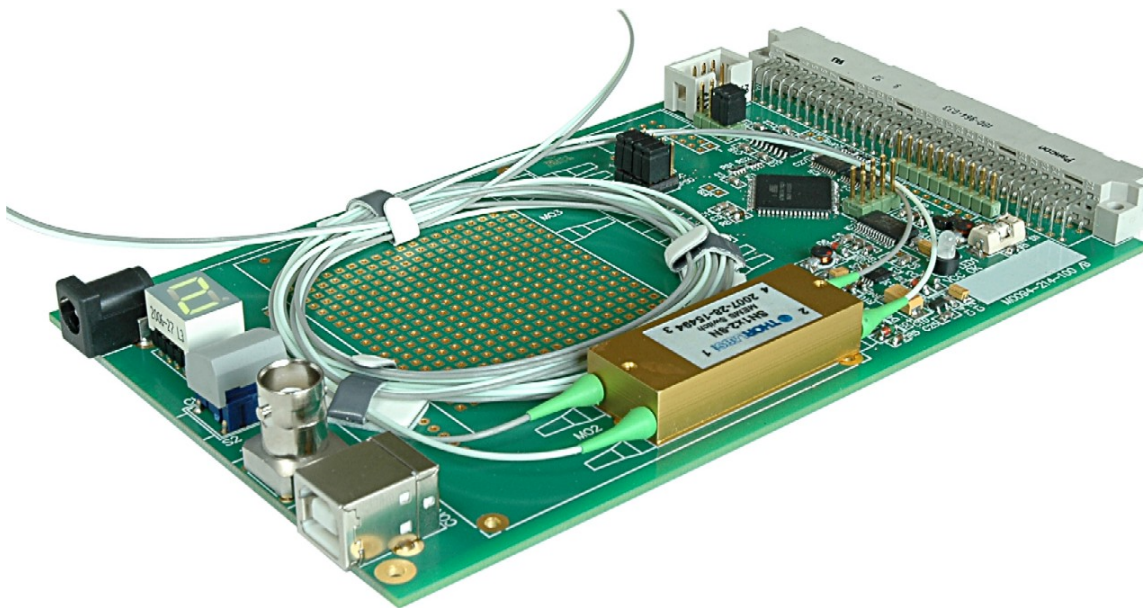




MEMS Fiber Optic Switch Kits

OSW12(22)-xxxE Operation Manual



2018

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We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and constantly improve our products we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read this advice carefully!

1 General Information

The OSW12(22)-xxxE Series of Switch Kits include a MEMS optical switch with an integrated control circuit that includes an USB 2.0 interface for easy integration into your optical system. It is available as 1x2 or 2x2 (1x4 and 1x8 on request) MEMS modules with operating wavelengths of 488, 633, 780, 830, 980, or 1310 and 1550 nm. These bi-directional switches have low insertion loss and excellent repeatability. The switching mechanism is based on silicon MEMS technology, which ensures high reliability, provides exceptionally low crosstalk between channels, and is inherently very fast (switching time <1ms).

The OSW12(22)-xxxE switches are designed for the distribution and routing of signals at the indicated visible or near infrared wavelengths. The switches can be controlled via USB2.0 by the included GUI and driver package, via an on-board toggle switch, or via BNC input (TTL signal). A seven segment LED display indicates the active channel.

By default, all switches are shipped without fiber connectors. Termination of the fibers is available upon request; please contact your local Thorlabs office or distributor for pricing. Additionally, 1x4 and 1x8 MEMS switch modules are available on request.

The OSW12(22)-xxxE Series Switch Kits can be powered via the USB port or the onboard DC power connector.

A universal 9 V wall power supply is included with these Switch Kits.

1.1 Safety

Attention

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly as it was designed for.

The OSW12(22)-xxxE must not be operated in explosion endangered environments!

Only with written consent from *Thorlabs GmbH* may changes to single components be made or components not supplied by *Thorlabs GmbH* be used.

This precision device is only serviceable if properly packed into the complete original packaging. If necessary, ask for a replacement package prior to return.

Warning

When operating this unit with a laser be sure to pay strict attention to the safety recommendations of the appropriate laser safety class of the used laser!

**When operated incorrectly, this can cause severe damage to your eyes and health!
Do not look directly into any of the optical fiber terminations.**

Cover any unused fiber termination.

