PD-95XX-10GC

Multiport Multigig Series User Guide

Introduction

Microchip's family of Power over Ethernet (PoE) Midspans, PD-95XX-10GC/AC, inject power over data-carrying Ethernet cabling. Employing these devices reduces the need for AC outlets, local UPS, and AC/DC adapters near powered devices (PDs) .

PD-9506-10GC, PD-9512-10GC, and PD-9524-10GC Midspans support 6, 12, and 24 ports respectively, in a 2.5/5/10GBaseT Ethernet network, over TIA/EIA-568 category 5e/6/6A cabling. The PD-95xx-10GC family can provide up to 60W according to the new IEEE$^®$ 802.3bt standards. DC power is fed over both spare and data pairs of wires within a cable (1/2, 3/6, 4/5, and 7/8) to terminal units.

PoE Midspan normally powers devices that are PoE enabled or are equipped to receive PoE. These devices are called PDs.

PoE Midspans offer the following important features.

- Safe and reliable power over an existing Ethernet infrastructure.
- Remote management using web control and/or simple network management protocol (SNMP)v3.
- High-level of network security.
- Safe solution that protects network infrastructure.
- Standards compliant: IEEE 802.3bt.
- Provides safe power and data over a single RJ-45 cable.

Table of Contents

1. Standards and Safety Guidelines

The following sections mention the standard and safety guidelines for the product.

1.1 Part Numbers Definition

PD-95xx-10GC/AC: 4-pair AC family, where:

Table 1-1. Part Number Definition

Symbol	Description
xx	Represents the number of ports (6,12, or 24).
AC	Midspan has AC input (24 and 12-port units also have DC input).

1.2 Electrical Compatibility Approvals

Microchip PD-95xx-10GC/AC series comply with the following standards.

- FCC Part 15, Class B UTP cabling
- EN 55032, Class B with UTP cabling
- EN 55024 (CISPR 24)
- Canadian ICES-003, Class B
- VCCI

1.3 Safety Standard Approvals

Microchip meets the following safety standards.

- UL/cUL per CSA/UL 62368-1
- Consult Microchip for additional approvals

1.4 CE Marking

CE marking on this product indicates that this product complies with EMC directive and low voltage directive.

1.5 Safety Information

Read the safety information before using the PoE Midspan unit.

1.5.1 General Guidelines

Read the following safety information before carrying out any installation, removal, or maintenance procedures on the PoE Midspan. The 1.5.2 Warnings section contains directions to be followed for the safety of personal and product.

1.5.2 Warnings

- Read installation instructions in 4. PoE Midspan Installation before connecting Midspan to its power source.
- Read instructions in 4. PoE Midspan Installation before connecting Midspan-to-Midspan power backup.
- Only trained and qualified personnel must be allowed to install, replace, and service this equipment.
- Midspan must be connected using a grounded power cord, as defined in 1.5.3 Power Cord.
- This ITE device must be connected to PoE (power supply over Ethernet) networks only, without routing to other networks.
- The power cord must not be attached to the surface of the building or pass-through walls, ceilings, floors, and similar openings in the building structure.

- Steps must be taken to prevent physical damage to the power cord, including proper routing.
- This product relies on building installation for short-circuit (over-current) protection. Use only a fuse or circuit breaker not higher than 15A for 120 VAC (U.S.) or 10A for 230 VAC (international).
- All wiring and connections must conform to NFPA 70 (NEC)
- Do not work on the system or connect/disconnect cables during lightning storms.
- A voltage mismatch can damage the equipment and can pose a fire hazard. If voltage indicated on the label is different from the power outlet voltage, do not connect Midspan to this outlet.
- For shelf-mounted equipment, verify that surface is stable and strong enough to support the equipment. Do not stack more than **four** Midspan units.
- When disposing this product, follow all local laws and regulations.
- **Data** and **Data and Power** ports of the Midspan are shielded RJ-45 data sockets. They cannot be used as Plain Old Telephone Service (POTS) sockets. Only connect RJ-45 data connectors to these sockets.
- Associated Ethernet wiring must be limited to the inside of the building.

1.5.3 Power Cord

Follow the local requirements, to replace the power cord.

- To ensure a reliable connection to an AC mains supply, the equipment provides an appliance IEC60320 inlet to connect a detachable power supply cord.
- The power socket outlet must be located near the Midspan and easily accessible. The only way of shutting down the unit is by disconnecting the power cord from the outlet.
- This unit operates under safety extra low voltage (SELV) conditions according to EN60950-1/IEC60950-1.
  Note: Conditions are met only if the equipment, to which the unit is connected, also operates under SELV conditions.

