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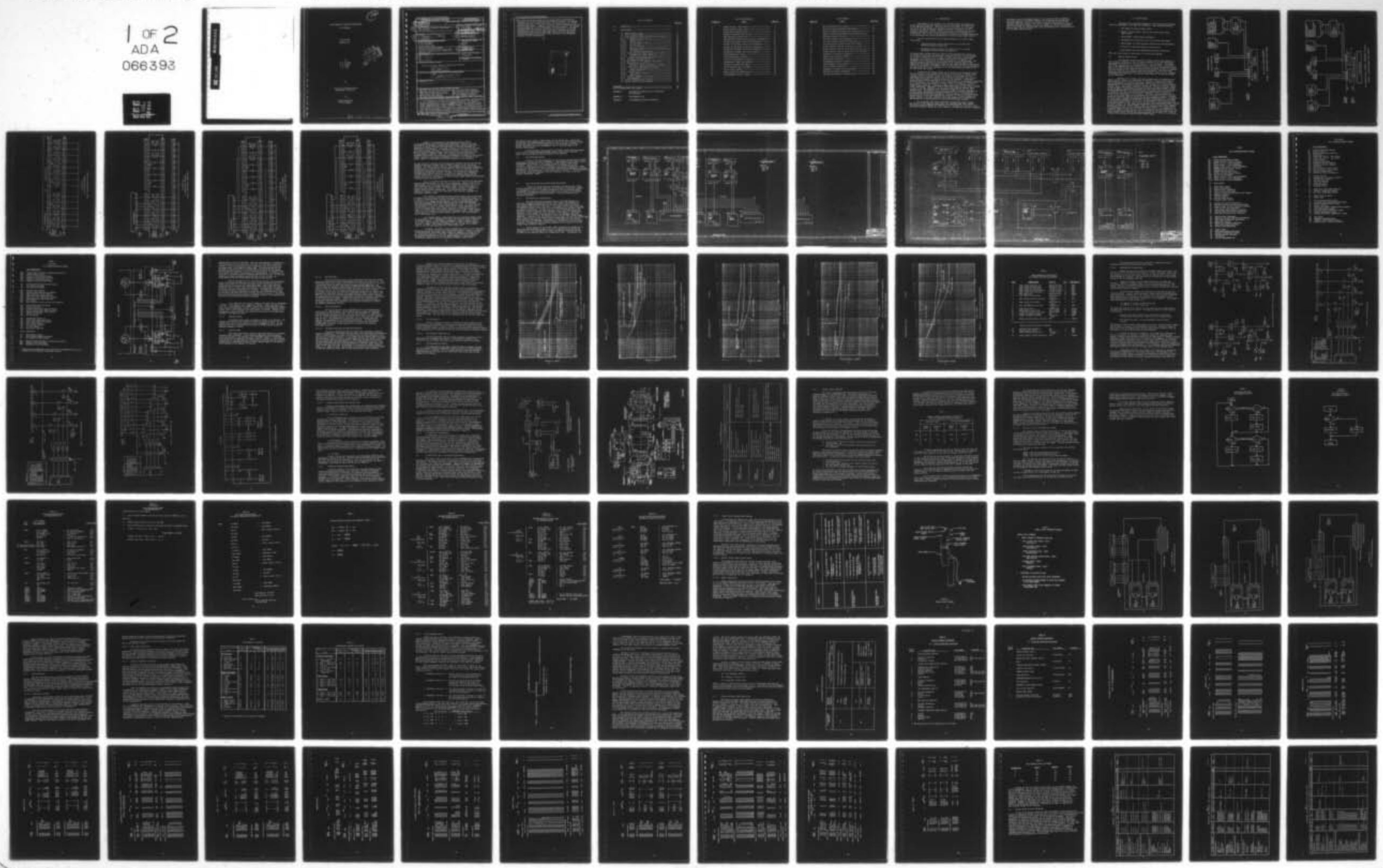

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AAES LABORATORY SIMULATOR REQUIREMENTS

(A-7 AIRCRAFT)

FINAL REPORT

DECEMBER 1978

By

J. R. Perkins
D. E. Lautner
J. L. Jones
A. J. Marek

For

Naval Air Development Center
Department of the Navy

By

VOUGHT CORPORATION
An LTV Company

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Advanced Aircraft Electrical System (AAES)

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

AAES (Adv. Aircraft Electrical System)
HVDC (High Voltage Direct Current)
SOSTEL (Solid State Electric Logic)
AMUX (Avionics Multiplexing)
PGS (Power Generation System)
ADM (Adv. Development Hardware)
Power Conversion and Conditioning
AAES TA-7C Laboratory Simulator
LMC (Load Management Center)
Solid State Signal Sources, Power Controllers

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This program was conducted for establishing requirements and developing specific design data for a hot bench mockup (simulator). The simulator system being developed is based on the AAES Prototype Design evolved by the Vought Corporation under contract N62269-75-C-0391. The simulator system will ultimately be used by NADC to provide a laboratory verification of the operation and performance of the AAES in an aircraft weapon system environment. The evolved simulation design is formulated around the TA-7C aircraft → (over)

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electrical and avionic systems and the general physical/installation constraints of the TA-7C forward and mid fuselage sections. The designs developed under this contract were limited to electrical-avionic system definition and design. Simulator structural, system installation and wire harness designs will be developed under a follow-on contract. The designs developed under this contract include the full application of the AAES technologies to the TA-7C electrical and avionic subsystem and systems. The AAES technologies include HVDC (High Voltage DC) power generation, SOSTEL (Solid State Electric Logic) power distribution and management, and AMUX (Avionic Multiplexing).

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1.0 INTRODUCTION

The purpose of this program was to establish system requirements and develop specific design data leading to the full development and construction of the AAES TA-7C Simulator. This simulator will in essence be a hot bench mock up of the AAES technologies designed to operate and control the TA-7C electrical and avionic systems. The hot bench mock up configuration, the ADM equipment installation and system interconnect wiring closely simulates an actual TA-7C. Thus it will allow laboratory verification of the AAES technologies in an environment that closely approximates an actual aircraft weapon system.

The work performed under this program consisted of two major items, these being:

- completing specific design tasks relative to the AAES TA-7C Laboratory Simulator Design and,

- performing technical services for NADC relative to the AAES development and ADM hardware procurements.

The design tasks included evolving a modular system implementation concept for the simulator; developing system designs, interconnection data and wire diagrams for the TA-7C systems and circuits using the AAES technologies; establishing requirements for system control including a methodology for automatic load management; and identifying the use and requirements for the ADM hardware. The technical services consisted of participating in and assisting NADC in AAES Program and ADM Hardware Development design reviews, assisting NADC in establishing AAES system and hardware requirements, and providing NADC with planning information and data for definition and implementation of the AAES Laboratory Simulator and the AAES Flight Test System.

A modular system design concept for the simulator was developed to allow test and checkout of the complete TA-7C systems and circuits on a "group" basis. A modular design is necessary because the simulator will encompass the full complement of TA-7C systems; however, due to resource limitation, only a partial set of AAES ADM equipment is being developed for the simulator. The modular design developed allows reassignment of the ADM equipment for operating and controlling the TA-7C systems in four functional groups. These four groups are characterized as (1) weapon control and release, (2) flight control, (3) navigation and (4) communications subsystems. Interspersed among these groups are the various airframe utility subsystems. Assignments of the utility subsystems was based on enabling most of the ADM components to be functional during each of the four test configurations. The modular concept therefore provides a realistic simulation of aircraft electrical/electronic system integration as well as intersystem EMI (Electromagnetic Interference) environments. The final aspect of the modular design evolved is that it will allow updating the simulator to a "full-up" system with minimal changes to the basic simulator other than adding the full complement of ADM hardware and incorporating the full-up system operational software.

As an overview, this report identifies the functional areas, systems and circuits of the simulator design which were completed under this contract. The level of design addressed and completed by this program is in the area of the electrical/electronic system and circuit designs. The simulator structure, equipment installation, and wire harness designs are to be evolved under a subsequent Full Scale Simulator Development Program. The design data and documentation developed under this contract will therefore form the starting base of the Simulator Development Program. The level of design and documentation completed under this program is summarized herein and examples of the data and drawings are provided. The bulk documentation (data and drawings) will be delivered along with the AAES Simulator System.

2.0 SYSTEM DESIGN

Discussed in the following paragraphs are the design tasks performed toward the development of the AAES TA-7C Simulator. Tasks performed include:

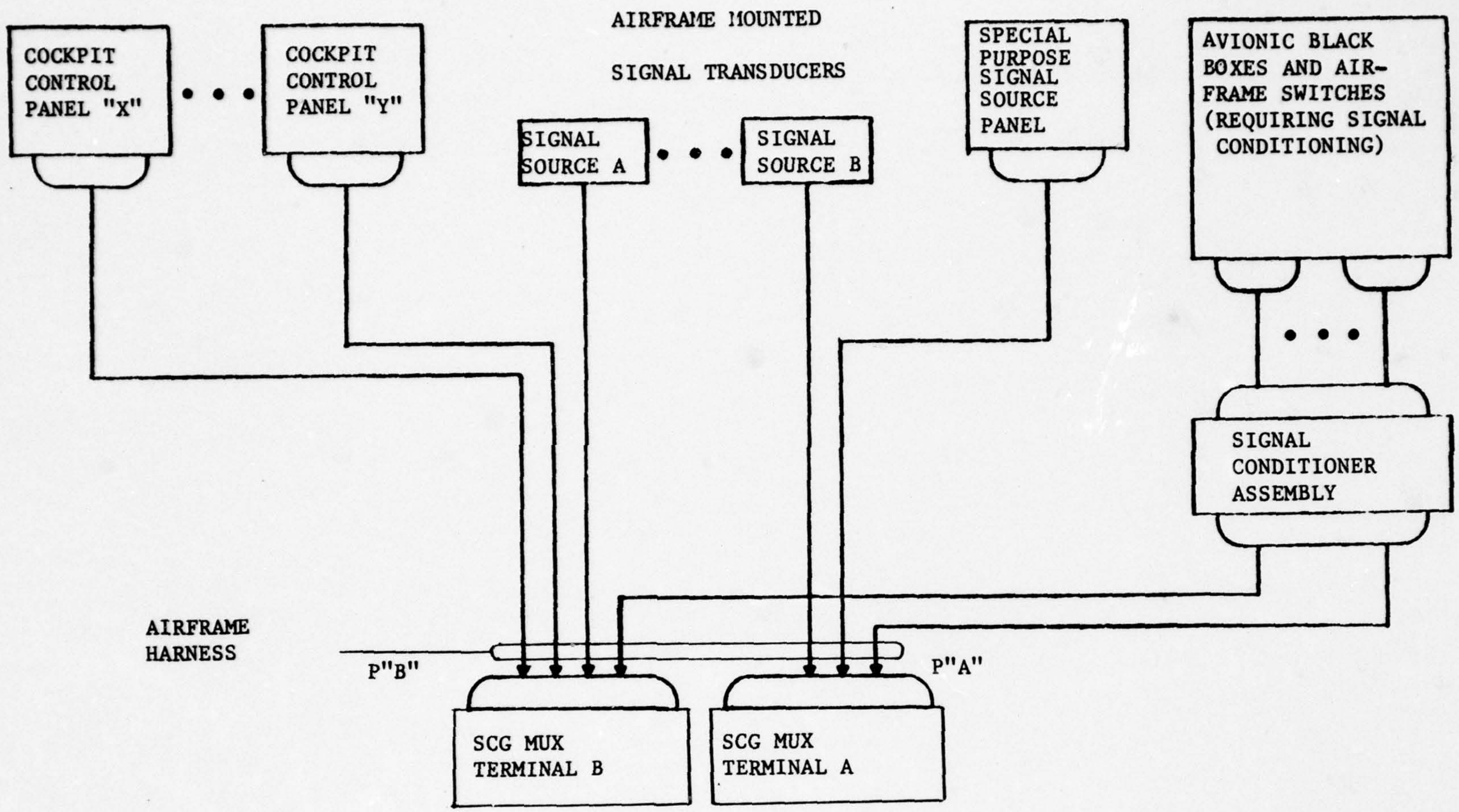
- o Development of modular design concept
- o Design of TA-7C systems, circuits and control panels using AAES concepts
- o Establishment of PGS design requirements
- o Development of system control and I/O interface requirements
- o Establishment of avionic multiplex system scope and requirements
- o Definition of AAES ADM hardware utilization and
- o Establishment of system implementation/checkout priorities

These and related tasks are discussed in the following paragraphs.

2.1 Modular Design Concept

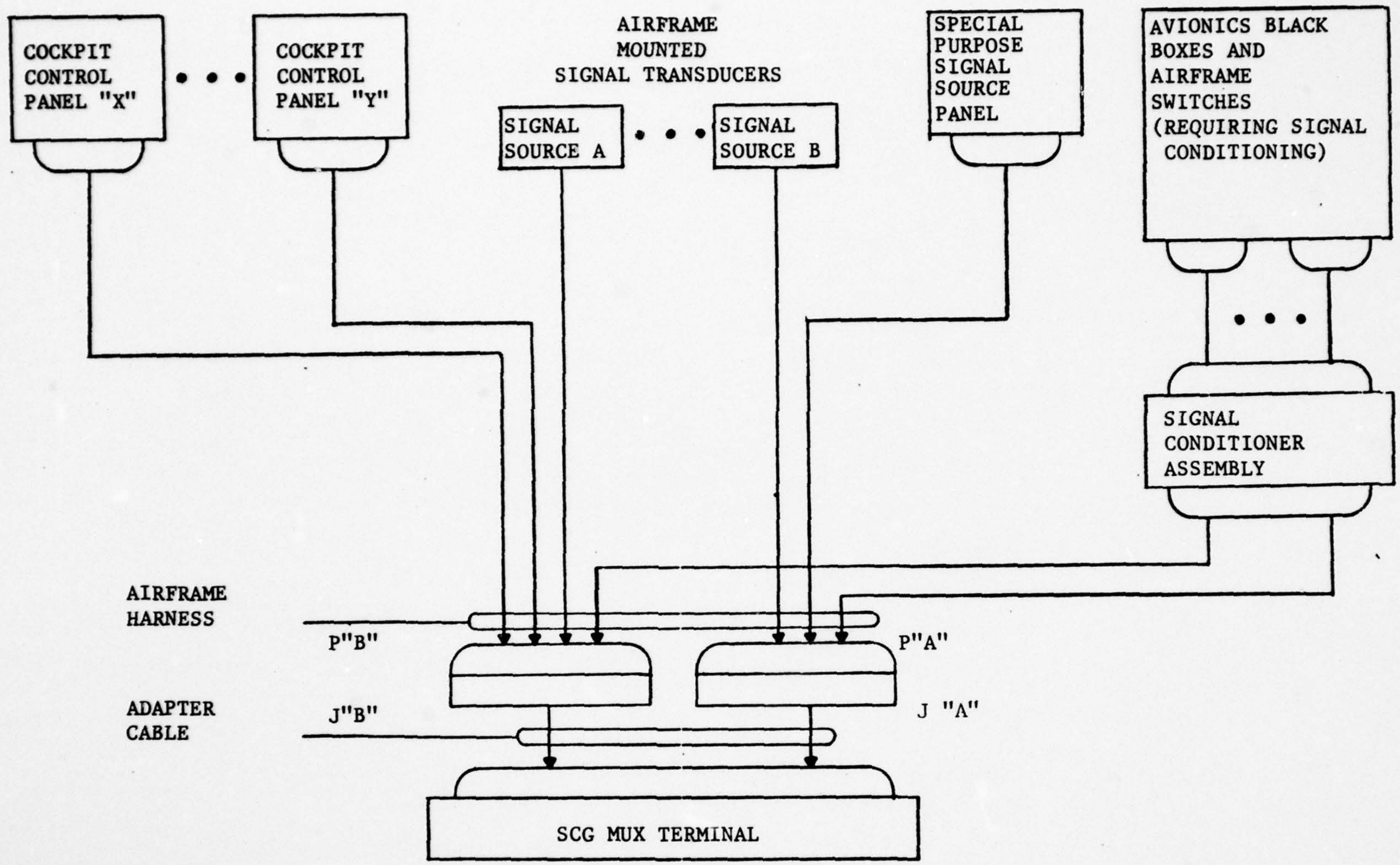
The simulator design is based on allowing operation and checkout of each circuit or subsystem on the TA-7C using a partial set of AAES ADM hardware (approximately 50 percent of that required for a full up system). The design was further evolved based on allowing growth to a full up system with minimal impact to the simulator in terms of design, hardware, wiring and installation details. Based on the ADM hardware available and the specific hardware required to implement the TA-7C Simulator, four checkout groups were established. These functional groups are characterized as weapon control and release, flight control, navigation and communication subsystems. Interspersed among these are the various airframe utility subsystems.

Figures 1 and 2 reflect the basic approach used for accomplishing the modular design. Figure 1 is illustrative of the modular concept in the area of system input control and related interfaces. Figure 1-a illustrates the signal source multiplexer interfaces and associated wire harnesses for a full-up simulator implementation. This interface primarily involves the multiplex terminals, signal sources, signal conditioning, system wiring harnesses, and special adapter cables. Of this equipment, the multiplex terminals and solid state signal sources are being developed (ADM equipment) in limited quantities for application on the simulator. It is expected that the signal sources being developed will not initially be available for installation on the simulator. Therefore, simulated signal sources of the various types needed will be mechanized for the simulator using a "standard" switch with resistors added to achieve the switched impedance function. To complete the input signal category, a full complement of signal conditioning will be provided for interfacing miscellaneous "black box" and "inaccessable" switch function types to the SOSTEL Control Group. As a result, the only input related ADM hardware lacking sufficient quantity for full simulator mechanization is the SCG multiplex terminals. As shown in Figure 1-b, special adapter cables are therefore used to route signals from equipment/circuits to the "available" multiplex terminal. An appropriate set of adapter cables are thus used to select the required set of input signals for each of the four modular checkout groups. Since the multiplex terminal inputs change in terms of signal source function and equation variable for the load to be controlled, a unique set of software is used for each checkout group.



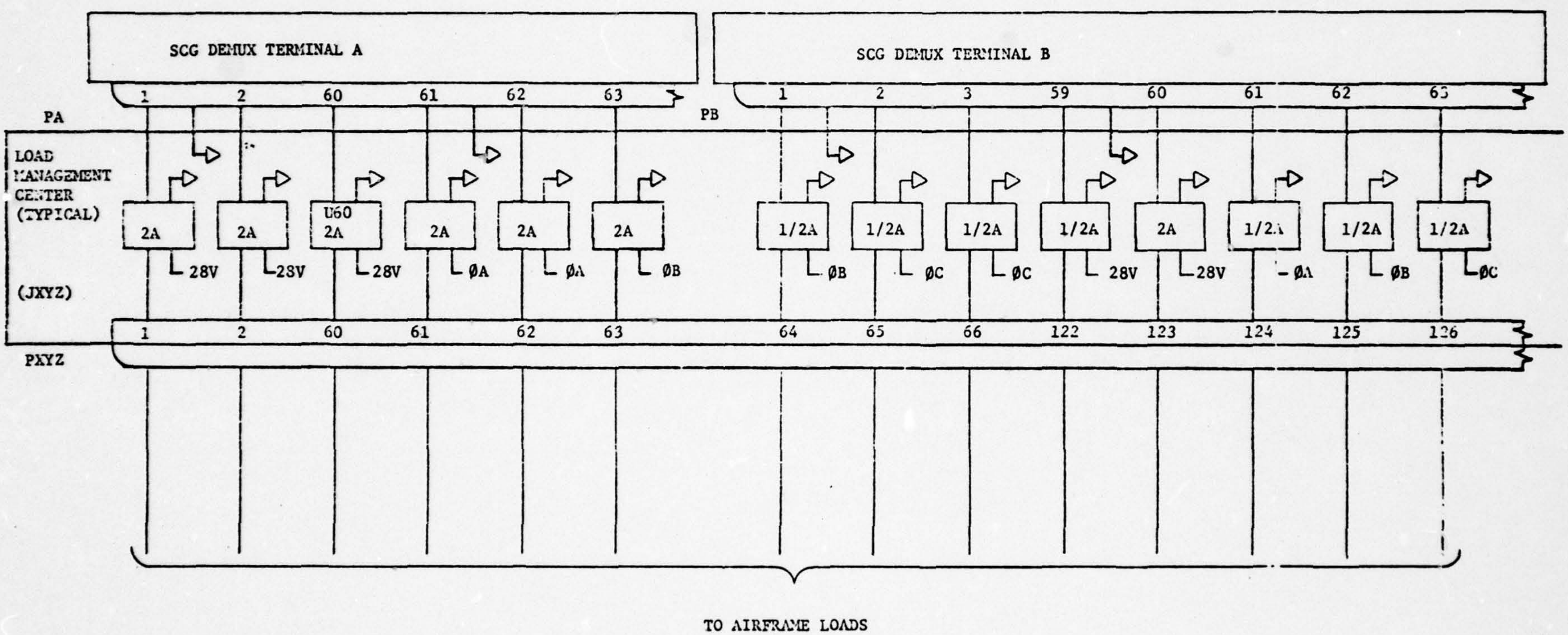
(a) FULL-UP SYSTEM ARRANGEMENT

FIGURE 1 - MODULAR CONCEPT, INPUT CONTROL



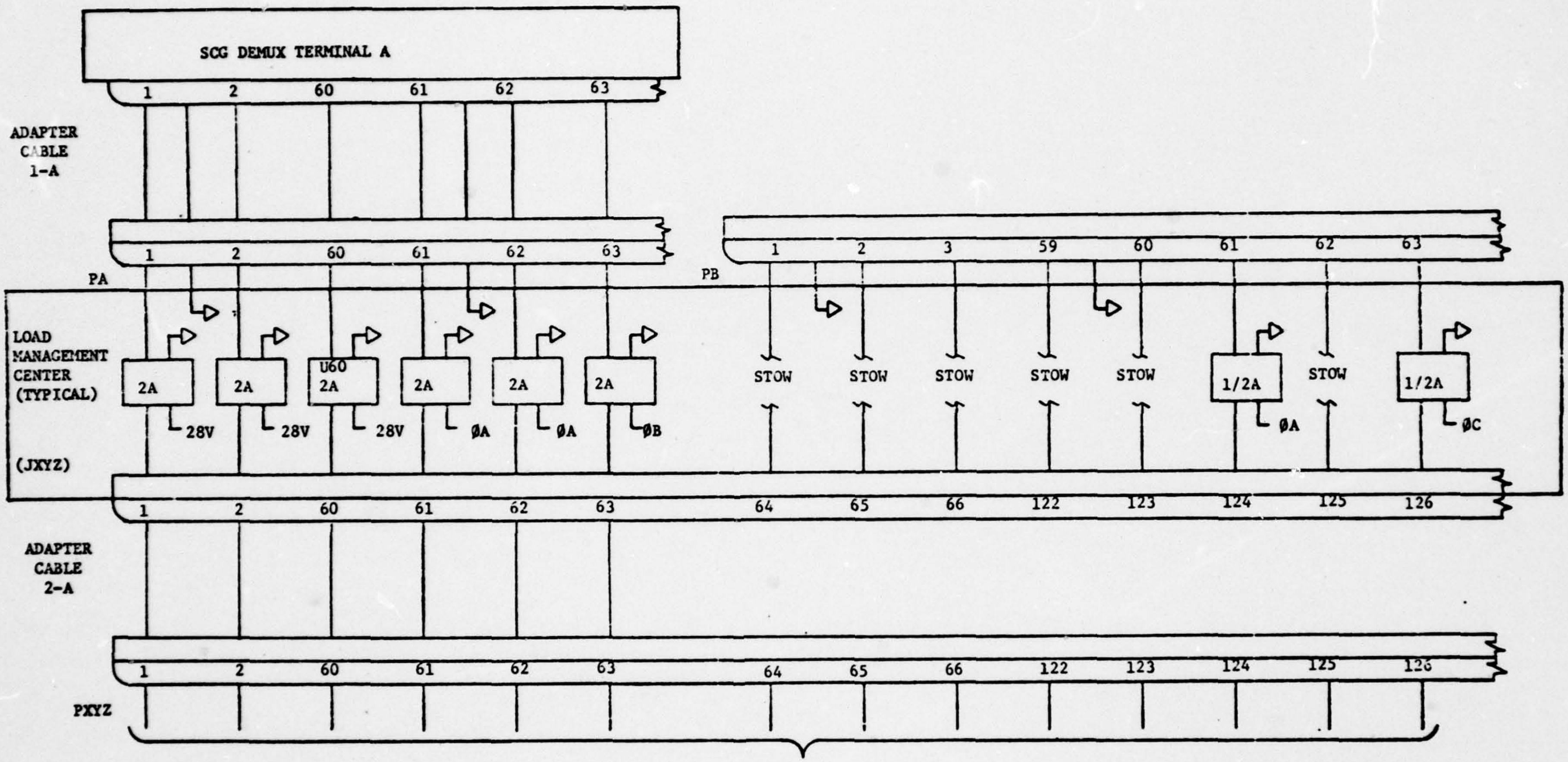
(b) CHECKOUT GROUP 1 THROUGH 4 ARRANGEMENT (TYPICAL)

FIGURE 1 - MODULAR CONCEPT, INPUT CONTROL



(a) FULL-UP SYSTEM ARRANGEMENT

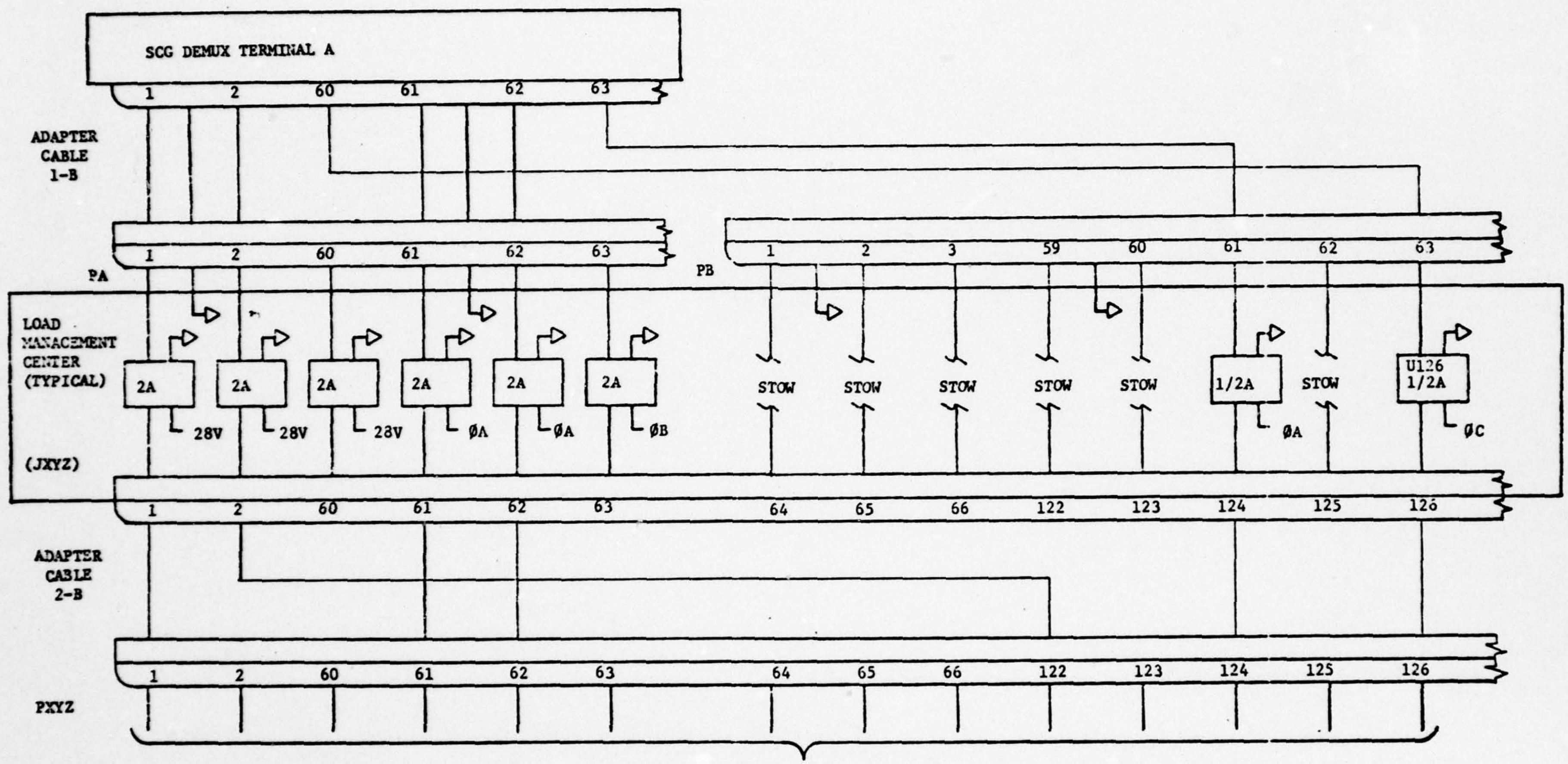
FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



TO AIRFRAME LOADS

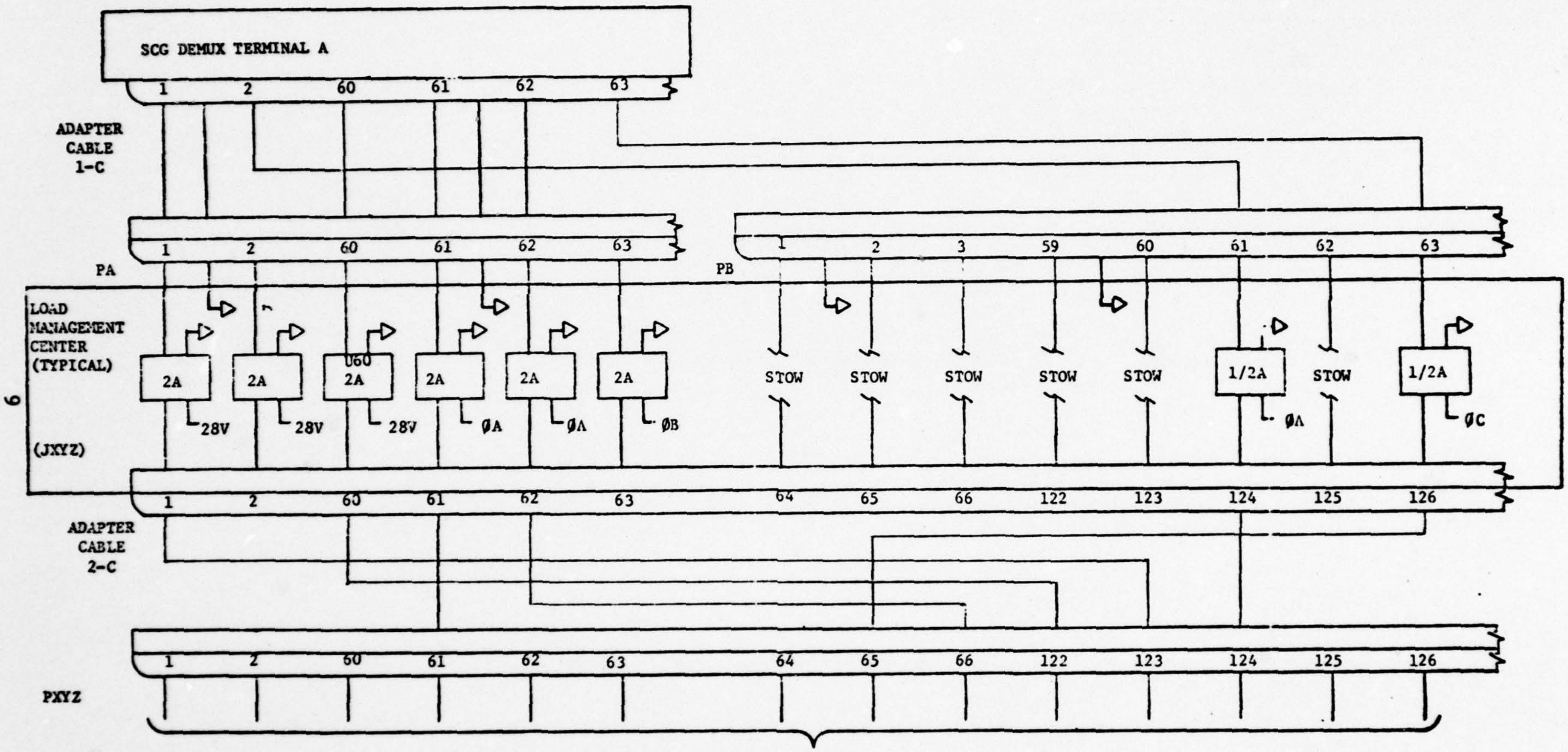
(b) CHECKOUT GROUP 1 ARRANGEMENT

FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



(c) CHECKOUT GROUP 2 ARRANGEMENT

FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL



TO AIRFRAME LOADS

(d) CHECKOUT GROUP 3 ARRANGEMENT

FIGURE 2 - MODULAR CONCEPT, OUTPUT CONTROL

Figure 2 is illustrative of the modular design as related to the system output control and associated interfaces. Similar to the case described for the multiplex terminals and signal sources, limited quantities of demultiplex terminals and power controllers will be initially available for application on the simulator. One notable difference is that it is not practical to simulate the power controller. Therefore in addition to change out of the "demux to controller"adapter harnesses and software, the power controllers must be reinterfaced to different loads. The controllers are contained in Load Management Centers which are configured as subassemblies for production line producibility. Because of the connector subassembly interface, it is feasible to use adapter cables for establishing the desired controller to load interfaces.

The load controller interface with SCG demultiplex terminals and with the airframe harnessing (and hence airframe loads) is shown in Figure 2-a for the full-up simulator. This figure depicts a typical Load Management Center (LMC) electrical configuration to be used on the full-up simulator. The only difference between this configuration and one which would be used on a production aircraft lies in the demultiplex terminal/load controller interface. In a production configuration, the demultiplex terminal size would be sufficiently smaller (due to MSI/LSI terminal construction) to permit the terminal to be installed within the LMC. Installation within the LMC reduces the control harness length between the demultiplex terminals and the load controllers.

Since the simulator initially will have less controllers and demultiplex terminals than are required for the full-up configuration, adapter cables will be added between (a) the load controllers and the demultiplex terminal, and (b) the load controllers and the airframe harnessing (loads). Figure 2-b through 2-d illustrates these adapter cables. The three figures also show the variation in adapter cables end-to-end terminations. These variations permit limited demultiplex channels to control the "available" load controller complement for powering all simulator loads.

The variation in signal/power paths between checkout groups can be seen by examining the interconnection paths from channel 60 of demultiplex terminal "A". In Figure 2-b (checkout Group 1) channel 60 signal routes through adapter cable 1-A to the input of a 2 ampere, 28 VDC controller. Power is then switched by this controller (designated U60) through adapter cable 2-A to the load associated with airframe harness contact 60 of plug designated P "XYZ". To transition from checkout group 1 to group 2, adapter cables 1-A and 2-A are replaced by cables 1-B and 2-B respectively. This second interconnect configuration (shown in Figure 2-c) permits demultiplex terminal channel 60 to be routed through adapter cable 1-B to a 1/2 ampere, 115 VAC controller (designated U126). Power switched by this controller is routed through adapter cable 2-B to the load associated with P "XYZ" contact 126.

In a similar manner, transitioning from set B switching adapter cables to set C adapter cables reconfigures the LMC to the interface shown in Figure 2-d for checkout group 3. In this group 3 arrangement, channel 60 again controls the 28 VDC, 2 ampere controller designated U60 as occurred in checkout group 1. In group 3, however, U60 controller switches dc power through the 2-c adapter cable to a 28 VDC load associated with P "XYZ" contact 122.

In summary, the modular concept implementation shown for load controllers facilitates sharing the limited output related ADM equipment. However, in addition to load controllers, solid state output drivers are required to provide the full set of SCG output signals. A full set of these output drivers are defined for the simulator system to allow it to be easily expanded to a full-up system. Of particular significance is that this modular checkout concept allows the simulator basic wiring to remain intact for the full-up case. Also in the interim case, the systems/equipment operated in each of the four functional groups are basically equivalent to those operational at any given time in a full-up system. And lastly, the group assignments result in a maximum usage of the available ADM equipment.

The ADM equipment usage versus that available is described in paragraph 2.4.4 as are the various special equipments (signal conditioners, simulated signal sources and adapter harnesses) needed for the simulator.

2.2 TA-7C Subsystem Designs

A total of 121 TA-7C subsystems and circuits were designed using the AAES technologies, hardware and control techniques. These subsystems are listed in Table 1. Documentation was prepared for the designs using CAD (Computer Aided Design) techniques. Figures 3 and 4 are representative of the designs evolved and the level of completeness and detail contained in the prepared documentation. These representative designs are for the Liquid Oxygen Gauging and the Emergency Accumulator Test systems. The documentation for each system will be expanded to include appropriate harness and termination assignment upon their completion as a part of the Full Simulator Development Program.

