

# Agilent 86060C Series Lightwave Switches

## Product Overview



**Agilent Technologies**

Innovating the HP Way

# Lightwave Switching for Test Automation

- **Temperature stabilized performance with low insertion loss**
- **Easy-to-use manual interface with visual signal path display**
- **Repeatable switching with 10 million cycle minimum life**
- **SCPI-compatible remote commands via GPIB and RS-232**
- **Multilayer switches and other custom configurations available**

The Agilent 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 in manufacturing. They are designed to be versatile and can be easily configured with several different options for automated test environments.

The Agilent 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 GPIB or RS-232 interfaces.

## Agilent 86060C Features and Benefits

Agilent's new "C" series of lightwave switches are now temperature stabilized and thus, offer excellent repeatability and insertion loss stability. They are designed for long reliable service with low insertion loss and low back reflections, for accurate lightwave measurements in automated test setups where the switch is an integral part of the measurement.

The Agilent 86060C 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.

New to the "C" series switch family is the Agilent 86061C—a mid-size switch in a half-width chassis, available with one or two input channels. It can accommodate from four to twelve output channels on the front panel and up to eighteen outputs on the rear panel.

The Agilent 86062C is a full-width instrument with 20 to 100 output channels. It is designed for automated production and evaluation testing of large numbers of devices.

The Agilent 86060 Series Lightwave Switches are designed for 9/125  $\mu\text{m}$  single-mode, as well as 62.5/125 and 50/125  $\mu\text{m}$  multi-mode operation. Switching is bi-directional. The 1xN switching module is built around a precision stepper motor.

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

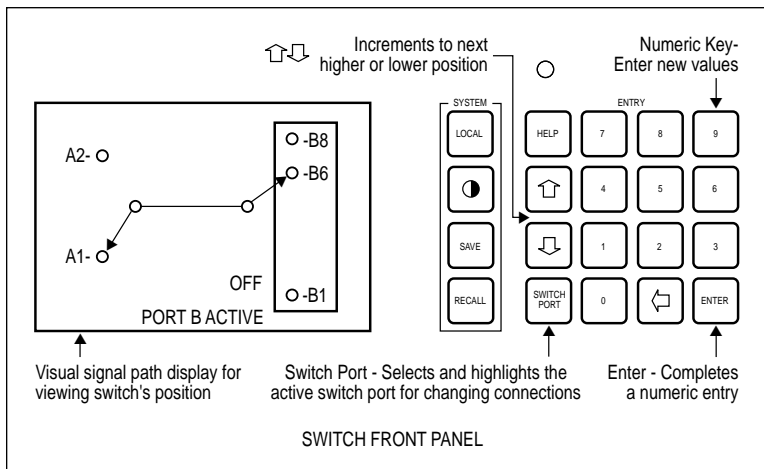


Figure 1. Agilent's manual interface and visual signal routing display (top diagram).

## Switching Operation

The basic 1xN switching design of the 8606XC is shown in Figure 2. It consists of a single input channel that is routed through a movable arm. The arm is controlled by the stepper motor to align the input to any output position<sup>1</sup>. Very low insertion loss and excellent repeatability are achieved using high quality optics and precise motor control.

A two input switch diagram is shown in Figure 3. In this configuration, the two input arms move together to connect either input channel to an output channel. The standard Agilent 8606XC design is called “non-blocking” since the unselected input channel is not blocked to the output. In this example, connecting A1 to B1 may also connect A2 to B2. “Blocking” type switches that only allow one of the input channels to be connected to the output can also be configured in the Agilent 86060C family. These are available as special options at this time. For additional information about blocking switches, please refer to the custom switching configuration section of this document or contact your local Agilent field office.

