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Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

SPACECRAFT HARNESS

MICHAEL J. COLBY

The Johns Hopkins University
Applied Physics Laboratory
Laurel, MD 20723-6099
Tel: (301) 953-6000 X4237
Fax: (301) 953-6556
Email: COLBYMJ1@jhuapl.edu

Spacecraft Harness

- Harness Design

- Development Sequence

- Power Distribution

- Signal Distribution

- 1553 Harness

- Ordnance Schematics

- Thermal Harness

- Harness Weight Estimate

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Spacecraft Harness Design

EMC considerations:
-- Shielding of single or twisted pair signal lines will be utilized
        -- 1553 bus is shielded with the shields tied to the connector shell
        -- any shielded wire(s) will have the shield tied to the connector shell

Connectors:
-- 191 D-type connectors, 6 circular pyro connectors, 6 micro-miniture connectors,
   3 Torque Rod circular connectors, 2 Umbilical circular connectors, 2 Rectangular arming
   plug, and ~ 400 2 or 4 pin Winchestors (for Thermostats, Temperature Sensors, and heaters)

Drawings:
-- Drawings are completed in Clarisdraw on D size or can be sized to fit 11x17 paper
   for quick checking and presentations. (some details not readable at that reduction)

Wirelist (S/C and Thermal Harness):
-- The software used for the wirelists and Connector list is Filemaker Pro

Wire:
-- The wire type has been changed from the Durad-T teflon insulated wire used on previous
   programs to Tefzel MIL-W-22759/43C & 44 fluoropolymer-insulated wire for weight
   savings.   SOR has approved this wire for use on TIMED.

Harness Specification (7363-9022)

- Defines grounding specifics
  (i.e. SPG, shields tied at both ends, etc.)

- Defines wire sizing
  (i.e. Pwr - #20AWG, signal - #24AWG, etc.)

- Defines Connector selection
  (D-type unless design prohibited)

- Specifies Harness fabrication
  (construction, shielding, routing, etc.)

- Specifies Harness Electrical Testing
  (Continuity, bonding, isolation.)

- Specifies Harness Flow
  (design, Construction, Bakeout, etc.)

- Outlines drawing layouts and wire and connector lists.

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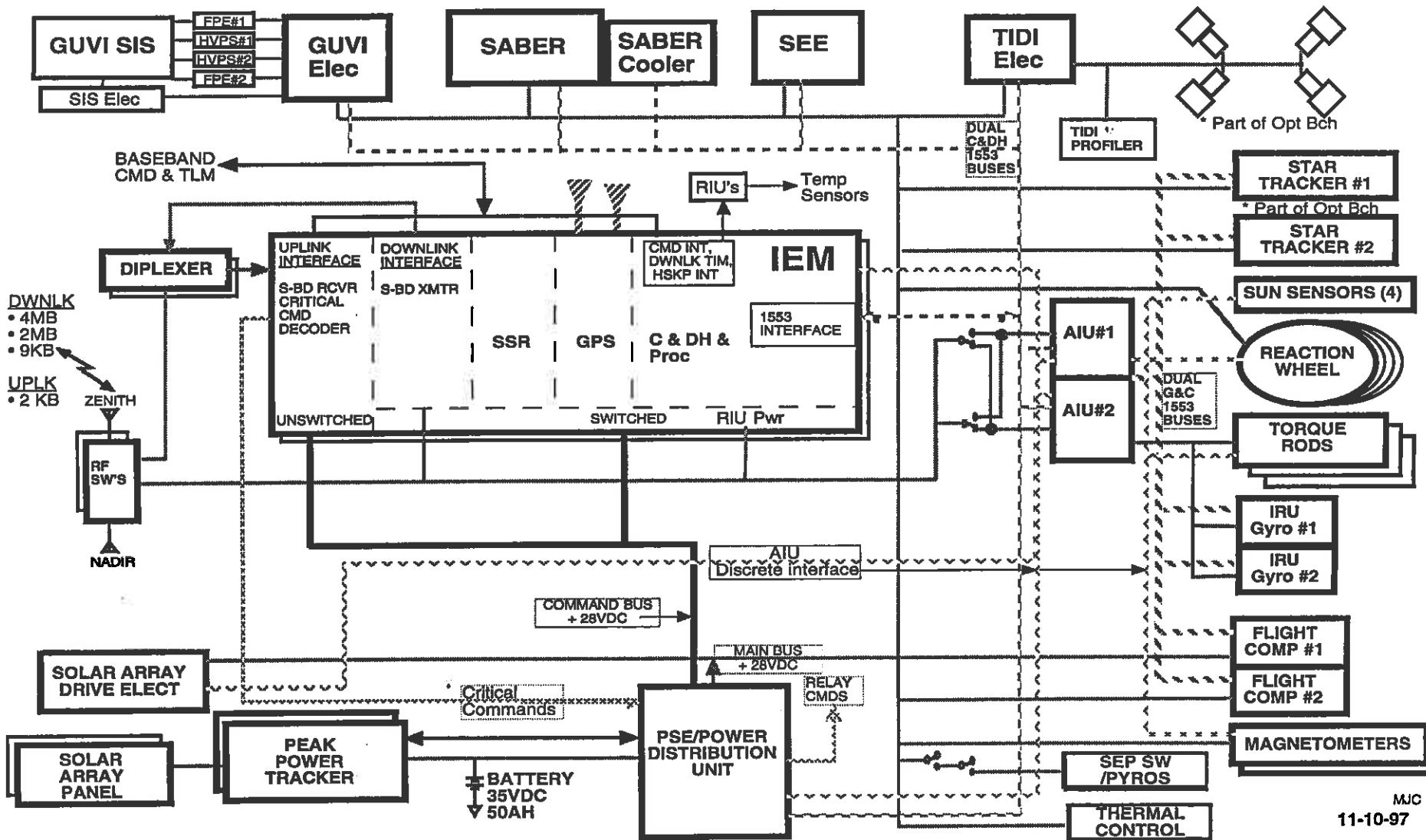
Harness Development Sequence