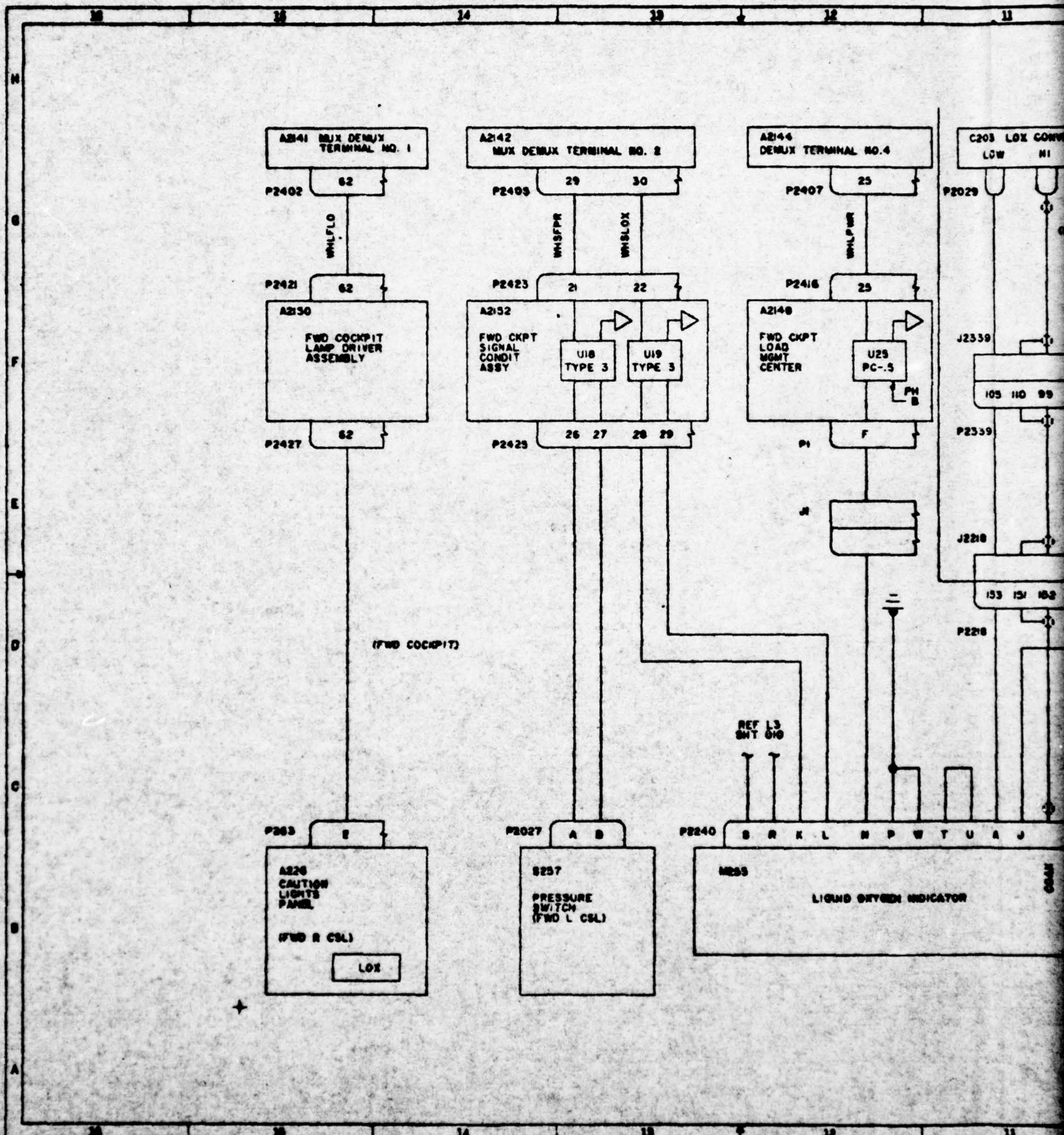
2.3 Power Generating System (PGS) Design Requirements

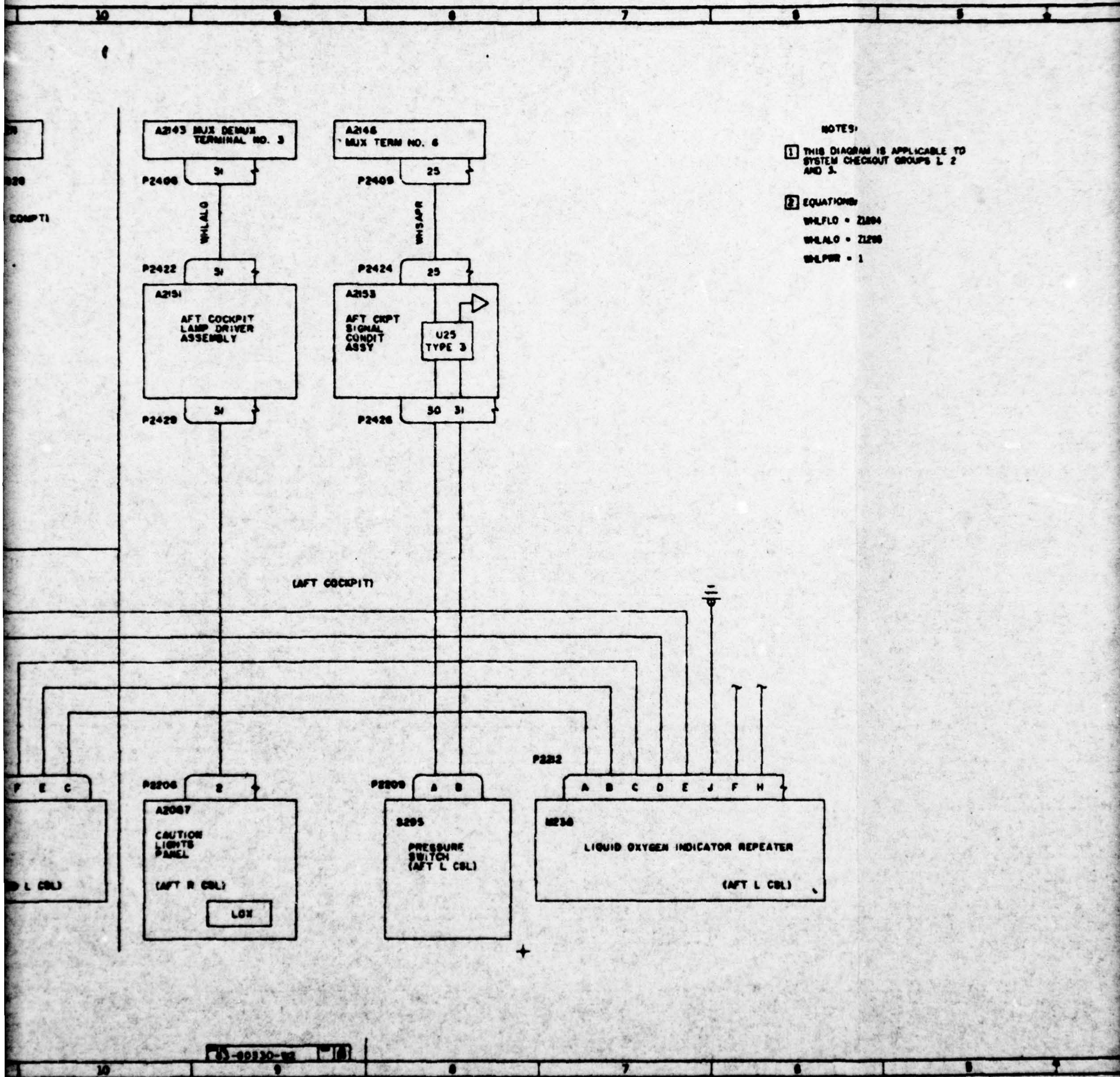
A number of related tasks were performed concerning the PGS. These included preparing a PGS system definition and description, establishing a method for supplementary loading of the ADM 45 KW generator with the simulator system, establishing a preliminary grounding philosophy for the simulator, and defining the A-7 engine pad-generator mounting interface. These are discussed in the subsequent paragraphs.

2.3.1 PGS Definition and Description

The power generation subsystem design for the AAES simulator is based upon performance requirements defined in procurement specifications for the generator (NADC-VT-TS-7502 dated 13 June 1975) and the power conditioner units (NADC-VT-TS-7503 dated 8 July 1975). The primary electric power source for the simulator consists of two 45 KW, 270 volt DC generators as defined by the NADC procurement specification. The generators will not be an integral part of the simulator but will be operated from a "generator drive stand" in the NADC AAES Laboratory. Power feeders will route the power to the simulator. The point of regulation will be located on the simulator as will all equipment except the generators. A portion of the 270 VDC power will be used to power 270 VDC "dummy" loads located external to the simulator and a limited number of loads (the SCG and AMUX WRAs) mounted in the simulator. The remainder of the power will be converted to 28 volts DC by two 100 ampere converters and to 115/200 volt AC by two 10 KVA inverters. The generation and conversion equipment will be connected to provide primary buses as shown in Figure 5.

System operation is as follows: When one generator is brought up to rated speed and the output voltage at the point of regulation (located on the simulator) is at rated voltage (270 ± 5 VDC), the HVDC bus controller (BC) and the HVDC bus tie controller (BTC) will automatically close. The generator now


A2141 MUX DEMUX TERMINAL NO. 1
A2142 MUX DEMUX TERMINAL NO. 2
A2144 DEMUX TERMINAL NO.4
C203 LOX CONV
LOW
HI
P2402
P2403
P2407
P2029
WHLFLO
WHSFPR
WHSLOX
WHLPWR
P2421
P2423
P2416
A2130
FWD COCKPIT LAMP DRIVER ASSEMBLY
A2152
FWD CKPT SIGNAL CONDIT ASSY
U18 TYPE 3
U19 TYPE 3
A2148
FWD CKPT LOAD MGMT CENTER
U25 PC-.5
J2339
P2339
P2427
P2425
P1
J1
J2216
P2216
(FWD COCKPIT)
REF L3 SHT 010
P263
P2027
P2240
A226 CAUTION LIGHTS PANEL
(FWD R CSL)
LOX
S257
PRESSURE SWITCH (FWD L CSL)
M255
LIQUID OXYGEN INDICATOR



NOTES:

1. THIS DIAGRAM IS APPLICABLE TO SYSTEM CHECKOUT GROUPS 1, 2 AND 3.

2. EQUATIONS:

WHLFLO = Z1204

WHLALO = Z1206

WHLPWR = 1

NOTES:

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2. EQUATIONS:

WHLFLO = Z1204

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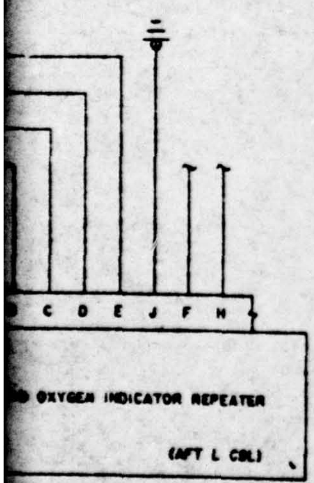
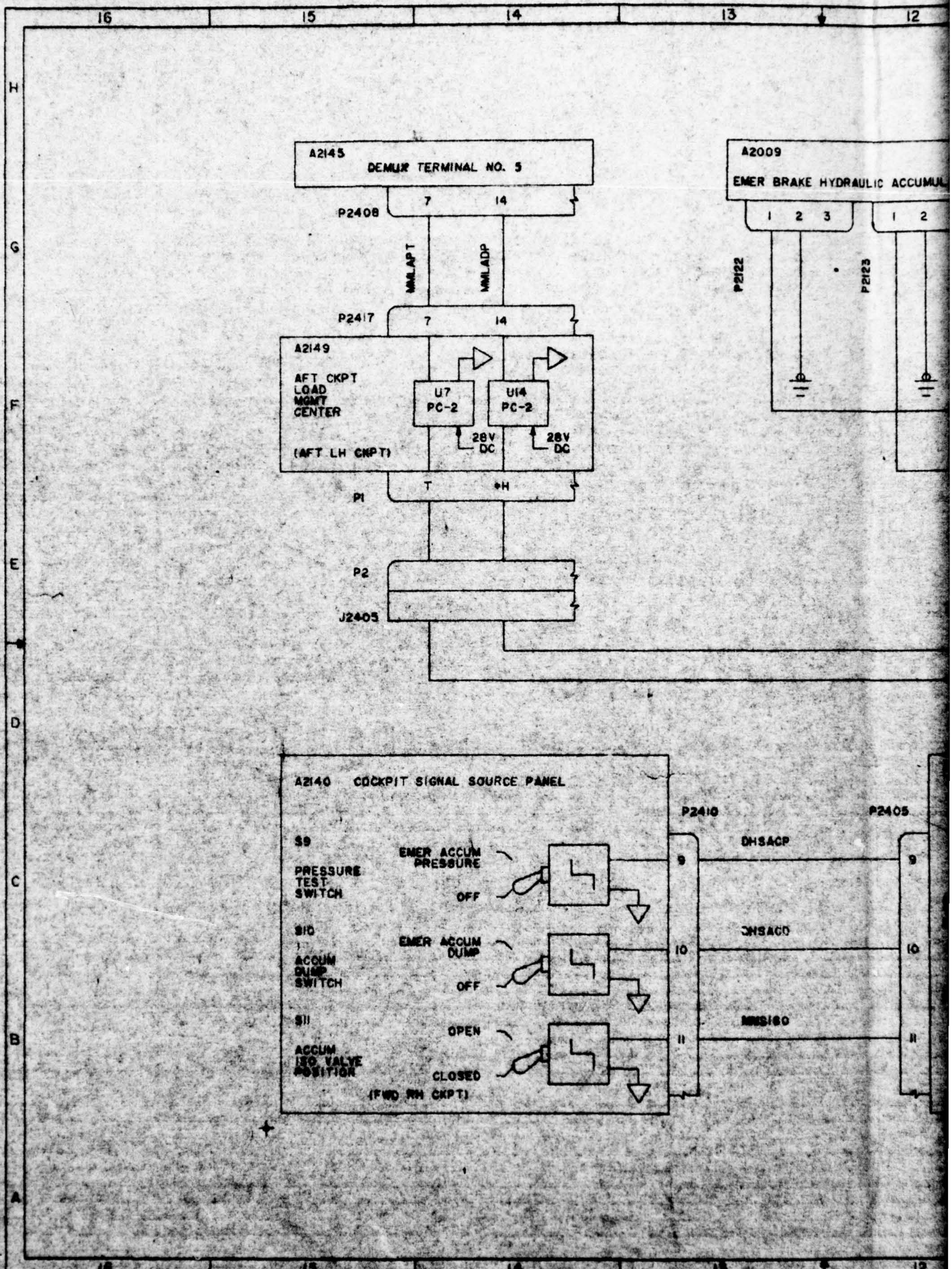


FIGURE 3

AAES WIRING DIAGRAM LIQUID OXYGEN GAGING

83-80330-112

DWG 82-80220-WS
SH 010
3E X 88



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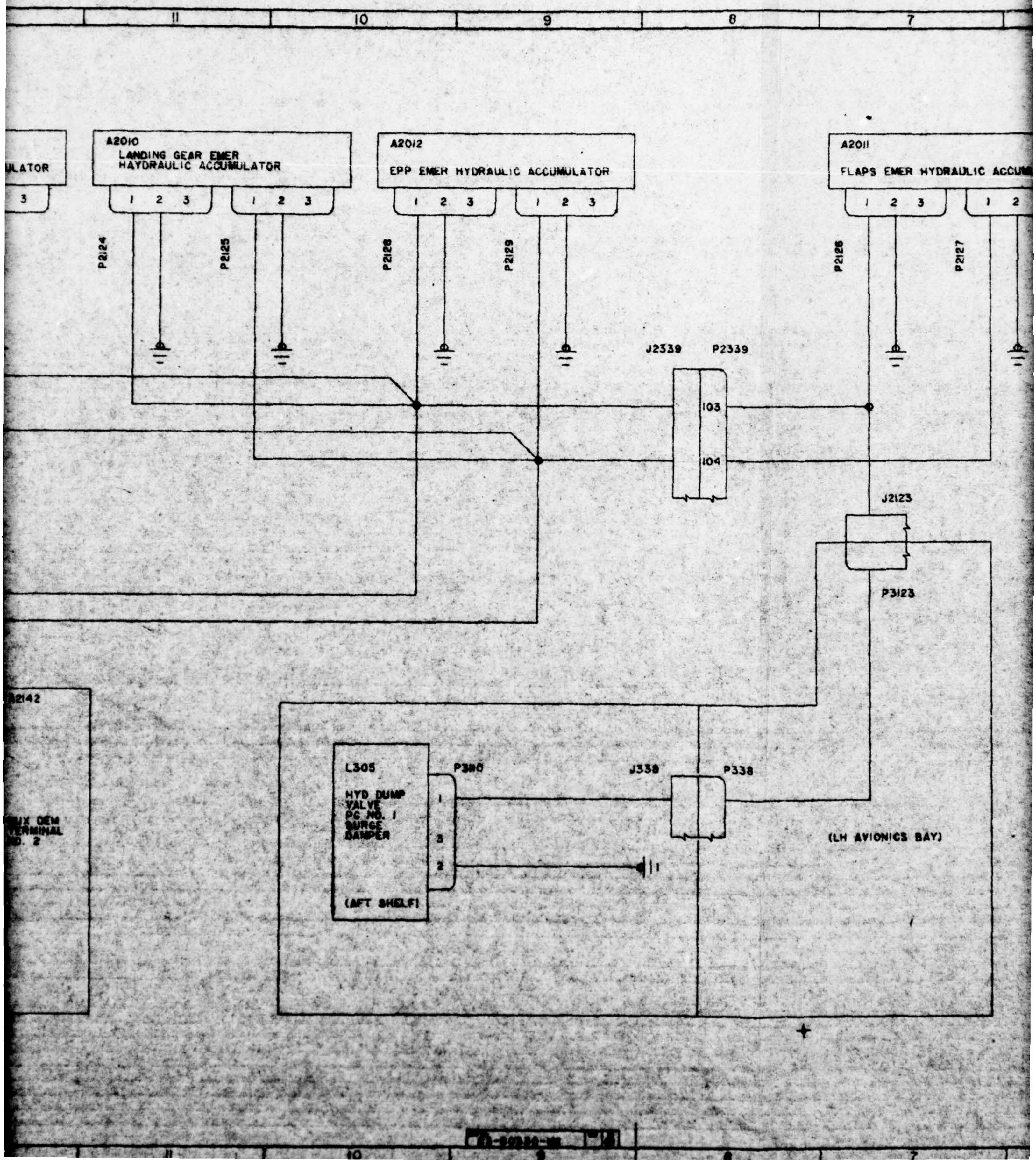
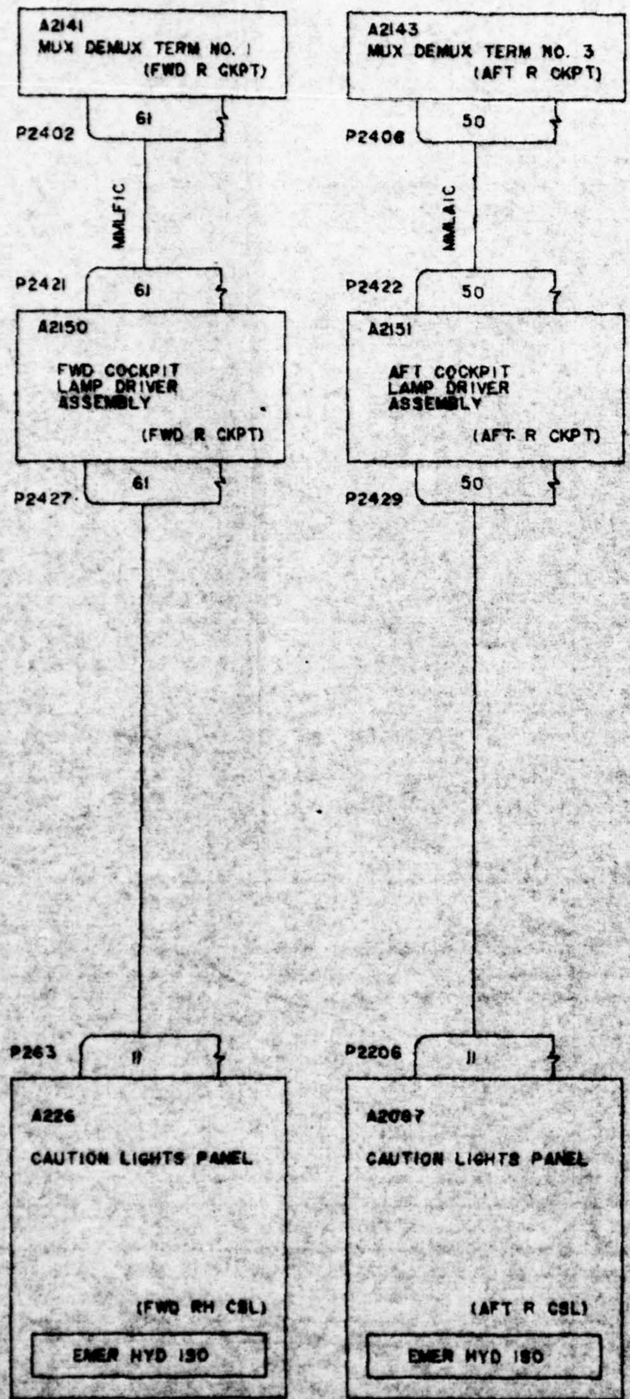

11
10
9
8
7
ULATOR
A2010
LANDING GEAR EMER
HAYDRAULIC ACCUMULATOR
A2012
EPP EMER HYDRAULIC ACCUMULATOR
A2011
FLAPS EMER HYDRAULIC ACCUM
P2124
P2125
P2128
P2129
P2126
P2127
J2339
P2339
103
104
J2123
P3123
A2142
AUX OEM
TERMINAL
NO. 2
L305
HYD DUMP
VALVE
PC NO. 1
SURGE
DAMPER
(AFT SHELF)
P340
J338
P338
(LH AVIONICS BAY)



NOTES:

[1] THIS DIAGRAM IS APPLICABLE TO SYSTEM CHECKOUT GROUP 3.

[2] EQUATIONS:

MMLAPT = Z1270

MMLADP = Z1271

MMLFIC = Z1272

MMLAIC = Z1273

FIGURE 4

AAES WIRING DIAGRAM
EMERGENCY
ACCUMULATOR TEST

TABLE 1

TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS	
*A1	Shrike Improved Display System
*A2	Armament Station Control- Jettison
*A3	Weapon Station 1 Stores Management
*A4	Weapon Station 2 Stores Management
*A5	Weapon Station 3 and 4 Stores Management
*A6	Armament Advisory-Forward Cockpit
*A7	M61-Internal Gun System
*A8	Armament Advisory-Aft Cockpit
*A9	Nav/Wpn Del Cmptr-Release Control
*A10	Electric Fuzing System
*A11	Weapon Station 5 and 6 Stores Management
*A12	Weapon Station 7 Stores Management
*A13	Weapon Station 8 Stores Management
B1	KB-18 Camera
C1	Speed Brake Control
C2	Wheels Flaps Warning
C3	Approach Power Compensator
C4	Pitch and Roll Trim System
C5	Automatic Flight Control System- Roll Channel
C6	AFCS-Pitch Channel
C7	AFCS-Yaw Channel
C8	Variable Flaps Control
C9	Emergency Flaps Control
D1	Landing Gear Position Indication
D2	Hydraulic Pressure Indication and Warning
D3	Weight-on-gear and Deck Compression Sensing
D4	Pitch and Roll Trim Indication
D5	Leading Edge Flaps Position Indication
D6	Trailing Edge Flaps Position Indication
D7	Speed Brake Flaps Position Indication
E1	Pressure Ratio Indication
E2	Engine Oil Pressure Indication and Warning
E3	Fuel Quantity Indication and Warning
E5	Engine Fuel Control
E6	Engine Fuel Flowmeter Indication
E7	Fuel Filter Bypass Indication
E8	Turbine Inlet Temperature
F1	Doppler Radar
F2	Pitot Heater/Engine Anti-Icing
F3	Counting Accelerometer System
F4	Standby Attitude Indication
F5	IMS Control
F6	Inertial Measurement Set

(Continued)

TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS

F7	Inertial Measurement System
F8	Angle of Attack
F9	Horizontal Situation Indicator
F10	Heading Mode
F11	Flight Mode Control - Fwd. Cockpit
F12	Flight Mode Control - Aft Cockpit
F13	Head Up Display
F14	Projected Map Display
F15	Nav/Weapon Delivery Computer
F16	Nav/Weapon Delivery Computer
F17	HUD Monitor
F18	ARA-63 Appraoch Control System
F19	HUD & ADI Landing Select Control
F20	Command Transfer Control
F21	Horizontal Situation Indicators
G1	Windfold Control
G2	Landing Gear Safety/Position Detent
G3	Arresting Gear Control
G4	Nose Gear Steering
G5	Launch Bar Control
G6	Anti-Skid Brakes
G7	Parabrake Control
H1	Temperature Control/Rain Repellant
H2	Hydraulic Accumulator Heaters
H3	Electronic Compartment Cooling
K1	Engine Crank and Ignite
K2	Engine Bleed
L1	Flood Lighting-Forward Cockpit
L2	Instrument Board Lighting-Forward Cockpit
L3	Console Lighting-Forward Cockpit
L4	Exterior Lighting
L5	Warning and Advisory Lighting-Forward Cockpit
L6	Flood Lighting-Aft Cockpit
L7	Instrument Board Lighting-Aft Cockpit
L8	Console Lighting-Aft Cockpit
L9	Warning and Advisory Lighting-Aft Cockpit
M1	Seat Adjust
M2	Emergency Accumulator Test
M3	Emergency Power Package Actuator
M4	Canopy Actuation Control and Warning

TABLE 1

(Continued)

TA-7C SUBSYSTEM/CIRCUIT DESIGNS

TA-7C SUBSYSTEMS	
*PA1	Primary Power Generation, Conversion and Control
*PB1	External Power Control
*PC1	Primary 270 VDC Load Bus System
*PC2	Emergency 270 VDC Load Bus System
*PC3	Primary 28 VDC Load Bus System
*PC4	Emergency 28 VDC Load Bus System
Q1	In-Flight Refueling and Ground Fueling
Q2	Fuel Transfer and Dump
Q3	Low Level Fuel Warning
*RD1	UHF-ADF System (ARA-50)
*RL1	Auxiliary Radio Receiver Set (ARR-60)
*RN1	TACAN Navigation System (ARN-52)
RP1	ASW-25 Data Link (Display Control)
RP2	ASW-25 Data Link (Forward/Aft Control)
*RU1	UHF Communication System (ARC-51A)
*RZ1	Audio System
*RZ2	Weapon Release and Low Altitude Tone Generator
*SA1	Radar Height Indication System
SN1	Altitude Indicator
SS1	Forward Looking Radar (Dig. Scan Conv.)
SS2	Forward Looking Radar (NWDC Interface)
SS3	Forward Looking Radar (Power Control)
SX1	IFF System (APX-72)
SX2	IFF Aft Control
TE1	Interference Blanker Set
TE2	ALR-50 Radar Homing and Warning
TE3	ALR-45 Radar Homing and Warning
TM1	ALE-29 Chaff Dispenser
TN1	True Airspeed Indicator
TN2	Air Data Computer
TQ1	Radar Beacon (APN-154)
U1-U3	AMUX System
W1	Fire Detection System
W2	Liquid Oxygen Gauging and Warning
W3	Rain Removal Overheat Warning
*XA1	Emergency Power Generation, Conversion and Control
*XB1	Primary AC Load Bus System
*XB2	Emergency AC Load Bus System

* Systems Requiring Additional Circuit Definition and Design which are to be completed on Full Simulation Development contract.

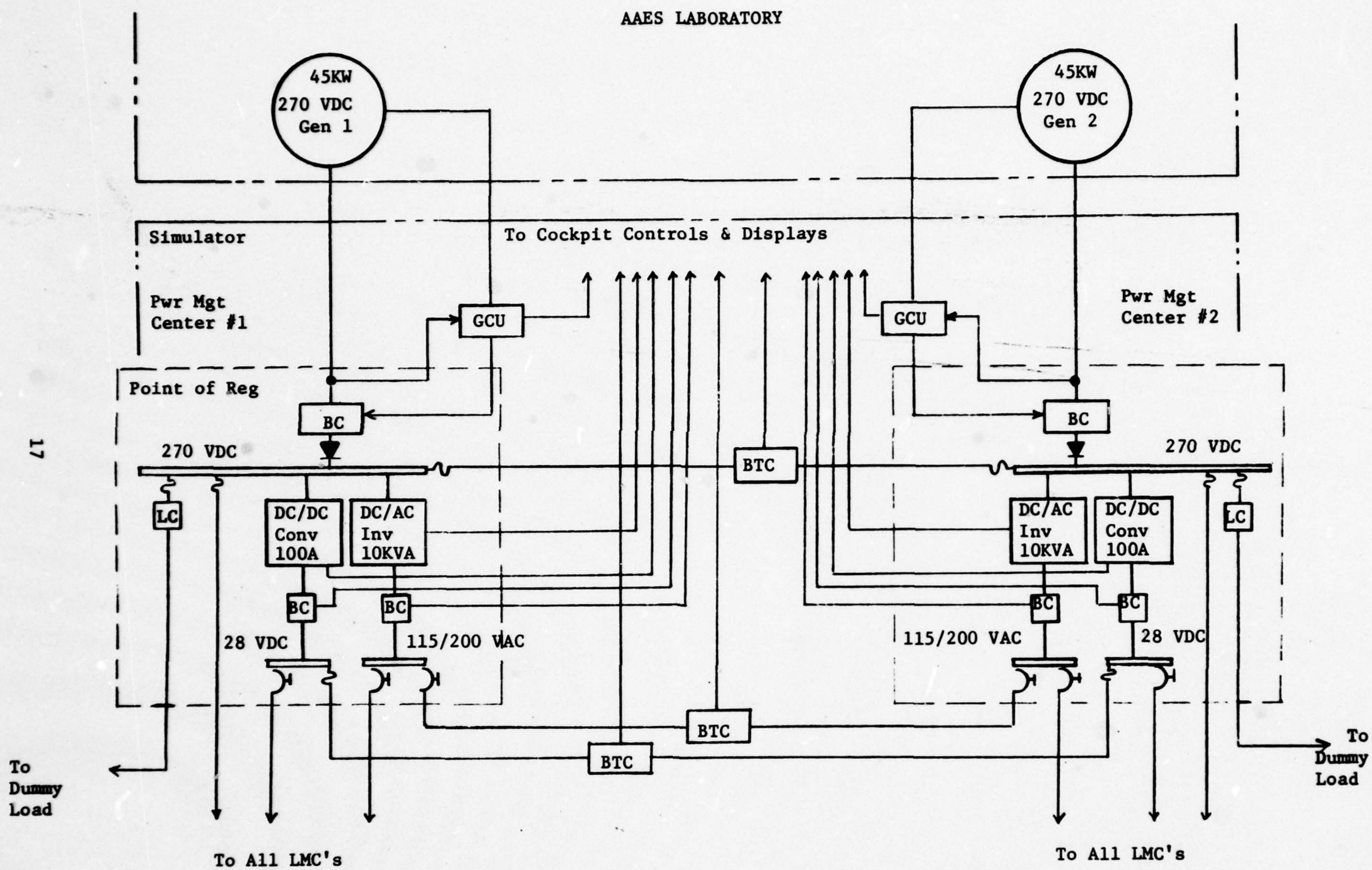


FIGURE 5. AAES Laboratory Simulator Power Generation Subsystem

supplies power to both 270 VDC buses. When the other generator is brought up to rated speed and its output voltage is less than 5.0 volts above the main bus voltage, its HVDC bus controller closes automatically and the two generators now supply power to the simulator system loads. The two generators are now operating in parallel which is the normal mode of operation for the system. The main buses are regulated to 270 $\pm$ 5 volts DC by each of the generator GCUs which ensures the load on each generator is equally divided. Isolated mode of operation is provided by manually commanding the HVDC BTC to open. In the event a generator becomes inoperative (generator, GCU or drive failure), the failed generator will be automatically disconnected from the bus.

The bus controllers for the converter and inverter are automatically closed (with manual override) when the output voltage characteristics of the inverter and converter are within prescribed limits. The AC bus controller closes when the two inverters are synchronized and voltage levels are within prescribed limits to ensure equal load division. The normal mode of operation for the two converters and inverters is parallel. Isolated mode of operation is provided by manually commanding the 28 VDC BTC and 115/200 VAC BTC to open. The converters and inverters contain overload and fault protection. MIL-STD-704 power at the main buses is maintained by automatic opening of the respective bus controller should MIL-STD-704 limits be exceeded.

It is noted that all control of power to the main buses is independent of SOSTEL. Data, however, can be supplied to SOSTEL to effect the control of loads (i.e., load management) by SOSTEL. Useful data includes generator temperature, converter temperature, inverter temperature, bus voltage (270 VDC, 28 VDC, 115/200 VAC), AC bus frequency and ripple content on DC buses. SOSTEL can be programmed to remove loads when data indicates the removal of loads might avert shutdown of the complete system.

2.3.1.1 Emergency System

An emergency power source as defined by SD-24K is not provided. The emergency operation will be simulated by having one generator operate as the primary source and the other generator serve as an emergency source. The non-essential loads will be removed from the buses via SOSTEL control during the simulated emergency condition.

2.3.1.2 External Power

The Vought AAES Simulator Design is presently based on not including "External Power" provisions. In the event that NADC wants "external power" provisions included on the simulator, this requirement should be established prior to award of the simulator development contract. Design data and interface requirements for the power monitor, external power receptacle and bus controller hardware must be established by NADC to enable adequate design of the External Power interface on the simulator if required.

2.3.1.3 Bus Controller

The bus controller function can be implemented with either an electromechanical, solid state or hybrid (electromechanical and solid state) device. The DC bus controller can be either a directional or a bi-directional device. If it is a directional device, it must have reverse voltage blocking capability. The controller must be capable of conducting and switching the maximum power source output current without affecting the normal operation of the power source protective circuitry. That is, the bus controller must not impede the flow of current. The minimum current level is 150 percent of generator rating for the inverter and converter bus controllers (specification NADC-VT-TS-7503 dated 8 July 1975). The HVDC bus controller must also have a minimum blocking voltage rating of 500 VDC. The Hartman contactor, part no. A-751RG, meets the HVDC bus controller requirements for the laboratory environment. Vought will establish the installation and connection requirements for the converter and inverter bus controller based on the Hartman contactor unless notified to the contrary by NADC prior to award of the Simulator Development Contract.

2.3.1.4 Bus Tie Controller

The bus tie function can be implemented with an electromechanical, solid state or a hybrid device. The DC devices must be capable of conducting and switching bi-directional current. Bus tie controllers must be compatible with the opening characteristics of feeder protectors (fuses or circuit breakers), that is, it must not impede the flow of current to the extent that the protector will not open. The Hartman bus tie controller, part no. A-751RG, meets the HVDC bus tie requirements for the laboratory environment. The AAES simulator designs, installation and electrical interface will be based on this device unless Vought is advised to the contrary prior to award of the Simulator Development Contract.

2.3.1.5 Protective Circuitry and System Coordination

To provide compatibility with the power source (generator, converter, inverter) equipment, it is necessary that the feeder protector opening characteristics (fuse or circuit breaker) not cause interference with the normal operation of the power source protective circuitry i.e., the feeder protector device must open before the power source trips off the bus. System design requires the capability of supplying full system load from either generator. Therefore, the HVDC bus tie feeder and associated feeder protectors must be rated for 100% generator capacity. This creates a problem because the trip characteristics of available feeder protectors (high voltage fuses) can allow the generator to trip before the feeder protector opens, i.e., clears the fault. This results in the generator protecting the feeder in some load conditions rather than the fuse providing the feeder protection.

Additionally, available feeder protectors that are needed for protecting feeders to some of the LMCs are not compatible with the converter and/or inverter protective circuitry. That is, the LMC feeder protector (fuse or circuit breaker) can allow the converter and/or inverter to trip before the feeder protector opens. These problems are primarily due to the tight trip limits established for the generator, converter and inverter. This is not a serious problem for the simulator since feeder faults will be an unlikely occurrence due to the simulator environment. Should a feeder fault occur, the worst thing that could happen would be a nuisance power source (generator, converter or inverter) trip. Vought will therefore select feeder protectors based upon feeder current ratings. Possible solutions exist for actual aircraft applications which include changing the power source trip limits, or paralleling feeders to allow use of current protectors that have lower trip ratings.

The generator, power converter, feeder protector coordination conditions as they exist for the AAES TA-7C Simulator are highlighted in Figures 6 through 10. Figure 6 identifies the trip coordination for the generator 270 VDC protection and the PCU feeder protector. This shows that the generator will trip off-line rather than the fuse opening to isolate PCU feeder faults for overload conditions in excess of 120 percent of generator rating, i.e., 200 amperes. Also shown is the compatibility between the generator with respect to the TA-7C composite overload as imposed by an overloaded PCU. Figure 7 indicates the incompatibility between the PCU trip protection and the worst case LMC feeder circuit breaker. In this case the PCU will trip rather than the circuit breaker for 28 VDC overloads exceeding 150 amperes. Also the PCU will not carry the full simulator composite load under a feeder fault condition. The PCU will, however, marginally carry the full simulator 28 VDC composite load under normal conditions. Figures 8, 9 and 10 indicate the coordination conditions for 115 VAC for cases of using MIL-C-5809 circuit breakers, MIL-F-5372 fuses and MIL-F-15160 fuses, respectively. Proper coordination is obtained using the circuit breaker and the 5372 fuse. The 15160 fuse is not compatible with the PCU trip protection limits.

