

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD
PROGRAM CHANGE REQUEST

Completed by 324

1.0 COMPLETED BY ORIGINATOR

1.1 ORIGINATOR FS5/ R. W. Carl	DATE 7-27-70	1.2 ORGANIZATION Flight Software	APPROVAL	DATE
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1.3 EFFECTIVITY Luminary Apollo 15	1.4 TITLE OF CHANGE PGNCS/AGS RR data transfer
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1.5 REASON(S) FOR CHANGE
To provide the Abort Guidance System with Rendezvous Radar data via the PGNCS to AGS downlink telemetry line for the AGS Automatic RR update program.

1.6 DESCRIPTION OF CHANGE
Changes should be made in accordance with the interface description given in the attachment to this PCR.

2.0 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH
DECISION FOR VISIBILITY IMPACT ESTIMATE BY MIT

2.1 <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED	2.2 REMARKS:
2.3 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH SIGN OFF	
DATE	

3.0 MIT VISIBILITY IMPACT EVALUATION:

3.1 SCHEDULE IMPACT	3.2 IMPACT OF PROVIDING DETAILED EVALUATION
3.3 STORAGE IMPACT	3.4 REMARKS:
3.5 MIT COORDINATOR	
DATE	

4.0 SOFTWARE CONTROL BOARD ACTION

4.1 <input checked="" type="checkbox"/> IMPLEMENT AND PROVIDE DETAILED CHANGE EVAL. <input type="checkbox"/> PROVIDE DETAILED CHANGE EVALUATION <input type="checkbox"/> DIS-APPROVED	4.2 REMARKS
4.3 SOFTWARE CONTROL BOARD SIGN OFF	
DATE 8/13/70	

5.0 MIT DETAILED PROGRAM CHANGE EVALUATION

5.1 MIT COORDINATOR	5.2 MIT EVALUATION
DATE	

6.0 SOFTWARE CONTROL BOARD DECISION ON MIT
DETAILED PROGRAM CHANGE EVALUATION

6.1 <input type="checkbox"/> START OR CONTINUE IMPLEMENTATION <input type="checkbox"/> DISAPPROVED OR STOP IMPLEMENTATION	6.2 REMARKS:
6.3 SOFTWARE CONTROL BOARD SIGN OFF	
DATE	

Interface Description
PGNCS/AGS RR Data Transfer

A. Introduction

This document describes the requirements and agreements reached on the software interface between the IM Guidance Computer (IGC) of the Primary Guidance, Navigation and Control System (PGNCS) and the Abort Electronics Assembly (AEA) of the Abort Guidance System (AGS) for the PGNCS to AGS Rendezvous Radar (RR) data transfer for the AGS Automatic RR Update Program.

B. AGS Requirements

The data requirements of the AEA software for the Automatic RR Update Program are discussed in this section.

1. RR data will be obtained via the PGNCS to AGS, downlink transfer link. Data is transmitted serially over the PGNCS Downlink Telemetry line at a rate of fifty 40-bit words per second when in the high bit rate mode (see section D). The Downlink Telemetry Register of the AEA is an 18 bit shift register which is loaded by the Instrumentation Subsystem and permits the loading of only the first 18 bits of the 40 bit downlink word. After an appropriate command has been given to the AEA via the DEDA, the PGNCS Downlink Input Subroutine interrogates the PGNCS Downlink Stop Pulse Discrete. When the Stop Pulse Discrete is found, the subroutine loads the contents of the Downlink Telemetry Register into the AEA. A search is made for the correct Downlist I.D. word. When the correct I.D. word is found, the next 16 words are read and stored in a buffer area of the AEA. Only the most significant 16 bits of the 18 bit Downlink Telemetry Register are considered by AEA software to contain information. For the above reasons the following general restrictions are placed on any data transmitted to the AEA via the PGNCS downlink transfer link.
 - a. Any pertinent data must be found in the first 16 bits of the 40-bit PGNCS downlink word.
 - b. Any pertinent data must be found in the first 17 words of the 100 downlink words of an IGC downlist.
2. The following data is required by the AEA for the Automatic RR update program.
 - a. Downlist ID word
 - b. Raw RR Range Data
 - c. Raw RR Range Rate Data
 - d. RR Shaft Angle CDU

- e. RR Trunnion Angle CDU
 - f. A composite code word
3. The following additional restrictions and requirements are placed on the transmitted data of (2) above.
- a. The Shaft and Trunnion Angle CDU's must be located consecutively on the list. They may appear in either order, but the first one must be in an even numbered word where the Downlist ID word is word number 1 of the list.
 - b. The composite code word must be the last of the data transmitted. It will consist of a special 14-bit flag with set and reset configurations and 1 bit to indicate high and low scaling of the RR Range data. The set and reset configurations of this word should be as shown below. The word length corresponds to an LGC computer word without the parity bit.

