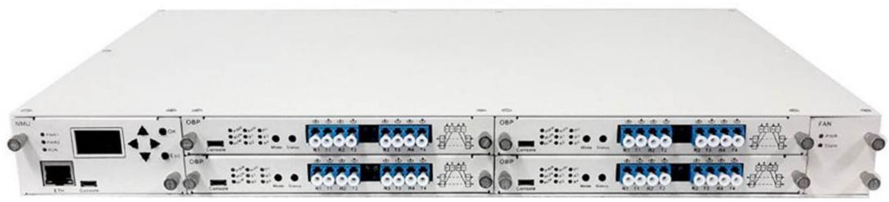
MEMS 1xN Fiber Optical Switch

(N Up to 196 Ports, Non-Blocking, Bidirectional, Passive, 65dB on/off)

The MEMS Fiber Optical Switches establish optical signal paths passively within milliseconds, supporting all data rates with industry-leading performance, repeatability, and long-term reliability suited for continuous operation. Designed for automated test environments, the flexible rack-mount platform supports a variety of optical modules, including variable attenuators, power monitors, and polarization-dependent loss (PDL) measurement modules, making it ideal for testing passive components, transponders, and line cards. Control connectivity includes local RS-232, USB, GPIB, with GUI interfaces, as well as a remote Ethernet GUI compatible with standard network management protocols. The 1U front panel accommodates approximately 40 LC connectors (1×36 configuration), with box height dependent on connector type and port count. A comprehensive command set is provided for software integration; custom code debugging is not included, though an optional Application Programming Interface (API) service is available to simplify remote manufacturing integration. For minimum command-to-switch latency, a dedicated real-time computer — such as a single-board system running real-time Linux — is recommended for optimal performance.

Due to inherent computer delays under Windows, response speed can be improved by using a Linux-based controller or executing stored switching sequences directly on the board. In this mode, the host computer simply issues start, pause, and repeat commands.



Features

- Low Cost
- High Reliability
- Low Insertion Loss
- Broad Band
- Up To 500 Port
- 750, 850, 1550, 2000nm

Applications

- Optical Signal Routing
- Network Protection
- Wavelength Management
- Signal Monitoring
- Instrumentation

Telcordia®
RoHS compliant

Specifications [1]

Parameters		Min	Typical	Max	Unit
Operation Wavelength		750	1250~1670	2400	nm
Insertion Loss [1] (SM)	1x8	0.5	0.7	0.8	dB
	1x24	0.5	0.8	1.0	
	1x32	0.5	0.9	1.2	
	1x64	0.5	1	1.5	
	1x128	0.5	1.5	1.8	
Insertion Loss [2] (MM)		0.5	1	4.3	dB
Crosstalk, On/Off Ratio (SM) [3]		65			dB
Polarization Extinction Ratio (PM)		20		26	dB
Switch Speed (Rise, Fall) [4]			5	20	ms
Durability		10^9			cycle
Polarization Dependent Loss			0.04	0.2	dB
Wavelength Dependence Loss [5]			0.1	0.3	dB
Return Loss[3]		50			dB
Repeatability			0.05	0.1	dB
Operating Temperature		-5		65	°C
Port to Port Time Delay Difference				0.5	ns
Optical Power Handling (CW) [6]			300	500	mW
Storage Temperature		-40		85	°C
AC Power Source		90 ~ 240 V (50 / 60 Hz)			
Weight		15 kg			
Package Dimension		1RU / 2RU / 4RU <400mm(D)			

Notes:

[1]. Measurement Conditions: Losses are measured at 1550 nm without connectors for SM28 fiber. Each connector adds 0.2–0.3 dB of loss. Loss increases for shorter or longer wavelengths. **0.5dB Low Loss version is available**

[2]. Multimode Switch Performance: The optical performance of a multimode switch depends on the mode fill ratio across the core (CPR).Small Fill Ratio: using a single-mode laser, results in lower loss. Large Fill Ratio: using an LED, results in higher loss. The difference can be 50X.

[3]. Fiber Type Considerations: Multimode (MM) fiber typically exhibits lower performance values compared to single-mode (SM) fiber in similar conditions.

[4]. Intrinsic Switch Performance: The performance values provided reflect the intrinsic switch component capabilities. Remote control introduces additional delay, with Ethernet having the longest delay. Using a Linux-based computer can reduce CPU-induced delay.

[5]. Bandwidth Range: Performance specifications are valid within a 50 nm bandwidth around the central wavelength.

[6]. The maximum rating applies to the 1×N configuration. For N×1 applications, the maximum input power is the sum of the power from all input ports. The specified maximum value is valid for wavelengths above 1310 nm; at shorter wavelengths, the optical power handling is reduced due to the smaller mode field diameter.

