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Requirements

(Insert in 625-205, Galileo Orbiter
Functional Requirements Book)

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JET PROPULSION LABORATORY

No. GLL-4-2023, Rev. B
2 May 1989
SUPERSEDES:
GLL-4-2023, Rev. A.
18 February 1981

FUNCTIONAL REQUIREMENT

GALILEO ORBITER FLIGHT EQUIPMENT

PLASMA WAVE SUBSYSTEM

1.0 SCOPE

This document establishes the functional requirements of the Galileo Orbiter plasma wave subsystem (PWS) which is used to investigate electric and magnetic waves in space plasmas.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this Functional Requirement.

NOTE

GLL-3-100, Galileo Orbiter Requirements and Constraints applies to this document. Requirements of other Galileo level-three documents may also be applicable. It is the responsibility of the user to adequately acquaint himself with the organization and pertinent content of the level-three documents, as well as with the material contained herein.

Requirements

Jet Propulsion Laboratory

GLL-3-100	Functional Requirements, Galileo Orbiter Requirements & Constraints
GLL-3-110	Functional Requirements, Galileo Orbiter Functional Block Diagram & Interface Listings
GLL-3-170	Functional Requirements, Galileo Orbiter Functional Accuracies & System Capabilities
GLL-3-180	Functional Requirements, Galileo Orbiter Configuration
GLL-3-190	Functional Requirements, Galileo Orbiter Structural Design Criteria
GLL-3-200	Functional Requirements, Galileo Orbiter Inertial Properties
GLL-3-210	Functional Requirements, Galileo Orbiter
GLL-3-220	Functional Requirements, Galileo Orbiter Electronic Equipment Design
GLL-3-230	Functional Requirements, Galileo Orbiter Equipment List and Mass Allocations
GLL-3-240	Functional Requirements, Galileo Orbiter Environmental Design Requirements
GLL-3-250	Functional Requirements, Galileo Orbiter Power Profile & Allocation
GLL-3-260	Functional Requirements, Galileo Orbiter Electrical Grounding & Interfacing
GLL-3-270	Functional Requirements, Galileo Orbiter Data System Intercommunication Description & Requirements
GLL-3-280	Functional Requirements, Galileo Orbiter Telemetry Measurements & Data Formats
GLL-3-0290	Functional Requirements, Galileo Orbiter Command Structure & Assignments
GLL-3-1110	Functional Requirement, Galileo Orbiter Support Equipment Functional Block Diagram & Interface Listings

DRAWINGS

Jet Propulsion Laboratory

10085825	Circuit Data Sheet Index and Guide
10086759	PWS Interface Control Drawing
10086769	PWS Interface Control Drawing

Jet Propulsion Laboratory

PD625-50	Galileo Orbiter Science Requirements Document
PD625-52	Project Galileo Policies and Requirements for Orbiter Science Investigations
PD625-232	Galileo Orbiter System Configuration Management Plan

3.0 FUNCTIONAL REQUIREMENTS

GENERAL

The function of the PWS shall be to measure the characteristics of wave electric and magnetic fields in the Jovian magnetospheric plasma. The scientific objectives of this investigation are to study the characteristics and origin of plasma waves in Jupiter's magnetosphere. The measurements obtained with the PWS will be used to analyze wave-particle interactions that play important roles in controlling the dynamics of the Jovian magnetosphere and to study satellite-magnetosphere interactions. As a secondary objective a study will be made of Jovian radio emissions.

3.2 Sensing and Analog Processing

The PWS shall use sensors capable of detecting wave electric fields and wave magnetic fields.

3.2.1 Frequency Coverage

The PWS shall measure wave phenomena at frequencies between 5 Hz and 160 kHz. The PWS shall also measure wave electric fields at frequencies in selected narrow band passes in the frequency range 100 kHz to 5.6 MHz.

3.3.2 Frequency Resolution

The PWS shall measure wave phenomena in four filter channels between 5 Hz and 50 Hz. Nominal bandwidths shall be + 15 Percent of the

center frequency. The PWS shall have 112 filter channels between 40 Hz and 160 kHz with bandwidths of approximately + 2 percent of the center frequency. The PWS shall also have 42 channels with 3 kHz bandwidths at frequencies between 100 kHz and 5.6 MHz. m e Galileo 2.4 kHz power supply frequency shall be notched in each of these filter channels at frequencies above 400 kHz. The PWS shall also make high frequency resolution measurements with a wideband waveform receiver that will sample wave phenomena rapidly enough to enable reconstruction of the waveform in selectable bandwidths of 5 Hz to 1 kHz, 50 Hz to 10 kHz, and 50 Hz to 80 kHz.

3.2.3 Dynamic Range

The PWS shall make measurements over a dynamic range greater than 90 dB with spurious free response over a dynamic range greater than 70 dB.

3.2.4 Amplitude Resolution

The PWS shall resolve the amplitude of wave phenomena measured to within ±2 dB.

3.3 Data Processing

The instrument shall cycle through various filters, collecting, compressing, A to D converting, and formatting data for output. The output shall be in 1 of 4 fixed formats

3.4 Signal Interfacing

The instrument shall contain a data interface with the command and data subsystem (CDS). This interface shall condition signals for communication with the CDS to provide instrument synchronization, mode selection, and data readout.

3.5 Power Conversion

The PWS shall accept 2.4 kHz power form the power/pyro subsystem (PPS) and convert it to the necessary voltages for circuit operation.

4.0 FUNCTIONAL DESCRIPTION

4.1 Major Functional Elements

The PWS shall consist of a four channel frequency spectrum analyzer, a 112 channel sweep frequency receiver, a wideband waveform receiver, a 42-channel high frequency receiver, a data processing unit, and electric dipole antenna assembly, a search coil magnetic antenna assembly, input electronics, a calibration generator, a search coil preamplifier supplemental heater, and a power supply. The PWS functional block diagram shall be as shown in Figure 1.