AGS BIT 15 14

Bit No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Set	A	0	1	1	1	1	1	1	1	1	1	1	1	1	1 → 0
Reset	A	1	0	0	0	0	0	0	0	0	0	0	0	0	0

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where A = 1 for high range scaling
 A = 0 for low range scaling
 and the configuration of
 A does not matter in the
 reset configuration.

- c. The composite code word should be placed in the set configuration approximately once per minute, immediately after the reading of range and range rate and placing this data along with the shaft and trunnion angle data on the downlink. The code word should be placed in the set configuration only if the RR data good discrete was present during the radar reading and a hardware restart had not occurred since the last radar reading. The code word should be placed in the reset configuration no sooner than two seconds after being placed in the set configuration and no later than two seconds before being placed in the set configuration again.
- d. The radar data should remain unchanged on the downlink for at least two seconds after the code word is placed in the set configuration.

C. IGC Downlink Description for Automatic AGS RR Updating

The details of the IGC downlink list which will provide RR data to the AEA are enumerated in this section.

1. General Downlink Description

Each IGC downlist contains 100 downlink words. Each downlink word is composed of a "word order code bit," two 16-bit IGC computer words (15 data bits plus an odd parity bit per word), plus seven "filler bits" to total a 40 bit downlink word. The downlist is transmitted at a rate of 50 40-bit downlink words per second when in high bit rate mode (see section D).

The first word in each list is the Downlist ID word and the sync register. The first and fifty-first words on the downlist have a word order code bit of zero. All other words on the list have a word order code bit of one.

2. The IGC downlist which will transmit RR data to the AEA of the AGS is the Rendezvous and Pre-thrust Downlist.
3. The first 17 words of the Rendezvous and Pre-Thrust Downlist will be as follows.

<u>Word No.</u>	<u>WOC</u>	<u>First Register</u>	<u>Second Register</u>
1	0	*List ID (777758)	Sync bits (773408)
2	1	CSM State Vector R _x	CSM State Vector R _x
3	1	CSM State Vector R _y	CSM State Vector R _y
4	1	CSM State Vector R _z	CSM State Vector R _z
5	1	CSM State Vector V _x	CSM State Vector V _x
6	1	CSM State Vector V _y	CSM State Vector V _y
7	1	CSM State Vector V _z	CSM State Vector V _z
8	1	CSM State Vector Time	CSM State Vector Time
9	1	MARKTIME	MARKTIME
10	1	MKCDUY	MKCDUZ
11	1	MKCDUX	No. of Marks
12	1	*RR Trunnion CDU	RR Shaft CDU
13	1	*RR SHAFT CDU	~ Garbage ~
14 17	1	T _F	T _F
15 14	1	*RR Range (Raw Data)	RR Range Rate (Raw Data)
16 15	1	*RR Range Rate (Raw Data)	~ Garbage ~
17 16	1	*AGS RR Composite Code Word	~ Garbage ~

* Data pertinent to AGS Automatic RR update program.

4. A description of the data pertinent to AGS Automatic RR updating is provided here.
 - a. Word number 1a is the Downlist ID word of the Rendezvous and Pre-thrust Downlist. It will have the value 77775 (octal).
 - b. Words 12a and 13a are RR Trunnion and Shaft CDU's, respectively. These are unsigned 15-bit fractions scaled degrees/360.
 - c. Word 15a is RR Range (Raw Data). Treated as a 15 bit integer the following computation must be performed to convert to units of feet:

(15-bit integer) X (75.04) for high scale
or
(15-bit integer) X (9.38) for low scale
 - d. Word 16a is RR Range Rate (Raw Data). Treated as a 15 bit integer the following computation must be performed to convert to units of feet per second:

(15-bit integer minus 17000) X (-0.6278)

A negative quantity indicates closing.
 - e. Word 17a is the AGS Composite Code word. It will contain the values as discussed in paragraphs B.3.b and B.3.c.

D. General Operating Requirements

1. The following will be necessary to cause transfer of RR data from the PGNCS to the AGS.
 - a. Telemetry high bit rate (LGC).
 - b. An astronaut entry via the DEDA enabling the AGS routines which pick the RR data off the LGC downlist.
 - c. LGC in P20 or P20 in the background of a program that uses the Rendezvous and Pre-thrust Downlist with the RR in LGC and locked on, data good discrete present and R22 (P20 subroutine which takes an RR mark about once per minute) actively running.