2.3.1.6 PGS Installation

The bus controllers, inverter, converter and feeder protectors will be installed in close proximity to each other and physically protected to form a "power management center" as shown in Figure 5. This will negate the need for feeder protectors between the HVDC bus and the inverter/converter. Detailed installation data/design will be generated as part of the Full Simulator Development contract.

2.3.1.7 PGS Equipment Responsibility

The power generation and bus network equipment requirements for the AAES simulator are summarized in Table 2. Identified are equipment types, quantities, and procurement responsibility as presently understood by Vought.

2.3.2 PGS Supplementary Loading

The HVDC generator and power converter/inverter equipment procured for the simulator requires supplementary loading in order to provide equipment evaluation at full capacity. This is required because limited ADM equipment is being initially procured and the TA-7C electrical load is less than the ADM generator 45 KW rating.

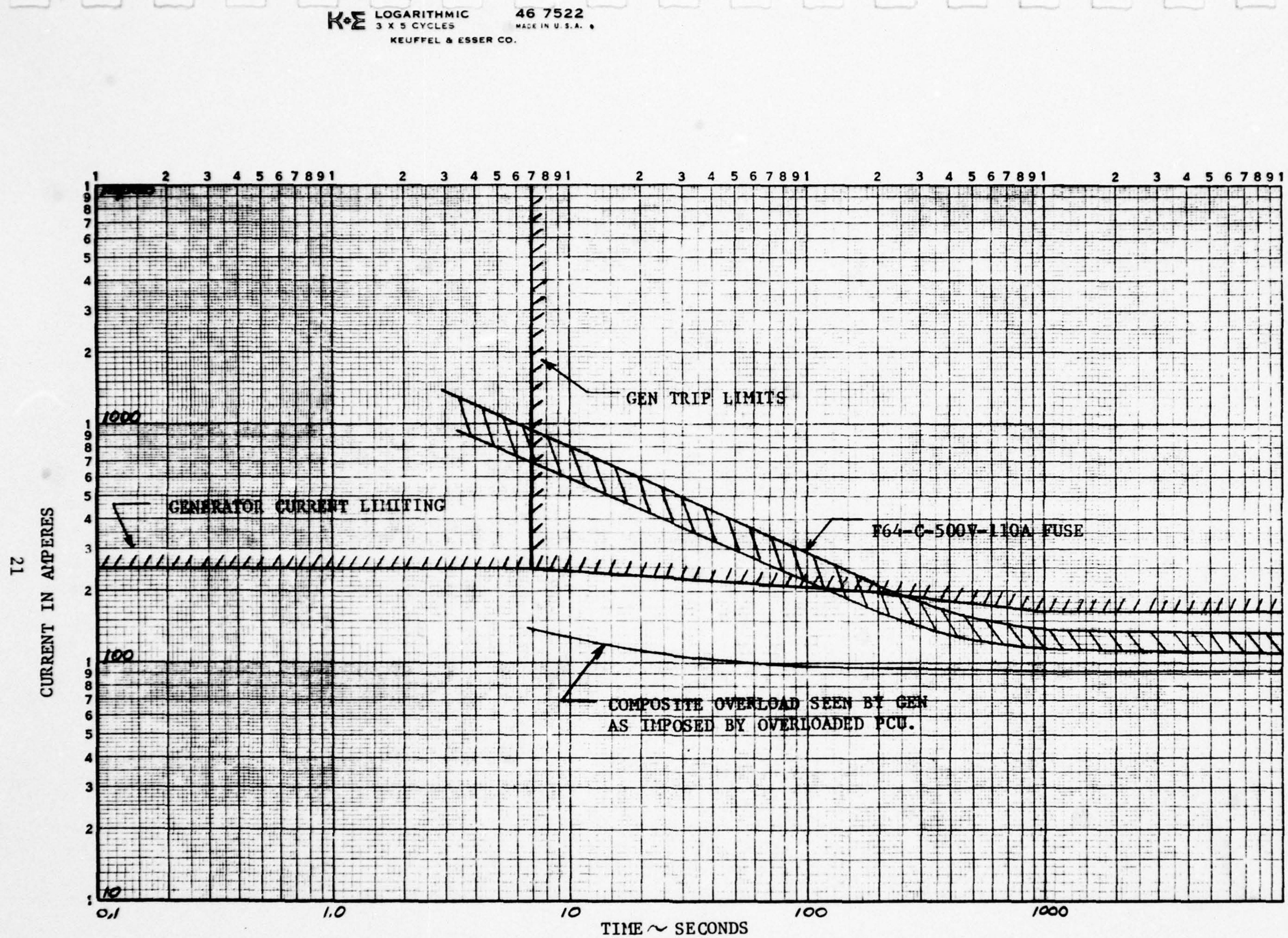


FIGURE 6 GENERATOR-PCU 270 VDC FEEDER PROTECTION COORDINATION

(MIL-F-15160 FUSES)

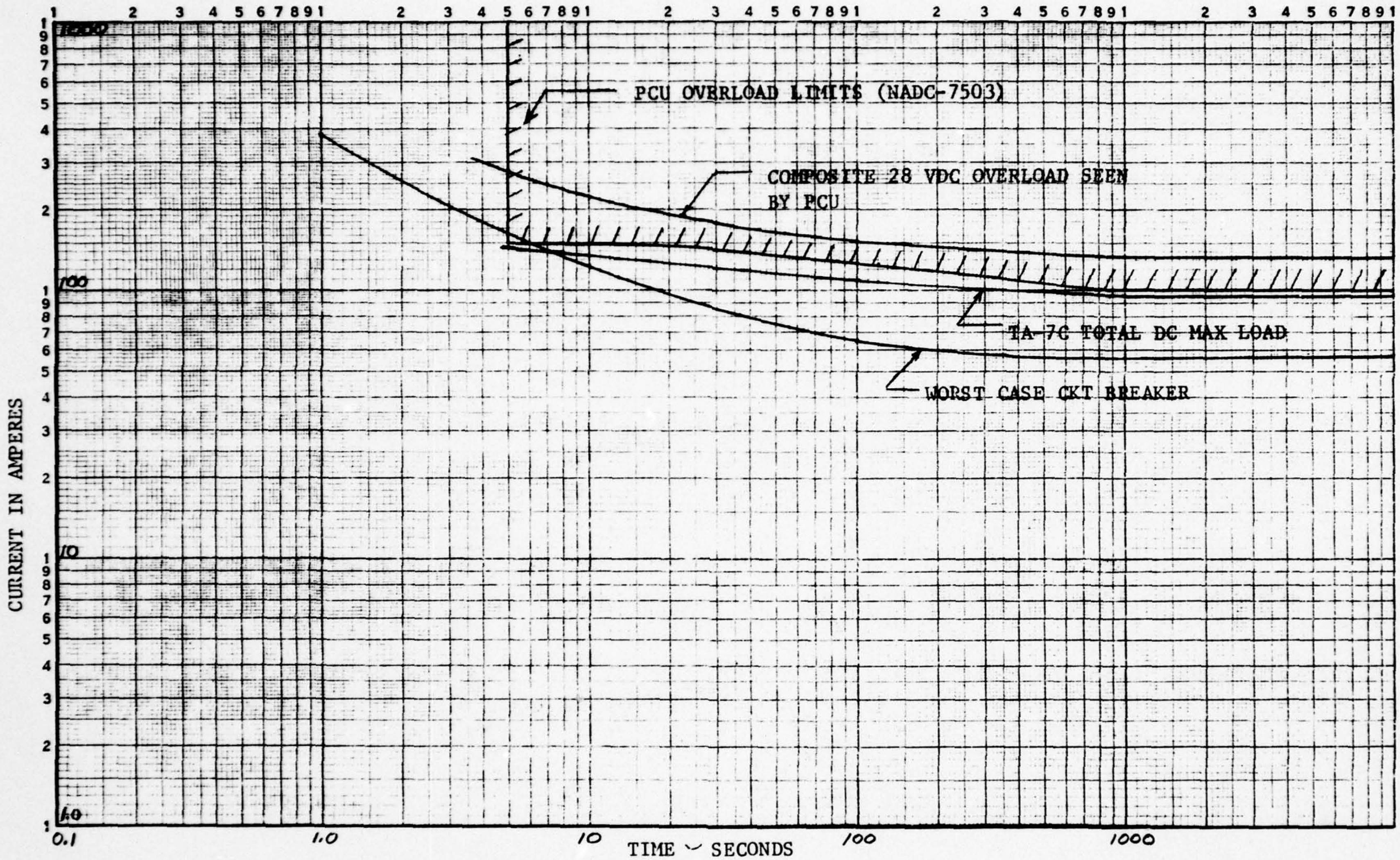


FIGURE 7 PCU-LMC 28 VDC FEEDER PROTECTION COORDINATION

(MIL-C-27715 CIRCUIT BREAKERS)

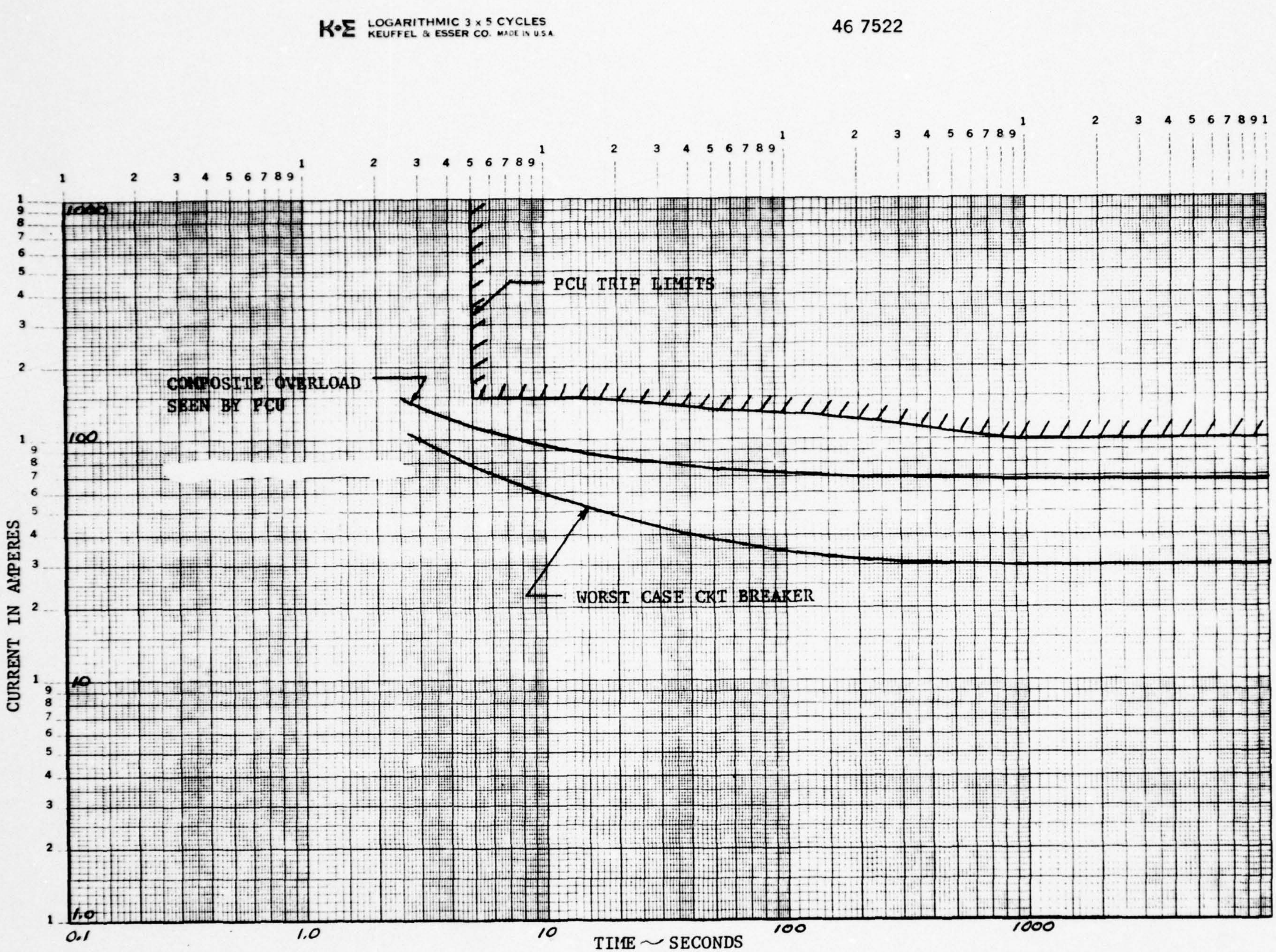


FIGURE 8 PCU-LMC 115 VAC FEEDER PROTECTION COORDINATION

(MIL-C-5809 CIRCUIT BREAKERS)

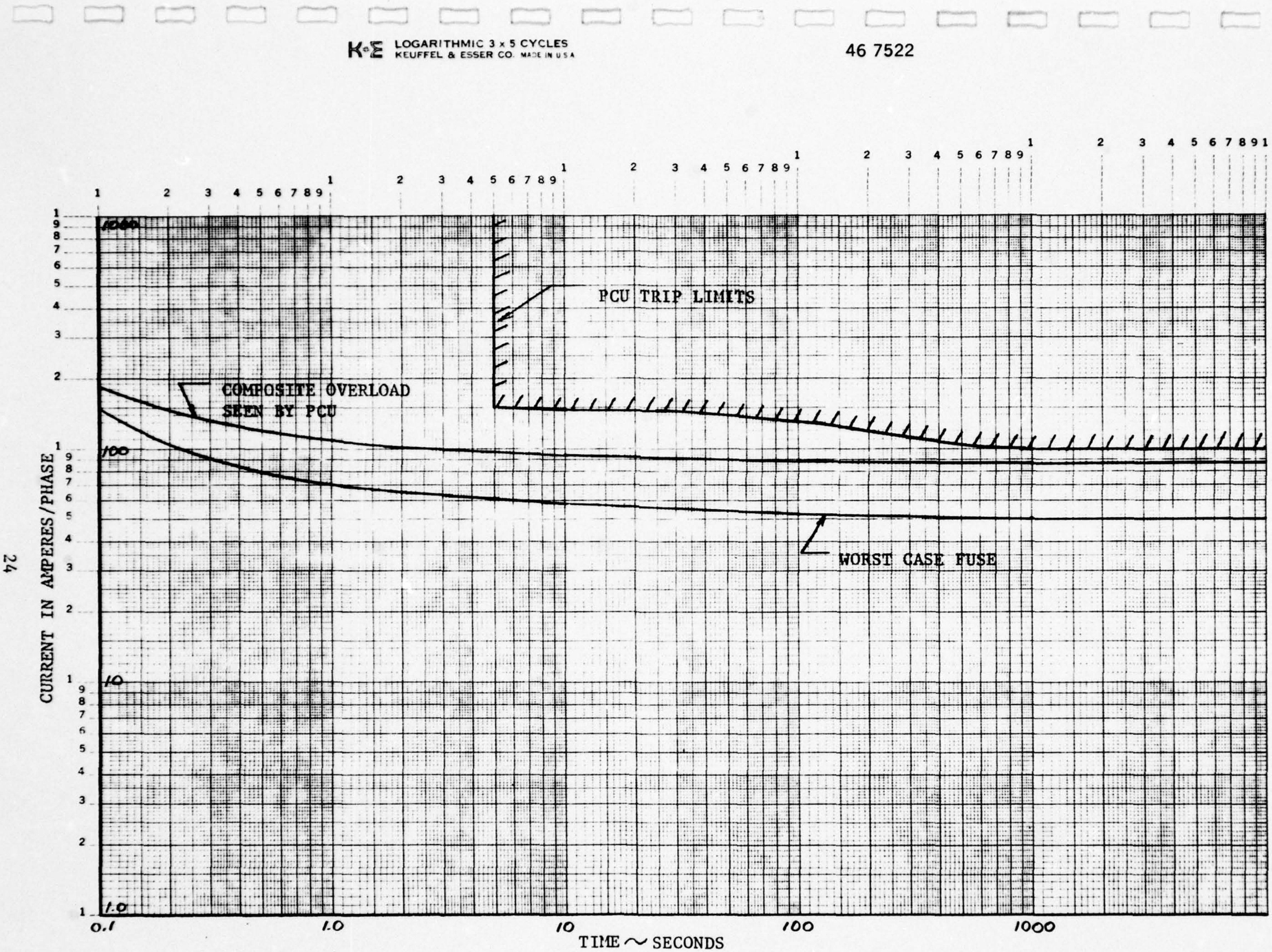


FIGURE 9 PCU-LMC 115 VAC FEEDER PROTECTION COORDINATION

(MIL-F-5372 FEEDER PROTECTORS)

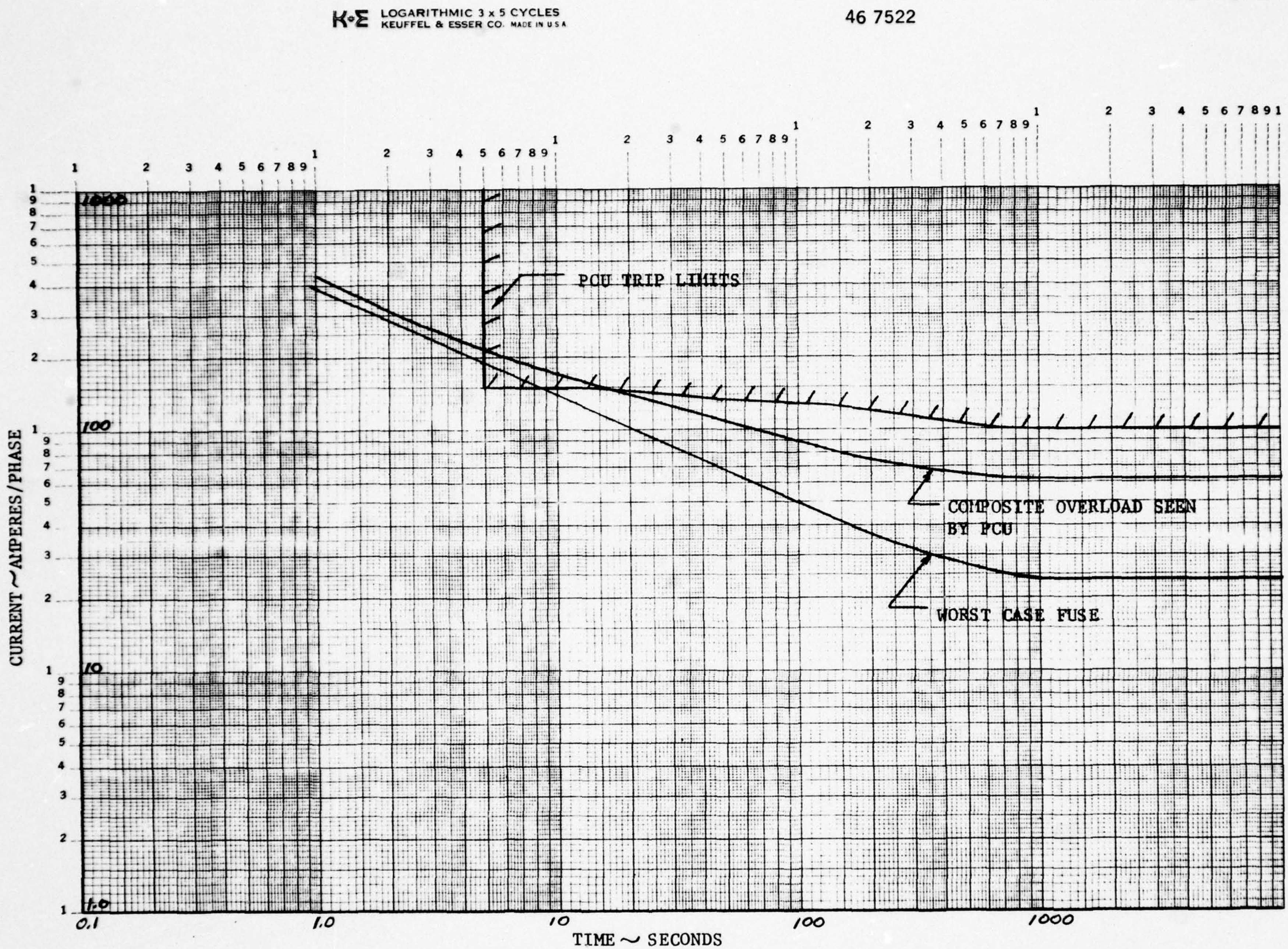


FIGURE 10 PCU-LMC FEEDER PROTECTION COORDINATION

(MIL-F-15160 FEEDER PROTECTORS)

TABLE 2.

POWER GENERATION SUBSYSTEM AND
BUS NETWORK EQUIPMENT REQUIREMENTS

ITEM	NOMENCLATURE	PART NO.	QTY	FURNISHED BY
1	45KW, 270VDC Generator Sys	NADC-VT-TS-7502	2	NADC
2	100A, 28VDC Pwr Conditioner	NADC-VT-TS-7503	2	NADC
3	200A, 270VDC Bus Controller	A-751RG or Equiv	2	NADC
4	200A, 270VDC Bus Tie Controller	A-751RG or Equiv	1	NADC
5	100A, 270VDC Load Controller	A-754R or Equiv	8	NADC
6	HVDC Feeder Fuse	Type F64-C-500	24	Vought
7	100A, 28VDC Bus Controller	MS24141-D1 or Equiv	2	NADC
8	50A, 115/200 VAC Bus Controller	MS24168-D1 or Equiv	2	NADC
9	100A, 28VDC Bus Tie Contr	MS24141-D1 or Equiv	1	NADC
10	50A, 115/200VAC Bus Tie Contr	MS24168-D1 or Equiv	1	NADC
11	28VDC Feeder Fuse	MS28937-XXXX	2	Vought
12	28VDC Feeder Circuit Bkrs	MS24571-XXXX	14	Vought
13	115/200 VAC Feeder Circuit Bkrs	MS14153-XXXX	16	Vought
14	Cockpit Controls & Displays	TBD	-	Vought
15	10KVA, 115/200VAC Pwr Cond.	NADC-VT-TS-7503	2	NADC
16	Diodes, Reverse Current Protection	TBD	2	Vought
	External Power Provisions if Required			
17	External Power Receptacle	TBD	1	NADC
18	External Power Monitor	TBD	1	NADC
19	200A, 270VDC Bus Controller	A-751RG, or Equiv	1	NADC
20	Diode, Reverse Current Protection	TBD	1	Vought

The discussion which follows describes a recommended design for artifically loading the AAES simulator power system.

2.3.2.1 Supplementary Loading Design

Design provisions for artificial (or dummy) loads are provided on the simulator to allow the power system capacity to be fully exercised. These loads are connected to the main power buses (270 VDC, 28 VDC and 115/200 VAC) through electromechanical contactors. The contactors are controlled by the SCG terminal located in the aft equipment shelf LMC.

Figure 11 provides a block diagram overview of the dummy load circuitry. Figures 12 through 14 depict the load interconnection at each main bus and identify the recommended hardware and load current requirements. The figures also show the division between simulator installed hardware and provisions versus external simulator hardware.

As shown in the figures, the contactors are controlled by the SCG via relay drivers. Ideally, this relay driver function would be provided by ADM load controllers. However, due to the limited initial load controller quantities being procured for the simulator, the contactors may be energized by solid state custom designed relay drivers controlled by an SCG terminal. The estimated load requirements for these drivers are:

3.5 amperes at 28 VDC for 500 milliseconds
0.4 amperes at 28 VDC continuously

Provisions are included in the design to allow connection of the dummy loads to the main power buses via SCG control. The dummy load control via the SCG will be derived by:

- o The state of various signal sources installed in the General Purpose Signal Source Panel located on the aft equipment shelf
- o The operational mode of SCG Load Management system software routine.

This method of control permits dummy loading of the power system by manual (signal source panel) or automatic (load management) operations. The Boolean logic for this control will be integrated into the power distribution software of the SCG Processors to be delivered by Vought with the simulator.

As shown in Figures 12 through 14, a total dummy load requirement of 135 to 270 kilowatts is required to adequately evaluate the simulator power system. Since the required mounting space for the dummy loads is somewhat excessive, mounting of dummy loads external to the simulator is recommended. In addition, to keep the simulator relatively "clean" of power system "test" hardware, the power contactors and wire harnessing associated with dummy load control should also be located in mounting racks located external to the simulator. Figure 15 schematically depicts this external rack configuration. It is anticipated that existing generator load banks at NADC can be used for the dummy loads to reduce hardware costs.

Interconnection points are provided on the simulator for interfacing the load rack (Figure15) to the main power buses and to the appropriate SCG demultiplex terminal channels. The power bus terminations (identified as Point A in Figures 12 through 14)are downstream of the feeder protectors but within the associated Main Power Center to maintain physical protection of the power bus.

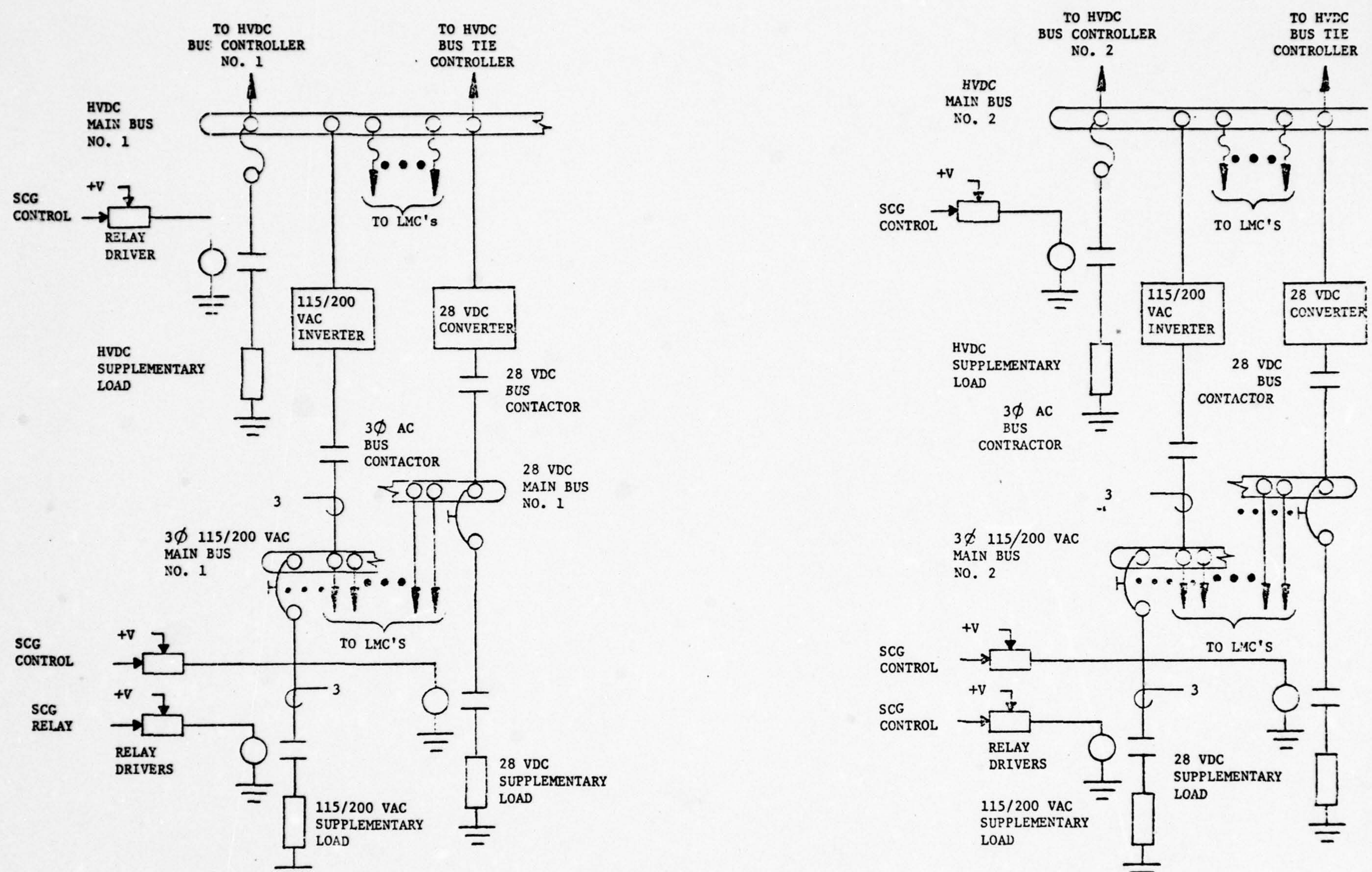


FIGURE 11 - SUPPLEMENTARY LOAD CIRCUITRY - BLOCK DIAGRAM

HARDWARE LIST

REF DES	DESCRIPTION	PART NO.
F1	FUSE	F63-C-500-701
F2	FUSE	F63-C-500-701
F3	FUSE	F63-C-500-701
F4	FUSE	F63-C-500-701
K1	CONTACTOR	A-754R(HARTMAN)
K2	CONTACTOR	A-754R (HARTMAN)
K3	CONTACTOR	A-754R (HARTMAN)
K4	CONTACTOR	A-754R (HARTMAN)
	RELAY DRIVERS	TBD

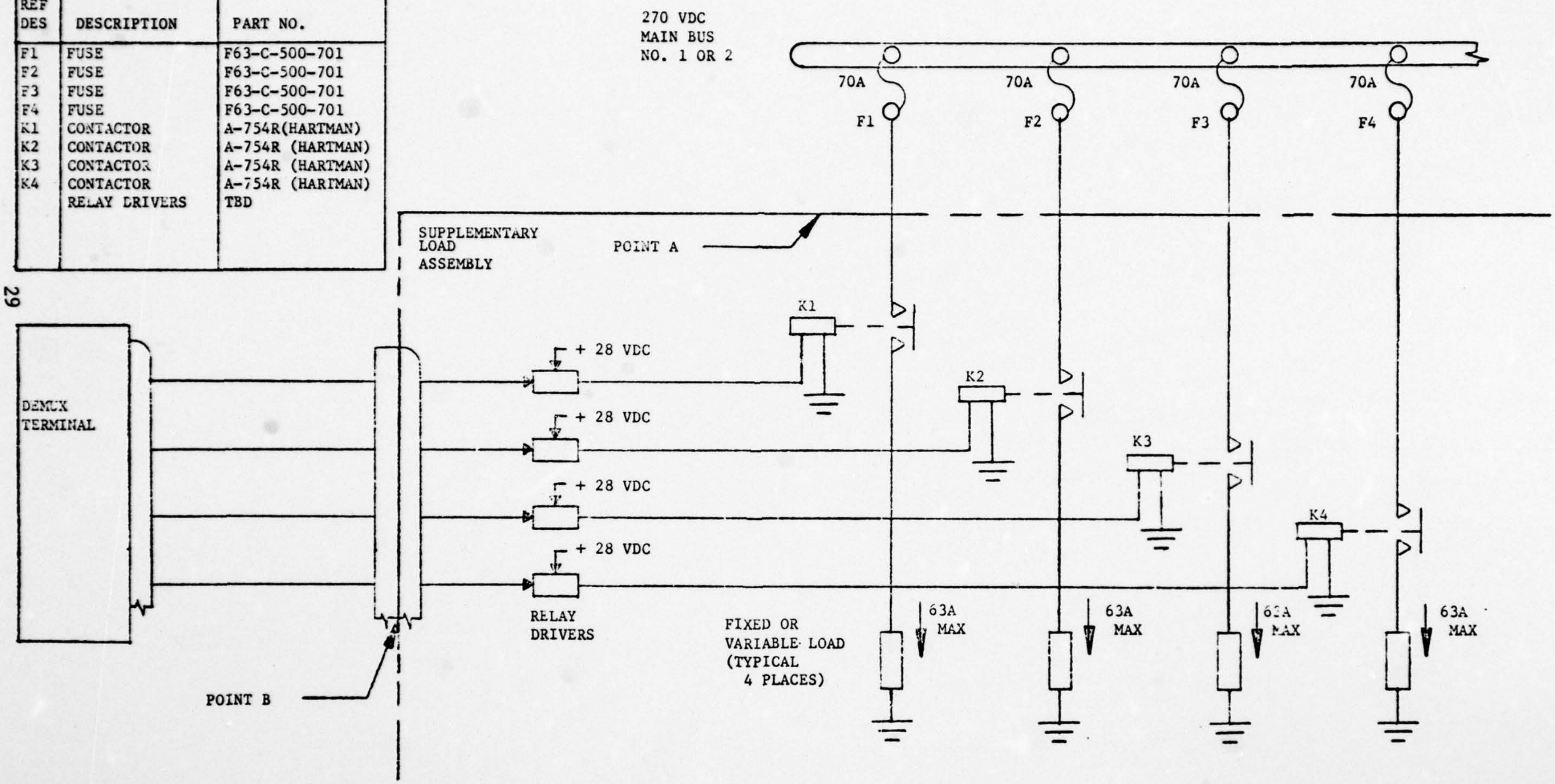


FIGURE 12 - HVDC SUPPLEMENTARY LOADING

HARDWARE LIST

REF DES	DESCRIPTION	PART NO.
CB1	CIRCUIT BREAKER	MS24571-50
CB2	CIRCUIT BREAKER	MS24571-50
CB3	CIRCUIT BREAKER	MS24571-50
CB4	CIRCUIT BREAKER	MS24571-50
K1	CONTACTOR	M6106/15-001
K2	CONTACTOR	M6106/15-001
K3	CONTACTOR	M6106/15-001
K4	CONTACTOR	M6106/15-001
	RELAY DRIVERS	TBD

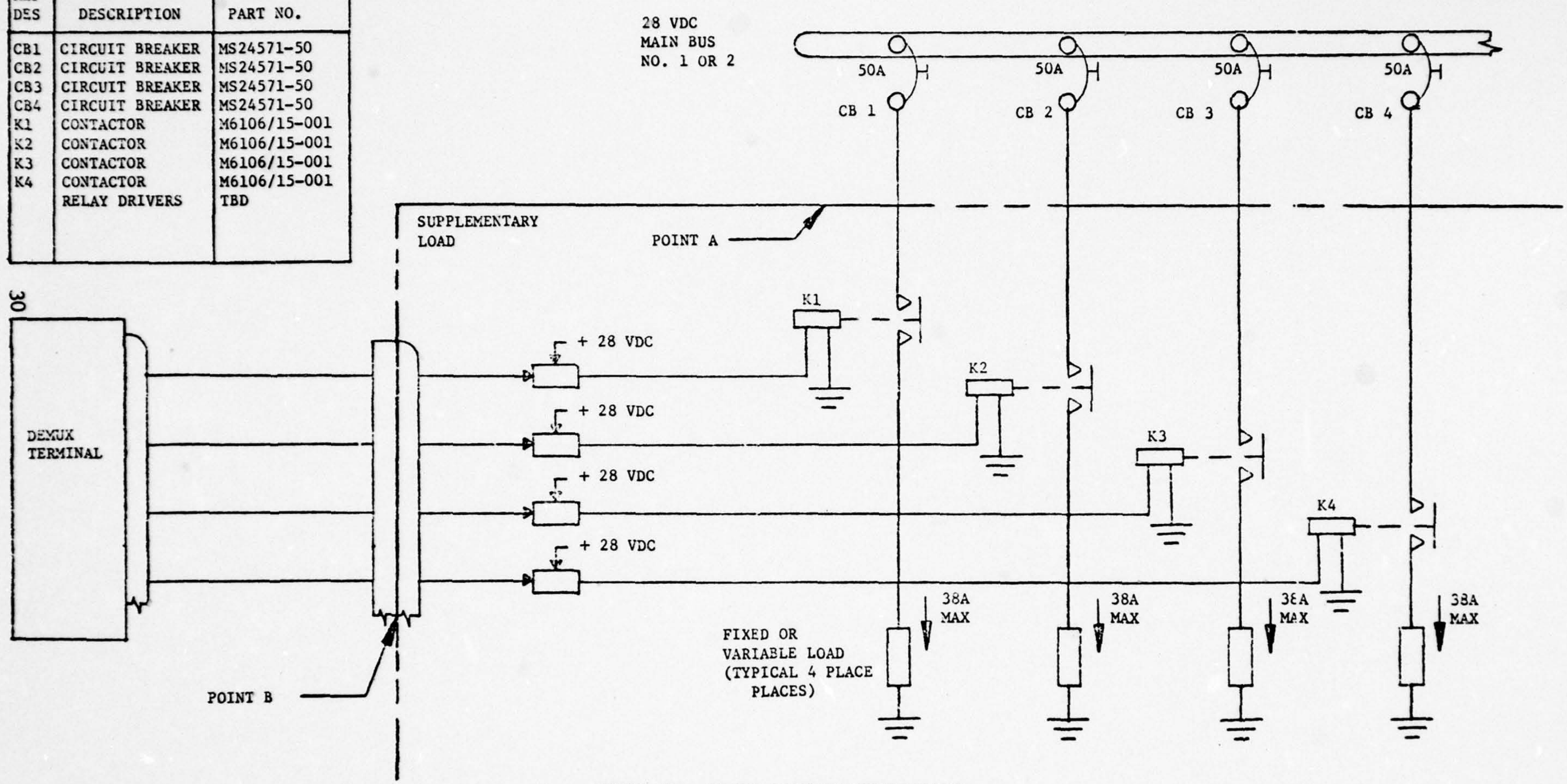


FIGURE 13 - 28 VDC SUPPLEMENTARY LOADING

HARDWARE LIST

REF DES	DESCRIPTION	PART NO.
CB1	CIRCUIT BREAKER	MS21954-50
CB2	CIRCUIT BREAKER	MS21954-50
CB3	CIRCUIT BREAKER	MS21954-50
CB4	CIRCUIT BREAKER	MS21954-50
K1	CONTACTOR	M6106/9-001
K2	CONTACTOR	M6106/9-001
K3	CONTACTOR	M6106/9-001
K4	CONTACTOR	M6106/9-001
	RELAY DRIVERS	TBD

