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HIGH RESOLUTION INFRARED RADIATION SOUNDER

FOR THE

NIMBUS F SPACECRAFT

E.W. Koenig, et. al.

ITT Aerospace/Optical Division
3700 E. Pontiac Street
Fort Wayne, Indiana 46803

Quarterly Report for Period July - Sept., 1973

Prepared for

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Goddard Space Flight Center
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1.0 INTRODUCTION

This report describes the activities on the HIRS program for the period of July through September, 1973. Completion of design activity and early fabrication effort on the protoflight unit were the major efforts. Operation of the Engineering Model in spacecraft integration tests was completed during July and August, after which the unit was returned to ITT for added test and evaluation.

2.0 GENERAL

2.1 Highlights

The acceptance of a design approach for the mirror scan system cleared the last remaining design decision and permitted detailed effort on protoflight fabrication to proceed.

The engineering model completed tests at General Electric, confirming system compatibility in Bench Acceptance, Bench Integration, System Compatibility, and Orbit Simulation Tests. The unit worked well through the test phase, with a number of interface details in system design being recognized and a number of areas of specific interest uncovered that will lead toward improved test procedures for later units.

A high level program review headed by Mr. C. Mathews of NASA Headquarters was held at ITT on September 14 to review technical, management, and production performance.

A Technical Review Team headed by Mr. D. Femiano held a detailed design review at ITT on July 18-19 as a normal part of spacecraft instrument review.

Fabrication of the protoflight instrument is on or near the same schedule submitted at the end of the last quarter, with delivery at the end of December or early January. Details of the equipment status and plans are given later in this report.

2.2 Visits and Trips

Table 2-1 lists the visits made by ITT personnel during the quarter.

Personnel from the Nimbus project office visiting ITT are listed in Table 2-1 also. These persons were particularly interested in the design details as they were completed, and in the program work flow. This means of direct technical interface was successful in keeping direct contact between the equipment design engineers and the spacecraft review team.

Other major visits were the Critical Design Review Team on July 18-19, and the visit by Mr. C. Mathews and others on September 14 for a general review of the HIRS and AVHRR programs.

TABLE 2 - 1

ITT Travel

July 5	N. Zaun, D. Forsythe	National Semiconductor;Expediting Parts
July 10	E. Koenig	NASA/GSFC;Nimbus HIRS manager's review
July 10-17	R. Annable, P. Murray, D. Melton	Ferson Optics; Proto Optics acceptance
July 13-17	G. Sonnek	Gulton Industries; Harmonic Drive eval.
July 16-27	R. O'Neil	GE-MSVD; EM Integration
July 26-30	A. Smith	Quality Visits-Computer Devices Corp. -Microsemiconductor Corp.
Aug. 9-10	E. Koenig	GE-MSVD; BAT, BIT Data Evaluation
Aug. 15	A. Smith	Surface Finishes; Proto Cooler Parts acceptance
Aug. 20-31	R. O'Neil	GE-MSVD; EM Integration
Aug. 23-24	E. Koenig	GE-MSVD; Nimbus F S/C Design Review
Aug. 29	E. Koenig	NASA/GSFC; Nimbus HIRS manager's review
Aug. 29-31	A. Smith	Schaeffer Magnetics; Motor acceptance
Aug. 30	A. Smith	Microsemiconductor Corp.; Quality visit

Visits to ITT

July 2-3	B.L. Johnson, Jr., NASA; Observe EM tests Dr. W. Smith, NOAA, D. Schwartz, G.E. R. Edgar, G.E.
July 11-13	B.L. Johnson, Jr., NASA; Observe EM tests
July 18-19	D. Femiano et al, NASA; Critical Design Review
Aug. 15-28	B.L. Johnson, NASA; Technical monitoring
Aug. 28-Sep.7	J. Balla, NASA; Technical monitoring
Sept.11-14	B.L. Johnson, Jr., NASA; Project review
Sept.6-14	T. Anderson, NASA; Technical monitoring
Sept.14	C. Mathews, et al, NASA; Program Review
Sept.23-25	M. Donohoe, NASA; Review Cooler Design
Sept.27-28	P. Hui, NASA; Review Stepper Design
Sept.27-Oct.5	B.L. Johnson, NASA; Technical monitoring

2.3 Program Reviews

2.3.1 Critical Design Review

The Nimbus Project Experiment Review held on July 18, 19 at ITT was reported in the monthly report for July. Since that time we have received and responded to a series of questions from the review. Many of the questions were no longer relevant since they pertained to the mirror scan system design which was in the process of change at the time of the review. The only action item still remaining to be submitted is the thermal math model of the instrument, which is nearly ready for submission. An interim engineering report, containing the material presented at the review has been completed and is ready for submission at this time.

2.3.2 Headquarters Program Review

The HIRS system was reviewed in a meeting on September 14, attended by C. Mathews and W. Stoney of NASA HQ.; F. Price, S. Weiland, J. Arlauskas, W. Hovis, B. Johnson and L. Draper of NASA/GSFC. Material was presented concerning design activity, equipment status, and program plans.

Technical discussions were related to many of the unique features of the HIRS instrument. Descriptions of the filter wheel concept, mirror scan method and signal generation were given to relate the program activities to system performance.

Dr. Hovis questioned the differences in the cooler cone surface finish as related to SCMR. R. Annable responded later that the wider sun angle required a lower absorption than the gold used on SCMR. All other design aspects of the cooler are identical.

The preamplifier design changes were discussed, with questions on failure conditions, and the ability of meeting NEΔN without the change. Our response was to state that the failure of the offset circuitry would not inhibit detector operation, and that in the absence of the offset signals, we would experience greater bias signals in each channel which would require more constant attention to calibration. The NEΔN could probably be achieved even in the absence of offset signals.

Significant discussions were held relative to parts procurement difficulties. The example of recent major delays in National Semiconductor delivery (with no specific solution at this time) was recognized as a typical problem of small quantity buys of Hi-Rel parts. Several actions will be taken to help relieve the immediate situation, and S. Weiland informed Mr. Mathews of the considerations of having NASA or spacecraft integrators provide basic stocks of preferred parts.

Schedules as presented to S. Weiland in July, and as now conceived, were discussed at length. The effect of parts receipt, failure repairs, extended tests, and other factors were considered.

Displays and demonstration of hardware at the ITT Space Facility was received with great interest. All visitors spent time studying the filter assembly, patch, optics and harnesses. A demonstration of the scan drive system was a center of interest for a number of the group.

The general tone of the visit was encouraging in that we felt that they had enough exposure to the system operation, problems, and plans to be able to make a considered judgement of the value, status, and schedule impact. No conclusions were given at the meeting.

3.0 SYSTEM DESIGN STATUS

Design status of the HIRS instrument has stabilized, with nearly all circuits complete and in fabrication process. A recent review of the mirror scan system has raised the possibility that we may have an improved system by a slight change in drive method. This consideration and recent tests on the feedback control of mirror drive hold these circuits from final fabrication.

The design of the analog processor is described in the August monthly report. Fabrication of this assembly is under way for retrofit of the engineering model as a test of the new design.

Improvements in a number of other circuits have taken place during this period. A second voltage reference has been added to provide the reference for the analog/digital converter. Power supply regulators have been improved, and the circuits for photodiode sync pulse detection have been improved. These are reported in the previous monthly reports.

3.1 Radiation Balance Performance

Tests on the engineering model were conducted on the bench cooler assembly (where the cooler housing is vacuum pumped and cooled) and in the vacuum chamber for evaluation of radiation balance methods. On the bench cooler we were able to see the output of the longwave detector by inserting a wide band amplifier. With the detector cooled to 130°K the output was seen to contain level offsets in each channel, and a web pulse as shown in Figure 3-1a. Target signals are seen as sinusoids in each channel interval and were obtained by filling the field of view with a hot plate.

The inclusion of the radiation balance signal provides a means of individually controlling a negative pedestal for each channel to reduce the base line of all channels to a uniform level. This effect may be noted in Figure 3-1b. In addition to the baseline control, we add a negative triangular signal to the video at the time of transition from filter to filter (when the detector sees the .050 inch aluminum web of the filter wheel). This negative web signal is constant for all filter segments and is adjusted for best attenuation of all detector web signals. As shown, the reduction is in the order of 60%. This may be reduced even more in the complete system, but even this amount is significant in reducing the overshoot that extends into the integration time.

The engineering model is being upgraded with the full set of prototype design modules permitting a test of these circuits in a low noise environment where a system evaluation may be performed.

FIGURE 3-1a. LONGWAVE DETECTOR OUTPUT

FIGURE 3-1b. OUTPUT WITH RADIANCE BALANCE AND WEB OFFSET SIGNALS

Gain change in the new design will be applied to both long wave and short wave channels. The new design adds increased gain in several channels as shown in Table 3-1.

