Redefining the State-of-the-Art in ATE

Agilent Technologies
3499A/B Switch/Control System
At Agilent, we continuously drive the state-of-the-art with our products.
So you can do the same with yours.

High Performance, Low Impact, Easy Decision

The Agilent 3499 is a state-of-the-art switch/control system for automated test equipment (ATE) applications. Its high-speed architecture and high-density switching capabilities put it on a performance curve that other mainframes simply cannot match. And its new low price and compact design—delivering a 30 percent cost and space savings over its predecessor, the Agilent 3488—means you get great performance with minimal impact on your budget and operating environment. That’s a primary advantage of coming to Agilent for your ATE solutions. We constantly push the price/performance envelope. So you always have access to state-of-the-art technologies, whenever and wherever you need them.

**High Throughput, Small Footprint**
You can increase test throughput while not adding floor space.

**The “Right Test”**
Wide range of 30 modules means you can get the precise test solution you need: no more no less.

**Smart Design**
Multi-function modules that integrate switching and digital I/O allow you to make best use of all available resources.

**Simple Maintenance**
Built-in relay cycle counters help make sure maintenance happens on schedule, as expected.

**Easy Set-Up**
Easy wiring simplifies cabling and increases reliability. Simple, robust interconnections accelerate system set-up and module swapping.

Learn more at www.agilent.com/find/test
High speed, high density, highly usable.

The Agilent 3499 gets high marks in ATE environments worldwide.

Performance Overview

Both configurations of the Agilent 3499—the five-slot 3499A and two-slot 3499B—can scan at rates up to 350 channels per second, or open/close 200 channels in less than 0.1 second. The 3499A can accommodate up to five plug-in modules, routing up to 200 channels in a test system. You can choose from 30 plug-in modules to switch 1310 to 1550 nm optical signals, and electronic signals from DC to 30 GHz, or 1 mV to 1,000 V, or 1 mA to 8 A. The 3499B is a half-rack-width, 2-slot mainframe, allowing switching for up to 80 channels for ATE or desktop operations. Both units have an efficient user interface that works equally well on the manufacturing floor and in desktop applications. High-performance switching modules, multi-function modules, built-in relay cycle counters and straightforward connections all contribute to the performance and day-to-day usability of the 3499. Here’s what it means in the real world…

Blazing Throughput

While traditional switching mainframes open/close relays in sequence, the Agilent 3499A/B systems use innovative parallel driving circuits to open/close switches simultaneously, significantly increasing test throughput. The systems also provide high-density modules with up to 40 channels per module. Three multi-function modules integrate switching, digital I/O and DAC in one module to enhance system performance.
Total Flexibility

The 3499A and 3499B mainframes accommodate a full range of 30 modules, including multiplexer, fiber-optical multiplexer, general-purpose relay, matrix, digital I/O, VHF module, RF module, microwave module, Form-C relay, and three special multifunction modules. By combining these mainframes and modules, a test system can be set up with fewer modules in less space, and the cost and complexity of the system can be reduced.

Fast Set-Up

An easy-to-use interface and industry-standard connections mean fast set-up and integration with the 3499. Usability features include:
- Standard RS-232 and GPIB interfaces
- SCPI (Standard Commands for Programmable Instruments)
- Simplified configuration procedures
- Self-guiding front panel interface
- Easy-to-use module connection accessories
- Built-in relay cycle counters
- Well-organized user documentation

Cost-Sensitive Test

With two mainframes and 30 modules to choose from, you can make sure the 3499 meets your exact needs. Build the system you need today, add more modules later as your needs change. That means you buy only the test capability you need. Newly designed high-density switch modules further reduce the cost-of-test by combining a large number of channels on a single module. And with up to 40 switching channels per module, the 3499 reduces per-channel cost while saving rack and floor space. You get a simpler system with fewer modules, reducing the cost of buying, owning and maintaining your system.
Multi-Function Flexibility

Three multifunction modules are supported with the 3499. The Agilent N2264A includes 12 general-purpose relay channels, three high-current general-purpose relay channels, and 16 bits of digital I/O. These high current channels are ideal for cell phone test, battery test and UPS test where only two or three high-current channels are required. The N2265A combines a 4x4 matrix switch with 16 bits of digital I/O on one module. The N2269A provides 16-bit optically isolated digital I/O and two 16-bit DACs in one module, along with three power relay channels that can switch signals up to 5 A.

Simple Wiring

The 3499 reduces wiring time with removable screw terminal blocks and crimp-and-insert terminal blocks that are detachable from the switching modules. This eliminates the need to spend time rewiring the connectors if a switching module is replaced. The seven high-density modules use industry standard DIN96 connectors for better flexibility. The modules are equipped with DIN96-to-D50(25) cables for easy connection to the DUT and test instruments. These cables completely eliminate wiring.

Zero Downtime

The 3499 takes the guesswork out of relay maintenance. A built-in relay cycle counter automatically counts every individual relay closure and stores the values on-board in non-volatile memory. A simple command (DIAG: CYC? Chan. xx) recalls the total number of cycles completed for each individual relay. You can use the counter to accurately predict end-of-life relay failures, and perform preventive maintenance ahead of time, virtually eliminating unplanned downtime due to failed relays.

Easy Migration

The 3499 is hardware and software compatible with its predecessor, the 3488A. All 3488A modules will work in a 3499A/B mainframe in combinations of N2260A-81A modules. The 3499A/B mainframes can be operated with SCPI (Standard Commands for Programmable Instruments) or the 3488A command sets. Upgrading from the 3488A to the 3499A doubles channel capacity and lowers your cost-per-channel with no additional cost in modules or software revisions.
The Agilent 3499 adapts to the needs of manufacturers in the real world.

**Cell Phone Test**

A typical test system for cell phones includes a switch system, a GSM/CDMA test set, a DMM (digital multimeter), a power supply, and a spectrum analyzer. An Agilent 3499A with a multifunction module (N2264A), a digital I/O module (N2263A), and a matrix module (N2262A) provides a complete switching solution for this test system. The three general-purpose high-current relays in the N2264A switch the cell phone power supplies: main battery, backup battery, or charger. With the three relays on the N2264A, the DMM tests the sleeping, standby, and working current between 0.1 mA and about 4 A. Eight bits of digital I/O drives the external solenoid coils to simulate key pressing. Eight additional bits of digital I/O are used to drive a coaxial relay to route the RF signal coming from the phone antenna to the GSM/CDMA test set (for camping, call set-up, power level, or bit-error-rate test), or to a spectrum analyzer (for spectrum leakage tests). Three more bits of digital I/O are used to communicate with the cell phone under test. Working with DMM, the matrix module switches the voice signals to/from the cell phone for audio testing.

**Pager Test**

A typical test system that tests a pager PC board consists of a 3499B equipped with one multiplexer module (N2260A), one matrix module (N2262A), one DMM, and one power supply. This compact test system can test one pager. In this configuration, one two-meter rack is capable of holding six to eight test systems. One matrix channel switches the DUT on and off. Using a multiplexer channel, the DMM tests the bias voltage of the mixer, front-end amplifier, and filters to ensure that the different circuits of the pager are working properly. Using a multiplexer channel, the DMM also tests the working/standby current to ensure that the pager’s battery has adequate working life.
**General-Purpose Test**

A general-purpose relay is used in applications to turn on/off the DUT, instruments, motors, pumps and LEDs. It’s also used in applications to form and attenuate networks with L, C, and R components.

A multiplexer is used for signal switching into instrumentation connecting many test points to an instrument, or for connecting a DUT to many instruments. Instruments can include multimeters, oscilloscopes, spectrum analyzers, counters and more. Multiplexers can have one, two, three or four wires.

- A one-wire multiplexer is useful in high frequency (30 MHz - 26 GHz) applications and common ended signal switching.
- A two-wire multiplexer is useful for floating measurements where the "high" and "low" paths need to be switched.
- A three-wire multiplexer is used primarily for guarded measurements that have very high CMRR (common mode rejection ratio).
- A four-wire multiplexer is mainly used for four-wire precision ohm measurements.

