Fly Foundational Robots

Summary of Payload Separable Interfaces

Mission Background

The Fly Foundational Robots (FFR) mission is a flight demonstration intended to validate autonomous robotic capabilities in microgravity. Led by Motiv Space Systems in partnership with NASA, FFR supports NASA's ISAM strategy by:

- Demonstrating advanced robotic mobility, manipulation, and autonomy in LEO
- Testing foundational behaviors necessary for future servicing and assembly operations
- Enabling collaboration across government, industry, and academia through an open experimentation framework

FFR is positioned as a key step toward scalable orbital infrastructure and provides a rare opportunity to flight-test robotic systems in an operational space environment.

Figure 1: Notional picture of the FFR payload in-orbit.

Payload Separable Interfaces

Several separable interfaces have been incorporated into the design of the FFR payload to support both the current FFR mission objectives as well as the objectives of future missions:

- Motiv Space Systems CrossLink Cleat (Active and Passive)
- iBOSS Intelligent Space System Interface (Active)
- SpaceWorks FuseBlox (Passive)

While all four separable interfaces listed above have the ability to facilitate power and data pass-thru, those interfaces labeled as passive (passive CrossLink Cleat and FuseBlox) are not responsible for initiating mechanical docking; instead, docking is driven by their respective mating active interfaces. The deck-mounted Intelligent Space System Interface (iSSI) is active and therefore capable of initiating mechanical docking, but its androgynous design allows its mating interface to be either active or passive.

To enable end-over-end walking and repositioning of an Orbital Replacement Unit (ORU), the payload robotic arm (RA) is outfitted with two active CrossLink cleats – one on either side. These end effectors (EE) allow the RA to interface with any of the deck-mounted passive CrossLink cleats or with one mounted onto an ORU. During ORU repositioning, the RA is capable of supplying both power and data to the ORU via its mated end effector.

(a) Passive CrossLink Cleat (b) iSSI (Active) (c) FuseBlox (Passive)

Figure 2: Visualizations of payload deck separable interfaces.

Table 1: Capabilities of FFR payload separable interfaces.

FFR Payload CrossLink Cleat Capabilities	
Quantity on Deck	3x (1x Reserved at all times for RA)
Power Pass-Thru from Deck[1]	RA power (28V, 3A avbl.), Heater power (24V - 32V, 3A avbl.), Chassis Ground
Power Pass-Thru from Deck (Via RA EE)[1]	RA power (28V, 3A avbl.), Heater power (24V - 32V, 3A avbl.), Chassis Ground
Data Pass-Thru to/from Deck[1]	4x RS422 Channels (1x Reserved at all times for RA), Gigabit Ethernet, ESTOP
Data Pass-Thru to/from Deck (Via RA EE)[1]	2x RS422 Channels, ESTOP
Deck Interface Dimensions[2]	⌀172mm × 111mm
Mating Interface	Active CrossLink Cleat (RA EE)
Mating Interface Dimensions[2]	⌀142mm × 122mm

FFR Payload iSSI Capabilities	
Quantity on Deck	1x
Power Pass-Thru from Deck[1]	24V Power (3A avbl.), Heater power (24V - 32V, 3A avbl.)
Data Pass-Thru to/from Deck[1]	Gigabit Ethernet
Deck Interface Dimensions[2]	⌀145mm × 49mm
Mating Interface	iSSI passive interface or iSSI active interface
Mating Interface Dimensions[2]	⌀145mm × 26mm

FFR Payload FuseBlox Capabilities	
Quantity on Deck	1x
Power Pass-Thru from Deck[1]	24V - 32V Unregulated power (3A avbl.)
Data Pass-Thru to/from Deck[1]	Gigabit Ethernet
Deck Interface Dimensions[2]	100mm × 100mm × 40mm (base × width × height)
Mating Interface	Fuseblox active interface
Mating Interface Dimensions[2]	100mm × 100mm × 200mm (base × width × height)

[1] Specified power and data pass-thru's reflect what is available from the payload deck, not the full capabilites of the respective interfaces.

[2] Specified dimensions are centered with respect to separable interface.

