Network Switch User Guide

Distribution Statement

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1.0 Objective

This document provides guidance for the integration of the Umbra Network Switch into the user's flight hardware configuration. The Umbra Network Switch offers proven flight heritage with eight ethernet ports that provide high bandwidth Gigabit ethernet communication between networked devices.

2.0 Document References

This section contains the document number and description for documents that are referenced herein.

2.1 Umbra Documents

5091H10000	UMBRA NETWORK SWITCH MICD

2.2 Standard Documents

AS22759	WIRE, ELECTRICAL, FLUOROPOLYMER-INSULATED, COPPER OR COPPER ALLOY
GSFC-STD-7000	GENERAL ENVIRONMENTAL VERIFICATION STANDARD (GEVS)
MIL-STD-461	MILITARY STANDARD: ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS REQUIREMENTS FOR EQUIPMENT
SAE-AS50881	WIRING, AEROSPACE VEHICLE

3.0 Document Authority

In the case of a conflict between any dimensional, mounting pattern, or pinout information defined within this document and other information sources, the released mechanical and electrical drawings shall supersede this document.

3.1 Revision Notes

This document is Version 1.0.

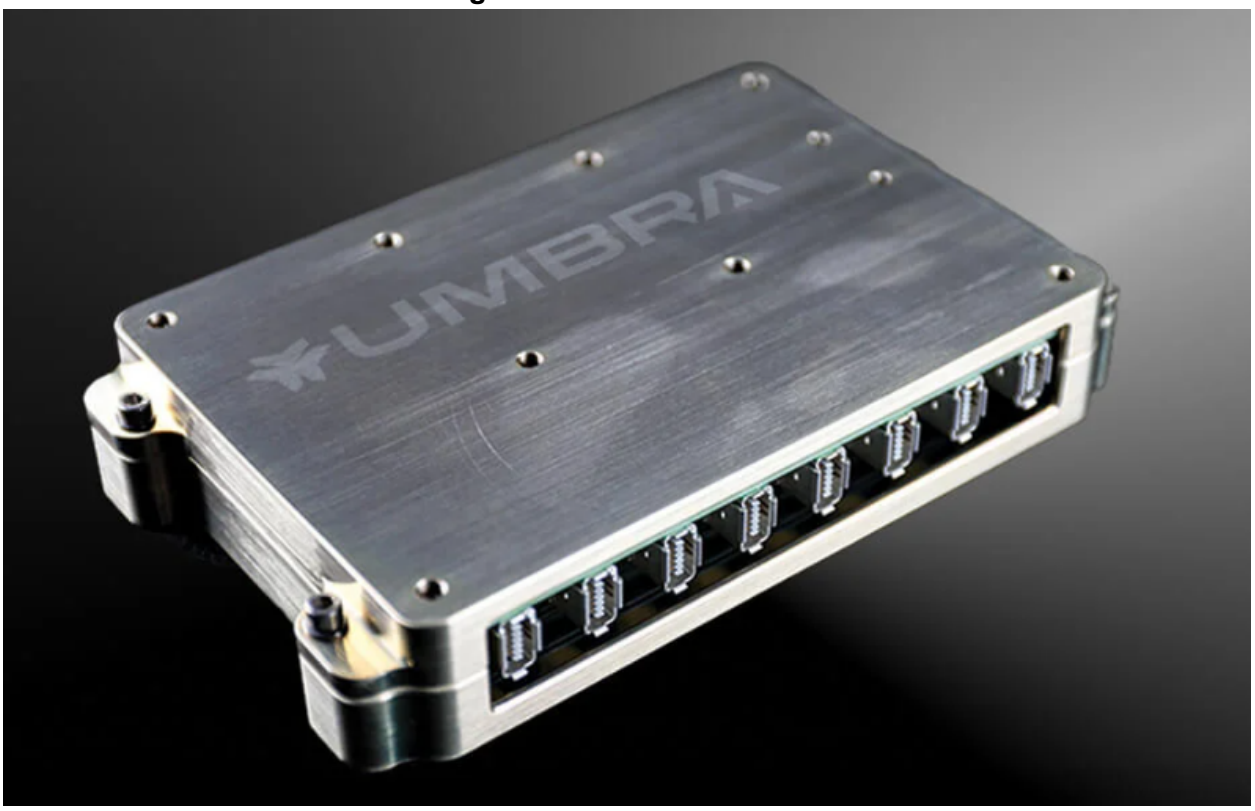
3.2 Document Disclaimer

DISCLAIMER: This User Guide is intended to provide a brief summary of our knowledge and guidance regarding the use of this item. The information contained herein has been compiled from sources considered by Umbra Lab, Inc. to be dependable and is accurate to the best of Umbra's knowledge. It is not meant to be an all-inclusive document on worldwide hazard communication regulations. This information is offered in good faith. Each user of this material needs to evaluate the conditions of use and design the appropriate protective mechanisms to prevent employee exposure, personal injury, property damage or release to the environment of any hazardous substances. Umbra assumes no responsibility for injury, damage, or loss sustained by the recipient or third persons or for any damage to any property resulting from misuse of the product. Purchase and use of the product(s) identified herein are governed by the terms of sale under which you purchase the product(s) from Umbra Lab, Inc.

4.0 Hardware Handling

For receiving and unpacking info, refer to section 4.1.3.

Figure 1. Umbra Network Switch Module



4.1 Mechanical Handling

Failure to read and follow the instructions contained in this User Guide may result in damage to the module, operators, and other property if stored or used improperly. Contact Umbra Lab, Inc. if any Umbra Network Switch fails any procedure as described in this document. Do not continue using any Umbra Network Switch with any suspected damage.

