



Mini-Circuits

USB & ETHERNET

12-Port Mesh Network Emulator **ZTMN-1295A-N**

50Ω 30 to 2500 MHz Rack-Mount N-type Female

THE BIG DEAL

- 12 fully interconnected test ports
- Single rack-mountable chassis, 5U height
- 95 dB programmable attenuation per path
- Configure automated sweep / hop / fading sequences
- Ethernet & USB control

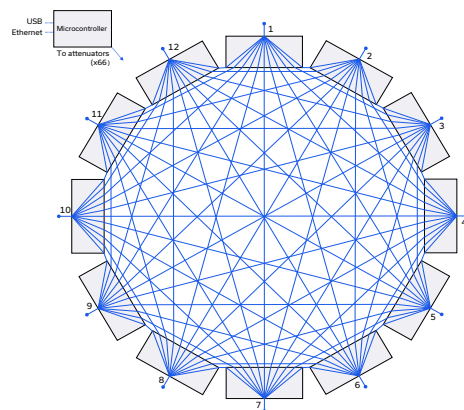


Generic photo used for illustration purposes only

APPLICATIONS

- Military VHF / UHF radio testing
- ISM band fire & security monitoring
- Production, R&D, qualification testing
- Test & measurement systems

FUNCTIONAL BLOCK DIAGRAM



66 internal paths with programmable attenuators on each path

PRODUCT OVERVIEW

Mini-Circuits' ZTMN series mesh network emulators are multi-port test systems with independently variable attenuation on each internal path. This concept allows simulation of a "real-world" mesh communication network within the confined space of a production environment. Path loss can be varied independently between any pair of devices on the network without affecting any other combination of devices, allowing simulation of a complex range of test cases.

ZTMN-1295A-N is a 12-port mesh covering the 30 MHz to 2.5 GHz bands, with 0 to 95 dB attenuation range on each of the internal paths. Mini-Circuits' novel design approach significantly shrinks the rack cabinet space required for a 12-port mesh, integrating the complete system with 66 internal paths into a 5U height, 19-inch rack chassis, with all RF connectors on the front panel. The ZTMN series also supports custom mesh network combinations, with port counts, attenuation and frequency ranges configured according to your needs.

The system can be controlled via USB or Ethernet (supporting SSH, HTTP & Telnet protocols). Full software support is provided, including our user-friendly GUI application for Windows and a full API with programming instructions for Windows and Linux environments (both 32-bit and 64-bit systems).

KEY FEATURES

| Feature | Advantages |
|---------------------------|--|
| Wide attenuation range | Independently controllable 0-95 dB attenuators on each path allow simulation of a wide range of test scenarios including receiver sensitivity, device / base-station handovers, device failures, and interference effects. |
| Wide bandwidth | Operation from 30 MHz to 2.5 GHz incorporates the VHF / UHF bands utilized by a wide range of military radio systems. |
| Single rack-mount chassis | 5U height, 19" rack-mountable chassis minimizes the rack space required in crowded production test environments. |
| Ethernet & USB control | USB HID and Ethernet (SSH / HTTP / Telnet) interfaces ensure compatibility with most software environments and connection requirements. |



