# LightBend™
# 4x4 Series Fiber Optic Switch

**(Bidirectional. SM, MM, PM, SM High power, MM High Power, PM High power)**

(Protected by U.S. pending patents)

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The LightBend 4x4 Series fiber optic switch connects optical channels by redirecting any of four incoming optical signals into any of four output fibers. This is achieved using a patent pending opto-mechanical configuration and activated via an electrical control signal. Latching operation preserves the selected optical path after the drive signal has been removed. This new material-based advanced design significantly reduces moving part position sensitivity, offering unprecedented  high stability as well as an unmatched low cost. The LB 4x4 series Switch can be made of a variety of fibers, including SM, MM, PM fibers, in standard or high-power version. Electronic Driver  is  available for  this series of switches.  The LightBend 4x4 series switch is bidirectional.

## Features

- Unmatched Low Cost
- Low Optical Distortions
- High Isolation
- High Reliability
- Epoxy-Free Optical Path

## Specifications

| Parameter | | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Operation Wavelength | | 780, 850, 980, 1060, 1310, 1550 | | | nm |
| Insertion Loss | | | 1.2 | 2.0 | dB |
| Wavelength Dependent Loss | | | 0.15 | 0.25 | dB |
| PDL (SM) | | | | 0.15 | dB |
| Extinction Ratio (PM) | | 18 | 25 | | dB |
| Cross Talk | SM, PM | 50 | 55 | | dB |
| | MM | 35 | 50 | | dB |
| Return Loss | SM, PM | 50 | 55 | | dB |
| | MM | 35 | 45 | | dB |
| Switching Time | | | 4 | 10 | ms |
| Repeatability | | | | ± 0.05 | dB |
| Operating Voltage | | 4.5 | 5 | 6 | VDC |
| Operating Current | | | 30 | 60 | mA |
| Voltage Pulse Width (Latching) | | | 20 | | ms |
| Switching Type | | Latching, Non-Latching | | | |
| Operating Temperature | | -5 | | 70 | °C |
| Storage Temperature | | -40 | | 85 | °C |
| Optical Power Handling | Standard | | 300 | 500 | mW |
| | High Power | | 5 | 10 [3] | W |
| Fiber Type | SM | SMF-28, or equivalent | | | |
| | MM | MM 50/125, MM 62.5/125, or equivalent | | | |
| | PM | Panda 250 PM, 400 PM, or equivalent | | | |

**Notes**:

[1]. Excluding connectors.

[2]. For LB Multimode series switch, Light source CPR<14 dB.

[3]. Continuous operation, for pulse operation call.

**Warning**: **This device must use the reference circuit to driver otherwise it is unstable**

## Applications

- Channel Blocking
- Configurable Add/Drop
- System Monitoring
- Instrumentation

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## Mechanical Dimensions (mm)



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1550 nm LB 4x4 Fiber Optical Switch
P/N: LBSW-445111331
S/N: xxxxxxxxx