Ensure that any transportation of the Umbra Network Switch occurs in an environment described in the “Storage and Transport Environments” section.

Do not drop the Umbra Network Switch.

Only lift Umbra Network Switch by the chassis.

Do not disassemble the Umbra Network Switch.

Do not lift the Umbra Network Switch by the connectors.

Ensure dust caps are installed on all connectors while transporting or handling the Umbra Network Switch. If possible, it is recommended to cover the ethernet port chassis opening with Kapton tape when the interfaces are not mated to ensure no FOD entry near the connectors. More information is available in Appendix B.

4.1.1 Hazards

The Umbra Network Switch does not contain any hazardous materials subject to exposure during intended use.

4.1.2 ESD Sensitivity

The Umbra Network Switch is ESD sensitive to both the human-body model and charge device model as per the following table.

Table 1. ESD Sensitivity

			Value
V_{ESD}	Electrostatic Discharge	Human Body Model	+/- 2000V
		Charge Device Model	+/- 500V

Failure to follow ESD requirements and recommendations may result in damage to components and/or personnel injury.

An ESD ground strap shall be worn by the person(s) handling the hardware. Refer to ESD Standard for space hardware. Follow ANSI/ESD S20.20 while handling ESD sensitive components.

4.1.3 Unpacking

- If applicable, check shock detection stickers
- Remove assembly from transportation container
- Perform visual inspection for damage
- Take pictures as received
- Inspect connections then re-apply protective dust covers.

4.2 RBF / Red Tag GSE

Items in table 2 must be removed prior to installation into the customer spacecraft.

Table 2. RBF Items

Item	Critical/Optional	Notes
8x Ethernet Connector Dust Cap	Critical	Ethernet link dust covers
J9 Dust Cap	Critical	Micro D Connector

4.3 Electrical Mate/Demate

Table 3. Flight Connectors

Connector Designation	Assembly Connector	Mating Flight Connector
J9 Power	MMDS-009	MMDP-009
J1-J8	IX61G-A-10P	ND9-AP54-00

The Micro-D power connector can withstand up to 2000 mating cycles.

The Micro-D power connector should not be mated and de-mated while the supply rail is active (also known as “hot plugging”) to prevent damage to the electronics.

The iX Industrial™ Ethernet connectors can withstand up to 5000 mating cycles.

The iX Industrial™ Ethernet connectors are hot pluggable while the Network Switch is powered on.

4.4 Connector Strain

It is recommended to secure all harnessing interfacing to the Umbra Network Switch per the guidance found in SAE-AS50881 which describes guidance on the installation of wiring harnesses.