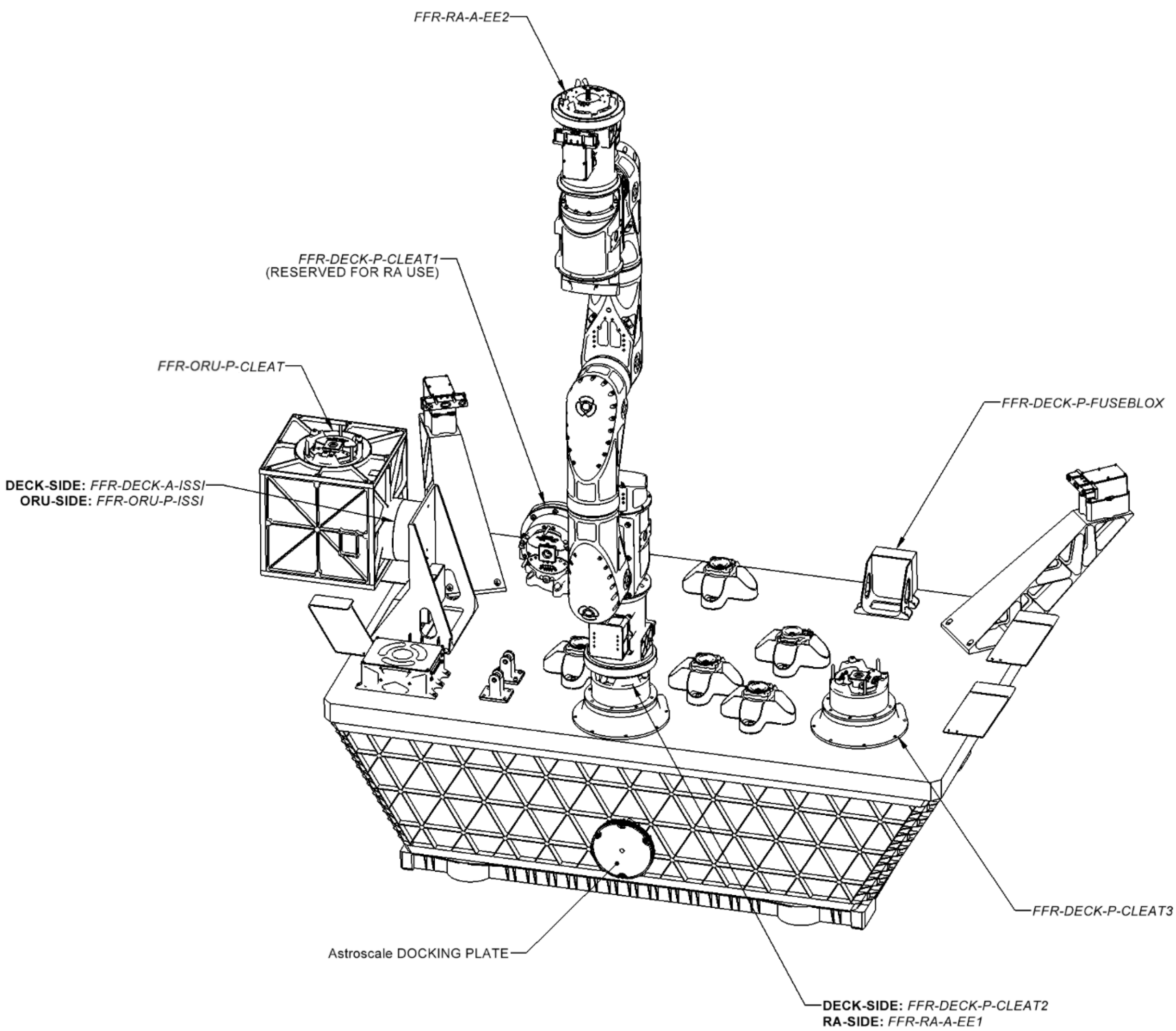

Figure 3: Representative FFR payload deck layout with separable interfaces labeled[3].

Table 2: Status of FFR payload separable interfaces following baseline mision demonstration.