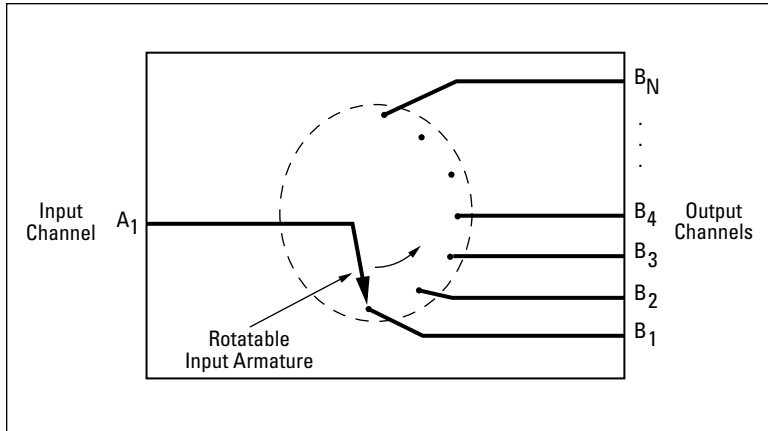


Figure 2. 1xN switching configuration

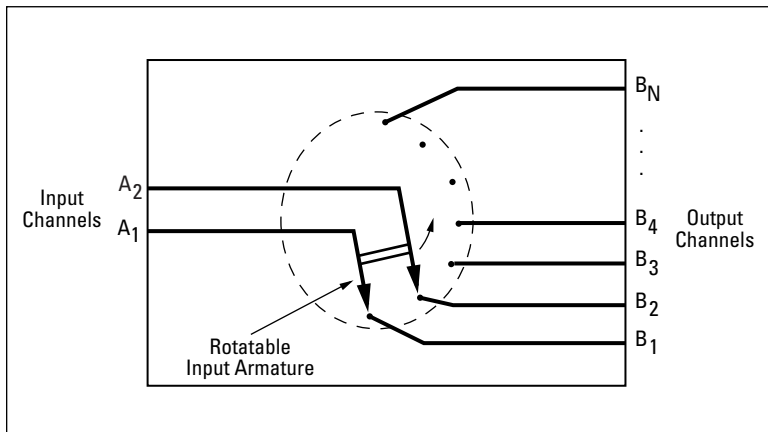


Figure 3. 2xN non-blocking configuration

<sup>1</sup> The terms “input” and “output” denote one side of the switch versus the other. They do not imply that transmission can only occur in one direction. The 86060C series switches are all bi-directional (i.e., signals can transmit in either direction).

### Custom configurations

In addition to the many standard options, Agilent offers a variety of custom configurations to tailor the optical switch for specific test applications. Some of the more important configurations are described here. For information on other types of custom switches, please contact your local Agilent field representative.

### Multi-layered Switches

The 86060C family offers multi-layered switch configurations in a single chassis. This provides added flexibility and functionality while minimizing rack or bench space. Integrated multi-layer software can control up to 4 separate switch layers in a single box. An example of a 4 layer switch is shown in Figure 4. It consists of two 1x2 switches on layers S1 and S2 and two 2x8 switches in layers S3 and S4 in a single chassis. The front panel display in Figure 5 shows the channel configuration in each of the four layers.

### Blocking Switches

In addition to the standard “non-blocking” design, the Agilent 8606XC series switches can be specified in a “blocking” configuration (i.e., only one input channel can be connected to the output). This is achieved in two ways.

The first type of blocking solution is where every other output channel position is utilized (see Figure 6). In this configuration only one input channel can be connected to

