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Attention: Mr. E, Stern

Subject: LEM Guidance Computer programs to be supplied by MIT to support checkout of the LEM flight vehicle system, GAEC radar integration tests, and GAEC flight control integration tests,

Gentlemen:

This document is being submitted by MIT for approval by the Apollo Guidance Software Control Panel. The document defines the test programs which will be supplied by MIT to support checkout of the LEM flight vehicle system, GAEC radar integration tests, and GAEC flight control integration tests. These programs will be incorporated into the basic Block 2 computer service program designated as AURORA by MIT. It was agreed at NASA Coordination Meeting # L18A and GAEC/MIT Checkout Work Group Meeting # 14 that these programs, which were outlined in the above meetings, would satisfy all of the LGC program requirements for the above checkout and integration tests.

Unless otherwise stated, the same testing capability will exist when using either the flight or test ropes. The G & N Subsystem tests are listed in this document for purposes of information and completeness only. It is not intended that this document define or constrain LGC test programs required for G & N Subsystem (37000) checkout. It does, however, define test programs required for integrated FCS (60,000)checkout. The test programs are described in this document and are sometimes designated by the number and name of the applicable test in the LEM GORP (LPL 610-3C).

I. G & N Subsystem Tests

A. 37001 - G & N Functional

1. LGC Operation Test

a. LGC Self Check

b. Sum Check

c. DSKY Checkout

d. Uplink - Downlink

e. Relay Check

2. G & N Operational

B. 37002 G & N Subsystem Checkout

1. Failure Indicating Circuitry Test

a. G & N Condition Lights

b. LGC Alarms and Interrupts

2. Mode Tests

a. CDU zero

b. Coarse Align

c. Fine Align

d. Attitude Control

C. 37003 - G & N Scale Factor Determination

1. IRIG scale factor and gimbal torque test

2. PIPA scale factor determination

D. 37004 - IRIG Coefficient Determination

A program to position the IMU to specific orientations and then calculate various inertial component parameters,

E. 37005 - G & N Fine Alignment

A program to align the IMU to specific attitudes using AOT - Optical Target information

F. 37007 - AOT - 3 Position Detent Calibration Check

A program to calculate the angles between the 3 positions of the AOT using AOT - Optical Target information

G. Earth Prelaunch Alignment for Unmanned Flights

A program to align the IMU stable member to the launch azimuth.

11.1 Integrated Teat

A. 37511 - R. R. Tracking Test and 60027 - R. R. Antenna/ G & N Alignment Check

These tests will utilize the radar programs which are described in Section IV.

B. 60011, 19, 30 - EMC Tests

The following programs will be utilized for the EMC tests:

1. G & N Operational Check
2. LGC Self Check
3, Interface Monitoring (See Section II. D. 7. h)

C. **60033** - Combined FCS/RCS Checkout

A program to provide a maximum of two pulses to each RCS jet individually. The program to be **uscd** during this test is described in Section III. D.

D, 60023 - FCS Checkout Automatic Mode

The test profiles described below represent the PGNCS automatic portion of Test **60023** - FCS Checkout. Figure 1 is a basic time line of these profiles. During the initialization period, the IMU and AGS will be aligned and the Rendezvous Radar will be designated. The LGC will support these functions, A brief description of the program requirements to support the FCS checkout follows:

1. Landing and Rendezvous Radar ,Systems

The radar programs to be uscd during test 60023 arc described in Section IV.

2. IMU

The IMU will be monitored for proper operation through ACE-S/C.

3. LGC

The LGC Self Check will be performed whenever possible.

4. RCS & Engines

In performing the tests providing the RCS and cnginc commands to the SCS, inputs to the LGC will bo processed by test and flight programs. These include manual inputs, mode **and** status information and jet failure signals. Profiles of RCS and engine commands will be provided by test programs to the SCS through the

LGC output channels. The RCS and engine test profiles and sequences are described below:

a. RCS Jets

A nominal command profile will be supplied by the LGC to the jet driver preamps. This profile will be repeated as required to provide RCS testing during engine tests. The nominal profile is described in section III. D.

b. Engines

Figures 2, 3 and 4 and Sections III. A., III. B., and III. C. describe nominal LGC engine command profiles. During the interval t_1 - t_4 (Refer to Fig. 2) the LGC will provide the auto throttle and gimbal trim commands. In addition, there are certain manual functions which must be checked while the engines are being exercised. These are as follows:

(1) Descent engine on-off capability with "Abort" button energized - verify during t_2 - t_3 time interval (descent engine) that "Engine Arm" signal appears when "Abort" button is energized. Also verify receipt of "Abort" signal by LGC.

