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Experiment Interface Panel (EIP)
User's Guide

NASA Ames Research Center

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1.0 Introduction.

1.1 What is an EIP?

Experimenter Interface Panels (EIP) are a standard power and data interface for instruments flying on board NASA Airborne Science platforms. The EIP supplies AC (3Φ, 400Hz), DC (28V), and switched contacts to power and control experiments. The primary data interface is Ethernet but EIPs also offer several connections for legacy protocols (RS-232, ARINC-429, IRIG-B, Synchro). In this document, the words 'experiment,' 'instrument,' and 'payload' are used interchangeably to describe hardware that connects to an EIP intended to fly onboard a NASA aircraft.

An overview of the EIP interface, including history, versions, and design philosophy are covered in "EIP: A Standard Experimenter Interface Panel," presented at SPIE Optical Applications, 2012. A copy of the - paper is available on request from the NASA Airborne Sensor Facility.

2.0 Quick Start Guide

The following describes the most basic connections required to operate an EIP on the bench. Refer to Sections 3.0, 4.0, and Appendix A for more detailed information on pinouts, connector part numbers, and signals.

2.1 Payload DC Power

Note: The current limit below is below the EIP specification. See Sections 3.0 and 4.0 for more details.

1. Configure a DC power supply for 28VDC ± 1V.
    a. For high current power supplies, limit the output to 35A maximum.
    b. Power off or disable the supply before proceeding.
2. Connect the power supply to a single circuit on EIP J15:
    a. Power supply '+' to J15 / A
    b. Power supply '-' to J15 / B
3. Power on the DC supply.
    a. The standby current draw should be about 350mA.
    b. The amber 'DC' lamp on the EIP front panel should be illuminated, and the blue 'EIP' lamp should be off.

Note: Each of the following signal measurements should be performed in reference to their respective power returns (see Appendix A) OR the EIP chassis.

4. 28V DC should now be present on the following signals:
    a. J11, contacts 'A' and 'C'
    b. J6, J7, J8, and J9, contacts 'D' and 'H.'
    c. J2, J3, J4, and J5, contact 'K.'
    d. J1, contact 'j' (ZJ).
5. Power off the supply.

2.2 EIP Switches

1. Verify all EIP power supplies are off.
2. Interlock Jumper:
    a. Connect a jumper from J2 / C to J2 / D.
3. Switch control input:
    a. Connect a switched 28V signal to J1 / k (ZK).
    b. Refer the switched signal return to EIP Payload power return.
4. Solid State Relay Input:
    a. Connect J2 / K to J2 / B (28V to switch input)
5. Connect EIP Payload power per Section 2.1.
6. Power on the EIP payload power supply.
7. Activate the switch signal:
    a. J2 / A should toggle to 28V with the switch.

2.3 EIP Legacy Switch

1. Verify all EIP power supplies are off.
2. Interlock Jumper:
    a. Connect a jumper from J1 / A to J1 / C.
3. Switch control input:
    a. Connect a switched 28V signal to J1 / d (ZD).
    b. Refer the switched signal return to EIP Payload power return.
4. Verify the following mechanical relay contacts:
    a. J1 N.O. Contact: J1 / EE to J1 / HH should measure >1MΩ.
    b. J1 N.C. Contact: J1 / GG to J1 / HH should measure <1Ω.

5. Connect EIP Payload power per Section 2.1.
6. Power on the EIP payload power supply.
7. Activate the switch signal:
    a. J1 N.O. Contact: J1 / EE to J1 / HH should measure $<1\Omega$.
    b. J1 N.C. Contact: J1 / GG to J1 / HH should measure $>1M\Omega$.

2.4 EIP Internal Power

Note: The following assumes separate supplies are used for powering the Payload and EIP Internal circuits. A single supply can be used to power both circuits; note the values for currents and lamps will change accordingly.

1. Configure a DC power supply for 28VDC ± 1V.
    a. For high current power supplies, limit the output to 3A maximum.
    b. Power off or disable the supply before proceeding.

Note: The EIP Internal Power is intentionally isolated from the EIP Chassis and can be tied at the user's option.

2. Connect the power supply to EIP J18:
    a. Power supply '+' to J18 / DD
    b. Power supply '-' to J18 / EE
    c. (Optional) Power supply '-' to EIP Chassis.
3. Power on the DC supply.
    a. The standby current draw should be about 350mA.
    b. The blue 'EIP' lamp on the EIP front panel should be illuminated.

2.5 Ethernet and EIP Status Packets

Note: The following step requires a quadrax to RJ45 adapter; these units can either be built by hand or obtained from the NASA Airborne Sensor Facility. See Appendix E for more details.

1. Connect a single quadrax to RJ45 adapter cable to EIP J19, insert 'A.'
    a. Recommended: Insert the quadrax into a mating shell first.
    b. Alternate: Mate the quadrax manually; the quadrax key should align with the key for the J19 receptacle (towards the enclosure engraving).
2. Configure and apply EIP internal power per Section 2.2.
3. Use an Ethernet capture program, such as Wireshark or tcpdump to capture EIP status packets.
    a. The EIP status broadcasts should have an IP address of 10.3.0.15.
    b. Refer to Appendix B for the status packet format.

2.6 Payload AC Power

CAUTION: THE FOLLOWING INVOLVES HIGH VOLTAGES WHICH, WHEN HANDLED IMPROPERLY, CAN RESULT IN SHOCK OR DEATH. THE FOLLOWING STEPS ARE SAFETY-CRITICAL AND SHALL ONLY BE PERFORMED BY AUTHORIZED PERSONNEL.

Note: The current limit below is below the EIP specification. See Sections 3.0 and 4.0 for more details.

1. Locate a 3-phase AC power supply (typically 115VAC, 400Hz).
    a. For high current power supplies, limit the output to 10A maximum.
    b. Power off or disable the supply before proceeding.
2. Connect the 3 phase AC supply to EIP J16 per the Appendix A pinouts.
3. Power on the AC supply.
4. 115VAC should now be present on the following signals:
    a. J6, J7, J8, and J9, contacts 'A,' 'B,' and 'C' with respect to neutral 'N.'
    b. J6, J7, J8, and J9, contacts 'J,' 'K,' and 'L' with respect to neutral 'S.'
5. Power off the supply.

3.0 Payload Interface

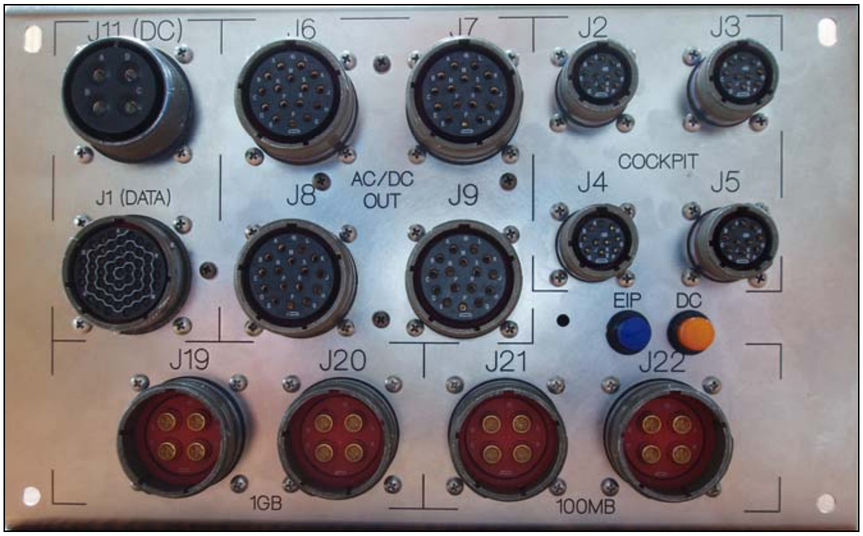


Figure 3: Mark III EIP Front Panel (Instrument Interface)

3.1 Mixed AC/DC Connector ('AC/DC')

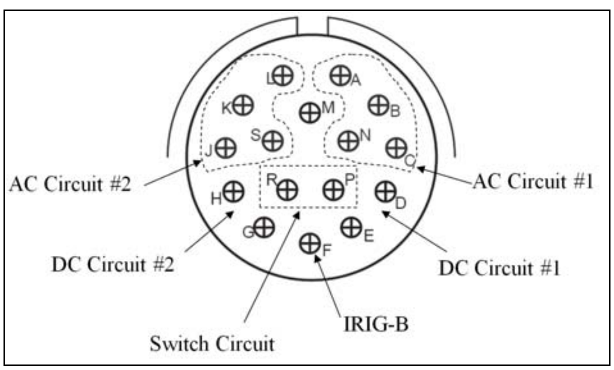


Figure 4: Mixed AC/DC Connector (J6-J9)

The EIP delivers AC and DC power over a MIL-DTL-38999/III connector at four locations. Connectors J6 through J9 are pin-compatible with the Mark II Global Hawk design, and provide the same AC and DC power capability as the Mark I units. However, the Mark III connector differs from both previous versions in the following respects:

1. Connector style and pinout are changed.
2. No amplified GPS feed (pin M on the Mark II).
3. The switch circuit is a unidirectional, solid state circuit rated at 5A (Mark II was mechanical @ 15A).
4. Shield pins on the Mark I design were eliminated; any shield connections tie to the plug shell.

