Science and Facility Instruments to ISS System Services Interface Control Document

ICD 1.9/3.6

Issued By: Project Support Department

Approval required by:	
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Version Control

REVISION CHART			
Version	Author(s)	Description of Version	Approved Date
A	Andy Rudeen	Initial Version.	March 21, 1997
B	Chas Cavedoni	Detailed in Change Control Form #116, attached.	Dec 1, 1999
C	M. Lazo/C. Cavedoni	Reflect construction implementation and errors corrections.	May, 2001
D	Manuel Lazo	Improve interfacing to ISS, include DPS and adapting for Instruments. A new ICD template is used.	Dec 2005
E	M. Close, G. Perez, G. Gausachs, M. Lazo, J. White, R. Galvez	Updated document for accuracy and to align with current practices: (1) Added section stating instrument builder's responsibilities. (2) Corrected specification details including temperature ranges for coolants, fix GIS connector detail, add nuance on power current. (3) Remove DPS (Differential Pressure Switch) which was never implemented at the ISS. (4) Added notes concerning usage to GIS interface and audio communications sections. (5) Regrouped communications services into fiber optics and coax sections and updated details. (6) Clarified ISS mechanical section.	October 17, 2014
F	Madeline Close	(1) Incorporated ICD-derived requirements at end of document (2) Remove standards now included in Instruments Common Requirements and Standards document.	April 07, 2016 CR-16 2493
G	Jeff Radwick	(1) Incorporated rationale statements for all requirements. (2) Changed all instances of "Analysis" Verification Method to "Inspection". "Analysis" was cited incorrectly in the requirements set. (3) Added the requirement that a maximum of 2.0 kW of power can be provided to each thermal enclosure at the ISS connector panel.	06 August 2018
H	Jeff Radwick	Updated Coolant Service Specifications.	30 August 2018
J	Manuel Lazo / Brian Chinn/ Ruben Diaz	Add GNAO-AOB at Section 1, revise and emphasize the max power of 2.88 kW per ISS AC power outlets in req SVC.7.2. Add GNAO and AOB Acronyms.	03 August 2021

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1 Description

This document describes the Gemini System Services interface to Science and Facility instruments installed on the Instrument Support Structure (ISS). For non-ISS-mounted instruments, Gemini may provide these Systems Services at another location on a case-by-case basis.

The instruments served by this interface include:

- Science Instruments (3 Science Instruments may be mounted on the ISS at one time)
- Facility Instruments
  - A&G
  - AO Facilities (CANOPUS at GS and ALTAIR, GNAO-AOB at GN)
  - GCAL

The System Services provided at the ISS Services Panel include:

- Coolant Service
- Helium Closed Cycle Cooling Service
- Compressed Air Service
- Fiber Optic Communications
- Coax Service
- AC Power Service
- GIS Interface
- Other Cabling Services

1.1 Acronyms and Abbreviations

A&G	Acquisition and Guiding System
ALTAIR	ALTitude conjugate Adaptive optics for InfraRed (located at GN)
AO	Adaptive Optics
AOB	Adaptive Optics Bench
BNC	Bayonet Neill–Concelman Connector (also known as Bayonet Nut Connector)
CANOPUS	AO Bench for GeMS (located at GS)
CRCS	Cassegrain Rotator Control System
ES	Emergency Stop
GCAL	Gemini Calibration Unit
GeMS	Gemini Multiconjugated Adaptive Optics System (located at GS)
GIS	Gemini Interlock System
GM	Gifford-MacMahon (Type of cryogenic cooler)
GN	Gemini North
GNAO	Gemini North Adaptive Optics
GS	Gemini South
IOC	Input-Output Controller or Input-Output Crate
ISS	Instrument Support Structure

JT	Joule-Thomson* (Type of cryogenic cooler) **Gemini is moving away from this type*
ISS	Instrument Support Structure
MM	Multi Mode Fiber
NCI	Non-conforming Instruments
OIWFS	On-Instrument Wavefront Sensor
PLC	Programmable Logic Controller
SCS	Secondary Control System
SM	Single Mode Fiber

1.2 Instrument Builder Statement of Responsibility

The instrument builder is responsible for providing the Instrument Patch Panel that will interface with the ISS Service Panel[1]. The instrument builder should also supply all auxiliary equipment used in their pre-delivery stage to test and verify the instrument, including interconnecting cables, hoses, fitting, etc. Gemini will provide alternate equipment as needed to support Gemini lab and telescope setups.

2 References

Document Number	Document Name
ICD 1.1.13/1.9	Interlock System to Science Instruments
SPE-ASA-G0008	Gemini Electronics Design Specification

Drawing Number	Version	Drawing Title	Description
89-GP-1000-0004	E	AVAILABLE CASSEGRAIN INSTRUMENT SPACE	Describes the Cassegrain Instruments envelope.
89-GP-1000-5004	E	CASSEGRAIN CABLE WRAP INSTRUMENT SERVICES PANELS	Describes the locations of the Services Panels and Instrument mounting orientation.
83-GP-2000-1599	C	ISS PANELS DISTRIBUTION	Describes the ISS connector panels distribution and numbering.

[1] **REQ SVC.1.1**

3 ISS Panel Mechanical Interface

The ISS is where Science and Facility instruments are mounted to the telescope and interface to the telescope optical system. There are five ports for mounting, one on each side of the ISS and one on the bottom (the top is where the ISS connects to the telescope). There are four ISS Service Panels located on the corners between the side ports, on the outside of the ISS. The instruments share these Service Panels to interface to the Gemini System Services. Figure 1 depicts the ports, Service Panels and instrument assignments as seen from below the ISS.