Designation	Description	Status
FFR-DECK-P-CLEAT1	FFR Deck CrossLink Cleat 1 (Passive)	RESERVED
FFR-DECK-P-CLEAT2	FFR Deck CrossLink Cleat 2 (Passive)	IN USE
FFR-DECK-P-CLEAT3	FFR Deck CrossLink Cleat 3 (Passive)	UNUSED
FFR-DECK-A-ISSI	FFR Deck Active iSSI Interface	IN USE[4]
FFR-DECK-P-FUSEBLOX	FFR Deck Passive FuseBlox Interface	UNUSED
FFR-RA-A-EE1	CrossLink Robotic Arm End Effector 1 (Active)	IN USE
FFR-RA-A-EE2	CrossLink Robotic Arm End Effector 2 (Active)	UNUSED
FFR-ORU-A-CLEAT	FFR ORU CrossLink Active Cleat	UNUSED
FFR-ORU-P-CLEAT	FFR ORU CrossLink Passive Cleat	UNUSED
FFR-ORU-P-ISSI	FFR ORU Passive iSSI Interface	IN USE

[3] Interface labeling convention is as follows: *<mission>–<subsystem>–<active/passive>–<interface_name>*

[4] At the end of the baseline FFR mission demonstration, an ORU is already docked to FFR-DECK-A-ISSI. This ORU can be moved if a future ORU is designed to mate to FFR-DECK-A-ISSI instead.

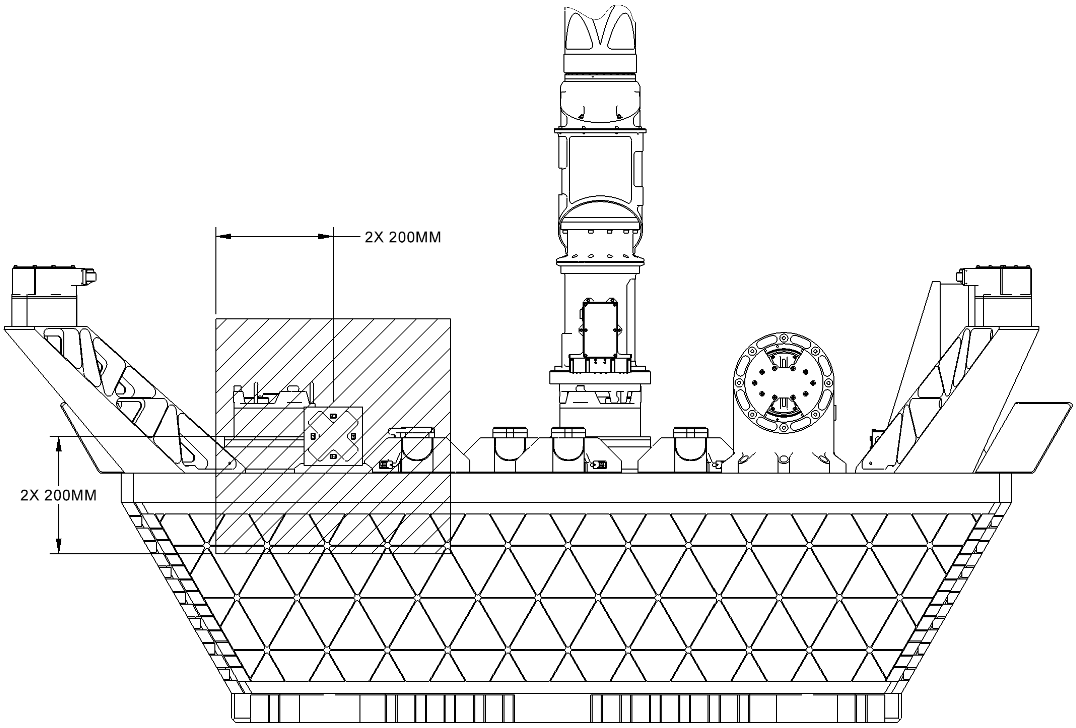

Figure 4: Maximum cross-section of an ORU designed to mate to FFR-DECK-P-FUSEBLOX[5].

