

Distribution of 13th Instrumentation and Communication  
Panel Meeting Minutes

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GEORGE C. MARSHALL SPACE FLIGHT CENTER  
HUNTSVILLE, ALABAMA

*Memorandum*

R-ASTR-IP-65-236  
Mr. Golden/876-3938  
DATE April 16, 1965

TO See Distribution

FROM MSFC Chairman, Instrumentation  
Communication Panel

SUBJECT Minutes of the Thirteenth Meeting of the Instrumentation and  
Communication Panel on March 31, 1965

1. The thirteenth meeting of the Instrumentation and Communication Panel (I&CP) was held at the Office of Manned Space Flight (MSF) on March 31, 1965. A list of attendees is included as enclosure 1. A summary list of action items established during this meeting is included as enclosure 2. Action items from previous meetings were not discussed, therefore, a description of these is not included in the minutes.

2. Agenda Item a - Report of the Unified S-Band Implementation Sub-Panel

a. Mr. P. Varson (GSFC) made the Sub-Panel's presentation. Charts depicting the cost breakdown of different possible configurations of the proposed Unified S-Band (USB) ground stations are included as enclosure 3.

3. The Sub-Panel met on March 23, 1965, at the Manned Spacecraft Center (MSC). Two items were discussed at this meeting, the question of a USB station at Grand Bahama Island (GBI), and Grand Turk, and the April 1st presentation the Sub-Panel is to give to General S. Phillips.

(1) The Sub-Panel stated that their findings have shown that it is possible to fly without a USB station at GBI. However, it was felt that this would not be a good practice and recommends that GBI have a full USB station capability. The addition of a USB station at Grand Turk was also discussed and the Sub-Panel recommends against this implementation.

(2) The proposed outline of the presentation for General Phillips was briefly described. It will be as follows:

(a) What will be the result of not having a USB station at GBI?

(b) What is the minimum possible USB station at GBI and its corresponding effects?

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(c) What are the spacecraft's USB requirements in regard to GBI?

b. The I&CP endorsed the recommendations and the proposed outline of the Sub-Panel. Since the Office of Tracking and Data Acquisition (OTDA) has not been officially approached, Mr. Robinson (OTDA) abstained from the concurrence.

c. A new membership and assignment of the Sub-Panel was established.

(1) The new membership of the Sub-Panel is as follows:

Mr. P. Varson (GSFC) Chairman  
Mr. T. Barr (MSFC)  
Mr. D. Collins (KSC)  
Mr. H. Kyle (MSC)  
Mr. J. Raleigh (MSF-Bellcomm)  
Mr. L. Robinson (OTDA)

(2) The Sub-Panel was assigned the responsibility of reviewing the design specifications of all the USB transponders (including MSFC's Command and Communication System - CCS). They will identify those parameters that must be identical. This is to enable the ground implementors to eliminate unnecessary procedural changes and design modifications.

3. Agenda Item b - Report by OTDA on NASA's position on vacating the VHF telemetry band by 1970.

a. Mr. O. Hoberg (MSFC) briefed the Panel on the nature of this problem. Mr. J. Rorex (MSFC) then explained why Marshall Space Flight Center (MSFC), in particular, is concerned about this problem. The Joint Chiefs of Staff have issued an edict specifying that all military missile telemetry systems must switch to an S-Band frequency by 1970. Although OTDA has indicated that this edict is not binding on NASA agencies, it was felt that NASA must establish an official position regarding this problem because of the extensive interface with the military.

b. Mr. L. Robinson (OTDA) explained to the Panel the history of 1970 VHF - S-Band telemetry frequency negotiations. He further stated that NASA has a strong need for the VHF telemetry band and will continue to use it as long as necessary. He distributed a copy of a memo (see

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enclosure 4) outlining NASA's present position. However, only the NASA representative to IRAC can establish the permanent NASA position. This representative is presently in the process of doing this.

c. Since a definite NASA position shall be issued shortly, Mr. Robinson was asked to stay abreast of the progress of establishment of this position and be prepared at the next I&CP meeting to give the Panel a status report. The Panel members, in turn, should determine the impact of switching to the S-Band telemetry band by 1970 if it becomes a requirement. This impact is to be considered from both the space vehicle and supporting ground aspects. If OTDA determines that they need additional information, the Panel members must be prepared to discuss this impact in the next Panel meeting.

4. Agenda Item c - Discussion of the SA-201 and 202 flight profile impact upon the space vehicle's instrumentation systems

a. The main objective of this agenda item was to identify SA-201 instrumentation and communication problem areas for the I&CP to report on at the upcoming Panel Review Board (PRB) meeting. No response had been received on I&CP action item 12-8 (same as the agenda item) which indicates that there are no problems in supporting SA-201 and 202. However, two possible problems were mentioned in the meeting. They are the question of the Eastern Test Range (ETR) downrange telemetry capability and whether or not a ship will be available to support SA-201 and 202. Both of these problems were discussed in the last Joint Operations Group (JOG) meeting and were assigned as action items to the Operations Support Requirement Organization (OSRO) for resolution. These will be resolved before the PRB meeting.

To assure no problem areas have been overlooked, each Panel member should again carefully review SA-201 and determine if there are any problems concerned with this vehicle. Mr. D. Broome (MSC) will make the presentation to the PRB.

b. SA-501 flight profile is still in question. Conflicting parameters exist if apogee occurs over a null area (not in sight of an active MSFN station) when 2nd burn occurs over a well covered area. The Flight Dynamics, Mechanics, Guidance and Control Panel (FDMG&CP) is responsible for determining the SA-501 flight profile. It was felt by the I&CP that Goddard Space Flight Center (GSFC) should prepare a summary and status report on



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the Manned Space Flight Network (MSFN) capabilities in support of SA-501. This report should then be given to the FDMG&CP at their next meeting. It is hoped that this consideration will be taken into account in the finalization of an agreed upon flight profile.

5. Agenda Item d - Presentation by MSFC on their SA-203 ground instrumentation and support requirements

a. Mr. Barr (MSFC) outlined to the Panel the TV and Udata requirements of the LH<sub>2</sub> experiment. A total listing of all SA-203 requirements shall appear in the Saturn IB Program Support Requirement Document (PSRD) and the SA-203 Mission Support Requirement Document (MSRD).

b. Mr. Barr described the changes the program has undergone in the past few months. These changes will officially appear in the Saturn IB PSRD.

(1) There will be two TV cameras looking into the LH<sub>2</sub> tank. They will be separate high rate systems, with only one transmitting at any one time. Switching from one system to the other will be by RF command. The four stations called out for TV support are:

Kennedy Space Center  
Bermuda  
Carnarvon  
Corpus Cristi

Corpus Cristi shall be a mobile station which will be supplied by MSFC and operated by GSFC. All deliveries by MSFC to GSFC will be on schedule.

(2) RF command support is not required from these stations, per se. Present capability of MSFN sites is satisfactory. MSC has stated in a Flight Control Operations Panel (FCOP) meeting that the use of the Mission Control Center (MCC) Houston in support of SA-203 should be avoided if possible. A letter shall be written to the FCOP stating MSFC's SA-203 orbital command requirements and asking the FCOP to clarify MSC's position on the use of the MCC Houston in support of SA-203.

c. Mr. P. Goodwin (JPL) questioned MSFC on the anticipated splatter of the TV system into the 2290-2300 MHz (Mcps) band. Mr. Goodwin will advise MSFC on the amount of attenuation JPL feels is necessary on the

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transmitter's sidebands in the 2290-2300 MHz band. MSFC in the meantime will investigate the possibility of changing the carrier frequency and adding a filter to the system.

6. Agenda Item f - Review of the McClanahan-Hibbert presentation

The McClanahan-Hibbert presentation on the status and problem areas of the RF systems of the Saturn-Apollo program had been carefully reviewed by each Center. In this meeting each Center presented their comments and proposed revisions. Mr. McClanahan and Mr. Hibbert, in turn, will consider these comments and/or proposed revisions and will update their presentation accordingly.

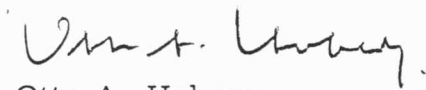
MSFC, MSC, and GSFC took slightly different approaches in the formulation of their comments. MSFC (see enclosure 5) did not go into detail, and comments were on a general nature. MSC, on the other hand, actually did go into detail (see enclosure 6) and gave a status report on each MSC related item called out in the presentation. GSFC's (see enclosure 7) remarks were brief and also general in nature. KSC had no comments.

7. Other Business

a. A TWX had been received by the Panel requesting a special I&CP meeting to review each Center's activities in the electro-magnetic interference (EMI) control programs. Mr. Hoberg stated that this meeting will be held some time in late May. No definite date was set. Mr. McClanahan, originator of the TWX, stated that Bellcomm will assimilate the data presented and discussed in the I&CP meeting and make a summary type presentation to General Phillips.

b. The need for a configuration control between the space vehicle and the supporting ground networks was briefly discussed. Mr. McClanahan stated that he, as a member of MSF, will write a letter to OTDA and suggest that some form of configuration control be implemented.

  
Douglas Broome  
MSC Co-Chairman

  
Otto A. Hoberg  
MSFC Co-Chairman

7 Encs:  
See next page

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7 Encs:

1. Attendees List
2. Action Item Summary List
3. USB Station Cost Breakdown
4. Memo dated March 30, 1965 "Frequencies for Telemetry"
5. MSFC Comments to the McClanahan-Hibbert Presentation
6. MSC Comments to the McClanahan-Hibbert Presentation
7. GSFC Comments to the McClanahan-Hibbert Presentation

Distribution:

See I&CP Distribution List

## ATTENDANCE LIST

O. A. Hoberg	MSFC Co-Chairman
H. Golden	MSFC Co-Secretary
J. McKenzie	MSC Co-Secretary
F. H. Kurtz	MSFC Member
L. Bell	MSFC Member
T. A. Stuart	MSC Member
H. Kyle	MSC Member
J. J. Hibbert	Bellcomm Member
J. C. McClanahan	MSF Member
R. L. Owen	GSFC Member
P. S. Goodwin	JPL Member
L. M. Robinson	OTDA Member
D. D. Collins	KSC Member
D. C. McMath	KSC Member
W. R. Stelges	KSC Member
T. A. Barr	MSFC
J. Shaughnessey	MSC
D. J. Hudson	MSC
C. A. Beers	MSC
R. G. Irvin	MSC
C. C. Williams	MSC
P. H. Vavra	MSC
J. White	KSC
R. W. Blanchard	KSC
J. T. Raleigh	Bellcomm
P. F. Sennewald	MAS/Bellcomm
G. Jacobson	MSF
W. P. Varson	GSFC
P. F. Barritt	OTDA
N. A. Renzetti	JPL
J. E. Rorex	MSFC

Action Item Status  
Instrumentation and Communication Panel

Enclosure 2

Item No.	Item	Responsi- bility	Status	Due
13-1	OTDA will report to the I&CP on the development of a NASA position in regard to vacating the VHF telemetry band by 1970.	Mr. Robinson OTDA		At next Panel meet- ing
13-2	Panel members must determine the impact if switching to the S-Band telemetry band by 1970 is to become a requirement. This impact must be considered from both the space vehicle and supporting ground aspects. The Panel members must be prepared, if required, to discuss this in the next Panel meeting.	All Panel members		By next Panel meet- ing
13-3	Action items 12-8 called for the determination of problem areas for SA-201, 202, and 501. Since Mr. Broome will be reporting to the PRB on SA-201 problem areas, the Panel again asks that each Panel member review this vehicle, and immediately report to Mr. Broome any items that are problems or even just warrant investigation.	All Panel members		April 12, 1965
13-4	GSFC will prepare a summary and status report on the MSFN capabilities in support of SA-501. This report is proposed to be given at the next Flight Dynamics, Mechanics, Guidance and Control Panel meeting.	Mr. Owen GSFC		At the next FDMG & CP meet- ing

