5.0 Airborne Support Equipment (ASE)

The WIRE spacecraft Airborne Support Equipment (ASE) provides power, commanding, and monitoring while the satellite is integrated with the Pegasus launch vehicle and the L-1011 Pegasus Carrier Aircraft (PCA). There are two ASE racks used at WR, one serves as the power console during ground processing (see Figure 5-1) and the second is installed in the L-1011 for launch. The ASE interfaces to the WIRE spacecraft through two connectors: the standard umbilical and the auxiliary umbilical connectors. The ASE is not located near the launch vehicle and does not pose a hazard as a result of seismic event. The following is a detailed list of ASE functions:

1. Spacecraft Power for testing.
2. Generation (GEN) of discrete commands (8)
3. Appropriate modulation of NRZ-L command bit stream for spacecraft ingest (hard-line input).
4. Monitoring of selected spacecraft temperatures, voltages, and currents.
5. GEN of spacecraft relay command signals.
6. Hard copy output of selected monitoring points.
7. Receiver no-lock override of the transponder.
8. Battery charge capability and charge rate control.

In addition to the above functions the ASE performs three functions during ground integration and test activities:

1. Provides an I/F between the SMEX (WIRE) I&T GSE and the spacecraft for downlink of baseband telemetry at 4.5 mega-symbols per second.
2. The ASE provides simulation of three payload separation loopback signals.

The ASE is fail-safe. Loss of ASE function during any mission phase will not result in a hazard.

5.1 HARDWARE DESCRIPTION

The ASE includes a power console; a strip chart recorder; the Solar Array Simulator (SAS); the PSK Subcarrier Modulator; a power shunt box; and a power converter. Launch operations will use the ASE to provide external power to the spacecraft. The P/S mimics the solar array characteristics. The P/S limits the steady state bus to exceed 40 volts. Single power GEN GSE failures can not damage the spacecraft. The ASE is designed to requirements of Federal Aviation Administration (FAA) Regulations (CFR 14, Part 25) and L-1011 Environment (power is 115 VAC, 400 Hz)

The ASE Block Diagram is shown in Figure 5-2.