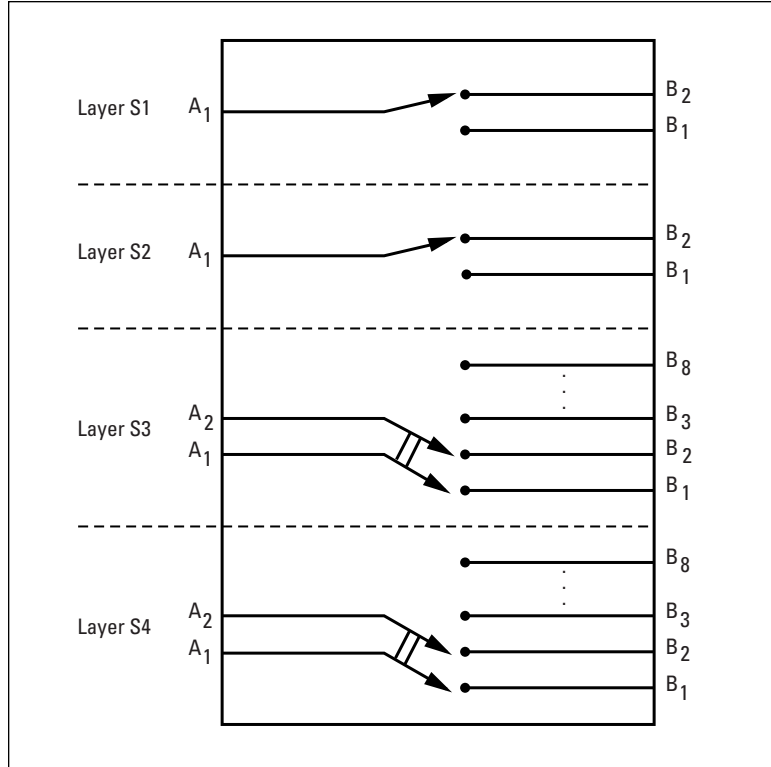


Figure 4. Multi-layered switch example

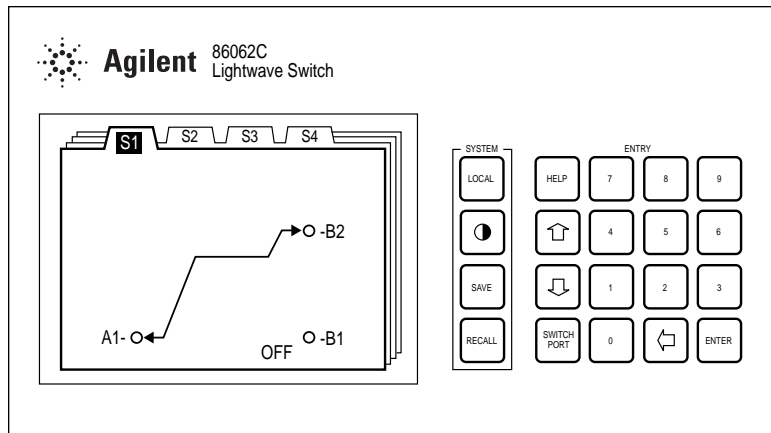


Figure 5. Layer S1 showing input side of automated testbed shown in Figure 2

an output channel, while the other input is not aligned to any connecting port. The advantage to this design is that low insertion loss can be maintained. However, the total number

of available output channels is reduced by half. For the Agilent 8606XC family, the limit would be 50 output channels in this blocking configuration.

If more than fifty channels are required, another blocking solution is available in the “C” version by adding an Mx1 switching element in front of a 1xN armature switch (See Figure 7). The implication of this design is that there is slightly higher insertion loss than the standard “C” specification, and the input/output channels are controlled on two separate layers via front panel keys or remote control. When programming the switch, two SCPI commands are needed to connect a one of the input channels to a desired output channel.

**More Than Two Input Channels**

The 8606XC family of switches can be configured to have more than 2 input channels. Up to 4 input channels can be accommodated. Figure 8 depicts a 4xN configuration. In this design, the four input arms move together to connect any input channel to any output channel.

For other types of special configurations (such as angled connector contacts, enhanced specifications, special fiber type, etc.), please contact your local Agilent field representative or regional customer call center.