Attention

**The OSW12(22)-xxxE module is electrostatic discharge sensitive.
Observe the precautions for handling ESD sensitive modules.**

Attention

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

1.2 Ordering Codes

Ordering code	Short description
OSWxx-yyyE:	
xx = 12	SN1x2 switch with electronic board
xx = 22	SN2x2 switch with electronic board
xx = 14 ¹⁾	SN1x4 switch with electronic board
xx = 18 ^{1,2)}	SW1x8 switch with electronic board
yyyy = 488	Operating Wavelength Range 480 to 650 nm
yyyy = 633	Operating Wavelength Range 600 to 800 nm
yyyy = 780	Operating Wavelength Range 750 to 950 nm
yyyy = 830	Operating Wavelength Range 800 to 1000 nm
yyyy = 980	Operating Wavelength Range 970 to 1170 nm
yyyy = 1310	Operating Wavelength Range 1280 to 1625 nm

¹⁾ On request.

²⁾ Available for 1280 to 1625 nm only.

1.3 Requirements

These are the requirements to the PC intended to be used for remote operation of the OSW12(22)-xxxE.

1.3.1 Hardware Requirements

CPU:	1 GHz or higher
RAM:	256 MB
Graphic card	Min. 32 MB memory
Hard disc	Min 100 MB free storage space
Interface	free USB2.0 port, USB cable according the USB 2.0 specification alternatively one free RS232 (COM) port

1.3.2 Software Requirements

The OSW12(22)-xxxE software is compatible with the following operating systems:

- Windows® 2000 SP3
- Windows® XP (32-bit) SP3
- Windows® Vista (32-bit, 64-bit)
- Windows® 7 (32-bit, 64-bit)
- Windows® 8 (32-bit, 64-bit)

For operation of the OSW12(22)-xxxE, also an NI-VISA (version 3.4 or higher) is required. This NI-VISA engines comes with the Thorlabs GmbH OSW12(22)-xxxE installation CD, but can be downloaded also from National Instruments' website www.ni.com.

2 Getting Started

2.1 Parts List

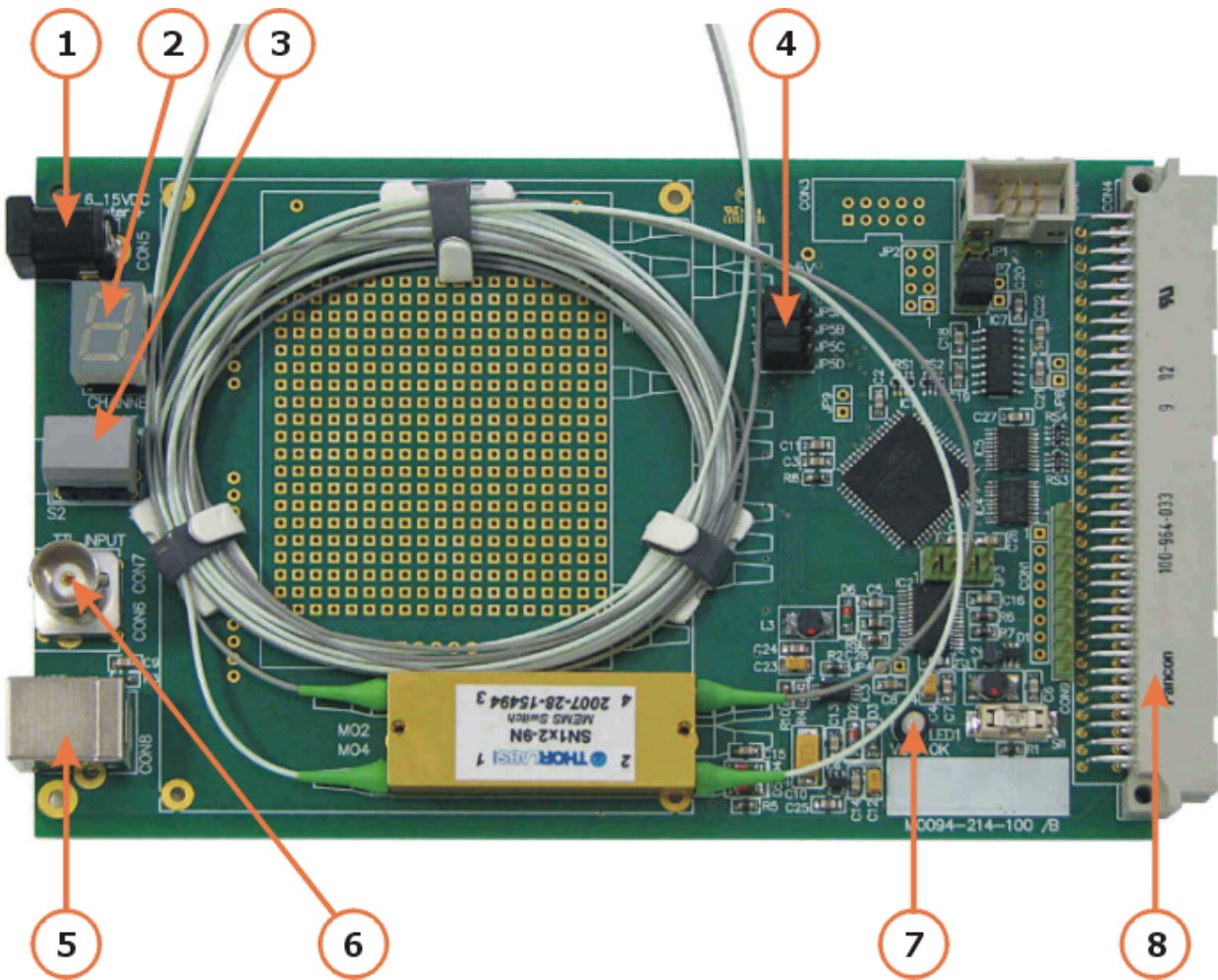
Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the OSW12(22)-xxxE mechanically and electrically.