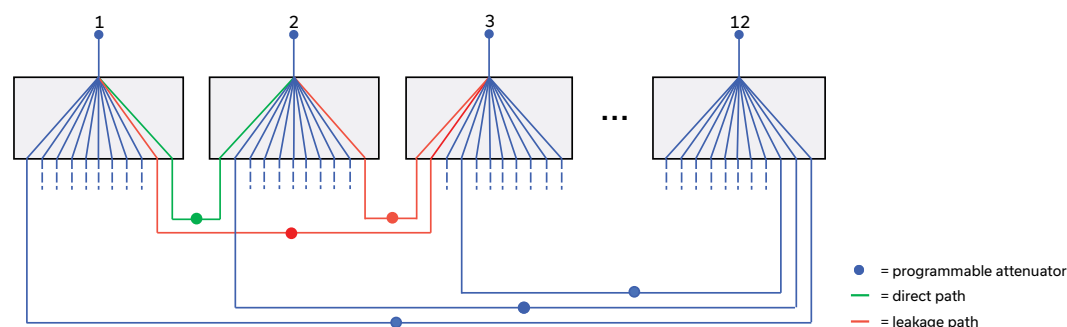
**ELECTRICAL SPECIFICATIONS AT +25°C**

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|-----------------------------|--|------|------|------|-------|
| Frequency Range | | 30 | | 2500 | MHz |
| Insertion Loss ¹ | 30-1000 MHz | | 34 | 37 | dB |
| | 1000-2500 MHz | | 39 | 44 | |
| Isolation | Direct path @ max attenuation ² | | 110 | | dB |
| | Leakage path (30-1000 MHz) ³ | | 55 | | |
| | Leakage path (1000-2500 MHz) ³ | | 63 | | |
| Return Loss | | | 12 | | dB |
| Input Power | Per port | | | +30 | dBm |
| Attenuation Range | Per path | 0 | | 95 | dB |
| Attenuation Steps | 0 – 90 dB range | | 0.25 | | dB |
| | 90 – 95 dB range | | 0.5 | | |

1. Path loss on the direct path between 2 ports when the attenuator in path is at 0 dB

2. Path loss on the direct path between 2 ports with all attenuators at max attenuation

3. Path loss on the leakage path between 2 ports with the 2 attenuators in the leakage path at 0 dB and all others at max attenuation

MESH ISOLATION CHARACTERISTIC

The green path in the diagram above is the direct path between ports 1 & 2. In an ideal mesh this would be the only route between these 2 ports. The insertion loss (IL) on the direct path is approximately as below, when the attenuator highlighted in green is set to 0 dB:

$$IL_{\text{DIRECT}} = IL_{\text{SPLITTER}} + IL_{\text{ATTENUATOR}} + IL_{\text{SPLITTER}}$$

The red path highlights an indirect, leakage path which also exists between ports 1 & 2 due to the finite isolation of the splitter / combiner component. A number of similar leakage paths also exist across the output ports of the other splitter / combiner components within the mesh. The worst-case isolation (ISO) of the red leakage path is approximately as below, when the attenuators highlighted in red are set to 0 dB:

$$ISO_{\text{LEAKAGE}} = IL_{\text{SPLITTER}} + IL_{\text{ATTENUATOR}} + ISO_{\text{SPLITTER}} + IL_{\text{ATTENUATOR}} + IL_{\text{SPLITTER}}$$

Mini-Circuits minimizes the leakage paths by design; a well-designed splitter / combiner component can offer in the order of 20 dB isolation over a wide bandwidth. It is not possible to remove entirely the leakage paths but their effects can be mitigated during operation of the mesh through careful choice of the programmable attenuation values in path. Mini-Circuits' recommendations are:

1. Terminate any unused external ports around the mesh to ensure the best impedance match throughout.
2. Set all programmable attenuators to their maximum values (90 dB) initially to ensure all direct and leakage paths are isolated, then reduce the attenuation on the specific paths required by the test scenario.
3. When leakage paths are affecting measurements, consider increasing the value on all internal programmable attenuators to minimize their significance. Every 1 dB increase in insertion loss on all direct paths, leads to a 2 dB increase on all indirect paths.



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CONTROL INTERFACES

| | | |
|------------------|-------------------------------------|--|
| Ethernet Control | Supported Protocols | TCP / IP, SSH, HTTP, Telnet, DHCP, UDP (limited) |
| | Max Data Rate | 100 Mbps (100Base-T Full Duplex) |
| USB Control | Supported Protocols | HID – High Speed |
| | Min Communication Time ⁴ | 400 μs typ |

4. Based on the polling interval of the USB HID protocol (125 μs with 1024 bytes per packet) and no other significant CPU or USB activity

SOFTWARE & DOCUMENTATION

Mini-Circuits' full software and support package including user guide, Windows GUI, API, programming manual and examples can be downloaded free of charge (refer to the last page for the download path).

