

Wide-Field Imaging Survey Polarimeter  
WISP

Telemetry, Commands, and Electrical Interface  
Specification

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## 1. Telemetry

The telemetry interface will be compatible with the Vector Pulse Code Modulation (PCM) telemetry system used on sounding rockets. The purpose of this system is to transmit CCD images and engineering data from the WISP. The science data rates are 1 pixel (15 bits) every 22.5  $\mu$ sec, so that a high rate PCM system is required. The payload will transmit a NRZ-L 2 pole filtered data stream at a continuous 2 MHz rate to the TM section. The clock is generated within the payload. Clock accuracy and stability are TBD. The data is arranged in packets, or frames. There are 10 words per science data frame. Each word is 9 bits wide. Each frame contains a fixed pattern 10 bit sync word, a 10 bit CCD line counter, a 10 bit telemetry frame counter, a 3 bit ID that indicates the type of data being sent, and 6 data bytes. (Parity is not transmitted during sync word, i.e., the PCM receiver will see the recommended 10 bit sync word as given in the PCM Handbook, NASA publication 1171 Table 19.) The data frame will have the following format:

Science Data Frame (SDF)

0 0 0 1 1 1 0 1 1 (Sync)				
P	Line Cnt(7)	0 (Sync)		
P	Science Data (MS byte Pixel A)			
P	Science Data (LS byte Pixel A)			
P	Engineering Data			
P	Engineering Data			
P	Science Data (MS byte Pixel B)			
P	Science Data (LS byte Pixel B)			
P	SDF Cnt(5)	Line Cnt(3)		
P	SDB(1)	SDA(1)	ED(1)	SDF Cnt(5)

Note:

- Parity (P) is odd and is transmitted last.
- Frame period is 45  $\mu$ sec.
- Data is shifted out to the right MSB first, starting with Sync.
- ED, SDA, SDB are ID status bits indicating, if "1", data in frame.

The ground station(s) will record the data on tape and provide a 9 track digital tape following the launch. During the test, pre-launch, and launch phases, the experiment GSE will receive a NRZ-L serial data stream, TTL compatible, along with a reconstructed 2 MHz clock from the PCM receiver. The science data will be transmitted in real time via the high speed PCM data link at a rate of 2 Megabits per second. Clock duty cycle shall be 50%. The data will change on the rising edge of the zero degree clock; the experimenter will sample the data line on the falling edge of the clock. The signal levels shall be TTL compatible fed over 50 ohm coax with the experimenter terminating the lines in 50 ohms. The ground station(s) must record data from T-30 seconds to the end.

## 2. Commands

The experiment will require 3 digital commands from the TM/ACS section. These signals shall be open circuit switch closures to experiment signal ground at the time of function activation. Open circuit voltage shall be +5 volts and the TM section must sink 5 mA with no more than 0.2 volts drop with respect to experiment signal ground.

### 2.1 Aspect Picture

Prior to the experiment acquiring the science target, it may take two pictures of the sky at the time the ACS has acquired the tracker stars. The experiment will monitor the "Aspect Cam" signal from the ACS. This signal must remain at a logical "zero" for a minimum of 3 seconds at the time of exposure. It must go to a logical "one" state for a minimum of 3 seconds between the first and second exposure before returning to a logical "zero" at the time of the second exposure. The signal should return to a logical "one" after the second exposure.

### 2.2 At Altitude

When the rocket has reached a predetermined altitude, a timer will issue an "At Altitude" signal to the experiment. This switch closure to ground will remain throughout the flight. (Note: This signal is currently not used.)

### 2.3 On Target

When the ACS has acquired fine mode on the science target the ACS shall issue an "On Target" signal to the experiment.

## 3. Power and Grounding

The experiment shall require a nominal +28 volts. Peak voltage shall not exceed +35 volts at any time. Minimum voltage shall be greater than +21 volts. Power will be 150 watts, average; 200 watts, peak. Experiment power shall be removed prior to chute opening. Primary power return will be

isolated from experiment signal ground within the experiment by at least 1 Megohm in parallel with .05  $\mu$ fd. Both returns are isolated from chassis by at least 1 Megohm in parallel with .05  $\mu$ fd. Primary return and signal return are connected to chassis within the TM section at a single point. Experiment DC-DC converters shall be of the linear regulated type in order to minimize EMI.