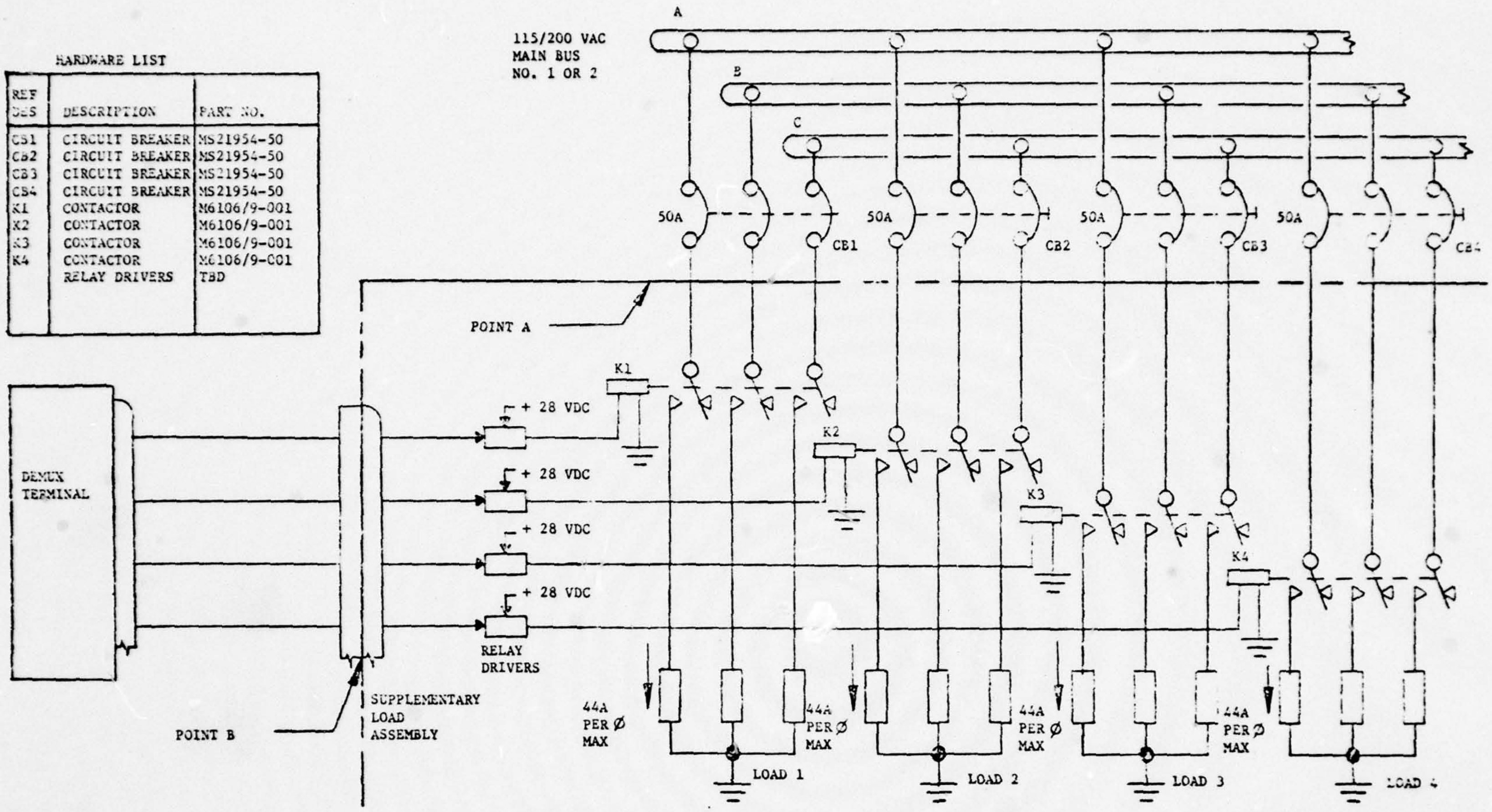


FIGURE 14 - 115/200 VAC SUPPLEMENTARY LOADING

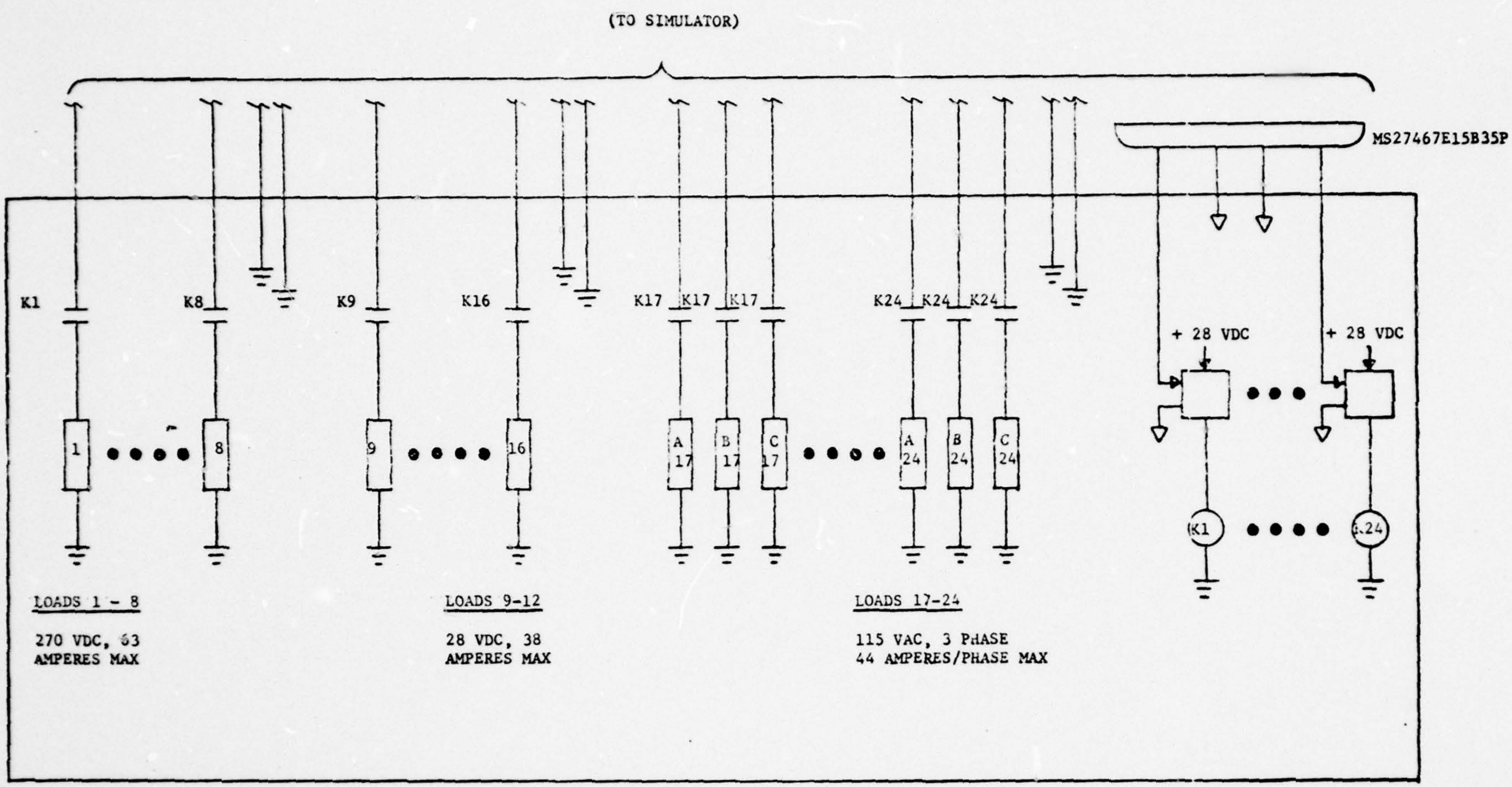


FIGURE 15 - SUPPLEMENTARY LOAD ASSEMBLY

The termination location reduces personnel hazards by eliminating exposed "hot" points on the simulator. The SCG demultiplex terminal channel interface is provided by a connector break at the simulator aft equipment shelves (Point B of Figures 12 through 14). A jumper plug will be provided with the simulator to maintain proper terminal channel loading (for SCG BIT) on these channels when the external dummy loading racks are not connected.

2.3.2.2 Hardware Requirements and Considerations

Hardware requirements and considerations for implementing and demonstrating the PGS supplementary loading involve the HVDC power contactors rated at 100 amperes, relay drivers for contactor control, and load banks having the required wattage ratings. These are discussed in the subsequent paragraphs.

1. HVDC Power Contactors

Due to the apparent lack of hybrid or solid state HVDC bus controller availability, large electromechanical contactors will likely be required for switching power to HVDC dummy loads. An "off-the-shelf" contactor has been identified for use as the main HVDC bus controller. This contactor, rated at 400 amperes at 270 VDC, requires considerable mounting space (at least 144 cubic inches per contactor) for the eight HVDC dummy load contactors required for the simulator implementation. A preferred approach is to use a contactor rated closer to the 75 ampere requirement. The manufacturer (Hartman) providing the 400 ampere contactor is presently investigating the adequacy and availability of an A-754-R series contactor for this application, i.e., a rating of 100 amperes at 270 VDC for the laboratory environment application. The coil voltage would remain at 28 VDC as currently used in the present A-754 contactor design.

2. Relay Driver

A device which provides the relay driver function is required. This device is certainly within the state-of-the-art, but requires design and fabrication. As previously stated, estimated driver load requirements are to switch 3.5 amperes at 28 VDC for 500 milliseconds and 0.4 amperes at 28 VDC continuous. The input control circuitry of the driver must be compatible with SCG terminal interface.

3. Load Bank

Figure 15 depicts the approximate load requirements needed for the supplementary loading of the PGS. Variable loads are desirable but not mandatory. Load power factors should be comparable to those used for testing the ADM generator and converter/inverter equipment. Use of existing NADC load banks is recommended to the extent of their availability and adequacy.

2.3.3 Simulator Grounding Requirements

Grounding philosophy to be employed on the AAES Simulator should include provisions for personnel safety and proper operation of equipment. To provide optimum safety to personnel, the simulator structure should be connected to earth ground or to some conducting body which serves in place of the earth. It is expected commercial Power (110/220 VAC, 60 Hz) operated equipment such as drills, lamps, power supplies, etc., will be used in the vicinity and on the simulator. A faulty equipment could result in the simulator being at commercial power potential if the simulator is not connected to earth.

All equipment enclosures should be electrically connected to the simulator structure. This is to preclude the housing being at some high potential due to an internal power-to-case fault. All equipment circuit grounds should be connected to the simulator structure. Equipment circuit grounds having isolated (different) power supplies should use separate ground terminals. For example, the 28 VDC ground and 115/200 VAC ground should not share the same ground terminal. Single point grounds should be used in applications where equipment operation is sensitive to EMI. Grounds isolated from the structure is permissible (from a personnel safety view point) in systems operating at not more than 30 volts (AC or DC) between conductors.

The use of a "shock hazard detection system" needs to be investigated. A shock hazard monitor would automatically disconnect the power source from the simulator in the event that the simulator structure is above ground potential.

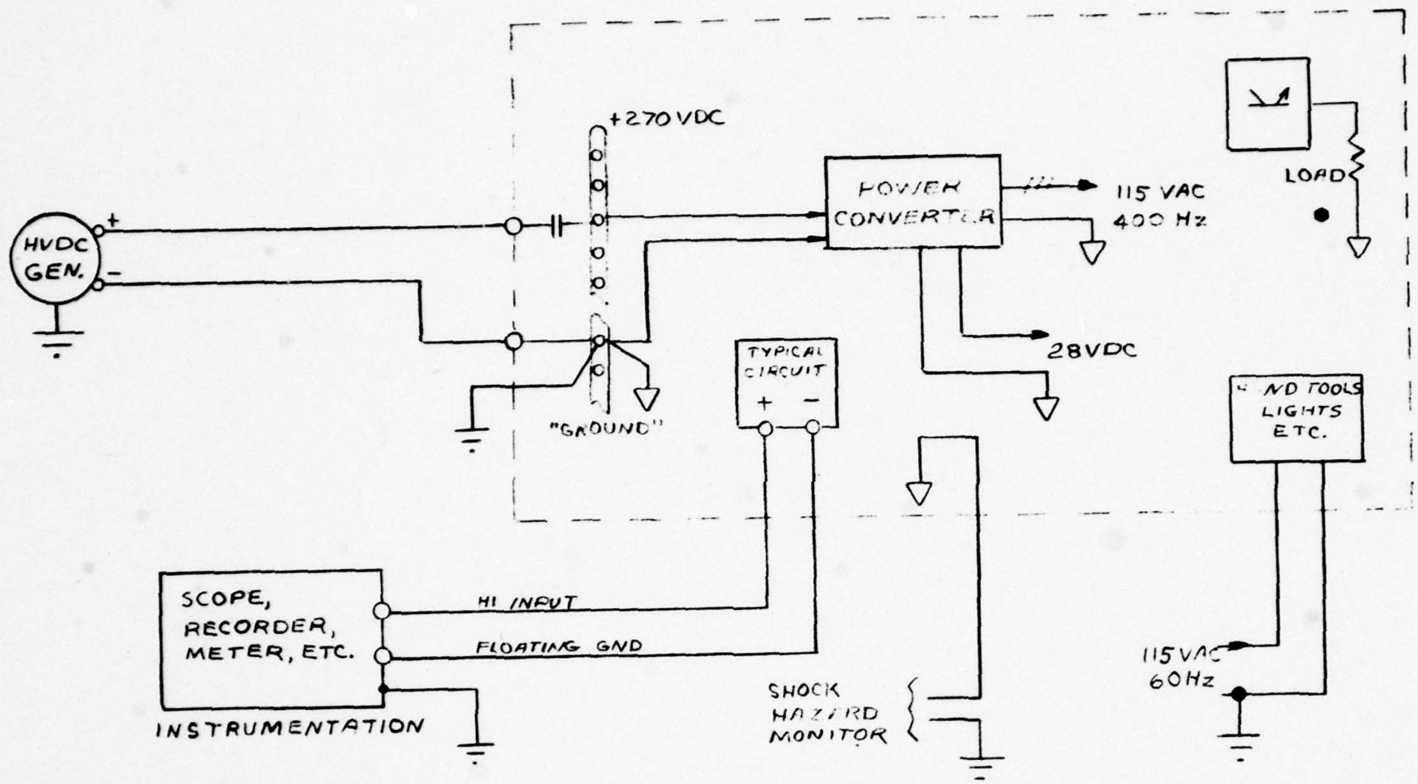
It is recommended that the PGS (270 VDC) power ground not be tied to the earth ground at the generator but at the earth ground point on the simulator. It is further recommended that the simulator structure not be used as the ground return for signal and HVDC power circuits. Instrumentation equipment should use a floating ground that is tied to the simulator common earth ground point with a sufficiently large conductor to minimize instrumentation error (based on instrumentation impedance circuit) . The instrumentation equipment enclosure(s) should be tied to earth ground for safety. The grounding concept and requirements are schematically depicted in Figure 16.

2.3.4 A-7 Engine Pad Requirements

An assessment was made concerning the mounting drive requirements for the HVDC generator for application on the A-7. Interface and performance requirements were established for TA-7C (TF30-P-408 Engine) and the A-7E (TF41-A-2 Engine). These requirements are contained in Appendix A. Additionally, data was obtained on a gear box which has the potential for being used for interfacing the HVDC generator to the A-7 pad. The candidate gear box will provide the approximate required speed range; however, availability and torque requirements were not fully established. The gear box was used in conjunction with the 20 KVA VSCF Generator, General Electric Model No. 2CM38 and is illustrated in Figure 17. Availability and full compliance to AAES TA-7C system requirements should be established upon solidifying of the Flight Test Program Plans.

2.4 System Control and I/O Interface Requirements

The control logic in the form of Boolean combinational and sequential equations was prepared in conjunction with design of the AAES TA-7C subsystems and circuits. The formats and form in which these control equations were prepared are discussed in the subsequent paragraphs. Examples of methods for implementing and solving these equations using a one-bit processor and a more general purpose type processor are also provided. In addition, techniques were established for accomplishing the signal source function in the absence of a full complement of ADM solid state devices. Simulated signal sources, signal adapters and general purpose signal source panels,and airframe signal sources are defined for these purposes. Special purpose power output switches and lamp driver circuits are used for achieving the required interface between the demultiplexer and various aircraft "low power" loads. These devices and applications are described in the following paragraphs.

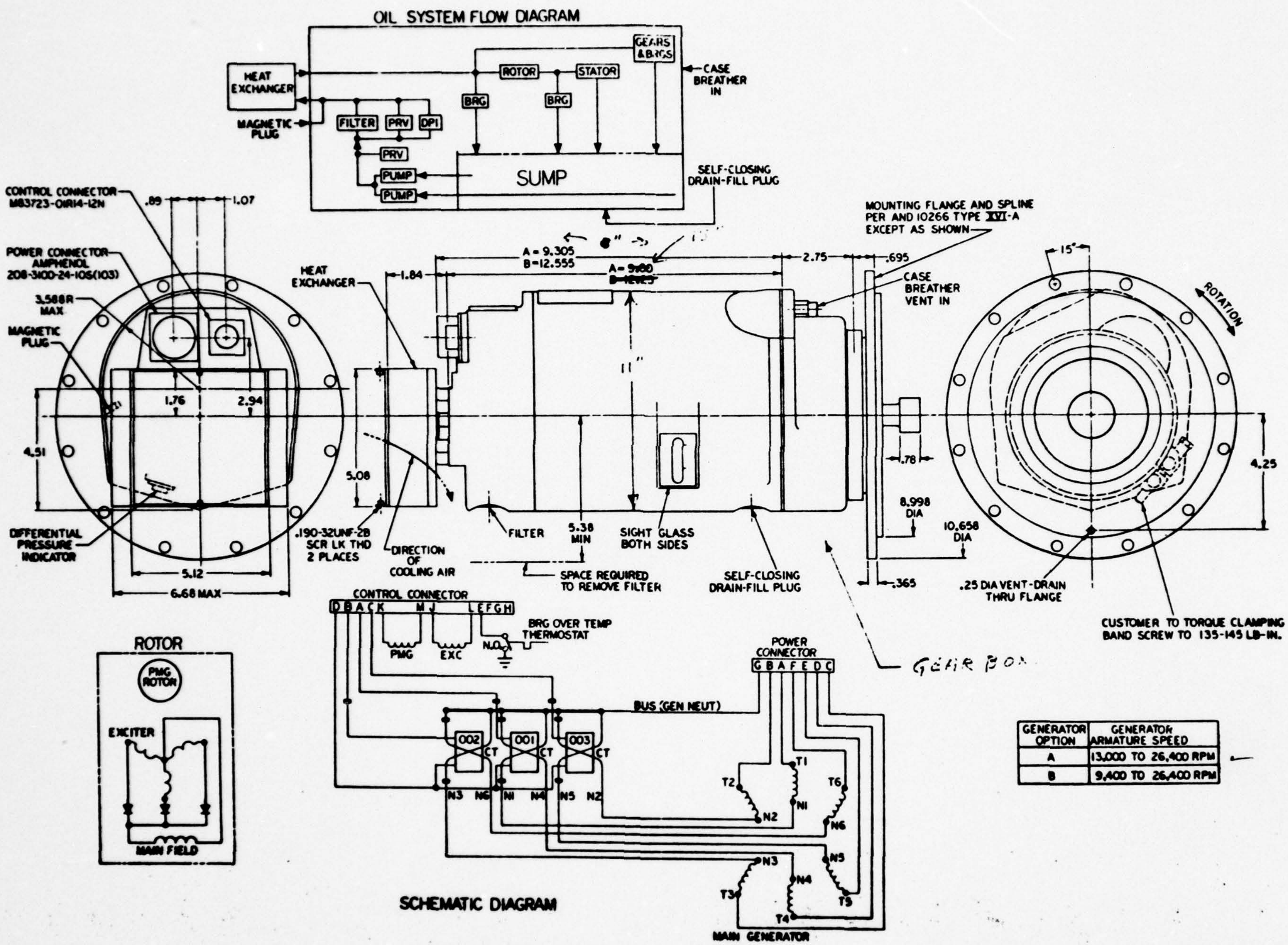


⏚ Earth Ground

▽ Simulator Ground (Structure)

● Structure Return vs Conductor Ground Return to be Established on Circuit by Circuit Basis.

FIGURE 16 - SIMULATOR GROUNDING REQUIREMENTS



GENERATOR OPTION	GENERATOR ARMATURE SPEED
A	13,000 TO 26,400 RPM
B	9,400 TO 26,400 RPM

FIGURE 17 - 20KVA VSCF GENERATOR (MODEL NO. 2CM381)

GEZ-5206A-2

TABLE 3
AAES SIMULATOR TYPICAL CONTROL EQUATIONS

SIMULATOR SUBSYSTEM	CONTROL EQUATIONS	
	PRESENT FORMAT	GARRETT FORMAT
<u>83-80330-N2</u> EMERGENCY ACCUMULATOR TEST	MMLAPT = (0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,N), Z1270/ Z1250 = DHSACP/ MMLADP = (0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,N),Z1271/ Z1271 = DHSACD * "(PASDC1 + PASDC2)"/ MMLFIC = Z1272/ Z1272 = MMSISO + LCSFLT/ MMLAIC = Z1273/ Z1273 = MMSISO + LCSALT/	MMLAPT = DHSACP, M(N000000000000000)/ MMLADP = DHGACD * -(PASDC1 + PASOC2), M(N000000000000000)/ MMLFIC = MMSISO + LCSFLT/ MMLAIC = MMSISO + LCSALT/
<u>83-80330-N2</u> LIQUID OXYGEN GAGING	WHLFLO = (N,N,N,0,N,N,0,N,N,0,N,N,N,N,0,N), Z1294/ Z1294 = WHSFPR + WHSLOX + LCSFLT/ WHLALO = (N,N,N,0,N,N,0,N,N,0,N,N,N,N,0,N), Z1295/ Z1295 = WHSAPR + WHSLOX + LCSALT/ WHLFWR = (1,1,1,0,1,1,0,1,1,0,1,1,1,1,0,1)/	WHLFLO = WHSFPR + WHSLOX + LCSFLT, M(NONNNNONNONNONNN)/ WHLALO = WHSAPR + WHSLOX + LCSALT, M(NONNNNONNONNONNN)/ WHLFWR = M(1011110110110111)/
<u>83-80330-F20</u> COMMAND TRANSFER - AUTO CARRIER LANDING	FWLFAY = (N,0,0,0,N,N,0,0,0,0,0,0,0,0,0,N), Z1006/ Z1006 = YACSEL * "LCSFLT" + "YACSEL" * LCSFLT/ YACSEL = (YACLFW + YACLAF) * "YACSEL" + "(YACLFW + YACLAF)" * YACSEL/ YACLFW = FWSFAC * "YACF"/ YACLAF = FWSAAC * "YACA"/ T1(1), YACF = FWSFAC / T1(1), YACA = FWSAAC /	FWLFAY = YACSEL * -LCSFLT + -YACSEL * LCSFLT, M(N000000000NN000N)/ YACSEL = (YACLFW + YACLAF) * -YACSEL + -(YACLFW + YACLAF) * YACSEL/ YACLFW = FWSFAC * -YACF/ YACLAF = FWSAAC * -YACA/ YACF = FWSFAC, T:1(0.01)/ YACA = FWSAAC, T:1(0.01)/

2.4.1 System Control Equations

The control requirements were developed for each of the TA-7C subsystems designed for the AAES Simulator. This design information was prepared on keypunch coding forms. Table 3 contains typical Boolean equations which are used for control of the AAES TA-7C Simulator subsystems and circuits. Shown in the table are the form of the equations as currently written and the format to which they will be modified on the Full Simulator Development Contract. The change in format is required for achieving compatibility with the SCG hardware currently under development by the Garrett Corporation. Upon being updated to the required format and checked for completeness/correctness, the equations will be key-punched for listing. Both the listings and punched cards will be delivered on the Full Simulator Development contract. The basic control equations will also be shown on the wiring diagram drawings which are described in paragraph 2.2.

In addition to the basic system control equations SCG modifier equations were prepared for providing the load management control capability. These are also written on key-punch coding forms. These, like the basic Boolean control equations, will be revised to the Powertran format required by the SCG ADM hardware and key-punched. Listings will be prepared and the punched cards delivered under the Full Simulator Development contract.

Since four different (nonsimultaneous) checkout groups will be used to verify operation of all simulator subsystems, four separate sets of software are used for the SCG processor. In addition, one processor software set is used for the full-up simulator configuration. In that the basic Boolean equation for any specific load does not change between checkout groups (or full-up configuration), the difference between the five software sets is:

a) the correlation between SCG terminal channels and input/output variable names, and
b) activation or use of the applicable Boolean equations of the full complement.

The software "interface" data to be delivered with the simulator basically consists of the Boolean equations, equation modifiers, terminal bus address assignments and terminal channel assignments. This data will allow compilation of the operational software for the SCG processors using the POWERTRAN programming language. The control data to be delivered with the simulator will also define:

a) the applicable checkout groups for each Boolean equation and equation modifier,
b) the variable name assigned to each terminal channel for each of the four checkout groups; and
c) the terminal bus address assignment for each checkout group.

It is noted that definition of terminal bus addresses and channel assignments for the full-up configuration cannot be completed until the final configuration and procured quantities of the SCG hardware are defined. Specifically, the SCG configuration variations yet to be fully established are the universal terminal concept versus the present dedicated multiplex or demultiplex terminal concept and subsequently the mix of dedicated multiplex, demultiplex, and multiplex/demultiplex terminals versus universal terminals.

As a means for more specifically establishing the computational capability and memory requirements needed by the SCG Processor for solving combinational/sequential logic control equations an analysis was conducted. The Z80 instruction set and the ICU one bit processor instruction set were compared for two different approaches for solving a typical sequential logic problem. These two approaches are: (1) a flow chart implementation and (2) a Boolean next state equation implementation.. The flow chart method proved to be the most efficient approach for solving the sequential logic problem for both processor instruction set implementations as is illustrated in Table 4.

TABLE 4

SUMMARY OF MEMORY REQUIREMENTS AND EXECUTION TIMES FOR SEQUENTIAL EQUATION SOLUTION

	FLOW CHART METHOD		BOOLEAN EQUATION METHOD	
	MEMORY (BITS)	EXECUTION TIME μs	MEMORY (BITS)	EXECUTION TIME μs
Z80	496	34-70	1280	112-150
ICU	360	20	450	25

The memory requirements are given in terms of total bits since the word length is not the same for the Z80 and ICU. The Z80 memory is organized as an 8 bit byte, however, the ICU would be organized as an 18 bit word.

The ICU one bit processor proved to be much more efficient in terms of memory required and execution time; 20 microseconds execution time compared to 34 to 70 microseconds for the Z80, and 360 bits compared to 496 bits for the Z80 memory. There was even greater improvement in the ICU over the Z80 for the Boolean equation approach; 25 microseconds compared to 112 to 150 microseconds for the Z80, and 450 bits compared to 1280 bits of memory for the Z80.

It is noted that the Boolean equation approach requires six temporary scratch pad locations for implementation of software flip-flops and partial results. Only one temporary memory location was used in the flow diagram approach.

If a microprocessor is used for equation solutions, it is recommended that a one bit processor be used or an optimized Boolean solution instruction set be micro coded in a general processor for solving Boolean equations whether combinational or sequential.

In solving sequential Boolean equations, the flow chart approach proved to be more efficient than the Boolean logic method (20 words and 20 microseconds versus 25 words and 25 microseconds, respectively). This approach although more efficient, differs from the current equation solution approach where the computer compiler program takes the control equations and automatically generates the equation solution instructions. If the flow diagram approach is used, the flow diagram must be made for each sequential function and the program coded based on the flow diagram. A new compiler program could be written to do the compiling of the sequential equation functions based on the flow diagram algorithms, however, because of the limited number of sequential equations, the cost of this compiler would be difficult to justify. Standard combinational logic equations are generally solved as simply using the Boolean equation flow approach as compared to the flow chart method.

Sequential equations are basically ones that depend on memory elements. The memory elements can be provided by the scratch pad memory. Since the SCG specification requires a capability for 20 percent of the equations to be sequential with or without time delays, and one memory element per equation is assumed, then the processor requires about 200 locations in the scratch pad memory for the sequential circuits. When the requirement for time delays, partial solution to combinational logic, etc., are added, the processor scratch pad memory requirement is about 500 bits.

2.4.1.1 Sequential Circuit Implementation Example

The Automatic Carrier Landing System (ACLS) in the two-place TA-7C is controlled by either the Forward or Aft control panels. A push button switch is provided in both cockpits for alternately selecting either the Forward or Aft control panel for control of the Automatic Carrier Landing System. Each push button switch may be used to select or de-select control of the ACLS. Control is always given to either the Forward or Aft control panels. The push button switch is used to toggle this control from forward to aft or vise versa. Transfer of control is not allowed until the command - transfer pushbutton switch is released after having been activated.

The input and output variables for the sequential logic problem are defined below.

FWSFAC - Forward ACLS Command Transfer Switch
FWSAAC - Aft ACLS Command Transfer Switch
YACSEL - ACLS Control - Cockpit Select Transfer Command

The flow chart for the sequential circuit is shown in Table 5. Note that dummy variables FLG1 and FLG2 are used for implementing the sequential function. FLG1 is used to remember that FWSFAC has been activated. The transfer of control is initiated only after FWSFAC is deactivated provided that FLG1 was previously set by having activated FWSFAC. FLG2 serves the same purpose as FLG1 for the FWSAAC AFT ACLS command transfer switch.

Programming of this flow diagram for the Z80 microcomputer is shown in Table 5a, and for the 1-bit ICU processor in Table 5b.

The programming with the Z80 instruction set makes use of the bit set, reset and bit test instructions for an eight bit byte while the ICU instruction set addresses each bit directly. Note that the ICU has a unique output enable (OEN) instruction which disables output store commands if the output enable variable is false. This enables the ICU to efficiently implement flow diagrams without branch on condition instructions.

The Boolean equation approach for the sequential circuit design is shown in Table 6. The equations, when implemented with software, perform the same seq ential logic function as the flow diagram described previously.

Dummy variables FLG1, FLG2, S1, S2, and R1, R2 are used to control the sequential operation. The FLG1 and FLG2 equations are RS flip-flops which remember that the command transfer switches (FWSFAC and FWSAAC) have been activated. Equations S1 and S2 are partial solutions used in the toggle flip-flop equation YACSEL. Variables R1 and R2 are used to reset the FLG1 and FLG2 RS flip-flops after the command transfer switches have been released and control transfer has been completed.

TABLE 5

FLOW CHART SOLUTION
FOR SEQUENTIAL CIRCUIT

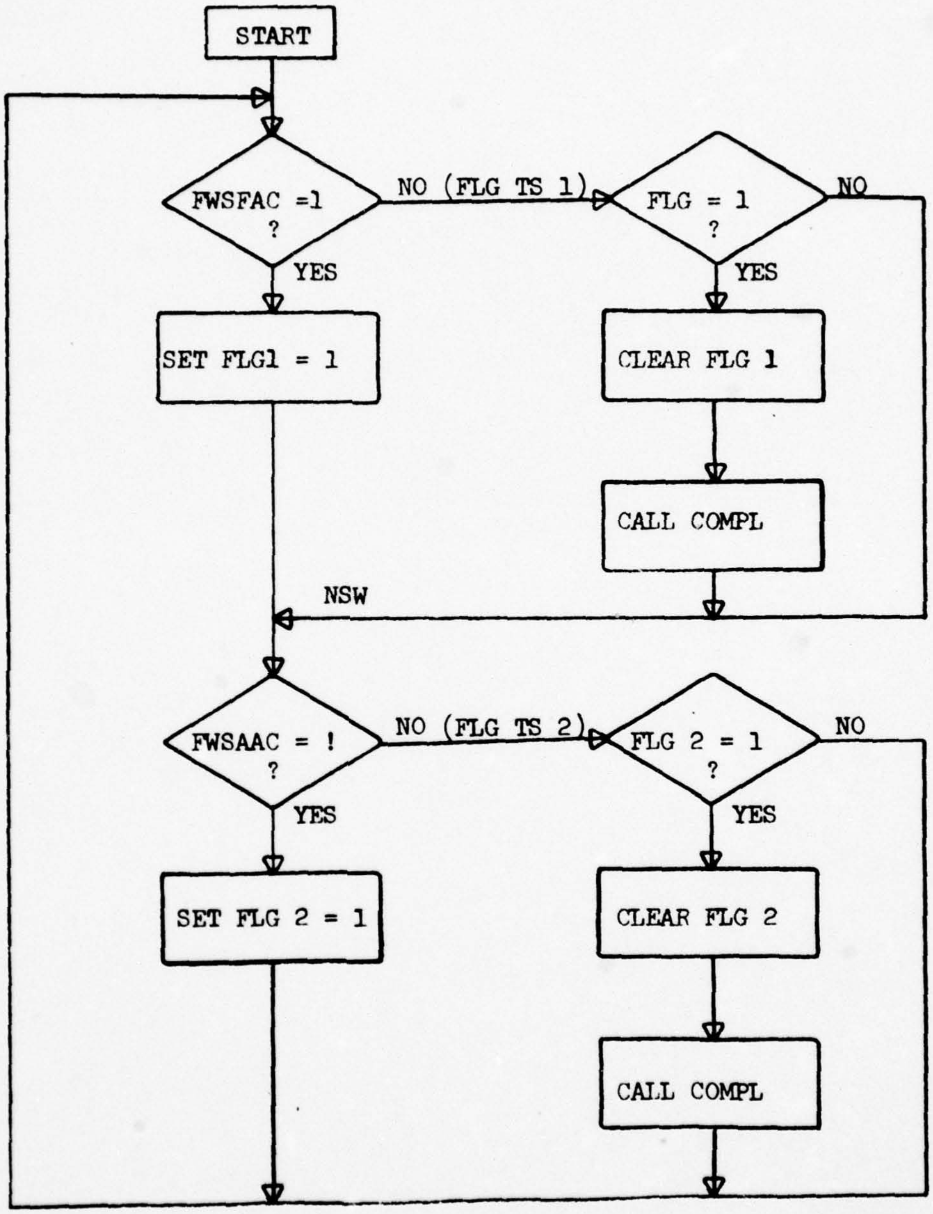


TABLE 5
(Continued)

FLOW CHART SOLUTION
FOR SEQUENTIAL CIRCUIT

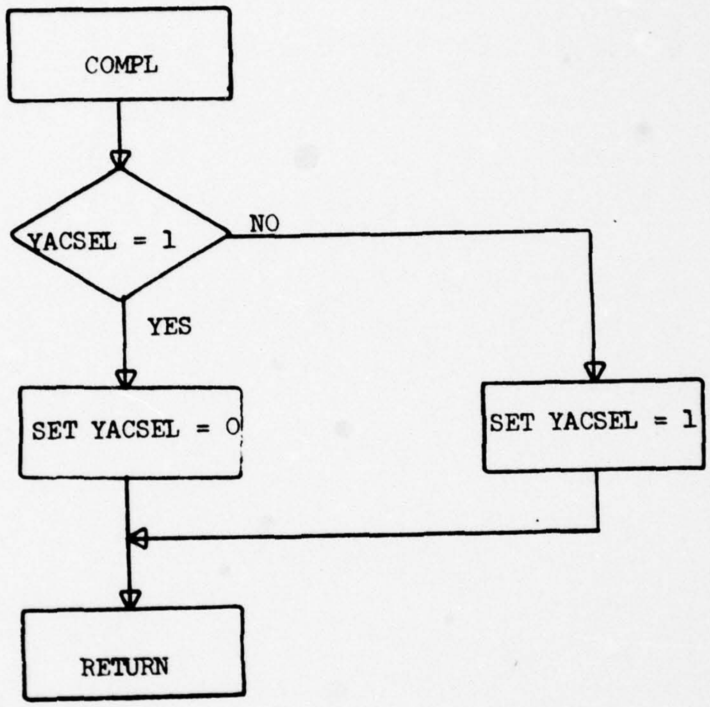


TABLE 5a

FLOW CHART SOLUTION USING
Z80 INSTRUCTION SET

```
                        ┌─ BIT ADDR ─┐
BYTE                    ↓            ↓                                                    T
ADDR.                   | 7 |  BYTE  | 0 |                                     BYTES/STATES

START          LD A, (STATUS)              ;  Get status byte                      3/13
               LD HL, DABYTI               ;  Get SW1 Byte Address                 3/16
               BIT FWSFAC, (HL)            ;  Is FWSFAC on?                        2/12
               JR Z, FLGTS1                ;  Jump if no                           2/7
               SET FLG1, A                 ;  Set FLG1 in status byte              2/8
               JR NSW                      ;  Jump to next switch                  2/12

FLGTS1         BIT FLG1, A                 ;  FLG1 Bit Set?                        2/8
               JR Z, NSW                   ;  Jump if no                           2/7
(28 Total Instructions
               RES, FLG1, A                ;  Clear FLG1                           2/8
 for Sequential Circuit)
               CALL COMPL                  ;  Complement control bit               3/17

NSW            LD HL, DABYTZ               ;  Get SW2 byte address                 3/16
               BIT FWSAAC, (HL)            ;  Is FWSAAC on?                        2/12
               JR Z, FLGTS2                ;  Jump if no                           2/7
               SET FLG2, A                 ;  Set FLG2 in status word              2/8

SAVE:          LD (STATUS), A              ;  Save status word                     3/13
               JR START                    ;  Repeat                               2/12

FLGTS2         BIT FLG2, A                 ;  FLG2 bit set?                        2/8
               JR Z, SAVE                  ;  Jump if no                           2/7
               RES FLG2, A                 ;  Clear FLG2                           2/8
               CALL COMPL                  ;  Complement Bit control               3/17
               JR SAVE                     ;  Return                               2/12

COMPL          LD HL, OUTBYT 1             ;  Get contl bit byte address           3/16
               BIT YACSEL, (HL)            ;  Is bit set?                          2/12
               JR Z SET                    ;  Jump if no                           2/7
               RES YACSEL, (HL)            ;  Clear contl bit                      2/8
               RET                                                                 1/10

SET            SET YACSEL, (HL)            ;  Set contl bit                        2/15
               RET                                                                 1/10

STATUS         DEFB 1                      ;  Flag byte location                   1/0
DABYT1         EQU ADDSW1                  ;  Address of byte containing SW1
FWSFAC         EQU BITSW1                  ;  Bit containing FWSFAC
FLG1           EQU 0                       ;  Bit 0 equal FLG1
FLG2           EQU 1                       ;  Bit 1 equal FLG2
DABYT2         EQU ADDSW2                  ;  Address of byte containing SW2
FWSAAC         EQU BITSW2                  ;  Bit containing FWSAAC
OUTBYT1        EQU ADDCTL                  ;  Address of byte containing YACSEL
YACSEL         EQU BITCTL                  ;  Bit containing YACSEL Function .
```