1.5.4 Country-wise Power Cord Specifications

U.S.A. and Canada	- Cord must be UL-approved or CSA certified. - Minimum specification for flexible cord is: - No. 18 AWG - Type SV or SJ - Three-conductor - Cord set must have a rated current capacity of at least 13A for PD-95xx-25/5/10GC/AC - Attachment plug must be an earth-grounding type with a NEMA 5-15P (15A, 125V) or NEMA 6-15P (15A, 250V) configuration
Denmark	Supply plug must comply with section 107-2-D1, standard DK2-1a or DK2-5a.
Switzerland	Supply plug must comply with SEV/ASE 1011.
France and Peru	IT supplies cannot power this unit. If your supplies are an IT type, the unit must be powered by 230V (2P+T) through an isolation transformer with a 1:1 ratio, and with secondary connection point labeled Neutral and connected directly to the ground.
U.K.	PoE Midspan is covered by General Approval NS/G/12345/J/100003, for indirect connection to a public telecommunications system.

2. Information en Matière de Sécurité

Lire les informations suivantes en matière de sécurité avant d'utiliser d'activer l'alimentation sur votre appareil Ethernet Midspan.

2.1 Directives Générales

Lire les informations suivantes en matière de sécurité avant d'installer ou enlever quoi que ce soit, ou procéder à l'entretien de l'alimentation de votre appareil Ethernet Midspan. Les mises en garde contiennent des instructions qui doivent être suivies pour la sécurité des personnes et du produit. Suivre les instructions soigneusement.

2.2 Mises En Garde

- Lire les instructions d'installation dans la cette 4. PoE Midspan Installation avant de connecter le Midspan à une source d'alimentation.
- Lire les instructions d'installation dans la cette 4. PoE Midspan Installation avant de connecter le Midspan à une source de sauvegarde Midspan.
- Seul du personnel formé et qualifié doit être autorisé à installer, remplacer et entretenir cet équipement.
- Le Midspan doit être connecté au moyen d'une corde d'alimentation avec prise de terre, comme précisé à la 1.5.3 Power Cord.
- Cet ITE appareil doit être branché à des réseaux PoE (alimentation électrique par Ethernet) seulement, et ce, sans routage vers d'autres réseaux.
- Le cordon d'alimentation ne doit pas être fixé à la surface du bâtiment ni traverser les murs, les plafonds, les planchers et les ouvertures similaires de la structure du bâtiment.
- Des mesures doivent être prises pour éviter tout dommage physique au cordon d'alimentation, y compris un acheminement approprié.
- Ce produit dépend de l'installation électrique de l'immeuble pour une protection contre les courts-circuits (surcharges de courant). Utiliser seulement un fusible ou un disjoncteur dont la puissance ne dépasse pas 15A pour 120VAC (É.-U.), ou 10A pour 230VAC (international).
- Tout le câblage et les connexions doivent être conformes à la norme NFPA 70 (NEC)
- Ne pas exécuter de travaux sur le système, connecter ou déconnecter des câbles pendant les orages.
- Une disparité de voltage peut endommager l'équipement et constituer un risque d'incendie. Si le voltage indiqué sur l'étiquette est différent du voltage de la source d'alimentation, ne pas connecter le Midspan à cette prise.
- Pour un équipement monté sur une tablette, vérifier que la surface est stable et suffisamment solide pour le supporter. Ne jamais empiler plus de **quatre** unités Midspan.
- Pour disposer/jeter ce produit, suivre les lois et règlements locaux.
- Les ports **Data** et **Data et Power** du PoE Midspan sont des prises de données blindées RJ45. Elles ne peuvent pas être utilisées comme prises de service téléphonique traditionnel. Connecter seulement des connecteurs de données RJ45 à ces prises. Le câblage Ethernet connexe doit être limité à l'intérieur de l'immeuble.

3. 2.5/5/10GBASE-TX Ports Definition

The following sections detail the PD-95xx-10GC ports and their functions.

3.1 Data Input Ports

Midspan has 6 ,12, or 24 10GBASE-T **Data In** ports, located on PoE front panel (see 3.1 Data Input Ports), configured in a non-crossover manner (straight-wired).

The following ports are designed to carry Ethernet data only (Tx/Rx) over standard 4-wire pairs (pins 1/2, 3/6, 4/5, and 7/8) (10GBASE-T).

3.2 Data and Power Output Ports

Midspan has 6 ,12, or 24 2.5/5/10GBase-T **Data & Power Out** ports, located on the front panel as shown in the following figure. These ports are configured in a non-crossover manner (straight wired) and carry Ethernet data over:

- Standard 4-wire pairs (pins 1/2, 3/6, 4/5, and 7/8) (10GBase-T)
- PD-95xxGC/AC series carry DC power over 4-wire pairs (pins 4/5, 7/8 and pins 1/2, 3/6)

> **Important:** PoE Midspan is not a repeater; therefore, maximum distance from the Ethernet switch must not exceed 100 meters (328 ft). PoE Midspan is guaranteed to work only within this distance, as specified in IEEE 802.3bt standard.