(2) Abort Stage Interlock - During time interval (t_4 - t_5), verify the removal of D. E.-on signal within the prescribed delay (relay off time) when the "Abort Stage" button is energized. Also verify that the LGC receives the "Abort Stage" signal and that, with the LGC commanding an engine-on signal to the descent engine (still during interval t_4 - t_5), the ascent engine receives the on signal after the prescribed delay (at present 400 milliseconds).

(3) Manual override of automatic signals (D. E. and A. E.). With the "Engine Arm" signal present and the engine being commanded off by the LGC (t_5 - t_6), verify engine on with "Start" button actuated. Then when the engine is being commanded on by the LGC (t_6 - t_7), verify engine off with either and both "Stop" buttons actuated.

5. Manual

With the Guidance Select Switch in "PGNCS" and the Mode Select Switch in "Automatic", the abort button will be pressed. The LGC

will provide positivc indication of receipt of this signal via a DSKY display. Abort Stage operations will be checked in a similar manner (Abort Stage button pressed.)

The "Staging Verified" signal will be provided to the LGC which will then provide positive indication of signal receipt.

The Manual Descent Engine throttle control will be set to some nominal position above the minimum. The LGC will then command throttle settings above and below the manual throttle setting. The verification of throttle control above the manual setting and no throttle below the manual setting will then be made.

6. AGS State Vector Update

The AGS will be on and operating. Monitoring will include the G&N state vector.

The LGCwill, through a Verb-Noun program, select a special downlink list which will include the 30 registers which store the LEM and CSM state vectors. The special downlink list will be issued 10 times. The state vector storage registers will be pre-loaded with the values desired for AGS checkout.

7. Displays and Interfaces

For checkout of the PGNCS driven vehicle displays the following programs will be utilized.

a. FDAI Total Attitude

The IMU Coarse Align program will be uscd for testing the total attitude readout of the FDAI. This program allows any combination of the outer, middle and inner gimbals to be torqued either through or to any angle in the range of ± 359.99 degrees. The operator must specify the angle for each gimbal. The average rate of change about each gimbal axis is approximately 15 degrees per second.

b. FDAI Attitude Error

The LGC program for driving the attitude error interface between the ISS CDU's and the pitch, yaw and roll FDAI attitude error indicators will service the three channels. The operator can load any command between ± 10 7/8 degrees on any channel;

the command increments are 158.2 arc seconds. All commands 'are issued at a rate of 140.6 degrees per second.

c. Altitude and Altitude Rate Display

The LGC program for commanding the altitude and altitude rate display calls for a load of initial altitude, final altitude and altitude rate. The altitude rote and initial altitude displays are first commanded, then the altitude is changed at the prescribed rate until the final value is achieved. The initial and final altitude value can be specified from 0 to 60,000 ft. in increments of 2.345 ft., the altitude rate can bc specified bctwcen ±8192 fps in increments of 0.5 fps.

d. Forward and Lateral Velocity Displays

The LGC program for exercising the forward and lateral velocity displays is capable of commanding values between ± 200 fps. The specified values are issued at a constant rate.

e. Caution and Warning Displays

The LGC Test Alarms program will issue commands to the PGNCS Caution, LGC Warning and ISS Warning lights.

f. 60023-FCS Chcckout Attitude Hold 'Mode

For LEM attitude hold mode checkout, the LGC will contain programs to check the rate of descent switch and the interfaces with the attitude and translation hand controllers. These programs will display information on the DSKY pertinent to the activated interface, i.*e.*; ± rate of descent, ± x, y, z translation and the attitude rate command,

g. Fault Isolation

The full capabilities of the program described in section III.A., B., C., and D will be available by loading other than nominal profiles under K-START control for RCS and engine fault isolation testing. In addition, the capability to directly load the appropriate output channels will be provided *so* as to be able to command ascent/descent engine on and/or any combination of RCS jet commands for an indefinite time (termination by operator).

h. Interface Verification

During LEM checkout, all interfaces between the LGC and other subsystems must be verified. These interface signals are listed in ICD LIS-370-10004. To facilitate this requirement, two special LGC programs are provided for interface monitoring during LEM vehicle level tests. These two programs provide a special monitoring capability of the LGC input channels and the input data from the landing and rendezvous radars.