| Fabrication On Mockup | → | Short & Continuity Tests | → | Bakeout | → | Weigh & Install on S/C | → | Final Ringout |

MJC-5

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Simplified Functional Block Diagram

GUVI SIS

FPE#1
HVPS#1
HVPS#2
FPE#2

SIS Elec

GUVI Elec

SABER

SABER Cooler

SEE

TIDI Elec

* Part of Opt Bch

DUAL C&DH 1553 BUSES

TIDI PROFILER

BASEBAND CMD & TLM

RIU's → Temp Sensors

STAR TRACKER #1

* Part of Opt Bch

STAR TRACKER #2

DIPLEXER

UPLINK INTERFACE

DOWNLINK INTERFACE

CMD INT, DWNLK TIM, HSKP INT

IEM

DWNLK
• 4MB
• 2MB
• 9KB

UPLK
• 2 KB

ZENITH

S-BD RCVR CRITICAL CMD DECODER

S-BD XMTR

SSR   GPS   C & DH & Proc

1553 INTERFACE

SUN SENSORS (4)

REACTION WHEEL

AIU#1

AIU#2

DUAL G&C 1553 BUSES

UNSWITCHED

SWITCHED

RIU Pwr

TORQUE RODS

RF SW's

IRU Gyro #1

NADIR

IRU Gyro #2

AIU Discrete Interface

COMMAND BUS + 28VDC

MAIN BUS + 28VDC

FLIGHT COMP #1

SOLAR ARRAY DRIVE ELECT

RELAY CMDS

FLIGHT COMP #2

Critical Commands

SOLAR ARRAY PANEL

PEAK POWER TRACKER

BATTERY 35VDC 50AH

PSE/POWER DISTRIBUTION UNIT

MAGNETOMETERS

SEP SW /PYROS

THERMAL CONTROL

S/C Power Distribution

Allows two stage GSE power up of the spacecraft:
- -- Command Power Bus: power to command and data handling from ground power supplies for bringing up the S/C in minimum power to verify (modify if necessary) relay status prior to Main bus turn-on

- -- Main Power Bus: power to the main power bus from ground power supplies initially, then by Battery (by ground command) supplemented by the Solar Array Simulator (SAS)

   NOTE: The battery will not be able to be commanded off by s/c command. That command (Off Cmd) is only wired through the umbilical, back to the Blockhouse Control Unit(BCU), for ground use only. The BCU, during ground testing, will be able to send a 56V pulse to switch the battery relays Off.

Provides distribution of main power bus to the heaters:
- -- S/C Operational heaters, S/C Survival heaters, Battery heaters, and SA Damper heaters primary and secondary for each and Instrument Survival Heater Power.
- -- Instrument Oper Htrs are powered from the same relay as the main Inst power except for SABER which has a separate relay for Oper htr Pwr.

