HEWLETT® PACKARD

HP 86060 Series of Lightwave Switches

Product Overview

Performance Characteristics and Ordering Information

HP 86060B Compact Lightwave Switch
HP 86062B Full-Size Lightwave Switch

Lightwave Switching for Test Automation

- **Visual signal path display with easy-to-use manual interface**
- **Multilayer software for controlling multiple switch configurations available**
- **Repeatable switching with 10 million cycle minimum life**
- **High performance specifications available**
- **Custom configurations available**
- **HP-IB and RS-232 control**
- **SCPI-compatible commands**
- **RS-485 expansion bus available**

The HP 86060 series of programmable lightwave switches cover a broad range of switching capacity and provide easy signal routing for accurate and repeatable measurement automation. These switches provide an important building block for implementing automated test systems.

The HP 86060 switch family features an easy-to-use manual interface and a visual signal routing display. The interface allows quick manual operation for initially setting up a measurement or for quick investigation of test device performance. Selected switch positions can be saved and recalled. The switches can be easily integrated into automated test systems using SCPI-compatible commands via HP-IB or RS-232 interfaces.

Hewlett-Packard's lightwave switches are designed for long, reliable service with excellent repeatability, low back reflections, and low insertion loss for accurate lightwave measurements.

The HP 86060B is a compact switch available with four to eight output channels and one or two inputs. The switch is designed for easy configuration with HP optical attenuators, lightwave multimeters, OTDRs, and other lightwave test instrumentation for either benchtop or automated system applications. In addition, the HP 86060B can now be special ordered in a new mid-size half-width chassis which can accomodate one, two, or three inputs and up to sixteen front or rear panel outputs.

The HP 86062B is a full-width instrument with 4 to 100 output channels. It is designed for automated production and evaluation testing of large numbers of devices. The HP 86060 Series Lightwave Switches are designed for 9/125 µm single-mode, as well as 62.5/125 and 50/125 µm multi-mode operation. Switching is bi-directional. The 1xN switching module is built around a precision stepper motor.

Standard configurations include fiber "pigtails" or FC, SC, or ST connectors. Other connector types including DIN, Diamond or angled physical contact are available on request. (Unlike most Hewlett-Packard products, these connector types are not interchangeable.)

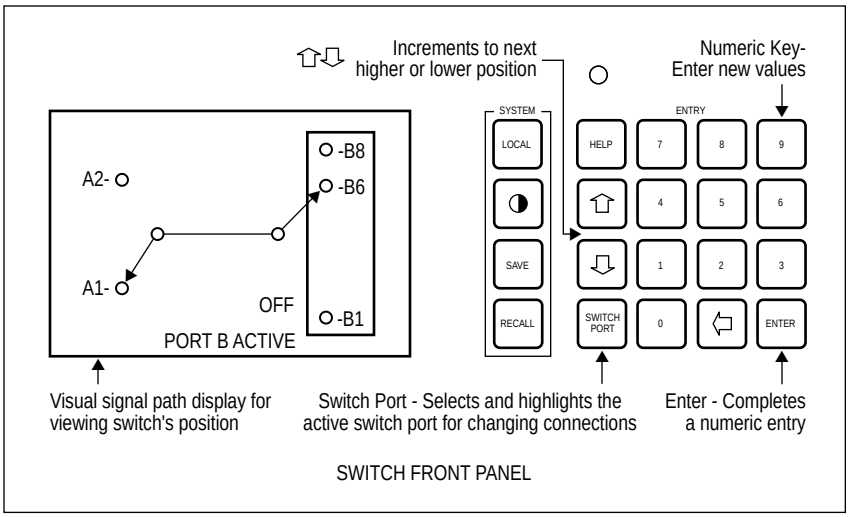


Figure 1. HP's manual interface and visual signal routing display (top diagram).

New Multilayer Control Software for Integrated Multiple Switch Applications

Integrated multi-layer control software is now available through special order for both HP 86060B and 86062B switches. This software enables multiple switches to be controlled from a single manual or automated control system. A single interface can control up to four switching layers with each layer supporting one or two switches.

Figure 2 shows a manufacturing test application which requires two switches. Both of these switches can now share a single cabinet and be easily controlled through a single manual interface. Figures 3 and 4 show the two switches as they would appear on the display of an HP 86062B with the new multilayer software. Figure 3 shows the source side of the testing platform in layer S1 on the HP 86062B's display. The test system is currently using the 1550 nm test source. The second switch in the S1 layer is used to choose which of the devices under test is currently being tested. In the example shown, we are testing the 3rd device, which is referred to as port B3 in layer S1. To complete the test, the 1 x 4 switch at the receiving end of the testbed is set to port D3 (see Figure 4). This is shown as layer S2 on the manual interface. The new multilayer software allows the user to graphically see both switches with just one touch of a button. The instrument's display also shows confirmation of each layer's status when the switches are being controlled remotely (HP-IB or RS-232), thus making it easy to write and troubleshoot programs for automated testing.