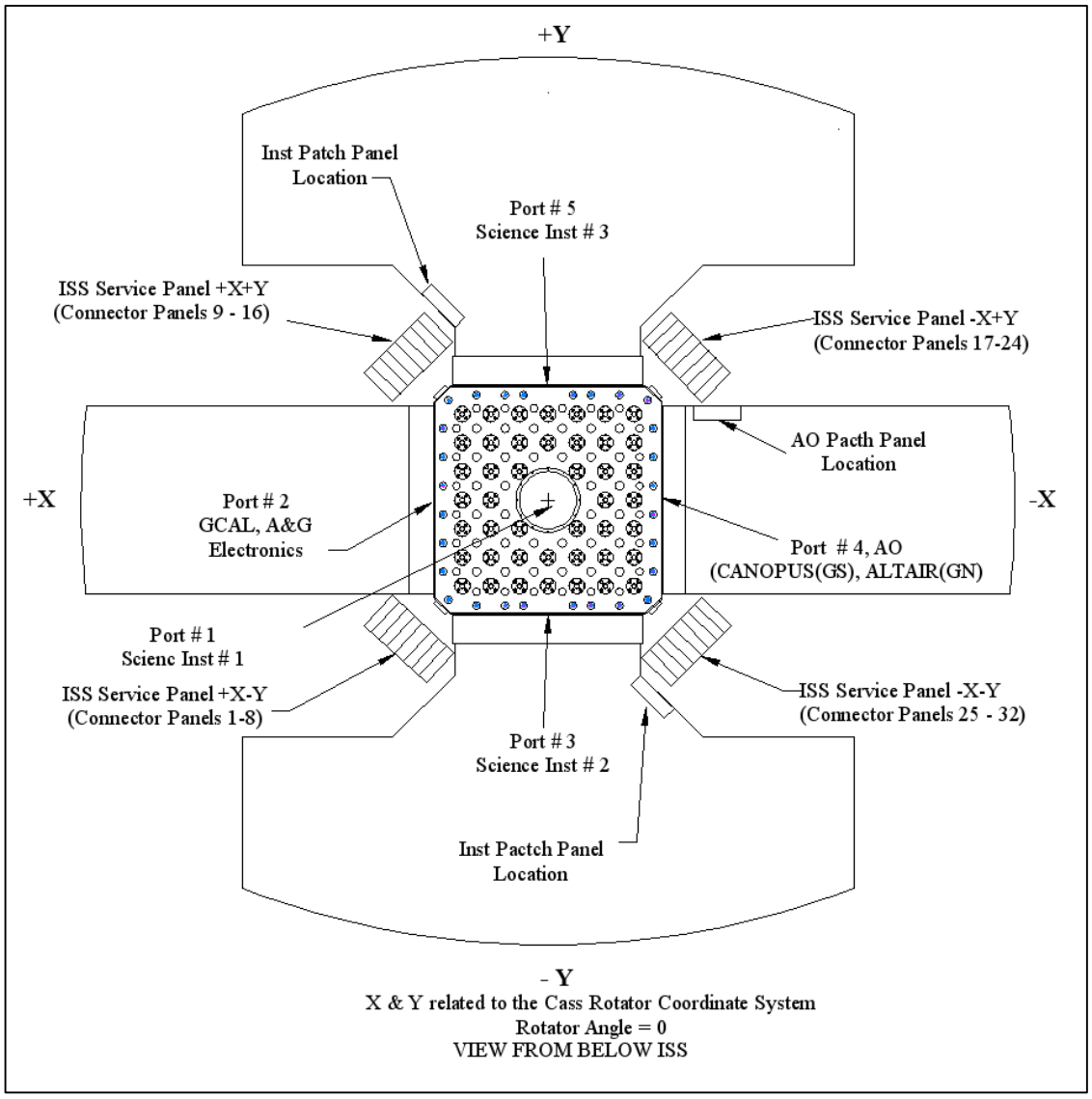

Figure 1: ISS Service and Instrument Panels Location (Viewed from below ISS).

Facility instruments reside permanently in their assigned ports as shown in Table 2.

Table 1: ISS Port Assignments

ISS Port	Description	Assigned to
1	The lower face of the ISS cube	Science Instrument #1
2	The +X face of the ISS cube	GCAL and A&G Control Electronics
3	The –Y face of the ISS cube	Science Instrument #2
4	The –X face of the ISS cube	AO system
5	The +Y face of the ISS cube	Science Instrument #3
NA	Internal ISS volume	A&G System

For three-dimensional projection guidelines, refer to the instrument space envelope specified in the ***89-GP-1000-0004*** drawing.

3.1 ISS Service Panel Definition and Assignment

The four Service Panels consist of 32 Connector Panels, arranged into four groups of eight. The Connector Panels are each 100 x 500 mm in size, except the mechanical services coupling panels that are 200 x 500 mm. Connectors are inset 10 mm from the edge of the panel to avoid the mounting structure behind from the edge of the panel. The panels are parallel to the XY plane, with Z = -363 mm when the telescope is in the zenith position (Cassegrain rotator co-ordinate system).

Each group of eight Connector Panels is arranged into a Service Panel, which are located outside the diagonals of the ISS cube. This area can be accessed by personnel and cable harnesses as the area underneath is ‘out of bounds’ to the instrument patch panel.

The panel’s distribution is shown in drawings ***83-GP-2000-1599*** and ***89-GP-1000-5004***, and the panels are designated for specific Instrument connections as shown in Figure 1 and Table 2.