Pin 1   2

29   30

I1
I2
I3
I4

O1
O2
O3
O4

56.0

62.0

3.0

3.0   98.0

4x Ø3.0   104.0

**Package 1**

15.8

2

**Package 2**

20.1

2

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

## Functional Diagram



I1 → → O1
I2 → → O2
I3 → → O3
I4 → → O4

LB 4x4 Series Switch

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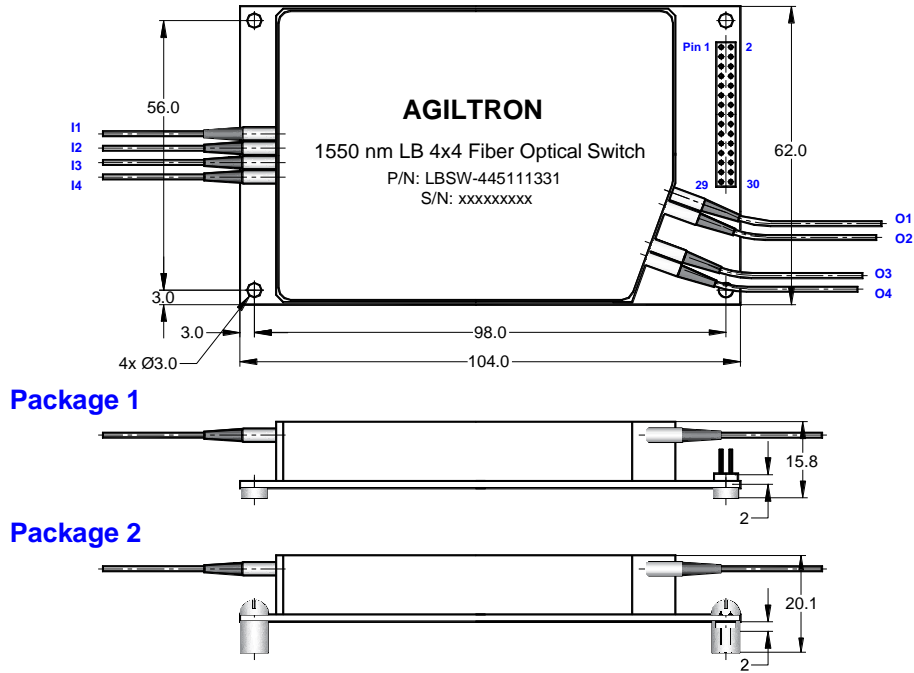### (Bidirectional. SM, MM, PM, SM High power, MM High Power, PM High power)
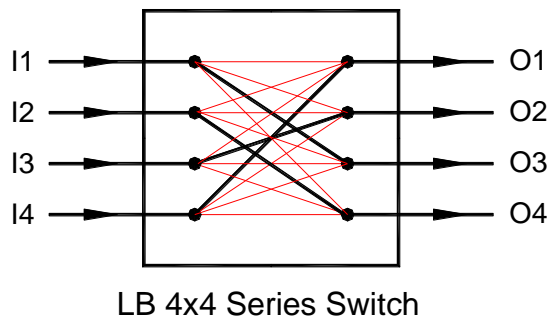(Protected by U.S. pending patents)

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## Electrical Driving Requirements

The load is a resistive coil which is activated by applying 5V (draw ~ 40mA). However, the current flow direction must be correct otherwise it will cancel the permanent magnet inside causing instability. We strongly recommend to use the reference circuit to avoid major issues. We offer pushbutton elevation driver for verifications or convenient income inspection.

### Latching Type

**Application Note**: Applying a constant driving voltage increases stability. The switches can also be driven by a pulse mode using Agiltron recommended circuit for energy saving.

| No | Optical Path | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | I1→O1, I2→O2, I3→O3, I4→O4 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 |
| 2 | I1→O1, I2→O2, I3→O4, I4→O3 | + | 0 | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | | | 0 | + | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 |
| 3 | I1→O1, I2→O3, I3→O4, I4→O2 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | | | + | 0 | | | + | 0 | 0 | + | + | 0 |
| 4 | I1→O1, I2→O3, I3→O2, I4→O4 | + | 0 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 |
| 5 | I1→O1, I2→O4, I3→O3, I4→O2 | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | | | + | 0 | 0 | + | + | 0 |
| 6 | I1→O1, I2→O4, I3→O2, I4→O3 | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | + | 0 | 0 | + | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 |
| 7 | I1→O2, I2→O1, I3→O3, I4→O4 | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | 0 | + | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 |
| 8 | I1→O2, I2→O1, I3→O4, I4→O3 | + | 0 | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | | | 0 | + | 0 | + | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 |
| 9 | I1→O2, I2→O3, I3→O1, I4→O4 | + | 0 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | 0 | + | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 |
| 10 | I1→O2, I2→O3, I3→O4, I4→O1 | + | 0 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | 0 | + | + | 0 | | | + | 0 | | | + | 0 | 0 | + |
| 11 | I1→O2, I2→O4, I3→O1, I4→O3 | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | 0 | + | 0 | + | + | 0 | | | + | 0 | 0 | + | + | 0 | | | + | 0 |
| 12 | I1→O2, I2→O4, I3→O3, I4→O1 | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | | | + | 0 | 0 | + |
| 13 | I1→O3, I2→O2, I3→O1, I4→O4 | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | | | 0 | + | | | + | 0 | 0 | + | + | 0 | + | 0 |
| 14 | I1→O3, I2→O2, I3→O4, I4→O1 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | | | 0 | + | | | + | 0 | | | + | 0 | 0 | + |
| 15 | I1→O3, I2→O1, I3→O2, I4→O4 | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | | | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 |
| 16 | I1→O3, I2→O1, I3→O4, I4→O2 | + | 0 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | | | + | 0 | 0 | + | + | 0 | 0 | + | + | 0 | + | 0 |
| 17 | I1→O3, I2→O4, I3→O2, I4→O1 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | | | | | 0 | + | | | + | 0 | 0 | + | 0 | + | + | 0 |
| 18 | I1→O3, I2→O4, I3→O1, I4→O2 | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | + | 0 | + | 0 | | | | | + | 0 | 0 | + | 0 | + | + | 0 | + | 0 | | |
| 19 | I1→O4, I2→O3, I3→O2, I4→O1 | 0 | + | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | | | | | 0 | + | | | + | 0 | 0 | + | | |
| 20 | I1→O4, I2→O3, I3→O1, I4→O2 | 0 | + | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | | | | | + | 0 | 0 | + | 0 | + | + | 0 | | |
| 21 | I1→O4, I2→O2, I3→O3, I4→O1 | 0 | + | + | 0 | | | + | 0 | + | 0 | 0 | + | + | 0 | + | 0 | | | 0 | + | | | + | 0 | | | + | 0 | 0 | + |
| 22 | I1→O4, I2→O2, I3→O1, I4→O3 | 0 | + | + | 0 | | | + | 0 | + | 0 | + | 0 | 0 | + | + | 0 | | | 0 | + | | | + | 0 | 0 | + | + | 0 | + | 0 |
| 23 | I1→O4, I2→O1, I3→O2, I4→O3 | 0 | + | + | 0 | | | + | 0 | + | 0 | + | 0 | + | 0 | + | 0 | | | + | 0 | 0 | + | + | 0 | + | 0 | + | 0 | | |
| 24 | I1→O4, I2→O1, I3→O3, I4→O2 | 0 | + | + | 0 | | | + | 0 | + | 0 | + | 0 | 0 | + | + | 0 | | | + | 0 | 0 | + | | | + | 0 | 0 | + | + | 0 |