Verify that you have received the following items within the package:

1. OSW12-yyyyE or OSW22-yyyyE Optical Switch with electronic board
2. Wall Power Supply 90 - 264 V AC / 9 V DC 1.1 A with adapters for Europe, USA, UK, Australia
3. USB cable A-B, 2 m
4. Operation Manual for OSW12E/OSW22E Series
5. Distribution CD for OSW12-E/OSW22-E Series (containing manuals, drivers and software)

2.2 Operating Elements



- 1 CON5 - DC Power Jack (2.1 mm DC plug, center pin "+")
- 2 MO1 - Status Indicator
For OSW12 switches: 1 = bar state (2 ↔ 4)
 2 = cross state (2 ↔ 3)
For OSW22 switches: 1 = bar state (2 ↔ 4; 1 ↔ 3)
 2 = cross state (2 ↔ 3; 1 ↔ 4)
- 3 S1 - Manual Toggle Switch
- 4 Jumpers JP5A ... JP5D (see section [Interface Setup](#)^[10])
- 5 CON8 - USB Connector (see section [Interface Setup](#)^[10])
- 6 CON6 - BNC TTL Input for toggle signal (falling edge triggered)
- 7 LED1 - Power-On Indicator
- 8 [CON4 - 64 pin Connector](#)^[15]

2.3 First Steps

Note

We recommend operating the OSW12(22)-xxxE in a shielded housing connected to protective ground and / or the optical table.

Connecting the Power Supply

You have 4 possibilities to connect a DC power supply to your OSW12(22)-xxxE:

- Use the provided Thorlabs power supply and insert the 2.1 mm DC plug into the corresponding DC power jack.
- Connect a high quality regulated power supply with 6V...15V DC output capable of delivering a current of min. 300mA to the coaxial DC power jack CON5. Use a standard 2.1 mm coaxial DC plug for connection (Center pin +).
- Connect a high quality regulated power supply with 6V...15V DC output capable of delivering a current of min. 300mA to the [64-pin connector CON4](#) ¹⁵ on pins A30/C30 (+) and pins A28/A29/A31/C28/C29/C31 (–).
- Use the USB cable to connect a PC or Hub to the USB jack CON8. The unit will be powered by the USB interface.

3 Operating Instruction

3.1 Operating the OSW12-yyyyE

Once the power supply is connected, the 7 Segment display shows “1” and the optical switch is set to bar state: I/O 2 is connected to I/O 4.

The switch status can be changed by two methods:

- Push the toggle button to change between bar state (2↔4) and cross state (2↔3) and vice versa. On cross state, “2” is shown at the 7 segment display (see [Switch States](#)^[16]).
- Apply a TTL logic signal to the BNC input jack or to pin C10 of the [64-pin connector CON4](#)^[15]. Every falling edge (5V → 0V) of the signal toggles the switch status.

Note

Please note that a TTL input is sensitive to bouncing. The connection of a mechanical switch to the BNC or 64-pin jack is not recommended! The on board toggle switch is de-bounced.

The actual switch state is indicated by the state signals SW_STAT[0...7] at the pins C19...C12 of the [64-pin connector](#)^[15].

3.2 Operating the OSW22-yyyyE

Once the power supply is connected, the 7 Segment display shows “1” and the optical switch is set to bar state: I/O 2 is connected to I/O 4, I/O 1 is connected to I/O 3.

The switch status can be changed by two methods:

- Push the toggle button to change between bar state (2↔4 / 1↔3) and cross state (2↔3 / 1↔4) and vice versa. On cross state, “2” is shown at the 7 segment display (see [Switch States](#)^[16]).
- Apply a TTL logic signal to the BNC input jack or to pin C10 of the 64-pin connector CON4 (see Figure 2 on page):
Every falling edge (5V → 0V) of the signal toggles the switch status.