The panels are numbered sequentially from 1 to 32 with panels #1 through #8 located outside and nearest to the +X-Y ISS cube edge. Panels increment in number in the clockwise direction as seen from beneath the cable wrap. Panels #9 through #16 are located outside the +X+Y ISS cube edge, panels #17-#24 are outside the –X+Y ISS cube edge, and panels #25-#32 are outside the -X-Y ISS cube edge.

Table 2: ISS Connectors and Services Panel Summary

Conn. Panel #	Function	Connectors	Instrument	Service Panel Location
1	Spare FO to C. Room/ES	Duplex SC (9 pairs)	Sci Inst#1-Port 1 (lower face)	+X-Y diagonal
2	Electronic Conn's	Duplex SC, coax, MS circular	Sci Inst#1-Port 1 (lower face)	
3	MAINS/UPS Power	NEMA L5-30R (4x)	Sci Inst#1-Port 1 (lower face)	
4	Air, Helium, Coolant	Couplings (various)	Sci Inst#1-Port 1 (lower face)	
5	Air, Helium, Coolant	Couplings (various)	Fac Inst Cal/A&G-Port 2 (+X)	
6	MAINS/UPS Power	NEMA L5-30R (4x)	Fac Inst Cal/A&G-Port 2 (+X)	
7	Electronic Conn's	Duplex SC, coax[2], MS circular	Fac Inst Cal/A&G-Port 2 (+X)	
8	Blank Panel[3]			
9	Spare FO to C. Room/ES	Duplex SC (9 pairs)	Fac Inst Cal/A&G-Port 2 (+X)	+X+Y diagonal
10	Electronic Conn's	Duplex SC, coax, MS circular	Fac Inst Cal/A&G-Port 2 (+X)	
11	MAINS/UPS Power	NEMA L5-30R (4x)	Fac Inst Cal/A&G-Port 2 (+X)	
12	Air, Helium, Coolant	Couplings (various)	Sci Inst #3-Port 5 (+Y)	
13	Air, Helium, Coolant	Couplings (various)	Sci Inst #3-Port 5 (+Y)	
14	MAINS/UPS Power	NEMA L5-30R (4x)	Sci Inst #3-Port 5 (+Y)	
15	Electronic Conn's	Duplex SC, coax, MS circular	Sci Inst #3-Port 5 (+Y)	
16	Blank Panel			
17	SM FO spares (9 pairs)/ES	Duplex SC (9 pairs)	Future usage	-X+Y diagonal
18	Spare Audio/GIS	MS circular	Spare TWP ckts	
19	MAINS/UPS Power	NEMA L5-30R (4x)	Spare 1P ckts (future usage)	
20	Air, Helium, Coolant	Couplings (various)	Spare Future usage	
21	Air, Helium, Coolant	Couplings (various)	Spare Future usage	
22	MAINS 3-phase Power[4]	NEMA L14-20R (3x)	208 VAC 3-Phase power	
23	Event/RM FO fm. SC (SCS)	Duplex SC feedthru's	From Center Section SCS	
24	Blank Panel			
25	Spare FO to C. Room/ES	Duplex SC (9 pairs)	Fac Inst AO-Port 4 (-X)	-X-Y diagonal GN only
26	Electronic Conn's	Duplex SC, coax, MS circular	Fac Inst AO-Port 4 (-X)	
27	MAINS/UPS Power	NEMA L5-30R (4x)	Fac Inst AO-Port 4 (-X)	
28	Air, Helium, Coolant	Couplings (various)	Fac Inst AO-Port 4 (-X)	
29	Air, Helium, Coolant	Couplings (various)	Sci Inst#2-Port 3 (-Y)	
30	MAINS/UPS Power	NEMA L5-30R (4x)	Sci Inst#2-Port 3 (-Y)	
31	Electronic Conn's	Duplex SC, coax, MS circular	Sci Inst#2-Port 3 (-Y)	
32	Blank Panel + Main 3-phase power[5]	NEMA L14-20R (1x)	208 VAC 3-Phase power	

[2] Some of these coax (BNC) connectors are used for the Time bus and others are used for general purpose to the server room.
[3] At GN, some of these blank panels are being used for vibration cabling.
[4] At GN, one of these connectors has been moved to another port to provide better access to instruments that need 3 phase power.
[5] Main 3-phase power at GN only

3.2 Cables and Services Connection to Instruments

The cables and services connection from each Instrument Patch Panel to the ISS Services panel must not be rigid and must allow a small relative rotation (±1 degrees) of the instrument cluster w.r.t. the Cassegrain cable wrap without exceeding a reaction torque against the rotator of 50 N-m.[6]

Within the instrument's volume the helium, compressed air and coolant services should be distributed to the instruments devices using appropriate tees and manifolds, so only one set (one supply and one return) of helium and coolant lines and one line of compressed air are required to run between the Instrument Patch Panel and the ISS Service Panel, per Figure 2 below.[7]