Action Item Status  
Instrumentation and Communication Panel

Enclosure 2

Item No.	Item	Responsibility	Status	Due
13-5	The Panel co-secretaries shall investigate getting 13-4 on the agenda of the next FDMG&CP meeting.	Mr. Golden MSFC		Immed
13-6	The USB Implementation Sub-Panel will review the design specifications of all the USB transponders (including CCS). They will identify those design parameters that must be identical. This will enable the ground implementors to eliminate unnecessary procedural and design modifications.	Mr. Varson GSFC		9/1/65
13-7	JPL is to advise MSFC on the amount of attenuation that is necessary to the LHz TV transmitter sidebands in the 2290-2300 MHz band.	Mr. Goodwin JPL		5/1/65
13-8	MSFC in turn will investigate the possible methods to avoid interference in this band.	Mr. Barr MSFC		5/1/65
13-9	A letter shall be written to the Flight Control Operations Panel (FCOP) stating MSFC's SA-203 orbital command requirements and asking the FCOP to clarify MSC's position on the use of the Mission Control Center, Houston in support of SA-203.	Mr. Golden MSFC Mr. Kurtz MSFC		4/15/65

## GROUND RULES

1. PRIMARY FUNCTION:  
    LAUNCH SUPPORT  
    ABORT SUPPORT
2. PROVIDE GAP COVERAGE BETWEEN MILA AND BDA DURING LAUNCH
3. PROVIDE S-BAND TRACKING DURING ABORT
4. MOBILE SINGLE S-BAND FACILITY
5. IF S-BAND RANGING REQUIRED, USE JPL RECEIVER/EXCITER AND RANGING SUBSYSTEM
6. STATION SHOULD HAVE MISSION SUPPORT CAPABILITIES
7. ACQUISITION INFORMATION WILL BE PROVIDED
8. GROUND TRANSMITTER POWER  $\geq$  S/C TRANSMITTER + 10 DB, ASSURES UP-LINK LOCK CAPABILITY IF DOWN-LINK LOCK IS FEASIBLE

## MOBILE USE STATION

### CAPABILITIES:

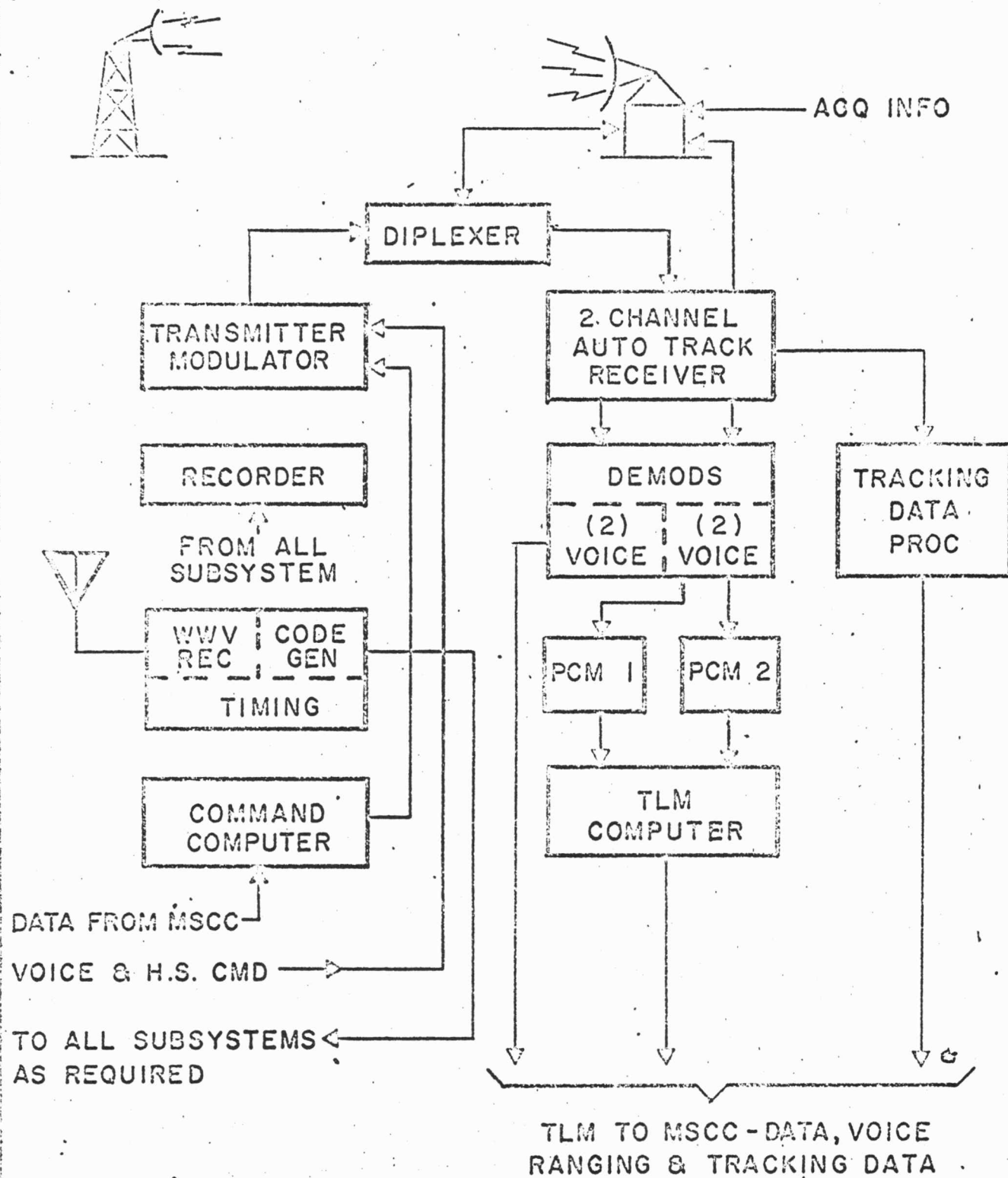
1. SINGLE USE EQUIPMENT
2. UP-DATA, VOICE, AND S/C TLM
3. TRACKING DATA
4. REDUNDANT TLM AND VOICE
5. DATA PROCESSING
6. DATA TRANSMISSION TO MSCC

### OPTIONS:

1. AS ABOVE WITHOUT BACKUP TLM
2. AS ABOVE WITHOUT TRACKING DATA
3. AS ABOVE WITHOUT BACKUP TLM  
AND TRACKING DATA



# RECOMMENDED SYSTEM'S BLOCK DIAGRAM



# ANTENNA SYSTEMS CONSIDERED

ANTENNA TYPE	USB 30'	SYNCOM 30'	S-A/TACO 30'	SYNCOM 16'	S-A/TACO 10'
COST	360K	330K	235K	325K	175K
ACCURACY	0.025°	0.05°	0.15°	0.05°	0.25°
MOUNT	X-Y	AZ-EL	AZ-EL	AZ-EL	AZ-EL
0.5 PWR B.W.	1°	1°	1°	2°	2°

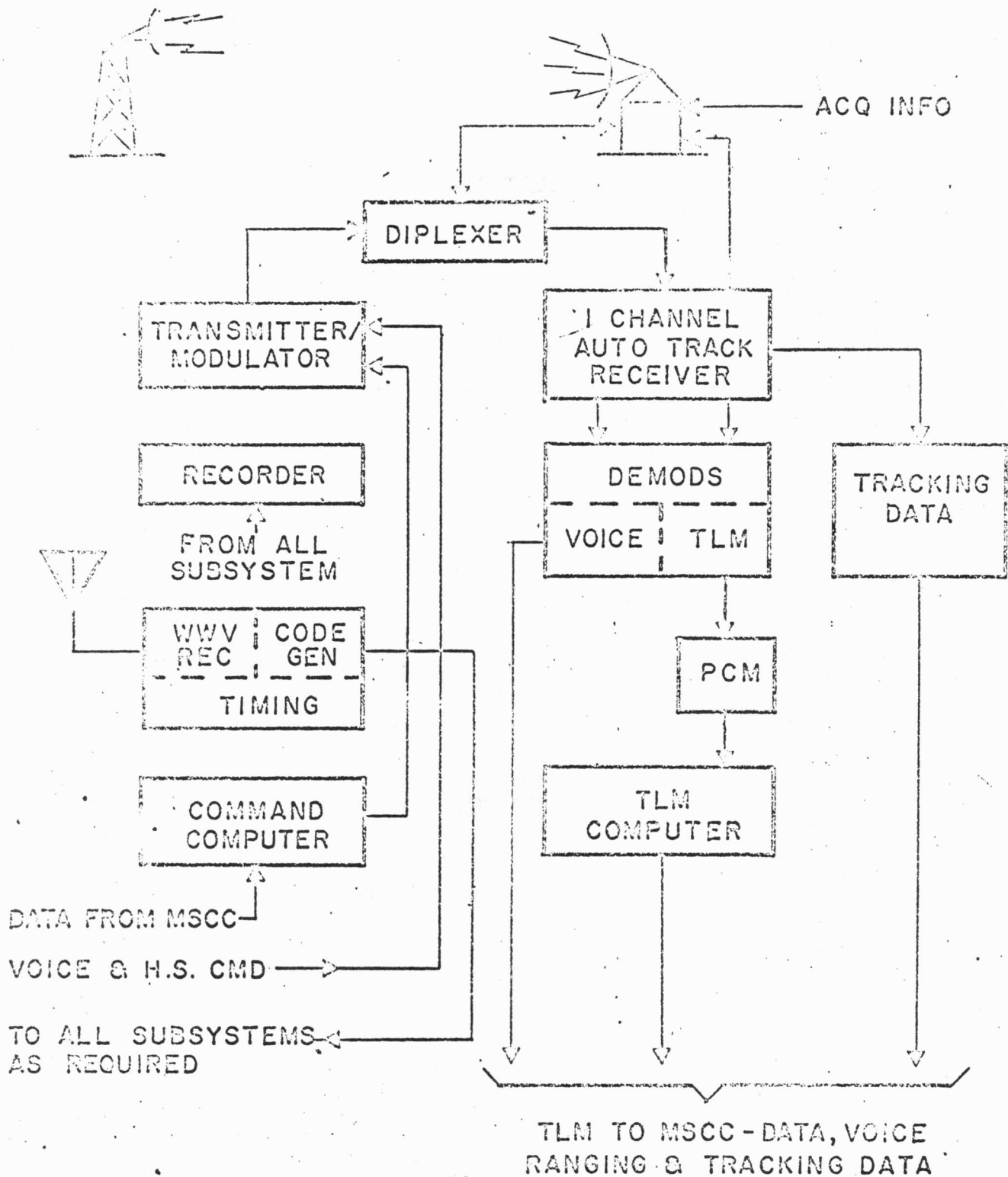
ENC: 3

# RECOMMENDED SYSTEM'S COST

ANTENNA SYSTEM (SYNCOM 30')	330K
COLLIMATION SYSTEM	75K
RF SUBSYSTEM	300K
NETWORK EQUIPMENT	1,320K
TRACKING DATA EQUIPMENT	340K
SPARES	250K
STANDARD TEST EQUIPMENT	200K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	245K
10% CONTINGENCY	330K
TOTAL	3,900K

ENC:

# OPTION No. 1 SYSTEM'S BLOCK DIAGRAM

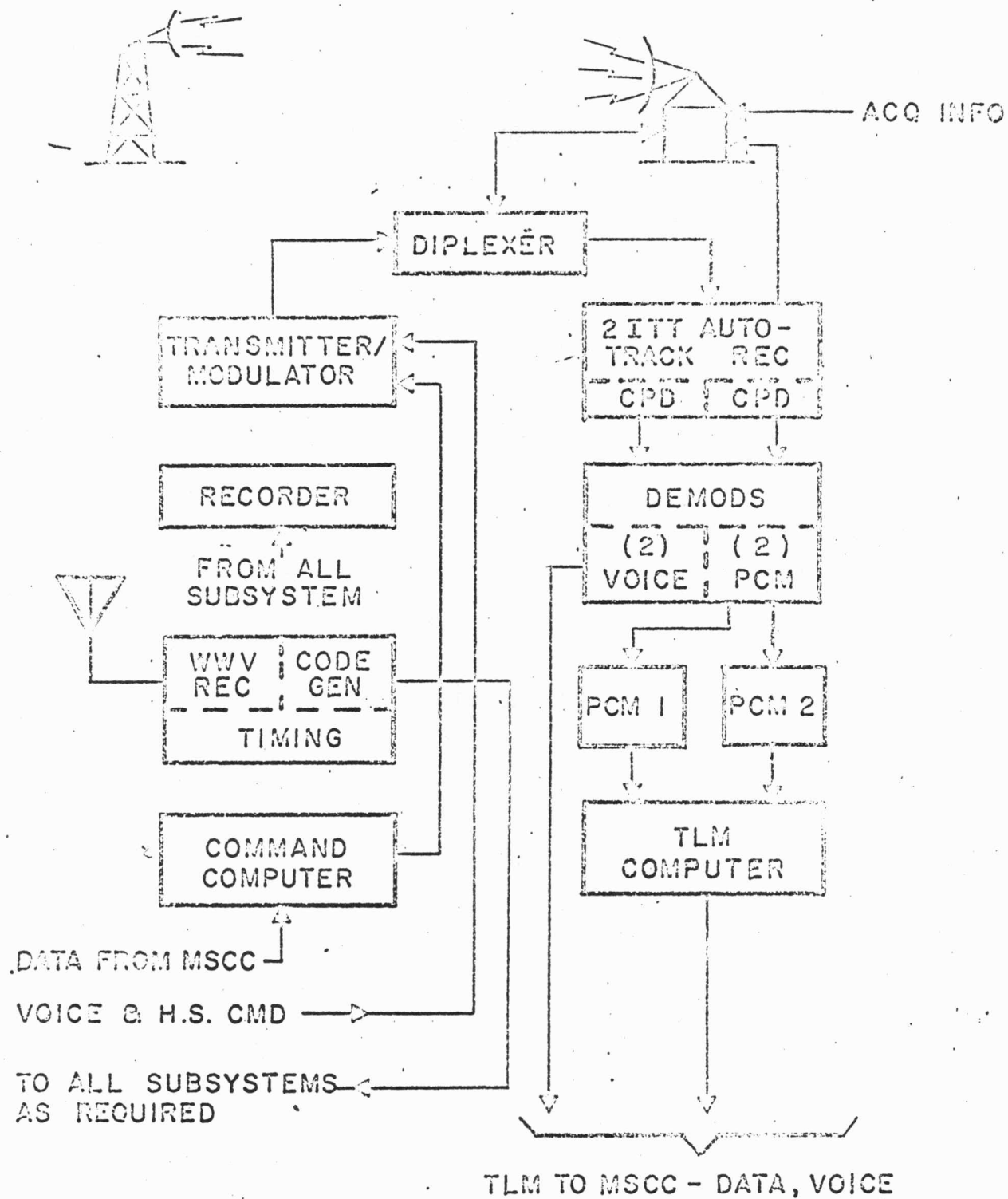


ENC:

OPTION #1 SYSTEM'S COST

ANTENNA SYSTEM (SYNCOM 30')	330K
COLLIMATION SYSTEM	75K
RF SUBSYSTEM	700K
NETWORK EQUIPMENT	1,170K
TRACKING DATA EQUIPMENT	340K
SPARES	225K
STANDARD TEST EQUIPMENT	200K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	230K
10% CONTINGENCY	330K
TOTAL	3,640K

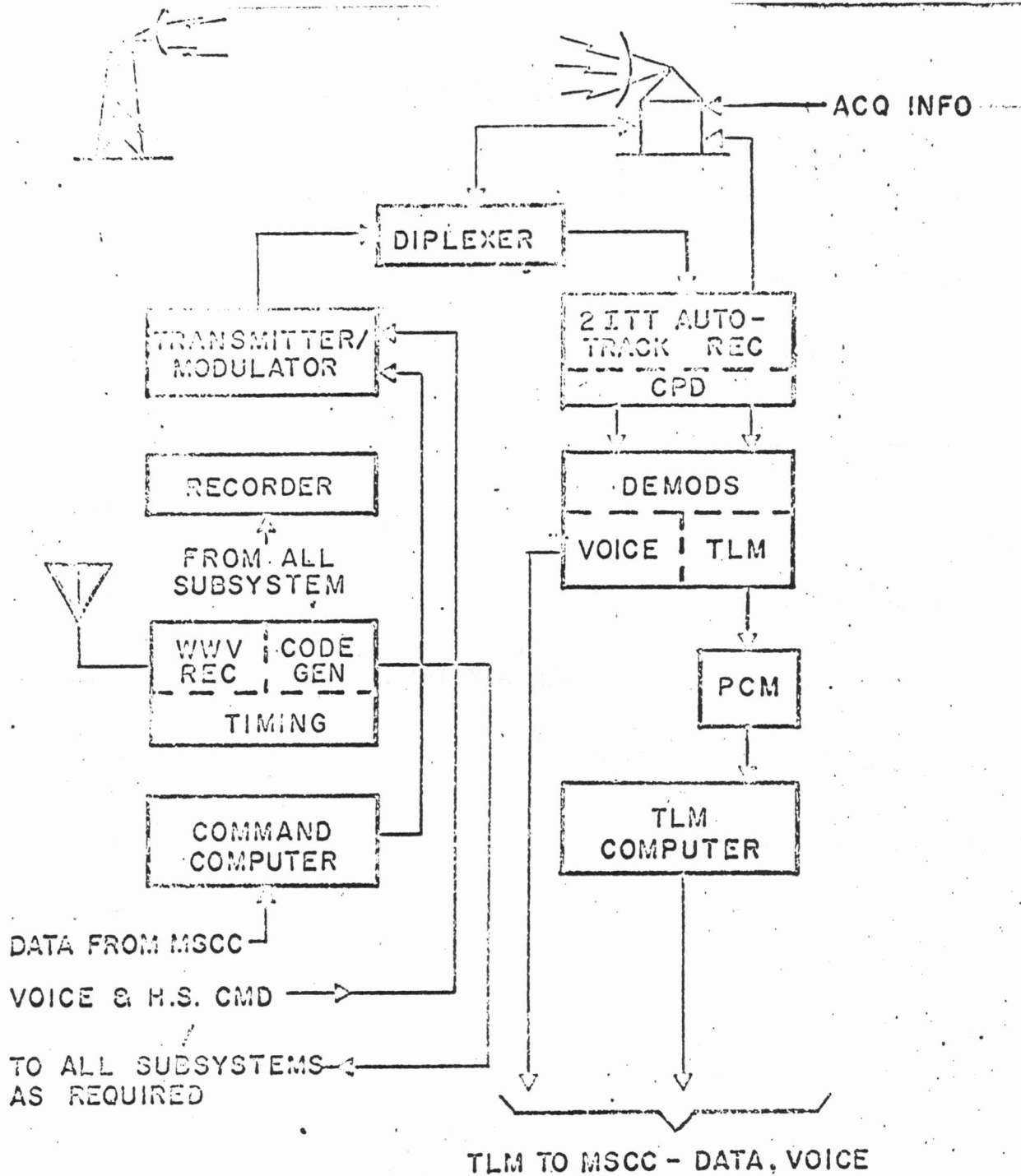
# OPTIONAL NO. 2 SYSTEM'S BLOCK DIAGRAM



OPTION #2 SYSTEM'S CCST

ANTENNA SYSTEM (S-A/TACO 16')	175K
COLLIMINATION SYSTEM	75K
RF SUBSYSTEM	450K
NETWORK EQUIPMENT	1,320K
SPARES	200K
STANDARD TEST EQUIPMENT	180K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	200K
10% CONTINGENCY	265K
TOTAL	2,905K

# SYSTEM'S BLOCK DIAGRAM





### OPTION #3 SYSTEM'S COST

ANTENNA SYSTEM (S-A/TACO 16')	175K
COLLIMINATION SYSTEM	75K
RF SUBSYSTEM	400K
NETWORK EQUIPMENT	1,170K
SPARES	180K
STANDARD TEST EQUIPMENT	170K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	180K
10% CONTINGENCY	240K
TOTAL	2,630K

# ANTENNA EQUIPMENT VARI



MAINT., STORAGE, AND TEST EQPT. (APPROX. 30' x 3')

SERVO  
CONT.

ENC  
REC  
#1

REC  
#2  
ENC &  
R.REC

MAIN  
REC

ISO AMPS

REC  
#2  
RENG  
SYS

DEMOC  
& SCO

PATCH

TRNG  
FORMAT

MARK &  
STOR-  
AGE  
(4' x 8')

DESK

FILE

FILE

TIME

W.B. RCD

ANA  
RCD

VER  
REC

INTER COMM

DATA  
MODEM (4)

MARK &  
STOR-  
AGE  
(4' x 8')

PCM NO. 1

PCM  
SIM

PCM NO. 2

CDF

ASR

SWITCH  
1200

(4)  
DTU's

TAPE  
IN/OUT

1213  
32K MEM

I/O  
CONSOLE

DCS  
MOD  
DEMOC

1213  
32K MEM

I/O  
CONSOLE

TAPE  
IN/OUT

2 HQ  
2 TR  
COMM  
TEST &  
PATCH

MAINT., STORAGE, AND TEST EQPT. (APPROX. 30' x 3')

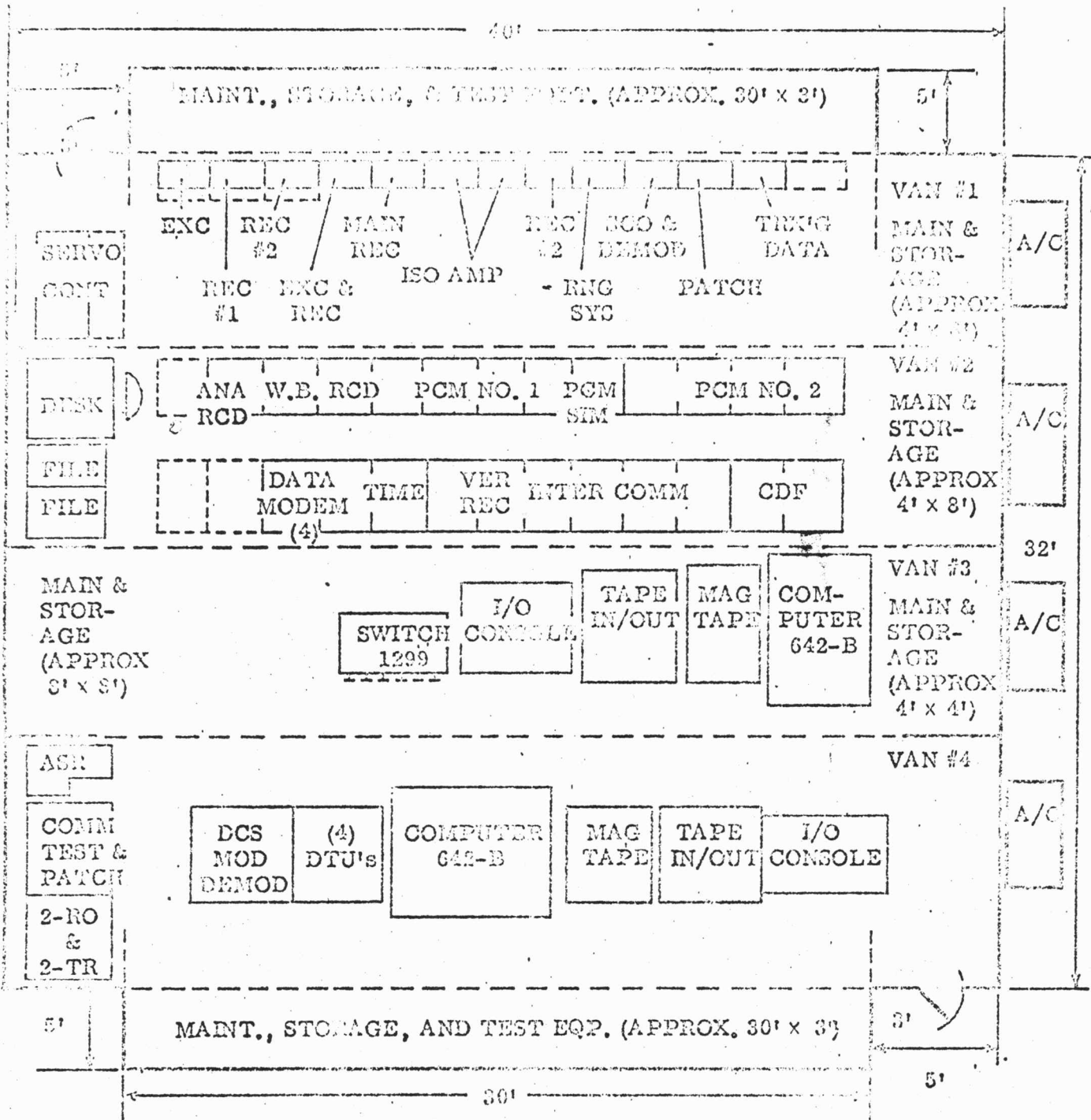
3'