A matrix switch is used when one or more instruments are connected to one or more test points at the same time. By using a matrix switch, you can connect any point on the column to any point on the row. A matrix switch offers maximum flexibility, but you need to use more relays and pay attention to the crosstalk between channels.

A digital I/O module has both input and output bits for digital sensing and is mainly used to control external devices, such as motors, LEDs, and microwave relays. The digital I/O can also be used to send and receive digital pattern data to and from the DUT, and to communicate with other devices.

For more information, please view our Test System Switching application note online at www.agilent.com/find/3499.

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**Go Configure**

Broad configuration flexibility using up to 30 plug-in modules accounts for the wide adoption of the Agilent 3499 worldwide. The following tables make the point. The 3499 is built for the unpredictable, ever-shifting needs of ATE.

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### Agilent 3499 Mainframe Specifications

<table>
<thead>
<tr>
<th>Items</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
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<tr>
<td>Display</td>
<td>Vacuum fluorescent</td>
</tr>
<tr>
<td>Rear Panel Connectors</td>
<td>GPIB; RS-232; 8-pin mini DIN Connector (5 pins for Digital I/O, 3 pins for external trigger)</td>
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<tr>
<td>Power Supply</td>
<td>100 to 240 VAC universal input (47 Hz to 63 Hz); 100-127 VAC (400Hz); 40 VA maximum</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>0°C to 55°C, &lt;80% RH (0°C to 40°C)</td>
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<tr>
<td>Storage Environment</td>
<td>-40°C to +70°C</td>
</tr>
<tr>
<td>Net Weight</td>
<td>3499A: 3.8 kg (8.4 lbs); 3499B: 2.5 kg (5.5 lbs)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>3499A: H 89mm, W 426mm, L 348mm; 3499B: H 89mm, W 213mm, L 348mm</td>
</tr>
<tr>
<td>Safety</td>
<td>Conforms to CSA, UL-1244, IEC 1010 Cat I</td>
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<tr>
<td>RFI and ESD</td>
<td>CISPR 11, IEC 80 1/2/3/4</td>
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<tr>
<td>Warranty</td>
<td>1 year</td>
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<tr>
<td><strong>System</strong></td>
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<tr>
<td>Slot Capacity</td>
<td>3499A: 5 slots; 3499B: 2 slots.</td>
</tr>
<tr>
<td>Memory</td>
<td>Store states: 10 states in SCPI mode; 40 states in 3488A mode; Error store: 10 in SCPI mode, 1 in 3488 mode</td>
</tr>
<tr>
<td>Relay Setting Time</td>
<td>Automatically selected by the mainframe for each module.</td>
</tr>
<tr>
<td>Trigger Source</td>
<td>External trigger (real panel Mini-DIN connector); GPIB bus (GET,*TRG) or RS-232 (*TRG)</td>
</tr>
<tr>
<td>External Trigger</td>
<td>Trigger pulse width: &gt;2µs; External trigger delay: &lt;2ms.</td>
</tr>
<tr>
<td>Built-in 4 digital I/O</td>
<td>Input: TTL compatible; Vo (L): &lt;0.8V @ Io = -100mA; Vo (H): &gt;2.4V @ Io = 1mA; Vout (H) ≤ 42V.</td>
</tr>
</tbody>
</table>
There are 30 plug-in modules including multiplexer, RF multiplexer, fiber-optical multiplexer, general-purpose relay, matrix, digital input/output, Form-C, breadboard, multifunction modules. Please refer following table for plug-in module selection.

### Plug-in Module Selection Table

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Max. Voltage</th>
<th>Max. Current per Chan.</th>
<th>Initial Closed Channel Resistance</th>
<th>Thermal Offset per Chan.</th>
<th>Bandwidth</th>
<th>Connection Type</th>
<th>Relay Cycle Counter</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td><strong>Multiplexer Modules</strong></td>
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<tr>
<td>N2260A</td>
<td>40-channel 200V 1A &lt;1 Ω  &lt;3µV 10MHz T or C Yes 10</td>
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<tr>
<td>N2266A</td>
<td>40-channel 200V 0.5A &lt;1 Ω  &lt;3µV 10MHz T or C Yes 10</td>
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<tr>
<td>N2270A</td>
<td>10-channel 1000V 1A &lt;1 Ω  &lt;200µV 5MHz Crimp &amp; Insert Yes 19</td>
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<tr>
<td>44470A</td>
<td>10-channel 250V 2A &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<td>44470D</td>
<td>20-channel 250V &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<td><strong>General-purpose Relay Modules</strong></td>
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<td>N2261A</td>
<td>40-channel 200V 1A &lt;0.5 Ω  &lt;3µV 10MHz T or C Yes 11</td>
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<td>N2267A</td>
<td>8-channel 250V 8A &lt;0.08 Ω  &lt;3µV 20MHz Crimp &amp; Insert Yes 16</td>
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<tr>
<td>44471A</td>
<td>10-channel 250V 2A &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<tr>
<td>44471D</td>
<td>20-channel 250V 1A &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<td><strong>Matrix Modules</strong></td>
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<td>N2262A</td>
<td>4 x 8 matrix 200V 1A &lt;1 Ω  &lt;3µV 10MHz T or C Yes 12</td>
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<td>44473A</td>
<td>4 x 4 matrix 250V 2A &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<td><strong>Digital I/O Modules</strong></td>
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<tr>
<td>N2263A</td>
<td>32-bit TTL 42V 0.6A NA NA NA T or C 13</td>
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<td>44474A</td>
<td>16-bit TTL 30V 0.125A NA NA NA T 25</td>
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<td><strong>Multifunction Modules</strong></td>
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<td>N2264A</td>
<td>12 GP 200V 1A &lt;0.5 Ω  &lt;3µV 10MHz T or C Yes 14</td>
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<td>3 GP 125V 5A &lt;0.1 Ω  &lt;3µV 10MHz T or C Yes 14</td>
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<tr>
<td>16-bit DIO 42V 0.6A NA NA NA T or C 14</td>
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<td>N2265A</td>
<td>4 x 4 matrix 200V 1A &lt;1 Ω  &lt;3µV 10MHz T or C Yes 15</td>
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<tr>
<td>16-bit DIO 42V 0.6A NA NA NA T or C 15</td>
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<td>N2269A</td>
<td>2 DAC 12V 10mA NA NA NA T or C 18</td>
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<tr>
<td>16-bit DIO TTL-compatible NA NA NA T or C 18</td>
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<td><strong>Form-C Relay Module</strong></td>
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<td>44477A</td>
<td>7-channel 250V 2A &lt;1 Ω  &lt;3µV 10MHz T 25</td>
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<td><strong>Fiber-optical Multiplexer Modules (typical specs)</strong></td>
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<tr>
<td>Modules</td>
<td>Description</td>
<td>Insertion loss</td>
<td>Stability</td>
<td>Repeatability</td>
<td>Wavelength</td>
<td>Connector</td>
<td>Switching Time</td>
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<td>N2280A</td>
<td>Quad 1 x 2</td>
<td>0.5 dB</td>
<td>±0.03dB</td>
<td>±0.003dB</td>
<td>1310/1550 nm</td>
<td>SC/APC</td>
<td>15 ms</td>
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<tr>
<td>N2281A</td>
<td>Single 1 x 4</td>
<td>0.5 dB</td>
<td>±0.03dB</td>
<td>±0.003dB</td>
<td>1310/1550 nm</td>
<td>SC/APC</td>
<td>20 ms</td>
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<tr>
<td>N2282A</td>
<td>Single 1 x 8</td>
<td>0.5 dB</td>
<td>±0.02dB</td>
<td>±0.005/0.01dB</td>
<td>1270/1670 nm</td>
<td>SC/APC</td>
<td>250 ms</td>
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<td><strong>RF &amp; Microwave Modules</strong></td>
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<tr>
<td>Modules</td>
<td>Description</td>
<td>Insertion loss</td>
<td>Cross talk</td>
<td>SWR</td>
<td>Bandwidth</td>
<td>Impedance</td>
<td>Connector</td>
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<tr>
<td>N2268A</td>
<td>Dual 1 x 4</td>
<td>&lt;0.35dB</td>
<td>&lt;-64dB</td>
<td>&lt;1.20</td>
<td>3.5 GHz</td>
<td>50 Ω</td>
<td>SMA</td>
<td></td>
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<tr>
<td>N2272A</td>
<td>Single 1 x 9</td>
<td>&lt;0.5dB</td>
<td>&lt;-75dB</td>
<td>&lt;1.20</td>
<td>1.0 GHz</td>
<td>50 Ω</td>
<td>BNC</td>
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<tr>
<td>N2276A</td>
<td>Dual 1 x 6</td>
<td>&lt;0.36dB</td>
<td>&lt;-100dB</td>
<td>&lt;1.20</td>
<td>20 GHz</td>
<td>50 Ω</td>
<td>SMA</td>
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<tr>
<td>N2276B</td>
<td>Relay driver can support 2 microwave switches. Technical specs depend on the mounted relays. 21</td>
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<tr>
<td>44472A</td>
<td>Dual 1 x 4</td>
<td>&lt;0.75dB</td>
<td>&lt;-85dB</td>
<td>&lt;1.12</td>
<td>300 MHz</td>
<td>50 Ω</td>
<td>BNC</td>
<td></td>
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<tr>
<td>44478A</td>
<td>Dual 1 x 4</td>
<td>&lt;1.18</td>
<td>&lt;-70dB</td>
<td>&lt;1.35</td>
<td>1.3 GHz</td>
<td>50 Ω</td>
<td>BNC</td>
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<tr>
<td>44478B</td>
<td>Dual 1 x 4</td>
<td>&lt;1.18</td>
<td>&lt;-70dB</td>
<td>&lt;1.35</td>
<td>1.3 GHz</td>
<td>75 Ω</td>
<td>BNC</td>
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<tr>
<td>44476A</td>
<td>Triple 1 x 2</td>
<td>&lt;0.25dB</td>
<td>&lt;-60dB</td>
<td>&lt;1.15</td>
<td>18 GHz</td>
<td>50 Ω</td>
<td>SMA</td>
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<tr>
<td>N2294A</td>
<td>Screw terminal block for N2264A</td>
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<tr>
<td>N2296A</td>
<td>Crimp &amp; insert terminal block for N2260/1/2/3/4/5/6A.</td>
<td></td>
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<tr>
<td>N2279A</td>
<td>1.5 m cable for connecting DUT to N2260/1/3/4/5/6A, one DIN96-to-Twin-D50.</td>
<td></td>
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<tr>
<td>N2279B</td>
<td>1.5 m cable for connecting to DUT to N2262A, one DIN96-to-D25.</td>
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<tr>
<td>N2298A</td>
<td>1.5 m cable for connecting to N2260/1/3/4/5/6A, one DIN96-to-Quad D25.</td>
<td></td>
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</tr>
</tbody>
</table>