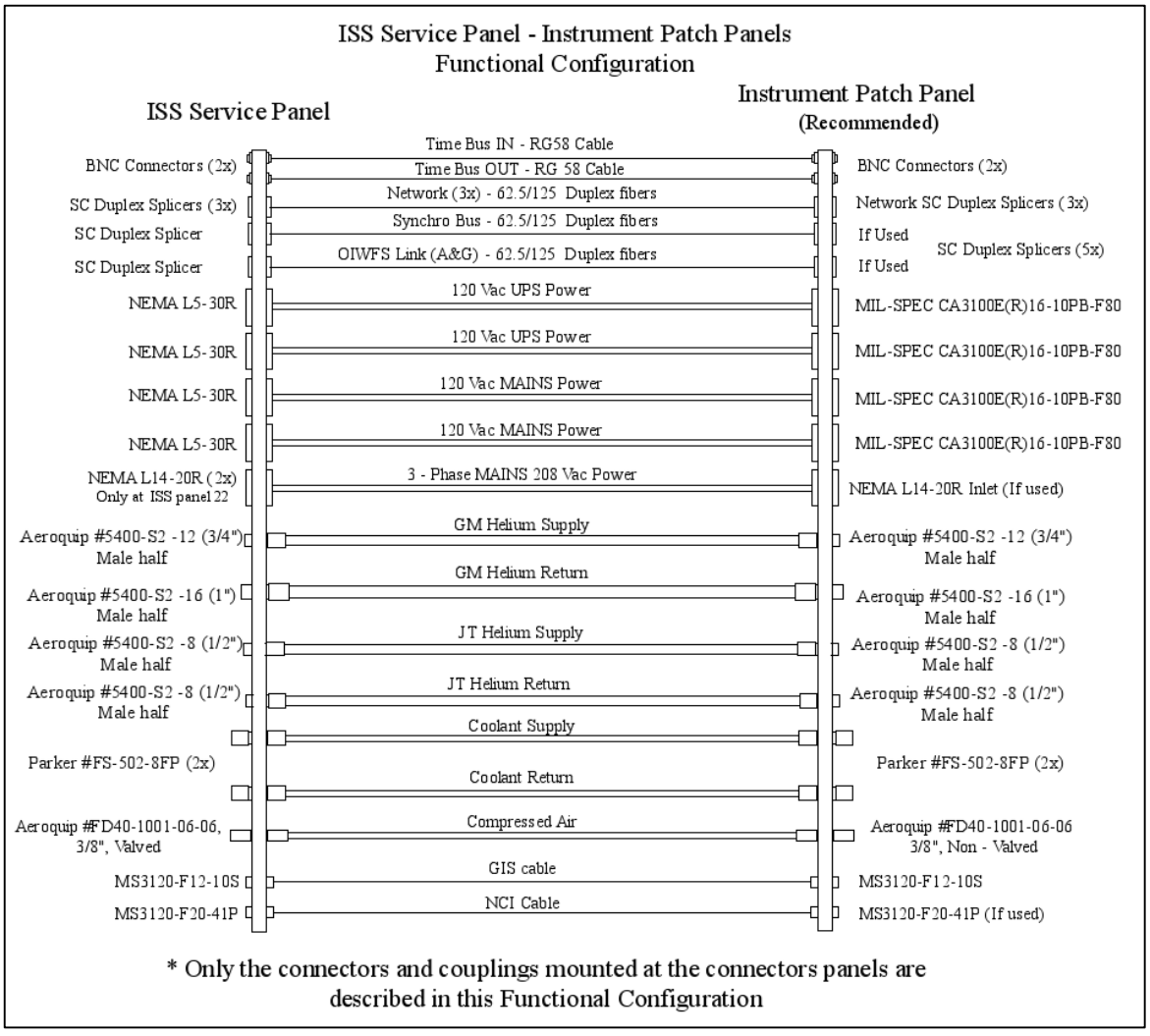

Figure 2: ISS Service Panel to Instrument Patch Panel Functional Configuration

[6] **REQ SVC.1.2**
[7] **REQ SVC.1.3**

3.3 Instrument Patch Panel Location

The AO Facility Instrument on Port #4 of the ISS should have its Instrument Patch Panel located at the left hand side when facing the ISS-mounting face to assure optimal cable routing to Panels #25-28 near the -X-Y diagonal of the ISS.

When designing a new instrument, Gemini instrument engineers must be consulted to determine whether there is a preferred side for the Instrument Patch Panel. This determination will be based on location-specific information about current instruments and ISS panel usage.

4 System Services Interfaces and Specifications

4.1 Coolant Service

Table 3: Coolant Service Specifications[8]

Coolant Type	Dowtherm SR-1, 40 % by volume and water
Maximum Supply Pressure at Source	GN: 75 PSIG
	GS: 75 PSIG
Maximum Return Pressure at Source	>20 PSIG
Flow Rate	GN: 8 liter/min per ISS face @ 40 PSIG
	GS: 8 liter/min @ 40 PSIG
Coolant Supply Temperature at Source	GN: -7 °C +/-2 °C
	GS: 10 °C +/-2 °C

4.1.1 Coolant Lines

The 3/4" ID coolant lines in both service runs contain manifolds which branch to 1/2" supply and return coolant couplers on each set of Instrument or Facility connector panels.

[8] **REQ SVC.2.1**

4.1.2 Coolant Connectors

The ISS coolant couplings are 1/2" self-sealing, Quick Disconnect Couplings. The quick disconnect couplings both have 1/2" FNPT interfaces, consequently the hoses that connect to the coupler and nipple should have compatible 1/2" MNPT fittings. Identical 1/2" couplings are specified at the Instrument Patch Panel. The configuration of the interconnecting coolant hoses for the ISS Service Panel to Instrument Patch Panel is diagrammed below in Figure 3.

Table 4: Coolant Coupling Specifications[9]

Supply Coupling at Panels	1/2" Parker #FS-502-8FP Quick Disconnect, Nipple at the panel (2 per Service Panel).
Return Coupling at Panels	1/2" Parker #FS-502-8FP Quick Disconnect, Nipple at the panel (2 per Service Panel).
Supply Coupling at Hose	1/2" Parker #FS-501-8FP, Quick Disconnect, Coupler.
Return Coupling at Hose	1/2" Parker #FS-501-8FP, Quick Disconnect, Coupler.