Rev 08/12/26

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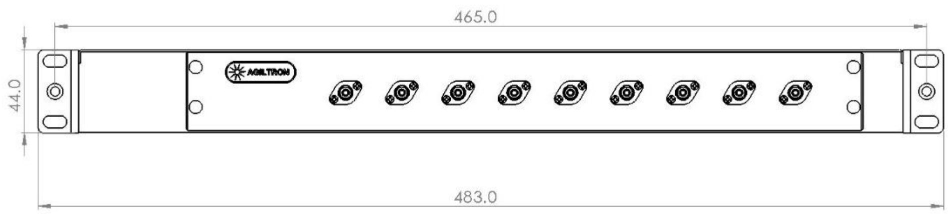
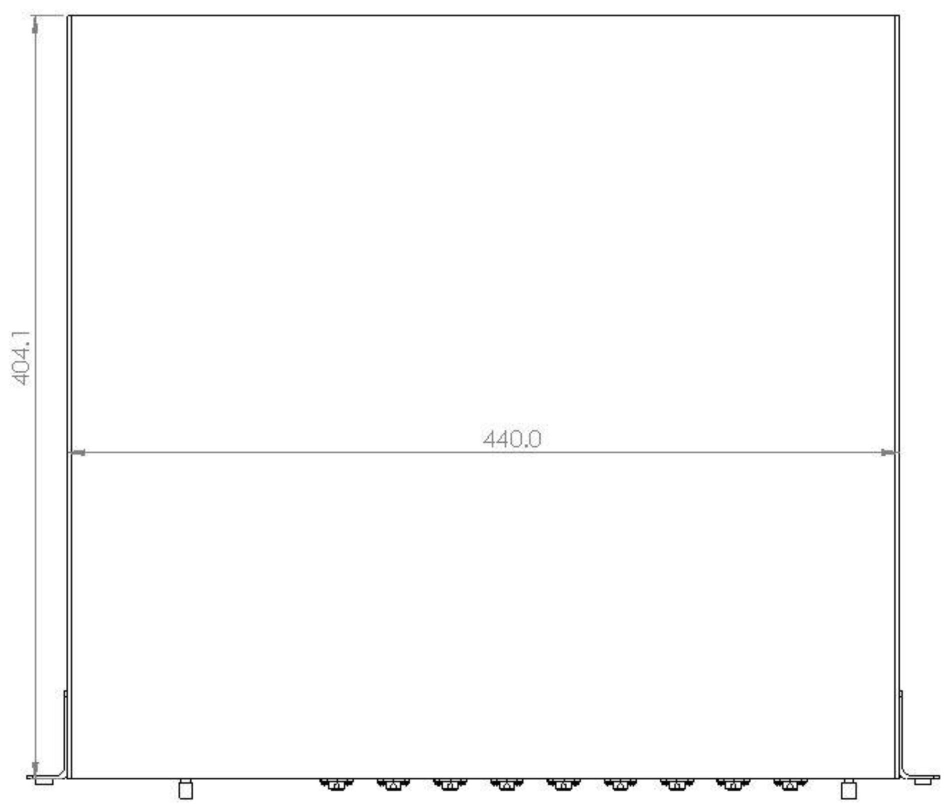
Mechanical Dimensions (mm)

1U Rack Mount





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

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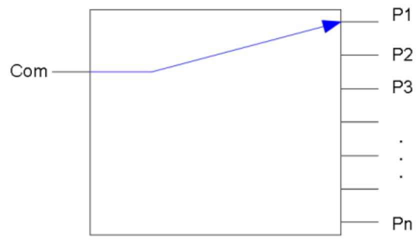
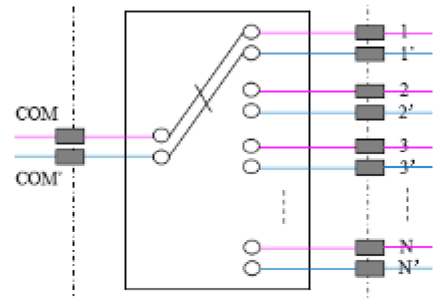
Optical Path Illustration