30'

5'

ENC: 3

MOBILE S-BAND SITE



### MOBILE S-BAND SITE

MOBILE XMIT, DUAL REC'G, AND RANGING CAPABILITIES  
WITH 642-B DATA PROCESSOR SYSTEM

UNITED STATES GOVERNMENT

# Memorandum

TO : TA/Mr. C. R. Morrison  
Director, Program Support and Advanced Systems

DATE: MAR 30 1965

FROM : TN/Chief, Communications and Frequency Management

SUBJECT: Frequencies for telemetering

REF : Verbal request for a statement; L.M.R. - 29 March 1965

NASA is aware of the decision taken by the military to withdraw their telemetry operations from the 225-260 Mc/s band in favor of air-ground communications by 1 January 1970.

NASA currently plans to continue to use the 44 channels utilized for telemetry in the 225-260 Mc/s band. Our laboratories, test centers, data read-out stations, and launch facilities will retain their transmitting, receiving, and test capabilities in the band.

In addition, it is understood that the DOD National Ranges will retain their telemetry receiving ability in this band, thus continuing to support NASA projects and launches using these frequencies.



Paul A. Price

Enclosure 4



## GENERAL

1. Definition of Operational and R&D is not the same at MSFC and MSC. A more universal breakdown is recommended.

2. Don't agree with problem classification

Propose:

a. Major Problem - One requiring a schedule or large cost impact decision or action. Also, items that are in development and have been found to be either technically unworkable or incompatible.

b. Minor Problem - One causing complications but requiring no schedule impact nor sizeable cost increase.

c. In development - Item under development with only complications that are encountered in normal engineering development. Also on items that have never flown, which have been completed and tested in labs, but still may encounter a problem during actual flight and require modification.

3. MSFC will have a mission on some flights after separation of the spacecraft and S-IVB/IU. For example on SA-204, MSFC will have a requirement for 4 orbit support on C-Band Radar, Telemetry, and Command.

4. Mission 207 which is used as an example for the Saturn IB is not a complete representation of both the launch vehicle and spacecraft. SA-204 should also be used as an example.

5. An explanation of the present configuration of the Mission Control Data telemetry setup is included to give Headquarters a better understanding of the launch vehicle's approach.

The first interconnection of multiplexers S-IVB/IU, occurs on SA-204. In this case all S-IVB MCD is routed to one Mux. and wired to the IU's PCM for telemetry. One IU mux, with no MCD is wired to the S-IVB's PCM. The net result is all S-IVB/IU MCD on SA-204 is transmitted from only the IU. On SA-205 and subsequent Saturn IB's both the IU and S-IVB will transmit this data. SA-501, 502, and 503 will have the same configuration as SA-204 with the subsequent Saturn V's having the same as SA-205.

The S-Band telemetry will be paralleled to the IU's PCM and CCS is paralleled to the S-IVB's PCM.

NOTE: On all vehicles, even when the MCD is redundant, the computer bit stream portion of the MCD is not.

## Individual Charts

### Hibbert

#### 1. Mission 207

- a. Add Radar to C-Band
- b. Add partial to transposition and docking under,
  - (1) S-IVB telemetry
  - (2) IU Telemetry
    - Command
    - C-Band Radar

#### 2. Communication Problem Areas (11)

- a. Add new category E - in development
- b. Change CCS from R to E
- c. Change S-Band Telemetry from Y to E
- d. Add S-Band Telemetry Antenna and classify as E
- e. Add C-Band transponder antenna, G on 201 and 202 - E on remainder
- f. AZUSA - leave blank except for 201, 202, and SA-203 - G in those
- g. MISTRAM - eliminate Y in 203 - leave blank, the rest remains the same.
- h. Add CCS Antenna - E under 501, 502, 503, and 504, et. seq.
- i. Radar Altimeter - Change Y to R all the way across.

#### 3. Problem Areas IV

- a. This chart should be revised to update comments to preceding items.
- b. General comments.
  - (1) Antennas called out are in development
  - (2) Radar Altimeter represents a major problem because of the lack of an official decision from Headquarters. MSFC still desires to fly it on the R&D vehicles.
  - (3) The choice of the MISTRAM will mean some additional development is necessary. The system must be updated and modernized.

### McClanahan

#### 1. Saturn IB

- a. See general comment 1
- b. 2nd Chart (individual vehicles)
  - (1) MISTRAM removed on SA-203 and eliminate (a) from rest.
  - (2) Eliminate AZUSA on SA-204
  - (3) On Operational telemetry PAM/FM/FM becomes straight FM/FM.
  - (4) Operationally the S-IVB is presently agreed as 1 PCM/FM with provisions for 1 FM/FM.

## 2. Saturn V

a. See general comment 1

b. 2nd Chart (individual vehicles)

(1) SA-504 and 505 will have operational telemetry systems in the IU and S-IVB.

(2) PC/FM should be PCM/FM.

(3) PAM/FM/FM becomes FM/FM on operational vehicles.

(4) Operationally the S-IVB is presently agreed to as 1 PCM/FM with provisions for 1 FM/FM.

(5) ODOP is presently scheduled for all Saturn V's.

(6) Special Television has been eliminated from SA-501.

(7) S-II split system 504 and 505 consists of 1 PCM, 1 PAM/FM/FM, 2 FM/FM, 1 SS/FM, operationally will be 1 PCM/FM, 2 FM/FM.

c. 3rd Chart (IU)

(1) See b-1

(2) See b-3

(3) Add 1 next to MISTRAM all the way across.

(4) Eliminate AZUSA.

(5) Add 503 to Radar Altimeter.

UNIFIED S-BAND

(1) SIGNAL DESIGN NOT COMPLETE:

- (A) LEM: SIGNAL DESIGN COMPLETE BASED ON FM LUNAR STAY MODE. MSFN-LEM P & I SPEC. WILL BE CONTRACTUALLY NEGOTIATED WITH GAEC BY 30 APRIL 1965.

UNUSUAL PROBLEMS: NONE

POSSIBLE PERTURBATIONS:

- LUNAR STAY MODE CHANGE FROM FM TO PM - DECISION BY 15 APRIL 1965.
- UDL INCLUSION IN LEM - DECISION BY 20 MAY 1965

- (B) BLOCK II CSM: SIGNAL DESIGN COMPLETE; BLOCK II CSM-MSFN P & I SPEC HAS BEEN NEGOTIATED INTO NAA CONTRACT.

POSSIBLE PERTURBATION:

- CHANGE OF PLAYBACK PCM SCO FROM 1.024 TO 256 KC - DECISION BY 20 APRIL 1965.

UNUSUAL PROBLEMS: NONE

- (2) ACQUISITION PROCEDURE: ACQUISITION PROCEDURE WAS AGREED UPON BY "ACQUISITION PROCEDURE WORKING GROUP" ON 5 FEBRUARY 1965. THIS PROCEDURE IS ACCEPTABLE FOR BLOCK II AND, WITH MINOR MODIFICATION, FOR BLOCK I. IMPACT OF MODIFICATION TO LEM TRANSPONDER TO MAKE IT COMPATIBLE, ACQUISITION-WISE, WITH BLOCK II TRANSPONDER IS BEING INVESTIGATED. DECISION DUE BY 30 APRIL 1965.

UNUSUAL PROBLEMS: POSSIBLY THE USE OF THE 3-FOOT ACQUISITION DISH FOR TRANSMISSION.



- (3) RECEIVER DYNAMIC RANGE: ISD REQUESTED GSFC BY TWX ON 25 JANUARY 1965 TO PROVIDE GROUND TRANSMITTER POWER CONTROL. GSFC HAS NOT YET RESPONDED. A PROBLEM OF RECEIVER SATURATION THEREFORE STILL EXISTS DURING PRE-LAUNCH CHECKOUT AND EARLY LAUNCH PHASES.

UNUSUAL PROBLEMS: NONE

- (4) RANGE OF RECEIVER VCO: SAME COMMENT AS FOR "ACQUISITION PROCEDURE".
- (5) LEM ADAPTER PANEL ANTENNA INTERFERENCE: POSSIBLE COMMUNICATIONS PROBLEM FOR EO TRAINING FLIGHTS. NAA IS ALLEVIATING PROBLEM BY INCLUDING S-BAND CAPABILITY ON SM SCIM. ANTENNA.

UNUSUAL PROBLEMS: NONE

- (6) REENTRY BLACKOUT: IN 1961-62, STUDIES SHOWED NO PRACTICAL METHOD FOR PROVIDING REENTRY COMMUNICATION. RE-EVALUATION OF REQUIREMENT SHOWED THAT, ALTHOUGH DESIRABLE, NO MANDATORY REQUIREMENT EXISTED. PROGRESS TO DATE HAS SHOWN NO REAL CHANGE FROM HARDWARE STATUS IN 1962. MSC THEREFORE MAINTAINS ITS POSITION THAT REENTRY COMMUNICATIONS IS NOT AN APOLLO REQUIREMENT.

UNUSUAL PROBLEMS: NONE

- (7) HARD COPY UP-DATA PRINTOUT: RE-EVALUATION OF REQUIREMENTS VS IMPACT RESULTED IN ELIMINATION OF HCP REQUIREMENT.

UNUSUAL PROBLEMS: NONE

- (8) UP-DATA LINK NEED: GAEC IS ASSESSING IMPACT OF LEM UDL IMPLEMENTATION. MSC IS ASSESSING NEED. DECISION DUE BY 20 MAY 1965.

UNUSUAL PROBLEMS: POSSIBLE ADVERSE SCHEDULE IMPACT.

- (9) LIMITED FLIGHT TESTS: ONLY PRIME OPNL FUNCTION NOT REDUNDANT ON EARLY BLOCK II FLIGHTS IS TLM. MSC DOES NOT PLAN TO BACKUP THIS FUNCTION SINCE THE PCM CHANNEL CIRCUITRY IS NOT CHANGED OR MODIFIED FROM THE BLOCK I CIRCUITRY.

UNUSUAL PROBLEMS: NONE

- (10) TELEVISION QUALITY: PREVIOUS CONDITIONS AND CALCULATIONS RESULTED IN A NEGATIVE TELEVISION SIGNAL MARGIN. SHORTENING THE ANTENNA CABLE AND REDUCING REQUIRED RECEIVER BANDWIDTH HAVE RESULTED IN POSITIVE MARGIN OF 2.4 DB ABOVE THE GSFC REQUIRED 10 DB S/N INTO THE DEMODULATOR (MSC TESTS SHOW 6 DB TO PROVIDE ADEQUATE PICTURE QUALITY).

UNUSUAL PROBLEMS: NONE

- (11) S-BAND OMNI ANTENNA PATTERNS: BLOCK I AND II CSM AND LEM ARE TOO LARGE FOR TRUE OMNI COVERAGE FROM SINGLE ANTENNA ELEMENT. MULTIPLE ELEMENTS, ANTENNA ORIENTATION AND ANTENNA SWITCHING ARE THEREFORE USED TO MEET REQUIRED COVERAGES.