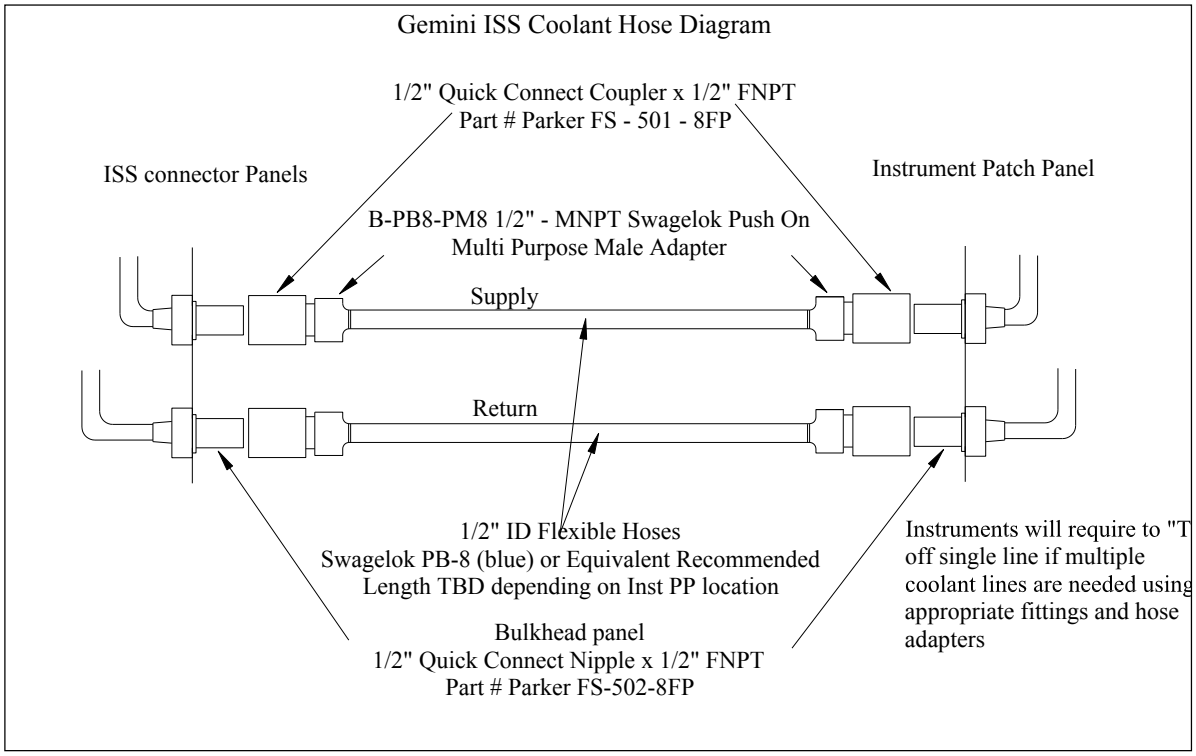

Figure 3: ISS Coolant Hoses Connection Diagram.

4.1.3 Coolant Safety

The corrosion inhibitors in Dowtherm SR-1 react with zinc forming a white milky paste that clogs the heat exchangers and piping system. Therefore, absolutely NO zinc or galvanized coated fittings, pipes or components are allowed to come in contact with the coolant.[10]

[9] **REQ SVC.2.2**

[10] **Also see Common Requirements and Standards document, "Mechanical Standards" section.**

4.2 Helium Closed Cycle Cooling Service

Table 5: Helium Service Specifications[11]

Helium Cooler Type	GM
Maximum Supply Pressure	300 PSI
Maximum Return Pressure	> 60 PSI
Maximum Flow Rate Available Per Circuit	120 SCFM (3400 SPLM) at 300 PSI
Line	3/4" ID Line

Helium Cooler Type	JT* (This service can also be configured for GM coolers)
Maximum Supply Pressure	300 PSI
Maximum Return Pressure	0 PSI (Vacuum)
Maximum Flow Rate	30 SCFM
Line	3/4" ID Line

**note Gemini is moving away from this type*

4.2.1 Helium Lines

The system helium lines also follow the routing described for the coolant above. The helium lines are routed in three service runs, namely Circuit +X, Circuit –X and Circuit JT and contain manifolds which branch to each helium coupler on the four service panels described above. The JT service can also be configured for GM coolers as noted below.

4.2.2 Helium Connectors

The Helium couplings at the ISS panels will be double self-sealing quick disconnects. The mating coupling (female half) in the flex hoses accept adapters to various end fittings. It is anticipated that flexible lines that connect to the helium connectors will be purchased preassembled to mate with the Aeroquip couplings described above.

Table 6: Helium Coupling Specifications[12]

GM Supply Coupling at Panels	Aeroquip #5400-S2-12 (3/4”), Male half (2 per Service Panel)
GM Return Coupling at Panels	Aeroquip #5400-S2-16 (1”), Male half (2 per Service Panel)
GM Coupling at Hose	Aeroquip #5400-S5-12/16/8, Female half

JT Supply Coupling at Panels	Aeroquip #5400-S2-8 (1/2”), Male half (1 per Service Panel)
JT Return Coupling at Panels	Aeroquip #5400-S2-8 (1/2”), Male half (1 per Service Panel)
JT Coupling at Hose	Aeroquip #5400-S5-12/16/8, Female half

[11] **REQ SVC.3.1**
[12] **REQ SVC.3.2**

4.3 Compressed Air Service

Table 7: Compressed Air Service Specifications[13]

System Pressure	80 – 100PSI
Maximum Flow Capacity	120 SLPM (~4.24 SCFM) per connector plate
Dew Point	-40 °C

4.3.1 Compressed Air Lines

Compressed air lines (1/2" ID) are routed through each of the two cable wrap services loops within the wrap, and are branched with 3/8" ID lines to couplers on the 6 coupler plate assemblies described above.
This "raw" compressed air is regulated, filtered and dried at the Gemini plant room approximately 120 meter far from the ISS panels. It is recommended that the instrument builder considers appropriate filtering, dryer and pressure regulators as close as possible to the instrument when using ISS compressed air.[14]

4.3.2 Compressed Air Connectors

The Compressed Air couplings at the panels will be self-sealing, quick disconnect and valved.