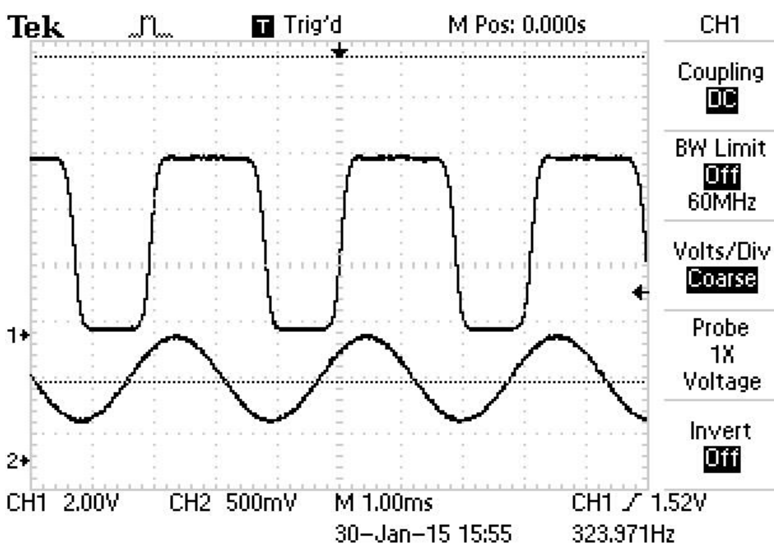




- 1xN
- 2xN

10^9 Switching Cycle Test

We have tested MEMS 1x2 switch at the resonant frequency ~300Hz for more than 40 days, as shown in the attachment, which corresponds over 10^9 switching cycles. The measurements show little changes in Insertion loss, Cross Talk, Return loss, etc, all parameters are within our specs.



Control & Electric Interface

The switch default control is Ethernet with a GUI.

- Physical Layer: 10/100Base-T
- Data Link Layer: Ethernet Protocol per IEEE 802.3
- Network Layer: IPv4
- Transport Layer: TCP
- Application Protocol: SNMP
- Connector Type: RJ-45
- Dual 48V/110-220V Power Input

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

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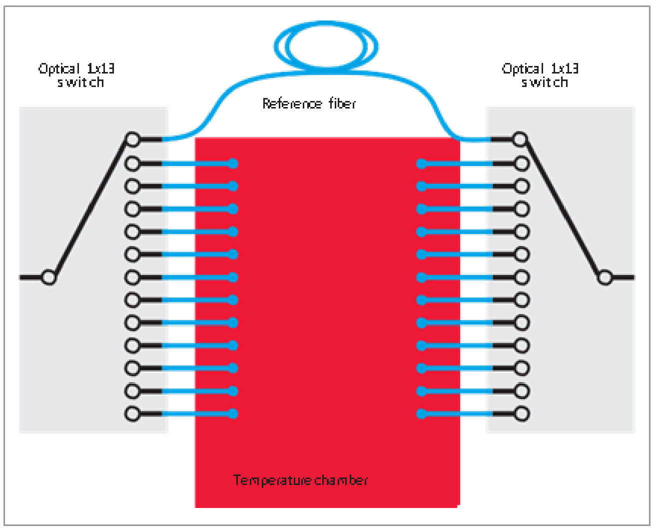
Parallel Testing Configuration

In many cases, valuable signal source and analysis instrumentation can be used more effectively in a parallel-test configuration. For example, multiple cables or components can be tested together during temperature cycling. On the other hand, an increasing use of inherently parallel components, as for optical interconnections for 40G or 100G using 10 Gb/s components, calls for identical testing in multiple paths. These are well supported by the 1x13 switch configuration and the 13th path can often be used as a permanent reference path.



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Ordering Information (Part Number)

	□□□	□	□	□	□	□	□	□	□	□	□
Prefix	**Type [1]**	**Wavelength [2]**	**Control Interface [3]**	**Package [4]**	**Fiber Type**	**Power Supply**	**Connector [5][9]**	**On/Off**	**PER [6]**	**Monitor [7]**	**API [8]**
MEMS-	1x4 = AA4	1240-1620nm = 1	Ethernet = 2	1RU = 1	SMF-28 = 1	110-220V = 4	FC/PC = 2	Regular = 1	Non = N	Non = 1	Non = N
	1x8 = AA8	1310nm = 3	RS232 = 3	1.5U = 5	50/125 = 2	48V = 5	FC/APC = 3	SM65dB = 2	>18 = 1	Output = 2	Python = P
	1x12 = A12	1410nm = 4	USB = U	2RU = 2	Hi1060 = 3	Dual110-220V = 6	SC/PC = 4	MM50dB = 3	23 = 2	Input/Output = 3	LabVIEW = L
	1x16 = A16	1550nm = 5	GPIB = G	4RU = 4	PM1550 = 5	Dual48V = 7	SC/APC = 5	PM65dB = 5	29 = 3	Input = 4	
	1x24 = A24	1060nm = 6	Special = 0	Special = 0	780HP = 8	Special = 0	ST/PC = 6	Special = 0	Special = 0	Port Display = D	
	1x32 = A32	850nm = 8			PM980 = 9		LC/PC = 7			Bidirectional [9] = B	
	1x64 = A64	750nm = 7			62.5/125 = 6		Duplex LC/PC = 8				
	1x96 = A96	2000nm = 2			105/125 = M		LC/APC = A				
	1x128 = 128	Special = 0			SM800 = A		LC/UPC = U				
	1x192 = 192				PM850 = B		MPO = Y				
	1x256 = 256				PM780 = C		MTP 12 = S				
	Dual1x4 = DA4				PM1310 = D		MTP 24 = P				
	Dual1x8 = DA8				SM1950 = E		DuplexSC/PC = Q				
	Dual1x12 = D12				PM1950 = F		DuplexSC/APC = R				
	Dual1x16 = D16				Special = 0		E2000/APC = E				
	Dual1x32 = D32						Special = 0				
	Duplexl1x8=PA8										
	Duplex1x12=P12										
	Duplex1x16=P16										
	Dplex1x32= P32										
	Special = 000										