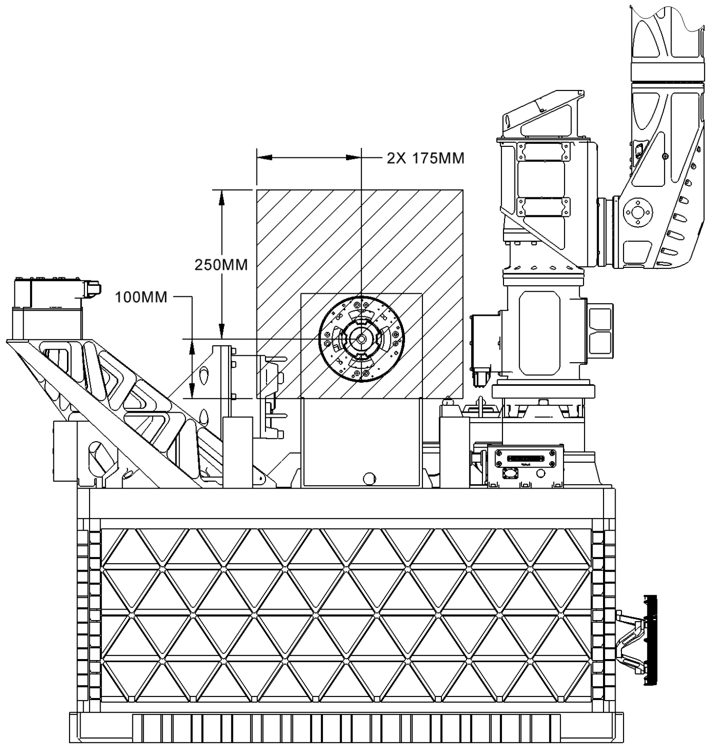

Figure 5: Maximum cross-section of an ORU designed to mate to FFR-DECK-A-ISSI[5].

[5]Allowable ORU height depends on placement of ORU Passive CrossLink Cleat and its relation to the RA workspace.

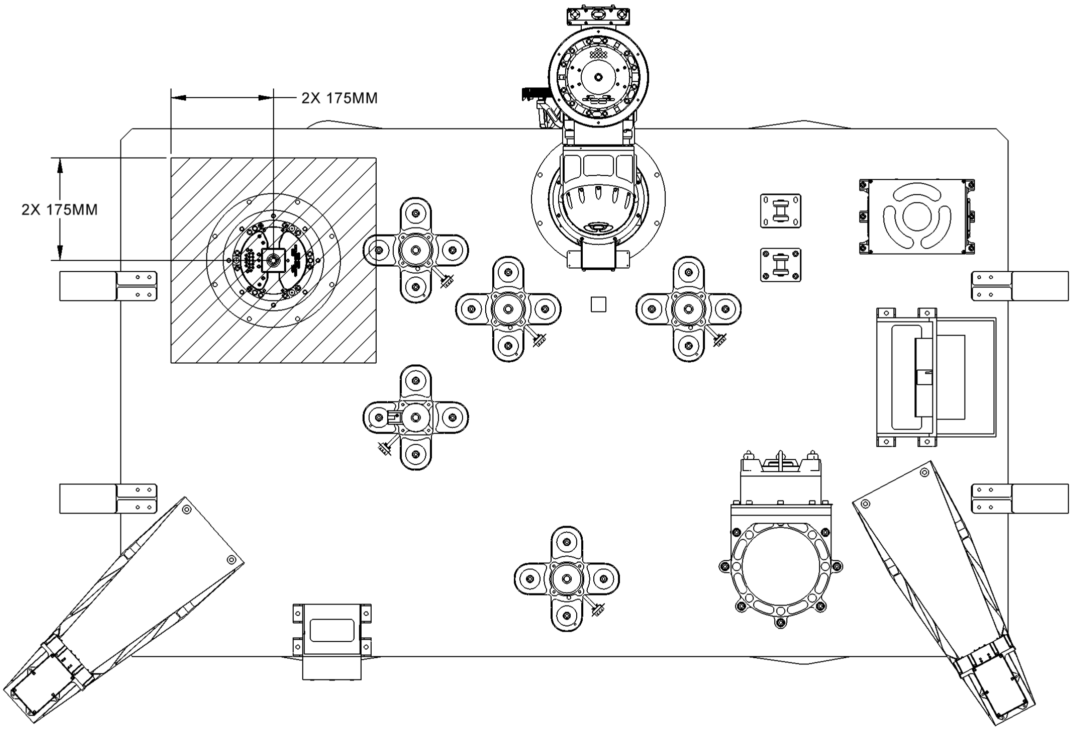

Figure 6: Maximum cross-section of an ORU designed to mate to FFR-DECK-P-CLEAT3[5].

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