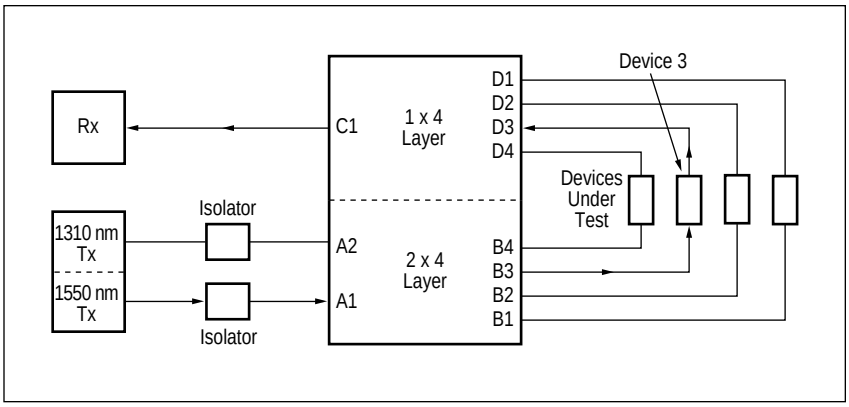


Figure 2. Automated testbed for connector, cable, component, and device testing

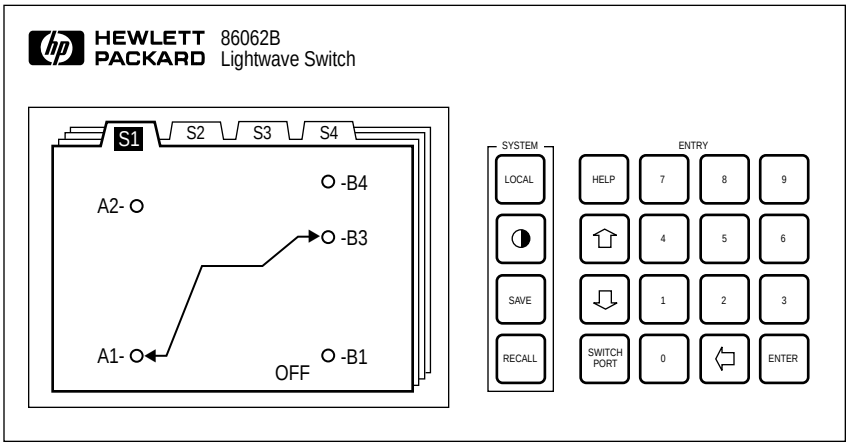


Figure 3. Layer S1 showing input side of automated testbed shown in Figure 2

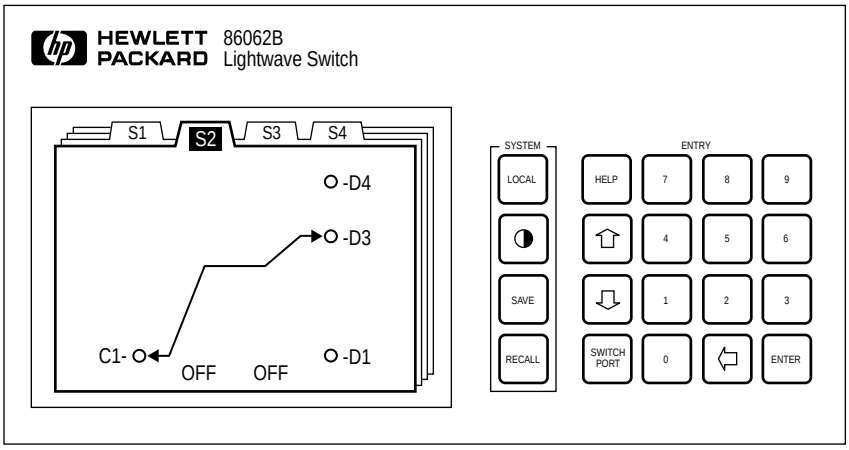


Figure 4. Layer S2 showing receive side of automated testbed shown in Figure 2

Applications

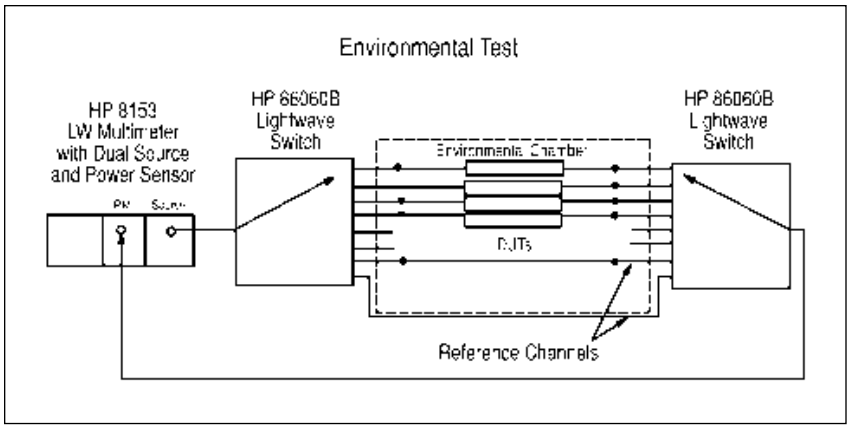


Figure 5. Insertion loss as a function of temperature

A well-implemented automated test system can help reduce manufacturing costs. An automated test system can perform a wide range of tests without the need to manually reset operating conditions. Measurements can be performed and recorded much more rapidly than with a manual system. Automated systems can be implemented to reduce the necessary operator skill level and amount of training required. Automated systems can also reduce the time spent recording, recov-ering, and publishing test results.

Increasing measurement throughput by greatly reducing time per test, a single automated test system can do the work of several manual stations, thereby reducing both cost per test and the total capital investment (and depreciation) required for the test.