Figure 3-1. Front-View (PD-9x12GC) of PoE Midspan
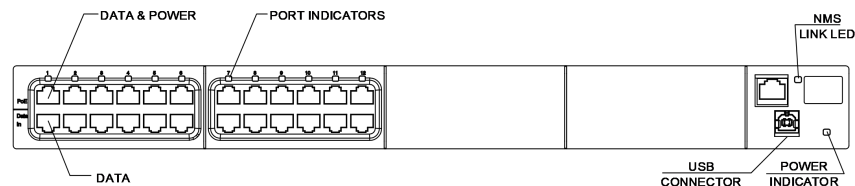
3.3 Indicators

A set of indicators displays the status of the PoE Midspan and its ports. Refer Table 3-1 and Table 3-2 for details about status information during operation.

3.3.1 Power Indicator LED

Power indicator LED on the front panel displays the power status of the PoE Midspan. A green lit LED indicates that the Midspan is receiving AC power. For additional information, see Table 3-1.

3.3.2 Port Indications

The following sections detail the PD-95xxGC port indicators.

3.3.2.1 PD-95xxGC/AC Midspan Series

The bi-color (green and yellow) indicator on each port indicates the port status:

- Green: The terminal unit (PD) has been identified as **PoE Enabled**; it is active and receiving power over 4-wire pairs.
- Yellow: The terminal unit (PD) has been identified as **PoE Enabled**; it is active and receiving power over 2-wire pairs.
- Blinking green: The port does not supply power and is inactive.

Note: PDs that are not PoE-enabled devices are not powered by Midspan.

Table 3-1. Power Status Indications

Indicator	Color	Main Power Status	Remarks
Power Indicator	Off	Power supply unit is unplugged	—
	Green	Power input is active	Power supply voltage is within limits.
	Green light blinks once every second (only if power backup is connected)	Midspan power supply failure (disconnected or out of voltage range)	Unit receives backup power and continues to function normally. Maintenance measures must be taken whenever possible.

Table 3-2. Port Status Indications PD-95xx Series

Port LED Color	Port Load Conditions	Port Voltage
Off	Inactive load or unplugged port.	Power to port is disconnected. No DC voltage is present on port output lines.
Green	Active load is plugged in and complies with normal load conditions.	Continuous nominal DC voltage is present according to 4-pairs configuration.
Yellow	Active load is plugged in and complies with normal load conditions.	Continuous nominal DC voltage is present on 2-wire pairs.
Green blinks once every second	Overload or short circuit.	Power to port is disconnected. No DC voltage is present on the port output lines.
Green blinks once every 0.5 seconds	Valid load. Total aggregated power exceeds pre-defined power budget.	Power is not connected to port. No DC voltage is present on the port output lines.

3.4 Connectors

There is a Console port on Midspan's front panel. Using a standard USB cable (USB Type B connector), connect a terminal to this port and load software.

Note: USB connection requires `CP210x Driver.exe` installation.
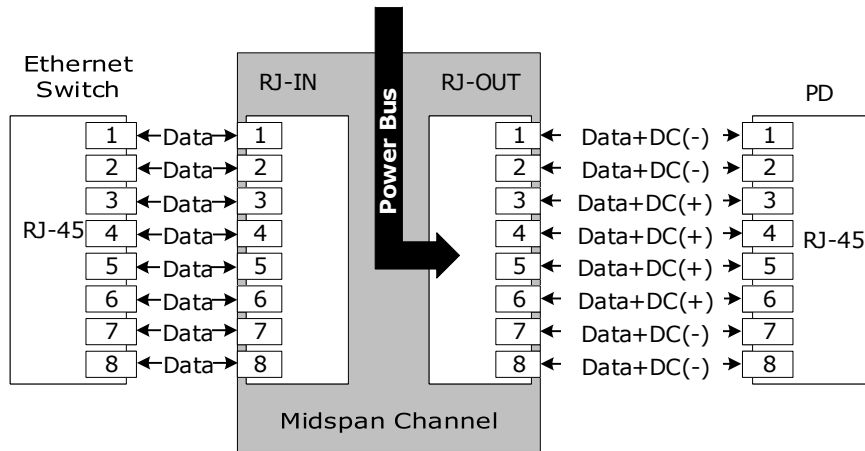
To install the USB driver, visit:

https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

The Console port is set to 38,400-baud for managed units and 19,200-baud for unmanaged units, 8 data bits, no parity, and 1 stop bit.

The figure below displays the pin connections for this connector.

Figure 3-2. Connecting to Midspan

Each data port is configured, as shown in the previous figure, as data **Pass-Through** ports for all data pins (pins 1, 2, 3, 6, 4, 5, 7, and 8). Ensure that cabling of Category 6A or higher is used.

4. PoE Midspan Installation

The following sections describe how to install a Midspan.