4.1.1 Four Channel frequency Spectrum Analyzer

The four channel frequency spectrum analyzer shall measure the amplitude of signals in four filter channels with a logarithmic compressor. m e center frequencies and the nominal bandwidth of these four channels are shown in Table 1.

Table 1. Spectrum Analyzer Filter Characteristics

Compressor	Filter	Center Frequency (Hz)*	Frame Number
	4	5.62	1, 5, 9, 13, 17, 21 25 2, 6 10, 14, 18, 22, 26 3, 7, 11, 15, 19, 23, 27 4, 8, 12, 16, 20, 24, 28

*Nominal bandwidth of + 15%

4.1.2 One-Hundred Twelve Channel Sweep Frequency Receiver

The 112 channel sweep frequency receiver shall measure the amplitude of signals in 112 filter channels with four logarithmic compressors. The center frequencies and bandwidth of these 112 channels are shown in Table 2.

4.1.3 Wideband Waveform Receiver

The wideband waveform receiver shall sample and convert to digital form with 4-bit accuracy the waveform of the signal received by an automatic gain control (AGC) receiver rapidly enough to allow reconstruction of the waveform in one of three bandpasses: 50 Hz to 10 kHz, 40 Hz to 80 kHz, or 5 Hz to 1 kHz. This hi-rate data shall be supplied, serially to the bulk memory through a special purpose interface, similar to the SSI hi-rate data. The waveform receiver shall operate in one of three hi-rate modes and a waveform survey mode (data included in LRS format) as listed in Table 3.

4.1.4 Forty-two Channel High Frequency Receiver

The forty-two channel high frequency receiver shall measure the amplitude of signals in forty-two filter channels with one logarithmic compressor. The center frequencies of these forty-two channels are shown in Table 4. The nominal bandwidth of these channels is 3 kHz.

GALILEO PLASMA WAVE SUBSYSTEM (PWS)