4.5 Storage and Transport Environment

Do not store the Umbra Network Switch in direct sunlight.

Do not store the Umbra Network Switch in such a way that damages part markings.

Ensure that critical RBF components called out in section 4.2 are in place during all transport of the Umbra Network Switch.

Table 4. Storage and Transport Environment

Parameter	Value
Storage Temperature	-30 °C to +60 °C
Humidity	< 50% relative humidity
Maximum Storage Lifetime	10 years

4.6 Operating Environment

Maintain a FOD awareness zone around the Umbra Network Switch during Spacecraft assembly integration and test.

Table 5. Operating Environment

Parameter	Value
Operating Temperature	-30 °C to +65 °C

4.7 Survival Environment

The Umbra Network Switch has been lab tested to survive in the following environment with no impact to function.

Table 6. Survival Environment

Parameter	Value
Survival Temperature	-40 °C to +85 °C
Vibration	Qualified to 14.16 g RMS profile enveloping GEVS, Falcon 9, SpaceX Rideshare, and Electron levels.
Shock	Qualified to 1000g peak profile enveloping GEVS, Falcon 9, SpaceX Rideshare, and Electron levels.
Minimum Survivable Total Ionizing Dose	Designed to withstand at least 30 krad TID. Lab tested up to 20 krad TID.

4.8 Mounting

See the Appendix B for information on mounting the Umbra Network Switch.
It is recommended that the Umbra Network Switch be mounted within the bus or payload.

5.0 Electrical Properties

Table 7. Electrical Properties

Parameter	Min	Nom	Max	Units
Input Voltage	25	28 ± 3	32	V
Power Consumption	-	3	4.6	W

The Umbra Network Switch does not support Power over Ethernet (PoE).

5.1 Connector Pinouts

See **Error! Reference source not found.** “Electrical Properties” for more information about provided power.

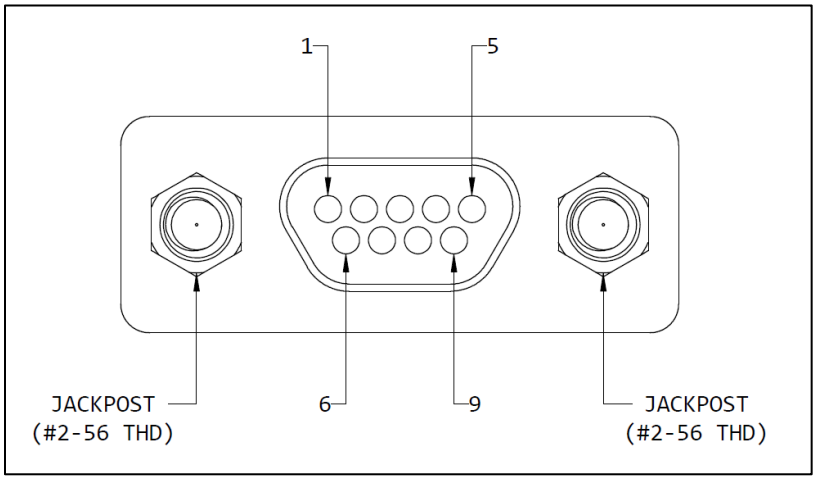
5.1.1 Power Connector Pinout

The Umbra Network Switch J1 connector (MMDS-009) is described in Appendix B. Refer to Table 8 for pinout and Figure 2 for the mating face view.

Table 8. J1 Connector Pinout

PIN	SIGNAL
1	28 V
2	28 V
3	28 V
4	28 V
5	28 V
6	GND
7	GND
8	GND
9	GND

Figure 2. MMDS-09 Connector Mating Face View



The connector body is electrically connected to CHASSIS and isolated from GND (power ground). The harness connector body and backshell should be isolated from GND as well – they will be electrically bonded to CHASSIS ground through the mating jackposts and jackscrews.

See Sections “Power Requirements” and “Current Requirements” for more information about “GND” and “POWER SUPPLY.”