4.1 Background Information

As shown in the following figure, Midspan is connected in series to an Ethernet switch/hub. The data output terminals of the switch are connected to Midspan. Midspan delivers power over 4-wire twisted pairs (pins 7/8, 4/5 and, pins 1/2, 3/6) in PD-95xx-10GC/AC series of Category 6A cabling, regardless of data quality. Most installations require Midspan to be rack mounted.

Figure 4-1. Typical Installation
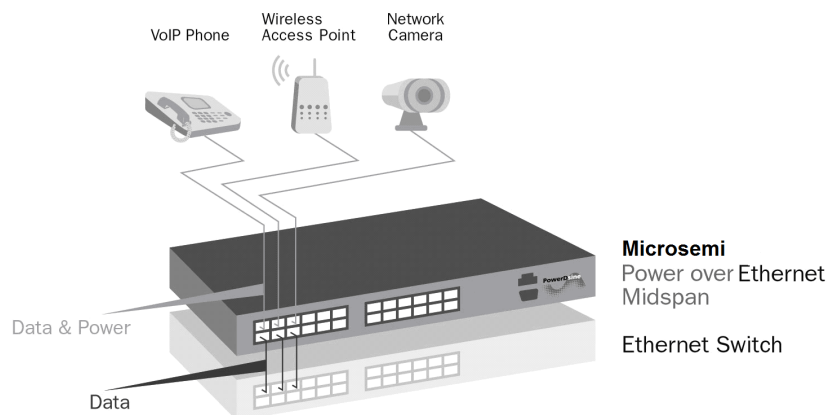
4.2 Verifying Kit Contents

Unpack the kit and verify that the following items are included.

- PoE Midspan
- Mounting brackets (for 19-inch racks)
- Screws for assembling the mounting brackets
- Self-adhesive rubber feet
- User guide (this file)

Before proceeding, record the serial number of the unit in the rectangle below for future reference. The serial number is found on the information label at the back of the Midspan.

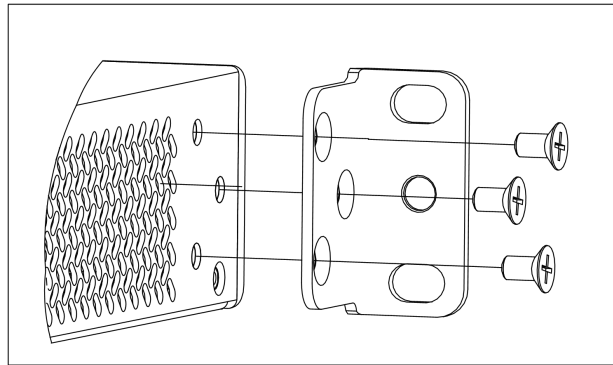**Figure 4-2. Serial Number**

4.3 Rack Mounting Brackets

Midspan comes with 19-inch mounting brackets and screws.

To install Midspan into a 19-inch rack:

1. Remove the self-adhesive rubber feet from the bottom surface.
2. Install the brackets using three screws each side.

Note: Rack-mounting screws are not provided with the kit.

Figure 4-3. Installing the Mounting Brackets

4.4 Installation Factors

Follow the installation factors carefully:

- Elevated Operating Ambient Temperature: If installed in a closed or multi-unit rack assembly, the operating ambient temperature in the direct rack environment might be greater than the room ambient temperature. Therefore, install the equipment in an environment compatible with manufacturer's maximum rated ambient temperature (T_{mra}).
- Reduced Air Flow: Install the equipment in a rack in a manner that does not compromise the airflow required for safe operation of the equipment.
- Mechanical Loading: While mounting the equipment on a rack, ensure that the mechanical loading is even.
- Circuit Overloading: Take into consideration the connection of the equipment to the power supply circuit and the effect that overloading the circuits might have on over-current protection and supply wiring. The equipment nameplate ratings must be considered while addressing this concern.
- Reliable Grounding (Earthing): Maintain reliable grounding of the rack mounted equipment. Pay attention to the supply connections, other than direct connections to branch circuit (for example, the use of power strips).

4.5 Connecting Ethernet Cables

Ports on the Midspan's front panel are configured as **Pass Through** ports for eight (1, 2, 3, 6, 4, 5, 7, and 8) conductors of RJ-45 connectors. Use Category 5e/6/6A cabling while connecting.

1. Connect cables from the Ethernet switch to the **DATA IN** ports (lower row on the front panel).
2. Connect cables from PoH or IEEE 802.3bt ready terminals (PDs) to the corresponding **DATA & POWER OUT** ports (upper row on the front panel).

4.6 Connecting Power Cables

While using an AC source to power Midspan, plug-in the provided power cord to the back of the AC connector.

4.7 Powering up the Unit

Midspan does not have on/off switch. To apply or remove power from Midspan, insert or remove the power cable to the AC socket on the back panel of the unit.