- A. BLOCK I CSM: PATTERNS FIRM AND AVAILABLE; ATTITUDE PROGRAMMING FOR FLIGHTS 204 AND 205 HAS BEEN ALLOCATED BY ASPO FOR S-BAND SYSTEM QUALIFICATION.
- B. BLOCK II CSM: S-BAND "OMNI" ANTENNA ELEMENTS HAVE BEEN SPECIFIED FOR BOTH CM AND SM TO PROVIDE MAXIMUM POSSIBLE LAUNCH, INJECTION, EO, INSERTION AND ENTRY S-BAND TRANSMISSION CAPABILITY. PATTERNS WILL BE AVAILABLE AUGUST, 1966.
- C. LEM: 1/6 SCALE AND FULL-SCALE FREE SPACE PATTERNS WILL BE AVAILABLE BY APRIL 30, 1965.

UNUSUAL PROBLEMS: NONE

- (12) LACK OF HIGH-GAIN ANTENNA: REFERS TO SA 501 AND 502. EARLY TRAJ.'S SHOWED 12 KNM MAX RG; LATEST TRAJ. SHOWS 7500 NM. NO HIGH-GAIN ANTENNA REQUIRED FOR 7500 NM. SHOULD MAX RG GO BACK UP, HIGH-POWER VHF TRANSMITTERS WILL BE PROVIDED AS REQUIRED.

UNUSUAL PROBLEMS: NONE

- (13) HIGH-GAIN ANTENNA LIMITATIONS/FIELD OF VIEW/AUTO. POINTING RELIABILITY:

PROBLEMS:

- A. UP TO 500 MANUAL RE-ACQS PER FLIGHT.
- B. NO CAPABILITY FOR AUTO. RE-ACQ FOR SLEEPING ASTRONAUT
- C. IR COULD LOCK ON FALSE TARGETS
- D. UNIFORM RF ILLUMINATION OF EARTH NOT PROVIDED AT MINIMUM TRANSPOSITION RANGE

SOLUTIONS:

- A. } UTILIZATION OF INERTIAL REFERENCE DATA FROM SCS WITH
- B. } RATE INTEGRATION AND COORDINATE CONVERSION. LIMIT
- C. } SENSORS PREVENT S/C SKIN TRACK.
- D. MAXIMUM BEAMWIDTH HAS BEEN EXPANDED FROM 35° TO 80°.

ENC: 6

VHF VOICE AND TELEMETRY

(1) OMNI ANTENNA COVERAGE:

- A. BLOCK I CSM: PATTERNS AVAILABLE NOW.
- B. BLOCK II CSM: PATTERNS SCHEDULED FOR AUGUST, 1965.
- C. LEM PATTERNS AVAILABLE.

UNUSUAL PROBLEMS: NONE

(2) ANTENNA POLARIZATION (CSM-LEM):

LEM - CIRCULAR

CSM - ELLIPTICAL

PROBLEM: POSSIBLE LOSS OF GAIN DUE TO ANTENNA MISMATCH OF UP TO TWO DB.

UNUSUAL PROBLEMS: NONE

(3) MESSAGE ACCEPTANCE PULSE:

MAP DATA WORD WILL BE PROVIDED ON BOTH HBR AND LBR PCM FORMATS FOR BOTH BLOCK I AND II CSM'S.

UNUSUAL PROBLEMS: NONE

(4) LIMITED RANGE (CSM-LEM):

- A. VOICE: MAX. CALC. RG: 550 NM  
MAX. SPEC. RG: 550 NM  
MAX. LOS RG: 125 NM
- B. LBR PCM: MAX. CALC. RG: 300 NM  
MAX. SPEC. RG: 320 NM  
MAX. LOS RG: 125 NM

UNUSUAL PROBLEMS: NONE

C-BAND TRANSPONDER

(1) OMNI ANTENNA PATTERNS:

- A. BLOCK I AND II CSM: OMNI COV. EFFECTIVELY ACHIEVED BY USE OF COMPARATOR TRANSPONDER.
- B. LEM: DEVELOPMENT AND TRAINING FLIGHTS WILL UTILIZE GFE C-BAND TRANSPONDER (AN/DPN-66) SUCH AS WAS SUCCESSFULLY FLOWN ON BP-12, 13, 23, 15, AND 22. LEM ANTENNA LINE DIAMETER IS ALMOST SAME AS BP ANTENNA LINE DIAMETER. LEM PATTERNS SHOULD BE SIMILAR.

UNUSUAL PROBLEMS: NONE

(2) COMPARATOR SWITCHING: TECHNIQUE PROVEN BY MSC TESTS CONDUCTED AT EGLIN AFB.

- A. CSM: COMPARATOR TRANSPONDER
- B. LEM: NO COMPARATOR

UNUSUAL PROBLEMS: NONE

UHF UP-DATA

REFERS TO 501 AND 502 MAXIMUM ALTITUDE BEING BEYOND 450 MC TRANSMISSION SYSTEM RANGE. S/C ALSO HAS S-BAND CAPABILITY WHICH DOES REACH MAXIMUM RANGE.

RENDEZVOUS RADAR AND TRANSPONDER

- (1) CSM RENDEZVOUS RADAR: DELETED
- (2) CSM RENDEZVOUS RADAR TRANSPONDER: NO MAJOR TECHNICAL PROBLEMS
- (3) LEM RENDEZVOUS RADAR: NO MAJOR TECHNICAL PROBLEMS
- (4) LEM RENDEZVOUS RADAR TRANSPONDER: DELETED

UNUSUAL PROBLEMS: NONE

Enc: 6

### X-BAND LANDING RADAR

ACCURACY IS PRESENTLY A PROBLEM. SCHEDULE IS OKAY. NO OTHER MAJOR TECHNICAL PROBLEMS.

### MISCELLANEOUS

- (1) USB COVERAGE DURING LAUNCH: SEE "S-BAND OMNI ANTENNA PATTERNS".
- (2) TRACKING TGTS SEPARATED BY MORE THAN ONE BEAMWIDTH: USE OF BOTH "C" AND "S" BAND EQUIPMENT ON THE LEM AND THE CSM FOR DEVELOPMENT AND TRAINING FLIGHTS ALLEVIATES PROBLEMS.
- (3) COVERAGE DURING REENTRY IF NO SKIP OUT: C-BAND RADAR TRACK OF PLASMA SHEATH.
- (4) NEED FOR INCR. VHF TLM AND C-BAND RADAR TRACK RG FOR 501 AND 502: MAXIMUM RG HAS BEEN LOWERED; S-BAND IS ONBOARD; HIGH-POWER VHF TLM TRANSMITTERS ARE AVAILABLE.

UNITED STATES GOVERNMENT

# Memorandum

TO : Otto Hoberg, Chairman  
Instrumentation and Communications Panel

FROM : W. P. Varson, Chairman  
USB Implementation Subpanel

SUBJECT: GSFC's Comments on McClanahan/Hibbert Presentation

DATE: April 23, 1965

In addition to the problem areas identified by Messrs. Hibbert and McClanahan in their discussion at the last Instrumentation and Communications (I&C) Panel meeting, GSFC is still concerned about the first use of the Block II spacecraft equipment needed for operational support. All of the qualification tests of the spacecraft against the network are conducted with Block I equipment. There will be no Block II flights prior to the time that the network is required to provide primary mission support data with the Unified S-Band (USB) equipment. This is considered to be a serious problem. The following comments are provided for the listed Manned Space Flight Network (MSFN) problem areas:

## 1. Acquisition Methods by the USB System

There has been considerable work and coordination in this area by MSC, JPL, and GSFC; and acquisition procedures have been developed to the point where only refinements are required. It is expected that these procedures have been developed in sufficient detail to define the design of the equipment. Since they will probably require extensive modification after the first operational use of a USB station, further effort in this area at this time is not considered worthwhile.

## 2. Improve Capability for Carnarvon and Ascension

GSFC has secured a proposal from the Collins Radio Company which shows that it is practical to achieve a 3 db improvement by the use of a cooled parametric amplifier. Further improvements of 1 db to  $1\frac{1}{2}$  db can be achieved at considerable increase in cost and complexity to the equipment. However, this additional 1 db to  $1\frac{1}{2}$  db is not considered warranted in view of the resulting increase in operational complexity and decrease in reliability of the equipment. GSFC further questions the need for this improvement in view of the fact that the spacecraft high-gain antenna is to be employed at an altitude of approximately 2,500 nautical miles. It appears that the use of the high-gain antenna would alleviate the need for improved sensitivity of the stations.



Subject: GSFC's Comments on McClanahan/Hibbert Presentation

3. Reliability of Ships, Aircraft, and Ground Stations  
Depending on HF Communications

The transmission of wideband data over HF radio links and their general reliability is a problem which has always been present in the network. The communications network uses diversified routing to improve the HF transmission paths. However, these are subject to physical limitations which cannot be overcome. It does not appear that any great improvement in the reliability of communications from these stations can be accomplished until communications satellites become operational. GSFC is currently exploring the feasibility of using these systems and there are programs under discussion at NASA Headquarters for the implementation of communications satellites for the network. One (1) example is the successful use of the SYNCOM satellite to provide communications with the Indian Ocean ship for GT-3.

4. RFI on Apollo Aircraft

The Apollo aircraft are being instrumented by the Air Force in conjunction with the NASA-prepared specifications. GSFC is not aware of any RFI problem currently existing or expected on these aircraft, however, this is receiving explicit study during the PDP by the two (2) selected contractors. The required study includes a complete analysis of all spurious or undesired signals which may degrade the operation of any on-board system. Also included is filtering, isolation, and a special study of Multipath RF interference.

5. USB System Coverage During Launch

This problem has been under considerable study by the Subpanel established by the I&C Panel. As you know, the Subpanel reported to General Phillips on April 1, 1965, and recommended a station be implemented at Grand Bahama Island to fulfill this coverage.

6. Polarization Diversity for the USB System

There has been considerable study of the requirement for polarization diversity for the USB System. The feeds of the USB System are presently equipped for polarization diversity. A cost estimate has been prepared which indicates that 5 to 6 million dollars would be required to implement polarization diversity for the command module data channel only. Due to the expense and complexity of the equipment, it is not desirable to implement this in the network unless absolutely



Subject: GSFC's Comments on McClanahan/Hibbert Presentation

necessary. The ground specifications for the Block II S-band omnidirectional antenna if they are achieved by North American Aviation, will not require the use of polarization diversity in the network. There can be no firm decision on whether or not polarization diversity is required until the spacecraft antennas are defined.

7. Tracking of Multiple Targets Separated by More than One Beamwidth of the USB System

The network is capable of tracking with both the USB System and the C-band radars. If simultaneous tracking of two (2) vehicles is required, it is recommended that the mission be arranged so that C-band radars can be used to track one (1) vehicle while the USB System is tracking the second vehicle. There is no stated requirement for the USB System to track two (2) vehicles separated by more than one beamwidth.

8. Availability of Apollo Ships

The number of ships required has been established by the Office of Manned Space Flight. The scheduling of these ships is a mission requirement, and it is expected that it would vary from mission to mission. The only solution to this problem appears to be scheduling since the number of ships being implemented to support the Apollo program is fixed.

9. Requirement for Third PCM

This has been resolved in favor of supplying the third PCM at the network stations. As soon as this is formalized, GSFC will implement procurement plans to provide the third PCM.

10. Reprogramming of Computers for Flight Controllers Between Missions

The reprogramming of the on-site computers is recognized by GSFC to be a major task. It is planned to implement a programming capability as part of the network support team at the Mission Control Center. It is expected that the programs will be written so that changes of the type required by the flight controllers can be introduced without a major reprogramming activity.