In addition to the gain change, it is important to recognize the effect on calibration output signal, since a given level of calibrate input signal is affected by amplifier gain and integration time.

The effect of these functions can cause a widely differing output from the various channels. To offset this, we have included attenuation in the calibration signal input circuit to cause the outputs to be nearly consistent in amplitude. These signals may be reviewed by the aralyses of Table 3-2. The short wave amplifier characteristics were not changed, and reflect the same relative amplitudes as in the engineering model design. The low level of calibrate signal output in channel 16 is the result of the short integrate time period and the fact that energy in channel 16 is so much greater than in the other short wave channels that an attenuation of signals is necessary to keep radiance outputs in the proper relationship.

TABLE 3 - 1

DYNAMIC RANGE CHANGES

Channel	FORMER COUNTS FROM $T_{MAX}-T_{MIN}$	Gain Change	ANTICIPATED COUNTS $T_{MAX}-T_{MIN}$	MAX COUNT (SPACE)
1	80	10	770	2740
2	300	2	600	2450
3	240	2	480	3560
4	440	1	440	2740
5	480	1	480	2000
6	860	1	860	2590
7	1050	1	1050	2360
8	3860	1	3860	3690
9	520	2	1040	2070
10	240	2	480	2400
11	1880	1	1880	2460
12	1530	1	1530	2960
13	840	1	840	2430
14	500	1	500	3690
15	800	1	800	2390
16	5500	1	5500	3690
17	4080	1	4080	4080

Note: The controlling channels for gain adjustment are channels 1, 3, 8, 14, 16 and 17. Actual values are probably very different from the above, depending on detector response, channel radiation bias, gain settings and other factors.

Channel 16 will have a high signal value at a max target temperature of 340°K which may be higher than space look.

TABLE 3 - 2

CALIBRATION SIGNAL OUTPUT

Channel	Amp Gain	Cal Gain	Integrate Cycles	Output (Relative)
1	10	.07	7	4.9
2	2	.5	4	4.0
3	2	.5	5	5.0
4	1	1	5	5.0
5	1	1	3	3.0
6	1	1	4	4.0
7	1	1	4	4.0
8	1	1	4	4.0
9	2	1	2	4.0
10	2	.5	3	3.0
11	2.5		3	7.5
12	2.5	1	3	7.5
13	2.5	1	3	7.5
14	2.5	1	3	7.5
15	2.5	1	3	7.5
16	1	1	1	1.0
17	1	1	1	1.0

Note: The precise values of amplifier gain and calibration gain will be set during test and may not be as shown.

4.0 EQUIPMENT STATUS

4.1 Engineering Model

The engineering model is presently at ITT in the process of being refurbished with a new analogue video processor, feedback damper and other changes to bring it close to protoflight operational status. 'efore these changes took place the unit was operated on the bench cooler for tests of the new radiance offset circuitry and for another evaluation of cooler performance.

The analogue video processor circuitry description and circuit diagrams were included in the August monthly report. During the bench cooled tests and chamber tests the levels of radiance from the filters were measured as the detector cooled. This information may be used to establish the value of radiance offset as a function of detector temperature.

Data on cooler performance was obtained during the chamber test, with an investigation of the effect of simulated loads and the effect of the system in an unloaded condition. From this we established that cooler performance was not compatible with earlier tests run on the cooler alone. Several experiments were made to determine the effect of cooler housing, earth shield, and simulated loads. The problem centered on limited cone cooling. Upon removal of the HIRS from the chamber a careful visual check was made of all mirror surfaces, insulation, alignment, and patch surfaces. After many cycles of bench cooled operation, travel and spacecraft integration, and chamber tests, the unit had noticeable film on many of the mirror surfaces, but most prominently on the earth shield (cone cover door). This door had been closed during preconditioning and was opened after one hour of cooling in the chamber. A film was apparent around the edges, where gases from the cone insulating blanket would collect. This indicates contamination of the insulating blanket. We also noted a slight misalignment of the door, permitting the patch to see a .03 inch strip of the door (at housir temperature). The instrument was then disassembled, and the cone assembl removed. Investigators found a warping of the insulation blanket away from a portion of the cone plate, permitting the cone to look directly at the cooler housing, absorbing unnecessary energy. These seem conclusive factors in explaining the poor cone cooling performance.

The cone was removed, cleaned, and a completely new insulating blanket installed. Tiedowns were added to insure blanket position integrity. It is anticipated that the reassembled unit will perform significantly better in the next chamber test. The cooler assembly has now been reinstalled in the system and is ready for test.

Disassembly of the filter wheel system permitted removal of the gold foil attached to the web and machining of the web bevel to a right angular edge. This is expected to reduce the web radiance signal. The system was cleaned and reassembled into the instrument.

Design changes are being incorporated in the scan system of the Engineering model. The tachometer damper system will become a part of the Engineering model. This activity is moving slowly because of continuing evaluation of the design. New components (printed board, connector, tach and torquer mount) must be added to the scan housing. The shell of the scan housing had to be extended .63 inches to accommodate the new electronics and tachometer.

4.2 Protoflight Unit

4.2.1 General

The protoflight activity is at a high level, attempting to accommodate all of the design evaluation and changes requested by NASA and yet maintain a high level of fabrication activity. The goal of delivery of the protoflight unit of January 1, 1974, has been our guide in programming the construction activity. These activities go beyond the fabrication of the instrument to include math modeling, test procedure preparation, design reviews, and detailed planning tasks. The verification tests of performance of optics, motors and thermal sensors is nearly complete, and an analytical study of performance is in process to predict the output of the system based on the measured optical and detector performance.

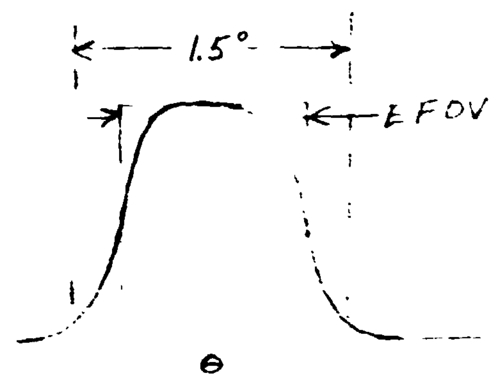
4.2.2 Optics

The results from the acceptance test of the Protoflight optics were obtained in September. The registration test gave the following values for the difference in the center of energy between the three different bands.

LW - Visible	0.0029 inch
LW - SW	0.0045 inch
SW - Visible	0.0070 inch

The center of energy is computed after taking measurements from a detector when a small bright light course is placed at 100 points covering the field of view. From the detector measurements and the position of the light source for each measurement, the centroid of energy is computed. The values above correspond to the difference between the centroid obtained for each band. The specification on the differences is 0.004 inch which corresponds to a one-percent registration between bands. Probably the most important registration is the LW-SW since most of the sounding measurements are taken in these two bands. These values of registration are the best values that have been obtained on any instrument. This test will be repeated when the unit is completed, and the final cooled detectors are used as the sensors.

From the registration measurements the effective field of view was also calculated for the three bands. This value is obtained by generating a three-dimensional plot of position and energy from the 100 measurements taken and placing the integrated measurement under a cylinder whose height corresponds to the maximum signal and having the same integrated signal. The diameter of the cylinder corresponds to the effective FOV. This is shown graphically as follows.



The values obtained for each of the three bands is given below.

Effective FOV

LW	1.22 degrees
SW	1.24 degrees
Visible	1.39 degrees

The system is described as having a 1.5° field of view. As can be seen, these values are below the 1.5 degrees, but this is not unexpected since the guiding requirement is to have 97 percent of the energy within 1.5 degrees and the energy at the boundaries has a bell shaped distribution. The total energy measurement showed that 97 percent of the energy collected by the detector does come from within the 1.5 degrees.

All of the other measurements, including transmission values, physical measurements and vignetting test were acceptable.

4.2.3 Detector and Cooler

The patch assembly has been constructed for the protoflight. Detectors have been selected for the protoflight unit. In the long wave band, Mercury Cadmium Telluride detector X-3 has been installed, and in the short wave band we will use the Indium Antimonide serial number 2. These are the devices with high sensitivity and are considered the best choices for this unit.

A new procedure has been used for gold coating the inner surfaces of the patch assembly. The aluminum parts are plated using electroless nickel 30 to 50 microinches (1 micron) thick, then electroplated with gold 100 microns thick. The use of a nickel base eliminates a previous problem of copper diffusion through the gold, and provides a highly uniform surface of very low emissivity. Tests on witness samples of these parts indicate emissivities in the order of 2 to 3 percent out to a spectral wavelength of 20 microns. This should significantly aid the cooling capacity of the protoflight system.