[1]. Duplex Mode: Both switches operate simultaneously, designed for Tx/Rx pairs in communication fiber link applications. 0.5dB low loss version exchange A to L

[2]. Wavelength Coverage: The device supports a wide range of wavelengths. Devices labeled 1, 2, 3, 4, and 5 are the same model but measured at different wavelengths. Customers can request measurements at additional wavelengths for an extra cost.
0(Special) : Operating Wavelength is 1250-1670nm.

[3]. Manual Switching: A button located on the front panel allows for manual switching, which overrides remote control functionality when activated.
0(Special) : Ethernet(TCP)/RS232(USB)

[4]. Rack Size: The rack size depends on the connector selection; the smallest size will be chosen whenever possible.

[5]. 0(Special) : SC/UPC
Regular fiber connector has PER ~22dB. Connector with PER >27 dB is available using special process

[6]. PER Definition: PER refers to the polarization extinction ratio for PM (polarization-maintaining) fiber.

[7]. Input and Output Monitoring: The output monitor function uses an external detector to tap a portion of the passing light and measure its intensity. Input and output monitor uses two external detectors that is more expensive. Port Display Option: A front panel LCD displays the selected channel, designed to function alongside the manual push-button control.

[8]. GUI and a command set are include. Application Programing Interface (API): Python $**560**. LabVIEW interface libraries $**750**

[9]. The connector cannot be installed directly onto bare fiber, as it is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. The customer can remove this protective tube after testing. The optical power handling of a standard connector is less than 0.5 W for SM28 fiber and decreases further with smaller core fibers.

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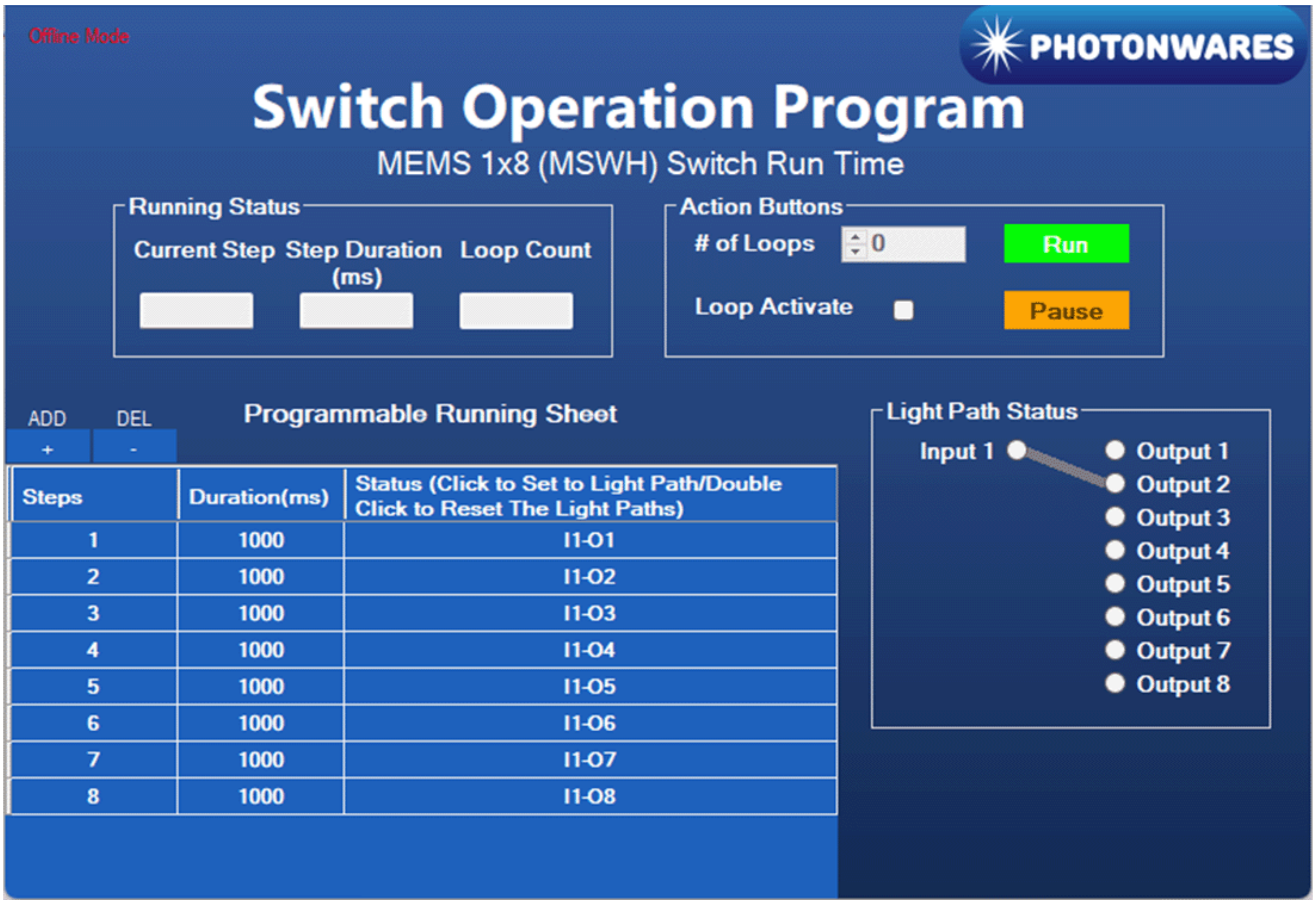
Example of RS232 Control GUI
(one can create a running receipt, pause, repeat loop)