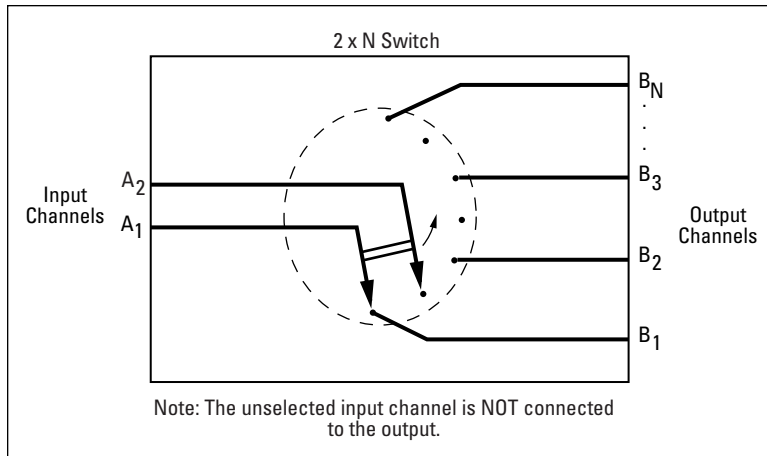


Figure 6. Agilent 8606XC blocking switch configuration 1

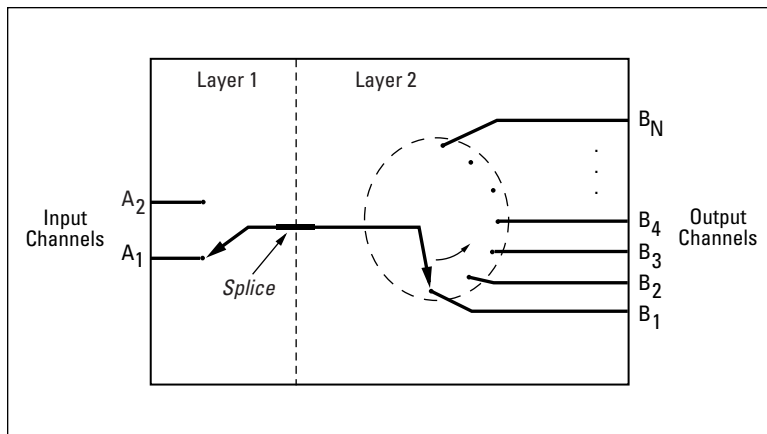


Figure 7. Agilent 8606XC blocking switch configuration 2

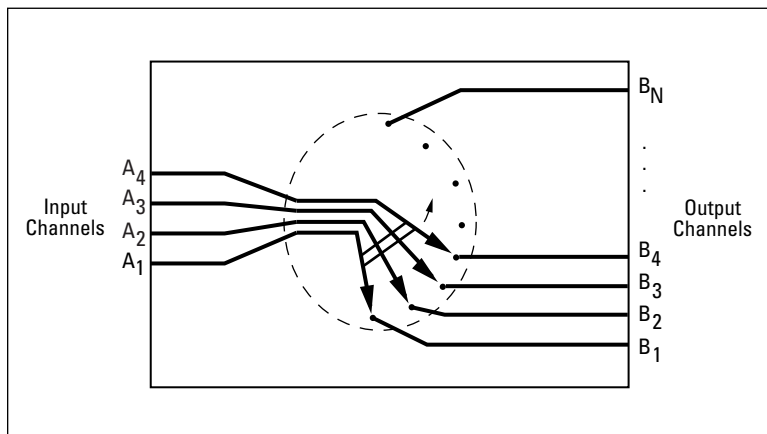


Figure 8. 4xN switch configuration

# Applications

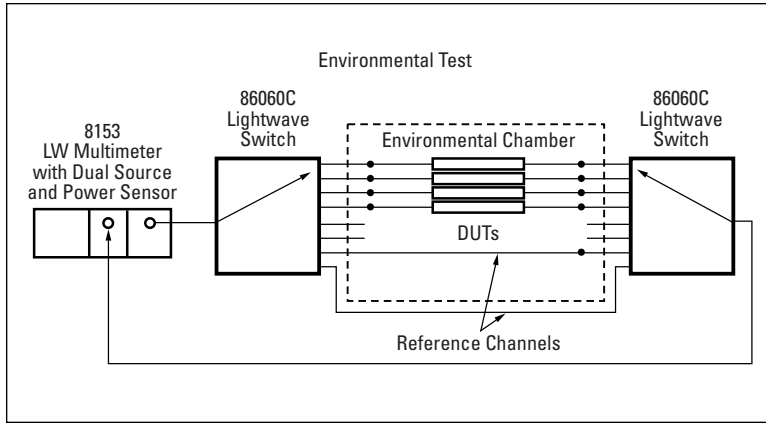


Figure 9. Insertion loss as a function of temperature

A well-implemented automated test system can help reduce manufacturing costs. A wide range of measurements can be performed and recorded much more rapidly, eliminating the need to manually reset operating conditions. Automated systems can be implemented to reduce the necessary operator skill level and amount of training required. They can also reduce the time spent recording, recovering, 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 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 9 shows an automated environmental test system using two Agilent 86060C Lightwave Switches and an 8153 Lightwave Multimeter with the 81554SM Dual Laser Source module and the 81532A Power Sensor

module. Multiple devices are connected for the test (for example, 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 Agilent 86062C 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 10 shows an eight channel WDM/router test setup which uses a multi-layered Agilent 86062C switch with three switching modules. The Agilent 11896A Polarization Controller allows the devices under test to be tested for amplitude and wavelength