DC Circuits:

Item	Notes
Power	420W maximum per circuit @ 28VDC, 2.2kW maximum per EIP
Protection	Overcurrent protected at 15A, surge current at 120A, reverse voltage at 100V. Inputs are lightning protected.
Monitoring	Output voltage, current, surge and overcurrent trip status
Operation	Circuits become active with area power (J15), reset tripped circuits by cycling area power.
Input Voltage Range	Input is located at J15. Vin = 4V to 36VDC, surge to 80V @ 0.1s
Output Voltage Range	Vout = Vin – (0.007*I + 0.35V), where I = load current.
Grounding / Reference	Each circuit has its own power return. All DC returns are referenced to the EIP chassis.

Switch Circuits #2-5 (J6-J9):

Item	Notes
Power	140W maximum per circuit @ 28VDC
Protection	Overcurrent protected at 5A, surge current at 80A, reverse voltage at 60V. Inputs are lightning protected.
Monitoring	Output voltage, current, surge and overcurrent trip status
Operation	J6-J9 are controlled by cockpit switches #2-5, respectively. Interlock on J2-J5 must be terminated to ground to operate.
Input Voltage Range	Vin = 4V to 36VDC, surge to 80V @ 0.1s
Output Voltage Range	Vout = Vin – (0.014*I + 0.35V), where I = load current.
Grounding / Reference	Switch circuit voltages are referenced to and share return currents with the J6-J9 DC power returns

Switches #2 through 5 are solid-state, unidirectional circuits and can only **source** electrical current.

AC Circuits:

Item	Notes
Power	5.175kVA / circuit, 17.25kVA maximum per EIP (@115VAC)
Protection	None; protection must be provided externally.
Monitoring	N/A
Operation	Circuits become active with area power (J16).
Input Voltage Range	Input is located at J16. Designed for 115VAC, 400Hz on 3 phases
Output Voltage Range	Designed for 115VAC, 400Hz on 3 phases
Grounding / Reference	The EIP does not tie any AC phase or neutral signal to chassis; any connections are made on the aircraft.

IRIG-B: Pin F is a #16 coaxial insert; the center carries IRIG-B, and the shell carries return.

Appendix A contains detailed pin-outs and part numbers for all connectors.

3.2 Commonality with the Mark I Interface

The EIP provides several payload-side interfaces. To maintain backwards compatibility with legacy instruments, two payload connectors are exact duplicates of the MK1 design. J11 ('DC') is a MS5105-type, direct pass-through of the EIP's two 28VDC input circuits, rated at 40A (35A steady-state) per circuit. The J1 ('DATA') connector is identical in pinning and circuitry with the Mark I J1 connector. J1 is a MIL-DTL-26482 type and provides a cockpit-controlled switch, interlock interface #1, and altitude and landing gear relays. Several signals are also allocated for pass-through of the same RS-232, ARINC-429, Synchro, and IRIG-B signals available previously. On some aircraft, these signals are isolated and buffered by the system's navigation recorder (NASDAT).

3.3 Payload Pilot Interface (J1 through J5)

Connector J1 is identical in pinout, functionality, and specification to the Mark I design. All mechanical relay contacts are rated at 0.5A (steady state). All legacy data signals (RS-232, ARINC-429, etc.) are wired pass-thrus from the NASDAT drivers; no active circuitry is present in the EIP.

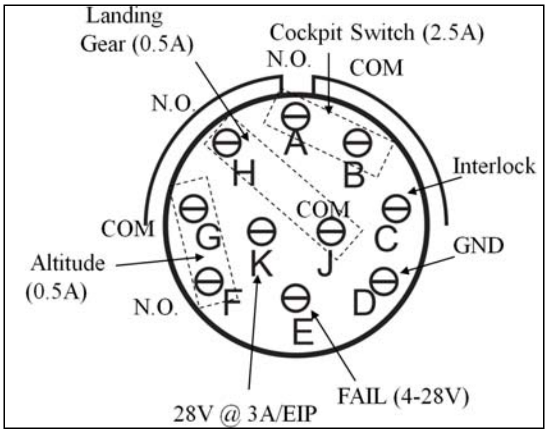


Figure 5: Payload Pilot Interface, Switches #2-5

Optimized versions of the Mark I J2 through J5 'DATA' connectors carry the same designators on the Mark III design. The 'COCKPIT' connectors provide only the cockpit switch and interlock interfaces #2 through 5 on a smaller, MIL-DTL-38999/III connector. Relay contacts for altitude and landing gear relays are also included. 28V and ground contacts are available for limited loads.

Figure 5 illustrates the instrument interface to the indicator panel for switches #2 through 5. Per Figure 5, the EIP interfaces each instrument via a set of three relays and two indicator lines. One relay corresponds to the on/off switch in the cockpit; two additional relays indicate the status of the aircraft landing gear and an altitude sensor. The first indicator line is a simple, ground-tied, interlock to tell the pilot the instrument is electrically connected. The fail indicator is payload specific and provides a basic payload status during start-up and operation.

Switches #2-5:

Item	Notes
Power	70W maximum per circuit @ 28VDC
Protection	Nominal rating is 2.5A, steady state. Circuit is polyfuse protected.
Monitoring	Output voltage, current, surge and overcurrent trip status
Operation	J2-J5 are controlled by cockpit switches #2-5, respectively. Interlock on J2-J5 must be terminated to ground to operate.
Input Voltage Range	Vin = 4V to 36VDC, surge to 80V @ 0.1s
Output Voltage Range	Vout = Vin – (0.014*I + 0.35V), where I = load current.
Grounding / Reference	Switch circuit voltages are referenced to and share return currents with the GND pin on J2-J5.

Switches #2 through 5 are solid-state, unidirectional circuits and can only **source** electrical current. See Appendix F for details on migrating from mechanical relays to solid state.

Altitude and Landing Gear Relays:

Item	Notes
Power	14W maximum per circuit @ 28VDC
Protection	None. Circuit is rated at 0.5A steady state.
Monitoring	Relay state (on/off) is recorded in the EIP status packet.
Operation	Aircraft-specific
Input Voltage Range	5-28VDC, nominal
Output Voltage Range	5-28VDC, nominal
Grounding / Reference	Use 28V return.

Most of the MK3 EIP payload control circuitry is a direct copy of the MK1 design implemented in modern packaging. The altitude, landing gear, and switch #1 relays are 0.5A (resistive) M39016/19 mechanical relays identical to the legacy EIP. Switches #2-5 are polarized solid state devices, and operate in concert with their counterparts on J6 through J9. However, the J2 through J5 switch contacts are rated lower (2.5A resistive). The EIP status packet reports on/off status for all relays and indicators, and power consumption for the solid state components.

With the exception of the aforementioned relay devices, the cockpit switch logic and circuitry is identical to the legacy design. Below is a very general "pseudo code" description of the cockpit relay logic. Other descriptions and diagrams can be found in the ER-2 or WB-57 Experimenter's handbook, or in the Mark III DCMON PCB schematics.

1. IF (Cockpit Switch = ON) AND (Interlock = GND) then (Cockpit On-Lamp = ON)
2. IF (Cockpit On-Lamp = ON) AND (4V < FAIL Input <28V) then (Cockpit Fail Lamp = OFF) ELSE (Cockpit Fail Lamp = ON).

Installations that do not have a cockpit switch interface can still use the switches, but must remember to tie the interlock to ground in order to activate the experimenter relay.

3.4 Payload Data Interface and Ethernet Network

While legacy data protocols are available for existing instruments, a driving technology in the Mark III design is Ethernet. Each EIP incorporates a modified COTS Ethernet switch with four 1000BASE-T and eight 10/100BASE-T ports available to instruments. The switch also contains a thirteenth internal port dedicated to the EIP monitor. In a typical installation, two 1000BASE-T ports are consumed by the aircraft network backbone, leaving a total of ten ports available for payloads. All payload Ethernet ports are interfaced over MIL-DTL-38999/III connectors with #8 AWG quadrax inserts. Four inserts exist per connector; two inserts are required for a 1000BASE-T connection.