Qualification testing can be very expensive, with the additional cost of operating an environmental chamber on top of tying up lots of test equipment for long periods to test multiple devices. Figure 5 shows an automated environmental test system using two HP 86060B Lightwave Switches and an HP 8153 Lightwave Multimeter with the HP 81554SM Dual Laser Source module and the HP 81532A Power Sensor module. Multiple devices are under test (perhaps isolators, patchcords, or attenuators). Insertion loss is measured versus temperature. Reference channels are used for system calibration and to compensate for system drift. This system could be expanded to test return loss versus temperature with the addition of a coupler and a reflectance standard. This test system can also be set up using a single HP 86062B switch with two layers.

Multi-port device testing can complicate manufacturing test. Flexible lightwave switch configurations provide a versatile building block for test systems design. Figure 6 shows an eight channel WDM/router test setup which uses a multi-layered HP 86062B switch with three switching modules. The HP 11896A Polarization Controller allows the devices under test to be tested for amplitude and wavelength polarization dependency. The HP 71452B Optical Spectrum Analyzer provides spectral characteristics such as free spectral range, channel bandwidth, and isolation/crosstalk. The HP 86120B Multi-Wavelength Meter is used to make extremely accurate channel wavelength and channel spacing measurements. The switch configuration provides for an 8 x 8 or multiple 1 x 8 test device configurations.