Table 8: Compressed Air Coupling Specifications[15]

Coupling at Panels	Aeroquip #FD40-1001-06-06, 3/8", Female half, Valved (2 per Service Panel)
Coupling at Hose	Aeroquip #FD40-1014-06-06, Male half, Non-valved, Male pipe end fitting

4.4 Fiber Optic Communications

A total of 81 duplex SC fiber connectors (162 Multimode, 62.5/125 μm fiber channels) are available on the ISS Service Panels and linked to the Computer Rooms. These fibers are multi-purpose and can be used to for the Ethernet network or in other configurations such as the event bus or reflective memory, as described below. The Service Panels also provide many extra fibers to support "raw" data transmission from the instruments back to the telescope operations/computer rooms in the support facility.

Fiber Optic cables for the Event Bus and Synchro bus systems running in a single 18-channel cable originating from the SCS on the Telescope Center Section will be distributed to individual Facility Instrument service panels via Duplex fiber jumper cables from the incoming termination point on the ISS panel # 23 in the -X+Y panel area.

[13] **REQ SVC.4.1**
[14] **REQ SVC.4.2**
[15] **REQ SVC.4.3**

Local ISS distribution of fiber optic lines unique to the Wavefront Sensor systems will also be performed via the cable wrap connector panels using fiber optic duplex-type SC feed-through adapter connectors. Connector panels supporting Science and Facility Instruments will contain duplex SC adapters for this purpose.

Physical devices required for communications such as switches, servers and boards must be located within instrument electronics enclosures.[16]

In addition to the Multi-Mode fibers described above, a 9-pair Single-Mode Fiber Optic cable (8.3/125um) was installed and terminated in spare connector panel #17 -X+Y for future use. This type of fiber will support Gigabit rate data transfer. At GN the fiber has since been removed due to damage to the sheathing.

*4.4.1 **Ethernet Network***

Ethernet is provided through only one pair of fibers. Instrument's Data and Control is communicated through this single pair.[17] Gemini is currently working to expand this to two fiber connections per switch to provide redundancy.

Table 9: Ethernet Service and Connector Specifications[18]

Service	Ethernet Network
Protocol	TCP/IP
ISS Connector	SC Duplex
Cable	MM Fiber Optic 62.5/125

*4.4.2 **Synchro Bus***

The Synchro Bus is a series connection. In/out signals must be bridged at the connector panels when not connected to instruments, and the two connectors of the pair must be bridged to keep the integrity of the bus.

Table 10: Synchro Bus Service and Connector Specifications[19]

Service	Synchro Bus
Protocol	Reflective Memory
ISS Connector	SC Duplex
Cable	MM Fiber Optic 62.5/125

[16] **REQ SVC.5.1**
[17] **REQ SVC.5.2**
[18] **REQ SVC.5.3**
[19] **REQ SVC.5.4**

4.4.3 Event Bus

The instrument builder must include the Event Bus connector if it is going to be used.

Table 11: Event Bus Service and Connector Specifications[20]

Service	Event Bus (Also see ICD 11 Event Bus)
Protocol	N/A
ISS Connector	SC Duplex
Cable	MM Fiber Optic 62.5/125

4.4.4 Wavefront sensor system

Table 12: Wavefront Sensors Service and Connector Specifications[21]

Service	Wavefront sensor
Protocol	N/A
ISS Connector	SC Duplex
Cable	MM Fiber Optic 62.5/125

4.5 Coax Services

Two BNC female connectors located on three of the ISS Service Panels, at connector panels 2, 10, and 26 provide RG-59 coax high bandwidth channels to the telescope computer room. BNC cables are used to transmit the IRIG-B time code[22], and can also support any control/data interface for non-conforming instruments.

4.5.1 Time Bus

In/out signals must be bridged at the connector panels when not connected to instruments.

Table 13: Time Bus Service and Connector Specifications[23]

Services	Time Bus In, Time Bus Out
Protocol	IRIG-B
ISS Connector	BNC Female
Cable	Coaxial RG 58

[20] REQ SVC.5.5
[21] REQ SVC.5.6
[22] REQ SVC.6.1
[23] REQ SVC.6.2

4.6 AC Power Services

New instruments should be designed to use the minimum number of power connections required.[24] Although there are four possible power connections for each instrument and one 208 3 phase connection, other facility requirements consume some of these connections.

4.6.1 AC Power Services

AC power is provided to the science instrument via two locking, dual 3-prong, 120 VAC outlets (NEMA L5-30) mounted on the cable wrap interface plate. A single 3-phase, 208 VAC circuit is available in the ISS area for future usage (Terminated in ISS connector panel # 22 in –X+Y quadrant). The outlet is NEMA L14-20, but it is recommended that all instruments be powered from 120 VAC single phase. In consultation with Gemini Development the 208 VAC 3-phase circuit available at ISS panel 22 could be used for 3-phase cryocoolers.