A comprehensive set of software control options is provided:

- GUI for Windows – Simple software interface for control via Ethernet and USB
- Programming / automation via Ethernet
 - Complete set of control commands which can be sent via any supported protocol – simple to implement in the majority of modern programming environments
- Programming / automation via USB
 - DLL files provide a full API for Windows with a set of intuitive functions which can be implemented in any programming environment supporting .Net Framework or ActiveX
 - Direct USB programming is possible in any other environment (not supporting .Net or ActiveX)

Please contact testsolutions@minicircuits.com for support

MINIMUM SYSTEM REQUIREMENTS

| | |
|-------------------------------|---|
| Hardware | Intel i3 (or equivalent) or later |
| GUI (USB or Ethernet Control) | Windows 7 or later |
| USB API DLL | Windows 7 or later with support for Microsoft .Net Framework or ActiveX |
| USB Direct Programming | Windows 7 or later; Linux |
| Ethernet | Windows, Linux or macOS with Ethernet TCP / IP support |

PROGRAMMING COMMANDS

The key ASCII / SCPI commands for control of the system for control via the Ethernet or USB API are summarized below (refer to the programming manual for full details):

| Command / Query | Description |
|--|--|
| :MN? | Read model name |
| :SN? | Read serial number |
| :FIRMWARE? | Read firmware version |
| : [address]:[channels]:SETATT:[value] | Set attenuation: <ul style="list-style-type: none"> • [address] = Address of the attenuator module (refer to the Attenuator Path Map table) • [channels] = Channel number (1 to 8) within the 8-channel attenuator module. Multiple channels can be listed in a string, separated by colon (":"). • [value] = Attenuation value to set (from 0 to 95 dB) • Example: 01:CHAN:1:2:3:SETATT:10.25 |
| : [address]:[channels]:ATT? | Return a single attenuator value: <ul style="list-style-type: none"> • [address] = Address of the attenuator module (refer to the Attenuator Path Map table) • [channels] = Channel number (1 to 8) within the 8-channel attenuator module • Example: 01:CHAN:1:ATT? |





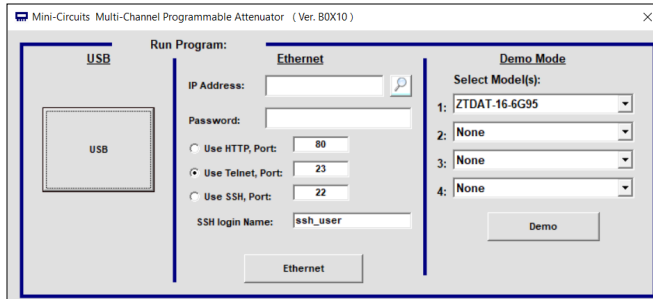
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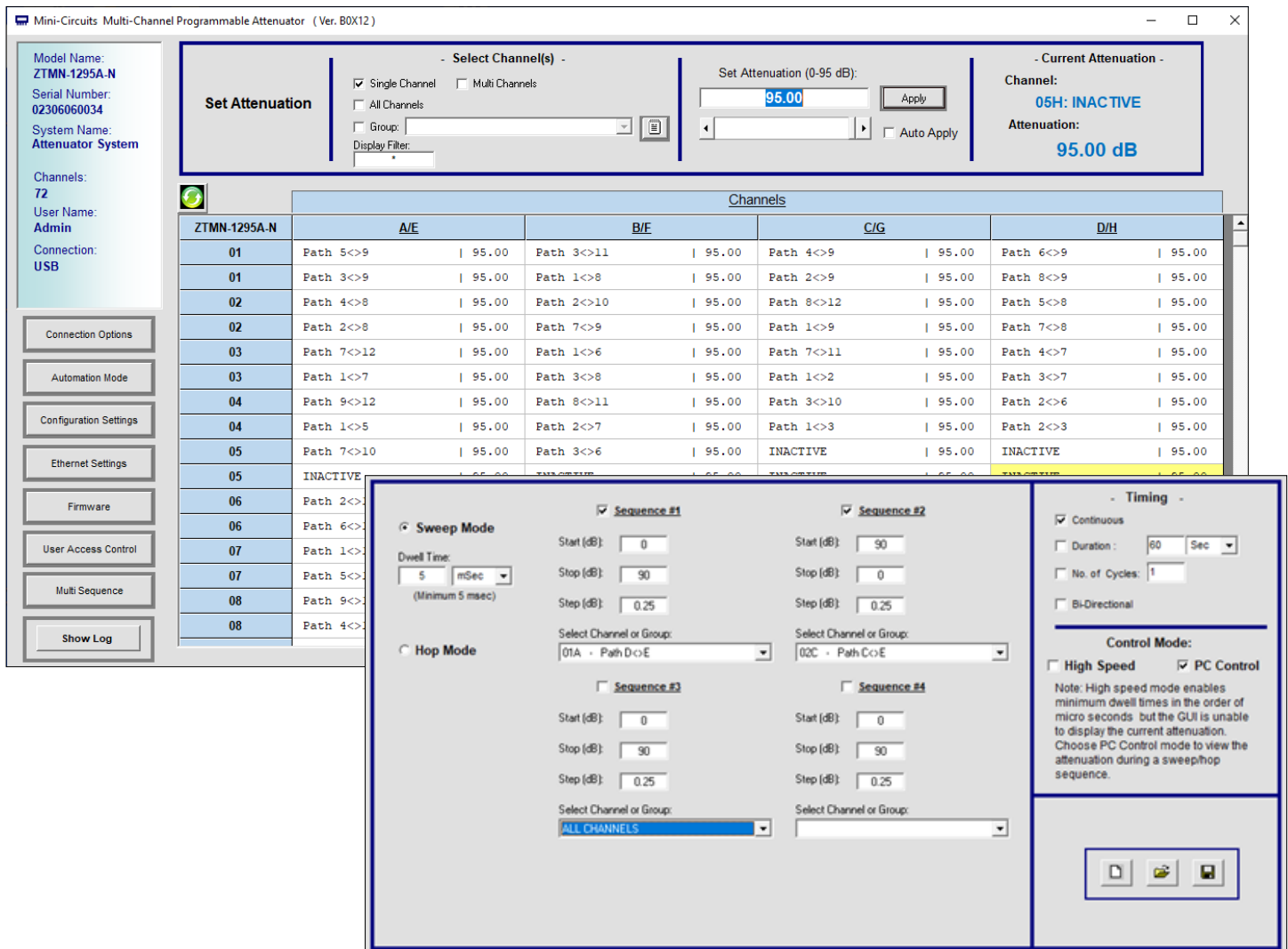
50Ω 30 to 2500 MHz Rack-Mount N-type Female