(1) Input Channel Monitoring Program

This program, which is primarily intended for use during the LEM vibration test at GAEC, will monitor input channels 30, 31, 32 and 33 at 10 samples per second. During each sample the program logically compares the present state of each input channel to the logical comparison of all previous states. The logical comparisons are stored in erasable memory registers. Before this program is initiated, the operator should load the erasable memory registers with values which agree with the initial states of the inputs to channels 30, 31, 32 and 33. Any combination of ones and zeros as initial conditions is permissible. The states of the erasable memory registers reveal whether or not the program has detected a change of any of the inputs.

(2) Landing and Rendezvous Radar Data Monitoring

This program is described in section IV. I.

i. LEM Mission Programmer (LMP)

The LGC will be programmed to provide commands to actuate any individual relay in the program coupler assembly in response to an uplink input from either the digital command assembly or the K-START This applies to LEMs with unmanned missions.

j. Downlink

For increased monitoring capability during checkout, a provision is incorporated in the downlink program which allows the transmission of modified data lists. The data lists must be established prior to a test run and entered into erasable memory via the K-START or DSKY.

III. RCS and Engine Test Programs

Programs to exercise the RCS jets, descent/ascent engine on-off and descent engine trim and throttle arc provided for integrated testing. These programs can be run separately or simultaneously at the discretion of the test operator. These programs issue profiles of commands to their respective interfacing subsystems in accordance with the values contained in sets of erasable memory registers. The contents of the erasable memory registers must be loaded via the K-START or DSKY.

A brief description of these programs, their erasable memory requirements and the nominal profile values follows,

A, Engine On-Off Task

This task turns the LEM ascent or descent engine on and off according to the constants stored in the five sets of registers called:

1. CYLTIMES
   Which contains the number of times a particular step will be performed
2. NEXTCYLT
   Which contains the time between steps scaled for the LGC TIME 3 counter (the least significant bit equals 10 ms, the maximum value is two minutes).
3. ONTIME
   Which contains the time to turn the engine on, which also determines the length of time the engine will be off within a series of on - off cycles, scaled for T3.
4. OFFTIME
   Which contains the number of 2 minutes intervals before the engine will be turned off.
5. OFFTIMER
   Which contains the residual time before the engine will be turned off, scaled for T3.

OFFTIME and OFFTIMER determine the length of time the engine will be on in any one cycle. There are three sets of these registers (5 per set).

THE ENGSTEP register is used as an index to pick up a particular set of the above 5 registers. This job will be entered but immediately ended if ENGSTEP and CYLTIMES = +0. The allowable values of ENGSTEP are + 0, 1 and 2.

Table 1 contains the nominal profile values.

B. Throttle Task

This program issues a profile of throttle commands to the LEM descent engine. The profile is determined by the values in the THRTSTEP REGISTER and the 6 sets of registers, 5 per set, called DOTIMES, DELAY, THRITIME, THCOMM1 and THCOMM2. The THRTSTEP REGISTER value is used to index the 6 sets of 5 registers and has allowable values of + 0 through + 5. The 5 registers per set are defined as follows:

1. DOTIMES determines the number of times the throttle will be exercised as per the values of THRITIME, THCOMM1 and THCOMM2 of the current step. It has allowable values of + 0 through 37777 OCT.
2. DELAY determines the time between the start of a step and the beginning of THRITIME. It is called only once per step, i.e.; repeats of the same THCOMM1 and THCOMM2 start at THRITIME. DELAY must be formatted for T3 and hence has a maximum value to 2 minutes.
3. THRITIME determines the time between the end of DELAY and the start of THCOMM1 during the first sequence of a step. If a step is to be repeated, i.e.; DOTIMES greater than 1, it determines the time between the end of THCOMM2 and the start of THCOMM1 of the next step. It must be formatted for T3.
4. THCOMM1 and THCOMM2 determine the number of thrust increase or decrease pulses to be issued at a 3.2 KPPS rate. The range of possible values of either is from POSMAX (OCT 37777) to NEGMAX (OCT 40000), although the actual throttle range is from OCT 6116 to OCT 71661 (+,- 3150 DEC).