TABLE 5a
(Continued)

FLOW CHART SOLUTION USING
Z80 INSTRUCTION SET

Assumptions made for this program:

1. Input variables FWSFAC and FWSAAC are bits located in ITRAM, but not in same byte.

2. Output function YACSEL is a bit in the ORAM.

3. FLG1 and FLG2 bits are located in the same status byte in temporary RAM.

4. T State = 1 clock cycle = 0.25 μsec

TOTAL MEMORY = 62 BYTES

Longest exec time = (281 x 0.25) = 70.25 μs

Shortest exec time = (136 x 0.25) = 34 μs

TABLE 5b

FLOW CHART SOLUTION USING
ICU ONE BIT PROCESSOR INSTRUCTION SET

```
START    LD FWSFAC        ;  Load FWSFAC
         STOC TEMP        ;  Save FWSFAC
         OEN RR           ;  Enable output 1F RR = 1
         STO FLG1
         LD TEMP          ;  Load FWSFAC
         AND FLG1         ;  And FLG1
         OEN RR           ;  Enable output if RR = 1
         STOC FLG1
         LD YACSEL        ;  Load YACSEL
         STOC YACSEL      ;  Complement YACSEL
         LD FWSAAC        ;  Load FWSAAC
         STOC TEMP        ;  Save FWSAAC
         OEN RR           ;  Enable output if RR = 1
         STO FLG2
         LD TEMP          ;  Load FWSAAC
         AND FLG2         ;  And FLG2
         OEN RR           ;  Enable output if RR = 1
         STOC FLAG2
         LD YACSEL        ;  Load YACSEL
         STOC YACSEL      ;  Complement YACSEL
         JMP START
```

Total Memory = 20 Words

Execution Time = 20 μs

18 bit words for
16K bit address field and
4 bit OPT code

TABLE 6

BOOLEAN EQUATION SOLUTION FOR SEQUENTIAL CIRCUIT

$$\mathrm{FLG1} = \mathrm{FWSFAC} + \overline{\mathrm{R1}} * \mathrm{FLG1}$$

$$\mathrm{FLG2} = \mathrm{FWSAAC} + \overline{\mathrm{R2}} * \mathrm{FLG2}$$

$$\mathrm{S1} = \mathrm{FLG1} * \overline{\mathrm{FWSFAC}}$$

$$\mathrm{S2} = \mathrm{FLG2} * \overline{\mathrm{FWSAAC}}$$

$$\mathrm{YACSEL} = (\mathrm{S1} + \mathrm{S2}) * \overline{\mathrm{YACSEL}} + \overline{(\mathrm{S1} + \mathrm{S2})} * \mathrm{YACSEL}$$

$$\mathrm{R1} = \overline{\mathrm{FWSFAC}}$$

$$\mathrm{R2} = \overline{\mathrm{FWSAAC}}$$

TABLE 6a

BOOLEAN EQUATION SOLUTION USING
Z80 INSTRUCTION SET

					T BYTES/STATES
	START	LD A, (STATUS)	;	Get status	3/13
		LD HL, DATBYT1	;	Get byte addr.	3/16
		BIT FWSFAC, (HL)	;	Is FWSFAC on?	2/12
		JR Z, NXT1	;	Jump if no	2/7
	SET1	SET FLG1, A	;	Set FLG1	2/8
(a)	OUT1	LD (STATUS), A	;	Save status	3/13
FLG1		JR FLG2EQ	;	Solve next equation	2/12
(14 instructions)	NXT1	BIT R1, A	;	Is R1 set?	2/8
		JR NZ, ZRO1	;	Jump if yes	2/7
EXEC TIME		BIT FLG1, A	;	Is FLG1 set?	2/8
=		JR Z, ZRO1	;	Jump if no	2/7
20.25 -		JR SET1	;	Set FLG1	2/12
27.7 μs	ZRO1	RES FLG1, A	;	Clear FLG1	2/8
		JR OUT1	;	Save status and return	2/12
	FLG2EQ	LD HL, DATBYT2	;	Get byte addr.	3/16
		BIT FWSAAC, (HL)	;	Is FWSAAC set?	2/12
		JR. Z, NXT2	;	Jump if no	2/7
	SET2	SET FLG2, A	;	Set FLG2	2/8
	OUT2	LD (STATUS), A	;	Save status	3/13
FLG2		JR S2EQ	;	Solve next equation	2/12
(13 instructions)	NXT2	BIT R2, A	;	Test R2	2/8
		JR NZ, ZRO2	;	Jump if not zero	2/12
EXEC TIME		BIT FIG2, A	;	Test FLG2	2/8
=		JR Z, ZRO2	;	Jump if zero	2/7
17 -		JR SET 2,	;	Set FLG2	2/12
28.75 μs	ZRO2	RES FLG2, A	;	Clear FLG2	2/8
		JR OUT2	;	Save and return	2/12
	S2EQ	BIT FLG2, A	;	Test FLG2	2/8
S2		JR Z, ZRO3	;	Jump if zero	2/7
(9 instructions)		BIT FWSAAC, (HL)	;	Test FWSAAC	2/12
EXEC TIME		JR NZ, ZRO3	;	Jump if not zero	2/7
=		SET S2, A	;	Set S2	2/8
15 -	OUT3	LD (STATUS), A	;	Save status and	3/13
16.75 μs		JR S1EQ	;	Next Equation	2/12
	ZRO3	RES S2, A	;	Zero answer	2/8
		JR OUT3	;		2/12
	S1EQ	BIT FLG1, A	;	Test FLG1	2/8
S1		JR Z, ZRO4	;	Jump if zero	2/7
(10 instructions)		LD HL, DATBYT1	;	Get Byte address	3/16
		BIT FWSFAC, (HL)	;	Is FWSFAC on?	2/12
EXEC TIME		JR NZ, ZRO4	;	Jump if on	2/7
=		SET S1, A	;	One answer	2/8
15 -	OUT4	LD (STATUS), A	;	Save status	3/13
23.75 μs		JR YACEQ	;	Next equation	2/12
	ZRO4	RES S1, A	;	Zero answer	2/9
		JR OUT4	;		2/12

TABLE 6a
(Continued)

BOOLEAN EQUATION SOLUTION USING
Z80 INSTRUCTION SET

YACSEL
(14 instructions)

EXEC TIME
=
21.25 -
27.5 μs

```
                                                                     T
                                                               BYTES/STATES
YACEQ     LD HL, OUTBYT1       ;  Get byte address                  3/16
          BIT YACSEL, (HL)     ;  Is YACSEL set?                    2/12
          JR Z, NXT3           ;  Jump if no                        2/7
          BIT S1, A            ;  Test S1                           2/8
          JR NZ, NXT3          ;  Jump if not zero                  2/7
          BIT S2, A            ;  Is S2 set?                        2/8
          JR NZ, NXT3          ;  Jump if yes                       2/7
OUT5      SET YACSEL, (HL)     ;  Set ORAM Bit                      2/8
          JR EQR1              ;  Next equation                     2/12
NXT3      BIT S1, A            ;  Is S1 set?                        2/8
          JR NZ, OUT5          ;  Jump if yes                       2/7
          BIT S2, A            ;  Is S2 set?                        2/8
          JR NZ, OUT5          ;  Jump if yes                       2/7
          RES YACSEL, (HL)     ;  Clear ORAM Bit                    2/15
```

R1
(6 instructions)
EXEC TIME
=
12.75 μs
9.75 μs

```
EQR1      LD HL, DATBYT1       ;  Get byte address                  3/16
          BIT FWSFAC, (HL)     ;  Test FWSFAC                       2/8
          JR NZ, ZRO5          ;  Jump if not zero                  2/7
          SET R1, A            ;  Set R1                            2/8
          JR EQ R2             ;  Next equation                     2/12
ZRO5      RES R1, A            ;  Clear R1                          2/8
```

```
EQR2      LD HL, DATBYT2       ;  Get byte address                  3/16
          BIT FWSAAC, (HL)     ;  Test FWSAAC                       2/12
          JR NZ, ZRO6          ;  Jump if set                       2/7
          SET R2, A            ;  Set R2                            2/8
          JP START             ;  Repeat                            3/10
ZRO6      RES R2, A            ;  Clear R2                          2/8
          JP START             ;  Repeat                            3/10

STATUS    DEFB 0               ;  Status location                   1/0
DATBYT1   EQU ADDSW1           ;  Address of byte containing SW1
FWSFAC    EQU BITSW1           ;  Bit containing FWSFAC
FLG1      EQU 1                ;  Bit 1
FLG2      EQU 2                ;  Bit 2
S1        EQU 3
S2        EQU 4
R1        EQU 5
R2        EQU 6
YACSEL    EQU BITCTL           ;  Bit in ORAM for contl func.
OUTBYT1   EQU ADDCTL           ;  Address of byte containing YACSEL
DATBYT2   EQU ADDSW2
```

TOTAL BYTES = 160 BYTES

Longest Exec time = 150.45 μs
Shortest Exec time = 111.5 μs

TABLE 6b

BOOLEAN EQUATION SOLUTION USING MOTOROLA ICU ONE-BIT PROCESSOR

FLG1	START	LDC R1	;	Load Complement R1
4 instructions		AND FLG1	;	and FLG1
ET = 4 μs		OR FWSFAC	;	Or FWSFAC
		STO FLG1	;	Store in FLG1
FLG2		LDC R2	;	Load complement R2
4 instructions		AND FLG2	;	And with FLG2
ET = 4 μs		OR FWSAAC	;	Or with FWSAAC
		STO FLG2	;	Store in FLG2
S1		LDC FWSFAC	:	Load Complement FWSFAC
3 instructions		AND FLG1	;	And with FLG1
ET = 3 μs		STO S1	;	Store in S1
S2		LDC FWSAAC	;	Load complement FWSAAC
31 instructions		AND FLG2	;	And with FLG2
ET = 3 μs		STO S2	;	Store in S2
YACSEL		LD S1	;	Load S1
6 instructions		OR S2	;	Or with S2
ET = 6 μs		STO TEM	;	Store in tem
		LD YACSEL	;	Load YACSEL
		XNOR TEM	;	Exclusive or with YACSEL
		STO YACSEL	;	Store in YACSEL
R1		LDC FWSFAC	;	Load complement FWSFAC
2 instructions		STO R1	;	Store in R1
ET = 2 μs				
R2		LDC FWSAAC	;	Load complement FWSAAC
3 instructions		STO R1	;	Store in R1
ET = 3 μs		JMP START	;	Repeat

TOTAL MEMORY = 25 WORDS

EXECUTION TIME = 25 μs

2.4.2 Signal Source Implementation Methods

A wide variety of signal source types and installation designs are used in the TA-7C. As identified in Table 7, several design alternatives exist for the AAES signal source implementation. These include replacement of the conventional switch function with a solid state signal source, adding resistors to the existing contact type switch to provide the signal source function, and using external signal conditioning. The advantages and disadvantages of each design approach are listed in Table 7. The use of solid state transducers are preferred. However, due to the limited quantities of signal sources and also because of retrofit difficulty in some equipments, either the simulated signal source or external conditioning approaches are used. Retrofit difficulty is typically a result of unique switch physical configuration or inaccessibility of the switch, i.e., in an actuator, avionic subsystem, etc. Figure 18 is representative of both of these cases. Table 8 provides a summary of the switch types needed for this representative application and the implementation alternatives.

Because of the limited types, quantities and initial inavailability of ADM signal sources being procured for the simulator, simulated signals sources and "existing switches" buffered with signal conditioning circuits will be used on the simulator. The evolved system designs described in paragraph 2.2 are based on using these methods to achieve a "full-up" implementation of signal sources in the simulator. A total of 152 signal sources consisting of 5 types are used in the simulator system.

2.4.2.1 General Purpose Signal Source Panels

The transducers associated with airframe actuated functions cannot feasibly be implemented on the simulator. Typical of these functions are landing gear and control surface position sensing transducers. The simulator design uses toggle and rotary signal sources mounted on three special purpose panels to provide the input signals to the SCG for these type functions. This allows representative system operation without the need for the large, complex and costly mechanization of the moving surfaces and pressurized fluid subsystems. However, the general purpose panels are minimally used since their application is restricted to functions which are not an integral part of the simulator.

2.4.2.2 Signal Conditioners

Signal conditioner cards were defined for achieving compatibility between the SCG and signals eminating from various avionic "black boxes". The subsystem and circuit designs were developed based on use of five signal conditioner assemblies. A total of 137 conditioner channels consisting of five types of conditioners are required for the "full-up" simulator. The system design and adapter harness assemblies are based on a full set of signal conditioners and simulated signal sources being supplied with the simulator. Thus, the only factor which requires use of the modular concept (in the input control area) is the reduced quantity of multiplex terminals needed for simultaneous operation of all simulator subsystems. Use of the signal conditioners in conjunction with the modular concept is depicted in Figure 19.

TABLE 7

COMPARISON OF CONVERSION APPROACHES

APPROACH	ADVANTAGE	DISADVANTAGE
REPLACE WITH SOLID STATE TRANSDUCER	o BIT UP TO (& INCLUDING) SIGNAL SOURCE o REPRESENTATIVE OF FUTURE IMPLEMENTATION o AIRFRAME WIRING LESS COMPLEX o OVERALL SYSTEM MORE RELIABLE	o NON-STANDARD SIGNAL TRANSDUCERS o REWORK OF EQUIPMENT REQUIRED o HIGHEST INITIAL COST (RELATIVE COST = 50C) o REQUIRES EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION
ADD RESISTOR NETWORK INTO EQUIPMENT	o BIT UP TO EQUIPMENT o AIRFRAME WIRING LESS COMPLEX o USE EXISTING EM SWITCHES o AIRFRAME PART OF SYSTEM REPRESENTATIVE OF FUTURE IMPLEMENTATION	o REWORK OF EQUIPMENT REQUIRED o MEDIUM INITIAL COST (RELATIVE COST = 5C) o RELIABILITY IMPACT OF SWITCHING LOW LEVEL SIGNALS o REQUIRES EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION
USE EXTERNAL SIGNAL CONDITIONING	o LOW COST (RELATIVE COST = 1C) o USE EXISTING EQUIPMENT WITHOUT MODIFICATION o DOES NOT REQUIRE EQUIPMENT TO BE AVAILABLE DURING SIMULATOR CONSTRUCTION	o MORE COMPLEX AIRFRAME WIRING o LEAST RELIABLE o LIMITED BIT o NOT REPRESENTATIVE OF FUTURE IMPLEMENTATION

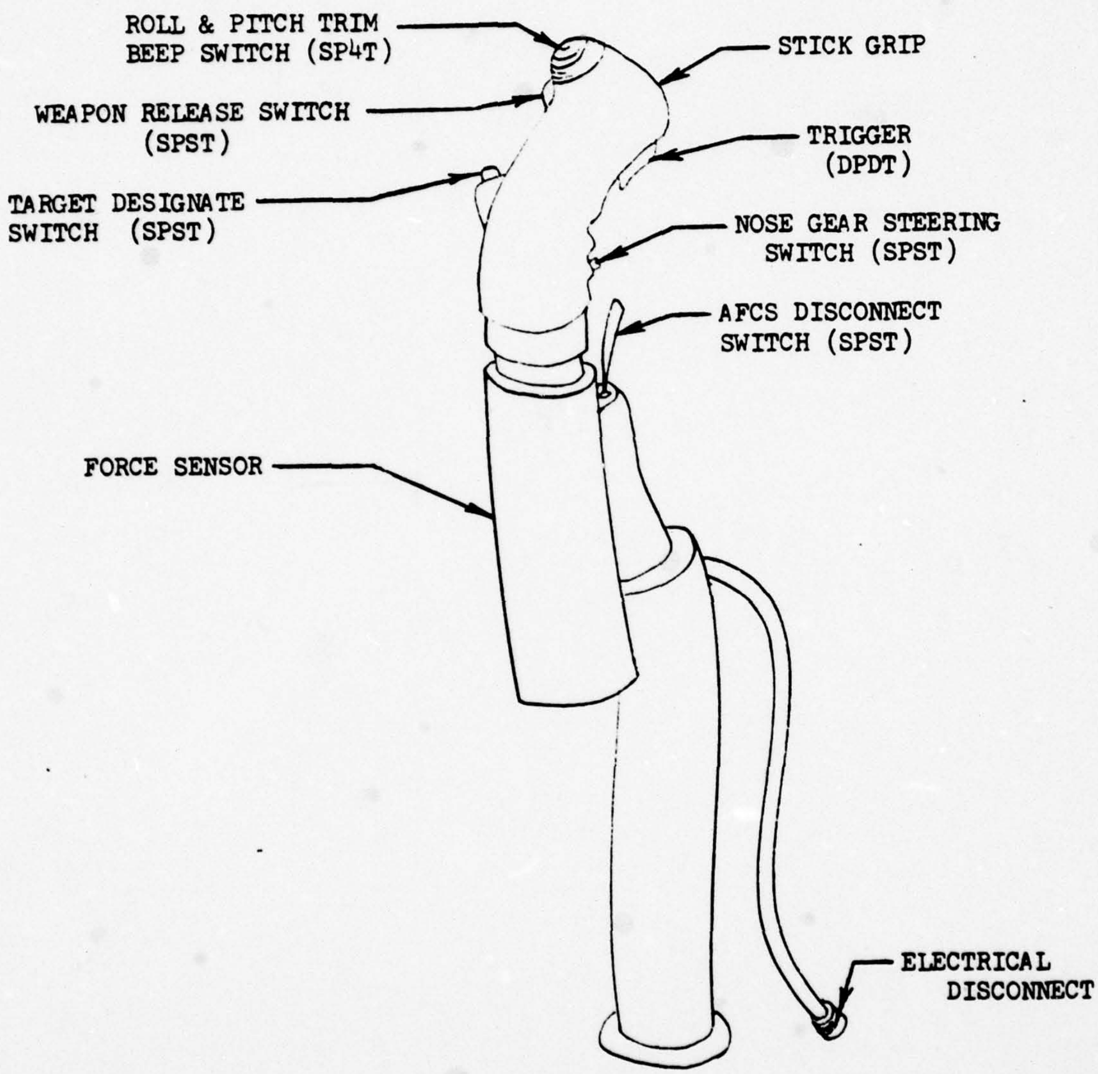


FIGURE 18

CONTROL STICK ASSEMBLY

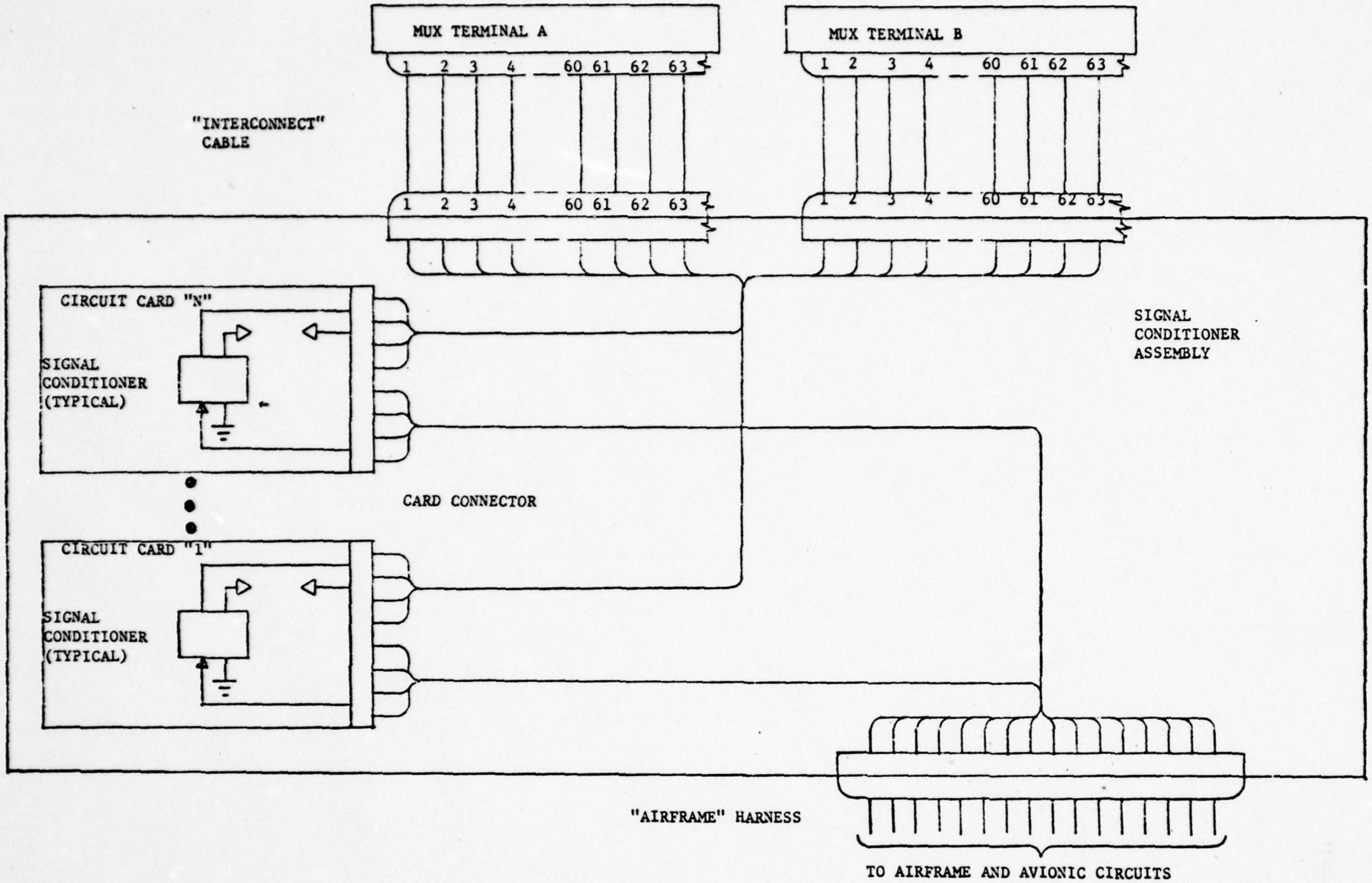
TABLE 8

SIGNAL SOURCE CONVERSION EXAMPLE

CONTROL STICK ASSEMBLY

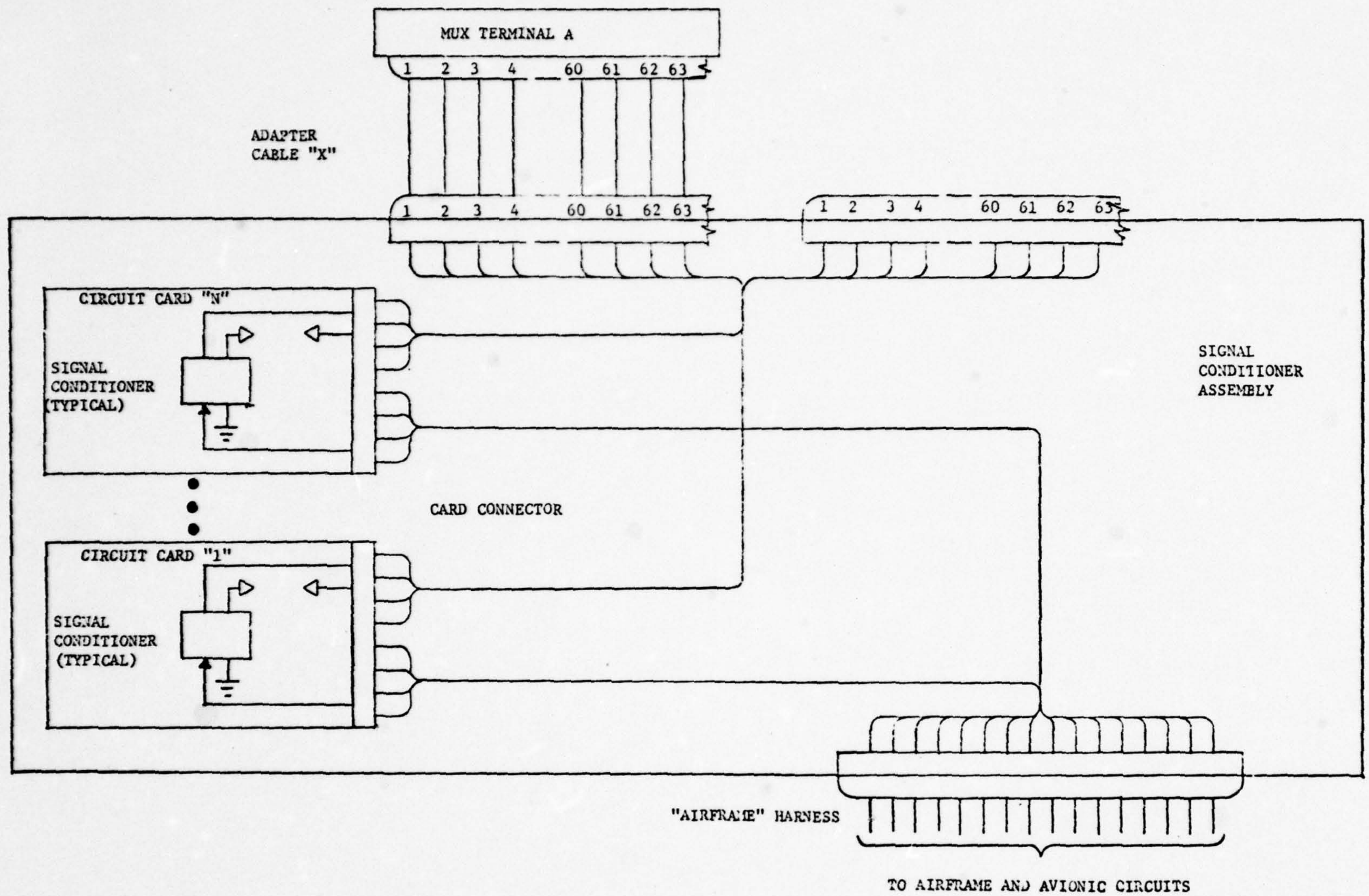
- SIGNAL SOURCES TO INTERFACE WITH AAES
  - ROLL & PITCH TRIM SWITCH (SP4T)
    (MS27708-3)
  - WEAPON RELEASE SWITCH (SPST)
    (MS25089-4AR)
  - TARGET DESIGNATE SWITCH (SPST)
    (MS25089-5AR)
  - NOSE GEAR STEERING ENABLE SWITCH (SPST)
    (MS25089-4AR)
  - TRIGGER SWITCH (DPDT)
    (SPECIAL)
  - AFCS DISCONNECT SWITCH (SPST)
    (SPECIAL)

- TECHNIQUES OF ADAPTION TO AAES
  - REPLACE EM SWITCH WITH SOLID STATE TRANSDUCER
  - ADD RESISTOR DIVIDER NETWORK IN STICK GRIP ASSEMBLY OR IN FORCE SENSOR
  - WIRE CONTROL STICK TO MUX TERMINAL VIA SIGNAL CONDITIONER CARD



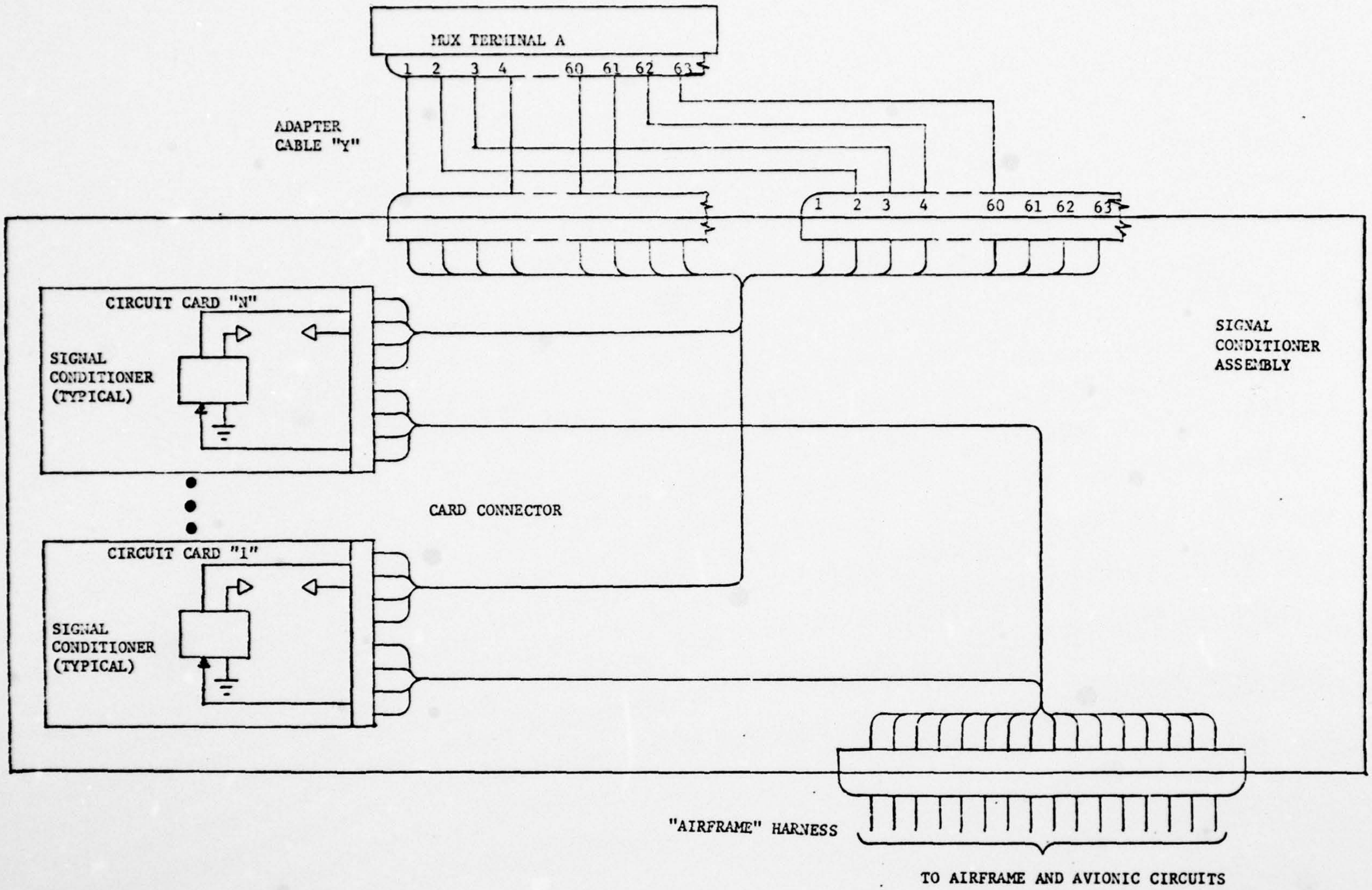
(a) FULL-UP SIMULATOR

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION



(b) CHECKOUT GROUP X

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION



(c) CHECKOUT GROUP Y

FIGURE 19 - SIGNAL CONDITIONER IMPLEMENTATION

Figure 19a depicts the signal conditioner interface with the multiplex terminals and airframe harnessing for a full-up simulator configuration. As shown in the figure, the airframe harness connects directly to the signal conditioner assembly. The multiplex terminals, however, connect to the signal conditioner assembly through an interconnect cable. The primary factors requiring use of the interconnect cable is that the multiplex terminals must interface both the signal conditioner assembly and airframe harnesses for access to signal transducers mounted in various assemblies. This airframe harness interface eliminates the ability to connect the signal conditioner assembly harness directly to the multiplex terminals.

For the simulator interim configuration, the multiplex terminal-to-signal conditioner interconnect cable will be replaced by a series of adapter cables which connect the limited multiplex terminal channels to selected signal conditioners. Figures 19-b and 19-c illustrate use of adapter harnesses for reassignment of the available multiplex terminal channels for two representative checkout groups. Thus, by using adapter cables between the multiplex terminals and signal conditioner assemblies, all AAES Simulator subsystems can be operated and evaluated with the limited number of SCG multiplex terminals. The full-up simulator configuration is achieved (in the input control area) by inserting the "full-up" interconnect harness.

2.4.3 Load Controllers

The load controllers cannot be feasibly simulated as could the signal sources. Therefore, the simulator system and wire harness designs are based on sharing the available quantities of load controllers. This design approach was discussed in paragraph 2.1 under the modular design concept. To achieve the full-up system (in the output power and control areas) requires that full quantities of controllers be installed in the LMCs and removal of the two adapter harness associated with each LMC. A total of 342 controllers are required for the full-up simulator, however, a total of only 200 controllers (28VDC, 270VDC, 26VAC, and 115VAC) are required with the modular concept.

2.4.3.1 Power Output Switches

Application of the modular concept to the low level power output switches is comparable to the implementation concept used for signal conditioners. In both cases sufficient low-level power output devices will be fabricated to service the full-up simulator configuration. The limitation forcing use of the modular implementation is the limited number of demultiplex terminals. However, since the power output card assemblies are installed within the LMCs, the modular implementation is the same as that used for load controllers in paragraph 2.1.

The circuit interconnection for the low level power output switches corresponds to that shown in Figure 2-b through 2-d except a full quantity of drivers are provided. The only hardware sharing required is for terminal channels. For this reason, conversion between checkout groups in the initial simulator configuration is accomplished by changing adapter cables between the LMC (low level power output devices) and the demultiplex terminals and between the LMC and "airframe" harness. Rework of the initial simulator to the full-up arrangement only requires removing the adapter cables associated with the LMC and reconnecting the associated SCG terminal, LMC and airframe harness connectors.

A quantity of 122 output drivers consisting of five basic types are used in the simulator design.

2.4.3.2 Solid State Lamp Drivers

The simulator system design is based on using a full set of lamp driver assemblies. The interconnect technique for the lamp drivers is the same as that used for the signal conditioning modules described in paragraph 2.4.2.2, Figures 19-a though 19-b. Conversion between the four checkout groups and the full-up simulator is achieved through interchanging the adapter harnesses. A total of 265 lamp drivers consisting of 3 types are used in the simulator.

2.4.4 Simulator Equipment Utilization

In order to provide an overview of the equipment requirements for both the full-up and the interim modular implementations, summary tables were prepared, Tables 9 and 10. Table 9 lists the ADM hardware requirements. Shown are the quantities of hardware being procured for each device and rating. Also shown are the quantity of hardware for the full-up and modular arrangements. Since the modular arrangement contains four checkout groups, the quantity of hardware "active" during each group is shown. It is further noted that the full-up and interim quantity of SCG terminals is based on the ADM "types" of hardware. If Universal Terminals are used in transitioning to the full-up system, a total of 19 will be required. Also, in the area of signal sources, the simulator will be initially implemented with a full set of Vought furnished simulated signal sources. The table does not reflect requirements that may occur in order to fully accommodate integration of the AAS (Advanced Armament System) capability.

Table 10 identifies the quantity of supplementary hardware required for the simulator. The supplementary equipment consists of the signal conditioners (5 types as shown), power output switches (5 types as shown), lamp drivers (3 types as shown) and the adapter cables. Since Vought is to supply a full-up set of the supplementary equipment items, the full-up and modular implementation quantities are the same. Since in most of the simulator system areas, the full-up arrangement is derived by removing adapter cables and connecting up the basic system wire harness connectors, only 6 interconnect harnesses are required for the full-up implementation.

Appendix B contains the list of GFE required for the simulator. Table B-1 is the baseline GFE recommended for inclusion on the simulator. These GFE items will allow checkout and evaluation of the systems and circuits which can be operated in a meaningful manner. Table B-2 contains a list of additional GFE that is relevant to the TA-7C simulator. However, these equipments cannot be "fully operated" or would be difficult to "adequately evaluate" as a result of basic limitations of the simulator. As an example, M61 gun clearing solenoid can be operated but should be loaded and checked for force and actuation time to fully determine if degradation of performance occurs as a result of the AAES implementation.