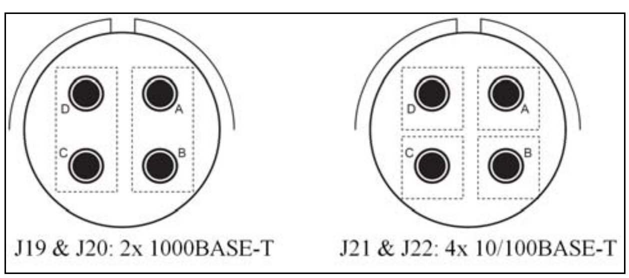


Figure 6: Quadrax-Based Ethernet Connectors (J19-J22)

Quadrax is used on the EIP for performance and reliability reasons and can be used on instruments. However, many users find the Amphenol military RJ45 (RJFTV) series is simpler and cheaper to install.

Quadrax to RJ45 adapters can be built or bought for both 10/100BASE-T and 1000BASE-T applications. If using quadrax, contact the NASA Airborne Facility for parts, pin-outs, and special guidance.

3.5 Payload Software Interface

The EIP provides the physical interface to several software data services available to payloads on the Sensor Net system. Most platforms will incorporate a NASA Airborne Science Data Acquisition and Transmission unit (NASDAT) that replaces the legacy Navigation Recorder. The NASDAT isolates, ingests, and rebroadcasts navigation data and environmental conditions on the payload network. NASDAT also provides a highly stable timekeeping system served over Network Time Protocol (NTP) or distributed over wire by IRIG-B. Both navigation data and time synchronization are services available to payloads flying on the Sensor Net platforms.

Instruments on the Sensor Net system are generally required to broadcast low-rate UDP status packets that contain basic health and monitoring information. EIPs also broadcast status packets containing payload DC power information, cockpit switch states, and general environmental conditions. EIP status packets are ingested, stored, and rebroadcast by the NASDAT on the payload network. Status packet formats are standardized in accordance with IWGADTS.

4.0 Observatory Interface

The EIP left panel is the observatory power and control interface. Connectors J15, J16, and J18 are pin-out compatible with the legacy Mark I EIP design. The EIP DC power input (J15) carries two #8 AWG circuits rated at 35A each. Both payload power returns are bolted to the EIP chassis.

> **Note:** the EIP 28V input circuits on J15 do not have a breaker or reverse polarity clamp and must be protected externally. Reversing polarity on J15 will activate lightning protection circuitry in the solid state devices, causing excessive current flow that can damage the EIP in extreme cases.

The AC power input (J16) carries two, #12 AWG, 3-Φ circuits rated at 25A each. Note that wire rating varies with configuration, temperature, and altitude; needs beyond those listed may be accommodated based on further discussion of the application.

The 'AIRCRAFT' connector (J18) carries several types of signals:

1. Switch #1 through 5 control signals
2. Manned cockpit panel lamp indicator signals
3. Legacy data signals for:
    a. (1) IRIG-B circuit,
    b. (1) Synchro Pitch & Roll circuit
    c. (3) ARINC-429 circuits, and
    d. (2) RS-232 circuits.
4. Altitude and Weight-on-Wheels (WoW) mechanical relay coil contacts
5. EIP Internal power
6. EIP Network ID jumpers

Items #1 through 4 are pin for pin copies of the legacy design. The EIP contains no active circuitry for any of the legacy data signals; they are merely a wire and PCB-trace pass-through to the instrument connectors. EIP internal power operates the DC power monitor, Ethernet switch, and survival heater. The DC power monitor and switch operate on a 20W isolated DC/DC converter circuit that can ingest 19 to 48VDC and is reverse-voltage protected. The 70W survival heater activates when internal device temperatures drift colder than -40C.

> **Note:** The EIP internal power return on J18 not tied to the EIP chassis. It should be referenced to the aircraft chassis external to the EIP in a manner which minimizes system ground loops and noise. The DC/DC secondaries for the monitor and switch are isolated from the J18 power input and are referenced internally to the EIP chassis.

The EIP network ID jumpers provide a means for an EIP to identify its location on the aircraft. The four bits provide up to sixteen unique addresses. Each bit is pulled to a logic '1' by default; no voltage is required to configure the ID jumpers. Leaving all signals disconnected assigns the EIP to a default ID of 15. Setting a bit to logic '0' simply requires a jumper to the J18 shell.

> **Note:** Do not apply voltage to configure the ID jumpers! Applying 28VDC to the ID jumper signals **will** damage the EIP ID circuitry.

Ethernet Interface:
The Mark III EIP is designed to accompany an aircraft Ethernet network backbone. The intended nework is , built on the Amphenol quadrax and Tensolite system, built in accordance with ARINC-664 Part 2.

The Sensor Net switches are fully-managed and can be configured based on the aircraft. The recommended network topology for large networks is a 1000BASE-T fault-tolerant ring, implemented by the EIP as an RSTP mesh. A separate 28V DC power line must be provided for each EIP to bring up the entire network simultaneously. In installations where cockpit switch monitoring is required, the network must be powered on prior to any payload power. Aircraft that tie network and payload power together can use a star topology with the master switch powered from the master payload breaker. Small aircraft can feasibly operate their entire network on a single standalone switch.

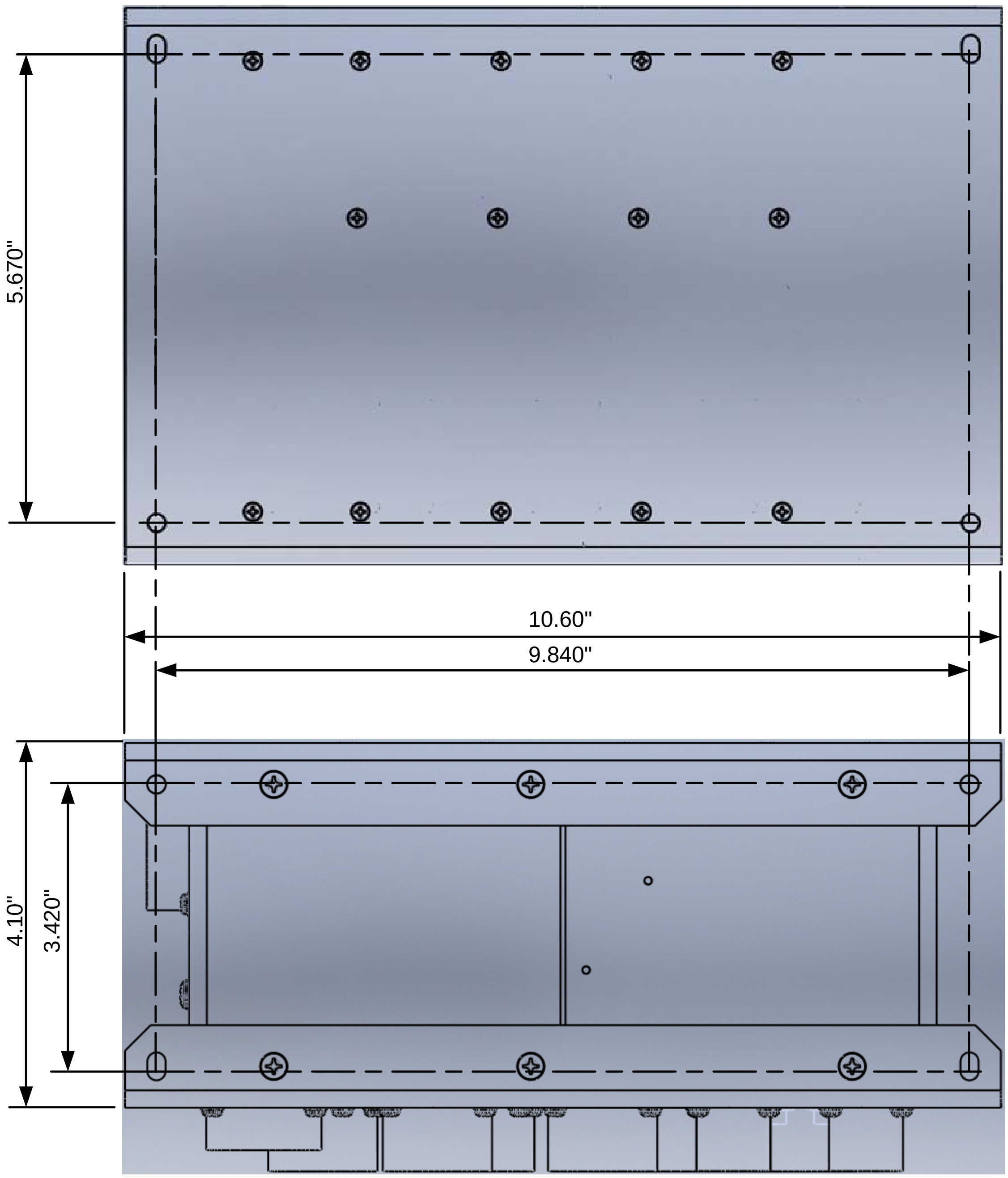
Other Notes:

The J1 (DATA) connector features a connection for a temperature probe that can be read out in the EIP status packets. The temperature probe must be an Analog Devices AD590 or AC2626. The +12V is protected for shorts to ground, and the sensor input is ESD protected. However, neither is protected for shorts to 28V. While these signals may be useful, caution should be exercised when making the connections.

