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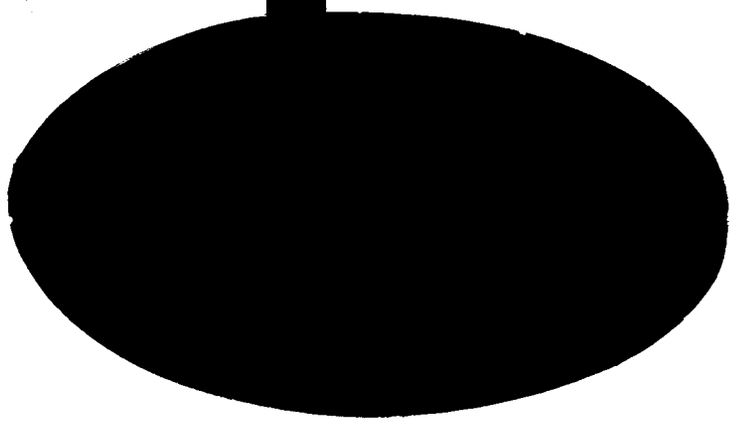
APOLLO

GUIDANCE, NAVIGATION AND CONTROL



MIT CHARLES STARK DRAPER LABORATORY

CAMBRIDGE MASSACHUSETTS 02139

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

APOLLO

GUIDANCE, NAVIGATION AND CONTROL

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R-693

GUIDANCE SYSTEM OPERATIONS PLAN FOR MANNED CM EARTH ORBITAL MISSIONS USING PROGRAM SKYLARK I

SECTION 4 OPERATIONAL MODES (REV. 01)

May 1972

MIT CHARLES STARK DRAPER LABORATORY
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R-693

GUIDANCE SYSTEM OPERATIONS PLAN FOR MANNED CM EARTH ORBITAL MISSIONS USING PROGRAM SKYLARK 1

SECTION 4 OPERATIONAL MODES
REVISION 01

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REVISION INDEX COVER SHEET

GUIDANCE SYSTEM OPERATIONS PLAN

GSOP No. R-693 Title: For Manned CM Earth Orbital Missions Using Program SKYLARK 1

Section No. 4 Title: Operational Modes

This section incorporates the following NASA/MSC approved changes to Colossus 3 (ART REV 72) and becomes the control document for SKYLARK I.

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
003	Improved Short Burn Logic	P40, R00
004	Deletion of V94 (Cislunar Tracking)	VERBS
005	Deletion of V59 (Optics Cal. Mark)	VERBS, V59, p. 4-14, 4-18
006	Deletion of V52 (Offset Landing Site Mark)	VERBS
007	Deletion of V44 & 45 (Set and Reset of Surface Flag)	VERBS, P20, R31, R34, R61, V44, V45
008	Routine 57 Deletion (Optics Cal. Routine)	INDEX
009	Routine 33 Deletion	INDEX
010	Routine 05 Deletion (S-Band Antenna)	INDEX, VERBS, NOUNS, p. 4-11
011	Programs 72 thru 79 Deletion	INDEX, NOUNS, P20, P34, P35, P36, P38, P40, P41, R00, R07, R23, R31, p. 4-2
013	Deletion of Lunar Surface Alignment Option	P52, P54, OPT CODE
014	Program 39 Deletion	INDEX
015	Program 38 Deletion	INDEX
016	Program 37 Deletion	INDEX, OPT CODE, ALARMS, P20, P37 R22, p. 4-25

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
017	Program 23 Deletion	INDEX, NOUNS, CL CODES, P20, R22, R52, V67, V93
018	Program 22 Deletion	INDEX, NOUNS, P20, P51, R22, R52, R53, V67, V93
019	Program 24 Deletion	INDEX, NOUNS, P20, R52, R53
021	Program 32 Deletion	INDEX, NOUNS, P32, R07
025	Extended Range Capability	P20, P48, R22, R61
032	VHF Range Rate Computation & Display	INDEX, NOUNS, P20, P25, P48, R00, R08, R22, R27, p. 4-7
036	Compute ATM Star Tracker Gimbal Angles	INDEX, NOUNS, OPT CODE, ALARMS, P55, R00, R53
040	SKYLAB Digital Autopilot	INDEX, VERBS, NOUNS, P20, P40, P41, P52, P54, R00, R03, R04, R60, R62, V44, V45, V46, V59, V64
042	SKYLAB 4 Maneuver DKI Sequence	INDEX, P31, P32, P33
043	Moon Ephemeris Suppression in Skylab	P51, P52, P54, R56
400	Program 15 Deletion	INDEX, NOUNS, p. 4-4
405	Transform Optics Angles to Tracking Angles	INDEX, VERBS, R64, V64
410*	Delete Lunar Capability	INDEX, P20, P21, P29, P30, P51, P52, P54, P61, R30, R31, R34, R41, R56, R61, V46, p. 4-1
411*	Delete HAM Targetting Program	P31, R07
412*	Delete ECSTEER	P34, P35, P36, P38
413	ATM Orientation Determination Program (P50)	INDEX, NOUNS, OPT CODE, P50, R00, R53, R56
414	Docked Alignment Capability in P51	P20, P51, P53, R53, R56
415	Docked Alignment Capability in P52	NOUNS, P20, P52, P54, R53, R56
416	Add Gyro Trim to R50	P52, P54, R50

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
420	Display Separation Angle in N05	NOUNS, R54
421	Allow Overwrite of N59 in P36	P36
422*	Initialize Rendezvous Navigation to Update the CSM State Vector	P20
423	Change Conic to Precision Integration in All Rendezvous Targetting Programs	P36
424	Improve Minkey Gyro Torquing Logic	P52
434	Correct α_{ATM} in P50	P50
435*	Do not Automatically take VHF in P20	R07
436*	Nominal Use of ATM Sources in P52 and P54	P52, P53, P54, R56
438*	Incorrect Star Tracker Angle in P55	P55
439 REV 1	VHF Range Rate Filter Enable/Disable by Extended Verb	VERBS, R22, V76, V77
442*	Modification to R22	R22
443	Improved R61 Tracking	R61
445*	Modification #3 to Skylark Memo #14	P33
448	Modification #4 to Skylark Memo #14	ALARMS, P31, P32
450*	Add Check for G&N Auto at Start of R67	R67
452	Precision Integration for V90	R36
454	Docked DAP Alarm Codes	ALARMS, R04
455*	Change to P35, P36 and R00 to fix Anomaly ART 07	P35, P36, R00

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
456*	Zeroing HOLDFLAG	P20, R00, R60, R61, R67, V56
457*	Editorial Changes to GSOP No. R-577 Section 4 Rev. 16	INDEX, VERBS, ALARMS, P00, P03, P27, P29, P30, P40, P52, P62, R21, R23, R36, R40, R41, R52, R53, R61, R63, R67, V41N20, V42, V57, V86, p. 4-4, 4-8, 4-11, 4-14, 4-15, 4-18, 4-24, 4-25, OPT CODE

The following Skylark Memos have been referenced as source material for the indicated changes.

SLM #2	Operational Modes for SKYLARK Rendezvous Program	INDEX, NOUNS, P20, P31, P32, P33, P34, P35, P36, P37, P38, P47, R00, R07, R23, R31
SLM #8	Modification of VHF $\dot{R}$ Proposals	P25, P48
SLM #19	VHF $\dot{R}$ Displays; P48 Change; R22/R27 in P20	INDEX, NOUNS, P20, P25, P48, R08, R22, R27
SLM #20	GSOP Modifications for SKYLARK Complex Impulsive Burn Logic	P40

Date: May, 1972

REVISION INDEX COVER SHEET
GUIDANCE SYSTEM OPERATIONS PLAN

GSOP No. R-693 Title: For Manned CM Earth Orbital Missions Using Program SKYLARK 1

Section No. 4 Title: Operational Modes (Revision 01)

This section incorporates the following NASA/MSC approved changes and becomes the control document for SKYLARK I (ART REV 72).

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
459	VHFR Changes	P20, P25, P48, R27, V76
460	Legal Star Codes in P55 and P20	P20, P55
464	Let NN = 0 in P35	P35
468*	Current ϕ in R27 not computed during any integration	R27
470*	Add Possible Operator Error Light at V06N14 in R53	R53
489*	Editorial and Technical Changes to Skylark 1 Section 4 GSOP	4-5, 4-8, 4-17, 4-18, 4-21, P20, P25, P27 P31, P32, P33, P34, P35, P37, P38, P40, P41, P47, P48, P50, P51, P52, P53, P54, P55, P77, R00, R22, R23, R27, R30, R31, R34, R40, R53, R56, R60, R61, R64, R67, V35, V36, V40, V41(N20), V42, V55, V56, V61, V62, V63, V67, V69, V91, V96, VERBS, NOUNS, ALARMS

NOTE: For the numbered front pages, a row of dots in the margin indicates a change in specification authorized by the PCR (PCN*) listed at the bottom of the page.

For the computer-printed pages, all changes are indicated in the "PROG CONT" column by + signs bracketing the affected area and by the authorizing PCR/PCN number.

FOREWORD

SECTION 4

The Guidance System Operations Plan (GSOP) for Program SKYLARK 1 is published in five sections as separate volumes:

2. Data Links
3. Digital Autopilots
4. Operational Modes
5. Guidance Equations
7. Erasable Memory Programs

Since the information in Section 1 of the Colossus 2E GSOP is also applicable to the SKYLARK Program, Section 1 will not be republished for SKYLARK. The reader is referred, therefore, to R577 Colossus 2E GSOP, Section 1, Revision 2, January 1970. Also, Section 6 will not be published for SKYLARK.

With this issue, Section 4 is revised from the previous issue of SKYLARK 1 (August, 1971), in order to reflect the NASA/MSC-approved changes listed on the "Revision Index Cover Sheet" at the beginning of this volume.

This volume is published as a control document governing operational modes for SKYLARK 1, including GNCS interfaces with the flight crew and MCC. Revisions constituting changes to the SKYLARK 1 Program require NASA approval.

TABLE OF CONTENTS

NOTE: The reproduction of IBM print-outs in Sections 4.4.1 through 4.9 inclusive are deliberately not paginated. Reference to the material on these pages is accomplished by using title and line numbers of Section 4.4 and page title (lower right corner) for Section 4.5 through 4.9.

TABLE OF CONTENTS

4. GNCS OPERATIONAL MODES

4.0 Introduction

Preparation of the GNCS for any mission involves the generation of computer programs, flight and ground crew procedures, and the provision of hardware to meet interface, accuracy, and instrumentation requirements. All of these mission-related items are specified in the Guidance System Operations Plan.

The guidance operational concept is designed to comprise a set of manually-initiated programs and functions which may be arranged by the flight crew to implement a large class of flight plans. This concept of operation will permit both a late flight-plan definition and a capability for real-time flight-plan changes.

The GNC System is designed to perform the CM guidance and navigation functions required in a self-contained mode within specified accuracy and maneuver propellant constraints. The System is also designed to accept navigation data from earth-based facilities whenever required to improve accuracy, to reduce maneuver propellant requirements, or to gain some other operational advantage.

4.1 AGC Program Control

To efficiently coordinate the design of the AGC* Programs, as well as define the astronaut and ground control procedures with respect to the GNC system, it is necessary to define the operating inter-relationships between the GNC system, other S/C systems, the astronauts and the ground.

In primary GNCS control modes the AGC can automatically compute required mission parameters and automatically command both GNCS and CSM subsystems. Complete automation of this control throughout a mission is neither feasible nor desirable. For primary as well as secondary GNCS control modes the astronauts and/or the ground must be capable of initiation or termination of AGC Programs. These procedures must be thoroughly defined to permit the design of the AGC Program logic for astronaut/ground participation.

4.1.1 AGC Program Initiation

4.1.1.1 AGC Programs

Due to the random time sequencing of many of the AGC tasks the design of Programs capable of being utilized at varied times and in varied circumstances offers the best method of accomplishing these tasks. These Programs must incorporate sufficient logic to clearly define the particular time and/or application for which they are to be used. They must also standardize astronaut/AGC communication procedures, ground/AGC communication procedures and GNCS and SCS Mode determination.

A logical arrangement of these Programs has been supplemented by simpler routines not requiring identification as Programs. The programs, and their associated routines are outlined in detail in Section 4.4.

When a single program is in process in the AGC, its program number is displayed in the Program lights on the DSKY. When more than one program is in process at the same time, the program which is making primary use of the DSKY will be displayed. There are three cases of dual program operation: programs with P20 in background, P27 with P00, P02 or P20 in background, and P03 with P02 in background.

The AGC is programmed to initiate a Program only in response to the initiation of a specific mission task and will continue the programmed sequence of computations and displays for the specific task until Program completion or termination.

Programs are generally initiated by manual keyboard entry (astronaut) or by AGC UPLINK command (ground). In certain cases Program initiation is automatically performed by the preceding Program. The diagrams of Section 4.4 show Program selection as it should occur normally.

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*AGC is an acronym for Apollo Guidance Computer. In the CSM, this computer is officially designated as the CMC (CM Guidance Computer).

4.1.1.2 Special AGC Routines

In addition to the AGC Programs there are many routines and subroutines not specifically identified with a Program. The majority of these are automatically performed in a particular computation or control sequence and involve no notification to the "outside world" that they are in process. While they may occasionally be referred to in this document their large number requires that detailed descriptions be restricted to special AGC program documents.

Several special routines are described in detail herein because of one or more of the following characteristics:

(a) The routine involves AGC communication with the astronaut.
(b) The routine is of importance in understanding the Programs.
(c) The routine involves significant sequences of AGC/Astronaut action but could be performed while certain programs are in process.

These routines include those automatically called by the AGC as well as those manually called. If the routine required AGC/astronaut communication, it will start with a particular display which acts as a key to the astronaut that the AGC has automatically entered the routine.

4.1.2 AGC Program Termination

Normally there are two ways by which an AGC Program in process is terminated:

1. At completion, the program in process will transfer control to (a) the Final Automatic Request Terminate Routine (R00), (b) a subsequent Program.
2. Via a terminate response by the astronaut to an AGC generated flashing display on the DSKY (usually results in transferring control to R00).

In addition to the above, the astronaut may terminate a particular AGC Program as follows:

1. Select a new Program to operate via the DSKY.
2. Select a routine via the DSKY which has been specifically designed to terminate a particular program or activity (e.g. state vector integration).
3. Select the FRESH START routine which essentially initializes the AGC.

4.2 AGC/Astronaut/Ground Communications

4.2.1 AGC/Ground Communications

The AGC/Ground Communications are via the AGC UPLINK and AGC DOWNLINK and are described in detail in Section 2 of the GSOP.

4.2.2 AGC/Astronaut Communications

The display and keyboard logic in the AGC processes information exchanged between the AGC and the computer operator. This information is exchanged via the display and keyboard (DSKY).

The modes of operation are basically:

(a) Display of internal data - This includes simple displays and periodically updated displays of data; and displays of requests for operator action required by the AGC.

(b) Loading of external data - the process of inserting data into the AGC via the DSKY.

(c) Program or Routine calling - Initiated by operator action via the DSKY.

The following paragraphs and Table 4-1 (page 4-18) provide a limited description of the DSKY, and the crew/DSKY operating procedures. They are included herein to facilitate understanding of the Program logic in Section 4.4 and do not comprise a complete instruction manual for the use of the DSKY. For detailed DSKY operating instructions refer to other MIT documents.

4.2.2.1 The DSKY (refer to Figure 4-1 page 4-19)

(a) UPLINK ACTY Light

1. is energized by the first character of a digital UPLINK message received by the AGC. If the light is not extinguished by the UPLINK transmission it should be extinguished by crew use of the RSET or KEY REL buttons when the UPLINK transmission is complete.
2. is energized during the Universal Tracking program (P20) when the tracking attitude routine (R61) detects that the 10^{o} test has failed (see Section 3. for criteria), that HOLDFLAG is not positive non-zero, and that the V50N18 Flag is not set.

(b) NO ATT Light - is energized when the AGC is in operate mode and there is no inertial reference; i.e. the ISS is caged or in the coarse align mode.

(c) STBY Light - is energized when the AGC is in standby mode and deenergized when the AGC is in operate mode.

(d) KEY REL Light

(1) Energized when:

(a) An internal display comes up while astronaut has the DSKY.

(b) An astronaut keystroke is made when an internal flashing display is currently on the DSKY. (Note three exceptions: PRO (proceed), RSET (reset) and ENTR (enter) if ENTR is a single button response.)

(c) The astronaut makes a keystroke on top of (his own) Monitor Verb display. This is the so-called "suspended monitor" case. (Monitor Verbs display data updated every one second.)

(2) De-energized when:

(a) Astronaut relinquishes DSKY by hitting KEY REL button.

(b) Astronaut terminates his current sequence normally, e.g.

i) with final ENTR of a load sequence.

ii) the ENTR of a response to a flashing display.

iii) the ENTR of an extended verb request.

(3) Some special DSKY cases that may not be universally appreciated are:

(a) The astronaut may select a non-Monitor Verb display on top of his own previously selected Monitor Verb. This will cause KEY REL light to flash (See 1 (c) above). Hitting the KEY REL button will bring back (unsuspend) the monitor and extinguish the light. However, if these sequences are selected on top of an internal display, the KEY REL light will not go out as the monitor is unsuspended. It requires one more KEY REL button operation to extinguish the light and bring back the internal display.

(b) Suppose the astronaut selects another verb-noun combination (e.g. a V16 monitor) on top of an internal flashing

display. That internal display can still be answered with a PRO or VERB 34 ENTR (terminate), which wipes everything from the DSKY till the next internal display. Therefore, an astronaut selected monitor should, as a rule, never be terminated with VERB 34 ENTR, because that may not be the desired response to the flashing display. The KEY REL button should be used instead.

(e) TEMP Light - the AGC receives a signal from the IMU when the stable member temperature is in the range 126.3°F to 134.3°F. In the absence of this signal, the TEMP light on the DSKY is actuated.

(f) GIMBAL LOCK Light - energized when the middle gimbal angle exceeds $\pm 70^{\circ}$ from its zero position. When MGA exceeds $\pm 85^{\circ}$ the ISS is downmoded to Coarse Align and the No Attitude lamp on the DSKY is actuated except during Average-G when the "config" window of DAPDATR1 indicates Saturn configuration.

(g) PROG Light - The program alarm actuates the PROG light on the DSKY. A program alarm is generated under a variety of situations. For further information relative to program alarm see Sections 4.3.3 and 4.3.4.

(h) TRACKER Light

1. Failure within the optics CDUs generates a fail discrete (Optics CDU Fail) which is an input to the computer. The TRACKER light is energized by this error signal. The discrete will be set if any or all of the following conditions in either OCDU exist for approximately 2-10 seconds.
   a. CDU fine error - in excess of 1.0V rms
   b. READ COUNTER limit cycle - in excess of 160 cps
   c. COS (θ - ϕ) - below 2.0V
   d. +14 VDC supply - decrease to 50% of normal level

2. In addition to the conditions described in (1.) the TRACKER light is energized when the VHF Range Read Routine (R08)

reads VHF Range data via the VHF DATA link but the DATA GOOD DISCRETE is missing. R08 is called by the rendezvous tracking data processing routine (R22) and the VHF range rate mark processing routine (R27).

3. It is de-energized if the DATA GOOD DISCRETE is present after reading VHF Range data and by keying in V88E.

   It is also de-energized if the conditions described in (1.) and (2.) do not exist.

(i) OPR ERR Light - is energized when the DSKY operator performs an improper sequence of key depressions. The light is de-energized by pressing the RSET button.

(j) COMP ACTY Light - is energized when the AGC is occupied with an internal sequence. It is not an indicator of whether the operator may use the DSKY or whether the AGC is not capable of handling further computation.

(k) RESTART Light - in the event of Restart during operate a latch is set in the AGC which maintains the RESTART light on the DSKY until the latch is manually reset by pressing the RSET button. For further detail see section 4.3.4.

(l) Display Panel - consists of 24 electroluminescent sections arranged as in Fig. 4-1, page 4-19. Each section is capable of displaying any decimal character or remaining blank, except the 3 sign sections. These display a plus sign, a minus sign, or a blank. The numerical sections are grouped to form 3 data display registers, each of 5 numerical characters; and 3 control display registers, each of 2 numerical characters. The data display registers are referred to as R1, R2, R3. The control display registers are known as VERB, NOUN, and PROGRAM.

At maximum activity, the complete display panel may be updated in approximately 1/2 second.

(m) Keyboard - contains the following buttons:

VERB - pushing the button indicates that the next two numerical characters keyed in are to be interpreted as the Verb Code.

NOUN - pushing the button indicates that the next two numerical characters keyed in are to be interpreted as the Noun Code.

+ and — -sign keys used for sign convention and to identify decimal data.

0 – 9 -numerical keys.

CLR - used during a data loading sequence to clear or blank the data display register (R1, R2, R3) being used. It allows the operator to reload the data word.

PRO - this pushbutton performs two functions:

1. When the AGC is in a standby mode, pressing this button will put the AGC in the operate mode, turn off the STBY light (see (c)), update CMC time counter, and select Routine 00 in the AGC.
2. When the AGC is in the operate mode but Program 06 is not selected, pressing the button will provide the proceed function. Proceed directs the AGC to continue to the next programmed event. In response to an AGC request it further indicates crew compliance with the request. If the PRO button is pressed when the VERB lights contain verb 21, 22, or 23, the button is rejected and the OPR ERR light is energized.

2a. When the AGC is in the operate mode and Program 06 is selected, pressing the button will put the AGC in the standby mode and turn on the STBY light (see (c)).

KEY REL - releases the DSKY displays initiated by keyboard action so that the DSKY is available for displays generated by the AGC program.

ENTR - is used in three ways:

1. To direct the AGC to execute the Verb/Noun code now appearing on the Verb Noun lights.
2. To direct the AGC to accept a data word just loaded.
3. In response to a "please perform" request (see section 4.2.2.7).

RSET - turns off PROG light, RESTART light, and OPR ERR light; also clears R1 and R2 of the N09 registers containing the alarm code (FAILREG's).

4.2.2.2 Verbs and Nouns

The basic language of communication between the astronaut and the DSKY consists of Verb and Noun Codes. The Verb Code indicates what action is to be taken. The Noun Code indicates to what this action is applied.

Verb Noun codes may be originated either by manual operation or by the AGC Program in process.

The standard procedure for a manual keyboard operation consists of a sequence of 7 key depressions:

VERB V_1 V_2 NOUN N_1 N_2 ENTR

The VERB key depression blanks the Verb lights on the display panel and clears the Verb Code register within the computer. The next two numerical characters punched in are interpreted as the Verb Code. Each of these characters is displayed in the Verb lights on the display panel as it is punched in. The NOUN key operates similarly for the Noun lights and Noun Code register.

The depression of the ENTR key causes the performance of the Verb-Noun combination appearing in the lights at the time of depression. Thus it is not necessary to follow any order in punching in the Verb or Noun Code. They may be done in reverse order, or an old Verb or old Noun may be used without repunching it.

No action is ever taken in performing the Verb-Noun combination until ENTR is pressed. If an error is noticed in either the Verb Code or the Noun Code before the ENTR is pressed, correction is simple. Merely press the VERB or NOUN key and repunch the originally intended code, without necessarily changing the other. Only when the astronaut has verified that the desired Verb and Noun Codes are in the lights, should he press the ENTR key to execute the Verb-Noun combination.

A Noun Code can refer to a group of computer erasable registers, a group of counter registers, or may serve merely as a label. A label Noun refers to no particular computer registers, but conveys information by its Noun Code number only. The group of registers to which a Noun Code refers may be a group of 1, 2 or 3 members. These are generally referred to as 1, 2, or 3 component Nouns. The component is understood as a component member of the register group to which the Noun refers. The machine addresses for the registers to which a Noun refers are stored within the computer in Noun tables.

A single Noun Code refers to a group of 1, 2, or 3 component members. It is the Verb Code that determines which component member of the Noun group is operated on. Thus, for instance, there are 5 different Load Verbs. Verb 21 is required for loading the first component of whatever Noun is used therewith; Verb 22 loads the second component of the Noun; Verb 23, the third component; Verb 24, the first and second components of the Noun; and Verb 25 loads all three components of the Noun. A similar component format is used in the Display and Monitor Verbs.

When the decimal Display Verb is employed, all the component members of the Noun being used are scaled as appropriate, converted to decimal, and displayed in the data display registers.

Decimal data is identified by a + or - sign preceding the numerical characters. If decimal is used for loading data of any component members of a multi-component Load Verb, it must be used for all components of the Verb. Thus no mixture of decimal and octal data is permitted for different components of the same Load Verb. (If this is violated, the OPR ERR light is turned on.)

There is a class of verbs called Monitor Verbs which display data every one second. Once a Monitor Verb is executed, the data on the display panel continues to be updated until the Monitor is turned off.

The Monitor may be turned off by keying in: PRO, VERB 34 ENTR (terminate), VERB 32 ENTR (recycle), by internal program initiation of the Keyboard and Display System Program, (if the DSKY is not busy) or by a Fresh Start or Restart of the AGC.

Monitor action is suspended (but not ended) by the depression of any key, except RSET, KEY REL, and ENTR. This turns on the KEY REL light immediately. Monitor action continues after the Keyboard and Display System is released. Thus it is possible to suspend a monitor while the astronaut loads some data (or requests another display) and to return to the original monitor when his intervention is concluded.

After any use of the DSKY, the numerical characters (verb, noun, and data words) remain visible until the next use of the DSKY. If a particular use of the DSKY involves fewer than 3 data words, the data display registers (R1, R2, R3) not used remain unchanged, unless blanked by deliberate program action.

The DSKY procedures above were described for manual operation; however, the principles described remain the same for DSKY operation by the AGC Programs and routines.

As outlined in the Mission Programs (section 4.4) the majority of DSKY operations are of the following categories:

a) Display - to display data to the operator. Display Verbs present data computed by the mission program.

b) Load - to request a data load as described in detail below.

c) Please Perform - to request an action from the astronaut. (see section 4.2.2.7)

d) Please Mark - to request the astronaut to push the "MARK" button for an optics sighting. (see section 4.2.2.8)

AGC initiated Verb/Noun combinations are either statically displayed or flashed. If static they identify data displayed only for astronaut information requiring no response from him. If the Verb/Noun is flashing, appropriate astronaut response is required as dictated by the Verb/Noun combination. In this case the AGC Program or Routine is interrupted until the astronaut responds appropriately, then the Verb/Noun flash is terminated and the Program or Routine is resumed. (In some cases, e.g. R31, and R34, the displays will be continuously updated until the flash is terminated).

An appropriate astronaut response to a flashing Verb/Noun should be a data load and ENTR, VERB 32 ENTR (recycle), PRO, or VERB 34 ENTR (terminate). The internal program response to any one of these astronaut responses varies according to the Verb/Noun flashing and the Program in process as described below and in Section 4.4.

4.2.2.3 Acceptance of Keys

The numerical keys, the CLR key, and the sign keys are rejected if struck after completion (final ENTR) of a data display or data load Verb. At such time, only the VERB, NOUN, ENTR, RSET, or KEY REL are accepted. Thus the data keys are accepted only after the control keys have instructed the program to accept them.

Similarly the plus (+) and minus (-) keys are accepted just before the first numerical character of R1, R2, R3 is punched in, and at no other time.

The 8 or 9 key is accepted only while defining a program number, a verb, a noun, or when loading a data word into R1, R2, or R3 which was preceded by a plus or minus sign. (If this is violated, the OPR ERR light is turned on.)

If more than two numerical characters are punched in while loading the Verb, Noun, or Program code in the noun register, or more than five numerical characters while loading a data word, the excess characters are not accepted.

4.2.2.4 Release of Keyboard and Display System

The Keyboard and Display System Program can be used by internal computer programs. However, any operator keyboard action (except RSET) makes the Keyboard and Display System Program busy to internal routines. The operator has control of the Keyboard and Display System until he wishes to release it. Thus he is assured that data he wishes to observe will not be replaced by internally initiated data displays. There are four cases in which the operator initiated normal displays will be replaced by internally initiated action. These are: in P40/P41 when the DSKY is blanked at T-35 seconds, in P20 when DSKY is blanked during return from R60 to R61 at end of maneuver, when P63 is initiated from P62, and at lift off when P11 is initiated. In general, it is recommended that the operator release the Keyboard and Display System for internal use when he has temporarily finished with it. This is done by pressing the KEY REL button.

If an internal program attempts to use the Keyboard and Display System, but finds that the astronaut has used it and not yet released it, the KEY REL light is turned on. When the astronaut finds it convenient, he should strike the

KEY REL button to allow the internal program to use the keyboard and display panel.

4.2.2.5 Display - Verb/Noun Flashing

This is an internally initiated action. The appropriate astronaut response to a flashing display Verb/Noun combination is:

(a) Correct the data (see Section 4.2.2.6 below). Perform the appropriate Load Verb sequence. Upon the final ENTR, the program proceeds normally.

(b) VERB 32 ENTR (recycle). This causes the program to return to a previous location.

(c) PRO. This indicates acceptance of the displayed data, and a desire for the internal sequence to continue normally.

(d) VERB 34 ENTR (terminate). The astronaut wishes to terminate the operation.

NOTE: Uncommon responses are defined in the program logic of Section 4.4.

4.2.2.6 Load - Verb/Noun Flashing

Whenever any data is to be loaded the Verb/Noun flashes. The flash occurs whether the data load is initiated by the AGC or by the astronaut. The appropriate data display register (R1, R2, or R3) is blanked in anticipation of the data load. Data is loaded in 5-character words and is displayed character-by-character in one of the 5-position data display registers as it is keyed in.

Numerical data is considered decimal if the data word is preceded by a plus or minus sign; if no sign is supplied it is considered octal. The plus and minus keys are accepted only when they precede the first numerical character of the data word; they are ignored at any other time. Both decimal and octal data may be loaded with high order zeros suppressed. If decimal is used for any component of a multi-component Load Verb, it must be used for all components of that Verb. No mixing of octal and decimal data is permitted for different components of the same Load Verb. (If this principle is violated, the OPR ERR light is turned on.)

The ENTR key must be pressed after each data word. This tells the program that the numerical word punched in is complete. The flash is turned off after the last ENTR of a loading sequence.

As data is loaded, it is temporarily stored in buffers. It is not placed into its final destination, as specified by the Noun Code, until the final ENTR of the load sequence.

If an attempt is made to key in more than 5 numerical characters in sequence, the sixth and subsequent characters are simply rejected. If the 8 or 9 key is punched during octal load (as identified by lack of a sign entry), it is rejected and the OPR ERR light is turned on.

In multi-component load situations, the appropriate single component Load Verbs are flashed one at a time. The computer always instructs the astronaut through a loading sequence. For example: the astronaut (or the internal program) initiates the sequence by selecting VERB 25, "load 3 components of:" (any 3-component noun will do). The Verb Code is changed to 21, "load first component of:" and the flash is turned on. VERB 21 continues to be flashed as the astronaut punches in the first word of data. When the ENTR is pressed, the Verb Code is changed to 22. Flashing continues while the astronaut punches the second data word. When ENTR is pressed, the Verb Code is changed to 23, "load third component," and again the flash continues while the third data word is punched in. When ENTR is pressed, the flash is turned off, and all three data words are placed in the locations specified by the Noun. Throughout the changing of the Verb Codes, the Noun Code is left unchanged.

The CLR button is used during data loading to remove errors in R1, R2, or R3. It allows the astronaut to begin loading the data word again. It does not clear the Program, Noun, or Verb lights. (The Noun lights are blanked by the NOUN key; the Verb lights, by the VERB key.) In the following discussions, the term Clearing Function will be used to mean blanking the data display register.

For single component Load Verbs, the CLR button depression performs the Clearing Function on whichever register is being loaded, provided that CLR is punched before data ENTR. Once ENTR is depressed, CLR does nothing. The only way to correct an error after the data ENTR for a single component Load Verb is to begin the Load Verb again.

For the 2- or 3-component Load Verbs, there is a retrograde sequencing feature of CLR. The first depression of the CLR button performs the Clearing Function on whichever register is being loaded. (CLR may be pressed after any character, before its ENTR.) Consecutive depressions of CLR perform the Clearing Function on the data display register preceding the current one, and also change the VERB light to indicate the register being acted upon until R1 is cleared. Any attempt to back up beyond R1 is simply ignored.

The retrograde sequencing of CLR operates only on data pertinent to the Load Verb which initiated the loading sequence. For example, if the initiating Load Verb was a load second component only, no backing-up action is possible.

4.2.2.7 Please Perform - Verb/Noun Flashing

This is always an internally initiated action, as astronaut response is always required to the "please perform" request; the Verb-Noun is always flashed, and the Program is interrupted. The "please perform" verb (50) is usually used with the "Checklist" noun (25) with an appropriate "checklist code" number in R1. The appropriate response is:

(a) PRO to indicate an affirmative response to the request.

(b) ENTR to indicate a negative response to the request.

4.2.2.8 Please Mark

The "please mark' verbs (51 and 53) are flashed when the AGC is prepared to accept optical sighting data upon the pushing of the "MARK" button and ENTER button, respectively. The logic associated with the "please mark" function is completely described in Section 4.4. Marking is also allowed during P20 option 0, 4 without the presence of a please mark verb.

4.2.2.9 Machine Address to be Specified

There is a class of Noun available to allow any machine address to be used. These are called "Machine Address to be Specified" Nouns. When the ENTR which causes the Verb-Noun combination to be executed senses a noun of this type, R3 is blanked and the flash is immediately turned on. The Verb Code is left unchanged. The astronaut should load the 5-octal-character complete machine address of interest. It is displayed in R3 as it is punched in. If an error is made in loading the address, the CLR may be used to remove it. Pressing ENTR causes the verb to be executed.

4.2.2.10 Program Selection

VERB 37 ENTR is used to select a Program. The ENTR causes the Noun display register to be blanked and the Verb Code to be flashed. The 2-character Program Code would then be loaded. For verification purposes, it is displayed as it is loaded in the Noun display register. The ENTR causes 1) the noun register to be blanked and the 37 remaining in the verb register to be non-flashing, 2) a request for the new Program to be entered, and 3) the new Program Code to be displayed (if allowed) in the Program display register.

4.2.2.11 Alarm Philosophy

The OPR ERR light is turned on when the astronaut performs some improper sequence of key depressions.

4.2.2.12 Illegal Verbs, Nouns and Combinations

The simplest alarm situation is an attempt to use an undefined (or spare) Verb Code or Noun Code. The OPR ERR light is turned on when the ENTR that attempts to execute the Verb/Noun combination is pressed. No further action is taken.

It is possible to choose a Verb that is defined and a Noun that is defined, but have the combination of Verb and Noun be illegal (for example, the "decimal display" Verb used with a Noun which is restricted to be "octal only"). The OPR ERR light is turned on at the ENTR that attempts to execute the Verb/Noun combination for display verbs and at the ENTR following the final data load for load verbs. No further action is taken.

Violation of the following principles causes the OPR ERR light to be turned on. No further action is taken.

(a) An undefined (or spare) verb must not be used.

(b) An undefined (or spare) noun must not be used.

(c) In octal Display and Monitor Verbs and all Load verbs, the components number of the verb must not exceed the number of components in the noun. (Note, all "machine address to be specified" nouns are considered 3 component.)

(d) The octal Display and Monitor Verbs must not be used with a "decimal only" noun.

(e) The decimal Display and Monitor Verbs must not be used with an "octal only" noun.

(f) The double precision decimal Display and Monitor Verbs (07, 17) must not be used with mixed nouns (codes 40-99).

(g) No Load Verb (except V21, V22 and V23) may be used with a noun restricted to be "no load". All nouns having split MIN/SEC scale or 2 integers for any component are "no load" for the entire noun.

(h) No input code other than those which are defined may be punched into the keyboard.

4.2.2.13 Illegal Data and Recycle

Many legal Verb/Noun combinations require the loading of additional data (either numerical or machine address). It is possible that the data supplied may itself be improper for the Noun selected. Examples are: (1) the numerical data exceeds the maximum value allowed by the scale factor associated with the Noun, and (2) decimal data is loaded into an "octal only" noun.

In general the offense is detected at the final ENTR of the loading sequence. The alarm is turned on and a recycle is performed back to the beginning of the loading sequence. The flash is left on, and the data display register associated with the first data word in the sequence is blanked again. It is necessary for the astronaut only to supply the data again; he need not attempt to re-execute the Verb/Noun combination. (Note, if decimal data is supplied for the address of a "machine address to be specified" noun, the alarm and recycle are performed at the ENTR immediately following the address keyed in.)

Violation of the following principles causes the OPR ERR light to be turned on, and a recycle to be performed.

(a) The address keyed in for a "machine address to be specified" noun must be octal.

(b) In multicomponent load verbs, no mixing of octal and decimal data is permitted. All the data words loaded for a given noun must either be all octal or all decimal.

(c) Octal data must not be loaded into a "decimal only" noun.

(d) Decimal data must not be loaded into an "octal only" noun.

(e) Decimal data loaded must not numerically exceed the maximum permitted by the scale factor associated with the appropriate component of the noun.

(f) Negative decimal data must not be loaded using the Y optics scale.

(g) All 3 words must be loaded for the Hours, Minutes, Seconds scale.

(h) When loading with the Hours, Minutes, Seconds scale, the minutes must not exceed 59; the seconds must not exceed 59.99; and the total magnitude must not exceed 745 hours, 39 minutes, 14.55 seconds.

(i) Two numerical characters must be supplied for the Program Code under V37.

4.2.2.14 Operator Error and Key Rejection

There are five situations which cause the OPR ERR light to be turned on and the offending key depression to be simply rejected. These are:

(a) An 8 or 9 is punched while loading a word which was not preceded by a plus or minus sign. The 8 or 9 is simply rejected. The remaining characters may then be supplied or the offending word removed and its loading begun again.

(b) Certain program controlled cases (see Section 4.4).

(c) An attempt to call an extended verb on top of a priority display or an attempt to call an extended verb with displays on top of another extended verb with displays without allowing proper termination of the first.

(d) The PRO button may not be pressed when the VERB lights contain VERB 21, 22, or 23.

(e) Neither V30E or V31E can be called if R1 of N26 is zero.

[x] Revised SKYLARK 1 PCN # 489
[ ] Added GSOP # R693 PCR # _____ Rev. 01 Date May 1972

ASTRONAUT RESPONSE	DISPLAY OF INFORMATION		REQUEST FOR ASTRO ACTION		REQUEST FOR DATA LOAD	REQUEST FOR OPTICS MARK
	Type of information identified by V__N__ followed by up to three available registers of information, R1, R2, R3.		Request identified V50, V97, V99, or V37.	Request identified by V53	Request identified by V____ and type of data by N____. Loaded data appears in registers R1, R2, R3, At. completion, key in "ENTER".	Request identified by V51 At completion of "MARK"s identify target (final entry is "ENTER")
	CMC Awaiting ASTRO Response V_N_Flashing	CMC Not Awaiting ASTRO V_N_Static	CMC Always Awaiting ASTRO Response	CMC always awaiting ASTRO response	V_N_ Flashing	CMC Always Awaiting ASTRO Response V51 Flashing
Key in "ENTR"	No CMC Action	No CMC Action	CMC assumes ASTRO did not comply, terminates flashing Verb-Noun, and continues	CMC assumes ASTRO complied	CMC takes loaded data, terminated flashing Verb-Noun and continues	V51: No CMC Action
Key in "PRO"	CMC assumes displayed data is correct, terminates flashing Verb-Noun, and continues	No CMC Action	CMC assumes ASTRO complied, terminates flashing Verb-Noun, and continues	In R23 CMC assumes ASTRO has taken sufficient marks. In R56 response is not accepted	Varies with program in progress	See appropriate routine in Section 4.4
Key in "Terminate" (V34E)	Varies with program in progress	No CMC Action	Varies with program in process		Varies with program in process	Varies with program in process
Key in "Recycle" (V32E)	CMC returns to earlier point in sequence	No CMC Action	Incorrect Response		Incorrect response	V51: No CMC Action
Press MARK button	If there is no request for a mark at the time of key depression (P20 option 0, 4 not operating) the PROG Light is turned on. Marking is also allowed during P20 option 0 or 4 without the presence of a please mark verb. Pressing MARK will cause CMC to read 2 optics angles, 3 CDU angles and time and store for R22.					CMC reads 2 optics angles, 3 CDU angles, and time, terminates flashing Verb-Noun if a suitable number of marks have been made and continues

ASTRONAUT RESPONSE TO DSKY DISPLAYS
AND CMC RESULTANT ACTION
Table 4-1

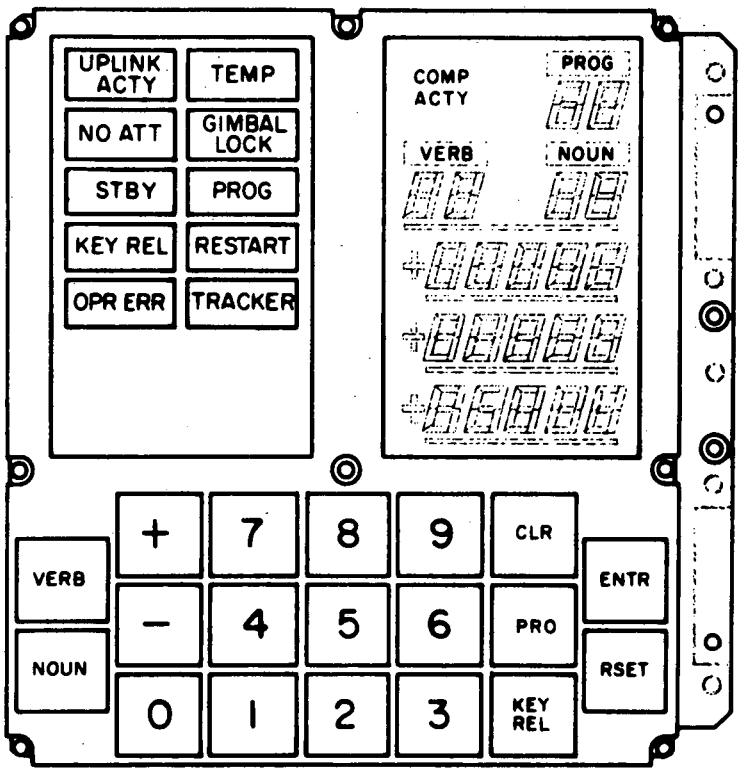


Fig. 4-1 Display and Control Panel

4.3 GNCS Failure Monitor

The GNCS performance and operational readiness are self-monitored and caution and warning information are displayed to the crew. Two warning (red) lamps are actuated by the GNCS on the Caution/Warning Panel: AGC Warning indicates computer failure; ISS warning indicates failure of the inertial subsystem. Also a GNCS Caution (amber) light is actuated to indicate non-critical problems in the system. Further detail regarding the caution items is displayed by means of the DSKY event lamps and the DSKY data registers (in the event of a program alarm).

4.3.1 AGC Warning

An AGC warning alarm is generated in the event of AGC power failure, scaler failure of either of two types, restart or counter failure during AGC operate, or in response to an alarm test program. A scaler fail or prime power fail result in an immediate alarm indication whereas the other inputs are buffered by a filter so as to prevent transient disturbances from causing a warning alarm. In this subsection the various inputs and conditions associated with AGC warning are defined.

(a) SCAFAL - Occurs if scaler stage 17 (1.28-sec. period) fails to produce pulses. This provides a check on the timing for all logic alarms.

(b) COUNTER FAIL - Occurs if counter increments happen too frequently or else fail to happen following an increment request. "Too frequently" means continuous counter requests and/or incrementing for from 0.625 to 1.875 ms.

(c) SCADBL - Occurs if the 100 pps scaler stage operates at a pulse rate of 200 pps or more.

(d) PARITY FAIL - Occurs if any accessed word in fixed or erasable memory whose address is octal 10 or greater contains an even number of "ones".

(e) RUPT LOCK - Occurs if interrupt is either too long or too infrequent. The criterion for "too long" is phase dependent, varying in duration from 140 ms. to 300 ms. Likewise the criterion for "too infrequent" varies in absence from 140 ms to 300 ms.

(f) TC TRAP - Occurs if too many consecutive TC or TCF instructions are run or TC or TCF instructions are too infrequent. The criterion for "too many" varies in duration from 5 ms to 15 ms. The criterion for "too infrequent" varies in absence from 5 ms to 15 ms.

(g) NIGHT WATCHMAN - Occurs if the computer should fail to access address octal 67 within a period whose duration varies from 0.64 sec. to 1.92 sec.

(h) V FAIL - Occurs if the AGC voltages (28, 14, 4) are out of limits. This signal produces STRT1 if it stays on for a period of between 157 and 470μ sec. If the computer is in the STANDBY mode, an input to the AGC WARNING FILTER is generated simultaneously with STRT1. The following criteria apply for V FAIL:

4 V Supply > 4.4 V	14 V Supply > 16 V
4 V Supply < 3.65V	14 V Supply < 12.5V
	28 V Supply < ~22.6V

(i) STANDBY - This is a signal which turns on RESTART and turns off the switchable +4 and +14 voltage, thus putting the AGC into a low power mode where only the scaler, timing signal, and a few auxiliary signals are operative. STANDBY is initiated by first setting the ENABLE STANDBY outbit (CH13 B11), and then pressing the PRO button on the DSKY for a time which varies from 0.64 sec. to 1.92 sec. at the end of which time the STANDBY light is turned on. (All AGC alarms are inhibited during the Standby mode with the exception of AGC WARNING, which can be caused by VOLTAGE FAIL or SCALER FAIL; and TEMPERATURE CAUTION, which can be caused by TEMP ALARM.) Normal operation is resumed by pressing the PRO Button on the DSKY again, time of depression same as above.

(j) RESTART - RESTART occurs at next time 12 following occurrence of any one or more of the following parameters: Rupt lock, TC Trap, Night Watchman, parity fail, and Standby as described above.

RESTART occurs immediately and forces time counter to 12 upon occurrence of OSCILLATOR FAIL. (See paragraph (1) below.)

RESTART causes the computer to transfer control to fixed memory address 4000_8 as soon as it disappears. It sets a flip-flop which lights the RESTART CAUTION lamp in the DSKY.

The flip-flop is reset either by the ALARM RESET hard-wired signal or by the CAUTION RESET outbit CH11 B10. ALARM TEST operates the lamp but not the flip-flop.

(k) WARNING FILTER - This circuit is used to operate the AGC WARNING output following repeated or prolonged occurrences of any of certain parameters. All occurrences of these signals are stretched so that no more than one input to the filter is generated in each 160-millisecond period. Approximately six consecutive stretched pulses cause AGC WARNING to turn on for about 5 seconds. Non-consecutive stretched pulses may also cause AGC WARNING after an interval dependent on the frequency of the pulses. The output will not occur if input pulses occur at a frequency of less than 0.9 pps; and the output will remain on if pulses occur at a frequency of 0.6 pps or more. The threshold of the filter resumes its normal level with a time constant of many seconds after the filter has received inputs. An immediate reset of the AGC WARNING due to a WARNING FILTER output is therefore not possible.

(l) OSCILLATOR FAIL - Occurs if the oscillator stops. Has nominal 250-millisecond delay to keep signal present after the oscillator starts. Also occurs when AGC is in STANDBY because of loss of power to front end of circuit. This results in a 250-millisecond delay in starting when AGC comes out of STANDBY into OPERATE and causes an immediate restart without waiting for time pulse 12.

4.3.2 ISS Warning

The ISS Warning signal is the logical "OR" of the following parameters, any one of which will cause an ISS Warning under the following conditions:

(a) IMU Fail

(1) IG Servo Error - greater than 2.9 mr for 2 sec

(2) MG Servo Error - greater than 2.9 mr for 2 sec

(3) OG Servo Error - greater than 2.9 mr for 2 sec

(4) 3200 cps supply - decrease to 50% of normal voltage level

(5) 800 cps wheel supply - decrease to 50% of normal voltage level

These parameters are generated in the Inertial Subsystem. However, the "WARNING" signal itself is under AGC program control. It is ignored by the AGC program when the G&N system is in the Coarse Align Mode and during the 5-second interval following Coarse Align. During this mode the servo errors normally exceed the above criteria.

(b) PIPA FAIL

Pipa fail occurs if no pulses arrive from a PIPA during a 312.5-microsec period, or else if both plus and minus pulses occur, or if a "long

time" elapses without at least one plus pulse and at least one minus pulse arriving. By "long time" is meant a period between 1.28 sec. and 3.84 sec.

This FAIL signal is generated totally within the AGC and thus is completely under AGC program control. Its generation is enabled by the AGC only during AGC controlled translation or thrusting maneuvers.

(c) ISS CDU FAIL (Monitored for each of 3 CDU's) Set if any or all of the following conditions exist for approximately 2-10 sec.

(1) CDU fine error - in excess of 1.0 V rms

(2) CDU coarse error - in excess of 2.5 V rms

(3) READ COUNTER limit cycle - in excess of 160 cps

(4) Cos (θ - ϕ) - below 2.0 V

(5) +14 VDC Supply - decrease to 50% of normal level

These parameters are generated in the Inertial Subsystem. However the response to the "FAIL" signal itself is under AGC program control. It is ignored by the AGC program for about 8 seconds after the CDU Zero Mode has been commanded. During this Mode the CDU errors normally exceed some of the above criteria.

4.3.3 GNCS Caution

The GNCS Caution lamp is actuated by the following undesirable and non-critical events:

(a) CMC Restart during operation. In the event of Restart during operate a latch is set in the CMC which maintains the GNCS Caution alarm and the RESTART lamp on the DSKY until the latch is reset by the program or until the latch is manually reset by pressing the RSET button. For further detail see section 4.3.4.

(b) Temperature out of Limits. The CMC receives a signal from the IMU when the stable member temperature is in the range 126.3^{o}F to 134.3^{o}F. In the absence of this signal, the Caution alarm and the TEMP lamp on the DSKY are actuated.

(c) Gimbal Lock. When the CMC determines that the middle gimbal angle (MGA) of the IMU is greater than 70^{o}, the Caution alarm and the Gimbal Lock lamp on the DSKY are actuated. When MGA exceeds 85^{o} the ISS is downmoded to Coarse Align and the No Attitude lamp on the DSKY is actuated except during Average-G when the "config" window of DAPDATR1 indicates Saturn configuration.

(d) Program Alarm. Under a variety of situations a program alarm is generated. One example is that of a PIPA fail when the vehicle is not in a thrusting mode. Under program control the CMC inhibits this program alarm for 10 sec. after system turn-on. The program alarm actuates the Caution alarm and the Program light on the DSKY. For further information see Section 4.3.4.

4.3.4 Restart and Program Alarms

Program Alarms

1. Alarm conditions are indicated by lighting the PROG ALARM light and storing the appropriate alarm code so that it may be examined by keying V05N09E. In some special cases V05N09 is automatically displayed. The light is turned off and R1, R2 of N09 are cleared by pressing the RSET button. For non-ABORT alarm conditions the normal program flow is not interrupted.

2. The ABORT type of alarm conditions preclude continuation of normal program flow; in these special cases recovery from the condition is accomplished by the software by means of a "software restart". These ABORT conditions are divided into two classes:

a. "BAILOUT" alarms, designated by a five-digit alarm code with 3 as the first digit, e.g. 31201.

These alarms cause suspension of non-restartable program activity and continuation of only that program activity which is restartable. This type of alarm condition is generally due to temporary overloading of the system; the BAILOUT procedure will relieve the situation and allow continuation of the program.

b. "POODOO" alarms, designated by a five-digit alarm code with 2 as the first digit, e.g., 21302.

These alarms are caused by conditions which are less likely to be correctable than the "BAILOUT" alarm conditions, e.g. inconsistencies in mathematical calculations. Software recovery procedures for POODOOS depend on program environment at the time:

1.) If AVERAGE G is active, the "BAILOUT" recovery procedure is followed. *

2.) If an extended verb is active, the "BAILOUT" recovery procedure is followed. *

*When a POODOO abort condition triggers a BAILOUT recovery procedure, the POODOO alarm code is retained.

E

3.) If neither of the above applies, current program flow is terminated and a flashing V37 is displayed, requesting astronaut selection of a new program.

3. Exit from a continuous "BAILOUT" loop can be accomplished by simultaneous depression of the RSET and MARK REJECT buttons, as in the case of a hardware restart loop. Exit from either a hardware or a software restart loop by means of the above will cause reinitialization of the software by a Fresh Start.

Restarts

Hardware restarts will light the Restart lamp on the DSKY.

4.3.5 Restart Protection

With the exception of P06, the pulse torquing option of P52 and P54 (following ENTR on V50N25, R1 = 00013 until V50N25, R1 = 00014), and in P52 following PRO on V50N25 R1 = 00020 until termination of P52, all programs are restart protected. All routines which are called by a program are restart protected. Restart logic is designed such that significant information is not lost due to a restart. Extended verb routines and manually called displays are not restart protected.

4.3.6 Channel 31, 33 Fail Bit Protection

A new erasable C31FLWRD has been defined which is examined by the AGC to determine if the channel representations of the CMC MODE SWITCH, SC CONTROL SWITCH, OPTICS MODE SWITCH, or OPTICS ZERO SWITCH are to be used or if back-up indications are to be used. The erasable is of the form $AxxDx_8$.

If A = 0 or 4, the CMC MODE SWITCH and SC CONTROL SWITCH indications are assumed valid. Other values of A cause the AGC to use a back-up indication as shown in Table I.

If D = 0 or 4, the OPTICS MODE SWITCH and OPTICS ZERO SWITCH indications are assumed valid. Other values of D cause the AGC to use a back-up indication as shown in Table II.

C31FLWRD is padloaded as 0xx0x. If the astronaut desires to bypass the channel representation, he should load C31FLWRD via V21 N01 to the values shown in Tables I and II.

Table I

A value	Meaning
1	G&N control FREE
2	G&N control ATT. HOLD
3	G&N control AUTO
5	SCS control FREE
6	SCS control ATT. HOLD
7	SCS control AUTO

Table II

D value	Meaning
1	OPTICS Mode CMC
2	OPTICS Mode ZERO
3	OPTICS Mode MANUAL
5	OPTICS Mode CMC
6	OPTICS Mode ZERO
7	OPTICS Mode MANUAL

4.4 AGC Logic/Ground/Crew Interface Diagrams Description

These diagrams outline the detailed logic of the inter-relationship between the AGC/Crew/Ground. For ease of correction and reproduction the diagrams have been incorporated in a computer memory and are presented as a computer printout.

The diagrams contain the following:

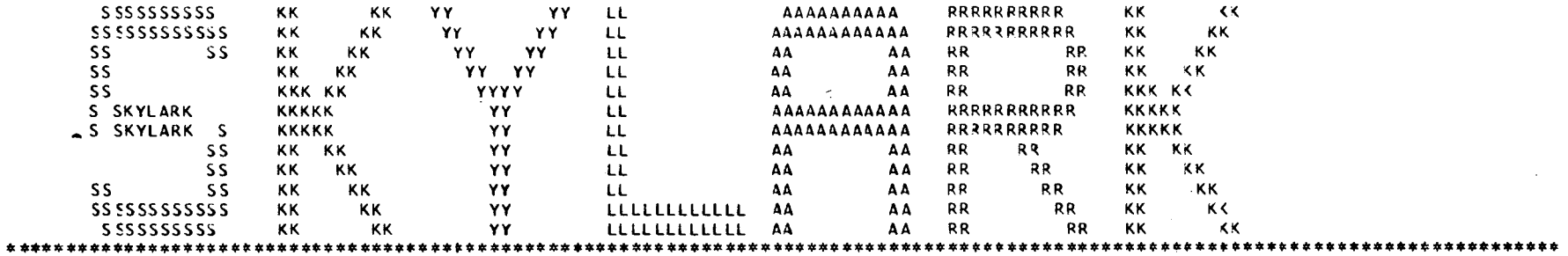
1) Program Control - Indication of sequence interruptions and the following display notation:
   a) PRIO (Priority) - denotes a priority display
   b) HOLD - denotes that the verb-noun and data will continue to be displayed until the astronaut takes DSKY action.
   c) TEMP HOLD (Temporary HOLD) - denotes that the duration of the display on the DSKY (non-flashing) is controlled by the AGC.
   d) POSS HOLD (Possible HOLD) - denotes that the display is a possible path taken by the AGC.
   e) MON (Monitor) - denotes that the displayed data is automatically updated and displayed by the AGC.
   f) SNAP - denotes that the displayed data is not automatically updated (monitored) by the AGC.

2) AGC
3) Ground
4) Crew

The sequence logic and interface relationships of the AGC logic, ground operations and crew activities.

5) A line count is provided on the far right hand side of the page.

6) The AGC Program (or Routine) number and the PROGRAM assembly specification are printed on the lower right hand corner of each page e.g. P40/SKYLARK.



4.4.1 THIS LIST REPRESENTS THE PROGRAMS AND ROUTINES DIAGRAMMED IN SECTION 4.4.2 FOR PROGRAM SKYLARK.
REV 00 05/19/71

PHASE	PROGRAM NUMBER	PROGRAM TITLE	PCR/PCN
PRE-LAUNCH AND SERVICE	00	CMC IDLING	
	01	INITIALIZATION	
	02	GYRO COMPASSING	
	03	OPTICAL VERIFICATION OF GYRO COMPASSING	
	04	-----*	
	05	-----*	
	06	CMC POWER DOWN	
	07	SYSTEM TEST**	
	08	-----*	
	09	-----*	
BOOST	10	-----*	

	11	EARTH ORBIT INSERTION MONITOR
	12	-----*
	13	-----*
	14	-----*
	15	-----*
	16	-----*
	17	-----*
	18	-----*
	19	-----*
COAST	20	UNIVERSAL TRACKING
	21	GROUND TRACK DETERMINATION
	22	-----*
	23	-----*
	24	-----*
	25	CONTINGENCY VHF RANGE RATE
	26	-----*
	27	CMC UPDATE
	28	-----*
	29	TIME OF LONGITUDE
PRE-THRUSTING	30	EXTERNAL DELTA V
	31	NC1 TARGETING
	32	NC2 TARGETING
	33	NCC TARGETING
	34	NSR TARGETING
	35	TPI TARGETING
	36	TPM TARGETING
	37	RENDEZVOUS FINAL PHASE
	38	PLANE CHANGE TARGETING

	39	-----*
THRUST-ING	40	SPS
	41	RCS
	42	-----*
	43	-----*
	44	-----*
	45	-----*
	46	-----*
	47	THRUST MONITOR
	48	RENDEZVOUS THRUST MONITOR
	49	-----*
ALIGN-MENT	50	ATM ORIENTATION DETERMINATION
	51	IMU ORIENTATION DETERMINATION
	52	IMU REALIGN
	53	BACKUP IMU ORIENTATION DETERMINATION
	54	BACKUP IMU REALIGN
	55	ATM STAR TRACKER GIMBAL ANGLE
	56	-----*
	57	-----*
	58	-----*
	59	-----*
ENTRY	60	-----*
	61	ENTRY - PREPARATION
	62	ENTRY - CM/SM SEPARATION AND PRE-ENTRY MANEUVER
	63	ENTRY-INITIALIZATION
	64	ENTRY - POST 0.05G
	65	ENTRY - UP CONTROL

	66	ENTRY - BALLISTIC
	67	ENTRY - FINAL PHASE
	68	-----*
	69	-----*
POST THRUSTING	70	-----*
	71	-----*
	72	-----*
	73	-----*
	74	-----*
	75	-----*
	76	-----*
	77	CSM VELOCITY VECTOR UPDATE
	78	-----*
	79	-----*

ROUTINE	ROUTINE TITLE
00	FINAL AUTOMATIC REQUEST TERMINATE
01	ERASABLE AND CHANNEL MODIFICATION
02	IMU STATUS CHECK
03	CSM DAP DATA LOAD
04	DOCKED DAP DATA LOAD
05	-----*
06	-----*
07	MINKEY CONTROLLER
08	VHF RANGE READ
09	-----*

10 -----*
11 -----*
12 -----*
13 -----*
14 -----*
15 -----*
16 -----*
17 -----*
18 -----*
19 -----*
20 -----*
21 RENDEZVOUS TRACKING SIGHTING MARK
22 RENDEZVOUS TRACKING DATA PROCESSING
23 RENDEZVOUS BACKUP SIGHTING MARK
24 -----*
25 -----*
26 -----*
27 VHF RANGE RATE MARK PROCESSING
28 -----*
29 -----*
30 ORBITAL PARAMETERS DISPLAY
31 RENDEZVOUS PARAMETER DISPLAY NO. 1
32 -----*
33 -----*
34 RENDEZVOUS PARAMETER DISPLAY NO. 2
35 -----*
36 RENDEZVOUS OUT-OF-PLANE DISPLAY
37 -----*
38 -----*

39 -----*
40 SPS THRUST FAIL
41 STATE VECTOR INTEGRATION (MID TO AVE)
42 -----*
43 -----*
44 -----*
45 -----*
46 -----*
47 -----*
48 -----*
49 -----*
50 COARSE ALIGN
51 -----*
52 AUTOMATIC OPTICS POSITIONING
53 SIGHTING MARK
54 SIGHTING DATA DISPLAY
55 GYRO TORQUING
56 ALTERNATE LOS SIGHTING MARK
57 -----*
58 -----*
59 -----*
60 ATTITUDE MANEUVER
61 TRACKING ATTITUDE
62 CREW-DEFINED MANEUVER
63 RENDEZVOUS FINAL ATTITUDE
64 OPTICS ANGLES TRANSFORM
65 -----*
66 -----*

67	ROTATION
68	-----*
69	-----*
70	-----*
71	-----*
72	-----*
73	-----*
74	-----*
75	-----*
76	-----*
77	-----*
78	-----*
79	-----*

* THIS PROGRAM OR ROUTINE DOES NOT EXIST FOR ASSEMBLY SKYLARK

** THIS PROGRAM IS DOCUMENTED IN SECTION 1 OF R577

CHANGE CONTROL NOTES

REV 00 PCR 008,009,010,011,014,015,016,017,018,019,021,032,036,040,042,400,405,413, PCN 410,457, SL MEMO #2,#19

4.4.2 CMC LOGIC/GROUND/CREW INTERFACE DIAGRAMS
FOR PROGRAM SKYLARK

CMC IDLING PROGRAM (P00) REV 00 05/19/71

PURPOSE: (1) TO PROVIDE A PROGRAM TO FULFILL THE FOLLOWING REQUIREMENTS:

(A) PROVIDE AN INDICATION TO THE CREW THAT THE CMC IS ENGAGED IN NO CONTROL OR COMPUTATIONAL OPERATIONS WHICH MIGHT REQUIRE CONSIDERATION FOR COORDINATION WITH OTHER CREW TASKS IN PROGRESS.

(B) TO MAINTAIN THE GNCS IN A CONDITION WHERE MANUAL ATTITUDE MANEUVERS CAN BE MADE BY THE CREW WITH MINIMAL CONCERN FOR THE GNCS (SEE ASSUMPTION 2).

(C) MAINTAIN THE CMC IN A CONDITION OF READINESS FOR ENTRY INTO OTHER PROGRAMS EXCEPT DURING STATE VECTOR EXTRAPOLATION.

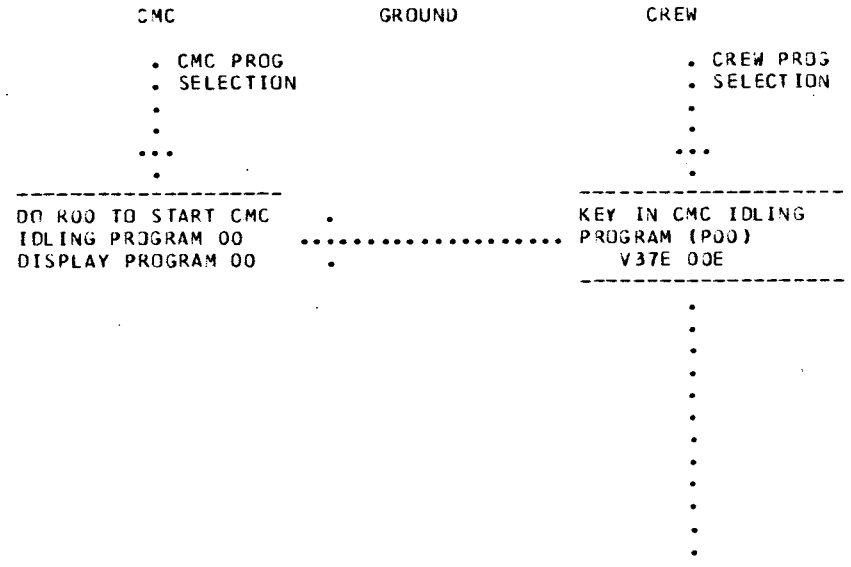
(2) TO UPDATE THE CSM AND OWS STATE VECTORS EVERY FOUR TIME STEPS.

ASSUMPTIONS: (1) THE IMU MAY OR MAY NOT BE ON. IF ON, THE IMU IS INERTIALLY STABILIZED BUT NOT NECESSARILY ALIGNED TO AN ORIENTATION WHICH IS KNOWN TO THE CMC.

(2) IF NON-GNCS CONTROLLED ATTITUDE MANEUVERS ARE MADE BY THE CREW CARE MUST BE TAKEN TO AVOID IMU GIMBAL LOCK. THE IMU GIMBAL ANGLES MAY BE MONITORED BY OBSERVING THE ICDUS (V16 N20) OR BY MONITORING THE FDAI BALL.

(3) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(4) THIS PROGRAM IS AUTOMATICALLY SELECTED BY V96E, WHICH MAY BE DONE DURING ANY PROGRAM. STATE VECTOR INTEGRATION IS PERMANENTLY INHIBITED FOLLOWING V96E. NORMAL INTEGRATION FUNCTIONS WILL RESUME AFTER SELECTION OF ANY PROGRAM OR EXTENDED VERB. P00 INTEGRATION WILL RESUME WHEN P00 IS RESELECTED. USAGE OF V96 CAN CAUSE INCORRECT W-MATRIX AND STATE VECTOR SYNCHRONIZATION.



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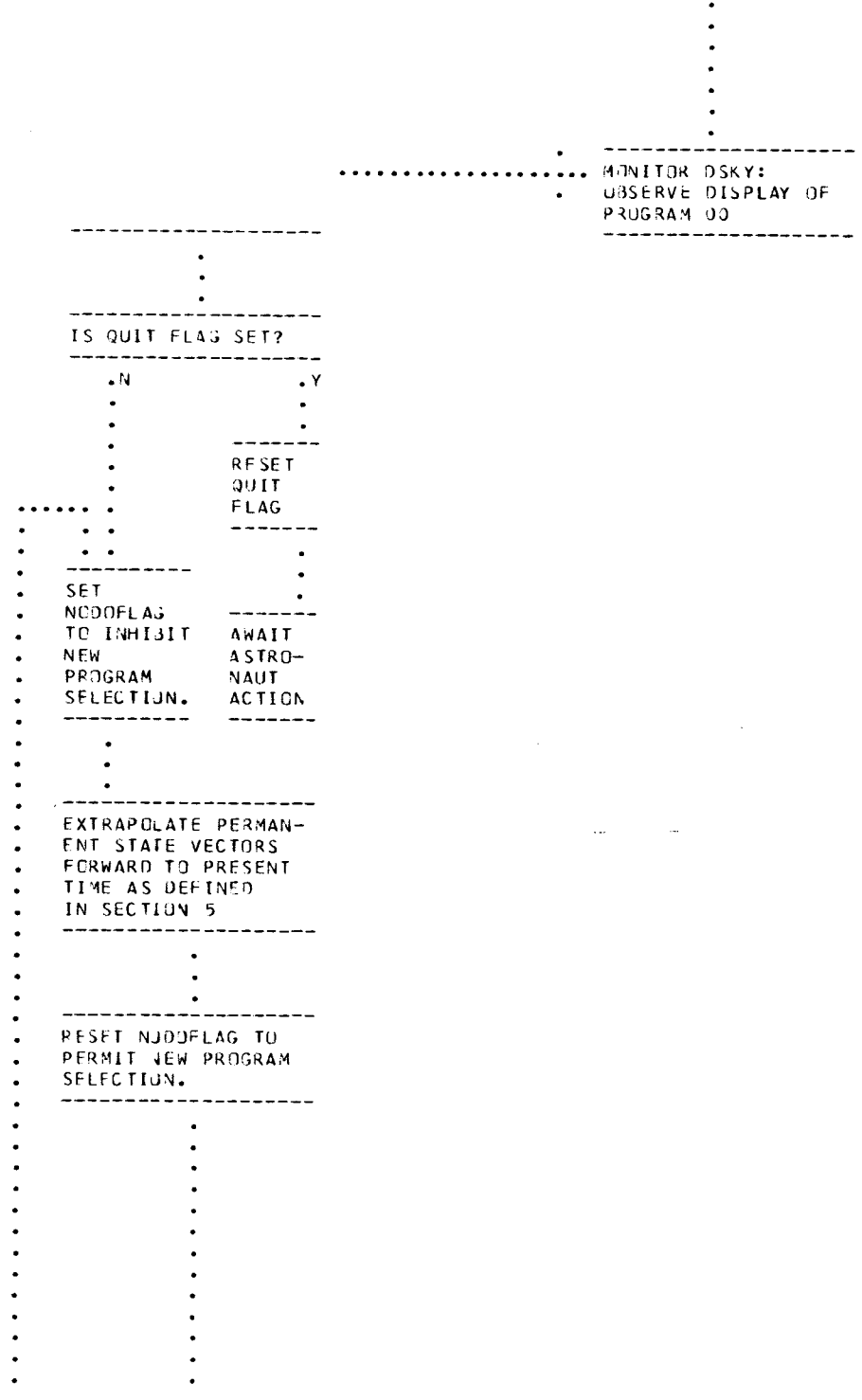
MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 00
IS QUIT FLAG SET?
N
Y
RESET
QUIT
FLAG
SET
NODOFLAG
TO INHIBIT
NEW
PROGRAM
SELECTION.
AWAIT
ASTRO-
NAUT
ACTION
EXTRAPOLATE PERMAN-
ENT STATE VECTORS
FORWARD TO PRESENT
TIME AS DEFINED
IN SECTION 5
RESET NODOFLAG TO
PERMIT NEW PROGRAM
SELECTION.

#20

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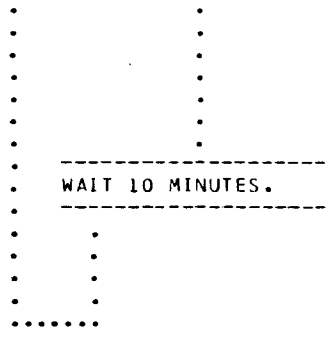

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CHANGE CONTROL NOTES

REV 00 PCN 457

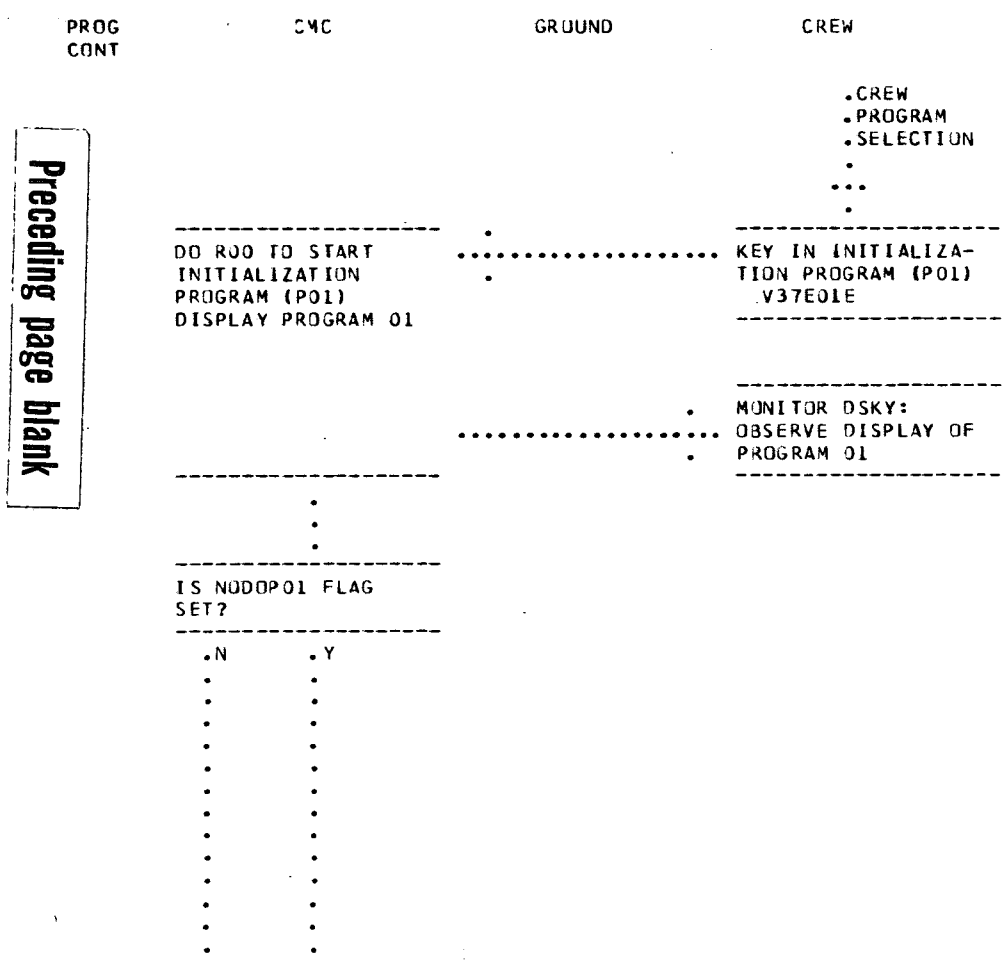
INITIALIZATION PROGRAM (P01) REV 00 05/19/71

PURPOSE: (1) TO INITIALIZE THE PLATFORM FOR THE PRELAUNCH PROGRAMS.

(2) TO PROVIDE AN INITIAL STABLE MEMBER ORIENTATION FOR GYRO COMPASSING (P02).

ASSUMPTIONS: (1) THE PROGRAM IS MANUALLY SELECTED BY DSKY ENTRY.

(2) ERASABLE LOCATIONS HAVE BEEN PROPERLY INITIALIZED.(AZIMUTH, +1; LATITUDE, +1; LAUNCHAZ, +1; IMU COMPENSATION PARAMETERS)



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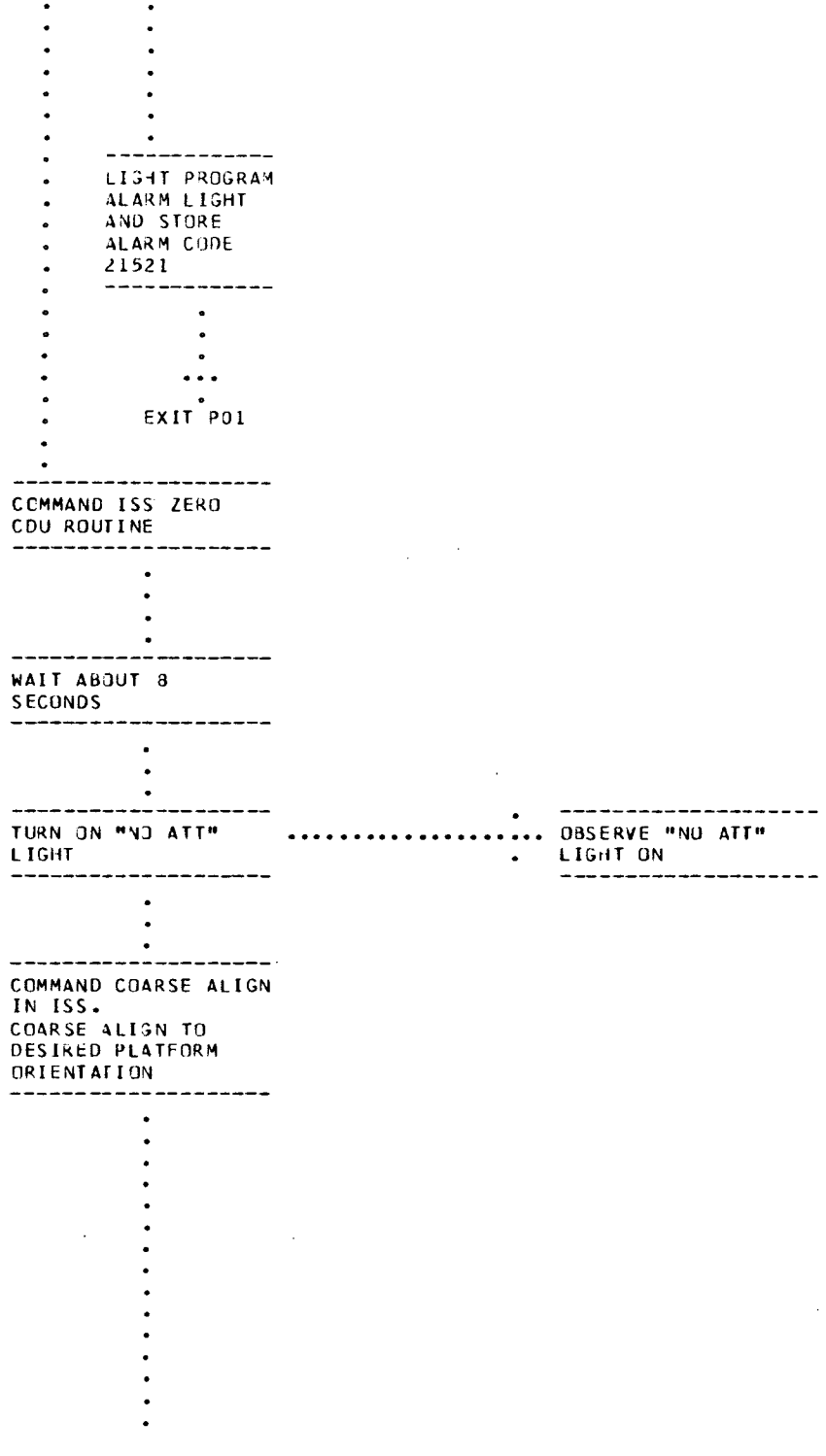

LIGHT PROGRAM ALARM LIGHT AND STORE ALARM CODE 21521
EXIT P01
COMMAND ISS ZERO CDU ROUTINE
WAIT ABOUT 8 SECONDS
TURN ON "NO ATT" LIGHT
OBSERVE "NO ATT" LIGHT ON
COMMAND COARSE ALIGN IN ISS.
COARSE ALIGN TO DESIRED PLATFORM ORIENTATION

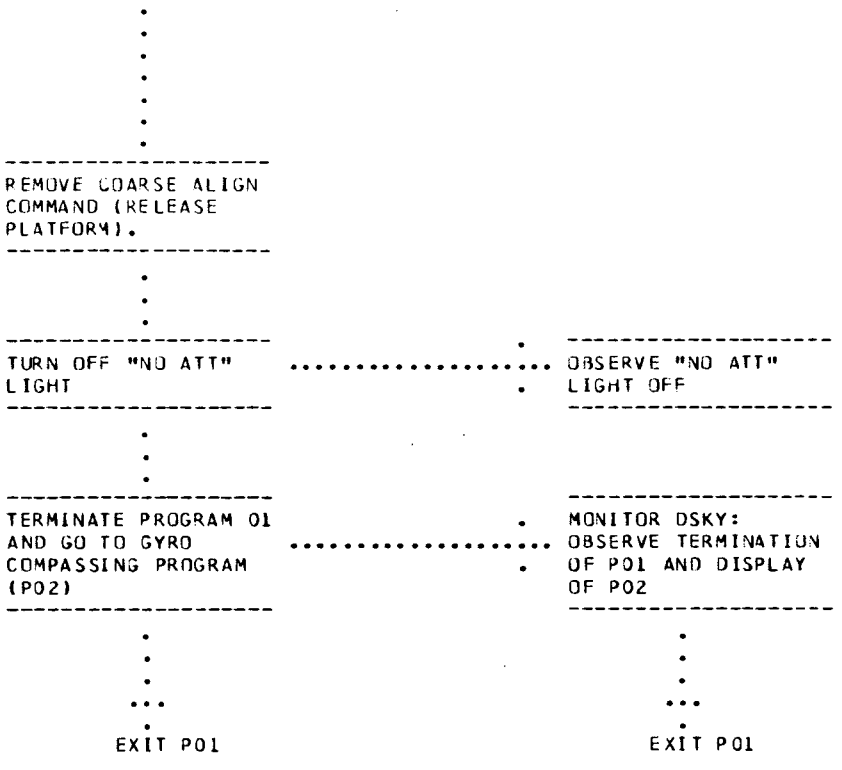
#30

#40

#50

#60

#70



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#90

#100

CHANGE CONTROL NOTES

GYRO COMPASSING PROGRAM (P02) REV 00 05/19/71

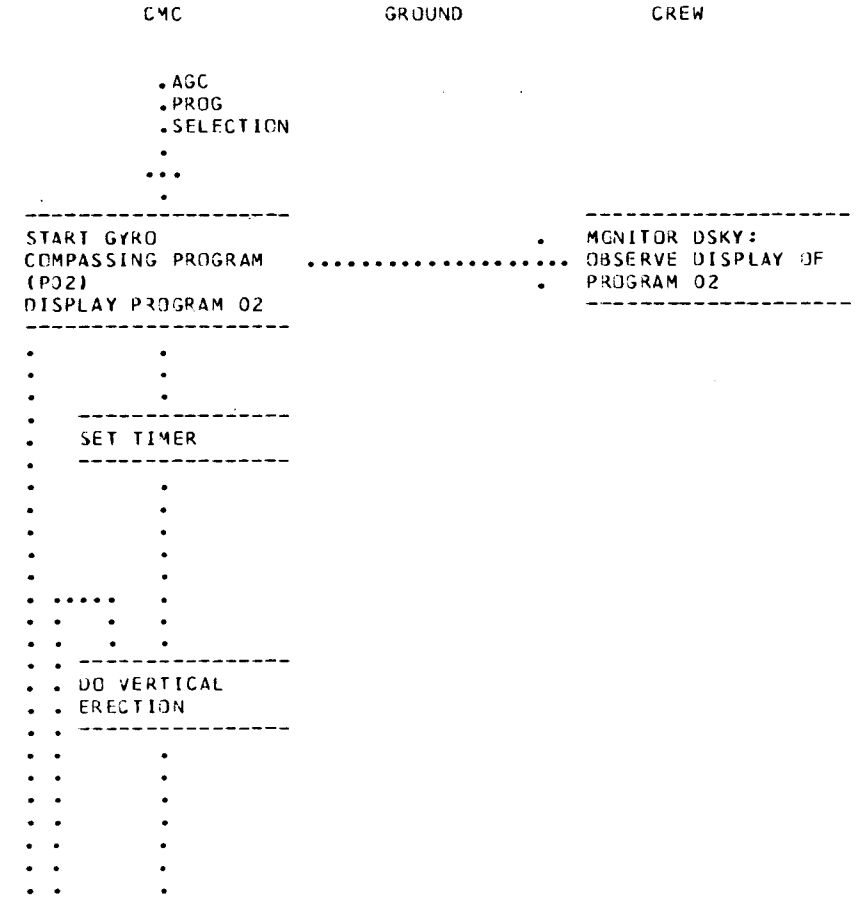
PURPOSE: (1) TO PROVIDE THE PROPER STABLE MEMBER ORIENTATION FOR LAUNCH.

ASSUMPTIONS: (1) THIS PROGRAM MAY BE INTERRUPTED TO PERFORM THE OPTICAL VERIFICATION OF GYRO COMPASSING PROGRAM (P03).

(2) V75 WILL BE KEYED IN AND DISPLAYED DURING THIS PROGRAM TO PERMIT CREW BACKUP OF THE LIFTOFF DISCRETE.

(3) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE INITIALIZATION PROGRAM (P01).

(4) THIS PROGRAM HAS THE CAPABILITY (VIA V78E) TO CHANGE LAUNCH AZIMUTH OF THE STABLE MEMBER WHILE GYROCOMPASSING.



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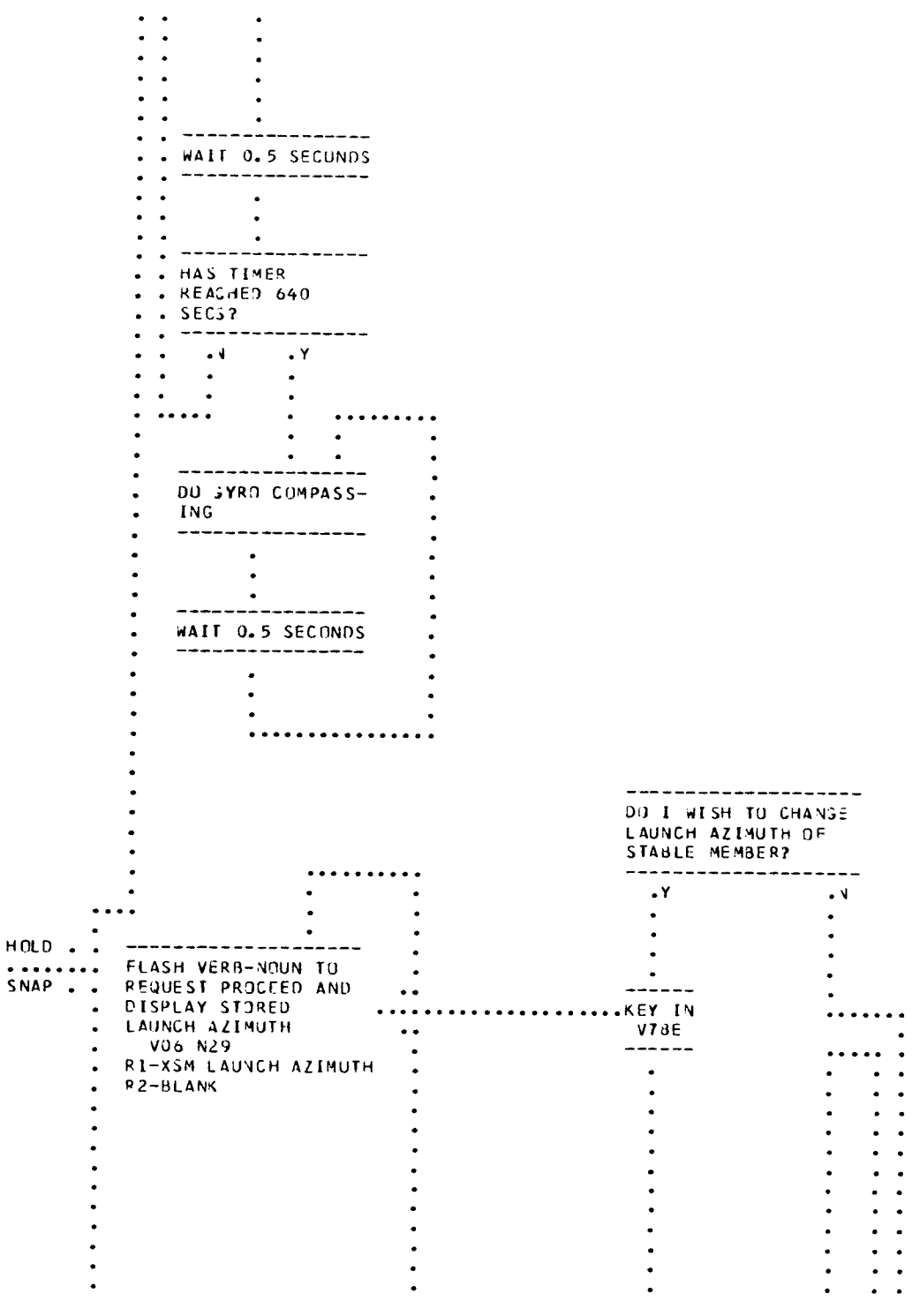

WAIT 0.5 SECONDS
HAS TIMER REACHED 640 SECS?
.N
.Y
DO GYRO COMPASSING
WAIT 0.5 SECONDS
DO I WISH TO CHANGE LAUNCH AZIMUTH OF STABLE MEMBER?
.Y
.N
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PROCEED AND DISPLAY STORED LAUNCH AZIMUTH
V06 N29
R1-XSM LAUNCH AZIMUTH
R2-BLANK
KEY IN V78E

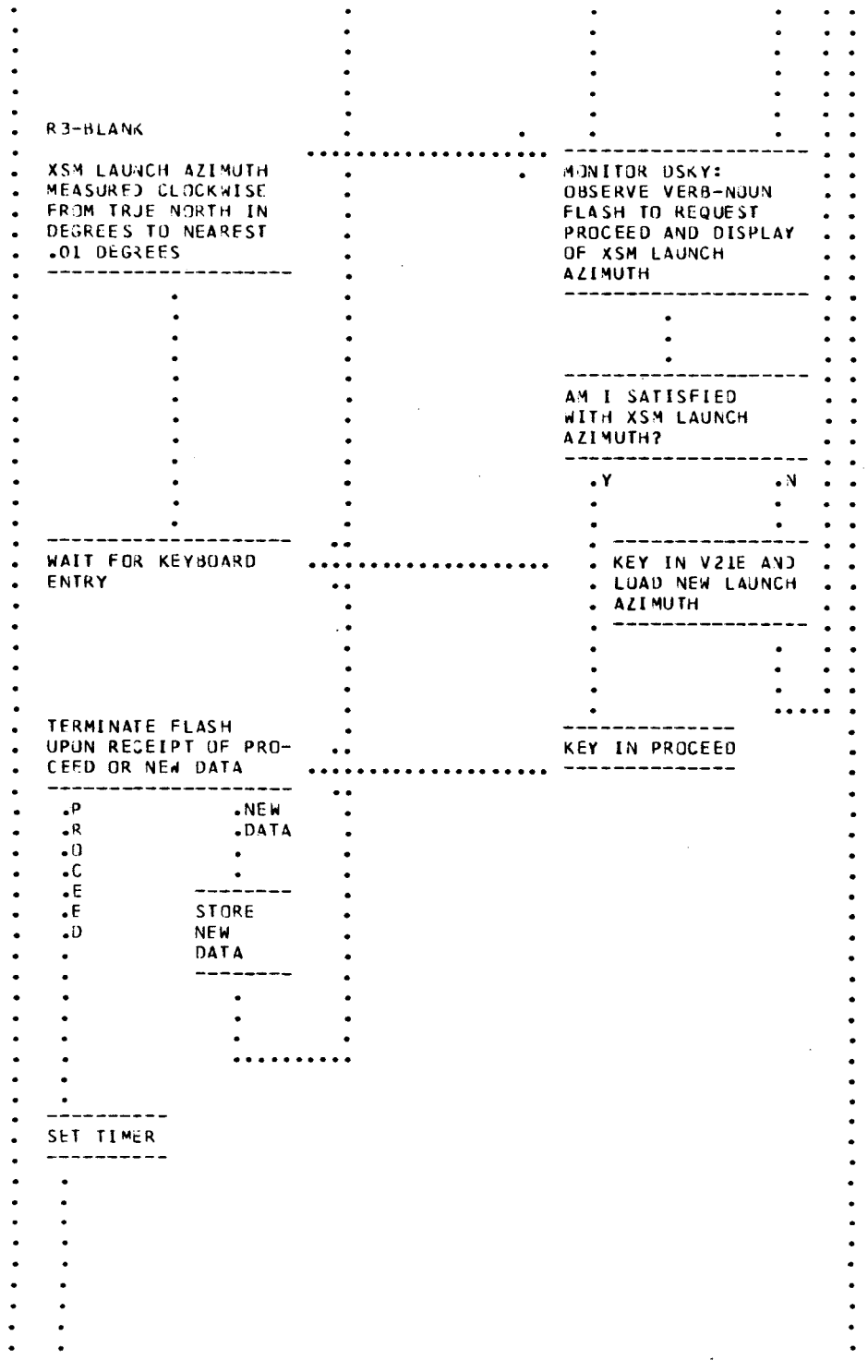
#40

#50

#60

#70

#80



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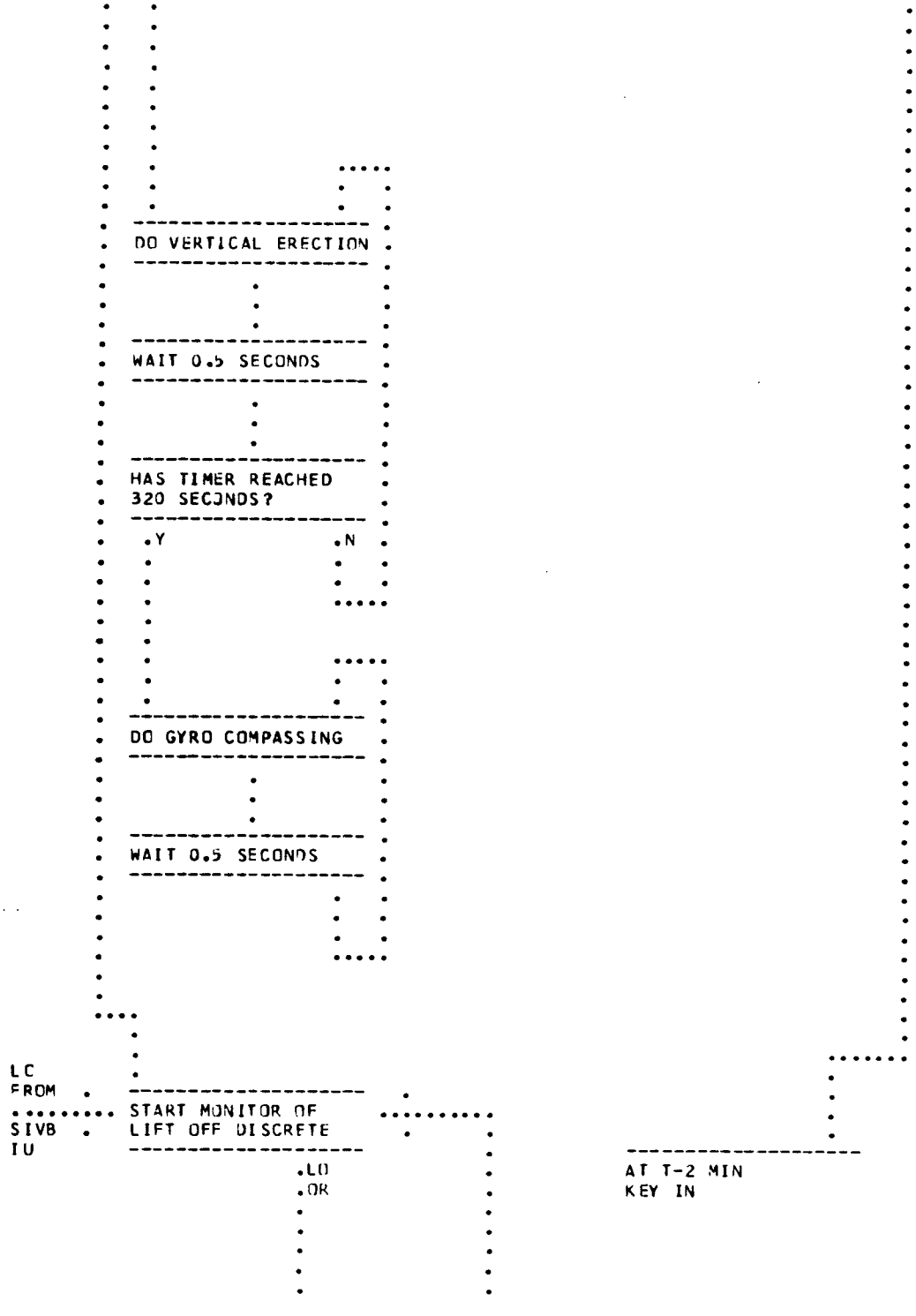
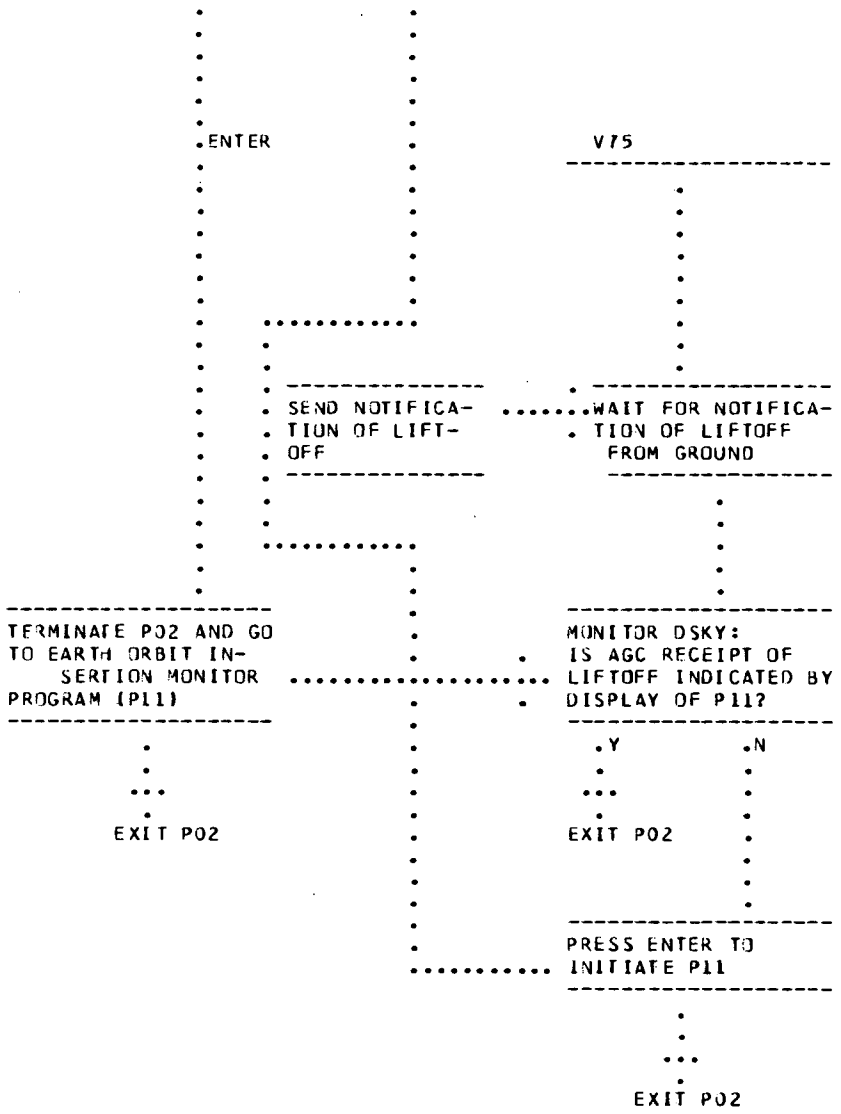




CHANGE CONTROL NOTES

OPTICAL VERIFICATION OF GYRO COMPASSING (P03) REV 00 05/19/71

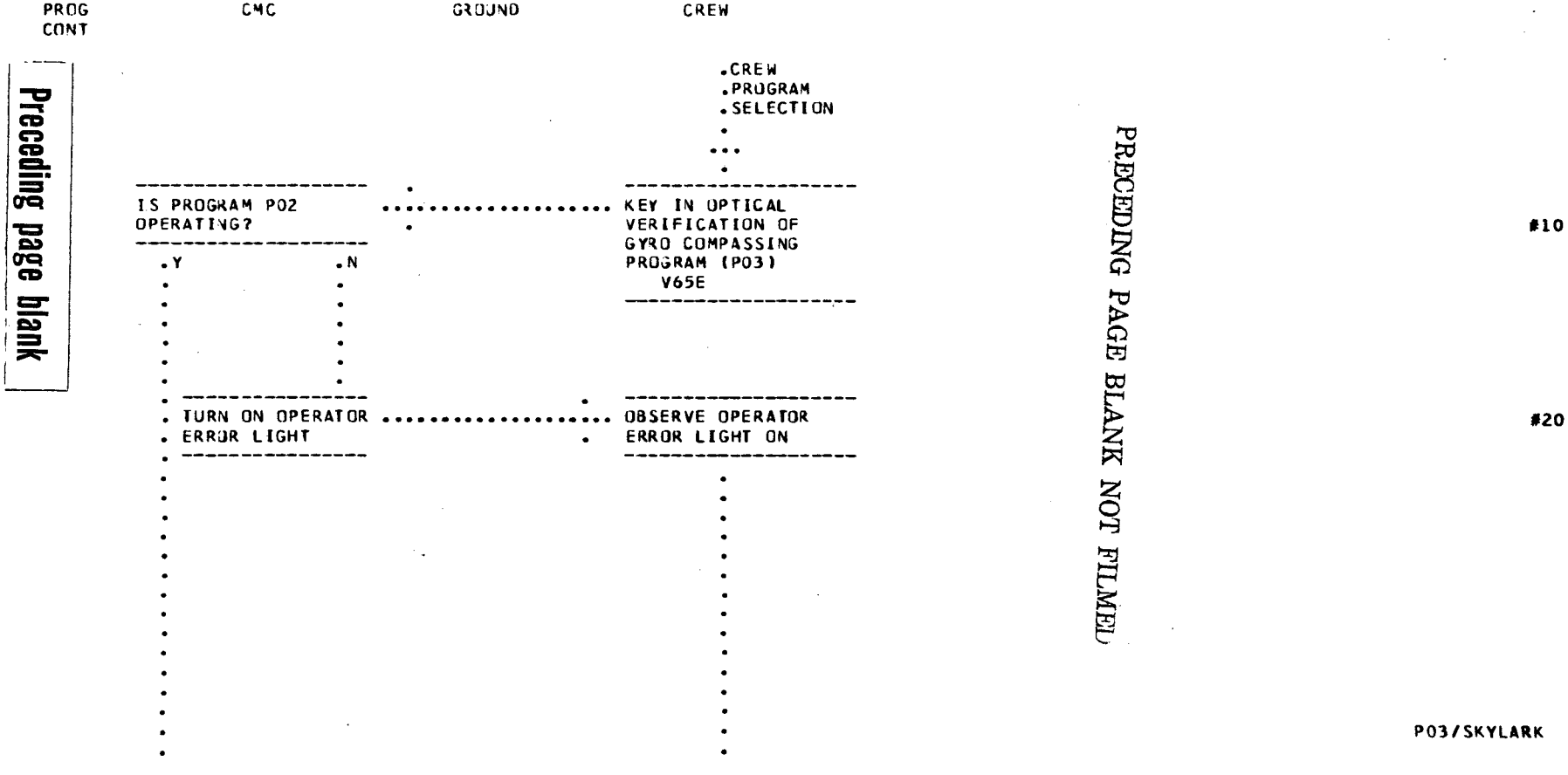
PURPOSE: (1) TO PROVIDE AN OPTICAL CHECK FOR VERIFICATION OF ALIGNMENT OF THE STABLE MEMBER OF THE ISS DURING GYRO COMPASSING PRIOR TO LAUNCH.

ASSUMPTIONS: (1) THE PROGRAM IS MANUALLY SELECTED BY DSKY ENTRY.

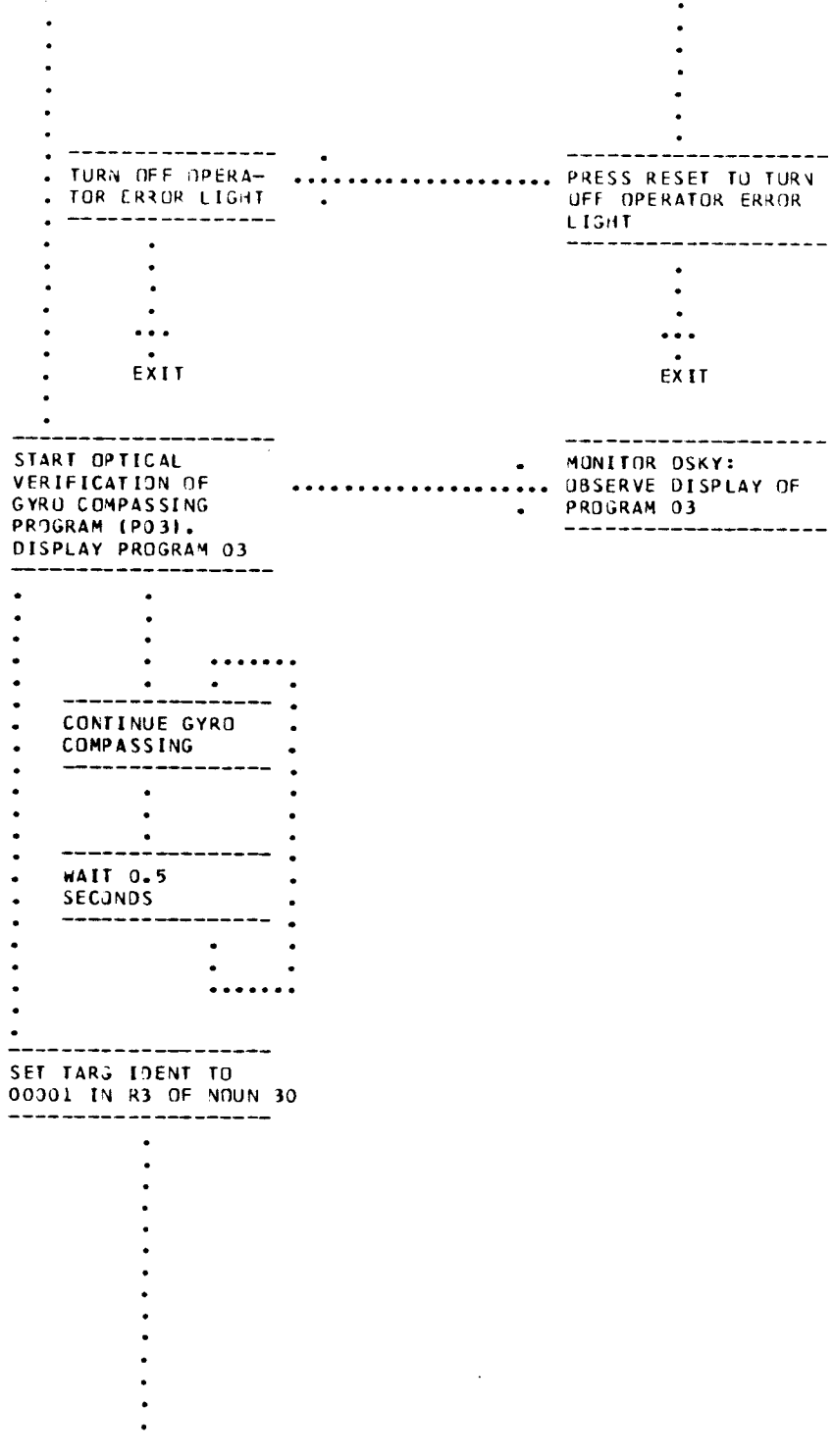
(2) THE ASTRONAUT HAS ZEROED THE OPTICS JUST PRIOR TO PROGRAM (P03) SELECTION.

(3) A MINIMUM OF 45 MINUTES BETWEEN V78E AND P03 (V65E) INSURES PROPER DAMPING OF TRANSIENTS.

(4) IN ORDER TO PREMATURELY TERMINATE THIS PROGRAM AND RETURN TO P02 THE ASTRONAUT MAY KEY IN V34E ON ANY FLASHING DISPLAY



P03/SKYLARK


TURN OFF OPERA-
TOR ERROR LIGHT
EXIT
PRESS RESET TO TURN
OFF OPERATOR ERROR
LIGHT
EXIT
START OPTICAL
VERIFICATION OF
GYRO COMPASSING
PROGRAM (P03).
DISPLAY PROGRAM 03
MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 03
CONTINUE GYRO
COMPASSING
WAIT 0.5
SECONDS
SET TARG IDENT TO
00001 IN R3 OF NOUN 30

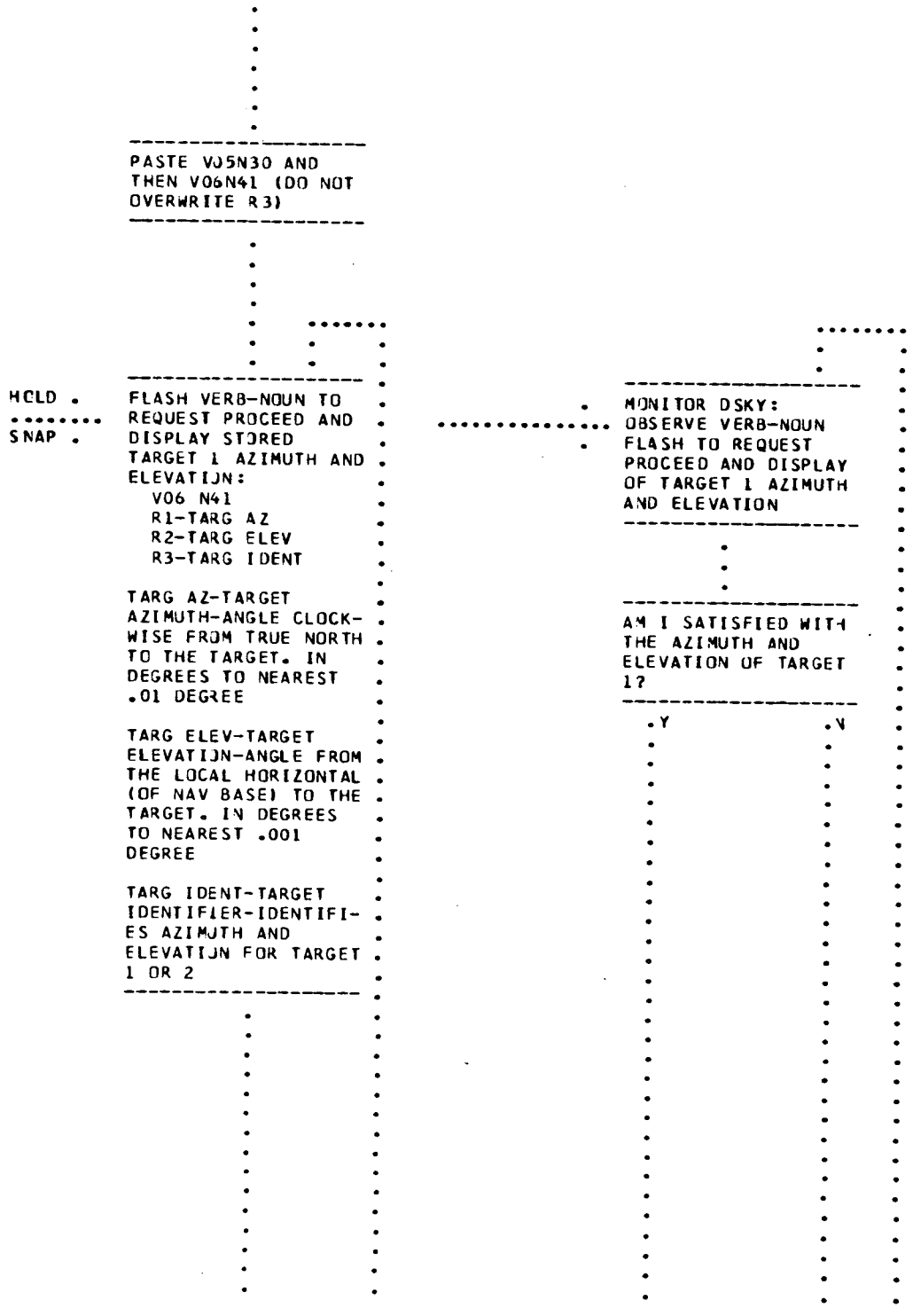
#30

#40

#50

#60

#70


PASTE V05N30 AND THEN V06N41 (DO NOT OVERWRITE R3)
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PROCEED AND DISPLAY STORED TARGET 1 AZIMUTH AND ELEVATION:
V06 N41
R1-TARG AZ
R2-TARG ELEV
R3-TARG IDENT
TARG AZ-TARGET AZIMUTH-ANGLE CLOCK-WISE FROM TRUE NORTH TO THE TARGET. IN DEGREES TO NEAREST .01 DEGREE
TARG ELEV-TARGET ELEVATION-ANGLE FROM THE LOCAL HORIZONTAL (OF NAV BASE) TO THE TARGET. IN DEGREES TO NEAREST .001 DEGREE
TARG IDENT-TARGET IDENTIFIER-IDENTIFI-ES AZIMUTH AND ELEVATION FOR TARGET 1 OR 2
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PROCEED AND DISPLAY OF TARGET 1 AZIMUTH AND ELEVATION
AM I SATISFIED WITH THE AZIMUTH AND ELEVATION OF TARGET 1?
Y
N

#80

#90

#100

#110

#120

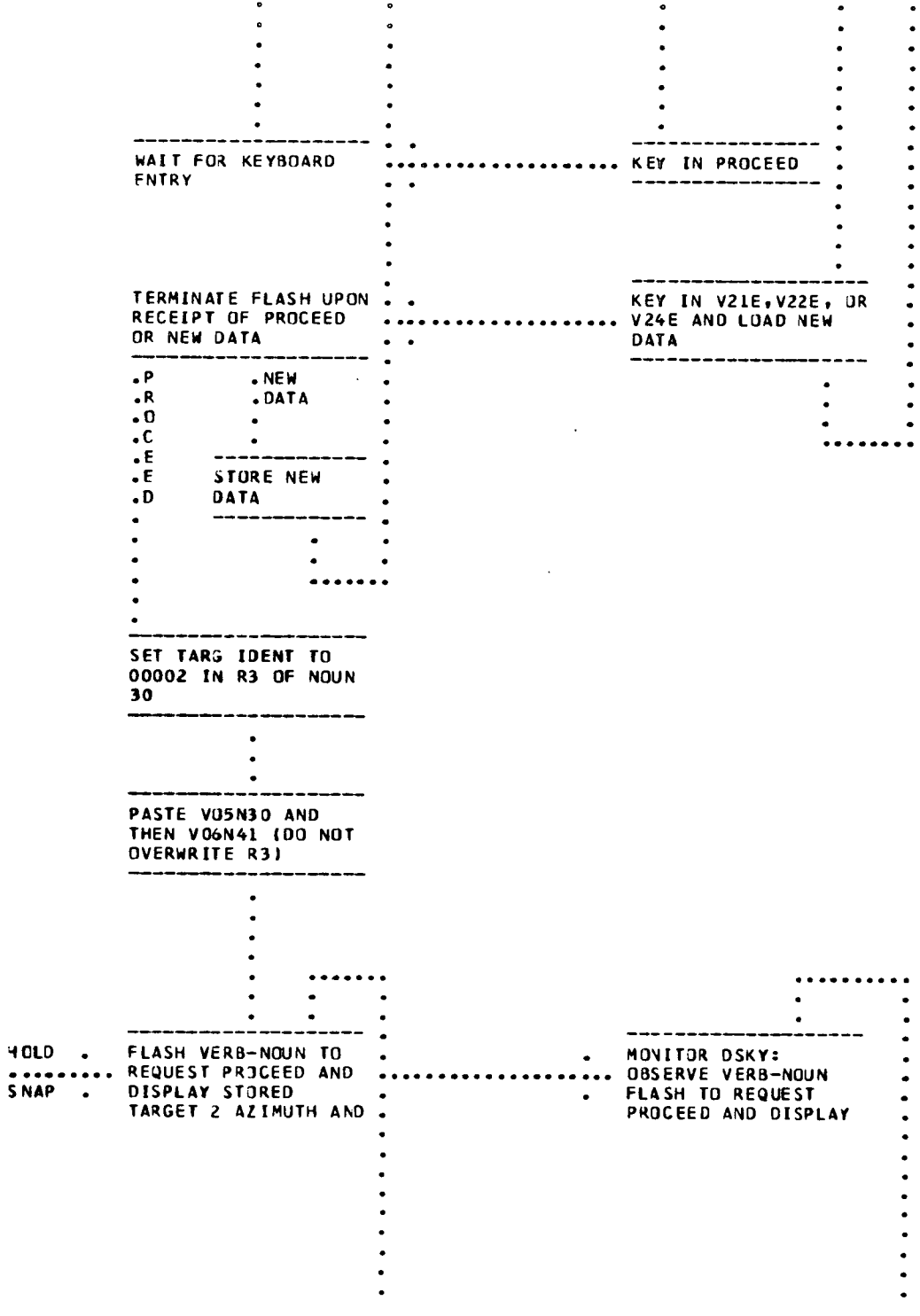
#130

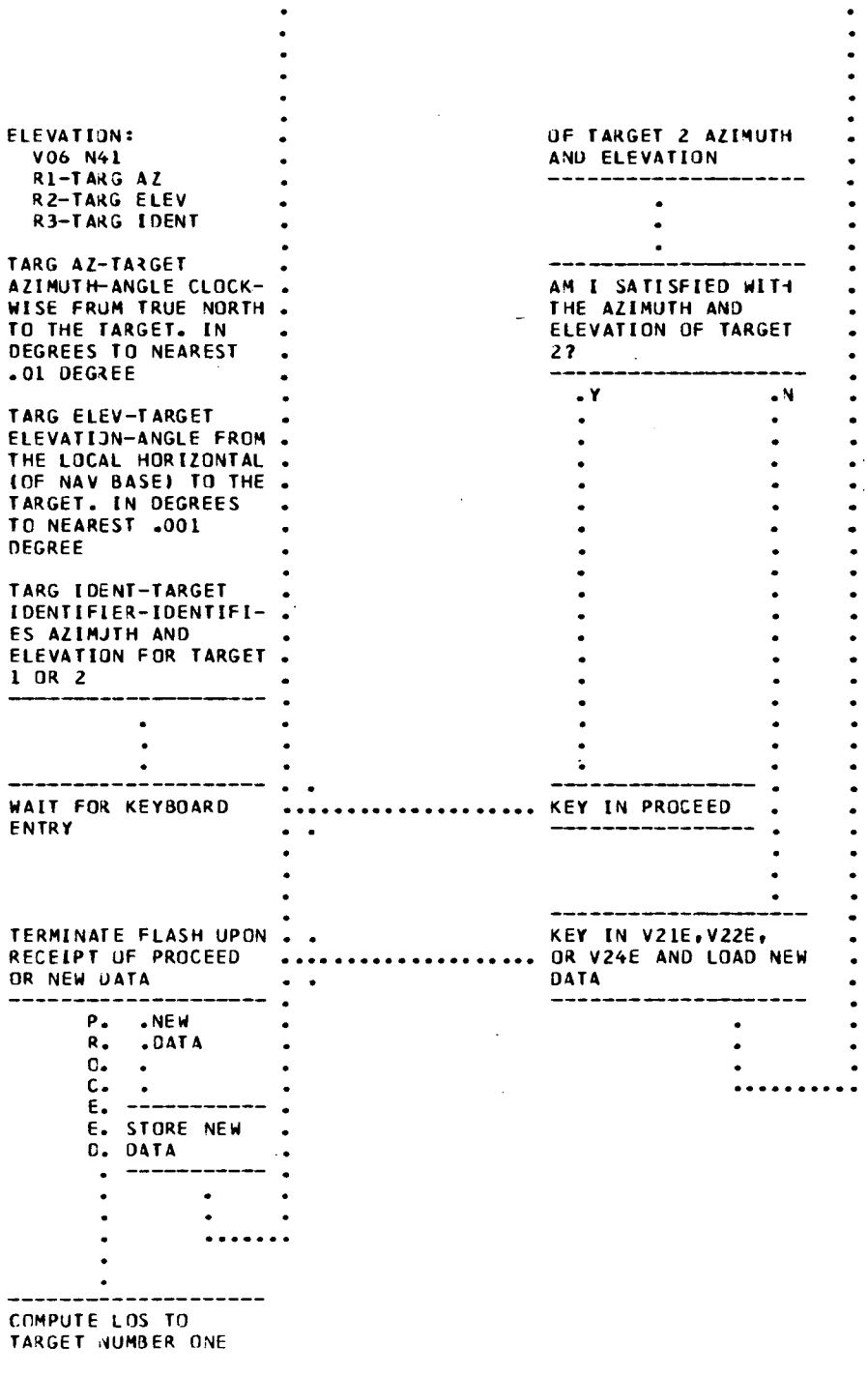
#140

#150

#160

#170





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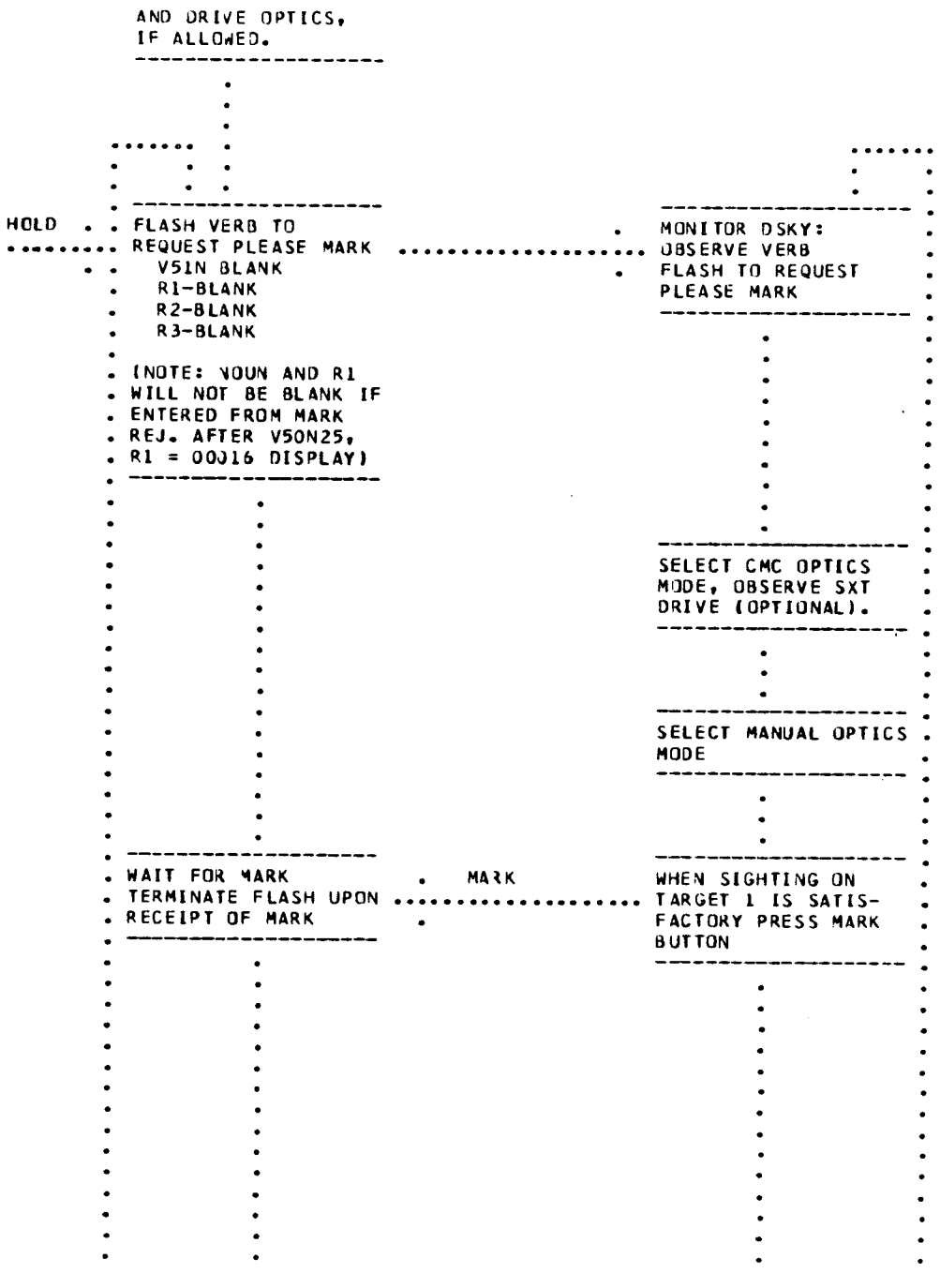

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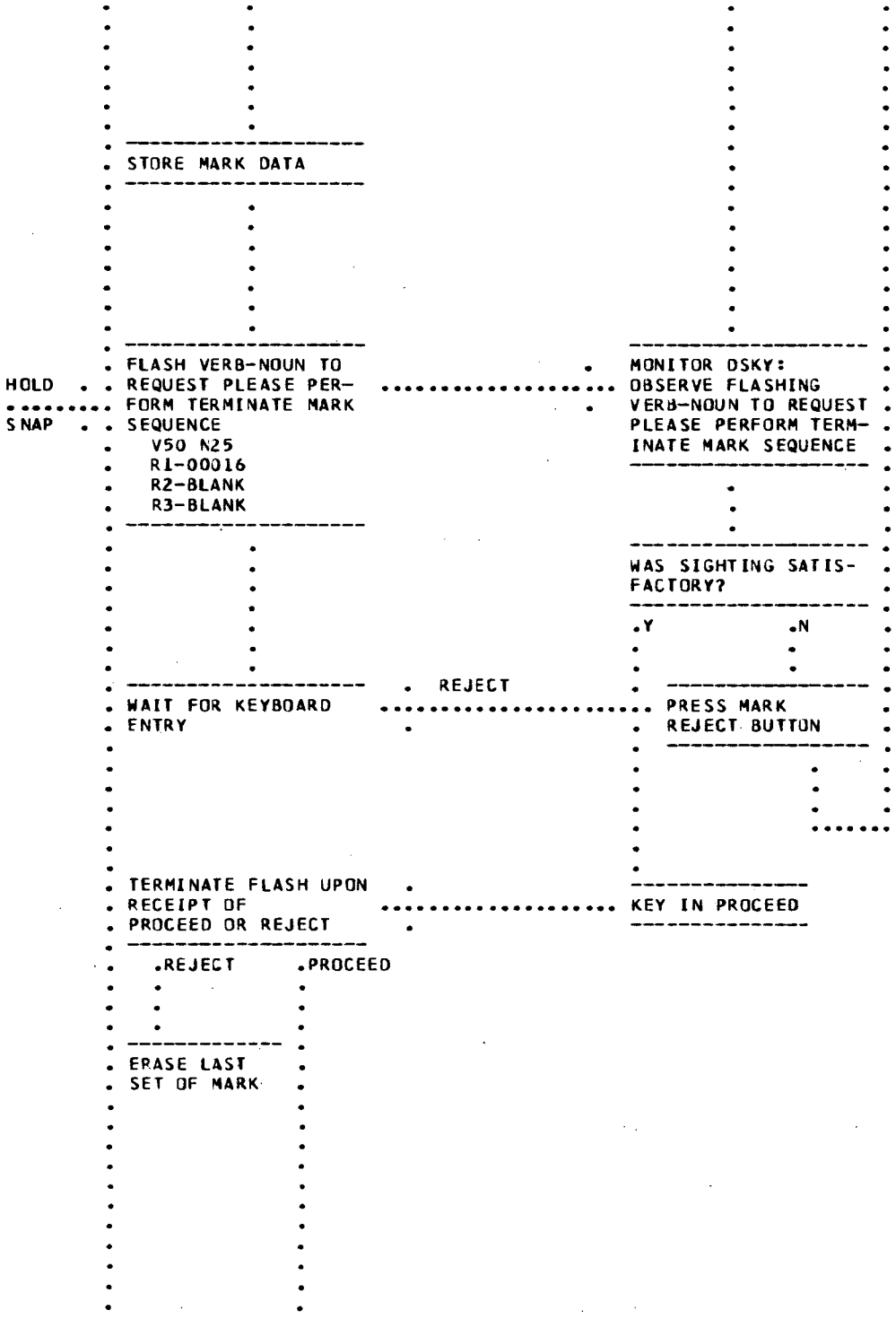
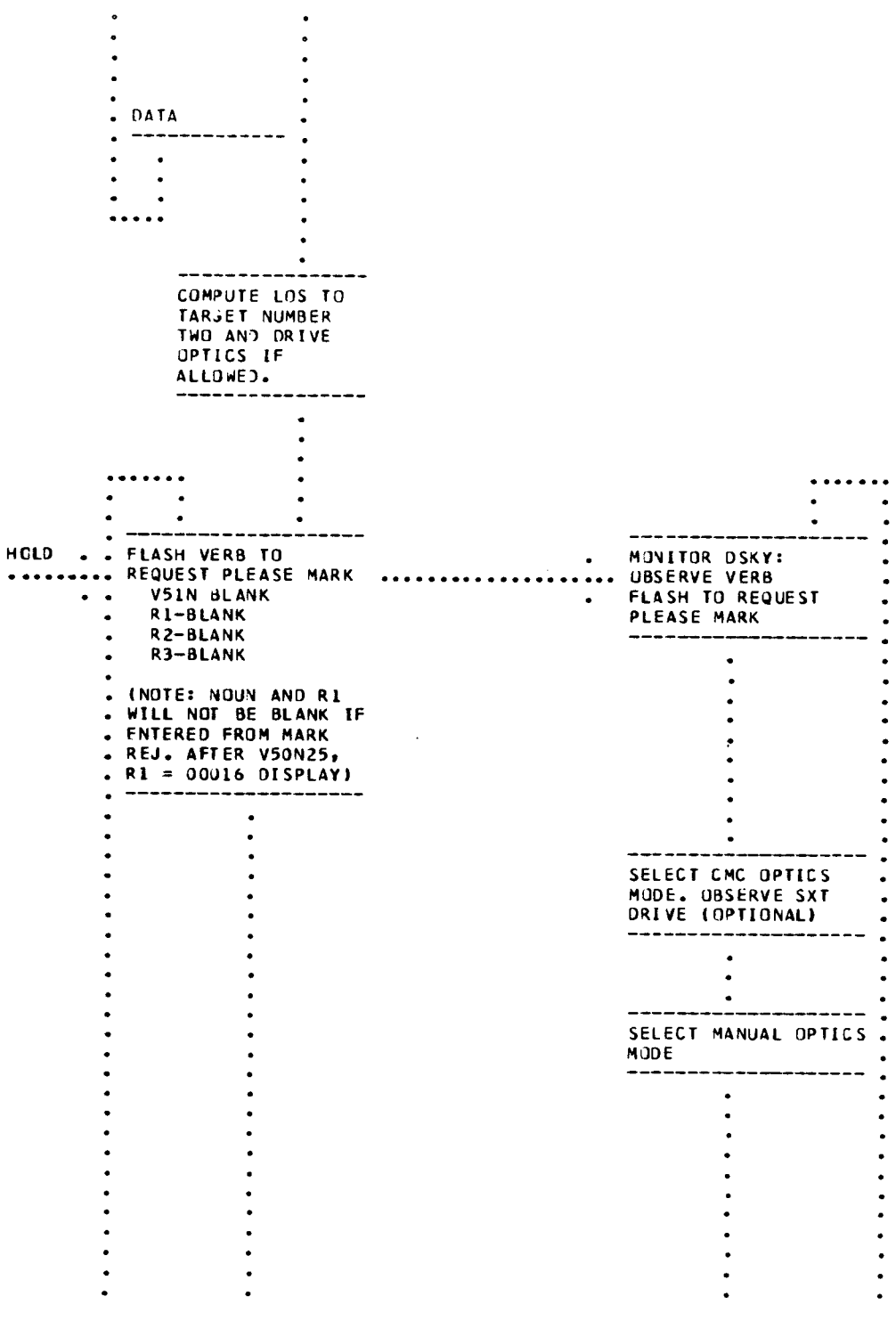

STORE MARK DATA
#280
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM TERMINATE MARK SEQUENCE
V50 N25
R1-00016
R2-BLANK
R3-BLANK
HOLD
SNAP
MONITOR DSKY: OBSERVE FLASHING VERB-NOUN TO REQUEST PLEASE PERFORM TERMINATE MARK SEQUENCE
#290
WAS SIGHTING SATISFACTORY?
#300
Y
N
REJECT
WAIT FOR KEYBOARD ENTRY
PRESS MARK REJECT BUTTON
#310
TERMINATE FLASH UPON RECEIPT OF PROCEED OR REJECT
KEY IN PROCEED
REJECT
PROCEED
#320
ERASE LAST SET OF MARK



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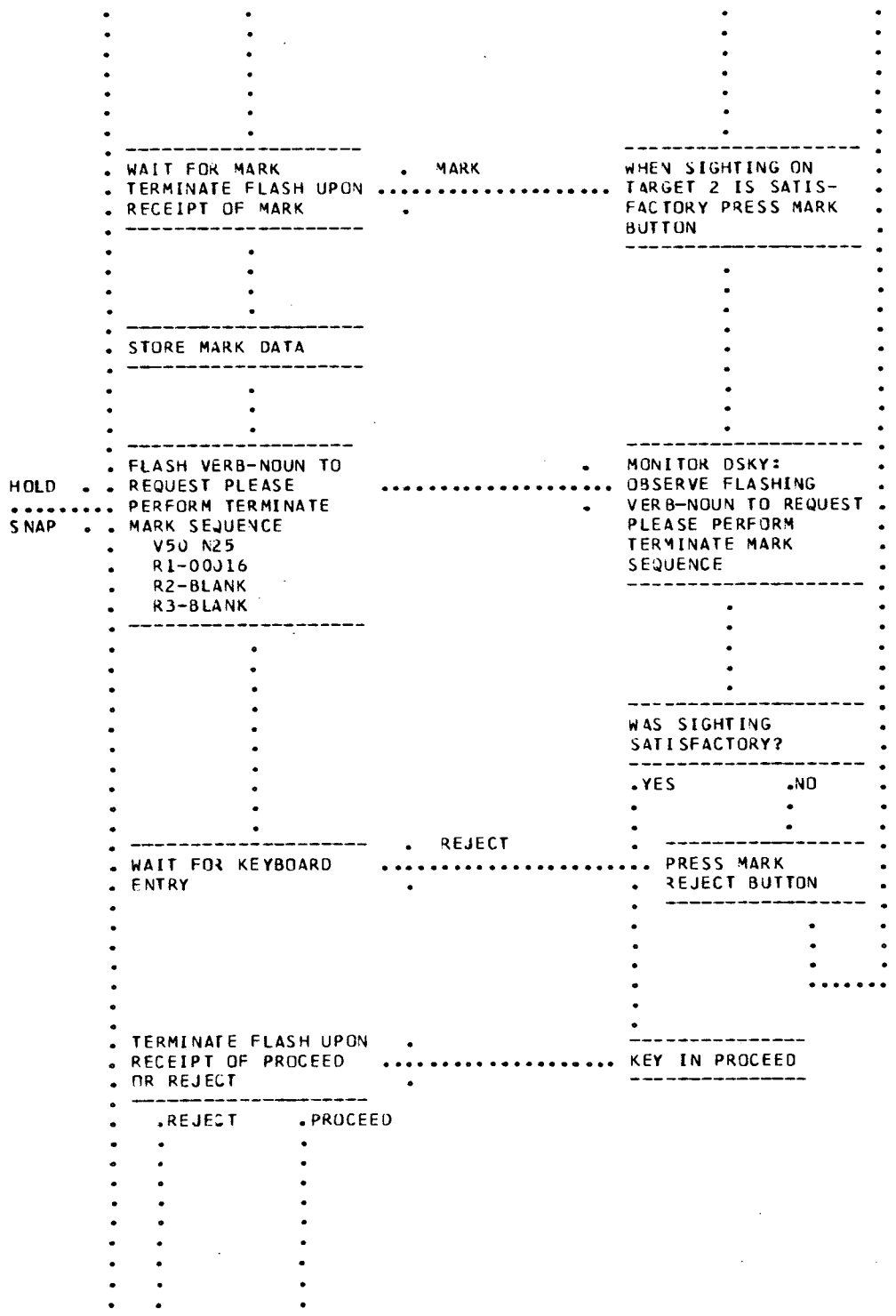

WAIT FOR MARK
TERMINATE FLASH UPON
RECEIPT OF MARK
MARK
WHEN SIGHTING ON
TARGET 2 IS SATIS-
FACTORY PRESS MARK
BUTTON
#380
STORE MARK DATA
#390
HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST PLEASE
PERFORM TERMINATE
MARK SEQUENCE
V50 N25
R1-00016
R2-BLANK
R3-BLANK
MONITOR DSKY:
OBSERVE FLASHING
VERB-NOUN TO REQUEST
PLEASE PERFORM
TERMINATE MARK
SEQUENCE
#400
WAS SIGHTING
SATISFACTORY?
YES
NO
#410
REJECT
WAIT FOR KEYBOARD
ENTRY
PRESS MARK
REJECT BUTTON
#420
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR REJECT
KEY IN PROCEED
REJECT
PROCEED

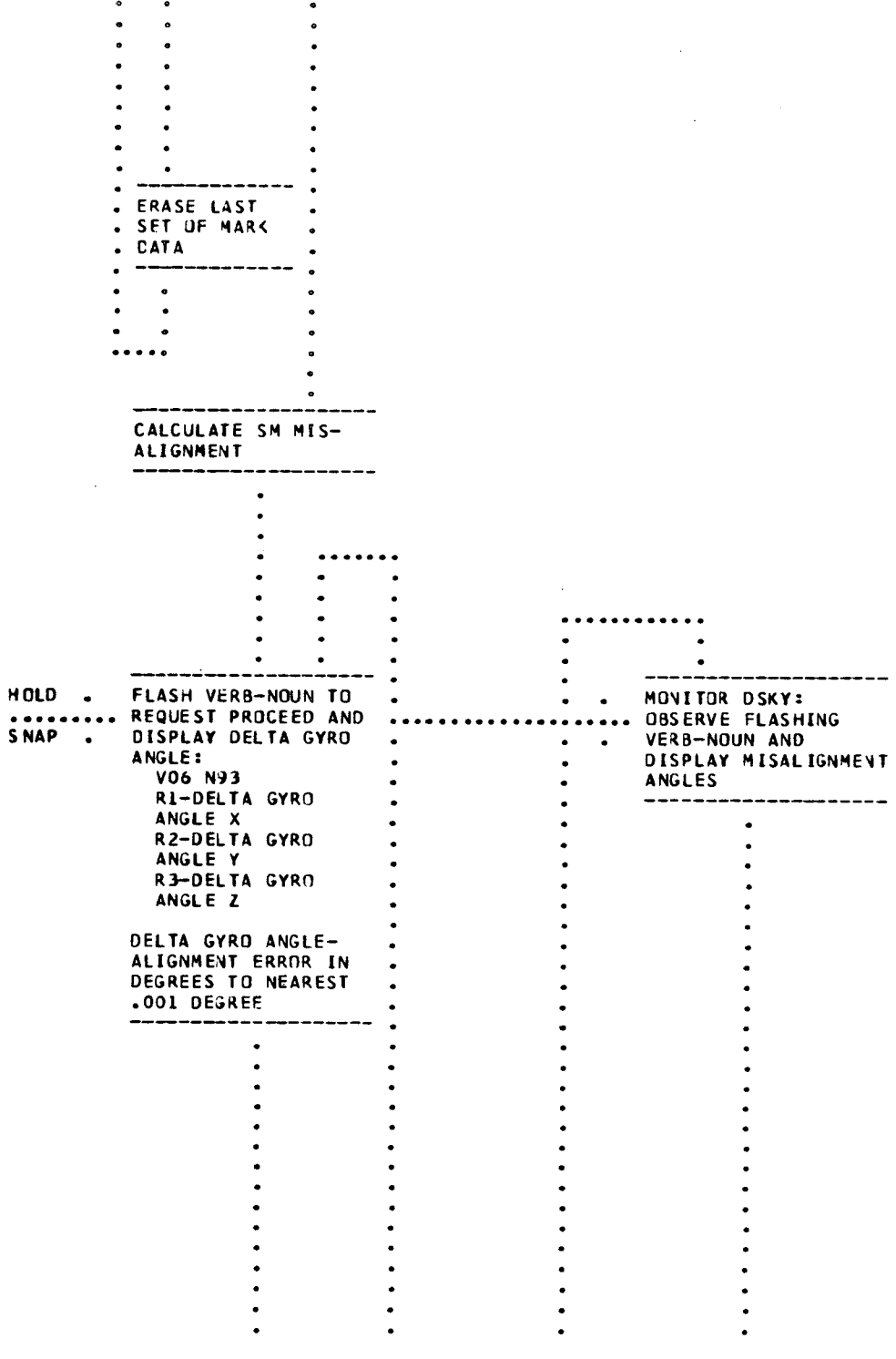
#430

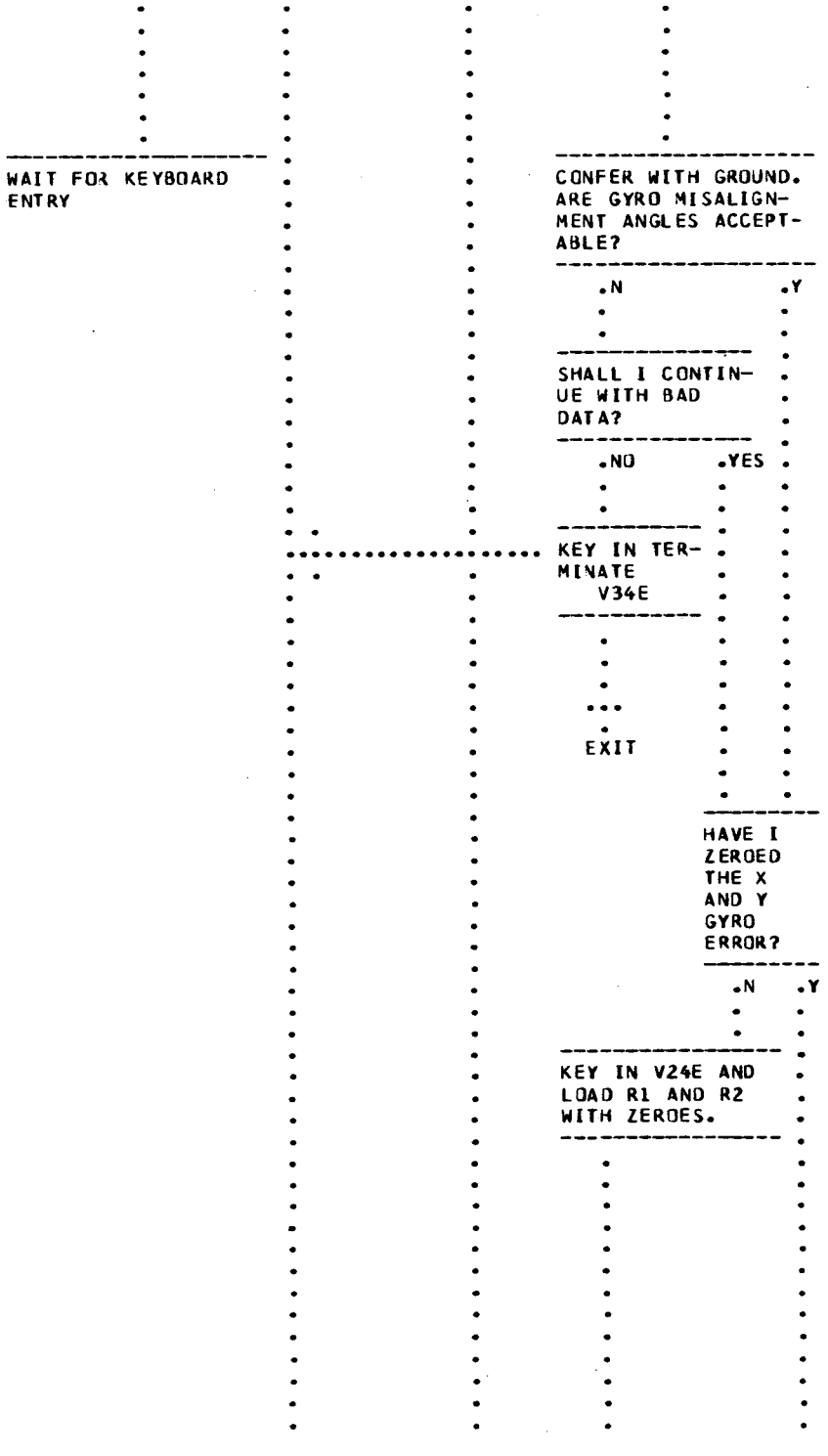
#440

#450

#460

#470





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#500

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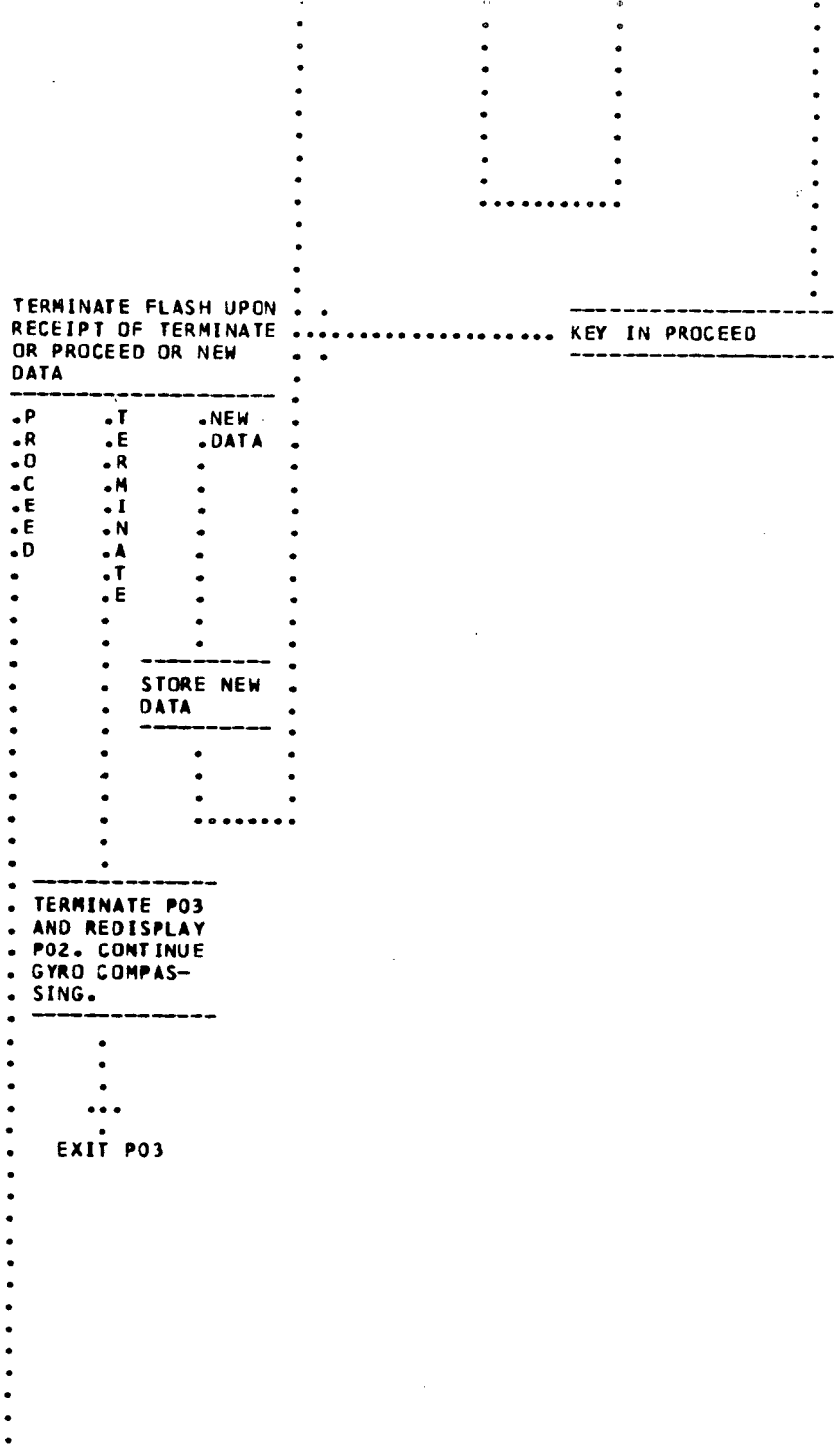

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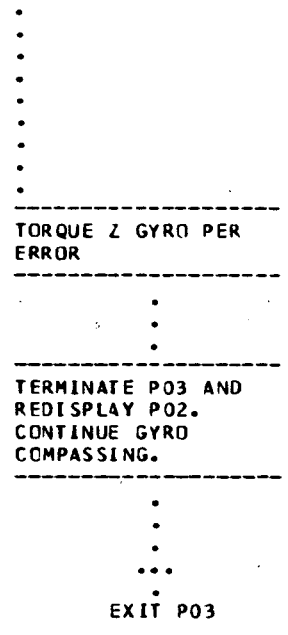

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#590

CHANGE CONTROL NOTES

REV 00 PCN 457

CMC POWER DOWN PROGRAM (P06) REV 00 05/19/71

PURPOSE: (1) TO TRANSFER THE CMC FROM THE OPERATE TO THE STANDBY CONDITION.

ASSUMPTIONS: (1) WHEN THIS PROGRAM IS TURNED ON THE ASTRONAUT MUST POWER DOWN THE CMC TO STANDBY. HOWEVER, THE PROGRAM IS NOT RESTART PROTECTED.

(2) THE NORMAL CONDITION OF READINESS OF THE GNCS WHEN NOT IN USE IS STANDBY. ALL THE G/N CKT BKRS (PANEL 5) ARE CLOSED, THE IMU AND OPTICS G/N POWER SWITCHES (LEB PANEL 100) ARE OFF AND THE CMC STANDBY LIGHT (DSKY) IS ON. IN THIS CONDITION THE IMU IS IN STANDBY WITH ONLY HEATER POWER ON, OPTICS POWER IS OFF AND THE CMC IS IN STANDBY.

(3) A POSSIBLE CONDITION OF READINESS OF THE GNCS WHEN NOT COMPLETELY ON IS THE SAME AS STANDBY (2) ABOVE, EXCEPT THE CMC STANDBY LIGHT ON THE MAIN AND LEB DSKYS IS OFF. IN THIS CONFIGURATION THE CMC IS RUNNING FOR COMPUTATIONAL PURPOSES THAT DO NOT REQUIRE THE IMU OR OPTICS.

(4) IF THE COMPUTER POWER IS SWITCHED OFF IT WILL BE NECESSARY TO PERFORM A COMPUTER FRESH START (V36E) TO INITIALIZE THE ERASABLE STORAGE. THE CMC UPDATE PROGRAM (P27) WOULD HAVE TO BE DONE TO UPDATE THE STATE VECTOR AND COMPUTER CLOCK TIME.

(5) THE CMC IS CAPABLE OF MAINTAINING AN ACCURATE VALUE OF GROUND ELAPSED TIME (GET) FOR ONLY 23 HRS WHEN IN THE STANDBY MODE. IF THE CMC IS NOT BROUGHT OUT OF THE STANDBY CONDITION TO THE RUNNING CONDITION (SEE (3) ABOVE) AT LEAST ONCE WITHIN 23 HOURS THE CMC VALUE OF GET MUST BE UPDATED.

(6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW
			. CREW PROG . SELECTION . . ... .
	DO R00 TO START CMC POWER DOWN PROGRAM (P06) DISPLAY PROGRAM 06	. ...	KEY IN CMC POWER DOWN PROGRAM (P06) V37E 06E

#10

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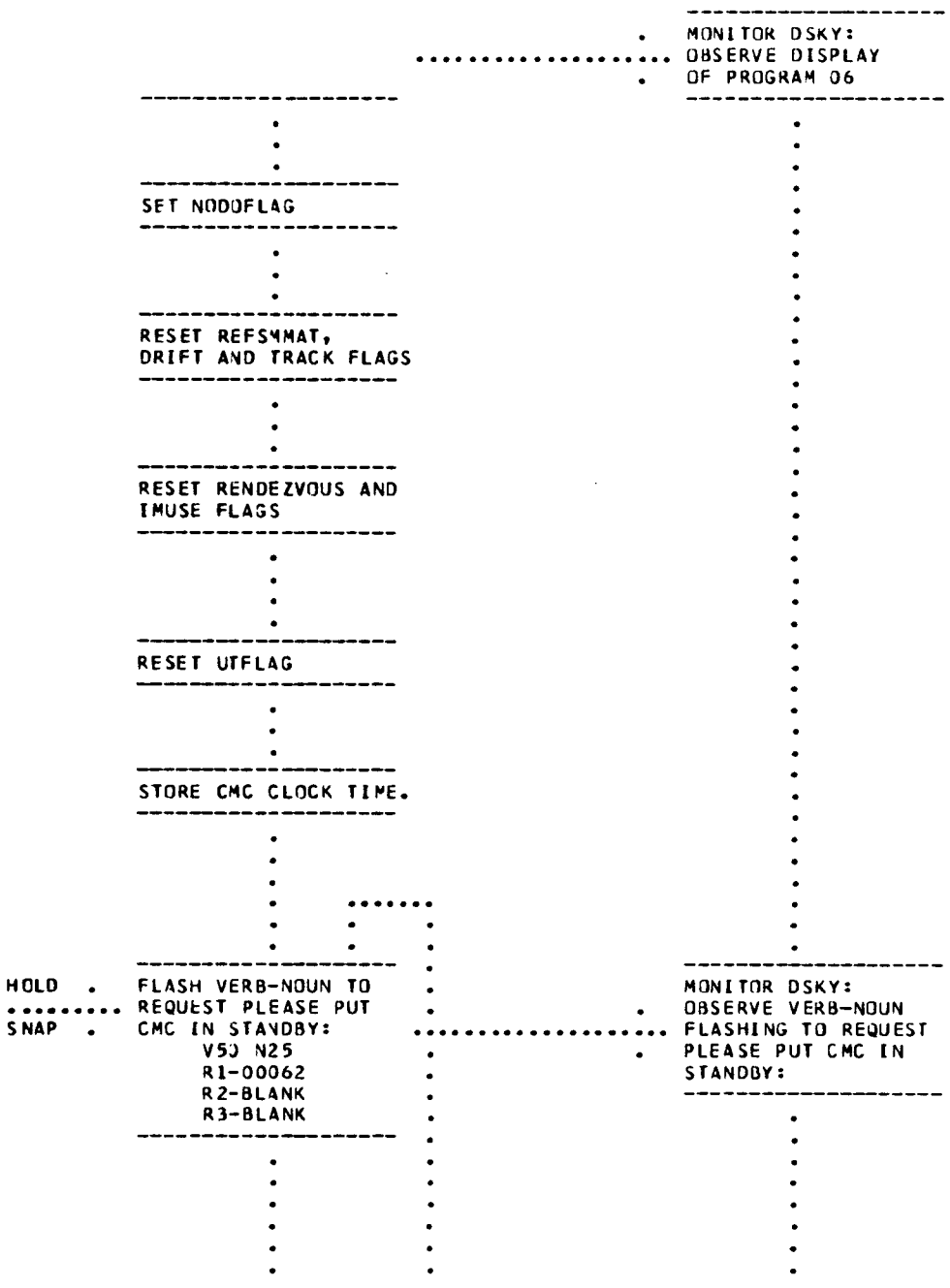

MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 06
SET NODOFLAG
RESET REFSMMAT,
DRIFT AND TRACK FLAGS
RESET RENDEZVOUS AND
IMUSE FLAGS
RESET UTFLAG
STORE CMC CLOCK TIME.
HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST PLEASE PUT
CMC IN STANDBY:
V50 N25
R1-00062
R2-BLANK
R3-BLANK
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASHING TO REQUEST
PLEASE PUT CMC IN
STANDBY:

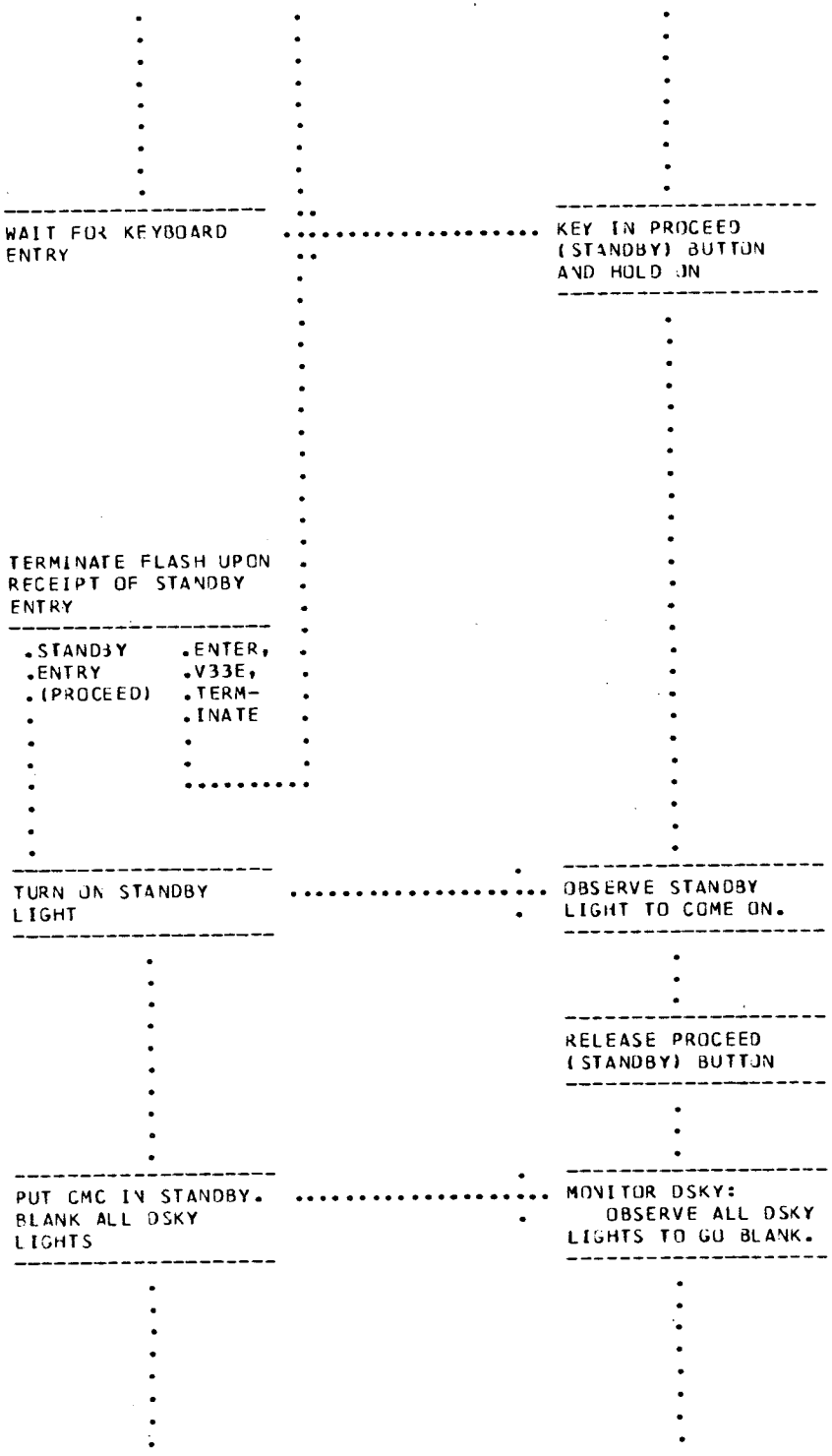
#20

#30

#40

#50

#60



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#120

EXIT P06

EXIT P06

#130

NOTE: WHEN IT IS DESIRED TO BRING THE CMC FROM STANDBY TO OPERATE THE FOLLOWING PROCEDURES APPLY.

#140

WAIT FOR STANDBY ENTRY	.....	KEY IN PROCEED (STANDBY) BUTTON AND HOLD ON
TURN OFF STANDBY LIGHT	.....	OBSERVE STANDBY LIGHT TO GO OFF

#150

CLEAR STANDBY ENABLE DISCRETE.

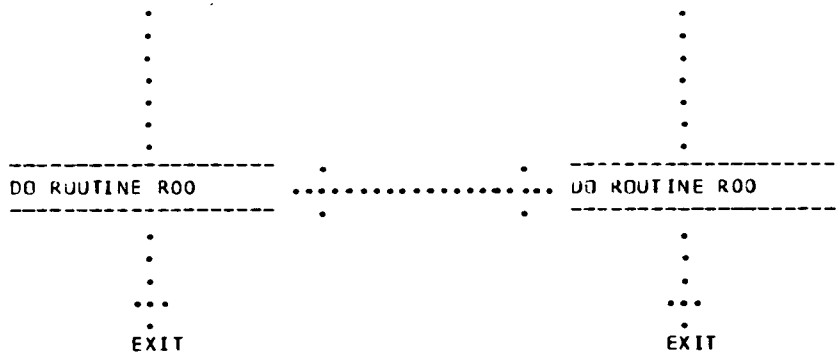
RELEASE PROCEED (STANDBY) BUTTON

#160

RESET NODOFLAG

UPDATE CMC TIME COUNTER

#170



#180

CHANGE CONTROL NOTES

EARTH ORBIT INSERTION MONITOR PROGRAM (P11) REV 00 05/19/71

PURPOSE: (1) TO INDICATE TO THE ASTRONAUT THAT THE CMC HAS RECEIVED THE LIFTOFF DISCRETE.

(2) TO GENERATE AN ATTITUDE ERROR INDICATION ON THE FDAI ERROR NEEDLES, SCALED FOR THE 50/15/15 SETTING; FROM LIFTOFF TO THE BEGINNING OF PITCHOVER/ROLLOUT THE ATTITUDE ERROR IS EQUAL TO THE DIFFERENCE BETWEEN THE CURRENT VEHICLE ATTITUDE AND THE ATTITUDE STORED AT LIFTOFF. DURING PITCHOVER/ROLLOUT THE ATTITUDE ERROR IS EQUAL TO THE DIFFERENCE BETWEEN THE CURRENT VEHICLE ATTITUDE AND THE CMC NOMINAL COMPUTATION OF VEHICLE ATTITUDE BASED ON THE STORED POLYNOMIALS IN PITCH AND ROLL.

(3) TO DISPLAY CMC COMPUTED TRAJECTORY PARAMETERS.

(4) CMC TAKEOVER OF SATURN DURING BOOST
(A) AUTOMATIC CONTROL - ALL STAGES:
SHOULD THE SATURN PLATFORM FAIL (DURING ANY STAGE OF EARTH ORBIT INSERTION) THE ASTRONAUT MAY SET THE LAUNCH VEHICLE GUIDANCE SWITCH FROM IU TO CMC. THIS STORES THE CURRENT ATTITUDE ERRORS AS A BIAS. THE ATTITUDE ERROR ROUTINE FOR EACH CYCLE THEREAFTER WILL COMPUTE THE ATTITUDE ERROR, SUBTRACT THE BIAS, AND TRANSMIT THE DIFFERENCE INFORMATION TO THE SATURN INSTRUMENTATION UNIT (IU) FOR STEERING.

(B) MANUAL CONTROL - SIV-B STAGE ONLY:
THE ASTRONAUT MAY SELECT THE SATURN STICK FUNCTION VIA V46E (DAP CONFIG = 3). THIS WILL TERMINATE THE ATTITUDE ERROR ROUTINE.

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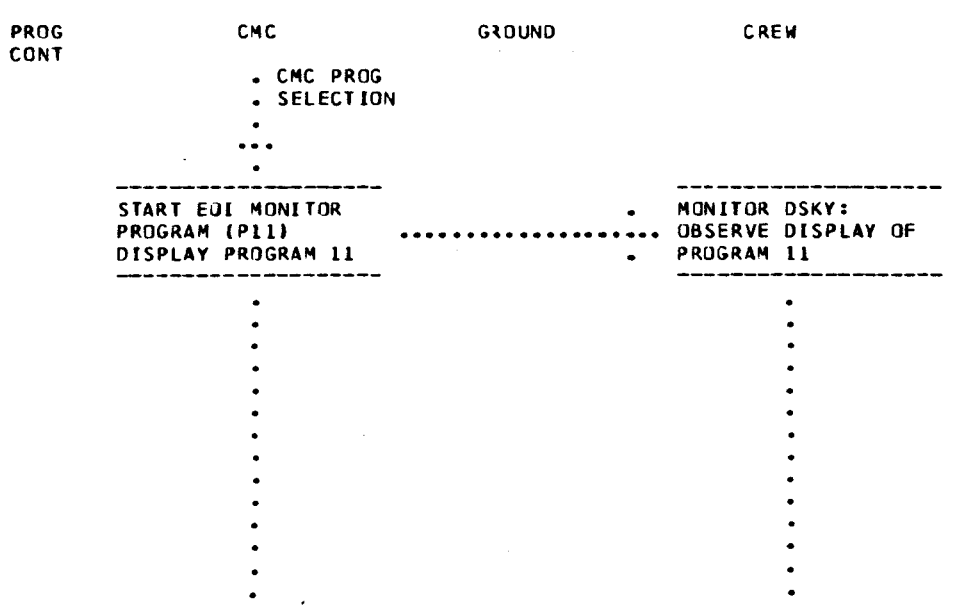
ASSUMPTIONS: (1) THE PROGRAM IS NORMALLY AUTOMATICALLY SELECTED BY THE GYRO COMPASSING PROGRAM (P02) WHEN THE CMC RECEIVES THE LIFTOFF DISCRETE FROM THE SIVB. IN THE BACKUP CASE IT WOULD HAVE BEEN SELECTED BY KEYING IN V75 ENTER AS NOTED EARLIER IN P02.

(2) THE ORBITAL PARAMETERS DISPLAY ROUTINE IS AVAILABLE BY KEYING IN V82E.



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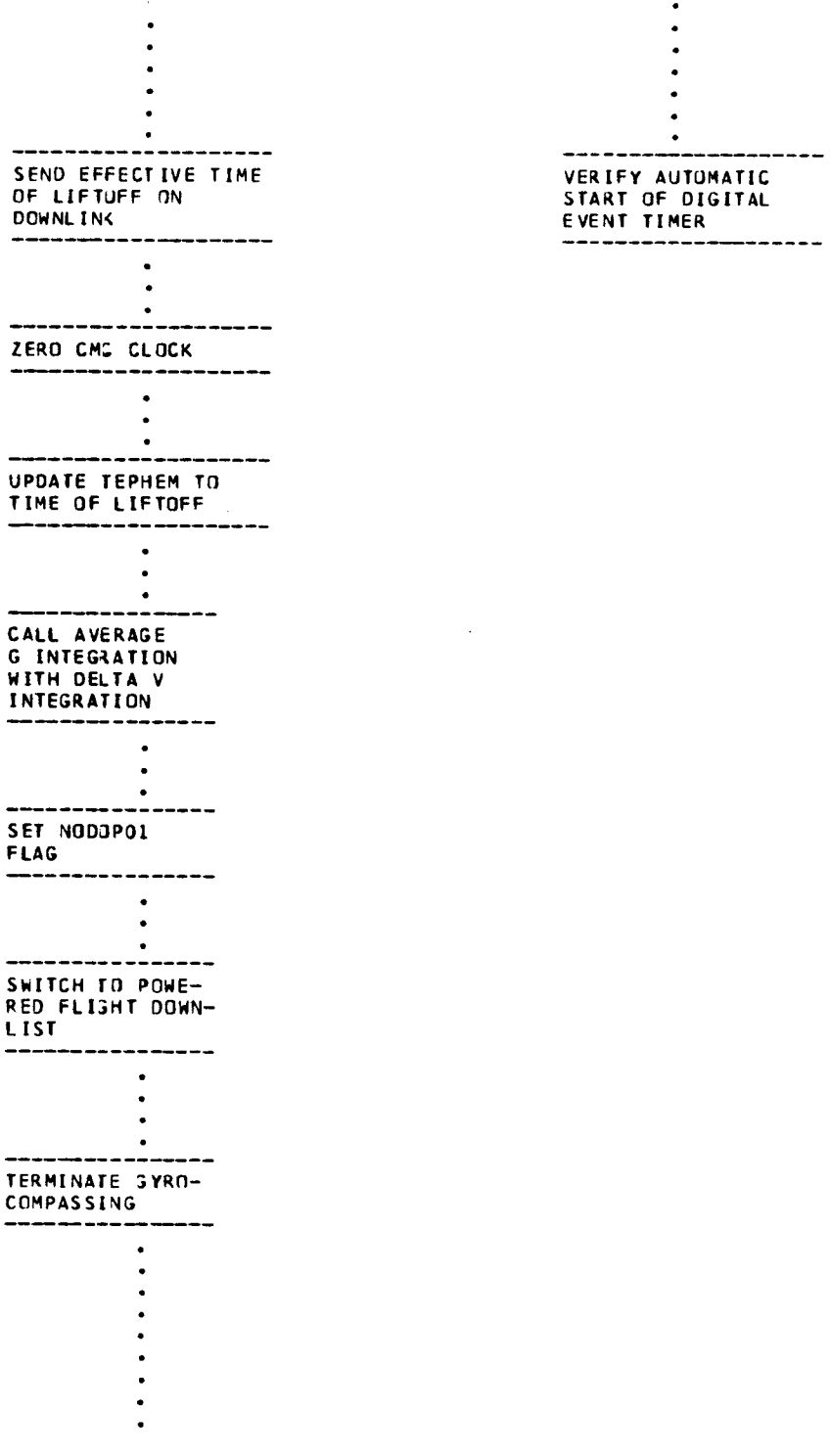
P11/SKYLARK


SEND EFFECTIVE TIME OF LIFTOFF ON DOWNLINK
ZERO CMC CLOCK
UPDATE TEPHEM TO TIME OF LIFTOFF
CALL AVERAGE G INTEGRATION WITH DELTA V INTEGRATION
SET NODOP01 FLAG
SWITCH TO POWERED FLIGHT DOWNLIST
TERMINATE GYROCOMPASSING
VERIFY AUTOMATIC START OF DIGITAL EVENT TIMER

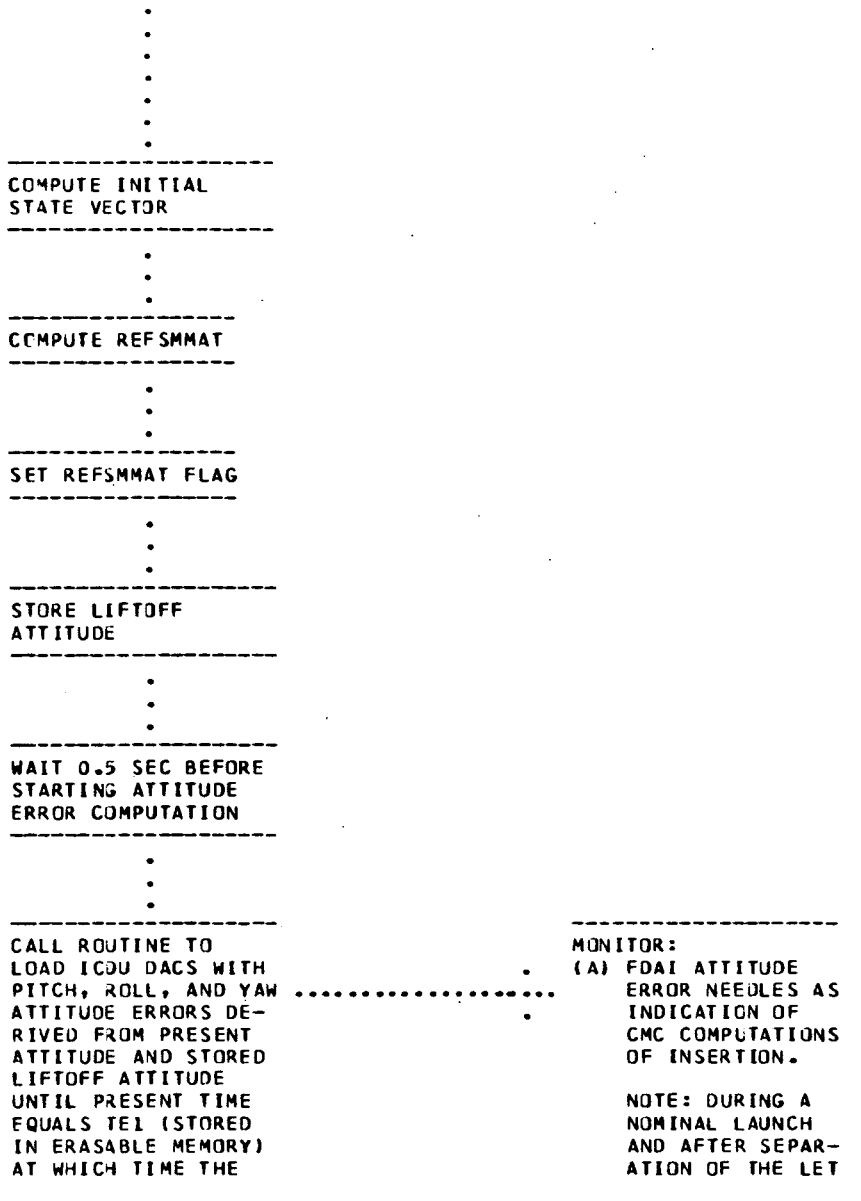
#20

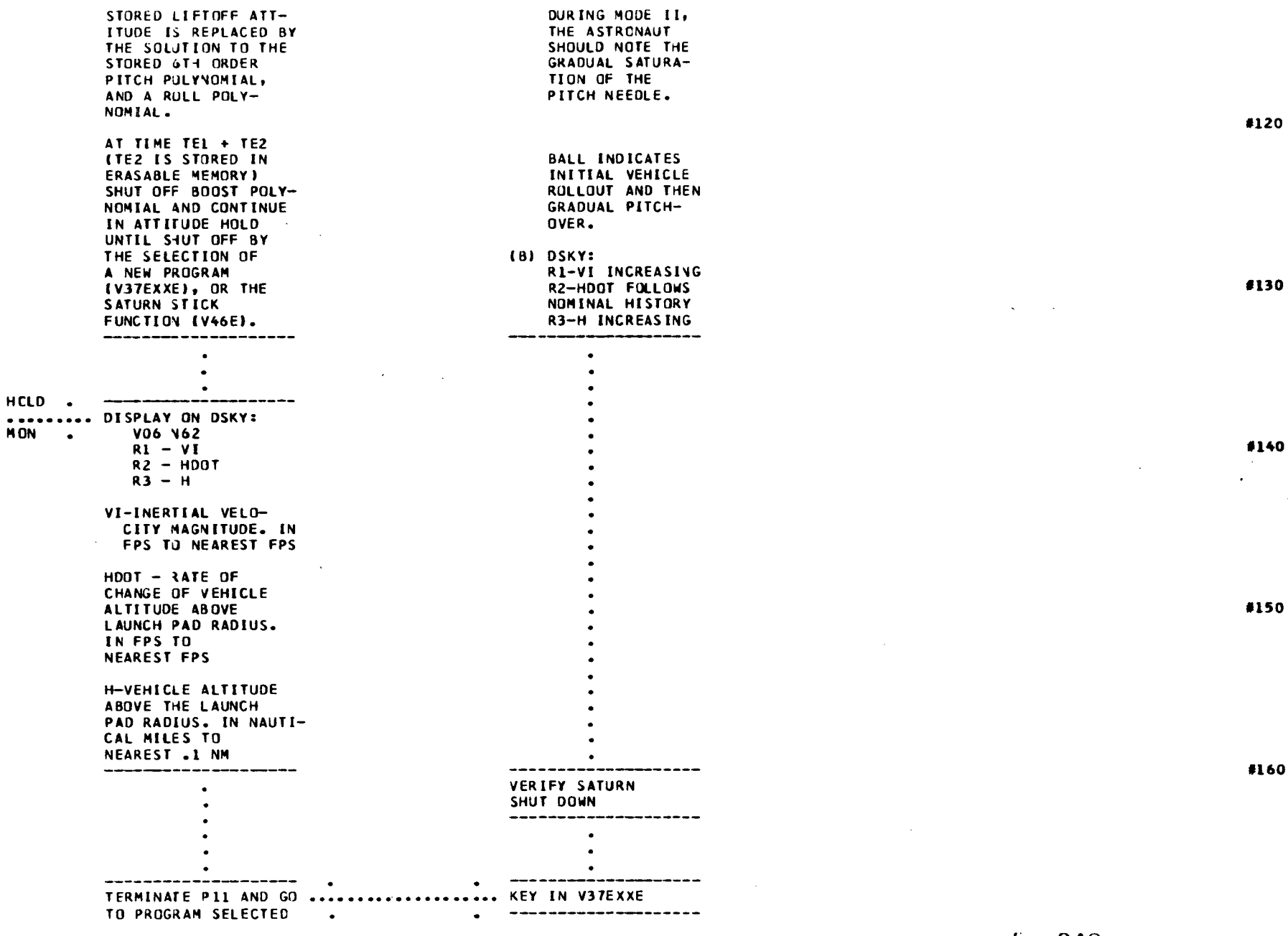
#30

#40

#50

#60


COMPUTE INITIAL STATE VECTOR
#70
COMPUTE REFSMMAT
#80
SET REFSMMAT FLAG
#90
STORE LIFTOFF ATTITUDE
WAIT 0.5 SEC BEFORE STARTING ATTITUDE ERROR COMPUTATION
#100
CALL ROUTINE TO LOAD ICDU DACS WITH PITCH, ROLL, AND YAW ATTITUDE ERRORS DERIVED FROM PRESENT ATTITUDE AND STORED LIFTOFF ATTITUDE UNTIL PRESENT TIME EQUALS TE1 (STORED IN ERASABLE MEMORY) AT WHICH TIME THE
MONITOR:
(A) FDAI ATTITUDE ERROR NEEDLES AS INDICATION OF CMC COMPUTATIONS OF INSERTION.
NOTE: DURING A NOMINAL LAUNCH AND AFTER SEPARATION OF THE LET
#110


STORED LIFTOFF ATT-
ITUDE IS REPLACED BY
THE SOLUTION TO THE
STORED 6TH ORDER
PITCH POLYNOMIAL,
AND A ROLL POLY-
NOMIAL.
AT TIME TE1 + TE2
(TE2 IS STORED IN
ERASABLE MEMORY)
SHUT OFF BOOST POLY-
NOMIAL AND CONTINUE
IN ATTITUDE HOLD
UNTIL SHUT OFF BY
THE SELECTION OF
A NEW PROGRAM
(V37EXXE), OR THE
SATURN STICK
FUNCTION (V46E).
HOLD
MON
DISPLAY ON DSKY:
V06 N62
R1 - VI
R2 - HDOT
R3 - H
VI-INERTIAL VELO-
CITY MAGNITUDE. IN
FPS TO NEAREST FPS
HDOT - RATE OF
CHANGE OF VEHICLE
ALTITUDE ABOVE
LAUNCH PAD RADIUS.
IN FPS TO
NEAREST FPS
H-VEHICLE ALTITUDE
ABOVE THE LAUNCH
PAD RADIUS. IN NAUTI-
CAL MILES TO
NEAREST .1 NM
TERMINATE P11 AND GO
TO PROGRAM SELECTED
DURING MODE II,
THE ASTRONAUT
SHOULD NOTE THE
GRADUAL SATURA-
TION OF THE
PITCH NEEDLE.
BALL INDICATES
INITIAL VEHICLE
ROLLOUT AND THEN
GRADUAL PITCH-
OVER.
(8) DSKY:
R1-VI INCREASING
R2-HDOT FOLLOWS
NOMINAL HISTORY
R3-H INCREASING
VERIFY SATURN
SHUT DOWN
KEY IN V37EXXE
#120
#130
#140
#150
#160

#170

CHANGE CONTROL NOTES

UNIVERSAL TRACKING PROGRAM (P20)

REV 01 03/20/72

PURPOSE: (1) TO CONTROL CSM ATTITUDE/OPTICS OR ATTITUDE RATES DEPENDING ON WHICH OF THE FIVE OPTIONS IS SELECTED. THEY ARE AS FOLLOWS:

OPTION 0 - POINT SPECIFIED SPACECRAFT VECTOR ALONG LOS TO OWS WITHOUT CONSTRAINING ROTATION ABOUT VECTOR (VECPOINT). THIS OPTION IS USED TO ACQUIRE THE OWS IN THE SXT FIELD.

OPTION 1 - POINT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED HEAVENLY BODY WITHOUT CONSTRAINING ROTATION ABOUT VECTOR (VECPOINT). THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.

OPTION 2 - PERFORM ROTATION ABOUT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED RATE AND BEGINNING AT SPECIFIED TIME. THIS OPTION IS NORMALLY USED TO EFFECT PTC. THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.

OPTION 4 - POINT SPECIFIED SPACECRAFT VECTOR ALONG LOS TO OWS, ALSO CONSTRAINING ROTATION ABOUT VECTOR (3-AXIS). THIS OPTION IS USED TO ACQUIRE THE OWS IN THE SXT FIELD AND IS AUTOMATICALLY ENABLED BY THE MINKEY CONTROLLER.

OPTION 5 - POINT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED HEAVENLY BODY, ALSO CONSTRAINING ROTATION ABOUT VECTOR (3-AXIS). THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.

(2) TO UPDATE EITHER THE OWS OR CSM STATE VECTOR (AS SPECIFIED BY THE ASTRONAUT BY DSKY ENTRY) ON THE BASIS OF OPTICAL TRACKING DATA AND/OR VHF RANGE DATA (OPTIONS 0 AND 4 ONLY). TO UPDATE THE CSM AND OWS STATE VECTORS EVERY FOUR TIME STEPS (OPTIONS 1,2 AND 5 ONLY)

ASSUMPTIONS: (1) THE IMU MUST BE ON AND ALIGNED IN ORDER TO PERFORM THIS PROGRAM.

(2) THE GNCS IS IN CONTROL OF THE VEHICLE IN THE AUTO MODE IN THE NOMINAL CASE. IF THE ASTRONAUT TAKES OVER CONTROL OF THE VEHICLE WITH RHC THE CSM WILL REMAIN AT THE ATTITUDE IT IS DRIVEN TO. REGARDLESS OF MODE SELECTION THE GNCS WILL CALCULATE THE DESIRED TRACKING ATTITUDE.

(3) ROUTINE R03 (R04 FOR CSM-OWS DOCKED) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM, IN ORDER FOR THE GNCS TO PERFORM THE AUTOMATIC ATTITUDE MANEUVERS THE ASTRONAUT SHOULD KEY IN V46E (V45E FOR CSM-OWS DOCKED) AT SOME TIME PRIOR TO THE FIRST MANEUVER.

(4) THE OWS OPTICAL BEACON IS VISIBLE TO THE CSM. (OPTIONS 0 OR 4).

(5) THE OPERATION OF THE PROGRAM INCLUDES THE FOLLOWING FLAGS:

RENDEZVOUS FLAG- CONTROLS THE PERMANENT TERMINATION OF THE TOTAL RENDEZVOUS NAVIGATION PROCESS, OPTION 0,4. THESE OPTIONS WILL ONLY RUN OR RESUME RUNNING WHEN THIS FLAG IS SET. SET BY P20 SELECTION OF OPTION 0 OR 4. RESET BY P20 SELECTION OF OPTION 1,2 OR 5, SELECTION OF CMC IDLING PROGRAM(P00), CMC POWER DOWN PROGRAM(P06), CONTINGENCY VHF RANGE RATE PROGRAM(P25), RENDEZVOUS THRUST MONITOR PROGRAM(P48), OR BY V56E, P00000 OR V34E FROM R60 OR R22. THE KEYING IN OF V56E WILL IMMEDIATELY TERMINATE P20 UNLESS A NAVIGATION MEASUREMENT IS BEING PROCESSED IN WHICH CASE IT WILL HOLD UNTIL COMPLETION OF THE INCORPORATION AND THEN TERMINATE P20.

TRACK FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE TRACKING PROCESS. RESET OF THIS FLAG INTERRUPTS THE AUTOMATIC ATTITUDE MANEUVER/OPTICS POINTING PROCESS, AS WELL AS THE STATE VECTOR UPDATE PROCESS. THE SET OF THIS FLAG ENABLES ALL THESE PROCESSES. SET BY P20,21,29,30,31,32,33,34,35,36,37 AND 38. SET BY P52, P54 SELECTION IF OPTION 2 OF P20 IS RUNNING. RESET BY ANY V37EXXE, P00000 AND V56E.

++
+01
+
+489
++

SNAPFLAG - INHIBITS R22 MARK PROCESSING DURING CDU-SNAPSHOT AT TIME TD IN R27. SET BY R27 20 SEC. BEFORE TD. RESET IN R27 AFTER TC AND ALSO BY ANY V37EXXE.

UPDATE FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE STATE VECTOR UPDATE PROCESS ONLY. SET BY P20 (OPTION 0 OR 4), 30,31,32,33,34,35,36,37,38 SELECTION. RESET BY ANY V37EXXE, V56E, AND IT IS ALSO RESET AND SET DURING THE PRETHRUST COMPUTATIONS TO PROTECT ERASABLE MEMORY.

STICK FLAG - RESET BY EXECUTION OF A PROGRAM CHANGE VIA R00 AND BY V58E. SET BY TAKING RHC OUT OF DETENT WHEN THE SC CONTROL SWITCH IS CMC AND WHEN THE THC IS NOT CLOCKWISE. CDU RATE DRIVE IS NOT PERFORMED IF THE STICK FLAG IS SET. SET BY RCS DAP WHEN MIDDLE GIMBAL ANGLE IS GREATER THAN + OR - 75 DEGREES DURING AN AUTOMATIC MANEUVER.

STATE VECTOR FLAG - DEFINES WHICH STATE VECTOR WILL BE UPDATED BY SIGHTING MARKS AND VHF RANGING. SET TO CSM BY P20 TURN ON AND V81E. SET TO OWS BY V80E.

VHF RANGE FLAG - SET BY V87E, RESET BY V88E. ALLOWS AUTOMATIC VHF RANGE DATA TO BE USED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22).

AZIMFLAG- SET BY SELECTION OF MINKEY AND P20 (OPTIONS 4 OR 5) TO CONSTRAIN ATTITUDE ABOUT POINTING VECTOR. RESET BY SELECTION OF P20 (OPTIONS 1,2, OR 5).

V50N18 FLAG - SET BY V37EXXE (EXCEPT XX=00) AND BY V58E; RESET BY R61.

UTFLAG- CONTROLS THE PERMANENT TERMINATION OF THE UNIVERSAL TRACKING PROGRAM P20, OPTIONS 1,2,5. THESE OPTIONS WILL ONLY RUN OR RESUME RUNNING WHEN THIS FLAG IS SET. SET BY SELECTION OF P20 OPTIONS 1,2, OR 5. RESET BY SELECTION OF P20 OPTIONS 0 OR 4 AND BY SELECTION OF CMC IDLING PROGRAM (P00), CMC POWER DOWN PROGRAM (P06), BY V56E, P00D00, IMU TURNOFF, OR V34E FROM R63.

R27FLAG- SET BY V76E AND RESET BY V77E AND AT P20 SELECTION. ALLOWS R22 TO CALL THE VHF RANGE-RATE MARK PROCESSING ROUTINE (R27).

R67FLAG- INDICATES THAT R67 (ROTATION ROUTINE) IS ACTIVE. SET WHEN R67 IS INITIATED OR RESTARTED. RESET IN R67 IF TRACKFLG IS RESET, BY V56E, AND BY SELECTION OF V37EXXE.

(6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY AND BY MINKEY. IT MAY BE TERMINATED BY THE SELECTION OF THE CMC IDLING PROGRAM (P00), CMC POWER DOWN PROGRAM (P06), V34E FROM R60 OR R22, OR BY V56E. P00 SELECTION WILL TERMINATE P20 AND ANY OTHER PROGRAM IN PROCESS AND ESTABLISH P00. ALL OTHER PROGRAMS SELECTED WILL CHANGE THE PROGRAM NUMBER DISPLAYED ON THE DSKY BUT WILL NOT TERMINATE P20. THIS PROGRAM IS DESIGNED TO OPERATE AUTOMATICALLY AND SIMULTANEOUSLY WITH ANOTHER PROGRAM WITHOUT REQUIRING USE OF THE DSKY UNLESS NON-NOMINAL CIRCUMSTANCES REQUIRE CMC COMMUNICATION WITH THE ASTRONAUT. IF V56E IS KEYED INTO THE DSKY AND P20 IS THE ONLY PROGRAM RUNNING, ROUTINE R00 WILL BE INITIATED.

(7) W-MATRIX INITIALIZATION FOR RENDEZVOUS MAY BE ENABLED IN ANY OF THE FOLLOWING WAYS:

(A) KEYING IN OF VERB 93E

(B) COMPUTER FRESH START (KEYING IN OF VERB 36E)

(C) STATE VECTOR UPDATE FROM THE GROUND

(D) DURING MINKEY BY AUTOMATIC W-MATRIX INITIALIZATION.

(8) THERE IS A RENDEZVOUS OPTICS MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF OPTICS MARKS USED TO CHANGE EITHER STATE VECTOR AND THERE IS A RENDEZVOUS VHF RANGING MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF VHF RANGING MARKS USED TO CHANGE EITHER STATE VECTOR.

THESE COUNTERS ARE ZEROED BY SEVERAL DISTINCT EVENTS, THEY ARE:

(A) INITIALIZATION OF THE W-MATRIX FOR RENDEZVOUS (FOR ANY REASON, SEE ASSUMPTION 7).

(B) KEYING V36E (REQUEST FOR FRESH START)

(9) SUMMARY OF EXTENDED VERBS ASSOCIATED WITH THE PROGRAM:
V54E - DO R23 - ALLOWS BACKUP MARKING ON THE OWS.
V56E - RESET THE RENDEZVOUS FLAG, RESET UTFLAG. CAUSES TERMINATION OF P20.
V57E - ALLOWS CREW TO CHANGE SETTING OF FULL TRACK FLAG.
V58E - RESET STICK FLAG, SET V50N18 FLAG - ALLOW AUTO MANEUVERS
V67E - W-MATRIX RSS ERROR DISPLAY
V76E - ENABLE R27 (DURING P20 OPTION 0,4)
V77E - DISABLE R27 (DURING P20 OPTION 0,4)
V80E - SET STATE VECTOR FLAG TO OWS. DATA WILL UPDATE OWS STATE VECTOR
V81E - SET STATE VECTOR FLAG TO CSM. DATA WILL UPDATE CSM STATE VECTOR
V87E - SET VHF RANGE FLAG - ALLOWS R22 TO ACCEPT RANGE DATA.
V88E - RESET VHF RANGE FLAG - STOPS ACCEPTANCE OF RANGE DATA BY R22.
V93E - RESET RENDWFLG - CAUSE INITIALIZATION OF W-MATRIX FOR RENDEZVOUS AT NEXT DATA INCORPORATION

(10) PROGRAMS ALLOWING P20 TO RUN IN BACKGROUND (SET TRACKFLG):

PROGRAM NUMBER:	COMPATIBLE OPTIONS: 0	1	2	4	5
P21*	X	X	X	X	X
P27		X	X		X
P29*	X	X	X	X	X
P30	X	X	X	X	X
P31-P38	X			X	
P52			X		
P54			X		

* TRACKING ONLY (NO NAVIGATION).

(11) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88, HOWEVER, UNIT VECTORS ARE RECOMMENDED.

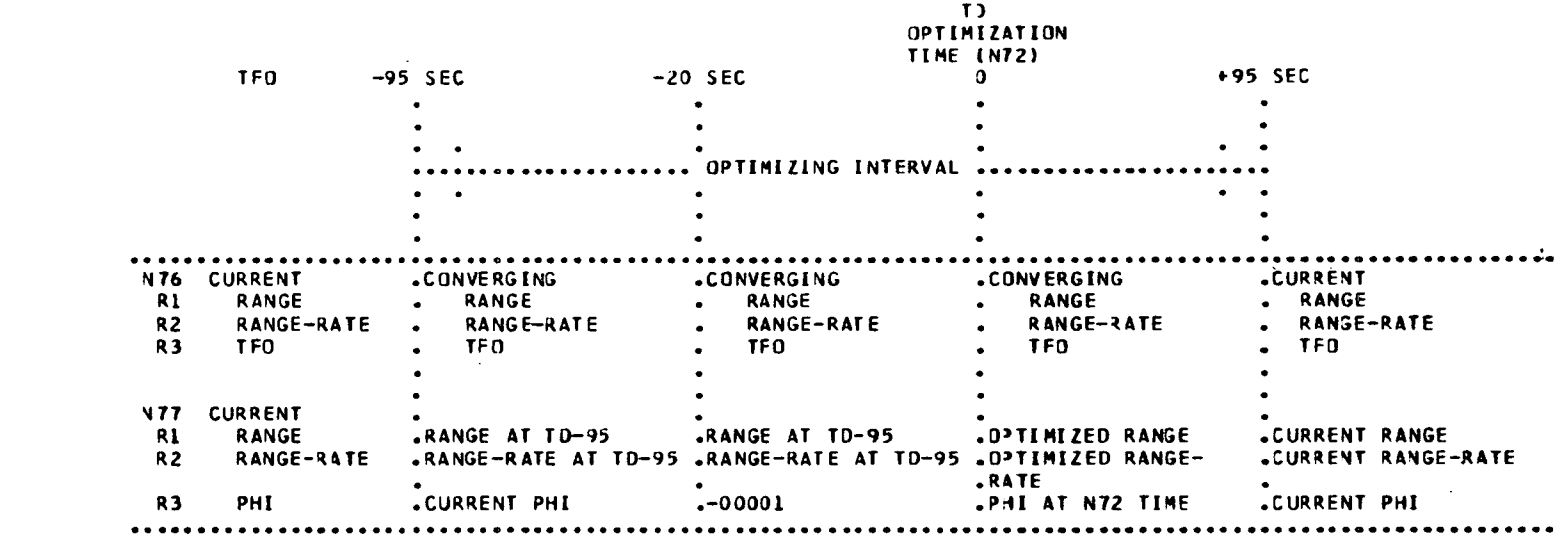
(12) INFORMATION FROM THE VHF RANGE RATE MARK PROCESSING ROUTINE (R27) IS AVAILABLE IN OPTIONS 0 AND 4 IF R27 HAS BEEN ENABLED IN P20 BY V76E.

THE NOUNS ASSOCIATED WITH R27 ARE:
N72 - TIME OF R27 OPTIMIZATION (TD)
N76 - R1 - RANGE - VHF RANGE TO OWS IN NAUT. MI. TO .01 NM
R2 - RANGE-RATE - RANGE-RATE BETWEEN CSM, OWS CALCULATED BY VHF RANGE-RATE FILTER IN FPS TO NEAREST .1 FPS. NEGATIVE SIGN INDICATES CLOSING
R3 - TFO TIME FROM NOW TO OPTIMIZATION TIME (N72) IN MIN AND SEC TO NEAREST SEC. THE VALUE IS +59859 IF NO OPTIMIZATION WAS REQUESTED.

N76 CONTAINS EITHER CURRENT OR CONVERGING VALUES OF RANGE-RATE AS SHOWN IN TABLE BELOW

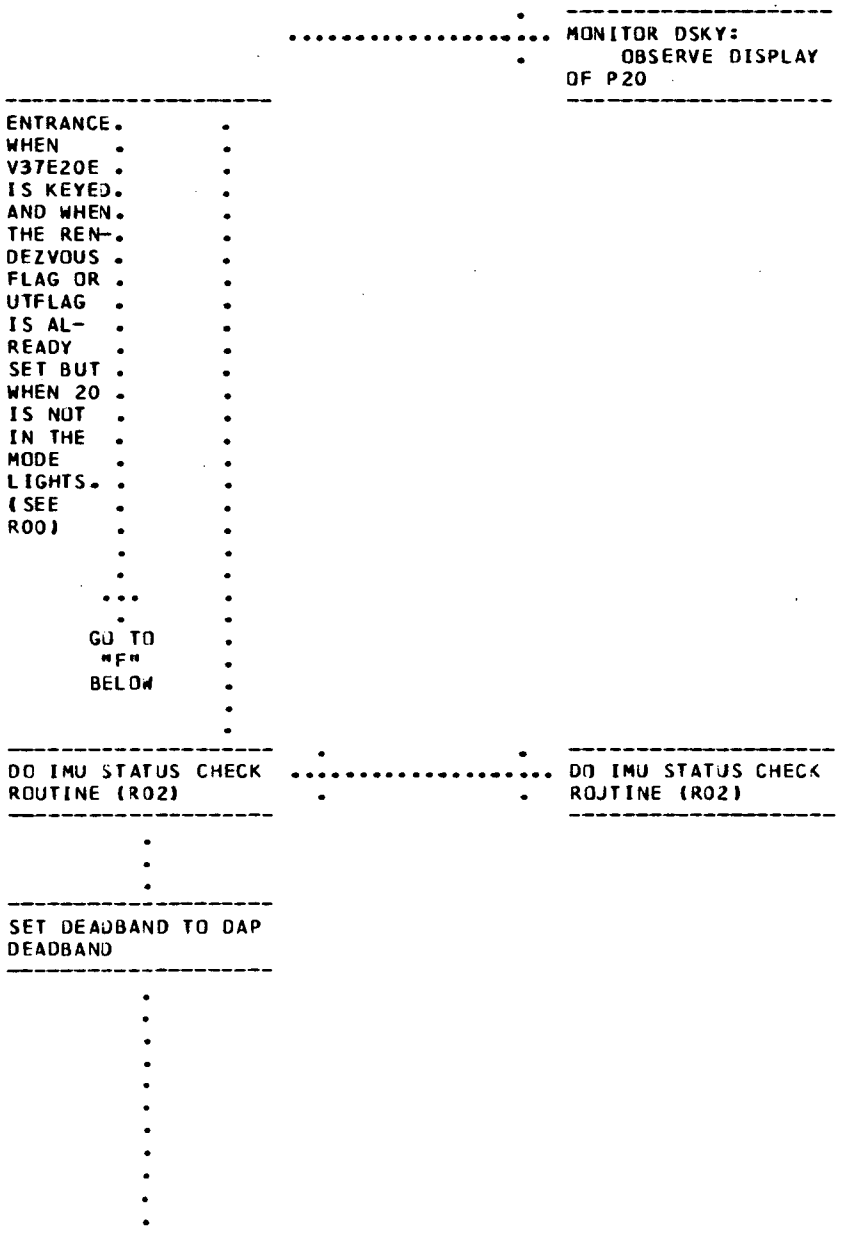
N77 R1 - RANGE
R2 - RANGE-RATE
R3 - PHI OR -00001 - THE ANGLE IN DEGREES TO NEAREST .01 DEGREE BETWEEN THE LOCAL HORIZONTAL AND THE SEXTANT LINE-OF SIGHT.

N77 CONTAINS CURRENT, CONVERGING OR OPTIMIZED VALUES OF RANGE AND RATE. THE ANGLE PHI IS EITHER THE CURRENT ANGLE OR THE ANGLE AT OPTIMIZATION TIME.



PROG CONT	CMC	GROUND	CREW
	AUTOMATIC PROGRAM SELECTION		CREW PROGRAM SELECTION
	DO R00 TO START UNIVERSAL TRACKING PROGRAM (P20). DISPLAY P20		KEY IN UNIVERSAL TRACKING PROGRAM (P20) V37E20E

#10


MONITOR DSKY:
OBSERVE DISPLAY
OF P20
ENTRANCE WHEN V37E20E IS KEYED AND WHEN THE REN-DEZVOUS FLAG OR UTFLAG IS AL-READY SET BUT WHEN 20 IS NOT IN THE MODE LIGHTS. (SEE R00)
GO TO "F" BELOW
DO IMU STATUS CHECK ROUTINE (R02)
DO IMU STATUS CHECK ROUTINE (R02)
SET DEADBAND TO DAP DEADBAND

#20

#30

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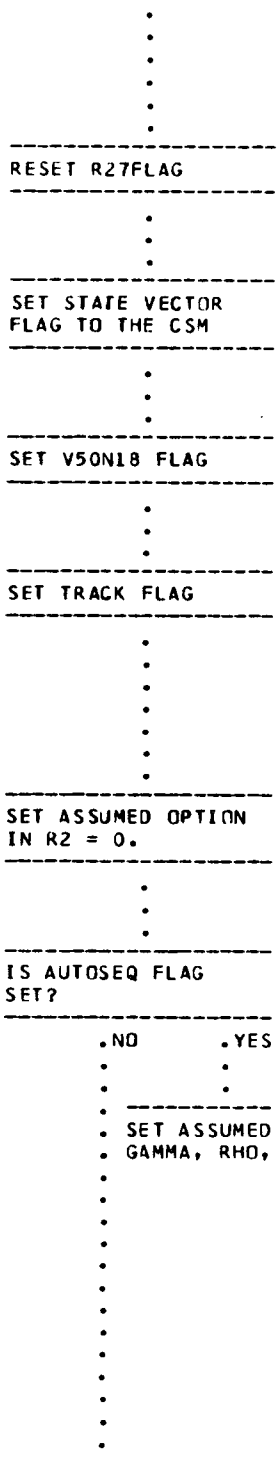

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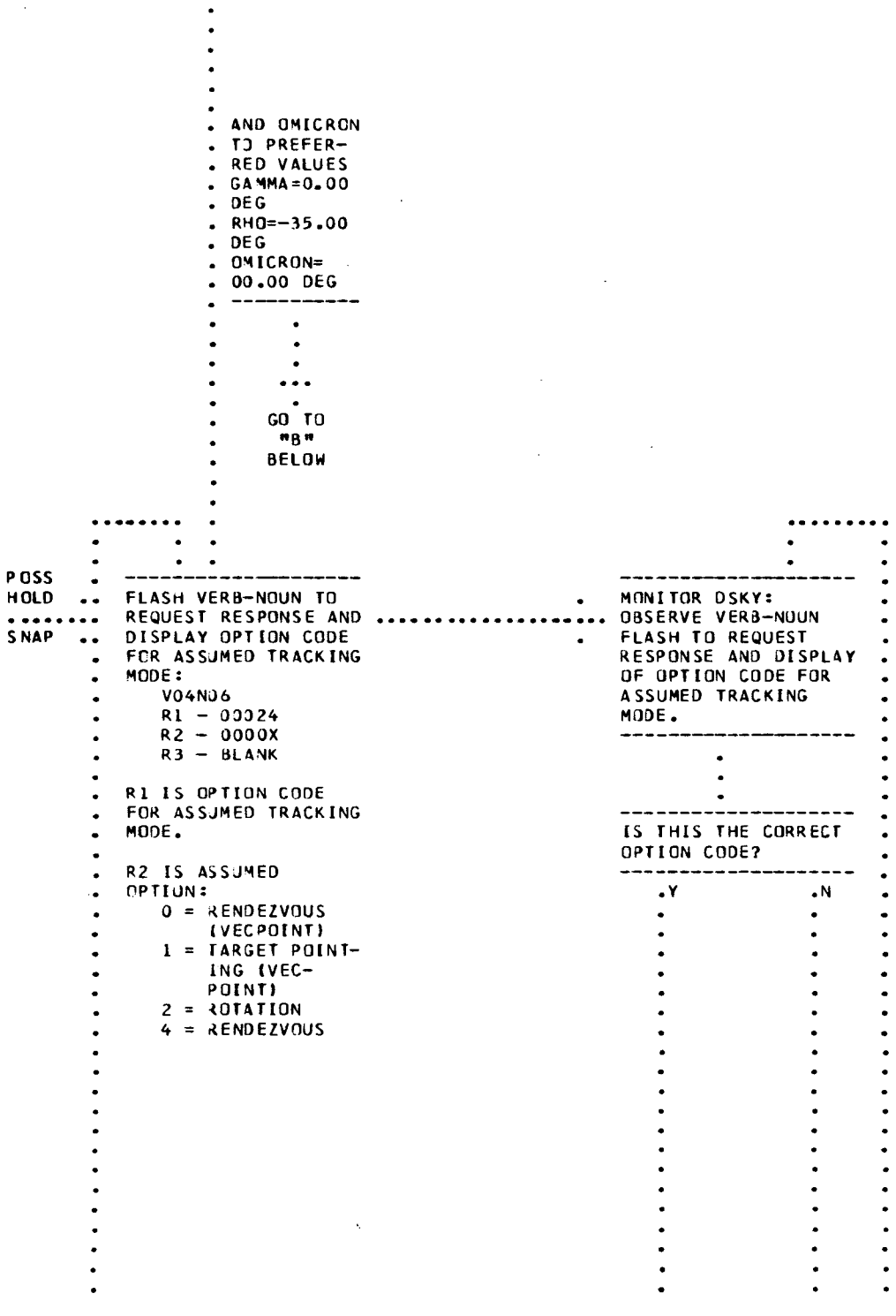

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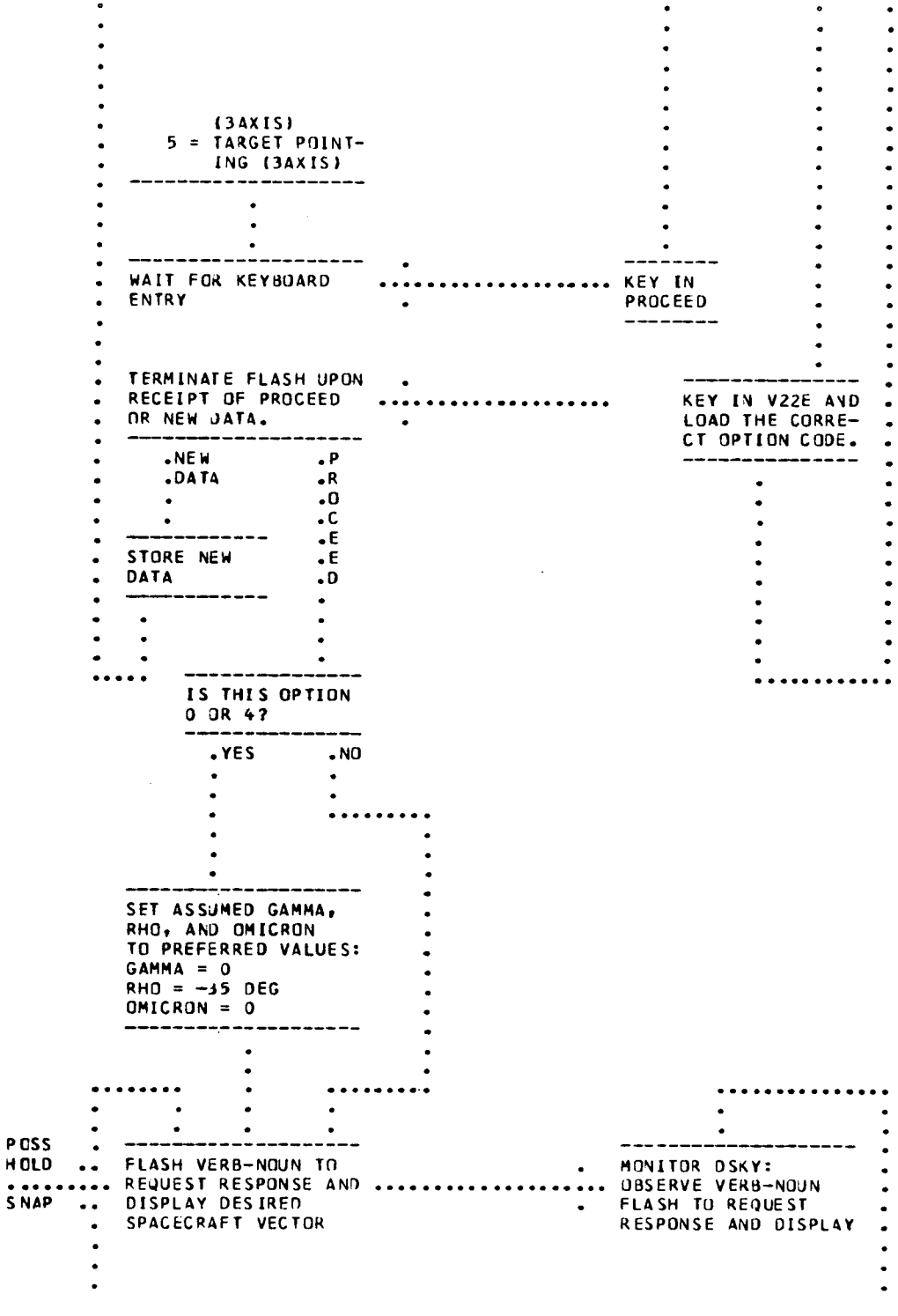

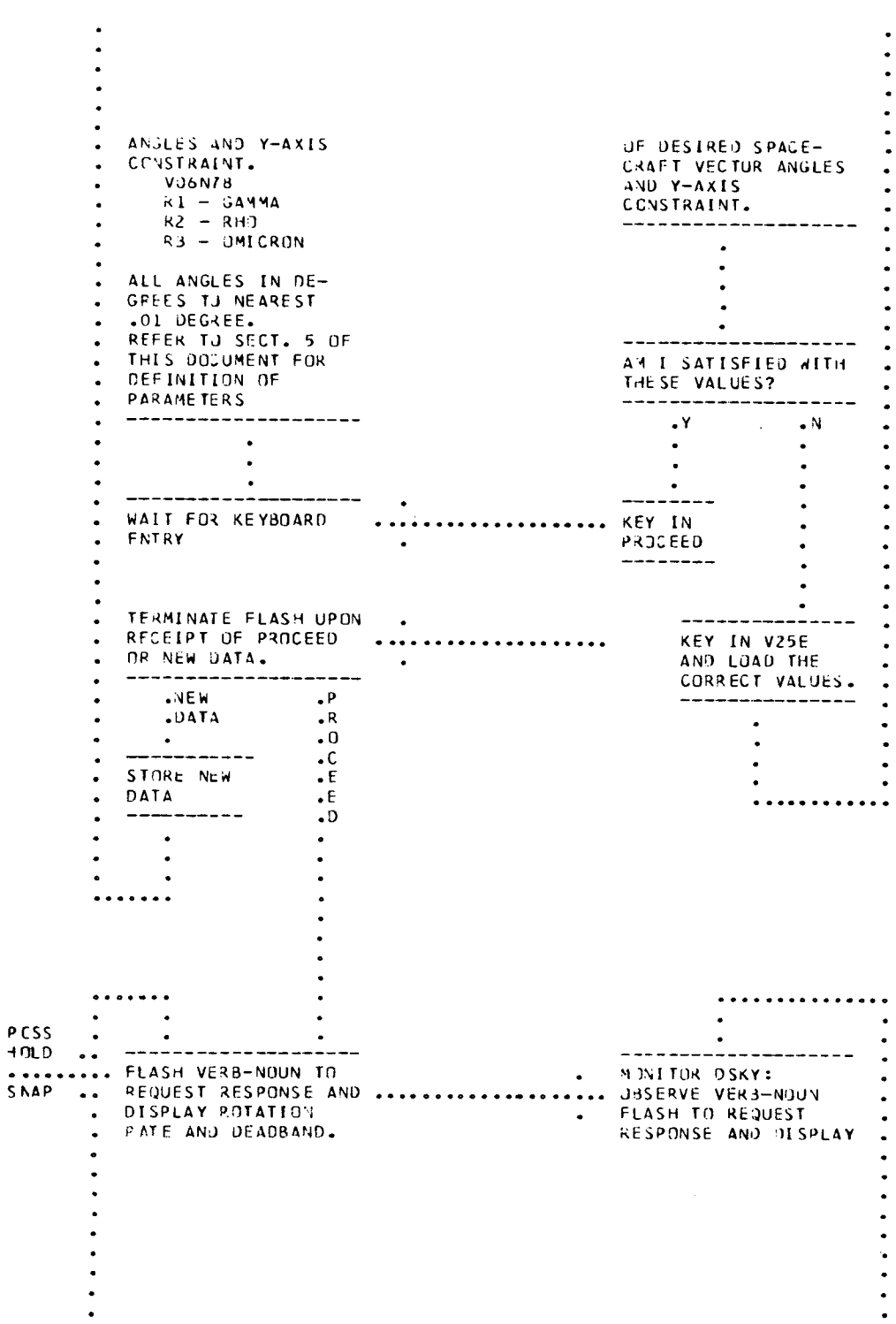

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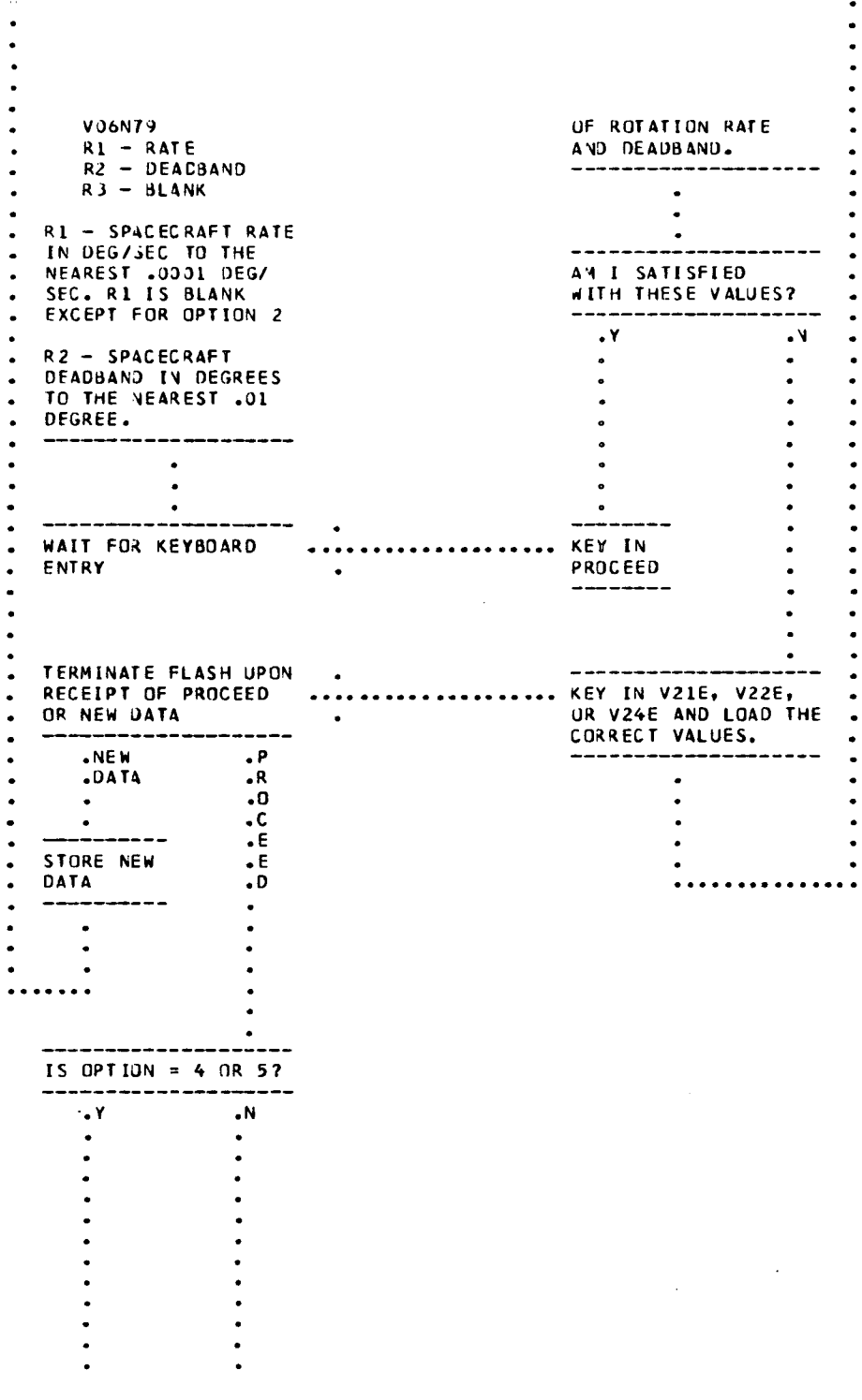
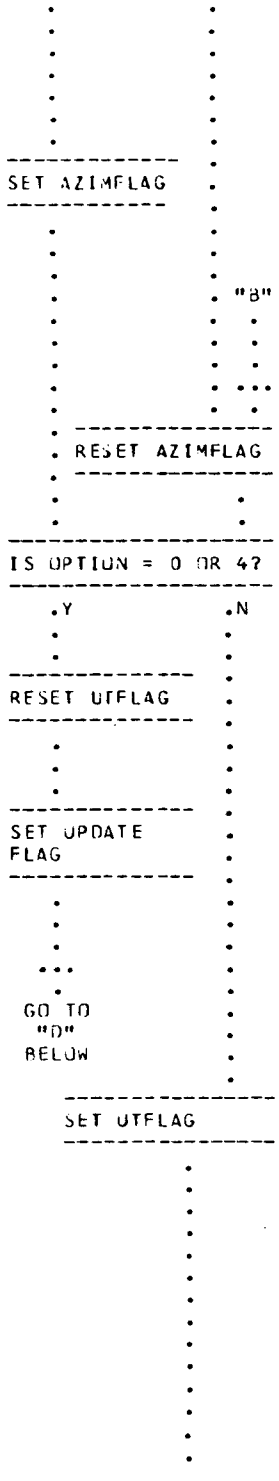

V06N79
R1 - RATE
R2 - DEADBAND
R3 - BLANK
R1 - SPACECRAFT RATE IN DEG/SEC TO THE NEAREST .0001 DEG/SEC. R1 IS BLANK EXCEPT FOR OPTION 2
R2 - SPACECRAFT DEADBAND IN DEGREES TO THE NEAREST .01 DEGREE.
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
.NEW DATA
.PROCEED
STORE NEW DATA
IS OPTION = 4 OR 5?
.Y
.N
OF ROTATION RATE AND DEADBAND.
AM I SATISFIED WITH THESE VALUES?
.Y
.N
KEY IN PROCEED
KEY IN V21E, V22E, OR V24E AND LOAD THE CORRECT VALUES.
#270
#280
#290
#300
#310



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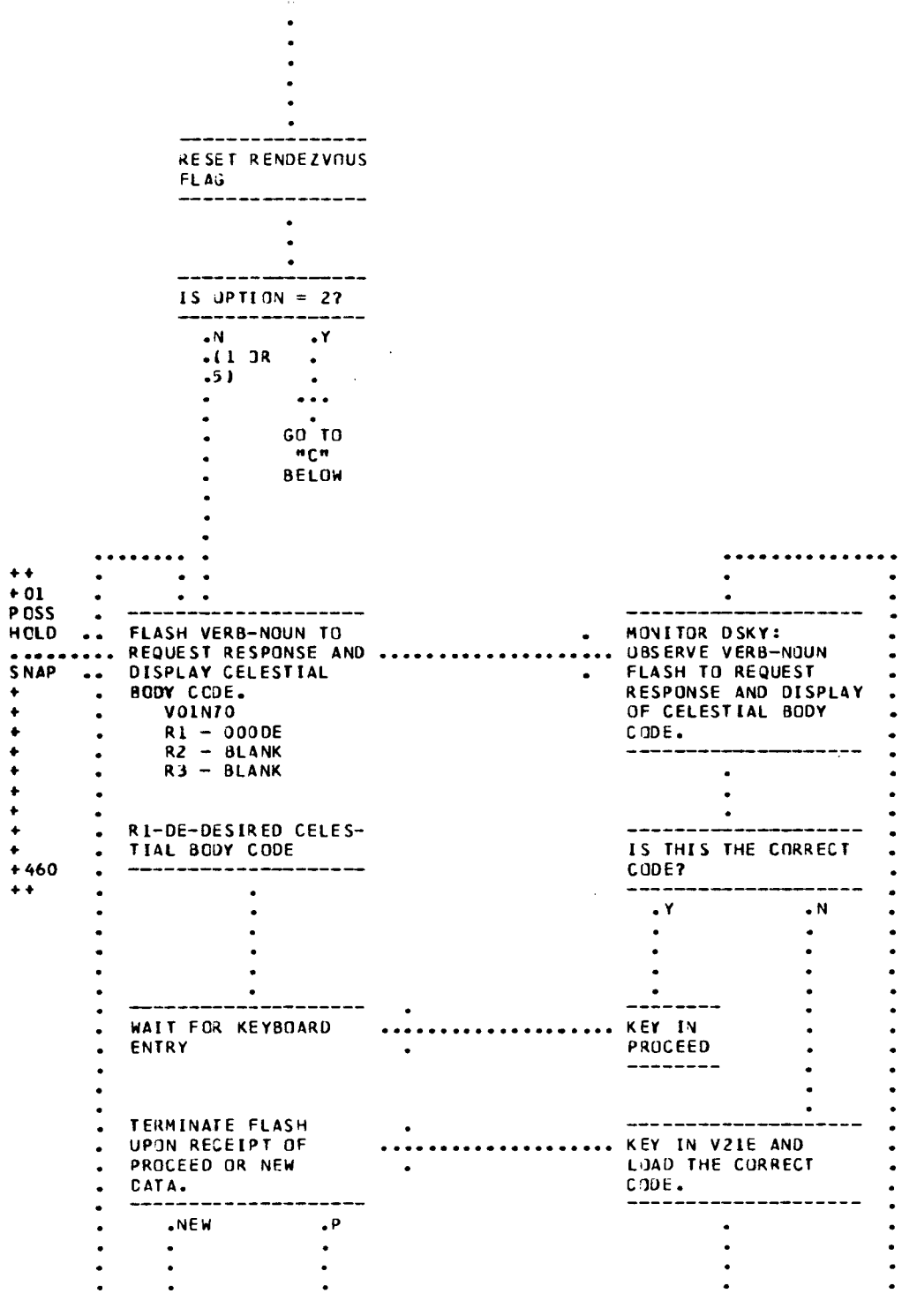
#360



#370

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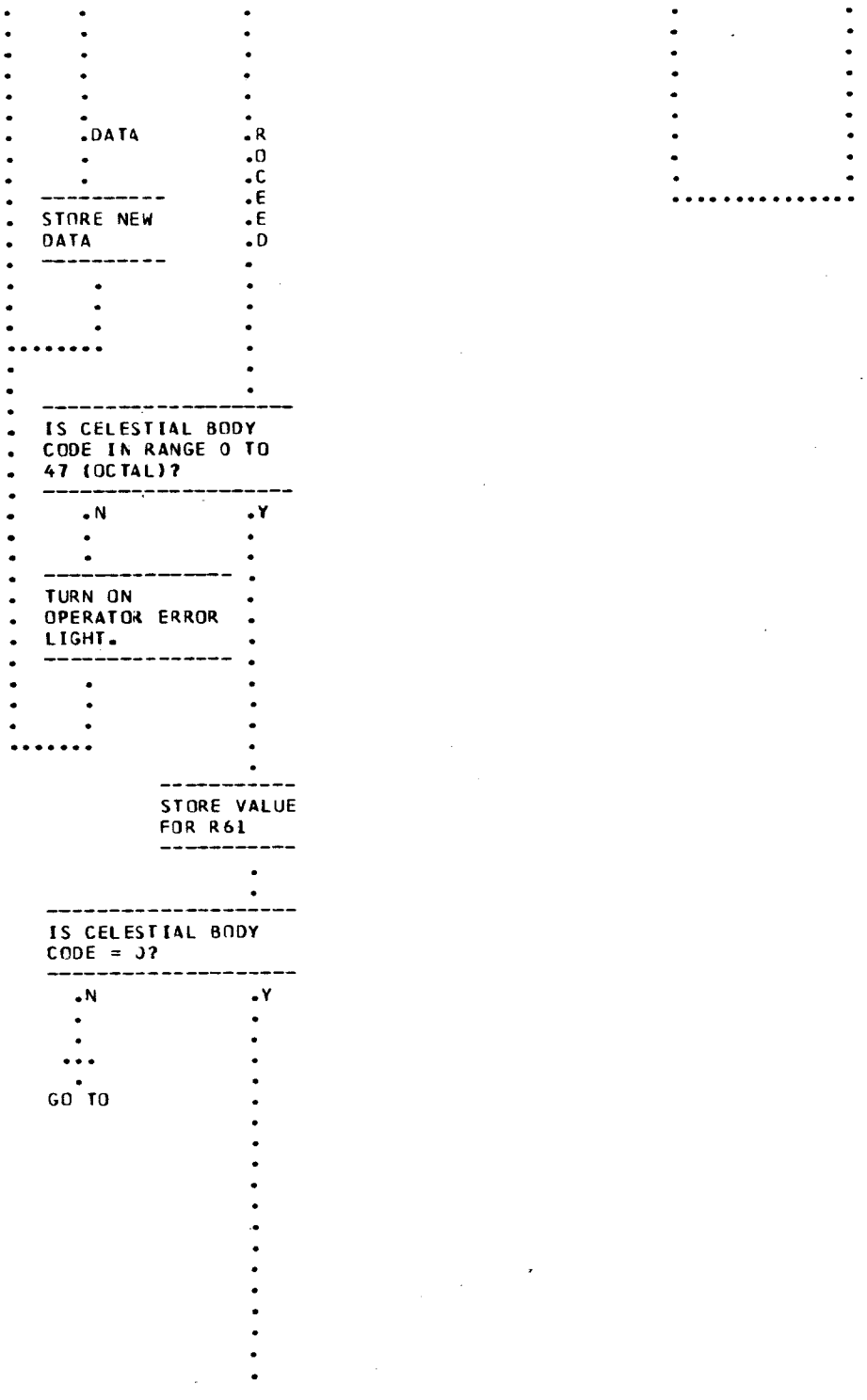

#430

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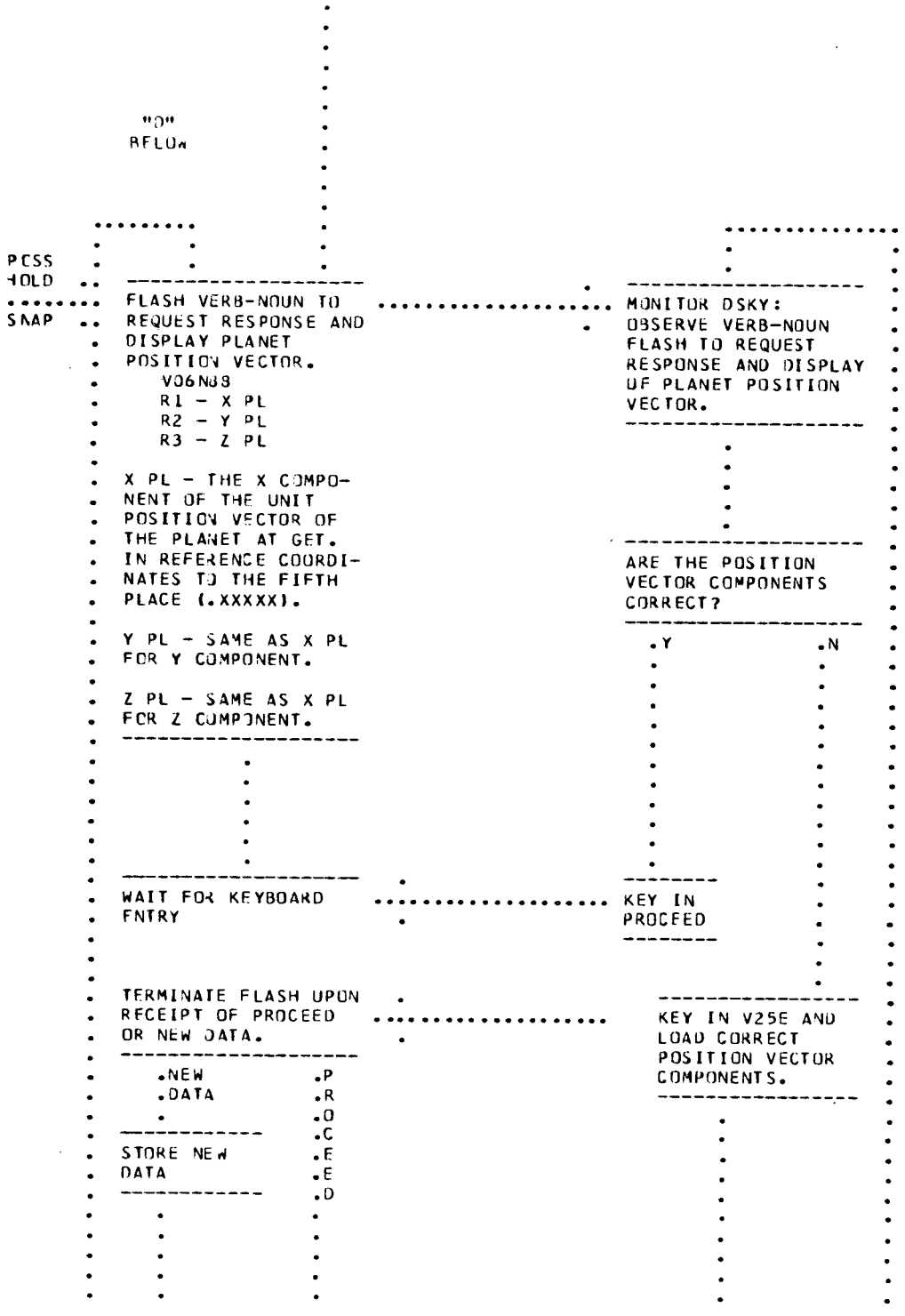

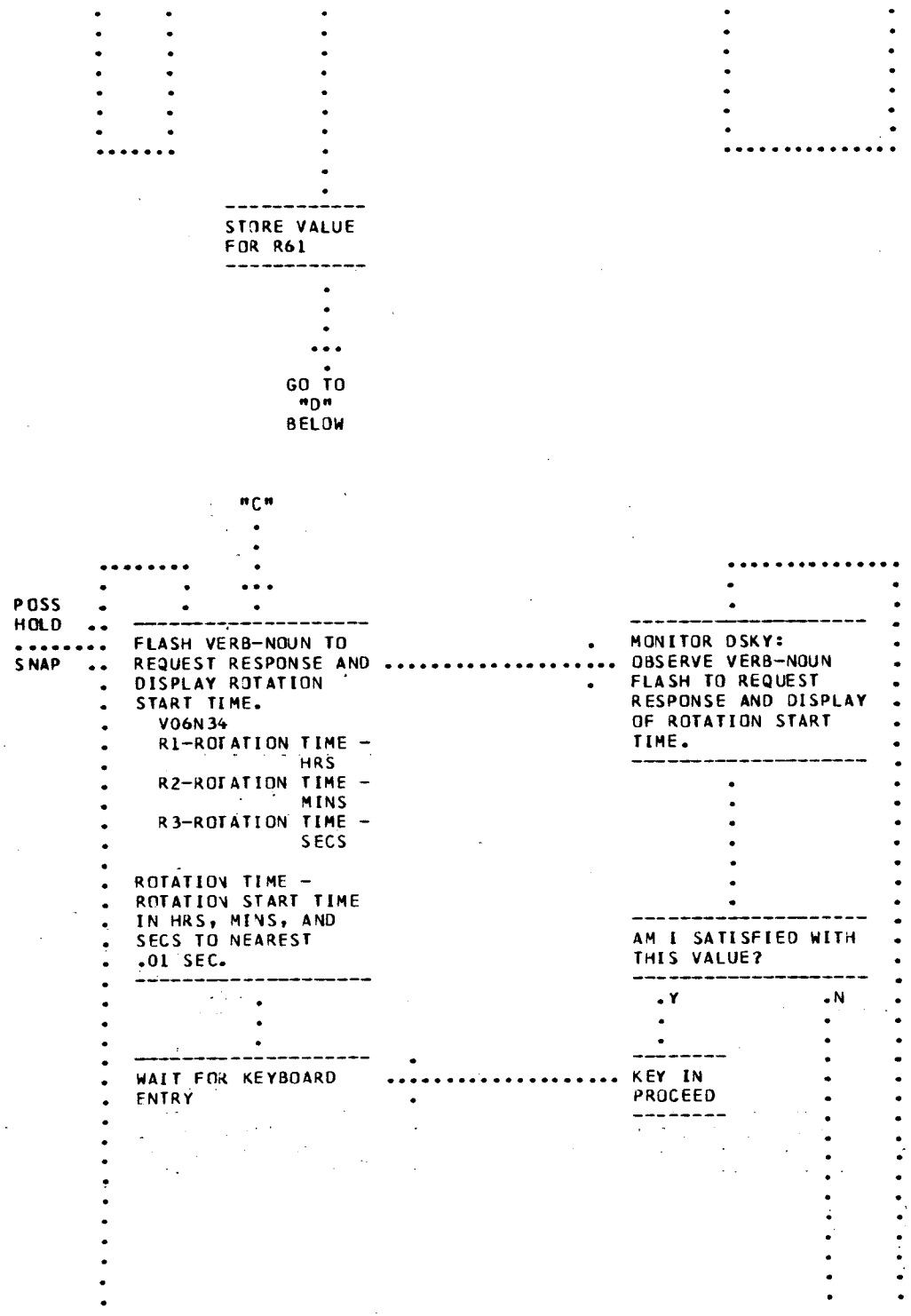

#530

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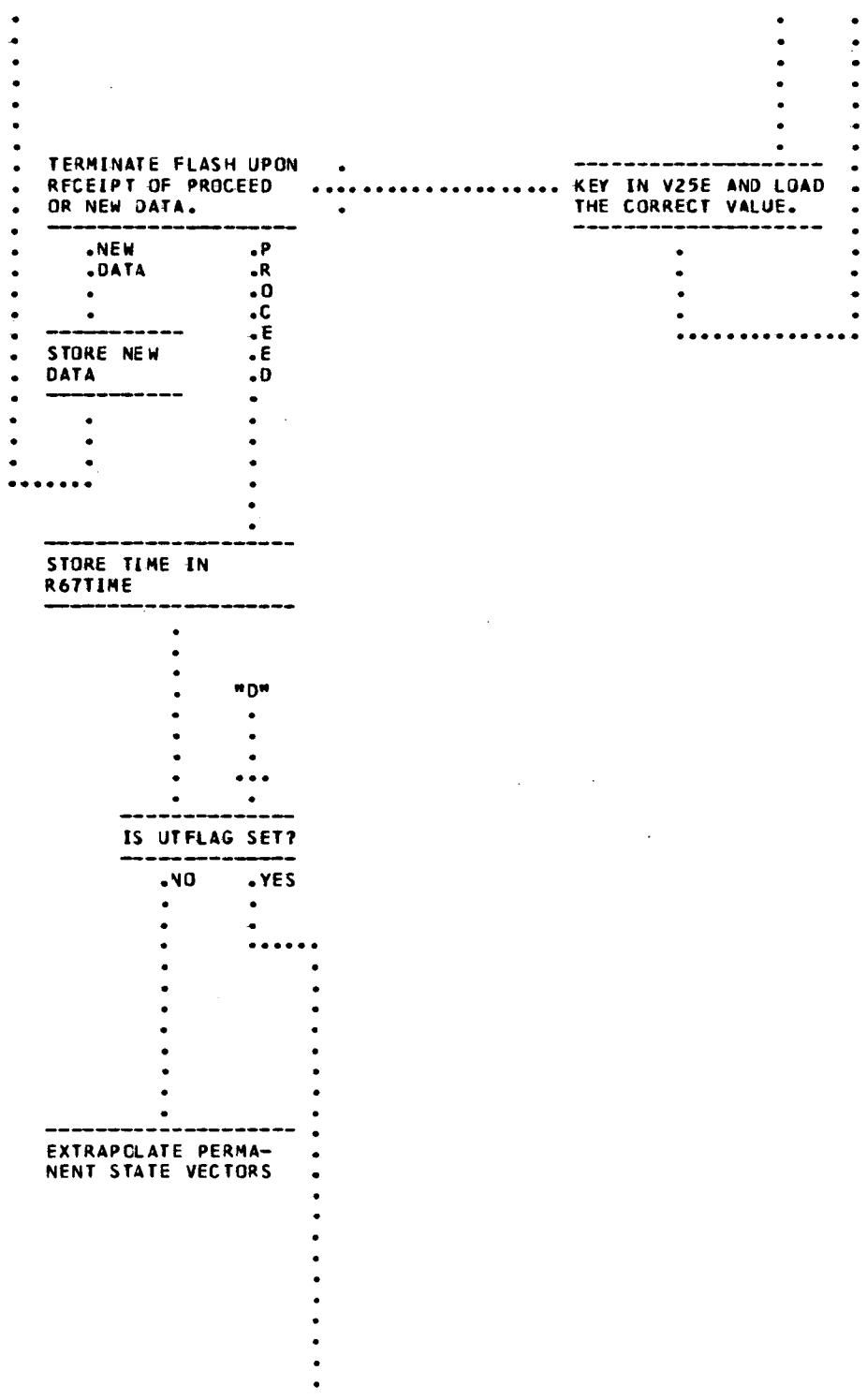
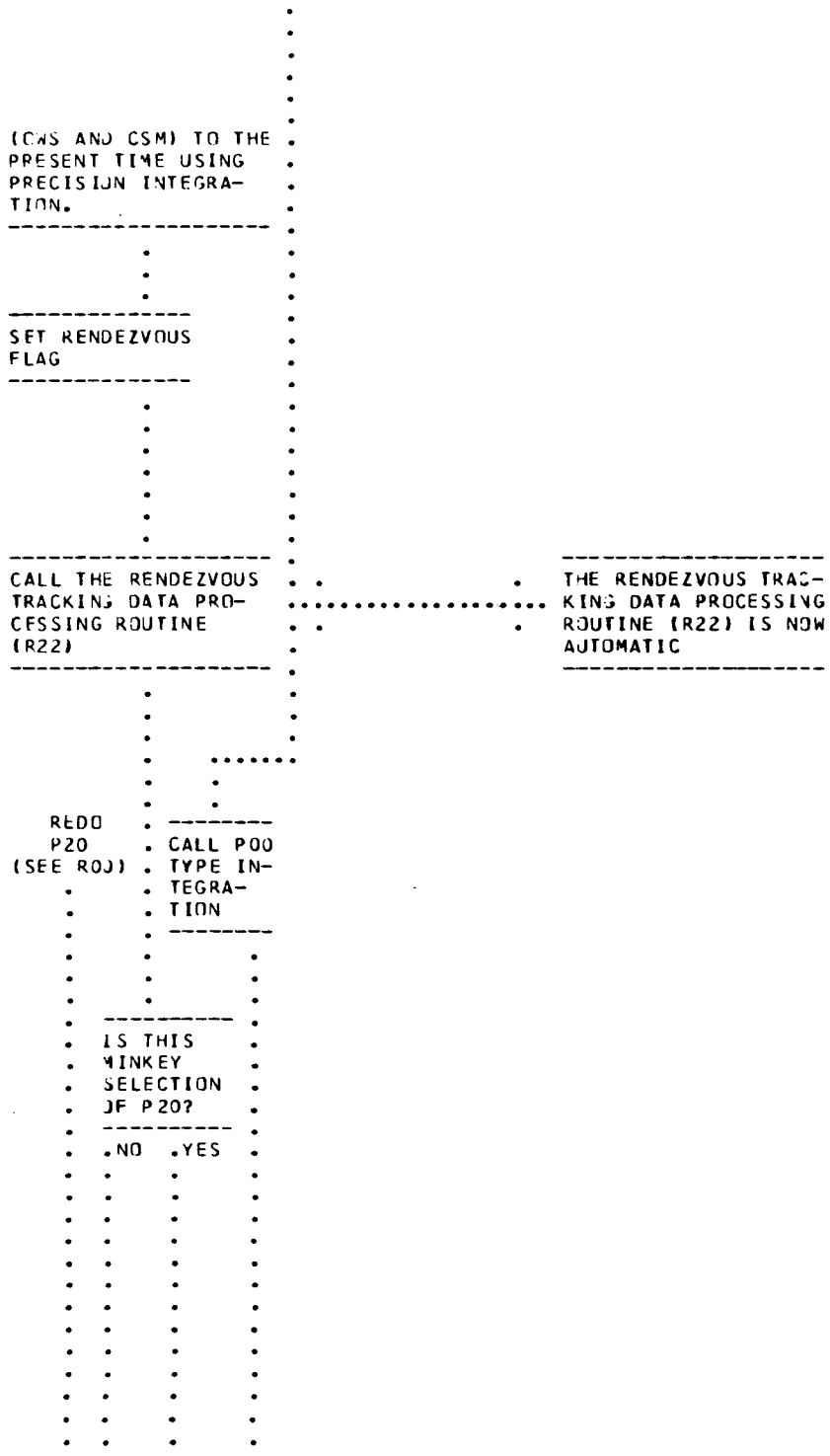
#550

#560

#570

#580


TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA.
KEY IN V25E AND LOAD THE CORRECT VALUE.
.NEW .DATA
.P .R .O .C .E .E .D
STORE NEW DATA
#590
STORE TIME IN R67TIME
#600
"D"
#610
IS UTFLAG SET?
.NO
.YES
#620
EXTRAPOLATE PERMANENT STATE VECTORS
#630


(CWS AND CSM) TO THE PRESENT TIME USING PRECISION INTEGRATION.
SET RENDEZVOUS FLAG
#640
CALL THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22)
THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) IS NOW AUTOMATIC
#650
#660
REDO P20 (SEE ROJ)
CALL P00 TYPE INTEGRATION
#670
IS THIS MINKEY SELECTION OF P20?
NO
YES

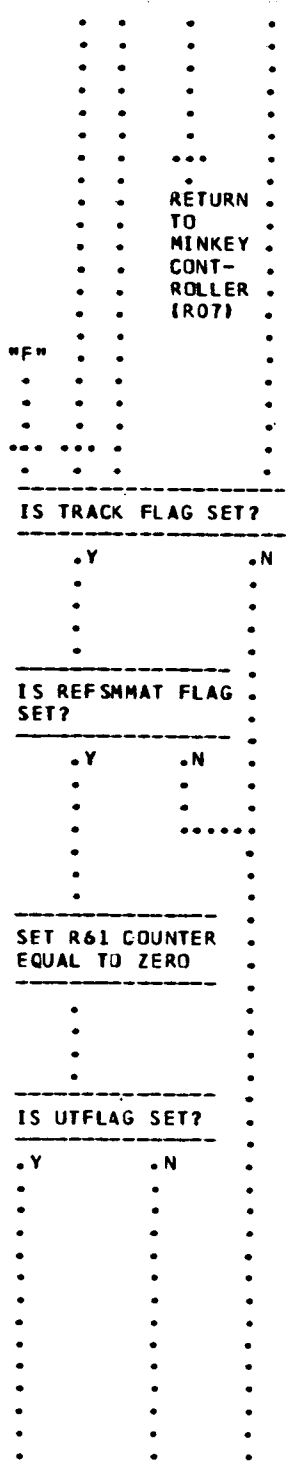
#680

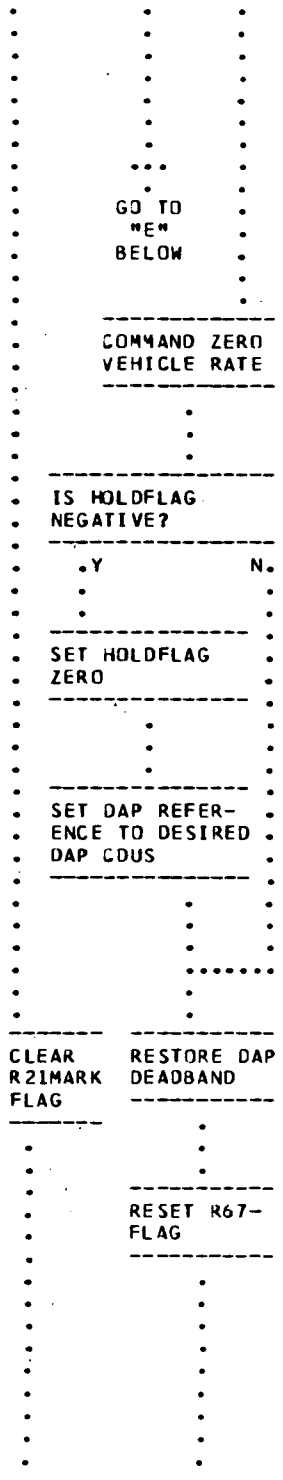
#690

#700

#710

#720





++
+01
+
+
+489
++

#730

#740

#750

#760

#770

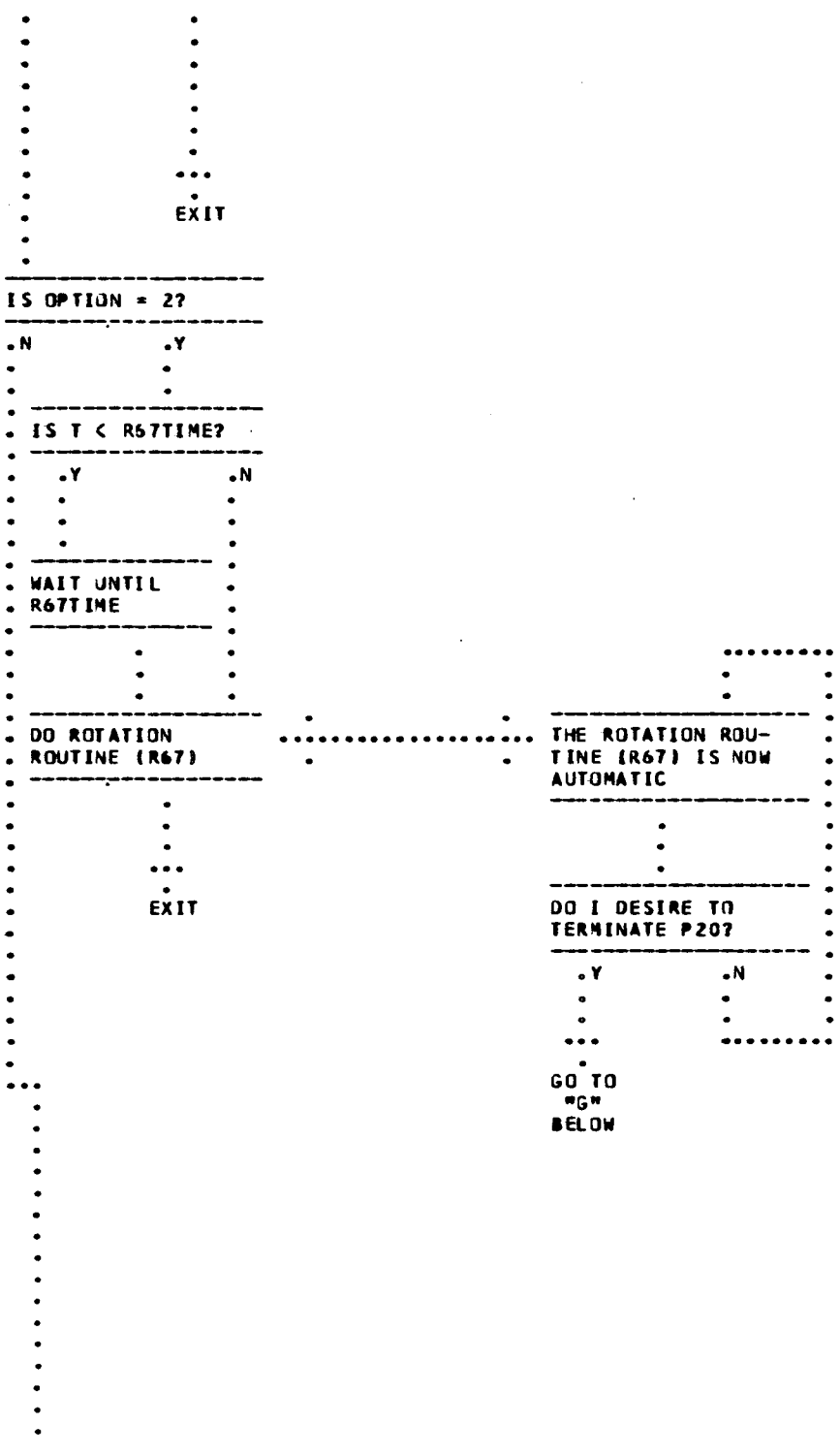
#780

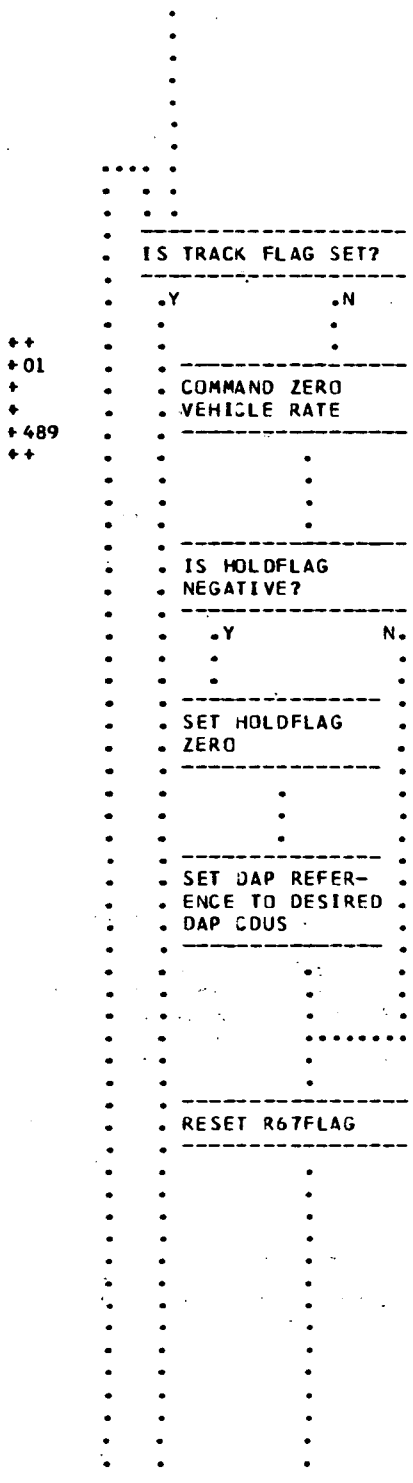
#790

#800

#810

#820





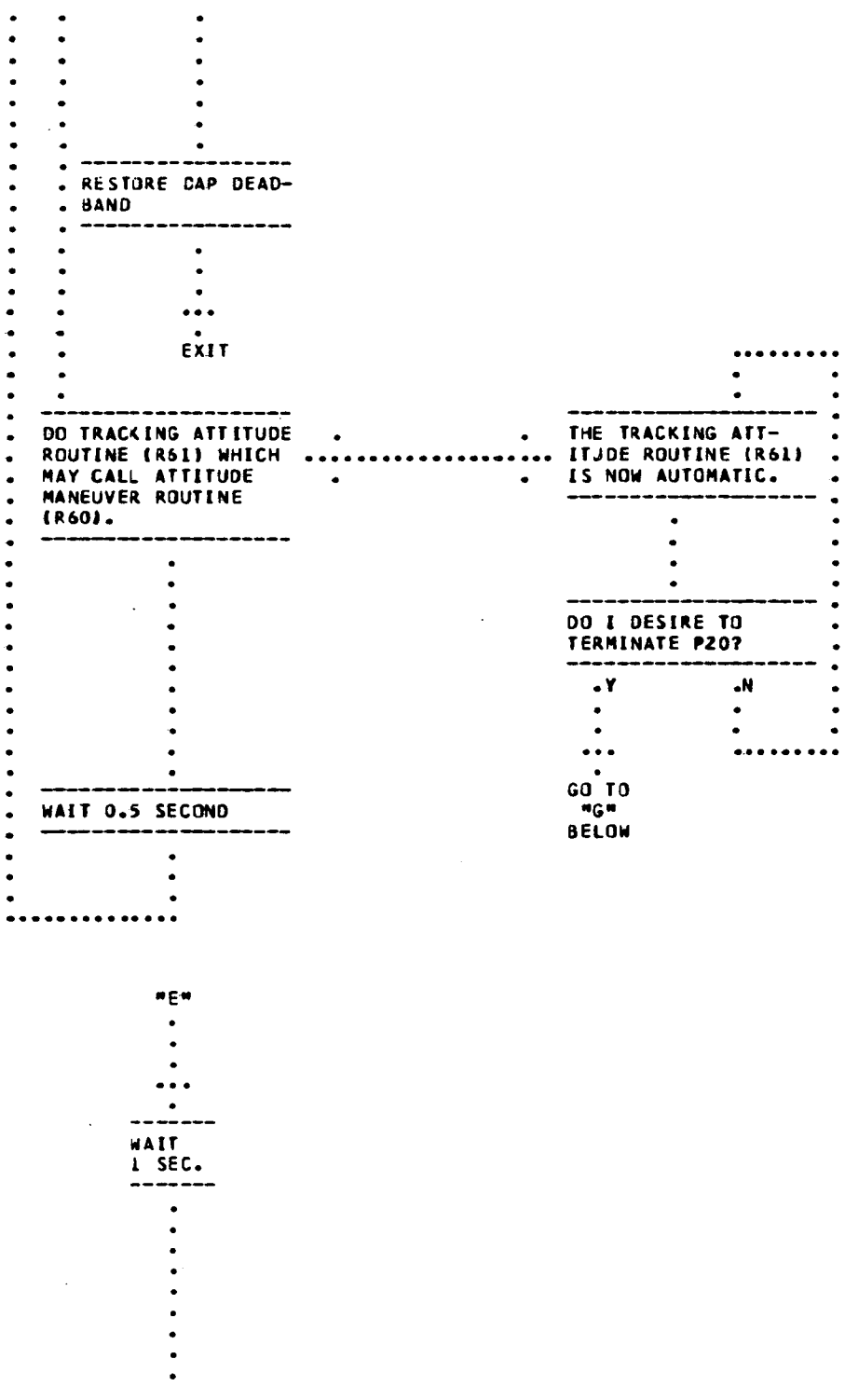
#830

#840

#850

#860

#870



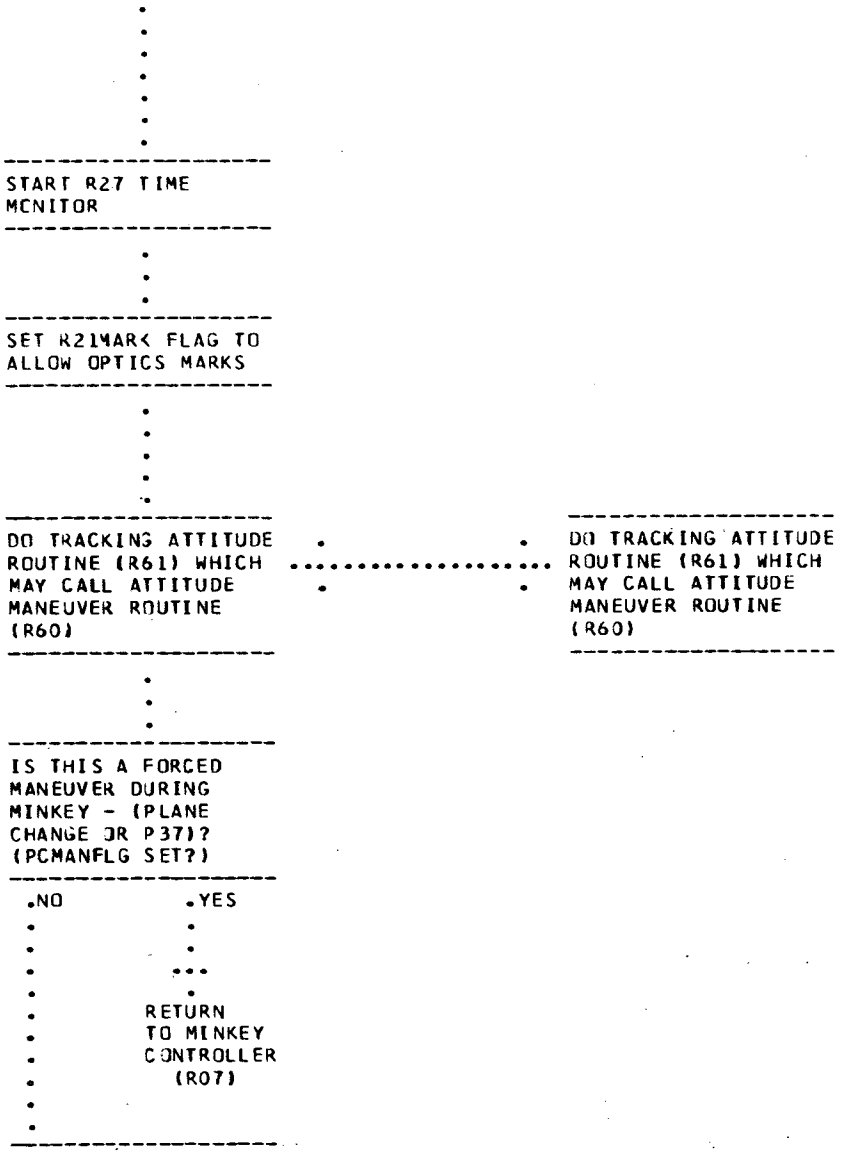
#880

#890

#900

#910

#920



#930

#940

#950

#960

#970

++
+01
+
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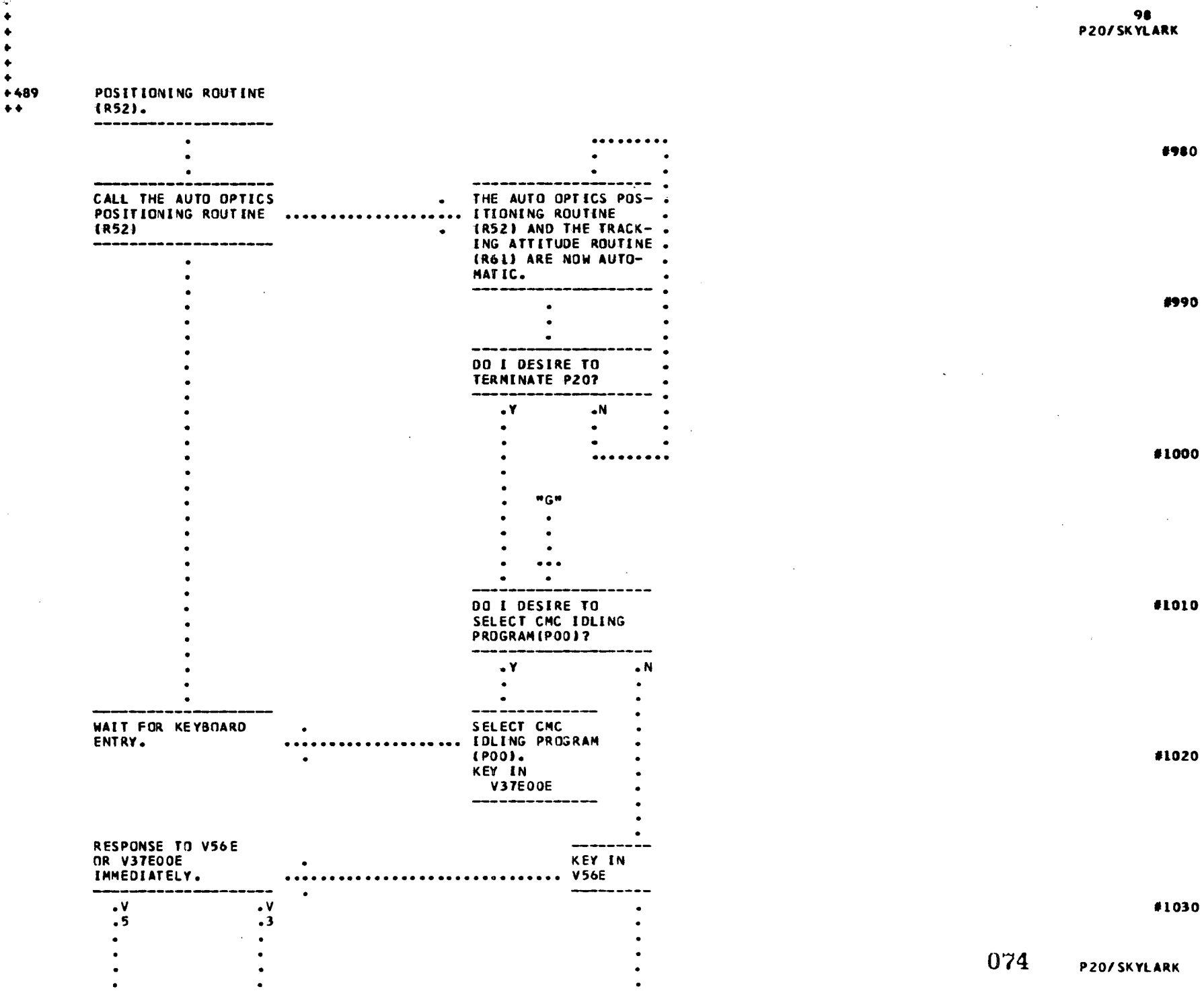
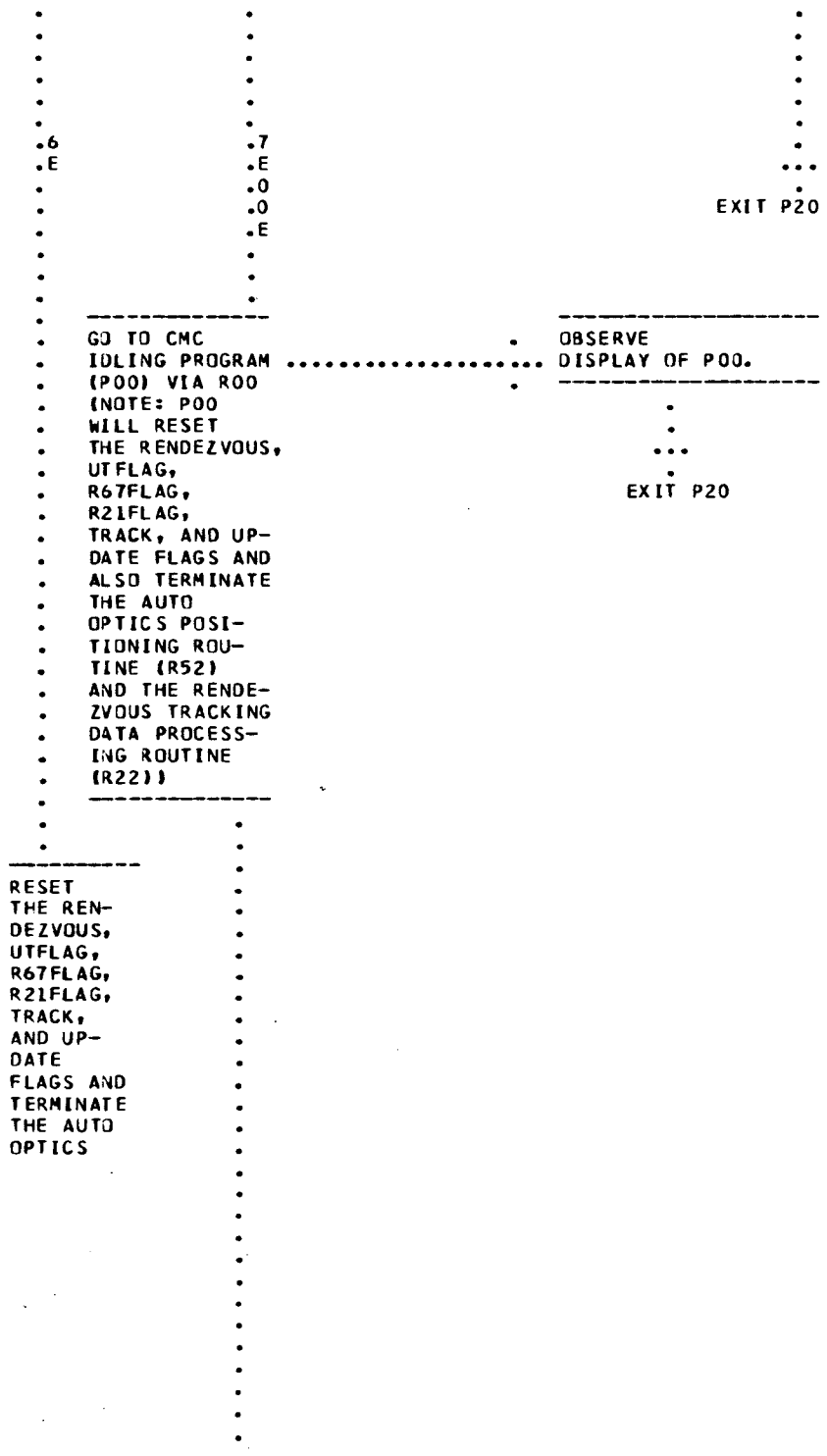

#489
POSITIONING ROUTINE (R52).
CALL THE AUTO OPTICS POSITIONING ROUTINE (R52)
WAIT FOR KEYBOARD ENTRY.
RESPONSE TO V56E OR V37E00E IMMEDIATELY.
.V 5
.V 3
THE AUTO OPTICS POSITIONING ROUTINE (R52) AND THE TRACKING ATTITUDE ROUTINE (R61) ARE NOW AUTOMATIC.
DO I DESIRE TO TERMINATE P20?
.Y
.N
"G"
DO I DESIRE TO SELECT CMC IDLING PROGRAM(P00)?
.Y
.N
SELECT CMC IDLING PROGRAM (P00). KEY IN V37E00E
KEY IN V56E
#980
#990
#1000
#1010
#1020
#1030

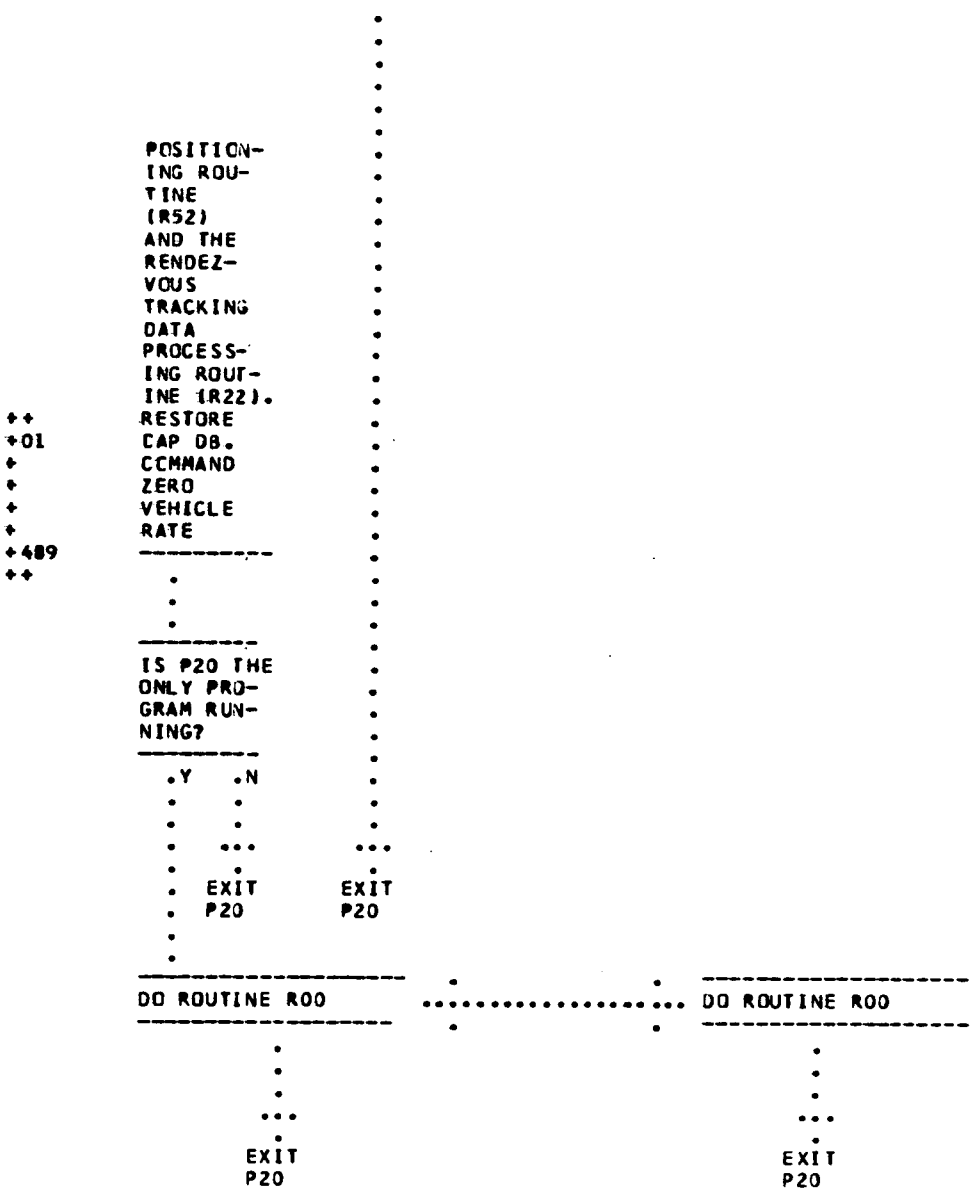


#1040

#1050

#1060

#1070



#1080

#1090

#1100

#1110

#1120

CHANGE CONTROL NOTES

REV 00 PCR 007,011,016,017,018,019,025,032,040,414,415, PCN 410,422,456, SKYLARK MEMO #2,#19
REV 01 PCR 459,460, PCN 489

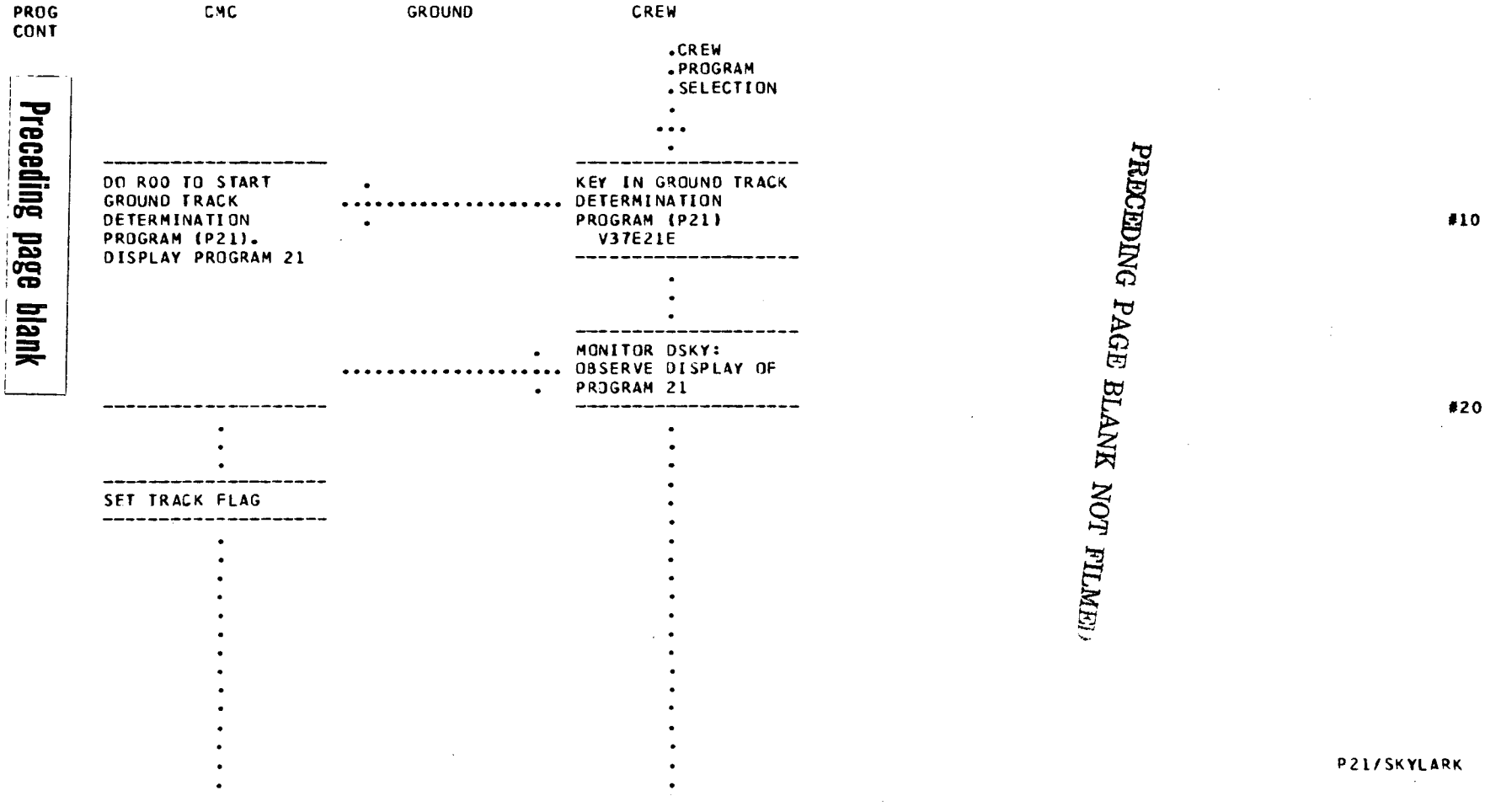
GROUND TRACK DETERMINATION PROGRAM (P21) REV 00 05/19/71

PURPOSE: (1) TO PROVIDE THE ASTRONAUT DETAILS OF HIS GROUND TRACK WITHOUT THE NEED FOR GROUND COMMUNICATION.

ASSUMPTIONS: (1) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THIS PROGRAM MAY BE SELECTED WHILE THE CSM IS IN EARTH ORBIT TO DEFINE THE GROUND TRACK OF EITHER THE OWS OR CSM.

(3) THIS PROGRAM ASSUMES THE VEHICLE WHOSE GROUND TRACK PARAMETERS ARE CALCULATED TO REMAIN IN FREE FALL FROM THE PRESENT TIME UNTIL T LAT LONG.



#30

SET CMC ASSUMED
OPTION TO 00001.

#40

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
SNAP . DISPLAY OPTION CODE
FOR ASSUMED VEHICLE
(OWS OR CSM)
V04 N06
R1 0J002
R2 0000X
R3 BLANK

R1 IS THE OPTION
CODE FOR ASSUMED
VEHICLE.

R2 IS THE CMC
ASSUMED OPTION:
00001 - THIS
VEHICLE
00002 - OTHER
VEHICLE

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED VEHICLE
(OWS OR CSM).

#50

IS THE ASSUMED
OPTION CORRECT?

.Y .N

#60

KEY IN
PROCEED

#70

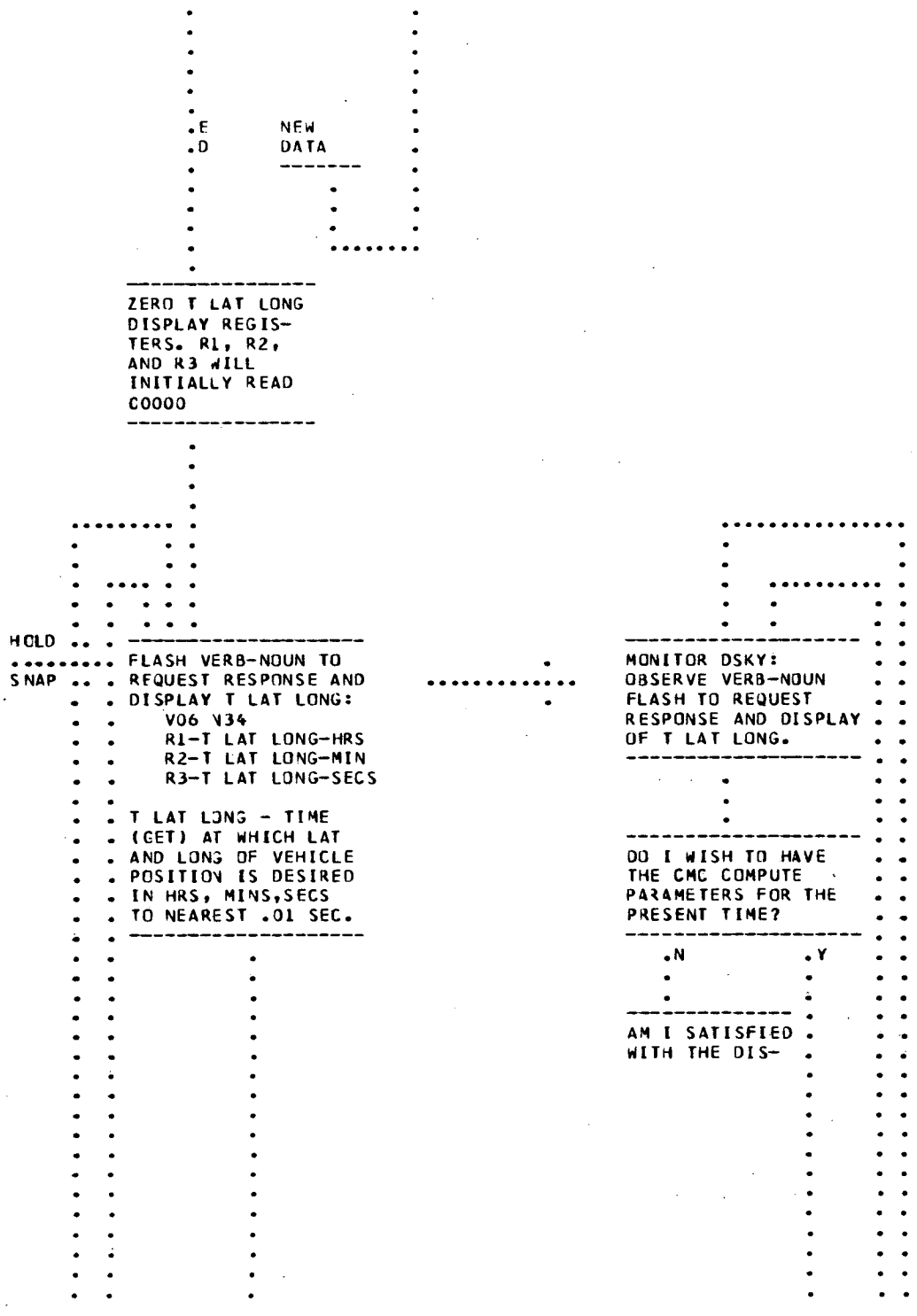
WAIT FOR KEYBOARD
ENTRY

KEY IN V22E
AND LOAD THE
DESIRED OPTION
INTO R2

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

#80

.P .NEW
.R .DATA
.O .
.C
.E STORE



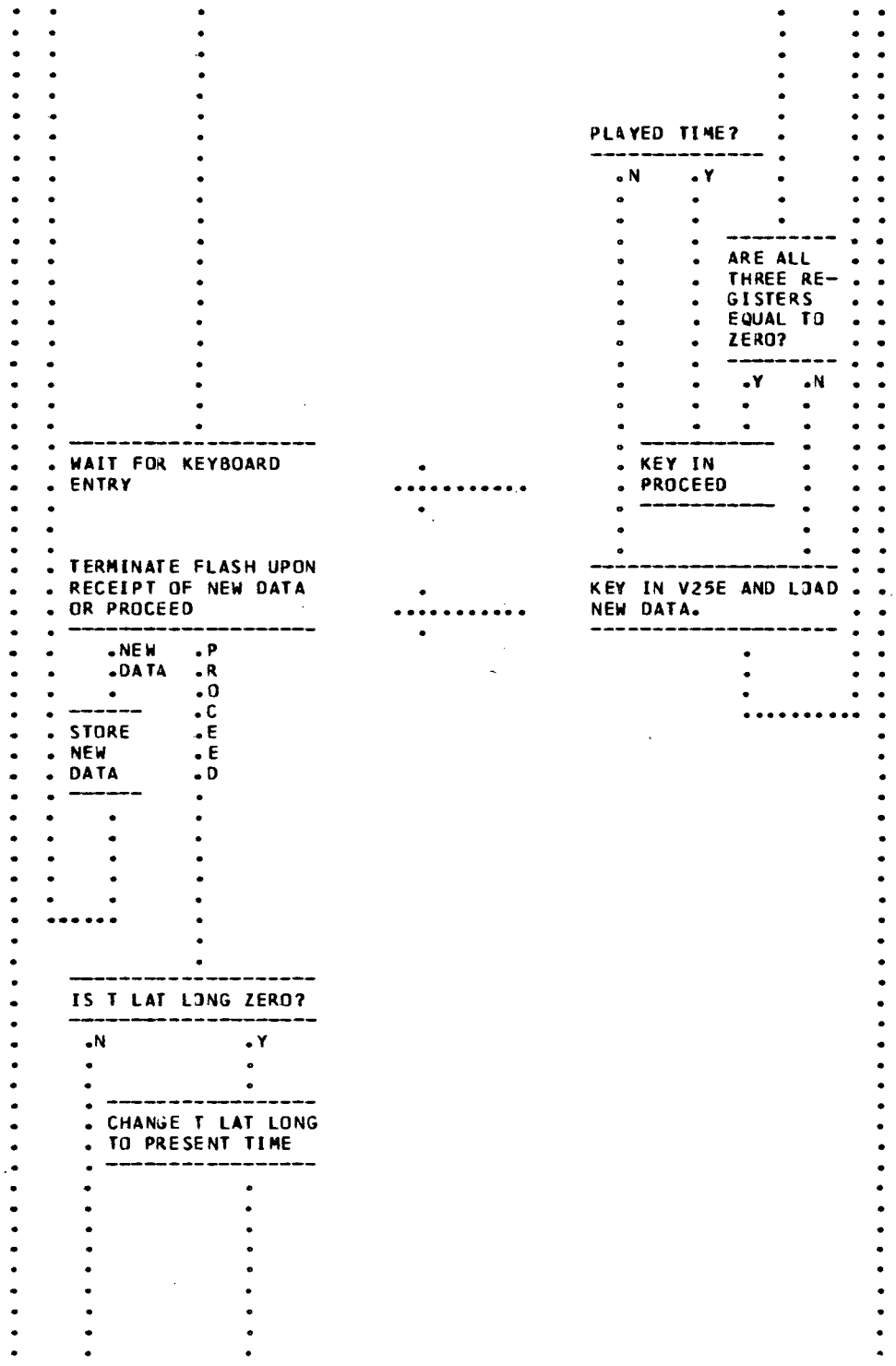
#90

#100

#110

#120

#130



#140

#150

#160

#170

#180

#190

CALCULATE VELOCITY AND FLIGHT PATH ANGLE FOR DISPLAY IN N73 AT ASTRONAUT REQUEST.

#200

CALCULATE LATITUDE, LONGITUDE AND ALTITUDE OF VEHICLE AT T LAT LONG

#210

CALCULATE ALTITUDE FOR DISPLAY IN N73 AT ASTRONAUT REQUEST.

#220

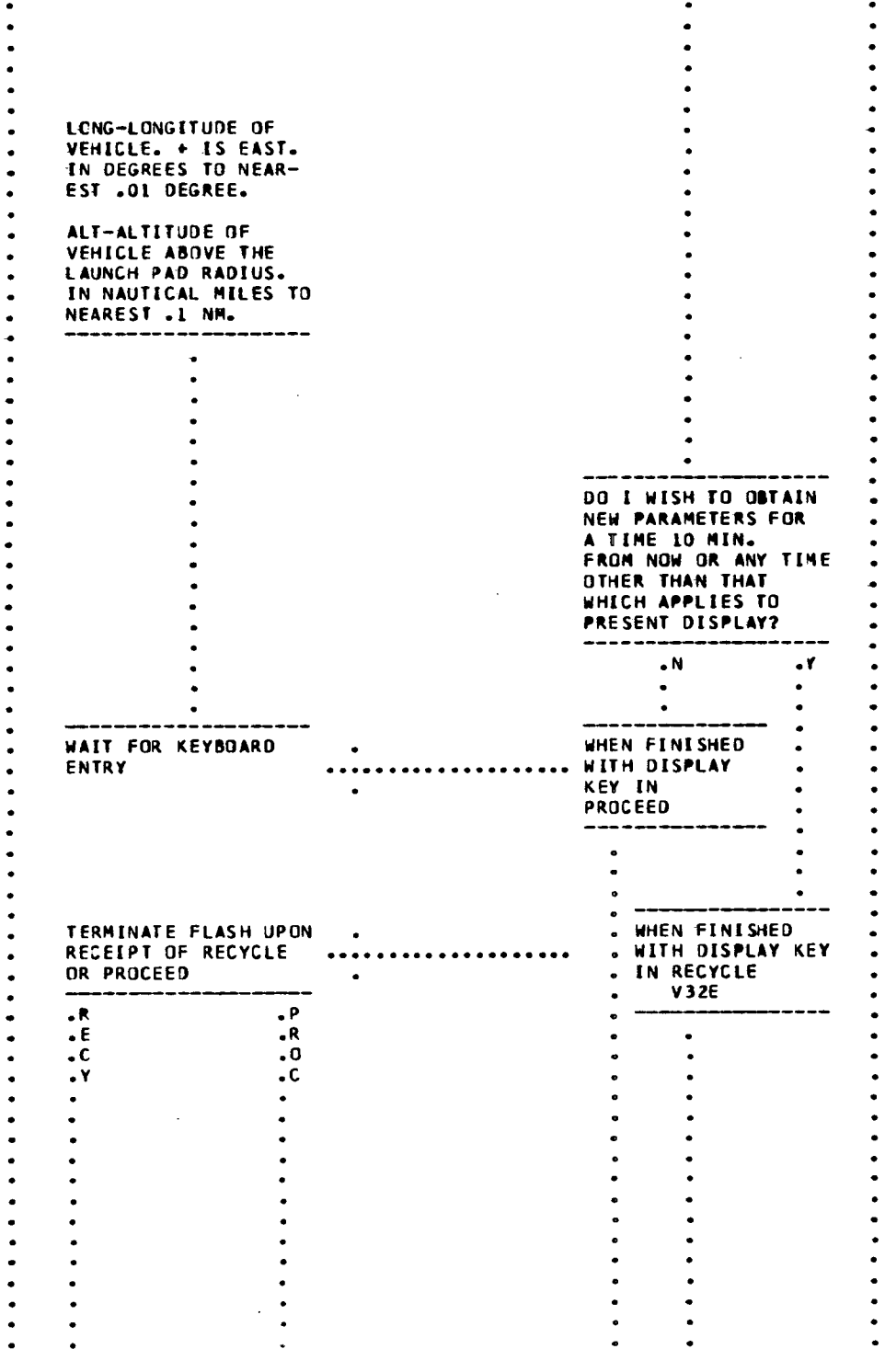
HOLD / SNAP

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY LATITUDE, LONGITUDE AND ALTITUDE:
V06 N43
R1-LAT
R2-LONG
R3-ALT

LAT-LATITUDE OF VEHICLE. + IS NORTH. IN DEGREES TO NEAREST .01 DEGREE.

MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF LATITUDE, LONGITUDE AND ALTITUDE

#230



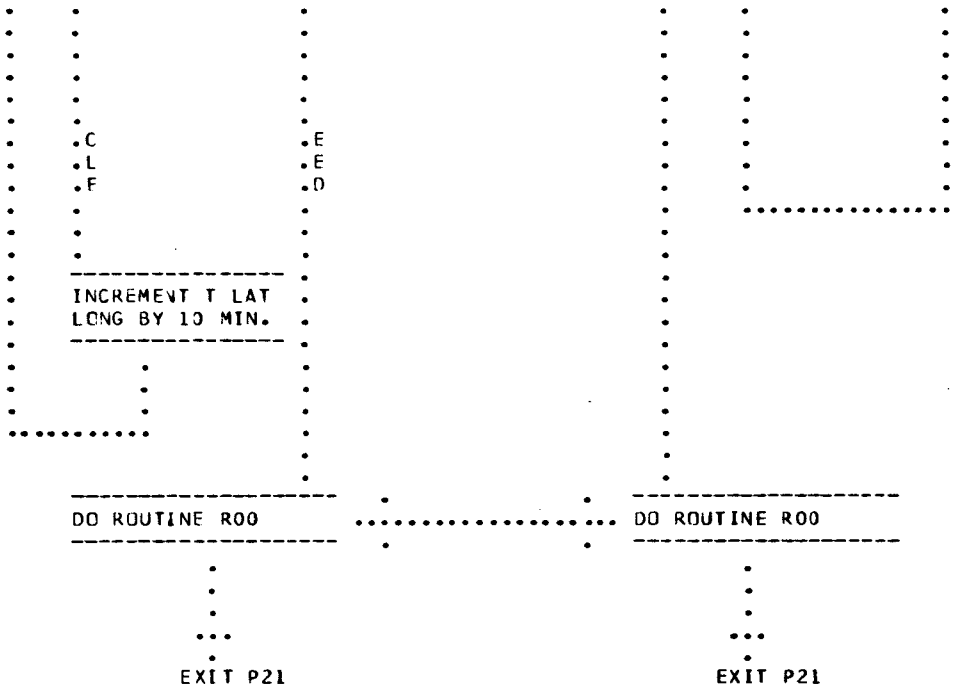
#240

#250

#260

#270

#280



#290

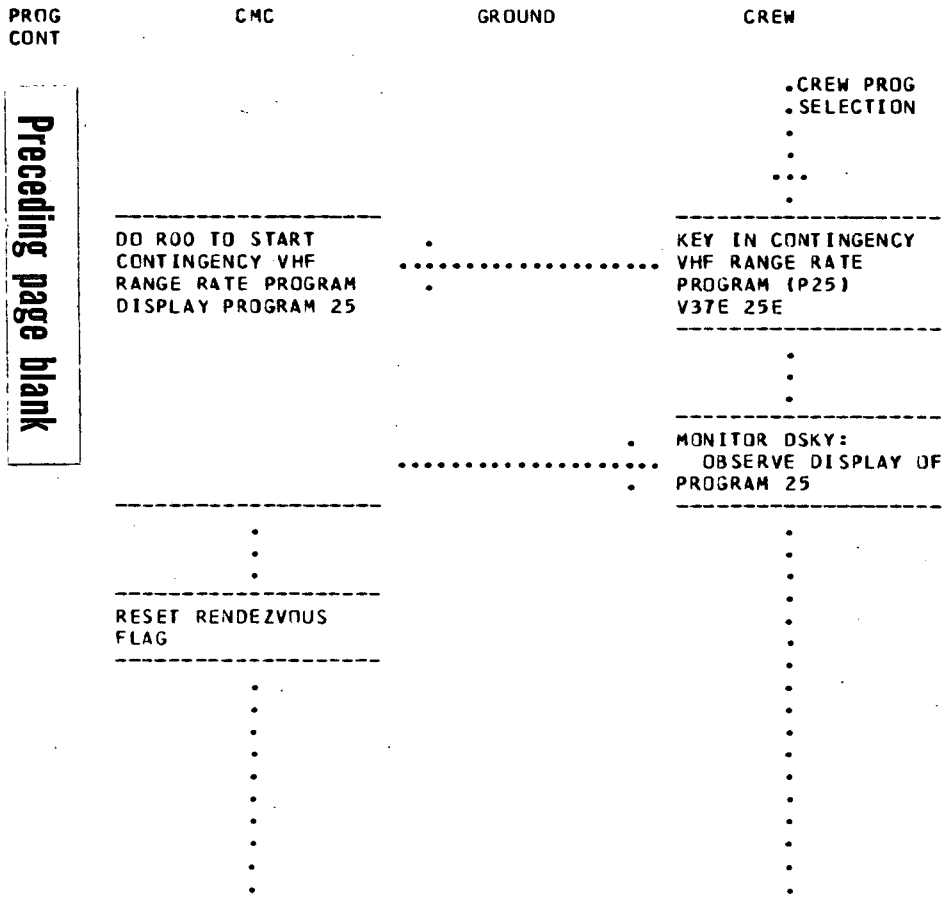
#300

CHANGE CONTROL NOTES

REV 00 PCN 410

CONTINGENCY VHF RANGE RATE PROGRAM (P25) REV 01 03/20/72

PURPOSE: (1) TO DISPLAY TO THE ASTRONAUT RANGE AND RANGE RATE FROM A SOURCE INDEPENDENT OF THE VEHICLE STATE VECTORS.
++
+01 (2) TO ALLOW THE ASTRONAUT TO SELECT A SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.
+
ASSUMPTIONS: (1) THE VHF MUST BE OPERATING.
+
+ (2) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES, BEGINNING WITH THAT TIME (N72) SELECTED BY THE ASTRONAUT.
+459
++ (3) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



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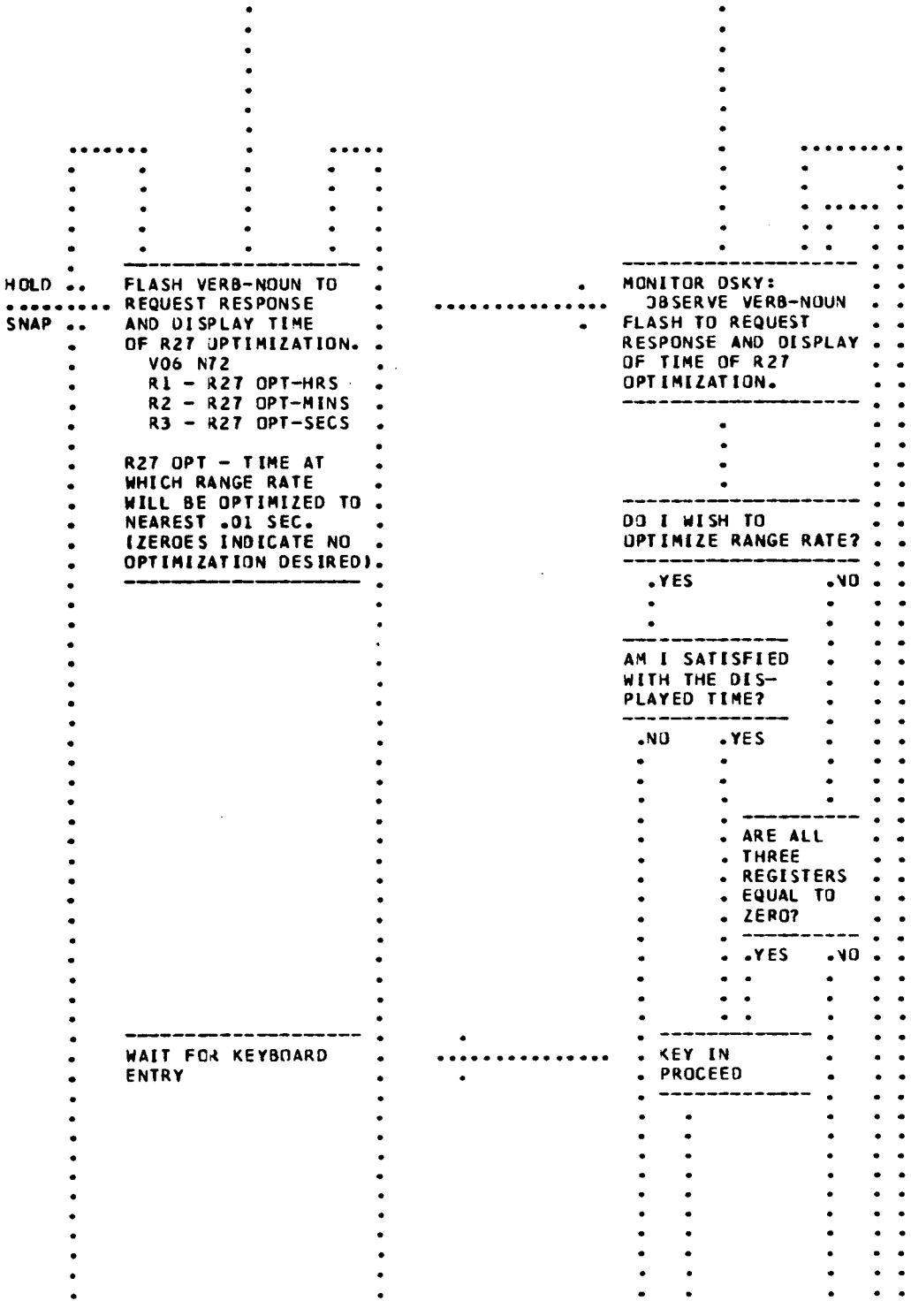
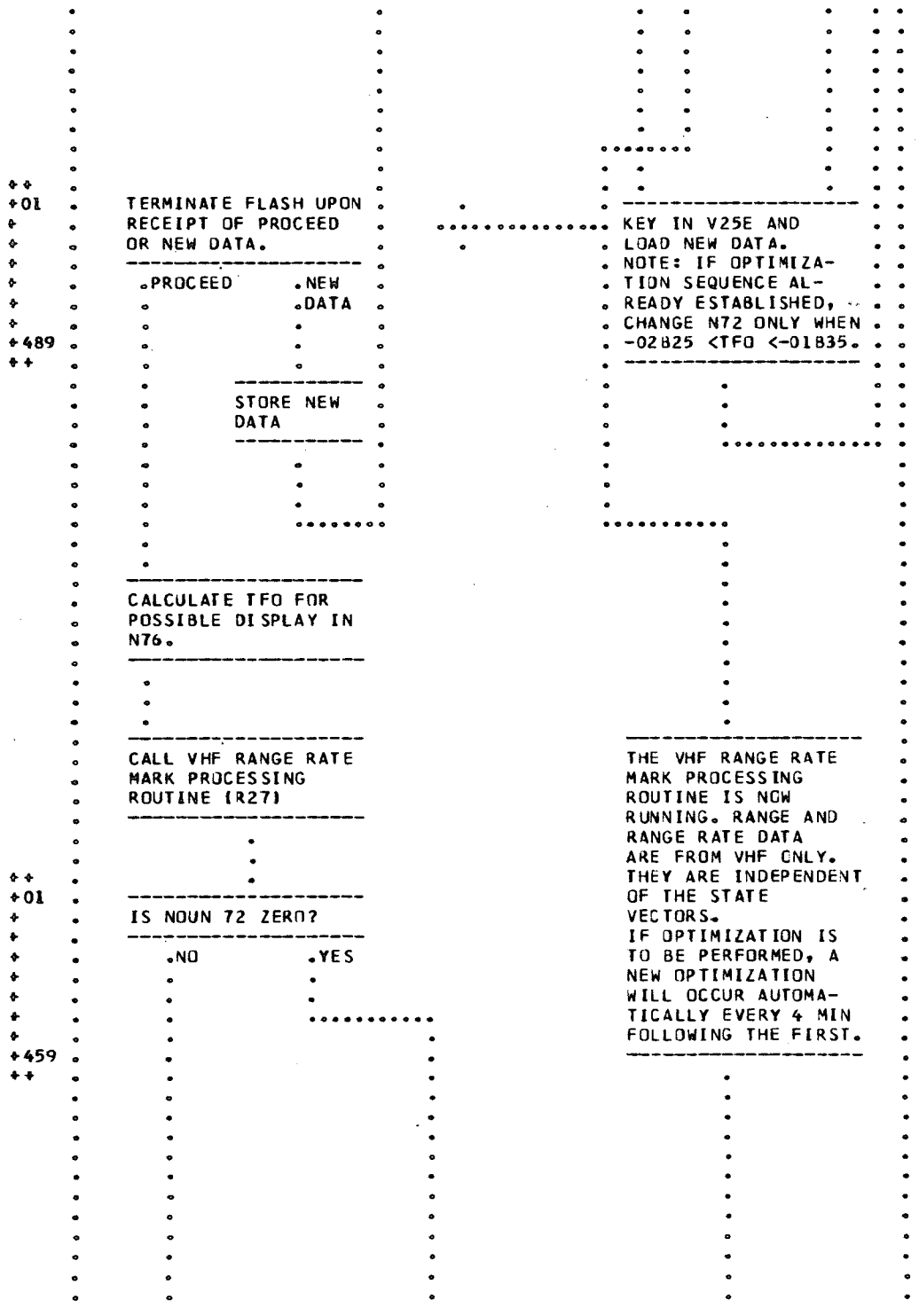

HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TIME OF R27 OPTIMIZATION.
V06 N72
R1 - R27 OPT-HRS
R2 - R27 OPT-MINS
R3 - R27 OPT-SECS
R27 OPT - TIME AT WHICH RANGE RATE WILL BE OPTIMIZED TO NEAREST .01 SEC. (ZEROES INDICATE NO OPTIMIZATION DESIRED).
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIME OF R27 OPTIMIZATION.
DO I WISH TO OPTIMIZE RANGE RATE?
.YES
.NO
AM I SATISFIED WITH THE DIS-PLAYED TIME?
.NO
.YES
ARE ALL THREE REGISTERS EQUAL TO ZERO?
.YES
.NO
KEY IN PROCEED
#40
#50
#60
#70
#80



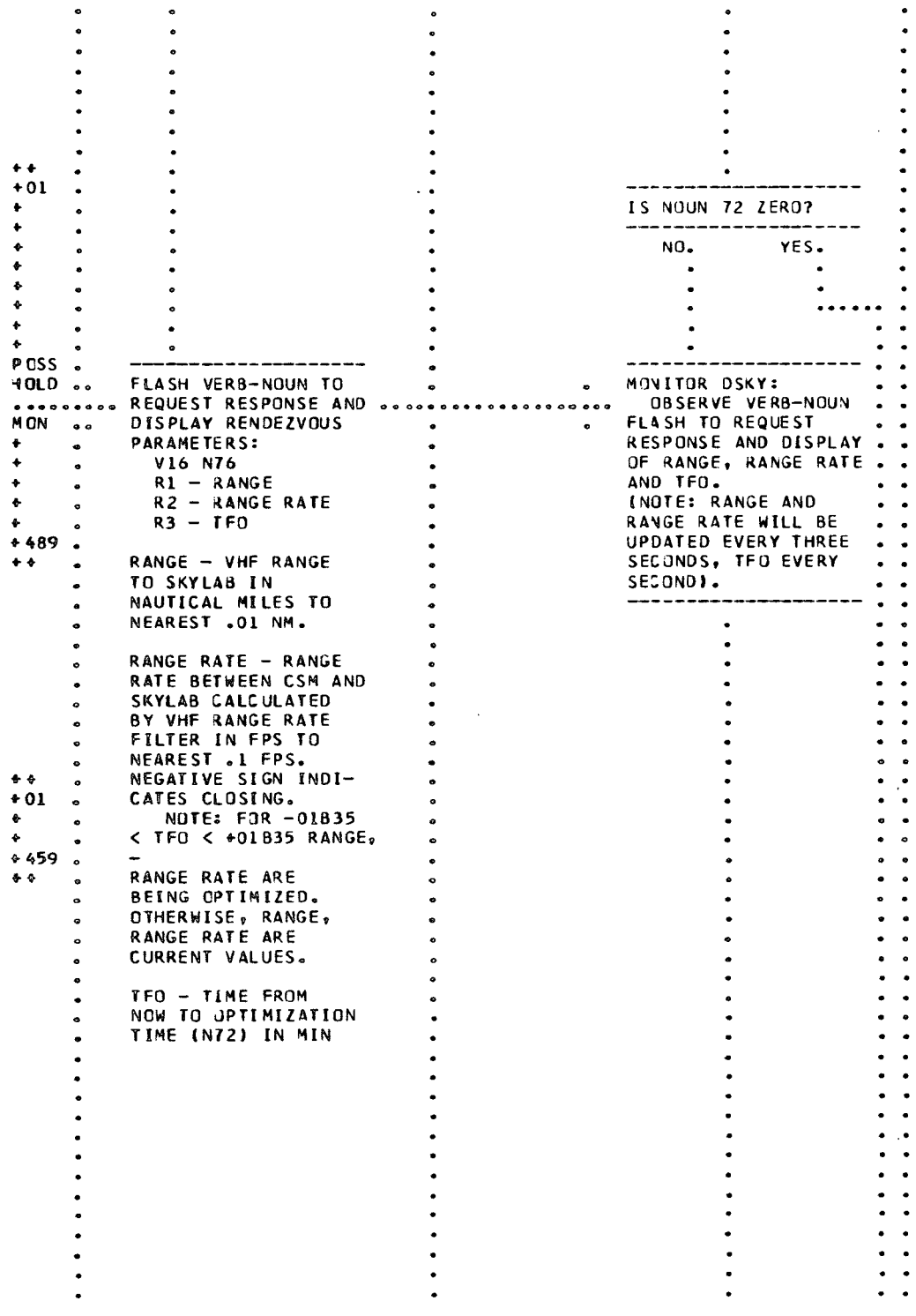
#90

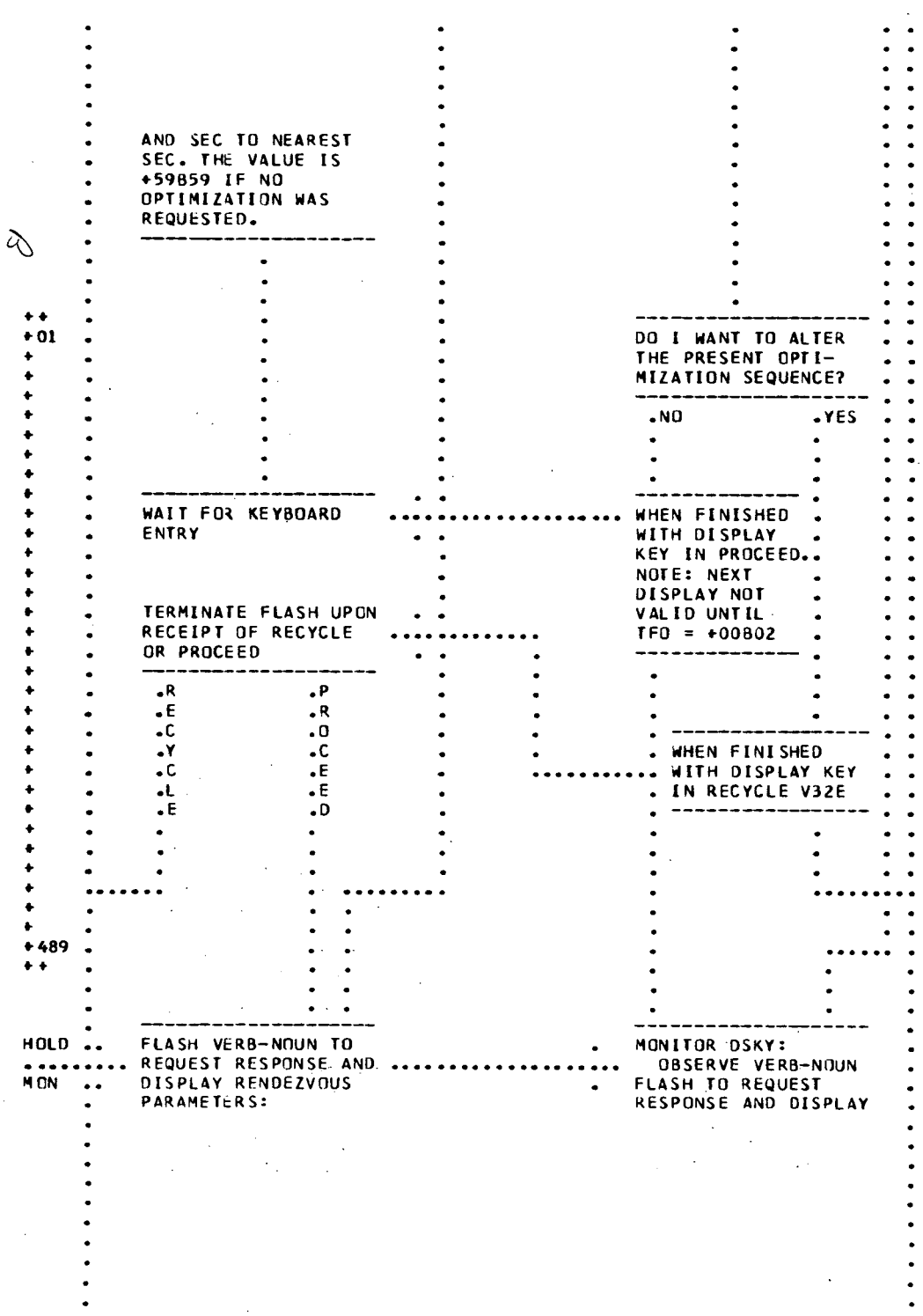
#100

#110

#120

#130


IS NOUN 72 ZERO?
NO.
YES.
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY RENDEZVOUS PARAMETERS:
V16 N76
R1 - RANGE
R2 - RANGE RATE
R3 - TFO
RANGE - VHF RANGE TO SKYLAB IN NAUTICAL MILES TO NEAREST .01 NM.
RANGE RATE - RANGE RATE BETWEEN CSM AND SKYLAB CALCULATED BY VHF RANGE RATE FILTER IN FPS TO NEAREST .1 FPS.
NEGATIVE SIGN INDICATES CLOSING.
NOTE: FOR -01835 < TFO < +01835 RANGE, RANGE RATE ARE BEING OPTIMIZED. OTHERWISE, RANGE, RANGE RATE ARE CURRENT VALUES.
TFO - TIME FROM NOW TO OPTIMIZATION TIME (N72) IN MIN
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF RANGE, RANGE RATE AND TFO.
(NOTE: RANGE AND RANGE RATE WILL BE UPDATED EVERY THREE SECONDS, TFO EVERY SECOND).
#140
#150
#160
#170


AND SEC TO NEAREST SEC. THE VALUE IS +59859 IF NO OPTIMIZATION WAS REQUESTED.
DO I WANT TO ALTER THE PRESENT OPTIMIZATION SEQUENCE?
.NO
.YES
WAIT FOR KEYBOARD ENTRY
WHEN FINISHED WITH DISPLAY KEY IN PROCEED.. NOTE: NEXT DISPLAY NOT VALID UNTIL TFO = +00802
TERMINATE FLASH UPON RECEIPT OF RECYCLE OR PROCEED
.R .E .C .Y .C .L .E
.P .R .O .C .E .E .D
WHEN FINISHED WITH DISPLAY KEY IN RECYCLE V32E
+01
+489
HOLD MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY RENDEZVOUS PARAMETERS:
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY
#180
#190
#200
#210
#220

V16 N77
R1 - RANGE
R2 - RANGE RATE
R3 - THETA/PHI/CODE

RANGE - VHF RANGE TO SKYLAB IN NAUTICAL MILES TO NEAREST .01 NM.