Power harness wiring will be routed separately from the rest of the harness where possible.
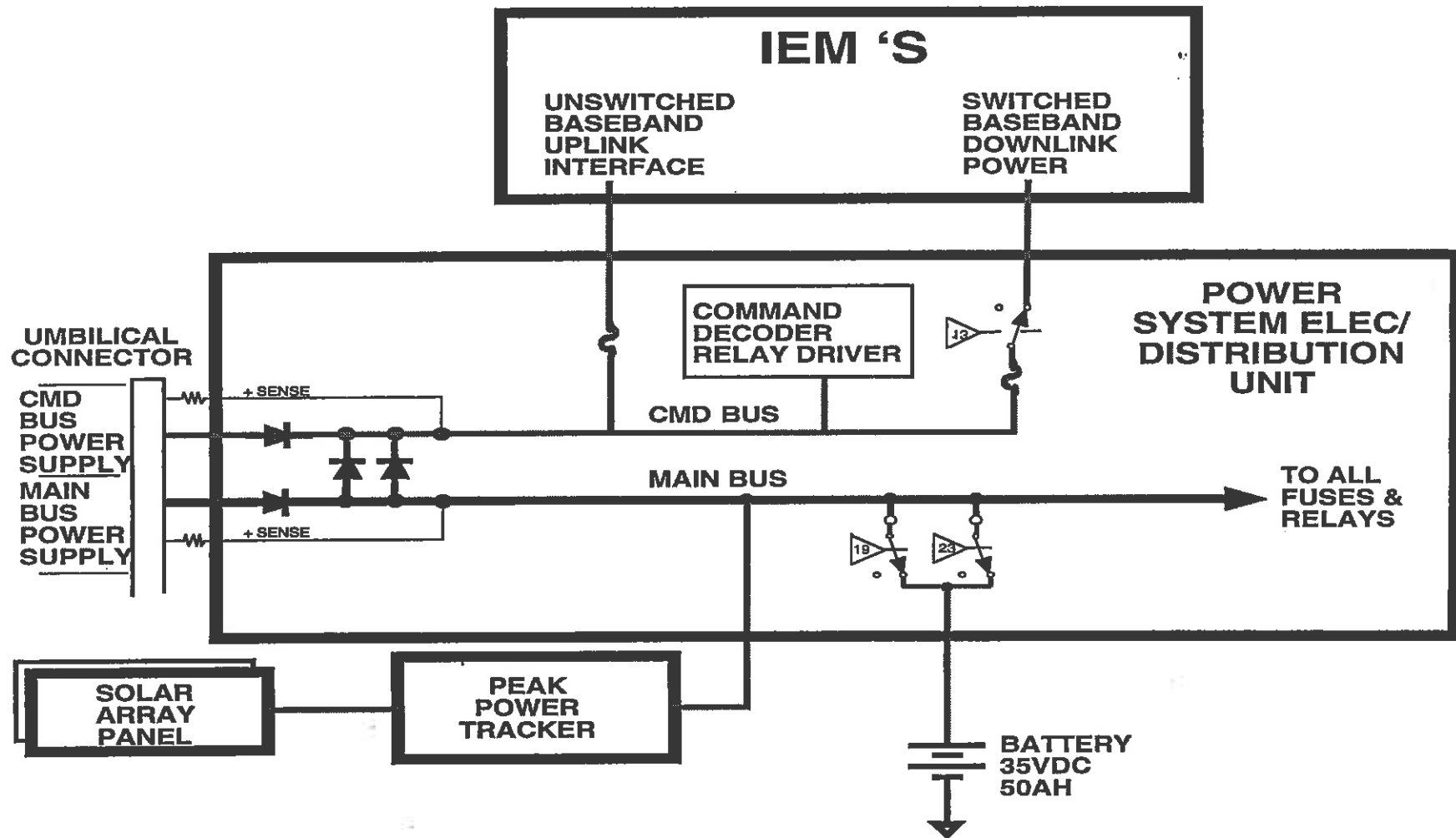
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S/C Power Distribution
(Dwg# 7363-8102)