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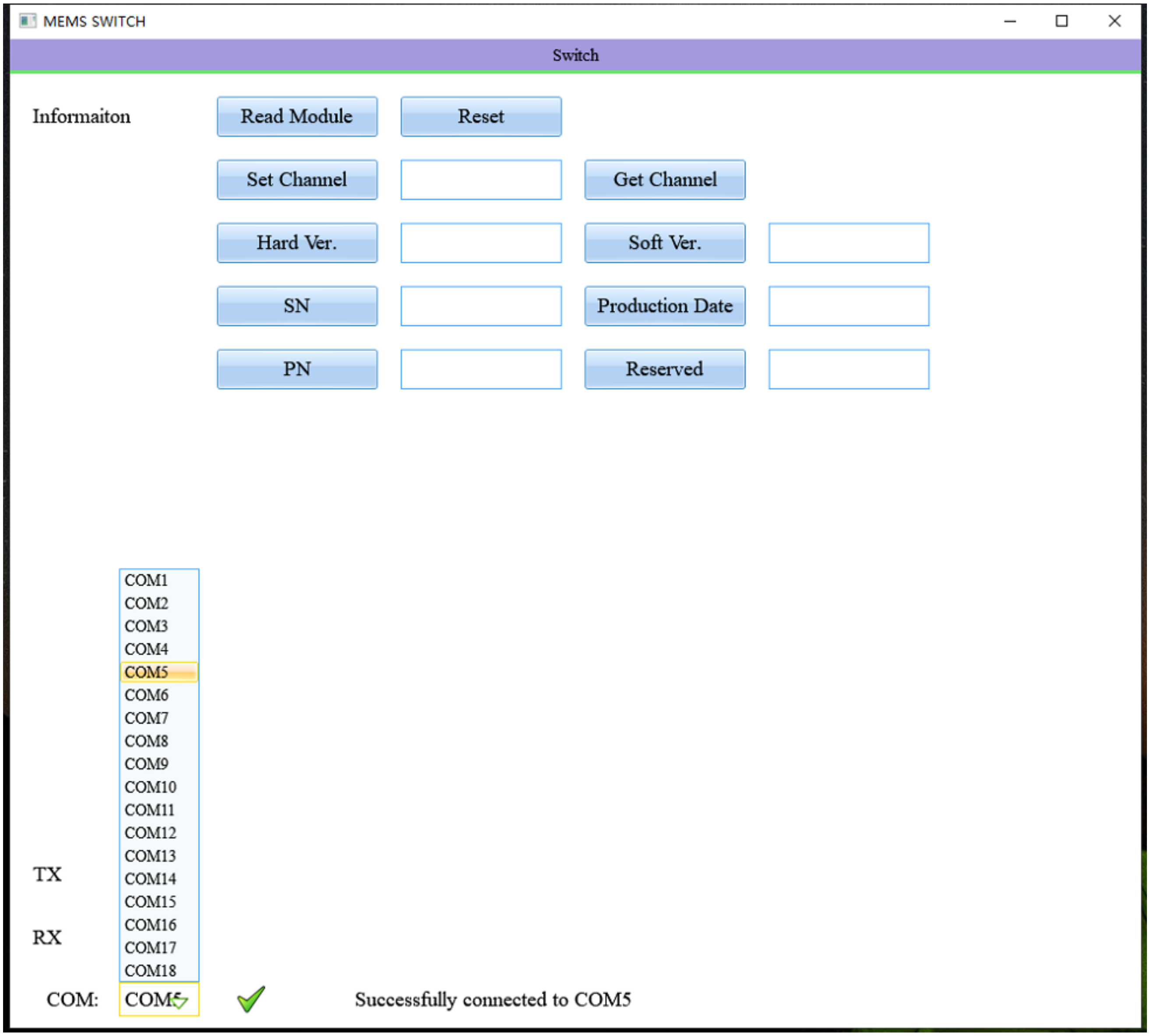
Example of RS232 Remote Control GUI