RANGE RATE - RANGE RATE BETWEEN CSM AND SKYLAB CALCULATED AND OPTIMIZED TO N72 TIME BY VHF RANGE RATE FILTER. IN FPS TO NEAREST .1 FPS. NEGATIVE SIGN INDICATES CLOSING.

THETA/PHI/CODE - USED AS A CODE, FIXED AT -00001 THROUGHOUT P25.

NOTE: IF R27 OPT=0, RANGE AND RANGE RATE ARE CURRENT VALUES.

++
+01
IF R27 OPT NOT 0:
TFO < -01835 RANGE, RANGE RATE ARE CURRENT VALUES;

-01835 < TFO < +00802 RANGE, RANGE RATE FIXED AT LAST CURRENT VALUE;

+00802 < TFO < +01835 RANGE, RANGE RATE ARE OPTIMIZING VALUES;

TFO > +01835 RANGE, RANGE RATE ARE CURRENT VALUES.

OF RANGE, RANGE RATE, AND THETA/PHI/CODE.
NOTE: RANGE RATE OPTIMIZATION IS DISCUSSED IN GSOP SECTION 5, R27.

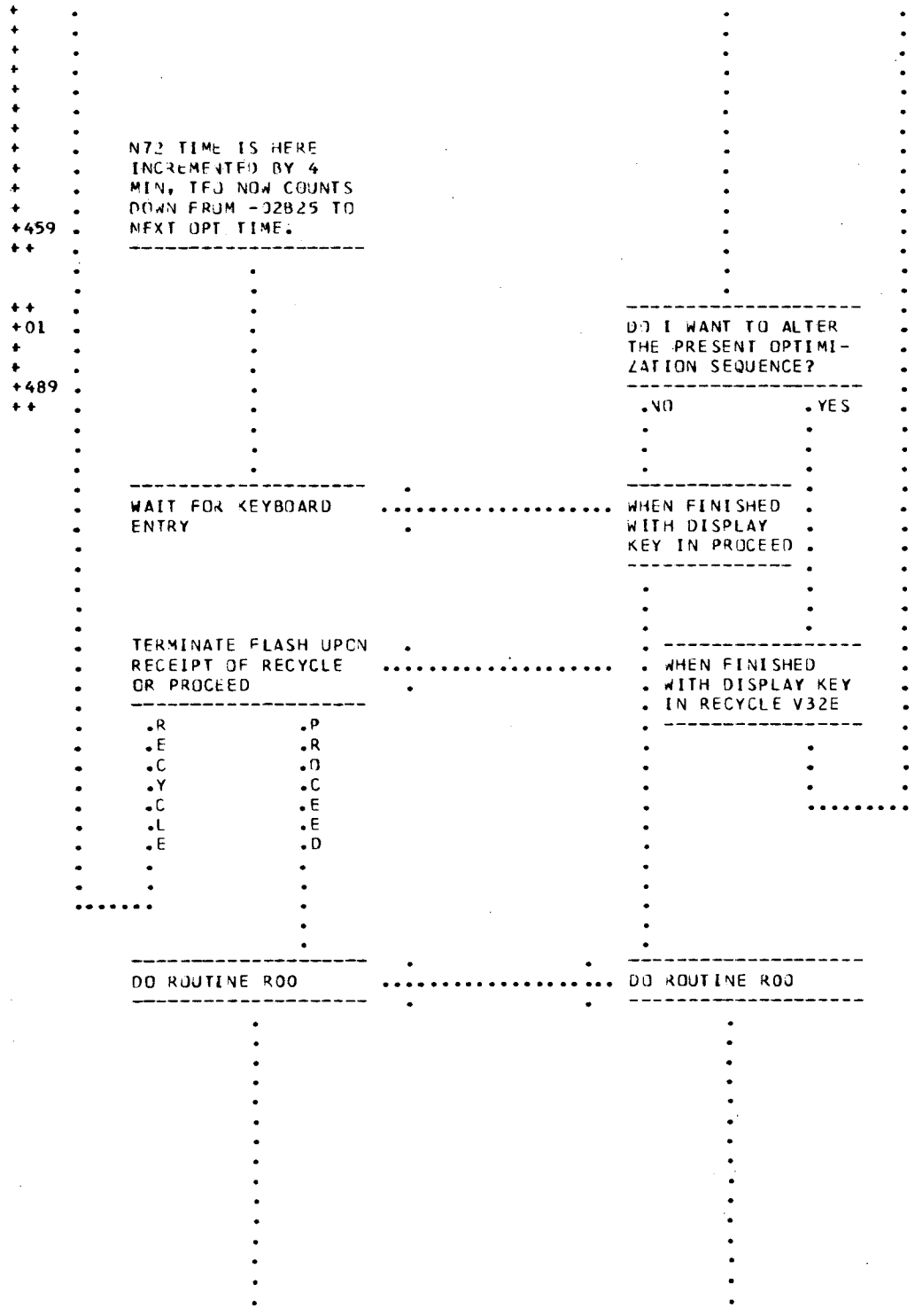
#230

#240

#250

#260

#270


N72 TIME IS HERE
INCREMENTED BY 4
MIN, TFO NOW COUNTS
DOWN FROM -02825 TO
NEXT OPT TIME.
+459
++
++
+01
+
+
+489
++
DO I WANT TO ALTER
THE PRESENT OPTIMI-
ZATION SEQUENCE?
.NO
.YES
#280
#290
WAIT FOR KEYBOARD
ENTRY
WHEN FINISHED
WITH DISPLAY
KEY IN PROCEED
#300
TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED
.R
.E
.C
.Y
.C
.L
.E
.P
.R
.O
.C
.E
.E
.D
WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE V32E
#310
DO ROUTINE R00
DO ROUTINE R00
#320

EXIT
P25

EXIT
P25

#330

CHANGE CONTROL NOTES

REV 00 PCR 032, SKYLARK MEMOS #8,19
REV 01 PCR 459, PCN 489

CMC UPDATE PROGRAM (P27) REV 01 03/20/72

PURPOSE: (1) TO INSERT INFORMATION INTO THE CMC VIA THE DIGITAL UPLINK BY TRANSMISSION FROM THE GROUND OR VIA THE DSKY KEYBOARD BY CREW MANUAL INPUT.

ASSUMPTIONS: (1) THE CMC MUST BE IN THE OPERATE CONDITION. THE IMU MAY BE IN STANDBY OR OPERATE CONDITION.

(2) CMC UPDATES ARE OF FOUR CATEGORIES:

(A) PROVIDE AN UPDATE FOR CMC LIFTOFF TIME (V70).

(B) PROVIDE AN OCTAL INCREMENT FOR THE CMC CLOCK ONLY (V73).

(C) PROVIDE LOAD CAPABILITY FOR A BLOCK OF SEQUENTIAL ERASABLE LOCATIONS (1-18 INCLUSIVE LOCATIONS WHOSE ADDRESS IS SPECIFIED) (V71).

(D) PROVIDE LOAD CAPABILITY FOR 1-9 INCLUSIVE INDIVIDUALLY SPECIFIED ERASABLE LOCATIONS (V72).

(3) A COMPLETE DESCRIPTION OF THE CMC UPLINK FORMAT IS INCLUDED IN SECTION 2 OF R-693.

(4) UPDATE IS ALLOWED IN THE CSM WHEN THE CMC IS IN P00, P02, OR P20 (OPTIONS 1, 2, OR 5), AND IF THE DSKY IS AVAILABLE.

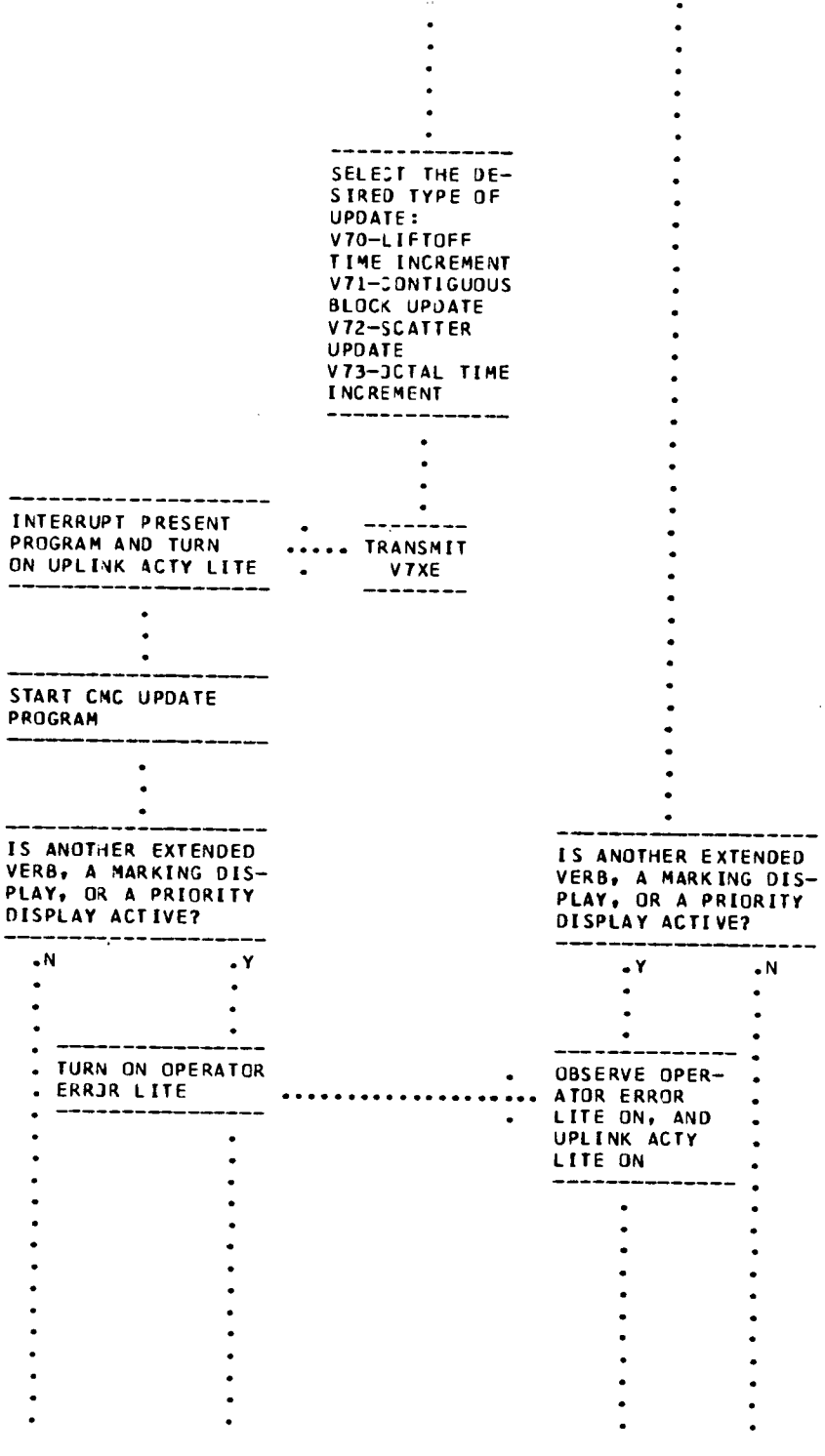
(5) THE UPTEL ACCEPT/BLOCK SWITCH MUST BE IN ACCEPT FOR TELEMETRY UPDATE.

(6) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE GROUND BY UPLINK TRANSMISSION.

(7) THE AUTOMATIC MODE OF UPDATE IS PROGRAM SELECTION AND UPDATE VIA THE GROUND BY UPLINK TRANSMISSION. THE ONLY DIFFERENCE BETWEEN THIS AND MANUAL SELECTION BY THE ASTRONAUT IS THAT THE DSKY RESPONSES ARE KEYED IN BY THE ASTRONAUT RATHER THAN TRANSMITTED.

PROG CONT	CMC	GROUND	CREW
		NOTIFY CREW OF INTENTION TO UPDATE. SPECIFY PARAMETERS AND COORDINATE TIME.	VERIFY THAT UPDATE WILL BE SATISFACTORY W.R.T. TIME, WORK IN PROGRESS AND CMC ACTIVITY.

#10


SELECT THE DESIRED TYPE OF UPDATE:
V70-LIFTOFF TIME INCREMENT
V71-CONTIGUOUS BLOCK UPDATE
V72-SCATTER UPDATE
V73-OCTAL TIME INCREMENT
INTERRUPT PRESENT PROGRAM AND TURN ON UPLINK ACTY LITE
TRANSMIT V7XE
START CMC UPDATE PROGRAM
IS ANOTHER EXTENDED VERB, A MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?
.N
.Y
TURN ON OPERATOR ERROR LITE
IS ANOTHER EXTENDED VERB, A MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?
.Y
.N
OBSERVE OPERATOR ERROR LITE ON, AND UPLINK ACTY LITE ON

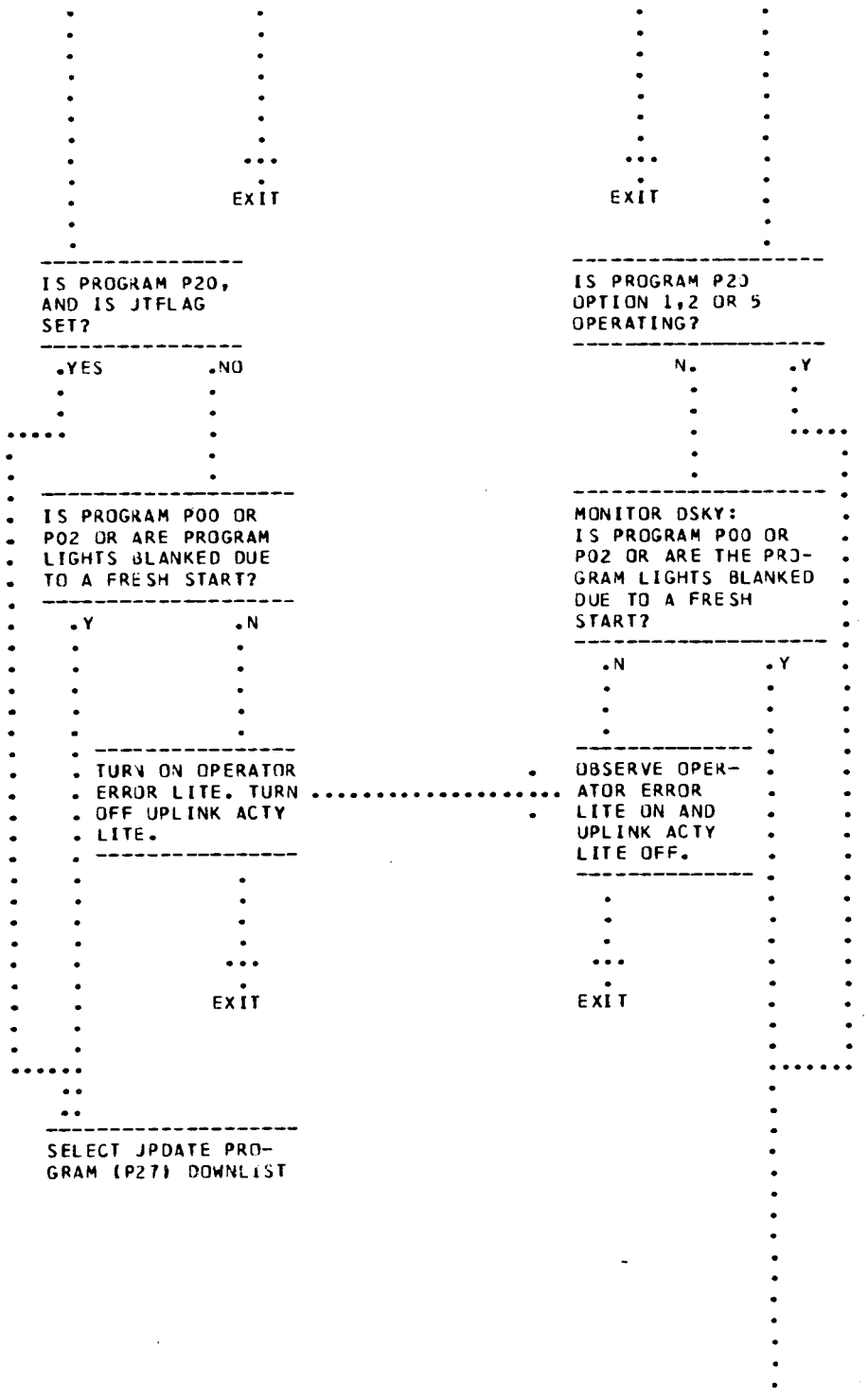
#20

#30

#40

#50

#60



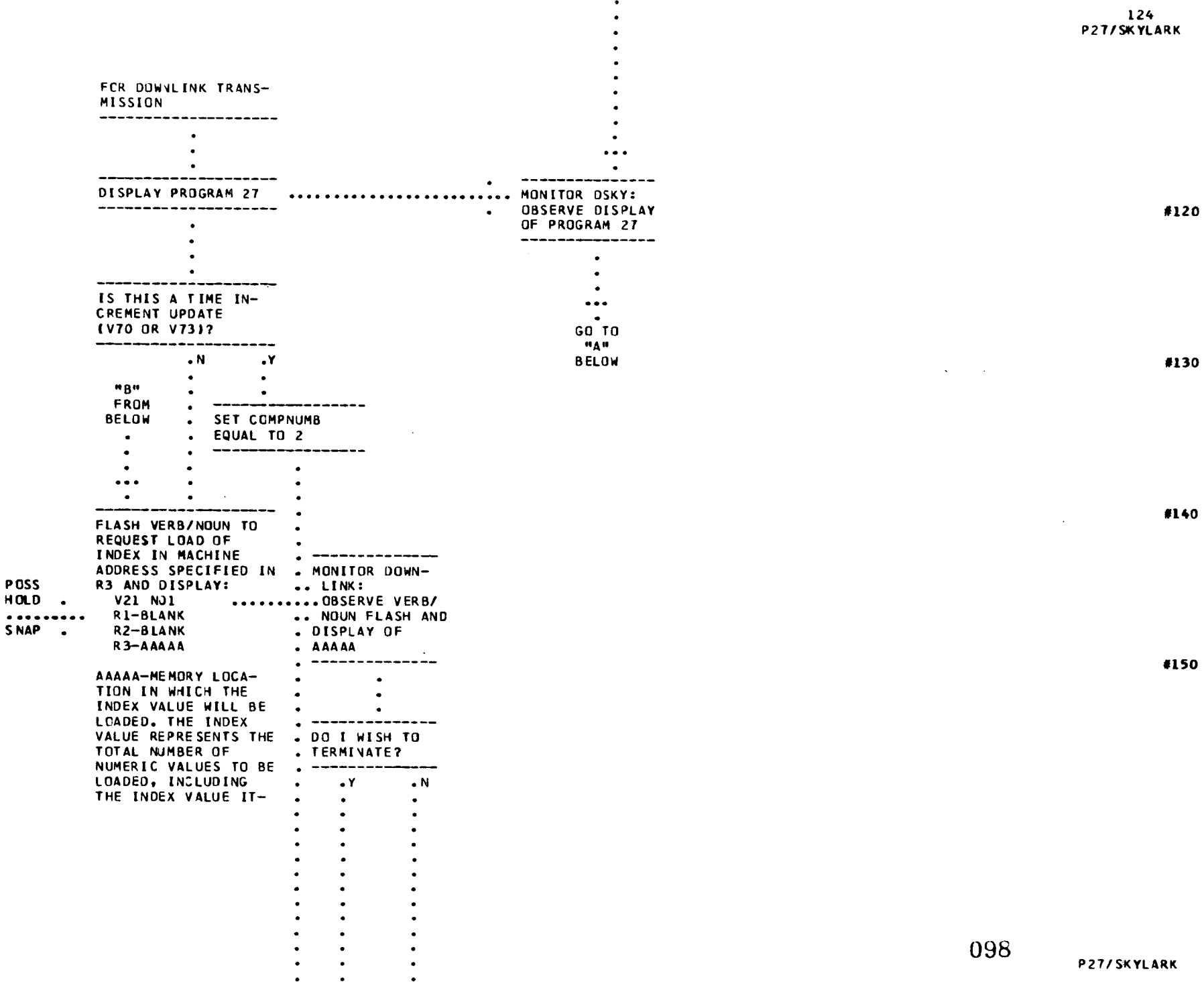
#70

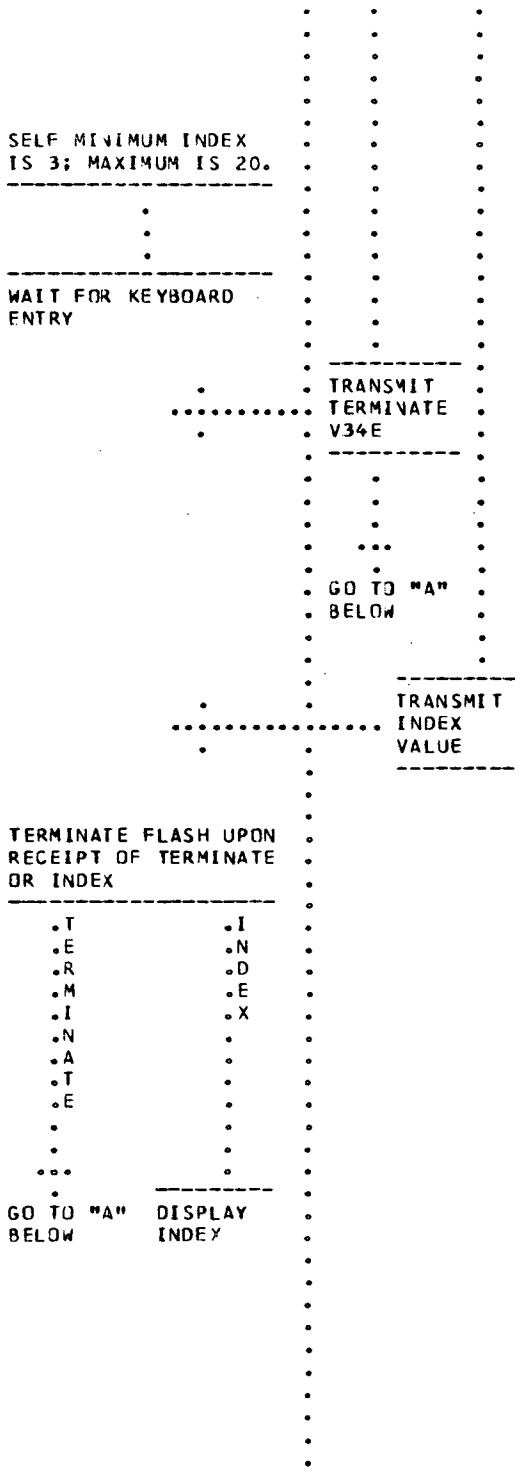
#80

#90

#100

#110


FOR DOWNLINK TRANS-
MISSION
DISPLAY PROGRAM 27
IS THIS A TIME IN-
CREMENT UPDATE
(V70 OR V73)?
N
Y
"B"
FROM
BELOW
SET COMPNUMB
EQUAL TO 2
FLASH VERB/NOUN TO
REQUEST LOAD OF
INDEX IN MACHINE
ADDRESS SPECIFIED IN
R3 AND DISPLAY:
V21 N01
R1-BLANK
R2-BLANK
R3-AAAAA
AAAAA-MEMORY LOCA-
TION IN WHICH THE
INDEX VALUE WILL BE
LOADED. THE INDEX
VALUE REPRESENTS THE
TOTAL NUMBER OF
NUMERIC VALUES TO BE
LOADED, INCLUDING
THE INDEX VALUE IT-
POSS
HOLD
SNAP
MONITOR DOWN-
LINK:
OBSERVE VERB/
NOUN FLASH AND
DISPLAY OF
AAAAA
DO I WISH TO
TERMINATE?
Y
N
MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 27
GO TO
"A"
BELOW
#120
#130
#140
#150



#160

#170

#180

#190

#200

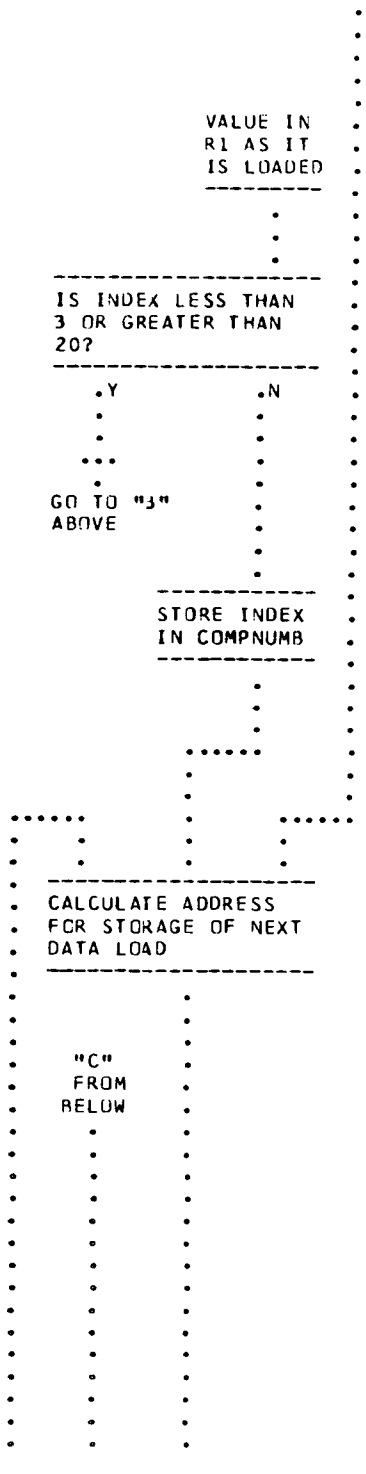
#210

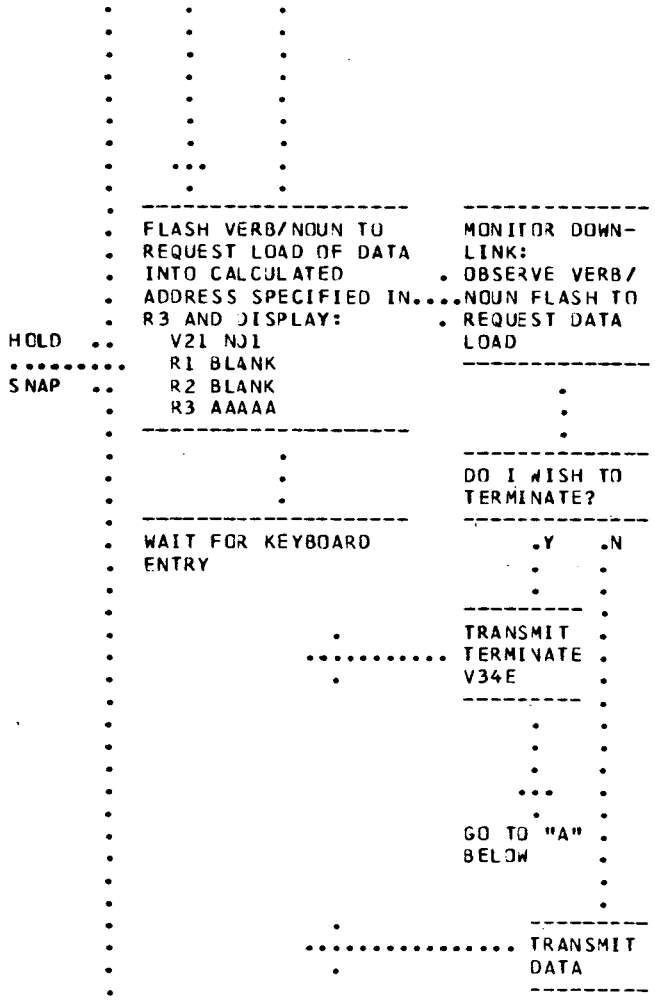
#220

#230

#240

#250





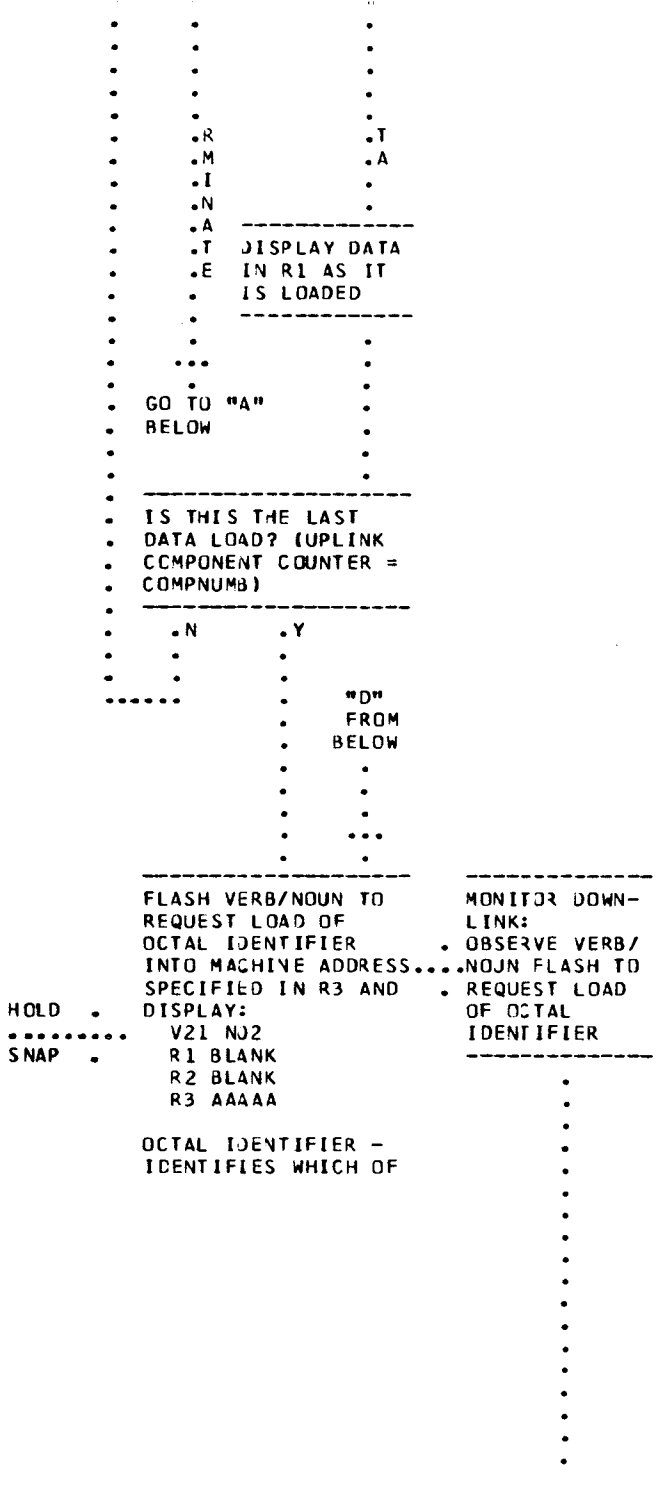
#260

#270

#280

#290

#300



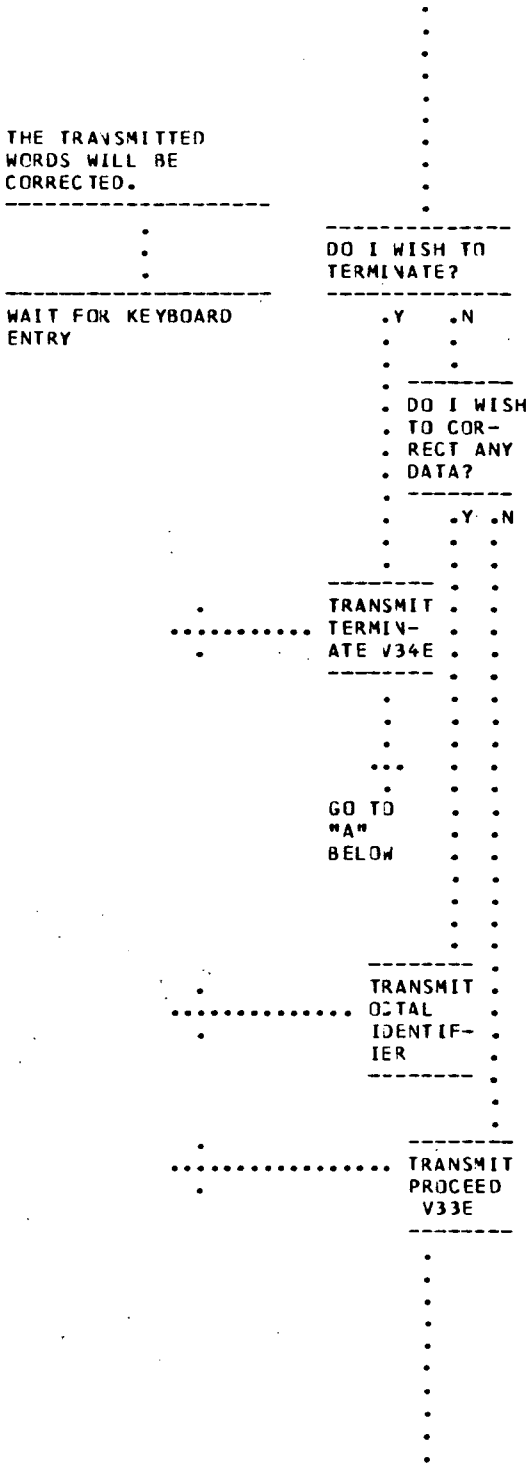
#310

#320

#330

#340

#350



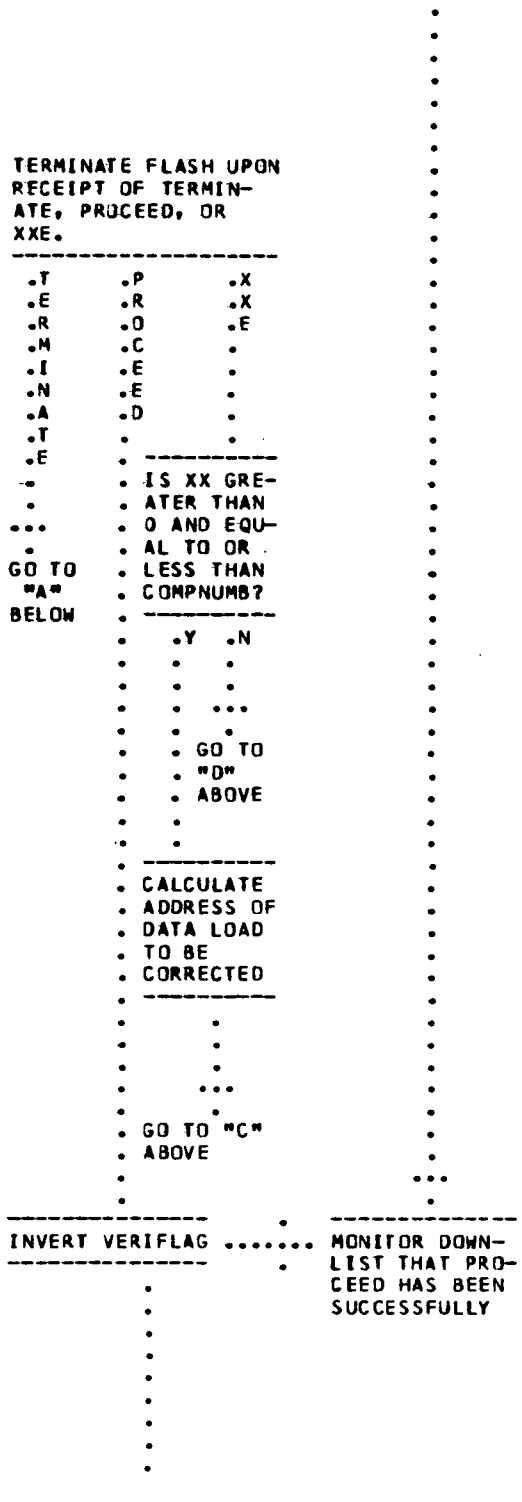
#360

#370

#380

#390

#400



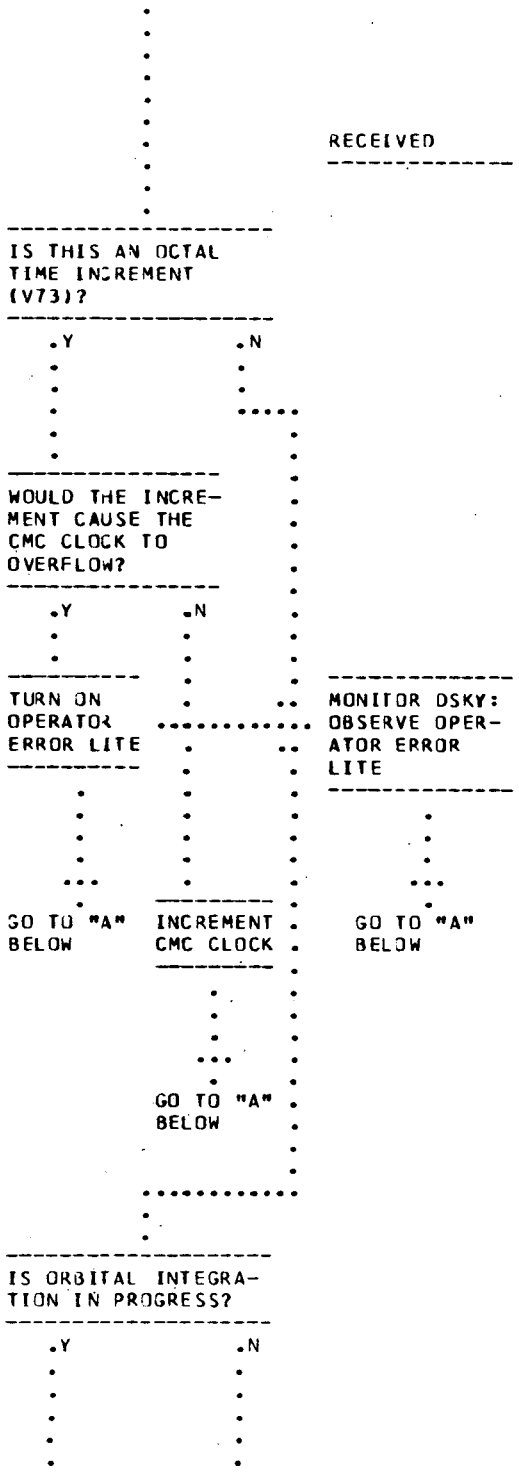
#410

#420

#430

#440

#450



#460

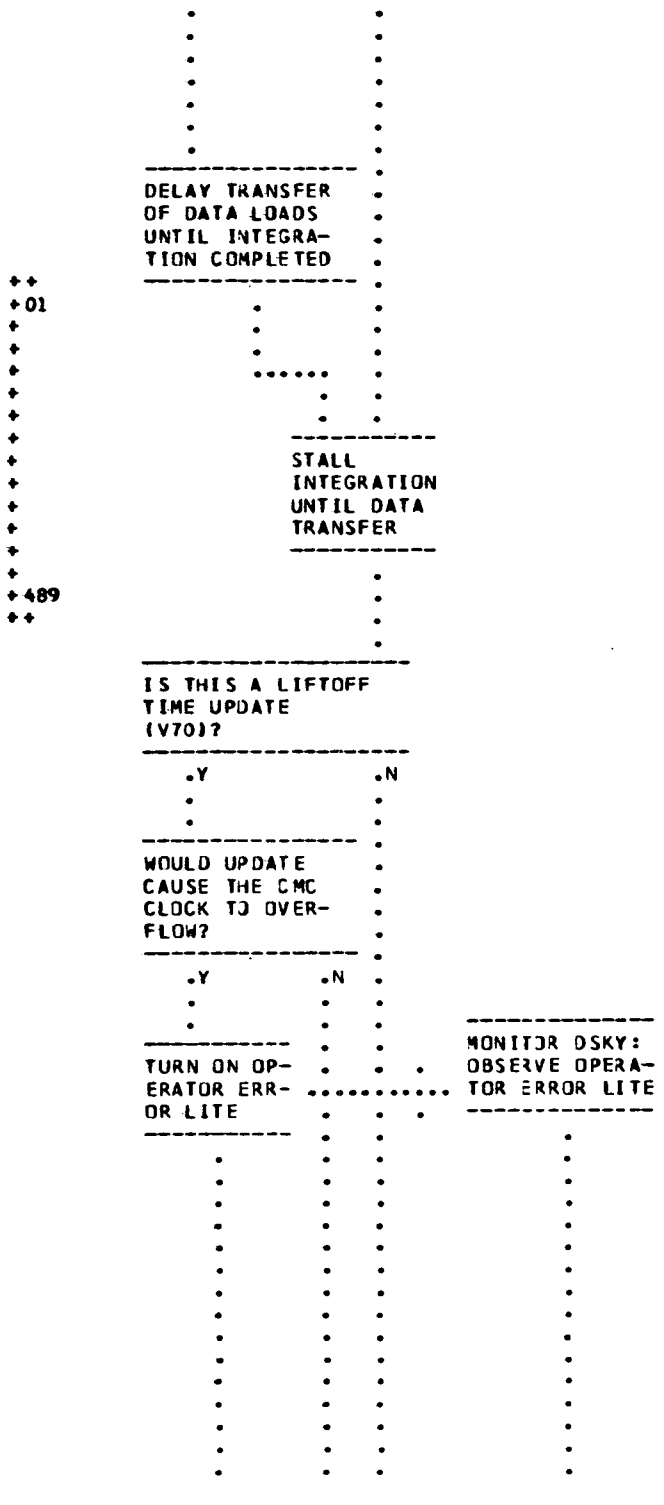
#470

#480

#490

#500

#510



#520

#530

#540

#550

#560

GO TO "A" BELOW

GO TO "A" BELOW

#570

INCREMENT TEPHEM AND DECREMENT STATE VECTOR TIME TAGS AND CMC CLOCK

#580

GO TO "A" BELOW

#590

ARE ALL LOADED ADDRESSES LEGAL?
NOTE 1 - FOR V72 COMPNUMB MUST BE AN ODD NUMBER
NOTE 2 - FOR V71 ALL ADDRESSES MUST BE IN THE SAME E-BANK.

#600

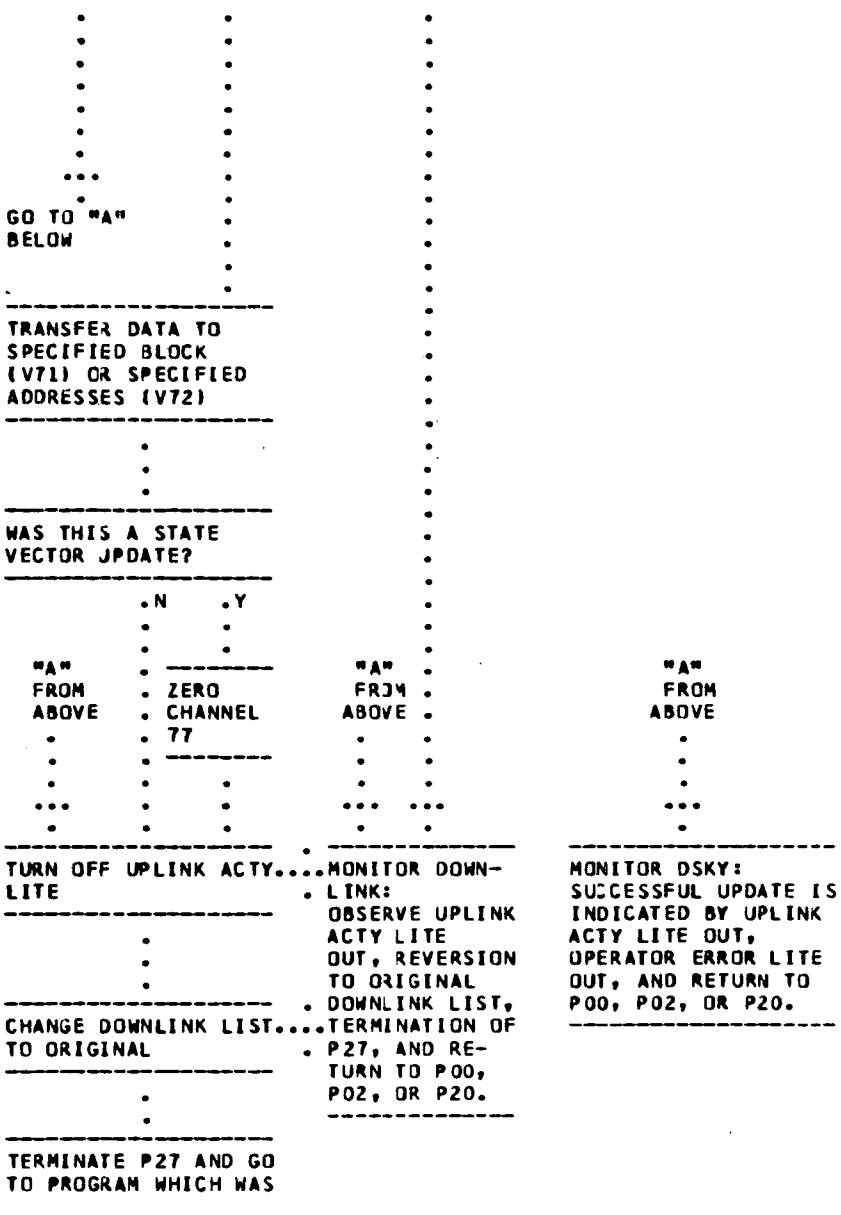
N

Y

TURN ON OPERATOR ERROR LITE

MONITOR DSKY: OBSERVE OPERATOR ERROR LITE

#610



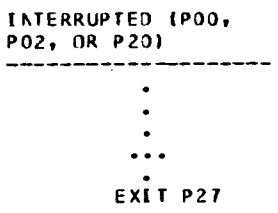
#620

#630

#640

#650

#660



CHANGE CONTROL NOTES

REV 00 PCN 457
REV 01 PCN 489

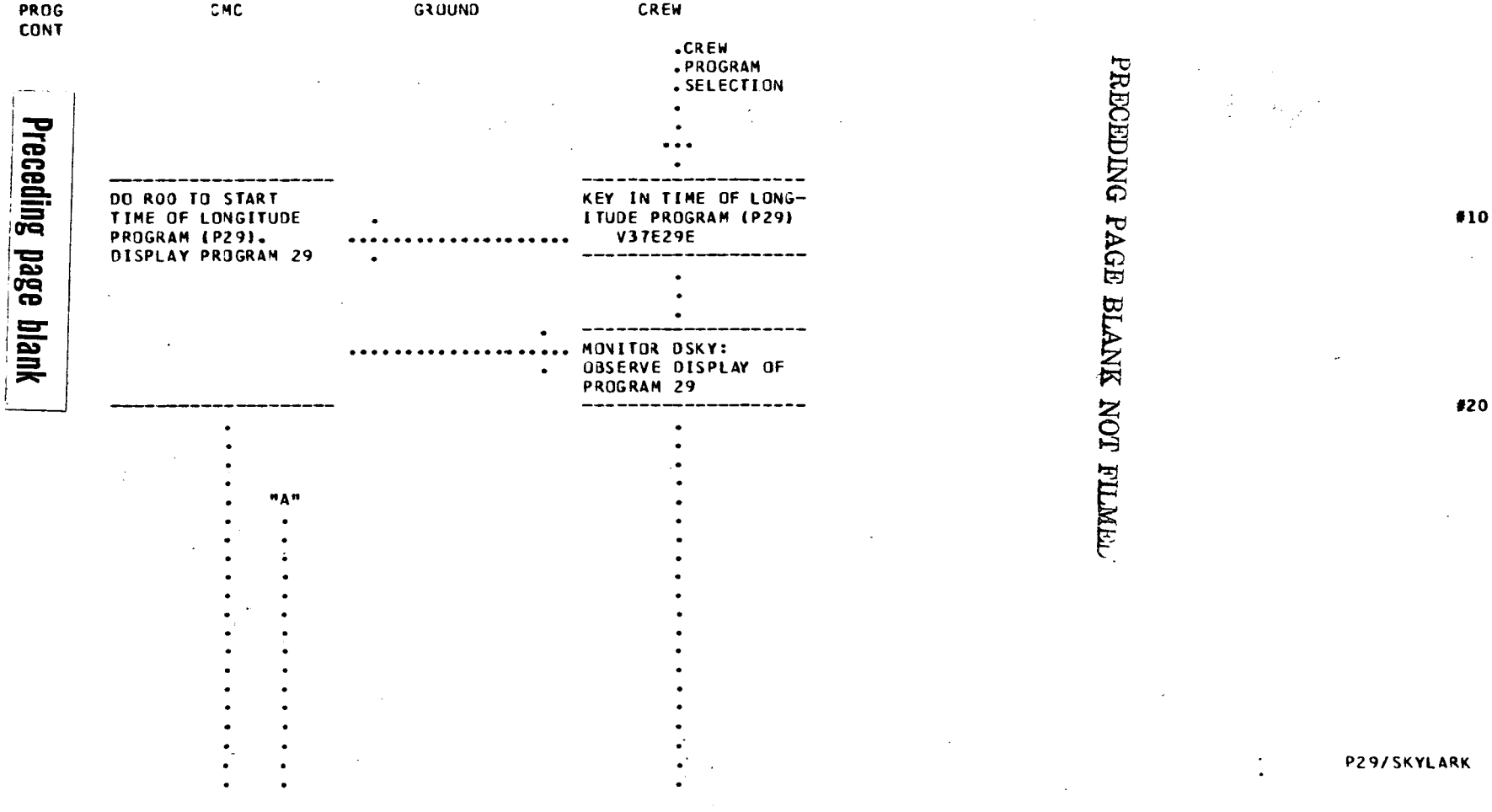
TIME OF LONGITUDE PROGRAM (P29) REV 00 05/19/71

PURPOSE: (1) TO PROVIDE THE ASTRONAUT ESTIMATED TIME OF PASSAGE OVER A SELECTED LONGITUDE.

ASSUMPTIONS: (1) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THIS PROGRAM MAY BE SELECTED TO FIND THE TIME OF LONGITUDE OF EITHER THE OWS OR CSM.

(3) THIS PROGRAM ASSUMES THE VEHICLE WHOSE GROUND TRACK PARAMETERS ARE CALCULATED TO REMAIN IN FREE FALL FROM THE SELECTED START TIME UNTIL TIME OF LONGITUDE CROSSING.



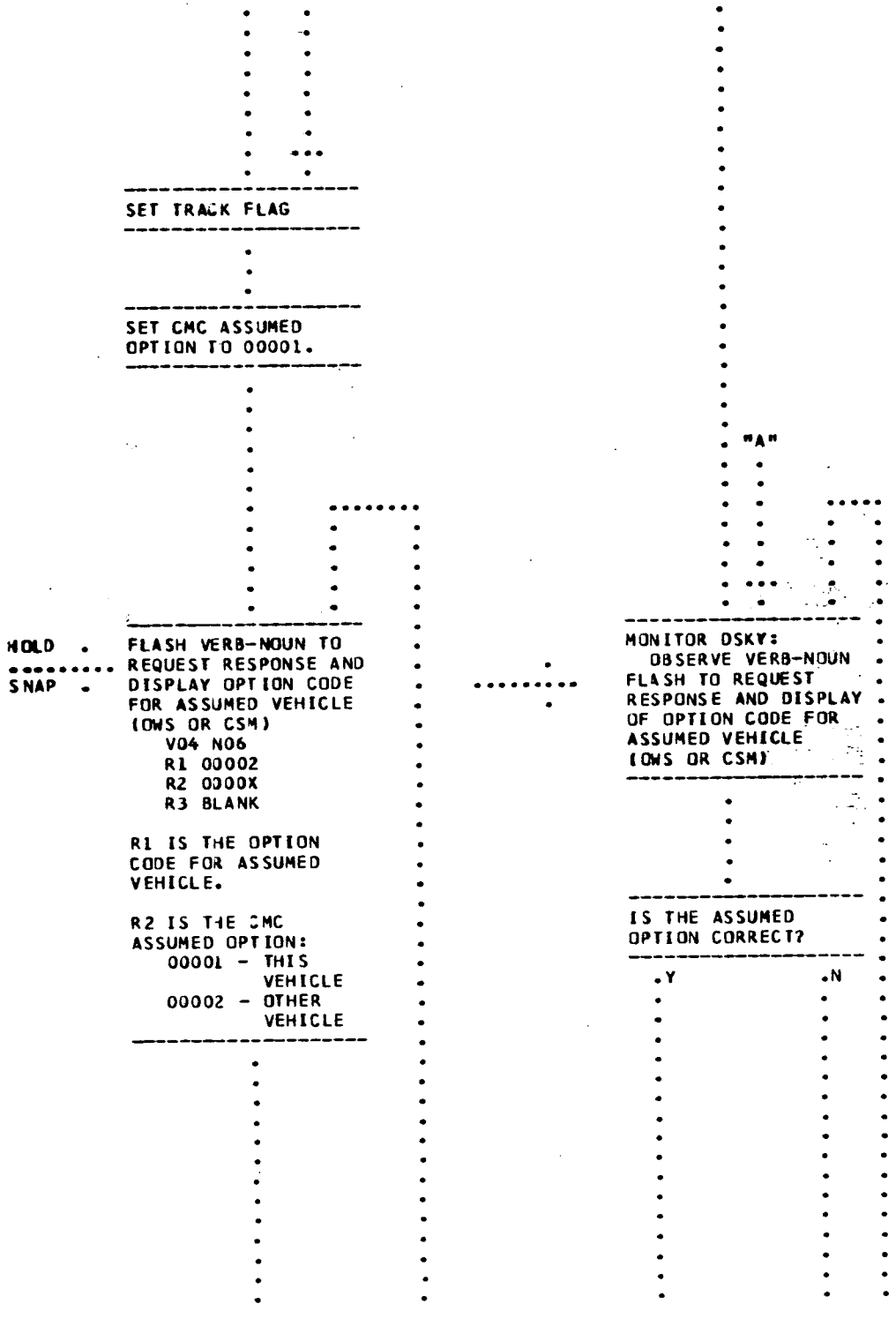
#30

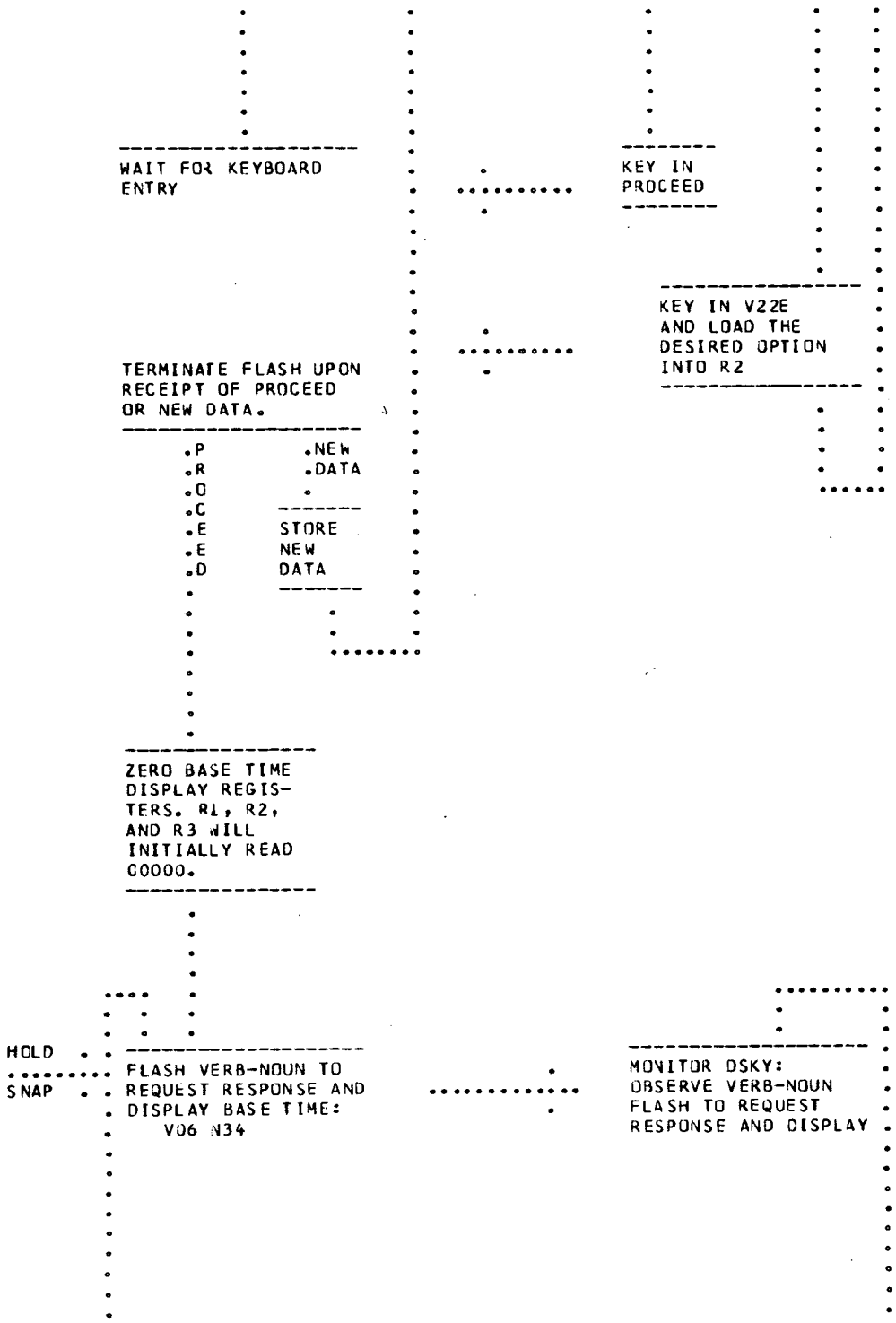
#40

#50

#60

#70


SET TRACK FLAG
SET CMC ASSUMED OPTION TO 00001.
"A"
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTION CODE FOR ASSUMED VEHICLE (OWS OR CSM)
V04 N06
R1 00002
R2 0000X
R3 BLANK
R1 IS THE OPTION CODE FOR ASSUMED VEHICLE.
R2 IS THE CMC ASSUMED OPTION:
00001 - THIS VEHICLE
00002 - OTHER VEHICLE
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF OPTION CODE FOR ASSUMED VEHICLE (OWS OR CSM)
IS THE ASSUMED OPTION CORRECT?
Y
N



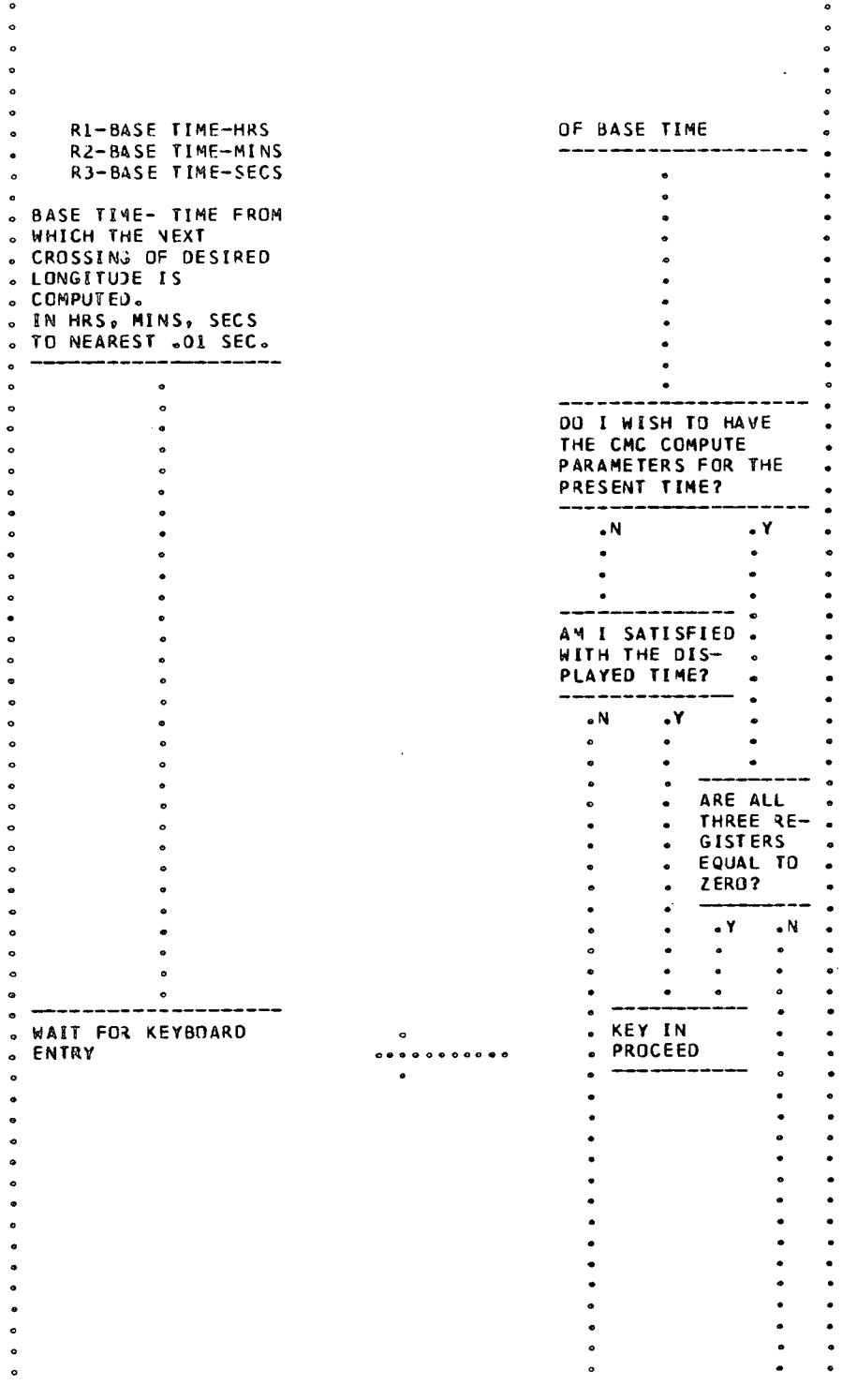
#80

#90

#100

#110

#120



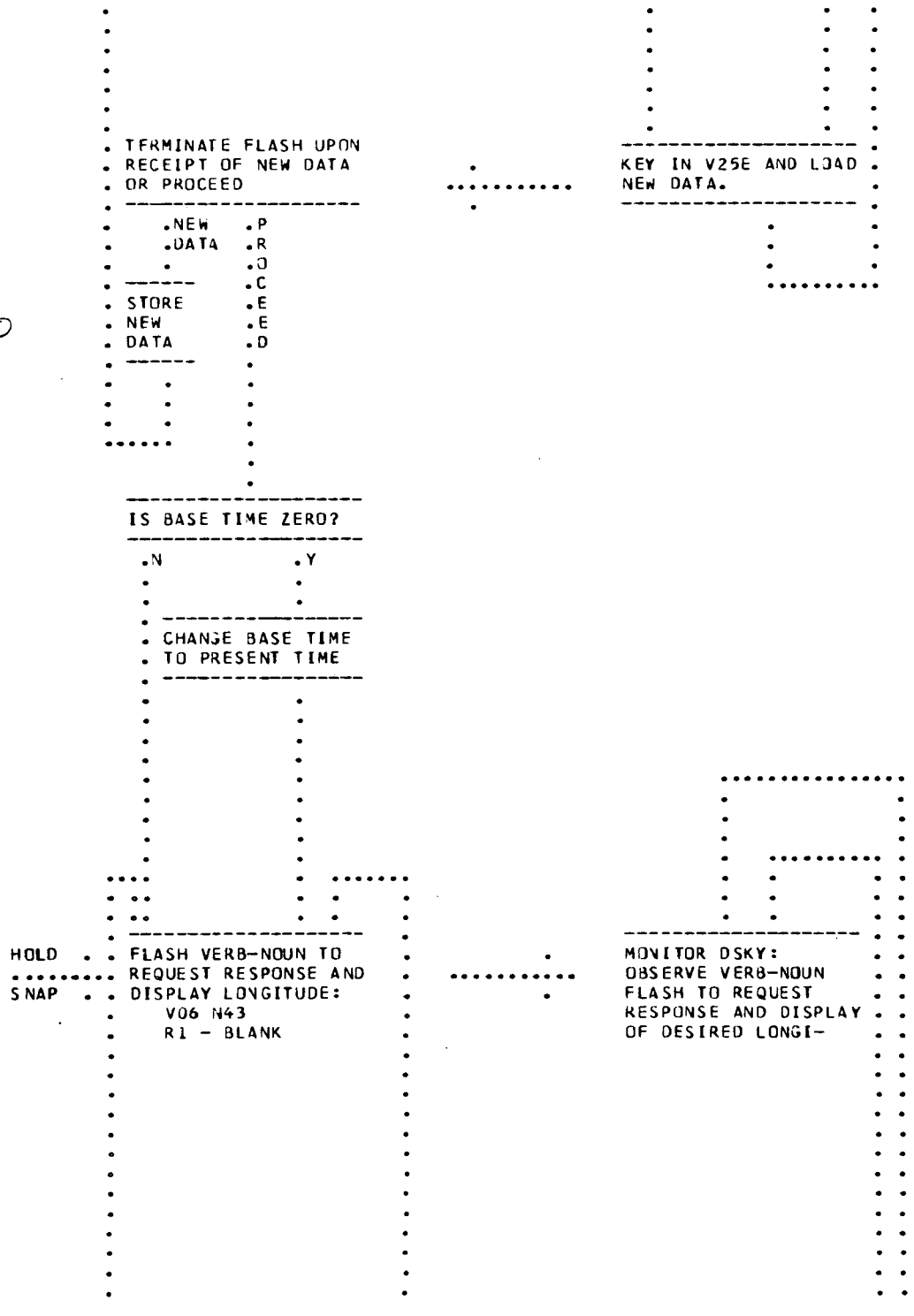
#130

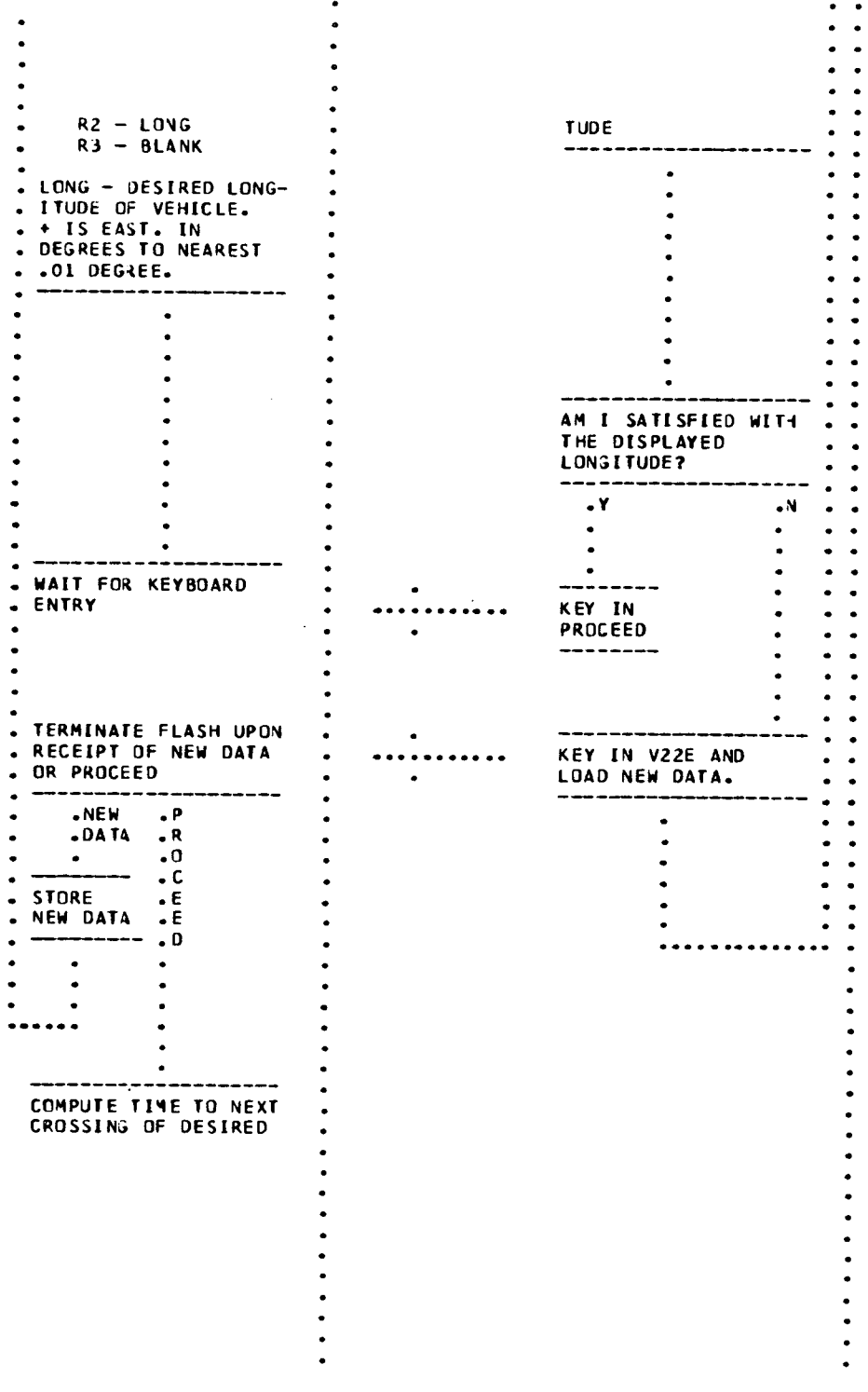
#140

#150

#160

#170


TERMINATE FLASH UPON RECEIPT OF NEW DATA OR PROCEED
NEW DATA
PROCEED
STORE NEW DATA
KEY IN V25E AND LOAD NEW DATA.
#180
#190
IS BASE TIME ZERO?
N
Y
#200
CHANGE BASE TIME TO PRESENT TIME
#210
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY LONGITUDE:
V06 N43
R1 - BLANK
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF DESIRED LONGI-
#220



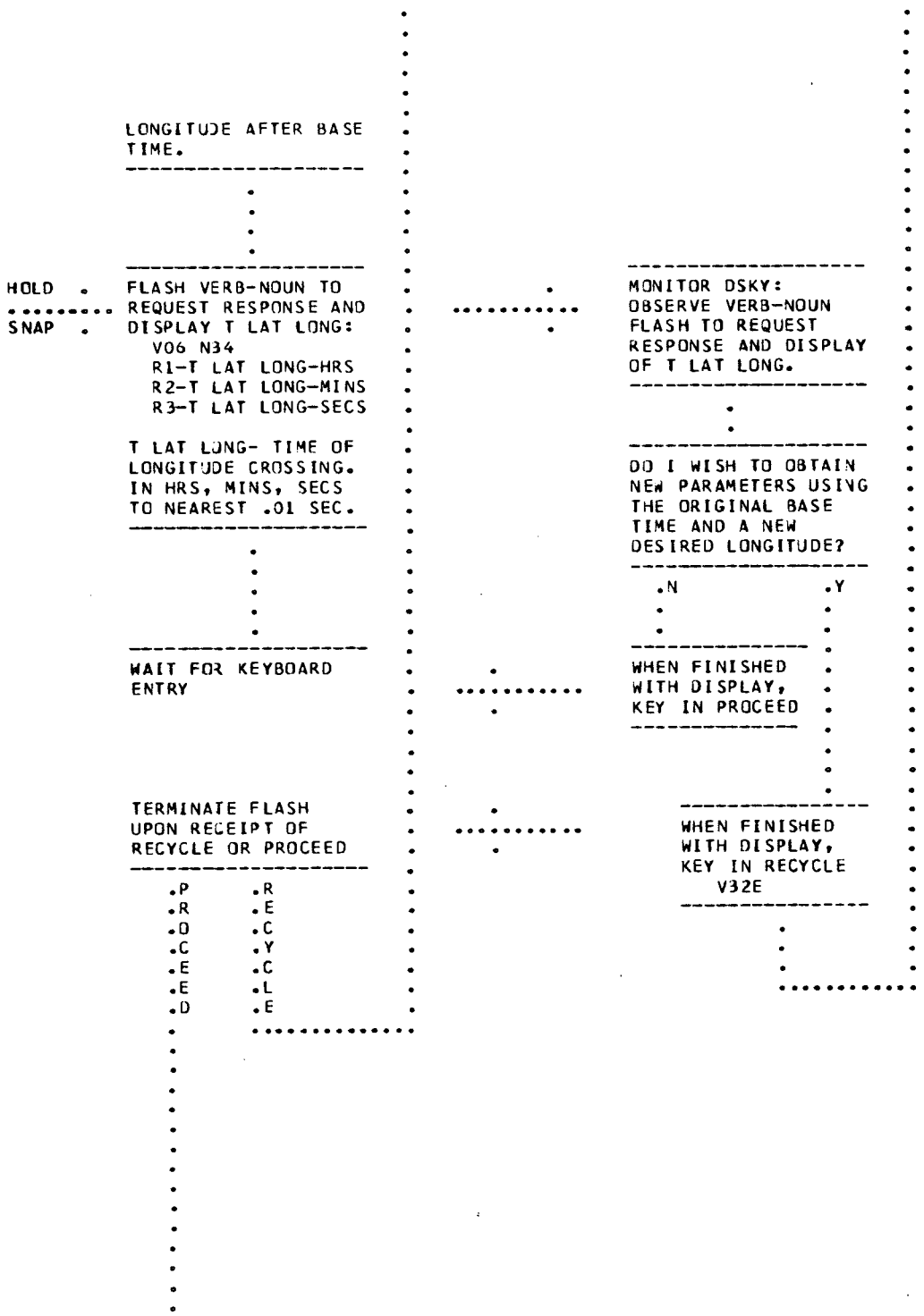
#230

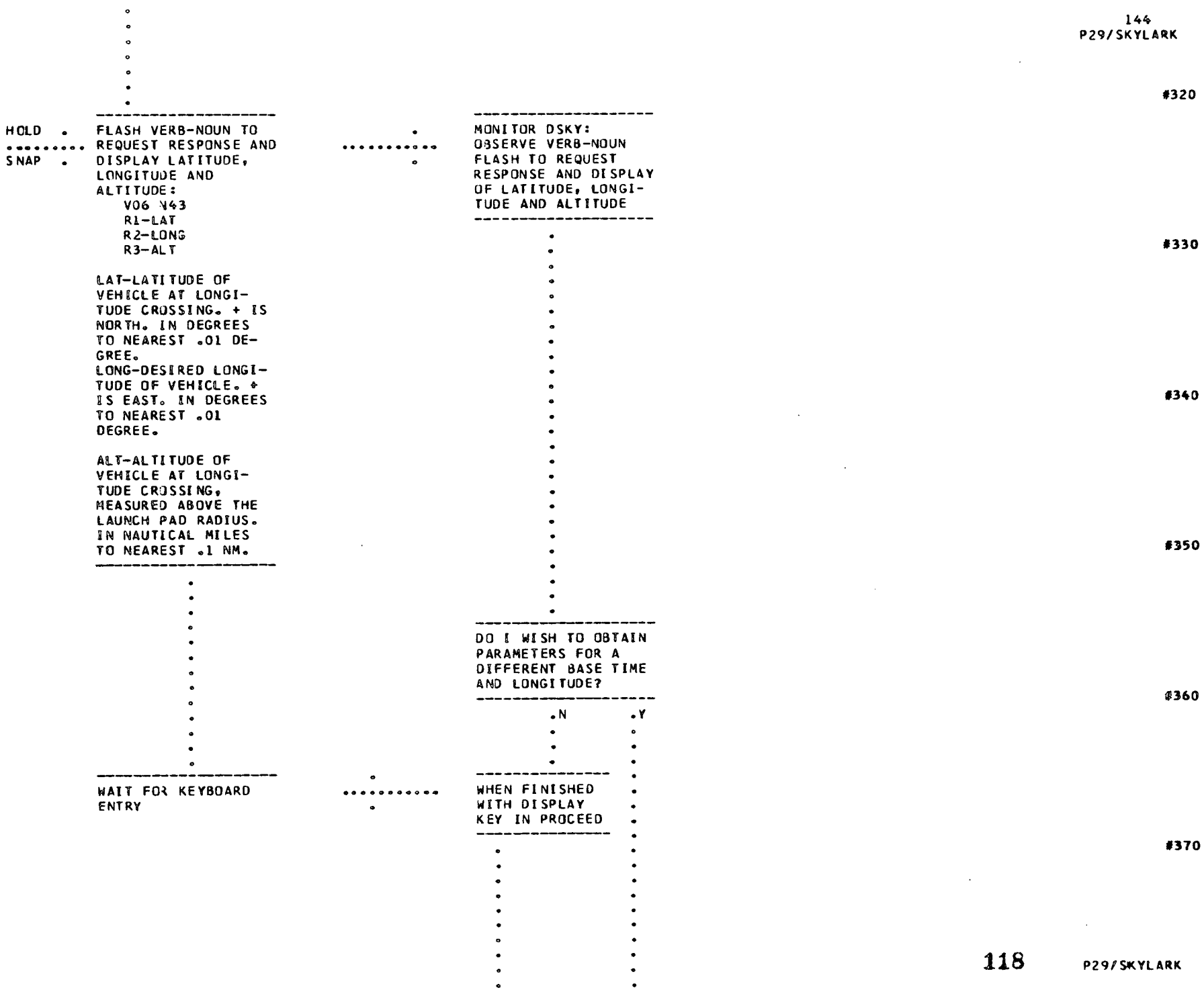
#240

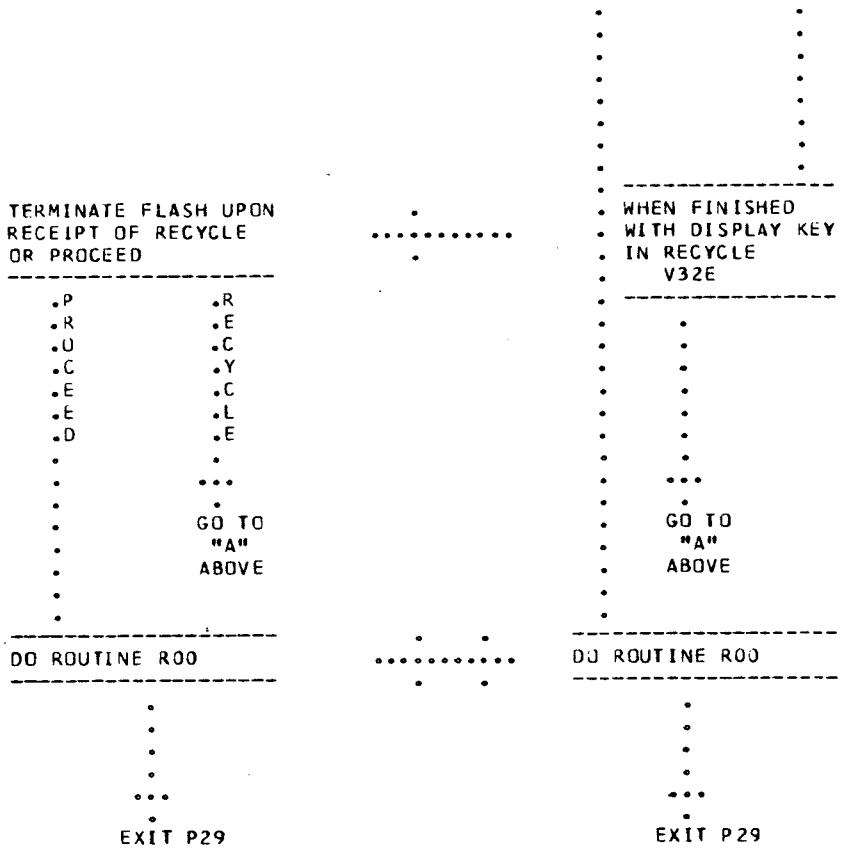
#250

#260

#270


LONGITUDE AFTER BASE TIME.
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY T LAT LONG:
V06 N34
R1-T LAT LONG-HRS
R2-T LAT LONG-MINS
R3-T LAT LONG-SECS
T LAT LONG- TIME OF LONGITUDE CROSSING. IN HRS, MINS, SECS TO NEAREST .01 SEC.
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF RECYCLE OR PROCEED
.P .R .E .C .Y .C .L .E .D .E
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF T LAT LONG.
DO I WISH TO OBTAIN NEW PARAMETERS USING THE ORIGINAL BASE TIME AND A NEW DESIRED LONGITUDE?
.N
.Y
WHEN FINISHED WITH DISPLAY, KEY IN PROCEED
WHEN FINISHED WITH DISPLAY, KEY IN RECYCLE V32E
#280
#290
#300
#310


#320
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY LATITUDE, LONGITUDE AND ALTITUDE:
V06 N43
R1-LAT
R2-LONG
R3-ALT
LAT-LATITUDE OF VEHICLE AT LONGITUDE CROSSING. + IS NORTH. IN DEGREES TO NEAREST .01 DEGREE.
LONG-DESIRED LONGITUDE OF VEHICLE. + IS EAST. IN DEGREES TO NEAREST .01 DEGREE.
ALT-ALTITUDE OF VEHICLE AT LONGITUDE CROSSING, MEASURED ABOVE THE LAUNCH PAD RADIUS. IN NAUTICAL MILES TO NEAREST .1 NM.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF LATITUDE, LONGITUDE AND ALTITUDE
#330
#340
#350
DO I WISH TO OBTAIN PARAMETERS FOR A DIFFERENT BASE TIME AND LONGITUDE?
#360
.N
.Y
WAIT FOR KEYBOARD ENTRY
WHEN FINISHED WITH DISPLAY KEY IN PROCEED
#370



#380

#390

#400

CHANGE CONTROL NOTES

REV 00 PCN 410,457

EXTERNAL DELTA V PROGRAM (P30) REV 00 05/19/71

PURPOSE: (1) TO ACCEPT TARGETING PARAMETERS OBTAINED FROM A SOURCE (S) EXTERNAL TO THE CMC AND COMPUTE THEREFROM THE REQUIRED VELOCITY AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR EXECUTION OF THE DESIRED MANEUVER. THE TARGETING PARAMETERS INSERTED INTO THE CMC ARE THE TIME OF IGNITION(TIG) AND THE IMPULSIVE DELTA V ALONG CSM LOCAL VERTICAL AXES AT TIG.

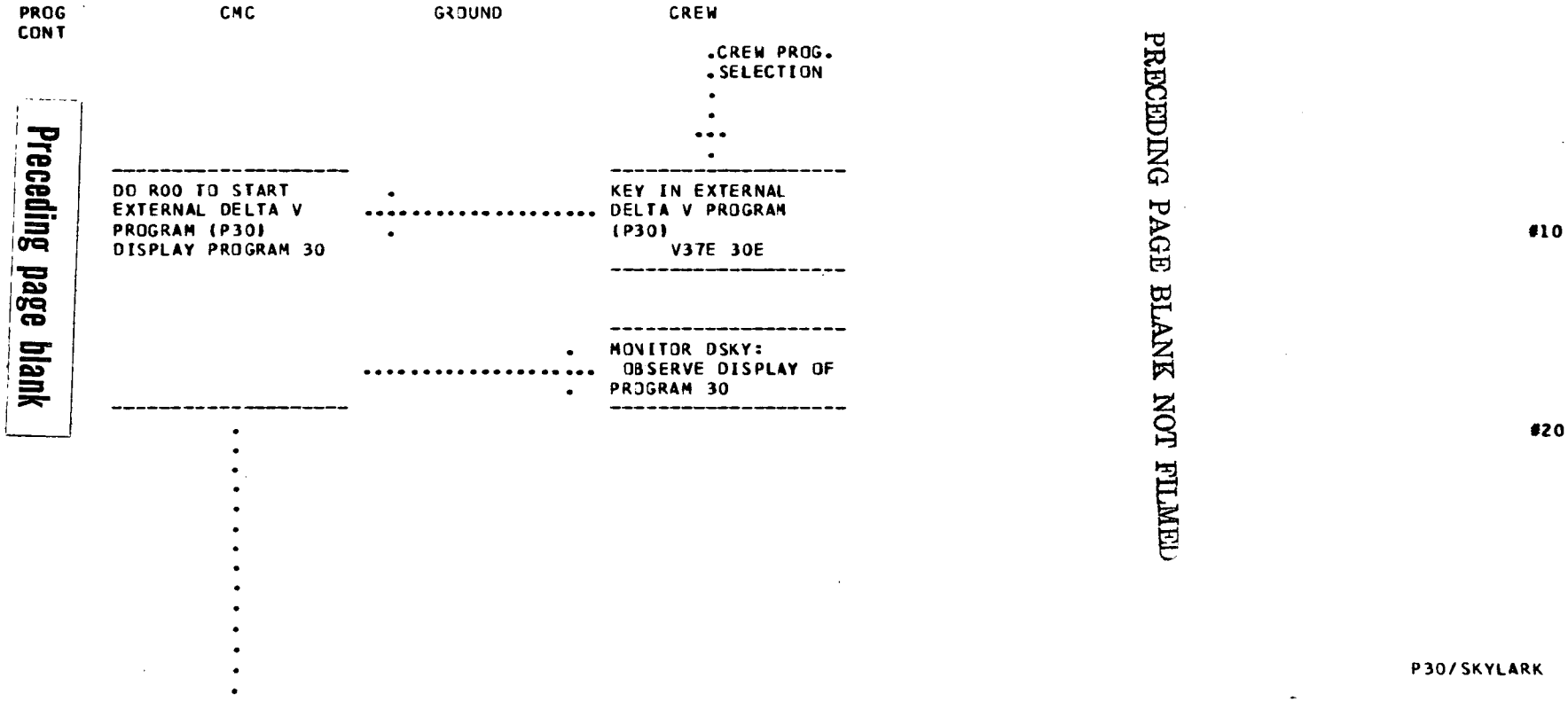
(2) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN SPECIFIC DEPENDENT VARIABLES ASSOCIATED WITH THE DESIRED MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

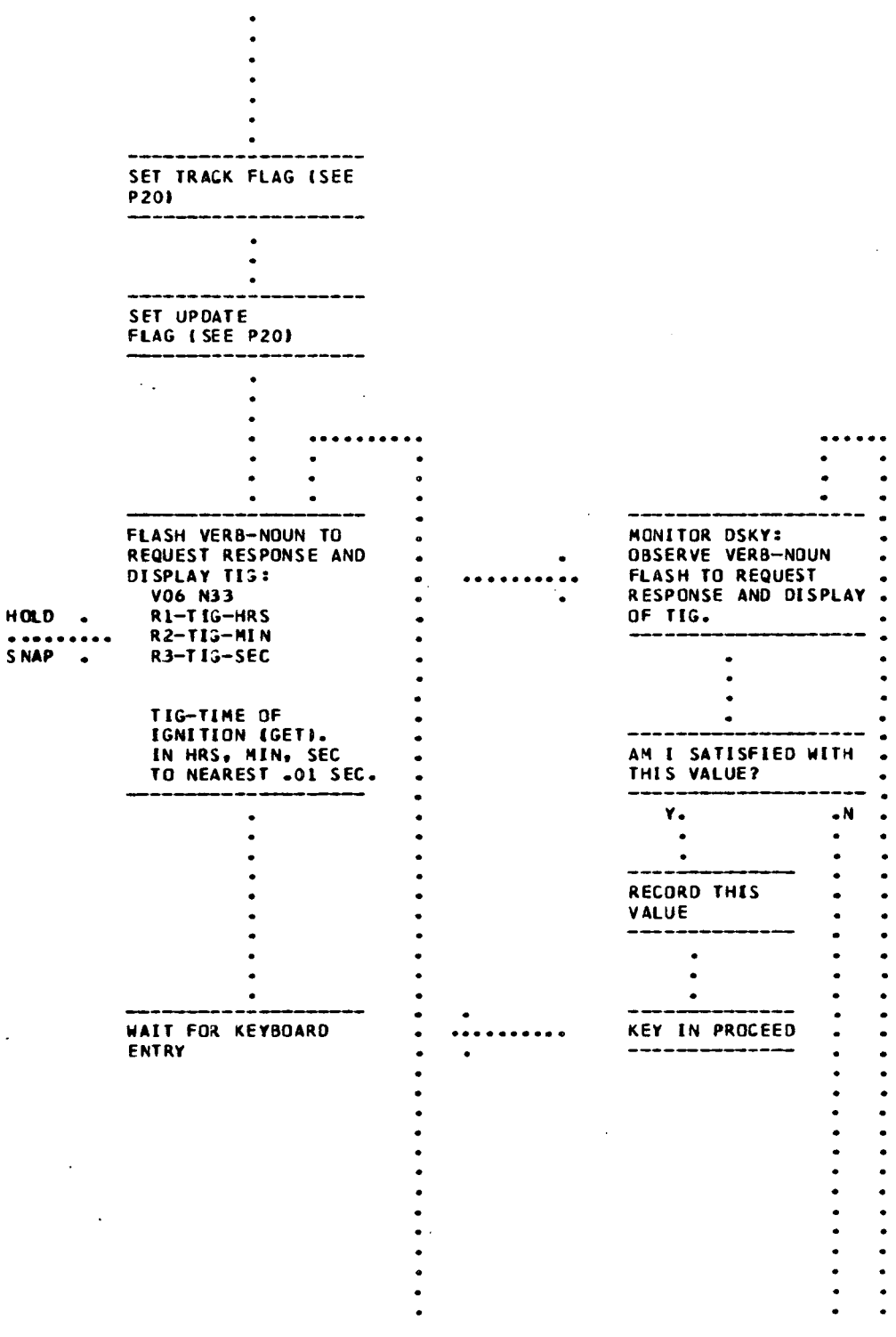
ASSUMPTIONS: (1) THE TARGET PARAMETERS (TIG AND DELTA V(LV)) MAY HAVE BEEN LOADED FROM THE GROUND DURING A PRIOR EXECUTION OF P27.

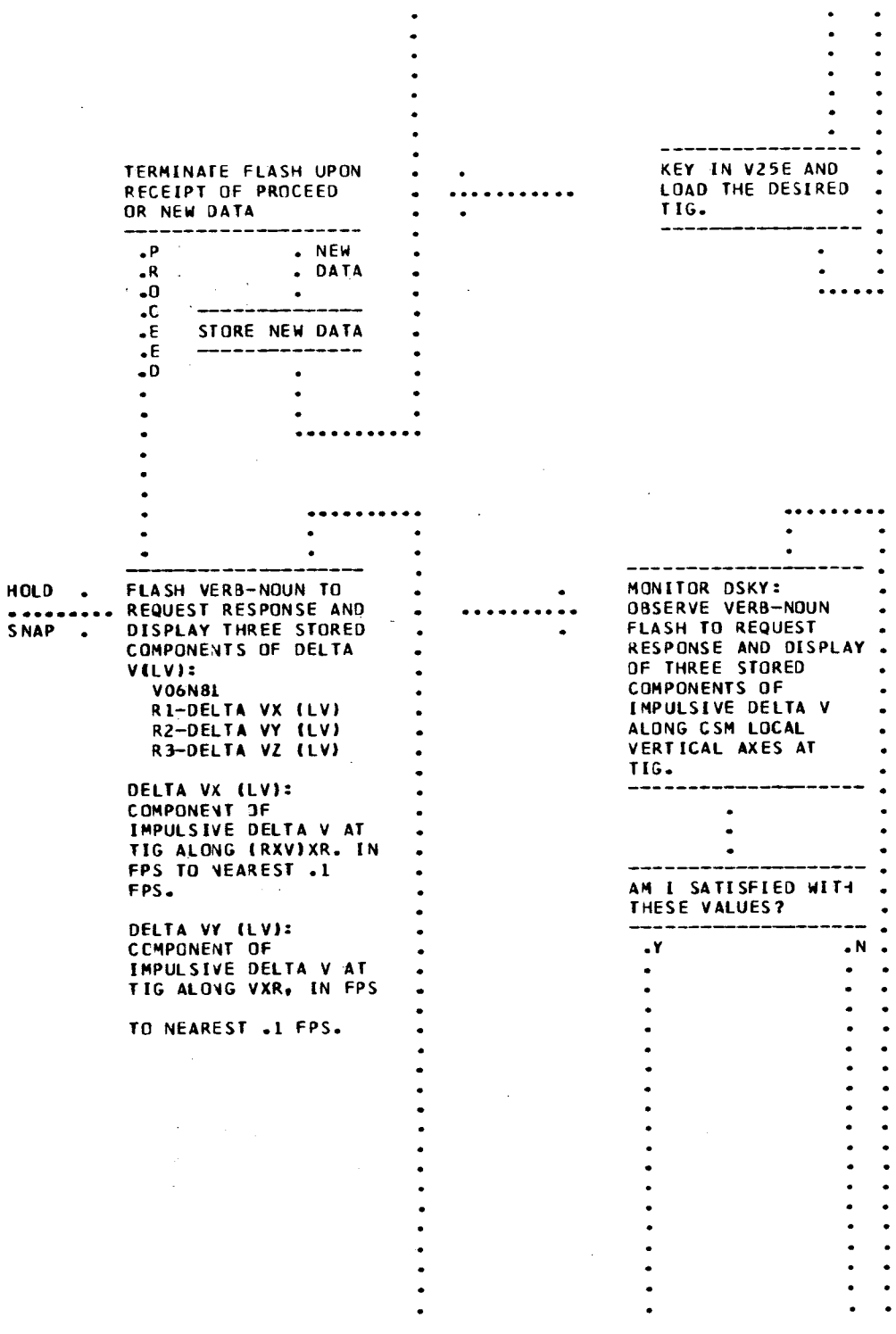
(2) THE EXTERNAL DELTA V FLAG IS SET DURING THIS PROGRAM TO DESIGNATE TO THE THRUSTING PROGRAM THAT EXTERNAL DELTA V STEERING IS TO BE USED.

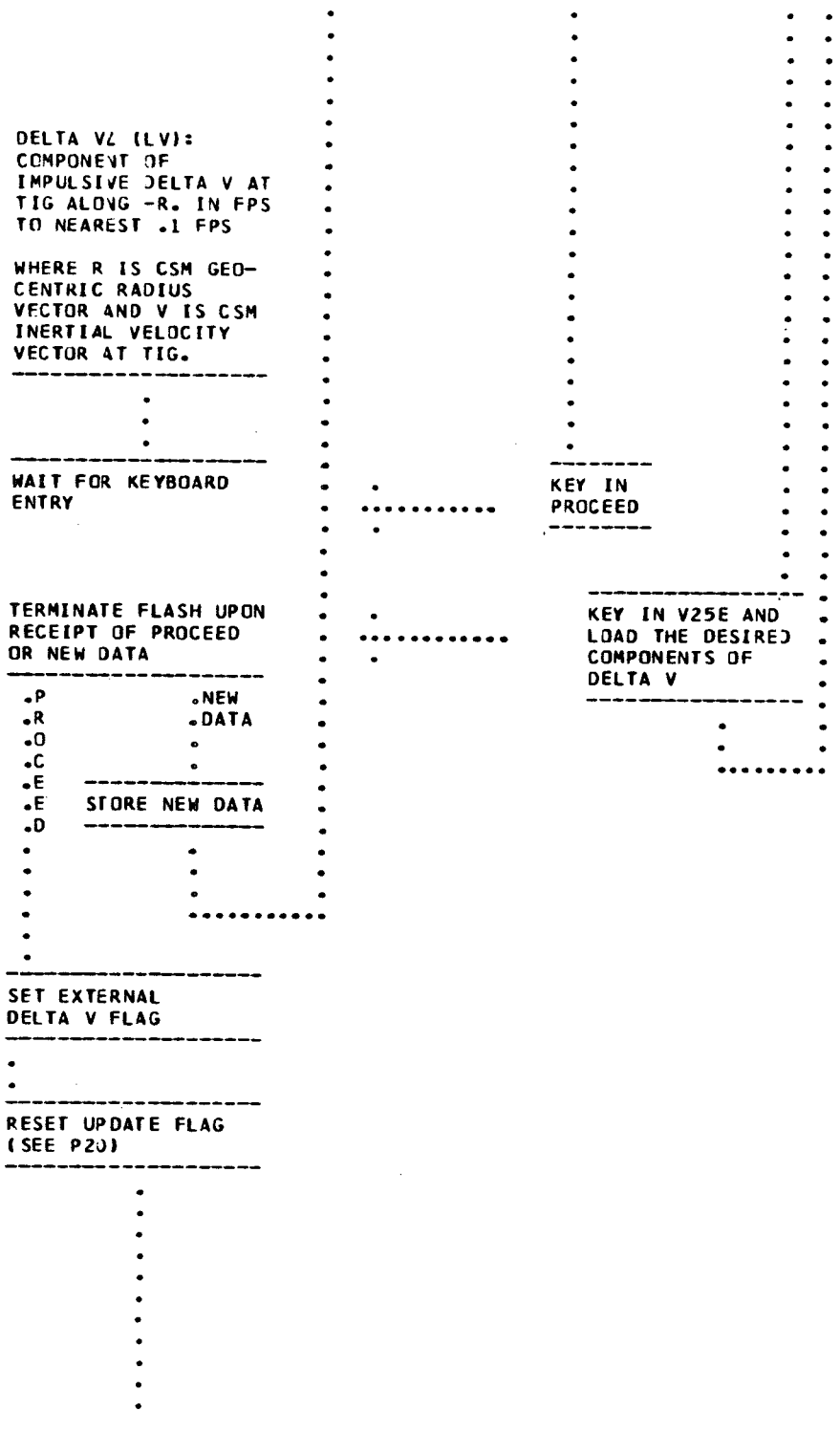
(3) THE ISS NEED NOT BE ON TO COMPLETE THIS PROGRAM.

(4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.




SET TRACK FLAG (SEE P20)
SET UPDATE FLAG (SEE P20)
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TIG:
V06 N33
R1-TIG-HRS
R2-TIG-MIN
R3-TIG-SEC
TIG-TIME OF IGNITION (GET). IN HRS, MIN, SEC TO NEAREST .01 SEC.
HOLD
SNAP
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIG.
AM I SATISFIED WITH THIS VALUE?
Y.
.N
RECORD THIS VALUE
KEY IN PROCEED
#30
#40
#50
#60
#70


TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
.P
.R
.O
.C
.E
.E
.D
NEW DATA
STORE NEW DATA
KEY IN V25E AND LOAD THE DESIRED TIG.
#80
#90
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY THREE STORED COMPONENTS OF DELTA V(LV):
V06N81
R1-DELTA VX (LV)
R2-DELTA VY (LV)
R3-DELTA VZ (LV)
DELTA VX (LV): COMPONENT OF IMPULSIVE DELTA V AT TIG ALONG (RXV)XR. IN FPS TO NEAREST .1 FPS.
DELTA VY (LV): COMPONENT OF IMPULSIVE DELTA V AT TIG ALONG VXR, IN FPS
TO NEAREST .1 FPS.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF THREE STORED COMPONENTS OF IMPULSIVE DELTA V ALONG CSM LOCAL VERTICAL AXES AT TIG.
#100
#110
AM I SATISFIED WITH THESE VALUES?
.Y
.N



#120

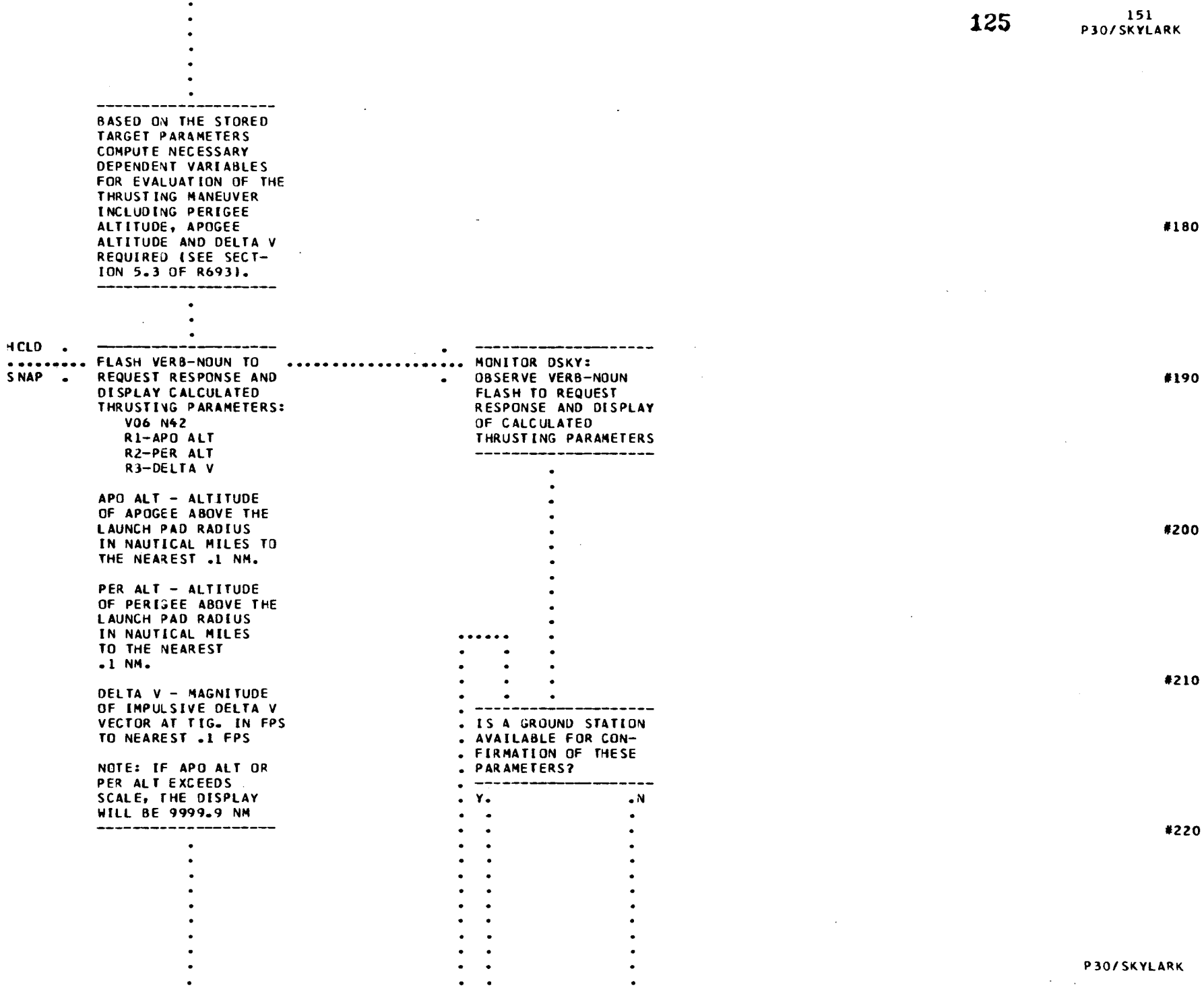
#130

#140

#150

#160

#170


BASED ON THE STORED TARGET PARAMETERS COMPUTE NECESSARY DEPENDENT VARIABLES FOR EVALUATION OF THE THRUSTING MANEUVER INCLUDING PERIGEE ALTITUDE, APOGEE ALTITUDE AND DELTA V REQUIRED (SEE SECTION 5.3 OF R693).
#180
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY CALCULATED THRUSTING PARAMETERS:
V06 N42
R1-APO ALT
R2-PER ALT
R3-DELTA V
APO ALT - ALTITUDE OF APOGEE ABOVE THE LAUNCH PAD RADIUS IN NAUTICAL MILES TO THE NEAREST .1 NM.
PER ALT - ALTITUDE OF PERIGEE ABOVE THE LAUNCH PAD RADIUS IN NAUTICAL MILES TO THE NEAREST .1 NM.
DELTA V - MAGNITUDE OF IMPULSIVE DELTA V VECTOR AT TIG. IN FPS TO NEAREST .1 FPS
NOTE: IF APO ALT OR PER ALT EXCEEDS SCALE, THE DISPLAY WILL BE 9999.9 NM
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF CALCULATED THRUSTING PARAMETERS
#190
#200
#210
IS A GROUND STATION AVAILABLE FOR CONFIRMATION OF THESE PARAMETERS?
Y.
.N
#220

MONITOR CMC DOWNLINK TELEMETRY OF APO ALT, PER ALT AND DELTA V REQUIRED. COORDINATE EVALUATION OF CMC COMPUTED PARAMETERS WITH ASTRONAJT

COORDINATE EVALUATION OF THE CMC COMPUTED PARAMETERS WITH THE GROUND

#230

SELECT ONE OF THE FOLLOWING FIVE ALTERNATIVES:

#240

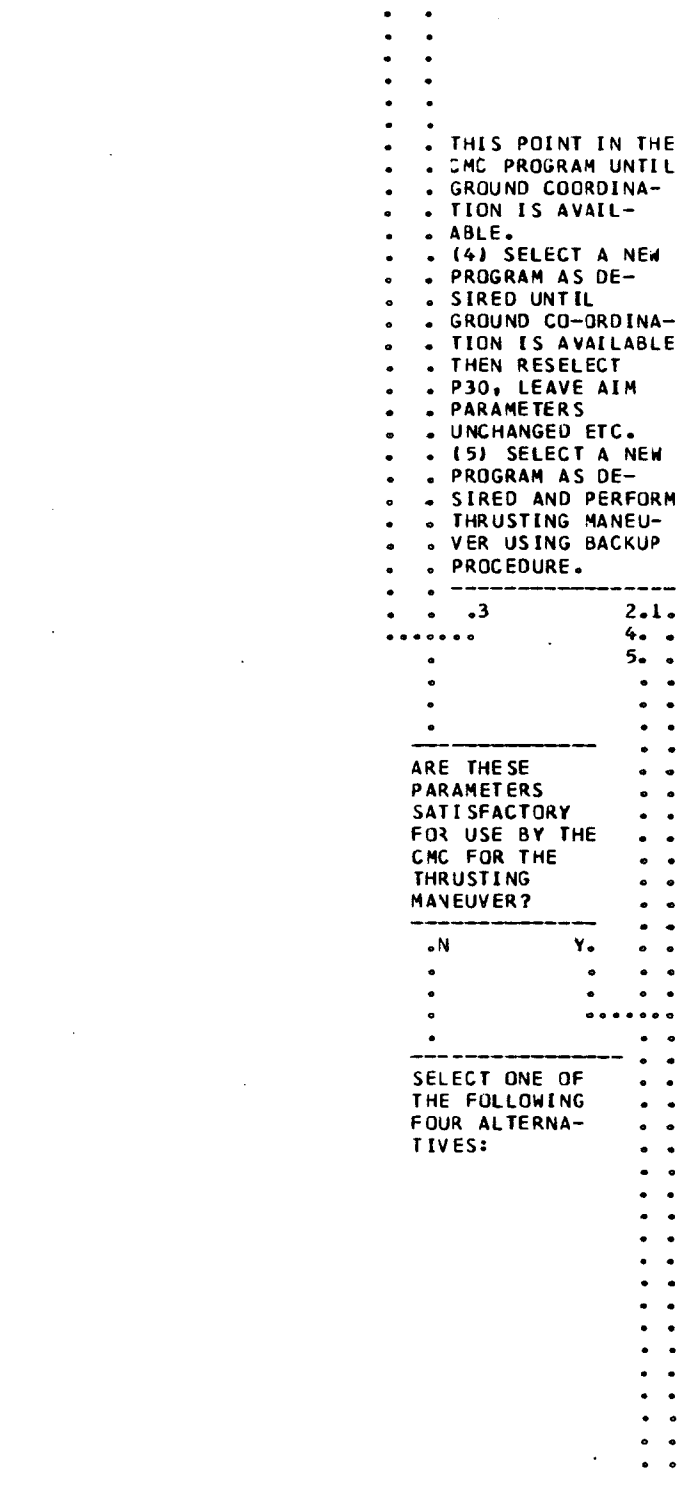
(1) IF THE CALCULATED DATA IS SATISFACTORY, PERFORM THE THRUSTING MANEUVER USING THE CMC CALCULATED PARAMETERS WITHOUT GROUND CONFIRMATION.

#250

(2) IF THE CALCJLATED DATA IS NOT SATISFACTORY ADJUST THE CALCULATED PARAMETERS BY RESELECTING P30 AS NECESSARY AND CHANGING THE LOADED AIM PARAMETERS UNTIL CMC COMPUTED PARAMETERS ARE SATISFACTORY. THEN PERFORM THE THRJSTING MANEUVER.

#260

(3) REMAIN AT



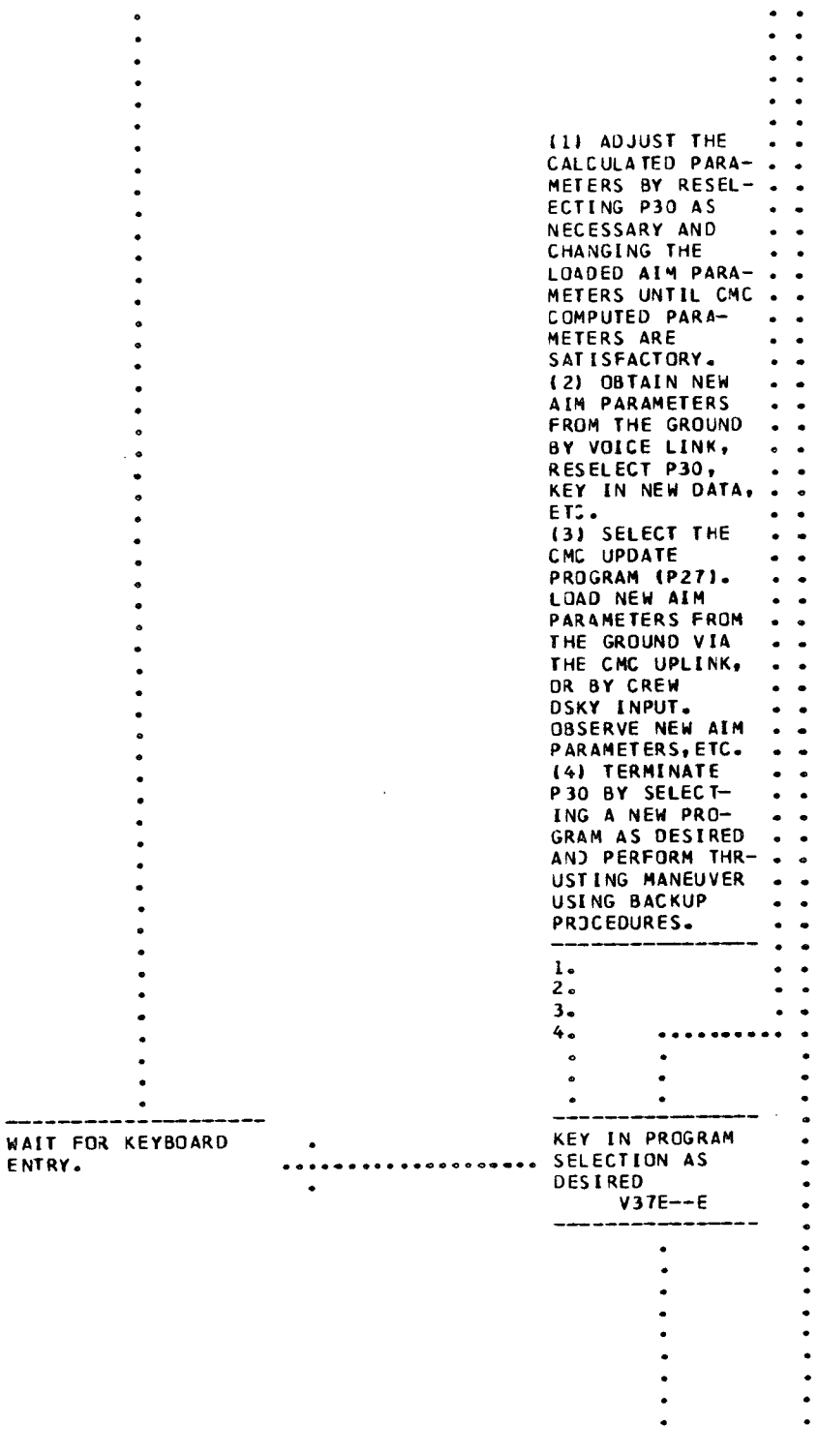
#270

#280

#290

#300

#310


(1) ADJUST THE CALCULATED PARAMETERS BY RESELECTING P30 AS NECESSARY AND CHANGING THE LOADED AIM PARAMETERS UNTIL CMC COMPUTED PARAMETERS ARE SATISFACTORY.
(2) OBTAIN NEW AIM PARAMETERS FROM THE GROUND BY VOICE LINK, RESELECT P30, KEY IN NEW DATA, ETC.
(3) SELECT THE CMC UPDATE PROGRAM (P27). LOAD NEW AIM PARAMETERS FROM THE GROUND VIA THE CMC UPLINK, OR BY CREW DSKY INPUT. OBSERVE NEW AIM PARAMETERS, ETC.
(4) TERMINATE P30 BY SELECTING A NEW PROGRAM AS DESIRED AND PERFORM THRUSTING MANEUVER USING BACKUP PROCEDURES.
1.
2.
3.
4.
WAIT FOR KEYBOARD ENTRY.
KEY IN PROGRAM SELECTION AS DESIRED
V37E--E
#320
#330
#340
#350
#360

#370

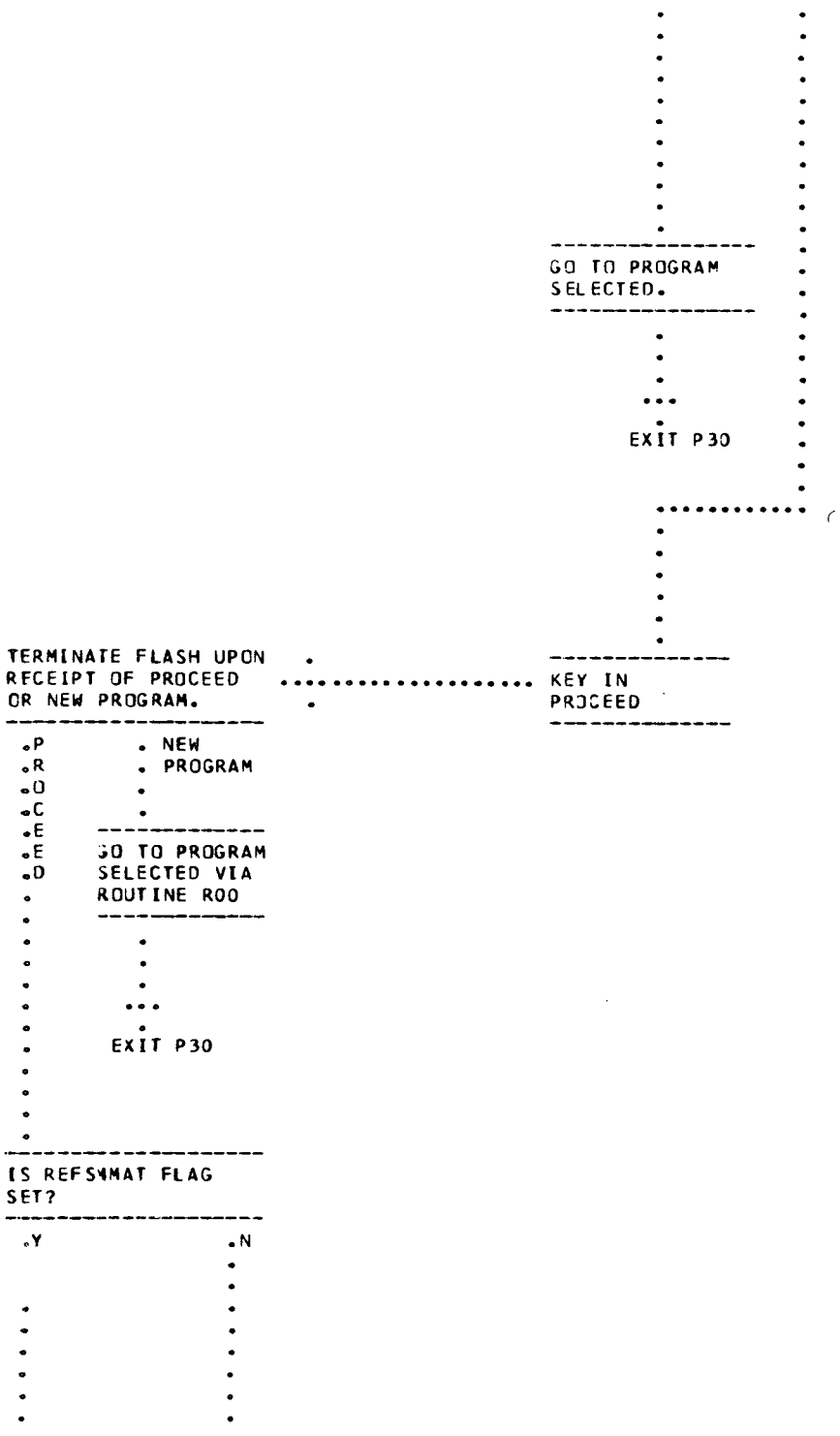
#380

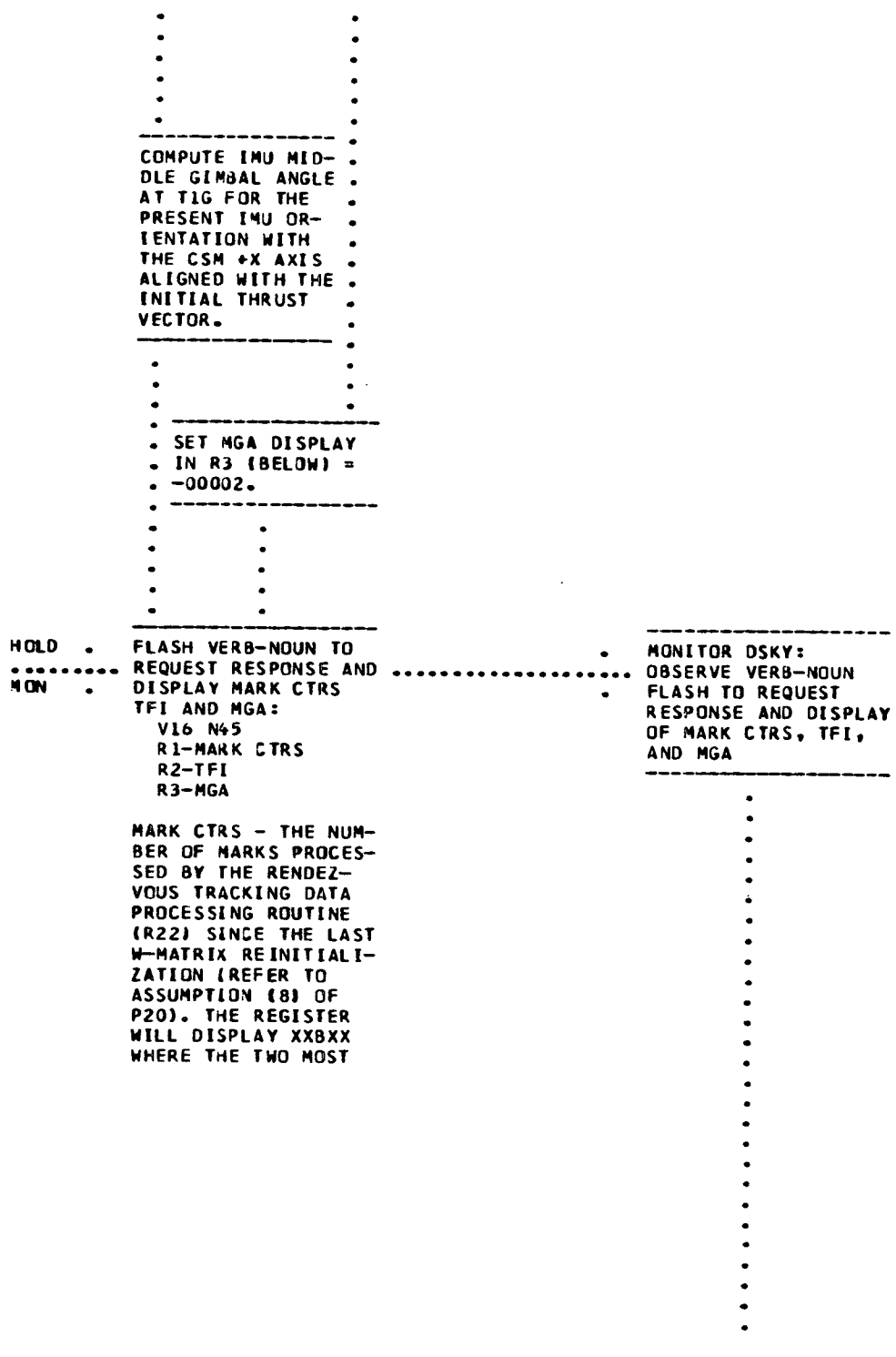
#390

#400

#410

#420





#430

#440

#450

#460

SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS IS THE OPTICS MARK COUNTER.
NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS. #470 #480

TFI - TIME FROM TIG. IN MIN AND SEC TO NEAREST SEC. MAXIMUM READING IS 59859. (- BEFORE + AFTER TIG.)

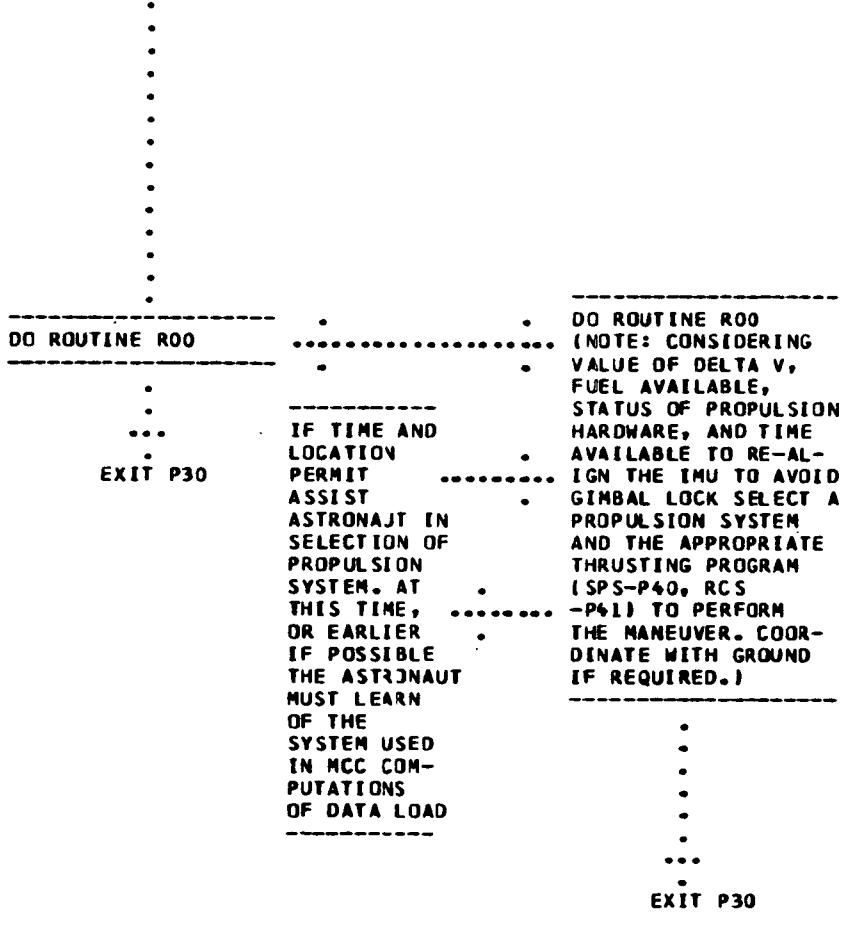
MGA-MIDDLE GIMBAL ANGLE AT TIG IF +X CSM AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION. SIGN IS ALWAYS + EXCEPT WHEN THE IMU IS NOT ALIGNED THE VALUE IS -00002. IN DEGREES TO NEAREST .01 DEGREE #490 #500

WAIT FOR KEYBOARD ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON RECEIPT OF PROCEED #510

.PRO



#520

#530

#540

#550

CHANGE CONTROL NOTES

REV 00 PCN 410,457

NC1 TARGETING PROGRAM (P31) REV 01 03/20/72

PURPOSE: (1) TO CALCULATE THE PARAMETERS ASSOCIATED WITH THE NC1 MANEUVER FOR DELTA V BURNS.

(2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NC1 MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE NC1 TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) AT A SELECTED TPI TIME, THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS IS SELECTED TO BE A PRESCRIBED ANGLE (E) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE POSITION.

(2) THE NC1, NC2, NCC MANEUVERS ARE CONSTRAINED TO BE HORIZONTAL MANEUVERS.

(3) THE NSR MANEUVER IS CONSTRAINED TO RESULT IN COELLIPTIC ORBITS FOLLOWING THE MANEUVER.

(4) THE FOLLOWING TIME CONSTRAINTS APPLY:
A) THE TPI TIME AND THE TIME BETWEEN THE NCC AND NSR MANEUVERS ARE SPECIFIED (DSKY INPUT AND PAD-LOAD RESPECTIVELY).

++
+01 B) THE TIMES BETWEEN THE NC1 AND NC2 MANEUVERS AND THE NC2 AND NCC MANEUVERS ARE INDIRECTLY SPECIFIED BY
+ SPECIFYING THE NUMBER OF 1/2 REVOLUTIONS INVOLVED IN THE TRANSFERS BETWEEN THE MANEUVERS (DSKY INPUT AND
+ PAD-LOAD RESPECTIVELY).
+
+489 (5) THE ALTITUDES BETWEEN THE OWS ORBIT AND THE CSM AT BOTH NCC AND NSR TIME ARE SPECIFIED (DSKY INPUT).
++

(6) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE NORMALLY LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR CONCENTRIC FLIGHT PLAN MANEUVER SEQUENCES.

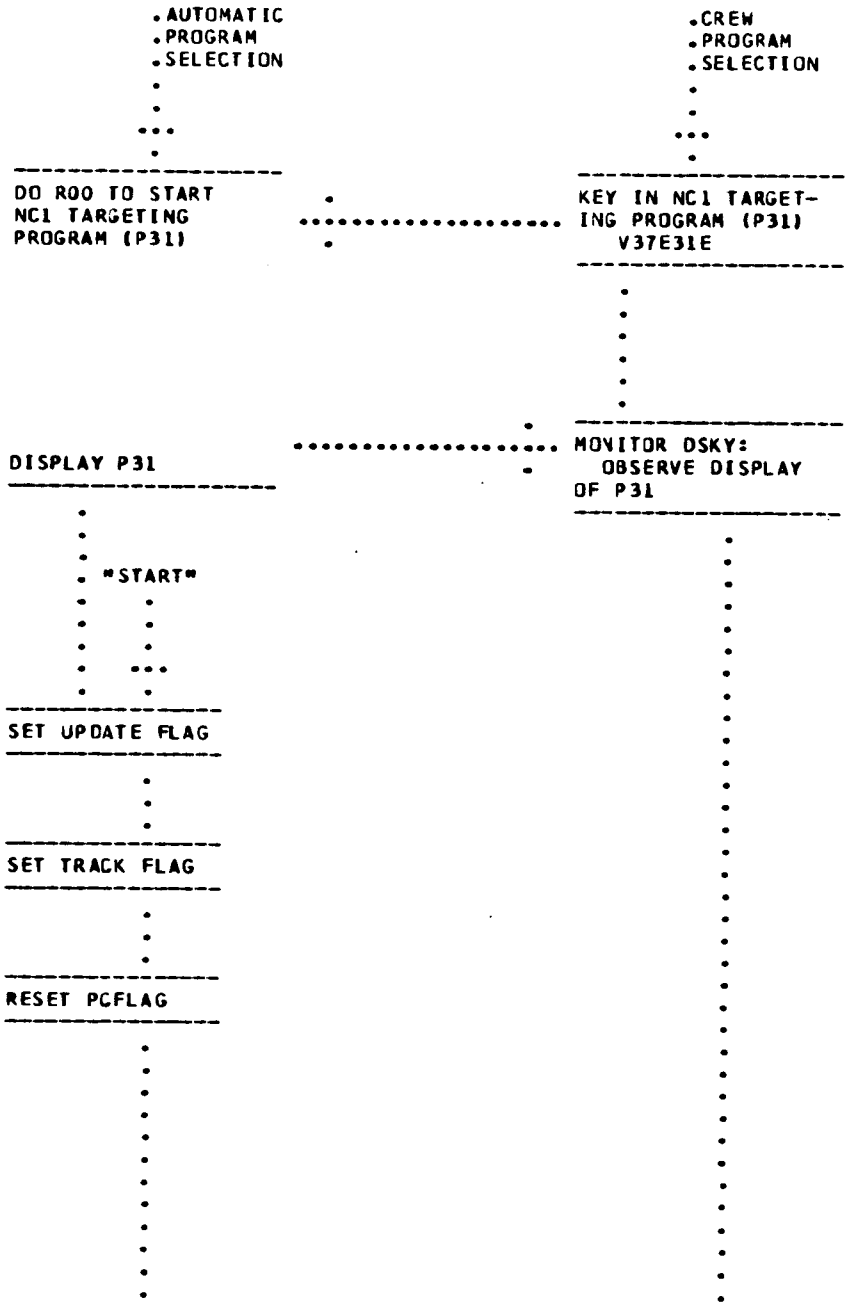
(7) IF P20 IS IN OPERATION WHILE THE PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

(8) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

PROG	CMC	GROUND	CREW

CONT

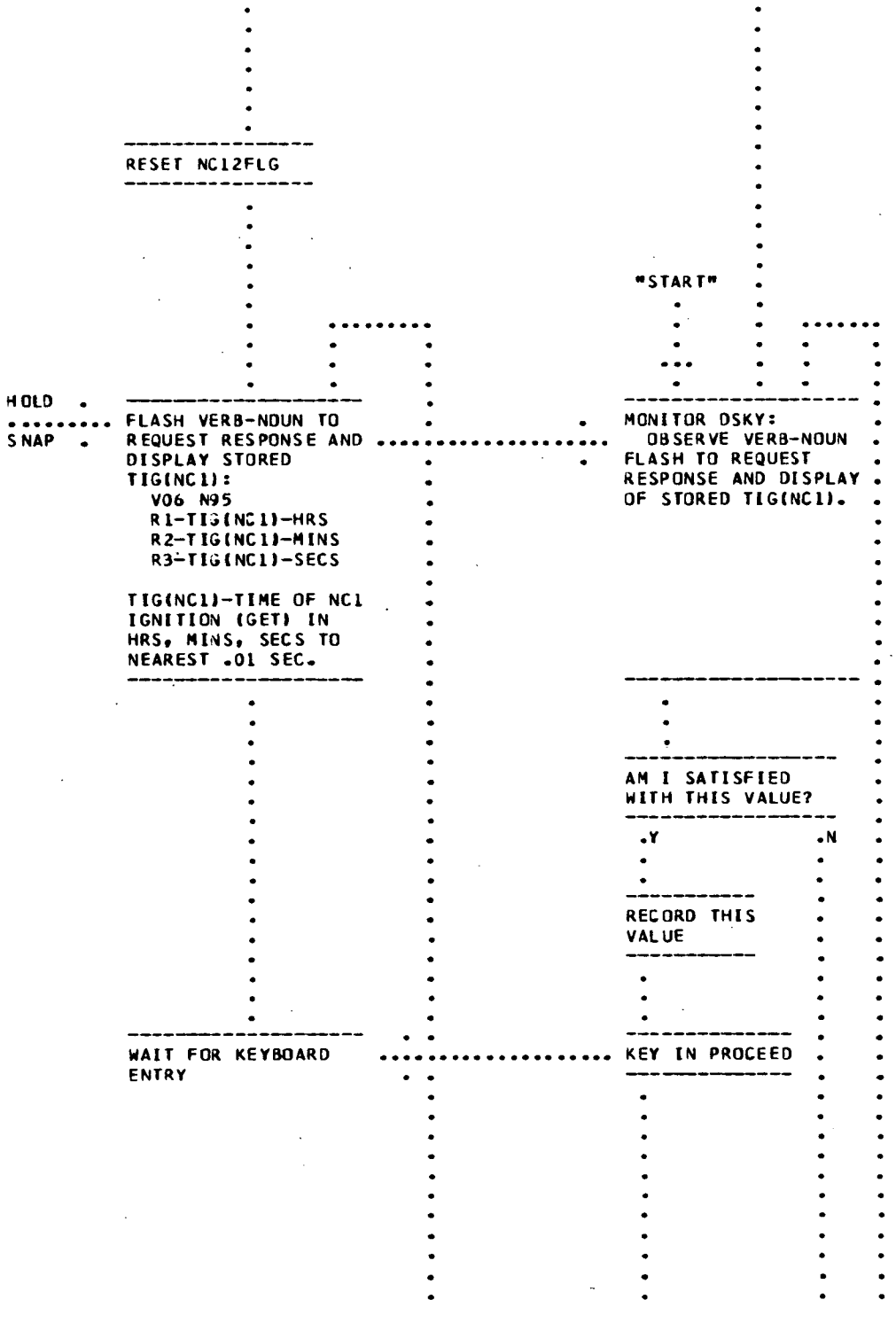


#10

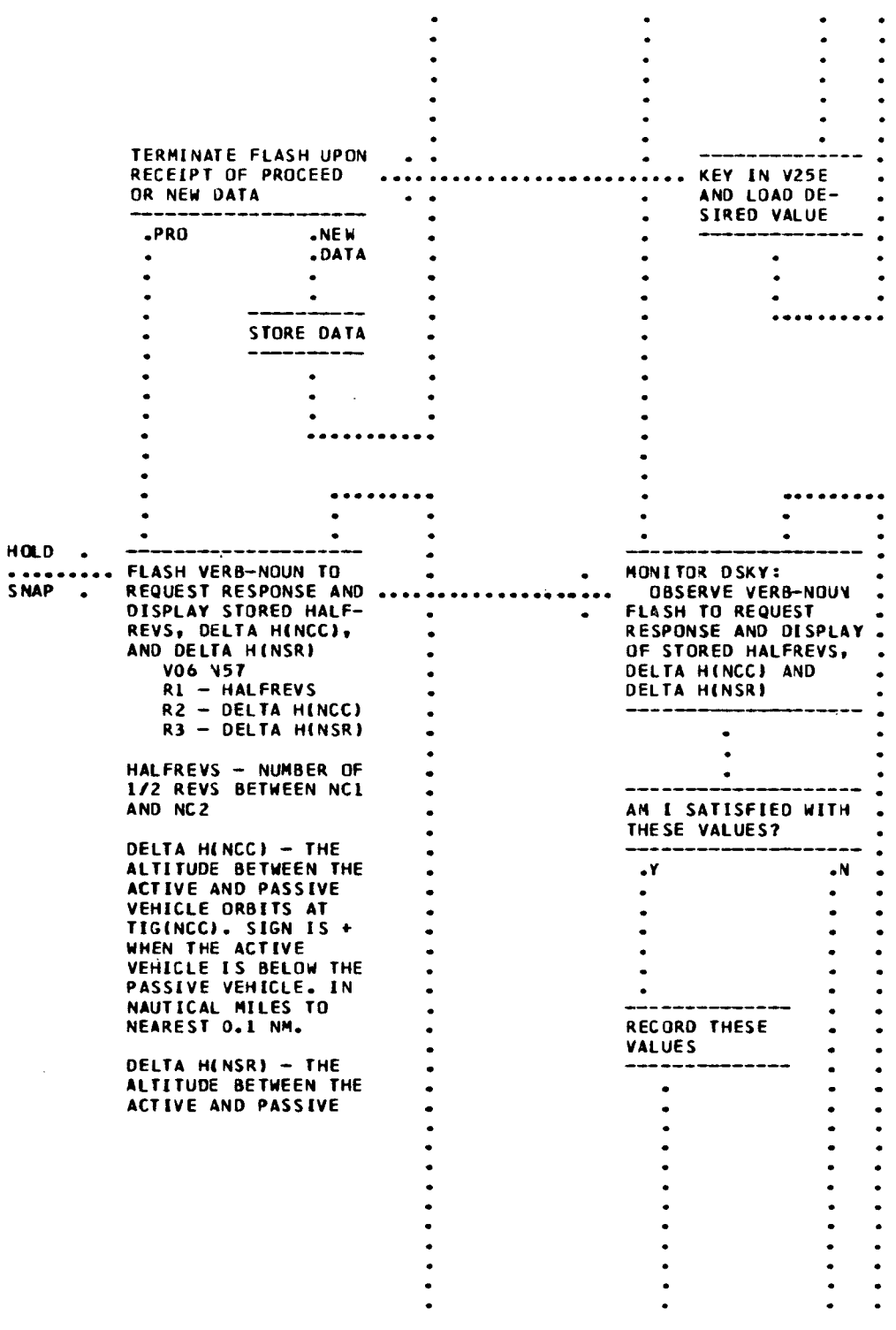
#20

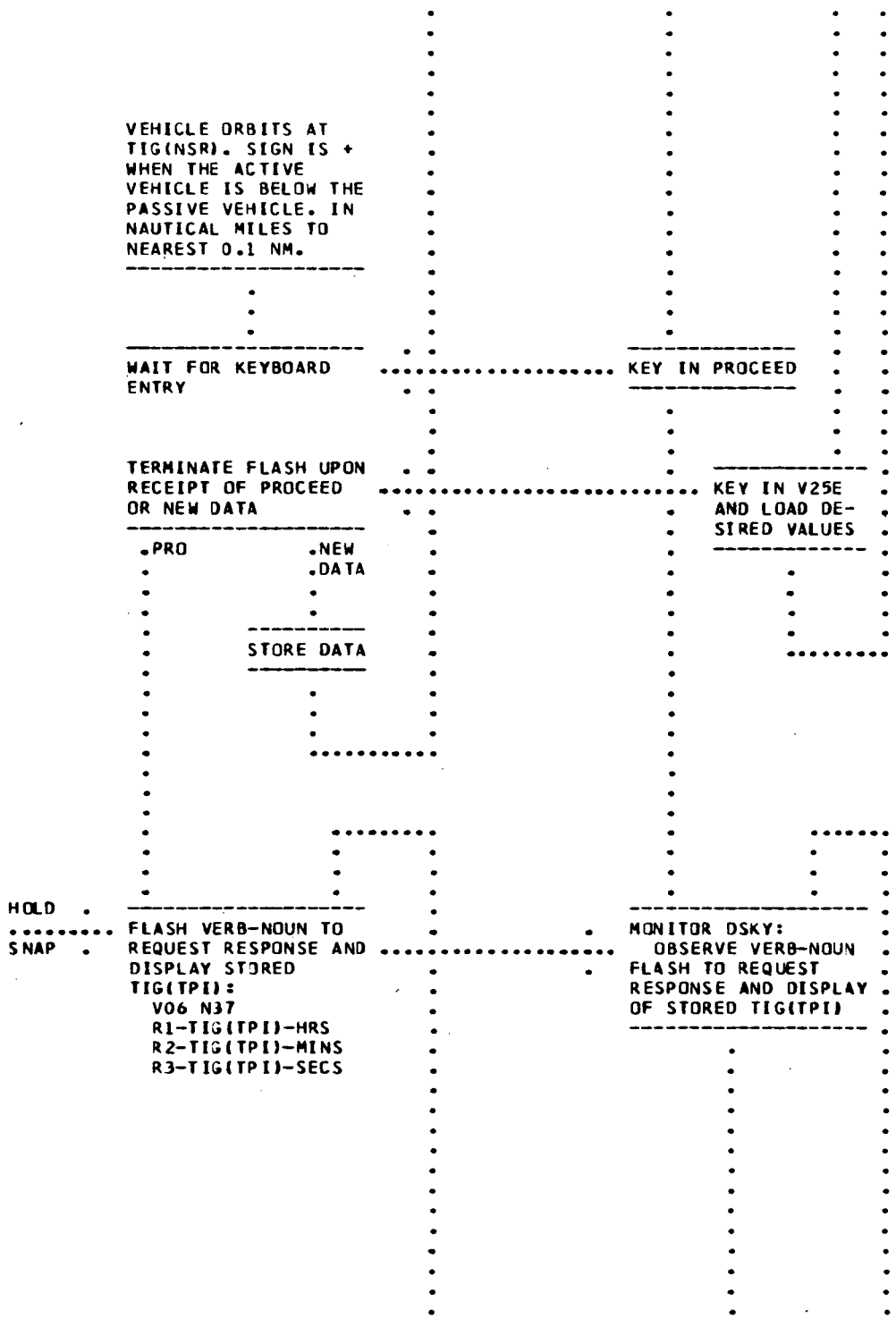
#30

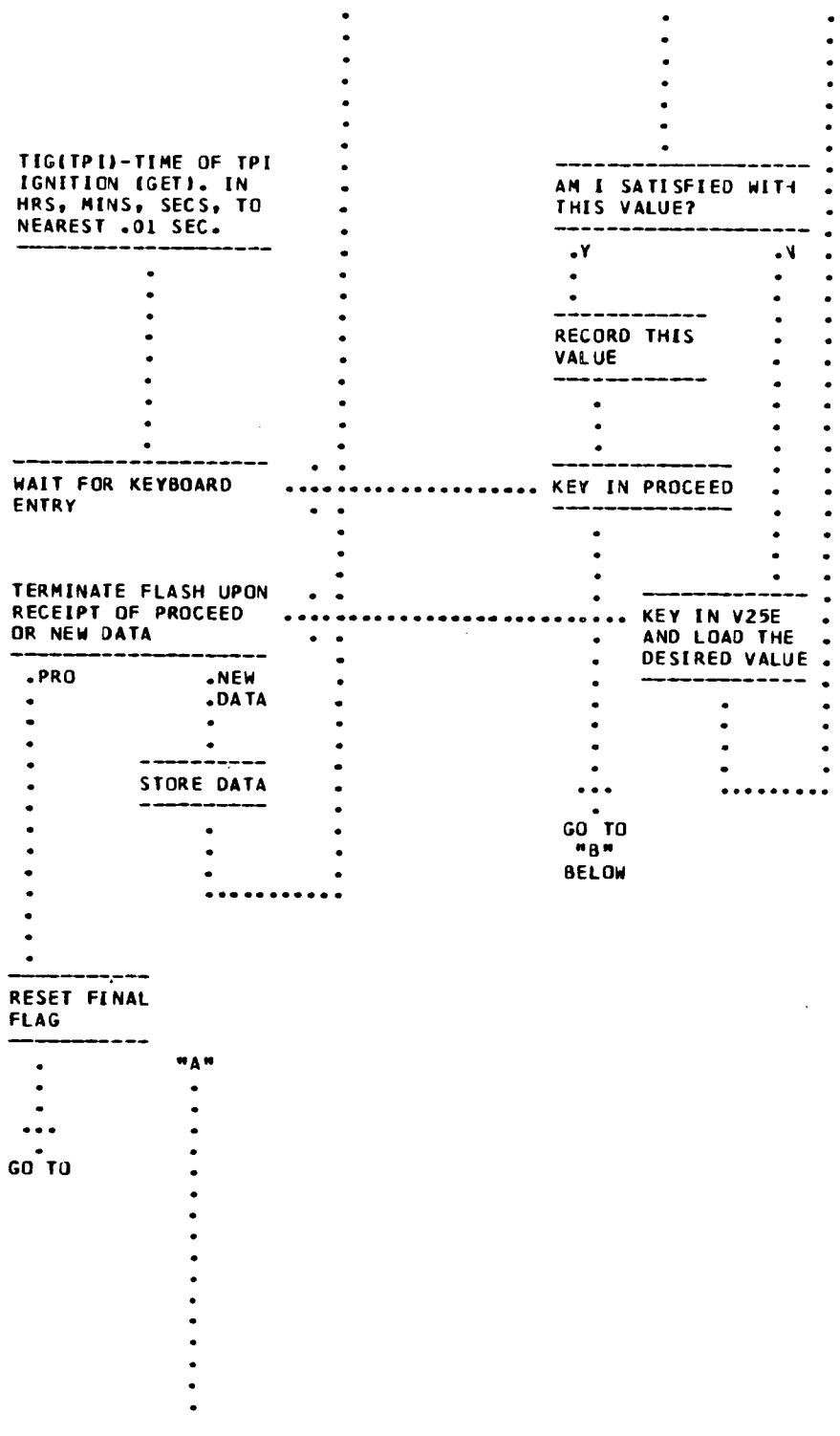
#40



#50
#60
#70
#80
#90
#100


TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
.PRO
.NEW DATA
STORE DATA
KEY IN V25E AND LOAD DESIRED VALUE
#110
#120
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED HALFREVS, DELTA H(NCC), AND DELTA H(NSR)
V06 N57
R1 - HALFREVS
R2 - DELTA H(NCC)
R3 - DELTA H(NSR)
HALFREVS - NUMBER OF 1/2 REVS BETWEEN NC1 AND NC2
DELTA H(NCC) - THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT TIG(NCC). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM.
DELTA H(NSR) - THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STORED HALFREVS, DELTA H(NCC) AND DELTA H(NSR)
#130
AM I SATISFIED WITH THESE VALUES?
.Y
.N
#140
RECORD THESE VALUES
#150


VEHICLE ORBITS AT TIG(NSR). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM.
WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
KEY IN V25E AND LOAD DESIRED VALUES
.PRO
.NEW DATA
STORE DATA
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED TIG(TPI):
V06 N37
R1-TIG(TPI)-HRS
R2-TIG(TPI)-MINS
R3-TIG(TPI)-SECS
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STORED TIG(TPI)
#160
#170
#180
#190



#200

#210

#220

#230

#240

```
                    .
                    .
                    .
                    .
                    .
                    .
 "B"                .
BELOW               .
                   ...
                    .
--------------------
BASED ON THE STORED
TARGET PARAMETERS,
COMPUTE AND STORE
THE FOLLOWING
PARAMETERS:
TIG(NC2) IN N28
TIG(NCC) IN N11
++      TIG(NSR) IN N13
+01     DELTA V(LV) FOR NC1
+             IN N81
+       DELTA V(NC2) IN R1
+                    N84
+       DELTA H(NC2) IN R2
+                    N84
+489    DELTA V(NCC) IN R3
++                   N84
        DELTA V(LV) FOR NSR
              IN N82

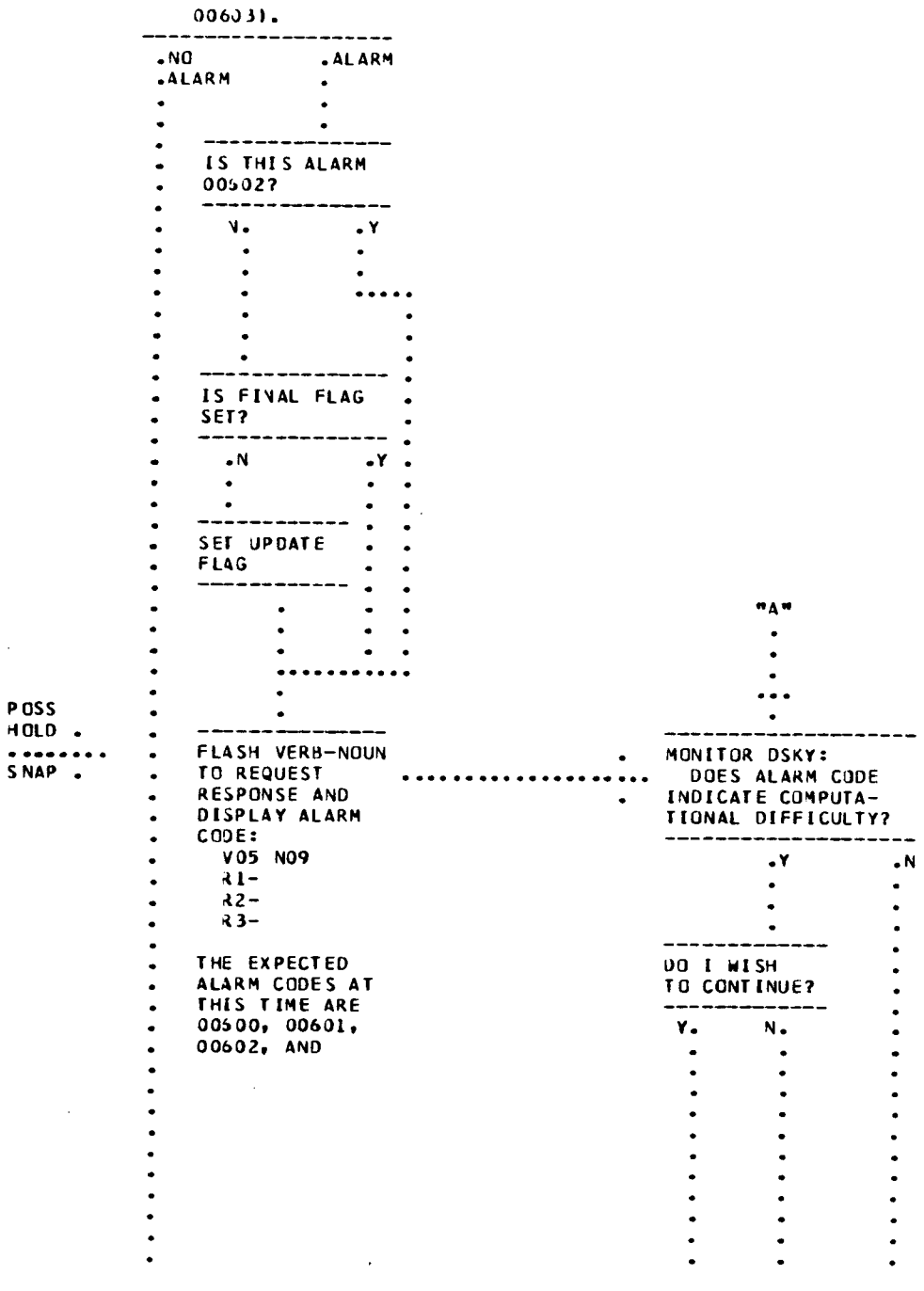
ESTABLISH ALARM IF:
(A) FAILURE IN THE
    PHASE MATCH
    ITERATION.
    (ALARM CODE
    00600).

(B) FAILURE IN EITHER
    THE NC2 OR NCC
    HEIGHT MANEUVER
    ITERATIONS
    (ALARM CODE
    00601).

(C) FAILURE IN THE
    OUTER (PHASE)
    LOOP ITERATION
    (ALARM CODE
    00602).

(D) FAILURE IN THE
    QRDTPI ITERATION
    (ALARM CODE
```

#250 #260 #270 #280 #290



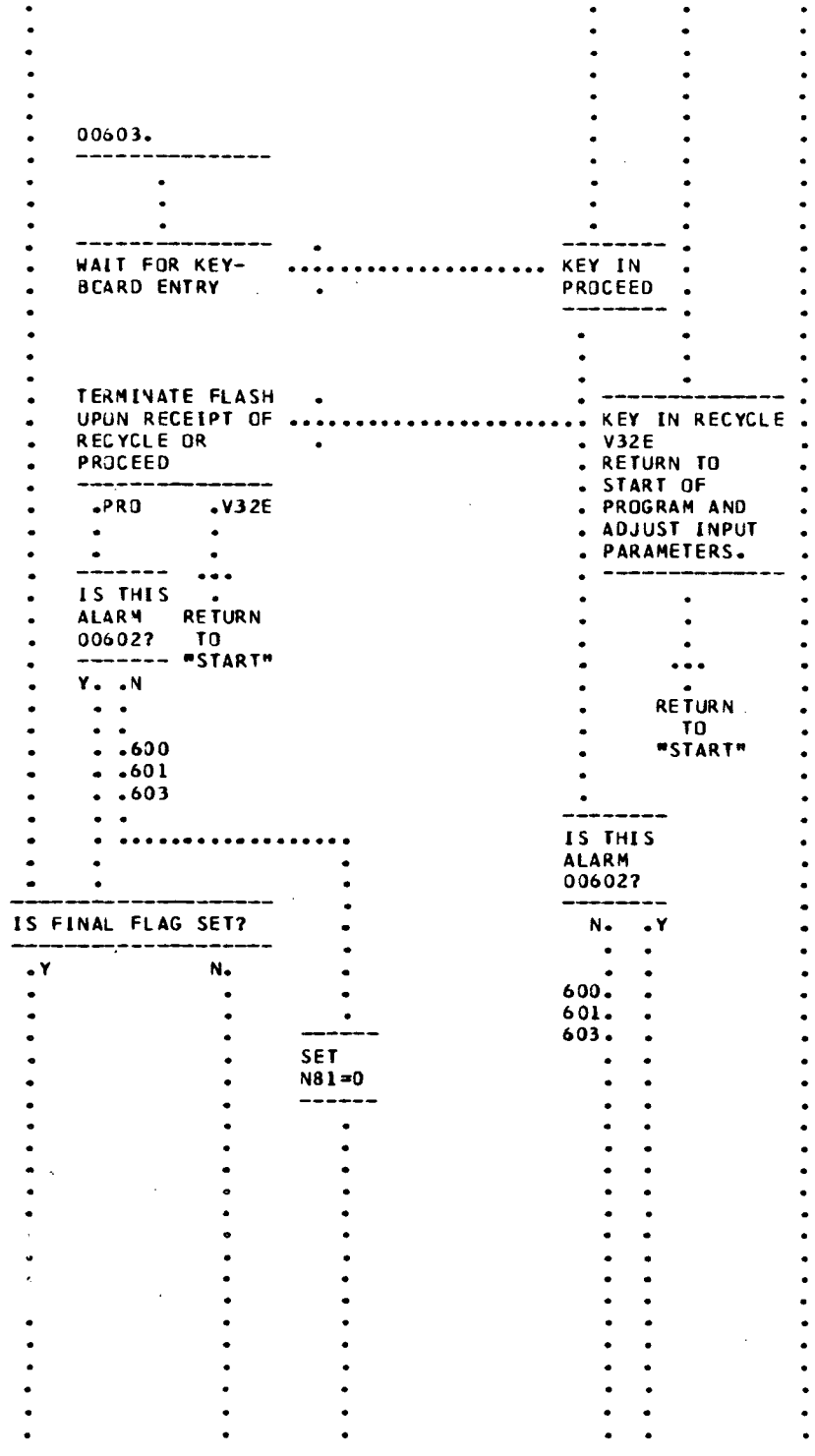
#300

#310

#320

#330

#340



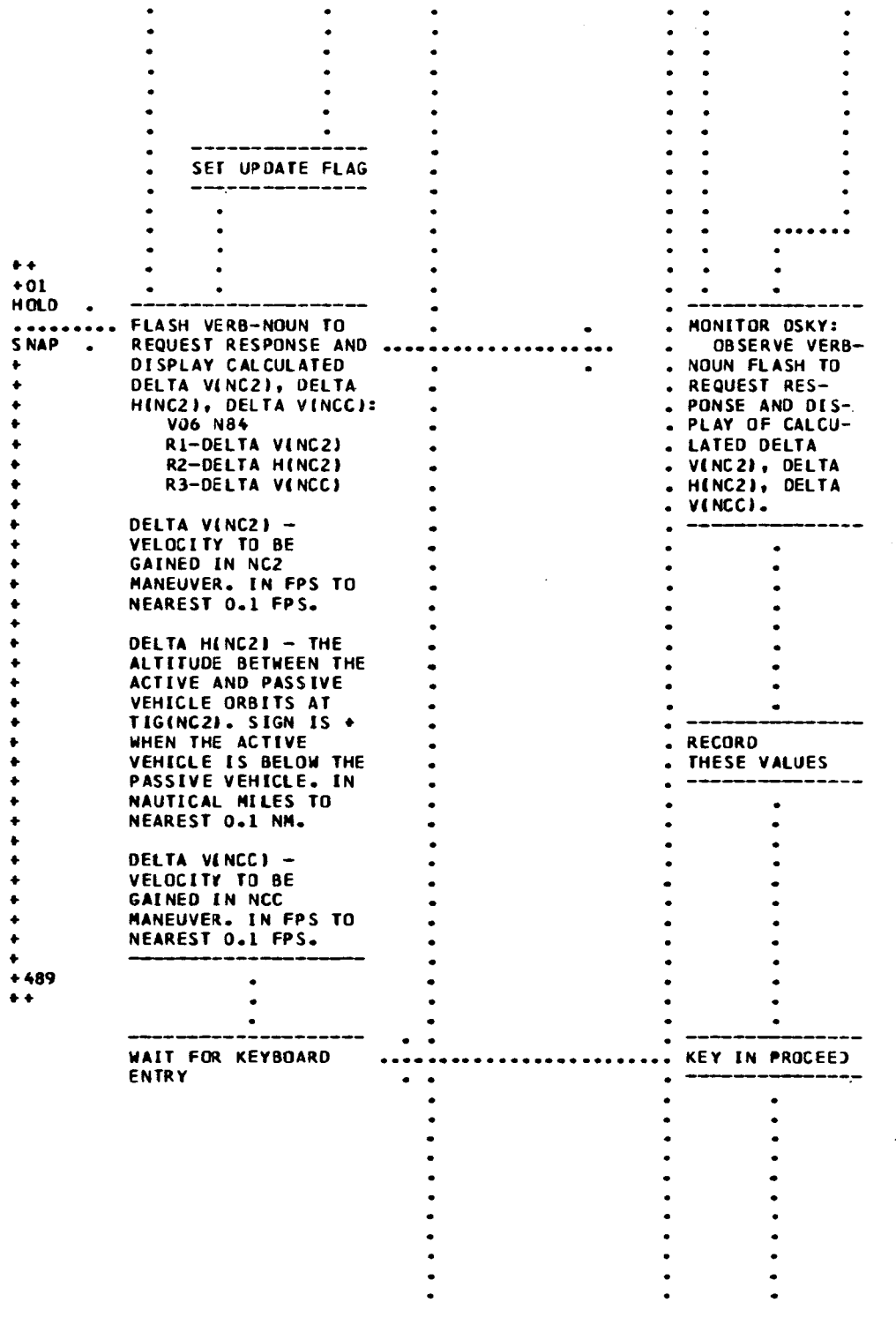
#350

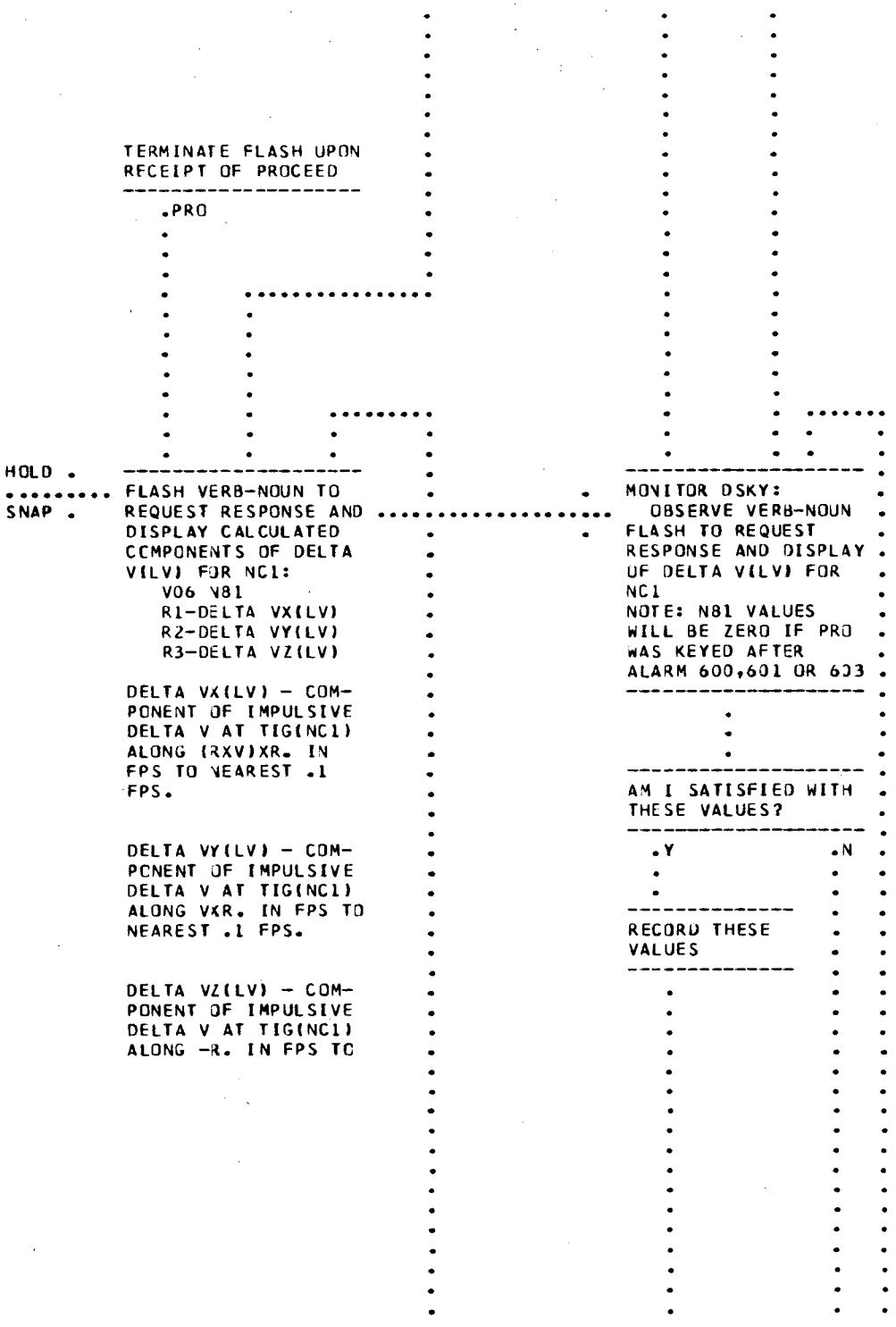
#360

#370

#380

#390


SET UPDATE FLAG
++
+01
HOLD
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY CALCULATED DELTA V(NC2), DELTA H(NC2), DELTA V(NCC):
V06 N84
R1-DELTA V(NC2)
R2-DELTA H(NC2)
R3-DELTA V(NCC)
SNAP
DELTA V(NC2) - VELOCITY TO BE GAINED IN NC2 MANEUVER. IN FPS TO NEAREST 0.1 FPS.
DELTA H(NC2) - THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT TIG(NC2). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM.
DELTA V(NCC) - VELOCITY TO BE GAINED IN NCC MANEUVER. IN FPS TO NEAREST 0.1 FPS.
+489
++
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF CALCULATED DELTA V(NC2), DELTA H(NC2), DELTA V(NCC).
RECORD THESE VALUES
KEY IN PROCEED
#400
#410
#420
#430
#440

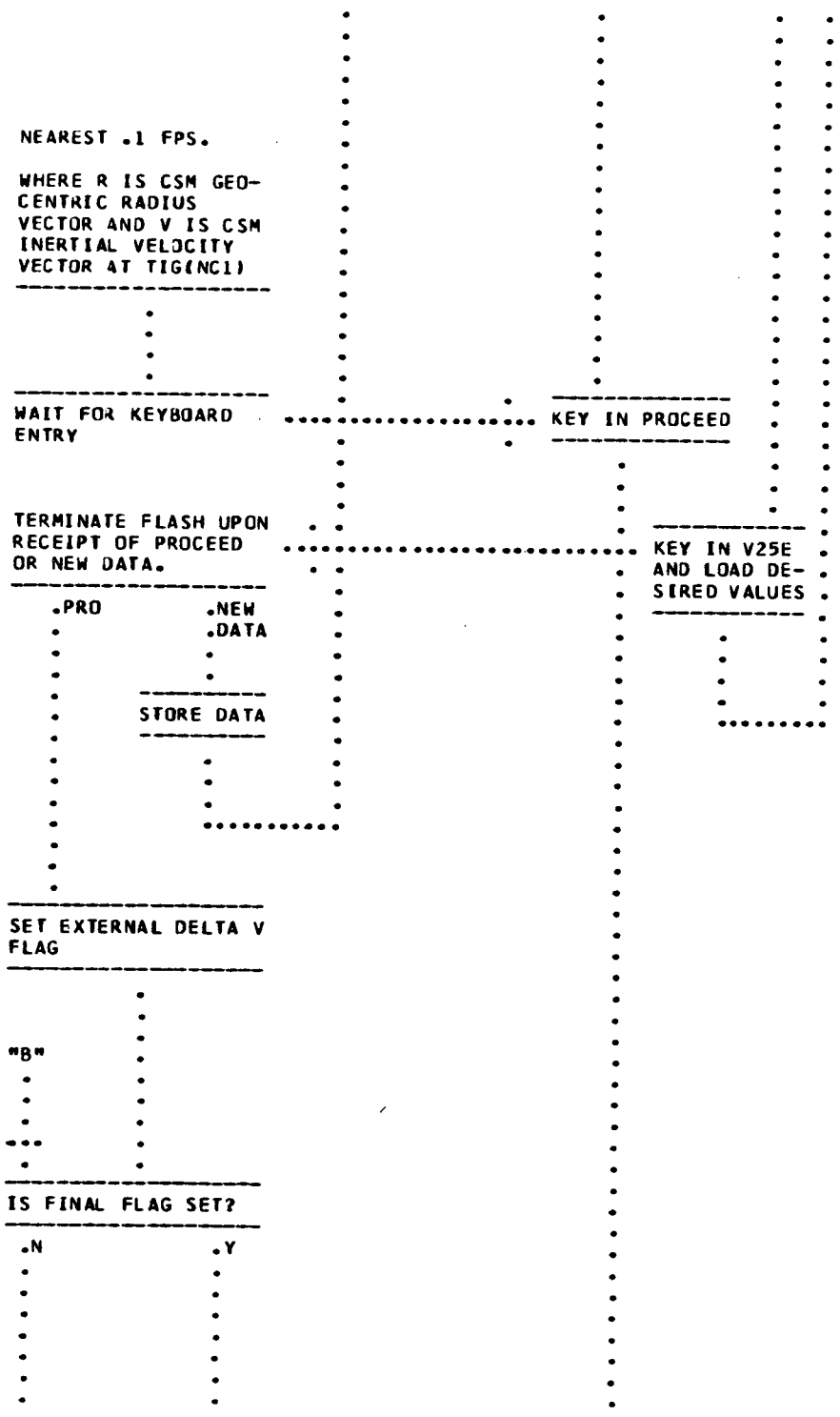


#450

#460

#470

#480



#490

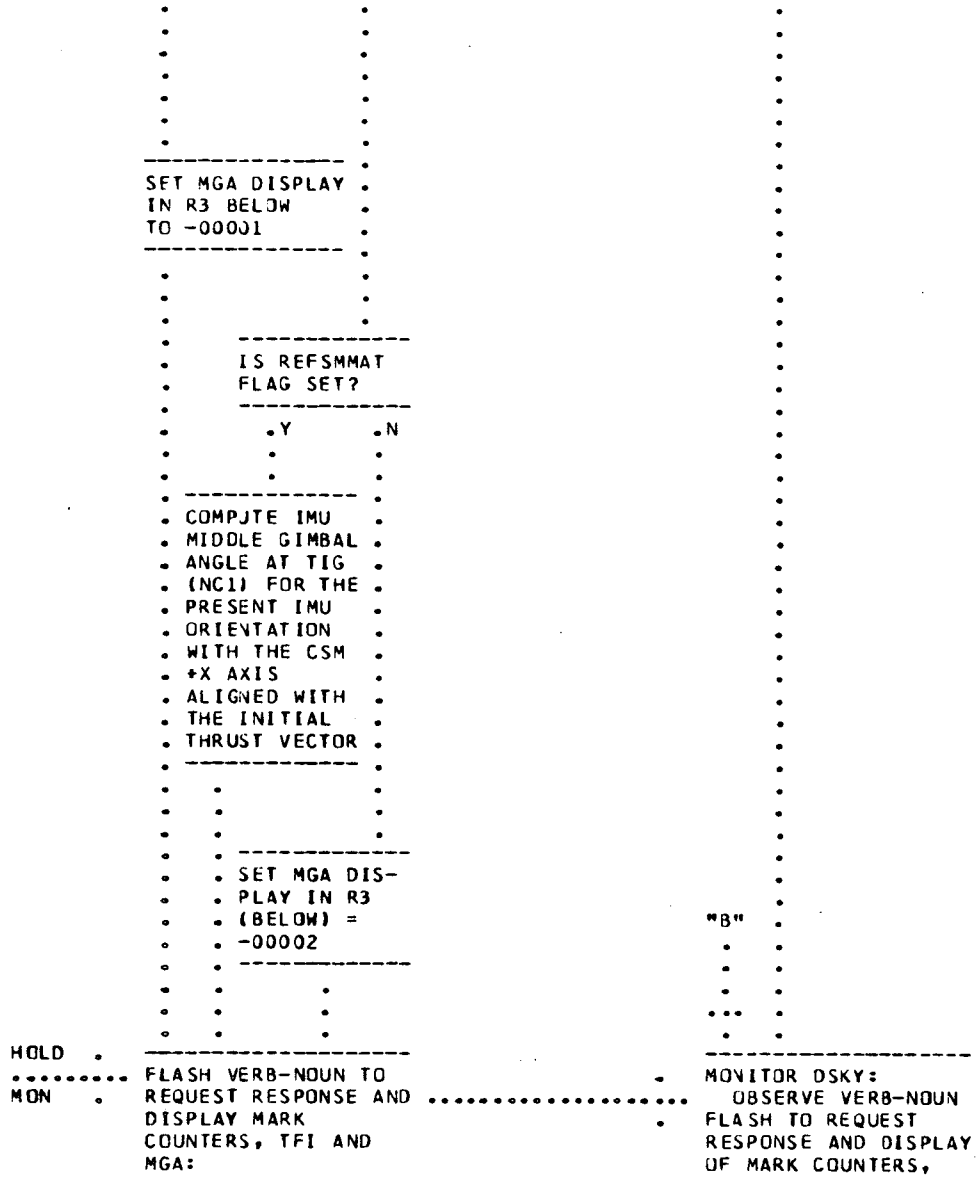
#500

#510

#520

#530

#540



#550

#560

#570

#580

#590

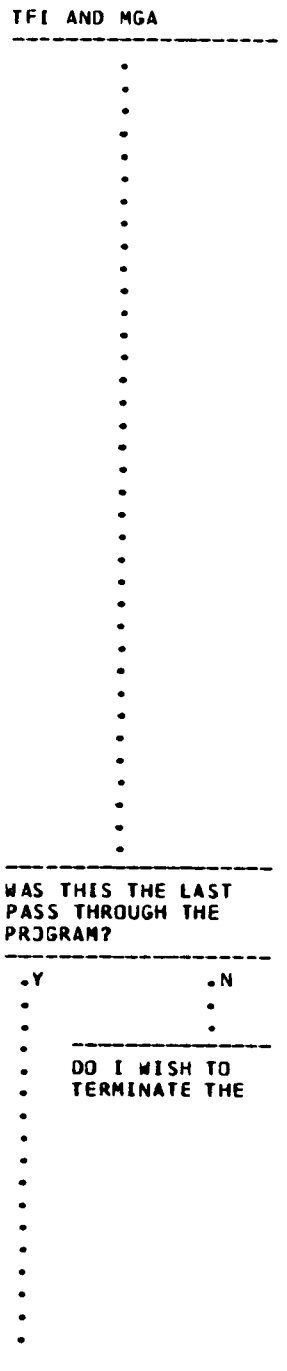
V16 N45
R1-MARK COUNTERS
R2-TFI
R3-MGA

MARK COUNTERS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE THE LAST W-MATRIX REINITIALIZATION (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBXX WHERE THE TWO MOST SIGNIFICANT DIGITS COMPRISE THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS COMPRISE THE OPTICS MARK COUNTER. (NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.)

TFI-TIME FROM TIG(NC1). IN MIN AND SEC TO NEAREST SEC. MAX READING IS 59859 SIGN IS - BEFORE, + AFTER TIG(NC1).

MGA-MIDDLE GIMBAL ANGLE AT TIG(NC1) IF CSM +X AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION. IN DEGREES TO THE NEAREST .01 DEGREE. SIGN IS ALWAYS + EXCEPT:

(A) WHEN DISPLAYED

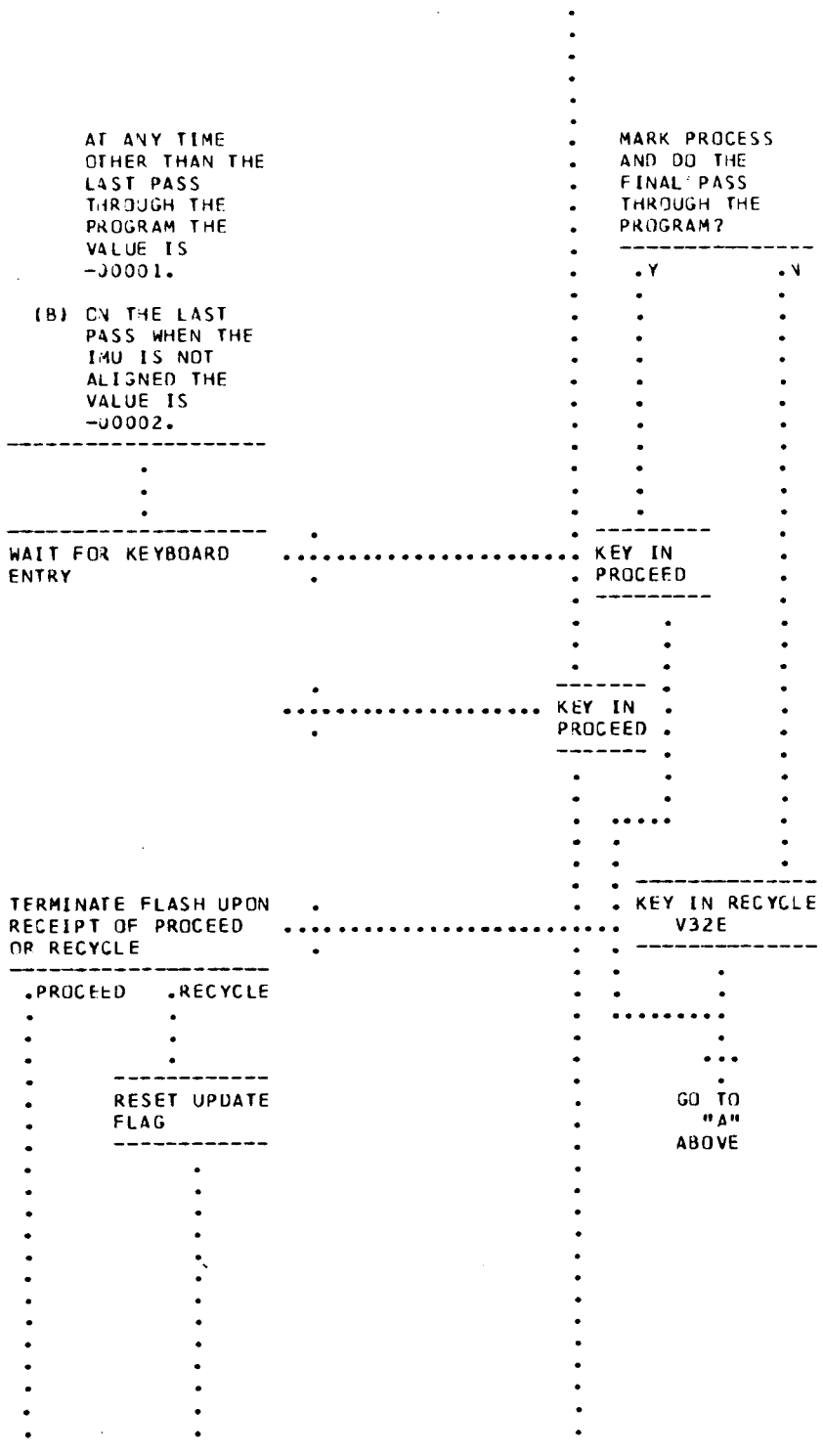


#600

#610

#620

#630



#640

#650

#660

#670

#680

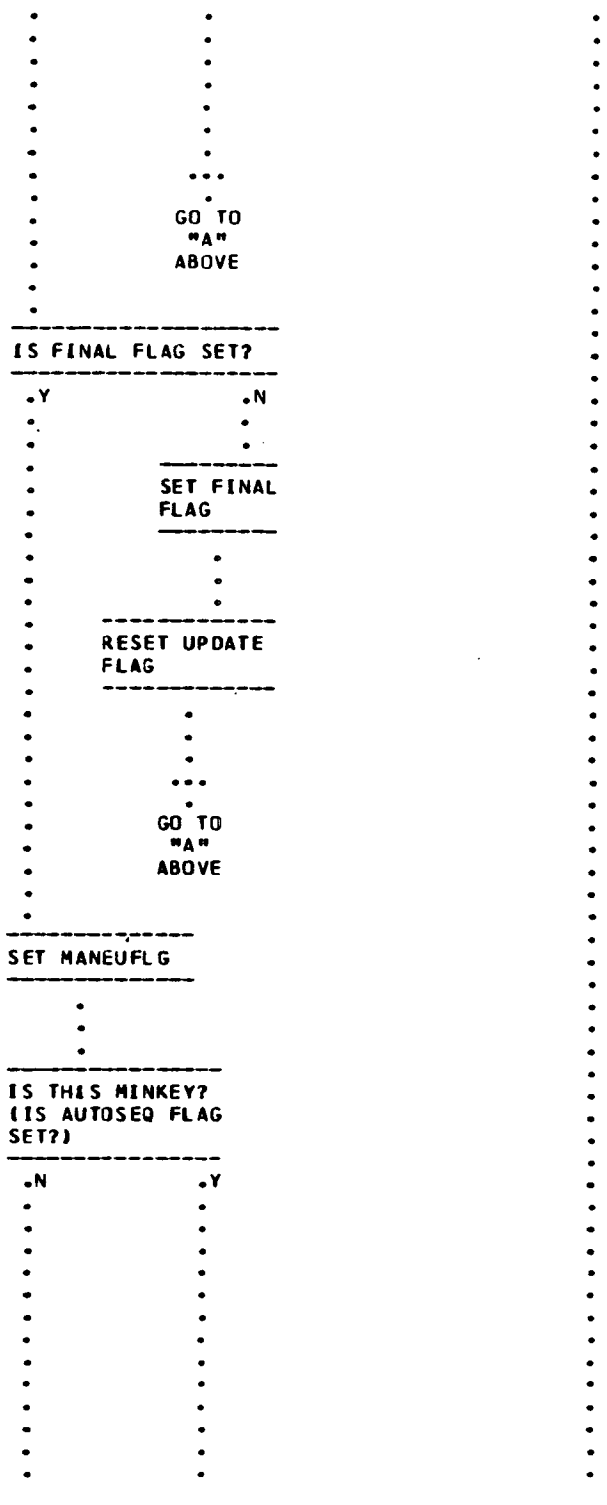
#690

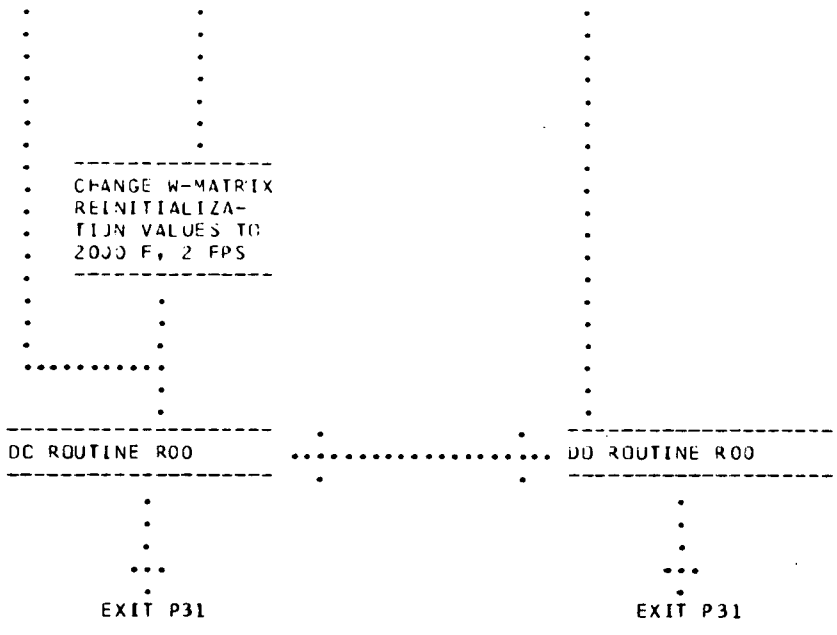
#700

#710

#720

#730





#740

#750

#760

CHANGE CONTROL NOTES

REV 00 PCR 042,448, PCN 411, SL MEMO #2
REV 01 PCN 489

NC2 TARGETING PROGRAM (P32) REV 01 03/20/72

PURPOSE: (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NC2 MANEUVER FOR DELTA V BURNS.

(2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NC2 MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE NC2 TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) AT A SELECTED TPI TIME, THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS IS SELECTED TO BE A PRESCRIBED ANGLE (E) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE POSITION.

(2) THE NC2 AND NCC MANEUVERS ARE CONSTRAINED TO BE HORIZONTAL MANEUVERS.

(3) THE NSR MANEUVER IS CONSTRAINED TO RESULT IN COELLIPTIC ORBITS FOLLOWING THE MANEUVER.

(4) THE FOLLOWING TIME CONSTRAINTS APPLY:

A) THE TPI TIME AND THE TIME BETWEEN THE NCC AND NSR MANEUVERS ARE SPECIFIED (DSKY INPUT AND PAD-LOAD RESPECTIVELY).

B) THE TIME BETWEEN THE NC2 AND NCC MANEUVERS IS INDIRECTLY SPECIFIED BY SPECIFYING THE NUMBER OF REVOLUTIONS INVOLVED IN THE TRANSFER BETWEEN THE MANEUVERS (PAD-LOAD).

++
+01 (5) THE ALTITUDE BETWEEN THE OWS ORBIT AND THE CSM AT NSR IS SPECIFIED (DSKY INPUT).
+
+489 (6) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE
++ NORMALLY LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR CONCENTRIC FLIGHT PLAN MANEUVER SEQUENCES.

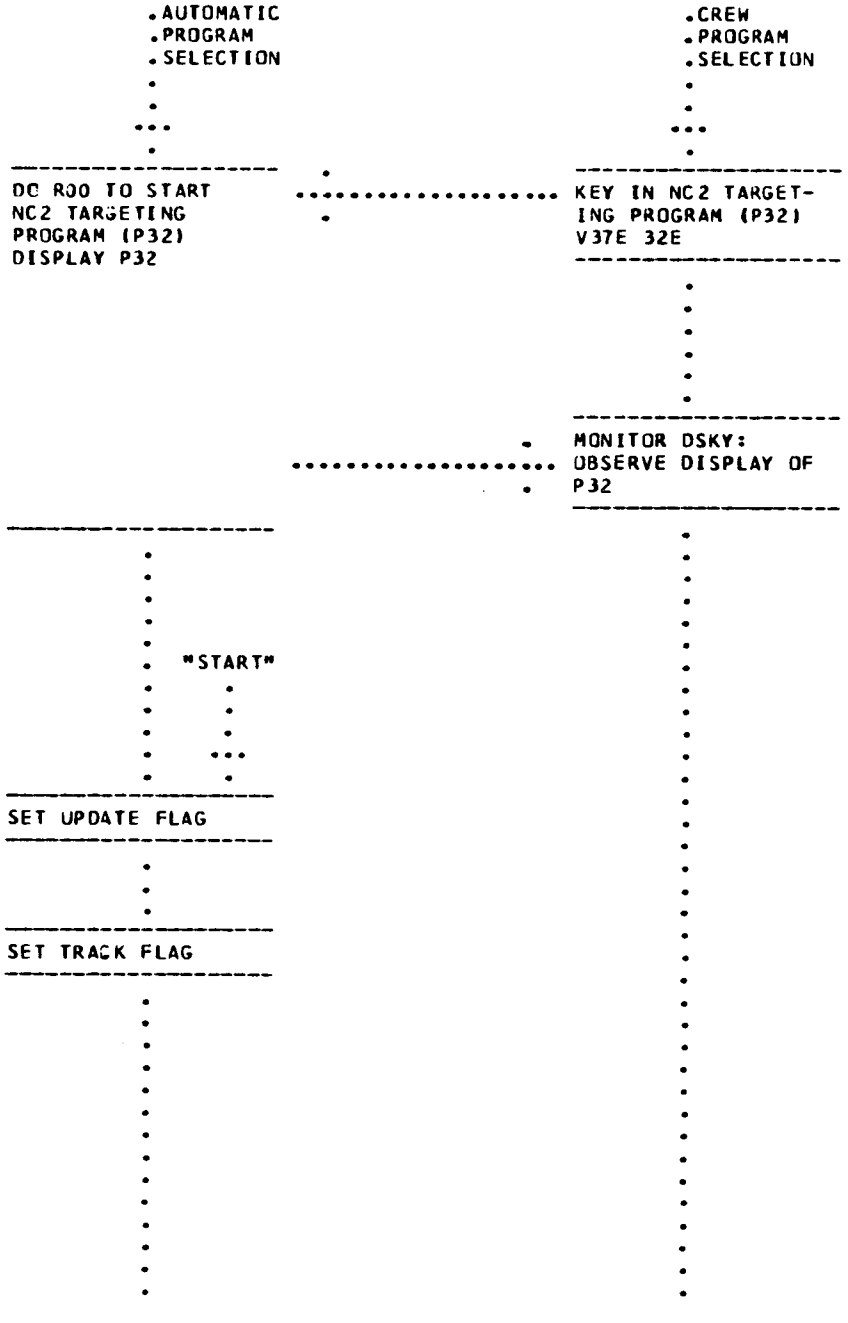
(7) IF P20 IS IN OPERATION WHILE THE PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

(8) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

PROG	CMC	GROUND	CREW

CONT

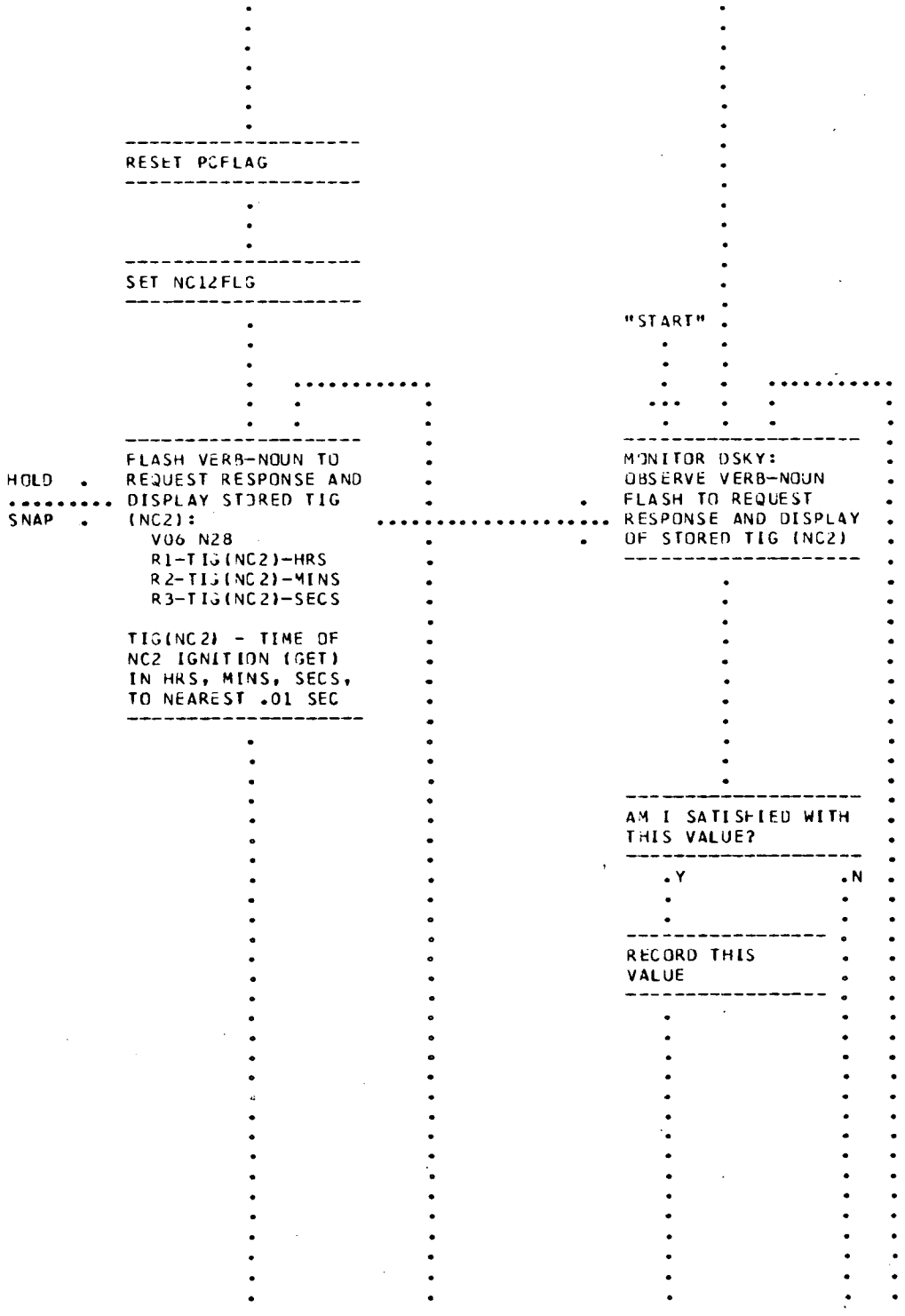


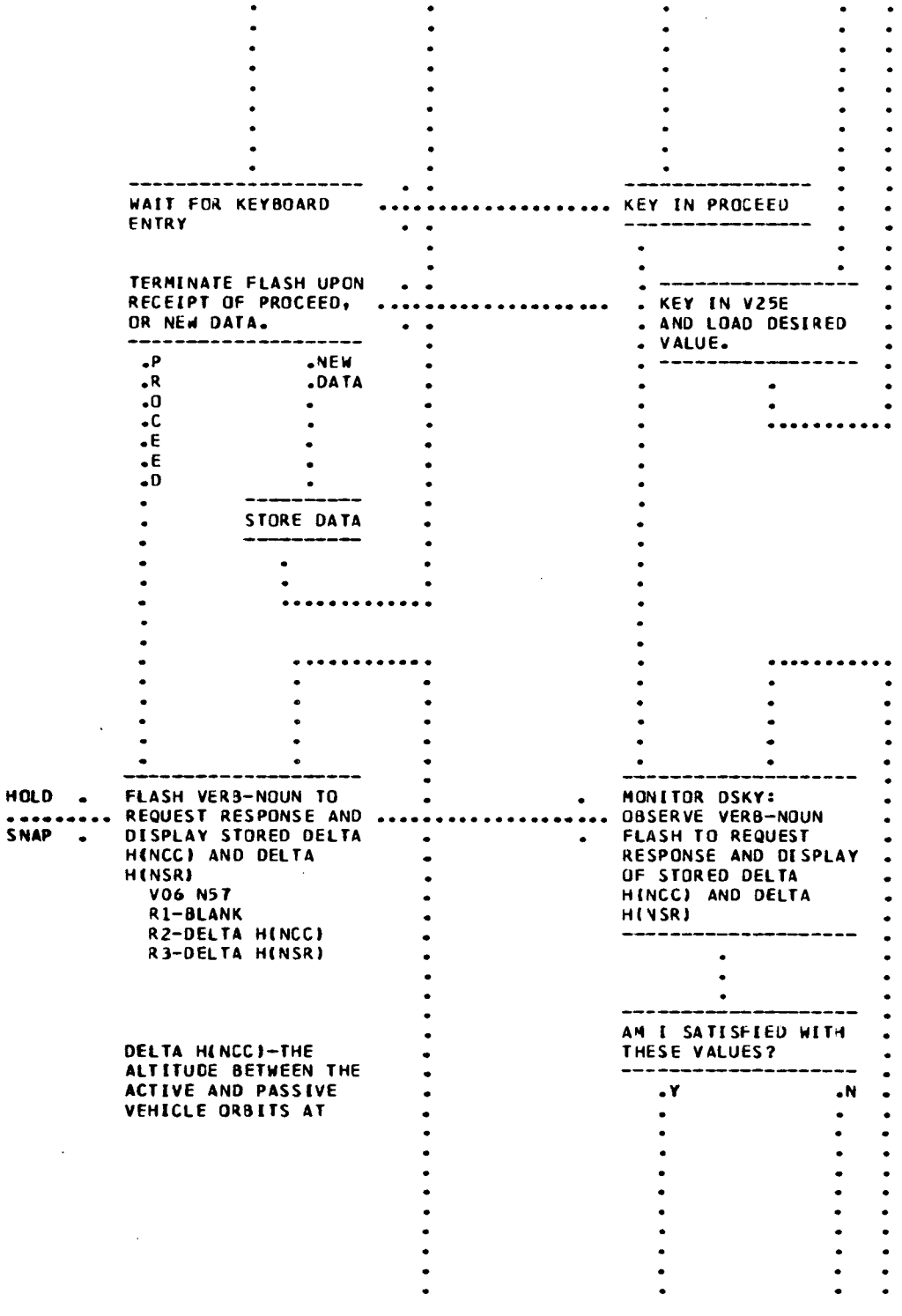
#10

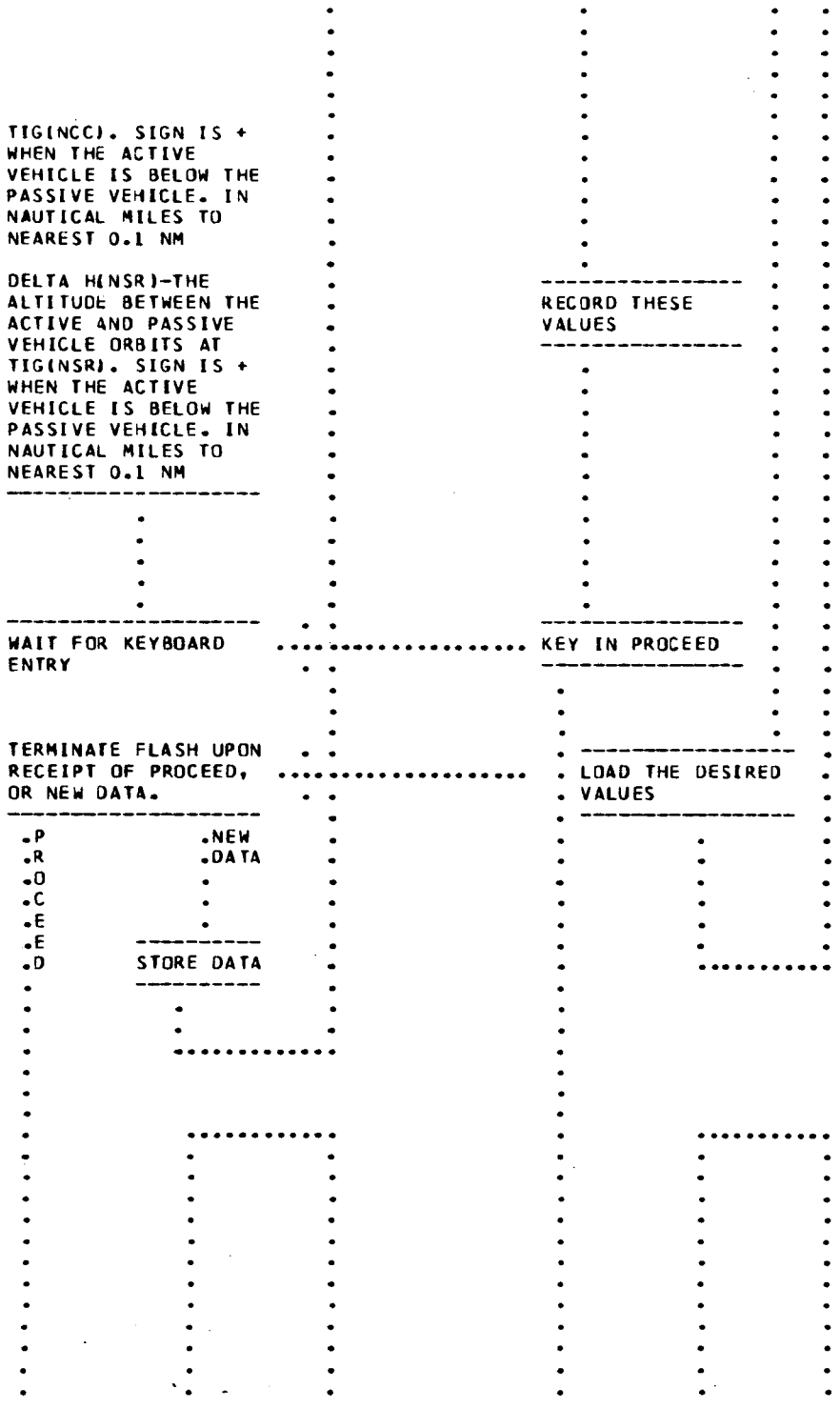
#20

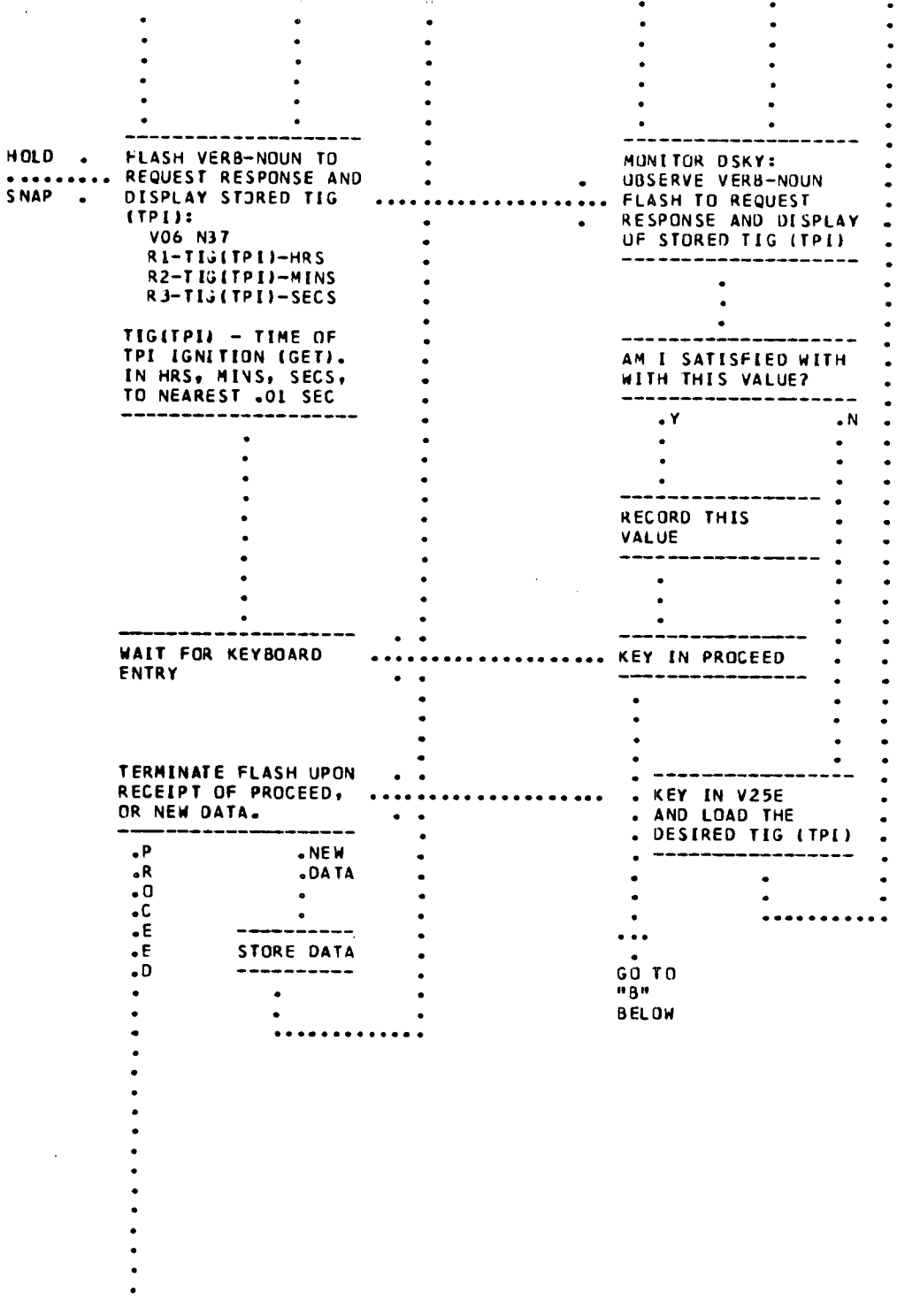
#30

#40


RESET PCFLAG
SET NC12FLG
"START"
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED TIG (NC2):
V06 N28
R1-TIG(NC2)-HRS
R2-TIG(NC2)-MINS
R3-TIG(NC2)-SECS
TIG(NC2) - TIME OF NC2 IGNITION (GET) IN HRS, MINS, SECS, TO NEAREST .01 SEC
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STORED TIG (NC2)
AM I SATISFIED WITH THIS VALUE?
Y
N
RECORD THIS VALUE
#50
#60
#70
#80
#90


WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
#100
TERMINATE FLASH UPON RECEIPT OF PROCEED, OR NEW DATA.
KEY IN V25E AND LOAD DESIRED VALUE.
.PROCEED
.NEW DATA
#110
STORE DATA
#120
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED DELTA H(NCC) AND DELTA H(NSR)
V06 N57
R1-BLANK
R2-DELTA H(NCC)
R3-DELTA H(NSR)
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STORED DELTA H(NCC) AND DELTA H(NSR)
#130
#140
DELTA H(NCC)-THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT
AM I SATISFIED WITH THESE VALUES?
.Y
.N


TIG(NCC). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM
DELTA H(NSR)-THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT TIG(NSR). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM
RECORD THESE VALUES
#150
#160
WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
#170
TERMINATE FLASH UPON RECEIPT OF PROCEED, OR NEW DATA.
LOAD THE DESIRED VALUES
.P
.R
.O
.C
.E
.E
.D
.NEW
.DATA
STORE DATA
#180
#190



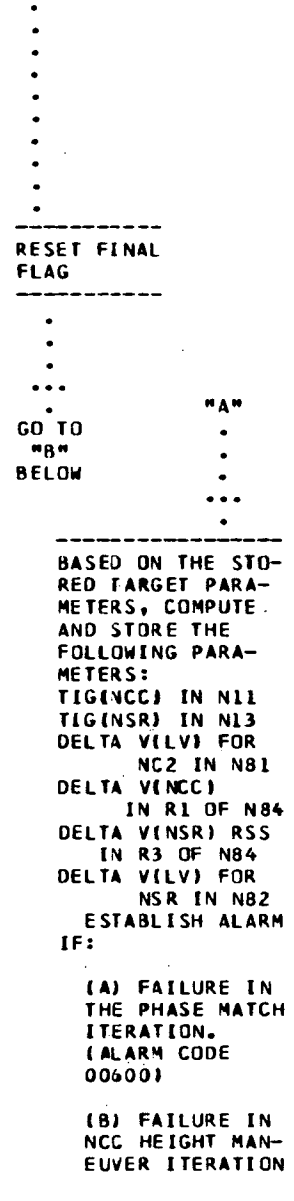
#200

#210

#220

#230

#240



#250

#260

#270

#280

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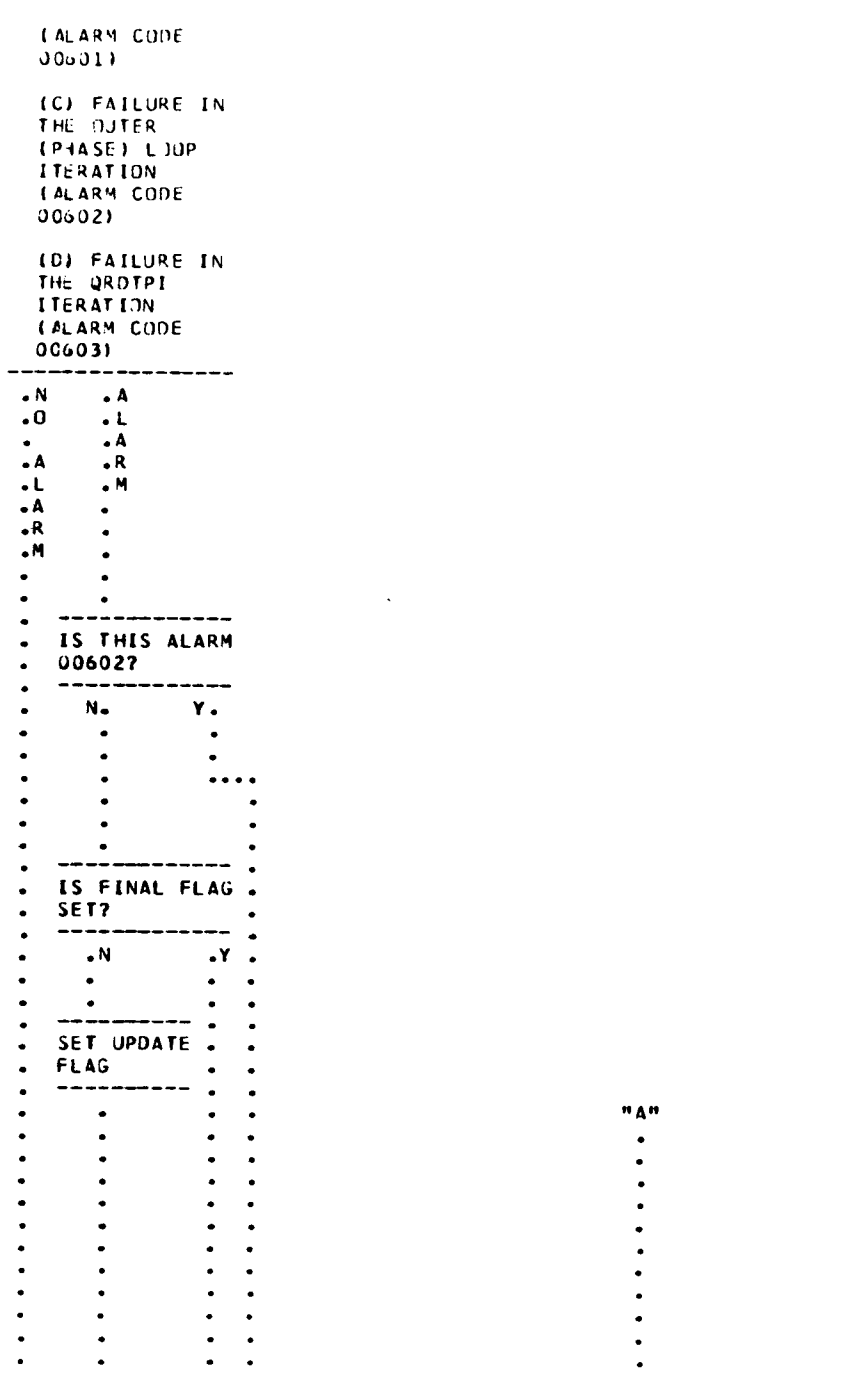

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#320

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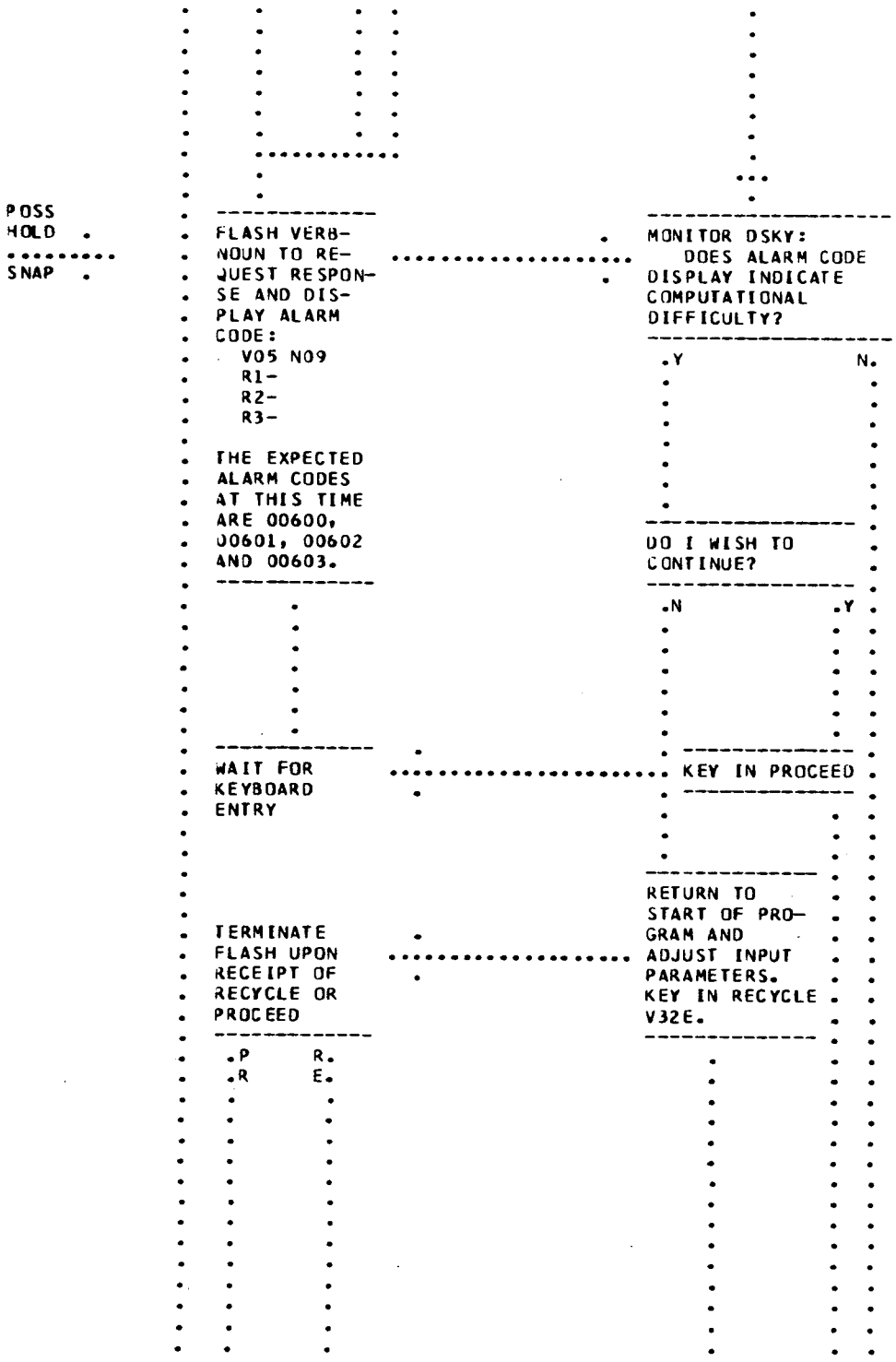
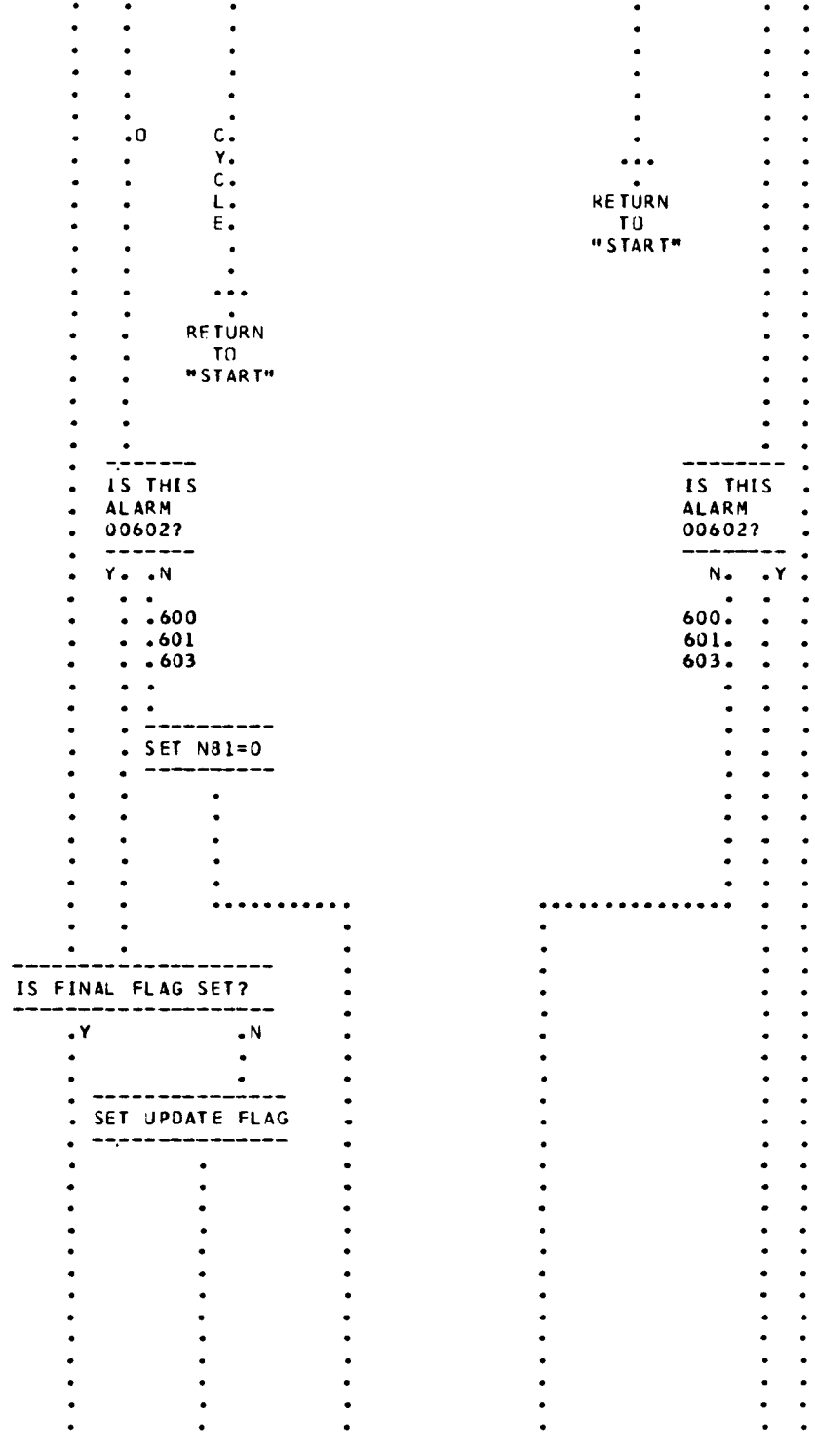


#350

#360

#370

#380



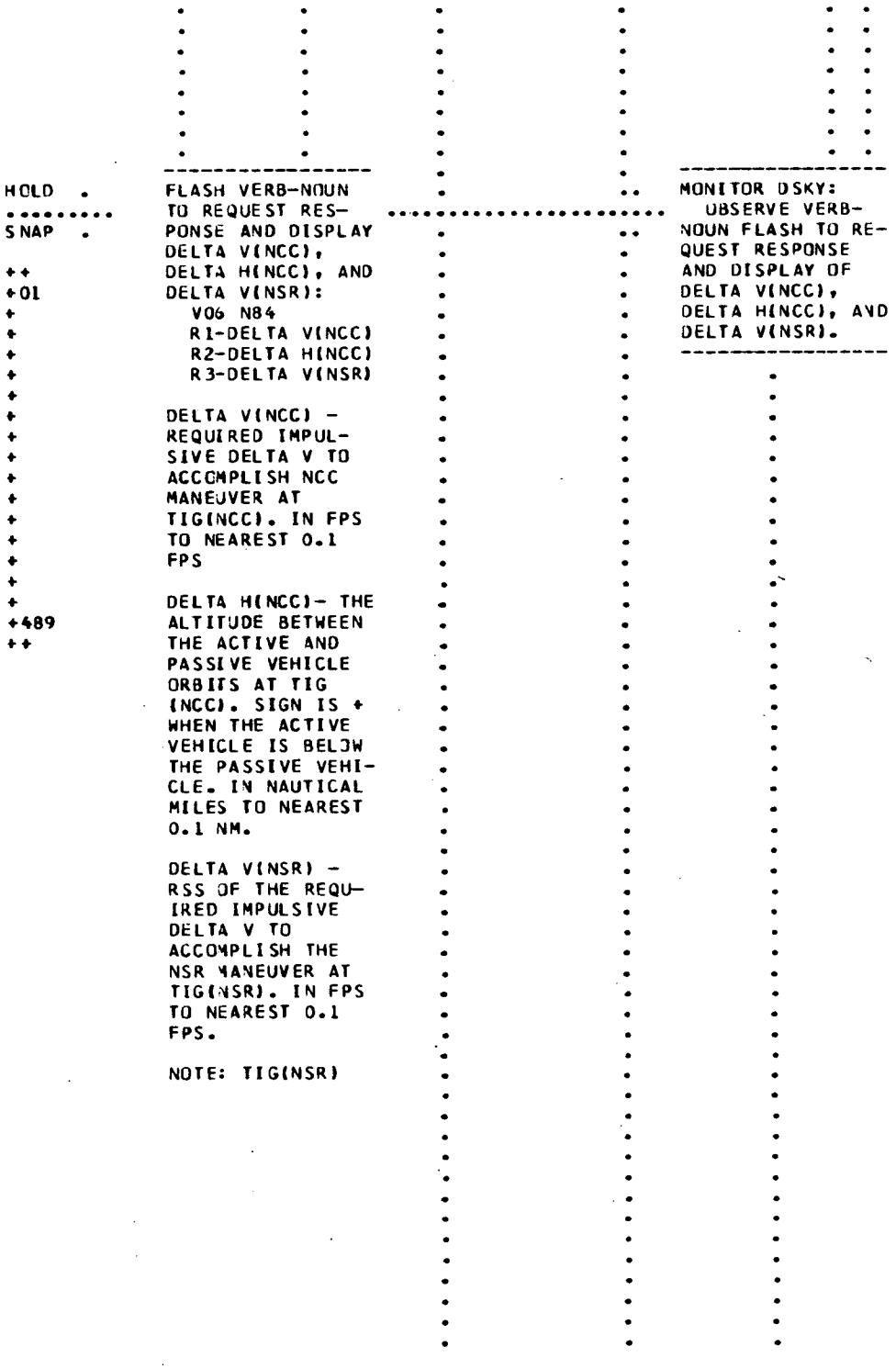
#390

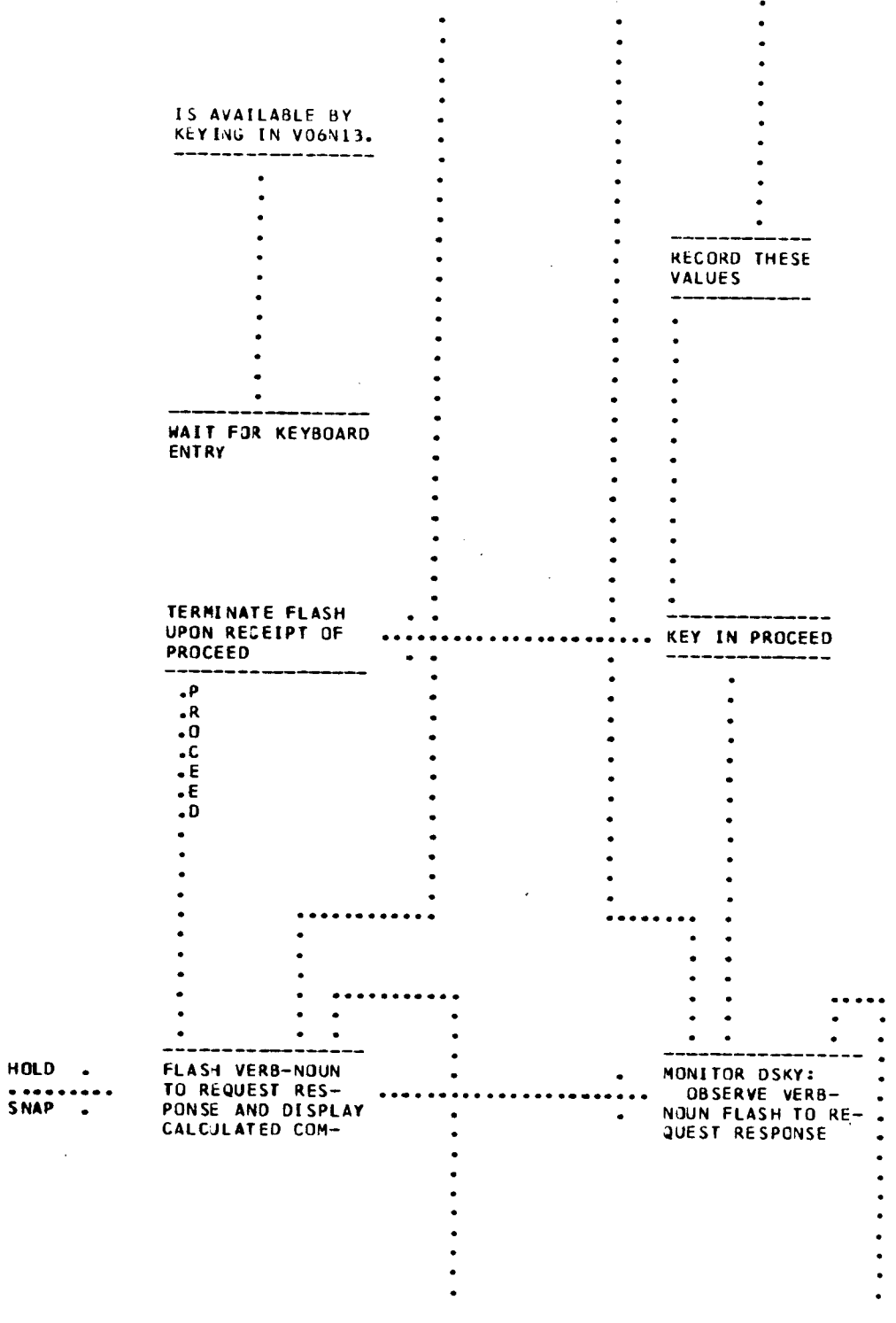
#400

#410

#420

#430


HOLD
SNAP
++
+01
+
+489
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DELTA V(NCC), DELTA H(NCC), AND DELTA V(NSR):
V06 N84
R1-DELTA V(NCC)
R2-DELTA H(NCC)
R3-DELTA V(NSR)
DELTA V(NCC) - REQUIRED IMPULSIVE DELTA V TO ACCOMPLISH NCC MANEUVER AT TIG(NCC). IN FPS TO NEAREST 0.1 FPS
DELTA H(NCC)- THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT TIG (NCC). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO NEAREST 0.1 NM.
DELTA V(NSR) - RSS OF THE REQUIRED IMPULSIVE DELTA V TO ACCOMPLISH THE NSR MANEUVER AT TIG(NSR). IN FPS TO NEAREST 0.1 FPS.
NOTE: TIG(NSR)
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF DELTA V(NCC), DELTA H(NCC), AND DELTA V(NSR).
#440
#450
#460
#470
#480



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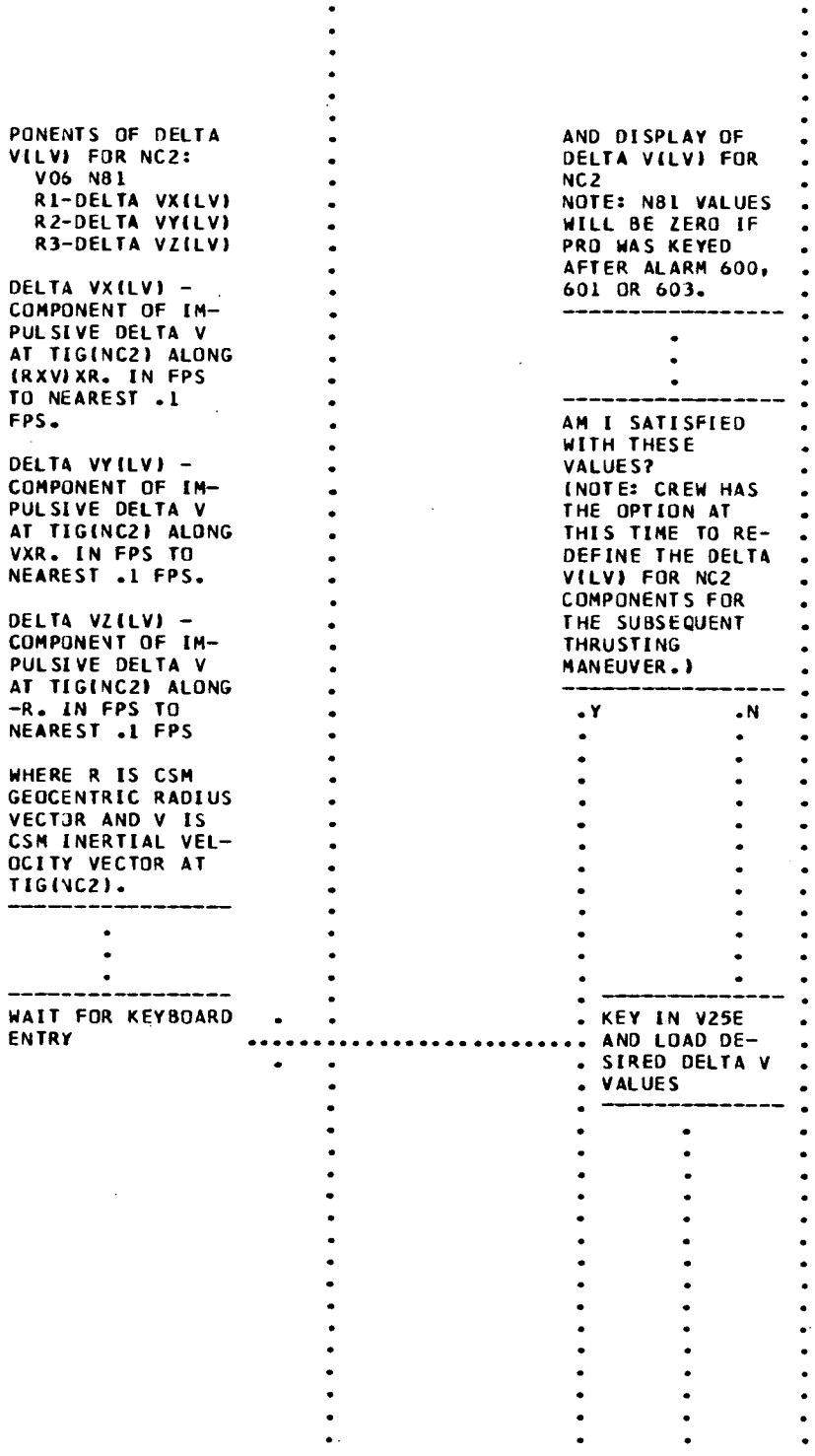

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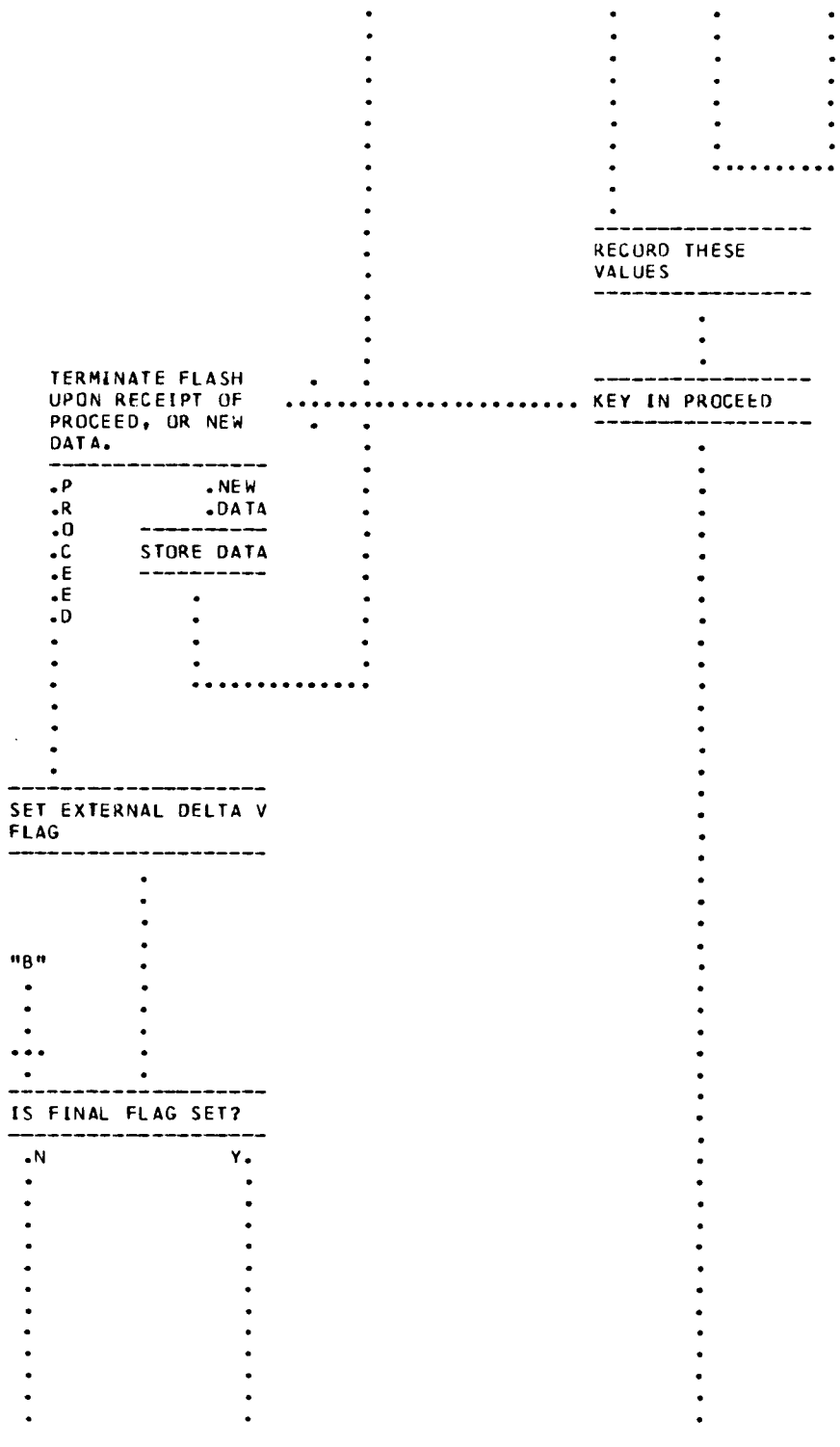
#570

#580



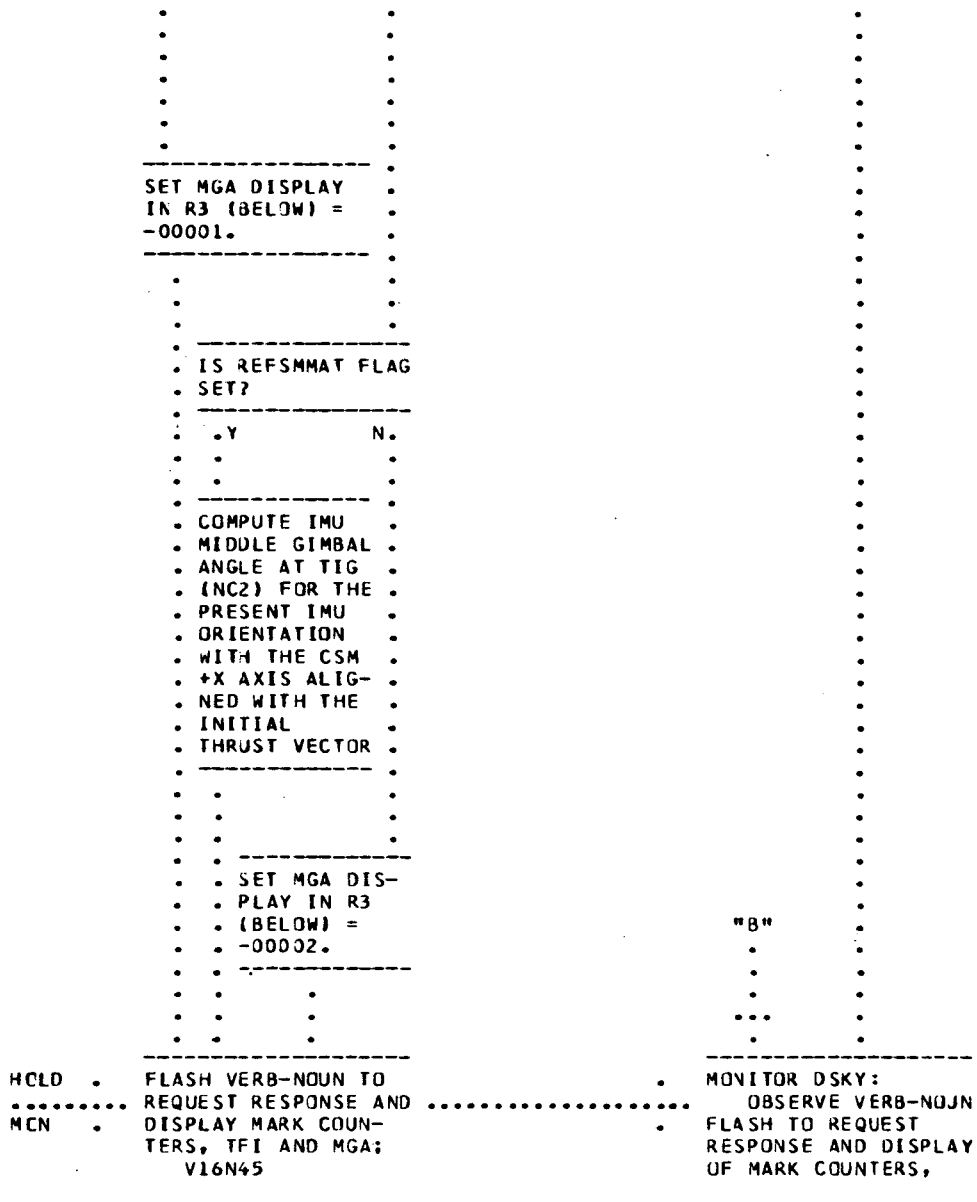
#590

#600

#610

#620

#630



#640

#650

#660

#670

#680

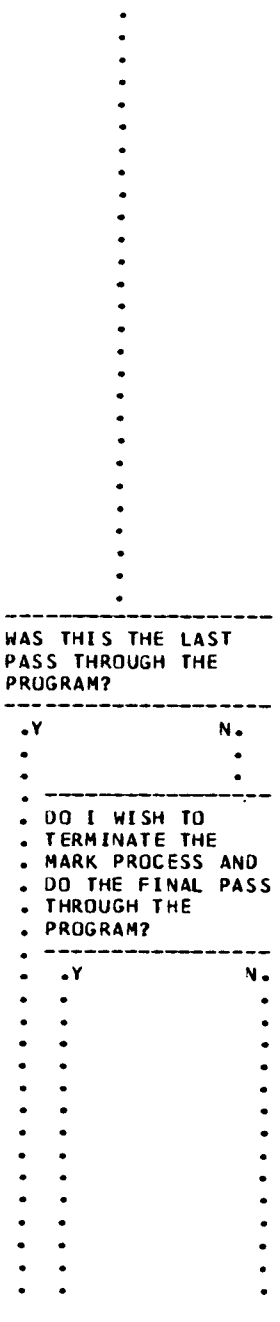
R1-MARK COUNTERS
R2-TFI
R3-MGA

MARK COUNTERS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE THE LAST W-MATRIX REINITIALIZATION (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBXX WHERE THE TWO MOST SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNI-FICANT DIGITS IS THE OPTICS MARK COUNTER. (NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BE-TWEEN BACKUP AND PRIMARY MARKS.)

TFI - TIME FROM TIG (NC2). IN MIN AND SEC TO NEAREST SEC. MAX READING IS 59859. SIGN IS - BEFORE, + AFTER TIG(NC2).

MGA - MIDDLE GIMBAL ANGLE AT TIG(NC2) IF CSM +X AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION. IN DEGREES TO NEAR-EST .01 DEGREE. SIGN IS ALWAYS + EXCEPT:

(A) WHEN DISPLAY-

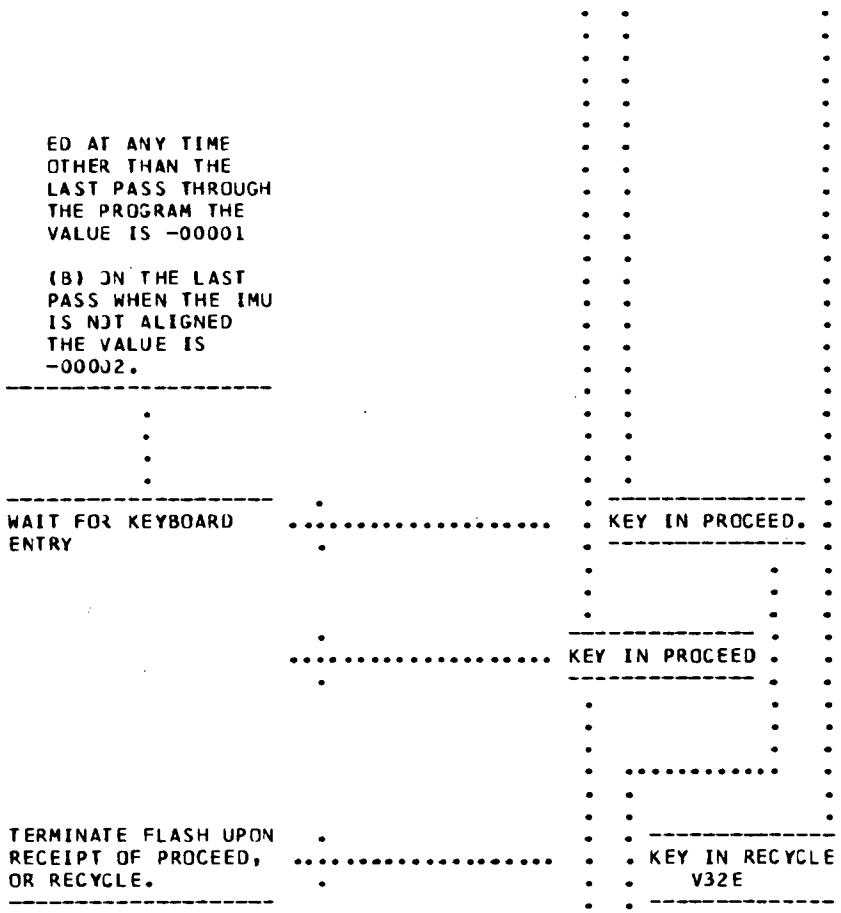


#690

#700

#710

#720



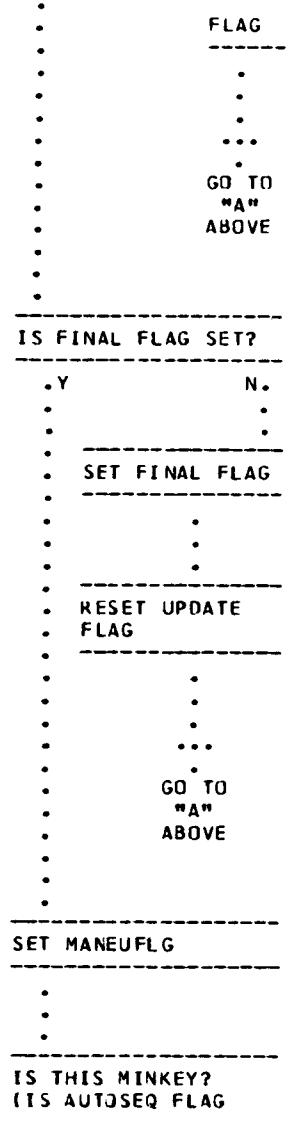
#730

#740

#750

#760

#770



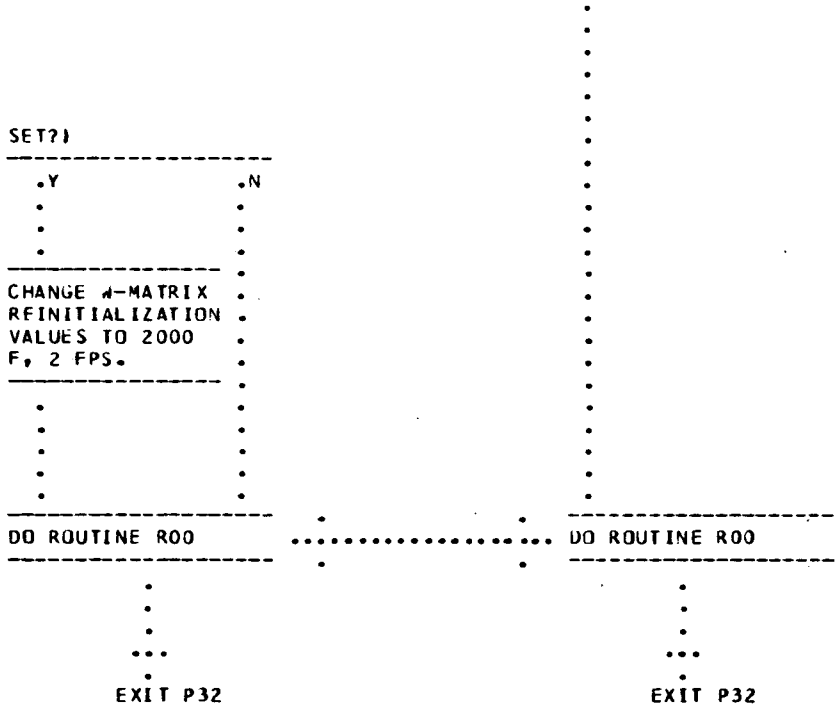
#780

#790

#800

#810

#820



#830

#840

#850

CHANGE CONTROL NOTES

REV 00 PCR 021,042,448, SL MEMO #2
REV 01 PCN 489

NCC TARGETING PROGRAM (P33) REV 01 03/20/72

PURPOSE: (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NCC MANEUVER FOR LAMBERT STEERING DELTA V BURNS.

(2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE DSKY BY THE ASTRONAUT.

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NCC MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE NCC TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) THIS PROGRAM IS BASED UPON PREVIOUS COMPLETION OF THE NC2 TARGETING PROGRAM (P32). THEREFORE:

++
+01
+
+489
++

(A) AT A SELECTED TPI TIME (NOW IN STORAGE) THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS WAS SELECTED TO BE A PRESCRIBED ANGLE (E) (NOW IN STORAGE) FROM HORIZORIZONTAL PLANE DEFINED AT THE ACTIVE VEHICLE POSITION.

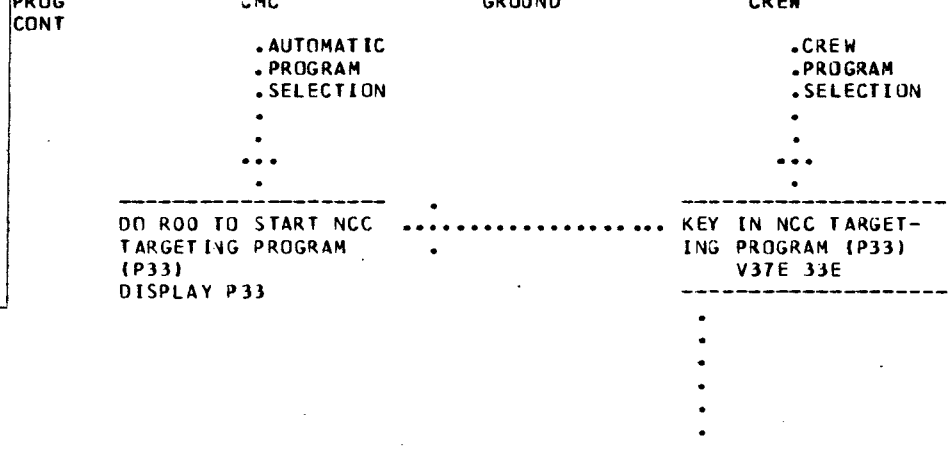
(B) THE NCC AND NSR MANEUVERS WERE ASSUMED TO BE PARALLEL TO THE PLANE OF THE OWS ORBIT. HOWEVER, THE N81 DISPLAY IS MODIFIED TO ESTABLISH AN ANTINODE AT NSR.

(2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND.

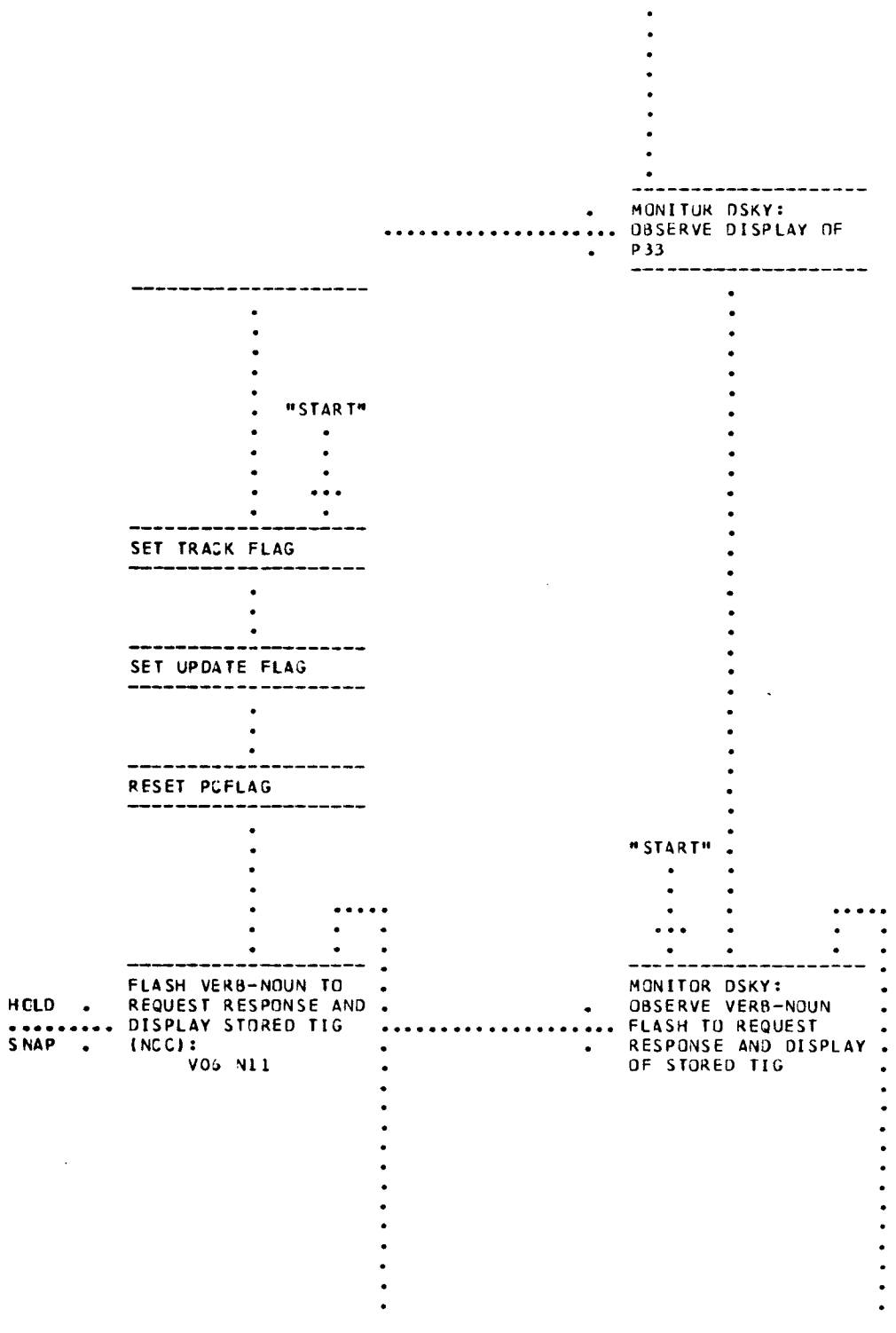
(3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

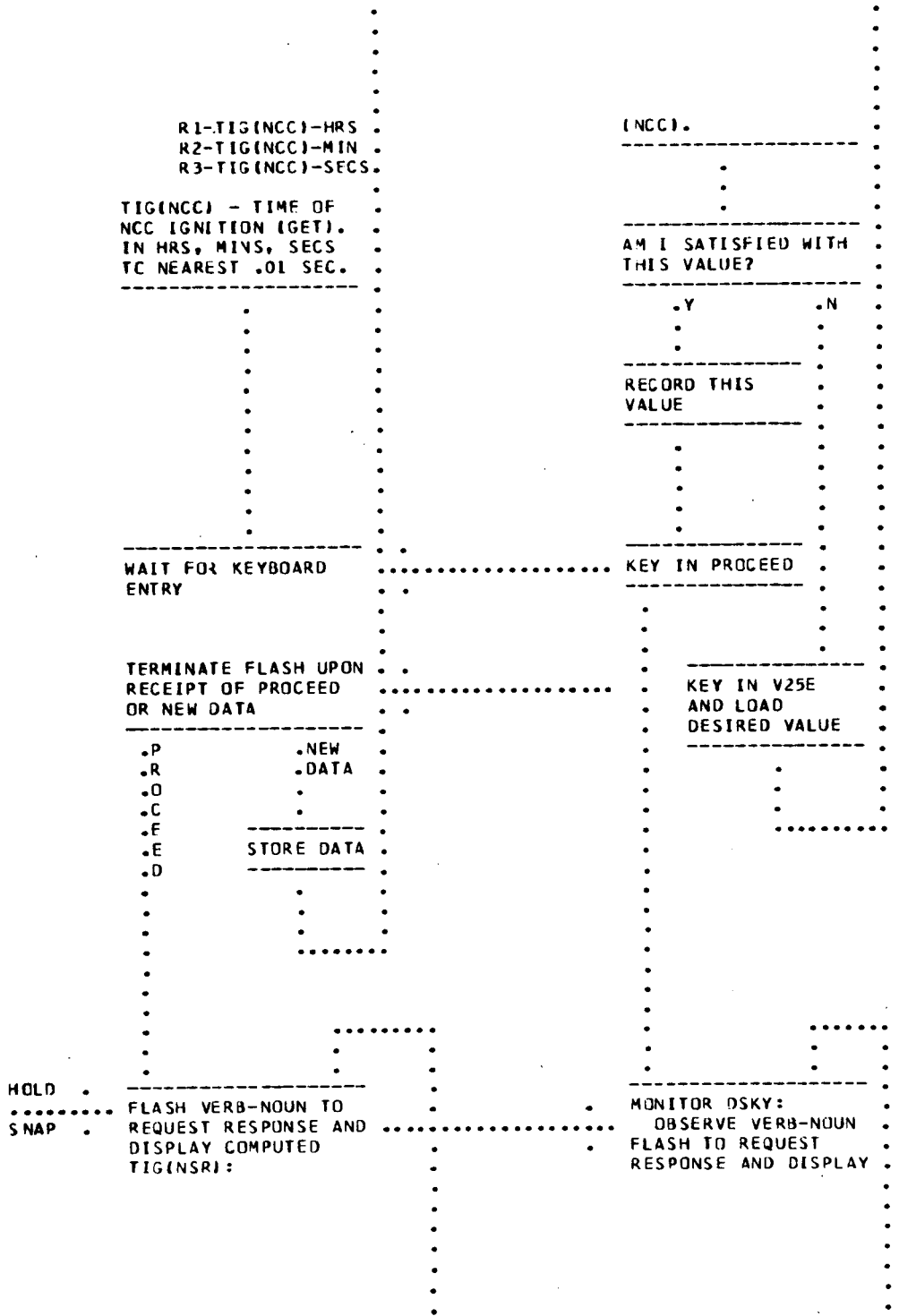
(4) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).



#10


MONITOR DSKY:
OBSERVE DISPLAY OF
P33
#20
"START"
#30
SET TRACK FLAG
SET UPDATE FLAG
#40
RESET PCFLAG
#50
"START"
HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED TIG
(NCC):
V06 N11
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED TIG
#60



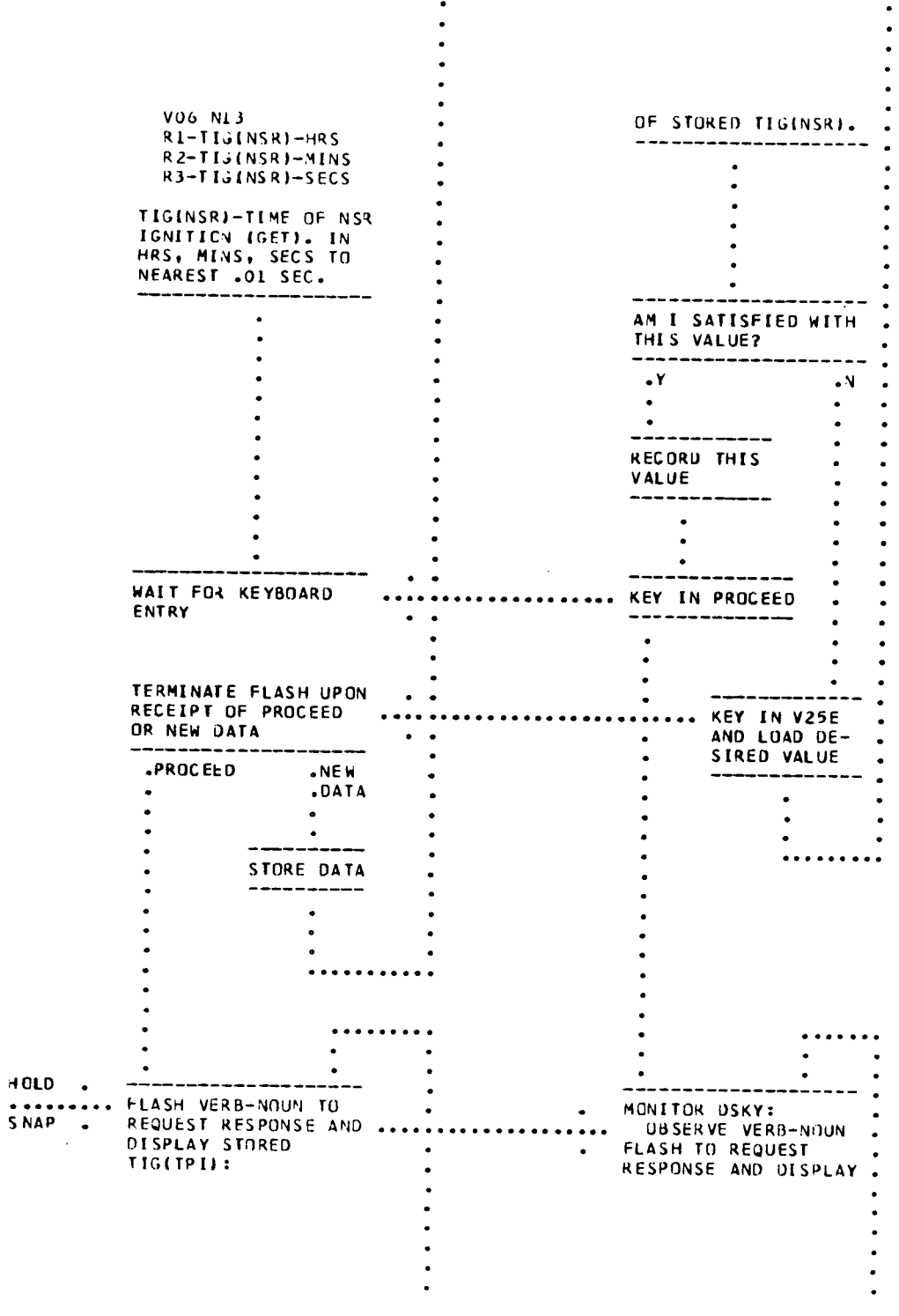
#70

#80

#90

#100

#110



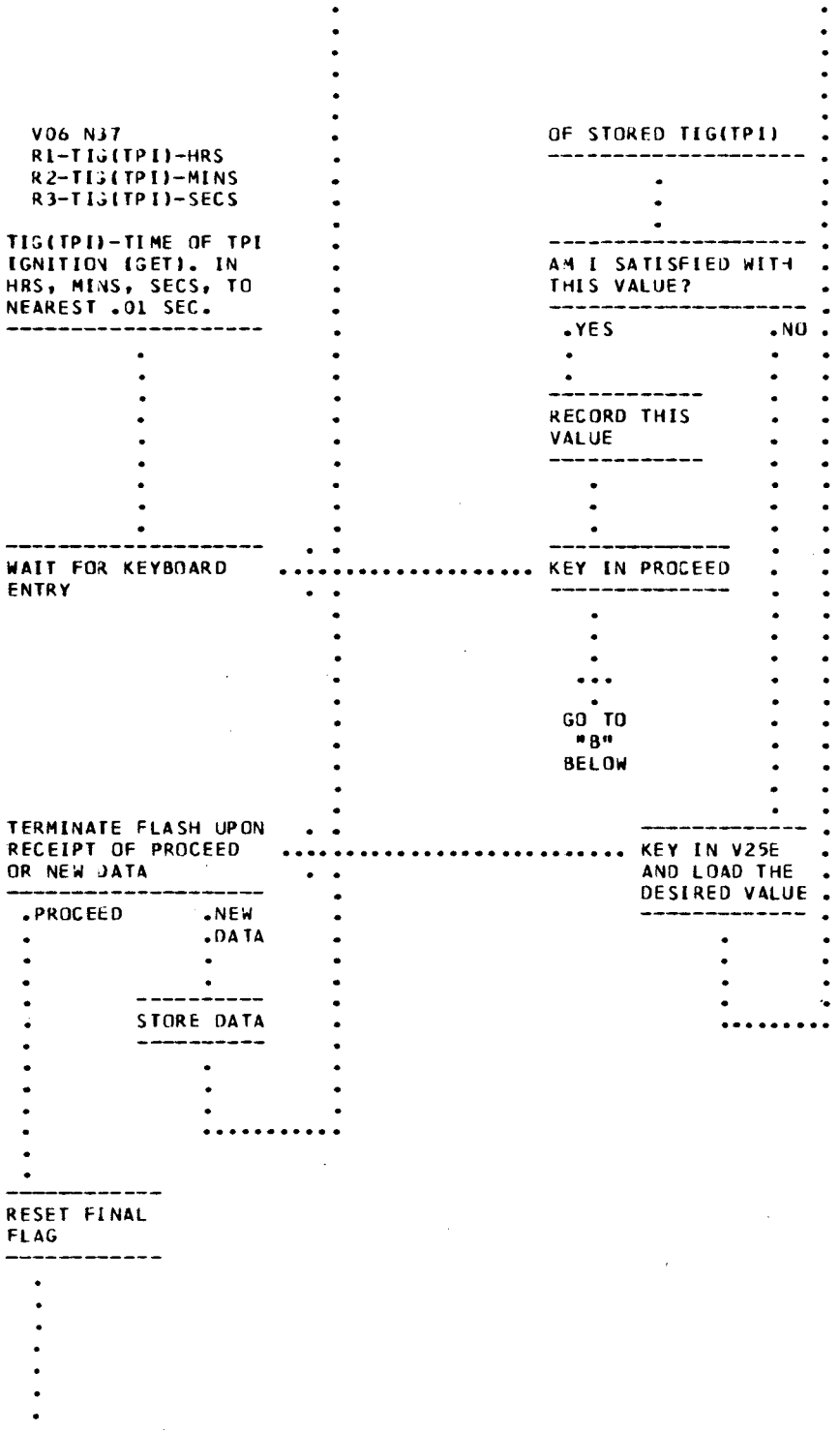
#120

#130

#140

#150

#160



#170

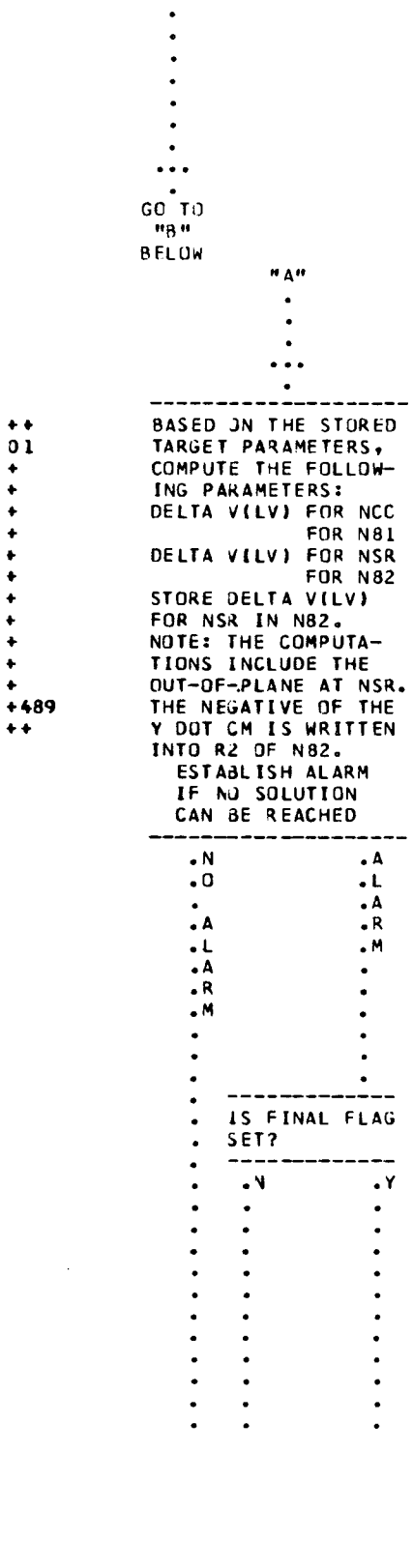
#180

#190

#200

#210

#220



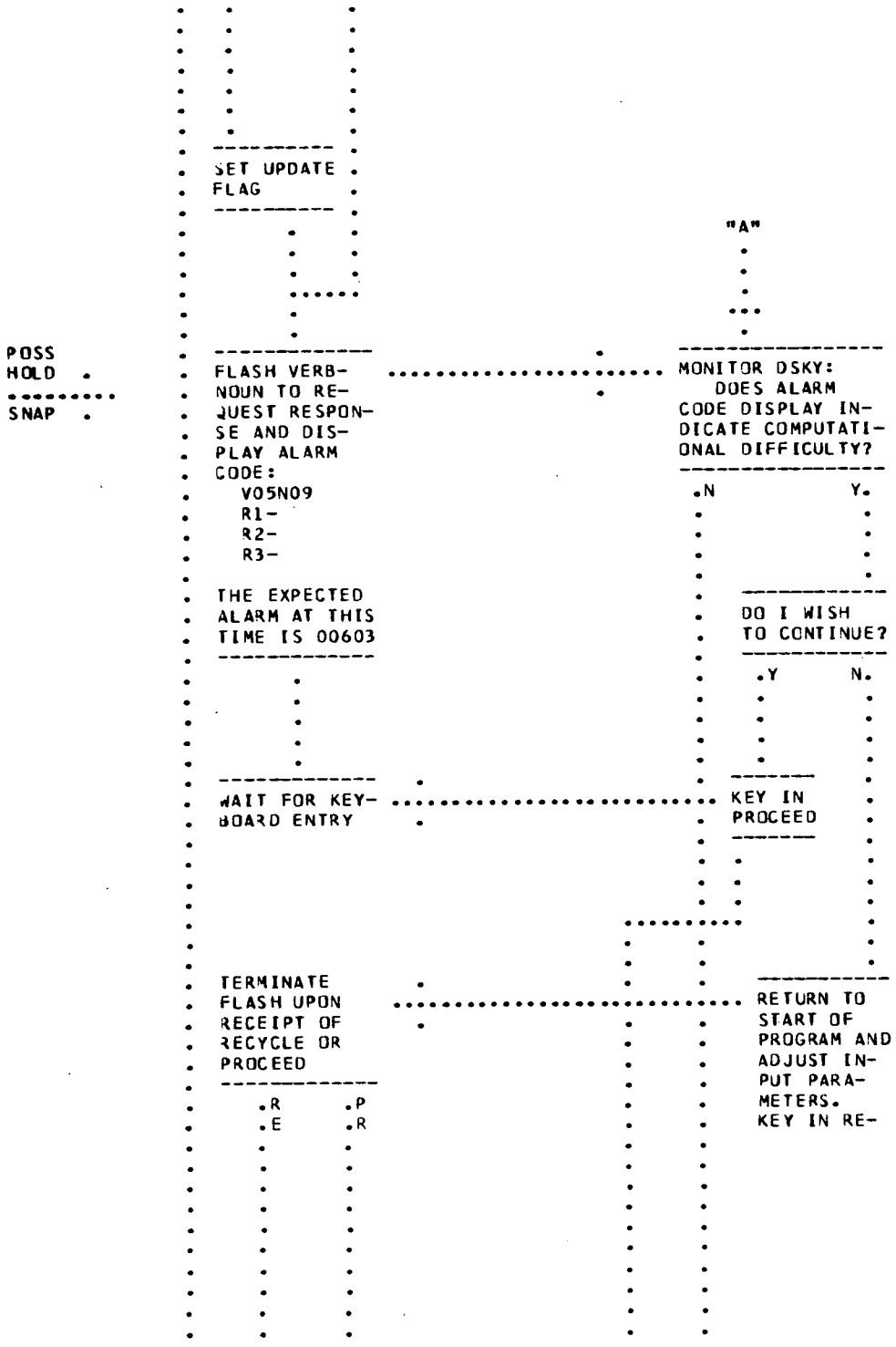
#230

#240

#250

#260

#270



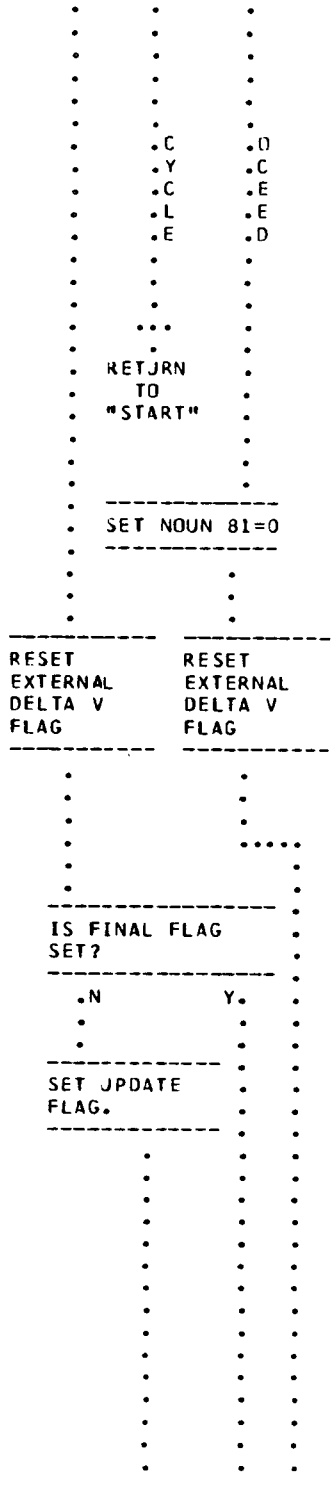
#280

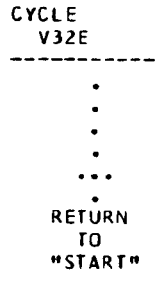
#290

#300

#310

#320





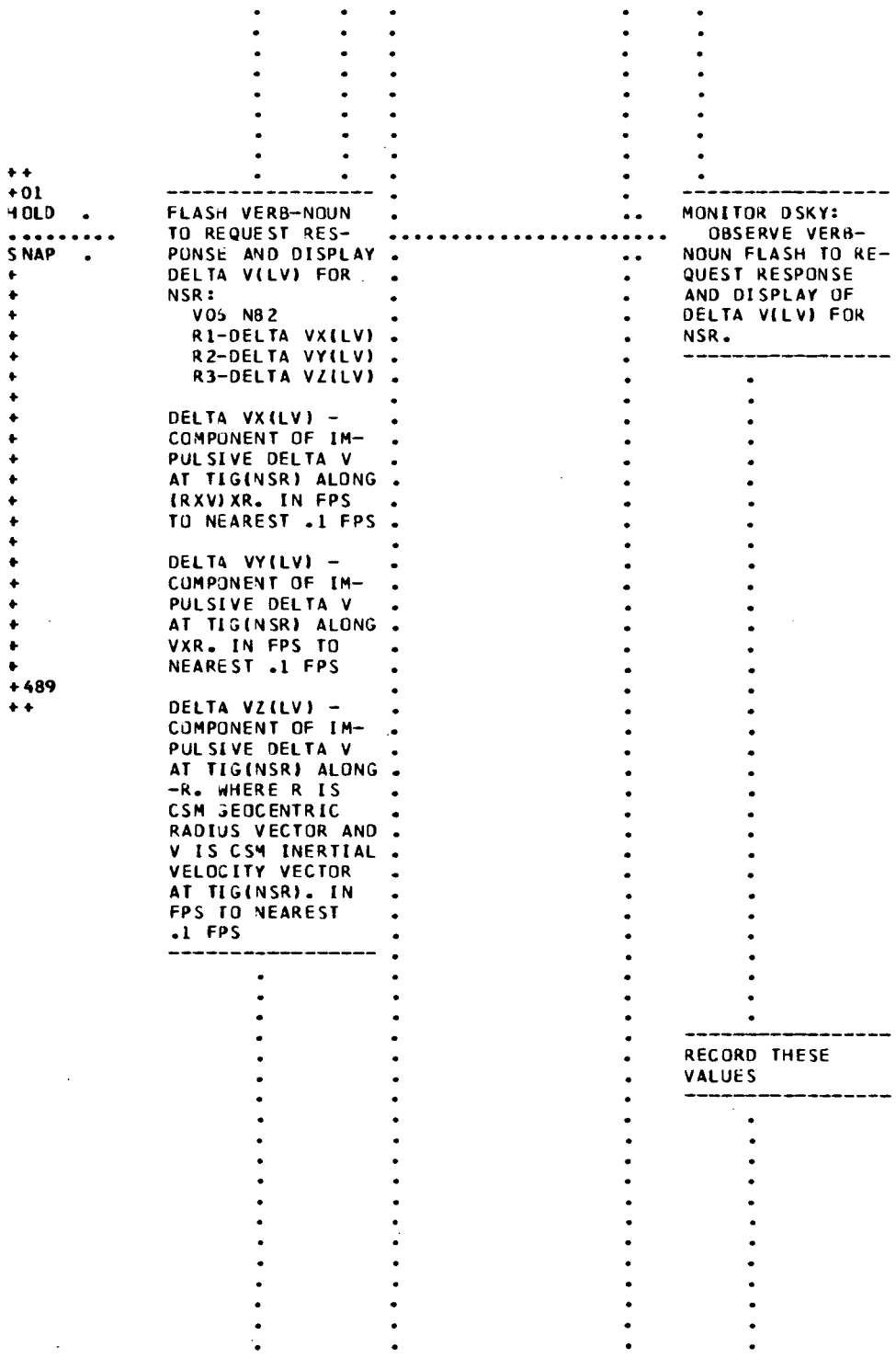
#330

#340

#350

#360

#370



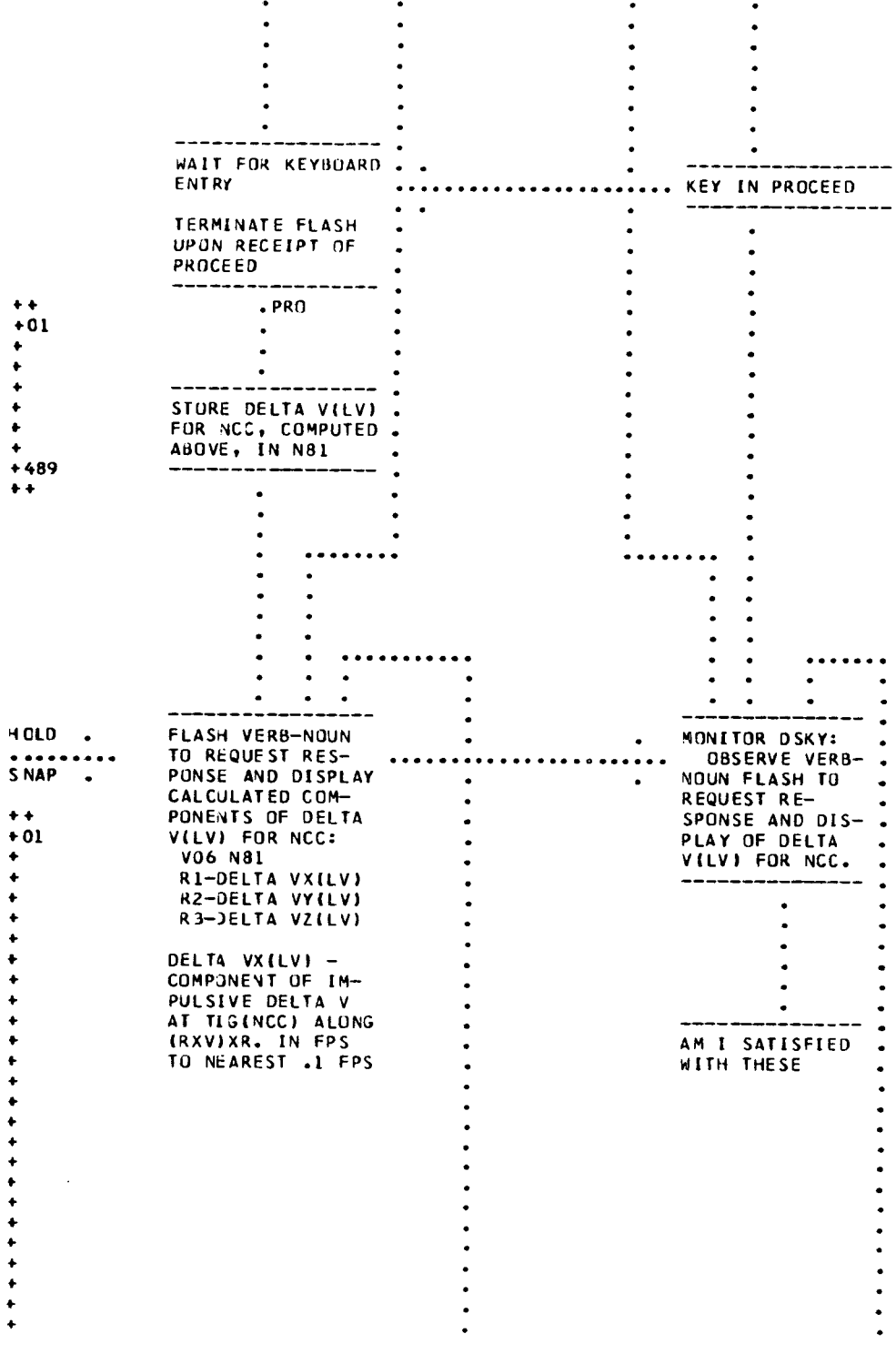
#380

#390

#400

#410

#420

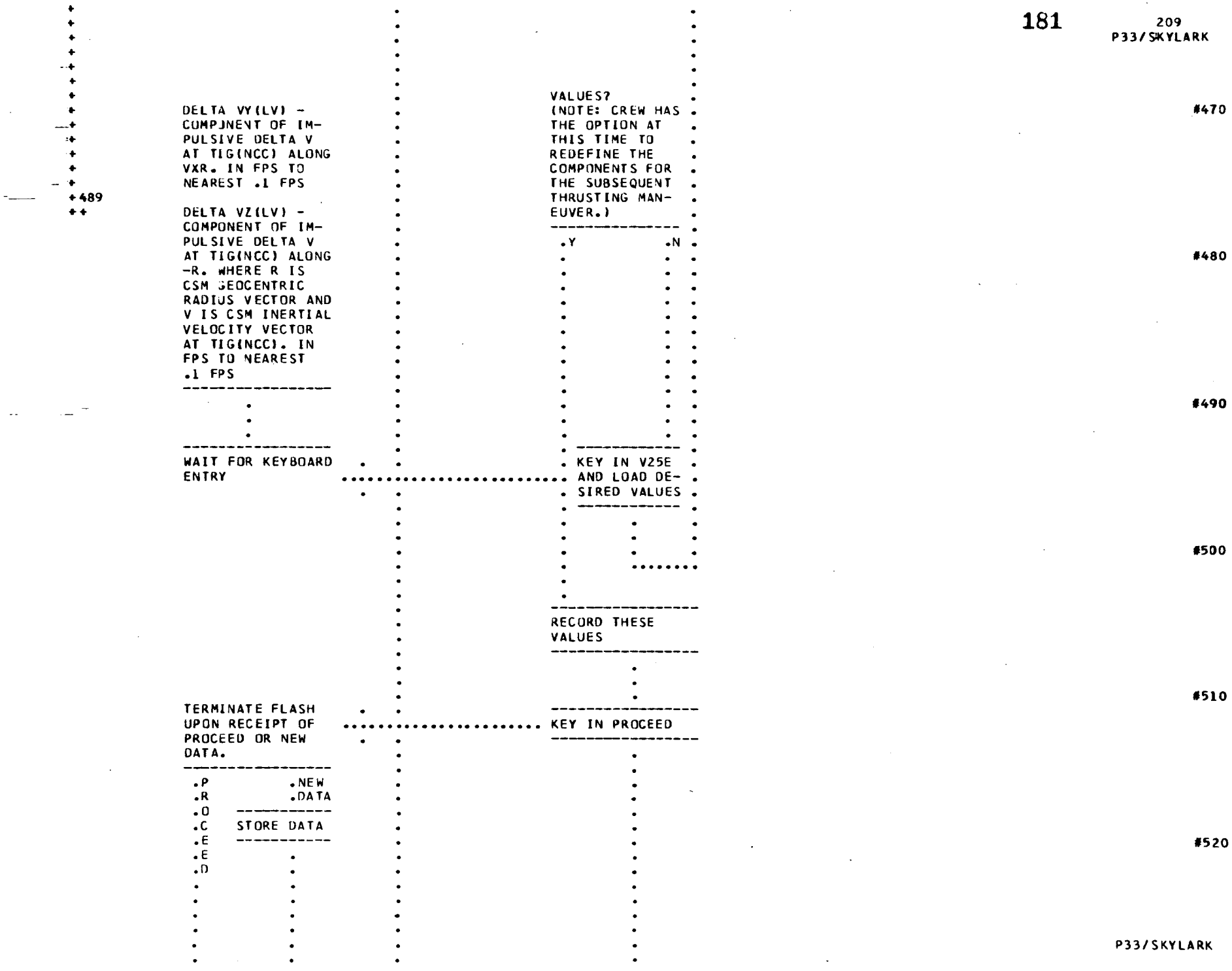


#430

#440

#450

#460


DELTA VY(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG(NCC) ALONG VXR. IN FPS TO NEAREST .1 FPS
DELTA VZ(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG(NCC) ALONG -R. WHERE R IS CSM GEOCENTRIC RADIUS VECTOR AND V IS CSM INERTIAL VELOCITY VECTOR AT TIG(NCC). IN FPS TO NEAREST .1 FPS
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA.
.P .R .O .C .E .E .D
.NEW .DATA
STORE DATA
VALUES? (NOTE: CREW HAS THE OPTION AT THIS TIME TO REDEFINE THE COMPONENTS FOR THE SUBSEQUENT THRUSTING MANEUVER.)
.Y
.N
KEY IN V25E AND LOAD DESIRED VALUES
RECORD THESE VALUES
KEY IN PROCEED
#470
#480
#490
#500
#510
#520

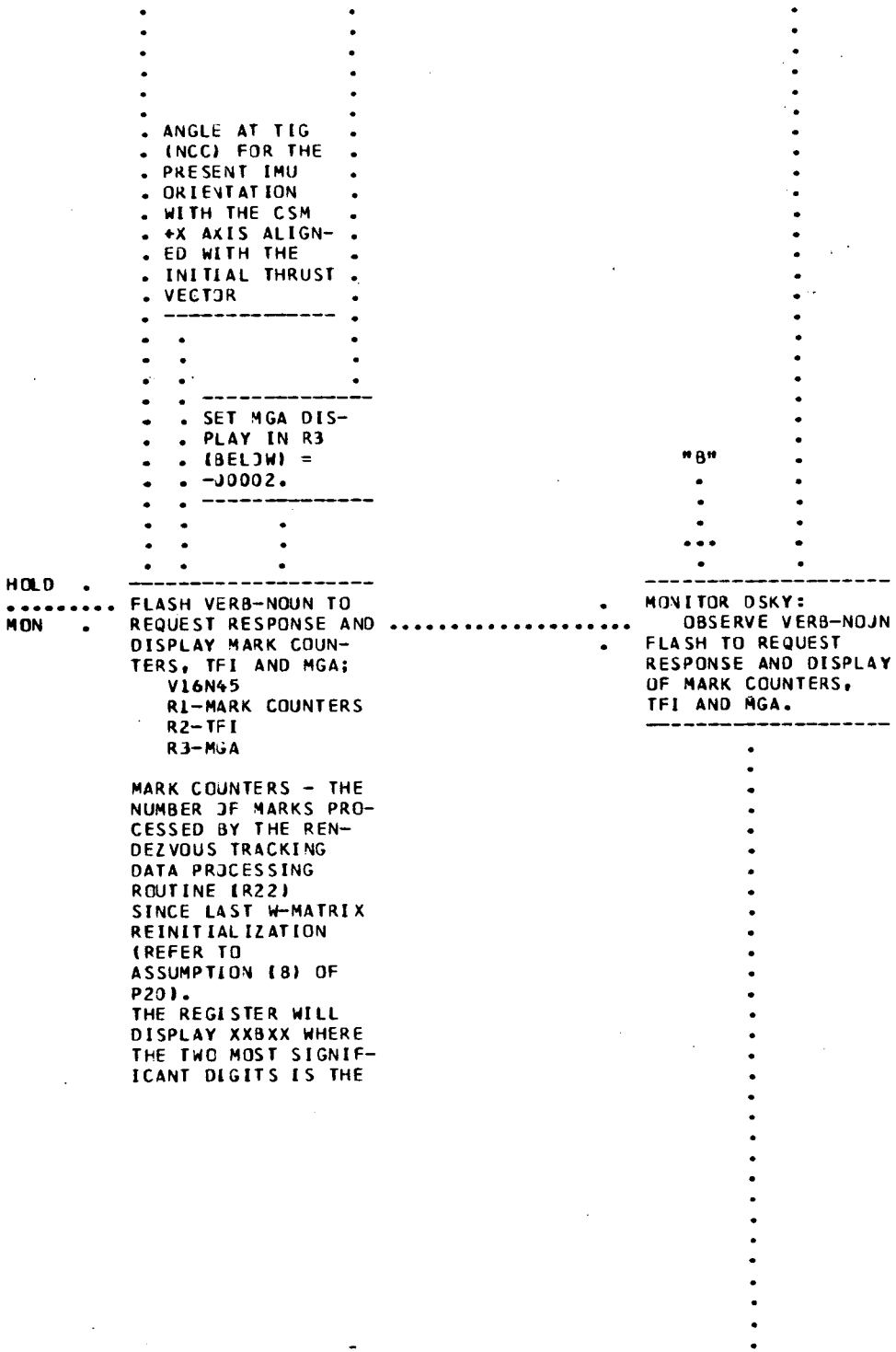
#530

#540

#550

#560

#570

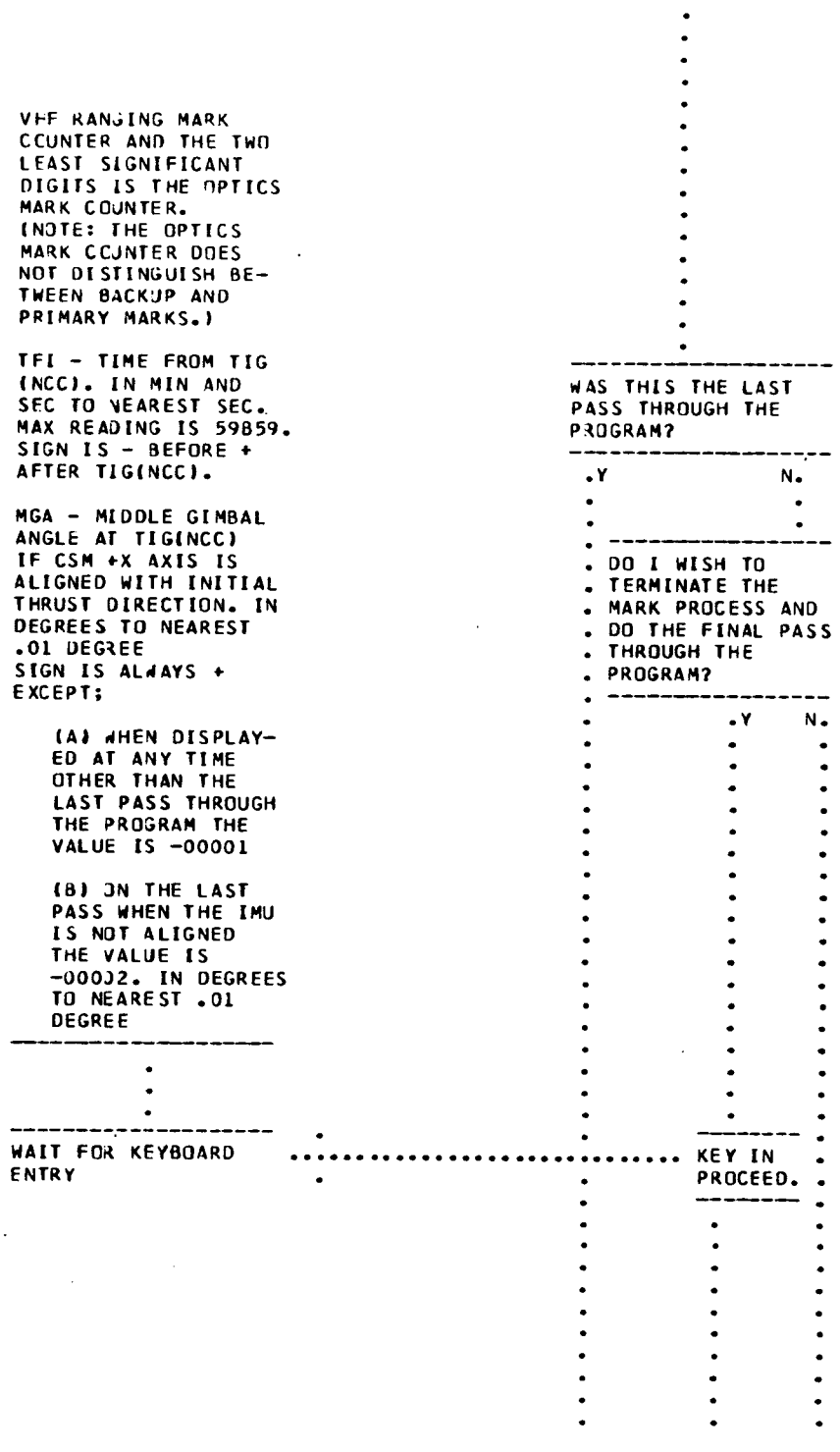


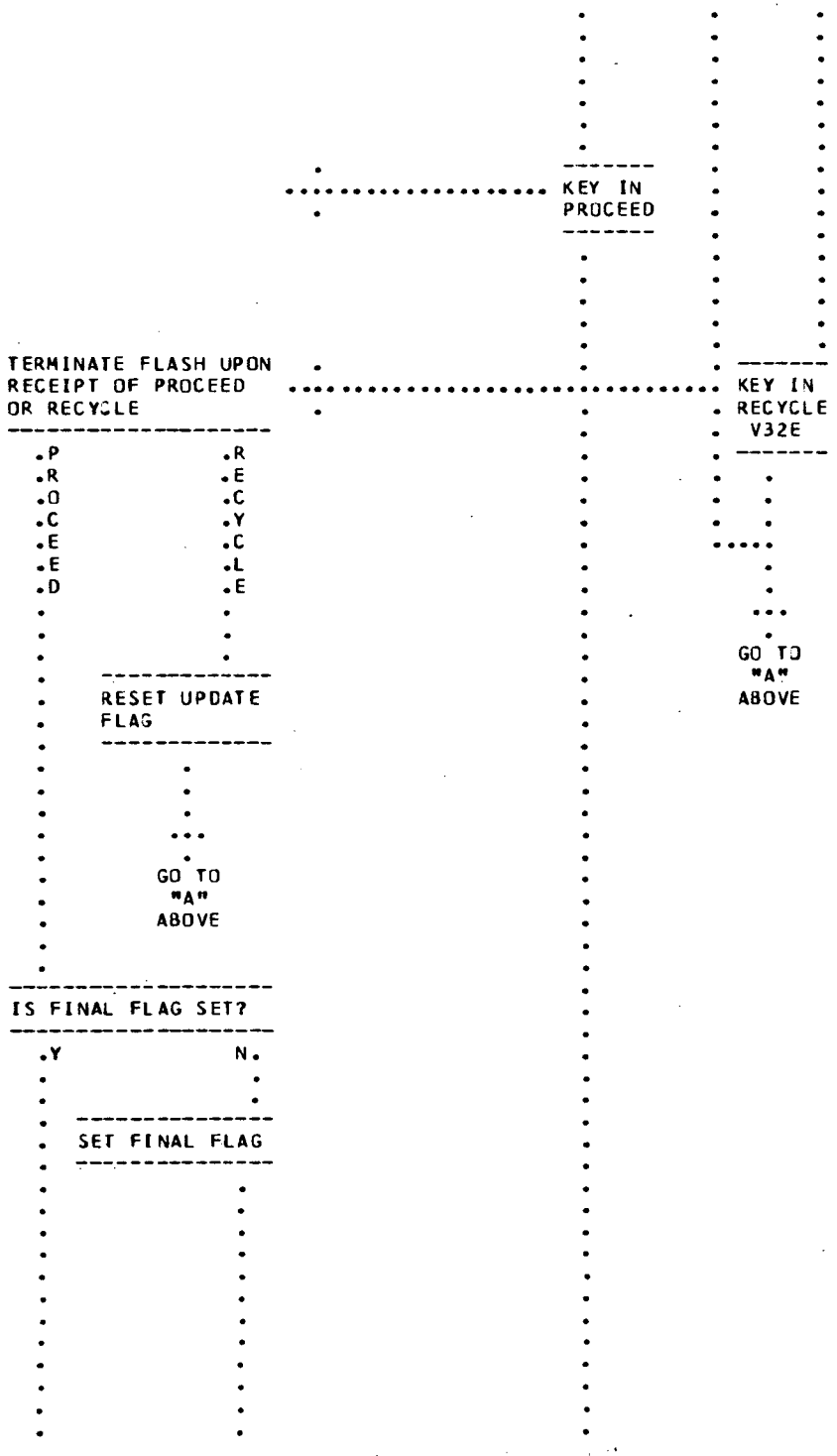
#580

#590

#600

#610


VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS IS THE OPTICS MARK COUNTER. (NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.)
TFI - TIME FROM TIG (NCC). IN MIN AND SEC TO NEAREST SEC. MAX READING IS 59859. SIGN IS - BEFORE + AFTER TIG(NCC).
MGA - MIDDLE GIMBAL ANGLE AT TIG(NCC) IF CSM +X AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION. IN DEGREES TO NEAREST .01 DEGREE SIGN IS ALWAYS + EXCEPT;
(A) WHEN DISPLAYED AT ANY TIME OTHER THAN THE LAST PASS THROUGH THE PROGRAM THE VALUE IS -00001
(B) ON THE LAST PASS WHEN THE IMU IS NOT ALIGNED THE VALUE IS -00002. IN DEGREES TO NEAREST .01 DEGREE
WAIT FOR KEYBOARD ENTRY
WAS THIS THE LAST PASS THROUGH THE PROGRAM?
Y
N.
DO I WISH TO TERMINATE THE MARK PROCESS AND DO THE FINAL PASS THROUGH THE PROGRAM?
Y
N.
KEY IN PROCEED.
#620
#630
#640
#650
#660



#670

#680

#690

#700

#710

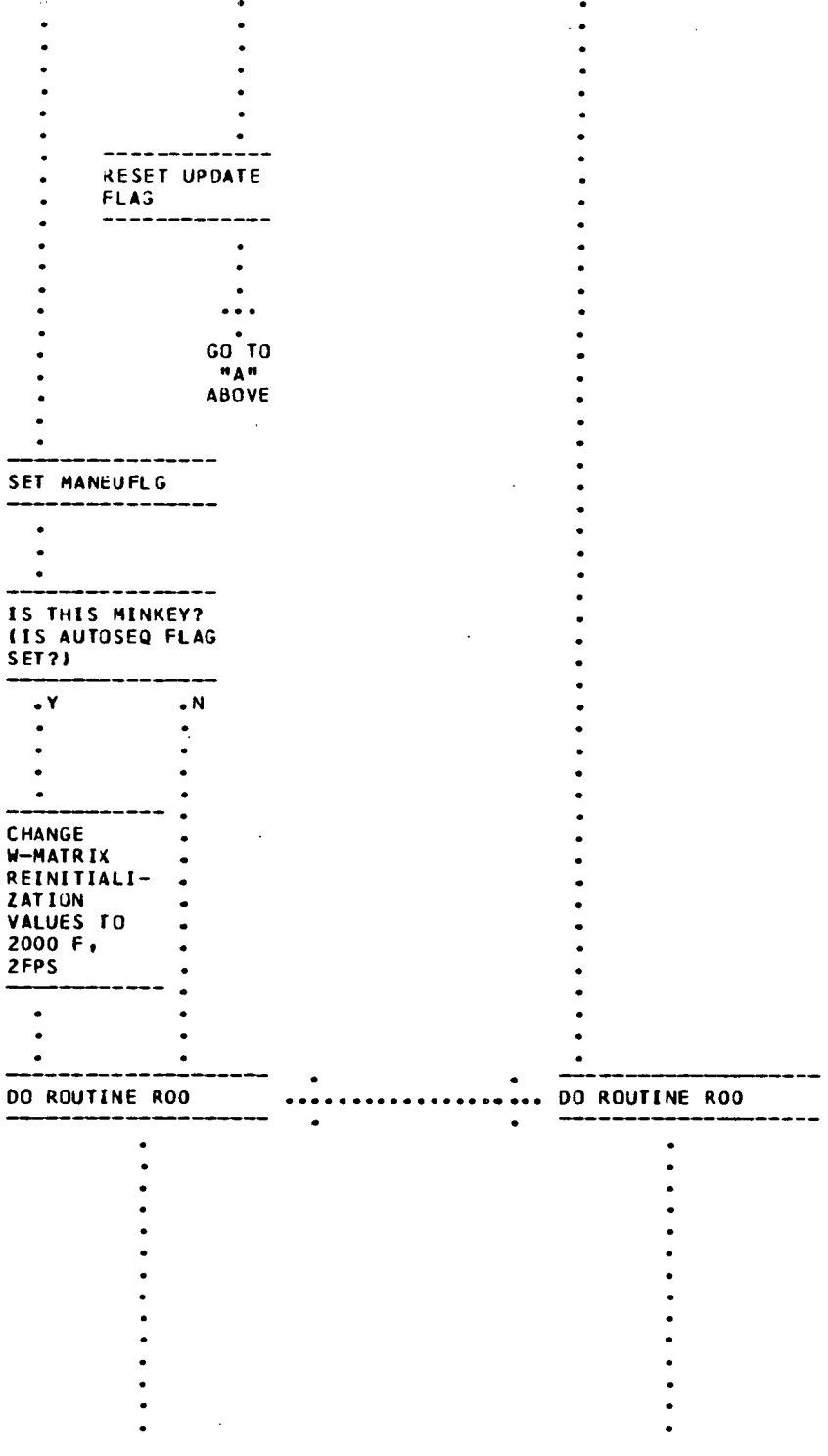
#720

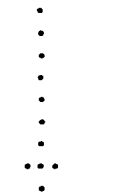
#730

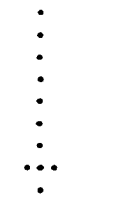
#740

#750

#760







#770

CHANGE CONTROL NOTES

REV 00 PCR 042, PCN 445, SKYLARK MEMO #2
REV 01 PCN 489

NSR TARGETING PROGRAM (P34). REV 01 03/20/72

PURPOSE: (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NSR MANEUVER FOR DELTA V BURNS.