Note: GP = General-purpose, DIO = Digital I/O, T = Terminal Block, C = Cable.
Agilent N2260A, N2266A

- Ultra-high speed switching
- Reconfigurable to 1, 2, and 4-wire mode
- Built-in relay cycle counters

The N2260A and N2266A are high-density reconfigurable multiplexer (MUX) modules for high-throughput production test. They can be operated in either SCPI or 3488A mode. In SCPI mode, they can be configured in any of the following ways:

- one 80-channel, 1-wire MUX
- one 40-channel, 2-wire MUX
- dual independent 20-channel 2-wire MUXs
- one 20-channel 4-wire MUX.

Up to five N2260/66As can be included in a 3499A mainframe to build a 1-to-200-channel, 2-wire MUX. Screw terminal block, crimp & insert terminal block, and DIN96-to-D50/25 cables are available for ease of wiring. The N2266A can scan at up to 350 channels/second. Low thermal offset voltage makes the N2260A ideal for low-level signal switching.
The N2261A general-purpose relay module provides 40 independent single-pole-single-throw (SPST) latching relays. Each channel can switch up to 200 V, 1 A, and 60 W or 62.5 VA. The innovative parallel driving circuits allow 10 channels to be operated simultaneously for high throughput. It can be operated in either SCPI mode or 3488A mode. A pair of signals can be switched together by using a pair of channels on two N2261A modules. The N2261A can be operated in single-channel break-before-make (BBM) or multiple-channel open/close mode. Screw terminal block, crimp & insert terminal block and DIN96-to-D25/50 cables are available to simplify wiring.

### Specifications

#### General Specifications
- **Relays:** Armature latching relay
- **Thermal Offset:** <3µV
- **Relay Life**
  - Mechanical: 10^6
  - Electrical: 5x10^5 (at 1A load)
- **Maximum Scan Rate:** 80 Chan/sec

#### Input Characteristics
- **Maximum Voltage:** 200V
- **Maximum Current:**
  - Per channel: 1A
  - Per module: 20A
- **Maximum Power:**
  - Per channel: 60W or 62.5VA
  - Per module: 1200W or 1250 VA
- **Initial Closed Channel Resistance:** <0.5 Ω

#### DC Isolation
- **Open Channel, Channel-Channel:** <(40°C, 50% RH) >10^9 Ω
- **Channel-Chassis:** <(40°C, 50% RH) >10^9 Ω

#### AC Isolation
- **Capacitance (with 1 channel closed):**
  - Open Channel, Channel-Channel: <10pF
  - Channel-Chassis: <20pF
- **Insertion Loss (with 50 Ω termination):**
  - 100kHz: <0.10dB
  - 1MHz: <0.20dB
  - 10MHz: <0.50dB
- **Crosstalk (with 50 Ω termination):**
  - 100kHz: <-70dB
  - 1MHz: <-50dB
  - 10MHz: <-30dB

### Module Accessories
- **N2291A:** Screw terminal block
- **N2296A:** Crimp & insert terminal block
- **N2297A:** DIN-to-Twin-D50 cable
- **N2299A:** DIN-to-Quad-D25 cable

**Note:** All voltage and current are in DC or AC RMS if not specified.
The N2262A 4x8 matrix module contains 32 cross points organized in a 4-row by 8-column configuration. It provides a convenient way to connect a group of test instruments to multiple test points on DUTs. Each cross point in the module switches two wires for the high and low measurement. Multiple matrix modules can be connected for applications that require large matrices. For example, four N2262As can be combined as a 16x8 matrix. N2262As can be used in conjunction with other modules (such as multiplexer modules) to provide a wide variety of switching combinations. More than one switch can be closed at the same time, allowing any combination of rows to be connected to columns. Up to eight channels can be operated in parallel for high-speed switching. Three module accessories are available to simplify wiring.

### Specifications

#### General Specifications

- **Relays:** Armature latching relay
- **Thermal Offset:** <3µV
- **Relay Life**
  - Mechanical: 10^6
  - Electrical: 10^5 (at 1A load)

#### Input Characteristics

- **Maximum Voltage:** 200V
- **Maximum Current:**
  - Per channel: 1A
  - Per module: 4A
- **Maximum Power:**
  - Per channel: 60W or 62.5VA
  - Per module: 240W or 250VA
- **Initial Closed Channel Resistance:** <1Ω

#### DC Isolation

- **Open Channel, Channel-Channel:** (<40°C, 50% RH) >10^11 Ω
- **HI-LO:** (<40°C, 50% RH) >10^10 Ω
- **Channel-Chassis:** (<40°C, 50% RH) >10^10 Ω

#### AC Isolation

- **Capacitance (with 1 channel closed):**
  - Open Channel, Channel-Channel: <7pF
  - HI-LO: <30pF
  - Channel-Chassis: <50pF
- **Insertion Loss (with 50 Ω termination):**
  - 100kHz: <0.10dB
  - 1MHz: <0.20dB
  - 10MHz: <0.60dB
- **Crosstalk (with 50 Ω termination):**
  - 100kHz: <-73dB
  - 1MHz: <-53dB
  - 10MHz: <-28dB

#### Module Accessories

- N2292A: Screw terminal block
- N2296A: Crimp & insert terminal block
- N2298A: DIN96-to-D25
The N2263A provides 32-bit bidirectional lines and three handshake and control lines. The 32-bit I/O lines are TTL compatible input/output, or TTL compatible input and open collector output up to 42 V. The 32-bit I/O lines can be addressed individually (byte-by-byte), either as a 32-bit port, four independent 8-bit ports, or as two independent 16-bit ports. A Zener diode is used in each channel for input voltage over-protection (> 42 V DC), including ESD protection. Each I/O line can sink up to 0.6 A to control external devices, including:

- High-voltage/high current relays
- Microwave relays and attenuators (8710xx, 876xx and 849xx)
- Solenoid coils

The polarities of the I/O and handshake lines can be operated in positive or negative logic mode. With the three control lines (PCTL, I/O, and PFLG), you can define five handshake modes for communication with peripherals. Screw terminal block, crimp & insert terminal block, and DIN96-to-D25/50 cables are available for simple wiring.