5.0 Mechanical Interface

The EIP carries a universal mounting scheme identical in dimensions to the Mark I EIP.

Note the EIP utilizes the frame to conductively cool the internal electronics at altitude. The EIP panels are not perfectly flat, and therefore heat tends to pass primarily through the bolt connections. The EIP can survive all environments with the design as-is, but in some extreme cases use of Sil-Pad may be advisable.



All mounting holes are 0.198-0.203" diameter. Slot lengths are 0.34".

Tolerance:

.XX ± 0.02"

.XXX ± 0.005"

6.0 Frequently Asked Questions (FAQ)

Q: Does the EIP control experiments over Ethernet?
A: No. All EIP switches are controlled by wire. Unless the switch wires are controlled over software (i.e. for a UAV), there is zero software involved with controlling the EIP experiments.

Q: How is the EIP grounded?
A: The payload power returns are tied to the EIP chassis. The EIP internal power operates on an isolated DC/DC; its secondary is referenced to the EIP chassis. The EIP internal power primary return floats with respect to chassis.

Q: What do the EIP lamps mean?
A: The amber 'EIP' lamp signifies application of payload power (to J15). The blue 'DC' power indicates application of EIP internal power to J18.

Q: Where is switch #1?
A: Switch #1 is a mechanical M39016/19 relay located on connector J1.

Q: What is an SSPC, and why do I care?
A: SSPC stands for Solid State Power Controller. These devices are essentially a solid state relay, over-current and arc-current breaker, voltage and current monitor packaged into a small form factor. They are used for all of the J6 through J9 DC circuits and switches #2 through 5.

Q: Can the SSPCs on switches #2-5 take a reverse voltage?
A: The SSPCs are protected from a reverse voltage on its output to 60VDC.

Q: I need an Ethernet switch, but not an EIP. Can you recommend a switch?
A: The Ethernet switch used in the EIP has been repackaged into a standalone Ethernet switch unit that has been qualified for the NASA Airborne Science platforms. Contact the Airborne Sensor Facility for more details.

Figure 7: NASA Sensor Net Standalone Ethernet Switch.

Another option is the Amphenol Socapex RJSwitch. The RJSwitch is an RJ-45 based unit qualified for the Global Hawk platform and is available off the shelf from Newark. On the down side, the support is poor, it contains fewer ports than the ASF standalone switch and is nearly the size of an EIP.

Q: Why do the EIPs use quadrax instead of RJ45 connectors?
A: Packaging density and performance. An RJ45 based solution would simply not fit into the required EIP enclosure. Further discussion on this topic can be found in Reference 1.

Q: How do I make a quadrax to RJ45 cable?—
A: TBD

Q: Where can I buy quadrax components?
A: First, only use Amphenol quadrax for this application. The Airborne Sensor Facility can provide some of the more common quadrax inserts, connectors, and adapters to NASA Airborne Science instruments at no charge. Numerous commercial vendors exist, but Newark and PEI Genesis are common sources.

Q: Are there quadrax pressure bulkheads?
A: Yes. The NASA Airborne Sensor facility can provide pressure bulkheads connectors on request.

7.0 Troubleshooting

The Airborne Sensor Facility is responsible for service and maintenance of the Mark III EIPs. However, some issues can be diagnosed and serviced in the field. Even if the unit requires servicing, answering some of the listed questions in the field is of value to the repair process.

Problem: One or more EIP switches aren't working.

1. Are the interlocks for the switches in question tied to ground?
2. For switches #2 through 5, is the voltage source connected correctly (not backwards)?
3. Are all switches dead, or just switches #2 through 5?
    a. If only switch #1 is dead, the fuse may be blown. This can be handled in the field - see the servicing section for details.
    b. If switches #2 through 5 are dead, and #1 works, the unit needs to be returned to ASF for servicing.

Problem: All DC circuits on J6 through J9 are dead.

1. Is 28V available at J11? Is the amber light illuminated?
    a. If the answer to both of these is 'yes' the unit has a component failure and needs to be returned to the ASF.

Problem: One of the J6 through J9 DC circuits is dead, but the rest are fine.

1. Does the circuit measure 28V with respect to the EIP enclosure, but ~0V with respect to its return? If so, the unit may need to be returned to ASF.
2. Is the circuit connected to a load? Is the SSPC circuit breaker tripping? This information is reported in the status packet, and the fault can be cleared by power cycling.

Problem: I can't bootload the EIP code.

1. Confirm the RSTP settings for the Ethernet switch are disabled for port 13 (internal port). Modify this setting using the Sixnet Web GUI, under the 'Redundancy Settings' page.
2. The timing between powering the EIP and entering the tftp command can affect whether or not the transmission is successful. The EIP bootloader timeout is 45 seconds, and the Sixnet switch typically takes less than 30 seconds to configure itself.

APPENDIX A: EIP Mark III Pinouts

EIP Electrical Connector Interface

Ref Des	EIP Connector Part #	Mating Connector Part #	Function
J1	MS3470W22-55S	MS3476W22-55P	CONTROL / DATA OUT
J2	D38999/20WC98SN	D38999/26WC98PN	INTERLOCK / FAIL #1
J3	D38999/20WC98SN	D38999/26WC98PN	INTERLOCK / FAIL #2
J4	D38999/20WC98SN	D38999/26WC98PN	INTERLOCK / FAIL #3
J5	D38999/20WC98SN	D38999/26WC98PN	INTERLOCK / FAIL #4
J6*	D38999/20WG-16SN	D38999/26WG-16PN	AC/DC/SWITCH OUT #1
J7*	D38999/20WG-16SN	D38999/26WG-16PN	AC/DC/SWITCH OUT #2
J8*	D38999/20WG-16SN	D38999/26WG-16PN	AC/DC/SWITCH OUT #3
J9*	D38999/20WG-16SN	D38999/26WG-16PN	AC/DC/SWITCH OUT #4
J11	MS3452W22-22S	MS3456W22-22P	28V OUTPUT 35A x 2
J15	MS3452W22-22P	MS3456W22-22S	28V INPUT
J16	MS3452W22-23P	MS3456W22-23S	400HZ AC INPUT
J18	MS3470W22-55P	MS3476W22-55S	CONTROL / DATA IN
J19	10-628485-691N	TV06RQW-21-75S	GIGABIT ETHERNET x2
J20	10-628485-691N	TV06RQW-21-75S	GIGABIT ETHERNET x2
J21	10-628485-691N	TV06RQW-21-75S	100MBIT ETHERNET x4
J22	10-628485-691N	TV06RQW-21-75S	100MBIT ETHERNET x4
J23	NOT INSTALLED	NOT INSTALLED	GPS ANTENNA FEED

* - In addition to standard contacts, these connectors utilize a #16 coaxial socket insert, Amphenol part #77-428, mating pin insert #TBD