(2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE DSKY BY THE ASTRONAUT.

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NSR MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE NSR TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) THIS PROGRAM IS BASED UPON PREVIOUS COMPLETION OF THE NC1(P31), NC2(P32), NCC(P33) TARGETING PROGRAMS. THEREFORE:

(A) AT A SELECTED TPI TIME (NOW IN STORAGE) THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS WAS SELECTED TO BE A PRESCRIBED ANGLE (E) (NOW IN STORAGE) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE VEHICLE POSITION.

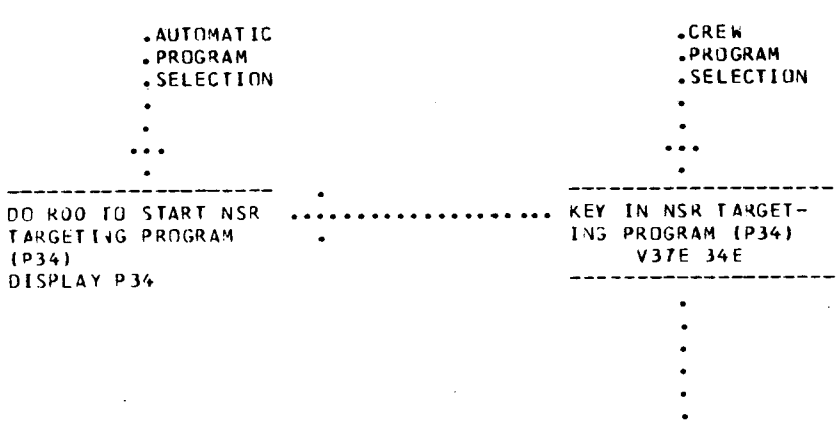
(B) THE NSR MANEUVER IS ASSUMED TO BE PARALLEL TO THE PLANE OF THE OWS ORBIT. HOWEVER, OUT-OF-PLANE PARAMETERS ARE COMPUTED FOR TIG(NSR) AND ARE AVAILABLE BY KEYING V06N33 E AT FL V16 N45 AFTER A COMP CYCLE. IN ADDITION, THE N81 DISPLAY IS MODIFIED TO ESTABLISH AN ANTINODE AT NSR.

(2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND.

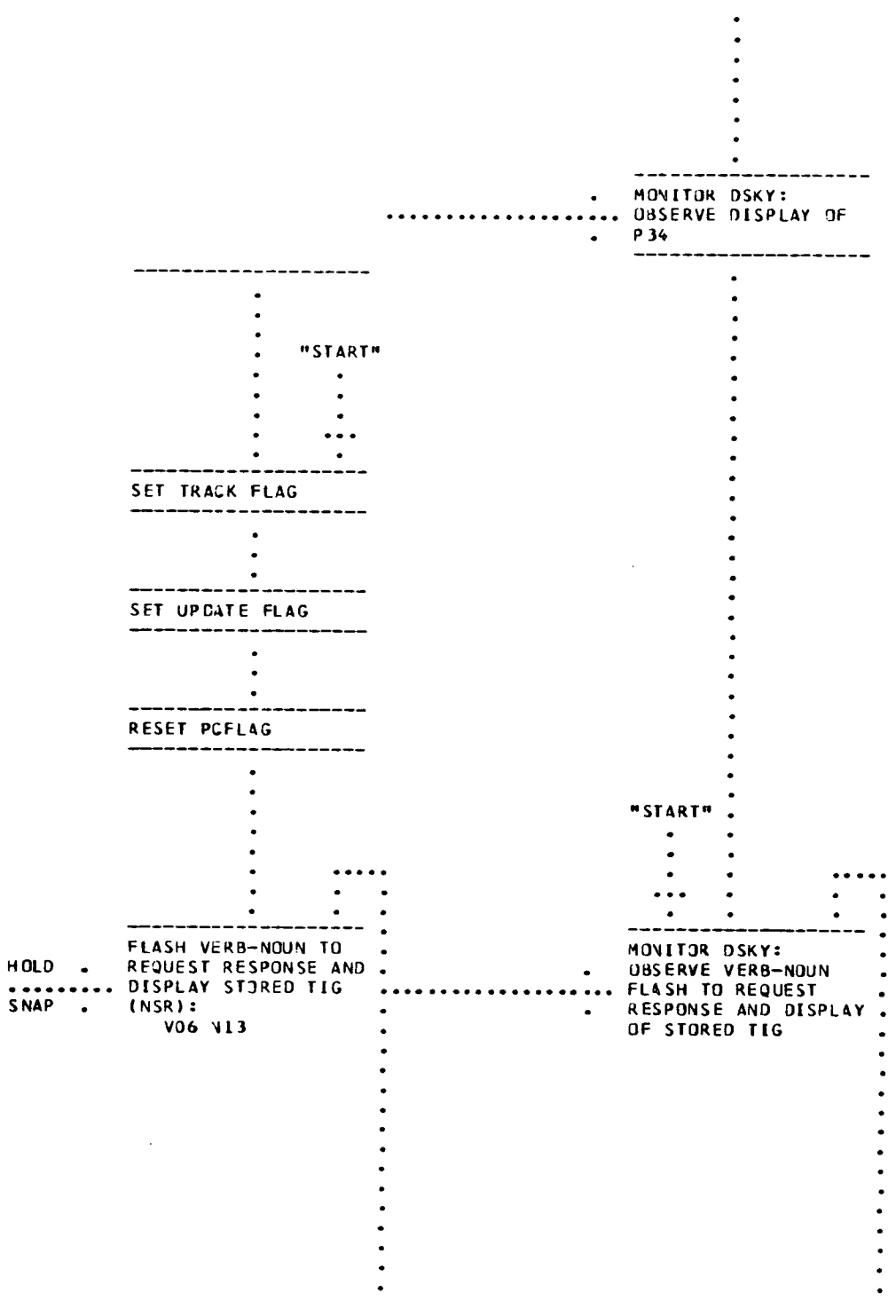
(3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

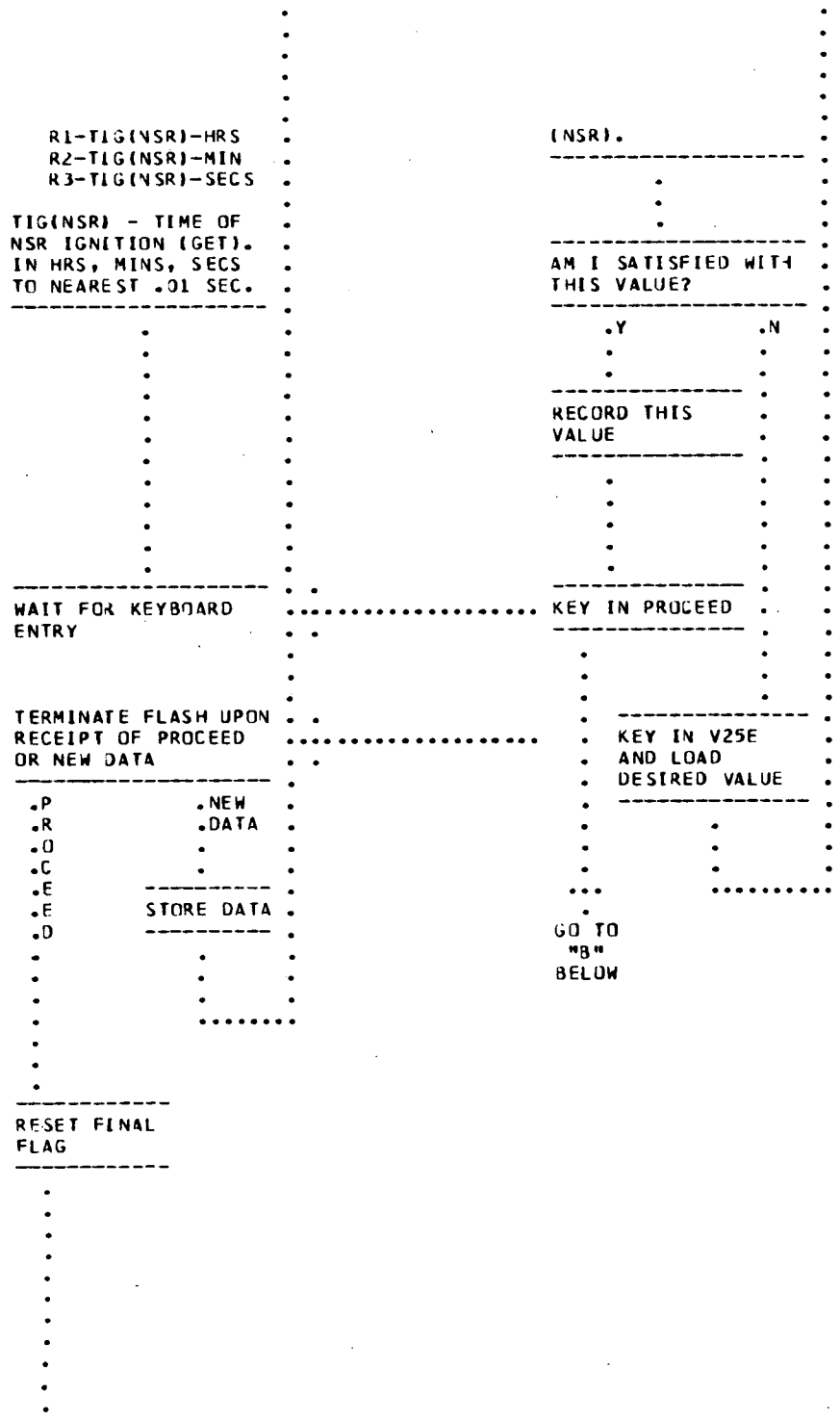
(4) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

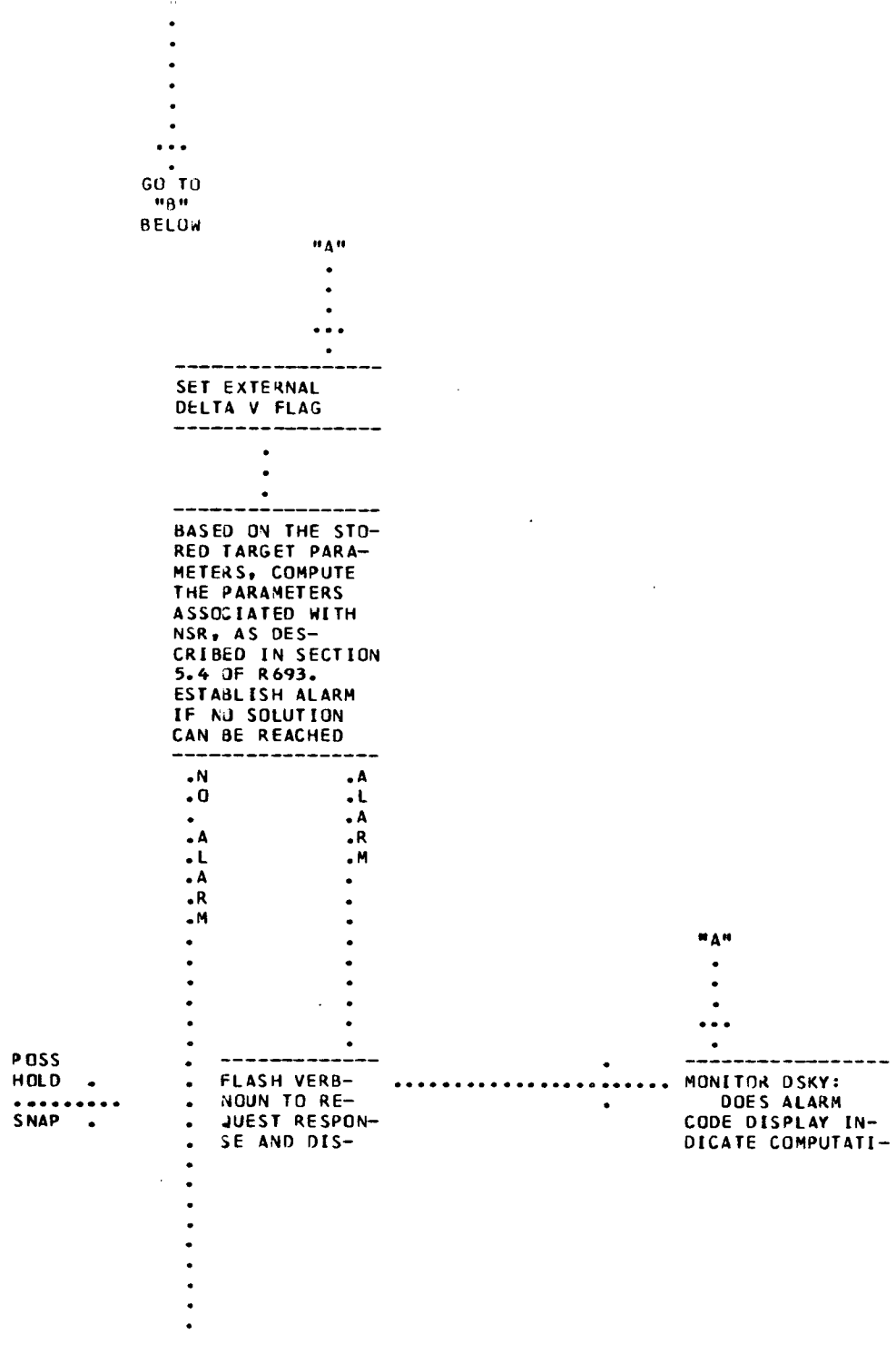


#10


MONITOR DSKY:
OBSERVE DISPLAY OF
P34
#20
"START"
#30
SET TRACK FLAG
SET UPDATE FLAG
#40
RESET PCFLAG
"START"
#50
HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED TIG
(NSR):
V06 N13
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED TIG
#60



#70
#80
#90
#100
#110



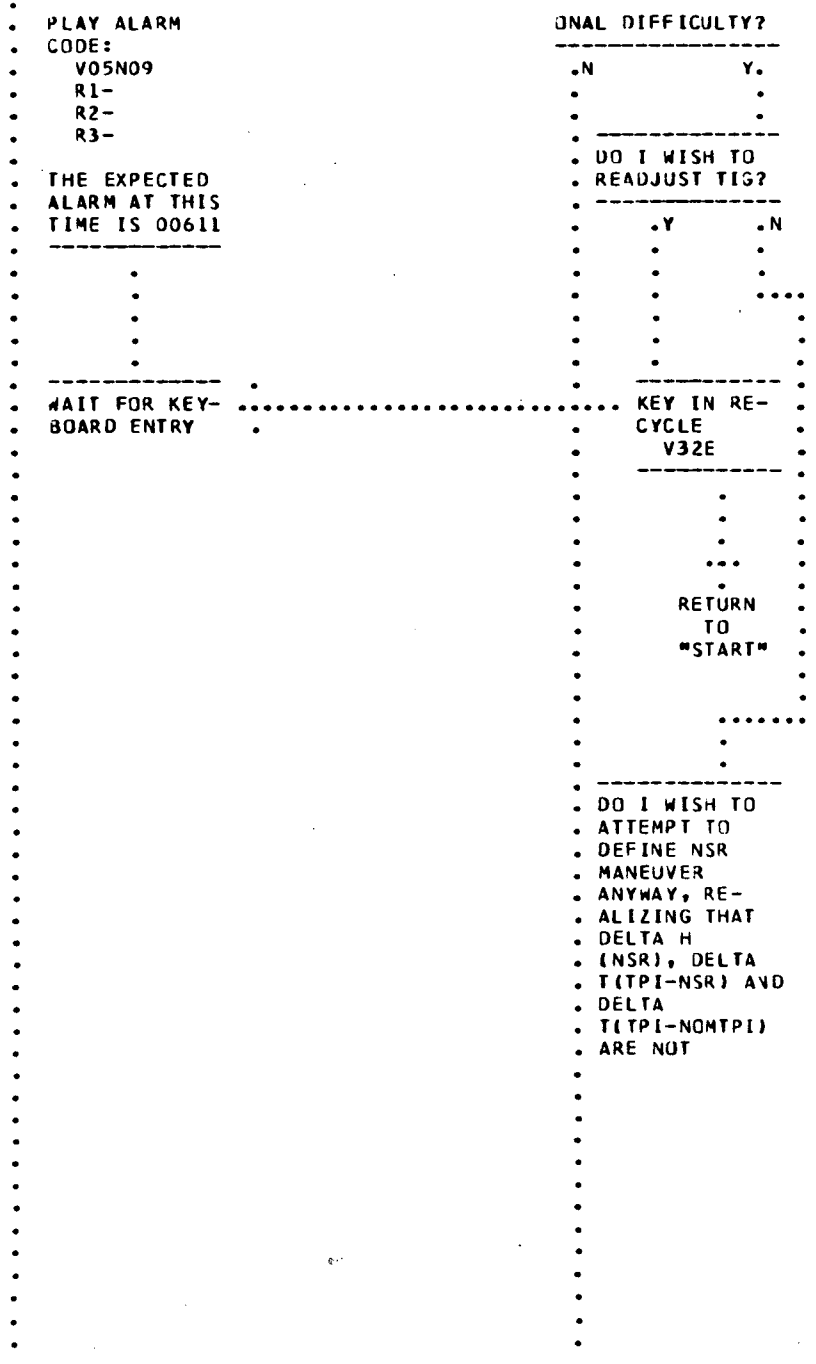
#120

#130

#140

#150

#160



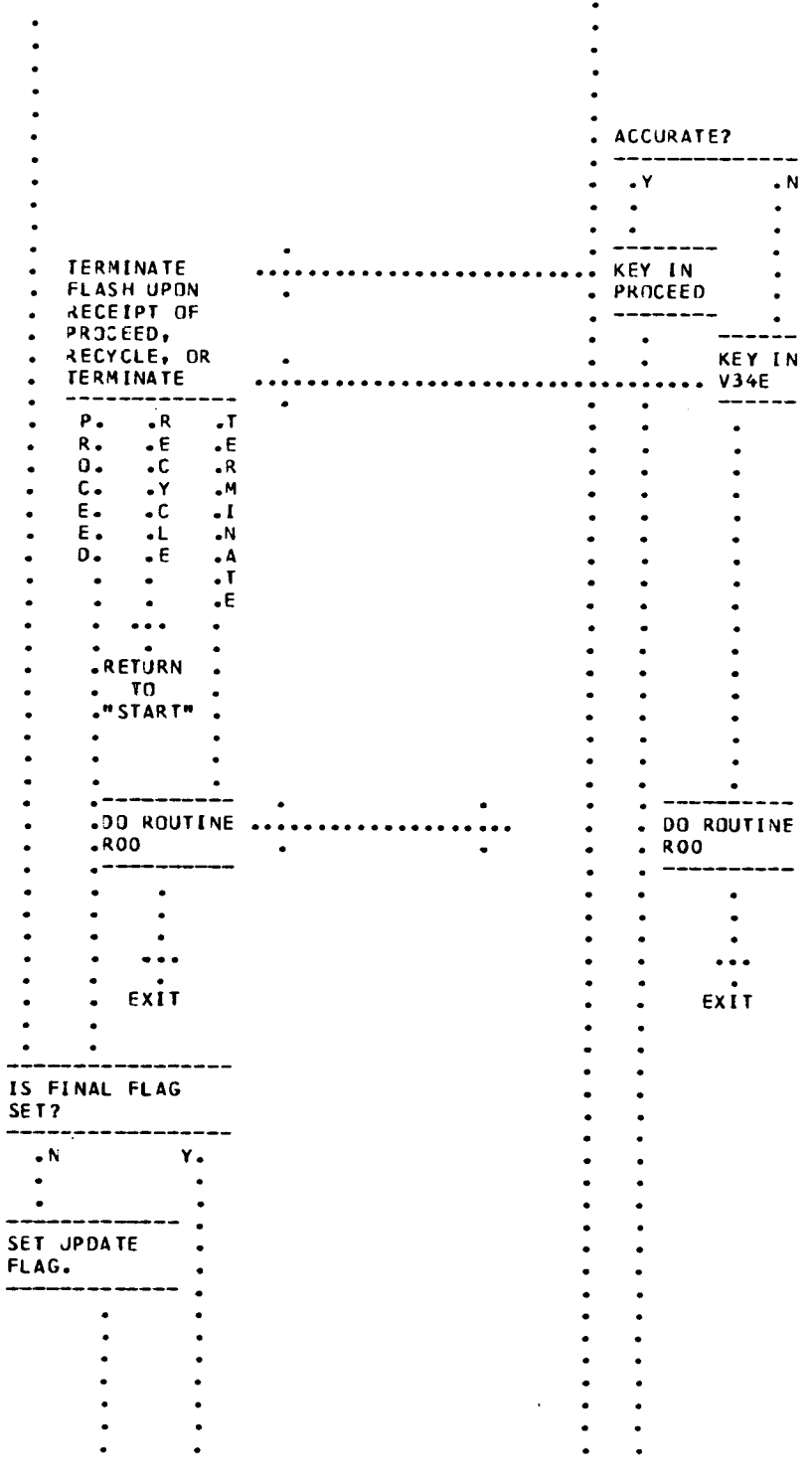
#170

#180

#190

#200

#210



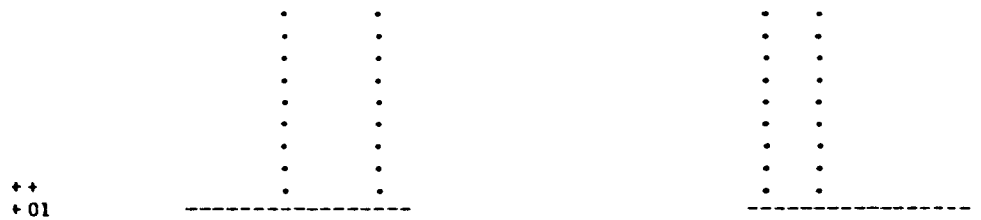
#220

#230

#240

#250

#260



#270

#280

DELTA H(NSR) - THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT TIG(NSR). SIGN IS + WHEN THE ACTIVE VEHICLE IS BELOW THE PASSIVE VEHICLE. IN NAUTICAL MILES TO THE NEAREST .1 NM

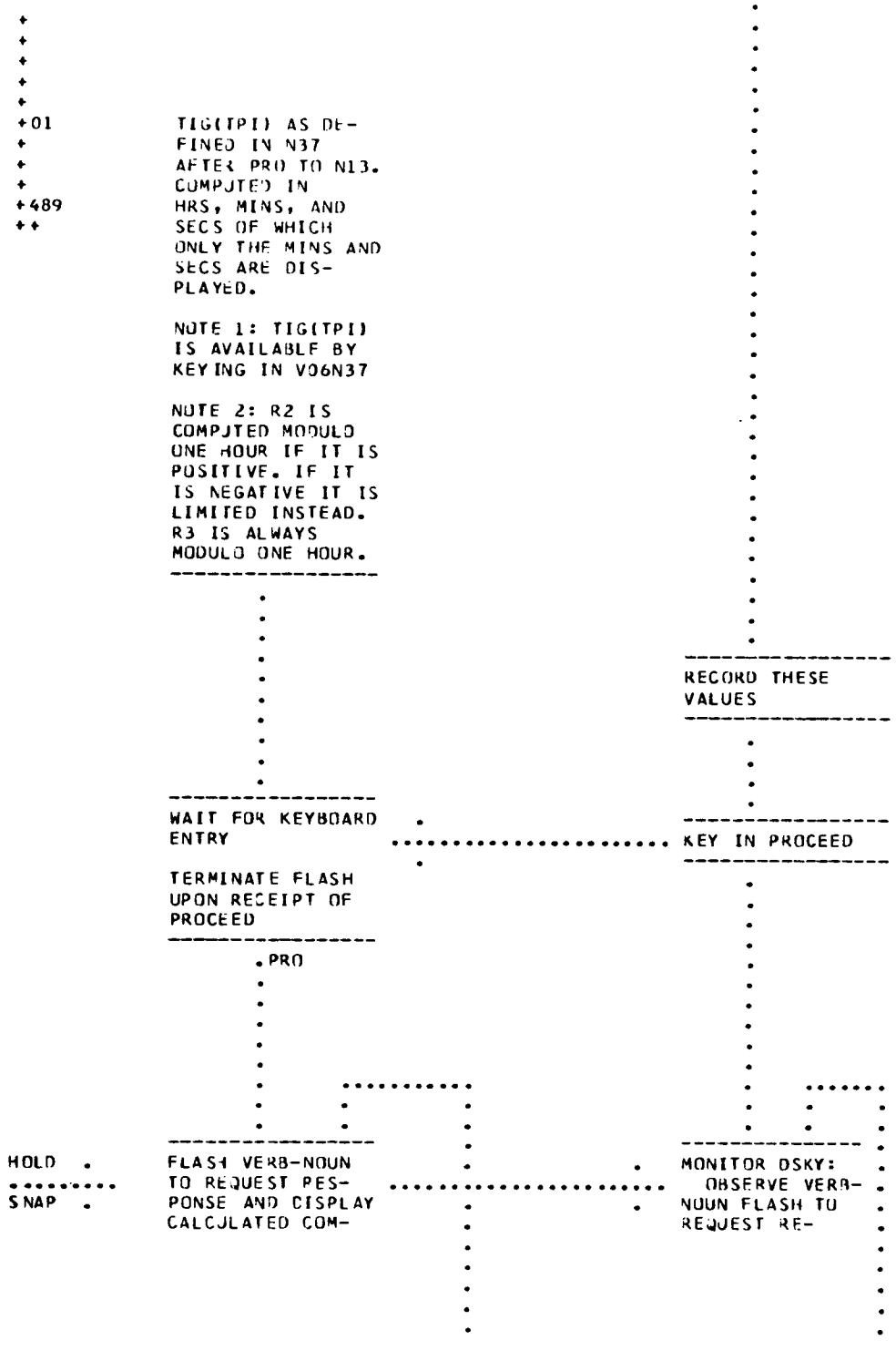
#290

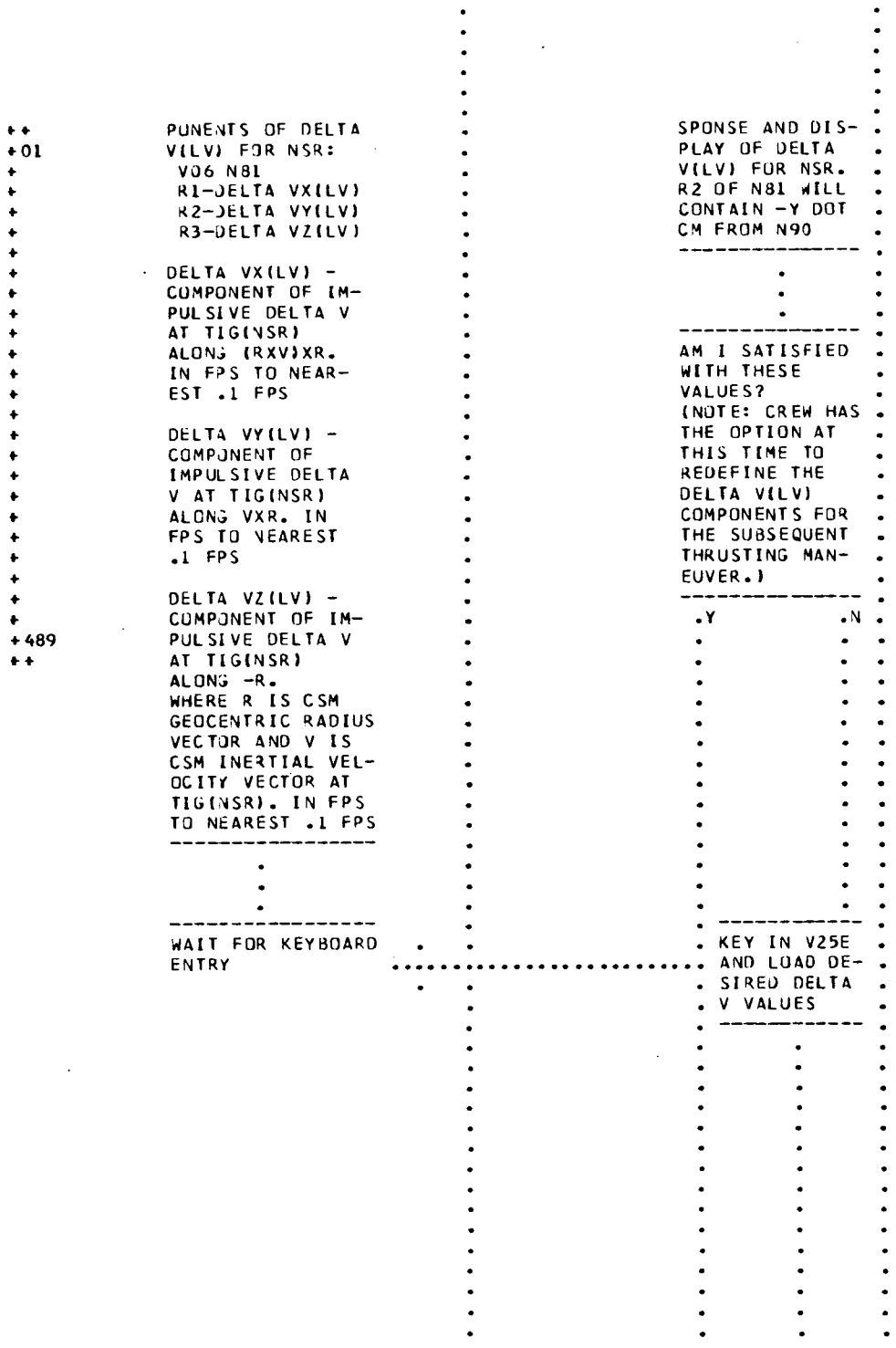
DELTA T(TPI-NSR)-TIG(TPI) AS DEFINED BY THIS PROGRAM MINUS TIG(NSR). COMPUTED IN HRS, MINS, AND SECS OF WHICH ONLY THE MINS AND SECS ARE DISPLAYED.

#300

DELTA T(TPI-NOMTPI) - TIG(TPI) AS DEFINED BY THIS PROGRAM MINUS

#310


+01
+489
++
TIG(TPI) AS DE-
FINED IN N37
AFTER PRO TO N13.
COMPUTED IN
HRS, MINS, AND
SECS OF WHICH
ONLY THE MINS AND
SECS ARE DIS-
PLAYED.
NOTE 1: TIG(TPI)
IS AVAILABLE BY
KEYING IN V06N37
NOTE 2: R2 IS
COMPUTED MODULO
ONE HOUR IF IT IS
POSITIVE. IF IT
IS NEGATIVE IT IS
LIMITED INSTEAD.
R3 IS ALWAYS
MODULO ONE HOUR.
RECORD THESE
VALUES
WAIT FOR KEYBOARD
ENTRY
KEY IN PROCEED
TERMINATE FLASH
UPON RECEIPT OF
PROCEED
PRO
HOLD
SNAP
FLASH VERB-NOUN
TO REQUEST RES-
PONSE AND DISPLAY
CALCULATED COM-
MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO
REQUEST RE-
#320
#330
#340
#350
#360



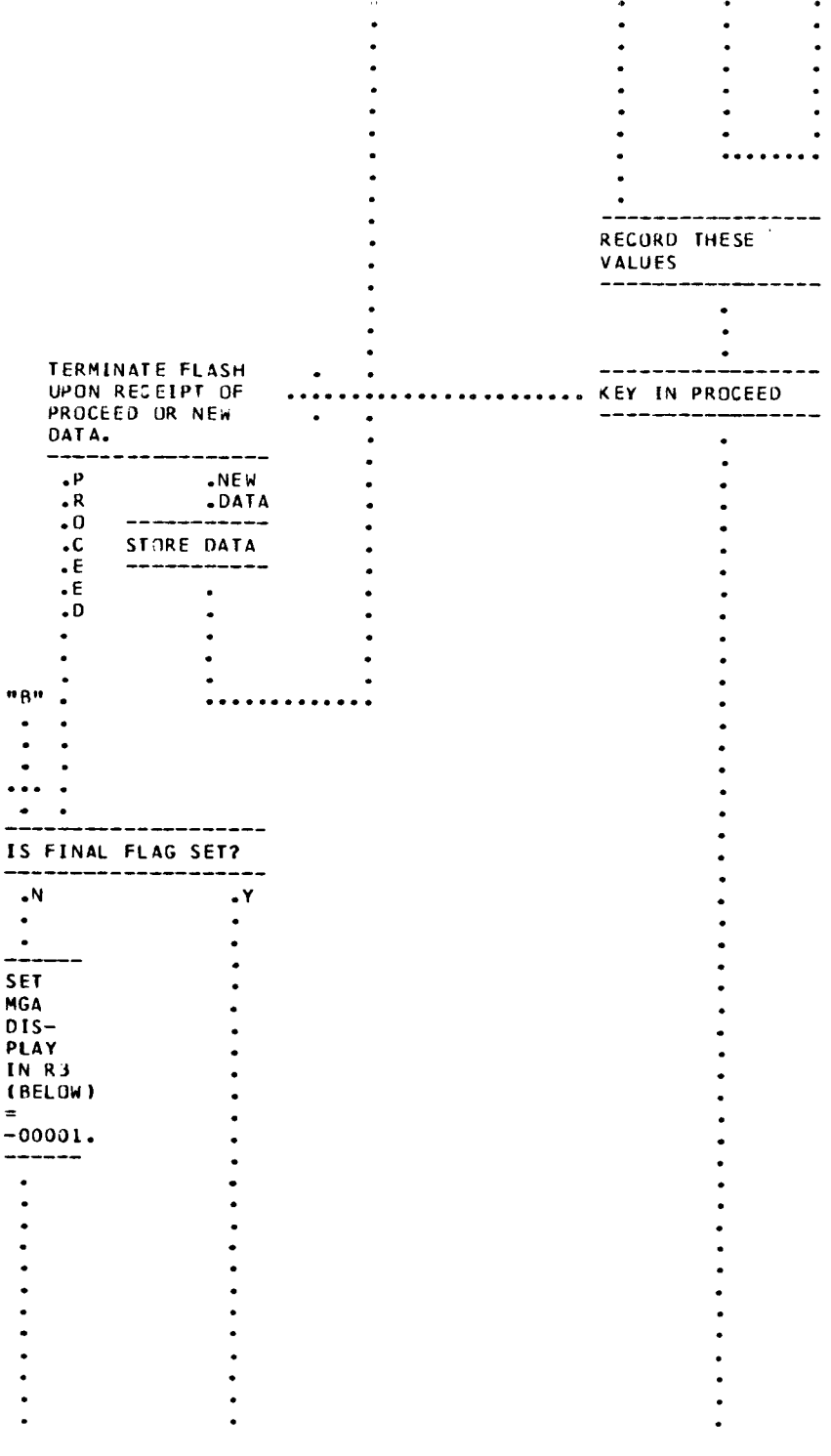
#370

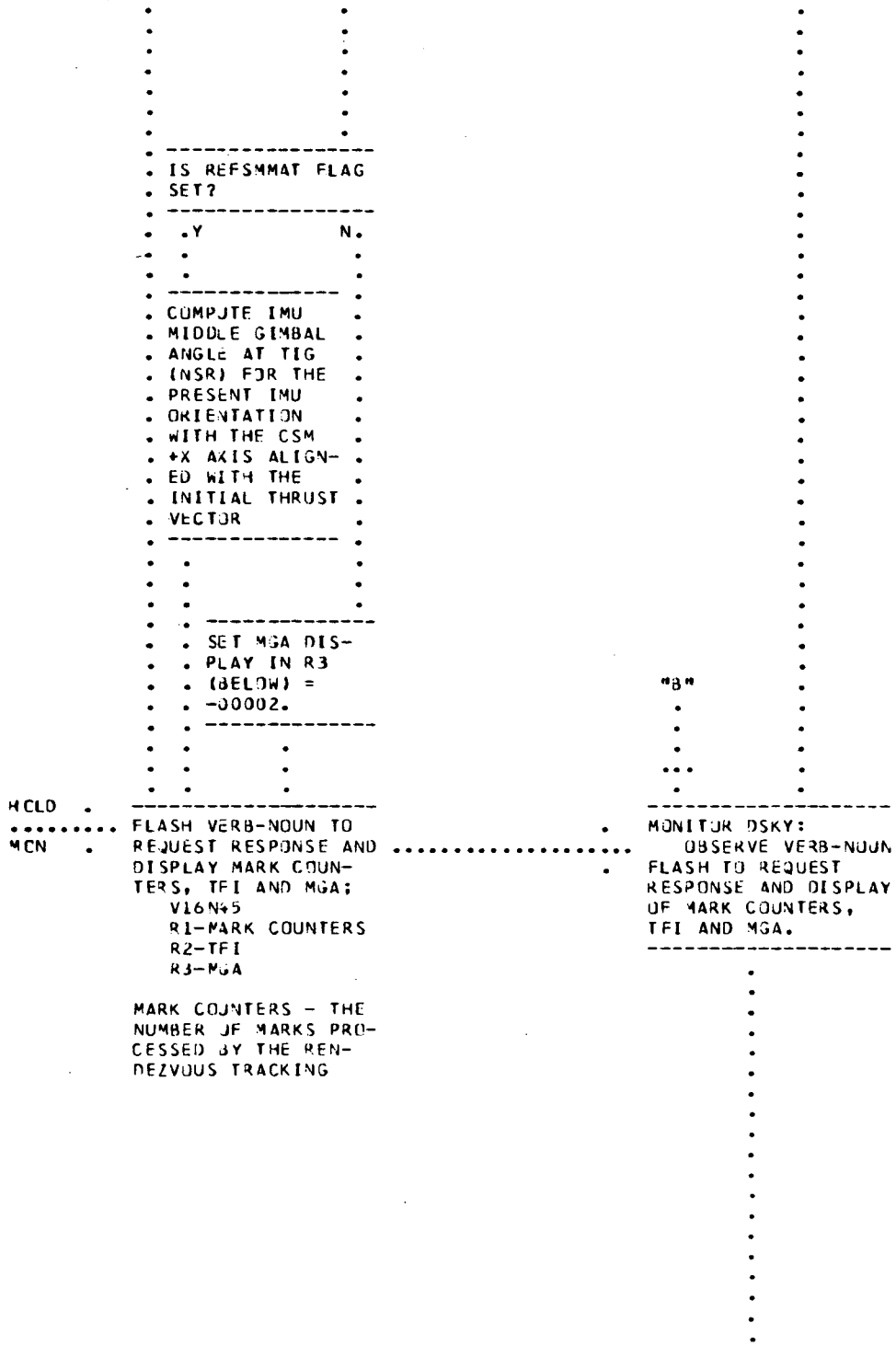
#380

#390

#400

#410


RECORD THESE VALUES
#420
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA.
.P
.R
.O
.C
.E
.E
.D
.NEW
.DATA
STORE DATA
#430
"B"
#440
IS FINAL FLAG SET?
.N
.Y
#450
SET MGA DIS- PLAY IN R3 (BELOW) = -00001.
#460



#470

#480

#490

#500

#510

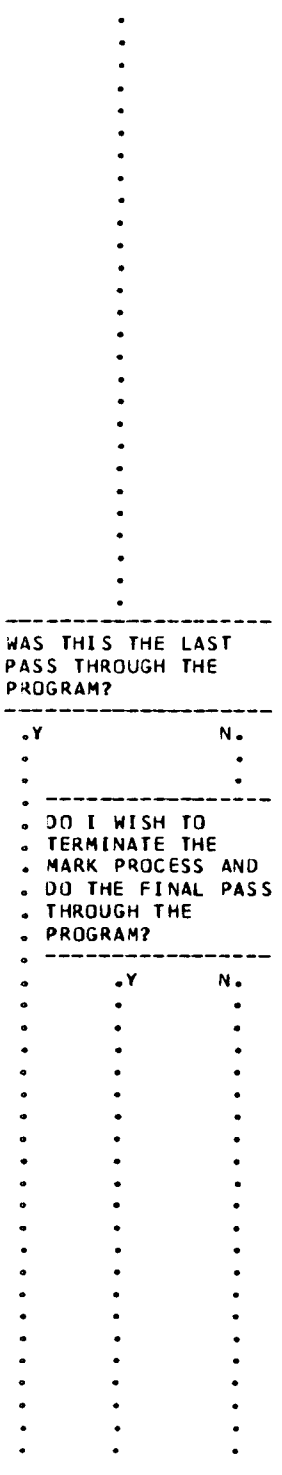
DATA PROCESSING
ROUTINE (R22)
SINCE LAST W-MATRIX
REINITIALIZATION
(REFER TO
ASSUMPTION (8) OF
P20).
THE REGISTER WILL
DISPLAY XXBXX WHERE
THE TWO MOST SIGNIF-
ICANT DIGITS IS THE
VHF RANGING MARK
COUNTER AND THE TWO
LEAST SIGNIFICANT
DIGITS IS THE OPTICS
MARK COUNTER.
(NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACKUP AND
PRIMARY MARKS.)

TFI - TIME FROM TIG
(NSR). IN MIN AND
SEC TO NEAREST SEC.
MAX READING IS 59859.
SIGN IS - BEFORE +
AFTER TIG(NSR).

MGA - MIDDLE GIMBAL
ANGLE AT TIG(NSR)
IF CSM +X AXIS IS
ALIGNED WITH INITIAL
THRUST DIRECTION. IN
DEGREES TO NEAREST
.01 DEGREE
SIGN IS ALWAYS +
EXCEPT;

(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

(B) ON THE LAST



#520

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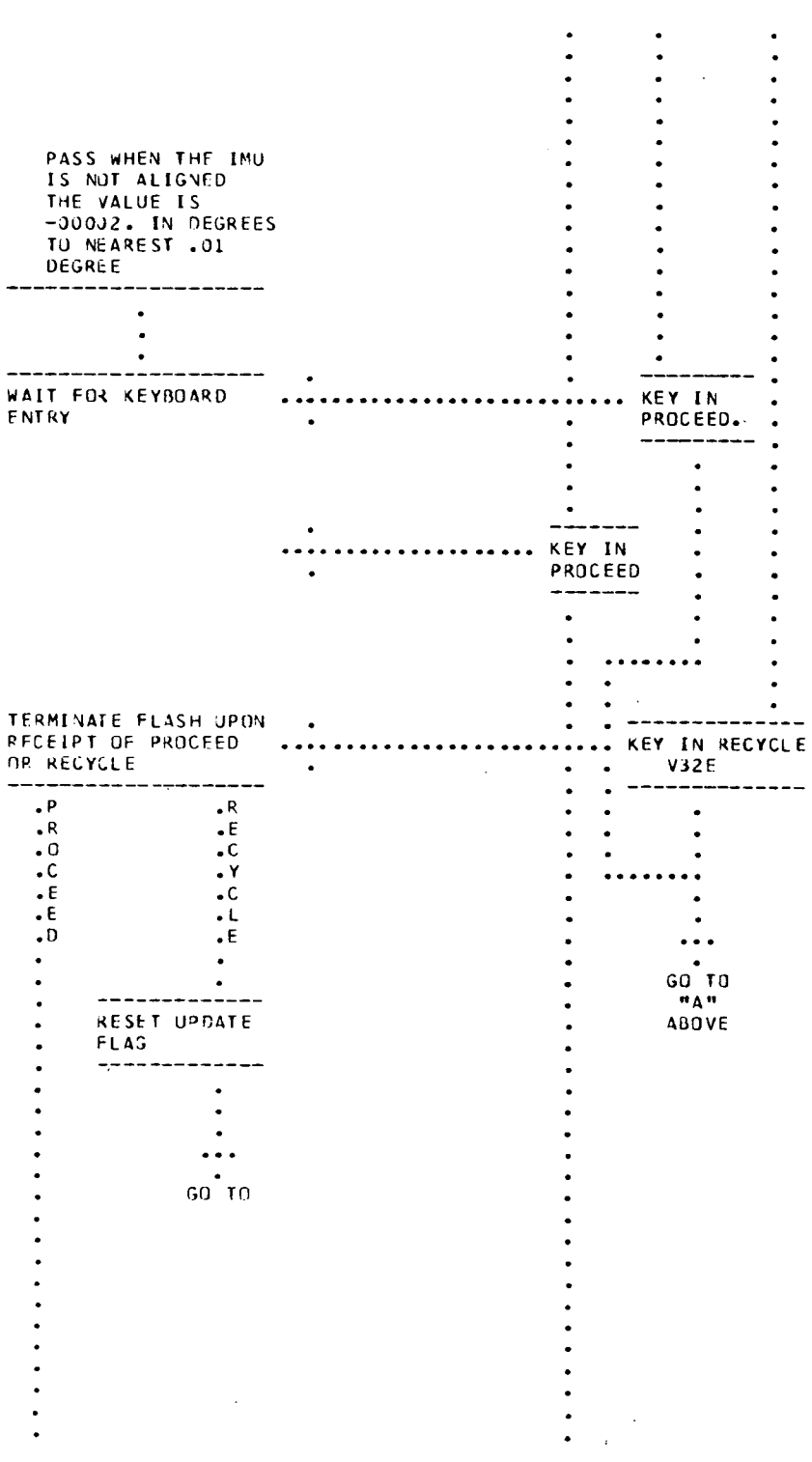

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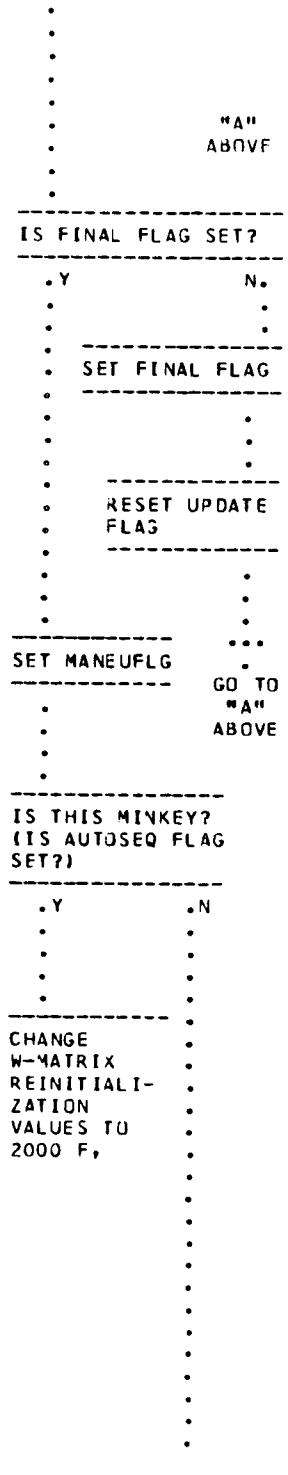

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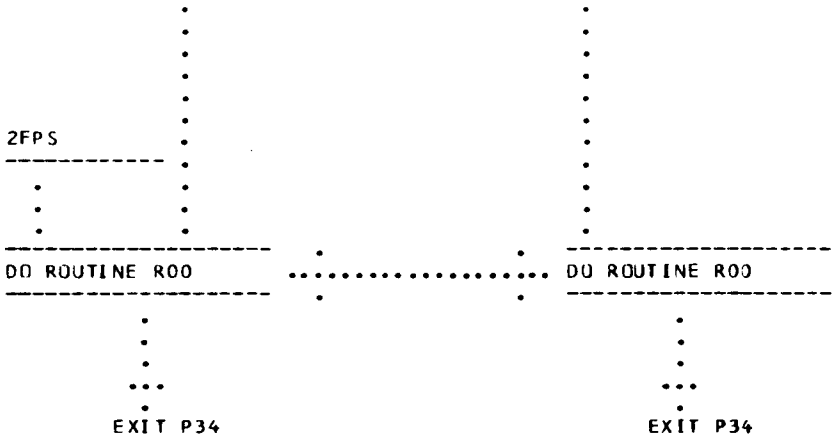


#660

#670

CHANGE CONTROL NOTES

REV 00 PCR 011, PCN 412, SKYLARK MEMO #2
REV C1 PCN 489

TPI TARGETING PROGRAM (P35) REV 01 03/20/72

PURPOSE: (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR EXECUTION OF THE TRANSFER PHASE INITIATION MANEUVER, GIVEN:

++
+01 (A) TIME OF IGNITION TIG (TPI) OR THE ELEVATION ANGLE (E) OF THE CSM/OWS LOS AT TIG(TPI)
+
+489 (B) CENTRAL ANGLE OF TRANSFER (CENTANG) OF 130 DEGREES FROM TIG(TPI) TO INTERCEPT TIME (TIG(TPF)).
++

(2) TO CALCULATE TIG (TPI) GIVEN E OR E GIVEN TIG (TPI).

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE TPI TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) THE PROGRAM MUST BE DONE OVER A TRACKING STATION FOR REAL TIME GROUND PARTICIPATION IN AGC DATA INPUT AND OUTPUT. AGC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME.

(2) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WOULD NOT BE INCORPORATED OR ACCUMULATED).
SEE P20 FOR DETAILED DESCRIPTION.

(3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.
THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(4) WHEN DETERMINING THE INITIAL POSITION AND VELOCITY OF THE TARGET AT INTERCEPT TIME, EITHER CONIC OR PRECISION INTEGRATION MAY BE USED.

(5) THE OPERATION OF THE PROGRAM UTILIZES THE FOLLOWING FLAGS:

FINAL FLAG - SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

EXTERNAL DELTA V FLAG - RESET BY THIS PROGRAM WHICH DESIGNATES THAT LAMBERT STEERING IS REQUIRED FOR EXECUTION OF THIS MANEUVER BY THE THRUSTING PROGRAM SELECTED AFTER COMPLETION OF THIS PROGRAM.

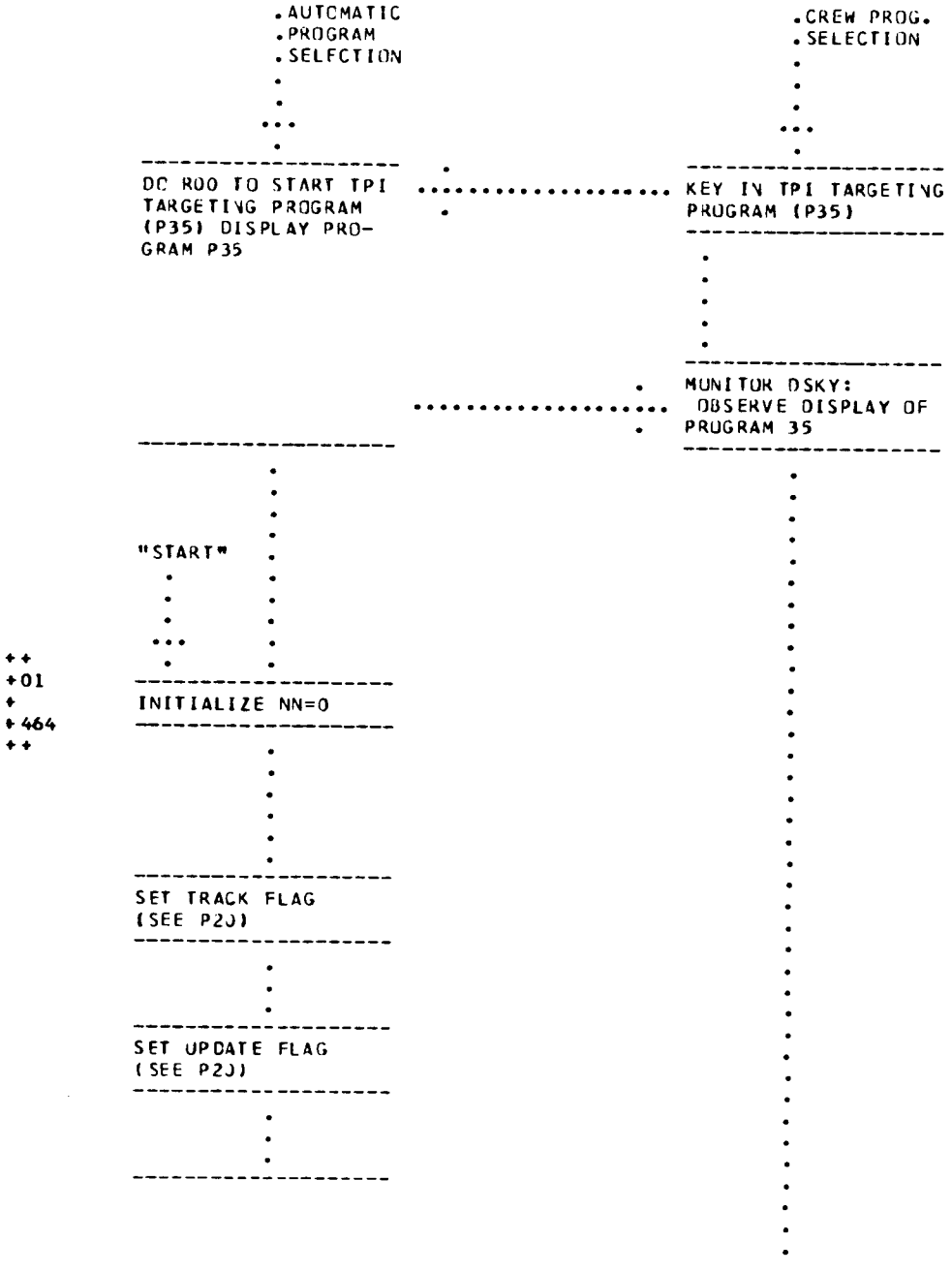
(6) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(7) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

(8) THE DELTA V IN LOS COORDINATES (N59) IS AVAILABLE AT FL V16 N45 AFTER EACH COMPUTATION CYCLE.

PROG CMC GROUND CREW

CONT



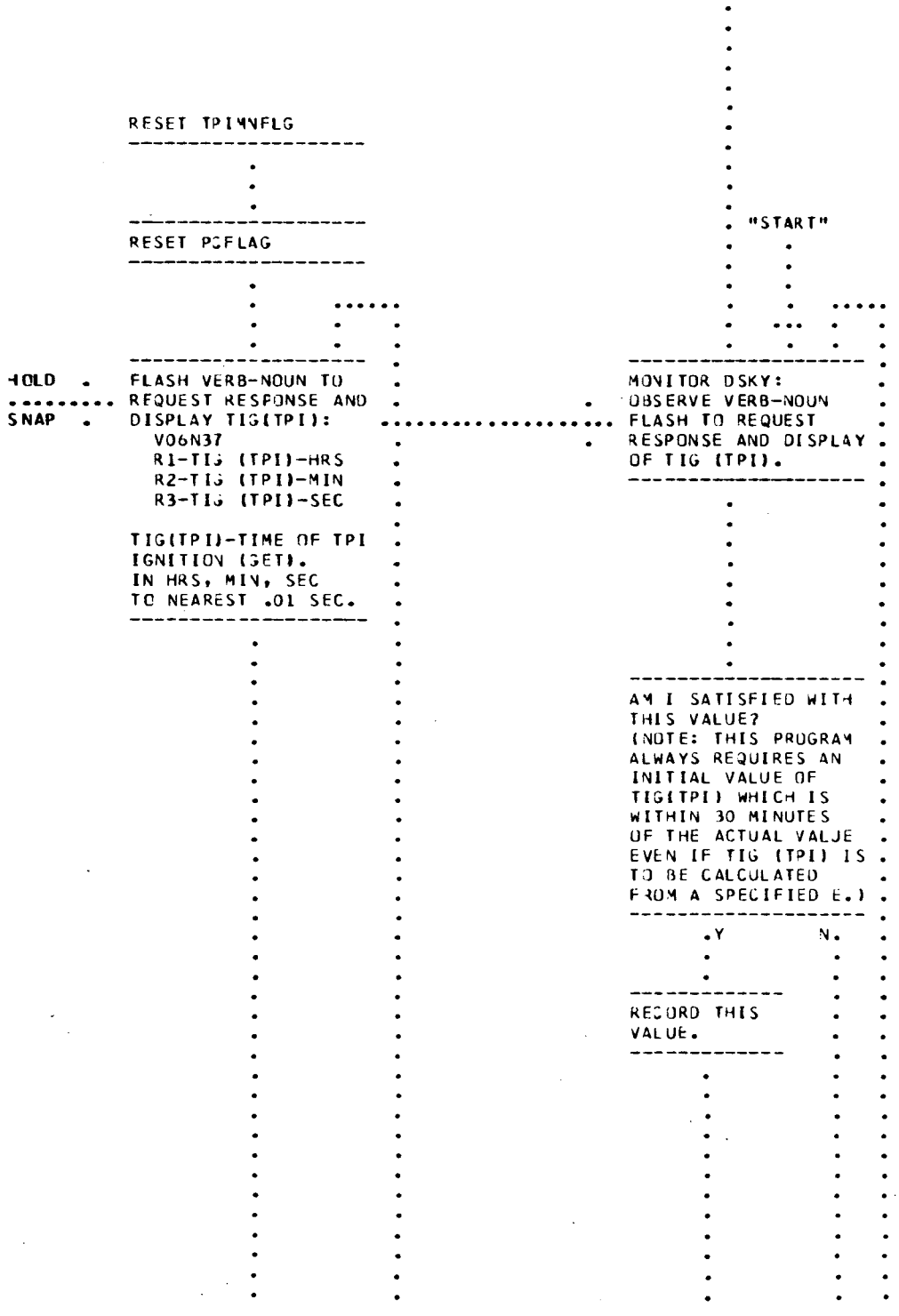
#10

#20

#30

#40

#50


RESET TPIMNFLG
RESET POFLAG
"START"
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TIG(TPI):
V06N37
R1-TIG (TPI)-HRS
R2-TIG (TPI)-MIN
R3-TIG (TPI)-SEC
TIG(TPI)-TIME OF TPI IGNITION (GET).
IN HRS, MIN, SEC
TO NEAREST .01 SEC.
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIG (TPI).
AM I SATISFIED WITH THIS VALUE?
(NOTE: THIS PROGRAM ALWAYS REQUIRES AN INITIAL VALUE OF TIG(TPI) WHICH IS WITHIN 30 MINUTES OF THE ACTUAL VALUE EVEN IF TIG (TPI) IS TO BE CALCULATED FROM A SPECIFIED E.)
Y
N
RECORD THIS VALUE.
#60
#70
#80
#90
#100

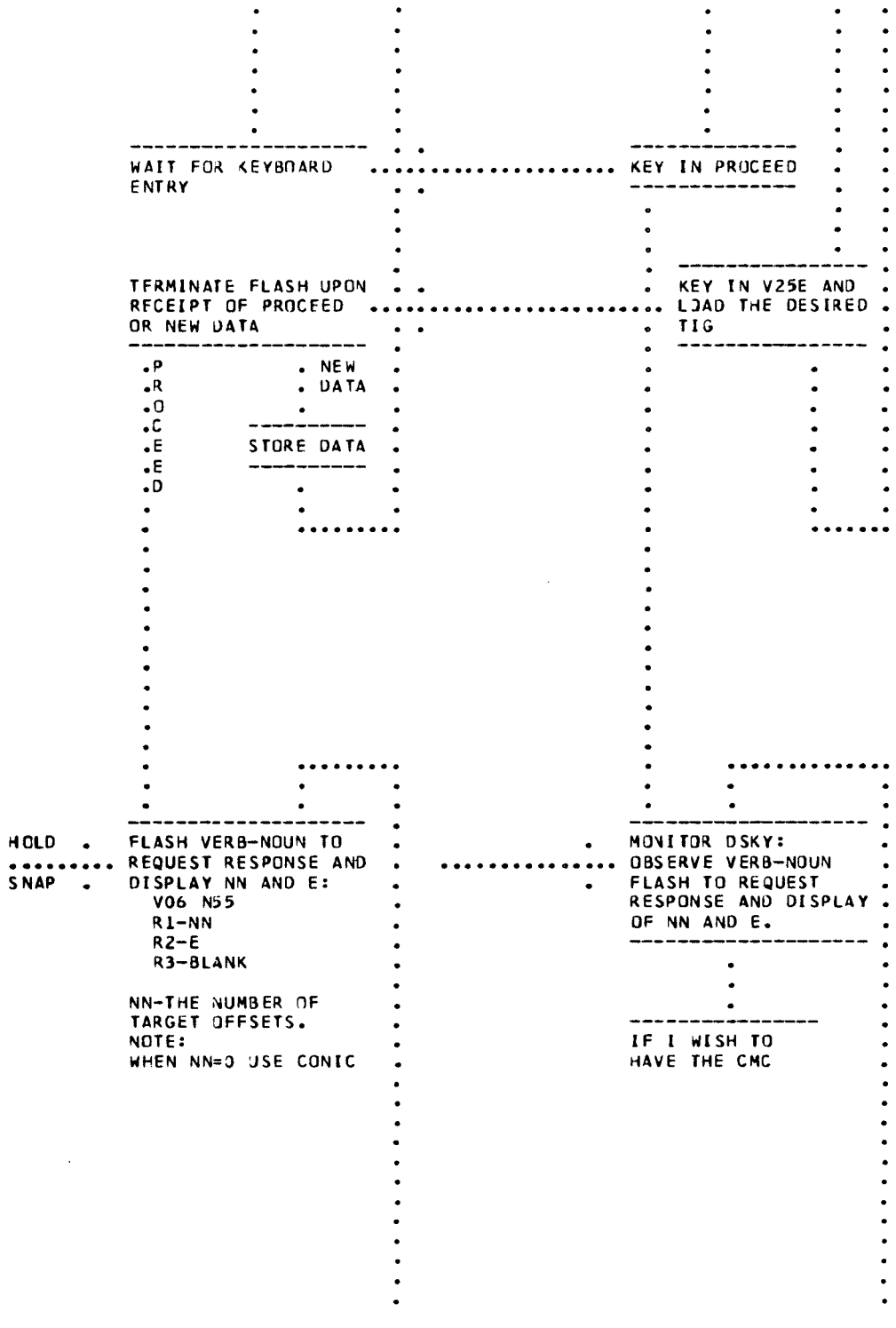
#110

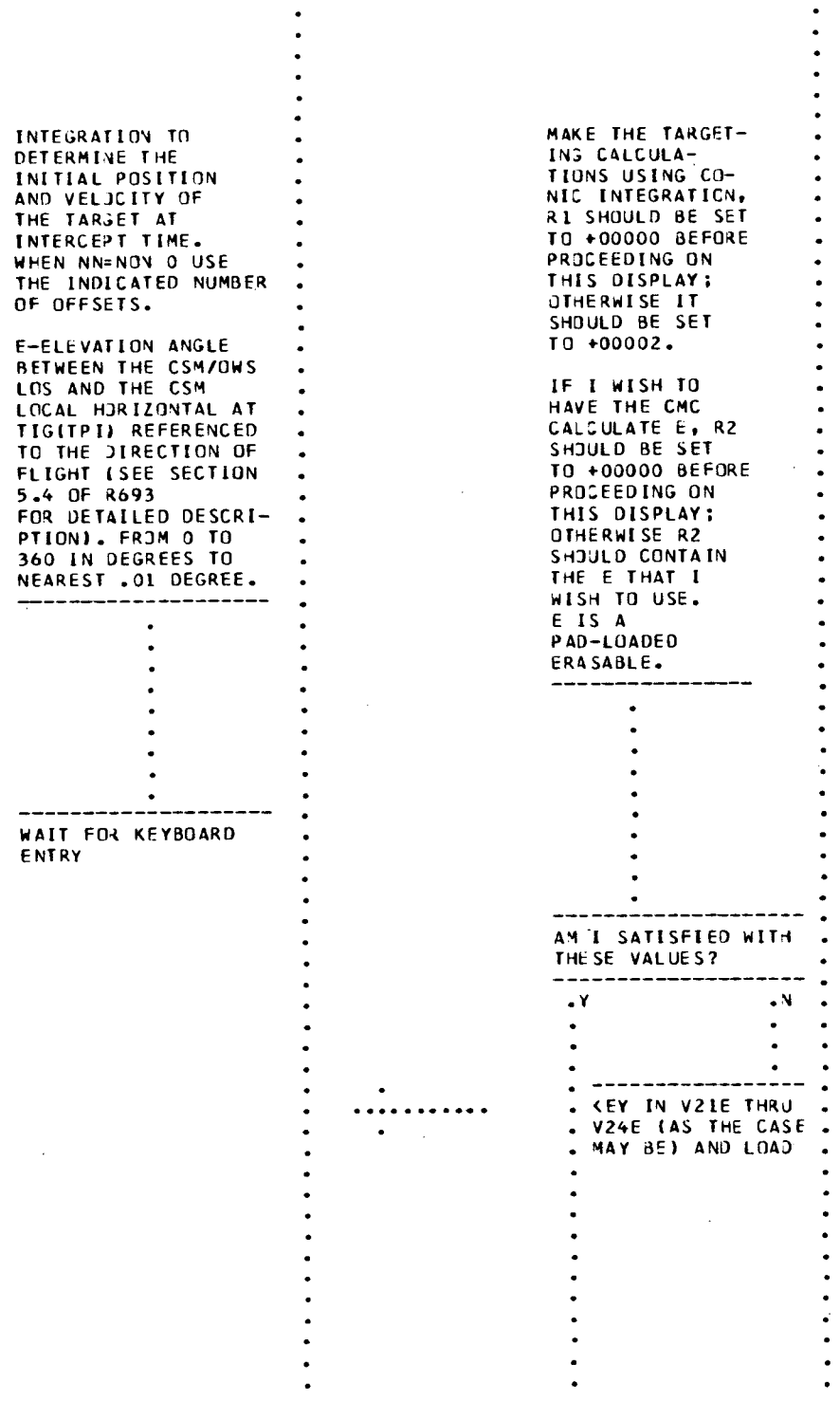
#120

#130

#140

#150





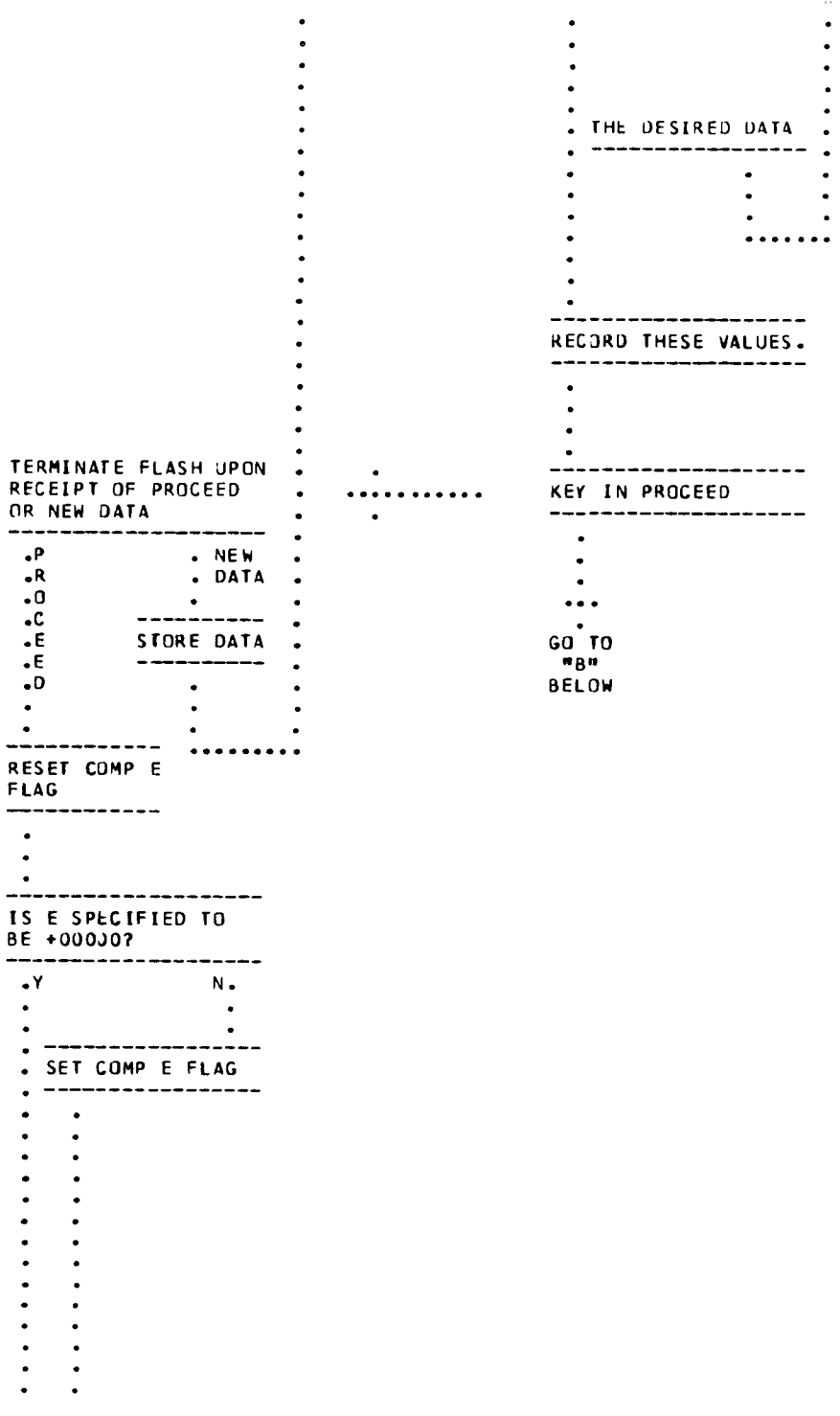
#160

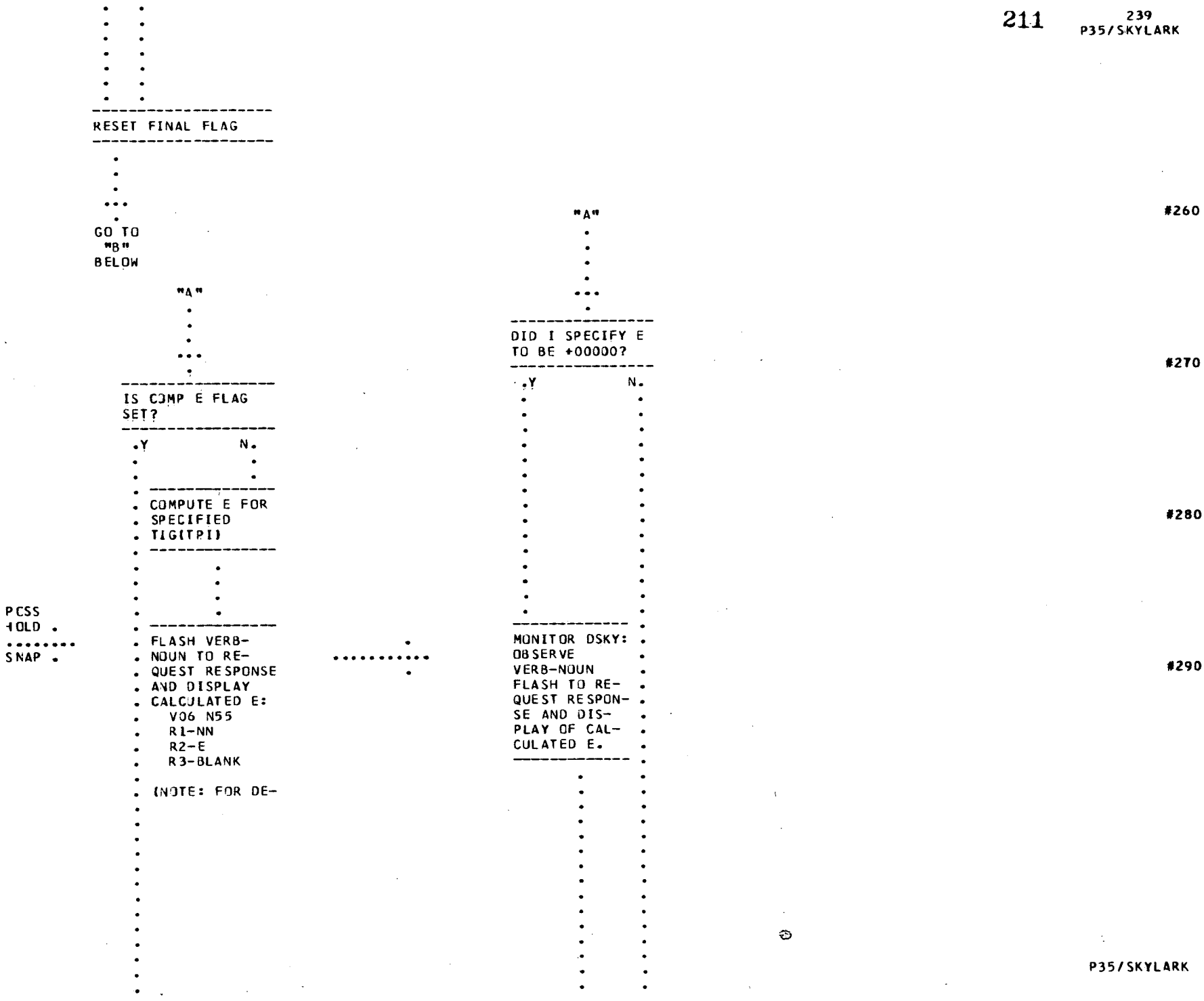
#170

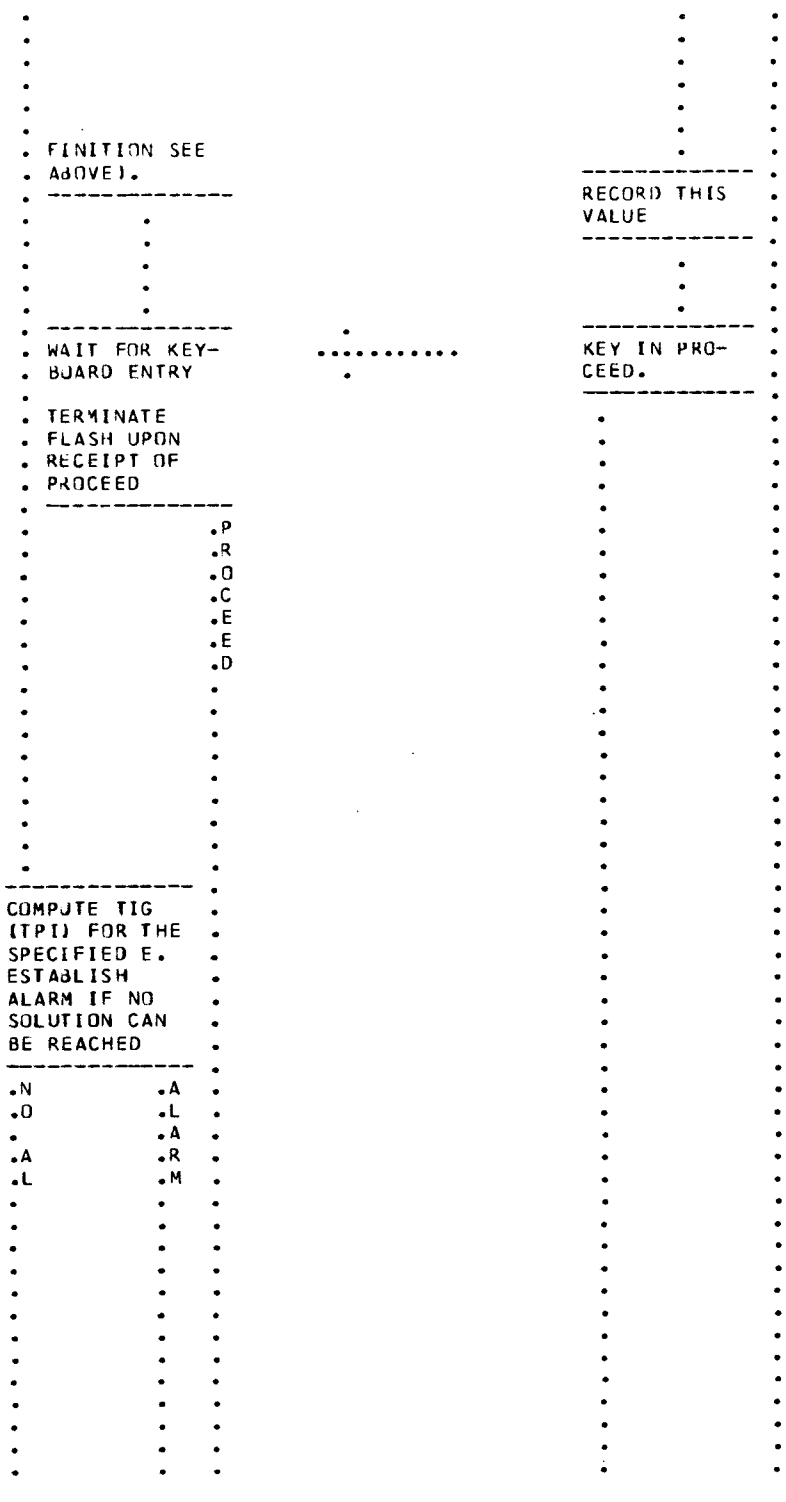
#180

#190

#200


THE DESIRED DATA
#210
RECORD THESE VALUES.
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
#220
KEY IN PROCEED
P
R
O
C
E
E
D
NEW DATA
STORE DATA
GO TO "B" BELOW
#230
RESET COMP E FLAG
IS E SPECIFIED TO BE +000J0?
#240
Y
N
SET COMP E FLAG
#250


RESET FINAL FLAG
GO TO "B" BELOW
"A"
IS COMP E FLAG SET?
.Y
N.
COMPUTE E FOR SPECIFIED TIG(TPI)
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY CALCULATED E:
V06 N55
R1-NN
R2-E
R3-BLANK
(NOTE: FOR DE-
PCSS HOLD
SNAP
"A"
DID I SPECIFY E TO BE +00000?
.Y
N.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF CALCULATED E.
#260
#270
#280
#290



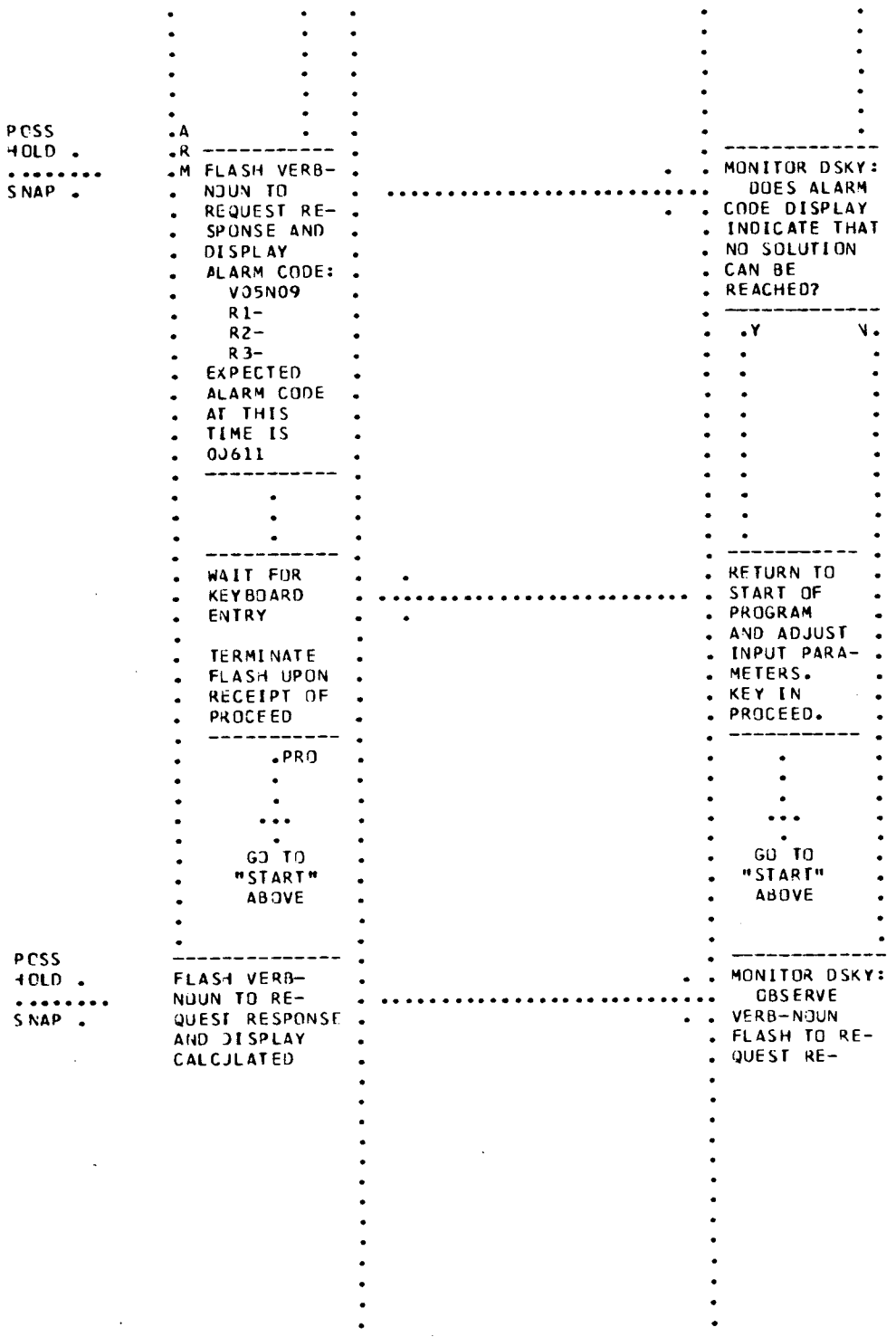
#300

#310

#320

#330

#340



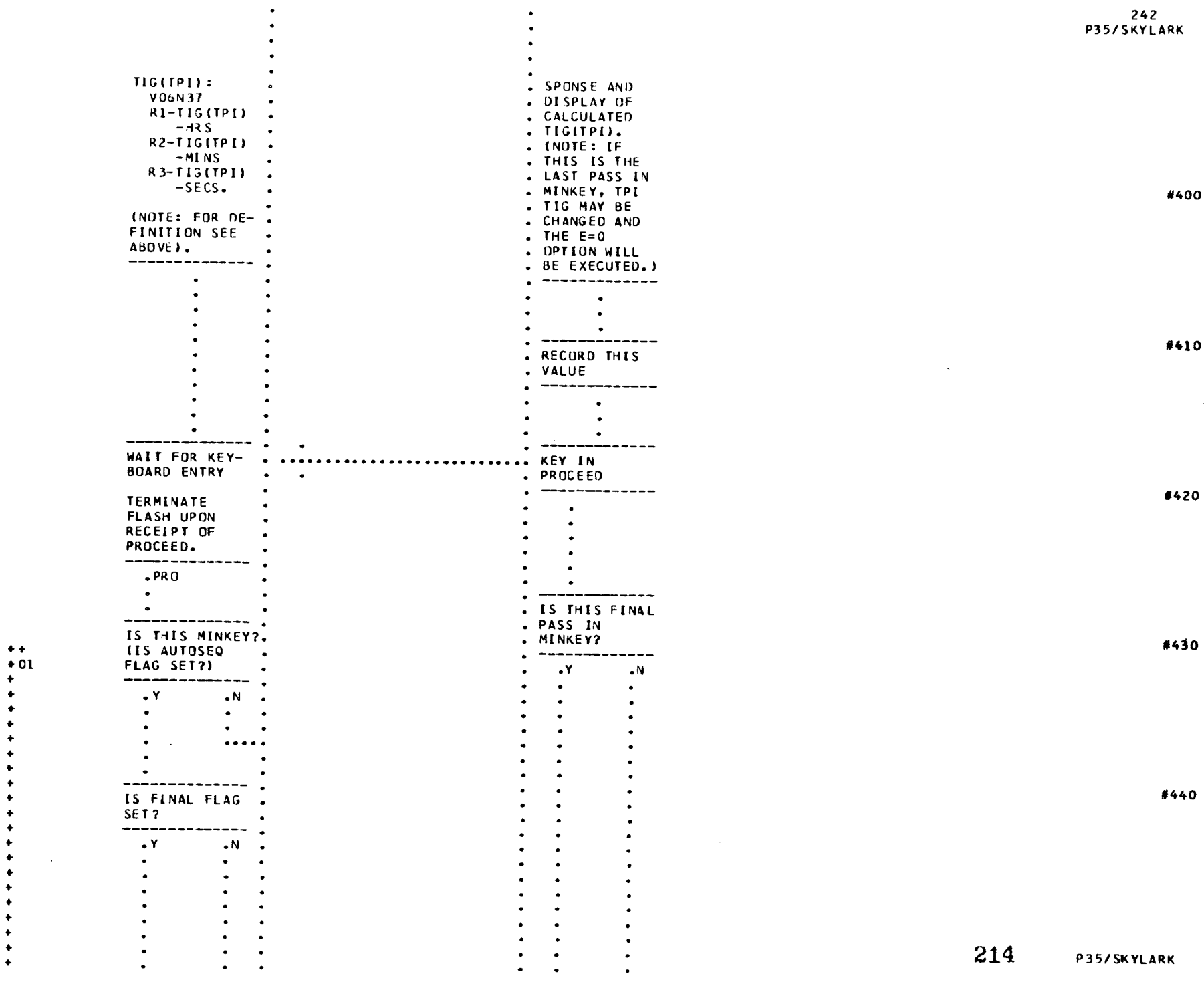
#350

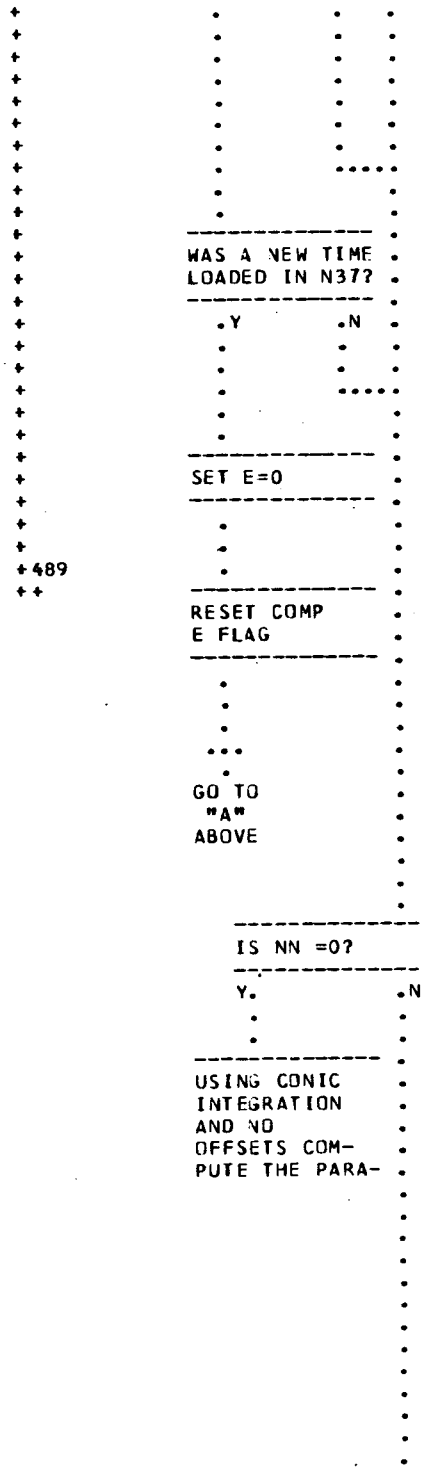
#360

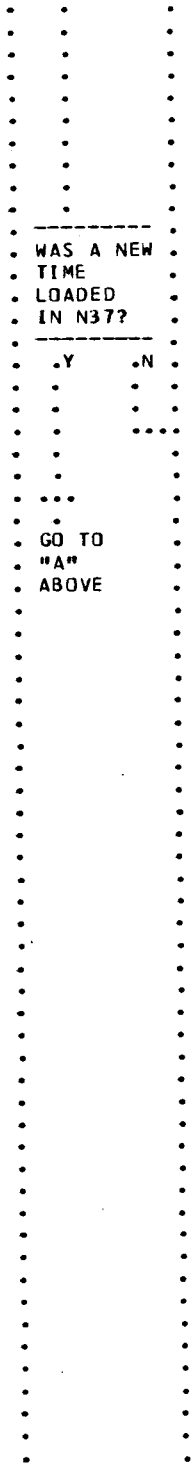
#370

#380

#390


TIG(TPI):
V06N37
R1-TIG(TPI) -HRS
R2-TIG(TPI) -MINS
R3-TIG(TPI) -SECS.
(NOTE: FOR DEFINITION SEE ABOVE).
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED.
.PRO
IS THIS MINKEY? (IS AUTOSEQ FLAG SET?)
.Y
.N
IS FINAL FLAG SET?
.Y
.N
SPONSE AND DISPLAY OF CALCULATED TIG(TPI). (NOTE: IF THIS IS THE LAST PASS IN MINKEY, TPI TIG MAY BE CHANGED AND THE E=0 OPTION WILL BE EXECUTED.)
RECORD THIS VALUE
KEY IN PROCEED
IS THIS FINAL PASS IN MINKEY?
.Y
.N
#400
#410
#420
#430
#440





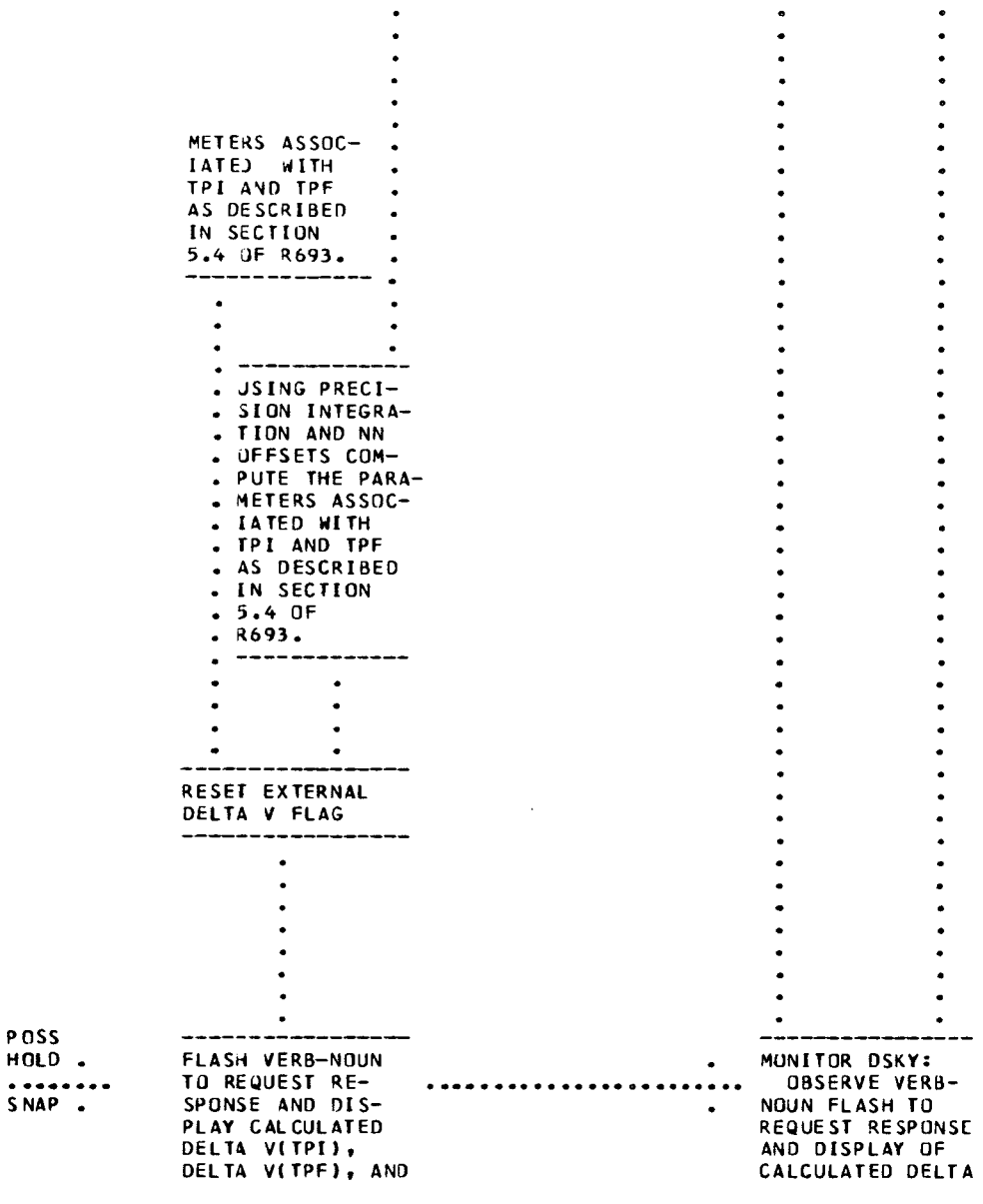
#450

#460

#470

#480

#490

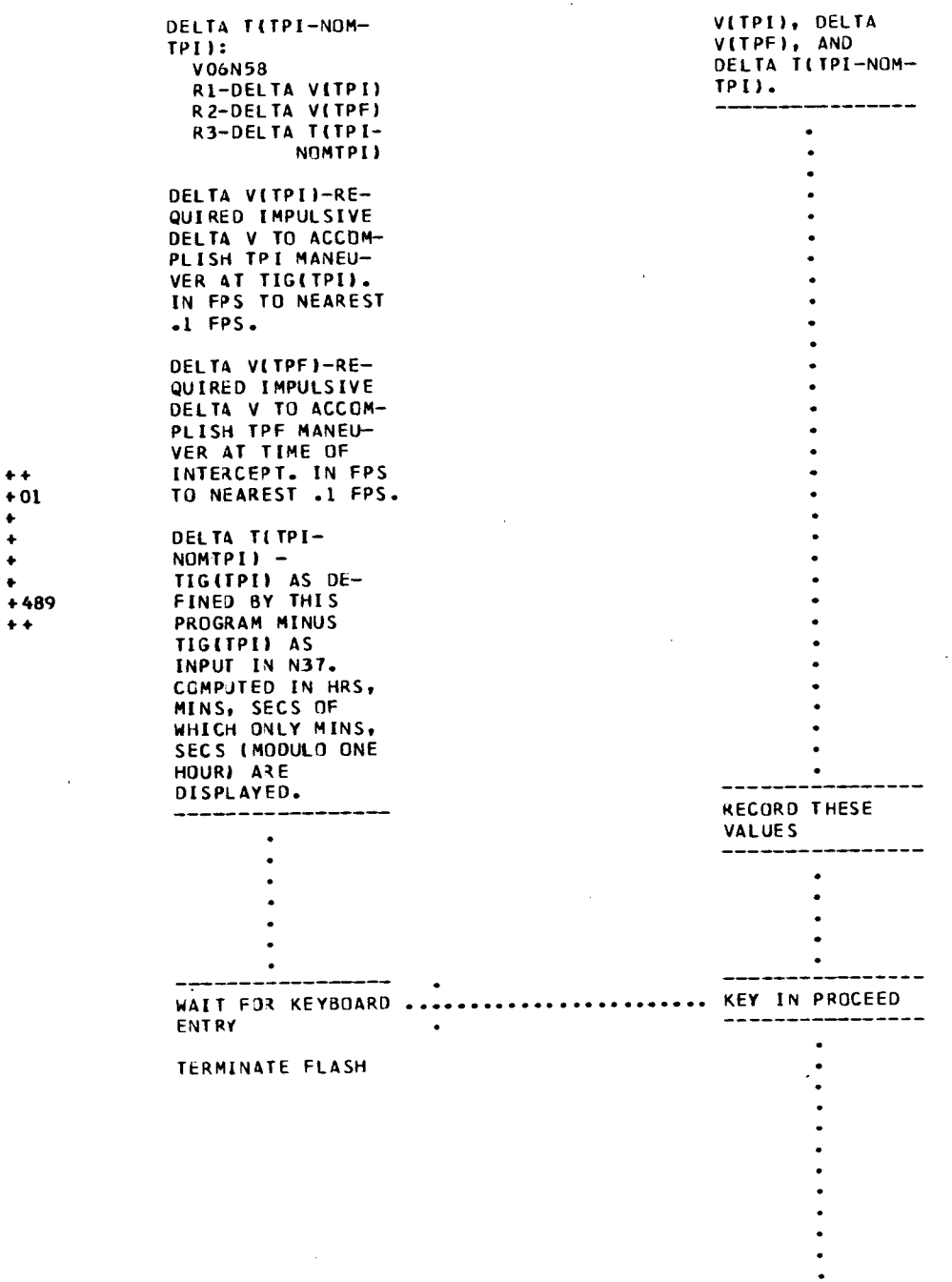


#500

#510

#520

#530



++
+01
+
+
+
+489
++

#540

#550

#560

#570

#580

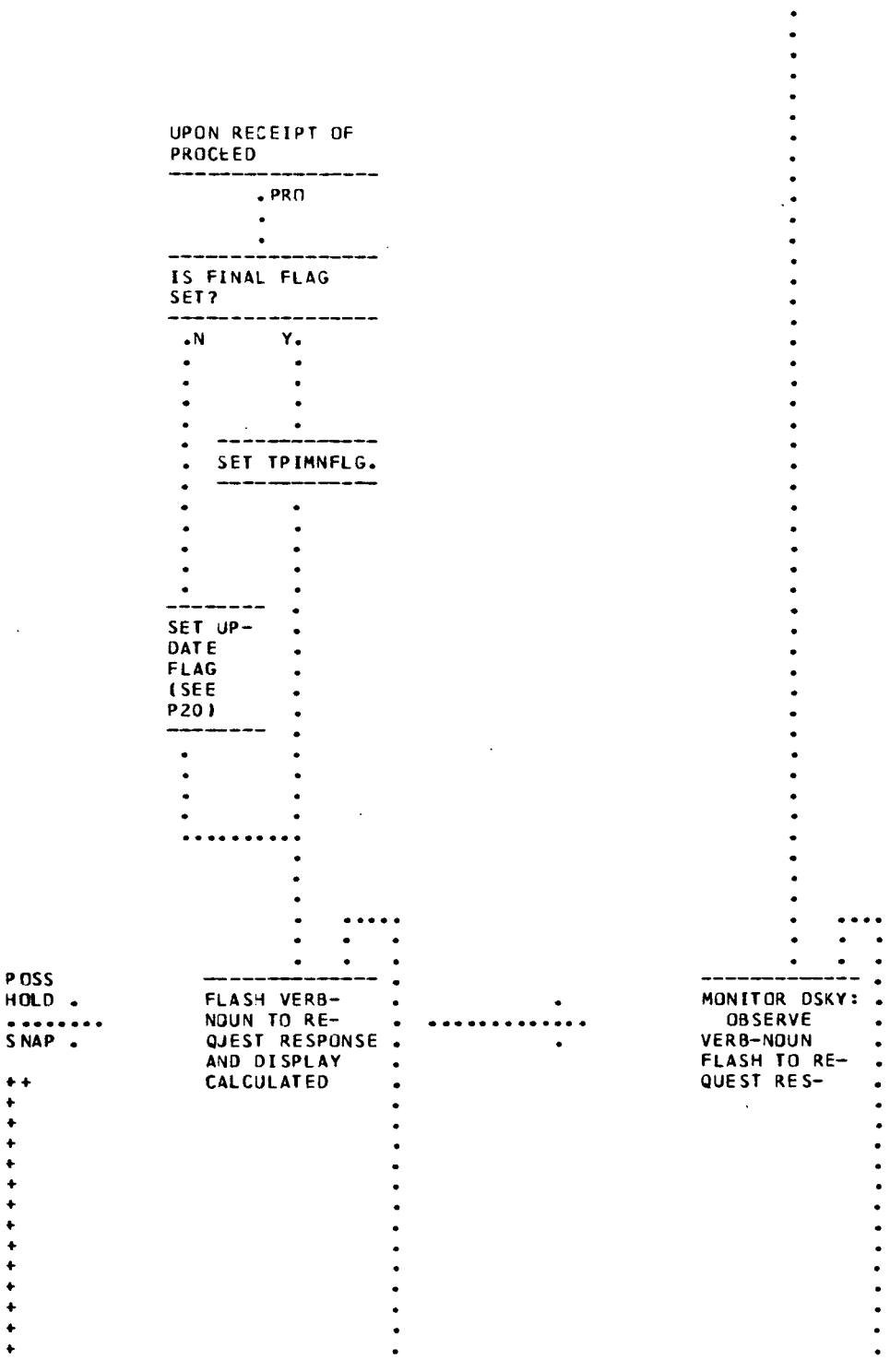
#590

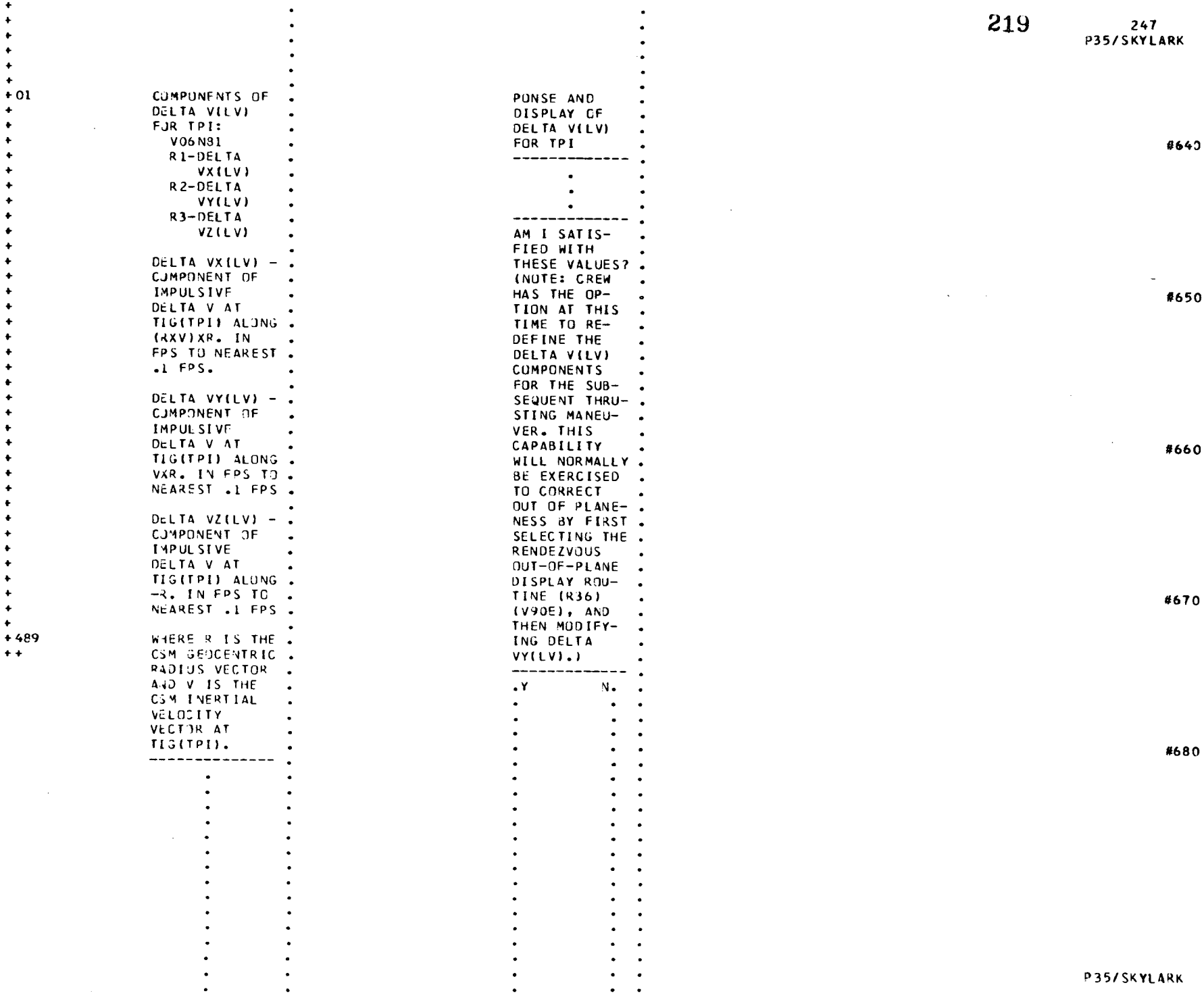
#600

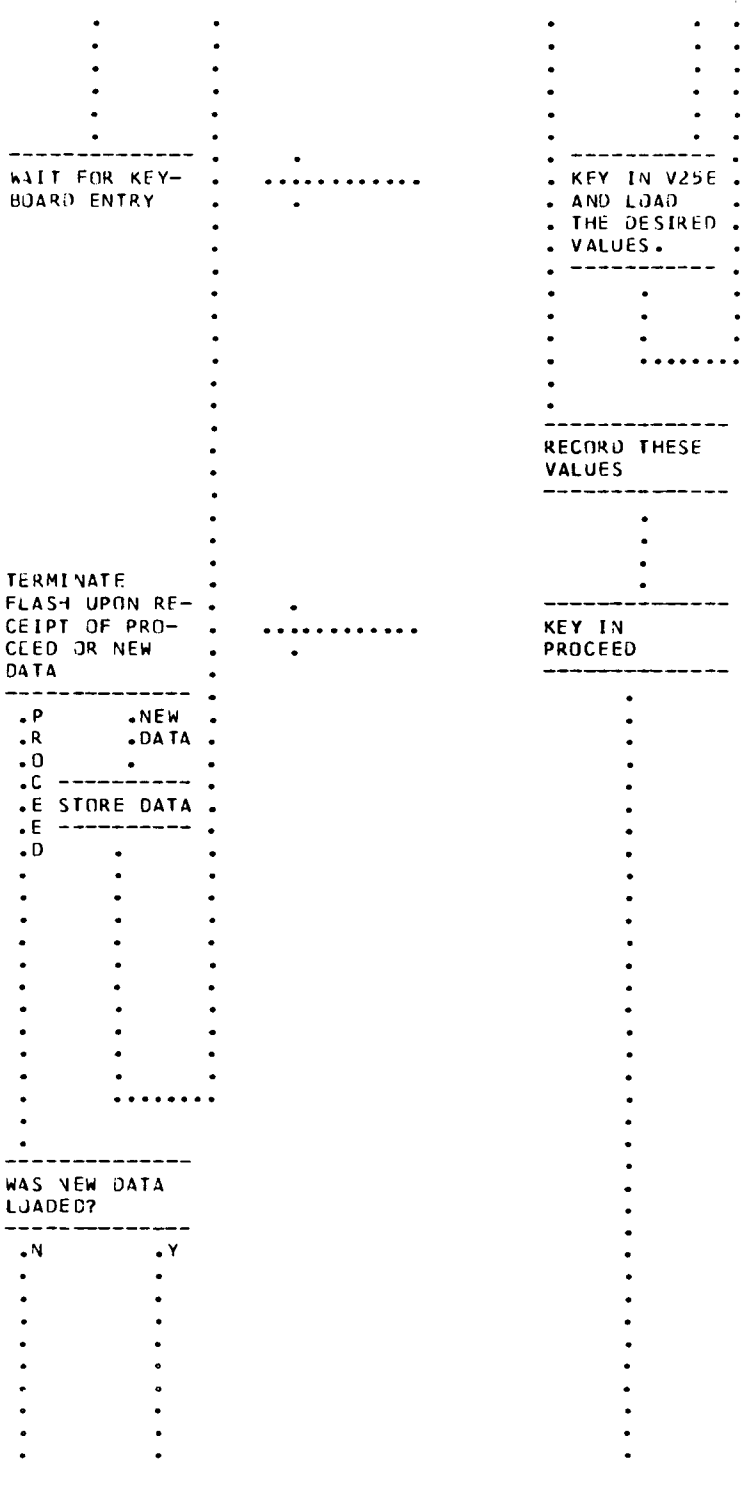
#610

#620

#630




01
COMPONENTS OF DELTA V(LV) FOR TPI:
V06N81
R1-DELTA VX(LV)
R2-DELTA VY(LV)
R3-DELTA VZ(LV)
DELTA VX(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG(TPI) ALONG (RXV)XR. IN FPS TO NEAREST .1 FPS.
DELTA VY(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG(TPI) ALONG VXR. IN FPS TO NEAREST .1 FPS
DELTA VZ(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG(TPI) ALONG -R. IN FPS TO NEAREST .1 FPS
489
++
WHERE R IS THE CSM GEOCENTRIC RADIUS VECTOR AND V IS THE CSM INERTIAL VELOCITY VECTOR AT TIG(TPI).
PONSE AND DISPLAY OF DELTA V(LV) FOR TPI
AM I SATISFIED WITH THESE VALUES? (NOTE: CREW HAS THE OPTION AT THIS TIME TO REDEFINE THE DELTA V(LV) COMPONENTS FOR THE SUBSEQUENT THRUSTING MANEUVER. THIS CAPABILITY WILL NORMALLY BE EXERCISED TO CORRECT OUT OF PLANENESS BY FIRST SELECTING THE RENDEZVOUS OUT-OF-PLANE DISPLAY ROUTINE (R36) (V90E), AND THEN MODIFYING DELTA VY(LV).)
.Y
N.
#640
#650
#660
#670
#680



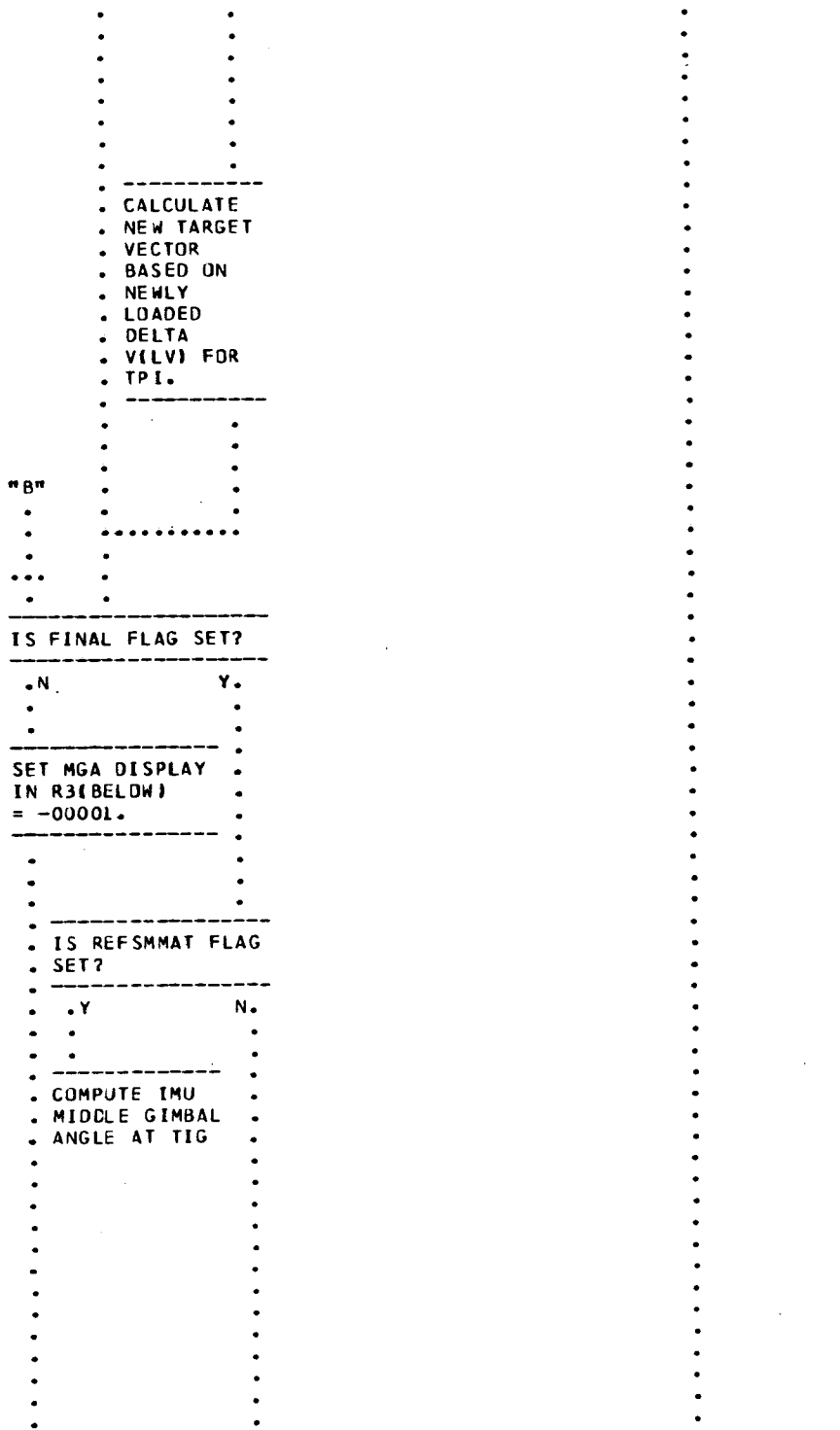
#690

#700

#710

#720

#730



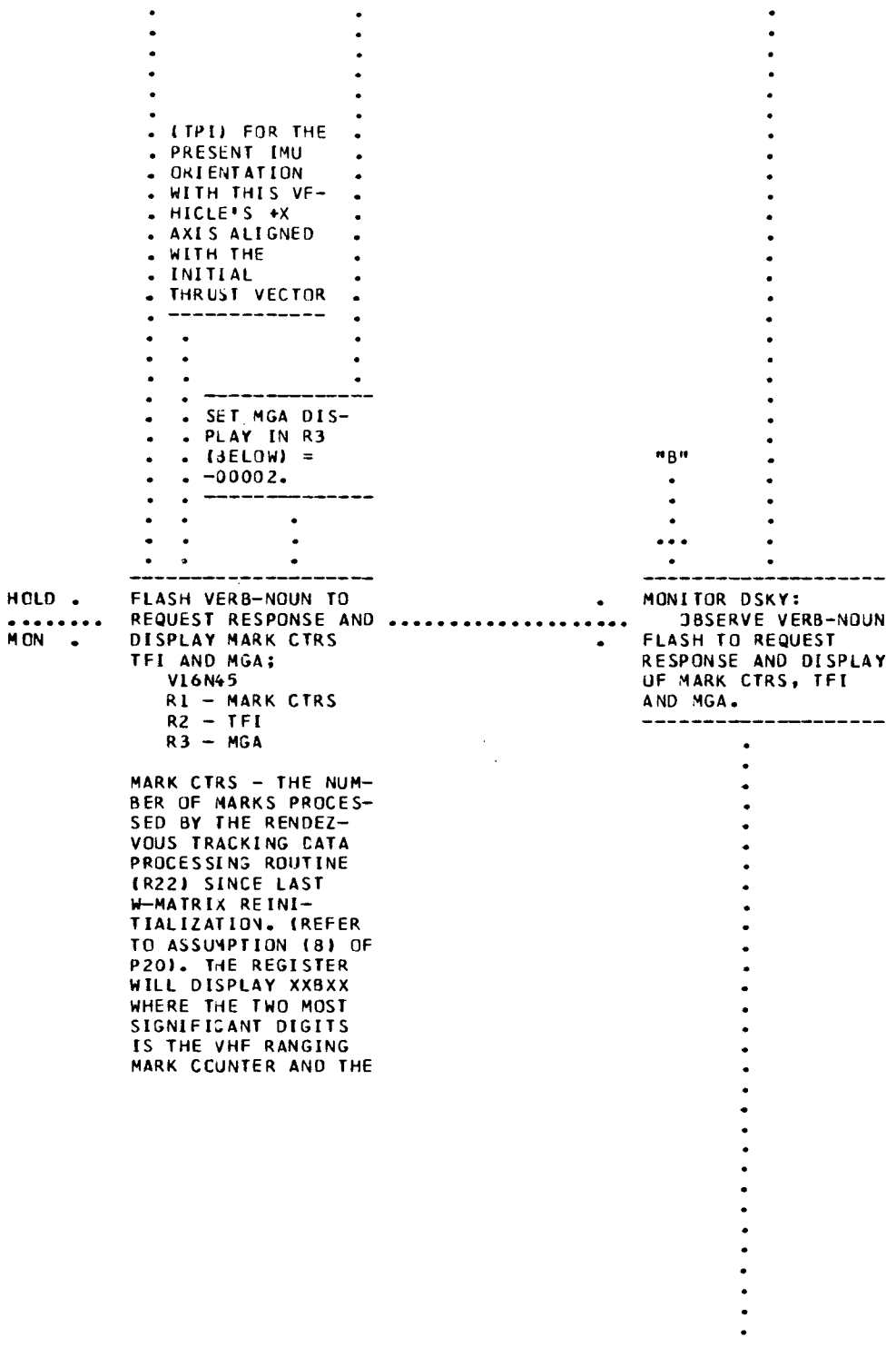
#740

#750

#760

#770

#780



#790

#800

#810

#820

#830

TWO LEAST SIGNIFI-
CANT DIGITS IS THE
OPTICS MARK COUNTER.
NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACKUP AND
PRIMARY MARKS.

#840

TFI-TIME FROM
TIG(TPI). IN MIN AND
SEC TO NEAREST SEC.
MAX READING IS
59859. SIGN IS
- BEFORE + AFTER
TIG(TPI).

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y N.

#850

MGA-MIDDLE GIMBAL
ANGLE AT TIG(TPI) IF
CSM +X AXIS IS ALIG-
NED WITH INITIAL-
THRUST DIRECTION.
SIGN IS ALWAYS +
EXCEPT:
(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

DO I WISH TO
TERMINATE THE
MARKING PROCESS
AND DO THE FINAL
PASS THROUGH THE
PROGRAM?

.Y N.

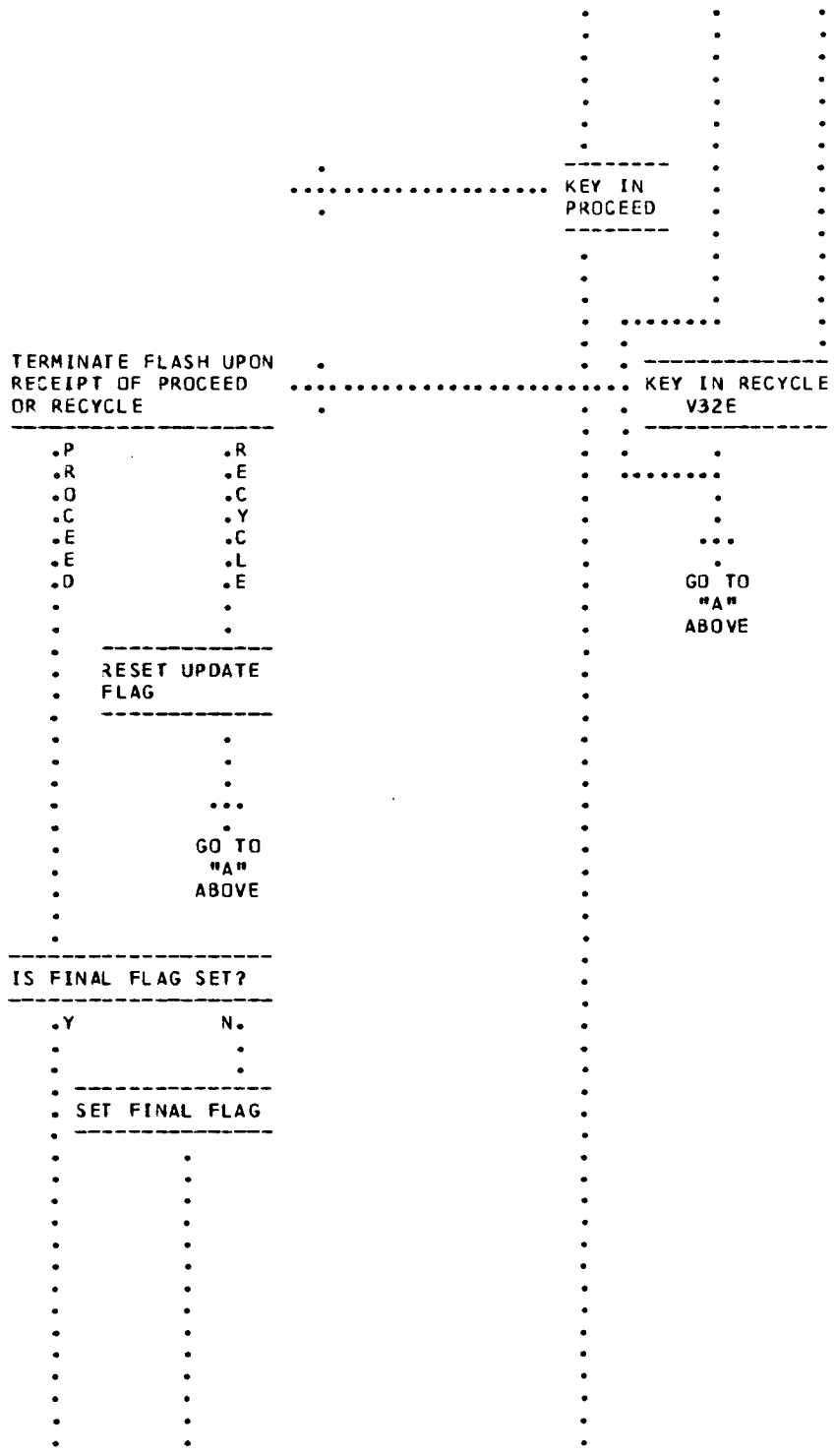
#860

(B) ON THE LAST
PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-00002.
IN DEGREES TO THE
NEAREST .01 DE-
GREES.

#870

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED.



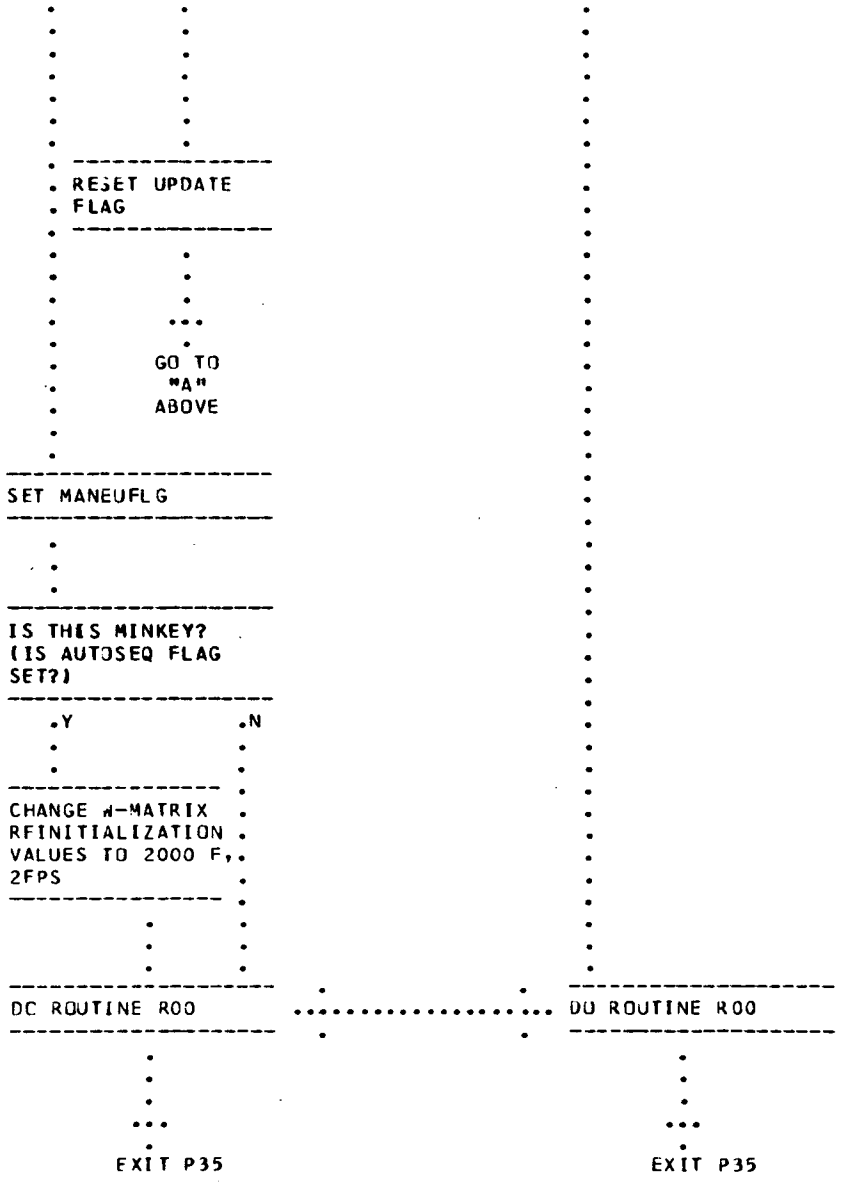
#880

#890

#900

#910

#920



#930

#940

#950

#960

#970

CHANGE CONTROL NOTES

REV 00 PCR 011, PCN 412,455, SKYLARK MEMO #2
REV 01 PCR 464, PCN 489

TPM TARGETING PROGRAM (P35) REV 00 05/19/71

PURPOSE: (1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR CSM EXECUTION OF THE NEXT MIDCOURSE CORRECTION OF THE TRANSFER PHASE OF AN ACTIVE CSM RENDEZVOUS.

ASSUMPTIONS: (1) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

(2) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.

THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(3) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS:

EXTERNAL DELTA V FLAG - RESET BY THIS PROGRAM WHICH DESIGNATES THAT LAMBERT STEERING IS REQUIRED FOR EXECUTION OF THIS MANEUVER BY THE THRUSTING PROGRAM SELECTED AFTER COMPLETION OF THIS PROGRAM.

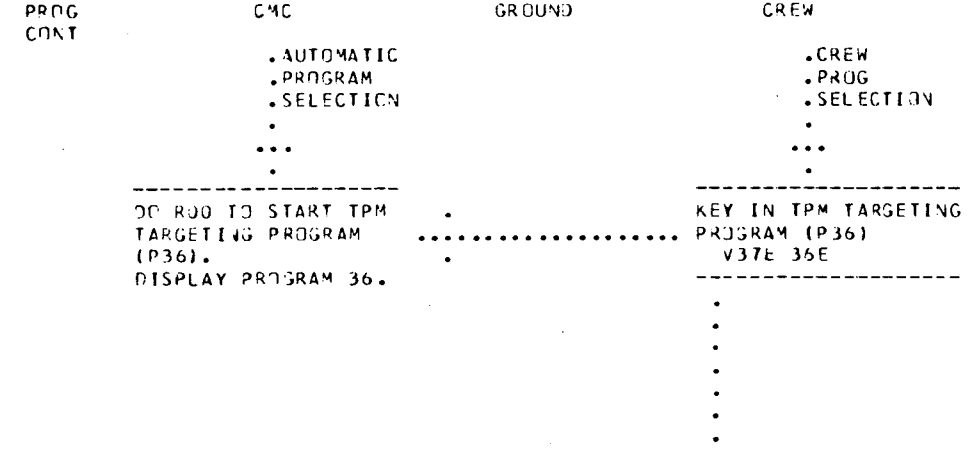
FINAL FLAG - SELECTS FINAL PROGRAM DISPLAY AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

(4) THE TIME OF INTERCEPT (T[INT]) WAS DEFINED BY PREVIOUS COMPLETION OF THE TPI TARGETING PROGRAM (P35) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.

(5) THE DELTA V IN LV COORDINATES IS AVAILABLE IN N81.

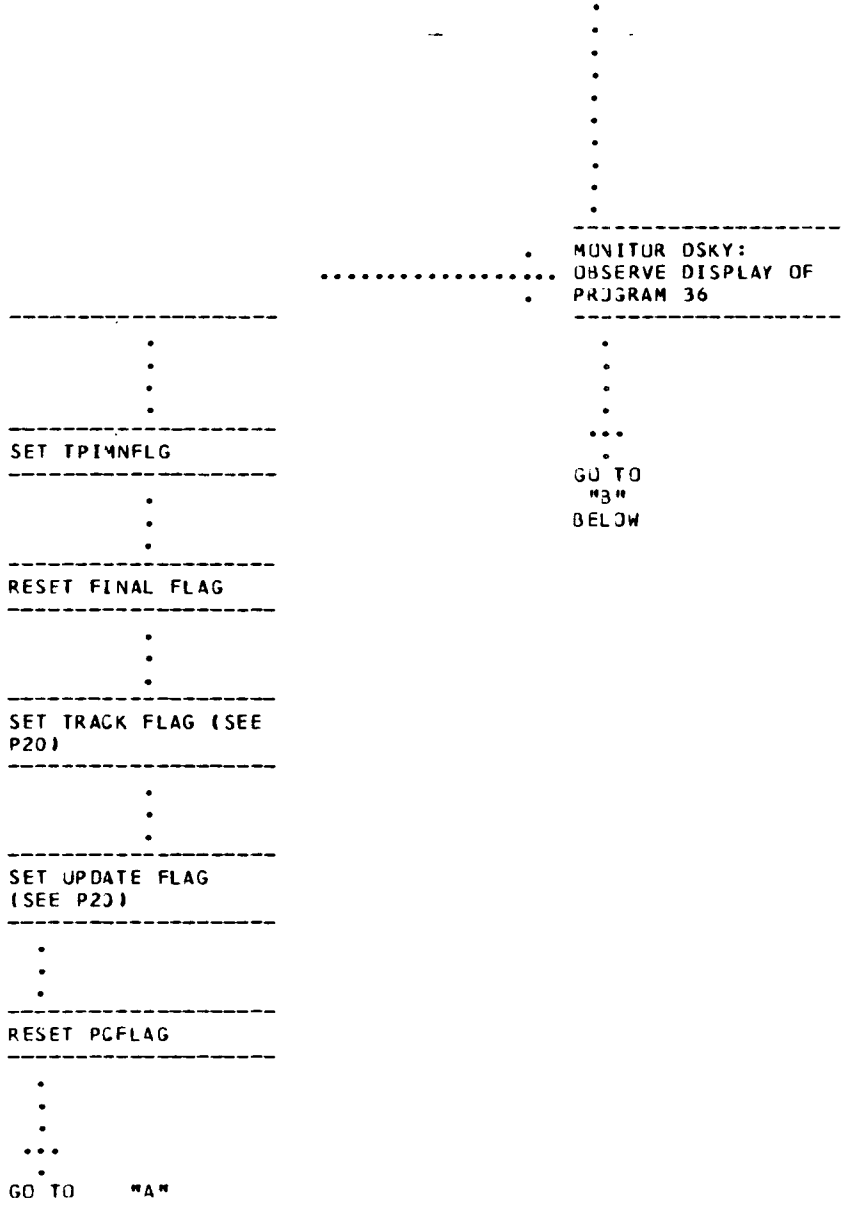
(6) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).



#10

P36/SKYLARK


MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 36
GO TO
"B"
BELOW
SET IPIMNFLG
RESET FINAL FLAG
SET TRACK FLAG (SEE
P20)
SET UPDATE FLAG
(SEE P20)
RESET PCFLAG
GO TO "A"

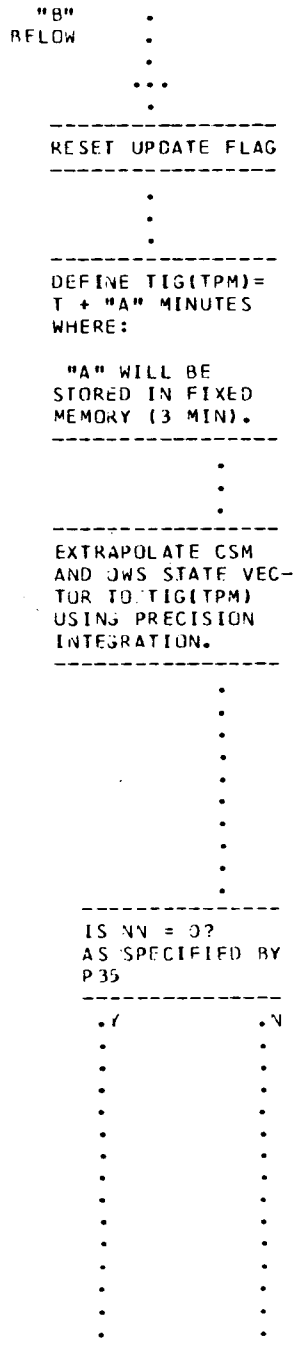
#20

#30

#40

#50

#60

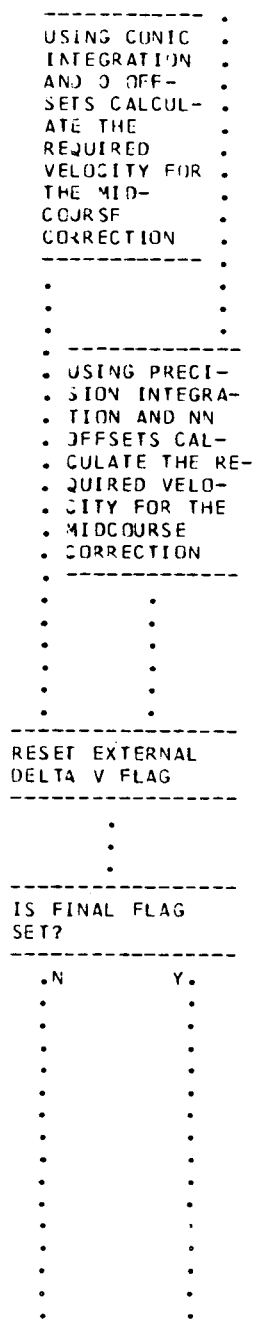

"B"
BELOW
RESET UPDATE FLAG
DEFINE TIG(TPM)=
T + "A" MINUTES
WHERE:
"A" WILL BE
STORED IN FIXED
MEMORY (3 MIN).
EXTRAPOLATE CSM
AND OWS STATE VEC-
TOR TO TIG(TPM)
USING PRECISION
INTEGRATION.
IS NN = 0?
AS SPECIFIED BY
P35
Y
N

#70

#80

#90

#100



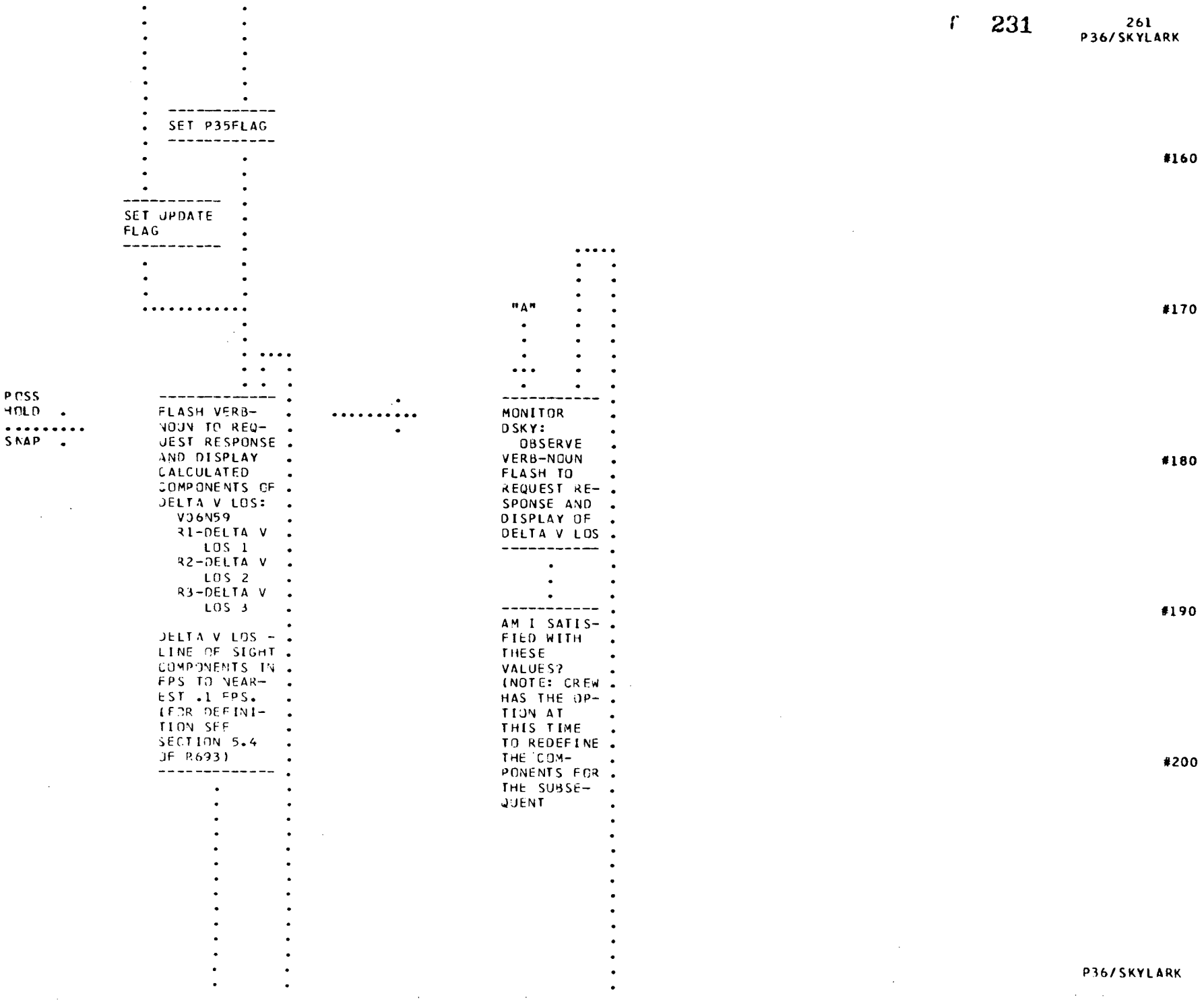
#110

#120

#130

#140

#150



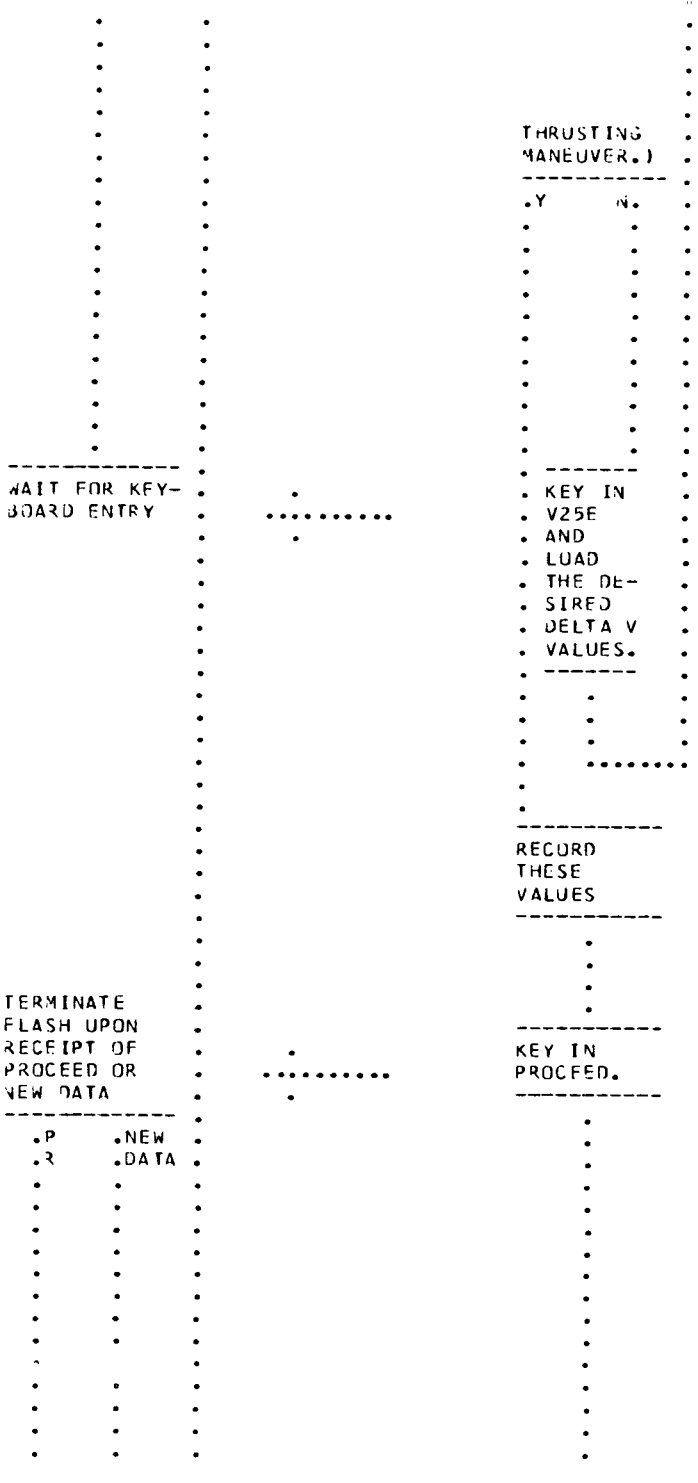
#160

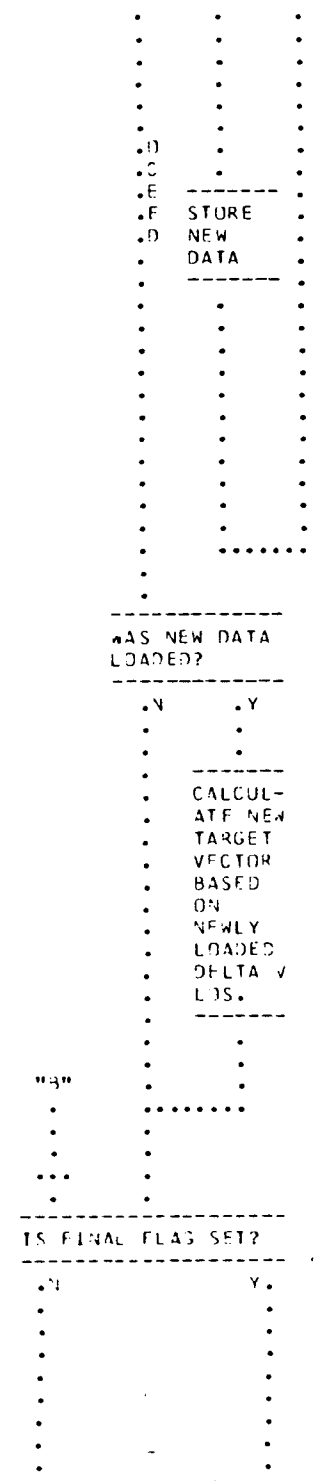
#170

#180

#190

#200


THRUSTING
MANEUVER.)
.Y
.N.
#210
WAIT FOR KEY-
BOARD ENTRY
KEY IN
V25E
AND
LOAD
THE DE-
SIRED
DELTA V
VALUES.
#220
#230
RECORD
THESE
VALUES
#240
TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR
NEW DATA
KEY IN
PROCEED.
.P
.R
.NEW
.DATA
#250



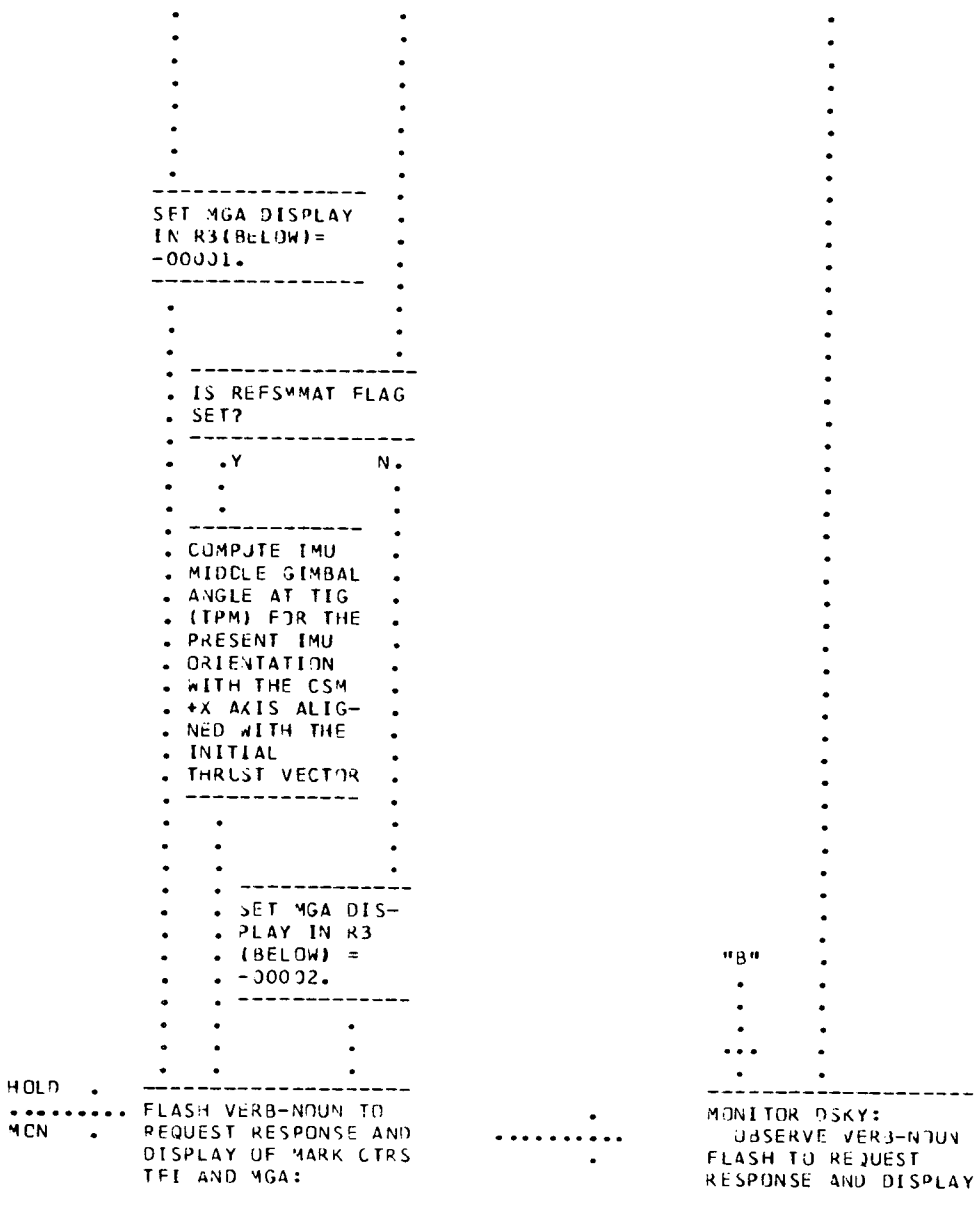
#260

#270

#280

#290

#300



#310

#320

#330

#340

#350

V16N45
R1-MARK CTRS
R2-TFI
R3-MGA

MARK CTRS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE THE LAST W-MATRIX REINITIALIZATION. (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBXX WHERE THE TWO MOST SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS IS THE OPTICS MARK COUNTER

NOTE : THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.

TFI-TIME FROM TIG (TPM) IN MIN AND SEC TO NEAREST SEC. MAX READING IS 59859. SIGN IS - BEFORE + AFTER TIG(TPM).

MGA-MIDDLE GIMBAL ANGLE AT TIG(TPM) IF CSM + X AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION. SIGN IS ALWAYS + EXCEPT:

(A) WHEN DISPLAYED AT ANY TIME

OF MARK CTRS, TFI AND MGA.

#360

#370

#380

WAS THIS THE LAST PASS THROUGH THE PROGRAM?

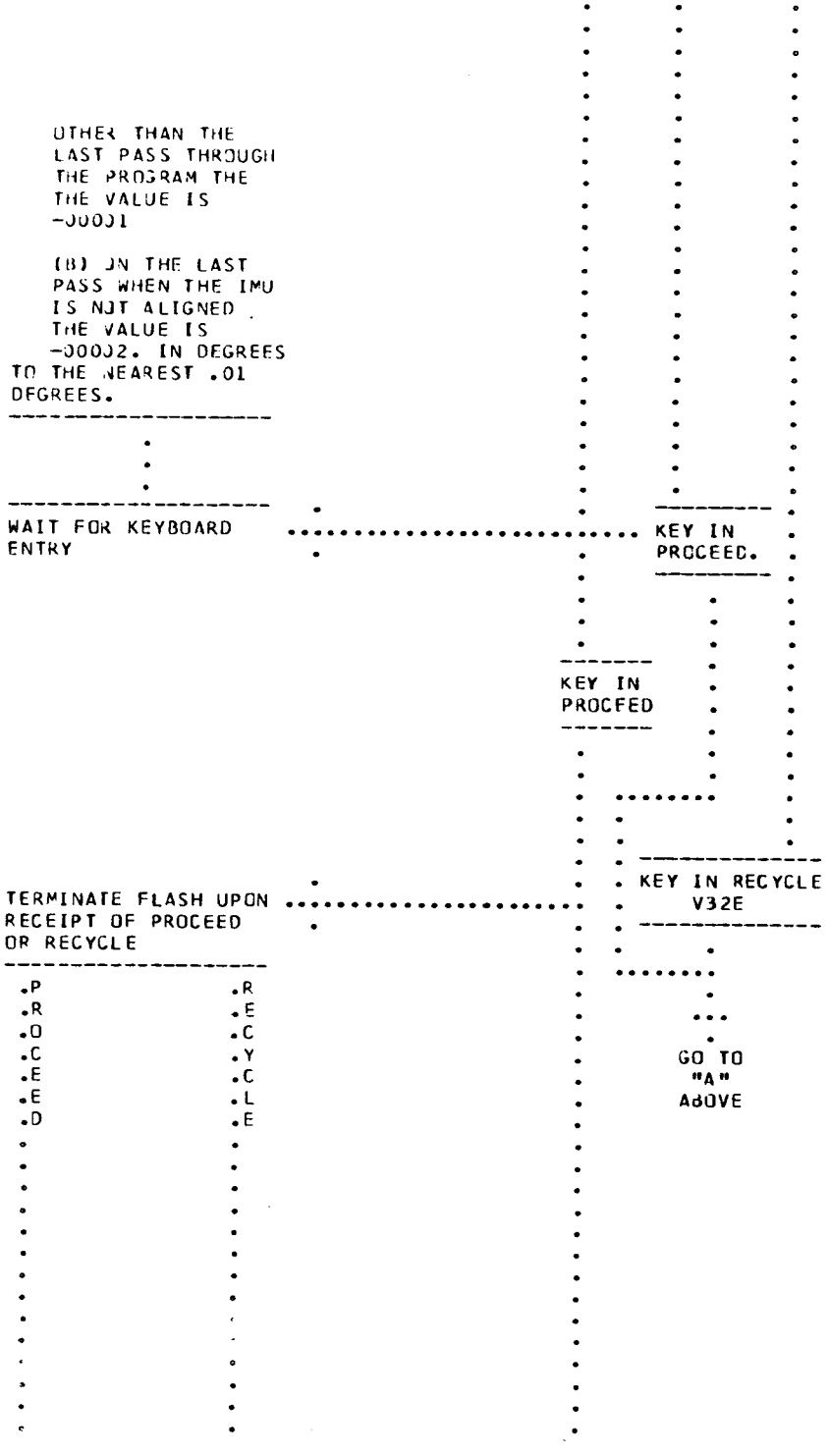
.Y N.

#390

DO I WISH TO TERMINATE THE MARK PROCESS AND DO THE FINAL PASS THROUGH THE PROGRAM?

.Y N.

#400

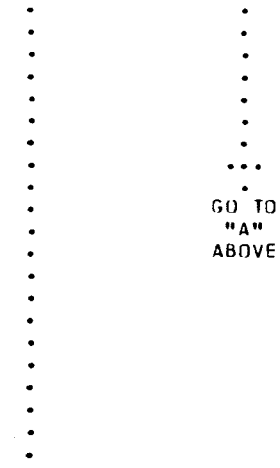


#410

#420

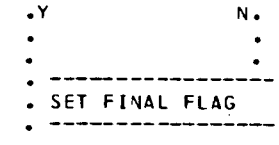
#430

#440



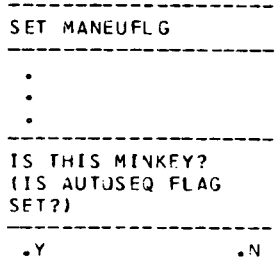
#450

#460

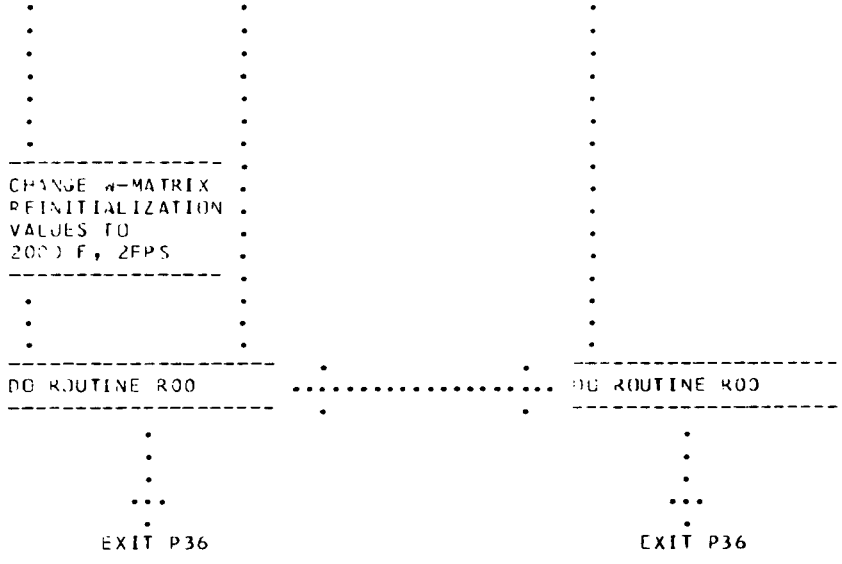


#470

#480



#490



#500

#510

CHANGE CONTROL NOTES

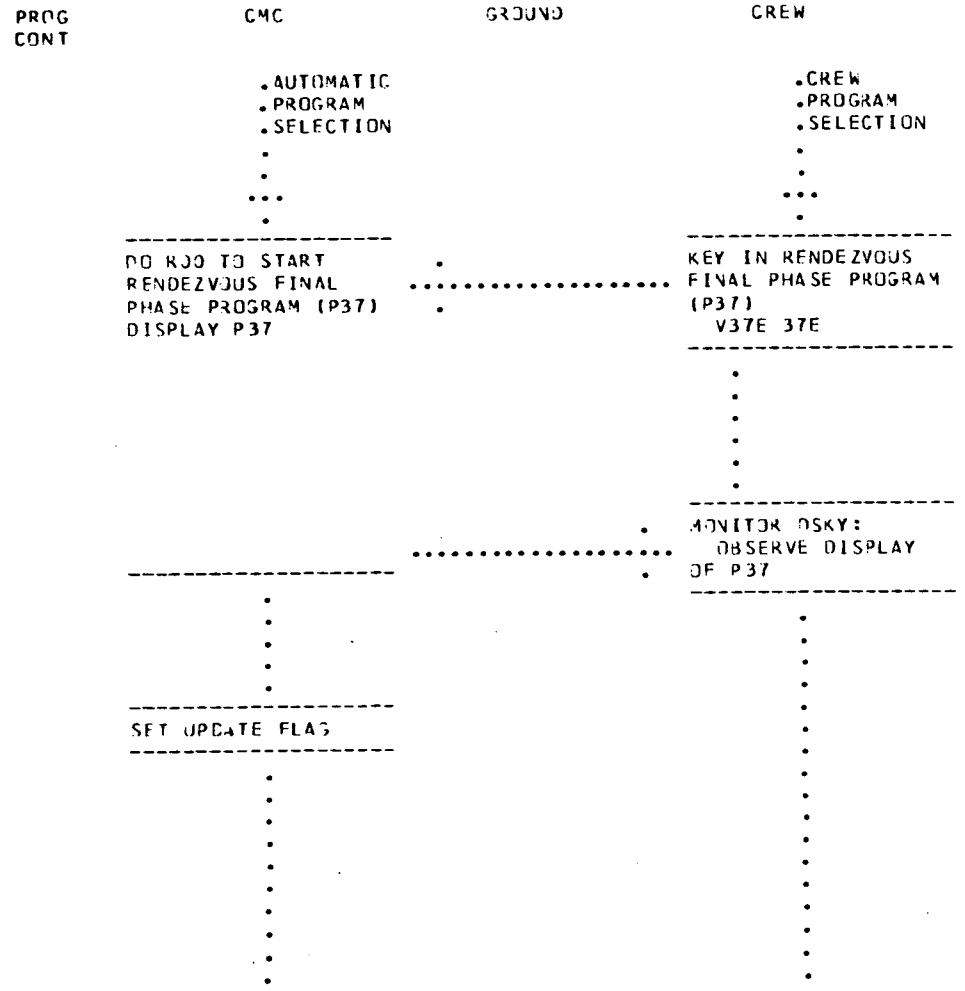
REV 00 PCR 411,421,423, PCN 412,455, SLA #2

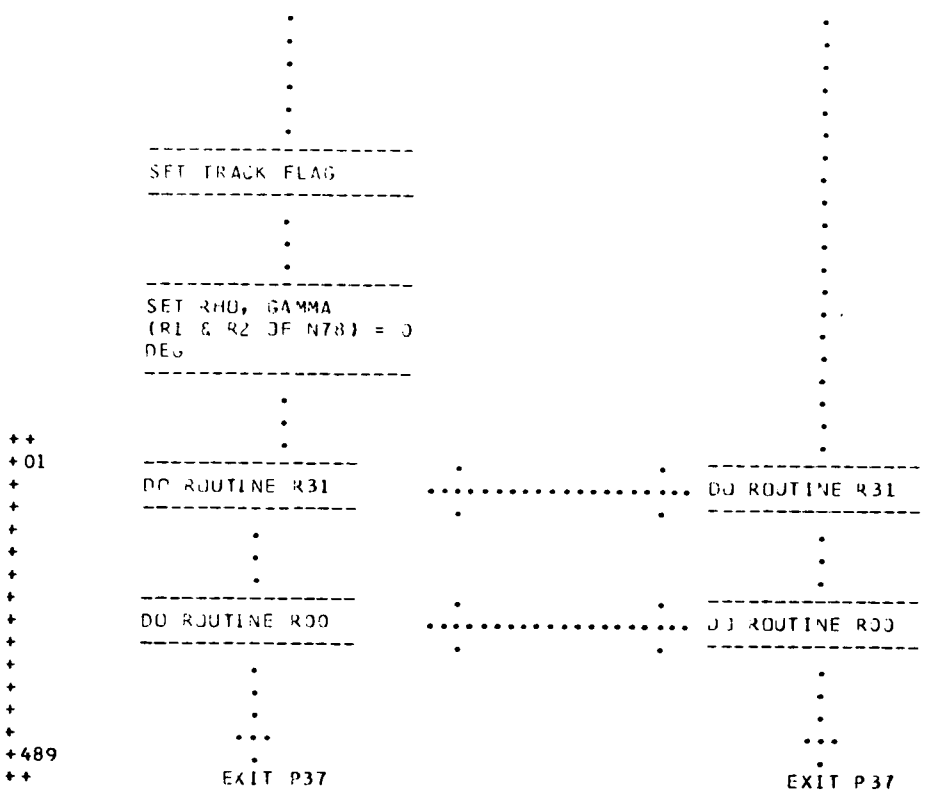
RENDEZVOUS FINAL PHASE PROGRAM (P37) REV 01 03/20/72

PURPOSE: (1) TO ESTABLISH X-AXIS TRACKING (P20, WITH RHO AND GAMMA=0 DEG.)

(2) TO SELECT R31 INTERNALLY TO PROVIDE RANGE AND RANGE RATE INFORMATION PRIOR TO THE BRAKING PHASE OF RENDEZVOUS.

ASSUMPTIONS: (1) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE MINKEY CONTROLLER.





#4C

#5C

#6C

CHANGE CONTROL NOTES

REV 00 PCR 016, SL MEMO #2
REV 01 PCN 489

PLANE CHANGE TARGETING PROGRAM (P38) REV 01 03/20/72

PURPOSE: (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE PLANE CHANGE (PC) MANEUVER FOR DELTA V BURNS.

(2) TO CALCULATE THESE PARAMETERS BASED ON MANEUVER DATA APPROVED AND KEYED INTO THE DSKY BY THE ASTRONAUT.

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE PC MANEUVER FOR APPROVAL BY ASTRONAUT/GROUND.

(4) TO STORE THE PC TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS: (1) THIS PROGRAM ASSUMES A STORED TIG FROM THE LAST MANEUVER, AN UPLINKED TIG OR TIG CREW-LOADED IN N39.

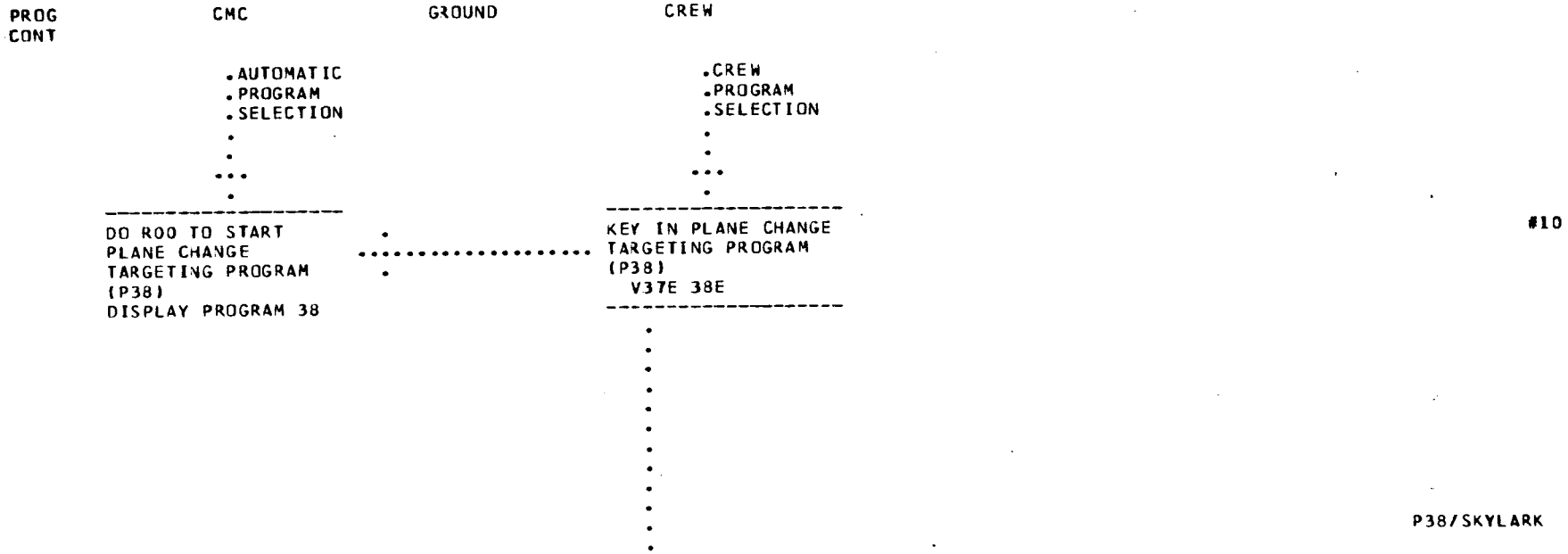
(2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND.

(3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED). SEE P20 FOR DETAILED DESCRIPTION.

(4) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE MINKEY CONTROLLER (R07).

(6) THIS PROGRAM IS NORMALLY USED TO TARGET A PLANE CHANGE BURN 90 DEGREES CENTRAL ANGLE FROM THE LAST MANEUVER.



#10

P38/SKYLARK

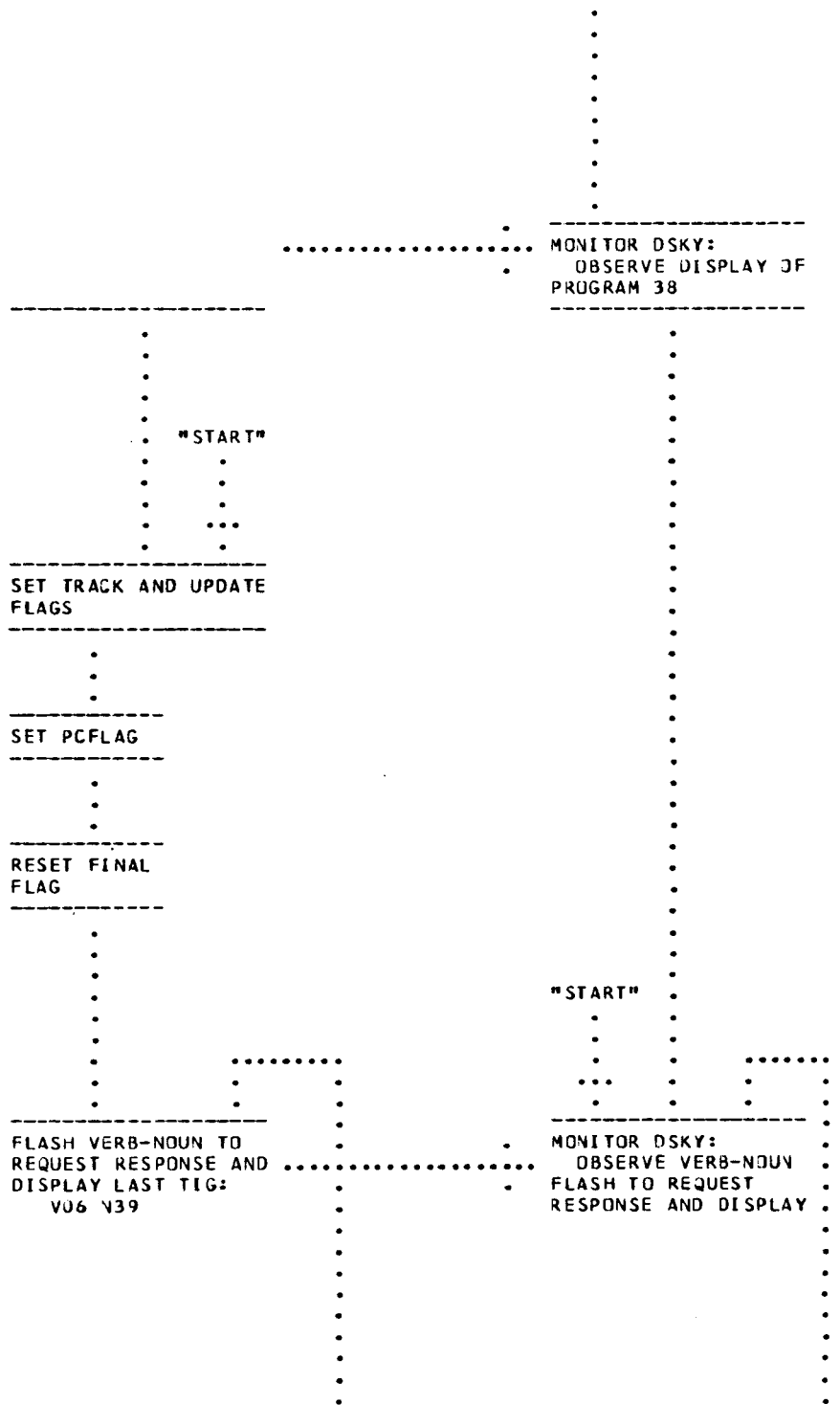
#20

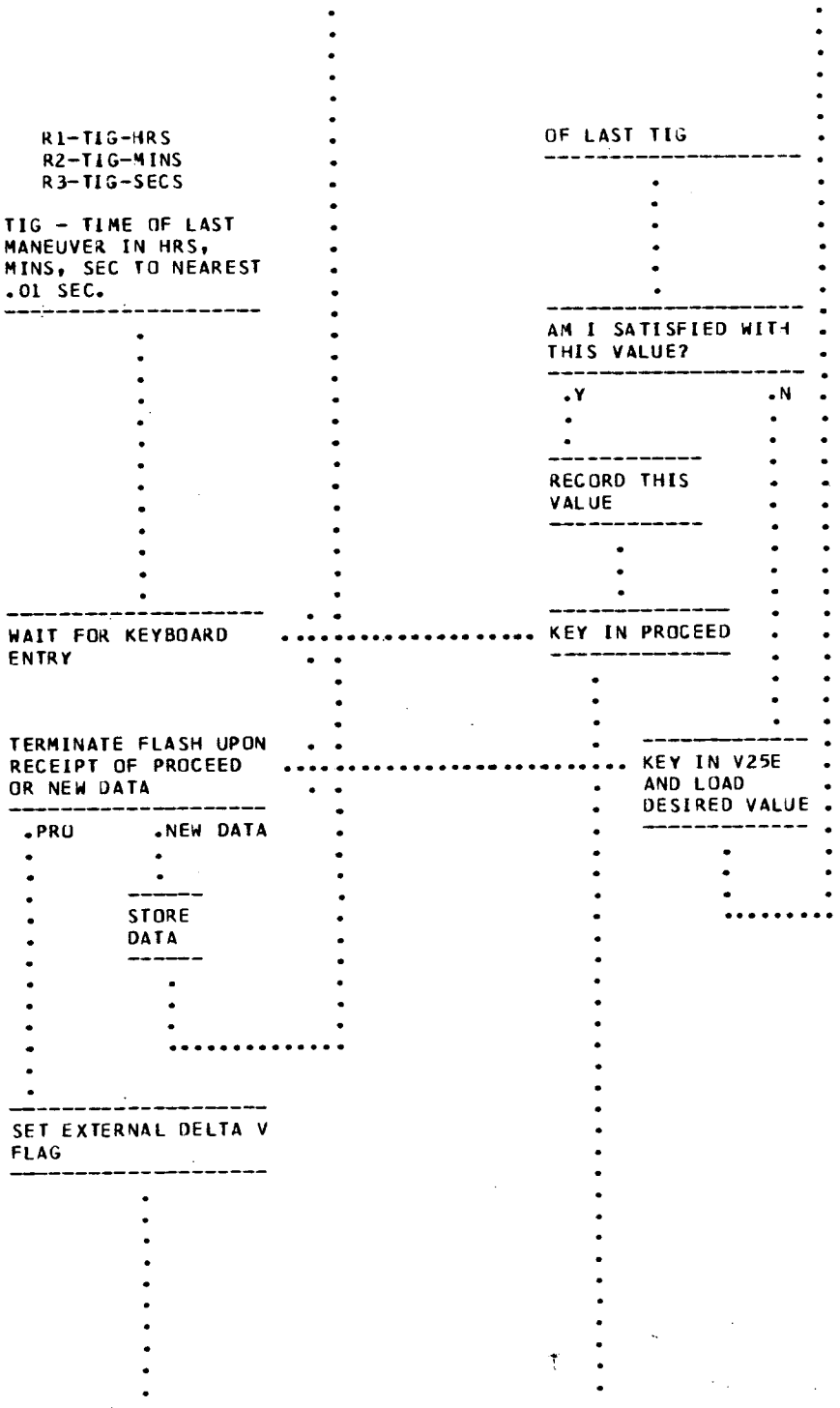
#30

#40

#50

#60


MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 38
"START"
SET TRACK AND UPDATE
FLAGS
SET PCFLAG
RESET FINAL
FLAG
"START"
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY LAST TIG:
V06 N39
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY



#70

#80

#90

#100

#110

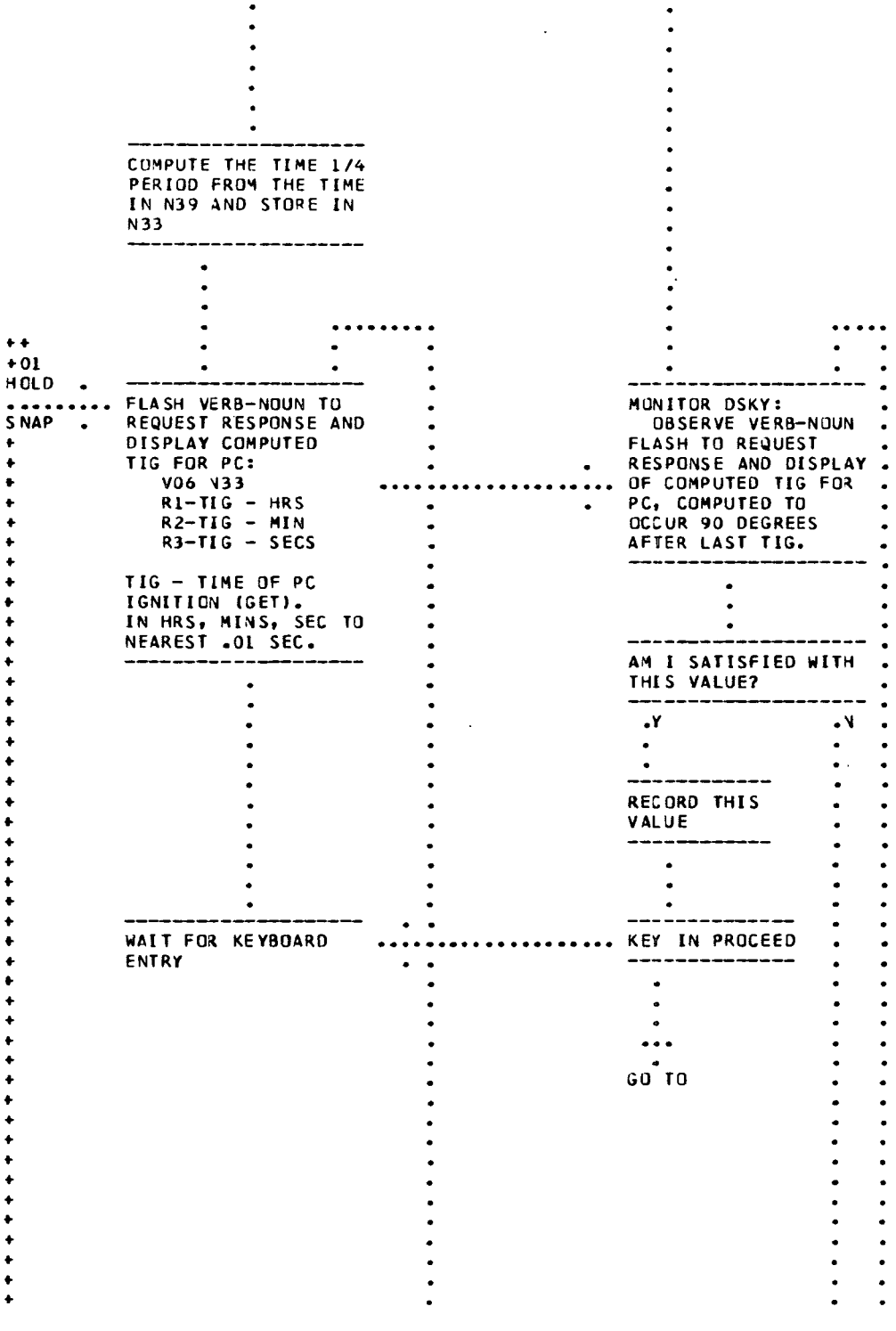
#120

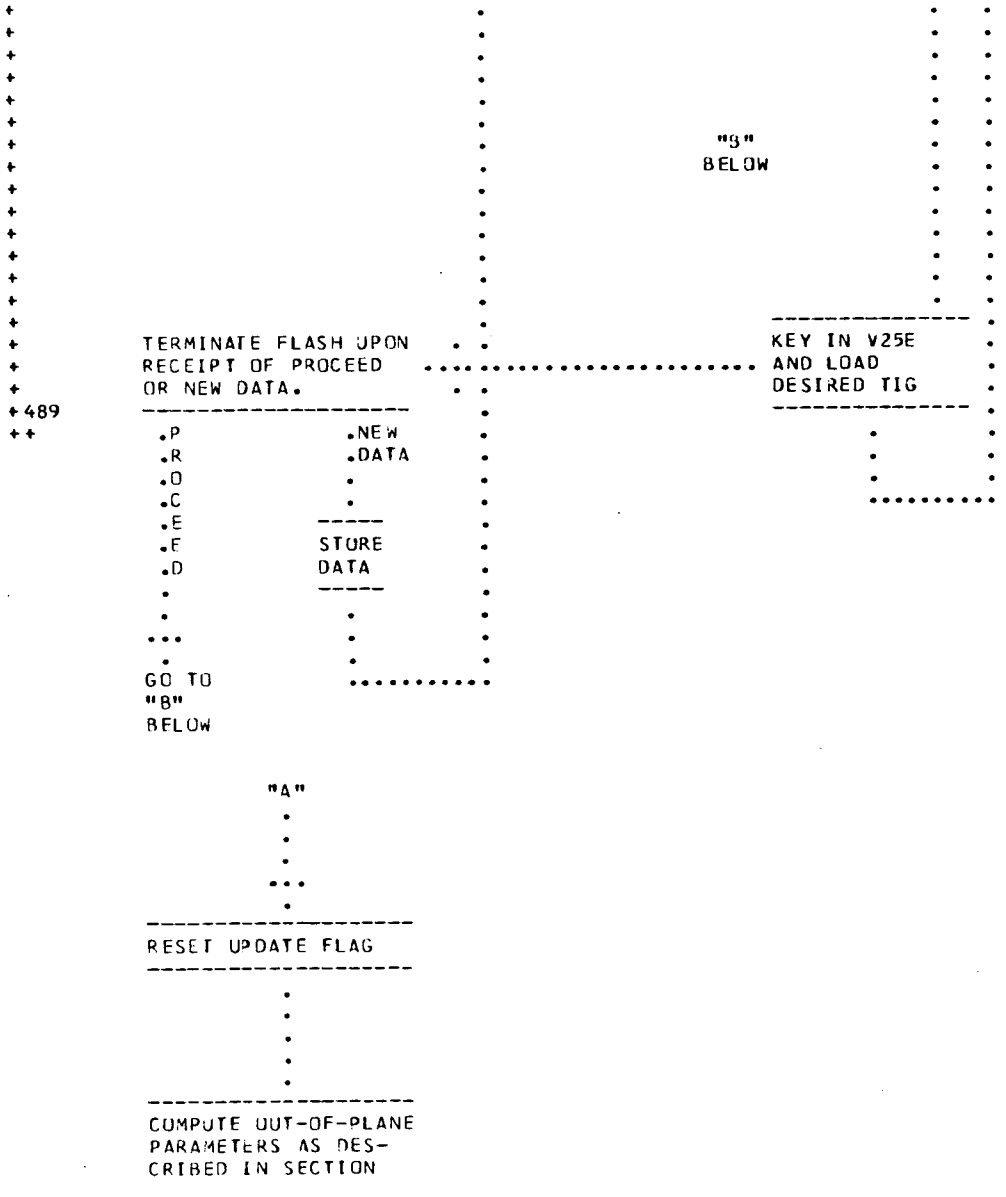
#130

#140

#150

#160





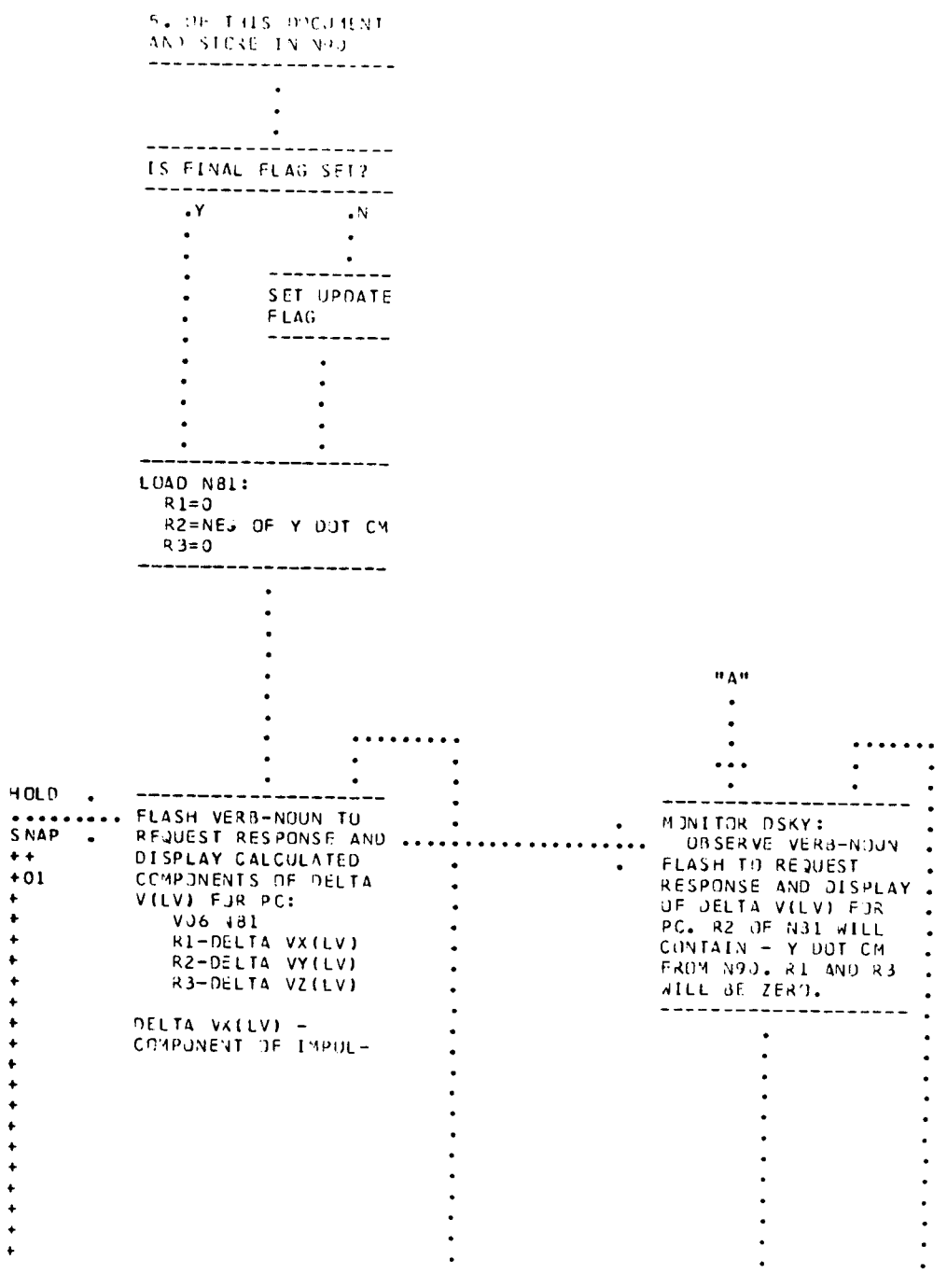
#170

#180

#190

#200

#210



#220

#230

#240

#250

#260

GIVE DELTA V AT TIG FOR PC ALONG (RXV)XR. IN FPS TO NEAREST .1 FPS.

DELTA VY(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG FOR PC ALONG VXR. IN FPS TO NEAREST .1 FPS.

DELTA VZ(LV) - COMPONENT OF IMPULSIVE DELTA V AT TIG FOR PC ALONG -R. IN FPS TO NEAREST .1 FPS.

WHERE R IS CSM GEOCENTRIC RADIUS VECTOR AND V IS CSM INERTIAL VELOCITY AT TIG FOR PC

AM I SATISFIED WITH THESE VALUES?

.Y

.N

RECORD THESE VALUES

#270

#280

#290

WAIT FOR KEYBOARD ENTRY

KEY IN PROCEED

#300

TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA.

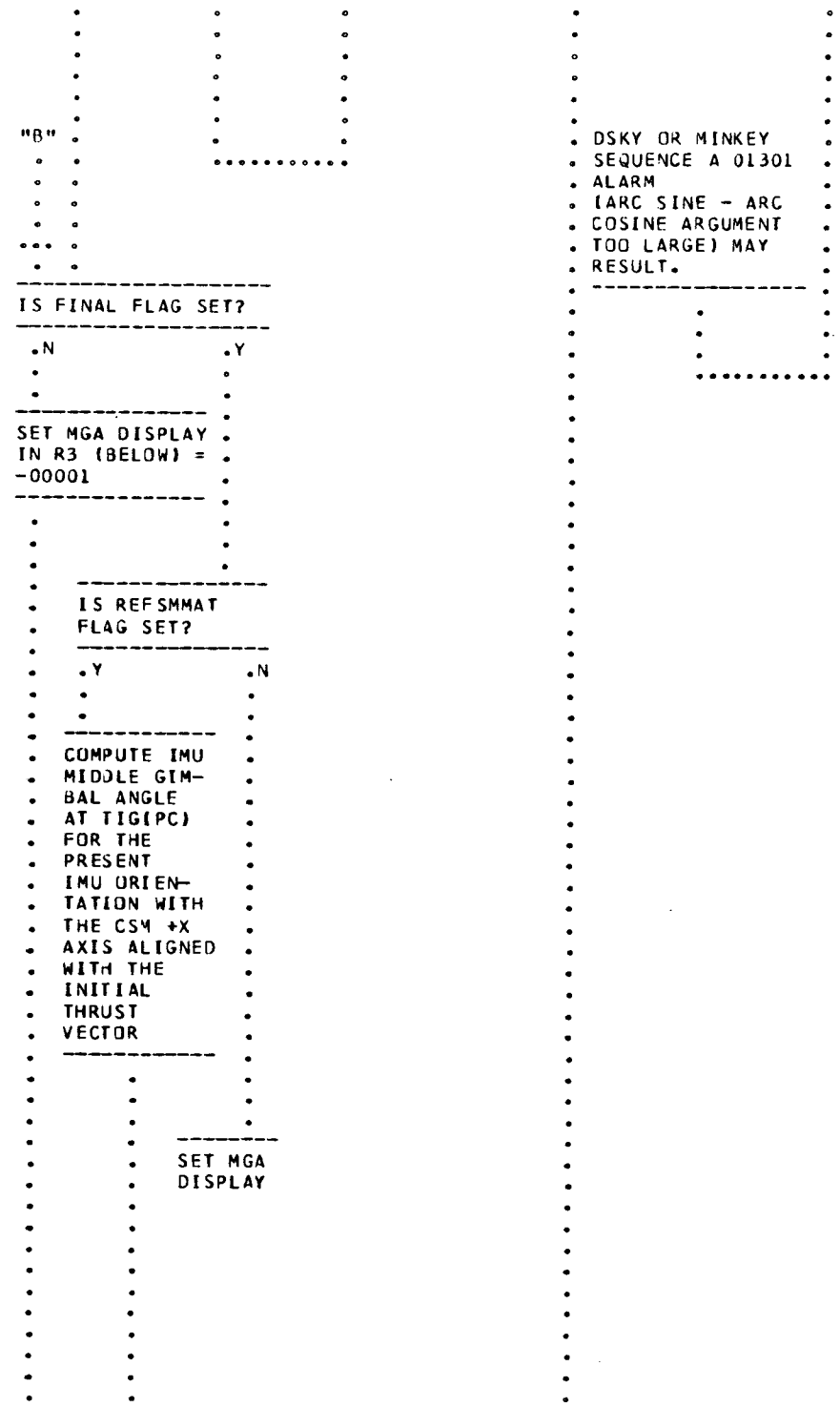
.PROCEED

.NEW DATA

STORE NEW DATA

KEY IN V22E AND LOAD DESIRED DELTA V VALUE. NOTE: OVERWRITING R1, R2, R3 WITH 0 DURING MINKEY SEQUENCE WILL CAUSE ENTRANCE INTO P52 FOLLOWING P38 TO BE BYPASSED IF N81 = 0,0,0 EITHER VIA THE

#310



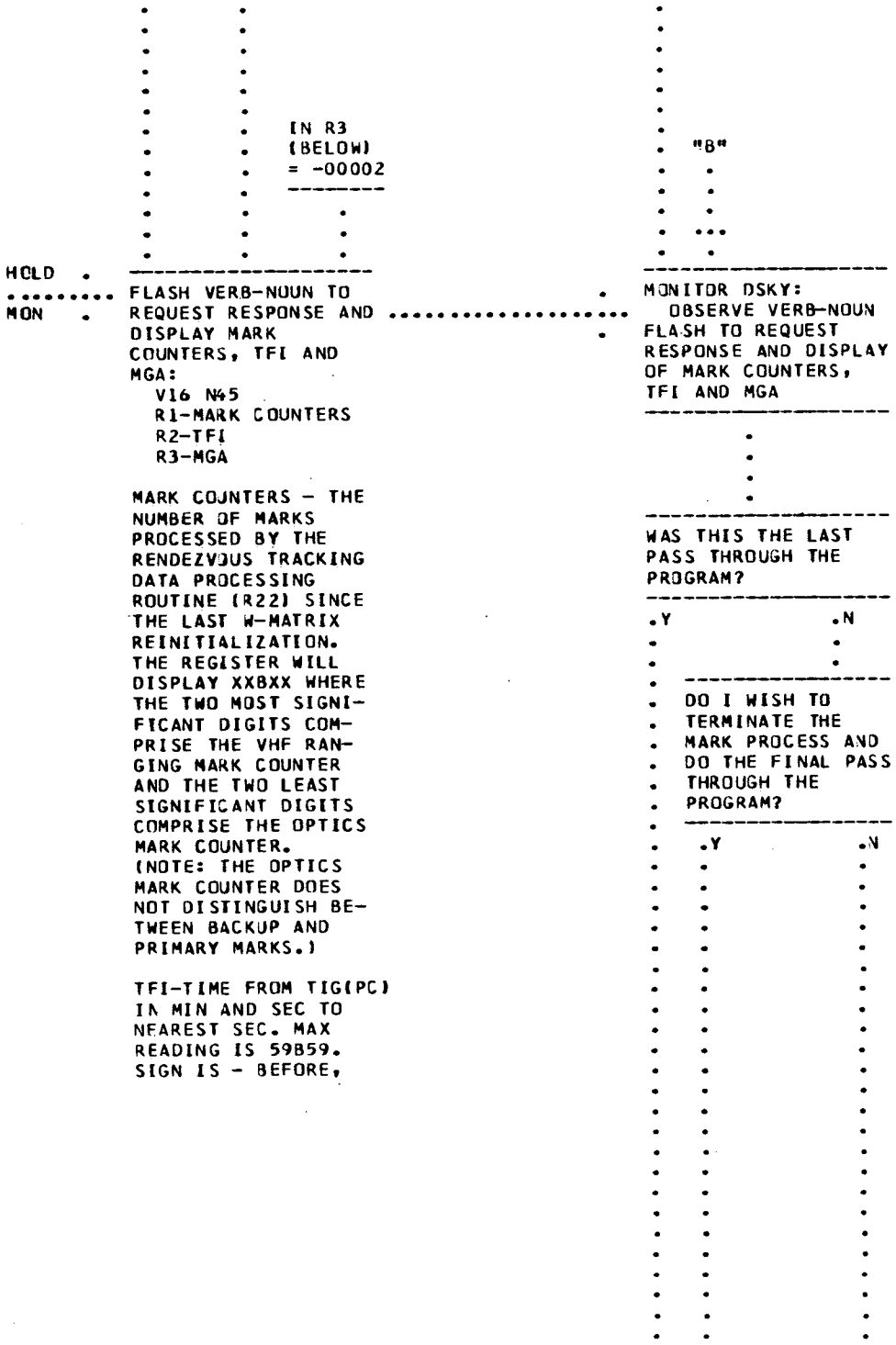
#320

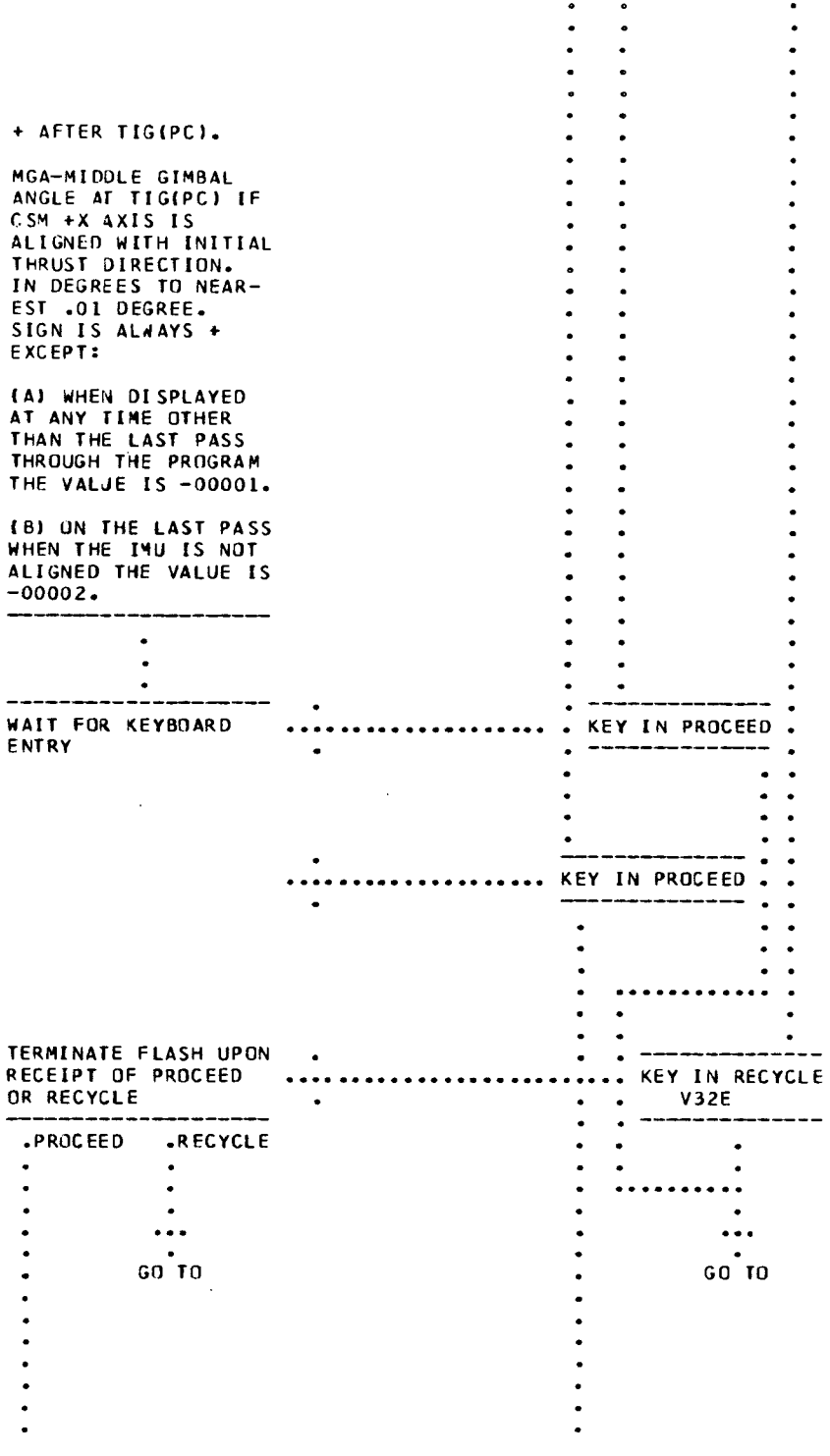
#330

#340

#350

#360


IN R3 (BELOW) = -00002
"B"
HOLD
MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY MARK COUNTERS, TFI AND MGA:
V16 N45
R1-MARK COUNTERS
R2-TFI
R3-MGA
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF MARK COUNTERS, TFI AND MGA
WAS THIS THE LAST PASS THROUGH THE PROGRAM?
Y
N
DO I WISH TO TERMINATE THE MARK PROCESS AND DO THE FINAL PASS THROUGH THE PROGRAM?
Y
N
MARK COUNTERS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE THE LAST W-MATRIX REINITIALIZATION. THE REGISTER WILL DISPLAY XXBXX WHERE THE TWO MOST SIGNIFICANT DIGITS COMPRISE THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS COMPRISE THE OPTICS MARK COUNTER. (NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.)
TFI-TIME FROM TIG(PC) IN MIN AND SEC TO NEAREST SEC. MAX READING IS 59859. SIGN IS - BEFORE,
#370
#380
#390
#400
#410



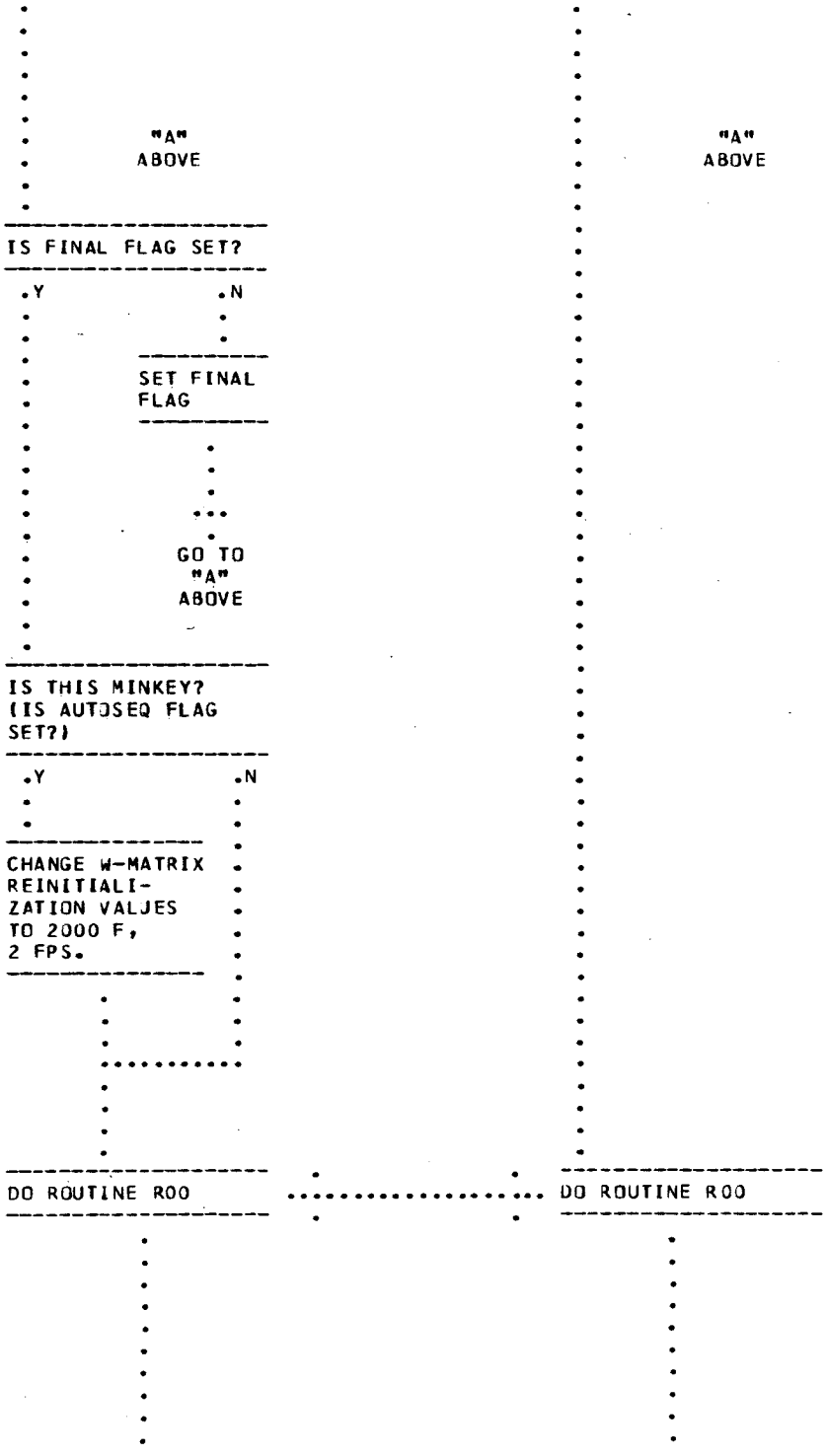
#420

#430

#440

#450

#460



#470

#480

#490

#500

#510

#520

```
      .
      .
      .
      .
      .
      .
      .
     ...
      .
    EXIT
    P38
```

```
      .
      .
      .
      .
      .
      .
      .
     ...
      .
    EXIT
    P38
```

CHANGE CONTROL NOTES

REV 00 PCR 011, PCN 412, SL MEMO #2
REV 01 PCN 489

SPS PROGRAM (P40) REV 01 03/20/72

PURPOSE: (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER.

(2) TO CALCULATE AND DISPLAY THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE WERE MANEUVERED TO THE PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU ORIENTATION, IF THE MIDDLE GIMBAL ANGLE IS NOT GREATER THAN 45 DEGREES, AND THE IMU HAS BEEN ALIGNED WITHIN THE LAST 3 HRS.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52.

(3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(4) TO CONTROL THE GNCS DURING COUNTDOWN, IGNITION, THRUSTING, AND THRUST TERMINATION OF A GNCS CONTROLLED SPS MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED THE CMC UPDATES VG ONLY AS A RESULT OF COMPENSATED ACCELEROMETER INPUTS.
FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

(3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

(5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) THE SPS THRUSTING PROGRAM DOES NOT MONITOR THE SC CONTROL DISCRETE (CHANNEL 31 BIT 15) DURING THRUSTING. THIS MEANS THAT THE CMC WILL CONTINUE TO GENERATE ENGINE ACTUATOR COMMANDS, SPS ENGINE ON DISCRETE, AND FDAI ATTITUDE ERROR NEEDLE COMMANDS UNTIL THE CMC SOLUTION INDICATES ENGINE OFF AT WHICH TIME THESE COMMANDS AND THE ENGINE ON DISCRETE ARE TERMINATED. HOWEVER, THIS PROGRAM IS NOT WRITTEN TO TAKE INTO ACCOUNT THE SITUATION WHERE CONTROL MAY BE TAKEN AWAY FROM THE GNCS AND THEN GIVEN BACK, AND IT IS NOT RECOMMENDED. IN EVENT CONTROL IS TAKEN AWAY FROM THE GNCS, THE CMC WILL ONLY BE RESPONSIBLE FOR COMPUTATION OF POSITION AND VELOCITY.

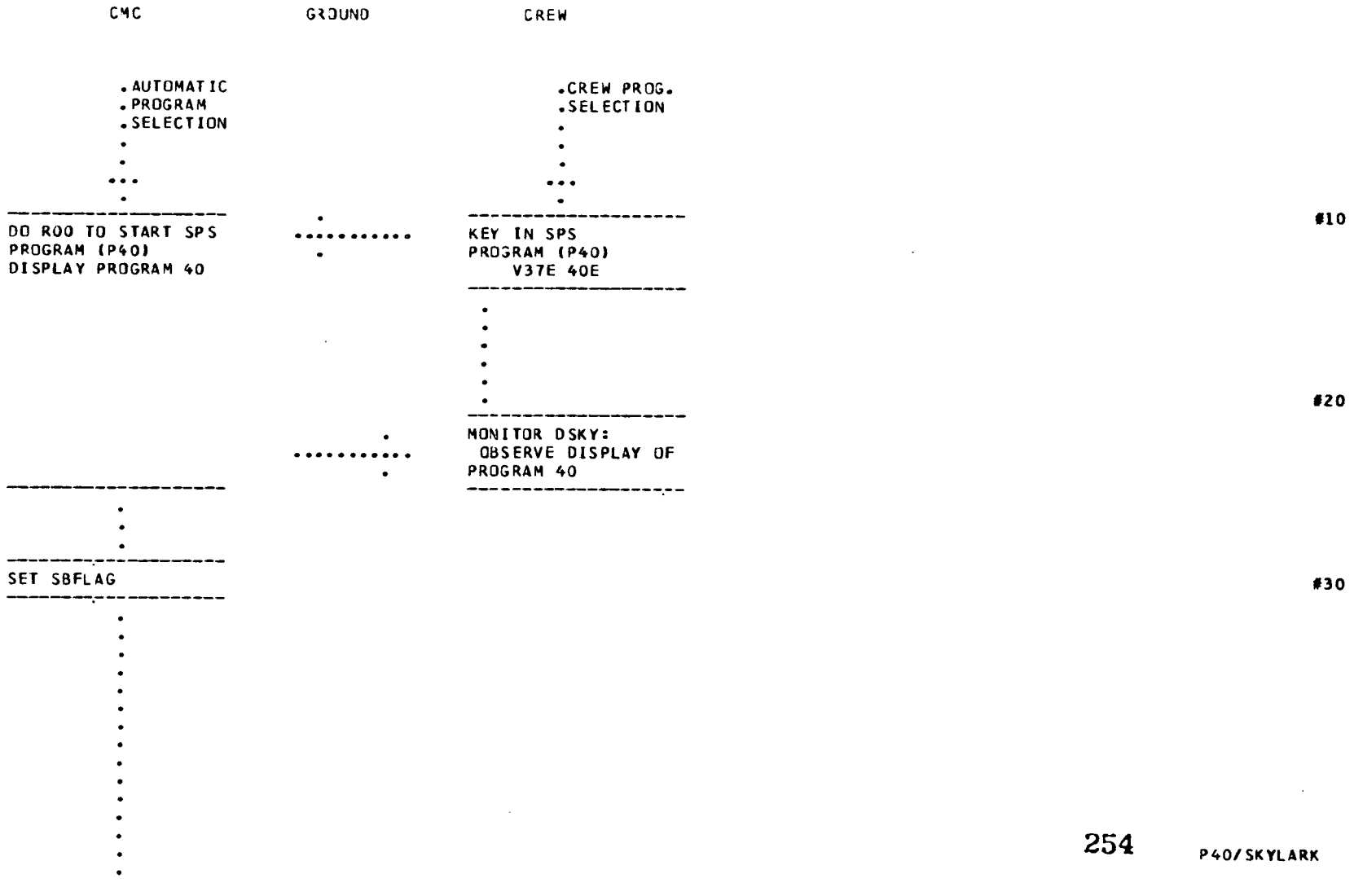
(7) ROUTINE R03 HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND CONTROL THE THRUSTING MANEUVER THE ASTRONAUT MUST KEY IN V46E AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

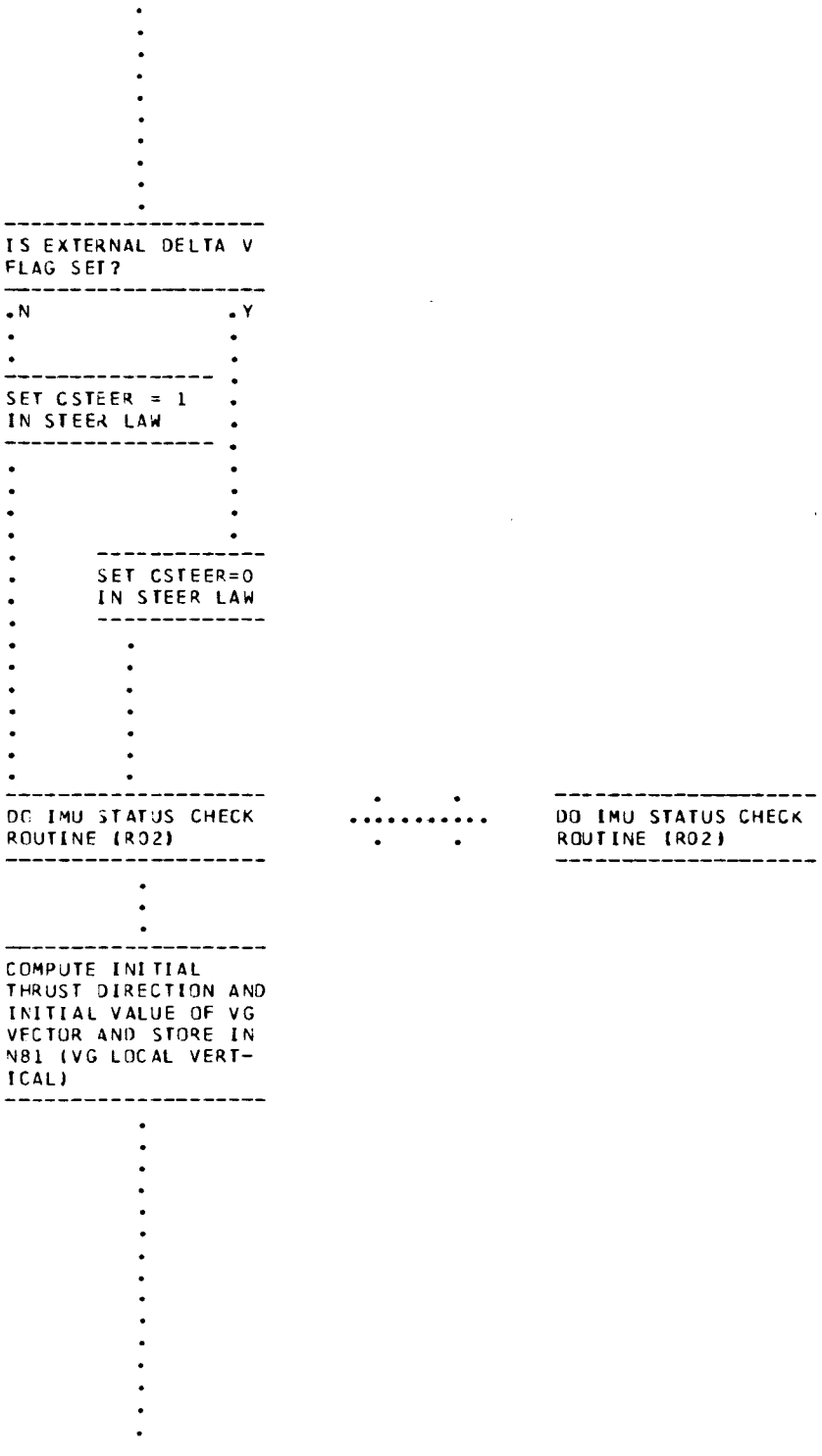
(8) P40 SHOULD NOT BE PERFORMED IN THE CSM-OWS DOCKED CONFIGURATION.

(9) THE VALUE OF DELTA V REQUIRED WILL BE STORED IN THE LOCAL VERTICAL COORDINATE SYSTEM AND IS AVAILABLE DURING THIS PROGRAM UNTIL AVERAGE G TURN ON BY KEYING IN V06N81.

(10) THE ORBITAL PARAMETERS DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

++ (11) THE CMC ISSUES AN SIV-B CUTOFF COMMAND (CHANNEL 12 BIT 14) FOR POSSIBLE BACK-UP USE.
THIS SIGNAL IS RECOGNIZED BY SATURN ONLY IF THE LAUNCH VEHICLE GUIDANCE SWITCH IS SET TO CMC.
+01
+
+ (12) THE ASTRONAUT MAY REQUEST A TFI DISPLAY (AVAILABLE UNTIL ENTRY INTO TVC DAP) BY KEYING IN EITHER V16N40 FOR
MINS-SECS (R1), OR V16N35 FOR HRS (R1), MINS (R2), AND SECS (R3).
+489
++ (13) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).




IS EXTERNAL DELTA V FLAG SET?
.N
.Y
SET CSTEER = 1 IN STEER LAW
SET CSTEER=0 IN STEER LAW
DO IMU STATUS CHECK ROUTINE (R02)
DO IMU STATUS CHECK ROUTINE (R02)
COMPUTE INITIAL THRUST DIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE IN N81 (VG LOCAL VERTICAL)

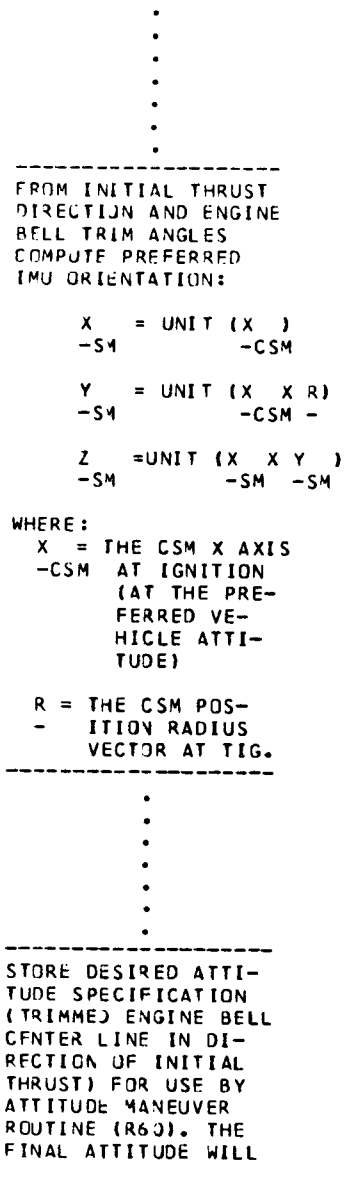
#40

#50

#60

#70

#80



#90

#100

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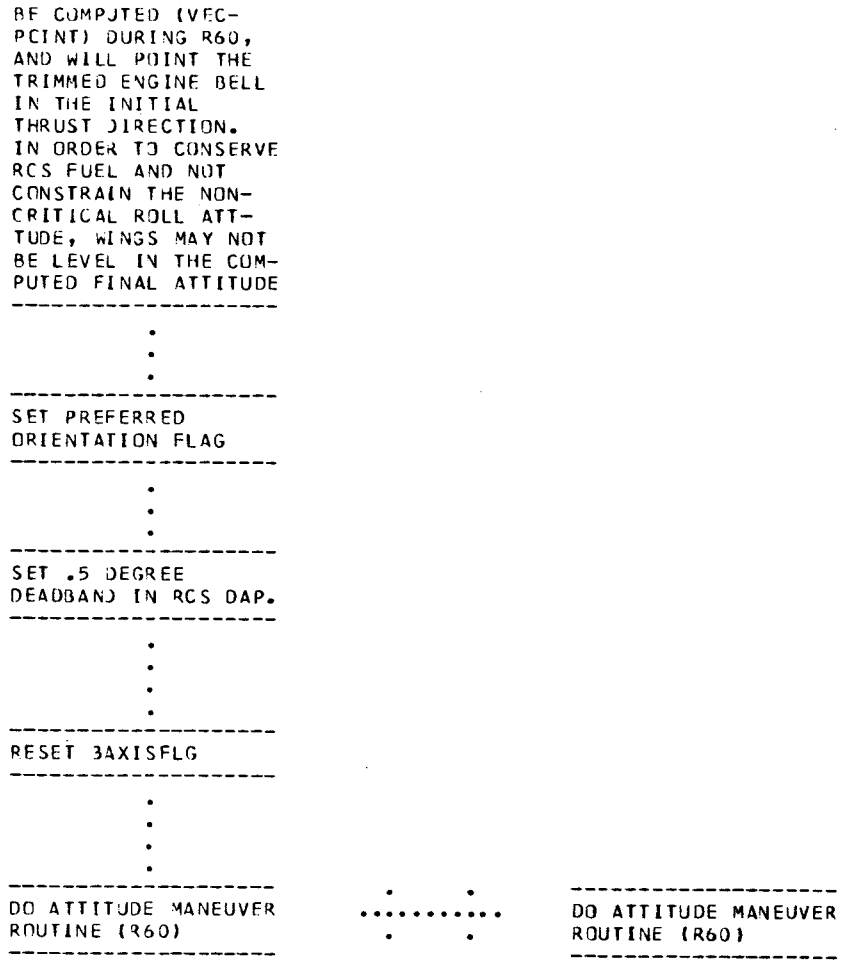
#120



#130

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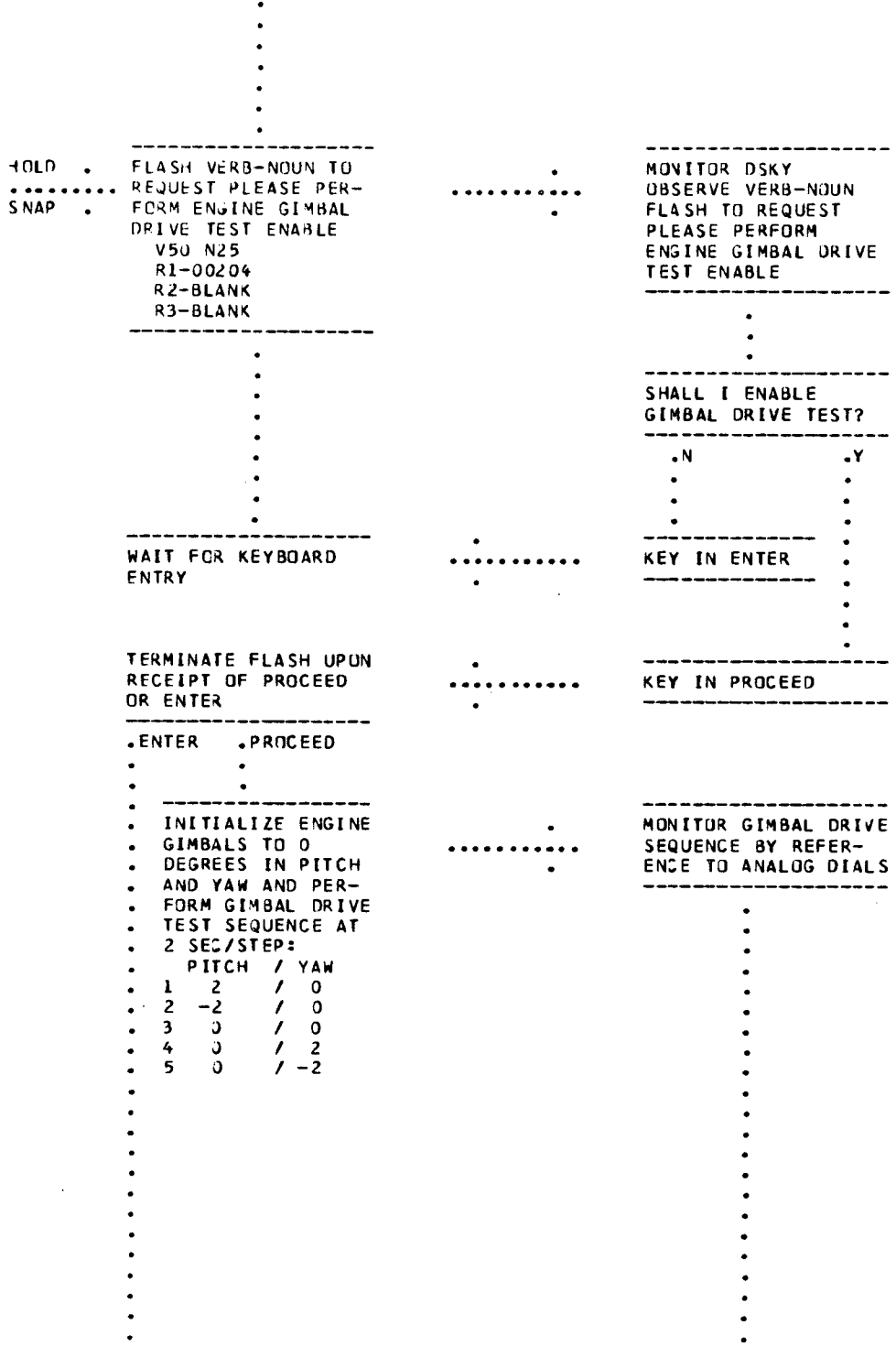
#170



#180

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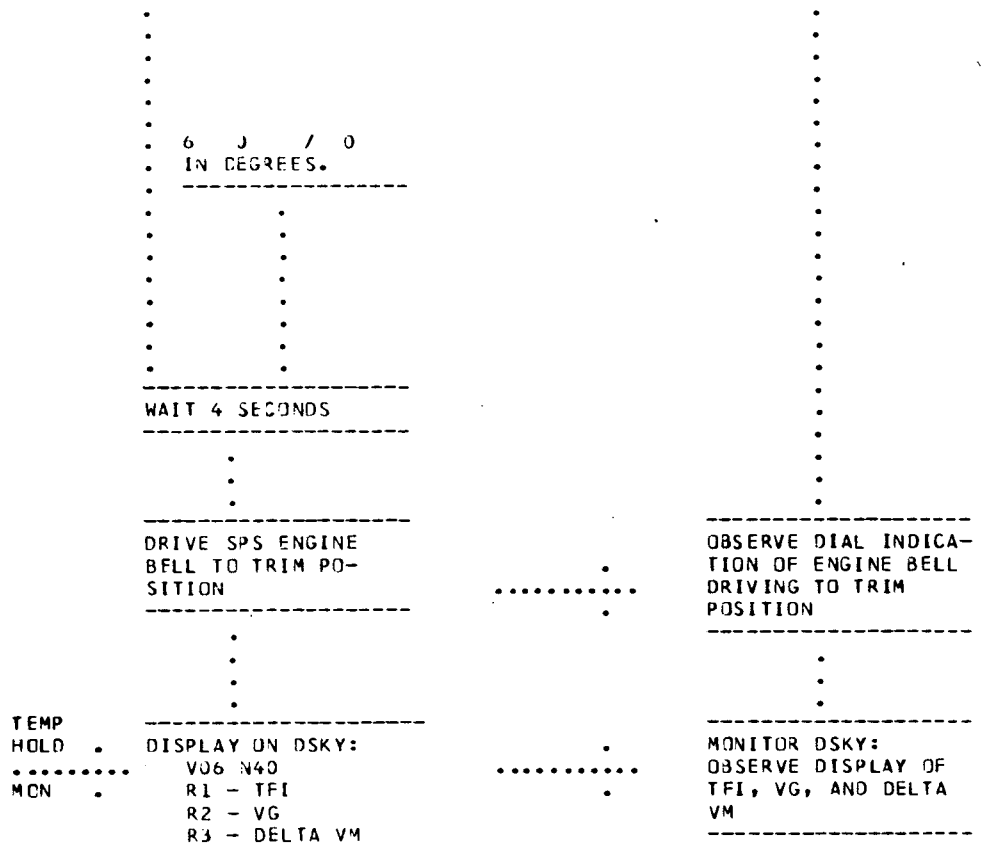
#220



#230

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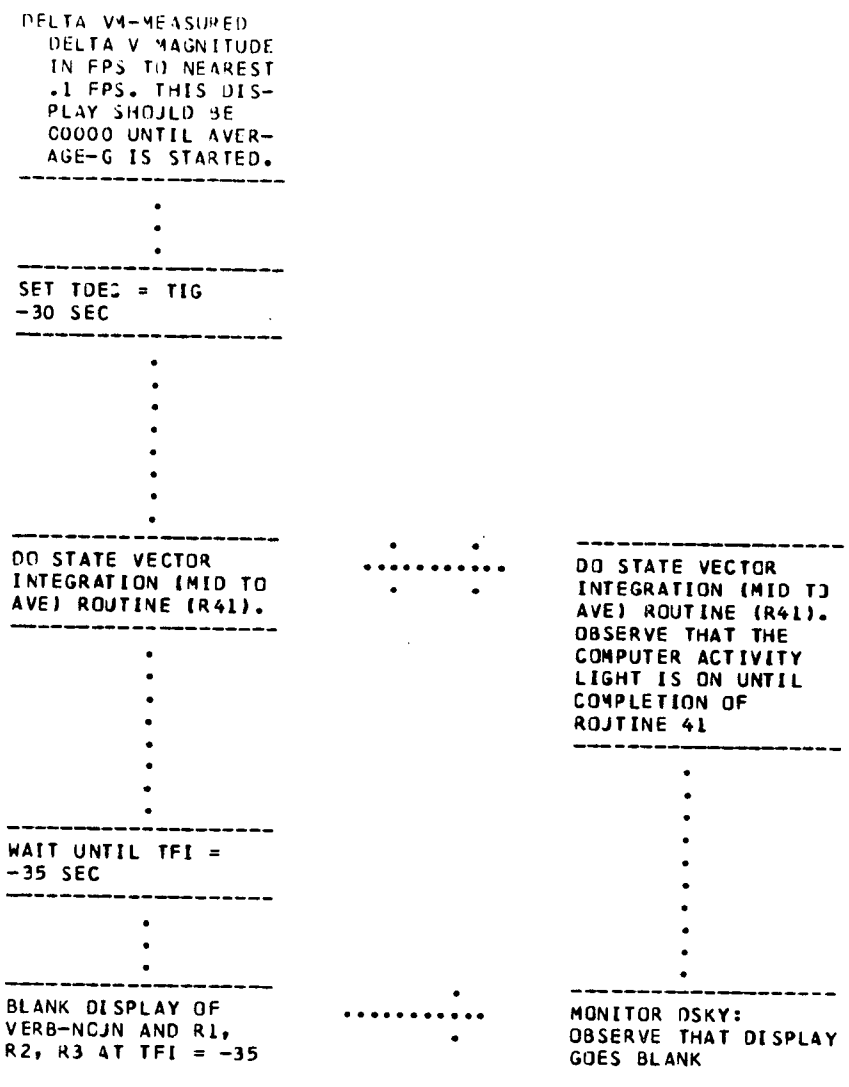
#270



#280

#290

#300

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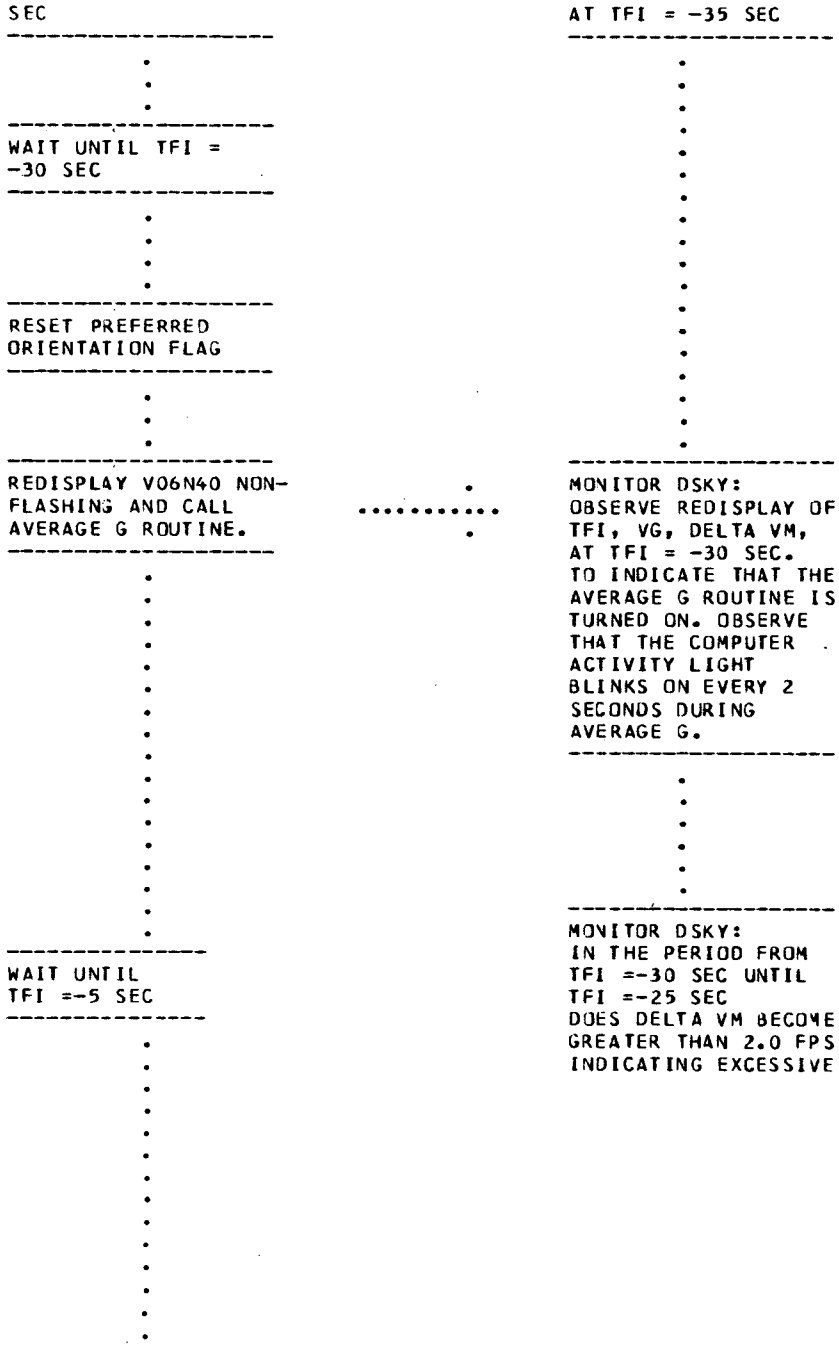


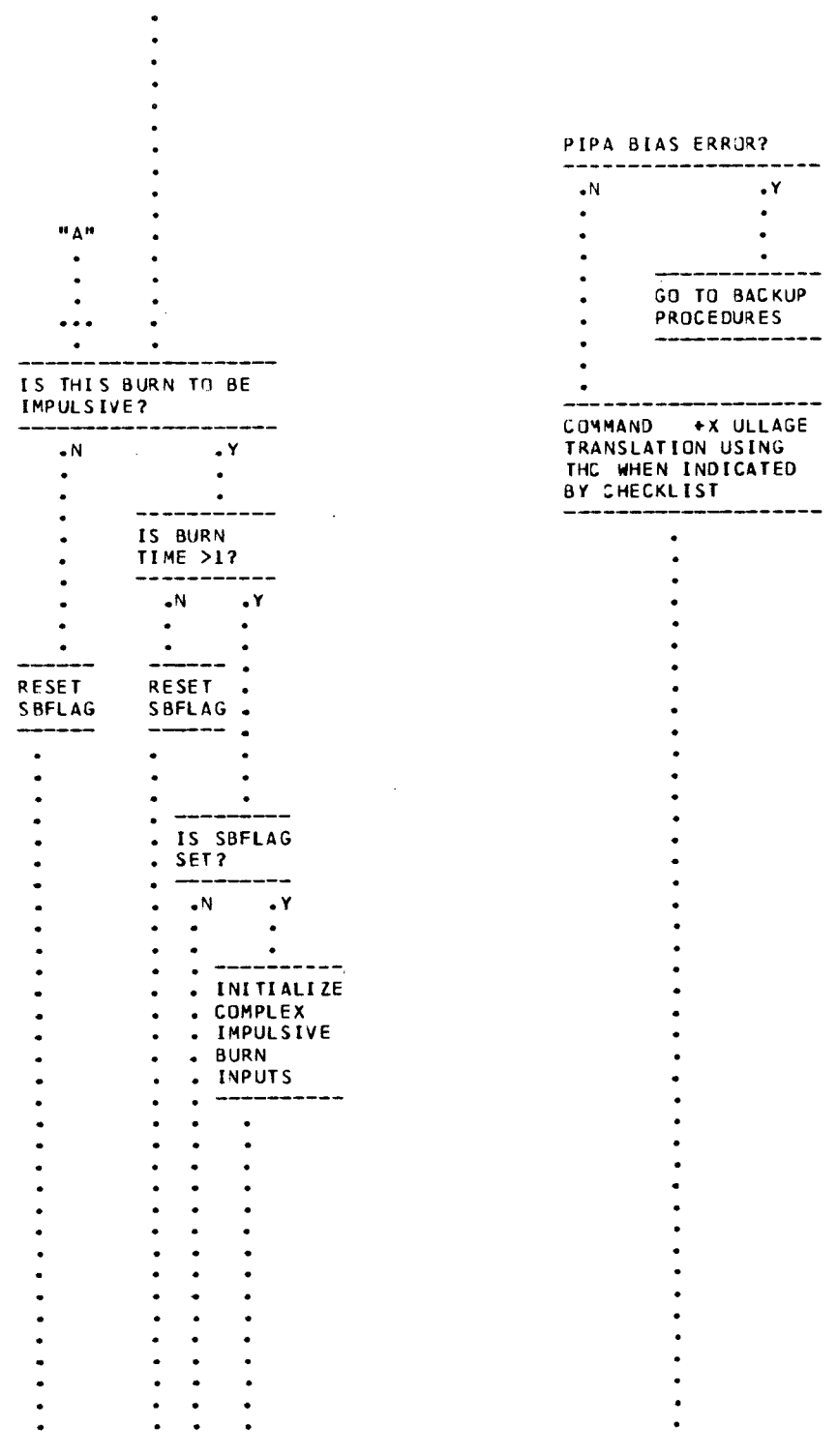
#320

#330

#340

#350

#360



#370

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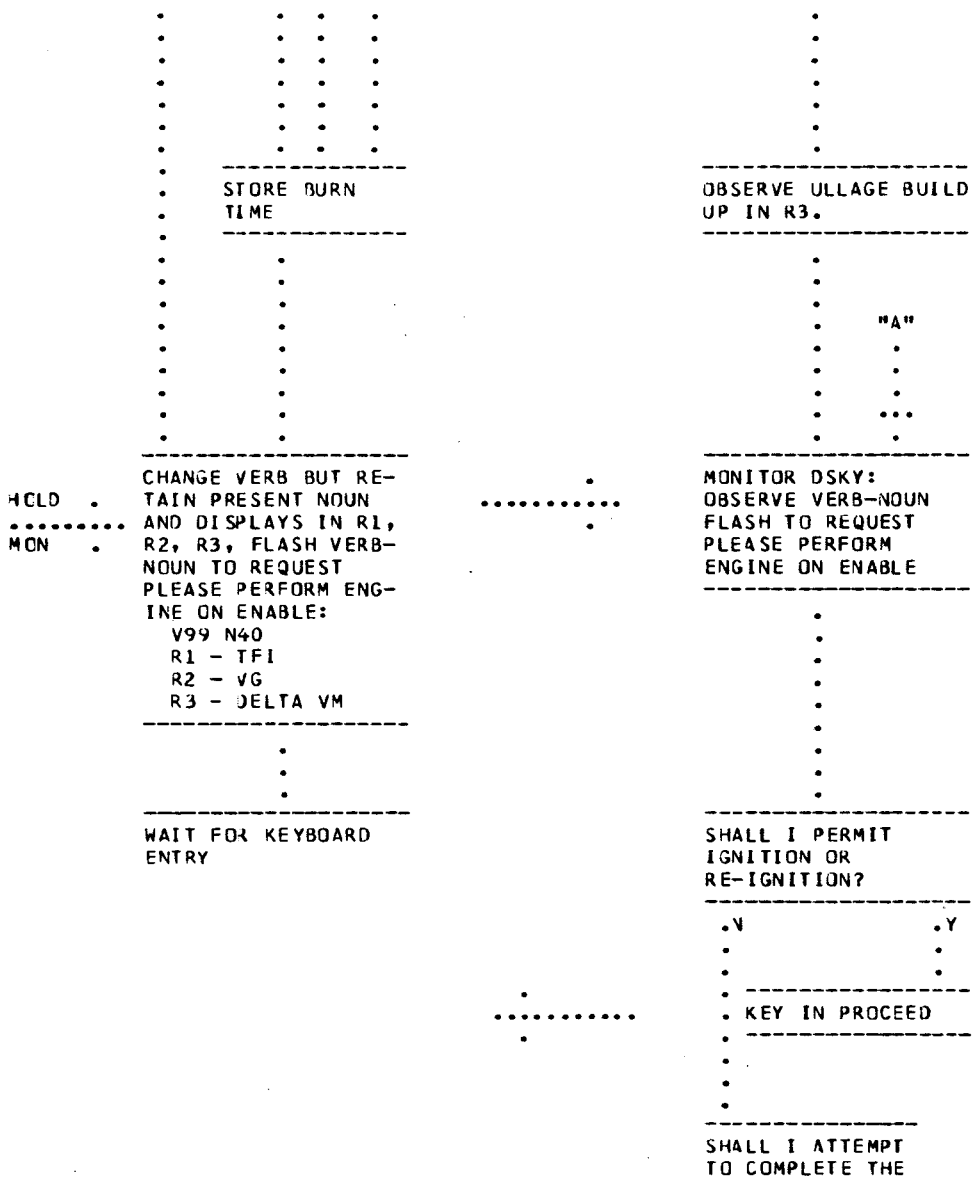

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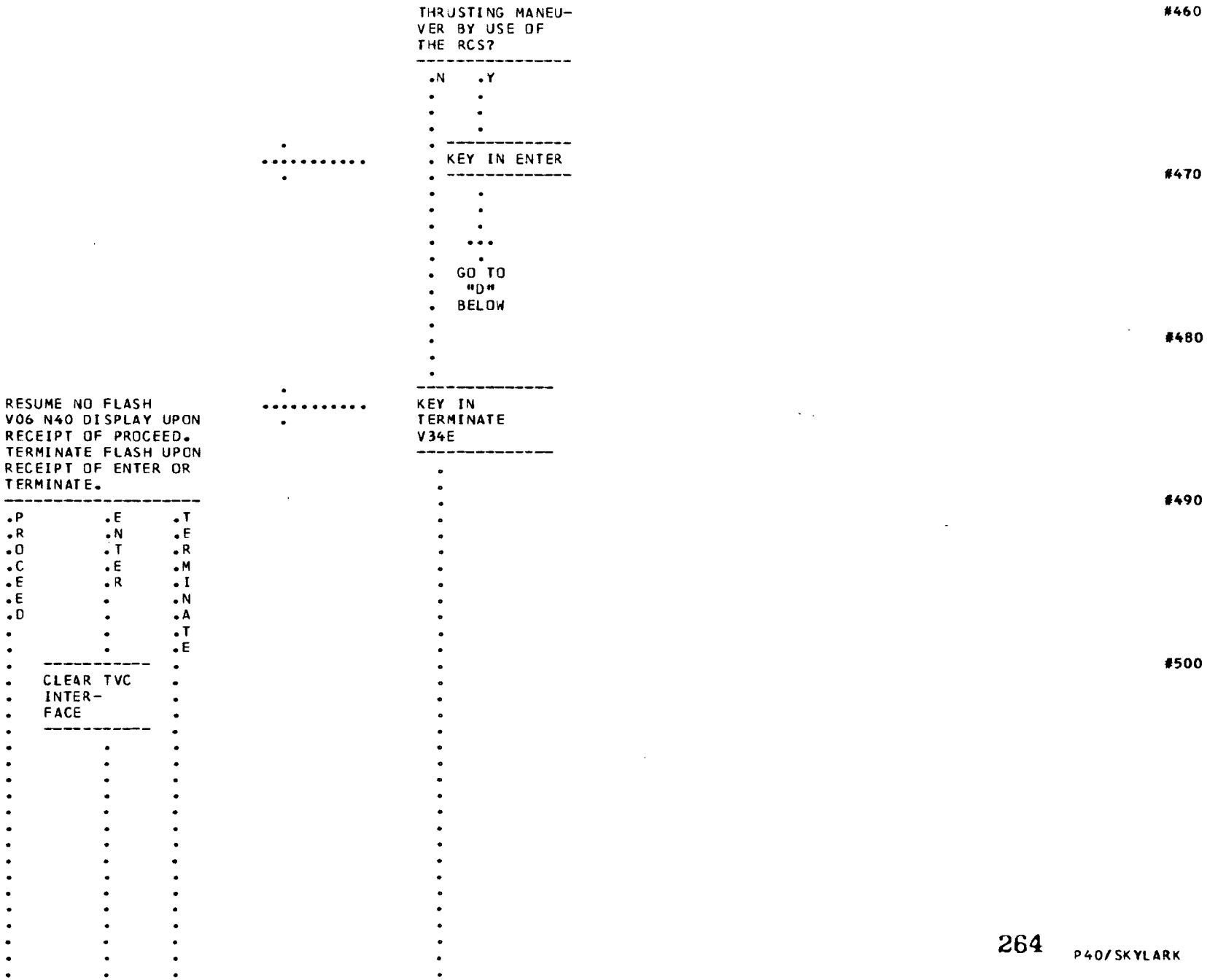
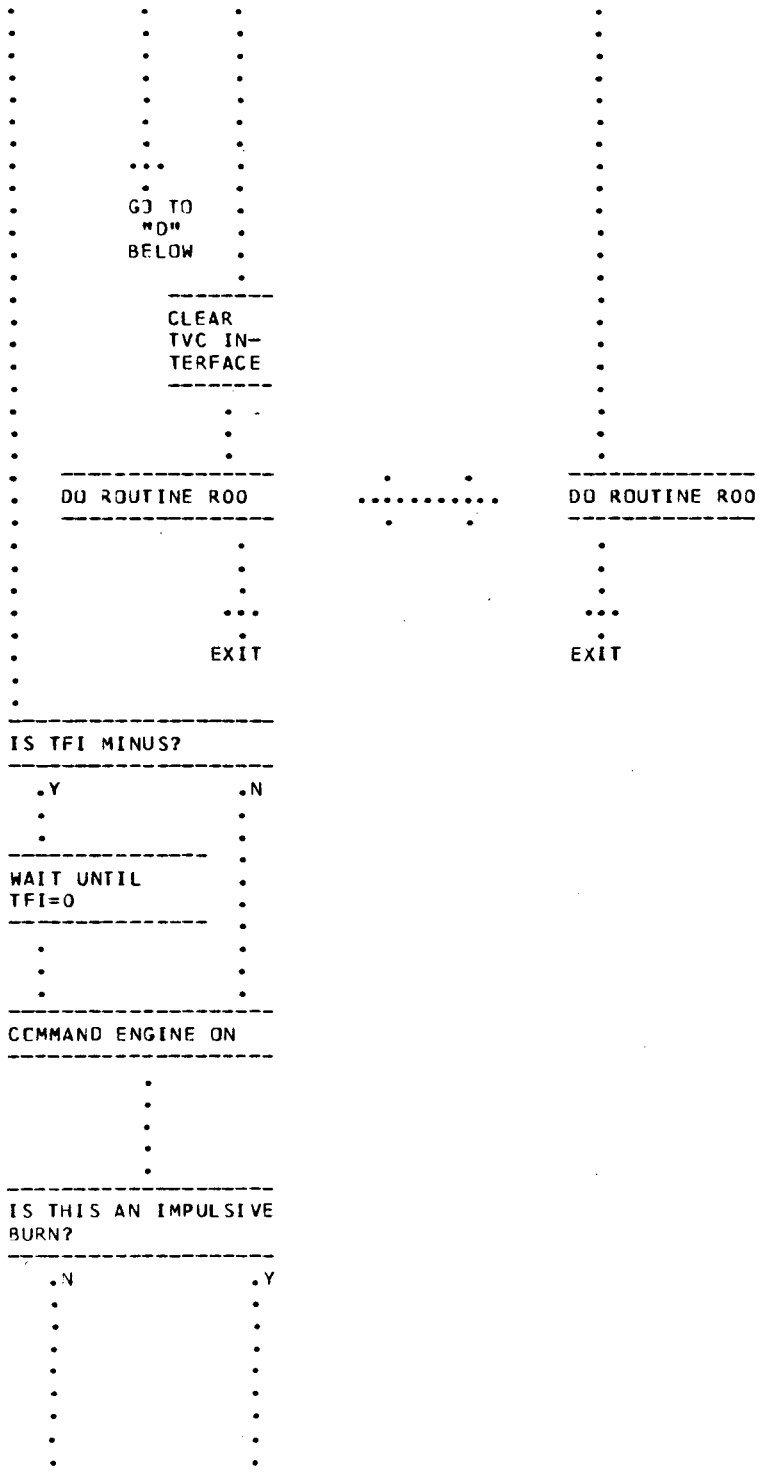

THRUSTING MANEU-
VER BY USE OF
THE RCS?
.N
.Y
KEY IN ENTER
GO TO
"D"
BELOW
#460
#470
#480
KEY IN
TERMINATE
V34E
#490
#500
RESUME NO FLASH
V06 N40 DISPLAY UPON
RECEIPT OF PROCEED.
TERMINATE FLASH UPON
RECEIPT OF ENTER OR
TERMINATE.
.PROCEED
.ENTER
.TERMINATE
CLEAR TVC
INTER-
FACE



#510

#520

#530

#540

#550

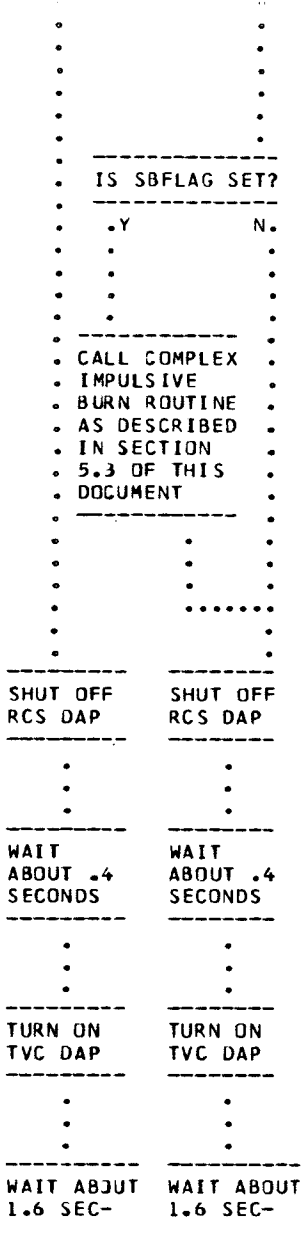
#560

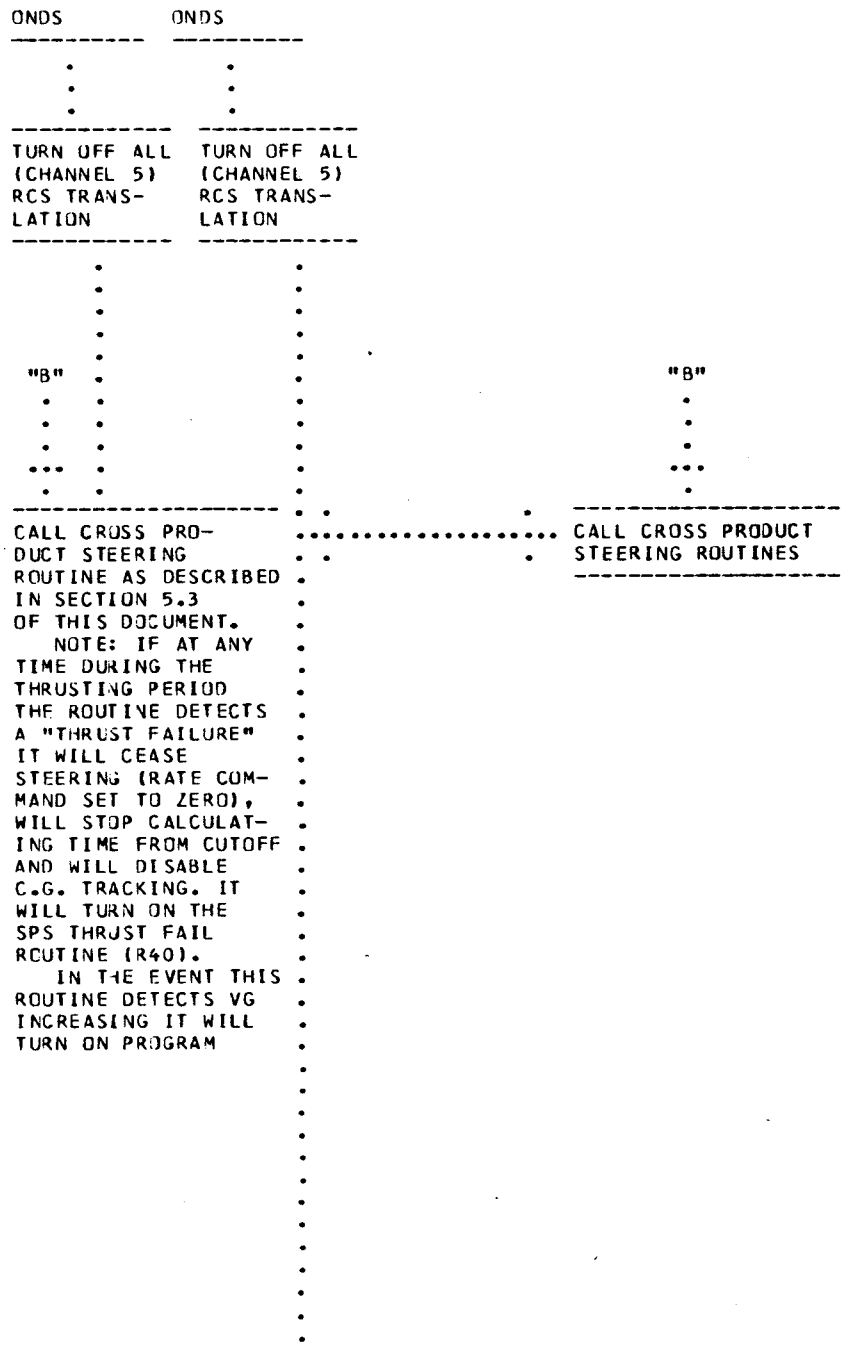
#570

#580

#590

#600





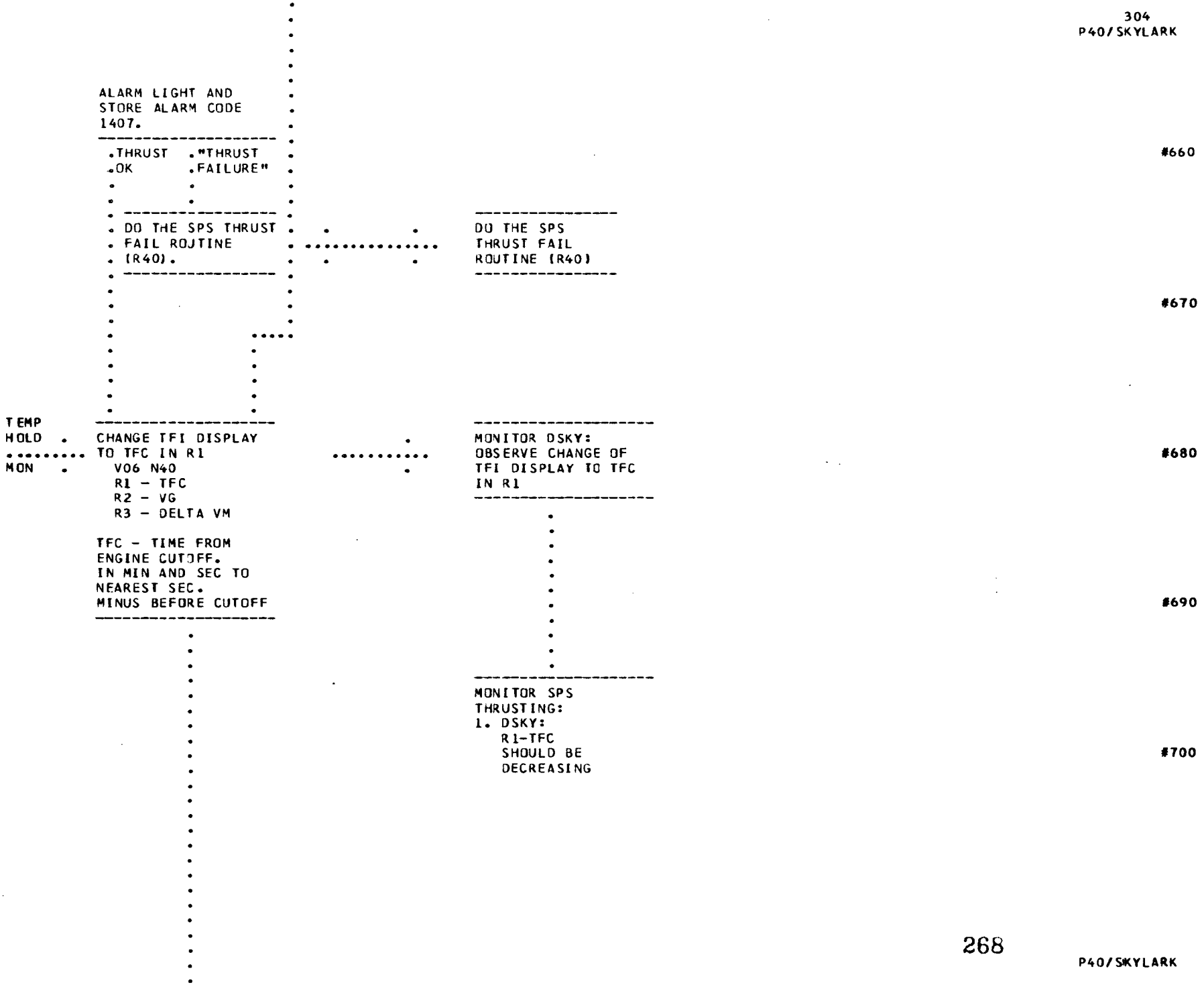
#610

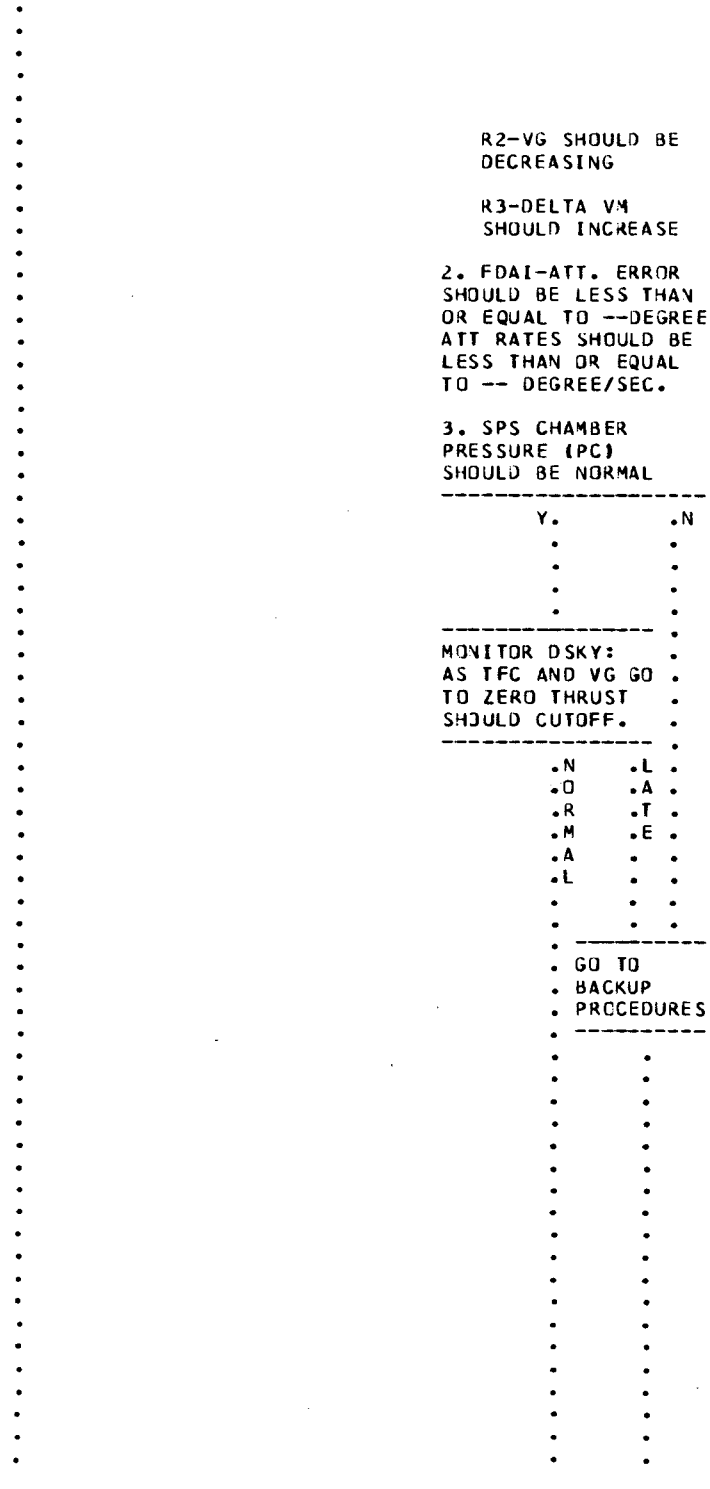
#620

#630

#640

#650


ALARM LIGHT AND
STORE ALARM CODE
1407.
.THRUST .OK
."THRUST .FAILURE"
DO THE SPS THRUST FAIL ROUTINE (R40).
DO THE SPS THRUST FAIL ROUTINE (R40)
#660
#670
TEMP HOLD MON
CHANGE TFI DISPLAY TO TFC IN R1
V06 N40
R1 - TFC
R2 - VG
R3 - DELTA VM
TFC - TIME FROM ENGINE CUTOFF.
IN MIN AND SEC TO NEAREST SEC.
MINUS BEFORE CUTOFF
MONITOR DSKY:
OBSERVE CHANGE OF TFI DISPLAY TO TFC IN R1
#680
#690
MONITOR SPS THRUSTING:
1. DSKY:
R1-TFC
SHOULD BE DECREASING
#700


R2-VG SHOULD BE DECREASING
R3-DELTA VM SHOULD INCREASE
2. FDAI-ATT. ERROR SHOULD BE LESS THAN OR EQUAL TO --DEGREE ATT RATES SHOULD BE LESS THAN OR EQUAL TO -- DEGREE/SEC.
3. SPS CHAMBER PRESSURE (PC) SHOULD BE NORMAL
Y.
.N
#710
#720
MONITOR DSKY: AS TFC AND VG GO TO ZERO THRUST SHOULD CUTOFF.
.N
.O
.R
.M
.A
.L
.L
.A
.T
.E
#730
GO TO BACKUP PROCEDURES
#740

#750

CMC TERMINATES ENGINE ON COMMAND WHEN INDICATED BY CROSS PRODUCT STEERING, COMPLEX IMPULSIVE BURN ROUTINE (AS DESCRIBED IN SECTION 5.3) OR IMPULSIVE THRUST TIMER (SET UP AT IGNITION AS DEFINED IN SECTION 5.3 OF R693)

#760

#770

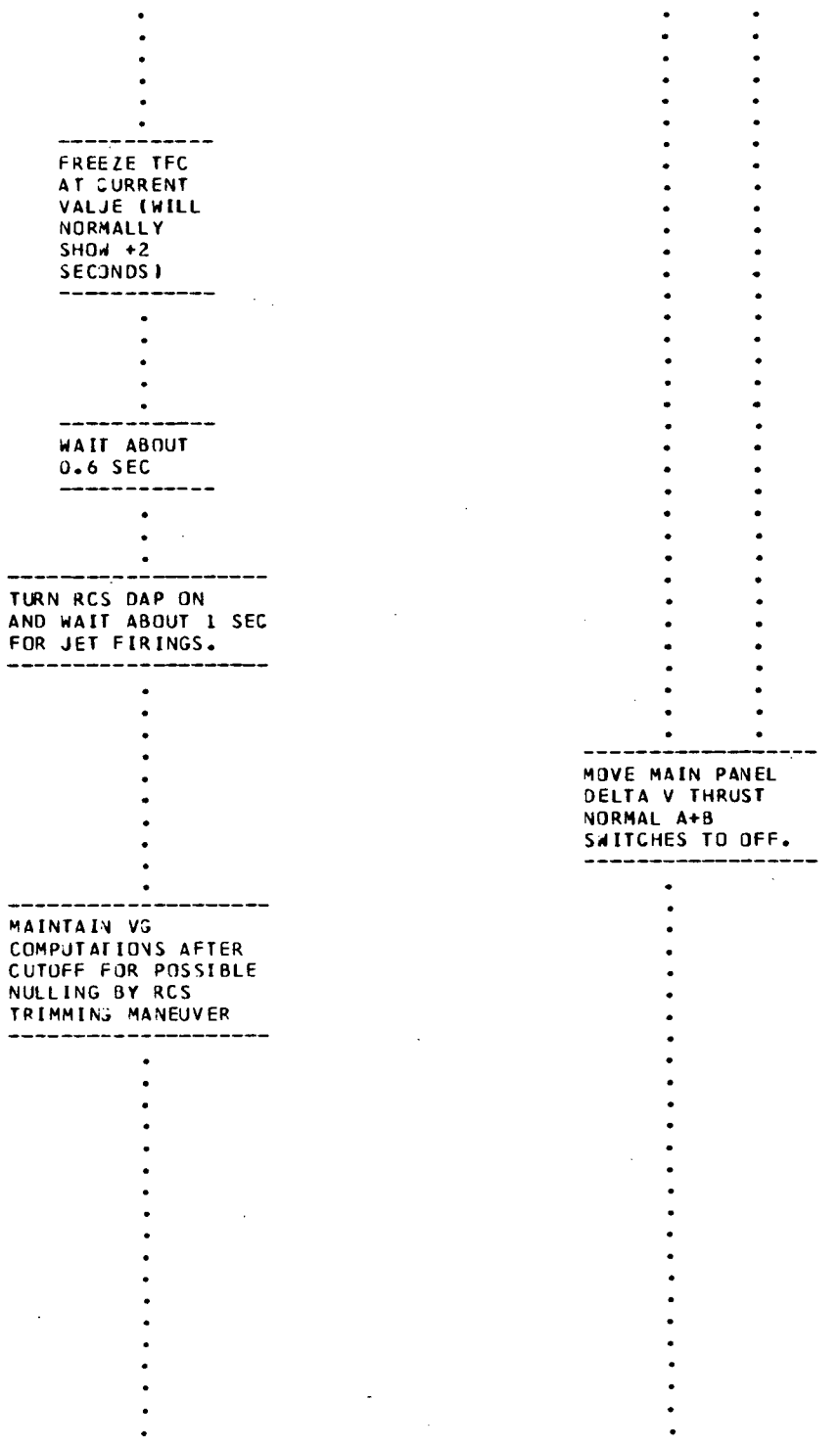
WAIT ABOUT 2.5 SECONDS

#780

SET WIDE DEADBAND IN RCS DAP

#790

TURN OFF TVC DAP AND DISABLE TVC INTERFACE



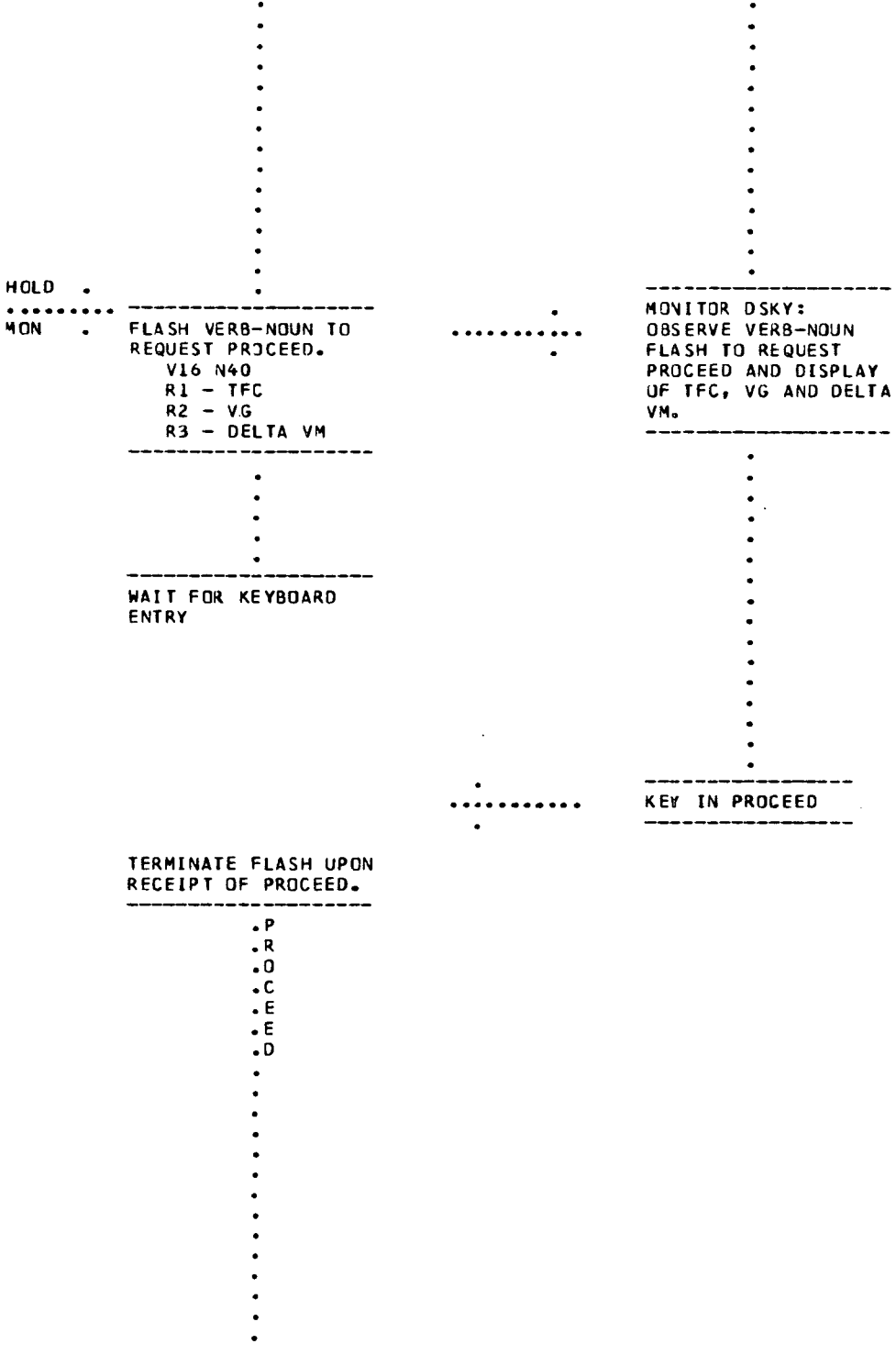
#800

#810

#820

#830

#840



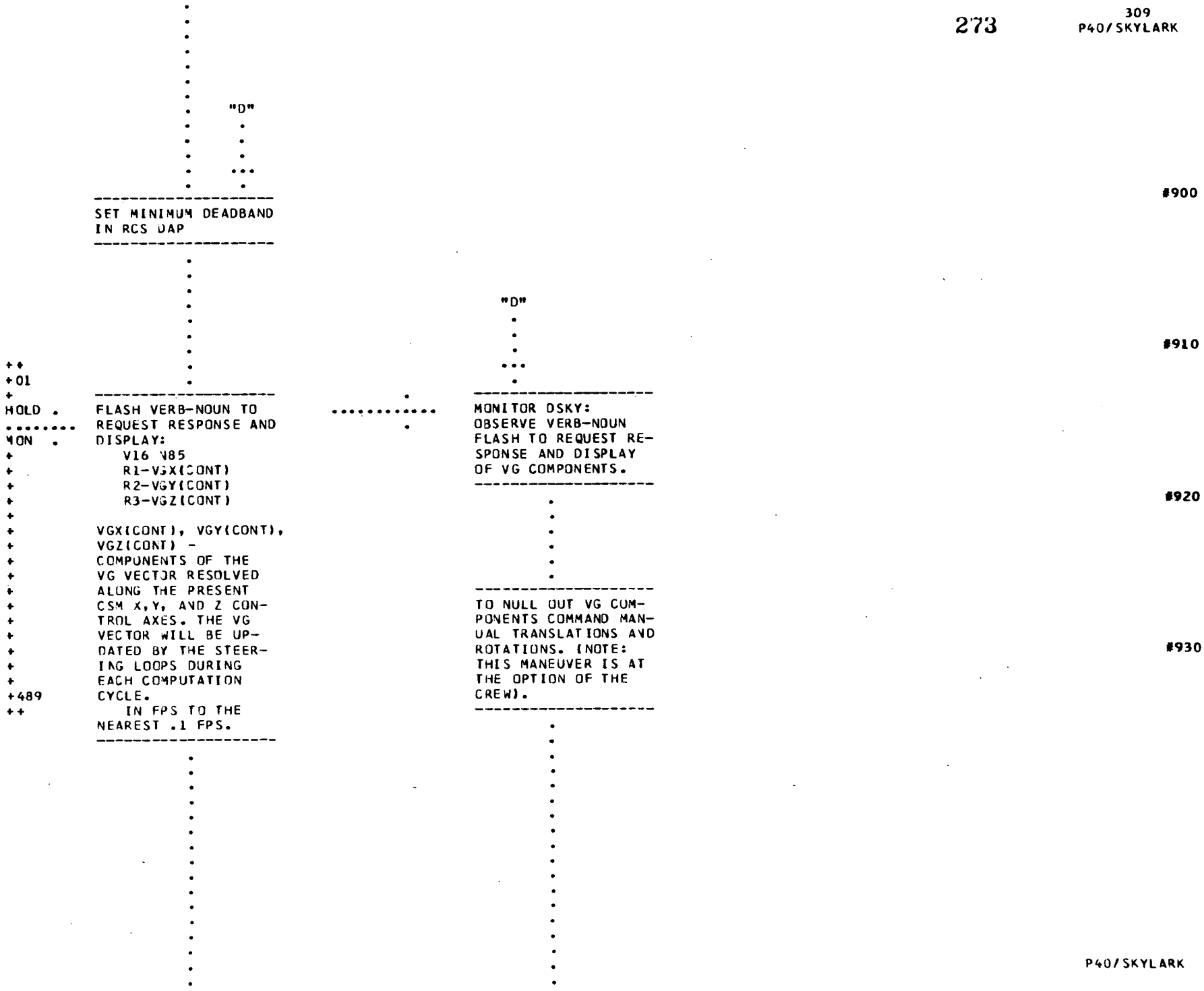
#850

#860

#870

#880

#890


"D"
SET MINIMUM DEADBAND IN RCS DAP
"D"
++
+01
+
HOLD .
.....
NON .
+
+
+
+
+
+
+
+
+
+
+
+
+489
++
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY:
V16 N85
R1-VGX(CONT)
R2-VGY(CONT)
R3-VGZ(CONT)
VGX(CONT), VGY(CONT), VGZ(CONT) - COMPONENTS OF THE VG VECTOR RESOLVED ALONG THE PRESENT CSM X,Y, AND Z CONTROL AXES. THE VG VECTOR WILL BE UPDATED BY THE STEERING LOOPS DURING EACH COMPUTATION CYCLE.
IN FPS TO THE NEAREST .1 FPS.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF VG COMPONENTS.
TO NULL OUT VG COMPONENTS COMMAND MANUAL TRANSLATIONS AND ROTATIONS. (NOTE: THIS MANEUVER IS AT THE OPTION OF THE CREW).
#900
#910
#920
#930

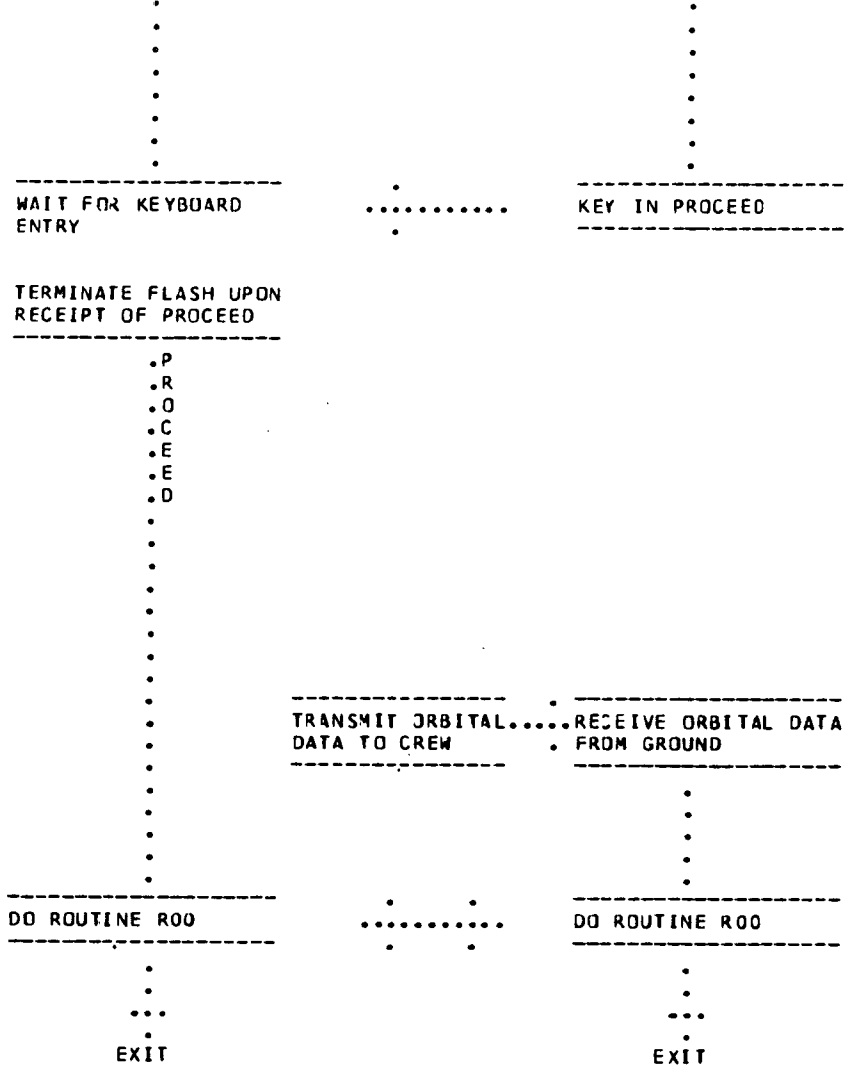
#940

#950

#960

#970

#980



CHANGE CONTROL NOTES

REV 00 PCR 003,011,040, PCN 457, SKYLARK MEMO #20
REV 01 PCN 489

RCS PROGRAM (P41) REV 01 03/20/72

PURPOSE: (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR AN RCS THRUSTING MANEUVER.

(2) TO CALCULATE THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE +X-AXIS WERE ALIGNED TO THE THRUST VECTOR. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU ORIENTATION (NOT RECOMMENDED IF MIDDLE GIMBAL ANGLE IS GREATER THAN 45 DEGREES), IF THE IMU HAS NOT BEEN ALIGNED WITHIN THE LAST 3 HRS, REALIGNMENT IS DESIRABLE.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52.

(3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(4) TO PROVIDE SUITABLE DISPLAYS FOR MANUAL EXECUTION OF THE THRUSTING MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRETHRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED, THE CMC UPDATES VG ONLY AS A RESULT OF COMPENSATED ACCELEROMETER INPUTS.
FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

(3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

(5) TRANSLATION INITIATION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) ROUTINE R03 (R04 IF CSM-OWS DOCKED) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND MAINTAIN ATTITUDE CONTROL THE ASTRONAUT MUST KEY IN V46E (V45E IF CSM-OWS DOCKED) AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

(7) THE VALUE OF DELTA V REQUIRED AT TIG IN LOCAL VERTICAL COORDINATES IS STORED IN NOUN 81 AND MAY BE CALLED UNTIL AVERAGE G IS TURNED ON BY KEYING IN V06N81E.

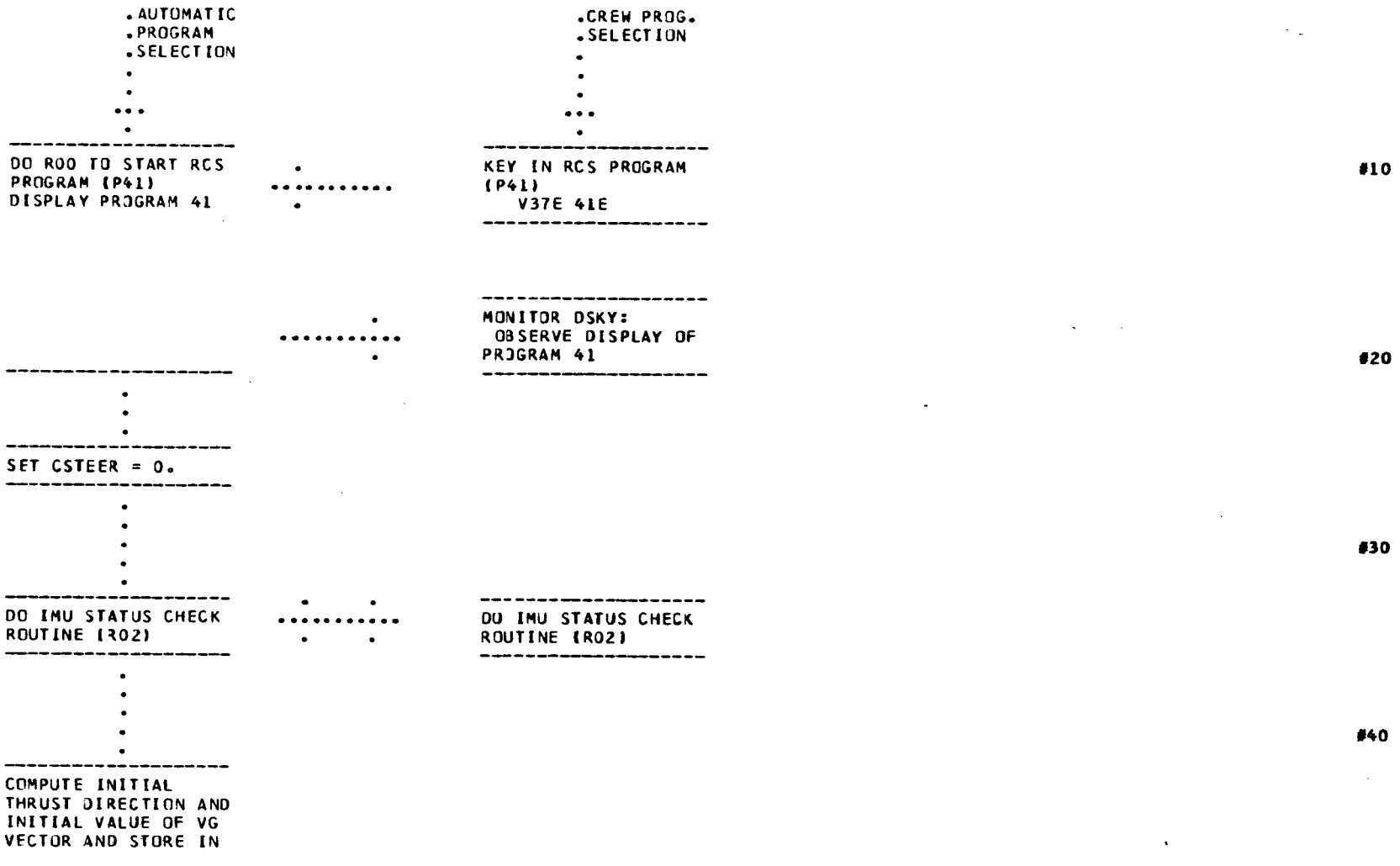
(8) THE ORBITAL PARAMETERS DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(9) THE ASTRONAUT MAY REQUEST A TFI DISPLAY BY KEYING IN EITHER V16N40 FOR MINS-SECS (R1), OR V16N35 FOR HRS (R1), MINS (R2), AND SECS (R3).

(10) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY MINKEY CONTROLLER (R07).

PROG	CMC	GROUND	CREW

CONT


.AUTOMATIC
.PROGRAM
.SELECTION
.CREW PROG.
.SELECTION
DO R00 TO START RCS PROGRAM (P41) DISPLAY PROGRAM 41
KEY IN RCS PROGRAM (P41) V37E 41E
#10
MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 41
#20
SET CSTEER = 0.
#30
DO IMU STATUS CHECK ROUTINE (R02)
DO IMU STATUS CHECK ROUTINE (R02)
#40
COMPUTE INITIAL THRUST DIRECTION AND INITIAL VALUE OF VG VECTOR AND STORE IN

NOUN 81 (VG LOCAL VERTICAL)

#50

.
.
.
.
.

#60

COMPUTE PREFERRED IMU ORIENTATION:

$X_{-SM} = UNIT(T_{-})$

$Y_{-SM} = UNIT(X_{-SM} \times R_{-})$

$Z_{-SM} = UNIT(X_{-SM} \times Y_{-SM})$

#70

WHERE:
T = INITIAL THRUST VECTOR

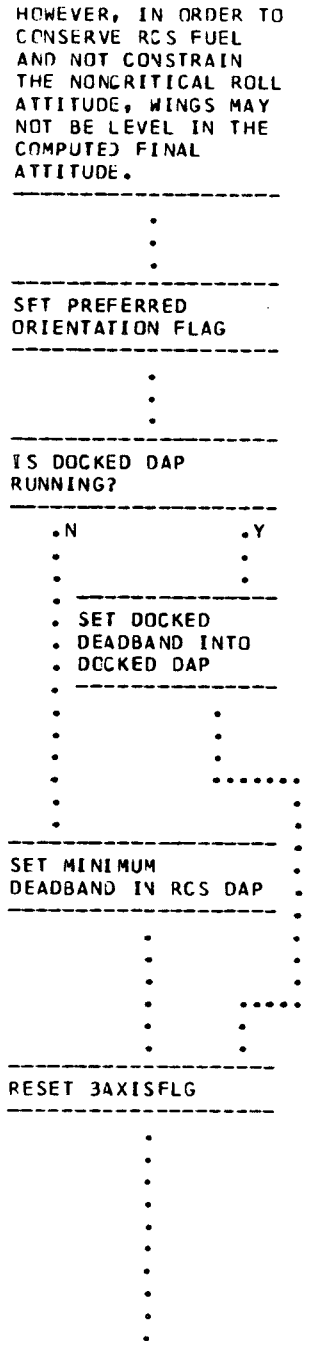
R = THE CSM POSITION RADIUS VECTOR AT TIG

.
.
.
.
.

#80

STORE DESIRED ATTITUDE SPECIFICATION FOR USE BY ATTITUDE MANEUVER ROUTINE (R60). THE FINAL ATTITUDE WILL BE COMPUTED DURING R60 AND WILL POINT THE +X TRANSLATION AXIS IN THE INITITAL THRUST DIRECTION.

#90



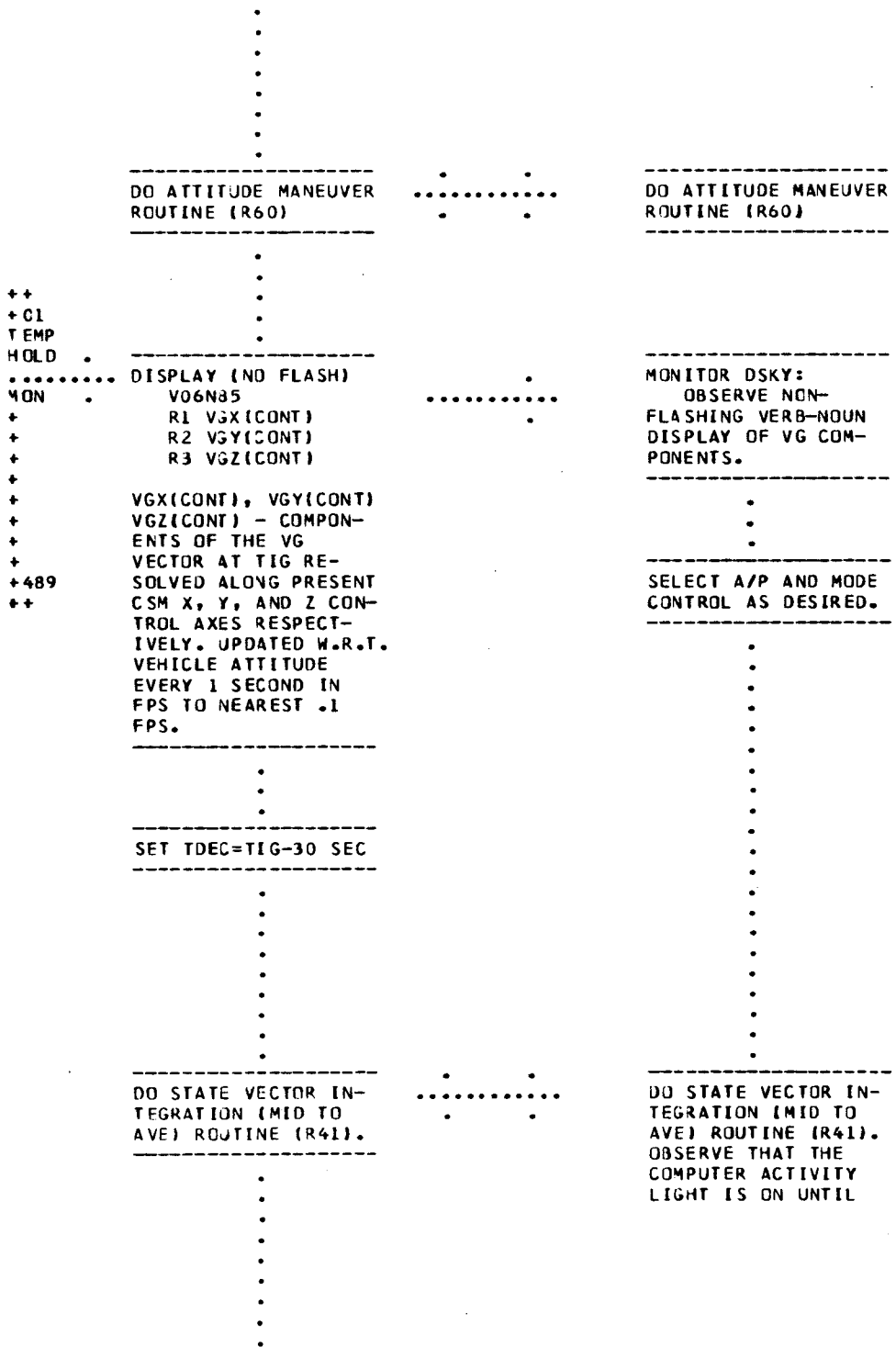
#100

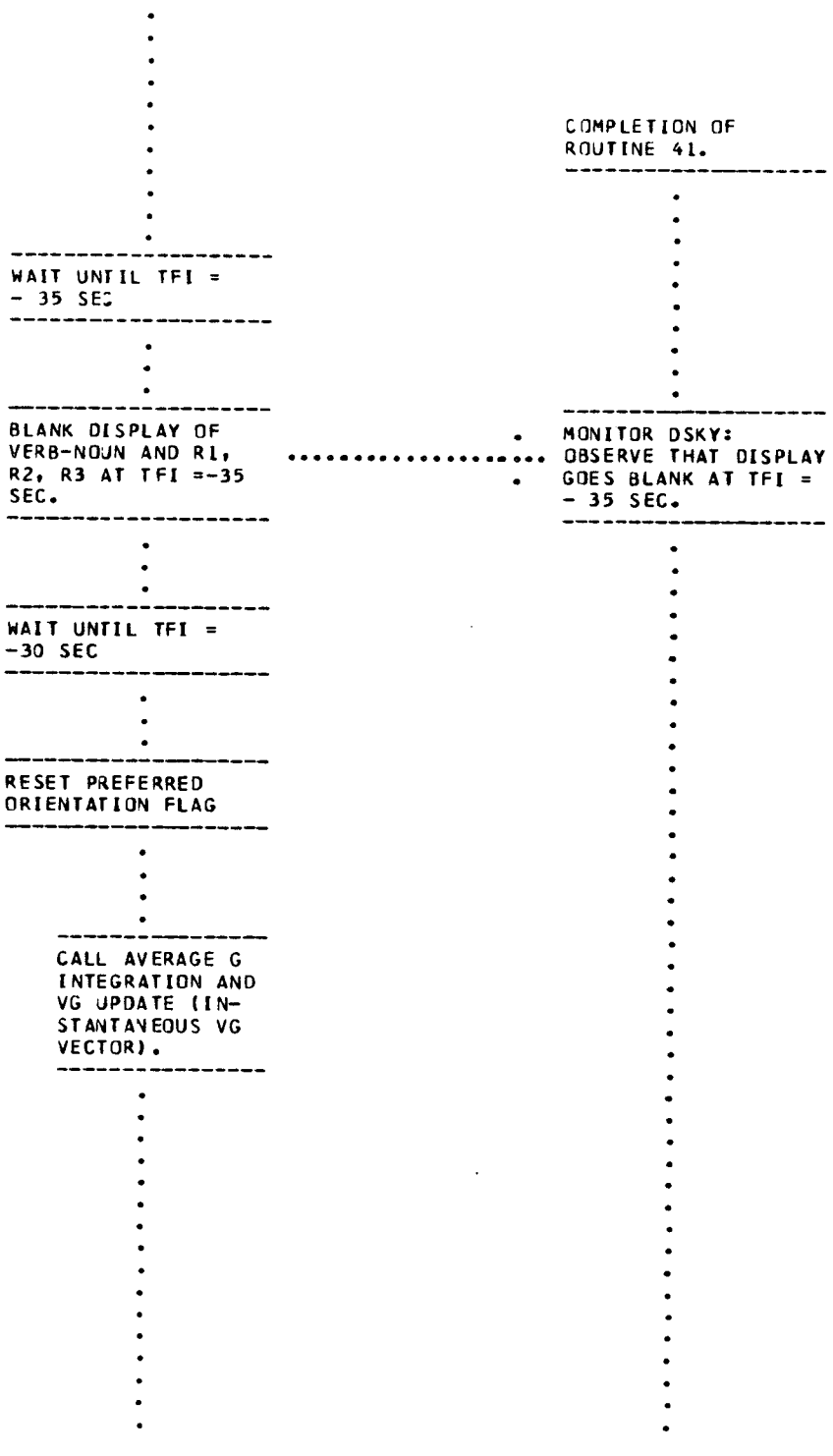
#110

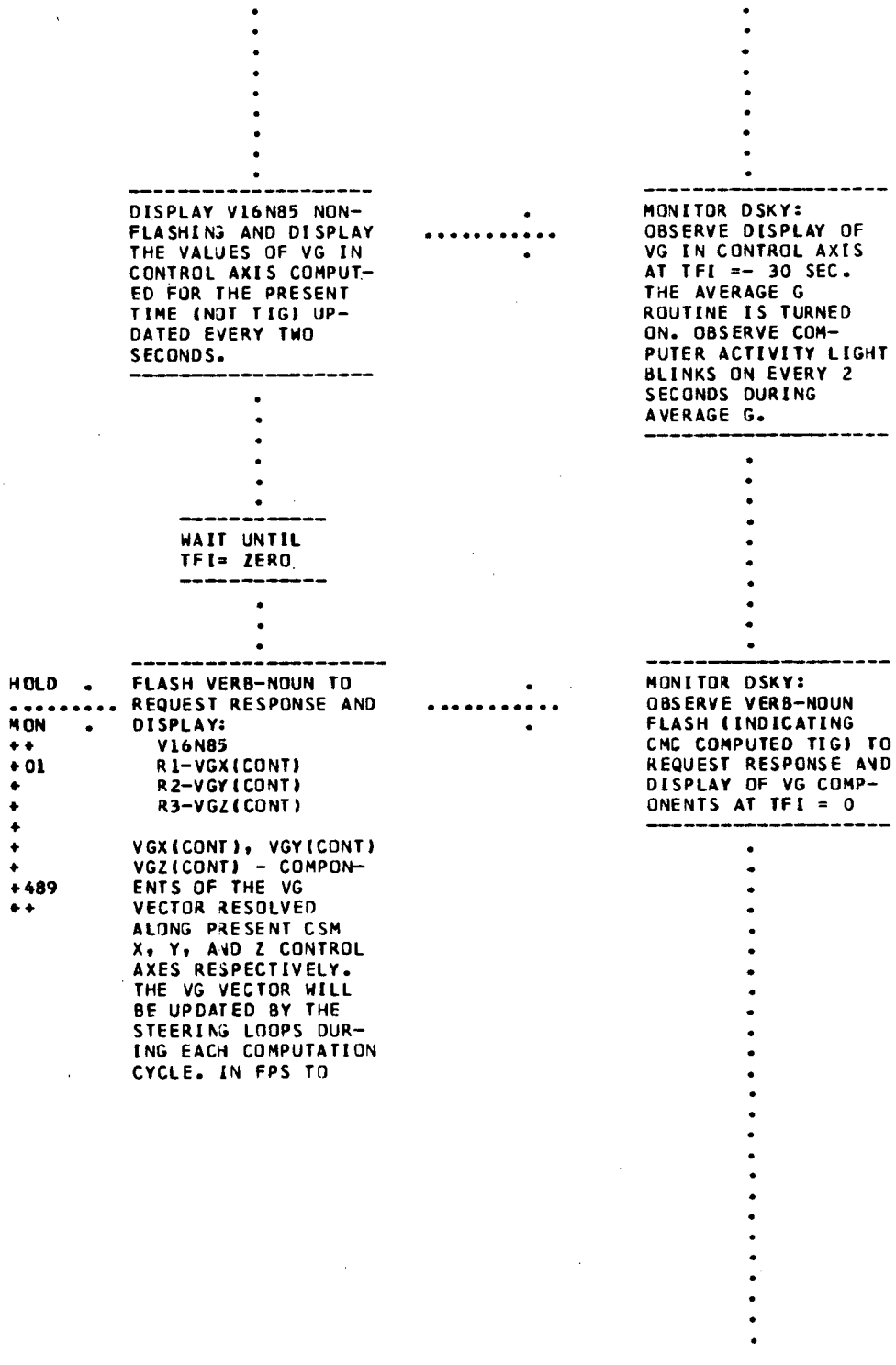
#120

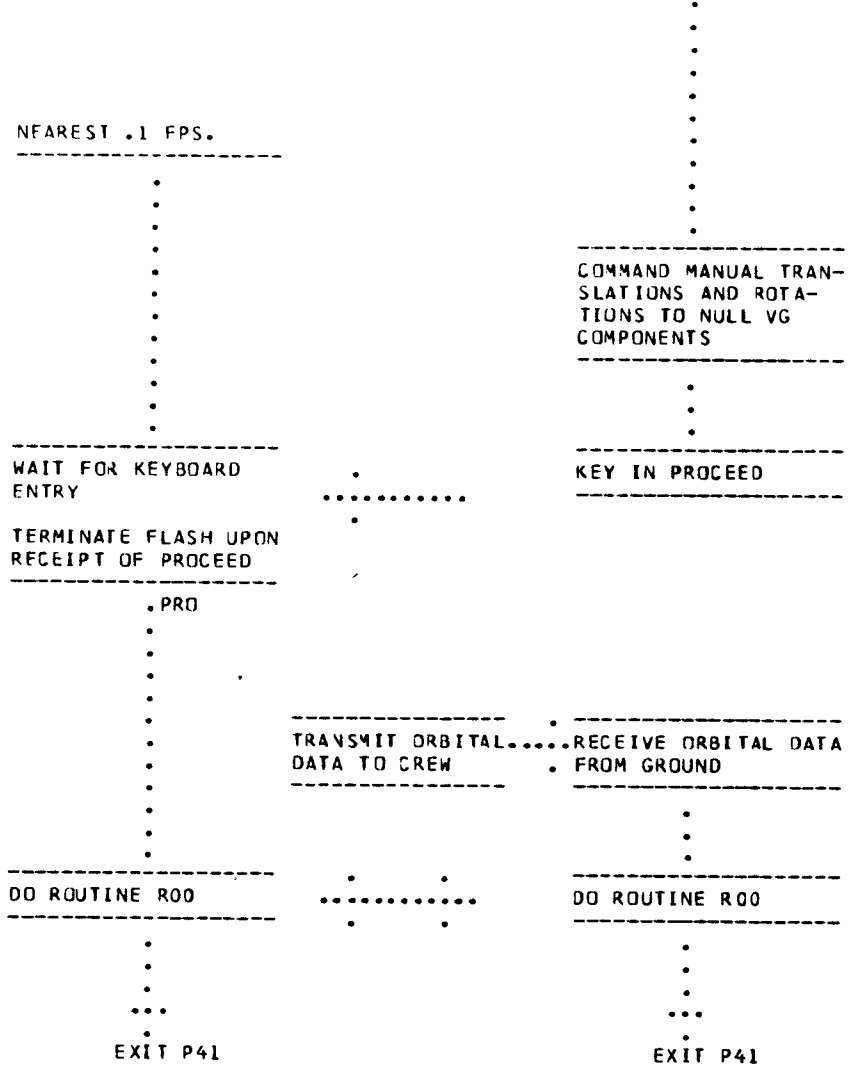
#130

#140


DO ATTITUDE MANEUVER ROUTINE (R60)
DO ATTITUDE MANEUVER ROUTINE (R60)
++
+C1
TEMP
HOLD .
DISPLAY (NO FLASH)
V06N85
R1 VGX(CONT)
R2 VGY(CONT)
R3 VGZ(CONT)
VGX(CONT), VGY(CONT) VGZ(CONT) - COMPONENTS OF THE VG VECTOR AT TIG RESOLVED ALONG PRESENT CSM X, Y, AND Z CONTROL AXES RESPECTIVELY. UPDATED W.R.T. VEHICLE ATTITUDE EVERY 1 SECOND IN FPS TO NEAREST .1 FPS.
+489
++
MONITOR DSKY:
OBSERVE NON-FLASHING VERB-NOUN DISPLAY OF VG COMPONENTS.
SELECT A/P AND MODE CONTROL AS DESIRED.
#150
#160
#170
SET TDEC=TIG-30 SEC
#180
#190
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41).
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41). OBSERVE THAT THE COMPUTER ACTIVITY LIGHT IS ON UNTIL


COMPLETION OF ROUTINE 41.
#200
WAIT UNTIL TFI = - 35 SEC
#210
BLANK DISPLAY OF VERB-NOUN AND R1, R2, R3 AT TFI =-35 SEC.
MONITOR DSKY: OBSERVE THAT DISPLAY GOES BLANK AT TFI = - 35 SEC.
#220
WAIT UNTIL TFI = -30 SEC
RESET PREFERRED ORIENTATION FLAG
#230
CALL AVERAGE G INTEGRATION AND VG UPDATE (INSTANTANEOUS VG VECTOR).
#240


DISPLAY V16N85 NON-FLASHING AND DISPLAY THE VALUES OF VG IN CONTROL AXIS COMPUT-ED FOR THE PRESENT TIME (NOT TIG) UP-DATED EVERY TWO SECONDS.
MONITOR DSKY: OBSERVE DISPLAY OF VG IN CONTROL AXIS AT TFI =- 30 SEC. THE AVERAGE G ROUTINE IS TURNED ON. OBSERVE COM-PUTER ACTIVITY LIGHT BLINKS ON EVERY 2 SECONDS DURING AVERAGE G.
#250
#260
WAIT UNTIL TFI= ZERO.
#270
HOLD .
..... .
MON .
++
+01
+
+
+
+489
++
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY:
V16N85
R1-VGX(CONT)
R2-VGY(CONT)
R3-VGZ(CONT)
VGX(CONT), VGY(CONT) VGZ(CONT) - COMPON-ENTS OF THE VG VECTOR RESOLVED ALONG PRESENT CSM X, Y, AND Z CONTROL AXES RESPECTIVELY. THE VG VECTOR WILL BE UPDATED BY THE STEERING LOOPS DUR-ING EACH COMPUTATION CYCLE. IN FPS TO
MONITOR DSKY: OBSERVE VERB-NOUN FLASH (INDICATING CMC COMPUTED TIG) TO REQUEST RESPONSE AND DISPLAY OF VG COMP-ONENTS AT TFI = 0
#280
#290



#300

#310

#320

#330

CHANGE CONTROL NOTES

REV 00 PCR 011,043
REV 01 PCN 489

THRUST MONITOR PROGRAM (P47) REV 01 03/20/72

PURPOSE: (1) TO MONITOR VEHICLE ACCELERATION DURING A NON GNCS CONTROLLED THRUSTING MANEUVER.