Note

Please note that a TTL input is sensitive to bouncing. The connection of a mechanical switch to the BNC or 64-pin jack is not recommended! The on board toggle switch is de-bounced.

The actual switch state is indicated by the state signals SW_STAT[0...7] at the pins C19...C12 of the [64-pin connector](#)^[15].

3.3 Operating the OSW14-yyyyE (Option)

Once the power supply is connected, the 7 Segment display shows “1” and the optical switch is set to connect the input to port A.

The switch status can be changed by two methods:

- Push the switch button to pass the cycle of state 1 ... 4 corresponding to port A ... D (see [Switch States](#) ^[16]).
- Apply a TTL logic signal to the BNC input jack or to pin C10 of the [64-pin connector CON4](#) ^[15].
On every falling edge (5V → 0V) of the signal the switch steps to the next state.

Note

Please note that a TTL input is sensitive to bouncing. The connection of a mechanical switch to the BNC or 64-pin jack is not recommended! The on board toggle switch is de-bounced.

The actual switch state is indicated by the state signals SW_STAT[0...7] at the pins C19...C12 of the [64-pin connector](#) ^[15].

3.4 Operating the OSW18-yyyyE (Option)

Once the power supply is connected, the 7 Segment display shows “1” and the optical switch is set to connect the input to port A.

The switch status can be changed by two methods:

- Push the switch button to pass the cycle of state 1 ... 8 corresponding to port A ... H (see [Switch States](#) ^[16]).
- Apply a TTL logic signal to the BNC input jack or to pin C10 of the [64-pin connector CON4](#) ^[15].
On every falling edge (5V → 0V) of the signal the switch steps to the next state.

Note

Please note that a TTL input is sensitive to bouncing. The connection of a mechanical switch to the BNC or 64-pin jack is not recommended! The on board toggle switch is de-bounced.

The actual switch state is indicated by the state signals SW_STAT[0...7] at the pins C19...C12 of the [64-pin connector](#) ^[15].

4 Computer Interface

The OSW12(22)-xxxE board can be controlled remotely from a PC. The communication uses a serial data link which is established either via [RS232 available on CON4](#)^[15] (Backplane connector) or via a Virtual COM Port over [USB](#)^[6]. The USB link needs special USB drivers to be installed.

4.1 Interface Setup

The data link is selected with the jumper block JP5 according to the following table:

Interface	JP5A	JP5B	JP5C	JP5D
Virtual COM Port over USB	1-2	1-2	1-2	1-2
RS232 Interface via CON4	2-3	2-3	2-3	2-3

Set up your control PC to meet the following communication setup:

Line setup **115200-8N1-Hardware Handshake (RTS/CTS)**
 Program message end character **<LF>** (Line Feed, 0A_{hex})
 Response message end characters **<CR><LF>** (Carriage Return, 0D_{hex}; Line Feed, 0A_{hex})

4.2 Message Exchange

The OSW12(22)-xxxE board uses a simple human readable command structure. A program message consists of a command, parameters depending on the command and a program message terminator (<LF> Line Feed, 0A_{hex}). As a separator between command and parameters a space character (20_{hex}) is used. Commands are not case sensitive.

Syntax: **COMMAND [, PARAMETER [, PARAMETER]] <LF>**

Depending on the command the OSW12(22)-xxxE board generates a command dependent response message. A response message is terminated with carriage return/newline characters (<CR><LF> Carriage Return, 0D_{hex}; Line Feed, 0A_{hex}).

Syntax: **COMMAND DEPENDENT RESPONSE <CR><LF>**

The OSW12(22)-xxxE board responds to command errors with an error message containing an [error code](#)^[11] and a description.

Syntax: **Error nn, Descriptive text <CR><LF>** (where nn is the error code).

4.3 Command Description

Set Switch State

Command: **S**
 Parameter: Switch state
 Response: None
 Description: Sets the switch state according to switch state table.
 Example: **S 2 <LF>**
 Sets the switch state to 2.

Query Switch StateCommand: `S?`

Parameter: None

Response: Switch State

Description: Queries the switch state according to switch state table.

Example: `S?<LF>`

In case the switch state is 2 the following response will be generated
`2<CR><LF>`

Query Type CodeCommand: `T?`

Parameter: None

Response: OSW type code

Description: Queries the OSW board type code according to the configuration table.

Example: `T?<LF>`

In case of a SN-1x2 switch the following response will be generated
`0<CR><LF>`

Query OSW board nameCommand: `I?`

Parameter: None

Response: OSW board name and version

Description: Queries the OSW name and the firmware version.

