Technical Data

INTEGRA SERIES

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www.keithley.com

A GREATER MEASURE OF CONFIDENCE
Introduction

The Integra Series of 6½-digit Multimeter/Switch systems blends Keithley’s high performance DMM technology, switching expertise, and data acquisition knowledge into compact, affordable, easy-to-use packages. This technical data booklet provides a comprehensive overview of the systems and includes detailed specifications.

There are three Integra systems: the Model 2700, 2701, and 2750. Each consists of a mainframe and a growing line of plug-in switch/control modules. The Model 2700 and 2701 each include two slots for the plug-in modules; the Model 2750 has five slots. Each slot can support a series of multiplexer, matrix, or control modules, and all the modules in a system operate simultaneously. Input modules can be mixed or matched to provide a broad range of measurement, acquisition, and control capabilities.

While the core functionality and programming of all Integra Series systems are identical, each mainframe has unique capabilities. For example, the Model 2701 is the only system to provide a 10/100BaseTX Ethernet interface, and the Model 2750 provides extended low ohms measurement capability.

Setting up an Integra system is simple and straightforward. When a plug-in module is inserted into a slot, it is ready to be used immediately. Settings can be configured from the front panel of the system or via the computer controller (over GPIB, RS-232, or Ethernet). Also, each channel can be configured independently.

If you have any questions after reviewing this information, please contact your local Keithley representative or call one of our Application Engineers at 1-800-552-1115 (U.S. only). Check Keithley’s website, www.keithley.com, for the names and numbers of our representatives around the world.
Integra Series
Multimeter/Switch Systems

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Model 2700

Use $mX+b$ or % scaling to convert sensor/transducer outputs directly into engineering units.

Measure the ratio or average of two input channels.

View a channel of interest without interrupting a scan by using the Channel Monitor feature.

Built-in linearization for thermocouples, RTDs, and thermistors.

Front panel input jacks simplify manual probing, troubleshooting, and calibration. Built-in signal conditioning with 1000V isolation simplifies system configuration and ensures good measurements.

Initialize the system with one of four fully programmable set-up conditions. System configuration is stored in non-volatile memory.

Non-volatile memory allows time-stamped storage of 55k readings.

Manually step through channels or scan automatically. Configure each channel independently.

Set the number of digits to be displayed as well as the reading rate.

Familiar DMM-like front panel scheme makes it easier to use on bench or rack. Select or change functions with the simple push of a button.

Built-in digital I/O lines provide for control, external triggering, and HI/LO alarm/limit outputs.

Trigger Link enables tightly synchronized triggering with other instruments in large ATE systems.

GPIB and RS-232 interfaces are standard.

A variety of measurement and control modules let you mix, match, and change input signals or control lines any time you like. Install up to two modules at a time to create up to an 80-channel “mini-ATE” system.

Rugged 50-pin D-sub connectors ensure dependability and quick setup/teardown in production test racks.

Built-in noise rejection circuitry ensures stable, predictable measurements.

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A GREATER MEASURE OF CONFIDENCE
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Multimeter/Switch Systems

Model 2701

If there’s a power failure, valuable data is protected with the battery-backed non-volatile memory and scans can automatically be resumed right where they stopped when power returns.

Built-in signal conditioning and statistical analysis is configurable per channel for maximum flexibility.

Open lead detection protects against false readings due to lead disconnections.

Fast and convenient 10/100BaseTX Ethernet with TCP/IP protocol.

Large memory buffer (450,000 readings) for storing data without tying up the network.

Immediate alarm notification independent of the PC provided by built-in open-collector digital I/O lines for control, external triggering, and HI/LO alarm/limit outputs.

A variety of measurement and control modules makes it simple to mix, match, and change input signals or control lines as needed. Get up to 80 differential channels and up to 500 channels per second scanning rate.

Front panel input jacks simplify manual probing, troubleshooting, and calibration. Includes 1000V protection in case of accidental overload.

Its familiar DMM-like front panel scheme makes the Model 2701 easy to use on the bench or in the rack. Select or change functions with the press of a button.

Built-in relay cycle counters on each module for ease of maintenance.

Open lead detection protects against false readings due to lead disconnections.
Integra Series

Multimeter/Switch Systems

Model 2750

Initialize the system with one of three fully programmable set-up conditions.
Use mX+b or 1/x % scaling to convert sensor/transducer outputs directly into engineering units.
Built-in independently programmable alarm limits per channel.
View slot capacity and channel closure status from front panel.
Front panel input jacks simplify manual probing, troubleshooting, and calibration.
Open lead detection protects against false readings due to lead disconnections.

Open or close single or multiple channels from the front panel.
Non-volatile memory allows time-stamped storage of 110K readings. Has built-in real-time clock.
Manually step through channels or scan automatically. Each channel independently configurable.
Familiar DMM-like front panel scheme makes it easier to use on bench or rack. Select or change functions with the push of a button.
Voltage clamped ohms (dry circuit) clamps voltage to 20mV.

Built-in digital I/O lines provide for control, external triggering, and Hi/Lo alarm/limit outputs.
Trigger Link enables tightly synchronized triggering with other instruments in large ATE systems.
A variety of measurement and control modules make it simple to mix, match, and change input signals or control lines whenever needed. Install up to five modules at once to create a system of up to 200 channels.
Built-in noise rejection circuitry ensures stable, predictable measurements.

GPIB and RS-232 interfaces are standard.
Built-in relay cycle counters on each module for ease of maintenance.
IDC connectors on selected modules are compatible with standard ribbon cable.
Rugged D-sub bulkhead connectors on selected modules.
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Measurement Ranges for the Integra Series Systems

The flexibility to mix and match switch/control modules in a single mainframe simplifies configuring Integra Series-based systems for a wide range of applications. Each module offers a different combination of capabilities, such as number of channels, speed, etc. Before selecting a module, it is critical to analyze the needs of the application carefully and consider future requirements for expansion.

Module Capabilities Overview

<table>
<thead>
<tr>
<th>Capability</th>
<th>7700</th>
<th>7701</th>
<th>7702</th>
<th>7703</th>
<th>7705</th>
<th>7706</th>
<th>7707</th>
<th>7708</th>
<th>7709</th>
<th>7710</th>
<th>7711</th>
<th>7712</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Volts</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DC Current</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<td>✓</td>
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<tr>
<td>Temperature</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>T/C w/Automatic CJC</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>T/C w/External CJC</td>
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<td>✓</td>
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<td>✓</td>
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<td>RTD</td>
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<tr>
<td>Thermistor</td>
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<td>✓</td>
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<tr>
<td>Resistance (2- or 4-wire)</td>
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<td>✓</td>
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<td>Continuity</td>
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<td>✓</td>
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<tr>
<td>AC Volts</td>
<td>✓</td>
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<tr>
<td>AC Current</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>Frequency</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>Event Counter/Totalizer</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Signal Routing/Control</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Digital Input</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Digital Output</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Analog Output</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>RF Performance</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
</tr>
</tbody>
</table>
# Module Selector Guide

This selector guide may prove helpful in identifying the best module for a specific application. Install up to five modules at a time in the Model 2750 mainframe or two modules in the Model 2700 or 2701 mainframe.

<table>
<thead>
<tr>
<th>Module</th>
<th># Analog Inputs</th>
<th>Configuration</th>
<th>Type of Connector</th>
<th>Max. Voltage</th>
<th>Max. Switched Current</th>
<th>Bandwidth</th>
<th>Contact Life</th>
<th>Switch Speed</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>7700</td>
<td>20</td>
<td>Multiplexer w/CJC</td>
<td>Screw terminals</td>
<td>300 V</td>
<td>1 A</td>
<td>50 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Maximum power = 125VA.</td>
</tr>
<tr>
<td>7701</td>
<td>52</td>
<td>Multiplexer</td>
<td>D-sub</td>
<td>150 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Maximum power = 125VA.</td>
</tr>
<tr>
<td>7702</td>
<td>40</td>
<td>Multiplexer</td>
<td>Screw terminals</td>
<td>300 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Maximum power = 125VA.</td>
</tr>
<tr>
<td>7703</td>
<td>52</td>
<td>Multiplexer</td>
<td>D-sub</td>
<td>500 V</td>
<td>500 mA</td>
<td>2 MHz</td>
<td>10^6</td>
<td>1 ms</td>
<td>Reed relays.</td>
</tr>
<tr>
<td>7704</td>
<td>40</td>
<td>Independent SPST</td>
<td>N/A</td>
<td>300 V</td>
<td>2A</td>
<td>10 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Maximum power = 125VA.</td>
</tr>
<tr>
<td>7706</td>
<td>20</td>
<td>Multiplexer w/CJC</td>
<td>Screw terminals</td>
<td>500 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>2 analog outputs. 16 digital outputs. Maximum power = 125VA.</td>
</tr>
<tr>
<td>7707</td>
<td>10</td>
<td>Multiplexer/Digital I/O</td>
<td>D-sub</td>
<td>300 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>32 digital I/O. Maximum power = 125VA.</td>
</tr>
<tr>
<td>7708</td>
<td>40</td>
<td>Multiplexer w/CJC</td>
<td>Screw terminals</td>
<td>300 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Maximum power = 125VA.</td>
</tr>
<tr>
<td>7709</td>
<td>48</td>
<td>Matrix</td>
<td>D-sub</td>
<td>500 V</td>
<td>1 A</td>
<td>2 MHz</td>
<td>10^6</td>
<td>5 ms</td>
<td>Connects to internal DMM. Daisy chain multiple cards for up to a 6x60 matrix. Maximum power = 125VA.</td>
</tr>
<tr>
<td>7710</td>
<td>20</td>
<td>Multiplexer w/CJC</td>
<td>Removable screw terminals</td>
<td>60 V</td>
<td>0.1 A</td>
<td>2 MHz</td>
<td>10^11</td>
<td>0.5 ms</td>
<td>Solid state relays, 60V max. 500 channels/second scan.</td>
</tr>
<tr>
<td>7711</td>
<td>8</td>
<td>Multiplexer</td>
<td>SMA</td>
<td>60 V</td>
<td>0.5 A</td>
<td>2 GHz</td>
<td>10^6</td>
<td>10 ms</td>
<td>Insertion loss &lt;1.0dB @ 1GHz. VSWR &lt;1.2 @ 1GHz.</td>
</tr>
<tr>
<td>7712</td>
<td>8</td>
<td>Multiplexer</td>
<td>Dual SMA</td>
<td>42 V</td>
<td>0.5 A</td>
<td>3.5 GHz</td>
<td>10^6</td>
<td>10 ms</td>
<td>Insertion loss &lt;1.1dB @ 2 GHz.</td>
</tr>
</tbody>
</table>

* Can be disconnected from internal DMM for routing external signals

### Connector Guide for Keithley Integra Series Modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Connector Type</th>
<th>Supplied Accessories</th>
<th>Available Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>7700</td>
<td>Oversized Screw Terminal</td>
<td>Strain Relief</td>
<td>7401 TC wire</td>
</tr>
<tr>
<td>7701</td>
<td>50-pin female D-sub &amp; 25-pin female D-sub</td>
<td>7789 connector kit</td>
<td>7790 connector kit, 7705-MTC-2 &amp; 7707-MTC-2 cables</td>
</tr>
<tr>
<td>7702</td>
<td>Oversized Screw Terminal</td>
<td>Strain Relief</td>
<td>7705-MTC-2 cable</td>
</tr>
<tr>
<td>7703</td>
<td>Two 50-pin female D-sub</td>
<td>7788 connector kit</td>
<td>7705-MTC-2 cable</td>
</tr>
<tr>
<td>7704</td>
<td>Two 50-pin female D-sub</td>
<td>7788 connector kit</td>
<td>7705-MTC-2 cable</td>
</tr>
<tr>
<td>7705</td>
<td>Screw Terminal</td>
<td>Strain Relief</td>
<td>7401 TC wire</td>
</tr>
<tr>
<td>7706</td>
<td>Screw Terminal</td>
<td>Strain Relief</td>
<td>7705-MTC-2 cable</td>
</tr>
<tr>
<td>7707</td>
<td>50-pin male D-sub &amp; 25-pin female D-sub</td>
<td>7790 connector kit</td>
<td>7789 connector kit, 7705-MTC-2 &amp; 7707-MTC-2 cables</td>
</tr>
<tr>
<td>7708</td>
<td>Oversized Screw Terminal</td>
<td>Strain Relief</td>
<td>7401 TC wire kit</td>
</tr>
<tr>
<td>7709</td>
<td>50-pin female D-sub &amp; 25-pin female D-sub</td>
<td>7790 connector kit</td>
<td>7789 connector kit, 7705-MTC-2 &amp; 7707-MTC-2 cables</td>
</tr>
<tr>
<td>7710</td>
<td>Quick Disconnect Screw Terminal</td>
<td>Strain Relief</td>
<td>7401 TC wire kit</td>
</tr>
<tr>
<td>7711</td>
<td>SMA</td>
<td>--</td>
<td>7711-BNC-SMA &amp; 7712-SMA-N adapters, 7712-SMA-A &amp; S46-SMA-A, 5-1 SMA cables, 7051-2, 5-10 BNC cables</td>
</tr>
<tr>
<td>7712</td>
<td>SMA</td>
<td>--</td>
<td>7712-SMA adapter, 7712-SMA-A &amp; S46-SMA-A, 5-1 SMA cables</td>
</tr>
</tbody>
</table>
Integra Series Multimeter/Switch Systems

Channel Configuration Capabilities

- **Measurement functions**: An Integra system can measure many different parameters: DC voltage, DC current, AC voltage, AC current, 2-wire Ω, 4-wire Ω, voltage clamped Ω (2750 only), temperature (using thermocouples, RTDs, and thermistors), frequency, period, and continuity.