4.2.4 Electronics

Activity in the HIRS Electronics centered on moving equipment fabrication and test as rapidly as possible. Effort was expanded to provide assistance in supervising and performing the fabrication effort. This has helped relieve the design engineers, who now concentrate on completing the designs and checking board layout, etc., for fabrication.

Only one area of design activity remains to be completely settled by ITT and NASA. The mirror scan system has been developed and tested on the bench, and is now in a detailed review of all circuit elements for performance and reliability improvement. Methods of setting feedback gains for the various scan modes is a typical study, while current limiting and overvoltage protection are also being considered. The scan system will be in final form during the next period and will be reported on at that time.

Several interface changes were incorporated during the past quarter. All interface connectors are now using standard plugs without filter pins. A Change Notice has been submitted to document the change.

Telemetry circuits ha[illegible] changed slightly, with improved circuits for mirror motor current and filter wheel motor current. Components are available for an additional temperature monitoring point but the decision has not been made if this will be used. The telemetry and command status are given in a later section.

Tests on the filter wheel motors are encouraging. Three motors have been received and tested on a dynamometer. Torque at high power input (-24 volts) is about 5.1 ounce inches, compared to 3.5 oz. inches for the present engineering model motor. Synchronous operation in air is much more likely with the new motor.

4.2.5 Commands and Telemetry

The Protoflight model motor current telemetry circuits were modified so as not to require Electronics "ON". The F/C Motor Current TM circuit is now located on the F/C Motor P.S. and Power Control Board and the Scan Motor Current TM circuit is now located on the Scan Regulator Board. These circuits were on the Motor Current TM/Patch Temp. Control/Data Output Buffer Board.

Scan Motor Temp. TM will be added to the interface VIP Analog TM connector (J4, Pin 29) where the Engineering Model referenced the LW Detector Bias TM. The PM VIP Analog TM connector list (J4) is included for reference in Table 4-1.

TABLE 4 - 1.

ANALOG TELEMETRY OUTPUTS

NOMENCLATURE	PIN NO.
CHASSIS GND	1
SPARE	2
SPARE	3
SCAN MIRROR TEMPERATURE	4
PRI MIRROR TEMPERATURE	5
SEC TELESCOPE TEMPERATURE	6
F/C HSG. TEMPERATURE NO. 1	7
F/C HSG. TEMPERATURE NO. 2	8
F/C HSG. TEMPERATURE NO. 3	9
F/C HSG. TEMPERATURE NO. 4	10
F/C MOTOR TEMPERATURE	11
CONE TEMPERATURE	12
COOLER HSG. TEMPERATURE	13
BASE PLATE TEMPERATURE	14
ELECTRONICS TEMPERATURE	15
PATCH TEMPERATURE	16
SPARE	17
SPARE	18
SIGNAL GND	19
CHASSIS GND	20
SPARE	21
PATCH POWER	22
COOLER COVER POSITION	23
+15VDC BUSS	24
-15VDC BUSS	25
+10VDC BUSS	26
+5VDC BUSS	27
TELEMETRY BUSS	28

TABLE 4 - 1.
(Continued)

NOMENCLATURE	PIN NO.
SCAN MOTOR TEMPERATURE	29
F/C MOTOR CURRENT	30
SCAN MOTOR CURRENT	31
SPARE	32
SPARE	33
SPARE	34
SPARE	35
SPARE	36
SIGNAL GND	37

TABLE 4 - 2

DIGITAL TELEMETRY CONNECTOR

NOMENCLATURE	PIN NO.
CHASSIS GND	1
SPARE	2
SPARE	3
ELECTRONICS	4
SCAN MOTOR	5
F/C MOTOR	6
F/C MOTOR MODE	7
SCAN NADIR	8
SPARE	9
SPARE	10
SPARE	11
SPARE	12
SIGNAL GND	13
CHASSIS GND	14
SPARE	15
F/C HSG. HEAT	16
CONE HEAT	17
PATCH HEAT	18
CALIBRATION	19
COOLER COVER ENABLE	20
COOLER COVER	21
SPARE	22
SPARE	23
SPARE	24
SIGNAL GND	25

The Protoflight contains eleven command relays, as did the original Engineering Model design. In the EM, the Patch Heat AUTO/FULL TIME command was removed prior to delivery to GE. The Protoflight Model will utilize the same MA-MB lines previously alloted to the Patch Heat AUTO/FULL TIME relay to control an added command relay in the PM; the CALIBRATE DISABLE ON/OFF. The previous MA-MB control for PATCH HEAT AUTO will now result in CALIBRATE DISABLE OFF. The VIP DIGITAL TM connector list (J5) is included for reference in Table 4-2.

4.2.6 Weight Estimate

The Protoflight weight estimate is given here as compared to the last prediction (June 1973).

	Previous	Present
Scan Module Assy.	8.2	10.3 pounds
Baseplate	13.7	13.8
Electronics	7.5	7.5
F/C Assy.	8.4	8.8
Cooler Housing Assy.	12.0	12.0
PreAmp Assy.	3.0	4.5
Optics Assy.	9.0	9.0
Cold Target Assy.	1.3	1.3
Warm Target Assy.	1.2	1.2
Sun Shields	.7	.7
	65.0	69.1 pounds

The changes are primarily in these areas:

1.	Scan Module: Addition of torq. mtr., tachometer, Hsg., and additional board.	2.1 pounds
2.	Preamp: Redesign of Housing plus new board.	1.5 pounds
3.	Base Assembly: New terminal boards and resistor mtg.	0.1 pound
4.	Filter/Chopper: Motor redesign and Housing changes.	0.4 pound
		4.1 pounds

4.2.7 Mechanical

Mechanical design of the HIRS has had to include a number of modifications to accommodate recent design changes.

The mirror scan system has required the addition of a shaft extension to the stepper motor to permit mounting of the tachometer and torque motor, and the addition of a third printed circuit board in the scan housing has required an extension of the housing. A total length increase of 0.63 inches brings the total equipment length to 21.23 inches. Figure 4-1 is a layout of the new scan housing cover, giving the new configuration.

A completely new video processing assembly has been designed to house the seven printed boards of that subsystem. The new housing replaces the two previous modules in the same volume. The housing makes use of the back plate of the cooler housing and mounts to that plate and the top of the filter wheel housing. A layout of the new assembly is shown in Figure 4-2.

The new filter wheel drive motor is larger and heavier than the previous design. Significant changes were made to the motor mount and housing to accommodate the size, and added thermal paths were included to transfer motor power to the main frame.

4.2.8 Thermal Model

The thermal math model for the HIRS instrument is complete. The model is presently being executed for various environmental conditions. The environmental conditions which will be exercised are outlined as follow:

A. Space Simulation

   1. Transient Analysis (Power On)

      a) $\beta = 0^{o}$

      b) $\beta = 10^{o}$

   2. Steady State Analysis

      a) $\beta = 0^{o}$

         1) Non-operational (Pwr Off)

         2) Operational (Pwr On)