Example: `I?<LF>`

In case of a 1x2 switch the following response will be generated
`OSW1x2 Optical Switch V1.1<CR><LF>`

4.4 Error Codes

Error code	Description
01	A general system error occurred
02	A math domain error was detected
03	The given value is out of range
06	Non-volatile memory error
10	A communication error occurred
11	The command is unknown
12	Wrong number of command parameters
13	The command parameter is invalid

5 Maintenance and Service

Protect the OSW12(22)-xxxE from adverse weather conditions. The OSW12(22)-xxxE is not water resistant.

Attention

To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

The unit does not need a regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs GmbH for return instructions.

Do not remove covers!

6 Appendix

6.1 Technical Data

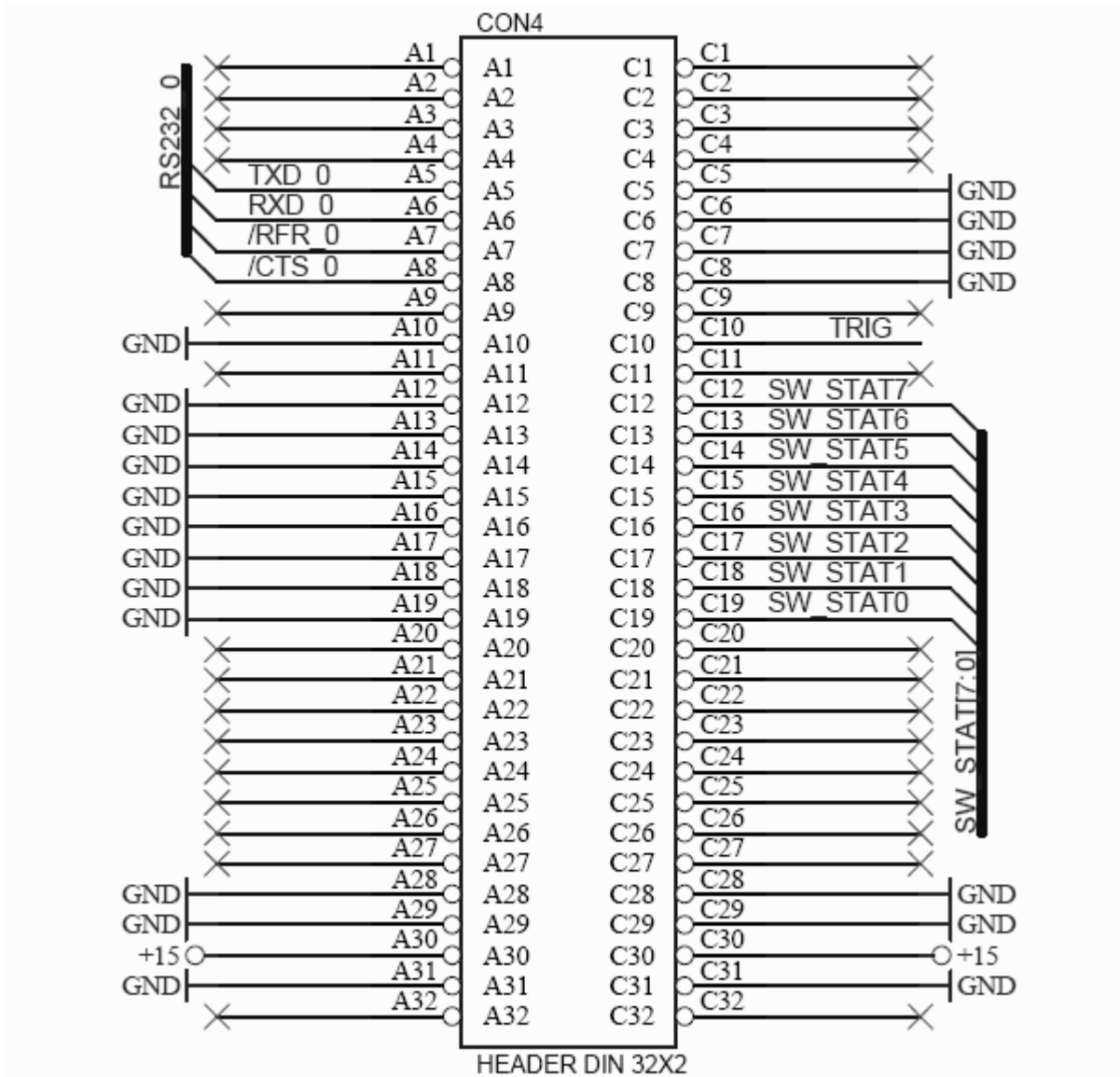
Operating Wavelength		
OSWxx-488E		480 ... 650 nm
OSWxx-633E		600 ... 800 nm
OSWxx-780E		750 ... 950 nm
OSWxx-830E		800 ... 1000 nm
OSWxx-980E		970 ... 1170 nm
OSWxx-1310E		1280 ... 1625 nm
Fiber Type and Connectors		
OSWxx-488E		Single Mode Fiber FiberCore SM450 (MFD 3.3 μm)
OSWxx-633E		Single Mode Fiber FiberCore SM600 (MFD 4.3 μm)
OSWxx-780E		Single Mode Fiber FiberCore SM750 (MFD 5.3 μm)
OSWxx-830E		Single Mode Fiber FiberCore SM800 (MFD 5.6 μm)
OSWxx-980E		Single Mode Fiber FiberCore SM980 (MFD 6.2 μm)
OSWxx-1310E		Single Mode Corning SMF-28E (MFD 9.2 μm @ 1310 nm MFD 10.4 μm @ 1550 nm)
Connectors		none (or on request)
Optical Power		
OSWxx-488E		max. 30 mW
OSWxx-633E		max. 50 mW
OSWxx-780E		max. 75 mW
OSWxx-830E		max. 85 mW
OSWxx-980E		max. 105 mW
OSWxx-1310E		max. 300 mW
Optical parameters		
Insertion Loss	OSWxx-488E	max. 2.0 dB (488 nm)
	OSWxx-633E	max. 1.5 dB; typ. 0.7 dB
	OSWxx-780E	
	OSWxx-830E	
	OSWxx-980E	
	OSWxx-1310E	
	OSW18-1310E	
Crosstalk		max. 60 dB; typ. 75 dB
Back Reflection	OSWxx-yyyyE	max. 50 dB; typ. 55 dB
	OSW18-1310E	max. 45 dB; typ. 55 dB
Polarization Depend-ent Loss	OSWxx-yyyyE	max. 0.05 dB; typ. 0.02 dB
	OSW18-1310E	max. 0.12 dB
Switching Time		max. 1 ms; typ. 0.5 ms
Lifetime (No Wear Out)		Proven up to 10^9 switching cycles
Operation		Non-latching