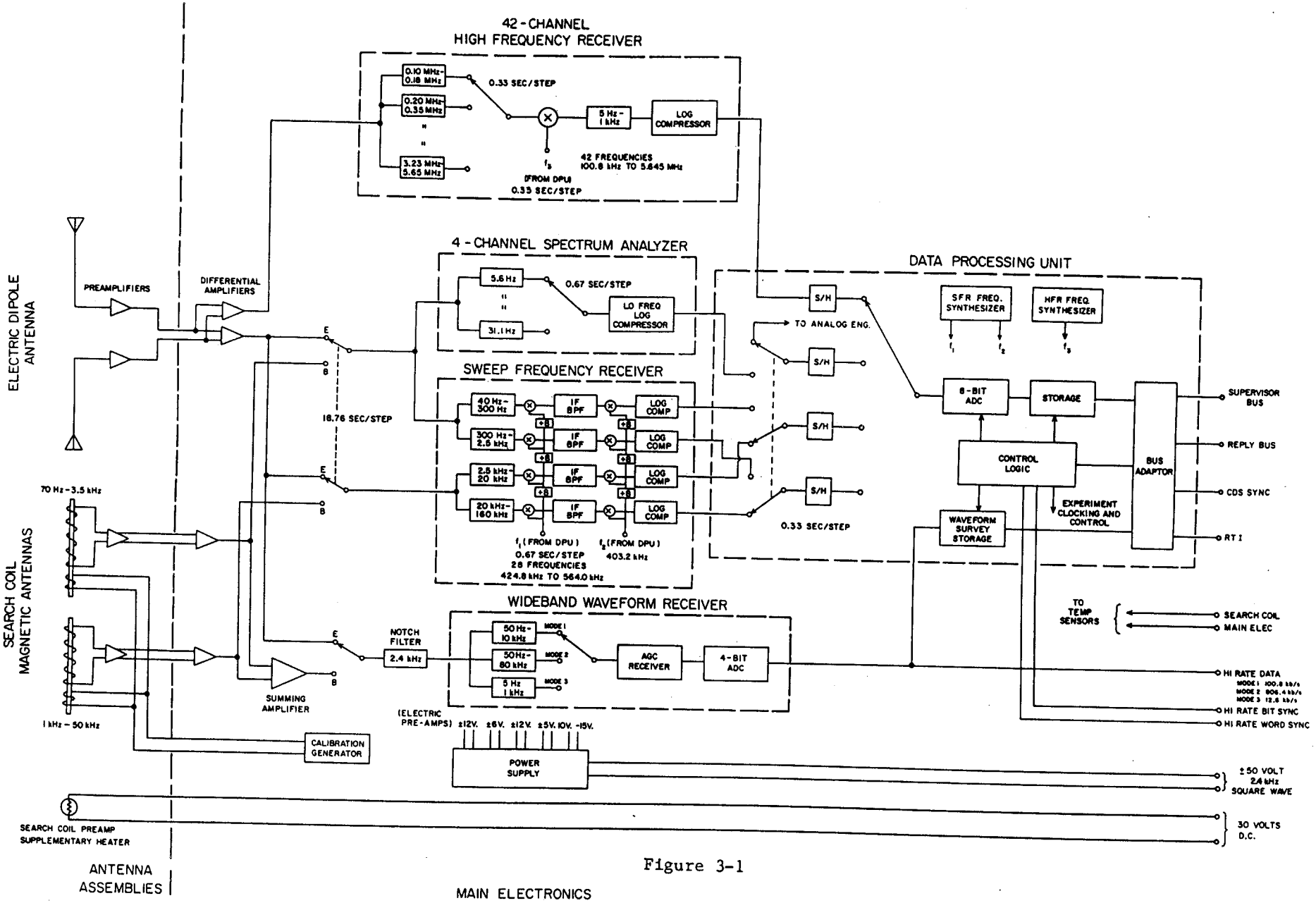


Figure 3-1

Table 2. SWEEP FREQUENCY RECEIVER FILTER CHARACTERISTICS

Band No.	Channel No.	Center Frequency (Hz)	Bandwidth (Hz)	Band No.	Channel No.	Center Frequency (Hz)	Bandwidth (Hz)	Band No.	Channel No.	Center Frequency (kHz)	Bandwidth (Hz)
	1	42.1			42	900			83	18.59	
	2	45.6			43	965			84	20.10	
	3	49.0			44	1031			85	21.6	
	4	52.5			45	1098			86	23.3	
	5	56.0			46	1201			87	25.1	
	6	59.6			47	1272			88	26.9	
	7	66.7			48	1380			89	28.7	
	8	70.4			49	1491			90	30.5	
	9	77.7		2	50	1606	±15		91	34.2	
	10	81.5			51	1724			92	36.0	
	11	89.0			52	1887			93	39.8	
	12	96.7			53	2013			94	41.7	
	13	104.5			54	2144			95	45.6	
1	14	112.5	±5.2		55	2325			96	49.5	
	15	120.6			56	2513			97	53.5	
	16	128.9			57	2.70 kHz		4	98	57.6	±720
	17	137.3			58	2.91			99	61.7	
	18	150.2			59	3.14			100	66.0	
	19	158.9			60	3.36			101	70.3	
	20	172.5			61	3.58			102	76.9	
	21	186.4			62	3.81			103	81.4	
	22	200.7			63	4.27			104	88.3	
	23	215.5			64	4.50			105	95.4	
	24	235.9			65	4.98			106	102.8	
	25	251.7			66	5.21			107	110.3	
	26	268.0			67	5.70			108	120.7	
	27	290.6			68	6.19			109	128.9	
	28	314.1			69	6.69			110	137.2	
	29	337		3	70	7.20	±90		111	148.8	
	30	364			71	7.72			112	160.8	
	31	392			72	8.25					
	32	420			73	8.78					
	33	448			74	9.61					
	34	476			75	10.17					
2	35	534			76	11.04					
	36	563			77	11.93					
	37	622			78	12.85					
	38	652			79	13.79					
	39	712			80	15.09					
	40	774			81	16.11					
	41	836			82	17.15					

4.1.5 Data Processing Unit

The data processing unit shall perform sampling, 8-bit analog-to- digital conversion, storage, and routing of data from the spectrum analyzer, the sweep frequency receiver, and the high frequency receiver. The data processing unit shall generate clocking and timing pulses from signals received on the CDS bus. The data processing unit shall provide a bus adapter to interface between the CDS bus and the PWS. The data processing unit shall also collect and route sampled data from the wideband waveform receiver in two bandpasses, 50 Hz to 10 kHz and S Hz to l Hz, when it is in the Waveform Survey Mode. A fixed number (280) of these samples shall be collected at a rate of 100.8 or 12.6 kb/s, stored in the data processing unit, and clocked into the low rate science format at an effective rate of 120 b/s.

Table 3. Wideband Waveform Receiver Operating Modes

Mode	Bandwidth	Hi-Rate Data Rate
Mode 1	50 Hz - 10 kHz	100.8 kb/s
Mode 2	50 Hz - 80 kHz	806.4 kb/s
Mode 3	5 Hz - l kHz	12.6 kb/s
Waveform Survey Mode (Mode 4)	50 Hz -10 kHz	100.8 kb/s, 12. 6 kb/s alternating every 9.3 sec. (14 LRS frames)

Note: Data rate is rate at which data is clocked into the CDS bulk memory. Effective data rates in spacecraft telemetry will be less than or equal to these rates, depending on how much data is clocked into the telemetry stream.

Table 4. High Frequency Receiver Filter Characteristics

1 F Filter (MHz)	Channel Number	Center Frequency (MHz)
0.10-0.18	1	0.1008
	2	0.1134
	3	0.1260
	4	0.1386
	5	0.1512
	6	0.1638
	7	0.1764
0.20-0.35	8	0.2016
	9	0.2268
	10	0.2520
	11	0.2772
	12	0.3024
	13	0.3276
	14	0.3528
0.40-0.71	15	0.4032
	16	0.4536
	17	0.5040
	18	0.5544
	19	0.6048
	20	0.6552
	21	0.7056
0.81-1.41	22	0.8060
	23	0.9070
	24	1.008
	25	1. 109
	26	1.210
	27	1.310
	28	1.411
1.61 2.82	29	1.613
	30	1.814
	31	2.016
	32	2.218
	33	2.419
	34	2.621
	35	2.822
3.23 5.65	36	3.226
	37	3.629
	38	4.032
	39	4.435
	40	4.838
	41	5.242
	42	5.645

4.1. 6 Electric DiPole Antenna Assembly

The electric dipole antenna assembly shall receive plasma wave electric fields with two deployable elements. Two preamplifiers integral with the assembly shall be used between the antenna elements and the main electronics package.

4.1.7 Magnetic Antenna Assembly

The magnetic antenna assembly shall receive plasma wave magnetic fields with two search coil magnetometers covering the frequency ranges 70 Hz to 3.5 kHz and 1 to 50 kHz. A preamplifier shall be used between each search coil and the main electronics package.

4.1.8 Input Electronics

Input electronics consisting of differential amplifiers, analog switches, notch filters, and drivers shall route and condition the signal between the two antenna assemblies and the major subassemblies within the main electronics package.

4.1.9 Calibration Generator

A calibration generator shall be provided to supply a calibration signal to the search coil magnetic antennas. This calibration signal shall consist of a one volt peak-to-peak square wave at 960 Hz. Calibration data will be processed by the PWS similar to normal science data.

4.1.10 Power Supply

The power supply shall convert the +50 volt, 2.4 kHz power for the Orbiter into regulated voltages required by the instrument.

4.1.11 Search Coil Preamplifier Supplemental Heater

To maintain suitable temperature for the search coil preamplifier, a supplemental electrical heater shall be provided. This heater will be switched by the CDS and powered from the S/C 30 VDC supply.

4.2 Data Processing and Format

PWS commands from CDS for instrument control will be shown in GLL-3-290, Command Structure and Assignments. Telemetry will be shown in GLL-3-280, Telemetry Measurements and Data Formats. Data bus protocol will be as shown in GLL-3-270, Galileo Orbiter Data System Intercommunication Requirements.