TABLE 9

ADM HARDWARE UTILIZATION

Item	Qty Procured	Qty Used: Full-Up	Qty Used: Modular Checkout	System Checkout Group 1	2	3	4
<u>SCG Equipment</u>							
o Processors	2	2	2	2	2	2	2
o Maintenance Panel	1	1	1	1	1	1	1
o Pilot Control Panel	1	1	1	1	1	1	1
o Multiplexer	6	5	5	5	5	5	5
o Demultiplexer	6	11	5	5	5	5	5
o Mux/Demux	4	5	3	3	3	3	3
o Data Bus Couplers	AR	50	34	34	34	34	34
<u>Power Controllers</u>							
28VDC Load Control							
o 1/2 Amp	25	38	22	10	20	13	13
o 2 Amp	45	83	41	17	35	25	25
o 5 Amp	15	29	15	4	5	8	7
o 10 Amp	15	20	10	8	0	0	2
115 VAC Load Control							
o 1/2 Amp	25	29	21	8	10	16	5
o 2 Amp	45	66	38	19	31	29	19
o 5 Amp	15	31	15	3	4	9	7
26 VAC Load Control							
o 1 Amp	15	16	13	1	5	10	6
270 VDC Load Control							
o 2 Amp	40	30	30	30	30	30	30
<u>Signal Sources</u>							
o Toggle (SPST)	65	51	51	17	29	27	31
o Toggle (SPDT)	0	27	27	5	7	11	16
o Pushbutton Ltd	65	45	45	17	0	27	16
o Rotary	35	18	18	18	0	0	0
o Proximity	35	14	14	6	6	13	12

Alternate total quantity is 19 universal terminals.

TABLE 10

SUPPLEMENTARY HARDWARE UTILIZATION

Item	Qty Used			System Checkout Group			
	Qty Procured	Full-Up	Modular Checkout	1	2	3	4
Signal Conditioners							
o Type 1 - Ground or Open/28VDC	43	43	43	6	18	14	14
o Type 2 - Open/Ground	36	36	36	11	6	10	8
o Type 3 - Open/Continuity	44	44	44	11	23	9	11
o Type 4 - Open/28VDC or Ground	12	12	12	12	0	0	0
5 Type 5 - Ground or Open/5VDC	2	2	2	2	0	2	0
Power Output							
o Type 1 - 28V, 400 ma	69	69	69	24	19	28	12
o Type 2 - Grd, 250 ma	43	43	43	23	9	9	19
o Type 3 - Grd, 2.5 a	3	3	3	1	0	1	1
o Type 4 - SPDT, 100 ma	2	2	2	0	0	2	0
o Type 5 - 6V, 100 ma	5	5	5	0	0	5	0
Lamp Drivers							
o Type 1 - 28V at 80 ma	120	120	120	32	40	45	34
o Type 2 - 6V at 400 ma	133	133	133	75	0	58	23
o Type 3 - 28V at 340 ma	6	6	6	0	6	2	0
Adapter Cables	AR	6	67	24	20	20	20

2.4.5 Load Management System

SOSTEL provides a capability for automatically adjusting power bus loading to match the generating system capacity. The load management capability greatly simplifies the bus management hardware requirements while providing a more sensitive bus loading control than can be feasibly implemented with conventional techniques. Reference 1 provides a discussion of the load management concept and identifies the benefits that it provides. The load management operation uses the inherent computerized control of SOSTEL for controlling the flow of power to individual loads. This allows loads to be powered-up or powered-down as a function of the power system capacity by providing the proper control equations in the SCG processors. Two sets of control data have been defined.

The first data set consists of the load management modifiers and are in accordance with the format of the Powertran Reference Manual[2]. A load management modifier has been defined for essentially all of the SCG output control equations. The primary exceptions are the output terms which are always enabled. These are for the critical emergency loads that are energized if any power is available.

The load management modifier format is illustrated in Figure 20. As shown, sixteen management states are provided for load control. One of the sixteen states is active at all times and control the load action during that state by the following criteria:

- o Management character = N: Output equation is solved normally and the associated load controller state is set based on the equation solution.
- o Management character = S: Solution of output equation is skipped and the last state of the output is maintained. The load controller state is set based on the previous output state.
- o Management character = 0: The output equation is forced to a logic "0". The associated load controller is turned off and the load deenergized.
- o Management character = 1: The output equation is forced to a logic "1". The associated load controller is turned on and the load energized.

As previously stated each load (i.e., load controller) has an associated load management modifier. The total load connected to the power generating-conversion equipment is therefore limited to the sum of all loads which have a management character of N, S or 1 in the specific management level or state in effect. This is illustrated by the following example for four loads which have control equations of:

	15	14	13	12	MANAGEMENT STATE LEVELS			
W = A,	M(N	0	1	0	.	.	.)	(load = 2KW)
W = B,	M(N	0	0	0	.	.	.)	(load = 1KW)
W = C,	M(0	N	1	0	.	.	.)	(load = .6KW)
W = D,	M(N	N	0	1	.	.	.)	(load = .2KW)

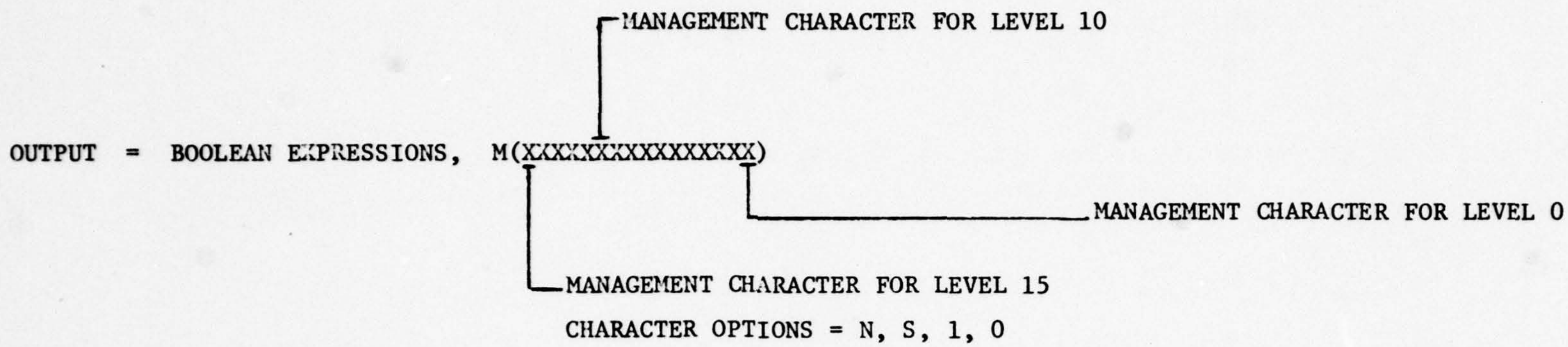


FIGURE 20 LOAD MANAGEMENT MODIFIER FORMAT

If management level 15 is selected and A, B, C and D are a logic 1, then the total load connected is 3.2 kilowatts; should the management state shift from level 15 to level 14, the connected load is reduced from 3.2 KW to 0.2 KW. If A, B, C and D are a logic 0, the connected load is zero for management levels 15 and 14, 2.6KW for level 13, and 0.2KW for level 12. In this manner, the total power demand on the main power buses can be adjusted by changing management states.

The second load management data set consists of equations which define management level selection.

Appendix C contains the preliminary equations which will be used to establish the management levels. Contained in the equations are terms which are functions of the aircraft flight mode, the PGS operational "health" state and the bus priority level. These equations will require refinement as more detailed or complete definition of the PGS health status functions and response characteristics become available. However, the equations as defined are illustrative of the control variables, time constants and management level operation. To the extent that PGS health signals are not available for automatically indicating the generator-power conditioner operational status, manually activated signal sources installed on the General Purpose Signal Source Panels can be used to simulate status. This will exercise the load management "load shedding" and "load addition" operation of the SCG but will not provide an effective evaluation-demonstration of the use of PGS sensed health parameters and associated PGS response characteristics.

Exercise of the load management operation will be somewhat limited during the initial simulator evaluation phase because of the lack of sufficient ADM hardware (SCG terminals and power controllers). The supplementary loading concept described in paragraph 2.3.2 however, minimizes this limitation. This can be accomplished by assigning load management modifiers to the supplementary loads. In this manner sufficient load changes can be made to occur during management level transitions to noticeably impact the generator-converter loading and consequently their level of performance.

Another factor which limits or perhaps complicates the load management operation on the simulator results from the power generation/conversion subsystem design. The PGS subsystem is being designed as basically a 45 kilowatt, dual channel, main system with no emergency power sources. In addition, the generators and converters can be operated in either a split synchronized or parallel mode. In either of these modes, load management will not typically initiate load shedding until the sum of the "present generating capacity" of both generators is less than the connected load. Since a dual channel system is typically designed so that either channel can power all connected loads, both generators would have to degrade to the point where the total generating capacity is less than 45 kilowatts. Therefore, load management will be exercised on the simulator only to the extent that supplementary loading on the main buses can increase the system load above 45 kilowatts.

The simulator design also includes provisions for a second PGS operational mode. In the second mode or alternate configuration, one channel serves as the main power source while the second channel serves as the emergency generator. Although this arrangement distorts the ratio of emergency power capacity to main power capacity, the impact and operation of power source switchover and load management can be evaluated for the single engine implementation. It is noted that for a"typical" single channel system having load management, the main power source load is reduced as a function of its "capacity to generate power". At the point where the degraded capacity of the main channel drops below the capacity available from the emergency source, the main source is disconnected (tripped) and the emergency source is brought on line. The single channel system load centers (LMC) also typically contain an essential bus and a non-essential bus. The essential sub-bus is powered from the main and the emergency sources. However, the non-essential bus is powered only from the main source. When the main source trips and the emergency source is activated, the connected load drops by virtue of only the LMC essential bus being powered. In this case, the load management software will sense an underload on the emergency generator (main generator tripped). This will result in loads being added until the underload condition load is removed or until all emergency loads are enabled. The number of effective load management levels is doubled as a result of powering only the loads connected to the hardwired essential buses. Since the simulator is being designed for a limited quantity of load controllers and for dual channel operation, it is not practical to split the LMC buses between essential and non-essential. Therefore, the initial simulator design will in effect not employ a split (essential and non-essential) bus.

In order to address both the single channel and dual channel power system operating modes, the management level selection equations in Appendix C contain terms which modify the load management operation as a function of system operation mode. These terms appear in the overload and underload equations of Tables C-2 and C-3 and in the level modifier equations of Table C-5. These additional terms are derived from three cockpit mounted signal sources:

(a) Load Management Enable,

(b) Emergency Generator, and

(c) Single/Dual Channel Mode

Table 11 contains a matrix which illustrates the load management operating mode for the various states of the three signal sources. This enables the load management routine to be exercised with the available simulator loads for both the dual channel and the single channel power system arrangement.

2.5 Avionic Multiplex System Definition

The Avionic Multiplex System (AMUX) provides data communication between the six avionic primary subsystems and seven secondary subsystems as listed in Tables 12-a and 12-b. The signals selected for multiplexing on the data bus represent a cross section of signal types and characteristics. Table 13 indicates the assignment of these signals to the four area multiplex terminals (AMTs). Given in Table 12 are the subsystem name, nomenclature and part numbers, and the location of equipment used in the signal list. The signal assignment list identifies the signal name and identification number, orgin and destination, and the general characteristics of each signal. Tables 13-a through 13-d are the assignments for the forward cockpit, aft cockpit, right avionics and left avionics terminals respectively. The candidate signals to be multiplexed are made up of 154 inputs and 178 outputs. Table 14 identifies the signal counts assigned to each terminal.

TABLE 11

LOAD MANAGEMENT OPERATING MODES

LOAD MANAGEMENT TRANSDUCER	EMERGENCY GENERATOR TRANSDUCER	SINGLE/DUEL CHANNEL TRANSDUCER	
		SINGLE CHANNEL	DUAL CHANNEL
ON	OFF CRUISE TAKE-OFF OR LANDING	BUS PRIORITY SELECTION AND FLIGHT PROFILE DETERMINES THE MANAGEMENT LEVEL AND THE ASSOCIATED CONNECTED LOAD.	
OFF	OFF	MANAGEMENT LEVEL 1 SELECT	LOAD MANAGEMENT LEVEL 15 IS SELECTED FOR NORMAL OPERATION (I.E., ALL LOADS ENABLED.)
	CRUISE	MANAGEMENT LEVEL FORCED TO LEVEL 4 OR 8.	
	TAKE-OFF OR LANDING	MANAGEMENT LEVEL FORCED TO LEVEL 9.	

TABLE 12

AVIONIC SYSTEMS MULTIPLEXED

(a) Primary Subsystems Interfaced

NO. OF UNITS	SUBSYSTEM NAME	PART NUMBER	LOCATION
	RADAR ALTIMETER (APN-194)		
1	Receiver Transmitter	RT-1042/APN-194	RC
2	Indicator	ID-1760A/APN-194	INST (Fwd and Aft)
1	Interference Blanker	MX-9132A/APN-194	RC
	DIGITAL DATA COMMUNICATION (ASW-25)		
1	SINS/Waypoints Receptacle	MS3120E16-8S	LWW
1	Converter Receiver	CV-2230/ASW-25	RME
1	Coupler Converter	CU-1923/ASW-25	AMO
2	SINS/Waypoint Switch	215-21209-3	LCSL (Fwd and Aft)
2	Control	C-7100A/ASW-25	LCSL (Fwd and Aft)
	TACAN (ARN-84)		
1	Receiver Transmitter	RT-1022/ARN-84	RA
2	Control	C-9054/ARN-84	RCSL (Fwd and Aft)
1	Mount	MT-4354/ARN-84	RA
1	Antenna Switching Unit	SA-521A/A	RA
	IFF TRANSPONDER (APX-72)		
1	Receiver Transmitter	RT-859A/APX-72	RA
1*	Control	C6200A/APX	LCSL (Fwd and Aft)
1	MK XII Computer	KIT-1A/TSEC	RA
1	Tester	TS-1843B/APX	RA
	UHF RADIO SET (ARC-159)		
2	Receiver Transmitter	RT-1150/ARC-159	RA
2	Control	C-9577/ARC-159	LCSL (Fwd and Aft)
2	Frequency Indicator	ID-1972/ARC-159	INST (Fwd and Aft)
	AUTOMATIC DIRECTION FINDER (ARA-50)		
2	Control	C-1457/ARR-40	LCSL
1	Antenna	AS-909/ARA-48	CD
1	Amplifier Relay	AM-3624/ARA-50	RA
1	Receiver	R-1286/ARR-69	RA

* IFF Control will not be incorporated in aft cockpit.

TABLE 12

AVIONIC SYSTEMS MULTIPLEXED

(b) Secondary Subsystems Interfaced

NO. OF UNITS	SUBSYSTEM NAME	PART NUMBER	LOCATION
	HEAD-UP DISPLAY (AVQ-7)		
1	Signal Data Processor	CP-915/AVQ-7	LA
	NAV/WEP DELIVERY COMPUTER (ASN-91)		
1	NWDC	CP-952/ASN	LA
	INERTIAL MEASUREMENT SYSTEM (ASN-90)		
1	Adapter Power Supply	PP-6141/ASN-90	LA
	FORWARD LOOKING RADAR		
1	Sweep Generator	SG-811/APO-126	LME
	INTERCOMMUNICATION SET (AIC-25)		
1	Tone Generator	0-1595/A	RA
	AUTOMATIC FLIGHT CONTROL SYSTEM		
1	Roll Control Amplifier	AM-4353/ASW-26	LA
	HEADING MODE SYSTEM		
2	Attitude Director Indicator	ID-1329/A	INST
2	Horizontal Situation Indicator	ID-1013/A	INST

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13a FWD COCKPIT AMT 1

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
INPUTS TO RA/IND										
21001	INDICATOR ALT		RA/RT	RC	RA/IND	INST	DC ANA	+ 25 VDC,OV	5	14
21003	SELF TEST		RA/RT	RC	RA/IND	INST	DISC	GROUND/OPEN	5	1
INPUTS TO HMS/HSI										
45011	RNG FLAG CONT		TAC/MT	RA	HMS/HSI	INST	DISC	GROUND/OPEN	5	1
45012	DISTANCE UNITS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45013	DISTANCE TENS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45014	DISTANCE HUNDS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45015	TACAN BEARING		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	13
45016	COURSE DEVIAT		TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-200 MVDC	5	12
45017	BRG FLAG		TAC/MT	RA	HMS/HSI	INST	DISC	+380 MVDC,OV	5	1
45018	TO/FROM		TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-300 MVDC	5	12
45019	CRS RSLVER ROT		TAC/MT	RA	HMS/HSI	INST	SYNCHR	26 VAC,OV	5	13
INPUTS TO HMS/ADI										
35011	EL STEERING		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
35034	LATERAL ERROR		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
OUTPUTS FROM DDC/S-W										
35004	WAYPOINTS		DDC/S-W	LCSL	DDC/RECPT	LWW	DISC	+ 28 VDC,OPEN	5	1

TABLE 13a (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM DDC/CONT										
35017	ANTI-JAM		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35018	EXT. SELECT		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,0V	5	1
35019	FREQ SEL 0.1		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35020	FREQ SEL 0.2		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35021	FREQ SEL 0.4		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35022	FREQ SEL 0.8		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35023	FREQ SEL 1.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35024	FREQ SEL 2.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35025	FREQ SEL 3.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35026	FREQ SEL 4.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35027	FREQ SEL 10.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
35028	FREQ SEL 20.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,0V	5	1
73010	D/L TEST		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,0V	5	1
OUTPUTS FROM IFF/CONT										
46001	SENSITIVIT CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46002	MODE 3/A ENABL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46003	MODE 2 ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46004	MODE C ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46005	MODE 1 ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46006	STBY CONTROL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46007	EMERGENCY CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46008	PWR RELAY CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46009	MOD 4 L-BND DI		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46010	IDENT CONTROL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46016	MODE 1 TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46017	MODE 2 TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46018	MODE 3/A TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46019	MODE C TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46021	AUDIO ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46022	MONITOR CNTRL		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46023	TST MODE CNTRL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46024	MODE 4 TEST		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46030	MODE 1 A1 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46031	MODE 1 A2 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1

TABLE 13a(cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
46032	MODE 1 A4 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46033	MODE 1 B1 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46034	MODE 1 B2 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46035	MODE 3/A A1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46036	MODE 3/A A2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46037	MODE 3/A A4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46038	MODE 3/A B1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46039	MODE 3/A B2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46040	MODE 3/A B4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46041	MODE 3/A C1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46042	MODE 3/A C2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46043	MODE 3/A C4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46044	MODE 3/A D1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46045	MODE 3/A D2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46046	MODE 3/A D4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46047	MODE 4 COD B E		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46048	MODE 4 COD HLD		IFF/CONT	LCSL	IFF/COMP	RA	DISC	+ 28 VDC,OPEN	5	1
46049	MODE 4 ZEROIZE		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
INPUTS TO IFF/CONT										
46015	TST LAMP ENABL		IFF/TSTR	RA	IFF/CONT	LCSL	DISC	+ 28 VDC,OPEN	5	1
46020	REPLY LIGHT EN		IFF/RT	RA	IFF/CONT	LCSL	DISC	+ 28 VDC,OPEN	5	1
OUTPUTS FROM TAC/CONT										
45001	TURN ON CMD		TAC/CONT	RCSL	TAC/MT	RA	DISC	GROUND/OPEN	5	1
45002	TST CMD/STATUS		TAC/CONT	RCSL	TAC/MT	RA	DISC	+ 28 VDC,OPEN	5	1
45004	MUX SERIL DATA		TAC/CONT	RCSL	TAC/MT	RA	S DIG	+ 28 VDC,OV	32	32

TABLE 13a(cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM UHF/CONT 1a										
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/RT 1	RA	S DIG	+2, -8	5	24
81003	PWR ON/OFF						DISC	GROUND/OPEN		1
81004	GRD RCVR ON/OFF							GROUND/OPEN		1
81005	TONE XMIT CONT							GROUND/OPEN		1
81006	SQUELCH				UHF/RT 1	RA		GROUND/OPEN		1
81007	ADF ENABLE 1				ADF/AMP	RA	DISC	GROUND/OPEN		1
81001	DATA HI/LO				UHF/IND 1	INST	S DIG	+2, -8		24
81001	DATA HI/LO				UHF/IND 2	INST	S DIG	+2, -8	5	24
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/CONT 1b	LCSL	S DIG	+2, -8	5	24
INPUTS TO UHF/CONT 1a										
81002	CLOCK HI/LO		UHF/RT 1	RA	UHF/CONT 1a	LCSL	S DIG	+2, -8	800	NA
81008	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 1a	LCSL	DISC	GROUND/OPEN	5	1
81001	DATA HI/LO		UHF/CONT 1b	LCSL	UHF/CONT 1a	LCSL	S DIG	+2, -8	5	24
OUTPUTS FROM UHF/CONT 2a										
81011	DATA HI/LO		UHF/CONT 2a	LCSL	UHF/RT 2	RA	S DIG	+2, -8	5	24
81013	PWR ON/OFF						DISC	GROUND/OPEN		1
81014	GRD RCVR ON/OFF							GROUND/OPEN		1
81015	TONE XMIT CONT							GROUND/OPEN		1
81016	SQUELCH				UHF/RT			GROUND/OPEN		1
81017	ADF ENABLE 2				ADF/AMP	RA	DISC	GROUND/OPEN		1
81011	DATA HI/LO				UHF/IND 1	INST	S DIG	+2, -8		24
81011	DATA HI/LO				UHF/IND 2	INST	S DIG	+2, -8	5	24
81011	DATA HI/LO				UHF/CONT 2b	LCSL	S DIG	+2, -8	5	24
81017	ADF ENABLE 2		UHF/CONT 2a	LCSL	ANT/SW	RA	DISC	GROUND/OPEN	5	1
INPUTS TO UHF/CONT 2a										
81012	CLOCK HI/LO		UHF/RT2	RA	UHF/CONT 2a	LCSL	S DIG	+2, -8	800	NA
81017	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 2a	LCSL	DISC	GROUND/OPEN	5	1
81011	DATA HI/LO		UHF/CONT 2b	LCSL	UHF/CONT 2a	LCSL	S DIG	+2, -8	5	24

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13b AFT COCKPIT AMT 2

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
INPUTS TO RA/IND										
21001	INDICATOR ALT		RA/RT	RC	RA/IND	INST	DC ANA	+ 25 VDC,OV	5	14
21003	SELF TEST		RA/RT	RC	RA/IND	INST	DISC	GROUND/OPEN	5	1
INPUTS TO HMS/HSI										
45011	RNG FLAG CONT		TAC/MT	RA	HMS/HSI	INST	DISC	GROUND/OPEN	5	1
45012	DISTANCE UNITS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45013	DISTANCE TENS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45014	DISTANCE HUNDS		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45015	TACAN BEARING		TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	13
45016	COURSE DEVIAT		TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-200 MVDC	5	12
45017	BRG FLAG		TAC/MT	RA	HMS/HSI	INST	DISC	+380 MVDC,OV	5	1
45018	TO/FROM		TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-300 MVDC	5	12
45019	CRS RSLVER ROT		TAC/MT	RA	HMS/HSI	INST	SYNCHR	26 VAC,OV	5	13
INPUTS TO HMS/ADI										
35011	EL STEERING		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
35034	LATERAL ERROR		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
OUTPUTS FROM DDC/S-W										
35004	WAYPOINTS		DDC/S-W	LCSL	DDC/RECPT	LWW	DISC	+ 28 VDC,OPEN	5	1
OUTPUTS FROM DDC/CONT										
35017	ANTI-JAM		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35018	EXT. SELECT		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,OV	5	1
35019	FREQ SEL 0.1		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35020	FREQ SEL 0.2		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35021	FREQ SEL 0.4		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35022	FREQ SEL 0.8		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35023	FREQ SEL 1.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35024	FREQ SEL 2.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35025	FREQ SEL 3.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35026	FREQ SEL 4.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35027	FREQ SEL 10.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35028	FREQ SEL 20.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
73010	D/L TEST		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,OV	5	1

TABLE 13b (Cont'd)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM UHF/CONT 1b										
81001	DATA HI/LO		UHF/CONT 1b	LCSL	UHF/RT 1	RA	S DIG	+2, -8	5	24
81003	PWR ON/OFF						DISC	GROUND/OPEN		1
81004	GRD RCVR ON/OFF							GROUND/OPEN		1
81005	TONE XMIT CONT							GROUND/OPEN		1
81006	SQUELCH				UHF/RT 1			GROUND/OPEN		1
81007	ADF ENABLE 1				ADF/AMP	RA	DISC	GROUND/OPEN		1
81001	DATA HI/LO				UHF/IND 1	INST	S DIG	+2, -8		24
81001	DATA HI/LO				UHF/IND 2	INST	S DIG	+2, -8	5	24
81001	DATA HI/LO		UHF/CONT 1b	LCSL	UHF/CONT 1a	LCSL	S DIG	+2, -8	5	24
INPUTS TO UHF/CONT 1b										
81002	CLOCK HI/LO		UHF/RT 1	RA	UHF/CONT 1b	LCSL	S DIG	+2, -8	800	NA
81007	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 1b	LCSL	DISC	GROUND/OPEN	5	1
81001	DATA HI/LO		UHF/CONT 1a	LA	UHF/CONT 1b	LCSL	S DIG	+2, -8	5	24
OUTPUTS FROM UHF/CONT 2b										
81011	DATA HI/LO		UHF/CONT 2b	LCSL	UHF/RT 2	RA	S DIG	+2, -8	5	24
81013	PWR ON/OFF						DISC	GROUND/OPEN		1
81014	GRD RCVR ON/OFF							GROUND/OPEN		1
81015	TONE XMIT CONT							GROUND/OPEN		1
81016	SQUELCH				UHF/RT 2			GROUND/OPEN		1
81017	ADF ENABLE 2				ADF/AMP	RA	DISC	GROUND/OPEN		1
81011	DATA HI/LO				UHF/IND 1	INST	S DIG	+2, -8		24
81011	DATA HI/LO				UHF/IND 2	INST	S DIG	+2, -8	5	24
81011	DATA HI/LO				UHF/CONT 2a	LCSL	S DIG	+2, -8	5	24
81017	ADF ENABLE 2		UHF/CONT 2b	LCSL	ANT/SW	RA	DISC	GROUND/OPEN	5	1
INPUTS TO UHF/CONT 2b										
81012	CLOCK HI/LO		UHF/RT 2	RA	UHF/CONT 2b	LCSL	S DIG	+2, -8	800	NA
81018	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 2b	LCSL	DISC	GROUND/OPEN	5	1
81011	DATA HI/LO		UHF/CONT 2a	LCSL	UHF/CONT 2b	LCSL	S DIG	+2, -8	5	24

TABLE 13b (cont)

SIGNAL NUMBER	NAME	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM TAC/CONT									
45001	TURN ON CMD	TAC/CONT	RCSL	TAC/MT	RA	DISC	GROUND/OPEN	5	1
45002	TST CMD/STATUS	TAC/CONT	RCSL	TAC/MT	RA	DISC	+ 28 VDC,OPEN	5	1
45004	MUX SERIL DATA	TAC/CONT	RCSL	TAC/MT	RA	S DIG	+ 28 VDC,OV	32	32

SIGNAL NUMBER	NAME	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM FLR/SG									
72023	ALT DATA XFER	FLR/SG	LME	RA/RT	RC	DISC	GROUND/OPEN	5	1
INPUTS TO FLR/SG									
21005	RELIABILITY	RA/RT	RC	FLR/SG	LME	DISC	+ 5 VDC,OV	25	1
21006	LINEAR ALT	RA/RT	RC	FLR/SG	LME	DC ANA	+ 25 VDC,OV	25	12
21009	LINEAR ALT	RA/RT	RC	FLR/SG	LME	DC ANA	+ 25 VDC,OV	25	12
OUTPUTS FROM DDC/CC									
35013	DDC DATA READY	DDC/CC	AMO	NWDC	LA	S DIG	+ 5 VDC,OV	100	1
35014	DDC DATA	DDC/CC	AMO	NWDC	LA	S DIG	+ 5 VDC,OV	100	20
35015	DDC ADDRESS	DDC/CC	AMO	NWDC	LA	S DIG	+ 5 VDC,OV	100	20
INPUTS TO DDC/CC									
11032	ADC/DDC TEST	NWDC	LA	DDC/CC	AMO	DISC	+ 28 VDC,OV	5	1
11064	DATA CLOCK	NWDC	LA	DDC/CC	AMO	S DIG	+ 5 VDC,OV	50K	1
35009	DATA LINK DATA	DDC/CR	RME	DDC/CC	AMO	P DIG	+ 12 VDC,OV	14	42
35010	DATA LINK RDY	DDC/CR	RME	DDC/CC	AMO	S DIG	+ 12 VDC,OV	14	1

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13c <u>RIGHT AVIONICS AMT 3</u>

SIGNAL NUMBER	NAME	FROM M UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM TAC/MT									
45007	TAC SERIAL DTA	TAC/MT	RA	NWDC	LA	S DIG	+ 5 VDC,OV	5	20
45011	RNG FLAG CONT	TAC/MT	RA	HMS/HSI	INST	DISC	GROUND/OPEN	5	1
45012	DISTANCE UNITS	TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45013	DISTANCE TENS	TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45014	DISTANCE HUNDS	TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	7
45015	TACAN BEARING	TAC/MT	RA	HMS/HSI	INST	SYNCHR	11.8 VAC,OV	5	13
45016	COURSE DEVIAT	TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-200 MVDC	5	12
45017	BRG FLAG	TAC/MT	RA	HMS/HSI	INST	DISC	+380 MVDC,OV	5	1
45018	TO/FROM	TAC/MT	RA	HMS/HSI	INST	DC ANA	+/-300 MVDC	5	12
45019	CRS RSLVER ROT	TAC/MT	RA	HMS/HSI	INST	SYNCHR	26 VAC,OV	5	13
INPUTS TO TAC/MT									
11010	ADRESS LINE B	NWDC	LA	TAC/MT	RA	S DIG	+ 5 VDC,OV	5	1
11011	READ ADDR LINE	NWDC	LA	TAC/MT	RA	S DIG	+ 5 VDC,OV	5	1
11012	SHIFT CLOCK	NWDC	LA	TAC/MT	RA	S DIG	+ 5 VDC,OV	1M	1
12063	MAG HEADING	IMS/APS	LA	TAC/MT	RA	SYNCHR	11.8 VAC,OV	5	13
45001	TURN ON CMD	TAC/CONT	RCSL	TAC/MT	RA	DISC	GROUND/OPEN	5	1
45002	TST CMD/STATUS	TAC/CONT	RCSL	TAC/MT	RA	DISC	+ 28 VDC,OPEN	5	1
45004	MUX SERIL DATA	TAC/CONT	RCSL	TAC/MT	RA	S DIG	+ 28 VDC,OV	32	32
INPUTS TO ANT/SW									
81017	ADF ENABLE 2	UHF/CONT 2a	LCSL	ANT/SW	RA	DISC	GROUND/OPEN	5	1
81017	ADF ENABLE 2	UHF/CONT 2b	LCSL	ANT/SW	RA	DISC	GROUND/OPEN	5	1
INPUTS TO ADF/AMP									
81007	ADF ENABLE 1	UHF/CONT 1a	LCSL	ADF/AMP	RA	DISC	GROUND/OPEN	5	1
81007	ADF ENABLE 1	UHF/CONT 1b	LCSL						
81017	ADF ENABLE 2	UHF/CONT 2a	LCSL						
81017	ADF ENABLE 2	UHF/CONT 2b	LCSL	ADF/AMP	RA	DISC	GROUND/OPEN	5	1

TABLE 13c (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM IFF/RT										
46020	REPLY LIGHT EN		IFF/RT	RA	IFF/CONT	LCSL	DISC	+ 28 VDC,OPEN	5	1
INPUTS TO IFF/RT										
46001	SENSITIVIT CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46002	MODE 3/A ENABL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46003	MODE 2 ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46004	MODE C ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46005	MODE 1 ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46006	STBY CONTROL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46007	EMERGENCY CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46008	PWR RELAY CNT		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46010	IDENT CONTROL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46021	AUDIO ENABLE		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46023	TST MODE CNTRL		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46030	MODE 1 A1 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46031	MODE 1 A2 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46032	MODE 1 A4 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46033	MODE 1 B1 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46034	MODE 1 B2 ENAB		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46035	MODE 3/A A1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46036	MODE 3/A A2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46037	MODE 3/A A4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46038	MODE 3/A B1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46039	MODE 3/A B2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46040	MODE 3/A B4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46041	MODE 3/A C1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46042	MODE 3/A C2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46043	MODE 3/A C4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46044	MODE 3/A D1 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46045	MODE 3/A D2 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
46046	MODE 3/A D4 EN		IFF/CONT	LCSL	IFF/RT	RA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM IFF/COMP										
73026	IFF ADV SIGNAL		IFF/COMP	RA	SCG/PROC	LA	DISC	+ 28 VDC,OPEN	5	1
INPUTS TO IFF/COMP										
46009	MOD 4 L-BND DI		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46024	MODE 4 TEST		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46047	MODE 4 COD B E		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
46048	MODE 4 COD HLD		IFF/CONT	LCSL	IFF/COMP	RA	DISC	+ 28 VDC,OPEN	5	1
46049	MODE 4 ZEROIZE		IFF/CONT	LCSL	IFF/COMP	RA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM IFF/TSTR										
* 46015	TST LAMP ENABL		IFF/TSTR	RA	IFF/CONT	LCSL	DISC	+ 28 VDC,OPEN	5	1

TABLE 13c (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM UHF/RT 1										
81002	CLOCK HI/LO		UHF/RT 1	RA	UHF/CONT 1a	LCSL	S DIG	+2, -8	800	NA
81002	CLOCK HI/LO		UHF/RT 1		UHF/CONT 1b	LCSL		+2, -8	800	NA
81002	CLOCK HI/LO		UHF/RT 1		UHF/IND 1	INST		+2, -8	800	NA
81002	CLOCK HI/LO		UHF/RT 1	RA	UHF/IND 2	INST	S DIG	+2, -8	800	NA
INPUTS TO UHF/RT 1										
81003	PWR ON/OFF		UHF/CONT 1a	LCSL	UHF/RT 1	RA	DISC	0,28	5	1
81004	GRD RCVR ON/OFF							0,28	5	1
81005	TONE XMIT CONT							0,12	5	1
81006	SQUELCH						DISC	0,12	5	1
81001	DATA HI/LO		UHF/CONT 1a				S DIG	+2, -8	5	24
81003	PWR ON/OFF		UHF/CONT 1b				DISC	0,28	5	1
81004	GRD RCVR ON/OFF							0,28	5	1
81005	TONE XMIT CONT							0,12	5	1
81006	SQUELCH						DISC		5	1
81001	DATA HI/LO		UHF/CONT 1b	LCSL	UHF/RT 1	RA	S DIG	+2, -8	5	24
81009	KEY XMIT 1		UHF/SA	LA	UHF/RT 1	RA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM UHF/RT 2										
81012	CLOCK HI/LO		UHF/RT 2	RA	UHF/CONT 2a	LCSL	S DIG	+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2		UHF/CONT 2b	LCSL		+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2		UHF/IND 1	INST		+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2	RA	UHF/IND 2	INST	S DIG	+2, -8	800	NA
INPUTS TO UHF/RT 2										
81013	PWR ON/OFF		UHF/CONT 2a	LCSL	UHF/RT 2	RA	DISC	0,28	5	1
81014	GRD RCVR ON/OFF							0,28	5	1
81015	TONE XMIT CONT							0,12	5	1
81016	SQUELCH						DISC	0,12	5	1
81011	DATA HI/LO		UHF/CONT 2a				S DIG	+2, -8	5	24
81013	PWR ON/OFF		UHF/CONT 2b				DISC	0,28	5	1
81014	GRD RCVR ON/OFF							0,28	5	1
81015	TONE XMIT CONT							0,12	5	1
81016	SQUELCH						DISC	0,12	5	1
81011	DATA HI/LO		UHF/CONT 2b	LCSL	UHF/RT 2	RA	S DIG	+2, -8	5	24
81019	KEY XMIT 2		UHF/SA	LA	UHF/RT 2	RA	DISC	GROUND/OPEN	5	1