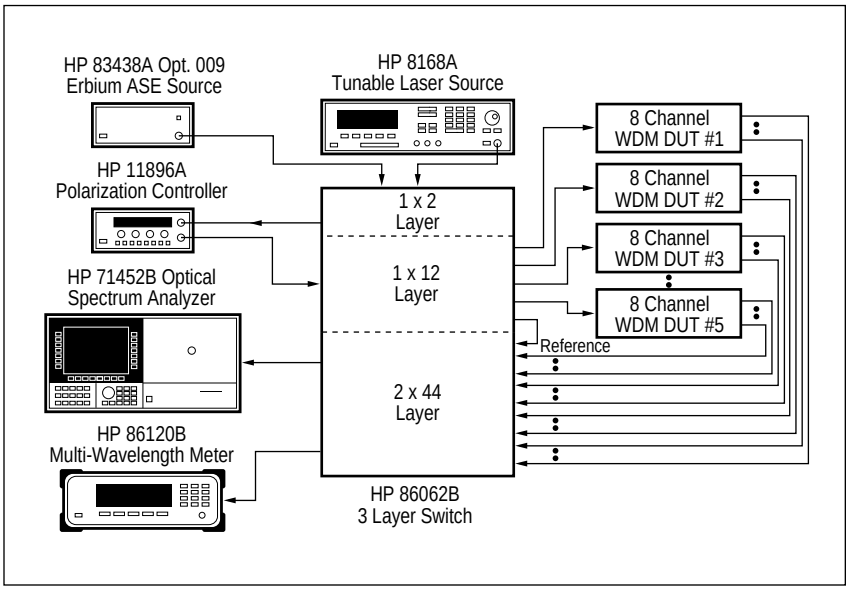


Figure 6. Eight channel WDM/router test setup

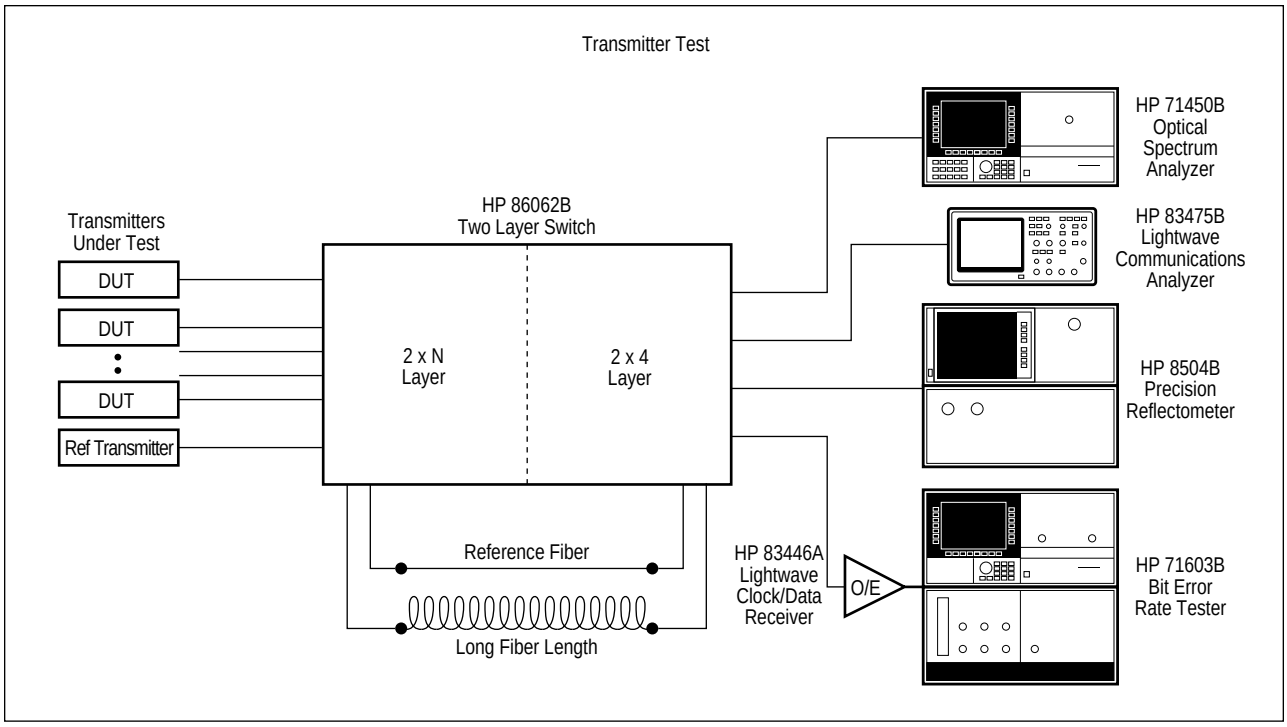


Figure 7. Automated transmitter test system

Products aimed at new telecommunications systems require extensive testing to industry standards such as ITU-TS (formerly CCITT) G.957 for the Synchronous Digital Hierarchy, and other standards for SONET and ATM. Increasingly, the performance of products for these markets must be well documented and supplied with the product. Manufacturers continue to strive to use testing as one tool to improve process performance and yields. Potential suppliers are carefully evaluated to insure that their products and components will meet overall system performance requirements. Environmental tests are frequently necessary to be certain that designs are robust compared to the operating conditions that must be met.

Figure 7 shows a system for performing extensive parametric measurements, such as those required for SDH and SONET, on multiple transmitters. The system provides for testing the spectral characteristics with the HP 71450B Optical Spectrum Analyzer. The system performs eye-diagram measurements using the HP 83475B Lightwave Communications Analyzer. The HP 8504B Precision Reflectometer is calibrated to remove the path length to the transmitters, and provides detailed measurement of the different sources of reflection in the transmitter. The HP 71603B Bit Error Rate Tester, together with the HP 83446A Lightwave Clock/Data Receiver, is used to monitor bit error rate performance.

The system can be expanded to construct a transceiver test system. Additional channels would be needed on the right hand switch. Microwave switching can be added in front of the HP 71603B BERT to sequentially measure the bit error rate performance of the receivers.

Hewlett-Packard has been supplying both standard microwave switches and custom microwave switch matrixes for many years.

Specifications and Characteristics

Specifications describe the instrument's warranted performance over the +5°C to +40°C temperature range, with RH from 0 to 80%, except where noted. **Characteristics** provide information about non-warranted instrument performance in the form of nominal values. Characteristics are at room temperature.