#### 4. Connectors

##### 4.1 Telemetry

The experiment shall have two bayonet style connectors on its baseplate. These connectors are labeled P400 and J401. P400 is a Bendix PT07SE-22-55P. J401 is a Bendix PT07SE-22-55S. Experiment interface assignments for P400 and J401 are listed below: All optically isolated signals are to be made available at the TM umbilical so that these can be fed to the experiment GSE in the block house.

##### P400: PT07SE-22-55P

Pin	Assignment	Notes
P400-A	+28V	Expt +28V
P400-B	+28V	Expt +28V
P400-C	+28V	Expt +28V
P400-D	+28V	Expt +28V
P400-E	+28V Rtn	+28V return
P400-F	+28V Rtn	+28V return
P400-G	+28V Rtn	+28V return
P400-H	+28V Rtn	+28V return
P400-J	Expt Reset	Opto isolated expt reset Hi Side
P400-K	Reset Rtn	Opto isolated expt reset Lo Side
P400-L	Clock Reset	Opto isolated clock reset Hi Side
P400-M	Clock Rtn	Opto isolated clock reset Lo Side
P400-N	Aspect Cam	Digital Discrete from ACS
P400-P	Aspect Cam Rtn	Experiment signal return
P400-R	Not Used #1	
P400-S	Not Used #2	
P400-T	Not Used #3	
P400-U	Not Used #4	

Pin	Assignment	Notes
P400-V	EEPROM Write Enable	Opto isolated EEPROM En. Hi Side
P400-W	EEPROM Enable Rtn	Opto isolated EEPROM En. Lo Side
P400-X	DEP Serial TXD	Opto isolated DEP TXD. Hi Side
P400-Y	DEP Serial TXD	Opto isolated DEP TXD. Lo Side
P400-Z	DEP Serial RXD	Opto isolated DEP RXD. Hi Side
P400-a	DEP Serial RXD	Opto isolated DEP RXD. Lo Side
P400-b	Serial TM Data	2Mbit/sec NRZ serial TM data
P400-c	Serial TM Data Rtn	Expt signal return
P400-d	Serial Data	2Mbit/sec serial GSE data Hi Side
P400-e	Serial Data Rtn	2Mbit/sec serial GSE data Lo Side
P400-f	Serial Clock	2Mbit/sec GSE clock Hi Side
P400-g	Serial Clk Rtn	2Mbit/sec GSE clock Lo Side
P400-h	At Altitude	Digital Discrete from TM/ACS
P400-i	At Altitude Rtn	Experiment signal return
P400-j	On Target	Digital Discrete from TM/ACS
P400-k	On Target Rtn	Experiment signal return
P400-m	Expt +28 battery voltage	0-5 Volt Analog
P400-n	Experiment current	0-5 Volt Analog
P400-p	Experiment +5 volts	0-5 Volt Analog
P400-q	Experiment +/- 15 volts	0-5 Volt Analog
P400-r	Motor +28 volts	0-5 Volt Analog
P400-s	DEP Cage Temp	0-5 Volt Analog
P400-t	Motor Current	0-5 Volt Analog
P400-u	TEC +12 volts	0-5 Volt Analog
P400-v	Detector Reg +8 volts	0-5 Volt Analog
P400-w	Detector Reg +28 volts	0-5 Volt Analog
P400-x	Detector Reg +/- 18 volts	0-5 Volt Analog
P400-y	Detector Int +23 volts	0-5 Volt Analog

Pin	Assignment	Notes
P400-z	Detector Int +/- 15 volts	0-5 Volt Analog
P400-AA	Detector Int +5 volts	0-5 Volt Analog
P400-BB	Detector Int +5 Aux volts	0-5 Volt Analog
P400-CC	Expt. Signal Return	
P400-DD	Expt. Signal Return	
P400-EE	Cold Sink Control	AD590 Hi to umbilical
P400-FF	Cold Sink Control	AD590 Lo to umbilical
P400-GG	Audio Speaker Hi to umbilical	
P400-HH	Audio Speaker Lo to umbilical	

