Network Switch User Guide

Distribution Statement	Export Control
No Restrictions	No US Export Control Information

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1.0 Objective

This document provides guidance on integrating the Umbra Network Switch 8-1G product into the customer's Flight hardware configuration. The Umbra Network Switch 8-1G 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

Number	Description
5091D0003	UMBRA NETWORK SWITCH MICD

2.2 Standard Documents

Number	Description
AS22759	WIRE, ELECTRICAL, FLUOROPOLYMER-INSULATED, COPPER OR COPPER ALLOY
GSFC-STD-7000	GENERAL ENVIRONMENTAL VERIFICATION STANDARD (GEVS) MIL-STD-461
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 Document Disclaimer

DISCLAIMER: This User Guide is intended to provide a 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 Unpacking.

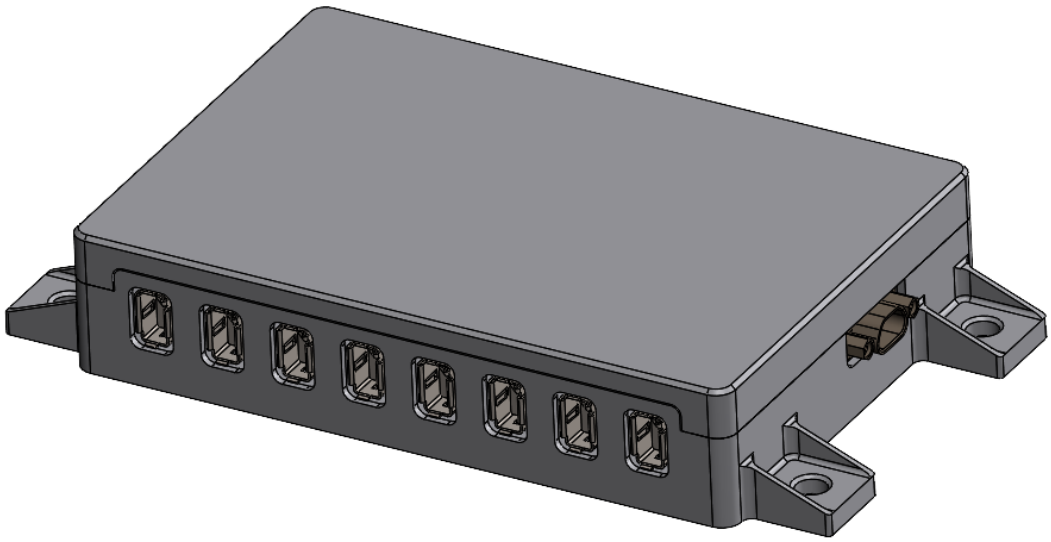


Figure 1. Umbra Network Switch 8-1G Module

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 misused. Contact Umbra Lab, Inc. if any Umbra Network Switch 8-1G fails to perform any procedure described in this document. Do not continue using any Umbra Network Switch 8-1G with any suspected damage.

1. Ensure that any transportation of the Umbra Network Switch 8-1G occurs in an environment described in Section 4.5 Storage and Transport Environment.
2. Do not drop the Umbra Network Switch 8-1G.
3. Only lift the Umbra Network Switch 8-1G by the chassis. Do not disassemble the Umbra Network Switch 8-1G.
4. Do not lift the Umbra Network Switch 8-1G by the connectors.
5. Ensure dust caps are installed on all connectors while transporting or handling the Umbra Network Switch 8-1G.

4.1.1 Hazards

The Umbra Network Switch 8-1G does not contain any hazardous materials that are subject to exposure during its intended use.

4.1.2 ESD Sensitivity

The Umbra Network Switch 8-1G is ESD sensitive to both the human-body model and charge device model as per the following table:

Table 1. ESD Sensitivity

Description			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 the 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 reapply protective dust covers.