4.2.1 Lo-Rate Data

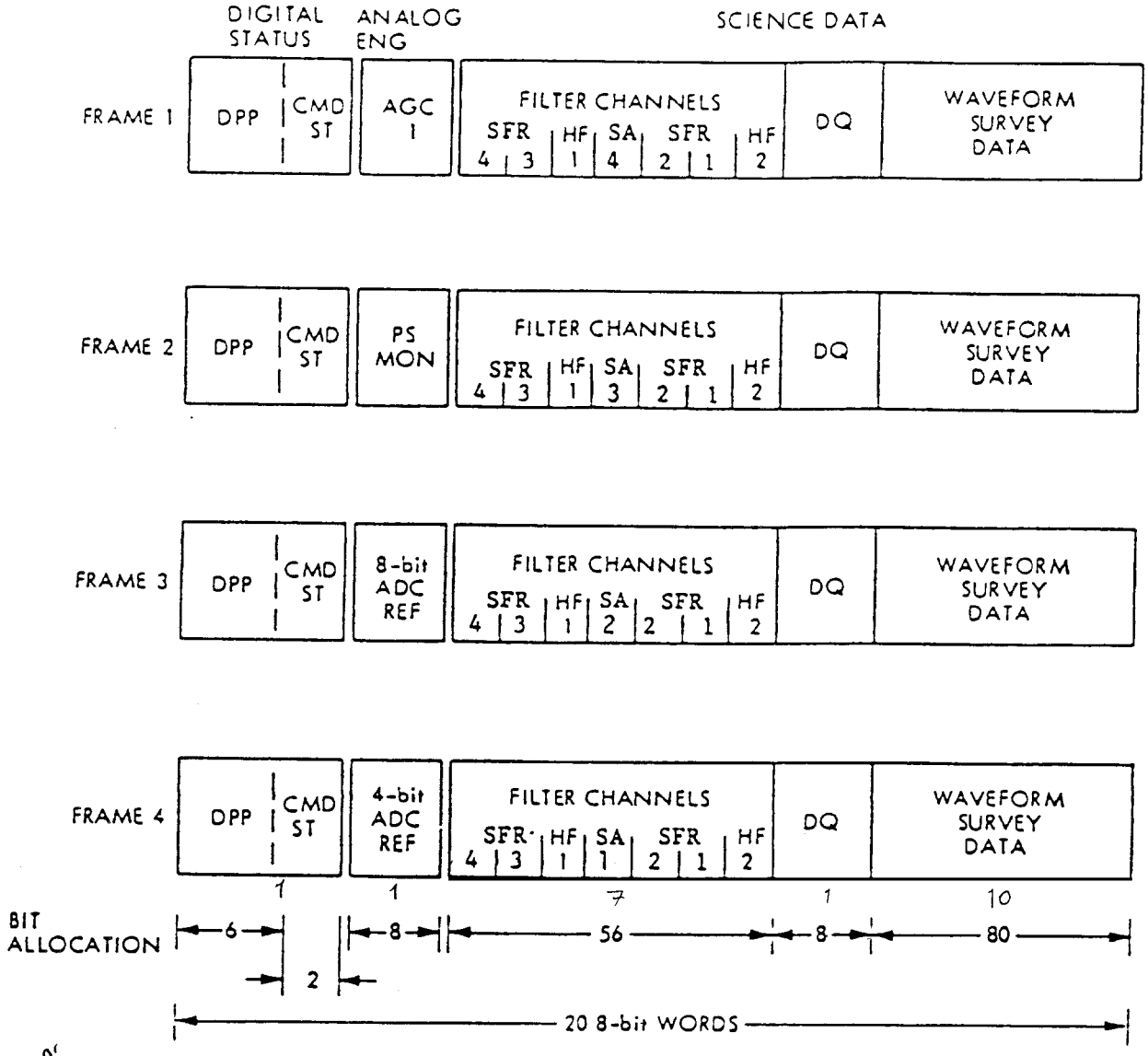
Data processing for the PWS lo-rate data shall consist of performing analog-to-digital conversions of data from the spectrum analyzer, sweep frequency receiver, the waveform receiver, and the high frequency receiver; storing the digitized data; and sending data to the CDS through the bus adapter. All PWS lo-rate science data shall be clocked serially to the CDS bus in one block of 18 eight-bit words. One 8-bit digital status word and one 8-bit analog engineering word will also be provided immediately preceding this 18-word block of science data. This results in a total block of 20 8-bit words at an effective data rate of 240 bits per second. The CDS will provide commands to enable the PWS to control the switching, sampling, and routing of these data. The format for the PWS science and engineering words is shown in Figure 2. The position of the high frequency receiver channels in the lo-rate science format is shown in Table 5. The position of the sweep frequency receiver channels in the lo- rate science format is shown in Table 6.

4.2.2 Hi-Rate Data

Data processing for the PWS hi-rate data shall consist of performing an analog-to-digital conversion of sampled data from the waveform receiver and routing that data to the CDS bulk memory via the hi-rate data interface. Appropriate synchronizing words shall be provided to enable the CDS to clock the data into the bulk memory. The Format for the hi-rate data is shown in Figure 3.

4.2.3 PWS Digital Status

The PWS shall make status measurements in the PWS digital status word as shown in Figure 4 and GLL-3-280.