### Specifications

#### I/O Lines

- **Maximum Voltage (line-chassis):** +42V DC
- **Maximum Sink Current (per bit):** 0.6A
- **Output Characteristics:**
  - \( V_{\text{out}} \) (high) \( \geq 2.4V \) @ \( I \leq 10\text{mA} \)
  - \( V_{\text{out}} \) (low) \( \leq 0.8V \) @ \( I \leq 600\text{mA} \)
- **Input Characteristics:**
  - \( V_{\text{in}} \) (high) \( \geq 2.0V \)
  - \( V_{\text{in}} \) (low) \( \leq 0.8V \)

#### Handshake Lines

- **Maximum Voltage (line-chassis):** +5V DC
- **Output Characteristics:**
  - \( V_{\text{out}} \) (high) \( \geq 2.4V \) @ \( I \leq 400\mu\text{A} \)
  - \( V_{\text{out}} \) (low) \( \leq 0.5V \) @ \( I \leq 1\text{mA} \)
  - \( I_{\text{out}} \) (low) \( <25\text{mA} \) (when shorted to +5 V)
- **Input Characteristics:**
  - \( V_{\text{in}} \) (high) \( \geq 2.0V \)
  - \( V_{\text{in}} \) (low) \( \leq 0.8V \)

### Module Accessories

- N2293A: Screw terminal block
- N2296A: Crimp & insert terminal block
- N2297A: DIN96-to-Twin-D50 cable
- N2299A: DIN96-to-Quad-D25 cable
The Agilent N2264A multifunction module combines 12 general-purpose relays, three high-current relays, and 16-bit digital input/output in one module, saving cost and space. Its three high-current channels are especially useful in automated test systems for cellular phone test or battery test, where only two or three low-resistance channels are needed. Four connection accessories simplify wiring.

The 12 general-purpose channels are non-latching relays that can switch up to 200 V, 1 A, 60 W or 62.5 VA. The three high-current channels are non-latching relays switching up to 5 A, 125 V DC, or 200 V AC RMS. The 16-bit digital I/O provides 16 bi-directional data lines (bits) plus three lines used for control and handshaking. The 16-bit I/O lines are TTL compatible input/output, or TTL compatible input and open collector output. The 16 I/O bits can be addressed individually, as two independent 8-bit ports, or as one 16-bit port. A Zener diode is used in each channel for input overvoltage protection (>42 V DC), including ESD protection. Each I/O line can sink up to 0.6 A to control external devices.

### Specifications

#### 12-channel General-purpose Relay

**General Specifications**
- Relays: Armature non-latching relay
- Thermal Offset: <3µV
- Relay Life
  - Mechanical: 10^6
  - Electrical: 5x10^5 (at 1 A load)
- Maximum Scan Rate: 80 Chans./sec

**Input Characteristics**
- Maximum Voltage: 200V
- Maximum Current: Per channel 1A
- Maximum Power: Per channel 60W; 62.5VA
- Initial Closed Channel Resistance: <0.5Ω

**DC Isolation**
- Open Channel, Channel-Channel: <(40°C, 50% RH) 10^10 Ω
- Channel-Chassis: <(40°C, 50% RH) 10^10 Ω

**AC Isolation**
- Capacitance (with 1 channel closed): Open Channel, Channel-Channel: <10pF
- Channel-Chassis: <20pF

For 16-bit Digital I/O specifications, please refer to the Agilent N2263A.

#### 3-channel High-current Relay

**General Specifications**
- Relays: Armature non-latching relay
- Relay Life
  - Mechanical: 5x10^7
  - Electrical: 10^6 (at 5 A load)
- Thermal Offset: <3µV
- Time to close one channel: 16ms

**Input Characteristics**
- Maximum Voltage: 125V DC or 200 V AC
- Maximum Current: 5A
- Maximum Power: 150W; 1250 VA

**DC Isolation**
- Open Channel, Channel-Channel: <(40°C, 50% RH) 10^8 Ω
- Channel-Chassis: <(40°C, 50% RH) 10^8 Ω

**Module Accessories**
- N2294A Screw terminal block for N2264A
- N2296A Crimp & insert terminal block
- N2297A DIN96-to-Twin-D50 cable
- N2299A DIN96-to-Quad-D25 cable

**Note:** All voltage and current are in DC or AC RMS if not specified.
Multifunction Module

Agilent N2265A

- 4x4 matrix and 16-bit digital I/O in one module
- High speed switching in parallel operation
- Built-in relay cycle counters

The N2265A multifunction module combines a 4x4 two-wire matrix and 16-bit digital I/O in one module to save floor space while reducing costs. It includes four connection accessories to simplify wiring. The 4x4 matrix (including 16 crosspoints) provides the most convenient way to connect a group of test instruments to multiple test points on DUTs. Each crosspoint in a module switches two wires for the high and low measurement. The N2265A includes 16 bi-directional data lines (bits) plus three handshake lines. The 16-bit I/O lines are TTL compatible input/output, or TTL compatible input and open collector output. The 16 I/O bits can be addressed individually, as two 8-bit ports, or one 16-bit port. A Zener diode is used in each channel for input over voltage protection (>42 V DC) and ESD protection. Each I/O line can sink up to 0.6 A to control external devices.

Specifications

4 x 4 Matrix

General Specifications
- Relays: Armature latching relay
- Relay Life
  - Mechanical: 10^8
  - Electrical: 5x10^6 (at 1A load)
- Maximum Scan Rate: 80 Chans./sec

Input Characteristics
- Maximum Voltage: 200V
- Maximum Current:
  - Per channel: 1A
  - Per module: 4A
- Maximum Power:
  - Per channel: 60W or 62.5VA
  - Per module: 240W or 250 VA
- Initial Closed Channel Resistance: <1 Ω

DC Isolation
- Open Channel, Channel-Channel: >10^10 Ω
- HI-LO:
  - (40°C, 50% RH): >10^7 Ω
  - Channel-Chassis (40°C, 50% RH): >10^9 Ω

AC Isolation
- Capacitance (with 1 channel closed): Open Channel, Channel-Channel: <7pF
- HI-LO: <25pF
- Channel-Chassis: <40pF
- Insertion Loss (with 50 Ω termination):
  - 100kHz: <0.10dB
  - 1MHz: <0.20dB
  - 10MHz: <0.60dB
- Crosstalk (with 50 Ω termination):
  - 100kHz: <76dB
  - 1MHz: <56dB
  - 10MHz: <33dB

16-bit Digital I/O

I/O Lines
- Output Characteristics:
  - V_{in} \leq +42V DC @ I_{sink} \leq 0.6A
  - V_{out (high)} \geq 2.4V @ I \leq 1mA output:
  - V_{out (low)} \leq 0.8V @ I \leq 0.6A input
- Input Characteristics:
  - V_{in (high)} \geq 2.0V
  - V_{in (low)} \leq 0.8V