(2) TO DISPLAY THE DELTA V APPLIED TO THE VEHICLE BY THIS THRUSTING MANEUVER.

ASSUMPTIONS: (1) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(2) THE RESPONSIBILITY OF AVOIDING GIMBAL LOCK DURING EXECUTION OF THIS PROGRAM IS UPON THE ASTRONAUT.

(3) THIS PROGRAM IS NORMALLY USED DURING RENDEZVOUS FINAL PHASE. IF THE CREW DESIRED TO DO ANY FINAL PHASE THRUSTING MANEUVERS AUTOMATICALLY UNDER GNCS CONTROL THEY MUST BE ACCOMPLISHED VIA SELECTION OF THE TPI TARGETING PROGRAM (P35) AND THEN THE SPS THRUSTING PROGRAM (P40) OR THE RCS THRUSTING PROGRAM (P41).

(4) RANGE, RANGE RATE, AND THETA MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY NO 1 ROUTINE (R31) WITH V83E.

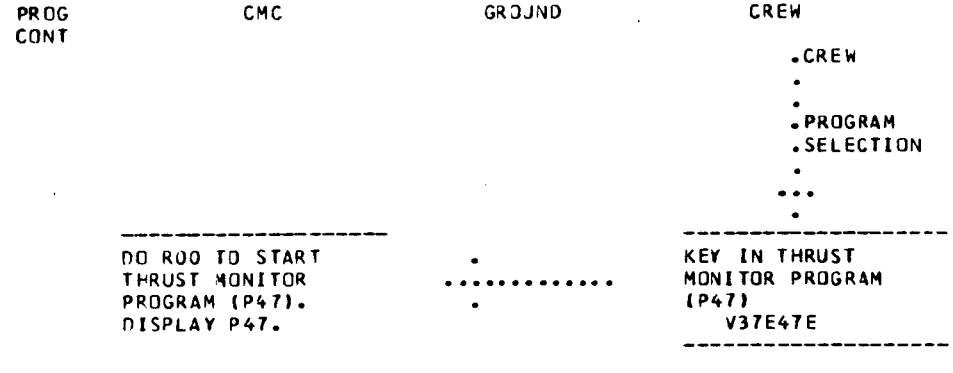
(5) RANGE, RANGE RATE, AND PHI MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY NO 2 ROUTINE (R34) WITH V85E.

(6) VI, HDOT, AND H MAY BE CALLED BY KEYING IN V16N62E.

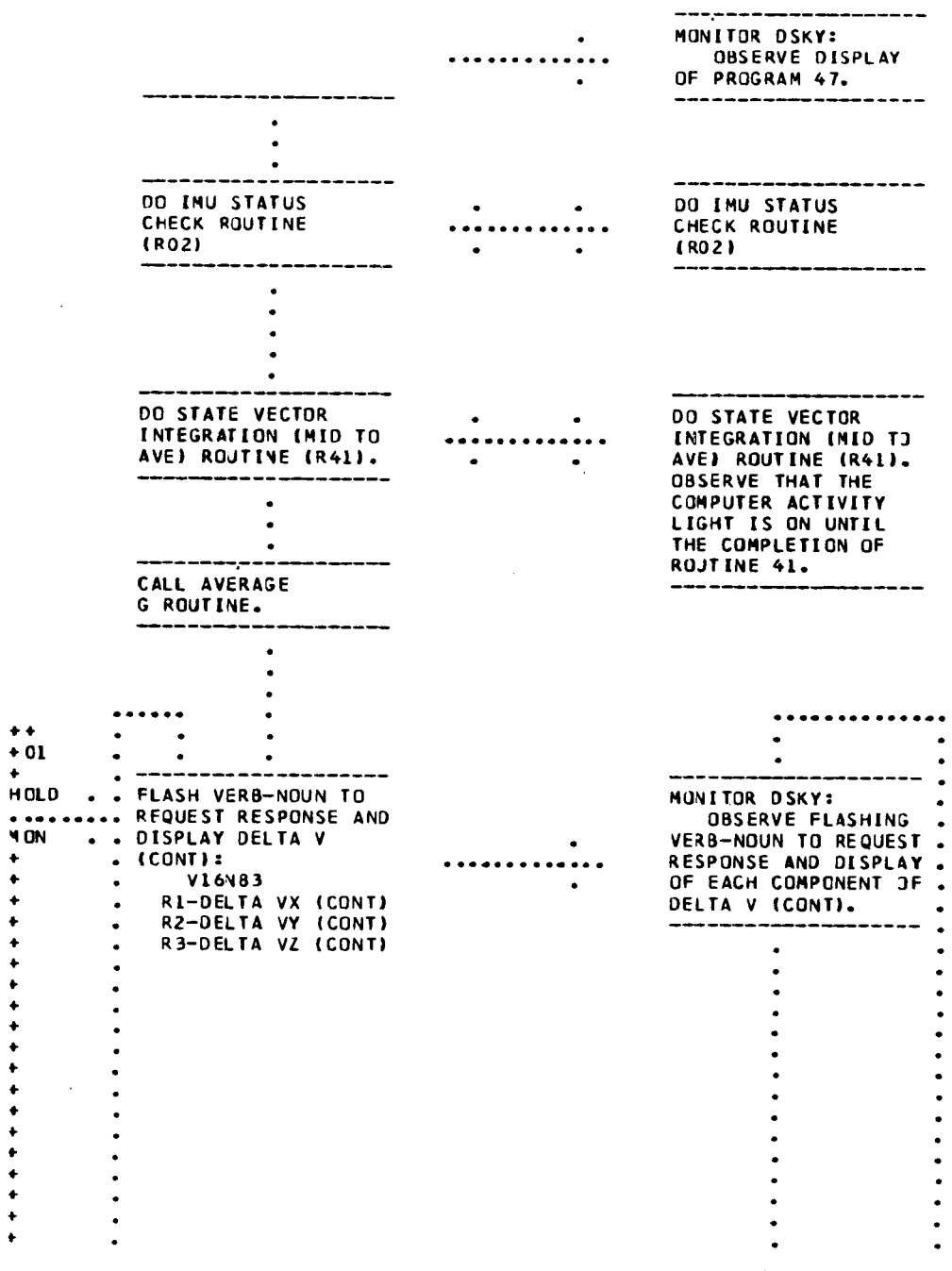
(7) THE ORBITAL PARAMETERS DISPLAY ROUTINE MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(8) THIS PROGRAM SHOULD BE TURNED ON JUST PRIOR TO THE PLANNED THRUSTING MANEUVER AND TERMINATED AS SOON AS POSSIBLE FOLLOWING THE MANEUVER IN ORDER TO KEEP IMU COMPENSATION AND AVERAGE G COMPUTATION ERRORS AT A MINIMUM.

(9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



#10


MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 47.
#20
DO IMU STATUS
CHECK ROUTINE
(R02)
DO IMU STATUS
CHECK ROUTINE
(R02)
#30
DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).
DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).
OBSERVE THAT THE
COMPUTER ACTIVITY
LIGHT IS ON UNTIL
THE COMPLETION OF
ROUTINE 41.
#40
CALL AVERAGE
G ROUTINE.
#50
++
+01
+
HOLD
MON
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DELTA V
(CONT):
V16N83
R1-DELTA VX (CONT)
R2-DELTA VY (CONT)
R3-DELTA VZ (CONT)
MONITOR DSKY:
OBSERVE FLASHING
VERB-NOUN TO REQUEST
RESPONSE AND DISPLAY
OF EACH COMPONENT OF
DELTA V (CONT).
#60

DELTA VX (CONT)-COMPONENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +X AXIS. IN FPS TO NEAREST .1 FPS.

DELTA VY (CONT)-COMPONENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +Y AXIS. IN FPS TO NEAREST .1 FPS.

DELTA VZ (CONT)-COMPONENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +Z AXIS. IN FPS TO NEAREST .1 FPS.

NOTE1: R1,R2, AND R3 WILL READ 00000 INITIALLY AND WILL REMAIN SC (EXCEPT FOR ACCELEROMETER BIASES) UNTIL A THRUSTING MANEUVER IS STARTED. THEY WILL BE UPDATED EVERY 2 SEC.

NOTE2: IN THE EVENT THIS PROGRAM IS USED TO MONITOR MANEUVERS WITH A DELTA V GREATER THAN 9999.9 FPS THIS DISPLAY WILL ONLY LOSE THE HIGH ORDER DIGIT. IT WILL OTHERWISE READ CORRECTLY.

489 ++

PERFORM THRUSTING MANEUVER AS DESIRED MONITOR FDAI BALL TO AVOID GIMBAL LOCK

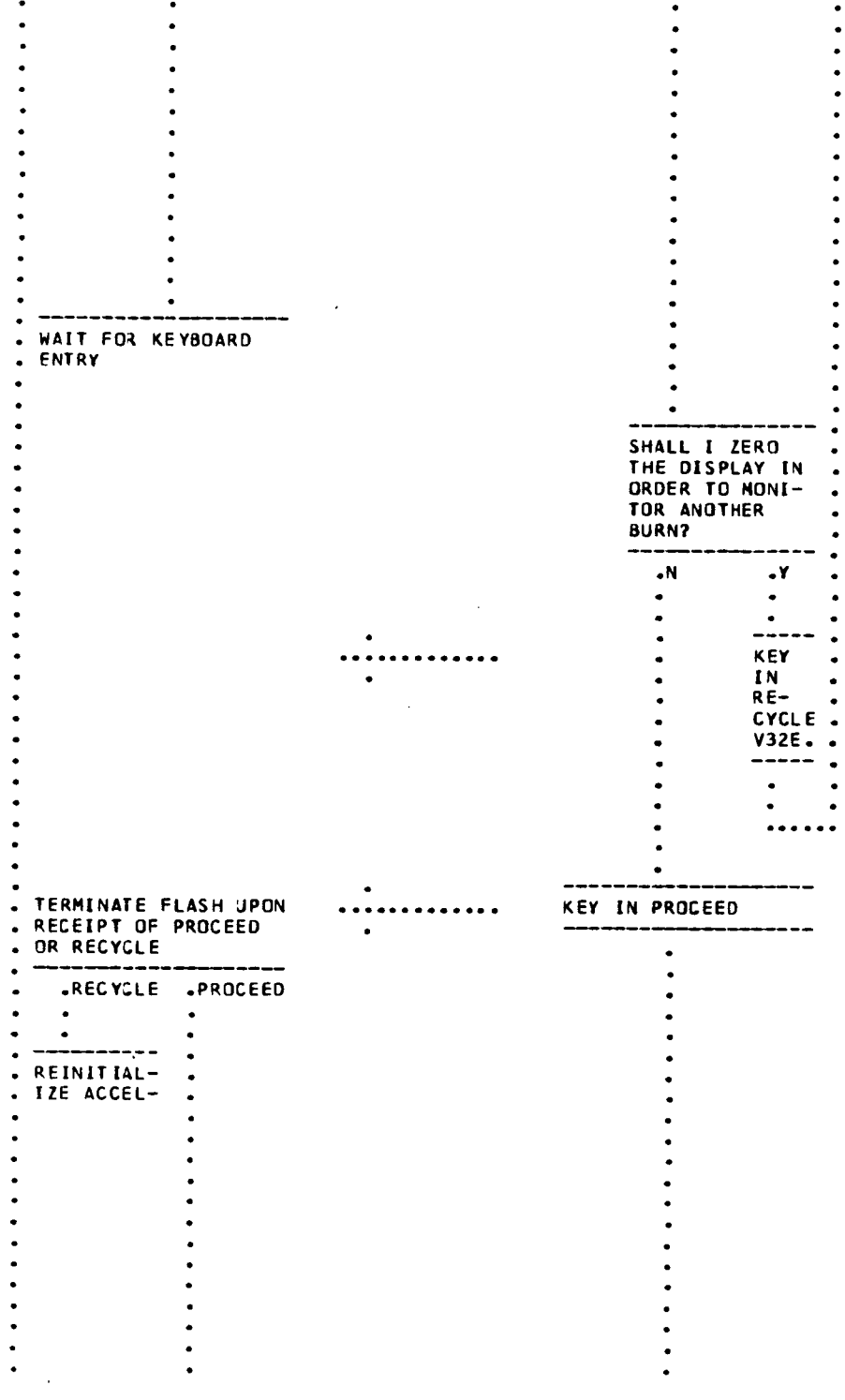
#70

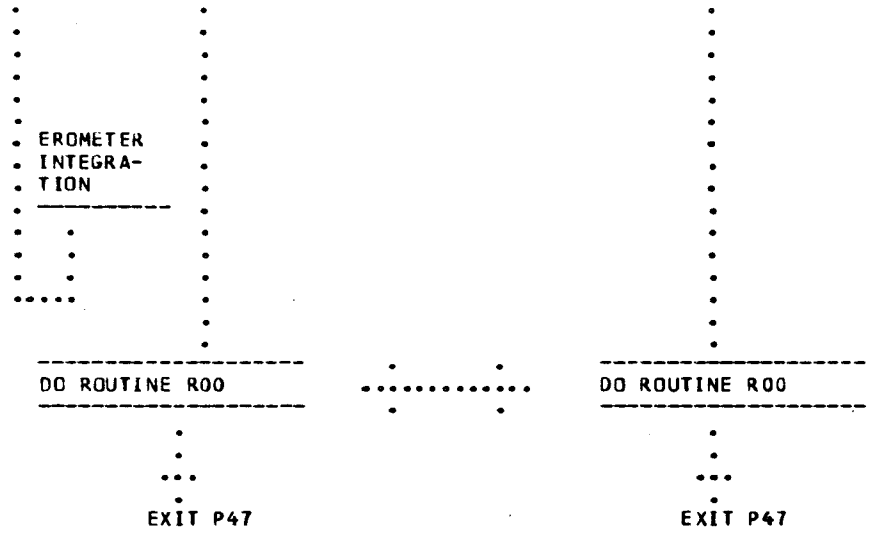
#80

#90

#100

#110


WAIT FOR KEYBOARD ENTRY
#120
SHALL I ZERO THE DISPLAY IN ORDER TO MONITOR ANOTHER BURN?
#130
N
Y
KEY IN RE-CYCLE V32E.
#140
TERMINATE FLASH UPON RECEIPT OF PROCEED OR RECYCLE
KEY IN PROCEED
#150
RECYCLE
PROCEED
REINITIAL-IZE ACCEL-



#160

#170

CHANGE CONTROL NOTES

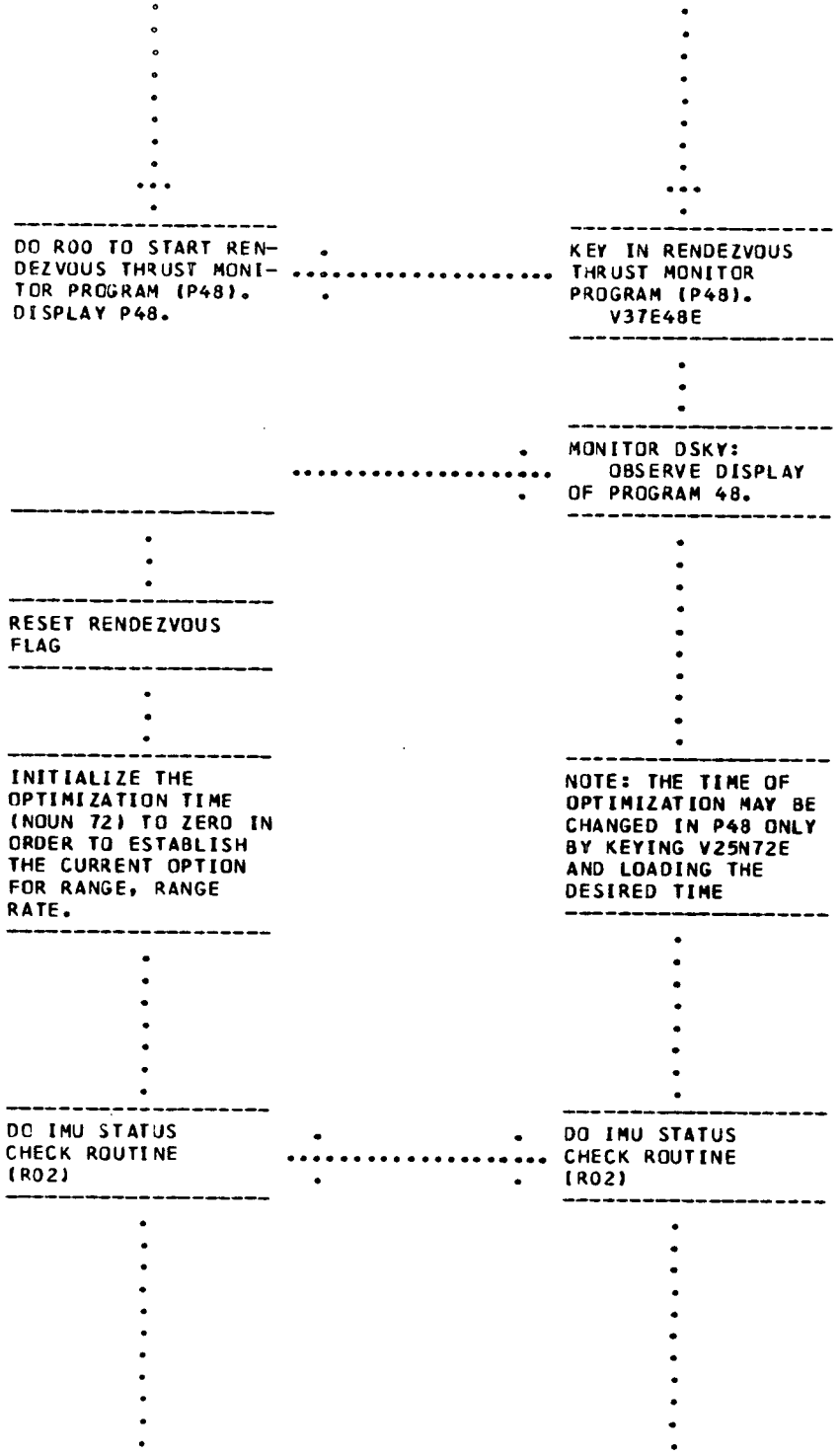
REV 00 SKYLARK MEMO #2
REV 01 PCN 489

RENDEZVOUS THRUST MONITOR PROGRAM (P48) REV 01 03/20/72

PURPOSE:
(1) TO DISPLAY TO THE ASTRONAUT RANGE AND RANGE RATE FROM A SOURCE INDEPENDENT OF VEHICLE STATE VECTORS.
+01
(2) TO DISPLAY CMC CALCULATED PARAMETER THETA.
+459
(3) TO ALLOW THE ASTRONAUT TO SELECT A FOUR - MINUTE SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.
(4) TO MONITOR VEHICLE ACCELERATION DURING A NON-GNCS CONTROLLED THRUSTING MANEUVER.
(5) TO DISPLAY THE DELTA V APPLIED TO THE VEHICLE BY THIS THRUSTING MANEUVER.

ASSUMPTIONS:
(1) THE VHF MUST BE OPERATING.
(2) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.
(3) THE RESPONSIBILITY OF AVOIDING GIMBAL LOCK DURING EXECUTION OF THIS PROGRAM IS UPON THE ASTRONAUT.
(4) RANGE, RANGE RATE, AND PHI (COMPUTED FROM STATE VECTORS) MAY BE DISPLAYED BY CALLING R34 WITH V85E.
(5) THE ORBIT PARAMETER DISPLAY ROUTINE MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.
(6) THIS PROGRAM IS NORMALLY USED DURING RENDEZVOUS FINAL PHASE.
(7) THIS PROGRAM SHOULD BE TURNED ON A FEW MINUTES PRIOR TO THE PLANNED THRUSTING MANEUVER (TO ALLOW R27 CONVERGENCE) AND TERMINATED AS SOON AS POSSIBLE FOLLOWING THE MANEUVER IN ORDER TO KEEP IMU COMPENSATION AND AVERAGE G COMPUTATION ERRORS AT A MINIMUM.
(8) +X OR -X TRANSLATION IS ASSUMED TO OCCUR ONLY ALONG THE LINE-OF-SIGHT TO THE OWS.
+C1
(9) NO +X OR -X TRANSLATION SHOULD BE PERFORMED DURING AN OPTIMIZATION.
+489
(10) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY MINKEY CONTROLLER (R07).

PROG CONT	CMC	GROUND	CREW
	.AUTOMATIC .PROGRAM .SELECTION		.CREW .PROGRAM .SELECTION


DO R00 TO START RENDEZVOUS THRUST MONITOR PROGRAM (P48). DISPLAY P48.
KEY IN RENDEZVOUS THRUST MONITOR PROGRAM (P48). V37E48E
MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 48.
RESET RENDEZVOUS FLAG
INITIALIZE THE OPTIMIZATION TIME (NOUN 72) TO ZERO IN ORDER TO ESTABLISH THE CURRENT OPTION FOR RANGE, RANGE RATE.
NOTE: THE TIME OF OPTIMIZATION MAY BE CHANGED IN P48 ONLY BY KEYING V25N72E AND LOADING THE DESIRED TIME
DO IMU STATUS CHECK ROUTINE (R02)
DO IMU STATUS CHECK ROUTINE (R02)

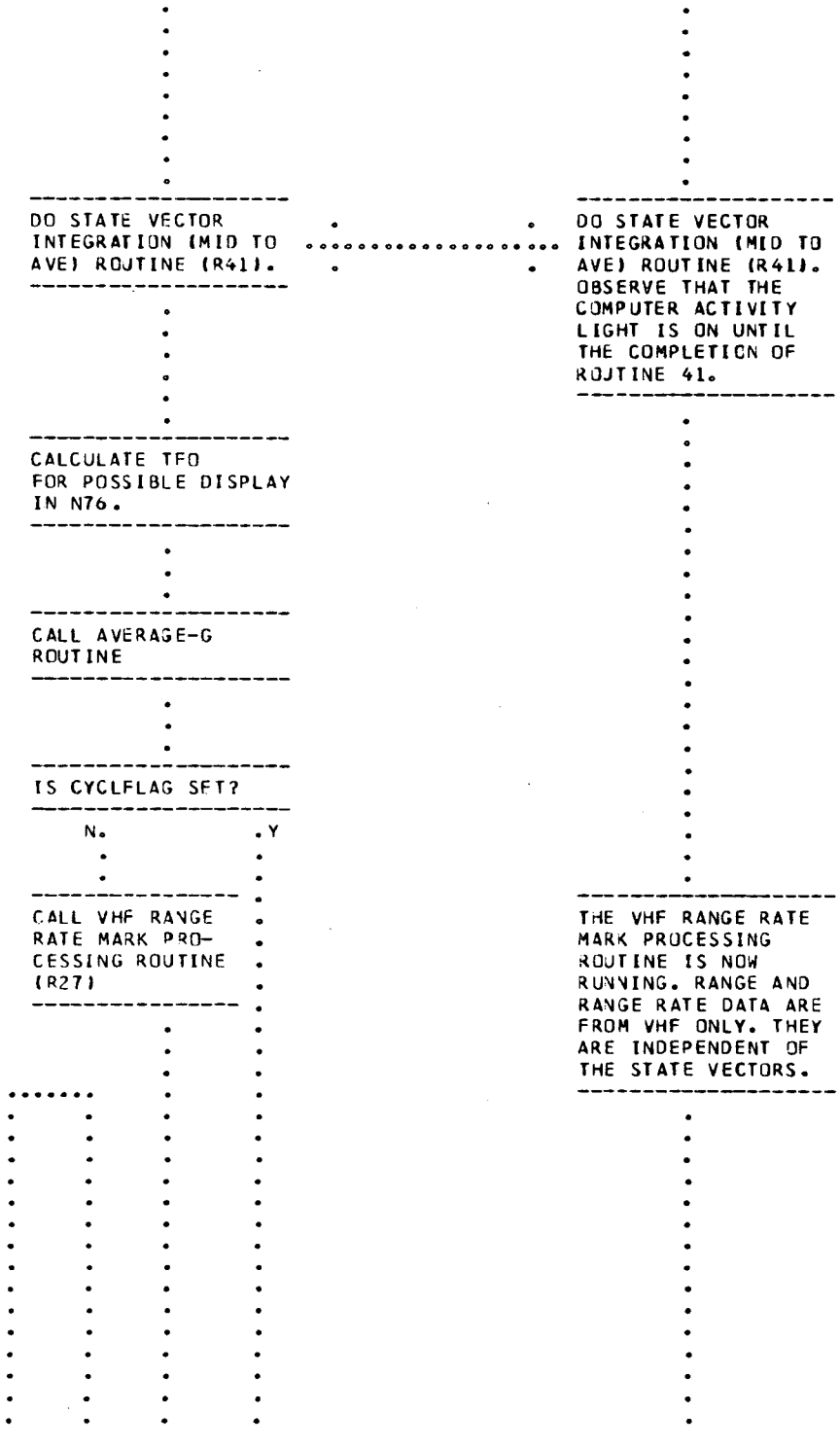
#10

#20

#30

#40

#50



#60

#70

#80

#90

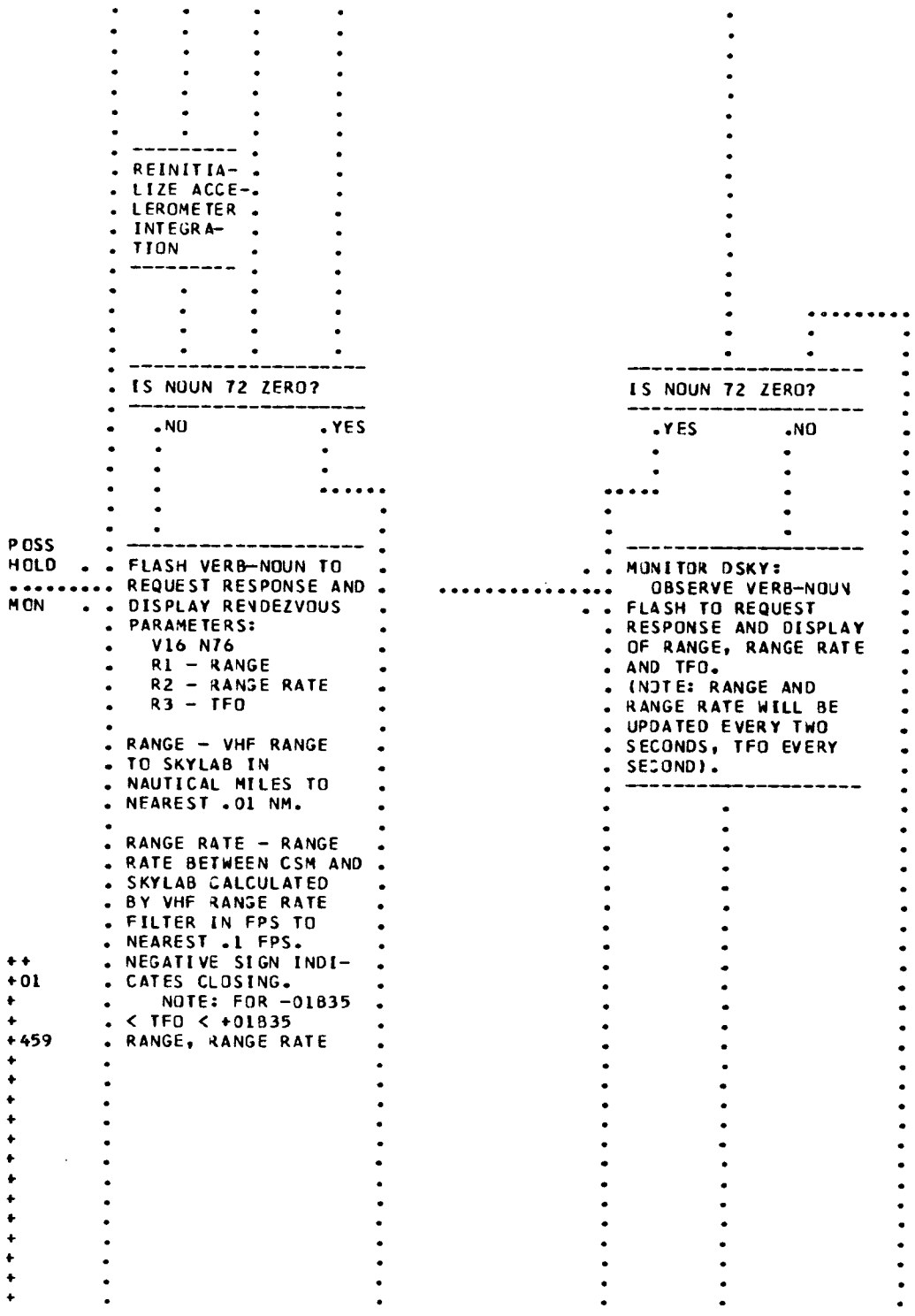
#100

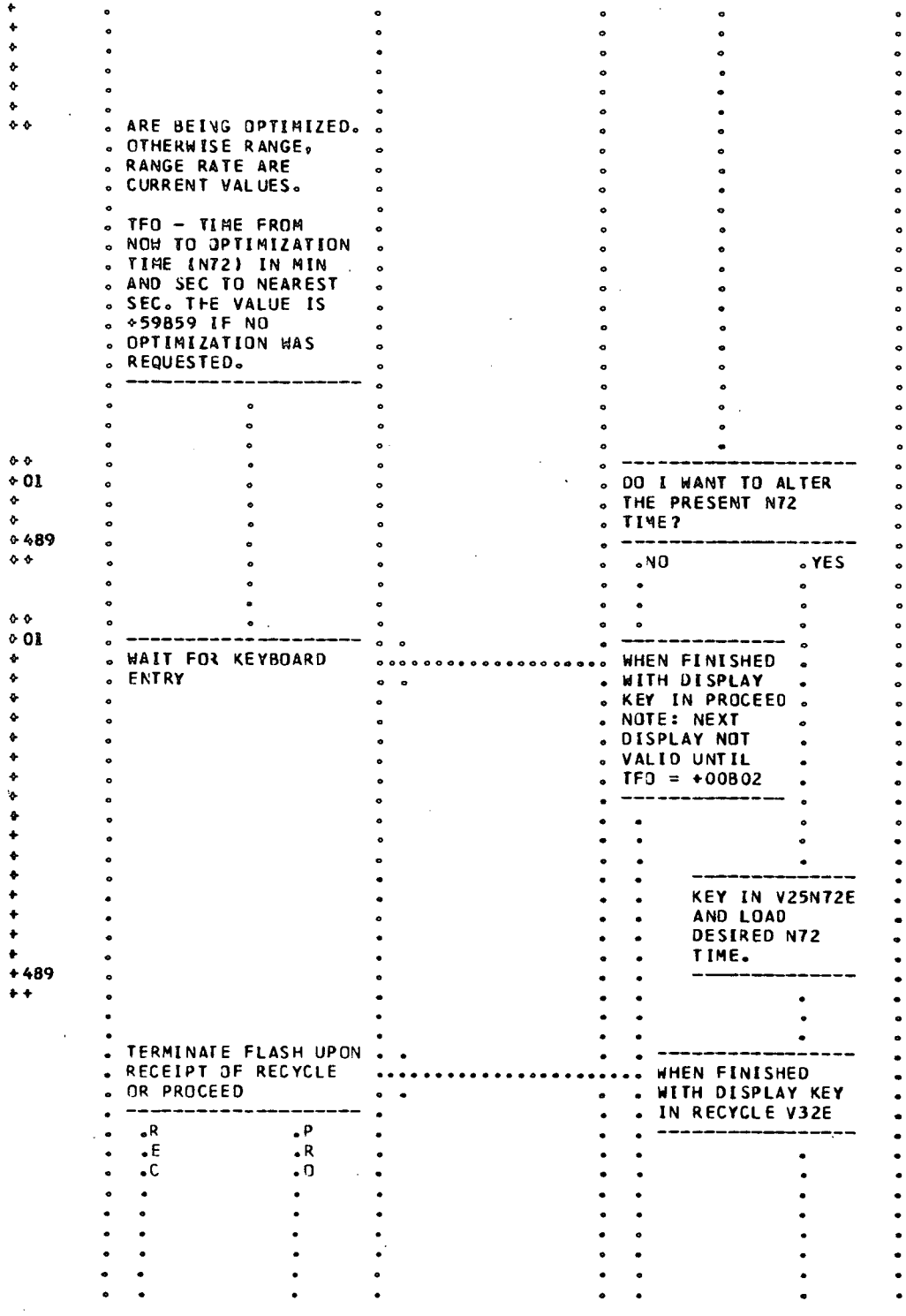
#110

#120

#130

#140





#150

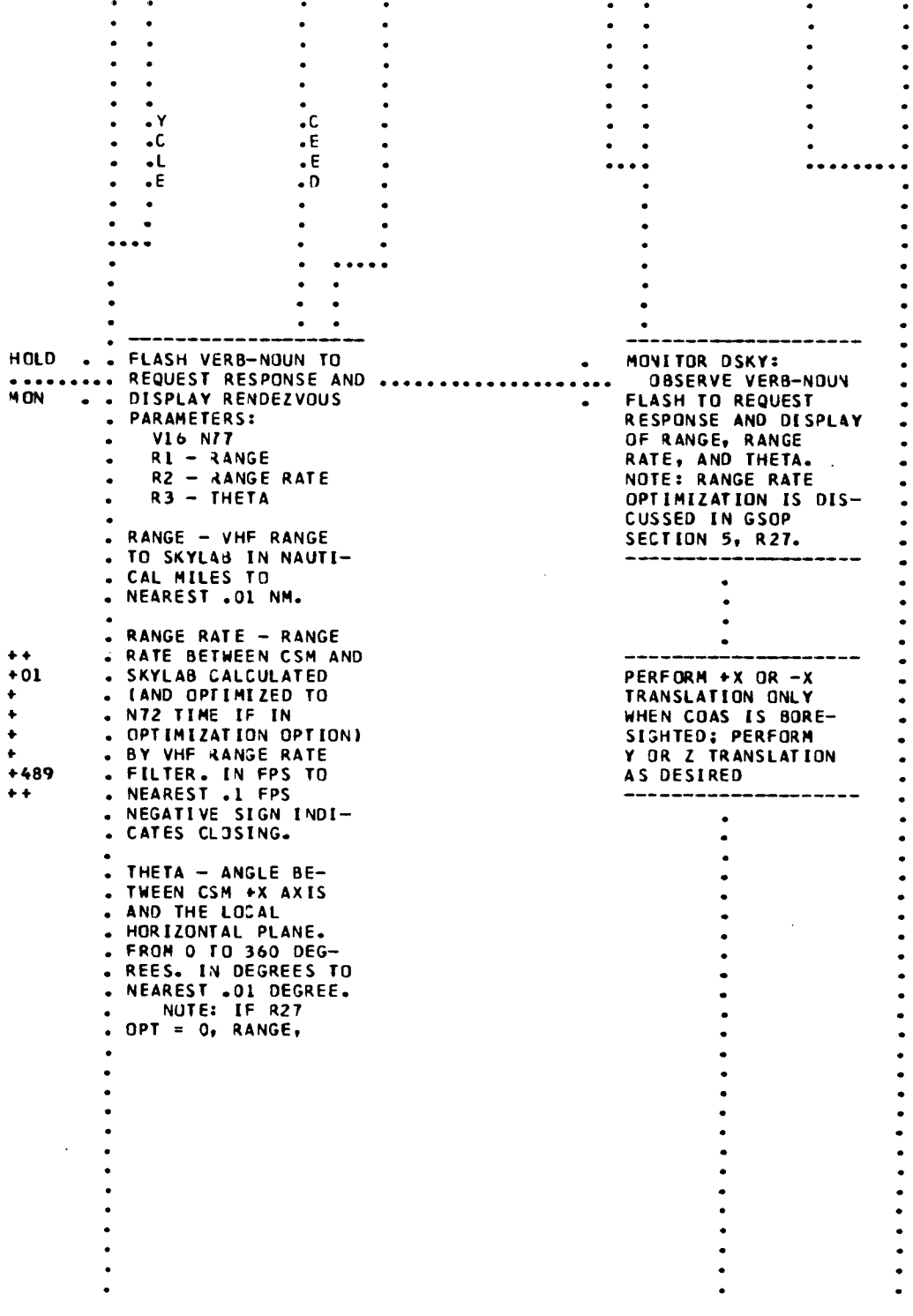
#160

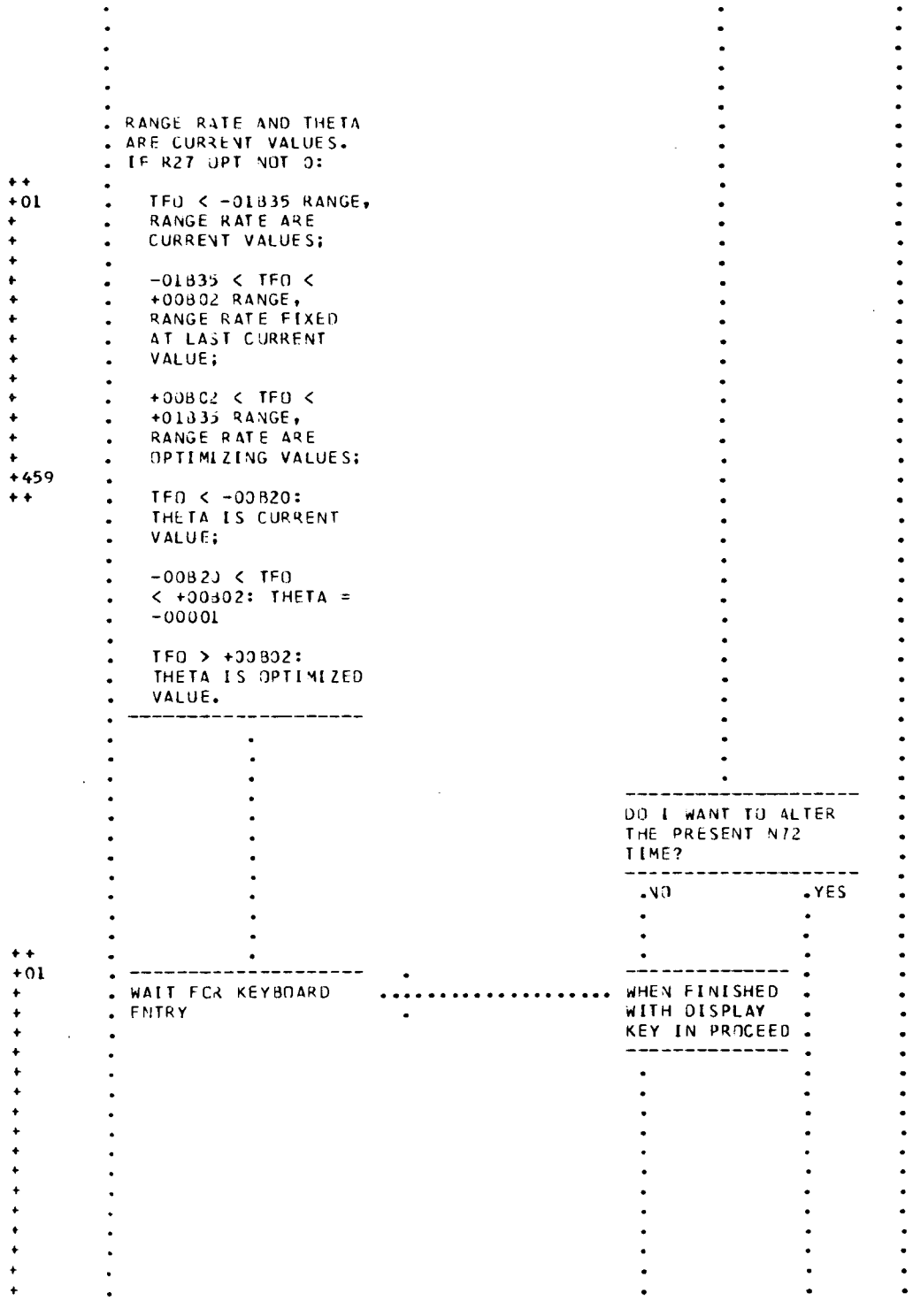
#170

#180

#190

#200


Y
C
L
E
C
E
E
D
HOLD
MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY RENDEZVOUS PARAMETERS:
V16 N77
R1 - RANGE
R2 - RANGE RATE
R3 - THETA
RANGE - VHF RANGE TO SKYLAB IN NAUTICAL MILES TO NEAREST .01 NM.
RANGE RATE - RANGE RATE BETWEEN CSM AND SKYLAB CALCULATED (AND OPTIMIZED TO N72 TIME IF IN OPTIMIZATION OPTION) BY VHF RANGE RATE FILTER. IN FPS TO NEAREST .1 FPS NEGATIVE SIGN INDICATES CLOSING.
THETA - ANGLE BETWEEN CSM +X AXIS AND THE LOCAL HORIZONTAL PLANE. FROM 0 TO 360 DEGREES. IN DEGREES TO NEAREST .01 DEGREE.
NOTE: IF R27 OPT = 0, RANGE,
++
+01
+
+
+
+489
++
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF RANGE, RANGE RATE, AND THETA.
NOTE: RANGE RATE OPTIMIZATION IS DISCUSSED IN GSOP SECTION 5, R27.
PERFORM +X OR -X TRANSLATION ONLY WHEN COAS IS BORESIGHTED; PERFORM Y OR Z TRANSLATION AS DESIRED
#210
#220
#230
#240
#250



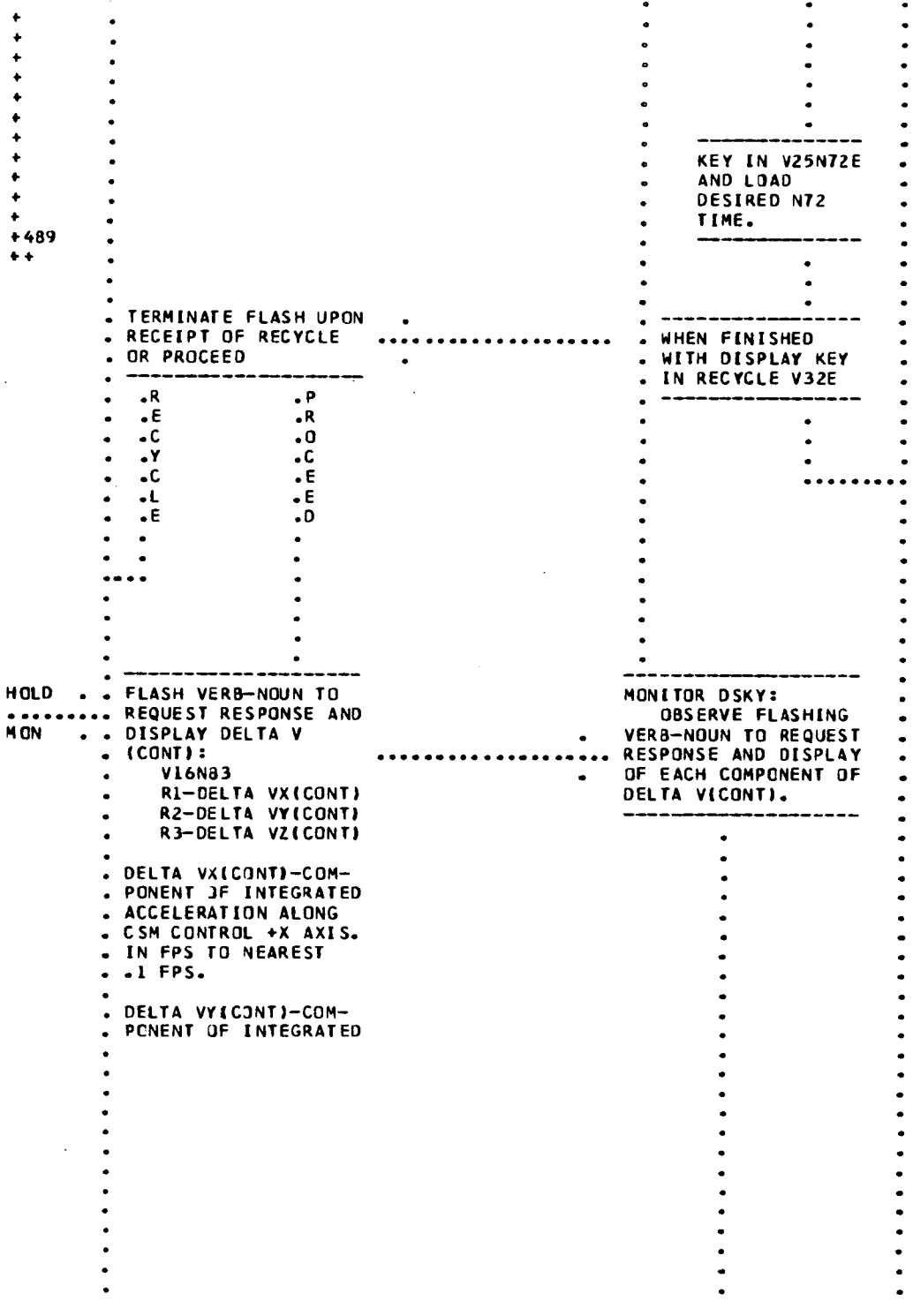
#260

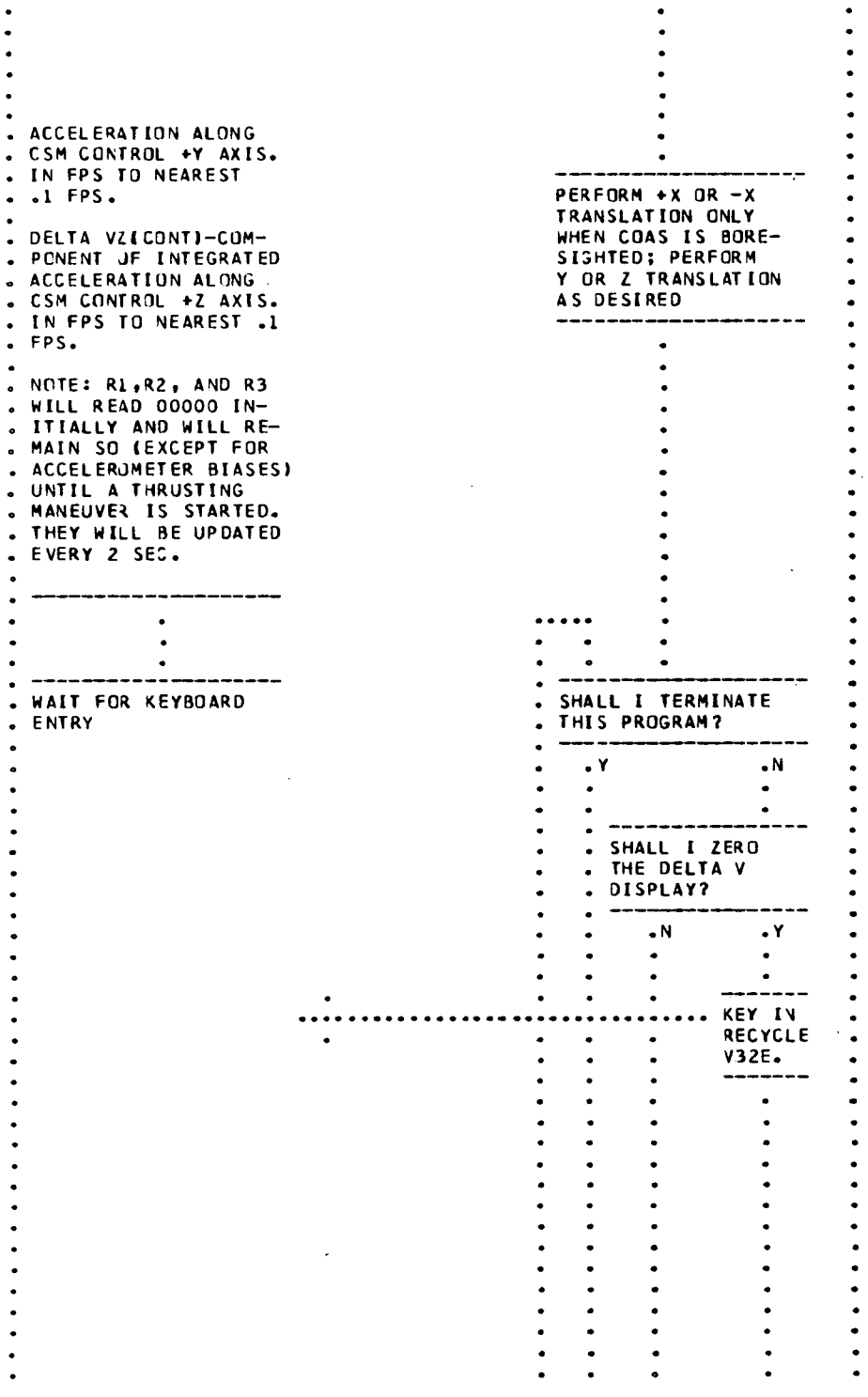
#270

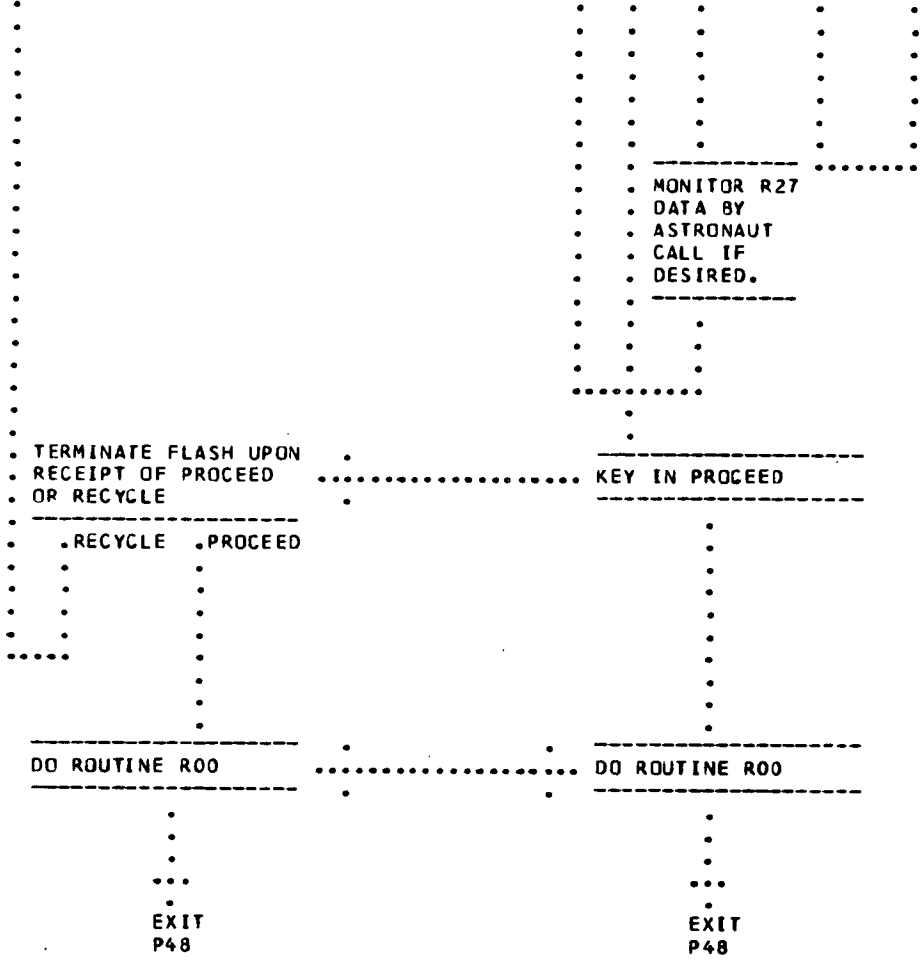
#280

#290

#300


+489
++
KEY IN V25N72E AND LOAD DESIRED N72 TIME.
#310
WHEN FINISHED WITH DISPLAY KEY IN RECYCLE V32E
TERMINATE FLASH UPON RECEIPT OF RECYCLE OR PROCEED
.R .E .C .Y .C .L .E
.P .R .O .C .E .E .D
#320
HOLD MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DELTA V (CONT):
V16N83
R1-DELTA VX(CONT)
R2-DELTA VY(CONT)
R3-DELTA VZ(CONT)
MONITOR DSKY:
OBSERVE FLASHING VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OF EACH COMPONENT OF DELTA V(CONT).
#330
DELTA VX(CONT)-COMPONENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +X AXIS. IN FPS TO NEAREST .1 FPS.
#340
DELTA VY(CONT)-COMPONENT OF INTEGRATED


ACCELERATION ALONG CSM CONTROL +Y AXIS. IN FPS TO NEAREST .1 FPS.
DELTA VZ(CONT)-COMPONENT OF INTEGRATED ACCELERATION ALONG CSM CONTROL +Z AXIS. IN FPS TO NEAREST .1 FPS.
NOTE: R1,R2, AND R3 WILL READ 00000 INITIALLY AND WILL REMAIN SO (EXCEPT FOR ACCELEROMETER BIASES) UNTIL A THRUSTING MANEUVER IS STARTED. THEY WILL BE UPDATED EVERY 2 SEC.
WAIT FOR KEYBOARD ENTRY
PERFORM +X OR -X TRANSLATION ONLY WHEN COAS IS BORESIGHTED; PERFORM Y OR Z TRANSLATION AS DESIRED
#350
#360
#370
SHALL I TERMINATE THIS PROGRAM?
Y
N
#380
SHALL I ZERO THE DELTA V DISPLAY?
N
Y
KEY IN RECYCLE V32E.
#390



CHANGE CONTROL NOTES

REV 00 PCR 025,032, SKYLARK MEMOS #3,19
REV 01 PCR 459, PCN 489

ATM ORIENTATION DETERMINATION PROGRAM (P50) REV 01 03/20/72

PURPOSE: (1) TO COMPUTE AND STORE THE ORIENTATION OF THE APOLLO TELESCOPE MOUNT SENSOR COORDINATE SYSTEM WITH RESPECT TO THE NAVIGATION BASE COORDINATE SYSTEM.

(2) TO COMPUTE AND DISPLAY THE DOCKING ANGLES CORRESPONDING TO THIS ORIENTATION.

ASSUMPTIONS: (1) THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY.

(2) THE +Z AXIS OF THE ATM SENSOR COORDINATE SYSTEM POINTS IN THE SAME DIRECTION AS THE SUN SENSOR. THE -Y AXIS OF THE ATM SENSOR COORDINATE SYSTEM POINTS IN THE SAME DIRECTION AS THE STAR TRACKER WHEN STAR TRACKER GIMBAL ANGLES ARE ZERO.

(3) THREE OPTIONS ARE AVAILABLE:

(A) OPTION 1 - ATM SUN SENSOR AND IMU ORIENTATION ARE USED TO DETERMINE ATM SENSOR ORIENTATION

(B) OPTION 2 - ATM SUN SENSOR, ATM STAR TRACKER, AND IMU ORIENTATION ARE USED TO DETERMINE ATM SENSOR ORIENTATION

(C) OPTION 3 - INDEPENDENT SOURCE IS USED TO DETERMINE ATM ORIENTATION

(4) ATM MUST BE IN SOLAR INERTIAL ATTITUDE FOR OPTIONS 1 AND 2.

(5) ASTRONAUT MUST RECORD STAR TRACKER GIMBAL ANGLES AT TIME OF MARK IN OPTION 2. THESE ARE USED AS INPUT (N14) LATER IN PROGRAM.

(6) IMU MUST BE ON AND ALIGNED FOR OPTIONS 1 AND 2.

(7) STAR TRACKER MUST BE LOCKED ON TO CELESTIAL BODY FOR OPTION 2.

(8) THE ASTRONAUT IDENTIFIES THE CELESTIAL BODY ACQUIRED BY THE STAR TRACKER. SUN AND EARTH ARE NOT VALID CELESTIAL BODIES FOR THE STAR TRACKER.

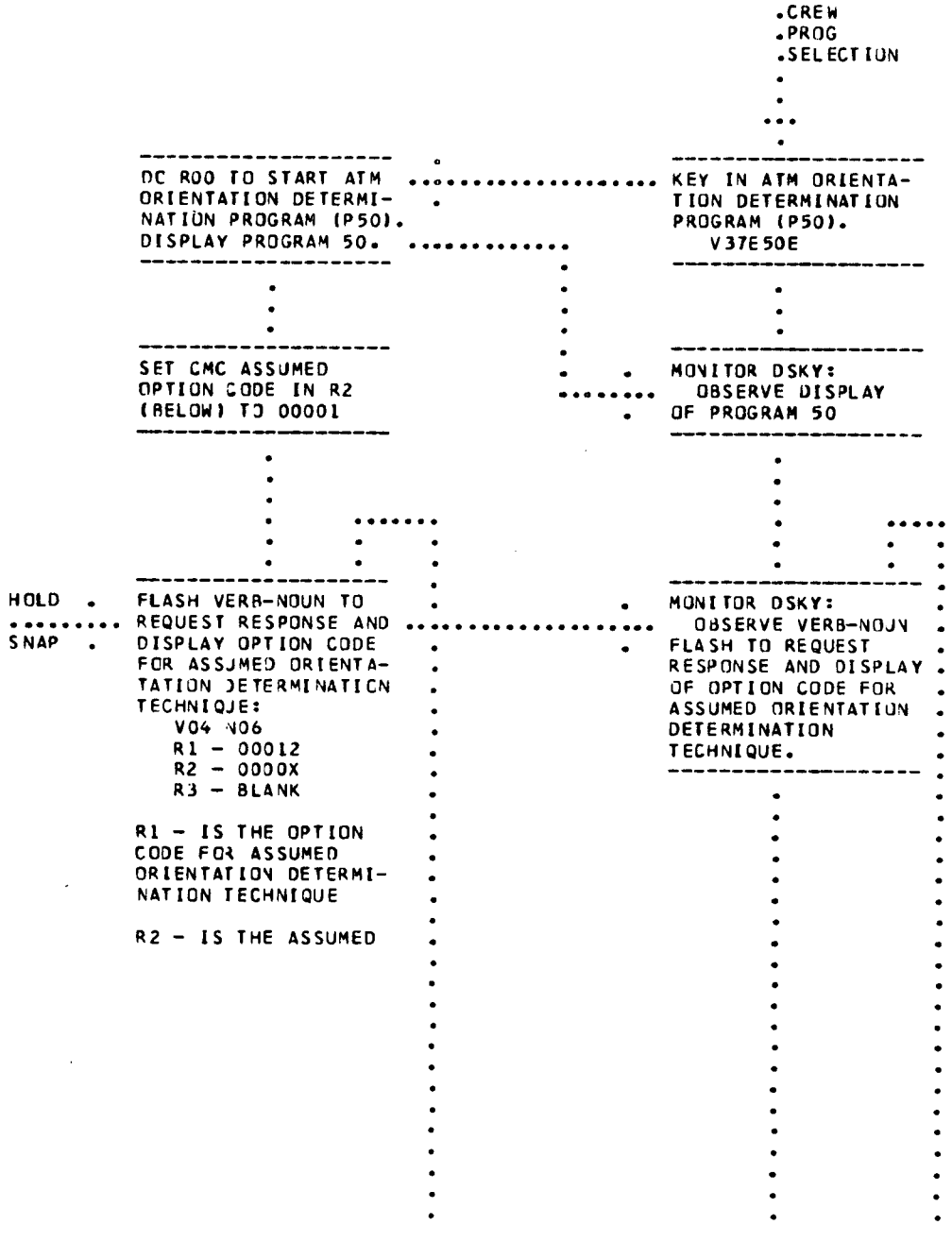
(9) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

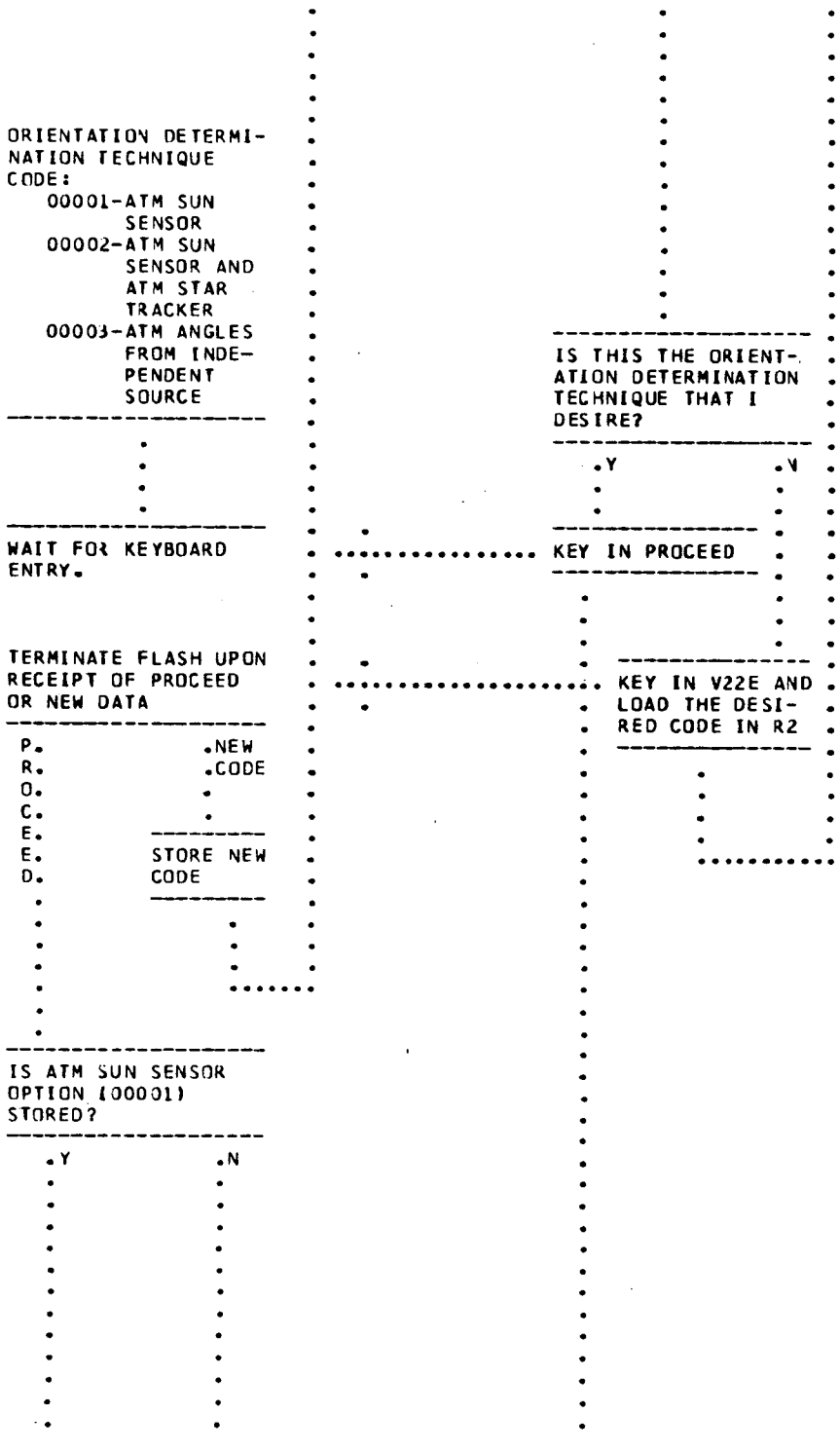
(10) THE ASTRONAUT HAS THE OPTION TO UPDATE OR NOT UPDATE THE CURRENTLY STORED ATM SENSOR ORIENTATION. OPTION 3 MAY BE USED TO DISPLAY CURRENT ATM SENSOR ORIENTATION.

(11) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG	CMC	GROUND	CREW

CONT


.CREW
.PROG
.SELECTION
DC R00 TO START ATM ORIENTATION DETERMI-NATION PROGRAM (P50). DISPLAY PROGRAM 50.
KEY IN ATM ORIENTA-TION DETERMINATION PROGRAM (P50). V37E50E
#10
SET CMC ASSUMED OPTION CODE IN R2 (BELOW) TO 00001
MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 50
#20
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTION CODE FOR ASSUMED ORIENTA-TATION DETERMINATION TECHNIQUE:
V04 N06
R1 - 00012
R2 - 0000X
R3 - BLANK
R1 - IS THE OPTION CODE FOR ASSUMED ORIENTATION DETERMI-NATION TECHNIQUE
R2 - IS THE ASSUMED
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF OPTION CODE FOR ASSUMED ORIENTATION DETERMINATION TECHNIQUE.
#30
#40


ORIENTATION DETERMI-
NATION TECHNIQUE
CODE:
00001-ATM SUN
SENSOR
00002-ATM SUN
SENSOR AND
ATM STAR
TRACKER
00003-ATM ANGLES
FROM INDE-
PENDENT
SOURCE
IS THIS THE ORIENT-
ATION DETERMINATION
TECHNIQUE THAT I
DESIRE?
.Y
.N
WAIT FOR KEYBOARD
ENTRY.
KEY IN PROCEED
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA
P.
R.
O.
C.
E.
E.
D.
.NEW
.CODE
STORE NEW
CODE
KEY IN V22E AND
LOAD THE DESI-
RED CODE IN R2
IS ATM SUN SENSOR
OPTION (00001)
STORED?
.Y
.N

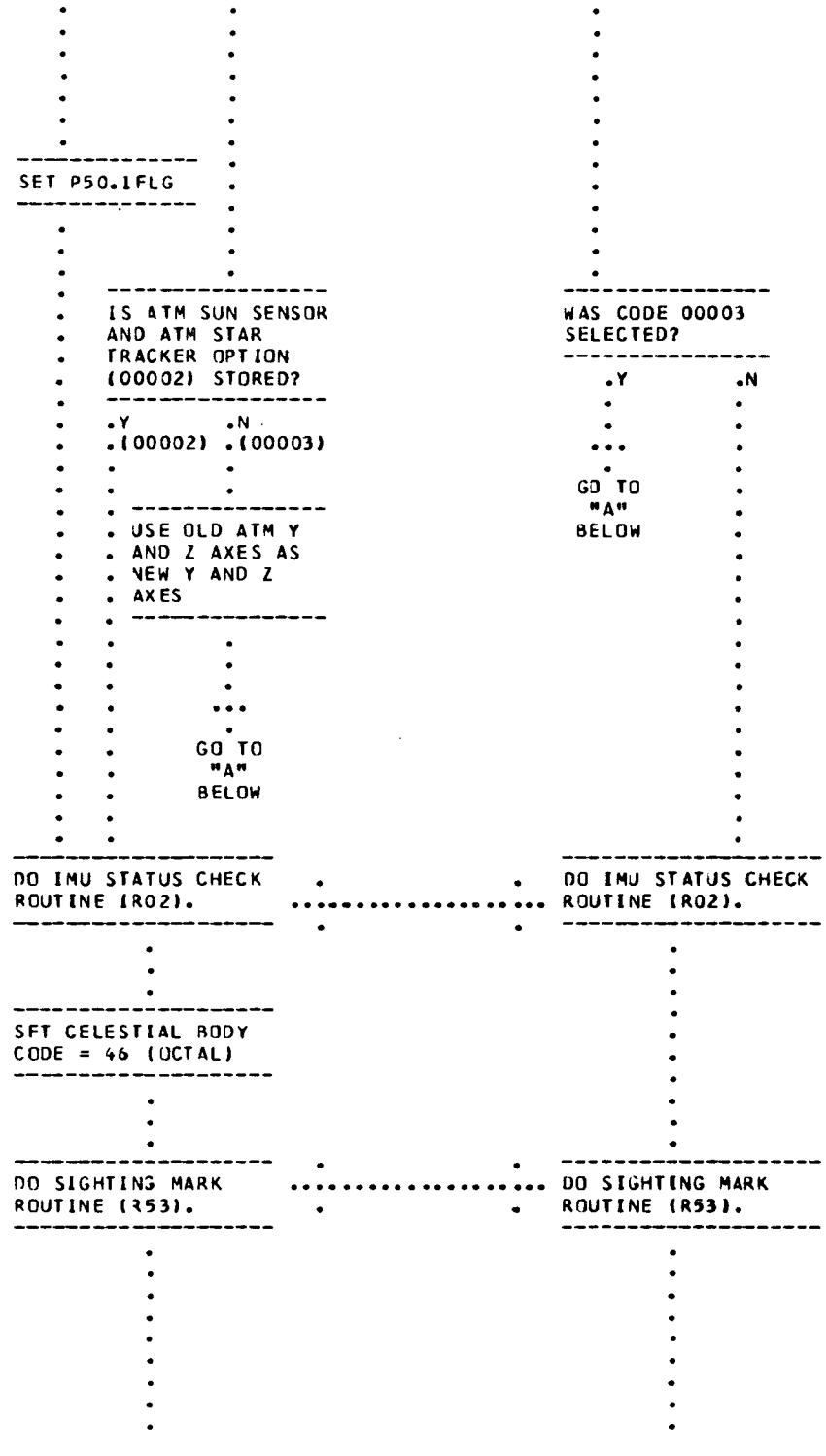
#50

#60

#70

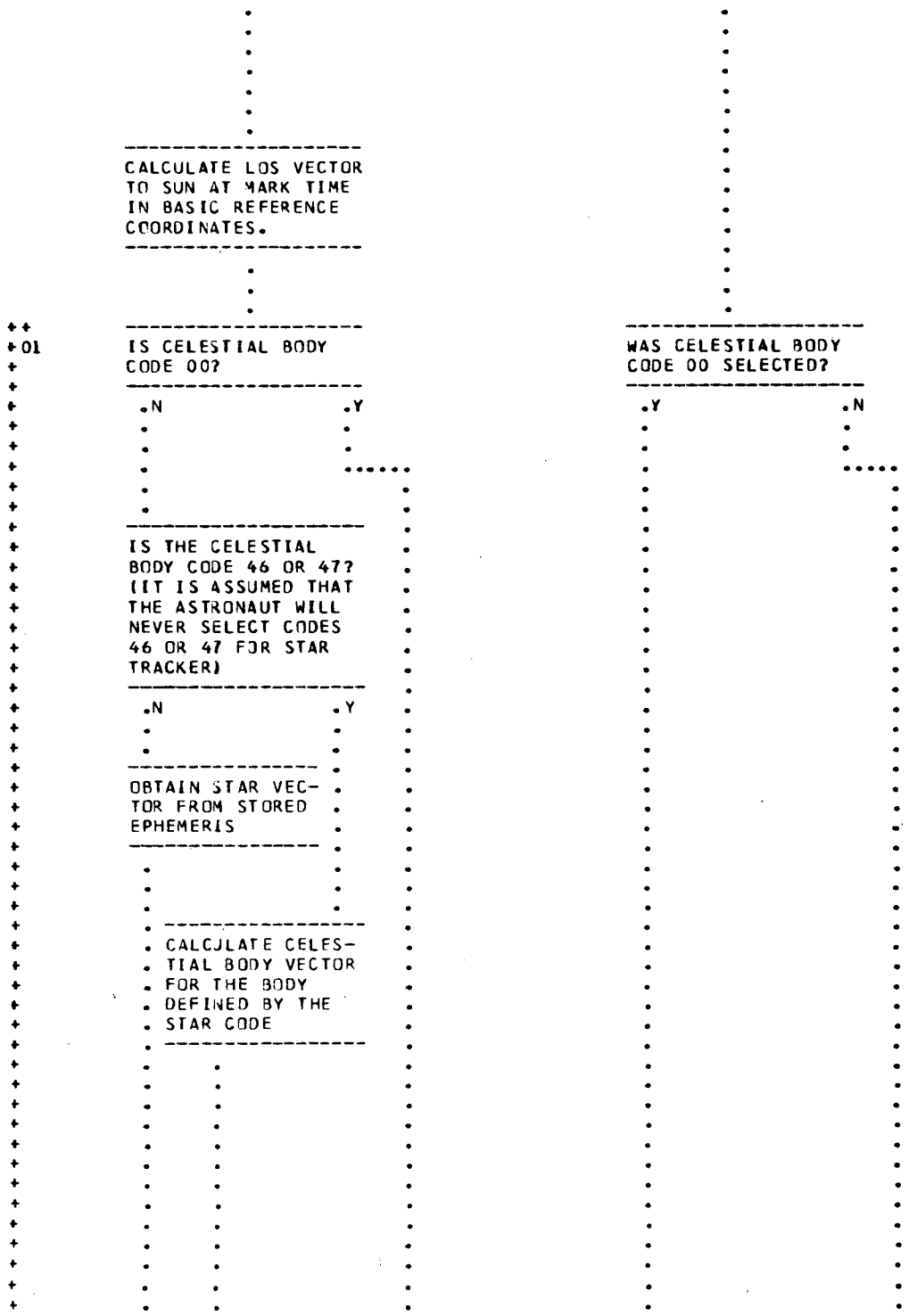
#80

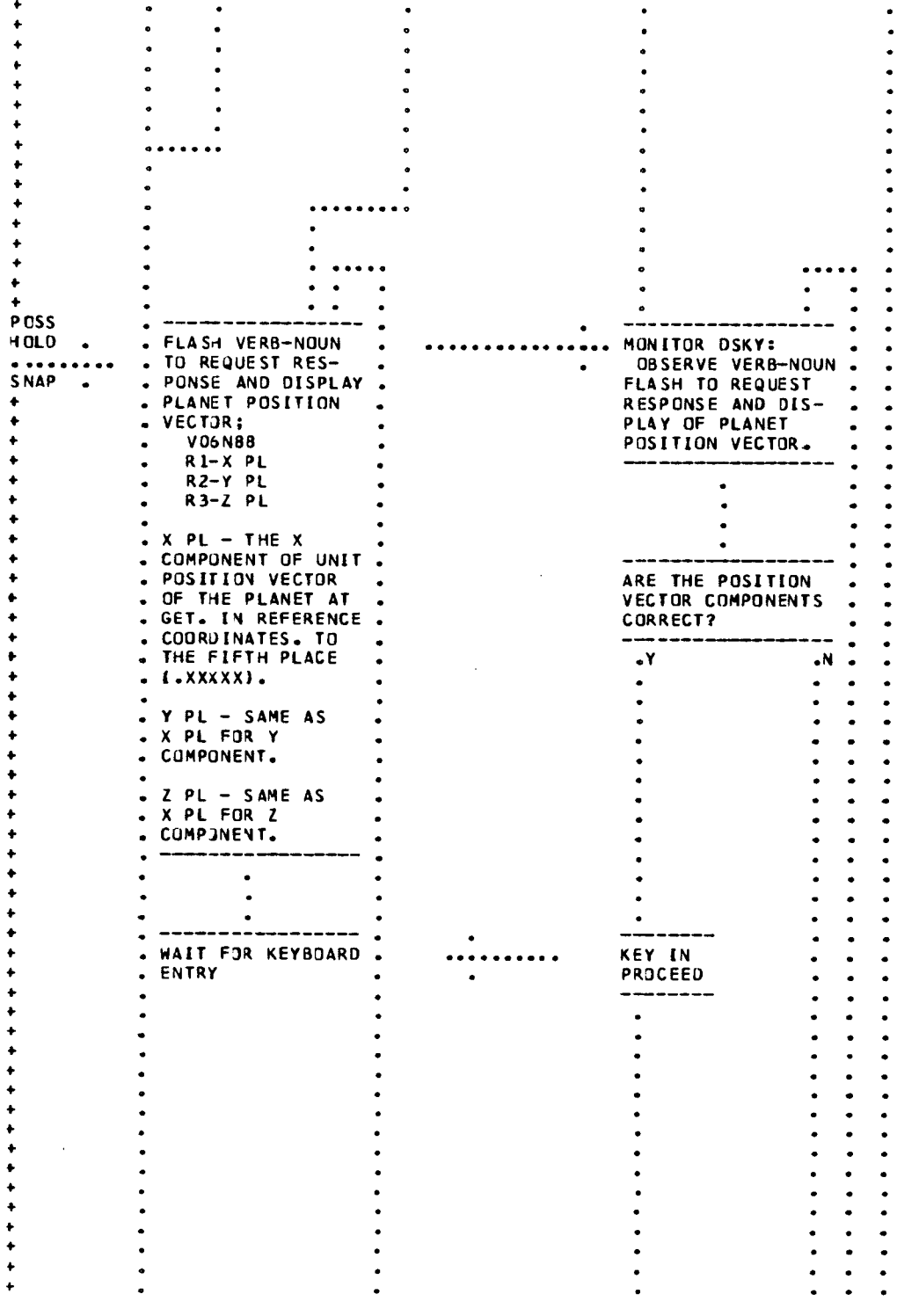
#90



++
+01
+
+489
++

#100
#110
#120
#130
#140


CALCULATE LOS VECTOR TO SUN AT MARK TIME IN BASIC REFERENCE COORDINATES.
#150
IS CELESTIAL BODY CODE 00?
.N
.Y
WAS CELESTIAL BODY CODE 00 SELECTED?
.Y
.N
#160
IS THE CELESTIAL BODY CODE 46 OR 47? (IT IS ASSUMED THAT THE ASTRONAUT WILL NEVER SELECT CODES 46 OR 47 FOR STAR TRACKER)
.N
.Y
#170
OBTAIN STAR VECTOR FROM STORED EPHEMERIS
#180
CALCULATE CELESTIAL BODY VECTOR FOR THE BODY DEFINED BY THE STAR CODE
#190



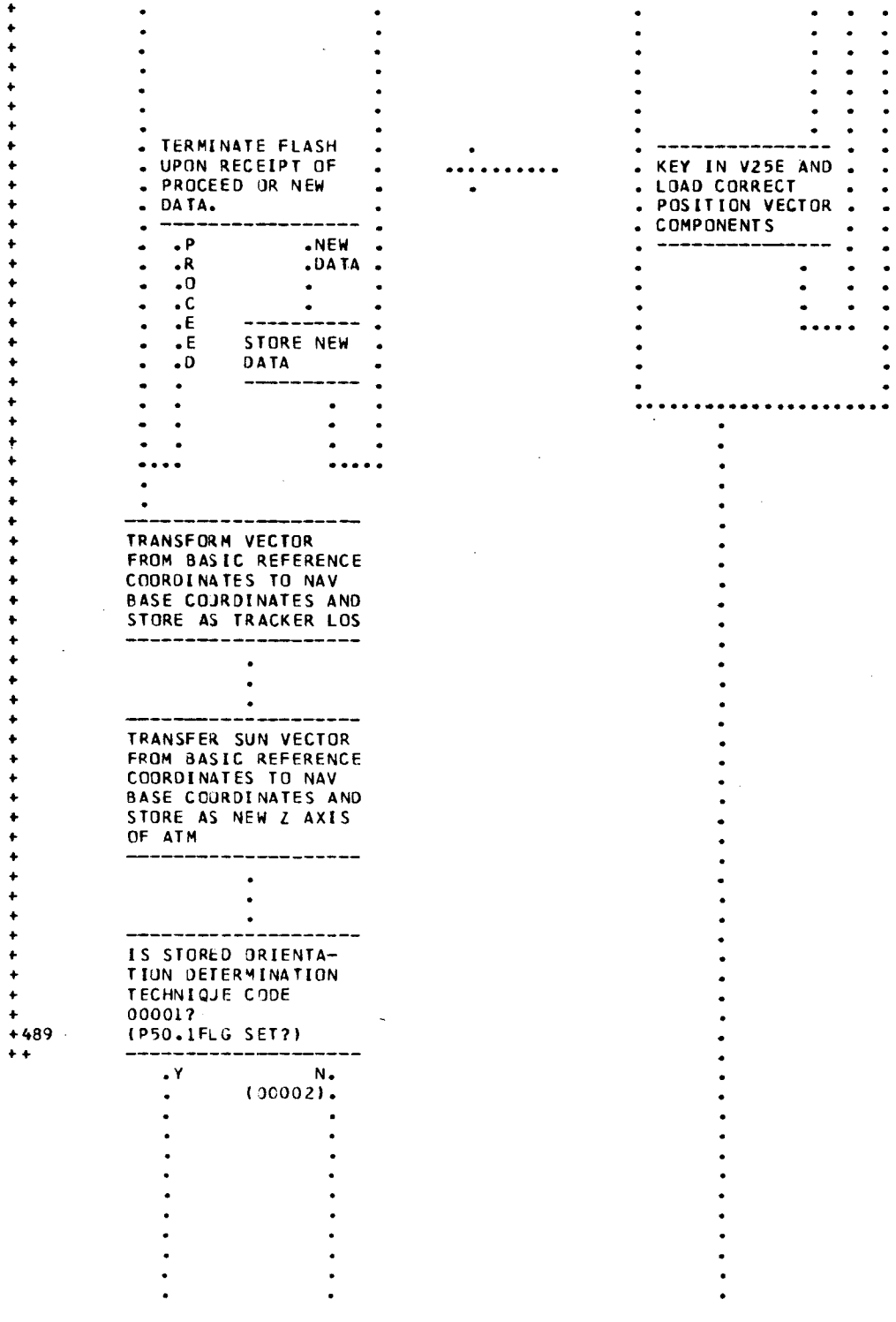
#200

#210

#220

#230

#240



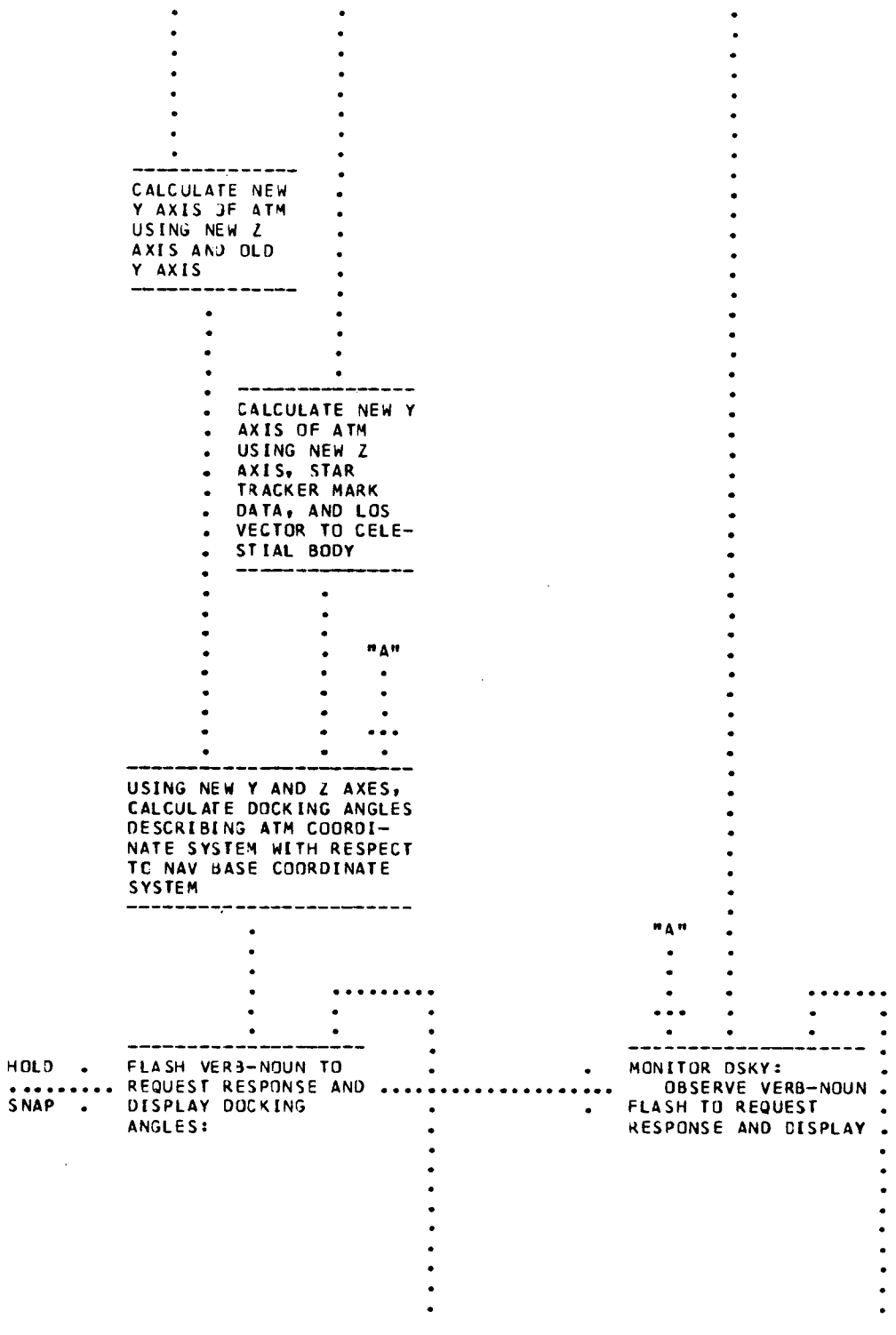
#250

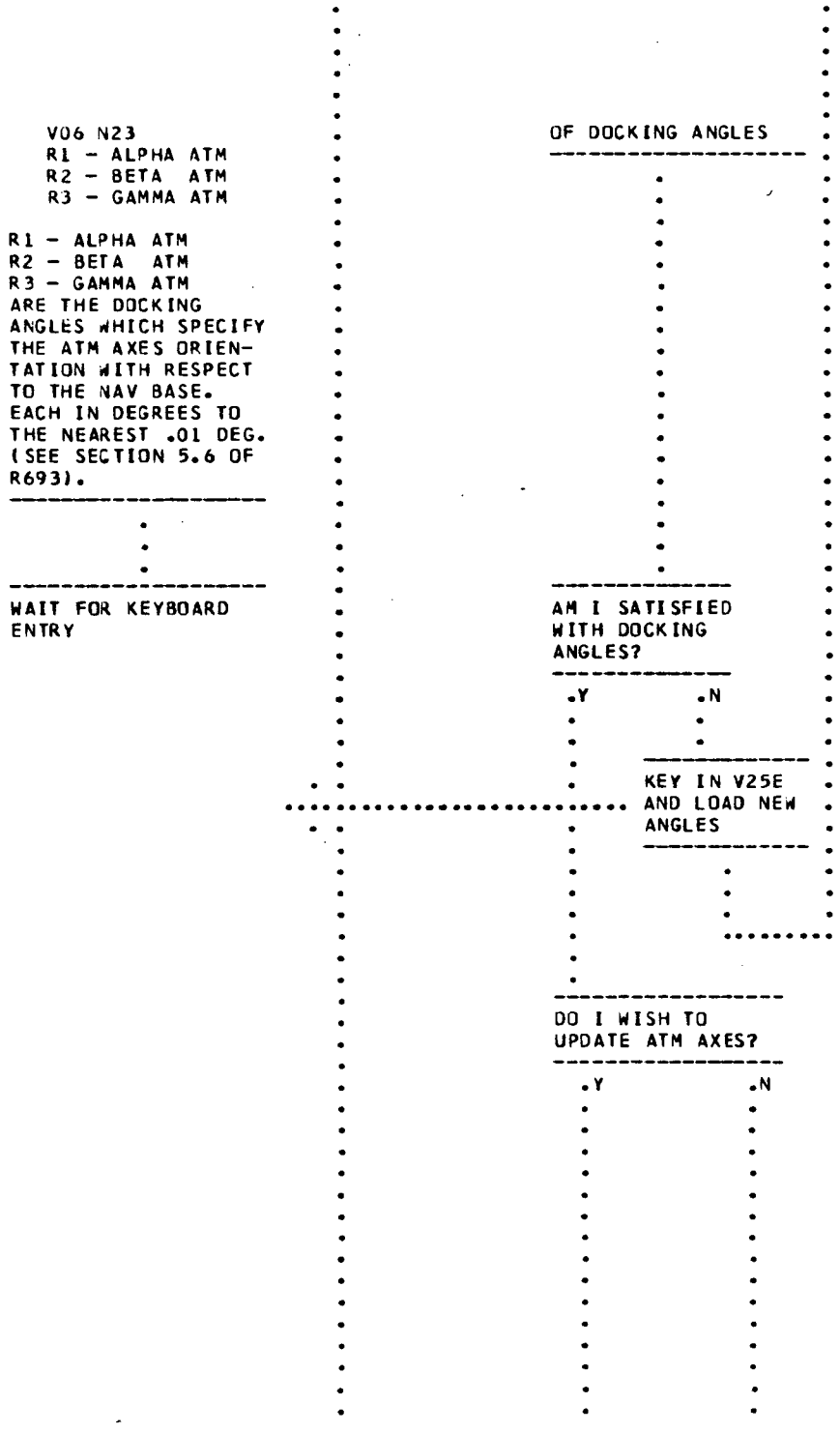
#260

#270

#280

#290


CALCULATE NEW Y AXIS OF ATM USING NEW Z AXIS AND OLD Y AXIS
#300
CALCULATE NEW Y AXIS OF ATM USING NEW Z AXIS, STAR TRACKER MARK DATA, AND LOS VECTOR TO CELESTIAL BODY
#310
"A"
#320
USING NEW Y AND Z AXES, CALCULATE DOCKING ANGLES DESCRIBING ATM COORDINATE SYSTEM WITH RESPECT TO NAV BASE COORDINATE SYSTEM
#330
"A"
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DOCKING ANGLES:
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY
#340



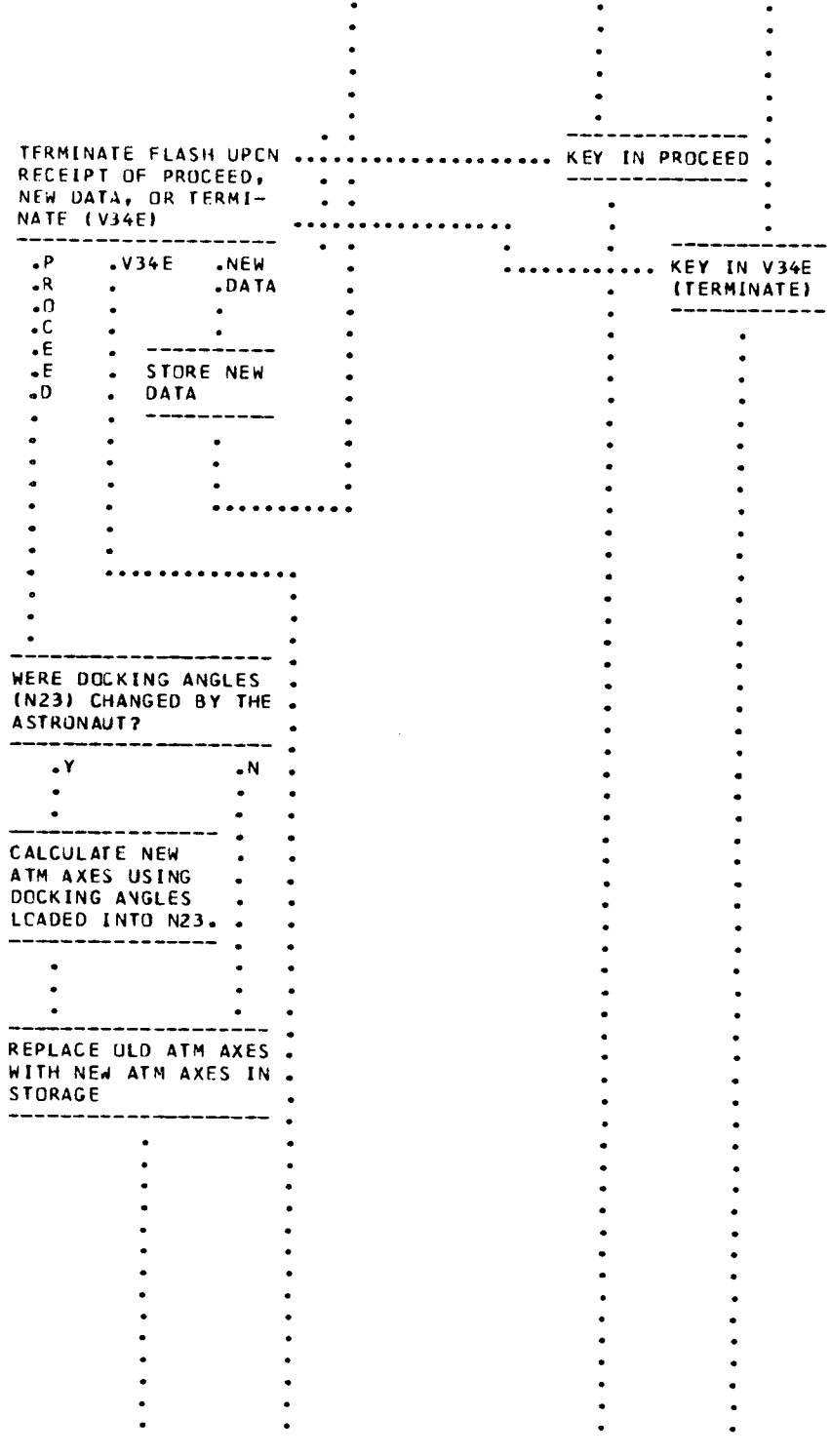
#350

#360

#370

#380

#390



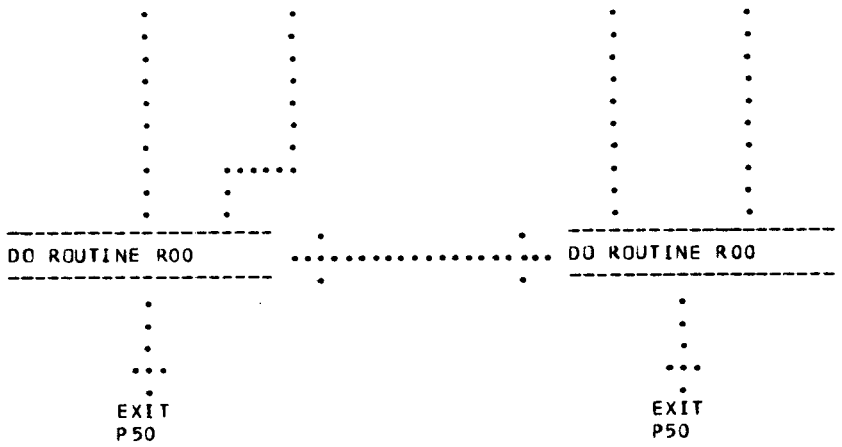
#400

#410

#420

#430

#440



#450

CHANGE CONTROL NOTES

REV 00 PCR 413,434
REV 01 PCN 489

IMU ORIENTATION DETERMINATION PROGRAM (P51) REV 01 03/20/72

PURPOSE: (1) TO DETERMINE THE INERTIAL ORIENTATION OF THE IMU USING SIGHTINGS ON TWO CELESTIAL BODIES USING THE SCANNING TELESCOPE, THE SEXTANT, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

ASSUMPTIONS: (1) THE IMU MAY BE:

(A) OFF (STANDBY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED.
IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED.

(2) THERE ARE NO RESTRAINTS UPON THE CSM ATTITUDE CONTROL MODES IN THIS PROGRAM.

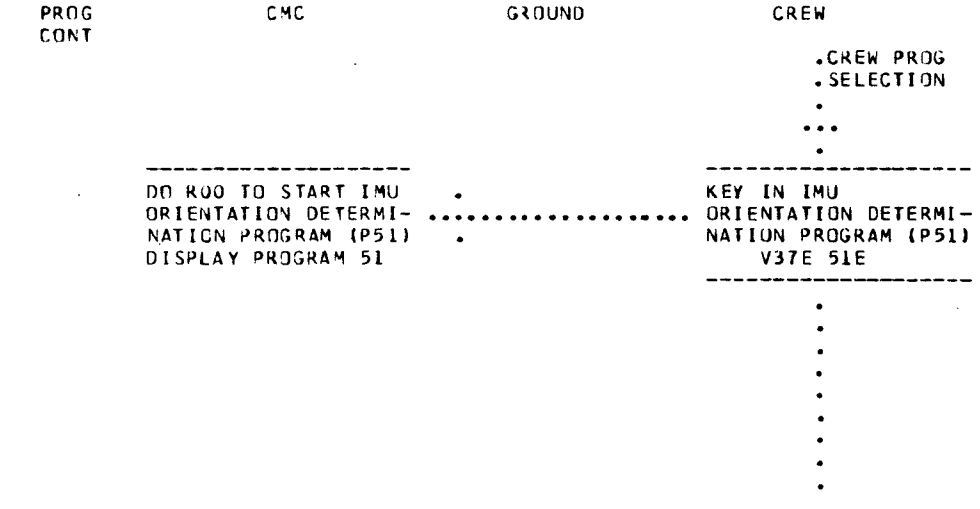
(3) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS.

(4) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

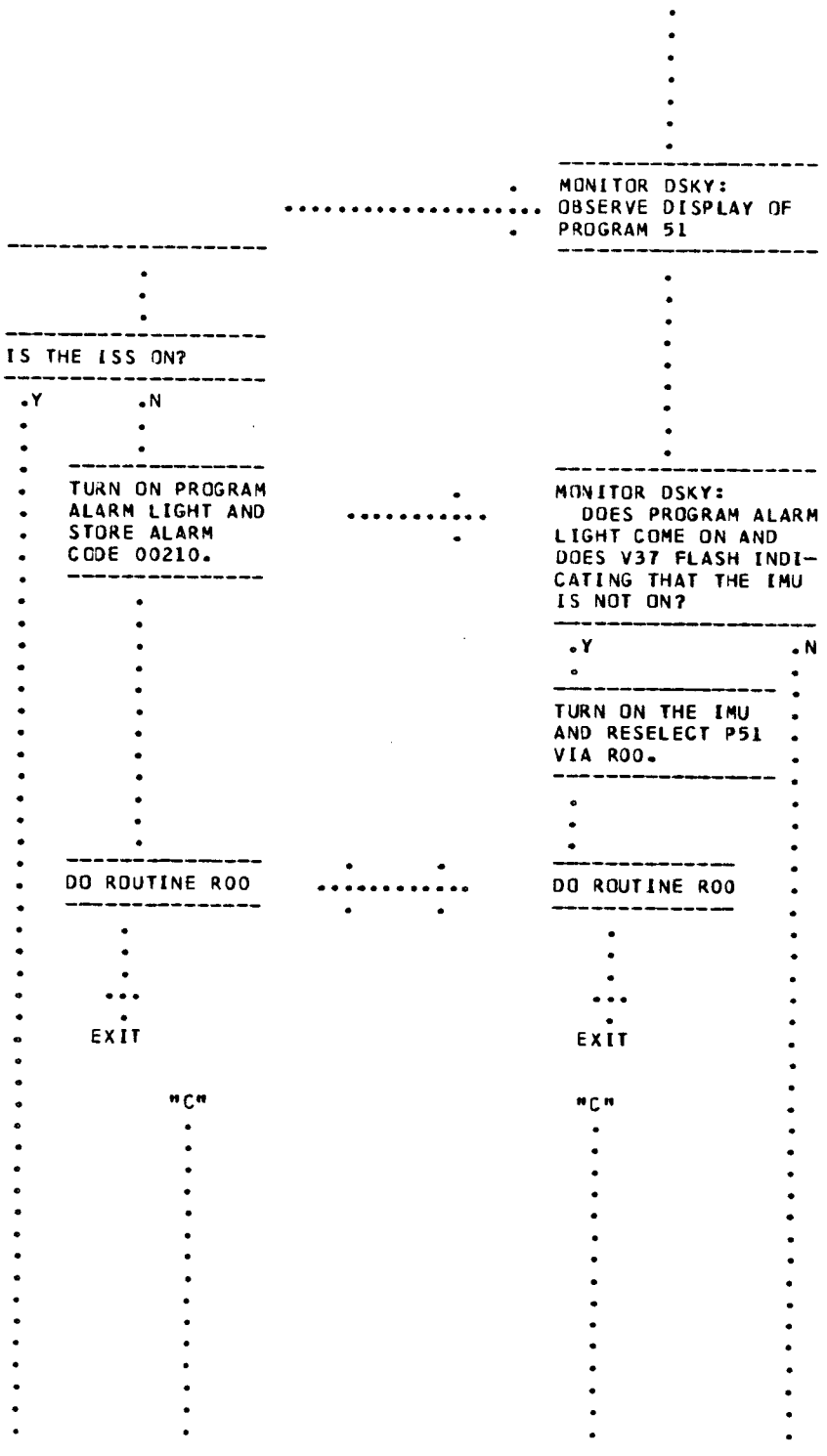
(5) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



#10


MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 51
IS THE ISS ON?
.Y
.N
TURN ON PROGRAM
ALARM LIGHT AND
STORE ALARM
CODE 00210.
DO ROUTINE R00
EXIT
"C"
MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON AND
DOES V37 FLASH INDI-
CATING THAT THE IMU
IS NOT ON?
.Y
.N
TURN ON THE IMU
AND RESELECT P51
VIA R00.
DO ROUTINE R00
EXIT
"C"

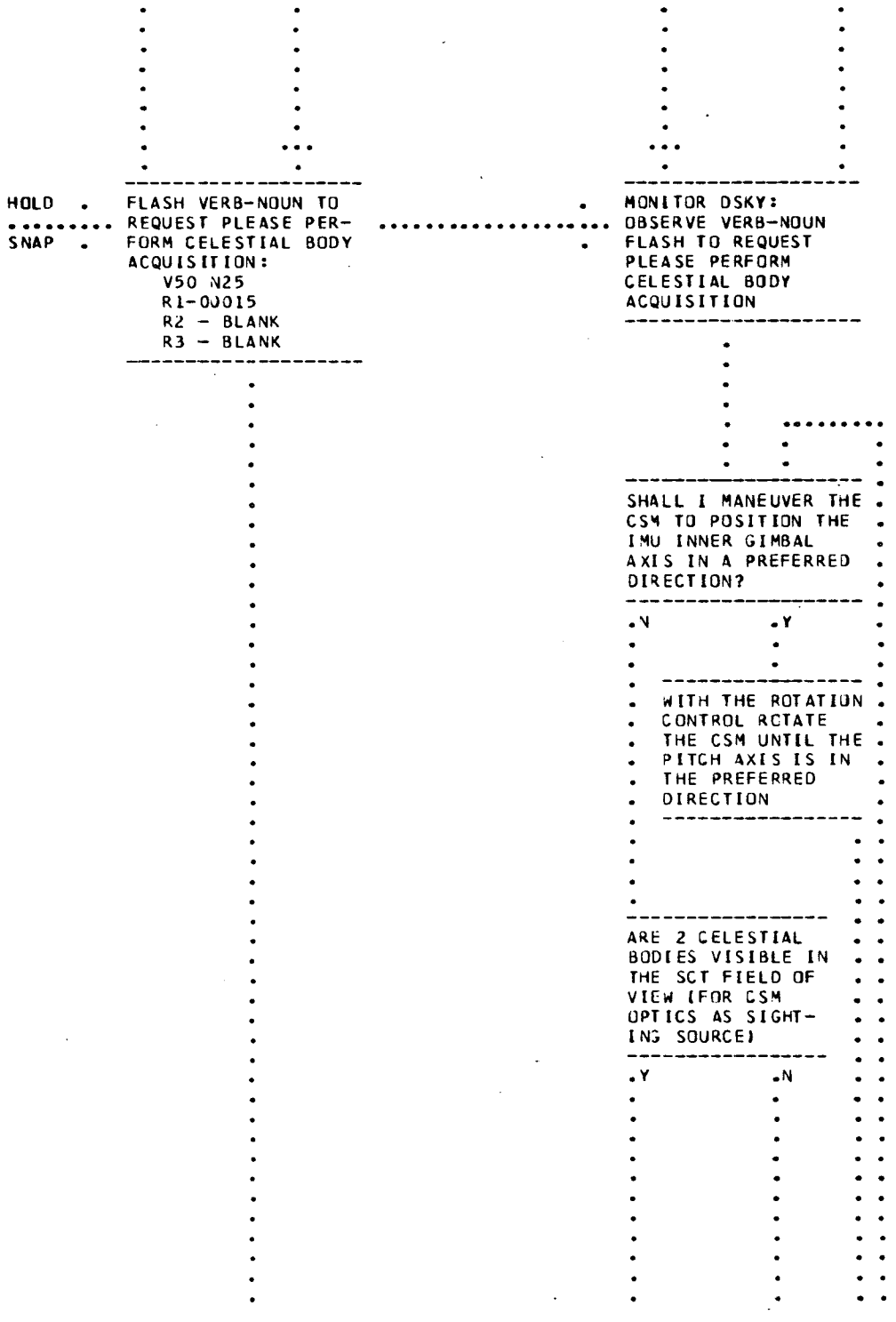
#20

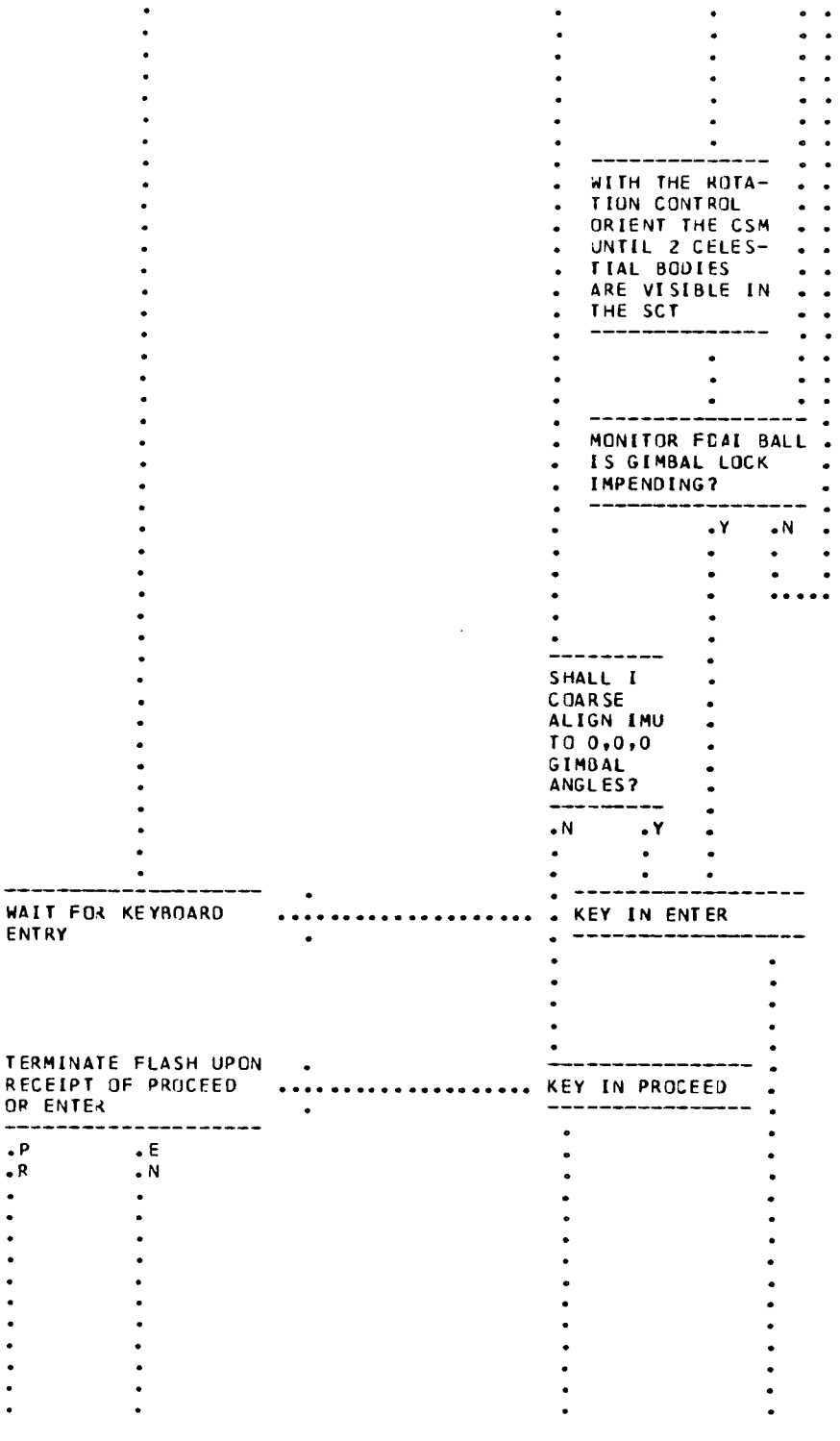
#30

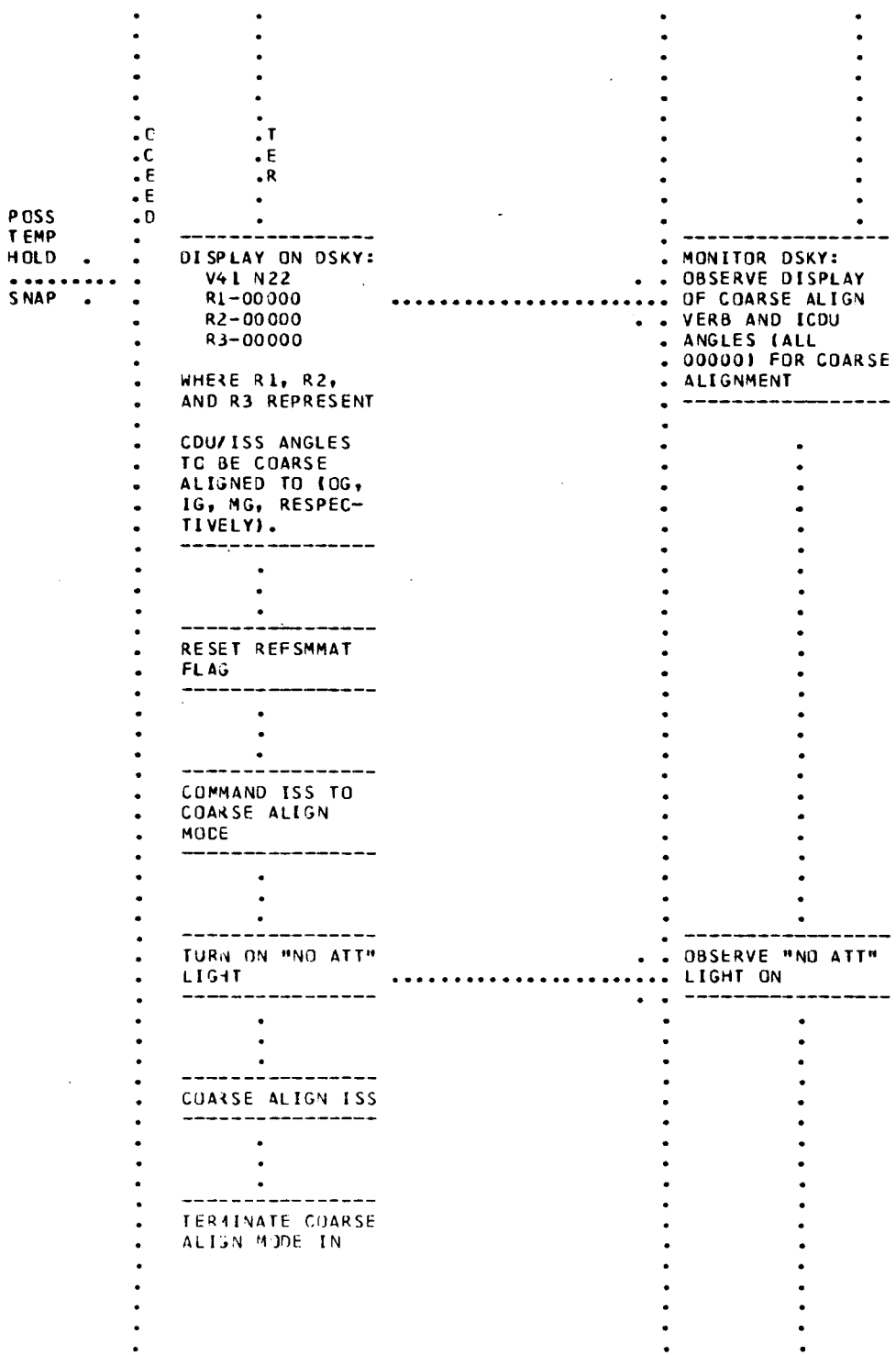
#40

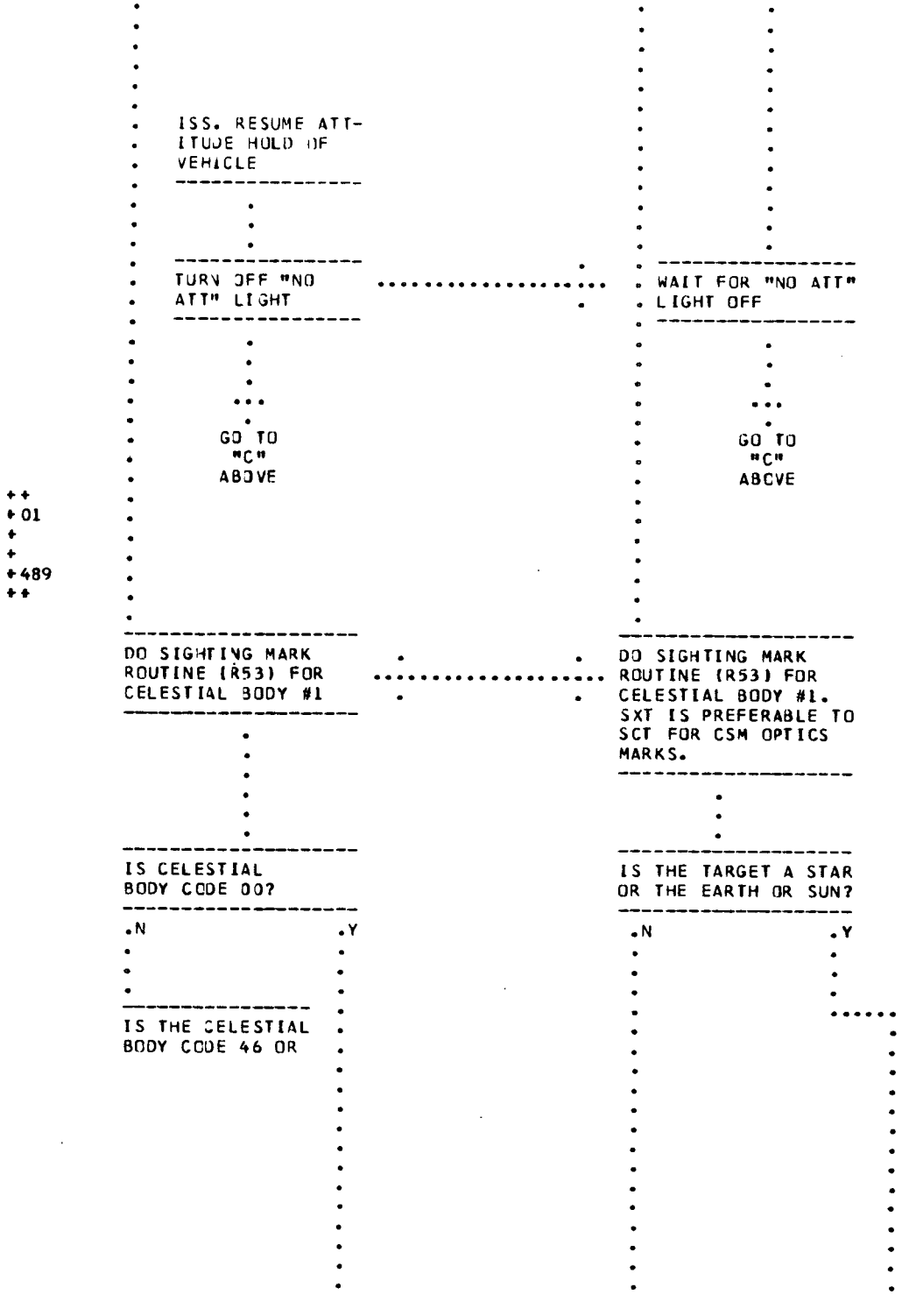
#50

#60


HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM CELESTIAL BODY ACQUISITION:
V50 N25
R1-00015
R2 - BLANK
R3 - BLANK
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM CELESTIAL BODY ACQUISITION
#70
SHALL I MANEUVER THE CSM TO POSITION THE IMU INNER GIMBAL AXIS IN A PREFERRED DIRECTION?
#80
N
Y
WITH THE ROTATION CONTROL RCTATE THE CSM UNTIL THE PITCH AXIS IS IN THE PREFERRED DIRECTION
#90
#100
ARE 2 CELESTIAL BODIES VISIBLE IN THE SCT FIELD OF VIEW (FOR CSM OPTICS AS SIGHTING SOURCE)
Y
N
#110


WITH THE ROTATION CONTROL ORIENT THE CSM UNTIL 2 CELESTIAL BODIES ARE VISIBLE IN THE SCT
#120
MONITOR FDAI BALL
IS GIMBAL LOCK IMPENDING?
.Y
.N
#130
SHALL I COARSE ALIGN IMU TO 0,0,0 GIMBAL ANGLES?
#140
.N
.Y
WAIT FOR KEYBOARD ENTRY
KEY IN ENTER
#150
TERMINATE FLASH UPON RECEIPT OF PROCEED OR ENTER
KEY IN PROCEED
.P
.R
.E
.N


CCEED
POSS TEMP HOLD
SNAP
TER
DISPLAY ON DSKY:
V41 N22
R1-00000
R2-00000
R3-00000
WHERE R1, R2, AND R3 REPRESENT
CDU/ISS ANGLES TO BE COARSE ALIGNED TO (OG, IG, MG, RESPECTIVELY).
RESET REFSMMAT FLAG
COMMAND ISS TO COARSE ALIGN MODE
TURN ON "NO ATT" LIGHT
COARSE ALIGN ISS
TERMINATE COARSE ALIGN MODE IN
MONITOR DSKY:
OBSERVE DISPLAY OF COARSE ALIGN VERB AND ICDU ANGLES (ALL 00000) FOR COARSE ALIGNMENT
OBSERVE "NO ATT" LIGHT ON
#160
#170
#180
#190
#200
#210



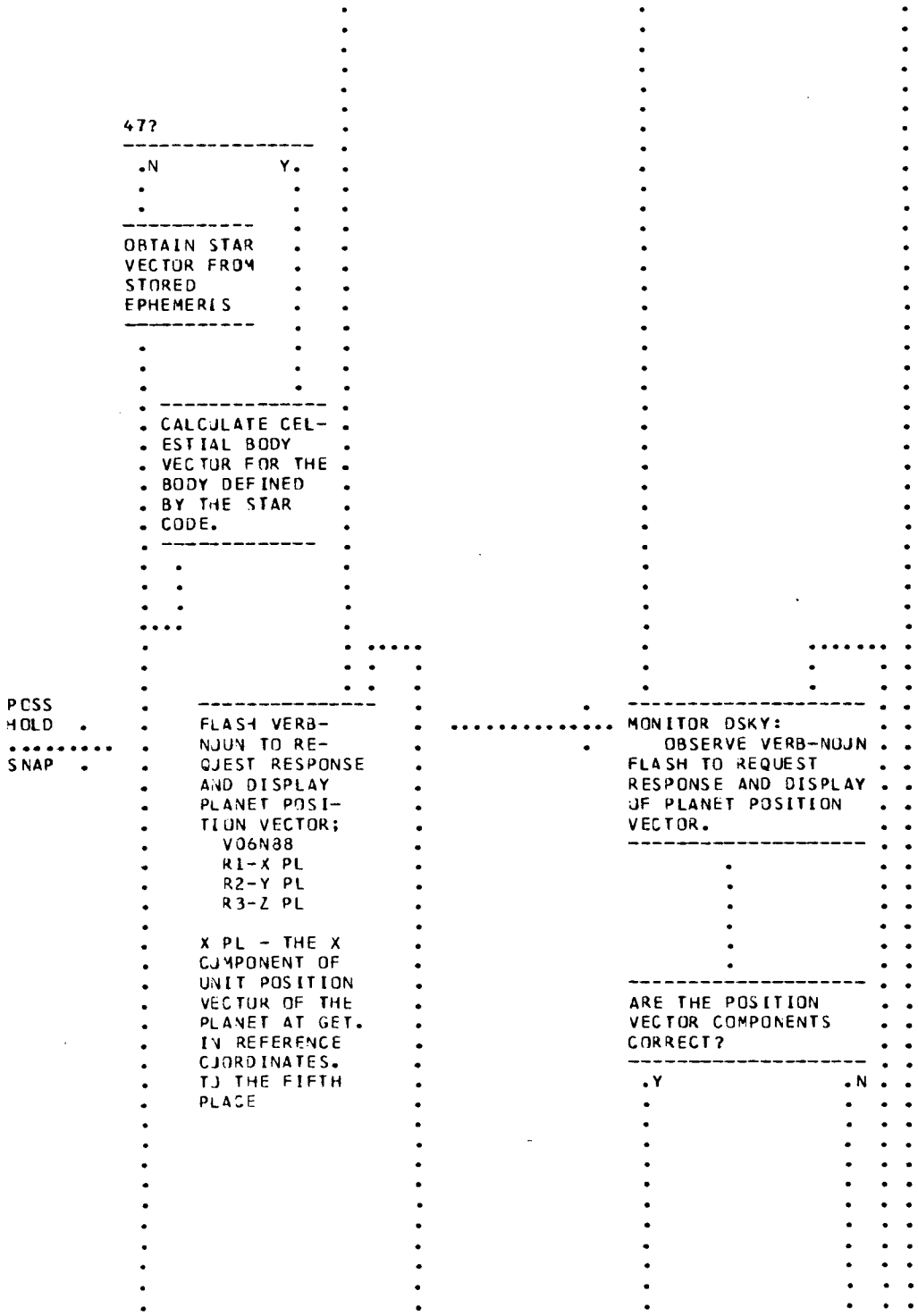
#220

#230

#240

#250

#260



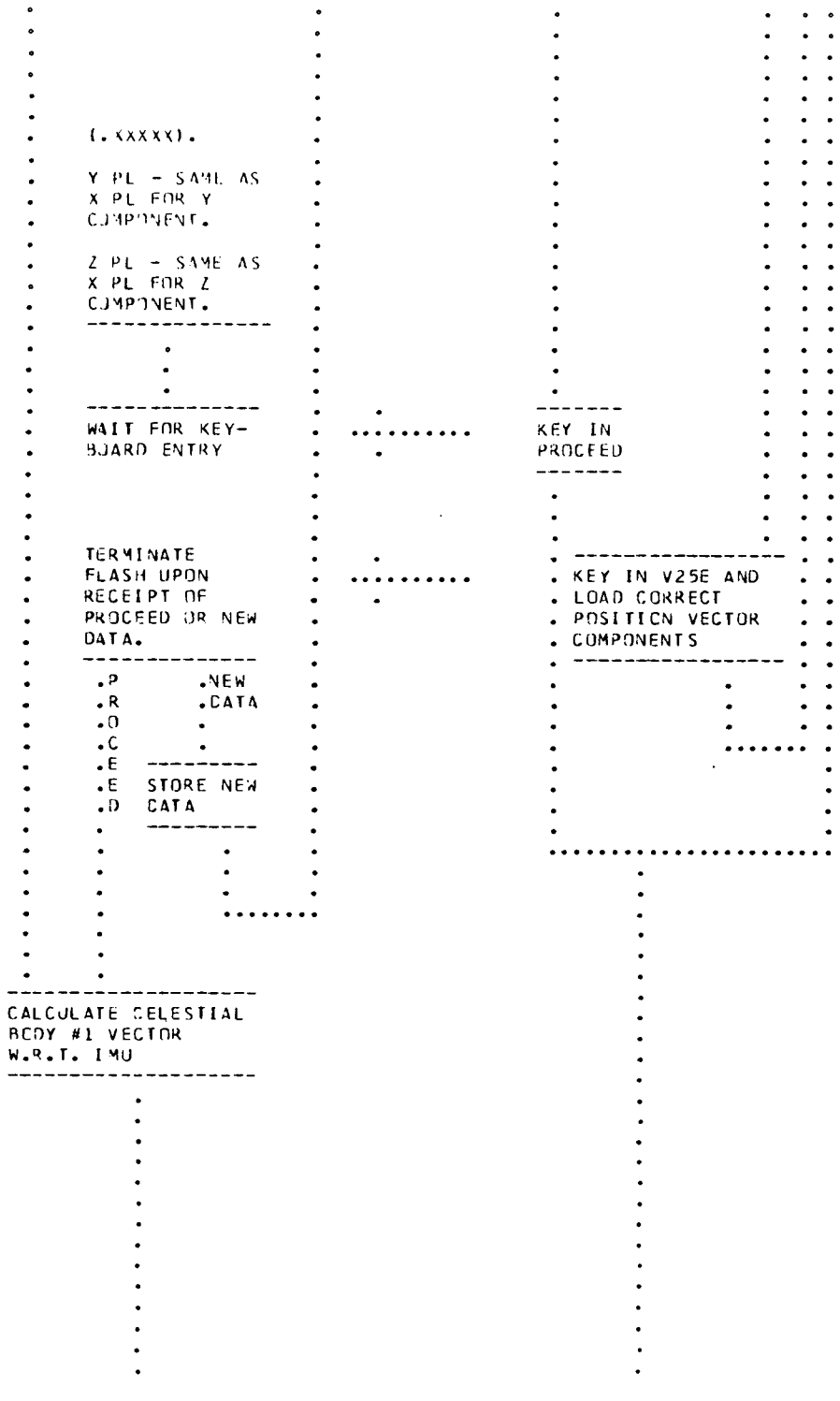
#270

#280

#290

#300

#310



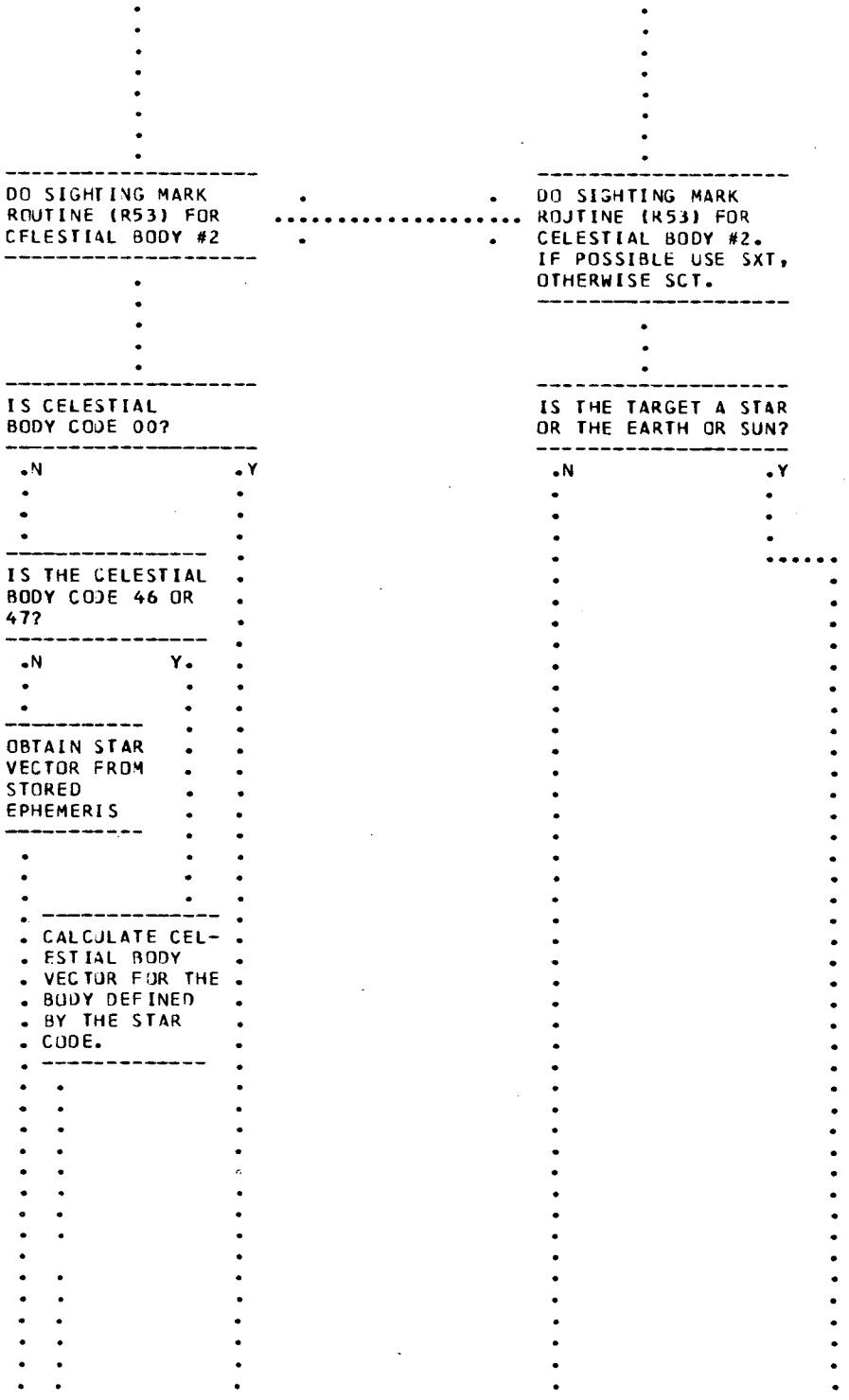
#320

#330

#340

#350

#360

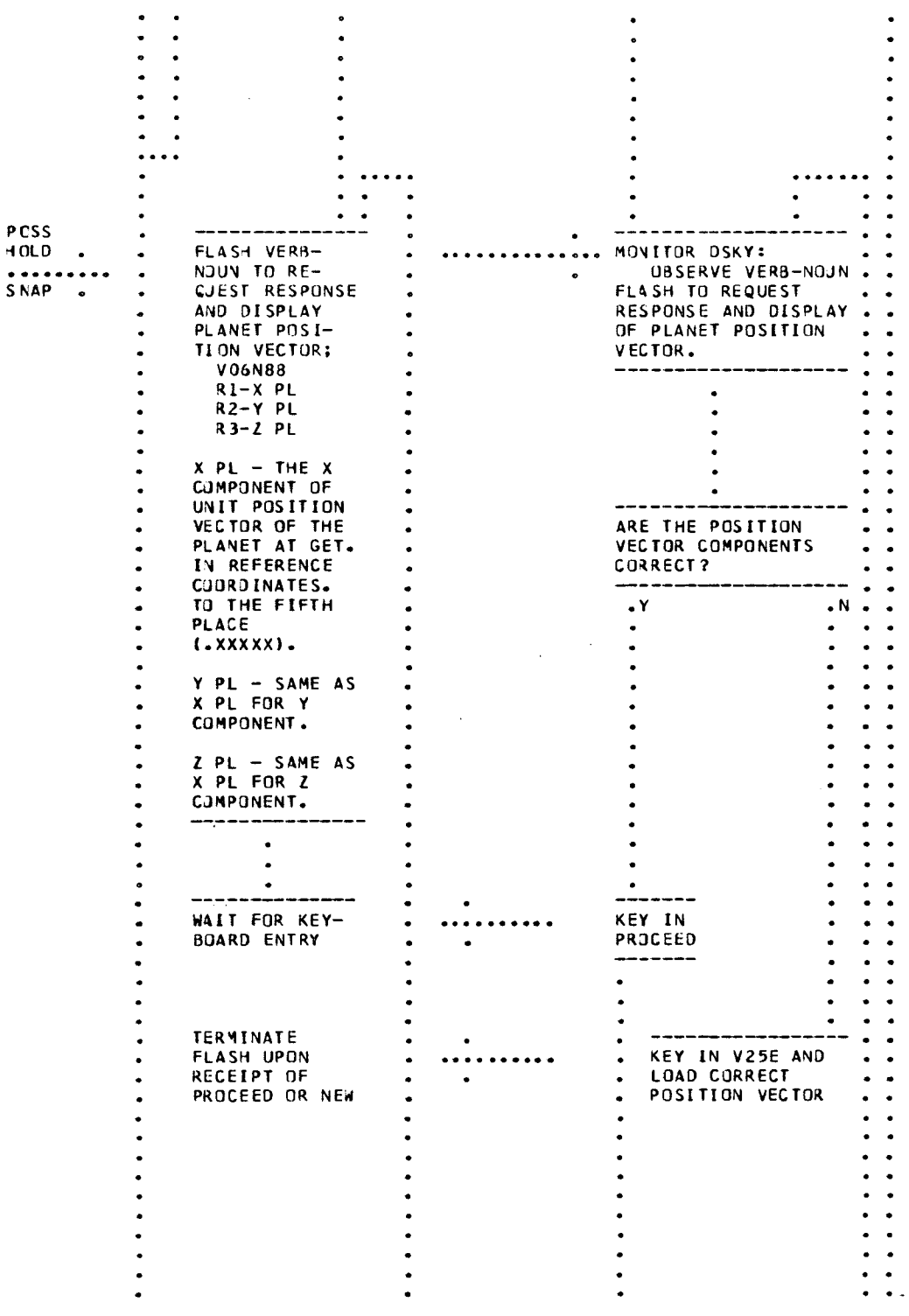


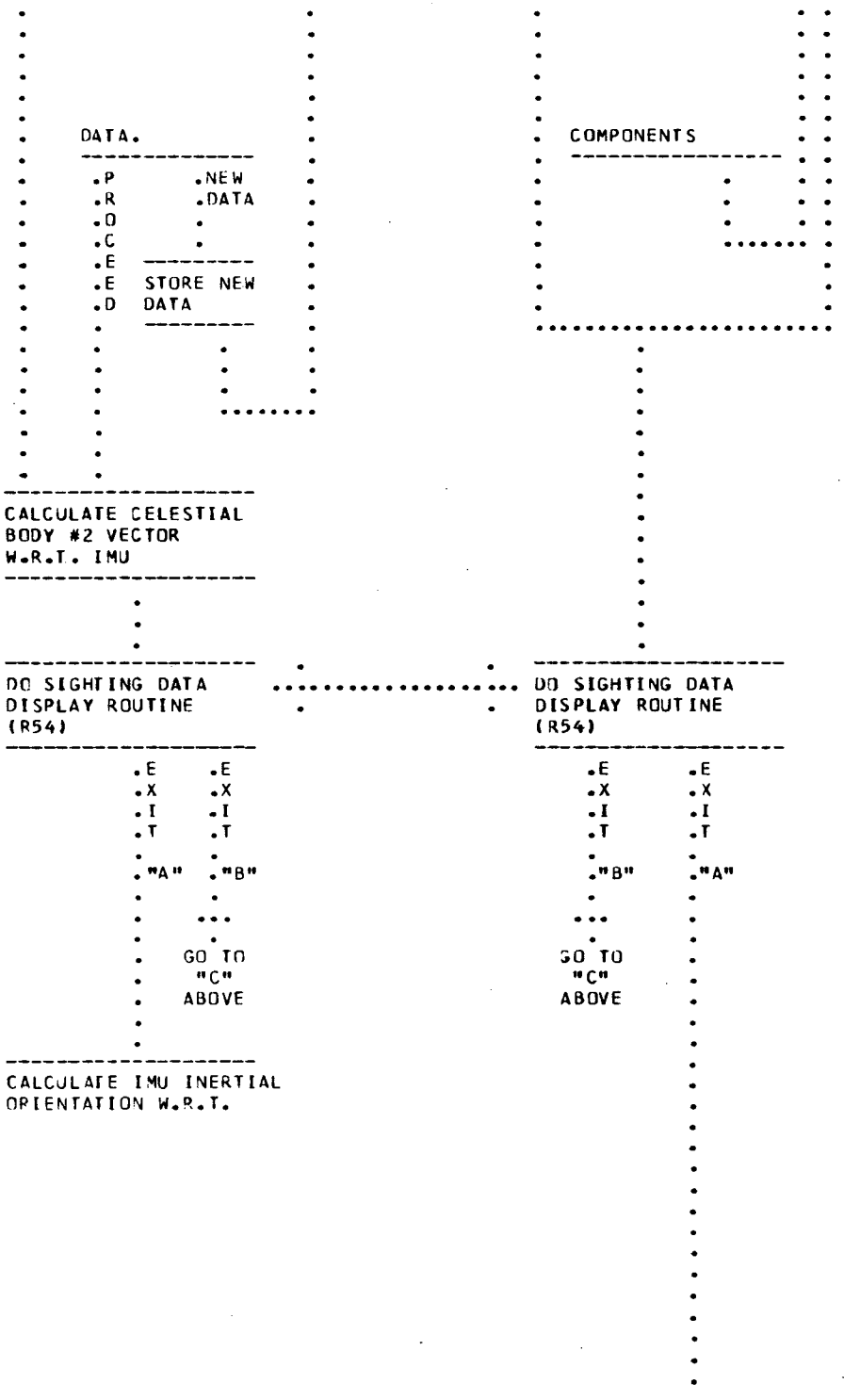
#370

#380

#390

#400


PCSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY PLANET POSITION VECTOR; V06N88 R1-X PL R2-Y PL R3-Z PL
X PL - THE X COMPONENT OF UNIT POSITION VECTOR OF THE PLANET AT GET. IN REFERENCE COORDINATES. TO THE FIFTH PLACE (.XXXXX).
Y PL - SAME AS X PL FOR Y COMPONENT.
Z PL - SAME AS X PL FOR Z COMPONENT.
WAIT FOR KEY-BOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF PLANET POSITION VECTOR.
ARE THE POSITION VECTOR COMPONENTS CORRECT?
Y
N
KEY IN PROCEED
KEY IN V25E AND LOAD CORRECT POSITION VECTOR
#410
#420
#430
#440
#450



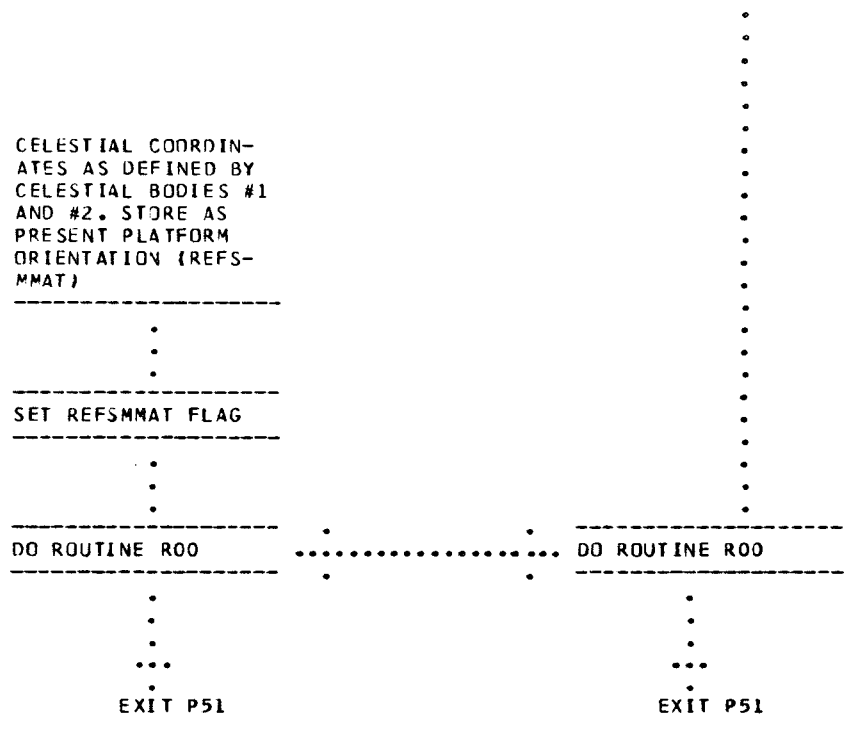
#460

#470

#480

#490

#500



#510

#520

#530

CHANGE CONTROL NOTES

REV 00 PCN 410, PCR 018,043,414
REV 01 PCN 489

IMU REALIGN PROGRAM (P52) REV 01 03/20/72

PURPOSE: (1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 4) ORIENTATION TO ONE OF THREE ORIENTATIONS SELECTED BY THE ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH THE SCANNING TELESCOPE, THE SEXTANT, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

(A) PREFERRED ORIENTATION

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE UPLINKED OR CALCULATED AND STORED BY A PREVIOUSLY SELECTED PROGRAM.

(B) NOMINAL ORIENTATION

$$X_{-SM} = UNIT(Y_{-SM} \times Z_{-SM})$$

$$Y_{-SM} = UNIT(V \times R)$$

$$Z_{-SM} = UNIT(-R)$$

WHERE:

R = THE GEOCENTRIC RADIUS VECTOR AT TIME T(ALIGN)
- SELECTED BY THE ASTRONAUT

V = THE INERTIAL VELOCITY VECTOR AT TIME T(ALIGN) SELECTED BY THE ASTRONAUT.
-

(C) REFSMMAT

SEE ASSUMPTION (4)

(2) TO ALIGN THE IMU TO A PRE-DETERMINED ORIENTATION SUITABLE FOR A PLANE-CHANGE MANEUVER AND TO REALIGN THE IMU AFTER THE MANEUVER TO THE PRE-PLANE CHANGE ORIENTATION.

$$X_{-SM} = UNIT(X_{-SMO} \cos 45 + Y_{-SMO} \sin 45)$$ BEFORE THE MANEUVER (AFTER MANEUVER IF $COS(CDUY).VGY_{LV} < 0$)

$$X_{-SM} = UNIT(X_{-SMO} \cos 45 - Y_{-SMO} \sin 45)$$ AFTER THE MANEUVER (BEFORE MANEUVER IF $COS(CDUY).VGY_{LV} < 0$)

$$Y_{-SM} = UNIT(Z_{-SM} \times X_{-SM})$$

$$Z_{-SM} = Z_{-SMO}$$

WHERE: SUBSCRIPT '0' REFERS TO THE ORIENTATION EXISTING BEFORE THE ALIGNMENT.

ASSUMPTIONS: (1) THE CONFIGURATION MAY BE SIVB/CSM, SKYLAB/CSM, OR CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO

THE CMC BY COMPLETION OF EITHER ROUTINE R03 OR R04 AND EITHER V45 OR V46 (DEPENDING ON CONFIGURATION).

(2) IF THE S/C CONTROL SWITCH IS IN CMC AND THE MODE SWITCH IS IN ATTITUDE HOLD OR AUTO DURING THE GYRO TORQUING ROUTINE (R55) OR THE GYRO TORQUING OPTION (ENTER ON V50N25, R1=13 OR PRO ON V50N25, R1=20) OR THE GYRO TRIM PORTION OF COARSE ALIGN ROUTINE (R50), THE DAP WILL MANEUVER THE VEHICLE TO FOLLOW THE PLATFORM.

(3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MANEUVER IF DESIRED MUST BE DONE MANUALLY. AN OPTION IS PROVIDED HOWEVER TO POINT THE SXT AT ASTRONAUT OR CMC SELECTED STARS EITHER MANUALLY BY CREW INPUT OR AUTOMATICALLY UNDER CMC CONTROL.

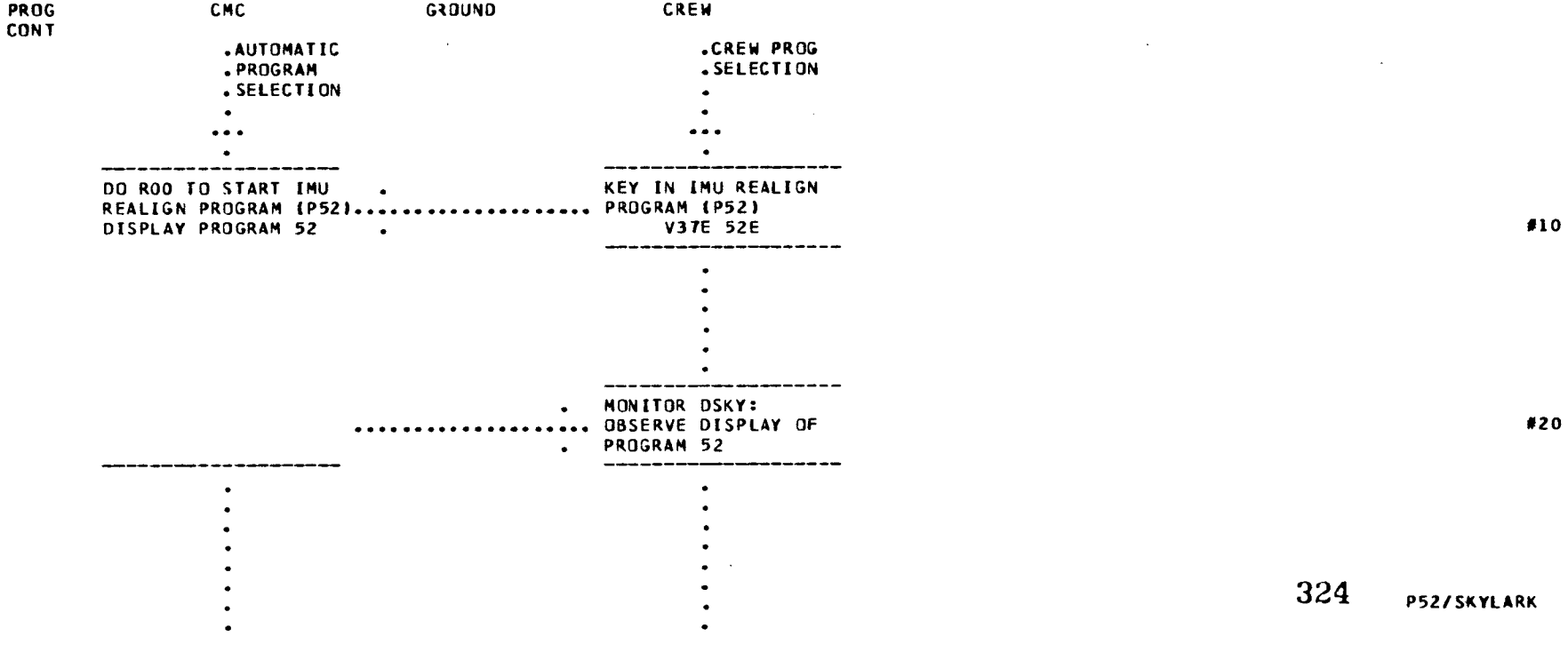
(4) THE ISS IS ON AND HAS BEEN ALIGNED TO A KNOWN ORIENTATION WHICH IS STORED IN THE CMC (REFSMMAT). THE PRESENT IMU ORIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRO DRIFT (I.E., NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST ALIGNMENT).

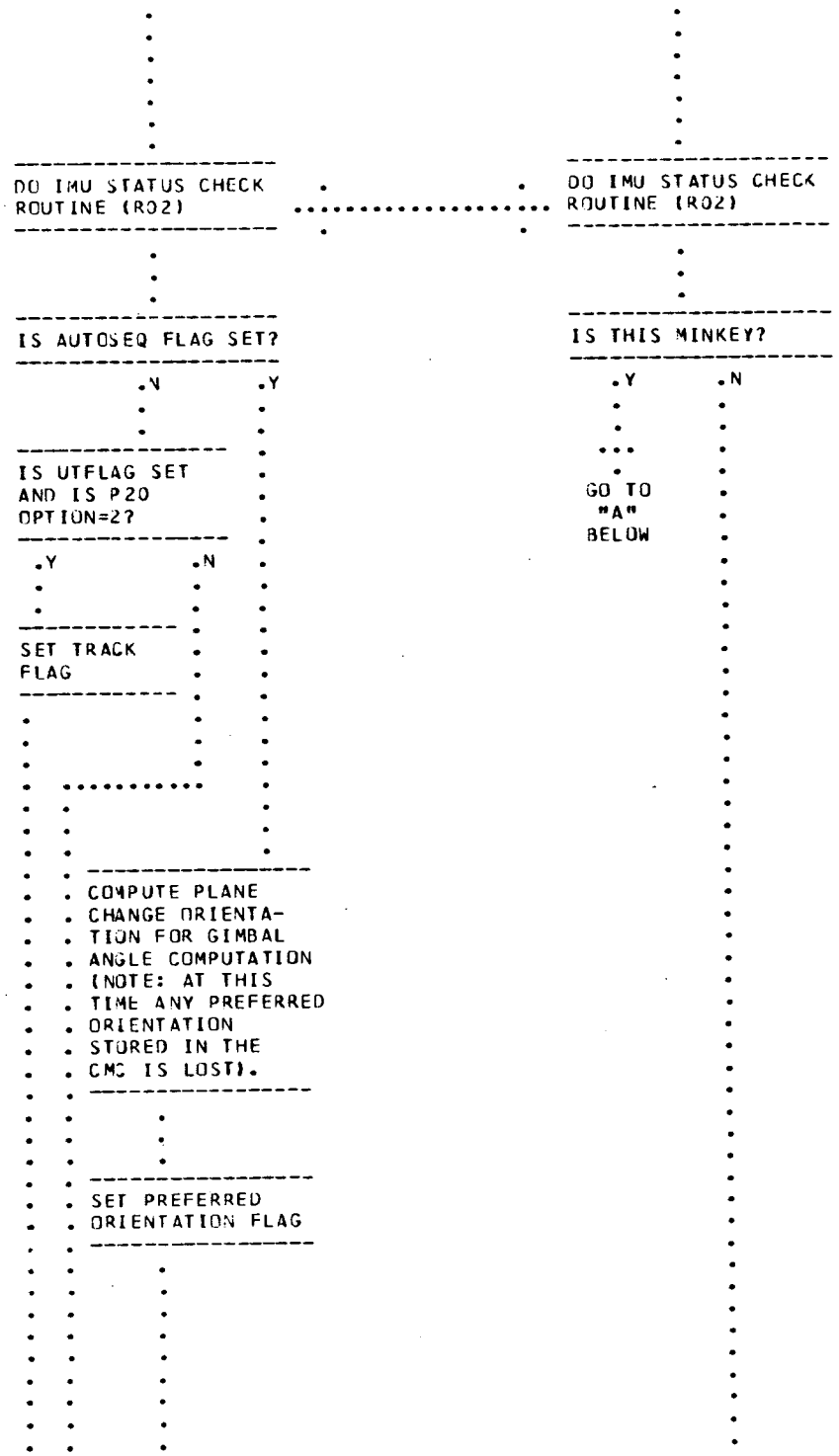
(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(8) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY FOR PURPOSE 1 AND BY MINKEY CONTROLLER (R07) FOR PURPOSE 2.




DO IMU STATUS CHECK ROUTINE (R02)
IS AUTOSEQ FLAG SET?
.N
.Y
IS UTFLAG SET AND IS P20 OPTION=2?
.Y
.N
SET TRACK FLAG
COMPUTE PLANE CHANGE ORIENTATION FOR GIMBAL ANGLE COMPUTATION (NOTE: AT THIS TIME ANY PREFERRED ORIENTATION STORED IN THE CMC IS LOST).
SET PREFERRED ORIENTATION FLAG
DO IMU STATUS CHECK ROUTINE (R02)
IS THIS MINKEY?
.Y
.N
GO TO "A" BELOW

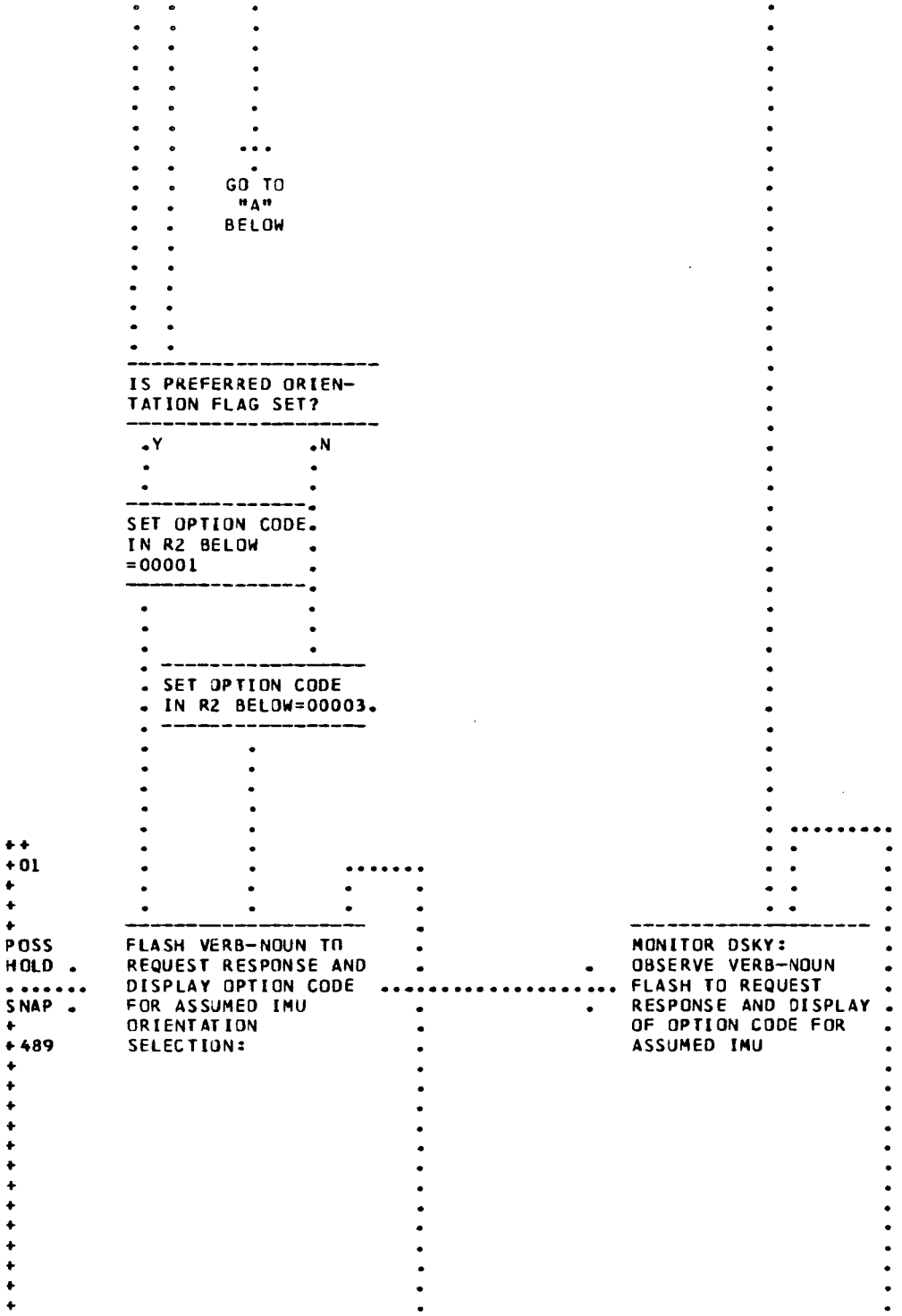
#30

#40

#50

#60

#70



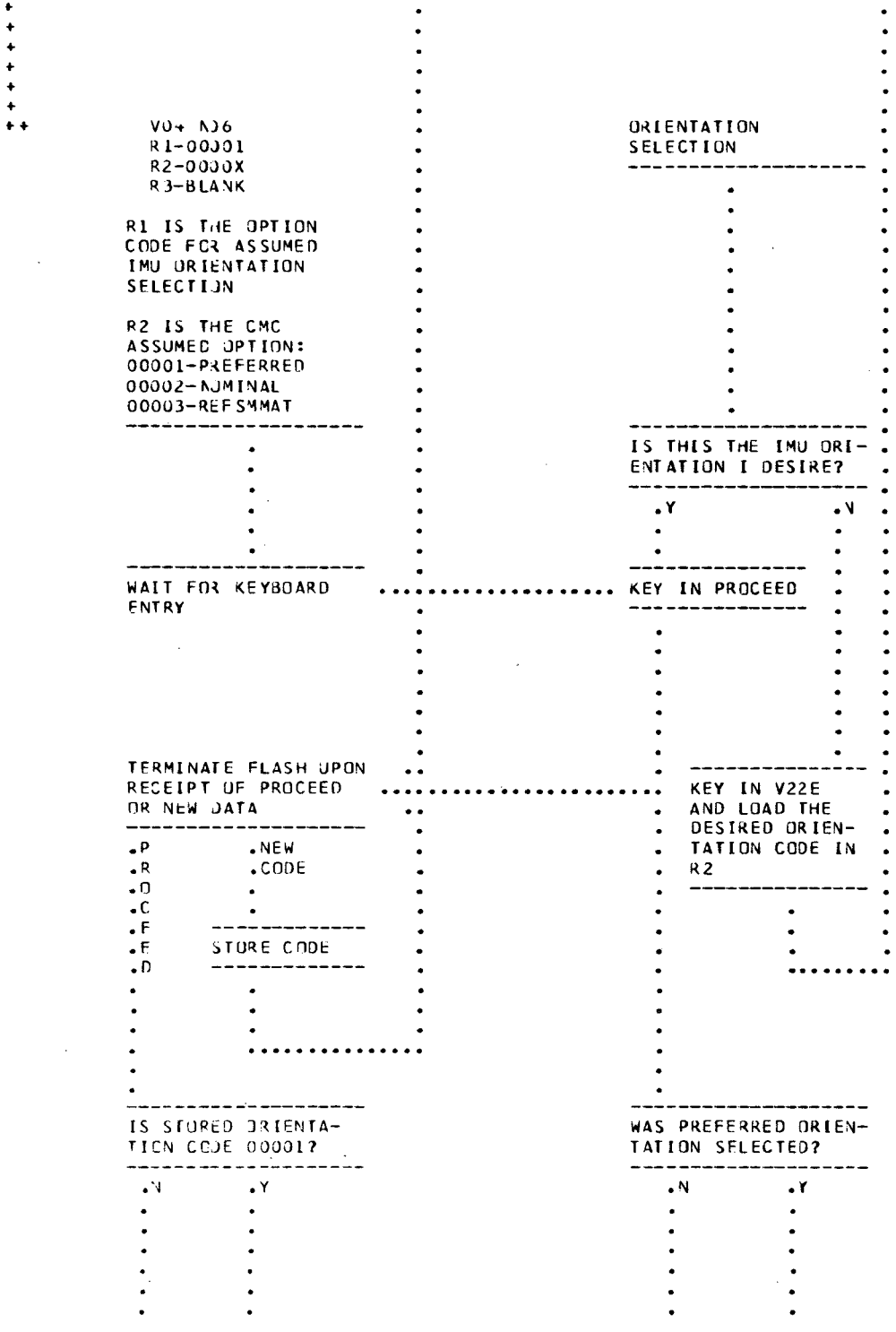
#80

#90

#100

#110

#120



#130

#140

#150

#160

#170

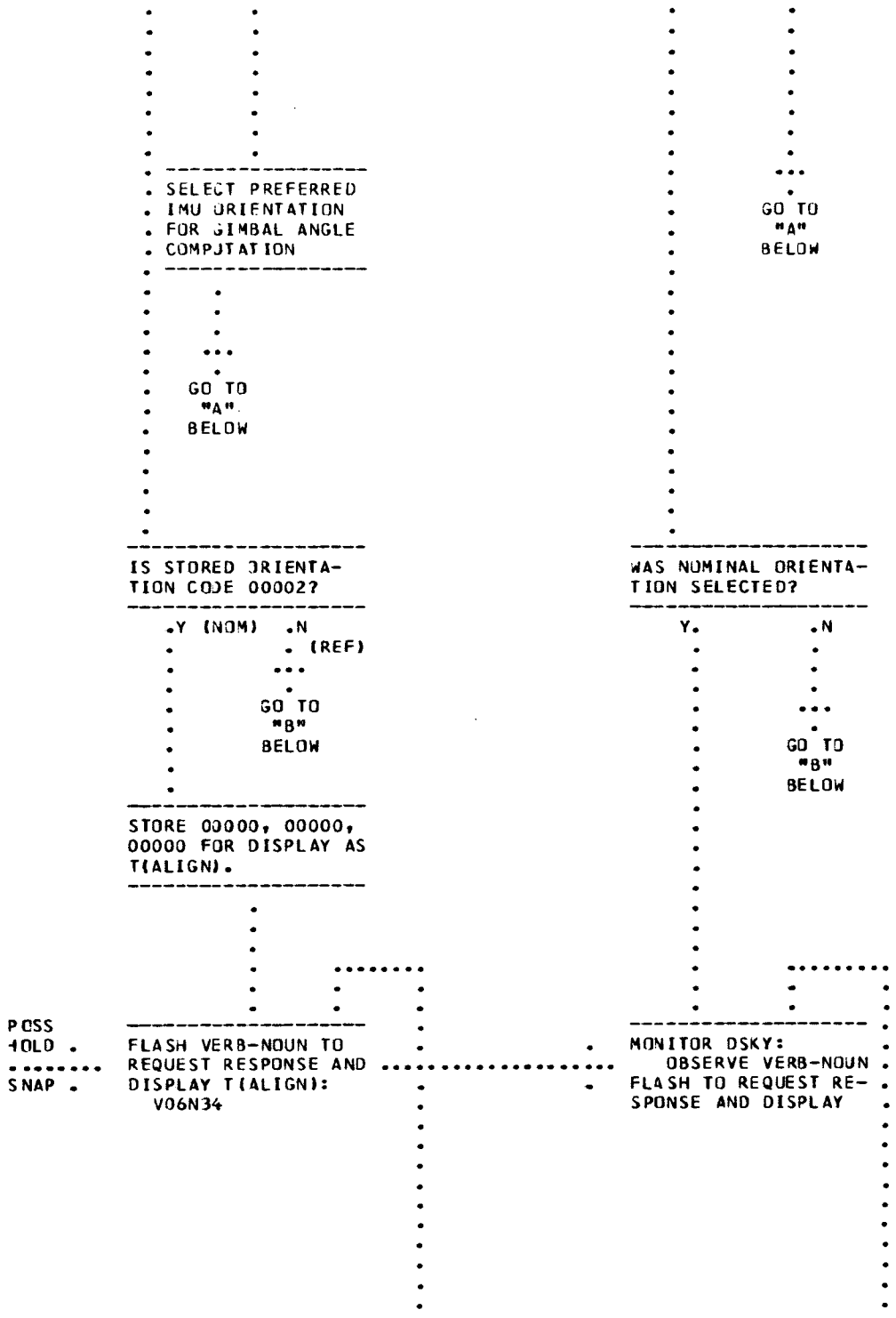
#180

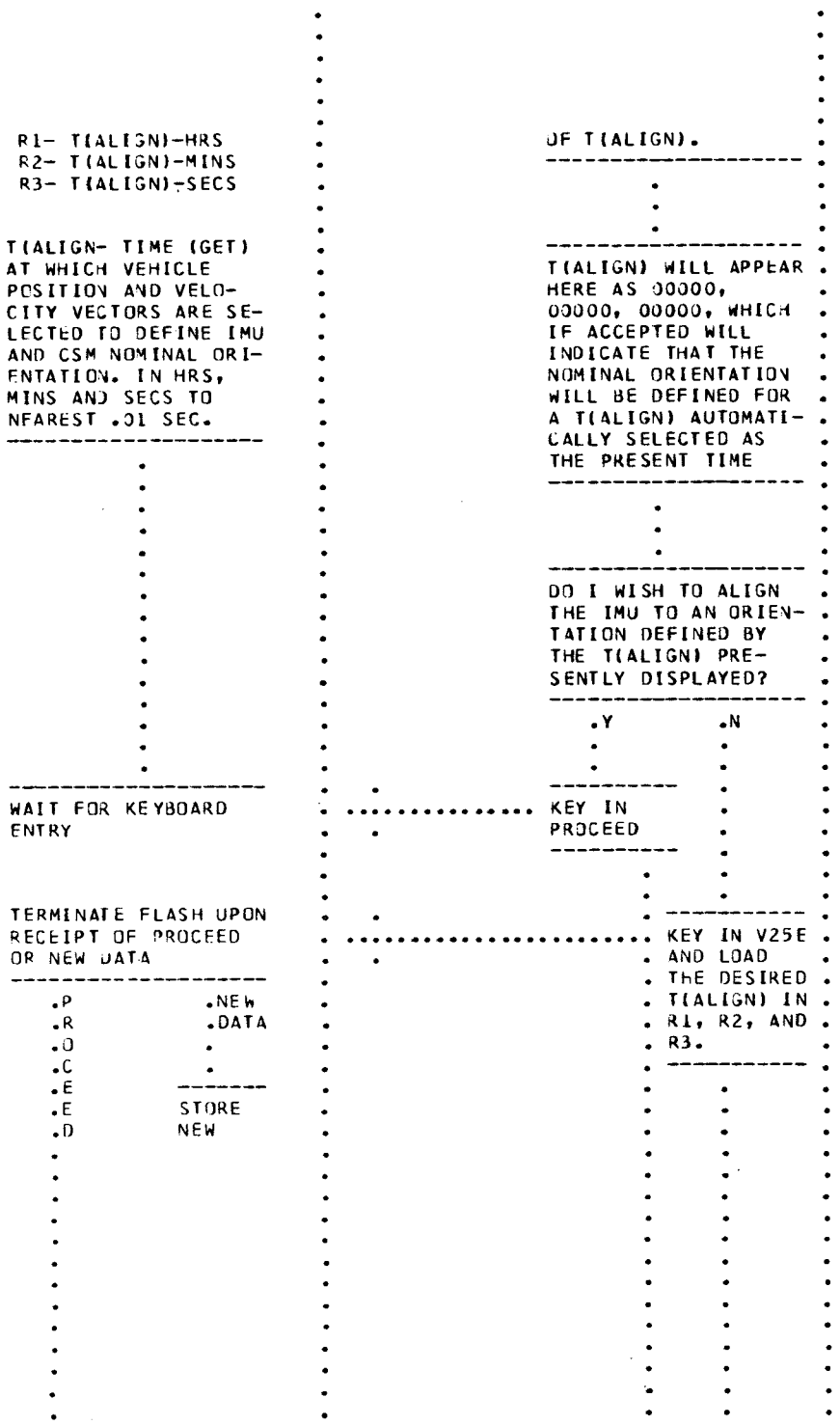
#190

#200

#210

#220





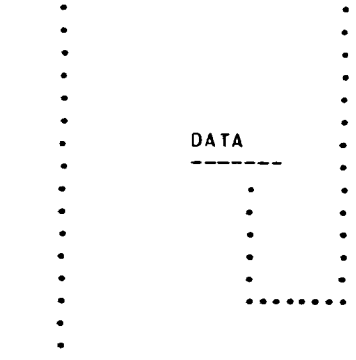
#230

#240

#250

#260

#270



#280

IS T(ALIGN) DEFINED TO BE= 0?

.Y .N

#290

DEFINE T(ALIGN) = T PRESENT.

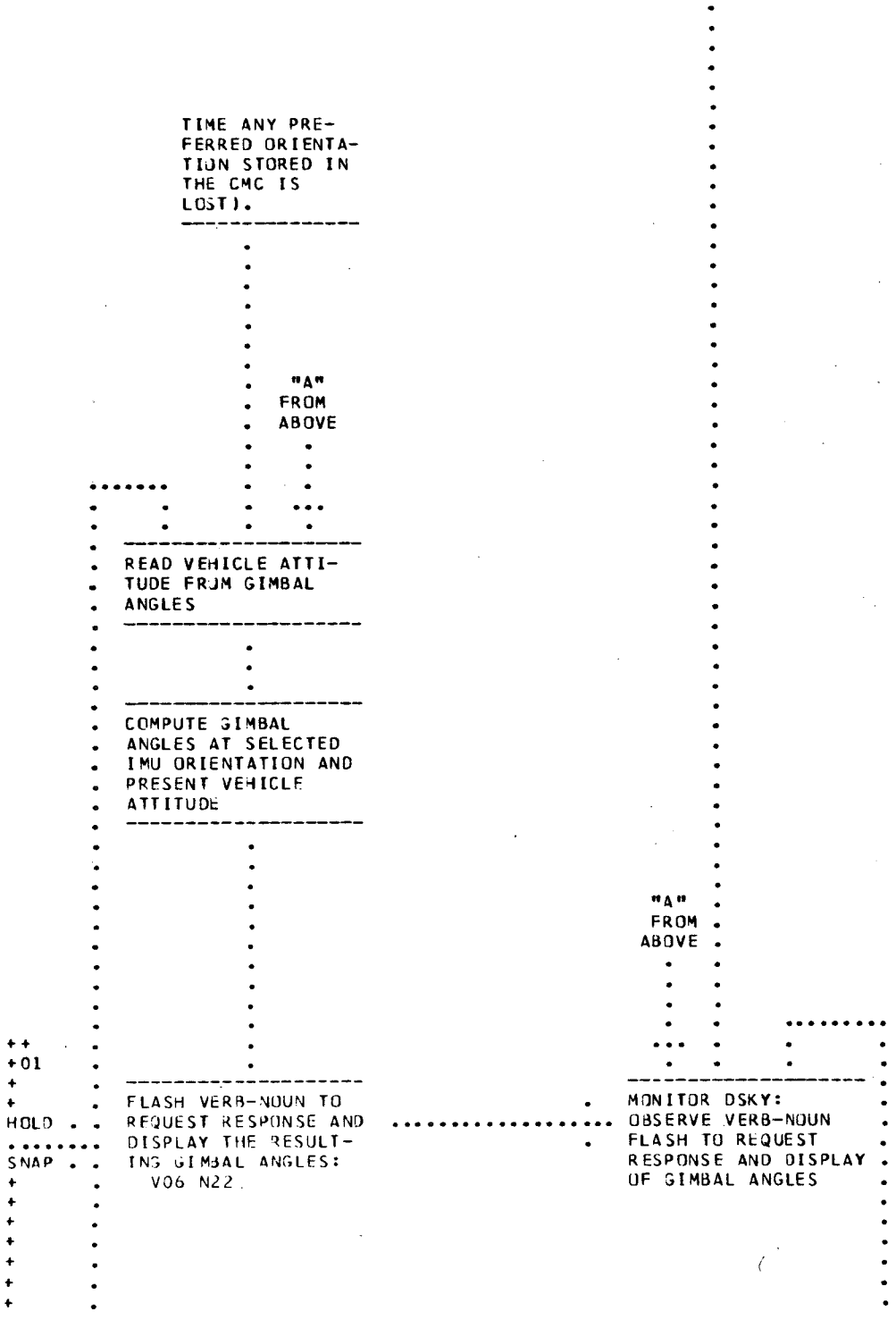
#300

FIND CSM STATE AT T(ALIGN) USING PRECISION INTEGRATION MODE

#310

COMPUTE NOMINAL ORIENTATION FOR THE PREVIOUSLY DEFINED T(ALIGN). SELECT THIS ORIENTATION FOR GIMBAL ANGLES COMPUTATION. (NOTE: AT THIS

#320



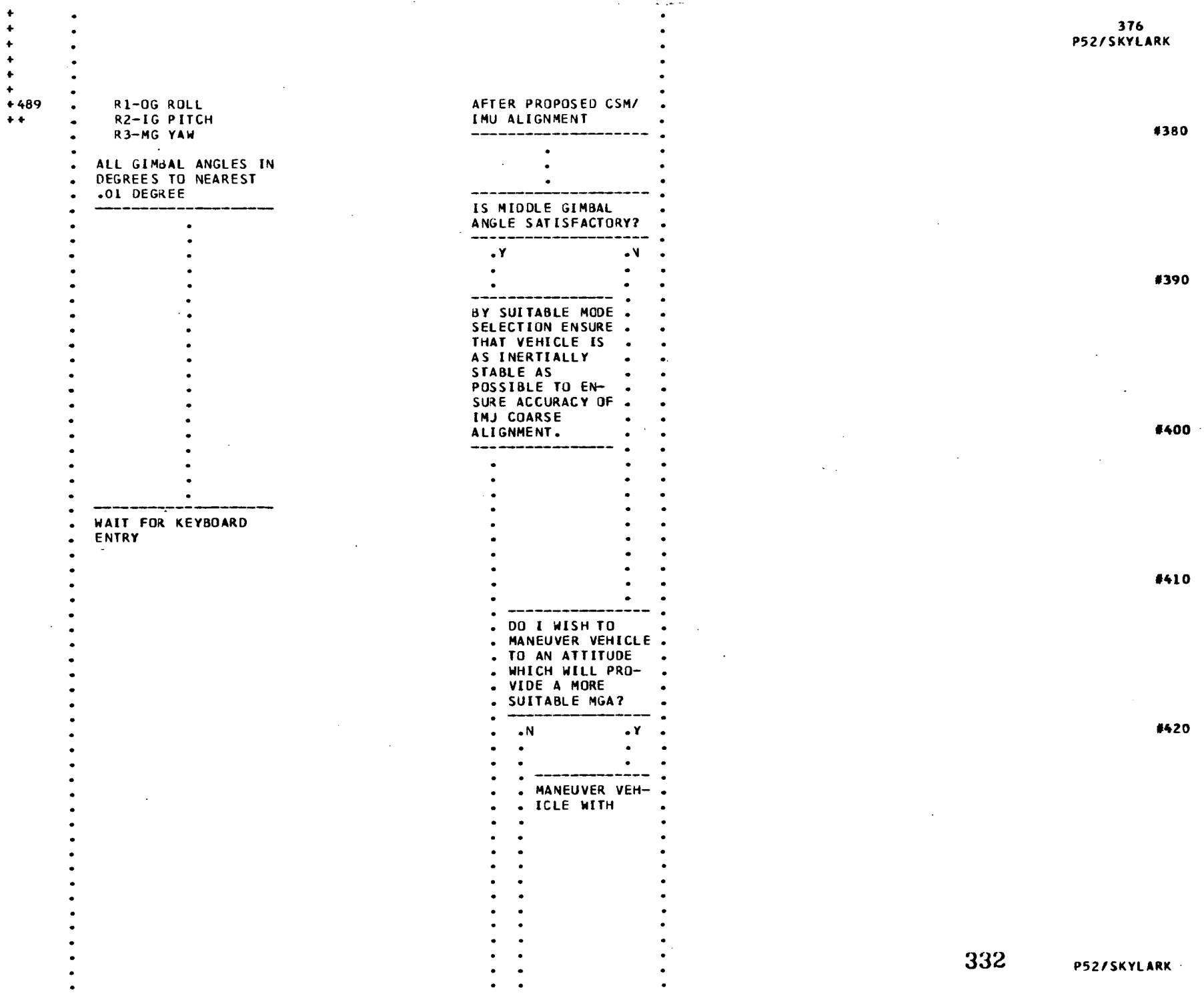
#330

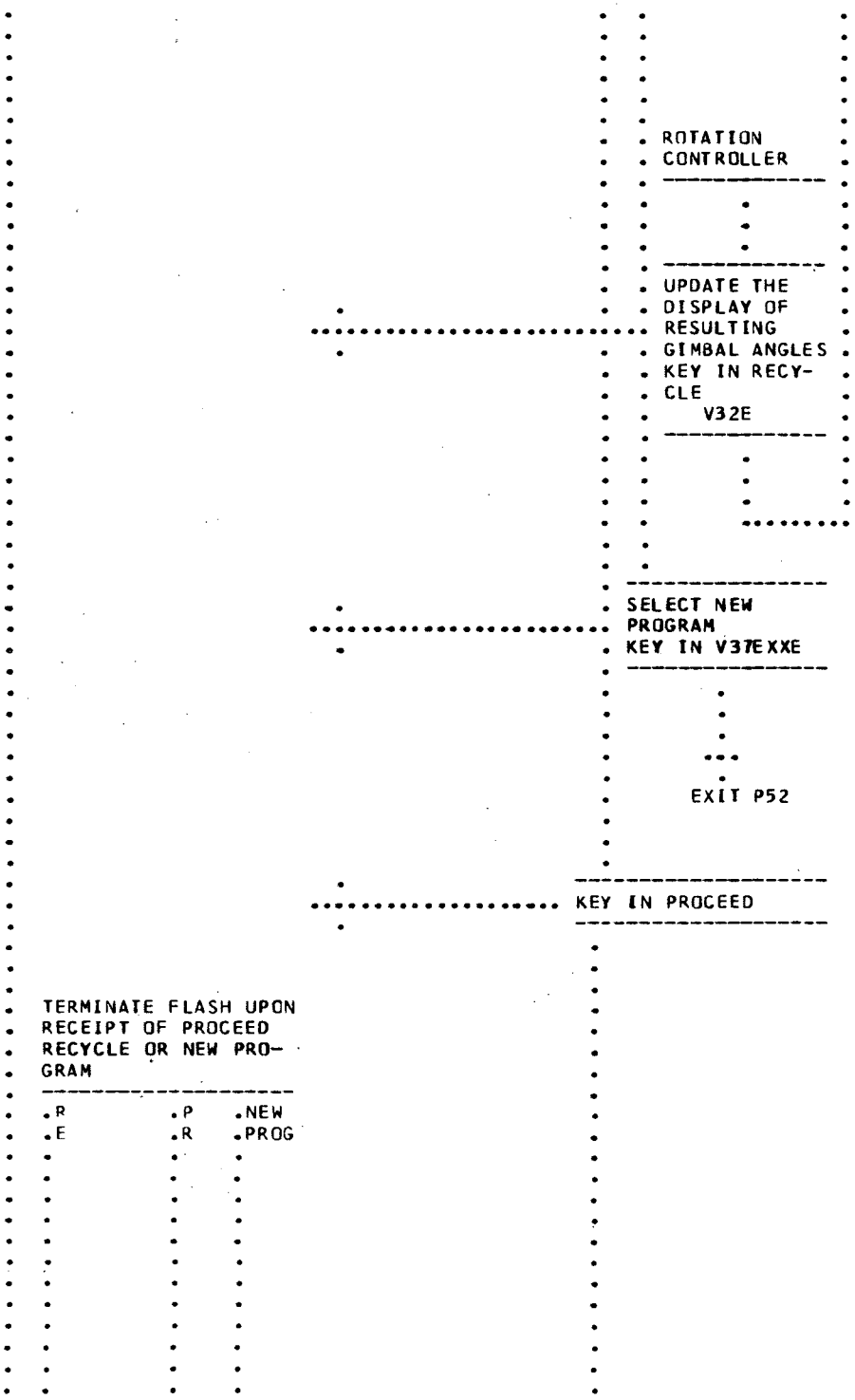
#340

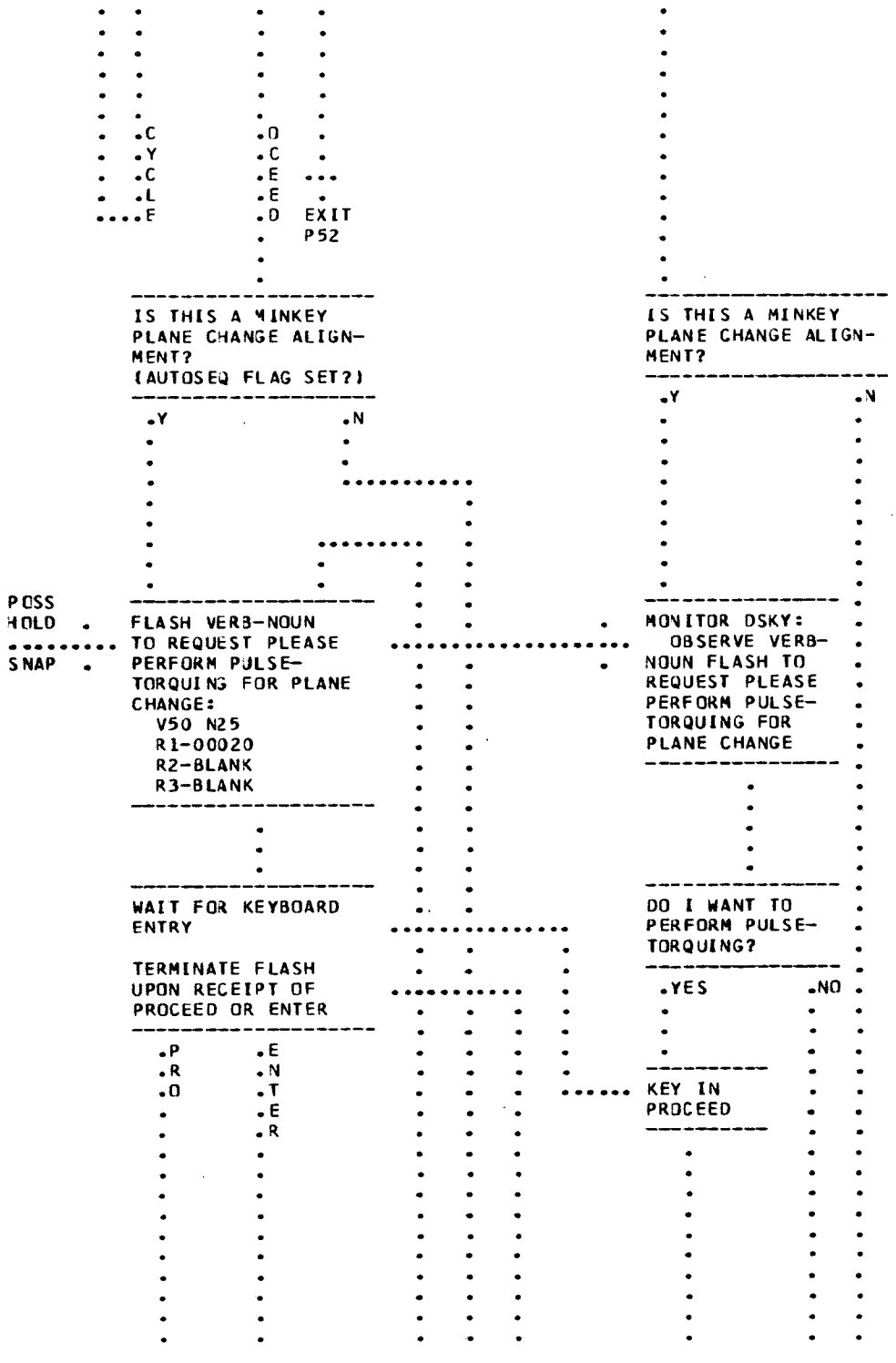
#350

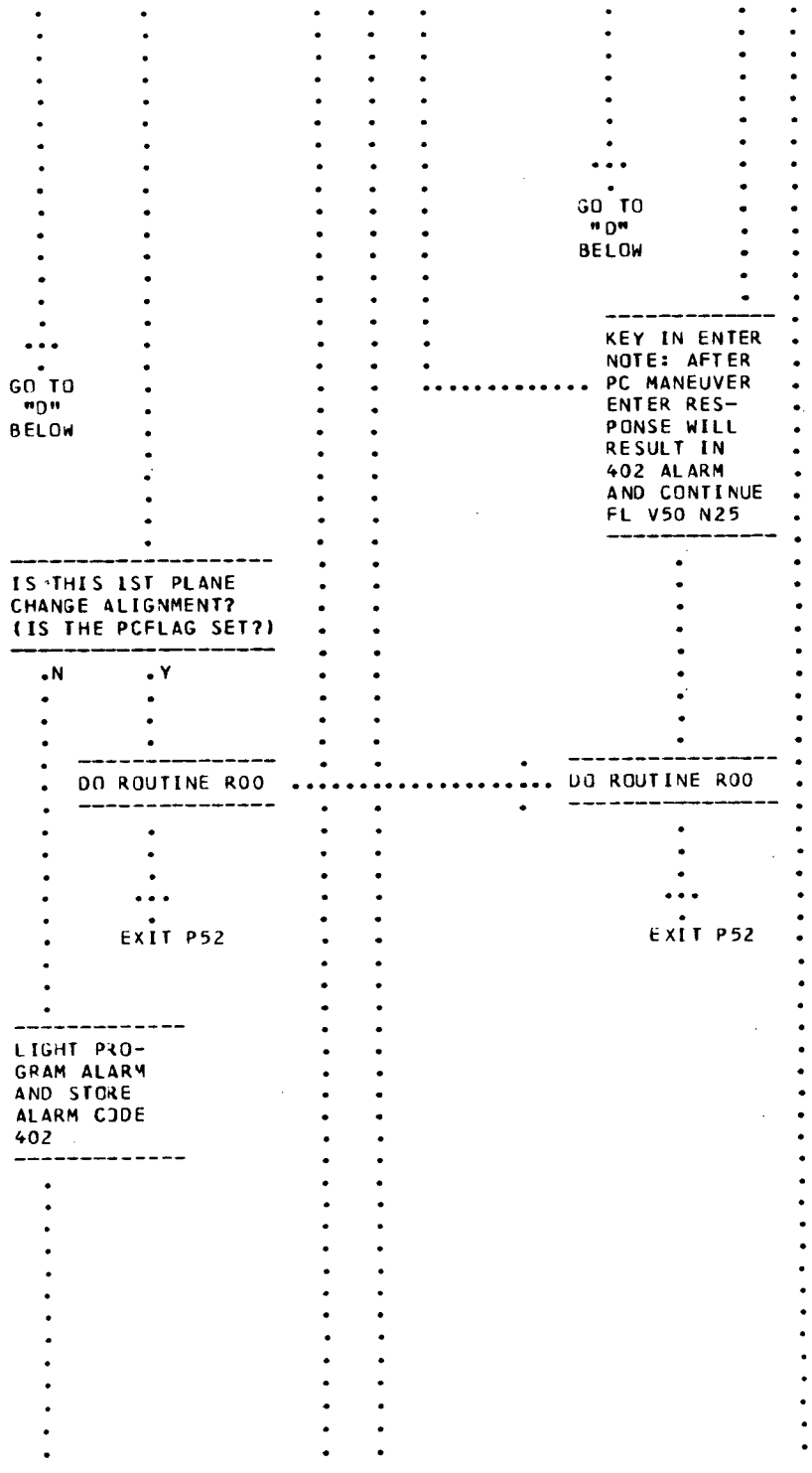
#360

#370


+489
++
R1-OG ROLL
R2-IG PITCH
R3-MG YAW
ALL GIMBAL ANGLES IN DEGREES TO NEAREST .01 DEGREE
WAIT FOR KEYBOARD ENTRY
AFTER PROPOSED CSM/ IMU ALIGNMENT
#380
IS MIDDLE GIMBAL ANGLE SATISFACTORY?
.Y
.N
#390
BY SUITABLE MODE SELECTION ENSURE THAT VEHICLE IS AS INERTIALLY STABLE AS POSSIBLE TO ENSURE ACCURACY OF IMJ COARSE ALIGNMENT.
#400
#410
DO I WISH TO MANEUVER VEHICLE TO AN ATTITUDE WHICH WILL PROVIDE A MORE SUITABLE MGA?
.N
.Y
#420
MANEUVER VEHICLE WITH


ROTATION CONTROLLER
#430
UPDATE THE DISPLAY OF RESULTING GIMBAL ANGLES KEY IN RECYCLE
V32E
#440
SELECT NEW PROGRAM KEY IN V37EXXE
#450
EXIT P52
#460
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF PROCEED RECYCLE OR NEW PROGRAM
#470
R E
P R
NEW PROG


.C
.Y
.C
.L
.F
.D
.C
.E
.E
.D
EXIT
P52
IS THIS A MINKEY PLANE CHANGE ALIGN-MENT? (AUTOSEQ FLAG SET?)
.Y
.N
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM PULSE-TORQUING FOR PLANE CHANGE:
V50 N25
R1-00020
R2-BLANK
R3-BLANK
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR ENTER
.P
.R
.O
.E
.N
.T
.E
.R
IS THIS A MINKEY PLANE CHANGE ALIGN-MENT?
.Y
.N
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM PULSE-TORQUING FOR PLANE CHANGE
DO I WANT TO PERFORM PULSE-TORQUING?
.YES
.NO
KEY IN PROCEED
#480
#490
#500
#510
#520



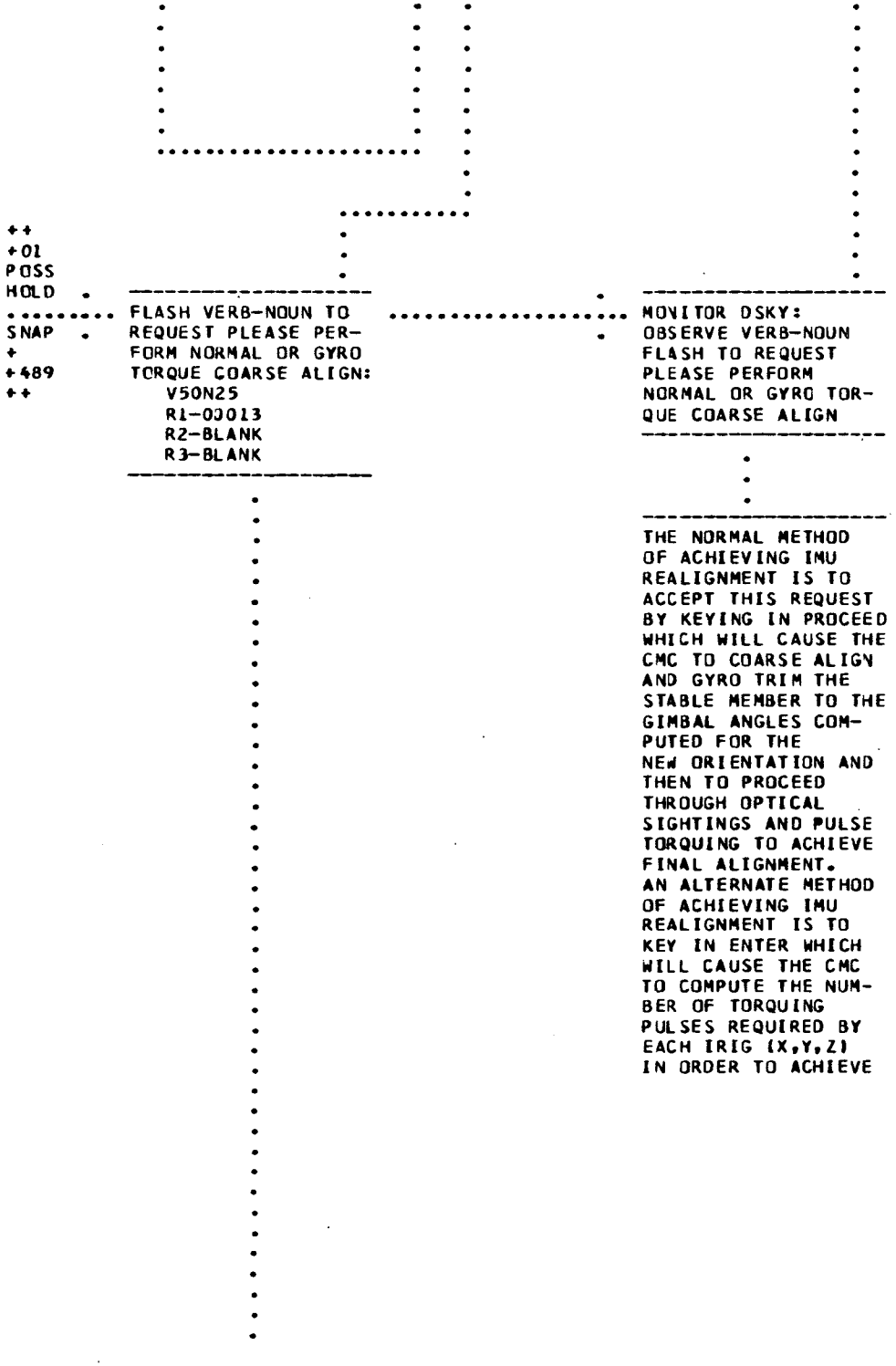
#530

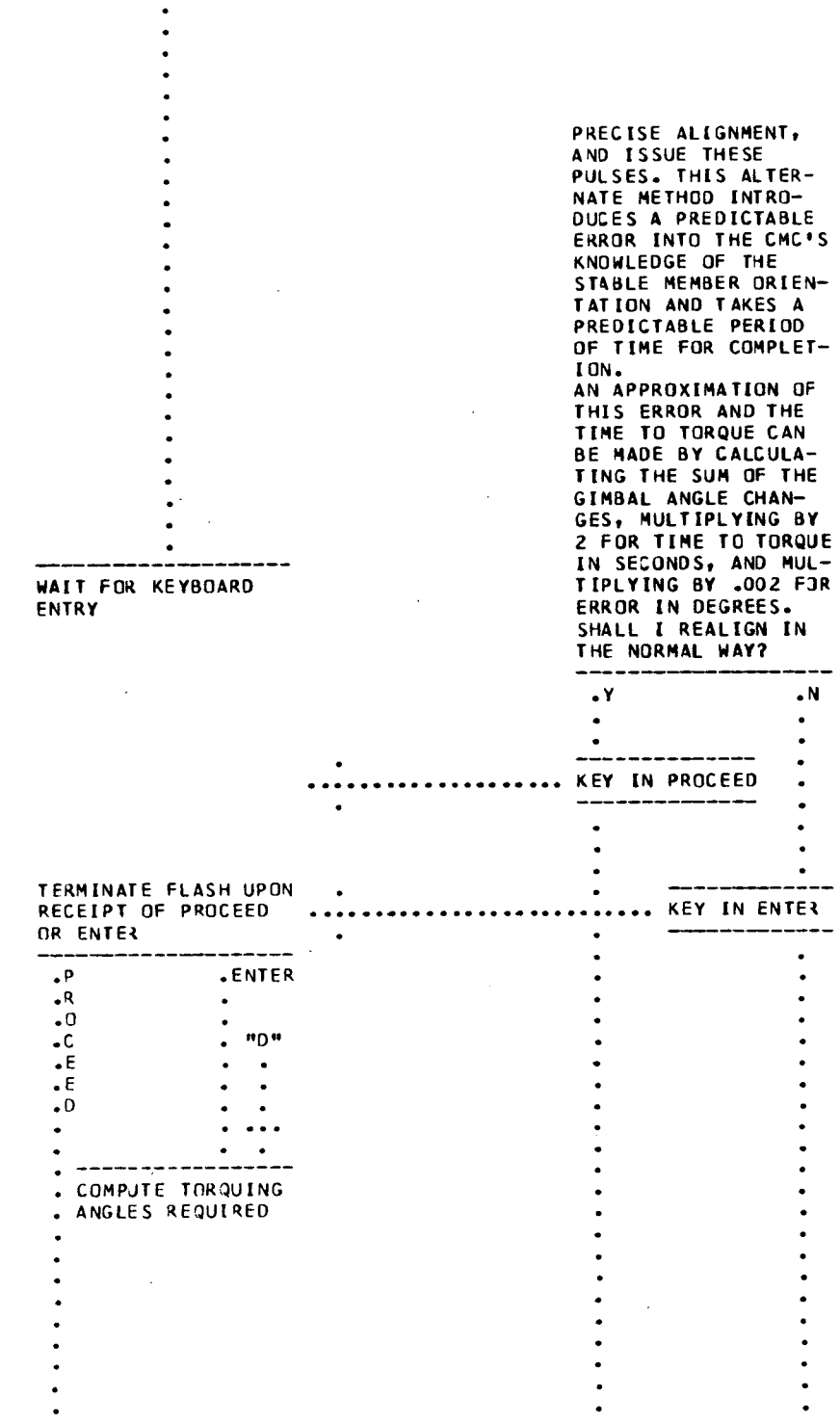
#540

#550

#560

#570


++
+01
POSS
HOLD
SNAP
+
+489
++
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM NORMAL OR GYRO TORQUE COARSE ALIGN:
V50N25
R1-00013
R2-BLANK
R3-BLANK
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM NORMAL OR GYRO TORQUE COARSE ALIGN
THE NORMAL METHOD OF ACHIEVING IMU REALIGNMENT IS TO ACCEPT THIS REQUEST BY KEYING IN PROCEED WHICH WILL CAUSE THE CMC TO COARSE ALIGN AND GYRO TRIM THE STABLE MEMBER TO THE GIMBAL ANGLES COMPUTED FOR THE NEW ORIENTATION AND THEN TO PROCEED THROUGH OPTICAL SIGHTINGS AND PULSE TORQUING TO ACHIEVE FINAL ALIGNMENT. AN ALTERNATE METHOD OF ACHIEVING IMU REALIGNMENT IS TO KEY IN ENTER WHICH WILL CAUSE THE CMC TO COMPUTE THE NUMBER OF TORQUING PULSES REQUIRED BY EACH IRIG (X,Y,Z) IN ORDER TO ACHIEVE
#580
#590
#600
#610
#620



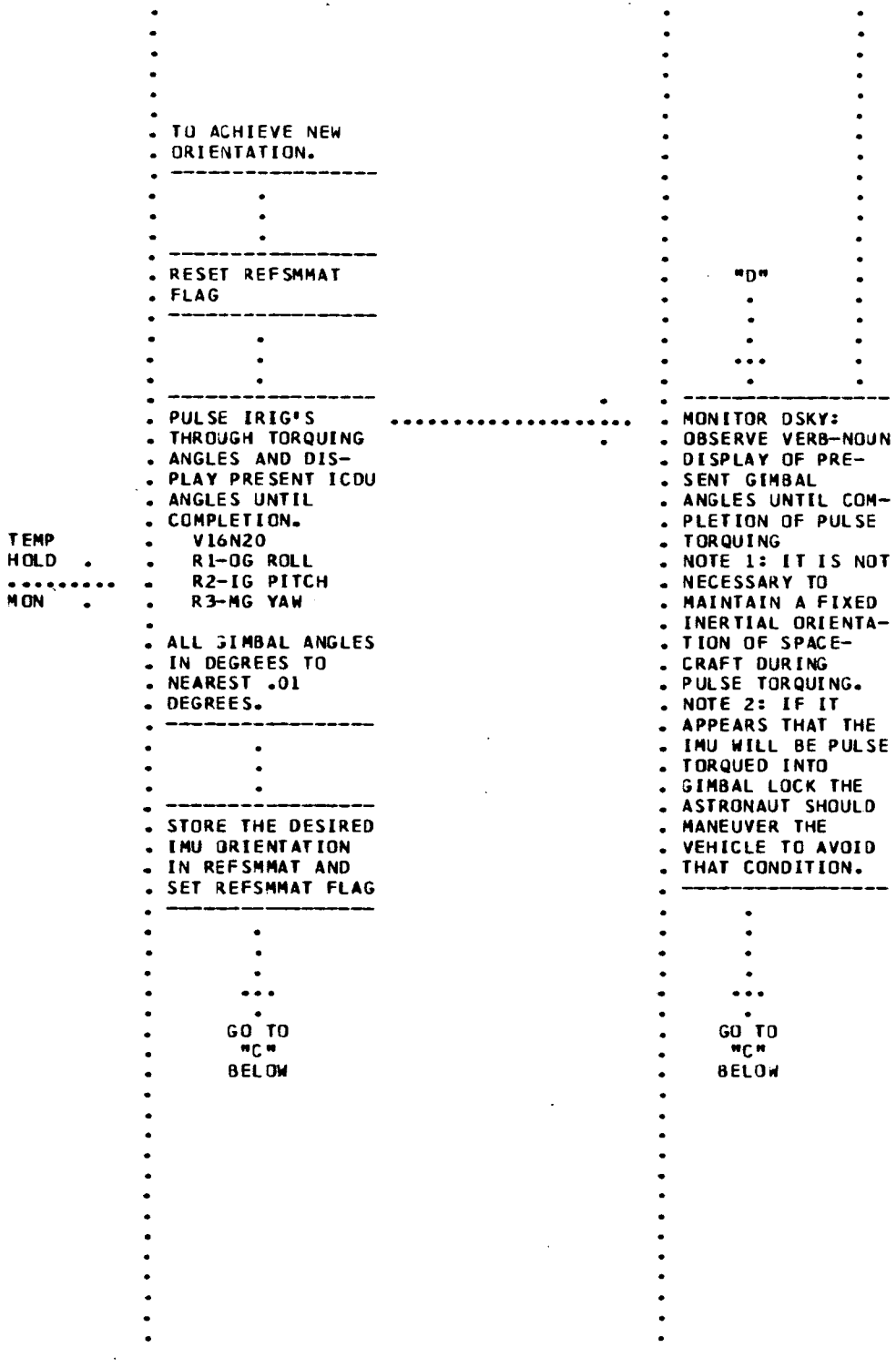
#630

#640

#650

#660

#670



#680

#690

#700

#710

#720

SELECT FINAL DESIRED IMU ORIENTATION FROM STORAGE FOR USE BY THE COARSE ALIGN ROUTINE (R50)

#730

DO COARSE ALIGN ROUTINE (R50)

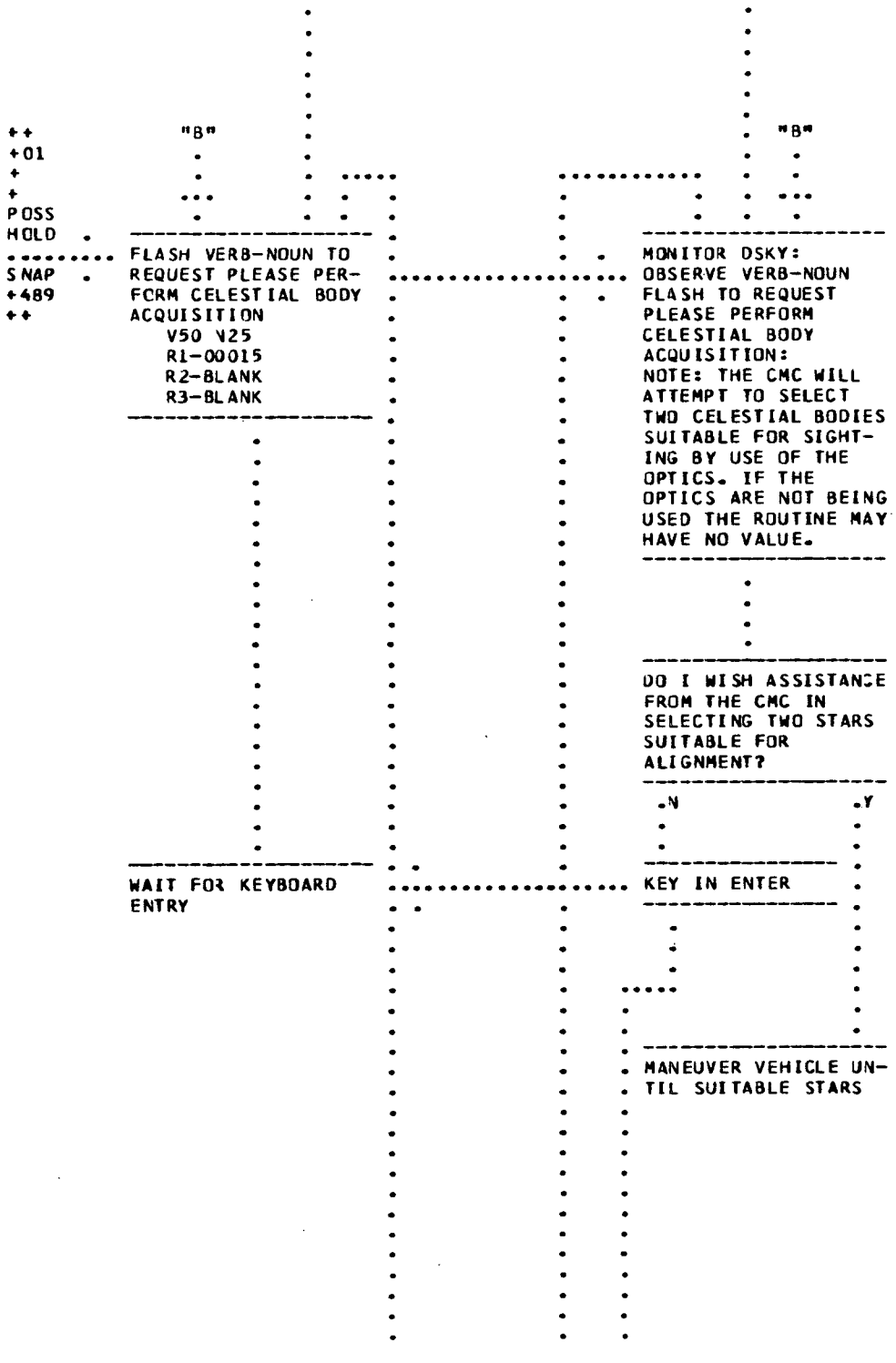
DO COARSE ALIGN ROUTINE (R50)

#740

#750

STORE THE PRESENT IMU ORIENTATION IN REFSMMAT AND SET REFSMMAT FLAG

#760



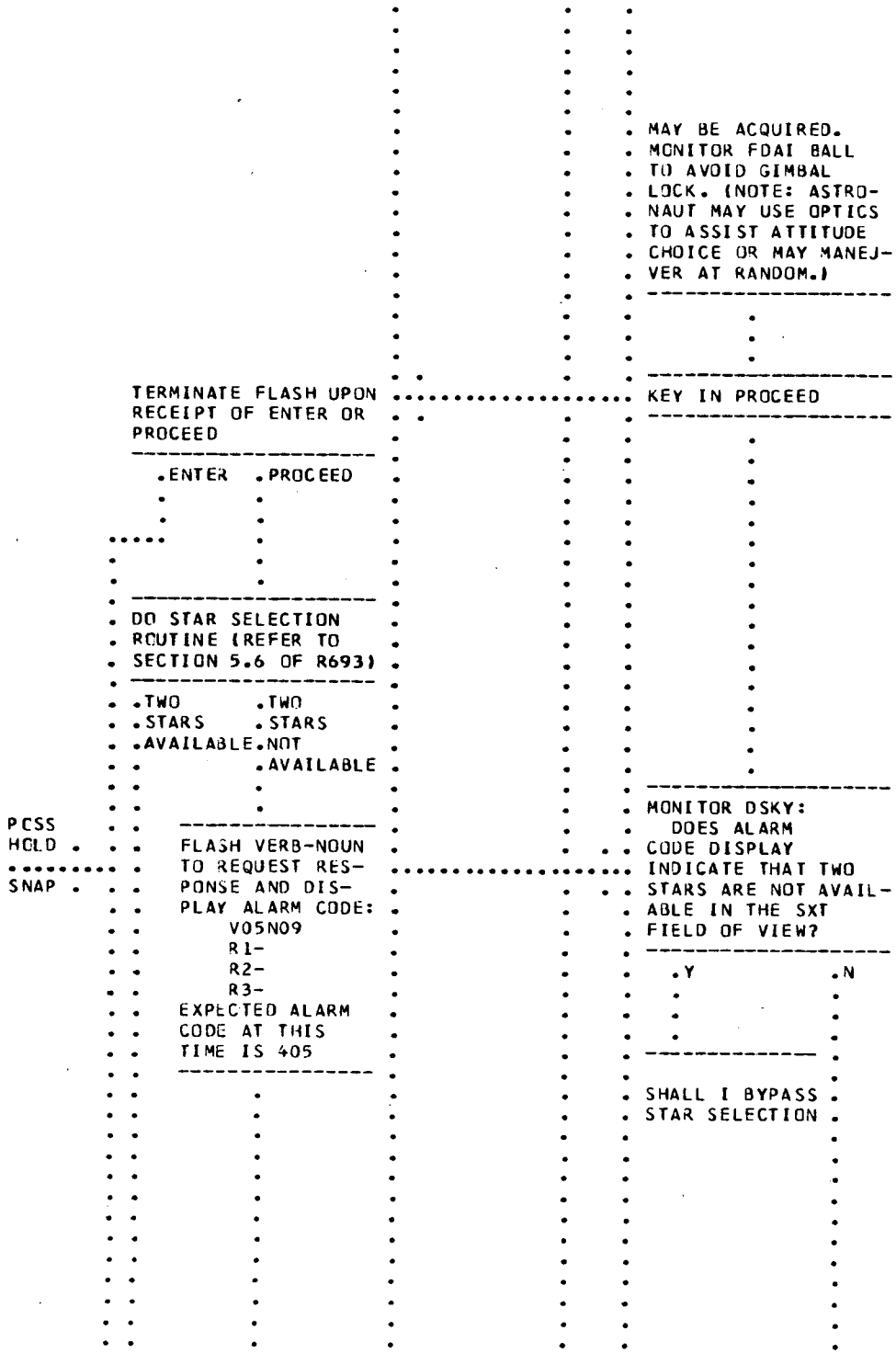
#770

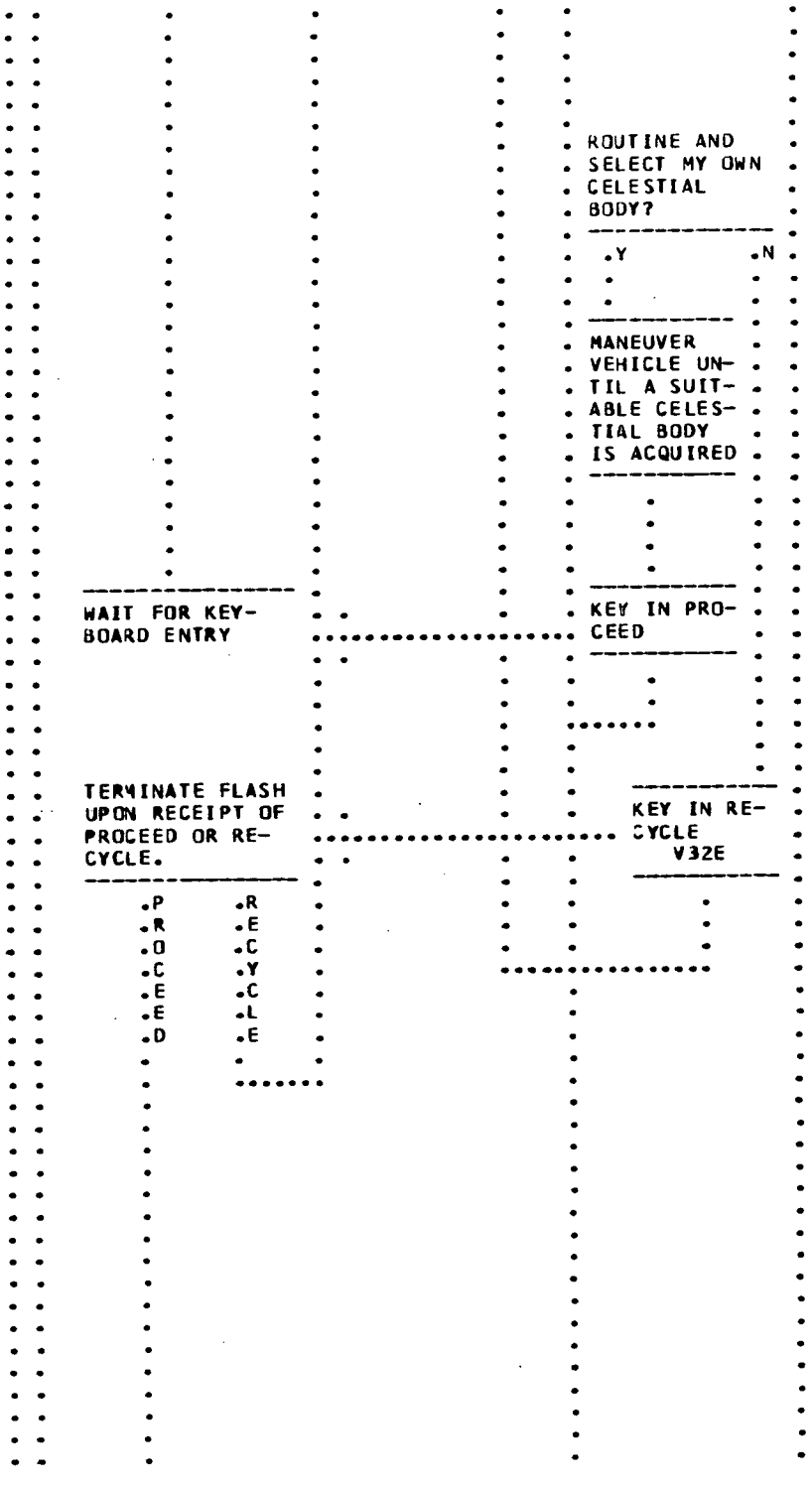
#780

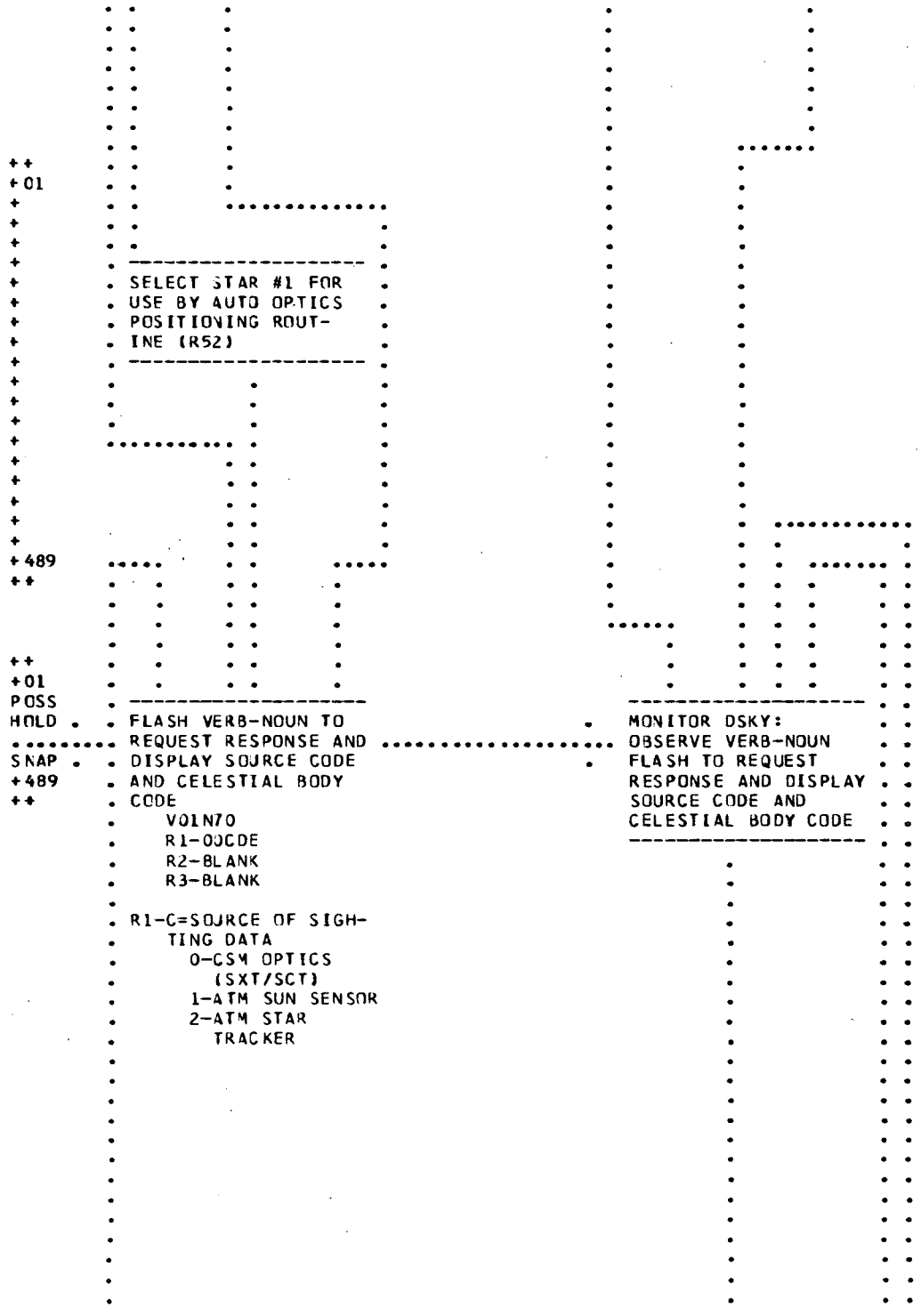
#790

#800

#810


MAY BE ACQUIRED. MONITOR FDAI BALL TO AVOID GIMBAL LOCK. (NOTE: ASTRONAUT MAY USE OPTICS TO ASSIST ATTITUDE CHOICE OR MAY MANEJVER AT RANDOM.)
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF ENTER OR PROCEED
.ENTER
.PROCEED
DO STAR SELECTION ROUTINE (REFER TO SECTION 5.6 OF R693)
.TWO STARS AVAILABLE
.TWO STARS NOT AVAILABLE
MONITOR DSKY: DOES ALARM CODE DISPLAY INDICATE THAT TWO STARS ARE NOT AVAILABLE IN THE SXT FIELD OF VIEW?
.Y
.N
PCSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY ALARM CODE:
V05N09
R1-
R2-
R3-
EXPECTED ALARM CODE AT THIS TIME IS 405
SHALL I BYPASS STAR SELECTION
#820
#830
#840
#850
#860


ROUTINE AND SELECT MY OWN CELESTIAL BODY?
.Y
.N
MANEUVER VEHICLE UNTIL A SUITABLE CELESTIAL BODY IS ACQUIRED
KEY IN PROCEED
KEY IN RECYCLE V32E
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR RECYCLE.
.PROCEED
.RECYCLE
#870
#880
#890
#900
#910

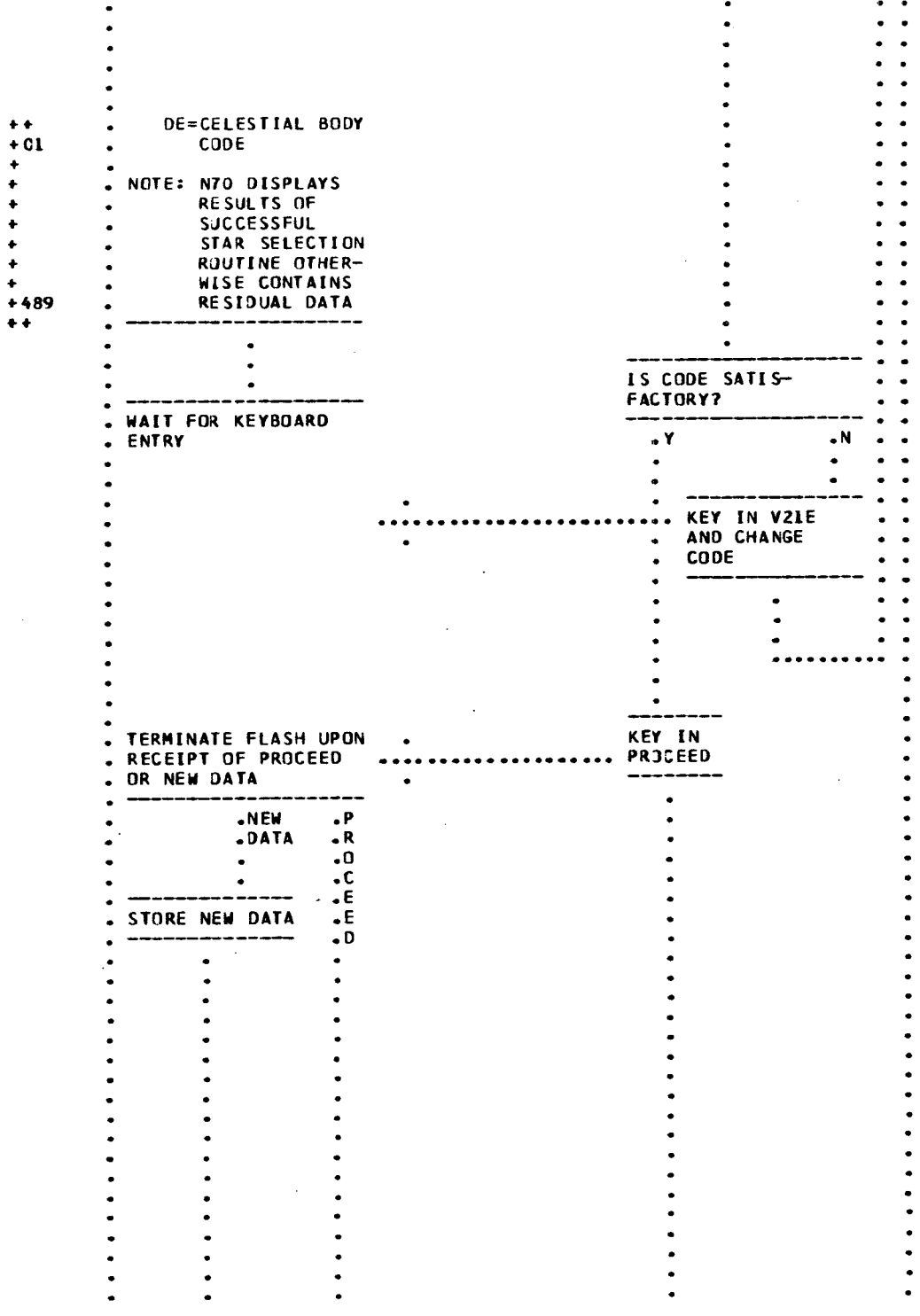


#920

#930

#940

#950



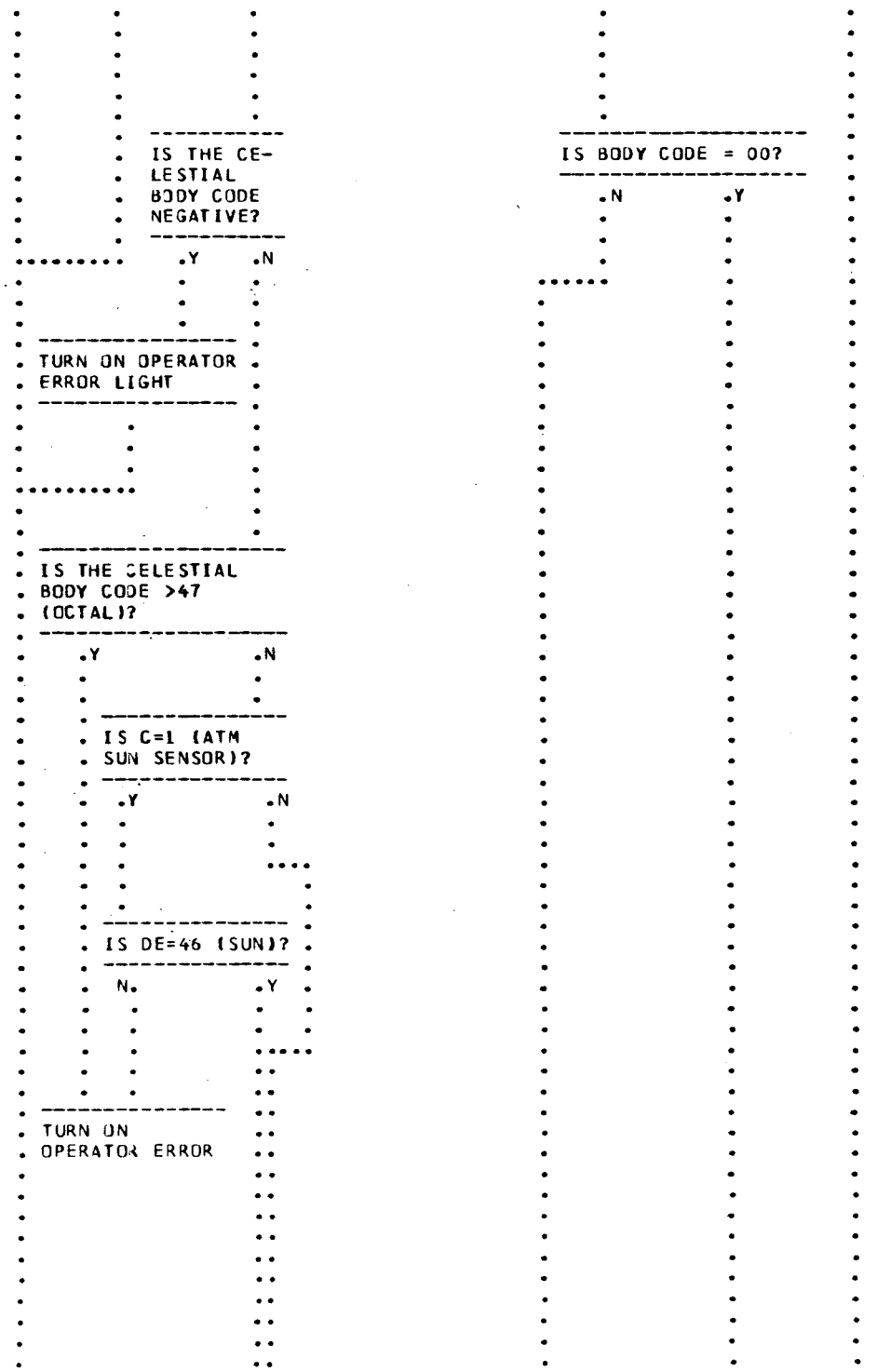
#960

#970

#980

#990

#L000



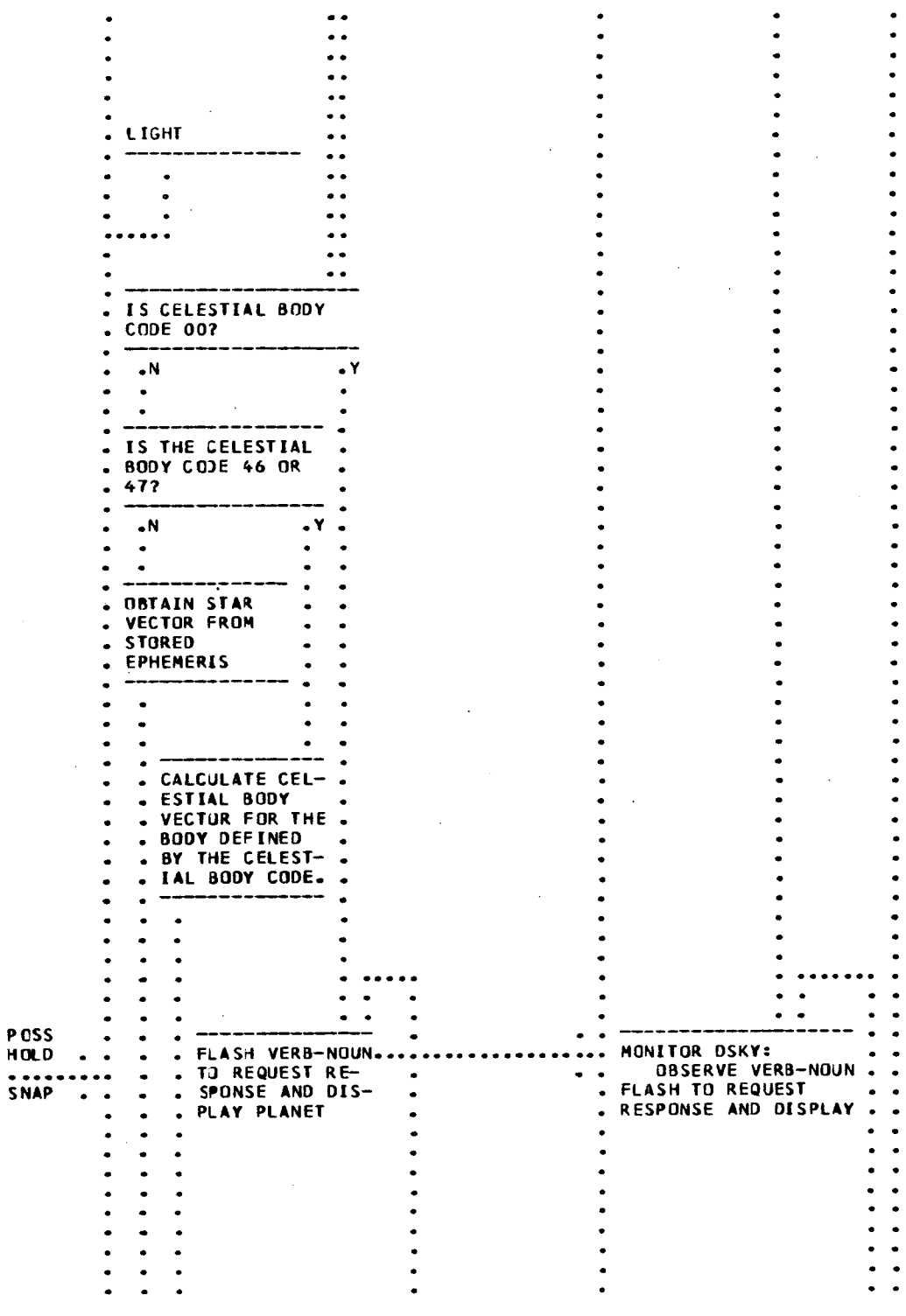
#1010

#1020

#1030

#1040

#1050



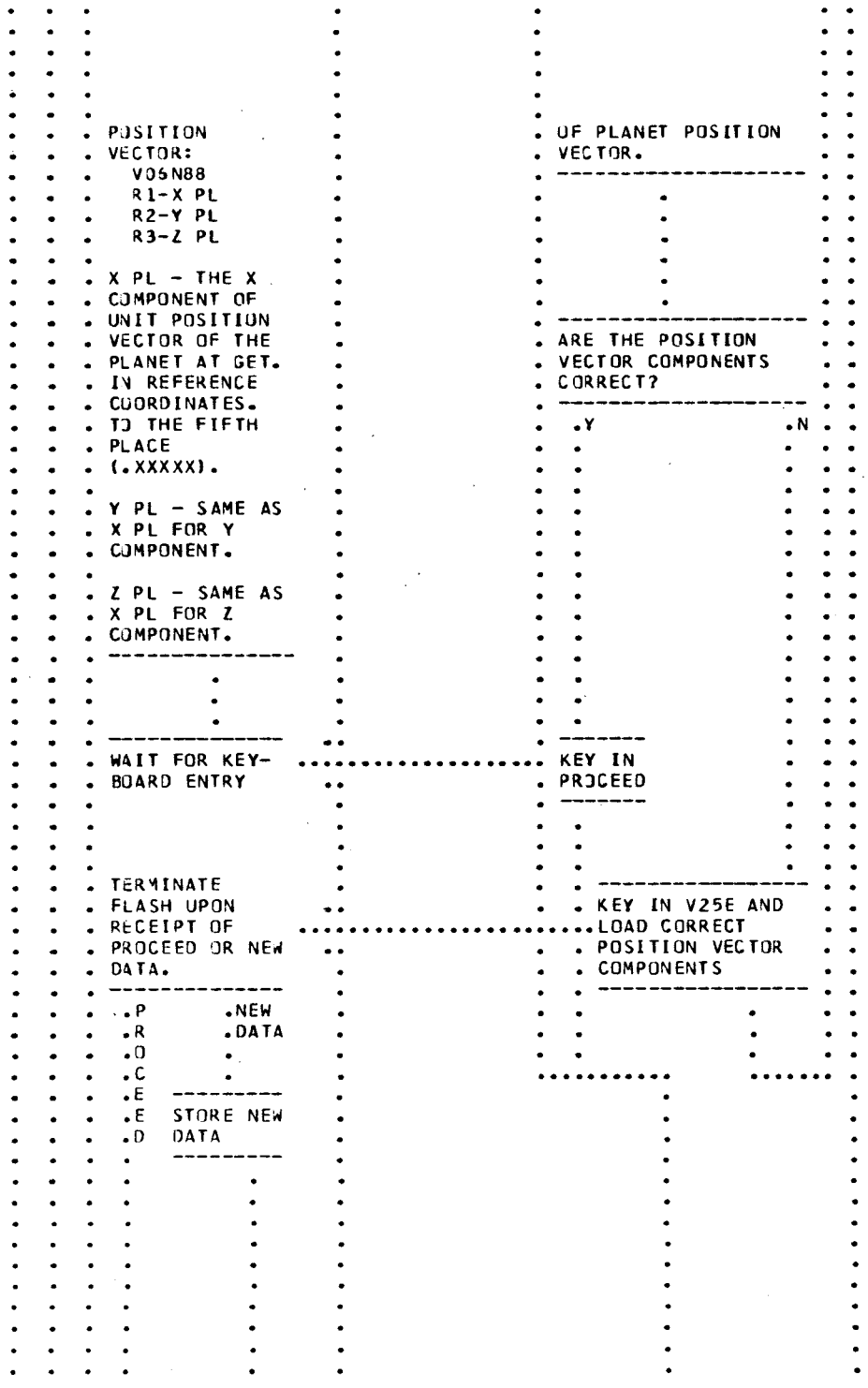
#1060

#1070

#1080

#1090

#1100



#1110

#1120

#1130

#1140

#1150

#1160

IS C=0 (CSM OPTICS)?

.Y

DO SIGHTING MARK ROUTINE (R53)

.N

WAS CSM OPTICS SELECTED?

.Y

DO SIGHTING MARK ROUTINE (R53)

.N

#1170

DO AUTO OPTICS POSITIONING ROUTINE R52 (INCLUDES SIGHTING MARK ROUTINE (R53))

DO AUTO OPTICS POSITIONING ROUTINE R52 (INCLUDES SIGHTING MARK ROUTINE (R53))

#1180

#1190

IS CELESTIAL BODY CODE 00?

.N

.Y

IS THE CELESTIAL BODY CODE 46 OR 47?

.N

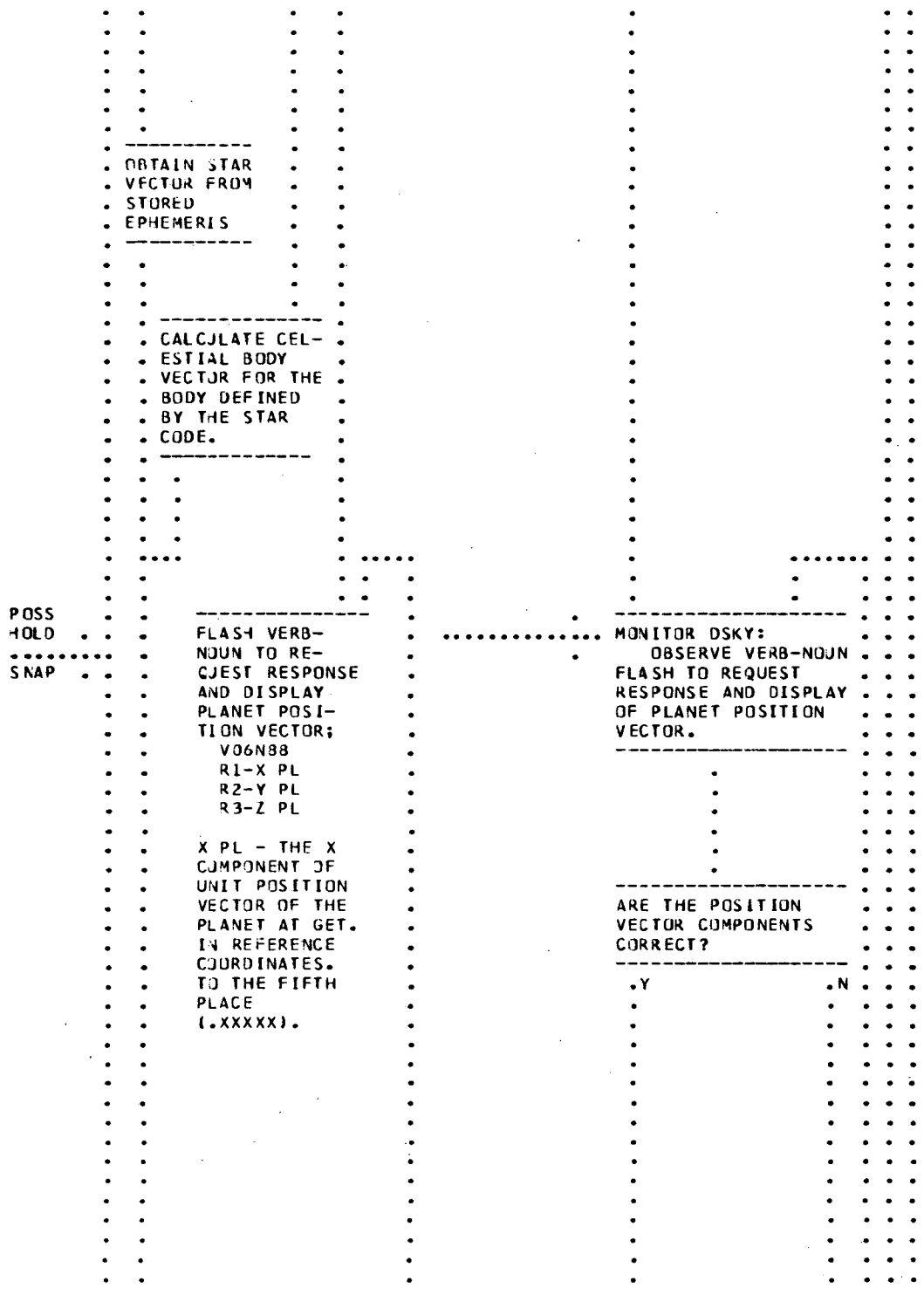
Y.

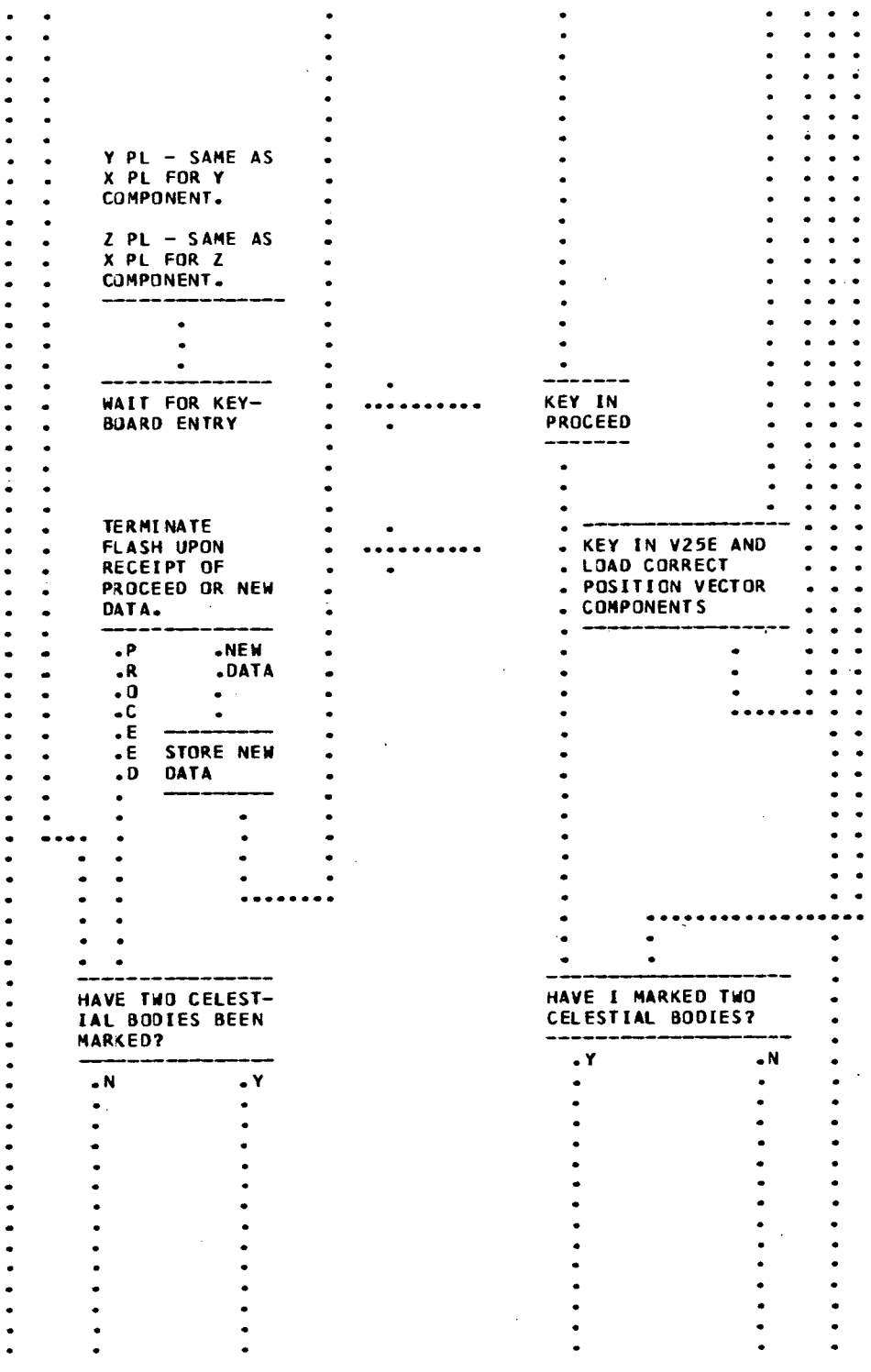
IS THE TARGET A STAR OR THE EARTH OR SUN?

.N

.Y

#1200


OBTAIN STAR VECTOR FROM STORED EPHEMERIS
CALCULATE CELESTIAL BODY VECTOR FOR THE BODY DEFINED BY THE STAR CODE.
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY PLANET POSITION VECTOR;
V06N88
R1-X PL
R2-Y PL
R3-Z PL
X PL - THE X COMPONENT OF UNIT POSITION VECTOR OF THE PLANET AT GET. IN REFERENCE COORDINATES. TO THE FIFTH PLACE (.XXXXX).
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF PLANET POSITION VECTOR.
ARE THE POSITION VECTOR COMPONENTS CORRECT?
.Y
.N
#1210
#1220
#1230
#1240
#1250



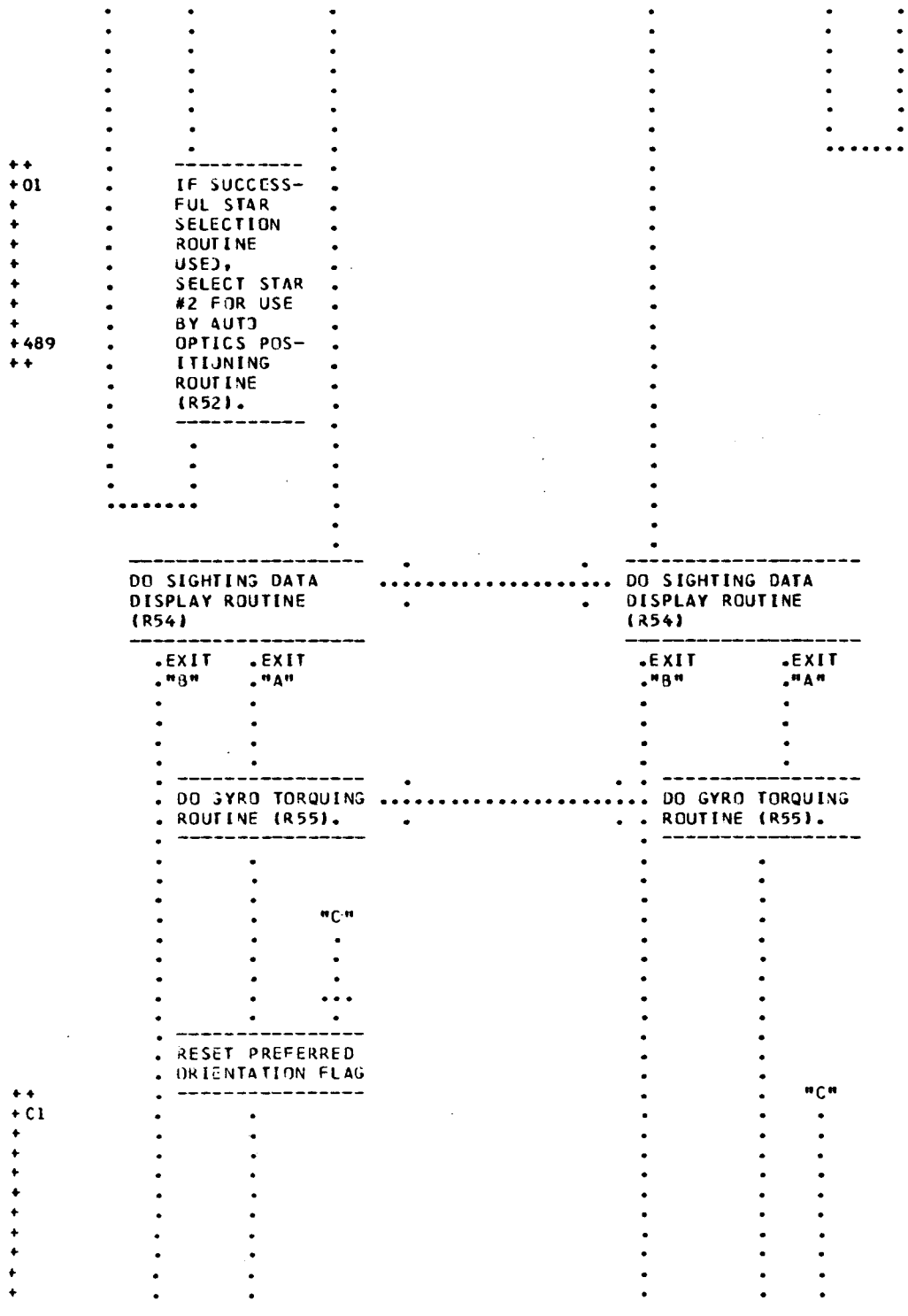
#1260

#1270

#1280

#1290

#1300



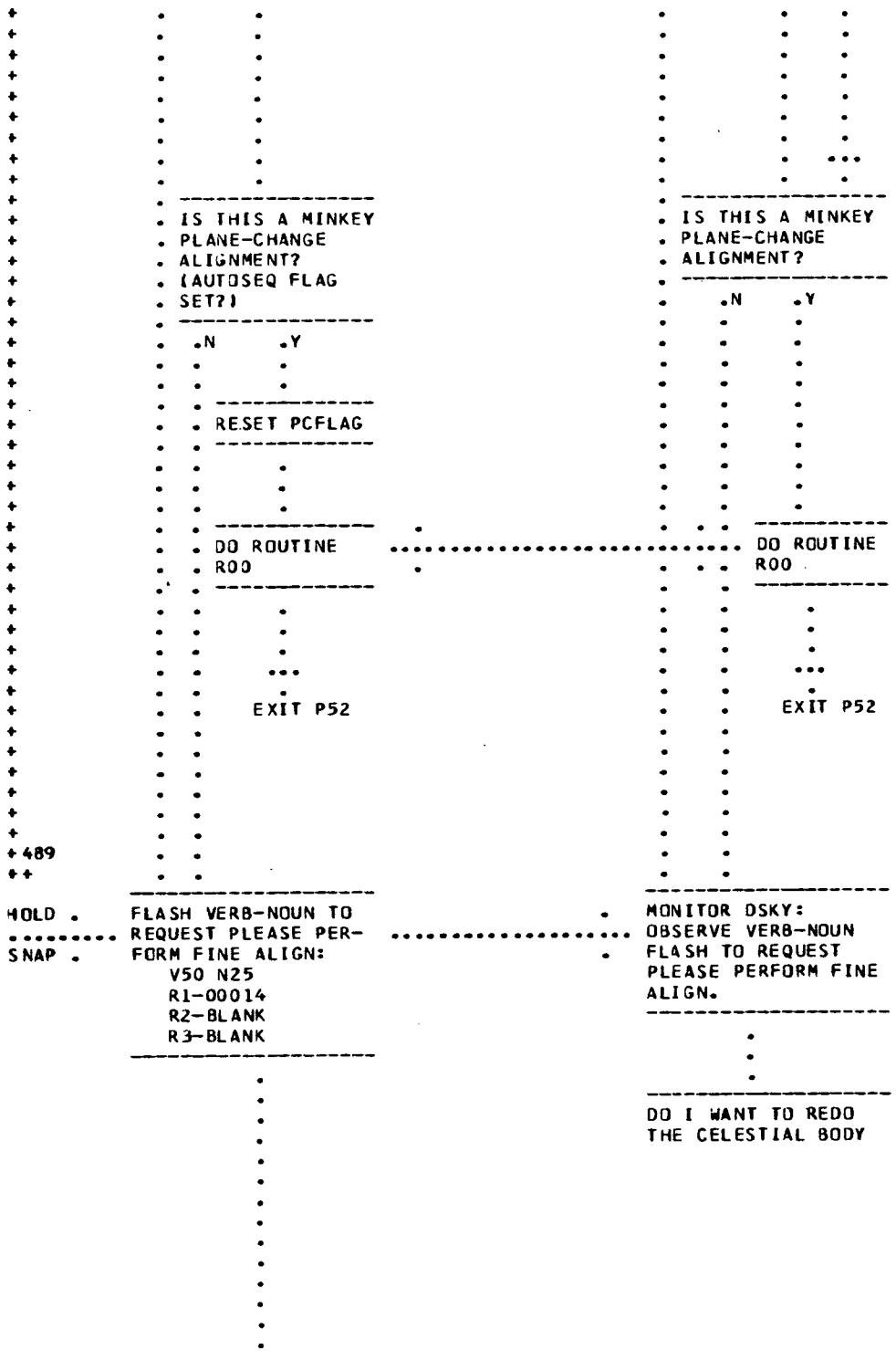
#1310

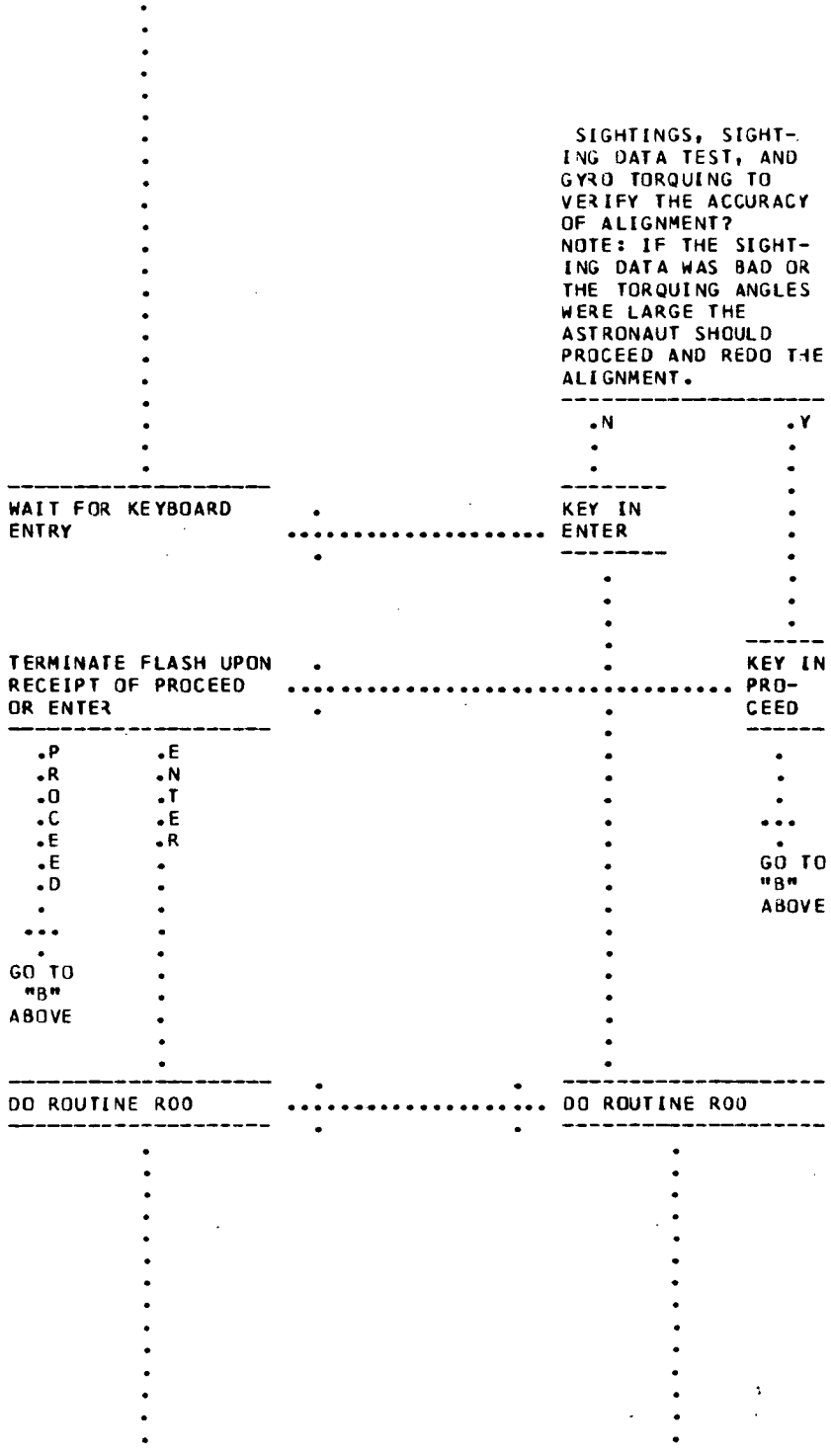
#1320

#1330

#1340

#1350


IS THIS A MINKEY PLANE-CHANGE ALIGNMENT? (AUTOSEQ FLAG SET?)
.N
.Y
RESET PCFLAG
DO ROUTINE R00
EXIT P52
IS THIS A MINKEY PLANE-CHANGE ALIGNMENT?
.N
.Y
DO ROUTINE R00
EXIT P52
#1360
#1370
#1380
#1390
#1400
489
HOLD .
SNAP .
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM FINE ALIGN:
V50 N25
R1-00014
R2-BLANK
R3-BLANK
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM FINE ALIGN.
DO I WANT TO REDO THE CELESTIAL BODY



#1410

#1420

#1430

#1440

#1450

CHANGE CONTROL NOTES

REV 00 PCR 013,040,043,415,416,424, PCN 410,436,457
REV 01 PCN 489

BACKUP IMU ORIENTATION DETERMINATION PROGRAM (P53) REV 01 03/20/72

PURPOSE: (1) TO DETERMINE THE INERTIAL ORIENTATION OF THE IMU USING A BACKUP OPTICAL DEVICE, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

ASSUMPTIONS: (1) THE IMU MAY BE:

(A) OFF (STANDBY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED.
IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED.

(2) THIS PROGRAM AND ITS ROUTINES HAVE THE SAME DISPLAY SEQUENCE AS P51 EXCEPT THAT R56 IS CALLED IN PLACE OF R53.

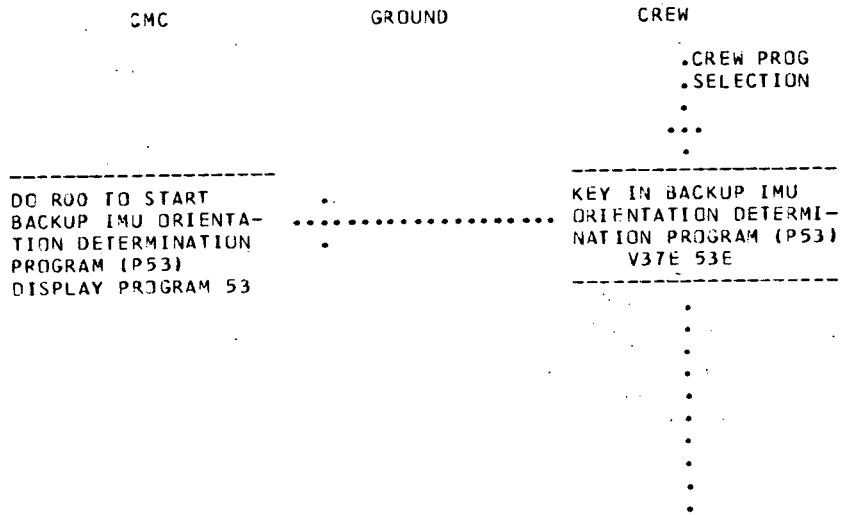
(3) THE CSM ATTITUDE CONTROL MODE SELECTED IS AT THE OPTION OF THE CREW.

(4) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS.

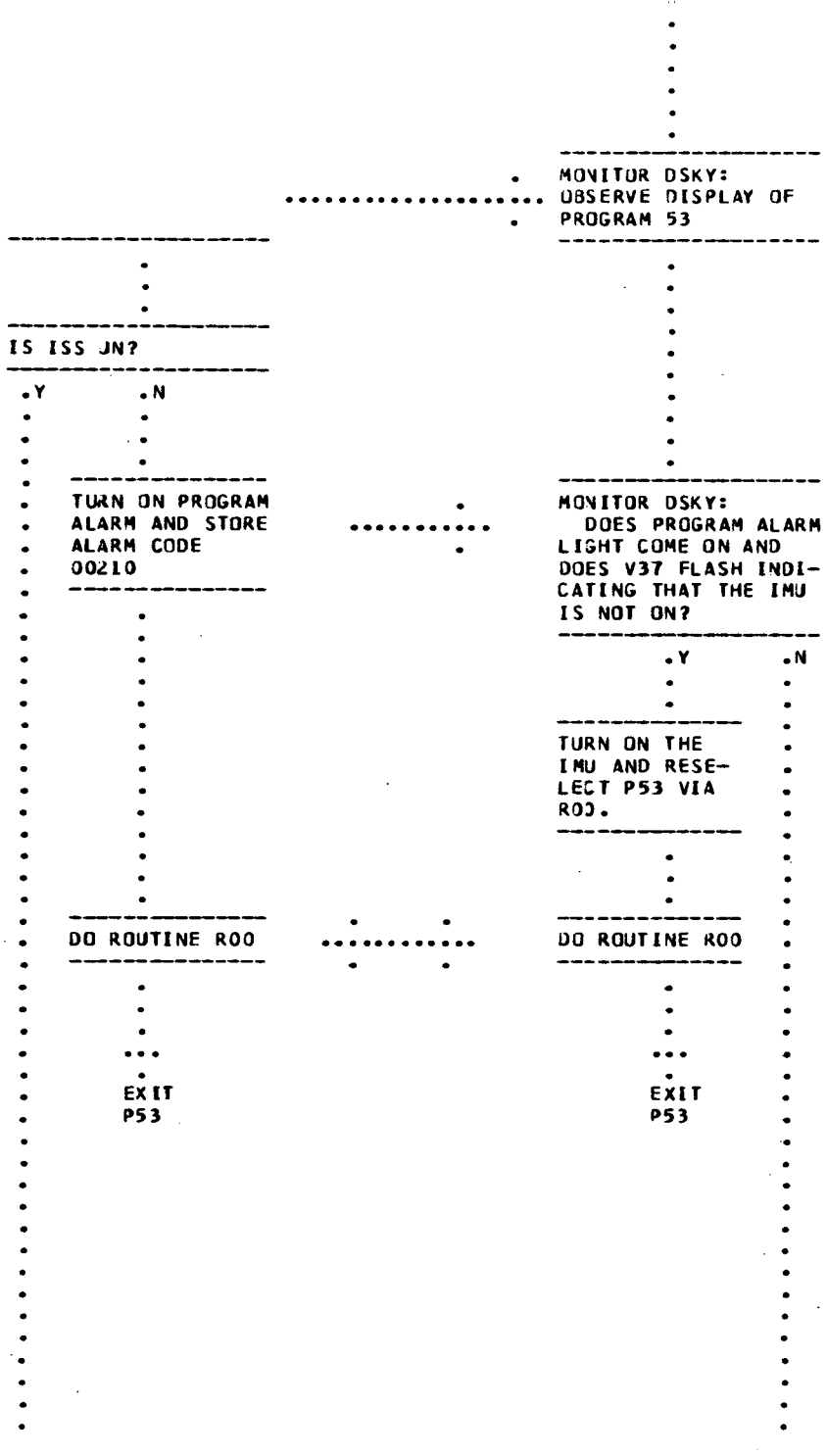
(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



#10


MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 53
IS ISS ON?
Y
N
TURN ON PROGRAM
ALARM AND STORE
ALARM CODE
00210
MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON AND
DOES V37 FLASH INDI-
CATING THAT THE IMU
IS NOT ON?
Y
N
TURN ON THE
IMU AND RESE-
LECT P53 VIA
ROD.
DO ROUTINE R00
DO ROUTINE R00
EXIT
P53
EXIT
P53

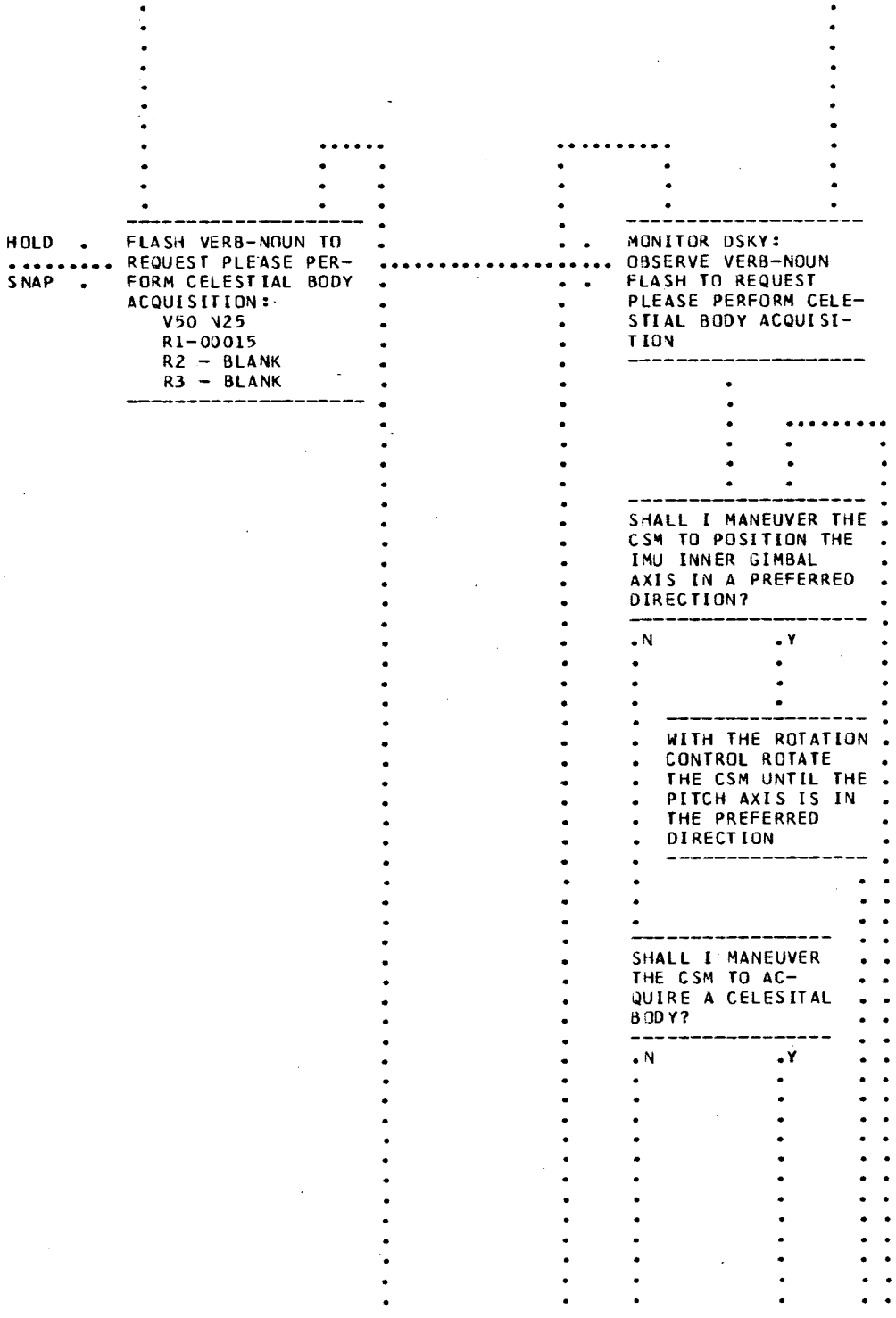
#20

#30

#40

#50

#60


HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM CELESTIAL BODY ACQUISITION:
V50 V25
R1-00015
R2 - BLANK
R3 - BLANK
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM CELESTIAL BODY ACQUISITION
#70
SHALL I MANEUVER THE CSM TO POSITION THE IMU INNER GIMBAL AXIS IN A PREFERRED DIRECTION?
#80
N
Y
WITH THE ROTATION CONTROL ROTATE THE CSM UNTIL THE PITCH AXIS IS IN THE PREFERRED DIRECTION
#90
SHALL I MANEUVER THE CSM TO ACQUIRE A CELESITAL BODY?
#100
N
Y

#110

WITH THE ROT-
ATIONAL HAND
CONTROLLER
ORIENT THE CSM

#120

MONITOR FDAI BALL
IS GIMBAL LOCK
IMPENDING?

.Y .N

#130

SHALL I
COARSE
ALIGN IMU
TO 0,0,0
GIMBAL
ANGLES?

.N .Y

#140

WAIT FOR KEYBOARD
ENTRY

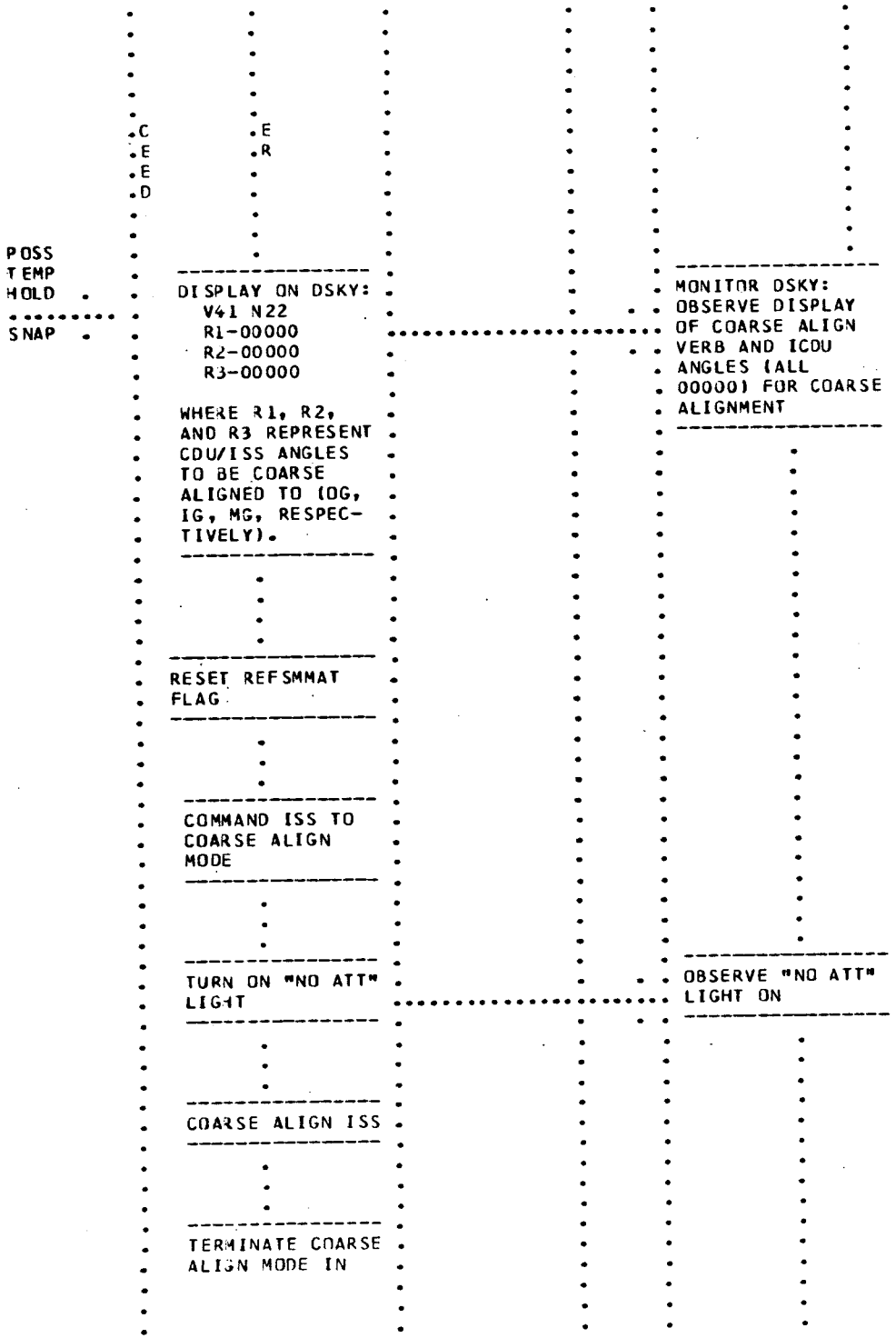
KEY IN
ENTER

#150

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

KEY IN PROCEED

.P .E
.R .N
.O .T



#160

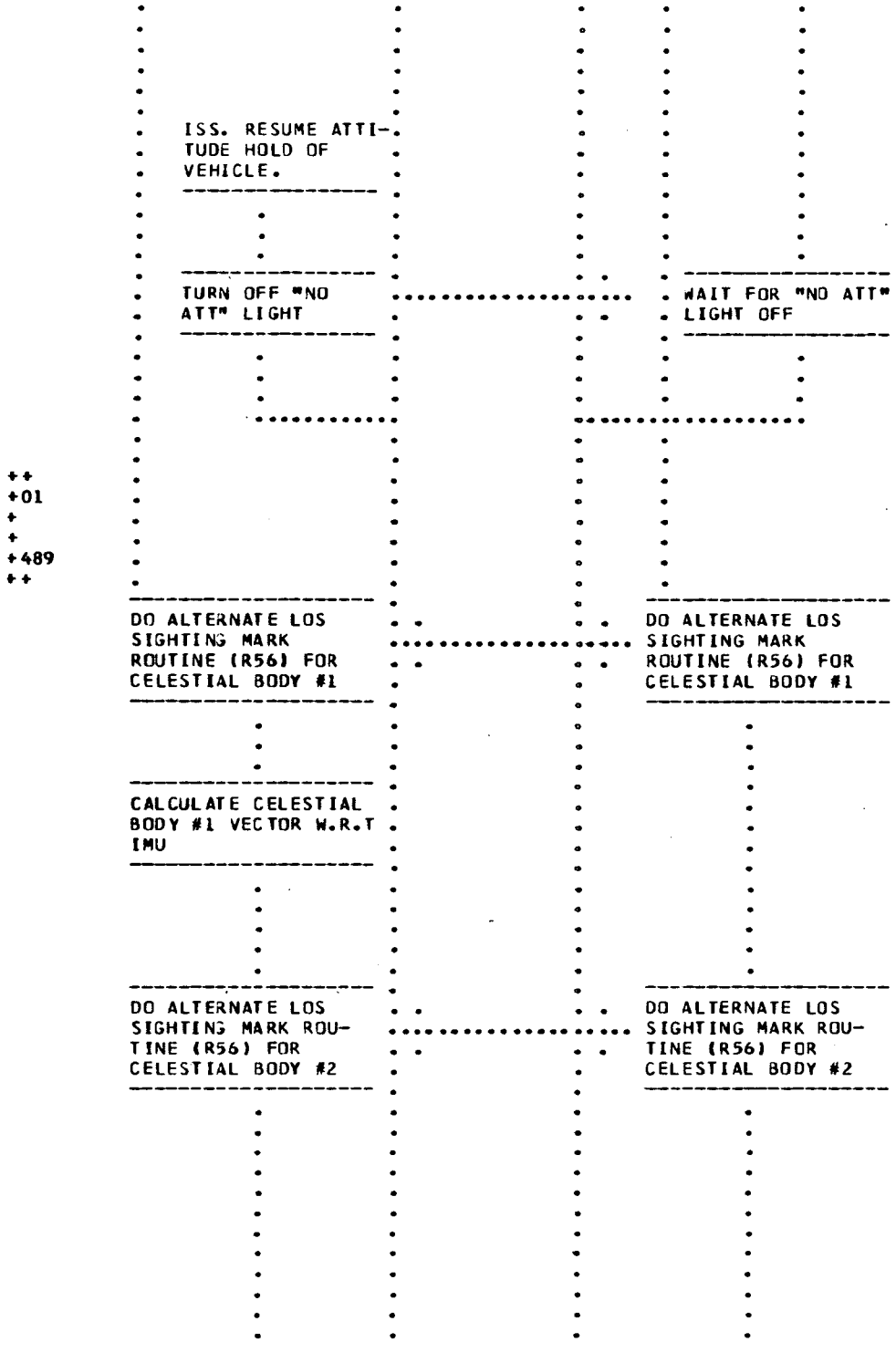
#170

#180

#190

#200

#210



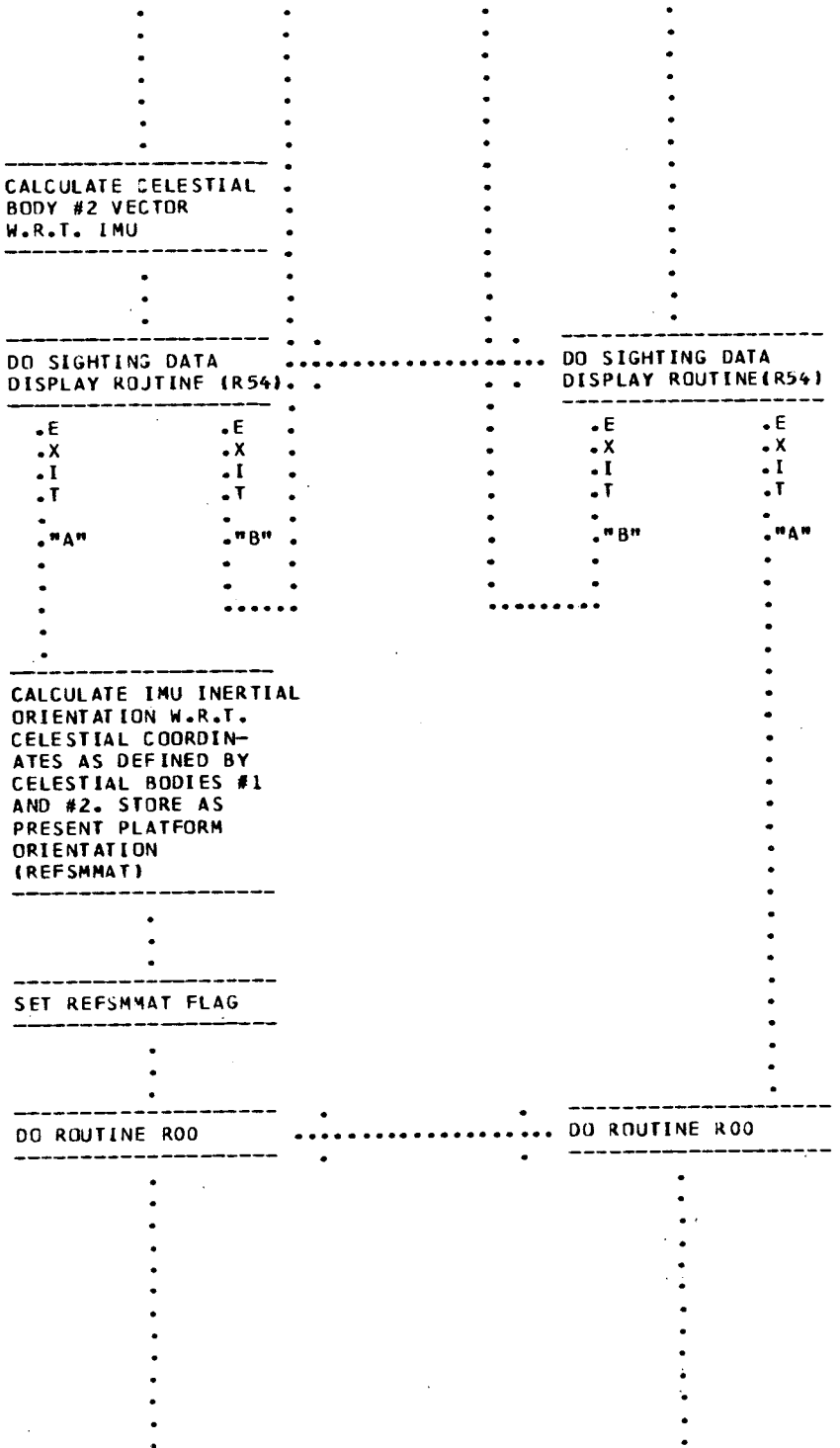
#220

#230

#240

#250

#260


CALCULATE CELESTIAL BODY #2 VECTOR W.R.T. IMU
#270
DO SIGHTING DATA DISPLAY ROUTINE (R54)
DO SIGHTING DATA DISPLAY ROUTINE(R54)
.E .X .I .T ."A"
.E .X .I .T ."B"
.E .X .I .T ."B"
.E .X .I .T ."A"
#280
CALCULATE IMU INERTIAL ORIENTATION W.R.T. CELESTIAL COORDIN- ATES AS DEFINED BY CELESTIAL BODIES #1 AND #2. STORE AS PRESENT PLATFORM ORIENTATION (REFSMMAT)
#290
#300
SET REFSMMAT FLAG
DO ROUTINE R00
DO ROUTINE R00
#310

```
        .
        .
        .
        .
        .
        .
        .
       ...
        .
      EXIT
      P53
```

```
        .
        .
        .
        .
        .
        .
        .
       ...
        .
      EXIT
      P53
```

CHANGE CONTROL NOTES

REV 00 PCR 414, PCN 436
REV 01 PCN 489

BACKUP IMU REALIGN PROGRAM (P54) REV 01 03/20/72

PURPOSE: (1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 4) ORIENTATION TO ONE OF THREE ORIENTATIONS SELECTED BY THE ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH A BACKUP OPTICAL DEVICE, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

(A) PREFERRED ORIENTATION

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE CALCULATED AND STORED BY A PREVIOUSLY SELECTED PROGRAM.

(B) NOMINAL ORIENTATION

$$X_{-SM} = UNIT(Y_{-SM} \times Z_{-SM})$$

$$Y_{-SM} = UNIT(V \times R)$$

$$Z_{-SM} = UNIT(-R)_{-SM}$$

WHERE:

$\underline{R}$ = THE GEOCENTRIC RADIUS VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT

$\underline{V}$ = THE INERTIAL VELOCITY VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT.

(C) REFSMMAT

SEE ASSUMPTION (4)

ASSUMPTIONS: (1) THE DOCKED CONFIGURATION MAY BE SIVB/CSM, SKYLAB/CSM, OR CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO THE CMC BY COMPLETION OF EITHER ROUTINE R03 OR R04 AND EITHER V45 OR V46 (DEPENDING ON CONFIGURATION).

(2) IF THE S/C CONTROL SWITCH IS IN CMC AND THE MODE SWITCH IS IN ATTITUDE HOLD OR AUTO DURING THE GYRO TORQUING ROUTINE (R55) OR THE GYRO TORQUING OPTION (ENTER ON V50N25,R1=13), OR THE GYRO TRIM PORTION OF COARSE ALIGN ROUTINE (R50), THE CAP WILL MANEUVER THE VEHICLE TO FOLLOW THE PLATFORM.

(3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MANEUVER, IF DESIRED, MUST BE DONE MANUALLY.

(4) THE ISS IS ON AND HAS BEEN ALIGNED TO A KNOWN ORIENTATION WHICH IS STORED IN THE CMC (REFSMMAT). THE PRESENT IMU ORIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRO DRIFT (I.E. NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST ALIGNMENT).

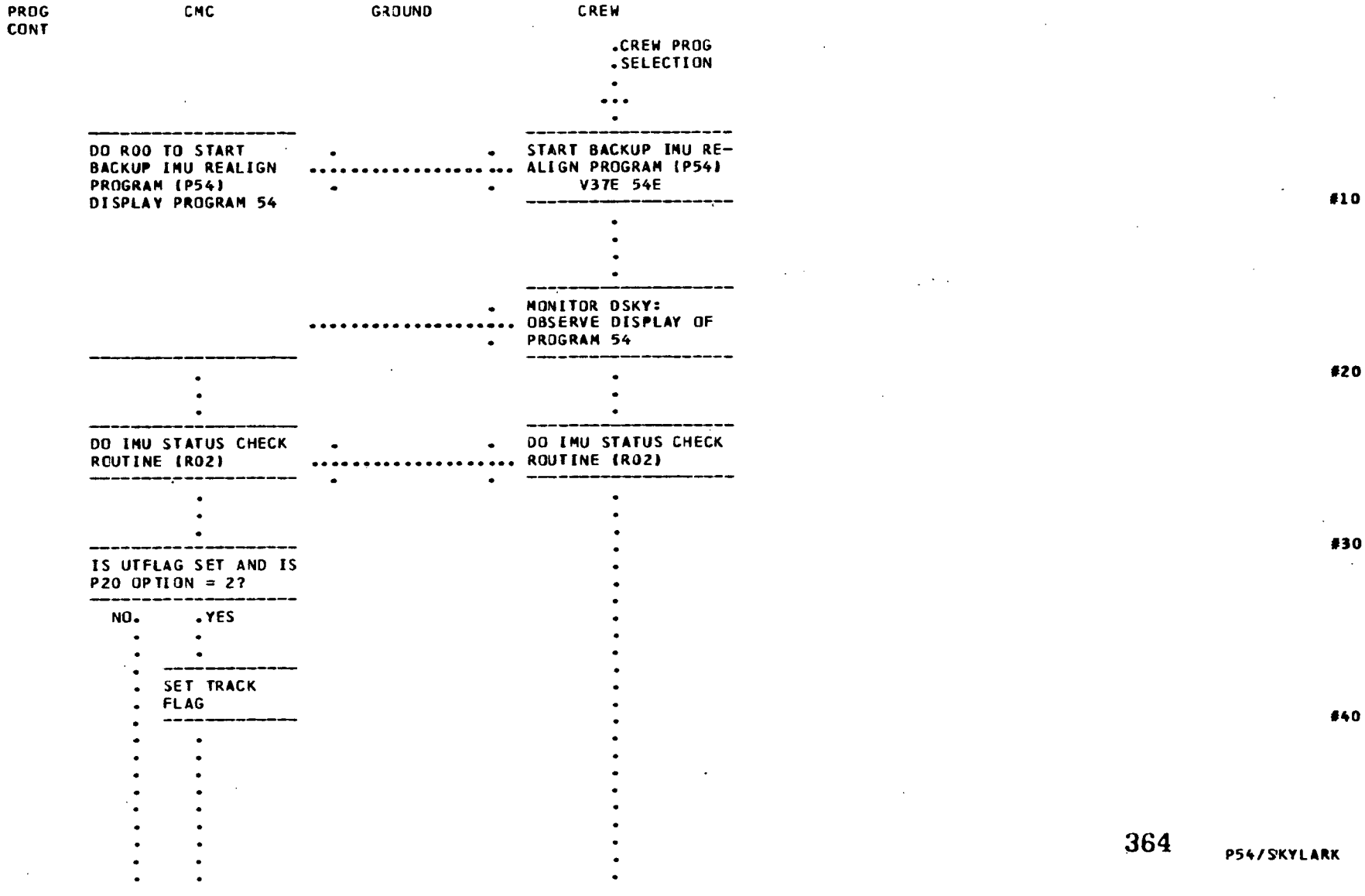
(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

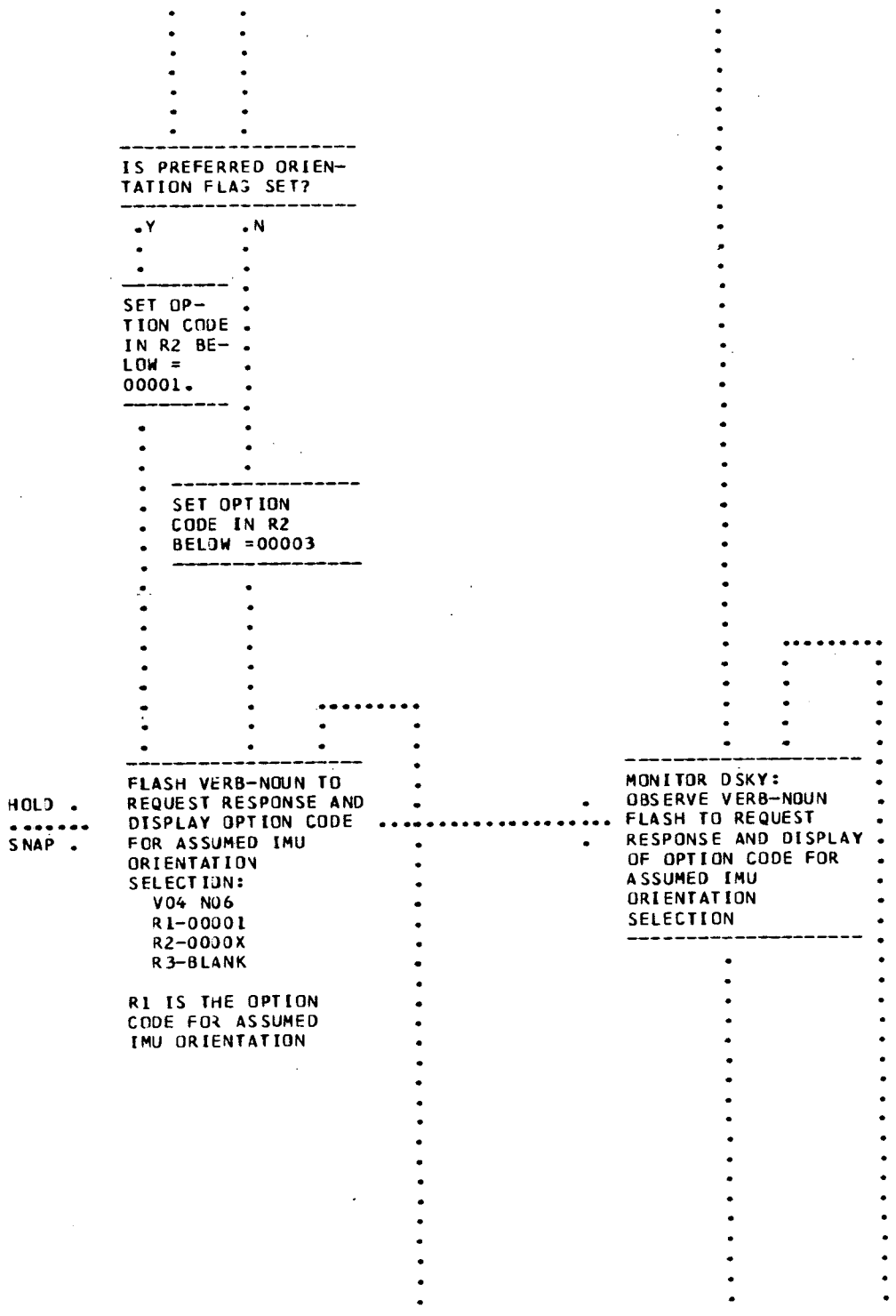
(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTA-

TION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(8) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



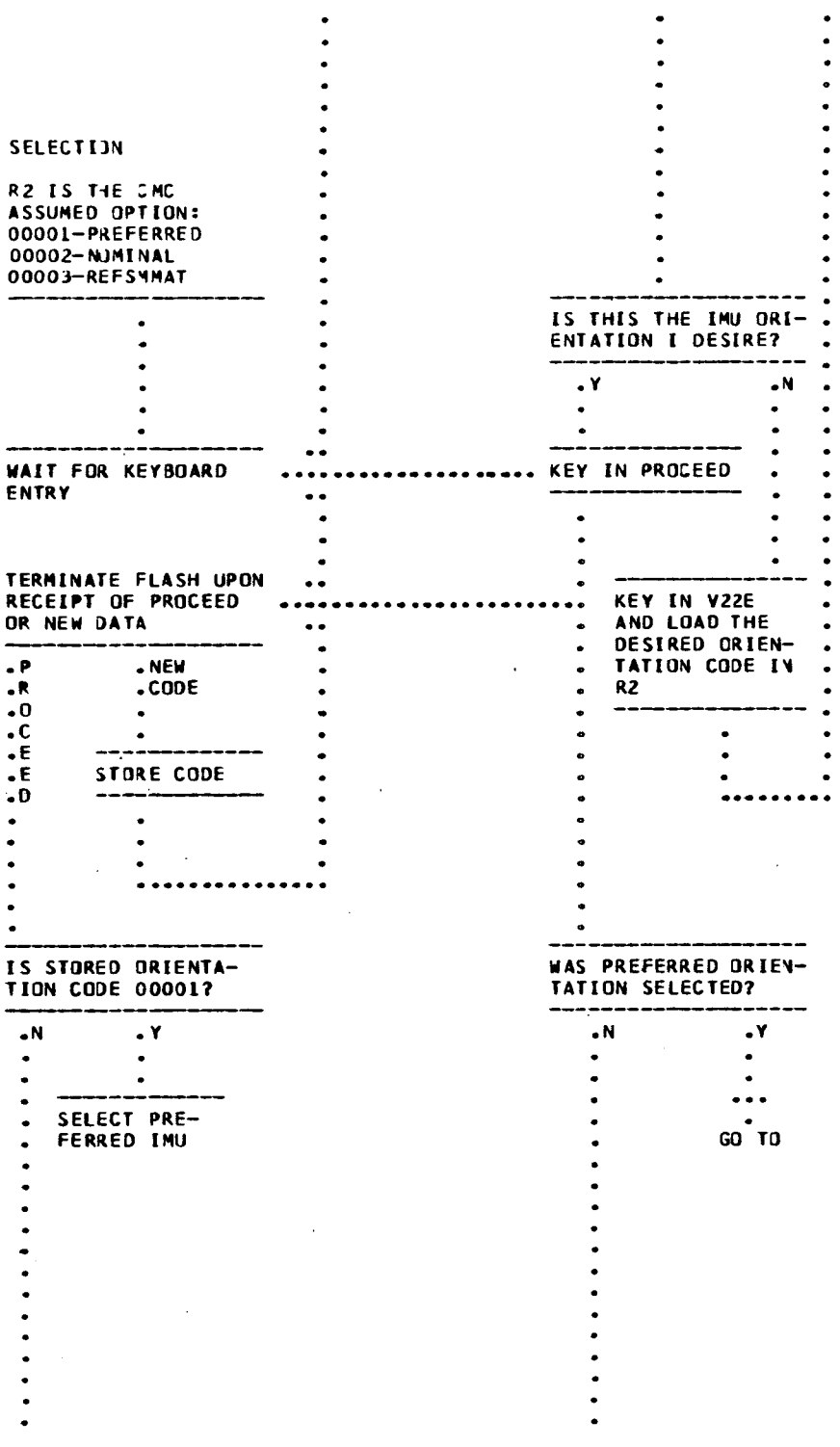

IS PREFERRED ORIEN-
TATION FLAG SET?
.Y
.N
SET OP-
TION CODE
IN R2 BE-
LOW =
00001.
SET OPTION
CODE IN R2
BELOW =00003
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED IMU
ORIENTATION
SELECTION:
V04 N06
R1-00001
R2-0000X
R3-BLANK
R1 IS THE OPTION
CODE FOR ASSUMED
IMU ORIENTATION
HOLD .
SNAP .
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED IMU
ORIENTATION
SELECTION

#50

#60

#70

#80



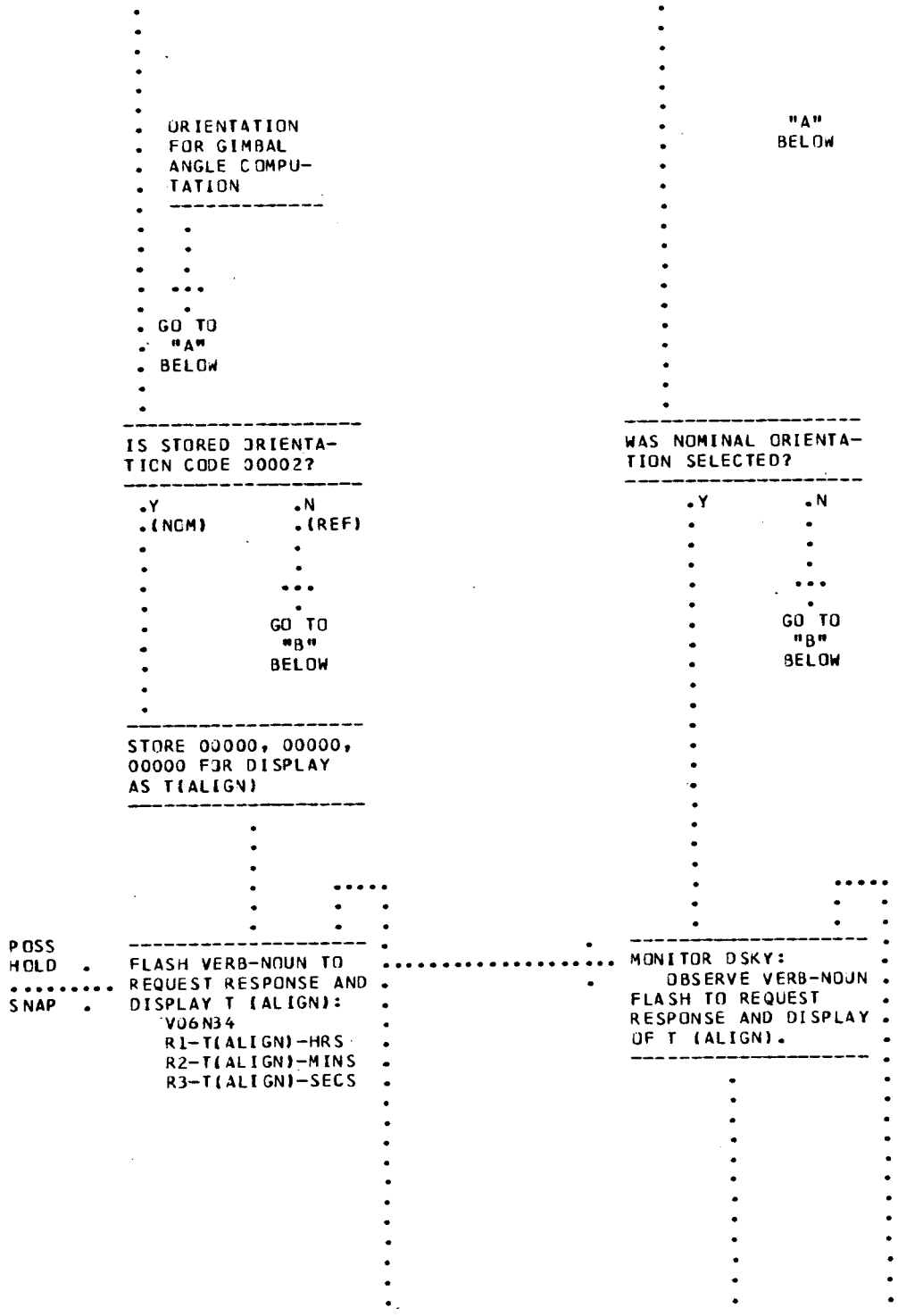
#90

#100

#110

#120

#130



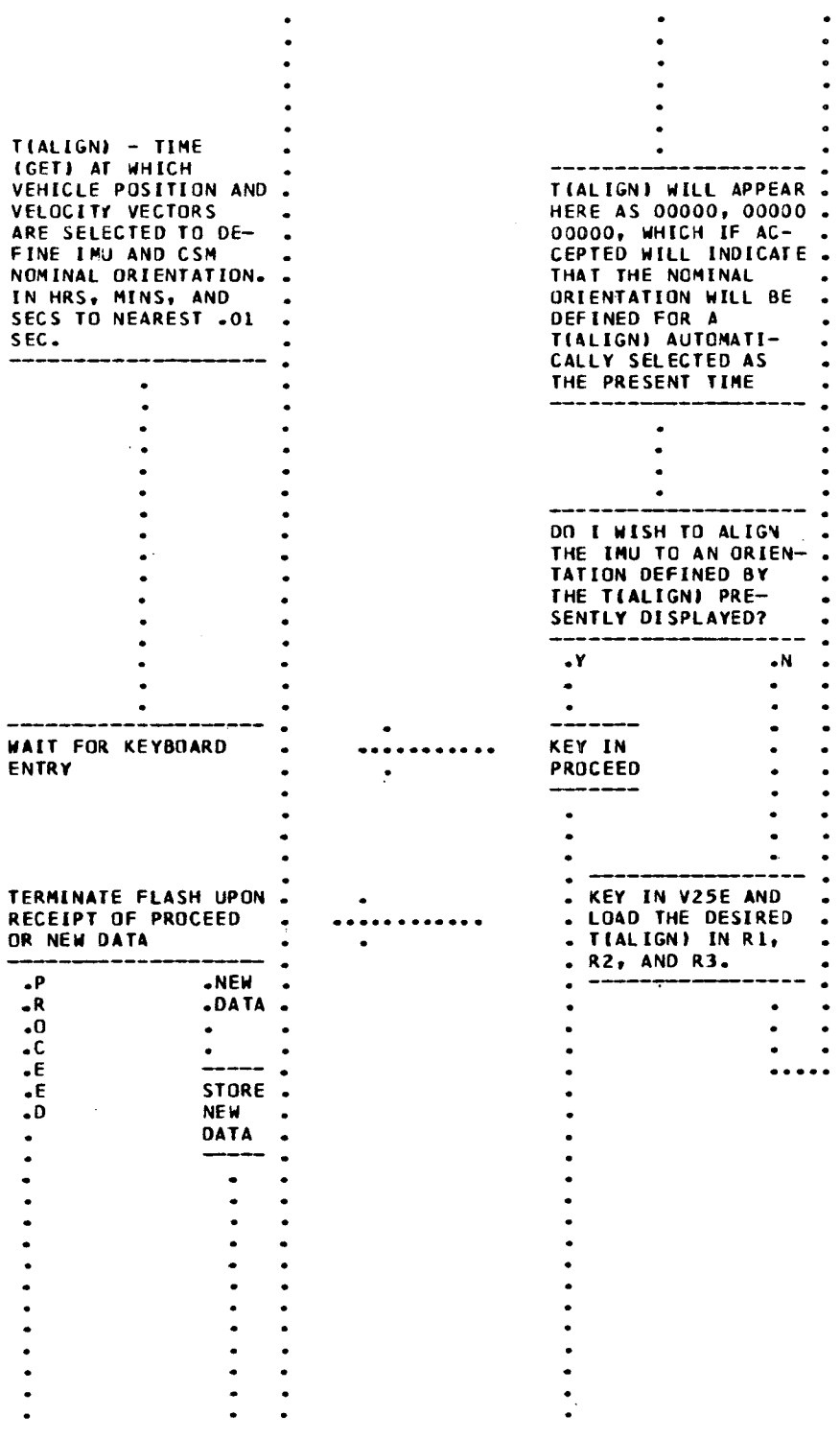
#140

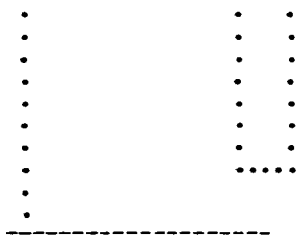
#150

#160

#170

#180


T(ALIGN) - TIME (GET) AT WHICH VEHICLE POSITION AND VELOCITY VECTORS ARE SELECTED TO DEFINE IMU AND CSM NOMINAL ORIENTATION. IN HRS, MINS, AND SECS TO NEAREST .01 SEC.
T(ALIGN) WILL APPEAR HERE AS 00000, 00000 00000, WHICH IF ACCEPTED WILL INDICATE THAT THE NOMINAL ORIENTATION WILL BE DEFINED FOR A T(ALIGN) AUTOMATICALLY SELECTED AS THE PRESENT TIME
#190
#200
DO I WISH TO ALIGN THE IMU TO AN ORIENTATION DEFINED BY THE T(ALIGN) PRESENTLY DISPLAYED?
#210
.Y
.N
WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
#220
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
KEY IN V25E AND LOAD THE DESIRED T(ALIGN) IN R1, R2, AND R3.
.P
.R
.O
.C
.E
.E
.D
.NEW
.DATA
STORE NEW DATA
#230



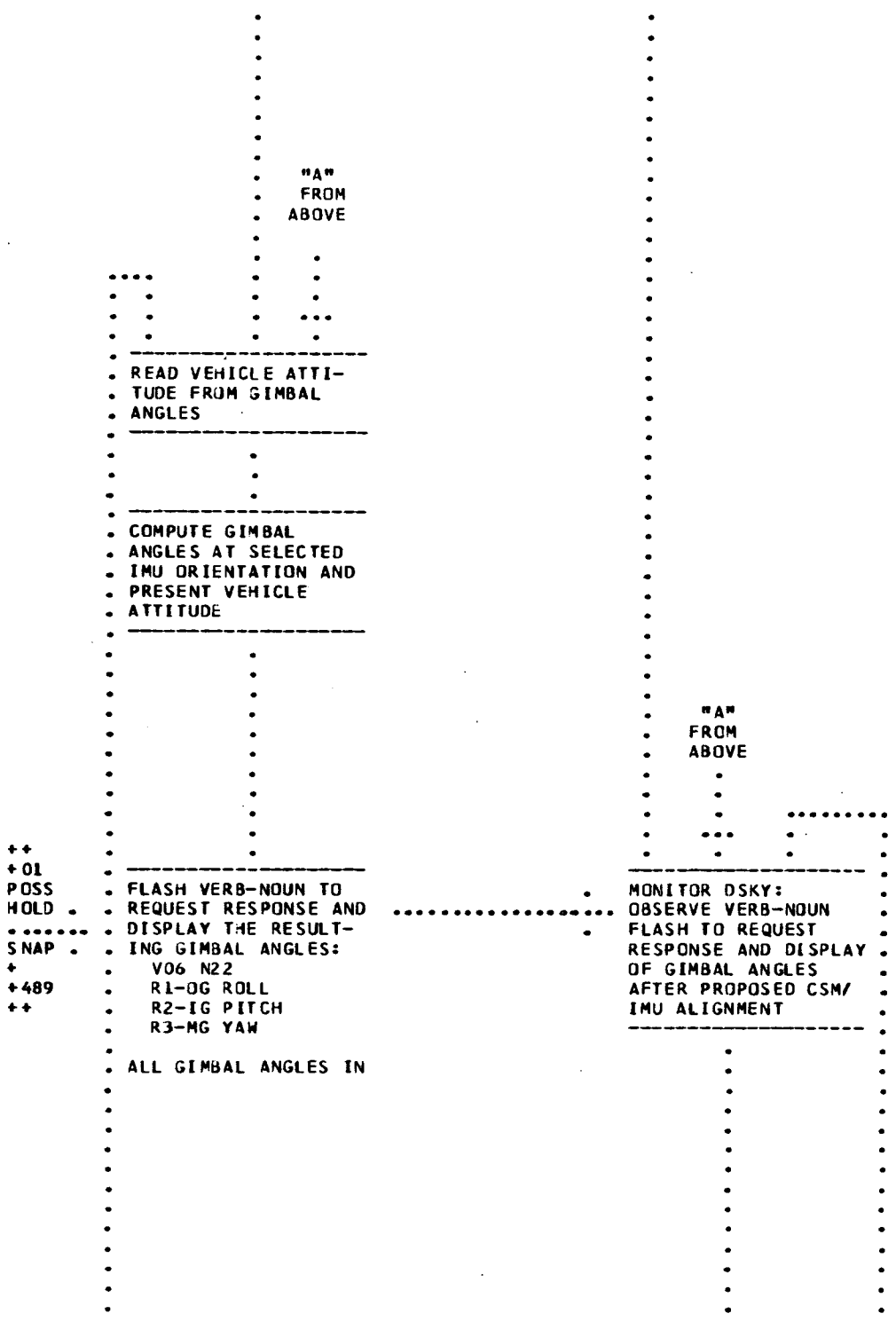
#240

#250

#260

#270

#280



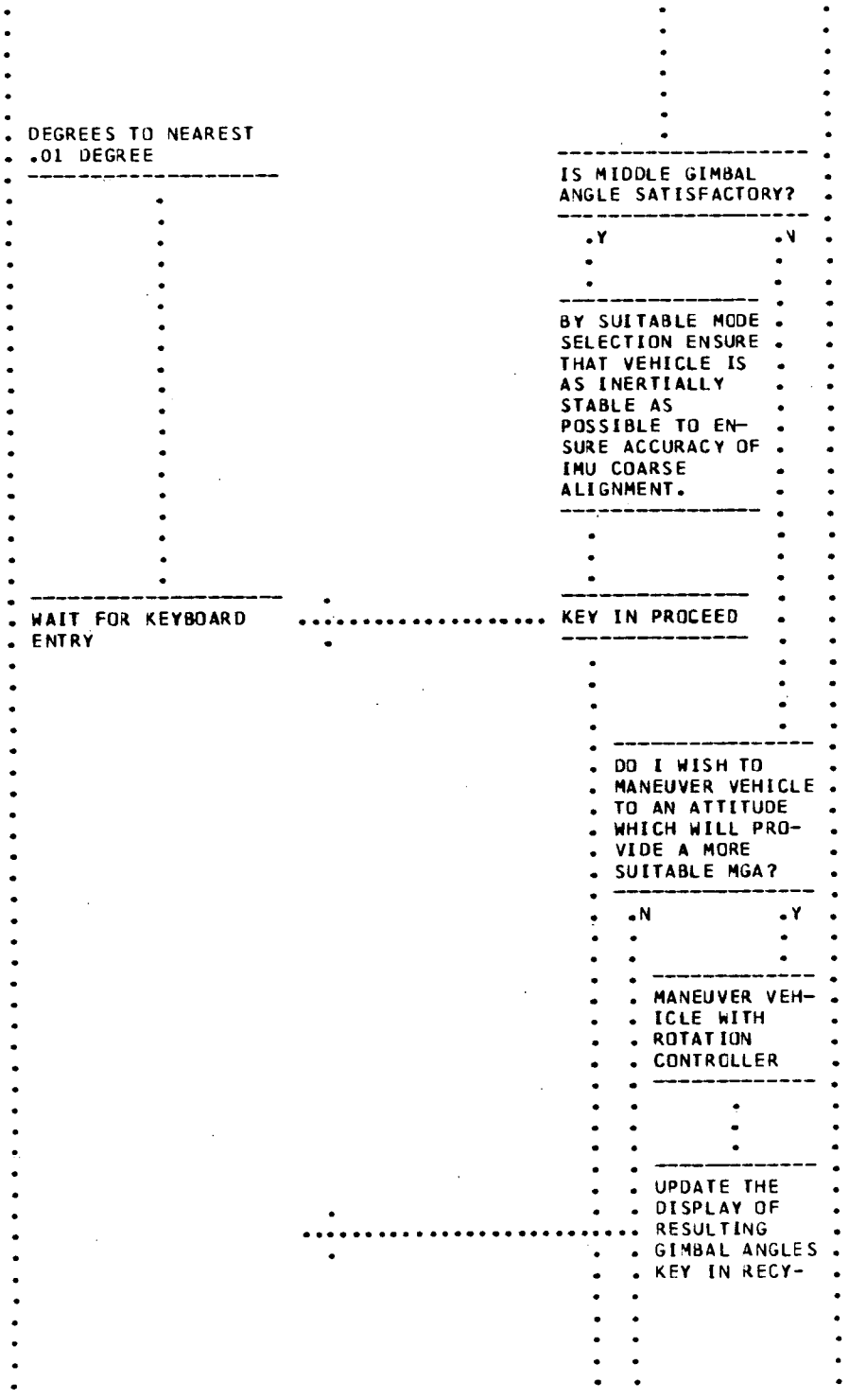
#290

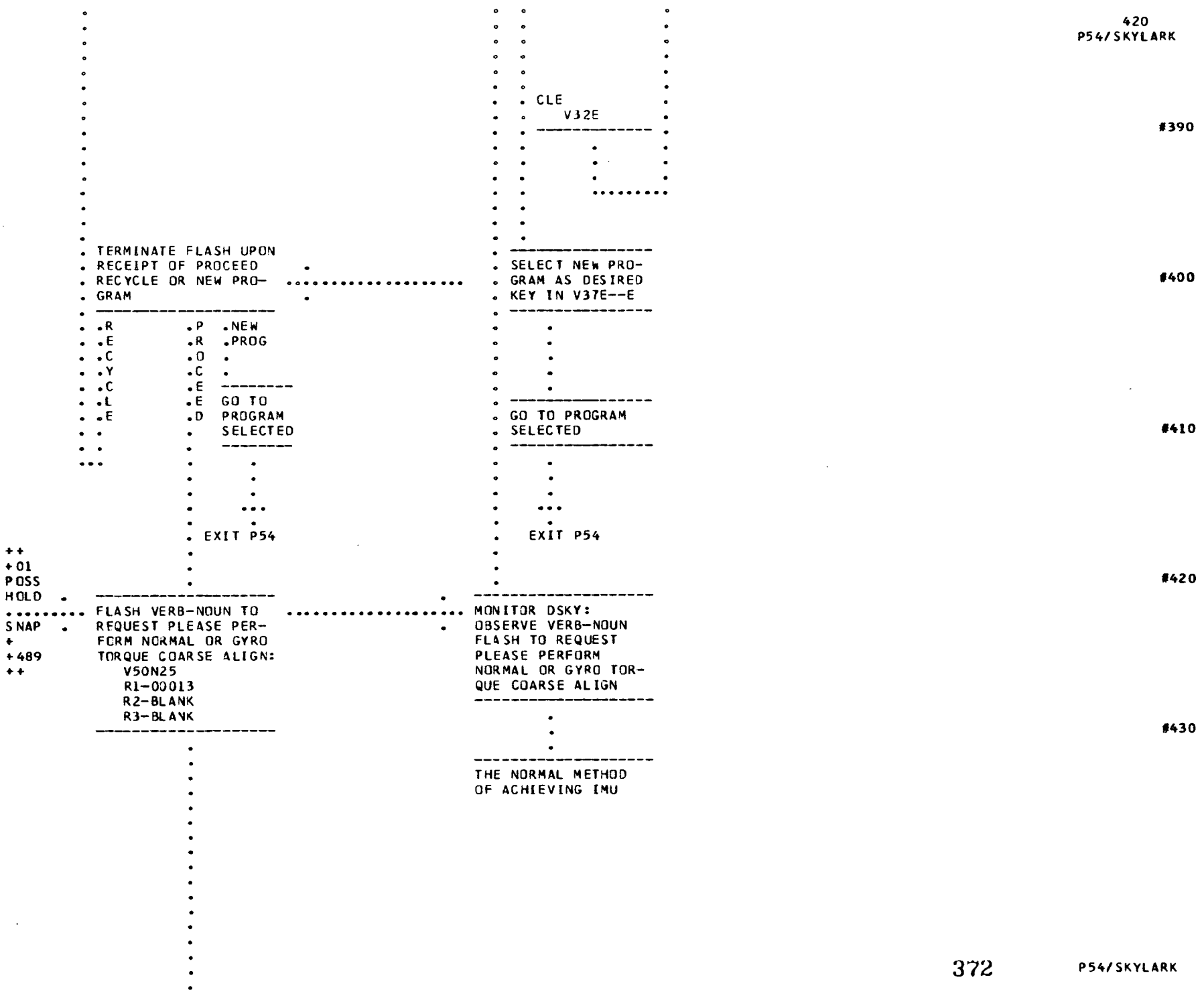
#300

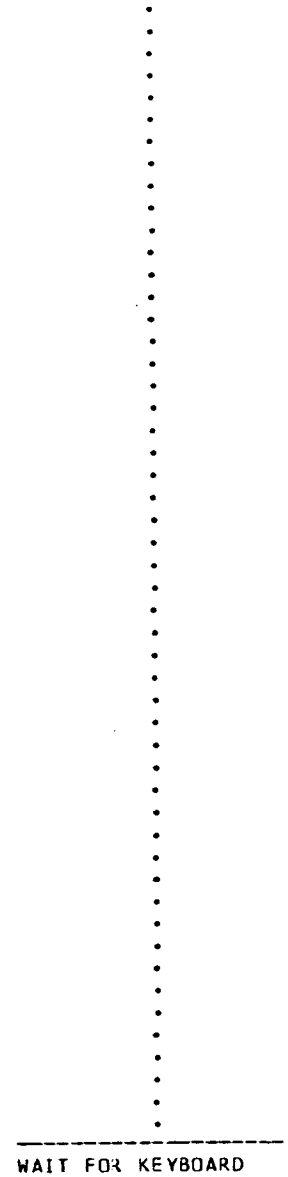
#310

#320

#330


DEGREES TO NEAREST .01 DEGREE
IS MIDDLE GIMBAL ANGLE SATISFACTORY?
.Y
.N
#340
BY SUITABLE MODE SELECTION ENSURE THAT VEHICLE IS AS INERTIALLY STABLE AS POSSIBLE TO ENSURE ACCURACY OF IMU COARSE ALIGNMENT.
#350
WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
#360
DO I WISH TO MANEUVER VEHICLE TO AN ATTITUDE WHICH WILL PROVIDE A MORE SUITABLE MGA?
.N
.Y
#370
MANEUVER VEHICLE WITH ROTATION CONTROLLER
#380
UPDATE THE DISPLAY OF RESULTING GIMBAL ANGLES
KEY IN RECY-


420
P54/SKYLARK
CLE
V32E
#390
TERMINATE FLASH UPON
RECEIPT OF PROCEED
RECYCLE OR NEW PRO-
GRAM
R
E
C
Y
C
L
E
P
R
O
C
E
D
NEW
PROG
GO TO
PROGRAM
SELECTED
SELECT NEW PRO-
GRAM AS DESIRED
KEY IN V37E--E
#400
GO TO PROGRAM
SELECTED
#410
EXIT P54
EXIT P54
++
+01
POSS
HOLD
#420
SNAP
+
+489
++
FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM NORMAL OR GYRO
TORQUE COARSE ALIGN:
V50N25
R1-00013
R2-BLANK
R3-BLANK
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
NORMAL OR GYRO TOR-
QUE COARSE ALIGN
#430
THE NORMAL METHOD
OF ACHIEVING IMU



WAIT FOR KEYBOARD
ENTRY

REALIGNMENT IS TO
ACCEPT THIS REQUEST
BY KEYING IN PROCEED
WHICH WILL CAUSE THE
CMC TO COARSE ALIGN
AND GYRO TRIM THE
STABLE MEMBER TO
THE GIMBAL ANGLES
COMPUTED FOR THE
NEW ORIENTATION AND
THEN TO PROCEED
THROUGH OPTICAL
SIGHTINGS AND PULSE
TORQUING TO ACHIEVE
FINAL ALIGNMENT.
AN ALTERNATE METHOD
OF ACHIEVING IMU
REALIGNMENT IS TO
KEY IN ENTER WHICH
WILL CAUSE THE CMC
TO COMPUTE THE NUM-
BER OF TORQUING
PULSES REQUIRED BY
EACH IRIG (X,Y,Z)
IN ORDER TO ACHIEVE
PRECISE ALIGNMENT,
AND ISSUE THESE
PULSES. THIS ALTER-
NATE METHOD INTRO-
DUCES A PREDICTABLE
ERROR INTO THE CMC'S
KNOWLEDGE OF THE
STABLE MEMBER ORIEN-
TATION AND TAKES A
PREDICTABLE PERIOD
OF TIME FOR COMPLET-
ION.
AN APPROXIMATION OF
THIS ERROR AND THE
TIME TO TORQUE CAN
BE MADE BY CALCULA-
TING THE SUM OF THE
GIMBAL ANGLE CHAN-
GES, MULTIPLYING BY
2 FOR TIME TC TORQUE
IN SECONDS, AND MUL-
TIPLYING BY .002 FOR
ERROR IN DEGREES.