ONE minor FRAME = 0.67 seconds
ONE SPECTRAL SCAN = 28 FRAMES
ONE SAMPLE OF BOTH E & B = 56 FRAMES
ONE WAVEFORM SURVEY SAMPLE = 14 FRAMES
SAMPLES OF BOTH WAVEFORM SURVEY FREQUENCY RANGES = 28 FRAMES
ONE HIGH FREQUENCY RECEIVER SAMPLE = 28 FRAMES
ONE SFR SAMPLE = 28 FRAMES

DPP = DIGITAL PERFORMANCE PARAMETERS
DQ = DATA QUALITY
CMD ST. = COMMAND STATUS
Hi Med & Lo HF = HIGH FREQUENCY RECEIVER CHANNEL
SFR = SWEEP FREQUENCY RECEIVER CHANNEL
SA = SPECTRUM ANALYSER CHANNEL

Figure 2. PWS Low Rate Science Format

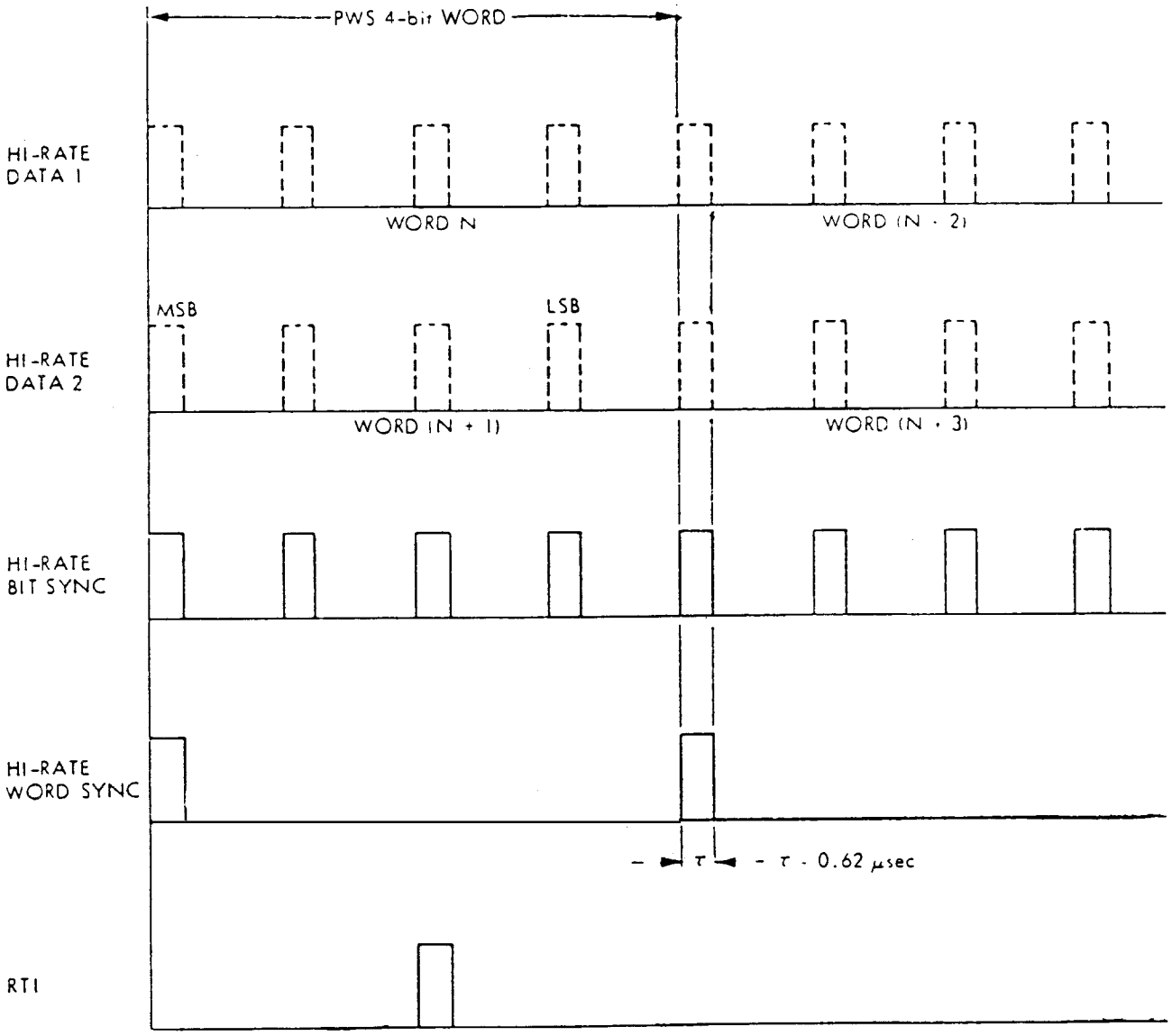
Table 5. Position of High Frequency Receiver Data
in PWS Low-Rate Science Format

Frame No.*	(Filter No.)	(Filter No.)
1	15	1
2	22	1
3	29	8
4	36	8
5	16	2
6	23	2
7	30	9
8	37	9
9	17	3
10	24	3
11	31	10
12	38	10
13	18	4
14	25	4
15	32	1
16	39	11
17	19	5
18	26	5
19	33	12
20	40	12
21	20	6
22	27	6
23	34	13
24	41	13
25	21	7
26	28	7
27	35	14
28	42	14

*See Figure 2 & Figure 4.

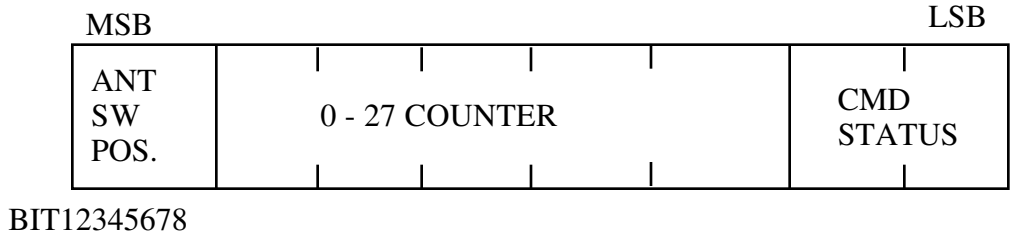
Table 6. Position of Sweep Frequency Receiver Data in Low-Rate Science Format