This task will be entered but immediately ended if the initial values of THRTSTEP and DOTIMES are + 0.

A fixed time delay of 250 ms is incorporated between the end of THCOMM1 and the start of THCOMM2 to insure adequate sampling by ACE.

The nominal profile values are shown in Table 2.

C. Trim Task

This program issues a profile of pitch and roll trim commands to the LEM descent engine gimbal in accordance with the values of the TRIMSTEP register and the 12 sets of 5 registers called NUMTIMES, STEPDLYT, TRIMONT, TRIMOFFT and TRIMIND. TRIMSTEP is used to pick up a

particular set of the 5 registers and has allowable values from + 0 through + 11 decimal. The 5 registers in each set are defined as follows:

1. NUMTIMES determines the number of times the command in TRIMIND will be issued. Values from + 0 to OCT 37777 are permitted.
2. STEPDLYT determines the time between the start of a step and the beginning of TRIMONT. STEPDLYT must be formatted for T3. It's maximum value is 2 minutes.
3. TRIMONT determines the time between the end of STEPDLYT or TRIMOFF and the time the trim commands are issued. It must be formatted for T3.
4. TRIMOFFT determines the length of time the trim command will be on, formatted for T3.
5. TRIMIND determines the pitch and roll command to be issued. The format is BIT 9 = 1 = + PITCH COMMAND ; BIT 10 = 1 = - PITCH BIT 11 = 1 = + ROLL; BIT 12 = 1 = - ROLL. A BIT = 0 indicates no command. Any combination of commands is permitted.

This task will be entered but immediately ended if TRIMSTEP & NUMTIMES = +0
The nominal profile values are shown in Table 3.

D. RCS Jetset Task

This task issues a profile of jet on - off signals as determined by the constants in a set of six registers. The six registers are:

1. NTIMES
   The number of times a particular step will be performed.
2. NEXTTIME
   The time between steps, a maximum of 2 minutes.
3. JETONTM
   The time to turn the jets on, scaled for T3.
4. JETOFFTM
   The time after JET ONTM to turn the jets off, scaled for T3.
5. XJETS
   The particular X jets to be turned on and off during each repeat of a step.
6. YZJETS
   The Y and Z jets to be turned on and off during each repeat of a step.

   XJETS and YZJETS must be in the same format as Channels 5 and 6 respectively. There are eight sets of these six registers.

The register JETSTEP is used to index the 8 sots of registers. The allowable **values** of JETSTEP **are'** + *0* through 7. This task will be entered but immediately ended if the initial values of JETSTEP and NTIMES are + 0. **Table 4** contains the nominal profile **values.**

IV. Rendezvous and Landing Radar Programs

The following radar programs will be incorporated in AURORA for support of all checkout and GAEC radar integration tests. Since a number of these programs will be used during the missions, every attempt has been made to give them the flexibility necessary for checkout and integration tests without seriously affecting their primary functions. Those programs denoted as special **are** provided only for checkout and integration tests **and** will not be used during a mission.

A. RR Antenna Mode Change

A program which enables the test operator to select the desired antenna gimbal mode through the DSKY. If the antenna is not in the selected mode, the program will request the designate program to make the change. This program also establishes the RR gimbal angle limits, which are used in other RR programs, for the selected antenna mode.

B. IMU-RR LOS Transformation

A program which transforms the desired LOS from IMU stable member coordinates to RR antenna coordinates (shaft and trunnion gimbal angles). The angles are then compared with the angular limits established for the antenna mode being used and, if they are outside the limits, the program will not send them to the designate program and will inform the calling progra

C. Rotary Table - RR LOS Transformation

A special program which transforms the desired LOS from rotary table coordinates to RR antenna coordinates (shaft and trunnion gimbal angles). The rotary table referred to is the one used in the GAEC radar integration test. The angles are then compared with the angular limits established for the antenna mode being used, and if they are outside the limits, the program will not send them to the designate program and will inform the calling progra

D. Designate

A program in T4RUPT which commands the RR antenna to the desired LOS by comparing the desired and indicated radar gimbal angles and establishing appropriate rate commands to the RR approximately once per second. When the indicated antenna position is within one degree of the desired LOS, the program issues the auto angle track enable discrete and checks for reception

of the RR data good discrete. If the data good discrete is absent, the program continues to check for the data good discrete, while it is absent, and updates the rate commands for a period of time before issuing an alarm and terminating its operation. If the data good discrete is present or appears before the above alarm is issued, the program will stop commanding rates and terminate itself.