GRAPHICAL USER INTERFACE (GUI) FOR WINDOWS

- Connect via USB or Ethernet
- Run GUI in demo mode to evaluate software without a hardware connection



- View and set all attenuator values, independently or in groups
- Configure automated sweep / hop / fading sequences
- Apply custom port / path names
- Configure system and Ethernet settings





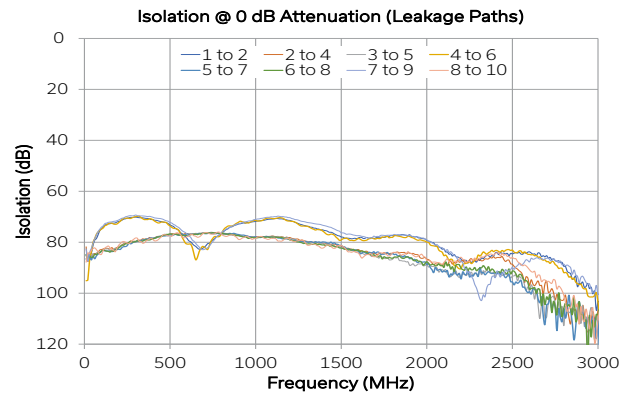
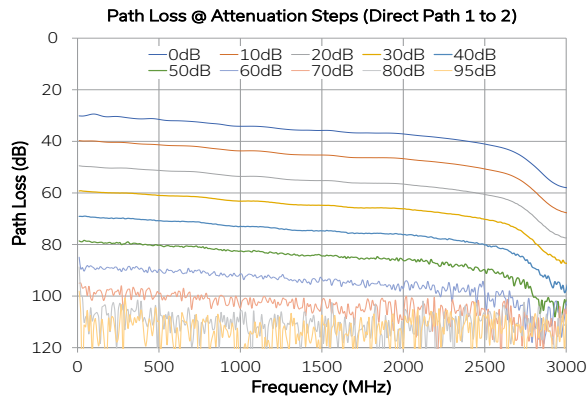
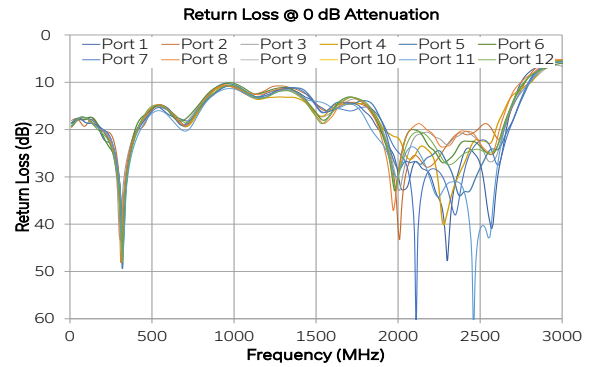
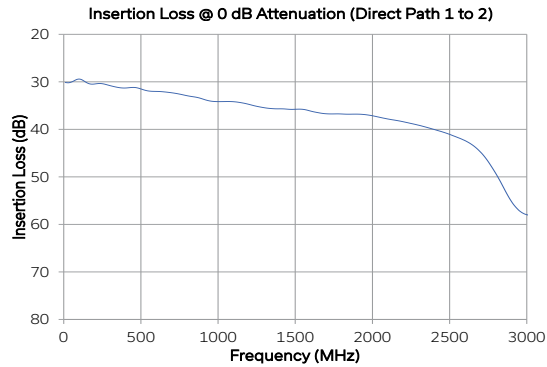
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TYPICAL PERFORMANCE GRAPHS