- **Math functions**: A variety of math functions are available at the push of a button, including channel average and ratio, mX+b scaling, min, max, average and standard deviation. All are available on a per-channel basis.

- **Measurement setup**: Each channel can be configured independently for making measurements. Selectable channel parameters include:
  
  | Speed | Individual “m” and “b” values in mX+b format | CJC type |
  | Range | Channel averaging | Thermistor type |
  | Resolution | Hi-Low limits | Thermocouple type |
  | Number of power line cycles (NPLC) | Resistance measurement method (2- or 4-wire) | RTD type |
  | Math functions | Offset compensation | Voltage clamped ohms (Dry Circuit, 2750 only) |
  | Ratio calculation | | |

- **DUT-to-modules connections**: It is easy to connect the device under test to the switch/control modules. The 7703 and 7705 modules use dual 50-pin “D-sub” input connectors for secure, quick connections. The 7701, 7707, and 7709 modules use “D-sub” connectors that are compatible with off-the-shelf standard ribbon cable. These connectors are especially convenient for rapid system setup. When greater connection flexibility is required, the 7700, 7702, and 7708 modules provide oversize screw terminal connectors that simplify setup by eliminating the need to handle small connectors. The standard wires used are 20AWG. Model 7710 uses removable terminal blocks to provide the simplicity of screw terminal connections with the speed of mass terminated cables. The 7711 and 7712 RF modules use industry standard SMA connectors.

- **Mainframe-to-modules connection**: Secure screws connect the modules to the mainframe. At power-up, the mainframe detects any attached modules automatically, which minimizes set-up time. All signals are routed internally from module to mainframe.

- **Front/rear switch**: The front inputs are used for manual probing, troubleshooting, and calibration. A switch on the front panel makes it easy to shift between the front and rear inputs. This eases setting up the equipment and speeds verifying proper setup and connections prior to automating the measurement.

Scanning Capabilities

- **Relay Closure Counts**: Relay closure counts are logged every time a channel is closed. These counts are permanently written to the EEPROM on the module at a user-settable time interval (factory default of 10 minutes) or whenever the counts are queried. Valid intervals (set in integer number of minutes) are between 1 and 1440 minutes (24 hours). Relay closures are counted when a relay cycles from open to closed state.

- **Open Sense Lead Indication**: The system can alert the user if there is a sense lead disconnection on any channel. In this case, the front panel display will show “OVERFLOW.” Therefore, the system does not need other equipment or calibration to inspect the broken connection or failed relay on the scanner card. In addition, the system will protect against erroneously passed conditions.

- **Scan count**: An Integra Series system can be programmed to run a given number of scans (up to 450,000) automatically and to record readings into the internal memory buffer. The instrument also allows programming the trigger source used to initiate each scan. (Refer to page 11 for more information on triggering.)
Integra Series

Multimeter/Switch Systems

- **Scan interval**: The user can set the interval after which each succeeding scan will begin. Scan intervals can be set anywhere from 0 to 99 hours in increments of 1ms.

- **Scan sequence/omitting channels**: In addition to scanning in numerical sequence, the system can be programmed to skip any channels that are not required for a particular test. This avoids recording irrelevant data and speeds the data acquisition process. This makes scanning both faster and more flexible.

- **Ratio (DCV only)**: The instrument can calculate and display the ratio of measurements of paired channels. Ratios can only be determined for specific channel pairs, depending upon the input module used. For example, channel pairs on the Model 7702 include Channels 1 and 21, Channels 2 and 22, etc. Hi/Lo limits are fully supported.

- **Channel average (DCV and thermocouple only)**: The instrument can calculate and display the average of two channel measurements. As with ratio calculations, only paired channels can be averaged. Hi/Lo limits are fully supported.

### Choice of Communication Interfaces

**RS-232**

All the Integra Series mainframes include RS-232 ports for computer control. RS-232 is a low cost point-to-point interface, allowing a computer to interface with a one mainframe per port at distances up to several hundred meters, depending on the baud rate setting. Slow baud rates can be run long distances, while the fastest baud rate settings are limited to several meters maximum distance. The Model 2700 and 2750 can receive commands and transfer data via RS-232 at various baud rates up to 19.2kbaud. The Model 2701 offers data rates up to 115.2kbaud with hardware handshaking.

**GPIB**

The Model 2700 and 2750 both offer a GPIB port. GPIB provides higher speed data transfers (up to 1Mbyte/sec.) than RS-232, and allows up to 32 devices to be addressed from a single GPIB controller card in a host computer. The maximum cabling distance for the GPIB interface is 2 meters between each GPIB connection. Up to 20 total meters of cable may be connected to a single controller card.

**Ethernet**

The Model 2701 offers a 10/100 BaseT Ethernet connection for high speed and long distance communication between a computer and a virtually infinite number of instruments. Any PC with an Ethernet port can connect to a single Model 2701 in a point-to-point configuration, to multiple 2701s through a hub, or to multiple 2701s distributed on a network. See the system configuration section on page 35 for more details on Ethernet connections.

The Model 2701 Ethernet port uses the industry-standard TCP/IP socket interface. This provides data rates up to 100Mbits/sec, and allows the instrument to be located up to 100 meters from the nearest computer or network hub in hardwired systems and miles in wireless Ethernet systems. The maximum distances between a control PC and the instruments are limited only by the size of the network. The instrument also provides a built-in diagnostic web page for easy remote access to the 2701. Entering the instrument’s IP address in the URL line of Microsoft® Internet Explorer® will allow communication with and control of the 2701. This Web page allows users to read and set network parameters, such as IP address, subnet mask, gateway, MAC address, and calibration dates, and to send commands to and query data from the 2701.
Triggenering and I/O Capabilities

Trigger sources
Any of the following sources can be used for triggering a reading or scan sequence:

A. **Immediate**: An Integra Series system self-triggers automatically. This default method is the simplest way to take a measurement on a single channel.

B. **An external trigger** is received via the Trigger Link connector. Triggering through Trigger Link is very precise (<0.5ms trigger latency) and provides tight timing control for synchronization in larger systems. Therefore, measurements can be taken at a precise time with very little uncertainty. This capability can be valuable when optimizing coordination with other system instruments, such as the Model 2400 SourceMeter® instrument in larger rack & stack applications.

C. **A bus trigger** is received (GET or *TRG) on GPIB or *TRG on RS-232 and Ethernet.

D. **Manual**: Use of front panel TRIG key.

E. **Analog trigger**: A display reading on a particular channel can be programmed as an analog trigger. A scan sequence is started whenever such a reading is reached [programmed for either a greater than (>) or less than (<) condition as a trigger]. In other words, this feature can be used to initiate a scan sequence based on some external factor, such as a temperature rising above a pre-set limit. After scanning all the configured channels on the instrument, the instrument then returns to the channel that acted as the analog trigger, and checks for the reading to be in conditional limits. Depending on the limits and current reading, the instrument decides whether to start the next scan. Only the data of interest are acquired, eliminating the need to spend hours searching through reams of normal readings to find anomalous data.

F. **Digital trigger**: Two digital inputs (TTL-level) are standard on each mainframe—one to serve as a trigger input and one to serve as a hardware interlock. The digital trigger is logical “and”-ed with the interlock. The interlock is default true. Therefore, the digital trigger input would be recognized for triggering only when the digital trigger and the interlock are both true. Thus, the interlock provides the user with a controlling mechanism for recognizing the digital trigger if necessary (see Figure 3).
Alarm Limits/Digital Outputs

The digital output lines can trigger external alarms without the need for a PC connection. The instrument can be programmed to provide alarms when any pre-set limits are breached. Limits can be applied to all measurement functions except continuity, which has its own alarm beeper. The limit test is performed after “mX + b” and math operations.

Limit types: Each channel has four independently programmable limits, each of which can be assigned a value. These are:

1. Limit1 High (for example, 1% higher than the expected reading)
2. Limit1 Low (for example, 1% less than the expected reading)
3. Limit2 High (for example, 5% higher than the expected reading)
4. Limit2 Low (for example, 5% less than the expected reading)

The outputs can be positive or negative true, pulse, or fixed level. Pulse widths are programmable.

Master Limit: In addition to these limit alarms, a master limit is provided. It is logically “or”-ed with the four limits and is active every time any of the other limits are breached.

Each of the alarm limits and the master alarm is mapped to a specific output pin on the 9-pin male connector that handles the output of that alarm limit.

Electrical Capabilities:

- 250mA sink (output).
- TTL level outputs (no external supply is needed).
- Open collector output up to 33V with external supply.
- Ability to trigger or start a scan by connecting to one of the digital input lines.

On-board Data Storage

Buffer: There are non-volatile ‘read and transmit’ memory buffers (in other words, the buffer can be emptied while it is being filled) in each system. The buffer can be configured in “wrap around” mode for recording readings continuously for long periods. There is no need to stop taking data, reset the instrument, or change memory cards. The wrap around memory can be configured to issue a Service Request (SRQ) at predetermined points in the scan. An SRQ can be issued when the buffer is one-quarter full, one-half full, three-quarters full, or completely full. The instrument can be commanded to download the readings without interfering with the current acquisition; therefore, data acquisition and retrieval can occur simultaneously. When the buffer is full, the instrument returns to the beginning of the buffer and starts writing in the locations emptied by the previous download.

Timestamp: The readings in the memory can be timestamped to trace the progress of a test. The time can be configured as either:

- Real time: The actual calendar day and time.
- Relative Time: Time is relative to the first reading stored in the buffer.
Integra Series Multimeter/Switch Systems

Saving/Recalling a Setup
All current set-up information for individual channels and the mainframe is battery backed and the measurement data is stored in the non-volatile memory. Therefore, while the instrument is switched off, the configuration for each channel is saved in the memory, then automatically recalled when the product is switched on again. Up to five (four for Model 2700 and three for Model 2750) different sets of setups can be recorded for each channel, so it’s unnecessary to set up each channel before a different test.

Power Failure Recovery
All set-up information is battery backed and data is stored in non-volatile RAM, so the system is immune to power failures and can resume scanning where it stopped once power is restored. There is no need to restart interrupted tests from the beginning. The scan resumption feature is user-selectable.

Channel Monitor
The channel monitor feature allows monitoring any specific input channel on the front panel display at any time during a scan. The system can scan across channels very rapidly, so the channel monitor offers a convenient way to view only the channel of interest without interrupting a scan.

Measurement Performance
Each Integra series system is a true 6½-digit (22-bit) instrument designed for high measurement precision. Its high precision enhances measurement repeatability and stability.

Measurement performance is a key advantage of all Keithley’s products. The Integra Series is based on a number of advanced technologies that improve its overall performance dramatically, including:

• Patented A/D converter IC circuitry design to increase the resolution, precision, and speed of measurement.
• Advanced signal conditioning hardware to filter out unwanted noise and provide necessary isolation.
• A unique “servo” front end design (Figure 6). While conventional DMMs typically measure and correct for the zero drift of front-end circuitry, these systems’ servo front end eliminates zero drift, which also eliminates the wasted measurement time usually required to check zero, further increasing measurement speed.

Figure 5. When the measurements matter, Keithley provides up to 10x better performance at equivalent reading rates or up to 10x faster speeds at equivalent measurement performance. Our patented A/D converter and high performance signal conditioning circuitry make this possible.

<table>
<thead>
<tr>
<th>Specification Conversion Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
</tr>
<tr>
<td>10%</td>
</tr>
<tr>
<td>1%</td>
</tr>
<tr>
<td>0.1%</td>
</tr>
<tr>
<td>0.01%</td>
</tr>
<tr>
<td>0.001%</td>
</tr>
<tr>
<td>0.0001%</td>
</tr>
<tr>
<td>0.00001%</td>
</tr>
<tr>
<td>0.000001%</td>
</tr>
<tr>
<td>0.0000001%</td>
</tr>
</tbody>
</table>

Integra Series Performance (6½-digit, 22-bit)
Integra Series

Multimeter/Switch Systems

Digital Filtering

For each major measurement function, users can employ either averaging or advanced digital filtering to reduce noise and increase the effective resolution.

Averaging Filter

The averaging filter operates over a range of from two to 100 readings. All readings included in the filter range are weighted equally. A step input of any size will ramp up linearly to the final value after obtaining the number of readings specified by the user. The averaging filter may be configured as either a moving averaging or as a repeat filter. Operation over the GPIB bus is often done in “repeat” mode to ensure that all readings are fully filtered. Also, taking filtered measurements in repeat mode requires only one trigger, simplifying programming. Only the repeat filter can be used while scanning.

Advanced Filter

When a DMM is used in bench mode, it’s often desirable for it to respond immediately upon connection to a test point, without the slow response associated with an averaging filter. The advanced filter addresses this need by providing a filter reset level. If the measured value deviates significantly from previous values, the filter is reset to the new value, and filtering is restarted. In this way, the user can set the filter reset level just above the maximum noise level anticipated and the multimeter will respond to new values immediately.

