S/C To Instrument Electrical Interface

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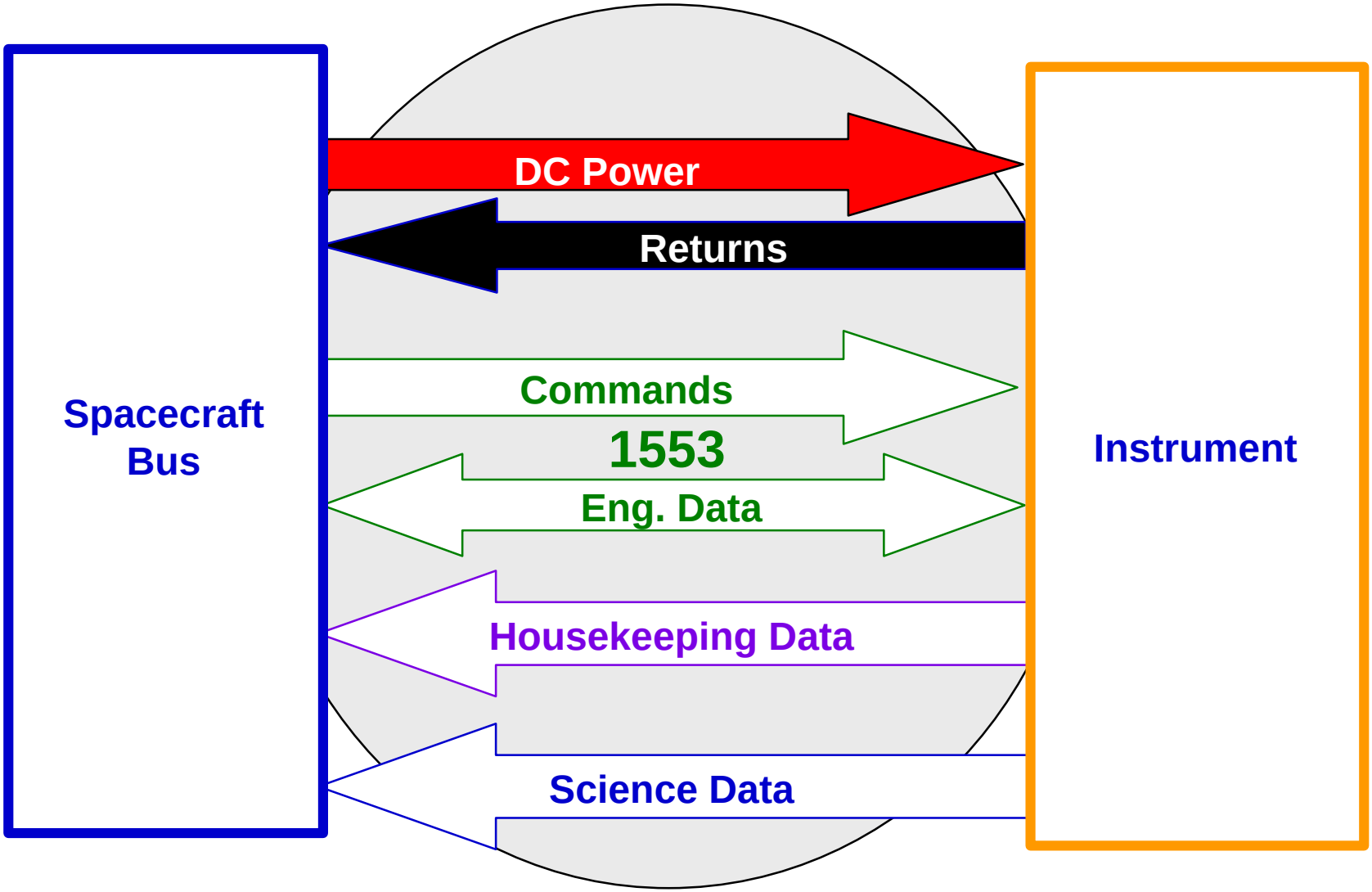
Top Level Requirements