General	
Operating elements	Manual toggle switch (push button) Switch state indicator (7-segment LED display)
Connectors	Power Supply (2.1 mm coaxial power jack, center pin "+") USB Connector type B 64-pin Connector DIN 41612 C / IEC 60603-2 BNC Connector (TTL switching signal)
Operating Voltage	4.75-5.25 V DC 300 mA (USB Connector) or 6-15 V DC 300 mA (DC Power Connector)
Wall Power Supply (included)	90 - 264 V AC / 9 V DC 1.1 A
Supply Current Consumption	max. 300 mA; typ. 100 mA
Operating Temperature Range ¹⁾	0 - 40 °C
Storage Temperature Range	-40 to 70 °C
Dimensions (L x W x H)	170 mm x 100 mm x 20 mm
Weight	< 0.3 kg

¹⁾ non-condensing

All technical data are valid at $23 \pm 5^\circ\text{C}$ and $45 \pm 15\%$ rel. humidity (non condensing)

6.2 Pin Assignment CON4



For explanation of SW_STAT0 ... SW_STAT7 please see section [Switch States](#) ¹⁶.

6.3 Switch States

The possible switch states depend on the type of OSW board. The switch state is displayed on the seven-segment display MO1. It is also indicated by the state signals SW_STAT[0..7] available at CON4. The switch state is stored in the μ C internal nonvolatile memory. When powering-up the OSW board the previous switch state is restored.

OSW12-E (1x2)

State	Description	State Signal SW_STATn							
		7	6	5	4	3	2	1	0
1	Bare State (2↔4)	GND	GND	GND	GND	GND	GND	GND	+5V
2	Cross State (2↔3)	GND	GND	GND	GND	GND	GND	+5V	GND

OSW22-E (2x2)

State	Description	State Signal SW_STATn							
		7	6	5	4	3	2	1	0
1	Bare State (1↔3; 2↔4)	GND	GND	+5V	GND	GND	GND	GND	+5V
2	Cross State (1↔4; 2↔3)	GND	GND	GND	+5V	GND	GND	+5V	GND

OSW14-E (1x4, Option)

State	Description	State Signal SW_STATn							
		7	6	5	4	3	2	1	0
1	Port A	GND	GND	GND	GND	GND	GND	GND	+5V
2	Port B	GND	GND	GND	GND	GND	GND	+5V	GND
3	Port C	GND	GND	GND	GND	GND	+5V	GND	GND
4	Port D	GND	GND	GND	GND	+5V	GND	GND	GND