NPLC

Selectable power line cycle integration allows the user to specify the number of power line cycles (NPLC) over which to integrate (1, 5, 10, etc.). Use of line cycle integration provides rejection of noise from line cycle interference, the most common source of noisy readings. In general, the longer the integration time chosen, the greater the noise rejection will be. The system can also be set to less than 1 NPLC integration time; as fast as 0.002 NPLC (~33µs at 60Hz) in the Model 2701 and 0.01 NPLC (~167µs at 60Hz) in the Model 2700 and 2750 for faster data measurement (but without power line noise rejection).

Line Cycle Synchronization

To attain the highest possible line cycle noise rejection, it is important to trigger the reading at the beginning of a power line cycle. The system can be set to start a measurement precisely when the power line signal crosses zero (see Figure 7). This function increases the normal mode noise rejection 30dB, providing an additional ×30 reduction in noise due to line cycle interference.

Autozero

Internal autozeroing is used to maintain the best measurement performance. The advanced firmware design does the required calculation, such as CJC compensation for thermocouple measurements with the 7700, 7706, 7708, and 7710, automatically in the background. This enables the Integra system to provide faster reading rates (competitive products spend half their measurement time validating their own zero). Autozero can be disabled to increase measurement speed, but this may result in greater measurement uncertainty.

Low Ohms Measurement (Model 2750 only)

The Model 2750 can measure low ohms on all of its switch/control modules that have multiplexers or matrix configurations. The four-wire ohms measurement supports low ohms measurements down to the $1\Omega$ range, with micro-ohm resolution. Measurements can be accommodated through ribbon cable or discrete wiring. On four-wire ohms measurements, up to five additional ohms of cable/switch card resistance can be tolerated per cable lead. This allows the use of ribbon cable without overloading the range.
**Offset Compensation**

For more accurate low resistance measurements, all Integra systems provide the offset compensation mode to eliminate errors from the thermoelectric EMF effects ($V_{\text{EMF}}$). During the measurement cycle, the built-in ohms current source is turned off, then turned on again, and the resulting EMF error is automatically subtracted. This technique is typically used when measuring values less than 100Ω using the four-wire ohms method.

**Voltage Limit/Dry Circuit Ohms (Model 2750 only)**

The use of dry circuit mode, when selected, limits the open-circuit voltage to 20mV. This allows resistance measurements to be made with low power. When measuring contact and connector resistances, it is important not to puncture oxides and films that may have formed. Standard resistance measurements have open-circuit voltage levels from 5.4V to 12.8V, depending on the selected range.

Dry circuit ohms can be used on the 1Ω, 10Ω, 100Ω, and 1kΩ ranges for the four-wire ohms (Ω4) function. Also, offset compensated ohms (OCOMP) can be used with dry circuit ohms to cancel the effect of thermoelectric EMFs.

Dry circuit ohms should be used for any device that could be damaged by high open-circuit voltage. If not sure, and the slightly degraded accuracy is not a consideration, it is good practice to use dry circuit ohms to measure low resistance.

The accuracy specifications for all dry circuit ohms ranges are with offset compensated ohms and line synchronization enabled.

**Temperature Measurements**

The Integra systems support three major types of temperature sensors with built-in signal conditioning and linearization: thermocouples, RTDs, and thermistors.

<table>
<thead>
<tr>
<th>Thermocouples</th>
<th>RTDs</th>
<th>Thermistors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>−200 ~ 1820°C</td>
<td>−200 ~ 630°C</td>
</tr>
<tr>
<td>Advantage</td>
<td>• Self-powered</td>
<td>• High stability</td>
</tr>
<tr>
<td></td>
<td>• Wide temperature range</td>
<td>• High accuracy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No CJC required</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

The Integra systems provide built-in algorithms for a variety of thermocouples, RTDs, and thermistors. To begin using a sensor, simply hook it up and the system does the rest.

- Thermocouples: Type J, K, N, T, E, R, S, B
- RTDs: D100, F100, PT100, PT385, PT3916, or user type
- Thermistors: 2250Ω, 5kΩ, and 10kΩ
Cold Junction Compensation Methods

Thermocouple measurements always require that the temperature be known at the point where the thermocouple is connected to the instrument. This connection point is known as the “cold junction.” The Integra systems support three different methods for including this “cold-junction” temperature in the temperature measurements.

**Automatic CJC**

The CJC sensors are mounted on the multiplexer module’s PC board (7700, 7706, 7708, and 7710). They sense the actual temperature across the module’s connector, then compensate all temperature measurements accordingly. The CJC scaling is done automatically when autozero is turned on, so the user does not have to acquire it separately. When autozero is turned off, the instrument is optimized for speed and does not refresh the CJC compensation. This allows the user to obtain faster scan rates for short periods of time while ambient temperature remains stable.

**External CJC**

A thermistor or RTD is attached to Channel 1 by the end user. This thermistor or RTD is then used to measure the temperature of the point(s) where the thermocouples are connected to the instrument or to copper wires leading to the instrument. The precision of the actual temperature measurement depends on the accuracy of the cold junction reading and how close the sensor is to the actual temperature of the connection.

**Simulated CJC**

When the “change” in temperature is of interest rather than the absolute temperature value, the user can enter a parameter as a cold junction reference point (for example, 23°C for room temperature). This parameter will be used to adjust the actual temperature measurement for each channel. This simulated temperature must be updated manually if ambient conditions change. This is also the method used when an actual ice bath is used to establish a cold junction of 0°C. The simulated parameter is then set to 0°C or 32°F.

**Open Thermocouple Detect**

A system can alert the user if any thermocouple becomes broken or otherwise disconnected from the input terminal blocks. When the Open T/C Detect feature is enabled, the system will perform (in the background) a two-wire resistance measurement across each thermocouple input channel. If an open connection is detected, the front panel display will show “OVERFLOW” for that channel.

**Calibration**

The design of the Integra Series and their calibration procedure were developed to address a variety of critical calibration issues. For example, the systems have front panel input jacks, so there’s no need to disassemble the system for periodic recalibrations. There’s also no need to buy, stock, and track spare “cal only” modules. The systems are connected to the calibrator through the front panel input jacks. The systems’ calibration procedure covers both verification and adjustment and can be performed through either the front panel or any of the remote interfaces. The calibration interval is user-selectable.
Integra Series

Multimeter/Switch Systems

Start-Up Software

Free built-in Web diagnostic tool (2701 only)

To start communicating with the Integra Series instrument, simply connect the 2701 to a PC Ethernet port using the supplied RJ-45 crossover cable, start Microsoft® Internet Explorer® version 5.0 or later, and type the instrument’s IP address into the URL line. The built-in web diagnostic interface allows for easy communication and debugging, without the need to install external software. This interface makes it easy to read and set network parameters such as IP address, subnet mask, gateway, MAC address, calibration dates, and other data stored in the Integra Series instrument. It also takes readings from the instrument and allows the user to send command strings and receive data.

Free customizable start-up software

This free TestPoint runtime offers basic datalogging capabilities that can get a system “up & running” almost immediately. With just a few clicks of the mouse, this software can confirm the system’s hardware, wiring, communications, and software drivers are installed and operating correctly. It can also configure instrument functions and perform simple data acquisition tasks. Data from multiple channels can be saved to disk and up to eight channels of data can be graphed automatically. If the application demands greater functionality, this runtime can be modified with the TestPoint application development package.

TestPoint™ Application Development Package

If Keithley’s free start-up software doesn’t provide a feature needed to support a specific application, the economical TestPoint application development package makes it simple to create a semi-custom solution by modifying the runtime application. By using the start-up runtime as a foundation, TestPoint offers the flexibility needed to build basic systems quickly, without in-depth programming. TestPoint uses object-oriented, drag-and-drop technology to bring both power and simplicity to data acquisition and test and measurement applications. TestWizards and pre-written application templates in a choice of graphical styles make it simple to create a complete application with a few mouse clicks. Additional objects can be modified and added to create custom enhancements.

Three optional toolkits make it easy to expand applications:

- Internet toolkit provides Web-based remote measurements and control.
- Database toolkit provides access to popular database packages like Access, SQL, Oracle, and others.
- Statistical process control (SPC) toolkit adds charts, statistics, and analysis capabilities.
Integra Series Multimeter/Switch Systems

Software

Datalogging/Data Acquisition Software
ExcelINX-1A

For advanced datalogging tasks, this powerful and economical add-in utility for Microsoft® Excel makes it simple to acquire data from the Integra Series instrument directly into Excel, then employ Excel’s graphic, charting, and analysis capabilities to turn that data into useful information. No programming is required—a few mouse clicks are all it takes to configure channels, set parameters, configure triggers, and scan lists. ExcelINX-1A can control up to three Integra Series instruments for up to 600 channels of data acquisition. Sold separately.

Custom Application Development with VISA Based IVI Driver

For building custom applications, programmers can take advantage of the VISA based Integra series IVI driver designed for use with software development environments like Visual Basic, Visual C/C++, LabVIEW, LabWindows/CVI, and TestPoint. The VISA (Virtual Instrument Software Architecture) layer of the driver allows the programmer to quickly reconfigure the communication bus between the PC and the instruments without changing a single line of source code. This means that changing GPIB control board vendors or switching the communication bus between GPIB, RS-232, and Ethernet requires no rework of a custom application program. The IVI (Interchangeable Virtual Instrument) layer of the driver provides a simplified command interface that is common to the entire Integra Series product family. The driver also includes a large set of examples for reference during software design.
Specifications are subject to change without notice.
**Integra Series Mainframes**

**Multimeter/Switch Systems**

### DC CHARACTERISTICS

**CONDITIONS:** MED (1 PLC)² or 10 PLC or MED (1 PLC) with Digital Filter of 10

#### INPUT RESISTANCE OR OPEN Ckt.

**Voltage**¹¹

<table>
<thead>
<tr>
<th>RANGE</th>
<th>RESOLUTION OR BURDEN VOLTAGE</th>
<th>CURRENT ±5% OF VOLTAGE</th>
<th>CURRENT ±5% OF VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000000 mV</td>
<td>0.1 µV</td>
<td>&gt;10 GΩ</td>
<td>&gt;10 GΩ</td>
</tr>
<tr>
<td>1.000000 V</td>
<td>1.0 µV</td>
<td>&gt;10 GΩ</td>
<td>&gt;10 GΩ</td>
</tr>
<tr>
<td>10.0000 V</td>
<td>10 µV</td>
<td>&gt;10 GΩ</td>
<td>&gt;10 GΩ</td>
</tr>
<tr>
<td>100.00 V</td>
<td>100 µV</td>
<td>10 Ω ± 1%</td>
<td>10 Ω ± 1%</td>
</tr>
<tr>
<td>1000.00 V</td>
<td>1 mV</td>
<td>10 Ω ± 1%</td>
<td>10 Ω ± 1%</td>
</tr>
</tbody>
</table>

#### Resistance

- **6Ω** ¹²: 1 ΩΩ, 10 mA
- **10Ω** ²¹: 10 mA
- **100Ω** ²²: 1 mA, 6.9 V, 12.2 V
- **1000Ω** ²³: 10 mA, 6.9 V, 12.2 V

#### Thermistor

| Type Range | Resolution | Reference Junction | Using 77XX Module | Temperature Coefficient
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
<td>0.05°C/°C</td>
<td></td>
</tr>
<tr>
<td>K ~200 to +760°C 0.001°C</td>
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<td></td>
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<tr>
<td>N ~200 to +760°C 0.001°C</td>
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<td>1°C</td>
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<td></td>
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</tr>
<tr>
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<td>1°C</td>
<td>0.05°C/°C</td>
<td></td>
</tr>
</tbody>
</table>

#### Thermocouples

<table>
<thead>
<tr>
<th>Type Range</th>
<th>Resolution</th>
<th>Reference Junction</th>
<th>Using 77XX Module</th>
<th>Temperature Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>J ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
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<td></td>
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<tr>
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<td>0.2°C</td>
<td>1°C</td>
<td>0.05°C/°C</td>
<td></td>
</tr>
</tbody>
</table>

#### DC SYSTEM SPEEDS¹⁵,¹⁸

- **RANGE CHANGES (excludes ØΩ)²⁴:** 50/s (42/s)
- **FUNCTION CHANGES:** 50/s (42/s)
- **AUTORANGE TIME:** <30 ms<br>±<30 ms
- **ASCII READINGS TO RS-232 (19.2k BAUD):** 55/s<br>300/s
- **MAX. EXTERNAL TRIGGER RATE:** 375/s<br>2000/s

---

**TEMPERATURE¹⁹**

(Displayed in °C, °F, or K. Exclusive of probe errors.)