J1: Control / Data Output Connector

Pin #	I/O	Signal Name	Description
A	I	INTERLOCK1	INTERLOCK #1
B	O	ON1	AIRCRAFT USE ONLY
C	N/A	GROUND	AIRCRAFT GROUND
D	O	FAIL1	AIRCRAFT USE ONLY
E	O	ON2	AIRCRAFT USE ONLY
F	O	FAIL2	AIRCRAFT USE ONLY
G	O	ON3	AIRCRAFT USE ONLY
H	O	FAIL3	AIRCRAFT USE ONLY
J	O	ALT_NO	ALTITUDE SWITCH N.O. CONTACT
K	O	ALT_COM	ALTITUDE SWITCH COMMON
L	O	ON4	AIRCRAFT USE ONLY
M	O	FAIL4	AIRCRAFT USE ONLY
N	O	PITCHX	PITCH – X AXIS
P	O	PITCHY	PITCH – Y AXIS
R	O	PITCHZ	PITCH – Z AXIS
S	O	ON5	AIRCRAFT USE ONLY
T	O	FAIL5	AIRCRAFT USE ONLY
U	O	ROLLX	ROLL - X AXIS
V	O	ROLLY	ROLL – Y AXIS
W	O	ROLLZ	ROLL – Z AXIS
X	O	COARSEX	COARSE ALTITUDE – X AXIS
Y	O	COARSEY	COARSE ALTITUDE – Y AXIS
Z	O	COARSEZ	COARSE ALTITUDE – Z AXIS
a	O	SYNCHHI	SYNCHRO EXCITATION – HI
b	O	SYNCHLO	SYNCHRO EXCITATION- LOW
c		SHIELD	SHIELD
d	O	SW1	SWITCH #1
e	O	429_HI1	ARINC 429 #1 – HI
f	O	429_LO1	ARINC 429 #1 – LOW

g	O	429_HI2	ARINC 429 #2 – HI
h	O	429_LO2	ARINC 429 #2 – LOW
i		SHIELD	SHIELD
j	O	28V	28V @ 1A
k	O	SW2	SWITCH #2
m	O	429_HI3	ARINC 429 #3 – HI
n	O	429_LO3	ARINC 429 #3 – LOW
p	O	AD590_PWR	AD590 SUPPLY (+12V @ 1mA)
q	I	AD590	AD590 OUTPUT
r	O	IRIG_HI	IRIG-B HI
s	O	IRIG_LO	IRIG-B LOW
t		SHIELD	SHIELD
u	O	WOW_NO	WoW – N.O. CONTACT
v	O	WOW_COM	WoW – COMMON
w	O	SW3	AIRCRAFT USE ONLY
x	O	232_HI1	RS232 #1 – HI
y	O	232_LO1	RS232 #1 – LOW
z	O	232_HI2	RS232 #2 – HI
AA	O	232_LO2	RS232 #2 – LOW
BB		SHIELD	SHIELD
CC	O	SW4	AIRCRAFT USE ONLY
DD	I	FAIL1	FAIL LAMP CONTROL 4-28V, 5mA
EE	O	SW1-NO	COMMAND RELAY - N.O. CONTACT
FF	O	SW5	AIRCRAFT USE ONLY
GG	O	SW1-NC	COMMAND RELAY - N.C. CONTACT
HH	O	SW1-COM	COMMAND RELAY - COMMON

J2: Experiment Control / Indication Connector

Pin #	I/O	Signal Name	Description
A	O	SW2-OUT	SWITCHED SSR #2 OUTPUT @ 1A
B	I	SW2-IN	SWITCHED SSR #2 INPUT 5-28V, 1A
C	I	INTERLOCK	INTERLOCK
D	I	GND	AIRCRAFT GND
E	I	FAIL	FAIL LAMP EXTINGUISH 4-28V, 5mA
F	O	ALT_NO	ALTITUDE SWITCH N.O.
G	O	ALT_COM	ALTITUDE SWITCH COM
H	O	WOW_NO	LANDING GEAR N.O.
J	O	WOW_COM	LANDING GEAR COM
K	O	28V	28V @ 3A (PER EIP)

J3: Experiment Control / Indication Connector

Pin #	I/O	Signal Name	Description
A	O	SW3-OUT	SWITCHED SSR #3 OUTPUT @ 1A
B	I	SW3-IN	SWITCHED SSR #3 INPUT 5-28V, 1A
C	I	INTERLOCK	INTERLOCK
D	I	GND	AIRCRAFT GND
E	I	FAIL	FAIL LAMP EXTINGUISH 4-28V, 5mA
F	O	ALT_NO	ALTITUDE SWITCH N.O.
G	O	ALT_COM	ALTITUDE SWITCH COM
H	O	WOW_NO	LANDING GEAR N.O.
J	O	WOW_COM	LANDING GEAR COM
K	O	28V	28V @ 3A (PER EIP)

J4: Experiment Control / Indication Connector

Pin #	I/O	Signal Name	Description
A	O	SW4-OUT	SWITCHED SSR #4 OUTPUT @ 1A
B	I	SW4-IN	SWITCHED SSR #4 INPUT 5-28V, 1A
C	I	INTERLOCK	INTERLOCK
D	I	GND	AIRCRAFT GND
E	I	FAIL	FAIL LAMP EXTINGUISH 4-28V, 5mA
F	O	ALT_NO	ALTITUDE SWITCH N.O.
G	O	ALT_COM	ALTITUDE SWITCH COM
H	O	WOW_NO	LANDING GEAR N.O.
J	O	WOW_COM	LANDING GEAR COM
K	O	28V	28V @ 3A (PER EIP)

J5: Experiment Control / Indication Connector

Pin #	I/O	Signal Name	Description
A	O	SW5-OUT	SWITCHED SSR #5 OUTPUT @ 1A
B	I	SW5-IN	SWITCHED SSR #5 INPUT 5-28V, 1A
C	I	INTERLOCK	INTERLOCK
D	I	GND	AIRCRAFT GND
E	I	FAIL	FAIL LAMP EXTINGUISH 4-28V, 5mA
F	O	ALT_NO	ALTITUDE SWITCH N.O.
G	O	ALT_COM	ALTITUDE SWITCH COM
H	O	WOW_NO	LANDING GEAR N.O.
J	O	WOW_COM	LANDING GEAR COM
K	O	28V	28V @ 3A (PER EIP)

J6: Experiment Connector

Pin #	I/O	Signal Name	Description
A	O	AC2A_J6	AC Circuit #2 Phase A
B	O	AC2B_J6	AC Circuit #2 Phase B
C	O	AC2C_J6	AC Circuit #2 Phase C
N	O	AC2N_J6	AC Circuit #2 Neutral
D	O	DC2P_J6	DC Circuit #2 Power
E	O	DC2N_J6	DC Circuit #2 Return
F-INNER	O	IRIG_J6	IRIG-B Coax
F-OUTER	O	IRIG-RET	IRIG-B Return
G	O	DC1N_J6	DC Circuit #1 Return
H	O	DC1P_J6	DC Circuit #1 Power
J	O	AC1C_J6	AC Circuit #1 Phase C
K	O	AC1B_J6	AC Circuit #1 Phase B
L	O	AC1A_J6	AC Circuit #1 Phase A
S	O	AC1N_J6	AC Circuit #1 Neutral
P	I	SW2-OUT	SWITCHED SSR #2 OUTPUT @ 2.5A
R	O	SW2-IN	SWITCHED SSR #2 INPUT 5-28V, 2.5A

J7: Experiment Connector

Pin #	I/O	Signal Name	Description
A	O	AC2A_J7	AC Circuit #2 Phase A
B	O	AC2B_J7	AC Circuit #2 Phase B
C	O	AC2C_J7	AC Circuit #2 Phase C
N	O	AC2N_J7	AC Circuit #2 Neutral
D	O	DC2P_J7	DC Circuit #2 Power
E	O	DC2N_J7	DC Circuit #2 Return
F-INNER	O	IRIG_J7	IRIG-B Coax
F-OUTER	O	IRIG-RET	IRIG-B Return
G	O	DC1N_J7	DC Circuit #1 Return
H	O	DC1P_J7	DC Circuit #1 Power
J	O	AC1C_J7	AC Circuit #1 Phase C
K	O	AC1B_J7	AC Circuit #1 Phase B
L	O	AC1A_J7	AC Circuit #1 Phase A
S	O	AC1N_J7	AC Circuit #1 Neutral
P	I	SW3-OUT	SWITCHED SSR #3 OUTPUT @ 2.5A
R	O	SW3-IN	SWITCHED SSR #3 INPUT 5-28V, 2.5A