Figure 5-1 ASE Rack

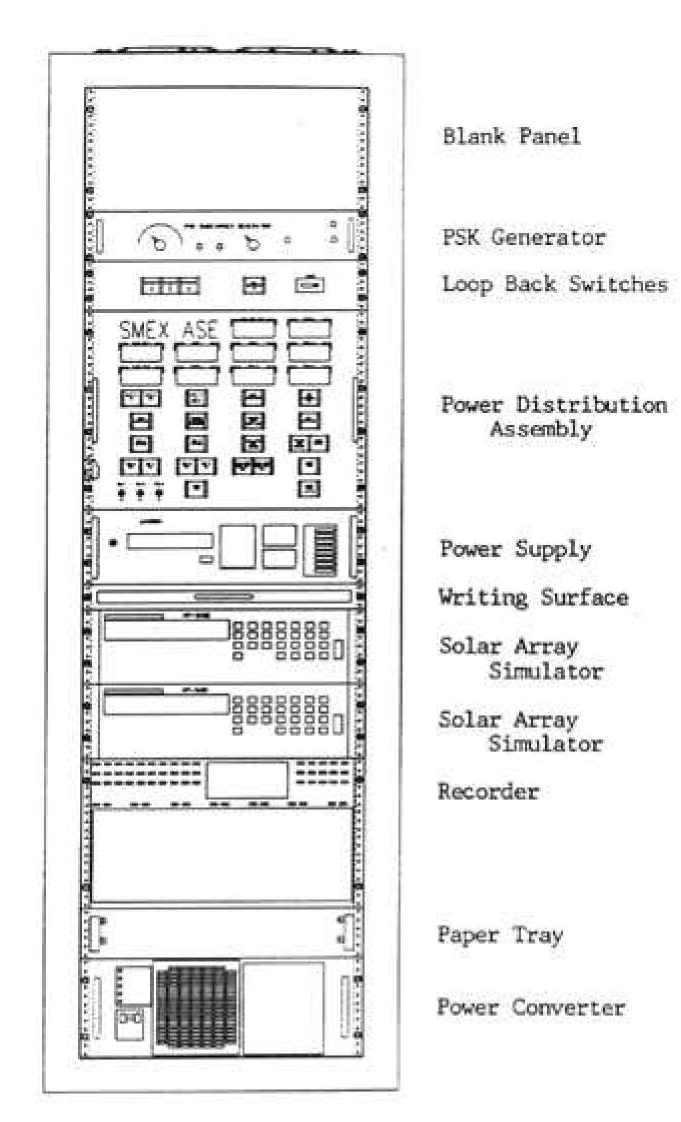
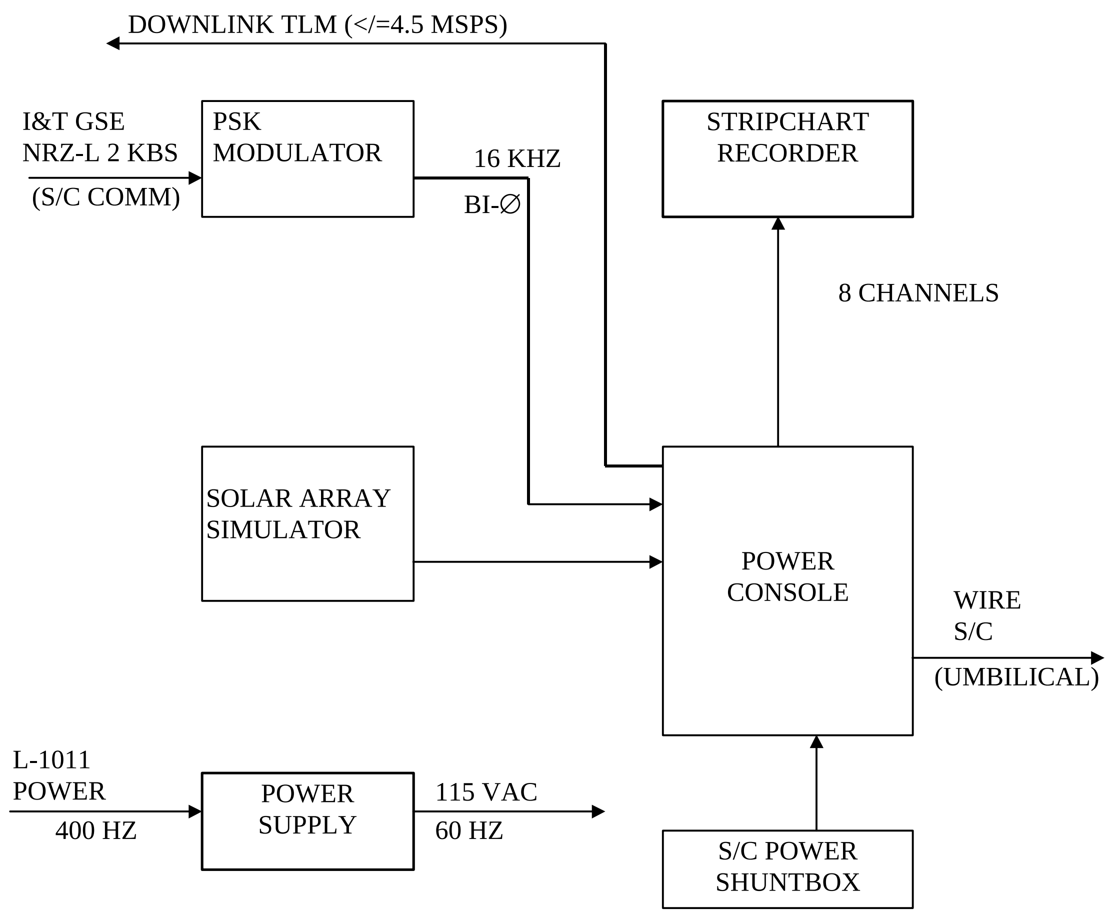


Figure 5-2 ASE Block Diagram



5.1.1 The Power Console

The Power Console provides the basic I/F to the spacecraft. It is similar in design to the one used for the SWAS spacecraft. The functions performed by the power console are outlined in Table 5-1.