HP 86060B and 86062B Optical Switches

	Standard Switch[1] Specifications (and Characteristics)		High Performance Specials[2] Specifications (and Characteristics)
	Option 001	**Option 002**	
Insertion Loss[3]			
Single-mode Switches	2.0 dB (1.0 dB)	4.0 dB (2.0 dB)	1.5 dB[4] (0.75 dB)
Multimode Switches	1.5 dB (1.0 dB)	3.5 dB (1.5 dB)	1.5 dB[4] (0.75 dB)
Insertion Loss Stability[5]	———	———	±0.04 dB (±0.02 dB)
Repeatability[6]			
Sequential	±0.02 dB (±0.01 dB)	±0.02 dB (±0.01 dB)	±0.01 dB (±0.005 dB)
Random	———	———	±0.025 dB
Optical Return Loss[7]			
Single-mode Switches	55 dB (58 dB)	54 dB (55 dB)	58 dB (60 dB)
Multimode Switches	20 dB (25 dB)	20 dB (25 dB)	20 dB (25 dB)
Polarization Dependent Loss[4, 8]			
N <24 Channels	0.05 dB (0.01 dB)	0.05 dB (0.02 dB)	0.015 dB (0.01 dB)
N >24 Channels	0.05 dB (0.01 dB)	0.05 dB (0.02 dB)	0.02 dB (0.01 dB)
Isolation	–80 dB (–100 dB)	–80 dB (–100 dB)	–90 dB (–100 dB)
Typical Switching Life	10 million cycles		10 million cycles

[1] Standard switches are available with 1 or 2 inputs and 4, 8, 12... 96 or 100 outputs. Option 002 includes a 1x2 solenoid switch in front of the optomechanical switch. **Note: Special Option H32 can provide significantly improved insertion loss over the standard option 002 for a small incremental cost.**

[2] Multifiber armatures are available with 1, 2, or 3 inputs and 4, 8, 12... 96 or 100 outputs. Larger numbers of inputs and outputs are available through special orders by cascading individual switch modules—please contact your local HP representative for pricing and availability. **Note: Special order switches are also available with custom configurations and ultra-high specifications—please contact your local HP representative for further details.**

[3] Insertion loss does not include connectors. Include an additional 0.25 dB (characteristic) for each connector.

[4] Specification valid for operating temperatures of 23 ±5°C.

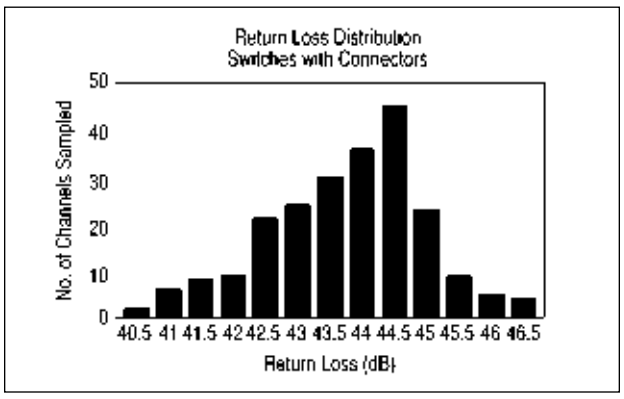
[5] Drift of any channel relative to one assigned reference channel during 7 day temperature cycling of ±3°C from ambient operating temperature.

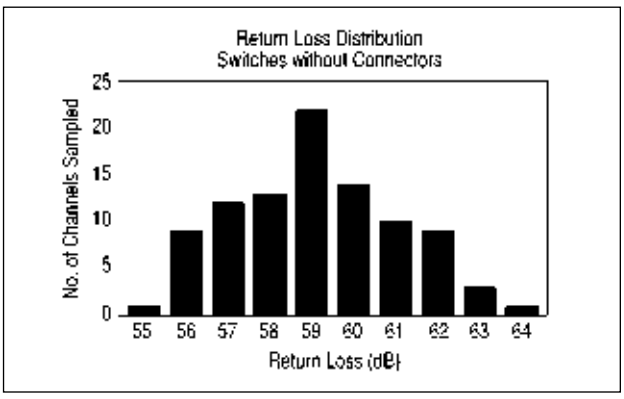
[6] Repeatability measured after four hours warmup and with an eight second pause between switch movements.