TABLE 13c (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE	UPDATE RATE	Q
OUTPUTS FROM DDC/CR										
35009	DATA LINK DATA		DDC/CR	RME	DDC/CC	AMO	P DIG	+ 12 VDC,OV	14	42
35010	DATA LINK RDY		DDC/CR	RME	DDC/CC	AMO	S DIG	+ 12 VDC,OV	14	1
35011	EL STEERING		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
35012	EL STEERING		DDC/CR	RME	HUD/SDP	LA	DC ANA	+/- 2.2VDC	25	8
35029	ROLL DISPLACE		DDC/CR	RME	AFCS/RCA	LA	DC ANA	26 VAC,OV	14	10
35030	PITCH DISPLACE		DDC/CR	RME	AFCS/PCA	LA	AC ANA	26 VAC,OV	14	10
35031	GOOD DATA		DDC/CR	RME	AFCS/PCA	LA	DISC	GROUND/OPEN	5	1
35032	GOOD DATA		DDC/CR	RME	AFCS/RCA	LA	DISC	GROUND/OPEN	5	1
35033	LATERAL ERROR		DDC/CR	RME	HUD/SDP	LA	DC ANA	+/- 2.2VDC	25	8
35034	LATERAL ERROR		DDC/CR	RME	HMS/ADI	INST	DC ANA	+/- 2.2VDC	25	8
INPUTS TO DDC/CR										
35007	SINS/WPTS DATA		DDC/RECPT	LWW	DDC/CR	RME	S DIG	+/- 5 VDC	63	80
35017	ANTI-JAM		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35018	EXT. SELECT		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,OV	5	1
35019	FREQ SEL 0.1		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35020	FREQ SEL 0.2		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35021	FREQ SEL 0.4		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35022	FREQ SEL 0.8		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35023	FREQ SEL 1.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35024	FREQ SEL 2.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35025	FREQ SEL 3.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35026	FREQ SEL 4.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35027	FREQ SEL 10.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
35028	FREQ SEL 20.0		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 5 VDC,OV	5	1
73010	D/L TEST		DDC/CONT	LCSL	DDC/CR	RME	DISC	+ 28 VDC,OV	5	1
INPUTS TO IFF/TSTR										
46016	MODE 1 TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46017	MODE 2 TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46018	MODE 3/A TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46019	MODE C TEST		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
46022	MONITOR CNTRL		IFF/CONT	LCSL	IFF/TSTR	RA	DISC	GROUND/OPEN	5	1
OUTPUTS FROM RA/RT										
21001	INDICATOR ALT		RA/RT	RC	RA/IND	INST	DC ANA	+ 25 VDC,OV	5	14
21003	SELF TEST		RA/RT	RC	RA/IND	INST	DISC	GROUND/OPEN	5	1
21005	RELIABILITY		RA/RT	RC	FLR/SG	LME	DISC	+ 5 VDC,OV	25	1
21006	LINEAR ALT		RA/RT	RC	FLR/SG	LME	DC ANA	+ 25 VDC,OV	25	12
21007	LINEAR ALT		RA/RT	RC	NWDC	LA	DC ANA	+ 25 VDC,OV	25	12
21008	LINEAR ALT		RA/RT	RC	HUD/SDP	LA	DC ANA	+ 25 VDC,OV	25	12
21009	LINEAR ALT		RA/RT	RC	FLR/SG	LME	DC ANA	+ 25 VDC,OV	25	12
INPUTS TO RA/RT										
72023	ALT DATA XFER		FLR/SG	LME	RA/RT	RC	DISC	GROUND/OPEN	5	1
OUTPUTS FROM RA/IB										
21011	TRANS BLANKER		RA/IB	RC	SCG/PROC	LA	DISC	GROUND/OPEN	5	1

ASSIGNMENT OF SIGNALS TO BE MULTIPLEXED

TABLE 13d LEFT AVIONICS AMT 4

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE	VOLTAGE		UPDATE RATE	Q
OUTPUTS FROM NWDC											
11010	ADRESS LINE B		NWDC	LA	TAC/MT	RA	S DIG	+ 5	VDC,OV	5	1
11011	READ ADDR LINE		NWDC	LA	TAC/MT	RA	S DIG	+ 5	VDC,OV	5	1
11012	SHIFT CLOCK		NWDC	LA	TAC/MT	RA	S DIG	+ 5	VDC,OV	1M	1
11032	ADC/DDC TEST		NWDC	LA	DDC/CC	AMD	DISC	+ 28	VDC,OV	5	1
11064	DATA CLOCK		NWDC	LA	DDC/CC	AMD	S DIG	+ 5	VDC,OV	50K	1
INPUTS TO NWDC											
21007	LINEAR ALT		RA/RT	RC	NWDC	LA	DC ANA	+ 25	VDC,OV	25	12
35013	DDC DATA READY		DDC/CC	AMD	NWDC	LA	S DIG	+ 5	VDC,OV	100	1
35014	DDC DATA		DDC/CC	AMD	NWDC	LA	S DIG	+ 5	VDC,OV	100	20
35015	DDC ADDRESS		DDC/CC	AMD	NWDC	LA	S DIG	+ 5	VDC,OV	100	20
45007	TAC SERIAL DTA		TAC/MT	RA	NWDC	LA	S DIG	+ 5	VDC,OV	5	20
OUTPUTS FROM IMS/APS											
12063	MAG HEADING		IMS/APS	LA	TAC/MT	RA	SYNCHR	11.8	VAC,OV	5	13
INPUTS TO HUD/SDP											
21008	LINEAR ALT		RA/RT	RC	HUD/SDP	LA	DC ANA	+ 25	VDC,OV	25	12
35012	EL STEERING		DDC/CR	RME	HUD/SDP	LA	DC ANA	+/- 2.2VDC		25	8
35033	LATERAL ERROR		DDC/CR	RME	HUD/SDP	LA	DC ANA	+/- 2.2VDC		25	8
INPUTS TO AFCS/RCA											
35029	ROLL DISPLACE		DDC/CR	RME	AFCS/RCA	LA	DC ANA	26	VAC,OV	14	10
35032	GOOD DATA		DDC/CR	RME	AFCS/RCA	LA	DISC	GROUND/OPEN		5	1
OUTPUTS FROM DDC/RECPT											
35007	SINS/WPTS DATA		DDC/RECPT	LWW	DDC/CR	RME	S DIG	+/- 5	VDC	63	80
INPUTS TO DDC/RECPT											
35004	WAYPOINTS		DDC/S-W	LCSL	DDC/RECPT	LWW	DISC	+ 28	VDC,OPEN	5	1

TABLE 13d (cont)

SIGNAL NUMBER	NAME	M	FROM UNIT	FROM LOC	TO UNIT	TO LOC	TYPE SIGNAL	VOLTAGE	UPDATE RATE	Q
INPUTS TO UHF/IND 1										
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/IND 1	INST	S DIG	+2, -8	5	24
81001	DATA HI/LO		UHF/CONT 1b					+2, -8	5	24
81011	DATA HI/LO		UHF/CONT 2a					+2, -8	5	24
81011	DATA HI/LO		UHF/CONT 2b					+2, -8	5	24
81002	CLOCK HI/LO		UHF/RT 1					+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2	LCSL	UHF/IND 1	INST	S DIG	+2, -8	800	NA
INPUTS TO UHF/IND 2										
81001	DATA HI/LO		UHF/CONT 1a	LCSL	UHF/IND 2	INST	S DIG	+2, 08	5	24
81001	DATA HI/LO		UHF/CONT 1b					+2, 08		
81011	DATA HI/LO		UHF/CONT 2a					+2, -8		
81011	DATA HI/LO		UHF/CONT 2b					+2, -8	5	24
81002	CLOCK HI/LO		UHF/RT 1					+2, -8	800	NA
81012	CLOCK HI/LO		UHF/RT 2	LCSL	UHF/IND 2	INST	S DIG	+2, -8	800	NA
OUTPUTS FROM SCG/PROC										
81008	TAKE CONTROL		SCG/PROC	LA	UHF/CONT 1a	LCSL	DISC	GROUND/OPEN	5	1
81008	TAKE CONTROL				UHF/CONT 1b					
81018	TAKE CONTROL				UHF/CONT 2a					
81018	TAKE CONTROL				UHF/CONT 2b	LCSL		GROUND/OPEN	5	1
73026	IFF ADV SIG		SCG/PROC	LA	IFF/COMP	RA	DISC	+28 VDC/OPEN	5	1

TABLE 14

AMUX TERMINAL-SIGNAL ASSIGNMENT

Terminal No.	Inputs	Outputs	Total
1	21	74	95
2	26	40	66
3	88	39	127
4	23	12	35
Total	158	165	323

Although the TA-7C provides for both forward and aft cockpit controls for the IFF transponder, only the forward controls will be handled over the AMUX system. This is basically in keeping with the A-7E aircraft implementation. It is also noted that switching logic is required for a group of 15 avionic discrete signals. Of these, 13 signals are used as control variables in Boolean equations and 2 signals are output controls, i.e., the results of equation solutions. All fifteen signals are transferred between the SCG and AMUX via the data bus interface. It is envisioned that the AMUX bus will be operated in the poll-contention mode, therefore, transfer of the signals will occur upon a "change of state" of the signal(s). However, the AMUX data bus operation and protocol is flexible as a result of the AMT being programmable. Consequently, a range of communication-data transfer schemes can be evaluated.

2.6 Avionic System Priority Assignment

In view of the limited quantity of AAES ADM equipment being procurred, the problem of requisitioning some of the GFE used on the TA-7C, and the difficulties and complexity of performing certain system tests and evaluations, a list was prepared for the purpose of establishing priority for the systems and equipment. The list was prepared on the basis of performing test and evaluation on a primary subsystem. Therefore, the equipments comprising that subsystem, other supporting subsystems required or desired, and test equipment needed were assembled into a list, Table 15. The table lists the pertinent part numbers for the various equipment. The table also identifies priorities for implementing and testing/evaluating the various TA-7C avionic subsystems on the AAES simulator based on such factors as complexity, equipment availability, special support equipment requirements, difficulty of testing as a result of requiring special set-up such as hydraulics, radiation, the equipment being classified, etc. The priorities range from 1 to 5 with 1 being the most desirable for implementing on the simulator.

TABLE 15

EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
TACTICAL COMPUTER SET (AN/ASN-91)				IMS } Almost HUD } Required			
Nav/Weapon Delivery Computer	216-37183-14	2RH6605004093124GA	None	Radar Altimeter	AN/ASN-395A Memory Loader Verifier	1	
NWDC Control Panel	216-21231-14	2RH6605004933733GA		Air Data Computer	AN/ASN-478 System Interface T/S		
Monitor Display Panel	220-21203-101	2RH5895010258539UA		Angle of Attack			
INERTIAL MEASUREMENT SET (AN/ASN-90)							
Inertial Measurement Unit	216-37340-7	2RE6605000227893TA		HUD Heading Mode Sys.	AN/ASN-478 System Interface T/S	1	
Adapter Power Supply	216-37631-9	2RE4920001823006GA	Tactical Computer				
Control Panel - Fwd.	216-21355-3	2RH6605001042771					
ML1 Remote Compass Transmitter	MS25396-1	2RH6605008335087FZ					
DOPPLER RADAR NAVIGATION SET (AN/APN-190)							
Receiver-Transmitter	216-37629-1	2RH5841000978741TA			AN/ASN-478 System Interface T/S	3	Radiation Required.
Control Panel - Fwd.	216-21380-1	2RH5841001049290GA	Tactical Computer	None	AN/APM-342A Nav T/S		
Antenna	216-37525-1	2RH5841001032707TA	Inertial Measurement				
FORWARD LOOKING RADAR (AN/APQ-126)							
Forward Assembly							
o Transmitter	T1091/APQ126	2RH5841000017075GA					
o Antenna-Receiver	AS2272/APQ126	2RH5841000017066GA					
o Power Supply	PP6130/APQ126	2RE5841000017088					
o Computer	CP954/APQ126	2RH5841000017109GA					
o Mount	MT4043/APQ126	2RH5841004776037		IMS			
Digital Scan Converter	220-27121-101	2RH5841010267278		ADC Radar Altimeter	TS2853C/APM-394		Classified equipment.
Fault Locator	216-27877-1	2RE5841001096060	Tactical Computer		Radar T/S AN/ASN-478	3	Radiation required.
Range Control Panel	216-21600-10	2RE5841001105379			System Interface T/S		
Radar Control Panel	216-21143-7	2RE5841001105370					
Indicator-Fwd.	220-21242-101	2RH5841010253175					
Indicator-Aft	220-21242-102	2RH5841010258738					
Antenna Tilt Control Panel	220-21186-101	Purchase Vought					
Blower	216-27393-4	2RE4140001393429					
Transformer	CVC6070-5	9N5950001052148					
Transformer	CVC6070-6	9N5950001052149					

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EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
HEAD-UP DISPLAY (AN/AVQ-7)							
Display Unit	216-21245-32	2RH66050015070 26TA					
Signal Data Processor	216-37267-21	2RE66050015064 99TA			None	1	
Camera	220-21201-101	2RH5821010258517UA	Tactical Computer	ADC			
HUD Monitor	220-21201-102	2RH5821010258553UA	Inertial Measurement	Angle of Attack			
Lateral Accelerometer	216-37194-1	2RH6615001812469GA					
In Range Indicator	CVC2600-7	9G6210008796232					
HUD Mount	216-21245-26	2RH66050041629 34TA					
AIR DATA COMPUTER				HUD			
True Air Speed Ind.	215-21127-1	(On rt slant pnl)					
Air Data Computer	220-37125-101	2RH66050102987 49		IFF	SN565A/ASM		
Total Temperature Probe	215-37152-1	9G6685006781082	None	Tactical Computer	AIDS Input T/S	2	
Altitude Ind-Fwd.	AAU-19/A	2RH6610000863840			AN/ASM-371A		
Altitude Indicator-Aft	AAU-19/A	2RH6610000863840			ADC System T/S		
Mach Inc.	215-21124-3	2RH6610005042839					
PROJECTED MAP DISPLAY SET (AN/ASN-99)							
Project Map Display	ID-1665/ASN-99	2RH6605001507043GA	Tactical Computer	IMS			
Signal Data Converter	218-37668-4	2RH6605001827544GA			None	1	
PMDS Transformer	218-27505-1	9N5950003508282					
RADAR ALTIMETER (AN/APN-194)							
Receiver-Transmitter	RT-1042/APN-194	2RH5841001653030WZ		Tactical Computer Heads-Up Display	AN/APM-347 Altimeter T/S	2	Radiation Required
Indicator-Fwd.	ID-1760A/APN-194	2RH5841001687812WZ	None				
Indicator-Aft	ID-1760A/APN-194	(Same as above)					
Antenna-Receiver	AS-1233/APN141	1RM5841000198501					
Antenna-Transmit	AS-1233/APN141	1RM5841000198501					
Interference Blanker	MX9132A/APN-194	1RM5841001104882WZ					
ANGLE OF ATTACK							
Transducer	220-27166-101	1RD6610010253196UA					
Rudder Pedal Shaker-Aft	C15302(83326)	2RH1680000457081GA					
Rudder Pedal Shaker-Fwd.	C15302(83326)	2RH1680000457081GA					
Indicator-Fwd.	MS28067-2	2RQ6610006207888FZ	None	TACTICAL COMPUTER			
Indicator-Aft	MS28067-2	2RQ6610006207888FZ		HUD			
Approach Lights	MS25318-2	9G6220009441332			None	1	
	MS25318-3	9G6220009441345					
	MS25318-4	9G6220009261311					
Indexer-Fwd.	MS25317-7	9N6220001812542					
Indexer-Aft.	MS25317-7	9N6220001812542					

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TABLE 15

EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
HEADING MODE SYSTEM							
Attitude Direction Indicator-Fwd.	MS18028-1	2RH6610009442632FZ					
Attitude Direction Indicator-Aft.	MS18028-1	2RH6610009442632FZ					
Horizontal Situation Indicator-Fwd.	MS17869-1	2RE5826009447012GA		Head-Up Display	T7A383	2	--
Horizontal Situation Indicator-Aft.	MS17869-1	2RE5826009447012GA	Tactical Computer		Line Analyzer (ADI)		
			Inertial Measurement				
Turn Rate Gyro 1	T751AJB3A	2RH1280002210649GA		TACAN			
Turn Rate Gyro 2	T751AJB3A	2RH1280002210649GA		Auto Direction Finder			
Electronic Switch Demodulator	215-27143-1	2RH5841000429723GA					
DC Amplifier	220-27105-101	2RH6610010241459UA					
STANDBY ATTITUDE INDICATING SYSTEM							
Rate Switching Gyro	MS17399-1	2RH6615009509736FZ	None	None	None	1	--
Vertical Displacement Gyro	CN1169A(30003)	2RH6615009587969FZ					
Attitude Indicator-Fwd.	MS17249-1	1A6610003101407					
Attitude Indicator-Aft.	MS17249-1	1A6610003101407					
AUTOMATIC FLIGHT CONTROL SYSTEM (AN/ASW-26)							
Control-Fwd.	215-21130-1	2RH6615000877443					
Control-Aft.	215-21130-2	2RH6615004113356					
Pitch Control Amplifier	215-37121-24	2RH6615002777204	None	Inertial Measurement Set	AN/ASM-499	5	Hydraulic system and
Roll Control Amplifier	215-37121-21	2RG6615001108926			AFCS T/S		actuators and Loads
Yaw Control Amplifier	215-37121-18	2RG6615004004257					Required.
Roll Actuator	210-32230-19	2RG1650001791148		Air Data Computer			
Pitch Actuator	210-32230-20	2RG1650002498983					
Yaw Actuator	210-32230-20	2RG1650002498983					
Running Time Indicator	MS17322-6A	6645009042754					
Lateral Accelerometer	216-37194-1	6615001812469					
Dual Command Coupler	220-37330-101	6615010281932					
Rate Gyro No. 1	215-37128-2	6615008772122					
Rate Gyro No. 2	215-37128-2	6615008772122					
Roll Solenoid Valve	215-32331-1	1650000597961					
Pitch Solenoid Valve	215-32331-1	1650000597961					
Yaw Solenoid Valve	215-32331-1	1650000597361					
ARI Gain Changer	215-48103-5	5905000899527					
AIL-RUD Transducer	215-38104-3	6610009956114					
Normal Accelerometer 1	215-37129-2	6615008775925					
Normal Accelerometer 2	215-37129-2	6615008775925					
APPROACH POWER COMPENSATOR (AN/ASN-54)							
Computer	215-37155-3	2RH66150078208 95GA					
Servo Actuator	215-47120-1	8RH6615000899084GA					
Servo Amplifier	215-37126-2	8RH6615001217677GA	Angle of Attack	None	AN/ASM-334	2	--
UHT Potentiometer	215-48071-1(Simulate)	(Simulace)			APC T/S		
Accelerometer	215-37178-2	1RD6615008801341					
APC Warning Light	CVC2600-9	9G6210001830523					

AD-A066 393 VOUGHT CORP DALLAS TEX F/G 1/3
AAES LABORATORY SIMULATOR REQUIREMENTS (A-7 AIRCRAFT).(U)
SEP 78 J R PERKINS, D E LAUTNER, J L JONES N62269-77-C-0377
UNCLASSIFIED 2-54100/8R-3510 NADC-77277-30 NL

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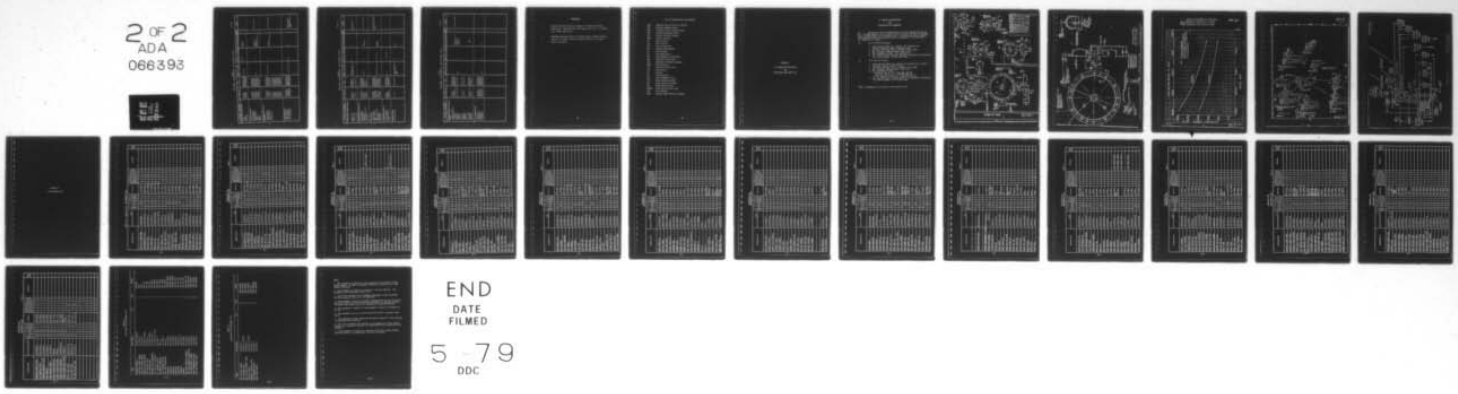

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TABLE 15

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EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
APPROACH CONTROL SYSTEM (AN/ARA-63)			Heading Mode	Data Link	AN/ARM-146 ACS T/S	3	--
Receiver	R1379/ARA63	8RG5826004917513EX					
Decoder	KY651/ARA63	8RH5826004917514EX					
Control-Fwd.	C7949/ARA63	8RH5895001688856EX					
Control-Aft.	C7949/ARA63	8RH5895001688856EX					
RADAR BEACON (AN/APN-154)			None	None	AN/APM-230B Radar Beacon T/S SM/658/APM Radar Beacon Simulator	3	Radiation Required.
Control Panel-Fwd.	C4419/APN154	2RH5841001687890					
Control Panel-Aft.	C4419/APN154	2RH5841001687890					
Receiver-Transmitter	RT763/APN154	2RH5895001108174					
KA Band Receiver	R1623/APN	2RH5895001687820					
Antenna 1	AS1739A/APN154	1RM5841000706136					
Antenna 2	AS2406/APR	2RH5841001687822					
Modulator	MD817/APN154	2RH5841001687819					
Duplexer	CU1104/APN154	1RD5841007636060					
DIGITAL DATA COMMUNICATION SET (AN/ASW-25)			Tactical Computer	None	SM-511/ASW Digital Data Simulator	3	Classified equipment.
Converter-Receiver	CV2230A/ASW-25	2RH5895008391404					
Coupler Converter	218-27590-1	2RH5895001688358GA					
Control Panel-Fwd.	C7100/ASW-25	2RH5895001683631					
Control Panel-Aft.	C7100/ASW-25	2RH5895001683631					
Antenna	218-77514-1	1RD5826001186221					
Data Link Lights							
	CVC2600-10	9G6210001830521					
	CVC2600-10	9G6210001830521					
	CVC2600-11	9G6210001830522					
	CVC2601-45	9G6210001830532					
	CVC2601-46	9G6210001830533					
	CVC2602-35	9G6210001830552					
	CVC2602-35	9G6210001830552					
	CVC2602-45	9G6210001193148					
	CVC2602-45	9G6210001193148					
UHF RADIO (AN/ARC-159)			Intercommunication Set	None	None	3	Radiation Required. (Alternate FSN 8RH5821001401817HZ for ID-1972)
Control Panel-Fwd.	C9815/ARC-159	8RH5821010213503JZ					
Control Panel-Aft.	C9815/ARC-159	(Same as above)					
Receiver-Transmitter	RT-1150/ARC-159	8RH5821010184240JZ					
Freq. Indicator-Fwd.	ID-1972/ARC-159	8RH5821001401785HZ					
Freq. Indicator-Aft.	ID-1972/ARC-159	(Same as above)					

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TABLE 15

EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
AUTOMATIC DIRECTION FINDER (AN/ARA-50)							
UHF-IFF Diplexer Antenna Amplifier-Relay Tail Cap Antenna	215-37151-1 AS909/ARA48 AM3624/ARA50 216-60090-4	9N5985000694614 2RH5826008490055 2RH5826000592726 1RD1560001030573	UHF Radio Intercommunications Set Heading Mode System	None	None	3	ADF Station must be available.
INTERCOMMUNICATIONS SET (AN/AIC-25)							
Control Panel-Fwd. Control Panel-Aft. Intercom Station Tone Generator Pilot's Service Disconnect Pilot's Headset Audio Unit	220-21362-101 220-21362-101 C6624/AIC-25 218-37530-1 215-21191-3 (Simulate) 220-27416-105	1RD1680010248762 1RD1680010248762 2RH5831008802833 2RH5821005147856 (Simulate) (Simulate) 2RH5950010274134	UHF Radio	None	TS387U Handphone T/S	2	Audio Source required.
TACAN (AN/ARN-84)							
Control Panel-Fwd. Control Panel-Aft. Receiver-Transmitter Mount Antenna Switching Unit Blower Assembly Lower Antenna Upper Antenna	C9054/ARN-84 C9054/ARN-84 RT1022/ARN-84 MT-4354/ARN-84 SA-521A A018709(82877) 218-77514-1 CV21-010001-4	1RD5826009480468 1RD5826009480468 8RH5826001688769TZ 8RH5826001688770TZ 5985008370000 1RM4140008786606 1RD5826001186221 1RM5826000899727	Heading Mode System	Tactical Computer	AN-ARM-155 AN-ARM-156	2	(The C2010 panels are an acceptable alternate for C9054.) --
IFF TRANSPONDER (AN/APX-72)							
Control Panel-Fwd. Control Panel-Aft. Receiver-Transmitter Tester	C6280/APX C6280/APX RT859A/APX-72 TS1843/APX-72	1RD5895001822980 1RD5895001822980 2RH5895001491319AZ 2RH5895008594446	None	Air Data Computer		2	--
INTERFERENCE BLANKER							
Interference Blanker	216-37162-3	2RH5841001066148	Forward Looking Radar Radar Altimeter TACAN IFF	None	None	2	--

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TABLE 15

EQUIPMENT REQUIREMENTS FOR SYSTEMS TESTS

SYSTEM & EQUIPMENT	LTV PART NO.	FSN	OTHER SYS. REQD.	OTHER SYS. DESIRED	TEST EQUIPMENT REQD	TEST DIFF.	NOTES
PASSIVE COUNTERMEASURES (AN/ALR-45 and ALR-50)							
45/50 Control Panel	218-21195-3	2RH5865001275166	None	None	AN/ASM-456, 457, 458 High Power RF Simulators. AN/ALM-140 ALR-50 T/S	2	Classified equipment.
Signal Distribution Unit	218-37503-4	2RH5865000011771					
45 Analyzer	TS3053/ALR-45	8RH5865001486059					
45 Indicator	31-011203-01(15280)	2RH5865009892107					
Preamp-45°, Preamp-135°, Preamp-225°, Preamp-315°	31-027824-01(15280)	2RH5865004345409					
50 Receiver	R1764/ALR-50	8RG5865000019653					
Antenna-45°, Antenna-315°, Antenna-225°, Antenna-125°	AS2605/ALR45	1RD5895004345306					
Upper Antenna	AT-141A	9N5985001060906					
Lower Antenna	01-23-03721(15280)	1RD5895001340900					
RHAW Lights	216-21347-11	(Simulate)					
RHAW Lights	CVC2601-44	9G6210001830538					
CHAFF DISPENSER (AN/ALE-29)							
Control Panel	218-21243-2	2RH5895004940781	None	None	None	1	—
Left Sequencer	SA1557/ALE-29A	2RH5895000874212					
Right Sequencer	SA1557/ALE-29A	2RH5895000874212					
Programmer	MX7718/ALE-29A	2RH5865001773417					
Left Dispenser	MX7721/ALE-29A	2RH5865000899754					
Right Dispenser	MX7721/ALE-29A	2RH5865000899754					

REFERENCES

1. Advanced Aircraft Electrical System, A-7E Prototype Design, Final Report NADC-76193-30, dated August 1977, by J. R. Perkins, etal, Vought Corporation.

2. POWERTRAN Reference Manual for Program Support Software Pakcage, Report No. 78-14905, dated 15 February 1978, by W. R. Sobko, Garrett Airesearch.

LIST OF ABBREVIATIONS AND ACRONYMS

AAES	Advanced Aircraft Electrical System
AAS	Advanced Armament System
ACLS	Automatic Carrier Landing System
ADM	Advanced Development Model
AMT	Avionic Multiplex Terminal
AMUX	Avionic Multiplex
BC	Bus Controller
BIT	Built In Test
BTC	Bus Tie Controller
CAD	Computer Aided Design
DT	Data Terminal
EM	Electromechanical
EMI	Electromagnetic Interference
GCU	Generator Control Unit
GFE	Government Furnished Equipment
HVDC	High Voltage DC
ICU	Industrial Control Unit
I/O	Input/Output
KW	Kilowatt
LC	Load Controller
LMC	Load Management Center
PCU	Power Conditioning Unit
PGS	Power Generation System
SCG	SOSTEL Control Group
SOSTEL	Solid State Electric Logic
TBE	To be Defined
VSCF	Variable Speed Constant Frequency

APPENDIX A

A-7 ENGINE PAD DEFINITION
FOR
INTERFACING HVDC GENERATOR

A-7 ENGINE PAD DEFINITION
FOR
INTERFACING HVDC GENERATOR

1.0 Enclosed are drive pad definitions for the two engines used on the A-7. The HVDC generator can be suitable mounted on either in terms of available space, overhung moment, and available torque. A suitable gear box is required for attaining the desired speed/rotation for the generator. The drive pads are summarized as follows:

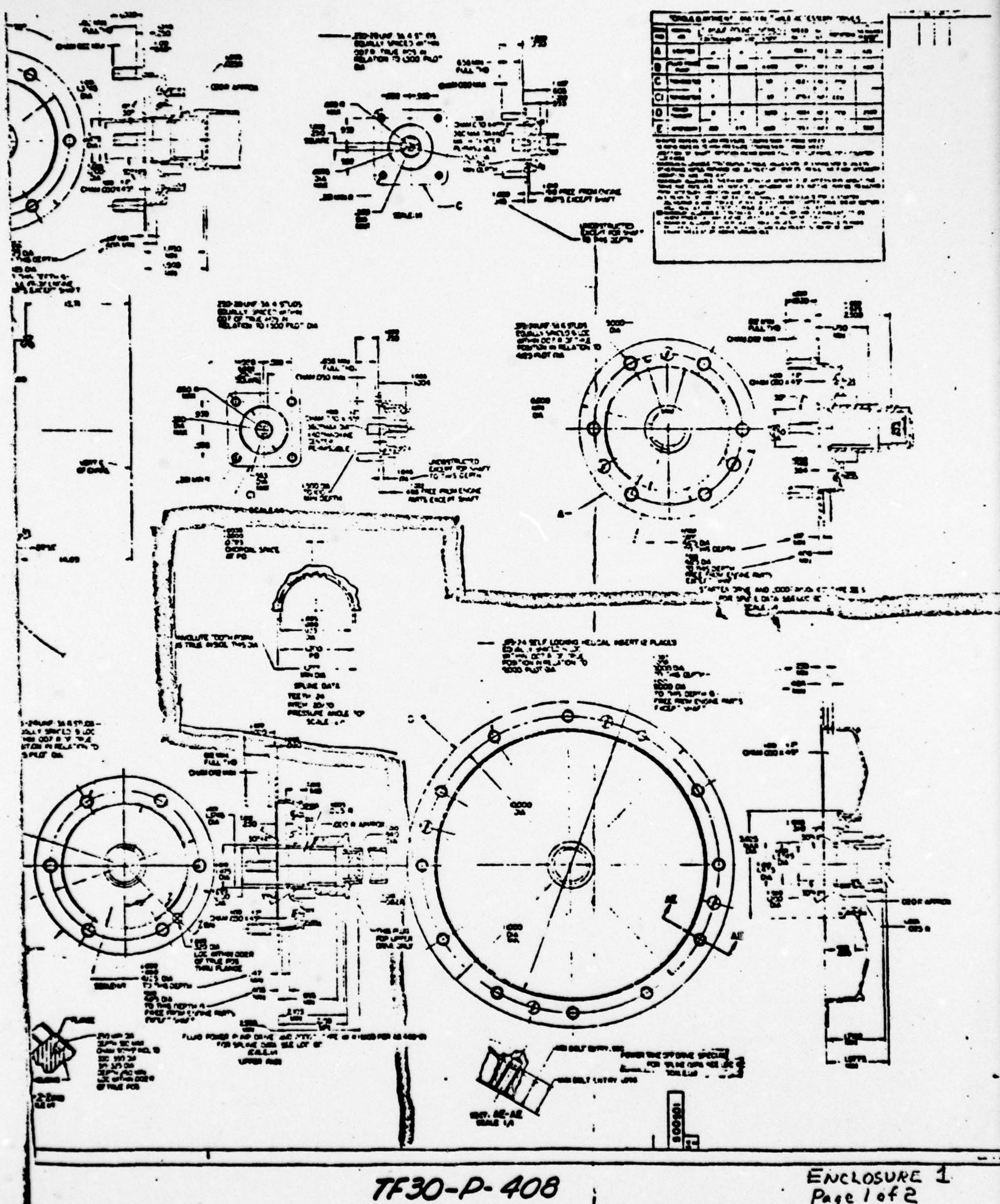
1.1 TA-7C (TF30-P-408 Engine)

a. Power Take-off (CSD) Pad - Special, see enclosure (1), counter clockwise rotation (looking at pad).
b. Pad Output RPM Range 4000 to 7500 RPM (.488 N_2 RPM).
c. Max. allowable overhung moment 2,500 in-lb.
d. Max. permissible torque, - See Enclosure (2).
e. Max. available space envelope available for generator installation: 11.0 inches diameter x 24.00 inches long.

1.2 A-7E (TF41-A-2 Engine)

a. Power Take-off (CSD) Pad - Special, see Enclosure (3), counter clockwise rotation (looking at pad).
b. Pad Output RPM Range 4074 to 7459 RPM (.574 N_2 RPM).
c. Max. allowable overhung moment 2,500 in-lb.
d. Max. permissible torque:
   Continuous 2354 lb.-in. @ 4074 RPM (152 HP),
   Continuous 1060 lb.-in. @ 7459 RPM (125 HP).
   5 Min. Overlead 3750 lb.-in. @ 4074 RPM (242 HP).
e. Max. available space envelope available for generator installation: 11.0 inches diameter x 24.0 inches long.

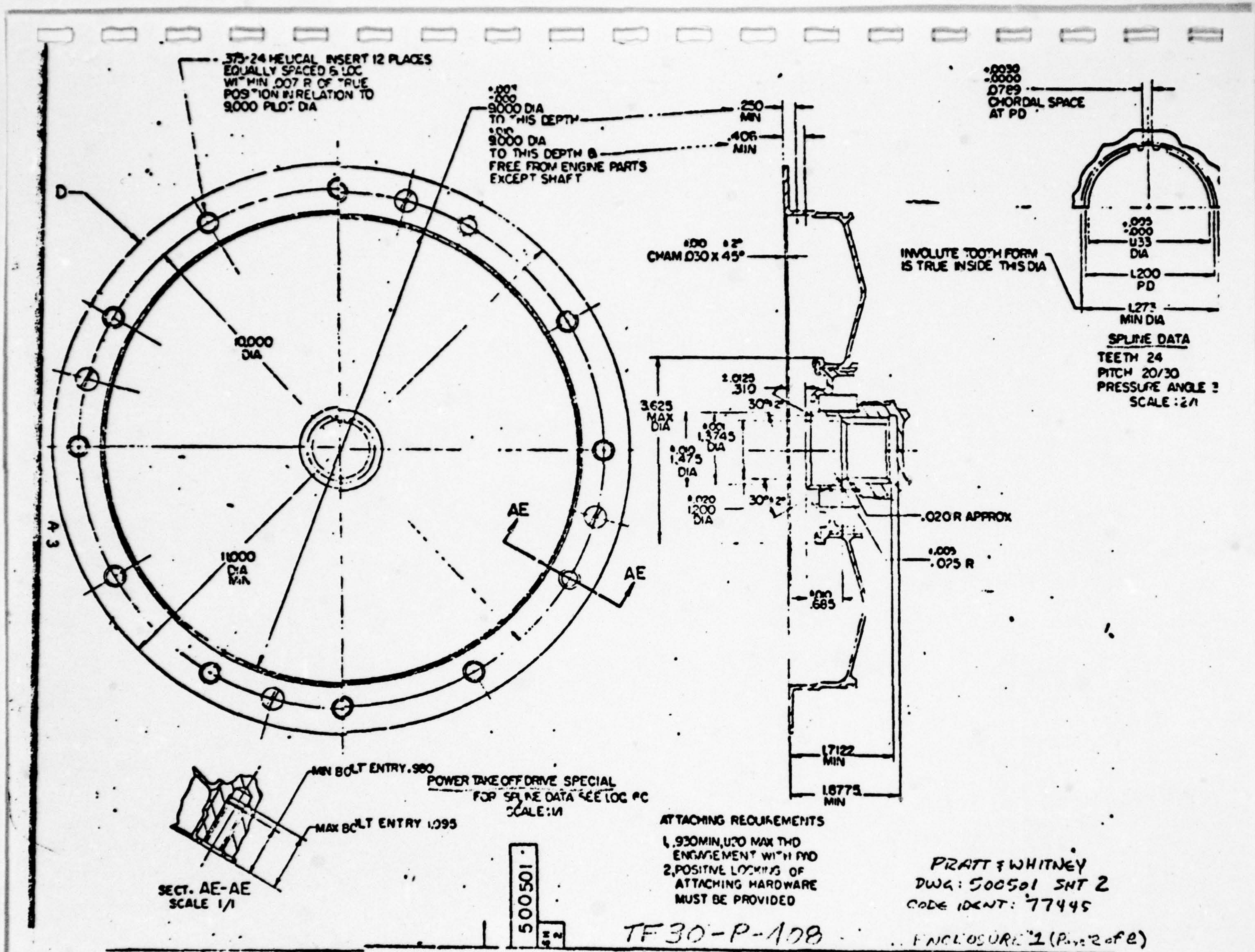
NOTE: Enlargements are provided to show details of pad.