**Thermocouples (Accuracy based on ITS-90.)**

<table>
<thead>
<tr>
<th>Type Range</th>
<th>Resolution</th>
<th>Temperature Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>J ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
<tr>
<td>K ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
<tr>
<td>N ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
<tr>
<td>T ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
<tr>
<td>E ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
<tr>
<td>S ~200 to +760°C 0.001°C</td>
<td>0.2°C</td>
<td>1°C</td>
</tr>
</tbody>
</table>

#### DC MEASUREMENT SPEEDS¹⁵

**Single Channel, 60Hz (50Hz) Operation**

<table>
<thead>
<tr>
<th>Function</th>
<th>Digits</th>
<th>Readings/s</th>
<th>PLCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCV, DCL, Ø (±100M)</td>
<td>6.5 (6.4)</td>
<td>5 (4)</td>
<td>10</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>6.5 (6.4)</td>
<td>35 (28)</td>
<td>1</td>
</tr>
<tr>
<td>Thermistor</td>
<td>6.5 (6.4)</td>
<td>45 (36)</td>
<td>1</td>
</tr>
<tr>
<td>2701 and 2750 only</td>
<td>4.5 (4.2)</td>
<td>2500 (2000)</td>
<td>0.01</td>
</tr>
<tr>
<td>2701 only</td>
<td>3.5</td>
<td>5000 (2000)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

**4ΩΩ (<10M)**

<table>
<thead>
<tr>
<th>Function</th>
<th>Digits</th>
<th>Readings/s</th>
<th>PLCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>4ΩΩ (±10M)</td>
<td>6.5 (6.4)</td>
<td>1.4 (1.1)</td>
<td>10</td>
</tr>
<tr>
<td>6.5 (6.4)</td>
<td>15 (12)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5.5 (5.4)</td>
<td>55 (45)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Channel Ratio**

<table>
<thead>
<tr>
<th>Function</th>
<th>Digits</th>
<th>Readings/s</th>
<th>PLCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel (Ratio)</td>
<td>6.5 (6.4)</td>
<td>2.5 (2)</td>
<td>10</td>
</tr>
<tr>
<td>Channel (AVG)</td>
<td>6.5 (6.4)</td>
<td>15 (12)</td>
<td>1</td>
</tr>
<tr>
<td>5.5 (5.4)</td>
<td>25 (20)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Multiple Channels, Into Memory**

<table>
<thead>
<tr>
<th>Function</th>
<th>Channels/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>7710 Scanning DCV</td>
<td>230/s</td>
</tr>
<tr>
<td>7710 Scanning DCV with Limits or Time Stamp On</td>
<td>230/s</td>
</tr>
<tr>
<td>7710 Scanning DCV alternating 2Ω</td>
<td>230/s</td>
</tr>
</tbody>
</table>

**Multiple Channels, Into and Out of Memory to GPIB**

<table>
<thead>
<tr>
<th>Function</th>
<th>Channels/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>7710 Scanning DCV</td>
<td>220/s</td>
</tr>
<tr>
<td>7710 Scanning DCV with Limits or Time Stamp On</td>
<td>220/s</td>
</tr>
<tr>
<td>7710 Scanning DCV alternating 2Ω</td>
<td>220/s</td>
</tr>
</tbody>
</table>

---

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www.keithley.com
**Integra Series Specifications**

**Mainframes**

**Multimeter/Switch Systems**

---

**DC SPEED vs. NOISE REJECTION**

<table>
<thead>
<tr>
<th>Rate Filter</th>
<th>Readings/s</th>
<th>10 Range</th>
<th>2700, 2750</th>
<th>2701</th>
<th>NMR</th>
<th>CMRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>50</td>
<td>0.1 (0.08)</td>
<td>6.5</td>
<td>&lt; 1.2 µV</td>
<td>&lt; 2.5 µV</td>
<td>110 dB</td>
</tr>
<tr>
<td>1</td>
<td>Off</td>
<td>15 (12)</td>
<td>6.5</td>
<td>&lt; 4 µV</td>
<td>&lt; 6 µV</td>
<td>90 dB</td>
</tr>
<tr>
<td>0.1</td>
<td>Off</td>
<td>500 (400)</td>
<td>5.5</td>
<td>&lt; 22 µV</td>
<td>&lt; 40 µV</td>
<td>—</td>
</tr>
<tr>
<td>0.01</td>
<td>Off</td>
<td>2500 (2000)</td>
<td>4.5</td>
<td>&lt; 150 µV</td>
<td>&lt; 500 µV</td>
<td>—</td>
</tr>
<tr>
<td>0.002</td>
<td>Off</td>
<td>5500 (2800)</td>
<td>3.5</td>
<td>—</td>
<td>&lt; 1 mV</td>
<td>—</td>
</tr>
</tbody>
</table>

**DC MEASUREMENT CHARACTERISTICS**

**DC VOLTS**

- A-D LINEARITY: 2.0 ppm of reading + 1.0 ppm of range.

**INPUT IMPEDANCE:**

- 100mV-10V Ranges: Selectable >10GΩ / with <40pF or 10MΩ ±1%.
- 100V, 1000V Ranges: 10MΩ ±1%.

**Dry Circuit:** 100Ω ± 1% / < 1µF

**EARTH ISOLATION:** 500V peak, >10GΩ and <300pF any terminal to chassis.

**INPUT BIAS CURRENT:** <75µA at 25°C.

**COMMON MODE CURRENT:** <500nA at 50Hz or 60Hz.

**AUTOZERO ERROR:** Add ±(2ppm of range error + 5µV) for < 10 minutes and ±1°C.

**INPUT PROTECTION:** 1000V all Source Inputs, 350V Sense Inputs. 300V with plug-in modules.

**RESISTANCE**

- Maximum ±2Ω LEAD RESISTANCE: 80% of range per lead (Dry Cat mode). 5Ω per lead for 1Ω range; 10% of range per lead for 10Ω, 100Ω, and 1kΩ ranges, 1kΩ per lead for all other ranges.

**OFFSET COMPENSATION:** Selectable on ±2Ω, 1Ω, 10Ω, 100Ω, 1kΩ, and 10kΩ ranges.

**CONTINUITY THRESHOLD:** Adjustable 1 to 1000 Ω

**INPUT PROTECTION:** 1000V all Source Inputs, 350V Sense Inputs. 50V with plug-in modules.

**DC CURRENT**

**SHUNT RESISTORS:** 100mV–3A, 0.1Ω, 20mA, 5Ω.

**INPUT PROTECTION:** 5A, 250V fuse.

**THERMOCOUPLES**

**CONVERSION:** ITS-90.

**REFERENCE JUNCTION:** Internal, External, or Simulated (Fixed).

**OPEN CIRCUIT CHECK:** Selectable per channel. Open >1kΩ ±200Ω.

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**DC NOTES**

1. 20% overrange except on 100V and 3A.

2. Add the following to “ppm of range” uncertainty: 100mV 15ppm, 1V and 1000V 2ppm; for Model 2750 1Ω and Dry Circuit 1Ω 6ppm, 10–30Ω 2ppm, for Models 2700/2710 10Ω, 30Ω, and 1Ω 10ppm, 100mΩ 40ppm.

3. ±2% (measured with 10MΩ input resistance, DMM, >10ΩGΩ DMM on 10MΩ and 100MΩ ranges). For Dry Circuit 1Ω, ±25% with Input HI connected to Sense HI, with Sense HI disconnected add 30mV

4. Relative to calibration accuracy.

5. For signal levels >500 add 0.02µmV/V uncertainty for portion exceeding 500V.

6. Specifications are for 4-wire; 1Ω, 10Ω, 100Ω, and 1000Ω with offset compensation on. With 77XX plug-in modules, LSYNC on. With offset compensation off, OPEN CKT, VOLTAGE is 12.8V. For 2-wire add ±1Ω to “ppm of range” uncertainty. HI range is 4-wire only

7. Must have 10% matching of lead resistance in Input HI and LO

8. Add the following to “ppm of reading” uncertainty when using plug in modules:

<table>
<thead>
<tr>
<th>Range</th>
<th>All Modules</th>
<th>10 kΩ</th>
<th>100 kΩ</th>
<th>1 MΩ</th>
<th>10 MΩ</th>
<th>100 MΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10 ppm</td>
<td>100 ppm</td>
<td>1000 ppm</td>
<td>1%</td>
<td>10%</td>
</tr>
<tr>
<td>7700, 7706, 7710 Modules</td>
<td>5 ppm</td>
<td>50 ppm</td>
<td>500 ppm</td>
<td>5000 ppm</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>7710 Module</td>
<td>23°C ±5°C</td>
<td>11 ppm</td>
<td>110 ppm</td>
<td>1100 ppm</td>
<td>1%</td>
<td>11%</td>
</tr>
</tbody>
</table>

9. Add 1.5V when used with plug in modules.

10. For RATIO, DCV only. For AVERAGE, DCV and Thermocouples only. Available with plug in modules only.

11. Add 4µV/°C “of range” uncertainty when using Models 7701, 7703, and 7707, and 3µV for Models 7706 and 7709.

12. Auto zero off.

13. For LSYNC On, line frequency ±0.1 %. For LSYNC Off, use 60dB for ≥ 1PLC.

14. For 1kΩ unbalance in LO lead, AC CMRR is 70dB.

15. Speeds are for 60Hz (50Hz) operation using factory defaults operating conditions (*RST). Autorange off, Display off, Limits off, Trigger delay = 0.

16. Speeds include measurements and binary data transfer out the GPIB or ASCII data transfer for Ethernet and RS-232 (reading element only).

17. Sample count = 1000, auto zero off (into memory buffer).

18. Auto zero off, NPLC = 0.01 (Models 2700 and 2750). NPLC = 0.002 (Model 2701).

19. Additional Uncertainty:

- 100MΩ–10V Ranges: < 1% of reading.
- 100kΩ–10V Ranges: < 3% of reading.
- 10kΩ–10V Ranges: < 5% of reading.
- 5kΩ–10V Ranges: < 7% of reading.
- 2.2kΩ–10V Ranges: < 10% of reading.
- 1.0kΩ–10V Ranges: < 15% of reading.

20. For lead resistance >0Ω, add the following uncertainty/Ω for measurement temperatures of:

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>−200 to +0°C</td>
<td>0.1</td>
</tr>
<tr>
<td>K</td>
<td>−200 to +0°C</td>
<td>0.2</td>
</tr>
<tr>
<td>N</td>
<td>−200 to +0°C</td>
<td>0.3</td>
</tr>
<tr>
<td>T</td>
<td>−200 to +0°C</td>
<td>0.4</td>
</tr>
<tr>
<td>R</td>
<td>−200 to +0°C</td>
<td>0.5</td>
</tr>
<tr>
<td>E</td>
<td>0 to +1000°C</td>
<td>0.6</td>
</tr>
<tr>
<td>S</td>
<td>0 to +1000°C</td>
<td>0.7</td>
</tr>
<tr>
<td>B</td>
<td>+350 to +1100°C</td>
<td>0.8</td>
</tr>
</tbody>
</table>

21. For 4-wire Ω only, offset compensation on, LSYNC on.

22. For Dry Circuit 1kΩ range, 2 readings max.

23. For 2750 Front Inputs, add the following to Temperature Coefficient “ppm of reading” uncertainty: 1Ω 25ppm, 10Ω 25ppm, 100Ω 250ppm, 100MΩ 2500ppm. Operating environment specified for 0°C to 50°C and 50% RH at 35°C.

24. Model 2750 only

25. Front panel resolution is limited to 0.1Ω.

---

**A GREATER MEASURE OF CONFIDENCE**
## AC SPECIFICATIONS

<table>
<thead>
<tr>
<th>Function</th>
<th>Range</th>
<th>Resolution</th>
<th>Calibration Cycle</th>
<th>Accuracy: ±(%) of reading + % of range, 23°C ± 5°C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 Hz–10 Hz</td>
<td>10 Hz–20 kHz</td>
<td>20 kHz–100 kHz</td>
<td>100 kHz–300 kHz</td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>100.0000 mV</td>
<td>100 µV</td>
<td>90 Days</td>
<td>0.35 ± 0.03</td>
</tr>
<tr>
<td></td>
<td>1.000000 V</td>
<td>1.0 µV</td>
<td>(all ranges)</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td></td>
<td>10.00000 V</td>
<td>10 µV</td>
<td>1 Year</td>
<td>0.11 ± 0.05</td>
</tr>
<tr>
<td></td>
<td>100.00000 V</td>
<td>100 µV</td>
<td></td>
<td>0.6 ± 0.08</td>
</tr>
<tr>
<td></td>
<td>750.000 V</td>
<td>1.0 µV</td>
<td></td>
<td>4.0 ± 0.5</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>1.000000 A</td>
<td>1.0 µA</td>
<td>90 Days</td>
<td>0.30 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>0.00000 A</td>
<td>10 µA</td>
<td>(3 Hz–10 Hz)</td>
<td>0.10 ± 0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(10 Hz–3 kHz)</td>
<td>0.14 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>100.00000 V</td>
<td>100 µV</td>
<td>(3 kHz–5 kHz)</td>
<td>0.04 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>750.000 V</td>
<td>1.0 µV</td>
<td>(5 kHz–10 kHz)</td>
<td>0.01 ± 0.04</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>100 mV</td>
<td>0.333 ppm</td>
<td>90 Days</td>
<td>100 ppm + 0.333 ppm (SLOW 1s gate)</td>
</tr>
<tr>
<td></td>
<td>3.00000 A</td>
<td>14 µA</td>
<td>(3 Hz–500 kHz)</td>
<td>100 ppm + 3.33 ppm (MED, 100ms gate)</td>
</tr>
<tr>
<td><strong>ADDITIONAL UNCERTAINTY ±(% OF READING)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Low Frequency Uncertainty</strong></td>
<td>MED</td>
<td>FAST</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 Hz – 50 Hz</td>
<td>0.5</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 Hz – 50 Hz</td>
<td>0</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 Hz – 100 Hz</td>
<td>0</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 Hz – 200 Hz</td>
<td>0</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>200 Hz – 500 Hz</td>
<td>0</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;500 Hz</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>CREST FACTOR: 5</strong></td>
<td>1–2</td>
<td>2–3</td>
<td>3–4</td>
<td>4–5</td>
</tr>
<tr>
<td></td>
<td>Additional Uncertainty:</td>
<td>0.05</td>
<td>0.15</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>Max. Fundamental Freq.:</td>
<td>50kHz</td>
<td>50kHz</td>
<td>3kHz</td>
</tr>
<tr>
<td></td>
<td>Maximum Crest Factor: 5 at full-scale.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## AC MEASUREMENT CHARACTERISTICS

**AC VOLTS**

MEASUREMENT METHOD: AC-coupled, True RMS.