With power applied:

- Midspan powers-up.
- Internal fan operates.
- Device runs its Power-On Self-Test (POST), which takes less than 10 seconds. During POST, all ports are disabled and indicators illuminate in the following sequence:

– Port indicators and power indicators illuminate in green.

– Power indicator remains lit in green while port indicators are off.

Ports are now ready (enabled) for normal operation.

If LEDs are not lit, then see 5. Troubleshooting.

5. Troubleshooting

The following sections describe troubleshooting procedures to address any problems with the unit.

5.1 Preliminary Steps

If you have a problem with the unit, verify the following:

- Power is applied to Midspan.
- The Ethernet cable used is not of a crossover-type.
- The Ethernet cable from the network is connected to the **DATA** port.
- The Ethernet cable to PD is connected to the **DATA & POWER** port.
- Cable pairs are attached to their corresponding ports.

5.2 Troubleshooting Steps

The following table provides a problem and solution sequence to assist in troubleshooting of minor operating problems. If these steps do not solve the problem, contact the local dealer for further assistance.

Table 5-1. Troubleshooting Steps

Symptom	Corrective Steps
Midspan does not power up	1. Make sure the power cord is properly connected. 2. Verify that the voltage at power inlet is between 100 VAC and 240 VAC. 3. Remove and reapply power to the device and check indicators during the power-up sequence.
A port indicator is not lit and corresponding PD does not operate.	1. Verify the port is enabled (Midspan does not detect a PD). 2. Verify that the PD is designed for PoE operation. 3. Ensure that a standard Category 5/5e/6, straight-wired cable, with four pairs is used. 4. If an external power splitter is in use, replace it with a viable splitter. 5. Verify that the PD is connected to the DATA & POWER OUTPUT port. 6. Try to reconnect the same PD to a different port on the same Midspan or to on another one. If it works, there is probably a faulty output port or RJ-45 connection. 7. Verify port shutdown command was not issued through web management.
End device operates, but there is no data link.	1. Verify that the port indicator on the front panel is continuously lit. 2. If an external power splitter is in use, replace it with a viable splitter. 3. Ensure that this link uses a standard UTP/FTP Category 5e/6/6A straight (non-crossover) cabling, with all four pairs, and that the link is no longer than 100 meters. 4. Try to reconnect the same PD to a different port on the same Midspan or on another one. If it works, there might be a defect in the port or in the RJ-45 connection.

6. Specifications

The following sections detail the specifications of the unit.

6.1 Physical Specifications

Dimensions (H x W x D): 44 x 435 x 271 mm

(1.75" x 17.2" x 10.7")

Table 6-1. Physical Specifications

P/N	Weight
PD-9524-10GC	5.48 Kg
PD-9512-10GC	5.34 Kg
PD-9506-10GC	4.54 Kg

6.2 Environmental Specifications

Table 6-2. Environmental Specifications

Parameter	Value
Operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature	–20 °C to 70 °C (–4 °F to 158 °F)
Humidity	10% to 90% (non-condensing)

6.3 Electrical Specifications

Table 6-3. Electrical Specifications for PD-9512/24-25/5/10GC and PD-9506GC-25/5/10GC

Parameter	PD-9512/24-25/5/10GC and PD-9506GC-25/5/10GC
AC input voltage	100–240 VAC at 50/60 Hz
Maximum input current	PD-9524-10GC – 12A PD-9512-10GC – 9A PD-9506-10GC – 5A
Nominal output voltage	50–57 VDC
Maximum output power	PD-9524-10GC – 950W PD-9512-10GC – 950W PD-9506-10GC – 450W
Maximum output power per port	PD-9506/12/24-10GC 60W

Table 6-4. Electrical Specifications for PD-PD-9512-10GC and PD-9524-10GC

| Parameter	PD-9512-10GC and PD-9524-10GC
DC input rated voltage	53–57 VDC ⎓
Input DC maximum current	20A

7.   Microchip's PowerView Pro

Microchip's PowerView Pro is a secure remote management system offering real-time monitoring and control with graphical representation, status indicators, and alarms. PowerView Pro manages Midspans through an Internet browser interface or through a Network Management System (NMS). One of the most important features is remote power enable/disable functionality on each Midspan port. It supports:

- Hard resets of remote terminals such as WLAN Access Points and VoIP Phones PowerView Pro
- Enabling monitoring and control at network and Element levels (as shown in the following figure).

For more details, see *Microchip's PowerView Web Manager User Guide*.