4.2 Remove Before Flight (RBF) GSE

Items in Table 2 must be removed prior to installation on the customer's spacecraft:

Table 2. RBF Items

Item	Critical/Optional	Notes
8X Ethernet Connector Dust Caps (5091G00002-1)	Critical	Ethernet IX connector dust covers

Item	Critical/Optional	Notes
1X J9 Dust Cap (D6257-009)	Critical	Micro-D connector

4.3 Electrical Mate & Demate

The following information outlines allowable mate and demate cycles for the connectors:

Table 3. Flight Connector List

Connector Designation	Assembly Connector	Recommended Mating Flight Connector	Allowable Cycles	Hot Pluggable
J1-J8	ND9AS1300	ND9-AP54-00	Up to 5000	Yes
J9 Power	MMDS-009	MMDP-009	Up to 2000	No

Additional notes:

- 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 are hot pluggable while the Network Switch is powered on.

4.4 Connector Cable Strain Relief

It is recommended to secure all harnessing interfacing to the Umbra Network Switch 8-1G according to the guidance provided in SAE-AS50881, which outlines the installation of wiring harnesses. Umbra suggests securing cables less than 12” of straight cable length from the connector body before any bends.

4.5 Storage and Transport Environment

- Do not store the Umbra Network Switch 8-1G in direct sunlight.
- Do not store the Umbra Network Switch 8-1G in such a way that damages part markings.
- Ensure that critical RBF components are in place during all transport of the Umbra Network Switch 8-1G.

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

The Umbra Network Switch 8-1G is designed and tested to operate in the following operating conditions:

Table 5. Operating Environment

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

4.7 Survival Environment

The Umbra Network Switch 8-1G has been lab-tested to withstand the following environment with no impact on function.

Table 6. Survival Environment

Parameter	Value
Survival Temperature	-40 °C to +85 °C
Vibration	Qualified to 14.15 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 Information

- See Appendix B (MICD) for information on mounting hole locations.
- It is recommended that the Umbra Network Switch 8-1G be mounted internally to the bus or payload without direct exposure to space to limit the temperature range.
- Maintain a FOD awareness zone around the Umbra Network Switch 8-1G during Spacecraft assembly integration and test.

5.0 Electrical Properties

Table 7. Electrical Properties

Parameter	Min	Nom	Max
Input Voltage	23 V	28 V	33 V
Power Consumption at 33 V and 28°C	2.2 W	5.1 W	5.4 W

Notes:

- The Umbra Network Switch 8-1G does not support Power over Ethernet (PoE).
- Min Power Consumption is idle power with zero active ports.
- Nom Power Consumption is active link on all eight ports without traffic.
- Max Power Consumption is all eight ports with max data rate traffic concurrently.

5.1 Connector Pinouts

5.1.1 Power Connector (J9) Pinout

The location of the Umbra Network Switch 8-1G J9 power connector (MMDS-009) is described in Appendix B (MICD). Refer to the following pinout table and mating face view for connection details:

Table 8. J9 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

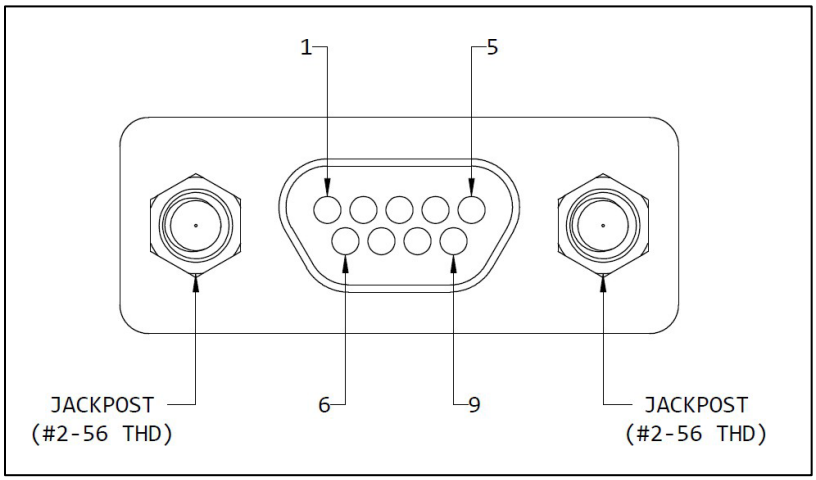


Figure 2. MMDS-09 Connector Mating Face View

- It is recommended to use all available 28 V Power and GND pins. However, a minimum of any 2X Power and 2X GND pins may be used.