Subject: GSFC's Comments on McClanahan/Hibbert Presentation

11. Coverage During Re-entry if no Skip-out Occurs

Communications through the plasma sheath during re-entry is a serious problem and to date, GSFC is not aware of any technique which can be expected to penetrate the plasma. GSFC is considering the feasibility of using HF-type radars to track the plasma sheath at long ranges as backup to other re-entry coverage so that in the event of non-programmed re-entries, it will be possible to determine the trajectory of the spacecraft during the blackout period.

12. Need for Increased VHF Capability and Range Capability on 501 and 502

To our knowledge, there has been no stated requirement to increase the capability of the ground VHF equipment for support of these missions. It is our understanding that MSC will increase the transmitter power of the spacecraft if communications at ranges in excess of those which currently can be provided are required.

13. HF Voice Compatibility Between Spacecraft and Ground Equipment

It is our understanding that although the spacecraft has a capability of receiving double sideband information on the HF channel that NASA has not been able to obtain the frequency allocation necessary for transmission of both sidebands. Therefore, the transmission of a single sideband-type HF information is required. GSFC is presently preparing the procurement plans to obtain single sideband HF transmission for the network.

W. P. Varson

512:WPV:brs.

APOLLO

LAUNCH TO INSERTION

OPERATIONAL SUPPORT REQUIREMENTS

2208

The information in this paper is unedited and is not official FGD information. It is released to provide rapid circulation and may later be incorporated in a formal paper.

## LAUNCH TO INSERTION DATA COVERAGE REQUIREMENTS

COVERAGE REQUIREMENTS	NOMINAL AND CONTINGENCY INSERTION PHASES	LAUNCH ABORT PHASE
TRACKING	CONTINUOUS	FROM INITIATION TO CSM SPS CUT OFF PLUS 1 MINUTE
TELEMETRY	CONTINUOUS	FROM INITIATION TO CSM SPS CUT OFF
VOICE	CONTINUOUS	FROM INITIATION TO APPROXIMATELY PLUS 3 MINUTES
COMMAND	CONTINUOUS	UNDEFINED AFTER INITIATION

## LAUNCH TO INSERTION DATA USE

### TRACKING

- ANALYSE FLIGHT PERFORMANCE
- DETERMINE TRAJECTORY TRENDS
- INSURE NO VIOLATION OF TRAJECTORY CONSTRAINTS
- DETERMINE INSERTION CONDITIONS
- EXERCISE ABORT LANDING AREA CONTROL
- DETERMINE INSERTION CORRECTIONS

### COMMAND

- ACTIVATE SPACECRAFT ABORT LIGHT
- UNDEFINED SPACECRAFT COMPUTER UPDATES

### TELEMETRY

- ANALYSE SYSTEM PERFORMANCE
- MONITOR SYSTEM SEQUENCES
- ANALYSE AERO MEDICAL DATA
- ALTERNATE TRAJECTORY DATA

### VOICE

- GROUND CONTROL-FLIGHT CREW COORDINATION
- SYSTEM VERIFICATION
- COMMAND
- FLIGHT CREW STATUS

## GBI COVERAGE IMPACT ON MISSION OPERATIONS

### GBI DATA COVERAGE

#### COVERAGE DEFICIENCY

#### IMPACT ON MISSION OPERATIONS

#### TRACKING

NO CSM BEACON DATA AFTER  
MISSION 503 FOR ABORT  
TRAJECTORIES

LACK OF CSM ABORT TRACKING DATA IS  
UNACCEPTABLE WITHOUT CSM TELEMETRY  
DATA

#### TELEMETRY

NO CSM DATA AFTER MISSION  
206 DURING ALL MISSION  
PHASES

LACK OF LAUNCH TO INSERTION PHASE  
COVERAGE IS UNACCEPTABLE

#### VOICE

NONE

VHF VOICE CAN BE USED FOR GBI COVERAGE

#### COMMAND

NO UPLINK TO CSM

LACK OF GROUND CAPABILITY TO ACTUATE  
CSM ABORT LIGHT IS UNACCEPTABLE

## IMPACT ON MISSION OPERATIONS WITH NO USB AT GBI

**TRACKING – NO GBI CSM ABORT TRACKING DATA UNLESS CM C-BAND BEACON IS RETAINED AFTER MISSION 503.**

- CSM ABORT TRAJECTORY DATA MUST BE PROVIDED BY CM G AND N TELEMETRY DATA WHEN CSM TRACKING DATA IS NOT AVAILABLE.
- RETENTION OF CM C-BAND BEACON REQUIRES RESOLUTION OF CM WEIGHT, SPACE AND DESIGN PROBLEMS.

**TELEMETRY – NO GBI CSM OR AERO MEDICAL DATA AFTER MISSION 206 UNLESS S-BAND GROUND RECEIVING SYSTEM COMPATIBLE WITH USB IS INSTALLED.**

**VOICE – NO GBI S-BAND GROUND TO CSM VOICE COMMUNICATIONS**

- VHF VOICE SYSTEM MUST BE USED.

**COMMAND – NO GBI UPLINK TO CSM ABORT LIGHT UNLESS USE OF RANGE SAFETY SYSTEM IS POSSIBLE AND FEASIBLE.**

- RANGE SAFETY APPROVAL IS REQUIRED
- NEW CSM/S-IVB INTERFACE PROBLEMS MUST BE RESOLVED
- NEW MCC-H/GBI RANGE SAFETY COMMAND SYSTEM INTERFACE PROBLEMS MUST BE RESOLVED
- SPECIAL PROCEDURES FOR COORDINATED NASA/RANGE SAFETY JOINT USE MUST BE DEVELOPED.

M<sup>c</sup>Kerr

4/20-15

APR 16 1 37 PM '65

T/Buckley

APR 16 1965

In reply refer to:  
M-C MAO 1400

M/Mueller

**Availability of the VHF TM frequencies 225-260 MCS band**

It has been brought to my attention that the DOD has directed their agencies to discontinue use of the VHF TM frequencies in the 225-260 MCS band by 1970. Also, after this date, DOD plans to use the band extensively for air-to-ground voice communications. I view this move by DOD with grave concern because of the direct effect on the Apollo program.

It is requested that I be advised as to the action OTDA is taking to ensure the continued availability of VHF TM frequencies for the Apollo program. Also, information is requested as to NASA policy concerning telemetry frequencies for future MEF programs.

Submitted by  
George E. Mueller  
Lieutenant Colonel, USAF

George E. Mueller  
Associate Administrator  
for Manned Space Flight

cc:  
TA/Robinson  
MEFC/Hoberg, IAC Panel Co-chairman  
MEC/Broome, IAC Panel Co-Chairman  
MEC/Radio Frequency Manager  
MEFC/Radio Frequency Manager  
MEC/Radio Frequency Manager

MAO/J. T. McClanahan:fp 4/9/65

MO/Christensen MA/Phillips



## GROUND RULES

1. PRIMARY FUNCTION:  
    LAUNCH SUPPORT  
    ABORT SUPPORT
2. PROVIDE GAP COVERAGE BETWEEN MILA AND BDA DURING LAUNCH
3. PROVIDE S-BAND TRACKING DURING ABORT
4. MOBILE SINGLE S-BAND FACILITY
5. IF S-BAND RANGING REQUIRED, USE JPL RECEIVER/EXCITER AND RANGING SUBSYSTEM
6. STATION SHOULD HAVE MISSION SUPPORT CAPABILITIES
7. ACQUISITION INFORMATION WILL BE PROVIDED
8. GROUND TRANSMITTER POWER  $\geq$  S/C TRANSMITTER + 10 DB, ASSURES UP-LINK LOCK CAPABILITY IF DOWN-LINK LOCK IS FEASIBLE

## MOBILE USB STATION

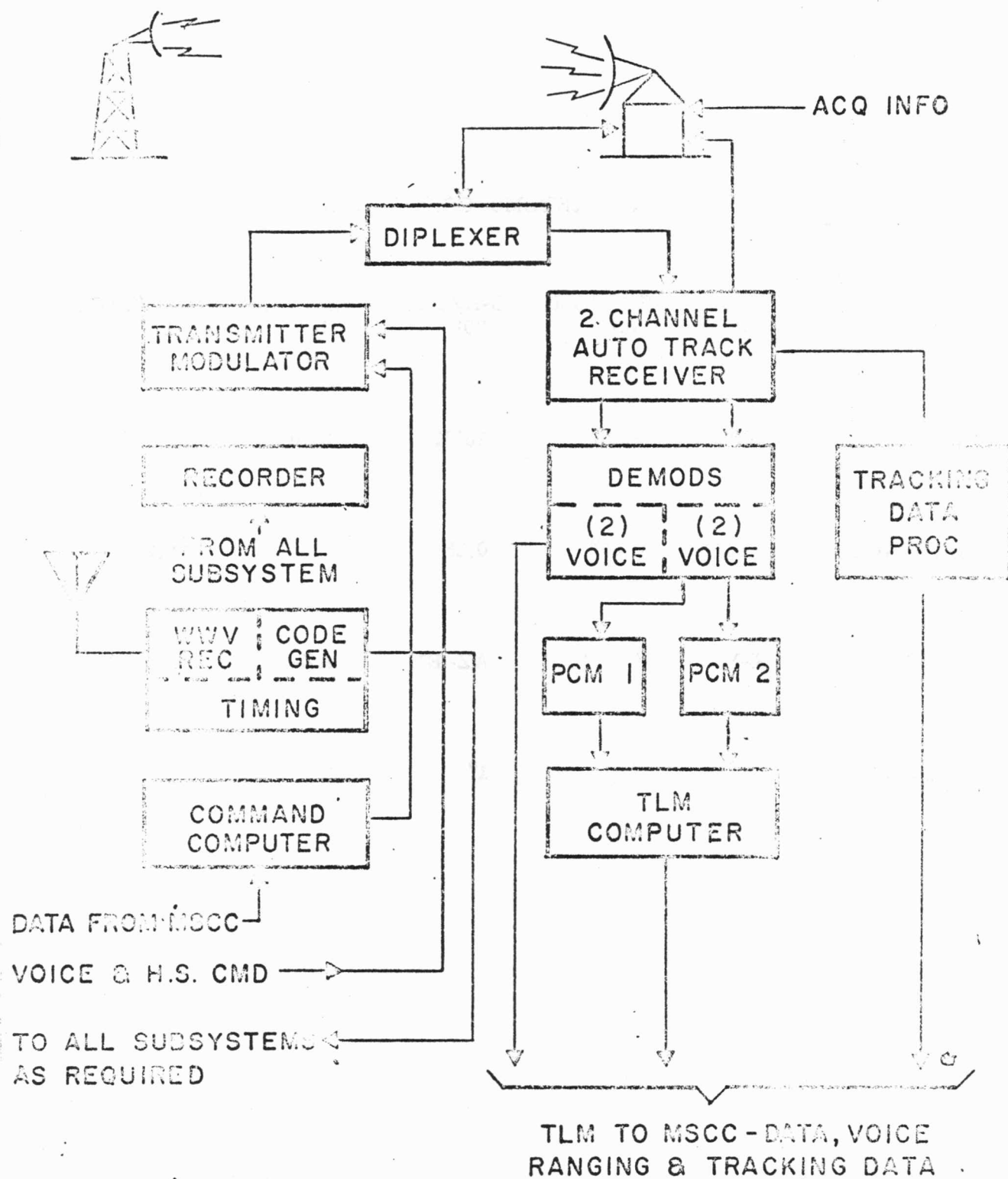
### CAPABILITIES:

1. SINGLE USB EQUIPMENT
2. UP-DATA, VOICE, AND S/C TLM
3. TRACKING DATA
4. REDUNDANT TLM AND VOICE
5. DATA PROCESSING
6. DATA TRANSMISSION TO MSCC

