellent core-to-core alignment when the connectors are mated. This is crucial for shorter wavelengths with smaller fiber core diameters that can increase the loss of many decibels above the specification if they are not perfectly aligned. Different vendors' connectors may not mate well with each other, especially for angled APC.

Fiber Cleanliness
Fibers with smaller core diameters (<5 μm) must be kept extremely clean, contamination at fiber-fiber interfaces, combined with the high optical power density, can lead to significant optical damage. This type of damage usually requires re-polishing or replacement of the connector.

Maximum Optical Input Power
Due to their small fiber core diameters for short wavelength and high photon energies, the damage thresholds for device is substantially reduced than the common 1550nm fiber. To avoid damage to the exposed fiber end faces and internal components, the optical input power should never exceed 20 mW for wavelengths shorter 650nm. We produce a special version to increase the how handling by expanding the core side at the fiber ends.

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Operation Manual

1. Connect a control signal to the SMA connector on the PCB.
2. Attach the accompanied power supply (typically a wall-pluggable unit).
3. The device should then function properly.

Note: Do not alter device factory settings.

Questions and Answers

Q: If the device were to fail, would the switch continue to pass the fiber light through the switch as configured before failure? When power is restored, does the IN/OUT configuration before failure remain in place?
A: This depends, if one mirror fails, it only affects the light go through that mirror. Yes, when power back up it will go to the previous points

Q: When power is restored, does the IN/OUT configuration before failure remain in place?
A: Yes, when power back up it will go to the previous flightpath

Q: If power to the device were shutoff, would the device continue to pass the fiber light as configured before failure?
A: This function is call latching. We uniquely offer MEMS latching switch but cost more.

Q: With the Ethernet Control Option, does the switch support SNMPv3
A: Yes. This internet standard protocol allows user to write their own control code

Q: With the Ethernet Control Option, what type of encryption does the SNMPv3 use?
A: MD5/DES

Q: With the Ethernet Control Option, could this device be controlled by multiple users at different locations and all users will also see the configuration updates?
A: Yes

Q: With the Ethernet Control Option, could this switch be controlled by multiple users at different locations and all users will also see the configuration updates?
A: Yes

Q: With the Ethernet Control Option, does the user need to install any software on their computer other than a web browser?
A: No

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Command List (page 1)

```
 Login：
1, Use the Windows Command Prompt,
2, telnet 192.168.1.200 or the current IP address
3, Username: root
4, Password: fs19681086

***** Command List *****
1, Request General information:
NMC B_?
Example:
[FAST@\h \W]# NMC B_?
Show NMC Info:
===== NMC Chassis Info =====
Name Power1Status Power2Status FanSwitch FanStatus DateTime
OTNS4443 open close open close 2021-07-15 08:28:13

===== NMC Basic Info =====
Type Slot SoftVer HardVer MadeDate DevType SeqNum
NMC 00 1.08.15 1.02.01 2021-01-01 OTNS-M4 1234567890AB

===== NMC Payload Info =====
Name Payload(%) PayloadThr(%) Status
CPU 2 80 normal
Memory 9 80 normal

===== NMC Database Info =====
Name AutoBackup(day) AutoRecord(hor) Capacity(row)
DBM 1 1 200

===== NMC Network Info =====
Version Switch NetAddress Netmask Gateway MacAddress
IPv4 open 192.168.001.200 255.255.255.000 192.168.001.001 70-b3-d5-46-04-29
IPv6 close fe80:0:0:0:1034:56 ff:fe78:9126/64 fe80:0:0:0:0:0:0:1 70-b3-d5-46-04-29

===== NMC SNMP Info =====
Version ReadCom WriteCom AuthPassword PrivPassword TrapIP TrapIP2
IPv4 public private 123456789 123456789 127.000.000.001 127.000.000.001
IPv6 public private 123456789 123456789 0:0:0:0:0:0:0:1

===== NMC RemoteLog Info =====
Version Switch NetAddress
IPv4 open 127.000.000.001
IPv6 close 0:0:0:0:0:0:0:1

2, Fan Operation:
2.1 Turn on the Fan
NMC FNC_1

2.2 Turn off the Fan
NMC FNC_0
Return Success or Fail
Example:
[FAST@\h \W]# NMC FNC_1
Send: FNC_1
Return: Operation Success
[FAST@\h \W]#
[FAST@\h \W]# NMC FNC_0
Send: FNC_0
Return: Operation Success
[FAST@\h \W]#
```