There are two cases where the program will designate the RR antenna to within 1° of a specified attitude and terminate itself without issuing the enable discrete or checking for the data good discrete. These occur when changing antenna modes and when the RR gimbal angles exceed the limits used in the RR monitor program.

E. Continuous Designation

A special waitlist program will be provided to enable the designate program to be used in Test # 60027 where the RR antenna is continuously directed to a specified attitude.

F. RR Monitor

A program which periodically monitors the RR auto mode and RR CDU fail discretes and the RR gimbal angles during normal radar tracking. If the gimbal angles exceed the limits established for the antenna mode being used, the program will issue an alarm and request the designate program to place the RR antenna at some specified attitude.

G. Radarupt

A program, operating in the interrupt mode, which receives all data from the high speed counter/shift register of either radar system and checks the appropriate radar discretes before storing the data in assigned storage locations. Range and range rate are received from the rendezvous radar, and V_{xa}, Y_{ya} V_{za} and slant range are received from the landing radar. The radar data being sampled is specified by the requesting program which sets the appropriate bits in Out Channel No. 13. If the appropriate data good discrete is not present upon reception of a data sample, the program will reject the sample and request another from the radar. The number of times the program will repeat this request without issuing an alarm is established by the program

which originally requested the data.
When receiving the range data from either radar system, the program checks the appropriate range low scale discrete and records its status.
The appropriate LR antenna position discrete is checked each time LR data is received and an alarm is issued if the discrete is not present.
Prior to sending a velocity data sample to an assigned storage location. the program subtracts out that portion which is due to a radar bias frequency
The program will also be capable of accumulating N samples of V_{xa}, V_{ya}, or V_{za} and depositing the result in an assigned location.
Time tags will be supplied with all data placed in storage.

II. Radar Readout During Integrated FCS Operation

A special requesting program, which is used in conjunction with the Radarupt program, to provide sequential readout of V_{xa}, V_{ya}, V_{za} and slant range from the landing radar or range, range rate and the RR CDU angles from the rendezvous radar. This program is intended for integrated FCS check-out (Test No. 1-60023) and other radar tests. The data will be available on downlink and may be displayed on the DSKY.

I. High Speed Radar Data Readout

A special requesting program, which is used in conjunction with the Radarupt program, to provide high speed readout (approx. 9 samples per second) of a selected radar data parameter (V_{xa}, Y_{ya}, V_{za}, LR slant range, RR range or RR range rate). Time tags will be supplied with all data samples and RR CDU angle data will be supplied with each sample of range or range rate from the rendezvous radar. The sampled data will be inserted into a special downlink list for ACE monitoring.