      b) $\beta = 10^{o}$

         1) Non-operational

         2) Operational

      c) $\beta = 20^{o}$

         1) Non-operational

         2) Operational

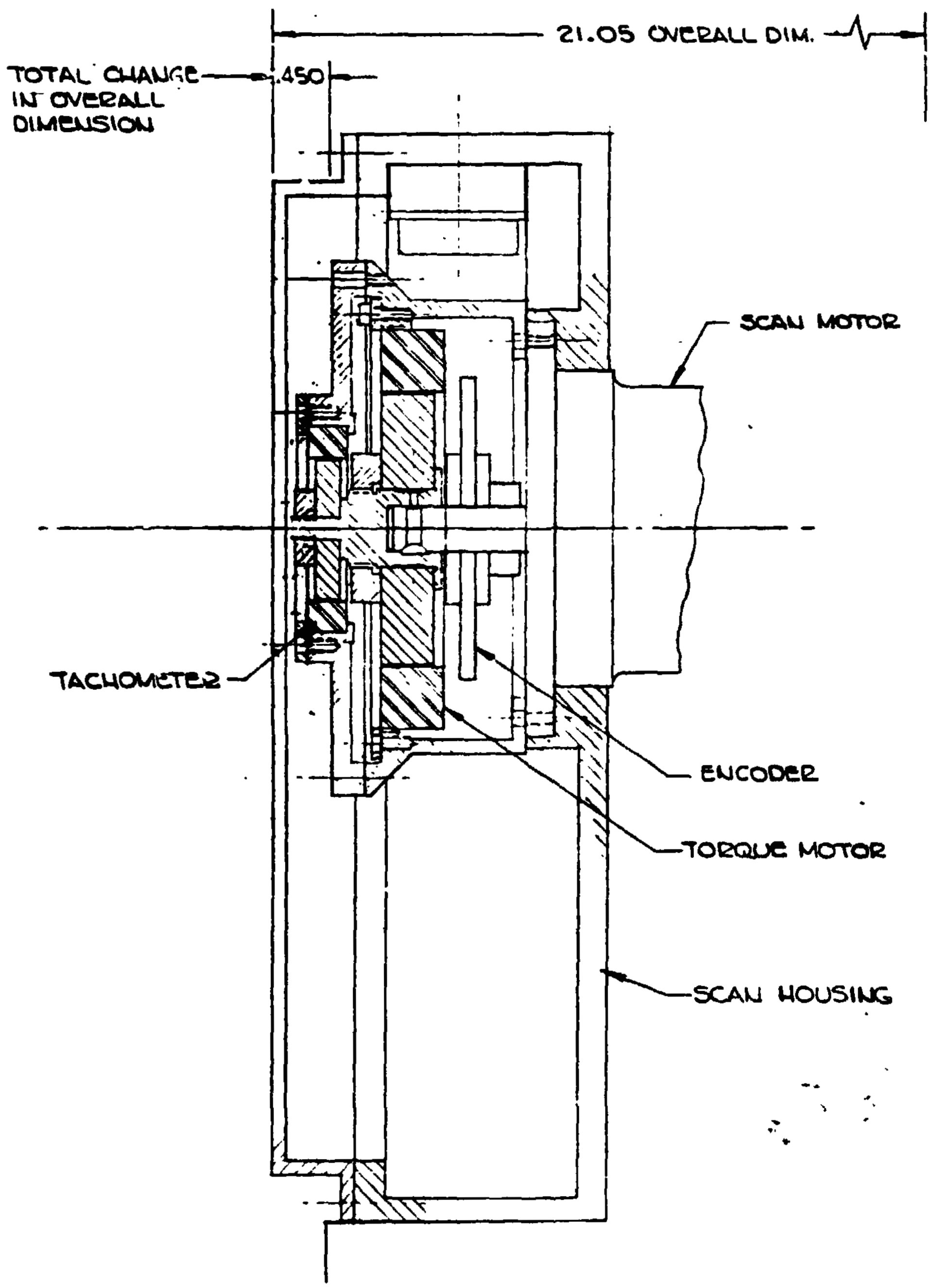


Figure 4-1. Scan Housing

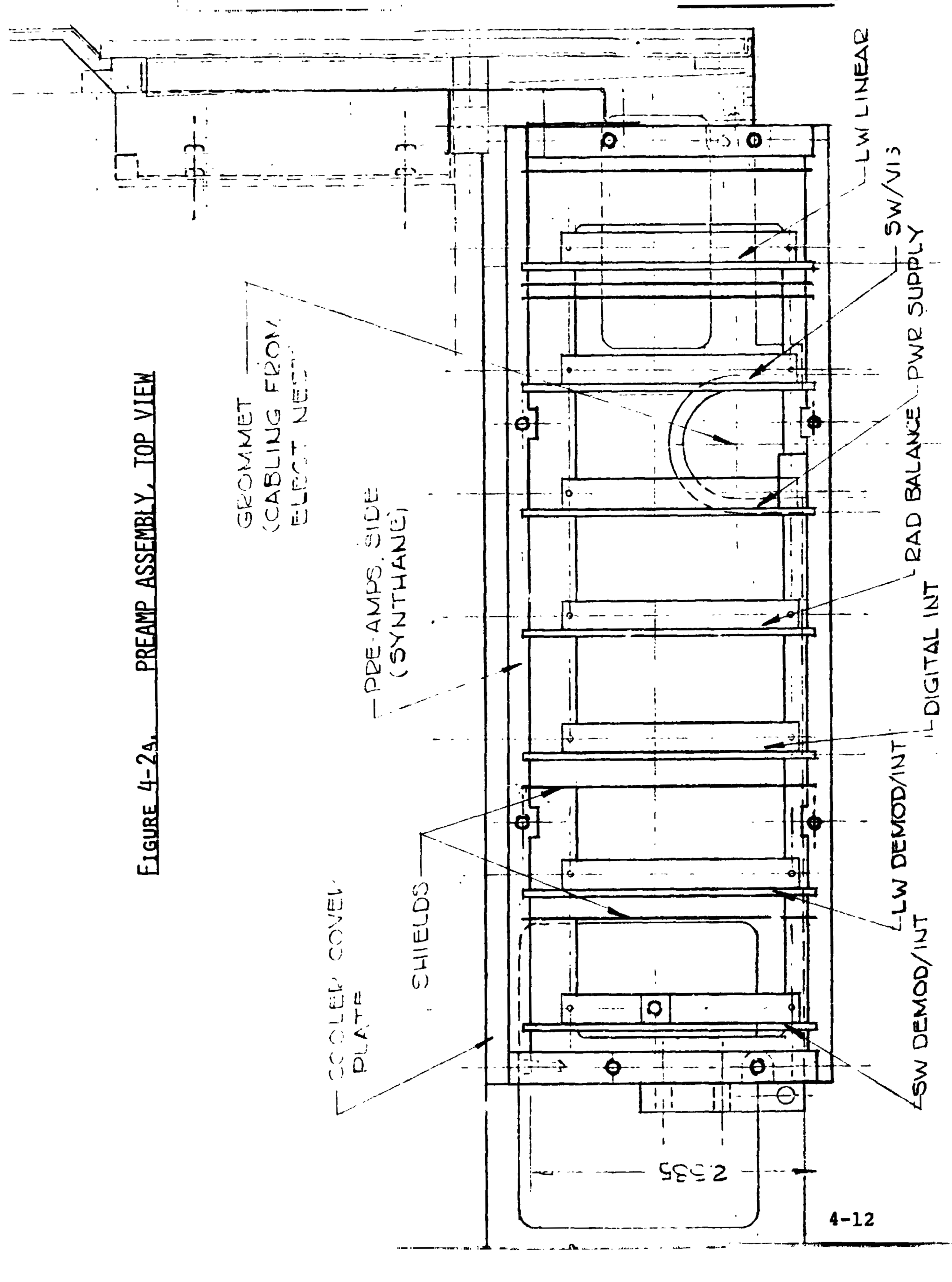


Figure 4-2a. PREAMP ASSEMBLY, TOP VIEW

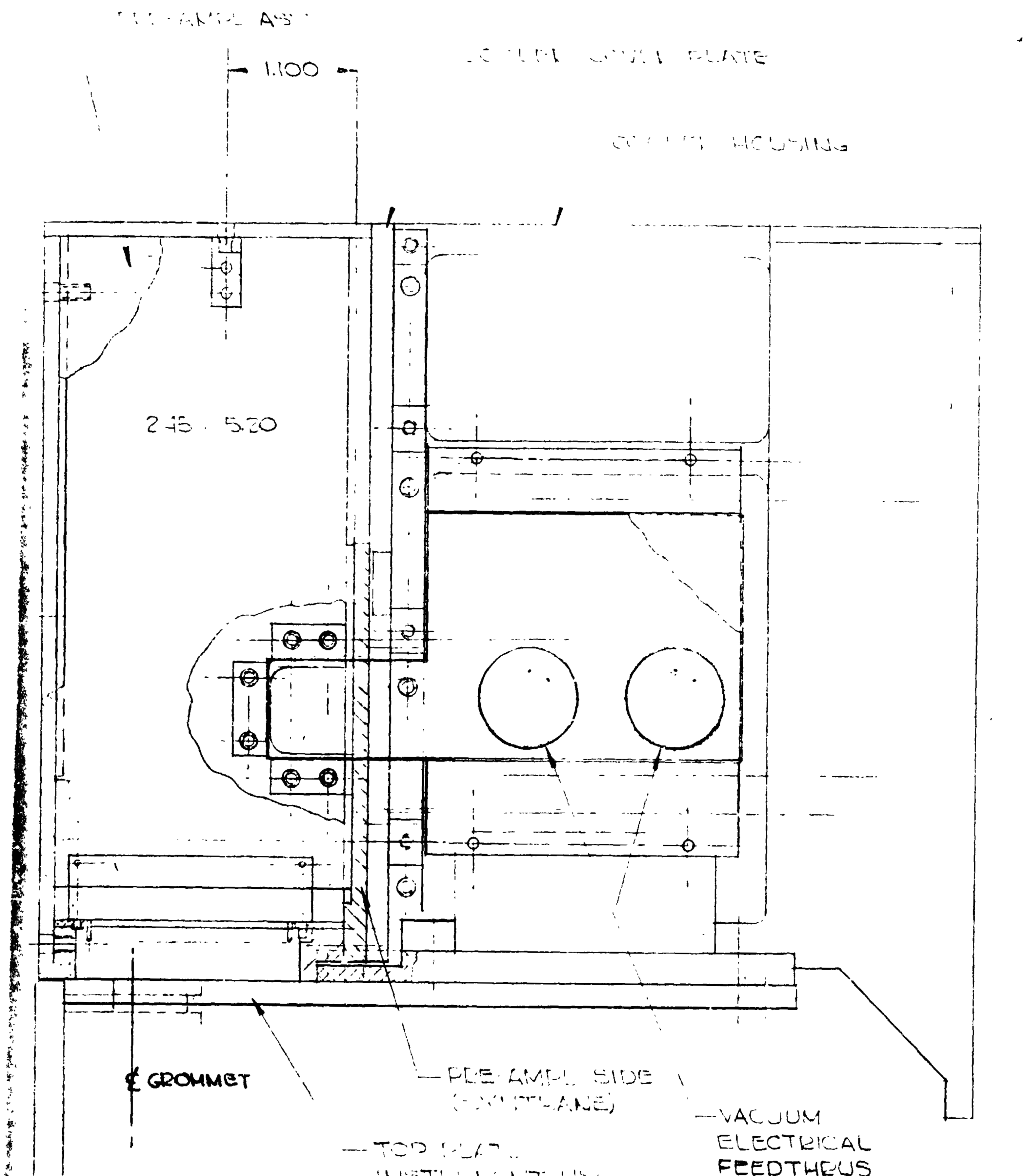


FIGURE 4-2b. PREAMP ASSEMBLY, END VIEW

B. Chamber Simulation (Steady State)

C. Worst Case Conditions (Steady State)

1. Min Temp
2. Max Temp

A maximum and minimum condition will be considered to provide a specific maximum and minimum possible temperature tolerance about a specific nominal temperature profile.

The maximum space environment can be defined as a condition where the following exis'

1. Power diss d to appropriate nodes at a maximum.

2. Solar input at maximum (i.e., Solar Constant S_o = 458 BTU/HR)

3. Emissivities of coatings minimum

4. Solar absorptance of coatings maximum

The minimum space environment can be defined as a condition where the following exists:

1. Power dissipated minimum

2. Solar Input Minimum (S_o = 422 BTU/HR)

3. Emissivities of coatings maximum

4. Solar absorptance minimum

5. $\beta \approx 0^o$

The above environmental conditions would provide a maximum and minimum temperature profile for which the instrument could experience due to degradation in surfaces, solar variations and instrument operating conditions.

4.2.9 Construction Status

Parts expediting has been one of the pacing activities in the fabrication and assembly of the protoflight model. Assembly of circuit modules has proceeded as rapidly as possible to the assembly stage. A number of printed board layouts have been delayed by the recent design changes, and a few boards have had to be reprocessed because of faults in layout not found in checking or inspection.

Wiring of the system is proceeding as rapidly as possible. The 36 card nest for the electronics housing has been completed and is being installed in the baseplate. Previously wired connectors and terminal boards have been prepared and are installed in the baseplate at the same time. It is anticipated that the wiring of the baseplate and cabling to the scan housing, targets, cooler housing, filter chopper housing and preamp will take most of the month of October.

Parts for the protoflight unit have been a constant problem. At the time of this writing most of the semiconductors have been delivered. Late delivery items are shown in Table 4-3), where the National Semiconductor parts have been the most concern. A concerted drive by NASA components group and ITT purchasing department has generated a backup position for all parts. Ithaco Corp. mailed 15 pieces LM101AH/883 on