5.1.2 Ethernet Connector Pinout

The Umbra Network Switch provides 8 iX Industrial™ Type A Ethernet ports and is wired with 4 pairs as shown below to support 1000BASE-T (1 Gigabit), 100BASE-TX (100 Megabit), and 10BASE-T (10 Megabit) operation as shown below.

100 Megabit and 10 Megabit operation allows for reduced harnessing with just 2 pairs. The Network Switch will auto-negotiate link speed and physical layer.

Figure 3. IX61G-A-10P Mating Face View

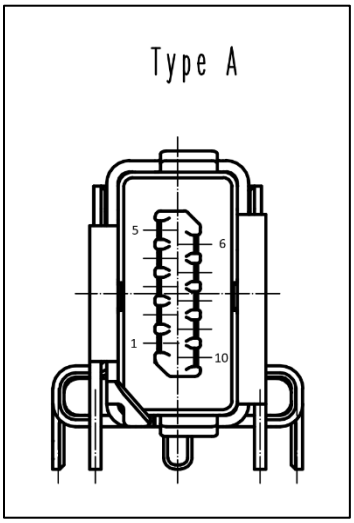


Table 9. Ethernet Connector Pinout

PIN	SIGNAL (1000BASE-T)	SIGNAL (10BASE-T, 100BASE-TX)
1	BI_DA+	TX+
2	BI_DA-	TX-
3	No Connect	No Connect
4	BI_DC+	No Connect
5	BI_DC-	No Connect
6	BI_DB+	RX+
7	BI_DB-	RX-
8	No Connect	No Connect
9	BI_DD+	No Connect
10	BI_DD-	No Connect
SH	ETHERNET_SHIELD	ETHERNET_SHIELD

5.2 Harnessing Recommendations

It is advised to secure the Ethernet harness as mentioned in section Power Connector Pinout. Space-rated harnesses connecting to the Umbra Network Switch should use wire in accordance with SAE AS22759.

5.3 Grounding Block Diagram

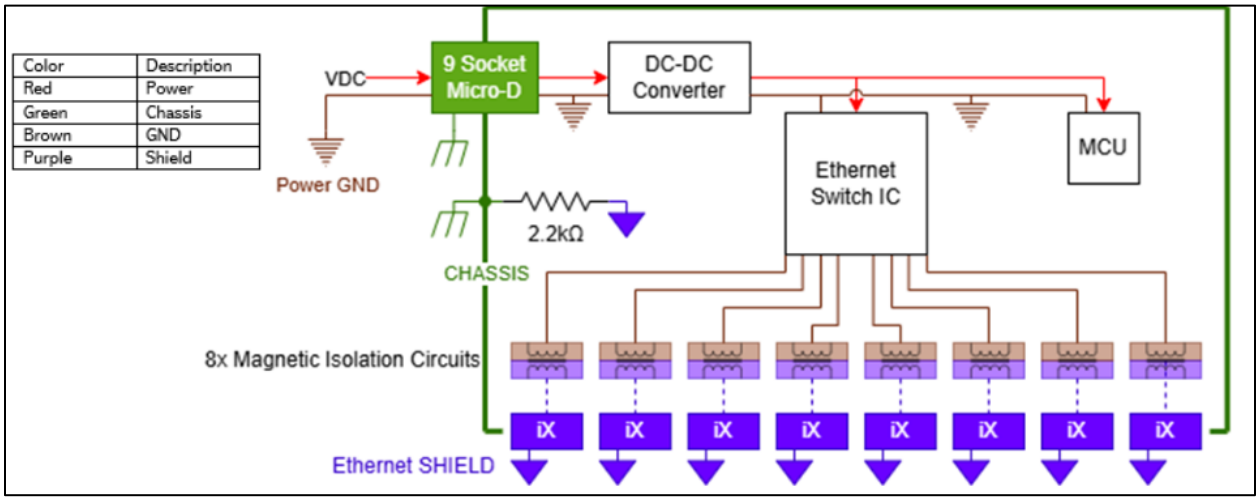
The Umbra Network Switch utilizes three distinct grounding domains: Power Return (Power GND), Chassis, and Ethernet Shield for flexibility in meeting a variety of spacecraft grounding requirements.