J. LR Antenna Position Change

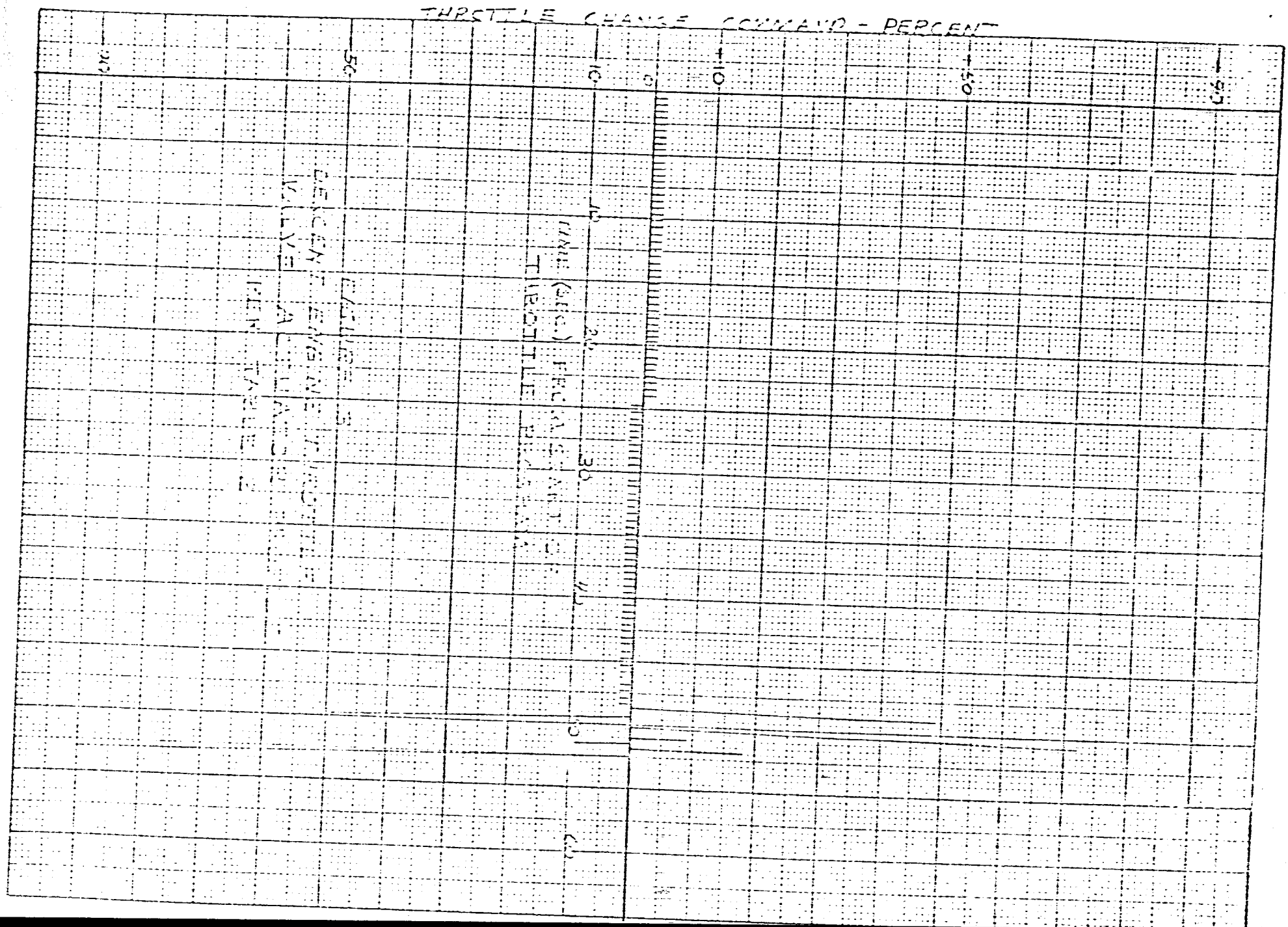
A program which commands the LR antenna from position 1 to position 2.

FUNCTION	INITIALIZATION	DESCENT PHASE C/O	ASCENT PHASE C/O
RADAR	LR ANTENNA [illegible]NTROL RR DESIGNATE	LR CHECKOUT	RR CHECKOUT
G & N ISS	COARSE ALIGN	MONITOR	MONITOR
LGC	SUPPORT	SUPPORT & SELF CHECK	SUPPORT SELF CHECK
RCS JETS	LOAD PROFILE	EXERCISE JET ON-OFF PROFILE	EXERCISE JET ON-OFF PROFILE
DESCENT ENGINE ON-OFF, THROTTLE, TRIM	LOAD PROFILES	EXERCISE PROFILE	
ASCENT ENGINE ON-OFF	LOAD PROFILE		EXERCISE
MANUAL INPUTS		EXERCISE MANUAL INTERRUPTS & OVERRIDES	EXERCISE MANUAL INTERRUPTS & OVERRIDES
AGS	ALIGN	MONITOR	MONITOR
DISPLAYS	CHECKOUT	DISPLAY TEST RESULTS	DISPLAY TEST RESULTS