Command List (page 2)

3, Set System Time

NMC TIME_2021-07-05-14-02-02
Example:
[FAST@\h \W]# NMC TIME_2021-07-05-14-02-02
Send: TIME_2021-07-05-14-02-02
Return: Operation Success
[FAST@\h \W]#

4, Set the Payload

4.1 CPU payload

NMC CPULIM_xx
Note: xx is the payload of CPU, from 1~99
Example: Set the CPU payload to 80%
[FAST@\h \W]# NMC CPULIM_80
Send: CPULIM_80
Return: Operation Success
[FAST@\h \W]#

4.2 Memory Payload

NMC MEMLIM_xx
Note: xx is the payload of system memory, from 1~99
Example: Set the memory payload to 80%
[FAST@\h \W]# NMC MEMLIM_80
Send: MEMLIM_80
Return: Operation Success
[FAST@\h \W]#

5, Network Operations

5.1 IP address

NMC IP_192.168.1.200
Example:
[FAST@\h \W]# NMC IP_192.168.1.200
Send: IP_192.168.1.200
Return: Operation Success
[FAST@\h \W]#

5.2 Subnet Mask

NMC MSK_255.255.255.000
Example:
[FAST@\h \W]# NMC MSK_255.255.255.000
Send: MSK_255.255.255.000
Return: Operation Success
[FAST@\h \W]#

5.3 Gateway

NMC GW_192.168.1.1
Example:
[FAST@\h \W]# NMC GW_192.168.1.1
Send: GW_192.168.1.1
Return: Operation Success
[FAST@\h \W]#

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Command List (page 3)

6, Card information

CARD -c xx B_?
xx is the card slot number, 2~16
Example:
[FAST@\h \W]# CARD -c 16 B_?
Show Card Info:

===== CARD Monitor Info =====

Chan	Mode	Wave(nm)	CurrPower(dBm)	ConfigPower(dBm)	CurrAtten(dB)	ConfigAtten(dB)	OutputThr(dBm)	OutputState
1	auto	1550	-50	-63.15	36	36	-69	normal
2	auto	1550	-50	-63.1	40	40	-19	alarm
3	auto	1550	-50	-63.1	40	40	-19	alarm
4	auto	1550	-50	-63.15	0	0	-19	alarm
5	auto	1550	-50	-63.1	0	0	-19	alarm
6	man	1550	-50	-63.13	9	9	-19	alarm
7	auto	1550	-50	-63.13	0	0	-18	alarm
8	man	1550	-50	-63.18	0	0	-70	normal

===== CARD Basic Info =====

Type	Slot	SoftVer	HardVer	MadeDate	DevType	SeqNum
VOA8	16	1.05.01	1.01.02	2021-03-16	VOA8-2table	123456789012

7, VOA Operations

7.1 Single Channel working mode setup

CARD -c xx My_z
Note:
xx is the slot number of the card, from 2~16
y is the Channel number on the card, from 1~8
z is the mode, 1 is auto mode, 0 is manual mode
Example of setting the channel 1 on Card 16 to auto mode:
[FAST@\h \W]# CARD -c 16 M1_1
Send: M1_1
Return: Operation Success
[FAST@\h \W]#
Example of setting the channel 1 on Card 16 to manual mode:
[FAST@\h \W]# CARD -c 16 M1_0
Send: M1_0
Return: Operation Success
[FAST@\h \W]#

7.2 All Channels working mode setup

CARD -c xx MTOT_z_z_z_z_z_z_z_z
Note:
xx is the slot number of the card, from 2~16
z is the mode, 1 is auto mode, 0 is manual mode
Example to set the channel 1 and 2 on card 16 to auto mode, the rest channels are set to manual mode:
[FAST@\h \W]# CARD -c 16 MTOT_1_1_0_0_0_0_0_0
Send: MTOT_1_1_0_0_0_0_0_0
Return: Operation Success
[FAST@\h \W]#

Command List (page 4)

7.3 Single Channel wavelength setup

```
CARD -c xx Wy_z
Note:
   xx is the slot number of the card, from 2~16
   y is the Channel number on the card, from 1~8
   z is the wavelength code, 1 is 1550nm, 0 is 1310nm
Example of setting the wavelength of channel 1 on card 16 to 1550nm:
[FAST@\h \W]# CARD -c 16 W1_1
Send: W1_1
Return: Operation Success
[FAST@\h \W]#
Example of setting the wavelength of channel 1 on card 16 to 1310nm:
[FAST@\h \W]# CARD -c 16 W1_0
Send: W1_0
Return: Operation Success
[FAST@\h \W]#
```