- The connector body is electrically bonded to the chassis ground (CHASSIS) and isolated from ground (GND) pins.
- The mating harness connector body and backshell should be isolated from the GND pins and will be electrically bonded to the CHASSIS ground through the mating jack posts and screws.

5.1.2 Ethernet Connector Pinout

The Umbra Network Switch 8-1G features eight IX Industrial Type A Ethernet ports and is wired with four pairs, as shown below, to support 1000BASE-T (1-Gigabit), 100BASE-TX (100-Megabit), and 10BASE-T (10-Megabit) operations.

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

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

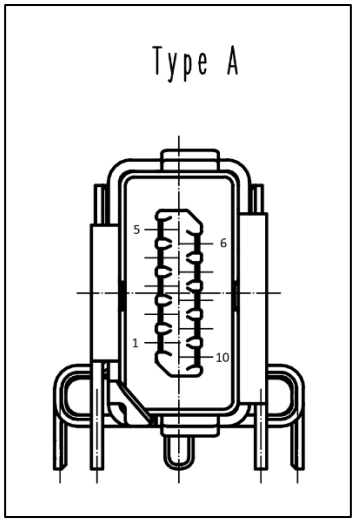


Figure 3. ND9AS1300 Connector Mating Face View

5.2 Harnessing Recommendations

It is recommended to use space-rated harnesses that connect to the Umbra Network Switch 8-1G, utilizing space-rated wire in accordance with SAE AS22759. The following mating connectors are suggested:

- IX Connector PN ND9-AP54-00

- Micro-D Power Connector PN A98000-009

5.3 Grounding Block Diagram

The Umbra Network Switch 8-1G 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 the Chassis to the Power GND at a single point in the spacecraft with 2.2 kΩ 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. The Ethernet Shield is connected to the Power GND at a single point in the module with a resistance of 2.2kΩ.