Interface Control Document



S/C - Instrument Power Interface

• Number Of Buses	2 Separate Buses, Designated Bus A, Bus B
• Power Characteristics	
• Voltage	
– Primary Instrument Voltage	Spacecraft Bus Power at 30+6,-6VDC
– Secondary Instrument Voltage	None
– Bus Impedance	TBD
– Input Ripple	TBD
– Unannounced Removal of Power	TBD
• Current	
– Amps Per Bus	TBD
– Inrush Current Limit	Limited to Twice the Average Input Operating Current and Shall Settle to Within 10% of Nominal Operating Values Within 200 Milliseconds After the Application of Power
– Back EMF	TBD
– Fault Protection	TBD Provided By Spacecraft PCDE
• Power Allocation	
– Operational	269 W
– GTO	30 W
– Survival	90 W

Instrument Power Allocation (Watts @ 28V)

Component	Operational	Transfer Orbit	Survival
• Focal Plane Assembly	8	0	0
• Analog Processing Electronics	15	0	0
• CCD Control Electronics	26	0	0
• Data Processing & Instrument Control *	50	0	0
• Focal Plane Heaters	3	0	0
• Instrument Heater	130	0	0
• Survival Heaters	0	20	60
• Total Power	232	20	60
• Contingency	89	10	30
• Design Limit	321	30	90

S/C - Instrument Power Interface

- Grounds, Returns and References
- Returns
  - Primary Power Returns — Connected to Single Point Ground at PCDE
  - Analog, Digital, High Level Returns — Connected to SPG Via CTD&H
  - High Level — Never Connected to SPG at Instrument
- Isolation — Primary Input Power And Returns Shall Be Isolated From the Case (Chassis) and Secondary Power Circuitry By A Minimum DC Resistance of 1 Megohm
- Bonding/grounding — Shall Be in Accordance With MIL-B-5087B
- Structure Grounding — Instrument Structure Shall Be Electrically Grounded to the Spacecraft Bus With Ground Straps Provided by NRL
- Bonding — Dc Impedance Shall Be <= 2.5 M? for Metal to Metal Surface, <= 10? for Metal to Composite Interfaces
- EMI/EMC — Mil-std-461D CS01, CS-02, CS-06, CE-01 and CE-03, RS(TBD Per Range Requirements)

S/C - Instrument Harness

- Harness
  - Harness Provider — NRL Shall Provide Interface Plate With Connectors, LMSC Shall Provide Harness From Instrument to Interface Plate
  - Harness Hardware — TBD
  - Harness Routing — TBD
    - Harness Tie Downs on Experiment — TBD
  - Harness Wiring
    - Power Wires — TBD
    - 1553 Wires — TBD
    - Analog Telemetry — TBD
  - Connectors
    - Number of Connectors — TBD
    - Connector Clearance — TBD
    - Keying — TBD
    - Test Connectors — TBD

S/C - Instrument Command and Engineering Data Interface (1 of 4)

• Bus Type	MIL-STD-1553B
• Bus Functions	Commands, Housekeeping Data
• Number of Buses	2 Redundant
• Bus Configuration	
– Bus Master	Spacecraft ISC
– Remote Terminal	Instrument
• Electrical Interface	
- Mode Codes	TBD
- Status Word	TBD
- Data Wrap Around	TBD
- Automatic Retry	TBD
- Data Buffering	TBD
- Remote Terminal Self Test	TBD
- Instrument Timeout	TBD
- Illegal Command Monitoring By Instrument RT	TBD
- Instrument Commands and Memory Load	TBD
- Packetization for Commands and Memory Loads	TBD
- Command Timing	TBD
- Stored Commands	TBD

S/C - Instrument Command and Engineering Data Interface (2 of 4)

- Electrical Interface (Continued)
  - Command Constraints TBD
  - MIL-STD-1553B Messages
  - Reloadable Tables TBD
    - Star Tracker Attitude TBD
    - Active Heater Temperature Set Points TBD
    - Star Catalog Updates TBD
    - Flight Software Patches TBD
    - Special Test Modes TBD
- Time Marks and Time Code Data
  - Time Mark Transfers TBD
  - Time Code Data TBD
    - Time Code Data and Format TBD
    - Time Code Data Transfer TBD
    - Time Code Data Epoch TBD
    - Missing Time Marks and Time Code Data TBD

S/C - Instrument Command and Engineering Data Interface (3 of 4)

- **Instrument Engineering Data**
  - **Definition of Instrument Engineering Data** **TBD**
  - **Engineering Data Packetization** **TBD**
  - **Engineering Data Constraints** **TBD**
  - **Engineering Data Packet Checksum** **TBD**
- **Health and Safety Monitoring of Engineering Data**
  - **Engineering Data Transfer** **TBD**
  - **Sampling Rate** **TBD**
  - **Data Transfer Cycle and Time Gap** **TBD**
  - **Engineering Data Formats** **TBD**