7.4 All Channels wavelength setup

```
CARD -c xx WTOT_z_z_z_z_z_z_z_z
Note:
   xx is the slot number of the card, from 2~16
   z is the wavelength code, 1 is 1550nm, 0 is 1310nm
Example of setting the channel 1 and 2 on card 16 to 1550mm, the rest channels are set to 1310nm:
[FAST@\h \W]# CARD -c 16 WTOT_1_1_0_0_0_0_0_0
Send: WTOT_1_1_0_0_0_0_0_0
Return: Operation Success
[FAST@\h \W]#
```

7.5 Single Channel Output Power setup

```
CARD -c xx Py_z
Note:
   xx is the slot number of the card, from 2~16
   y is the Channel number on the card, from 1~8
   z is the power in dBm
Example of setting the output power of Channel 1 on card 16 to 2dBm:
[FAST@\h \W]# CARD -c 16 P1_2
Send: P1_1
Return: Operation Success
Example of setting the output power of Channel 1 on card 16 to -1dBm:
[FAST@\h \W]#
[FAST@\h \W]# CARD -c 16 P1_-1
Send: P1_-1
Return: Operation Success
[FAST@\h \W]#
```

```
7.6 All Channels Output Power setup
CARD -c xx PTOT_z_z_z_z_z_z_z_z
Note:
   xx is the slot number of the card, from 2~16
   z is the power in dBm
   Example of setting the output power of Channel 1 and 2 on card 16 to 1dBm, the rest channels to 2dBm:
[FAST@\h \W]# CARD -c 16 PTOT_1_1_2_2_2_2_2_2
Send: PTOT_1_1_2_2_2_2_2_2
Return: Operation Success
[FAST@\h \W]#
```

Command List (page 5)

7.7 Single Channel attenuation setup

```
CARD -c xx Ay_z
Note:
   xx is the slot number of the card, from 2~16
   y is the Channel number on the card, from 1~8
   z is the attenuation in dB
Example of setting the output power of Channel 1 on card 16 to 10dB:
[FAST@\h \W]# CARD -c 16 A1_10
Send: A1_10
Return: Operation Success
[FAST@\h \W]#
[FAST@\h \W]# CARD -c 16 A1_20
Send: A1_20
Return: Operation Success
[FAST@\h \W]#
```

7.8 All Channels attenuation setup

```
CARD -c xx ATOT_z_z_z_z_z_z_z_z
Note:
   xx is the slot number of the card, from 2~16
   z is the attenuation in dB
Example of setting the output power of Channel 1 and 2 on card 16 to 1dB, the rest channels to 2dB:
[FAST@\h \W]# CARD -c 16 CARD -c 16 ATOT_1_1_2_2_2_2_2_2
Send: ATOT_1_1_2_2_2_2_2_2
Return: Operation Success
[FAST@\h \W]#
```

7.9 Single Channel alarm level setup

```
CARD -c xx RXy_z
Note:
   xx is the slot number of the card, from 2~16
   y is the Channel number on the card, from 1~8
   z is the power level in dBm
Example of setting the alarm level of channel 1 on card 16 to -20dBm
[FAST@\h \W]# CARD -c 16 RX1_-20
Send: RX1_-20
Return: Operation Success
[FAST@\h \W]#
Example of setting the alarm level of channel 1 on card 16 to -21dBm
[FAST@\h \W]# CARD -c 16 RX1_-21
Send: RX1_-21
Return: Operation Success
[FAST@\h \W]#
```

7.10 All Channels alarm level setup

```
CARD -c xx RXTOT_z_z_z_z_z_z_z_z
Note:
   xx is the slot number of the card, from 2~16
   z is the power level in dBm
Example of setting the alarm level of Channel 1 and 2 on card 16 to -10dB, the rest channels to -20dB:
[FAST@\h \W]# CARD -c 16 RXTOT_-10_-10_-20_-20_-20_-20_-20_-20
Send: RXTOT_-10_-10_-20_-20_-20_-20_-20_-20
Return: Operation Success
[FAST@\h \W]#
```