J8: Experiment Connector

Pin #	I/O	Signal Name	Description
A	O	AC2A_J8	AC Circuit #2 Phase A
B	O	AC2B_J8	AC Circuit #2 Phase B
C	O	AC2C_J8	AC Circuit #2 Phase C
N	O	AC2N_J8	AC Circuit #2 Neutral
D	O	DC2P_J8	DC Circuit #2 Power
E	O	DC2N_J8	DC Circuit #2 Return
F-INNER	O	IRIG_J8	IRIG-B Coax
F-OUTER	O	IRIG-RET	IRIG-B Return
G	O	DC1N_J8	DC Circuit #1 Return
H	O	DC1P_J8	DC Circuit #1 Power
J	O	AC1C_J8	AC Circuit #1 Phase C
K	O	AC1B_J8	AC Circuit #1 Phase B
L	O	AC1A_J8	AC Circuit #1 Phase A
S	O	AC1N_J8	AC Circuit #1 Neutral
P	I	SW4-OUT	SWITCHED SSR #4 OUTPUT @ 2.5A
R	O	SW4-IN	SWITCHED SSR #4 INPUT 5-28V, 2.5A

J9: Experiment Connector

Pin #	I/O	Signal Name	Description
A	O	AC2A_J9	AC Circuit #2 Phase A
B	O	AC2B_J9	AC Circuit #2 Phase B
C	O	AC2C_J9	AC Circuit #2 Phase C
N	O	AC2N_J9	AC Circuit #2 Neutral
D	O	DC2P_J9	DC Circuit #2 Power
E	O	DC2N_J9	DC Circuit #2 Return
F-INNER	O	IRIG_J9	IRIG-B Coax
F-OUTER	O	IRIG-RET	IRIG-B Return
G	O	DC1N_J9	DC Circuit #1 Return
H	O	DC1P_J9	DC Circuit #1 Power
J	O	AC1C_J9	AC Circuit #1 Phase C
K	O	AC1B_J9	AC Circuit #1 Phase B
L	O	AC1A_J9	AC Circuit #1 Phase A
S	O	AC1N_J9	AC Circuit #1 Neutral
P	I	SW5-OUT	SWITCHED SSR #5 OUTPUT @ 2.5A
R	O	SW5-IN	SWITCHED SSR #5 INPUT 5-28V, 2.5A

J11: 28V OUTPUT 35A x2

Pin #	I/O	Signal Name	Description
A	I	28V_1	28V CIRCUIT #1 @ 35A
B	I	28V_RET1	28V RETURN #1
C	I	28V_2	28V CIRCUIT #2 @ 35A
D	I	28V_RET2	28V RETURN #2

J15: 28V PAYLOAD POWER INPUT

Pin #	I/O	Signal Name	Description
A	I	28V_1	28V CIRCUIT #1
B	I	28V_RET1	28V RETURN #1
C	I	28V_2	28V CIRCUIT #2
D	I	28V_RET2	28V RETURN #2

J16: 400Hz AC INPUT

Pin #	I/O	Signal Name	Description
A	I	AC1A	AC #1 PHASE A
B	I	AC1B	AC #1 PHASE B
C	I	AC1C	AC #1 PHASE C
D	I	AC1N	AC #1 NEUTRAL
E	I	AC2A	AC #2 PHASE A
F	I	AC2B	AC #2 PHASE B
G	I	AC2C	AC #2 PHASE C
H	I	AC2N	AC #2 NEUTRAL

J18: Control / Data Input Connector

Pin #	I/O	Signal Name	Description
A			
B	O	ON1	AIRCRAFT USE ONLY
C	N/A	GROUND	AIRCRAFT USE ONLY
D	O	FAIL1	AIRCRAFT USE ONLY
E	O	ON2	AIRCRAFT USE ONLY
F	O	FAIL2	AIRCRAFT USE ONLY
G	O	ON3	AIRCRAFT USE ONLY
H	O	FAIL3	AIRCRAFT USE ONLY
J	I	ALT_NO	AIRCRAFT USE ONLY
K	N/A	+28V	AIRCRAFT USE ONLY

L	O	ON4	AIRCRAFT USE ONLY
M	O	FAIL4	AIRCRAFT USE ONLY
N	I	PITCHX	AIRCRAFT USE ONLY
P	I	PITCHY	AIRCRAFT USE ONLY
R	I	PITCHZ	AIRCRAFT USE ONLY
S	O	ON5	AIRCRAFT USE ONLY
T	O	FAIL5	AIRCRAFT USE ONLY
U	I	ROLLX	AIRCRAFT USE ONLY
V	I	ROLLY	AIRCRAFT USE ONLY
W	I	ROLLZ	AIRCRAFT USE ONLY
X	I	COARSEX	AIRCRAFT USE ONLY
Y	I	COARSEY	AIRCRAFT USE ONLY
Z	I	COARSEZ	AIRCRAFT USE ONLY
a	I	SYNCHHI	AIRCRAFT USE ONLY
b	I	SYNCHLO	AIRCRAFT USE ONLY
c		SHIELD	AIRCRAFT USE ONLY
d	I	SW1	AIRCRAFT USE ONLY
e	I	429_HI1	AIRCRAFT USE ONLY
f	I	429_LO1	AIRCRAFT USE ONLY
g	I	429_HI2	AIRCRAFT USE ONLY
h	I	429_LO2	AIRCRAFT USE ONLY
i		SHIELD	AIRCRAFT USE ONLY
j	I	ID_0	EIP ID BIT #0: GND=0, OPEN=1
k	I	SW2	AIRCRAFT USE ONLY
m	I	429_HI3	AIRCRAFT USE ONLY
n	I	429_LO3	AIRCRAFT USE ONLY
p	I	ID_1	EIP ID BIT #1: GND=0, OPEN=1
q	I	ID_2	EIP ID BIT #2: GND=0, OPEN=1
r	I	IRIG_HI	AIRCRAFT USE ONLY
s	I	IRIG_LO	AIRCRAFT USE ONLY
t		SHIELD	AIRCRAFT USE ONLY
u	I	WOW	AIRCRAFT USE ONLY
v	I	ID_3	EIP ID BIT #0: GND=0, OPEN=1

w	I	SW3	AIRCRAFT USE ONLY
x	I	232_HI1	AIRCRAFT USE ONLY
y	I	232_LO1	AIRCRAFT USE ONLY
z	I	232_HI2	AIRCRAFT USE ONLY
AA	I	232_LO2	AIRCRAFT USE ONLY
BB		SHIELD	AIRCRAFT USE ONLY
CC	I	SW4	AIRCRAFT USE ONLY
DD		28V_EIP1	EIP INTERNAL POWER
EE		RET_EIP1	EIP INTERNAL POWER RETURN
FF	I	SW5	AIRCRAFT USE ONLY
GG		28V_EIP1	REDUNDANT POWER INPUT
HH		RET_EIP1	REDUNDANT POWER RETURN

J19: 1000 BASE-T Ethernet

Insert #	I/O	Signal Name	Description
A	IO	PORT #9-A	ETHERNET PORT #9A
B	IO	PORT #9-B	ETHERNET PORT #9B
C	IO	PORT #10-A	ETHERNET PORT #10A
D	IO	PORT #10-B	ETHERNET PORT #10B

J20: Gigabit Ethernet

Pin #	I/O	Signal Name	Description
A	IO	PORT #11-A	ETHERNET PORT #11A
B	IO	PORT #11-B	ETHERNET PORT #11B
C	IO	PORT #12-A	ETHERNET PORT #12A
D	IO	PORT #12-B	ETHERNET PORT #12B

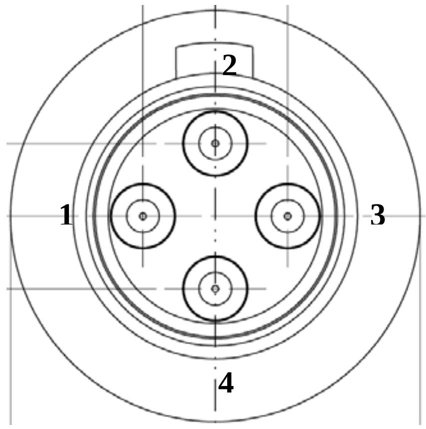
J21: 100Mbit Ethernet

Pin #	I/O	Signal Name	Description
A	IO	PORT #1	ETHERNET PORT #1
B	IO	PORT #2	ETHERNET PORT #2
C	IO	PORT #3	ETHERNET PORT #3
D	IO	PORT #4	ETHERNET PORT #4

J22: 100Mbit Ethernet

Pin #	I/O	Signal Name	Description
A	IO	PORT #5	ETHERNET PORT #5
B	IO	PORT #6	ETHERNET PORT #6
C	IO	PORT #7	ETHERNET PORT #7
D	IO	PORT #8	ETHERNET PORT #8

J19-J22 QUADRAX PIN CONTACT PINOUT:



Ref Des-Pin #	I/O	Signal Name	Description
1	O	TX+	Transmit + (Red)
2	I	RX+	Receive + (Blue + Stripe)
3	O	TX-	Transmit – (Red + Stripe)
4	I	RX-	Receive – (Blue)
INSERT SHELL		SHIELD	SIGNAL SHIELD

Note 1: **Pinout is per ARINC Specification 664P2-1, 6/30/06 Pub. Date, NOT per the Amphenol recommended pinout that ship with the contacts.**
Note 2: Wire colors per Tensolite NF24Q100 (recommended cable).