[1]. "+" is 4.5 ~ 6 V pulse, Typical is 5 V pulse.  [2]. "0" is 0 V.  [3]. The blank space means no electronic connection.

### Non-Latching Type

| No | Optical Path | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | I1→O1, I2→O2, I3→O3, I4→O4 | | | | | | | | | | | 0 | + | 0 | + | | | | | 0 | + | | | | | | | | | | |
| 2 | I1→O1, I2→O2, I3→O4, I4→O3 | | | | | | | 0 | + | | | | | | | 0 | + | | | 0 | + | | | | | | | | | | |
| 3 | I1→O1, I2→O3, I3→O4, I4→O2 | | | | | | | 0 | + | 0 | + | | | | | | | | | | | | | | | | | 0 | + | | |
| 4 | I1→O1, I2→O3, I3→O2, I4→O4 | | | | | | | 0 | + | 0 | + | | | | | | | | | | | 0 | + | | | | | | | | |
| 5 | I1→O1, I2→O4, I3→O3, I4→O2 | | | 0 | + | | | | | | | | | 0 | + | | | | | | | | | | | | | 0 | + | | |
| 6 | I1→O1, I2→O4, I3→O2, I4→O3 | | | 0 | + | | | | | | | | | | | 0 | + | | | | | 0 | + | | | | | | | | |
| 7 | I1→O2, I2→O1, I3→O3, I4→O4 | | | | | | | | | | | 0 | + | 0 | + | | | 0 | + | 0 | + | | | | | | | | | | |
| 8 | I1→O2, I2→O1, I3→O4, I4→O3 | | | | | | | 0 | + | | | | | | | 0 | + | 0 | + | 0 | + | | | | | | | | | | |
| 9 | I1→O2, I2→O3, I3→O1, I4→O4 | | | | | | | | | 0 | + | 0 | + | | | | | 0 | + | | | | | 0 | + | | | | | | |
| 10 | I1→O2, I2→O3, I3→O4, I4→O1 | | | | | | | 0 | + | 0 | + | | | | | | | 0 | + | | | | | | | | | | | 0 | + |
| 11 | I1→O2, I2→O4, I3→O1, I4→O3 | | | 0 | + | | | | | | | | | | | 0 | + | 0 | + | | | | | 0 | + | | | | | | |
| 12 | I1→O2, I2→O4, I3→O3, I4→O1 | | | 0 | + | | | | | | | | | 0 | + | | | 0 | + | | | | | | | | | | | 0 | + |
| 13 | I1→O3, I2→O2, I3→O1, I4→O4 | | | | | 0 | + | | | | | 0 | + | | | | | | | 0 | + | | | | | 0 | + | | | | |
| 14 | I1→O3, I2→O2, I3→O4, I4→O1 | | | | | 0 | + | 0 | + | | | | | | | | | | | 0 | + | | | | | | | | | 0 | + |
| 15 | I1→O3, I2→O1, I3→O2, I4→O4 | | | | | 0 | + | | | | | 0 | + | | | | | | | | | 0 | + | 0 | + | | | | | | |
| 16 | I1→O3, I2→O1, I3→O4, I4→O2 | | | | | 0 | + | 0 | + | | | | | | | | | | | | | 0 | + | | | | | 0 | + | | |
| 17 | I1→O3, I2→O4, I3→O2, I4→O1 | | | 0 | + | 0 | + | | | | | | | | | | | | | | | | | 0 | + | | | | | 0 | + |
| 18 | I1→O3, I2→O4, I3→O1, I4→O2 | | | 0 | + | 0 | + | | | | | | | | | | | | | | | | | | | 0 | + | 0 | + | | |
| 19 | I1→O4, I2→O3, I3→O2, I4→O1 | 0 | + | | | | | 0 | + | | | | | | | | | | | | | | | 0 | + | | | | | 0 | + |
| 20 | I1→O4, I2→O3, I3→O1, I4→O2 | 0 | + | | | | | 0 | + | | | | | | | | | | | | | | | | | 0 | + | 0 | + | | |
| 21 | I1→O4, I2→O2, I3→O3, I4→O1 | 0 | + | | | | | | | | | | | 0 | + | | | | | 0 | + | | | | | | | | | 0 | + |
| 22 | I1→O4, I2→O2, I3→O1, I4→O3 | 0 | + | | | | | | | | | | | | | 0 | + | | | 0 | + | | | | | 0 | + | | | | |
| 23 | I1→O4, I2→O1, I3→O2, I4→O3 | 0 | + | | | | | | | | | | | | | 0 | + | | | | | 0 | + | 0 | + | | | | | | |
| 24 | I1→O4, I2→O1, I3→O3, I4→O2 | 0 | + | | | | | | | | | | | 0 | + | | | | | 0 | + | | | | | | | 0 | + | | |