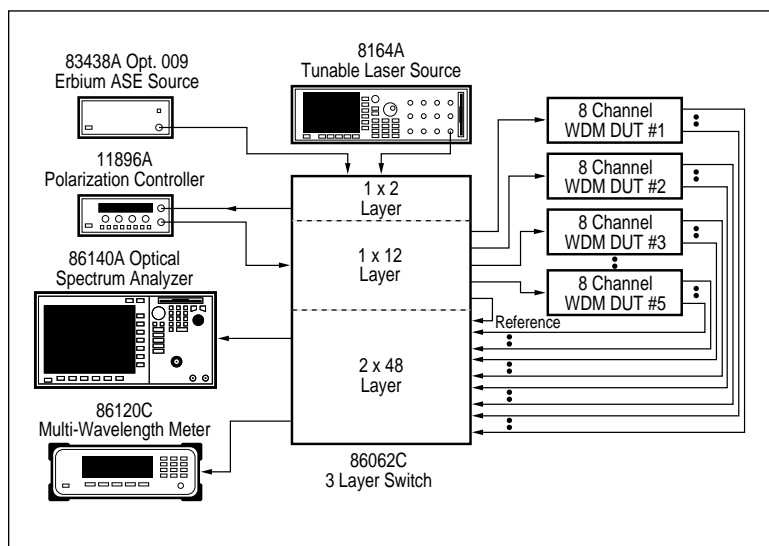


Figure 10. Eight channel WDM/router test setup

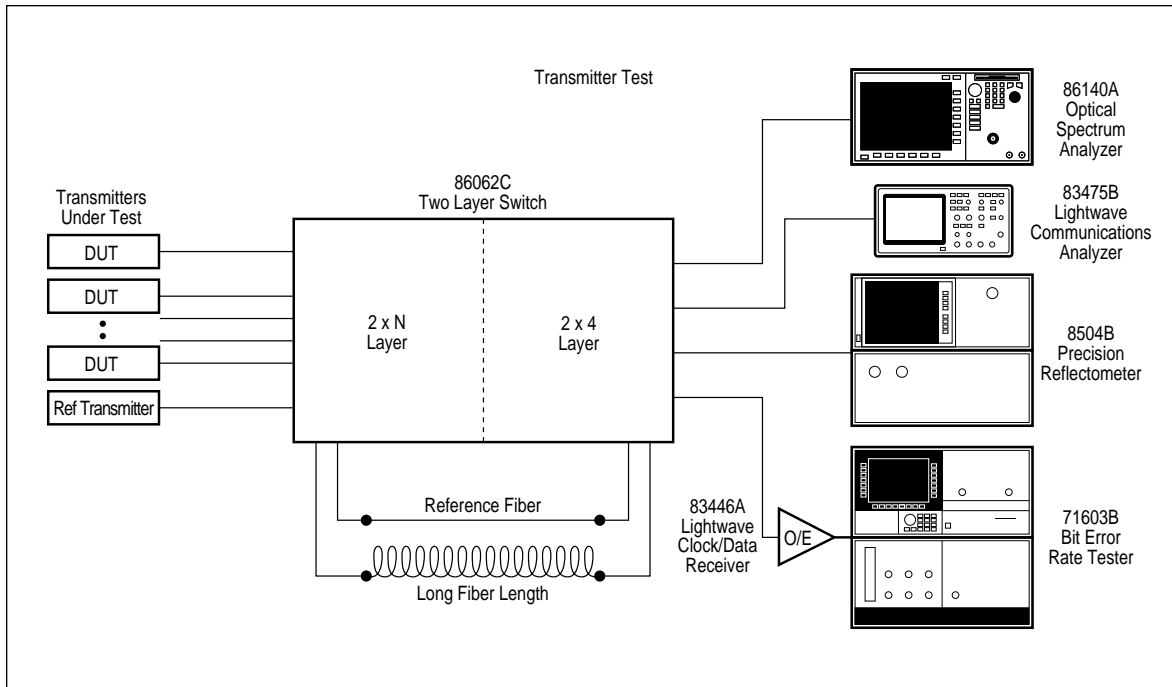


Figure 11. Automated transmitter test system

polarization dependency. The Agilent 86140A Optical Spectrum Analyzer provides spectral characteristics such as free spectral range, channel bandwidth, and isolation/crosstalk. The Agilent 86120C 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.