APPENDIX B: EIP PACKET FORMAT

The following describes the format of the status packets generated by the EIP internal monitor.

Code Version: 3.17 and later

Packet Format: ASCII Comma Separated (CSV), per IWG format

HEADER, TIME, STATUS, ID, J6_V, J6_I, J7_V, J7_I, J8_V, J8_I, J9_V, J9_I, SW2_V, SW2_I, SW3_V, SW3_I, SW4_V, SW4_I, SW5_V, SW5_I, SWITCH, ILOCK, FAIL, ALT, WOW, OC_TRIP, ARC_TRIP, HUMID, PICTEMP, I_EIP, AD590_1, SSPC_TEMP, COUNT, VERSION

Name	Element	Description	Units	Range	Significant Figures
HEADER	N/A	"EIP-0ID"	N/A	N/A	N/A
TIME	N/A	NTP Time	N/A	01-Jan-1970 00:00:00 default	N/A
STATUS	N/A	IWG Status	See Notes	N/A	3
ID	N/A	J18 Payload ID	N/A	0 to 15	2
J6_V	EIP-J6 Power SSPCs	Average Output Voltage on Port	Volts	0 to 50V	4
J6_I		Total current on port	Amps	0 to 28.4A	4
J7_V	EIP-J7 Power SSPCs	Average Output Voltage on Port	Volts	0 to 50V	4
J7_I		Total current on port	Amps	0 to 28.4A	4
J8_V	EIP-J8 Power SSPCs	Average Output Voltage on Port	Volts	0 to 50V	4
J8_I		Total current on port	Amps	0 to 28.4A	4
J9_V	EIP-J9 Power SSPCs	Average Output Voltage on Port	Volts	0 to 50V	4
J9_I		Total current on port	Amps	0 to 28.4A	4
SW2_V	Switch SSPC	Output Voltage	Volts	0 to 50V	4
SW2_I		Output Current	Amps	0 to 7.1A	4
SW3_V	Switch SSPC	Output Voltage	Volts	0 to 50V	4
SW3_I		Output Current	Amps	0 to 7.1A	4
SW4_V	Switch SSPC	Output Voltage	Volts	0 to 50V	4
SW4_I		Output Current	Amps	0 to 7.1A	4
SW5_V	Switch SSPC	Output Voltage	Volts	0 to 50V	4
SW5_I		Output Current	Amps	0 to 7.1A	4
SWITCH	Switches 1-5	Switch Status	N/A	$0x00_{16}$ to $0x1F_{16}$	N/A
ILOCK	EIP J1 through J5	Interlock Status (J5 is MSB)	N/A	$0x00_{16}$ to $0x\ 1F_{16}$	N/A
FAIL	EIP J1 through J5	Fail Light Status (J5 is MSB)	N/A	$0x00_{16}$ to $0x1F_{16}$	N/A
ALT	EIP Altitude Relay	Altitude Switch	N/A	0x0 to 0x1	N/A

WoW	EIP WoW Relay	Weight On Wheels	N/A	0x0 to 0x1	N/A
OC_TRIP	EIP J10 through J13	Raw SSPC OC Trip Status	See Notes	$0x000_{16}$ to $0xFFF_{16}$	N/A
ARC_TRIP	EIP J10 through J13	Raw SSPC ARC Trip Status	See Notes	$0x000_{16}$ to $0xFFF_{16}$	N/A
HUMID	EIP DCMON	Humidity Sensor	%RH	0 to 100%	4
PICTEMP	EIP DCMON	Board temperature near PIC	Celsius	-40C to 125C	4
I_EIP	EIP DCMON	Supply current for DCMON PCB & Ethernet Switch	Amps	0 to 1.85A	4
AD590_1		Peripheral temperature #1	Celsius	-60C to 125C	4
SSPC TEMP	EIP SSPC	SSPC Board Temperature	Celsius	-40C to 125C	4
SUPPLY TEMP	EIP DCMON	Board temperature near EIP DC/DC	Celsius	-40C to 125C	4
COUNT	EIP DCMON	Packet Counter	Packets	0 to 65535	16
VERSION		Code Version	N/A	v3.xx	5 (chars.)

Notes:

Header: EIP-0ID, where 'ID' is the aircraft ID set by jumpers on P18.

STATUS Codes:

Code	Meaning
1	Ready (Area Power OFF)
2	Operating (Area Power ON)
16	Invalid Data
256	Survival Heater ON, Area Power OFF
257	Survival Heater ON, Area Power ON

All bit fields (SWITCH, ILOCK, FAIL, WOW, ALT, OC_TRIP, ARC_TRIP) are transmitted as hex strings with the prefix '0x.' The following show the bit fields in binary for ease of visualization.

Cockpit Switch (SWITCH) word formats (binary – transmission is hexadecimal)

Bit	4	3	2	1	0
EIP Connector	J5/J9	J4/J8	J3/J7	J2/J6	J1
Switch #	5	4	3	2	1

Interlock (ILOCK) and Fail (FAIL) word formats (binary – transmission is hexadecimal):

Bit	4	3	2	1	0
EIP Connector	J5	J4	J3	J2	J1
Switch #	5	4	3	2	1

Field formats:

Value	0	1
Interlock	Disconnected	Connected
Fail Light	OFF	ON

OC_TRIP and ARC_TRIP word formats (binary – transmission is hexadecimal):

Bit	11	10	9	8	7	6	5	4	3	2	1	0
EIP Connector	J9/J5	J9	J9	J8/J4	J8	J8	J7/J3	J7	J7	J6/J2	J6	J6
SSPC#	SW	2	1	SW	2	1	SW	2	1	SW	2	1

Field formats:

Value	0	1
OC_TRIP	OK	TRIP
ARC_TRIP	OK	TRIP

Weight on Wheels and Altitude Switch: 0 = off, 1 = on

Humidity:

This sensor is mounted on an EIP PCB and represents the humidity on the EIP circuitry itself. This may or may not accurately represent the humidity in the air external to the EIP.

Packet Counter:

Value at startup is 0, increments 1 per packet, rolls over after 65535. A 1Hz packet rate equals a roll-over time of 18.2 hours.

APPENDIX C: ETHERNET SWITCH WEB GUI

The SensorNet EIP and Standalone Ethernet switches contain a COTS Ethernet switch PCB manufactured by Sixnet, LLC. The switch is a fully managed unit, allowing the user to configure a wide variety of networks, echo and monitor traffic, and track performance metrics. The Airborne Sensor Facility delivers each unit configured as follows:

1. Each switch's web GUI is configured with a unique IP address, typically 10.2.0.1XX, where XX is the switch serial number (located on the side panel).
2. For Ring Networks: Rapid Spanning Tree Protocol (RSTP) is enabled
3. For non-Ring Networks (i.e. star topology): RSTP disabled

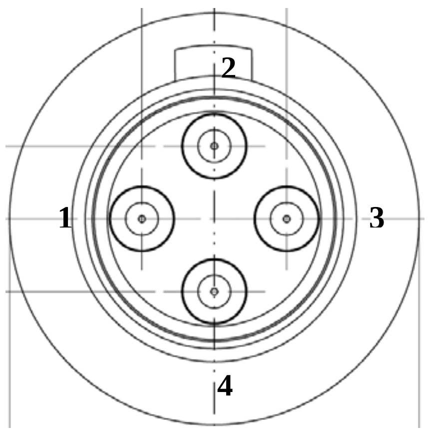
Connecting to the switch is simple:

1. Configure a PC with the following network settings:
    a. IP Address: 10.2.0.255
    b. Subnet Mask: 255.0.0.0
2. Physically connect the PC to any port on the network.
3. Verify the network is powered on; if not do so and wait ~1 minute for the network to configure itself.
4. Choose a switch on the network and write down its IP address.
5. Open a web browser and type the IP address of the switch in the address bar.
6. If prompted for credentials, user = admin, password = admin.
7. If prompted, accept the terms of agreement.'
8. The Web GUI has two main sections, one for monitoring and one for configuration. Most of it is intuitive. The most useful screen is the 'Port Status' under 'Monitoring. Sixnet wrote a manual for this GUI which the Airborne Sensor Facility can provide upon request.
9. If the switch did not load, try the default IP address (10.2.0.1).