Figure 7-1. Management Deployment
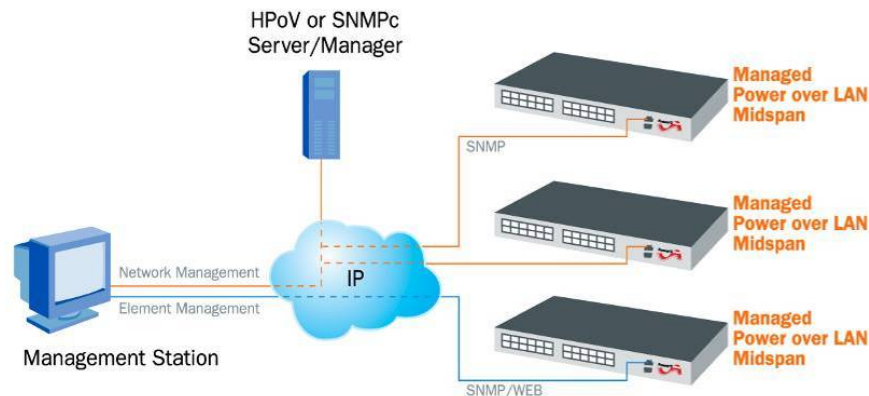
PowerView Pro provides a number of unique features for Midspan management:

- Remote web management of PoE for monitoring and configuration.
- Configuration using graphical representations of remote devices.
- Real-time monitoring and configuration with visual status indicators and alarms.
- Multi-manager capabilities.
- Event and performance data recording.
- Runs on a PC platform with Windows GUI.

8. Power Backup and Power Redundancy Connection

PD-9524-10GC and PD-9512-10GC have two options for ensuring continuous power supply:

- Power redundancy
- Power backup

8.1 Power Redundancy

Microchip 's power redundancy mode is available in the PD-95xx-10GC Midspan series. This mode enables internal power supply backup for two Midspans connected to each other. This mode provides seamless failover between two Midspans. If one of the two Midspans' internal power supplies fails, failure is detected automatically and power supply is provided to the other Midspan. Uptime of both Midspans is guaranteed to continue and all active ports continue to operate without any effect on connected powered devices.

Power redundancy mode is available in the following midspans:

- PD-9524-10GC/AC
- PD-9512-10GC/AC

Note: While using the power redundancy option, connect only the units that share the same power supply:

- PD-9524-10GC/AC (950W)
- PD-9512-10GC/AC (950W)

⚠ **WARNING** While connecting the power redundancy connectors, make sure that the AC power in both the Midspans is disconnected from the AC mains.

8.2 Power Backup

If one of the Midspans' power supplies fails, the unit maintains full functionality by using an optional backup power supply.

| Midspan Unit	Redundant Power Supply
PD-9524-10GC/AC	PD-9524-10GC/AC
PD-9512-10GC/AC	PD-9512-10GC/AC

8.3 Connectors

Power backup and power redundancy connectors are located on the back panel of the Midspan.

PD-9524-10GC and PD-9512-10GC power backup and power redundancy have two connectors (see the following figure):

- Power backup and power redundancy control signal connector, COM D-Sub: 15 pins, 3 rows female connector.
- DC voltage terminal block connector has two positive (+) terminals and two negative (-) terminals.

Figure 8-1. PD-9524-10GC and PD-9512-10GC Rear Panel Connectors
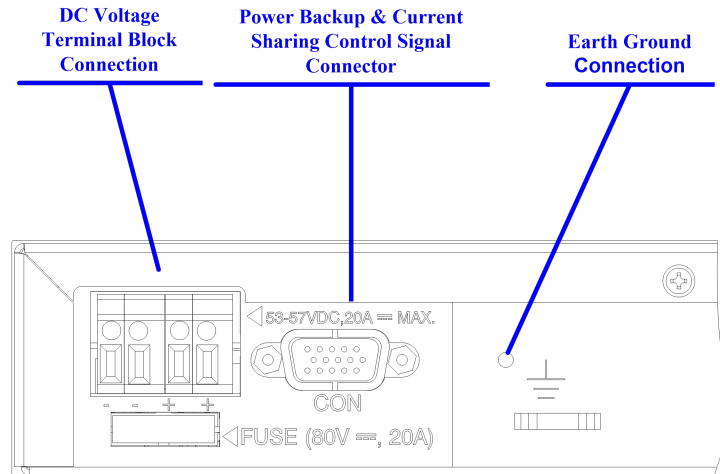
8.4 Connecting the Backup and Redundancy Connectors

⚠ **WARNING** — Before connecting one Midspan to another, disconnect both Midspans from the AC mains.

Implement the Power Backup and Power Redundancy modes by using the cable kit that includes a DC Cable and a signal COM.

To connect the connectors:

1. Verify that the Midspans are mounted securely on the rack.
2. Verify that the Midspans are not connected to the AC mains.
3. Connect the DC cable; two red wires (+), two black wires (-), and one yellow/green wire, as shown in the following figure.
4. Connect the COM cable.
5. Connect the Midspans to an AC outlet.
6. Verify that the power indicator LED is ON (Green LED).