INPUT IMPEDANCE: 1MΩ ±2% // by <100pF.

INPUT PROTECTION: 1000Vp or 400VDC, 300Vrms with plug in modules.

**AC CURRENT**

MEASUREMENT METHOD: AC-coupled, True RMS.

SHUNT RESISTANCE: 0.1Ω.

BURDEN VOLTAGE: 1A <0.5Vrms, 3A <1.5Vrms. Add 1.5Vrms when used with plug in modules.

INPUT PROTECTION: 3A, 250V fuse.

**FREQUENCY AND PERIOD**

MEASUREMENT METHOD: Reciprocal counting technique.

GATE TIME: SLOW 1s, MED 100ms, and FAST 10ms.

**AC GENERAL**

AC CMRR: 70dB.

VOLT HERTZ PRODUCE: <= 8 × 10⁻⁶.

## AC MEASUREMENT SPEEDS

Single Channel, 60Hz (50Hz) Operation

<table>
<thead>
<tr>
<th>Function</th>
<th>Digits</th>
<th>Readings/s</th>
<th>Rate</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACV, ACI</td>
<td>6.5</td>
<td>2x/s</td>
<td>SLOW</td>
<td>5 Hz–300 kHz</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>4.8 (4)</td>
<td>MED</td>
<td>50 Hz–300 kHz</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>40 (52)</td>
<td>FAST</td>
<td>300 Hz–300 kHz</td>
</tr>
<tr>
<td>Frequency, Period</td>
<td>6.5</td>
<td>1 (1)</td>
<td>SLOW</td>
<td>5 Hz–300 kHz</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>9 (9)</td>
<td>MED</td>
<td>50 Hz–300 kHz</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>35 (55)</td>
<td>FAST</td>
<td>300 Hz–300 kHz</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>65 (65)</td>
<td>FAST</td>
<td>300 Hz–300 kHz</td>
</tr>
</tbody>
</table>

Multiple Channel

7710 SCANNING ACV: 500x.

7710 SCANNING ACV WITH AUTO DELAY ON: 2x/reading.

## AC SYSTEM SPEEDS

<table>
<thead>
<tr>
<th>Function</th>
<th>Rate</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>7200/7250</td>
<td>2701</td>
<td></td>
</tr>
<tr>
<td>AC System Speed:</td>
<td>(19.2k)</td>
<td>(115.2k)</td>
</tr>
<tr>
<td>Range Changes: 24</td>
<td>4x (5x)</td>
<td>4x (5x)</td>
</tr>
<tr>
<td>Function Changes:</td>
<td>4x (5x)</td>
<td>4x (5x)</td>
</tr>
<tr>
<td>Autorange Time:</td>
<td>&lt; 3s</td>
<td>&lt; 3s</td>
</tr>
<tr>
<td>ASCII Readings to RS-232: (19.2k baud)</td>
<td>50x</td>
<td>300x</td>
</tr>
<tr>
<td>Max. External Trigger Rate:</td>
<td>250x</td>
<td>2000x</td>
</tr>
</tbody>
</table>

## AC NOTES

1. 20% overrange except on 750V and 3A.
2. Specification are for SLOW mode and sine wave inputs >5% of range. SLOW and MED are multi-sample A/D conversions. FAST is DETector: BANDwidth 300 with nPLC = 1.0.
3. Applies to 0°–18°C and 28°–50°C.
4. 20% overrange except on 750V and 3A.
5. Applies to non-sine waves >5Hz.
6. For 1kΩ unbalance in LO lead.
7. SPEEDS are for 60Hz (50Hz) operation using factory defaults operating conditions (*RST). Autorange off, display off, limits off, trigger delay = 0.
8. For ACV inputs at frequencies of 50 or 60Hz (±10%), add the following to ‘% of Range’ uncertainty: 100mV 0.25%, 1V 0.05%, 10V 0.13%, 100V 0.03%, 750V 0.015 (Model 2701 only).
10. Sample count = 1024.
11. DETector: BANDwidth 300 with nPLC = 0.006 (2701 only).
12. Maximum useful limit with trigger delay = 175ms.
13. Includes measurement and binary data transfer out GPIB or ASCII data transfer for Ethernet and RS-232 (Reading Element only).
## General Specifications:

**Expansion Slots:** 2 (2700, 2701), 5 (2750).

**Power Supply:** 100V / 120V / 220V / 240V ±10%.

**Line Frequency:** 45Hz to 66Hz and 360Hz to 440Hz, automatically sensed at power-up.

**Power Consumption:** 28VA (2700), 80VA (2701, 2750).

**Operating Environment:** Specified for 0°C to 50°C. Specified to 80% RH at 35°C.

**Storage Environment:** –40°C to 70°C.

**Battery:** Lithium ion battery-backed memory, 5 years @ 24°C (Models 2700, 2750) Lithium ion battery-backed memory, 30 days of buffer storage @ 23°C and >4 hours charge time. Battery lifetime: >5 years @ 25°C, >1.5 years @ 50°C (Model 2701)

**Warranty:** 1 year, excludes battery.

**EMC:** Conforms to European Union Directive 89/336/EEC EN61326-1.

**Safety:** Conforms to European Union Directive 73/23/EEC EN61010-1, CAT I.

**Vibration:** MIL-PRF-28800F Class 3, Random.

**Warm-up:** 2 hours to rated accuracy.

**Dimensions:**
- **Rack Mounting:** 89mm high × 213mm wide (2700, 2701) or 485mm wide (2750) × 370mm deep (3.5 in × 8.375 in or 19 in × 14.563 in).
- **Bench Configuration (with handle and feet):** 104mm high × 238mm wide (2700, 2701) or 485mm wide (2750) × 370mm deep (4.125 in × 9.375 in (2700, 2701) or 19 in (2750) × 14.563 in)

**Shipping Weight:** 6.5kg (14 lbs.) (2700, 2701) or 13kg (28 lbs.) (2750).

**Digital I/O:** 2 inputs, 1 for triggering and 1 for hardware interlock.

- 5 outputs, 4 for Reading Limits and 1 for Master Limit. Outputs are TTL compatible or can sink 250mA, diode clamped to 40V

**Triggering and Memory:**
- **Window Filter Sensitivity:** 0.01%, 0.1%, 1%, 10%, or Full-scale of range (none).
- **Reading Hold Sensitivity:** 0.01%, 0.1%, 1%, or 10% of reading.
- **Trigger Delay:** 0 to 99 hrs (1ms step size).
- **External Trigger Delay:** <2ms (2700), <1ms (2701, 2750).
- **External Trigger Jitter:** <1ms (2700), <500µs (2701), <500µs (2750).
- **Memory Size:** 55,000 readings (2700), 450,000 readings (2701), 110,000 readings (2750).

**Math Functions:** Rel, Min/Max/Average/Std Dev/Peak-to-Peak (of stored reading), Limit Test, %, 1/x, and mX+b with user defined units displayed.

**Remote Interface:**
- **GPIB (IEEE-488.2) (2700, 2750) and RS-232C.
- **Ethernet TCP/IP (10bT and 100bT) (2701).
- **SCPI (Standard Commands for Programmable Instruments).**
- **LabVIEW Drivers.**

**Accessories Supplied:**
- **Model 1751 Safety Test Leads, Product Information CD-ROM.** (Model 2701 only: Getting Started Foldout, 3m Ethernet crossover cable, software CD-ROM with IVI/VISA drivers for VB, VC++, LabVIEW, TestPoint, and LabWindows/CVI, plus free runtime start-up software.)

**Accessories Available:**
- **4288-7 Rack Mount Rear Support Kit (2750)
- **77XX Modules.
- **Extended Warranty.
- **ExcelLINK1A (Excel add-in datalogger software).
- **TestPoint® Software Development Package.

**For Model 2701:**
- **Ethernet:** RJ-45 connector, TCP/IP, 10bT and 100bT autosensed.
- **IP Configuration:** Static or DHCP.
- **Password Protection:** 11 Characters.
- **Software:** Windows 98, NT, 2000, ME, and XP compatible. Internet Explorer 5.0 or higher required. Web page server by 2701.
Integra Series

Multimeter/Switch Systems

7700 20-CHANNEL DIFFERENTIAL MULTIPLEXER W/AUTOMATIC CJC

FEATURES
- 20 channels for general-purpose measurements, plus two channels to measure current.
- 2- or 4-wire measurement.
- Oversize screw terminal connection blocks are standard for easier connections.
- Automatic CJC sensors on the scanner card mean there are no other accessories required to make thermocouple temperature measurements.
- Configurable as two independent banks of multiplexers.
- 500V, 1A capacity for voltage channels; 60W, 125VA.
- 3A capacity for current channels.
- Relay closures stored in onboard memory.

GENERAL
20 CHANNELS: 20 channels of 2-pole relay input. All channels configurable to 4-pole.
2 CHANNELS: 2 channels of current only input.
RELAY TYPE: Latching electromechanical.
ACTUATION TIME: <3ms
FIRMWARE: Specified for Model 2700 rev. A01, 2701 rev. A01, and 2750 rev. A01 or higher.

CAPABILITIES
CHANNELS 1-20: Multiplex one of 20 2-pole or one of 10 4-pole signals into DMM.
CHANNELS 21-22: Multiplex one of 2 2-pole current signals into DMM.

INPUTS
MAXIMUM SIGNAL LEVEL:
Channels (1-20): 300V DC or 300V rms (425V peak) for AC waveforms, 1A switched, 60W, 125VA maximum.
Channels (21-22): 60V DC or 30V rms, 3A switched, 60W, 125VA maximum.
CONTACT LIFE (typ.): >10³ operations at max signal level.
CONTACT RESISTANCE: <500mV typical per contact, 1µV max.
OFFSET CURRENT: <100µA.
CONNECTOR TYPE: Screw terminal, #20 AWG wire size.
ISOLATION BETWEEN ANY TWO TERMINALS: >10¹⁰Ω, <100pF.
ISOLATION BETWEEN ANY TERMINAL AND EARTH: >10⁹Ω, <200pF.
INSERTION LOSS (50Ω Source, 50Ω Load):
- Internal DMM: <0.1 dB, 1 MHz; 3 dB, 50 MHz
- w/o Internal DMM:
  - 1 MHz: <0.1 dB
  - 2 MHz: <3 dB
  - 50 MHz: <25 dB
CROSSTALK (50Ω Load):
- Internal DMM: <40 dB, <40 dB, <40 dB
- w/o Internal DMM:
  - 10 MHz: <25 dB
  - 25 MHz: ** Not valid
COMMON MODE VOLTAGE: 300V or 300V rms (425V peak) for AC waveforms between any terminal and chassis.
TEMPERATURE ACCURACY USING INTERNAL CJC: 1.0°C (see mainframe specification for details).
* Channels 24 and 25 are open. Refer to ROUTe:MULTiple command in 27XX User Manual.
** Not valid.

ENVIRONMENTAL:
OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
SPECIFIED: 80% R.H. at 35°C.
STORAGE ENVIRONMENT: –25°C to 65°C.
WEIGHT: 0.45kg (1 lb).
ACCESSORY AVAILABLE: Model 7401 Type K Thermocouple Wire, 30.5m (100 ft).

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**7701 LOW-VOLTAGE 32-CHANNEL DIFFERENTIAL MULTIPLEXER**

**FEATURES**
- Configurable for 32 channels of differential measurements, with up to 16 channels of 4-pole measurements.
- Configurable for 32 channels of common-side 4-wire ohms.
- Configurable as two independent banks of multiplexers.
- Two female D-shell connectors are standard for secure hook-up and quick teardown.
- 150V, 1A capacity for voltage channels; 60W, 125VA.
- Two mating IDC connectors for ribbon cable are supplied.
- Relay closures stored in on-board memory.
- Screw terminal jumpers allow user-configurable DMM connections.

**GENERAL**
- **32 CHANNELS:** 32 channels of 2-pole relay input. All channels configurable to 4-pole.
- **RELAY TYPE:** Latching electromechanical.
- **ACTUATION TIME:** <3ms.
- **FIRMWARE:** Specified for Model 2700 rev B03, Model 2701 rev A01, and Model 2750 rev A01 or higher.
- **DMM CONNECTIONS:** Screw terminals provide internal DMM connections to channels 34 and 35 and connections to external wiring access.

**CAPABILITIES**
- **CHANNELS 1–32:** Multiplex one of 32 2-pole or one of 16 4-pole signals into DMM. Configuration supports dual 1×16 independent multiplexers.