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ABSOLUTE MAXIMUM RATINGS⁵

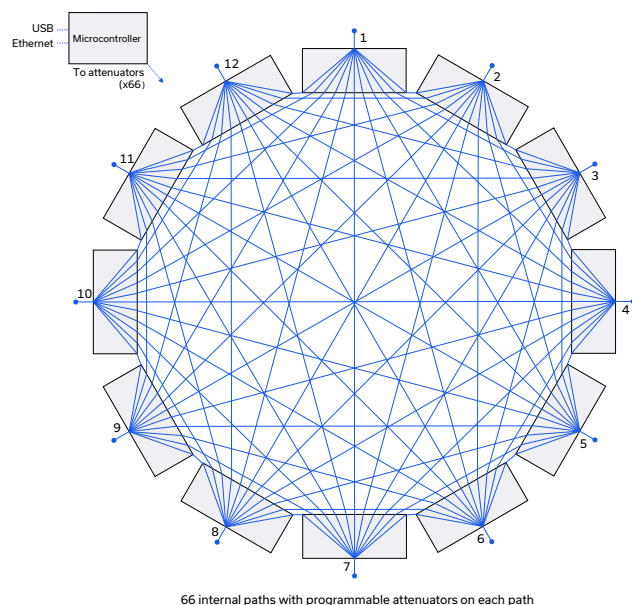
| Parameter | Conditions | Limits | Units |
|-------------------------|------------|------------|-------|
| Temperature | Operating | 0 to +50 | °C |
| | Storage | -20 to +60 | |
| Input Power (No Damage) | Per port | +30 | dBm |

5. Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

POWER SUPPLY

| | |
|-------------------|--|
| Power Supply | AC mains input: 100-240 V, 50 / 60 Hz |
| Fuse | 2A, 250V rating |
| Power Consumption | 85W maximum |

FUNCTIONAL BLOCK DIAGRAM



CONNECTIONS

| Port | Connector |
|----------------|---------------|
| 1 to 12 | N-type female |
| USB | USB type B |
| Ethernet / LAN | RJ45 |
| AC Input | IEC C14 inlet |