Frame No.	SFR 1 (Filter No.)	SFR 2 (Filter No.)	SFR 3 (Filter No.)	SFR 4 (Filter No.)
1	1	29	57	85
2	2	30	58	86
3	3	31	59	87
4	4	32	60	88
5	5	33	61	89
6	6	34	62	90
7	7	35	63	91
8	8	36	64	92
9	9	37	65	93
10	10	38	66	94
11	11	39	67	95
12	12	40	68	96
13	13	41	69	97
14	14	42	70	98
15	15	43	71	99
16	16	44	72	100
17	17	45	73	101
18	18	46	74	102
19	19	47	75	103
20	20	48	76	104
21	21	49	77	105
22	22	50	78	106
23	23	51	79	107
24	24	52	80	108
25	25	53	81	109
26	26	54	82	110
27	27	55	83	111
28	28	56	84	112



NOTE: ALTERNATE 4-BIT WORDS ARE CLOCKED ON PARALLEL DATA LINES

FIGURE 3. PWS Hi-Rate Data Format



BITS 1-6 DIGITAL PERFORMANCE PARAMETERS

BIT 1 Antenna Switch Position
0 = E
1 = B

BITS 2-6 0-27 counter

0-27 counter increments once per LRS frame; 0-27 counter- frame No. Minus one (1).

Waveform survey data: frame No. 1-14 is waveform survey low frequency range (5Hz - 1 kHz), frame No. 15-28 is waveform survey high frequency range (50Hz - 10 kHz).

Other science data: see Table 1, Table 5, and Table 6.

BITS 7-8 COMMAND STATUS

Frame 1	CMD WORD,	BITS 1-2
frame 2	CMD WORD,	BITS 3-4
Frame 3	CMD WORD,	BITS 5-6
Frame 4	CMD WORD,	BITS 7-8

(SEE FIGURE 6 FOR CMD WORD DEFINITION)

Figure 4. PWS Status Word

4.3 Operating Modes

The PWS shall operate in the operating modes shown in the PWS state diagram shown in Figure 5. The PWS command format is shown in Figure 6 and GLL-3-290. Commands are issued by the CDS and may be either around commands or sequenced commands.

5.0 INTERFACE DEFINITION

5.1 Electrical Interfaces

5.1.1 General

a. Basic requirements for electrical grounding, electrical bonding, electrical interface circuits, and electromagnetic compatibility are contained in GLL-3-260, Electrical Grounding and Interfacing.

b. Specific system-level requirements for electrical interface circuits and ground are contained in the applicable circuit data sheets. See JPL Drawing 10085825, Circuit Data Sheet Index and Guide.

c. All spacecraft flight and umbilical interface circuits, e.g., sub-system-system, subsystem-launch vehicle, and subsystem- support equipment through the umbilical connector, are listed in GLL-3-110, Functional Block Diagram and Interface Listings.

d. All spacecraft non-flight circuits, including direct access circuits, are listed in GLL-3-1110, Support Equipment Functional Block Diagrams and Interface Listings.

5.1 2 Power/Pyro Subsystem (PPS)

5.1.2.1 2.4 kHz Power (PPS)

The PPS will provide commandable on-off control of the 2.4 kHz, 50 V rms power.

5.1.2.2 30V DC Power

The PPS will provide commandable on-off control over a single interface for the search coil preamplifier supplemental heater.

5.1.3 PWS - PWS Sensor Interface

5.1.3.1 Electric Antenna Preamplifier - Main Electronics

The interface between the electric antenna preamplifiers and the main electronics includes positive and negative 11 volt power and signals from--both preamplifiers.