Handshake Lines
- V_{in} \leq 5V DC
- V_{out (high)} \geq 2.4V @ I \leq 0.5mA output
- V_{out (low)} \leq 0.5V @ I \leq 1mA input
  - V_{in (high)} \geq 2.0V
  - V_{in (low)} \leq 0.8V

Module Accessories
- N2295A Screw terminal block
- N2296A Crimp & insert terminal block
- N2297A DIN96-to-Twin-D50 cable
- N2299A DIN96-to-Quad-D25 cable
Agilent N2267A

- Switching up to 8 A, 250 V
- Built-in overheat protection for high reliability

The N2267A is designed for high-current (up to 8 A continuous), low-resistance switching applications, such as AC/DC power supply testing. It can also be used to switch on/off AC (up to 250 V) or DC (up to 125 V) power supplies and current sources. Each channel can carry 8 A current at the same time. For thermal protection and reliability, the N2267A has built-in temperature control circuitry that uses sensor ICs and a cooling fan. An over-temperature warning signal is also available to activate an external LED or buzzer. A crimp & insert connector (N2327A) is available. A protection network area is provided on the module’s PCB, for switching inductive loads such as electric motors, solenoids, contacts, chokes, electromagnets and incandescent lamps. To protect relays from overvoltage damage, the RC network or the varistors must be placed on this module, which can effectively absorb the surge voltage.

Specifications

**General Specifications**
- Relays: Non-latching relay
- Thermal Offset: <3µV
- Relay Life:
  - Mechanical: 5 x 10^7 (180cpm)
  - Electrical: 10^6
- Maximum Scan Rate: 20 Chans/sec

**Input Characteristics**
- Maximum Current:
  - (per channel) 8 A
  - (per module) 64 A
- Maximum Voltage: 125 VDC, 250 VAC
- Maximum Power:
  - Per channel 150 W or 2000 VA
  - Per module 1200 W or 16000 VA
- Initial Closed Channel Resistance: <0.08 Ω

**DC Isolation**
- Open Channel, Channel-Channel: <100Ω
- Channel-Chassis: <100Ω

**AC Isolation**
- Capacitance (with 1 channel closed):
  - Open Channel, Channel-Channel: <10pF
  - Channel-Chassis: <10pF
- Insertion Loss (with 50 Ω termination):
  - 100kHz: <0.10dB
  - 1MHz: <0.20dB
- Crosstalk (with 50 Ω termination):
  - 100kHz: <75dB
  - 1MHz: <55dB

**Module Accessories**
- N2327A: Crimp & insert connection kit for N2267A

*Note: All voltage and current are in DC or AC RMS if not specified.*
Dual 1 x 4 RF Multiplexer (3.5 GHz, 50 Ω)

Agilent N2268A

- Ideal for wireless communication test
- Insertion loss <1.7 dB at 3.5 GHz

The N2268A multiplexer module has two 1x4 independent multiplexers with SMA connectors, delivering high performance, very low insertion loss, high isolation, and excellent VSWR performance. This high-density RF multiplexer module is an economical RF signal switching solution. Its 3.5 GHz bandwidth guarantees signals will not be degraded when switched from source to destination. Each group of four channels is isolated from the other and from the chassis to prevent ground loops. The wide-bandwidth performance enables quality dynamic-range RF signal measurements using oscilloscopes, spectrum analyzers, network analyzers, and GSM/CDMA test sets. Typical test applications include switching signals of Bluetooth transceivers and L1/L2 GPS receivers, 1.8/1.9 GHz wireless communication devices (such as GSM, CDMA, 3G, DCS1800, and PCS1900 base stations), and mobile phones. It can be also used to route satellite signals.

Specifications

**Input Characteristics**
- Maximum Scan Rate: 20 Chans/sec
- Maximum Voltage: 30V, DC+AC peak
- Maximum Current: 0.5A, DC+AC peak
- Maximum Power: (per channel) 10W
- Characteristic Impedance: 50 Ω

**DC Performance**
- Thermal Offset: <3µV (<2µV, typ.)
- Initial Closed Channel Resistance: <1 Ω
- Insulation Resistance (between terminals): <(40°C, 50% RH) >10^10 Ω

**Capacitance**
- Center-Center: <0.06pF
- Center-Shield: <20pF
- Rise Time: <150psec
- Signal Delay: <1.5nsec

**AC Performance**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Insertion Loss</th>
<th>Crosstalk (Channel-Channel, Channel-Common)</th>
<th>VSWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 GHz</td>
<td>&lt;0.9dB</td>
<td>&lt;64dB</td>
<td>&lt;1.20</td>
</tr>
<tr>
<td>2 GHz</td>
<td>&lt;1.2dB</td>
<td>&lt;64dB</td>
<td>&lt;1.35</td>
</tr>
<tr>
<td>2.5 GHz</td>
<td>&lt;1.4dB</td>
<td>&lt;50dB</td>
<td>&lt;1.35</td>
</tr>
<tr>
<td>3.5 GHz</td>
<td>&lt;1.7dB</td>
<td>&lt;50dB</td>
<td>&lt;1.35</td>
</tr>
</tbody>
</table>
Agilent N2269A

- Block data transfer rate up to 3.57 M words/sec
- DACs for analog control or as waveform generator
- Isolation voltage up to 350 V

The N2269A provides optically isolated 16-bit output/input digital I/O plus two DACs in one module. It's designed for production-line automation control environments that require ground-noise-free inputs/outputs, elimination of ground current loops, or test system reference ground isolation from line voltage. An external power supply (+5 V DC) is required when using the isolation function in a two-reference ground system. Both the 16-bit input and output ports can be addressed as 16 1-bit ports, two 8-bit ports, or one 16-bit port. The two 16-bit DAC ports can output calibrated DC voltage from −12 V to +12 V, or an AC voltage signal with a sample rate of up to 781.25 K Sa/s. They can be used as programmable voltage sources or function generators. There is a 256 K 16-bit on-board memory which can be used as an input/output buffer for block data transfer, or as a DAC buffer when generating a waveform.

### Specifications

**I/O Lines**

- Max. Voltage (line-chassis): +5.25V
- Max. sink current (per bit): 16mA
- Output Characteristics:
  - $V_{out} \text{ (high)} \geq 2.4V @ 10mA$
  - $V_{out} \text{ (low)} \leq 0.8V @ 16mA$
- Input Characteristics:
  - $V_{in} \text{ (high)} \geq 2.0V$
  - $V_{in} \text{ (low)} \leq 0.8V$

**Handshake Lines**

- Max. Voltage (line-chassis): +5V DC
- Output Characteristics:
  - $V_{out} \text{ (high)} \geq 2.4V @ 400\mu A$
  - $V_{out} \text{ (low)} \leq 0.5V @ 1mA input$
- Input Characteristics:
  - $V_{in} \text{ (high)} \geq 2.0V$
  - $V_{in} \text{ (low)} \leq 0.8V$

**Digital I/O Isolation Voltage**

$\leq 350V$

### DAC ports

- Output Range: ±12V, non optical-isolated
- Resolution: 1mV
- Output Current: ≤10mA
- Setting Time: 1ms to 0.01% of output
- Accuracy (24 hours ± 1°C): 0.04% of output + 4mV
- Temp. Coefficient: ±(0.015% of output + 1mV)°C
- DAC Sample Rate: ≤781.25K Sa/S

### Module Accessories

- N2329A: Screw terminal block
- N2296A: Crimp & insert terminal block
- N2297A: DIN96-to-Twin-D50 cable
- N2299A: DIN96-to-Quad-D25 cable
10-channel 1000V Multiplexer

Agilent N2270A
• Switching up to 1 A, 1000 V
• Ideal for breakdown and leakage testing

The N2270A 2-wire multiplexer can be used to source external voltage up to 1000 V from the common end to any of 10 DUTs, or to monitor voltage from different sources using a voltmeter. It can be used in a scanner application where only one channel is closed at a time, or in distribution applications where several channels are simultaneously closed. Applications include capacitor breakdown voltage testing as well as high-resistance measurements of transformers, capacitors, relays, connectors, PCBs, and cables. A crimp & insert connection kit is designed to work with N2270A. High-voltage signals can be wired to the N2320A, which can be plugged into the connector on a N2270A.