ATTENUATOR / PATH MAP

- The mesh is constructed using nine 8-channel programmable attenuator blocks, addressed 01 to 09
- Each of the 8 channels within a block controls the path loss between a single pair of ports
- Refer to the table below to address the attenuator between any pair of ports

| | | Port | | | | | | | | | | |
|------|----|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Port | 1 | Att 3 - Ch G | Att 4 - Ch G | Att 9 - Ch B | Att 4 - Ch E | Att 3 - Ch B | Att 3 - Ch E | Att 1 - Ch F | Att 2 - Ch G | Att 8 - Ch D | Att 7 - Ch A | Att 6 - Ch C |
| | 2 | - | Att 4 - Ch H | Att 9 - Ch E | Att 9 - Ch A | Att 4 - Ch D | Att 4 - Ch F | Att 2 - Ch E | Att 1 - Ch G | Att 2 - Ch B | Att 7 - Ch D | Att 6 - Ch A |
| | 3 | - | - | Att 8 - Ch B | Att 9 - Ch D | Att 5 - Ch B | Att 3 - Ch H | Att 3 - Ch F | Att 1 - Ch E | Att 4 - Ch C | Att 1 - Ch B | Att 6 - Ch D |
| | 4 | - | - | - | Att 8 - Ch G | Att 9 - Ch G | Att 3 - Ch D | Att 2 - Ch A | Att 1 - Ch C | Att 8 - Ch E | Att 6 - Ch F | Att 7 - Ch G |
| | 5 | - | - | - | - | Att 9 - Ch H | Att 7 - Ch B | Att 2 - Ch D | Att 1 - Ch A | Att 9 - Ch F | Att 7 - Ch E | Att 6 - Ch G |
| | 6 | - | - | - | - | - | Att 9 - Ch C | Att 6 - Ch B | Att 1 - Ch D | Att 8 - Ch H | Att 8 - Ch F | Att 6 - Ch E |
| | 7 | - | - | - | - | - | - | Att 2 - Ch H | Att 2 - Ch F | Att 5 - Ch A | Att 3 - Ch C | Att 3 - Ch A |
| | 8 | - | - | - | - | - | - | - | Att 1 - Ch H | Att 8 - Ch C | Att 4 - Ch B | Att 2 - Ch C |
| | 9 | - | - | - | - | - | - | - | - | Att 8 - Ch A | Att 7 - Ch C | Att 4 - Ch A |
| | 10 | - | - | - | - | - | - | - | - | - | Att 7 - Ch H | Att 7 - Ch F |
| | 11 | - | - | - | - | - | - | - | - | - | - | Att 6 - Ch H |