Table 14: AC Power Specifications[25]

Power Sources	UPS conditioned power, MAINS power
Single-phase AC voltage	120 VAC
Line frequency	GN: 60 Hz
	GS: 50 Hz
Current	24 Amps maximum load (Fed at 30 Amps)
Power	2.0 kW maximum at the ISS connector panel.

The ISS connector panel outlets are rated for 30 Amps and clearly marked as "UPS" and "Mains". The circuit breakers for the outlets are located in the service room at telescope pier (1 breaker for each pair of MAINS and UPS outlets) and are sized for 30 Amps, but will trip at 80% of maximum load or 24 Amps. **A maximum of 2.88 Kw of power can be provided by each ISS connector panel outlet.**

4.6.2 AC Power Connectors and Pinout

In order to keep AC power standard with existing Gemini instruments and with the operational environment, the connector at the cable that mates the connector at the instrument patch panel should be a circular MIL-style bayonet connector as shown in Fig. 2, CA3106E16-10SB-F80, with 3 #12 crimp contacts, and a long endbell with clamp and bushing. The instrument patch panel connector should be a CA3100R16-10PB-F80, or CA3100E16-10PB-F80 or equivalent with 3 #12 crimp contacts, bayonet-lock, and endbell with shortened bushing. Alternatively, these connectors can be ordered with solder-type contacts by deleting the "-F80" suffix on the Part Number.

[24] **REQ SVC.7.1**
[25] **REQ SVC.7.2**

Table 15: AC Power Connectors[26]

Connector at ISS Service Panels	NEMA L5-30R
Connector at Instrument Patch Panels	CA3100R16-10PB-F80 (or CA3100E16-10PB-F80 or equivalent)
Connector at Cables	CA3106E16-10SB-F80

*Table 16: Circular MS*16-10 Power Connector Pinout*

Pin	Wire Color	Signal
A	BLACK	HOT
B	WHITE	NEUTRAL
C	GREEN	EARTH GND

4.6.3 AC Power Distribution

As a recommendation, AC Power should be distributed to the Instrument electronics through the instrument patch panel to power strips inside the Instrument Thermal Electronics Enclosures, possibly through block-type, in-line RFI filter modules such as the CORCOM #20VW1. The power cable should be #12 AWG, type SO or equivalent.[27]

[26] **REQ SVC.7.3**
[27] **REQ SVC.7.4**

4.7 GIS Interface

The GIS interface provides a way to interlock the telescope and CRCS motion. New instruments should only implement this interface if an interlock is required. Any implementation must be coordinated with the Development Division due to infrequent use (it is implemented on ALTAIR and GMOS). This interface is detailed in 1.1.13/1.9 ICD, Interlock System to Science Instruments.

4.7.1 ***GIS Connectors and Pinout***

The GIS interface supports TTL-level Event/Demand signals. The cable carrying these signals is specified as generic type #22AWG, 4 twisted pair with overall shield (Belden #8304 or equivalent). Pinout is tabled below with the usage of paired TTL and DC supply/gnd. signals conductors. The GIS cables originate at the Telescope Center Section PLC crate.

Table 17: GIS Connector Specifications[28]

Connector at Panels	KPSE00F12-10S (or MS3120-F12-10S) MIL-spec bayonet-lock bulkhead connector
Connector at Cables	KPSE00F12-10P (or MS3120-F12-10P)

Table 18: GIS Connector Pinout

Pin (* Twisted Pairs)	Signal
A	Cable Shield
B *	+5 Vdc
C *	Event #1 TTL1
* D	+5 Vdc GND
* E	Event#1 TTL2
F *	+5Vdc
G *	Demand #1 TTL1
* H	+5Vdc
* J	Demand #1 TTL2
K	Not Used

[28] **REQ SVC.8.1**

4.8 Other Cabling Services

4.8.1 Non-Conforming TWP Cables

Three single, 12-TWP, shielded cables (Belden #1078A, AWG#20) also run directly from the computer room to the three ISS Service Panels, at connector panels 2, 10 and 26. These cables also be used to support a control/data interface for nonconforming instruments.

Table 19: Non-Conforming TWP Connectors

Connector at Panels	MS3120F20-41P or equivalent, 41 #20 contacts
Connector at Cables	MS3126F20-41S or equivalent

Table 20: Non-Conforming Instrument TWP Cable Pinout

Pin (* Twisted Pair)	Signal	Pin	Signal
A	Overall Cable Shld	Y	TWP7 SHIELD
B *	TWP1A	Z *	TWP8A
C *	TWP1B	a *	TWP8B
D	TWP1 SHIELD	b	TWP8 SHIELD
* E	TWP2A	* c	TWP9A
* F	TWP2B	* d	TWP9B
G	TWP2 SHIELD	e	TWP2 SHIELD
* H	TWP3A	f *	TWP10A
* J	TWP3B	g *	TWP10B
K	TWP3 SHIELD	h	TWP10 SHIELD
L *	TWP4A	* i	TWP11A
M *	TWP4B	* j	TWP11B
N	TWP4 SHIELD	k	TWP11 SHIELD
* P	TWP5A	m *	TWP12A
* R	TWP5B	n *	TWP12B
S	TWP5 SHIELD	p	TWP12 SHIELD
T *	TWP6A	q	
U *	TWP6B	r	
V	TWP6 SHIELD	s	
* W	TWP7A	t	
* X	TWP7B	Not connected	

4.8.2 Audio Communications Cables

The original System Services ICD provided for audio communications using the GIS connection type MS3120-F12-10S. It is not clear how this would have worked in practice, and no instruments has required audio communications. The description below is included for completeness, but coordination with the Development Division would be required for any new instrument requiring audio communications.