### OPTIONS:

1. AS ABOVE WITHOUT BACKUP TLM
2. AS ABOVE WITHOUT TRACKING DATA
3. AS ABOVE WITHOUT BACKUP TLM  
AND TRACKING DATA

# RECOMMENDED SYSTEM'S BLOCK DIAGRAM



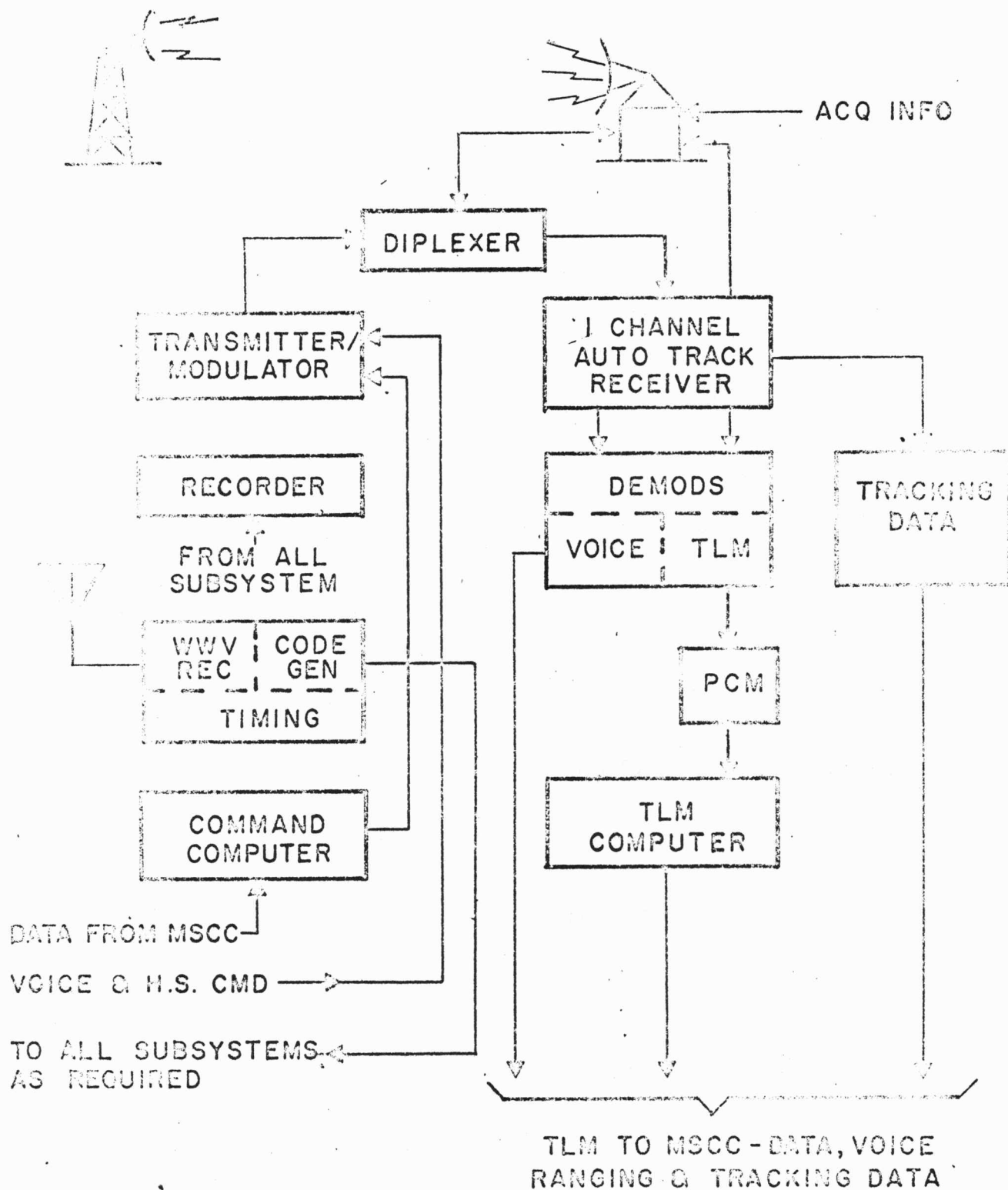
# ANTENNA SYSTEMS CONSIDERED

ANTENNA TYPE	USB 30'	SYNCOM 30'	S-A/TACO 30'	SYNCOM 16'	S-A/TACO 10'
COST	360K	330K	235K	325K	175K
ACCURACY	0.025°	0.05°	0.15°	0.05°	0.25°
MOUNT	X-Y	AZ-EL	AZ-EL	AZ-EL	AZ-EL
0.5 PWR B.W.	1°	1°	1°	2°	2°

# RECOMMENDED SYSTEM'S COST

ANTENNA SYSTEM (SYNCOM 30')	500K
COLLIMATION SYSTEM	75K
RF SUBSYSTEM	800K
NETWORK EQUIPMENT	1,320K
TRACKING DATA EQUIPMENT	315K
SPARE	300K
STANDARD TEST EQUIPMENT	200K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	200K
10% CONTINGENCY	200K
TOTAL	3,575K

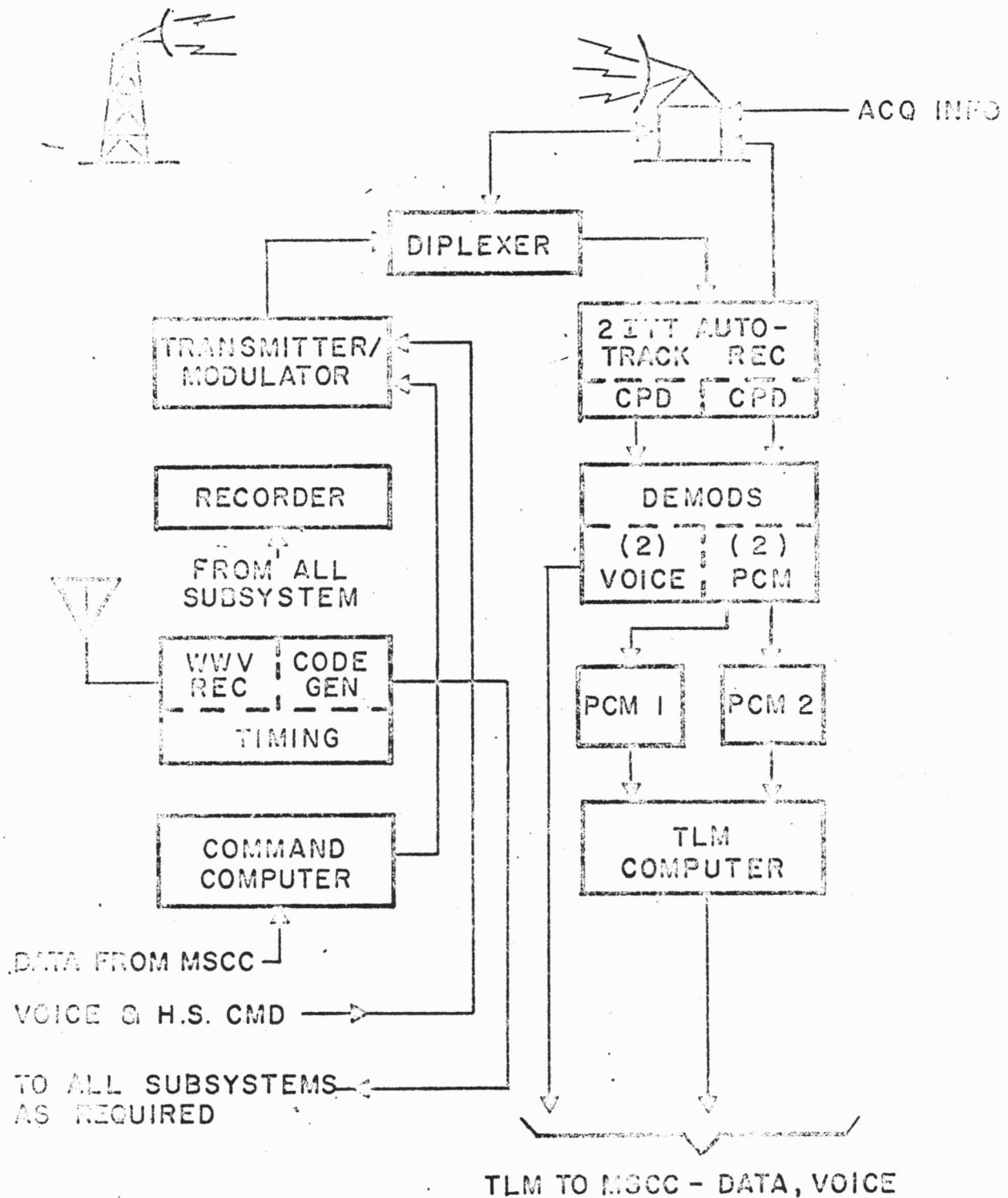
# OPTION No. 1 SYSTEM'S BLOCK DIAGRAM



OPTION #1 SYSTEM'S COST

ANTENNA SYSTEM (SYNCOM 30')	330K
COLLIMATION SYSTEM	75K
RF SUBSYSTEM	700K
NETWORK EQUIPMENT	1,170K
TRACKING DATA EQUIPMENT	340K
SPARES	225K
STANDARD TEST EQUIPMENT	200K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	220K
10% CONTINGENCY	330K
TOTAL	3,010K

# OPTION No. 2 SYSTEM'S BLOCK DIAGRAM

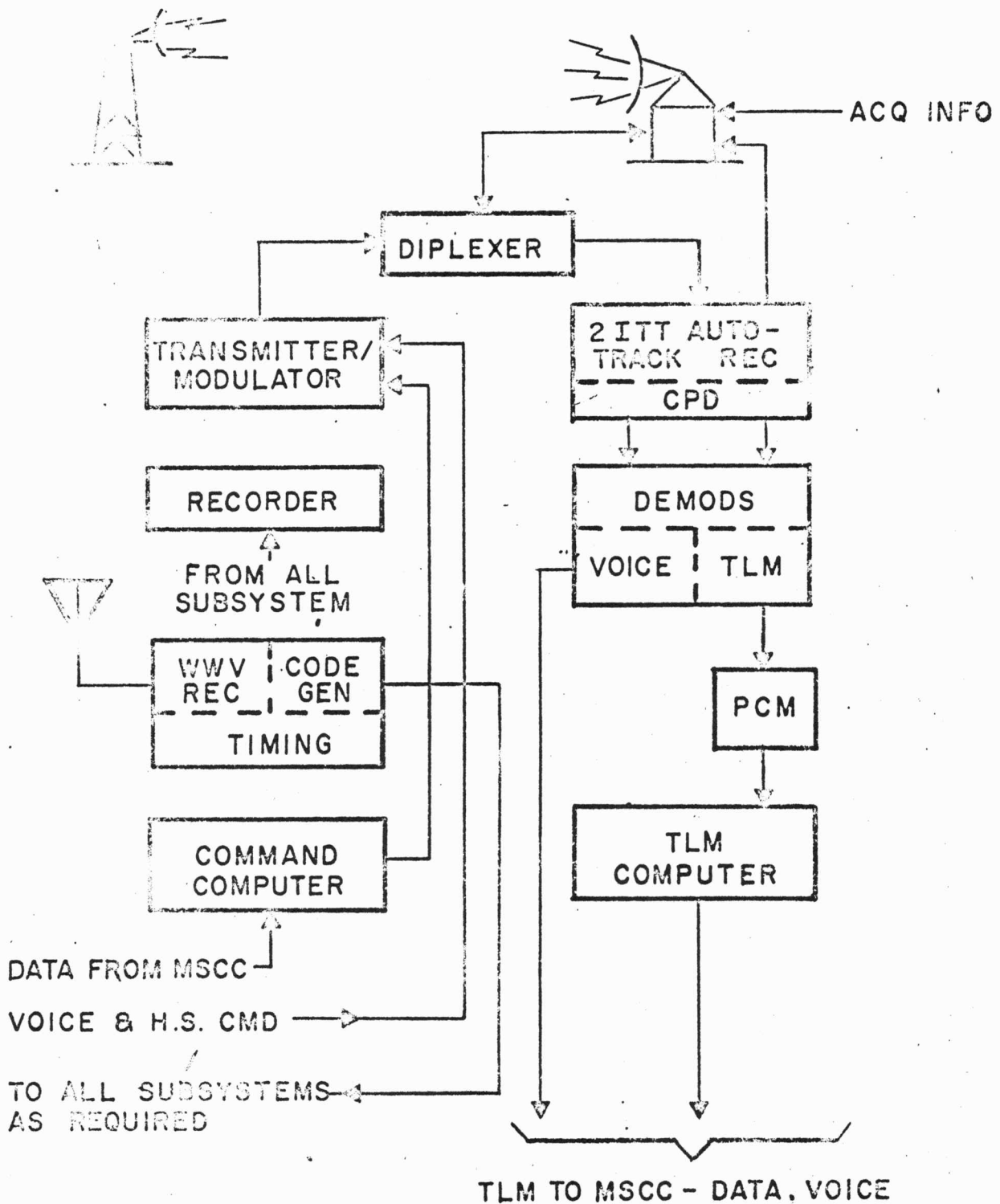




OPTION #2 SYSTEM'S COST

ANTENNA SYSTEM (S-A/TACO 16')	175K
COLLIMINATION SYSTEM	75K
RF SUBSYSTEM	450K
NETWORK EQUIPMENT	1,320K
SPARES	200K
STANDARD TEST EQUIPMENT	100K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	200K
10% CONTINGENCY	265K
TOTAL	2,905K