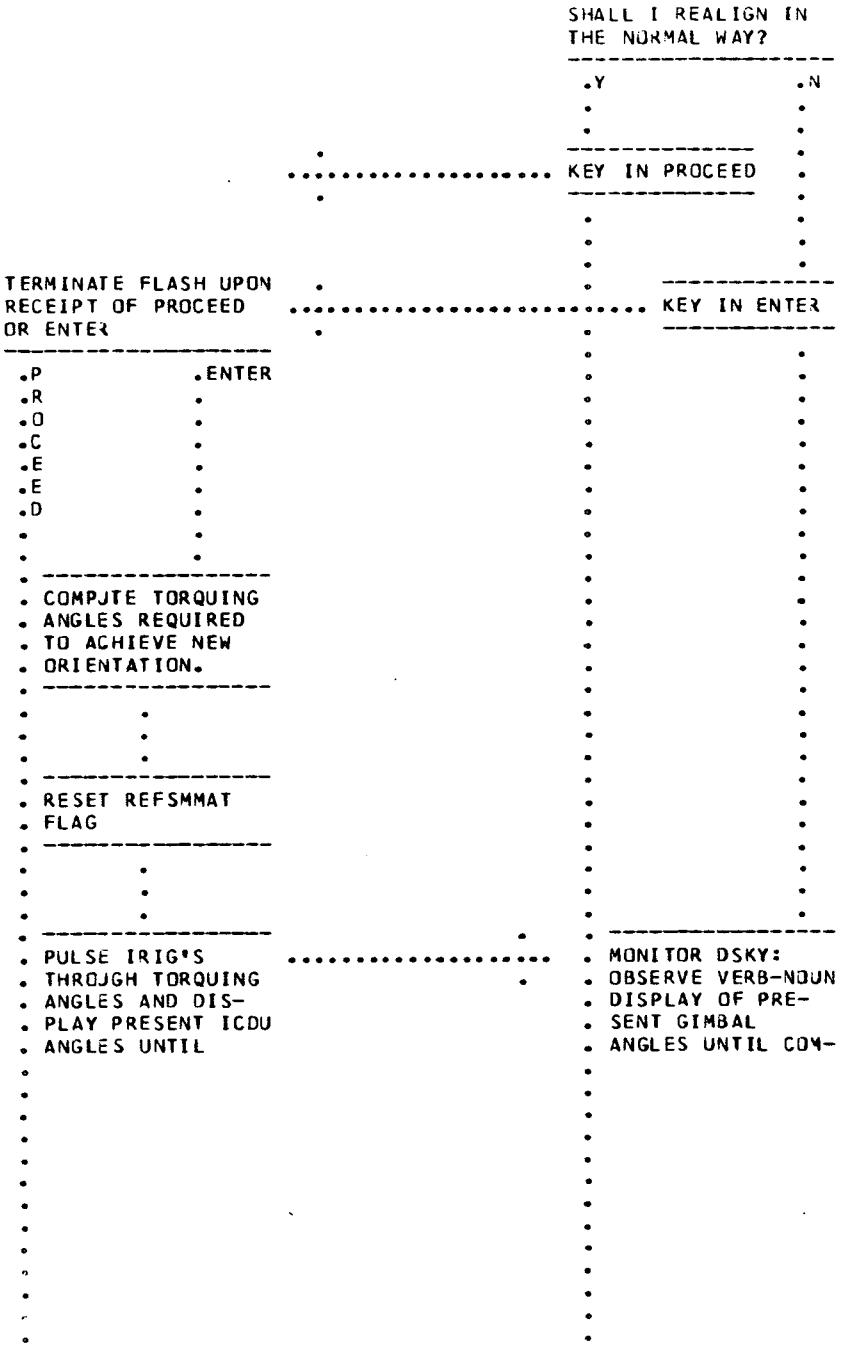
#440

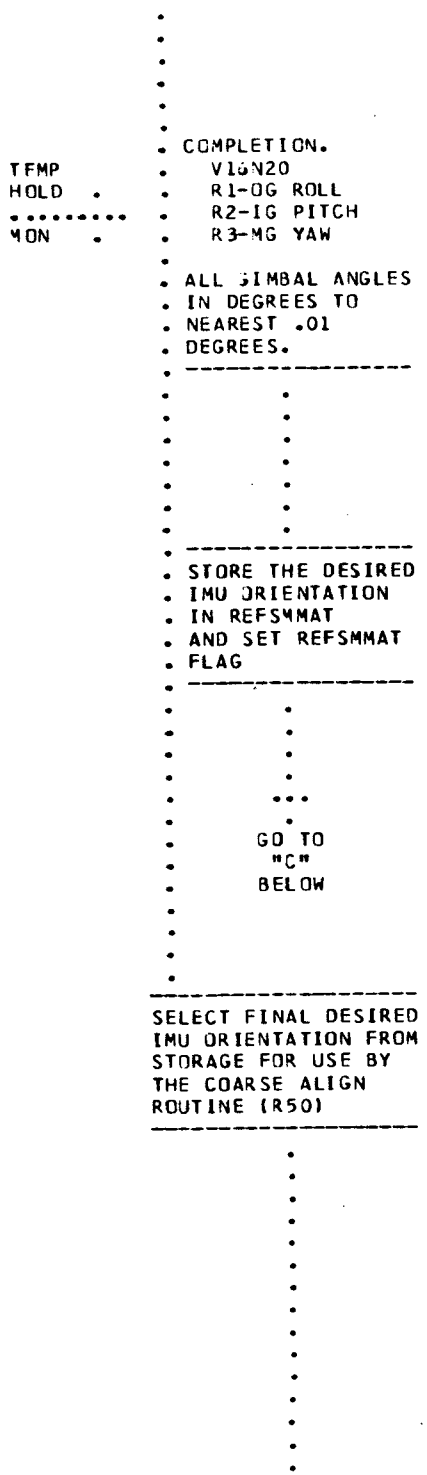
#450

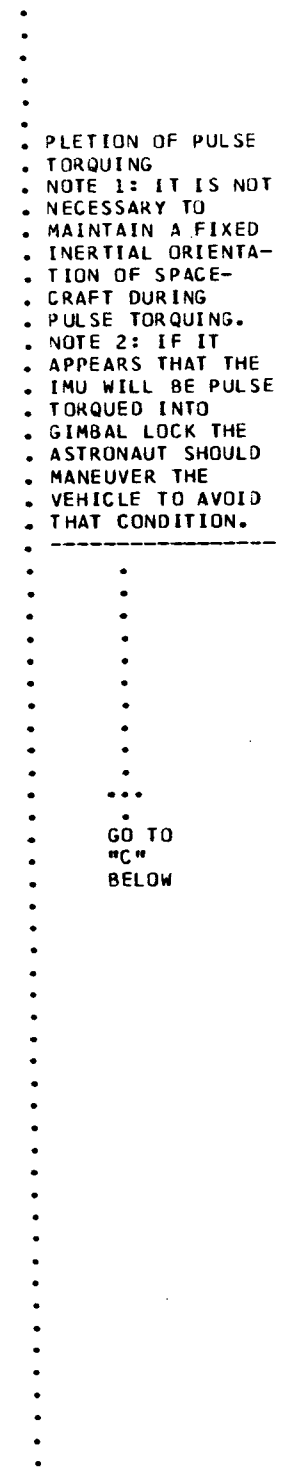
#460

#470

#480


SHALL I REALIGN IN THE NORMAL WAY?
.Y
.N
KEY IN PROCEED
#490
TERMINATE FLASH UPON RECEIPT OF PROCEED OR ENTER
KEY IN ENTER
.P
.R
.O
.C
.E
.E
.D
.ENTER
#500
COMPUTE TORQUING ANGLES REQUIRED TO ACHIEVE NEW ORIENTATION.
#510
RESET REFSMMAT FLAG
#520
PULSE IRIG'S THROUGH TORQUING ANGLES AND DIS- PLAY PRESENT ICDU ANGLES UNTIL
MONITOR DSKY: OBSERVE VERB-NOUN DISPLAY OF PRE- SENT GIMBAL ANGLES UNTIL CON-





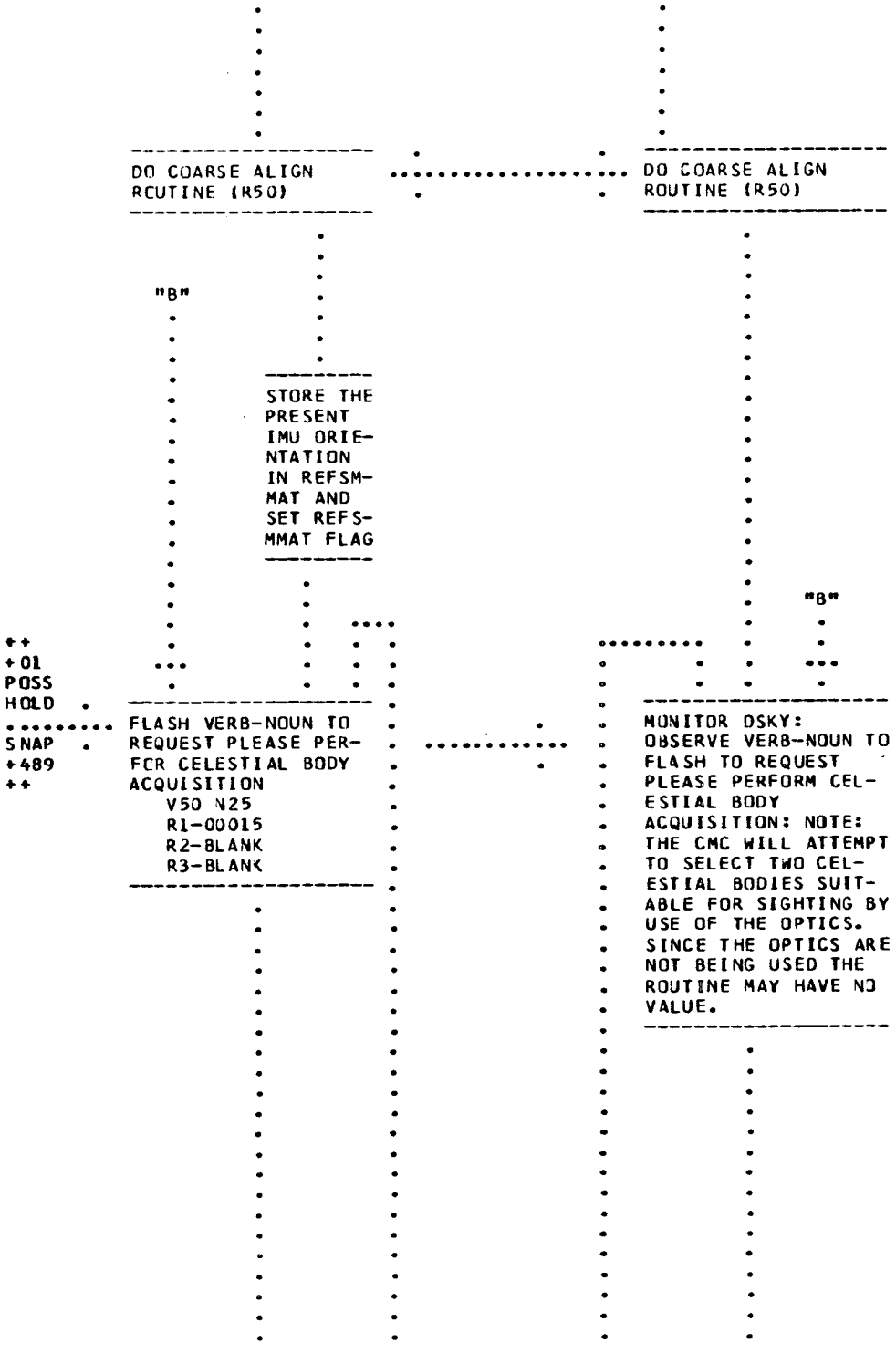
#530

#540

#550

#560

#570



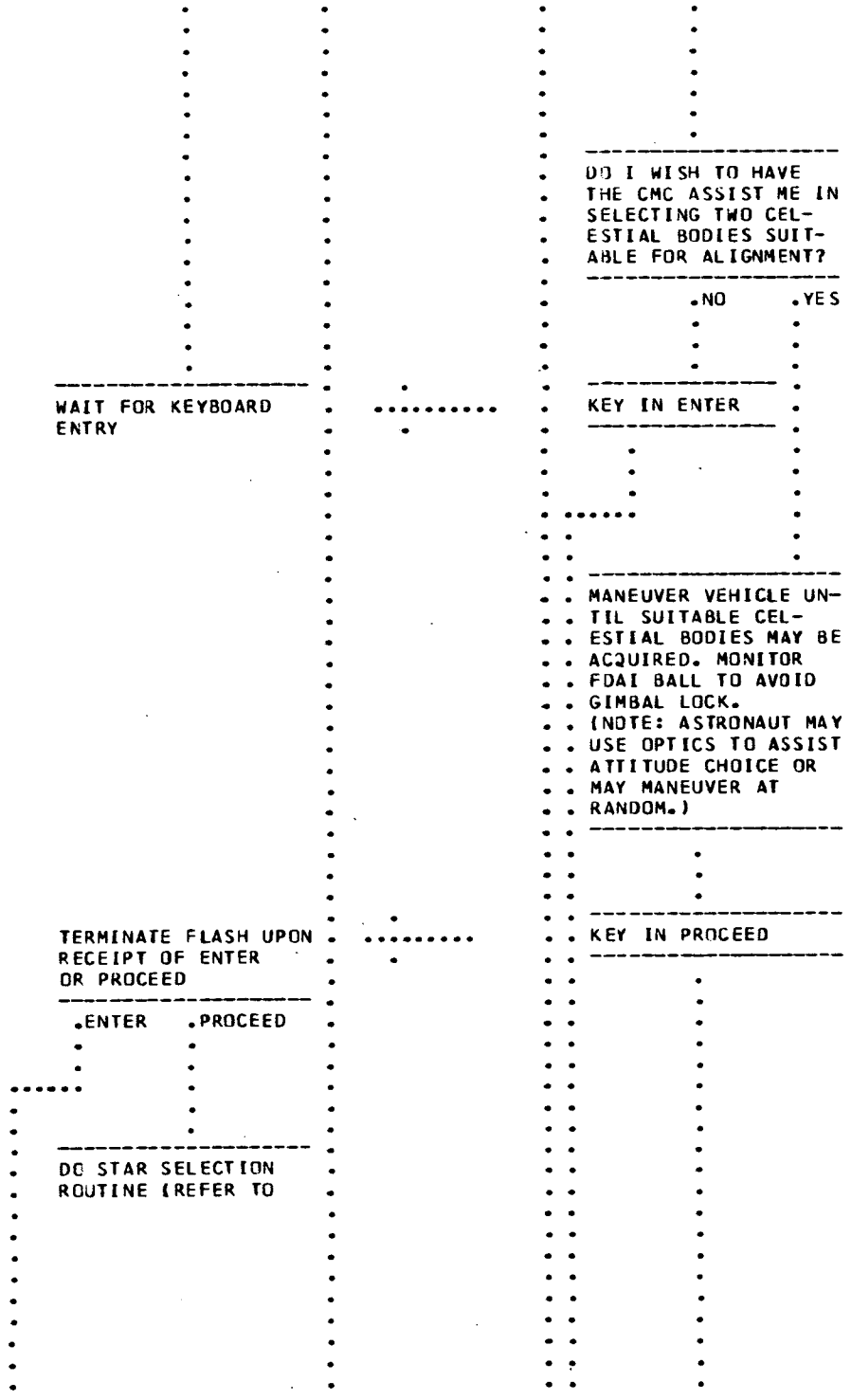
#580

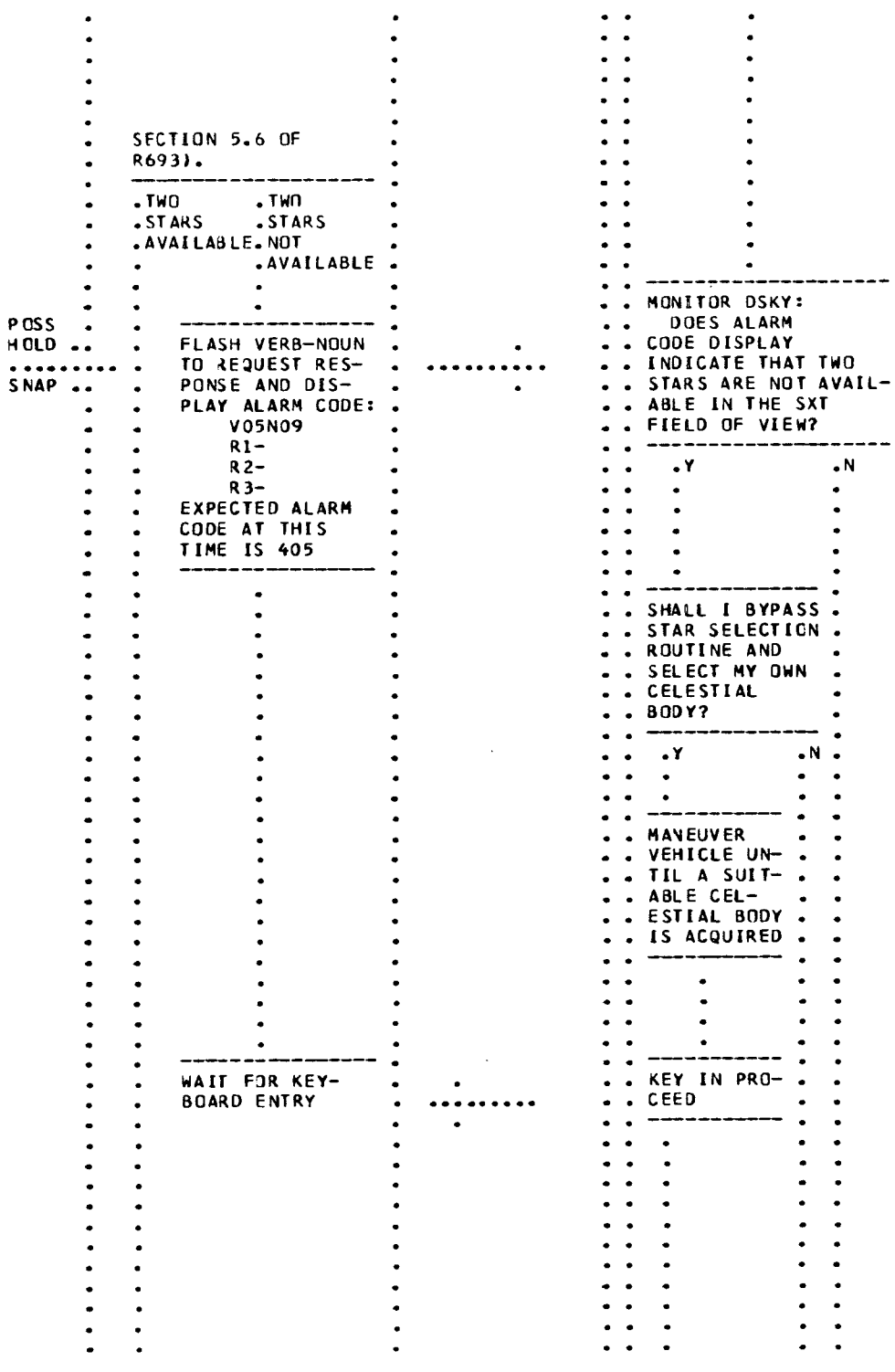
#590

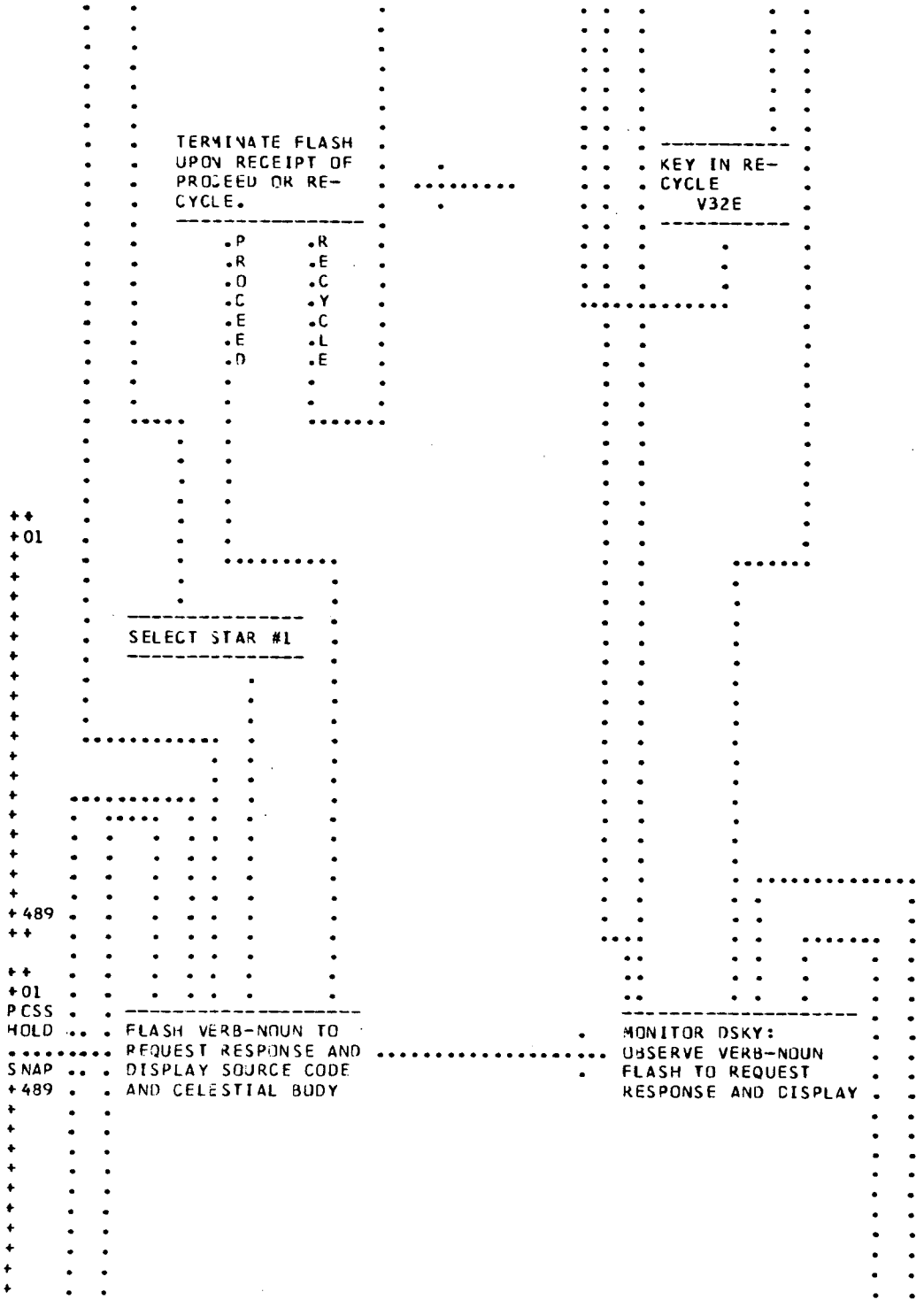
#600

#610

#620


DO I WISH TO HAVE THE CMC ASSIST ME IN SELECTING TWO CELESTIAL BODIES SUITABLE FOR ALIGNMENT?
#630
NO
YES
WAIT FOR KEYBOARD ENTRY
KEY IN ENTER
#640
MANEUVER VEHICLE UNTIL SUITABLE CELESTIAL BODIES MAY BE ACQUIRED. MONITOR FDAI BALL TO AVOID GIMBAL LOCK. (NOTE: ASTRONAUT MAY USE OPTICS TO ASSIST ATTITUDE CHOICE OR MAY MANEUVER AT RANDOM.)
#650
#660
TERMINATE FLASH UPON RECEIPT OF ENTER OR PROCEED
KEY IN PROCEED
ENTER
PROCEED
#670
DO STAR SELECTION ROUTINE (REFER TO


SECTION 5.6 OF
R693).
.TWO .STARS .AVAILABLE.
.TWO .STARS .NOT .AVAILABLE
MONITOR DSKY:
DOES ALARM CODE DISPLAY INDICATE THAT TWO STARS ARE NOT AVAILABLE IN THE SXT FIELD OF VIEW?
.Y
.N
SHALL I BYPASS STAR SELECTION ROUTINE AND SELECT MY OWN CELESTIAL BODY?
.Y
.N
MANEUVER VEHICLE UNTIL A SUITABLE CELESTIAL BODY IS ACQUIRED
KEY IN PROCEED
WAIT FOR KEYBOARD ENTRY
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY ALARM CODE:
V05N09
R1-
R2-
R3-
EXPECTED ALARM CODE AT THIS TIME IS 405
#680
#690
#700
#710
#720



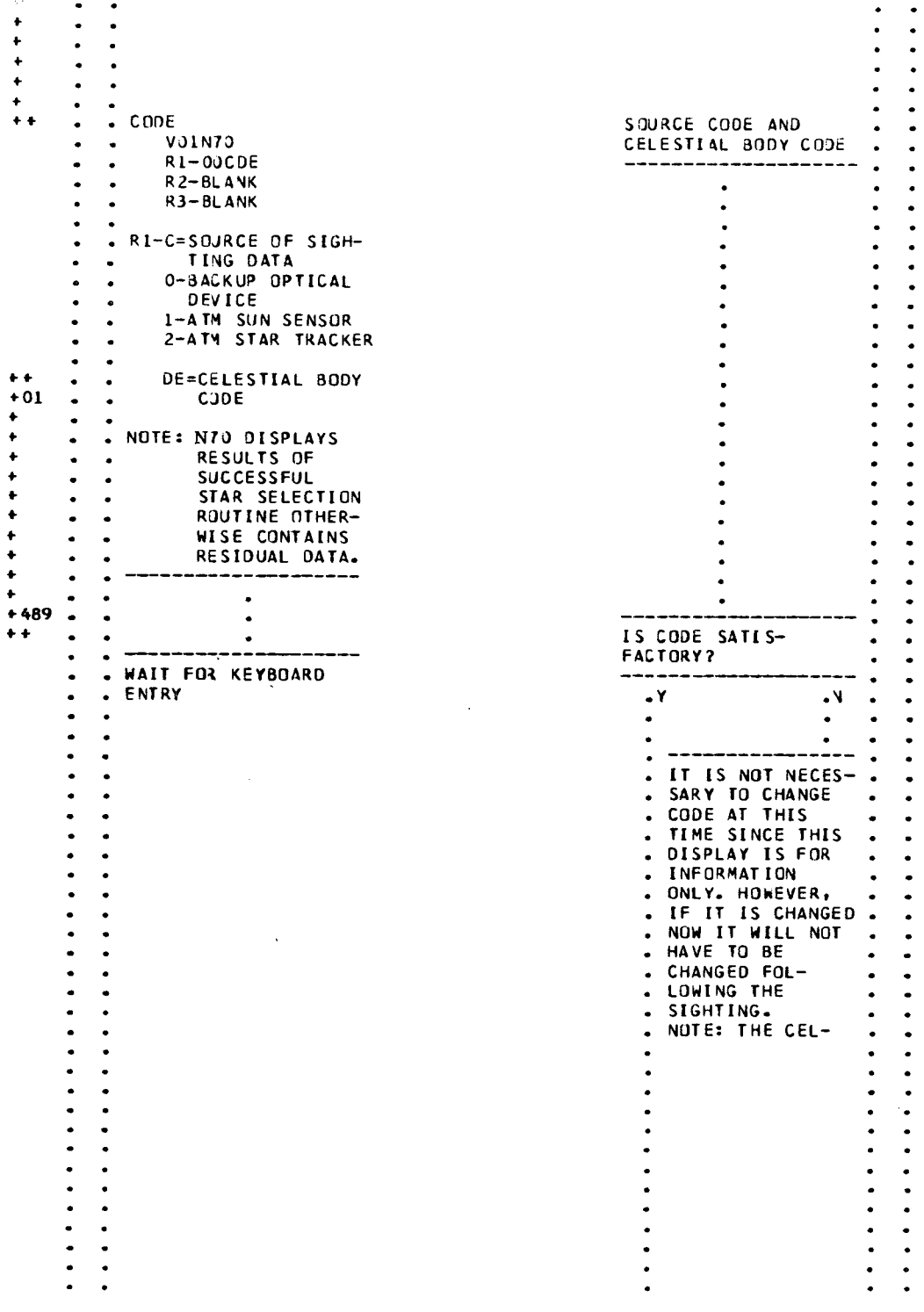
#730

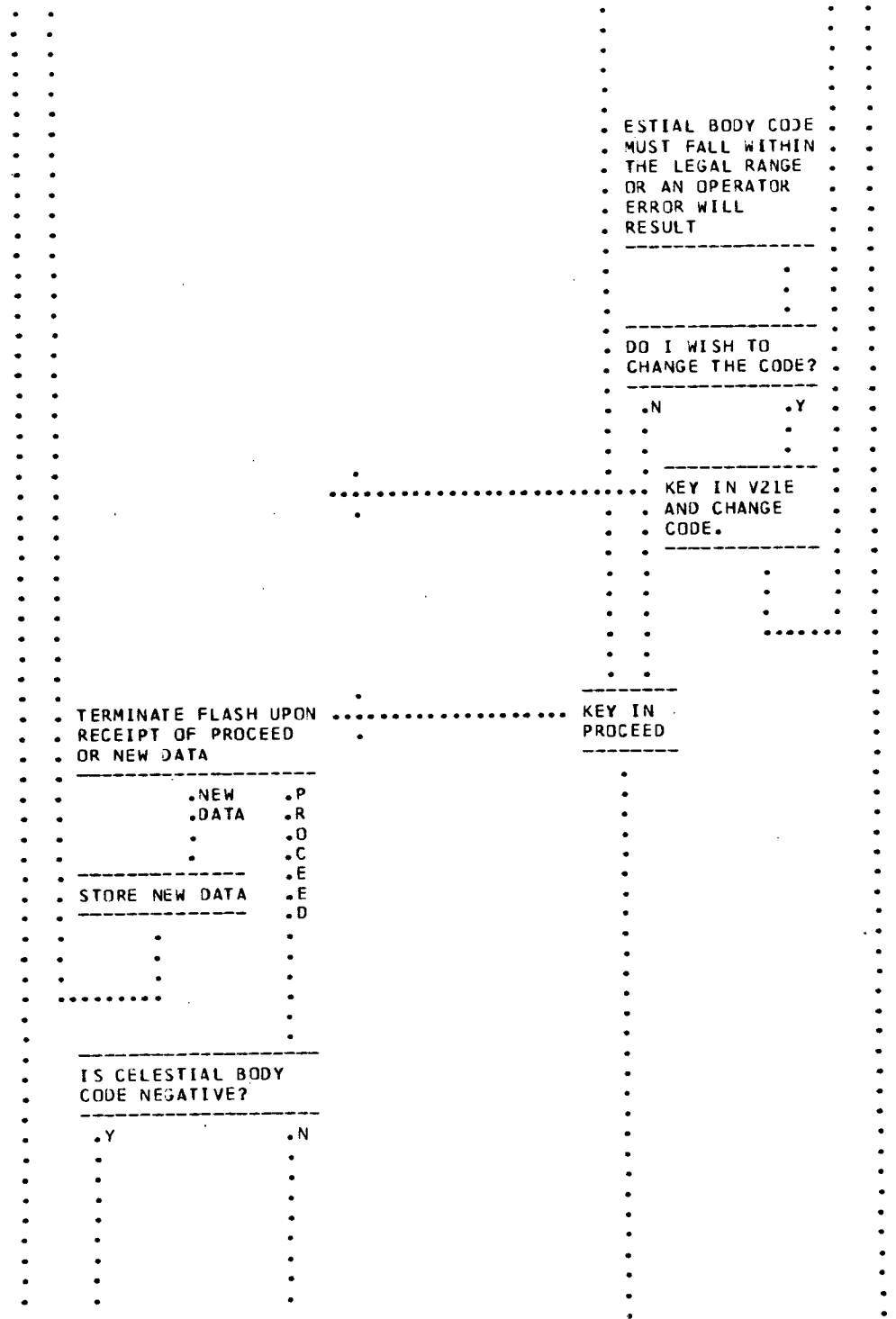
#740

#750

#760

#770


CODE
V01N70
R1-OOCDE
R2-BLANK
R3-BLANK
R1-C=SOURCE OF SIGHTING DATA
0-BACKUP OPTICAL DEVICE
1-ATM SUN SENSOR
2-ATM STAR TRACKER
DE=CELESTIAL BODY CODE
NOTE: N70 DISPLAYS RESULTS OF SUCCESSFUL STAR SELECTION ROUTINE OTHERWISE CONTAINS RESIDUAL DATA.
WAIT FOR KEYBOARD ENTRY
SOURCE CODE AND CELESTIAL BODY CODE
IS CODE SATISFACTORY?
Y
N
IT IS NOT NECESSARY TO CHANGE CODE AT THIS TIME SINCE THIS DISPLAY IS FOR INFORMATION ONLY. HOWEVER, IF IT IS CHANGED NOW IT WILL NOT HAVE TO BE CHANGED FOLLOWING THE SIGHTING.
NOTE: THE CEL-
#780
#790
#800
#810
#820



#830

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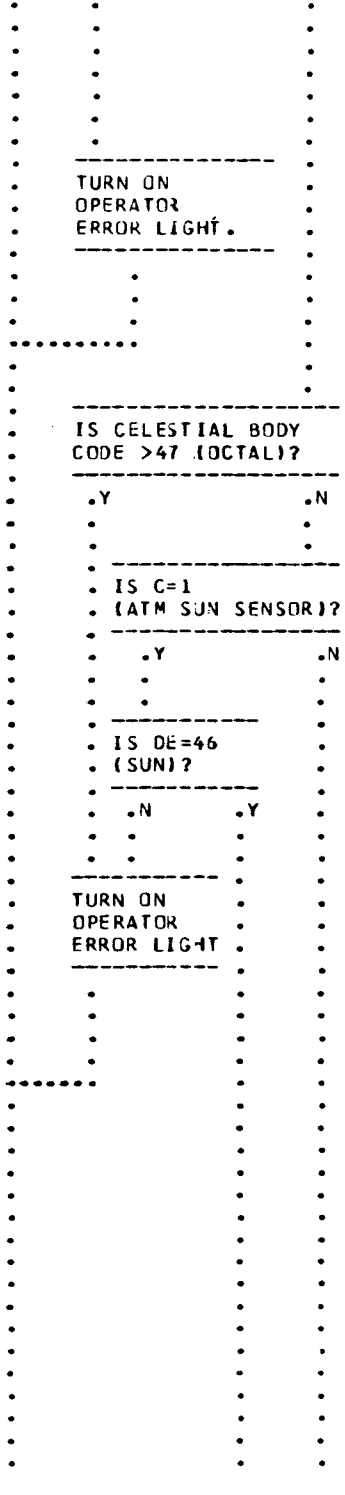
#860

#870



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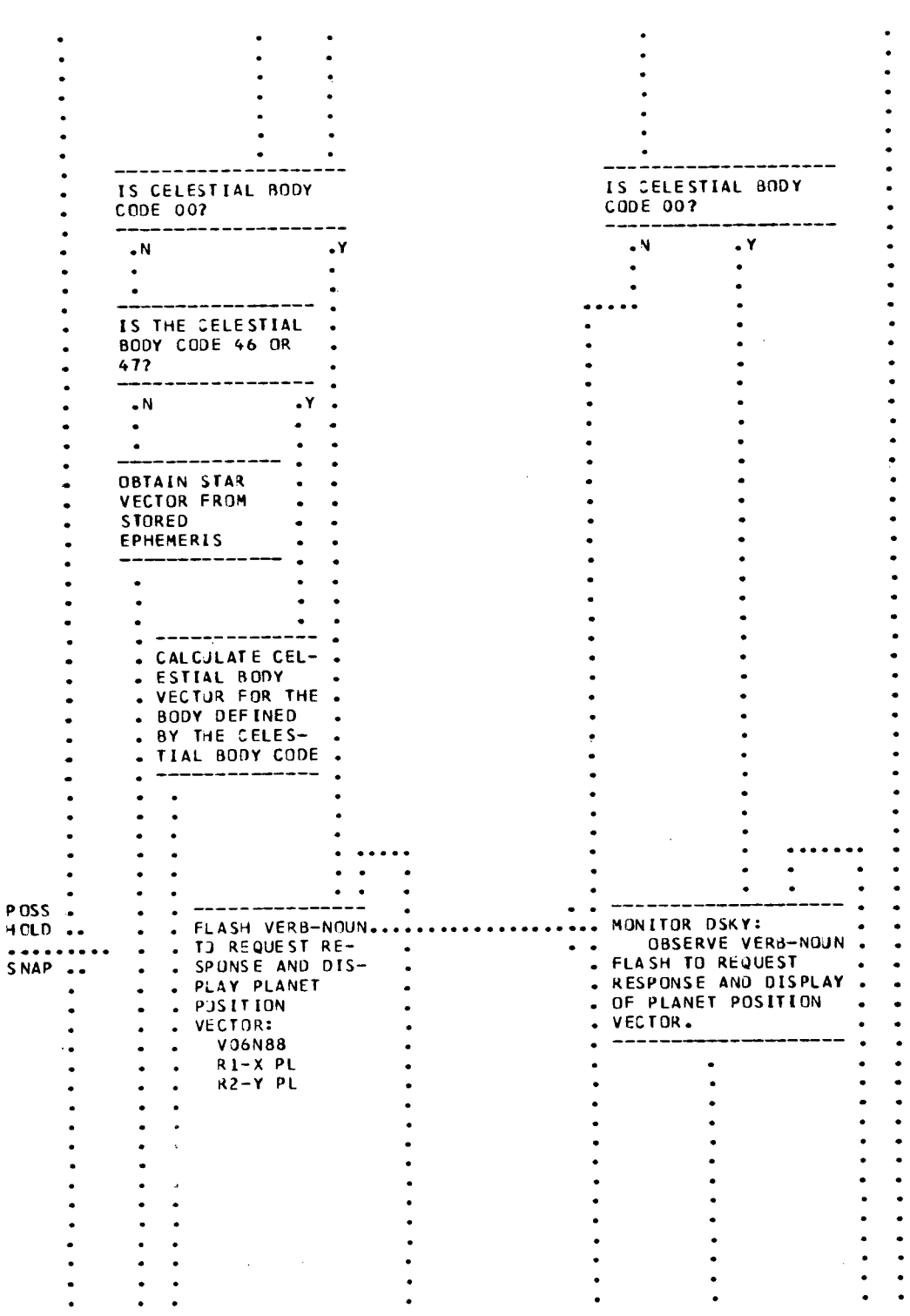

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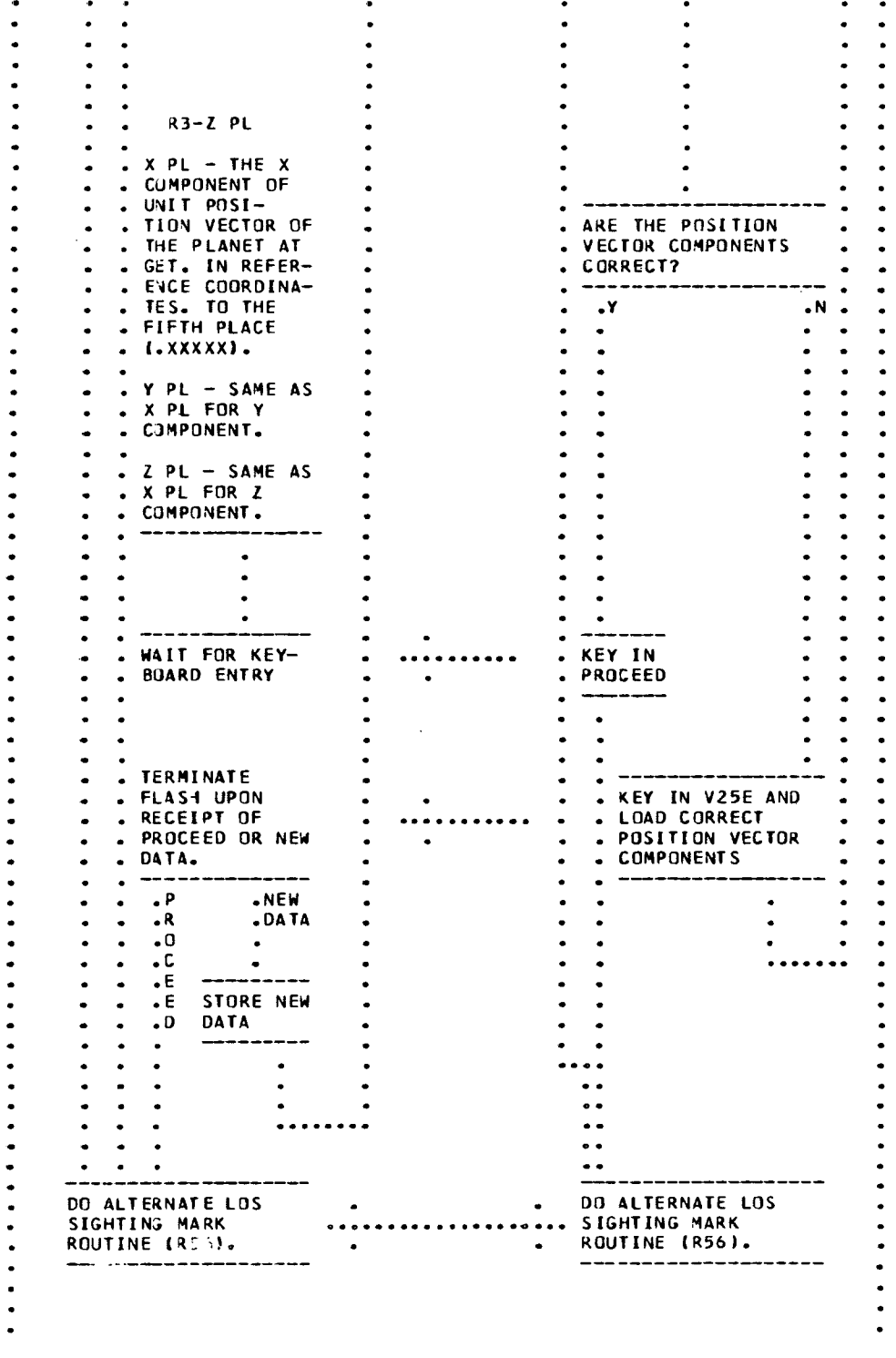


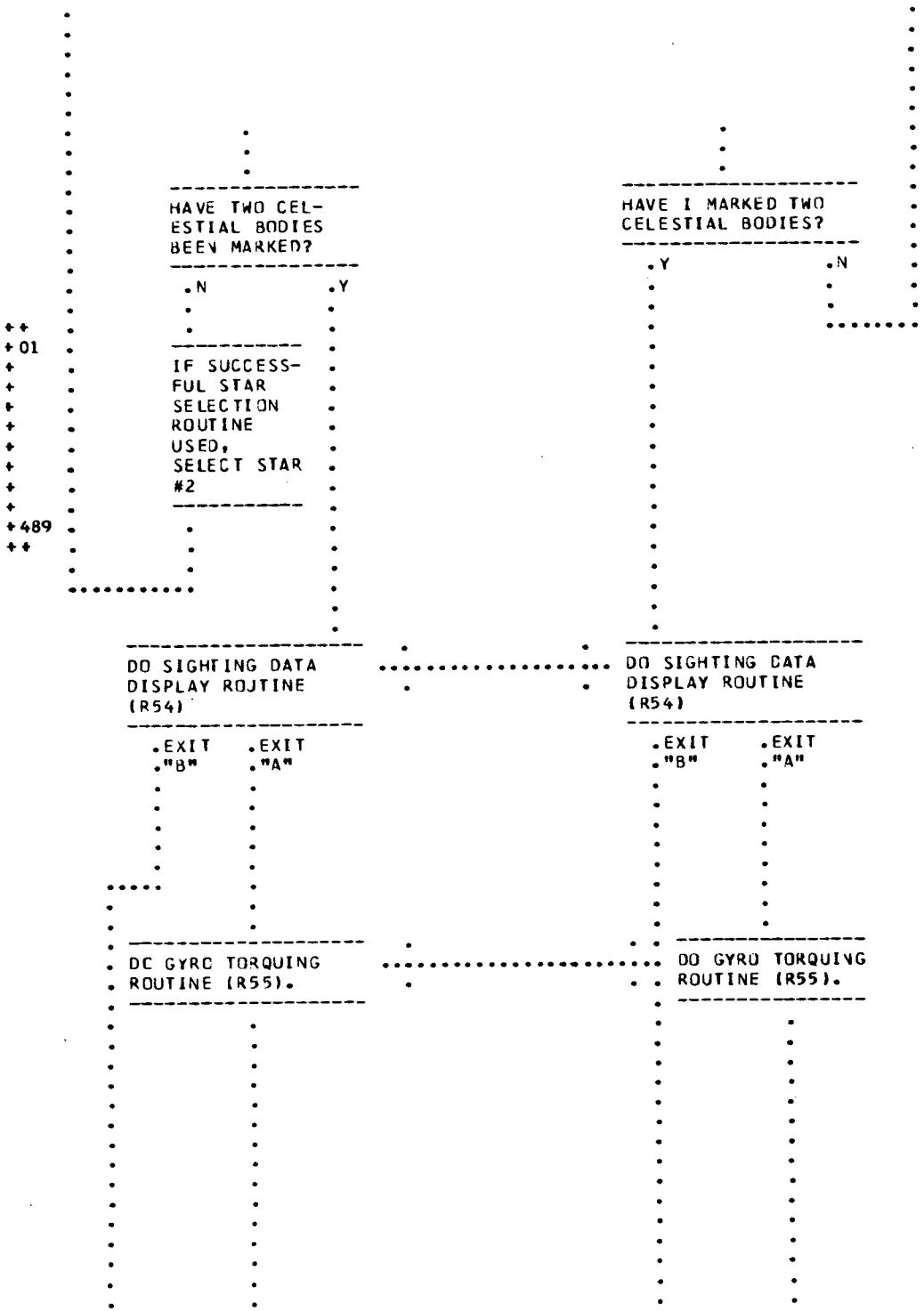
#980

#990

#1000

#1010

#1020



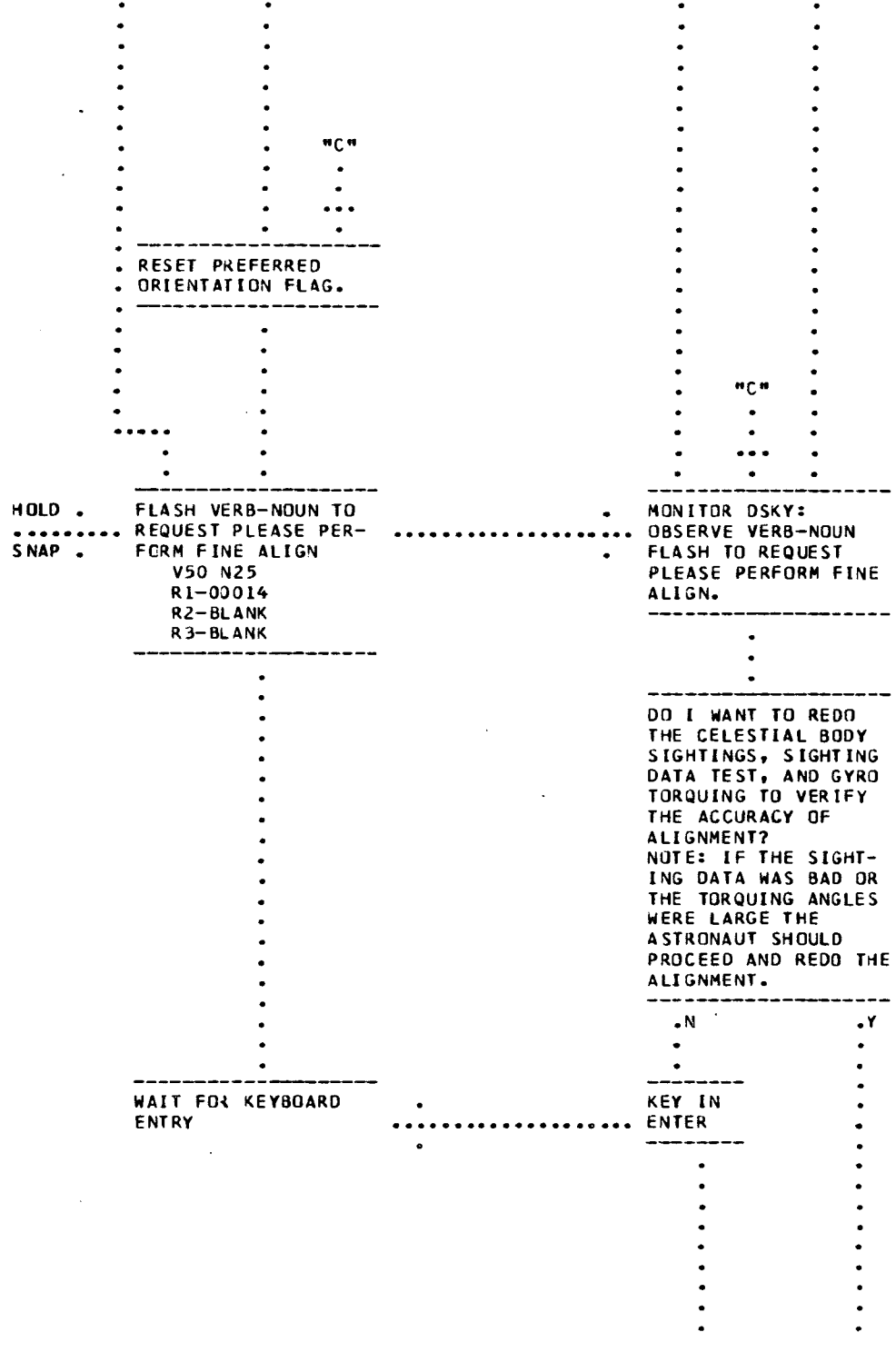
#1030

#1040

#1050

#1060

#1070



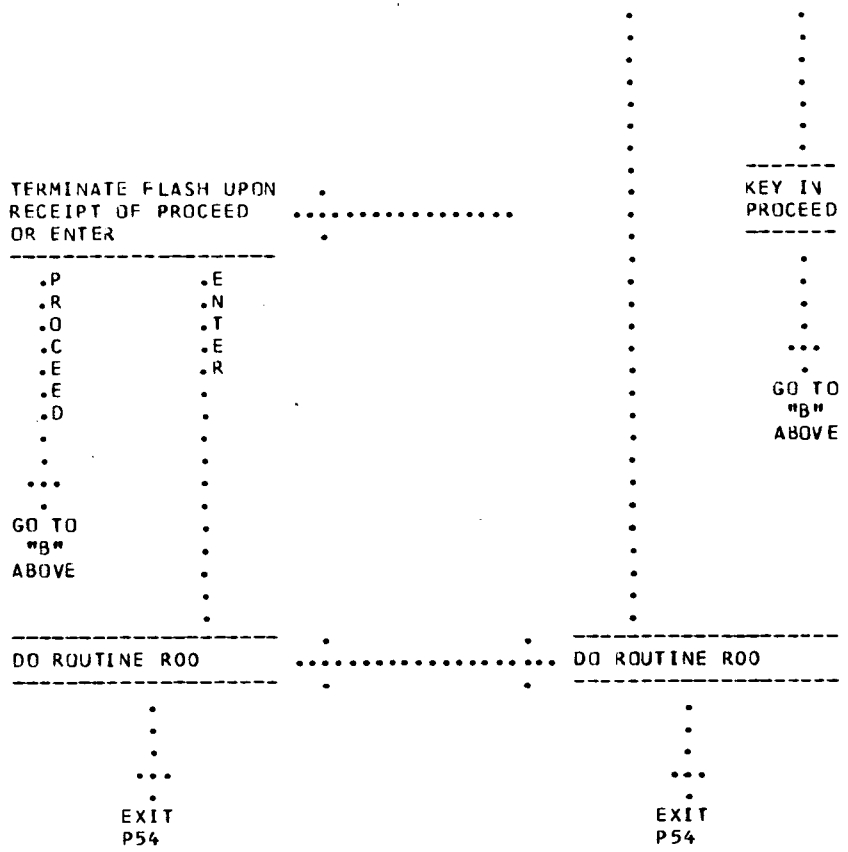
#1080

#1090

#1100

#1110

#1120



#1130

#1140

#1150

#1160

CHANGE CONTROL NOTES

REV 00 PCR 013,040,043,415,416, PCN 410,436
REV 01 PCN 489

ATM STAR TRACKER GIMBAL ANGLE PROGRAM (P55) REV 01 03/20/72

PURPOSE: (1) TO COMPUTE AND DISPLAY THE GIMBAL ANGLES REQUIRED BY THE ATM STAR TRACKER IN ORDER TO POINT AT A DESIRED CELESTIAL BODY.

ASSUMPTIONS: (1) THE ATM ORIENTATION DETERMINATION PROGRAM (P50) HAS BEEN USED PRIOR TO THE SELECTION OF THIS PROGRAM TO DETERMINE THE ATM SENSOR ATTITUDE VECTORS ($\bar{Y}$ - ATM AND $\bar{Z}$ - ATM).

(2) TWO OPTIONS ARE AVAILABLE:
(A) OPTION 1 - USES IMU ORIENTATION TO DETERMINE ATM STAR TRACKER GIMBAL ANGLES

(B) OPTION 2 - USES CSM OPTICS MARK AND LOS TO SUN TO DETERMINE ATM STAR TRACKER GIMBAL ANGLES

(3) THE ASTRONAUT IDENTIFIES THE CELESTIAL BODY TO BE ACQUIRED BY THE STAR TRACKER. SUN OR EARTH ARE NOT TO BE SELECTED AS CELESTIAL BODIES FOR THE STAR TRACKER.

(4) THE IMU MAY BE:
(A) ON AND ALIGNED (FOR OPTION 1)
(B) OFF (FOR OPTION 2)

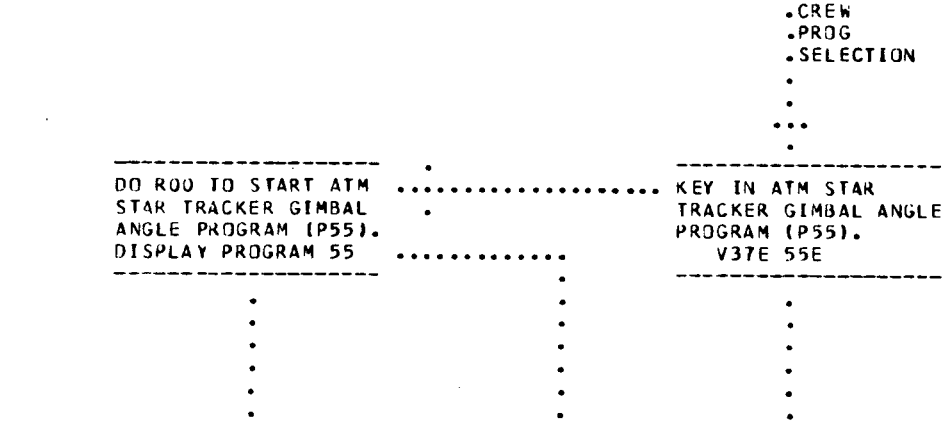
(5) ATM MUST BE IN SOLAR INERTIAL ATTITUDE IN ORDER TO USE OPTION 2.

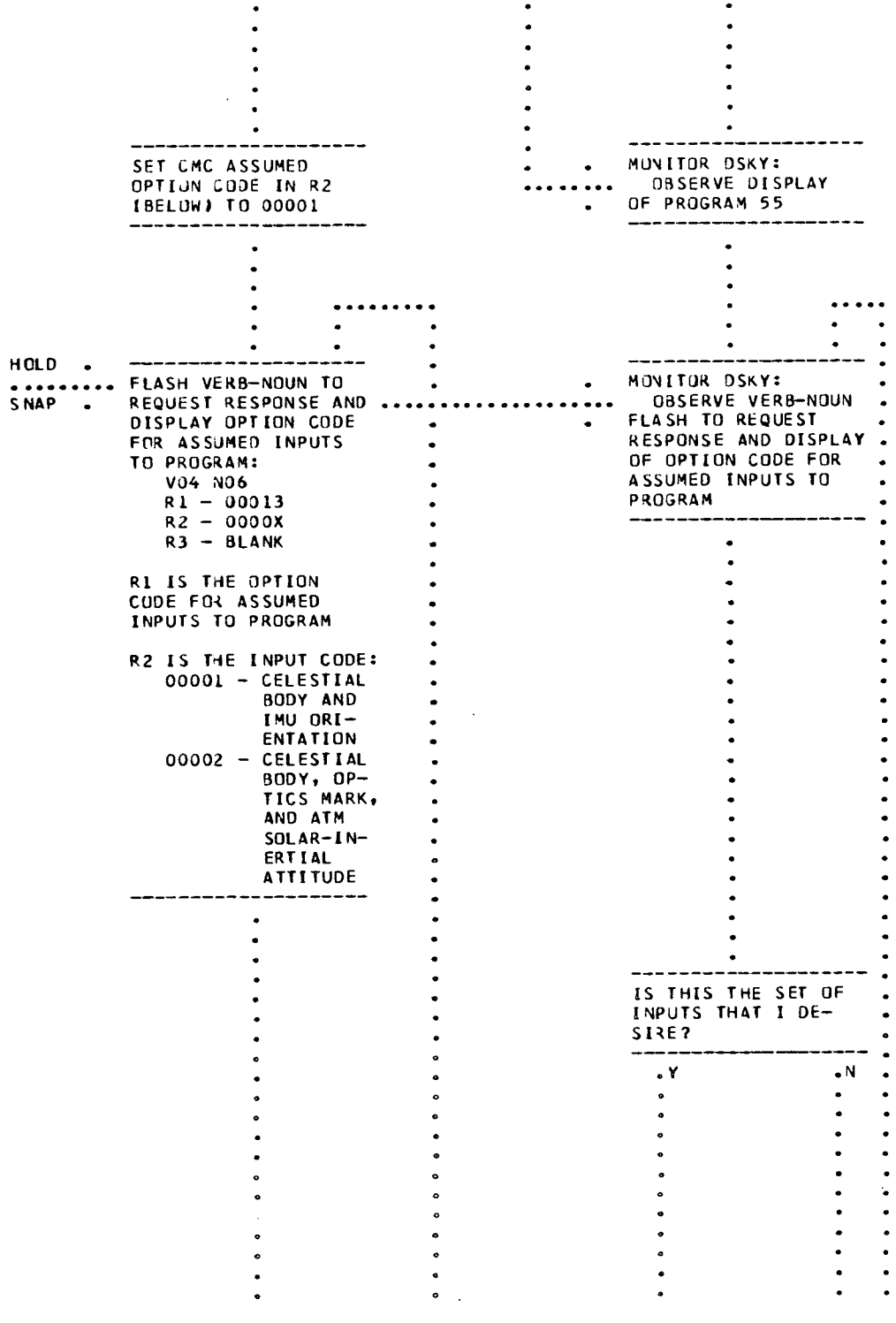
(6) THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY.

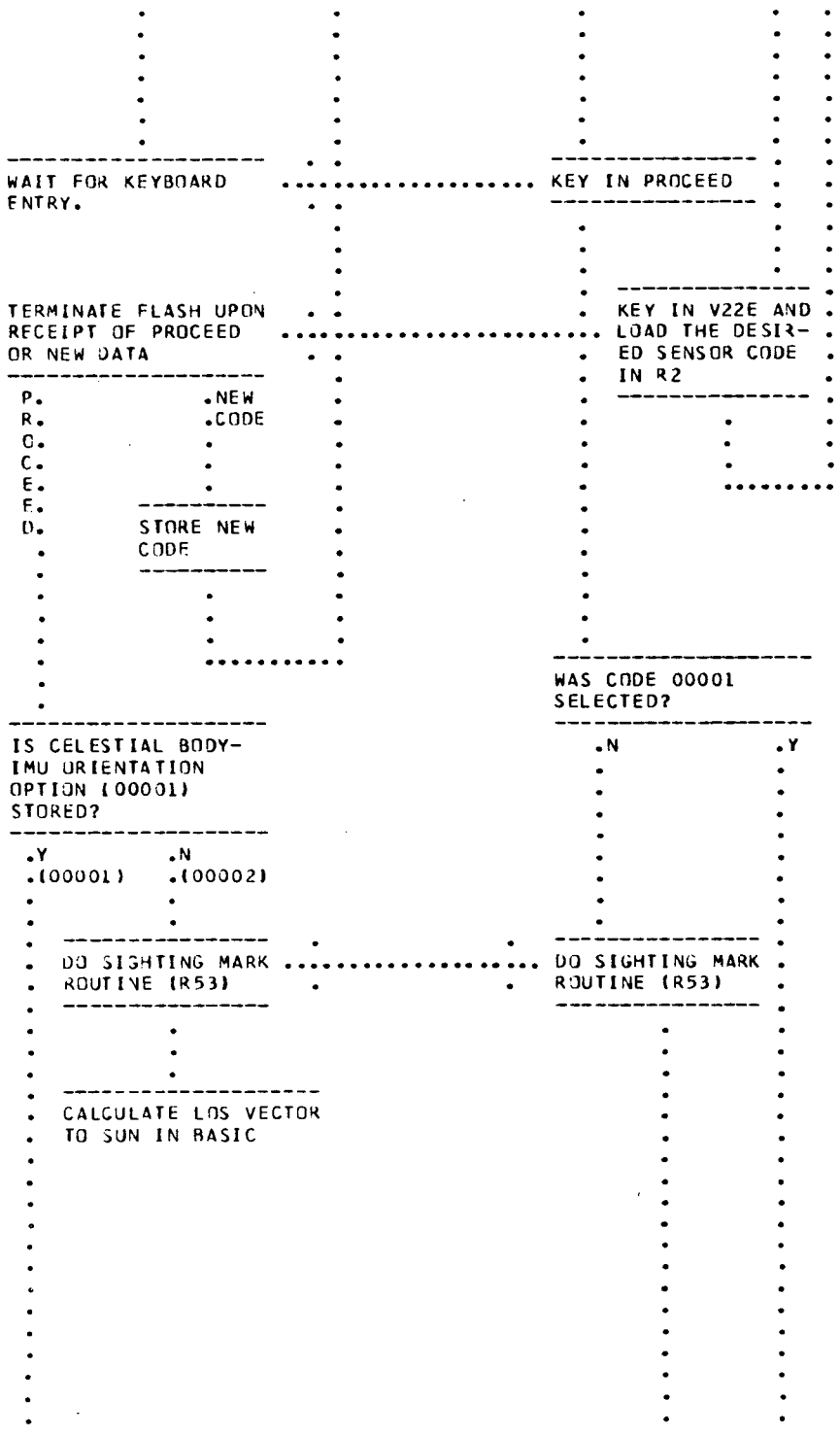
(7) THE FORMAT OF N19 (OCTAL AZIMUTH ANGLE) IS SUITABLE FOR LOADING DIRECTLY INTO ATM COMPUTER.

(8) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(9) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.




SET CMC ASSUMED OPTION CODE IN R2 (BELOW) TO 00001
MONITOR DSKY: OBSERVE DISPLAY OF PROGRAM 55
#20
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTION CODE FOR ASSUMED INPUTS TO PROGRAM:
V04 N06
R1 - 00013
R2 - 0000X
R3 - BLANK
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF OPTION CODE FOR ASSUMED INPUTS TO PROGRAM
#30
R1 IS THE OPTION CODE FOR ASSUMED INPUTS TO PROGRAM
#40
R2 IS THE INPUT CODE:
00001 - CELESTIAL BODY AND IMU ORI-ENTATION
00002 - CELESTIAL BODY, OP-TICS MARK, AND ATM SOLAR-IN-ERTIAL ATTITUDE
#50
IS THIS THE SET OF INPUTS THAT I DE-SIRE?
#60
Y
N



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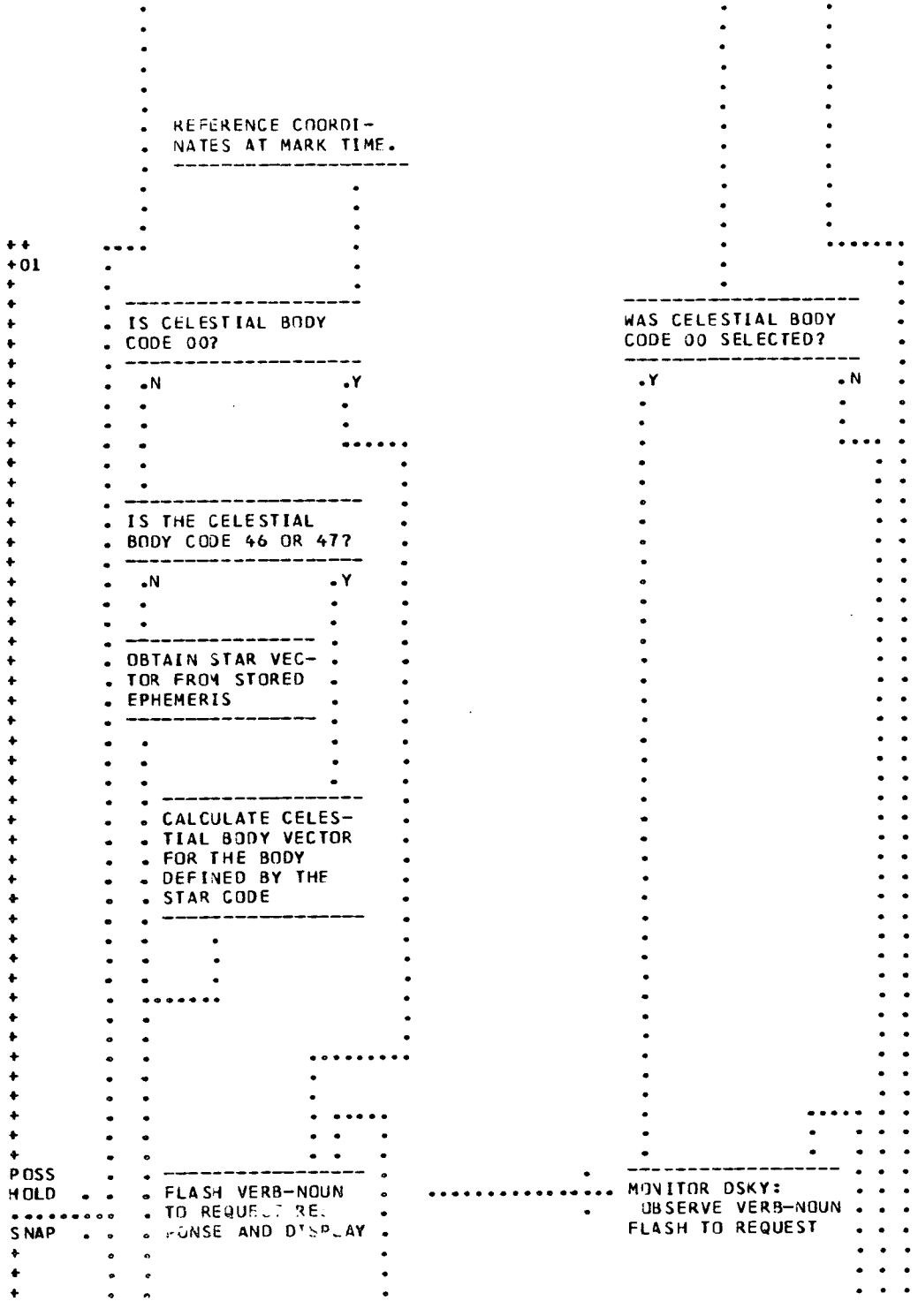
#90

#100

#110



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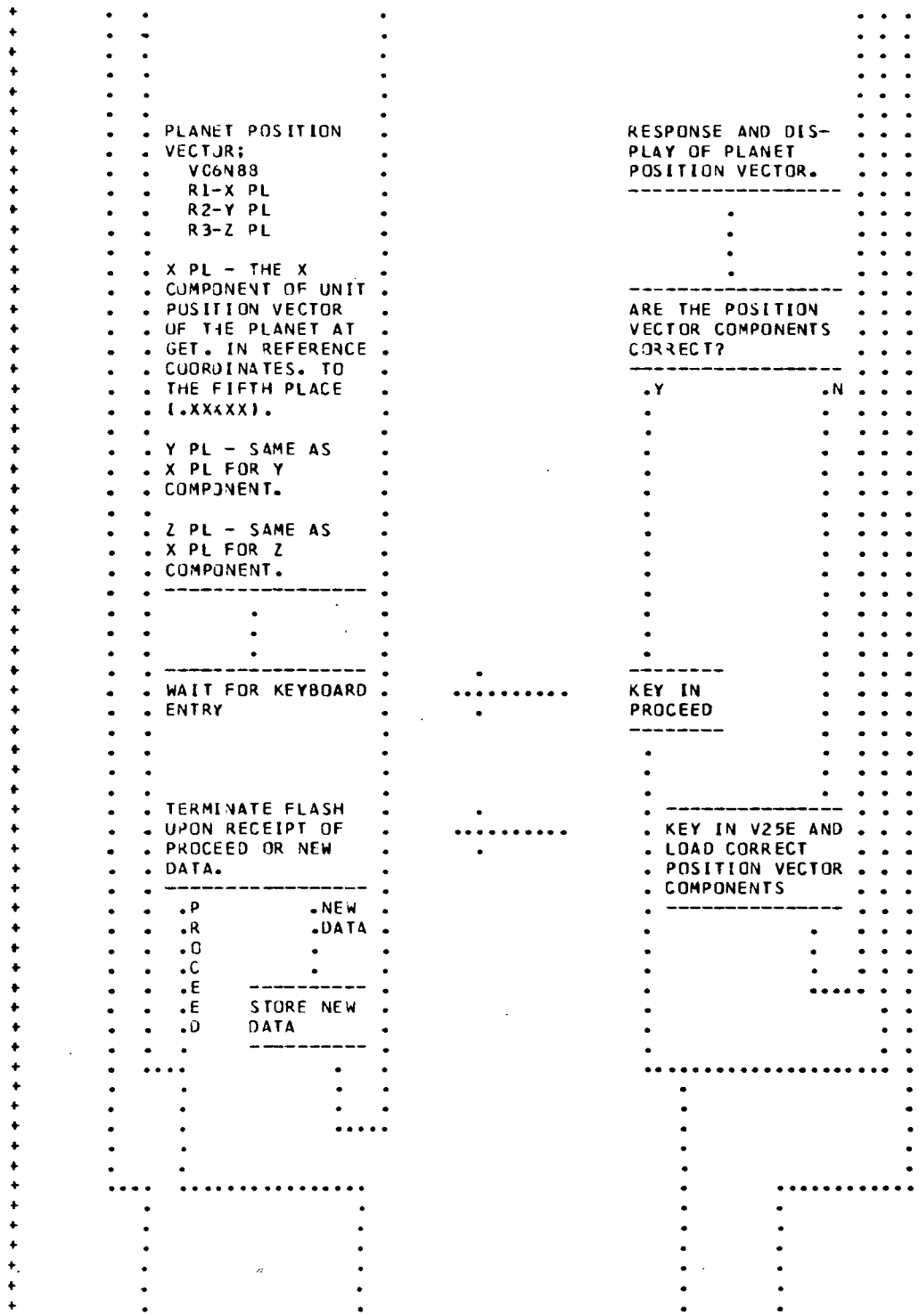

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#240

#250

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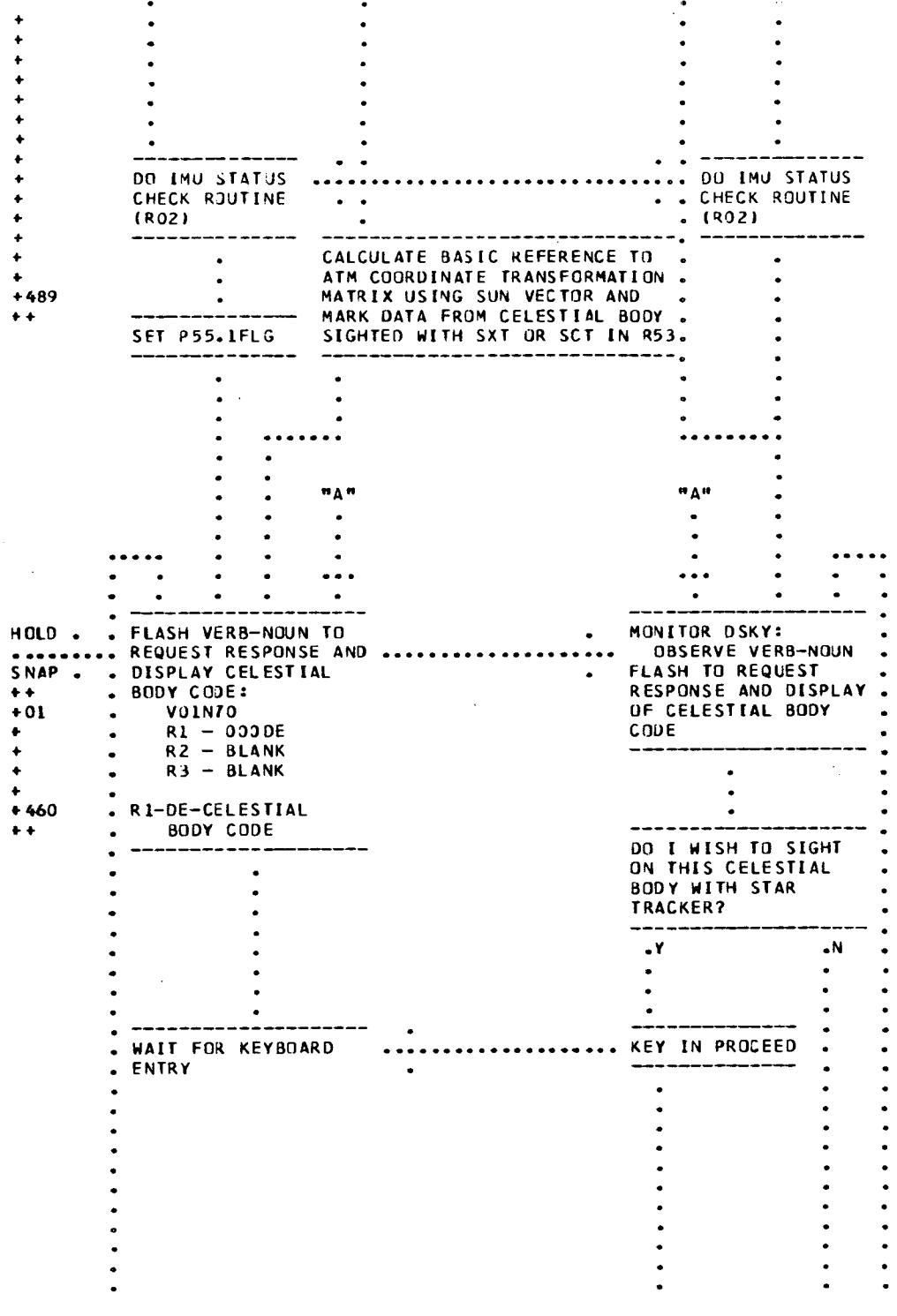

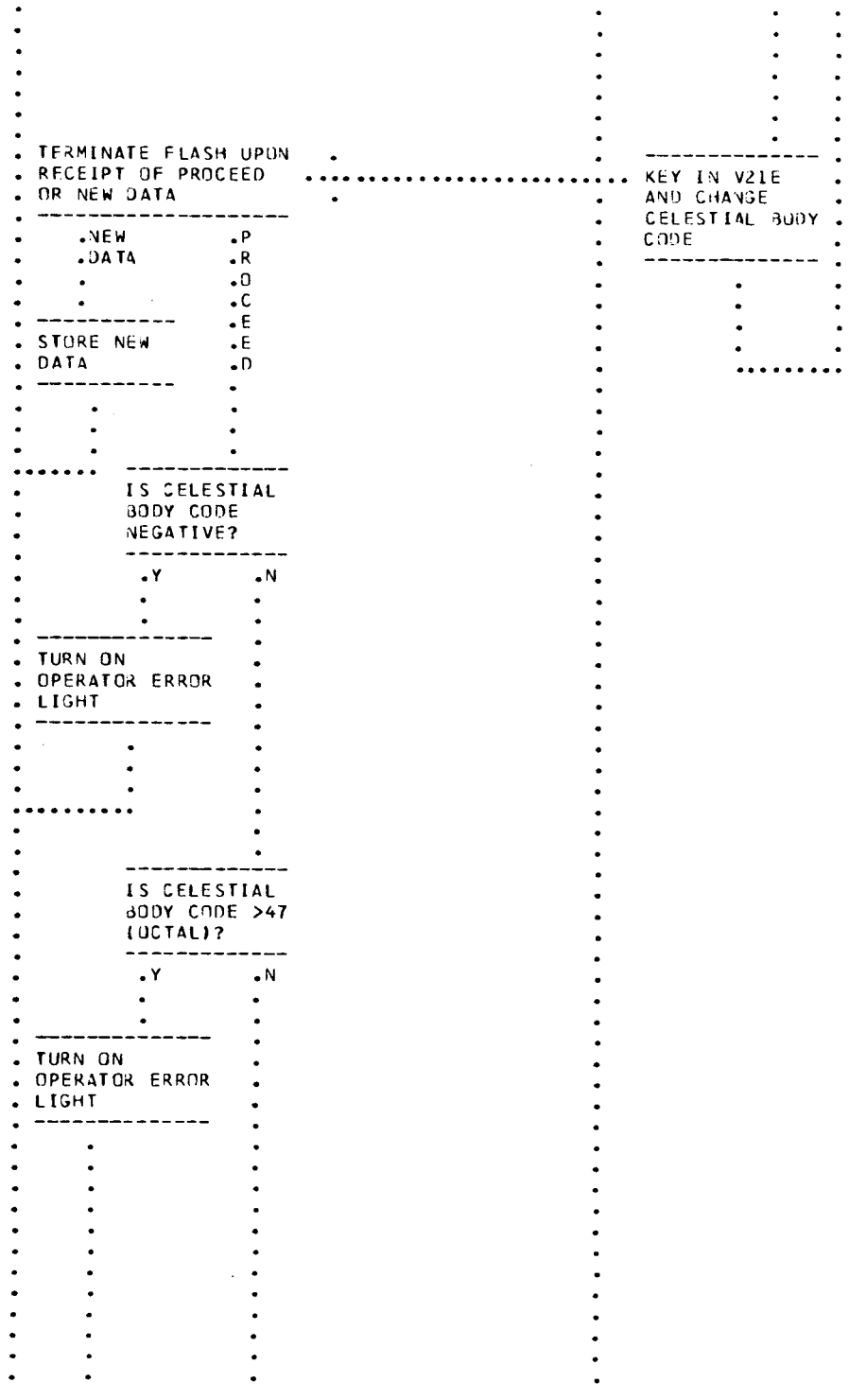

#280

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#320

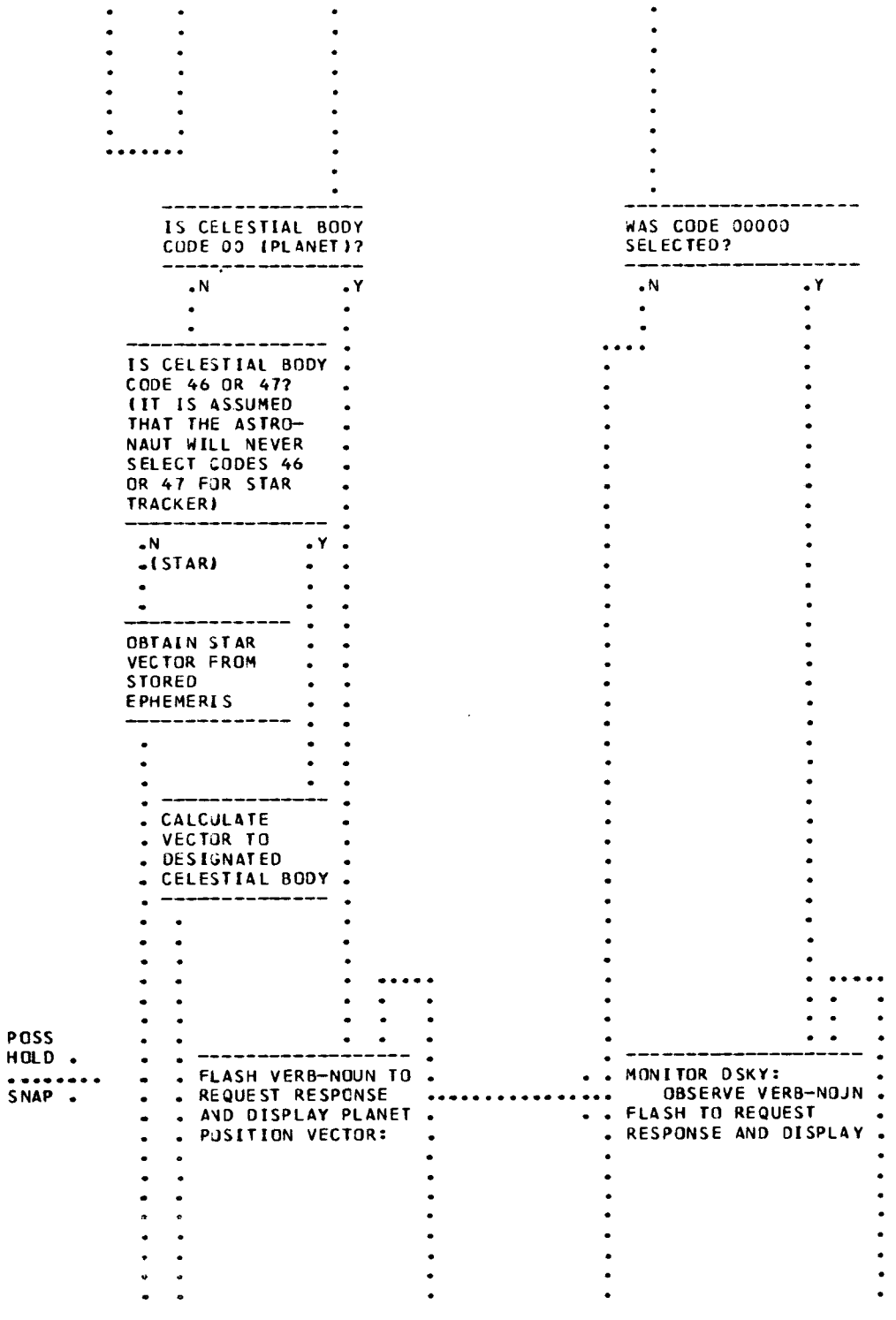
#330

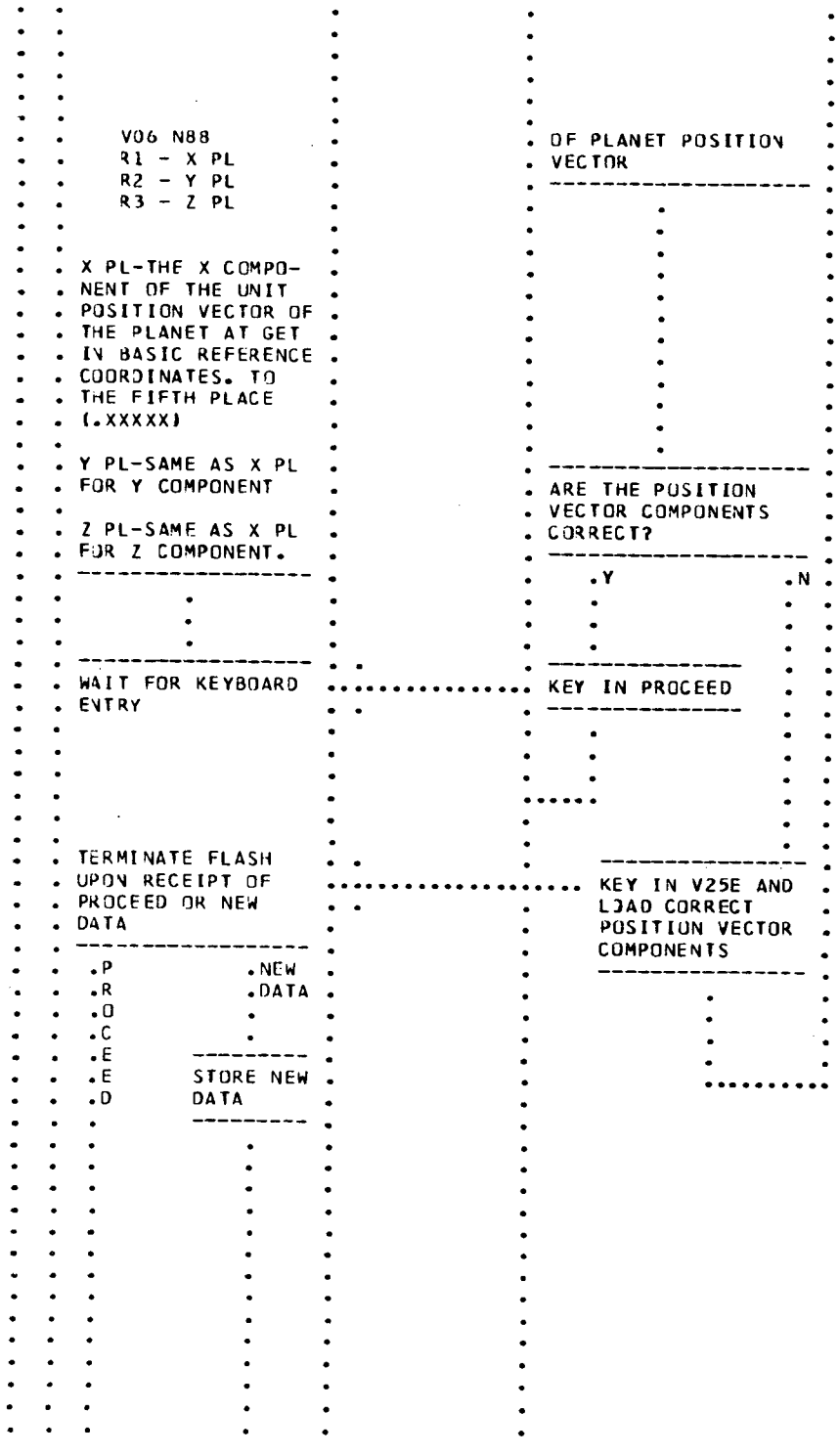
#340

#350

#360

#370





#380

#390

#400

#410

#420

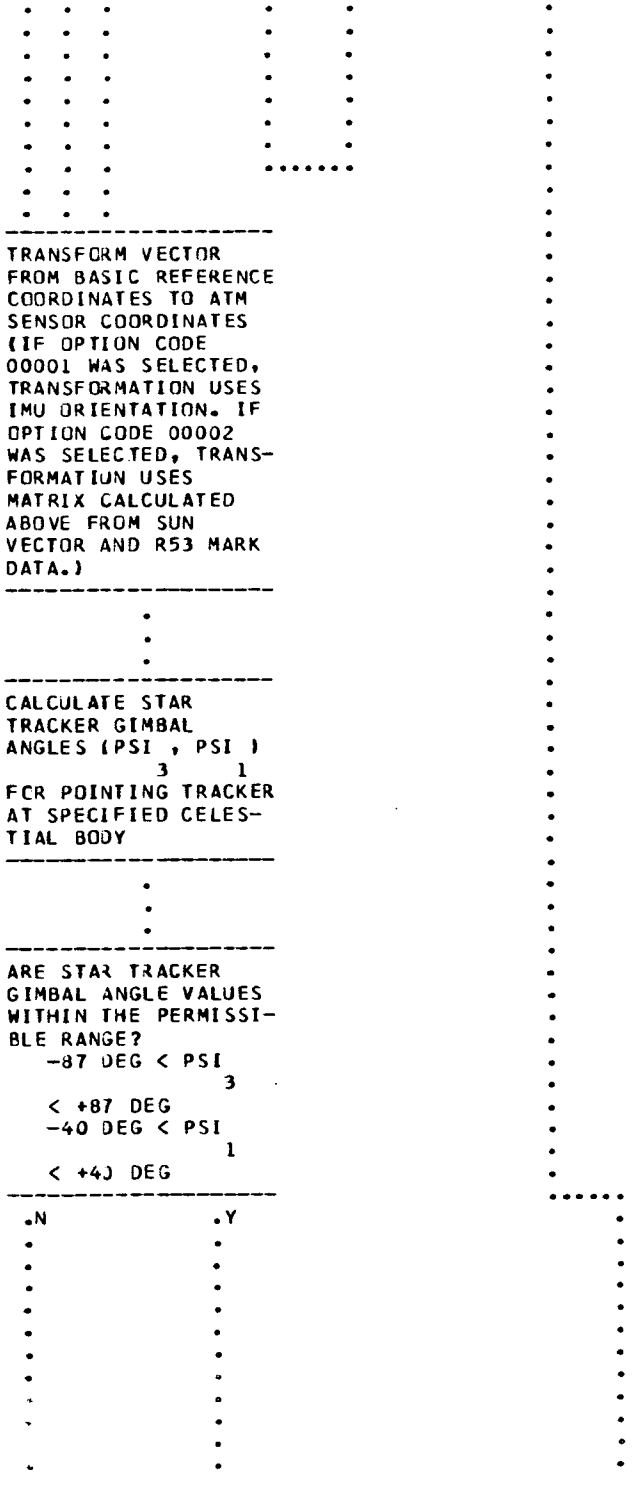
#430

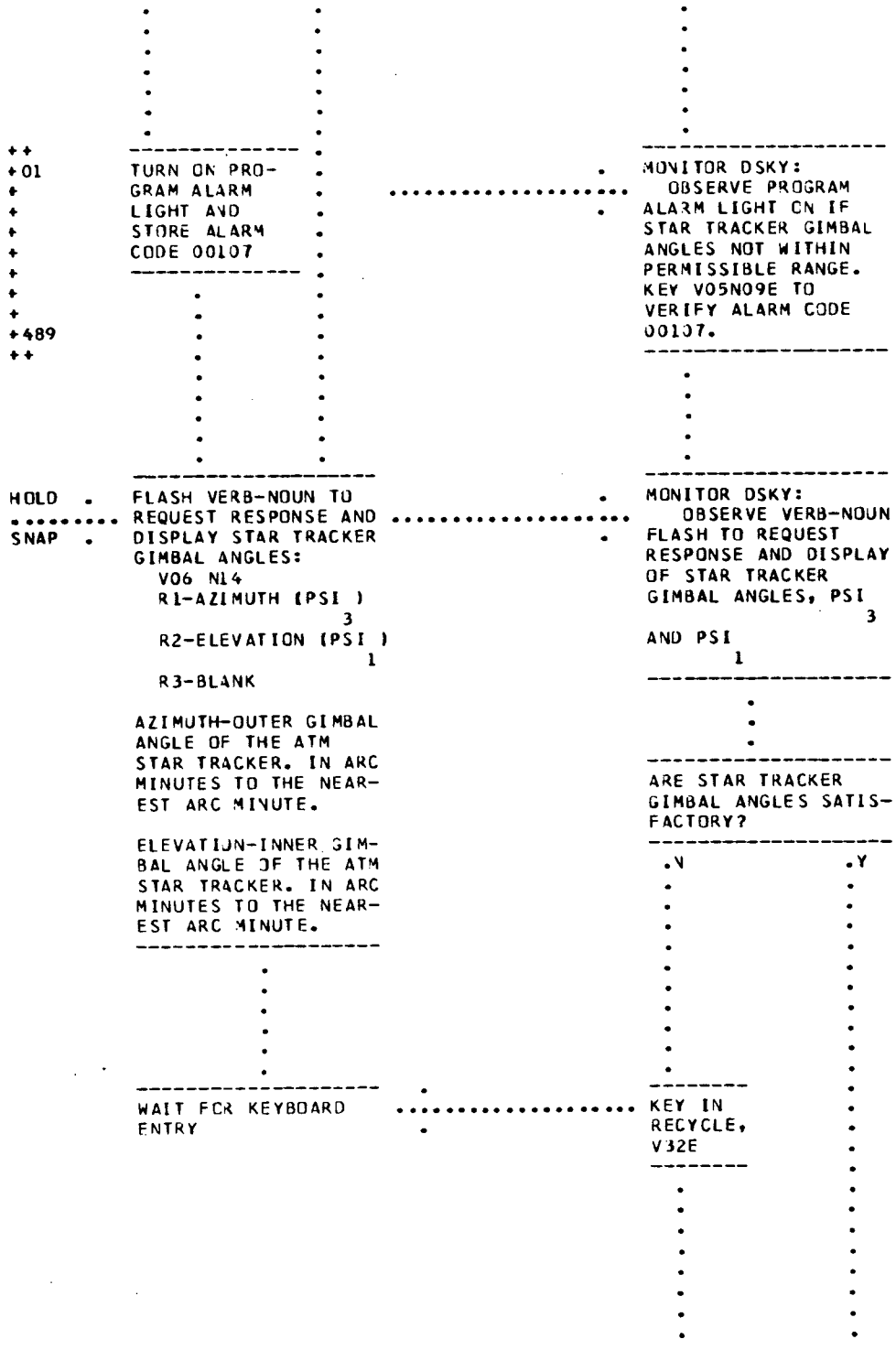
#440

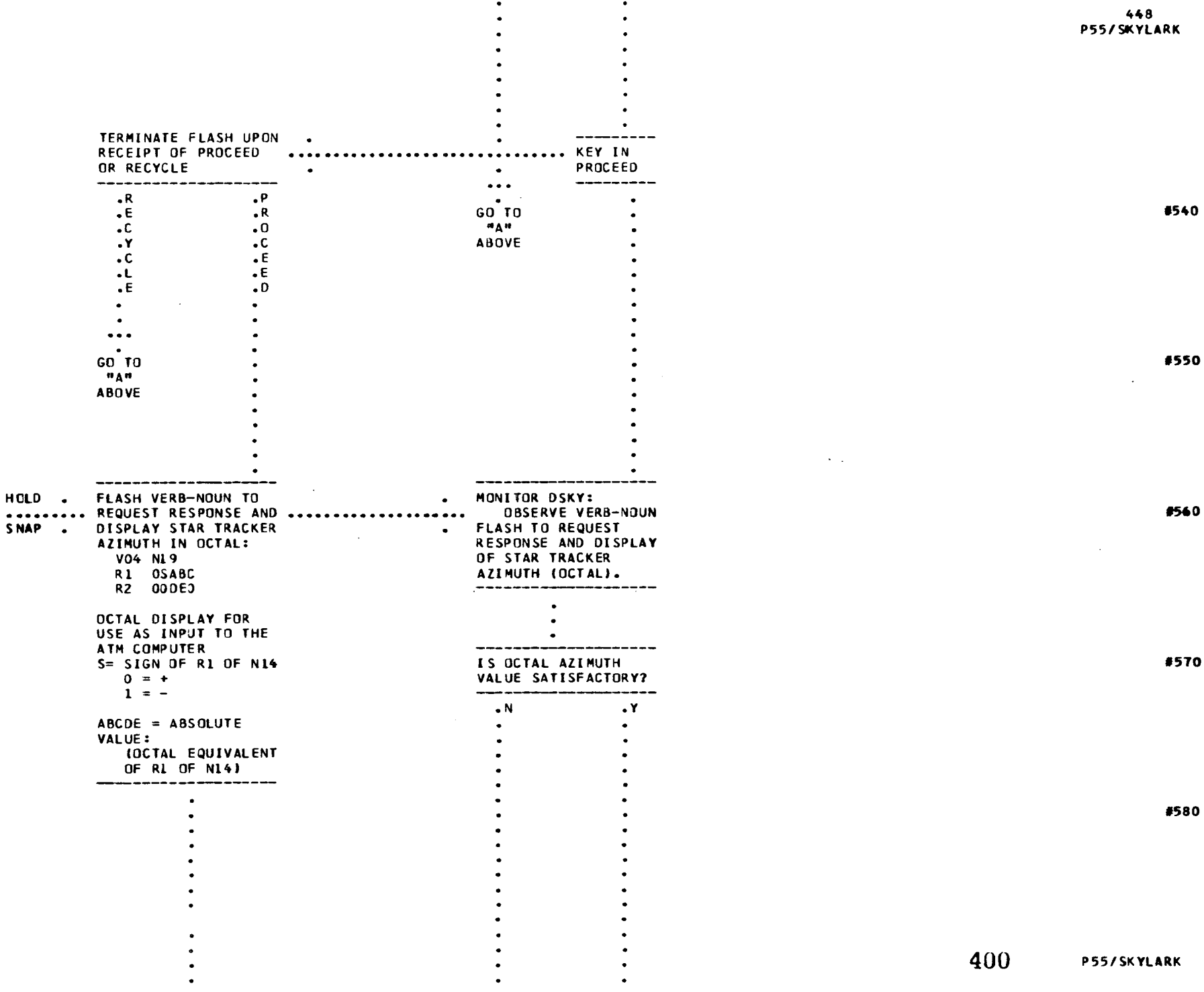
#450

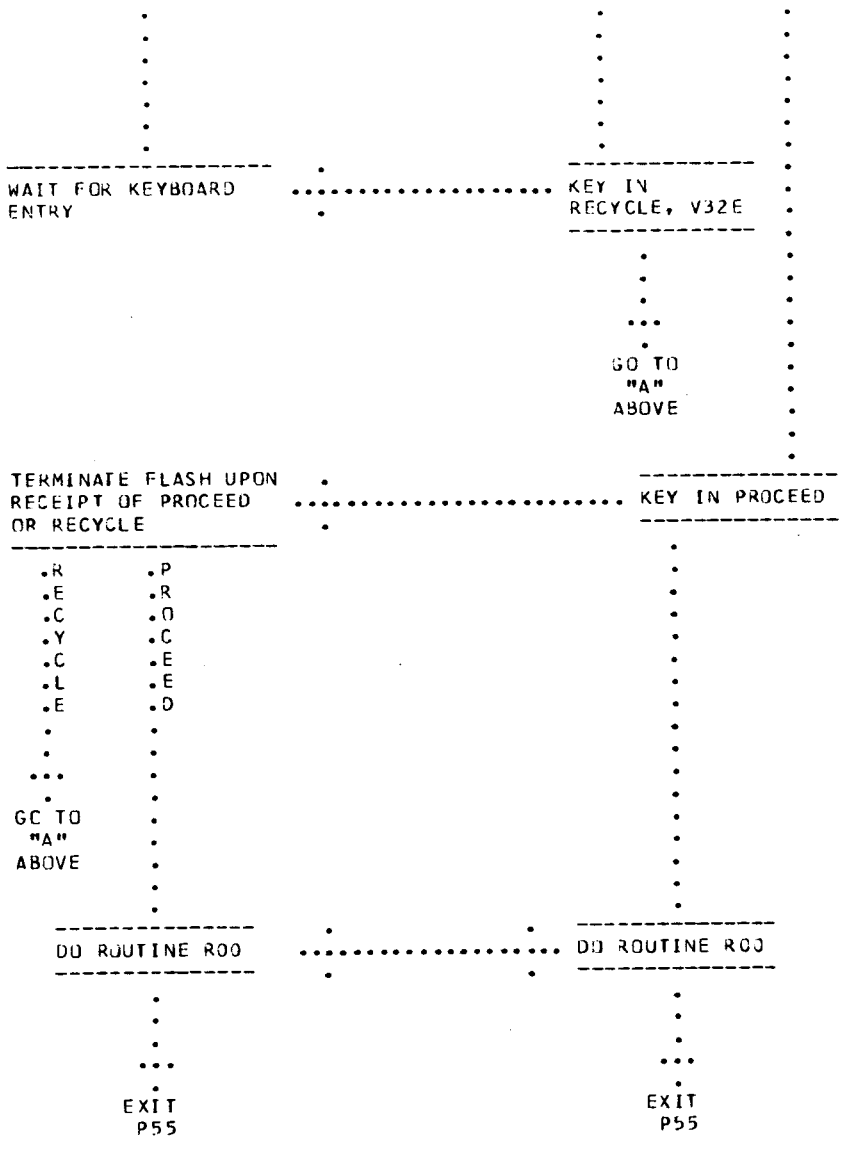
#460

#470




TURN ON PROGRAM ALARM LIGHT AND STORE ALARM CODE 00107
MONITOR DSKY: OBSERVE PROGRAM ALARM LIGHT ON IF STAR TRACKER GIMBAL ANGLES NOT WITHIN PERMISSIBLE RANGE. KEY V05N09E TO VERIFY ALARM CODE 00107.
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STAR TRACKER GIMBAL ANGLES: V06 N14 R1-AZIMUTH (PSI 3) R2-ELEVATION (PSI 1) R3-BLANK
AZIMUTH-OUTER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
ELEVATION-INNER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STAR TRACKER GIMBAL ANGLES, PSI 3 AND PSI 1
ARE STAR TRACKER GIMBAL ANGLES SATISFACTORY?
N
Y
WAIT FOR KEYBOARD ENTRY
KEY IN RECYCLE, V32E
#480
#490
#500
#510
#520
#530


TERMINATE FLASH UPON RECEIPT OF PROCEED OR RECYCLE
KEY IN PROCEED
.R .E .C .Y .C .L .E
.P .R .O .C .E .E .D
GO TO "A" ABOVE
GO TO "A" ABOVE
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STAR TRACKER AZIMUTH IN OCTAL:
V04 N19
R1 OSABC
R2 OODEO
OCTAL DISPLAY FOR USE AS INPUT TO THE ATM COMPUTER
S= SIGN OF R1 OF N14
0 = +
1 = -
ABCDE = ABSOLUTE VALUE:
(OCTAL EQUIVALENT OF R1 OF N14)
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STAR TRACKER AZIMUTH (OCTAL).
IS OCTAL AZIMUTH VALUE SATISFACTORY?
.N
.Y
#540
#550
#560
#570
#580



#590

#600

#610

#620

CHANGE CONTROL NOTES

REV 00 PCR 036, PCN 438
REV 01 PCR 460, PCN 499

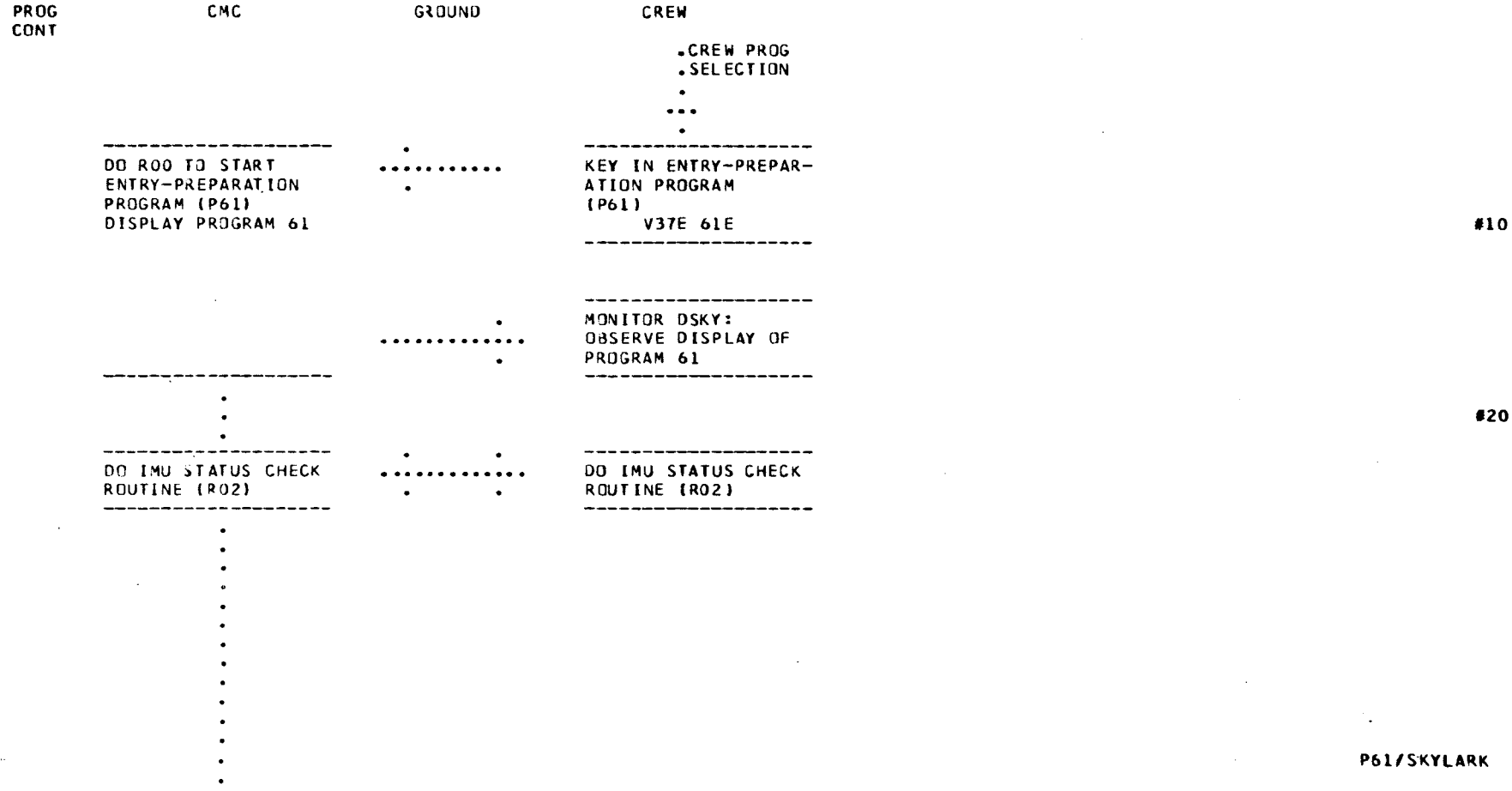
ENTRY-PREPARATION PROGRAM (P61) REV 00 05/19/71

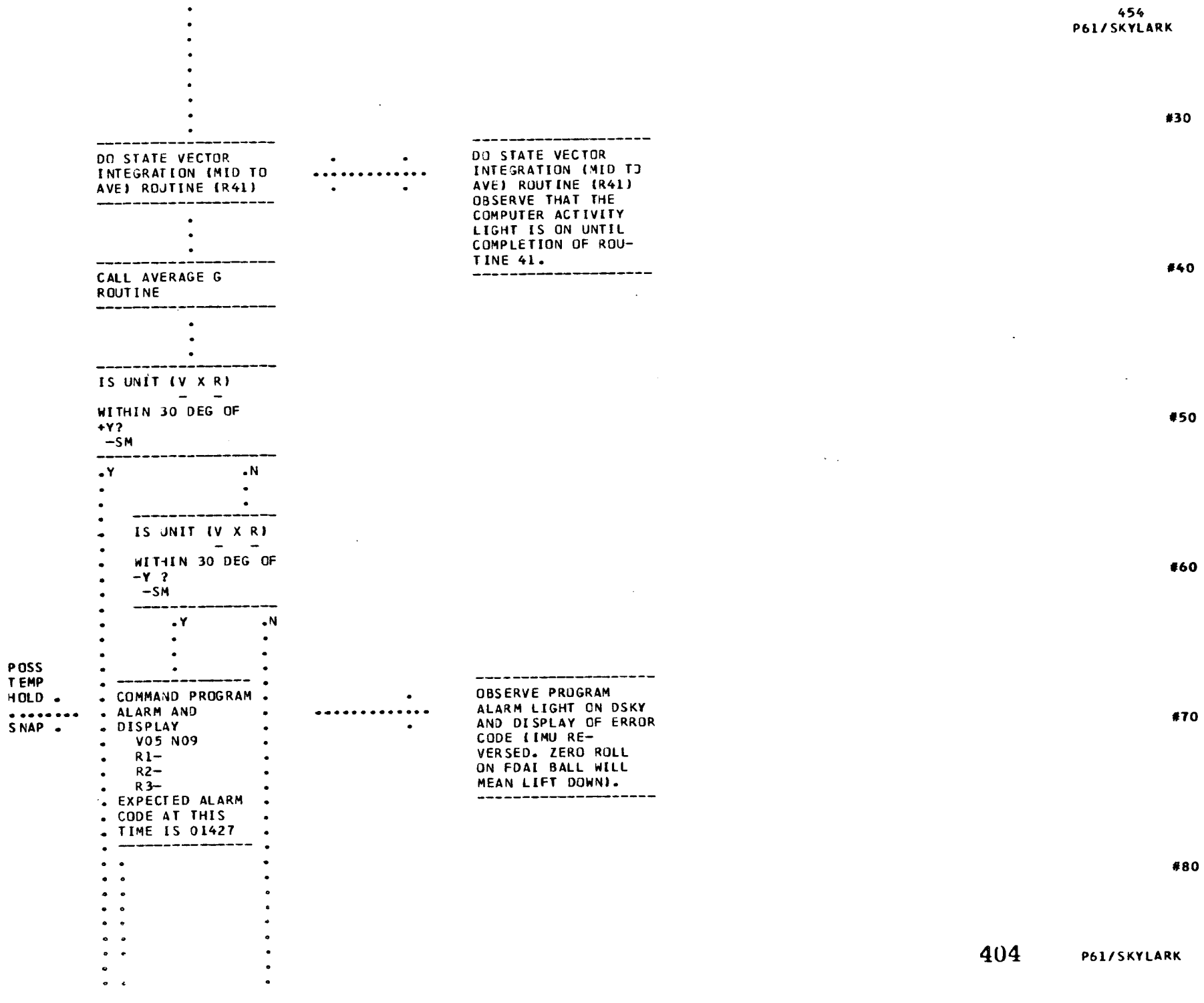
PURPOSE: (1) TO START NAVIGATION, CHECK IMU ALIGNMENT, AND PROVIDE ENTRY MONITOR SYSTEM INITIALIZATION DATA.

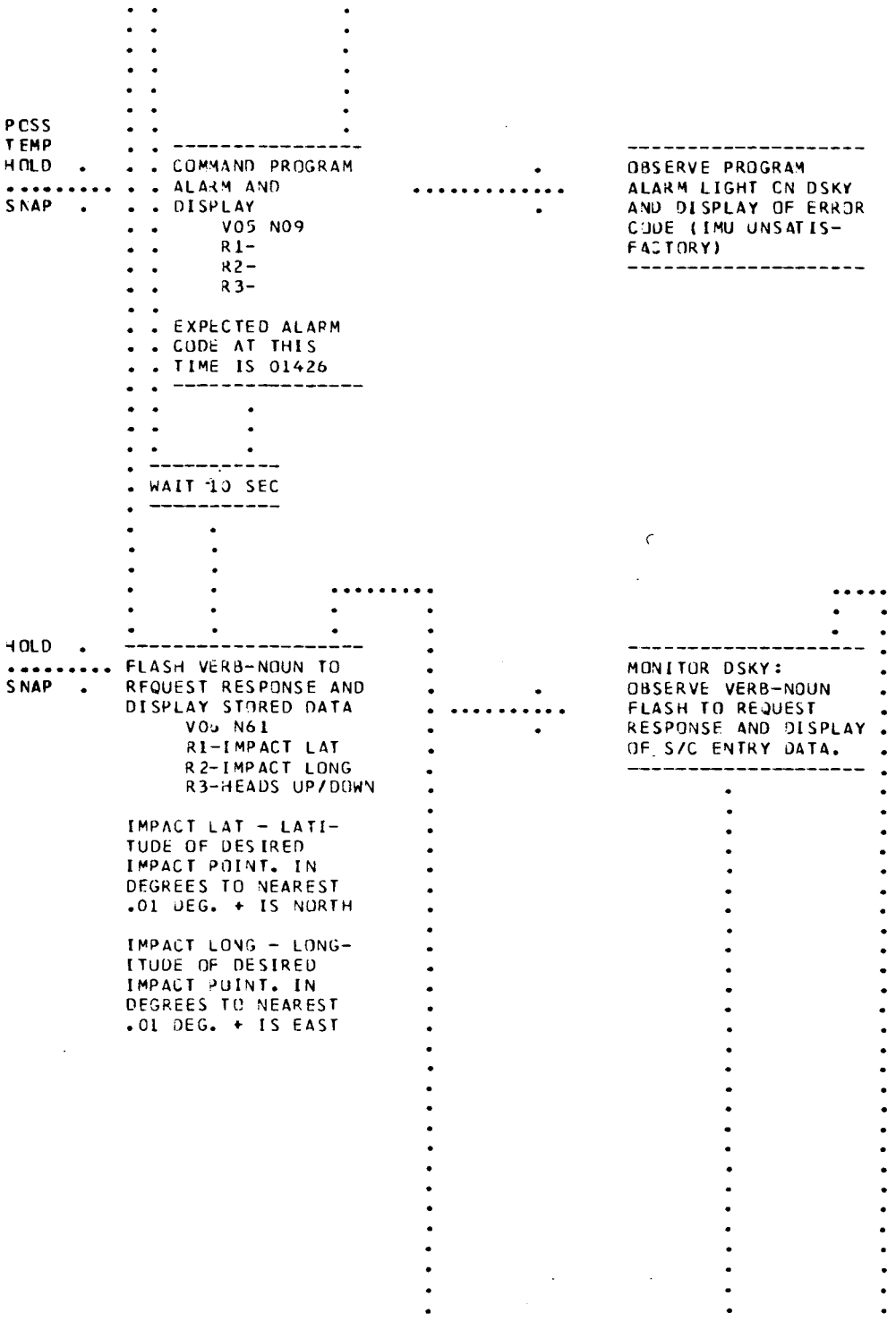
ASSUMPTIONS: (1) THE PROGRAM IS ENTERED WITH ADEQUATE FREE FALL TIME TO COMPLETE THE PREPARATIONS FROM A WORST CASE STARTING ATTITUDE.

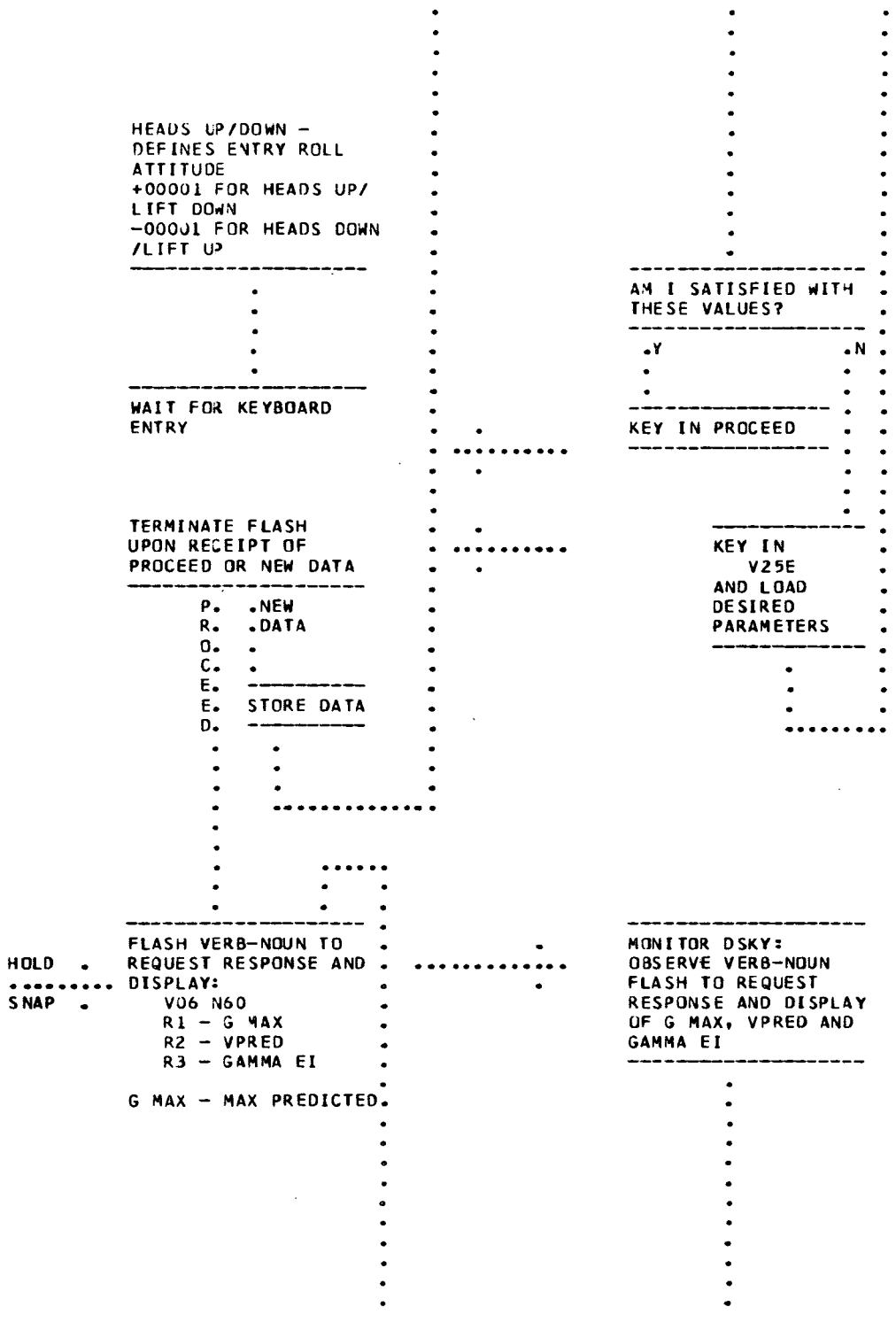
(2) THE ISS IS ON AND PRECISELY ALIGNED TO A SATISFACTORY ORIENTATION.

(3) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.




#30
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41)
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) OBSERVE THAT THE COMPUTER ACTIVITY LIGHT IS ON UNTIL COMPLETION OF ROUTINE 41.
#40
CALL AVERAGE G ROUTINE
#50
IS UNIT (V X R) WITHIN 30 DEG OF +Y? -SM
.Y
.N
IS UNIT (V X R) WITHIN 30 DEG OF -Y ? -SM
#60
.Y
.N
POSS TEMP HOLD
SNAP
COMMAND PROGRAM ALARM AND DISPLAY V05 N09 R1- R2- R3- EXPECTED ALARM CODE AT THIS TIME IS 01427
OBSERVE PROGRAM ALARM LIGHT ON DSKY AND DISPLAY OF ERROR CODE (IMU REVERSED. ZERO ROLL ON FDAI BALL WILL MEAN LIFT DOWN).
#70
#80


PCSS TEMP HOLD SNAP
COMMAND PROGRAM ALARM AND DISPLAY V05 N09 R1- R2- R3-
EXPECTED ALARM CODE AT THIS TIME IS 01426
WAIT 10 SEC
OBSERVE PROGRAM ALARM LIGHT ON DSKY AND DISPLAY OF ERROR CODE (IMU UNSATIS-FACTORY)
#90
#100
HOLD SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED DATA V06 N61 R1-IMPACT LAT R2-IMPACT LONG R3-HEADS UP/DOWN
IMPACT LAT - LATI-TUDE OF DESIRED IMPACT POINT. IN DEGREES TO NEAREST .01 DEG. + IS NORTH
IMPACT LONG - LONG-ITUDE OF DESIRED IMPACT POINT. IN DEGREES TO NEAREST .01 DEG. + IS EAST
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF S/C ENTRY DATA.
#110
#120



#130

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#160

#170

G FOR FREE FALL AND ENTRY AT NOMINAL BANK ANGLE (L/D = .18) IN GS TO NEAREST .01 G.

VPRED- PREDICTED INERTIAL VELOCITY AT 400,000 FT ALTITUDE ABOVE THE FISCHER ELLIPSOID. IN FPS TO NEAREST FPS.

GAMMA EI - FLIGHT PATH ANGLE. ANGLE BETWEEN INERTIAL VELOCITY AND THE LOCAL HORIZONTAL AT THE ENTRY INTERFACE ALTITUDE AT 400,000 FT ALTITUDE ABOVE THE FISCHER ELLIPSOID. IN DEGREES TO NEAREST .01 DEG.

MINUS INDICATES FLIGHT PATH IS BELOW THE HORIZONTAL PLANE.

RECORD DATA IF NECESSARY

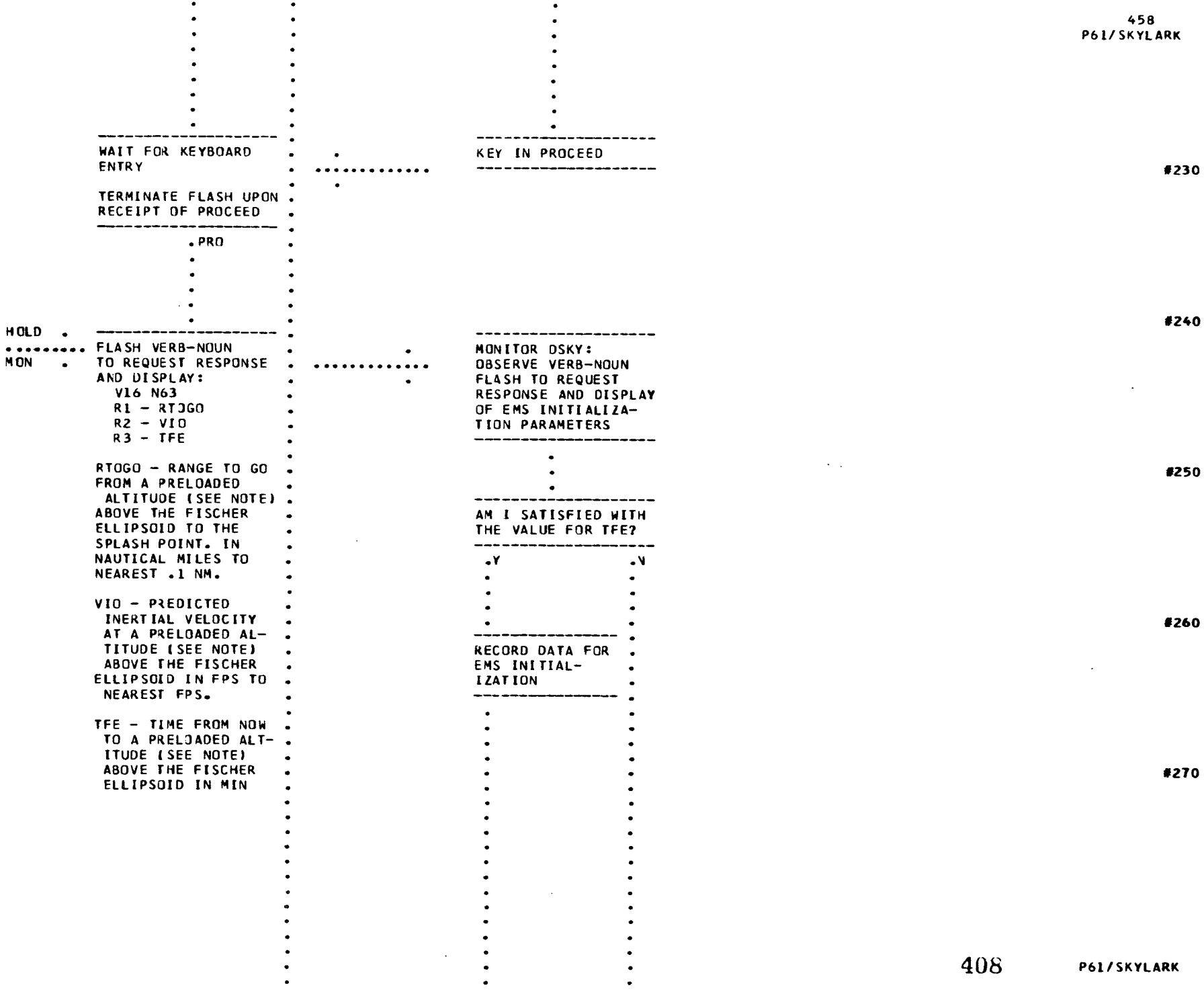
#180

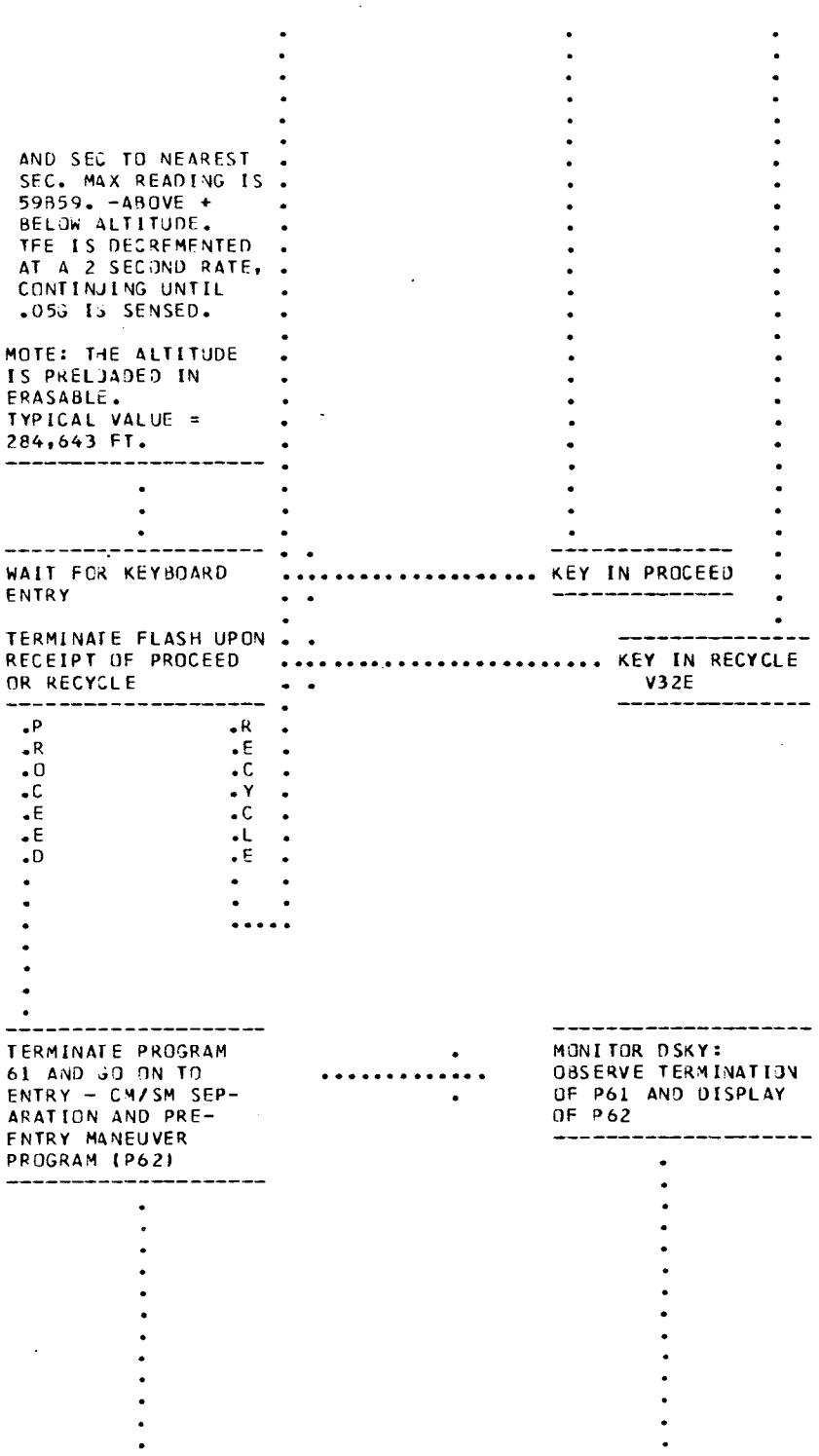
#190

#200

#210

#220


WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED
PRO
KEY IN PROCEED
#230
#240
HOLD MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY:
V16 N63
R1 - RTOGO
R2 - VIO
R3 - TFE
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF EMS INITIALIZATION PARAMETERS
#250
RTOGO - RANGE TO GO FROM A PRELOADED ALTITUDE (SEE NOTE) ABOVE THE FISCHER ELLIPSOID TO THE SPLASH POINT. IN NAUTICAL MILES TO NEAREST .1 NM.
AM I SATISFIED WITH THE VALUE FOR TFE?
Y
N
VIO - PREDICTED INERTIAL VELOCITY AT A PRELOADED ALTITUDE (SEE NOTE) ABOVE THE FISCHER ELLIPSOID IN FPS TO NEAREST FPS.
#260
RECORD DATA FOR EMS INITIALIZATION
TFE - TIME FROM NOW TO A PRELOADED ALTITUDE (SEE NOTE) ABOVE THE FISCHER ELLIPSOID IN MIN
#270



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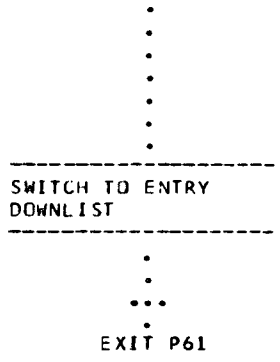
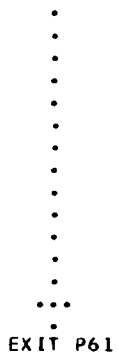
#320





#330

CHANGE CONTROL NOTES

REV 00 PCN 410

ENTRY - CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM (P62) REV 00 05/19/71

PURPOSE: (1) TO NOTIFY CREW WHEN THE GNCS IS PREPARED FOR CM/SM SEPARATION.

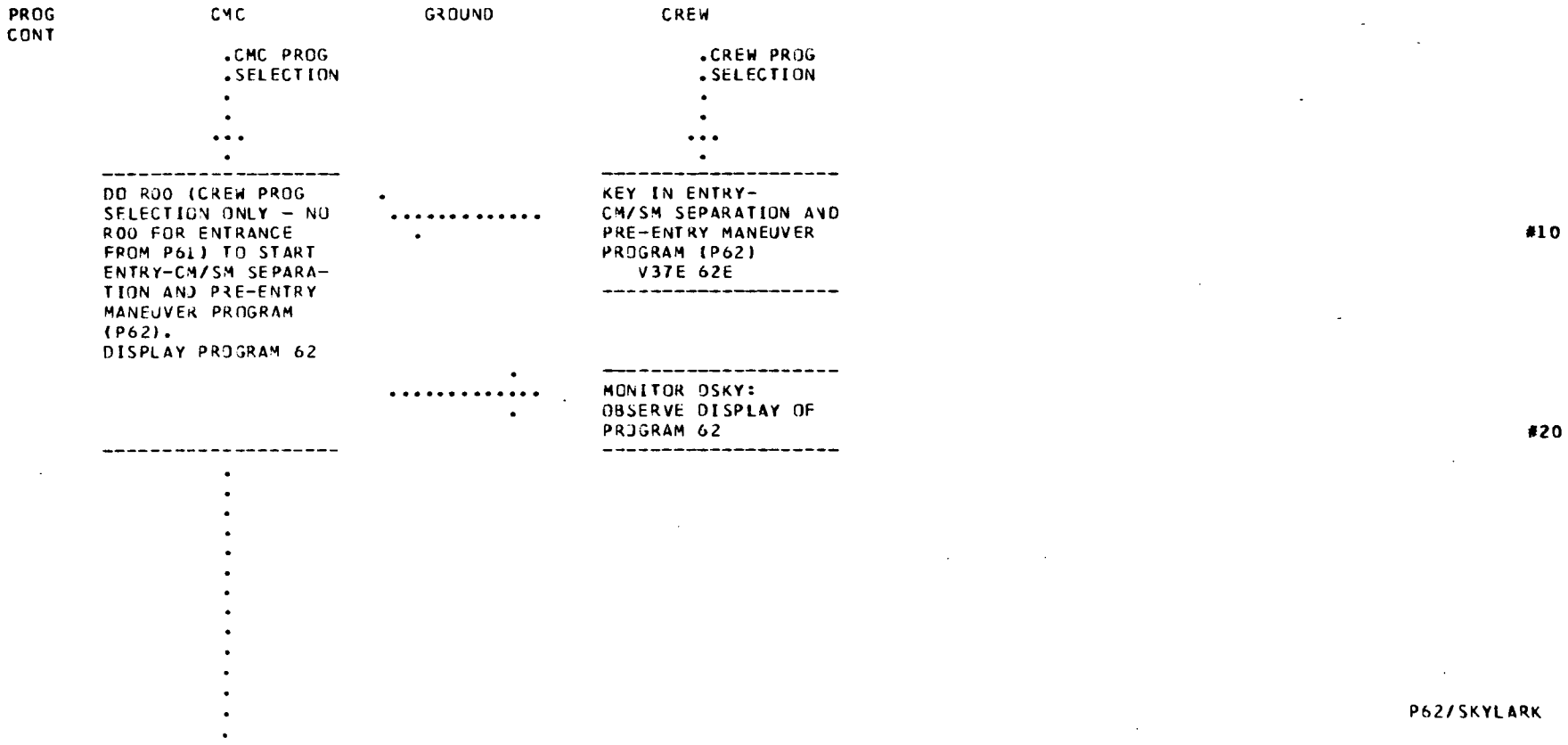
(2) TO ORIENT THE CM TO THE CORRECT ATTITUDE FOR ATMOSPHERIC ENTRY.

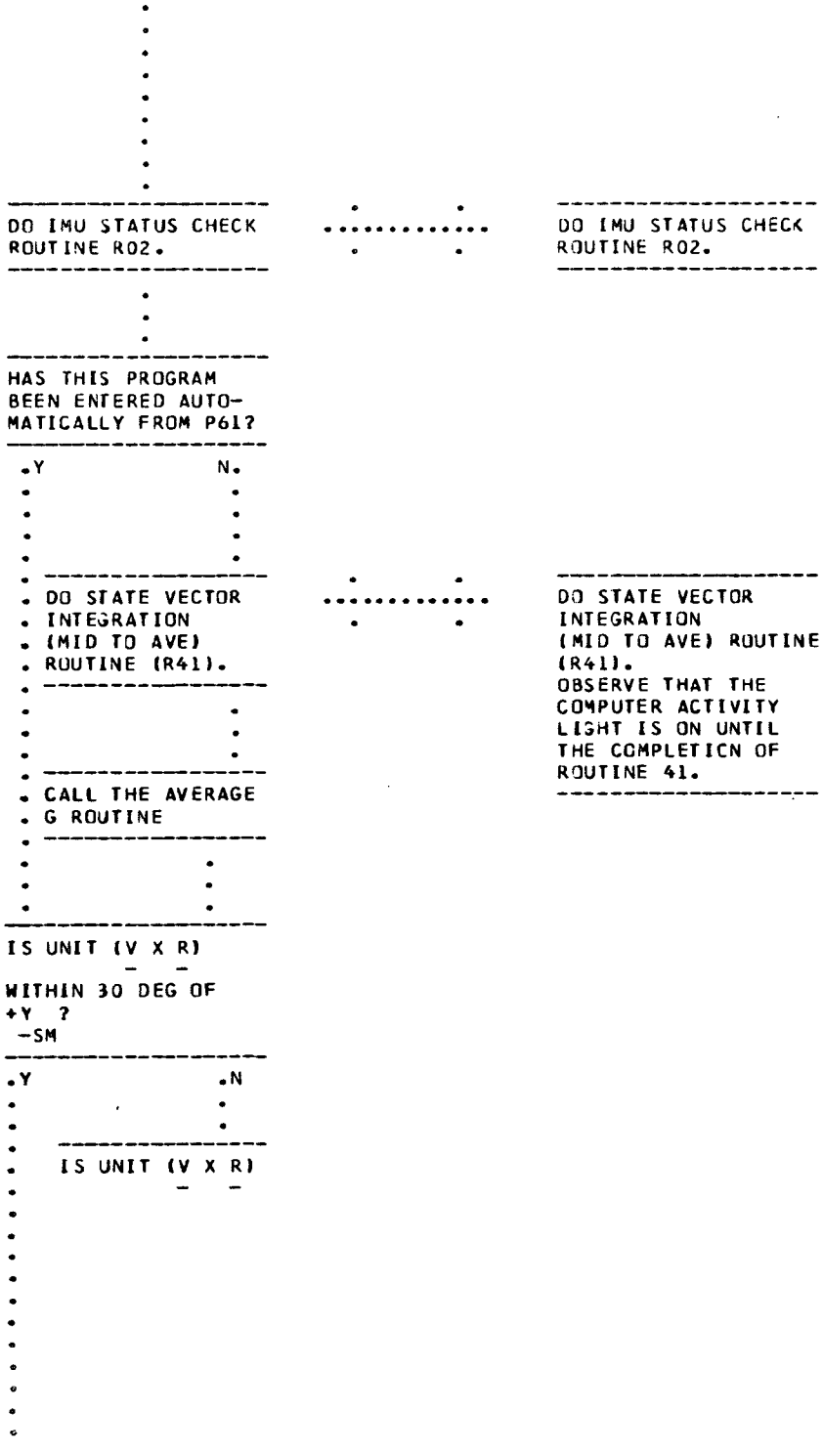
ASSUMPTIONS: (1) THE PROGRAM IS ENTERED WITH ADEQUATE FREE FALL TIME TO ACCOMPLISH CM/SM SEPARATION AND TO COMPLETE THE MANEUVER FROM A WORST CASE STARTING ATTITUDE.

(2) THE IMU IS SATISFACTORILY ALIGNED FOR ENTRY.

(3) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY-PREPARATION PROGRAM (P61) OR IT MAY BE SELECTED MANUALLY.

(4) IN ADDITION TO THE AUTOMATIC DISPLAYS, THE ASTRONAUT MAY MONITOR N53(RTOGO,VIO,TFE) BY KEYING IN V16N63E.




DO IMU STATUS CHECK ROUTINE R02.
HAS THIS PROGRAM BEEN ENTERED AUTO-MATICALLY FROM P61?
Y
N
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41).
CALL THE AVERAGE G ROUTINE
IS UNIT (V X R) WITHIN 30 DEG OF +Y ? -SM
Y
N
IS UNIT (V X R)
DO IMU STATUS CHECK ROUTINE R02.
DO STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41).
OBSERVE THAT THE COMPUTER ACTIVITY LIGHT IS ON UNTIL THE COMPLETICN OF ROUTINE 41.

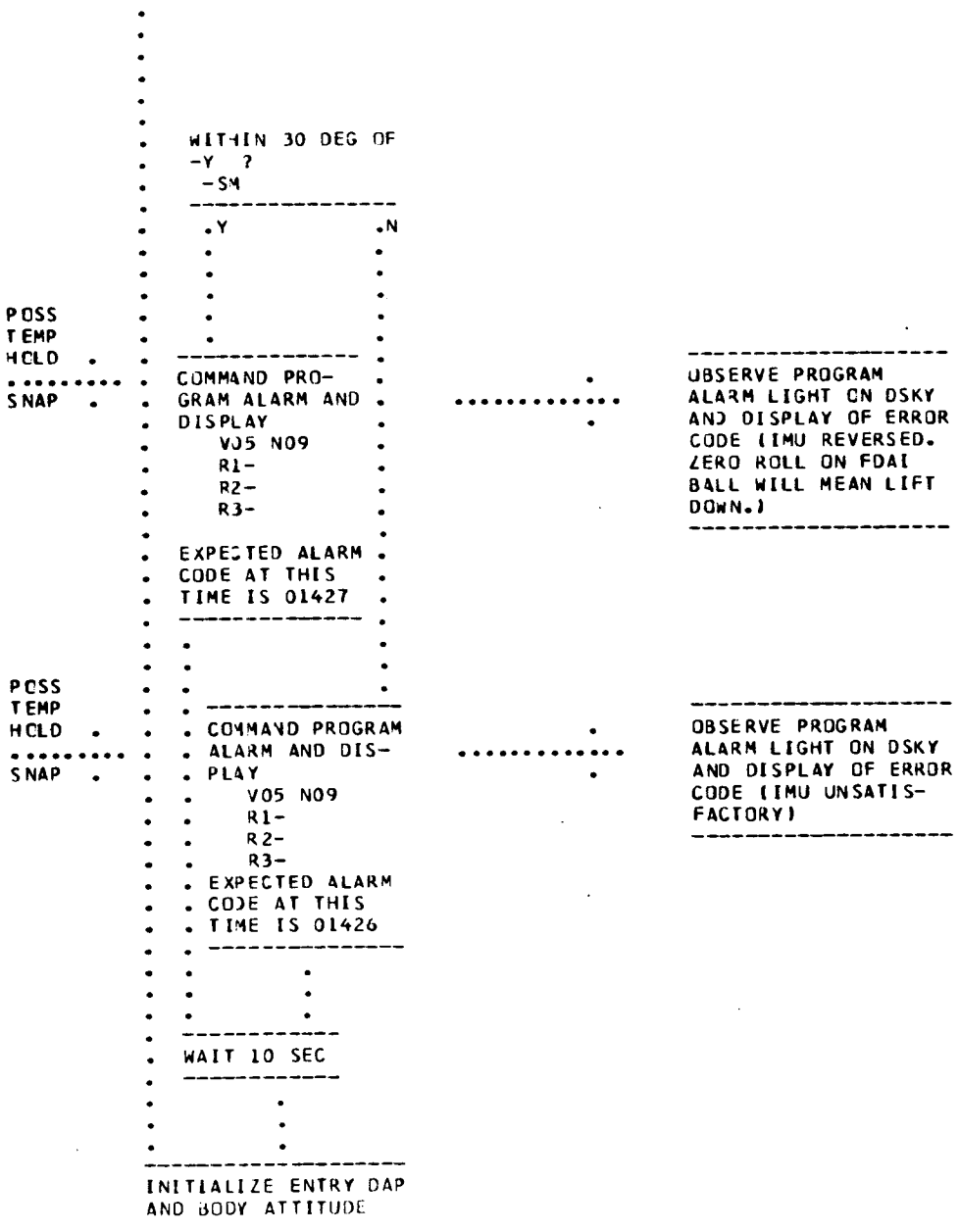
#30

#40

#50

#60

#70



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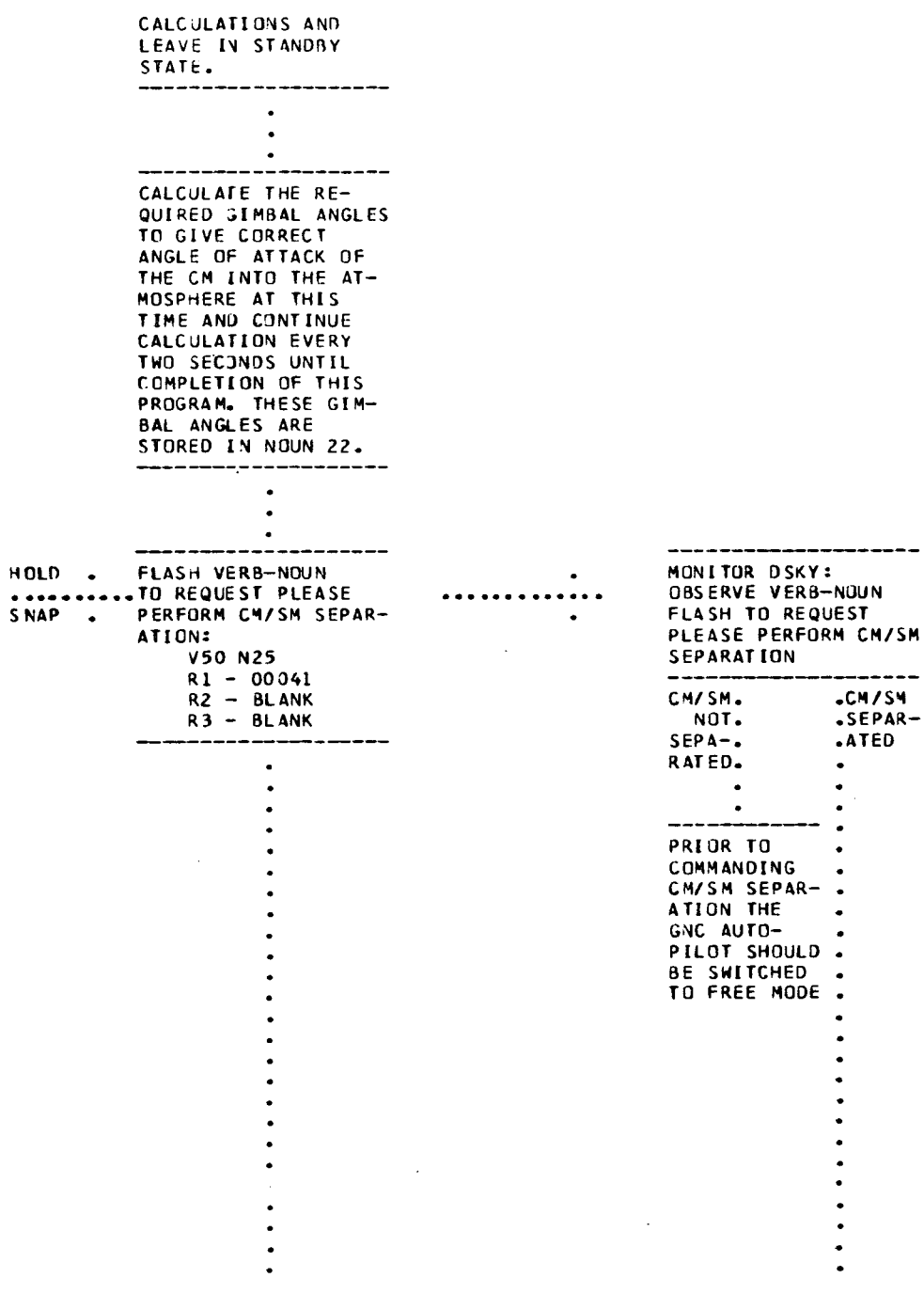

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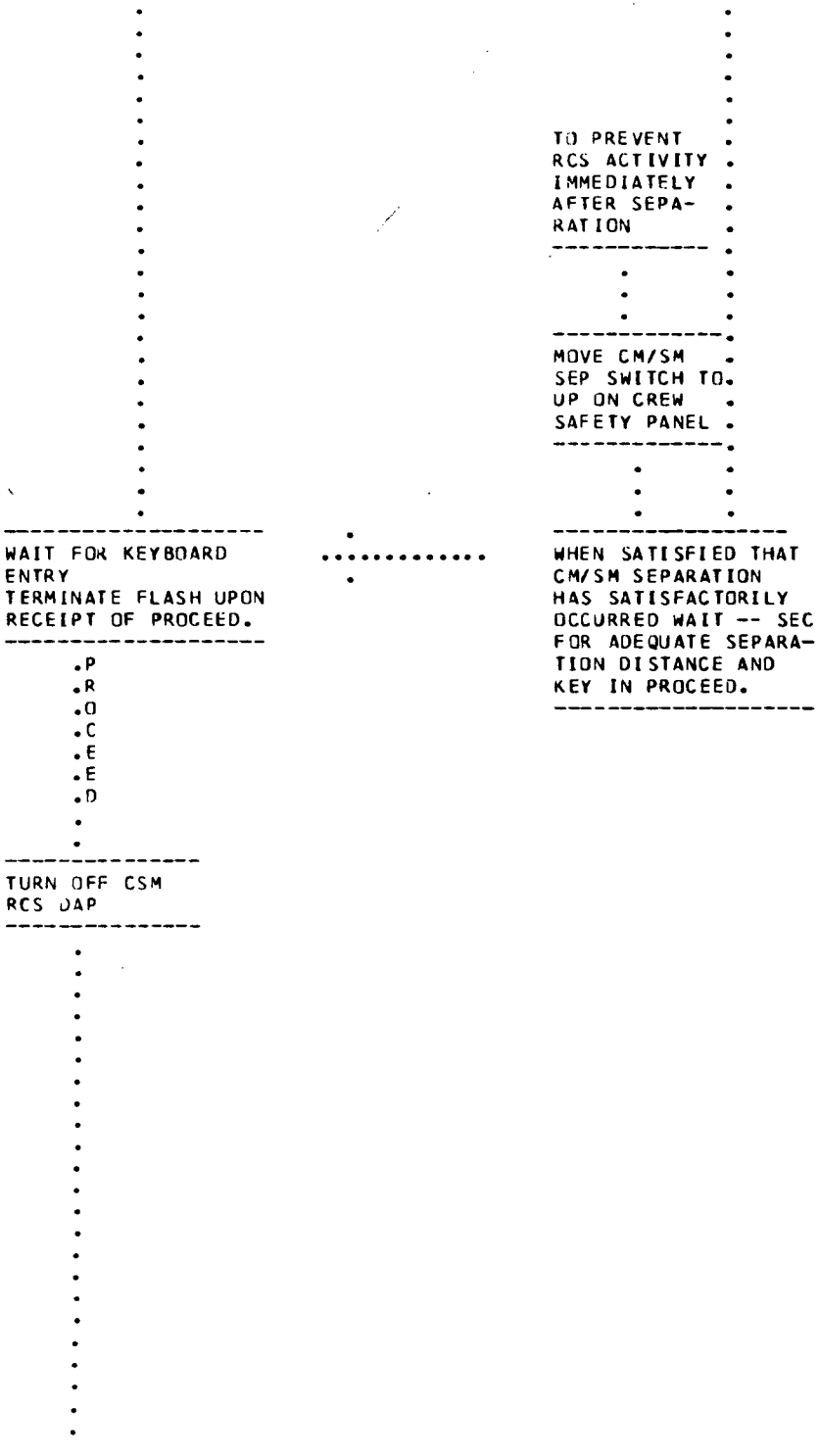

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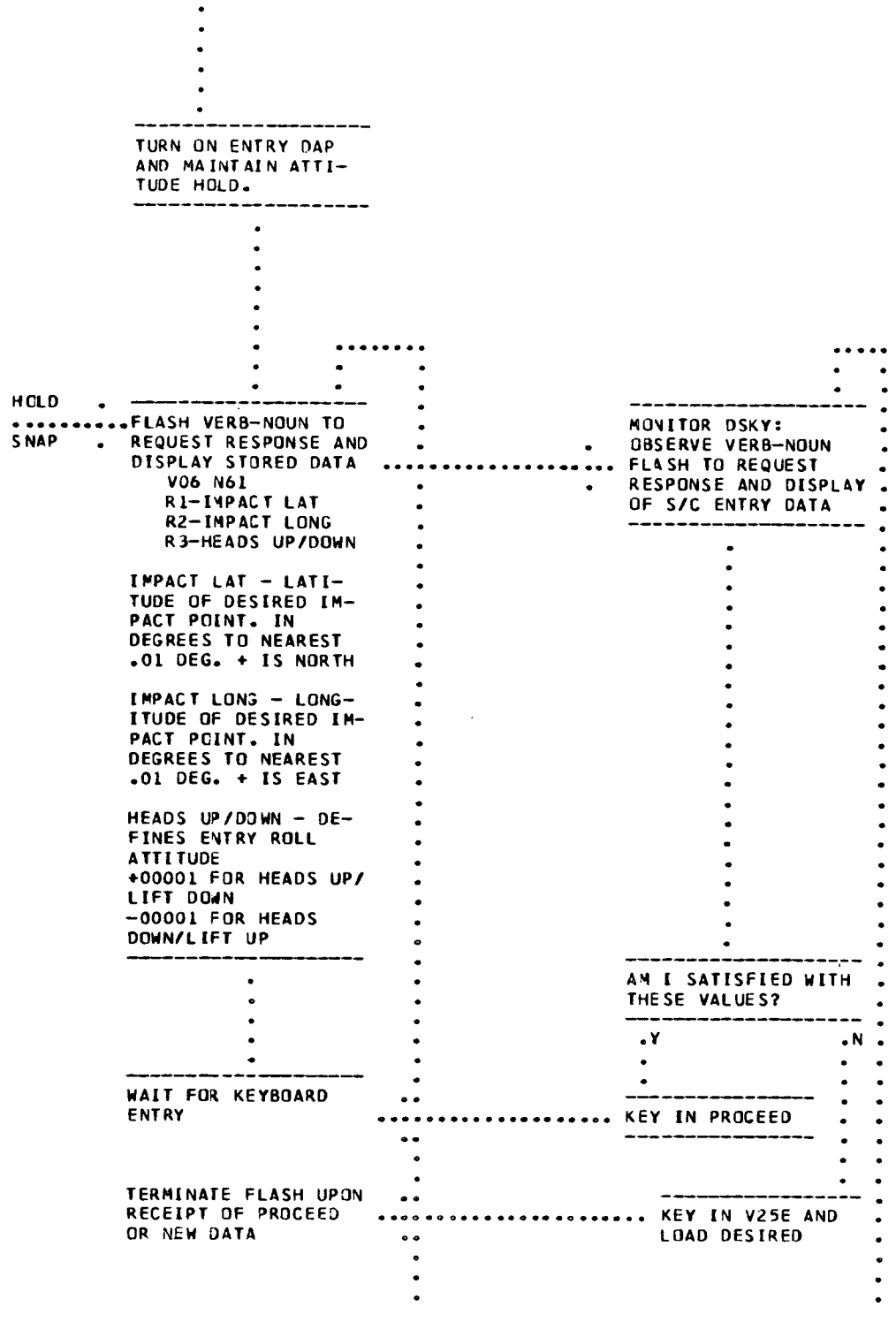
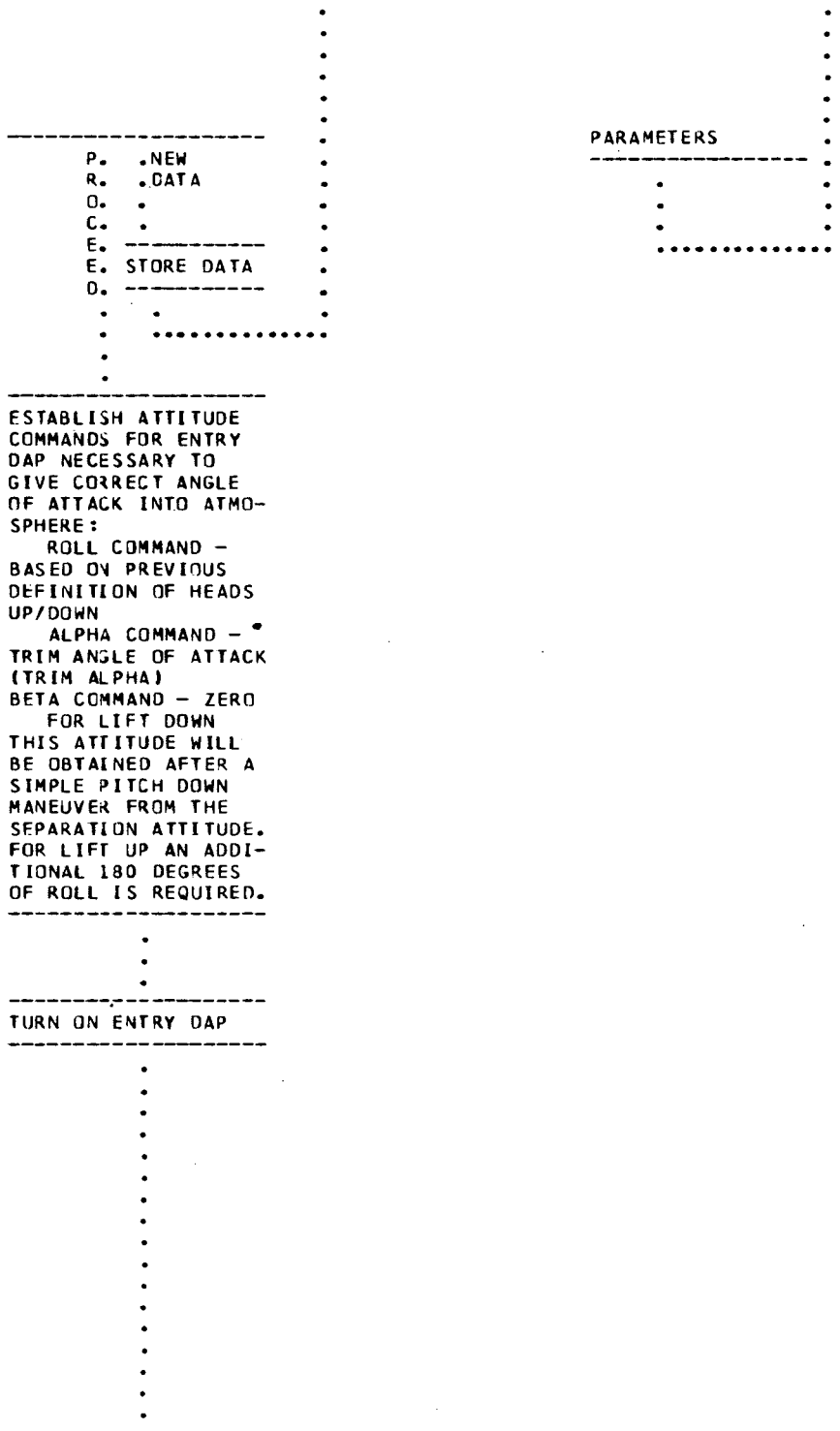
#200

#210


TURN ON ENTRY DAP AND MAINTAIN ATTITUDE HOLD.
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STORED DATA
V06 N61
R1-IMPACT LAT
R2-IMPACT LONG
R3-HEADS UP/DOWN
IMPACT LAT - LATITUDE OF DESIRED IMPACT POINT. IN DEGREES TO NEAREST .01 DEG. + IS NORTH
IMPACT LONG - LONGITUDE OF DESIRED IMPACT POINT. IN DEGREES TO NEAREST .01 DEG. + IS EAST
HEADS UP/DOWN - DEFINES ENTRY ROLL ATTITUDE
+00001 FOR HEADS UP/LIFT DOWN
-00001 FOR HEADS DOWN/LIFT UP
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF S/C ENTRY DATA
AM I SATISFIED WITH THESE VALUES?
.Y
.N
KEY IN PROCEED
KEY IN V25E AND LOAD DESIRED
#220
#230
#240
#250
#260
#270



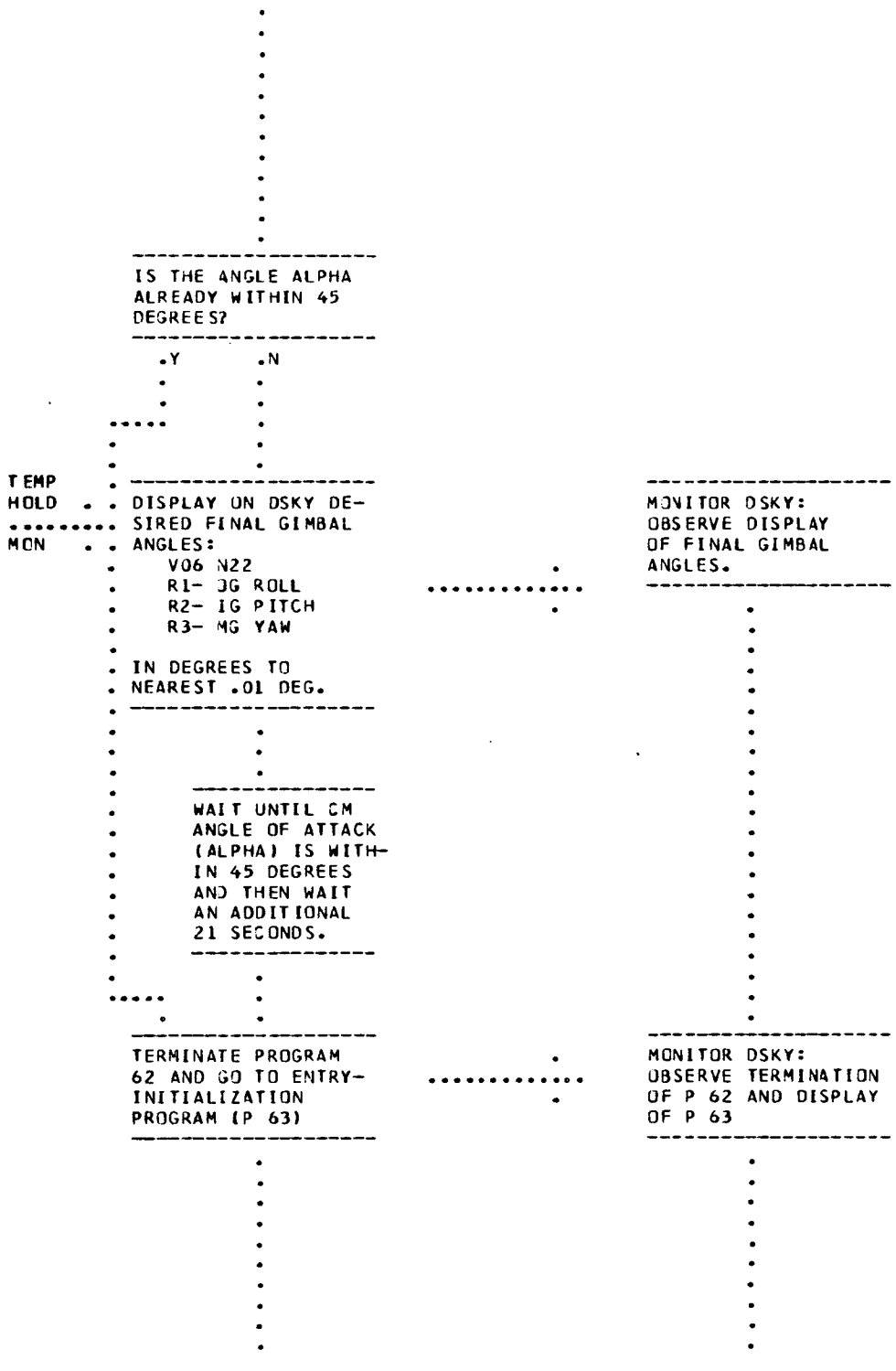
#280

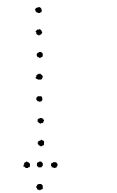
#290

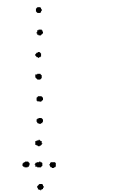
#300

#310

#320


IS THE ANGLE ALPHA ALREADY WITHIN 45 DEGREES?
Y
N
#330
TEMP HOLD MON
DISPLAY ON DSKY DESIRED FINAL GIMBAL ANGLES:
V06 N22
R1- OG ROLL
R2- IG PITCH
R3- MG YAW
IN DEGREES TO NEAREST .01 DEG.
MONITOR DSKY: OBSERVE DISPLAY OF FINAL GIMBAL ANGLES.
#340
#350
WAIT UNTIL CM ANGLE OF ATTACK (ALPHA) IS WITHIN 45 DEGREES AND THEN WAIT AN ADDITIONAL 21 SECONDS.
#360
TERMINATE PROGRAM 62 AND GO TO ENTRY-INITIALIZATION PROGRAM (P 63)
MONITOR DSKY: OBSERVE TERMINATION OF P 62 AND DISPLAY OF P 63
#370





CHANGE CONTROL NOTES

REV 00 PCN 457

ENTRY-INITIALIZATION PROGRAM (P63) REV 00 05/19/71

PURPOSE: (1) TO INITIALIZE THE ENTRY EQUATIONS.

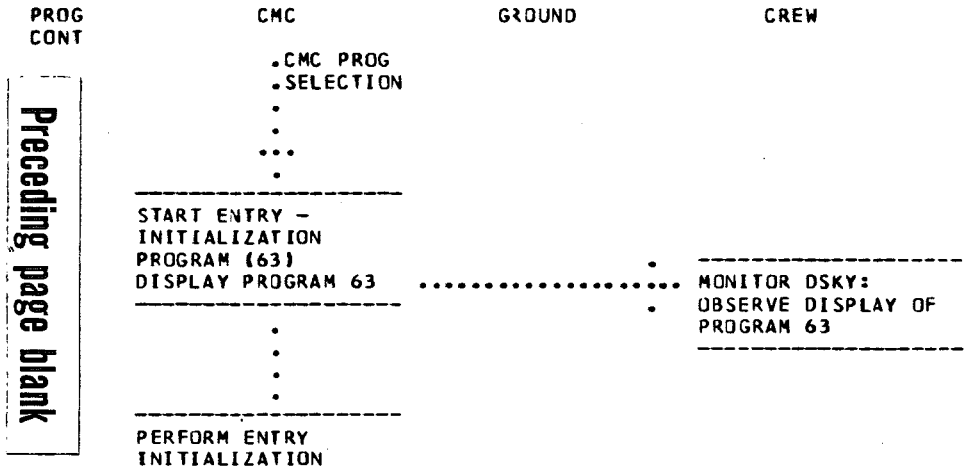
(2) TO CONTINUE TO HOLD THE CM TO THE CORRECT ATTITUDE WITH RESPECT TO THE ATMOSPHERE FOR THE ONSET OF ENTRY DECELERATION.

(3) TO ESTABLISH ENTRY DSKY DISPLAYS.

(4) TO SENSE .05G AND DISPLAY THIS EVENT TO THE CREW BY SELECTING THE ENTRY-POST 0.05G PROGRAM (P64).

ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY-CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM (P62).

(2) IN ADDITION TO N64(G,VI,R TO GO) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
N63 (RTOGO, VIO, TFE)
N68 (BETA, VI, HDOT)
N74 (BETA, VI, G)



#10

#20

RCUTINE WHICH
INCLUDES:

A-CONTINUE CALCU-
LATION OF INITIAL
ROLL ANGLE BASED ON
THE LATERAL RANGE OF
THE LANDING TARGET
AND HEADS UP/HEADS
DOWN AS SPECIFIED.

#30

B-CONTINUE CALCULATION
OF DESIRED CM
PITCH AND YAW
ATTITJDE AS DETERMI-
NED BY THE VEHICLE
POSITION AND VEL-
OCITY W.R.T. THE
ATMOSPHERE. PRIOR
TO .05G THIS
ATTITUDE IS ZERO
SIDESLIP AND ANGLE
OF ATTACK NEAR
TRIM VALUE.

#40

#50

MAINTAIN CM ATTITUDE
FOR LIFT VECTOR UP/
DOWN, AS SELECTED,
ZERO SIDESLIP,
AND TRIM ANGLE OF
ATTACK

#60

TEMP HOLD ON

DISPLAY ON DSKY:
V06 N64
R1-G
R2-VI
R3-R TO GO

MONITOR DSKY:
OBSERVE DISPLAY OF
G, VI AND R TO GO

#70

G-ACCELERATION IN G TO NEAREST .01G

VI-INERTIAL VELOCITY IN FPS TO NEAREST FPS

R TO GO - RANGE TO GO TO THE DESIRED SPLASH POINT ASSUMING SPLASH POINT LOCATED AT CALCULATED IMPACT TIME. IN NAUTICAL MILES TO NEAREST .1 NM. NEGATIVE AND COUNTING DOWN WHEN APPROACHING TARGET, POSITIVE AND COUNTING UP WHEN LEAVING TARGET.

WAIT FOR .05G INDICATION

ENTRY LOGIC DETECTS .05G

CHANGE ENTRY DAP FROM ATTITUDE HOLD

MONITOR GNCS CONTROL OF PRE - .05G CM ATTITUDE:

(1) DSKY:

R1-G-INCREASING

R2-VI-NOMINAL

R3-R TO GO NEGATIVE AND COUNTING DOWN WHEN APPROACHING TARGET, POSITIVE AND COUNTING UP WHEN LEAVING TARGET.

(2) FDAI:

ATTITUDE RATES LESS THAN--DEG./SEC.

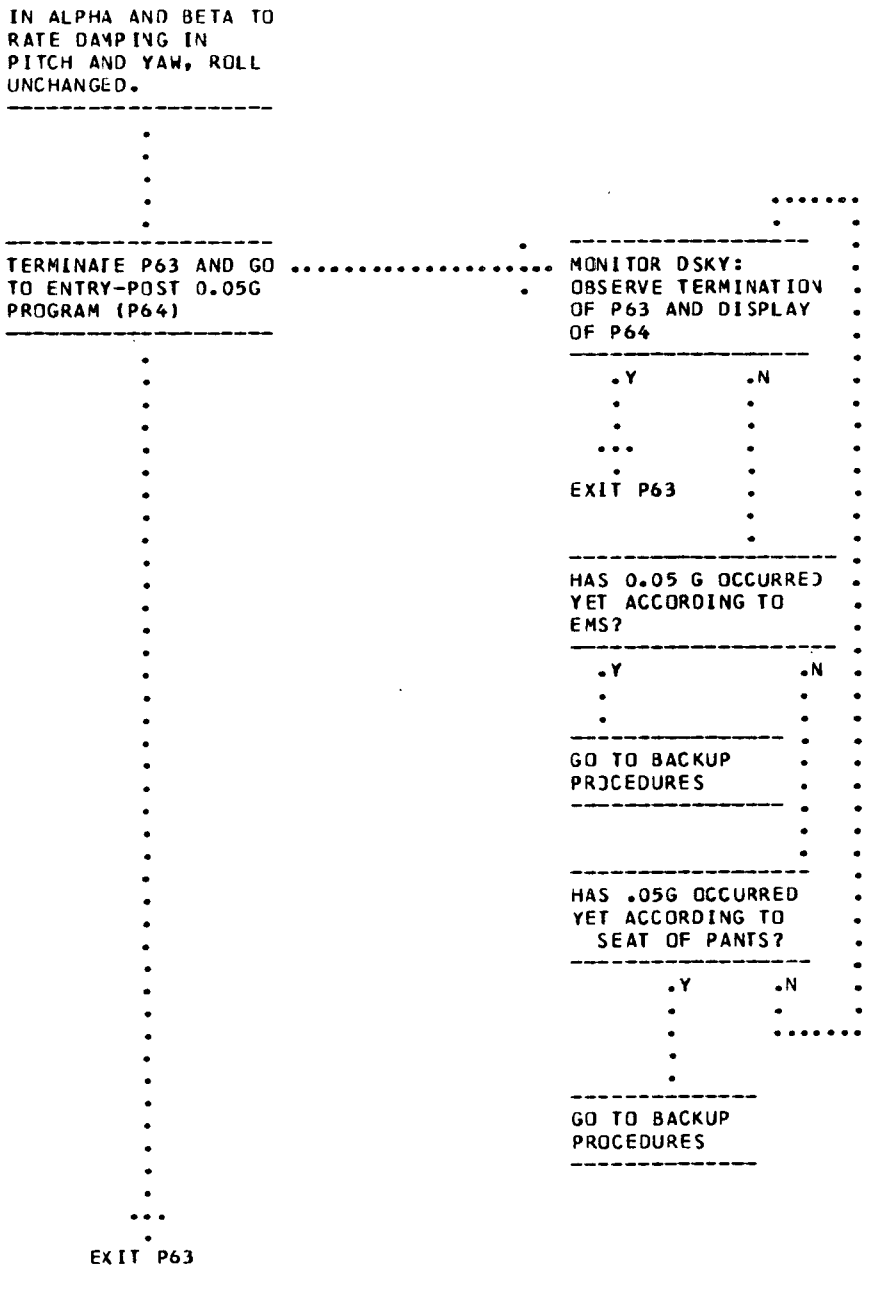
ATTITUDE ERRORS LESS THAN --DEG.

#80

#90

#100

#110



#120

#130

#140

#150

#160

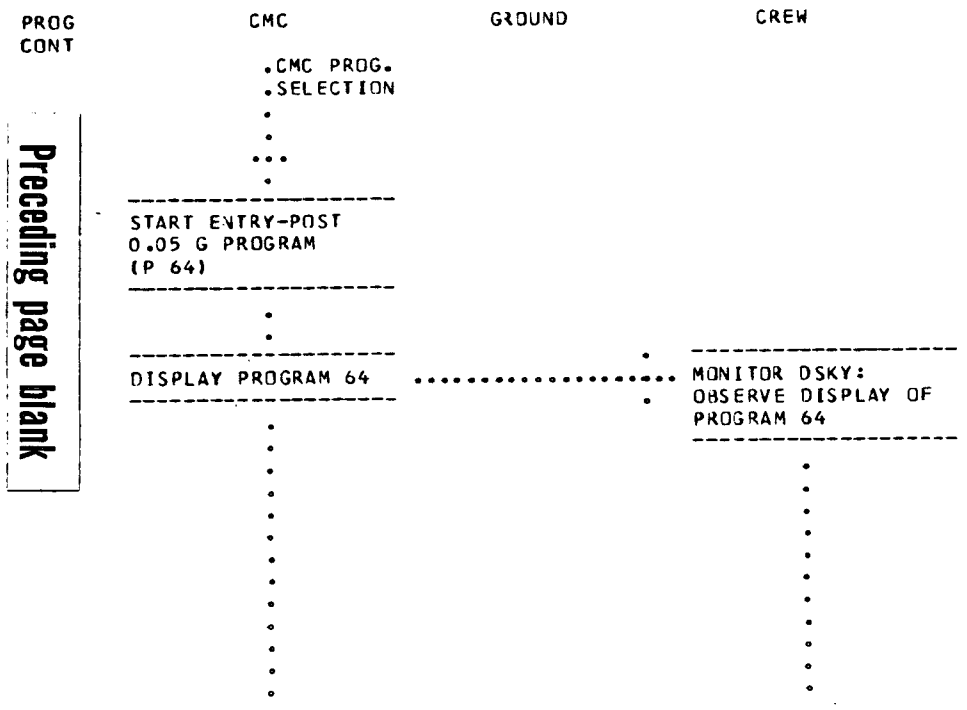
#170

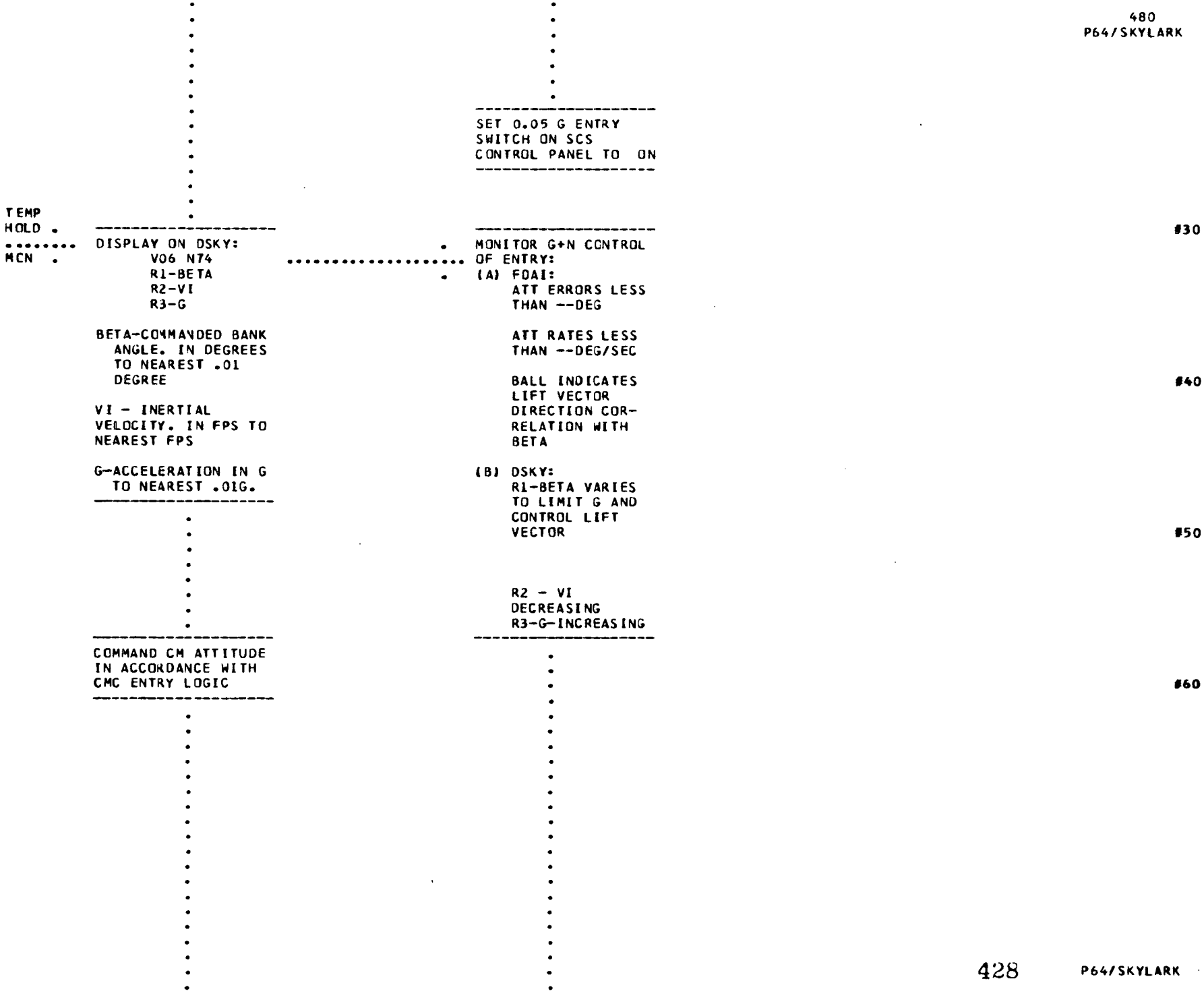
CHANGE CONTROL NOTES

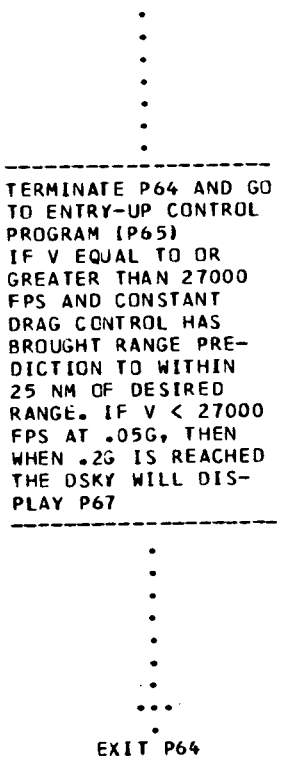
ENTRY - POST 0.05 G PROGRAM (P64) REV 00 05/19/71

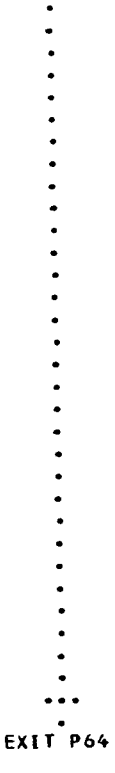
PURPOSE:
(1) TO START ENTRY GUIDANCE AT .05G SELECTING ROLL ATTITUDE, CONSTANT DRAG LEVEL, AND DRAG THRESHOLD, KA, WHICH ARE KEYED TO THE .05G POINT.
(2) SELECT FINAL PHASE (P67) WHEN 0.2G OCCURS IF V WAS <27000 FPS AT 0.05G.
(3) ITERATE FOR UPCONTROL SOLUTION (P65) IF V >27000 FPS AND IF ALTITUDE RATE AND DRAG LEVEL CONDITIONS ARE SATISFIED
(4) SELECT FINAL PHASE (P67) IF NO UPCONTROL SOLUTION EXISTS WITH VL >18000 FPS.
(5) TO ESTABLISH THE 0.05 G MODE IN SCS.
(6) TO CONTINUE ENTRY DSKY DISPLAYS.

ASSUMPTIONS:
(1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY INITIALIZATION PROGRAM (P 61).
(2) IN ADDITION TO N74 (BETA, VI, G) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
N64 (G, VI, R TO GO)
N68 (BETA, VI, HDOT)




SET 0.05 G ENTRY SWITCH ON SCS CONTROL PANEL TO ON
TEMP HOLD
MCN
DISPLAY ON DSKY:
V06 N74
R1-BETA
R2-VI
R3-G
BETA-COMMANDED BANK ANGLE. IN DEGREES TO NEAREST .01 DEGREE
VI - INERTIAL VELOCITY. IN FPS TO NEAREST FPS
G-ACCELERATION IN G TO NEAREST .01G.
MONITOR G+N CONTROL OF ENTRY:
(A) FDAI:
ATT ERRORS LESS THAN --DEG
ATT RATES LESS THAN --DEG/SEC
BALL INDICATES LIFT VECTOR DIRECTION CORRELATION WITH BETA
(B) DSKY:
R1-BETA VARIES TO LIMIT G AND CONTROL LIFT VECTOR
R2 - VI DECREASING
R3-G-INCREASING
COMMAND CM ATTITUDE IN ACCORDANCE WITH CMC ENTRY LOGIC
#30
#40
#50
#60





#70

#80

#90

CHANGE CONTROL NOTES

ENTRY - UP CONTROL PROGRAM (P65) REV 00 05/19/71
NOTE: P65 HAS NOT BEEN TESTED AND IS
THEREFORE NOT OPERATIONAL FOR SKYLARK.

PURPOSE: (1) TO EXECUTE ENTRY - UP CONTROL GUIDANCE WHICH STEERS THE CM TO A CONTROLLED EXIT (SKIP OUT) CONDITION.

(2) TO ESTABLISH ENTRY - UP CONTROL DISPLAYS WHICH ARE USED IN CONJUNCTION WITH THE EMS TO DETERMINE FOR THE ASTRONAUT IF THE BACKUP PROCEDURES SHOULD BE IMPLEMENTED.

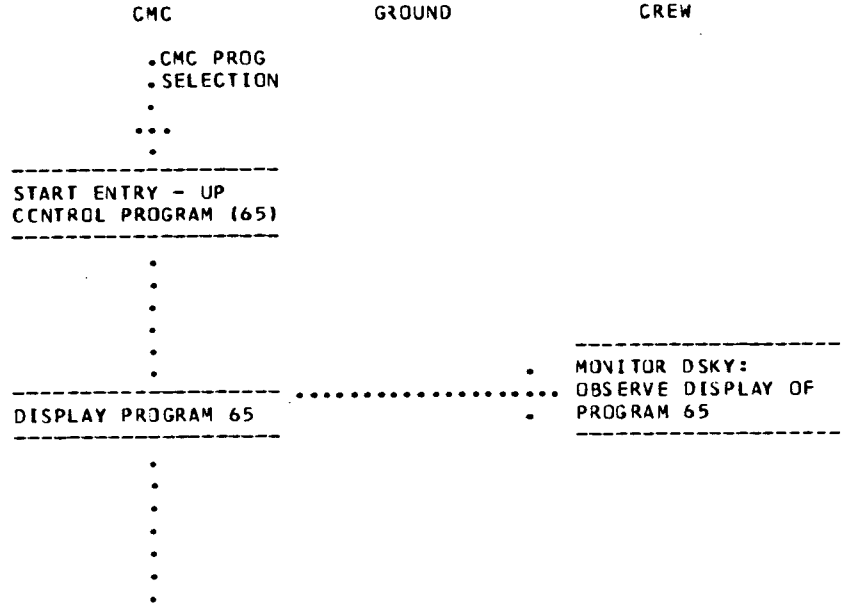
(3) TO SENSE EXIT (DRAG ACCELERATION LESS THAN .07 FPS^2) AND THEREUPON TO SELECT THE ENTRY - BALLISTIC PROGRAM (P66).

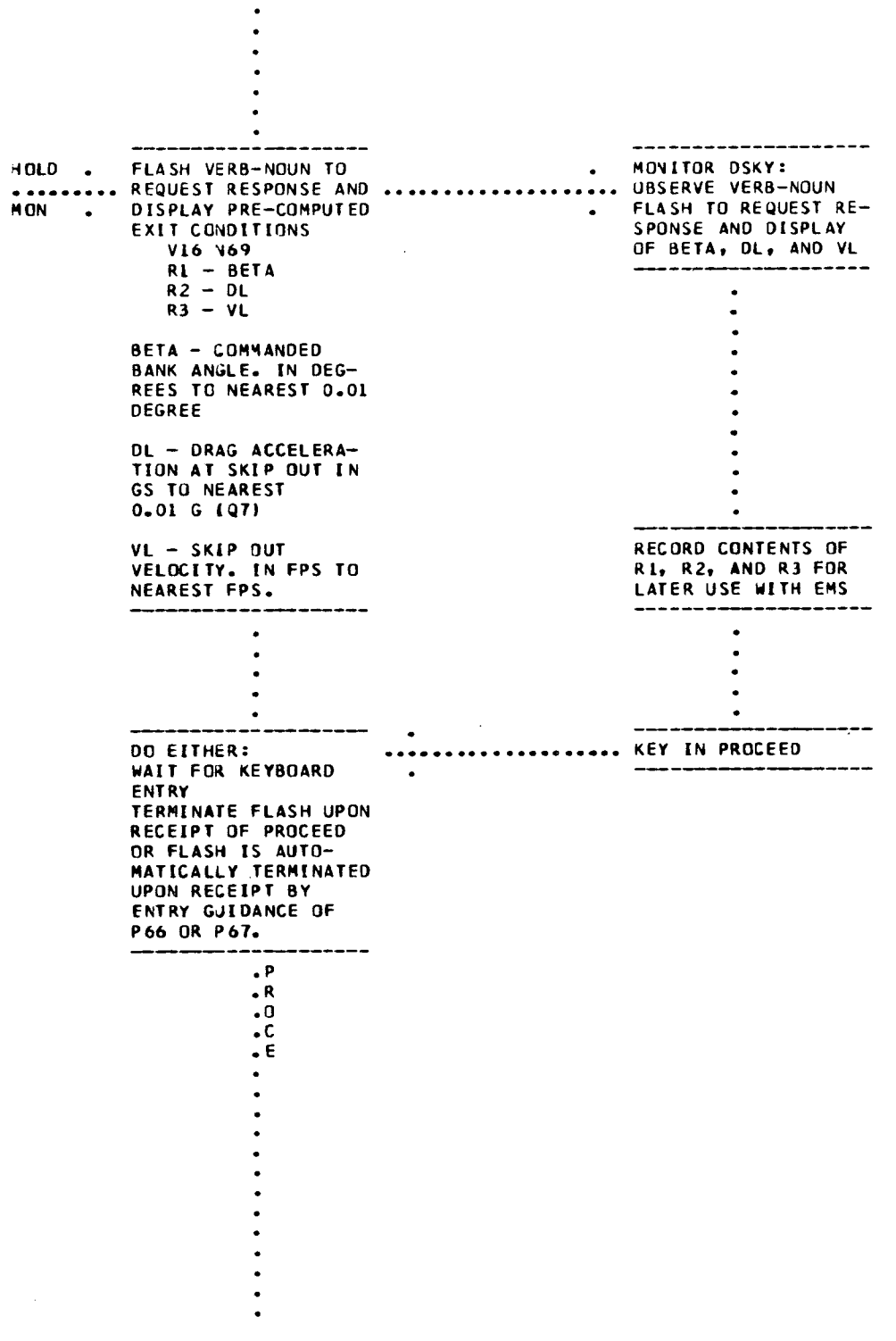
(4) WHERE RDOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-C18 NEG), PROGRAM WILL EXIT DIRECTLY TO P67 (FINAL PHASE).

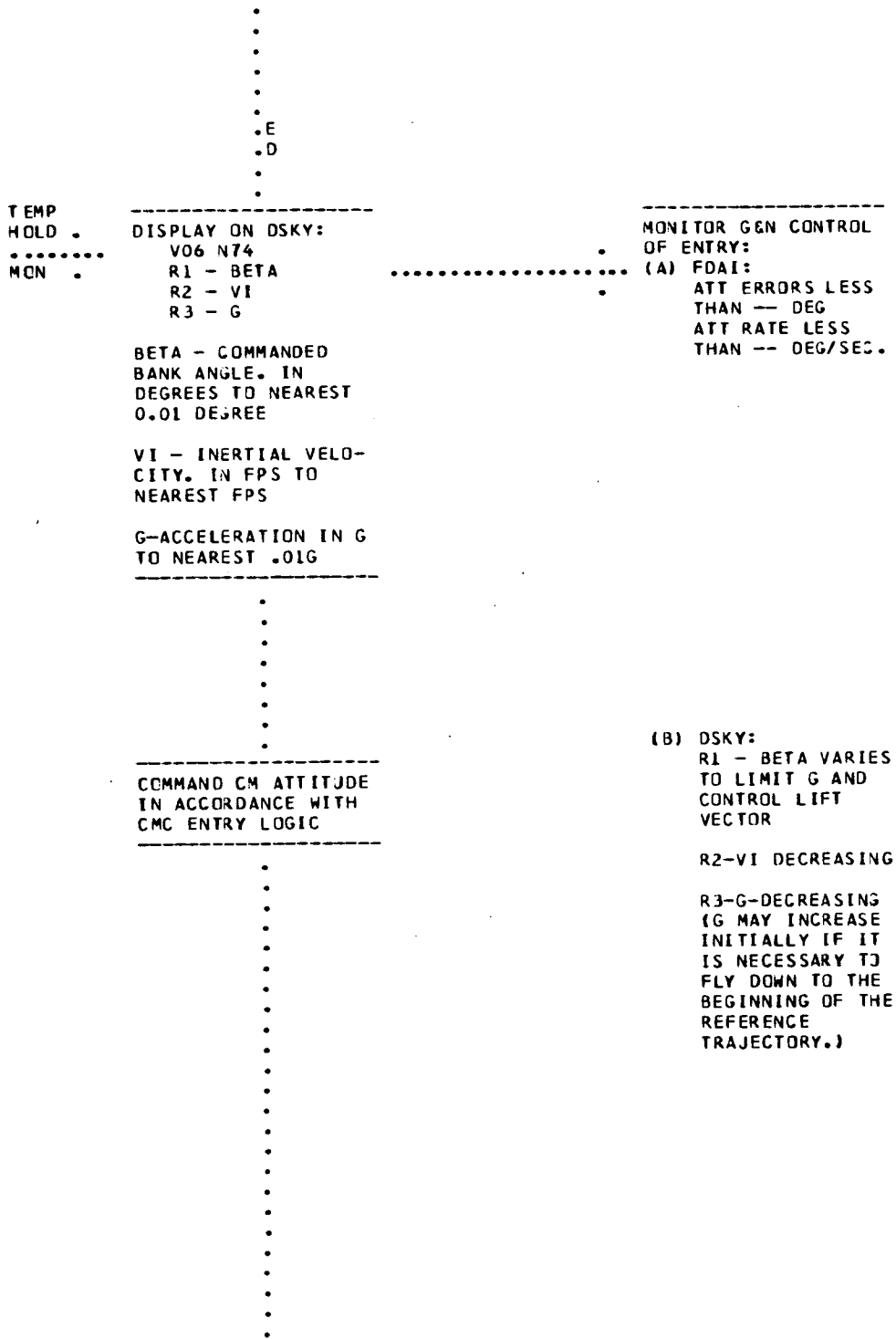
ASSUMPTIONS: (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY - POST 0.05G PROGRAM (P64) WHEN CONSTANT DRAG CONTROL HAS BROUGHT RANGE PREDICTION TO WITHIN 25 N.M. OF THE DESIRED RANGE. IT IS SKIPPED IN EARTH ORBIT MISSIONS.

(2) IN ADDITION TO N74 (BETA, VI, G) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
N64 (G, VI, R TO GO)
N68 (BETA, VI, HDOT)

(3) MANUAL RESPONSE TO N69 IS NOT NECESSARY TO TERMINATE P65. SELECTION OF EITHER P66 OR P67 BY ENTRY GUIDANCE PROVIDES AUTOMATIC TERMINATION.




HOLD
MON
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY PRE-COMPUTED EXIT CONDITIONS
V16 N69
R1 - BETA
R2 - DL
R3 - VL
BETA - COMMANDED BANK ANGLE. IN DEGREES TO NEAREST 0.01 DEGREE
DL - DRAG ACCELERATION AT SKIP OUT IN GS TO NEAREST 0.01 G (Q7)
VL - SKIP OUT VELOCITY. IN FPS TO NEAREST FPS.
DO EITHER:
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED
OR FLASH IS AUTOMATICALLY TERMINATED UPON RECEIPT BY ENTRY GUIDANCE OF P66 OR P67.
.PROCEE
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF BETA, DL, AND VL
RECORD CONTENTS OF R1, R2, AND R3 FOR LATER USE WITH EMS
KEY IN PROCEED
#30
#40
#50
#60



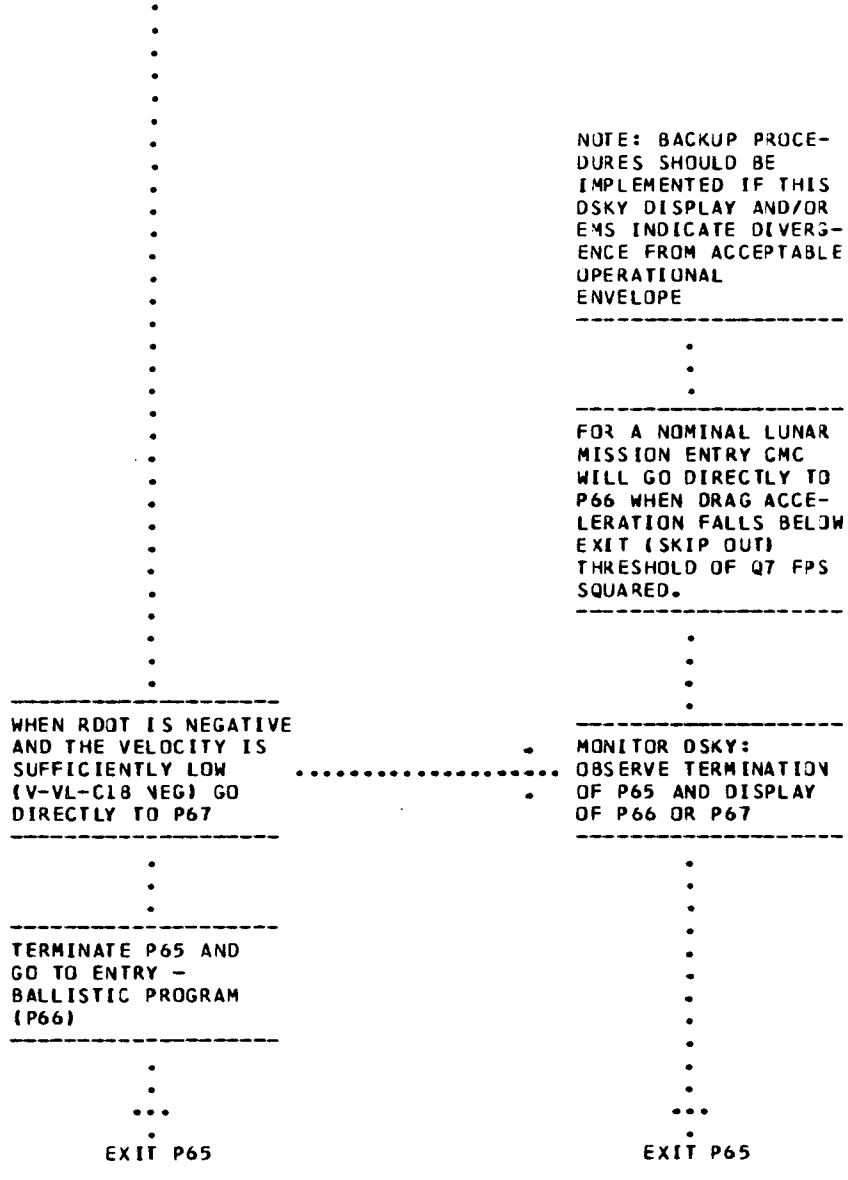
#70

#80

#90

#100

#110


NOTE: BACKUP PROCEDURES SHOULD BE IMPLEMENTED IF THIS DSKY DISPLAY AND/OR EMS INDICATE DIVERGENCE FROM ACCEPTABLE OPERATIONAL ENVELOPE
#120
FOR A NOMINAL LUNAR MISSION ENTRY CMC WILL GO DIRECTLY TO P66 WHEN DRAG ACCELERATION FALLS BELOW EXIT (SKIP OUT) THRESHOLD OF Q7 FPS SQUARED.
#130
#140
WHEN RDOT IS NEGATIVE AND THE VELOCITY IS SUFFICIENTLY LOW (V-VL-C18 NEG) GO DIRECTLY TO P67
MONITOR DSKY: OBSERVE TERMINATION OF P65 AND DISPLAY OF P66 OR P67
#150
TERMINATE P65 AND GO TO ENTRY - BALLISTIC PROGRAM (P66)
EXIT P65
EXIT P65
#160

CHANGE CONTROL NOTES

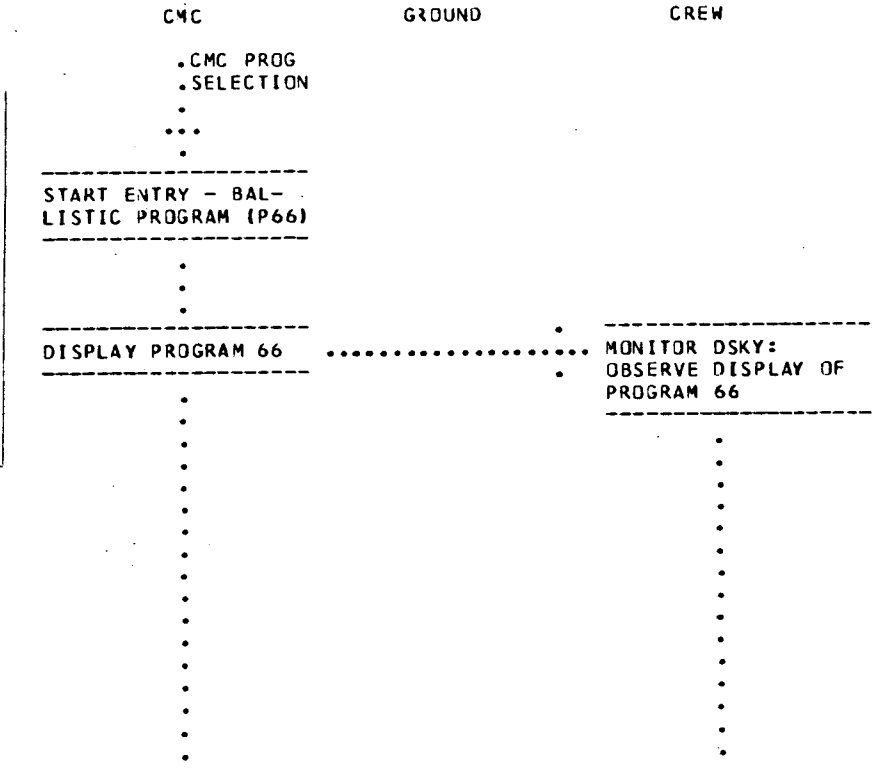
ENTRY - BALLISTIC PROGRAM (P66) REV 00 05/19/71
NOTE: P66 HAS NOT BEEN TESTED AND IS
THEREFORE NOT OPERATIONAL FOR SKYLARK.

PURPOSE: (1) TO MAINTAIN CM ATTITUDE DURING BALLISTIC (SKIP OUT) PHASE FOR ATMOSPHERIC RE-ENTRY.

(2) TO SENSE RE-ENTRY (DRAG ACCELERATION BUILDS UP TO Q7F + 0.5 FPS^2 OR APPROX. 0.2G) AND THEREUPON TO SELECT THE ENTRY - FINAL PHASE PROGRAM (P67).

ASSUMPTIONS: (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY - UP CONTROL PROGRAM (P65) WHEN DRAG ACCELERATION BECOMES LESS THAN Q7 FPS^2.

(2) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
N64 (G, VI, R TO GO)
N68 (BETA, VI, HDOT)
N74 (BETA, VI, G)



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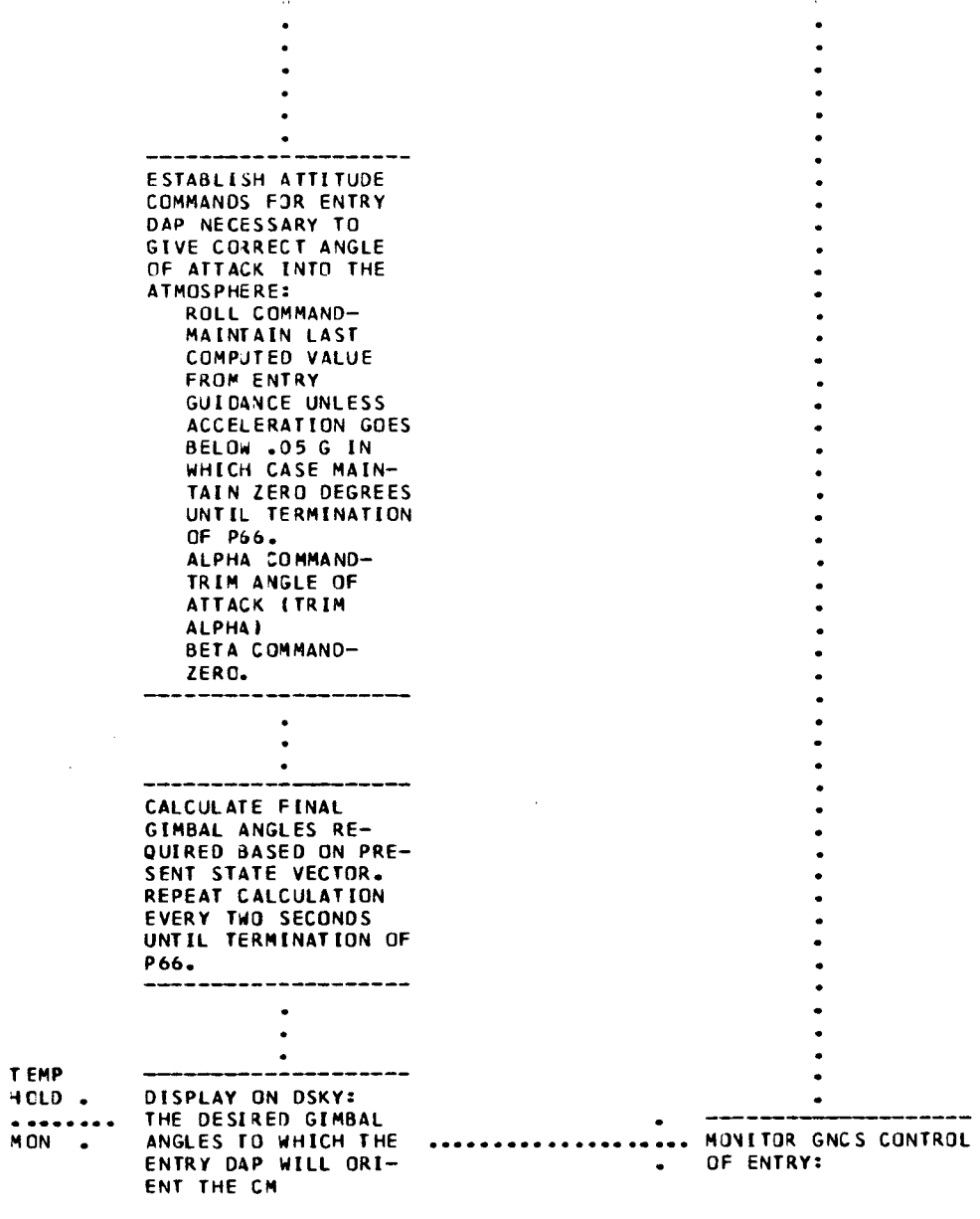

#20
ESTABLISH ATTITUDE COMMANDS FOR ENTRY DAP NECESSARY TO GIVE CORRECT ANGLE OF ATTACK INTO THE ATMOSPHERE:
ROLL COMMAND- MAINTAIN LAST COMPUTED VALUE FROM ENTRY GUIDANCE UNLESS ACCELERATION GOES BELOW .05 G IN WHICH CASE MAINTAIN ZERO DEGREES UNTIL TERMINATION OF P66.
ALPHA COMMAND- TRIM ANGLE OF ATTACK (TRIM ALPHA)
BETA COMMAND- ZERO.
#30
#40
CALCULATE FINAL GIMBAL ANGLES REQUIRED BASED ON PRESENT STATE VECTOR. REPEAT CALCULATION EVERY TWO SECONDS UNTIL TERMINATION OF P66.
#50
#60
TEMP HOLD MON
DISPLAY ON DSKY: THE DESIRED GIMBAL ANGLES TO WHICH THE ENTRY DAP WILL ORIENT THE CM
MONITOR GNCS CONTROL OF ENTRY:

V06 N22
R1-OG ROLL
R2-IG PITCH
R3-MG YAW

ALL COMMANDED GIMBAL ANGLES IN DEGREES TO NEAREST 0.01 DEGREE.

COMMAND CM ATTITUDE IN ACCORDANCE WITH CMC ENTRY - BALLISTIC PHASE LOGIC

ROLL ANGLE IS HELD AT LAST COMPUTED VALUE FROM ENTRY GUIDANCE UNLESS ACCELERATION GOES BELOW 0.05G IN WHICH CASE ZERO DEGREES IS HELD UNTIL TERMINATION OF P66.
PITCH AND YAW ATTITUDE IS DETERMINED BY THE VEHICLE POSITION AND VELOCITY W.R.T. THE ATMOSPHERE. THIS ATTITUDE IS ZERO SIDESLIP AND ANGLE OF ATTACK NEAR THE TRIM VALUE.

NOTE: THREE AXIS DAP CONTROL WAS REGAINED WHEN LESS THAN 0.05 G WAS SENSED AND

FDAI: ATTITUDE ERROR NEEDLES - DIFFERENCE BETWEEN THE TOTAL DESIRED ATTITUDE AND THE ACTUAL ATTITUDE (FLY TO POLARITY).

BALL: ACTUAL GIMBAL ANGLES READ ON BALL SHOULD AGREE WITH COMMANDED GIMBAL ANGLES READ ON DSKY.

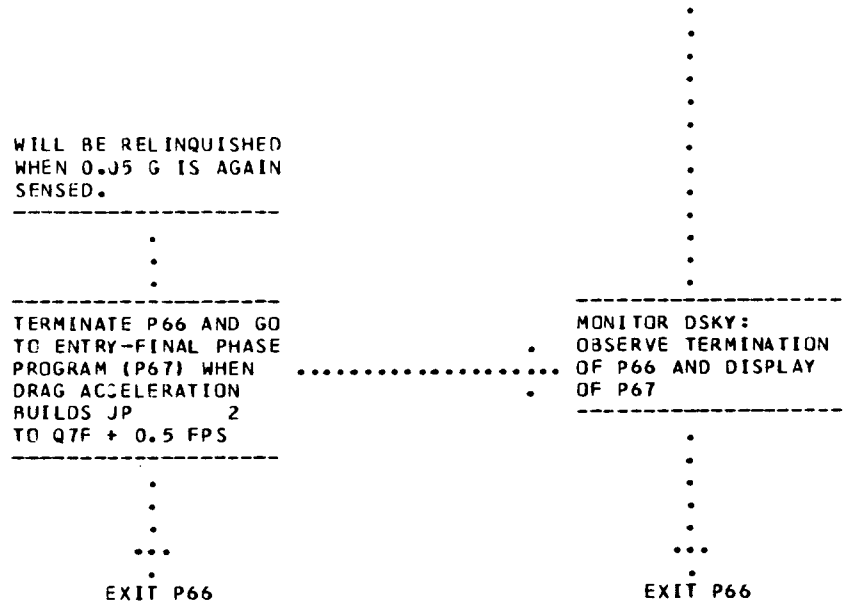
#70

#80

#90

#100

#110



#120

#130

CHANGE CONTROL NOTES

ENTRY - FINAL PHASE PROGRAM (P67) REV 00 05/19/71

PURPOSE: (1) TO CONTINUE ENTRY GUIDANCE AFTER Q7F + 0.5FPS^2 (OR APPROX. 0.2G) UNTIL TERMINATION OF STEERING WHEN THE CM VELOCITY WRT EARTH = 1000 FT/SEC (ALTITUDE IS APPROXIMATELY 65,000 FT.).

(2) TO CONTINUE ENTRY DSKY DISPLAYS.

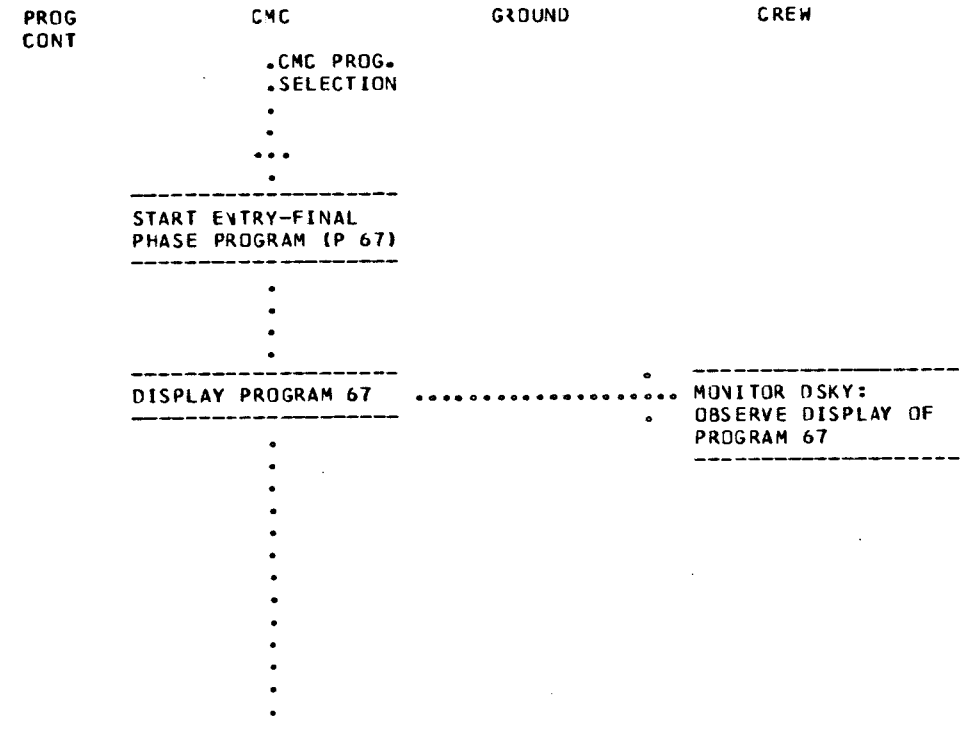
ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY:

(A) P65 WHEN RDOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-C18 NEG)

(B) P66 WHEN DRAG ACCELERATION BUILDS UP TO Q7F + 0.5 FPS^2. (OR APPROX. 0.2G)

(C) P64 IF NO UPCONTROL SOLUTION EXISTS WITH VL > 18000 FPS

(2) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
N64 (G, VI, R TO GO)
N68 (BETA, VI, HDOT)
N74 (BETA, VI, G)



TEMP HOLD . MCN .

DISPLAY ON DSKY:
V06 N66
R1-BETA
R2-X RNG ERR
R3-DWN RNG ERR

BETA-COMMANDED BANK ANGLE. IN DEGREES TO NEAREST .01 DEGREE.

X RNG ERR - CMC SOLUTION FOR CROSS RANGE ERROR. POSITIVE IF TARGET ON THE SOUTH SIDE OF TRAJECTORY PLANE. NEGATIVE IF ON THE NORTH SIDE OF TRAJECTORY PLANE. IN NAUTICAL MILES TO THE NEAREST .1 NM.

DWN RNG ERR - CMC SOLUTION FOR DOWN RANGE ERROR (DECREASING) POSITIVE FOR OVERSHOOT, NEGATIVE FOR UNDERSHOOT. IN NAUTICAL MILES TO NEAREST .1 NM. (PREDANGLE-THETA)

NOTE: THE DWN RNG ERR DISPLAY WILL BE 9999.9 NM ONCE THE TARGET HAS BEEN OVERSHOT.

MONITOR G+N CONTROL OF ENTRY:

(A)FDAI:
ATT ERRORS LESS THAN --DEG
ATT RATES LESS THAN --DEG/SEC.

BALL INDICATES LIFT VECTOR DIRECTION CORRELATION WITH BETA

(B) DSKY:
R1-BETA VARIES TO LIMIT G AND CONTROL LIFT VECTOR.

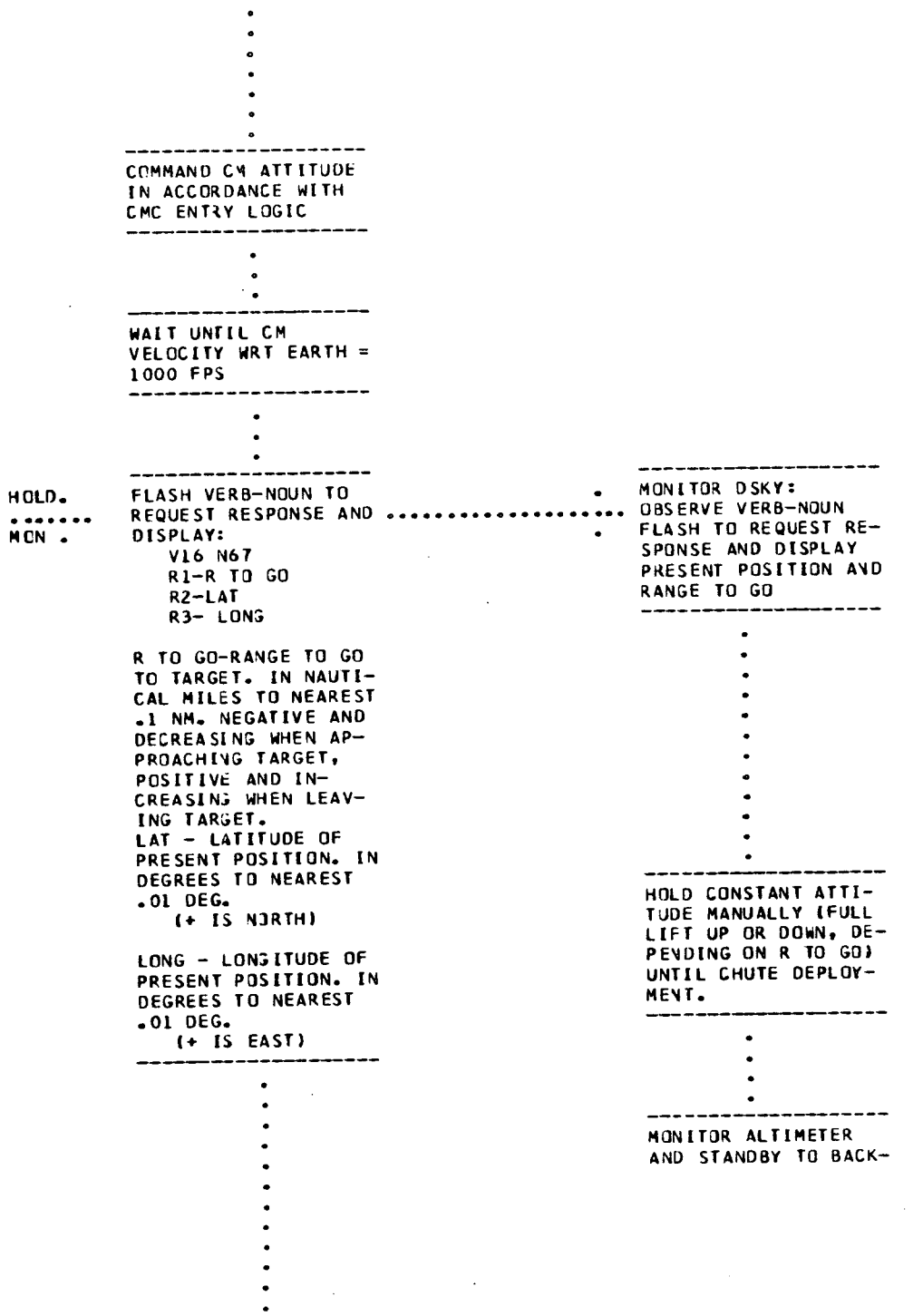
R3- DWN RNG ERR - DECREASING

#30

#40

#50

#60



#070

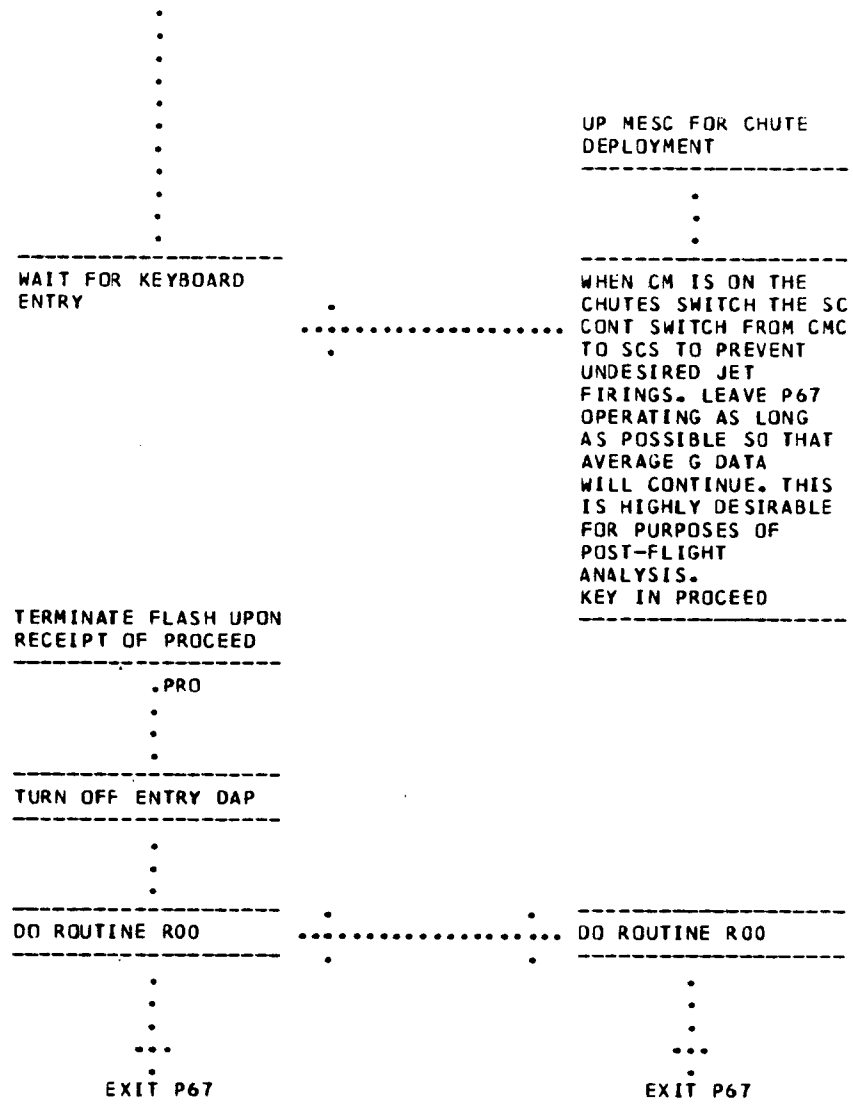
#080

#090

#100

#110

#120



#130

#140

#150

#160

CHANGE CONTROL NOTES

CSM VELOCITY VECTOR UPDATE PROGRAM (P77) REV 01 03/20/72

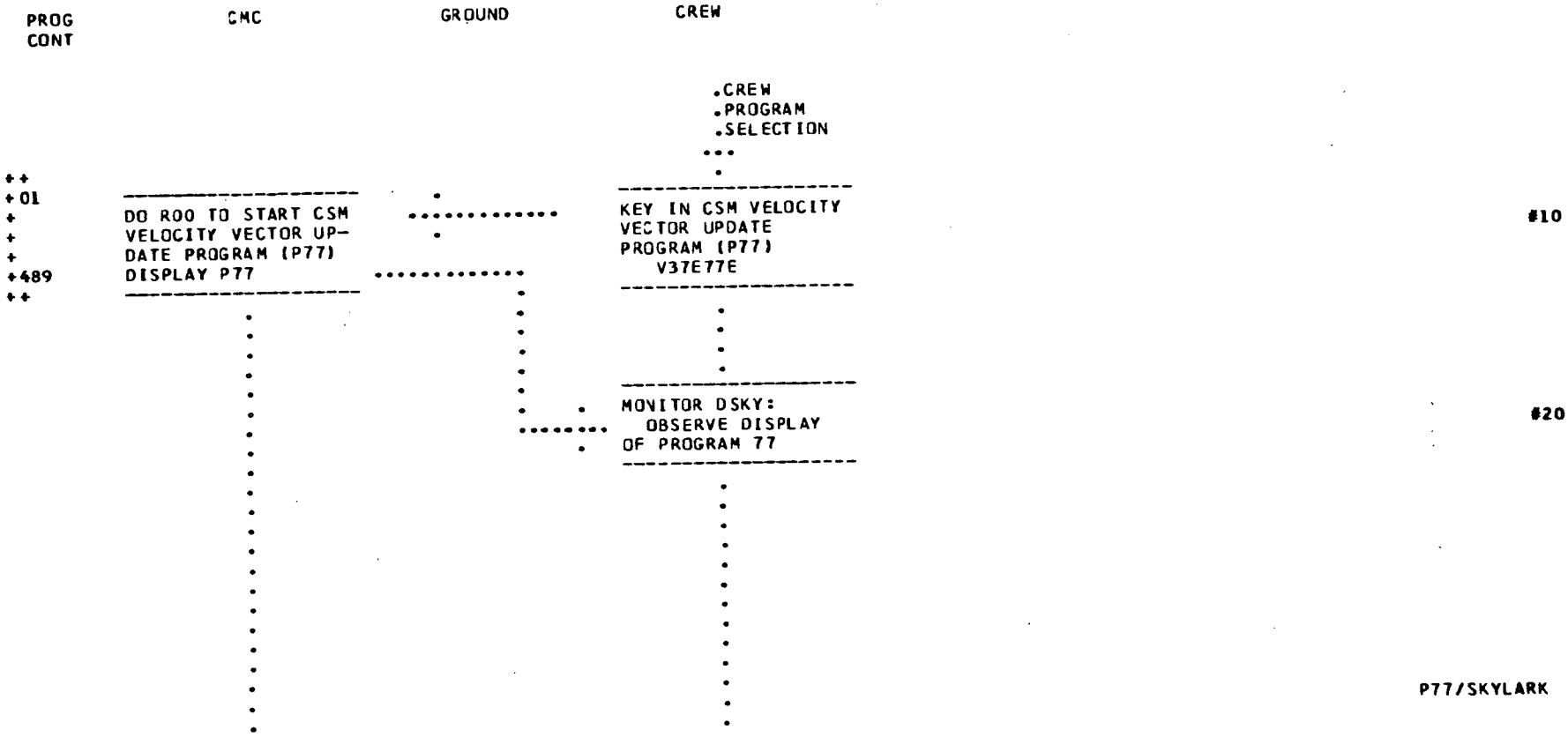
PURPOSE: (1) TO PROVIDE A MEANS OF NOTIFYING THE CMC THAT THE CM HAS CHANGED (OR WILL CHANGE) ITS ORBITAL PARAMETERS BY THE EXECUTION OF A THRUSTING MANEUVER WHEN AVERAGE G IS NOT RUNNING.

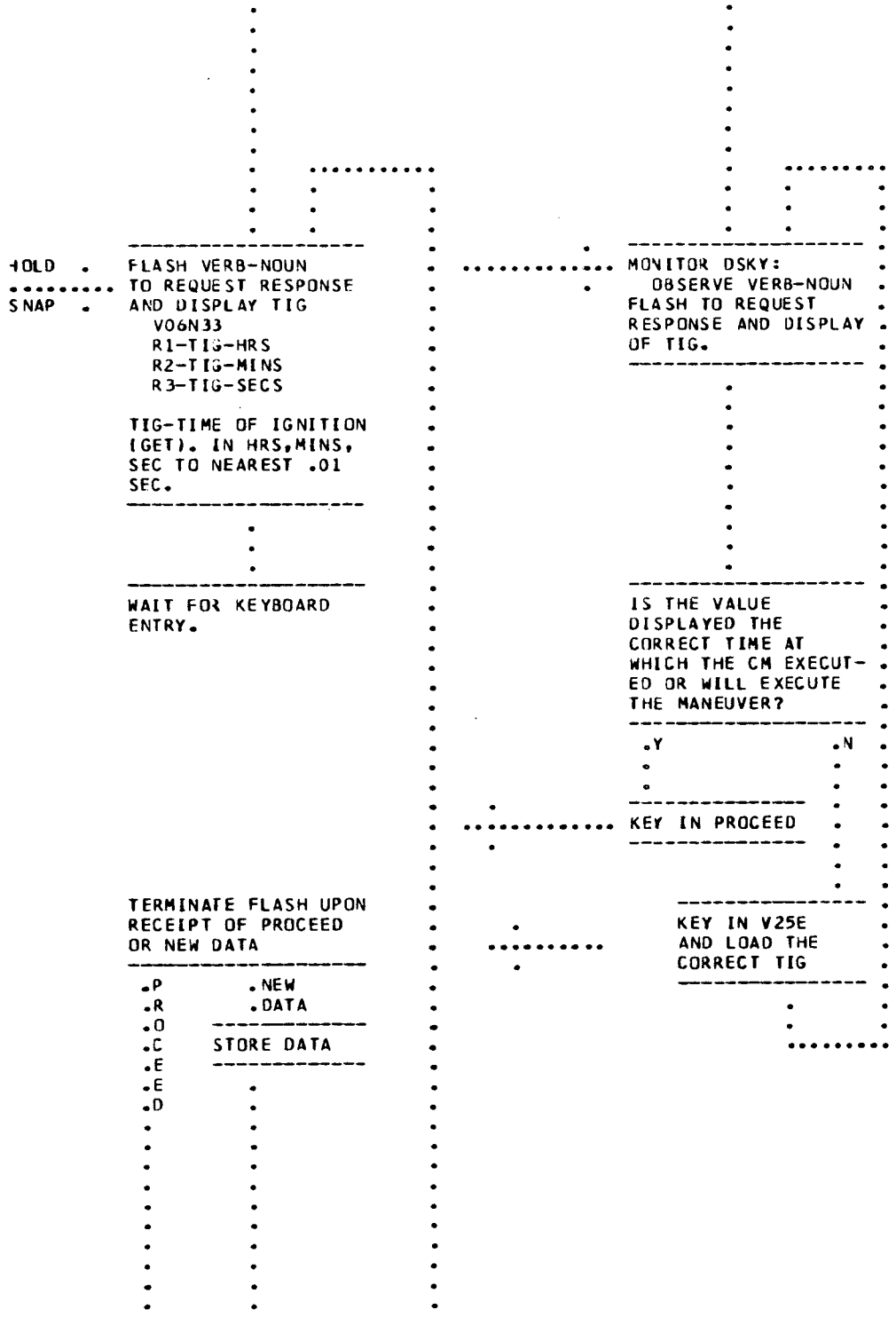
(2) TO PROVIDE TO THE CMC THE DELTA V APPLIED TO THE CM TO ENABLE AN UPDATING OF THE CM STATE VECTOR.

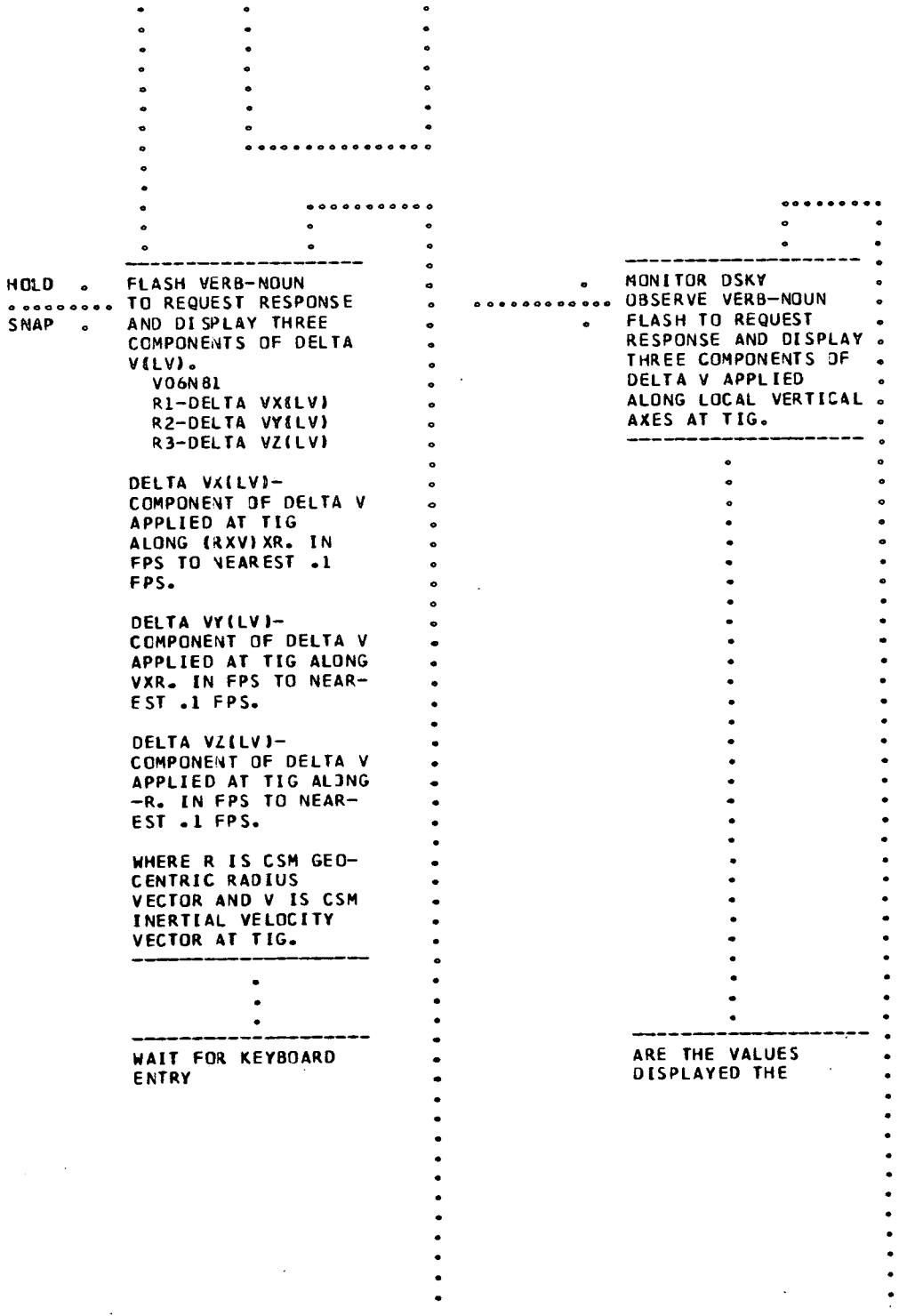
ASSUMPTIONS: (1) THE CSM CREW HAS THE DELTA V TO BE APPLIED BY THE CM IN LOCAL VERTICAL AXES AT A SPECIFIED TIG.

++
+01 (2) R03 SHOULD BE PERFORMED AFTER P77 TO UPDATE CSM WEIGHT.
+489
++ (3) THE CONTENTS OF N81 IS THE SAME AS THE PREVIOUS VALUE OF N81 AT ENTRANCE TO P77.

(4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.




HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TIG
V06N33
R1-TIG-HRS
R2-TIG-MINS
R3-TIG-SECS
TIG-TIME OF IGNITION (GET). IN HRS,MINS, SEC TO NEAREST .01 SEC.
WAIT FOR KEYBOARD ENTRY.
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
.P
.R
.O
.C
.E
.E
.D
.NEW
.DATA
STORE DATA
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIG.
IS THE VALUE DISPLAYED THE CORRECT TIME AT WHICH THE CM EXECUTED OR WILL EXECUTE THE MANEUVER?
.Y
.N
KEY IN PROCEED
KEY IN V25E AND LOAD THE CORRECT TIG
#30
#40
#50
#60
#70



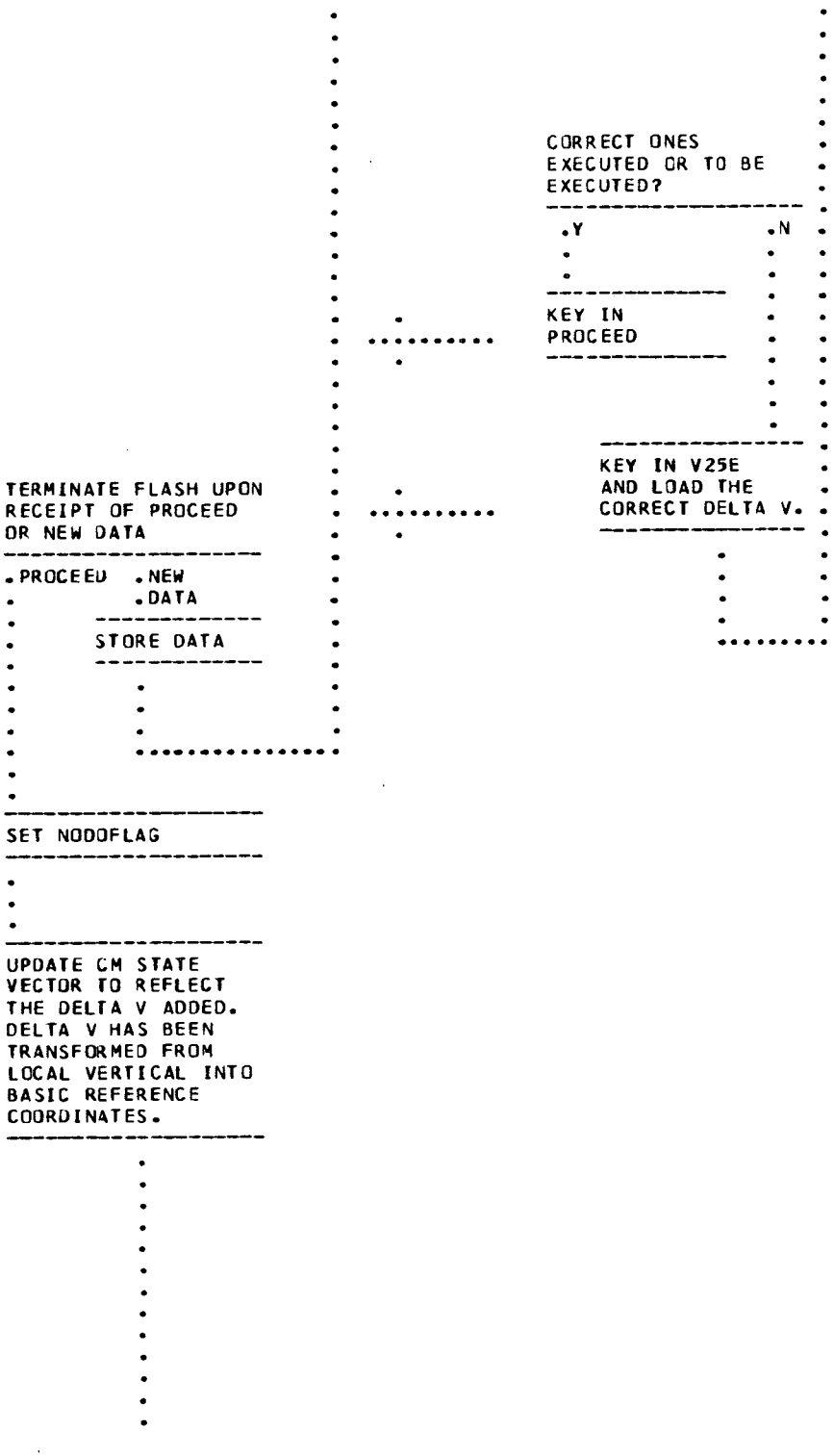
ø80

ø90

#100

#110

#120



#130

#140

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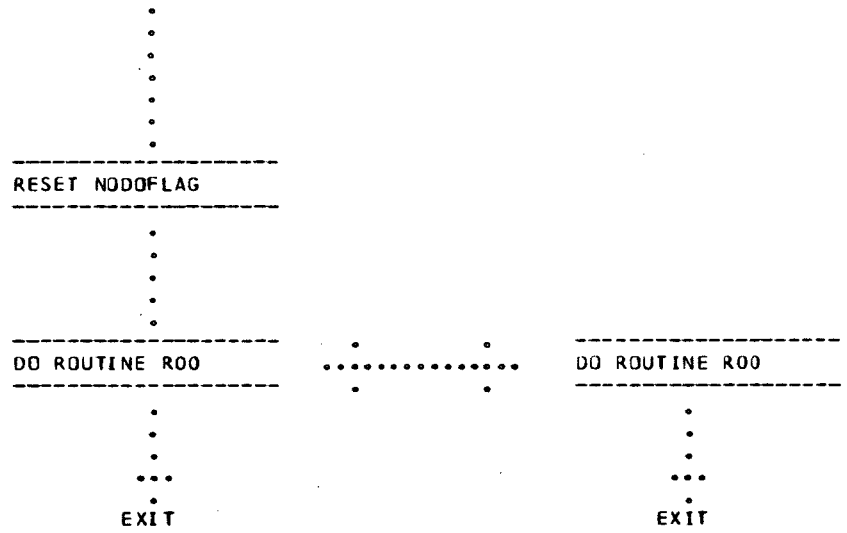
#160

#170



#180

#190

CHANGE CONTROL NOTES

REV 01 PCN 489

FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (R00) REV 01 03/20/72

PURPOSE: (1) TO PROVIDE A STANDARD EXIT FOR PROGRAMS, AND AN OPTION TO SELECT ANY PROGRAM DESIRED.

++ (2) TO PROVIDE A GENERAL DESCRIPTION OF THE COMPUTER ACTIVITY FOLLOWING ANY PROGRAM SELECTION.

+01

ASSUMPTIONS: (1) THE CALLING PROGRAM HAS SUCCESSFULLY COMPLETED ALL ITS FUNCTIONS OR THE OPERATOR HAS PREMATURELY TERMINATED THE PROGRAM OR A POODOO TYPE ABORT (WITHOUT AVERAGE G ACTIVE AND WITH NO EXTENDED VERB ACTIVE) HAS OCCURRED.

+489

++ (A) IF A PROGRAM HAS COMPLETED ALL ITS FUNCTIONS AND MINKEY IS RUNNING (AUTOSEQ SET) CONTROL WILL GO TO THE NEXT POINT IN THE MINKEY CONTROLLER (R07) INSTEAD OF FLASHING V37.

(B) PREMATURE TERMINATION OF AN OPERATION WILL TURN OFF MINKEY (RESET AUTOSEQ).

(2) THE COMPUTER CHECKS ON THE UNIVERSAL TRACKING PROCESS FOLLOWING ANY V37EXXE IN THE FOLLOWING WAYS:

(A) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY RUNNING AND WAS NOT RUNNING IN THE BACKGROUND IT WILL BE STARTED AS A NEW PROGRAM.

(B) IF P20 IS THE NEW PROGRAM KEYED IN AND P20 IS PRESENTLY RUNNING (I.E. 20 DISPLAYED IN THE PROG LIGHTS) IT WILL BE STARTED AS A NEW PROGRAM (I.E. RE-INITIALIZED).

++

+01 (C) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY THE ONLY PROGRAM RUNNING (I.E. A PROGRAM OTHER

+ THAN P20 IS DISPLAYED IN THE PROG LIGHTS) AND P20 IS RUNNING IN THE BACKGROUND THE PROG LIGHTS WILL

+ BE CHANGED TO 20 AND P20 WILL START AT P20 RESTART POINT WITH THE FLAGS SET TO ALLOW TRACKING. IN

+ ADDITION R22 WILL START AT THE R22 RESTART POINT FOR OPTIONS 0,4 AND ALLOW STATE VECTOR UPDATES; POO-

+489 TYPE INTEGRATION WILL START IN THE REMAINING OPTIONS.

++

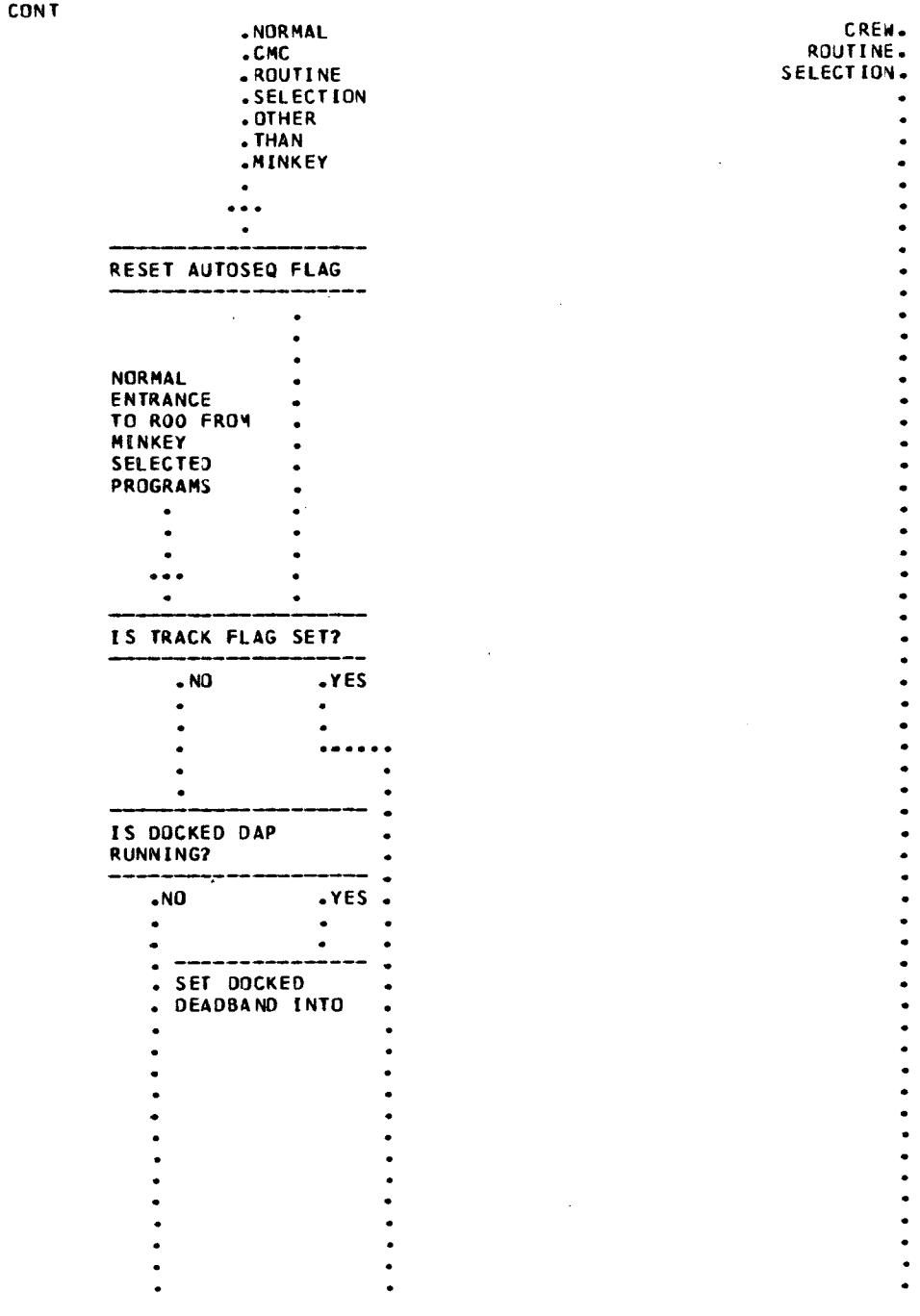
(D) IF POO IS SELECTED, THE RENDEZVOUS FLAG AND UTFLAG ARE RESET (SHUT OFF P20) AND POO IS STARTED.

(E) IF A PROGRAM OTHER THAN P20 AND POO IS KEYED IN, THE NEW PROGRAM WILL BE STARTED AND THE PROG LIGHTS WILL DISPLAY THE NEW PROGRAM. THE COMPUTER WILL THEN ATTEMPT TO RESTART P20 AND WILL BE SUCCESSFUL IF P20 WAS RUNNING IN THE BACKGROUND AND THE NEW PROGRAM WILL ALLOW TRACKING.

(F) IF NEW PROGRAM SELECTED IS P31-P38 AND P20, OPTION 0 OR 4, IS NOT RUNNING, ANY OTHER P20 OPTION WILL BE TERMINATED AND P20 OPTION 0 WILL BE STARTED WITH NOMINAL TRACKING VALUES. NO P20 DISPLAYS WILL APPEAR. IF THE IMU IS NOT ALIGNED (REFSMMAT FLAG SET) P20 WILL NOT BE STARTED.

(3) IF THE IMU IS ALIGNED AND THE NEW PROGRAM SELECTED IS P31-P38, FL V50 N25 R1=17 WILL BE DISPLAYED TO REQUEST CREW TO AUTHORIZE MINKEY SEQUENCE. THIS FLASHING DISPLAY MARKS THE TRANSITION FROM R00 TO MINKEY CONTROLLER (R07).

PROG	CMC	GROUND	CREW

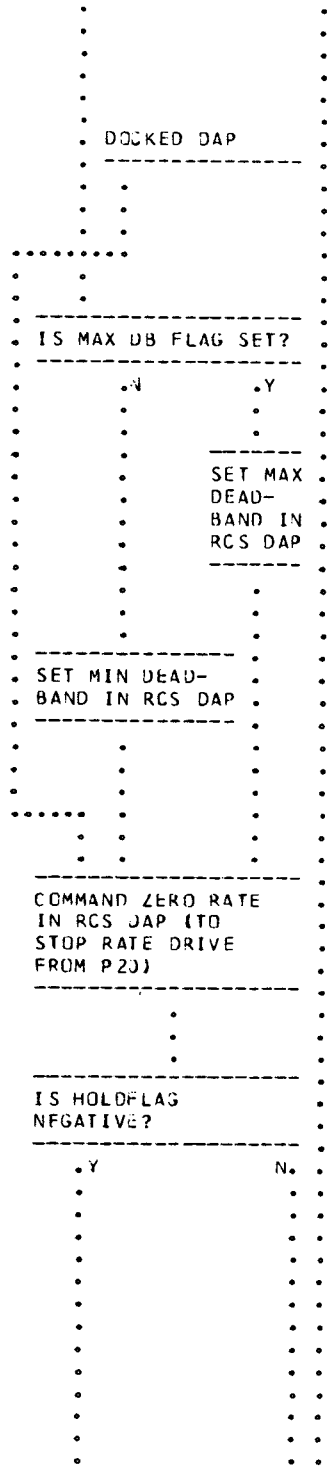

CONT
.NORMAL
.CMC
.ROUTINE
.SELECTION
.OTHER
.THAN
.MINKEY
CREW
ROUTINE
SELECTION
RESET AUTOSEQ FLAG
NORMAL ENTRANCE TO ROO FROM MINKEY SELECTED PROGRAMS
IS TRACK FLAG SET?
.NO
.YES
IS DOCKED DAP RUNNING?
.NO
.YES
SET DOCKED DEADBAND INTO

#10

#20

#30

#40


DOCKED DAP
IS MAX DB FLAG SET?
N
Y
SET MAX DEAD-BAND IN RCS DAP
SET MIN DEAD-BAND IN RCS DAP
COMMAND ZERO RATE IN RCS DAP (TO STOP RATE DRIVE FROM P20)
IS HOLDFLAG NEGATIVE?
Y
N

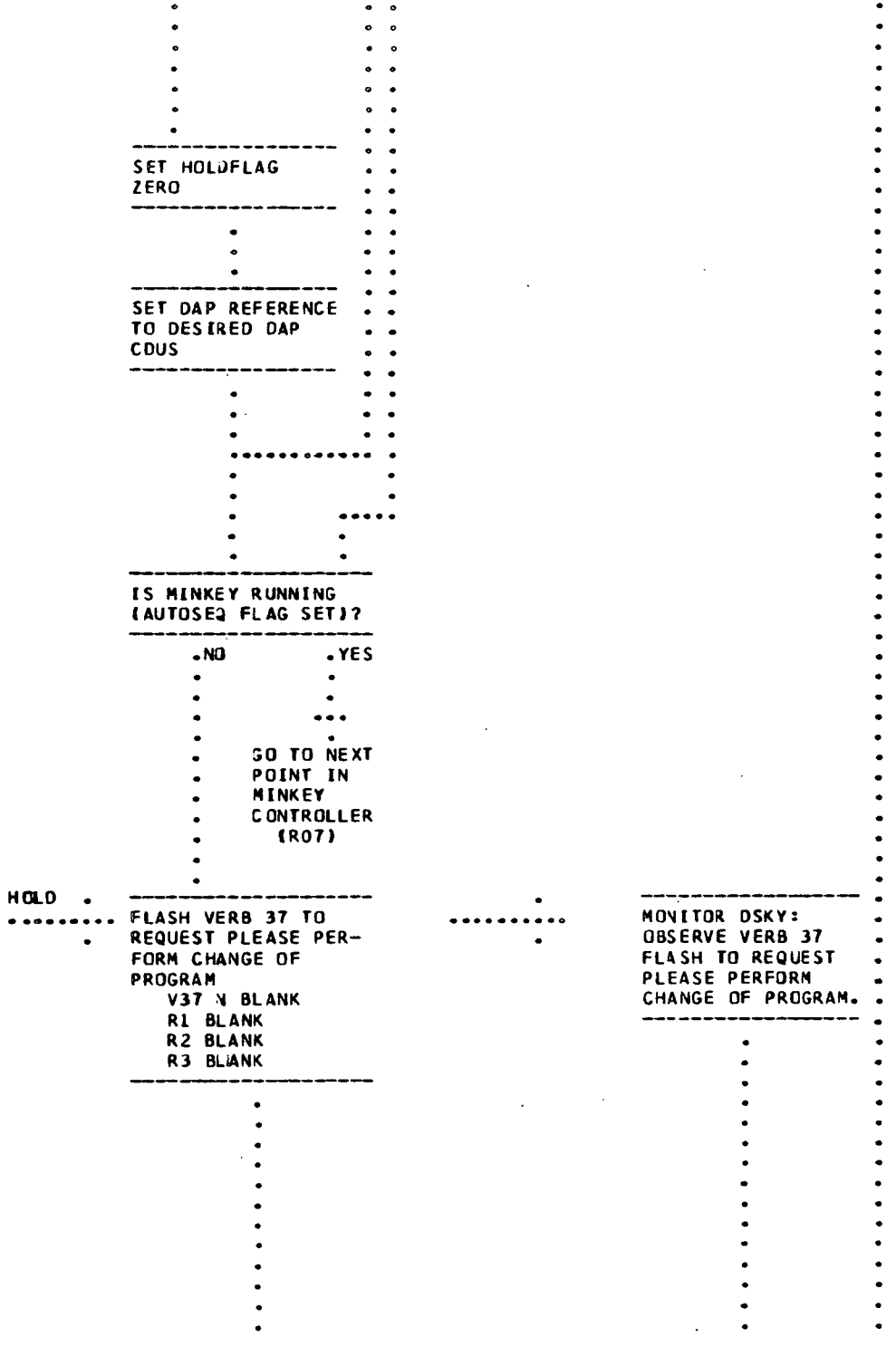
#50

#60

#70

#80

#90



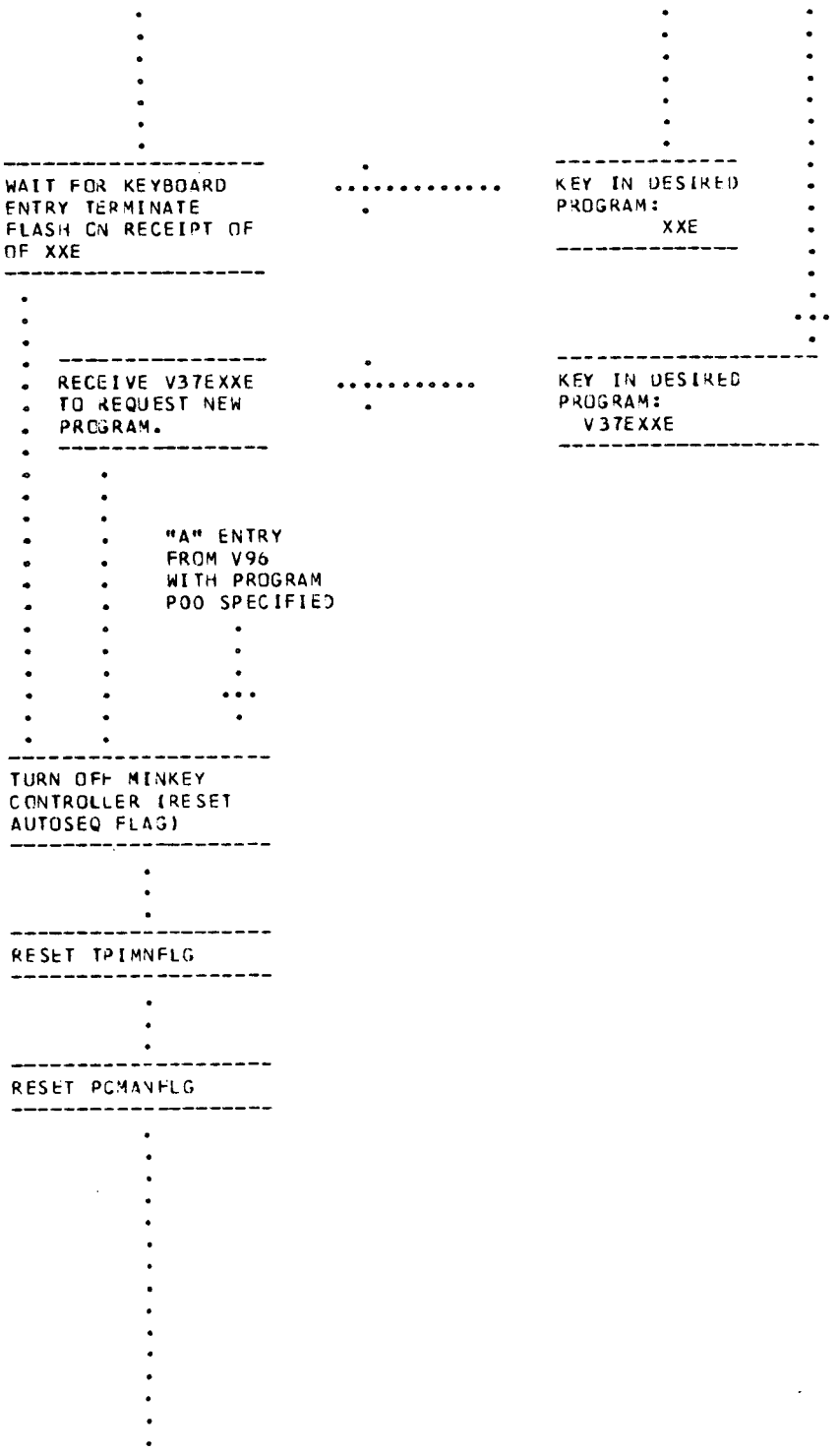
#100

#110

#120

#130

#140



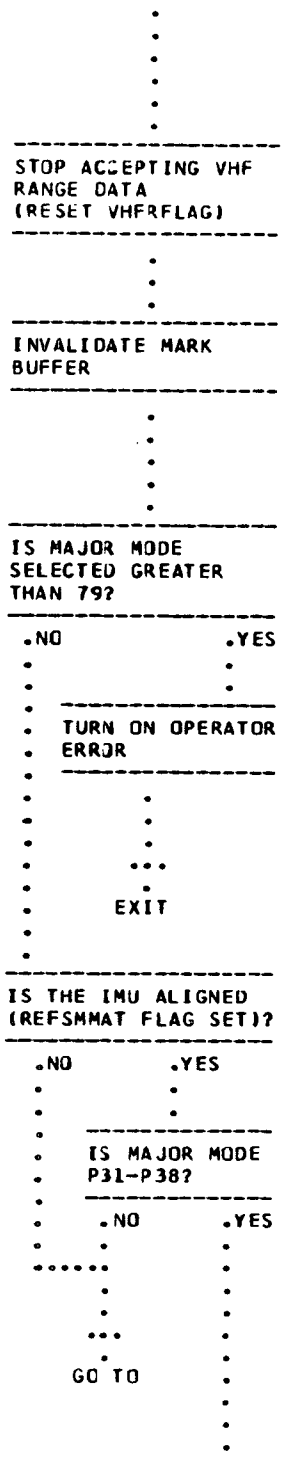
#150

#160

#170

#180

#190



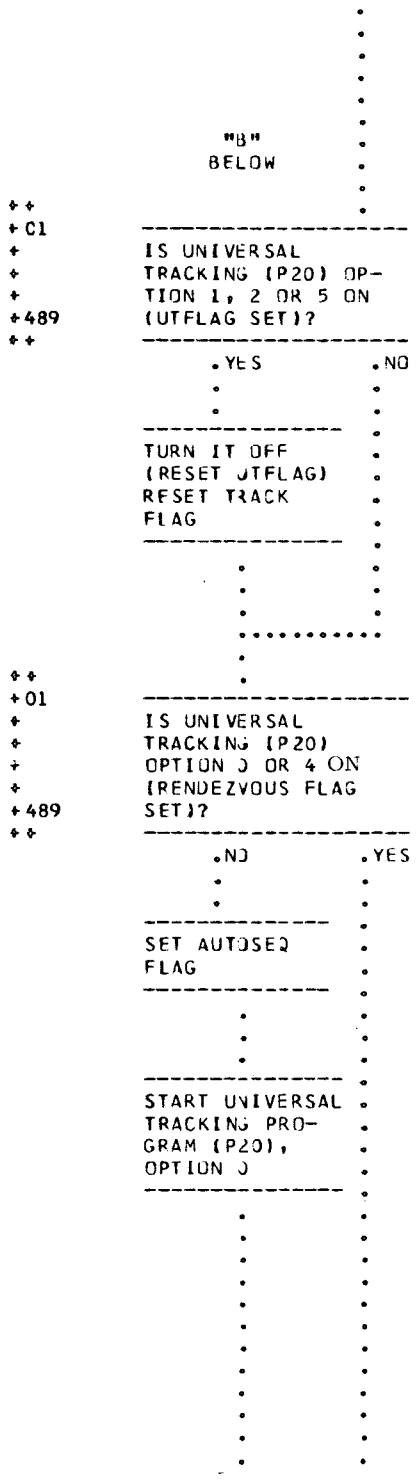
#200

#210

#220

#230

#240



#250

#260

#270

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#300

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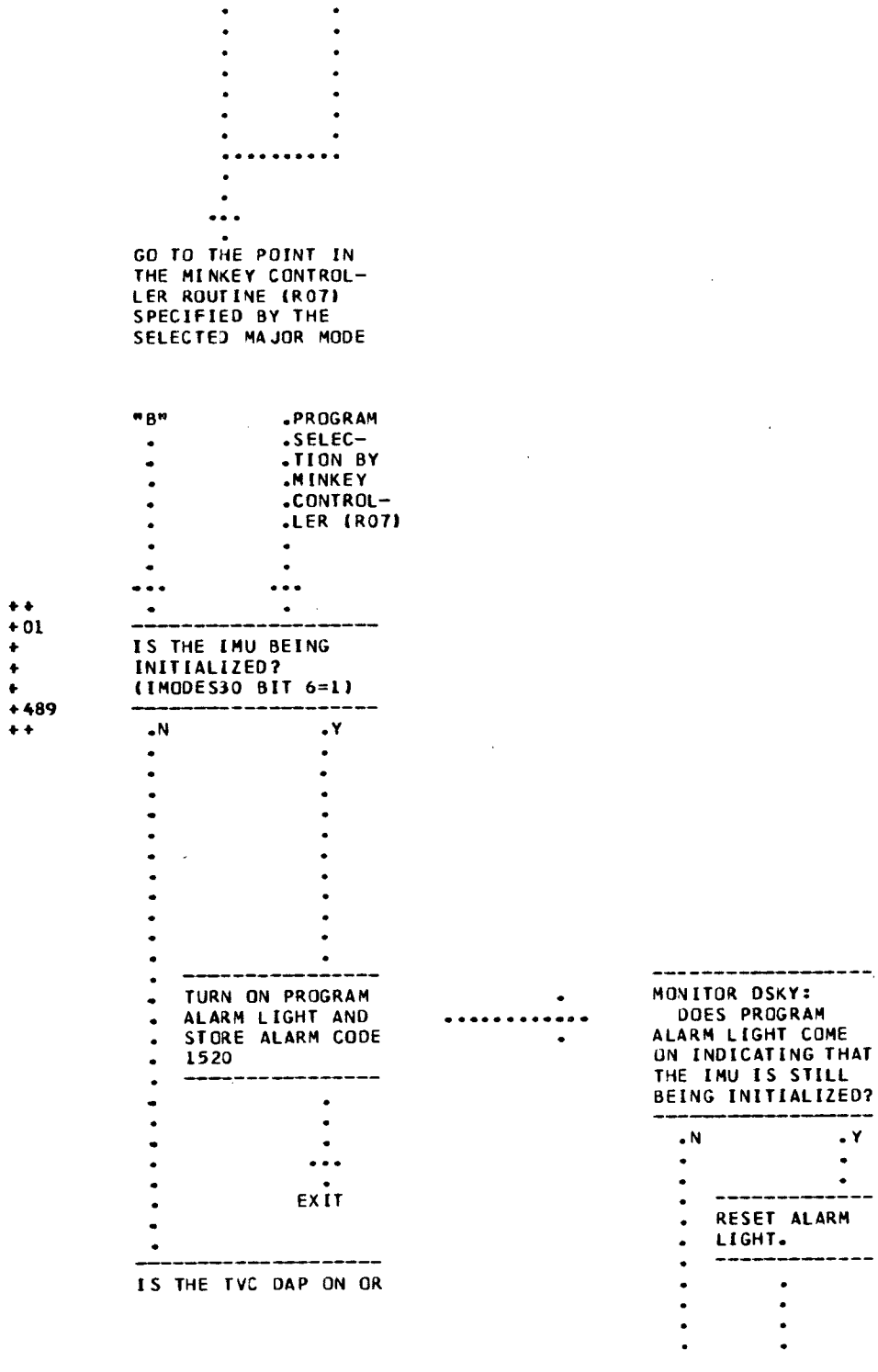
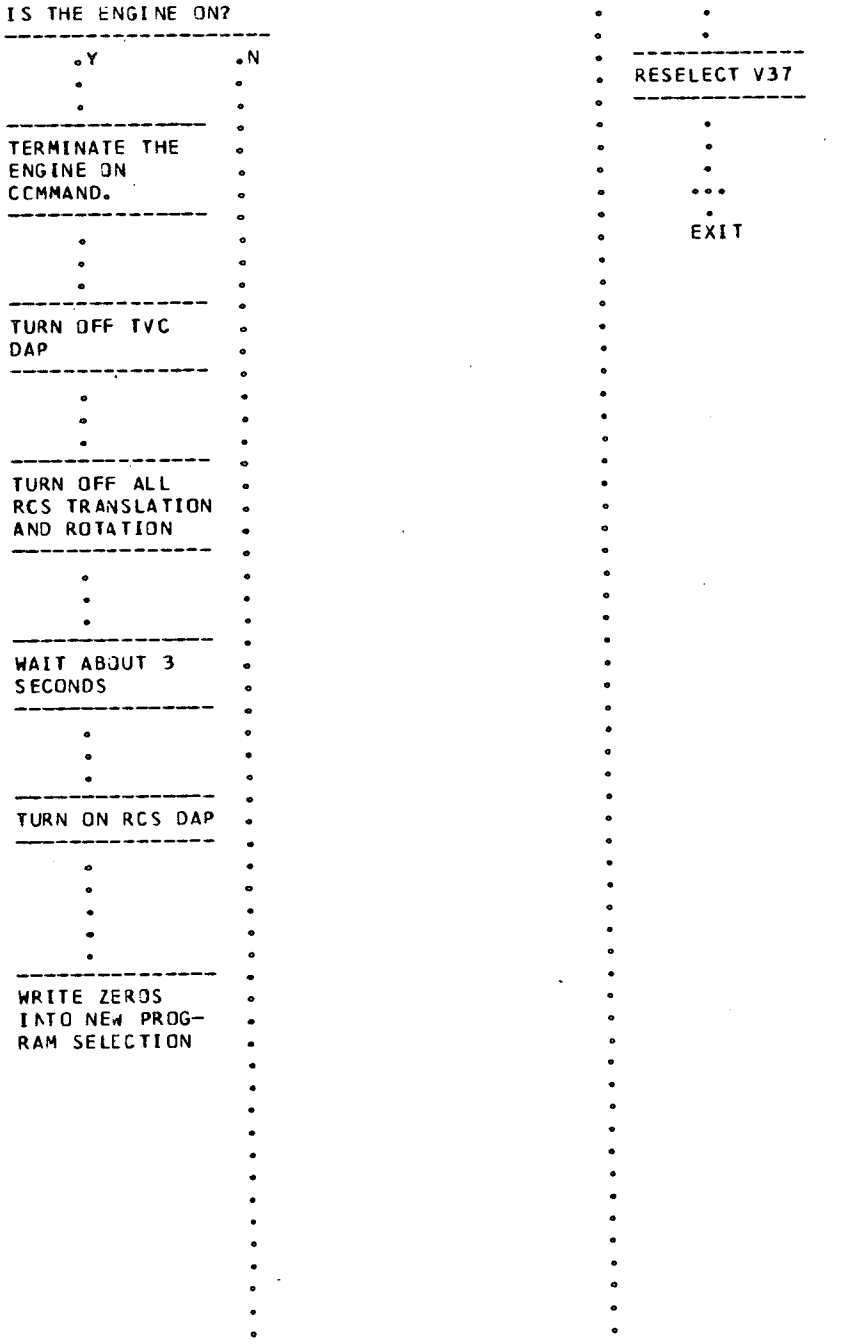
#320

#330

#340

#350





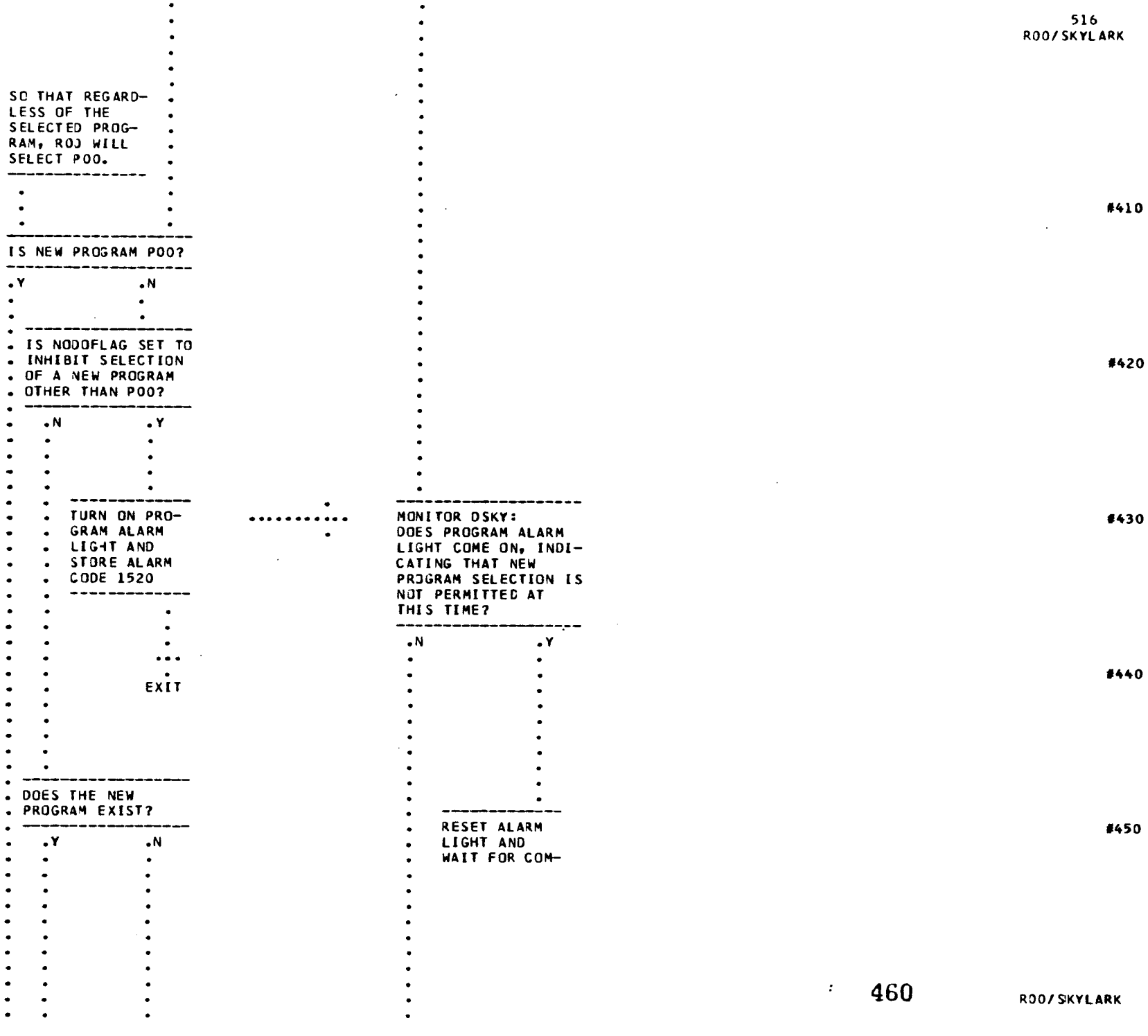
#360

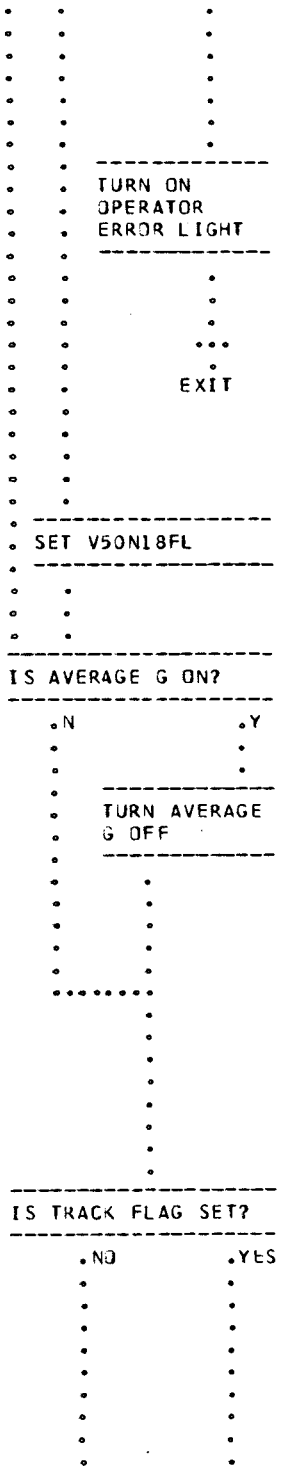
#370

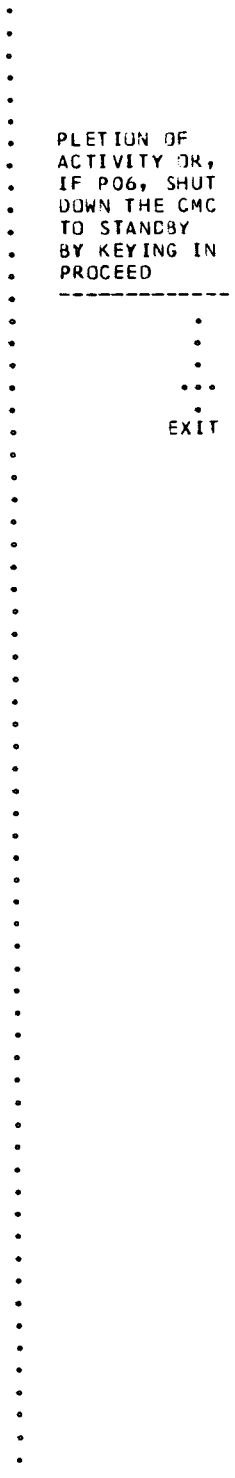
#380

#390

#400


SO THAT REGARD-
LESS OF THE
SELECTED PROG-
RAM, R03 WILL
SELECT P00.
#410
IS NEW PROGRAM P00?
.Y
.N
IS NODOFLAG SET TO
INHIBIT SELECTION
OF A NEW PROGRAM
OTHER THAN P00?
#420
.N
.Y
TURN ON PRO-
GRAM ALARM
LIGHT AND
STORE ALARM
CODE 1520
EXIT
MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON, INDI-
CATING THAT NEW
PROGRAM SELECTION IS
NOT PERMITTED AT
THIS TIME?
#430
.N
.Y
#440
DOES THE NEW
PROGRAM EXIST?
.Y
.N
RESET ALARM
LIGHT AND
WAIT FOR COM-
#450





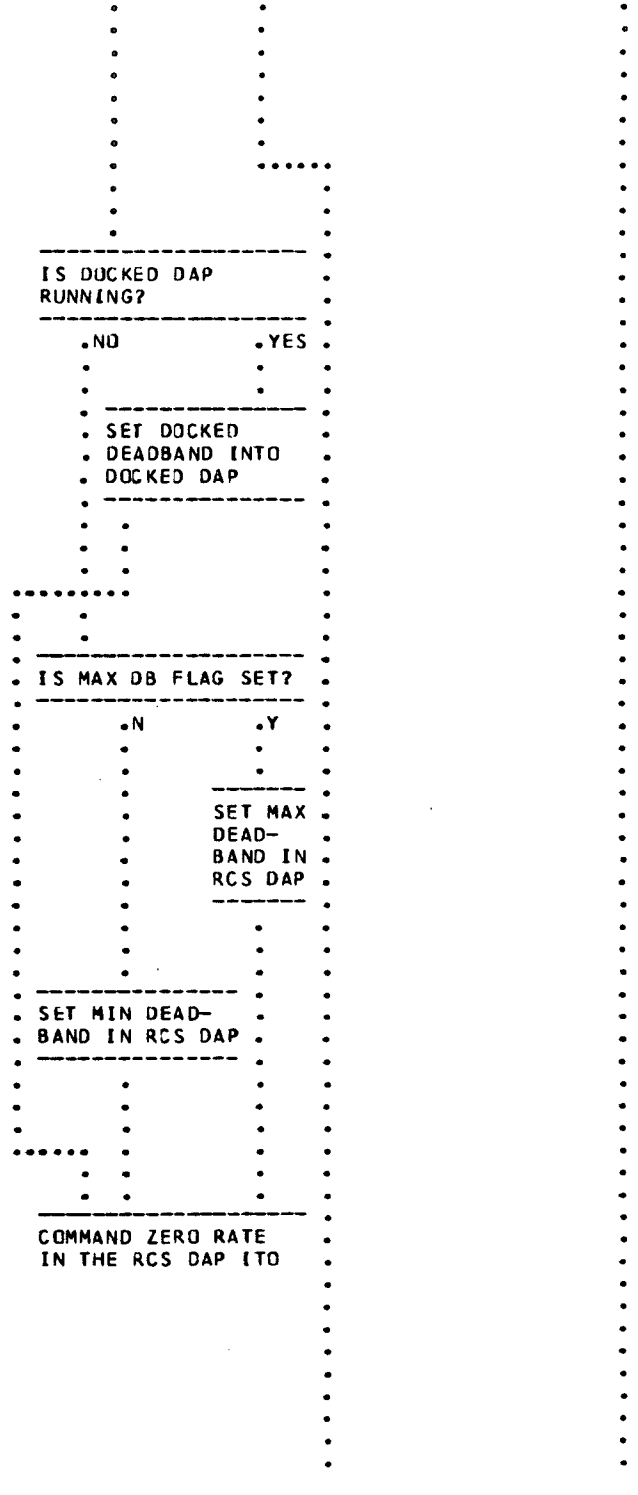
#460

#470

#480

#490

#500



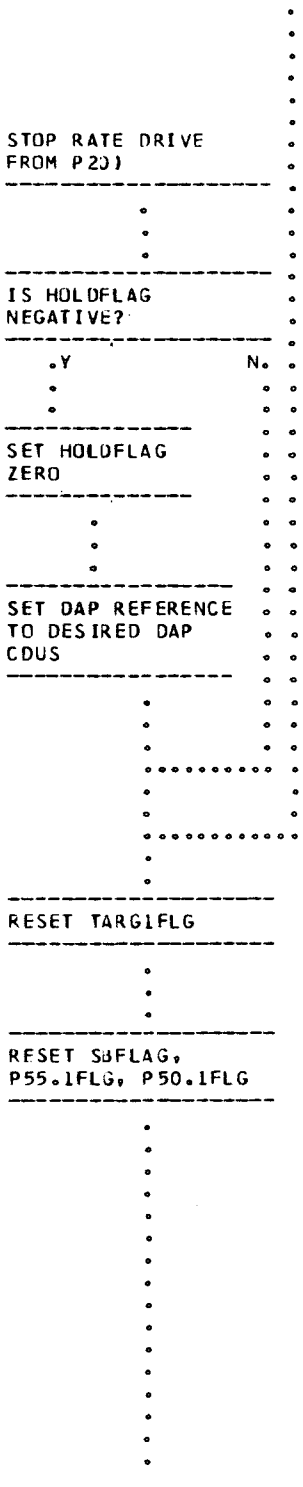
#510

#520

#530

#540

#550



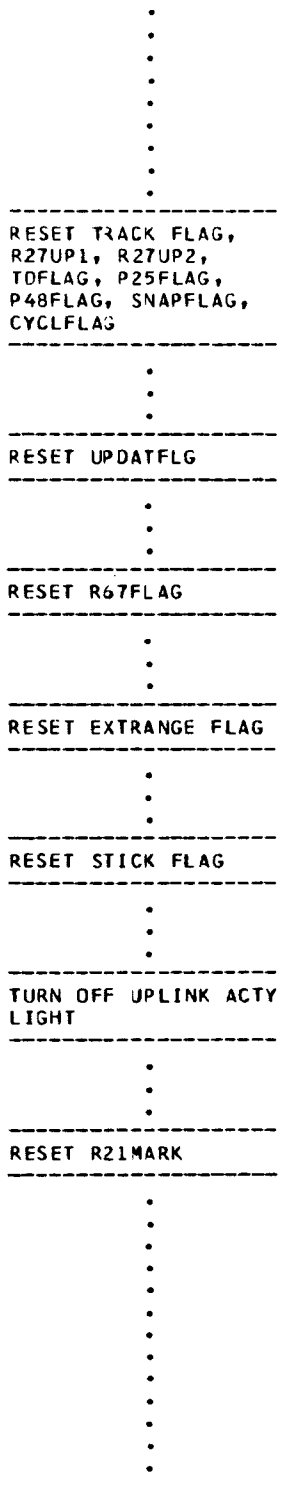
#560

#570

#580

#590

#600



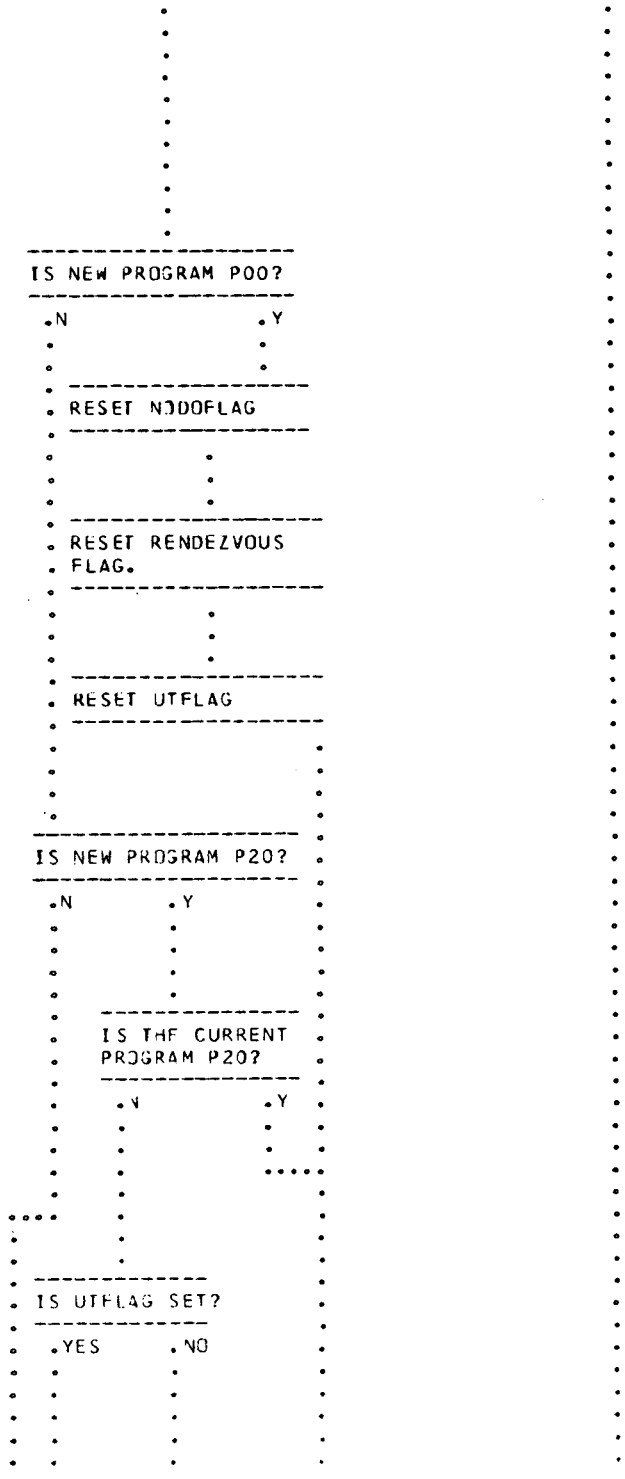
#610

#620

#630

#640

#650



#660

#670

#680

#690

#700

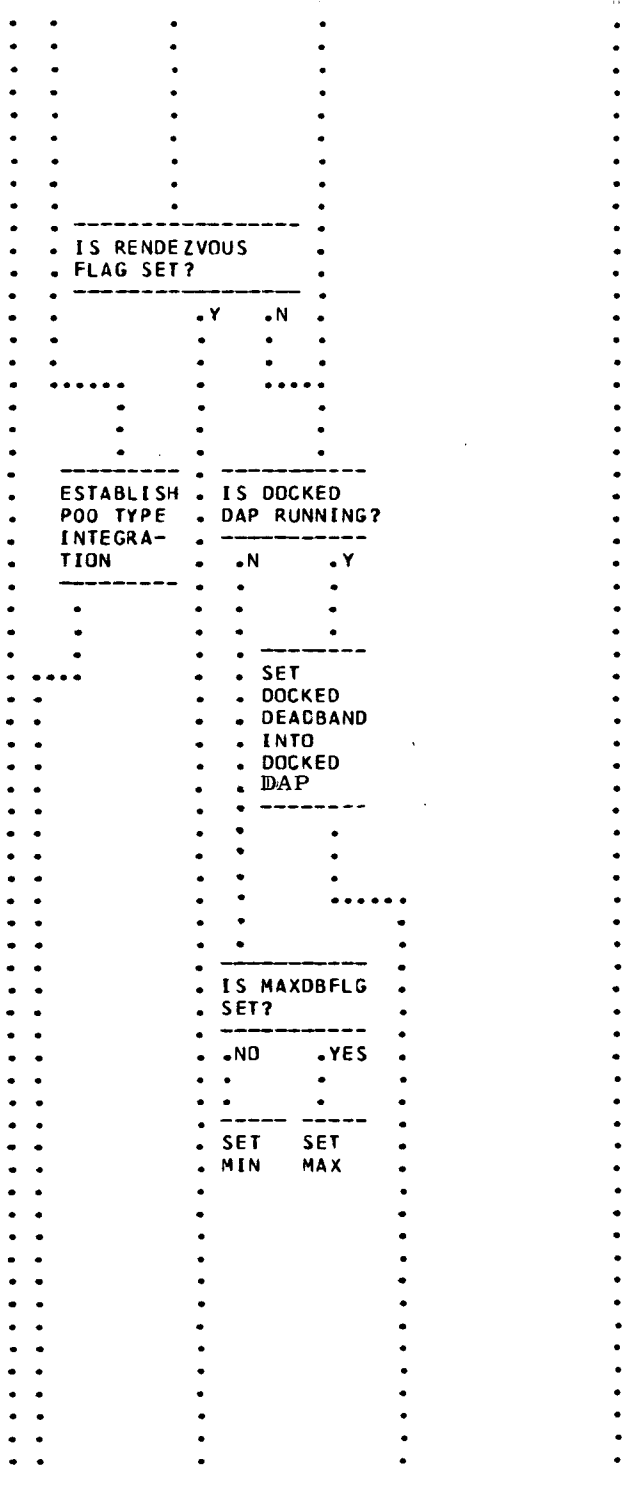
#710

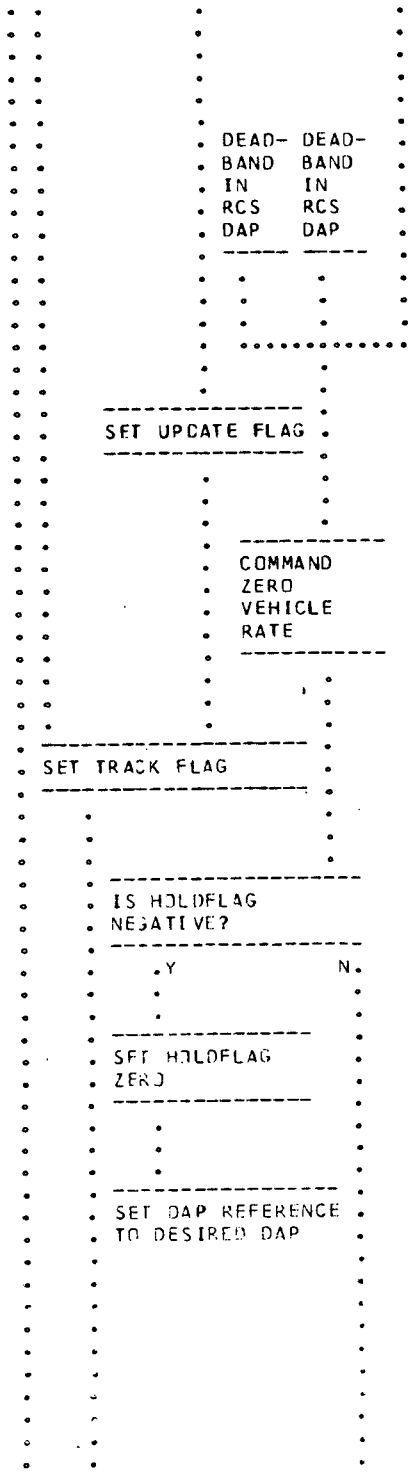
#720

#730

#740

#750





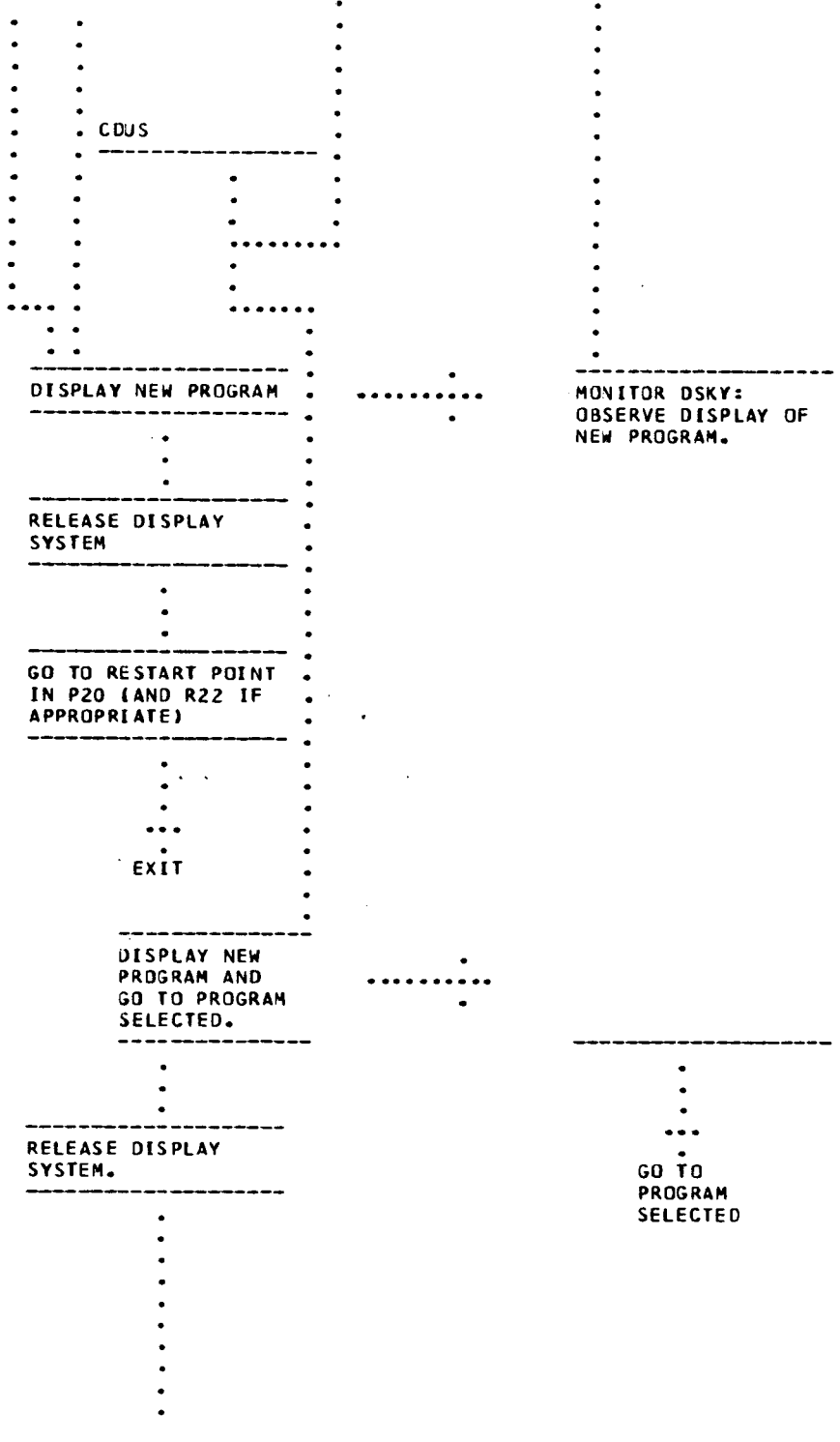
#760

#770

#780

#790

#800



#810

#820

#830

#840

#850

```
      .
      .
      .
      .
      .
      .
      .
     ...
      .
    EXIT
```

#860

CHANGE CONTROL NOTES

REV 00 PCR 003,011,032,036,040,413, PCN 455,456, SKYLARK MEMO #2
REV 01 PCN 489

ERASABLE AND CHANNEL MODIFICATION ROUTINE (R01)

REV 00 05/19/71

PURPOSE: (1) TO PROVIDE MANUAL CAPABILITY OF CHANGING FLAGWORD BITS OR CHANNEL BITS.