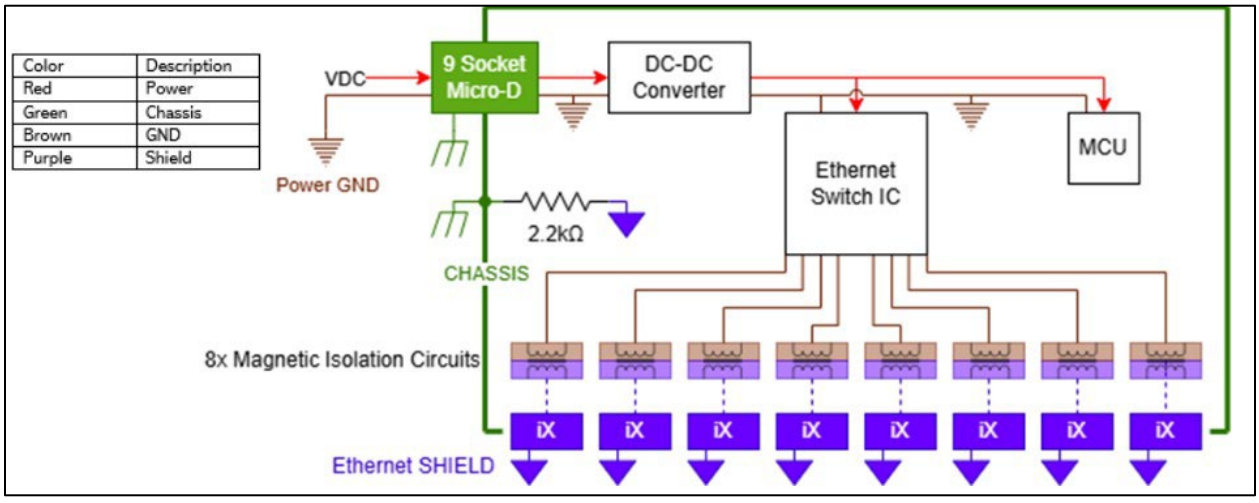


Figure 4. Ground Block Diagram

5.4 EMI/EMC Properties

The Umbra Network Switch 8-1G has not been tested for Electromagnetic Interference (EMI) or Electromagnetic Compatibility (EMC) in accordance with 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 due to their low outgassing. Refer to Appendix B for additional information on the material and surface finish properties of the external chassis components.

6.0 Software Properties

The Umbra Network Switch 8-1G 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 8-1G 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 8-1G supports automatic crossover between MDI (Medium-dependent Interface) ports and MDIX (MDI with Crossover) ports, eliminating the need for crossover cables between TX (Transmit) and RX (Receive) 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 8-1G supports automatic polarity (+/-) correction within twisted pairs for all eight Ethernet ports.

7.4 Unmanaged Switch

The base configuration of the Umbra Network Switch 8-1G is unmanaged and will pass data over IP between any of the eight Ethernet ports.

8.0 Operational Procedures

Follow all requirements and recommendations in Section 4.0 Hardware Handling while carrying out any procedures in this section. Umbra Network Switch 8-1G 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 steps must be completed before proceeding with any other procedures outlined in this user guide.

8.2.1 Assembly

1. The Umbra Network Switch may ship with dust covers. Remove these before installation.
2. Attach the Umbra Network Switch 8-1G using 4X #8 or M4 fasteners with NAS1149 or equivalent washers.
    a. Umbra suggests a minimum of 1.5 diameters of thread engagement in the mating bus structure, with a torque of 27 in-lbs over the prevailing torque using A286 or stronger fasteners. However, customers should perform bolted joint analysis for their joint stack-up.

8.2.2 Initial Checkout

1. Connect the power harness with the power off. Refer to Section 5.1.1 Power Connector (J9) Pinout Power Connector Pinouts for information about the power interface.
2. Connect at least two networkable devices to the unit using Ethernet cables with IX connectors. Configure each device’s Ethernet interface with known Static IP addresses.
3. Provide power, nominally at 28V with a 500 mA current limit.
4. From each device, ping the other device to inspect for reachability and proper switch operation. Move connectors between all eight ports and repeat ping tests to confirm functionality.

8.3 Sample Procedure

Not applicable.

8.4 On-Orbit Checkout

Verification of the Umbra Network Switch 8-1G functionality can be tested by demonstrating communications from the edge device connected to the Umbra Network Switch to the host.

If the 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 8-1G 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 a separate Power Ground and Ethernet Shield.

All customer-side devices must utilize magnetics to isolate the connector interface from the Ethernet PHY (Physical-layer chip) for each signal pair. An example circuit is shown in the figure below, with the connector interface on the left and referenced to Ethernet Shield, and the 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.

To prevent unwanted ground loops, do not connect the Ethernet Shield domain to the Chassis or Power Ground.