**INPUTS**
- **MAXIMUM SIGNAL LEVEL:** Any channel to Any Channel (1–32): 150V DC or 150Vrms (212V peak) for AC waveforms, 1A switched, 60W, 125VA maximum.
- **SAFETY:** Conforms to European Union Directive 73/23/EEC EN61010-1, CAT I.
- **CONTACT LIFE (typ):** >10^6 operations at max signal level
- **CONTACT RESISTANCE:** <1Ω any path and additional 1Ω at end of contact life.
- **CONTACT POTENTIAL:** <6µV per contact pair.
- **OFFSET CURRENT:** <100µA.
- **CONNECTOR TYPE:** 50-pin female D-shell, Channels 1–24.
- **ISOLATION BETWEEN ANY TWO TERMINALS:** >10^9Ω, <200pF.
- **ISOLATION BETWEEN ANY TERMINAL AND EARTH:** >10^9Ω, <200pF.
- **CROSS TALK (50Ω Source, 50Ω Load):** <–35dB.
- **INSERTION LOSS (50Ω Source, 50Ω Load):** <0.35dB below 1MHz.
- **COMMON MODE VOLTAGE:** 300VDC or 300Vrms (425V peak) for AC waveforms between any terminal and chassis.

**ENVIRONMENTAL**
- **OPERATING ENVIRONMENT:** Specified for 0°C to 50°C.
- **STORAGE ENVIRONMENT:** –25°C to 65°C.
- **WEIGHT:** <0.52kg (1.16 lb).

**ACCESSORIES AVAILABLE:**
- Model 7789 50/25 Pin Male D-Shell Solder Cup Connectors
- Model 7790 50/50/25 Pin Female/Male D-Shell IDC Connectors
- Model 7705-MTC-2 50 Pin Male to Female DSUB Cable, 2m (6.6 ft)
- Model 7707-MTC-2 25 Pin Male to Female DSUB Cable, 2m (6.6 ft)

See page 43 for common-side 4-wire ohms configuration example.
### Model 7702 Specifications

#### Integra Series Multimeter/Switch Systems

**7702 40-CHANNEL DIFFERENTIAL MULTIPLEXER**

**Features**
- There are 40 channels for general-purpose measurement, plus 2 channels to measure current.
- 2- or 4-wire measurement.
- Oversize screw terminal connection blocks are standard for easier connection.
- Configurable as two independent banks of multiplexers.
- 300V, 1A capacity for voltage channels; 60W, 125VA.
- 3A capacity for current channels.
- Relay closures stored in on-board memory.

**General**
- 40 channels of 2-pole relay input.
- All channels configurable to 4-pole.
- 2 channels of current only input.
- RELAY TYPE: Latching electromechanical.
- ACTUATION TIME: <3ms.
- FIRMWARE: Specified for Model 2700 rev. A01, 2701 rev. A01, and 2750 rev. A01 or higher.

**Capabilities**
- Channels 1-40: Multiplex one of 40 2-pole or one of 20 4-pole signals into DMM.
- Channels 41-42: Multiplex one of 2 2-pole current signals into DMM.

**Inputs**
- Maximum Signal Level:
  - Channels (1-40): 300V DC or rms, 1A switched, 60W, 125VA maximum.
  - Channels (41-42): 60V DC or 30V rms, 3A switched, 60W, 125VA maximum.
- Contact Life: >10^6 operations at max signal level.
- >10^6 operations cold switching.
- CONTACT RESISTANCE: <1Ω at end of contact life.
- CONTACT POTENTIAL: ±500mV typical per contact, |IaV| max.
  - ±500mV typical per contact pair, |IaV| max.
- OFFSET CURRENT: <100pA.
- CONNECTOR TYPE: Screw terminal, #20 AWG wire size.
- CROSS TALK (10MHz, 50Ω Load): <–40dB.
- INSERTION LOSS (50Ω Source, 50Ω Load): <0.1dB below 1MHz.
  - <3dB below 2MHz.
- COMMON MODE VOLTAGE: 300V between any terminal and chassis.

**Environmental**
- OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
  - Specified to 80% R.H. at 35°C.
- STORAGE ENVIRONMENT: –25°C to 65°C.
- WEIGHT: 0.5kg (1.1 lb).

**Diagram**

For more information, refer to the ROUTe:MULTiple command section in the Model 2700, 2701, or 2750 User’s Manual.

Channels 44 and 45 can be individually controlled using ROUTe:MULTiple if the module is not to be connected to the internal DMM.
Integra Series

Modules

7703 32-CHANNEL HIGH SPEED DIFFERENTIAL MULTIPLEXER

FEATURES

• There are 32 channels for general purpose measurement.
• Relay actuation time of less than 1ms for highspeed scanning.
• 2 or 4 wire measurement.
• Two 50-pin female “D-sub” connectors are standard for secure hook-up and quick teardown.
• Configurable as two independent banks of multiplexers.
• Reed relay base design with 300 volt, 500mA, 10VA.
• Two mating connector with solder cup (Model 7788) are supplied.
• Relay closures stored in onboard memory.

GENERAL

32 CHANNELS: 32 channels of 2-pole relay input.
All channels configurable to 4-pole.
RELAY TYPE: Reed.
ACTUATION TIME: <1ms.
FIRMWARE: Specified for Model 2700 rev. A01, 2701 rev. A01, and 2750 rev. A01 or higher.

CAPABILITIES

CHANNELS 1-32: Multiplex one of 32 2-pole or one of 16 4-pole signals into DMM.

INPUTS

MAXIMUM SIGNAL LEVEL:
Channels (1-32): 300V DC or rms, 0.5A switched, 10W maximum.
Contact Life (typ): >5x10^6 operations at max signal level.
>10^6 operations cold switching.
CONTACT RESISTANCE: <=1Ω at end of contact life.
CONTACT POTENTIAL: <=±3µV typical per contact, 6µV max.
<=±3µV typical per contact pair, 6µV max.
OFFSET CURRENT: <=100pA.
CONNECTOR TYPE: 50 pin D-sub x2.
RELAY DRIVE CURRENT: 20mA per channel.
ISOLATION BETWEEN ANY TWO TERMINALS: >10^9Ω, <200pF.
ISOLATION BETWEEN ANY TERMINAL AND EARTH: >10^9Ω, <200pF.
CROSS TALK (1 MHz, 50Ω Load): <=–40dB.
INSERTION LOSS (50Ω Source, 50Ω Load): <=35dB below 1MHz.
<=3dB below 2MHz.
COMMON MODE VOLTAGE: 300V between any terminal and chassis.

ENVIRONMENTAL

OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
Specified to 80% R.H. at 35°C.
STORAGE ENVIRONMENT: –25°C to 65°C.
WEIGHT: 0.8kg (1.75 lbs).
ACCESSORIES AVAILABLE:
Model 7705-MTC-2 50 Pin Male to Female DSUB Cable, 2m (6.6 ft).

For more information, refer to the ROUTEMULT command section in the Model 2700, 2701, or 2750 User’s Manual.
Integra Series

7705 40-CHANNEL CONTROL MODULE

FEATURES
- 40 channels designed for controlling power to the DUT, switching loads, controlling light indicators and relays, etc.
- Two 50-pin female “D-sub” connectors are standard for secure hook-up and quick teardown.
- 500V, 2A capacity.
- Two mating connectors with solder cup pins (Model 7788) are supplied.
- Relay closures stored in on-board memory.

GENERAL
RELAY SWITCH CONFIGURATION: 40 independent channels of 1-pole switching. Isolated from internal DMM.
CONTACT CONFIGURATION: 1 pole Form A
RELAY TYPE: Latching electromechanical.
CONNECTOR TYPE: Two 50-pin female D-sub connectors.
FIRMWARE: Specified for Model 2700 rev. A01, 2701 rev. A01, and 2750 rev. A01 or higher.

INPUTS
MAXIMUM SIGNAL LEVEL: 300VDC or rms, 2A switched, 60W (DC, resistive), 125VA (AC, resistive).
CONTACT LIFE: Cold Switching: 10^6 closures
At Maximum Signal Levels: 10^5 closures.
CHANNEL RESISTANCE (per conductor): <1Ω.
CONTACT POTENTIAL: ≤4µV per contact.
OFFSET CURRENT: <100pA.
ACTUATION TIME: 3ms.
ISOLATION: Channel to Channel: >10^9Ω, <50pF
Common Mode: >10^9Ω, <50pF.
CROSSTALK (1MHz, 50Ω load): <–35dB.
INSERTION LOSS (50Ω source, 50Ω load): <0.3dB below 1MHz, <3dB below 10MHz.
COMMON MODE VOLTAGE: 300V between any terminal and chassis.

ENVIRONMENTAL
OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
Specified to 80% R.H. at 35°C.
STORAGE ENVIRONMENT: –25°C to 65°C.
WEIGHT: 0.45kg (1 lb).
ACCESSORIES AVAILABLE:
Model 7705-MTC-2: 50 Pin Male to Female DSUB Cable, 2m (6.6 ft).
Integra Series Modules

7706 ALL-IN-ONE I/O MODULE

FEATURES

• 20 channels of analog input (w/automatic CJC) for general-purpose measurement.
• 16 channels of digital output.
• Event counter/totalizer can monitor and control system components, such as
  featuring limit switches, pass/fail indicators, external voltage sources, loads, door
  closures, revolutions, etc., while performing mixed signal measurement.
• 300V, 1A capacity, 60W, 125VA maximum.
• Configurable as two independent banks of multiplexers.
• Two analog outputs (±12V, 5mA).
• Relay closures stored in on-board memory.

GENERAL

20 CHANNELS: 20 channels of 2-pole relay input.
All channels configurable to 4-pole.
RELAY TYPE: Latching electromechanical.
ACTUATION TIME: <3ms.
FIRMWARE: Specified for Model 2700 rev. A02 or B01, 2701 rev. A01, and 2750 rev.
A01 or higher.

CAPABILITIES

CHANNELS 1–20: Multiplex one of 20 2-pole or one of 10 4-pole signals into DMM.
CHANNELS 21–25 are referenced to chassis ground.
CHANNELS 23–24: Analog Voltage Output (2).
CHANNELS 25: Totalize Input.

INPUTS

MAXIMUM SIGNAL LEVEL (Channels 1–20): 300V DC or rms, 1A switched, 60W, 125VA maximum.
CONTACT LIFE (typ.): >10^6 operations at max. signal level: >10^8 operations cold switching.
CONTACT RESISTANCE: <1Ω at end of contact life.
CONTACT POTENTIAL: <2μV typical per contact, 3μV max.
OFFSET CURRENT: <100pA.
CONNECTOR TYPE: Screw terminal, #20 AWG wire size.
ISOLATION BETWEEN ANY TWO TERMINALS: >10^12Ω, <100pF.
ISOLATION BETWEEN ANY TERMINAL AND EARTH: >10^12Ω, <200pF.
COMMON MODE VOLTAGE: 300V between any terminal and chassis.
TEMPERATURE ACCURACY USING INTERNAL CJC: 1.0°C (see mainframe specification for details).

TOTALIZE INPUT

MAXIMUM COUNT: 2^31–1.
TOTALIZE INPUT: 100kΩ (max), rising or falling edge, programmable.
SIGNAL LEVEL: 1Vp-p (min), 429Vpk (max).
THRESHOLD: 0V or TTL jumper selectable.
DATE INPUT: TTL-Hi, TTL-Lo, or none.
COUNT RESET: manual or Read+Reset.
READ SPEED: 50/s.

ANALOG VOLTAGE OUTPUT

DAC 1, 2: ±12V in 1mV increments, non-isolated.
RESOLUTION: 1mV
IOUT: 5mA max.
SETTLING TIME: 1ms to 0.01% of output.
ACCURACY ±(of output + mV):
1 year ±5°C: 0.15% + 19mV;
90 day ±5°C: 0.1% + 19mV;
24 hour ±1°C: 0.04% + 19mV.
TEMPERATURE COEFFICIENT:
±0.015% + 1mV/°C.

DIGITAL OUTPUT

VOUT(L): <0.8V @ Iout = 400mA
VOUT(H): >2.4V @ Iout = 1mA.
VOUT(MAX): <42V with external open drain pull-up.
WRITE SPEED: 50/s.

ENVIRONMENTAL

OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
Specified to 80% R.H. at 35°C.
STORAGE ENVIRONMENT: –25°C to 65°C.
WEIGHT: 0.5kg (1.1 lbs).

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Modules

7707 MULTIPLEXER-DIGITAL I/O MODULE

GENERAL
10 CHANNELS: 10 channels of 2-pole relay input.
All channels configurable to 4-pole.
RELAY TYPE: Latching electromechanical.
ACTUATION TIME: <3ms.
FIRMWARE: Specified for Model 2700 rev. B03, 2701 rev. A01, and 2750 rev. A01 or higher.
CAPACITY: Model 2700: (1) 7707 and (1) 77X7, except 7706.
   Model 2701: Any combination of 77XX modules.
   Model 2750: <4> 7707 and (1) 77XX, except 7706. A 7706 module may be substituted for a 7707 module.

CAPABILITIES
CHANNELS 1–10: Multiplex one of 10 2-pole or one of 5 4-pole signals into DMM.
CHANNELS 11–14: 32 Digital Inputs/Outputs referenced to chassis ground.
THERMAL PROTECTION: Channels 11–14 are thermally protected to 1A.

INPUTS (CHANNELS 1–10)
MAXIMUM SIGNAL LEVEL: Any Channel to Any Channel (1–10): 300VDC, or 300Vrms (425V peak) for AC waveforms, 1A switched, 60W, 125VA maximum.
CONTACT LIFE (typical): >10^6 operations at max. signal level: >10^9 operations cold switching.
CONTACT RESISTANCE: <1Ω any path and additional 1Ω at end of contact life.
CONTACT POTENTIAL: <4μV typical per contact pair and additional 3μV with Channels 11–14 at rate VN(d).(3).
OFFSET CURRENT: <100μA.
CONNECTOR TYPE: 50-pin male D-shell, Channels 11–14.
   25-pin female D-shell, Channels 1–10.
   Supplied with female and male IDC ribbon cable connectors.
ISOLATION BETWEEN ANY TWO TERMINALS: >10^12, <100pF with isolation channels 16 and 17 open.
ISOLATION BETWEEN ANY TERMINAL AND EARTH: >10^12, <200pF.
CROSS TALK (10MHz, 50Ω Load): <−35dB.
INSERTION LOSS (50Ω Source, 50Ω Load): <0.1dB below 1MHz.
<3dB below 2MHz.
COMMON MODE VOLTAGE: 300VDC or 300Vrms (425V peak) for AC waveforms between any terminal and chassis.