ASSUMPTIONS: (1) THIS PROCEDURE CAN BE PERFORMED AT ANY TIME.

(2) THIS PROCEDURE IS NOT RESTRICTED TO FLAGWORDS OR CHANNELS BUT CAN MODIFY ANY LEGITIMATE ERASABLE LOCATION > 30.

(3) THIS PROCEDURE CANNOT BE USED TO MODIFY CHANNEL 77.

DESCRIPTION: (1) NOUN 07 MUST BE LOADED BY V25N07E.

(2) NOUN 07 IS A THREE COMPONENT OCTAL NOUN WITH THE FOLLOWING DEFINITION:

R1 = AN ADDRESS SPECIFYING EITHER THE ECADR OF AN ERASABLE LOCATION OR THE NUMBER OF A CHANNEL:
IF R1>30, THE ADDRESS IS ASSUMED TO BE AN ECADR;
IF R1<30, THE ADDRESS IS ASSUMED TO BE A CHANNEL NUMBER.

AS IN ALL ATTEMPTS TO MODIFY CHANNEL 7, THE REQUEST IS IGNORED IF R1=7.

R2 = UP TO FIVE OCTAL DIGITS SPECIFYING BITS IN THE WORD TO BE SET (E.G.: 200 IS BIT 8).

R3 = POSITIVE NON-ZERO INDICATES A "1" IS TO BE SET INTO BIT POSITIONS SPECIFIED IN R2. ZERO, NEGATIVE, OR BLANK INDICATES A "0".

(3) AS AN EXAMPLE, SETTING OF BITS 1, 3 AND 13 TO "1" IN FLAGWORD 8 REQUIRES THE FOLLOWING SEQUENCE:

```
V25N07E
  104E
10005E
   1E
```

RESETTING THE SAME BITS TO "0" REQUIRES THE SEQUENCE:

```
V25N07E
  104E
10005E
   0E
```

(4) SETTING OF BIT 10 OF CHANNEL 12 TO "1" REQUIRES THE FOLLOWING SEQUENCE:

```
V25N07E
  12E
1000E
   1E
```

RESETTING THE SAME BIT TO "0" REQUIRES THE SEQUENCE:

```
V25N07E
  12E
1000E
   0E
```

CHANGE CONTROL NOTES

IMU STATUS CHECK ROUTINE (R02) REV 00 05/19/71

PURPOSE: (1) TO CHECK WHETHER IMU IS ON AND IF ON WHETHER IT IS ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.

(2) TO ESTABLISH A PROGRAM ALARM AND STORE AN ALARM CODE IF THE IMU IS OFF OR NOT ALIGNED TO AN ORIENTATION KNOWN BY THE CMC.

ASSUMPTIONS: (1) THE ROUTINE IS ONLY AUTOMATICALLY SELECTED.

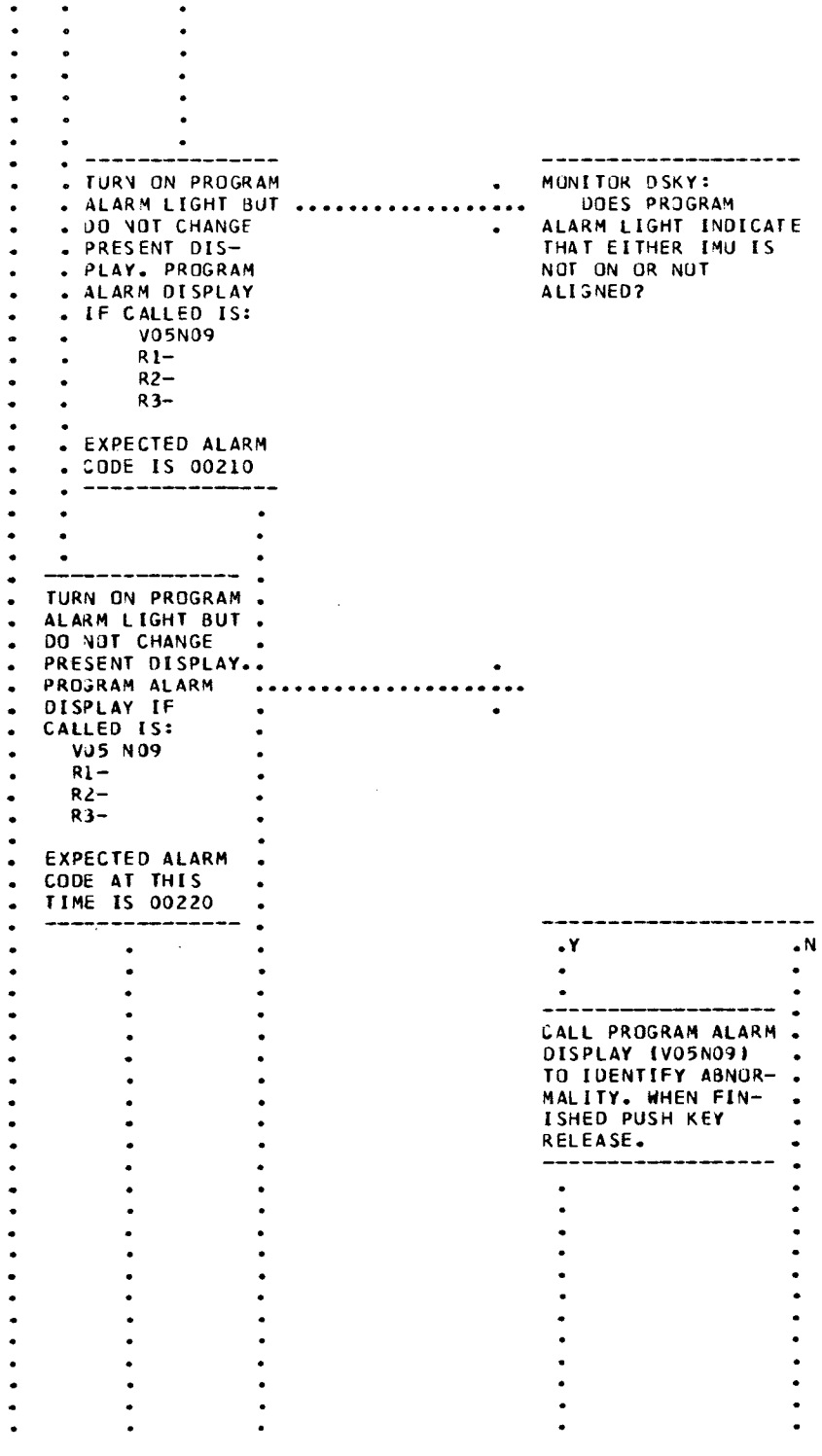
#30

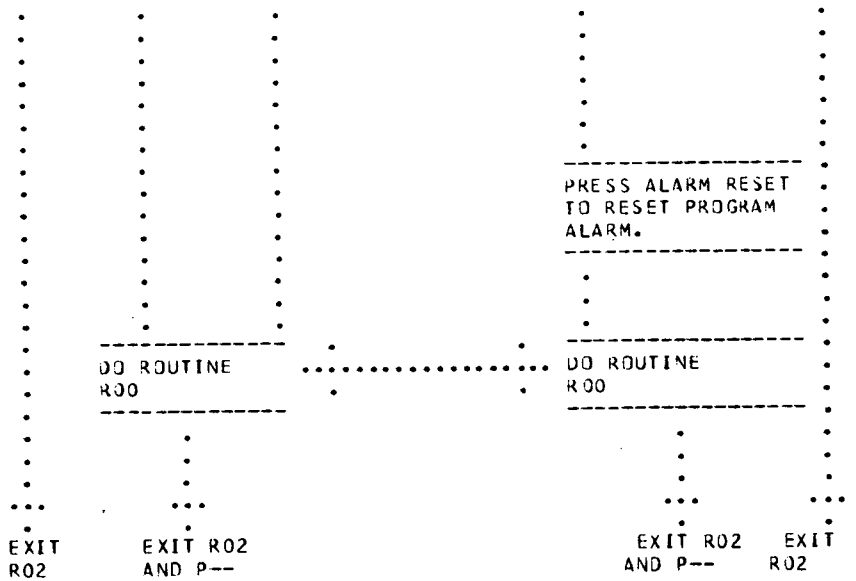
#40

#50

#60

#70


TURN ON PROGRAM ALARM LIGHT BUT DO NOT CHANGE PRESENT DISPLAY. PROGRAM ALARM DISPLAY IF CALLED IS:
V05N09
R1-
R2-
R3-
EXPECTED ALARM CODE IS 00210
MONITOR DSKY: DOES PROGRAM ALARM LIGHT INDICATE THAT EITHER IMU IS NOT ON OR NOT ALIGNED?
TURN ON PROGRAM ALARM LIGHT BUT DO NOT CHANGE PRESENT DISPLAY. PROGRAM ALARM DISPLAY IF CALLED IS:
V05 N09
R1-
R2-
R3-
EXPECTED ALARM CODE AT THIS TIME IS 00220
.Y
.N
CALL PROGRAM ALARM DISPLAY (V05N09) TO IDENTIFY ABNORMALITY. WHEN FINISHED PUSH KEY RELEASE.



#80

#90

#100

CHANGE CONTROL NOTES

CSM DAP DATA LOAD ROUTINE (R03) REV 00 05/19/71

PURPOSE: (1) TO LOAD AND VERIFY CMC DIGITAL AUTOPILOT (DAP) DATA FOR CSM.

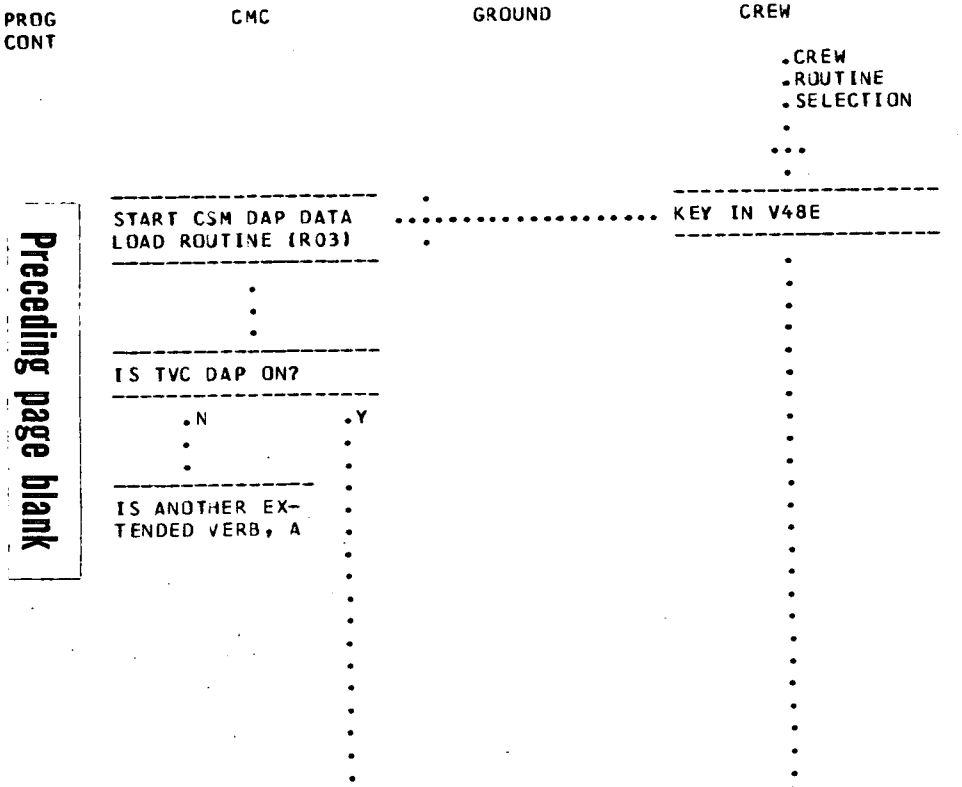
(2) TO PROVIDE THE CREW A MEANS FOR SELECTING APPROPRIATE COAST AUTOPILOTS. AFTER COMPLETION OF THIS ROUTINE, WHICH IDENTIFIES THE VEHICLE CONFIGURATION, THE USE OF VERB 46 ENTER (ACTIVATE CSM DAP) WILL CAUSE THE APPROPRIATE DAP TO BECOME ACTIVE. V45 IS NECESSARY TO START NEW DAP MODE: 1) WHEN SWITCHING FROM IDLE MODE TO SATURN OR RCS, 2) WHEN SWITCHING FROM SATURN TO RCS, 3) WHEN SWITCHING FROM SATURN OR RCS TO IDLE MODE.

ASSUMPTIONS: (1) THE MOMENTS OF INERTIA AND OTHER PERTINENT PARAMETERS ARE STORED IN THE CMC AS A FUNCTION OF THE KEYED IN WEIGHTS.

(2) THE VALUE FOR WEIGHT IS REDUCED LINEARLY AS A FUNCTION OF SPS MANEUVER TIME DURING SPS THRUSTING PROGRAM (P40) MANEUVERS ONLY. ALL THRUSTING MANEUVERS THAT ARE PERFORMED WITHOUT USING P40 COULD CAUSE THE CMC'S KNOWLEDGE OF WEIGHT TO BE COMPROMISED.

(3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(4) THIS ROUTINE IS NOT AVAILABLE IF UNDER THRUST VECTOR CONTROL.



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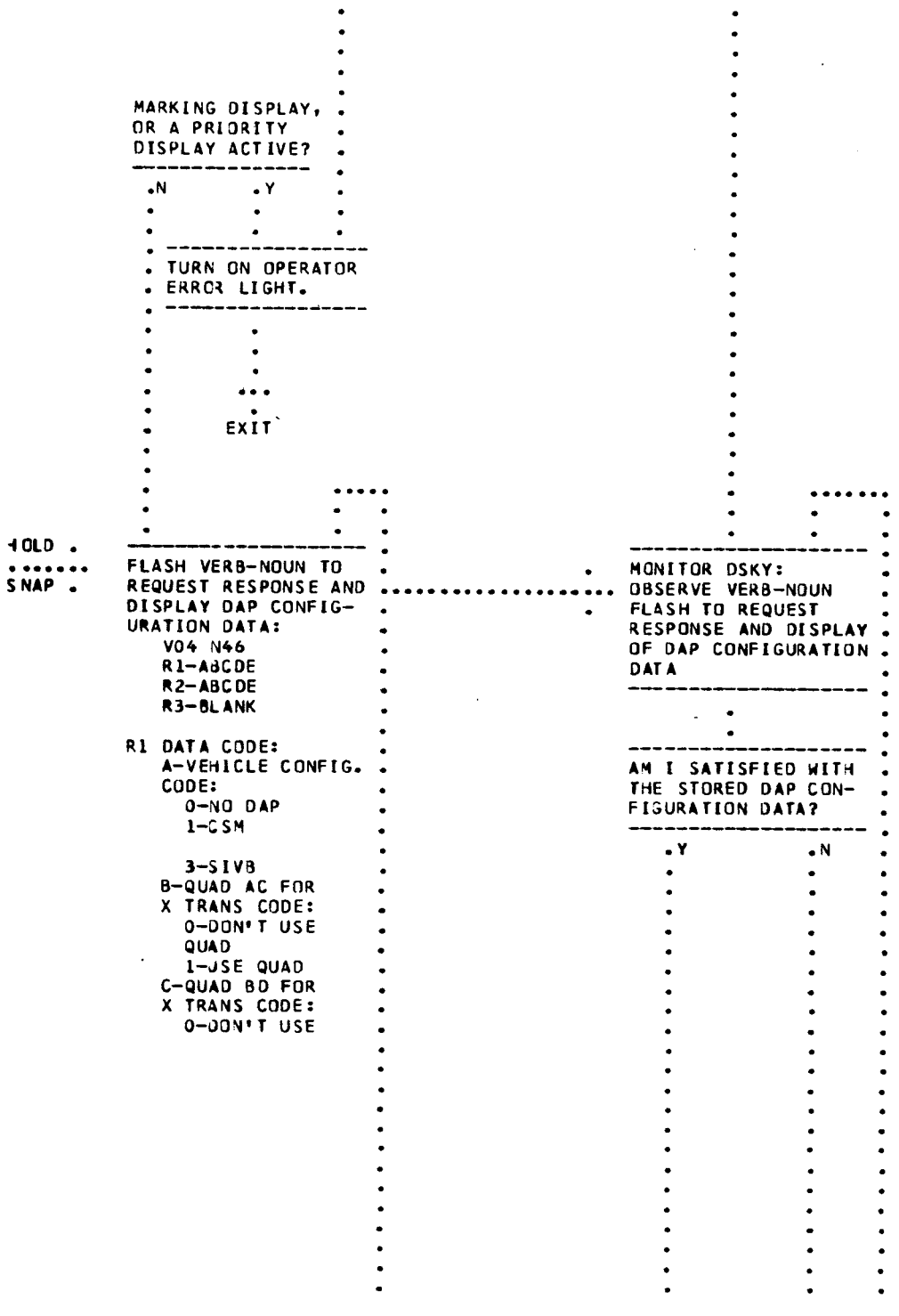
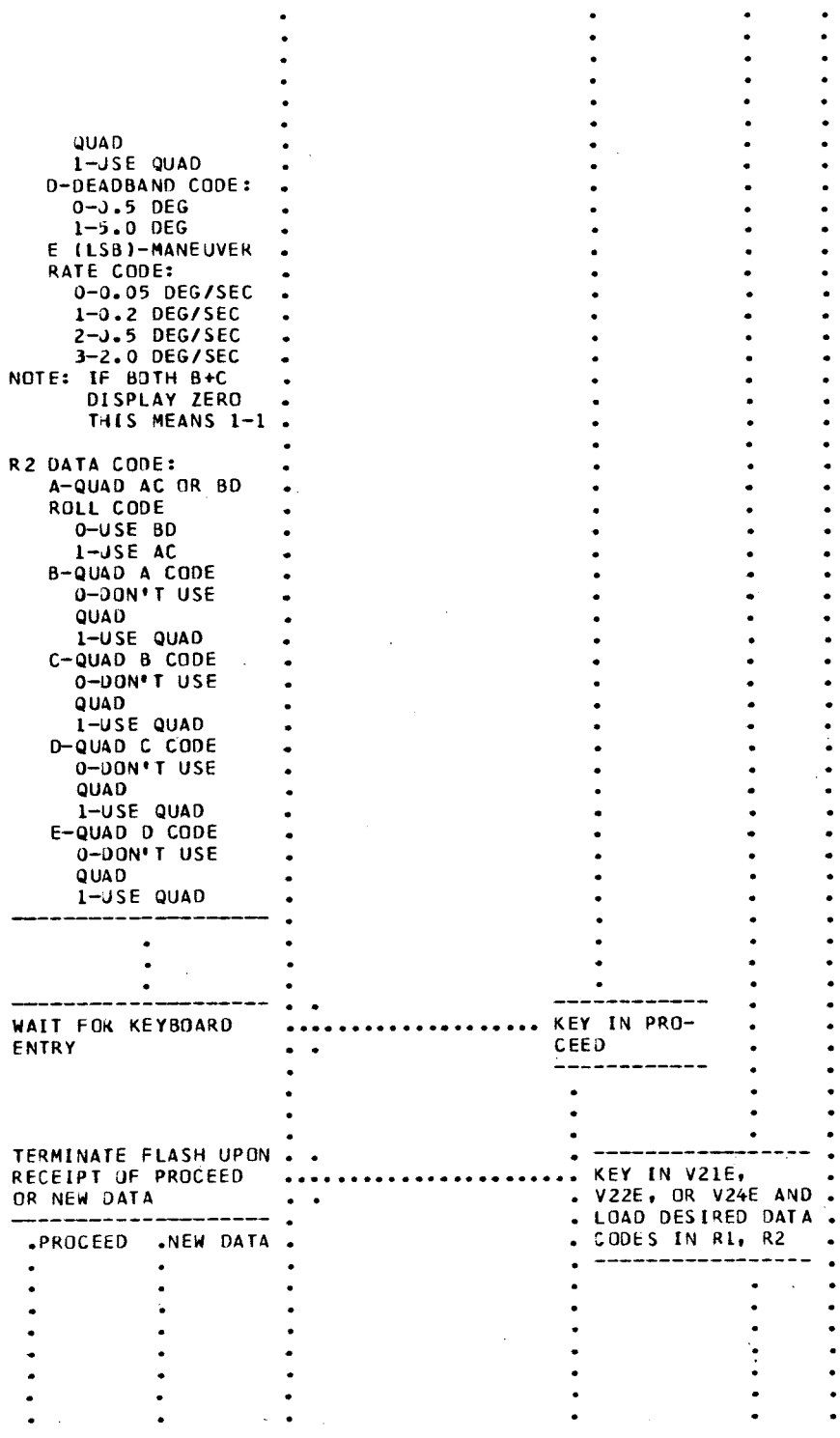

MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?
.N
.Y
TURN ON OPERATOR ERROR LIGHT.
EXIT
#30
#40
HOLD .
SNAP .
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DAP CONFIG-URATION DATA:
V04 N46
R1-ABCDE
R2-ABCDE
R3-BLANK
R1 DATA CODE:
A-VEHICLE CONFIG. CODE:
0-NO DAP
1-CSM
3-SIVB
B-QUAD AC FOR X TRANS CODE:
0-DON'T USE QUAD
1-USE QUAD
C-QUAD BD FOR X TRANS CODE:
0-DON'T USE
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF DAP CONFIGURATION DATA
#50
AM I SATISFIED WITH THE STORED DAP CON-FIGURATION DATA?
.Y
.N
#60



#70

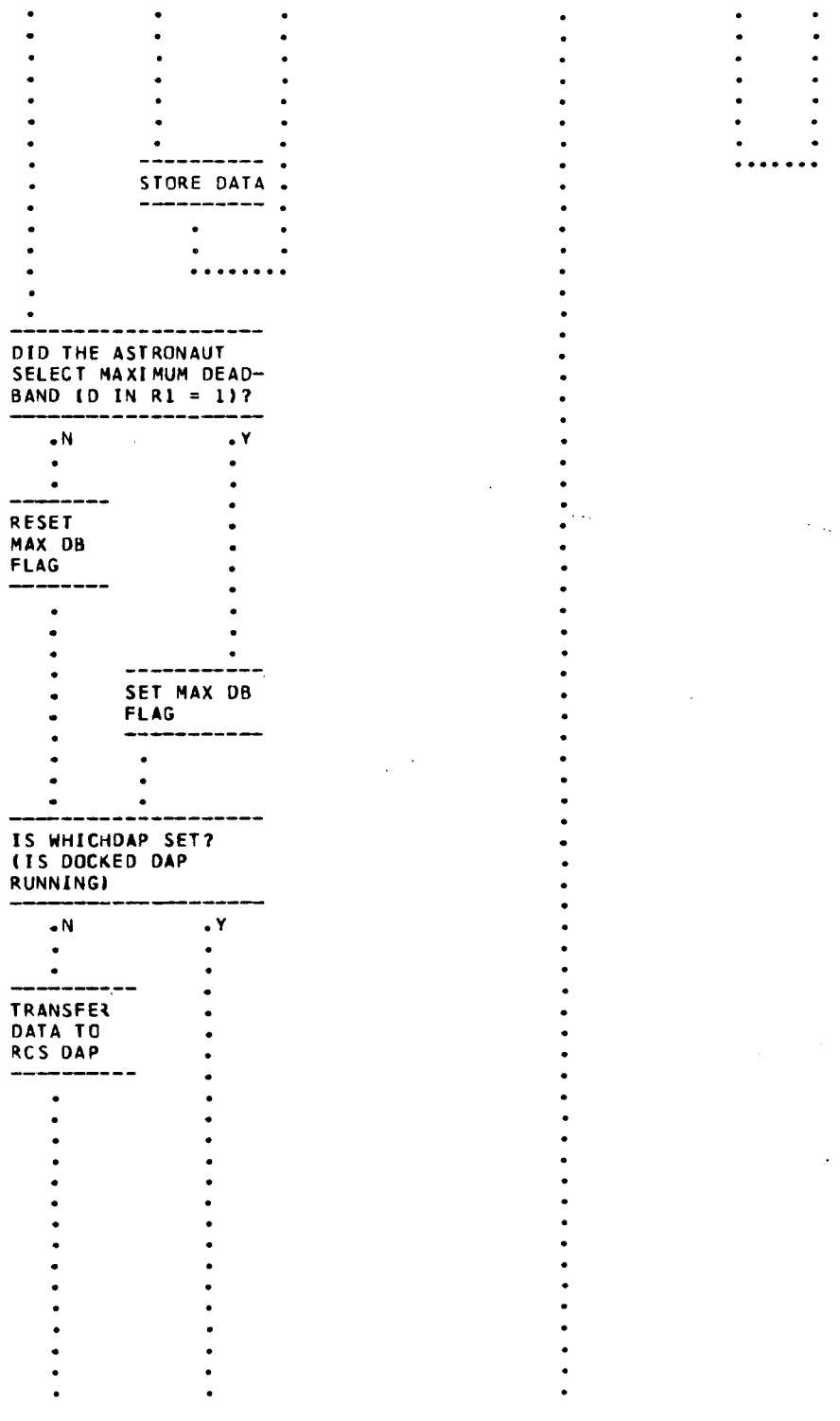
#80

#90

#100

#110

#120



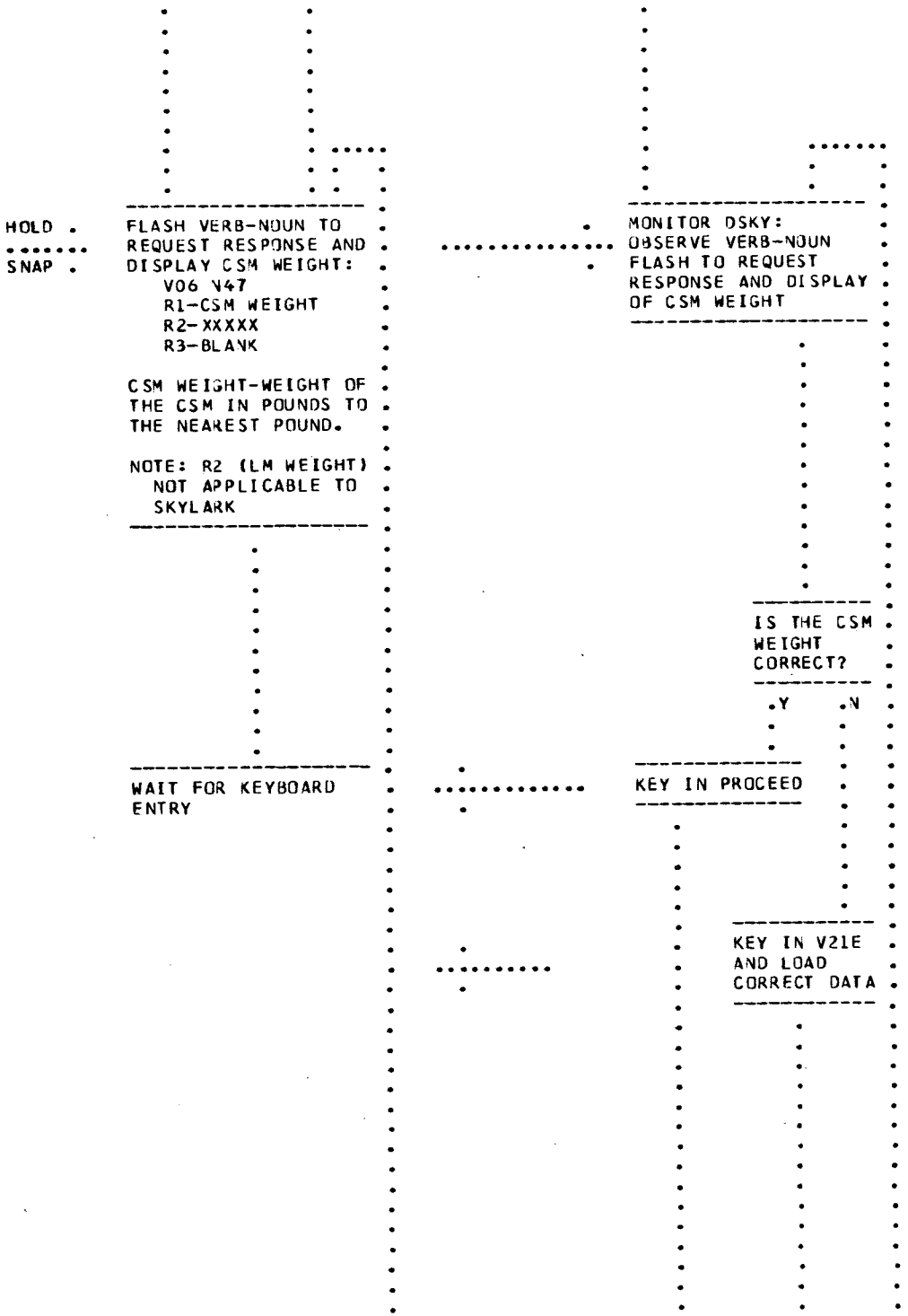
#130

#140

#150

#160

#170


HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY CSM WEIGHT:
V06 N47
R1-CSM WEIGHT
R2-XXXXX
R3-BLANK
CSM WEIGHT-WEIGHT OF THE CSM IN POUNDS TO THE NEAREST POUND.
NOTE: R2 (LM WEIGHT) NOT APPLICABLE TO SKYLARK
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF CSM WEIGHT
#180
#190
IS THE CSM WEIGHT CORRECT?
#200
Y
N
KEY IN PROCEED
#210
KEY IN V21E AND LOAD CORRECT DATA

#220

TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA

.P .NEW
.R .DATA
.O .
.C .
.E ----------
.E STORE DATA
.D ----------

#230

#240

IS THE VEHICLE CONFIGURATION CODE EQUAL TO 0 OR 3?

.Y .N

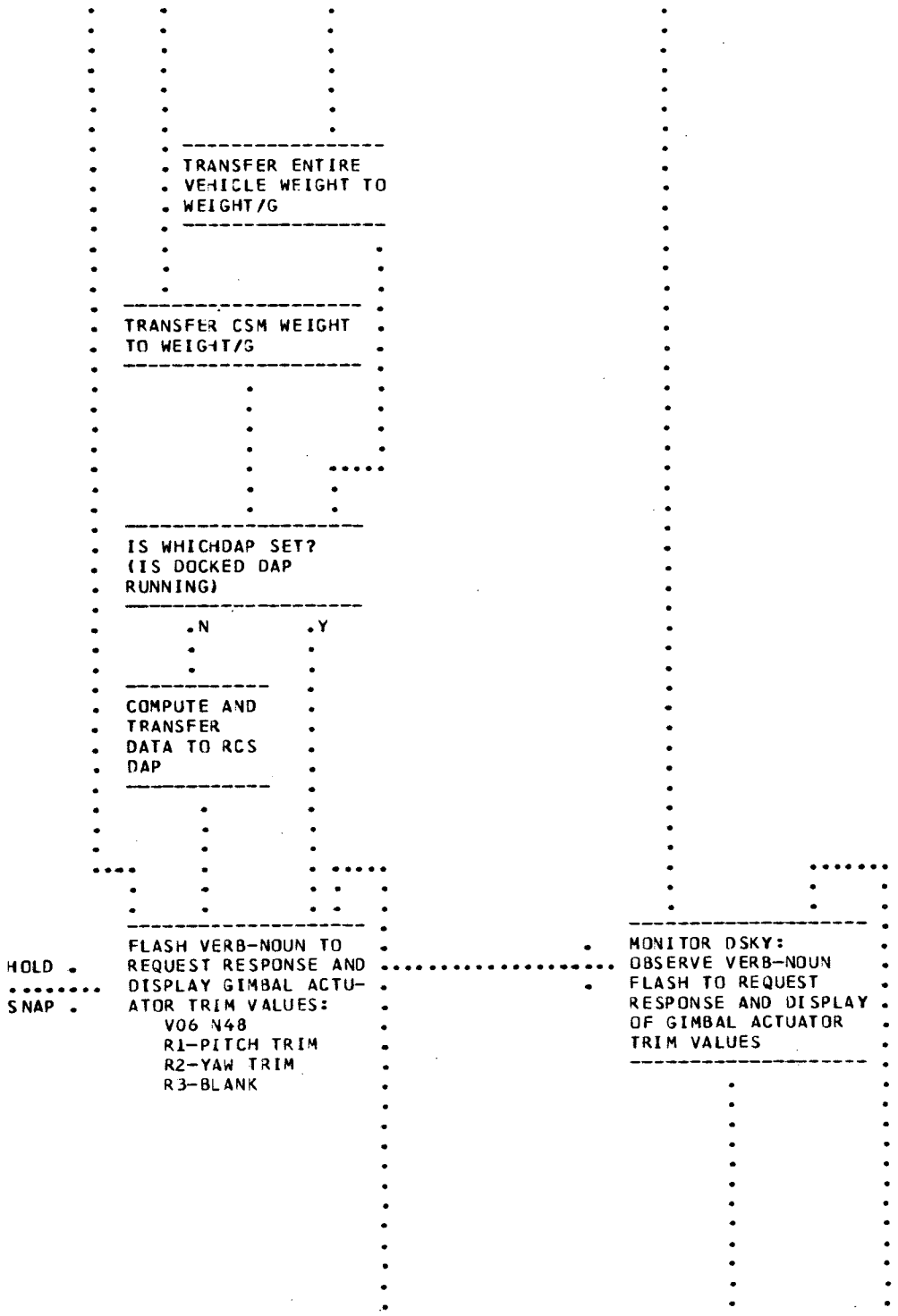
#250

COMPUTE MASS PROPERTIES

#260

IS VEHICLE CONFIGURATION CODE EQUAL TO 2 OR 6?

.N .Y



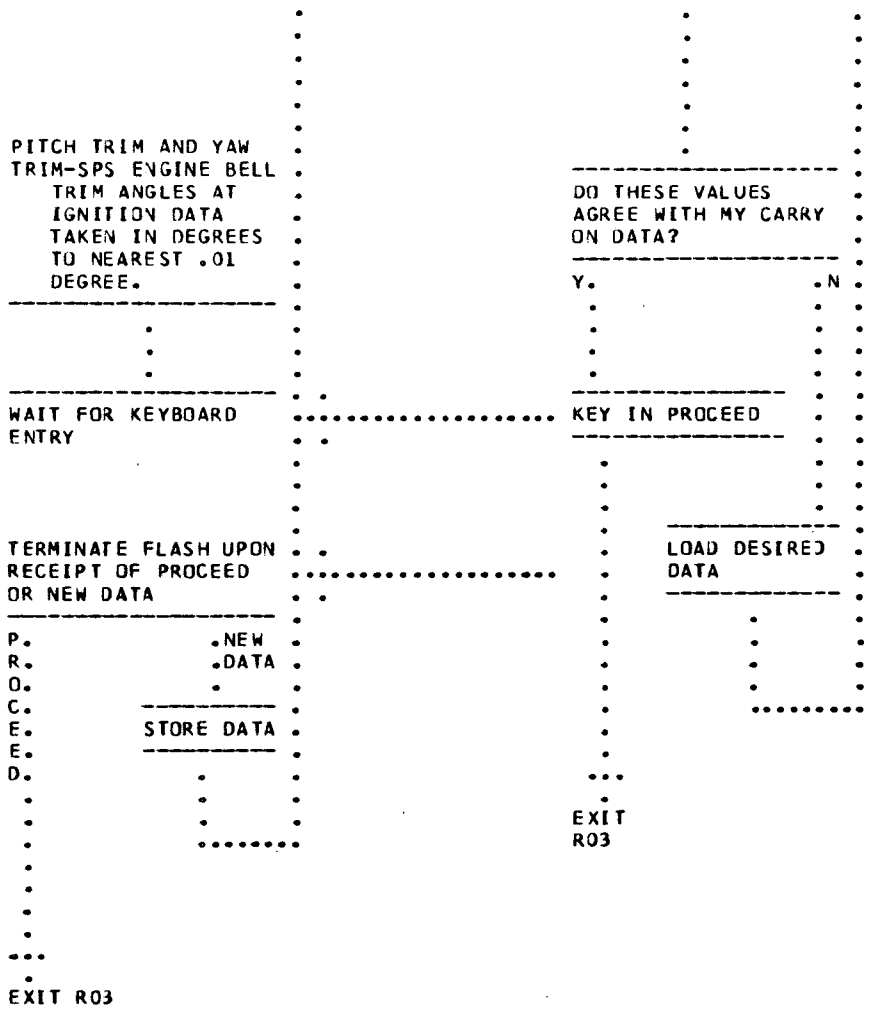
#270

#280

#290

#300

#310



#320

#330

#340

#350

CHANGE CONTROL NOTES

REV 00 PCR 040

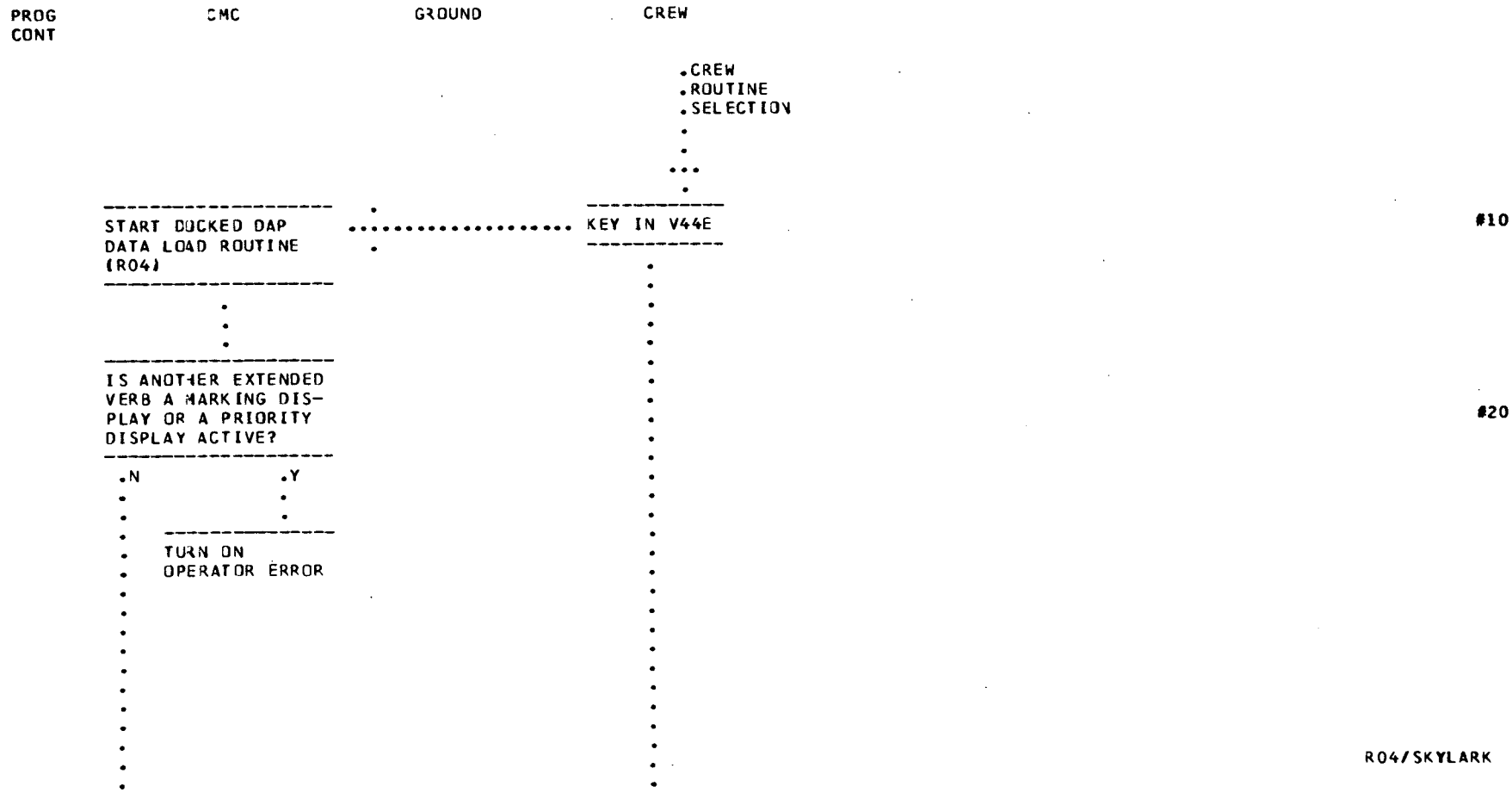
DOCKED DAP DATA LOAD (R04) REV 00 05/19/71

PURPOSE: (1) TO LOAD AND VERIFY CMC DIGITAL AUTOPILOT DATA FOR DOCKED DAP.

(2) AFTER COMPLETION OF THIS ROUTINE, KEYING V45E WILL ENABLE THE DOCKED RCS DAP AND DISABLE THE CSM-ALONE DAP OR SATURN TAKEOVER FUNCTION IF EITHER IS ACTIVE.

ASSUMPTIONS: (1) THIS ROUTINE IS NOT USED IF TVC DAP OR ENTRY DAP IS OPERATING.

(2) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



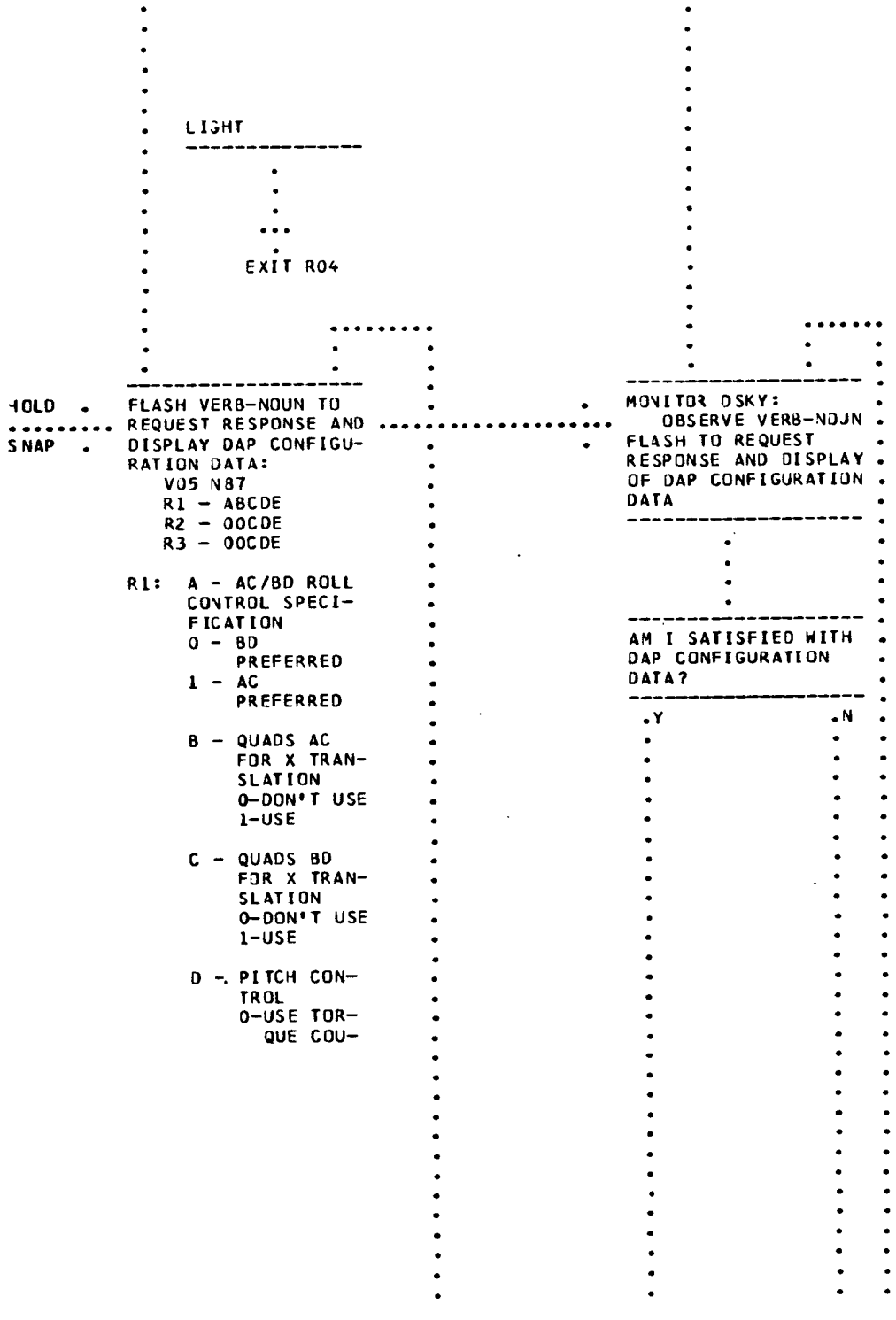
#30

#40

#50

#60

#70


LIGHT
EXIT R04
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DAP CONFIGURATION DATA:
V05 N87
R1 - ABCDE
R2 - 00CDE
R3 - 00CDE
R1: A - AC/BD ROLL CONTROL SPECIFICATION
0 - BD PREFERRED
1 - AC PREFERRED
B - QUADS AC FOR X TRANSLATION
0-DON'T USE
1-USE
C - QUADS BD FOR X TRANSLATION
0-DON'T USE
1-USE
D - PITCH CONTROL
0-USE TORQUE COU-
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF DAP CONFIGURATION DATA
AM I SATISFIED WITH DAP CONFIGURATION DATA?
Y
N

PLE CON-
TROL
1-USE Z
FORCE
CONTROL

E - YAW CONTROL
0-USE TOR-
QUE COU-
PLE CON-
TROL
1-USE Y
FORCE
CONTROL

#80

#90

R2: CHANNEL 5 JET
INHIBIT

TO INHIBIT JETS,
SELECT CORRE-
SPONDING OCTAL
VALUES FROM
FOLLOWING TABLE
AND LOAD THEIR
SUM (CDE) IN R2.

#100

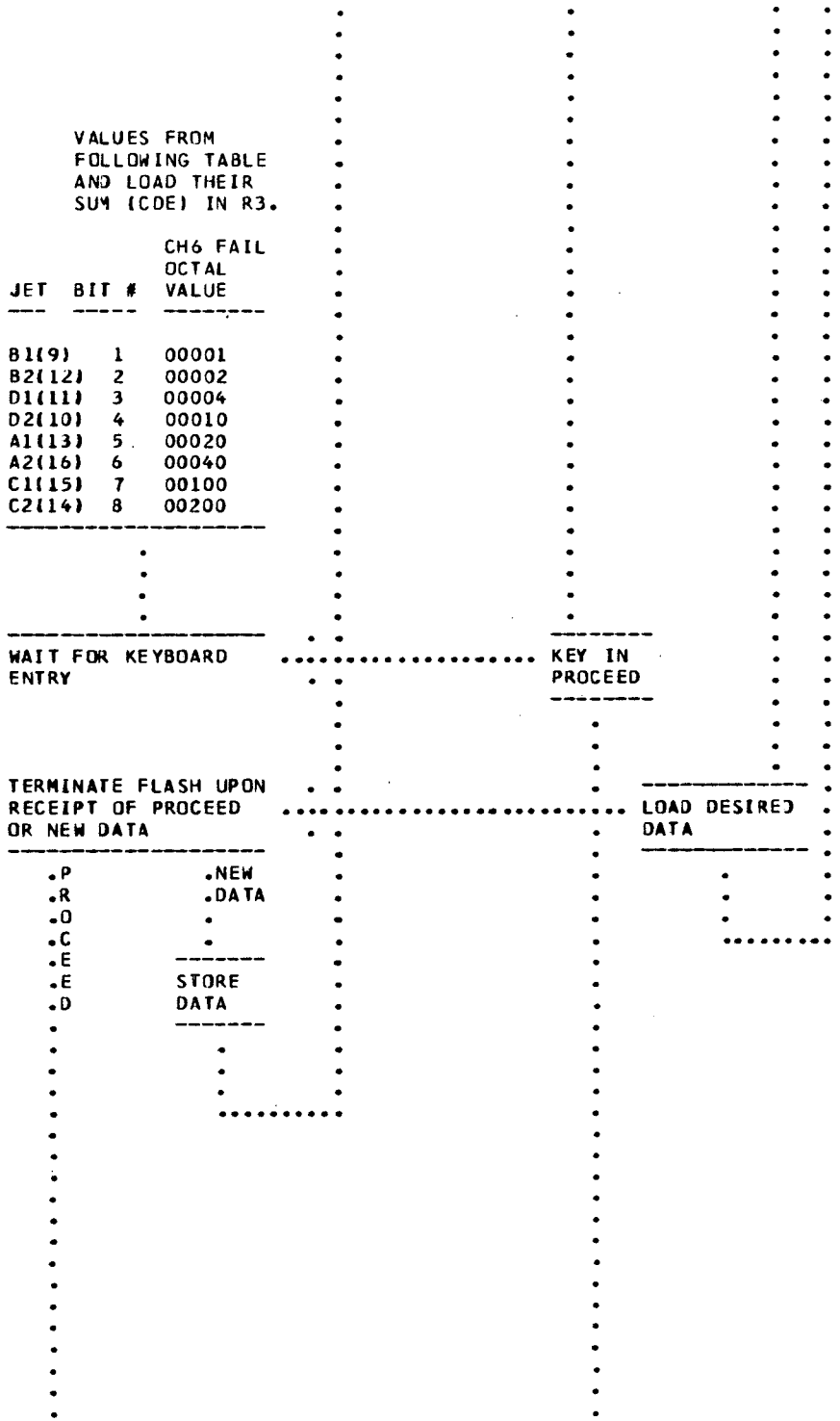
JET	BIT #	CH5 FAIL OCTAL VALUE
C3(1)	1	00001
C4(4)	2	00002
A3(3)	3	00004
A4(2)	4	00010
D3(5)	5	00020
D4(8)	6	00040
B3(7)	7	00100
B4(6)	8	00200

#110

R3: CHANNEL 6 JET
INHIBIT

TO INHIBIT JETS,
SELECT CORRE-
SPONDING OCTAL

#120



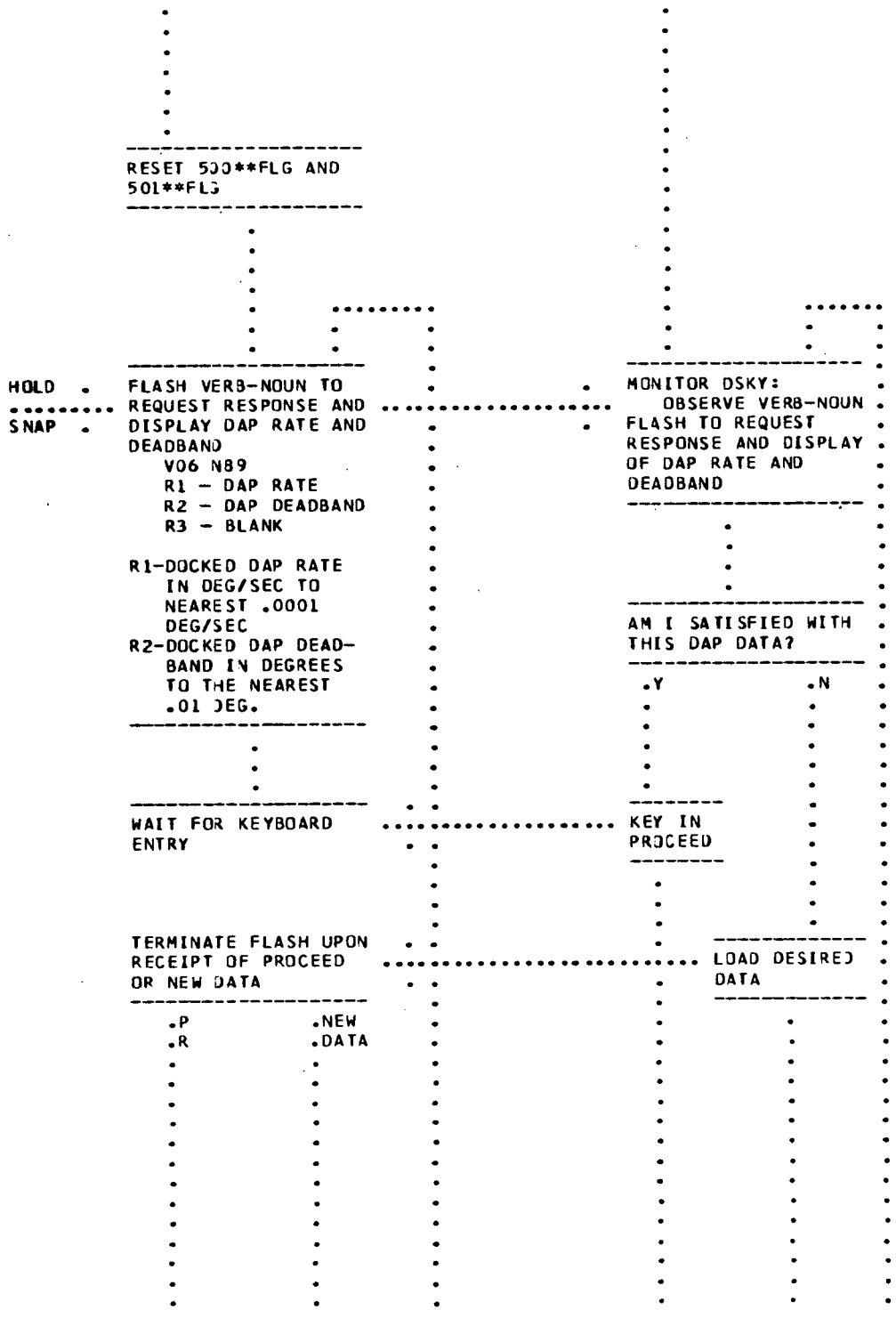
#130

#140

#150

#160

#170

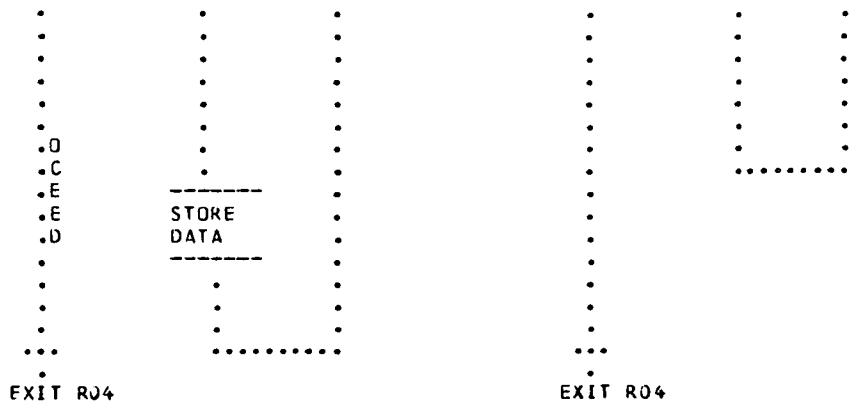


#180

#190

#200

#210



#220

#230

CHANGE CONTROL NOTES

REV 00 PCR 040,454

MINKEY CONTROLLER ROUTINE (R07) REV 00 05/19/71

PURPOSE: (1) TO PERFORM AUTOMATIC SEQUENCING OF RENDEZVOUS PROGRAMS.

(2) TO ESTABLISH UNIVERSAL TRACKING PROGRAM (P20) OPTION 4, WITH PRESET VALUES FOR P20 DISPLAYS. THESE DISPLAYS MAY BE ALTERED BY DSKY ENTRY.

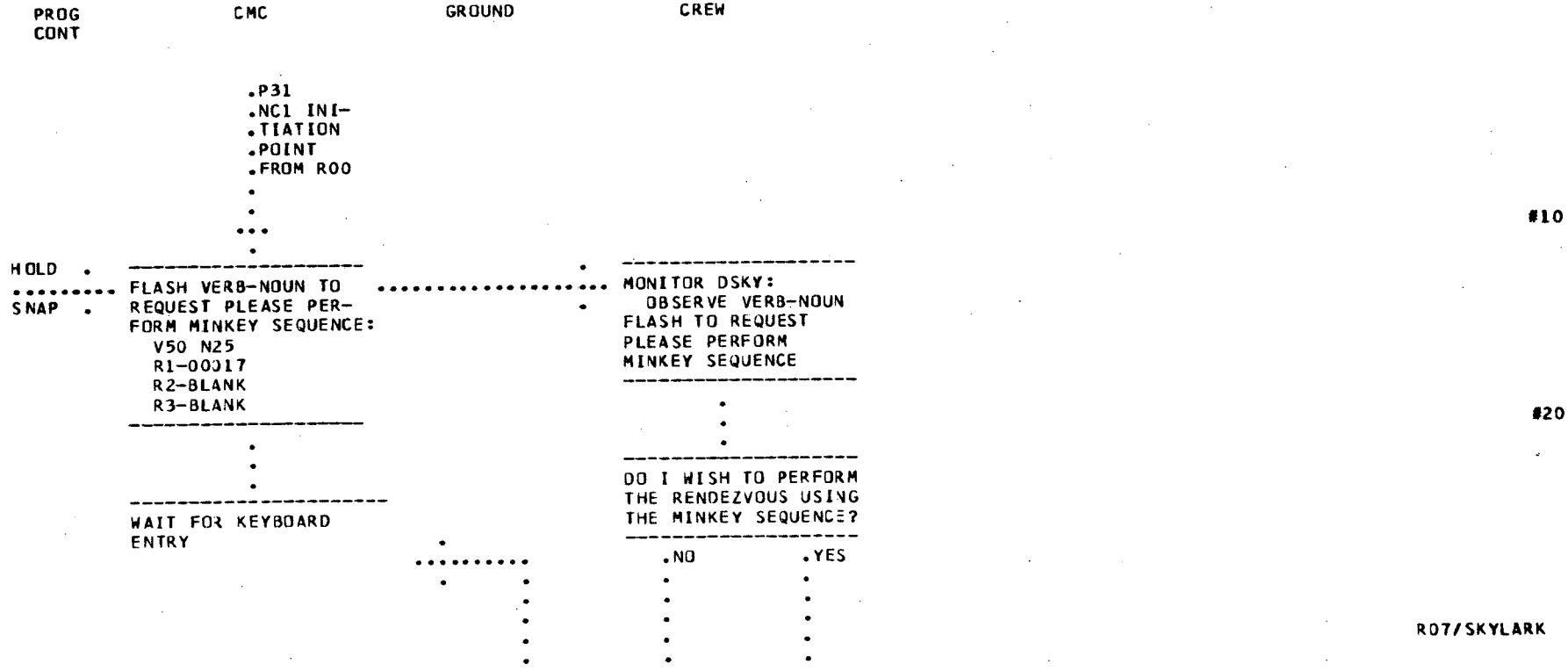
ASSUMPTIONS: (1) ROUTINE R03 HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO ESTABLISH P20 THE ASTRONAUT SHOULD KEY IN V46E AT SOME TIME PRIOR TO SELECTION OF A RENDEZVOUS TARGETING PROGRAM.

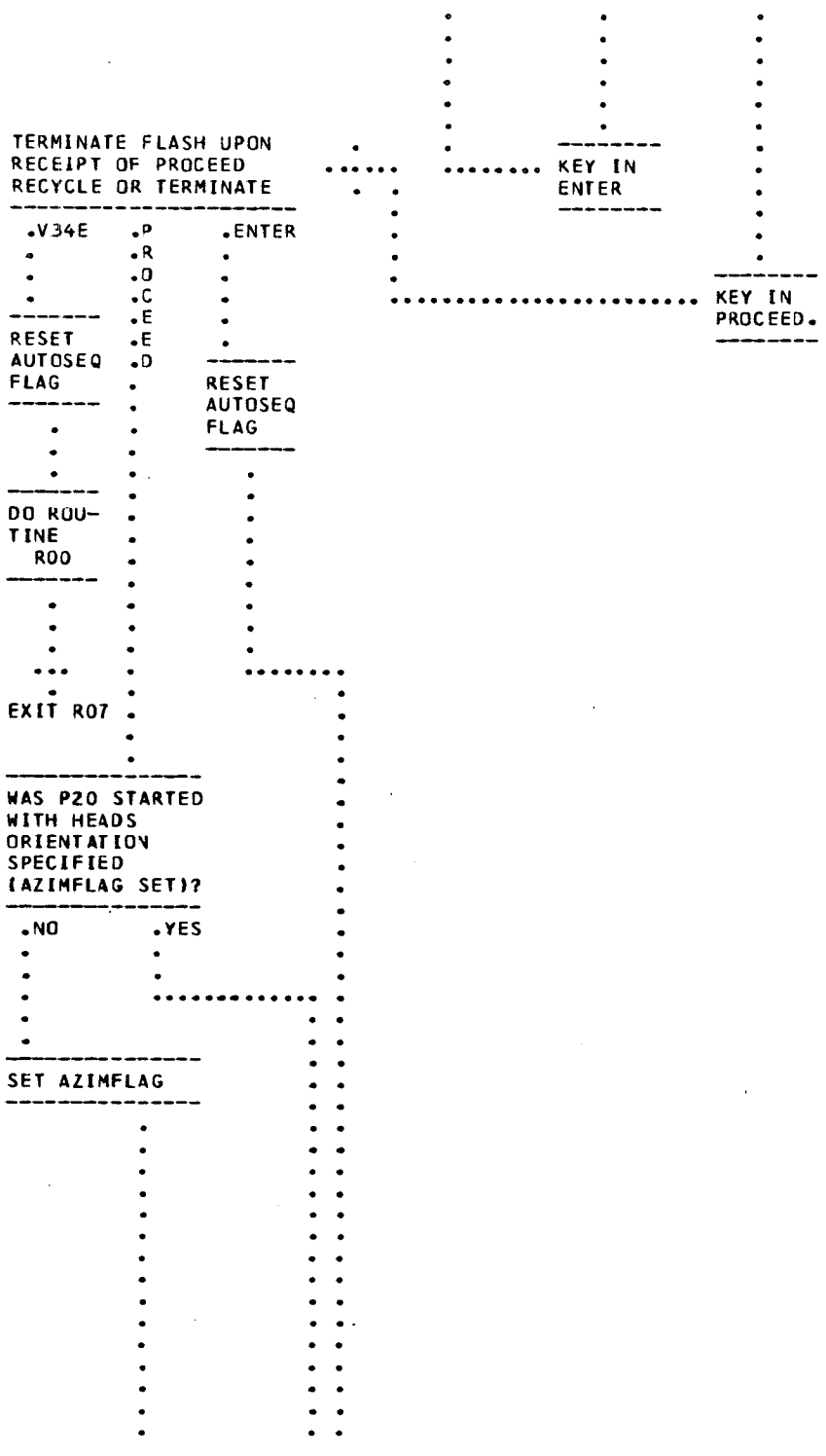
(2) THE INITIALIZATION VALUES FOR THE W-MATRIX (WRENDPOS AND WRENDVEL) MUST BE LOADED PRIOR TO SELECTION OF A RENDEZVOUS TARGETING PROGRAM.

(3) SOME TARGETING PROGRAMS REQUIRE THAT INPUTS TO PREVIOUS TARGETING PROGRAMS HAVE BEEN MADE.

(4) THIS ROUTINE IS INITIATED BY ASTRONAUT SELECTION OF A RENDEZVOUS TARGETING PROGRAM (V37E 3XE).

(5) PROGRAMS SELECTED BY R07 ENTER R00 AT "8".




TERMINATE FLASH UPON RECEIPT OF PROCEED RECYCLE OR TERMINATE
KEY IN ENTER
KEY IN PROCEED.
.V34E
.P
.R
.O
.C
.E
.E
.D
.ENTER
RESET AUTOSEQ FLAG
RESET AUTOSEQ FLAG
DO ROU-TINE R00
EXIT R07
WAS P20 STARTED WITH HEADS ORIENTATION SPECIFIED (AZIMFLAG SET)?
.NO
.YES
SET AZIMFLAG

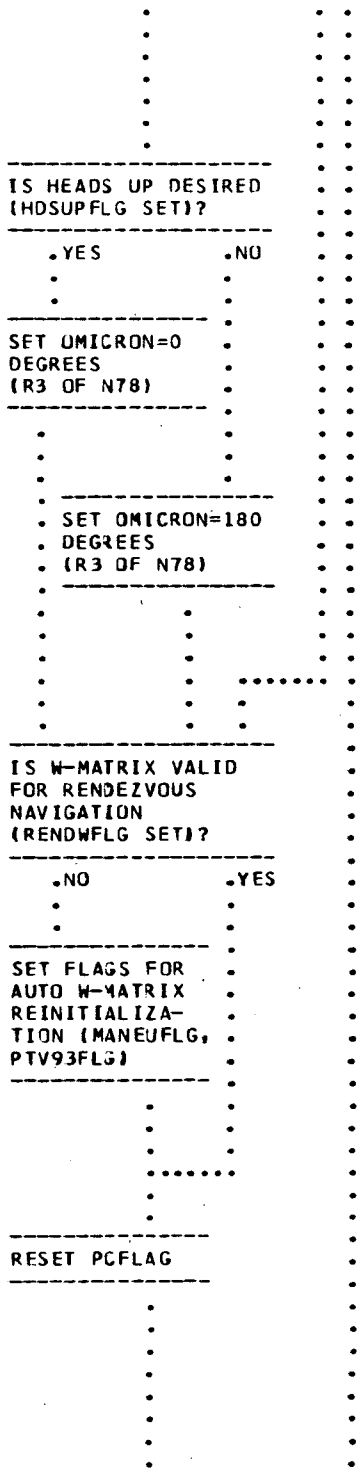
#30

#40

#50

#60

#70



#80

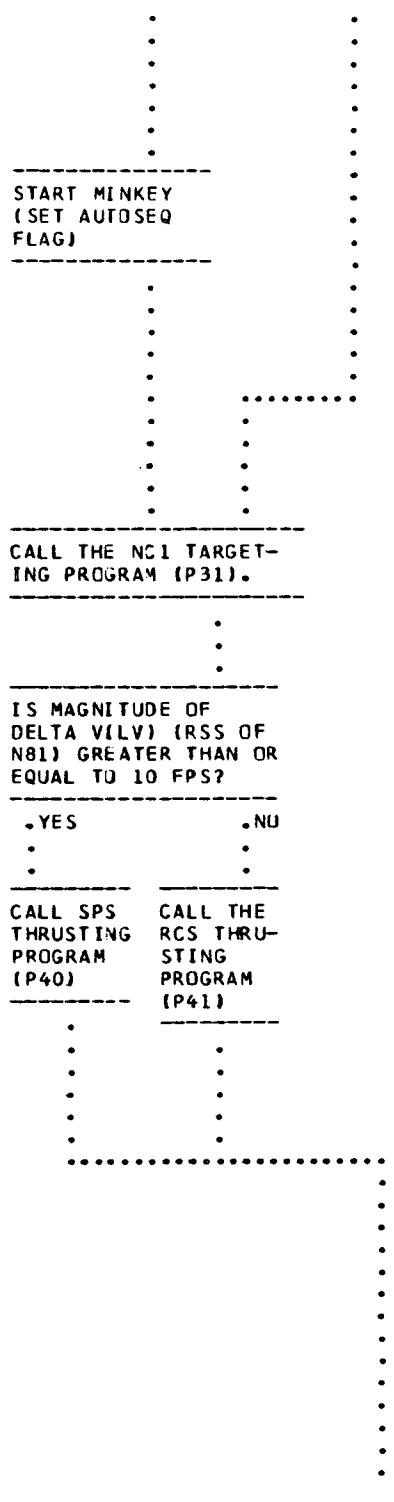
#90

#100

#110

#120

#130



#140

#150

#160

#170

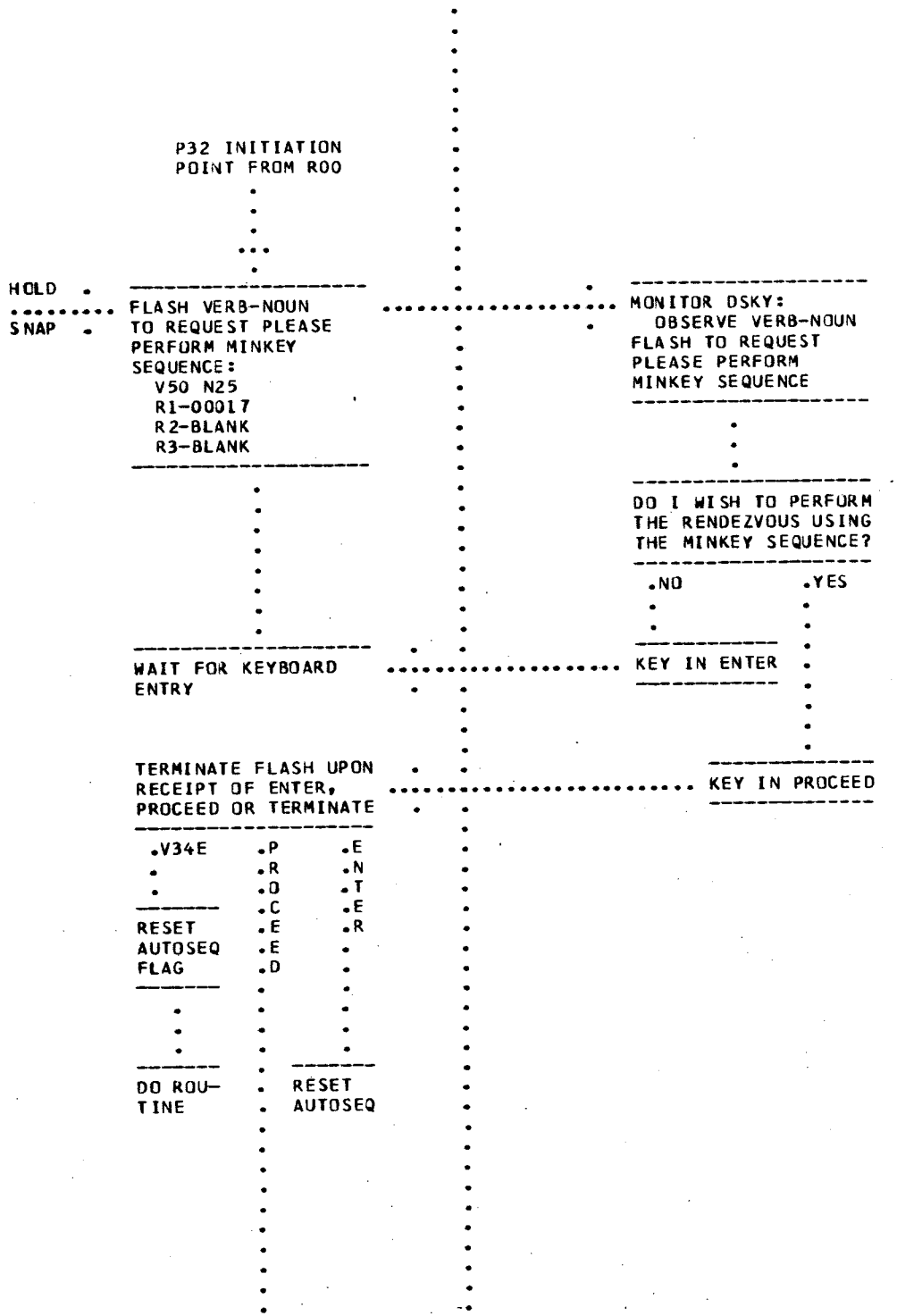
#180

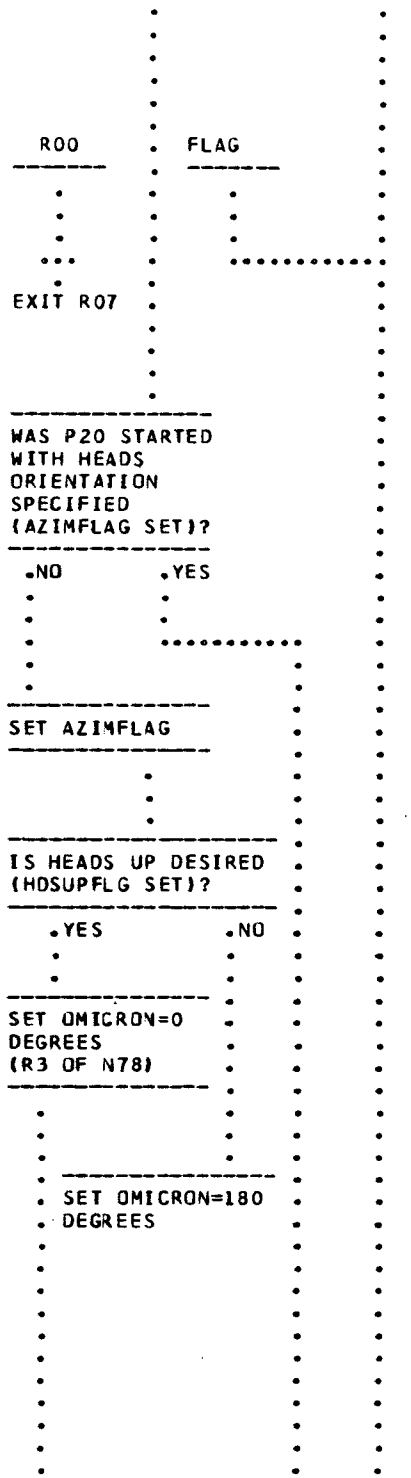
#190

#200

#210

#220





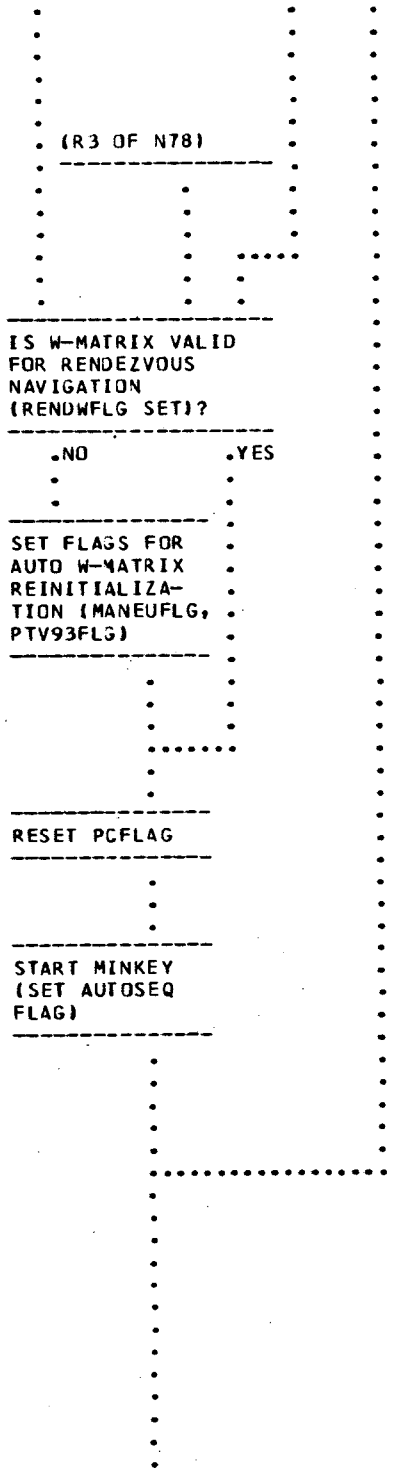
#230

#240

#250

#260

#270



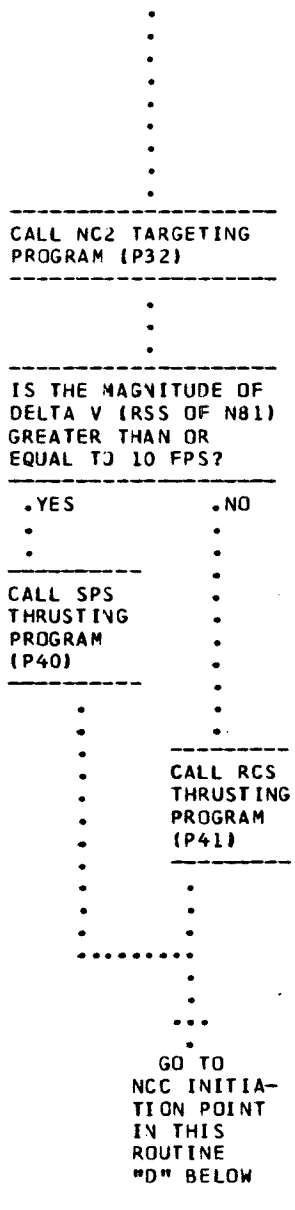
#280

#290

#300

#310

#320



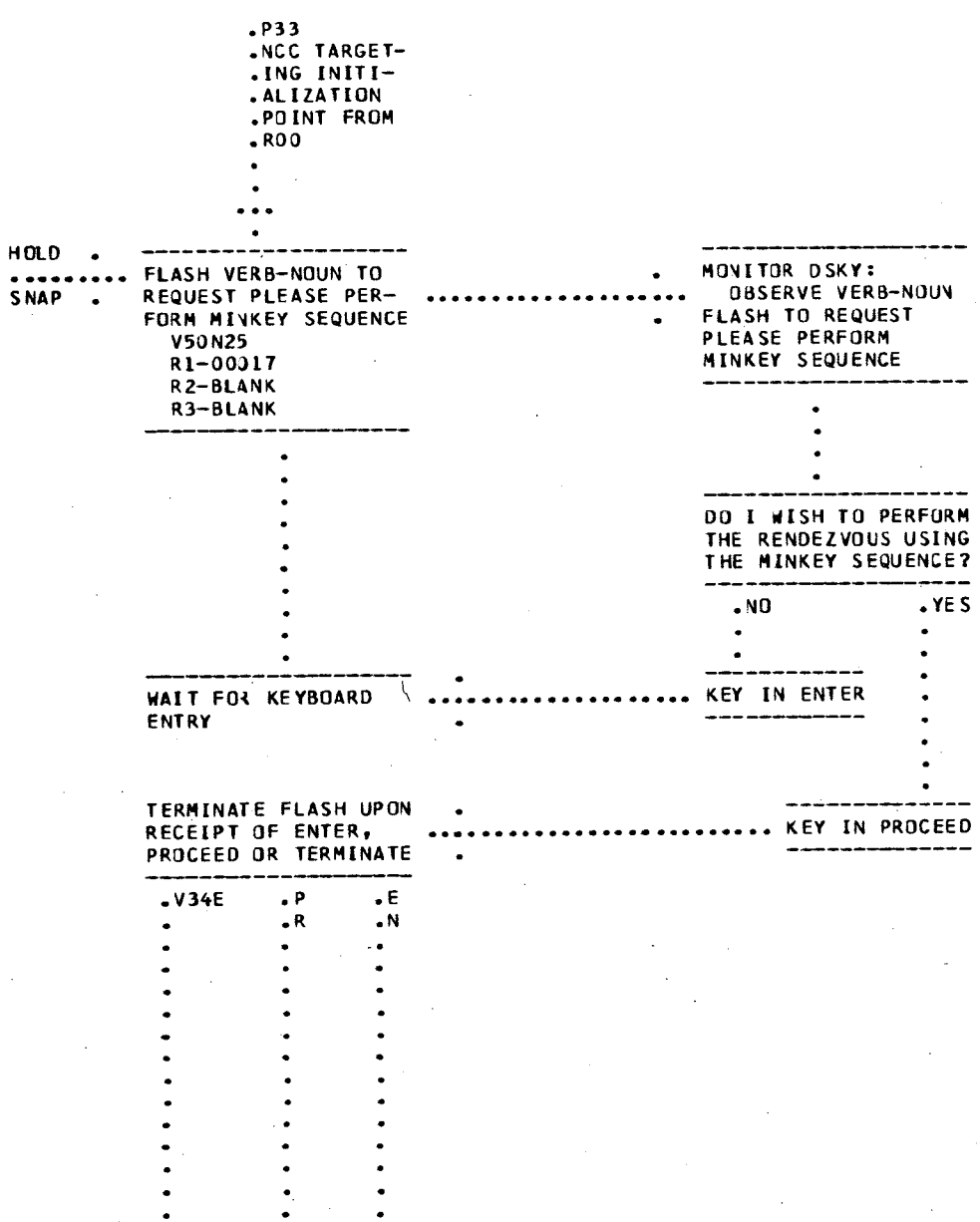
#330

#340

#350

#360

#370



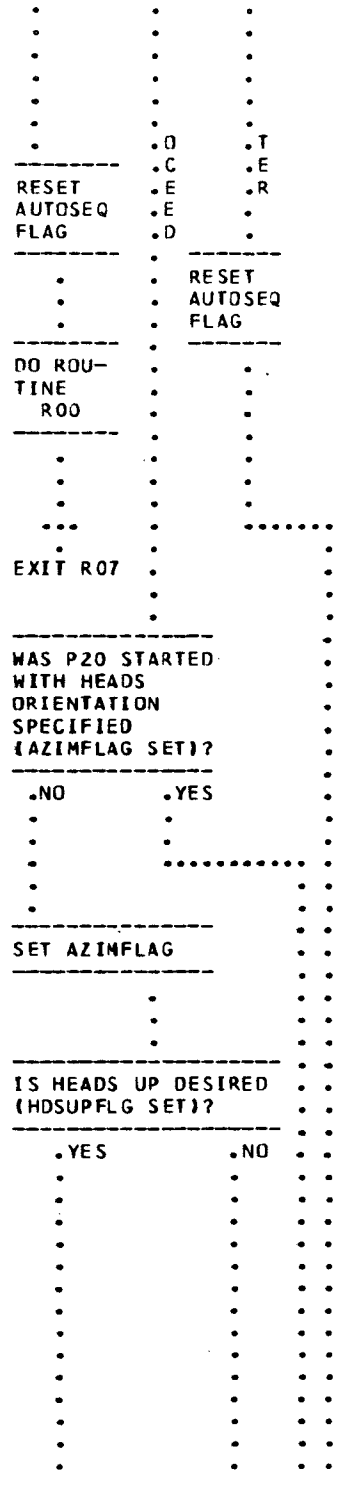
#380

#390

#400

#410

#420

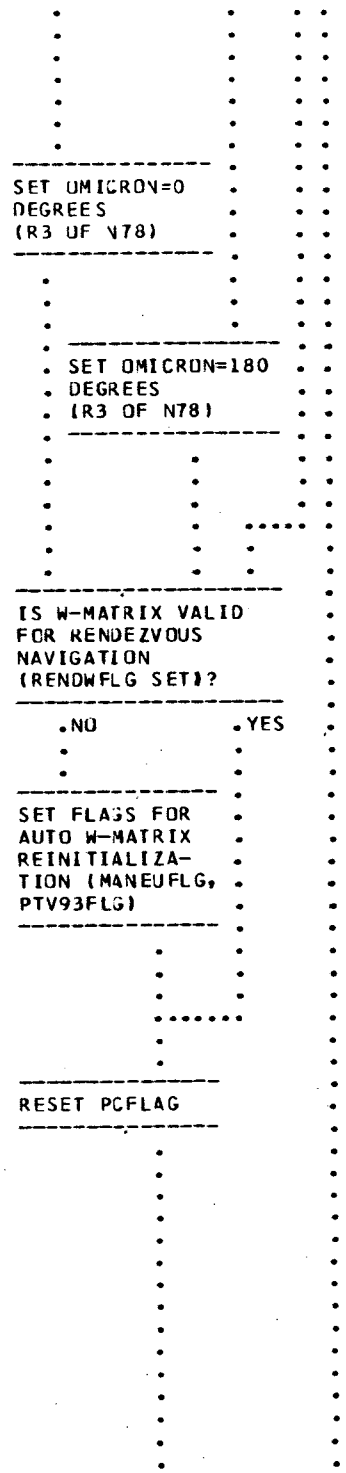


#430

#440

#450

#460



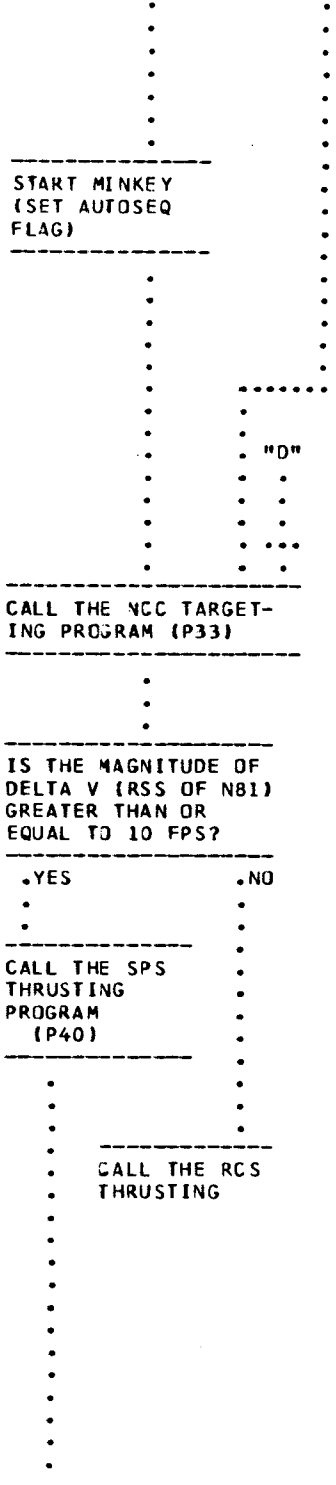
#470

#480

#490

#500

#510



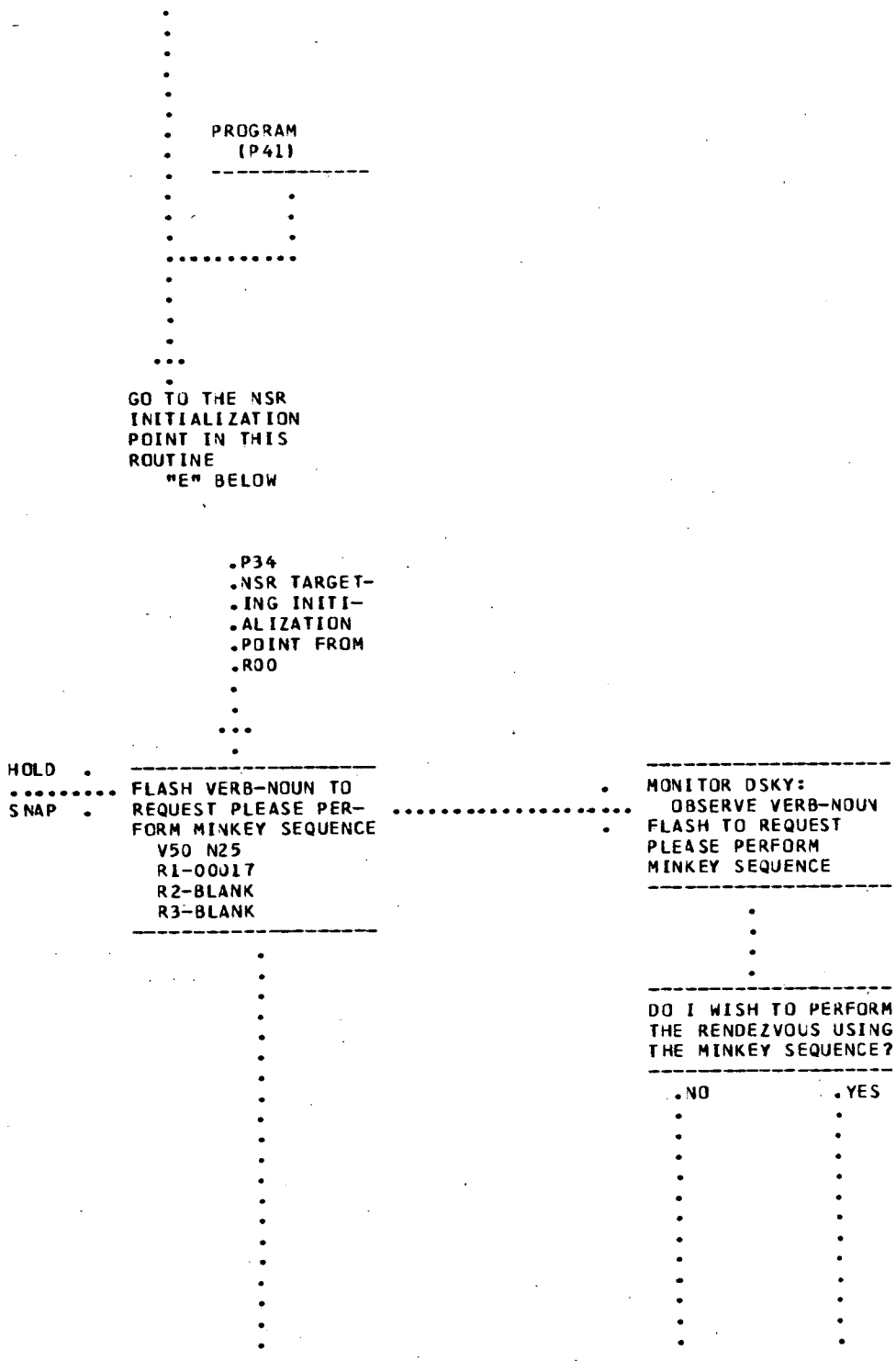
#520

#530

#540

#550

#560



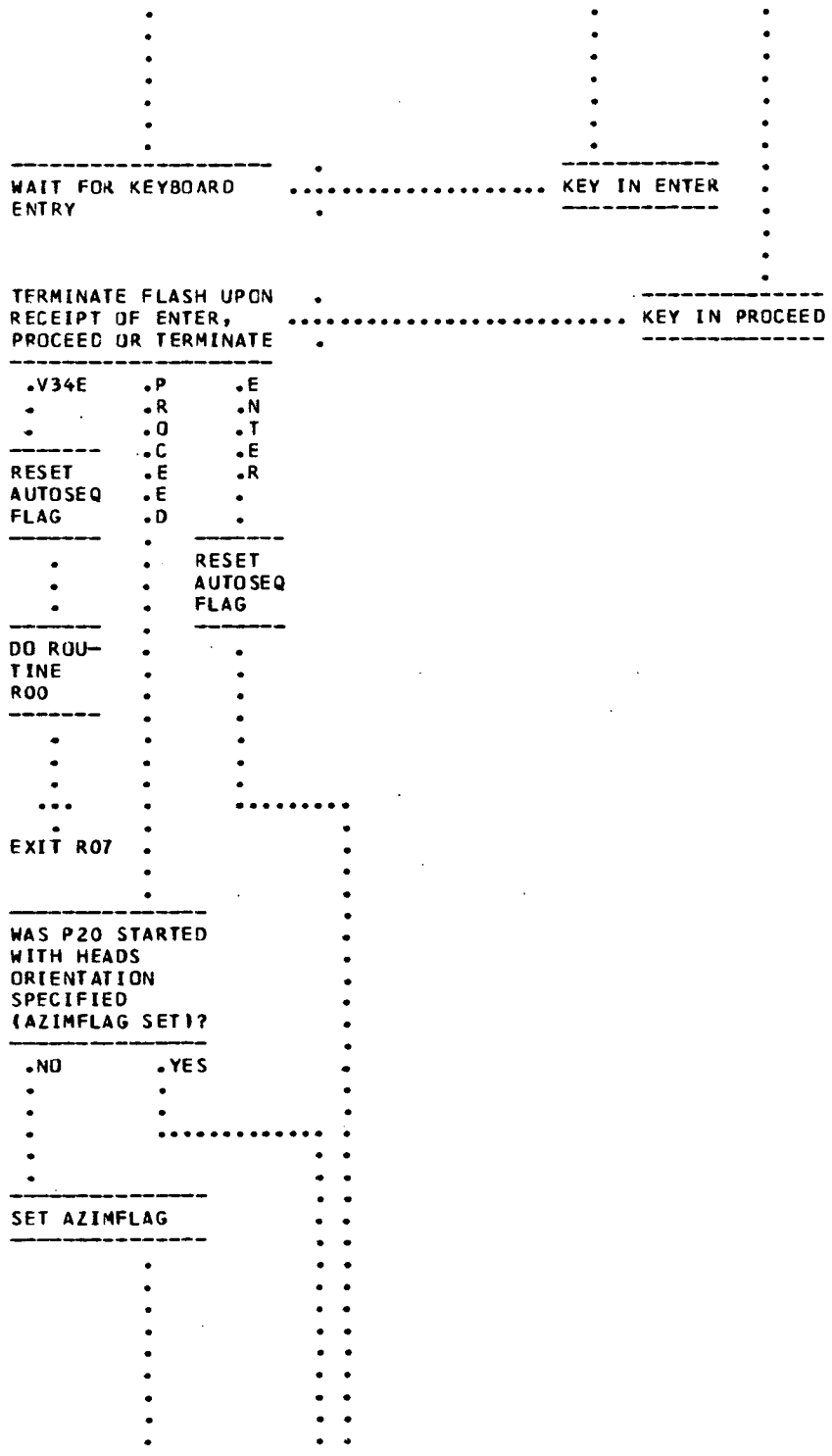
#570

#580

#590

#600

#610



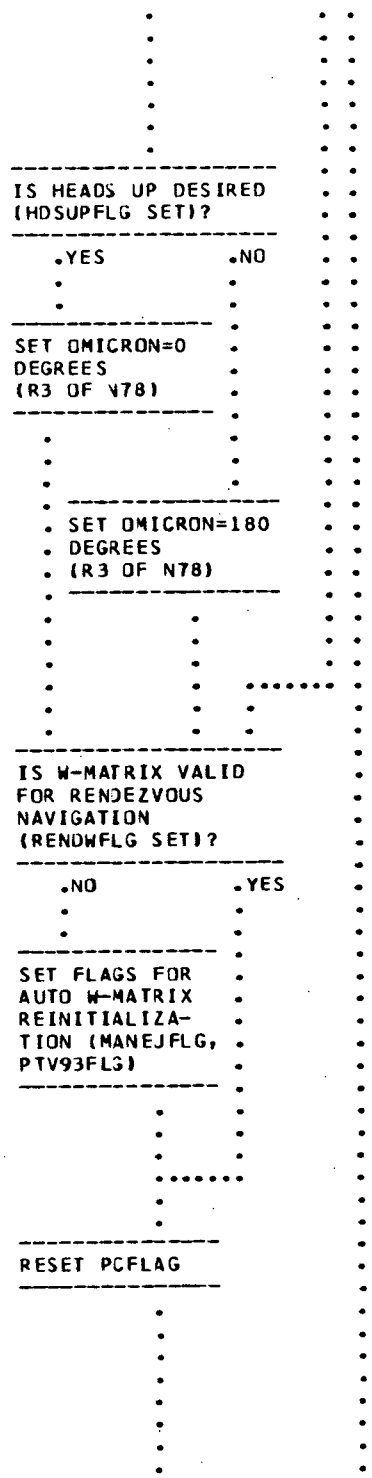
#620

#630

#640

#650

#660



#670

#680

#690

#700

#710

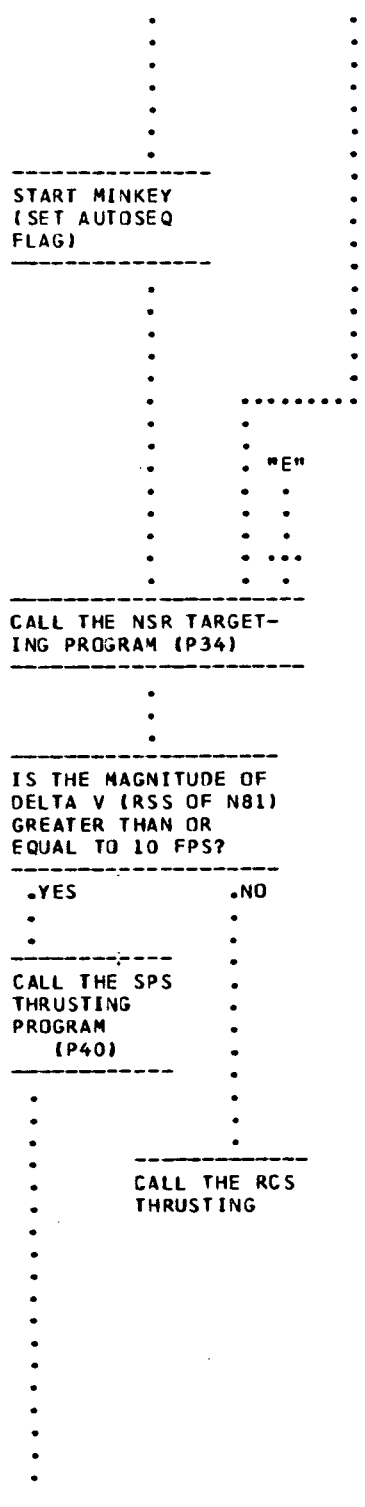
#720

#730

#740

#750

#760



#770

PROGRAM
(P41)

#780

GO TO THE TPI
TARGETING
INITIALIZATION
POINT IN THIS
ROUTINE
"F" BELOW

#790

.P35
.TPI TARGET-
.ING INITIA-
.LIZATION
.POINT FROM
.R00

#800

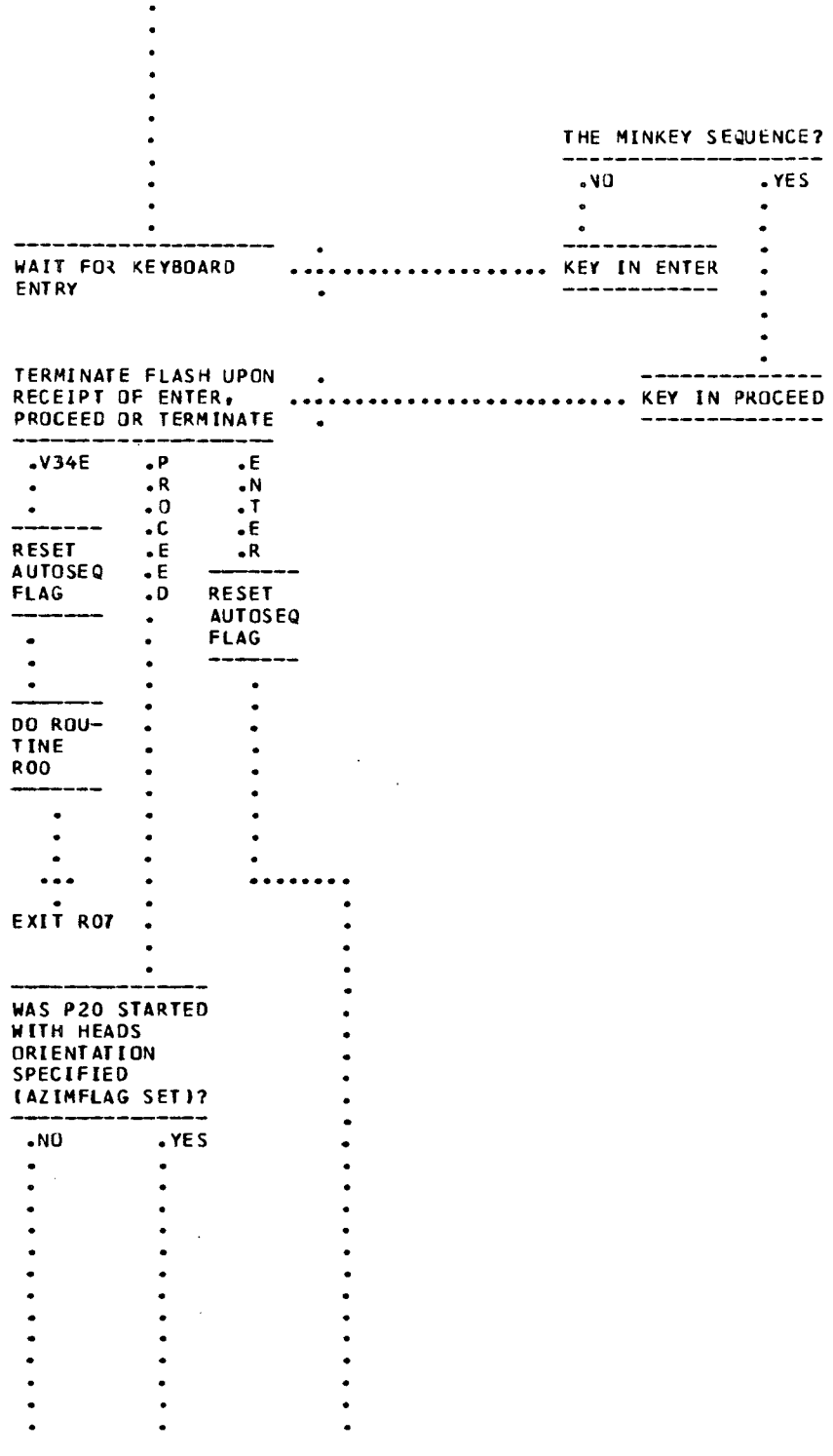
HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM MINKEY SEQUENCE
V50 N25
R1-00017
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
MINKEY SEQUENCE

#810

DO I WISH TO PERFORM
THE RENDEZVOUS USING



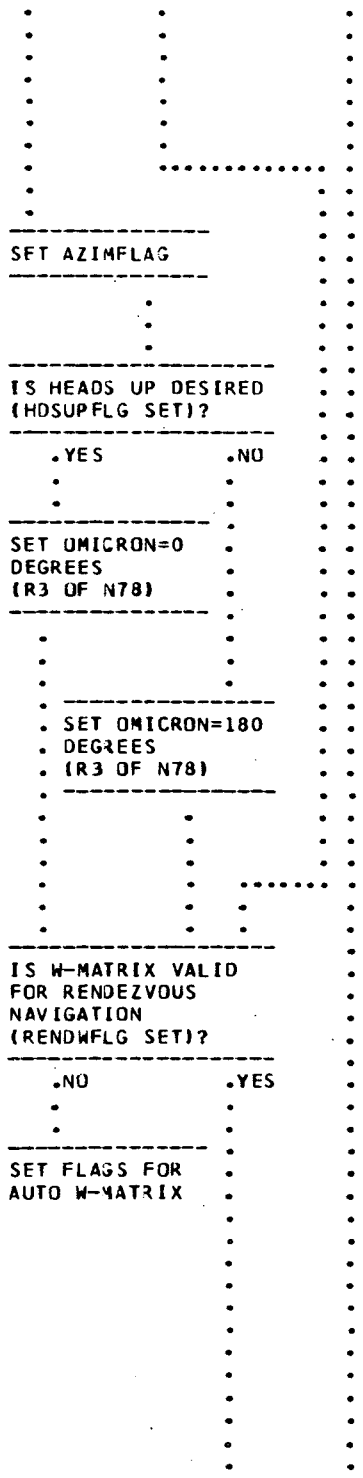
#820

#830

#840

#850

#860



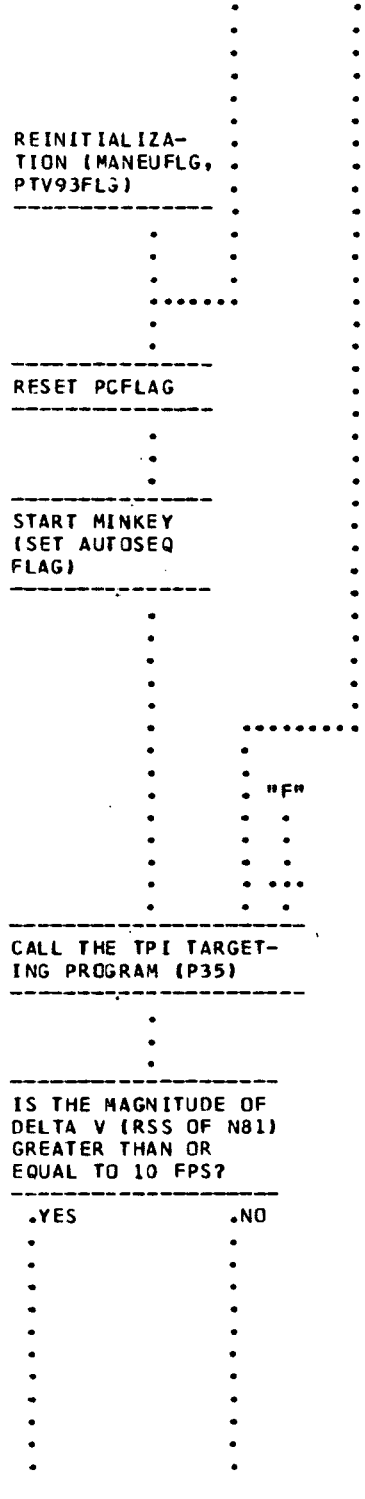
#870

#880

#890

#900

#910



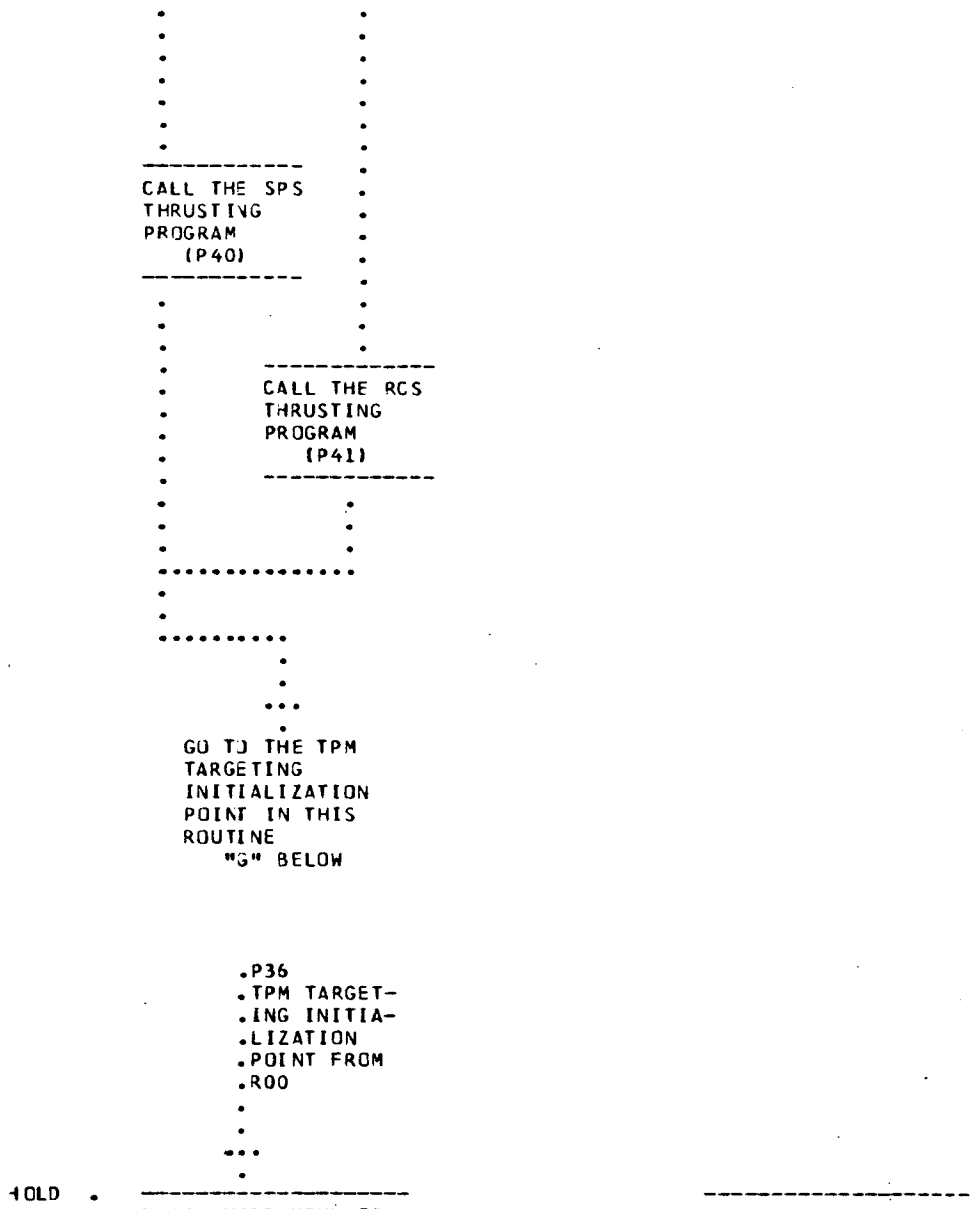
#920

#930

#940

#950

#960



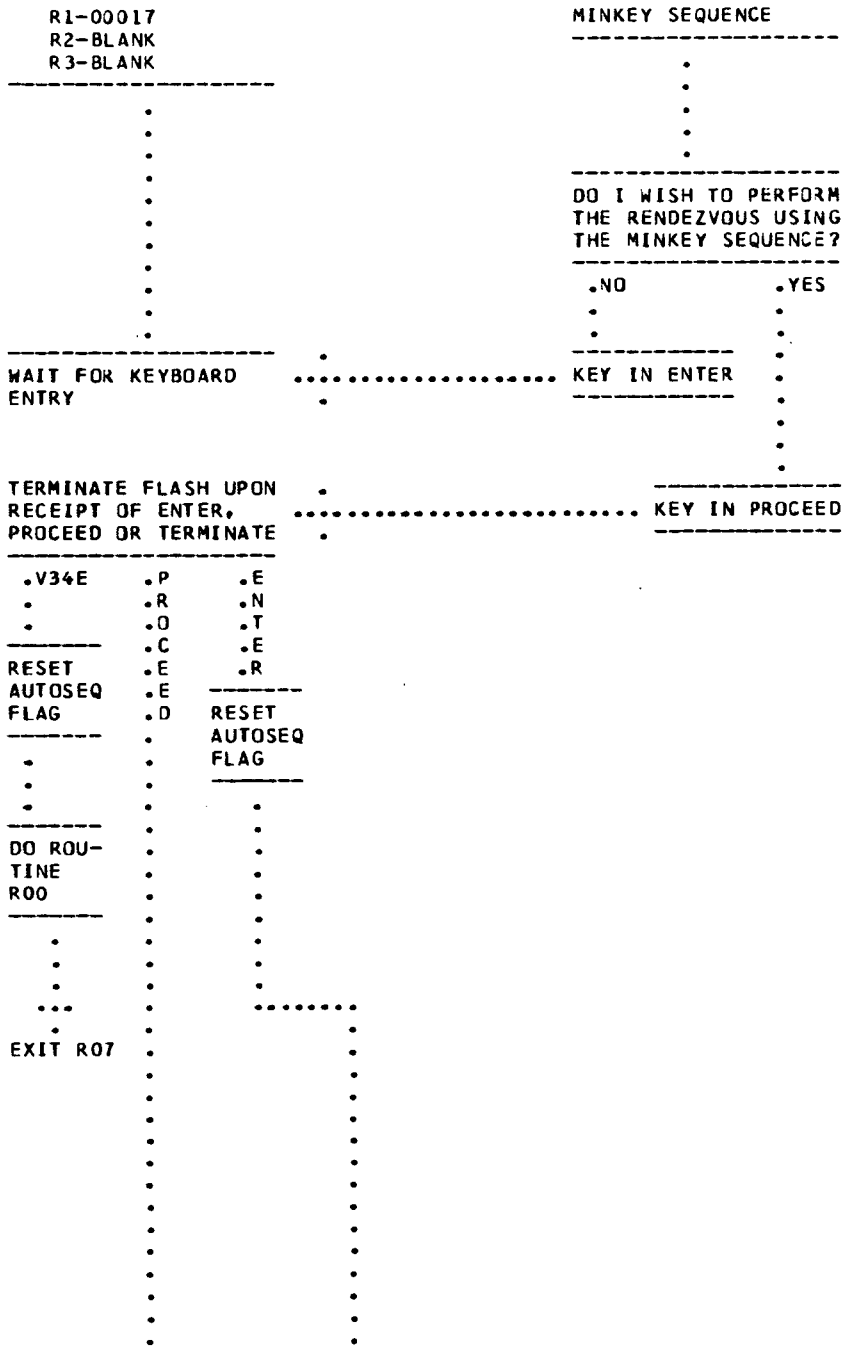
#970

#980

#990

#1000

#1010


R1-00017
R2-BLANK
R3-BLANK
MINKEY SEQUENCE
#1020
DO I WISH TO PERFORM THE RENDEZVOUS USING THE MINKEY SEQUENCE?
.NO
.YES
WAIT FOR KEYBOARD ENTRY
KEY IN ENTER
#1030
TERMINATE FLASH UPON RECEIPT OF ENTER, PROCEED OR TERMINATE
KEY IN PROCEED
.V34E
.P
.R
.O
.C
.E
.D
.E
.N
.T
.E
.R
#1040
RESET AUTOSEQ FLAG
RESET AUTOSEQ FLAG
DO ROU-TINE R00
#1050
EXIT R07

#1060

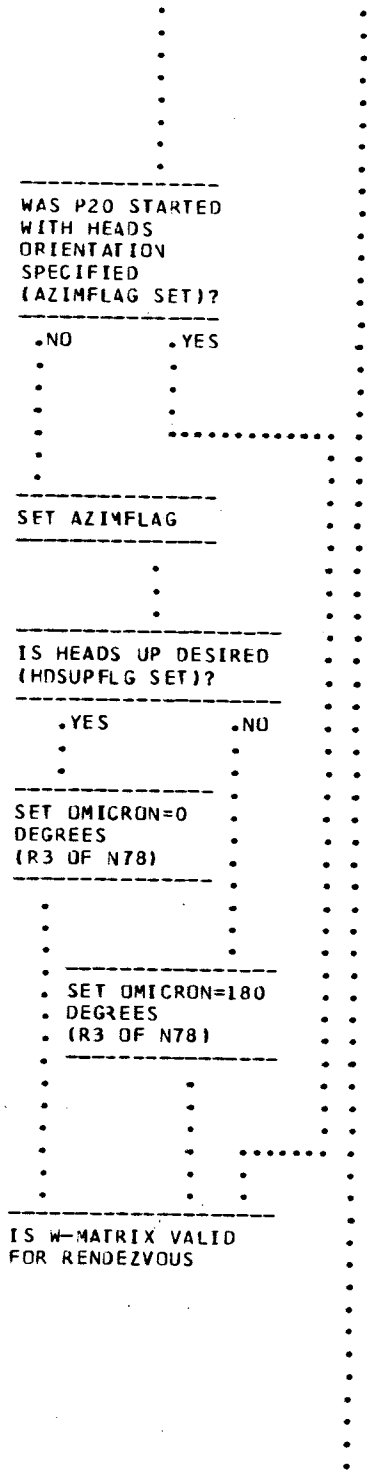
#1070

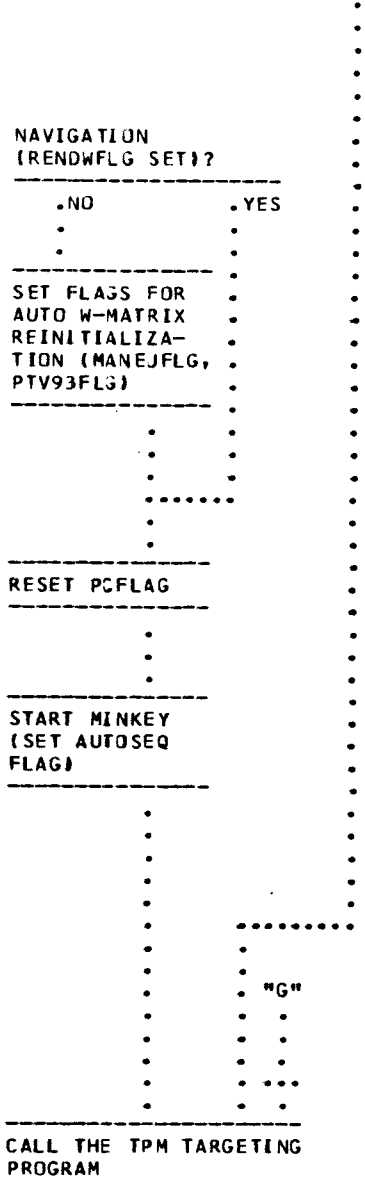
#1080

#1090

#1100

#1110



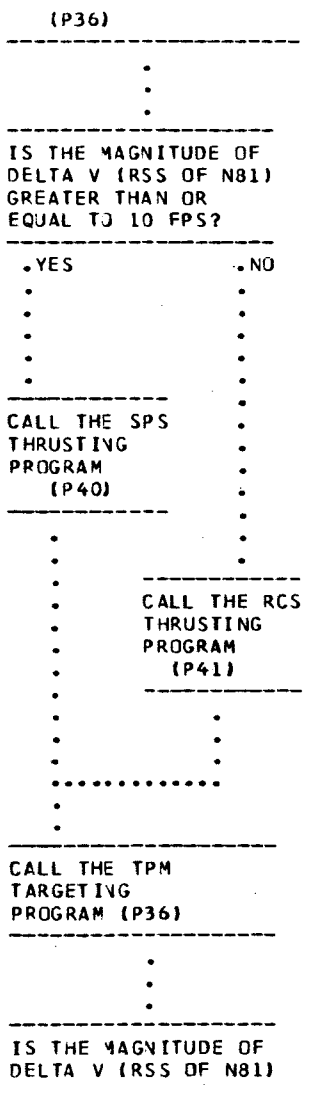


#1120

#1130

#1140

#1150



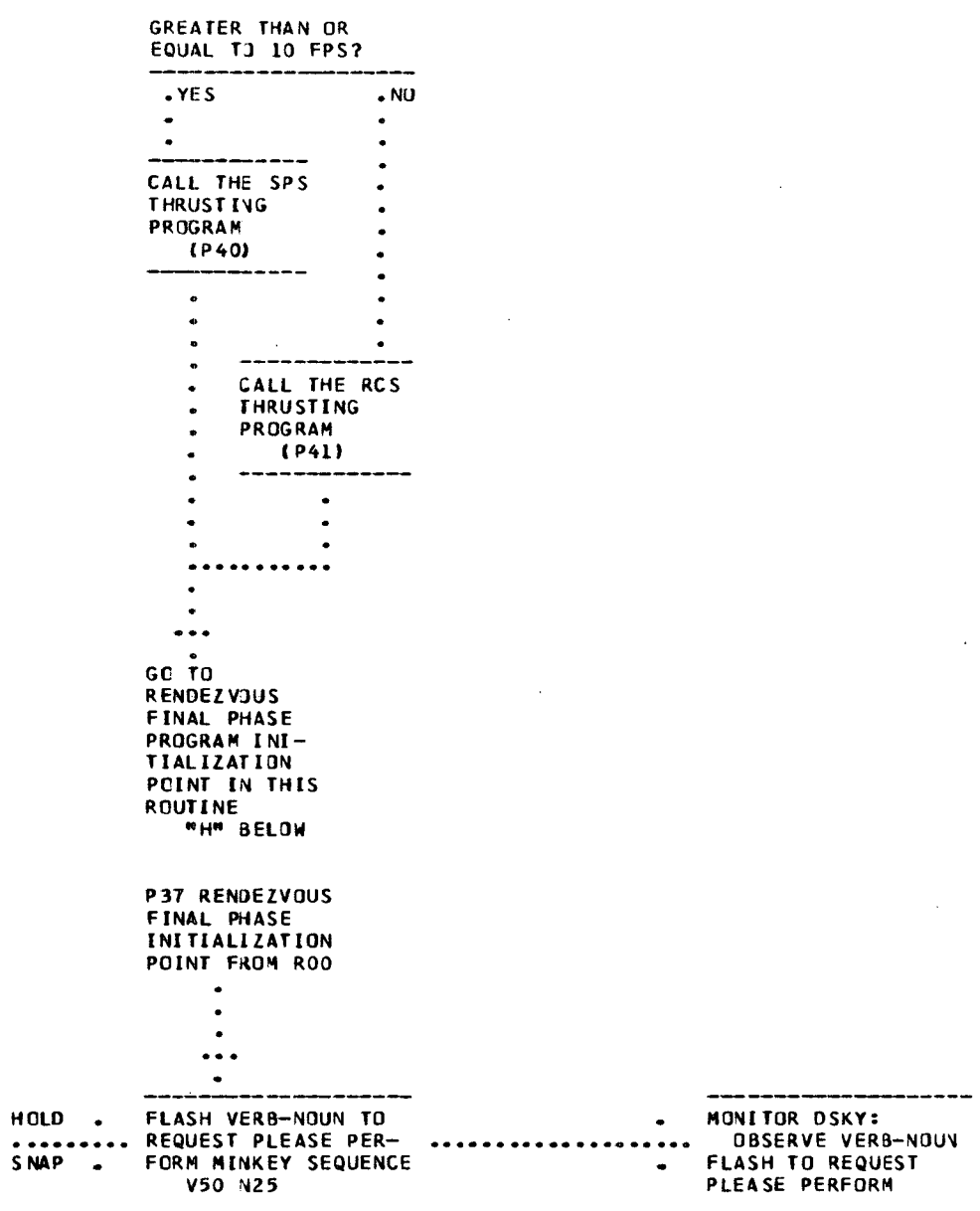
#1160

#1170

#1180

#1190

#1200



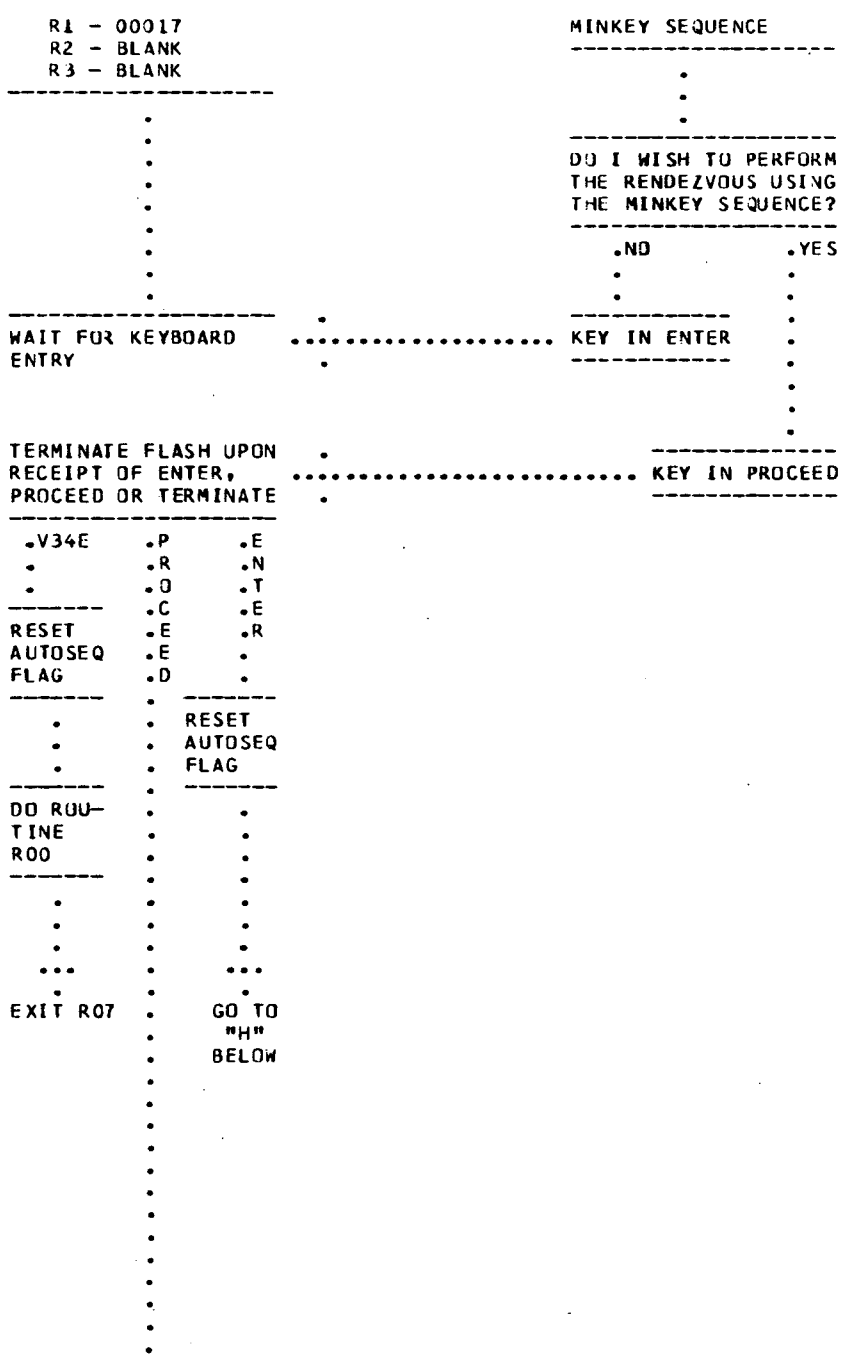
#1210

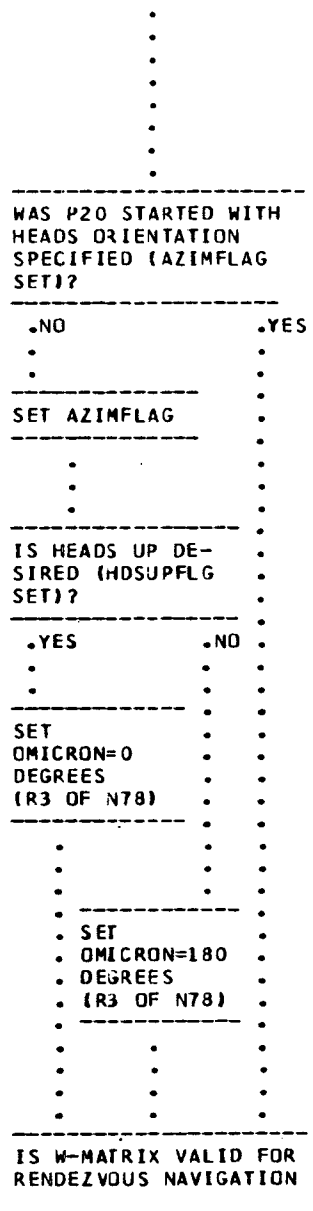
#1220

#1230

#1240

#1250


R1 - 00017
R2 - BLANK
R3 - BLANK
MINKEY SEQUENCE
#1260
DO I WISH TO PERFORM THE RENDEZVOUS USING THE MINKEY SEQUENCE?
.NO
.YES
#1270
WAIT FOR KEYBOARD ENTRY
KEY IN ENTER
TERMINATE FLASH UPON RECEIPT OF ENTER, PROCEED OR TERMINATE
KEY IN PROCEED
#1280
.V34E
.P
.R
.O
.C
.E
.E
.D
.E
.N
.T
.E
.R
RESET AUTOSEQ FLAG
RESET AUTOSEQ FLAG
#1290
DO ROU-TINE R00
#1300
EXIT R07
GO TO "H" BELOW



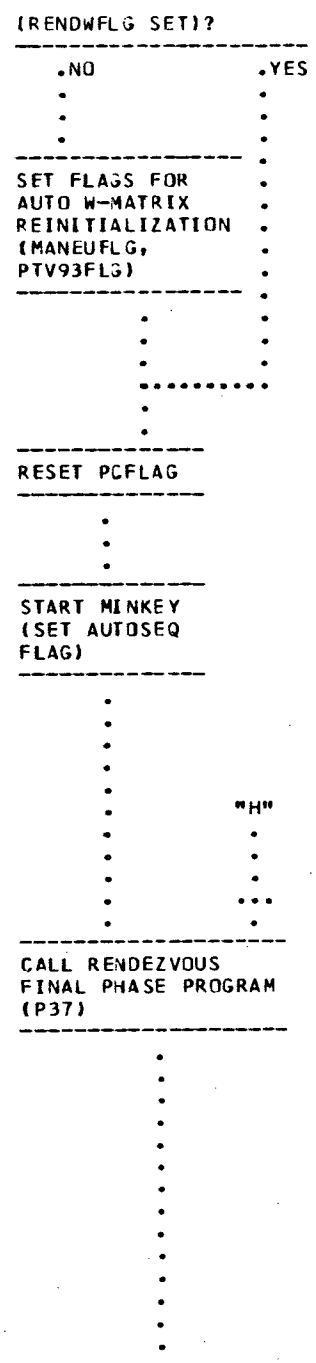
#1310

#1320

#1330

#1340

#1350



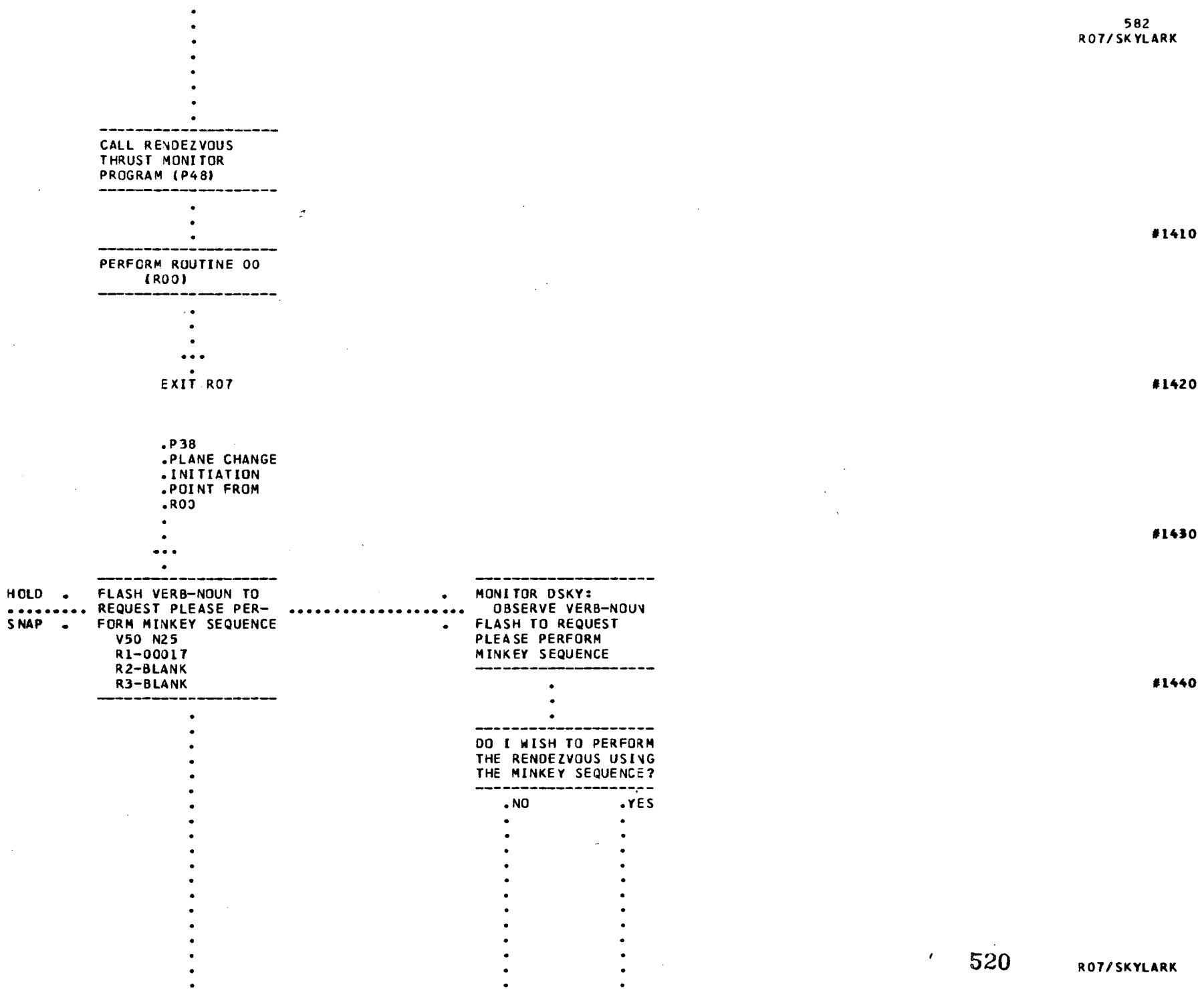
#1360

#1370

#1380

#1390

#1400

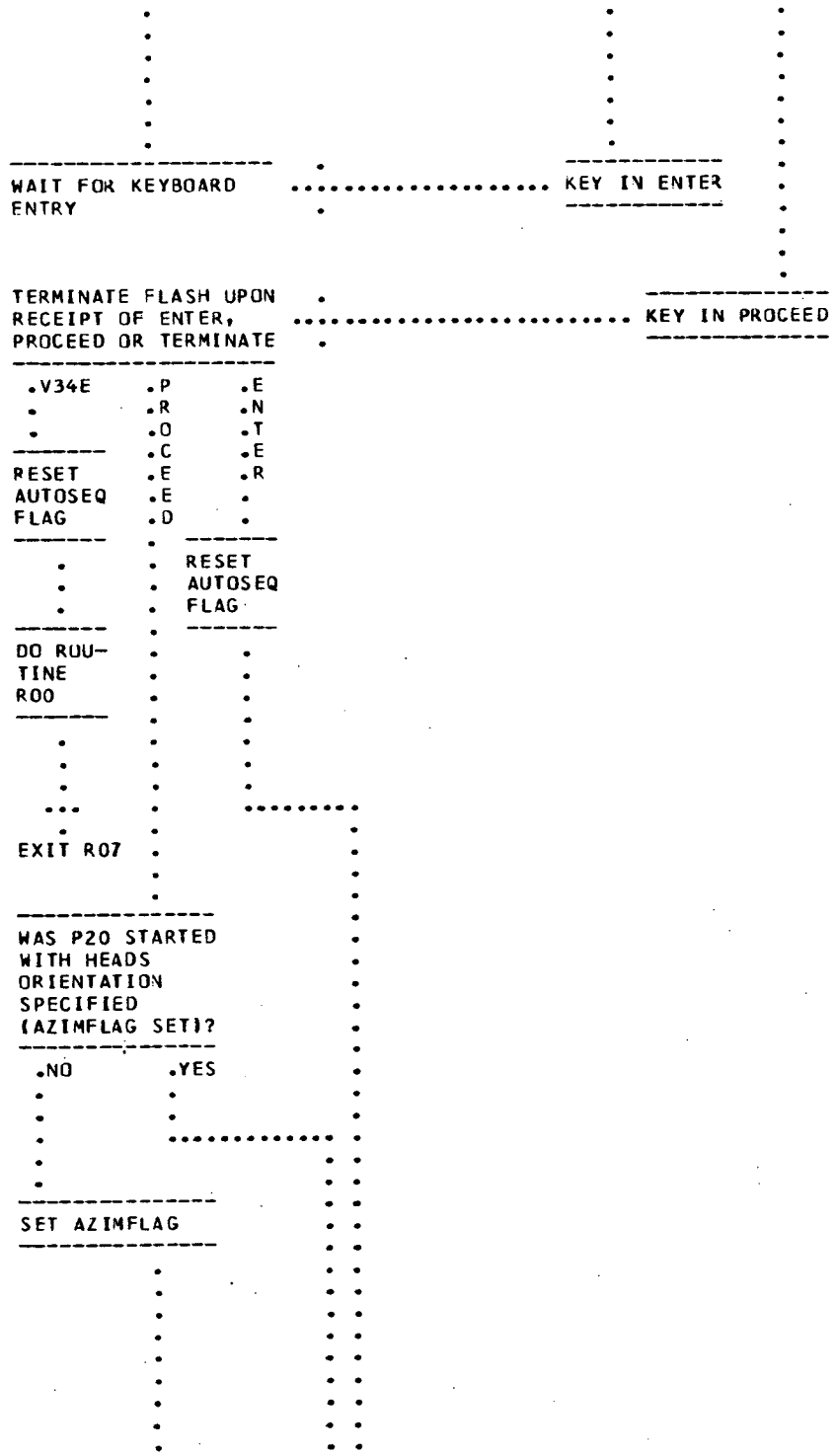


#1410

#1420

#1430

#1440



#1450

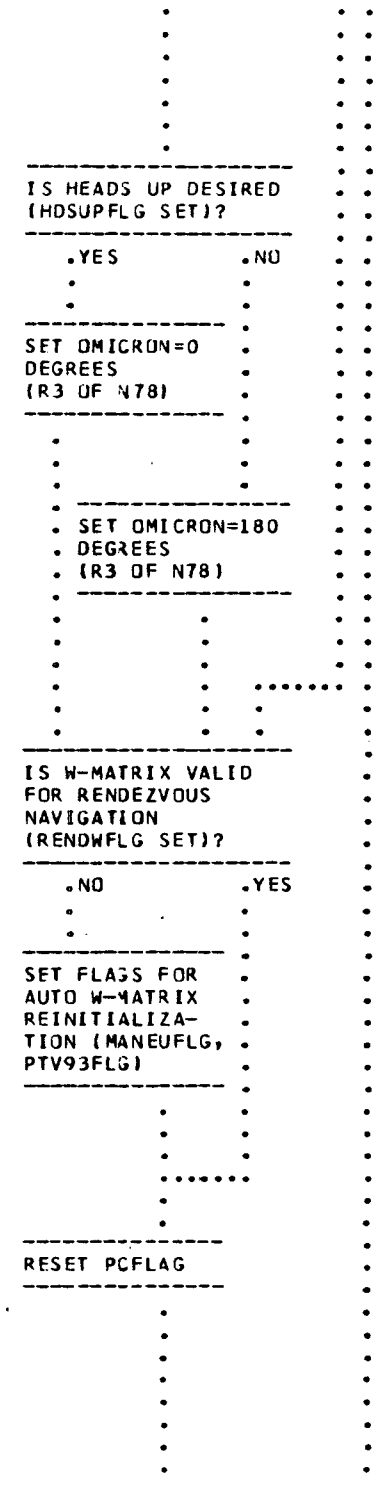
#1460

#1470

#1480

#1490

#1500



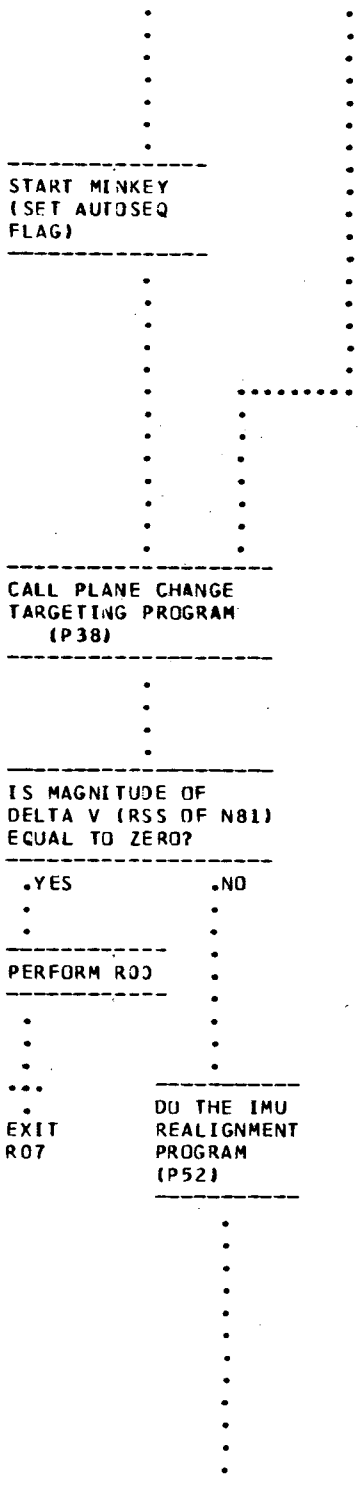
#1510

#1520

#1530

#1540

#1550



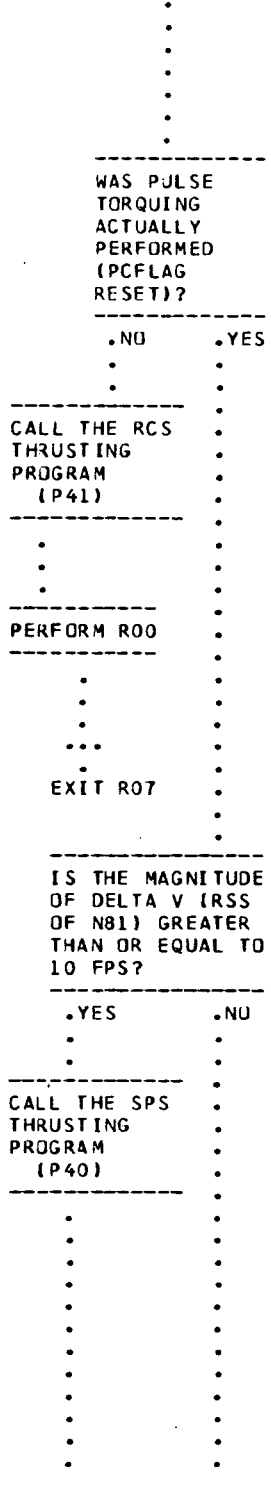
#1560

#1570

#1580

#1590

#1600



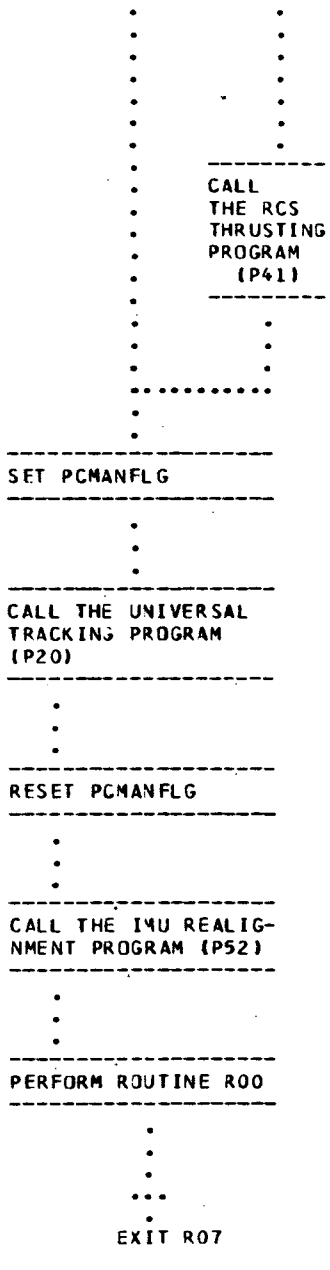
#1610

#1620

#1630

#1640

#1650



#1660

#1670

#1680

#1690

#1700

CHANGE CONTROL NOTES

REV 00 PCR 011,021, PCN 411,435, SL MEMO #2

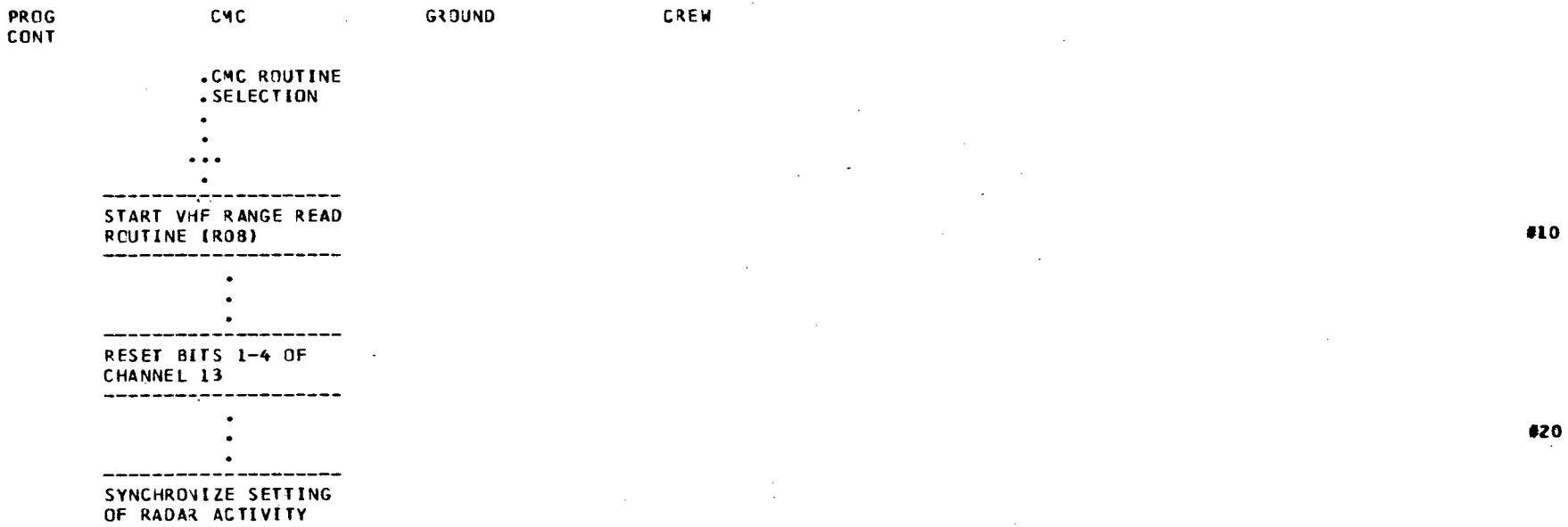
VHF RANGE READ ROUTINE (R08) REV 00 05/19/71

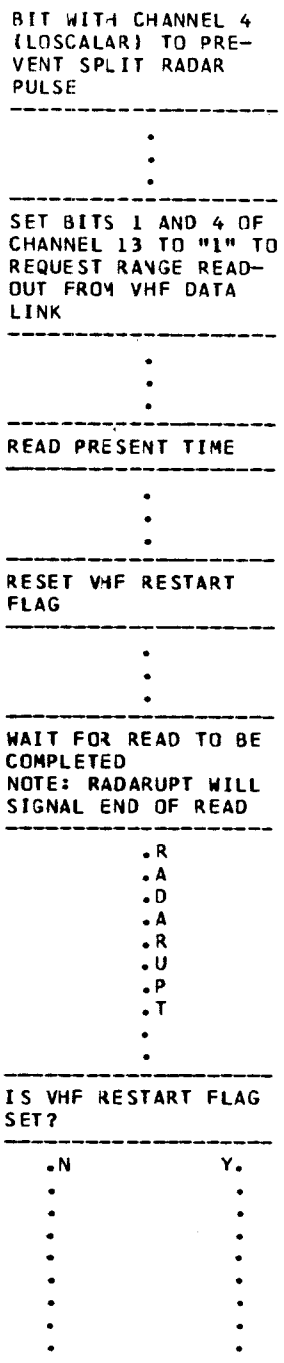
PURPOSE: (1) TO READ RANGE FROM VHF DATA LINK AND RECORD TIME OF THE READING.

ASSUMPTIONS: (1) THE VHF IS ON.

(2) THIS ROUTINE IS SELECTED BY R22 FOR VHF NAVIGATION MEASUREMENTS WHEN ENABLED BY V87E (DISABLED BY V88E).
THIS ROUTINE IS SELECTED BY R22 VIA R27 FOR RANGE RATE FILTER MEASUREMENT WHEN ENABLED BY V76E (DISABLED BY V77E).
THIS ROUTINE IS SELECTED BY P25 AND P48 VIA R27 FOR RANGE RATE FILTER MEASUREMENT.

(3) WHEN CALLED BY R22, THE VHF MEASURED RANGE IS EXTENDED BEYOND 327.67 N.M. IF INDICATED BY THE RANGE COMPUTED IN R61 USING THE ON-BOARD STATE VECTOR ESTIMATES.




BIT WITH CHANNEL 4 (LOSCALAR) TO PREVENT SPLIT RADAR PULSE
SET BITS 1 AND 4 OF CHANNEL 13 TO "1" TO REQUEST RANGE READOUT FROM VHF DATA LINK
READ PRESENT TIME
RESET VHF RESTART FLAG
WAIT FOR READ TO BE COMPLETED
NOTE: RADARUPT WILL SIGNAL END OF READ
.R
.A
.D
.A
.R
.U
.P
.T
IS VHF RESTART FLAG SET?
.N
Y.

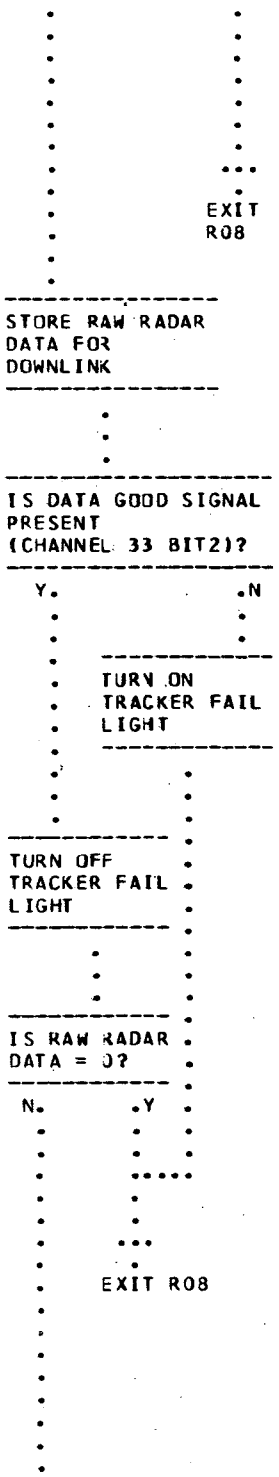
#30

#40

#50

#60

#70



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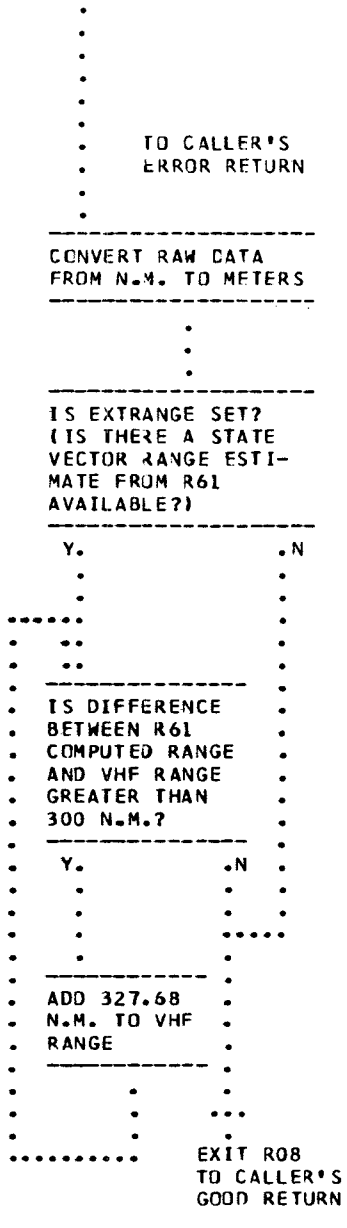

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#170

CHANGE CONTROL NOTES

REV 00 PCR 032, SL MEMO #19

RENDEZVOUS TRACKING SIGHTING MARK ROUTINE (R21) REV 00 05/19/71

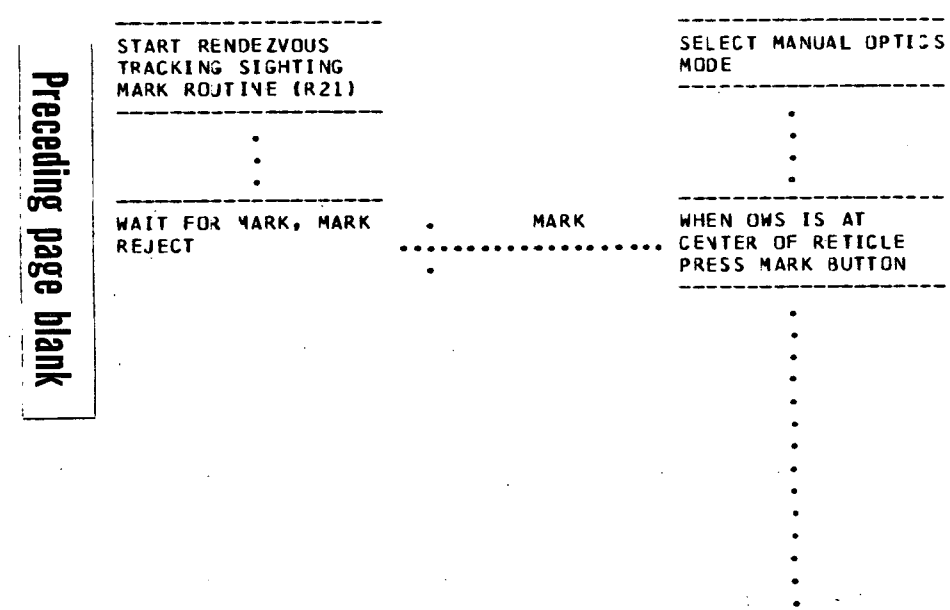
PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE UNIVERSAL TRACKING PROGRAM (P20), OPTIONS 0,4.

ASSUMPTIONS: (1) SIGHTINGS ARE MADE ON THE OWS USING THE SXT.

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 5 ANGLES (3 ICDUS AND 2 OCDUS) AND THE TIME OF MARK IN POSITION #1. IF A MARK IS REJECTED (BY PRESSING MARK REJECT BUTTON) THE MARK DATA IN POSITION #1 IS ERASED IF ANY. OTHERWISE A FLAG IS SET FOR R22 REJECTION BEFORE INCORP.
THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #1 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #1, IT IS MOVED TO POSITION #2 FOR PROCESSING BY (R22). IF NO DATA IS IN POSITION #1, R22 INTERROGATES POSITION #1 AFTER 4 SECONDS.
IF MARKS ARE MADE AT A GREATER FREQUENCY THAN R22 PROCESSES THEN THE OVERFLOW FROM POSITION #1 IS LOST.

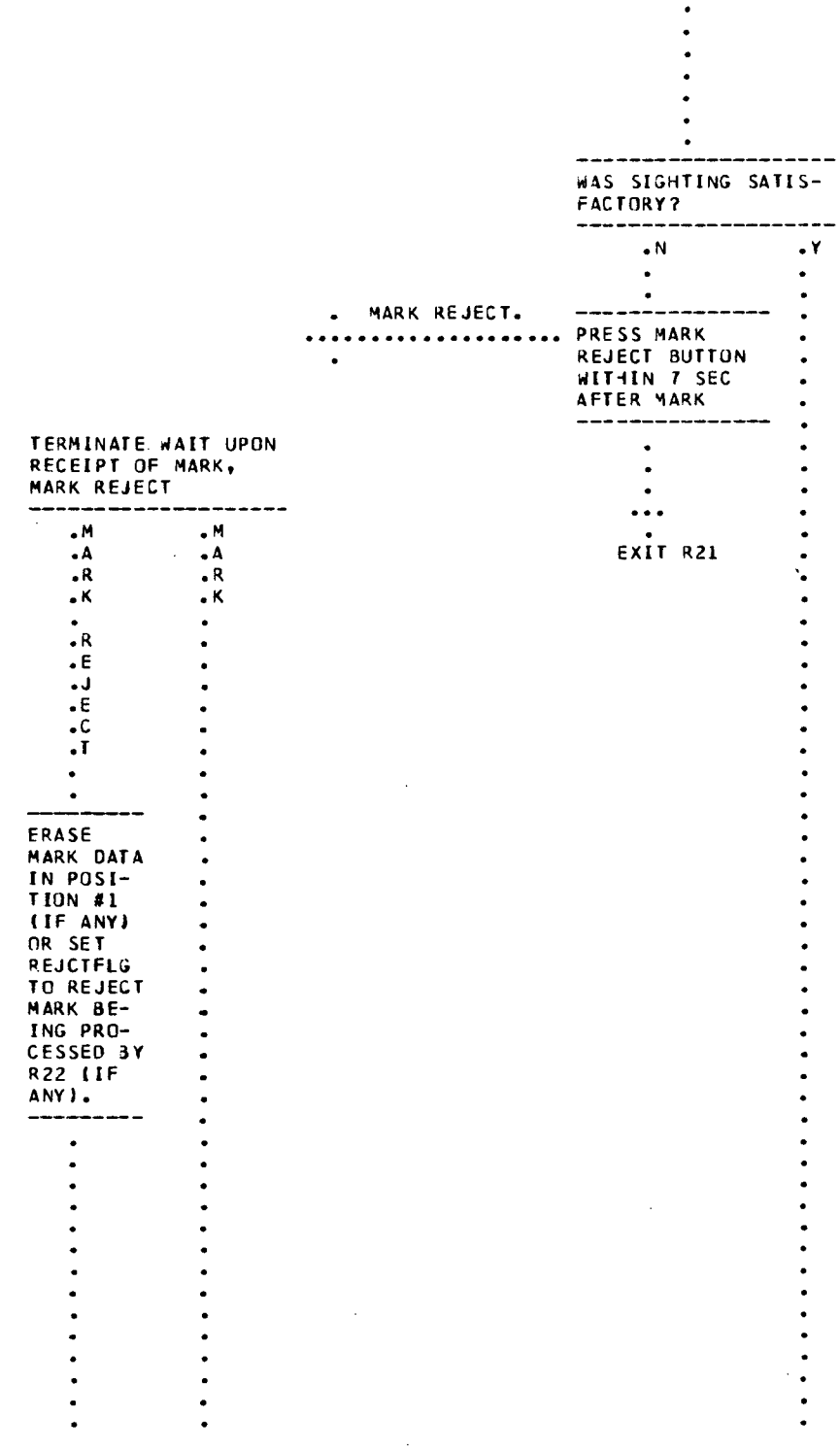
(3) THE TRACKING ATTITUDE ROUTINE (R61) WILL AUTOMATICALLY HOLD RENDEZVOUS REFERENCE VECTOR AIMED AT THE OWS, IF THE SC CONTROL SWITCH IS PLACED AT CMC, IF THE AUTOMODE IS SELECTED AND IF THE PREFERRED ATTITUDE IS SPECIFIED IN N78. IF THE FREE MODE IS SELECTED THE ASTRONAUT MAY HOLD THE OWS IN THE FIELD OF VIEW USING THE MINIMUM IMPULSE CONTROLLER OR ROTATIONAL HAND CONTROLLER. IF THE ATTITUDE HOLD MODE IS SELECTED THE ASTRONAUT MAY HOLD THE OWS IN THE FIELD OF VIEW USING THE ROTATIONAL HAND CONTROLLER.

(4) THIS ROUTINE IS AUTOMATICALLY SELECTED BY A SXT MARK OR MARK REJECT DURING P20, OPTIONS 0,4.



#10

R21/SKYLARK


WAS SIGHTING SATIS-FACTORY?
.N
.Y
. MARK REJECT.
PRESS MARK REJECT BUTTON WITHIN 7 SEC AFTER MARK
EXIT R21
TERMINATE WAIT UPON RECEIPT OF MARK, MARK REJECT
.M .A .R .K
.R .E .J .E .C .T
ERASE MARK DATA IN POSI-TION #1 (IF ANY) OR SET REJCTFLG TO REJECT MARK BE-ING PRO-CESSED BY R22 (IF ANY).

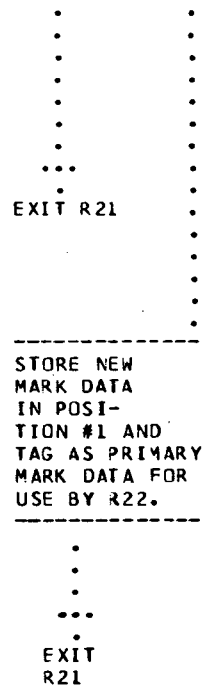
#20

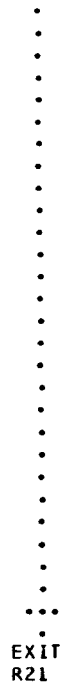
#30

#40

#50

#60


EXIT R21
STORE NEW MARK DATA IN POSI- TION #1 AND TAG AS PRIMARY MARK DATA FOR USE BY R22.
EXIT R21


EXIT R21

#70

#80

#90

RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) REV 01 03/20/72

PURPOSE: (1) TO PROCESS RENDEZVOUS SIGHTING MARK DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR OWS AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

(2) TO PROCESS RENDEZVOUS VHF RANGING DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR OWS AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).

(3) TO CALL R27 WHEN ENABLED BY V76E.

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY THE UNIVERSAL TRACKING PROGRAM (P20), OPTIONS 0,4.

(2) V06N49 DISPLAYED IN THIS ROUTINE IS A PRIORITY DISPLAY AND WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

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(3) V87E ENABLES VHF UPDATES. V37E XXE AND V88E INHIBIT VHF UPDATES.

(4) THERE IS A RENDEZVOUS OPTICS MARK COUNTER AND A VHF RANGING MARK COUNTER IN THE CMC TO COUNT THE NUMBER OF MARKS INCORPORATED INTO EITHER STATE VECTOR. THESE COUNTERS CAN BE ZEROED BY THE FOLLOWING:

(A) W-MATRIX REINITIALIZATION
(B) KEYING V36E (FRESH START)

(5) W-MATRIX INITIALIZATION FOR RENDEZVOUS MAY BE ENABLED IN ANY OF THE FOLLOWING WAYS:

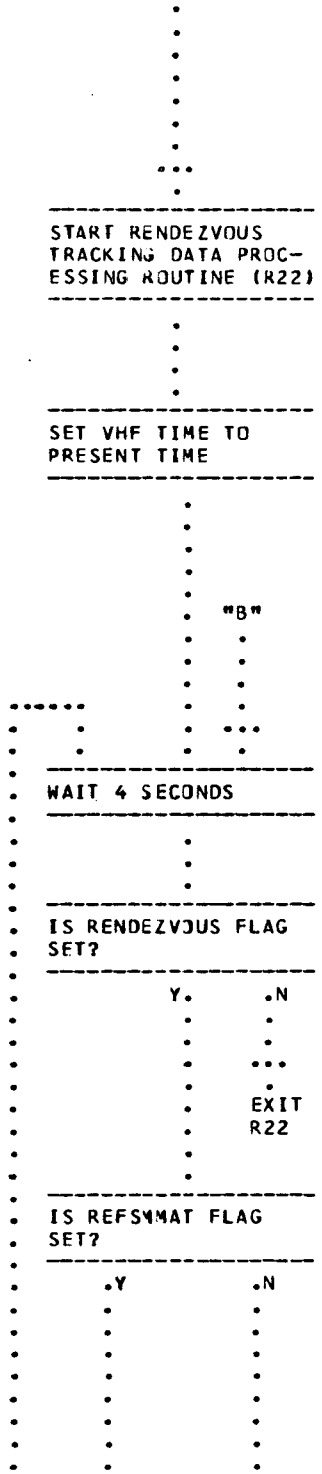
(A) KEY V93E
(B) KEYING V36E
(C) STATE VECTOR UPDATE FROM THE GROUND.
(D) DURING MINKEY BY AUTOMATIC W-MATRIX INITIALIZATION LOGIC (SEE SECTION 5 OF THIS DOCUMENT).

(6) THE TIME OF THE LAST W-MATRIX INITIALIZATION IS AVAILABLE BY KEYING V06 N31E.

(7) IN R22 V76E ENABLES R27 AND V77E INHIBITS R27.

PROG CONT

CMC	GROUND	CREW
.CMC .ROUTINE .SELECTION		


START RENDEZVOUS TRACKING DATA PROC-ESSING ROUTINE (R22)
SET VHF TIME TO PRESENT TIME
"B"
WAIT 4 SECONDS
IS RENDEZVOUS FLAG SET?
Y
N
EXIT R22
IS REFSMMAT FLAG SET?
Y
N

#10

#20

#30

#40

#50

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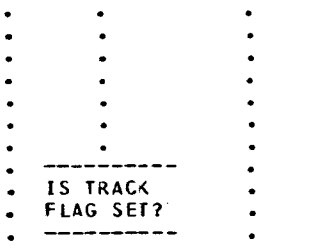

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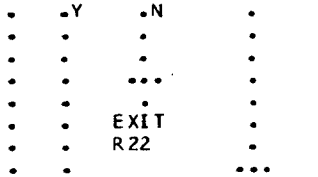

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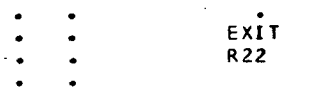

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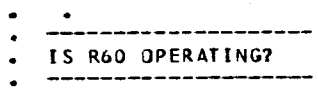

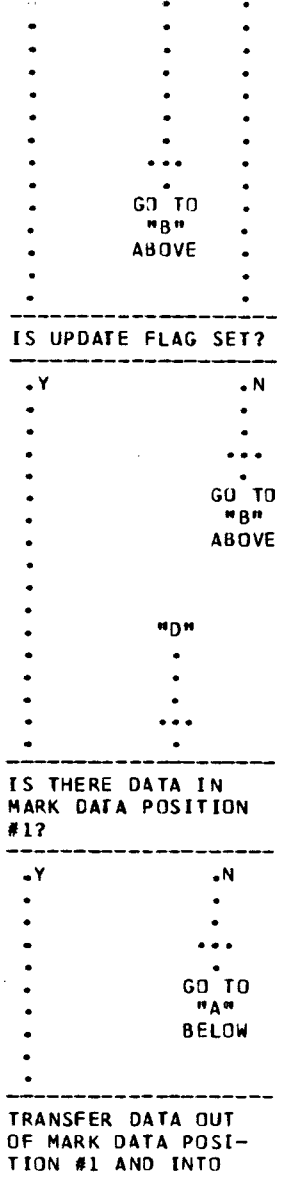

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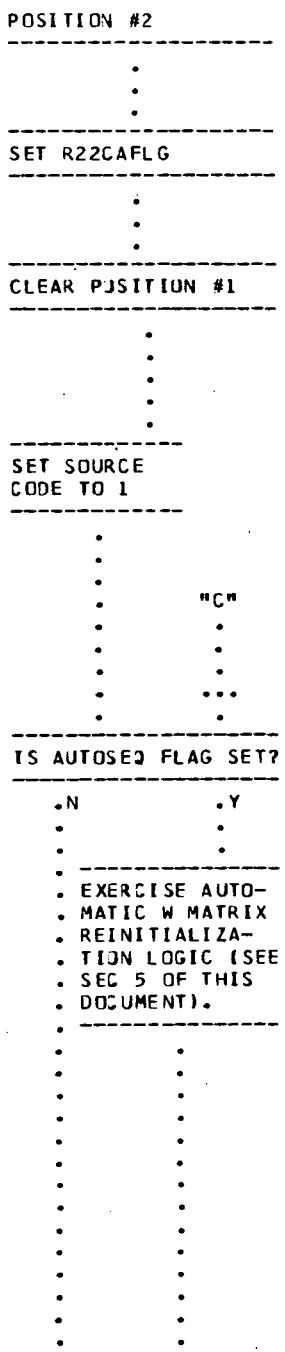


#160

#170

#180

#190

#200

"F"

#210

BASED ON THE DATA AND ITS SOURCE (OPTICS OR VHF AND, IF OPTICS-PRIMARY OR BACK UP) CALCULATE THE REQUIRED CORRECTION TO UPDATE THE STATE VECTOR DESIGNATED BY THE STATE VECTOR FLAG (SEE P20).

#220

FOR DESCRIPTION OF UPDATE PROCESS REFER TO SECTION 5.2 OF R693

#230

IS SOURCE CODE=1?

.Y .N

IS THIS THE 2ND OPTICS CORRECTION FOR THIS MARK?

#240

.Y .N

IS REJCTFLG SET?

.N .Y

#250

GO TO "E" BELOW

#260

IS THE MAGNITUDE OF THE STATE VECTOR CHANGE GREATER THAN THE TEST TOLERANCE STORED IN ERASABLE MEMORY?
FOR DEFINITION OF TEST TOLERANCE REFER TO ERASABLE LOAD FOR THE SPECIFIC MISSION.

.N .Y

#270

POSS PRIO HOLD ..... SNAP

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY EXCESSIVE UPDATE PARAMETERS.
V06 N49
R1-DELTA R
R2-DELTA V
R3-SOURCE CODE

DELTA R-MAGNITUDE OF THE DIFFERENCE BETWEEN THE POSITION VECTOR BEFORE AND AFTER INCORPORATION OF THIS MARK DATA. IN N.M. TO THE NEAREST .01 NM.

#280

MONITOR DSKY: DOES VERB NOUN FLASH TO REQUEST RESPONSE AND DISPLAY EXCESSIVE UPDATE PARAMETERS?

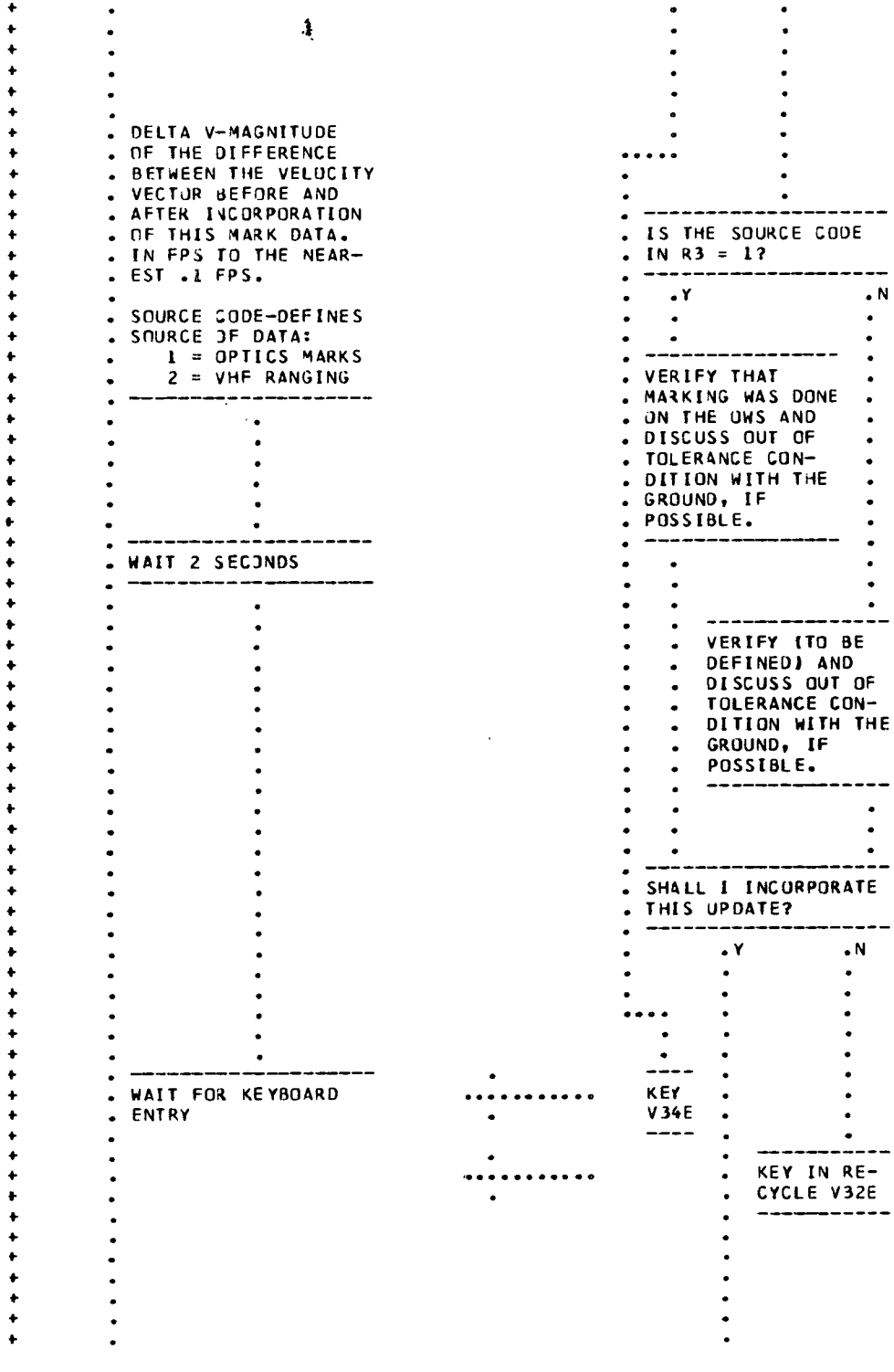
.Y .N

#290

DO I WISH TO TERMINATE P20?

Y. .N

++
+01
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+
+



#300
#310
#320
#330
#340
#350

```
                                                  KEY IN PROCEED

TERMINATE FLASH UPON   ...........
RECEIPT OF PROCEED
OR RECYCLE

  .P   .R        .V34E
  .R   .E
  .O   .C
  .C   .Y
  .E   .C  DO P20
  .E   .L  TERMINATION
  .D   .E  PROCESS
           (V56 LOGIC)

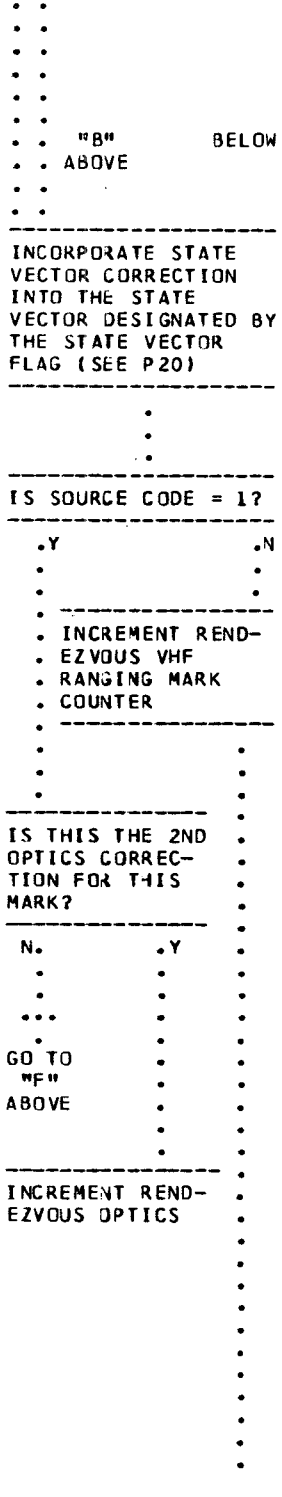
             EXIT
+489

                  "E"

      RESET R22CAFLG,
      REJCTFLG

      IS SOURCE CODE =
      1?
        .N          .Y

      GO TO        GO TO
                    "A"
```



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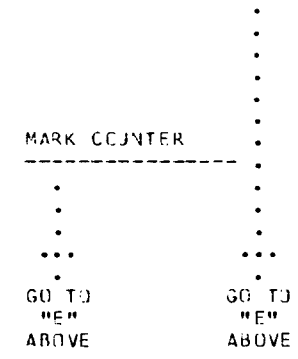
#430

#440

#450



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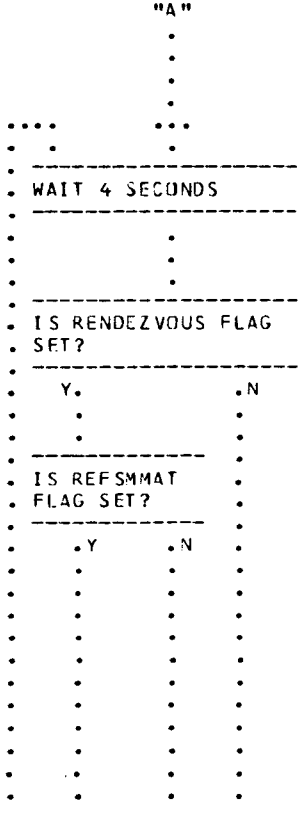

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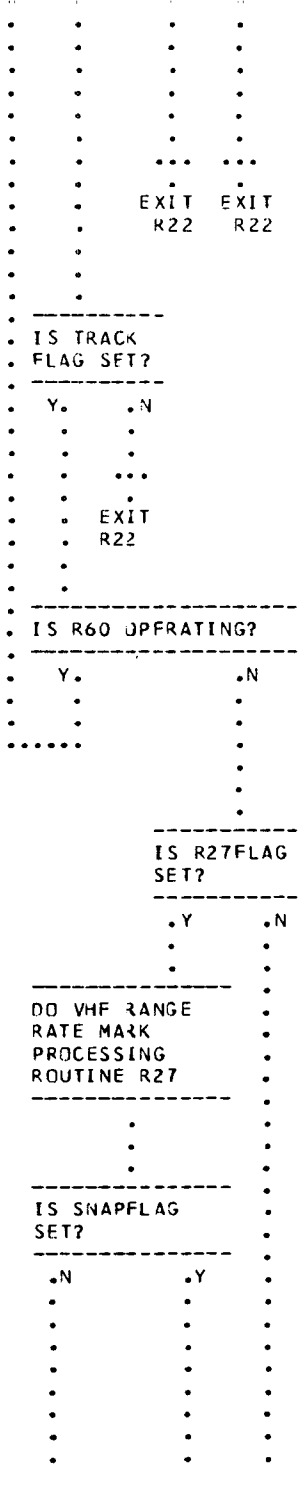

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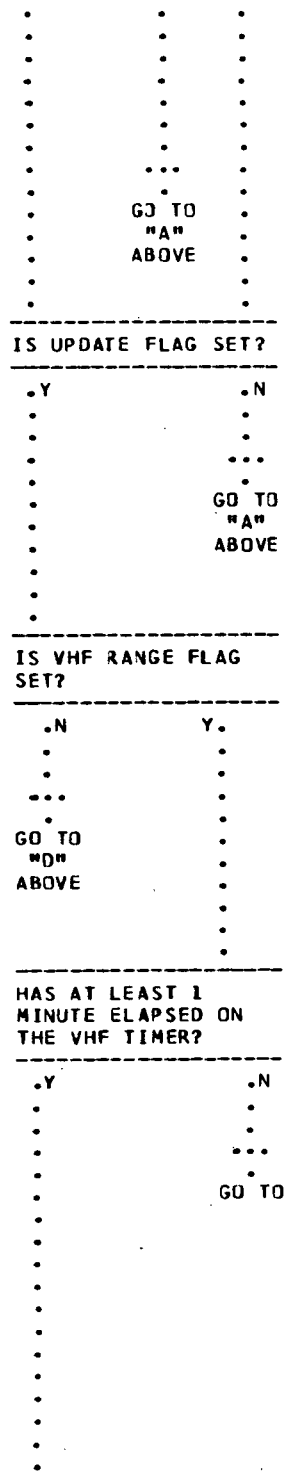

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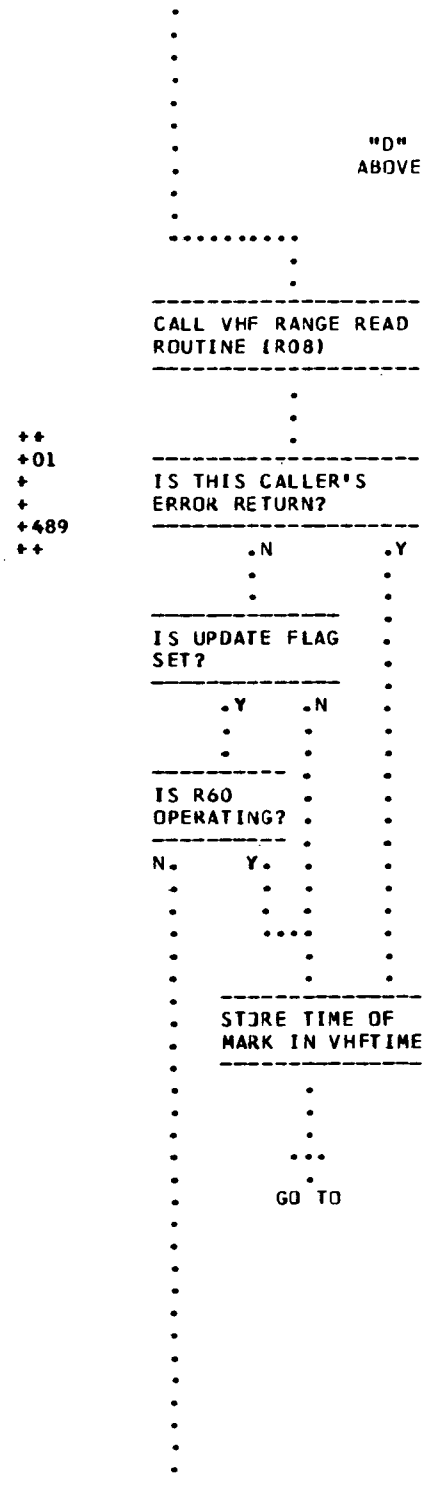

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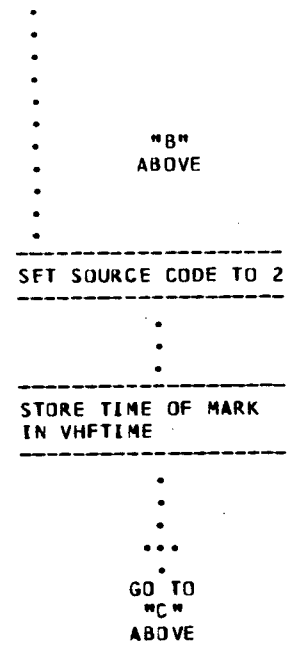


#660

#670

CHANGE CONTROL NOTES

REV 00 PCR 016,017,018,025,032,439, PCN 442, SKYLARK MEMO #19
REV 01 PCN 489

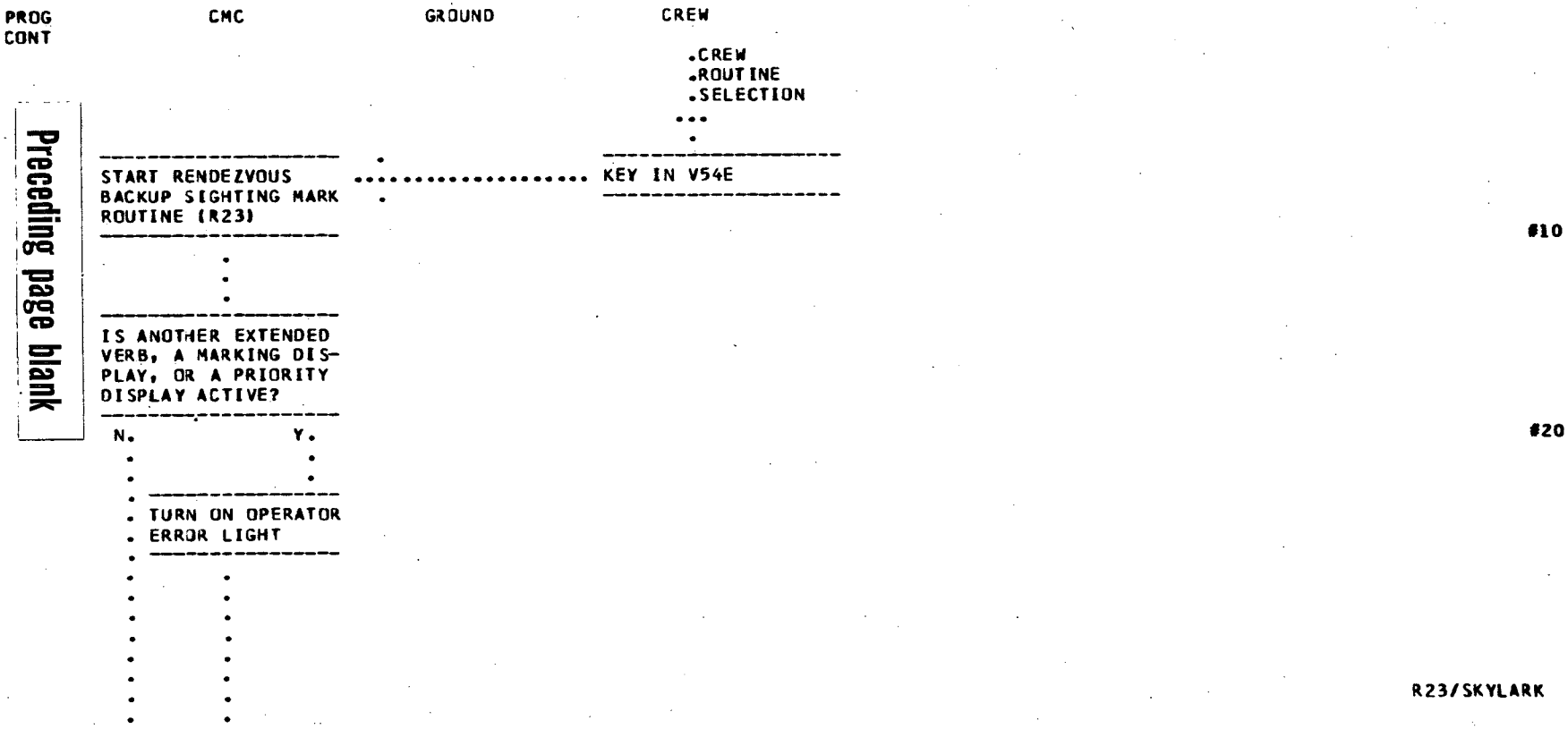
RENDEZVOUS BACKUP SIGHTING MARK ROUTINE (R23) REV 01 03/20/72

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE UNIVERSAL TRACKING PROGRAM (P20) OPTIONS 0,4, BY USE OF A BACKUP OPTICAL DEVICE.

ASSUMPTIONS: (1) THE ASTRONAUT KNOWS THE COORDINATES (OPTICS) OF THE ALTERNATE LOS HE MUST USE FOR THIS ROUTINE

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES THE 3 ICDU'S, THE CONTENTS OF NOUN 94 AND THE TIME OF MARK IN POSITION #1. IF A MARK IS REJECTED BY KEYING IN V86E THE MARK DATA IN POSITION #1 IS ERASED OR A FLAG IS SET TO REJECT THE MARK IF R22 IS PROCESSING A MARK.
THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #1 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #1, IT IS MOVED TO POSITION #2 FOR PROCESSING BY (R22). IF NO DATA IS IN POSITION #1, R22 INTERROGATES POSITION #1 AFTER 4 SECONDS.

(3) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V54E.



#30

EXIT

#40

IS RENDEZVOUS FLAG SET?

.Y .N

#50

IS TRACK FLAG SET (SEE P20)?

.Y .N

TURN ON PROGRAM ALARM LIGHT. NOTE: ALARM CODE IF CALLED BY ASTRONAUT IS:
V05N09
R1-
R2-
R3-
EXPECTED ALARM CODE AT THIS TIME IS 406

#60

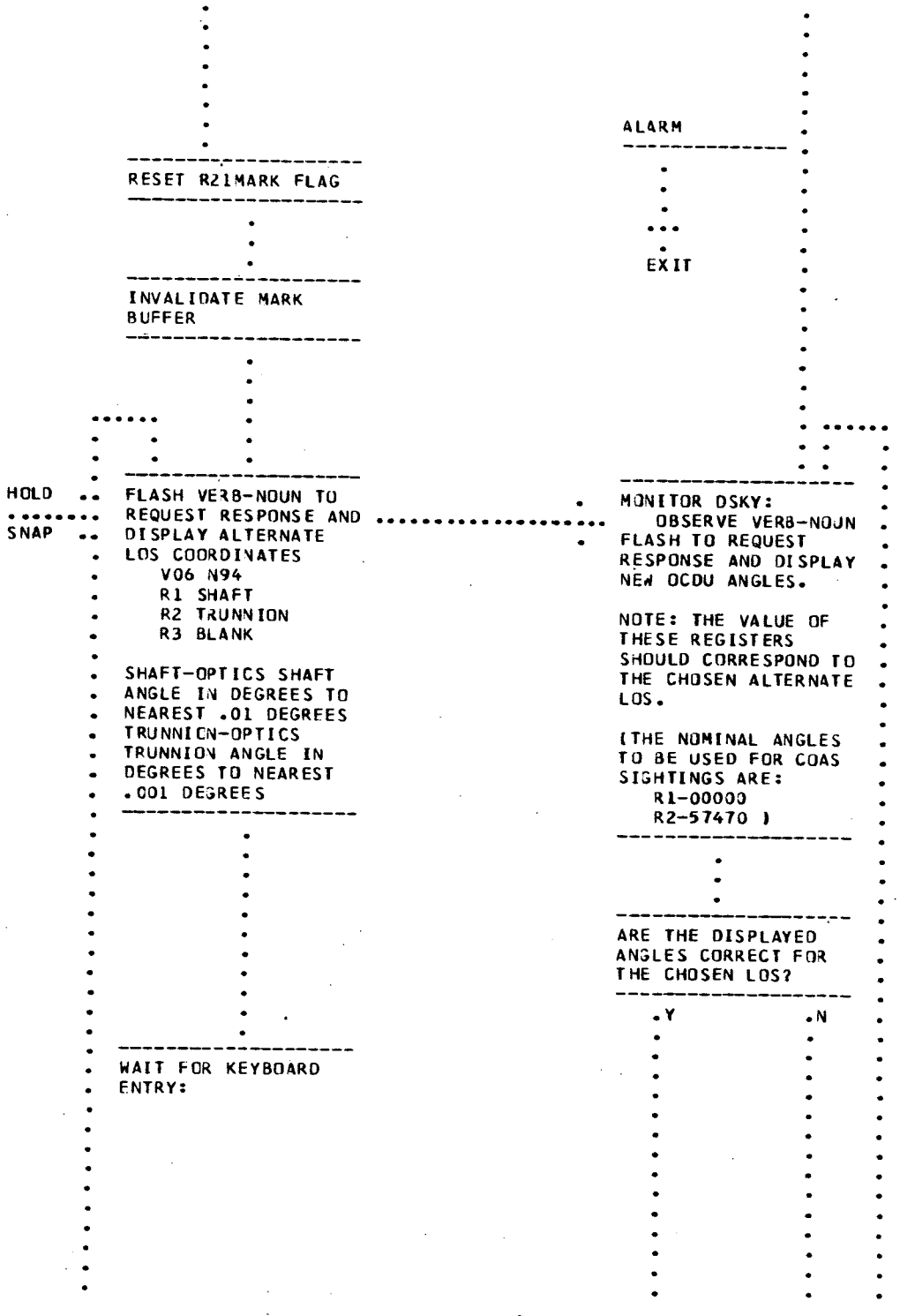
MONITOR DSKY: DOES PROGRAM ALARM INDICATE THAT THE UNIVERSAL TRACK PROGRAM P20 OPTION 0,4 IS NOT IN PROCESS?

.Y .N

#70

THIS ROUTINE MAY NOT BE SELECTED AT THIS TIME. PRESS ALARM RESET TO RESET PROGRAM

EXIT



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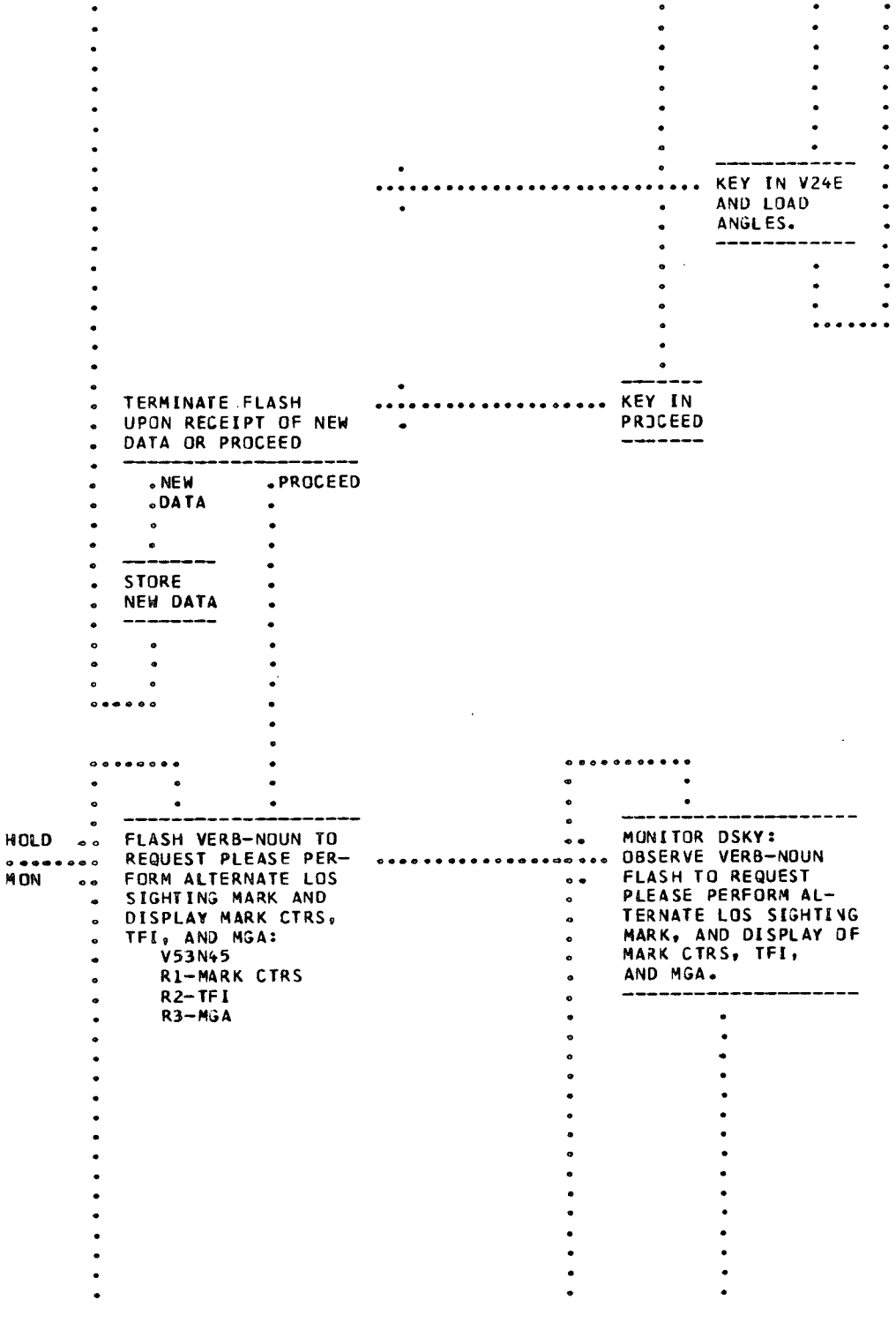

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MARK CTRS- THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE LAST W-MATRIX REINITIALIZATION (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBXX WHERE THE TWO MOST SIGNIFICANT DIGITS ARE THE VHF RANGING MARK COUNTER AND THE TWO LEAST SIGNIFICANT DIGITS ARE THE OPTICS MARK COUNTER.
NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.

TFI- TIME FROM TIG. IN MIN AND SEC TO NEAREST SEC. MAXIMUM READING IS 59859. (-BEFORE, + AFTER TIG)

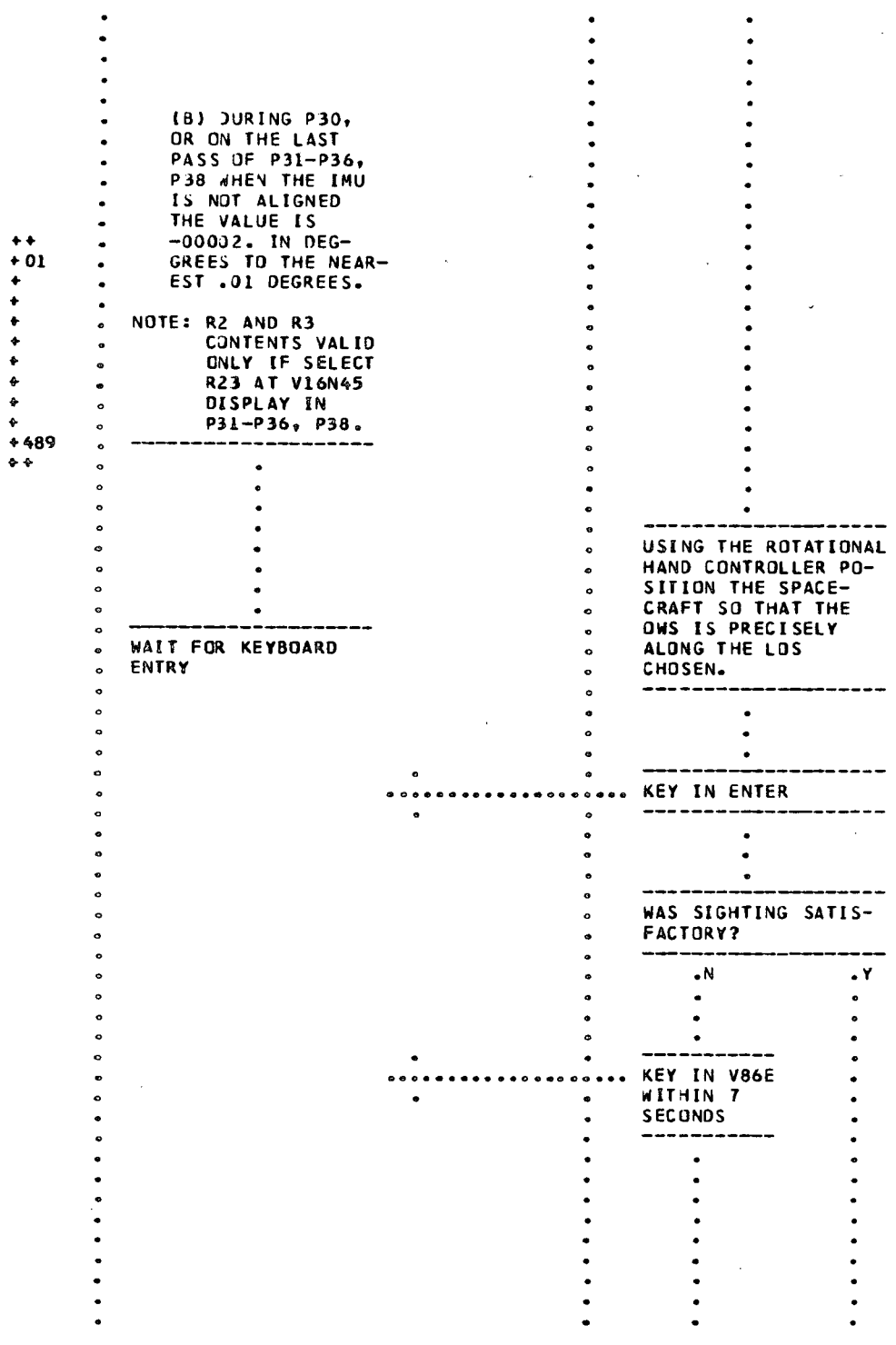
MGA- MIDDLE GIMBAL ANGLE AT TIG IF +X CSM AXIS IS ALIGNED WITH INITIAL THRUST DIRECTION.
SIGN IS ALWAYS + EXCEPT:
(A) WHEN DISPLAYED AT ANY TIME OTHER THAN THE LAST PASS THROUGH P31-P36, P38, THE VALUE IS -00001

#180

#190

#200

#210



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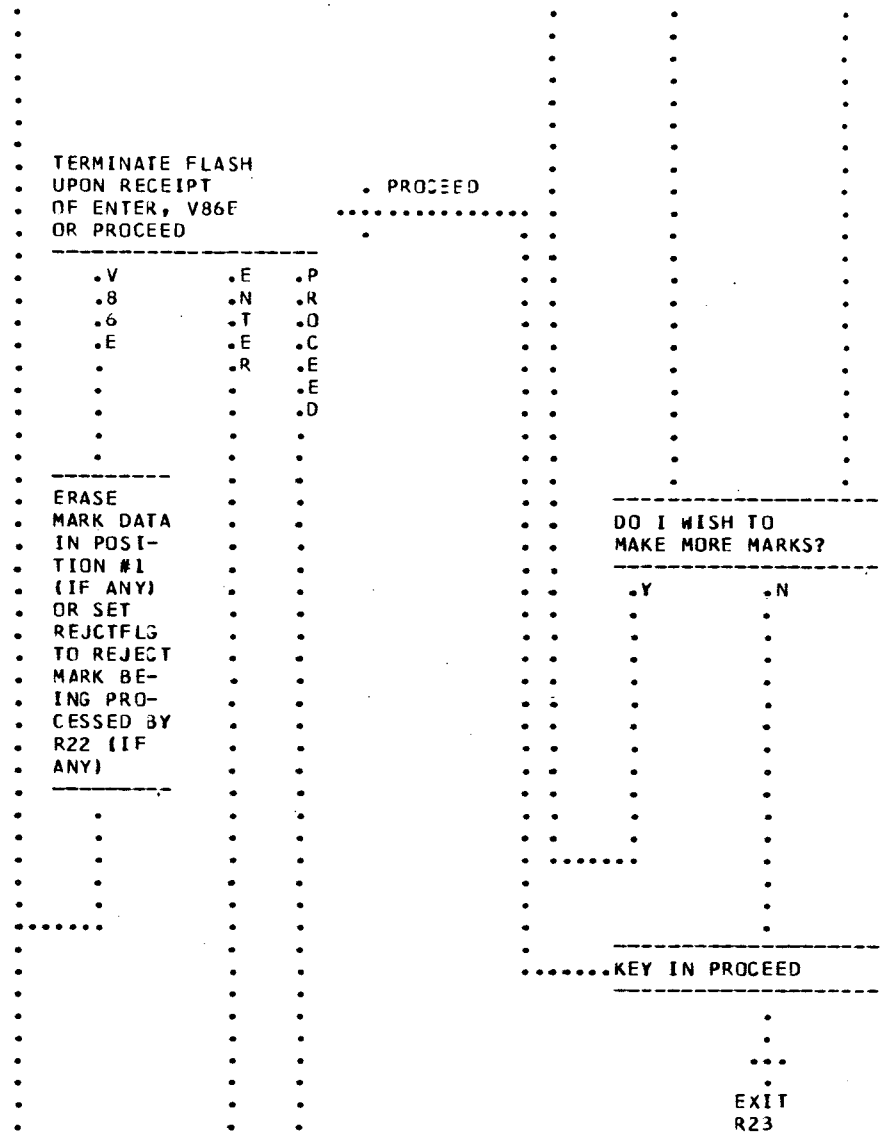

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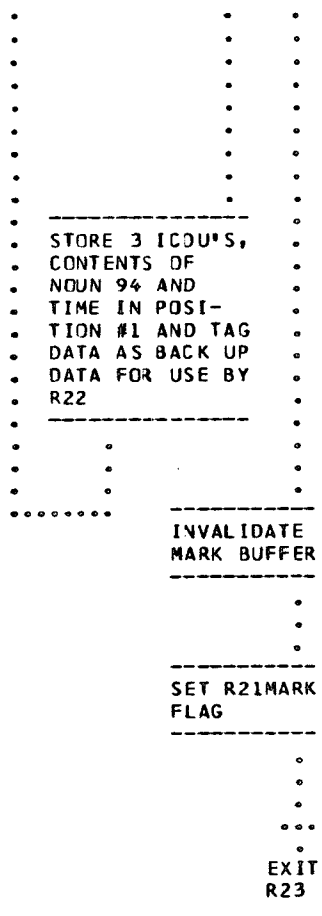

#320

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CHANGE CONTROL NOTES

REV 00 PCR 011, PCN 457, SKYLARK MEMO #2
REV 01 PCN 489

VHF RANGE RATE MARK PROCESSING ROUTINE (R27) REV 01 03/20/72

PURPOSE: (1) TO PROCESS VHF RANGING DATA TO UPDATE THE CURRENT RANGE STATE VECTOR (RANGE,RANGE RATE).

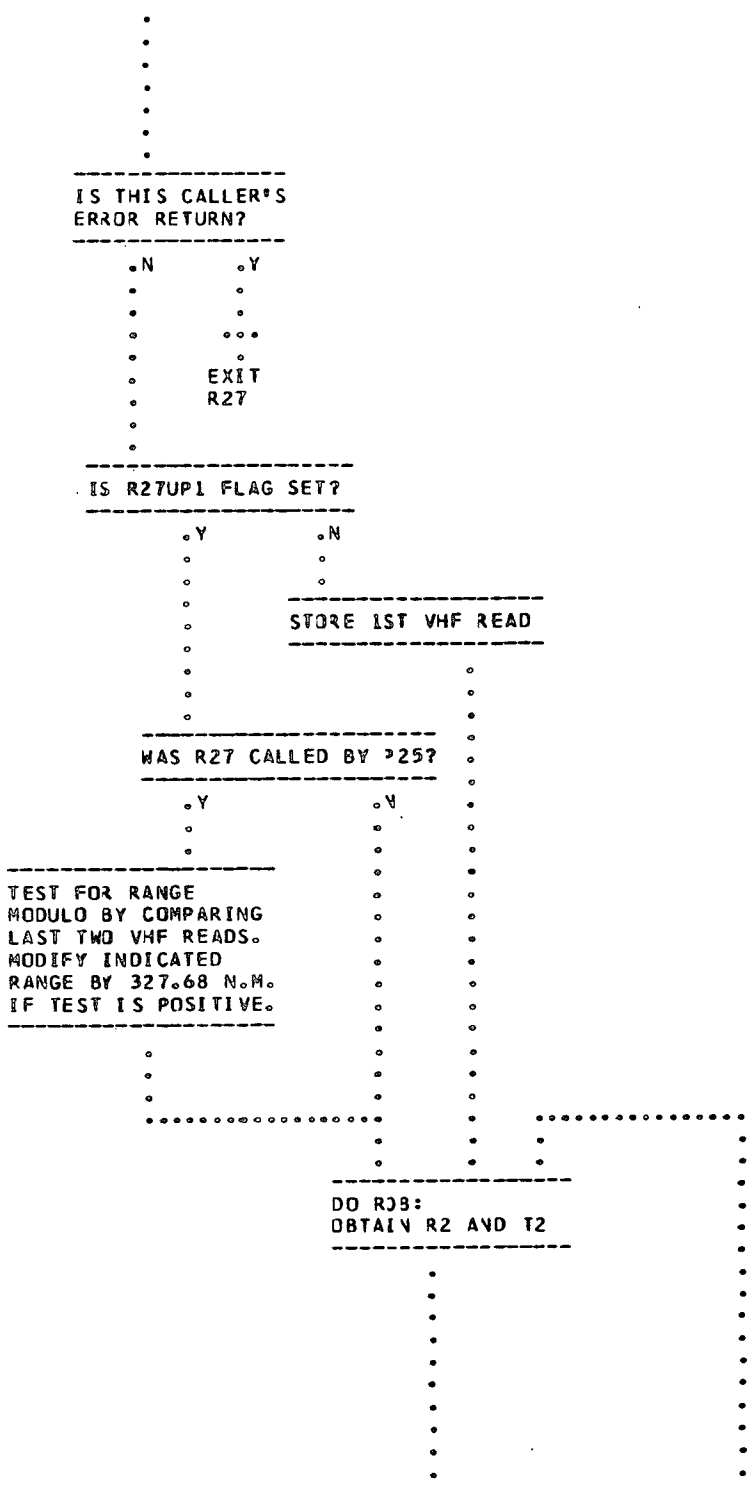
(2) TO PROCESS VHF RANGING DATA TO OBTAIN AN OPTIMUM ESTIMATE OF THE RANGE STATE VECTOR (RANGE,RANGE RATE) FOR A TIME TD SPECIFIED IN NOUN 72.

++
+01 (3) TO CALCULATE THE RENDEZVOUS PARAMETERS PHI OR THETA, DEPENDING ON THE CALLING PROGRAM.
+
+459 (4) TO INCREMENT OPTIMIZATION BY 4 MIN.
++

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY EITHER P25 OR P48.
++
+01 (2) THIS ROUTINE IS SELECTED BY R22 PROVIDED THE ASTRONAUT HAS SET R27FLAG BY KEYING V76E AND KEYING PRO ON THE
+ FLASHING V06N72 DISPLAY. R27 WILL CONTINUE WITHIN R22 UNTIL R27FLAG IS RESET BY KEYING V77E OR BY START OF P20
+ (SEE P20 INITIALIZATION LOGIC).
+
+ (3) THE RANGE RATE FILTER WILL BE REINITIALIZED BY THE PERFORMANCE OF ANY V37EXXE OR BY KEYING V76E AND PRO.
+
+489 (4) RANGE AND RANGE RATE ARE CALCULATED ON THE BASIS OF VHF RANGING DATA ONLY AND DO NOT REQUIRE EITHER VALID
++ STATE VECTORS OR, EXCEPT FOR P48, THAT THE ISS BE ON.
++
+01 (5) THE CALCULATION OF THE RENDEZVOUS PARAMETERS PHI (COMPUTED FOR R22) AND THETA (FOR P48) REQUIRES BOTH VALID
+468 STATE VECTORS AND THAT THE ISS BE ON AND ALIGNED TO A "KNOWN" ORIENTATION. IN THE CASE OF PHI, THE ISS MUST BE ON
++ AND OPERATIONAL AND INTEGRATION MUST NOT BE IN PROGRESS.
++
+01 (6) THE RANGE RATE FILTER REQUIRES APPROXIMATELY 190 SEC TO CONVERGE TO THE DESIRED ACCURACY.
+489
++ (7) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES,
++ BEGINNING WITH THAT TIME (N72) SELECTED BY THE ASTRONAUT.
+01
+459
++

PROG CONT	CMC	GROUND	CREW
	.CMC .ROUTINE .SELECTION		
	DO R08: OBTAIN R1 AND T1		
	. . . .		

#10


IS THIS CALLER'S ERROR RETURN?
N
Y
EXIT R27
IS R27UP1 FLAG SET?
Y
N
STORE 1ST VHF READ
WAS R27 CALLED BY P25?
Y
N
TEST FOR RANGE MODULO BY COMPARING LAST TWO VHF READS. MODIFY INDICATED RANGE BY 327.68 N.M. IF TEST IS POSITIVE.
DO R38: OBTAIN R2 AND T2

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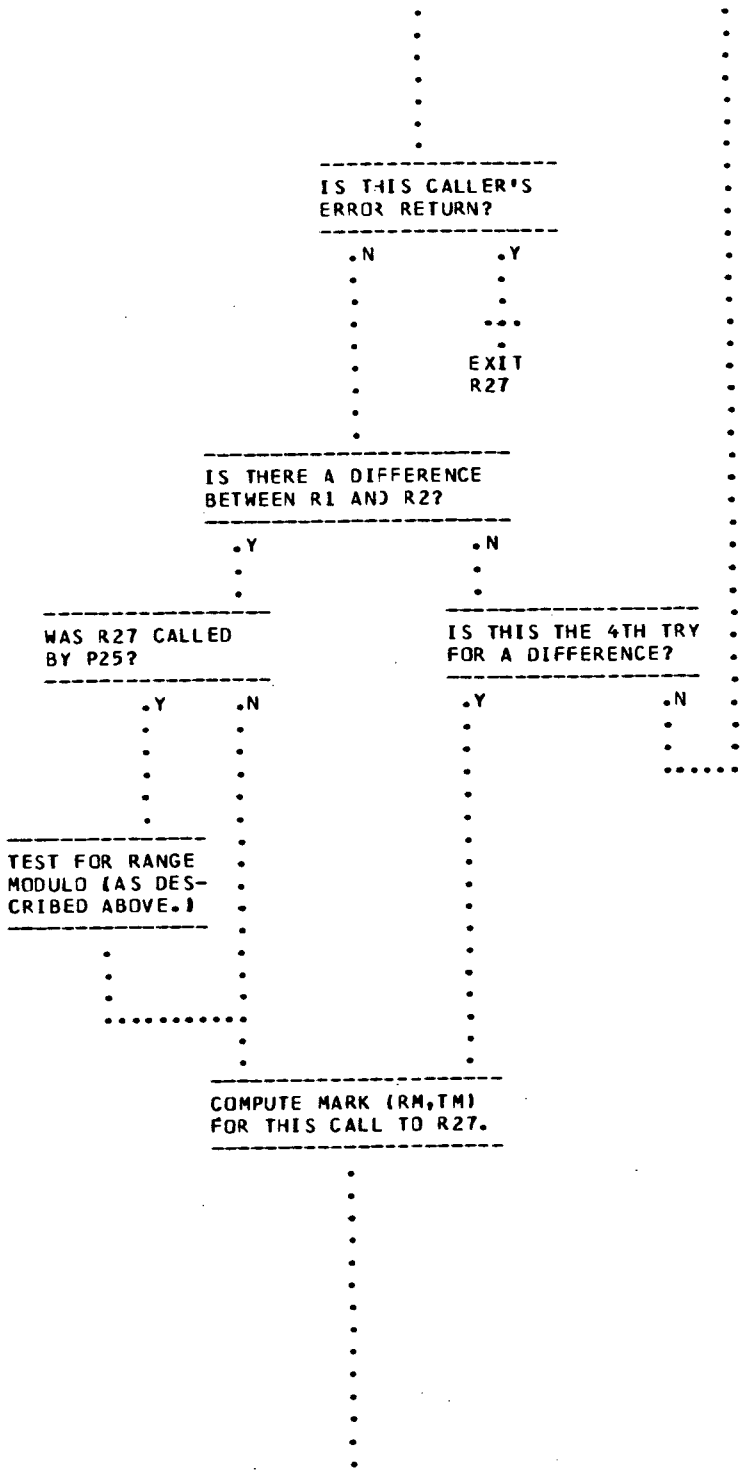

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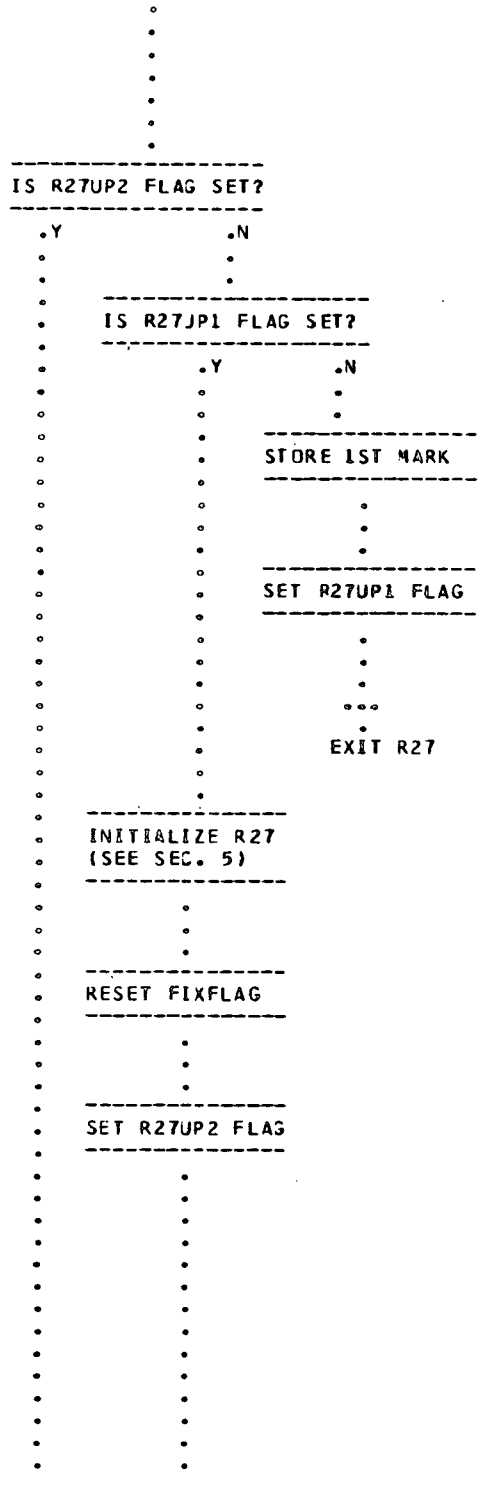

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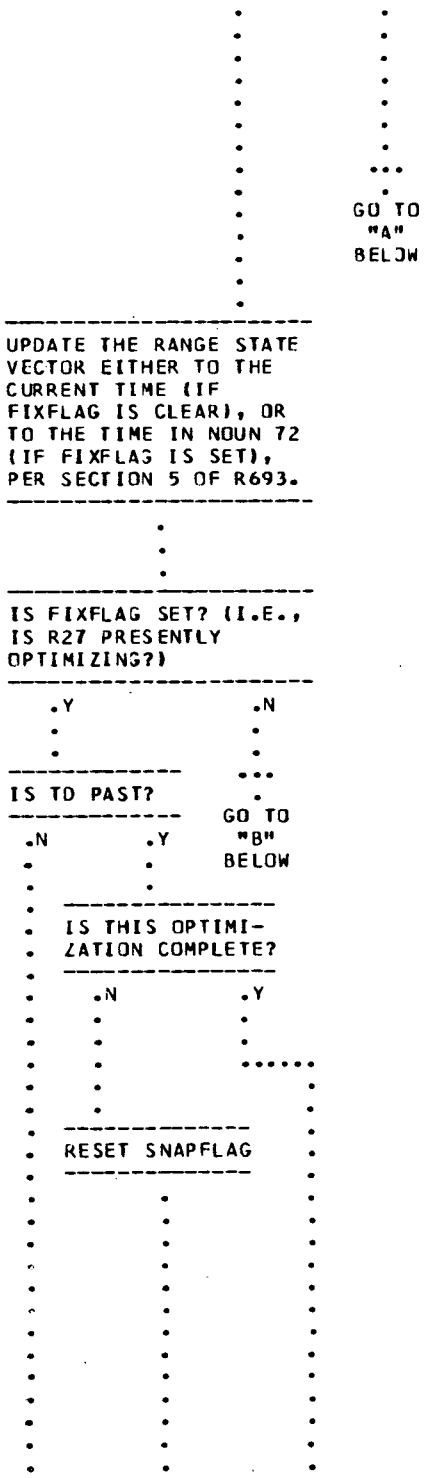

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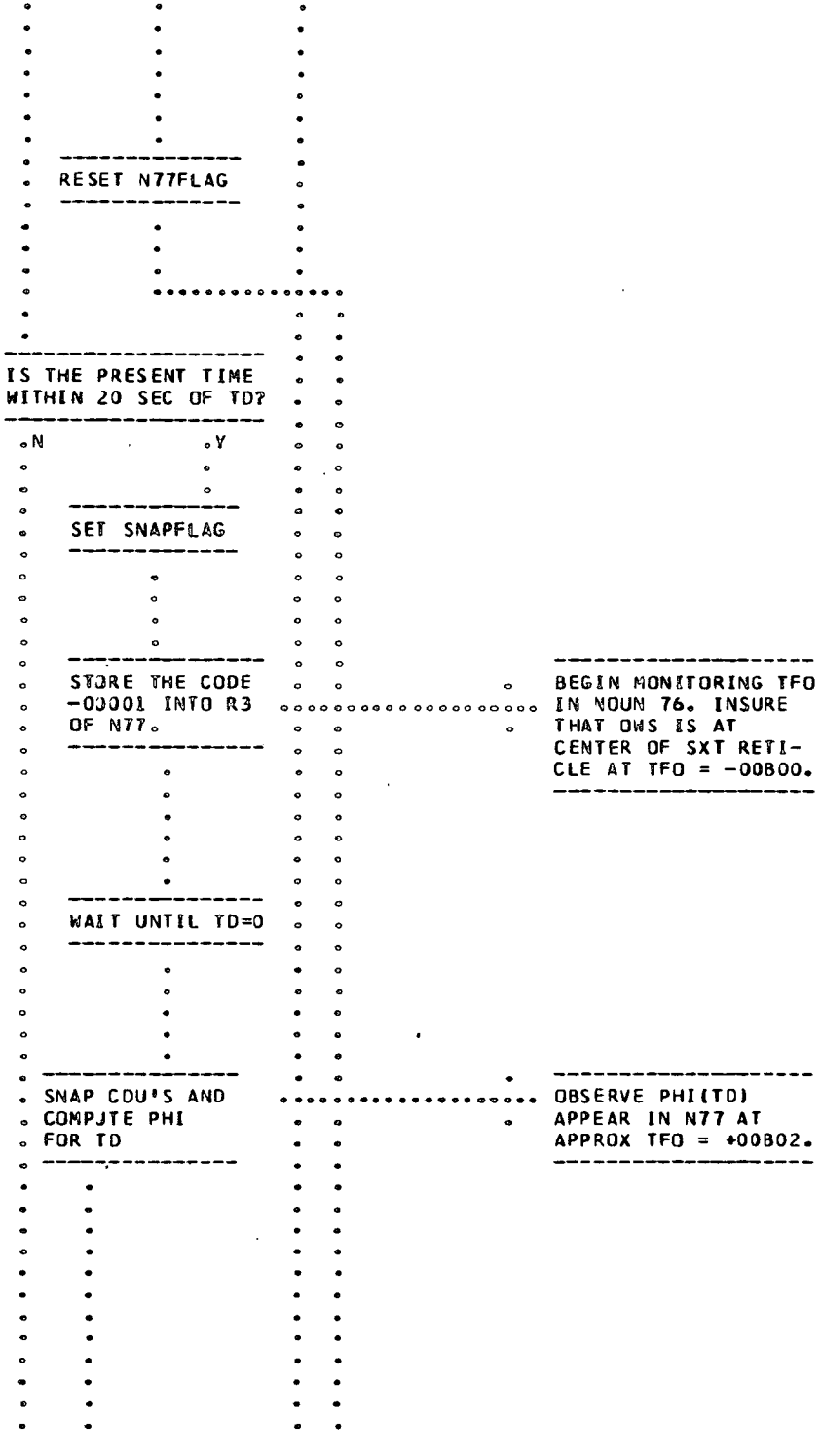

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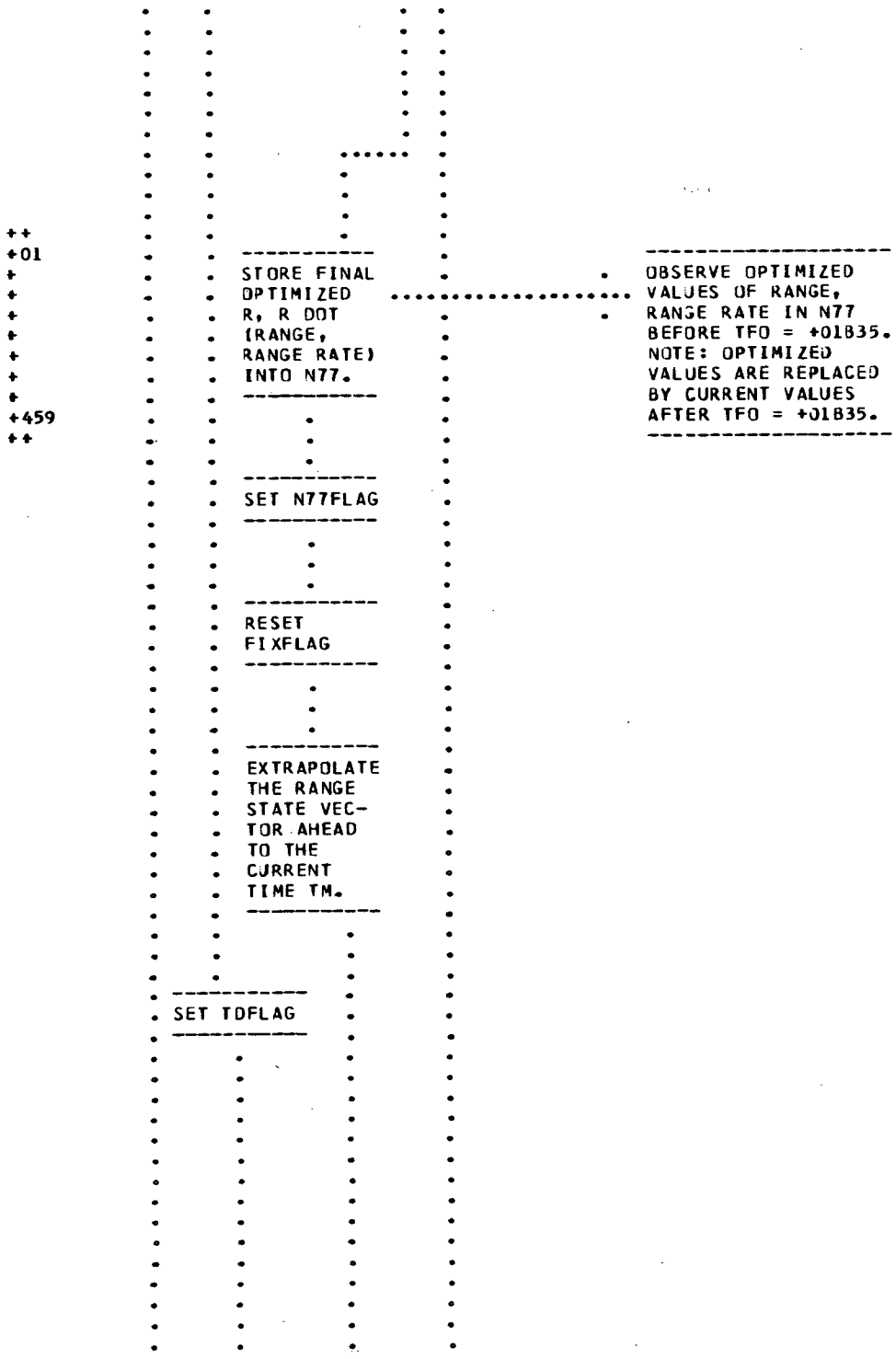

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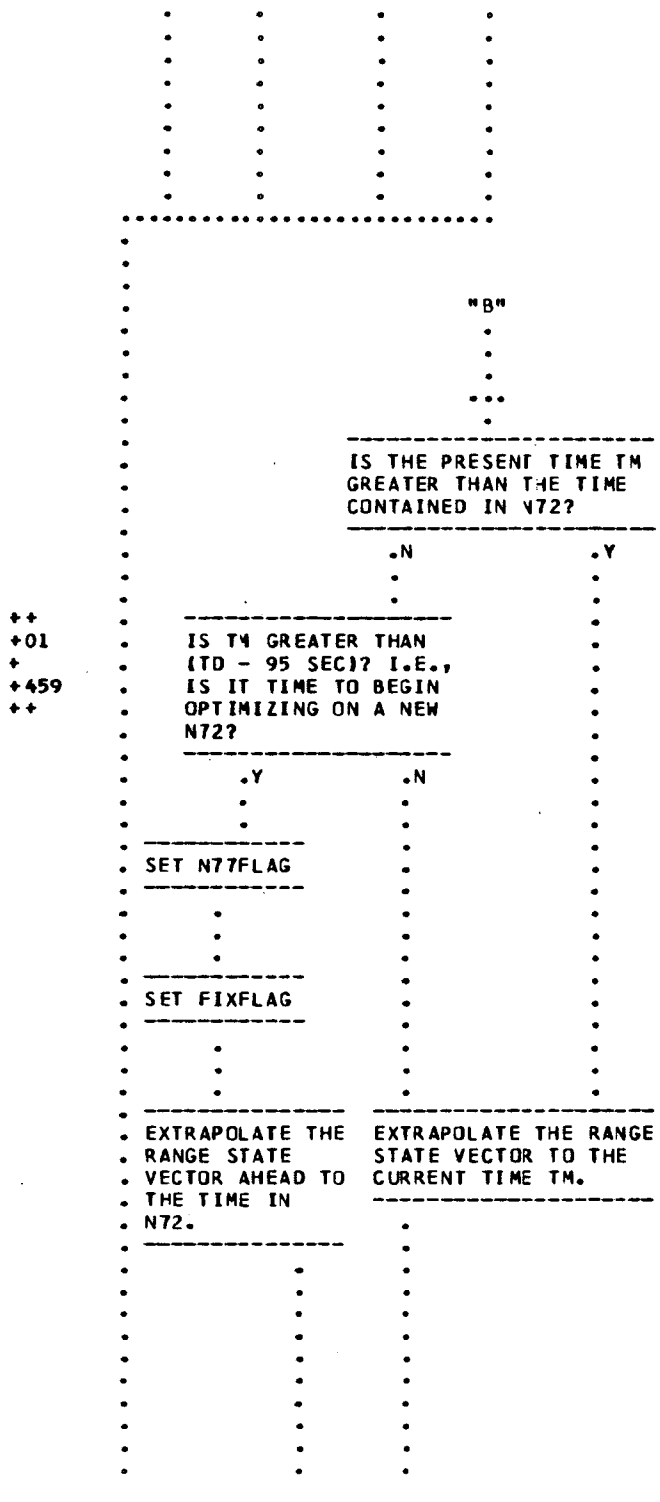

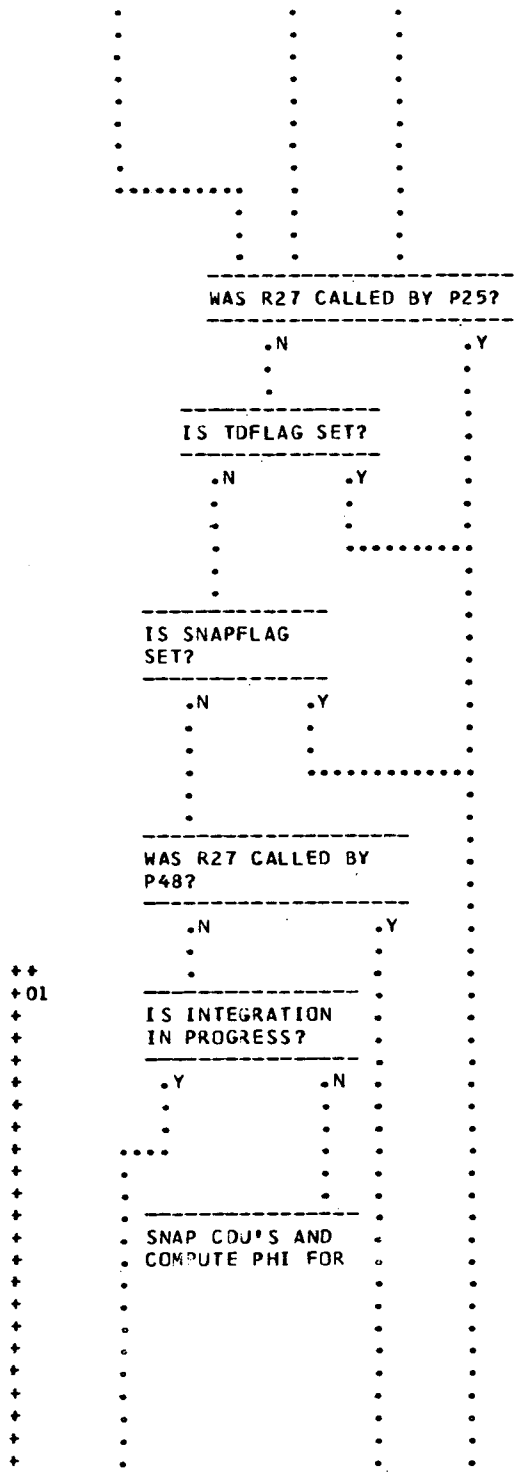

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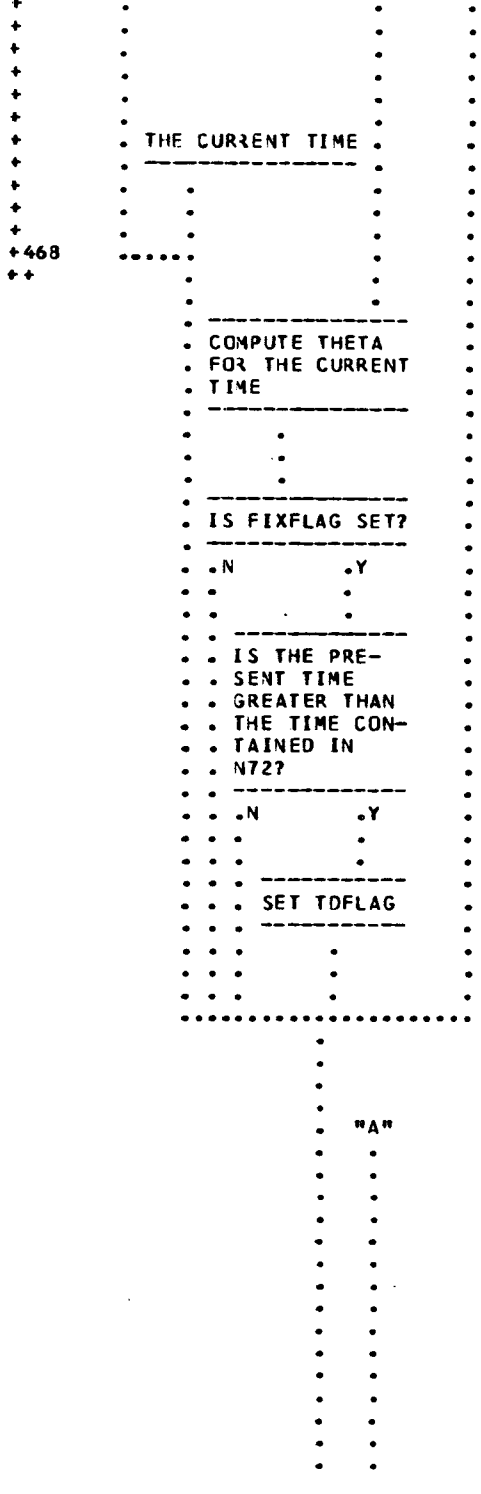

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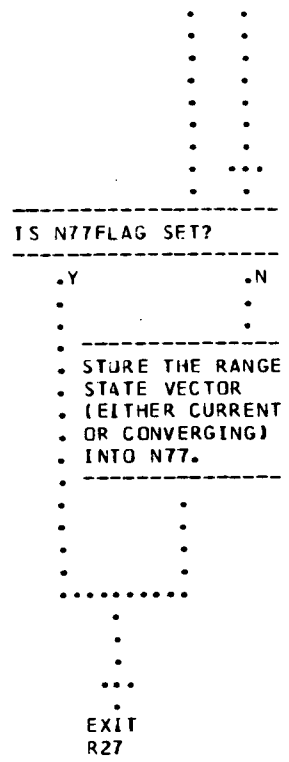

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CHANGE CONTROL NOTES

REV 00 PCR 032, SKYLARK MEMO #19
REV 01 PCR 459, PCN 468,489

ORBITAL PARAMETERS DISPLAY ROUTINE (R30) REV 01 03/20/72

PURPOSE: (1) TO PROVIDE THE ASTRONAUT PERTINENT ORBITAL PARAMETERS COMPUTED BY THE CMC TO SUPPLEMENT ORBITAL INFORMATION PROVIDED HIM BY THE GROUND.

ASSUMPTIONS: (1) THE COMPUTATIONS MADE DURING THIS ROUTINE ARE UPDATED ABOUT EVERY TWO SECONDS ONLY IF THE AVERAGE G ROUTINE IS ON WHEN THIS ROUTINE IS CALLED.

(2) THE VALUE OF TFF OR TPER WILL BE MADE TO COUNT DOWN IF THE AVERAGE G ROUTINE IS NOT ON WHEN THIS ROUTINE IS CALLED.

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(3) IF AVERAGE G ROUTINE IS OFF, THE ASTRONAUT MAY KEY IN THE PREDICTED GET TIME OF PERIGEE IN ORDER TO CAUSE THE CMC TO DO PRECISION INTEGRATION TO THAT TIME AND THEN MAKE A CONIC CALCULATION.

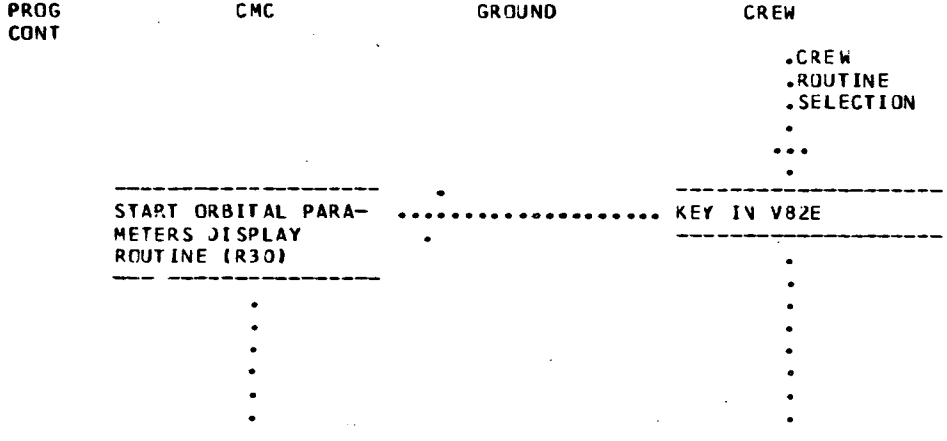
(4) IF TFF IS NOT COMPUTABLE BECAUSE TRAJECTORY DOES NOT INTERSECT THE INTERFACE ALTITUDE (E.G. ON THE PAD), THE CMC WILL SET TFF EQUAL TO -59859. ALSO, IF PER ALT IS GREATER THAN THE INTERFACE ALTITUDE OF 300,000 FT CMC WILL COMPUTE TPER; OTHERWISE TPER=0. TPER IS STORED IN N32 AND THE ASTRONAUT MAY CALL IT BY KEYING IN N32E.
TPER: TIME FROM NOW TO PERIGEE ALTITUDE IN HRS, MIN, AND SEC. FOR SIGN CONVENTION, SEE ASSUMPTION 5.

(5) SIGN CONVENTION FOR TFF AND TPER: DSKY DISPLAY IS NEGATIVE (DECREASING) AS INTERFACE ALTITUDE IS APPROACHED. BETWEEN INTERFACE ALTITUDE AND PERIGEE ALTITUDE, DISPLAY IS POSITIVE (INCREASING). WHEN PERIGEE IS PASSED, R30 CONTINUES TO DISPLAY POSITIVE INCREASING TIME EXCEPT DURING AVERAGE-G OR ON V32 RESPONSE TO V16N44. NEGATIVE (DECREASING) TIME WILL BE DISPLAYED FOR ELLIPSES IN THESE CASES.

(6) IF THIS ROUTINE IS CALLED WHILE THE EARTH ORBIT INSERTION MONITOR PROGRAM (P11) IS ON OR WHEN IN CMC IDLING PROGRAM (P00), THE CMC WILL DISPLAY SPLERROR IN N50 BY KEYING IN N50E. IF THE APOGEE IS ABOVE 300,000 FT ALTITUDE AND THE PERIGEE IS BELOW 300,000 FT ALTITUDE ABOVE THE LAUNCH PAD, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PREDICTED AND THE DESIRED ABORT TARGET. IF THESE CONDITIONS ARE NOT SATISFIED, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PRESENT POSITION VECTOR AND THE DESIRED ABORT TARGET.

(7) REFER TO THE NOUN LIST IN THE BACK OF THIS DOCUMENT FOR DEFINITION OF THE CONTENTS OF NOUNS 32 AND 50.

(8) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



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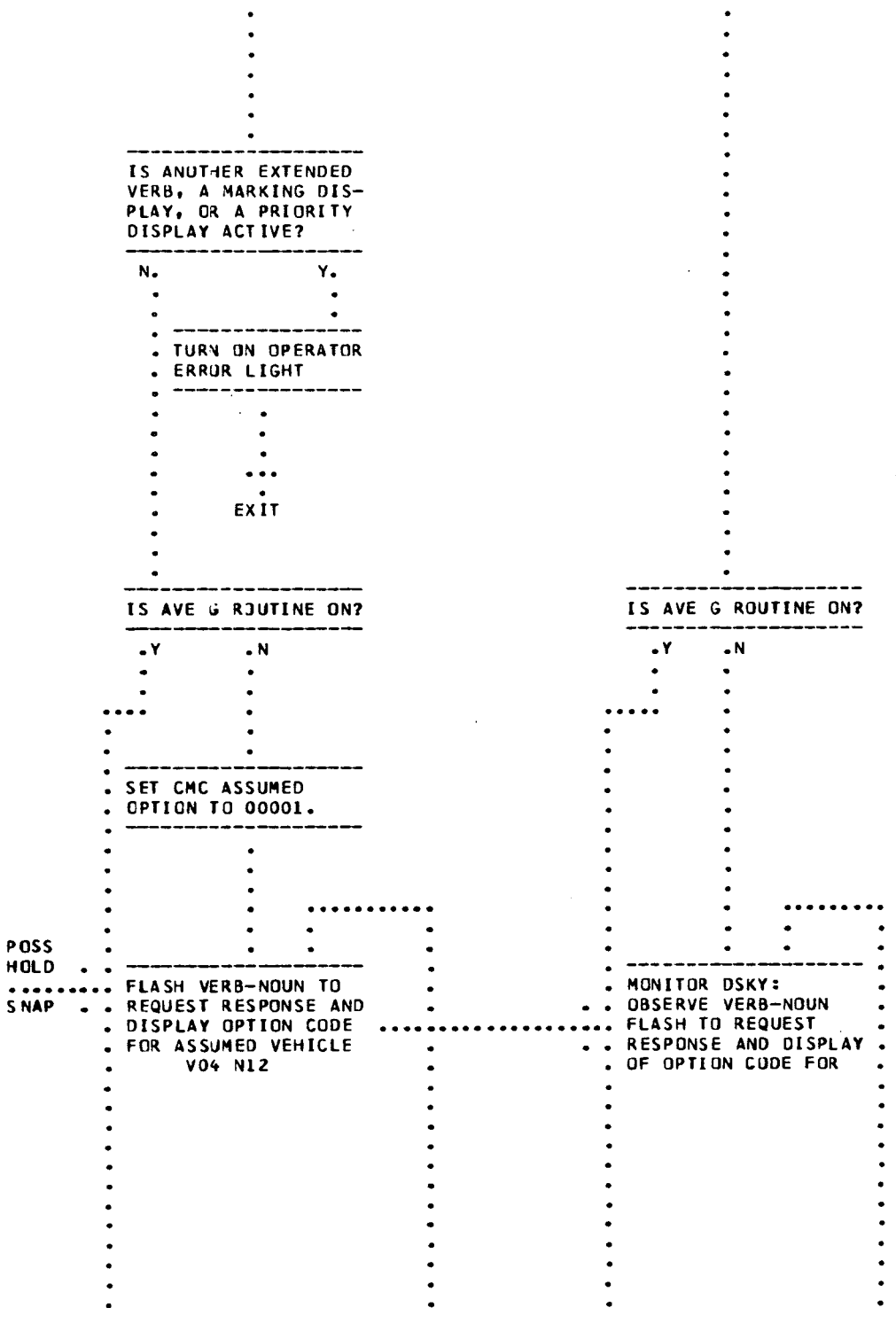
IS ANOTHER EXTENDED VERB, A MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?
N.
Y.
TURN ON OPERATOR ERROR LIGHT
EXIT
IS AVE G ROUTINE ON?
.Y
.N
SET CMC ASSUMED OPTION TO 00001.
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTION CODE FOR ASSUMED VEHICLE V04 N12
IS AVE G ROUTINE ON?
.Y
.N
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF OPTION CODE FOR

#20

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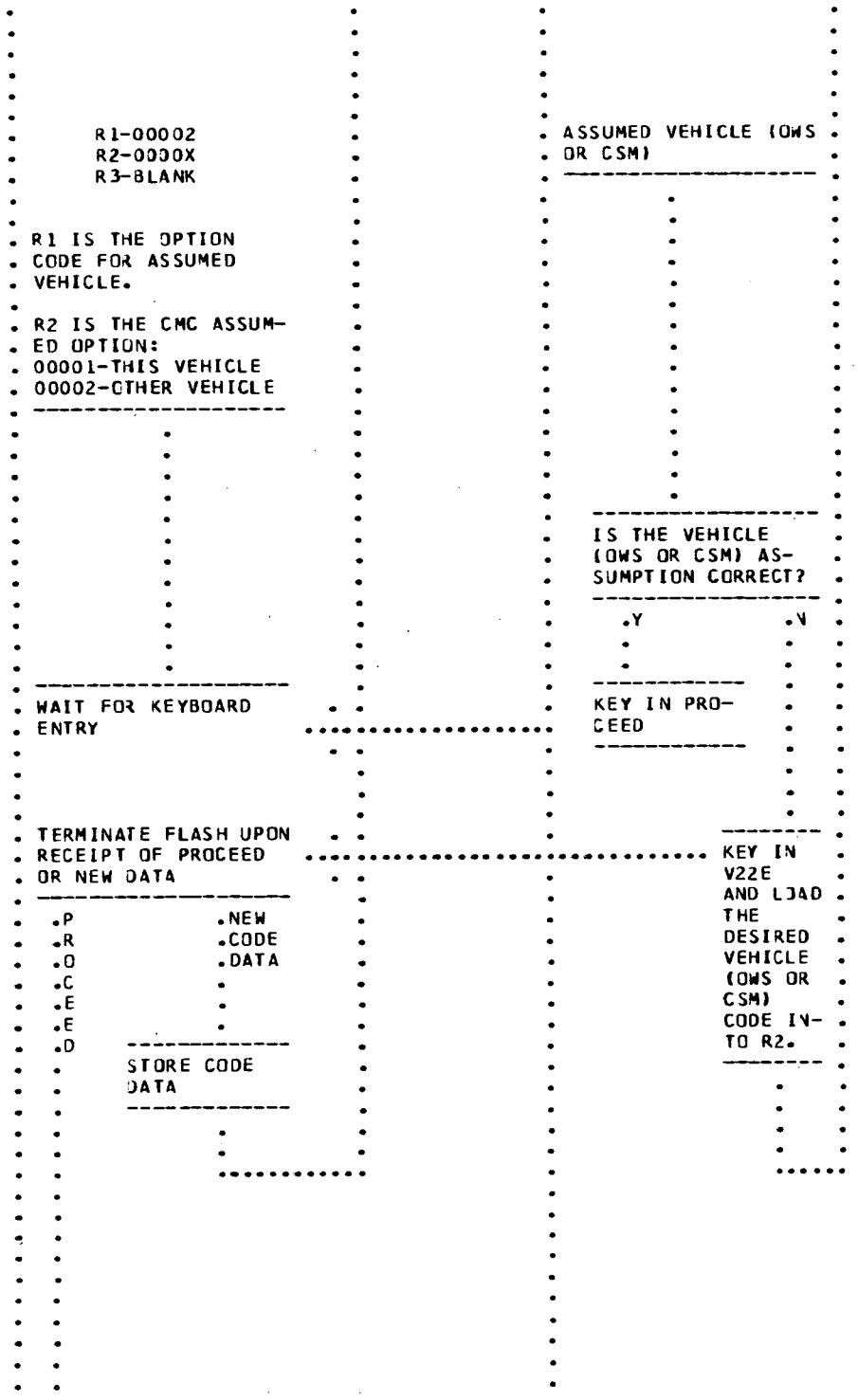

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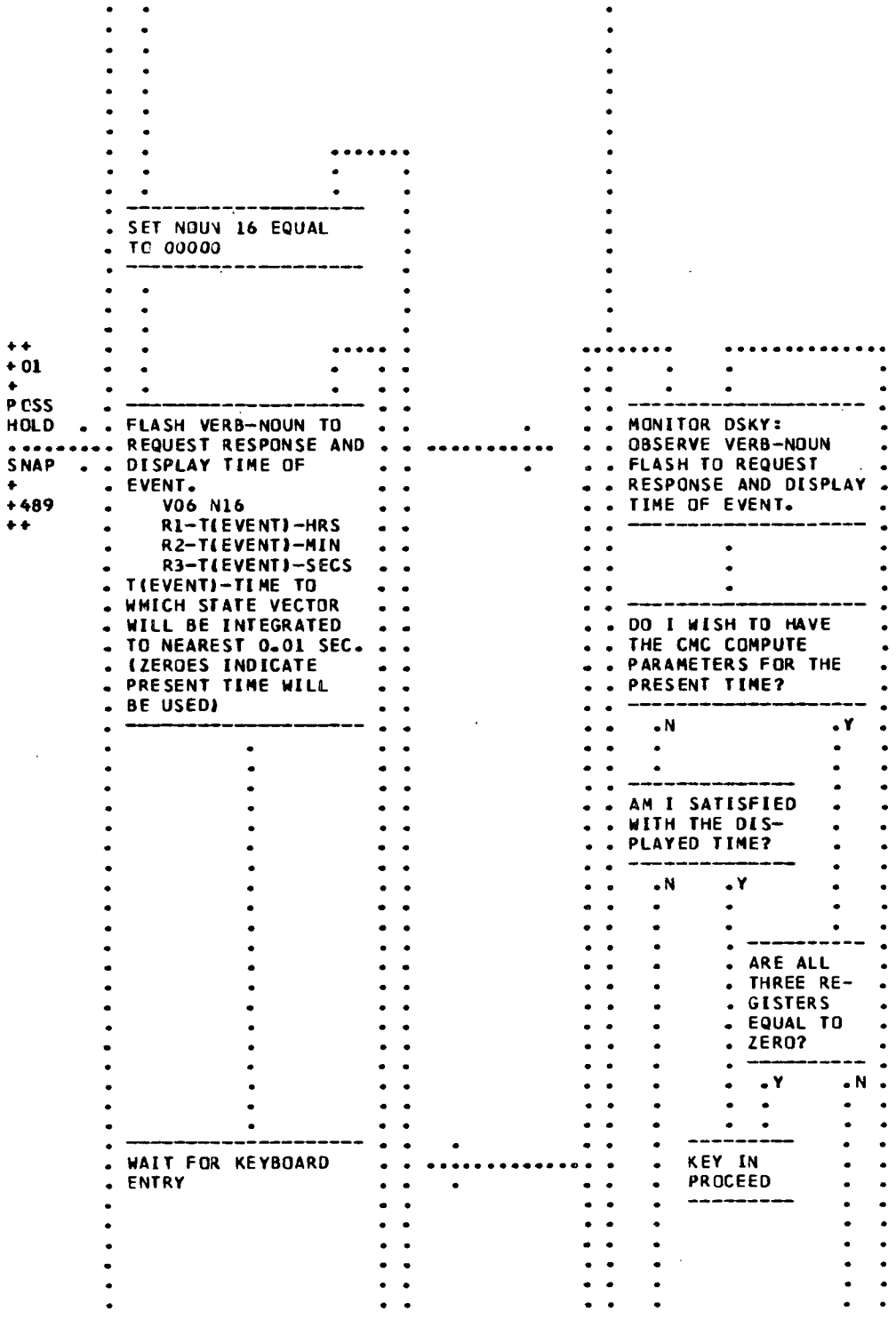

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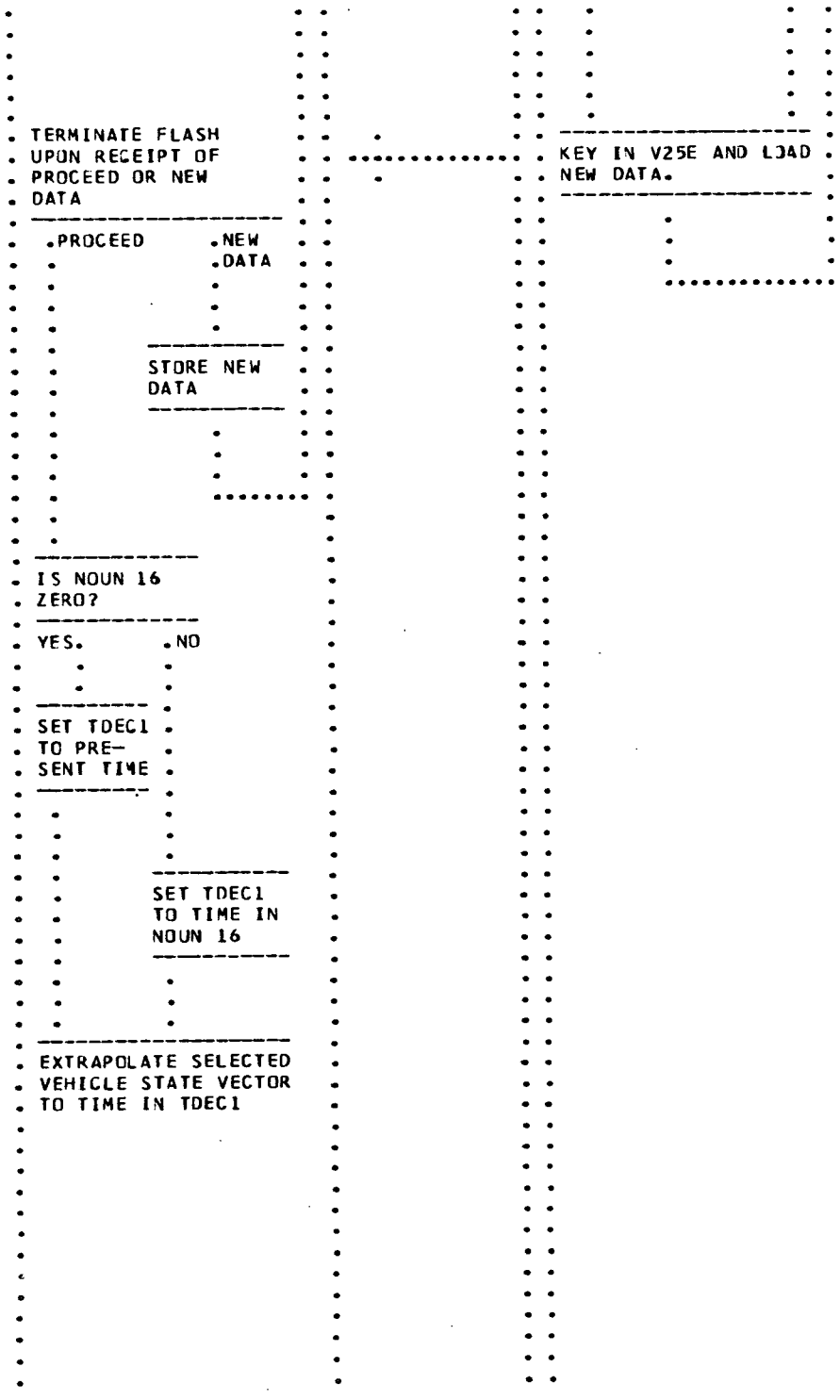

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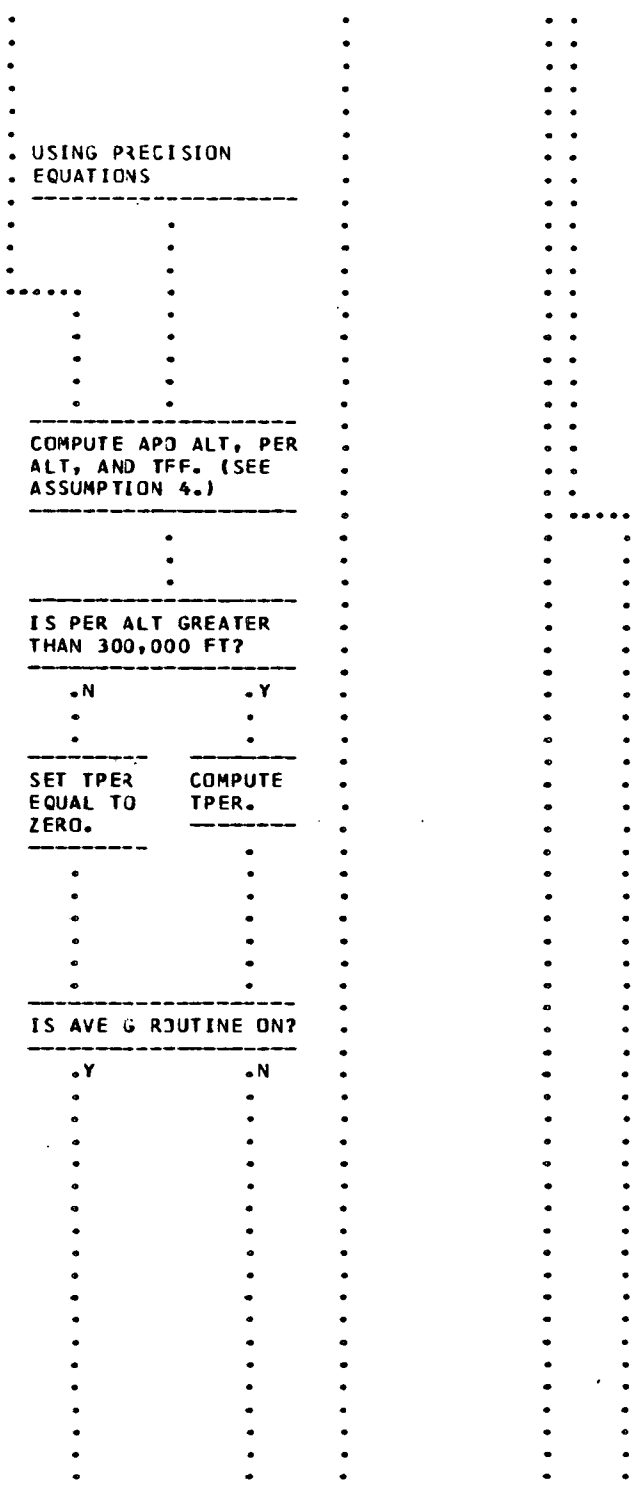

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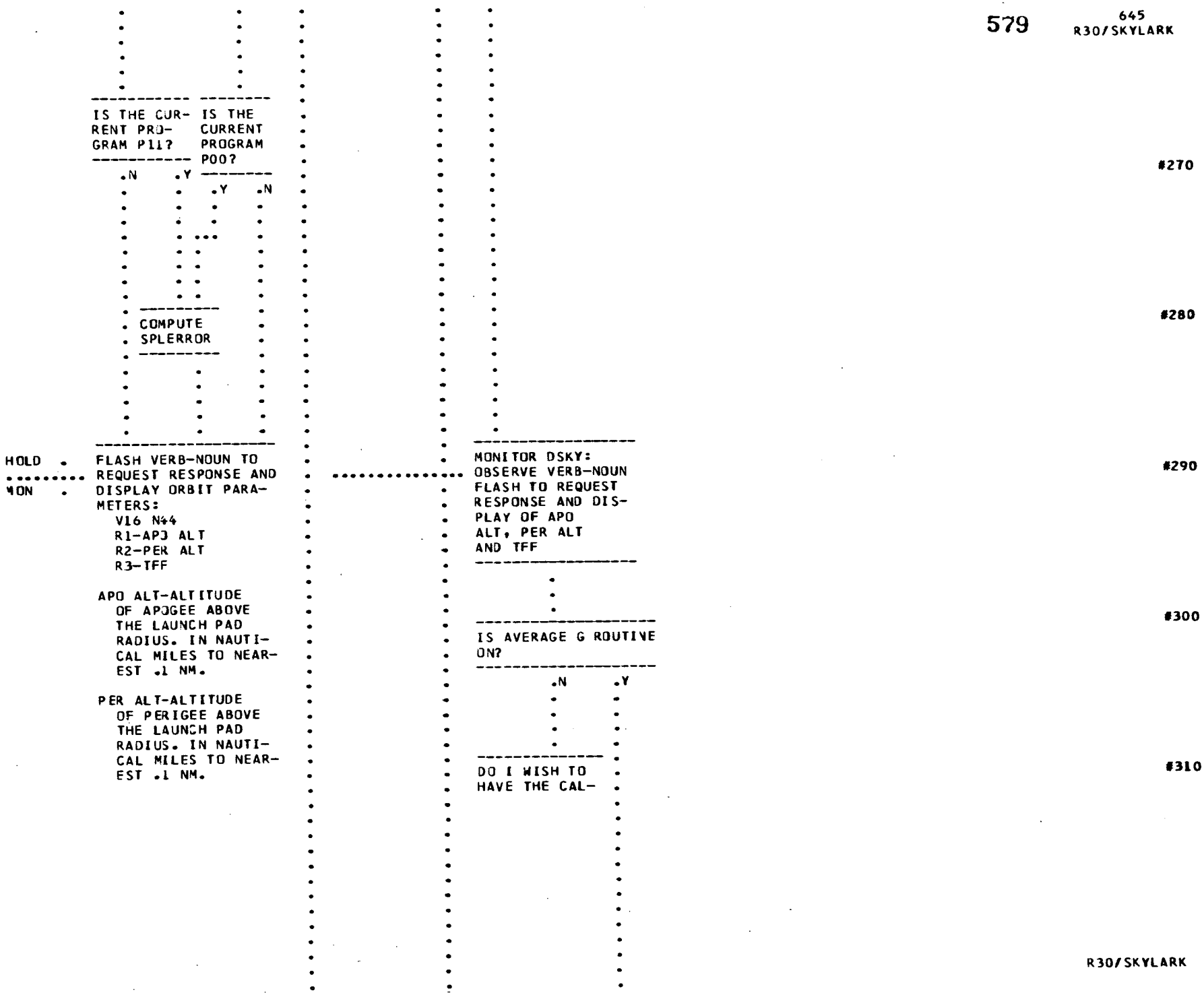
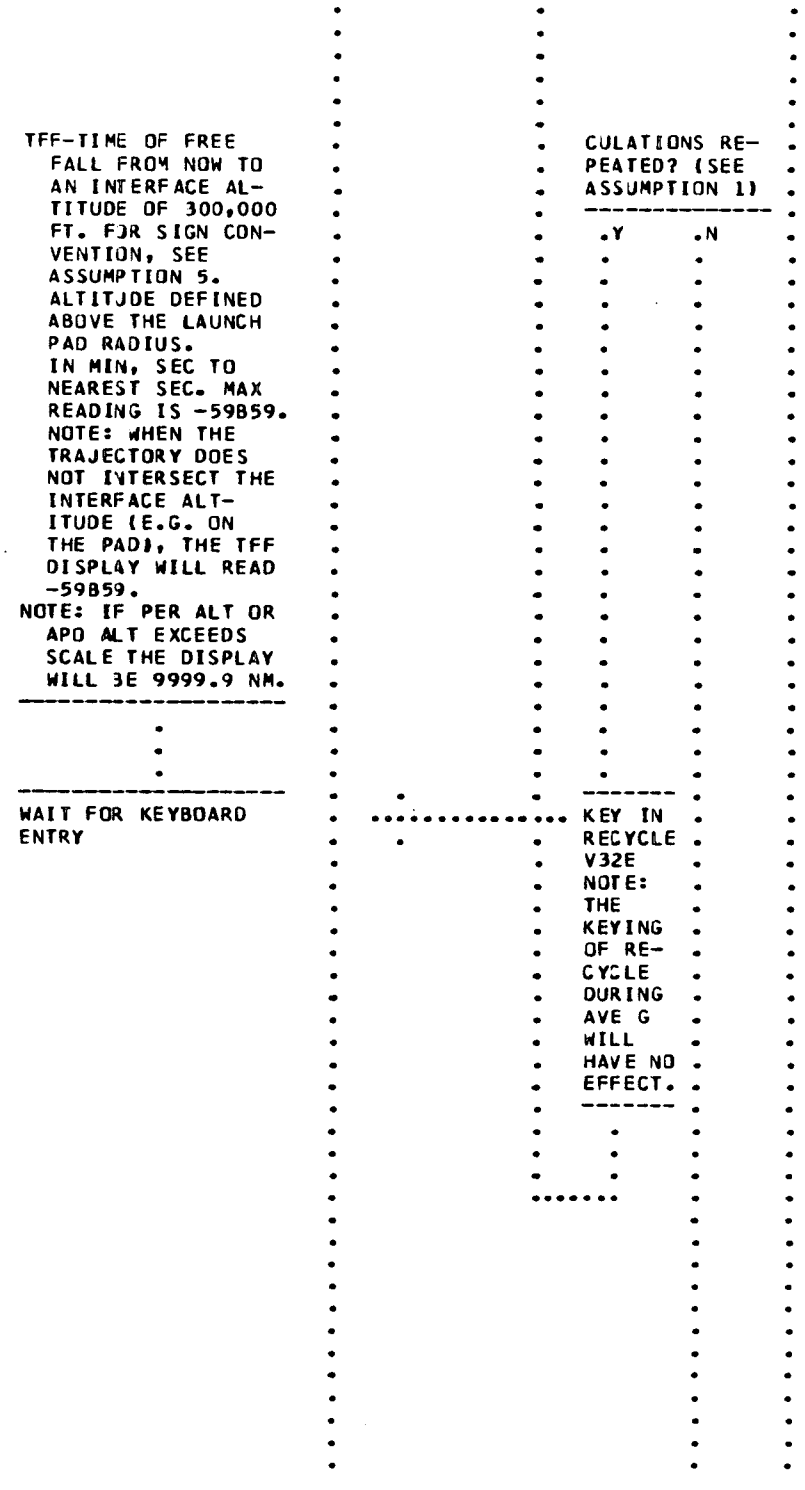

IS THE CUR-
RENT PRO-
GRAM P11?
.N
.Y
IS THE
CURRENT
PROGRAM
P00?
.Y
.N
COMPUTE
SPLERROR
HOLD
ON
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY ORBIT PARA-
METERS:
V16 N44
R1-APO ALT
R2-PER ALT
R3-TFF
APO ALT-ALTITUDE
OF APOGEE ABOVE
THE LAUNCH PAD
RADIUS. IN NAUTI-
CAL MILES TO NEAR-
EST .1 NM.
PER ALT-ALTITUDE
OF PERIGEE ABOVE
THE LAUNCH PAD
RADIUS. IN NAUTI-
CAL MILES TO NEAR-
EST .1 NM.
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DIS-
PLAY OF APO
ALT, PER ALT
AND TFF
IS AVERAGE G ROUTINE
ON?
.N
.Y
DO I WISH TO
HAVE THE CAL-
#270
#280
#290
#300
#310



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+01
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+489
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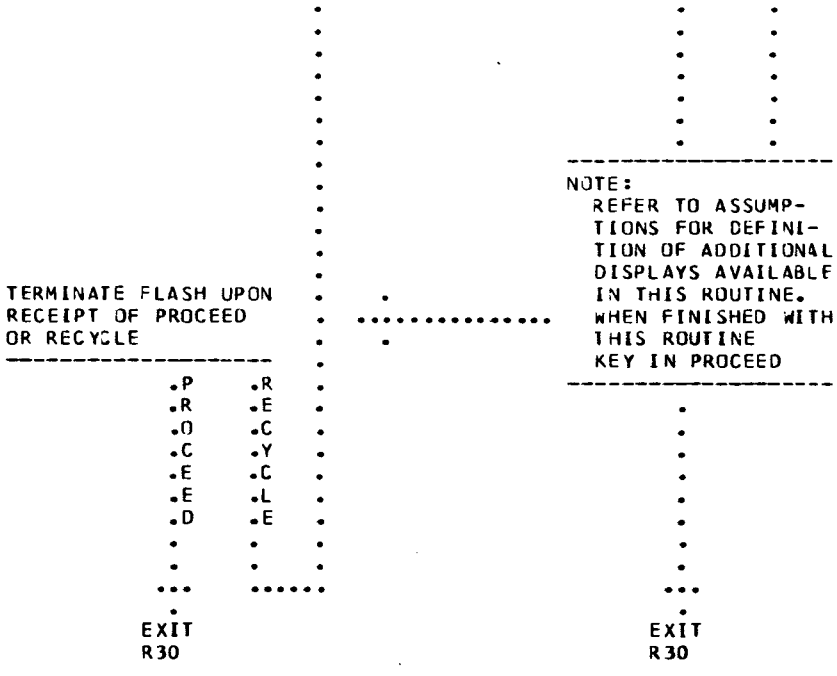

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CHANGE CONTROL NOTES

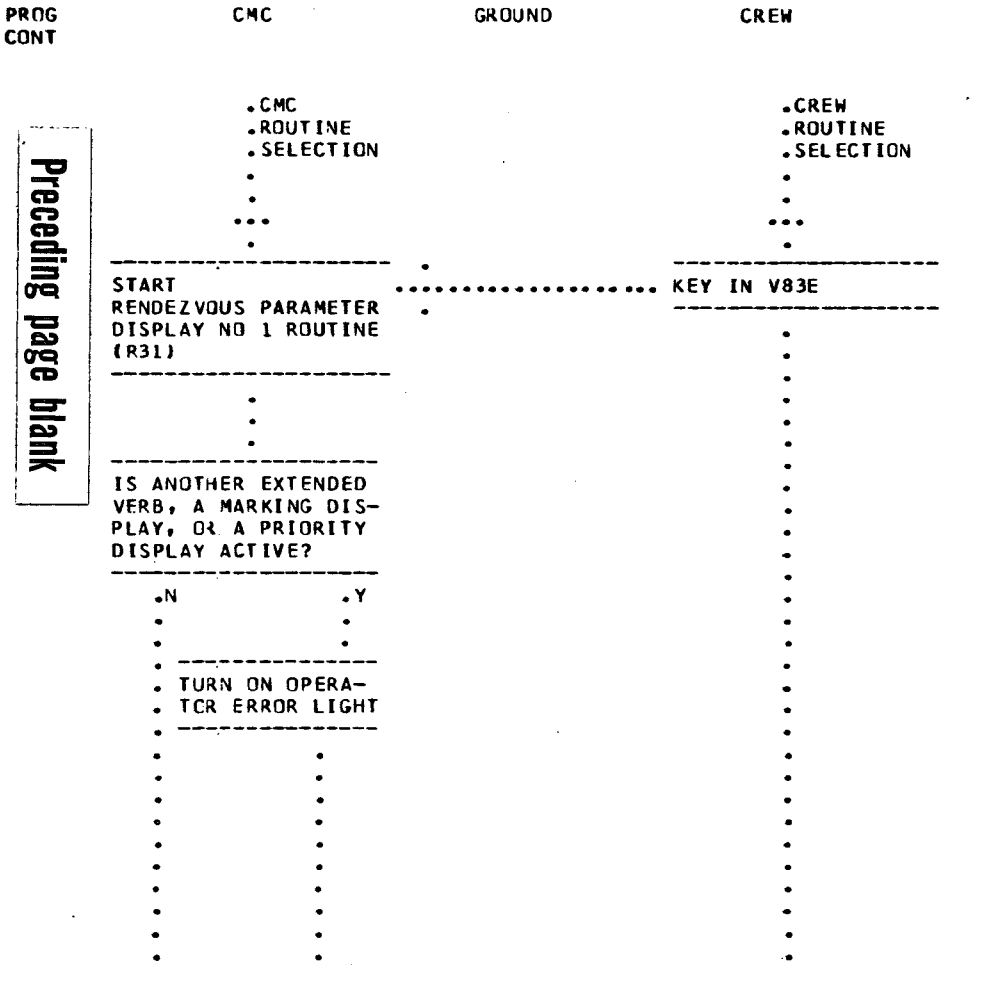
REV 00 PCN 410
REV 01 PCN 489

RENDEZVOUS PARAMETER DISPLAY NO 1 ROUTINE (R31) REV 01 03/20/72

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, THETA)

ASSUMPTIONS: (1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION IF A CORRECT DISPLAY OF THETA IS DESIRED. THE RANGE/RANGE RATE/THETA DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR AUTOMATICALLY SELECTED BY P37.



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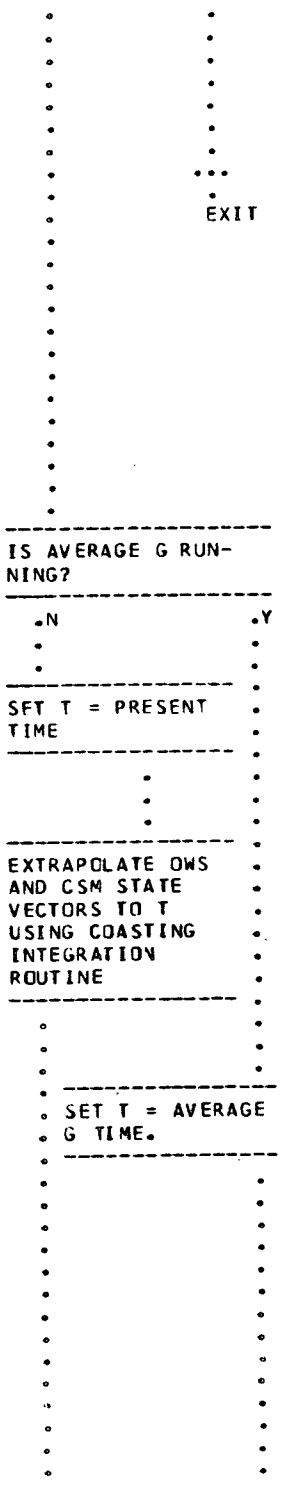
EXIT
IS AVERAGE G RUN-NING?
N
Y
SET T = PRESENT TIME
EXTRAPOLATE OWS AND CSM STATE VECTORS TO T USING COASTING INTEGRATION ROUTINE
SET T = AVERAGE G TIME.

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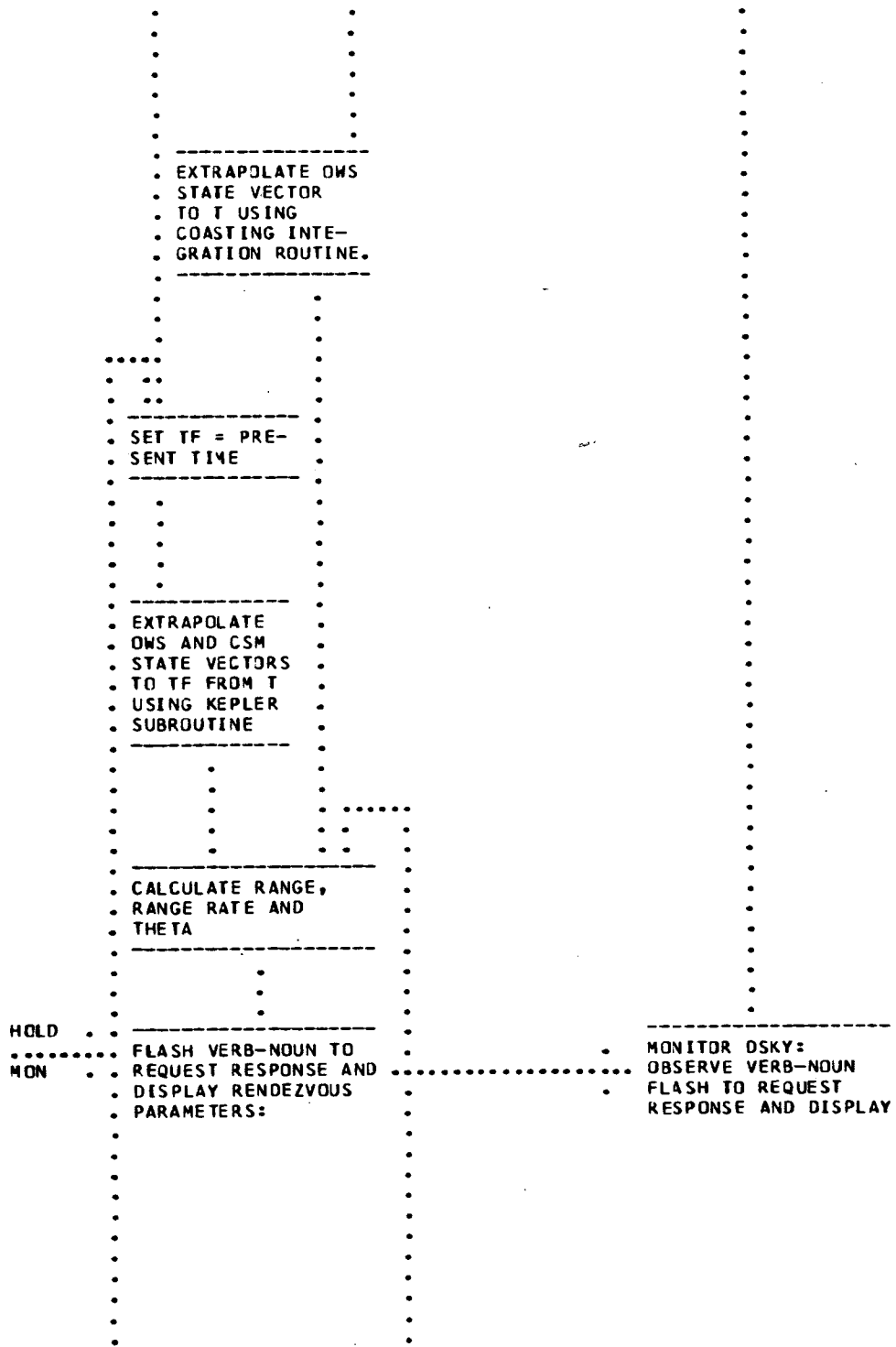

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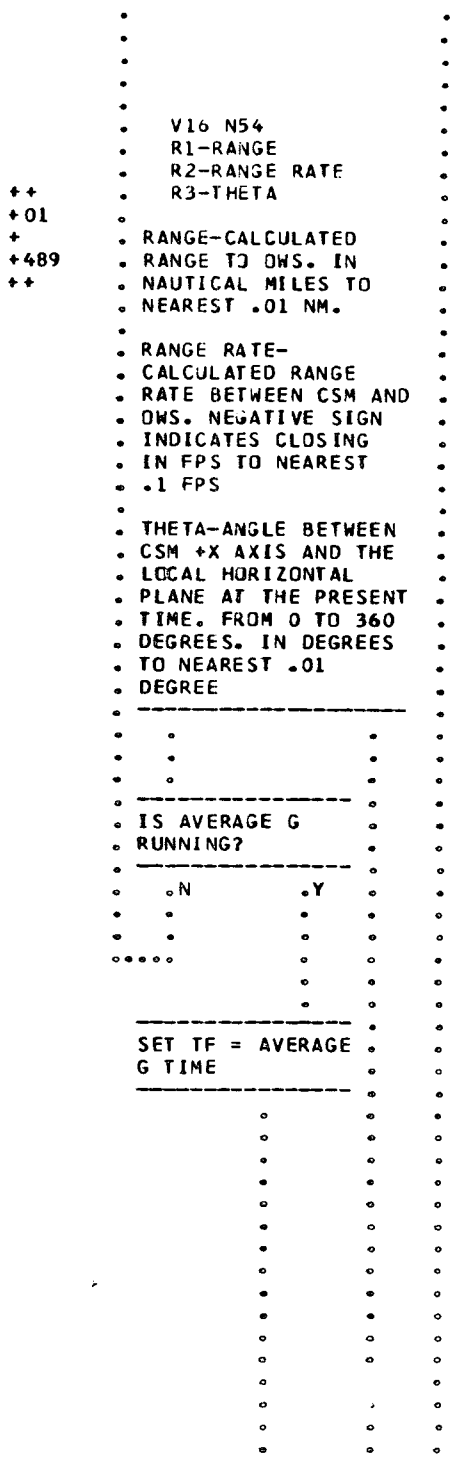

OF RENDEZVOUS
PARAMETERS.
(NOTE: THESE PARA-
METERS WILL BE
UPDATED ABOUT EVERY
TWO SECONDS.)

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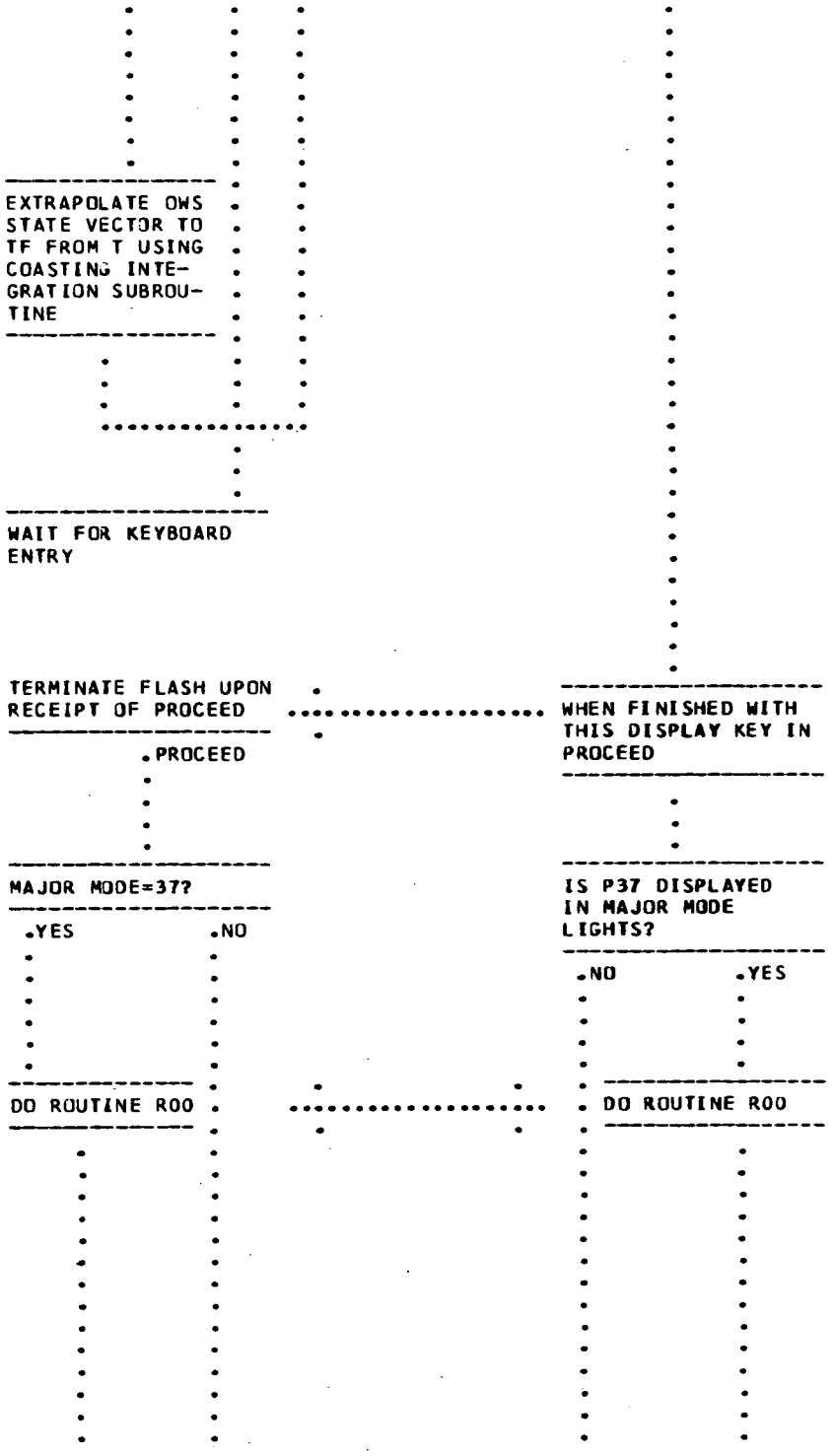

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CHANGE CONTROL NOTES

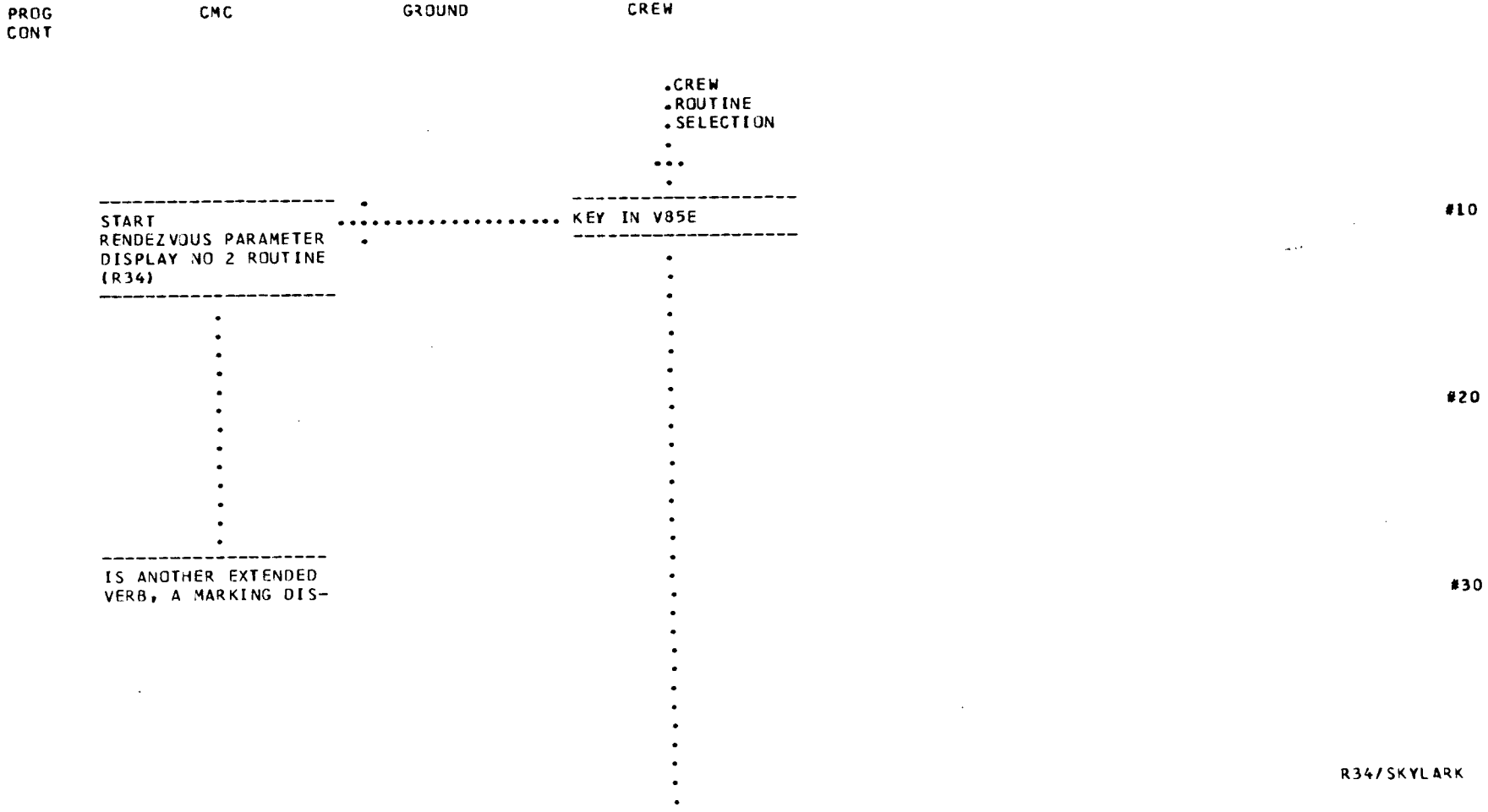
REV 00 PCR 007,011, PCN 410, SKYLARK MEMO #2
REV 01 PCN 489

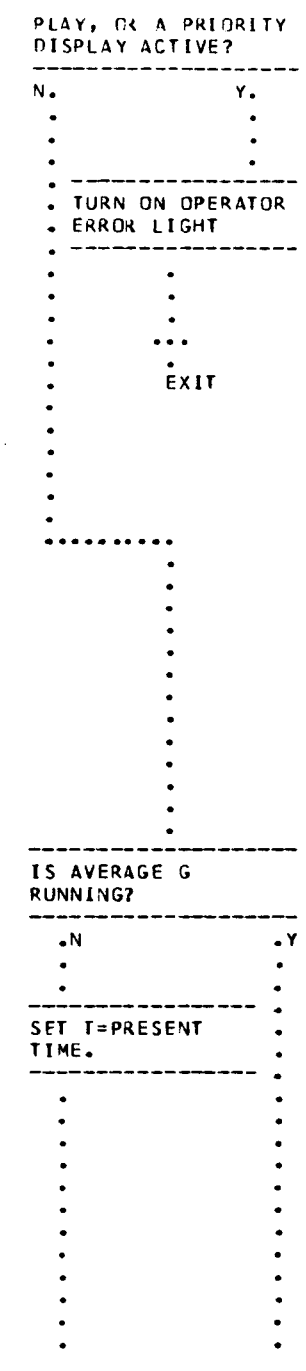
RENDEZVOUS PARAMETER DISPLAY NO 2 ROUTINE (R34) REV 01 03/20/72

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, PHI)

ASSUMPTIONS: (1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION AND THE OPTICAL SUBSYSTEM MUST BE ON AND OPERATIONAL, IF A CORRECT DISPLAY OF PHI IS DESIRED. THE RANGE/RANGE RATE/PHI DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED OR THE OPTICS IS OFF.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.




PLAY, OR A PRIORITY DISPLAY ACTIVE?
N.
Y.
TURN ON OPERATOR ERROR LIGHT
EXIT
IS AVERAGE G RUNNING?
.N
.Y
SET T=PRESENT TIME.

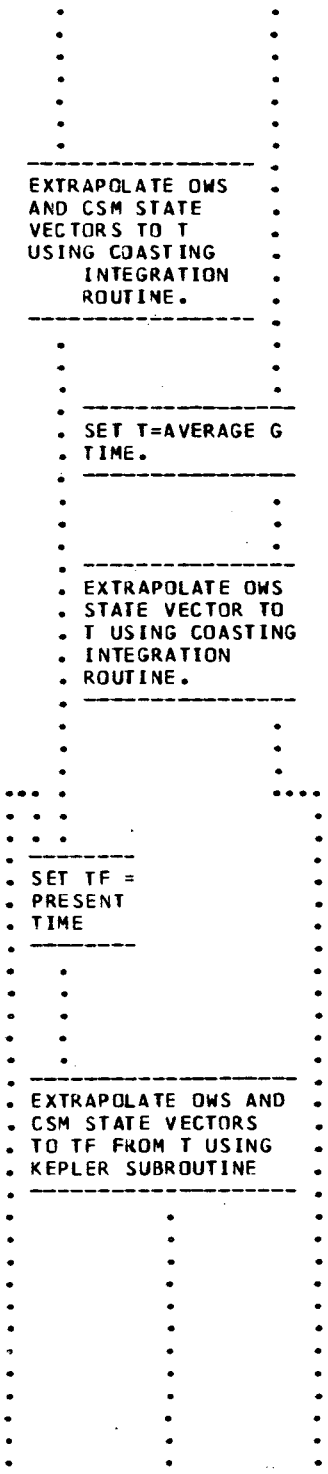
#40

#50

#60

#70

#80



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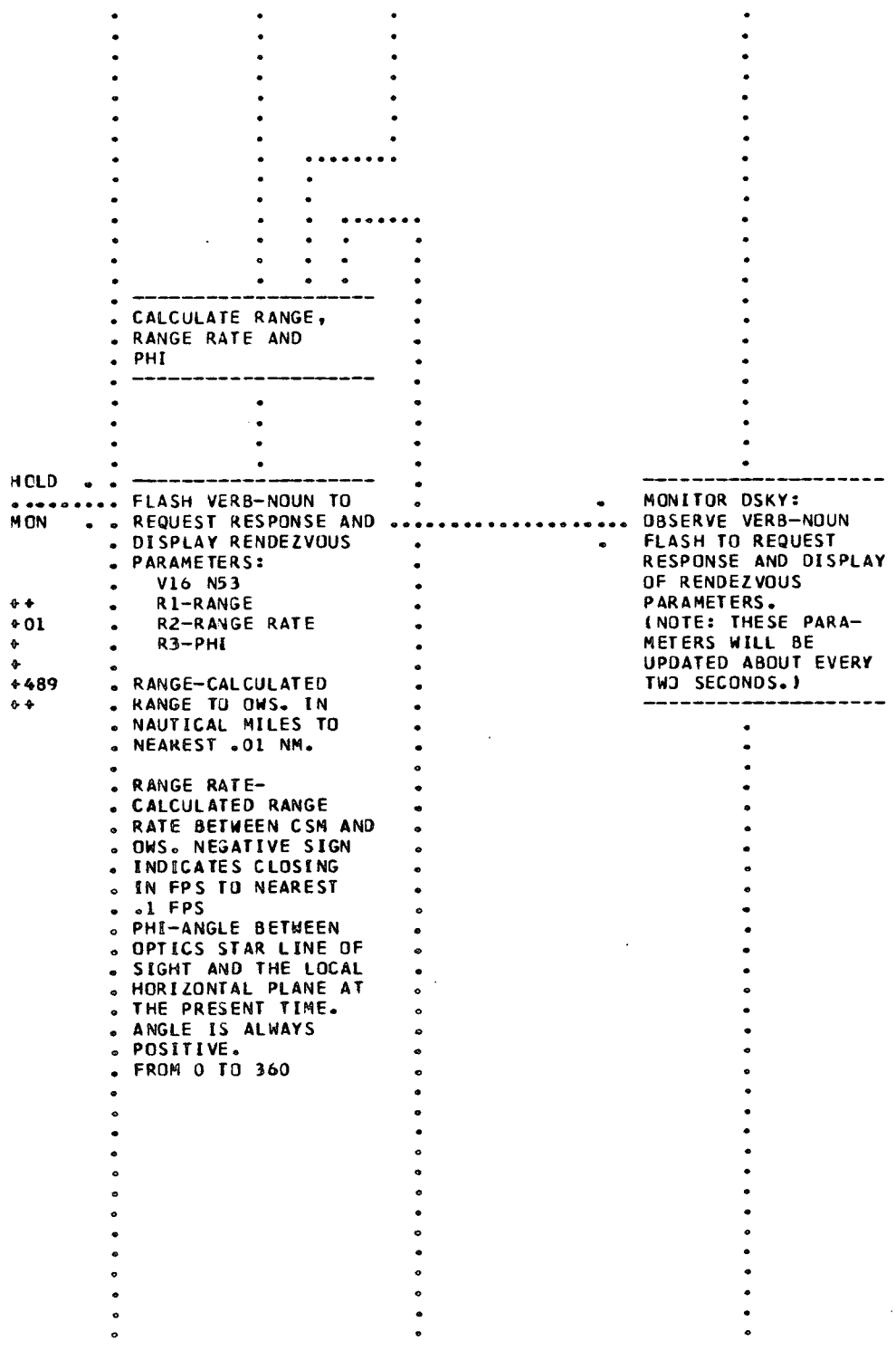

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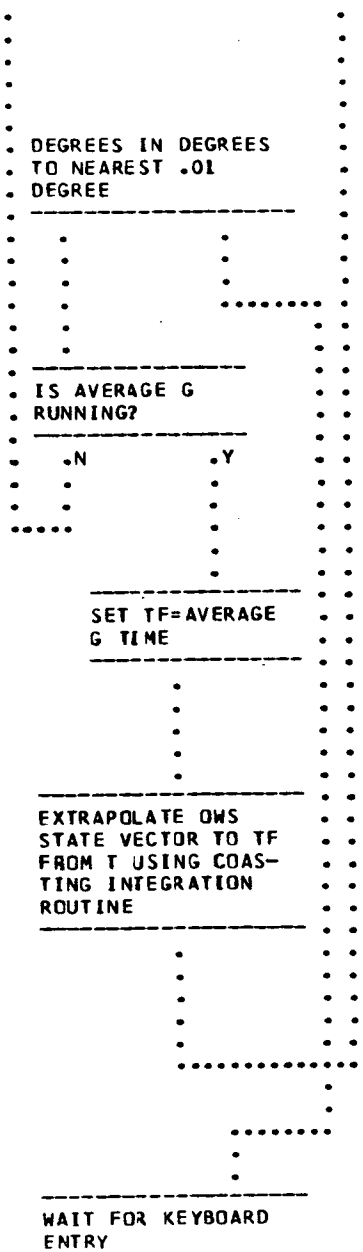

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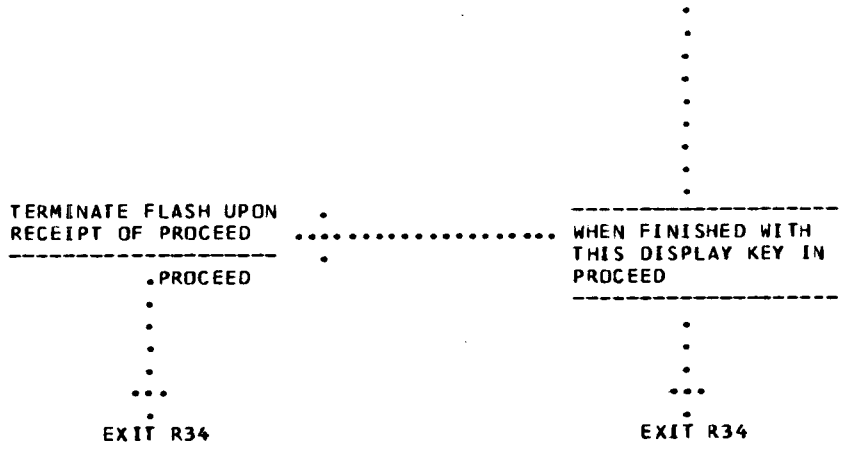


#240

CHANGE CONTROL NOTES

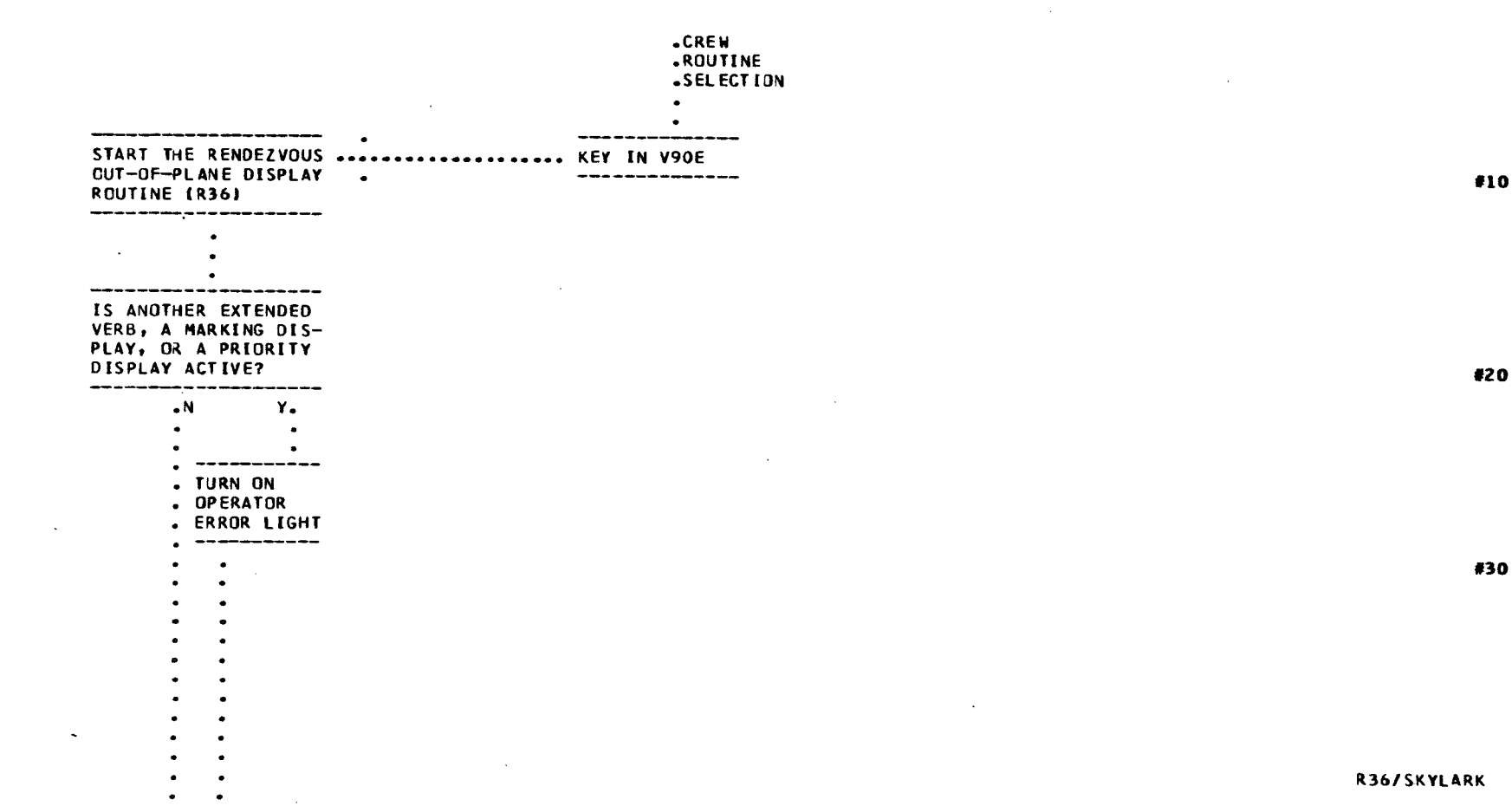
REV 00 PCR 007, PCN 410
REV 01 PCN 489

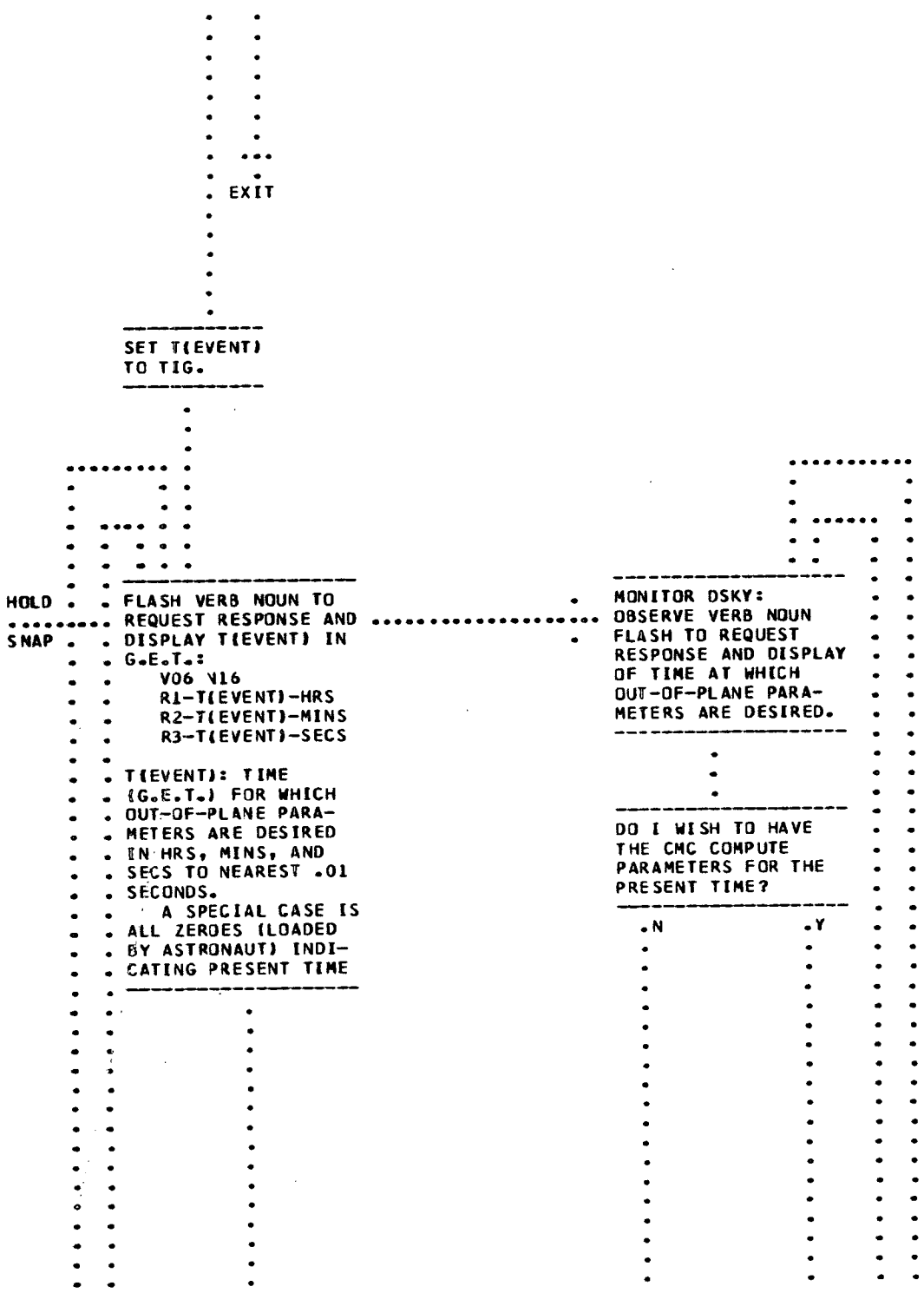
RENDEZVOUS OUT-OF-PLANE DISPLAY ROUTINE (R36) REV 00 05/19/71

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS OUT-OF-PLANE PARAMETERS (Y CM, Y DOT CM, Y DOT OWS).