5.1.2 The Stripchart Recorder

The Stripchart Recorder is a Gould® Model TA-5000. It is 10.5 x 17.5 x 19.75 inches and weighs 62 pounds. The recorder's capabilities are 100 to 240 VAC, 50/60 Hz or 400 Hz, 400 VA MAX, 200 VA typical, and it meets MIL-STD-810E. The strip chart recorder provides the hard copy of several voltages and currents during spacecraft testing and will have eight channel capability. The recorder provides hardcopy monitoring of battery temperature, battery voltage, battery current, MUE (essential) bus current, and non-essential bus current.

5.1.2.1 Solar Array Simulator (SAS)

The SAS is a modified Hewlett-Packard P/S HP-6654A. The two units are in parallel, at 40VDC @ 20 AMPS, 5.22 x 16.75 x 19.6 inches and weigh 54 pounds each, and are used to provide external power to the spacecraft during test and for charging the battery. The SAS is capable of delivering 40 volts DC at 20 amps, and has a voltage current characteristic which closely approximates the spacecraft solar array.

5.1.2.2 PSK Subcarrier Modulator

The PSK Modulator is a General Data Products Model 780+, it is 3.5 x 19 x 13 inches and weighs 10 pounds. The modulator's capabilities are 105-125 FAC, 47--63 Hz input, 40 to 90 degree F operating, TTL, 50 OHM inputs, BNC I/O connectors with shields isolated from the chassis ground. The PSK Subcarrier Modulator provides a means for generating the appropriate command uplink for the spacecraft. Its use during the captive carry phase is dependent upon the availability of an RF uplink from the ground to the ASE. The Modulator will be exercised during ground integration and test activities.

5.1.2.3 Power Shunt Box

The Power Shunt Box consists of eight 48 ohm resistors which dissipate energy exceeding the spacecraft needs. This unit is used only during ground testing to avoid unnecessary heating of the spacecraft shunts. Each shunt resistance has an indicator light which is illuminated when power is being dissipated in a particular shunt.

The Power Converter is a Elgar Global ® Universal P/S (GUPS-2400). The converter is 7 x 19 x 21 inches and weighs 126 pounds. It's capabilities are 85 to 280 VAC, 45 to 450 Hz input, 115 VAC, 60 Hz output, 21 AMP RMS, 63 AMP peak output current, and meets MIL-STD-810C, Method 515.2.

Table 5-1 ASE Power Console Functions

1. Spacecraft (S/C) RELAY COMMANDS
    - A. Battery Relay A- Off
    - B. Battery Relay B- Off
    - C. Battery Disconnect (Relay A & B Off)

2. POWER CONSOLE DISPLAY
    - A. Shunt Current
    - B. Battery Current
    - C. Battery Voltage
    - D. Battery Temperature
    - E. Essential Bus Current
    - F. Non-Essential Bus Current
    - G. Pyro Relay Monitoring
    - H. Essential Bus Current
    - I. Battery Relay A Status
    - J. Battery Relay B Status

3. BATTERY TRICKLE CHARGE CONTROL (SELECTABLE)
    - A. C/50 And C/100 (DC Supply In Console)

4. I/F BETWEEN SAS AND PAYLOAD (PEGASUS)
    - A. 40 VDC At 20 A (Adjustable 0-40 V, 0-20 A)

5. I/F TO I&T GSE FOR GROUND TESTING
    - A. Modulation Of Command Data On 16 KHZ Subcarrier
    FOR SPACECRAFT INGEST (TTL INPUT TO 50 OHMS)
    - B. Pass Throughs For TLM Hardline