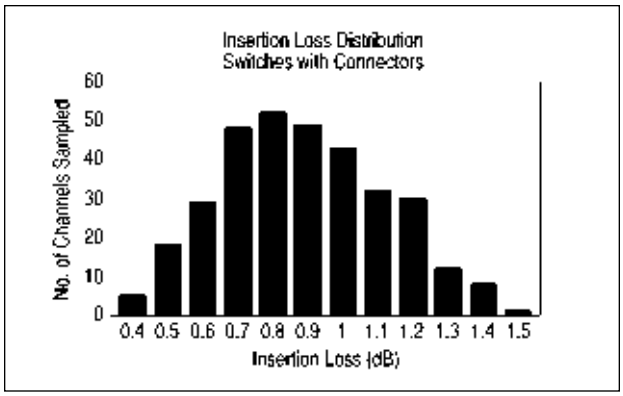
[7] Excludes external pigtail backscatter and connector reflections.

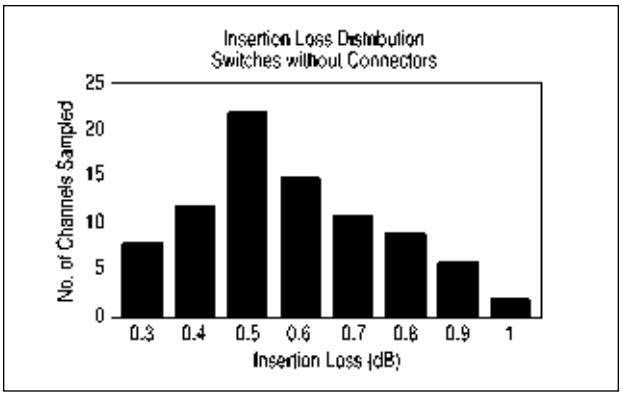
[8] Polarization Dependent Loss only applies to single-mode switches and is measured at 1550 nm.

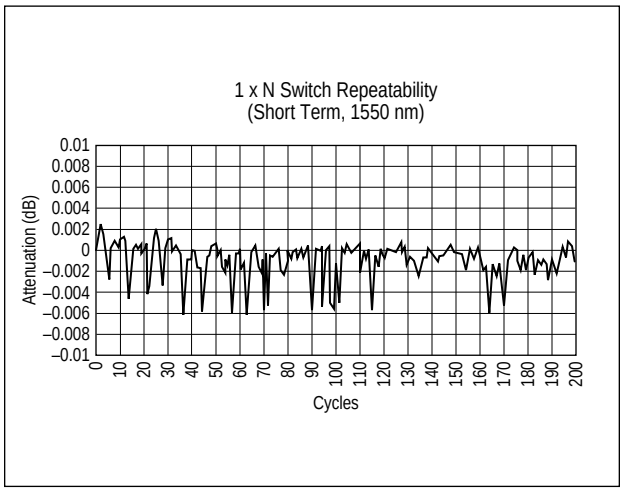
The following tables show the distribution of production line measurements of HP Standard Switches at room temperatures.

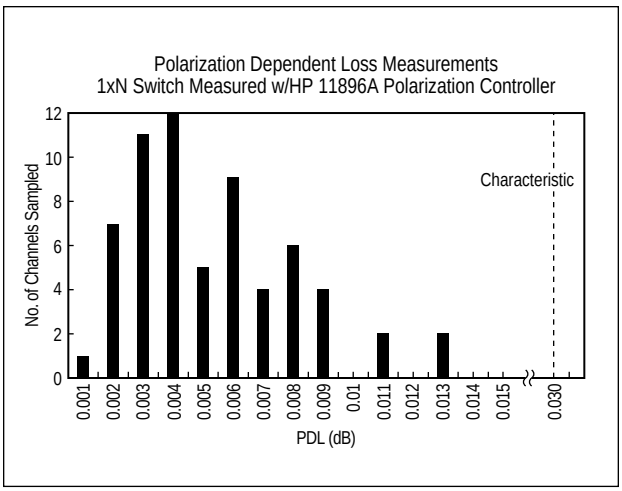












Switching Time (msec)

	Between Adjacent Channels	Plus Additional Time/Channel	Maximum Switching Time
HP 86060B	290	40	530
HP 86062B	260	10	993

250 msec settling time is allowed for best repeatability

General Specifications

Temperature Range:
Operational: +5 to +40°C, <80% R.H.
Storage: –20 to +45°C

Power Requirements:
100, 120, 220, or 240 volts (±10%), 47 to 63 Hz
Power Consumption: <75 VA

Weight: (dependent on the number of channels)
HP 86060B: 3.76 to 4.1 Kg (8.4 to 9.2 lbs)
HP 86062B: 7.72 to 13.74 Kg (17.25 to 30.7 lbs.)

Dimensions: (H x W x D)
HP 86060B: 132.6 x 213 x 345.4 mm
(5.25 x 8.39 x 14 in.)
HP 86062B: 177 x 425 x 345.4 mm
(7 x 16.75 x 14 in.)