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 11 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 Agilent 86140A Optical Spectrum Analyzer. The system performs eye-diagram measure-

ments using the Agilent 83475B Lightwave Communications Analyzer. The Agilent 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 Agilent 71603B Bit Error Rate Tester, together with the Agilent 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 Agilent 71603B BERT to sequentially measure the bit error rate performance of the receivers.

# Specifications and Characteristics

**Specifications** describe the instrument's warranted performance (including measurement uncertainty) 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.

	Characteristic	Specification
<b>Insertion Loss<sup>1</sup></b>		
Single-mode Switches	0.7 dB	1.0 dB
Multi-mode Switches	0.6 dB	0.8 dB
<b>Insertion Loss Stability<sup>2</sup></b>		
	±0.025 dB	±0.03 dB
<b>Repeatability<sup>3</sup></b>		
Sequential Switching	±0.005 dB	±0.008 dB
Random Switching	±0.01 dB	±0.025 dB
<b>Optical Return Loss<sup>4</sup></b>		
Single-mode Switches	62 dB	58 dB
Multimode Switches	25 dB	20 dB
<b>Polarization Dependent Loss<sup>5</sup></b>		
	0.02 dB	0.05 dB
<b>Isolation</b>		
	-100 dB	-80 dB
<b>Typical Switching Life</b>		
	10 million cycles	
<b>Switching Time</b>		
Between Adjacent Channels	330 msec	
Each Additional Channel	50 msec	

<sup>1</sup> Insertion loss does not include connectors. Include an additional 0.25 dB (characteristic) or 0.5 dB (hard spec) for each connector.

<sup>2</sup> Drift of any channel relative to one assigned reference channel at ±3°C for 7 days.

<sup>3</sup> Repeatability measured after four hours warmup and with an one second pause between movements.

<sup>4</sup> Excludes external pigtail backscatter and connector reflections.

<sup>5</sup> Polarization Dependent Loss only applies to single-mode switches and is measured at 1550 nm.

## General Specifications

### Temperature Range:

Operational: 0 to +55°C

Storage: -40 to +70°C

### Power Requirements:

100/115/230/240 V (range 90 to 254 vac).

Power Consumption: up to 80 VA (characteristic)

### Weight: (dependent on the number of channels)

Agilent 86060C: 3.76 to 4.1 Kg (8.4 to 9.2 lbs)

Agilent 86061C: 4.0 to 6.18 kg (8.8 to 13.6 lbs)

Agilent 86062C: 7.72 to 13.74 Kg (17.25 to 30.7 lbs)

### Dimensions: (H x W x D)

Agilent 86060C: 132.6 x 213 x 345.4 mm

(5.25 x 8.39 x 14 in.)

Agilent 86061C: 177 x 213 x 345.4 mm

(7 x 8.39 x 14 in.)

Agilent 86062C: 177 x 425 x 345.4 mm

(7 x 16.75 x 14 in.)

# Ordering Information

## Switch Configuration

### Chassis Size (must select one only)

- Agilent 86060C Compact Lightwave Switch
- Agilent 86061C Mid-Size Lightwave Switch
- Agilent 86062C Full-Size Lightwave Switch

### Number of Input Channels (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 163 830–1350 nm, 62.5/125 µm multimode fiber
- Option H51 830–1350 nm, 50/125 µm multimode fiber (special order)

### Port Type (must select one only)

- Option 050 Connectors on front panel (on compact and mid-size switches with Option 204 only)
- Option 051 Connectors on rear panel (for connectorized outputs only)
- Option 052 3 meter fiber out the rear panel (for connectorized outputs, connector is at the end of the 3 meter fiber)