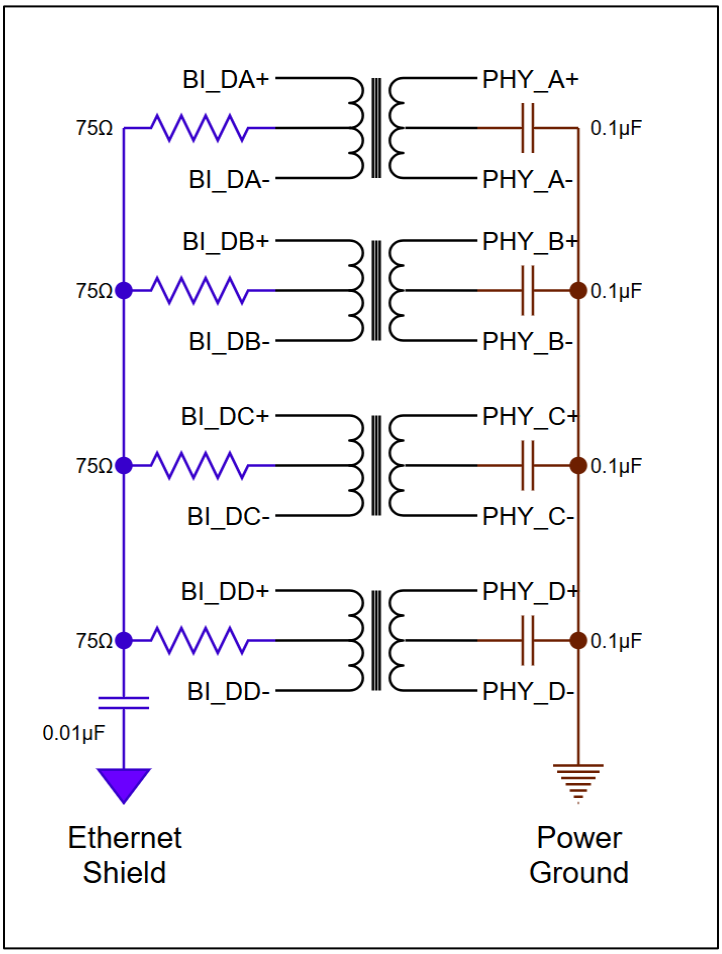


Figure 5. Device Ethernet Magnetic Isolation Circuit

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
RBF	Remove Before Flight
TID	Total Ionizing Dose

A.2 Units

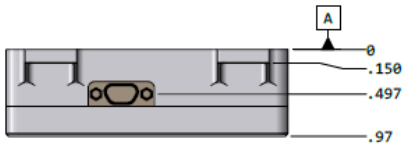
°C	Degrees Celsius
A	Ampere
krad	Kilorad
mA	Milliamperes
V	Volts