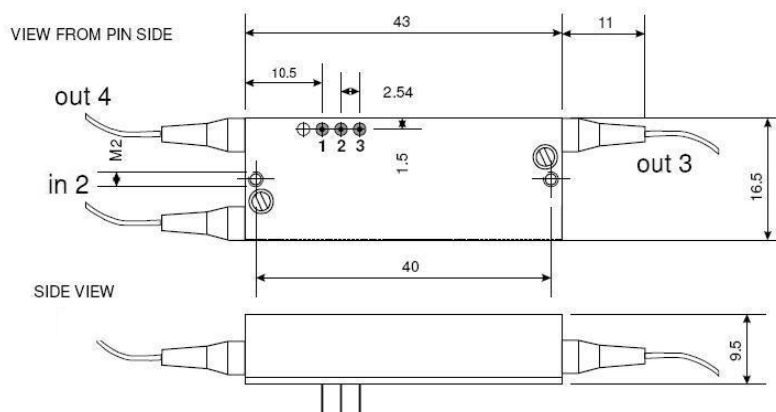
OSW18-E (1x8, Option)

State	Description	State Signal SW_STATn							
		7	6	5	4	3	2	1	0
1	Port A	GND	GND	GND	GND	GND	GND	GND	+5V
2	Port B	GND	GND	GND	GND	GND	GND	+5V	GND
3	Port C	GND	GND	GND	GND	GND	+5V	GND	GND
4	Port D	GND	GND	GND	GND	+5V	GND	GND	GND
5	Port E	GND	GND	GND	+5V	GND	GND	GND	GND
6	Port F	GND	GND	+5V	GND	GND	GND	GND	GND
7	Port G	GND	+5V	GND	GND	GND	GND	GND	GND
8	Port H	+5V	GND	GND	GND	GND	GND	GND	GND

6.4 Switch Outline Drawings

PIN CONNECTIONS

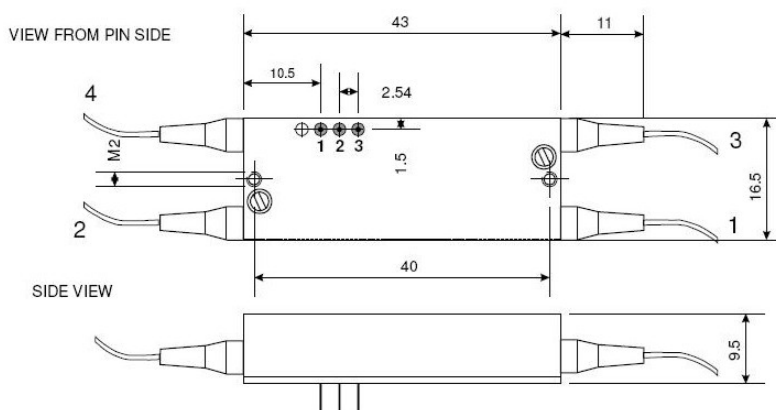
- 1 5 V supply, (2 mA)
- 2 selector 0 V: Bar
5 V: Cross
- 3 ground 0 V



Pin Layout SN1x2 - MEMS Switch Component for OSW12*

PIN CONNECTIONS

- 1 5 V supply, (2 mA)
- 2 selector 0 V: Bar
5 V: Cross
- 3 ground 0 V

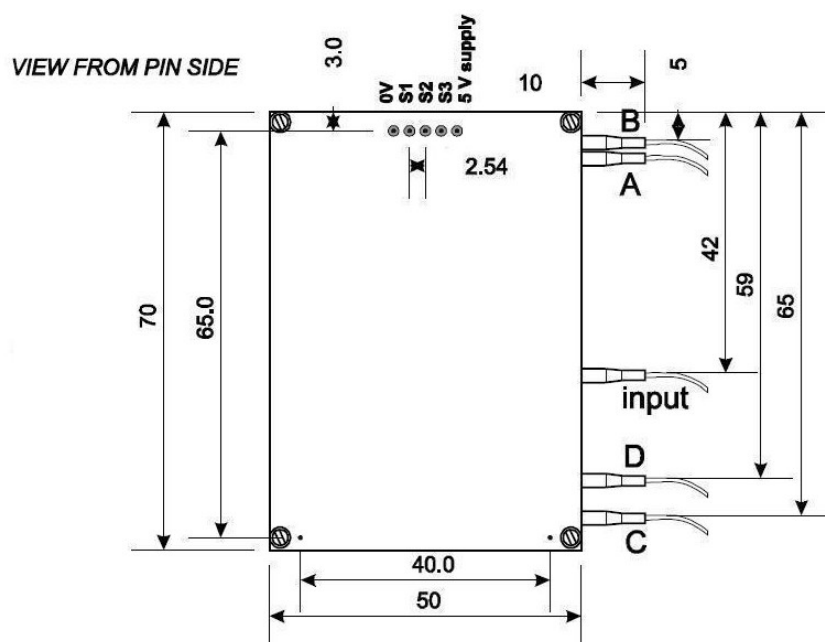


Pin Layout SN2x2 - MEMS Switch Component for OSW22*

Optical port selection:

- 1: 5V CMOS / TTL
- 0: 0V
- x: 0V or 5V

S1	S2	S3	Port
1	x	1	B
0	0	x	A
0	1	x	D
1	x	0	C

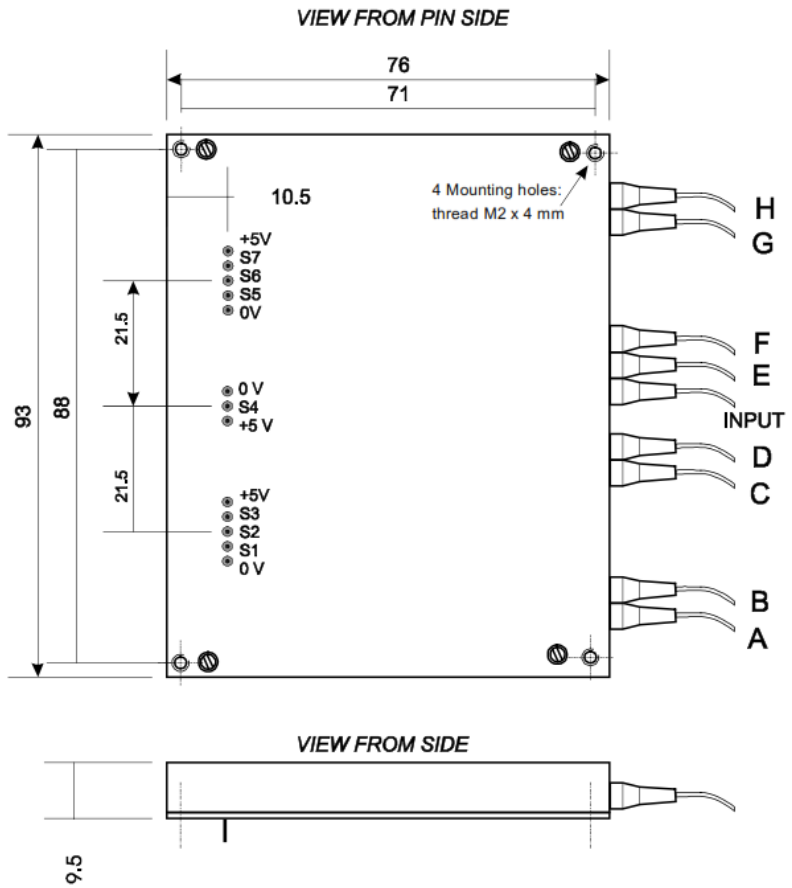


Pin Layout SN1x4 - MEMS Switch Component for OSW14*

Optical Port Selection

S1	S2	S3	S4	S5	S6	S7	Port
0	5	x	5	x	x	x	A
5	x	0	5	x	x	x	B
5	x	5	5	x	x	x	C
0	0	x	5	x	x	x	D
x	x	x	0	0	0	x	E
x	x	x	0	5	x	5	F
x	x	x	0	5	x	0	G
x	x	x	0	0	5	x	H

0 = 0 V (TTL or CMOS level)
 5 = 5 V (TTL or CMOS level)
 x = 0 V or 5 V



Pin Layout Sw1x8 - MEMS Switch Component for OSW18*

6.5 Warranty

Thorlabs GmbH warrants material and production of the OSW12(22)-xxxE for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs GmbH will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to Thorlabs GmbH. The customer will carry the shipping costs to Thorlabs GmbH, in case of warranty repairs Thorlabs GmbH will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs GmbH warrants the hard- and/or software determined by Thorlabs GmbH for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs GmbH does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs GmbH is not liable for consequential damages.

Restriction of Warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs GmbH does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs GmbH reserves the right to change this instruction manual or the technical data of the described unit at any time.

6.6 Copyright and Exclusion of Reliability

Thorlabs GmbH has taken every possible care in preparing this document. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this document is regularly updated and adapted to reflect the current status of the hardware and/or software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

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6.7 Thorlabs 'End of Life' Policy

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, *Thorlabs GmbH* offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for *Thorlabs GmbH* electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see figure below)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other *Thorlabs GmbH* products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB's, housings etc.).

Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs GmbH, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS Directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE Directive is to enforce the recycling of WEEE. A controlled recycling of end-of-life products will thereby avoid negative impacts on the environment.



*Crossed out
"Wheelie Bin" symbol*

6.8 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/contact for our most up-to-date contact information.



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