[1]. "+" is 4.5 ~ 6 VDC, Typical is 5 VDC.  [2]. "0" is 0 V.  [3]. The blank space means no electronic connection.

# LightBend™
# 4x4 Series Fiber Optic Switch
## (Bidirectional. SM, MM, PM, SM High power, MM High Power, PM High power)

(Protected by U.S. pending patents)

## Ordering Information

| | □□ | □ | □ | □ | □ | □ | □ | □ |
|---|---|---|---|---|---|---|---|---|
| **Prefix** | **Type** | **Wavelength** | **Switch** | **Power** | **Fiber Type** | **Fiber Cover** | **Fiber Length** | **Connector** |
| **LBSW-** [1]<br>**LBPM-** [2]<br>**LBHP-** [3]<br>**LBPH-** [4] | 4x4 = 44<br>4x3 = 43<br>4x2 = 42<br>3x3 = 33<br>3x2 = 32<br>Special = 00 | 1060 = 1<br>1310 = 3<br>1550 = 5<br>780 = 7<br>850 = 8<br>980 = 9<br>Special = 0 | Latching = 1<br>Non-latching = 2 | 5W = 4<br>10W = 5<br>Special = 0 | SMF-28 = 1<br>MM 50/125 = 5<br>MM 62.5/125 = 6<br>PM400 = A<br>PM1550 = B<br>Special = 0 | Bare fiber = 1<br>900um tube = 3<br>Special = 0 | 0.25m =1<br>0.5m = 2<br>1.0m = 3<br>Special = 0 | None = 1<br>FC/PC = 2<br>FC/APC = 3<br>SC/PC = 4<br>SC/APC = 5<br>ST/PC = 6<br>LC/PC = 7<br>Duplex LC/PC = 8<br>LC/UPC = U<br>Special = 0 |

[1]. **LBSW**: **L**ight**B**end 4x4 **SW**itch.

[2]. **LBPM**: **L**ight**B**end 4x4 **PM** Switch.

[3]. **LBHP**: **L**ight**B**end 4x4 **H**igh **P**ower Switch.

[4]. **LBPH**: **L**ight**B**end 4x4 **P**M **H**igh Power Switch.

**NOTE:**
- ❑ PM1550 fiber works well for 1310nm

### 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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## Driver Reference Design