DIGITAL INPUT/OUTPUT (CHANNELS 11–14)
VIN(L): <0.8V (TTL).
VIN(H): >2V (TTL).
VOUT(L): <1.0V @ IOUT = 100mA.
VOUT(H): >2.4V @ IOUT = 1mA.
VOUT(H)MAX: <40V with external open drain pull-up.
READ/WRITE SPEED: 500ns.

ENVIRONMENTAL
OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
   Specified to 50% R.H. at 55°C.
STORAGE ENVIRONMENT: −25°C to 65°C.
WEIGHT: <0.5kg (1.1 lbs).
ACCESSORIES AVAILABLE:
Model 7790: 50/50/25 Pin Female/Male D-Shell IDC Connectors.
Model 7705-MTC-2: 50 Pin Female to DSUB Cable, 2m (6.6 ft).
Model 7707-MTC-2: 25 Pin Male to Female DSUB Cable, 2m (6.6 ft).

FEATURES
- 10 channels of analog input for general-purpose measurement.
- 32 channels of digital input and output (four 8-bit ports) for I/O control.
- 300V 1A capacity; 60W, 125VA maximum (analog).
- Configurable as two independent banks of multiplexers.
- 33V 100mA capacity (digital).
- Two mating IDC connectors supplied.
- Digital outputs are short circuit protected.
- Relay closures stored in on-board memory.

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**Integra Series**

**Multimeter/Switch Systems**

**7708 40-CHANNEL DIFFERENTIAL MULTIPLEXER MODULE**

**FEATURES**

- 40 differential channels for general-purpose measurements.
- 2- or 4-wire measurements.
- Oversize screw terminal connection blocks are standard for easier connection.
- 300V, 1A capacity for voltage channels; 60W, 125VA.
- Configurable as two independent banks of multiplexers.
- Built-in CJC sensors automatically linearize thermocouples.
- Relay closures stored in on-board memory.

**GENERAL**

40 CHANNELS: 40 channels of 2-pole relay input. All channels configurable to 4-pole.

RELAY TYPE: Latching electromechanical.

ACTUATION TIME: <5ms.

FIRMWARE: Specified for Model 2700 rev. B02, 2701 rev. A01, and 2750 rev. A01 or higher.

**CAPABILITIES**

CHANNELS 1–40: Multiplex one of 40 2-pole or one of 20 4-pole signals into DMM.

**INPUTS**

MAXIMUM SIGNAL LEVEL:

Channels (1–40): 300V DC or rms, 1A switched, 60W, 125VA maximum.

CONTACT LIFE (typ): >10^6 operations at max. signal level.

CONTACT RESISTANCE: <112Ω at end of contact life.

CONTACT POTENTIAL: ≤±500mV typical per contact, ≤±500mV typical per contact pair, ≤±1µV max.

OFFSET CURRENT: <100pA.

CONNECTOR TYPE: Screw terminal, #20 AWG wire size.

ISOLATION BETWEEN ANY TWO TERMINALS: >10^12Ω, <100pF.

ISOLATION BETWEEN ANY TERMINAL AND EARTH: >10^12Ω, <100pF.

CROSS TALK (10MHz, 50Ω Load): <–40dB.

INSERTION LOSS (50Ω Source, 50Ω Load): <1dB below 1MHz.

<3dB below 2MHz.

COMMON MODE VOLTAGE: 300V between any terminal and chassis.

TEMPERATURE ACCURACY USING INTERNAL CJC: 1.0°C (see mainframe specification for details).

**ENVIRONMENTAL:**

OPERATING ENVIRONMENT: Specified for 0°C to 50°C.

STORAGE ENVIRONMENT: –25°C to 65°C.

WEIGHT: 0.52kg (1.16 lb).

ACCESSORIES AVAILABLE:

Model 7401 Type K Thermocouple Wire, 30.5m (100 ft).

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**NOTE**

Channels 43–46 in this schematic refer to the designations used for control and not actual available channels.

For more information, refer to the ROUTe:MULTiple command section in the Model 2700, 2710, or 2750 User’s Manual.
**Integra Series Modules**

**7709 6×8 MATRIX MODULE**

**FEATURES**
- Automatic 2- or 4-wire connection to DMM
- 6 row × 8 column matrix
- Two female “D-sub” connectors are standard for secure hook-up and quick teardown.
- 500 V/1 A capacity.
- Two mating IDC connectors for ribbon cable are supplied.
- Relay closures stored in onboard memory.

**GENERAL**
- **MATRIX CONFIGURATION**: 6 rows × 8 columns.
- **CONTACT CONFIGURATION**: 2 pole Form A.
- **FIRMWARE**: Specified for Model 2700 rev. B03, Model 2701 rev. A01, and Model 2750 rev. A01 or higher.
- **RELAY TYPE**: Latching electromechanical.
- **ACTUATION TIME**: <3 ms.

**CAPABILITIES**

**DMM CONNECTION:**
- **2-Wire Functions**
  - Row 1, channels 1–8, through channel 50.
- **4-Wire Functions**
  - Row 1, channels 1–4 (Source) through channel 50 and Row 2, channels 13–16 (Sense), through channel 49.

**CLOSE CHANNEL**: CLOSE command connects channels 1–8 to DMM. For 4-wire, channels 1–4 are automatically paired with channels 13–16. ROUTe:MULTiple allows any combination of rows and columns to be connected at the same time.

**INPUTS**
- **MAXIMUM SIGNAL LEVEL**: Any Channel to Any Channel (1–48): 300 VDC or 300 Vrms (425 V peak) for AC waveforms, 1 A switched, 60% 125% maximum.
- **CONTACT LIFE (typ)**: >105 operations at max signal level.
- **>106 operations cold switching**.
- **CONTACT RESISTANCE**: <1 Ω per contact pair.
- **OFFSET CURRENT**: <100 pA.
- **CONNECTOR TYPE**: 50-pin female D-shell for rows and columns, 25-pin female D-shell for “daisy-chain” rows.
- **ISOLATION BETWEEN ANY TWO TERMINALS**: >10 MΩ, <200 pF
- **ISOLATION BETWEEN ANY TERMINAL AND EARTH**: >10 MΩ, <400 pF
- **CROSS TALK (1 MHz, 50 Ω Load)**: <-35 dB
- **INSERTION LOSS (50 Ω Source, 50 Ω Load)**: <3 dB below 1 MHz.
- **COMMON MODE VOLTAGE**: 300 VDC or 300 Vrms (425 V peak) for AC waveforms between any terminal and chassis.

**ENVIRONMENTAL**
- **OPERATING ENVIRONMENT**: Specified for 0°C to 50°C.
- **STORAGE ENVIRONMENT**: –25°C to 65°C.
- **WEIGHT**: <0.52 kg (1.16 lb).
- **ACCESSORIES AVAILABLE**:
  - Model 7789: 50/25 Pin Male D-Shell Solder Cup Connectors
  - Model 7790: 50/50/25 Pin Female/Male D-Shell IDC Connectors
  - Model 7705-MTC-2: 50 Pin Male to Female D-SUB Cable, 2 m (6.6 ft).
  - Model 7707-MTC-2: 25 Pin Male to Female D-SUB Cable, 2 m (6.6 ft).
**7710 20-CHANNEL SOLID STATE/LONG-LIFE DIFFERENTIAL MULTIPLEXER W/AUTOMATIC CJC**

**FEATURES**
- Solid-state relays for long life and low maintenance (100 times longer life than mechanical relays)
- Higher scanning speeds of up to 500 channels per second
- Automatic CJC with no extra accessories required for thermocouple measurements
- Removable screw terminals offer simple, quick connections
- 20 channels for general purpose measurements
- Configurable as two independent banks of multiplexers

**GENERAL**
- **CHANNELS:** 20 channels of 2-pole relay input. All channels configurable to 4-pole.
- **RELAY TYPE:** Solid State Opto-Coupled FET
- **ACTUATION TIME:** <0.5ms (100mA load).
- **FIRMWARE:** Specified for Model 2700 Rev. B05, Model 2750 Rev. A04, and Model 2701 Rev. A01.

**CAPABILITIES**
- **CHANNELS 1–20:** Multiplex one of 20 2-pole or one of 10 4-pole signals into DMM.

**INPUTS**
- **MAXIMUM SIGNAL LEVEL:** Any channel to any channel (1–20): 60VDC or 42V rms, 100mA switched, 6W 4.2VA maximum.
- **COMMON MODE VOLTAGE:** 300VDC or 300V rms (42V peak) maximum between any terminal and chassis.
- **RELAY LIFE (TYP):** >10⁶ operational hours max. signal level or 10¹⁰ operations (guaranteed by design).
- **RELAY DRIVE CURRENT:** 6mA per channel continuous, 25mA during initial pulse.
- **CHANNEL RESISTANCE:** <5Ω.
- **CONTACT POTENTIAL:** <4μV per pair.
- **OFFSET CURRENT:** <5μA @ 23°C (per channel), additional 0.15μA/°C >23°C.
- **CONNECTOR TYPE:** 3.5mm removable screw terminals, #20 AWG wire size.
- **ISOLATION BETWEEN ANY TWO TERMINALS:** >10⁹ 100pF.
- **ISOLATION BETWEEN ANY TERMINAL AND EARTH:** >10⁹ 100pF.
- **RELAY DRIVE CURRENT:** 6mA per channel continuous, 25mA during initial pulse.
- **CONTACT POTENTIAL:** <4μV per pair.
- **OFFSET CURRENT:** <5μA @ 23°C (per channel), additional 0.15μA/°C >23°C.
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- **RELAY DRIVE CURRENT:** 6mA per channel continuous, 25mA during initial pulse.
- **CONTACT POTENTIAL:** <4μV per pair.
- **OFFSET CURRENT:** <5μA @ 23°C (per channel), additional 0.15μA/°C >23°C.

**ENVIRONMENTAL**
- **OPERATING ENVIRONMENT:** Specified for 0°C to 50°C. Specified for 80% R.H. at 35°C.
- **STORAGE ENVIRONMENT:** -25° to 65°C.
- **WEIGHT:** 0.45kg (1 lb).
- **ACCESSORIES AVAILABLE:** Model 7401 Type K Thermocouple Wire, 30.5m (100 ft).

---

**Outputs**
- **To Mainframe Backplane**
- **CARD SOURCE**
- **CARD SENSE**
- **Cold Junction Ref 3x**
- **CHANNEL 1**
- **CHANNEL 2**
- **CHANNEL 3**
- **CHANNEL 4**
- **CHANNEL 5**
- **CHANNEL 6**
- **CHANNEL 7**
- **CHANNEL 8**
- **CHANNEL 9**
- **CHANNEL 10**
- **CHANNEL 11**
- **CHANNEL 12**
- **CHANNEL 13**
- **CHANNEL 14**
- **CHANNEL 15**
- **CHANNEL 16**
- **CHANNEL 17**
- **CHANNEL 18**
- **CHANNEL 19**
- **CHANNEL 20**
- **CHANNEL 21**
- **CHANNEL 22**
- **CHANNEL 23**
- **4-Pole (opened)**
- **2-Pole (closed)**

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Integra Series Modules

7711 2GHz 50Ω RF MODULE

FEATURES
- Outstanding signal routing performance to 2GHz
- Dual 1x4 configuration
- Rear panel connections
- On-board switch closure counter
- On-board 5-parameter storage
- Switch up to 60VDC

AC PERFORMANCE (End of Life)
For $Z_{load} = Z_{source} = 50Ω$

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>&lt;100 MHz</th>
<th>500 MHz</th>
<th>1 GHz</th>
<th>1.5 GHz</th>
<th>2 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>&lt;0.4 dB</td>
<td>&lt;0.6 dB</td>
<td>&lt;1.0 dB</td>
<td>&lt;1.2 dB</td>
<td>&lt;2.0 dB</td>
</tr>
<tr>
<td>VSWR Max.</td>
<td>&lt;1.1</td>
<td>&lt;1.2</td>
<td>&lt;1.2</td>
<td>&lt;1.3</td>
<td>&lt;1.7</td>
</tr>
</tbody>
</table>

Ch-Ch Crosstalk1: -85 dB, -65 dB, -55 dB, -45 dB, -35 dB

1 Specification assumes 50Ω termination.
2 Add 0.1VSWR after 5×10^5 closures (no load).

INPUTS (CHANNELS 1-8)
MAXIMUM SIGNAL LEVEL: Any channel to any channel or chassis (1–8): 30Vrms (42V peak for AC waveforms) or 60VDC, 0.5A.
MAXIMUM POWER: 20W per module, 10W per channel (refer to 7711/7712 Manual PA818 for measurement considerations).
ISOLATION: Multiplexer to Multiplexer: >1GΩ
Center to Shield: >1GΩ, <25pF
Channel to Channel: >1GΩ.