FIGURE I

PGNCS AUTO (60023) TEST PROFILE

FIGURE 2
DESCENT ENGINE ON-OFF PROFILE
REF: TABLE 1



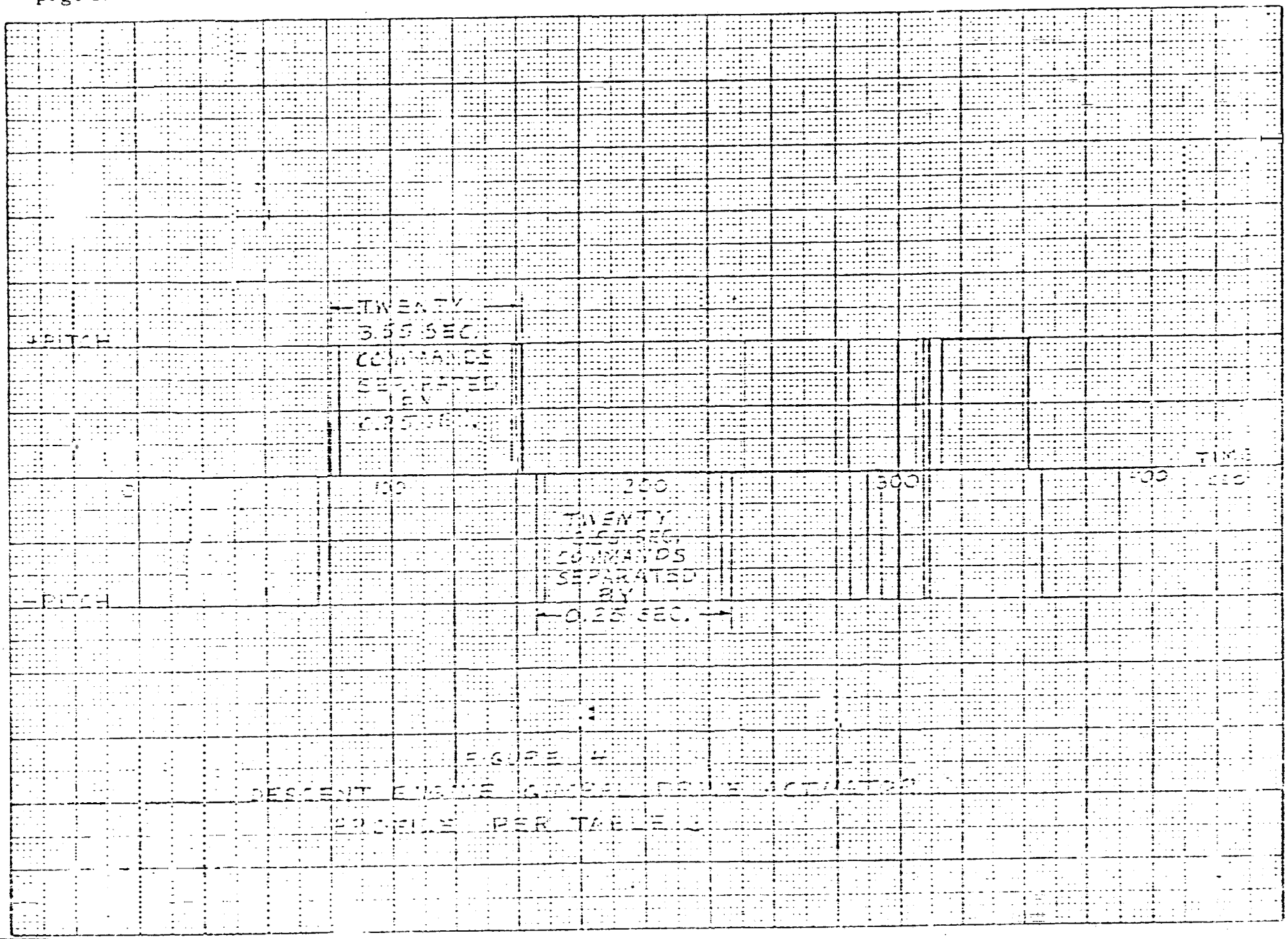


FIGURE 4

DESCENT ENGINE GIMBAL DEFLECTION

PROFILE PER TABLE 2

TABLE I

NOMINAL PROFILE VALUES

FOR THE

ASCENT/DESCENT ENGINE ON - OFF TEST

STEP	FIRST	SECOND	THIRD
c (ENGSTEP) = i	2	1	0
c (CYLTIMES + i)	1	1	1
c(NEXTCYLT + i)	0. 01 sec	24 sec	12 sec
c(ONTIME + i)	0.01 sec	0. 01 sec	0. 01 sec
c(OFFTIME + i)	0	6 (D. E.) 0 (A. E.)	0
c(OFFTIME + i)	12 sec	60 sec	36 sec