September 25; Hughes Aircraft mailed 6 pieces of LM104H and 12 pieces of LM105H on September 28; Aerojet mailed 45 pieces of LM108AH on October 2; and ITT obtained 2 pieces of LM109K directly from NSC on September 24. Eight pieces of LM120H were received from NSC but were unscreened. These have been put into screening and burn-in tests at ITT and will be used if required. We hope to use the fully screened parts to be shipped from NSC on October 18 if possible. Several of the component types received were not fully documented. A search of available data at the sources (Hughes and Aerojet) is underway to back up the acceptance of these items for flight use.

A process flow status report is given in Figure 4-3 . This indicates the position of each electronics module in the construction process. As noted on this chart, five modules are ready for board test, and 21 other modules are in the final stages of assembly and inspection.

4.2.10 Acceptance Test Plan

A plan has been generated and is ready for submission for Nimbus review. The flow chart shown in Figure 4- 4 is the basis of the plan and indicates the general test elements. Specific procedures are being developed for each segment of the test and will be completed in the next month. A number of items in the plan are still open to discussion. The place of performance of the RFI tests, the method of verifying optical integrity after vibration, and the details of radiation balance, gain adjustment and calibration of the instrument are not fully established. The plan will be discussed in detail with the technical officer and all these areas confirmed in the near future.

TABLE 4 - 3. HIRS CRITICAL COMPONENTS

Supp.	Part No.	Quantity Ordered	Quantity Needed	Need Date	Latest Promise	Notes
Nat [illegible]	LM101AH	15	6	9/26	10/18	(1)
	LM104H	20	4	9/20	10/18	(2)
	LM105H	12	1	9/26	10/18	(2)
	LM108AH	100	40	9/28	10/18	(3)
	LM109H	12	2	10/2	10/18	(4)
	LM109K	7	1	10/2	10/18	(5)
	LM120H/12V	19	5	10/4	10/18	(6)
Precision Mono	Volt Comparator	11	2	10/4	10/5	(7)
RCA	CMOS (ALL)			9/28	9/24	(8)
RCA	CA3080	55	17	10/4	9/28	(9)
Aeroflex	Tach & Torquer	4 ea.	3 ea.	10/26	11/2	(10)
Cannon	Connector(25Pin)	6	2	9/27	10/15	(11)

(1) 15 Pcs. shipped from Ithaco 9/28 as backup.
(2) 6 Pcs LM104 and 12 pcs. LM105 shipped from Hughes 10/2 as backup.
(3) 45 pcs. shipped from Aerojet 10/4 as backup.
(4) 4 pcs. received from NASA Space Stock 9/26.
(5) 2 pcs. received from NSC 9/24.
(6) 8 pcs. received from NSC 9/24, in ITT screening and burn-in as backup.
(7) 11 pcs. received from Prec. Mono. 10/3.
(8) Last item received 9/27.
(9) 25 pcs. received 10/2.
(10) Latest delivery now 11/14. Max. test using Unqual Tach until receipt.
(11) 2 pieces received from G.E. 10/1.