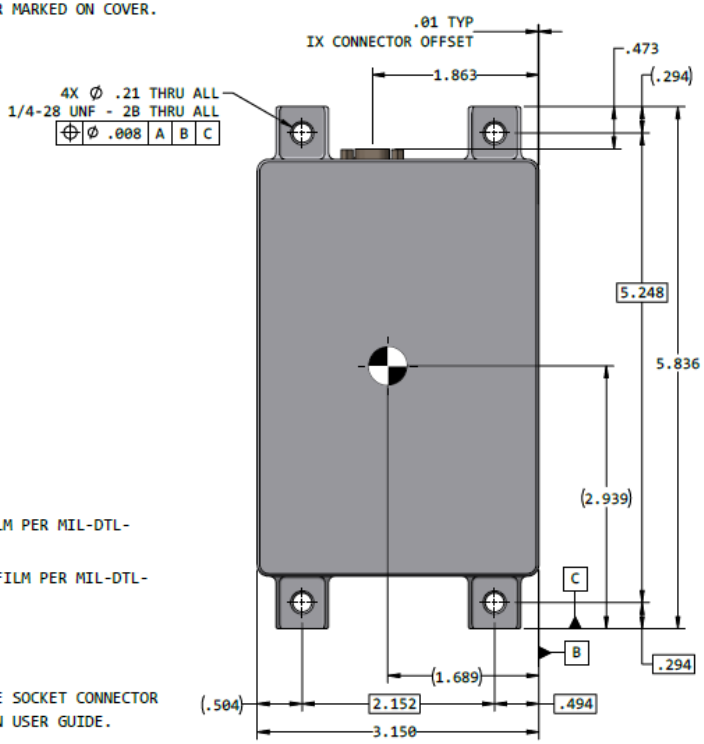
Appendix B

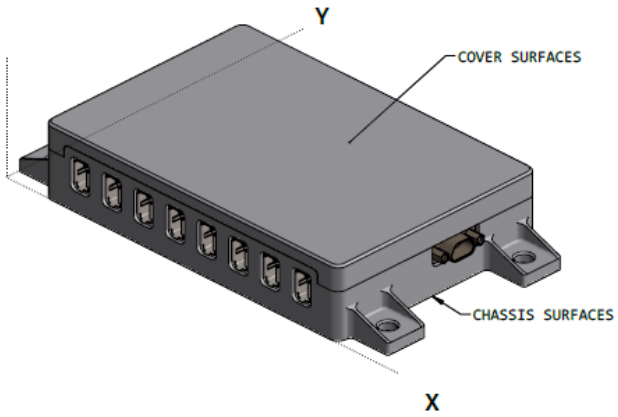
Mechanical Interface Control Drawing

DISTRIBUTION STATEMENTS:
UMBRA PUBLIC - NO RESTRICTIONS

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	01	INITIAL RELEASE	20251111	L. HERRERA
	02	UPDATED MAXIMUM POWER DISSIPATION	20251124	L. HERRERA







-1 CONFIGURATION SHOWN

NOTES: UNLESS OTHERWISE SPECIFIED

1. MARKING

A) PART NUMBER, REVISION, AND SERIAL NUMBER MARKED ON COVER.

2. MECHANICAL PROPERTIES:

A) MASS (± 10%): 0.508 LBM

B) CENTER OF MASS (± 10%):

X	2.939
Y	1.689
Z	0.450

C) MOMENT OF INERTIA (± 10%):

ABOUT CENTER OF MASS

Ixx	0.585 LBM*IN^2
Iyy	1.310 LBM*IN^2
Izz	1.780 LBM*IN^2

3. THERMAL PROPERTIES:

A) COVER SURFACES: AL 6061-T6 WITH CHEM FILM PER MIL-DTL-5541, TYPE II, CLASS 3, NO DYE.

B) CHASSIS SURFACES: AL 6061-T6 WITH CHEM FILM PER MIL-DTL-5541, TYPE II, CLASS 3, NO DYE.

C) MAXIMUM POWER DISSIPATION: 5.4W

4. ELECTRICAL INTERFACES:

A) SINGLE OMNETICS MICRO D-SUB 9-PIN FEMALE SOCKET CONNECTOR WHERE SHOWN. ADDITIONAL INTERFACE DETAIL IN USER GUIDE.

B) EIGHT FEMALE HIROSE IX ETHERNET CONNECTORS WHERE SHOWN. ADDITIONAL INTERFACE DETAIL IN USER GUIDE.

C) POWER GROUND AND CHASSIS GROUND ARE ISOLATED INTERNALLY. CHASSIS GROUND IS BONDED TO MOUNTING SURFACES. REFER TO GROUNDING DIAGRAM IN USER GUIDE.

5. MOUNTING:

A) INSTALL USING 4X #8 OR M4 FASTENERS.

B) MOUNTING HOLES ARE TAPPED TO FACILITATE REMOVAL AS REQUIRED.

UNLESS OTHERWISE SPECIFIED
-INTERPRET PER ASME Y14.5M-2009
-DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
ANGULAR ± .5°
DECIMAL .X ± .1
.XX ± .01
.XXX ± .005
BREAK CORNERS .005-.020
SURFACE ROUGHNESS 63
THIRD ANGLE PROJECTION

STATUS: **FLIGHT**

	SIGNATURES	DATE
ENG	J. BRIGHT	20251020
CHK	D. GARCKEN	20251024
MFG	L. HERRERA	20251111
TD		
ANL		
PM	M. LAPOINTE	20251027

UMBRA LAB, INC
SANTA BARBARA, CA 93101

TITLE: UMBRA NETWORK SWITCH MICD

SIZE	CAGE CODE	DRAWING NO	REV
B		5091D0003	02

SCALE 3:4 | WEIGHT 0.508 LB | SHEET 1 OF 1