Power GND is the reference for all active electronics within the Switch module and returns only to the Micro-D power connector. It is also the reference for the MDI signals on the Switch IC side of the magnetic isolation circuits.

Chassis is the reference connected to the module enclosure and Micro-D connector backshell. This is designed to float from Power GND to prevent extraneous ground loops in the integrated spacecraft. The customer is recommended to tie Chassis to Power GND at a single point in the spacecraft with 2.2kΩ of resistance.

Ethernet Shield is the reference for all the iX Industrial™ ethernet connector backshells, as well as the MDI signals on the connector side of the magnetic isolation circuits. Ethernet Shield is tied to Power GND at a single point in the module with 2.2kΩ of resistance.

Figure 4. Grounding Block Diagram



5.4 EMI/EMC Properties

The Umbra Network Switch has not been tested for Electromagnetic Interference (EMI) / Electromagnetic Compatibility (EMC) per MIL-STD-461. It has been successfully tested for self compatibility with X-Band, S-Band, and L-Band radios.

5.5 Material Properties

All Umbra products are manufactured from materials deemed space-rated based on low outgassing. See Appendix B for more information on material properties of the Umbra Network Switch.

6.0 Software Properties

The Umbra Network switch contains no user-accessible commanding software or telemetry packets. The serial configuration CLI is not exposed.

7.0 Performance Specifications

7.1 Physical Layer Standards

Table 10. Physical Layer Standard

Standard	Duplex	Description
10BASE-T	Half	10 Megabit Ethernet
10BASE-T	Full	10 Megabit Ethernet
100BASE-TX	Half	100 Megabit Ethernet
100BASE-TX	Full	100 Megabit Ethernet
1000BASE-T	Half	1 Gigabit Ethernet
1000BASE-T	Full	1 Gigabit Ethernet

The Umbra Network Switch will auto-negotiate with all connected devices to use the highest possible link speed for each device.

7.2 Auto-MDI/MDIX

The Umbra Network Switch supports automatic crossover between MDI ports and MDIX ports, eliminating the need for crossover cables between TX and RX pairs for 10BASE-T and 100BASE-T. For 1000BASE-T, pair A may be switched with pair B, and pair C may be switched with pair D as shown in the table below.

Table 11. MDI/MDIX Crossover

iX Connector Pin	MDI	MDIX
1	BI_DA+	BI_DB+
2	BI_DA-	BI_DB-
4	BI_DC+	BI_DD+
5	BI_DC-	BI_DD-
6	BI_DB+	BI_DA+
7	BI_DB-	BI_DA-
9	BI_DD+	BI_DC+
10	BI_DD-	BI_DC-

7.3 Polarity Correction

The Umbra Network Switch supports automatic polarity (+ -) correction within twisted pairs for all 8 ethernet ports.

7.4 Unmanaged Switch

The base configuration of the Umbra Network Switch is unmanaged and will simply pass data over IP between any of the 8 Ethernet ports.

8.0 Operational Procedures

Follow all requirements and recommendations in 4.1 Mechanical Handling while carrying out any procedures in this section. Umbra Network Switch may be damaged if mechanical handling requirements and recommendations are not followed while carrying out any procedure listed in this section.

8.1 Ground Support Equipment

Not applicable.

8.2 First Use Procedure

The following must be completed before any other procedures in this user guide are carried out.

8.2.1 Assembly

The Umbra Network Switch may ship with dust covers. Remove these before flight.

Attach the Umbra Network Switch using Qty. 4 #8-32 fasteners with a minimum of 1.5 diameters of thread engagement. Umbra recommends torquing to 27 in-lb over prevailing.

8.2.2 Initial Checkout

Connect power harness to the Network Switch. Refer to Section Connector Pinouts 5.1 for information about the power interface.

Connect two networkable devices to the Network Switch using iX Industrial™ Ethernet cables.

Configure each device’s Ethernet interface with known Static IP addresses.

Provide power, nominally at 28V, 0.5A current limit.

From each device, ping the other device to inspect for reachability and proper switch operation.
The following must be completed before any other procedures in this user guide are carried out.