IEM 'S

UNSWITCHED
BASEBAND
UPLINK
INTERFACE

SWITCHED
BASEBAND
DOWNLINK
POWER

**POWER
SYSTEM ELEC/
DISTRIBUTION
UNIT**

UMBILICAL
CONNECTOR

COMMAND
DECODER
RELAY DRIVER

J3

CMD
BUS
POWER
SUPPLY

+ SENSE

CMD BUS

MAIN
BUS
POWER
SUPPLY

+ SENSE

MAIN BUS

TO ALL
FUSES &
RELAYS

19   23

SOLAR
ARRAY
PANEL

PEAK
POWER
TRACKER

BATTERY
35VDC
50AH

S/C Signal Distribution
(Dwg# 7363-8103)

- Command/telemetry;
  - -- RF; IEM to diplexer to transceiver sw to antenna
  - -- Baseband; IEM to Umbilical
  - -- Critical commands from IEM to Power Switching Electronics (PSE/DU)

- Discretes;
  - -- Attitude Interface Unit(AIU) to:
    - -- Attitude sensors, torque rods, magnetometer, reaction wheels
    - -- IEM, safe mode discretes
    - -- PSE/DU, safe mode discretes
    - -- Solar Array Drives
  - -- PSE/DU to Peak Power Tracker (PPT)

- External Temp Monitors; IEM to RIU's

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S/C 1553 Harness
(Dwgs# 7363-8104 and 7363-8105)

- Redundant Command & Data Handling (C&DH) 1553 busses

- Redundant Guidance & Control (G&C) 1553 Busses

- Documents;
    - -- PI-10912   Purchase Instruction for MIL-STD-1553 Harness Data Bus
    - -- MIL-STD-1553   Design, Manufacturing, and Quality Standards for Custom Electromagnetic Devices for Space Applications
    - -- MIL-T-2103827/27   Specifications for Low power, pulse transformers, Type TP7SXNNNNKZ
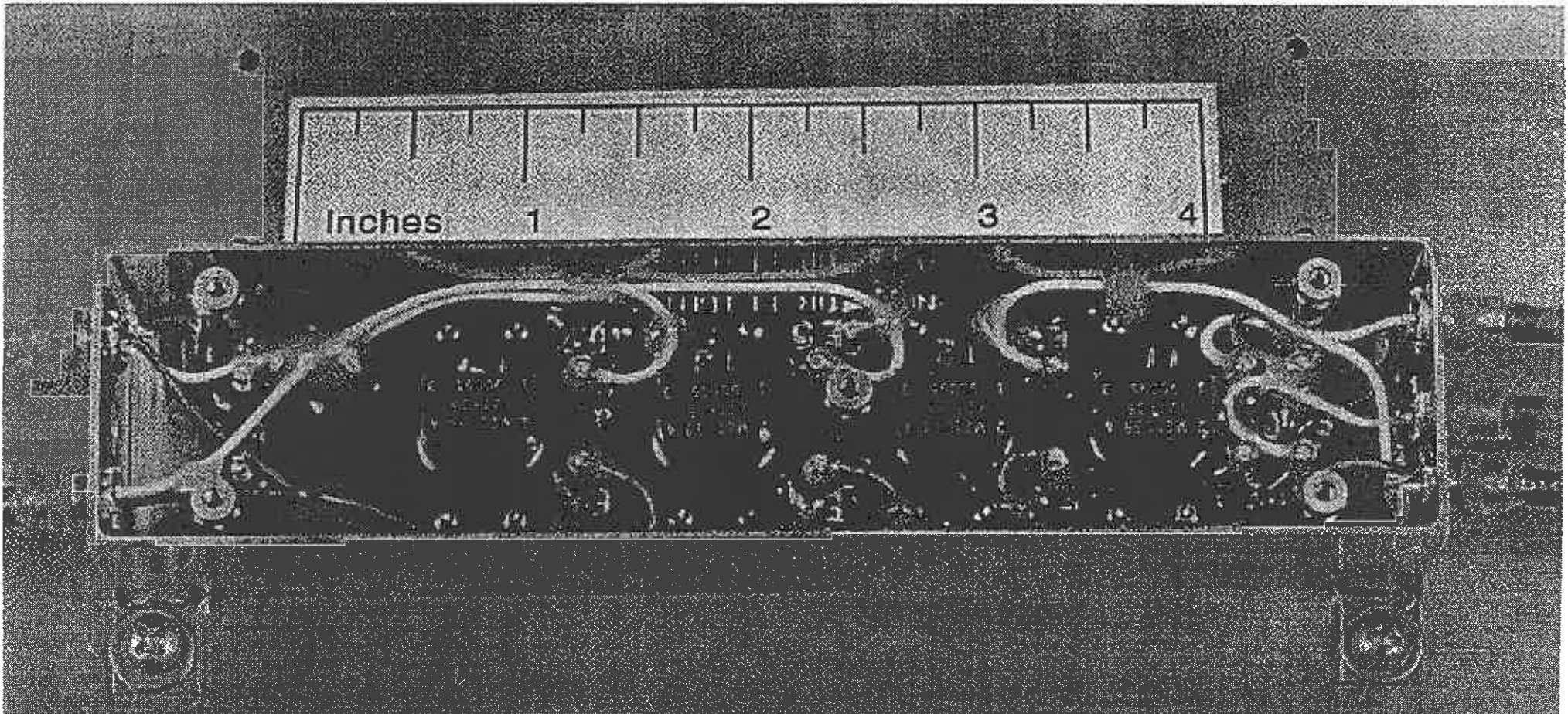   - -- NHB-5300.4(3A-2)   Soldering for Electrical Connections
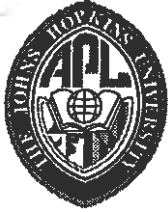
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S/C 1553 Harness
Bus Coupler (Typ)