S/C - Instrument Command and Engineering Data Interface (4 of 4)

- **Housekeeping Data Measured By FSC**

- Temperatures	TBD
- Voltage/Current Monitors	TBD
- Command Status Information	TBD
- Time Sync Pulse	TBD

S/C - Instrument Science Data Interface

• Science Data	
– Bus Type	Quad High Speed Serial (RS-422)
• Number of Buses	2
• Peak Data Rate	4 MBPS
• Science Data Packetization	TBD
• Science Data Packet Checksum	TBD
• Science Data Transfer Cycle	TBD
• Science Data Readiness Indicator	TBD
• Science Data Transfer Initialization	TBD
• Science Data Transfer Sequence	TBD
• Timing Restrictions	TBD
• Transfer Error Recovery	TBD
• Science Data Sampling Rate	TBD
• Science Data Transfer Cycle	TBD
• Science Data Time Gap	TBD
• Science Data Formats	TBD

Instrument Data Formats

- There Will Be Several Instrument Modes
  - Observations
  - Engineering
  - Acquisition
  - ??
- The Data Types Described Here Are for Observation Mode, Which Is the Mode the Instrument Is in for >95% of the Mission and Has the Highest Data Rate
- Observation Mode Packet Types
  - Binned Stars - Variable Length
    - Contains Two Application Data Types Intermixed
    - Variable Number of Data Type Units Per Packet
  - Unbinned Stars - Fixed Length
    - Contains Only One Application Data Type
    - One Data Type Unit Per Packet
  - Instrument Headers - Fixed Length
    - Contains Only One Application Data Type
    - One Data Type Unit Per Packet

Proposed Serial Interface Format

$$f(x) = x^{16} + x^{12} + x^{5} + 1$$

Sync Pattern	Packet Identification				Packet Sequence Control		Packet Length	Secondary Header	User Data Field	CRC	•••	Sync Pattern		CRC
	Version	Type	Secondary Header Flag	Application Process ID	Sequence Flags	Source Sequence Count	Packet Length	Clock Counts	Application Data					
0xEB90	'000'	'1'	'1'=present	(0-2046 decimal) (2047 dec. = fill	'11'							0xEB90	Next App. Packet	
(16)	(3)	(1)	(1)	(11)	(2)	(14)	(16)	(32)	(N*8)	(16)		(16)	(Var)	(16)

Data Is Set to Zero During the Interval Between Any Valid Messages. The CRC May Be Followed Immediately by the Next Message

The Packet Length Is Used to Determine When the Next Sync Pattern May Occur

Application Data - Star Data (2 Types Intermixed)

Star Data First Pixel

Sync Pattern	Column ID	Gain	Window Size	Bin Size	Chan. ID	Row ID	Pixel Data
0xFF	0-1023	0-2	code	code	0-47	0-2626	Data
(8)	(10)	(2)	(10)	(4)	(6)	(12)	(12)

1 Per Star (64 Bits Total)

Star Data Non-first Pixel

Chan. ID	Row ID	Pixel Data
0-47	0-2626	Data
(6)	(12)	(12)

9 Per Star (30 Bits Total)

Application Data - Unbinned Star Data

Unbinned Star Data

Column ID	Gain	Spare	Window Size	Chan. ID	Bin Size	Row ID	Pixel Data
0-1023	0-2	0x0	Code	0-47	Code	0-4095	Data
(10)	(2)	(4)	(10)	(6)	(4)	(12)	(200x12)

1 Per Star (2448 Bits Total)

Application Data - Instrument Headers

Instrument Headers

Sync. Pattern 0xffc143 (24)	Counter (8)	Houskeeping Format ID (4)	Clock Time (58)	Star Reference for Clock (28)	Quaternian (128)	Clock Reference for Quaternian (28)	Rotation Rate (26)	TDI Rate (20)

Command Received Count (8)	Command Rejected Count (8)	Command Result Code (8)	Command ID (8)	Comand Sequrence Count (8)	Execution Profile Max Time (16)	Task Completion Status (8)	Interface Status (16)

Health Status (8)	Housekeeping Data (1048)	Spares (124)

1 Per Second
(1584 Bits Total)