Audio communication cables are provided via two sets of 4-shielded twisted pair wires terminated in MS3120-F12-10S circular connectors at the 4 ISS Service Panels. These will be

arranged as 4 TWPS lines terminated in serial into two 10-pin MS connectors on each side Service Panels. These cables may be configured for either voice or RS-232 interconnection.

Table 21: "Audio" and Space Cable Pinout

Pin (* Twisted Pair)	Signal
A	Cable Shield
B *	TWP1A
C *	TWP1B
* D	TWP2A
* E	TWP2B
F *	TWP3A
G *	TWP3B
* H	TWP4A
* J	TWP4B
K	

4.8.3 Non-Conforming Interface Cables

Per Figure 3, a NCI MS3120F20-41P type connection is provided on each Service Panel and could be used for a variety of services.

5 Safety Specifications

Refer to SPE-ASA-G0008, Gemini Electronics Design Specification for a guide to "good" electronic practices for Gemini. The Instrument Common Requirements and Standards Document includes safety-related requirements and standards.

Appendix A: ISS System Services Interface Requirements

SVC.1 Mechanical Interface

SVC.1.1 Instrument Patch Panels

The instrument shall have instrument patch panel(s) that serve as the consolidated connection point for instrument services, to connectors leading to ISS services.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.1.2 Patch Panel Connectors Rotation

The instrument patch panels cables/connectors shall not be rigid, meaning they shall allow a small relative rotation (±1 degrees) of the instrument cluster w.r.t. the Cassegrain cable wrap without exceeding a reaction torque against the rotator of 50N-m.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.1.3 Single Patch Panel Connector per Service

The instrument shall not require more than one set of lines (supply/return) per service for helium, coolant and compressed air.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.2 Coolant Service

SVC.2.1 Coolant Service Specifications

If the instrument uses coolant, the instrument shall comply with the coolant specifications contained in Table 3.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.2.2 Coolant Coupling Specifications

If the instrument uses coolant, the instrument shall comply with the coolant coupling specifications contained in Table 4.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.3 Helium Service

SVC.3.1 Helium Service Specifications

If the instrument uses helium, the instrument shall comply with the helium specifications contained in Table 5.

Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.3.2 Helium Coupling Specifications

If the instrument uses helium, the instrument shall comply with the helium coupling specifications contained in Table 6.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.4 Compressed air service

SVC.4.1 Compressed Air Service Specifications

If the instrument uses Compressed air, the instrument shall comply with the Compressed air specifications contained in Table 7.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.4.2 Compressed Air Quality

If the instrument uses Compressed air, the instrument should employ filtering, dryer and pressure regulators as appropriate.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.4.3 Compressed Air Coupling Specifications

If the instrument uses Compressed air, the instrument shall comply with the Compressed air coupling specifications contained in Table 8.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.5 Fiber optics communication services

SVC.5.1 Physical Communications Hardware

The instrument shall contain all components for communications such as switches, servers and boards within the instrument electronics enclosures.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.5.2 Instrument Data and Control

The instrument shall use Ethernet for data and control communications between the instrument and operator.
Rationale: This is the current capability of the Gemini telescope.

Suggested Verification Method: Inspection

SVC.5.3 Ethernet Service Specifications

The instrument shall comply with the Ethernet specifications contained in Table 9.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.5.4 Synchro Bus Specifications

If the instrument uses the synchro bus, the instrument shall comply with the synchro bus specifications contained in Table 10.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.5.5 Event Bus Specifications

If the instrument uses the event bus, the instrument shall comply with the event bus specifications contained in Table 11.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.5.6 Wavefront Sensors Specifications

If the instrument uses on-instrument wavefront sensors, the instrument shall comply with the specifications contained in Table 12.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.6 Coax services

SVC.6.1 Coax Time Services

The instrument shall use Coax for timing.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.6.2 Coax Service Specifications

The instrument shall comply with the coax specifications contained in Table 13.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.7 AC power services

SVC.7.1 Minimizing Power Connections

The instrument should use the minimum number of power connections required, and shall not exceed two 120 VAC connections and one 208 VAC connection.

Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.7.2 AC Power Specifications

The instrument shall comply with the AC power specifications contained in Table 14. including **the maximum 2.88 kW of power that can be provided by each ISS connector panel outlet.**
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.7.3 AC Power Connector Specifications

The instrument shall comply with the AC power connector specifications contained in Table 15.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection
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SVC.7.4 AC Power Cable Type

The instrument power cable shall be #12 AWG, type SO or equivalent.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.

SVC.8 GIS service

SVC.8.1 GIS Connector Specifications

If the instrument uses GIS, the instrument shall comply with the GIS connector specifications contained in Table 17.
Rationale: This is the current capability of the Gemini telescope: The GIS interface supports TTL-level Event/Demand signals. The cable carrying these signals are specified as generic type #22AWG, 4 twisted pair with overall shield (Belden #8304 or equivalent). Pinout is ICD1.9/3.6 Table 18 with the usage of paired TTL and DC supply/gnd. signals conductors. The GIS cables originate at the Telescope Center Section PLC crate.
Suggested Verification Method: Inspection.

SVC.9 TWP service

SVC.9.1 TWP Connector Specifications

If the instrument uses TWP, the instrument shall comply with the TWP connector specifications contained in Table 19.
Rationale: This is the current capability of the Gemini telescope.
Suggested Verification Method: Inspection.