Ordnance Schematics

- 2 Separation Switches;
    1st safety for power to pyros

- 1 Primary Arming Plug with current limiting resistors
  1 Secondary Arming Plug with current limiting resistors
  2nd safety for power to pyros

- Separate relays for enabling (only enable the specific pyros required)

- Common relays for Firing (for simultaneous firing where required)

- Pyros are category B

Ordnance Schematics (Dwg# 7363-8101)

- Ordnance enabled by separation switches to PSE/DU

- Solar Arrays: 2 Primary and 2 Redundant / wing   (8 pyros total)

- GUVI SIS: 1 primary and 1 redundant   (2 pyros total)
  TIDI telescopes: 4 primary and 4 redundant   (8 pyros total)

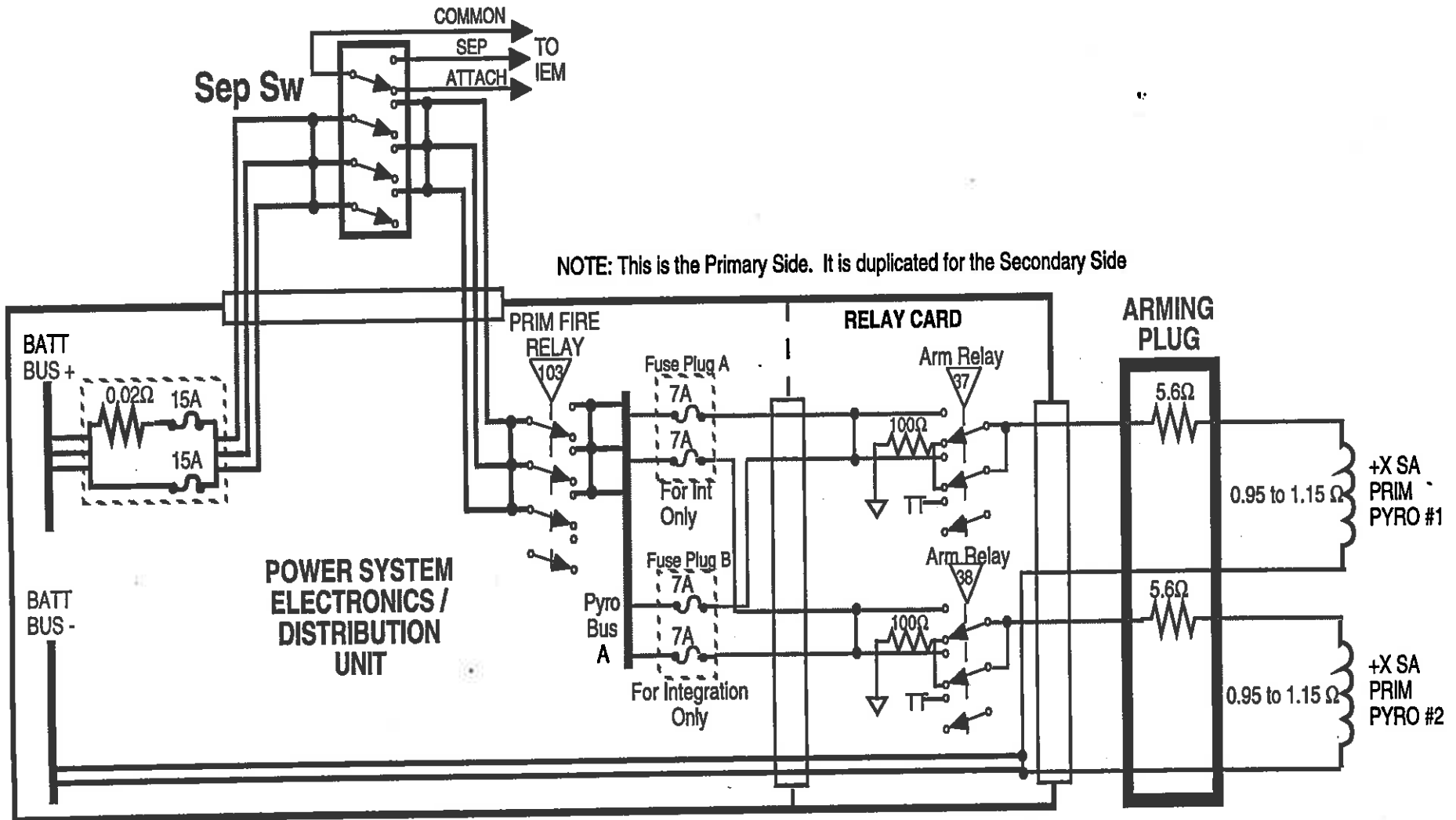- Opt Bench: 2 ea Primary and Redundant   (4 pyros total)