ASSUMPTIONS: (1) THESE PARAMETERS ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



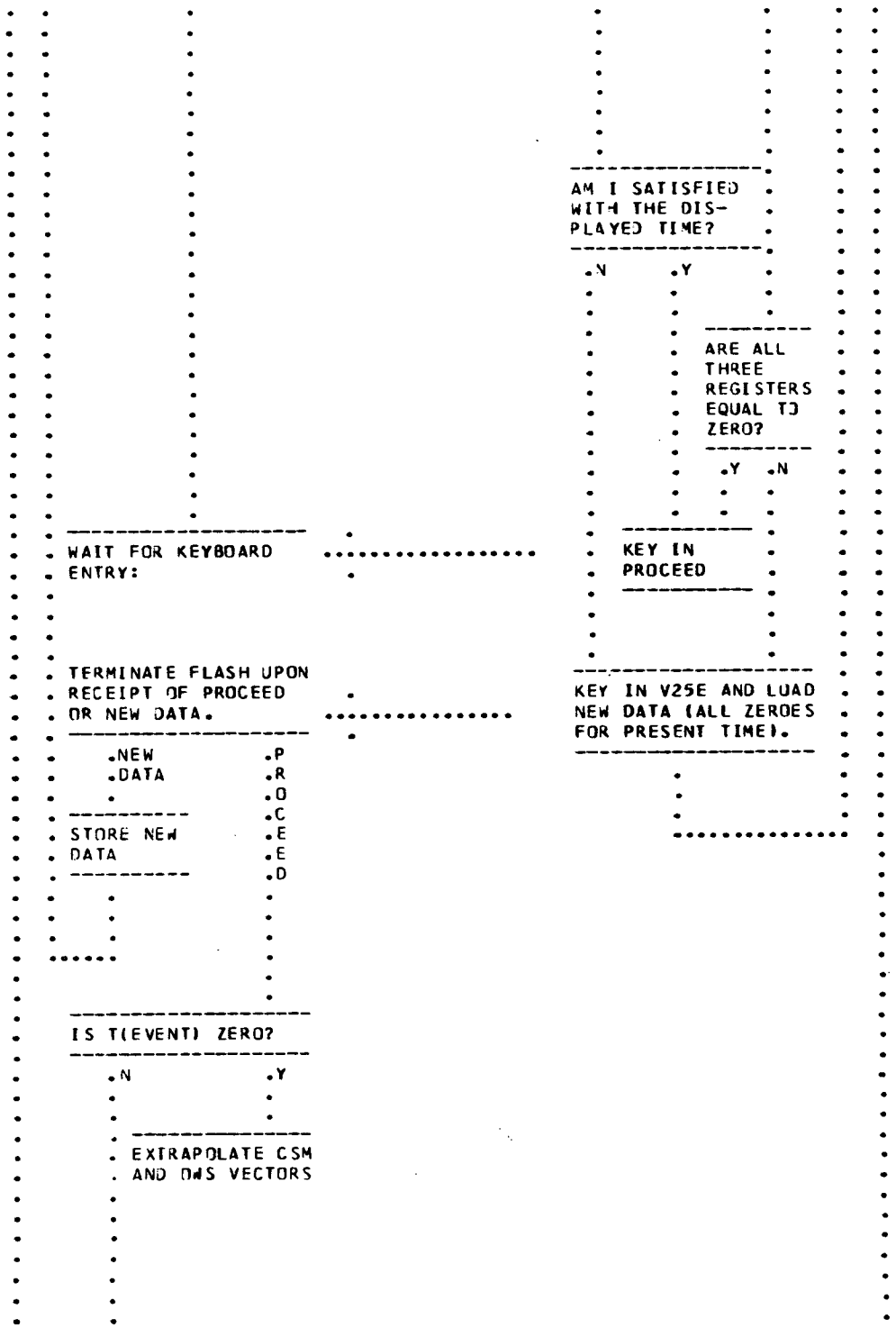

EXIT
SET T(EVENT)
TO TIG.
HOLD
SNAP
FLASH VERB NOUN TO
REQUEST RESPONSE AND
DISPLAY T(EVENT) IN
G.E.T.:
V06 N16
R1-T(EVENT)-HRS
R2-T(EVENT)-MINS
R3-T(EVENT)-SECS
T(EVENT): TIME
(G.E.T.) FOR WHICH
OUT-OF-PLANE PARA-
METERS ARE DESIRED
IN HRS, MINS, AND
SECS TO NEAREST .01
SECONDS.
A SPECIAL CASE IS
ALL ZEROES (LOADED
BY ASTRONAUT) INDI-
CATING PRESENT TIME
MONITOR DSKY:
OBSERVE VERB NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIME AT WHICH
OUT-OF-PLANE PARA-
METERS ARE DESIRED.
DO I WISH TO HAVE
THE CMC COMPUTE
PARAMETERS FOR THE
PRESENT TIME?
.N
.Y

#40

#50

#60

#70



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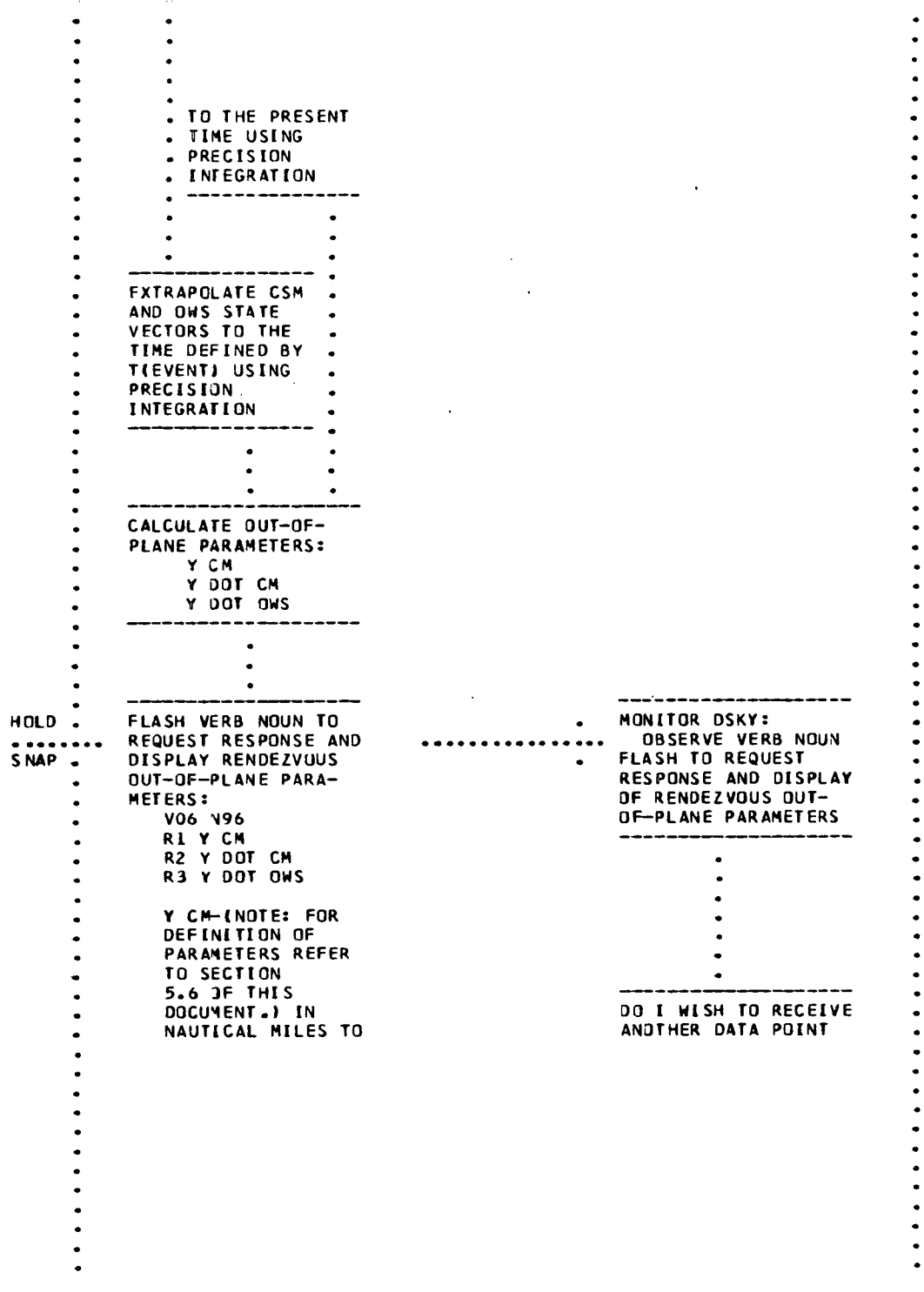

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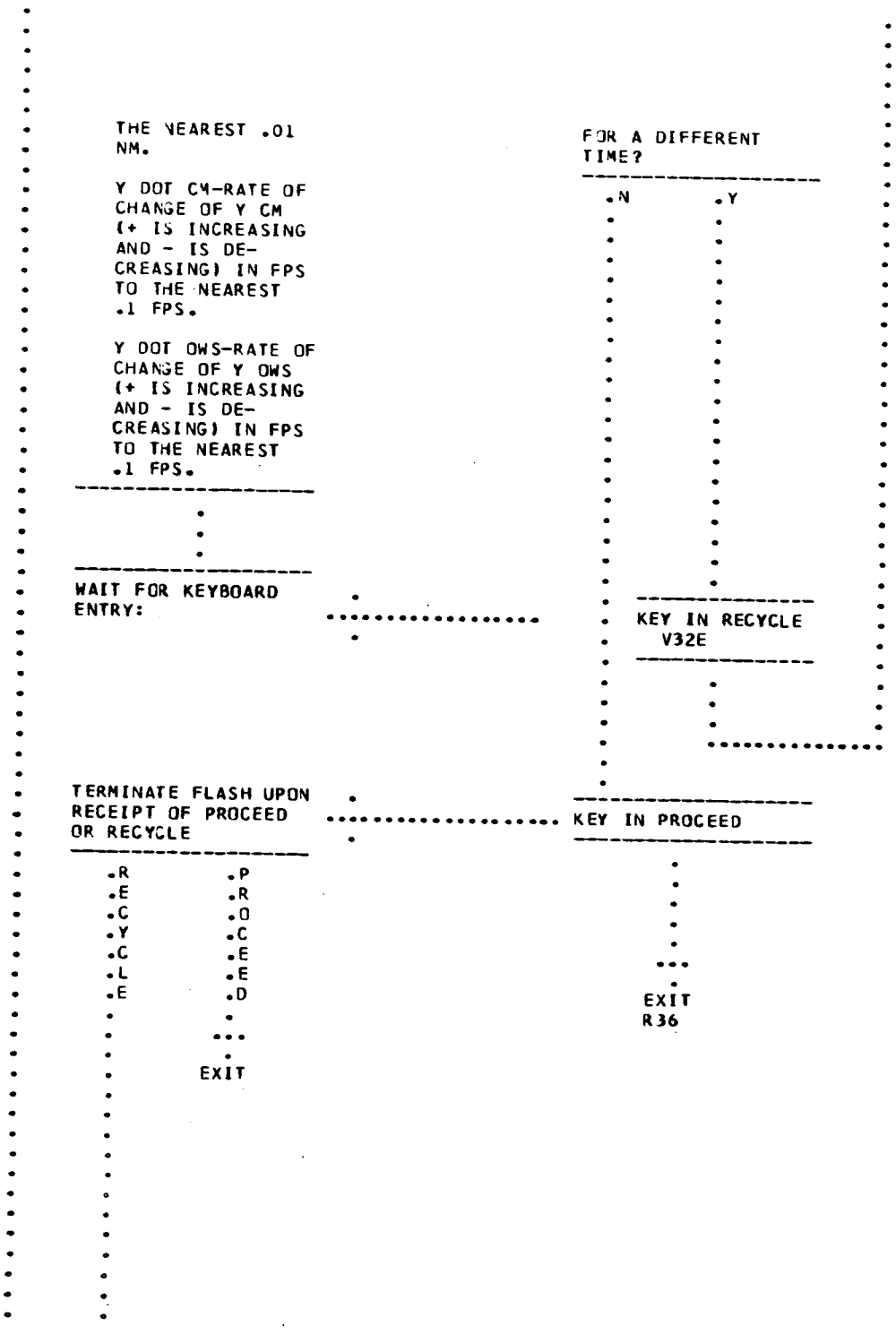

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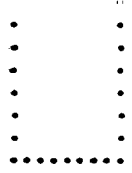


#230

CHANGE CONTROL NOTES

REV 00 PCR 452, PCN 457

SPS THRUST FAIL ROUTINE (R40) REV 01 03/20/72

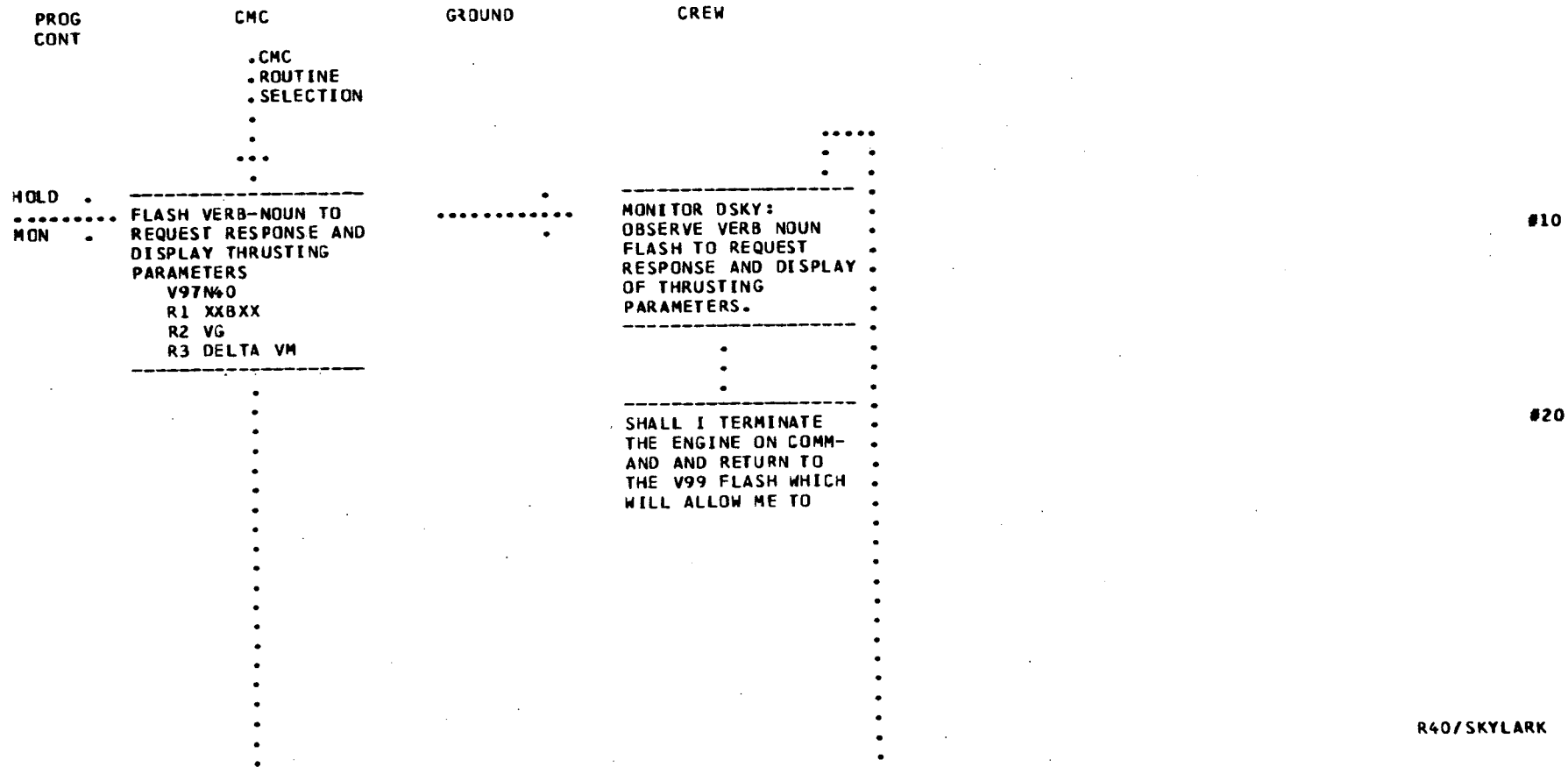
PURPOSE: (1) TO INDICATE TO THE ASTRONAUT THAT THE GNCS HAS DETECTED A THRUST FAILURE.

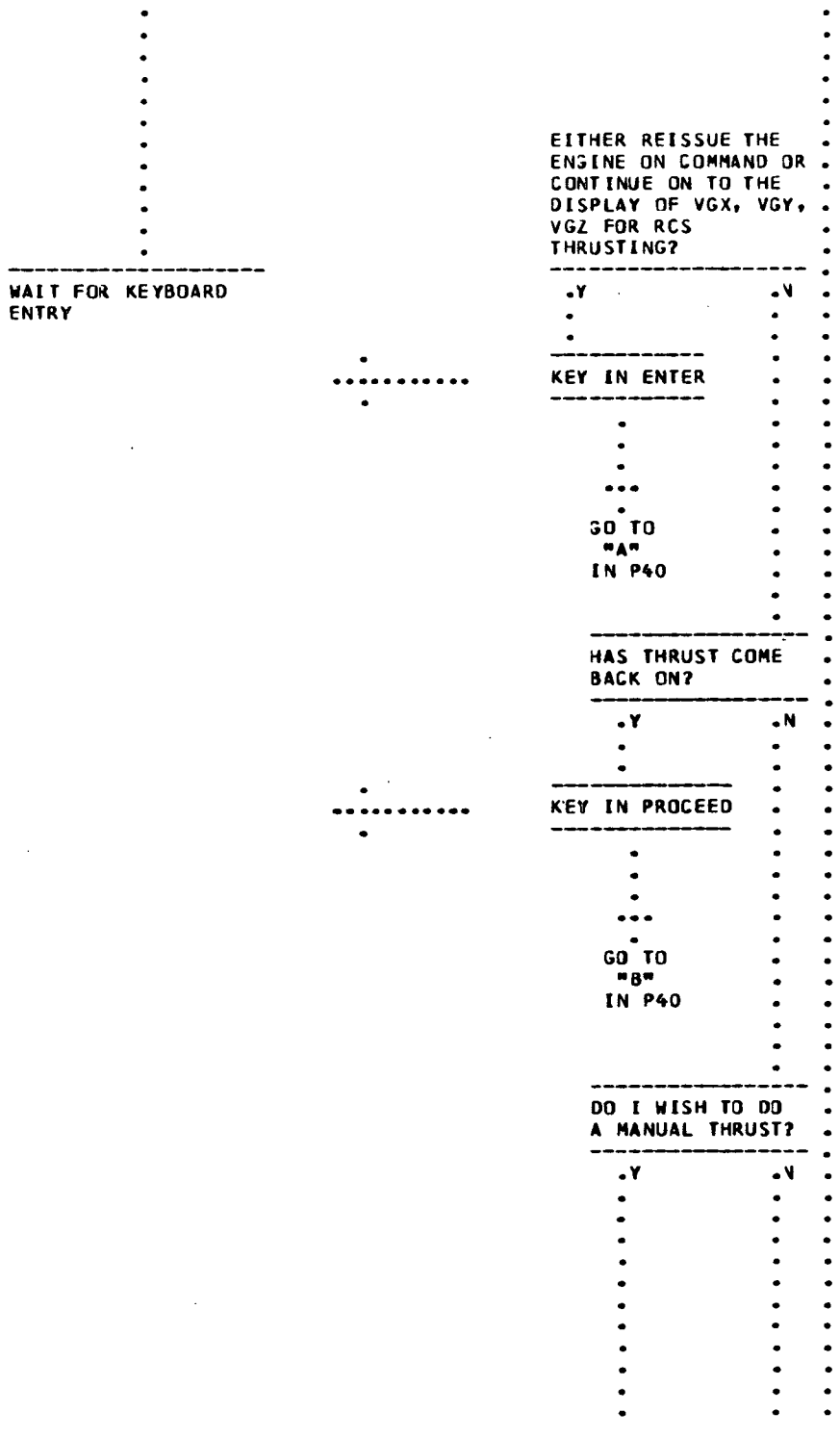
(2) TO PROVIDE THE ASTRONAUT A FLASHING DISPLAY TO WHICH HE CAN RESPOND AS DESCRIBED IN THE FLOW.

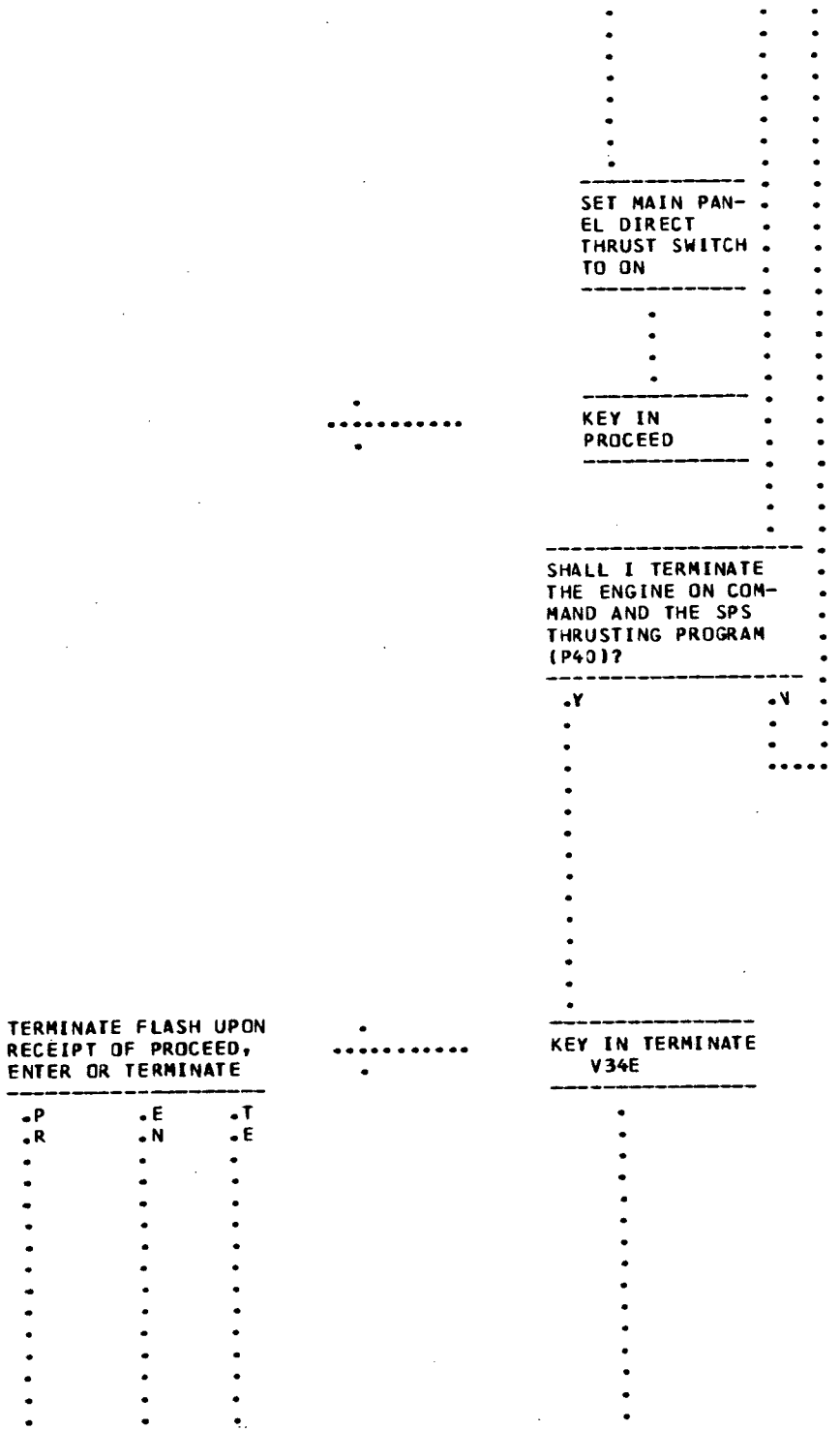
ASSUMPTIONS: (1) THE GNCS HAS DETECTED A THRUST FAILURE AND HAS SHUT OFF CROSS PRODUCT STEERING AND HAS STOPPED C.G. TRACKING.

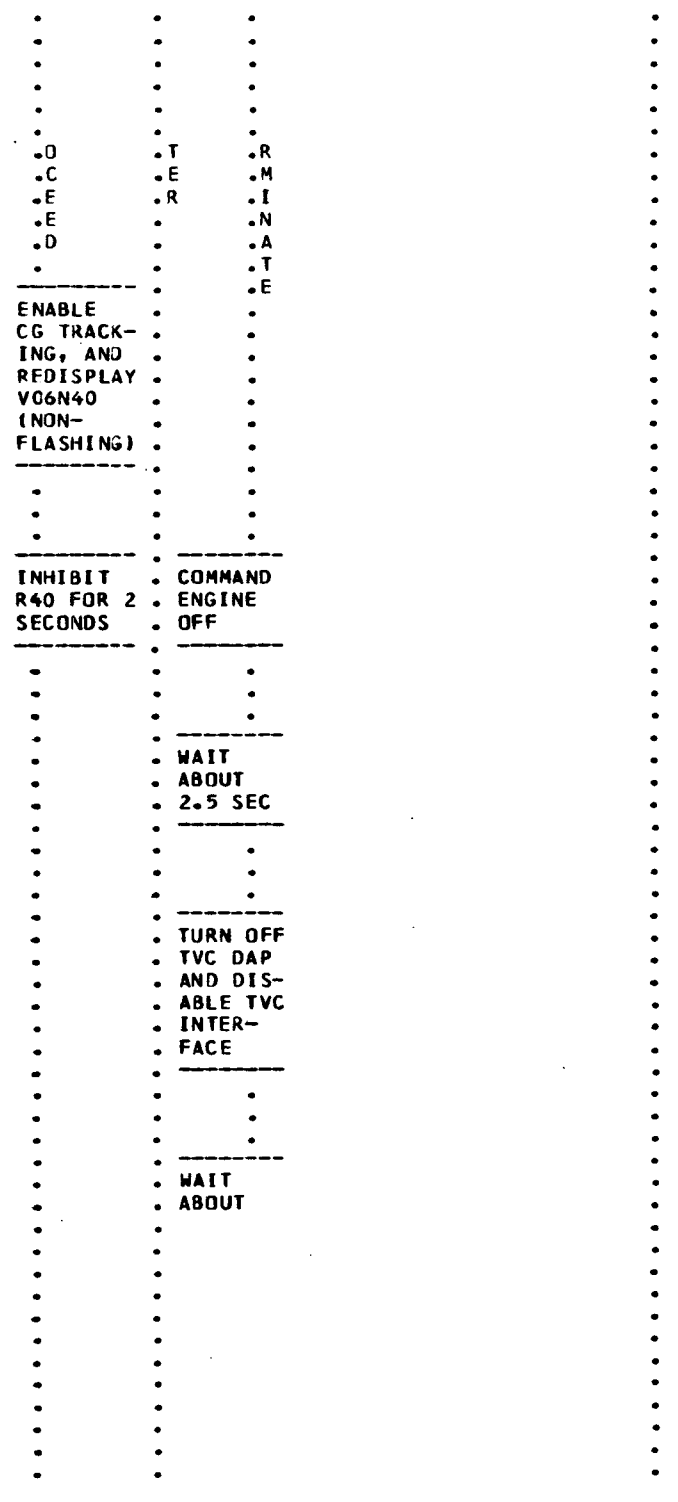
(2) IF THE ASTRONAUT KEYS IN PROCEED ON THIS DISPLAY THRUST FAILURE DETECTION WILL BE INHIBITED FOR 2 SECONDS TO PREVENT A PREMATURE THRUST FAIL INDICATION.

(3) THIS ROUTINE IS SELECTED BY THE SPS THRUSTING PROGRAM (P40)




EITHER REISSUE THE ENGINE ON COMMAND OR CONTINUE ON TO THE DISPLAY OF VGX, VGY, VGZ FOR RCS THRUSTING?
#30
WAIT FOR KEYBOARD ENTRY
.Y
.N
KEY IN ENTER
#40
GO TO "A" IN P40
HAS THRUST COME BACK ON?
#50
.Y
.N
KEY IN PROCEED
#60
GO TO "B" IN P40
DO I WISH TO DO A MANUAL THRUST?
#70
.Y
.N


SET MAIN PANEL DIRECT THRUST SWITCH TO ON
#80
KEY IN PROCEED
#90
SHALL I TERMINATE THE ENGINE ON COMMAND AND THE SPS THRUSTING PROGRAM (P40)?
#100
Y
N
#110
KEY IN TERMINATE V34E
TERMINATE FLASH UPON RECEIPT OF PROCEED, ENTER OR TERMINATE
#120
P R
E N
T E

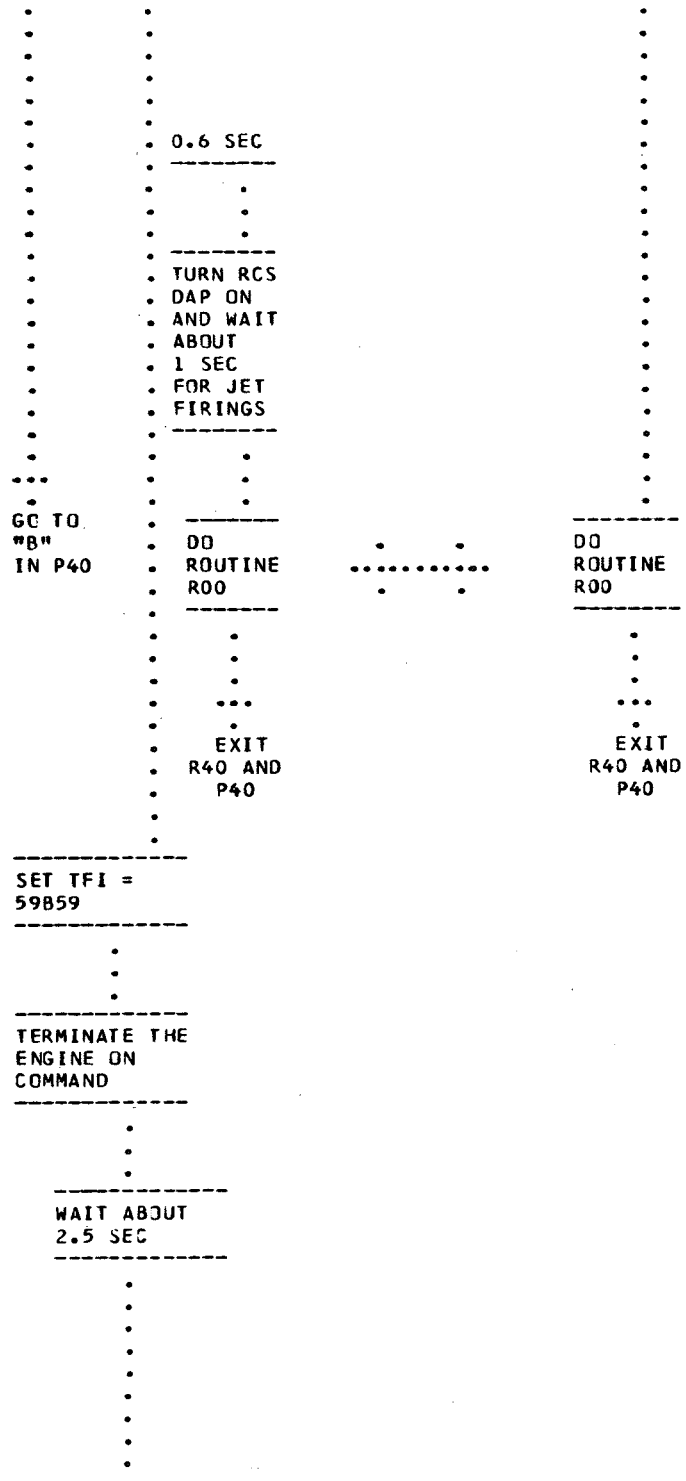


#130

#140

#150

#160



#170

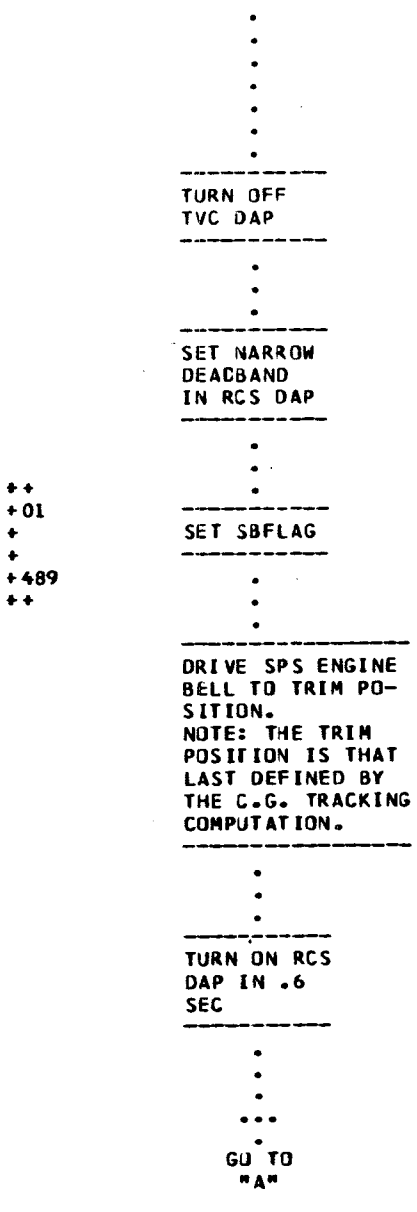
#180

#190

#200

#210

#220



#230

#240

#250

#260

IN P40

#270

CHANGE CONTROL NOTES

REV 00 PCN 457
REV 01 PCN 489

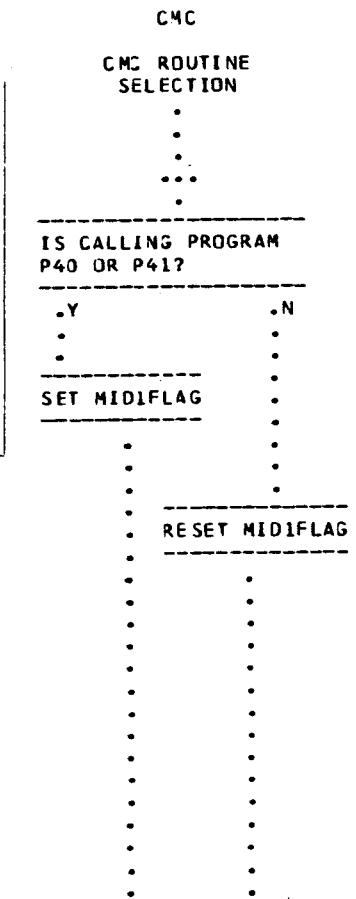
STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) REV 00 05/19/71

PURPOSE: (1) TO INTEGRATE THE STATE VECTOR OF THIS VEHICLE TO THE TIME AT WHICH THE AVERAGE G ROUTINE WILL BE TURNED ON BY THE CALLING PROGRAM.

(2) TO DEFINE A NEW TIG FOR PROGRAMS 40 OR 41 IN THE EVENT THE STATE VECTOR CAN NOT BE INTEGRATED TO THE TIME DEFINED BY PROGRAMS 40 OR 41 AND TO LIGHT THE ALARM LIGHT TO INFORM THE CREW THAT TIG HAS BEEN SLIPPED.

ASSUMPTIONS: (1) THERE IS A SIGNIFICANT AMOUNT OF TIME REQUIRED BY THE CMC TO TURN ON THE AVERAGE G ROUTINE. THIS TIME IS APPROXIMATELY 2 SECONDS PER TIME STEP IN EARTH ORBIT WHERE TIME STEP IS EQUAL TO APPROXIMATELY 240 SECONDS.

(2) THE ROUTINE IS ONLY AUTOMATICALLY SELECTED.



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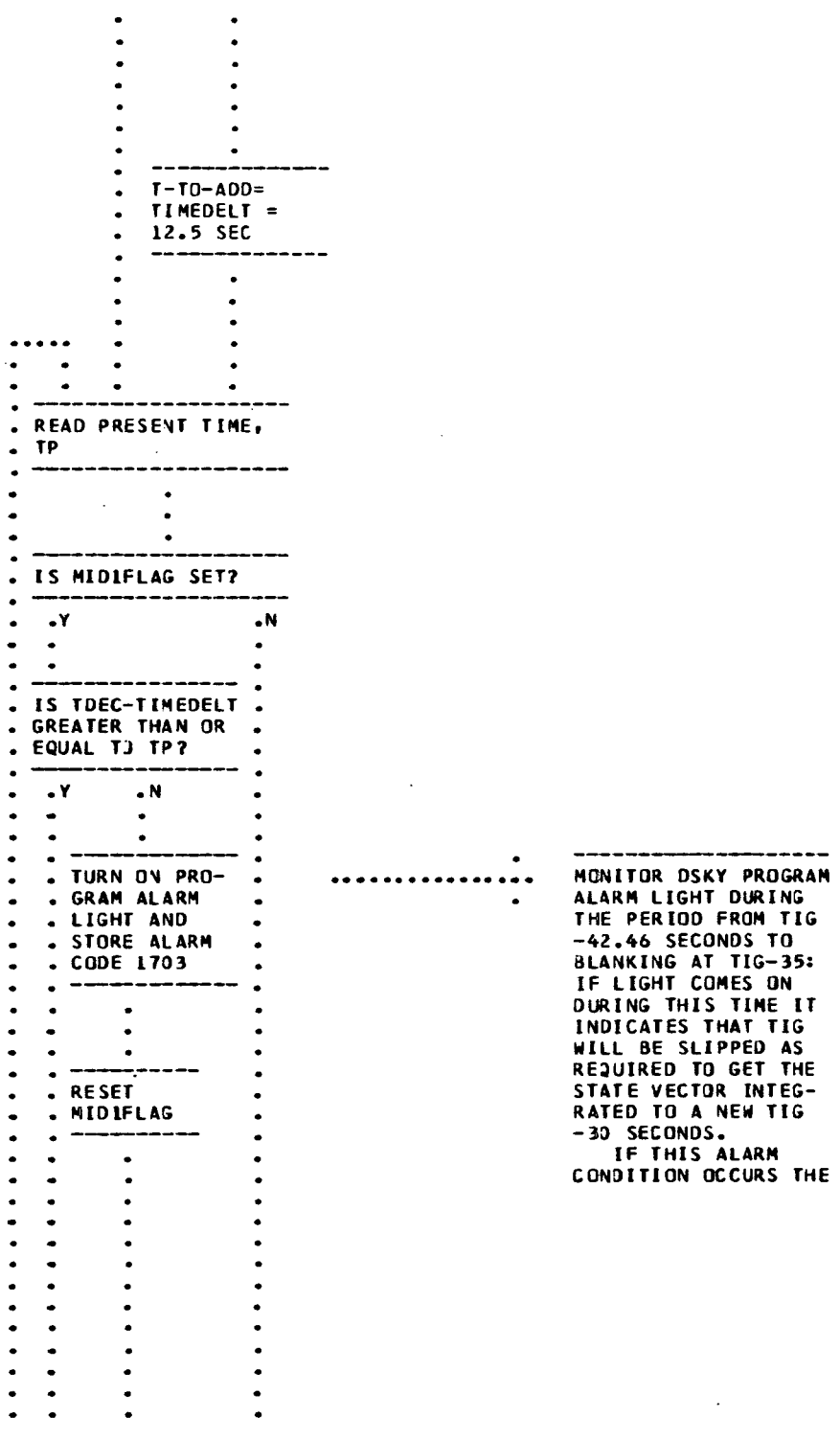
#20


T-TO-ADD=
TIMEDELT =
12.5 SEC
READ PRESENT TIME,
TP
IS MIDIFLAG SET?
.Y
.N
IS TDEC-TIMEDELT
GREATER THAN OR
EQUAL TO TP?
.Y
.N
TURN ON PRO-
GRAM ALARM
LIGHT AND
STORE ALARM
CODE 1703
RESET
MIDIFLAG
MONITOR DSKY PROGRAM
ALARM LIGHT DURING
THE PERIOD FROM TIG
-42.46 SECONDS TO
BLANKING AT TIG-35:
IF LIGHT COMES ON
DURING THIS TIME IT
INDICATES THAT TIG
WILL BE SLIPPED AS
REQUIRED TO GET THE
STATE VECTOR INTEG-
RATED TO A NEW TIG
-30 SECONDS.
IF THIS ALARM
CONDITION OCCURS THE

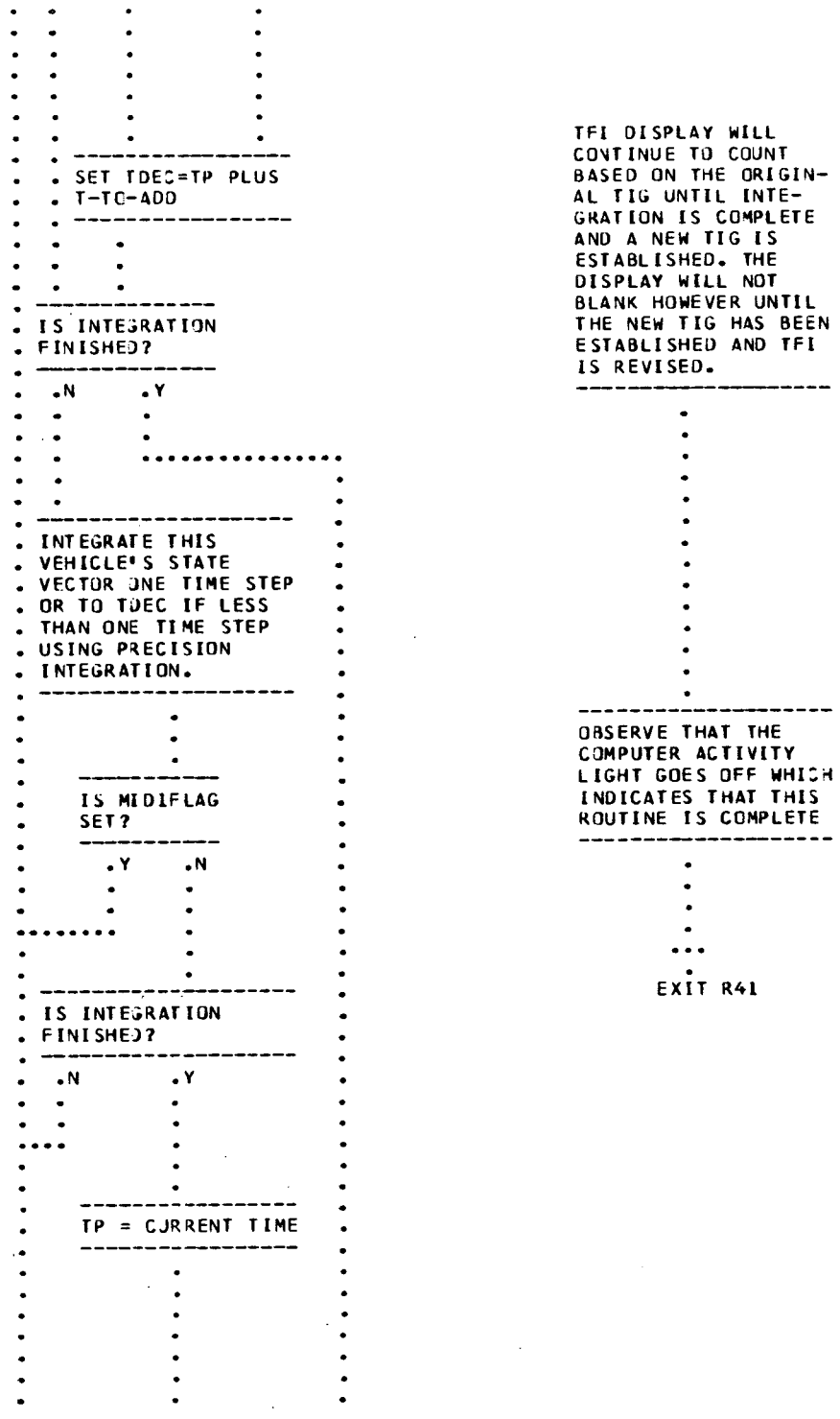
#30

#40

#50

#60

#70



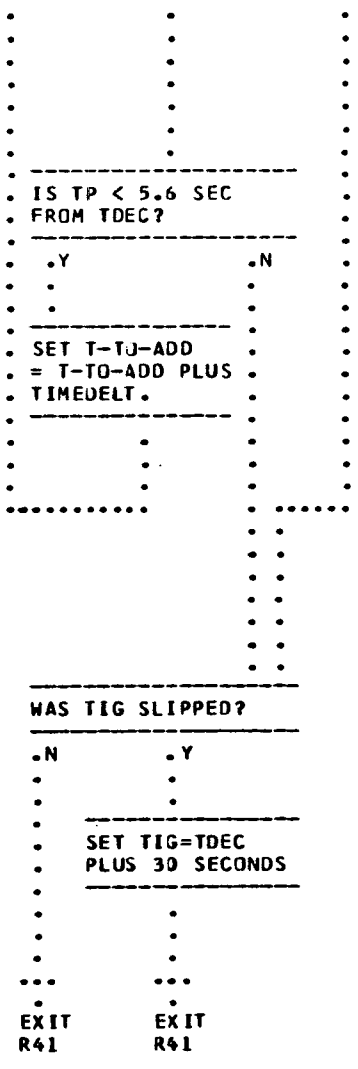
#80

#90

#100

#110

#120



#130

#140

#150

#160

#170

CHANGE CONTROL NOTES

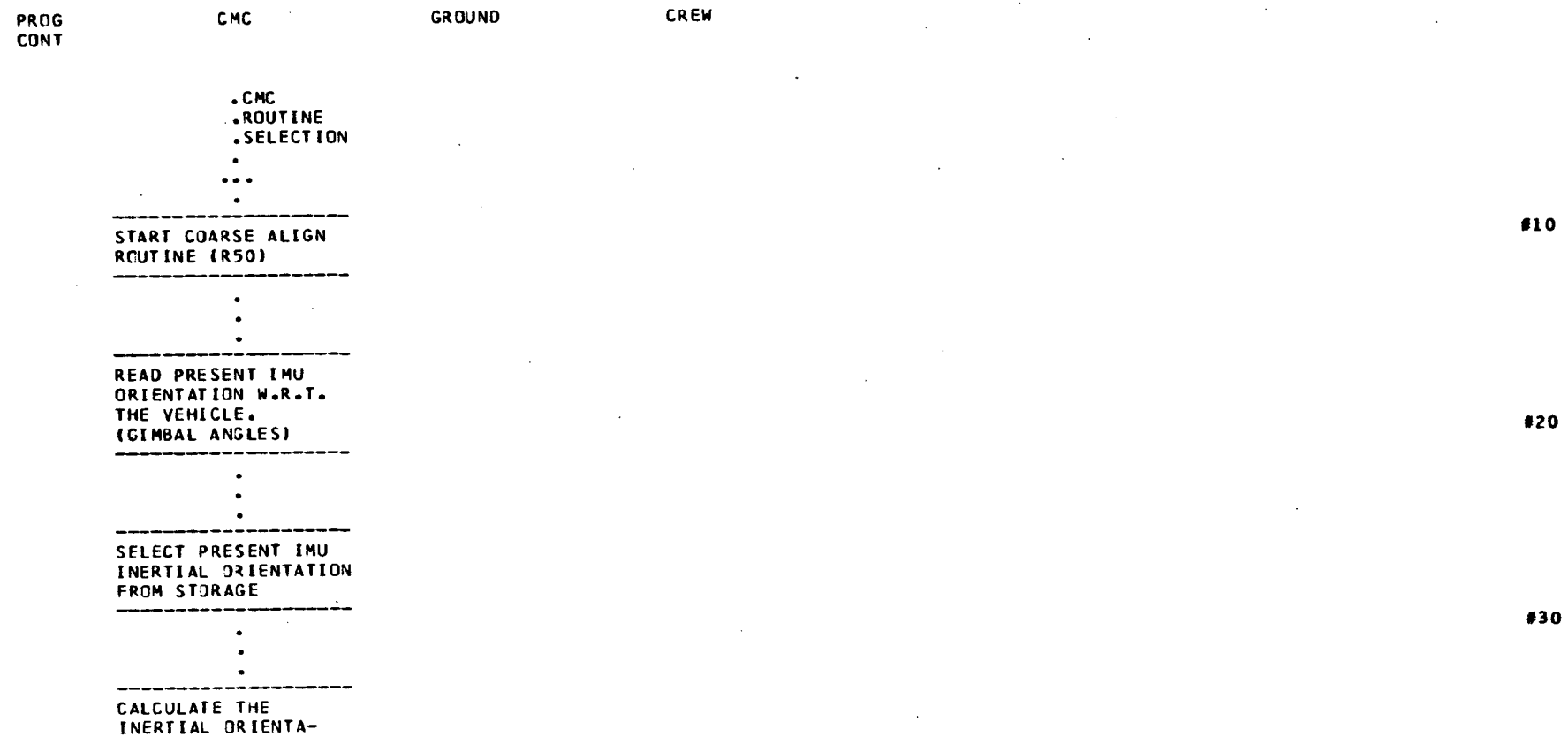
REV 00 PCN 410,457

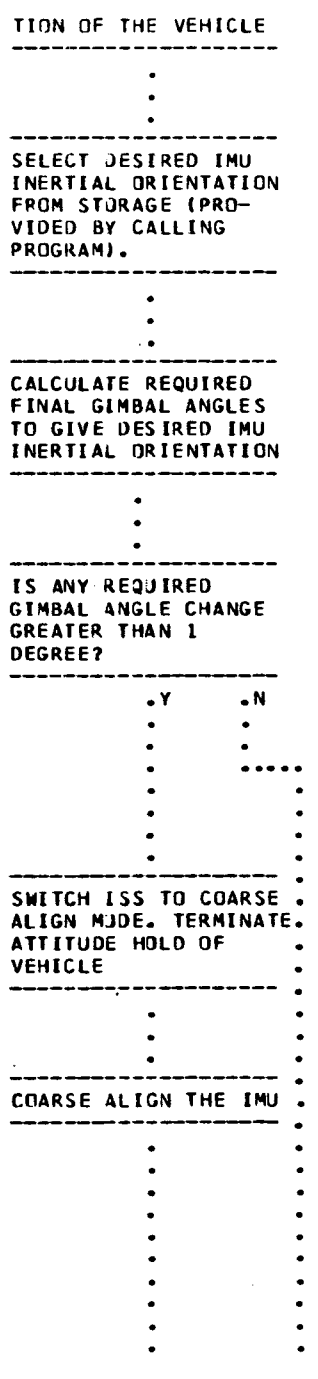
COARSE ALIGN ROUTINE (R50) REV 00 05/19/71

PURPOSE: (1) TO COARSE ALIGN AND GYRO TRIM THE IMU TO A DESIRED INERTIAL ORIENTATION.

ASSUMPTIONS: (1) THE DESIRED IMU INERTIAL ORIENTATION HAS BEEN SPECIFIED BY THE CALLING PROGRAM.

(2) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52) AND BY THE BACKUP IMU REALIGN PROGRAM (P54).




TION OF THE VEHICLE
SELECT DESIRED IMU INERTIAL ORIENTATION FROM STORAGE (PROVIDED BY CALLING PROGRAM).
CALCULATE REQUIRED FINAL GIMBAL ANGLES TO GIVE DESIRED IMU INERTIAL ORIENTATION
IS ANY REQUIRED GIMBAL ANGLE CHANGE GREATER THAN 1 DEGREE?
Y
N
SWITCH ISS TO COARSE ALIGN MODE. TERMINATE ATTITUDE HOLD OF VEHICLE
COARSE ALIGN THE IMU

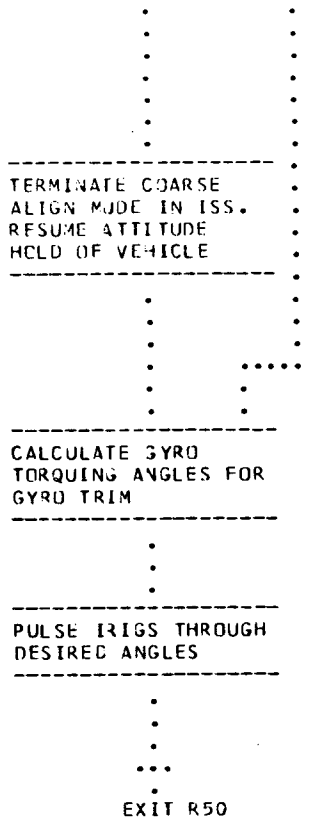
#40

#50

#60

#70

#80



#90

#100

#110

CHANGE CONTROL NOTES

REV 00 PCR 416

AUTOMATIC OPTICS POSITIONING ROUTINE (R52) REV 00 05/19/71

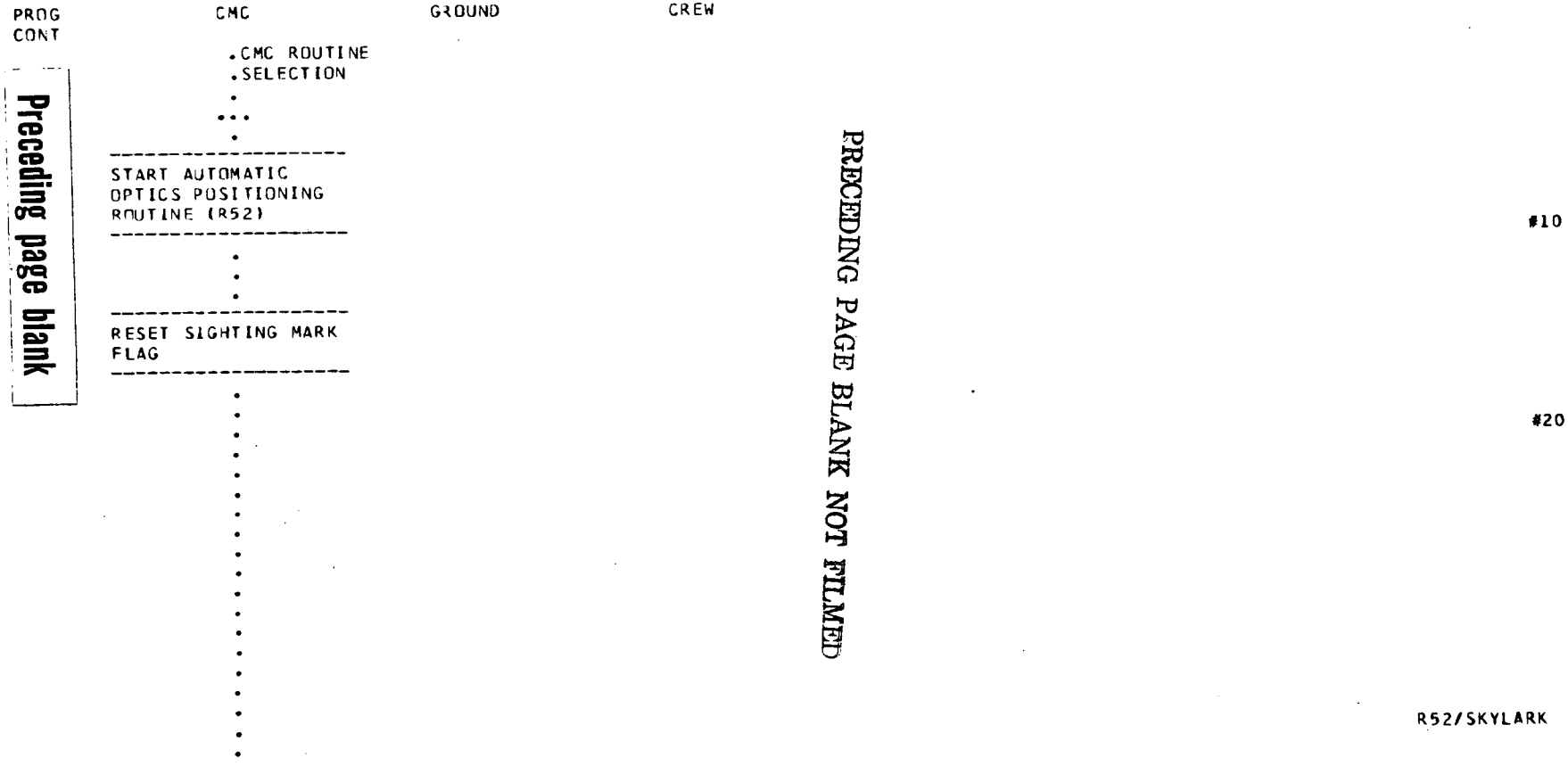
PURPOSE: (1) TO POINT THE STAR LOS OF THE OPTICS AT A STAR DEFINED BY THE PROGRAM OR BY DSKY INPUT (ASTRONAUT).

(2) TO POINT THE STAR LOS OF THE OPTICS AT THE OWS DURING RENDEZVOUS TRACKING OPERATIONS.

(3) TO DO THE TRACKING ATTITUDE ROUTINE (R61) APPROXIMATELY EVERY 2 SECONDS DURING RENDEZVOUS TRACKING OPERATIONS.

ASSUMPTIONS: (1) THE ROUTINE IS AUTOMATICALLY SELECTED BY IMU REALIGN PROGRAM (P52) OR BY THE UNIVERSAL TRACKING PROGRAM (P20).

(2) THIS ROUTINE IS SELF PERPETJATING AND IS TERMINATED BY THE SIGHTING MARK ROUTINE (R53) FOR STARS AND BY RESETTING THE TRACK FLAG FOR OWS.



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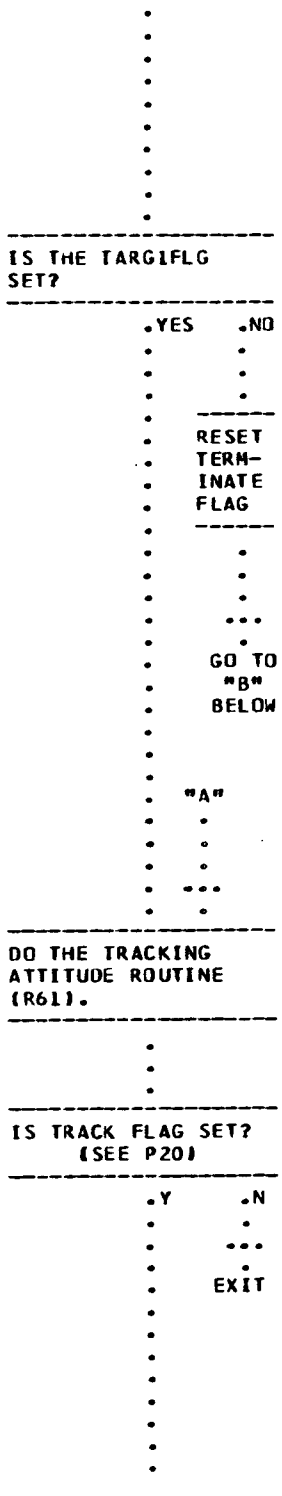


THE LOGIC FROM THIS POINT TO "B" BELOW IS FOR THE OWS TARGET CASE ONLY.

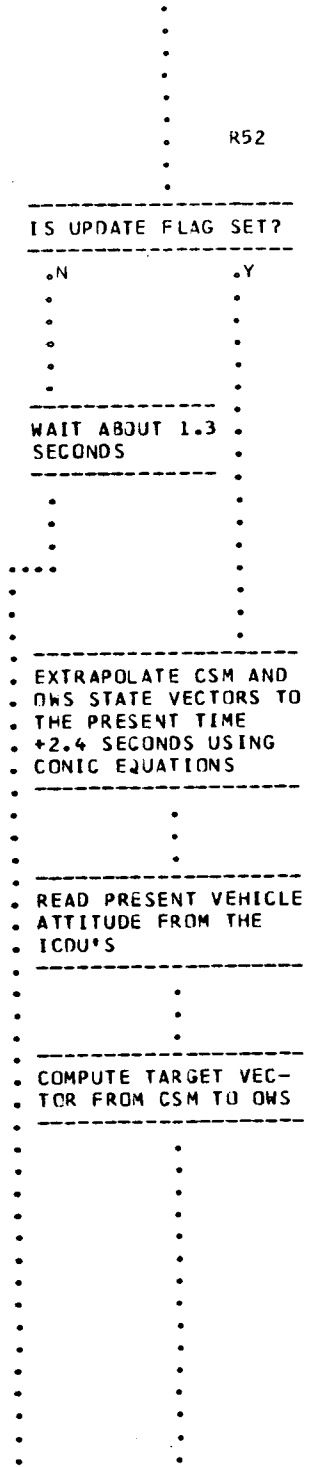
#30

#40

#50

#60

#70



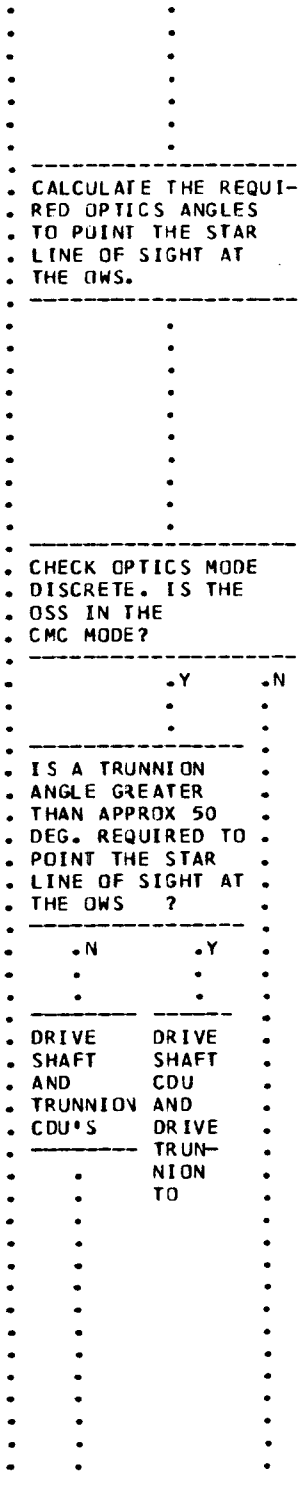
#80

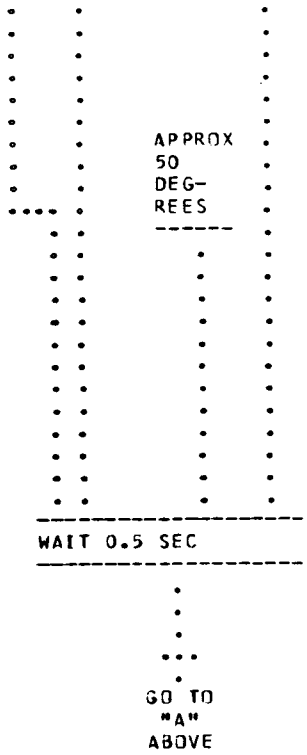
#90

#100

#110

#120


CALCULATE THE REQUI-
RED OPTICS ANGLES
TO POINT THE STAR
LINE OF SIGHT AT
THE OWS.
#130
CHECK OPTICS MODE
DISCRETE. IS THE
OSS IN THE
CMC MODE?
#140
Y
N
IS A TRUNNION
ANGLE GREATER
THAN APPROX 50
DEG. REQUIRED TO
POINT THE STAR
LINE OF SIGHT AT
THE OWS ?
#150
N
Y
DRIVE
SHAFT
AND
TRUNNION
CDU'S
#160
DRIVE
SHAFT
CDU
AND
DRIVE
TRUN-
NION
TO
#170



#180

#190

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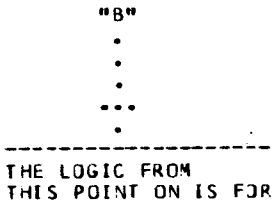
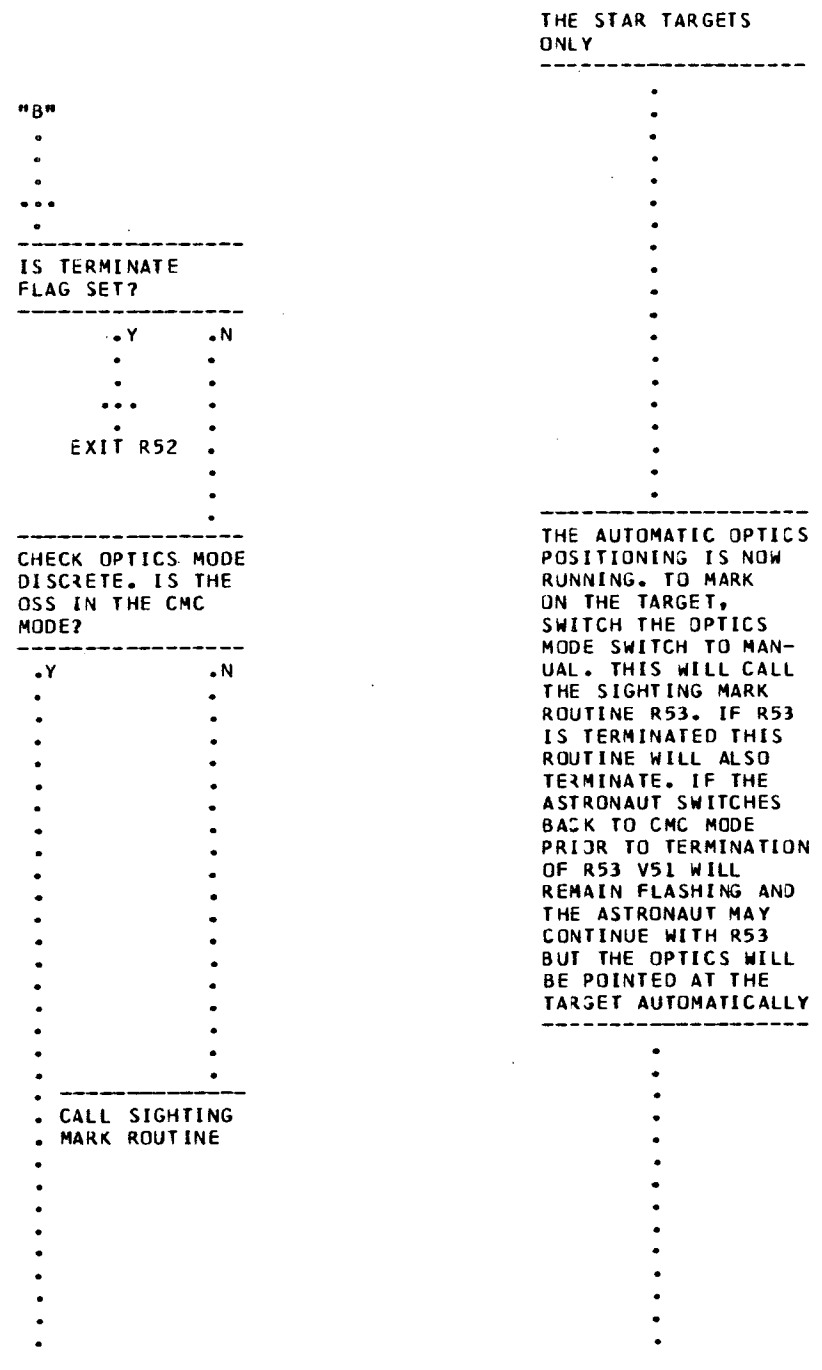




#220

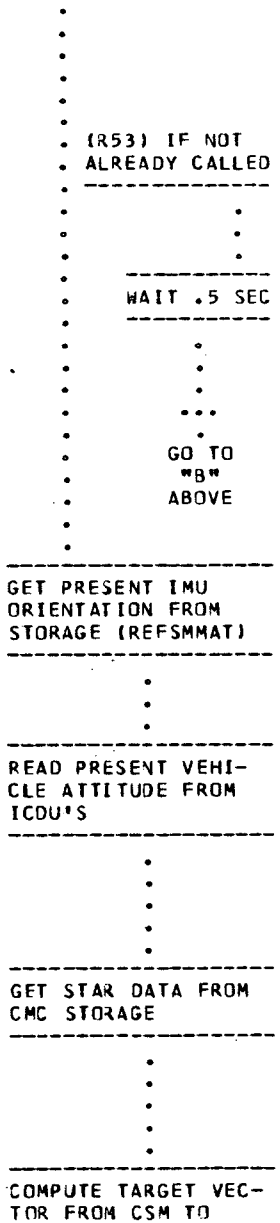
#230

#240

#250

#260

#270

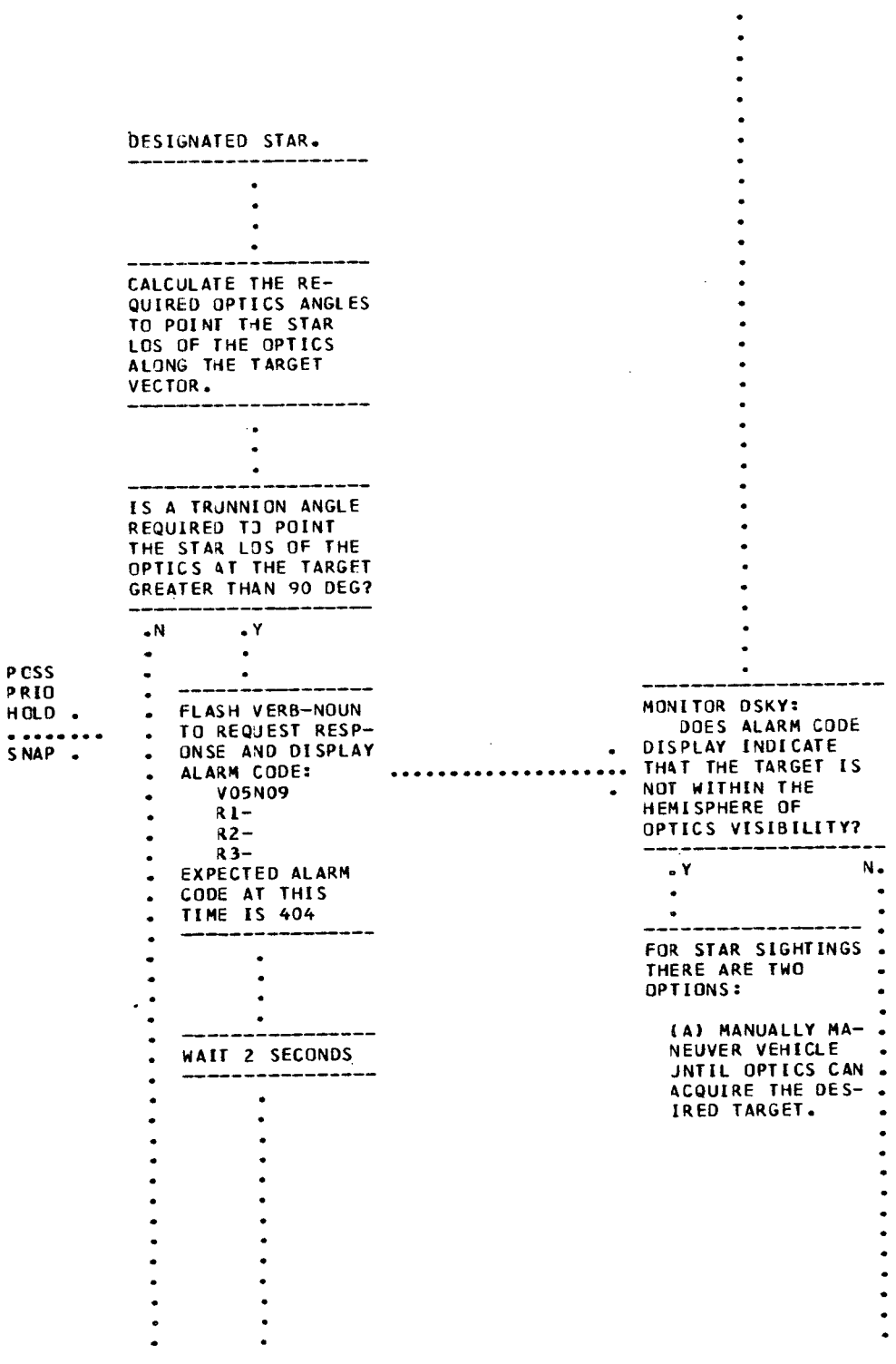


#280

#290

#300

#310



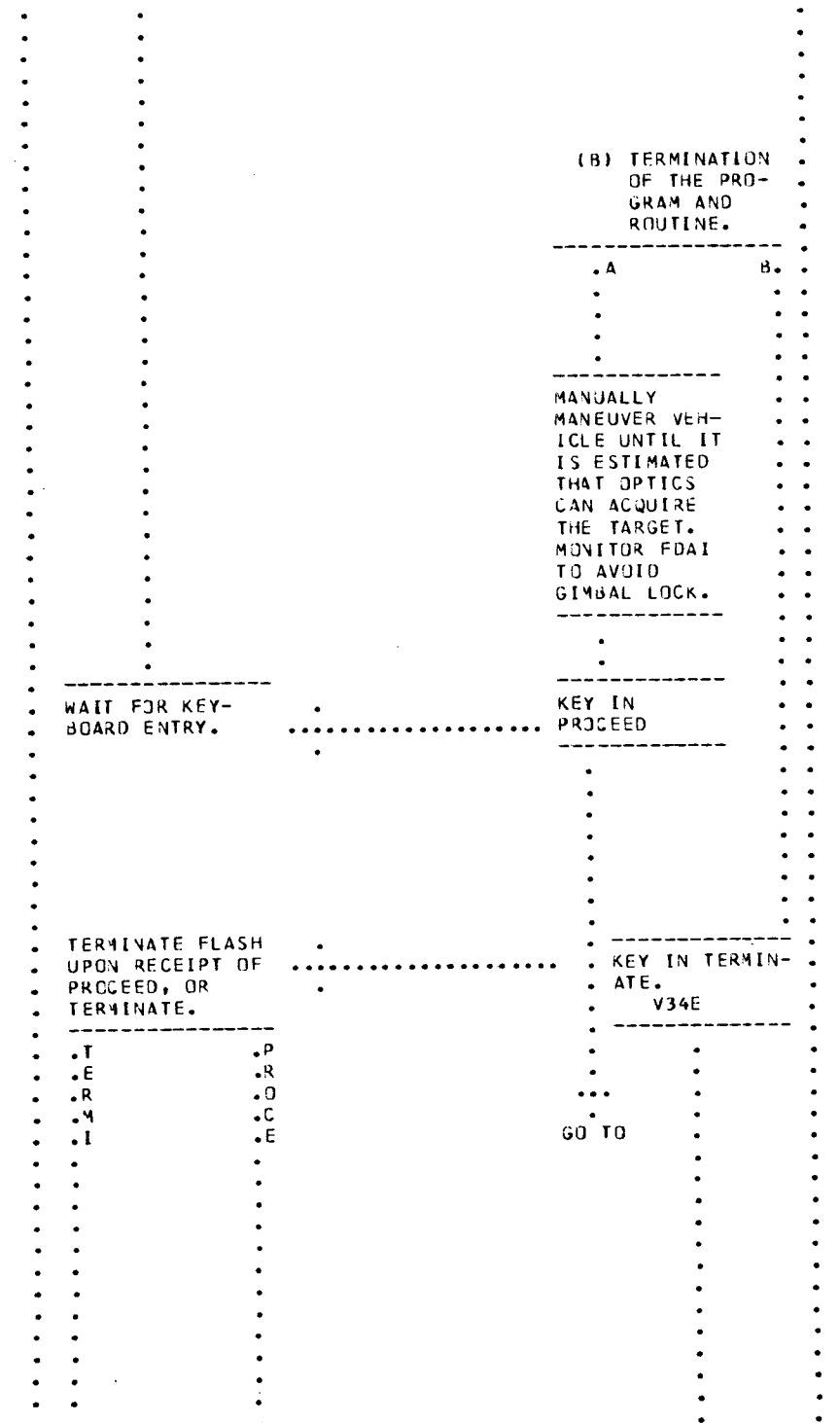
#320

#330

#340

#350

#360



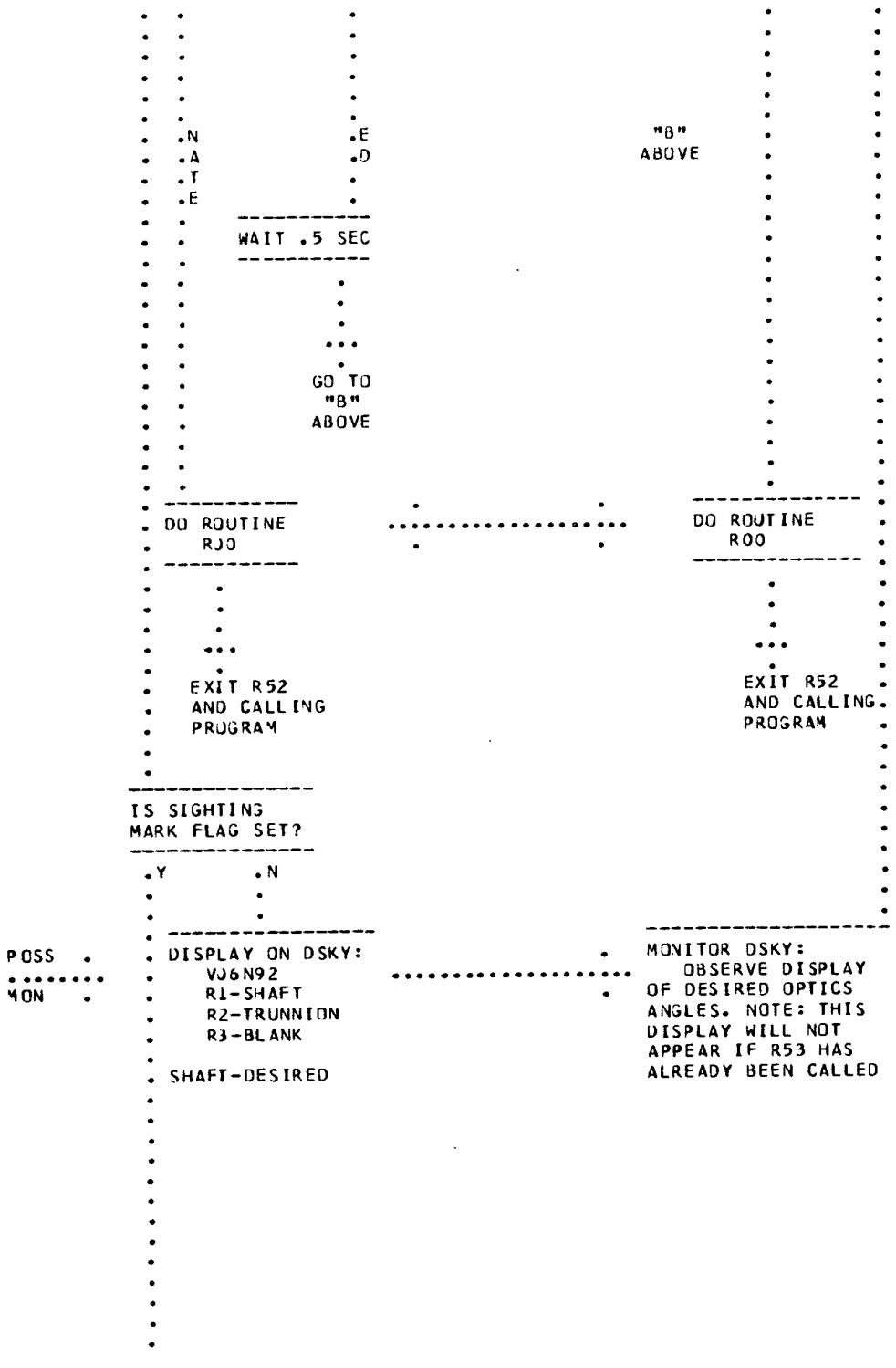
#370

#380

#390

#400

#410



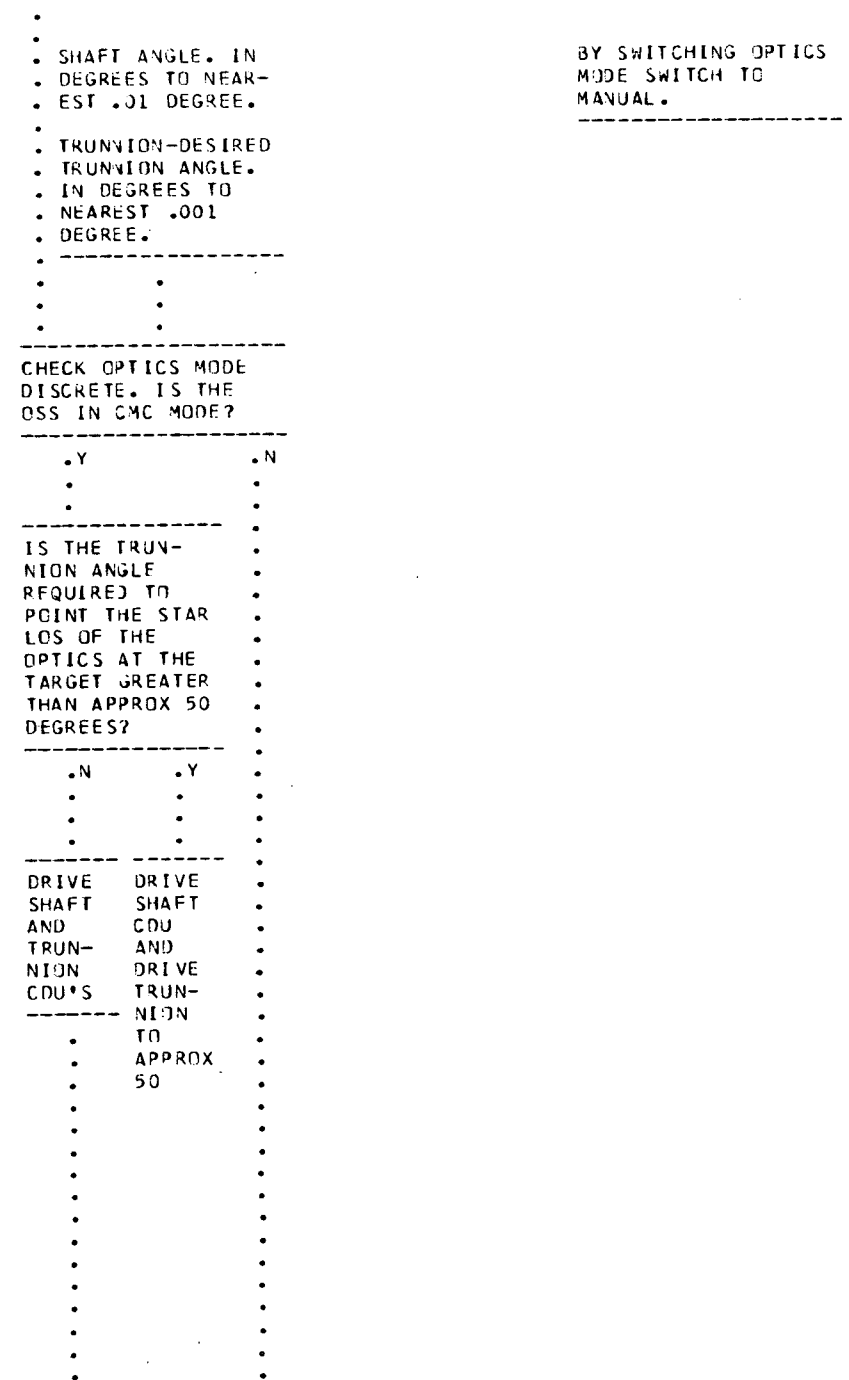
#420

#430

#440

#450

#460



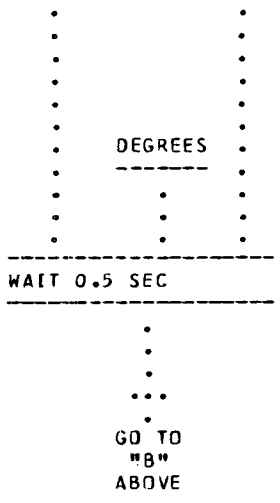
BY SWITCHING OPTICS MODE SWITCH TO MANUAL.

#470

#480

#490

#500



#510

#520

CHANGE CONTROL NOTES

REV 00 PCR 017,018,019, PCN 457

SIGHTING MARK ROUTINE (R53) REV 01 03/20/72

PURPOSE: (1) TO PERFORM A SATISFACTORY NUMBER OF OPTICAL SIGHTING MARKS FOR THE REQUESTING PROGRAM (OR ROUTINE).

ASSUMPTIONS: (1) SIGHTINGS ARE MADE WITH EITHER SCT, SXT, ATM SUN SENSOR OR ATM STAR TRACKER.

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 3 ICDU ANGLES, 2 OCDU ANGLES (FOR OPTICS MARKS), AND THE TIME OF THE MARK. IN ADDITION, IF THE MARK IS FOR THE ATM STAR TRACKER THE CREW WILL BE REQUESTED TO LOAD THE STAR TRACKER GIMBAL ANGLES (N14).

(3) THE ROUTINE REQUIRES THAT ONE MARK BE TAKEN FOR NORMAL TERMINATION. IF THE ASTRONAUT GETS INTO THIS ROUTINE AND ELECTS NOT TO MARK HE SHOULD KEY V34E OR CALL A NEW PROGRAM BY KEYING IN V37EXXE.

(4) THE ROTATION OR MINIMUM IMPULSE CONTROLLER MAY BE USED AS REQUIRED TO REDUCE THE S/C DRIFT RATE.

(5) IF THE MARK IS FOR THE ATM SUN SENSOR, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY AND THE ATM MUST BE IN THE SOLAR INERTIAL ATTITUDE.

(6) IF THE MARK IS FOR THE ATM STAR TRACKER, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY AND THE STAR TRACKER GIMBAL ANGLES LOADED IN N14 SHOULD BE THOSE RECORDED BY THE CREW AT THE TIME OF THE MARK.

(7) IN P50 THE ROUTINE IS SELECTED WHEN THE CREW SELECTS OPTION 1 OR 2 IN N06. FOR OPTION 1 A MARK IS MADE WHEN THE ATM IS IN THE SOLAR INERTIAL ATTITUDE. FOR OPTION 2 A MARK IS MADE WHEN THE ATM IS IN THE SOLAR INERTIAL ATTITUDE AND THE ATM STAR TRACKER IS TRACKING A STAR.

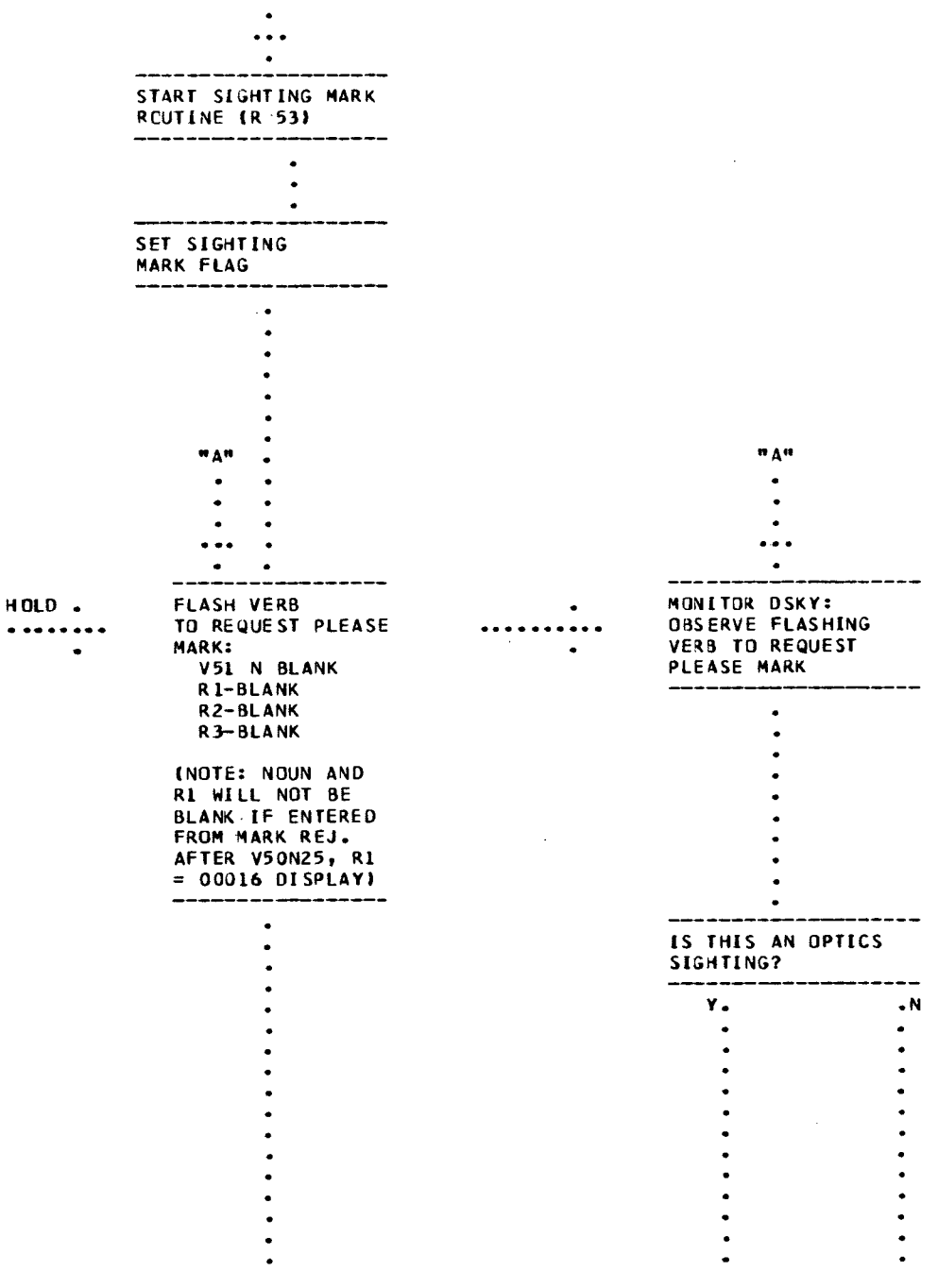
(8) THE ROUTINE IS AUTOMATICALLY SELECTED BY P51.

(9) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52) WHEN THE CREW LOADS THE SOURCE CODE FOR ATM SUN SENSOR OR ATM STAR TRACKER IN N70.

(10) IN P55 THE ROUTINE IS SELECTED WHEN THE CREW SELECTS OPTION 2 IN N06.

(11) THE ROUTINE IS SELECTED IN THE AUTO OPTICS POSITIONING ROUTINE (R52) BY CREW SELECTION OF MANUAL OPTICS MODE OR SWITCHING OPTICS ZERO TO ZERO.

PROG CONT	CMC	GROUND	CREW
	.CMC ROUTINE .SELECTION		


START SIGHTING MARK ROUTINE (R 53)
SET SIGHTING MARK FLAG
"A"
"A"
HOLD
FLASH VERB TO REQUEST PLEASE MARK:
V51 N BLANK
R1-BLANK
R2-BLANK
R3-BLANK
(NOTE: NOUN AND R1 WILL NOT BE BLANK IF ENTERED FROM MARK REJ. AFTER V50N25, R1 = 00016 DISPLAY)
MONITOR DSKY: OBSERVE FLASHING VERB TO REQUEST PLEASE MARK
IS THIS AN OPTICS SIGHTING?
Y
N

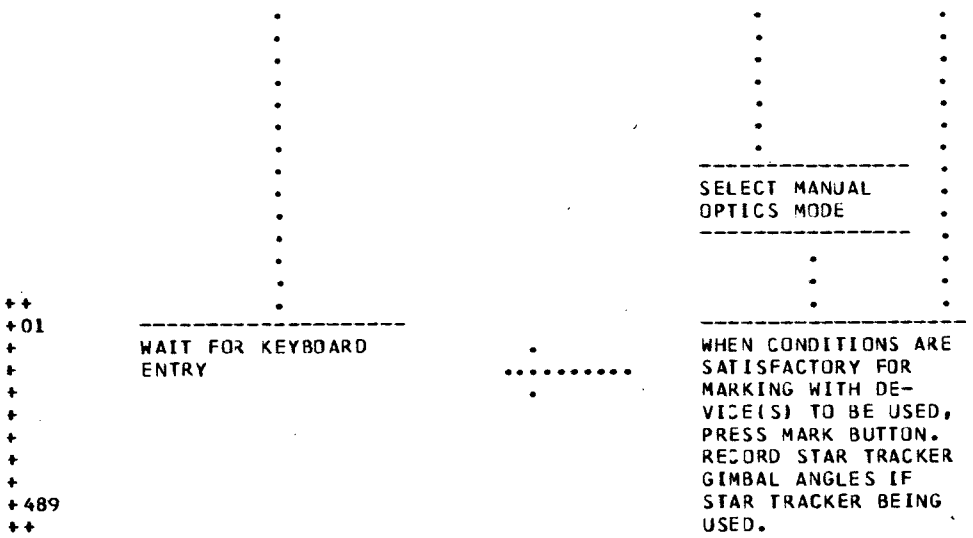
#10

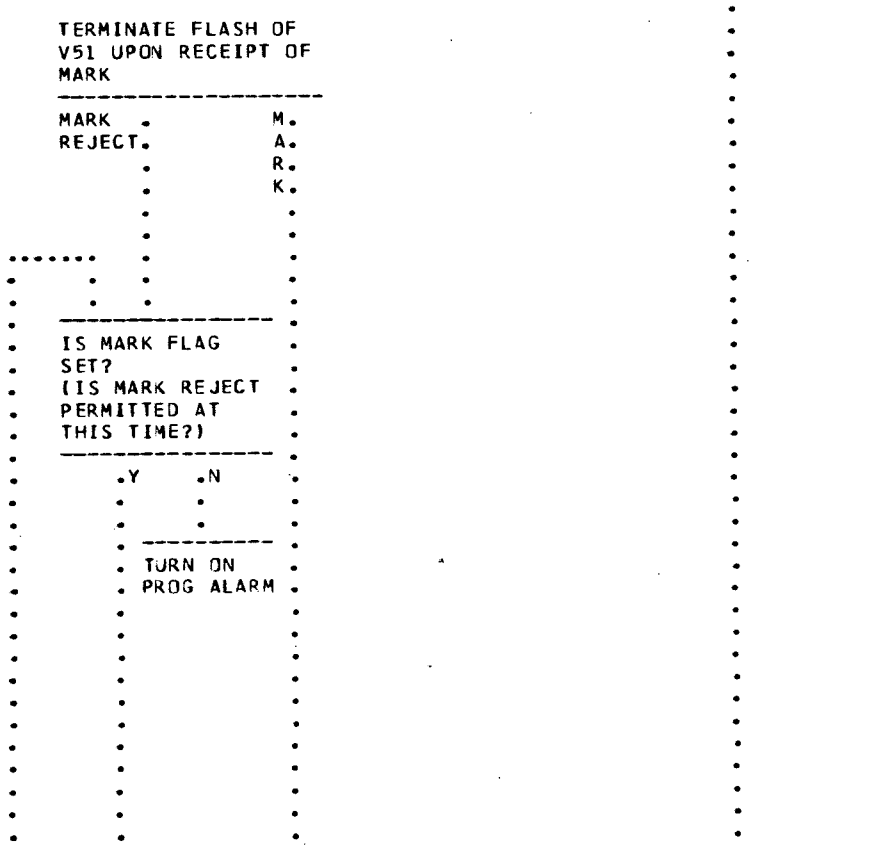
#20

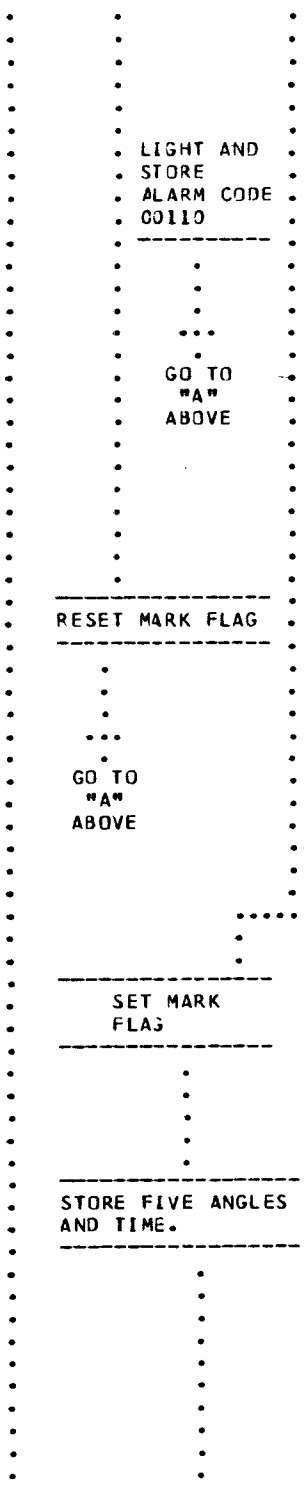
#30

#40

#50


SELECT MANUAL OPTICS MODE
WAIT FOR KEYBOARD ENTRY
WHEN CONDITIONS ARE SATISFACTORY FOR MARKING WITH DEVICE(S) TO BE USED, PRESS MARK BUTTON. RECORD STAR TRACKER GIMBAL ANGLES IF STAR TRACKER BEING USED.
+01
+489
#60
#70


TERMINATE FLASH OF V51 UPON RECEIPT OF MARK
MARK REJECT
MARK
IS MARK FLAG SET? (IS MARK REJECT PERMITTED AT THIS TIME?)
Y
N
TURN ON PROG ALARM
#80
#90
#100



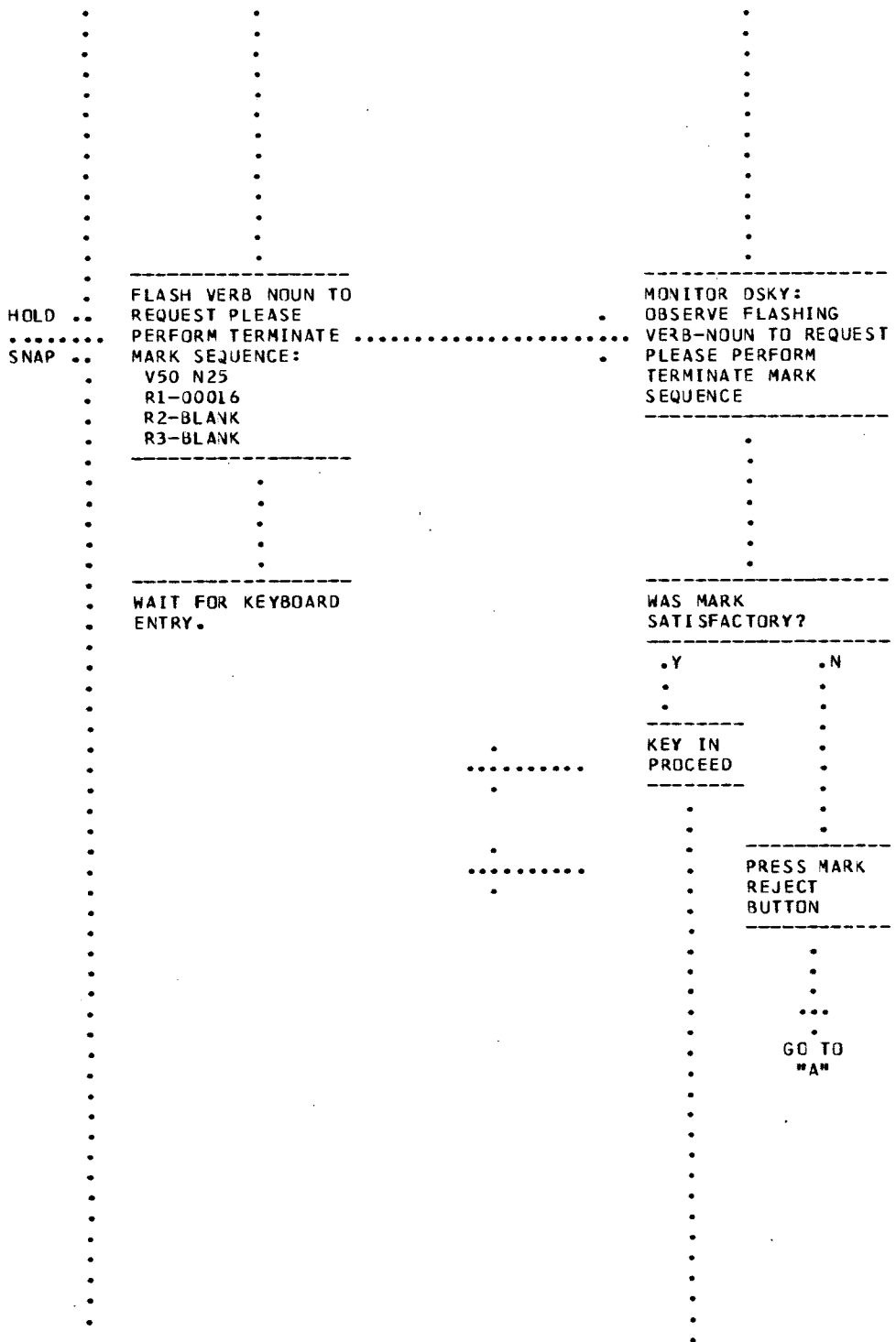
#110

#120

#130

#140

#150

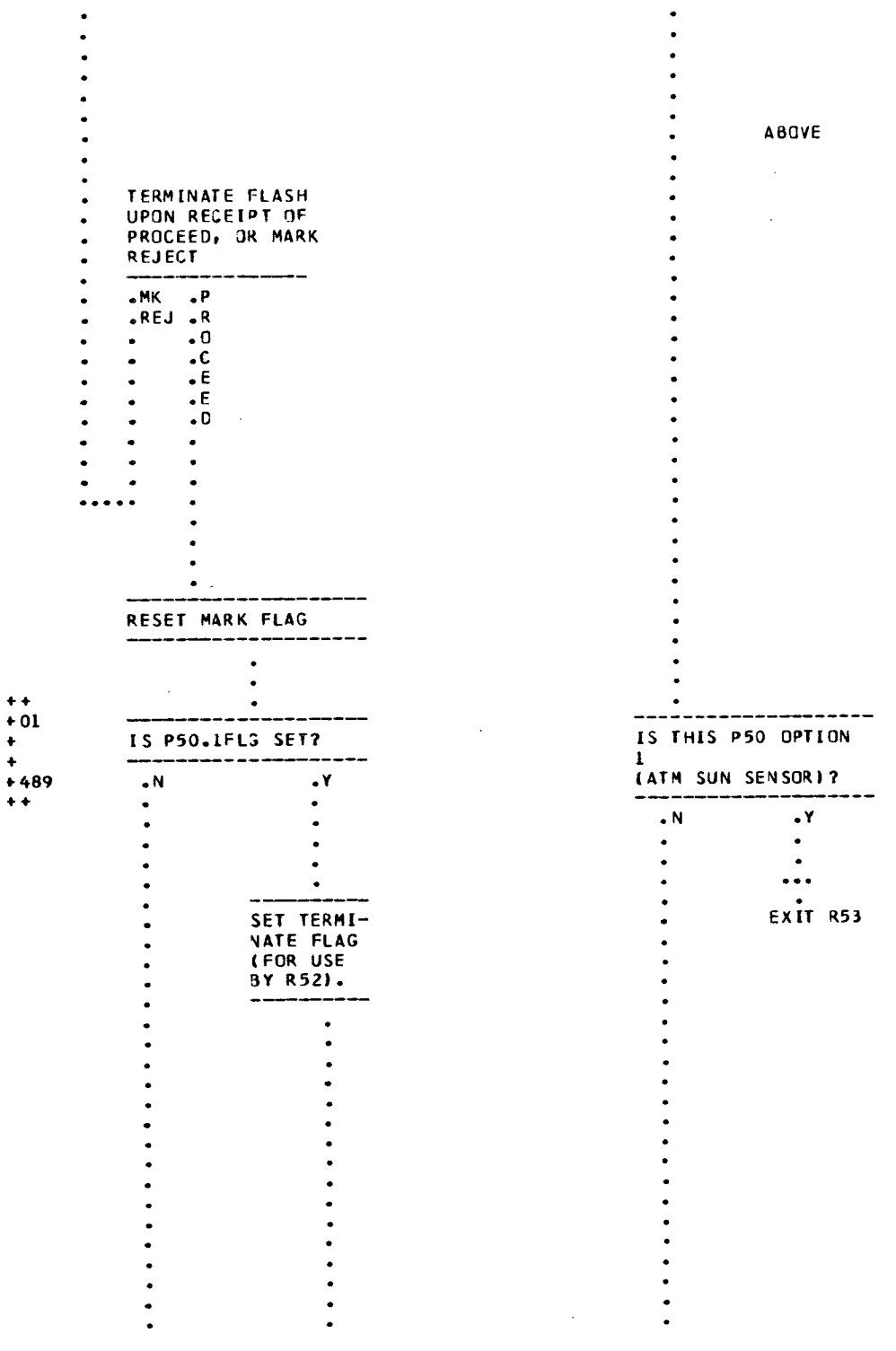


#160

#170

#180

#190



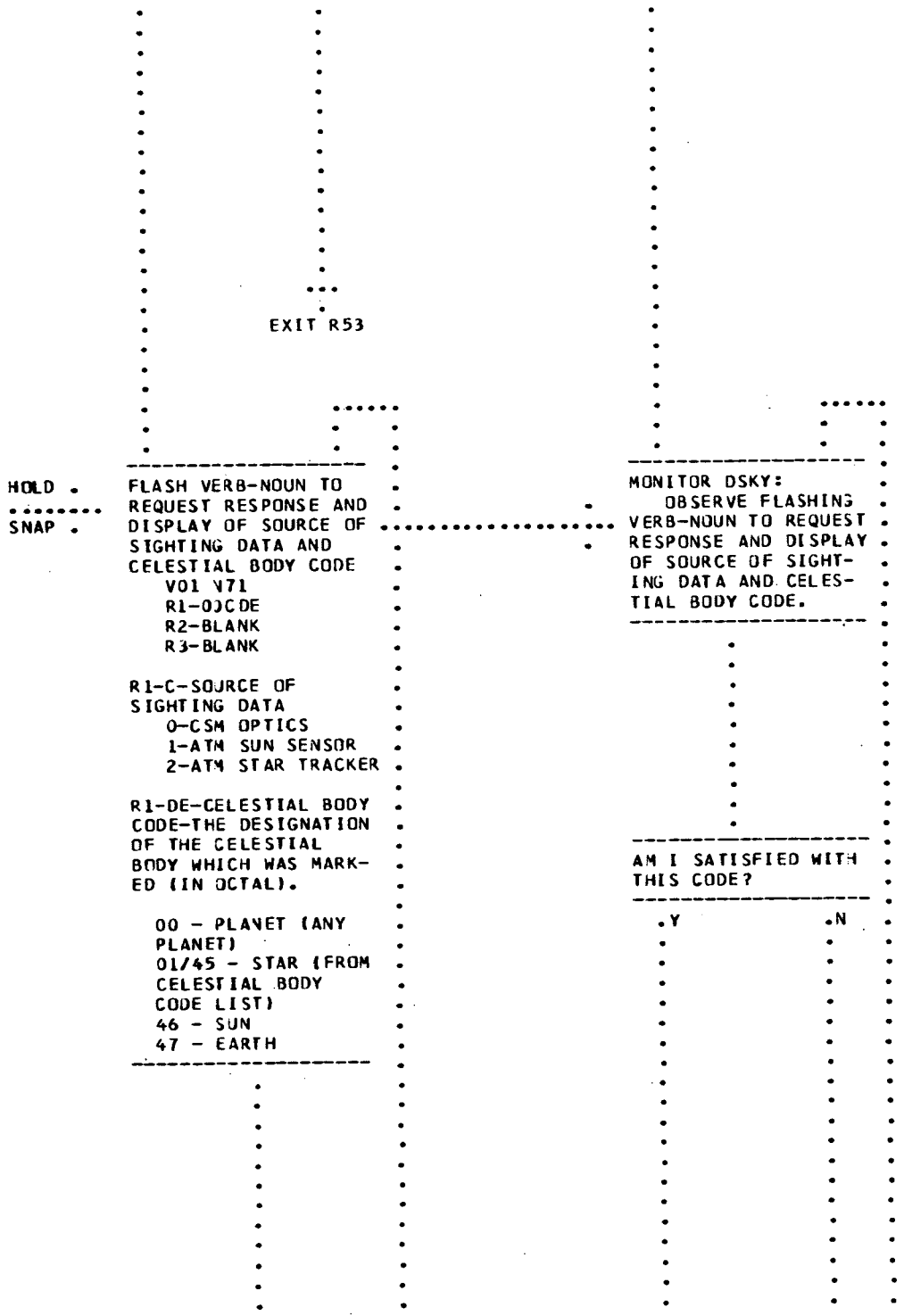
#200

#210

#220

#230

#240



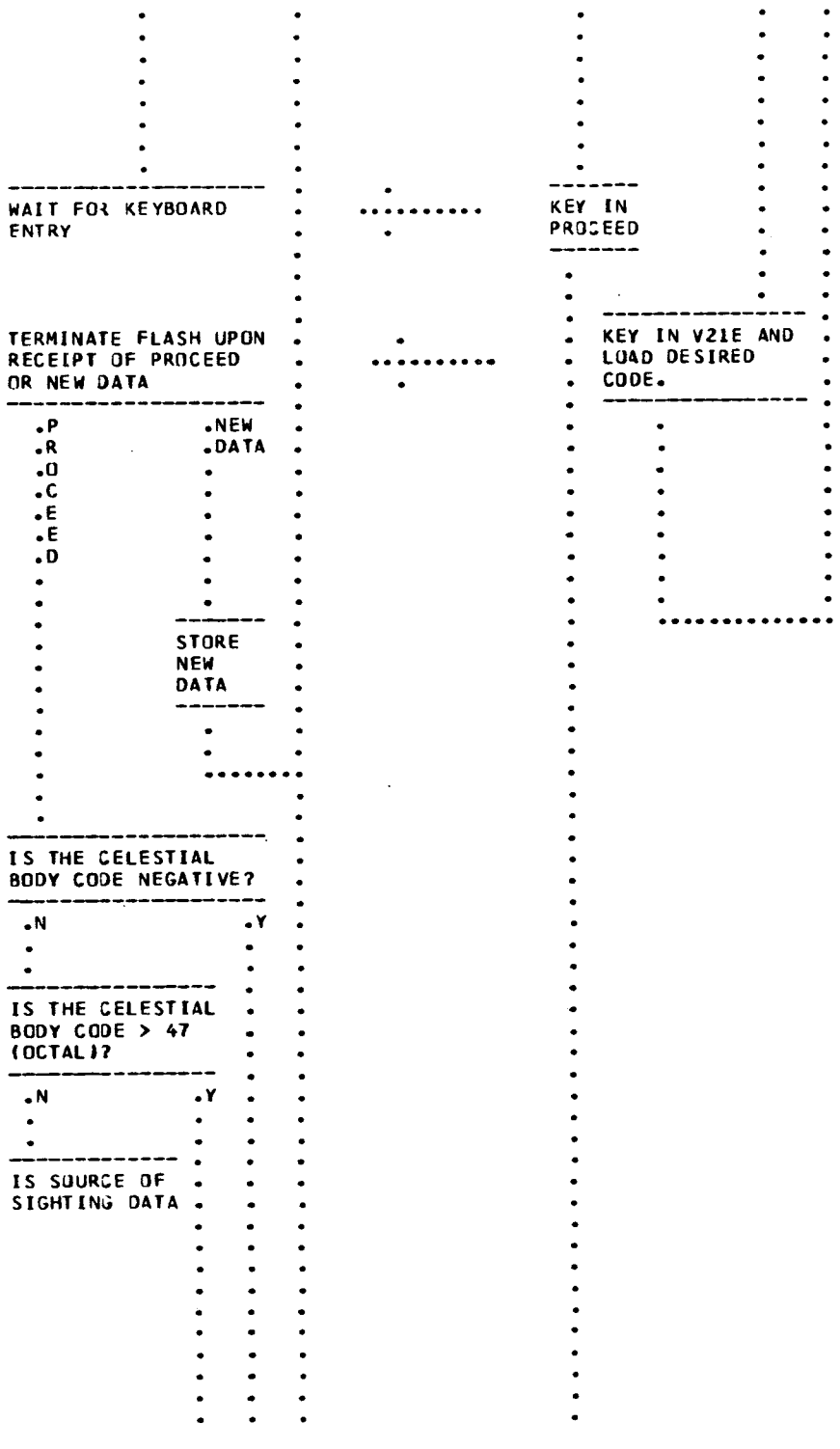
#250

#260

#270

#280

#290



#300

#310

#320

#330

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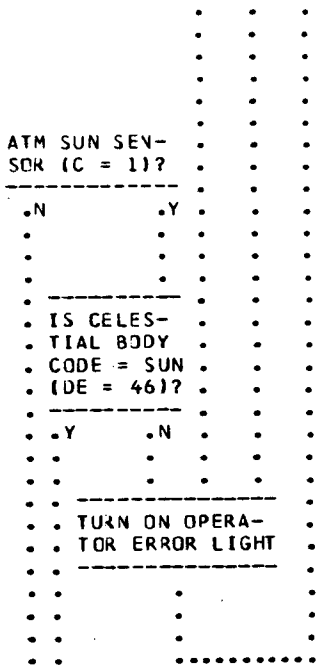
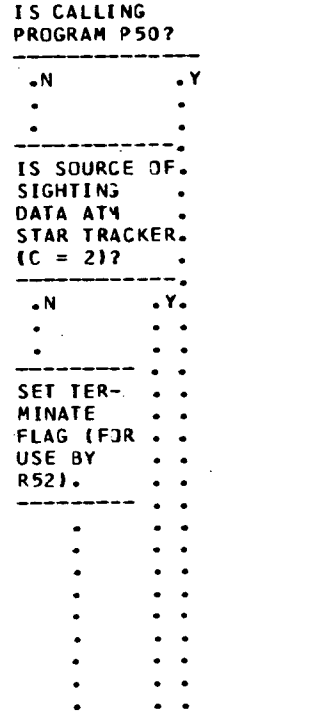
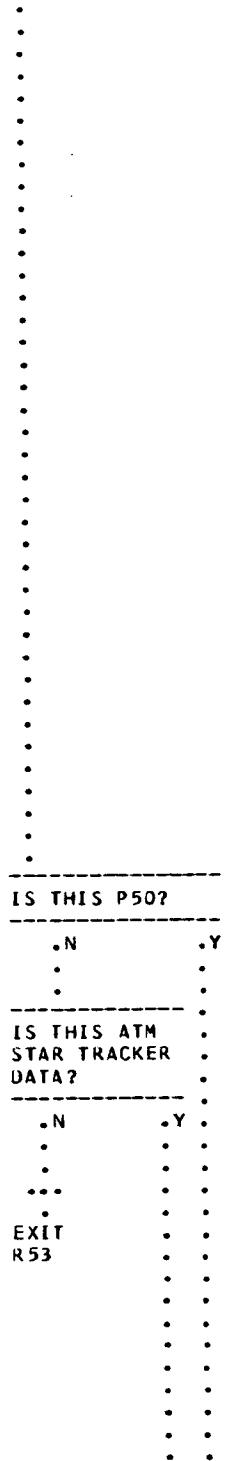






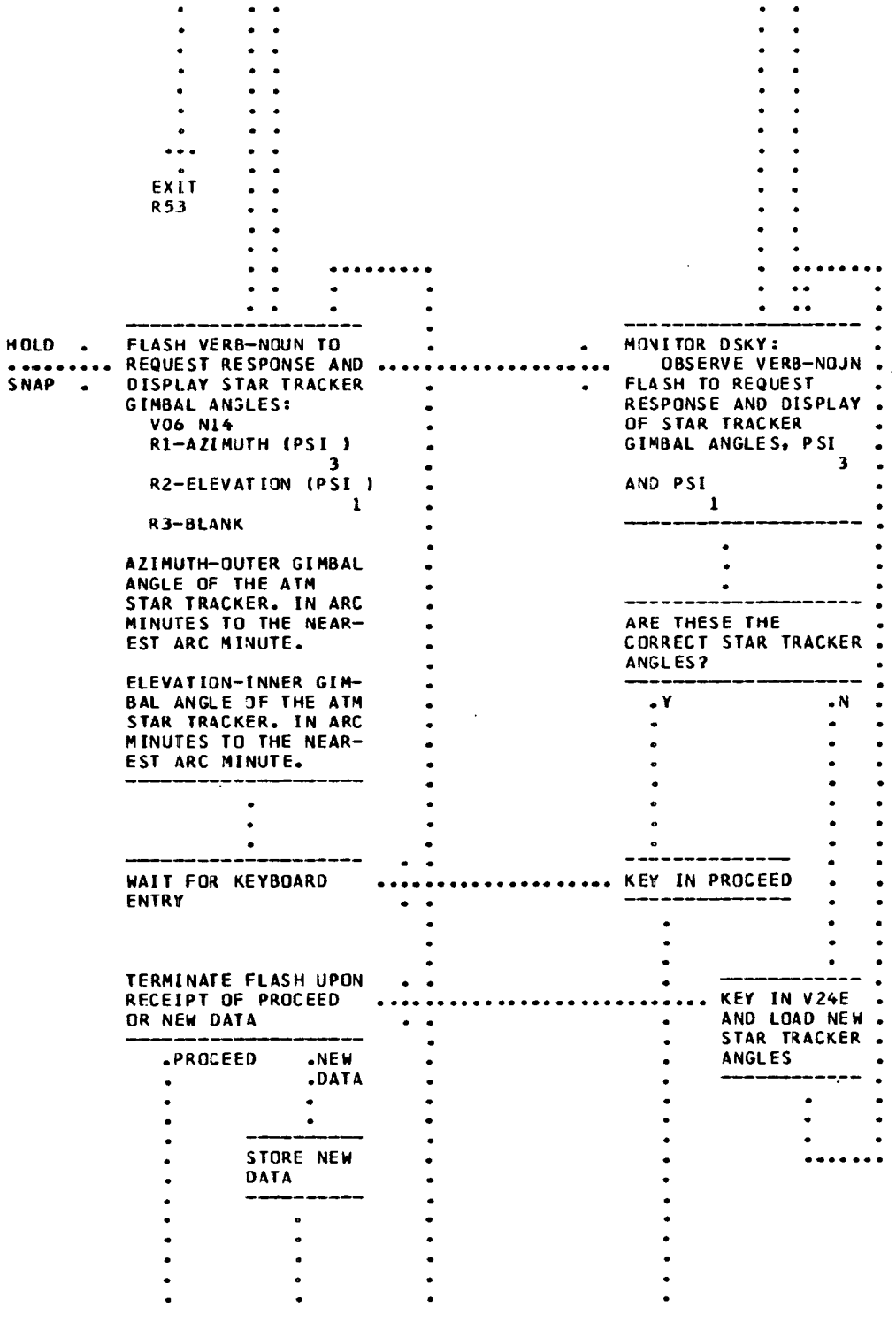
#350

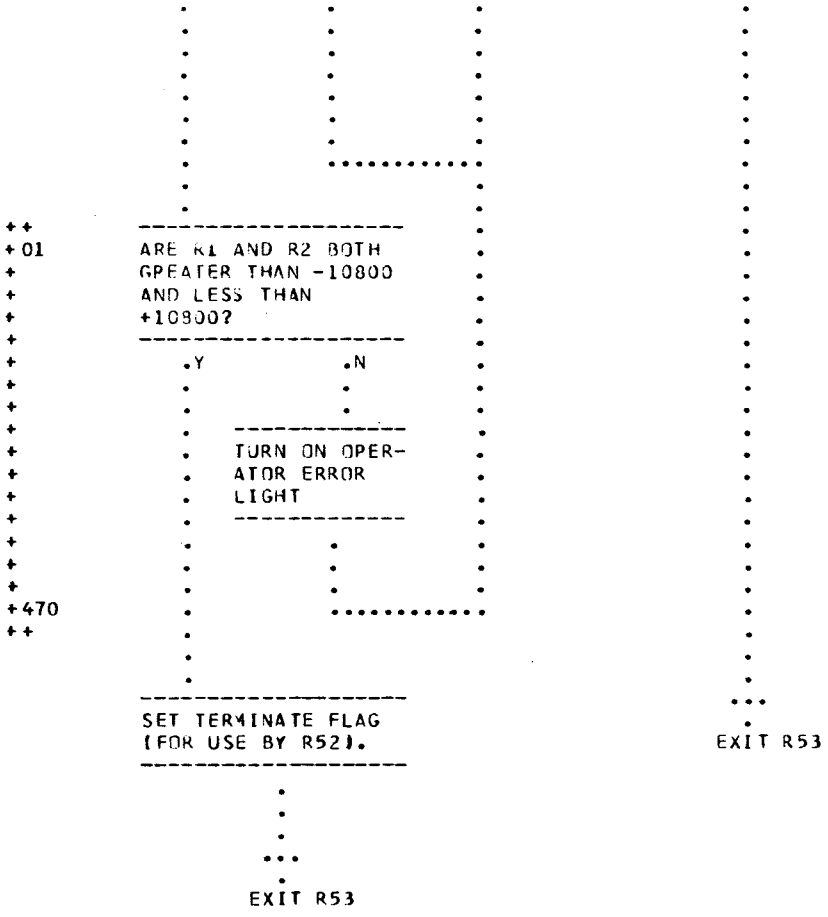
#360

#370

#380

#390


EXIT
R53
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STAR TRACKER GIMBAL ANGLES:
V06 N14
R1-AZIMUTH (PSI 3)
R2-ELEVATION (PSI 1)
R3-BLANK
AZIMUTH-OUTER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
ELEVATION-INNER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
PROCEED
NEW DATA
STORE NEW DATA
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STAR TRACKER GIMBAL ANGLES, PSI 3 AND PSI 1
ARE THESE THE CORRECT STAR TRACKER ANGLES?
Y
N
KEY IN PROCEED
KEY IN V24E AND LOAD NEW STAR TRACKER ANGLES
#400
#410
#420
#430
#440
#450



#460

#470

#480

#490

CHANGE CONTROL NOTES

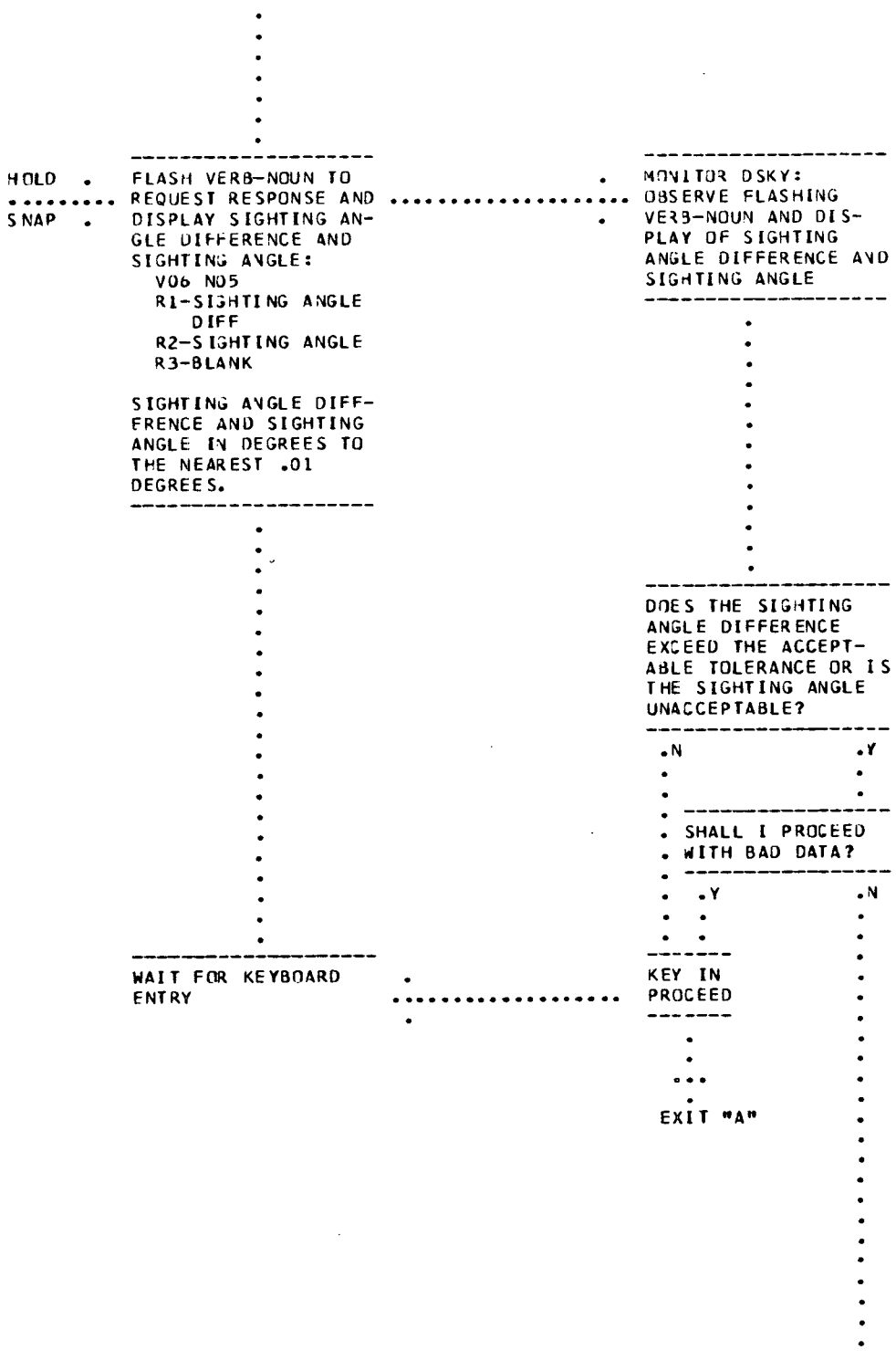
REV 00 PCR 018,019,036,413,414,415, PCN 457
REV 01 PCN 470,489

SIGHTING DATA DISPLAY ROUTINE (R54) REV 00 05/19/71

PURPOSE: (1) TO TEST THE ACCURACY OF A PAIR OF CELESTIAL BODY SIGHTINGS.

ASSUMPTIONS: (1) THE ROUTINE IS NORMALLY AUTOMATICALLY SELECTED BY THE IMU ORIENTATION DETERMINATION PROGRAM (P51), BY THE IMU REALIGN PROGRAM (P52), BY THE BACKUP IMU ORIENTATION DETERMINATION PROGRAM (P53), OR BY THE BACKUP IMU REALIGN PROGRAM (P54).

PROG CONT	CMC	GROUND	CREW	
	.CMC .ROUTINE .SELECTION			
	START SIGHTING DATA DISPLAY ROUTINE (R54).			#10
	. . .			
	CALCULATE ANGLE BETWEEN TWO CELESTIAL BODIES USING STORED EPHEMERIS DATA (ACTUAL)			#20
	. . .			
	CALCULATE ANGLE BETWEEN TWO CELESTIAL BODIES USING CELESTIAL BODY VECTORS DERIVED FROM MARK ANGLES (INDICATED)			#30
	. . . . .			


HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY SIGHTING ANGLE DIFFERENCE AND SIGHTING ANGLE:
V06 N05
R1-SIGHTING ANGLE DIFF
R2-SIGHTING ANGLE
R3-BLANK
SIGHTING ANGLE DIFFERENCE AND SIGHTING ANGLE IN DEGREES TO THE NEAREST .01 DEGREES.
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY: OBSERVE FLASHING VERB-NOUN AND DISPLAY OF SIGHTING ANGLE DIFFERENCE AND SIGHTING ANGLE
DOES THE SIGHTING ANGLE DIFFERENCE EXCEED THE ACCEPTABLE TOLERANCE OR IS THE SIGHTING ANGLE UNACCEPTABLE?
N
Y
SHALL I PROCEED WITH BAD DATA?
Y
N
KEY IN PROCEED
EXIT "A"

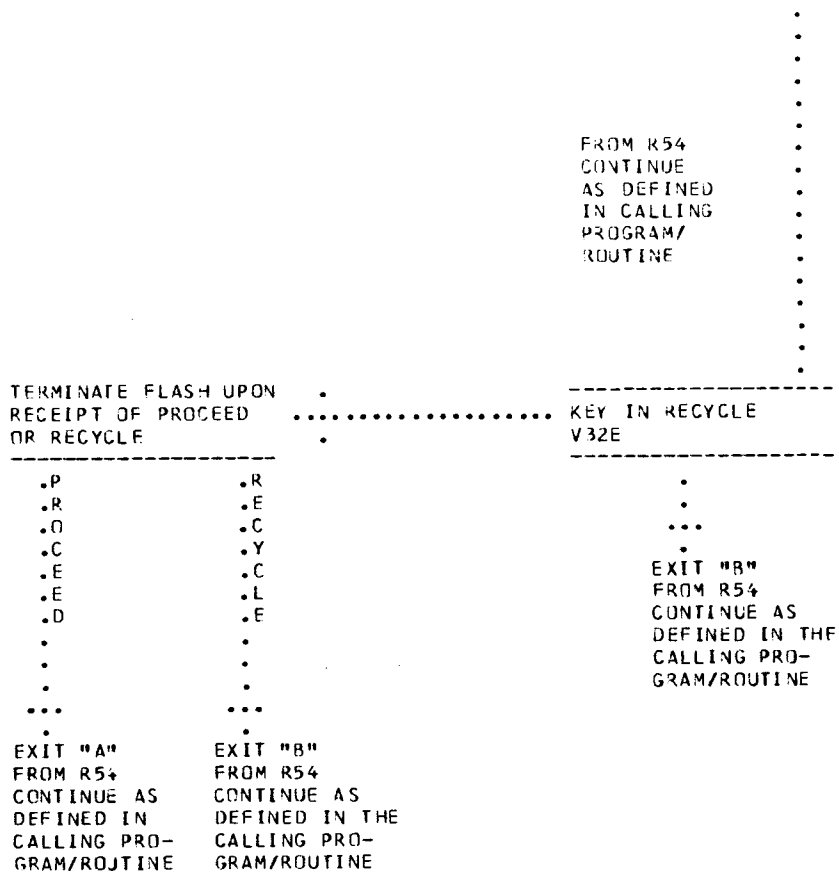
#40

#50

#60

#70

#80



#90

#100

#110

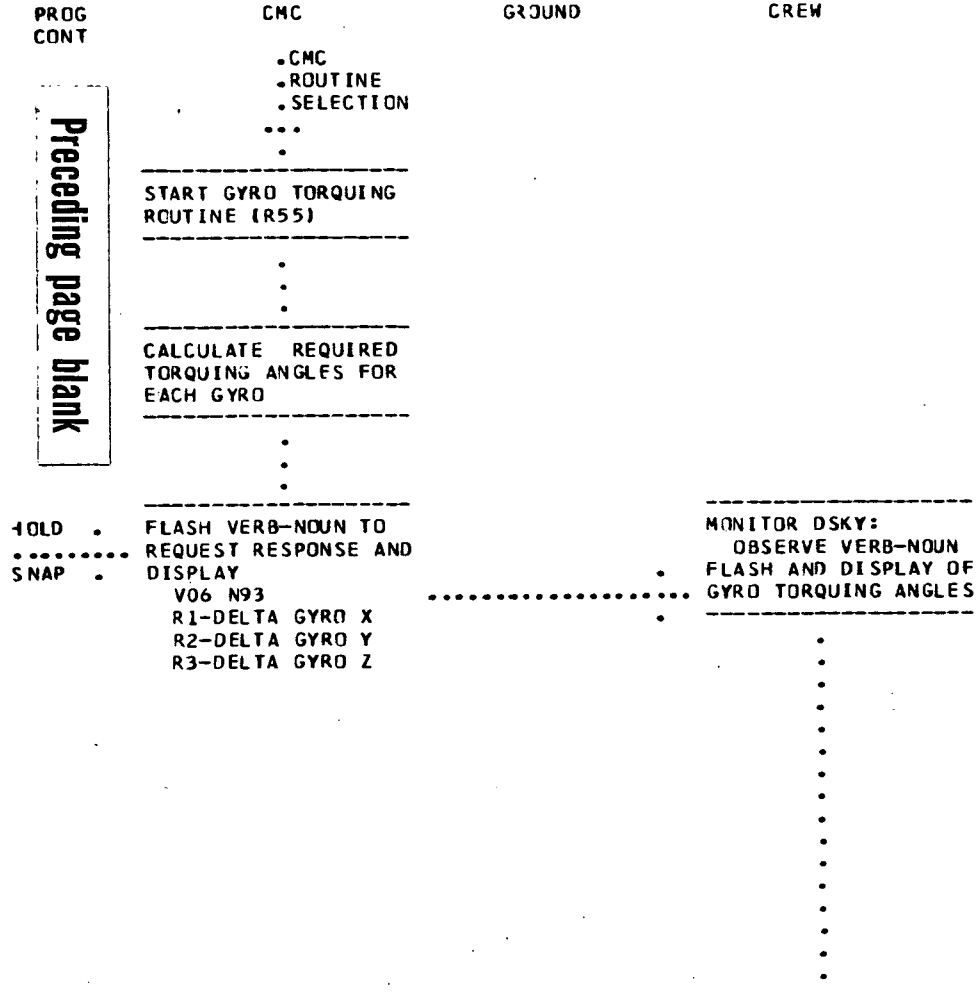
CHANGE CONTROL NOTES

REV 00 PCR 420

GYRO TORQUING ROUTINE (R55) REV 00 05/19/71

PURPOSE: (1) TO CALCULATE GYRO TORQUING ANGLES FOR FINAL (FINE) ALIGNMENT OF THE INERTIAL PLATFORM DURING AN INFLIGHT ALIGNMENT, TO DISPLAY THESE ANGLES AND TO TORQUE THE GYROS.

ASSUMPTIONS: (1) THE ROUTINE IS NORMALLY AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52), OR BY THE BACKUP IMU REALIGN PROGRAM (P54).



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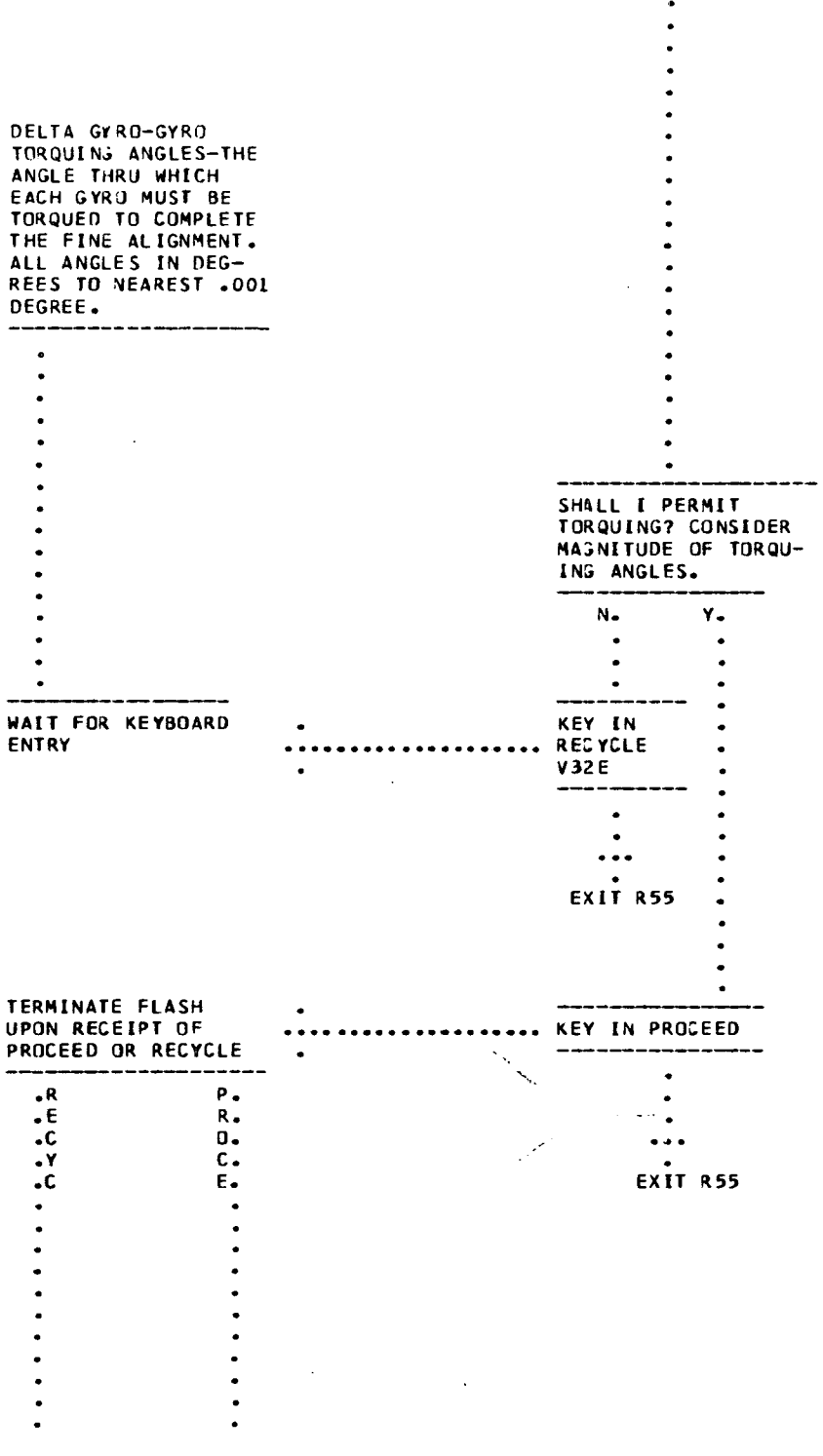

DELTA GYRO-GYRO TORQUING ANGLES-THE ANGLE THRU WHICH EACH GYRO MUST BE TORQUED TO COMPLETE THE FINE ALIGNMENT. ALL ANGLES IN DEGREES TO NEAREST .001 DEGREE.
SHALL I PERMIT TORQUING? CONSIDER MAGNITUDE OF TORQUING ANGLES.
N.
Y.
WAIT FOR KEYBOARD ENTRY
KEY IN RECYCLE V32E
EXIT R55
TERMINATE FLASH UPON RECEIPT OF PROCEED OR RECYCLE
KEY IN PROCEED
R
E
C
Y
C
P.
R.
O.
C.
E.
EXIT R55

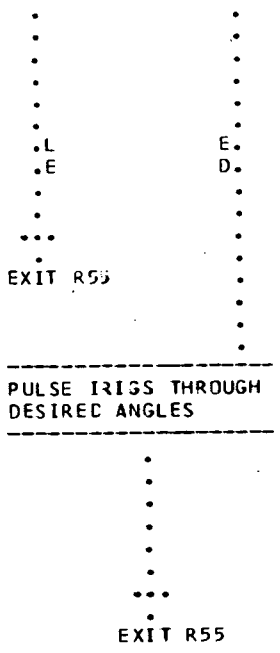
#30

#40

#50

#60

#70



#80

#90

#100

CHANGE CONTROL NOTES

ALTERNATE LOS SIGHTING MARK ROUTINE (R56) REV 01 03/20/72

PURPOSE: (1) TO PERFORM SIGHTING MARKS FOR THE BACKUP ALIGNMENT PROGRAMS (P53, P54).

ASSUMPTIONS: (1) SIGHTINGS ARE MADE WITH EITHER (A) CSM ALTERNATE LINE OF SIGHT, (B) ATM SUN SENSOR, OR (C) ATM STAR TRACKER.

(2) THE ASTRONAUT KNOWS THE COORDINATES (OPTICS) OF THE ALTERNATE LINE OF SIGHT (CASE A, ASSUMPTION 1) HE MUST USE FOR THIS ROUTINE.

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(3) WHEN THE ASTRONAUT KEYS IN ENTR IN RESPONSE TO FLASHING V53, THE CMC STORES THE TIME OF THE MARK, THE THREE ICDU ANGLES, AND THE TWO ANGLES DISPLAYED IN N94. IF THE MARK IS FOR THE ATM STAR TRACKER, THE CREW WILL BE REQUESTED TO LOAD THE STAR TRACKER GIMBAL ANGLES (N14). THIS INFORMATION THEN REPLACES THE N94 INFORMATION IN CMC STORAGE.

(4) THE RHC IS USED TO POSITION THE SPACECRAFT SO THAT THE ALTERNATE LOS POINTS TOWARD THE CHOSEN CELESTIAL BODY.

(5) IF THE MARK IS FOR THE ATM SUN SENSOR, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY, THE ATM MUST BE IN THE SOLAR INERTIAL ATTITUDE, AND THE ORIENTATION OF THE ATM WITH RESPECT TO THE NAV BASE MUST BE KNOWN.

(6) IF THE MARK IS FOR THE ATM STAR TRACKER, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY, THE ORIENTATION OF THE ATM WITH RESPECT TO THE NAV BASE MUST BE KNOWN, AND THE STAR TRACKER GIMBAL ANGLES LOADED INTO N14 SHOULD BE THOSE RECORDED BY THE CREW AT THE TIME OF THE MARK.

(7) THIS ROUTINE IS AUTOMATICALLY CALLED BY P53 AND P54.

(8) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

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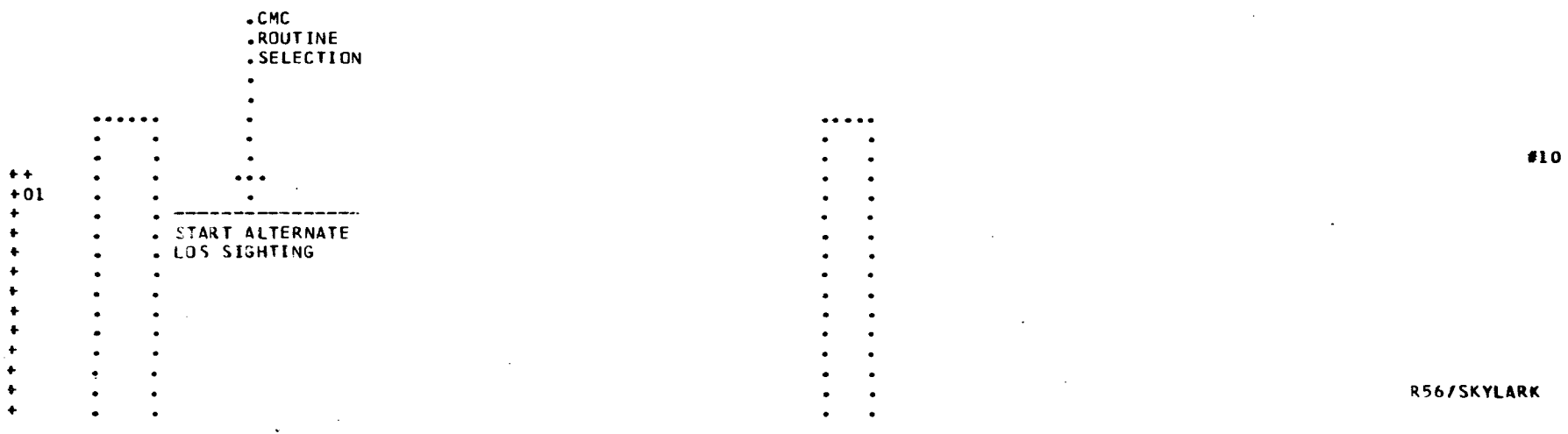

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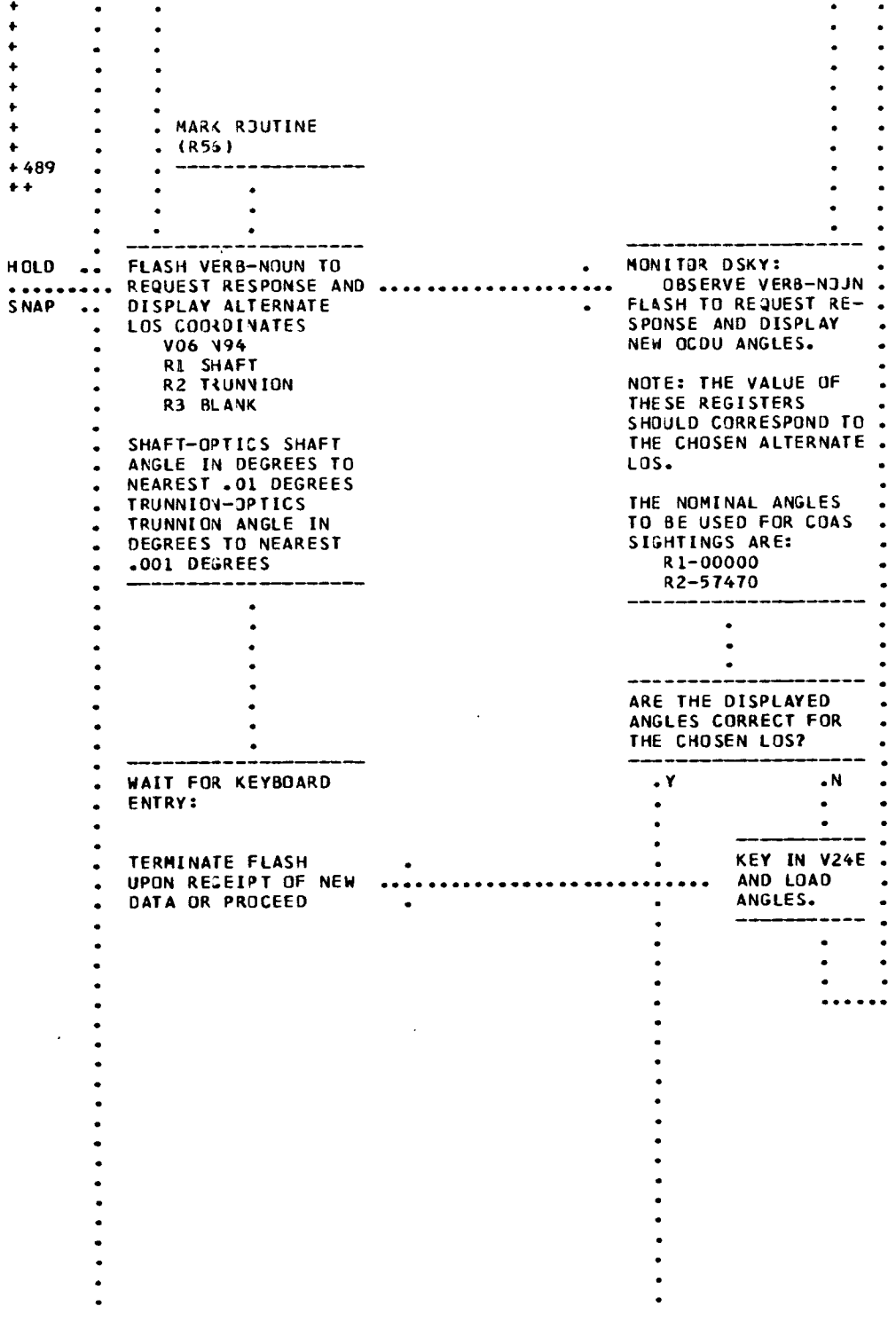
R56/SKYLARK


MARK ROUTINE
(R56)
489
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY ALTERNATE LOS COORDINATES
V06 V94
R1 SHAFT
R2 TRUNNION
R3 BLANK
SHAFT-OPTICS SHAFT ANGLE IN DEGREES TO NEAREST .01 DEGREES
TRUNNION-OPTICS TRUNNION ANGLE IN DEGREES TO NEAREST .001 DEGREES
WAIT FOR KEYBOARD ENTRY:
TERMINATE FLASH UPON RECEIPT OF NEW DATA OR PROCEED
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY NEW OCDU ANGLES.
NOTE: THE VALUE OF THESE REGISTERS SHOULD CORRESPOND TO THE CHOSEN ALTERNATE LOS.
THE NOMINAL ANGLES TO BE USED FOR COAS SIGHTINGS ARE:
R1-00000
R2-57470
ARE THE DISPLAYED ANGLES CORRECT FOR THE CHOSEN LOS?
Y
N
KEY IN V24E AND LOAD ANGLES.

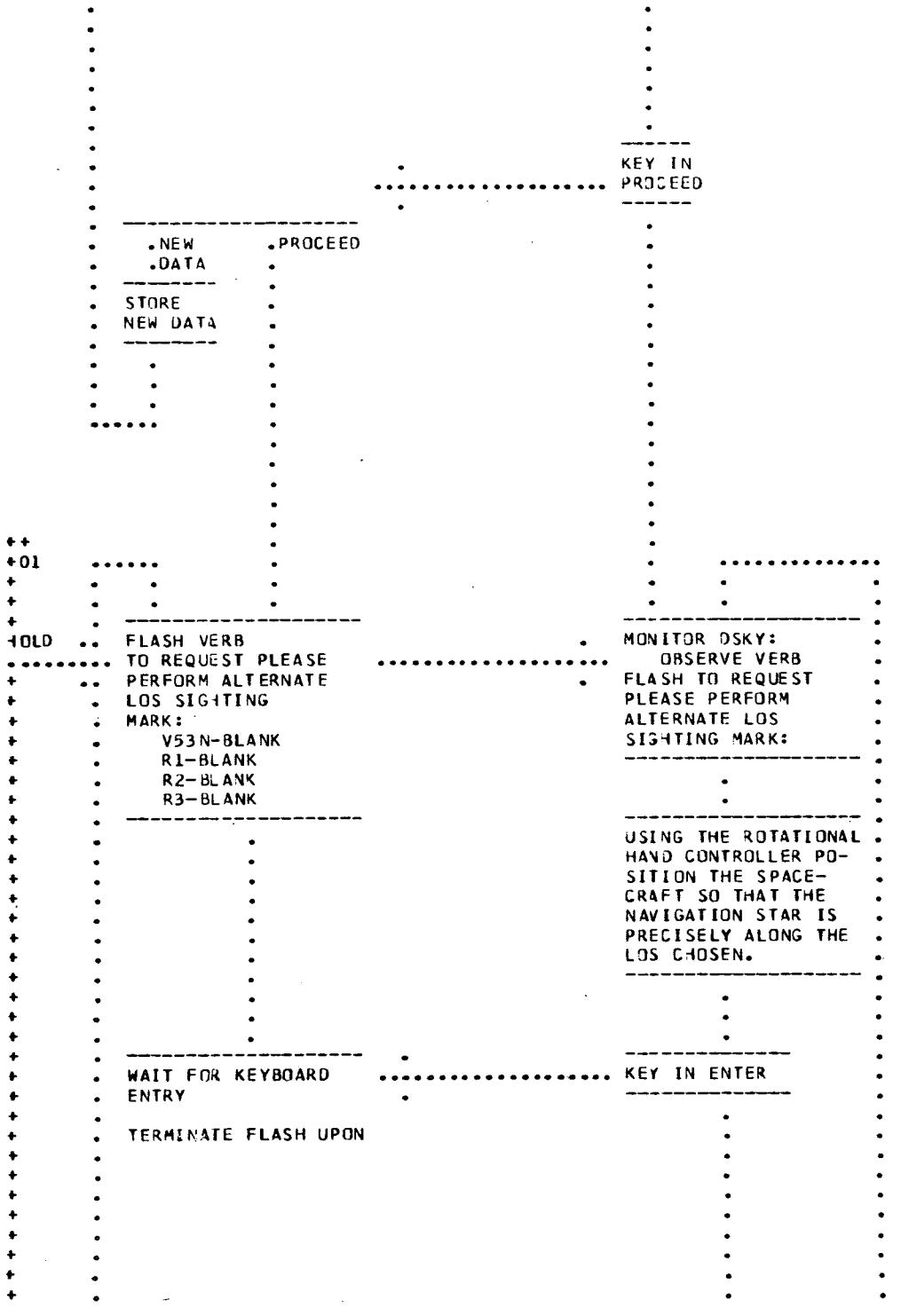
#20

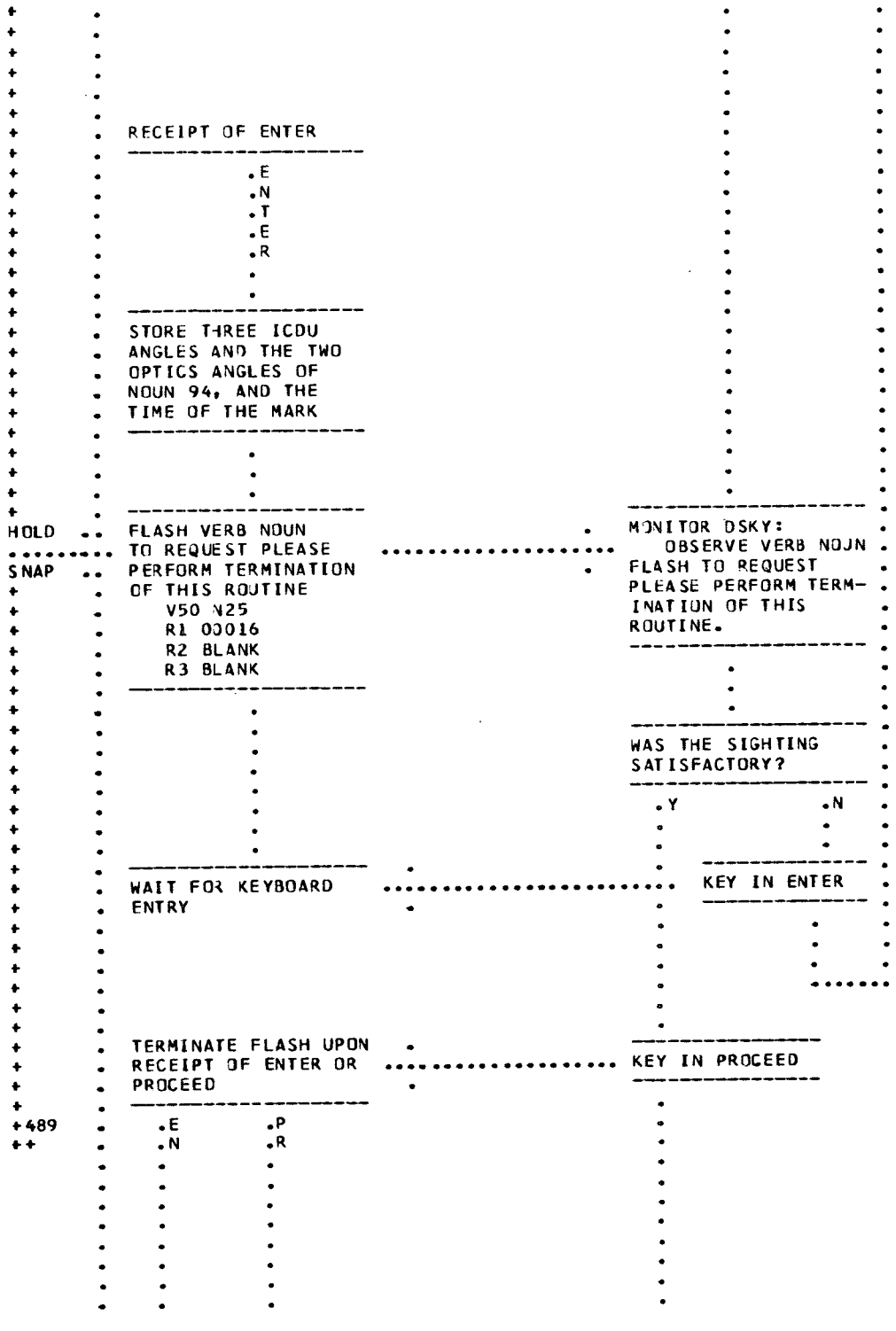
#30

#40

#50

#60


KEY IN PROCEED
.NEW .DATA
.PROCEED
STORE NEW DATA
#70
#80
#01
#90
HOLD
FLASH VERB TO REQUEST PLEASE PERFORM ALTERNATE LOS SIGHTING MARK:
V53N-BLANK
R1-BLANK
R2-BLANK
R3-BLANK
MONITOR DSKY:
OBSERVE VERB FLASH TO REQUEST PLEASE PERFORM ALTERNATE LOS SIGHTING MARK:
#100
USING THE ROTATIONAL HAND CONTROLLER POSITION THE SPACECRAFT SO THAT THE NAVIGATION STAR IS PRECISELY ALONG THE LOS CHOSEN.
#110
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON
KEY IN ENTER



#120

#130

#140

#150

#160

#170

#180

#190

#200

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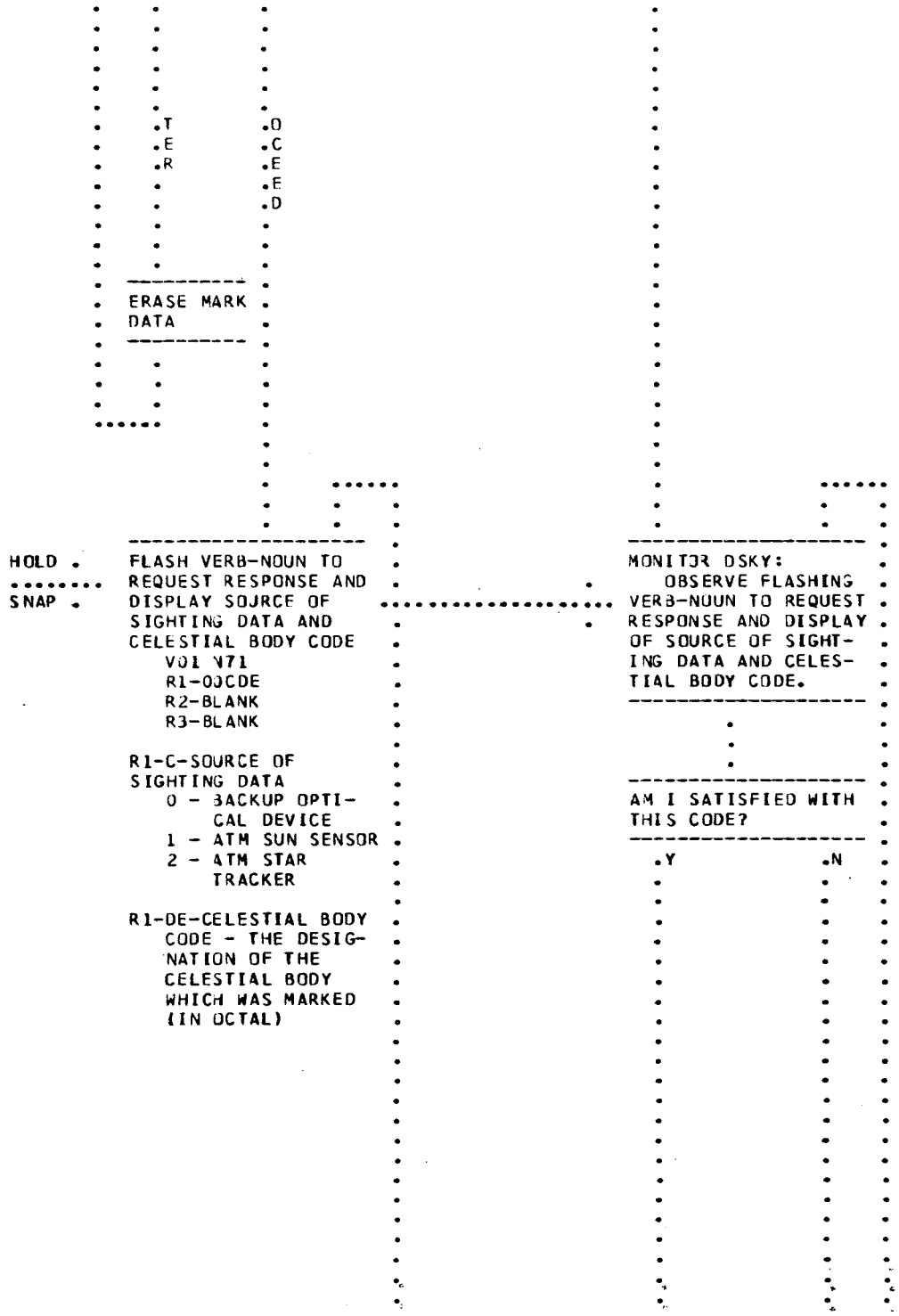

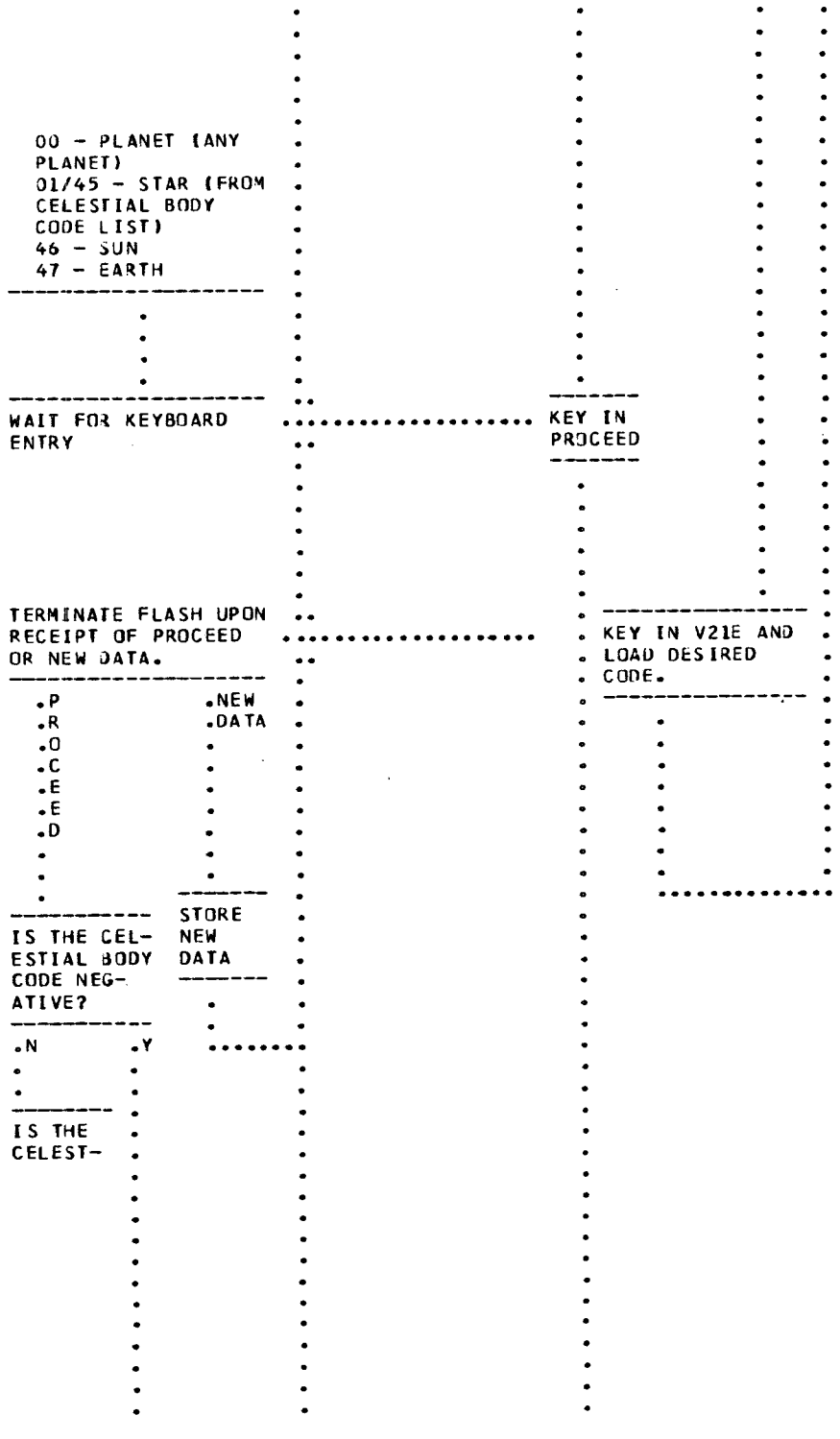

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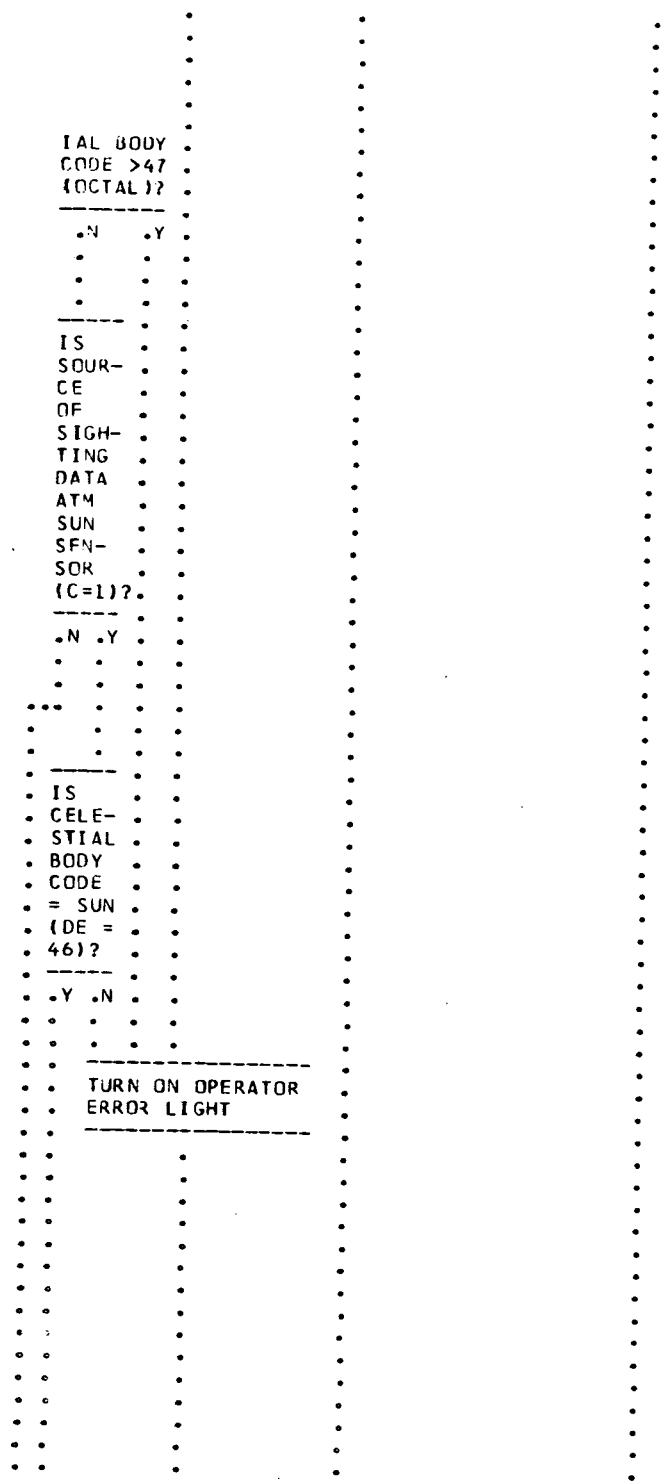


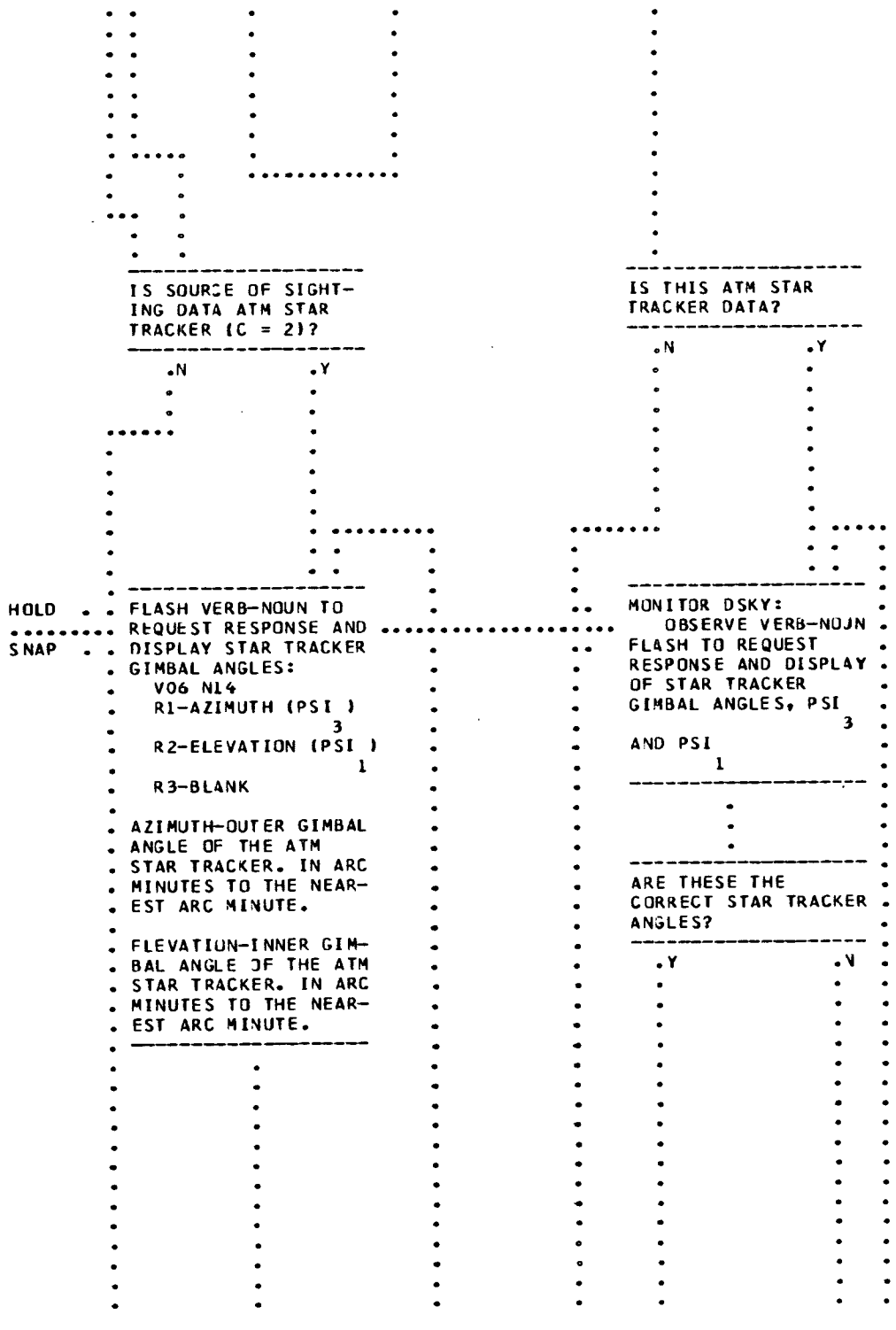
#270

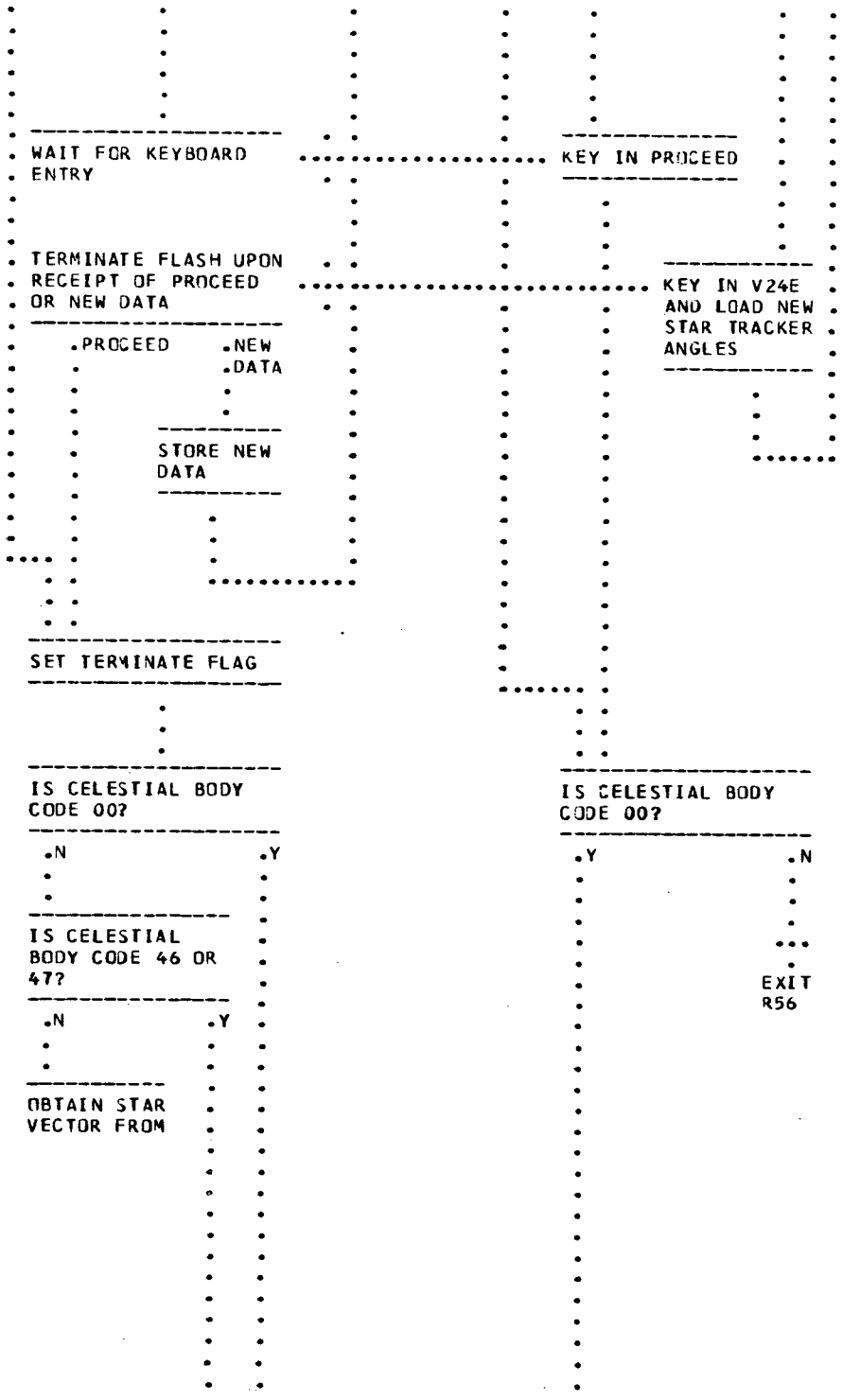
#280

#290

#300

#310


IS SOURCE OF SIGHTING DATA ATM STAR TRACKER (C = 2)?
.N
.Y
IS THIS ATM STAR TRACKER DATA?
.N
.Y
#320
#330
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY STAR TRACKER GIMBAL ANGLES:
V06 N14
R1-AZIMUTH (PSI 3)
R2-ELEVATION (PSI 1)
R3-BLANK
AZIMUTH-OUTER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
ELEVATION-INNER GIMBAL ANGLE OF THE ATM STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STAR TRACKER GIMBAL ANGLES, PSI 3 AND PSI 1
#340
ARE THESE THE CORRECT STAR TRACKER ANGLES?
.Y
.N
#350
#360



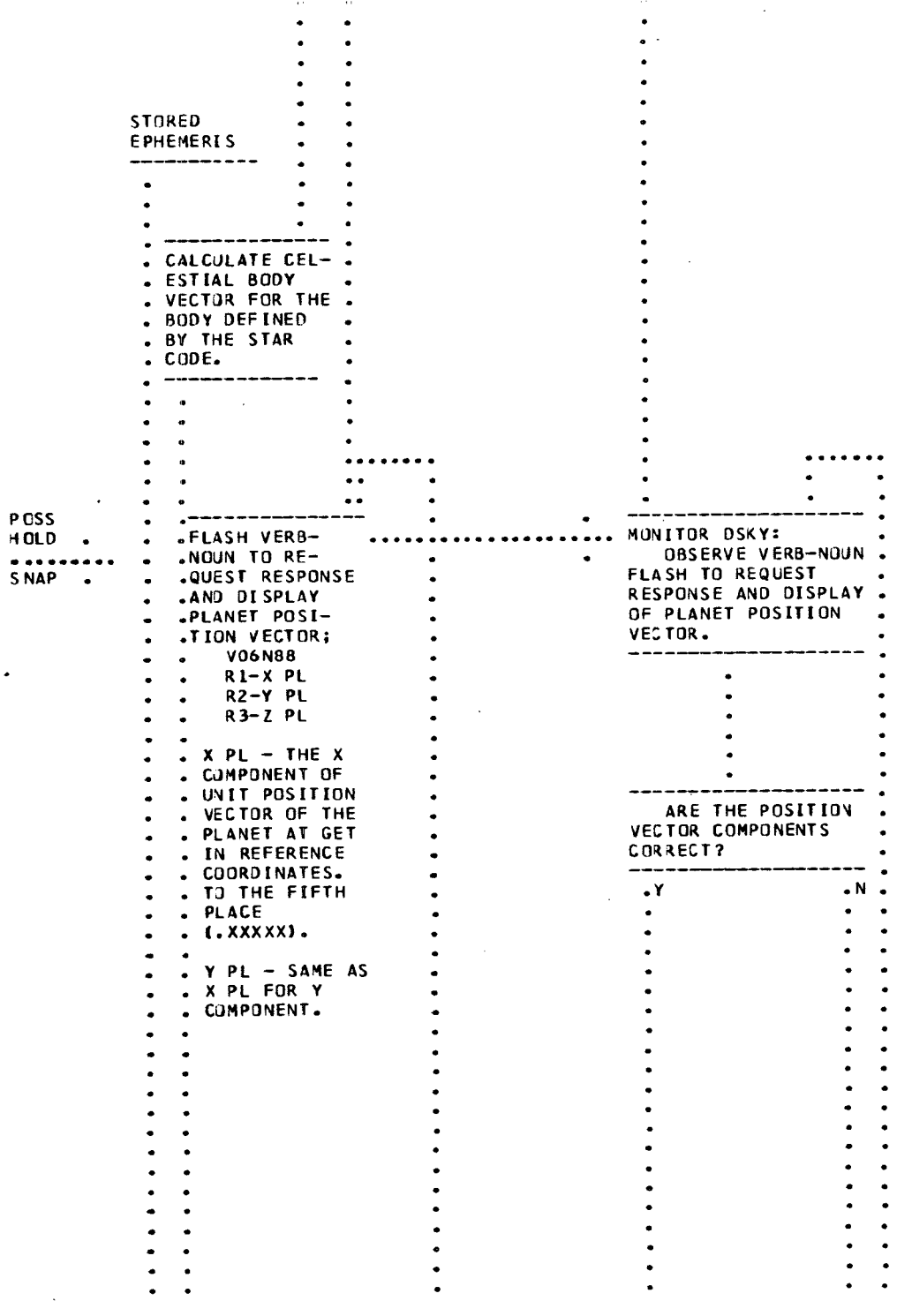
#370

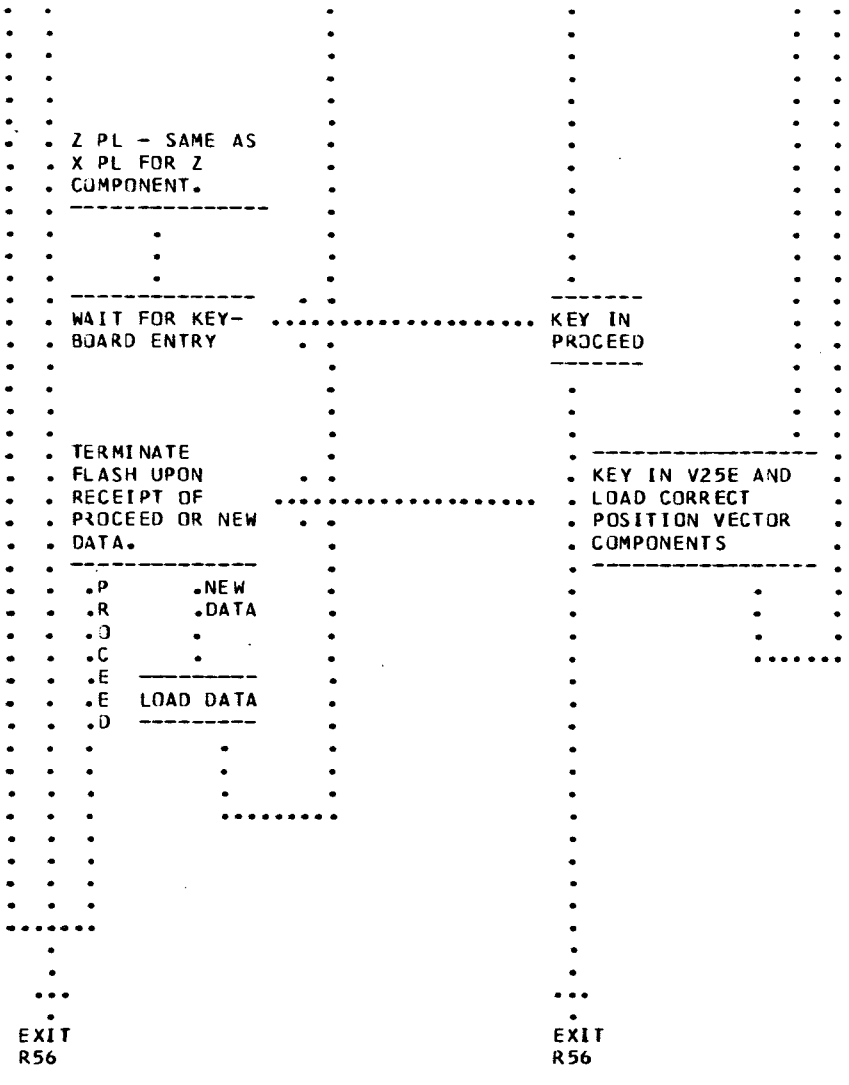
#380

#390

#400

#410


STORED EPHEMERIS
CALCULATE CELESTIAL BODY VECTOR FOR THE BODY DEFINED BY THE STAR CODE.
#420
#430
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY PLANET POSITION VECTOR; V06N88 R1-X PL R2-Y PL R3-Z PL
X PL - THE X COMPONENT OF UNIT POSITION VECTOR OF THE PLANET AT GET IN REFERENCE COORDINATES. TO THE FIFTH PLACE (.XXXXX).
Y PL - SAME AS X PL FOR Y COMPONENT.
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF PLANET POSITION VECTOR.
#440
ARE THE POSITION VECTOR COMPONENTS CORRECT?
#450
Y
N



#460

#470

#480

#490

#500

CHANGE CONTROL NOTES

REV 00 PCR 043,413,414,415, PCN 410,436
REV 01 PCN 489

ATTITUDE MANEUVER ROUTINE (R60) REV 01 03/20/72

PURPOSE: (1) TO MANEUVER THE SWS/CSM OR CSM ALONE TO AN ATTITUDE SPECIFIED BY THE PROGRAM IN PROGRESS.

ASSUMPTIONS: (1) THE FINAL ATTITUDE DESIRED, DEFINED AS FOLLOWS, HAS BEEN STORED BY THE CALLING PROGRAM:
(A) A SPECIFIC BODY FIXED VECTOR AND A DIRECTION IN SPACE TO WHICH THIS VECTOR IS TO BE ALIGNED (THE 3AXISFLG IS RESET).

(B) A THREE AXIS (ORTHOGONAL) INERTIAL ORIENTATION TO WHICH THE THREE BODY AXES ARE TO BE ALIGNED (THE 3AXISFLG IS SET).

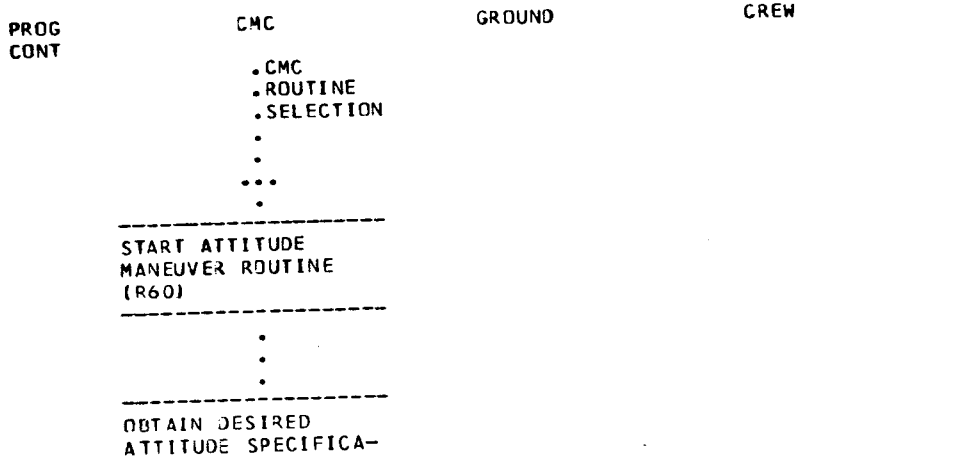
(2) THE MANEUVER MAY BE PERFORMED AUTOMATICALLY BY THE GNCS OR PERFORMED MANUALLY WITH AN OPTIONAL FINAL AUTOMATIC GNCS CONTROLLED TRIM MANEUVER. THIS OPTIONAL TRIM MANEUVER SHOULD BE CONSIDERED ESSENTIAL FOR MANEUVERS TO SPS THRUSTING ATTITUDES.

(3) THE DAP DATA LOAD ROUTINE (R03 OR R04) HAS BEEN PERFORMED PRIOR TO THIS ROUTINE.

(4) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE PROGRAM OR ROUTINE REQUIRING THE ATTITUDE MANEUVER.

(5) IF THIS ROUTINE WAS SELECTED BY THE TRACKING ATTITUDE ROUTINE (R61) THE V50N18 AND THE V06N18 IN THIS ROUTINE ARE PRIORITY DISPLAYS. THE V50N18 DISPLAY WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

(6) DURING ANY AUTOMATIC MANEUVER, A MIDDLE GIMBAL ANGLE GREATER THAN OR EQUAL TO 75 DEG (MAGNITUDE) CAUSES THE RCS DAP TO TERMINATE THE MANEUVER AND MAINTAIN ATTITUDE HOLD (SET STIKFLAG AND ZERO HOLDFLAG).



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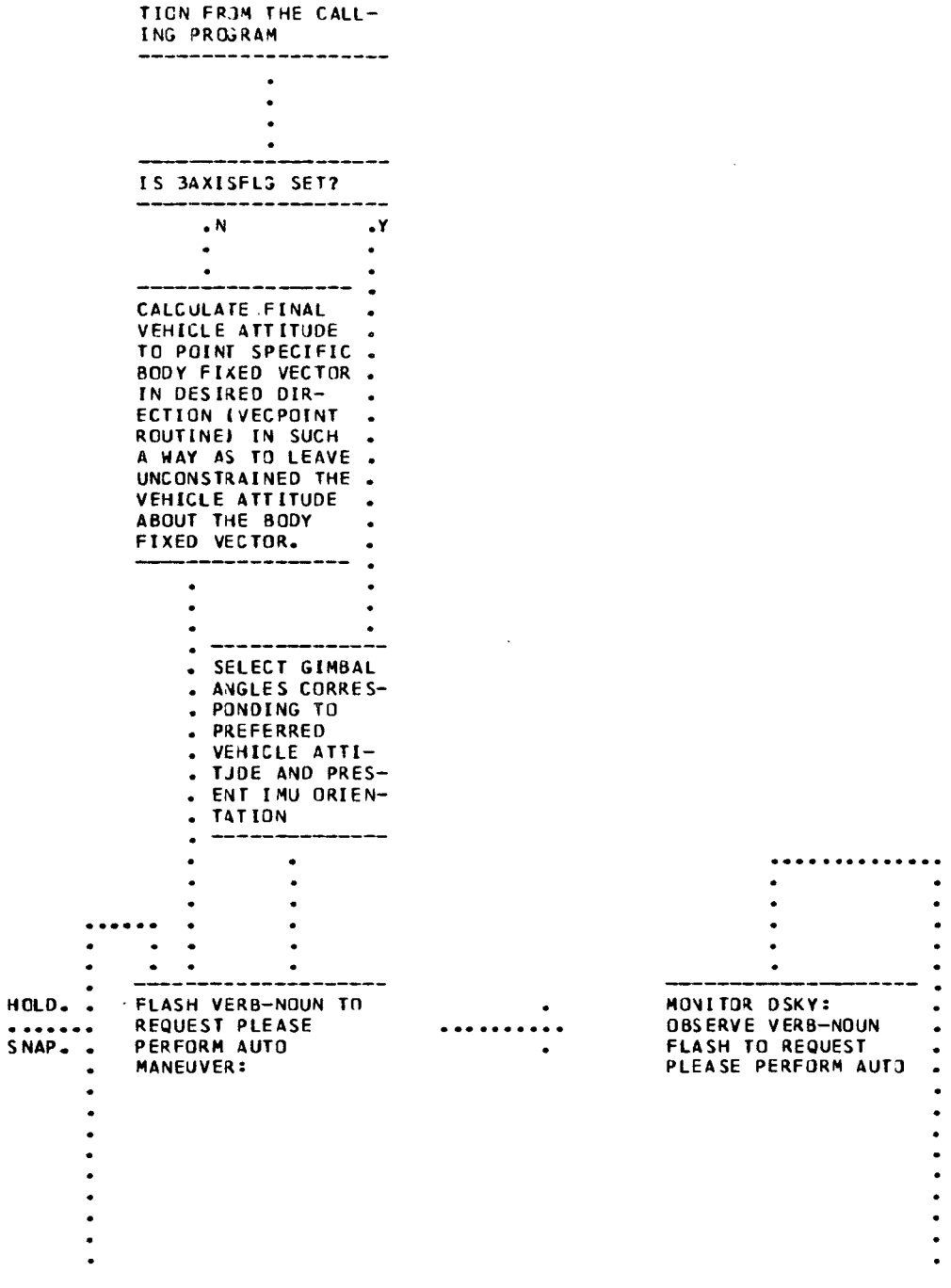

TION FROM THE CALL-
ING PROGRAM
IS 3AXISFLG SET?
N
Y
CALCULATE FINAL VEHICLE ATTITUDE TO POINT SPECIFIC BODY FIXED VECTOR IN DESIRED DIR-ECTION (VECPOINT ROUTINE) IN SUCH A WAY AS TO LEAVE UNCONSTRAINED THE VEHICLE ATTITUDE ABOUT THE BODY FIXED VECTOR.
SELECT GIMBAL ANGLES CORRES-PONDING TO PREFERRED VEHICLE ATTI-TJDE AND PRES-ENT IMU ORIEN-TATION
HOLD.
SNAP.
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM AUTO MANEUVER:
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM AUTO

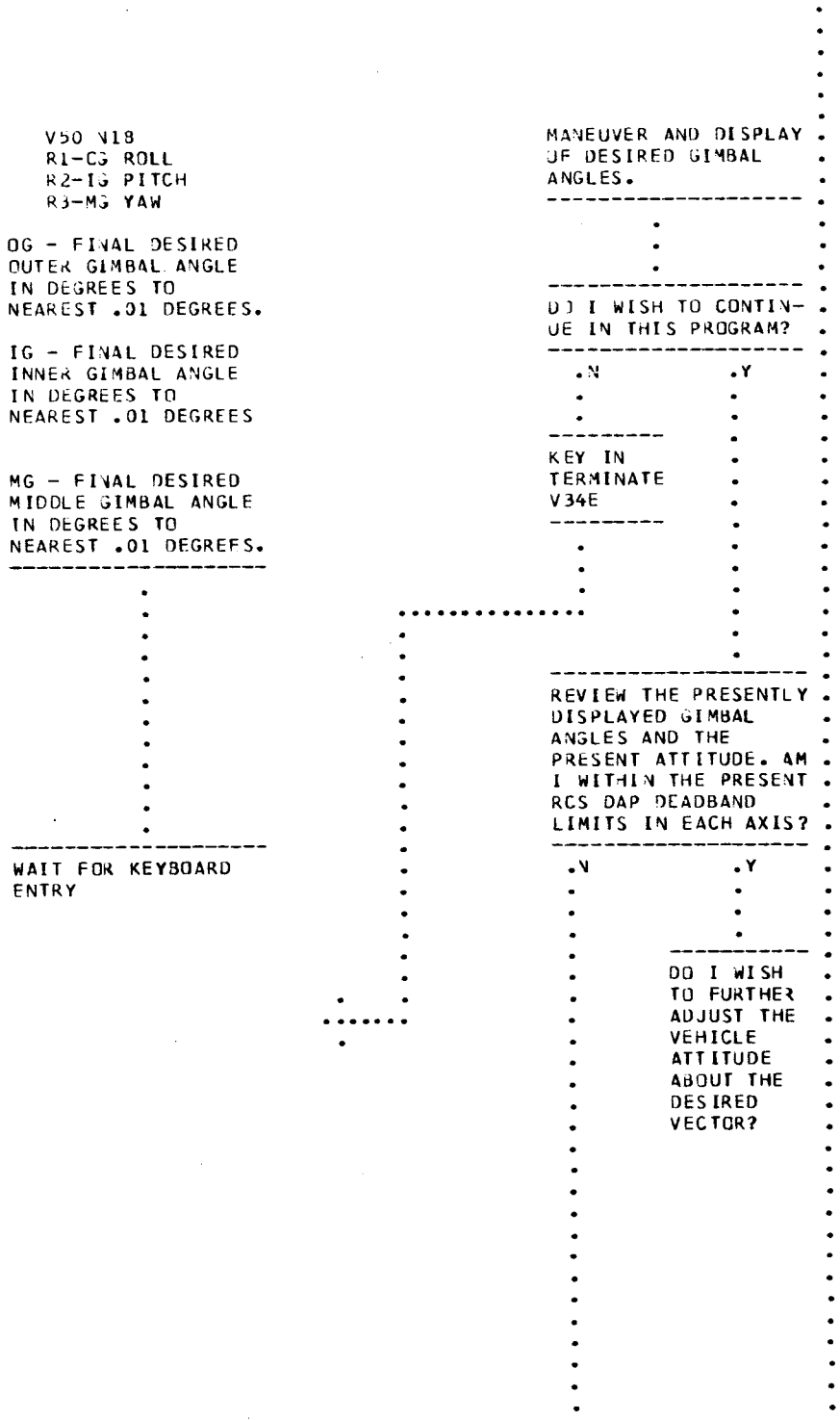
#20

#30

#40

#50

#60



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#110

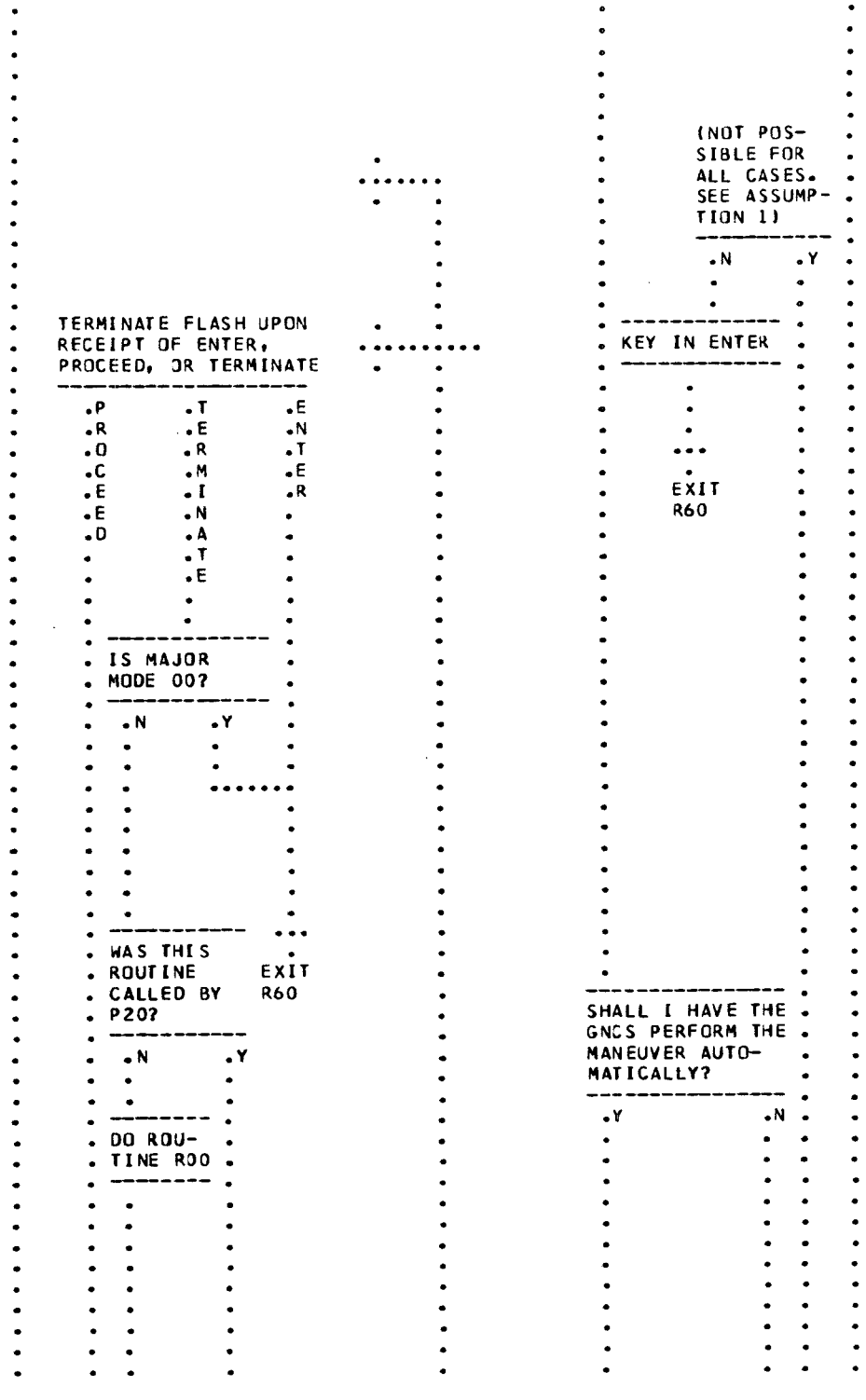
#120

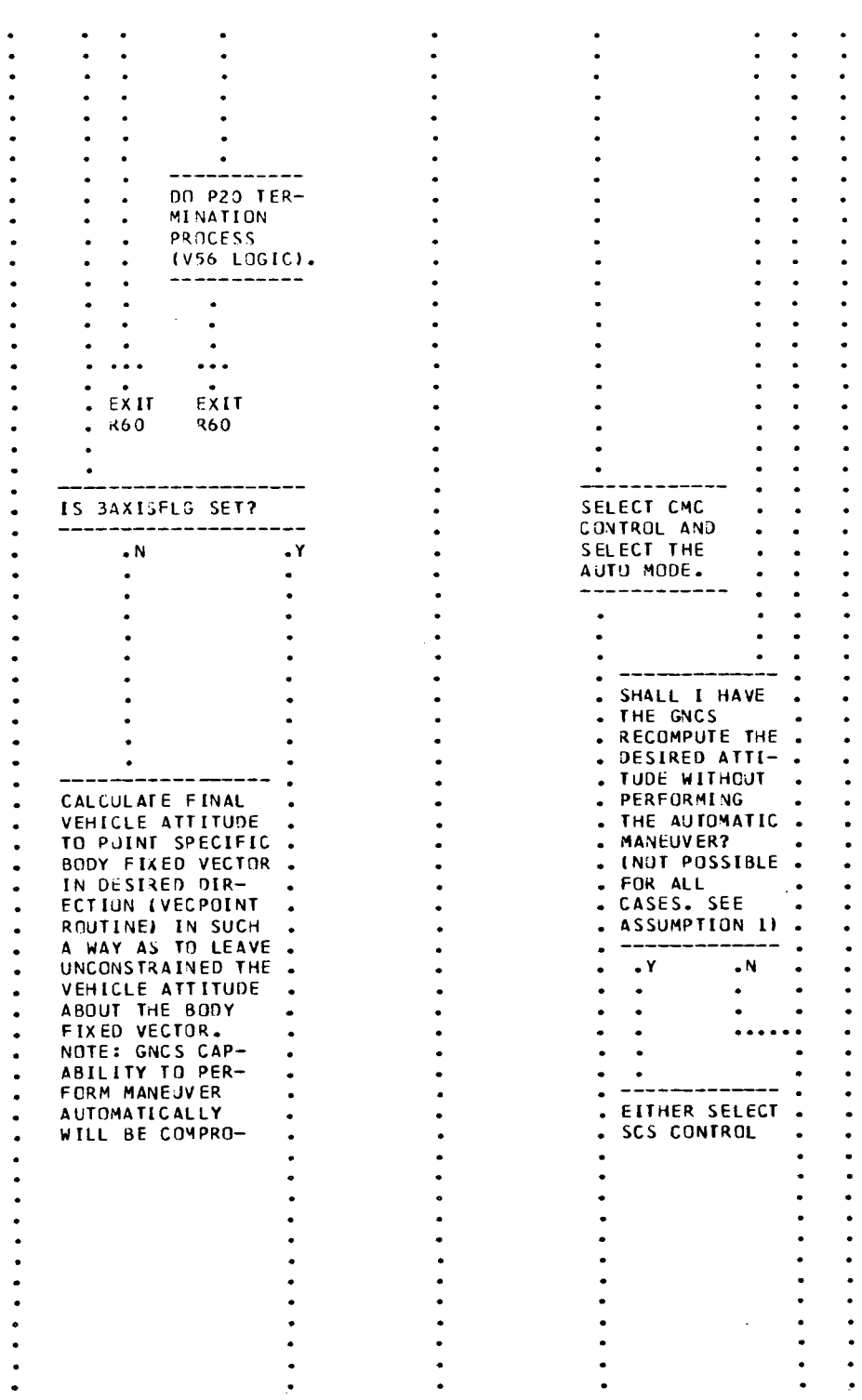
#130

#140

#150

#160





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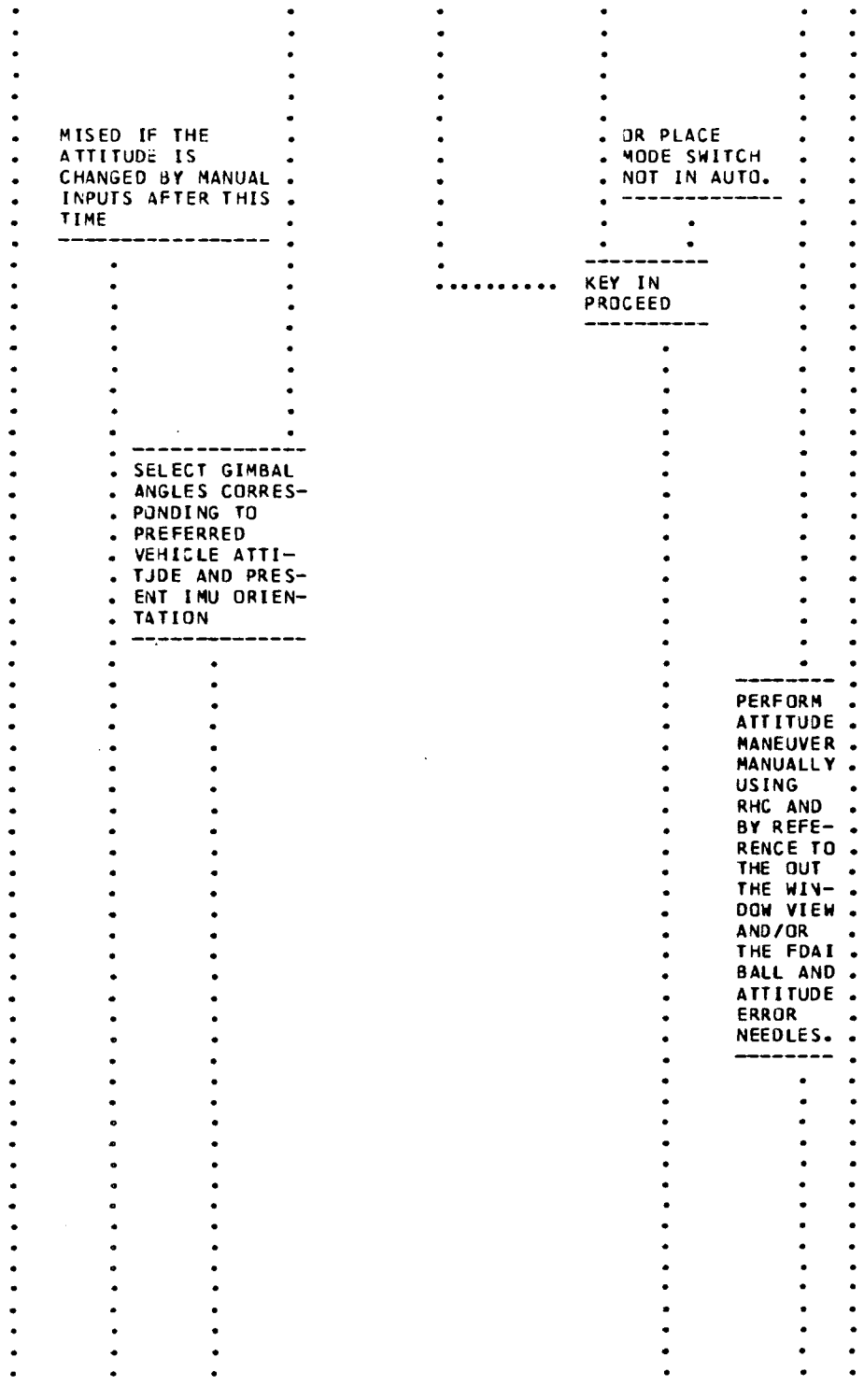

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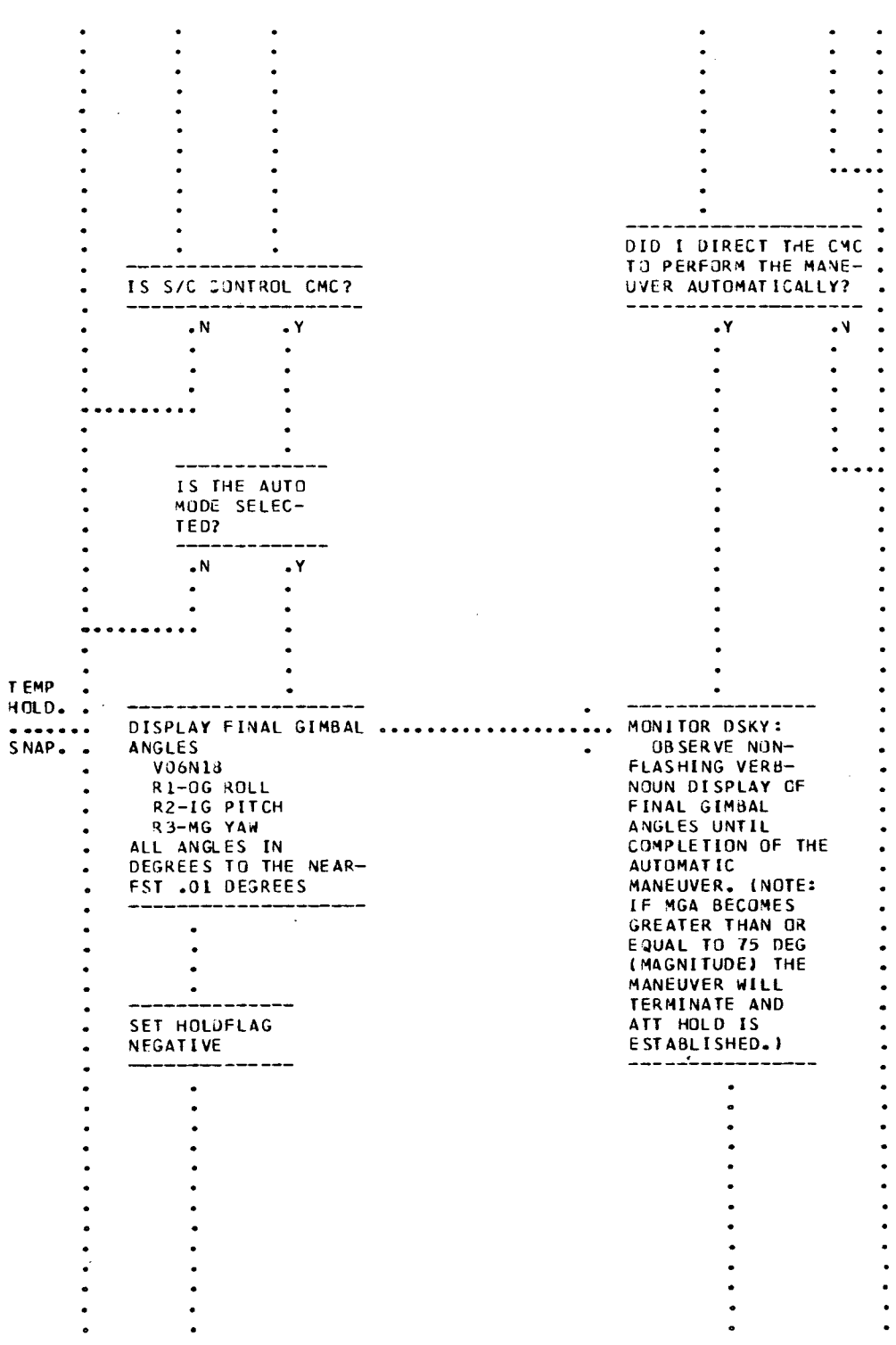
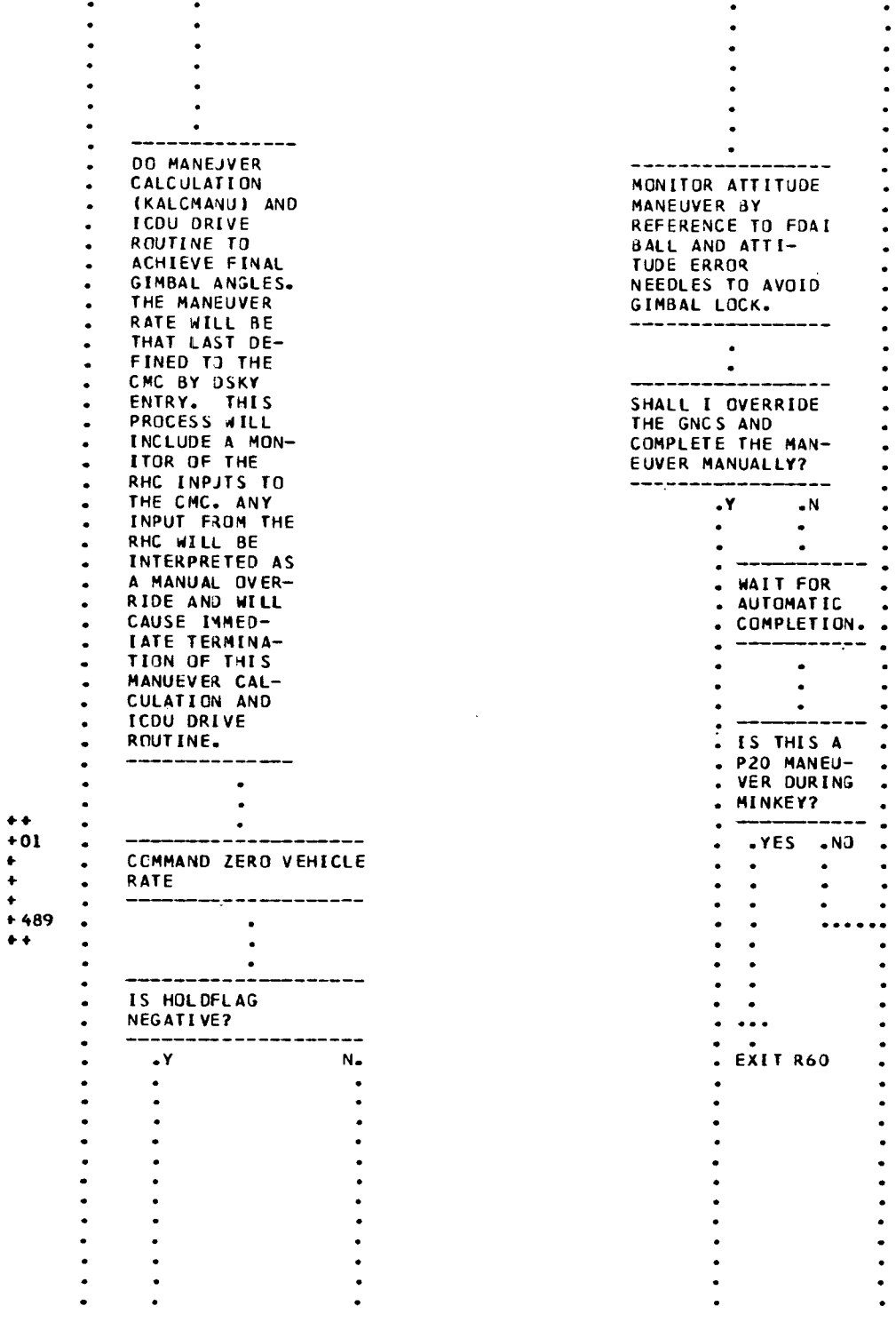

IS S/C CONTROL CMC?
.N
.Y
IS THE AUTO MODE SELEC-TED?
.N
.Y
DISPLAY FINAL GIMBAL ANGLES
V06N18
R1-OG ROLL
R2-IG PITCH
R3-MG YAW
ALL ANGLES IN DEGREES TO THE NEAR-EST .01 DEGREES
SET HOLDFLAG NEGATIVE
TEMP HOLD. SNAP.
DID I DIRECT THE CMC TO PERFORM THE MANE-UVER AUTOMATICALLY?
.Y
.N
MONITOR DSKY:
OBSERVE NON-FLASHING VERB-NOUN DISPLAY OF FINAL GIMBAL ANGLES UNTIL COMPLETION OF THE AUTOMATIC MANEUVER. (NOTE: IF MGA BECOMES GREATER THAN OR EQUAL TO 75 DEG (MAGNITUDE) THE MANEUVER WILL TERMINATE AND ATT HOLD IS ESTABLISHED.)
#270
#280
#290
#300
#310



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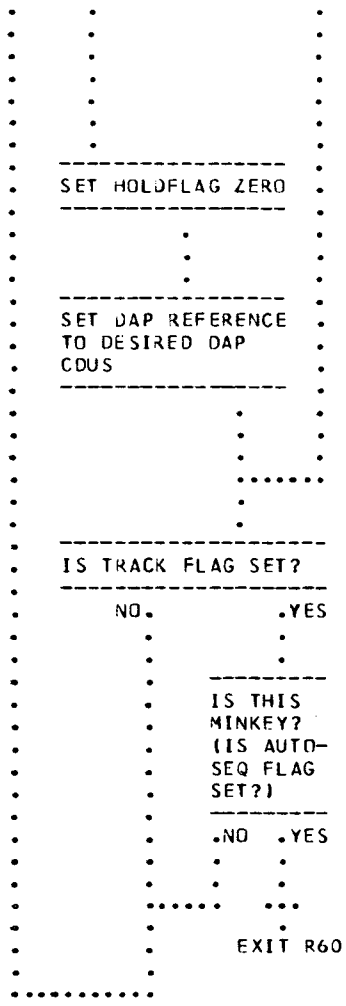
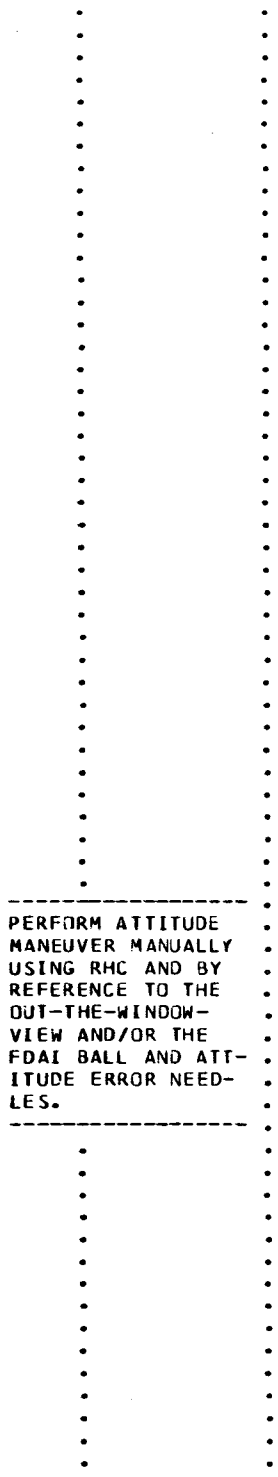
#330

#340

#350

#360





#370

#380

#390

#400

#410

CHANGE CONTROL NOTES

REV 00 PCR 040, PCN 456
REV 01 PCN 489

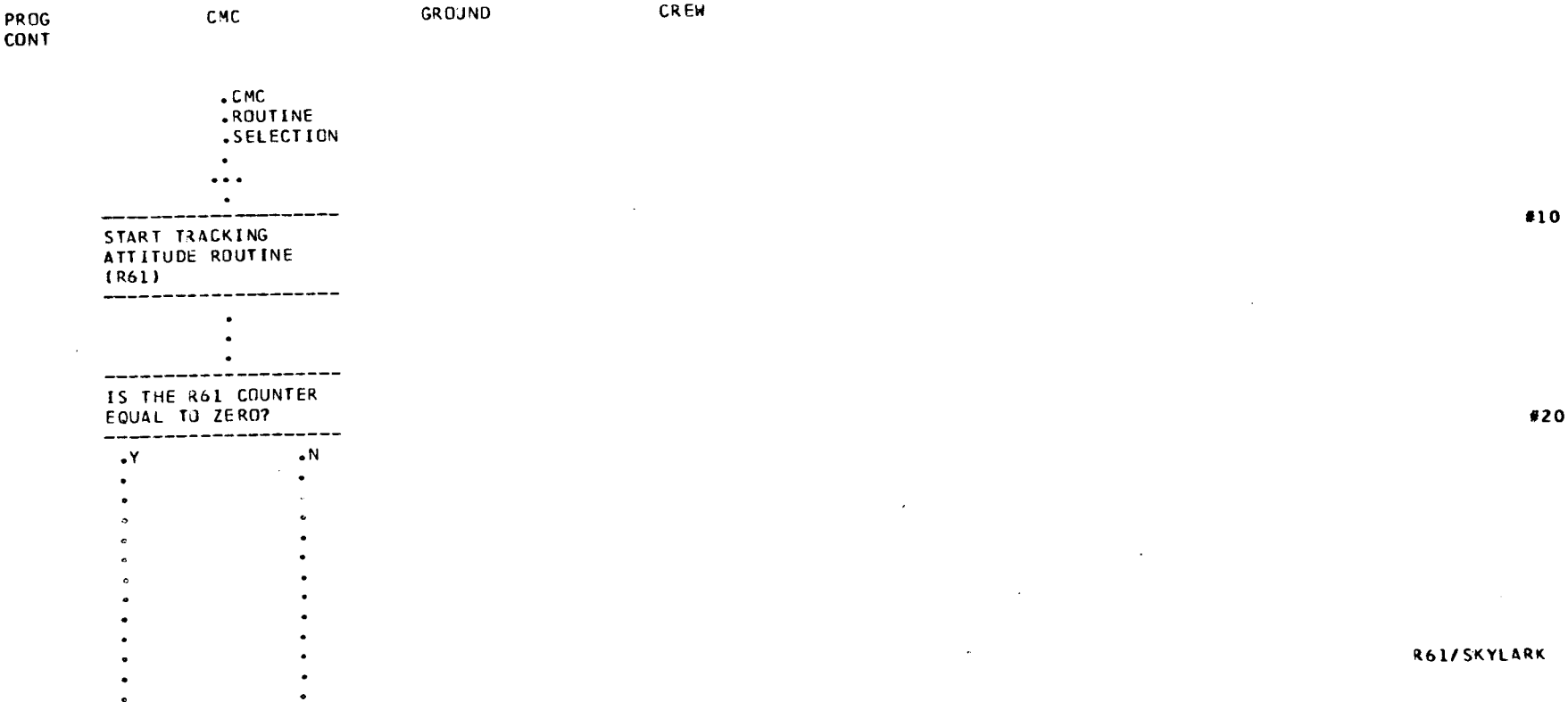
TRACKING ATTITUDE
ROUTINE (R61)

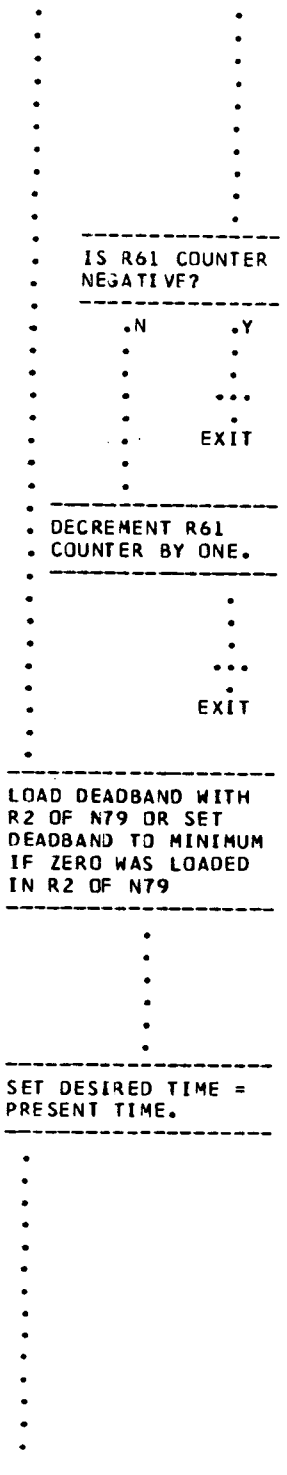
REV 01 03/20/72

PURPOSE: (1) TO COMPUTE THE DESIRED TRACKING ATTITUDE OF THE CSM WHICH ENABLES OPTICS TRACKING OF THE OWS.
++
+01 (2) TO COMPUTE THE DESIRED TRACKING ATTITUDE OF THE CSM WR CSM/OWS WHICH ENABLES TRACKING OF A CELESTIAL BODY.
+489
++ (3) TO CALL R60 IF A LARGE MANEUVER (SEE BELOW) IS REQUIRED, AND THE V50N18 FLAG IS SET.
TO LIGHT THE JPLINK ACTY LIGHT IF A LARGE MANEUVER (SEE BELOW) IS REQUIRED, THE V50N18 FLAG IS NOT SET AND R60 IS POSSIBLE (SEE BELOW).

ASSUMPTIONS: (1) THE CSM ORIENTATION ABOUT THE TRACK AXIS (I) IS A FUNCTION OF THE EXISTING ATTITUDE AT THE TIME OF THE CALCULATION AND IS CALCULATED SO AS TO YIELD A MINIMUM ATTITUDE MANEUVER, UNLESS P20 (OPTIONS 4,5) IS CALLED.

(2) THE ROUTINE IS AUTOMATICALLY CALLED BY THE UNIVERSAL TRACKING PROGRAM (P20) AND BY R52 DURING P20.




IS R61 COUNTER NEGATIVE?
.N
.Y
EXIT
DECREMENT R61 COUNTER BY ONE.
EXIT
LOAD DEADBAND WITH R2 OF N79 OR SET DEADBAND TO MINIMUM IF ZERO WAS LOADED IN R2 OF N79
SET DESIRED TIME = PRESENT TIME.

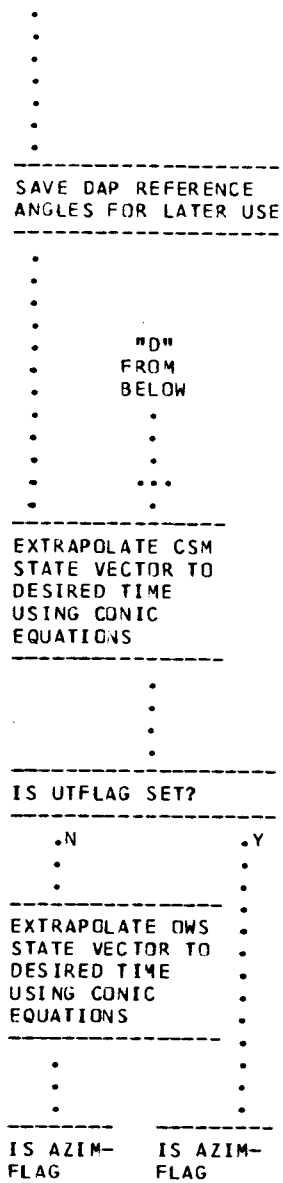
#30

#40

#50

#60

#70

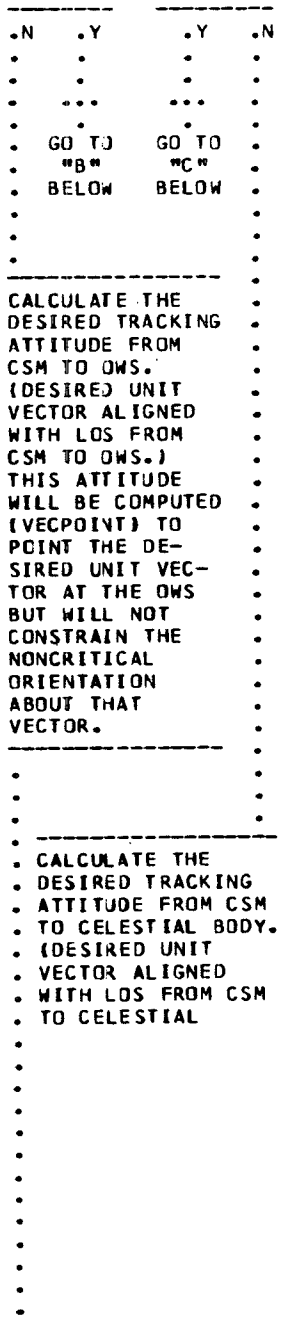

SAVE DAP REFERENCE ANGLES FOR LATER USE
"D" FROM BELOW
EXTRAPOLATE CSM STATE VECTOR TO DESIRED TIME USING CONIC EQUATIONS
IS UTFLAG SET?
N
Y
EXTRAPOLATE OWS STATE VECTOR TO DESIRED TIME USING CONIC EQUATIONS
IS AZIM-FLAG
IS AZIM-FLAG

#80

#90

#100

#110



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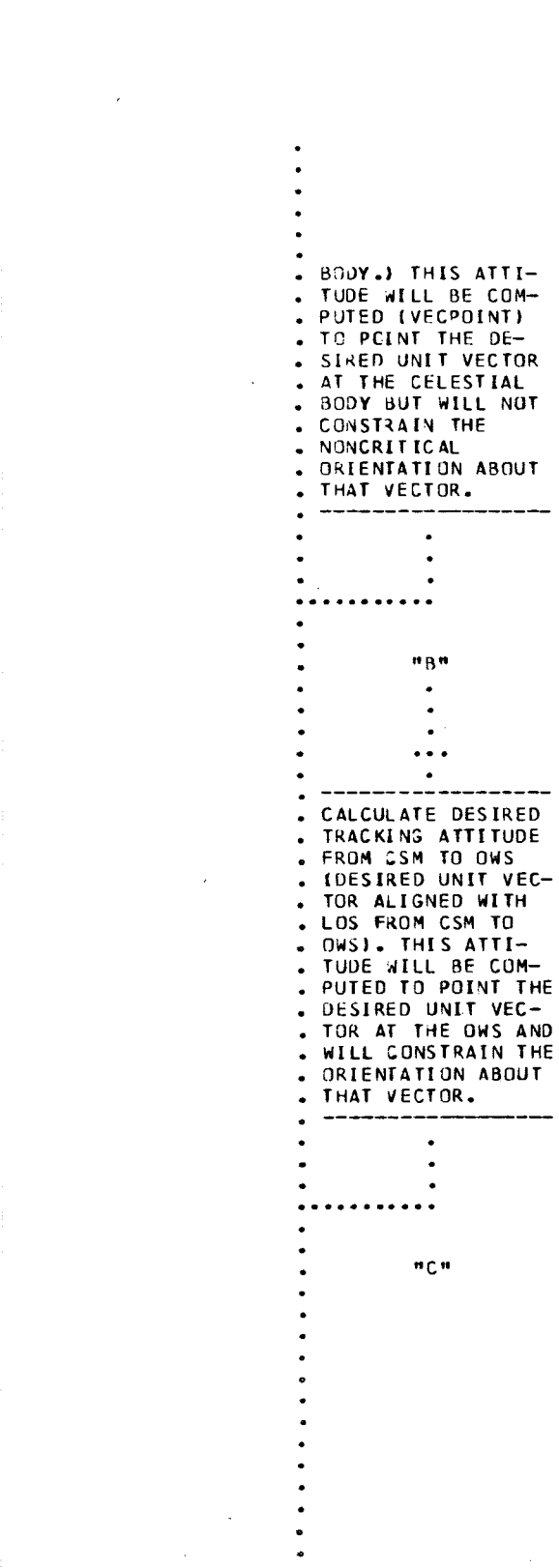


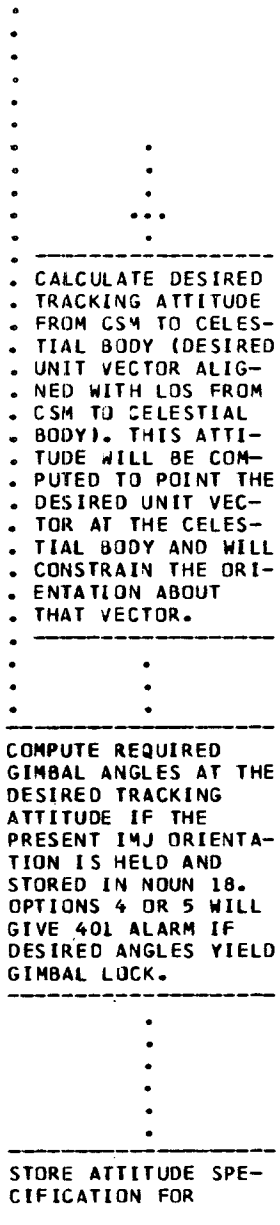
#170

#180

#190

#200

#210



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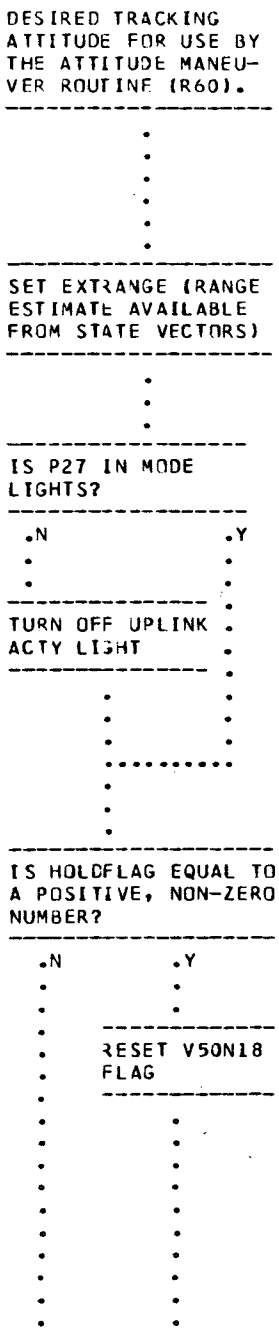
#230

#240

#250



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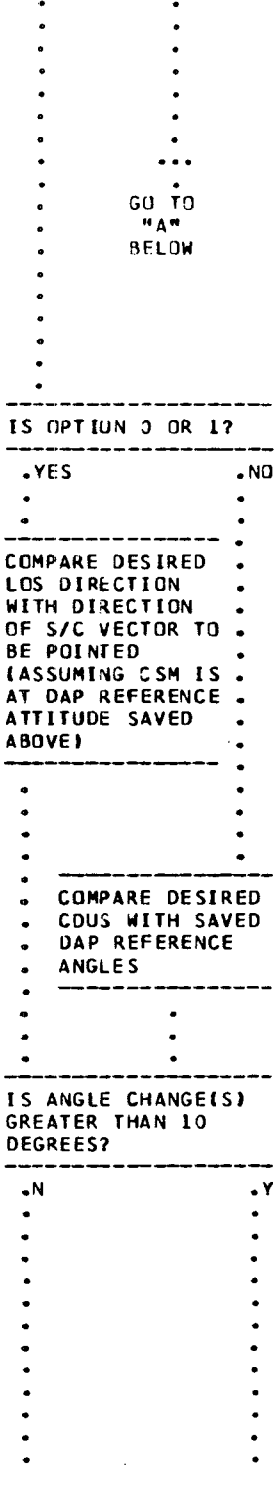

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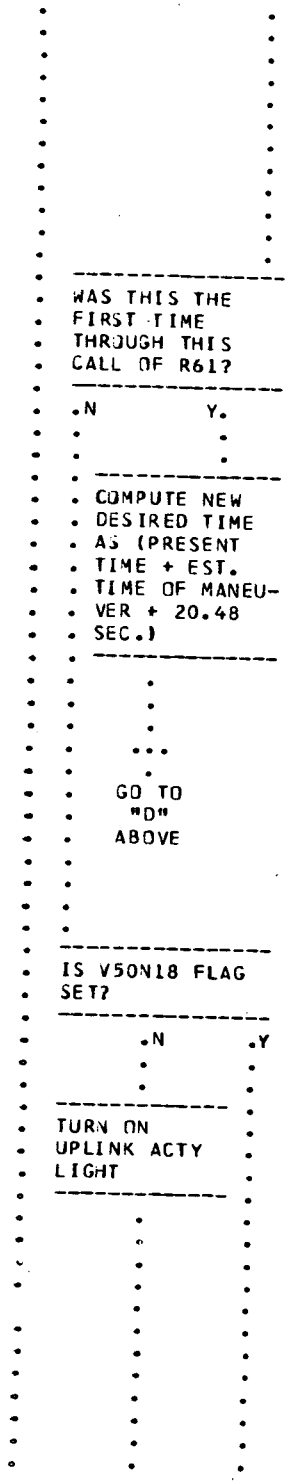
#370

#380

#390

#400



#410

"A"

#420

SET R61 COUNTER EQUAL TO 3.

#430

EXIT

#440

IS THE PRIORITY DISPLAY IN ROUTINE 22 USING THE DSKY?

.Y .N

SET R61 COUNTER EQUAL TO -1.

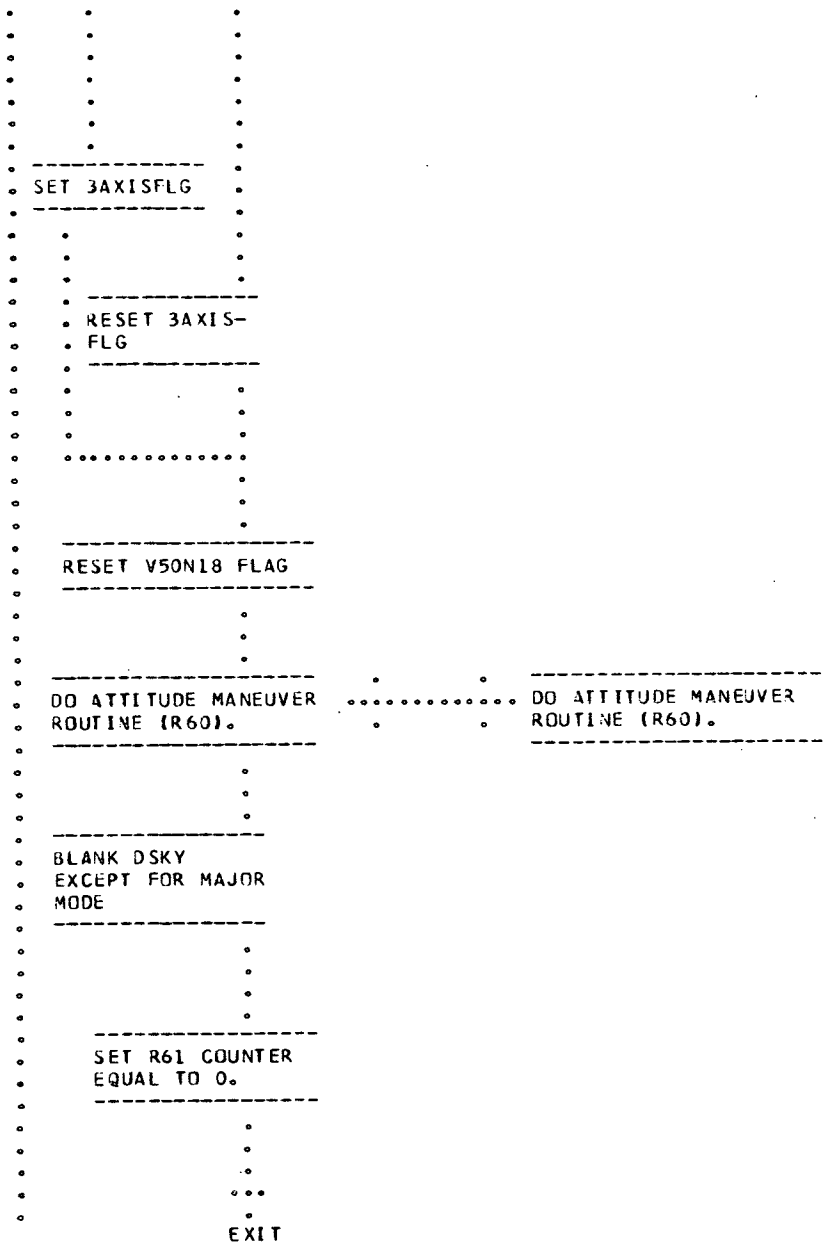
#450

EXIT

#460

IS AZIMFLAG SET?

.Y .N



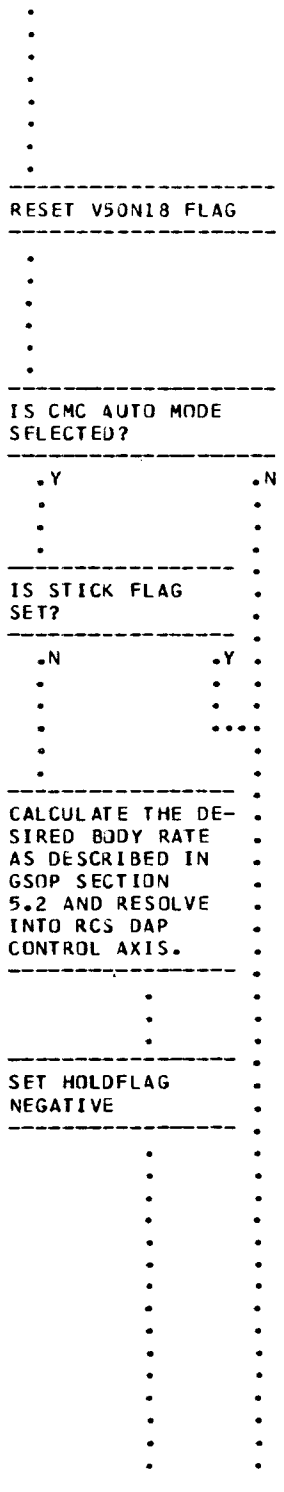
0470

0480

0490

0500

0510



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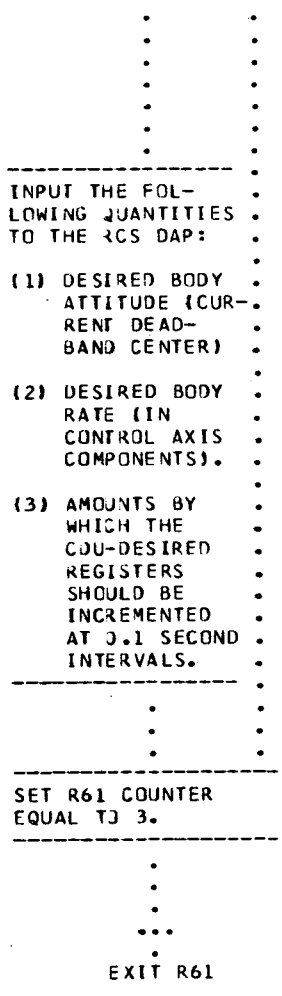
#530

#540

#550



#560

#570

#580

#590

CHANGE CONTROL NOTES

REV 00 PCR 007,025,443, PCN 410,456,457
REV 01 PCN 489

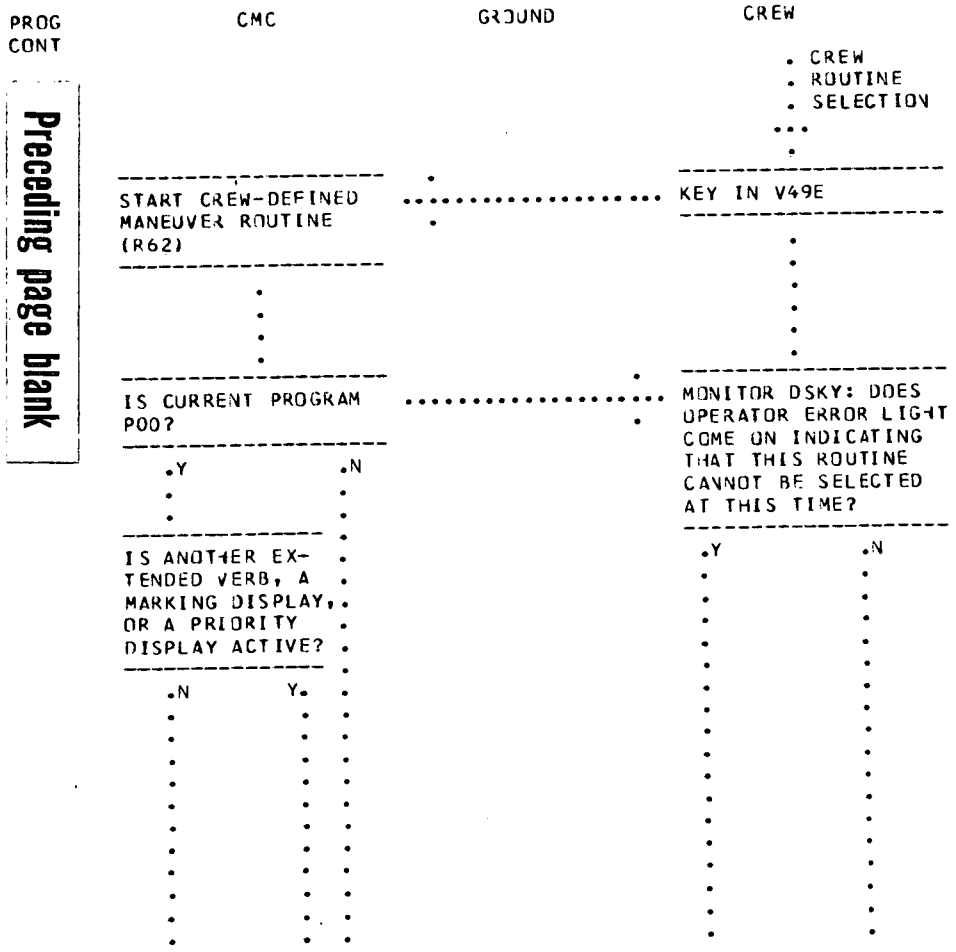
CREW-DEFINED MANEUVER ROUTINE (R62) REV 00 05/19/71

PURPOSE: (1) TO PROVIDE THE CREW WITH THE ABILITY TO SPECIFY A FINAL VEHICLE ATTITUDE FOR USE BY A CMC-CONTROLLED ATTITUDE MANEUVER.

ASSUMPTIONS: (1) THE ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THE CAP DEADBAND DURING THIS ROUTINE IS AS DEFINED BY THE LOAD DAP DATA ROUTINE (R03 OR R04).

(3) THIS ROUTINE CAN ONLY BE ENTERED FROM THE CMC IDLING PROGRAM (P00).



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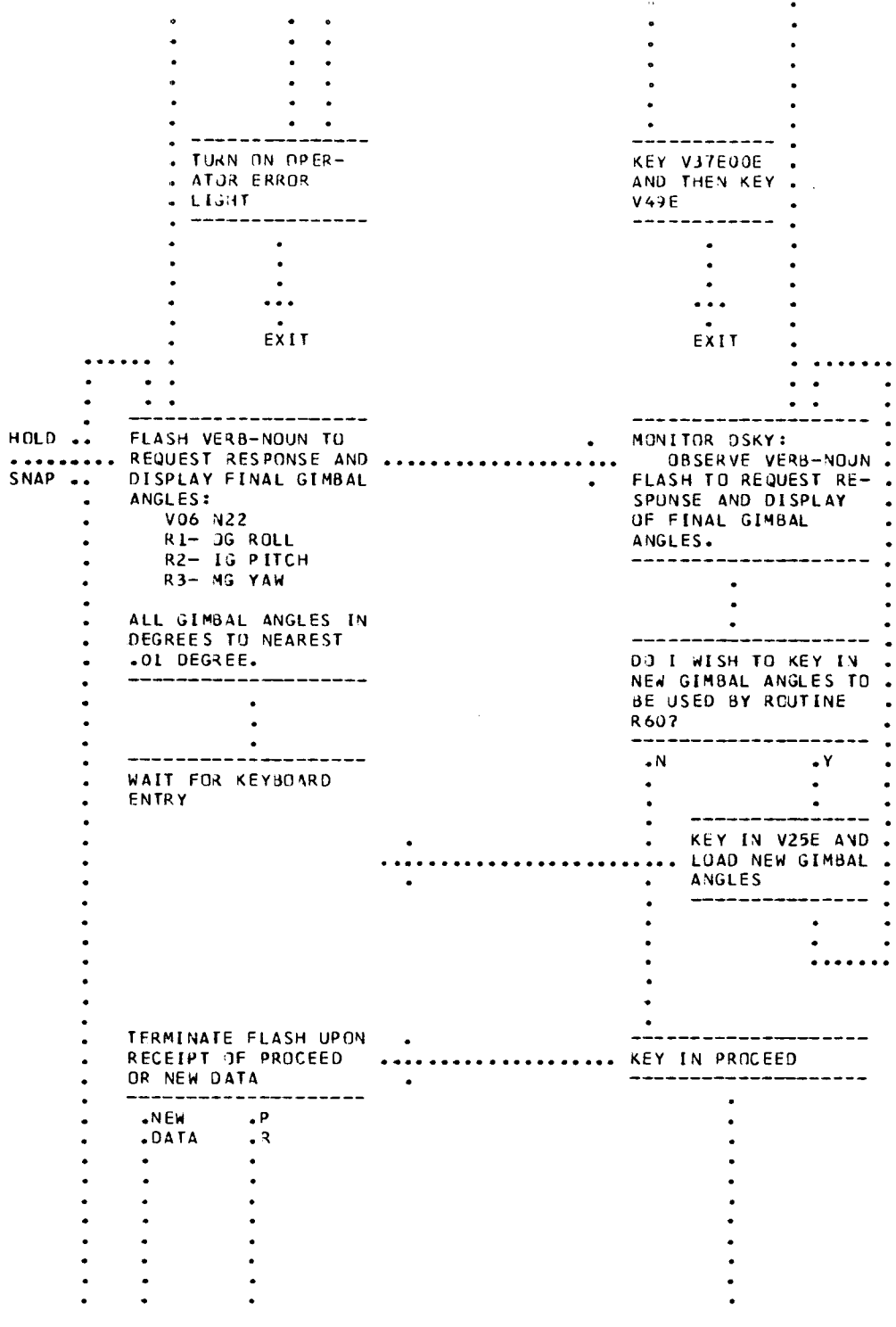
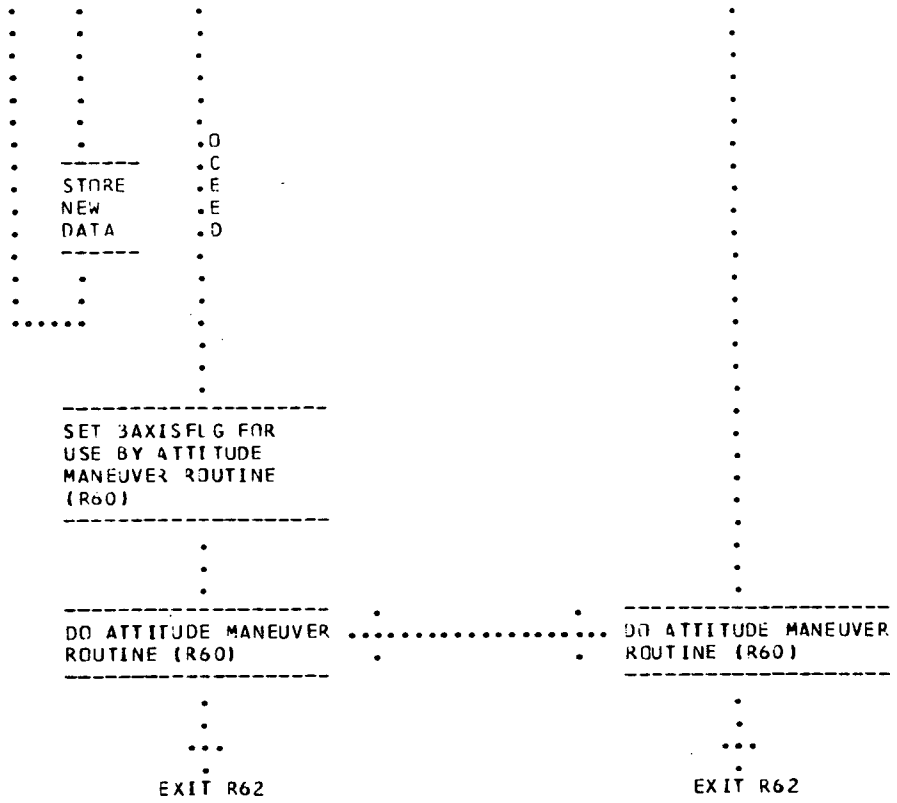

TURN ON OPER-
ATOR ERROR
LIGHT
EXIT
KEY V37E00E
AND THEN KEY
V49E
EXIT
HOLD
SNAP
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY FINAL GIMBAL
ANGLES:
V06 N22
R1- OG ROLL
R2- IG PITCH
R3- MG YAW
ALL GIMBAL ANGLES IN
DEGREES TO NEAREST
.01 DEGREE.
WAIT FOR KEYBOARD
ENTRY
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA
.NEW
.DATA
.P
.R
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST RE-
SPONSE AND DISPLAY
OF FINAL GIMBAL
ANGLES.
DO I WISH TO KEY IN
NEW GIMBAL ANGLES TO
BE USED BY ROUTINE
R60?
.N
.Y
KEY IN V25E AND
LOAD NEW GIMBAL
ANGLES
KEY IN PROCEED
#40
#50
#60
#70
#80



#90

#100

#110

CHANGE CONTROL NOTES

REV 00 PCR 040

RENDEZVOUS FINAL ATTITUDE ROUTINE (R63) REV 00 05/19/71

PURPOSE: (1) TO CALCULATE THE FINAL GIMBAL ANGLES REQUIRED TO POINT THE SPECIFIED AXIS AT THE DWS.

(2) TO DISPLAY THE GIMBAL ANGLES CORRESPONDING TO THE N78 ANGLES SELECTED BY THE ASTRONAUT.

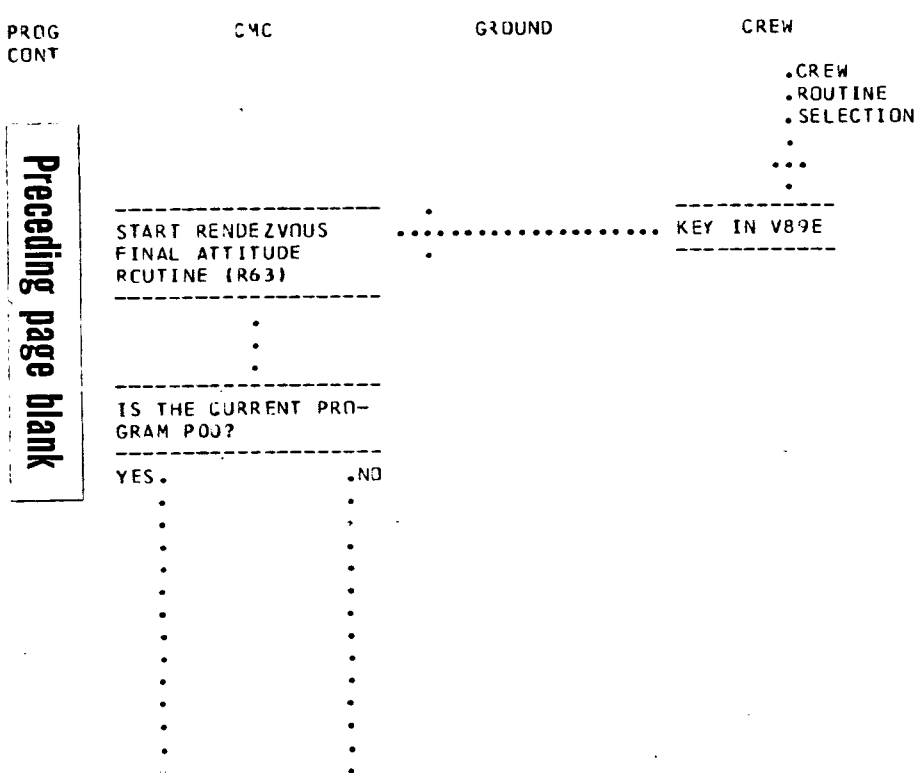
(3) TO CALL THE ATTITUDE MANEUVER ROUTINE (R60) FOR AUTOMATIC MANEUVER CAPABILITY.

ASSUMPTIONS: (1) THE CSM ORIENTATION ABOUT THE TRACK AXIS (I) IS A FUNCTION OF THE EXISTING ATTITUDE AT THE TIME OF THE CALCULATION AND IS CALCULATED SO AS TO YIELD A MINIMUM ATTITUDE MANEUVER.

(2) TO SAVE TIME THE CSM ATTITUDE CONTROL MODE SHOULD BE PRESELECTED (FOR AUTOMATIC MANEUVERS R03 SHOULD HAVE BEEN DONE AND THE CMC AUTO MODE SELECTED).

(3) THIS ROUTINE MAY BE SELECTED IN P00 ONLY.

(4) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



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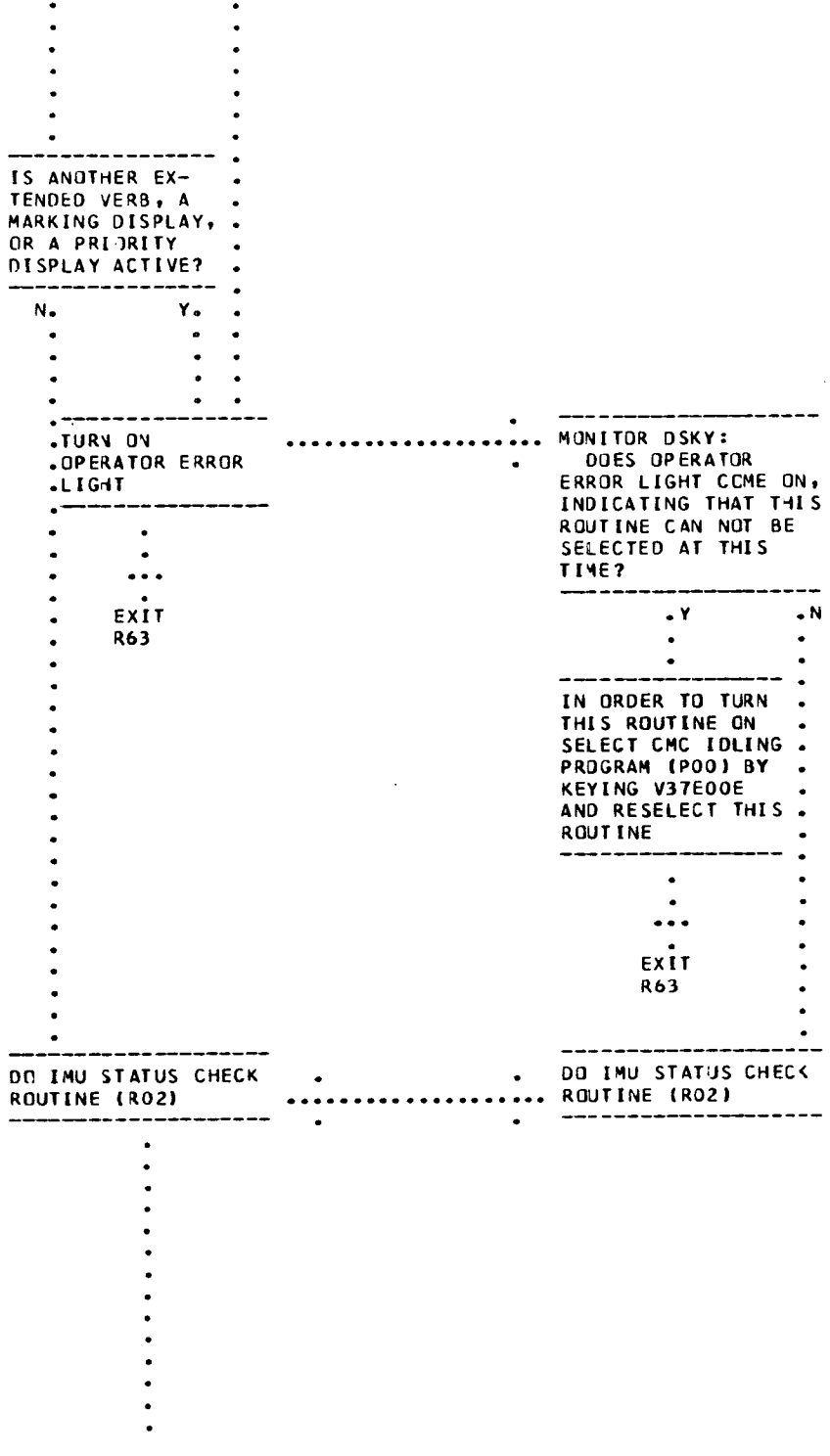

IS ANOTHER EX-
TENDED VERB, A
MARKING DISPLAY,
OR A PRIORITY
DISPLAY ACTIVE?
N.
Y.
TURN ON
OPERATOR ERROR
LIGHT
EXIT
R63
MONITOR DSKY:
DOES OPERATOR
ERROR LIGHT COME ON,
INDICATING THAT THIS
ROUTINE CAN NOT BE
SELECTED AT THIS
TIME?
.Y
.N
IN ORDER TO TURN
THIS ROUTINE ON
SELECT CMC IDLING
PROGRAM (P00) BY
KEYING V37E00E
AND RESELECT THIS
ROUTINE
EXIT
R63
DO IMU STATUS CHECK
ROUTINE (R02)
DO IMU STATUS CHECK
ROUTINE (R02)

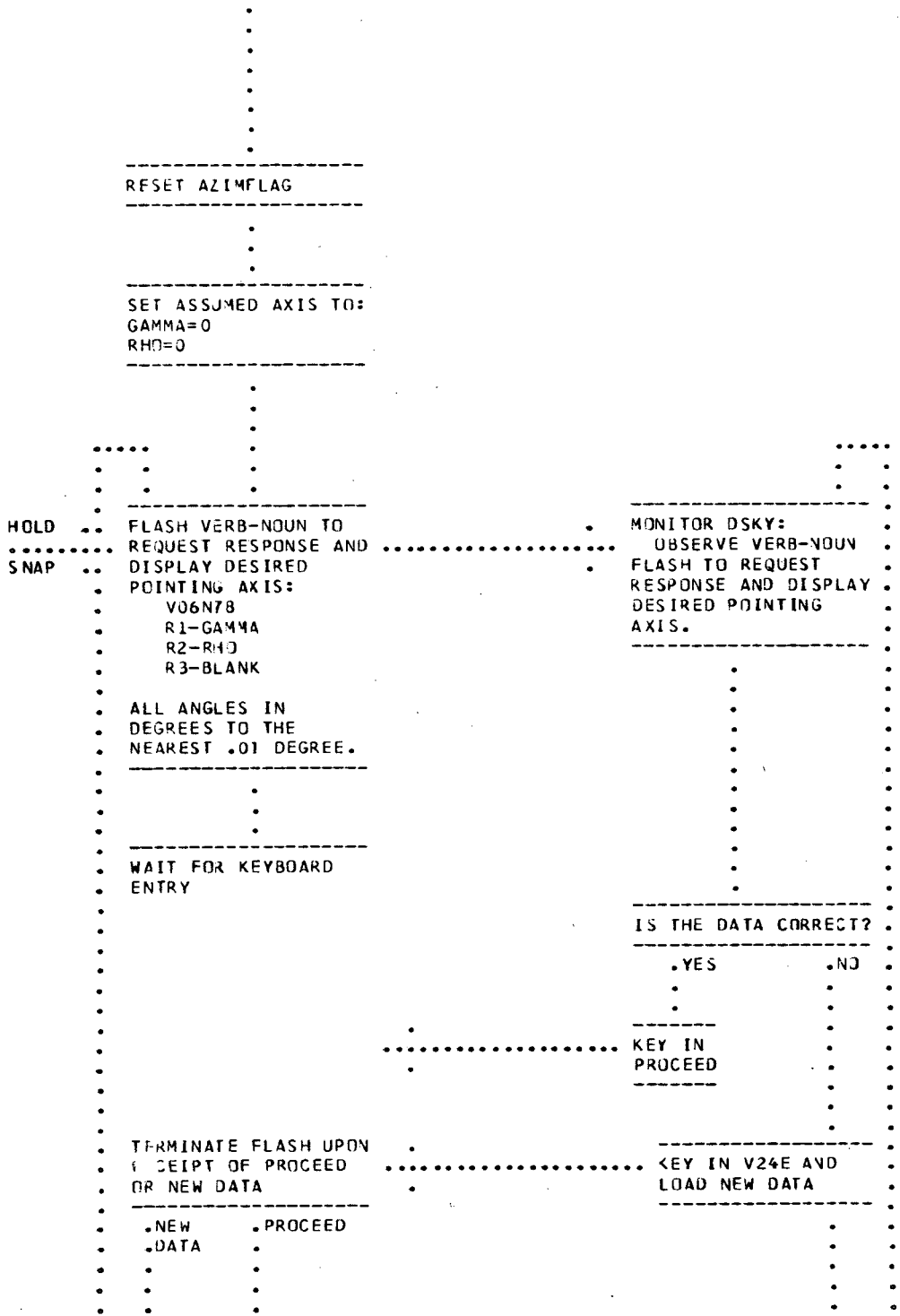
#30

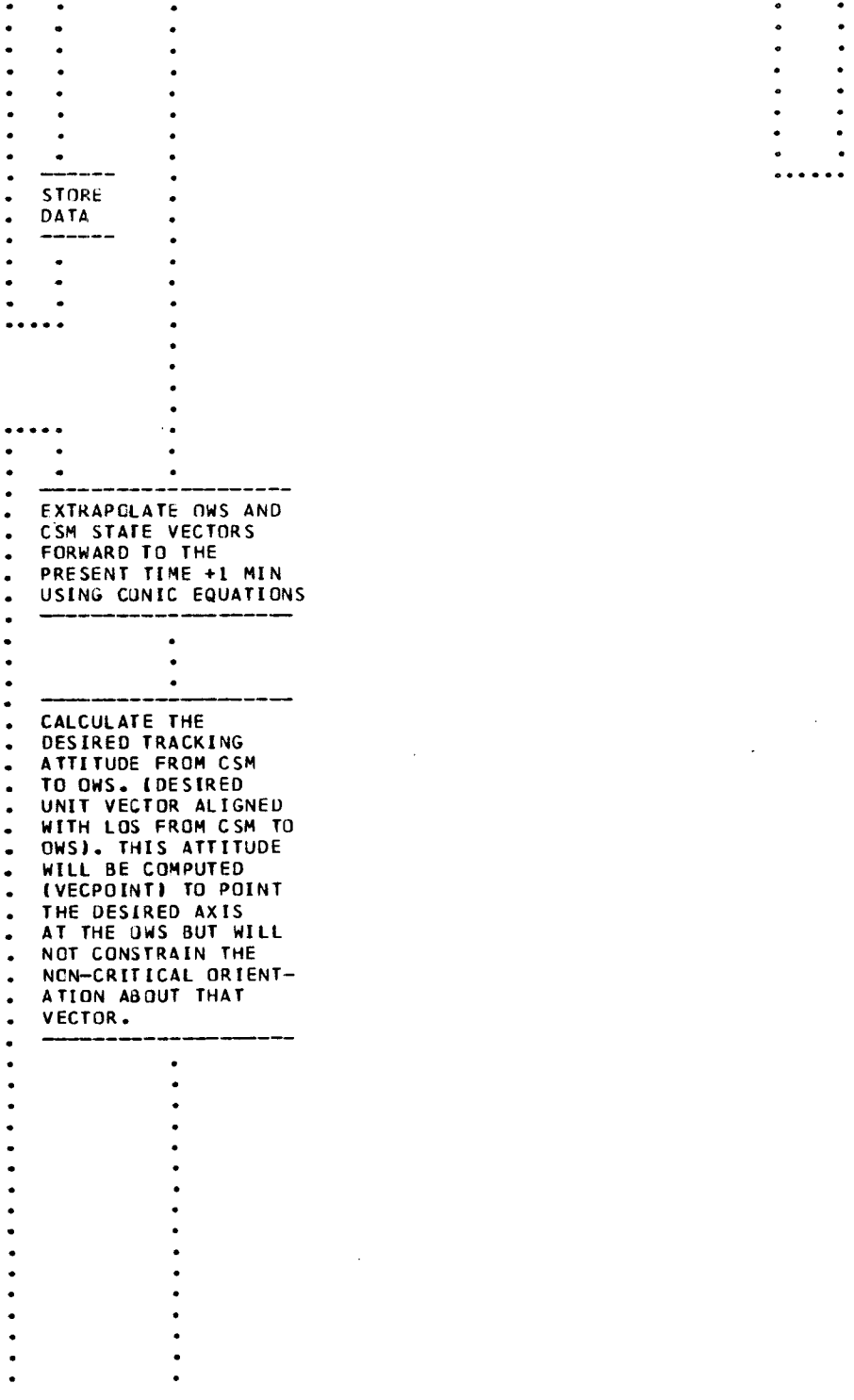
#40

#50

#60

#70


RESET AZIMFLAG
SET ASSUMED AXIS TO:
GAMMA=0
RHO=0
#80
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DESIRED POINTING AXIS:
V06N78
R1-GAMMA
R2-RHO
R3-BLANK
ALL ANGLES IN DEGREES TO THE NEAREST .01 DEGREE.
#90
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY DESIRED POINTING AXIS.
#100
WAIT FOR KEYBOARD ENTRY
#110
IS THE DATA CORRECT?
.YES
.NO
KEY IN PROCEED
#120
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA
.NEW DATA
.PROCEED
KEY IN V24E AND LOAD NEW DATA



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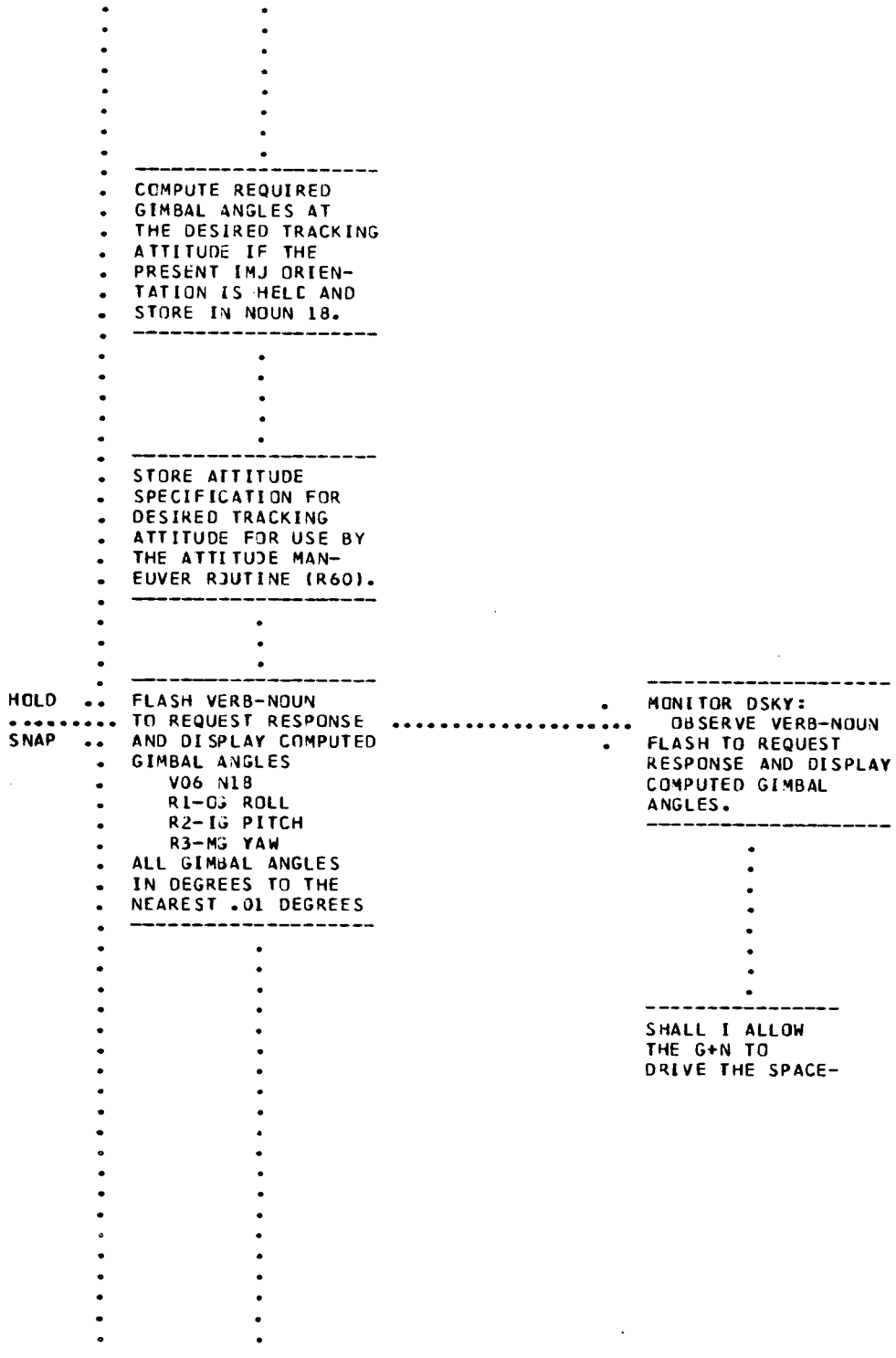
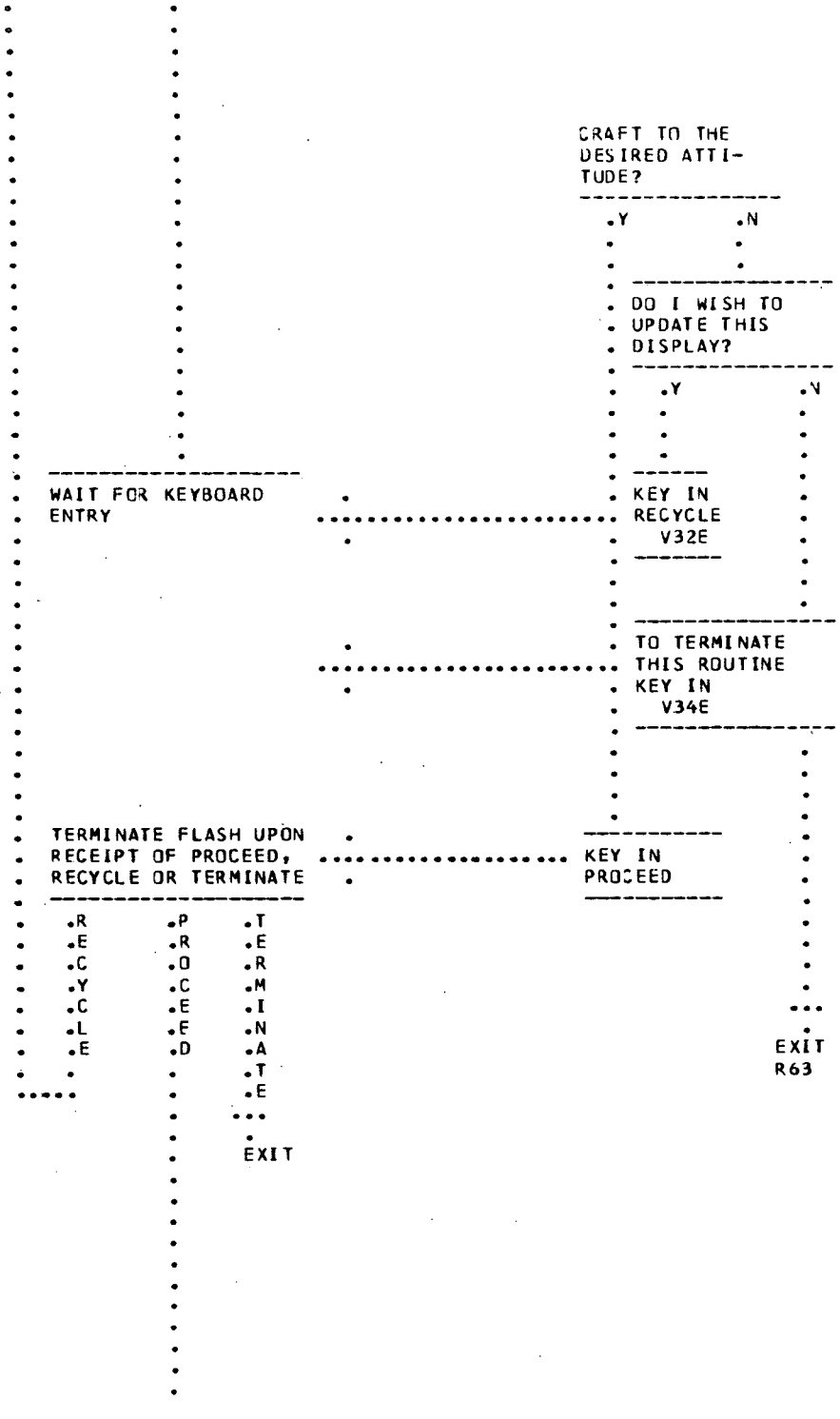

COMPUTE REQUIRED GIMBAL ANGLES AT THE DESIRED TRACKING ATTITUDE IF THE PRESENT IMJ ORIENTATION IS HELD AND STORE IN NOUN 18.
#180
#190
STORE ATTITUDE SPECIFICATION FOR DESIRED TRACKING ATTITUDE FOR USE BY THE ATTITUDE MANEUVER ROUTINE (R60).
#200
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY COMPUTED GIMBAL ANGLES
V06 N18
R1-OG ROLL
R2-IG PITCH
R3-MG YAW
ALL GIMBAL ANGLES IN DEGREES TO THE NEAREST .01 DEGREES
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY COMPUTED GIMBAL ANGLES.
#210
SHALL I ALLOW THE G+N TO DRIVE THE SPACE-
#220



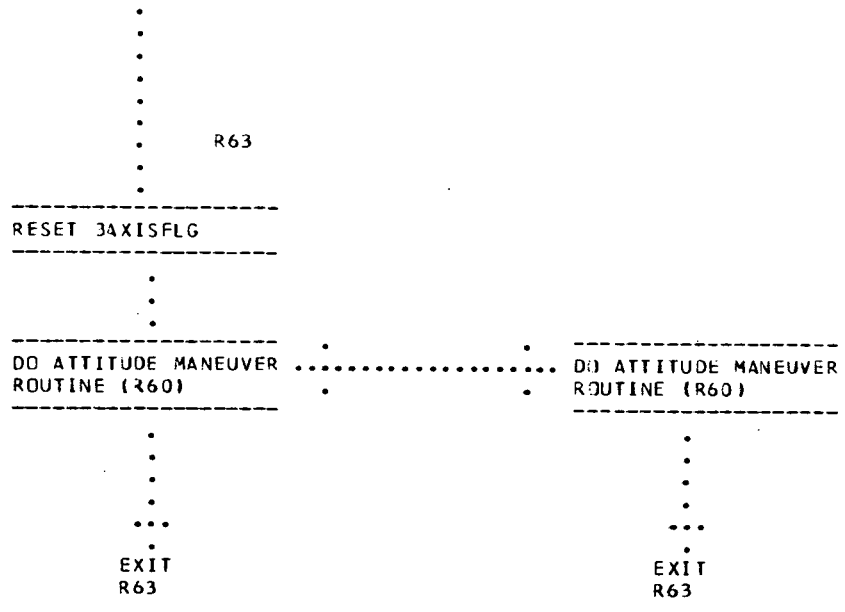
#230

#240

#250

#260

#270



#280

#290

CHANGE CONTROL NOTES

REV 00 PCN 457

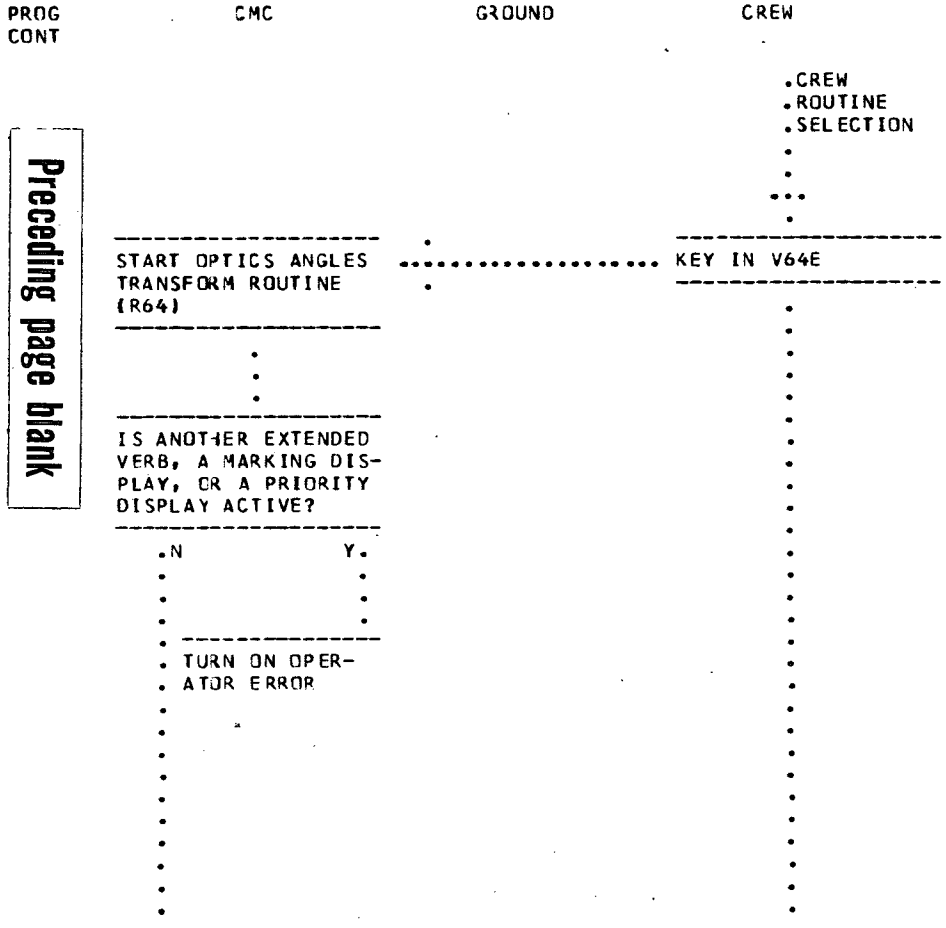
OPTICS ANGLES TRANSFORM ROUTINE (R64) REV 01 03/20/72

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST THE TRACKING ANGLES CORRESPONDING TO GIVEN OPTICS ANGLES. TRACKING ANGLES (N78) SPECIFY THE SPACECRAFT AXIS TO BE POINTED BY THE TRACKING PROGRAM.

(2) TO AUTOMATICALLY ALTER THE SPACECRAFT TRACKING AXIS (AS CONTAINED IN N78) SINCE R61 CONSTRUCTS THE TRACKING VECTOR FROM THE CONTENTS OF N78.

ASSUMPTIONS: (1) OPTICS ANGLES WILL REMAIN CONSTANT DURING THE TRACKING.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.



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#30

LIGHT

EXIT

#40

HOLD
SNAP

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTICS ANGLES:
V06 N94
R1 - SHAFT
R2 - TRUNNION
R3 - BLANK

SHAFT - SHAFT ANGLE IN DEGREES TO NEAREST .01 DEG.

TRUNNION - TRUNNION ANGLE IN DEGREES TO NEAREST .001 DEG.

MONITOR DSKY:
OBSERVE FLASHING VERB-NOUN AND DISPLAY OF OPTICS ANGLES.

#50

ARE OPTICS ANGLES CORRECT?

Y.

.N

#60

WAIT FOR KEYBOARD ENTRY

KEY IN PROCEED

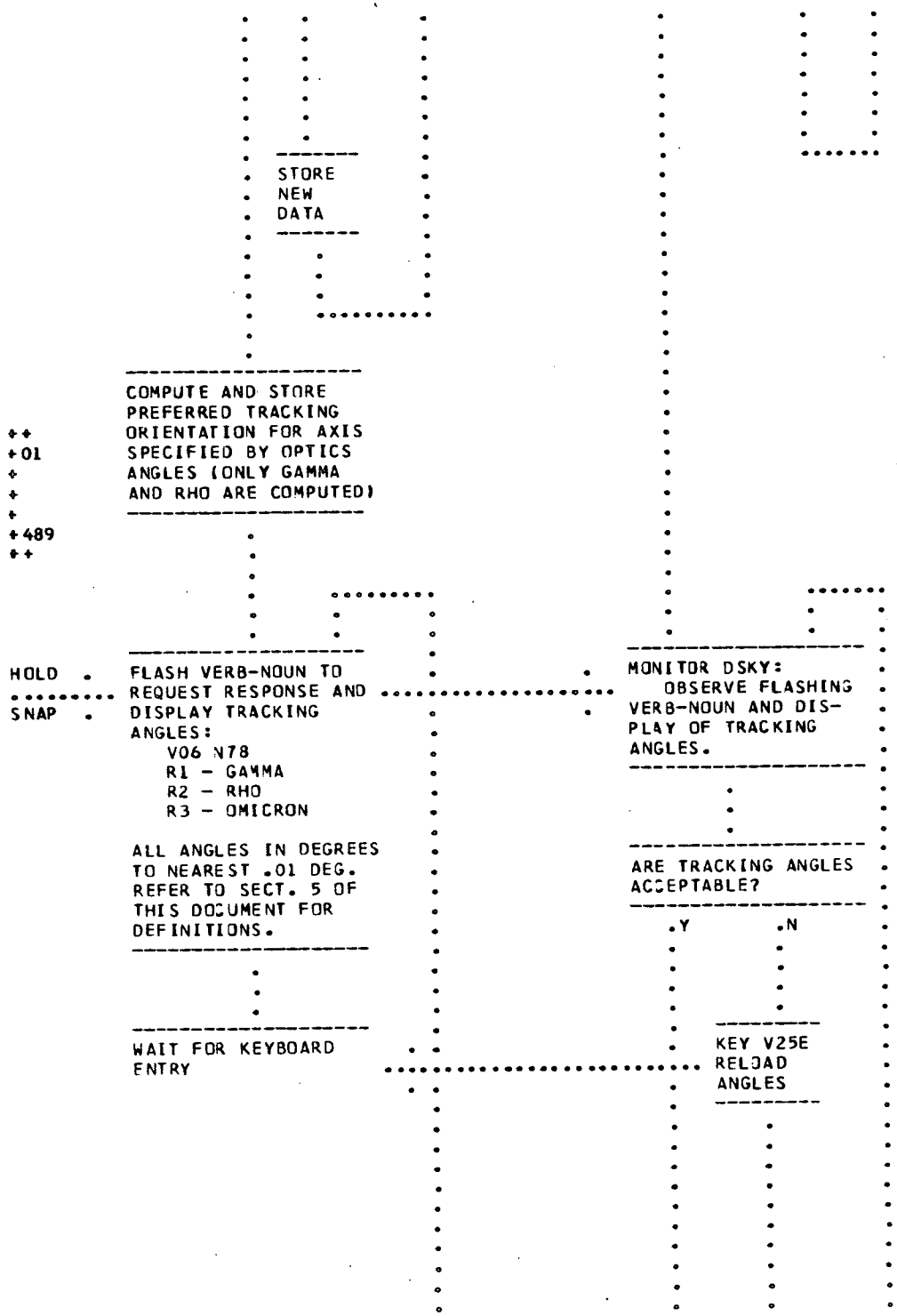
#70

TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA

KEY V24E AND RELOAD ANGLES

PROCEED.

.NEW DATA



#80

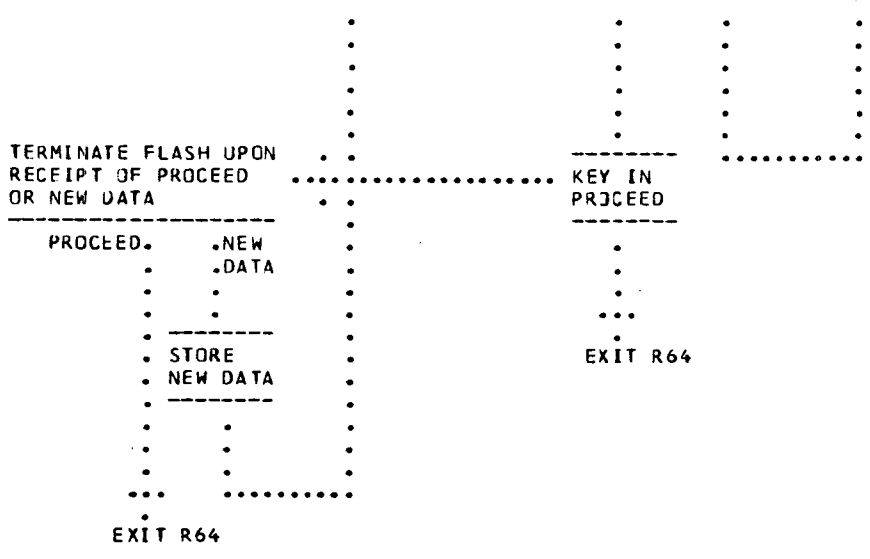
#90

#100

#110

#120

#130



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CHANGE CONTROL NOTES

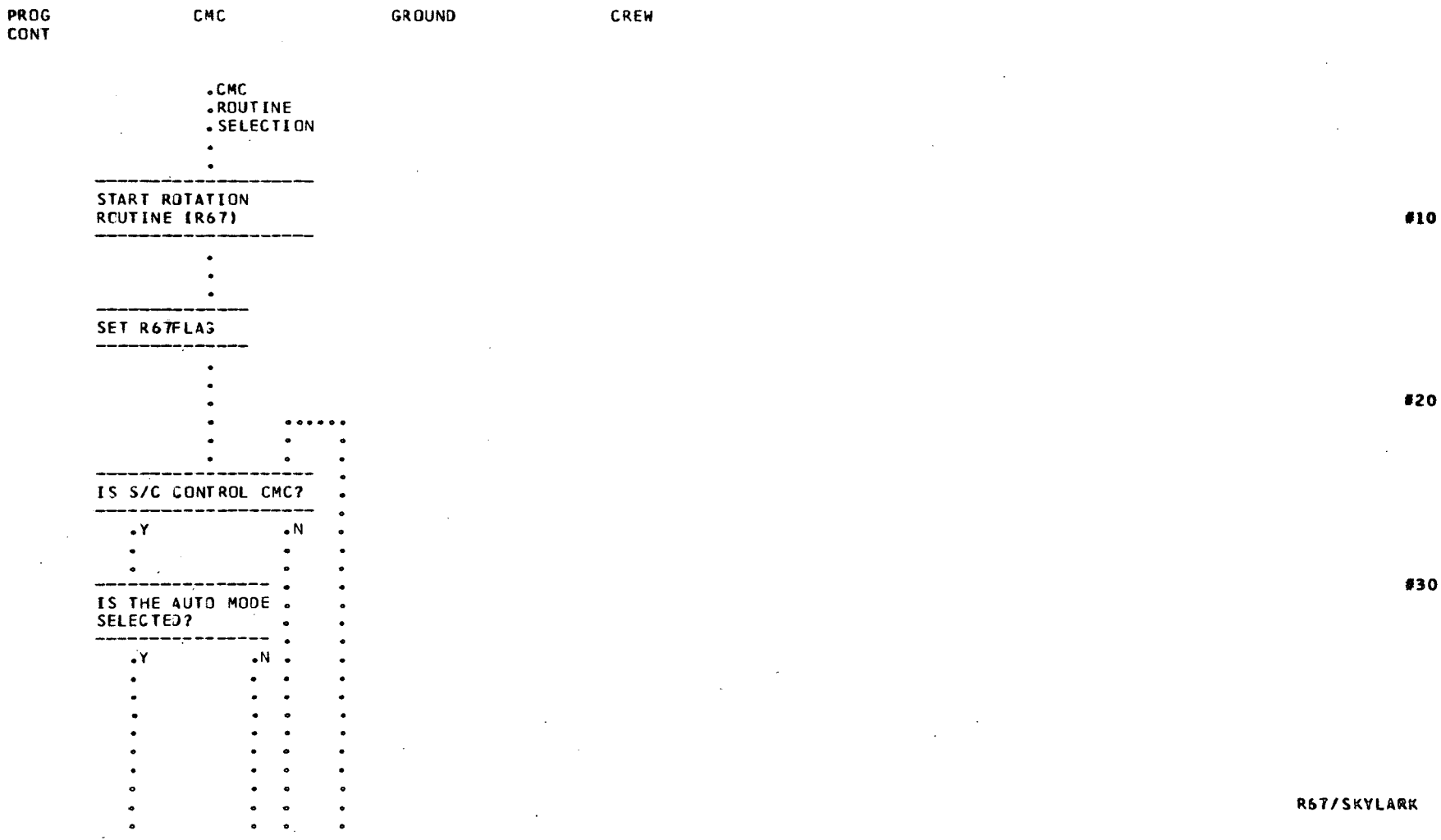
REV 00 PCR 405
REV 01 PCN 489

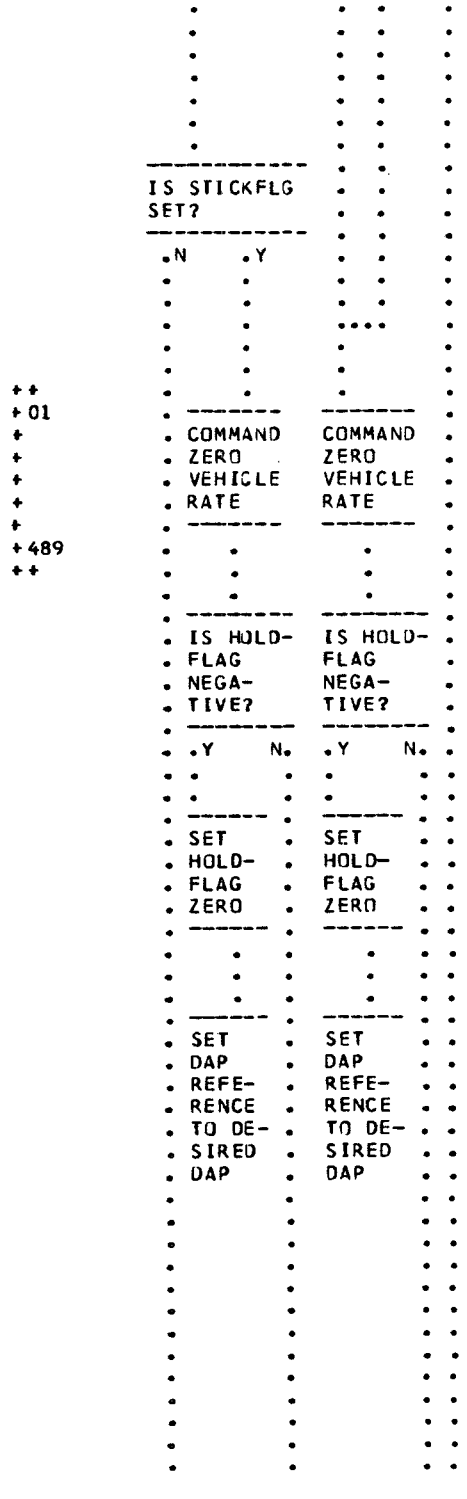
ROTATION ROUTINE (R67) REV 01 03/20/72

PURPOSE: (1) TO COMPUTE THE DAP COMMANDS FOR THE CSM WHICH ENABLES ROTATION OF THE CSM ABOUT THE SPECIFIED AXIS.

(2) TO PERFORM THE ROTATION MANEUVER.

ASSUMPTIONS: (1) THE ROUTINE IS CALLED BY THE UNIVERSAL TRACKING PROGRAM (P20), FOR OPTION 2.