## J401: PT07SE-22-55S

Pin	Assignment	Notes
J401-A	Det. Cold Finger Temp	0-5 Volt Analog
J401-B	Expt. #3 Temp	0-5 Volt Analog
J401-C	Coldsink Temp	0-5 Volt Analog
J401-D	Det. Temp Control Drive	0-5 Volt Analog
J401-E	TEC Voltage	0-5 Volt Analog
J401-F	TEC Current	0-5 Volt Analog
J401-G	Heater Current (not used)	0-5 Volt Analog
J401-H	Det. Cage Temp	0-5 Volt Analog
J401-J	Powercube Temp	0-5 Volt Analog
J401-K	Not Used #1	
J401-L	Not Used #2	
J401-M	Not Used #3	
J401-N	Not Used #4	
J401-P	Not Used #5	
J401-R	Not Used #6	
J401-S	Not Used #7	

Pin	Assignment	Notes
J401-T	Not Used #8	
J401-U	Expt. #1 Temp	0-5 Volt Analog
J401-V	Expt. #2 Temp	0-5 Volt Analog
J401-W	Det. Backplate Temp	0-5 Volt Analog
J401-X	Shutter Solenoid Temp	0-5 Volt Analog
J401-Y	Filter Motor Temp	0-5 Volt Analog
J401-Z	Waveplate Temp	0-5 Volt Analog
J401-a	Mercury Lamp Temp	0-5 Volt Analog
J401-b	Mercury Lamp Intensity	0-5 Volt Analog
J401-c	Det. Vacuum Gauge	0-5 Volt Analog
J401-d	Expt. Vacuum Gauge	0-5 Volt Analog
J401-e	Strain Gauge A	0-5 Volt Analog
J401-f	Strain Gauge B	0-5 Volt Analog
J401-g	Strain Gauge C	0-5 Volt Analog
J401-h	Strain Gauge D	0-5 Volt Analog
J401-i	Gas Controller Command	0-5 Volt Analog
J401-j	Gas Controller Equil Flag	0-5 Volt Analog
J401-k	Gas High Pressure	0-5 Volt Analog
J401-m	Gas Inlet Pressure	0-5 Volt Analog
J401-n	Gas Outlet Pressure	0-5 Volt Analog
J401-p	Focus Position LVDT	0-5 Volt Analog
J401-q	Focus Position Up Limit	0-5 Volt Analog
J401-r	Focus Position Dn Limit	0-5 Volt Analog
J401-s	Waveplate Rotation Pot	0-5 Volt Analog
J401-t	Waveplate CW Limit	0-5 Volt Analog
J401-u	Waveplate CCW Limit	0-5 Volt Analog
J401-v	Waveplate Hall Sensor A	0-5 Volt Analog
J401-w	Waveplate Hall Sensor B	0-5 Volt Analog

Pin	Assignment	Notes
J401-x	Shutter Open	0-5 Volt Analog
J401-y	Shutter Closed	0-5 Volt Analog
J401-z	A Filter Position	0-5 Volt Analog
J401-AA	B Filter Position	0-5 Volt Analog
J401-BB	Detector Readout Flag	0-5 Volt Analog
J401-CC	Detector Integrate Flag	0-5 Volt Analog
J401-DD	Detector Shutter Flag	0-5 Volt Analog
J401-EE	Audio Level	0-5 Volt Analog
J401-FF	Vac Gauge Filament Mon	0-5 Volt Analog
J401-GG	Experiment Signal Return	
J401-HH	Experiment Signal Return	

#### 4.2 Star Tracker Connectors

Control for the two startrackers, ST1 and ST2, will be via the two star tracker connectors, J142 and P142A, mounted on the instrument bulkhead:

##### ST1. J142: PT07SE-14-18S

Pin	Description:
J142-A	+28V
J142-B	+28V Rtn
J142-C	2 Degree FOV Cmd
J142-D	4 Degree FOV Cmd
J142-E	Tracker HV Cmd
J142-F	Acquire Cmd
J142-G	X (Ball "Pitch") Error
J142-H	Y (Ball "Yaw") Error
J142-J	Tracker Lock
J142-K	Star Mag
J142-L	HV Mon

Pin	Description:
J142-M	Signal Gnd
J142-N	Y (Ball "Yaw") Offset
J142-P	X (Ball "Pitch") Offset
J142-R	Brightness Ctl #1
J142-S	Brightness Ctl #2
J142-T	Chassis Gnd