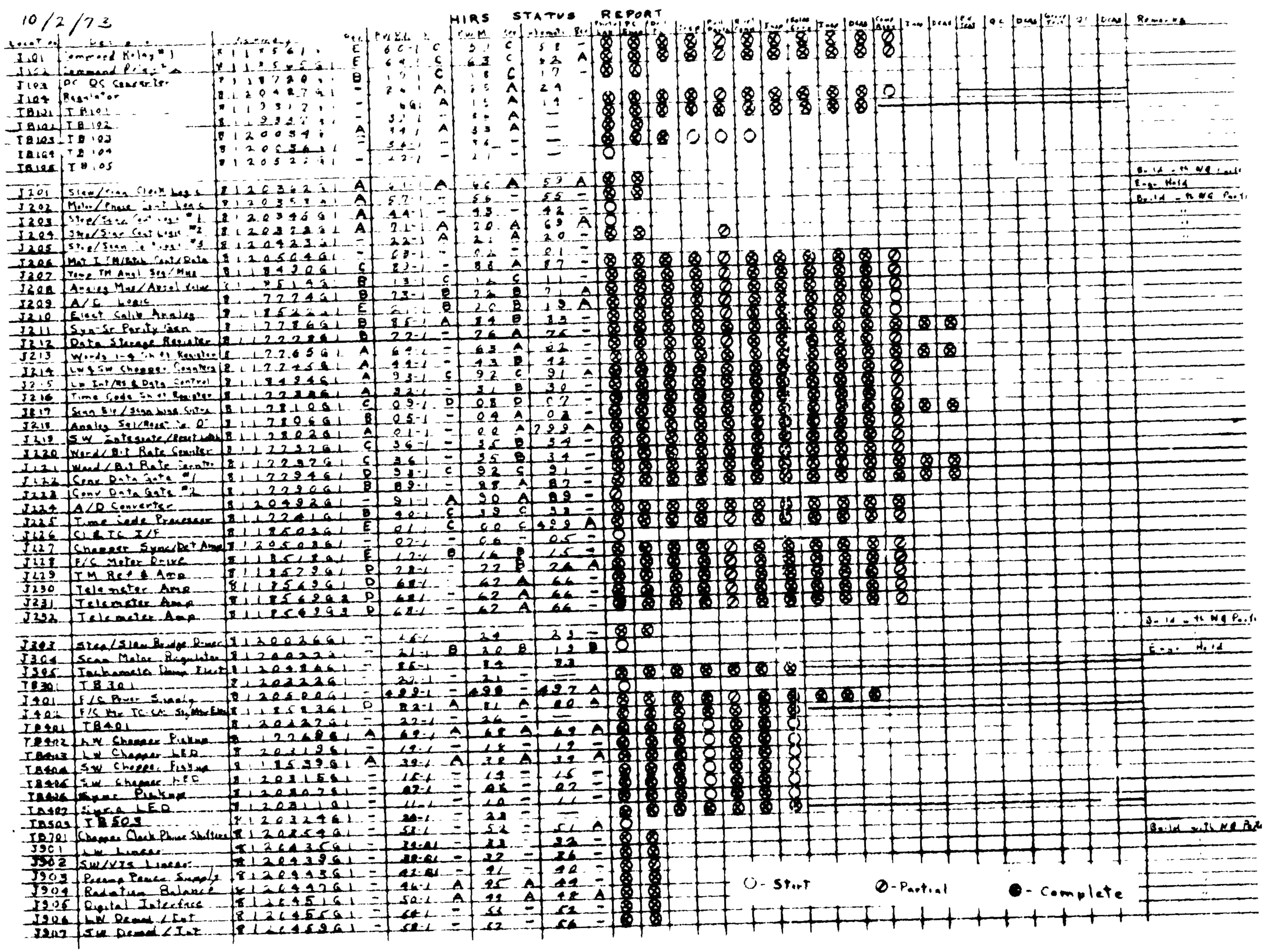


FIGURE 4 - 3. PROCESS FLOW CHART

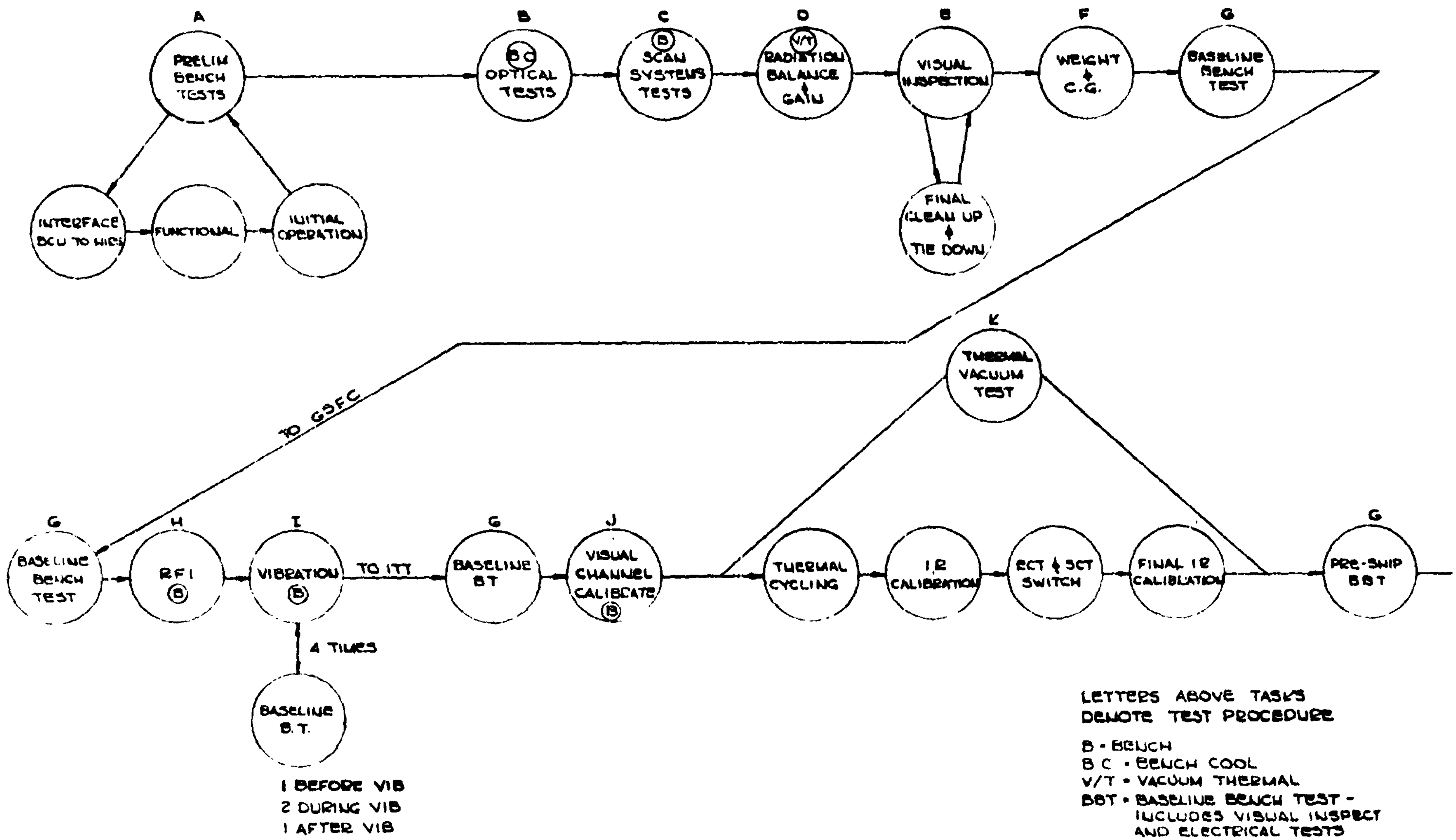


Figure 4-4. Acceptance Test Flow

TABLE 4 - 4. LIFE TEST PLAN

- MIRROR SCAN LIFE TEST -

Scan Modes	Normal, Nadir, Launch
ON/OFF Cycles	45 min. ON, 45 Min. OFF
Base Temp Cycles	7 Days 0 C
	14 Days 20C
	7 Days 40C
Data Output	Encoder Position
	Motor Current
	Motor Temp.
	Step Waveform
	Slew Waveform

- FILTER MOTOR LIFE TEST -

Power Mode	High, Normal
ON/OFF Cycles	45 Min. ON, 45 Min. OFF
Base Temp Cycles	7 Days 0 C
	14 Days 20C
	7 Days 40C
Data Output	Sync Loss Recognition
	Acceleration Time
	Deceleration Time
	Motor Power
	Motor Current
	Vibration Noise

4.3 Flight Model

Flight model activity is proceeding in a direct flow behind the protoflight model. Mechanical parts to the flight unit are in the fabrication cycle. The present problems of long term delivery on all parts is affecting this cycle, but should not impact the schedule.

The flight model detectors, filters, and mirror components are on hand. The optic assembly is ready for test, and will be inspected by ITT quality representative early in October. The optics will be shipped to ITT where the tests will be performed as the procedures were developed on the Protoflight unit.

Printed circuit boards for the flight unit have been fabricated with the protoflight units and are ready for completion of drilling, connector insertion and parts insertion. This activity will be held until the protoflight boards have passed board test. The final assembly and test of the flight boards will then proceed rapidly.

The major activity delaying the flight model will be the commitment of engineering and technical personnel to the Protoflight instrument. Fabrication of such parts as the cooler assembly and the main harness are best done by the same person on both units. These persons are busy on protoflight activity through October and will be free to start that effort in November. These activities are scheduled to mesh with the receipt of the mechanical parts and to permit concentration of the fabrication group on the flight unit when the major load is off the protoflight unit.

4.4 Life Test Program

A life test program for the mirror scan assembly and for the filter wheel drive assembly is being prepared. Table 4-4 gives the basic activities to be performed in the life test and an indication of the data to be taken. Electronic and mechanical parts are being assembled for this program.

It is anticipated that the filter wheel drive assembly can be started in life test by November 1. The parts for the mirror scan system will not be available at that time, making this system later in start, perhaps as late as December 1. Effort on preparation of the parts is proceeding and will be used to speed the beginning of these tests as much as possible.

4.5 Reliability

Malfunction Reports are listed in Table 4-5. All reports on the engineering model prior to integration testing at G.E. have been closed out by ITT.

All reports received to date from G.E. relating to bench integration and system tests have been completed and returned. It is anticipated that there are additional MR's which have not yet been transmitted to ITT.