### Output Channels (must select one only)

- Option 2XX (where XX is the # of connectorized output channels selected from the table below)
- Option 3XX (where XX is the # of non-connectorized output channels selected from the table below)

Agilent 86060C Compact Lightwave Switch # Output Channels	Agilent 86061C Mid-Size Lightwave Switch # Output Channels	Agilent 86062C Full-Size Lightwave Switch # Output Channels
04	04	20
06	08	24
08	12	28
	16	32
		40
		48
		56
		64
		72
		80
		00 (100 output channels)

### *Use only if needing connectorized ports or fibers.*

#### 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)

## Optional

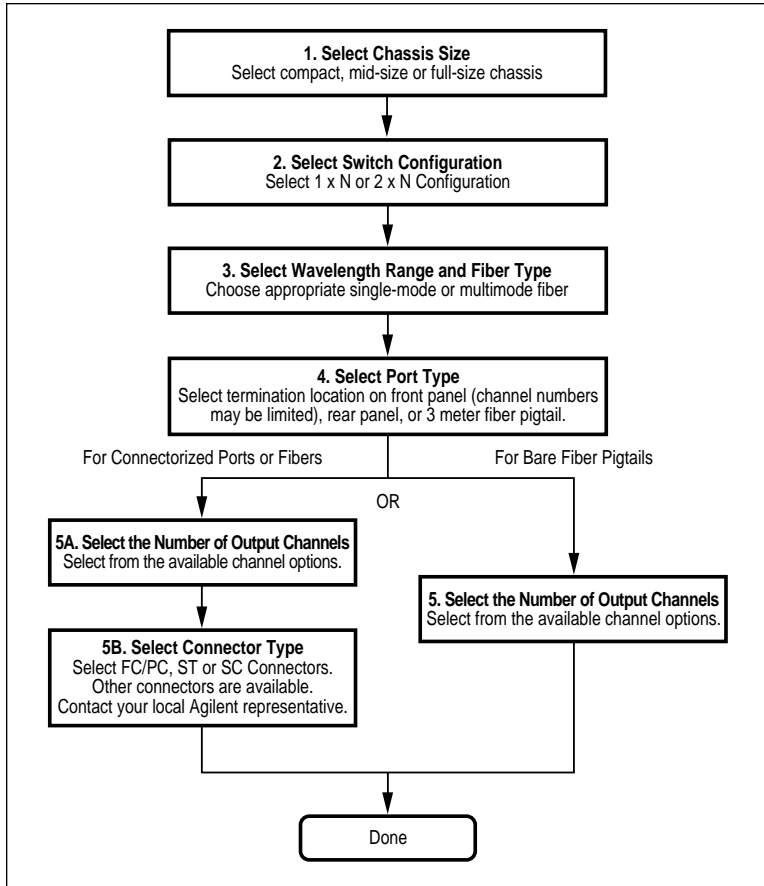
- Option UK6 Commercial calibration certificate with test data
- Option ABJ User's manual in Japanese

### Rack Mount Options (must select one only)

- Option 1CN Front handle kit
- Option 1CM Rack-mount flange kit
- Option 1CP Rack-mount flange kit with handles

## Special Orders

*Please contact your local Agilent representative.*



Configuration flowchart

## Configuration Examples

**Agilent 86060C** Compact Lightwave Switch

**Opt 001** One input channel

**Opt 109** 1280 to 1650 nm, 9/125  $\mu$ m fiber

**Opt 051** Connectors on rear panel

**Opt 208** 8 Connectorized outputs

**Opt 017** SC Connectors

**Agilent 86062C** Full-Size Lightwave Switch

**Opt 002** Two input channels

**Opt 163** 750 to 1350 nm, 62.5/125  $\mu$ m fiber

**Opt 052** 3 Meter fiber pigtails out the rear panel

**Opt 264** 64 Connectorized outputs

**Opt 012** FC Connectors

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[www.agilent.com/comms/lightwave](http://www.agilent.com/comms/lightwave)

You can also contact one of the following centers and ask for a test and measurement sales representative.

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(tel) 1 800 452 4844

**Canada:**

Agilent Technologies Canada Inc.  
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Mississauga, Ontario  
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(tel) 1 877 894 4414

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