TF30-P-408

Enclosure 1
Page 1 of 2

A 2



PRATT & WHITNEY
DWG: 500501 SHT 2
CODE IDENT: 77445

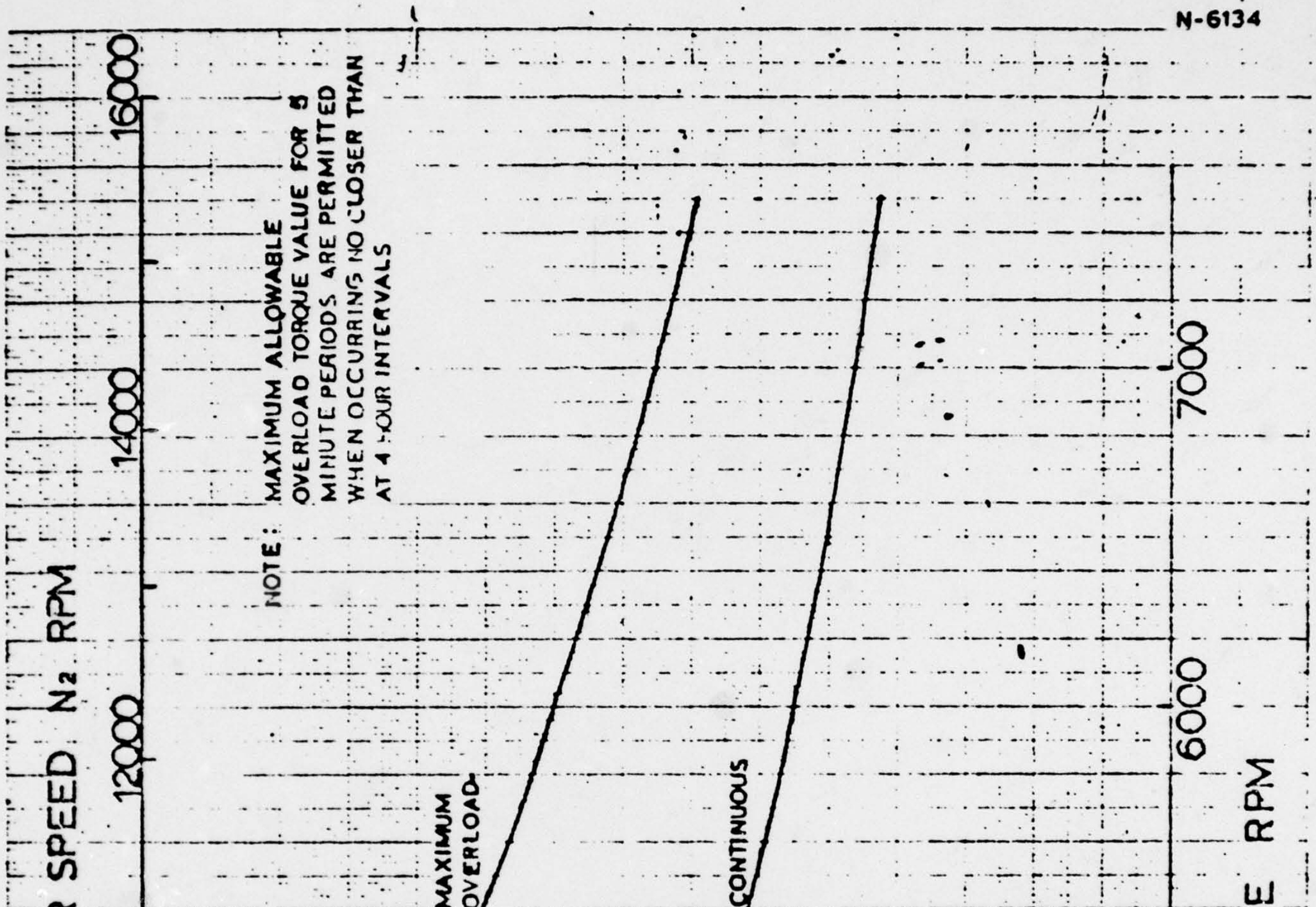
TF30-P-408

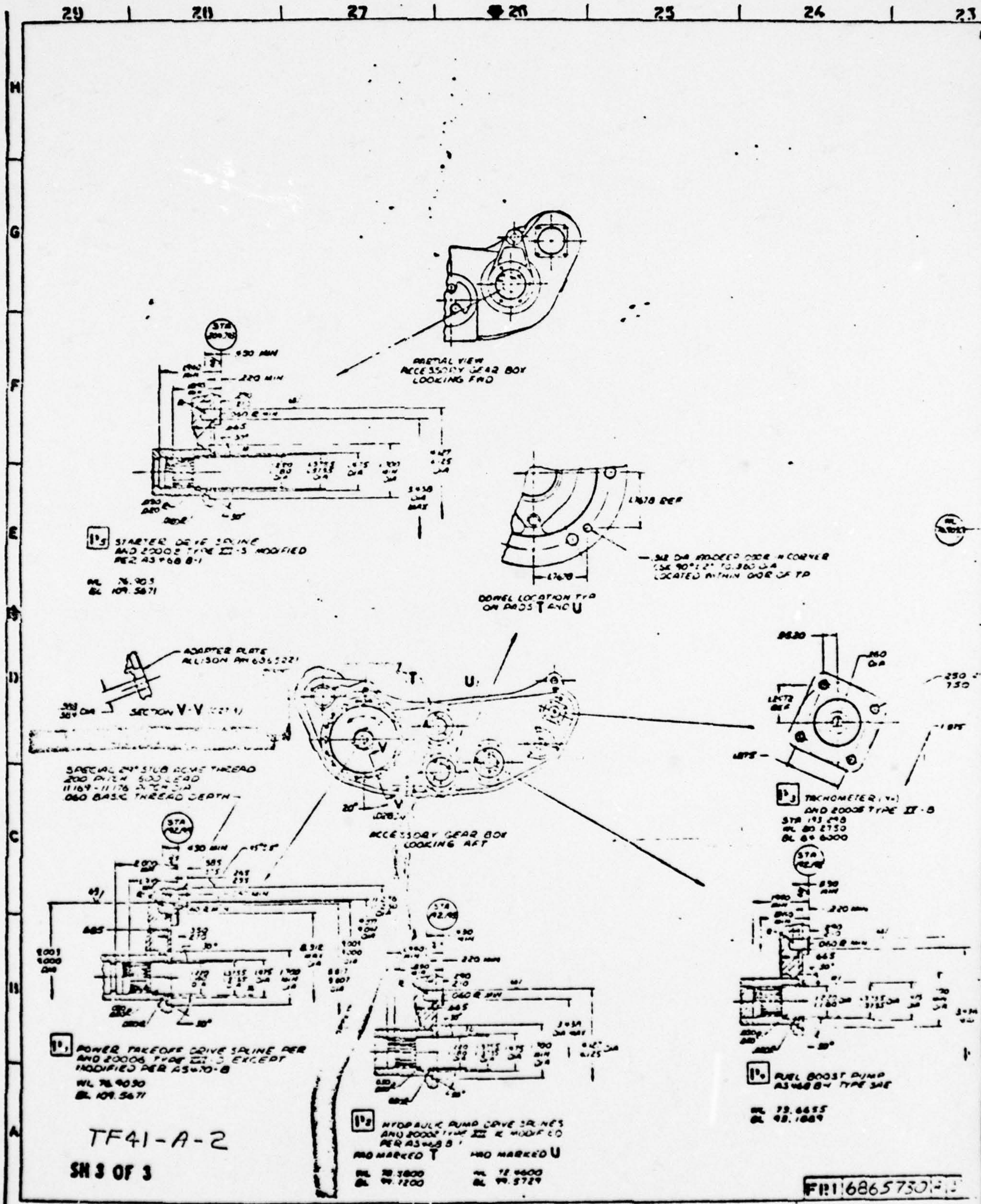
ENCLOSURE 1 (Page 2 of 2)

TF30-P-408 TURBOFAN ENGINE

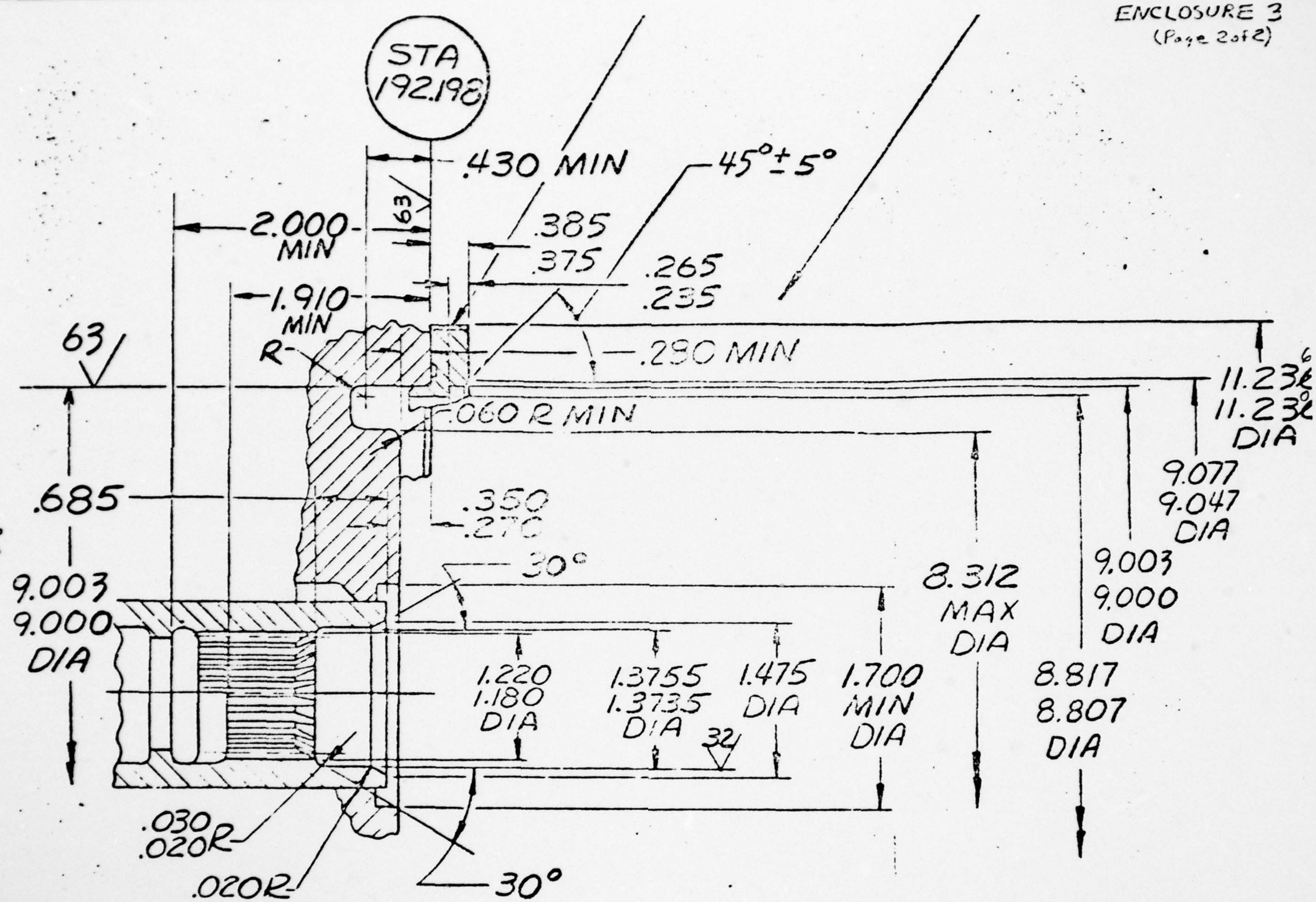
ALLOWABLE TORQUE vs RPM
FOR GENERATOR DRIVE PAD

ENCL (2)




PARTIAL VIEW
ACCESSORY GEAR BOX
LOOKING FWD
STARTER DRIVE SPLINE
DOWEL LOCATION TYP
ON PADS T AND U
ADAPTER PLATE
SECTION V-V
SPECIAL 29° STUB ACME THREAD
ACCESSORY GEAR BOX
LOOKING AFT
TACHOMETER
POWER TAKEOFF DRIVE SPLINE PER
HYDRAULIC PUMP DRIVE SPLINES
PAD MARKED T
PAD MARKED U
FUEL BOOST PUMP
TF41-A-2
SH 3 OF 3

ENCLOSURE 3
(Page 2 of 2)



TF41-A-2

Code Ident 73342
DWG No 6865730

APPENDIX B

GFE EQUIPMENT LIST

TABLE B-1: SIMULATOR GFE **EQUIPMENT LIST**

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK UP	OTHER	REMARKS	QUAL TEST REQD
SIDS SIG CONDITIONER	CV2529/APG			X	1				L AVIONIC									
DIODE/RESISTOR CARD	220-27182-101		X		1				AMMO CMPT				X					
FWD STICK GRIP	215-21132-3		X		1				FWD COCKPIT				X					
AFT STICK GRIP	215-21132-3		X		1				AFT COCKPIT				X					
ARMT ADV LTS	CVC260X SERIES		X		8				FWD INSTR BD				X					
ARMT ADV LTS	CVC 260X SERIES		X		7				AFT INSTR BD				X					
GUN CONTROL UNIT	216-27209-2		X		1				LOX CMPT									
GUN CMPT PURGE VALVE	215-26106-3		X		1				MID EQUIP									
FUZE FUNC CTL PNL	C-8213/AWW-2B			X	1				LCSL-FWD									
FUZING PWR SUPPLY	AM4708A/AWW-2A			X	1				L AVIONIC									
CAMERA CONTROL UNIT	LB-17A			X	1				L AVIONIC									
CAMERA	KB-18A			X	1				AFT SHELF									
THROTTLE QUADRANT	220-21241-101		X				1		LCSL-FWD				X					
THROTTLE QUADRANT	220-21241-102		X				1		LCSL-AFT				X					
SPEED BRAKE VALVE	215-32106-3		X		1				AFT SHELF									
WHLS/FLAPS WARN LT	CVC2553-58		X		1				FWD INSTR				X					
WHLS/FLAPS WARN LT	CVC2553-58		X		1				AFT INSTR				X					
FUEL MGMT PNL-FWD	218-21270-3		X				1		LCSL-FWD				X					

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
FUEL MGMT PNL-AFT	220-21269		X				1		LCSL-AFT				X					
APC WARNING LIGHT	CVC2600-9		X		2				FWD INSTR BD				X					
ACCEL TRANSDUCER	215-37178-2		X		1				L AVIONIC									
APC COMPUTER	215-37155-3		X		1				L AVIONIC									
APC AMPLIFIER	215-37126-2		X		1				L AVIONIC									
APC ACTUATOR	215-47120-1		X		1				AFT SHELF									
AFT GEN CTL PNL	220-21174-101		X				1		LCSL-FWD				X					
FWD GEN CTL PNL	218-11074-4		X				1		LCSL-AFT				X					
PITCH & ROLL TRIM AMPL	215-37134-4		X		1				L AVIONIC									
ROLL TRIM ACTUATOR	215-38030-5		X		1				AFT SHELF									
PITCH TRIM ACTUATOR	215-68050-3		X		1				AFT SHELF									
T.E. FLAPS CTL VALVE	215-22151-6		X		1				DORSAL									
EMER FLAPS VALVE	215-22106-1		X		1				L MID EQUIP									
L FWD SLANT PNL	218-21261-1		X				1		LCSL-FWD				X					
L AFT SLANT PNL	220-21375-101		X				1		LCSL-AFT				X					
FWD LDG GR HDL	CV21-406052-6		X		1				LCSL FWD				X					
AFT LDG GR HDL	CV21-406052-6		X		1				LCSL-AFT				X					
T.E. FLAPS SYNCHRO	215-77709-1		X		1				DORSAL				X					

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
SPEED BRAKE POS IND	216-21573-1		X		2				FWD & AFT INSTR BD				X					
SPD BRAKE POS SYNCHRO	215-77709-1		X		1				R CHEEK				X					
FUEL QTY IND-FWD	215-21301-1		X		1				FWD INSTR				X					
FUEL QTY IND-AFT	220-21301-101		X		1				AFT INSTR				X					
DOPPLER CTL PNL	216-21380-1			X	1				RCSL-FWD								APN=190 System (Doppler Ctl Pnl, Doppler Transciever, Doppler Antenna)	
DOPPLER TRANSCIEVER	216-37629-1			X	1				R AVIONIC									
DOPPLER ANTENNA	216-37525-1			X	1				MID EQUIP									
RH PITOT TUBE	856W4 (04274)			X	1				R COCKPIT				X					
STBY ATT IND	MS17249-1			X	2				FWD & AFT COCKPIT				X					
RATE GYRO	MS17399-1			X	1				L AVIONIC				X					
VERTICAL GYRO	CN1169A (30003)			X	1				R AVIONIC				X					
IMS CONTROL	216-21355-3			X	1				RCSL FWD								ASN-90 System (IMS Control, IM Unit, Adapt Pwr Supply)	
IM UNIT	216-37340-7			X	1				L AVIONIC									
ADAPT PWR SUPPLY	216-37631-9			X	1				L AVIONIC									
REMOTE COMPASS XMTR	MS25396-1			X	1				AFT EQUIP									
ANGLE OF ATTACK IND	MS28067-2			X	2				FWD & AFT INSTR BD				X					
APPROACH INDEXER	MS25317-7			X	2				FWD & AFT INSTR BD				X					
RUDDER PEDAL SHAKER	C15302 (83326)		X		2				FWD & AFT COCKPIT				X					

SIMULATOR GFE
EQUIPMENT LIST

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
APPROACH LTS	MS25318 (-2,-3,-4)		X		3				L DUCT WALL				X					
AOA TRANSDUCER	220-27166-101		X		1				L COCKPIT				X					
RELAY CARDS	216-17411-1		X		6				L AVIONIC				X					
DEMOD SWITCH	215-27143-1		X		1				AFT COCKPIT				X					
ATT DIR IND	MS18028-1			X	2				FWD & AFT INSTR BD									
AIRSPEED IND	215-21124-3		X		1				FWD INSTR BD									
DC AMPLR	220-27105-101		X		1				AFT COCKPT									
TURN RATE GYRO	MS17394-1			X	2				L AVIONIC									
AFT FLT MODE PNL	220-21271-101		X				1		AFT INSTR BD				X					
IN RANGE INDICATOR	CVC2600-7		X		2				FWD & AFT INSTR BD				X					
HEADS-UP DISPLAY	216-21245-32		X		1				FWD INSTR BD									
HUD ELEC UNIT	218-37267-21		X		1				L AVION									
HUD MOUNT	216-21245-26		X		1				FWD INSTR BD									
LATERAL ACCELOMETER	216-37194-1		X		1				L AVION									
PROJ MAP DISP UNIT	ID-1665/ASN-99			X	1				FWD INSTR									
PROJ MAP ELEC UNIT	218-37668-4			X	1				R AVION									
PMDS XFMR	218-27505-1		X		1				R AVION									
NWD CONTROL	216-21231-4			X	1				RCSL FWD									

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
NWD MONITOR DISP	220-21203-101		X		1				RCSL AFT									
NWD COMPUTER	216-37183-14			X	1				L AVIONIC									
DIG DATA FORMATTER	218-27590-1		X		1				MID EQUIP									
HUD CAMERA	220-21201-101		X		1				FWD INSTR BD									
HUD MONITOR	220-21201-102		X		1				AFT INSTR BD									
ACLS DECODER	KY651/ARA63			X	1				DUCT WALL									
ACLS RCVR	R1379/ARA63			X	1				DUCT WALL									
ACLS CNTL PNL	C7949/ARA63			X	2				FWD & AFT RCSL									
CMD XFER PNL	220-21366-103		X				1		FWD INSTR BD				X					
CMD XFER PNL	220-21366-104		X				1		AFT INSTR BD				X					
HORIZ SIT IND	MS17869-1			X	2				FWD & AFT INSTR BD				X					
WINGFOLD CTL ASSY	215-21222-25		X				1		RCSL FWD				X					
WINGFOLD VALVE	215-32101-1		X		1				MID EQUIP				X					
ARG VALVE	215-32331-1		X		1				AFT SHELF				X					
LGS SELECTOR VALVE	215-32331-1		X		1				MID EQUIP				X					
LAUNCH BAR WARN LT	218-21680-1		X		2				FWD & AFT INSTR BD				X					
LAUNCH BAR VALVE	215-22122-2		X		1				MID EQUIP				X					
HYD ACCUM HTR BLNKT	215-27156-3		X		1				MID EQUIP				X					

SIMULATOR GFE
EQUIPMENT LIST

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
ELECT COMPT FAN	215-36320-2A		X		2				L&R AVIONIC				X					
RED FLD LIGHTS	A9555-2 (72914)		X		17				COCKPIT				X					
WHT FLOOD LIGHTS	A4950A-1 (72914)		X		8				COCKPIT				X					
COCKPIT UTILITY LT	MS17245-5		X		2				COCKPIT				X					
LIGHTING XFMR	CV21-207503-2		X		6				COCKPIT				X					
TRIMMER PANEL	216-27383-26		X		1				COCKPIT				X					
DIMMER PWR SUPPLY	218-27538-1		X		4				COCKPIT				X					
DIMMER PWR SUPPLY	218-27538-4		X		2				COCKPIT				X					
LAND TAXI LIGHT	50-0018 (72914)		X		1				MID EQUIP				X					
UPPER ANTI-COLLISION LT	215-77300-1		X		1				MID EQUIP				X					
FORMATION LT	CV21-407505-1		X		2				MID EQUIP				X					
FORMATION LT	CV21-407505-1		X		2				AFT SHELF				X					
TAIL LT	A6331-1		X		2				AFT SHELF				X					
TAIL LT	B6271-1		X		2				AFT SHELF				X					
MASTER CAUTION LT	210-29276-1		X		2				FWD & AFT INSTR BD				X					
TRIMMER PANEL	216-27383-27		X		1				COCKPIT				X					
SEAT ADJUST ACTUATOR	220-21151-107		X		1				FWD COCKPIT				X					
CAPACITOR ASSY	CP53B5FE504V1		X		2				FWD & AFT COCKPIT				X					
SEAT ADJUST ACTVATOR	220-21151-109		X		1				AFT CKPT				X					

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
EPP ACTUATOR VALVE	215-22337-1		X		1				MID EQUIP									
CANOPY ACTUATOR	220-24515-101		X		1				COCKPIT				X					
CANOPY LOCK ACTUATOR	220-24514-102		X		1				COCKPIT				X					
BATTERY, CANOPY	220-27020-103		X		1				MID EQUIP									
BATTERY CHARGER	220-27021-102		X		1				MID EQUIP									
PROBE LIGHT	218-21675-2		X		1				MID EQUIP				X					
PROBE VALVE	215-22330-1		X		1				MID EQUIP				X					
THERMAL SENSOR	215-33308-1		X		2				MID EQUIP				X					
FUEL TRANSFER VALVE	215-43301-1		X		2				AFT SHELF				X					
FUEL DUMP VALVE	AV16B1601		X		2				MID EQUIP				X					
UHF-ADF ANTENNA	216-60090-4			X	1				DUCT WALL									
UHF-ADF AMP-RELAY	AM-3624/ARA-50			X	1				R AVIONIC									
UHF-IFF DUPLEXER	215-37151-1			X	1				R AVIONIC									
UHF-IFF ANTENNA	216-60090-4			X	1				AFT-SHELF									
TONE GENERATOR	218-37530		X		1				R AVION									
TACAN CONTROL	C9054/ARN-84			X	2				FWD & AFT RCSL									

SIMULATOR GFE
EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
TACAN MOUNT	MT4354/ARN84			X	1				R AVION									
TACAN XMTR/RCVR	RT1022/ARN84			X	1				R AVION									
TACAN BLOWER	ROTR-AD-18709		X		1				R AVION									
TACAN COAXIAL SW	SA-521A			X	1				R AVION									
TACAN UPPER ANT	CV21-010001-4		X		1				MID EQUIP									
TACAN LOWER ANT	218-77514-1		X		1				MID EQUIP									
DATA LINK DISC LTS	CVC2601 SERIES		X		9				FWD & AFT INSTR BD				X					
DATA LINK CTL	C7100/ASW-25			X	2				FWD & AFT LCSL									
DATA LINK RCVR- CNVTR	CV2230A/ASW-25			X	1				MID EQUIP									
DATA LINK ANTENNA	218-77514-1		X		1				DUCT WALL									
UHF CHANNEL IND	ID-1972/ARC-159			X	2				FWD & AFT INSTR BD									
UHF CONTROL PNL	C9815/ARC-159			X	4				FWD & AFT INSTR BD									
UHF SWITCHING UNIT	220-37455-101		X		1				L AVION									
UHF XMTR RCVR	RT1150/ARC-159			X	2				R AVION									
AUDIO CONTROL PNL	220-21362-101		X				2		FWD & AFT LCSL				X					
AUDIO UNIT	220-27416-105		X		1				MID EQUIP				X					
INTERCOM STATION	C6624/AIC-25			X	1				MID EQUIP									
HEIGHT INDICATOR	ID1760/APN-194			X	1				FWD & AFT INSTR BD									

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	(*) PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY: ADD	QTY: REMOVE	QTY: REWORK	QTY: REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
HEIGHT IND RCVR-XMTR	RT1042/APN-194			X	1				R AVION									
HEIGHT INTERFERENCE BLANKER	MX9132A/APN-194								R AVION									
HEIGHT IND ANTENNA	/APN-194			X	2				MID EQUIP									
ALTITUDE INDICATOR	AAU-19/A			X	2				FWD & AFT INSTR BD									
RADAR SET	216-27122-8		X		1				NOSE									
RADAR MOUNT	MT-4043/APQ126		X		1				NOSE									
RADAR INDICATOR	220-21242-101		X		1				FWD INSTR BD									
RADAR DIG SCAN CNVR	220-27121-101		X		1				MID EQUIP									
RADAR RANGE CTL	216-21600-10		X		1				FWD INSTR BD									
RADAR CTL PNL	216-21143-7		X		1				FWD LCSL									
RADAR INDICATOR	220-21242-102		X		1				AFT INSTR BD									
RADAR FAULT LOC	216-27877-1		X		1				CAN DECK									
RADAR PWR SUPPLY	PP6130/APQ126		X		1				NOSE									
RADAR BLOWER	216-27393-4		X		1				NOSE									
RADAR XFMR	CVC6070-5		X		1				NOSE				X					
RADAR XFMR	CVC6070-6		X		1				NOSE				X					

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CFE	GFE	QTY				LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
					ADD	REMOVE	REWORK	REPLACE										
RADAR ANT TILT CTL	220-21186-101		X		1				AFT LCSL									
IFF TRANSPONDER CTL	C-6280/APX			X	2				FWD & AFT LCSL									
IFF TRANSPONDER TESTER	TS-1843/APX-72			X	1				R AVION									
IFF RCVR-XMTR	RT-859/APX-72			X	1				R AVION									
INTERFERENCE BLANKER	216-37162-3		X		1				L AVION									
RHAW CTL PNL	218-21195-3		X		1				FWD RCSL									
RHAW RCVR	R1764/ALR-50			X	1				R AVION									
RHAW ANALYZER	TS3053/ALR-45		X		1				L AVION									
RHAW INTERFACE	218-37503-4		X		1				L AVION									
RHAW ANTENNA	AT-741A		X		1				MID EQUIP									
RHAW ANTENNA	01-23-03721		X		1				MID EQUIP								(CODE IDENT 15280)	
RHAW INDICATOR	31-011203-01		X		1				FWD INSTR BD								(CODE IDENT 15280)	
RHAW PREAMP	31-027824-01		X		4												(CODE IDENT 15280)	
RHAW ANTENNA	AS2605/ALR45		X		2				DUCT WALL									
RHAW ANTENNA	21-027827		X		2				AFT SHELF								(CODE IDENT 15280)	
INTEGRATED ECM PNL	218-21243-2		X		1				FWD RCSL									
PROGRAMMER	MX7718/ALE-29A			X	1				COCKPIT									
CHAFF SEQUENCER	SA1557/ALE29A			X	2				AFT SHELF									

SIMULATOR GFE
EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO (*)	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
CHAFF DISPENSER	MX7721/ALE29A			X	2				AFT SHELF									
AIR DATA COMPUTER	220-37125-101		X		1				R AVION									
TEMPERATURE PROBE	215-37152-1		X		1				MID EQUIP				X					
RADAR BEACON RCVR	R1623/APN			X	1				DUCT EQUIP									
RADAR BEACON XMTR	RT763/APN154			X	1				DUCT EQUIP									
RADAR BEACON DUPLEXER	CU-1104/APN154			X	1				DUCT EQUIP									
RADAR BEACON MODULATOR	MD-817/APN154			X	1				DUCT EQUIP									
RADAR BEACON ANTENNA	AS-1739A/APN154			X	1				DUCT EQUIP									
RADAR BEACON CTL PNL	C4419/APN154			X	2				FWD & AFT RCSL									
RADAR BEACON ANTENNA	AS2406/APR			X	1				DUCT EQUIP									
INT-EXT LTS CTL PNL	218-21399-3		X				1		FWD RCSL				X					
INT LTS CTL PNL	220-21299-101		X				1		AFT LCSL				X					
RELAY CARDS	216-17411-1		X		3				ERH U. AMMO				X					
RELAY CARDS	216-17411-1		X		2				L. AVIONIC				X					
RELAY CARDS	216-17411-1		X		3				R. AFT CKPT				X					
PURSE DOOR VALVE	216-32497-1		X		1				MID EQUIP									
HYDRAULIC SOLENOID	216-26205		X		1				MID EQUIP									
GUN RATE VALVE	216-32483-1		X		1				MID EQUIP									

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
ADVISORY LIGHTS PANEL	220-21353-101		X				1		FWD R CSL				X					
ADVISORY LIGHTS PANEL	220-21353-102		X				1		AFT R CSL				X					
HYDRAULIC PRESS XMITTER	216-32499-1		X		2				AFT SHELF									
PRESS RATIO INDICATOR	215-21185-1		X		2				FWD & AFT INSTR BD									
OIL PRESSURE INDICATOR	MS 17996-2		X		1				AFT INSTR BD									
OIL PRESSURE INDICATOR	218-21538-1		X		1				FWD INSTR BD									
FUEL QTY SIM ASSY	216-27361-1		X		1				MID EQUIP									
TACHOMETER INDICATOR	MS 21971-2		X		2				FWD & AFT INSTR BD									
FUEL FLOW INDICATOR	EFU-7/A		X		2				FWD & AFT INSTR BD									
TURBINE INLET TEMP IND	215-21338-1		X		2				FWD & AFT INSTR BD									
PITOT HEATER	856W-1		X		1				COCKPIT									
ACCEL COUNT INDICATOR	MS 25448-1		X		1				AFT SHELF									
ACCEL COUNT TRANSDUCER	MS 25447-7		X		1				AFT SHELF									
ANTI-SKID CONTROL UNIT	218-34251-4		X		1				RH AVION									
ANTI-SKID CONTROL VALVE	216-34251-1		X		1				AFT SHELF									
ANTI-SKID SHUTOFF VALVE	216-32498-1		X		1				AFT SHELF									
BATTERY RELAY ASSY	220-27225-101		X		1				R COCKPIT				X					

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
PARABRAKE CONTROL VALVE	215-22120-2		X		1				AFT SHELF									
EJECTOR VALVE	397690-1-1(99 193)		X		1				R COCKPIT									
RAIN REPELIANT VALVE	MS 29527-1		X		1				"RADAR COMPT"									
ACCUM HEATER BIANKET	215-27156-1		X		1				MID EQUIP									
ACCUM HEATFR BIANKET	215-27156-3		X		1				MID EQUIP									
FUEL SHUTOFF VALVE	215-43307-2		X		2				AFT SHELF									
ANTI-COLLISION LIGHT	216-37341-4		X		1				BASE									
WING POSITION LIGHT	215-87300-1		X		1				AFT SHELF									
WING POSITION LIGHT	215-87300-2		X		1				AFT SHELF									
WING FORMATION LIGHT	215-87120-1		X		1				AFT SHELF									
WING FORMATION LIGHT	215-87120-2		X		1				AFT SHELF									
FUSELAGE FORMATION LIGHT	CV21-408505-1		X		2				MID EQUIP									
HYD DUMP SURGE DAMPER	215-22308-1		X		1				AFT SHELF									
HYD ACCUMULATOR	215-22102-8		X		2				MID EQUIP									
HYD ACCUMULATOR	215-22102-10		X		1				MID EQUIP									
HYD ACCUMULATOR	215-22102-11		X		1				MID EQUIP									
FUEL SHUTOFF VALVE	215-73301-1		X		4				AFT SHELF									
THERMAL SENSOR CTL	215-33308-2		X		1				AFT SHELF									

SIMULATOR GFE

EQUIPMENT LIST

NOMENCLATURE	PART NO. OR SIMILAR TO	VENDOR	CFE	GFE	QTY ADD	QTY REMOVE	QTY REWORK	QTY REPLACE	LOCATION	DESIGN AND DEV TEST	GROUND TEST	FLIGHT TEST	SIMULATOR	EVALUATOR	MOCK-UP	OTHER	REMARKS	QUAL TEST REQD
PRESSURE SHUTOFF VALVE	215-73302-1		X		1				AFT SHELF									
AIR PRESSURE VALVE	215-43300-2		X		1				AFT SHELF									
PRESSURE REGULATOR VALVE	215-43304-5		X		1				AFT SHELF									
FIRE DETECTOR	215-27132-1		X		1				MID EQUIP									
FIRE DETECTOR SENSOR	215-47301-1		X		1				AFT SHELF									
LIQUID OXYGEN INDICATOR	GMU-61A		X		1				FWD L CSL									
LIQUID OXYGEN INDICATOR	GMU-65A		X		1				AFT L CSL									
LIQUID OXYGEN CONVERTER	33H1083(83533)		X		1				LOX COMPT									
LIQUID OXYGEN PRESS SWITCH	PS7000-14		X		2				FWD & AFT L CSL									
FWD RT SLANT PANEL	220-21213-101		X				1		FWD R CSL				X					
AFT RT SLANT PANEL	220-21313-101		X				1		AFT R CSL				X					
FWD ARMT RELEASE PANEL	218-21020-4		X				1		FWD INST BD				X					

TABLE B-2

ADDITIONAL GFE EQUIPMENT LIST

ITEM	PART NUMBER	FSN	NOTE	SYSTEM
CLEARING SOLENOID	11010205 (81840)		1	MG1 GUN
STICK GRIP FORCE SENSOR	215-21129-8		1	AFCS
STICK GRIP FORCE SENSOR	215-21129-8		1	AFCS
MAGNETIC PICK-UP SENSOR	114C2927 (05606)		2	MG1 GUN
FIRE VOLTAGE POINT	216-29126-1		2	MG1 GUN
LAST ROUND SWITCH	13535825 (05606)		2	MG1 GUN
PRESSURE RATIO TRANSDUCER	220-45302-101		5	ENG INSTR
OIL PRESSURE TRANSDUCER	MH-5/A9MIL-T-25642B		5	ENG INSTR
OIL PRESSURE SWITCH	215-55312-1		5	ENG INSTR
TACHOMETER GENERATOR	GEN-7/A		5	ENG INSTR
FUEL PRESSURE SWITCH	215-53301-1		4	FUEL CONTR
FUEL FLOW TRANSMITTER	TRU-12/A		5	ENG INSTR
WAVEGUIDE	216-37188-2		7	DOPPLER RADAR
WAVEGUIDE	216-37188-1		7	DOPPLER RADAR
WAVEGUIDE	216-37188-4		7	DOPPLER RADAR
WAVEGUIDE	218-27214-2		7	APP CTL LDG
WAVEGUIDE	218-27215-1		7	APP CTL LDG
WAVEGUIDE	218-27213-2		7	APP CTL LDG
ANTENNA	218-27500-1		7	APP CTL LDG
NOSE GEAR STEERING ACTUATOR	215-22130-1		11	NOSE GEAR STR
NOSE GEAR STEERING TRANSDUCER	215-68131-1		11	NOSE GEAR STR
AIR CONDITIONING CONTROL	216-26102-3		14	TEMP CONTROL
CABIN TEMPERATURE SENSOR	216-26119-1		14	TEMP CONTROL
SUIT AIR CONTROL PANEL	218-21257-1		14	TEMP CONTROL

TABLE B-2

ADDITIONAL GFE EQUIPMENT LIST

ITEM	PART NUMBER	FSN	NOTE	SYSTEM
SUIT AIR TEMP SENSOR	216-26119-1		14	TEMP CONTROL
SUIT AIRFLOW VALVE	397420-1-1 (99193)		14	TEMP CONTROL
SUIT AIR FLOW CONTROL PANEL	216-26118-2		14	TEMP CONTROL
CABIN AIR VALVE	397418-1-1 (99193)		14	TEMP CONTROL
HYDRAULIC SOLENOID VALVE	215-21067-1		11	ACCUM TEST
FUEL PRESSURE SWITCH	215-73317-1		4	FUEL TRANSFER
FUEL FLOAT SWITCH	215-73319-1		17	FUEL TRANSFER

NOTES:

1. This equipment is required for full operation of the Automatic Flight Control System. The AFCS was assigned a System Test Difficulty of 5 (the highest difficulty).

2. This equipment is required for operation of the M61 20MM gun. This system has a test difficulty rating of 5+.

3. Use of this equipment will be somewhat meaningless without providing the fluid pressure of which is to be monitored.

4. This equipment is part of the engine instrumentation set and will not be operational without the TF-30 engine which generates the measured condition or without some suitable device for simulating the measured condition.

5. This equipment is required if electromagnetic radiation is attempted in the lab.

6. This equipment will not be fully operational without a hydraulic power source.

7. This equipment requires complicated mechanical hardware to fully evaluate the anti-skid control function.

8. This item is required for operation of the temperature control system. However, air conditioner operation (or installation) is not practical in the simulator.

9. This equipment is required for operation of the fuel transfer system. Since fuel will not be transferred, this item is optional.