Note: While connecting a midspan to midspan, connect the earth ground cable between both units Earth Ground connection.
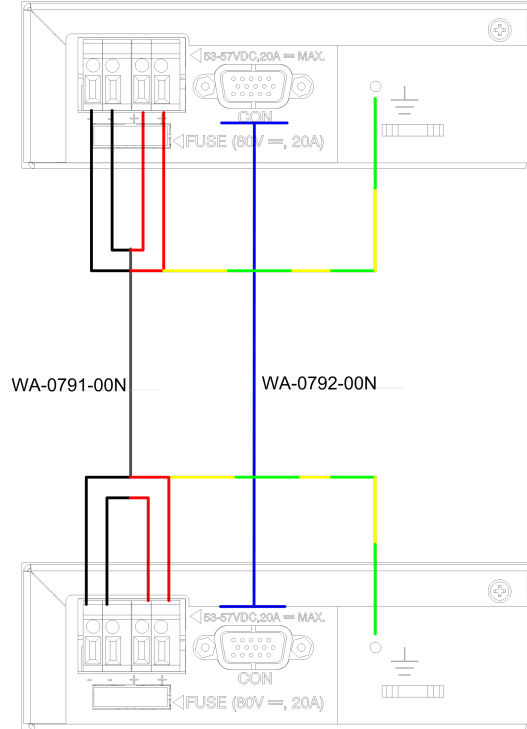
Figure 8-2. Connecting Backup and Redundancy Connectors

FLAT WASHER

SPRING WASHER

NUT
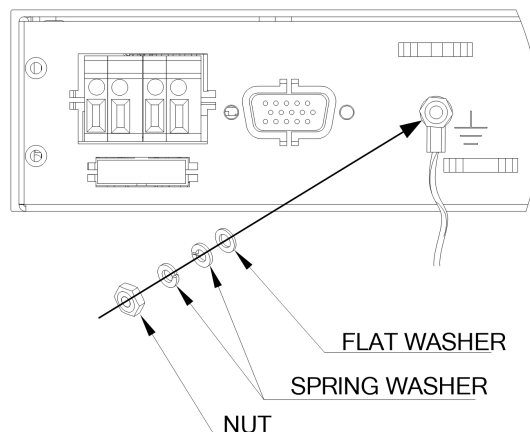
Notes:

- If the power indicator LED is not lit, see 5. Troubleshooting.
- The backup functionality can be monitored through NMS, as described in Figure 8-1.
- Consult Microchip for information on DC and COM cables.

Figure 8-3. PD-9524-10GC and PD9512-10GC Rear Panel Connections

8.5 Power Backup and Power Redundancy Indications

For information on NMS configuration, see *PowerView Pro User Guide*. During power backup and power redundancy, the NMS **View-Status** window displays a **Power Source Status** field. The **Power Source Status** field shows both internal and external power supply statuses (green indicates success and red indicates failure).

Figure 8-4. View Status in NMS

Note: Midspan provides another power failure indication through the Midspan's power indicator LED; whenever the unit's internal power supply fails, the power indicator LED blinks once every second (Green LED).

Figure 8-5. PD-95xx-10GC Front Panel LED Indication
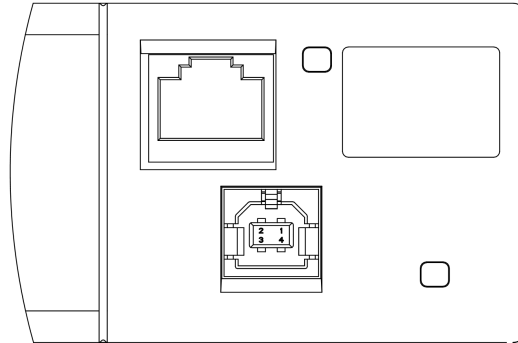
9.   Contacting Technical Support

If you encounter any problems while installing or using this product, contact the Microchip technical support team through the following contact number or website.

USA/Canada

+1 877 480 2323

www.microchip.com/support

10. Ordering Information

The following table lists the ordering details.

Table 10-1. Ordering Information

Part Number	Description
PD-9524-10GC/AC	24-port PoE Midspan, IEEE 802.3bt Type3 - 60W per port, 2.5/5/10GBaseT, AC Input w/Management, Full power (950W)
PD-9512-10GC/AC	12-port PoE Midspan, IEEE 802.3bt Type3 - 60W per port, 2.5/5/10GBaseT, AC Input w/Management, Full power (950W)
PD-9506-10GC/AC	6-port PoE Midspan, 6 IEEE 802.3bt Type3 - 60W per port, 2.5/5/10GBaseT, AC Input w/Management, Full power (450W)

11.   Revision History

Revision	Date	Description
A	July 2021	Initial Revision

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable." Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Legal Notice

Information contained in this publication is provided for the sole purpose of designing with and using Microchip products. Information regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGE, COST OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2021, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-5224-8412-7