APPENDIX D: Connecting the Network

The Ethernet Switch can be connected to other items on the SensorNet network that also use quadrax connections. The Tensolite cable (NF24Q100) designed for use with quadrax contacts carries a natural twist and can be confusing to terminate properly without guidance. A few simple rules exist to maximize network bandwidth, listed below:

1. All box receptacles carry a pin insert, all box plugs carry a socket.
2. All box receptacles carry the pinout shown in Figure 2.
3. Amphenol quadrax contacts and Tensolite NF24Q100 cable are used.
4. Cables with the same gender on each end shall wire in a cross-over pattern (Table 1).
5. Cables with opposite gender ends shall wire in a straight-through (1-1) pattern (Table 2).



Ref Des-Pin #	I/O	Signal Name	Description
1	O	TX+	Transmit + (TX+)
2	I	RX+	Receive + (RX+)
3	O	TX-	Transmit – (TX-)
4	I	RX-	Receive – (RX-)
INSERT SHELL		SHIELD	SIGNAL SHIELD

Note 1: **Pinout is per ARINC Specification 664P2-1, 6/30/06 Pub. Date, NOT per the Amphenol recommended pinout that ship with the contacts.**
Note 2: Wire colors per Tensolite NF24Q100 (recommended cable).

Figure 2: Quadrax box receptacle pinout

Table 1: Cross-over cable pin table

END 1 CONTACT	WIRE COLOR	END 1 CONTACT
1 (TX+)	RED	2 (RX+)
2 (RX+)	BLUE/BLK	1 (TX+)
3 (TX-)	RED/BLK	4 (RX-)
4 (RX-)	BLUE	3 (TX-)
INSERT SHELL	SHIELD	INSERT SHELL

Table 2: Straight-through (1-1) cable pin table

END 1 CONTACT	WIRE COLOR	END 1 CONTACT
1 (TX+)	RED	1 (TX+)
2 (RX+)	BLUE/BLK	2 (RX+)
3 (TX-)	RED/BLK	3 (TX-)
4 (RX-)	BLUE	4 (RX-)
INSERT SHELL	SHIELD	INSERT SHELL

APPENDIX E: UPDATING EIP FIRMWARE

Introduction:

This appendix describes the steps required to reprogram ('bootload') the EIP's internal firmware.

Required Equipment:

PC running Windows XP or later, or an OS with tftp capability
(Optional) Wireshark or other TCP/IP viewer software installed
Power supply, 28V @ 0.5A.
Quadrax to RJ45 adapter

Application Code Bootloading:

1. Power off all supplies.
2. Set the PC's IP address to 192.168.97.61, subnet 255.255.255.0 (all else blank).
3. Connect an RJ45 to quadrax adapter to the DCMON (or EIP) Ethernet port.
4. Connect the PC RJ45 port to the DCMON (or EIP) Ethernet port.
5. Locate the EIP application hex file, and copy it to C:\<filename>.hex
6. On the PC, open a command prompt and type the following at the DOS prompt but do not hit 'Enter:'

   tftp 192.168.97.60 put "C:\<filename>.hex"

On MK3 EIPs, the bootloader timeout is set to 45 seconds. The tftp transfer should complete within ~5 seconds of the timeout.

7. Power on the 28V supply, and hit 'Enter.'
8. Verify the command prompt returns a 'transfer successful' message. If timeout occurs, power cycling the 'EIP' supply may be required to get the right timing.

Verification:

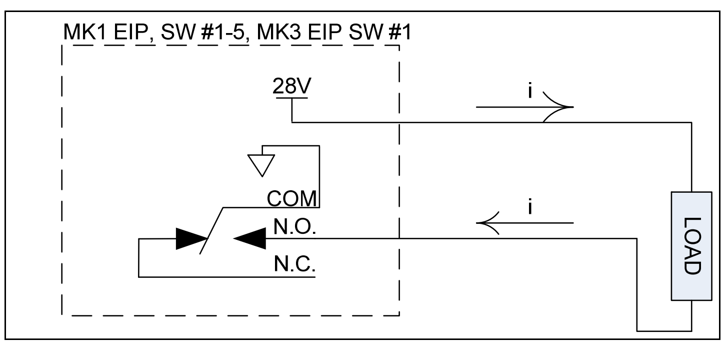
1. On the PC, open either Wireshark (or similar application)
2. Start capture in Wireshark.
3. Power cycle the DCMON.
4. Wait the timeout period for the board version.
5. Verify the EIP UDP packets transmit in Wireshark.
6. Verify the DCMON code version in the packet is as expected.

APPENDIX F: MECHANICAL AND SSR SWITCHING

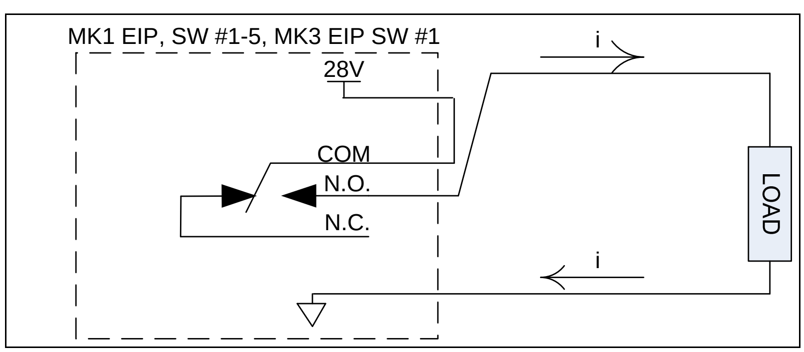
The Mark I EIPs carried five mechanical relays, spread out between the data connectors J1 through J5. Each relay provided a common (COM), normally open (N.O.), and normally closed (N.C.) contact. The availability of relay contacts and use of mechanical switches provides maximum flexibility for instruments.

Over time, it was found the majority of instruments simply ingested a switched 28V to drive a relay coil, opto-isolator, or some other low-current load. This high-side switching topology will translate to the Mark III EIP on all switches with no issues. In some cases, however, instruments were designed switch the low-side of a circuit. The Mark III EIP can accommodate a low-side switched circuit topology on switch #1 only. Switch #1 is designed as an exact duplicate to those used on the Mark I EIP.

The below figure illustrates low-side switching using a mechanical relay contact on the EIP. Current flows from the EIP 28V source and into a load. When the relay is activated from the cockpit, the EIP's normally open contact terminates to aircraft ground, completing the circuit. Since current flows into the EIP's relay, the switching device is **sinking** current.

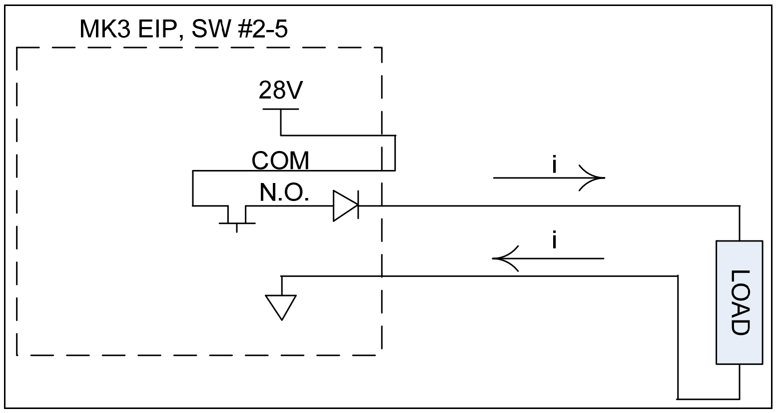


The following figure illustrates high-side switching using the same mechanical relay. The circuit is again completed by closing the relay. However, this time the relay **sources** current which then flows through the load and returns to aircraft ground in the EIP.



The Mark III EIP can accommodate both hi and low-side switching on switch #1 only. Switch #1 uses the same mechanical relay and both N.O. and N.C. contacts are available.

Switches #2 through 5 on the Mark III EIPs utilize a solid state device that can only switch voltages and **source** current. The below illustrates sourcing current using switches #2 through 5. Switch closure permits current to flow through the FET and diode, to the load, and returns to aircraft ground in the EIP.



It is important to note that J2 through J5 on the Mark III EIP carry both ground and 28V (pins D and K, respectively).

In summary, instruments that used the Mark I EIP relay contacts to perform low-side switching should either be modified to a high-side switching approach, or utilize switch #1 only. If both sides of the load are available at the instrument connector, the change can be accommodated by modifying the harness connections to the EIP.