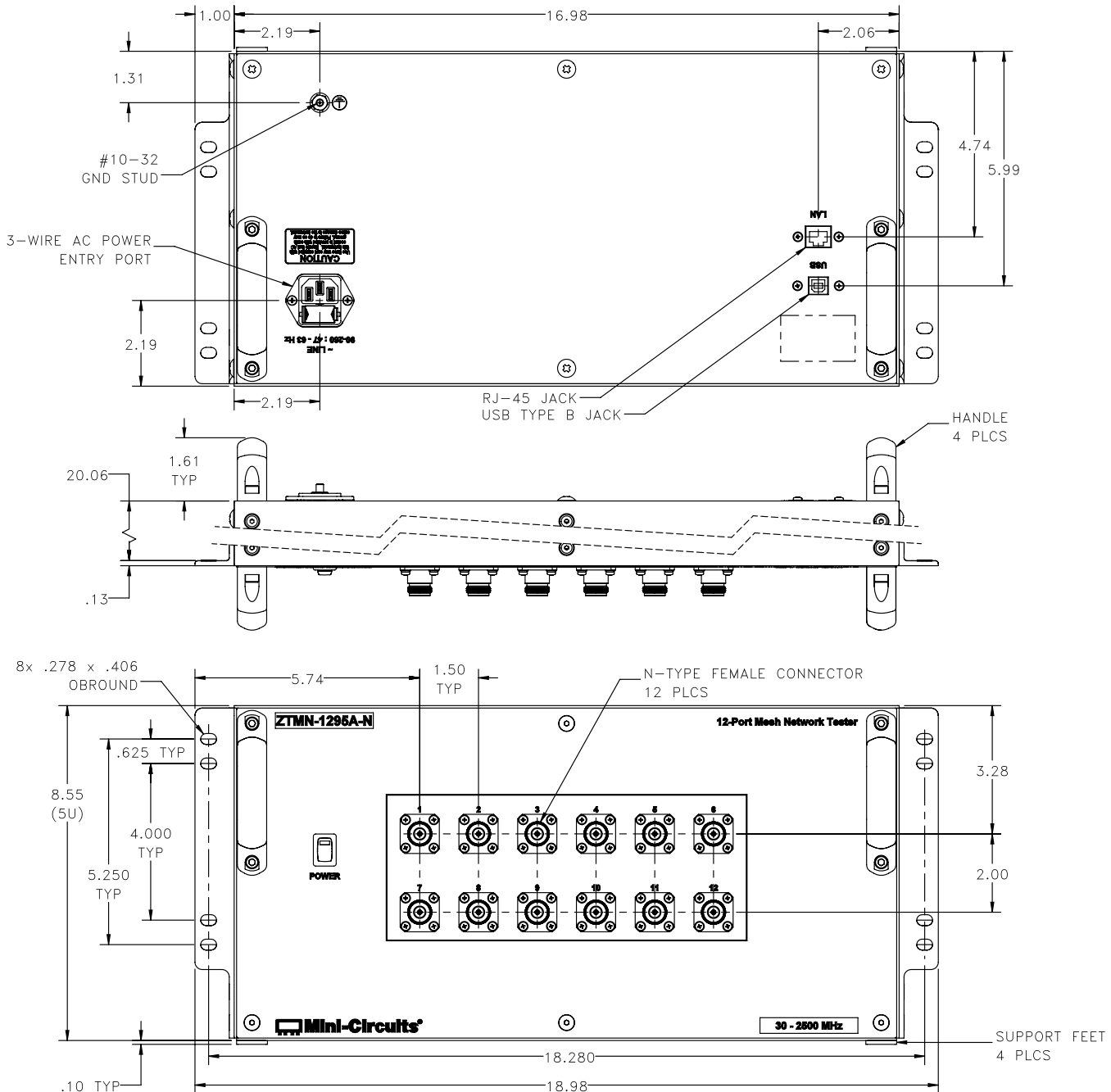


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OUTLINE DRAWING



PRODUCT MARKING

Product Marking: ZTMN-1295A-N

Product Description: 12-Port Mesh Network Test Drawer

Product Frequency: 30-2500 MHz

Unit ID Label: Serial number and other identification marks

*Marking may contain other features or characters for internal lot control





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DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE [CLICK HERE](#)

| | |
|---|--|
| Case Style | 99-01-3646 |
| Software, User Guide & Programming Manual | www.minicircuits.com/softwaredownload/multiatt.html |
| Environmental Rating | ENV55 |
| Regulatory Compliance | <p>Refer to our website for compliance methodologies and qualifications</p>  www.minicircuits.com/quality/environmental_introduction.html |

Contact Us: testsolutions@minicircuits.com

| Included Accessories | Part Number | Description |
|---|----------------|--|
| | CBL-3W-xx | AC power cord (IEC C13 connector to local plug) Select one option from the list below. Please contact Please contact testsolutions@minicircuits.com if your regions is not listed. |
|  | USB-CBL-AB-7+ | USB cable (6.8ft) type A to type B |
|  | CBL-RJ45-MM-5+ | Ethernet cable (5 ft) |

| AC Power Cord Options | Part Number | Description |
|---|-------------|---|
|  | CBL-3W-US | USA NEMA 5-15 plug (type B) to IEC C13 connector |
|  | CBL-3W-EU | Europe CEE 7/7 plug (type E/F) to IEC C13 connector |
|  | CBL-3W-UK | UK BS-1363 plug (type G) to IEC C13 connector |
|  | CBL-3W-AU | Australia & China AS/NZS 3112 plug (type I) to IEC C13 connector |
|  | CBL-3W-IL | Israel SI-32 plug (type H) to IEC C13 connector |

NOTES

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html





Environmental Specifications ENV55

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification | Test/Inspection Condition | Reference/Spec |
|--------------------------------|--------------------------------------|-----------------------------|
| Operating Temperature | -0° to 50° C Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -20° to 60° C Ambient Environment | Individual Model Data Sheet |
| Operating and Storage Humidity | 5% to 85% RH (non-condensing) | Ambient |
| Bench Handling Test | Bench Top Tip 45° & Drop | MIL-PRF-28800F |
| Transit Drop Test | Free Fall Drop, 20 cm (7.9 inches) | MIL-PRF-28800F Class 3 |