RS232 Command List (1x196 example)   (start)

```
##### COM SET #####
UART Control Setting
Baud Rate: 115200
Start Bits: 1
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None
```

RS232 Command List (1x196 example) (ending)

```
##### 1, Command Format #####
1.1 Command
FLAG           LEN            RES            CMD            DATA           SUM
2 Byte         1 Byte         1 Byte         1 Byte         0-N Byte       1 Byte

FLAG: 0xEFEF or 0xAAAA
LEN: Total number of bytes from RES to SUM
RES: 0xFF
SUM: Checksum, SUM=FLAG+LEN+RES+CMD+DATA

1.2 Response
FLAG           LEN            RES            RESP           DATA           SUM
2 Byte         1 Byte         1 Byte         1 Byte         0-N Byte       1 Byte

FLAG: 0xEDFA
LEN: Total number of bytes from RES to SUM
RES: 0xFF
SUM: Checksum, SUM=FLAG+LEN+RES+ RESP+DATA


##### 2, Command List #####
2.1 Set Channel
Command
     FLAG1     LEN            RES            CMD            DATA           SUM
     0xEFEF    0x04           0xFF           0x04           1 byte         SUM
     DATA = Channel
Response
     FLAG2     LEN            RES            RESP           DATA           SUM
     0xEDFA    0x04           0xFF           0x04           1 byte         SUM
     DATA = Result
Result = 0xEE  Success
Result = 0xEF  Fail

Example (Set Channel=180):
Command
     EF EF 04 FF 04 B4 99
Response
     ED FA 04 FF 04 EE DC

2.2 Get Channel
Command
     FLAG1     LEN            RES            CMD            DATA           SUM
     0xEFEF    0x03           0xFF           0x02           1 byte         SUM
Response
     FLAG2     LEN            RES            RESP           DATA           SUM
     0xEDFA    0x04           0xFF           0x02           1 byte         SUM
     DATA = Channel

Example (Get Channel=0):
Command
     EF EF 03 FF 02 E2
Response
     ED FA 04 FF 02 00 EC
```

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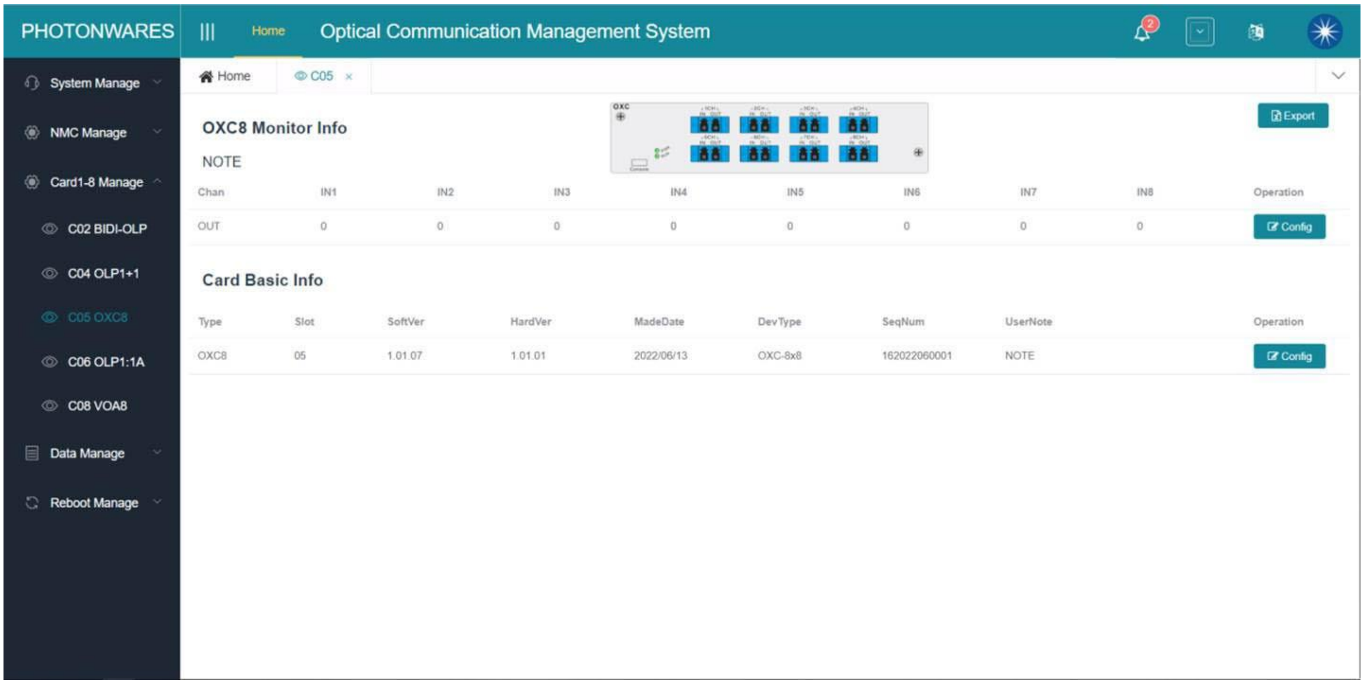
Example of Ethernet Remote Control GUI