CONTACT LIFE: 1×10^6 no load, 1×10^5 rated load (resistive load).
CONTACT POTENTIAL: <50V.
CONTACT RESISTANCE: <5Ω (initial), <1Ω (end of life).
RISE TIME: <300ps (guaranteed by design).
SIGNAL DELAY: <3ns.

GENERAL
RELAY TYPE: High frequency electromechanical.
CONTACT CONFIGURATION: Dual 1x4 multiplexer, single pole four throw, Channels 1 and 5 are normally closed.
NOTES: One channel in each multiplex bank is always closed to the corresponding OUT connector.
CLOSE CHANNEL: ROUTe:CLOSE allows a single channel in a multiplex bank to be closed. ROUTe:_MULTIPLE:CLOSE allows two channels (one in each bank) to be closed at one time.
OPEN CHANNEL: ROUTe:OPEN:ALL closes CH1 and CH5 to OUT A and OUT B respectively.
ACTUATION TIME: <10ms.
FIRMWARE: Specified for Model 2700 rev B04, 2701 rev A01, and 2750 rev A03 or higher.
CONNECTOR TYPE: Ten external rear panel SMA connectors.
MATING TORQUE: 0.9 N m (8 in-lb).

ENVIRONMENTAL
OPERATING ENVIRONMENT: Specified for 0°C to 50°C. Specified for 80% RH at 35°C.
STORAGE ENVIRONMENT: -25°C to 65°C.
WEIGHT: <0.5kg (1.1 lb).

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Integra Series Modules

Multimeter/Switch Systems

7712 3.5GHz 50Ω RF Module

Features
- 3.5GHz bandwidth
- Dual 1×4 configuration
- Rear panel SMA connections
- On-board switch closure counter
- On-board S-parameter storage

AC Performance (End of Life)
For \( Z_{\text{load}} = Z_{\text{source}} = 50\,\Omega \)

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>0.5GHz</th>
<th>1.0GHz</th>
<th>2.4GHz</th>
<th>3.5GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>&lt;0.5 dB</td>
<td>&lt;0.65 dB</td>
<td>&lt;1.1 dB</td>
<td>&lt;1.3 dB</td>
</tr>
<tr>
<td>VSWR MAX</td>
<td>&lt;1.15</td>
<td>&lt;1.2</td>
<td>&lt;1.45</td>
<td>&lt;1.45</td>
</tr>
<tr>
<td>Ch-Ch Crosstalk</td>
<td>&lt;75 dB</td>
<td>&lt;75 dB</td>
<td>&lt;75 dB</td>
<td>&lt;75 dB</td>
</tr>
</tbody>
</table>

1 Specification assumes 50Ω termination.
2 Add 0.1VSWR after 5×10⁶ closures (no load).

Inputs (Channels 1-8)
- Maximum Signal Level: Any channel to any channel or chassis (1–8): 50Vrms
- Maximum Power: 20W per module, 10W per channel (refer to 7711/7712 Manual PA-818 for measurement considerations).
- Isolation: Multiplexer to Multiplexer: >1GΩ.
- Center to Shield: >1GΩ, <20pF.
- Contact to Channel: >100MΩ.
- Contact Life: 5×10⁶ no load, 1×10⁵ rated load (resistive load).
- Contact Potential: <12µV.
- Contact Resistance: <5Ω (initial), <1Ω (end of life).
- Rise Time: <200ps (guaranteed by design).
- Signal Delay: <1.5ms.

General
- Relay Type: High frequency electromechanical.
- Contact Configuration: Dual 1×4 multiplexer, single pole four throw, Channels 1 and 5 are normally closed.
- Notes: One channel in each multiplex bank is always closed to the corresponding OUT connector.
- Close Channel: ROUTe>CLOSE allows a single channel in a multiplex bank to be closed. ROUTe>MULTiple>CLOSE allows two channels (one in each bank) to be closed at one time.
- Open Channel: ROUTe>OPEN:ALL closes CH1 and CH5 to OUT A and OUT B respectively.
- Actuation Time: <10ms.
- Firmware: Specified for Model 2700 rev B04, 2701 rev A01, and 2750 rev A03 or higher.
- Connector Type: Ten external rear panel SMA connectors.
- Mating Torque: 0.9 N m (8 in-lb).

Environmental
- Operating Environment: Specified for 0°C to 50°C. Specified for 80% RH at 35°C.
- Storage Environment: 0°C to 65°C.
- Weight: <0.5kg (1.1 lb).

Accessories Available
- 7712-SMA-1 SMA Cable, male to male, 1m (3.3 ft)
- 7712-SMA-N Female SMA to Male N-Type Adapter
- S46-SMA-0.5 SMA Cable, male to male, 0.15m (0.5 ft)
- S46-SMA-1 SMA Cable, male to male, 0.3m (1 ft)

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A GREATER MEASURE OF CONFIDENCE
**Integra Series**

**Multimeter/Switch Systems**

**Simple Computer to Single Instrument Control**

**Single Computer to Multiple Instruments**

**Multiple Computers to Multiple Instruments—Ethernet Only**

---

### System Configuration Examples

#### SW/iwitch/MEASURE SYSTEMS

<table>
<thead>
<tr>
<th>Interface</th>
<th>Maximum Distance</th>
<th>Maximum Speed</th>
<th>Cable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-232</td>
<td>~15 m†</td>
<td>115.2 kbps (2701)</td>
<td>Null modem cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19.2 kbps (2700, 2750)</td>
<td>Keithley Model 7009-5</td>
</tr>
<tr>
<td>GPIB</td>
<td>2 m</td>
<td>1 MB/s</td>
<td>Standard GPIB cable</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Hardwired: 100 m</td>
<td>100 Mb/s</td>
<td>Keithley Model 7007-*</td>
</tr>
<tr>
<td></td>
<td>Wireless: &gt;16 km</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

† RS-232 maximum distance is heavily dependent on the baud rate setting. Very slow baud rates can be operated at distances longer than 15m, while faster baud rates may require cables shorter than 15m.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Maximum No. of Instruments</th>
<th>Maximum Distance</th>
<th>Maximum Speed</th>
<th>Cable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIB</td>
<td>14 per controller</td>
<td>2m per cable</td>
<td>1 MB/s</td>
<td>Standard GPIB cable</td>
</tr>
<tr>
<td></td>
<td>20m per controller</td>
<td>100 Mb/s</td>
<td></td>
<td>Keithley Model 7007-*</td>
</tr>
<tr>
<td>Ethernet</td>
<td>∞</td>
<td>Hardwired: 100m</td>
<td>100 Mb/s</td>
<td>Standard RJ-45</td>
</tr>
<tr>
<td></td>
<td>Wireless: &gt;16 km</td>
<td>straight-through cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Call or visit www.keithley.com for Technical Note #2393, “Network Primer and Programming Tutorial for the Model 2701 Ethernet-Based DMM/Data Acquisition System.” This document explains the basic principles for using instruments over a network and programming methods for Ethernet.
Thermocouple Configuration Example Using Internal CJC

NOTE: The red lead is the LO signal on all thermocouples. This applies to U.S. standards.

Thermocouple Configuration Example Using External CJC

NOTE: If an RTD is connected as the cold junction reference, Channel 21 will be used for the sense leads of the RTD and is not available for connection of a thermocouple.

NOTE: The red lead is the LO signal on all thermocouples.

7708 Configuration Examples

Dual multiplexer mode example #1

See Model 7708 specifications.
Channel 43 ..... Closed
Channel 44 ..... Open
Channel 45 ..... Closed for DMM measure

NOTE: This configuration example can be duplicated with the 7700, 7701, 7702, 7703, 7706, 7707, and 7708 modules. See module specifications for their channel configurations.
7708 Configuration Examples (continued)

Using internal DMM and external instruments

See Model 7708 specifications.
Channel 43 ..... Open
Channel 44 ..... Open
Channel 45 ..... Closed

NOTE: This configuration example can be duplicated with the 7700, 7701, 7702, 7703, 7706, 7707, and 7708 modules. See module specifications for their channel configurations.

7705 Configuration Examples

Typical connections—indicator lamps, alarm, and relay

Model 7705

Indicator Lamp

Alarm

Relay

Equivalent Circuit

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7705 Configuration Examples (continued)

Variable AC line/load test connections

![Diagram of variable AC line/load test connections]

CAUTION: Maximum switch current is 2A.
Source is impedance limited from mains (Safety Category I signals).

Single Pole (Single Point Ground) Switching Example
Using the 7705 for independent switching and the 7701 to bring measurement of DUT to internal DMM of 2750

![Diagram of single pole (single point ground) switching example]

See Model 7701 specifications.
Channel 33 .....Closed
Channel 34 .....Closed
Channel 35 .....Closed
7705 independent switch and 7701 multiplexer example

7705

+ 48VDC
Input Power
-

DUT 1
DC to DC
Converter
Output

DUT 16
DC to DC
Converter
Output

7701

HI
LO

Ch. 1
Ch. 2
Ch. 31
Ch. 32
Ch. 33
Ch. 34
Ch. 35

Screw Terminals

Chs. 1–32
To Internal
DMM

Input
Power

See Model 7701 specifications.
Channel 33 ..... Closed
Channel 34 ..... Open
Channel 35 ..... Closed

DUT 1
DC to DC
Converter

DUT 16
DC to DC
Converter

... Ch. 16

Ch. 33
Ch. 34
Ch. 35

Screw Terminals

Output

Output

48VDC

48VDC

... Ch. 17

Ch. 31
Ch. 32

... Ch. 35

DUT 1
DC to DC
Converter

DUT 16
DC to DC
Converter

48VDC

48VDC
**Integra Series**

### Multimeter/Switch Systems

**Analog Output and Digital I/O Examples**

#### Typical digital output w/external power supply

![Diagram of typical digital output with external power supply]

**Digital Output**

The 7706 module has two non-isolated 8-bit output ports that can be used for outputting digital patterns. The two ports can be combined to output a single 16-bit word or a dual 8-bit byte. A simplified diagram of a single output bit is shown here.

The 7707 module has four non-isolated 8-bit input/output ports that can be used for outputting digital patterns. The two ports can be combined to output a 16-bit word, or dual or quad 8-bit bytes.

The 7707 can also be configured (in blocks of 8) as digital inputs.

#### Typical digital output (no external power supply)

![Diagram of typical digital output without external power supply]

**7706 analog output**

![Diagram of 7706 analog output]

**NOTE:** The 7706 module has two ±12V analog output channels.

- $V_{OUT}$ (16-bit resolution)
- $V_O$
- Output Common (non-isolated, instrument to chassis)

### System Configuration Examples

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Analog Output and Digital I/O Examples (continued)

Connecting the Model 7707 Digital I/O module to industry standard solid-state relays (SSRs) to switch high VA (up to 980VA).

**7707 Digital I/O**

- Dig. I/O Ch. 11: 1, 8
- Dig. I/O Ch. 12: 1, 8
- Dig. I/O Ch. 13: 1, 4, 5, 8 (Available)
- Dig. I/O Ch. 14: 1, 4, 5, 8 (Available)

**Industry Standard PB-24SM 24 SSR Baseboard**

- User Supplied Switch or Sense

**Output Relays:** SM-ODC5, SM-ODC5A, SM-OAC5, SM-OAC5A, SM-OAC5R

**Input Relays:** SM-IDC5, SM-IAC5A

CAUTION: Adequate insulation barriers must be used on PB-24SM and cable for systems with >42V.

**Matrix Configuration Example**

The 7709 Matrix Module can connect any combination of six differential channels of instrumentation to any combination of eight differential DUT channels. The instrumentation can be the Integra system's internal DMM or external equipment (AC and DC sources, internal or external meters, oscilloscopes, etc.) This matrix configuration allows wide flexibility for complex test systems.
7701 Configuration Example

*NOTE: Common side connections must be made carefully to eliminate all lead resistance from the 4-wire ohms measurement. The common side bus should be a single wire or bus bar that connects the HI side of all the DUTs. DMM Input HI should be connected to one end of the common side bus and DMM Sense HI should be connected to the other end.

**NOTE: Refer to ROUTE:MULT section of the 2700, 2701, or 2750 manual for more information.
Contact Information:

ASEAN / Australia (65) 6356 3900
Australia 00800 2255 4835

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777
Belgium 00800 2255 4835
Brazil +55 (11) 3759 7627
Canada 1 800 833 9200

Central East Europe and the Baltics +41 52 675 3777
Central Europe & Greece +41 52 675 3777

Denmark +45 80 88 1401
Finland +41 52 675 3777
France 00800 2255 4835

Germany 00800 2255 4835
Hong Kong 400 820 5835
India 000 800 650 1835
Italy 00800 2255 4835
Japan 81 (3) 6714 3010

Luxembourg +41 52 675 3777

Mexico, Central/South America & Caribbean 52 (55) 56 04 50 90
Middle East, Asia, and North Africa +41 52 675 3777

The Netherlands 00800 2255 4835

Norway 800 16098

People’s Republic of China 400 820 5835
Poland +41 52 675 3777
Portugal 80 08 12370
Republic of Korea 001 800 8255 2835

Russia & CIS +7 (495) 6647564

South Africa +41 52 675 3777
Spain 00800 2255 4835

Sweden 00800 2255 4835
Switzerland 00800 2255 4835
Taiwan 886 (2) 2656 6688

United Kingdom & Ireland 00800 2255 4835

USA 1 800 833 9200

Rev 0415

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