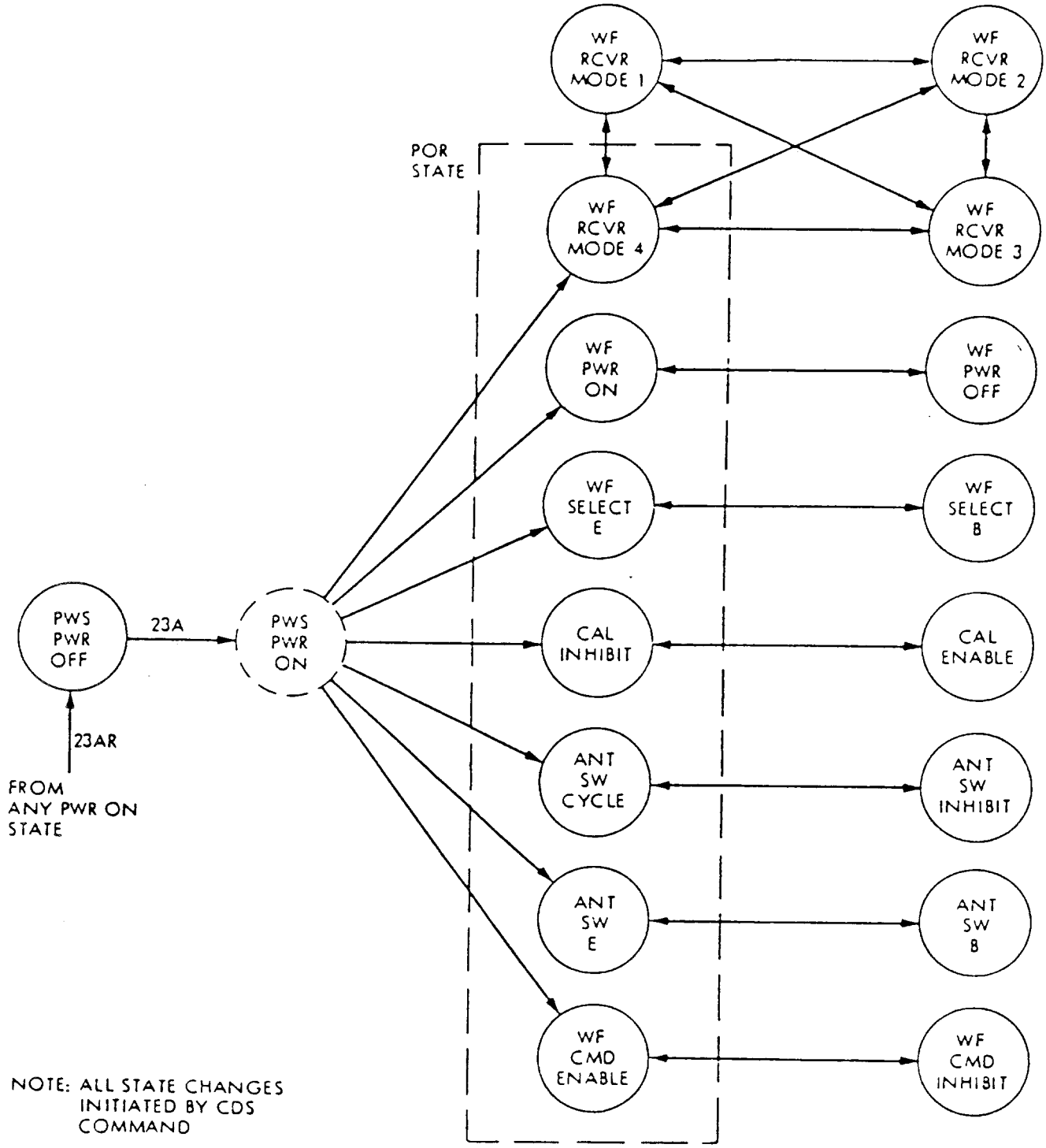


Figure 5. PWS State Diagram

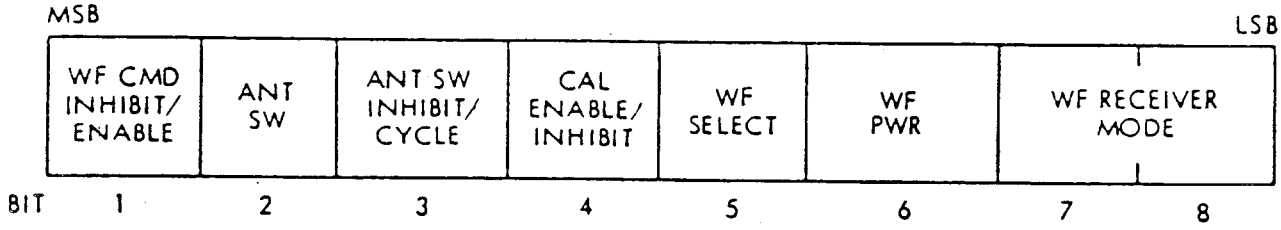
CDS BUS COMMAND FORMAT*

PSEUDO ID	1	1	0	1	0	1	1	1
ADDR HI **	0	0	0	0	0	0	0	0
ADDR LO **	0	0	0	0	0	0	0	0
DATA	8-bit CMD							

*THERE ARE OTHER BYTES IN THIS BUS TRANSACTION. THESE ARE THE ONES OF INTEREST TO PWS COMMAND DECODING CIRCUITRY.

**ADDR HI AND ADDR LO ARE IDENTICAL FOR PWS COMMANDS (0 0 0 0 0 0 0 0) AND SPACECRAFT TIME TRANSACTIONS (1 1 1 1 1 1 1 1).

DEFINITION OF 8-bit CMD WORD



BIT 1	WF CMD INHIBIT/ENABLE	0 = ENABLE	1 = INHIBIT
BIT 2	SA ANT SW	0 = E	1 = B
BIT 3	ANT SW INHIBIT/CYCLE	0 = CYCLE	1 = INHIBIT
BIT 4	CAL ENABLE/INHIBIT	0 = INHIBIT	1 = ENABLE
BIT 5	WF SELECT	0 = E	1 = B
BIT 6	WF PWR	0 = ON	1 = OFF
BITS 7-8	WF RCVR MODE	Ø 00 = WF SURVEY fills between 1 and 3 automatic in LRS ?	
		1 01 = 100.8 kb/sec → 50 Hz – 10 kHz	
		2 10 = 806.4 kb/sec → 50 Hz – 80 kHz	
		3 11 = 12.6 kb/sec → 5 Hz – 1 kHz	

*WF COMMANDS (BITS 5,6,7, AND 8) ARE IMMEDIATE AND INITIATED ONLY WHEN BIT 1, WF CMD INHIBIT/ENABLE IS EQUAL TO 0. ALL OTHER COMMANDS ARE DELAYED UNTIL START OF INSTRUMENT CYCLE (28 LRS FRAMES).

Figure 6. PWS Command Format

5.1.3.2 Magnetic Antenna Preamplifiers - Main Electronics.

The interface between the magnetic antenna preamplifiers and the main electronics includes positive and negative 11 volt power, signals from.. both preamplifiers, calibration signal to the search coils, and preamp temperature.

5.1.5 Command Data Subsystem (CDS)

a. Bus Sync. Bus sync is an 806.4 kHz square wave which, after being divided by two, is used to clock supervisory data into and reply data out of the PWS bus adapter. It is also used for basic timing within PWS and for clocking out high rate data.

b. Bus Real Time Interrupt (RTI) Bus RTI is a 620 ns pulse occurring every 66-2/3 ms. This pulse along with spacecraft time, broadcast over the supervisory data line, is used to synchronize the PWS with the CDS.

c. Supervisory Data Supervisory data is a 403.2 kb/s, quarter duty cycle, return to zero (RZ), simplex communication line to the CDS. It is used to transmit PWS lo-rate telemetry data to the CDS.

5.1.5.1 PWS to CDS Interfaces

a. Bus Reply Data. Bus reply data is a 403.2 kb/s, quarter duty cycle, RZ, simplex communication line to the CDS. It is used to transmit PWS lo-rate telemetry data to the CDS.

b. High Rate Data High Nybble. This line operates at 403.2 kb/s, 50.4 kb/s, or 6.3 kb/s to send every other 4-bit word from the wideband waveform receiver directly to the CDS DMS bulk memory.

c. High Rate Data Low Nybble. This line operates as above, carrying the alternate 4-bit words. CDS will assemble these two words into an 8-bit byte for further telemetry processing.

d. High Rate Data Bit Sync. A PWS generated signal used to clock high rate data on the two above lines.

e. High Rate Data Word Sync. A PWS generated pulse occurring every four high rate data bit syncs to synchronize CDS to the PWS high rate data words.

f. PWS Search Coil Preamp Temp. A CDS transducer signal indicating the temperature in the search coil preamplifier.

g. PWS Main Elect. Temp. A CDS transducer signal indicating the temperature in the PWS main electronics subchassis.