Ethernet Command List For Telnet/Python Control (start)

```
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 Switch Status:
CARD -c xx B_?
xx is the slot number of card. For example, to show the status of the card in slot 2:
[FT@\h \W]# CARD -c 02 B_?

Show Card Info:
===== CARD Monitor Info =====
Chan           MaxRoute       CurrRoute
1              64             64

===== CARD Basic Info =====
Type           Slot           SoftVer        HardVer        MadeDate       DevType        SeqNum
OSW64          02             1.01.07        1.02.01        2021/10/22     MOSW64-DEV     333333333333
[FT@\h \W]#
2, Set Switch status:
CARD -c xx S01_y
xx is the slot number of the card.
01 is the input channel number of the switch, for 1xN products this is fixed.
y is the output channel number of the switch, for a 1x64 switch it's 1~64.
Return value: Success means operation succeed, Fail means operation failed.
```

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Ethernet Command List For Telnet/Python Control (ending)

```
For example,:
1> Set the input #1 to output #1:
   [FT@\h \W]# CARD -c 02 S01_1
   Send: S01_1
   Return: Operation Success
   [FT@\h \W]#

2> Set the input #1 to output #64
   [FT@\h \W]# CARD -c 02 S01_64
   Send: S01_64
   Return: Operation Success
   [FT@\h \W]#

3> Request the current status:
   [FT@\h \W]# CARD -c 02 B_?
   Show Card Info:
   ===== CARD Monitor Info =====
   Chan         MaxRoute       CurrRoute
   1            64             64
   ===== CARD Basic Info =====
   Type         Slot           SoftVer        HardVer        MadeDate       DevType        SeqNum
   OSW64        02             1.01.07        1.02.01        2021/10/22     MOSW64-DEV     333333333333
```

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Ethernet Remote Control with Python

Several options: Telnet, HTTP/JSON API, or VISA Raw Socket mode (SCPI over TCP/IP)

```
##########################################################
Telnet:

import telnetlib

HOST = "192.168.0.1"
PORT = 23

#####################
username = "admin"
password="admin"
###################
tn=telnetlib.Telnet(HOST,PORT)

reply=tn.read_until(b"username:",timeout=10)
print(reply.decode("ascii"))#debug
tn.write(username.encode("ascii")+b"\r\n")

reply=tn.read_until(b"password:",timeout=10)
print(reply.decode("ascii"))#debug
tn.write(password.encode("ascii")+b"\r\n")

reply=tn.read_until(b"telnet>",timeout=10)
print(reply.decode("ascii"))#debug

tn.write(b"setswitch 31 32 0 0\r\n")
reply=tn.read_until(b"telnet>",timeout=10)
print(reply.decode("ascii"))#debug

tn.write(b"runswitch\r\n")
reply=tn.read_until(b"telnet>",timeout=10)
print(reply.decode("ascii"))#debug

tn.write(b"quit\r\n")

##########################################################
```

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Ethernet Remote Control with Python (ending)