Specifications

<table>
<thead>
<tr>
<th>General Specifications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Relays:</td>
<td>Non-latching reed relay</td>
</tr>
<tr>
<td>Thermal Offset:</td>
<td>&lt;200µV</td>
</tr>
<tr>
<td>Relay Life:</td>
<td>10^8 @ 1V, 10mA</td>
</tr>
<tr>
<td>Maximum Scan Rate:</td>
<td>100 Chans/sec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Characteristics</th>
<th></th>
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<tbody>
<tr>
<td>Maximum Current:</td>
<td>1 A</td>
</tr>
<tr>
<td>Maximum Voltage:</td>
<td>1000V</td>
</tr>
<tr>
<td>Maximum Power:</td>
<td>10W</td>
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<tr>
<td>Initial Closed Channel Resistance:</td>
<td>&lt;1 Ω</td>
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<table>
<thead>
<tr>
<th>DC Isolation</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Open Channel, Channel-Channel:</td>
<td>&lt;10^6 Ω</td>
</tr>
<tr>
<td>Channel-Chassis:</td>
<td>&lt;10^6 Ω</td>
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<table>
<thead>
<tr>
<th>AC Isolation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (with 1 channel closed):</td>
<td></td>
</tr>
<tr>
<td>Open Channel, Channel-Channel</td>
<td>≤7pF</td>
</tr>
<tr>
<td>HI-LO</td>
<td>≤50pF</td>
</tr>
<tr>
<td>Channel-Chassis</td>
<td>≤50pF</td>
</tr>
</tbody>
</table>

| Insertion Loss (with 50 Ω termination): |  |
| 100kHz | <0.10dB |
| 1MHz | <0.20dB |

| Crosstalk (with 50 Ω termination): |  |
| 100kHz | <-70dB |
| 1MHz | <-50dB |

<table>
<thead>
<tr>
<th>Module Accessories</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N2320A</td>
<td>Crimp &amp; insert connection kit for N2270A</td>
</tr>
</tbody>
</table>

Note: All voltage and current are in DC or AC RMS if not specified.
The N2270A occupies 2 slots.
Agilent N2272A

- Ease of channel density extension
- Ideal for high density RF signal routing
- Ease of wiring with BNC connectors

The N2272A RF high-density module provides a 1x9 multiplexer that can be widely used in RF test and measurement systems. It consists of a series of eight RF latching relays in a tree structure. The module’s low insertion loss, high isolation and excellent VSWR performance guarantee that the RF signals will not be degraded when routed from source to destination. In order to decrease the degradation when cascading, the auxiliary channel (channel 08) with smaller insertion loss and lower VSWR, is provided. In order to extend the channel count, channel 08 can be connected to the COM channel of the next N2272A module. It can also be used as a standard channel. BNC connectors on the module’s front panel are provided for ease of wiring.

The N2272A can only be operated in SCPI mode when installed in 3499A/B mainframes with firmware 3.0 or later.

### Specifications

**Input Characteristics**
- Total Channels: 9
- Maximum Voltage: 24V
- Maximum Current: 1A
- Maximum Power: 24W
- Characteristic Impedance: 50 Ω
- Connector: BNC
- Relay life: Mechanical 5x10^6
- Electrical (24V@1A DC) 10^6

**DC Performance**
- Thermal Offset: <8µV
- Initial Closed Channel Resistance: <0.8 Ω
- Insulation Resistance (between terminals): <125°C, 50% RH) >10^10 Ω
- Capacitance:
  - Center-Center: <0.006pF
  - Center-Shield: <60pF
- Rise Time: <500psec
- Signal Delay: <2.5nsec

**AC Performance**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>100 MHz</th>
<th>300 MHz</th>
<th>800 MHz</th>
<th>1 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>&lt;0.5dB</td>
<td>&lt;0.8dB</td>
<td>&lt;1.8dB</td>
<td>&lt;2.5dB</td>
</tr>
<tr>
<td>Crosstalk (Channel-Channel)</td>
<td>&lt;75dB</td>
<td>&lt;65dB</td>
<td>&lt;55dB</td>
<td>&lt;50dB</td>
</tr>
<tr>
<td>VSWR</td>
<td>&lt;1.20</td>
<td>&lt;1.30</td>
<td>&lt;1.36</td>
<td>&lt;1.55</td>
</tr>
</tbody>
</table>
Agilent N2276A/B

- **Quick set-up microwave switching to save integration time**
- **Modular microwave switching to fit each application**
- **Can also drive two external microwave attenuators**

The 3-slot N2276A module (option 206) provides dual 1 x 6 microwave multiplexers, with excellent insertion loss, isolation and VSWR performance. With option 204, the N2276A becomes a dual 1 x 4 microwave multiplexers, while keeping all the other features. The modular N2276A can exactly fit your application channel density needs, minimizing the redundant channel, thus offering the most cost effective microwave switching. The SMA connectors on module’s front panel are provided for high performance connections. The N2276A can also drive two external microwave attenuators (Agilent 84904/6/7/K/L).

The N2276B module is a microwave multiplexer/attenuator driver, deleting the microwave relays from the N2276A. Offering the most flexibility, it can drive any two 1x4 or 1x6 microwave relays (Agilent 87104A/B/C, Agilent 87106A/B/C). A custom microwave multiplexer module can be built with the N2276B and microwave relays, eliminating the external power supply or digital I/O that are used in previous customer-built microwave switching. Two 1.5m ribbon cables are included for connecting to external microwave relays. It can also drive two external microwave attenuators (Agilent 84904/6/7/K/L).

The N2276A/B can be used in the testing of cellular phone, cordless phone, mobile radios, cellular base station, broadband wireless communication transceivers, RFICs, and high-speed digital circuits.

The N2276A/B can only be operated in SCPI mode when installed in 3499A/B mainframes with firmware 3.0 or later.

### Specifications

<table>
<thead>
<tr>
<th>Total Channels (N2276A)</th>
<th>Dual 1 x 4 (option 204)</th>
<th>Dual 1 x 6 (option 206)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td>SMA</td>
<td></td>
</tr>
<tr>
<td>Frequency range</td>
<td>DC to 20 GHz</td>
<td></td>
</tr>
<tr>
<td>Insertion loss</td>
<td>0.3 dB + 0.015 dB × frequency (GHz)</td>
<td></td>
</tr>
<tr>
<td>Isolation</td>
<td>&gt;100dB @12 GHz; &gt;80dB @15 GHz; &gt;70dB @20 GHz</td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td>&lt;1.2 @4 GHz; &lt;1.35 @12.4 GHz; &lt;1.45 @18 GHz; &lt;1.7 @20 GHz</td>
<td></td>
</tr>
<tr>
<td>Repeatability (5M cycle @25°C)</td>
<td>&lt; 0.03dB</td>
<td></td>
</tr>
<tr>
<td>Switching time</td>
<td>25ms</td>
<td></td>
</tr>
<tr>
<td>Switch life</td>
<td>5 M cycles</td>
<td></td>
</tr>
</tbody>
</table>

### Module Accessories

<table>
<thead>
<tr>
<th>Module</th>
<th>SP4T microwave relays (4, 20, 26.5 GHz)</th>
<th>SP6T microwave relays (4, 20, 26.5 GHz)</th>
<th>0-11dB, 0-90dB, 0-70dB microwave attenuators (26.5, 40 GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>87104A/B/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>87106A/B/C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84904/6/7/K/L</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Learn more at www.agilent.com/find/test
Agilent N2280A, N2281A and N2282A

- Ideal for optical and electronic hybrid test system
- Modular optical switching to fit each test application
- High repeatability for accurate signal routing

The N2280A (Quad 1 x 2), N2281A (Dual 1 x 4) and N2282A (1 x 8) optical modules bring the flexibility of modular optical switching based on the Agilent 3499 switching family. The optical switching modules, combined with other 3499 family electronic modules, provide a total switching solution in hybrid test systems. With this modular optical switching, test engineers can set up an ATE system with just enough optical switching channels to fit the current application, and add more channels later as the application grows. The collimating lenses optical relays in the N2280A/81A/82A minimize the switching insertion loss, and improve the switching repeatability and stability. These three modules are ideal for SONET/SDH test, fiber-optical component test, and fiber-optical network monitoring. They can also be used in fiber-optical network configuration and multi-source selection/measurement. Two channels in different modules can be synchronously switched with the "CARD PAIR" command. These modules are optically passive operate independently of data rate, data format and optical signal direction; therefore, are transparent to signaling formats. The SC/APC connectors provide reliable and easy connection. A N2280A/81A/82A module occupies two slots in a 3499A/B mainframe. The N2282A can only be operated in SCPI mode when installed in 3499A/B mainframes with firmware 3.0 or later.