5.2 Thermal Interface

Two Radio Isotope Heater Units (RHUs) are mounted on the electric antenna assembly. The one RHU is mounted in the search coil to maintain appropriate temperatures. In addition, a supplementary electrical heater will be provided for the search coil preamplified by the Galileo Orbiter for adequate thermal control at Jupiter.

5.3 Mechanical Interfaces

The PWS will be mounted with the main electronics assembly on the Orbiter bus, the electric antenna assembly near the end of the MAG boom, and the search coil magnetic antenna assembly on the HGA sub- reflector as specified in GLL-3-180, Configuration, and in accordance with PWS Interface Control Drawings 10086759 and 10086769. Alignment requirements are listed in GLL-3-170, Functional Accuracies and System Capabilities.

6.0 PERFORMANCE PARAMETERS

6.1 Frequency Range

The PWS shall have a dynamic range greater than 90 dB in each log-arithmic compressor. It shall be measured at the antenna interface at frequencies of 31.1 z, 112.5 Hz, 900 Hz, 6.69 kHz, 57.6 kHz, and 1.008 MHz. The response shall be spurious free over a dynamic range of 70 dB at these frequencies.

6.3 Common Mode Rejection

The PWS shall have attenuation of in-phase interference signals at the antenna elements > 20 dB

6.4 Sensitivity

Approximate instrument sensitivity shall be as shown in Table 7.

7.0 PHYSICAL CHARACTERISTICS AND CONSTRAINTS

7.1 Mass

The total-mass of the PWS, excluding cabling shall not exceed its allocation as specified in GLL-3-230, Galileo Orbiter Equipment List and Mass Allocations. The mass expressed herein is for information only: Electric Antenna 1.68 kg; Main Electronics, 3.94 kg; Magnetic Antenna, 1.52 kg; Total, 7.14 kg. This mass includes 3 RHUs and thermal blankets.

7.2 Power

Power consumption of the PWS shall be as specified in GLL-3-250, Power Profile and Allocations. Power expressed herein is for information only: 5.92 W, waveform receiver power OFF ; 6.8 W, waveform receiver power ON . The power for the supplementary electrical heater shall be 3.00 W.

7.3 Volume

The volume of the PWS shall be as specified in ICDs 10086759 and 10086769. and GLL-3-180.

7.4 Environmental

The PWS shall be designed to operate within specification over the qualification temperature range, which is:

a.	Main Electronics	-20/+75°C
b.	Mag Pre Amp	-35/+75°C
c.	Elect Pre Amp	-45/+75°C
d.	Search Coils	-125/+75°C
e.	Dipole Antenna Elements	-196/+75°C

In Addition, the PWS shall be compatible with all the requirements of GLL-3-240, Environmental Design Requirements, and GLL-3-210, Design Criteria for Temperature Control.

7.5 Packaging

The PWS shall be packaged in accordance with the applicable sections of GLL-3-220, Electronic Equipment Design.

7.6 Identification and Marking

The PWS shall be identified in accordance with ICDs 10086759 and 10086769; Section VII, Part F, Configuration Management, of PD635-52, Project Galileo Policies, and Requirements for Orbiter Science Investigations; and Section VII, Equipment Identification and Marking, 625-232, Galileo Orbiter Configuration Management Plan

7.7 Inertial Properties

The PWS shall be in accordance with the applicable sections of GLL-3-200, Inertial Properties.

7.8 Structural Design

The structural design of the PWS shall be in accordance with GLL-3-190, Structural Design Criteria.

8.0 SAFETY CONSIDERATIONS

The PWS shall constitute no unusual safety hazard. Special handling is required for the RHUs. The search coils must be protected from large alternating magnetic fields.

9.0 SPECIAL

9.1 Oscillator Synchronization

In Orbiter subsystems, all oscillator circuits and countdown circuits in the range of 5 Hz to 6 MHz will be a harmonic of the 2.4 kHz power frequency unless otherwise approved by waiver.

9.2 Electromagnetic Interference

Electric and magnetic field interference from other subsystems measured at the PWS antenna assemblies should be below levels specified in PD625-50, Galileo Orbiter Science Requirements Document. These levels are repeated in Table 7, and are approximately equivalent to the PWS instrument sensitivity. Allowable subsystem emission levels are shown in GLL-3-240. If all sub-systems meet these requirements then the maximum science data will be possible.

Table 7. Maximum EMI Levels

Electric Field Interference at Electric Antenna Assembly

Frequency Range			Integrated Electric Field	
1 Hz	-	4 kHz	0.5	v/m in 30% bandwidth
4 Hz	-	400 kHz	0.5	v/m in 15% bandwidth
1 Hz	-	2 kHz	50	v/m
250 Hz	-	85 kHz	50	v/m
400 Hz	-	10 kHz	0.5	v/m in 1 kHz bandwidth between harmonics of 2.4 kHz power supply frequency

Magnetic Field Interference at Magnetic Antenna Assembly

Frequency Range			Integrated Electric Field	
1 Hz	-	1 kHz	40	in 30% bandwidth
1 Hz	-	400 kHz	30	in 15% bandwidth
1 Hz	-	2 kHz	2	
250 Hz	-	85 kHz	1	

9.3 Equipotential Spacecraft

The use of an equipotential spacecraft to control spacecraft charging will assist in controlling electromagnetic radiation from the Orbiter and possible electric interference from discharges on the surface of the Orbiter resulting from differential charging.

REVISION PAGE

Revision	Date	ECRs	Comments
Original Issue	9 Oct 1979		
Revision A	18 Feb 1981	23408, 23438	
	29 May 1981 Amendment 1	23565	Closed by
		23841, 23899, 24066	Closed by Amendment 2
		23841, 24115, 24135 24309, 24613	Closed by Amendment 3
Revision B	2 May 1989	35275	