Ordering Information

HP 86060B Compact Lightwave Switch

Switch Configuration *(must select one only)*
- ❑ Option 001 Single input channel
- ❑ Option 002 Two input channels

Wavelength and Fiber Type *(must select one only)*
- ❑ Option109 1280–1650 nm, 9/125 µm single-mode fiber
- ❑ Option 162 1280–1650 nm, 62.5/125 µm multimode fiber
- ❑ Option H63 800–1350 nm, 62.5/125 µm multimode fiber (special order)
- ❑ Option H50 1280–1650 nm, 50/125 µm multimode fiber (special order)
- ❑ Option H51 800–1350 nm, 50/125 µm multimode fiber (special order)

Port Type *(must select one only)*
- ❑ Option 050 Connectors on front panel (only available with option 204)
- ❑ Option 051 Connectors on rear panel (for connectorized outputs only)
- ❑ Option 052 1 meter fiber out the rear panel (for connectorized outputs, connector is at the end of the 1 meter fiber)

Output Channels
# of Connectorized Outputs *(must select one only)*
- ❑ Option 2XX where XX is the # of connectorized output channels (from 04 to 08)

Connector Type *(must select one only)*
- ❑ Option 012 FC Connectors
- ❑ Option 014 ST Connectors
- ❑ Option 017 SC Connectors
- ❑ FC/APC or SC/APC Connectors (special orders)

or

# of Non-connectorized Outputs *(must select one only)*
- ❑ Option 3XX where XX is the # of non-connectorized output channels (from 04 to 08)

Special Orders
- ❑ Please contact your local HP representative

HP 86062B Full-Size Lightwave Switch

Switch Configuration *(must select one only)*
- ❑ Option 001 Single input channel
- ❑ Option 002 Two input channels

Wavelength and Fiber Type *(must select one only)*
- ❑ Option 109 1280–1650 nm, 9/125 µm single-mode fiber
- ❑ Option 162 1280–1650 nm, 62.5/125 µm multimode fiber
- ❑ Option H63 800–1350 nm, 62.5/125 µm multimode fiber (special order)
- ❑ Option H50 1280–1650 nm, 50/125 µm multimode fiber (special order)
- ❑ Option H51 800–1350 nm, 50/125 µm multimode fiber (special order)

Port Type *(must select one only)*
- ❑ Option 051 Connectors on rear panel (for connectorized outputs only)
- ❑ Option 052 1 meter fiber out the rear panel (for connectorized outputs, connector is at the end of the 1 meter fiber)

Output Channels
# of Connectorized Outputs *(must select one only)*
- ❑ Option 204 4 Connectorized outputs
- ❑ Option 208 8 Connectorized outputs
- ❑ Option 212 12 Connectorized outputs
- ❑ Option 216 16 Connectorized outputs
- ❑ Option 220 20 Connectorized outputs
- ❑ Option 224 24 Connectorized outputs
- ❑ Option 228 28 Connectorized outputs
- ❑ Option 232 32 Connectorized outputs
- ❑ Option 236 36 Connectorized outputs
- ❑ Option 240 40 Connectorized outputs
- ❑ Option 244 44 Connectorized outputs
- ❑ Option 248 48 Connectorized outputs
- ❑ Option 252 52 Connectorized outputs
- ❑ Option 256 56 Connectorized outputs
- ❑ Option 260 60 Connectorized outputs
- ❑ Option 264 64 Connectorized outputs
- ❑ Option 268 68 Connectorized outputs
- ❑ Option 272 72 Connectorized outputs
- ❑ Option 276 76 Connectorized outputs
- ❑ Option 280 80 Connectorized outputs
- ❑ Option 284 84 Connectorized outputs
- ❑ Option 288 88 Connectorized outputs
- ❑ Option 292 92 Connectorized outputs
- ❑ Option 296 96 Connectorized outputs
- ❑ Option 200 100 Connectorized outputs