8.3 Sample Procedure

Not applicable.

8.4 On-Orbit Checkout

Verification of Umbra Network Switch functionality can be tested by demonstrating communications from the edge device connected to the Umbra Network Switch to the host.

If host is running an OS, then a compatible commercial network speed test application is recommended if desired.

8.5 Customer Grounding and Isolation Design

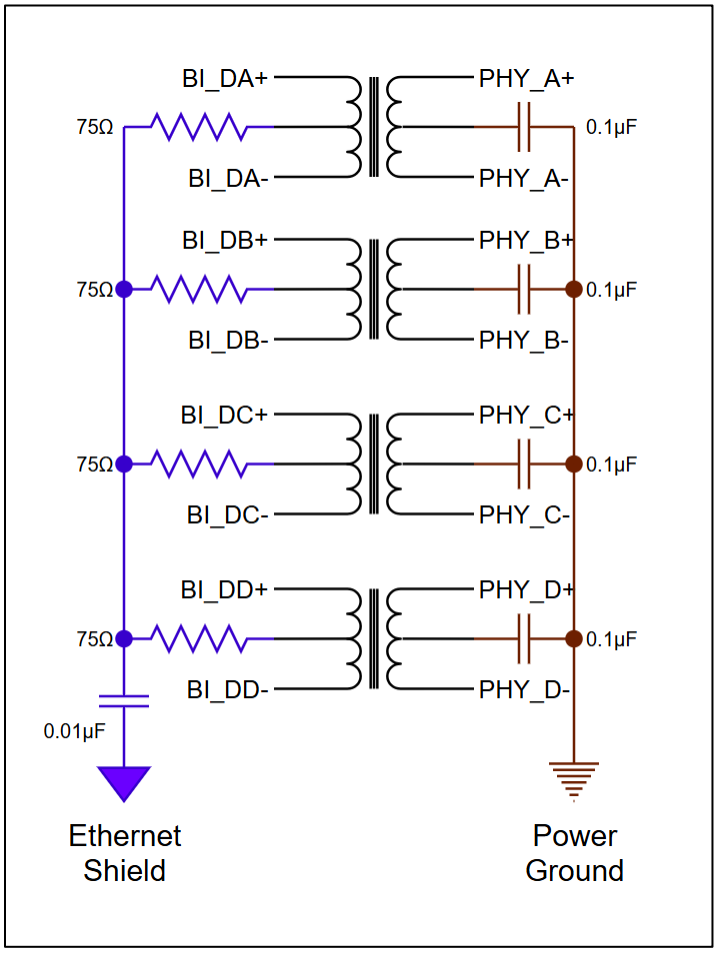
The Umbra Network Switch uses wire transformers and common mode chokes, commonly referred to as magnetics, to electrically isolate the Ethernet signal conductors between the switch and devices. This scheme also maintains separate Power Ground and Ethernet Shield.

All customer side devices must utilize magnetics to isolate the connector interface from the Ethernet PHY for each signal pair. An example circuit is shown in the figure below, with connector interface on the left and referenced to Ethernet Shield, and PHY interface on the right and referenced to Power Ground.

Ethernet harnesses may utilize a shield tied to the conductive plug bodies on both ends for fully shielded routing on the Ethernet Shield domain.

In order to prevent unwanted ground loops, do not tie the Ethernet Shield domain to Chassis or Power Ground.

Figure 5. Device Ethernet Magnetic Isolation Circuit



Appendix A

Acronyms and Abbreviations

A.1 Acronyms and Abbreviations

EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
FOD	Foreign Object Debris
GEVS	General Environmental Verification Standard
GND	Ground
GSE	Ground Support Equipment
ICD	Interface Control Document
MICD	Mechanical Interface Control Document
N/A	Not Available
NASA	National Aeronautics and Space Administration
RBF	Remove Before Flight
TID	Total Ionizing Dose

A.2 Units

°C	Degrees Celsius
A	Ampere
krad	Kilorad
mA	Milliamperes
V	Volts

Appendix B

Mechanical Interface Control Documentation