  Total: 22 pyros

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Typical Ordnance Circuit

NOTE: This is the Primary Side. It is duplicated for the Secondary Side.

COMMON
SEP
ATTACH

TO IEM

Sep Sw

BATT BUS +

0.02Ω   15A
         15A

PRIM FIRE RELAY
103

RELAY CARD

ARMING PLUG

Arm Relay
37

Fuse Plug A
7A
7A

For Int Only

100Ω

TT

5.6Ω

+X SA PRIM PYRO #1

0.95 to 1.15 Ω

POWER SYSTEM ELECTRONICS / DISTRIBUTION UNIT

BATT BUS -

Pyro Bus A

Fuse Plug B
7A
7A

For Integration Only

Arm Relay
38

100Ω

TT

5.6Ω

0.95 to 1.15 Ω

+X SA PRIM PYRO #2

MJC-14

Thermal Harness

- S/C Operational Heaters (Star Tracker):
  -- 2 Primary and 2 Secondary Thermostats, 2 Dual Element Heaters (Pri & Sec)

- Battery Heaters (These will be part of the battery, not part of the thermal harness):
  -- Operational Htrs: 2 Pri and 2 Sec Therm, 22 Dual Element Heaters (Pri & Sec)
  -- Differential Htrs: 2 Pri and 2 Sec Therm, 22 Dual Element Heaters (Pri & Sec)

- SA Damper Heaters(These will be part of the SA's, not part of the thermal harness):
  -- 10 Pri and 10 Sec Therm, 10 Dual Element Heaters (Pri & Sec)
     If more dampers are used the numbers could go from 10 to 16 each.

- S/C Survival Heaters:
  -- +Y (IEM): 2 Pri and 2 Sec Therm, 2 Dual Element Heaters (Pri & Sec)
  -- +Z: 2 Pri and 2 Sec Therm, 6 Dual Element Heaters (Pri & Sec)
  -- - Z: 2 Pri and 2 Sec Therm, 6 Dual Element Heaters (Pri & Sec)
  -- +X: 2 Pri and 2 Sec Therm, 3 Dual Element Heaters (Pri & Sec)
  -- - X: 2 Pri and 2 Sec Therm, 3 Dual Element Heaters (Pri & Sec)

Note: Instrument heaters are covered in the power distribution since the s/c bus only provides power to the instrument interfaces.

Harness Weight Estimate

- S/C Conn Weight: 5.47kg

- S/C 1553 Harness: 3.94kg

- S/C Harness: 25.01kg
  (includes Thermal Harness)

- Sub-total: 34.42kg

- Miscellaneous Harness Items: 1.72kg
  (~5% of sub-total harness wt.)

- S/C Total Harness Weight: 36.14kg