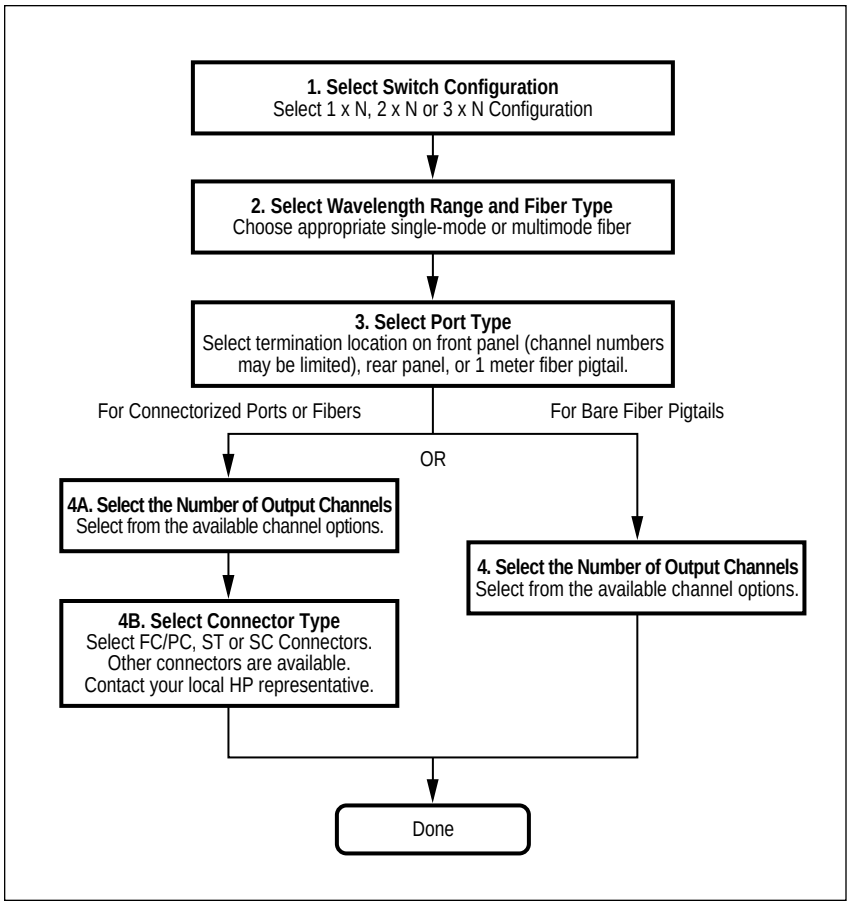
Connector Type *(must select one only)*
- ❑ Option 012 FC/PC Connectors
- ❑ Option 014 ST Connectors
- ❑ Option 017 SC Connectors
- ❑ FC/APC or SC/APC Connectors (special orders)

or

# of Non-connectorized Outputs *(must select one only)*
- ❑ Option 304 4 Non-connectorized outputs
- ❑ Option 308 8 Non-connectorized outputs
- ❑ Option 312 12 Non-connectorized outputs
- ❑ Option 316 16 Non-connectorized outputs
- ❑ Option 320 20 Non-connectorized outputs
- ❑ Option 324 24 Non-connectorized outputs
- ❑ Option 328 28 Non-connectorized outputs
- ❑ Option 332 32 Non-connectorized outputs
- ❑ Option 336 36 Non-connectorized outputs
- ❑ Option 340 40 Non-connectorized outputs
- ❑ Option 344 44 Non-connectorized outputs
- ❑ Option 348 48 Non-connectorized outputs
- ❑ Option 352 52 Non-connectorized outputs
- ❑ Option 356 56 Non-connectorized outputs
- ❑ Option 360 60 Non-connectorized outputs
- ❑ Option 364 64 Non-connectorized outputs
- ❑ Option 368 68 Non-connectorized outputs
- ❑ Option 372 72 Non-connectorized outputs
- ❑ Option 376 76 Non-connectorized outputs
- ❑ Option 380 80 Non-connectorized outputs
- ❑ Option 384 84 Non-connectorized outputs
- ❑ Option 388 88 Non-connectorized outputs
- ❑ Option 392 92 Non-connectorized outputs
- ❑ Option 396 96 Non-connectorized outputs
- ❑ Option 300 100 Non-connectorized outputs

Special Orders
- ❑ Please contact your local HP representative

Configuration Guide



Configuration flowchart

Configuration examples

HP 86062B Full-Size Lightwave Switch
Opt 002 Two input channels
Opt 109 1280 to 1650 nm, 9/125 µm single-mode fiber
Opt 051 Connectors on rear panel
Opt 208 8 Connectorized outputs
Opt 017 SC Connectors

HP 86062B Full-Size Lightwave Switch
Opt 002 Two input channels
Opt 109 1280 to 1650 nm, 9/125 µm single-mode fiber
Opt 051 Connectors on rear panel
Opt 244 44 Outputs
Opt 017 SC Connectors

For more information about Hewlett-Packard test and measurement products, applications, services, and for a current sales office listing, visit our web site, http://www.hp.com/go/tmdir. You can also contact one of the following centers and ask for a test and measurement sales representative.

United States:
Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

Canada:
Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
(905) 206 4725

Europe:
Hewlett-Packard
European Marketing Centre
P.O. Box 999
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(31 20) 547 9900

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