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office	**Australia - Sydney**	**India - Bangalore**	**Austria - Wels**
2355 West Chandler Blvd.	Tel: 61-2-9868-6733	Tel: 91-80-3090-4444	Tel: 43-7242-2244-39
Chandler, AZ 85224-6199	**China - Beijing**	**India - New Delhi**	Fax: 43-7242-2244-393
Tel: 480-792-7200	Tel: 86-10-8569-7000	Tel: 91-11-4160-8631	**Denmark - Copenhagen**
Fax: 480-792-7277	**China - Chengdu**	**India - Pune**	Tel: 45-4485-5910
Technical Support:	Tel: 86-28-8665-5511	Tel: 91-20-4121-0141	Fax: 45-4485-2829
www.microchip.com/support	**China - Chongqing**	**Japan - Osaka**	**Finland - Espoo**
Web Address:	Tel: 86-23-8980-9588	Tel: 81-6-6152-7160	Tel: 358-9-4520-820
www.microchip.com	**China - Dongguan**	**Japan - Tokyo**	**France - Paris**
Atlanta	Tel: 86-769-8702-9880	Tel: 81-3-6880- 3770	Tel: 33-1-69-53-63-20
Duluth, GA	**China - Guangzhou**	**Korea - Daegu**	Fax: 33-1-69-30-90-79
Tel: 678-957-9614	Tel: 86-20-8755-8029	Tel: 82-53-744-4301	**Germany - Garching**
Fax: 678-957-1455	**China - Hangzhou**	**Korea - Seoul**	Tel: 49-8931-9700
Austin, TX	Tel: 86-571-8792-8115	Tel: 82-2-554-7200	**Germany - Haan**
Tel: 512-257-3370	**China - Hong Kong SAR**	**Malaysia - Kuala Lumpur**	Tel: 49-2129-3766400
Boston	Tel: 852-2943-5100	Tel: 60-3-7651-7906	**Germany - Heilbronn**
Westborough, MA	**China - Nanjing**	**Malaysia - Penang**	Tel: 49-7131-72400
Tel: 774-760-0087	Tel: 86-25-8473-2460	Tel: 60-4-227-8870	**Germany - Karlsruhe**
Fax: 774-760-0088	**China - Qingdao**	**Philippines - Manila**	Tel: 49-721-625370
Chicago	Tel: 86-532-8502-7355	Tel: 63-2-634-9065	**Germany - Munich**
Itasca, IL	**China - Shanghai**	**Singapore**	Tel: 49-89-627-144-0
Tel: 630-285-0071	Tel: 86-21-3326-8000	Tel: 65-6334-8870	Fax: 49-89-627-144-44
Fax: 630-285-0075	**China - Shenyang**	**Taiwan - Hsin Chu**	**Germany - Rosenheim**
Dallas	Tel: 86-24-2334-2829	Tel: 886-3-577-8366	Tel: 49-8031-354-560
Addison, TX	**China - Shenzhen**	**Taiwan - Kaohsiung**	**Israel - Ra'anana**
Tel: 972-818-7423	Tel: 86-755-8864-2200	Tel: 886-7-213-7830	Tel: 972-9-744-7705
Fax: 972-818-2924	**China - Suzhou**	**Taiwan - Taipei**	**Italy - Milan**
Detroit	Tel: 86-186-6233-1526	Tel: 886-2-2508-8600	Tel: 39-0331-742611
Novi, MI	**China - Wuhan**	**Thailand - Bangkok**	Fax: 39-0331-466781
Tel: 248-848-4000	Tel: 86-27-5980-5300	Tel: 66-2-694-1351	**Italy - Padova**
Houston, TX	**China - Xian**	**Vietnam - Ho Chi Minh**	Tel: 39-049-7625286
Tel: 281-894-5983	Tel: 86-29-8833-7252	Tel: 84-28-5448-2100	**Netherlands - Drunen**
Indianapolis	**China - Xiamen**		Tel: 31-416-690399
Noblesville, IN	Tel: 86-592-2388138		Fax: 31-416-690340
Tel: 317-773-8323	**China - Zhuhai**		**Norway - Trondheim**
Fax: 317-773-5453	Tel: 86-756-3210040		Tel: 47-72884388
Tel: 317-536-2380			**Poland - Warsaw**
Los Angeles			Tel: 48-22-3325737
Mission Viejo, CA			**Romania - Bucharest**
Tel: 949-462-9523			Tel: 40-21-407-87-50
Fax: 949-462-9608			**Spain - Madrid**
Tel: 951-273-7800			Tel: 34-91-708-08-90
Raleigh, NC			Fax: 34-91-708-08-91
Tel: 919-844-7510			**Sweden - Gothenberg**
New York, NY			Tel: 46-31-704-60-40
Tel: 631-435-6000			**Sweden - Stockholm**
San Jose, CA			Tel: 46-8-5090-4654
Tel: 408-735-9110			**UK - Wokingham**
Tel: 408-436-4270			Tel: 44-118-921-5800
Canada - Toronto			Fax: 44-118-921-5820
Tel: 905-695-1980			
Fax: 905-695-2078			