MALFUNCTION REPORT LOG DATE 6-12-73 TO ______ SPACECRAFT NIMBUS-F EXPERIMENT HIRS

ENGINEERING MODEL

M.R. NO.	DATE 1973	GSFC 4-2 No.	ORIGINATOR	PART FAILED	FAILURE ANALYSIS	CORRECTIVE ACTION	DATE-CLOSE OUT
1	6 - 12	D01876	P. MURRAY	CK06 LEVEL "L"	NO - X-RAY DID NOT WORK	PM & FM WILL USE LEVEL "R"	- CLOSED 9-18
2	6 - 14	D01377	P. MURRAY	CK06 LEVEL "L"	NO - X-RAY DID NOT WORK	PM & FM WILL USE LEVEL "R"	- CLOSED 9-18
3	6 - 14	D01878	P. MURRAY	WIRING SOLDER JOINT BROKE OPEN	NO	PM & FM WILL USE SMALLER DIA. WIRE	- CLOSED 6-21
4	6 - 19	D01879	E. KOENIG	4 MALFUNCTIONS LISTED ON M.R.	NO	AS LISTEL ON M.R.	- CLOSED 9-18
5	6 - 25	D01880	R. O'NEIL	DESIGN ERROR C2 & C3 TOO LARGE	NO	DECREASE CAPAC. OF C2 & C3 TO 220 pF	- CLOSED 9-18
6	6 - 19	D01882	E. KOENIG	BACKSTREAMMING FROM VACUUM SYS.	NO	USED ANOTHER VACUUM CHAMBER	- CLOSED 9-18
7	7 - 1	D01883	E. KOENIG	COOLER DOOR OPEN TM MALFUNCTION	NO	SW ACTUATOR ADJUSTED	- CLOSED 9-18
8	6 - 5	D01884	J. LEVICK	WIRE MISSING	NO	NONE REQUIRED	- CLOSED 7-2

TABLE 4 - 5. MALFUNCTION REPORT LOG

MALFUNCTION REPORT LOG DATE 7-19 TO 7-27-73 SPACECRAFT Nimbus-F EXPERIMENT HIRS

ENGINEERING MODEL - AT GENERAL ELECTRIC

R. NO.	DATE	GSFC 4-2 No.	ORIGINATOR	PART FAILED	FAILURE ANALYSIS	CORRECTIVE ACTION	DATE-CLOSE O
9	7-19-73	D03775	At G.E.	CKR06 CAPAC.	NO	CAPAC. ELIMINATED	9-28-73 to G.
10	7-19-73	D03776	At G.E.	ASSEMBLY ERROR	NO	DRAWINGS CHECKED	
11	7-27-73	D08102	At G.E.	SIGNAL GROUND	NO	P.M. MODIFIED	
12	7-27-73	D08107	At G.E.	NOT ENOUGH HELIUM	NO	P.M. WILL BE OKAY	
13	7-27-73	D08110	At G.E.	NOISE IN PREAMP.	NO	P.M. REDESIGNED	
14	7-20-73	D08111	At G.E.	TRANSISTORS CLAMPED	NO	E.M. & P.M. REDESIGNED	9-28-73 to G.

MALFUNCTION REPORT LOG DATE 10-10 TO ____ SPACECRAFT ____ EXPERIMENT ____

PROTOFLIGHT

R. NO.	DATE	GSFC 4-2 No.	ORIGINATOR	PART FAILED	FAILURE ANALYSIS	CORRECTIVE ACTION	DATE-CLOSE O
1	10 - 10	D01885	J. LEVICK	RESISTOR VALUE WAS TOO LARGE	NO	CHANGED TO SMALLER RESIS. VALUE. ECN 6128-196	CLOSED 10-

One MR has been issued as the result of a protoflight board test. The value of a resistor was too large to permit reliable triggering of a circuit. This minor design change has been corrected and the MR issued.

Continued tests of the engineering model in the laboratory and in vacuum will be monitored by reliability engineering to assure compliance with reporting procedures.

The reliability prediction and stress analyses are continuing. Each circuit is being reviewed and each component is being designated for its maximum stress conditions. Computer aided analysis of the results will permit a complete stress analysis on the system under protoflight configuration.

5.0 NEW TECHNOLOGY

Discussion with Nimbus project is expected to determine whether the scan control system is considered new technology. This will be reported in the next monthly report.

6.0 PROGRAM FOR THE NEXT INTERVAL

Engineering model tests will be undertaken to prove the capability of the video processing techniques and the effectiveness of the refurbished cooler assembly.

Protoflight fabrication continues to be a major activity, with completion of the major elements of the system anticipated during the next interval.

The thermal math model will be exercised and data made available to the spacecraft integrator.

Early activity on flight model fabrication will continue, with the receipt of the optics being the major event.

Emphasis on completion of the protoflight in the earliest time schedule will press the activities on test procedures and keep the impetus on completion of that unit.

7.0 SCHEDULES

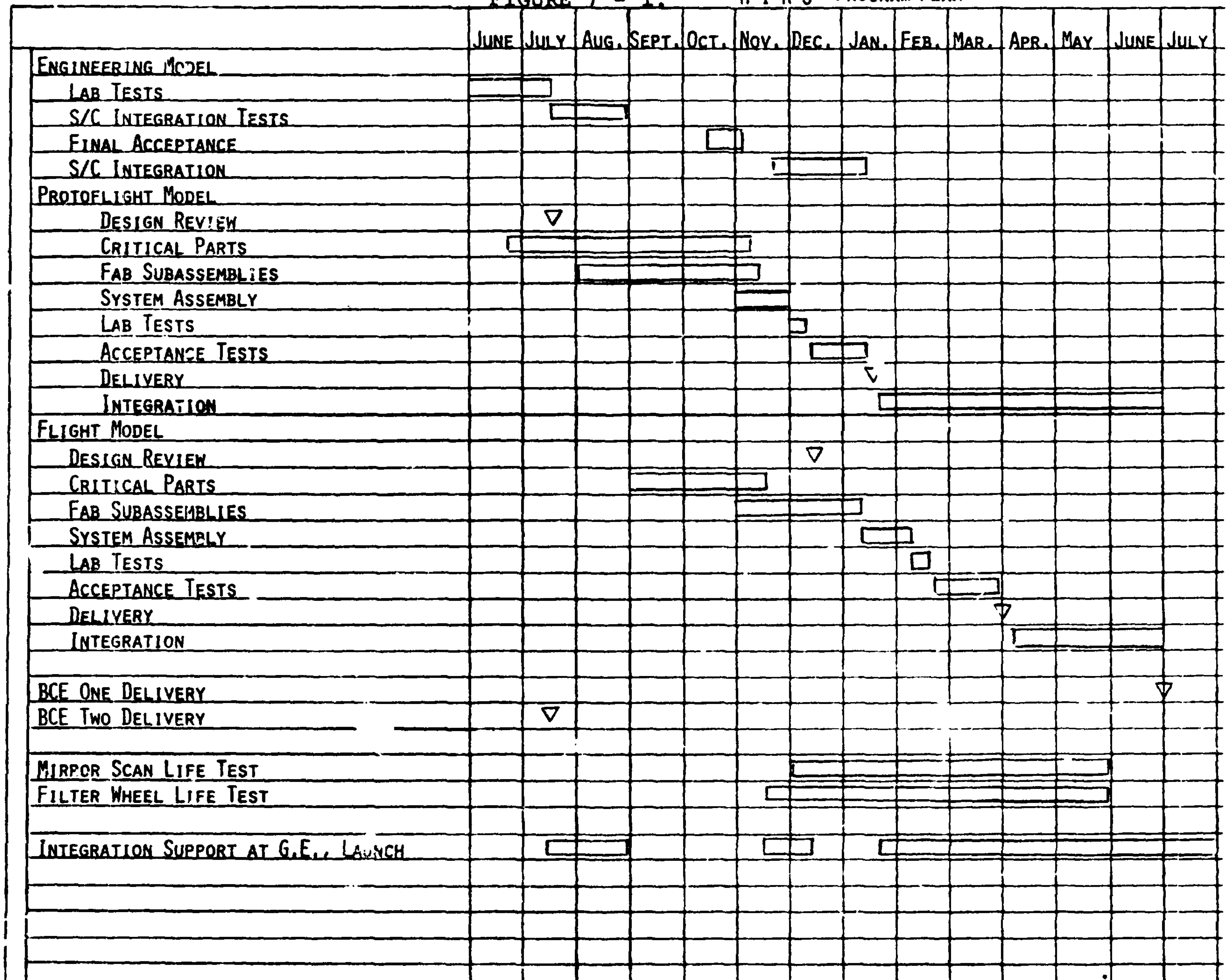
The HIRS schedules have changed slightly during the last quarter. The attached schedules (Figures 7-1, 2, 3), indicate the activity as projected at this time.