## ST2. P142A: PT07E-14-18P

Pin	Description:
P142A-A	+28V
P142A-B	+28V RTN
P142A-C	2 Degree FOV Cmd (+28V to Assert from ACS)
P142A-D	4 Degree FOV Cmd (+28V to Assert from ACS)
P142A-E	Tracker HV Cmd (Not Used)
P142A-F	Acquire Cmd (Gnd to Assert from ACS)
P142A-G	X (Ball "Pitch") Error (+/- 6V Analog to TM)
P142A-H	Y (Ball "Yaw") Error (+/- 6V Analog to TM)
P142A-J	Tracker Lock (Discrete to TM; +5V = Lock)
P142A-K	Star Mag (0-5V Analog to TM)
P142A-L	HV Mon (+5V to TM)
P142A-M	Signal Gnd
P142A-N	Z (Roll) Error (+/- 6V Analog to TM)
P142A-P	X (Ball "Pitch") Offset (N/C)
P142A-R	Brightness Ctl #1 (Gnd to Assert from ACS)
P142A-S	Brightness Ctl #2 (Gnd to Assert from ACS)
P142A-T	Chassis Gnd
P142A-U	RS232 TXD (38.4 Kbaud to TM)

### 4.3 Door and Ignitor Housing Connectors

Control for the ignitor housing will be passed through the experiment section via a bulkhead connector, J5. Pins P, R, S, and T are also used for the tracker door.

#### J5: PT07SE14-19S

Pin	Description	Ign Destination
J5-A	Sys 1 SCM	P164-4
J5-B	SCM Data Gnd	E101-19
J5-E	+5 Volts	E111-11
J5-G	2nd Stage Motor Pressure	P163-14
J5-H	Sep Loop Rtn	P114-9
J5-J	Sep Loop	P114-8
J5-K	Sys 2 SCM	P163-17
J5-M	S-19/ACS BTS Module	P111A-19
J5-N	TM Gnd Bus	E100-30
J5-P	Trkr Door +5 V Bus	E111-12
J5-R	Trkr Door Position Mon	P163-21
J5-S	Trkr Door Gnd Bus	E101-37
J5-T	Trkr Door Close/open Mon	P164-32
J5-U	TTS Sig Gnd A	E100-15
J5-V	TTS AGC TM Monitor	P165-32

The experiment door is controlled via the connector P3:

#### P3: PT07SE-12-10P

Pin:	Description:	Destination:
P3-A	Experiment Door Open	P111-7
P3-B	Experiment Door Open	P111-10
P3-C	Experiment Door Close	P111-13
P3-D	Experiment Door Close	P111-16
P3-E	Pwr Ground	E101-34

Pin:	Description:	Destination:
P3-F	Pwr Ground	E100-18
P3-G	Close/ Open Mon	P164-5
P3-H	+5V Input	E111-10
P3-J	Position Mon	P164-4
P3-K	Sig Gnd	E101-33

The tracker door is controlled via the instrument bulkhead connector P750, plus J5-P, -R, -S, and -T (see above).

P750: PT07SE-10-6P

Pin:	Description:	Destination:
P750-A	Trkr Door BTS Module	P111C-3
P750-B	Trkr Door BTS Module	P111C-8
P750-C	Trkr Door BTS Module	P111C-13
P750-D	Trkr Door BTS Module	P111C-18
P750-E	TM Ground Bus	E101-39
P750-F	TM Ground Bus	E100-23

#### 4.4 Umbilical - GSE

The rocket umbilical connector shall provide for a serial command link between the GSE, within the block house, and experiment DEP. Full duplex ASCII commands will be transmitted over these lines using an optically isolated current loop. Transmission rate shall be 2400 baud. In addition, 3 other optically isolated signals (system reset, clock reset, and parameter EEPROM write enable) are provided through the umbilical connector. A total of 7 twisted pair lines are required to be connected to experiment GSE within the blockhouse (see figure 1).

Prior to launch, there is a need to monitor and control the temperature of the cold sink within the payload. A purge/ cooling control system near the rocket rail will require 10 twisted pair lines back to the blockhouse GSE (see figure 1).

Figure 1. WISP Experiment/ GSE Block Diagram