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>N2280A/N2281A</th>
<th>N2282A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay Life</td>
<td>&gt;10^7(cycle)</td>
<td></td>
</tr>
<tr>
<td>Fiber type</td>
<td>9/125</td>
<td></td>
</tr>
<tr>
<td>Wavelength Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2280A/N2281A</td>
<td>1310/1550nm</td>
<td></td>
</tr>
<tr>
<td>N2282A</td>
<td>1270/1670nm</td>
<td></td>
</tr>
<tr>
<td>Insertion loss (SM)</td>
<td>≤ 0.8dB</td>
<td>≤ 0.7dB</td>
</tr>
<tr>
<td>Return loss (SM)</td>
<td>≥ 55dB</td>
<td>≤ 57dB</td>
</tr>
<tr>
<td>Polarization dependent loss (SM)</td>
<td>≤ 0.07dB</td>
<td>≤ 0.04dB</td>
</tr>
<tr>
<td>Insertion loss stability</td>
<td>N2280A/N2281A</td>
<td>≤ ±0.05dB</td>
</tr>
<tr>
<td></td>
<td>N2282A</td>
<td>≤ ±0.025dB</td>
</tr>
<tr>
<td>Repeatability</td>
<td>N2280A/N2281A</td>
<td>≤ ±0.005dB</td>
</tr>
<tr>
<td></td>
<td>N2282A(Sequential)</td>
<td>≤ ±0.01dB</td>
</tr>
<tr>
<td></td>
<td>N2282A(Random)</td>
<td>≤ ±0.05dB</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>N2280A/N2281A</td>
<td>≤ -60dB</td>
</tr>
<tr>
<td></td>
<td>N2282A</td>
<td>≤ -90dB</td>
</tr>
<tr>
<td>Optical input power</td>
<td>≤ 300mW</td>
<td></td>
</tr>
<tr>
<td>Switching time</td>
<td>N2280A</td>
<td>≤ 20ms</td>
</tr>
<tr>
<td></td>
<td>N2281A</td>
<td>≤ 25ms</td>
</tr>
<tr>
<td></td>
<td>N2282A</td>
<td>≤ 250ms</td>
</tr>
<tr>
<td>Connectors</td>
<td>SC/APC</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Excluding connectors.
Note 2: After one-hour warm-up. Drift of any channel relative to an assigned reference channel at ±3°C deviation of ambient temperature over a seven-day period.

1 Excluding connectors, 0.2dB typical connector insertion loss.
2 Excluding connectors.
3 Drift of any channel relative to an assigned reference channel at ±3°C deviation of ambient temperature over a seven-day period.
Microwave Multiplexer Module

**Agilent 44476A**

- Switching signals from DC to 18 GHz
- Triple 1-to-2 microwave multiplexers

The 44476A includes three independent SPDT 50 Ω coaxial relays with excellent electrical performance from DC to 18 GHz. For general-purpose microwave switching applications, the module can be used to switch separate signal sources for a multi-band receiver/transmitter testing application. The 3 mm SMA connector on the module edge simplifies wiring.

**Specifications**

**Input Characteristics**
- Frequency Range: DC to 18 GHz
- Characteristic Impedance: 50 Ω
- Input Power Rating: 1 W average (Also less than ± 7 V DC)
- 100 W peak
- Repeatability (after 10^6 operation): 0.03 dB
- Connector: SMA

**AC Isolation / Performance**
- Isolation: DC-18GHz > 90 dB
- Insertion Loss:
  - DC-2 GHz < 0.25 dB
  - DC-18GHz < 0.50 dB
- VSWR (3 mm SMA):
  - DC-2GHz < 1.15 dB
  - DC-12.4GHz < 1.25 dB
  - DC-18.0GHz < 1.40 dB

Microwave Relay Driver Module

**Agilent 44476B**

- Supporting varieties of microwave coaxial relays
- Two set mounting holes for coaxial relays

The 44476B brings multi-port 50/75 Ω coaxial switching flexibility to your test system. It has two set mounting panels, so any two Agilent 876XX coaxial switches can be mounted. The coaxial switches come in three-, four-, and five-port configurations. This flexibility allows you to use the different switches for a variety of applications, constructing transfer switches, switch matrices and more. Using the 876XX in conjunction with the 44476B allows you to extend your automated three-port switching to 26.5 GHz. Coaxial relays must be ordered separately when using with this module. The coaxial switches that can be used are listed below. Option 011 designates the switches for a coil voltage of 5 V DC.

**Agilent Technologies**

<table>
<thead>
<tr>
<th>Coaxial Switch</th>
<th>Port</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>8762A/Option 011</td>
<td>3</td>
<td>DC to 4 GHz</td>
</tr>
<tr>
<td>8762B/Option 011</td>
<td>3</td>
<td>DC to 18 GHz</td>
</tr>
<tr>
<td>8762C/Option 011</td>
<td>3</td>
<td>DC to 26.5 GHz</td>
</tr>
<tr>
<td>8762F/Option 011</td>
<td>3</td>
<td>DC to 4 GHz</td>
</tr>
<tr>
<td>8763B/Option 011</td>
<td>4</td>
<td>DC to 18 GHz</td>
</tr>
<tr>
<td>8763C/Option 011</td>
<td>4</td>
<td>DC to 26.5 GHz</td>
</tr>
<tr>
<td>8764B/Option 011</td>
<td>5</td>
<td>DC to 18 GHz</td>
</tr>
<tr>
<td>8764C/Option 011</td>
<td>5</td>
<td>DC to 26.5 GHz</td>
</tr>
</tbody>
</table>

**Note:** For details of Agilent 876XX specifications, please refer to publication number 5968-4314.
Agilent 44478A/B

- Switching up to 1 A, 24 W or 24 VA
- Insertion loss less than 1.9 dB at 1.3 GHz

The 44478A/B multiplexer module is an ideal choice for broadband switching of high-frequency or fast pulse signals. Dual 1-to-4 multiplexers provide bi-directional switching of signals from DC to 1.3 GHz. High channel isolation (>55 dB at 1 GHz) assures quality dynamic-range measurements using spectrum, network, or distortion analyzers. Each 1-to-4 multiplexer consists of seven relays in a "tree" structure, which provides high isolation and low VSWR (voltage standing wave ratio). All the connectors on the module’s edge are female BNC for ease of wiring. Off-channels can be terminated in resistors to maintain proper operation of DUT circuitry. Simply plug a 50/75 Ω SMB-type resistive termination onto the on-board male SMB connectors provided for each channel.