Recent activity on the Engineering Model indicates a completion of vacuum chamber tests in late October which will constitute the acceptance of this equipment. The unit will then be used for vibration survey and for some spacecraft system integration tests at General Electric.

The Protoflight schedule is updated to reflect the latest status of parts fabrication, assembly flow, and test plans. The delivery date in January is achievable only if all parts of the system meet their individual requirements and integrate into the system with no interface problems.

Flight model fabrication and assembly schedules are highly dependent on protoflight activity, in that manpower and facilities must be released for flight system work. The schedule shown meshes with the protoflight schedule in this respect.

FIGURE 7 - 1. H I R S PROGRAM PLAN



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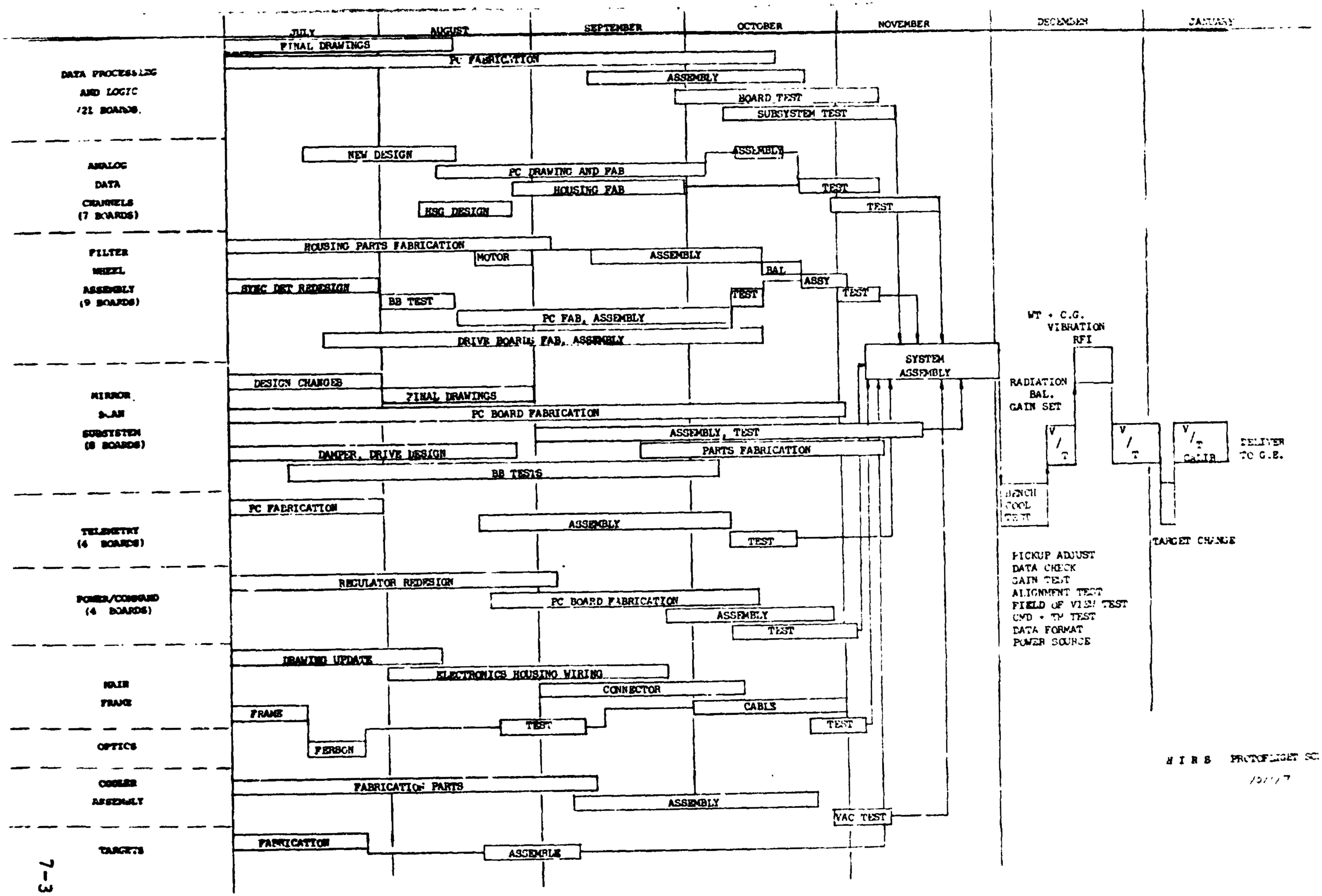

FIGURE 7 - 2. **PROTOFLIGHT SCHEDULE**

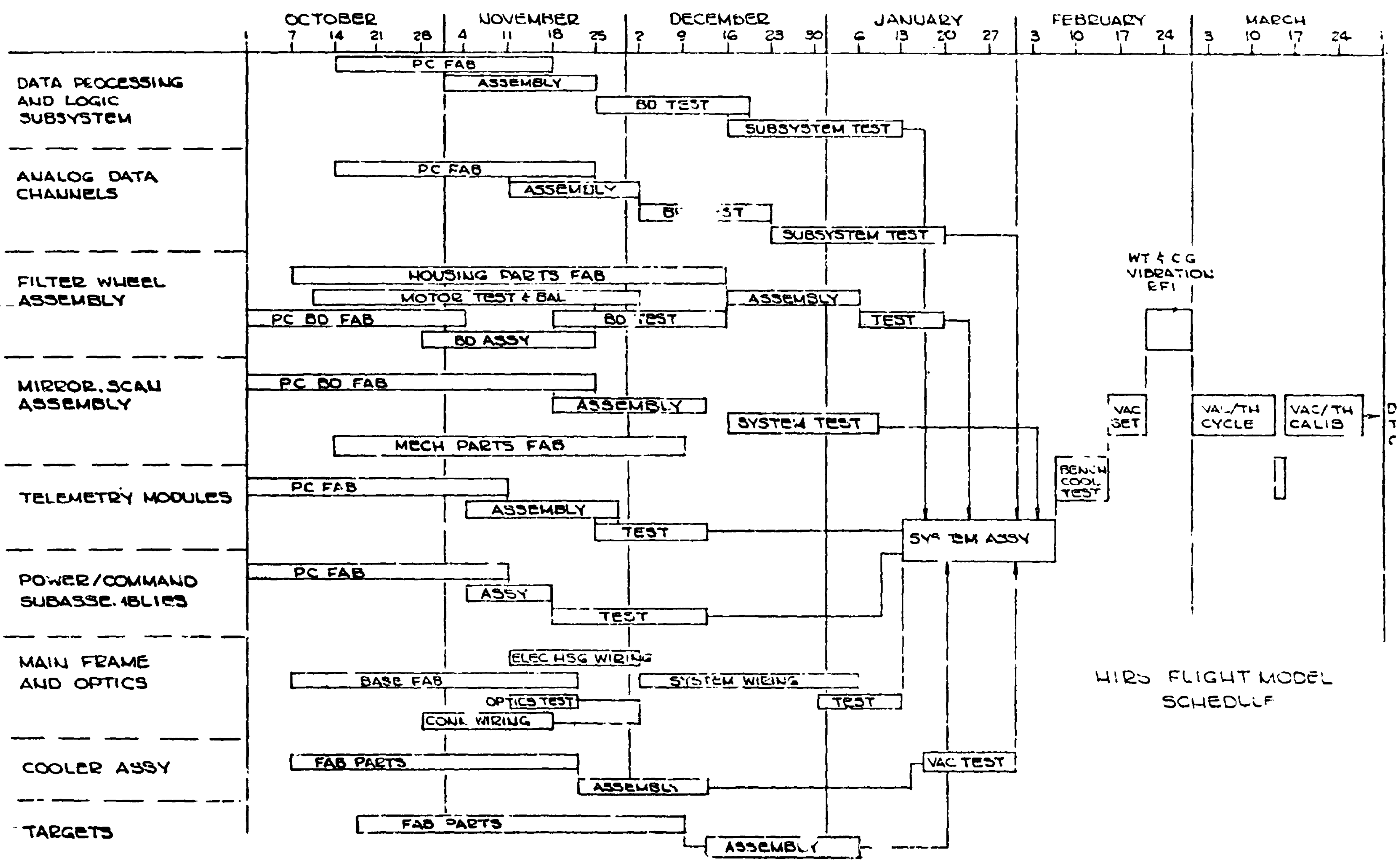

FIGURE 7 - 3. **FLIGHT MODEL SCHEDULE**