Several options: Telnet, HTTP/JSON API, or VISA Raw Socket mode (SCPI over TCP/IP)

```
##########################################################
API:
import requests

BASE_URL = "
TOKEN = "TOKEN"
def api_post(path, payload):
    r = requests.post(
        BASE_URL + path,
        json=payload,
        headers={"X-Auth-Token": TOKEN},
        timeout=3,
    )
    r.raise_for_status()
    return r.json()

def api_get(path):
    r = requests.get(
        BASE_URL + path,
        headers={"X-Auth-Token": TOKEN},
        timeout=3,
    )
    r.raise_for_status()
    return r.json()

# Set port 3
print(api_post("/api/set_permanent_port", {"port": 3}))
# Read status
print(api_get("/api/status"))

##############################################################
pyVISA:
import pyvisa

HOST = "192.168.0.1"
TOKEN = "TOKEN"

rm = pyvisa.ResourceManager()

inst = rm.open_resource(f"TCPIP0::{HOST}::5025::SOCKET")
inst.read_termination = "\n"
inst.write_termination = "\n"
inst.timeout = 2000  # ms

print("IDN:", inst.query("*IDN?").strip())

# Set port
inst.write("SWITCH:PERMANENTPORT 3")
print("PORT?:", inst.query("SWITCH:PERMANENTPORT?").strip())

# Status
print("STATUS:", inst.query("SWITCH:STATUS?").strip())

##############################################################
```

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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.

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?
A: This depends, if one mirror fails, it only affects the light going through that mirror.

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 the power to the device were shut off, would the device continue to pass the fiber light as configured before failure?
A: This function is called latching. We uniquely offer MEMS latching switches 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, does the user need to install any software on their computer other than a web browser?
A: No

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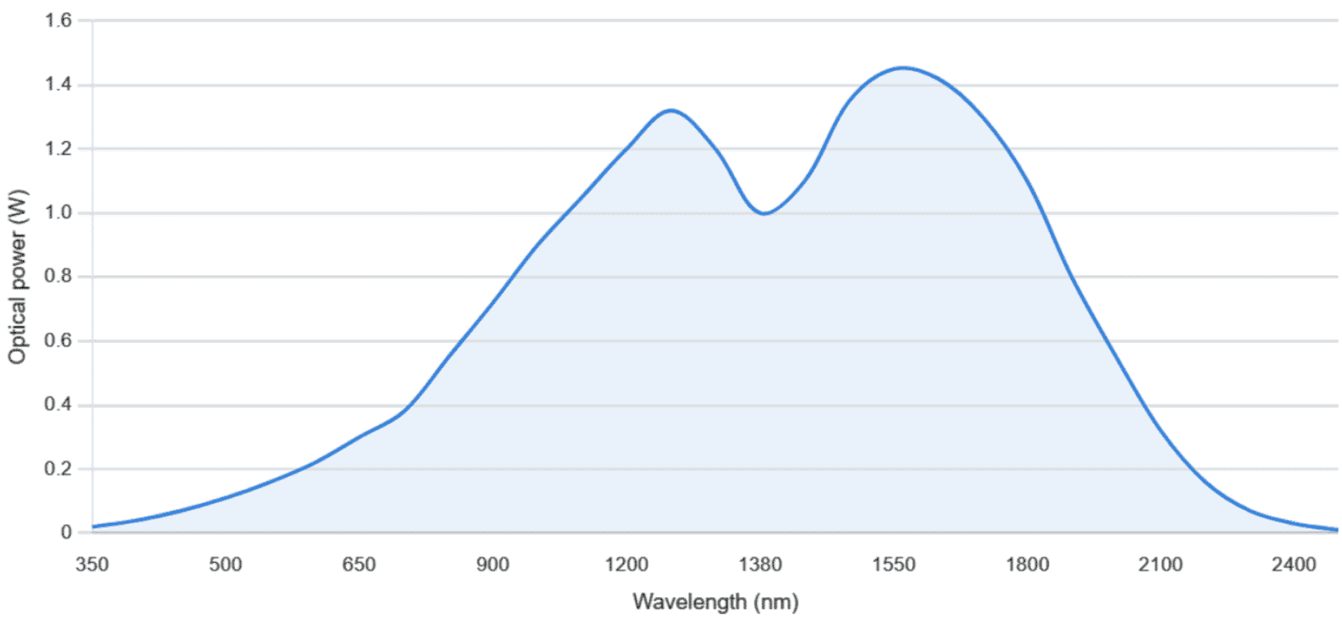
Regular Single Mode / Polarization Maintaining Fiber Optical Power Handing vs Wavelength



Single mode fiber optical power is limited by nonlinear effects in addition to absorption that increase loss and generate heat. The curve shows the approximate safe CW power envelope for standard single-mode fiber. Actual limits depend on fiber design, core size, length, and laser characteristics. Specialty fibers can significantly increase the power limit.