### Specifications

#### Input Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Scan Rate</td>
<td>43 Chans./sec</td>
</tr>
<tr>
<td>Maximum Voltage</td>
<td>42V, DC+AC peak</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>1A</td>
</tr>
<tr>
<td>Maximum Power:</td>
<td></td>
</tr>
<tr>
<td>(Per channel)</td>
<td>24W, 24VA or 44dBm</td>
</tr>
<tr>
<td>Characteristic Impedance:</td>
<td></td>
</tr>
<tr>
<td>44478A:</td>
<td>50 Ω</td>
</tr>
<tr>
<td>44478B:</td>
<td>75 Ω</td>
</tr>
</tbody>
</table>

#### DC Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Offset:</td>
<td>&lt;6µV (&lt;2µV, Typ.)</td>
</tr>
<tr>
<td>Initial Closed Channel Resistance:</td>
<td>&lt;1 Ω</td>
</tr>
<tr>
<td>Insulation Resistance (between terminals):</td>
<td>&gt;10³ Ω</td>
</tr>
</tbody>
</table>

#### Capacitance:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center-Center:</td>
<td>&lt;0.006pF</td>
</tr>
<tr>
<td>Center-Shield:</td>
<td>&lt;650pF</td>
</tr>
<tr>
<td>Rise Time:</td>
<td>&lt;300psec</td>
</tr>
<tr>
<td>Signal Delay:</td>
<td>&lt;3nsec</td>
</tr>
</tbody>
</table>

### AC Performance

#### Insertion Loss

<table>
<thead>
<tr>
<th>Frequency (°C, %RH)</th>
<th>Insertion Loss (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10MHz</td>
<td>&lt;0.3dB</td>
</tr>
<tr>
<td>100MHz</td>
<td>&lt;0.7dB</td>
</tr>
<tr>
<td>500 MHz</td>
<td>&lt;1.5dB</td>
</tr>
<tr>
<td>1.3GHz</td>
<td>&lt;3.0dB</td>
</tr>
</tbody>
</table>

#### Crosstalk

<table>
<thead>
<tr>
<th>Crosstalk</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel-Channel, Channel-Common</td>
<td>&lt;90dB</td>
</tr>
<tr>
<td>10MHz</td>
<td>&lt;80dB</td>
</tr>
<tr>
<td>100MHz</td>
<td>&lt;65dB</td>
</tr>
<tr>
<td>1.3GHz</td>
<td>&lt;55dB</td>
</tr>
</tbody>
</table>

#### Group-Group, Module-Module

<table>
<thead>
<tr>
<th>Frequency (°C, %RH)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10MHz</td>
<td>&lt;90dB</td>
</tr>
<tr>
<td>100MHz</td>
<td>&lt;80dB</td>
</tr>
<tr>
<td>500 MHz</td>
<td>&lt;70dB</td>
</tr>
<tr>
<td>1.3GHz</td>
<td>&lt;60dB</td>
</tr>
</tbody>
</table>

#### VSWR

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10MHz</td>
<td>&lt;1.20</td>
</tr>
<tr>
<td>100MHz</td>
<td>&lt;1.25</td>
</tr>
<tr>
<td>500 MHz</td>
<td>&lt;1.35</td>
</tr>
<tr>
<td>1.3GHz</td>
<td>&lt;1.55</td>
</tr>
</tbody>
</table>

- **10-channel Multiplexer Module** (2 A, 250 V) 44470A
- **20-channel Multiplexer Module** (2 A, 250 V) 44470D
- **10-channel General-purpose Module** (2 A, 250 V) 44471A
- **20-channel General-purpose Module** (1 A, 250 V) 44471D
- **Dual 1x4 RF Multiplexer Module** (300 MHz, 50 Ω) 44472A
- **4 x 4 Matrix Module** (2 A, 250 V) 44473A
- **16-Bit Digital I/O Module** (TTL compatible) 44474A
- **Breadboard Module** 44475A
- **7-channel Form-C Relay Module** (2 A, 250 V) 44477A

The 44470A, 44470D, 44471A, and 44471D are designed for low-channel-count applications, with higher switching capability (current or voltage) than N2260A or N2261A modules. The 44472A RF multiplexer module offers broadband switching capability for high-frequency and pulse signals. Two independent 50 Ω characteristic impedance 1x4 switches are provided for signal from DC to 300 MHz. BNC connectors on the module allow for easy connection.

The 44477A is a 7-channel Form-C relay module for general-purpose switching and control of external devices. All of the above modules, designed for 3488A mainframes, work in the 3499A/B.

**Rack Mounting Kits**

**Agilent 3499A Rack Mount Kit with Handles (Opt. 1CP)**

**Agilent 3499A Rack Mount Kit (Opt. 1CM)**

To rackmount an Agilent 3499B with a fill panel, order Option 1CM.

To rackmount two instruments in a sliding support shelf, please order shelf (P/N 5063-9255) and slide kit (P/N 1494-0015), and also use the included tie-down clip (03499-21002).

Learn more at www.agilent.com/find/test
Ordering Information

### 3499A 5 Slots Full-rack-width Switch/Control Mainframe
- Includes hard copy manual and power cord. Plug-in modules are purchased separately and are required to operate.
- **Option 0B0** Delete Hard Copy User’s Manual
- **Option 1CP** Rack Mount Kit with Handles
- **Option 0B3** Add Service Manual
- **Option 0B1** Add additional User’s Manual

### 3499B 2 Slots Half-rack-width Switch/Control Mainframe
- Includes hard copy manual and power cord. Plug-in modules are purchased separately and are required to operate.
- **Option 0B0** Delete Hard Copy User’s Manual
- **Option 1CM** Rack Mount Kit
- **Option 0B3** Add Service Manual
- **Option 0B1** Add additional User’s Manual

### Plug-in modules (Agilent 3488A family), include screw terminal blocks
- **44470A** 10-channel Relay Multiplexer Module
- **44470D** 20-channel Relay Multiplexer Module
- **44471A** 10-channel GP Relay Module
- **44471D** 20-channel GP Relay Module
- **44472A** Dual 1 x 4 RF (300MHz) Multiplexer Module (50Ω)
- **44473A** 4x4 Matrix Switch Module
- **44474A** 16-bit Digital I/O Module
- **44475A** Breadboard Module
- **44476A** Microwave Multiplexer Module
- **44476B** Microwave Switch Driver Module
- **44477A** 7-channel Form-C Relay Module
- **44478A** Dual 1x4 RF (1.3 GHz) Multiplexer (50Ω)
- **44478B** Dual 1x4 RF (1.3 GHz) Multiplexer (75Ω)

### Stand-alone modules
- **N2260A** 40-channel Multiplexer Module
- **N2261A** 40-channel General Purpose Relay Module
- **N2262A** 4 x 8 Matrix Module
- **N2263A** 32-bit Digital I/O Module
- **N2264A** 12 + 3 GP + 16-bit Digital I/O Module
- **N2265A** 4 x 4 Matrix + 16-bit Digital I/O Module
- **N2266A** 40-channel High-speed Multiplexer Module
- **N2267A** 8-channel 8 A General Purpose Relay Module
- **N2268A** Dual 1 x 4 RF (3.5 GHz) Multiplexer Module
- **N2269A** 32-bit Optical Isolated DIO + 2 DACs Module
- **N2270A** 10-channel 1000 V Multiplexer Module
- **N2272A** 1 x 9 RF (1GHz) Multiplexer Module
- **N2276A** Dual 1 x 6 Microwave Multiplexer Module
- **Option 204** Dual 1 x 4 Multiplexer
- **Option 206** Dual 1 x 6 Multiplexer
- **N2276B** Microwave Multiplexer Driver Module
- **N2280A** Quad Optical 1 x 2 Multiplexer Module, SC/APC
- **N2281A** Dual Optical 1 x 4 Multiplexer Module, SC/APC
- **N2282A** 1 x 8 Optical Multiplexer Module, SC/APC
- **N2289A** Mini-DIN-to-D9 cable for built-in DIO in 3499A/B
- **N2290A** Screw terminal block for N2260A and N2266A
- **N2291A** Screw terminal block for N2261A
- **N2292A** Screw terminal block for N2262A
- **N2293A** Screw terminal block for N2263A
- **N2294A** Screw terminal block for N2264A
- **N2295A** Screw terminal block for N2265A
- **N2296A** Crimp & Insert terminal block for N2260-5A
- **N2297A** DIN96-to-Twin-D50 cable for N2260-5A
- **N2298A** DIN96-to-D25 cable for N2262A
- **N2299A** DIN96-to-Quad-D25 cable for N2260-5A
- **N2320A** Crimp & Insert Connection kit for N2270A
- **N2329A** Screw Connection Kit for N2269A
- **N2327A** Crimp & Insert Connection kit for N2267A
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