STEP	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH
c (THRTSTEP) = i	5	4	3	2	1	0
c (DOTIMES + i)	46D	46 D	1	1	1	
c (DELAY + i)	0. 25 sec	0. 25 sec	0. 25 sec	0. 25 sec	0. 25 sec	0. 25 sec
c(THRITIME + i)	0. 25 sec	0. 25 sec	0. 01 sec	0. 01 sec	0. 01 sec	0. 01 sec
c (THCOMM1 + 1)	+ 2%	- 2 %	+ 49. 4%	+ 72 %	- 9%	- 90%
c (THCOMM2 + i)	0	0	- 49. 4 %	+ 9%	+ 18 %	0

TABLE 2

NOMINAL PROFILE VALUES FOR THE

DESCENT ENGINE THROTTLE VALVE ACTUATOR TEST

STEP	FIRST	SECOND	THIRD	FOURTH	FIFTH
c (TRIMSTEP) = i	9	8	7	6	5
c (NUMTIMES + i)	1	20	20	1	1
c (STEPDYLT + i)	0.01 sec	5 sec	5 sec	5 sec	0.01 sec
c (TRIMONT + i)	0.01 sec	0.25 sec	0.25 sec	0.01 sec	0.01 sec
c (TRIMOFFT + i)	71 sec	3.55 sec	3.55 sec	42.6 sec	7.1 sec
c (TRIMIND + i)	-P	+P	-P	+P	-P

STEP	SIXTH	SEVENTH	EIGHTH	NINTH	TENTH
c (TRIMSTEP) = i	4	3	2	1	0
c (NUMTIMES + i)	1	1	1	1	1
c (STEPDLYT + i)	5 sec	0.01 sec	3 sec	5 sec	5 sec
c (TRIMONT + i)	0.01 sec	0.01 sec	0.01 sec	0.01 sec	0.01 sec
c (TRIMOFFT + i)	7.1 sec	7.1 sec	2 sec	35.5 sec	30 sec
c (TRIMIND + I)	-P	+P	+P, -P	+P	-P

TABLE 3

NOMINAL PROFILE VALUES FOR THE

DESCENT ENGINE GIMBAL DRIVE ACTUATOR TEST

STEP	FIRST	SECOND	THIRD	FOURTH	FIFTH	SIXTH	SEVENTH
c (JETSTEP) = i	6	5	4	3	2	1	0
c (NTIMES + i)	1	15	15	150	150	300	300
c (NEXTTIME + i)	3 sec	3 sec	3 sec	3 sec	3 sec	3 sec	3 sec
c (JETONTM + I)	0.01 sec	0 5 sec	0.5 sec	0.1 sec	0 1 sec	0.09 sec	0.09 sec
c (JETOFFTM + i)	9 sec	0. 5 c	0.5 sec	0.1 sec	0.1 sec	0.01 sec	0.01 sec
c(XJETS + i)	1,5,9, 13 U 2,6,10,14 D	NONE	2,6,10,14 D	2,6,10,14 D	1,5,9,13 U	1,5,9,13 U	1,5,9,13 U 2,6,10,14 D
c (YZJETS + i)	4,8,12,16 S 3,7,11,15 F	6,8,12,16 S 3,7,11,15 F	3,7,11,15 F	4,8,12,16 S	3,7,11,15F	4,8,12,16 S	NONE

TABLE 4

NOMINAL PROFILE VALUES FOR THE RCS JET TEST

The digital autopilot program which will be used in tho GAEC flight control integration test will also be in AURORA. A description of this program will be in a lutur document.

MIT/IL urges your prompt review and approval of this document so as to cause no delay: in delivery of the AURORA programs.

Very truly yours,

David G. Hoag
Technical Director,
Apollo Guidance and Navigation

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