6. SIMULATION OF VEHICLE SEPARATION BY PROVIDING
    Control of Loop-Back Lines (Switches) GSE Function Only

7. GENERATION OF DISCRETE (8 COMMANDS/3 LINES)

8. RECEIVER NO-LOCK OVERRIDE

9. SOLAR ARRAY OVER VOLTAGE/OVER CURRENT LIMIT PROTECTION
    - A. Disconnect SAS From S/C If Bus Voltage Exceeds 39 V
    - B. Disconnect SAS From S/C If Bus Current Exceeds Set
      Value (Mission Unique 6-20 A)

10. CRYOSTAT HARDLINE MONITORING

The power converter is needed on the L-1011 to convert 400 Hz power to 60Hz for the ASE, and to provide a battery B/U to the ASE in the event of a power interruption. Full capability is maintained for a limited time (about five minutes) to allow an orderly spacecraft shutdown.

5.1.2.4 Mechanical Interface

The ASE is to be integrated into a 19 x 21 inch rack that will house the system hardware. The ASE is designed to remain integrated under a 9 g forward and a 5.2 g vertical load.

The ASE rack procured by the project was recommended by OSC as meeting OSC requirements. The rack mounted components are analyzed to withstand maximum loading without loss of structural integrity. The rack, with it’s components mounted, will be inspected by the FAA.

5.1.2.5 Electrical Functions

The ASE operates from single phase, 115 VAC, 400 HZ aircraft power in addition to standard 115 VAC, AC, 60 Hz.

All spacecraft return lines are isolated from the ASE chassis (prime power) ground. The SAS output return is isolated from the chassis ground. Provisions have been made so that the circuit commons can be tied to chassis ground easily, if it becomes necessary.

The solar array, shunt, essential bus, and non-essential bus current monitors are +/- 10 V analog signals 10V=5A. Spacecraft bus and battery voltage monitors are 0-40 V analog signals with IV=IV. The strip chart recorder provides hardcopy monitoring of battery temperature, battery voltage, ESP (essential) bus current, and non-essential bus current.

The ASE provides a source for battery trickle charge and charge rate control. The charge rate is selectable between either C/100 or C/50 (.09 and .18 Amps). The ASE also connects to a thermistor on the battery for battery temperature monitoring. This monitor provides the necessary current into the thermistor as well as read out of the voltage produced. Read-out is to be in degrees C. Overcharging of the battery is prevented by the use of an amp-hour integrator and voltage temperature controller in the spacecraft P/S electronics.

Relay monitors indicate the status of relays with lamp off indicating off, and lamp on indicating on. Relay commands are 28 V, 150 mA pulse with a minimum 100 ms duration.

Loop back signals are used to simulate vehicle separation. The loop backs are pin to pin jumpers with series switches. The switches are independently controllable as well as simultaneously switchable. These switches are only used during ground testing of the spacecraft.

5.1.2.6 Commanding

Discrete commanding relies on presenting the spacecraft with three discrete bi-level lines, each set of three state combinations corresponding to a Relative Time Sequence (RTS) in the spacecraft memory. See Figure 5-3 ASE I/Fs. These lines are controlled through switch closure spacecraft return. The three lines must be presented to the spacecraft simultaneously for at least three seconds. The default condition (no action) is 1,1,1 (all switches open). Pull-up resistors are used in the spacecraft so that these lines need only be pulled low to set the zero state.

The discrete commands from the ASE are used to initiate five RTSs for control of the WIRE spacecraft during captive carry. The other commands correspond to the following information listed in Table 5-2:

Table 5-2 WIRE ASE Discretes

ASE CMD NUMBER	DESCRIPTION	RTS NUMBER
1	SCS Initialization	1
2	Pre-Drop Checkout	2
3	Nominal Drop Checkout	3
4	Spare	4
5	Spare	5
6	Controlled S/C Pwr Down	6
7	Spare	7

Figure 5-3 ASE Interfaces