IS STICKFLG SET?
.N
.Y
COMMAND ZERO VEHICLE RATE
COMMAND ZERO VEHICLE RATE
IS HOLD-FLAG NEGA-TIVE?
IS HOLD-FLAG NEGA-TIVE?
.Y
N.
.Y
N.
SET HOLD-FLAG ZERO
SET HOLD-FLAG ZERO
SET DAP REFE-RENCE TO DE-SIRED DAP
SET DAP REFE-RENCE TO DE-SIRED DAP

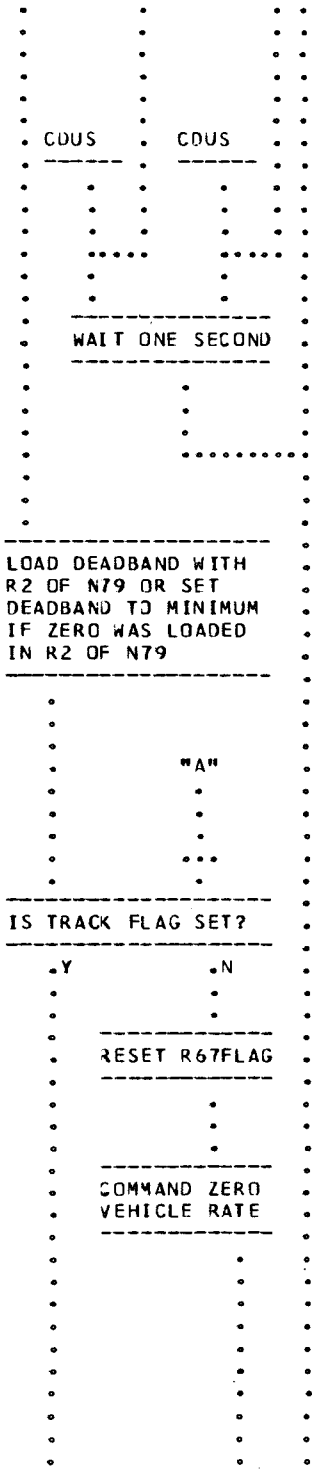
#40

#50

#60

#70

#80



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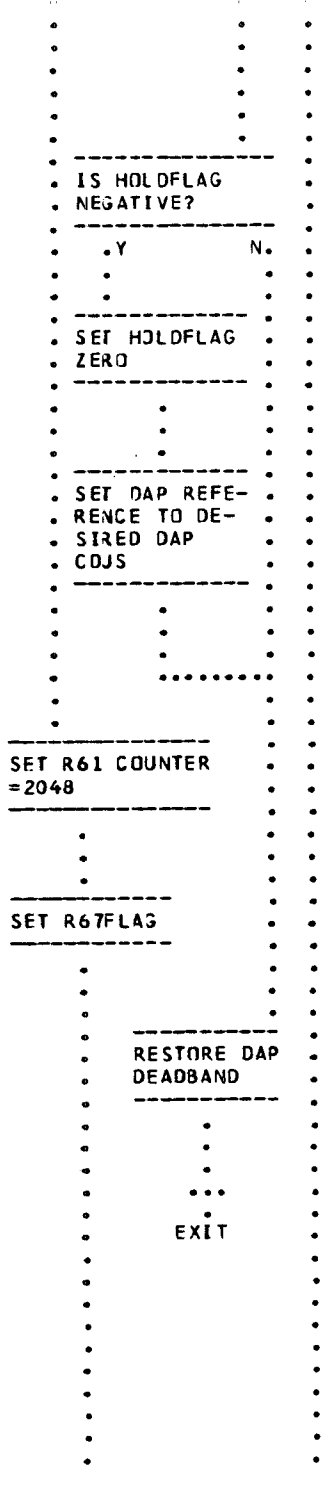
#100

#110

#120

#130

++
+01
+
+
+489
++



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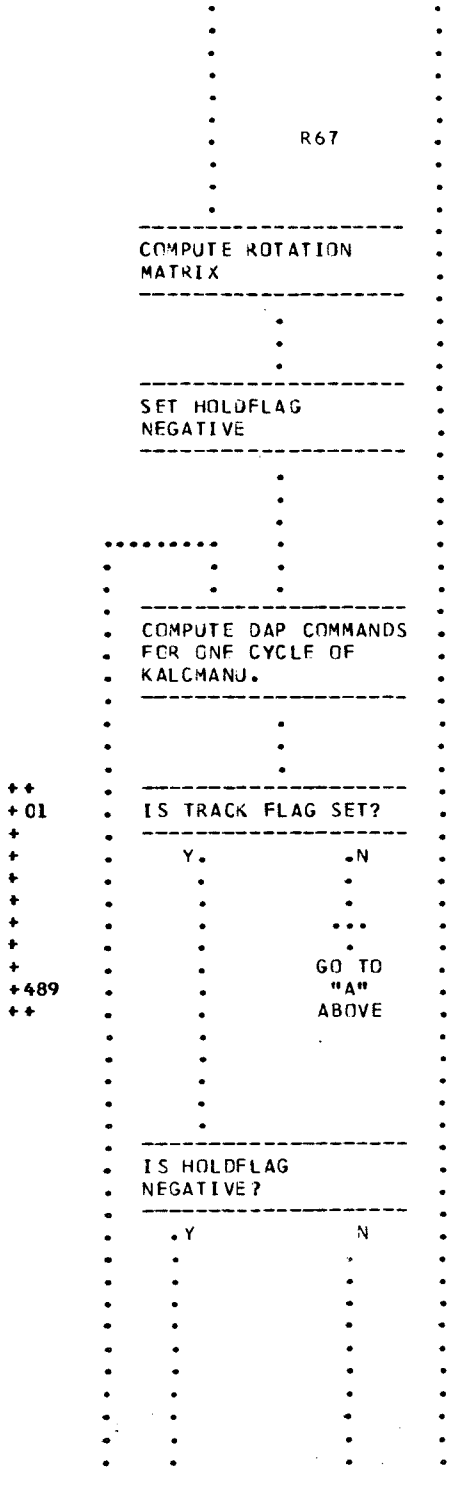


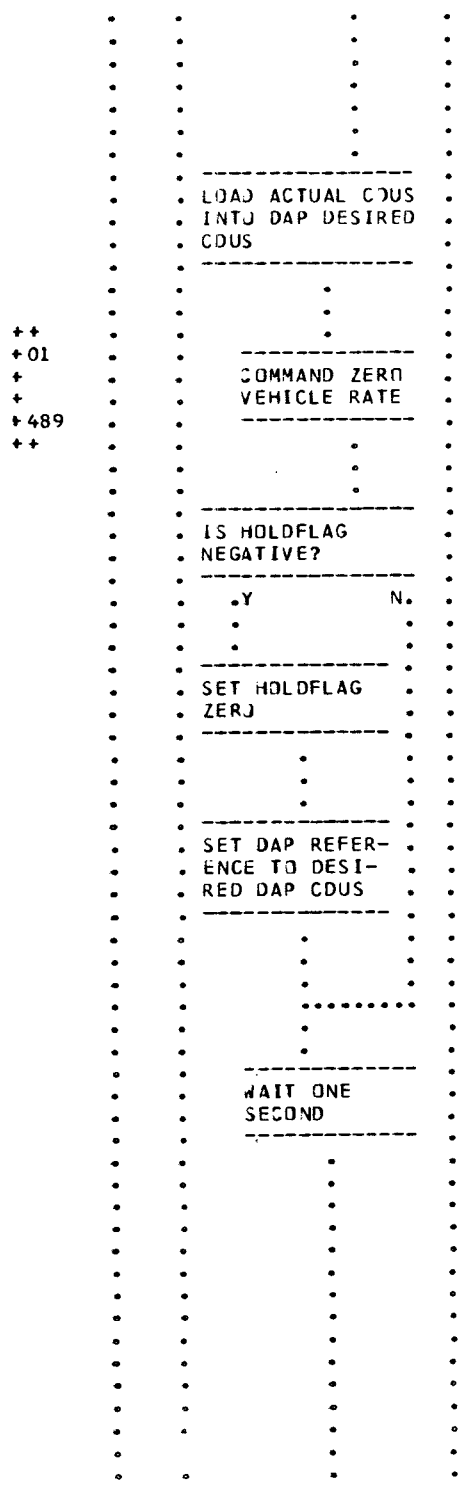
#190

#200

#210

#220

#230



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#270

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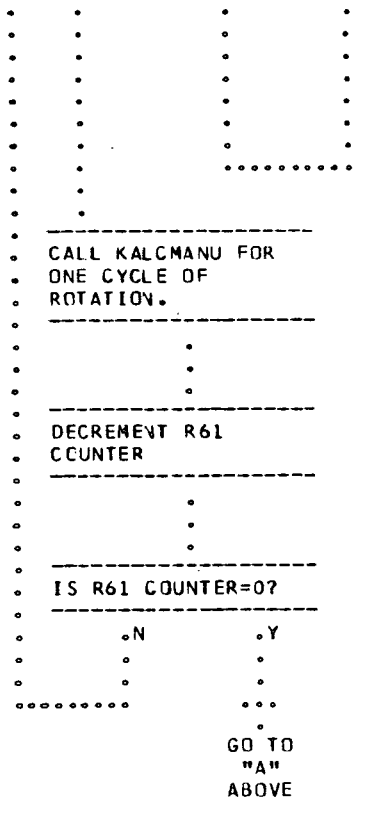


#290

#300

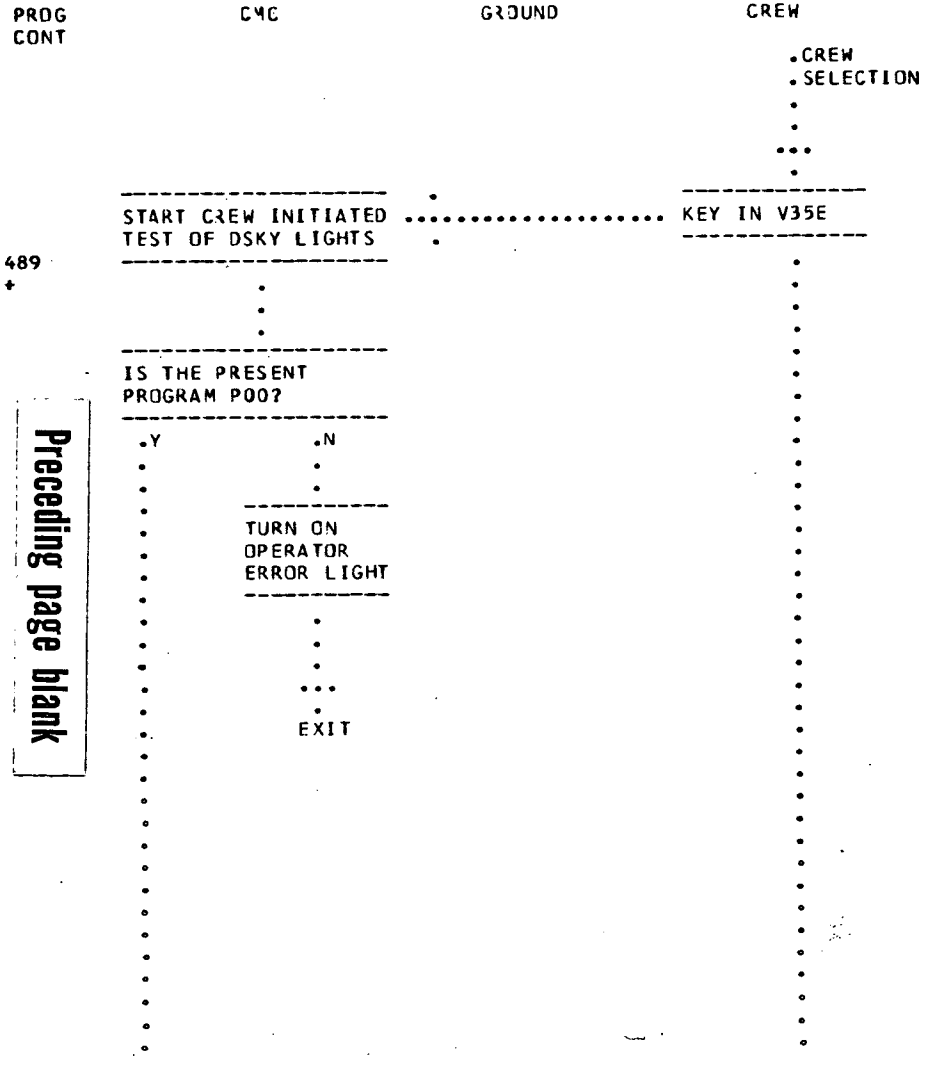
#310

CHANGE CONTROL NOTES

REV 00 PCN 450,456,457
REV 01 PCN 489

TEST DSKY LIGHTS VERB 35 REV 01 03/20/72

++
+01
PURPOSE: (1) TO CHECK THAT ALL THE DSKY LIGHTS ARE WORKING PROPERLY.
+
ASSUMPTIONS: (1) THE STATUS OF THE DSKY LIGHTS MAY BE CHECKED ONLY WHILE IN P00.
+
+



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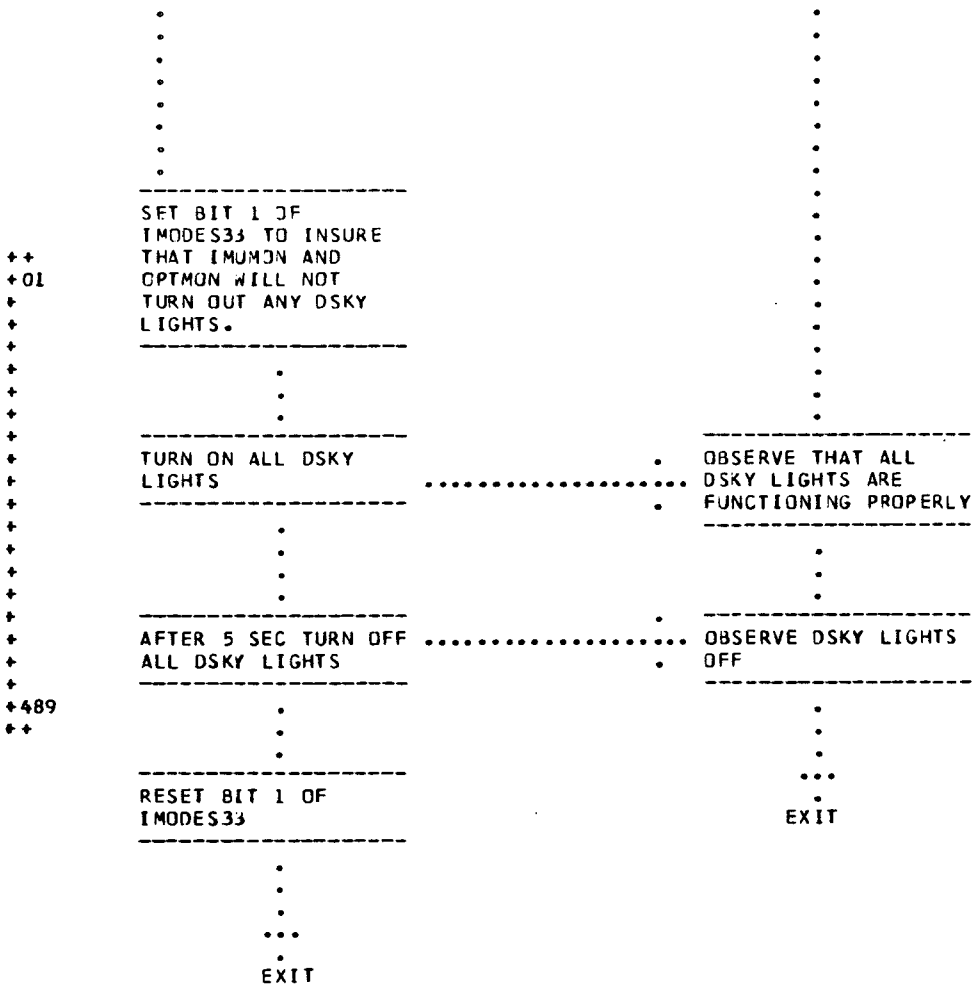

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CHANGE CONTROL NOTES

REV 01 PCN 489

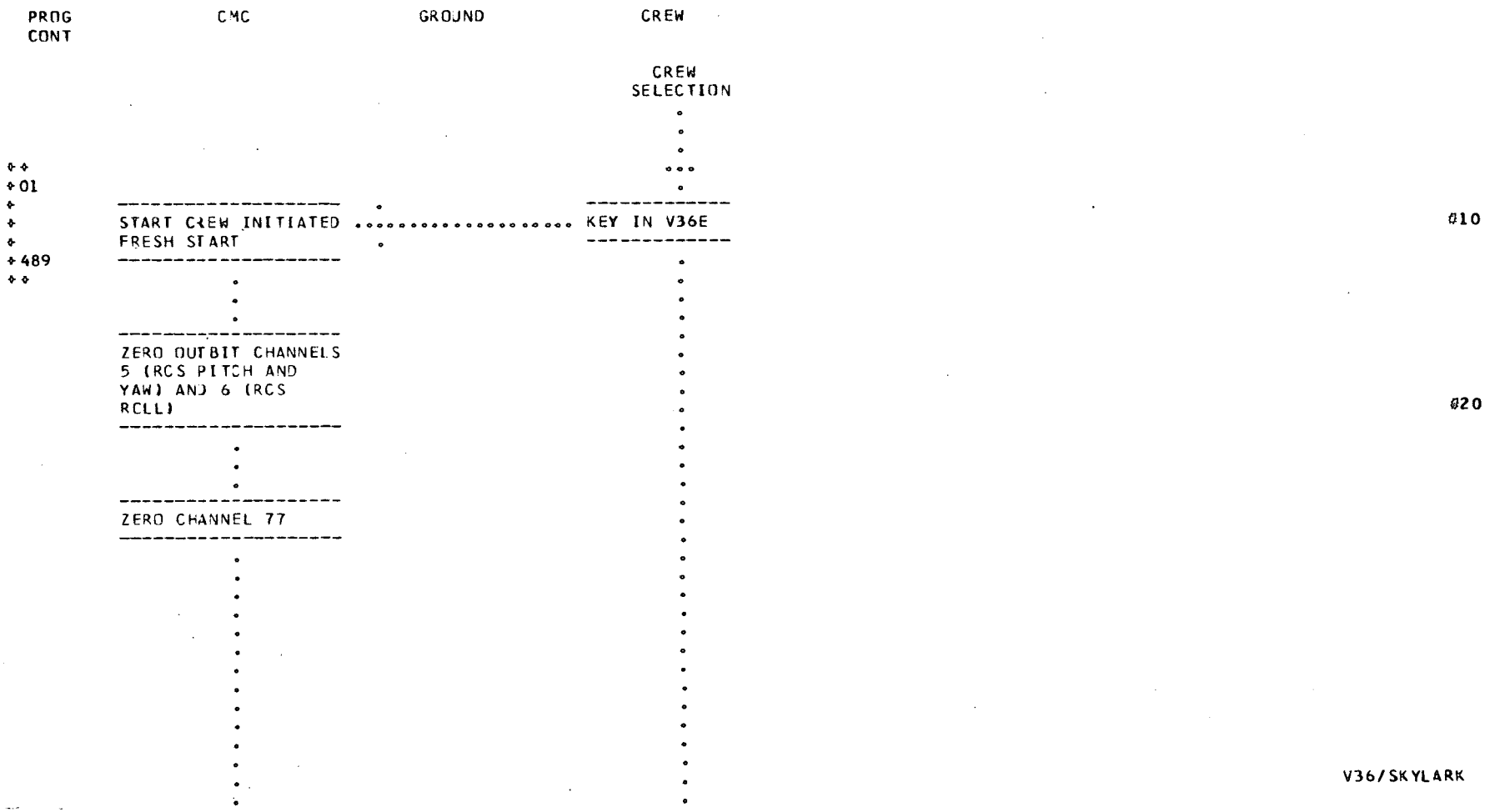
REQUEST FRESH START VERB 36 REV 01 03/20/72

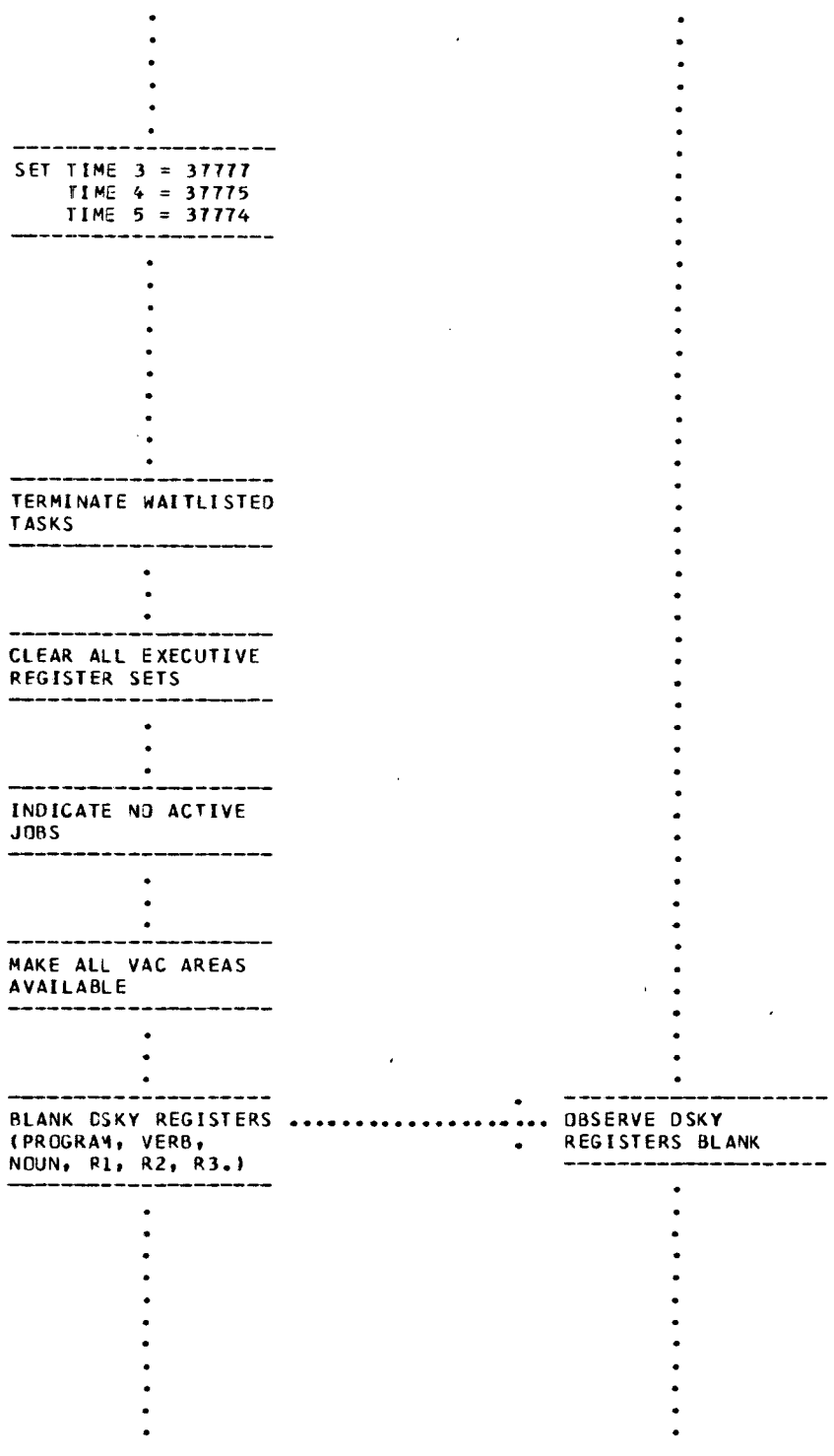
PURPOSE: (1) TO INITIATE A COMPUTER FRESH START

ASSUMPTIONS: (1) FRESH START IS CREW INITIATED BY DSKY ENTRY.

(2) IF A FRESH START INTERRUPTS STATE VECTOR INTEGRATION, THE STATE VECTOR MAY BE INVALIDATED.

(3) THIS PROCESS MAY BE SELECTED AT ANY TIME.





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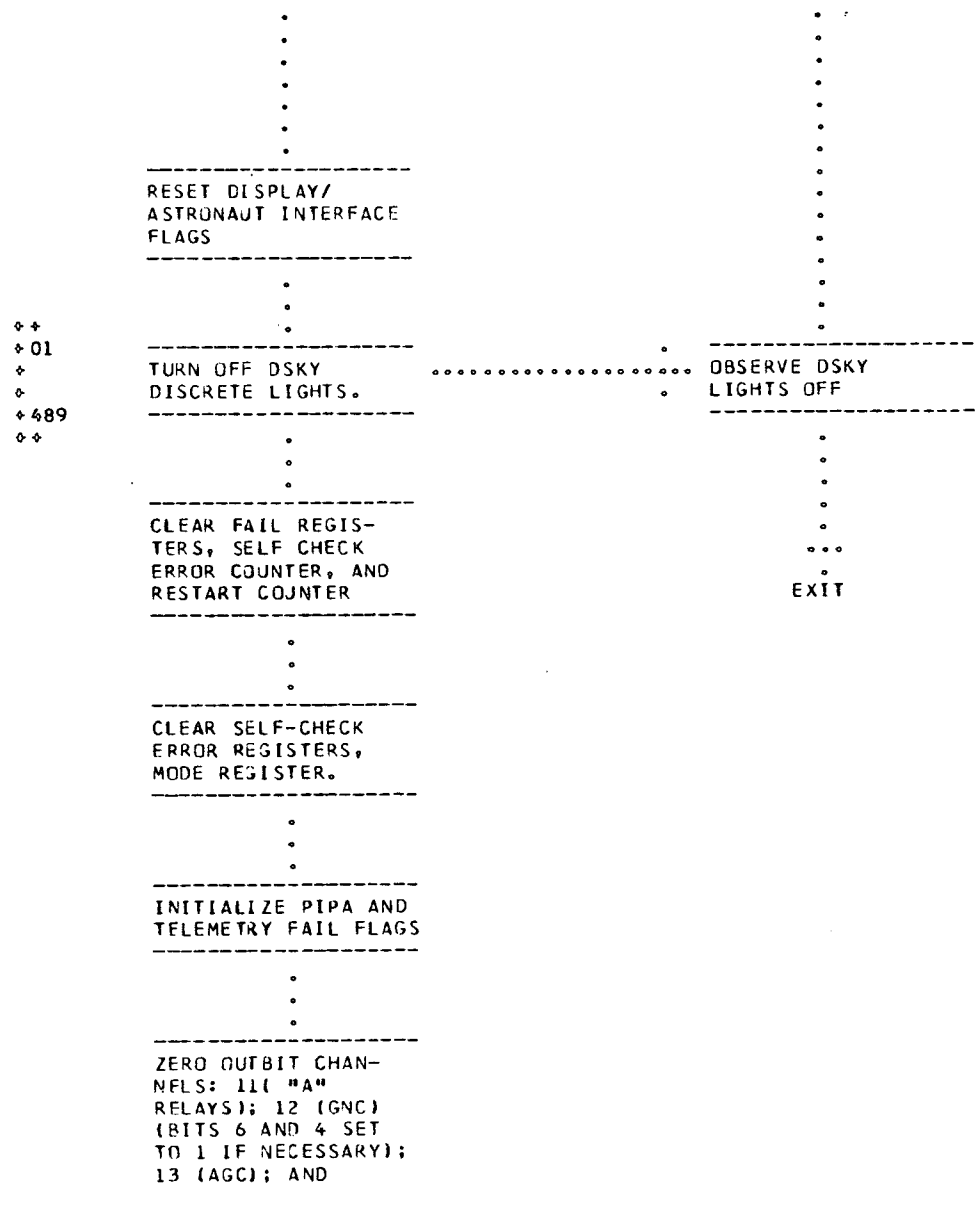
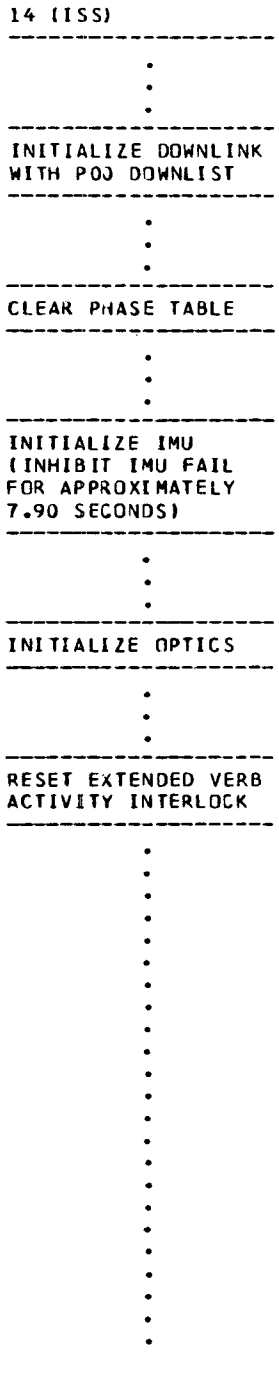


0090
0100
0110
0120



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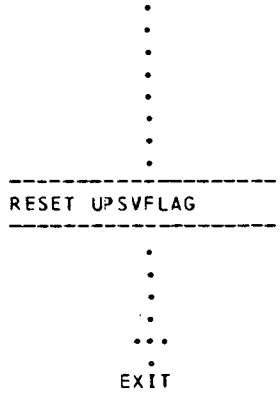


#180

CHANGE CONTROL NOTES

REV 01 PCN 489

ZERO IMU CDU EXTENDED VERB 40 REV 01 03/20/72

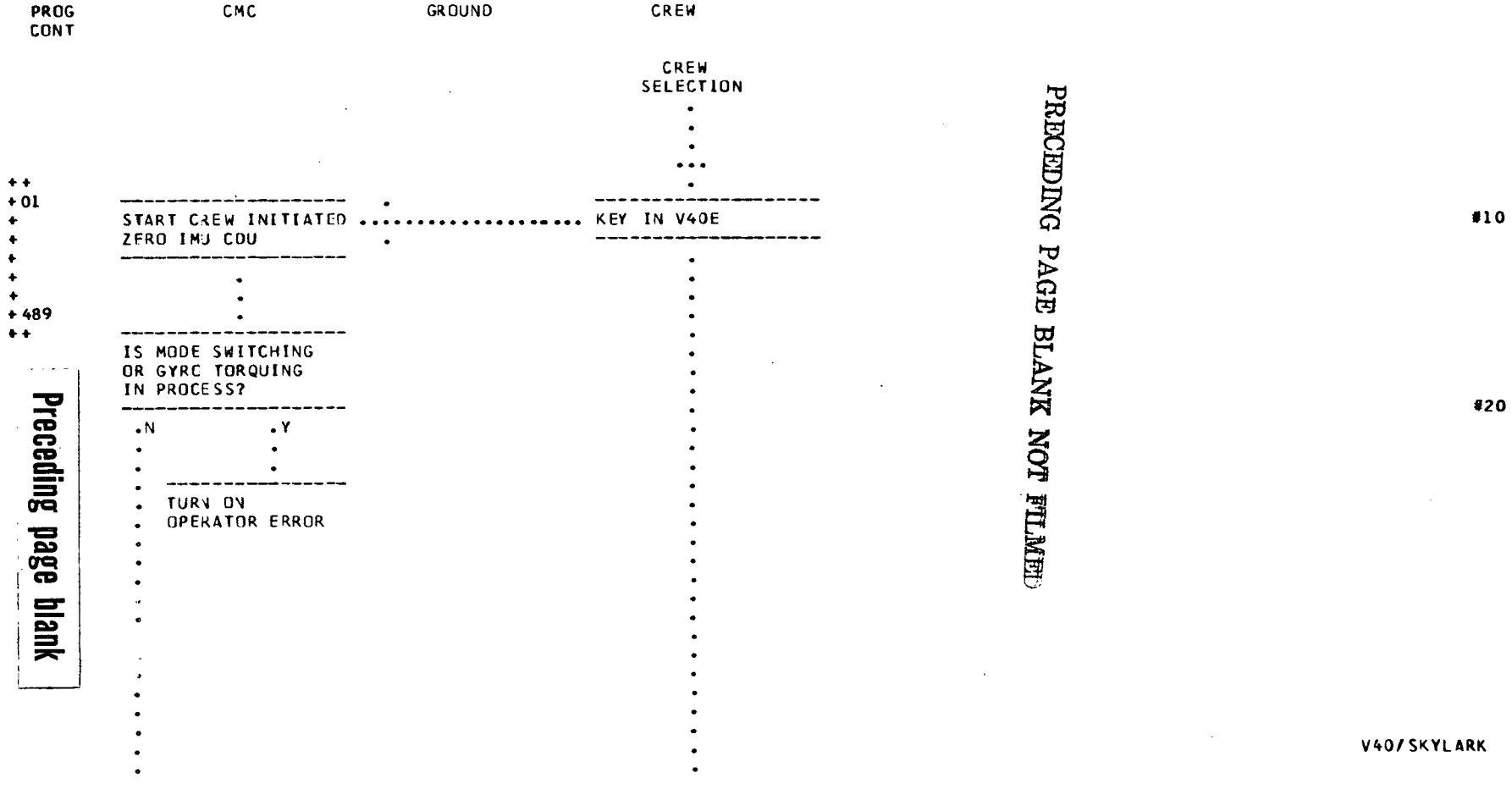
PURPOSE: (1) TO INSURE SYNCHRONIZATION BETWEEN THE ISS CDU COUNTERS AND THE CDU COUNTERS IN THE COMPUTER.

(2) TO TERMINATE THE IMU COARSE ALIGN MODE AND ENTER THE FINE ALIGN MODE (INERTIAL IMU).

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE PROCESS MAY NOT BE SELECTED IF THE ISS IS IN THE COARSE ALIGN MODE AND IN GIMBAL LOCK.

(3) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.



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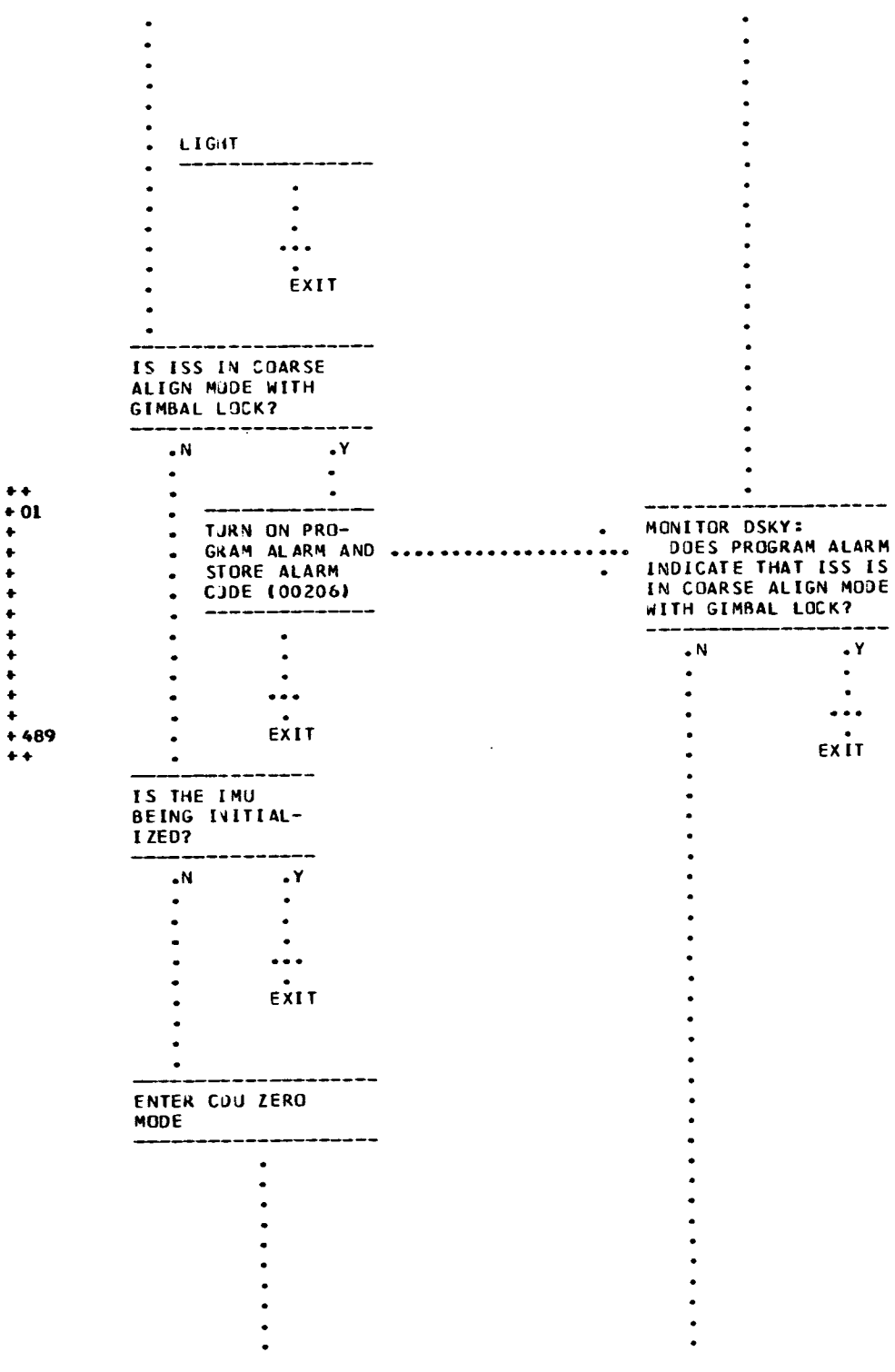
LIGHT
EXIT
IS ISS IN COARSE ALIGN MODE WITH GIMBAL LOCK?
.N
.Y
TURN ON PROGRAM ALARM AND STORE ALARM CODE (00206)
EXIT
IS THE IMU BEING INITIALIZED?
.N
.Y
EXIT
ENTER CDU ZERO MODE
MONITOR DSKY: DOES PROGRAM ALARM INDICATE THAT ISS IS IN COARSE ALIGN MODE WITH GIMBAL LOCK?
.N
.Y
EXIT

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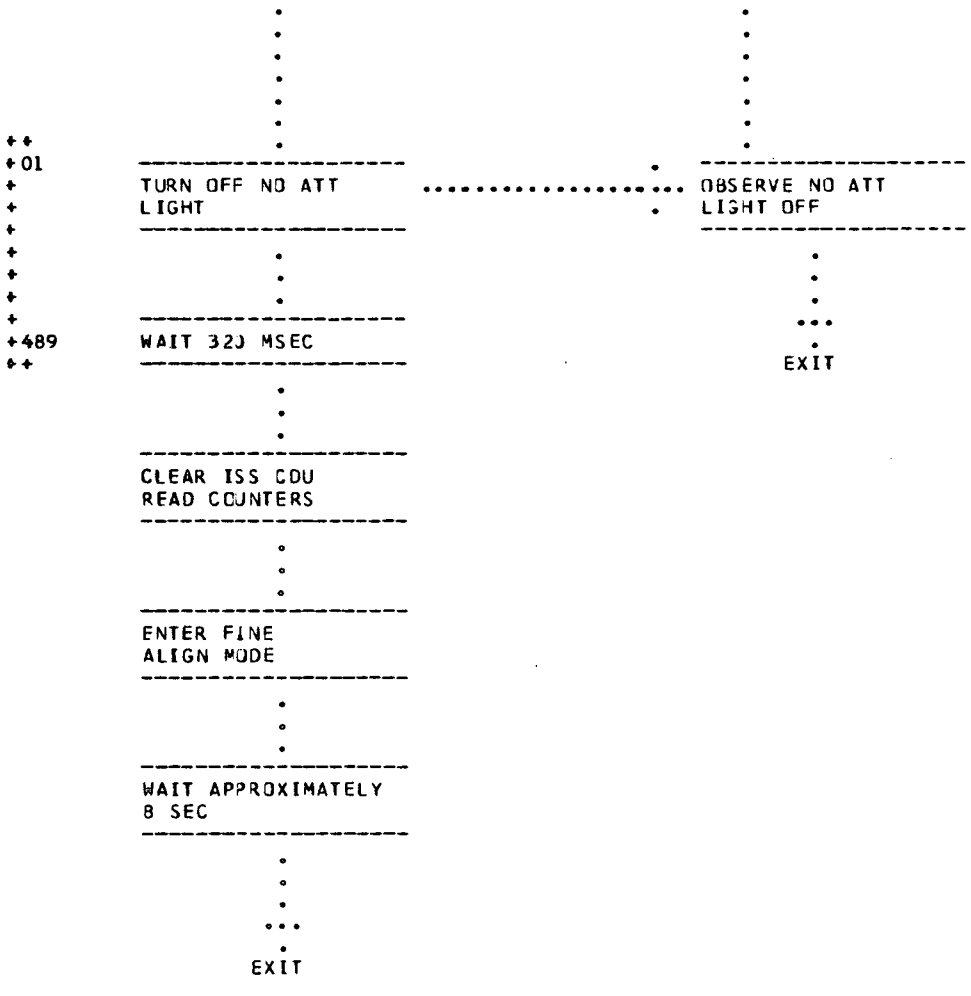

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CHANGE CONTROL NOTES

REV 01 PCN 489

COARSE ALIGN CDU EXTENDED VERB 41 (WITH N20) REV 01 03/20/72

PURPOSE: (1) TO ALIGN THE IMU TO GIMBAL ANGLES SPECIFIED BY THE ASTRONAUT.

(2) TO COARSE ALIGN TO 0,0,0 WHEN IN GIMBAL LOCK AND COARSE ALIGN.

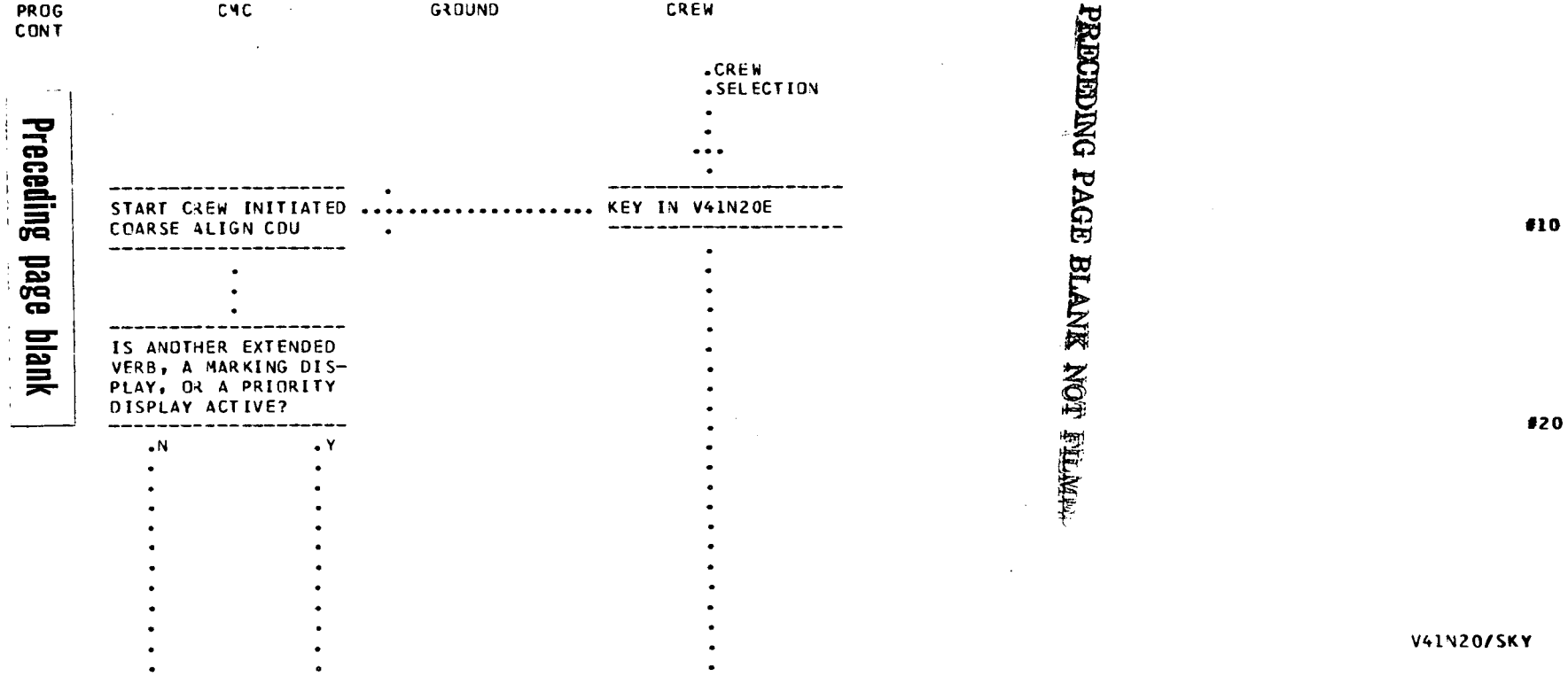
ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.

(3) THE ACCURACY OF THE ALIGNMENT IS TESTED TO A TOLERANCE OF +2 DEGREES. IF THIS TOLERANCE IS EXCEEDED, THE ASTRONAUT WILL BE NOTIFIED VIA A PROGRAM ALARM.

(4) V41 MAY ONLY BE USED WITH N20 OR N91. REFER TO OPTICS COARSE ALIGN EXTENDED VERB (V41N91).

(5) THE PROCESS SHOULD NEVER BE USED DURING A PROGRAM WHICH REQUIRES THAT THE IMU BE ON AND ALIGNED.



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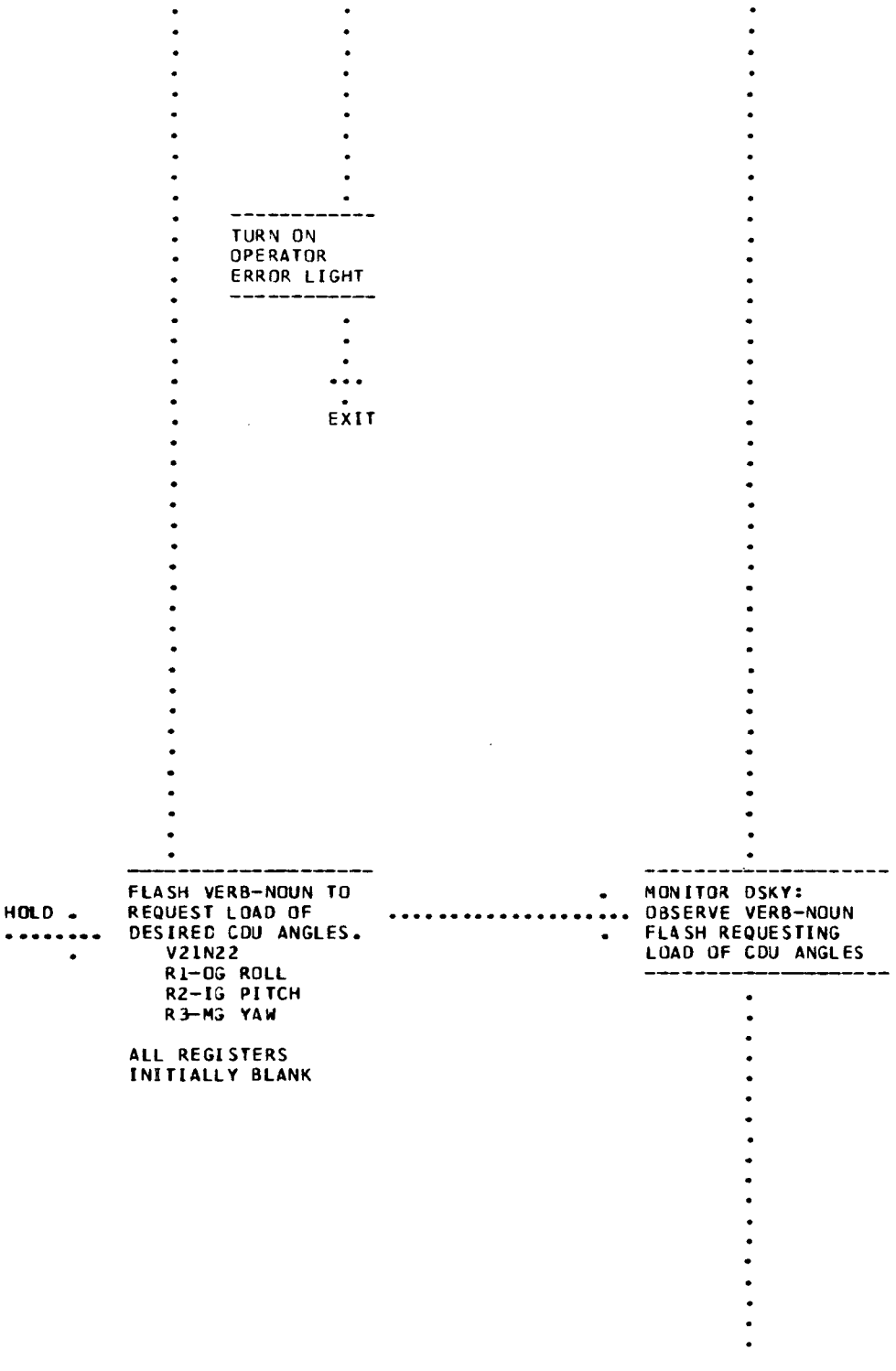
TURN ON
OPERATOR
ERROR LIGHT
EXIT
HOLD
FLASH VERB-NOUN TO
REQUEST LOAD OF
DESIRED CDU ANGLES.
V21N22
R1-OG ROLL
R2-IG PITCH
R3-MG YAW
ALL REGISTERS
INITIALLY BLANK
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH REQUESTING
LOAD OF CDU ANGLES

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#40

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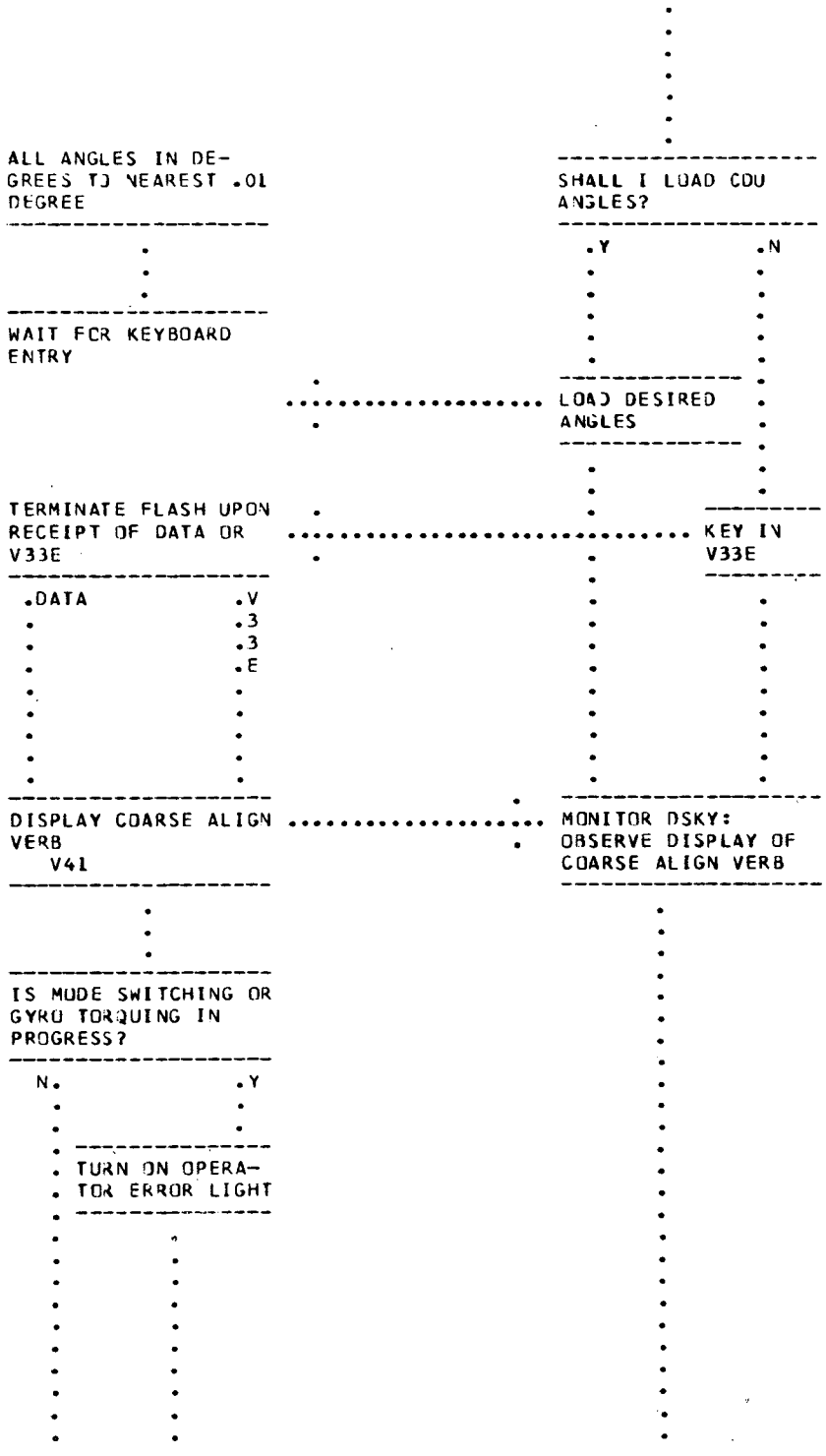

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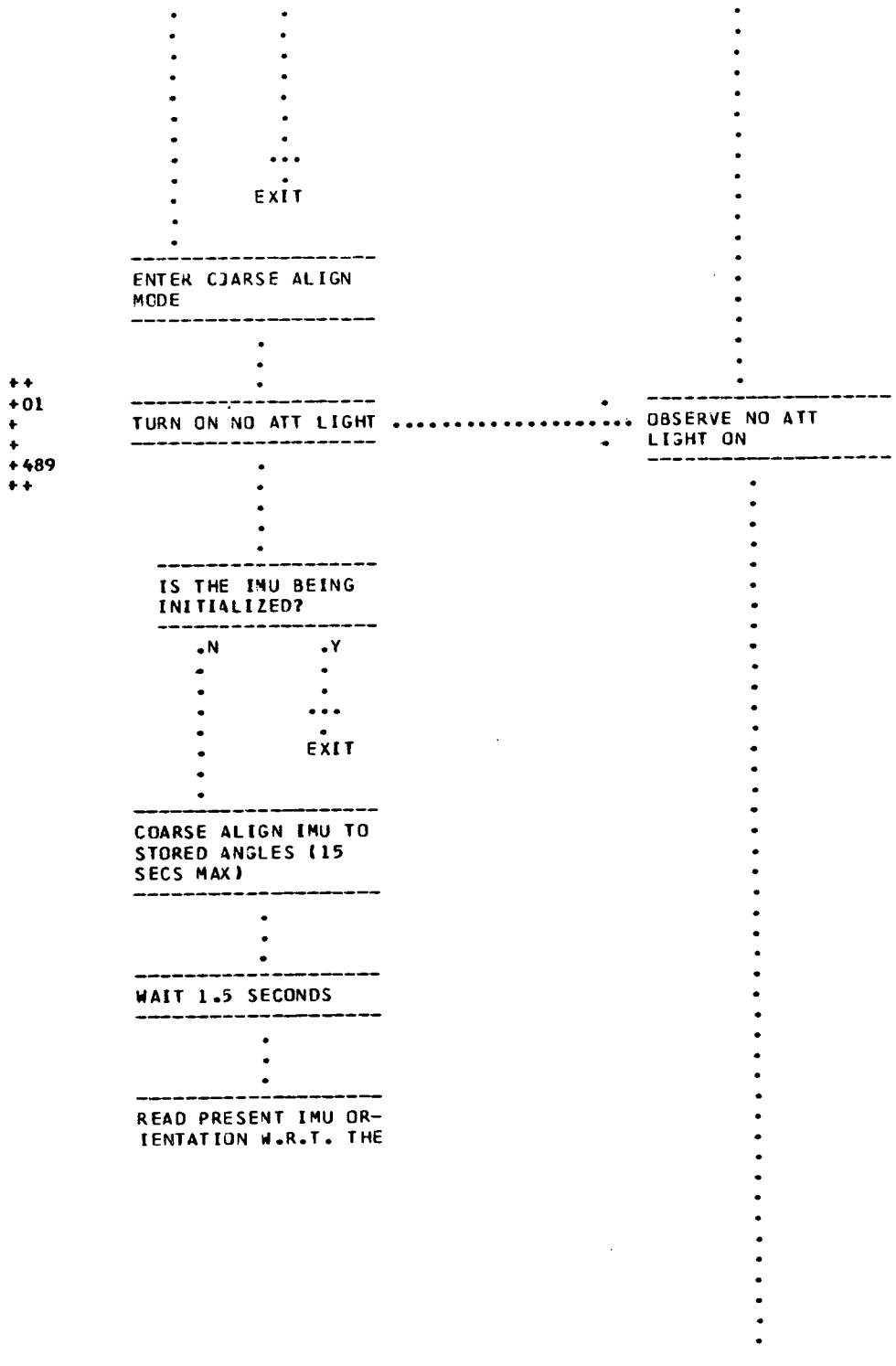

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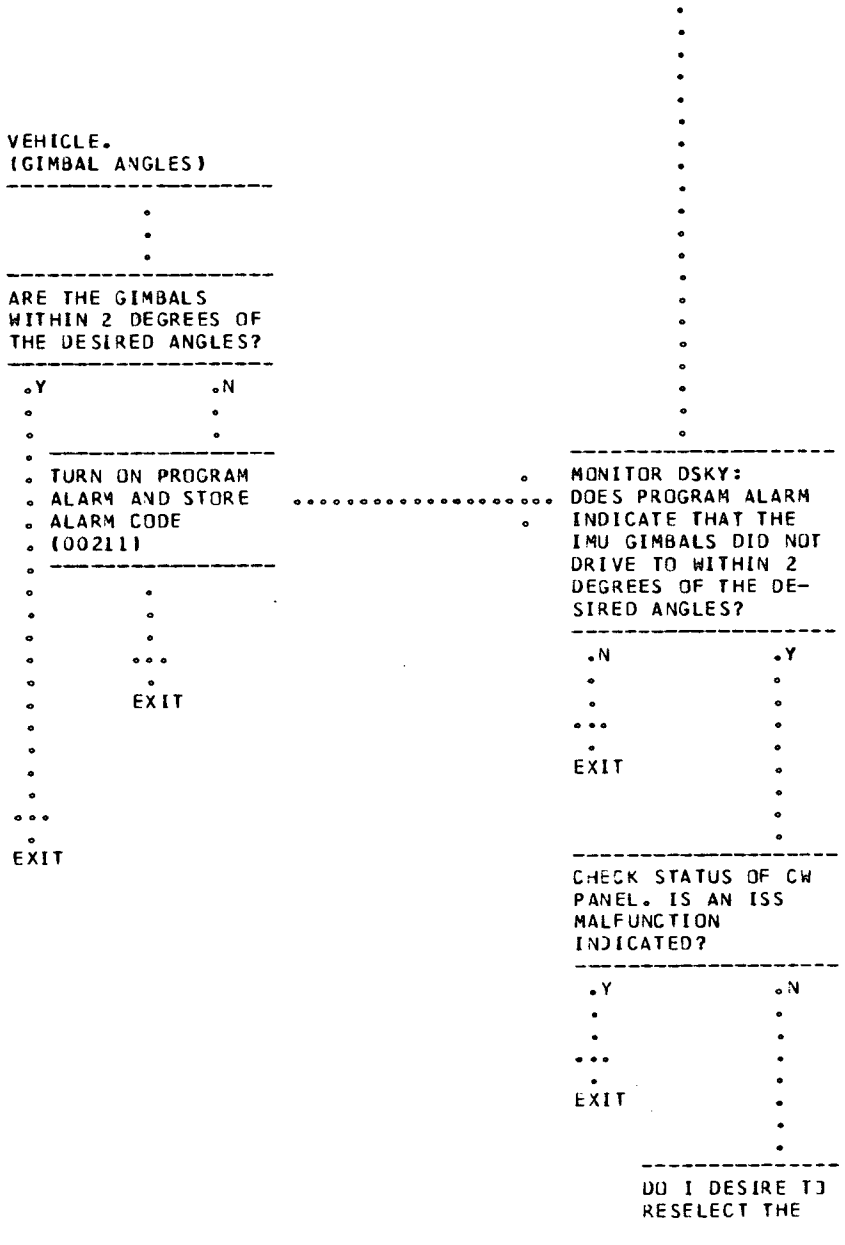


#180

#190

0200

0210

#220

```
COARSE ALIGN
PROCESS?
NOTE: THE
DEGREE OF
FAILURE MAY BE
CHECKED BY
COMPARING THE
SPECIFIED
GIMBAL ANGLES
(V16N22E) WITH                                  #230
THE CURRENT
ANGLES
(V16N20E).
---------------
 .N          .Y
 .           .
 .           .
 .          ...
 .           .
 .         EXIT                                  #240
...      RESEL-
 .       ECT
EXIT     COARSE
         ALIGN
         CDU
         (KEY
         V41N20E)
```

```
++
+01
+
+
+
+
+
+
+
+489
++
```

CHANGE CONTROL NOTES

REV 00 PCN 457
REV 01 PCN 489

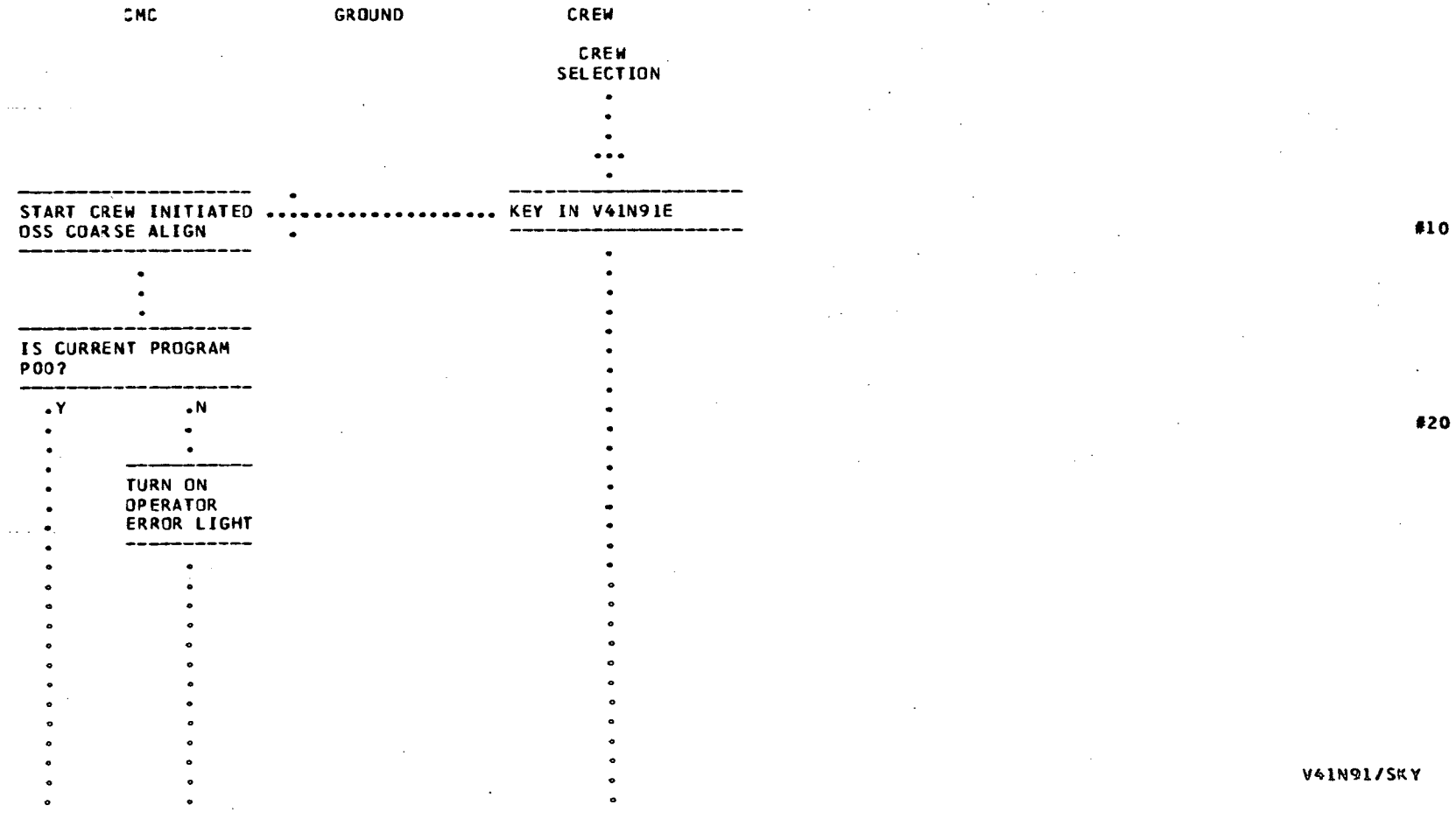
COARSE ALIGN CDU EXTENDED VERB 41 (WITH N91) REV 00 05/19/71

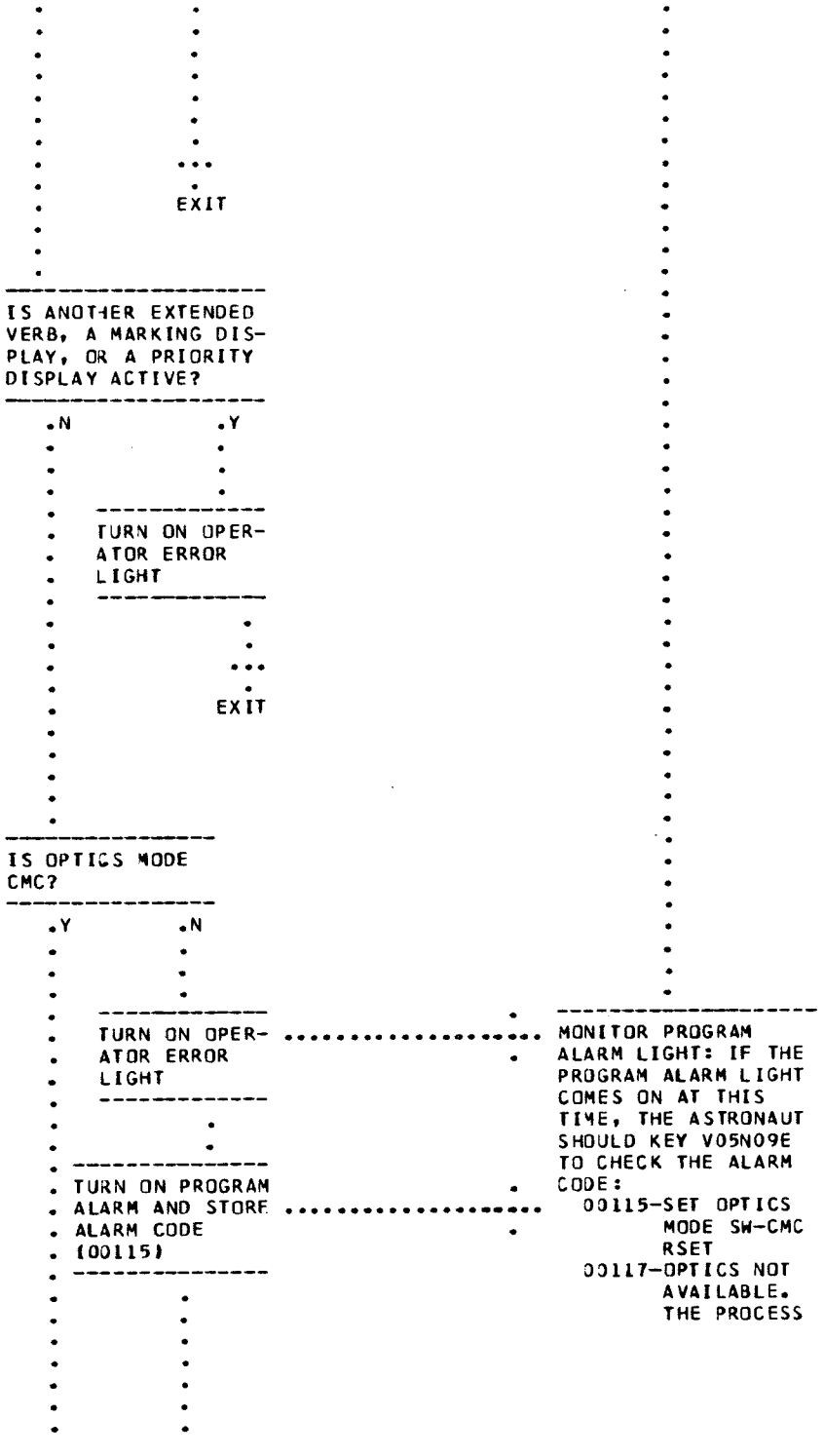
PURPOSE: (1) TO DRIVE THE OPTICS TO SHAFT AND TRUNNION ANGLES SPECIFIED BY THE ASTRONAUT.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.

(3) THE PROCESS MAY BE SELECTED ONLY WHEN THE CMC IS IN THE CMC IDLING PROGRAM (P00).





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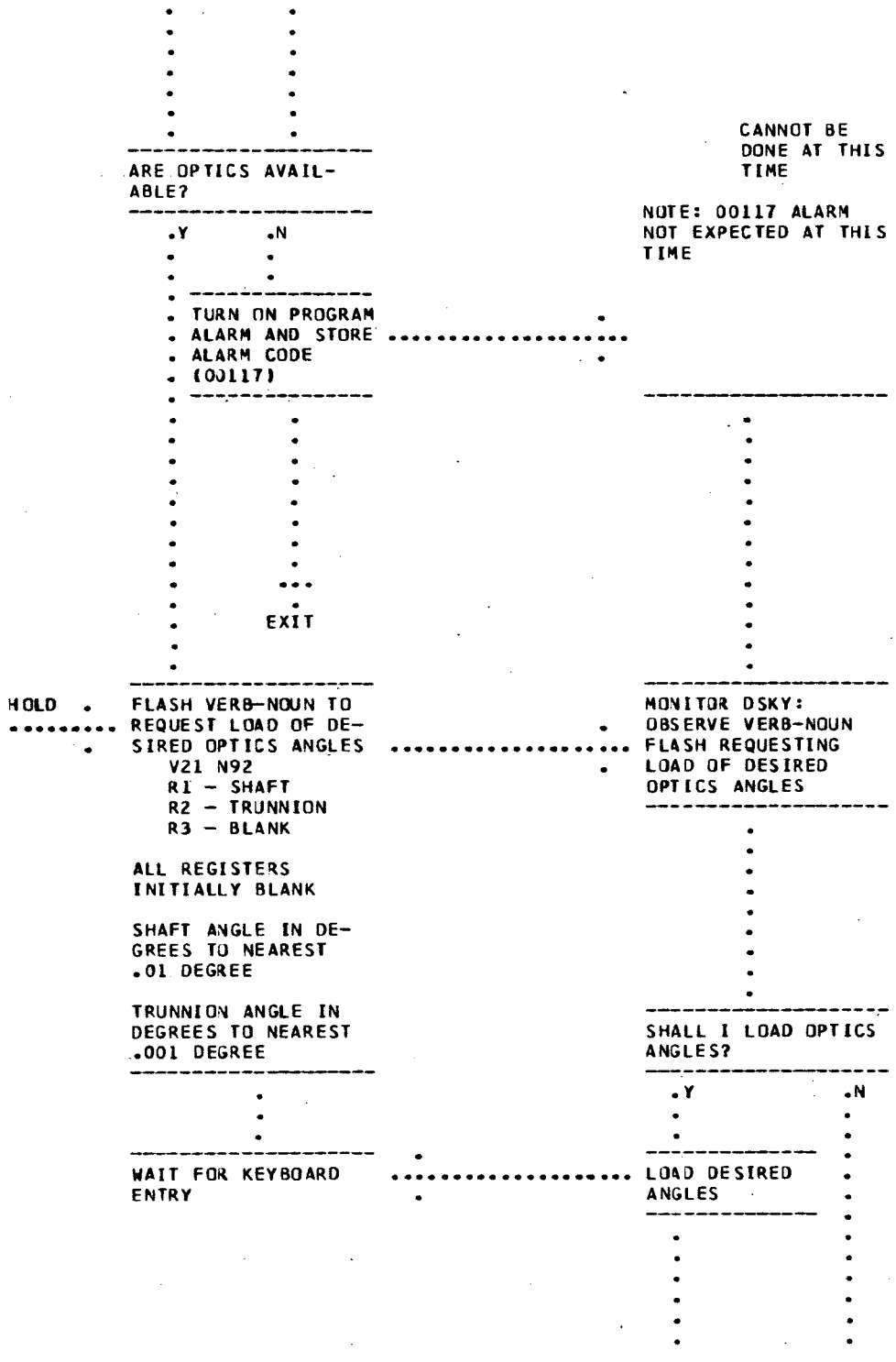
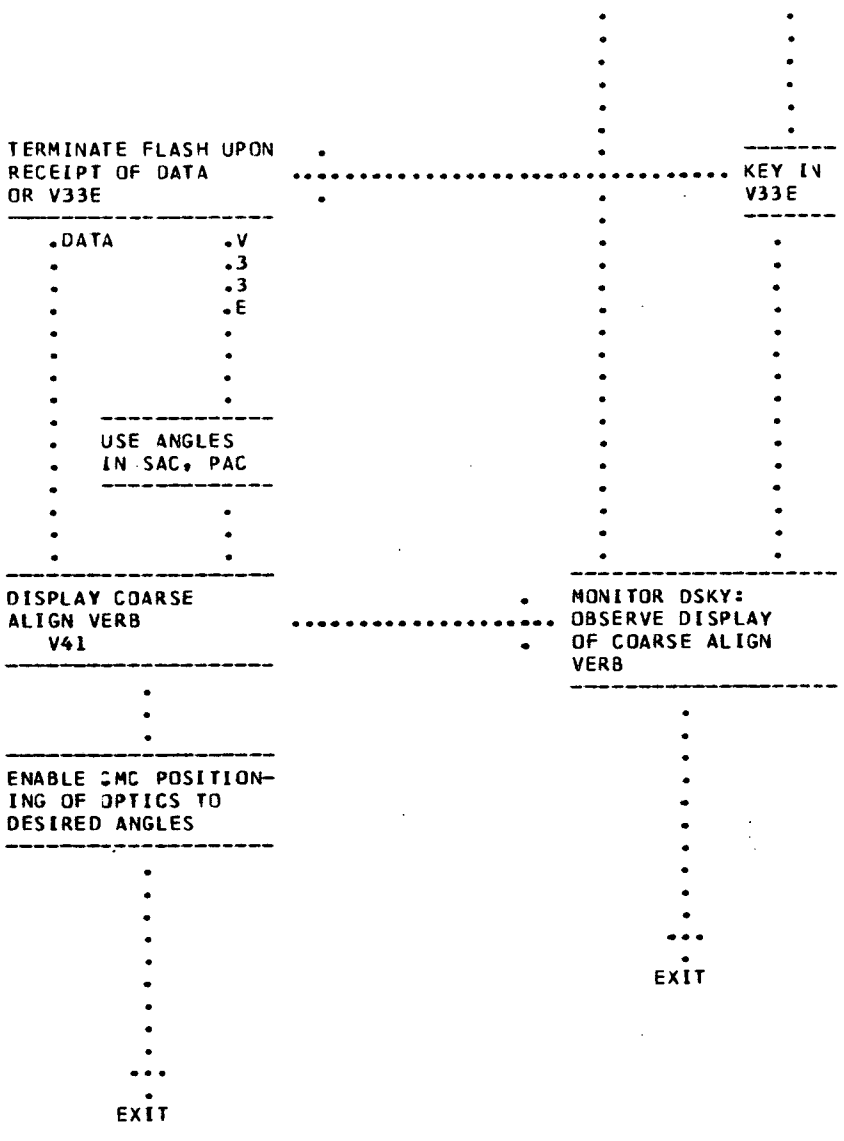

ARE OPTICS AVAIL-
ABLE?
.Y
.N
TURN ON PROGRAM
ALARM AND STORE
ALARM CODE
(00117)
EXIT
CANNOT BE
DONE AT THIS
TIME
NOTE: 00117 ALARM
NOT EXPECTED AT THIS
TIME
#90
#100
#110
HOLD
FLASH VERB-NOUN TO
REQUEST LOAD OF DE-
SIRED OPTICS ANGLES
V21 N92
R1 - SHAFT
R2 - TRUNNION
R3 - BLANK
ALL REGISTERS
INITIALLY BLANK
SHAFT ANGLE IN DE-
GREES TO NEAREST
.01 DEGREE
TRUNNION ANGLE IN
DEGREES TO NEAREST
.001 DEGREE
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH REQUESTING
LOAD OF DESIRED
OPTICS ANGLES
#120
SHALL I LOAD OPTICS
ANGLES?
#130
.Y
.N
WAIT FOR KEYBOARD
ENTRY
LOAD DESIRED
ANGLES
#140



CHANGE CONTROL NOTES

PULSE TORQUE GYROS EXTENDED VERB 42 REV 01 03/20/72

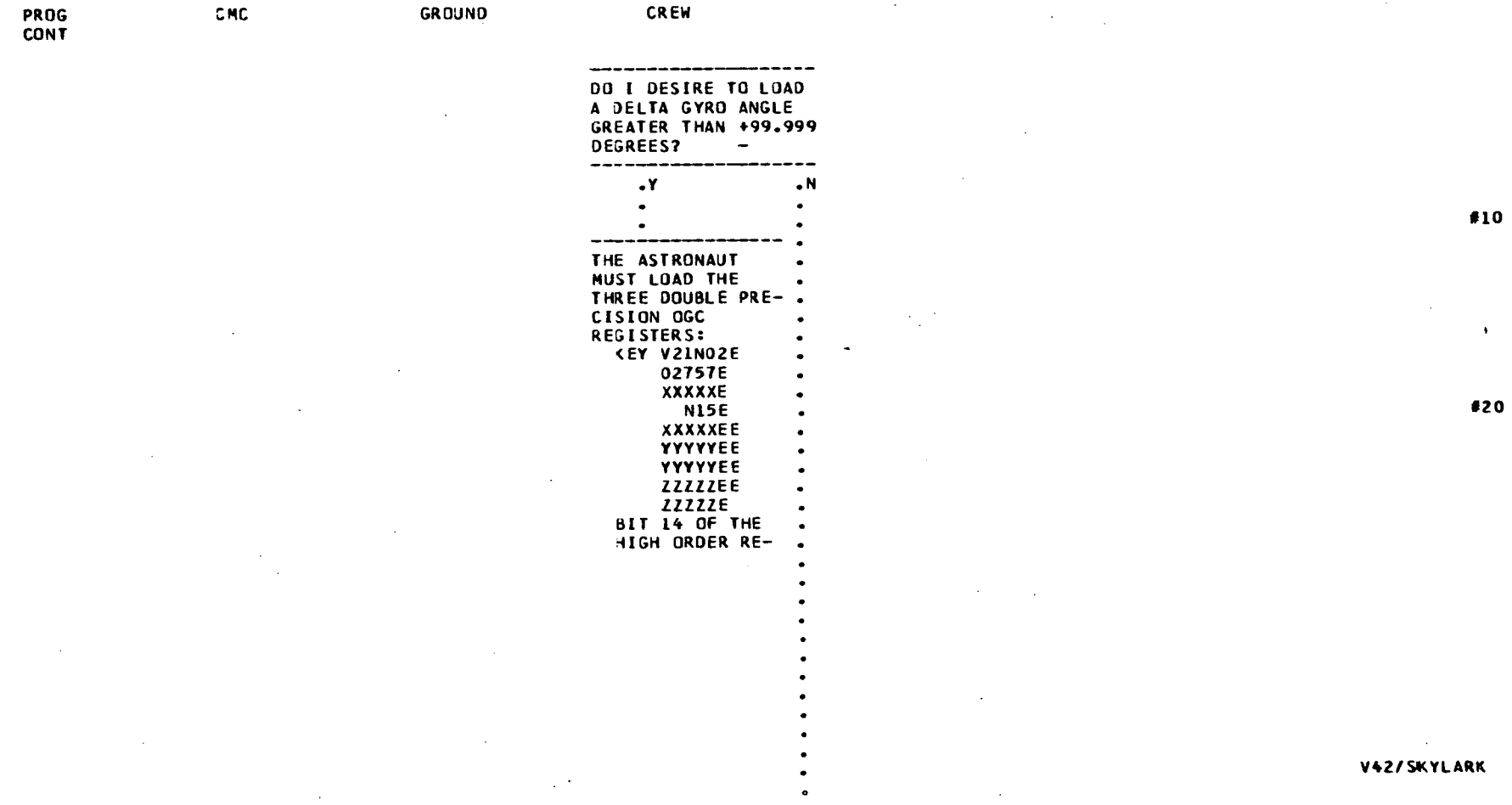
PURPOSE: (1) TO FINE ALIGN THE STABLE MEMBER BY TORQUING THE GYROS.

(2) TO TERMINATE THE COARSE ALIGN MODE AND ENTER THE INERTIAL MODE.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

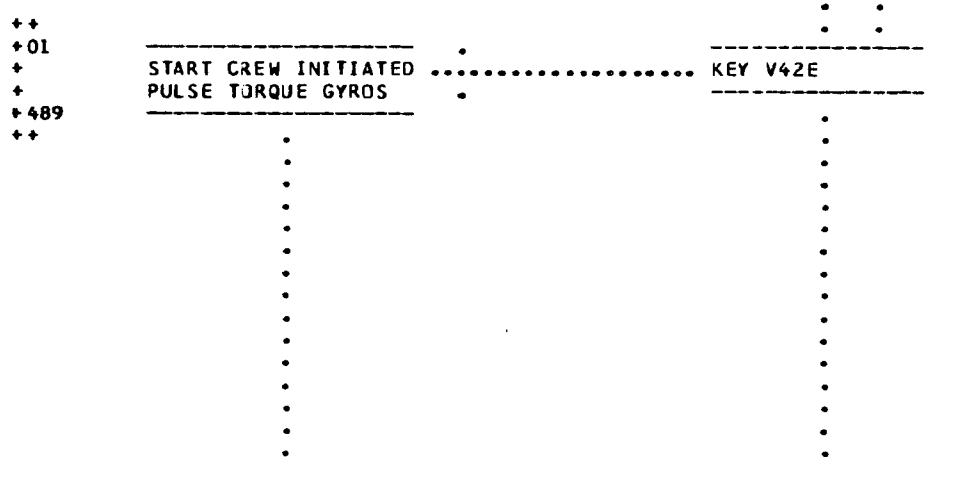
(2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.

(3) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.



PRESENTS 180 DEGREES; BIT 13, 90 DEGREES; ETC. THE MAXIMUM NEGATIVE GYRO TORQUING ANGLE IS 37777, 37743; THE MAXIMUM POSITIVE GYRO TORQUING ANGLE IS 40000, 40034. ANY ANGLE OF GREATER MAGNITUDE THAN THE GIVEN MAXIMUM WILL RESULT IN A COMMANDED TORQUING ANGLE OF ZERO. #30 #40

(NOTE: THE LOADING OF TORQUING ANGLES GREATER THAN 90 DEGREES SHOULD NOT BE PERFORMED DURING FLIGHT. THIS PROCEDURE IS INTENDED FOR USE ON THE GROUND.) #50 #60



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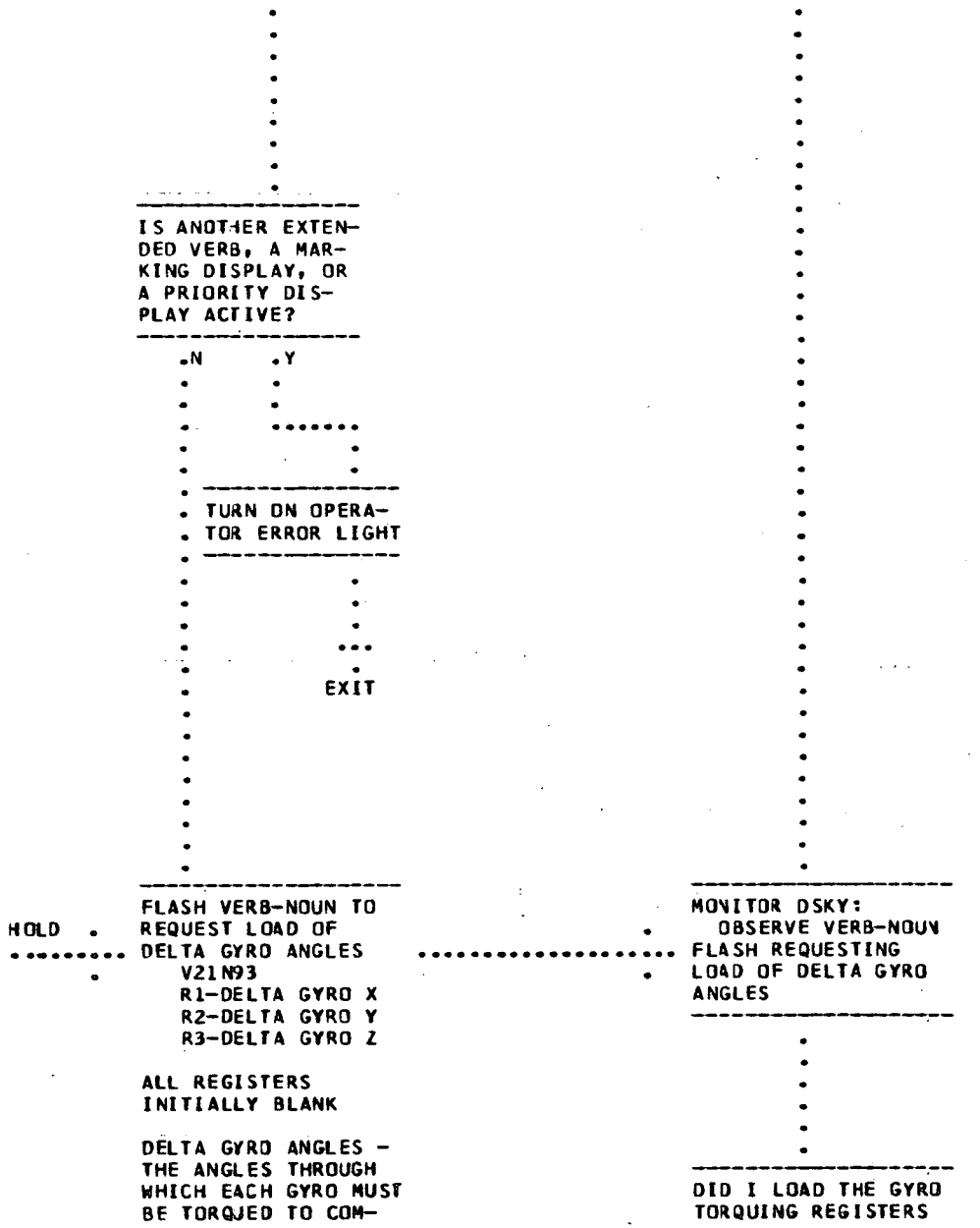

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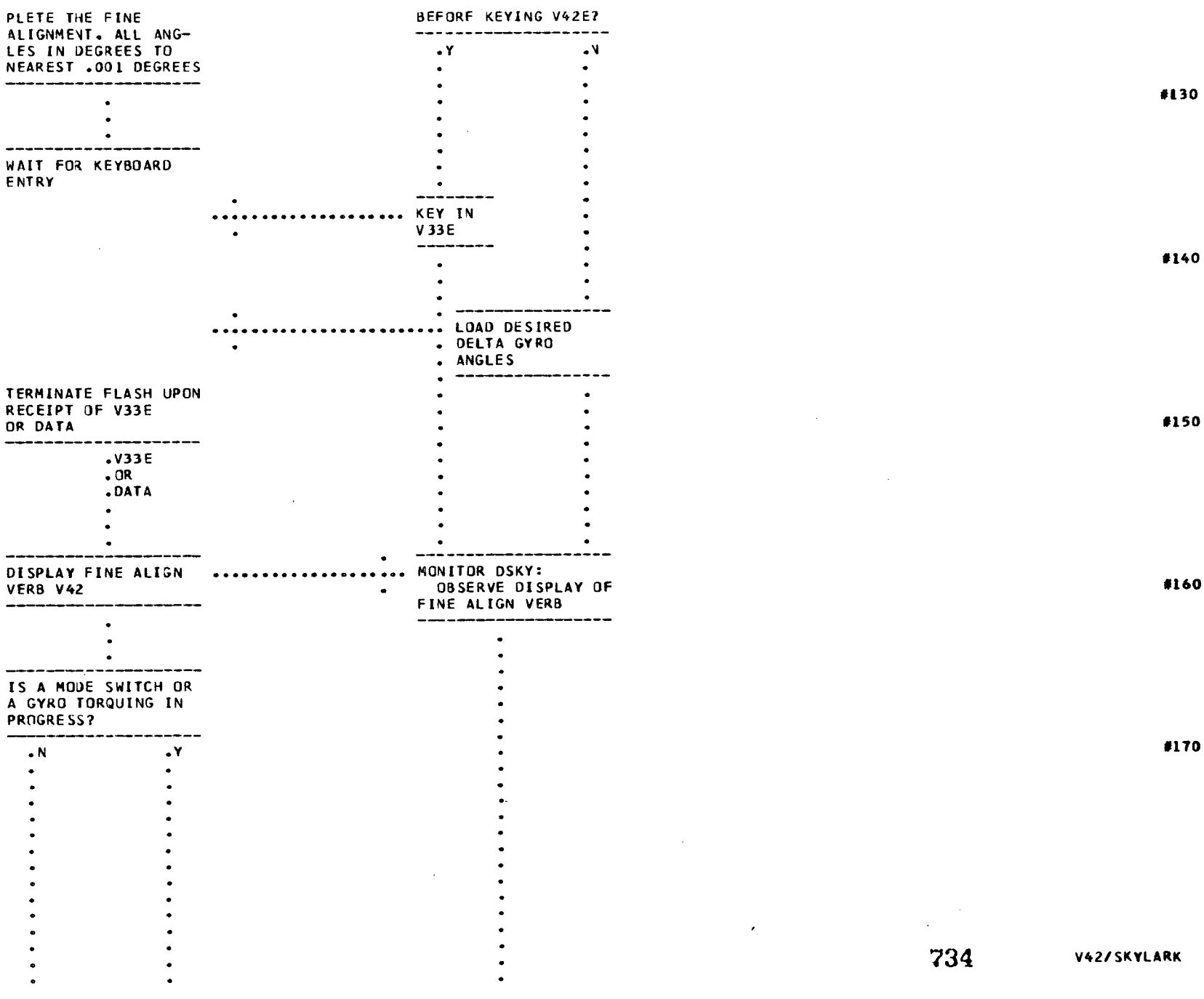
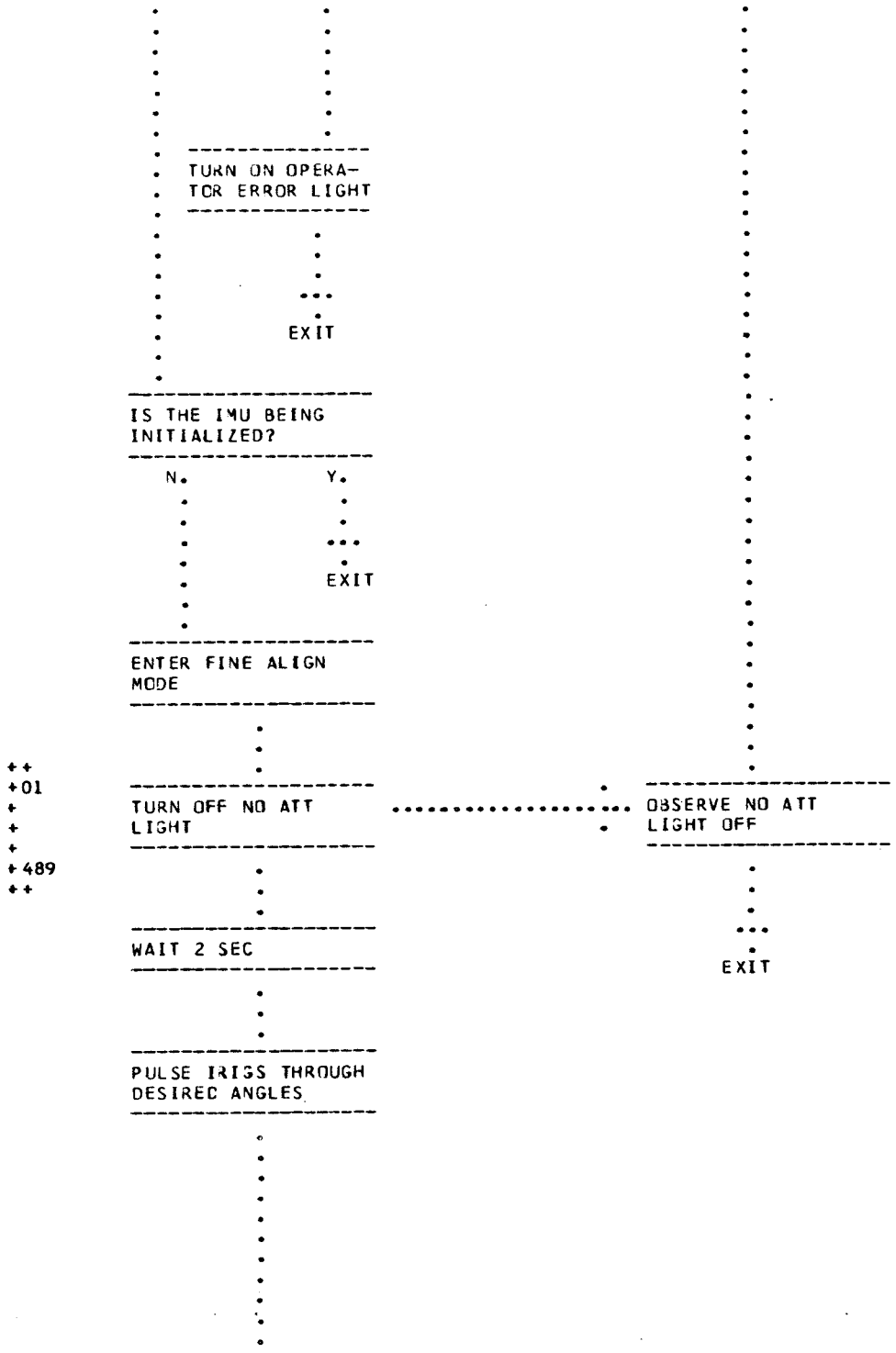

PLETE THE FINE ALIGNMENT. ALL ANGLES IN DEGREES TO NEAREST .001 DEGREES
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF V33E OR DATA
.V33E
.OR
.DATA
DISPLAY FINE ALIGN VERB V42
IS A MODE SWITCH OR A GYRO TORQUING IN PROGRESS?
.N
.Y
BEFORE KEYING V42E?
.Y
.N
KEY IN V33E
LOAD DESIRED DELTA GYRO ANGLES
MONITOR DSKY:
OBSERVE DISPLAY OF FINE ALIGN VERB
#130
#140
#150
#160
#170



#180

#190

#200

#210

#220

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    .
    .
    .
    .
    .
    .
    .
    .
    .
   ...
    .
  EXIT
```

#230

CHANGE CONTROL NOTES

REV 00 PCN 457
REV 01 PCN 489

LOAD FDAI ATT ERROR NEEDLES (TEST ONLY) REV 00 05/19/71
EXTENDED VERB 43

PURPOSE: (1) TO LOAD ASTRONAUT SPECIFIED ANGLES INTO THE FDAI ATTITUDE ERROR NEEDLES.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

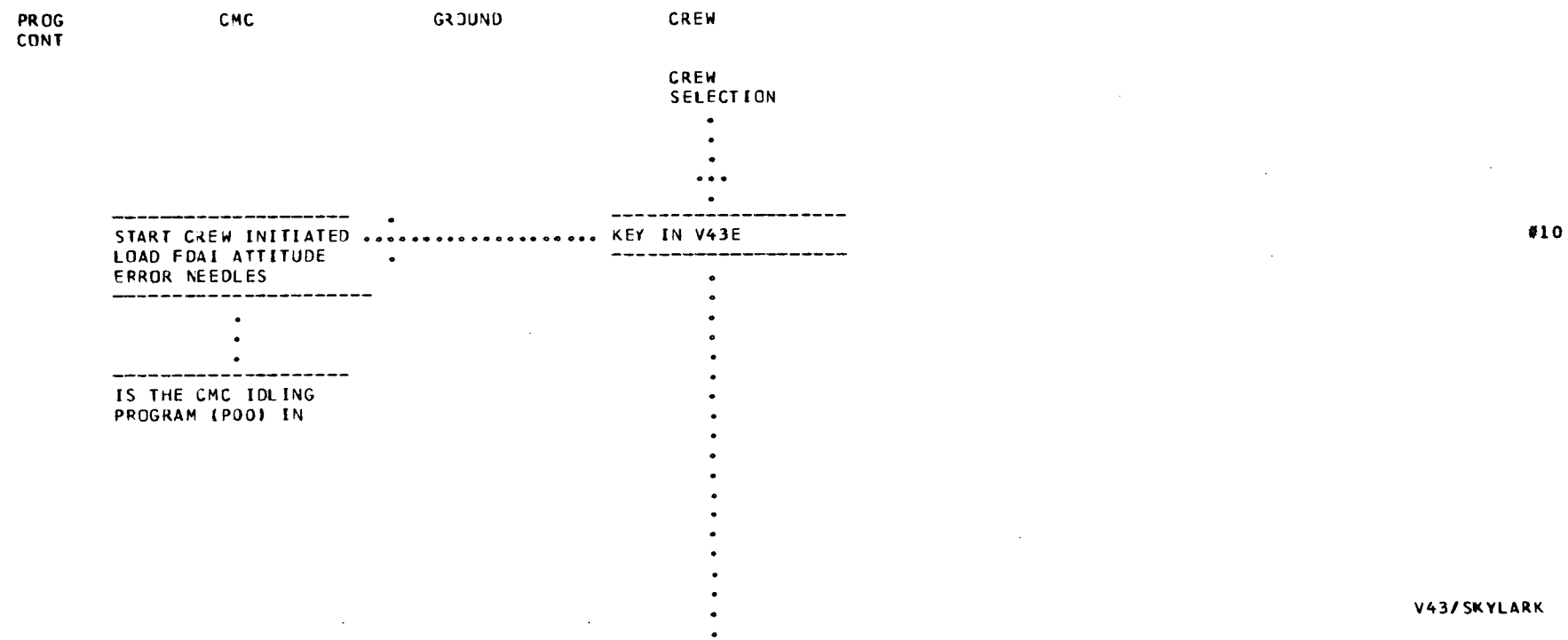
(2) IF LIFTOFF HAS OCCURRED, THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE. IF LIFTOFF HAS NOT OCCURRED, ANY OTHER EXTENDED VERB IN PROCESS WILL BE OVERRIDDEN.

(3) THE PROCESS MAY NOT BE SELECTED IF THE IMU IS IN THE COARSE ALIGN OR ZERO ICDU MODE.

(4) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.

(5) THE MAXIMUM ERROR ANGLE WHICH MAY BE LOADED IS +/- 16.88 DEGREES. ANY VALUE GREATER THAN THIS MAXIMUM WILL BE INTERPRETED AS =16.38 DEGREES. THE ASTRONAUT SHOULD SELECT THE FDAI SCALE APPROPRIATE TO THE ERROR ANGLES HE WISHES DISPLAYED. THE MAXIMUM ANGLES WHICH MAY BE SHOWN ON THE ERROR NEEDLES ARE: PITCH AND YAW -15 DEGREES; ROLL -50 DEGREES.

(6) THE PROCESS MAY BE SELECTED ONLY IN P00.



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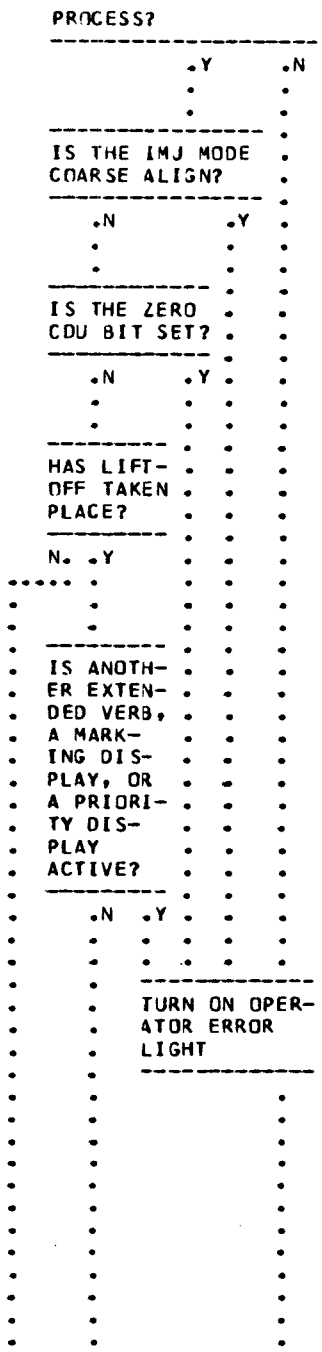
V43/SKYLARK


PROCESS?
.Y
.N
IS THE IMJ MODE COARSE ALIGN?
.N
.Y
IS THE ZERO CDU BIT SET?
.N
.Y
HAS LIFT-OFF TAKEN PLACE?
N.
.Y
IS ANOTH-ER EXTEN-DED VERB, A MARK-ING DIS-PLAY, OR A PRIORI-TY DIS-PLAY ACTIVE?
.N
.Y
TURN ON OPER-ATOR ERROR LIGHT

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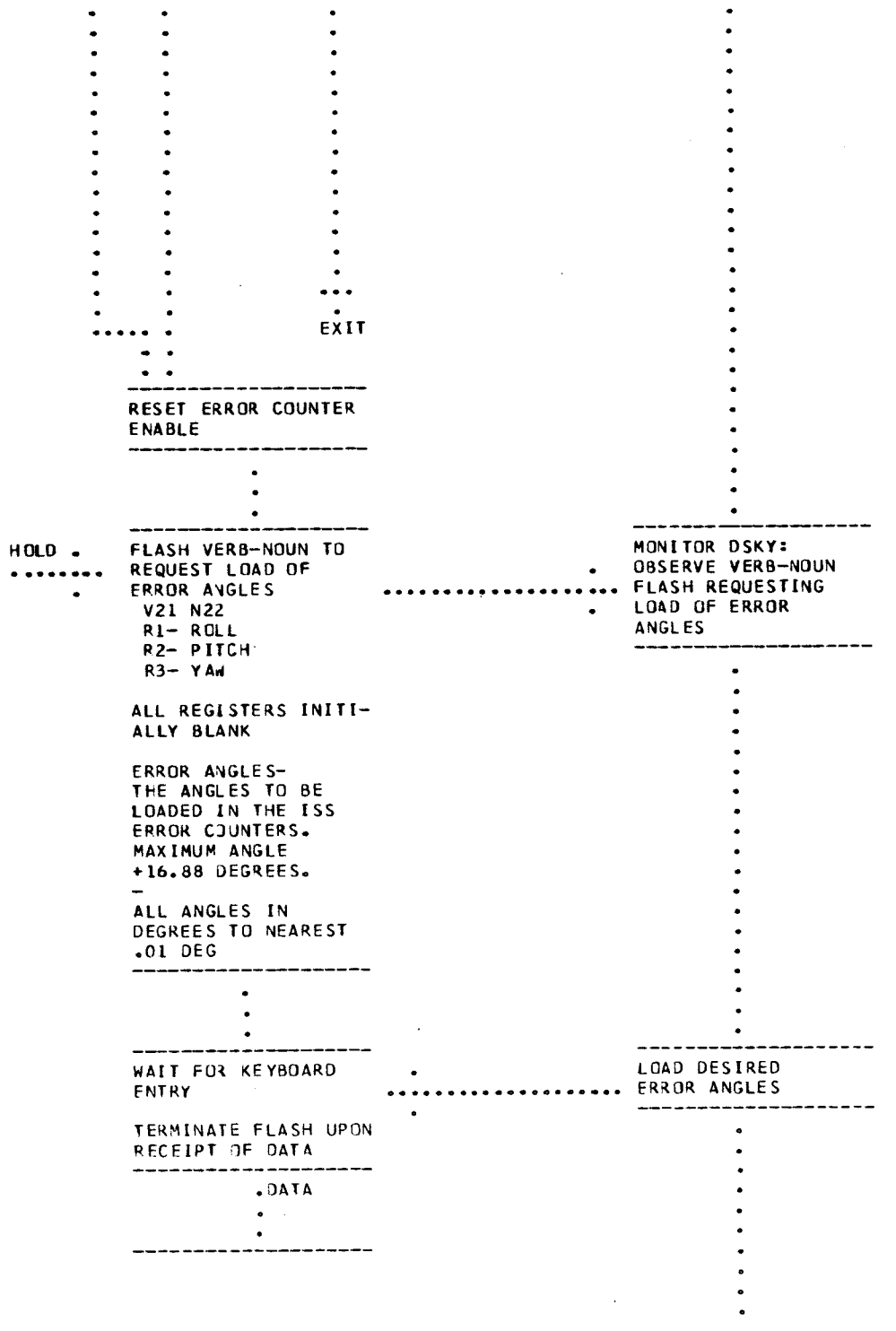

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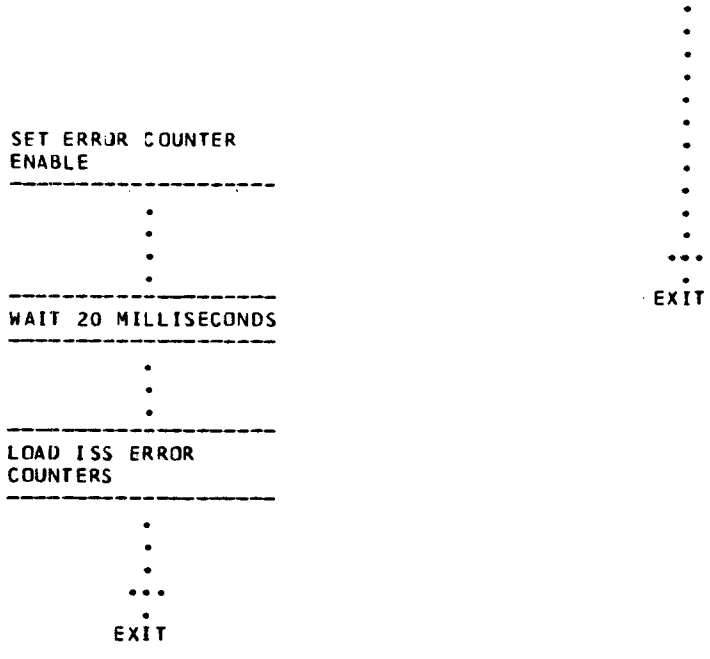
#90
#100
#110
#120



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CHANGE CONTROL NOTES

REQUEST DOCKED DAP DATA LOAD ROUTINE (R04) REV 00 05/19/71
EXTENDED VERB 44

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R04. SEE R04 FOR SPECIFICATION LOGIC FLOW FOR LOADING DAP DATA.

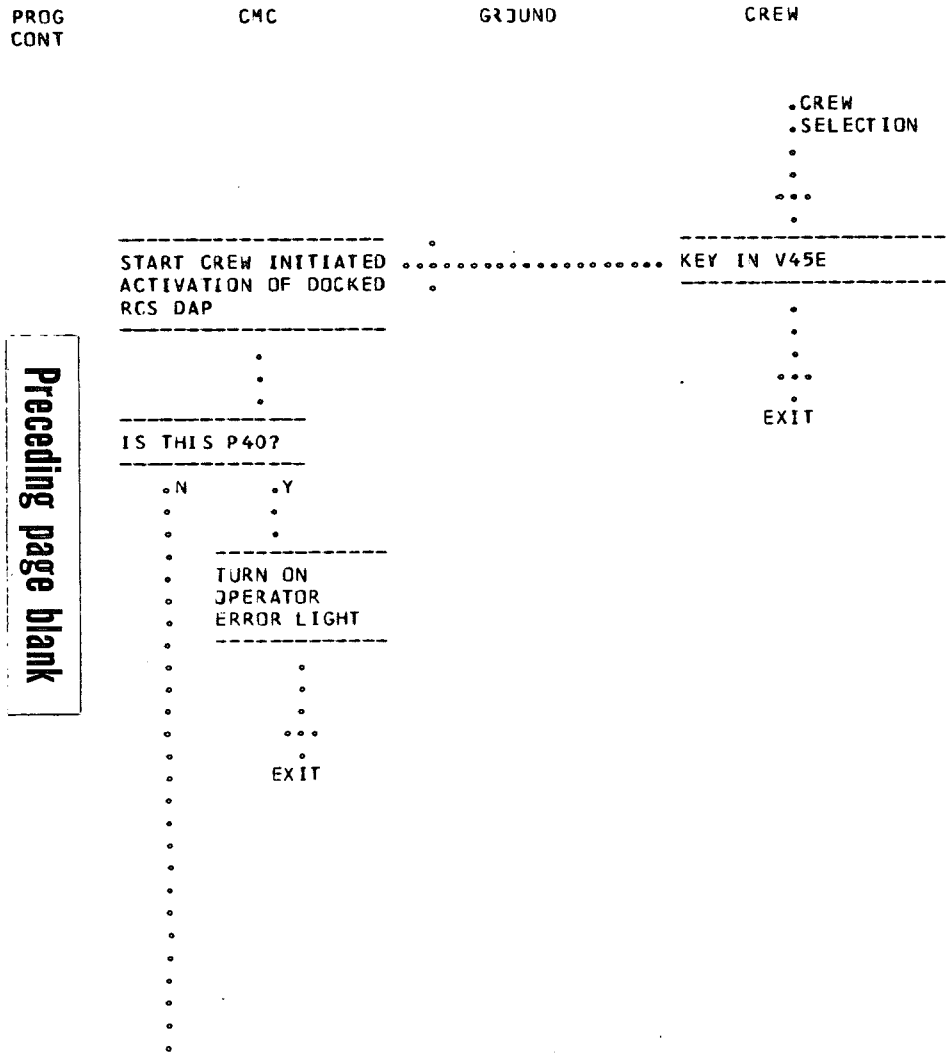
CHANGE CONTROL NOTES

REV 00 PCR 007,040

ACTIVATE DOCKED DAP EXTENDED VERB 45 REV 00 05/19/71

PURPOSE: (1) TO ACTIVATE DOCKED RCS DAP.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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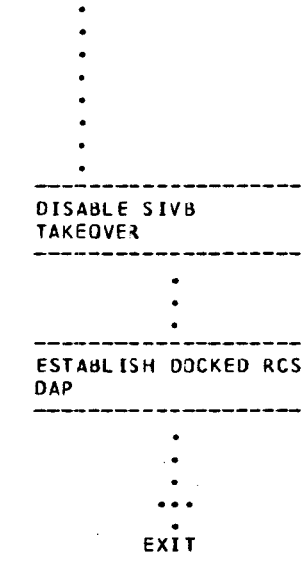

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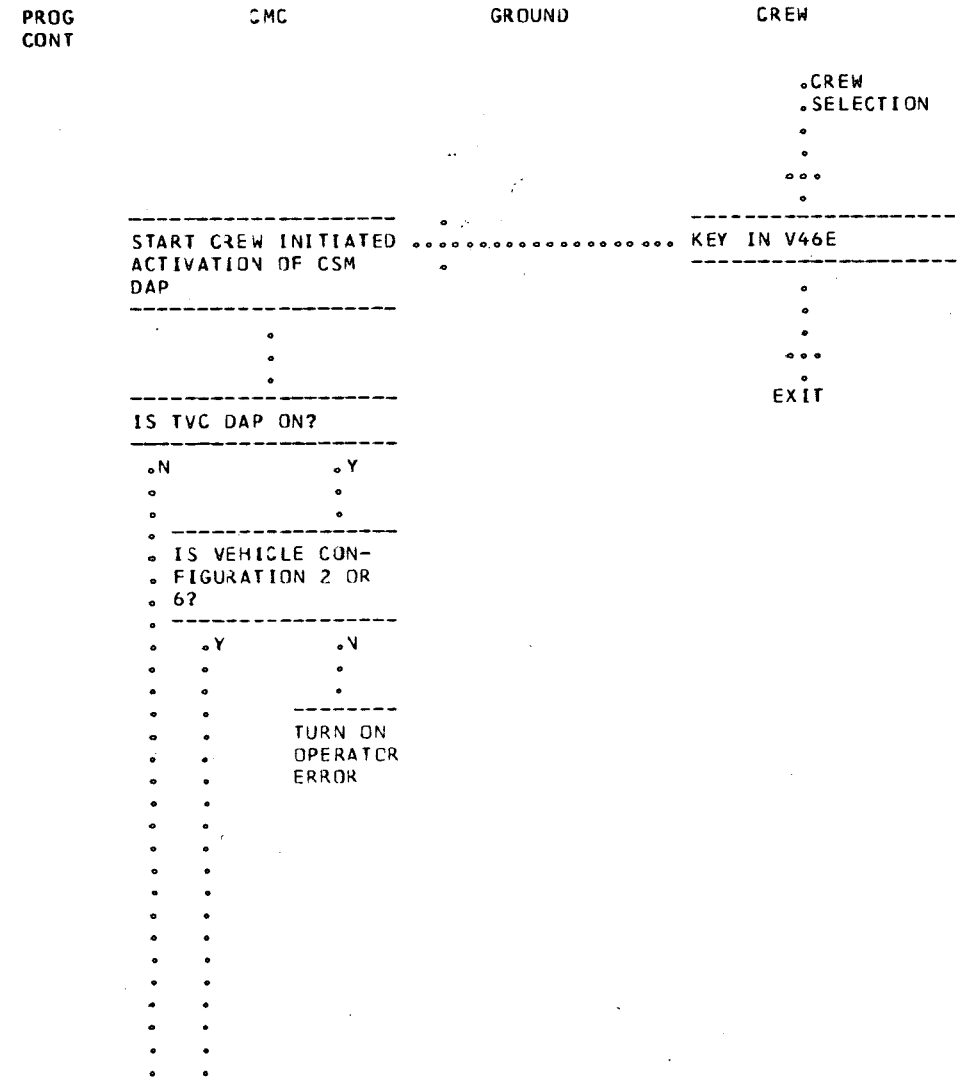
CHANGE CONTROL NOTES

REV 00 PCR 007,040

ACTIVATE CSM DAP EXTENDED VERB 46 REV 00 05/19/71

PURPOSE: (1) TO ACTIVATE THE CSM DAP.

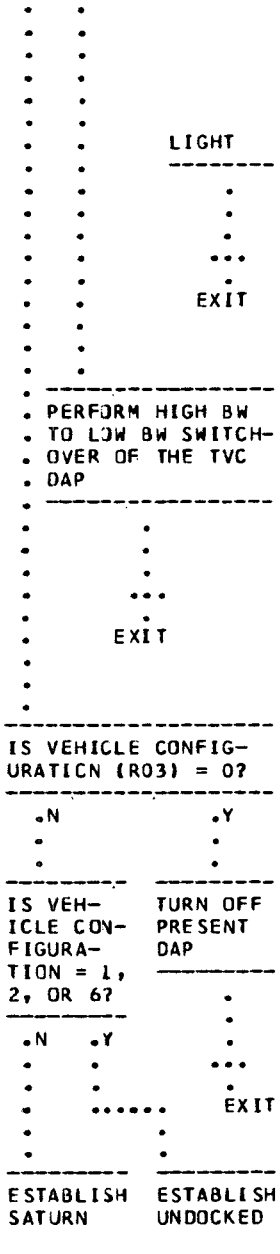
ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



010

020

030


LIGHT
EXIT
PERFORM HIGH BW TO LOW BW SWITCH-OVER OF THE TVC DAP
EXIT
IS VEHICLE CONFIG-URATION (R03) = 0?
N
Y
IS VEH-ICLE CON-FIGURA-TION = 1, 2, OR 6?
TURN OFF PRESENT DAP
EXIT
N
Y
ESTABLISH SATURN
ESTABLISH UNDOCKED

#40

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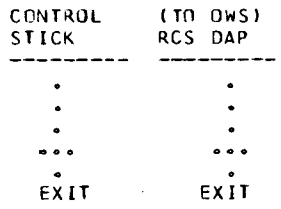


#90

CHANGE CONTROL NOTES

REV 00 PCR 040, PCN 410

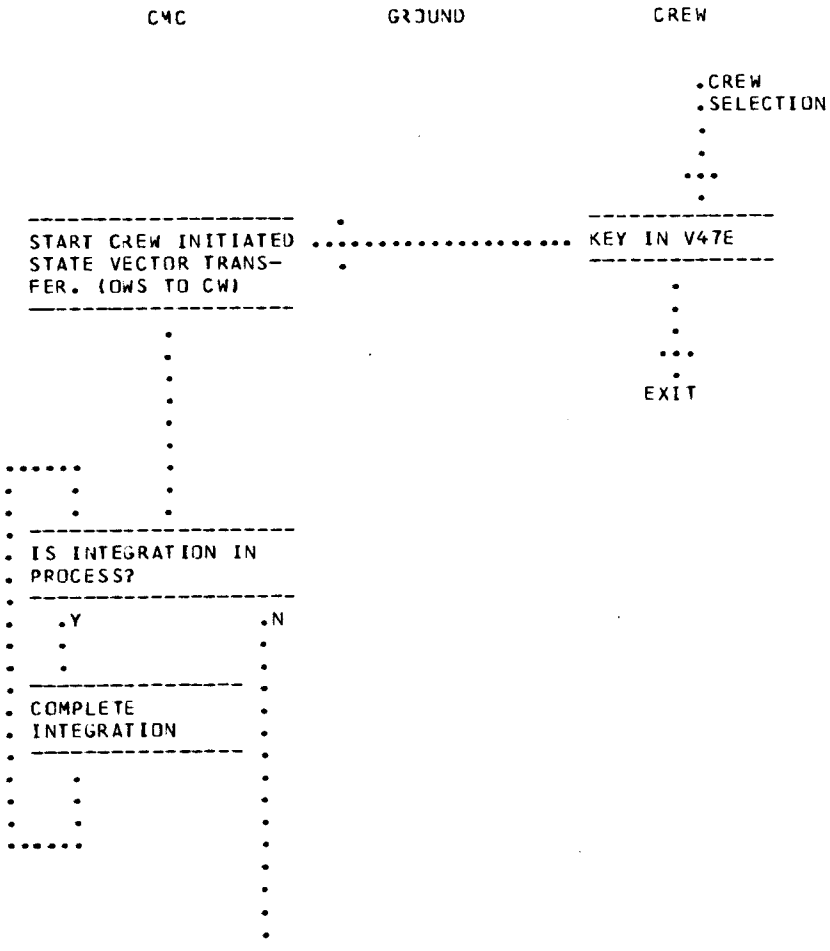
SET OWS STATE VECTOR INTO CSM STATE VECTOR
EXTENDED VERB 47

REV 00 05/19/71

PURPOSE: (1) TO TRANSFER THE OWS STATE VECTOR INFORMATION TO THE CSM STATE VECTOR.

ASSUMPTIONS: (1) THIS TRANSFER OF THE STATE VECTOR INFORMATION MAY BE ACCOMPLISHED AT ANY TIME EXCEPT WHEN AVERAGE-G IS ON.

(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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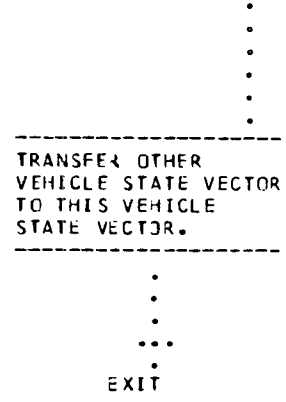

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CHANGE CONTROL NOTES

REQUEST CSM DAP DATA LOAD (R03)
EXTENDED VERB 48

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R03. SEE R03 FOR SPECIFICATION LOGIC FLOW FOR LOADING DAP DATA.

CHANGE CONTROL NOTES

START CREW-DEFINED MANEUVER (R62)
EXTENDED VERB 49

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R62. SEE R62 FOR THE SPECIFICATION LOGIC FLOW FOR A CREW DEFINED MANEUVER.

CHANGE CONTROL NOTES

PLEASE PERFORM EXTENDED VERB 50 REV 00 05/19/71

PURPOSE: (1) TO INTERRUPT A PROGRAM OR ROUTINE TO ALLOW THE ASTRONAUT TO MANUALLY ACCEPT OR REJECT THE INFORMATION DISPLAYED ON THE DSKY.

ASSUMPTIONS: (1) PRESSING PROCEED ON DSKY INDICATES REQUESTED ACTION HAS BEEN PERFORMED.

(2) EXECUTION OF ENTER INDICATES THE REQUESTED ACTION IS NOT DESIRED.

(3) THIS VERB ALWAYS APPEARS FLASHING ON THE DSKY.

(4) THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

PLEASE MARK EXTENDED VERB 51 REV 00 05/19/71

PURPOSE: (1) TO ALLOW THE ASTRONAJT TO OBTAIN OPTICAL SIGHTING DATA BY USE OF THE SXT, SCT, AND THE MARK BUTTON.

ASSUMPTIONS: (1) OPTICS IS ON AND OPERATIONAL.

(2) THIS VERB IS USED IN P03 AND R53. REFER TO THOSE PURPOSES AND ASSJMPTIONS FOR ADDITIONAL RESTRICTIONS.

(3) THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

PLEASE MARK ALTERNATE LOS EXTENDED VERB 53 REV 00 05/19/71

PURPOSE: (1) TO ALLOW THE ASTRONAUT TO OBTAIN OPTICAL SIGHTING DATA BY USE OF ANY DESIGNATED ALTERNATE LINE OF SIGHT.

ASSUMPTIONS: (1) THIS VERB IS USED IN R23 AND R56 ONLY.
REFER TO THE PURPOSES AND ASSUMPTIONS OF THESE ROUTINES FOR ADDITIONAL RESTRICTIONS.

(2) THIS VERB IS INTERNALLY GENERATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

START RENDEZVOUS BACKUP SIGHTING MARK (R23)
EXTENDED VERB 54

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R23. SEE R23 FOR THE SPECIFICATION LOGIC FLOW FOR RENDEZVOUS BACKUP SIGHTING MARK PROCESS.

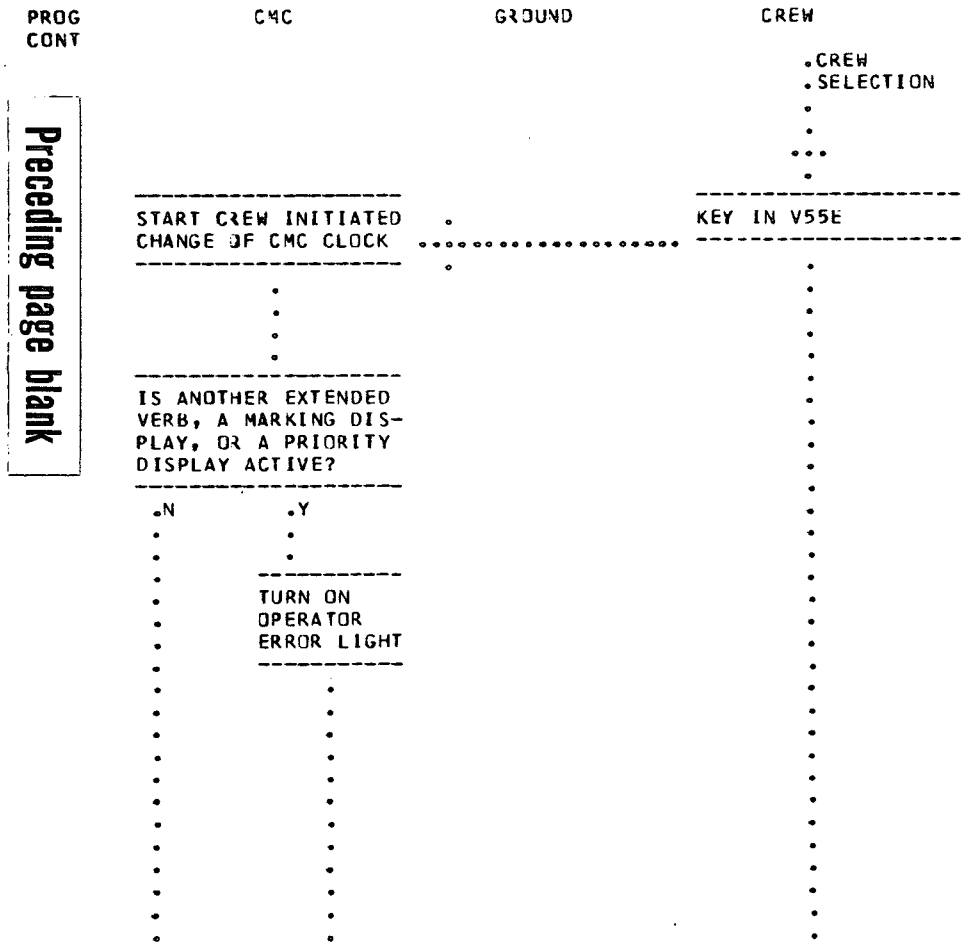
CHANGE CONTROL NOTES

INCREMENT CMC TIME (DECIMAL) EXTENDED VERB 55 REV 01 03/20/72

PURPOSE: (1) TO CHANGE THE CMC CLOCK TIME USING INCREMENTS (OR DECREMENTS) LOADED BY THE ASTRONAUT.

ASSUMPTIONS: (1) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.

(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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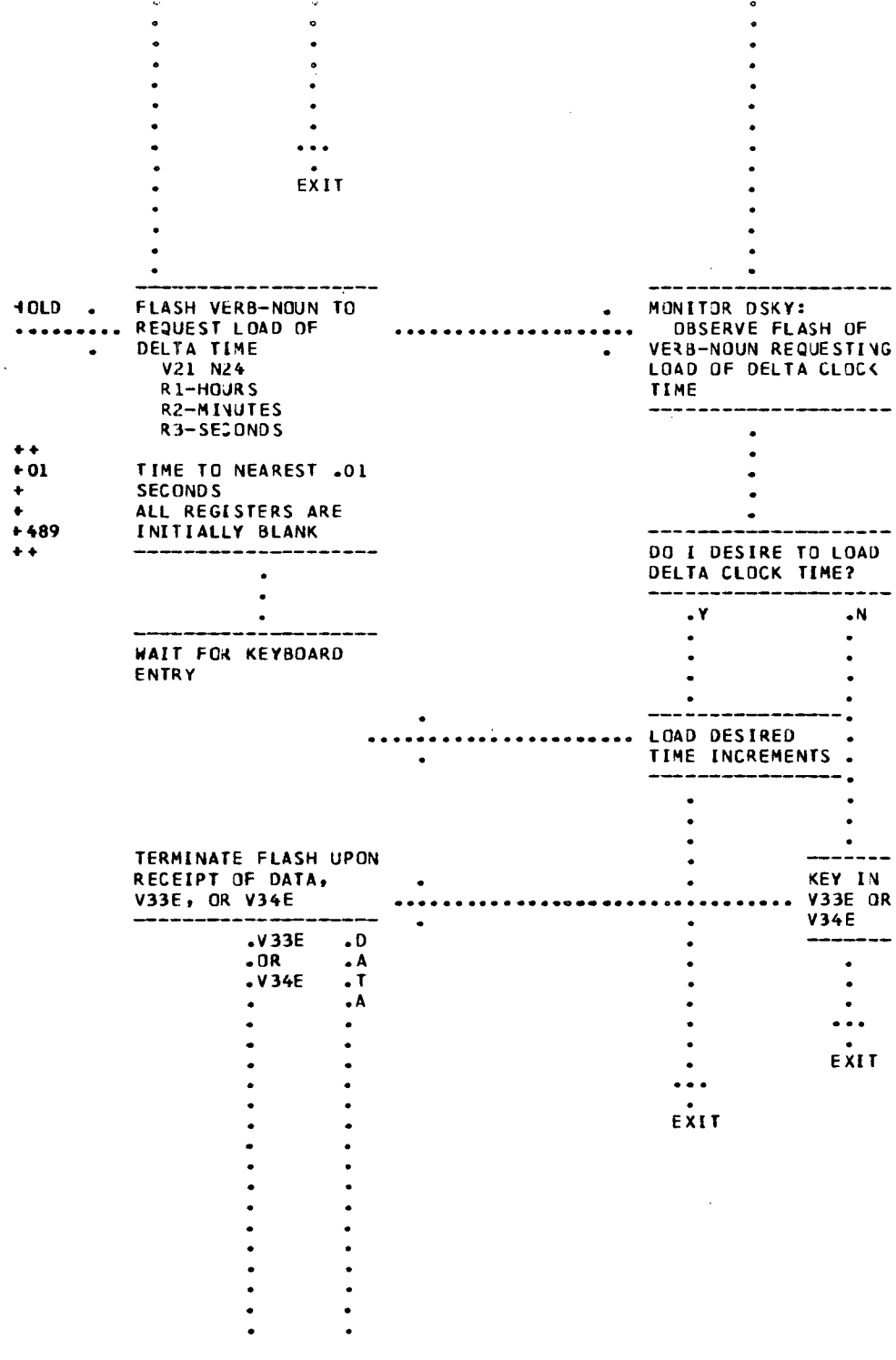
EXIT
HOLD
FLASH VERB-NOUN TO REQUEST LOAD OF DELTA TIME
V21 N24
R1-HOURS
R2-MINUTES
R3-SECONDS
TIME TO NEAREST .01 SECONDS
ALL REGISTERS ARE INITIALLY BLANK
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF DATA, V33E, OR V34E
.V33E .OR .V34E
.D .A .T .A
MONITOR DSKY:
OBSERVE FLASH OF VERB-NOUN REQUESTING LOAD OF DELTA CLOCK TIME
DO I DESIRE TO LOAD DELTA CLOCK TIME?
.Y
.N
LOAD DESIRED TIME INCREMENTS
KEY IN V33E OR V34E
EXIT
EXIT

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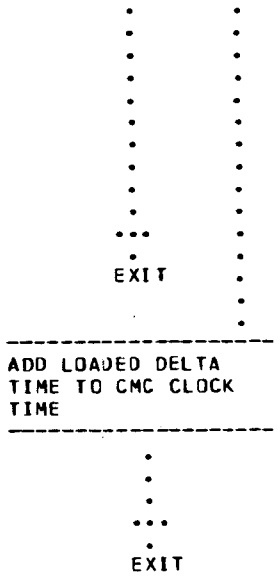

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CHANGE CONTROL NOTES

REV 01 PCN 489

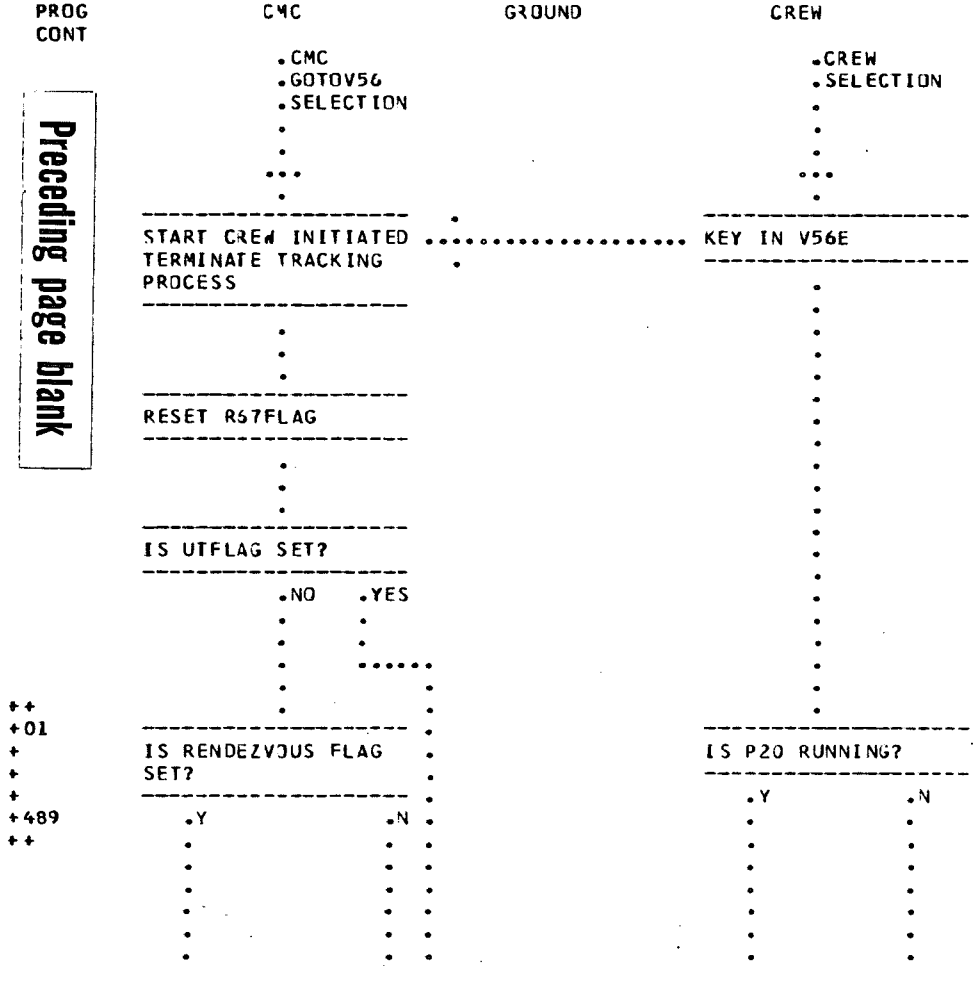
TERMINATE TRACKING EXTENDED VERB 56 REV 01 03/20/72

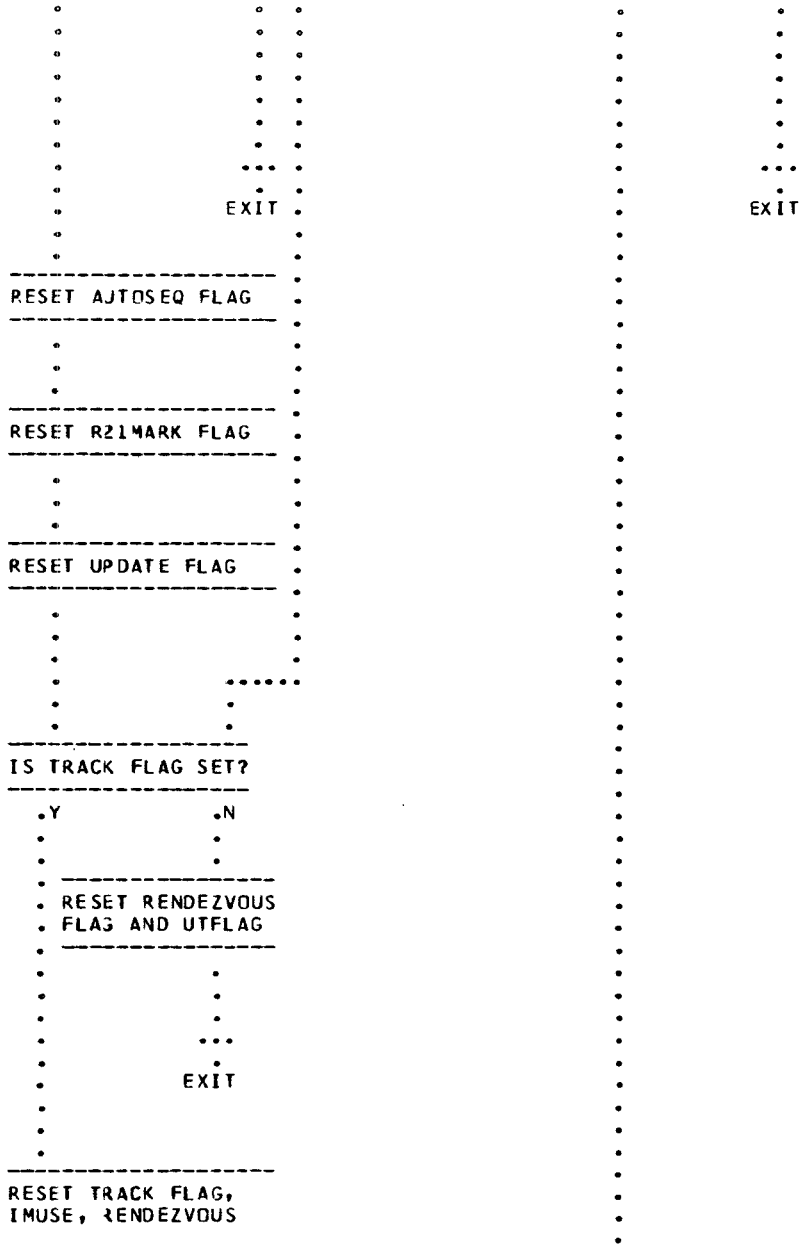
PURPOSE: (1) RESET UNIVERSAL TRACKING, R67 FLAGS. TURN OFF MINKEY SEQUENCE (CLEAR AUTOSEQ).

(2) TERMINATE PROGRAM P20.

ASSUMPTIONS: (1) THIS PROCESS MAY BE ENTERED VIA TERMINATE OPTION OF V06 N49 IN R22, AND THE TERMINATE OPTION OF THE MANEUVER DISPLAY IN R60 IF ENTERED FROM R61.

(2) PROCESS MAY BE CREW SELECTED BY DSKY ENTRY.




EXIT
RESET AJTOSEQ FLAG
RESET R21MARK FLAG
RESET UPDATE FLAG
IS TRACK FLAG SET?
Y
N
RESET RENDEZVOUS FLAG AND UTFLAG
EXIT
RESET TRACK FLAG, IMUSE, RENDEZVOUS
EXIT

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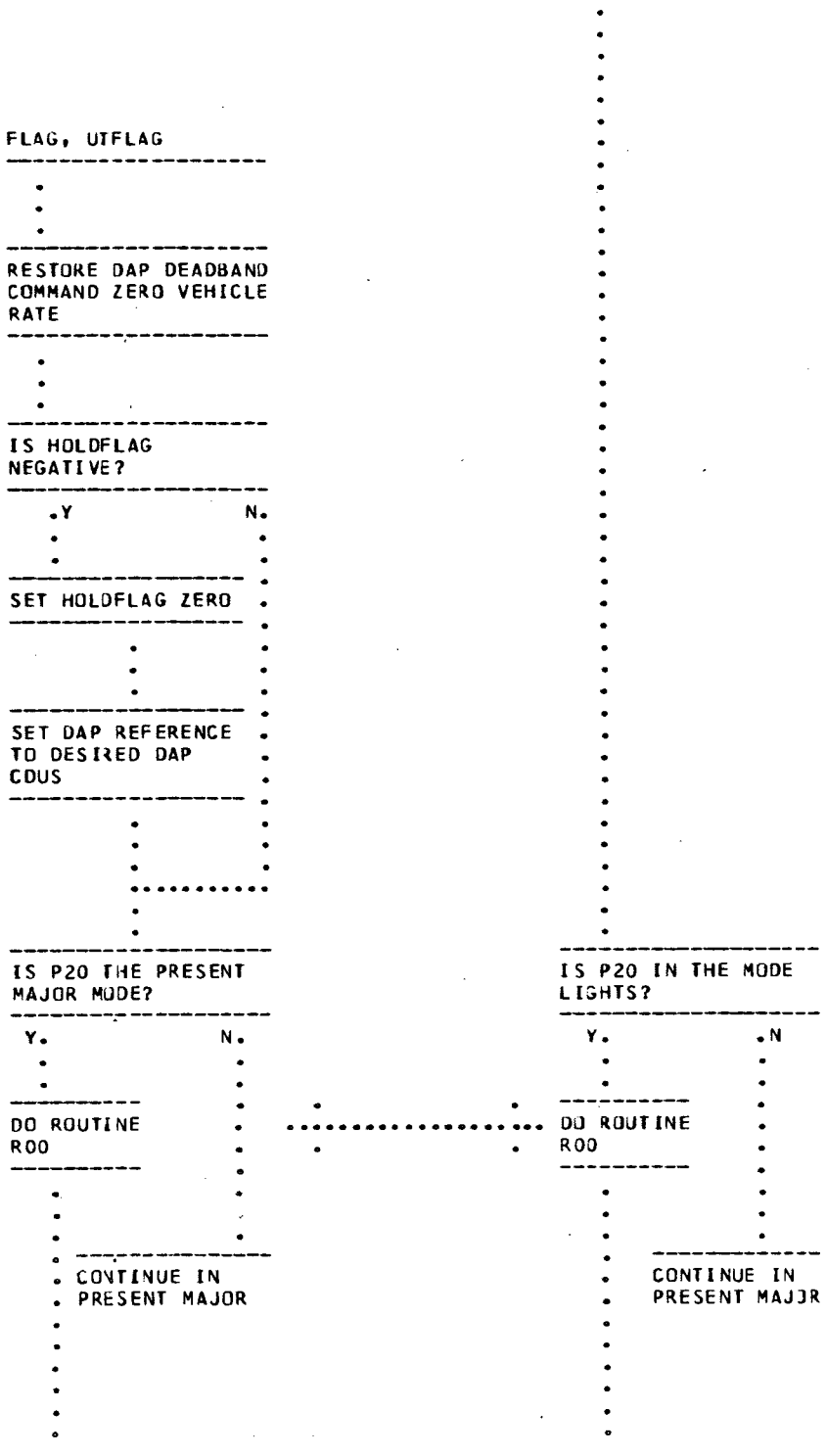

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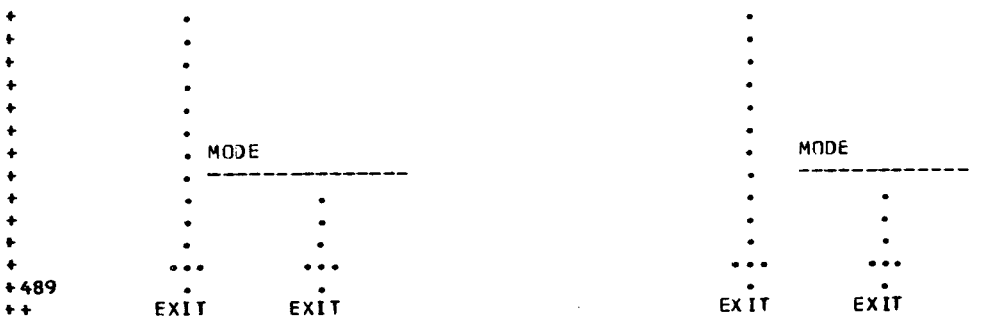


CHANGE CONTROL NOTES

REV 00 PCN 456
REV 01 PCN 489

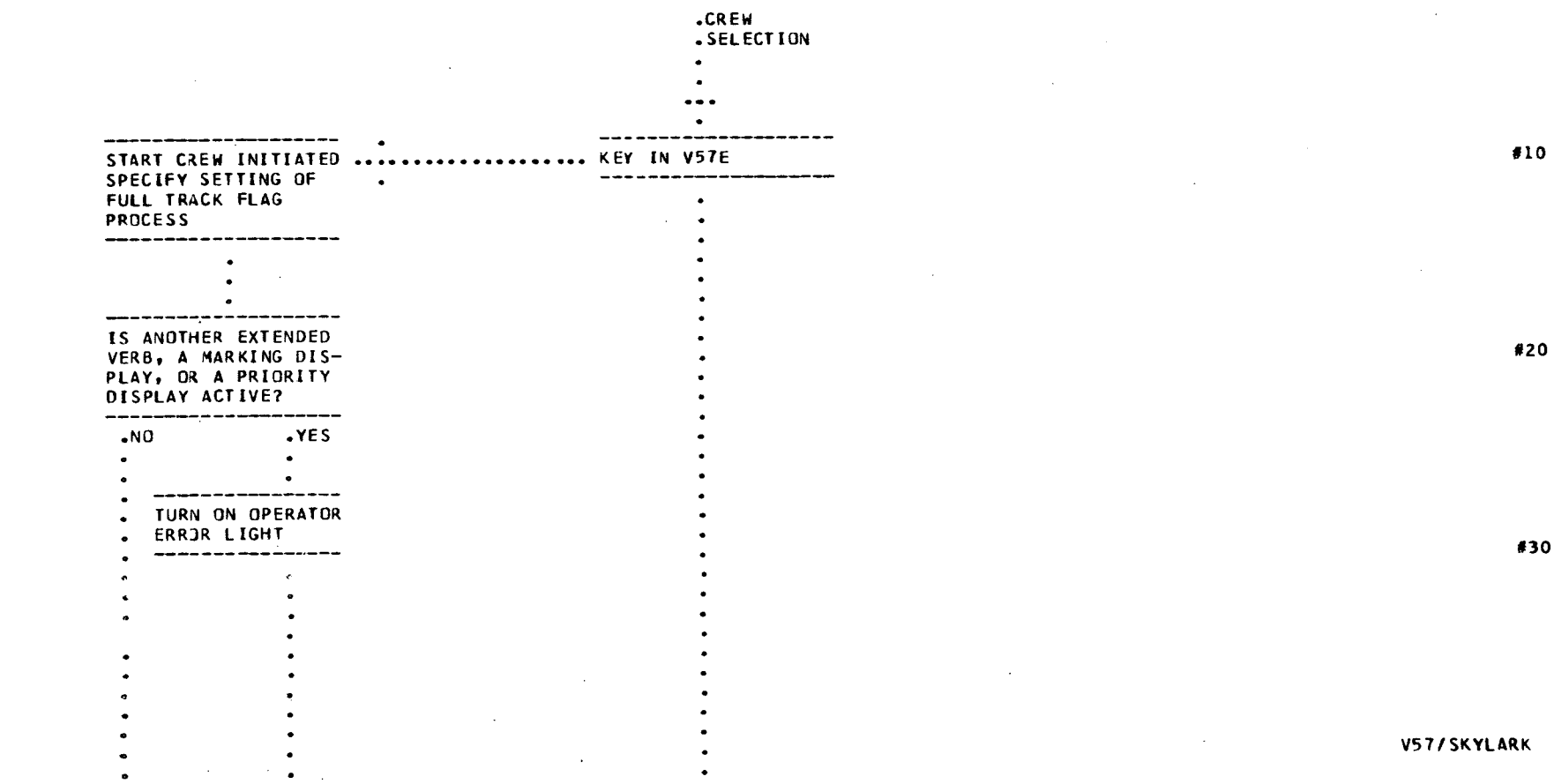
SPECIFY SETTING OF FULL TRACK FLAG
EXTENDED VERB 57

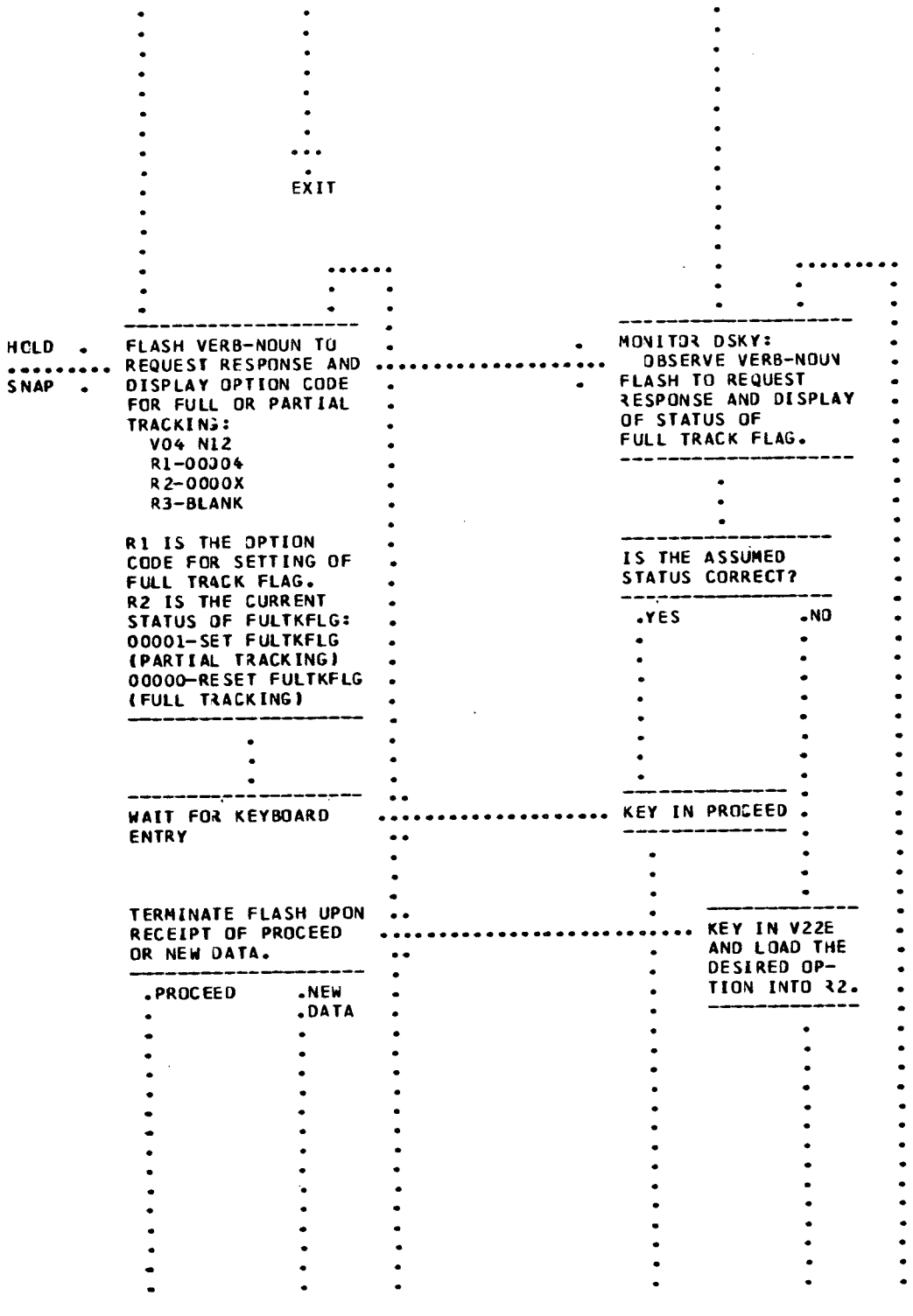
REV 00 05/19/71

PURPOSE: (1) TO DISPLAY STATUS OF FULL TRACK FLAG AND ALLOW CHANGE BY DSKY ENTRY.

ASSUMPTIONS: (1) FULTKFLG IS EXAMINED ONLY DURING AUTOMATIC W-MATRIX INITIALIZATION FOLLOWING TPI IN RENDEZVOUS SEQUENCE. IT INDICATES WHETHER BOTH NAVIGATION SENSORS (VHF AND SEXTANT) WILL BE USED FOLLOWING TPI.

(2) PROCESS IS CREW SELECTED BY DSKY ENTRY.




EXIT
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY OPTION CODE FOR FULL OR PARTIAL TRACKING:
V04 N12
R1-00004
R2-0000X
R3-BLANK
R1 IS THE OPTION CODE FOR SETTING OF FULL TRACK FLAG.
R2 IS THE CURRENT STATUS OF FULTKFLG:
00001-SET FULTKFLG (PARTIAL TRACKING)
00000-RESET FULTKFLG (FULL TRACKING)
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA.
.PROCEED
.NEW DATA
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF STATUS OF FULL TRACK FLAG.
IS THE ASSUMED STATUS CORRECT?
.YES
.NO
KEY IN PROCEED
KEY IN V22E AND LOAD THE DESIRED OPTION INTO R2.

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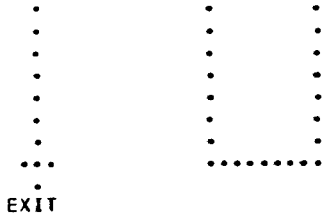

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CHANGE CONTROL NOTES

REV 00 PCN 457

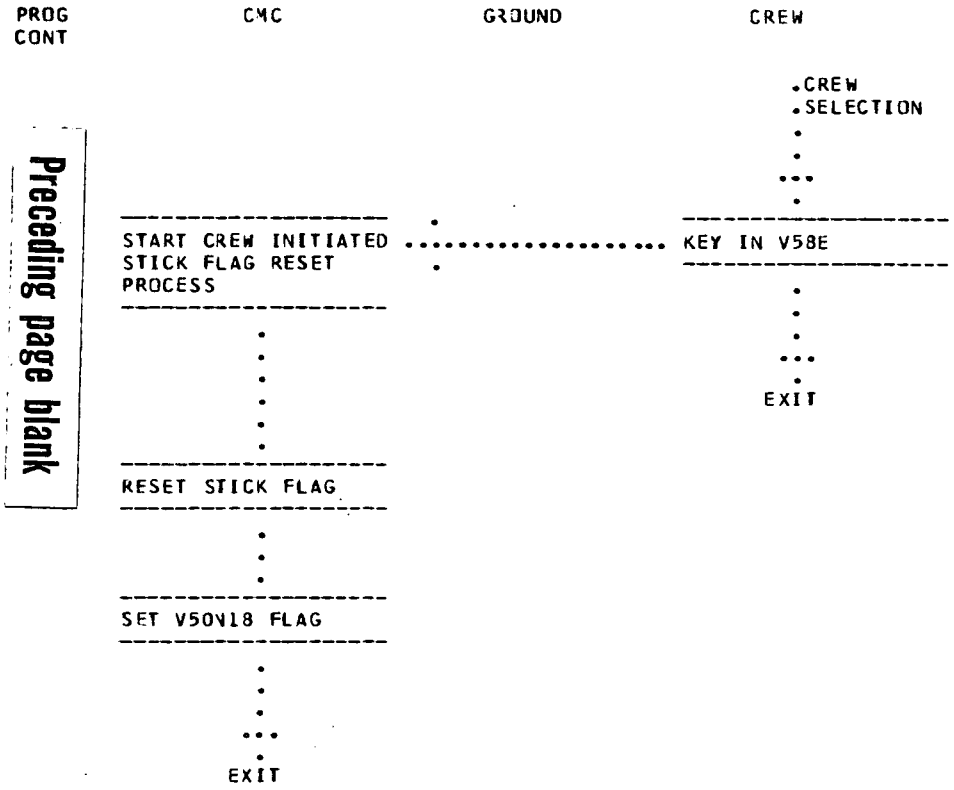
RESET STICK FLAG AND SET V50N18
FLAG EXTENDED VERB 58

REV 00 05/19/71

PURPOSE: (1) RESET THE STICK FLAG (SEE P20 AND R61)

(2) SET THE V50N18 FLAG (SEE P20 AND R61)

ASSUMPTIONS: (1) PROCESS IS CREW INITIATED BY DSKY ENTRY



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CHANGE CONTROL NOTES

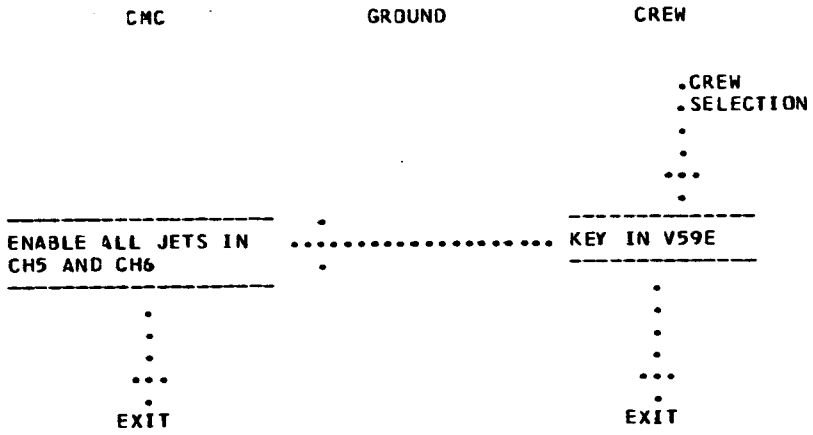
ENABLE ALL JETS (DOCKED) EXTENDED
VERB 59

REV 00 05/19/71

PURPOSE: (1) TO ALLOW THE ASTRONAUT TO QUICKLY RE-ENABLE ALL JETS IN DOCKED DAP WHICH HAD BEEN INHIBITED VIA CHANNEL 5 JET INHIBIT AND CHANNEL 6 JET INHIBIT IN DOCKED DAP DATA LOAD.

ASSUMPTIONS: (1) THE PROCESS IS USED DURING CSM-OWS DOCKED CONFIGURATION.

(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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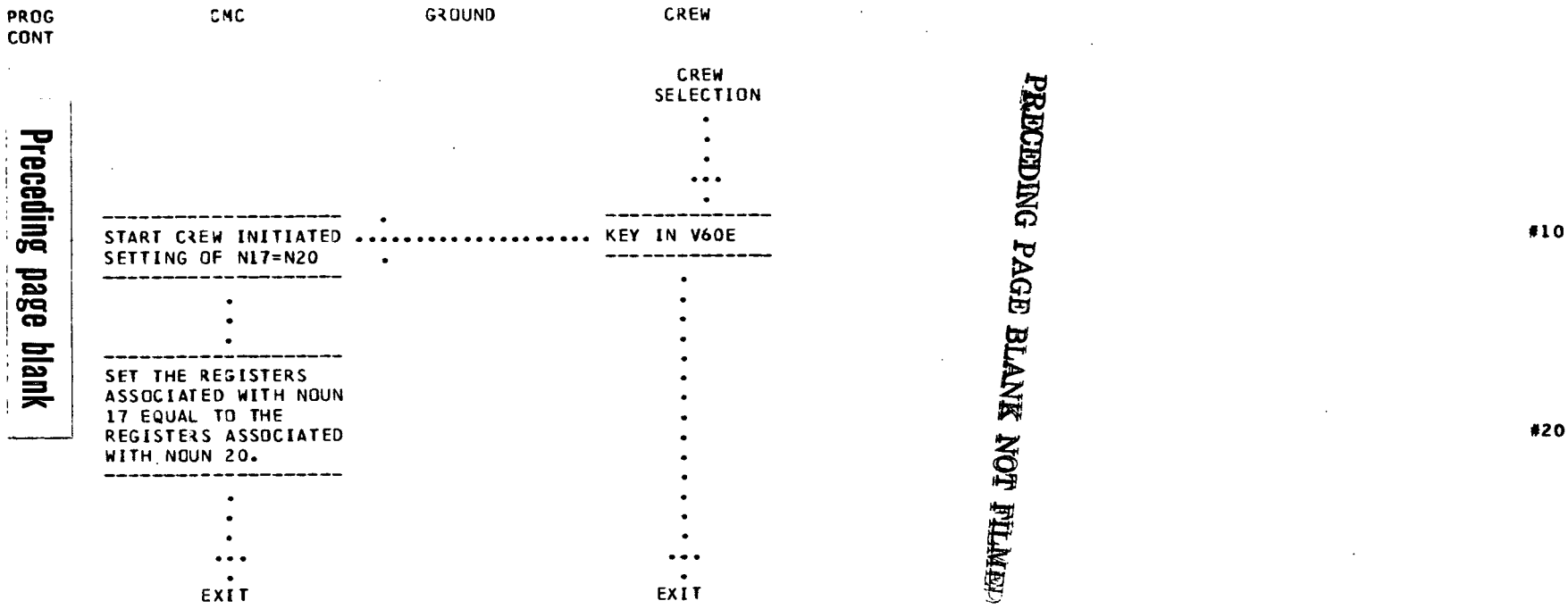
CHANGE CONTROL NOTES

REV 00 PCR 005,040

SET ATTITUDE ERROR REFERENCE TO PRESENT ATTITUDE REV 00 05/19/71
EXTENDED VERB 60

PURPOSE: (1) TO SET THE ASTRONAUT TOTAL ATTITUDE REGISTERS (N17) EQUAL TO THE PRESENT ATTITUDE (N20) (PROVIDE AN "ATTITUDE SET" FOR MODE 3).

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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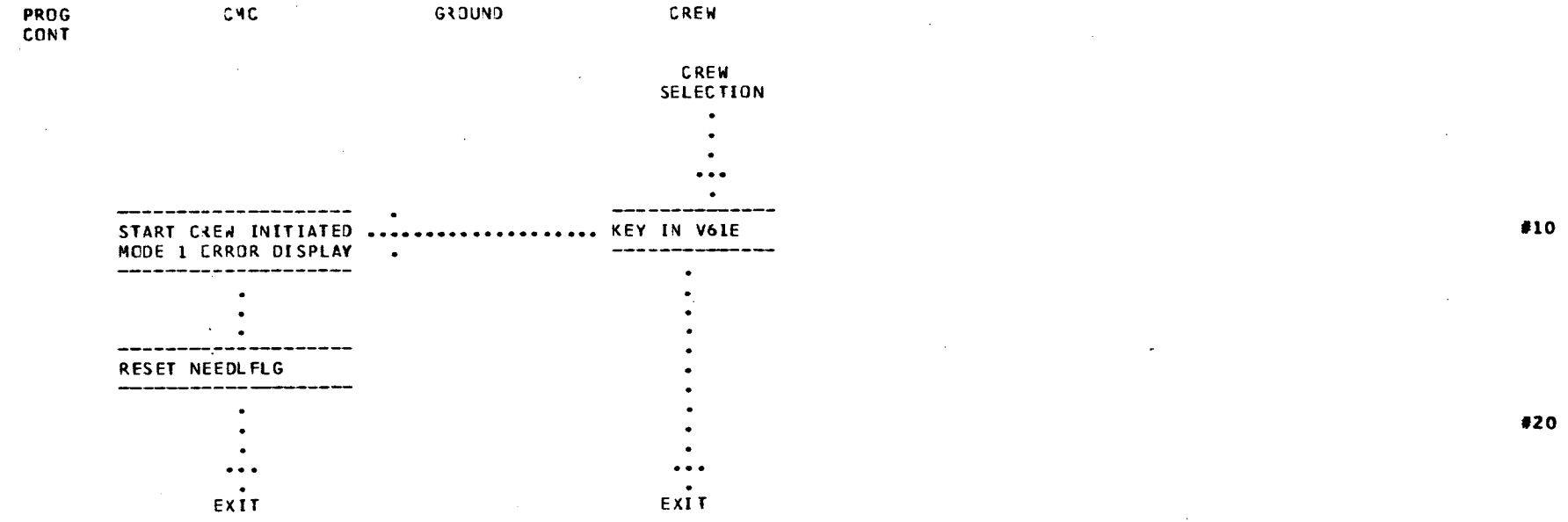
CHANGE CONTROL NOTES

++ SELECT MODE 1 (DISPLAY DAP ATTITUDE ERROR) REV 01 03/20/72
+01 EXTENDED VERB 61
+489
++

PURPOSE: (1) TO DISPLAY ON THE FDAI ERROR NEEDLES THE DIFFERENCE BETWEEN THE CURRENT CDU ANGLES AND THE DAP COMMANDED ANGLES.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.



CHANGE CONTROL NOTES

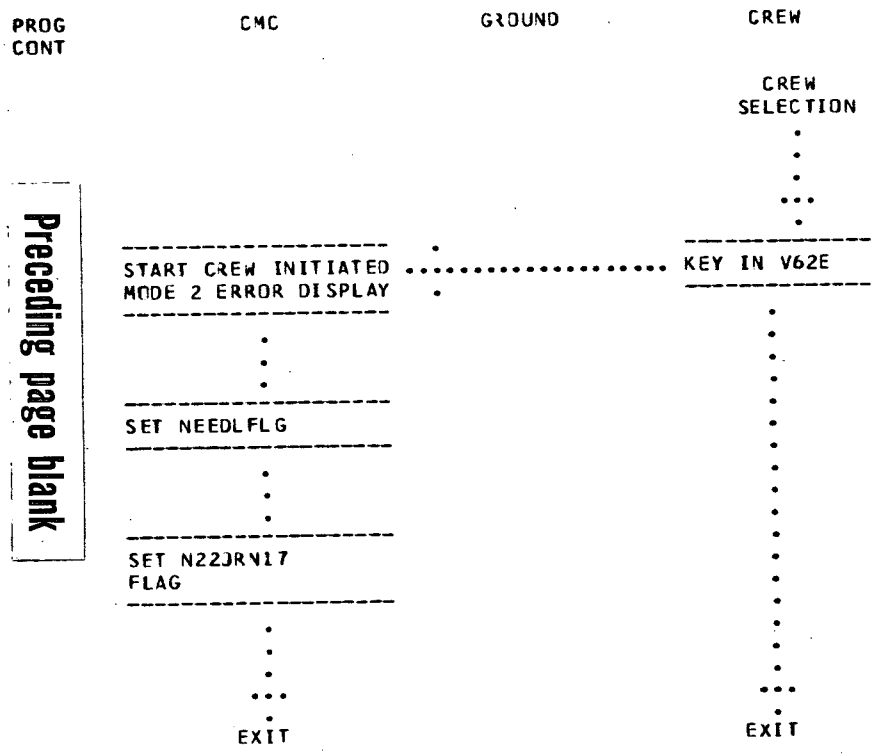
REV 01 PCN 489

++ SELECT MODE 2 (DISPLAY TOTAL ATTITUDE ERROR (N22-N20)) EXTENDED VERB 52 REV 01 03/20/72
+01
+489
++

PURPOSE: (1) TO DISPLAY THE TOTAL ATTITUDE ERROR (N22-N20) ON THE FDAI ATTITUDE ERROR NEEDLES.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.



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CHANGE CONTROL NOTES

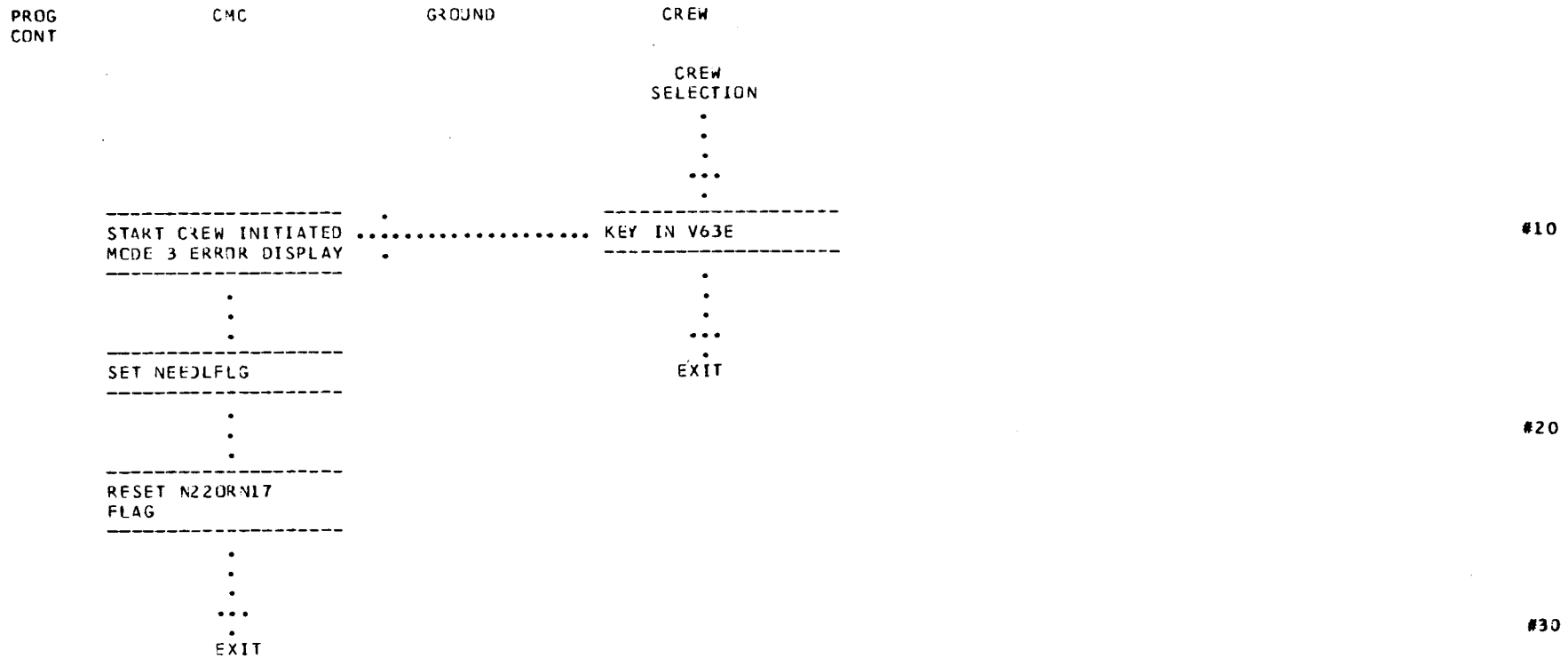
REV 01 PCN 489

++ SELECT MODE 3 (DISPLAY TOTAL ASTRONAUT ATTITUDE REV 01 03/20/72
+01 ERROR (N17-N20)) EXTENDED VERB 63
+489
++

PURPOSE: (1) TO DISPLAY TOTAL ASTRONAUT ATTITUDE ERROR (N17-N20) ON THE FDAI ATTITUDE ERROR NEEDLES.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.



CHANGE CONTROL NOTES

REV C1 PCN 489

REQUEST OPTICS ANGLES TRANSFORM ROUTINE (R64) REV 00 05/19/71
EXTENDED VERB 64

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R64. SEE R64 FOR THE SPECIFICATION LOGIC FLOW.

CHANGE CONTROL NOTES

REV 00 PCR 040,405

START OPTICAL VERIFICATION OF GYRO COMPASSING
(P03) EXTENDED VERB 65

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL PROGRAM P03. SEE PROGRAM P03 FOR THE SPECIFICATION LOGIC FLOW FOR STARTING THE OPTICAL VERIFICATION OF GYRO COMPASSING.

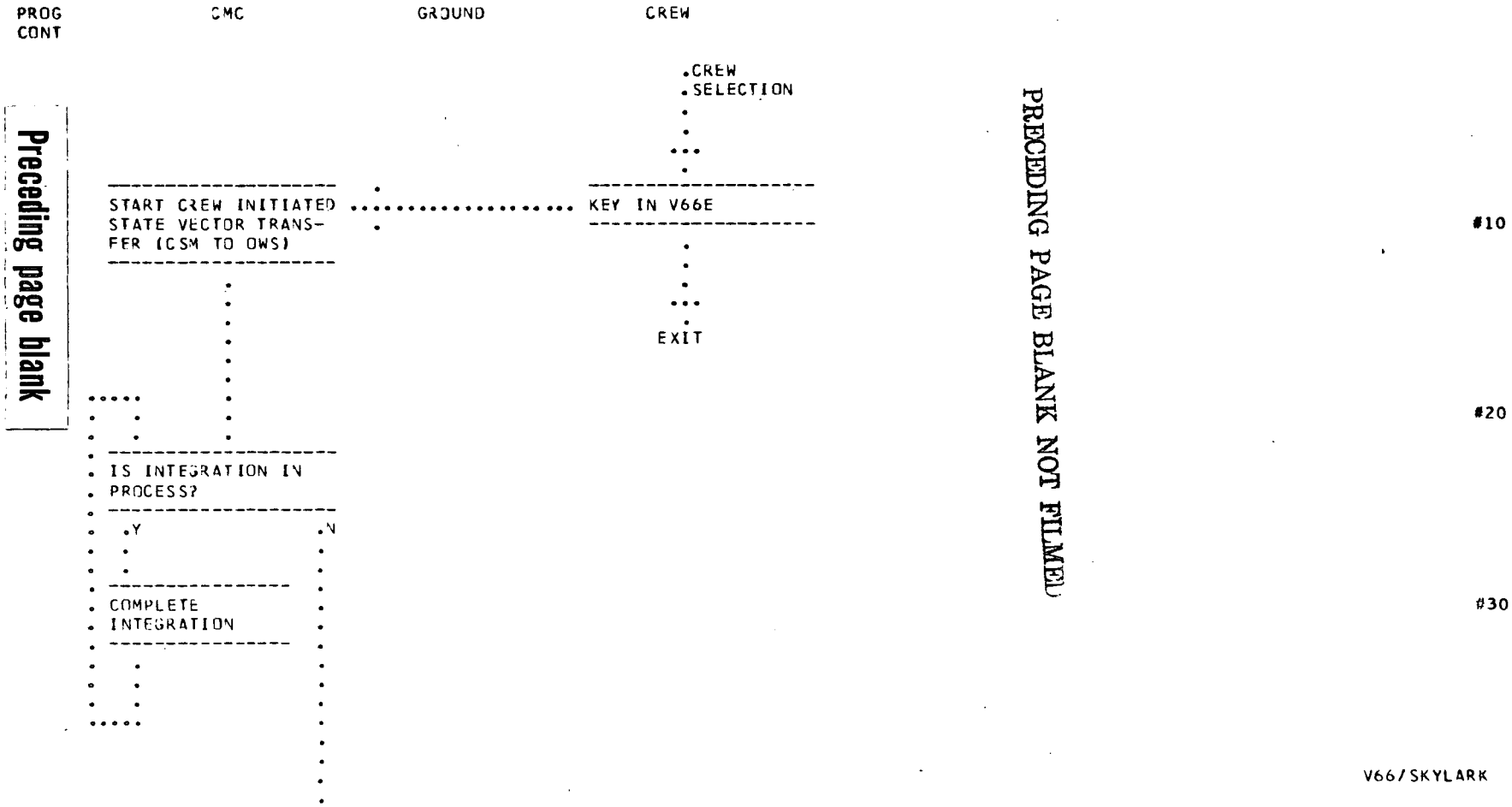
CHANGE CONTROL NOTES

SET CSM STATE VECTOR INTO OWS STATE VECTOR REV 00 05/19/71
EXTENDED VERB 66

PURPOSE: (1) TO TRANSFER THE CSM STATE VECTOR INFORMATION TO THE OWS STATE VECTOR.

ASSUMPTIONS: (1) THE TRANSFER OF THE STATE VECTOR INFORMATION MAY BE ACCOMPLISHED AT ANY TIME EXCEPT IF AVERAGE-G ROUTINE WAS IN PROCESS.

(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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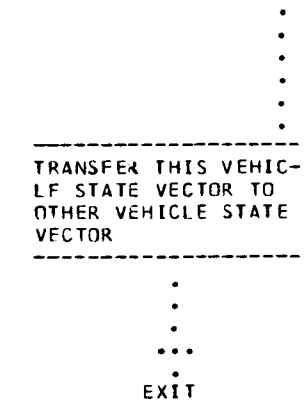

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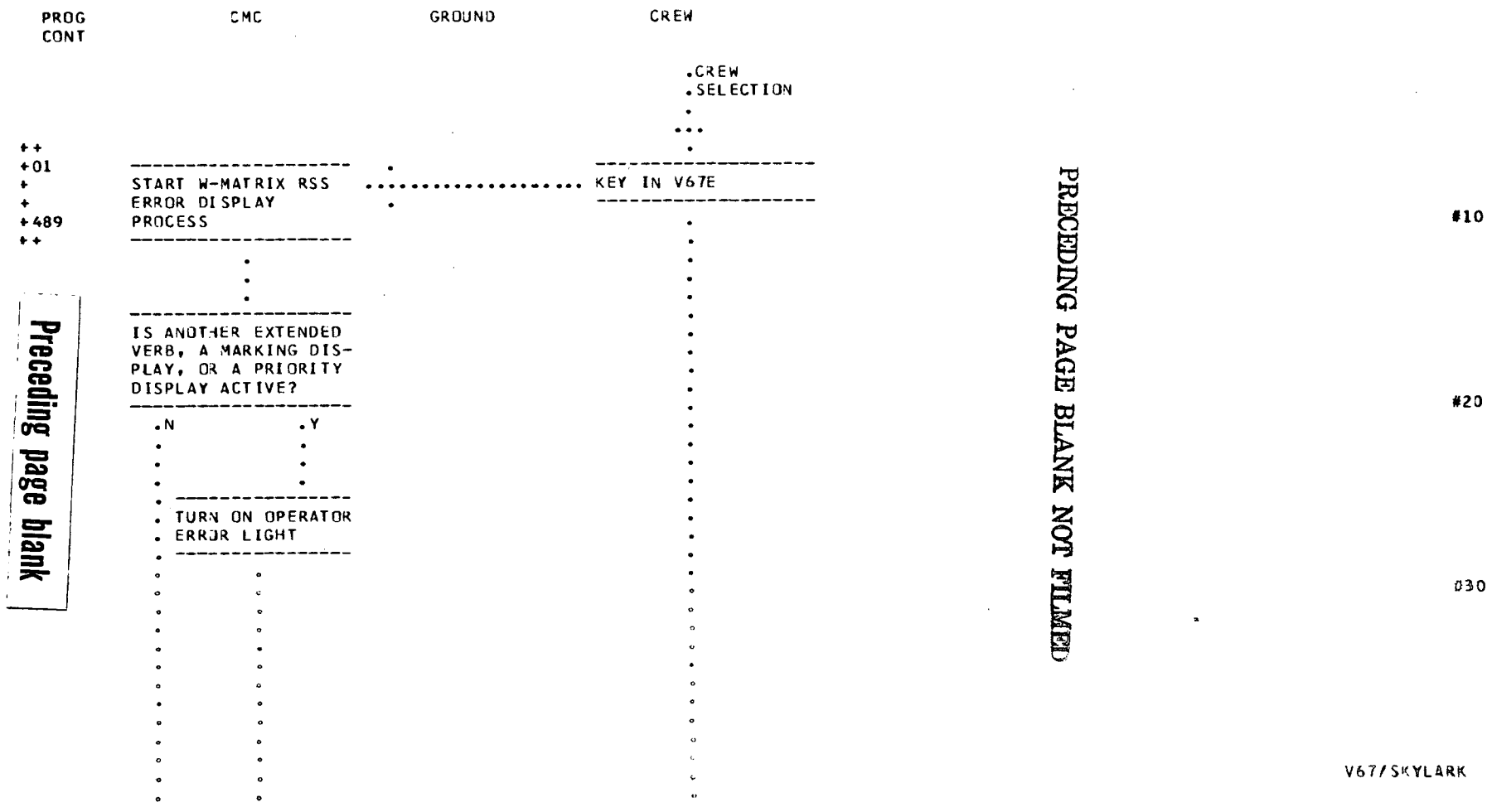
CHANGE CONTROL NOTES

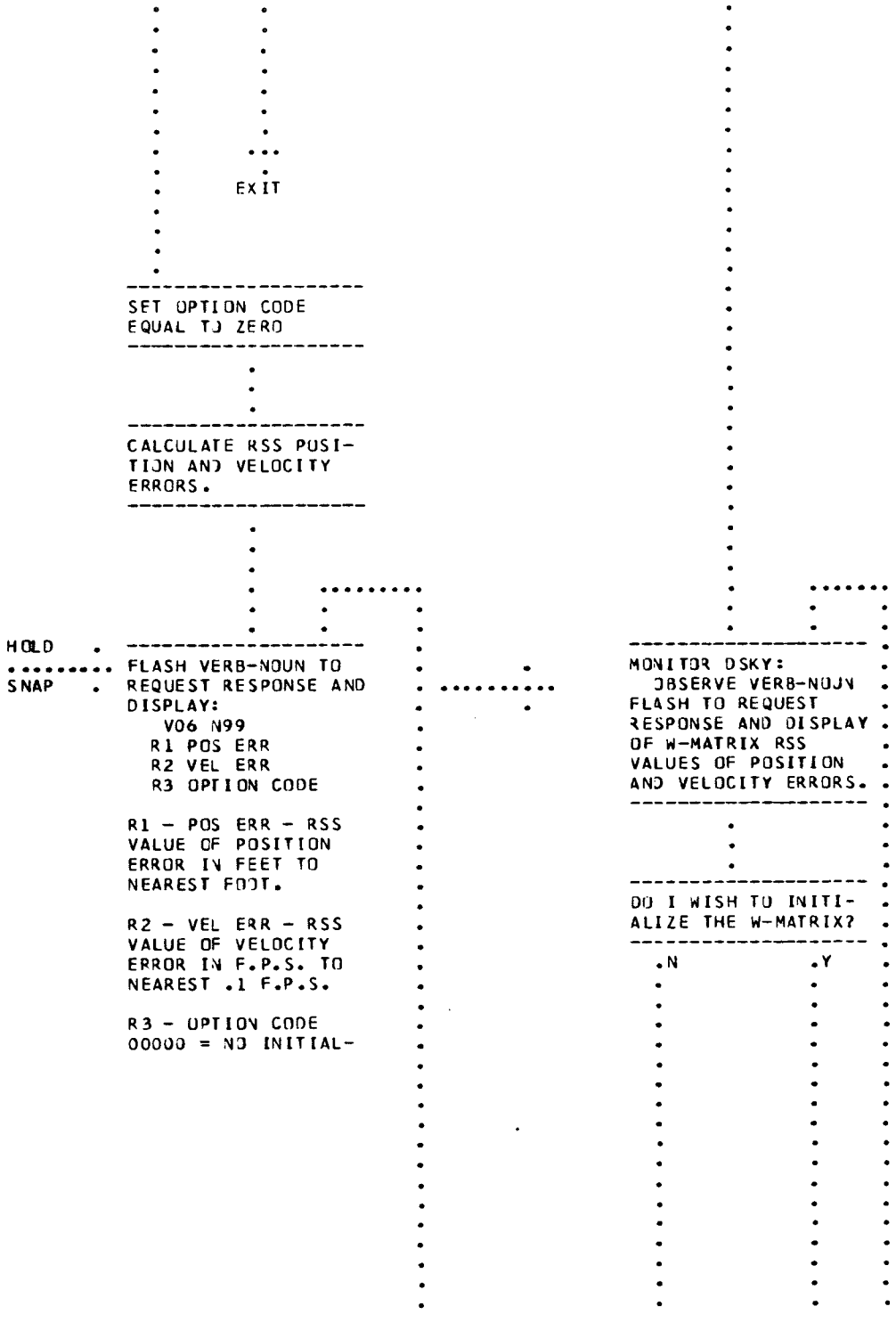
REQUEST W-MATRIX RSS ERROR DISPLAY EXTENDED VERB 67 REV 01 03/20/72

PURPOSE: (1) TO PROVIDE A MEANS OF DISPLAYING W-MATRIX INFORMATION AND LOADING NEW VALUES FOR REINITIALIZING THE W-MATRIX IF DESIRED.

ASSUMPTIONS: (1) NO OTHER EXTENDED VERBS ARE ACTIVE.

(2) THIS PROCESS IS CREW SELECTED BY DSKY ENTRY.




EXIT
SET OPTION CODE EQUAL TO ZERO
CALCULATE RSS POSITION AND VELOCITY ERRORS.
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY:
V06 N99
R1 POS ERR
R2 VEL ERR
R3 OPTION CODE
R1 - POS ERR - RSS VALUE OF POSITION ERROR IN FEET TO NEAREST FOOT.
R2 - VEL ERR - RSS VALUE OF VELOCITY ERROR IN F.P.S. TO NEAREST .1 F.P.S.
R3 - OPTION CODE 00000 = NO INITIAL-
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF W-MATRIX RSS VALUES OF POSITION AND VELOCITY ERRORS.
DO I WISH TO INITIALIZE THE W-MATRIX?
.N
.Y

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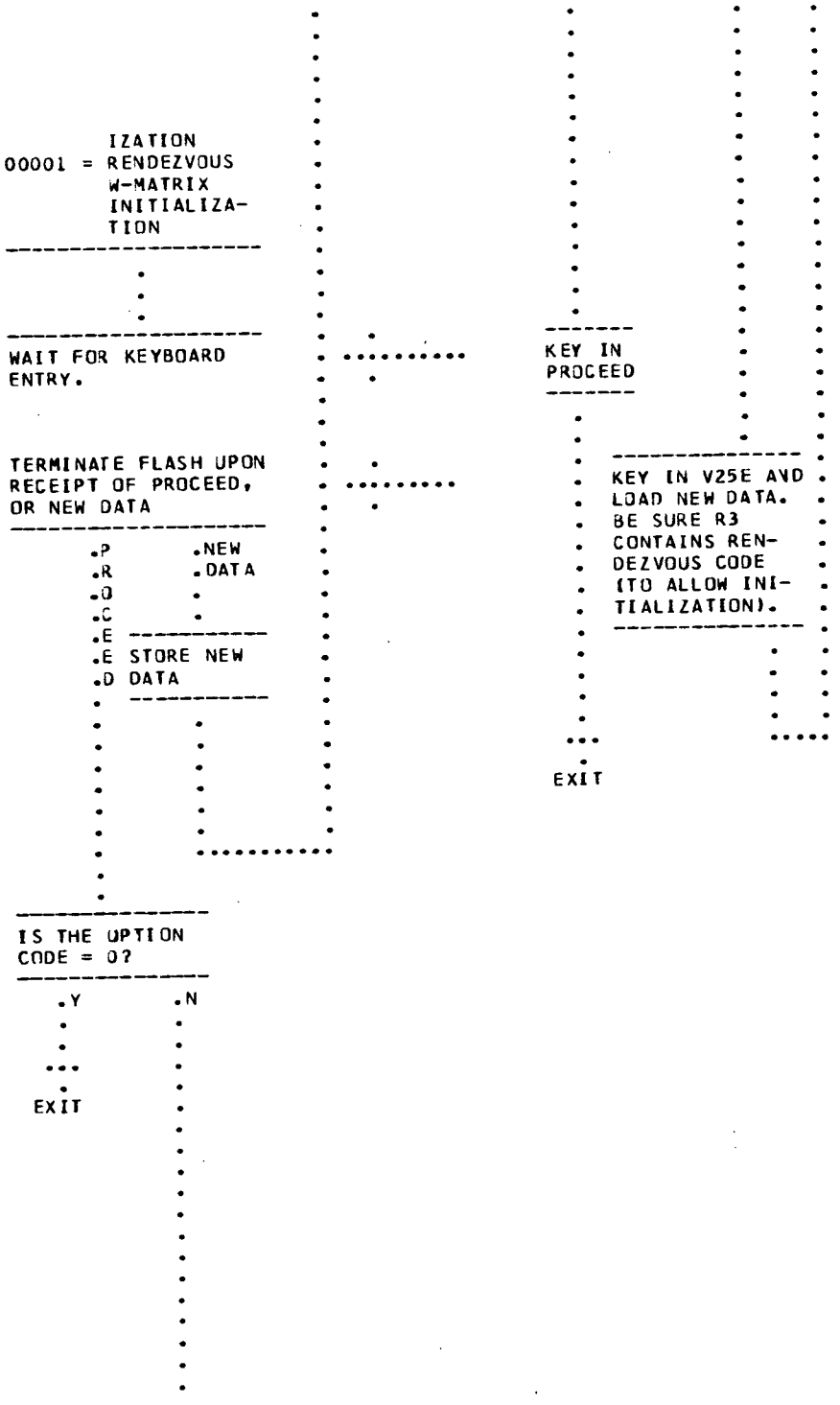

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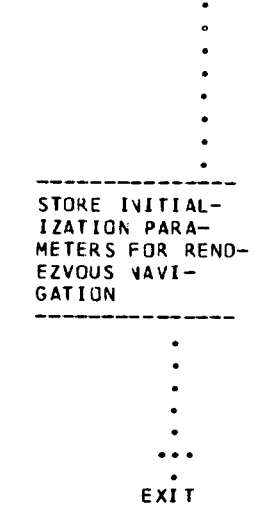

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CHANGE CONTROL NOTES

REV 00 PCR 017,018
REV 01 PCN 489

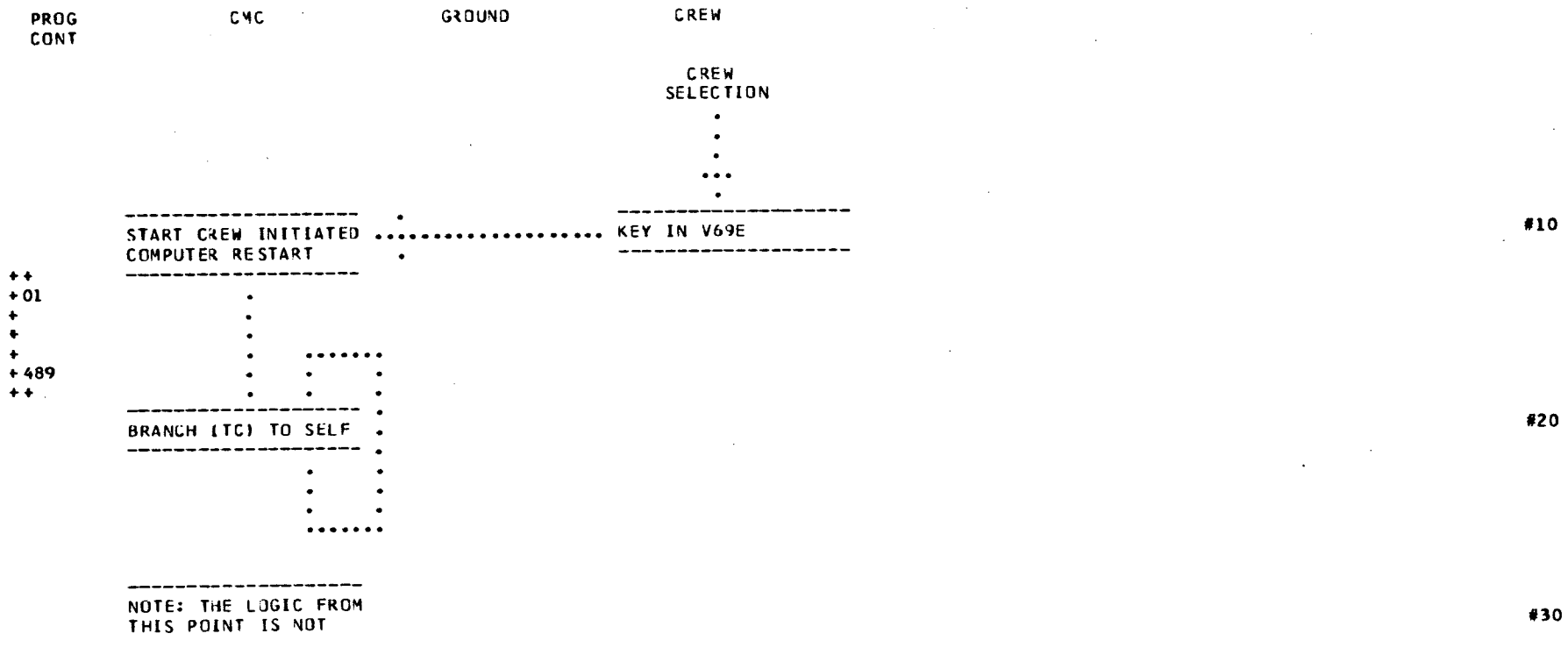
RESTART EXTENDED VERB 69 REV 01 03/20/72

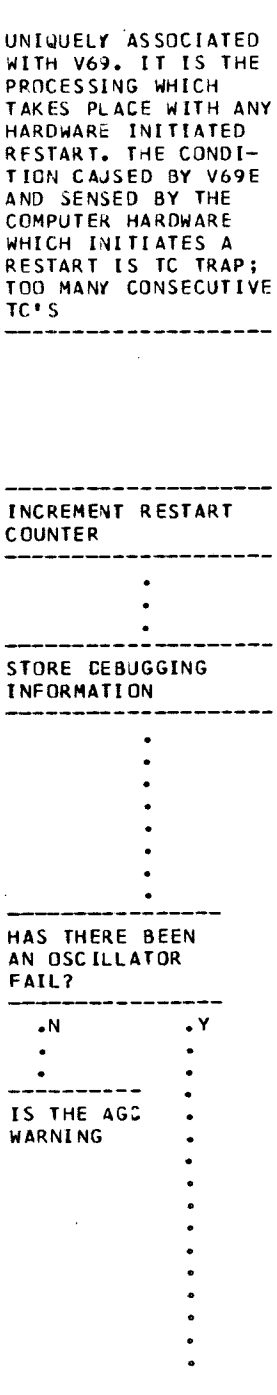
PURPOSE: (1) TO CAUSE A COMPUTER RESTART.

ASSUMPTIONS: (1) THE RESTART IS CREW INITIATED BY DSKY ENTRY.

(2) V69E DOES NOT DIRECTLY SELECT RESTART PROCESSING. IT CAUSES A SITUATION WHICH SATISFIES ONE OF THE CONDITIONS FOR AN AUTOMATIC RESTART, I.E. TOO MANY CONSECUTIVE TC INSTRUCTIONS.

(3) THIS PROCESS MAY BE SELECTED AT ANY TIME.




UNIQUELY ASSOCIATED WITH V69. IT IS THE PROCESSING WHICH TAKES PLACE WITH ANY HARDWARE INITIATED RESTART. THE CONDITION CAUSED BY V69E AND SENSED BY THE COMPUTER HARDWARE WHICH INITIATES A RESTART IS TC TRAP; TOO MANY CONSECUTIVE TC'S
INCREMENT RESTART COUNTER
STORE DEBUGGING INFORMATION
HAS THERE BEEN AN OSCILLATOR FAIL?
N
Y
IS THE AGC WARNING

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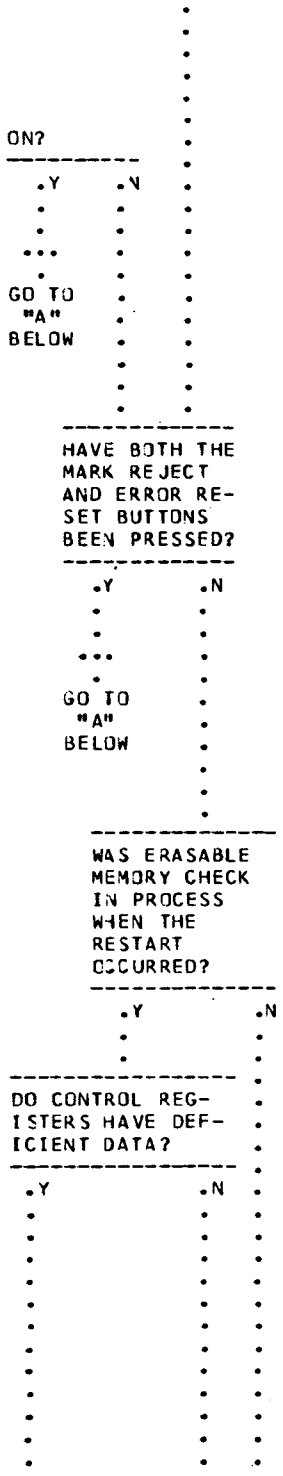

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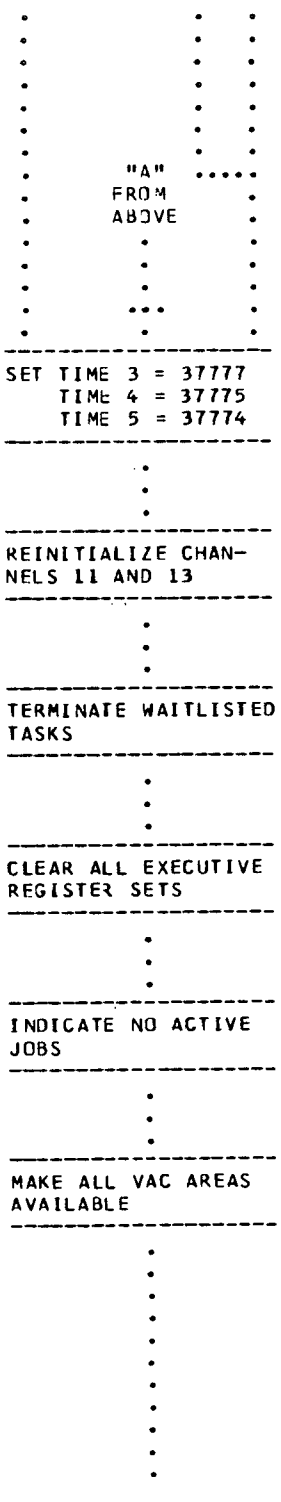

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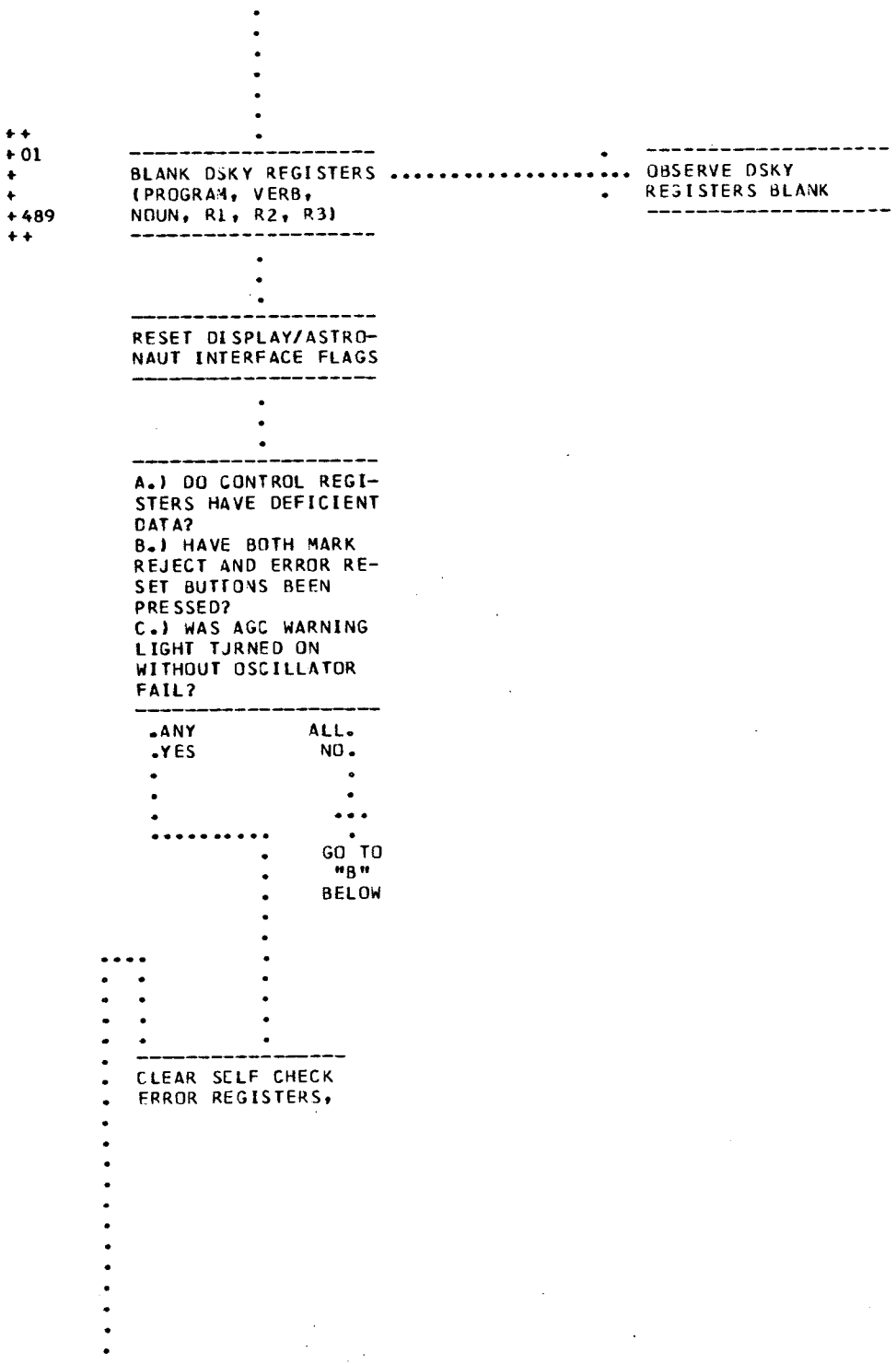

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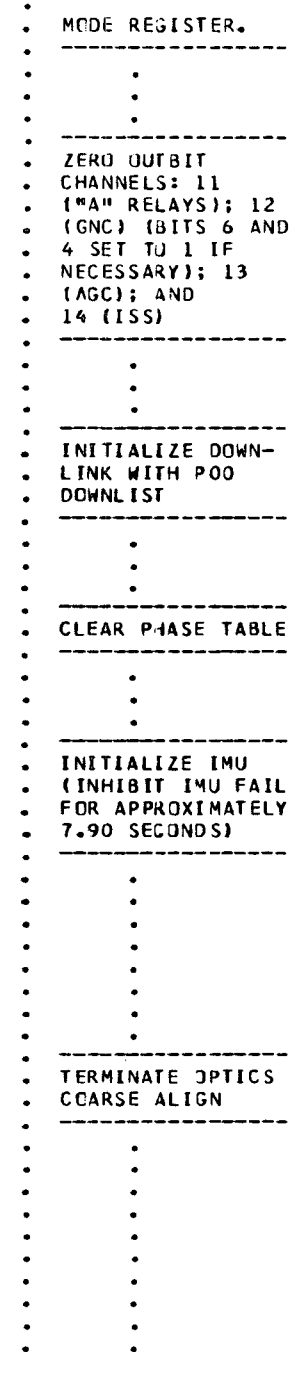

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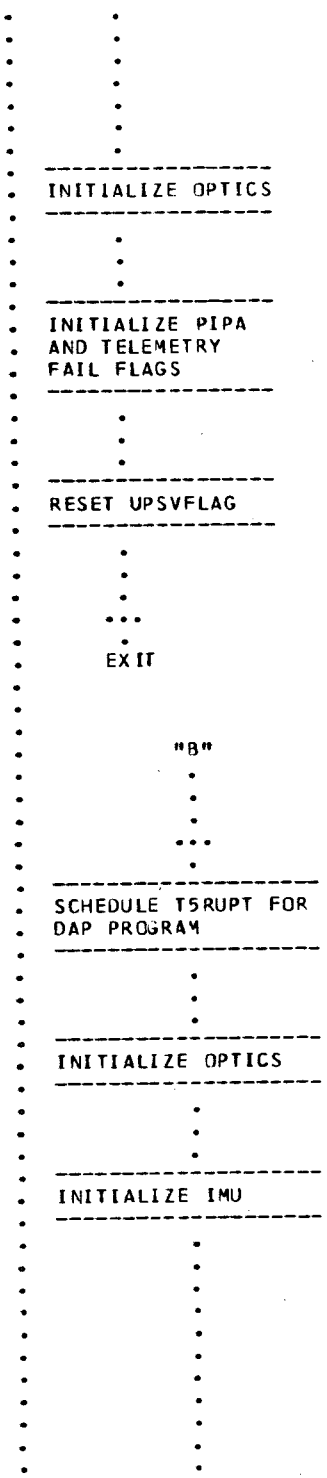

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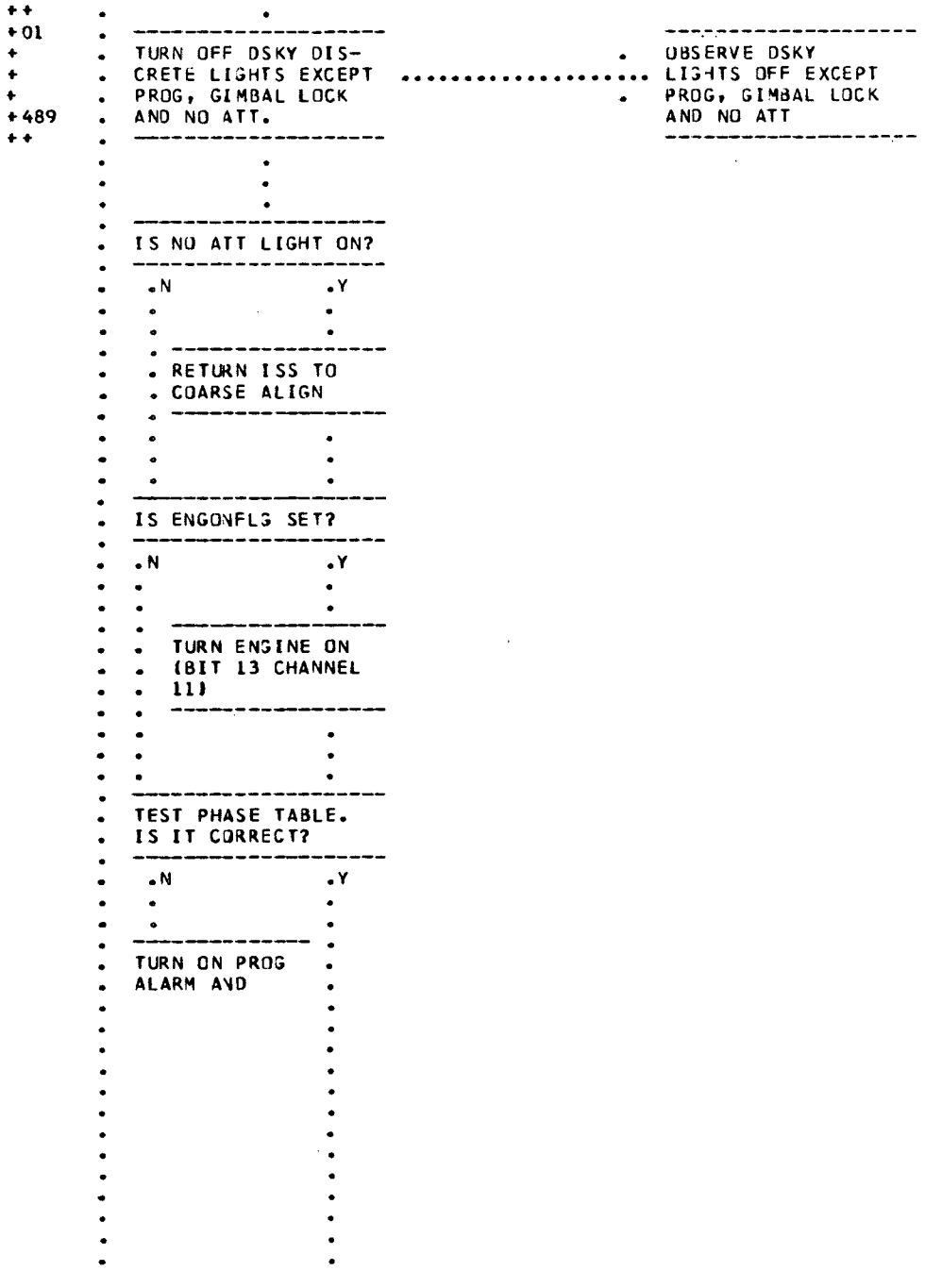

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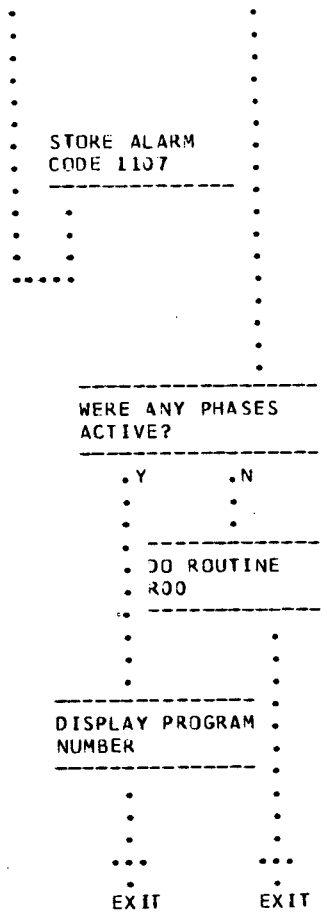

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CHANGE CONTROL NOTES

REV 01 PCN 489

UPDATE LIFTOFF TIME (P27) EXTENDED VERB 70 REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED BY UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC FLOW FOR UPDATING THE LIFTOFF TIME.

CHANGE CONTROL NOTES

UNIVERSAL UPDATE - BLOCK ADR (P27)
EXTENDED VERB 71

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED BY UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC FLOW FOR A BLOCK ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

UNIVERSAL UPDATE - SINGLE ADDRESS (P27)
EXTENDED VERB 72

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED WITH UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC FLOW FOR A SINGLE ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

REV 00 05/19/71

UPDATE CMC TIME (OCTAL) (27)
EXTENDED VERB 73

NOTE: THIS EXTENDED VERB IS USED BY THE UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC FLOW FOR THE OCTAL UPDATE OF CMC TIME.

CHANGE CONTROL VOTES

INITIALIZE ERASABLE DUMP VIA DOWNLINK
EXTENDED VERB 74

REV 00 05/19/71

PURPOSE: (1) TO DUMP ALL EIGHT BANKS OF ERASABLE MEMORY VIA DOWNLINK.

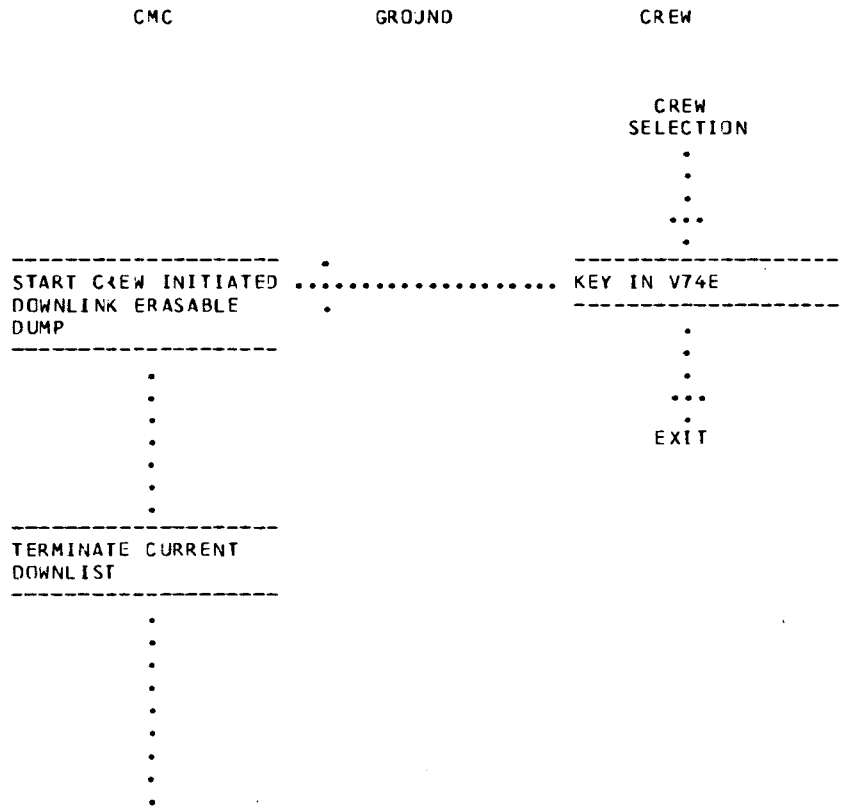
ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE DUMP OF EACH BANK IS PRECEDED BY AN ID WORD, SYNCH BITS, ECADR AND TIME.

(3) THE E BANKS ARE DUMPED IN ORDER, STARTING WITH E BANK ZERO.

(4) DUMPING OF ALL EIGHT BANKS IS REPEATED ONCE (TWO COMPLETE DUMPS) TO FACILITATE SUCCESSFUL GROUND RECORDING.

(5) THE TIME REQUIRED FOR 2 COMPLETE DUMPS IS 41.6 SECONDS (100 WORDS PER SEC BIT RATE).



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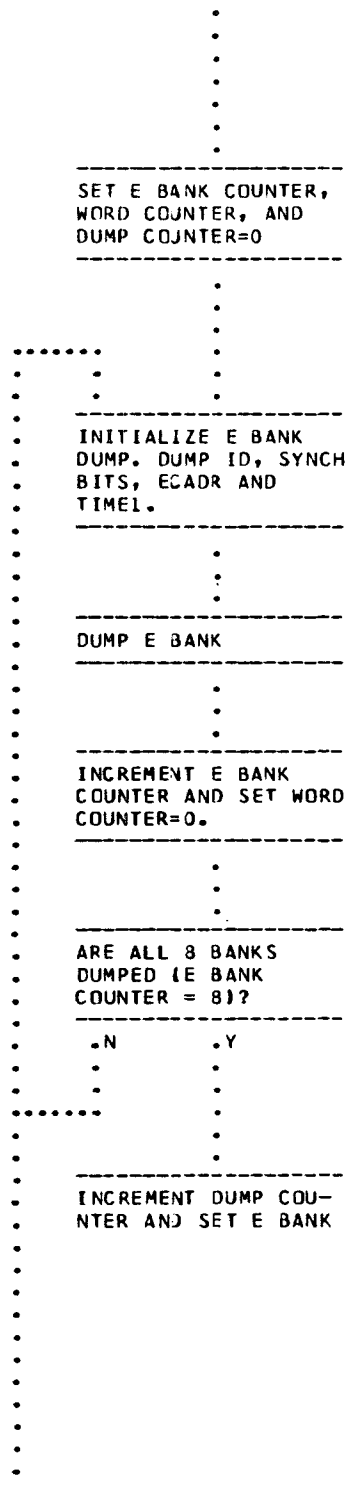
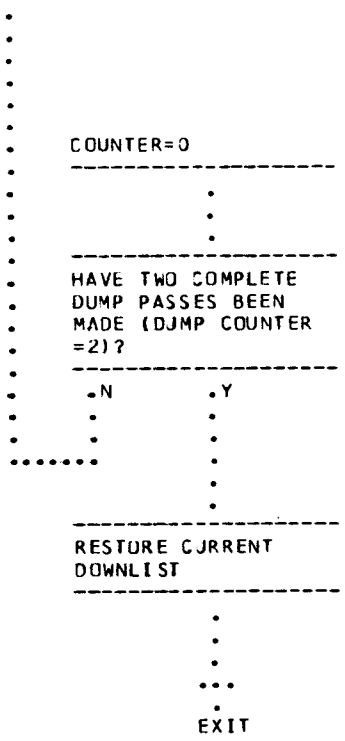

SET E BANK COUNTER, WORD COUNTER, AND DUMP COUNTER=0
#30
INITIALIZE E BANK DUMP. DUMP ID, SYNCH BITS, ECADR AND TIME1.
#40
DUMP E BANK
#50
INCREMENT E BANK COUNTER AND SET WORD COUNTER=0.
#60
ARE ALL 8 BANKS DUMPED (E BANK COUNTER = 8)?
N
Y
#70
INCREMENT DUMP COUNTER AND SET E BANK



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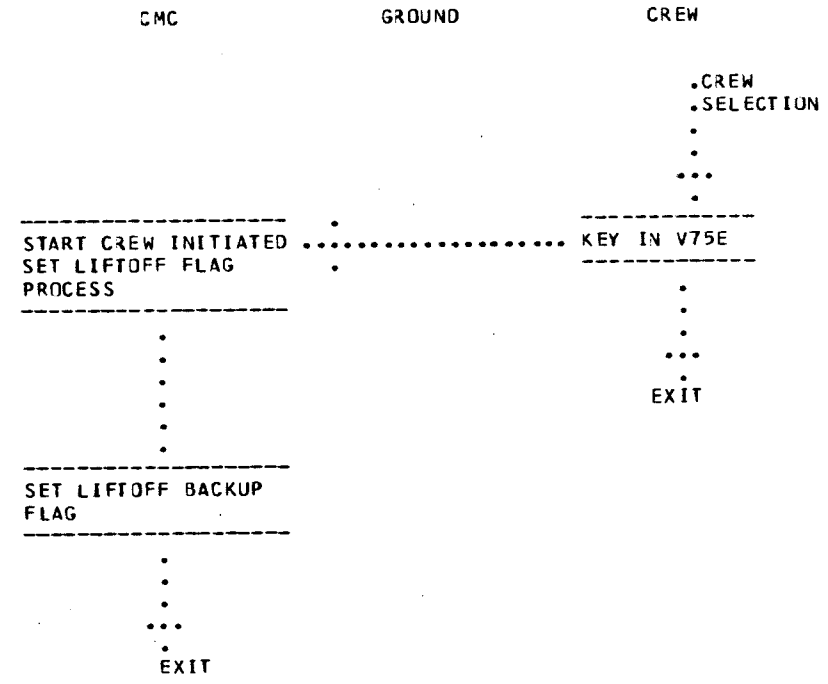
CHANGE CONTROL NOTES

SET LIFTOFF FLAG EXTENDED VERB 75 REV 00 05/19/71

PURPOSE: (1) SET LIFTOFF BACKUP FLAG.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.



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CHANGE CONTROL NOTES

ENABLE RANGE RATE MARK PROCESSING ROUTINE (R27) EXTENDED VERB 76

REV 01 03/20/72

PURPOSE: (1) TO ENABLE THE RANGE RATE MARK PROCESSING ROUTINE R27 TO BE CALLED FROM R22.

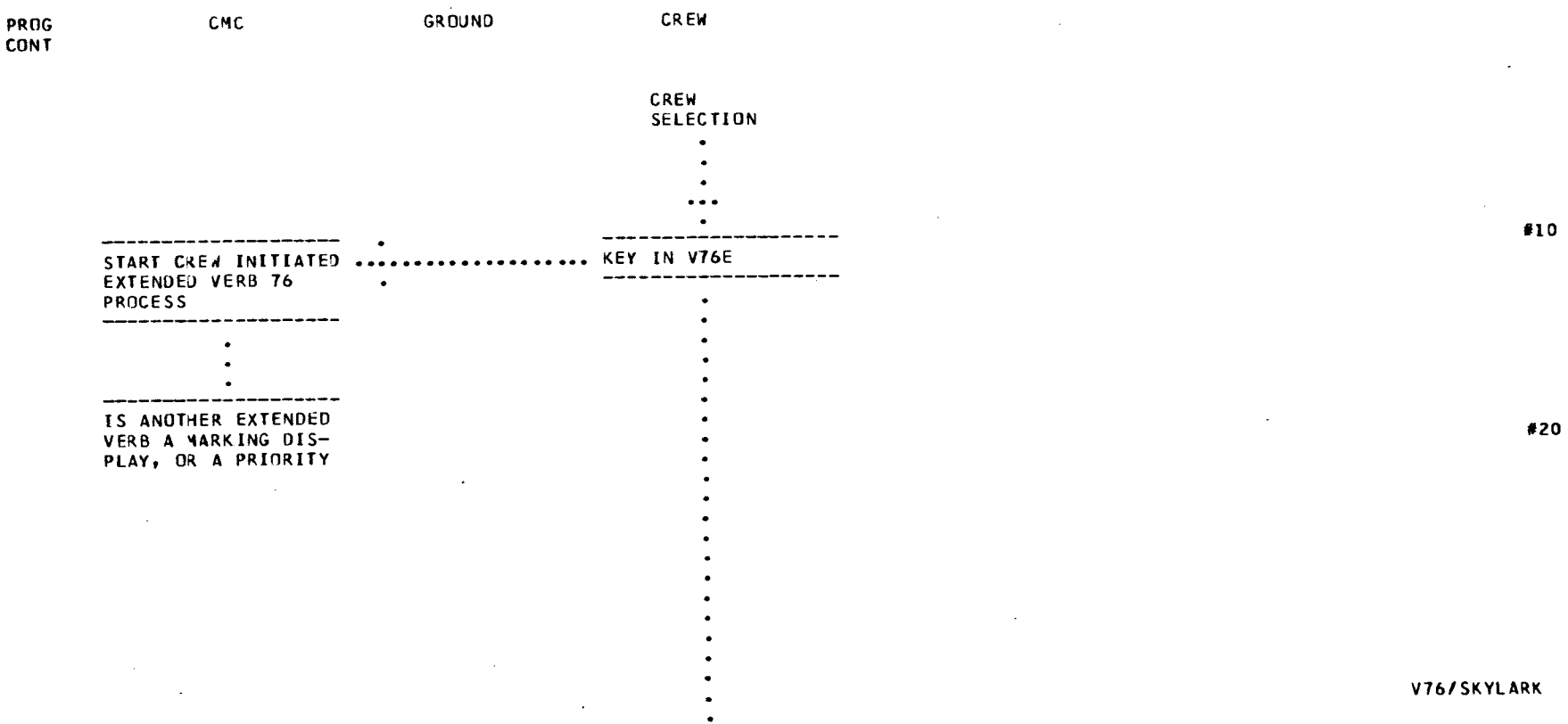
(2) TO ALLOW THE ASTRONAUT TO SELECT A SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.

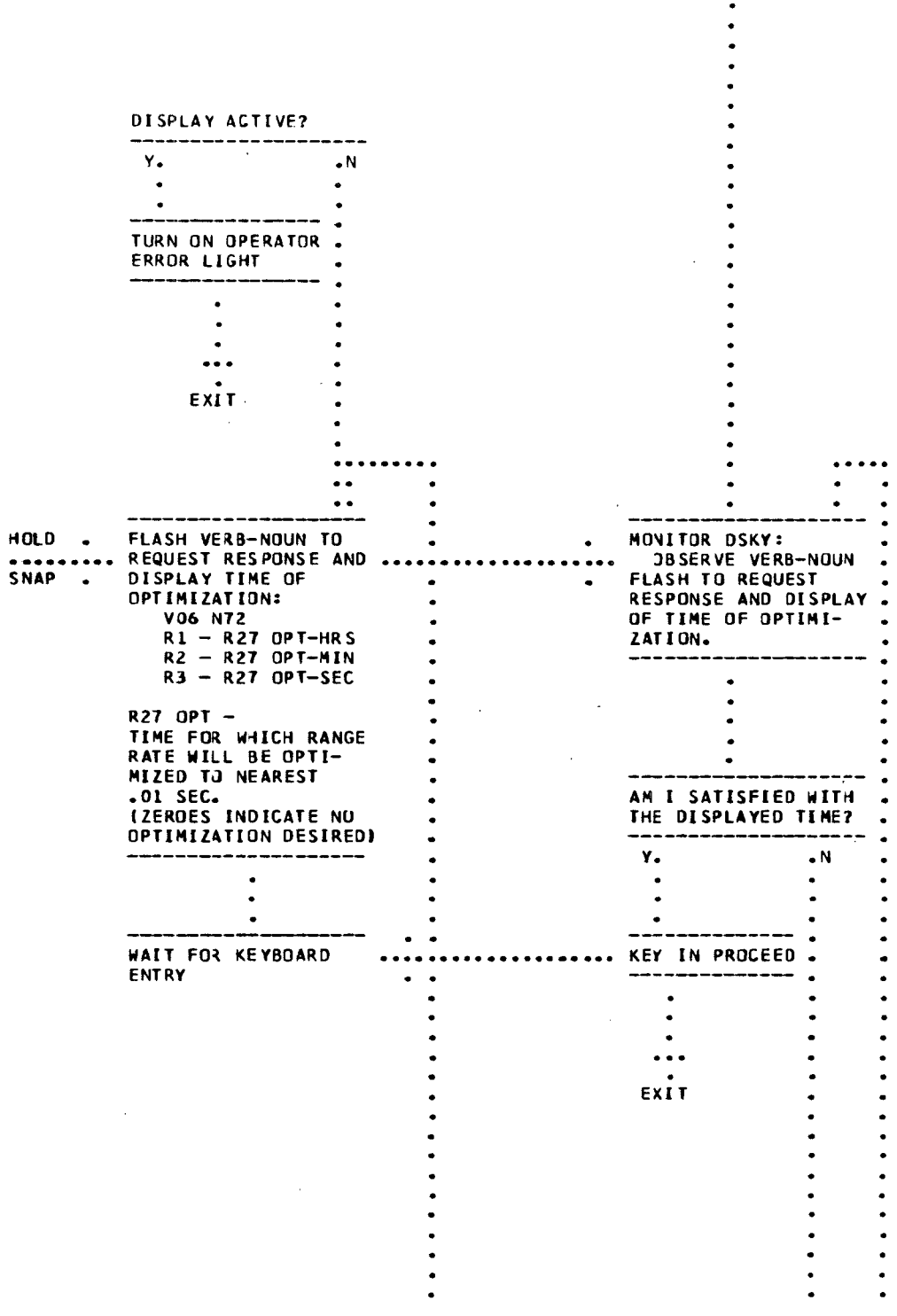
(3) TO PROVIDE A MEANS OF REINITIALIZING THE RANGE RATE FILTER.

ASSUMPTIONS: (1) THE RANGE RATE FILTER WILL REQUIRE APPROXIMATELY 120 SECONDS TO CONVERGE TO THE DESIRED ACCURACY.

(2) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES, BEGINNING WITH THAT TIME (N72) SELECTED BY THE ASTRONAUT.

(3) THIS PROCESS MAY BE CREW SELECTED BY DSKY ENTRY AT ANY TIME PRIOR TO FIRST USE OF R27 DURING P20. IT IS NOT NECESSARY TO SELECT V76E AGAIN DURING THE RENDEZVOUS UNLESS R27 HAS BEEN DISABLED VIA V77E.




DISPLAY ACTIVE?
Y.
.N
TURN ON OPERATOR ERROR LIGHT
EXIT
HOLD SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY TIME OF OPTIMIZATION:
V06 N72
R1 - R27 OPT-HRS
R2 - R27 OPT-MIN
R3 - R27 OPT-SEC
R27 OPT - TIME FOR WHICH RANGE RATE WILL BE OPTIMIZED TO NEAREST .01 SEC. (ZEROES INDICATE NO OPTIMIZATION DESIRED)
WAIT FOR KEYBOARD ENTRY
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIME OF OPTIMIZATION.
AM I SATISFIED WITH THE DISPLAYED TIME?
Y.
.N
KEY IN PROCEED
EXIT

#30

#40

#50

#60

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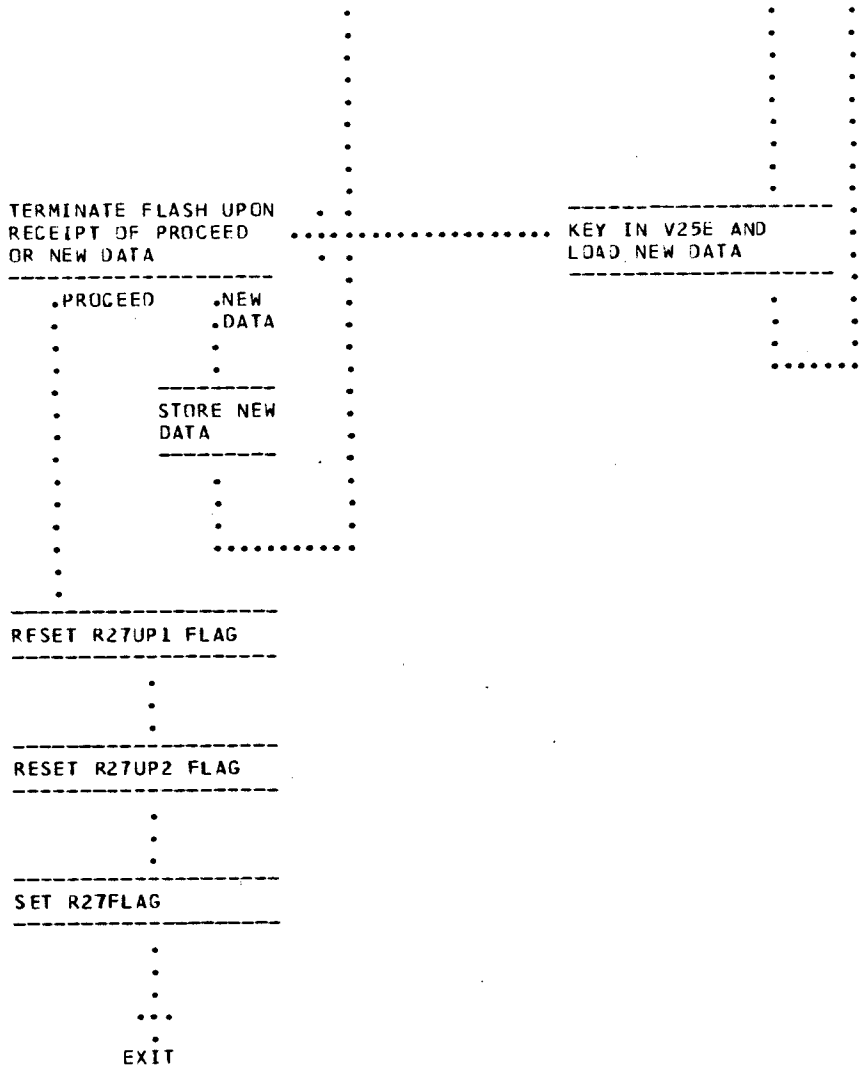

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CHANGE CONTROL NOTES

REV 00 PCR 439
REV 01 PCR 459

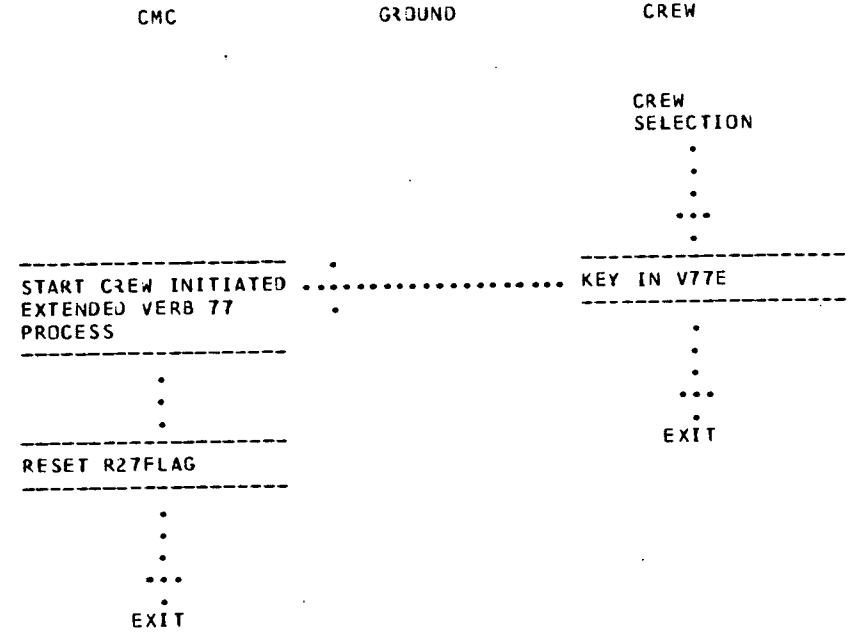
DISABLE VHF RANGE RATE MARK PROCESSING ROUTINE (R27) EXTENDED VERB 77

REV 00 05/19/71

PURPOSE: (1) TO TERMINATE OPERATION OF THE RANGE RATE MARK PROCESSING ROUTINE R27 IN R22.

ASSUMPTIONS: (1) R27 MAY ONLY BE CALLED AGAIN FROM R22 VIA V76E, WHICH WILL REINITIALIZE R27.

(2) THIS PROCESS MAY BE CREW SELECTED BY DSKY ENTRY AT ANY TIME.



CHANGE CONTROL NOTES

REV 00 PCR 439

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CHANGE GYRO COMPASS LAUNCH AZIMUTH
EXTENDED VERB 78

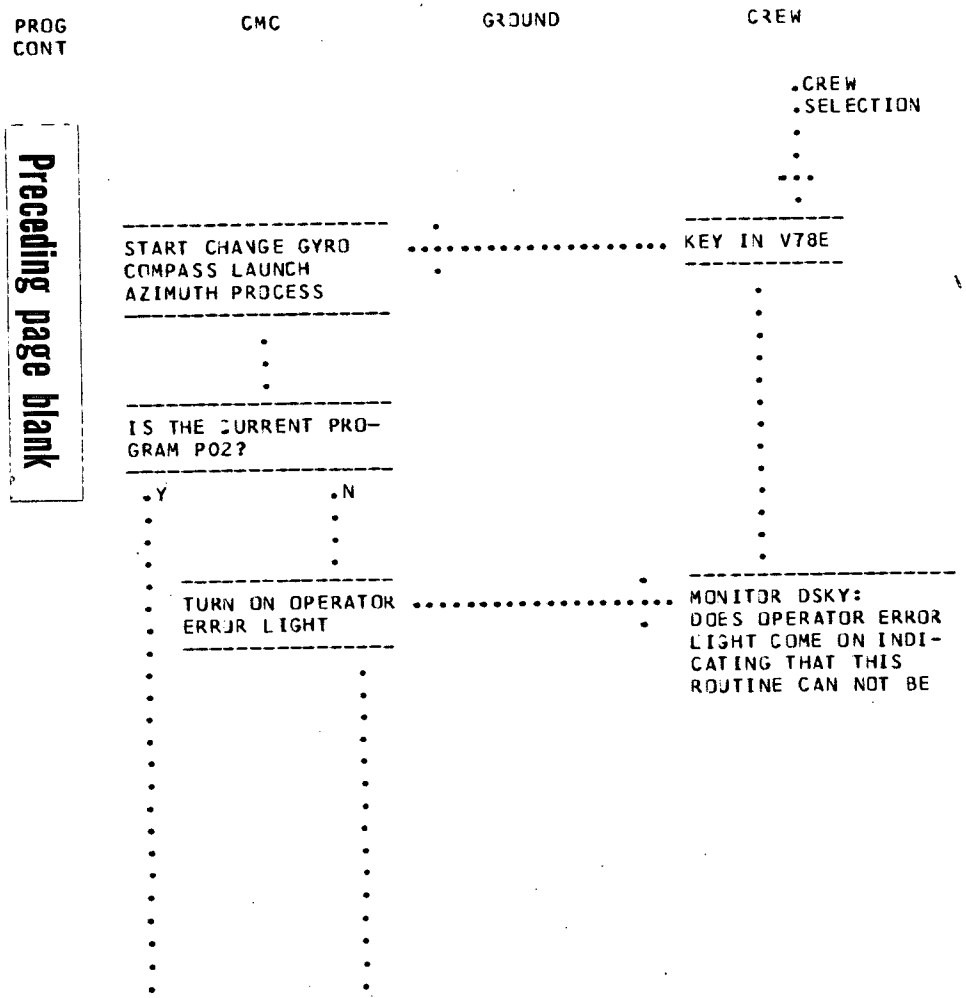
REV 00 05/19/71

PURPOSE: (1) TO PROVIDE THE PROPER STABLE MEMBER ORIENTATION FOR LAUNCH.

ASSUMPTIONS: (1) THE PROCESS HAS THE CAPABILITY TO CHANGE THE LAUNCH AZIMUTH OF THE STABLE MEMBER WHILE GYRO COMPASSING (P02)

(2) PROCESS IS CREW SELECTED BY DSKY ENTRY.

(3) THE PROCESS MAY BE SELECTED ONLY DURING GYRO COMPASSING PROGRAM (P02).



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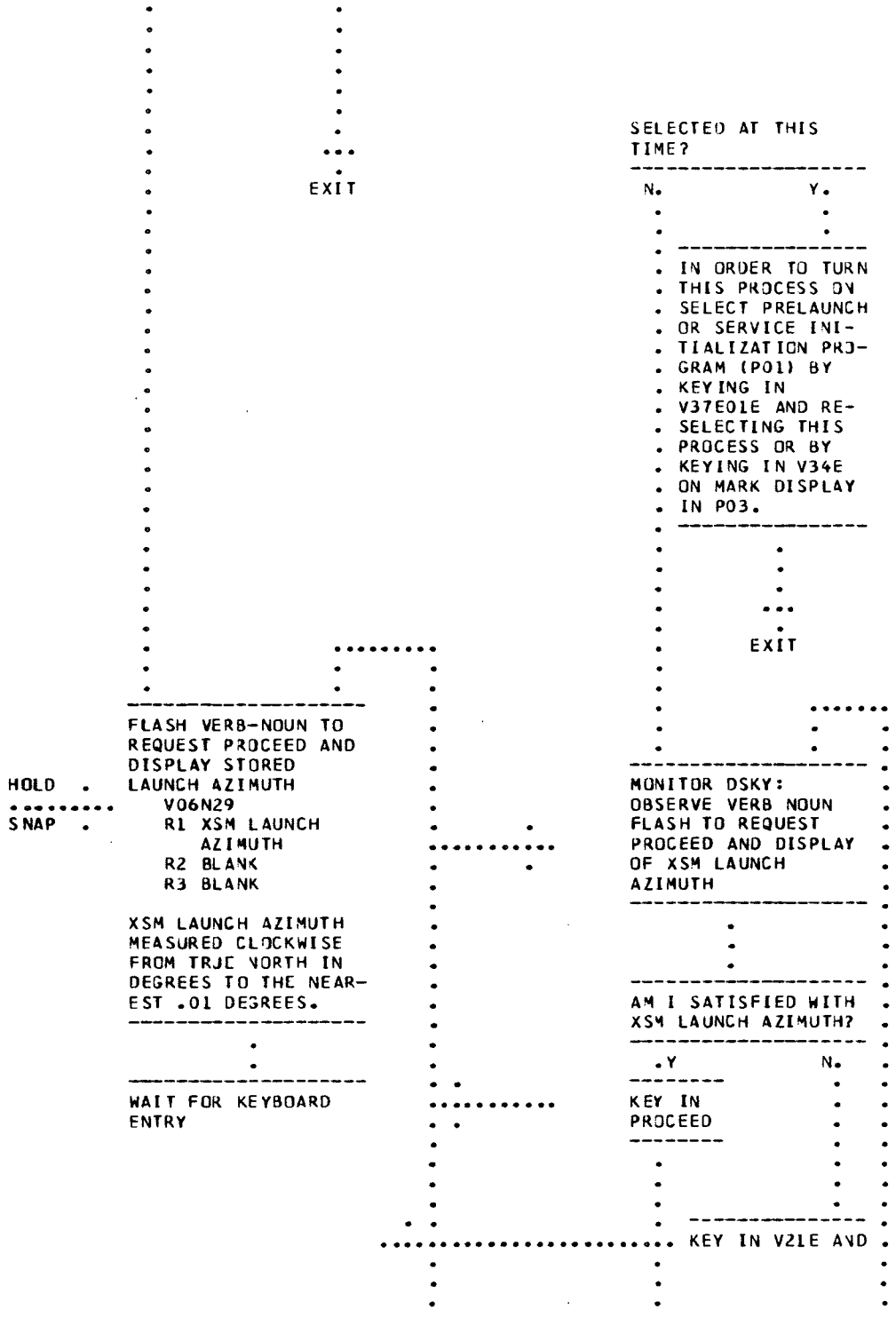

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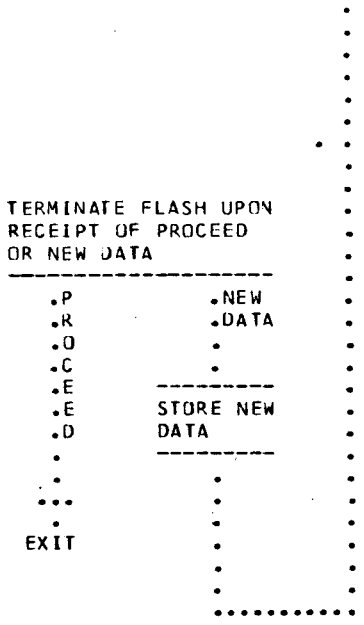

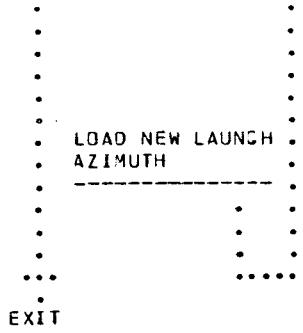

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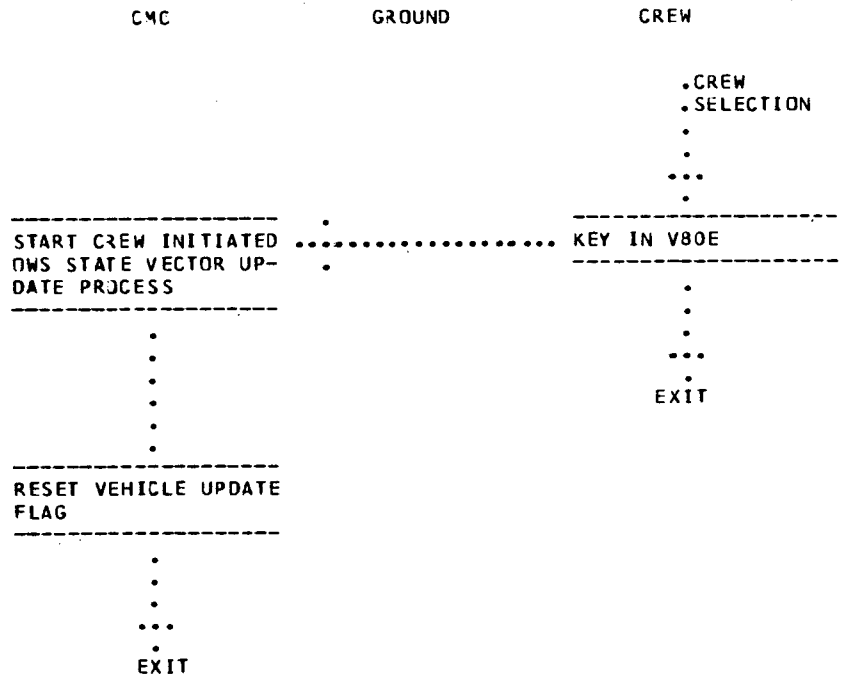
CHANGE CONTROL NOTES

UPDATE OWS STATE VECTOR EXTENDED VERB 80 REV 00 05/19/71

PURPOSE: (1) TO CAUSE THE RENDEZVOUS DATA PROCESSING RESULTS TO UPDATE THE OWS STATE VECTOR.

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.



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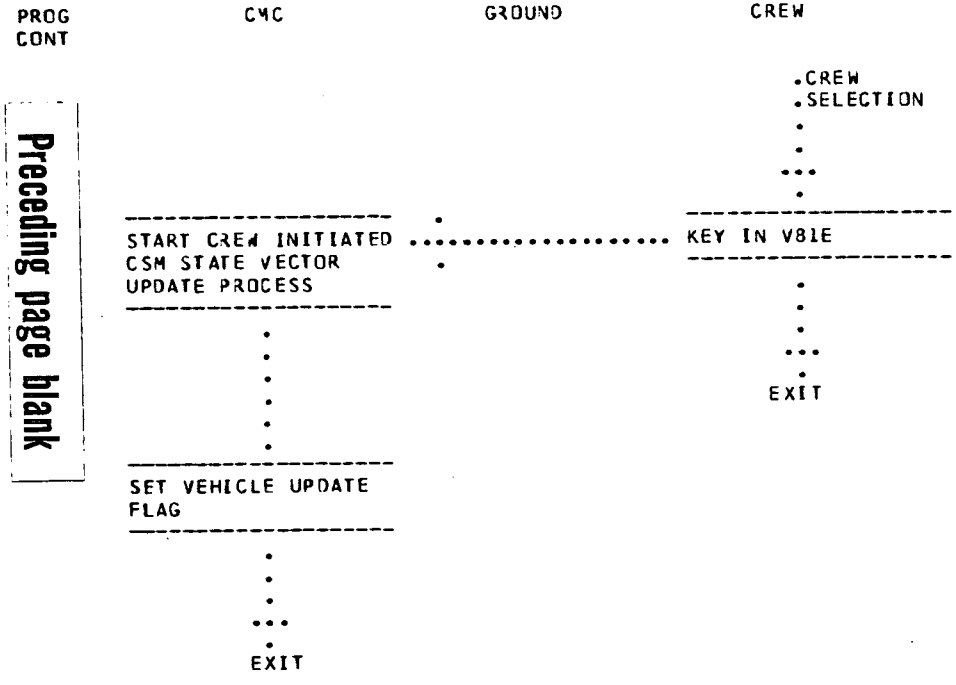
CHANGE CONTROL NOTES

UPDATE CSM STATE VECTOR EXTENDED VER3 81 REV 00 05/19/71

PURPOSE: (1) TO CAUSE THE RENDEZVOUS DATA PROCESSING RESULTS TO UPDATE THE CSM STATE VECTOR.

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.



CHANGE CONTROL NOTES

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REQUEST ORBITAL PARAMETERS DISPLAY (R30)
EXTENDED VERB 82

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 30. SEE R30 FOR THE SPECIFICATION LOGIC FLOW FOR REQUESTING ORBITAL PARAMETERS DISPLAY.

CHANGE CONTROL NOTES

REQUEST RENDEZVOUS PARAMETER
DISPLAY #1 (R31) EXTENDED VERB 83

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 31. SEE R31 FOR THE SPECIFICATION LOGIC FLOW FOR REQUESTING RENDEZVOUS PARAMETER DISPLAY #1

CHANGE CONTROL NOTES

REQUEST RENDEZVOUS PARAMETER
DISPLAY #2 (R34) EXTENDED VERB 85

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 34. SEE R34 FOR THE SPECIFICATION LOGIC FLOW FOR REQUESTING RENDEZVOUS PARAMETER DISPLAY #2.

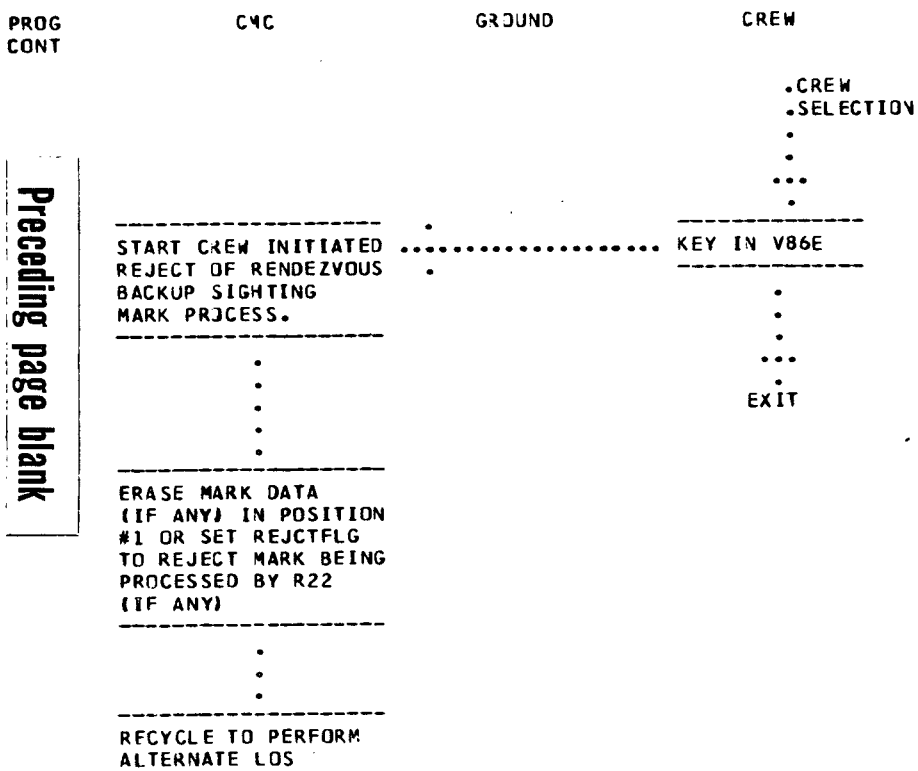
CHANGE CONTROL NOTES

REJECT RENDEZVOUS BACKUP SIGHTING MARK EXTENDED VERB 86

REV 00 05/19/71

PURPOSE: (1) IN THE EVENT OF AN UNSATISFACTORY SIGHTING MARK TAKEN DURING THE RENDEZVOUS BACKUP SIGHTING MARK ROUTINE (R23), V86E MAY BE USED TO ERASE THE MARK DATA (IF ANY) IN POSITION 1.

ASSUMPTIONS: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.



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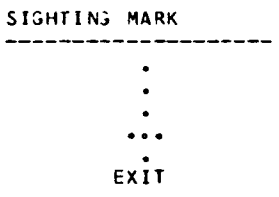

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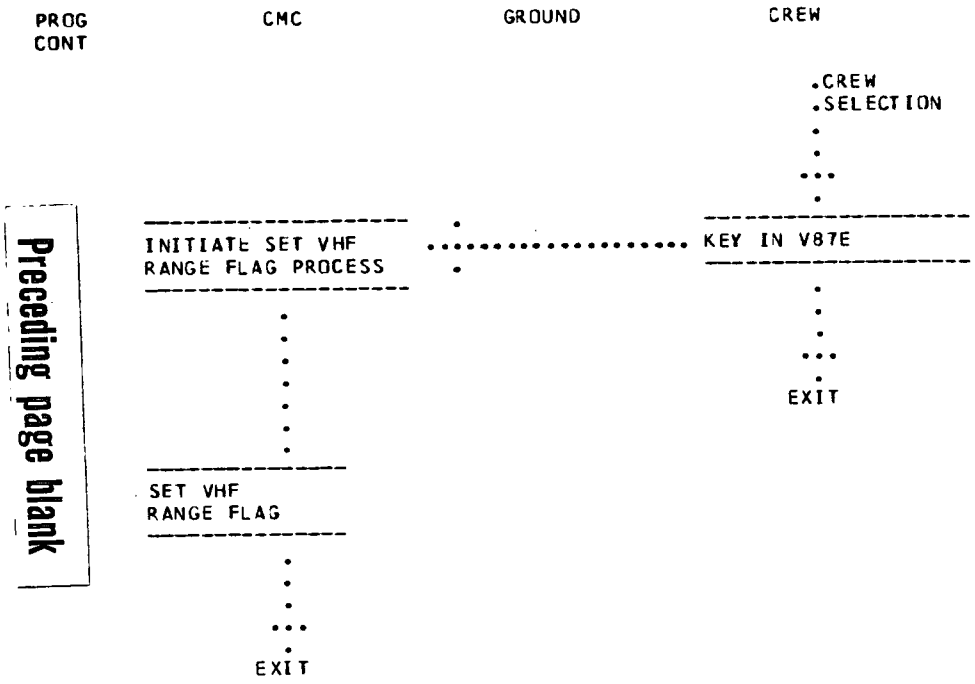
CHANGE CONTROL NOTES

REV 00 PCN 457

SET VHF RANGE FLAG EXTENDED VERB 87 REV 00 05/19/71

PURPOSE: (1) TO SET THE VHF RANGE FLAG

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY



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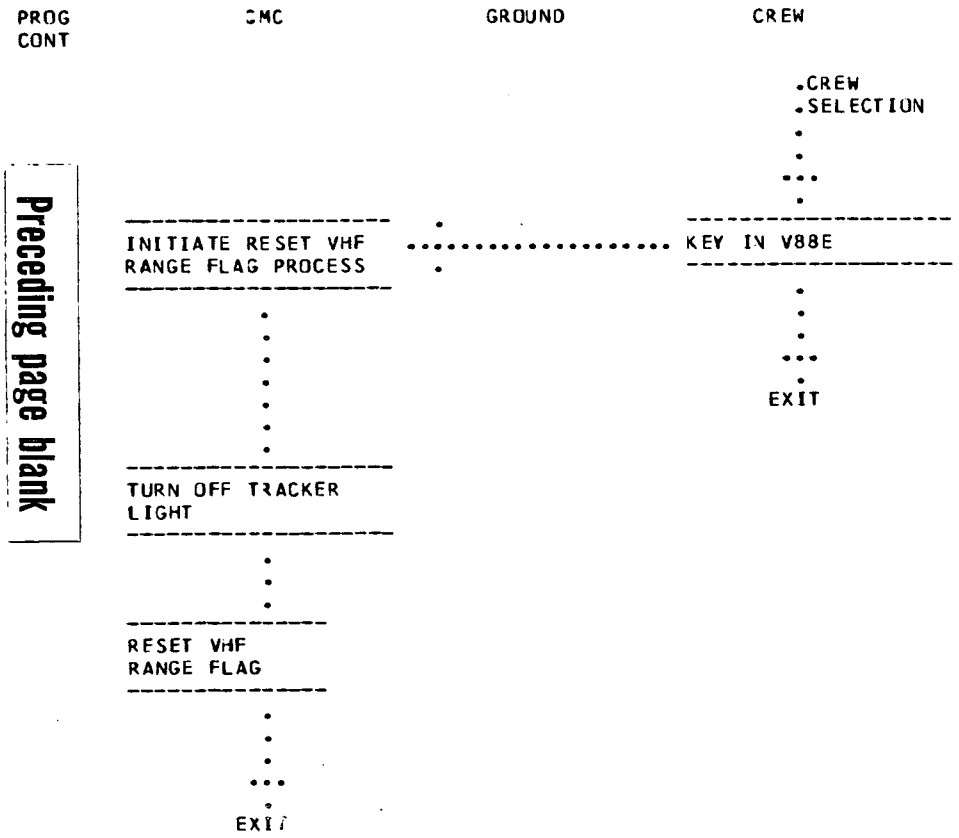
CHANGE CONTROL NOTES

RESET VHF RANGE FLAG EXTENDED VERB 88 REV 00 05/19/71

PURPOSE: (1) TO RESET THE VHF RANGE FLAG.

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.



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CHANGE CONTROL NOTES

START RENDEZVOUS FINAL ATTITUDE (R63) REV 00 05/19/71
EXTENDED VERB 89

NOTE: THIS EXTENDED VERB CALLS ROUTINE 63. SEE R63 FOR THE SPECIFICATION LOGIC FLOW TO START RENDEZVOUS FINAL ATTITUDE MANEUVER.

CHANGE CONTROL NOTES

REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY (R36)
EXTENDED VERB 90

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 36. SEE R36 FOR THE SPECIFICATION LOGIC FLOW OF THE REQUEST FOR RENDEZVOUS OUT-OF-PLANE DISPLAY.

CHANGE CONTROL NOTES

REQUEST BANKSUM DISPLAY
EXTENDED VERB 91

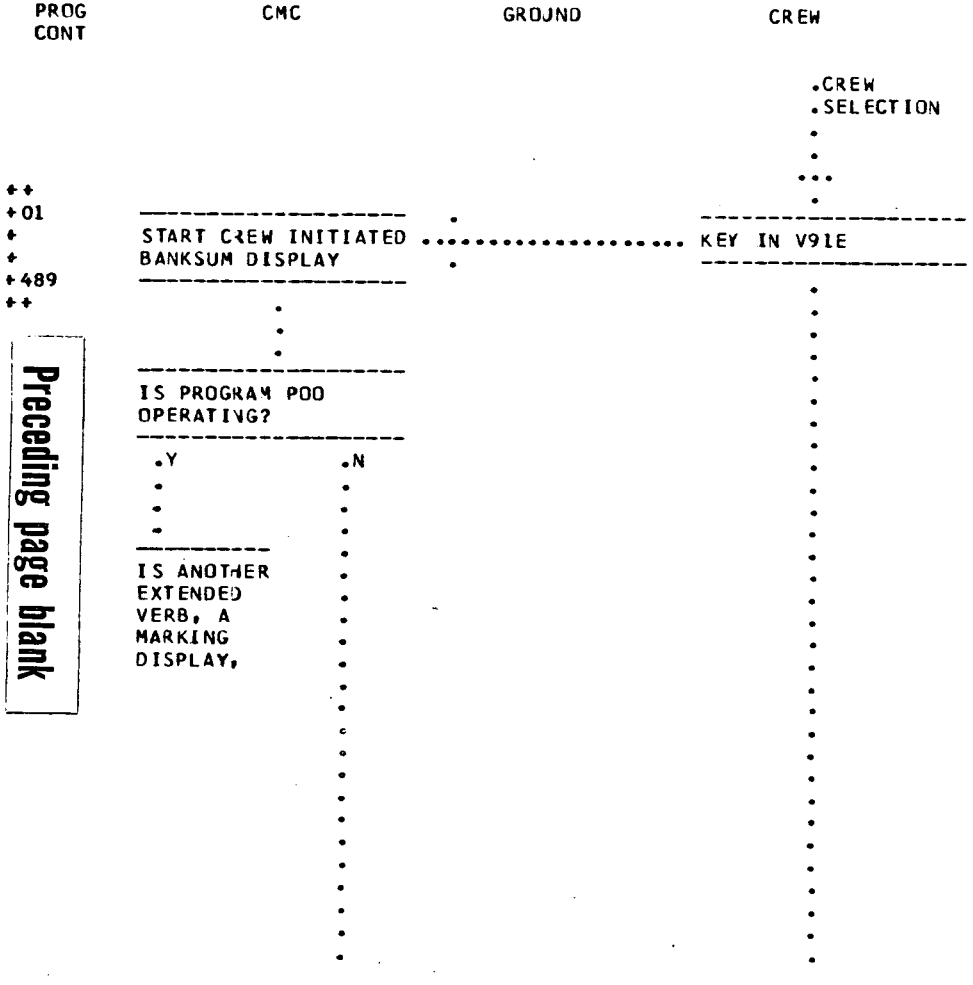
REV 01 03/20/72

PURPOSE: (1) DISPLAY THE SUM OF EACH BANK FOR COMPARISON.

ASSUMPTIONS: (1) POO IS OPERATING.

(2) NO OTHER EXTENDED VERB IS ACTIVE.

(3) PROCESS IS CREW SELECTED BY DSKY ENTRY



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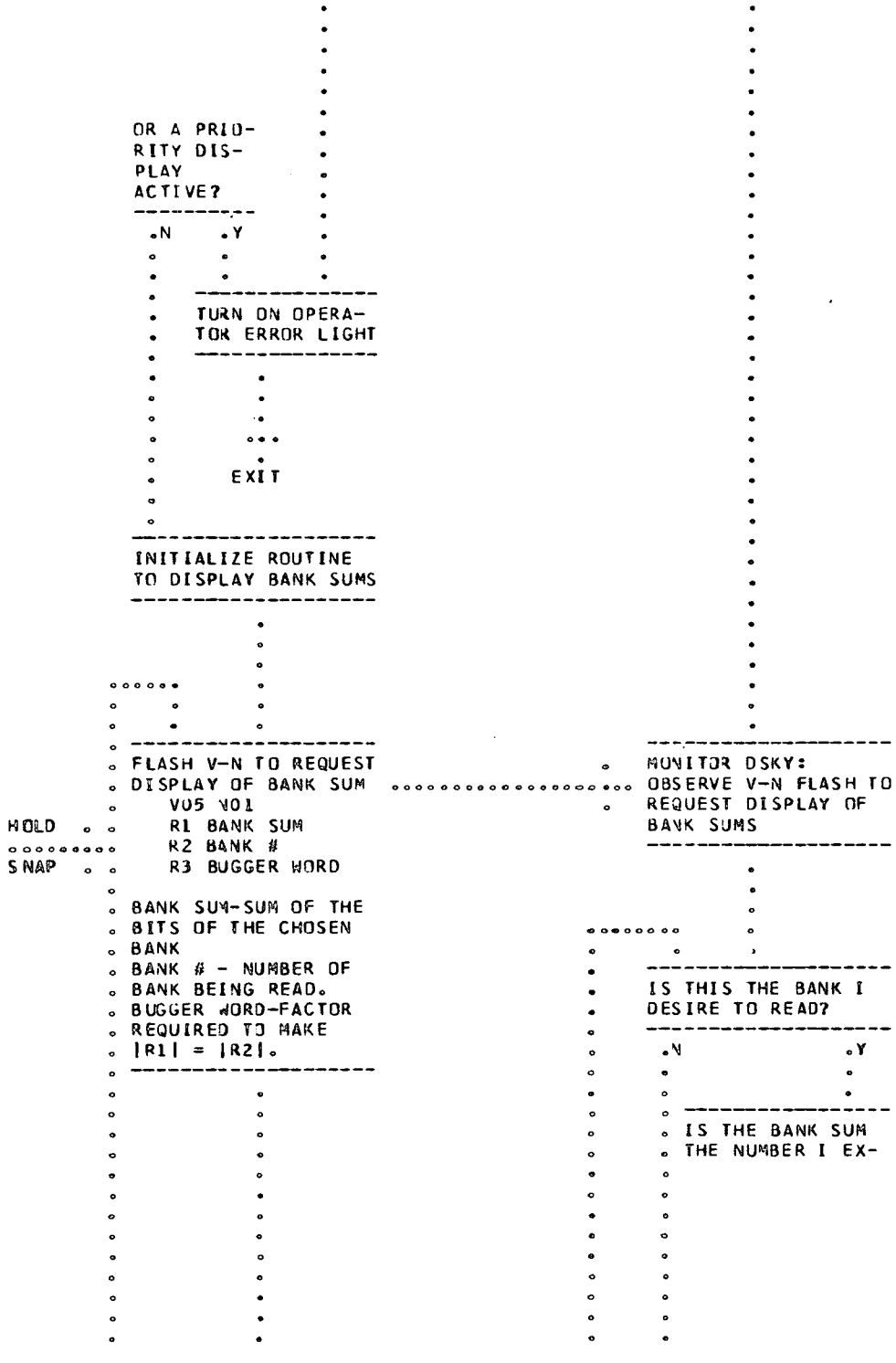
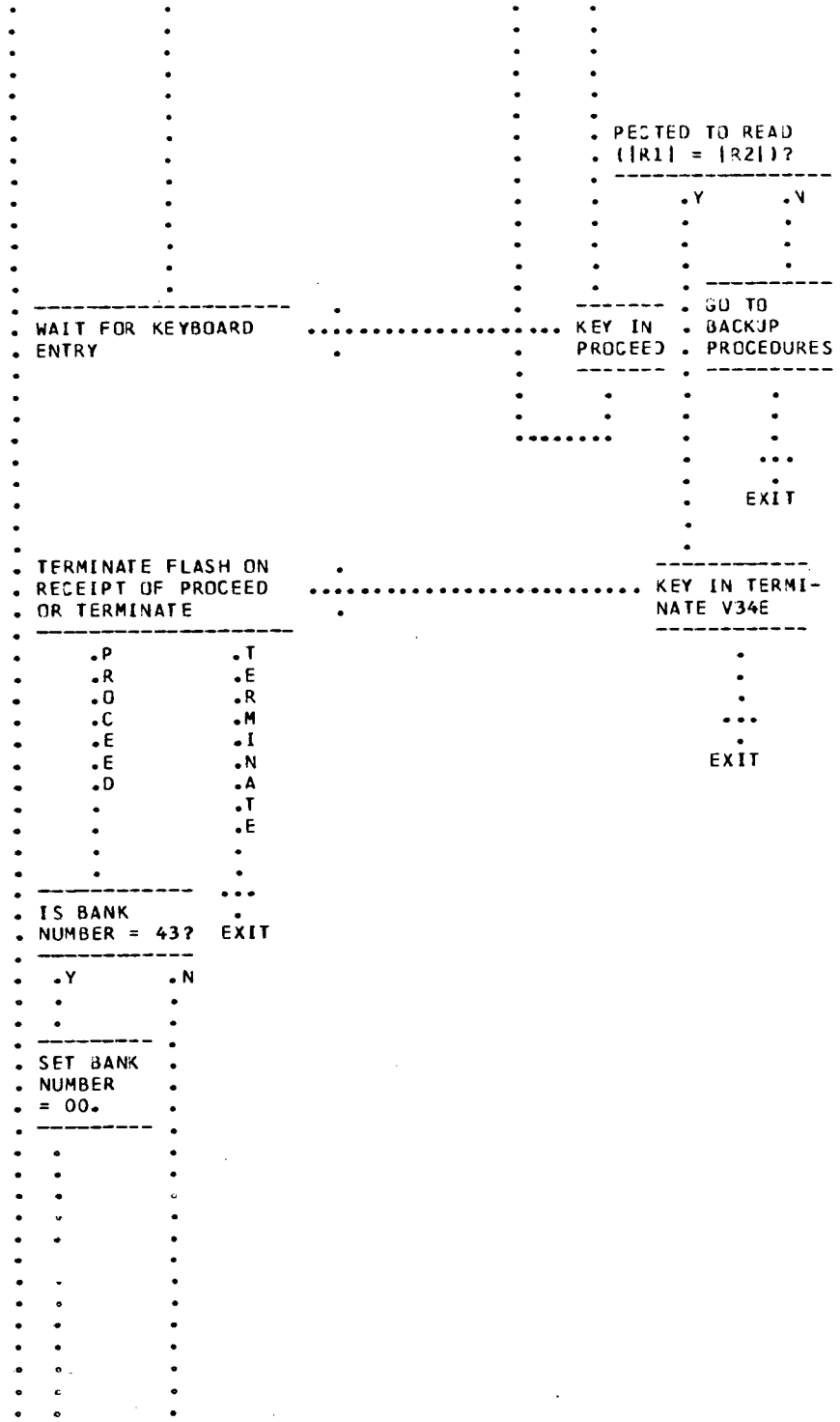

OR A PRIO-
RITY DIS-
PLAY
ACTIVE?
N
Y
TURN ON OPERA-
TOR ERROR LIGHT
EXIT
INITIALIZE ROUTINE
TO DISPLAY BANK SUMS
FLASH V-N TO REQUEST
DISPLAY OF BANK SUM
V05 N01
R1 BANK SUM
R2 BANK #
R3 BUGGER WORD
HOLD
SNAP
BANK SUM-SUM OF THE
BITS OF THE CHOSEN
BANK
BANK # - NUMBER OF
BANK BEING READ.
BUGGER WORD-FACTOR
REQUIRED TO MAKE
|R1| = |R2|.
MONITOR DSKY:
OBSERVE V-N FLASH TO
REQUEST DISPLAY OF
BANK SUMS
IS THIS THE BANK I
DESIRE TO READ?
N
Y
IS THE BANK SUM
THE NUMBER I EX-



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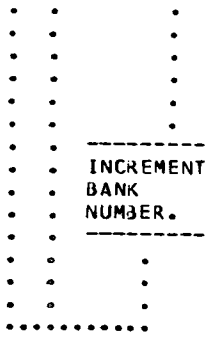

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CHANGE CONTROL NOTES

REV 01 PCN 489

ENABLE W-MATRIX INITIALIZATION EXTENDED VERB 93

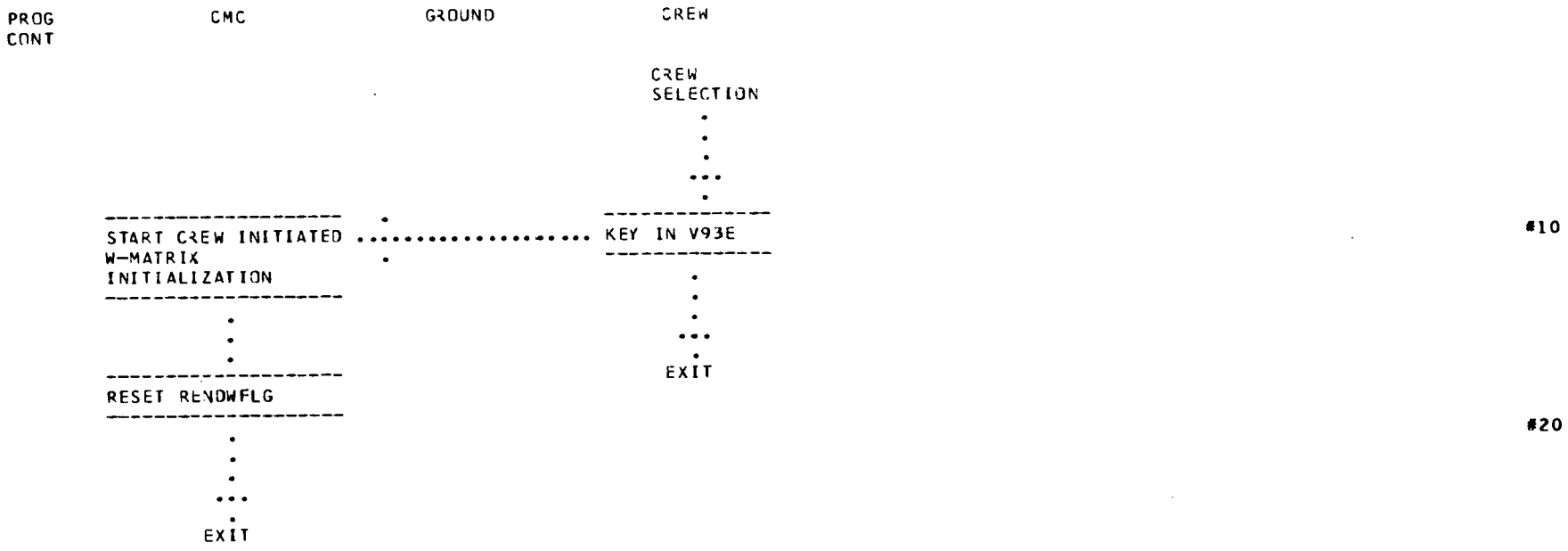
REV 00 05/19/71

PURPOSE: (1) TO REQUEST REINITIALIZATION OF THE W-MATRIX.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS RESETS THE RENDWFLG INDICATING THAT THE W-MATRIX IS NOT VALID AND MUST BE REINITIALIZED BEFORE BEING USED. THE RENDWFLG IS AUTOMATICALLY SET FOLLOWING W-MATRIX INITIALIZATION OR REINITIALIZATION.

(3) THIS PROCESS MAY BE SELECTED AT ANY TIME.



CHANGE CONTROL NOTES

REV 00 PCR 017,019

TERMINATE INTEGRATION AND GO TO P00
EXTENDED VERB 96

REV 01 03/20/72

PURPOSE: (1) TO PROVIDE A MEANS OF SUSPENDING STATE VECTOR INTEGRATION.

ASSUMPTIONS: (1) IF THE COASTING INTEGRATION ROUTINE IS IN OPERATION, IT IS TERMINATED AT THE END OF THE CURRENT TIME STEP.

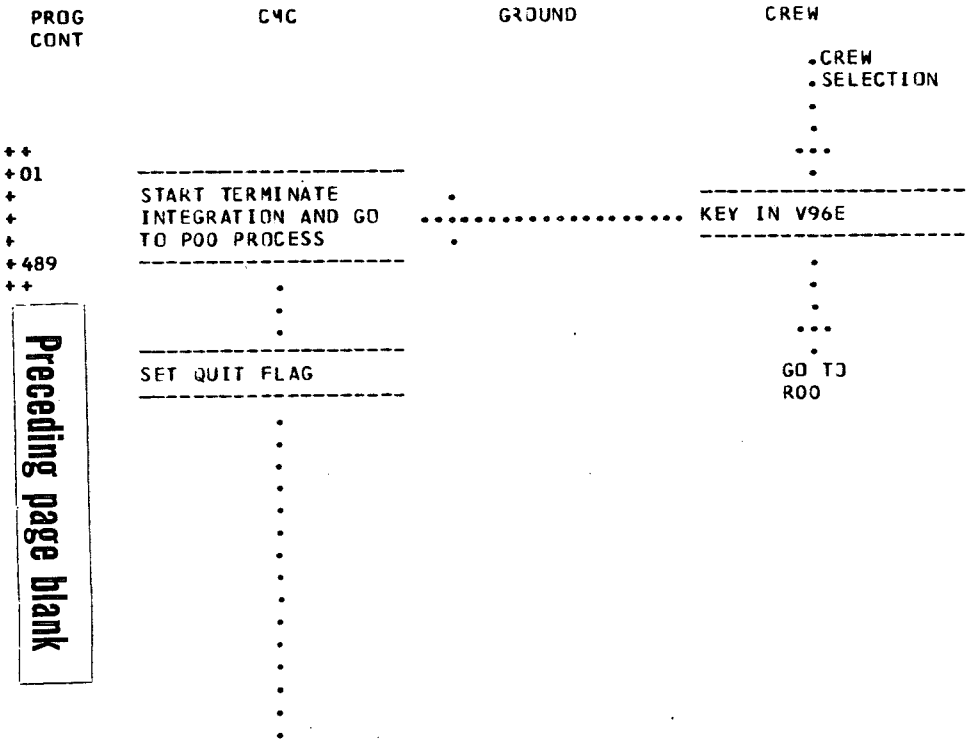
(2) THE CURRENT PROGRAM IS TERMINATED

(3) THE CMC IDLING PROGRAM IS ACTIVATED.

(4) NO STATE VECTOR INTEGRATION OCCURS UNTIL THE RESELECTION OF ANY PROGRAM OR EXTENDED VERB. NO P00 INTEGRATION OCCURS UNTIL THE RESELECTION OF P00.

(5) THIS ROUTINE DOES NOT MAINTAIN STATE VECTOR OR W-MATRIX SYNCHRONIZATION.

(6) RESELECTION OF A NEW PROGRAM WILL REINITIALIZE THE NORMAL TIMING OF STATE VECTOR INTEGRATION.



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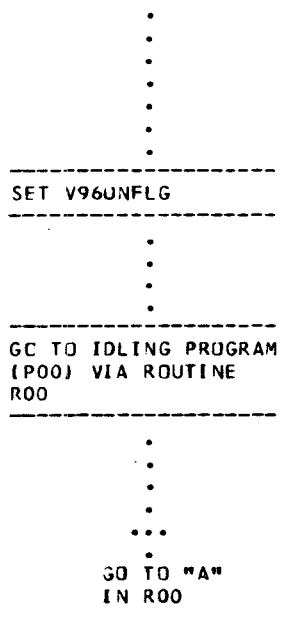

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CHANGE CONTROL NOTES

REV 01 PCN 489

THRUST FAIL DISPLAY EXTENDED VERB 97 REV 00 05/19/71

NOTE: EXTENDED VERB 97 IS USED IN THE SPS THRUST FAIL ROUTINE R40. SEE R40 FOR THE SPECIFICATION LOGIC FLOW FOR DISPLAY OF THRUST FAIL.

THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

CHANGE CONTROL NOTES

ENABLE ENGINE IGNITION EXTENDED VERB 99

REV 00 05/19/71

NOTE: EXTENDED VERB 99 IS USED IN THE SPS PROGRAM P40. SEE P40 FOR THE SPECIFICATION LOGIC FLOW TO ENABLE ENGINE IGNITION.

THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

CHANGE CONTROL NOTES

4.5 THIS LIST REPRESENTS THE VERBS USED IN PROGRAM SKYLARK REV 01 03/20/72

4.5.1 REGULAR VERBS PCR/PCN

00 NOT IN USE
01 DISPLAY OCTAL COMP 1 IN R1
02 DISPLAY OCTAL COMP 2 IN R1
03 DISPLAY OCTAL COMP 3 IN R1
04 DISPLAY OCTAL COMP 1,2 IN R1,R2
05 DISPLAY OCTAL COMP 1,2,3 IN R1,R2,R3
06 DISPLAY DECIMAL IN R1 OR R1,R2 OR R1,R2,R3
07 DISPLAY DP DECIMAL IN R1,R2
08 SPARE
09 SPARE
10 SPARE
11 MONITOR OCTAL COMP 1 IN R1
12 MONITOR OCTAL COMP 2 IN R1
13 MONITOR OCTAL COMP 3 IN R1
14 MONITOR OCTAL COMP 1,2 IN R1,R2
15 MONITOR OCTAL COMP 1,2,3 IN R1,R2,R3
16 MONITOR DECIMAL IN R1 OR R1,R2 OR R1,R2,R3
17 MONITOR DP DECIMAL IN R1,R2
18 SPARE
19 SPARE
20 SPARE
21 LOAD COMPONENT 1 INTO R1
22 LOAD COMPONENT 2 INTO R2
23 LOAD COMPONENT 3 INTO R3

24 LOAD COMPONENT 1,2 INTO R1,R2

25 LOAD COMPONENT 1,2,3 INTO R1,R2,R3

26 SPARE

27 DISPLAY FIXED MEMORY

28 SPARE

29 SPARE

30 REQUEST EXECUTIVE

31 REQUEST WAITLIST

32 RECYCLE

33 PROCEED

34 TERMINATE

35 TEST DSKY LIGHTS

36 REQUEST FRESH START

37 CHANGE PROGRAM

38 SPARE

39 SPARE

4.5.2 EXTENDED VERBS

40 ZERO IMU CDU

41 COARSE ALIGN CDU (W N20,N91)

42 PULSE TORQUE GYRO

43 LOAD FDAI ATT ERROR NEEDLES (TEST ONLY)

44 REQUEST DOCKED DAP DATA LOAD (R04)

45 ACTIVATE DOCKED DAP

46 ACTIVATE CSM DAP

47 SET OWS STATE VECTOR INTO CSM STATE VECTOR

48 REQUEST CSM DAP DATA LOAD (R03)

49 START C W-DEFINED MANEUVER (R62)

50 PLEASE PERFORM

51 PLEASE MARK

52 SPARE

53 PLEASE MARK ALTERNATE LOS

54 START RENDEZVOUS BACKUP SIGHTING MARK (R23)

55 INCREMENT CMC TIME (DECIMAL)

56 TERMINATE TRACKING

57 SPECIFY SETTING OF FULL TRACK FLAG

58 RESET STICK FLAG AND SET V50N18 FLAG

59 ENABLE ALL JETS (DOCKED)

60 SET ATTITUDE ERROR REFERENCE TO PRESENT ATTITUDE

61 SELECT MODE 1 (DISPLAY DAP ATTITUDE ERROR)

62 SELECT MODE 2 (DISPLAY TOTAL ATTITUDE ERROR (N22-N20))

63 SELECT MODE 3 (DISPLAY TOTAL ASTRONAUT ATTITUDE ERROR (N17-N20))

64 REQUEST OPTICS ANGLES TRANSFORM (R64)

65 START OPTICAL VERIFICATION OF GYRO COMPASSING (P03)

66 SET CSM STATE VECTOR INTO OWS STATE VECTOR

67 REQUEST W-MATRIX RSS ERROR DISPLAY

68 SPARE

69 RESTART

70 UPDATE LIFTOFF TIME (P27)

71 UNIVERSAL UPDATE-BLOCK ADR (P27)

72 UNIVERSAL UPDATE-SINGLE ADR (P27)

73 UPDATE CMC TIME (OCTAL) (P27)

74 INITIALIZE ERASABLE DUMP VIA DOWNLINK

75 SET LIFTOFF FLAG

76 ENABLE RANGE RATE MARK PROCESSING (R27) 489

77 DISABLE RANGE RATE MARK PROCESSING (R27) 489

78 CHANGE GYRO COMPASS LAUNCH AZIMUTH

79 SPARE

80 UPDATE OWS STATE VECTOR

81 UPDATE CSM STATE VECTOR

82 REQUEST ORBITAL PARAMETERS DISPLAY (R30)

83 REQUEST RENDEZVOUS PARAMETER DISPLAY #1 (R31)

84 SPARE

85 REQUEST RENDEZVOUS PARAMETER DISPLAY #2 (R34)

86 REJECT RENDEZVOUS BACKUP SIGHTING MARK

87 SET VHF RANGE FLAG

88 RESET VHF RANGE FLAG

89 START RENDEZVOUS FINAL ATTITUDE (R63)

90 REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY (R36)

91 REQUEST BANKSUM DISPLAY

92 SPARE

93 ENABLE W-MATRIX INITIALIZATION

94 SPARE

95 SPARE

96 TERMINATE INTEGRATION AND GO TO P00

97 THRUST FAIL DISPLAY

98 SPARE

99 ENABLE ENGINE IGNITION

CHANGE CONTROL NOTES

REV 00 PCR 004,005,006,007,010,040,405,439, PCN 457
REV 01 PCN 489

4.6 THIS LIST REPRESENTS THE NOUNS USED IN PROGRAM SKYLARK.

REV 01 03/20/72

PCR/PCN

NOUNS SPECIFIED AS NOT BEING LOADABLE ARE MARKED (NL).

00	NCT IN USE		
01	SPECIFY ADDRESS (FRAC)	.XXXXX FRAC .XXXXX FRAC .XXXXX FRAC	
02	SPECIFY ADDRESS (WHOLE)	XXXXX. INTEG XXXXX. INTEG XXXXX. INTEG	
03	SPECIFY ADDRESS (DEGREE)	XXX.XX DEG XXX.XX DEG XXX.XX DEG	
04	ATTITUDE ERROR (NL)	R XXX.XX DEG P XXX.XX DEG Y XXX.XX DEG	489
05	ANGULAR ERROR/DIFFERENCE SIGHTING ANGLE	XXX.XX DEG XXX.XX DEG	
06	OPTION CODE	OCT OCT	
07	CHANNEL/FLAGWORD/ERASABLE OPERATOR	OCT OCT OCT	
08	ALARM DATA	OCT OCT OCT	
09	ALARM CODES	OCT OCT OCT	
10	CHANNEL TO BE SPECIFIED	OCT	
11	TIG (NCC)	00XXX. HRS 00XXX. MIN 0XX.XX SEC	
12	OPTION CODE	OCT OCT	
13	TIG (NSR)	00XXX. HRS	

			OOOXX. MIN
			OXX.XX SEC
14	STAR TRACKER AZIMUTH		XXXXX. ARC MIN
	ELEVATION		XXXXX. ARC MIN
15	INCREMENT ADDRESS		OCT
16	TIME OF EVENT (USED BY EXT VERB ONLY)		OOXXX. HRS
			OOOXX. MIN
			OXX.XX SEC
17	ASTRONAUT TOTAL ATTITUDE	R	XXX.XX DEG
	(USED IN MODE 3 NEEDLES (V63))	P	XXX.XX DEG
		Y	XXX.XX DEG
18	BALL ANGLES AUTO MANEUVER	R	XXX.XX DEG
		P	XXX.XX DEG
		Y	XXX.XX DEG
19	STAR TRACKER AZIMUTH		OCT
			OCT
20	PRESENT ICDU ANGLES	R	XXX.XX DEG
		P	XXX.XX DEG
		Y	XXX.XX DEG
21	PIPAS	X	XXXXX. PULSES
		Y	XXXXX. PULSES
		Z	XXXXX. PULSES
22	NEW ICDU ANGLES	R	XXX.XX DEG
		P	XXX.XX DEG
		Y	XXX.XX DEG
23	NAV BASE TO ATM DOCKING ANGLES	ALPHA	XXX.XX DEG
		BETA	XXX.XX DEG
		GAMMA	XXX.XX DEG
24	DELTA TIME FOR CMC CLOCK		OOXXX. HRS
			OOOXX. MIN
			OXX.XX SEC
25	CHECKLIST (USED WITH V50)		XXXXX.
26	PRIO/DELAY,ADRES,BBCON		OCT
			OCT
			OCT
27	SELF TEST ON/OFF SWITCH		XXXXX.
28	TIG (NC2)		OOXXX. HRS
			OOOXX. MIN
			OXX.XX SEC
29	XSM LAUNCH AZ		XXX.XX DEG

489

30	TARGET CODE (GYROCOMPASSING VERIFICATION)	XXXXX. XXXXX. XXXXX.
31	TIME OF LAST W-MATRIX REINITIALIZATION	00XXX. HRS 000XX. MIN 0XX.XX SEC
32	TIME FROM PERIGEE	00XXX. HRS 000XX. MIN 0XX.XX SEC
33	TIG	00XXX. HRS 000XX. MIN 0XX.XX SEC
34	TIME OF EVENT	00XXX. HRS 000XX. MIN 0XX.XX SEC
35	TIME FROM EVENT	00XXX. HRS 000XX. MIN 0XX.XX SEC
36	TIME OF CMC CLOCK	00XXX. HRS 000XX. MIN 0XX.XX SEC
37	TIG (TPI)	00XXX. HRS 000XX. MIN 0XX.XX SEC
38	TIME OF STATE VECTOR	00XXX. HRS 000XX. MIN 0XX.XX SEC
39	TIG OF LAST MANEUVER	00XXX. HRS 000XX. MIN 0XX.XX SEC
40	TFI/TFC (NL) VG DELTA V (ACCUMULATED)	XXBXX M-S XXXX.X FPS XXXX.X FPS
41	TARGET AZIMUTH TARGET ELEVATION TARGET IDENTIFIER (OCTAL PASTE FROM N30)	XXX.XX DEG XX.XXX DEG 0000X
42	APO ALT PER ALT DELTA V (REQUIRED)	XXXX.X NM XXXX.X NM XXXX.X FPS
43	LATITUDE (+ NORTH) LONGITUDE (+ EAST) ALTITUDE	XXX.XX DEG XXX.XX DEG XXXX.X NM

489

44	APO ALT	(NL)	XXXX.X NM	489
	PER ALT		XXXX.X NM	
	TFF		XXBXX M-S	
45	MARKS (VHF-OPTICS)	(NL)	XXBXX	489
	TFI (NEXT BURN)		XXBXX M-S	
	MGA/CODE		XXX.XX DEG	
			/0000X.	
46	DAP CONFIG		OCT	
			OCT	
47	THIS VEHICLE WEIGHT		XXXXX. LBS	
	OTHER VEHICLE WEIGHT		XXXXX. LBS	
48	GIMBAL PITCH TRIM		XXX.XX DEG	
	GIMBAL YAW TRIM		XXX.XX DEG	
49	DELTA R		XXX.XX NM	
	DELTA V		XXXX.X FPS	
	SOURCE CODE		0000X.	
50	SPLERROR	(NL)	XXXX.X NM	489
	PERIGEE		XXXX.X NM	
	TFF		XXBXX M-S	
51	SPARE			
52	CENTRAL ANGLE OF ACTIVE VEHICLE		XXX.XX DEG	
53	RANGE		XXX.XX NM	
	RANGE RATE		XXXX.X FPS	
	PHI		XXX.XX DEG	
54	RANGE		XXX.XX NM	
	RANGE RATE		XXXX.X FPS	
	THETA		XXX.XX DEG	
55	NN		XXXXX.	
	ELEVATION ANGLE (E)		XXX.XX DEG	
56	VEHICLE RATE	(NL)	R X.XXXX DEG/SEC	489
			P X.XXXX DEG/SEC	
			Y X.XXXX DEG/SEC	
57	HALFREVS		XXXXX.	489
	DELTA H (NCC)		XXXX.X NM	
	DELTA H (NSR)		XXXX.X NM	
58	DELTA V (TPI)		XXXX.X FPS	
	DELTA V (TPF)		XXXX.X FPS	
	DELTA T (TPI-NOMTPI)		XXBXX M-S	489
59	DELTA V LOS 1		XXXX.X FPS	
	DELTA V LOS 2		XXXX.X FPS	
	DELTA V LOS 3		XXXX.X FPS	

60	G MAX	XXX.XX G	
	VPRED	XXXXX. FPS	
	GAMMA EI (+ UP)	XXX.XX DEG	
61	IMPACT LATITUDE	XXX.XX DEG	
	IMPACT LONGITUDE	XXX.XX DEG	
	HEADS UP/DOWN (+ UP)	+/- 00001.	489
62	VI ,INERTIAL VEL MAG	XXXXX. FPS	
	HDOT ,ALT RATE	XXXXX. FPS	
	H ,ALT ABOVE PAD RADIUS	XXXX.X NM	
63	RTOGO ,RNG FROM E.I. TO SPLASH (NL)	XXXX.X NM	489
	VIO , PREDICTED INERT VEL AT E.I.	XXXXX. FPS	
	TFE ,TIME FROM FROM E.I.	XXBXX M-S	
64	G, DRAG ACCELERATION	XXX.XX G	
	VI ,INERTIAL VELOCITY	XXXXX. FPS	
	R TO GO (+ OVSHT)	XXXX.X NM	
65	SAMPLED CMC TIME	00XXX. HRS	
	(FETCHED IN INTERRUPT)	000XX. MIN	
		0XX.XX SEC	
66	BETA, CMD BANK ANGLE	XXX.XX DEG	
	CROSS RANGE ERROR (+ TGT RT)	XXXX.X NM	
	DOWN RANGE ERROR (+ OVSHT)	XXXX.X NM	
67	R TO GO (+ OVSHT)	XXXX.X NM	
	LAT ,PRESENT POSITION (+ NORTH)	XXX.XX DEG	
	LONG ,PRESENT POSITION (+ EAST)	XXX.XX DEG	
68	BETA, CMD BANK ANGLE	XXX.XX DEG	
	VI ,INERTIAL VELOCITY	XXXXX. FPS	
	HDOT ,ALT RATE	XXXXX. FPS	
69	BETA	XXX.XX DEG	
	DL	XXX.XX G	
	VL	XXXXX. FPS	
70	SIGHTING SOURCE - CELESTIAL BODY CODE (BEFORE MARK)	OCT	
71	SIGHTING SOURCE - CELESTIAL BODY CODE (AFTER MARK)	OCT	
72	TIME OF R27 OPTIMIZATION	00XXX. HRS	
		000XX. MIN	
		0XX.XX SEC	
73	ALTITUDE	XXXXB. NM	
	VELOCITY	XXXXX. FPS	
	FLIGHT PATH ANGLE	XXX.XX DEG	
74	BETA, CMD BANK ANGLE	XXX.XX DEG	
	VI , INERTIAL VELOCITY	XXXXX. FPS	

	G , DRAG ACCELERATION	XXX.XX G	
75	DELTA H (NSR) (NL)	XXXX.X NM	489
	DELTA T (TPI-NSR)	XXBXX MIN/SEC	
	DELTA T (TPI-NOMTPI)	XXBXX MIN-SEC	
76	R27 RANGE (NL)	XXX.XX NM	489
	R27 RANGE RATE	XXXX.X FPS	
	TIME FROM R27 OPTIM	XXBXX M-S	
77	R27 RANGE	XXX.XX NM	489
	R27 RANGE RATE	XXXX.X FPS	
	R27 THETA/PHI/CODE	XXX.XX DEG /-00001	
78	GAMMA	XXX.XX DEG	
	RHO	XXX.XX DEG	
	CMICRON	XXX.XX DEG	
79	RATE (+ INCREASING CDU)	X.XXXX DEG/SEC	
	DEADBAND	XXX.XX DEG	
80	TFI/TFC (NL)	XXBXX M-S	489
	VG	XXXXX. FPS	
	DELTA V (ACCUMULATED)	XXXXX. FPS	
81	DELTA VX (LV)	XXXX.X FPS	
	DELTA VY (LV)	XXXX.X FPS	
	DELTA VZ (LV)	XXXX.X FPS	
82	DELTA VX (LV) FOR NSR	XXXX.X FPS	
	DELTA VY (LV) FOR NSR	XXXX.X FPS	
	DELTA VZ (LV) FOR NSR	XXXX.X FPS	
83	DELTA VX (CONT)	XXXX.X FPS	
	DELTA VY (CONT)	XXXX.X FPS	
	DELTA VZ (CONT)	XXXX.X FPS	
84	DELTA V (NEXT MANEUVER)	XXXX.X FPS	
	DELTA H (NEXT MANEUVER)	XXXX.X NM	489
	DELTA V (THIRD MANEUVER)	XXXX.X FPS	
85	VGX (CONT)	XXXX.X FPS	
	VGY (CONT)	XXXX.X FPS	
	VGZ (CONT)	XXXX.X FPS	
86	DELTA VX (LV)	XXXXX. FPS	
	DELTA VY (LV)	XXXXX. FPS	
	DELTA VZ (LV)	XXXXX. FPS	
87	DOCKED DAP FLAG SPECIFICATION	OCT	
	CHANNEL 5 JETS INHIBITED	OCT	
	CHANNEL 6 JETS INHIBITED	OCT	
88	PLANET UNIT POSITION VECTOR X	.XXXXX	
	Y	.XXXXX	

		Z	.XXXXX
89	DOCKED DAP RATE		X.XXXX DEG/SEC
	DOCKED DAP DEADBAND		XXX.XX DEG
90	REND OUT-OF-PLANE PARAMETERS (P3X)	Y CM	XXX.XX NM
		Y DOT CM	XXXX.X FPS
		Y DOT OWS	XXXX.X FPS
91	PRESENT OCDU ANGLES - SHAFT		XXX.XX DEG
	- TRUN		XX.XXX DEG
92	NEW OCDU ANGLES - SHAFT		XXX.XX DEG
	- TRUN		XX.XXX DEG
93	DELTA GYRO ANGLES	X	XX.XXX DEG
		Y	XX.XXX DEG
		Z	XX.XXX DEG
94	ALTERNATE LOS - SHAFT		XXX.XX DEG
	- TRUN		XX.XXX DEG
95	TIG (NC1)		00XXX. HRS
			000XX. MIN
			0XX.XX SEC
96	REND OUT-OF-PLANE PARAMETERS (BY V90E)	Y CM	XXX.XX NM
		Y DOT CM	XXXX.X FPS
		Y DOT OWS	XXXX.X FPS
97	SYSTEM TEST INPUTS		XXXXX.
			XXXXX.
			XXXXX.
98	SYSTEM TEST RESULTS		XXXXX.
	AND INPUTS		.XXXXX
			XXXXX.
99	RSS VALUE OF POSITION ERROR		XXXXX. FT
	RSS VALUE OF VELOCITY ERROR		XXXX.X FPS
	OPTION CODE		XXXXX.

CHANGE CONTROL NOTES

REV 00 PCR 010,011,017,018,019,021,032,036,040,400,413,415,420, SLM #2,19
REV 01 PCN 489

4.7 THIS LIST REPRESENTS THE CHECKLIST REFERENCE CODES USED WITH V50N25 FOR PROGRAM SKYLARK.
REV 00 05/19/71

PCR/PCN

R1 CODE ACTION TO BE EFFECTED

00013 PERFORM COARSE ALIGNMENT

00014 PERFORM FINE ALIGNMENT

00015 PERFORM CELESTIAL BODY ACQUISITION

00016 TERMINATE MARK SEQUENCE

00017 PERFORM MINKEY RENDEZVOUS

00020 PERFORM PULSE-TORQUING FOR PLANE CHANGE

00041 SWITCH CM/SM SEPARATION TO UP

00062 KEY CMC TO STANDBY

00204 PERFORM SPS GIMBAL TRIM

SWITCH-DENOTES CHANGE POSITION OF A CONSOLE SWITCH

PERFORM-DENOTES START OR END OF A TASK

KEY IN-DENOTES KEY IN OF DATA THRU THE DSKY

CHANGE CONTROL NOTES

REV 00 PCR 017

4.8 THIS LIST REPRESENTS THE OPTION CODES USED WITH V04N06 AND V04N12 FOR PROGRAM SKYLARK. REV 00 05/19/71

THE SPECIFIED OPTION CODES WILL BE DISPLAYED IN R1
IN CONJUNCTION WITH FL V04N06 OR FL V04N12 TO REQUEST THE
ASTRONAUT TO LOAD INTO R2 THE OPTION HE DESIRES.

R1 PCR/PCN

OPTION

CODE	PURPOSE	INPUT FOR R2
00001	SPECIFY IMU ORIENTATION	1=PREF 2= NOMINAL 3=REFSMMAT
00002	SPECIFY VEHICLE	1=THIS VEHICLE 2=OTHER VEHICLE
00004	SPECIFY STATE OF TRACKING=FULTKFLG	0=RESET (FULL) 1=SET (PARTIAL)
00012	SPECIFY P50 OPTION	1=ATM SUN SENSOR 2=ATM SUN SENSOR AND ATM STAR TRACKER 3=ATM ANGLES FROM INDEPENDENT SOURCE
00013	SPECIFY P55 OPTION	1=CELESTIAL BODY AND IMU ORIENTATION 2=CELESTIAL BODY, OPTICS MARK, AND ATM SOLAR-INERTIAL ATTITUDE
00024	SPECIFY ASSUMED TRACKING MODE	0=RENDEZVOUS (VECPOINT) 1=TARGET POINTING (VECPOINT) 2=ROTATION 4=RENDEZVOUS (3AXIS) 5=TARGET POINTING (3AXIS)

CHANGE CONTROL NOTES

REV 00 PCR 013,016,036,413, PCN 457

4.9 THIS LIST REPRESENTS THE ALARM CODES USED WITH V05N09 FOR PROGRAM SKYLARK. REV 01 03/20/72

R1

CODE	PURPOSE	SET BY	PCR/PCN
00107	STAR TRACKER ANGLES OUT OF LIMITS	P55	
00110	NO MARK SINCE LAST MARK REJECT	SXTMARK	
00113	NO INBITS	SXTMARK	
00114	MARK MADE BUT NOT DESIRED	SXTMARK	
00115	OPTICS TORQUE REQUEST WITH SWITCH NOT AT CMC	EXT VERB OPTICS CDU	
00116	OPTICS SWITCH ALTERED BEFORE 15 SEC ZERO TIME ELAPSED	T4RUPT	
00117	OPTICS TORQUE REQUEST WITH OPTICS NOT AVAILABLE (OPTIND=-0)	EXT VERB OPTICS CDU	
00120	OPTICS TORQUE REQUEST WITH OPTICS NOT ZEROED	T4RUPT	
00121	CDU'S NOT GOOD AT TIME OF MARK	SXTMARK	
00205	BAD PIPA READING	SERVICER	
00206	ZERO ENCODE NOT ALLOWED WITH COARSE ALIGN + GIMBAL LOCK	IMU MODE SWITCH IMU 2	
00207	ISS TURNON REQUEST NOT PRESENT FOR 90 SEC	T4RUPT	
00210	IMU NOT OPERATING	IMU MODE SWITCH, IMU 2, R02, P51, P53	
00211	COARSE ALIGN ERROR-DRIVE >2 DEGREES	IMU MODE SWITCH	
00212	PIPA FAIL BUT PIPA IS NOT BEING USED	IMU MODE SWITCH, T4RUPT	
00213	IMU NOT OPERATING WITH TURN-ON REQUEST	T4RUPT	
00214	PROGRAM USING IMU WHEN TURNED OFF	T4RUPT	
00217	BAD RETURN FROM STALL ROUTINES	P51,P52,P53,P54	
00220	IMU NOT ALIGNED (BAD REFSMMAT)	R02	
00401	DESIRED GIMBAL ANGLES YIELD GIMBAL LOCK	INF ALIGN, IMU2,R61	
00402	ENTER RESPONSE NOT ALLOWED	P52	

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00404	TARGET OUT OF VIEW (TRUN. ANGLE > 90 DEG)	R52
00405	TWO STARS NOT AVAILABLE	P52,P54
00406	REND NAVIGATION NOT OPERATING	R23
00421	W-MATRIX OVER FLOW	INTEGRV
00500	NOT ENOUGH JETS FOR SOME PITCH OR YAW ROTATION	DOCKED DAP
00501	NOT ENOUGH JETS FOR SOME ROLL ROTATION	DOCKED DAP
00600	FAILURE IN PHASE MATCH ITERATION	P31,P32
00601	FAILURE IN HEIGHT MANEUVER ITERATION	P31,P32
00602	FAILURE IN OUTER LOOP ITERATION	P31,P32
00603	FAILURE IN QRDTPI ITERATION	P31,P32,P33
00611	NO TIG FOR GIVEN ELEV ANGLE	P34,P35
00777	PIPA FAIL CAUSED THE ISS WARNING	T4RUPT
01102	CMC SELF TEST ERROR	SELF CHECK
01105	DOWNLINK TOO FAST	T4RUPT
01106	UPLINK TOO FAST	T4RUPT
01107	PHASE TABLE FAILURE. ASSUME ERASABLE MEMORY IS DESTROYED	RESTART
01301	ARCSIN-ARCCOS INPUT ANGLE TOO LARGE	INTERPRETER
01407	VG INCREASING	S40.8
01426	IMU UNSATISFACTORY	P61,P62
01427	IMU REVERSED	P61, P62
01520	V37 REQUEST NOT PERMITTED AT THIS TIME	V37
01600	OVERFLOW IN DRIFT TEST	OPT PRE ALIGN CALIB
01601	BAD IMU TORQUE	OPT PRE ALIGN CALIB
01703	INSUFFICIENT TIME FOR INTEG., TIG WAS SLIPPED.	R41
03777	ICDU FAIL CAUSED THE ISS WARNING	T4RUPT

04777	ICDU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT
07777	IMU FAIL CAUSED THE ISS WARNING	T4RUPT
10777	IMU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT
13777	IMU, ICDU FAILS CAUSED THE ISS WARNING	T4RUPT
14777	IMU, ICDU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT
20430	* INTEG. ABORT DUE TO SUBSURFACE S.V.	ALL CALLS TO INTEG.
20607	* NO SOLUTION FROM TIME THETA OR TIME RADIUS ROUTINE	ALL CALLS TO ROUTINE
21204	* NEGATIVE OR ZERO WAITLIST CALL	WAITLIST
21206	* SECOND JOB ATTEMPTS TO GO TO SLEEP VIA KEYBOARD AND DISPLAY PROGRAM	PINBALL
21210	* TWO PROGRAMS USING DEVICE AT SAME TIME	IMU MODE SWITCH
21302	* SQRT CALLED WITH NEGATIVE ARGUMENT	INTERPRETER
21501	* KEYBOARD AND DISPLAY ALARM DURING INTERNAL USE (NVSUB)	PINBALL
21502	* ILLEGAL FLASHING DISPLAY	GOPLAY
21521	* P01 ILLEGALLY SELECTED	P01
31104	* DELAY ROUTINE BUSY	SERVICE ROUTINES
31201	* EXECUTIVE OVERFLOW-NO VAC AREAS	EXEC
31202	* EXECUTIVE OVERFLOW-NO CORE SETS	EXEC
31203	* WAITLIST OVERFLOW-TOO MANY TASKS	WAITLIST
31211	* ILLEGAL INTERRUPT OF EXTENDED VERB	SXTMARK
32000	* DAP JASK STILL IN PROGRESS WHEN NEXT JASK ATTEMPTED	DOCKED DAP

* INDICATES ABORT TYPE. ALL OTHERS ARE NON-ABORTIVE.
2XXXX INDICATES A GO TO ROUTINE 00 TYPE ABORT (IF EXTENDED VERB ACTIVE OR IF AVERAGE G ON DO BAILOUT TYPE ABORT) 489
3XXXX INDICATES A BAILOUT TYPE ABORT

NOTE: FOR V05 N09 DISPLAYS:
R1-XXXXX (FIRST ALARM FOLLOWING ERROR RESET).
R2-XXXXX (SECOND ALARM FOLLOWING ERROR RESET).
R3-XXXXX (MOST RECENT ALARM)

ERROR RESET WILL SET R1 AND R2 TO ZERO, BUT
NOT AFFECT R3

CHANGE CONTROL NOTES

REV 00 PCR 016,036,448,454, PCN 457
REV 01 PCN 489

SKYLARK 1 (GSOP)

R693

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