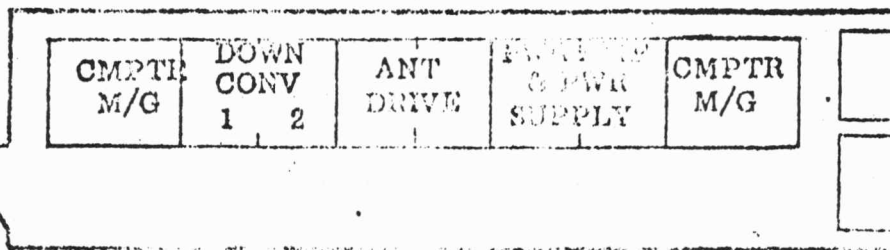
# SYSTEM'S BLOCK DIAGRAM



### OPTION #3 SYSTEM'S COST

ANTENNA SYSTEM (S-A/TACO 16')	175K
COLLIMINATION SYSTEM	75K
RF SUBSYSTEM	400K
NETWORK EQUIPMENT	1,170K
SPARES	180K
STANDARD TEST EQUIPMENT	170K
QUALITY ASSURANCE, LOGISTICS, AND DOCUMENTATION	40K
INSTALLATION AND CHECKOUT	180K
10% CONTINGENCY	240K
TOTAL	2,630K

# ANTENNA EQUIPMENT VAN



MAINT., STORAGE, AND TEST EQPT. (APPROX. 30' x 3')

SERVO  
CONT.

EXC

REC

MAIN  
REC

REC

DEMOD  
& SCO

TRK'G  
FORMAT

MAIN &  
STOR-  
AGE  
(4' x 8')

A/C

REC  
#1

EXC &  
R.REC

ISO AMPE

RGNG  
SYS

PATCH

DESK  
FILE  
FILE

TIME

W.B. RCDF

ANA  
RCDF

VER  
REC

INTER COMM

DATA  
MODEM (4)

MAIN &  
STOR-  
AGE  
(4' x 8')

A/C

PCM NO. 1

PCM  
SIM

PCM NO. 2

CDF

ASN

SWITCH

(4)

TAPE  
IN/OUT

1218  
32K MEM

I/O  
CONSOLE

DCS  
MOD

1218  
32K MEM

I/O  
CONSOLE

TAPE  
IN/OUT

2 RO  
2 TR  
COMM  
TEST  
DATA

DCS  
MOD  
DEMOM

DCS  
MOD  
DEMOM

DCS  
MOD  
DEMOM

DCS  
MOD  
DEMOM

DCS  
MOD  
DEMOM

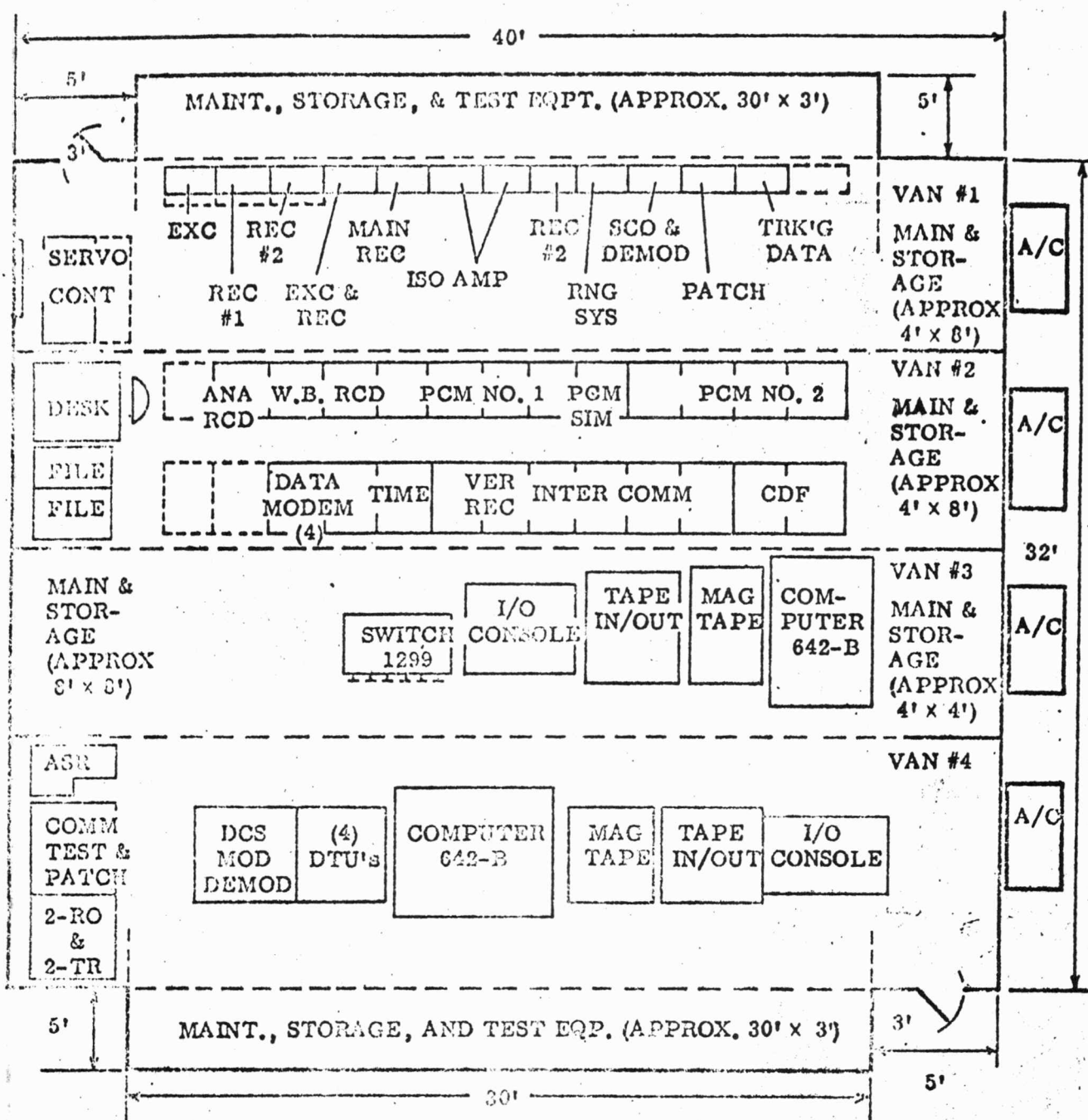
DCS  
MOD  
DEMOM

MAINT., STORAGE, AND TEST EQPT. (APPROX. 30' x 3')

30'

5'

MOBILE S-BAND SITE

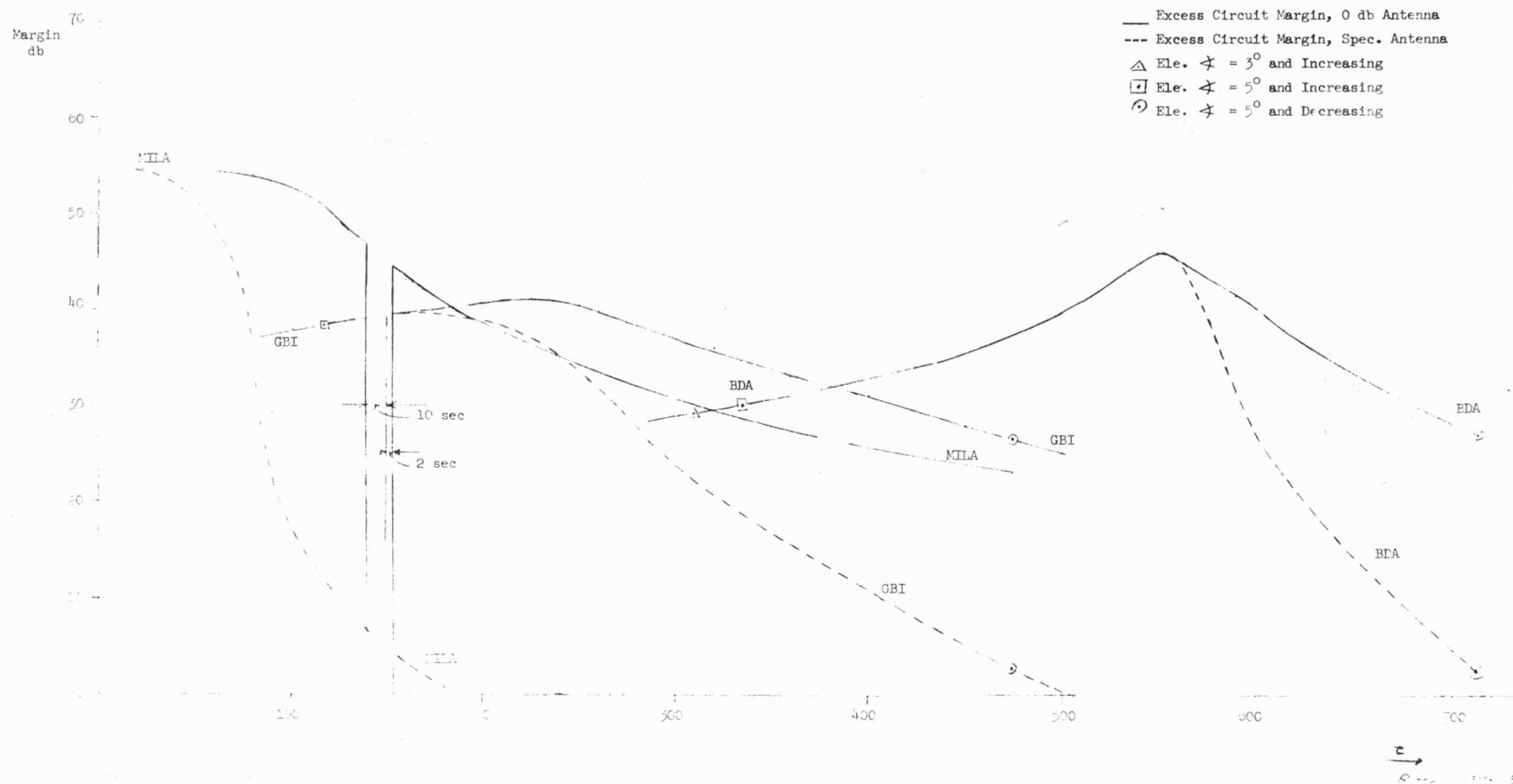


### MOBILE S-BAND SITE

SINGLE XMIT, DUAL REC'G, AND RANGING CAPABILITIES  
WITH 642-B DATA PROCESSOR SYSTEM

DATE \_\_\_\_\_ SUBJECT \_\_\_\_\_ SHEET NO. \_\_\_\_\_ OF \_\_\_\_\_  
BY DATE 7 \_\_\_\_\_ JOB NO. \_\_\_\_\_

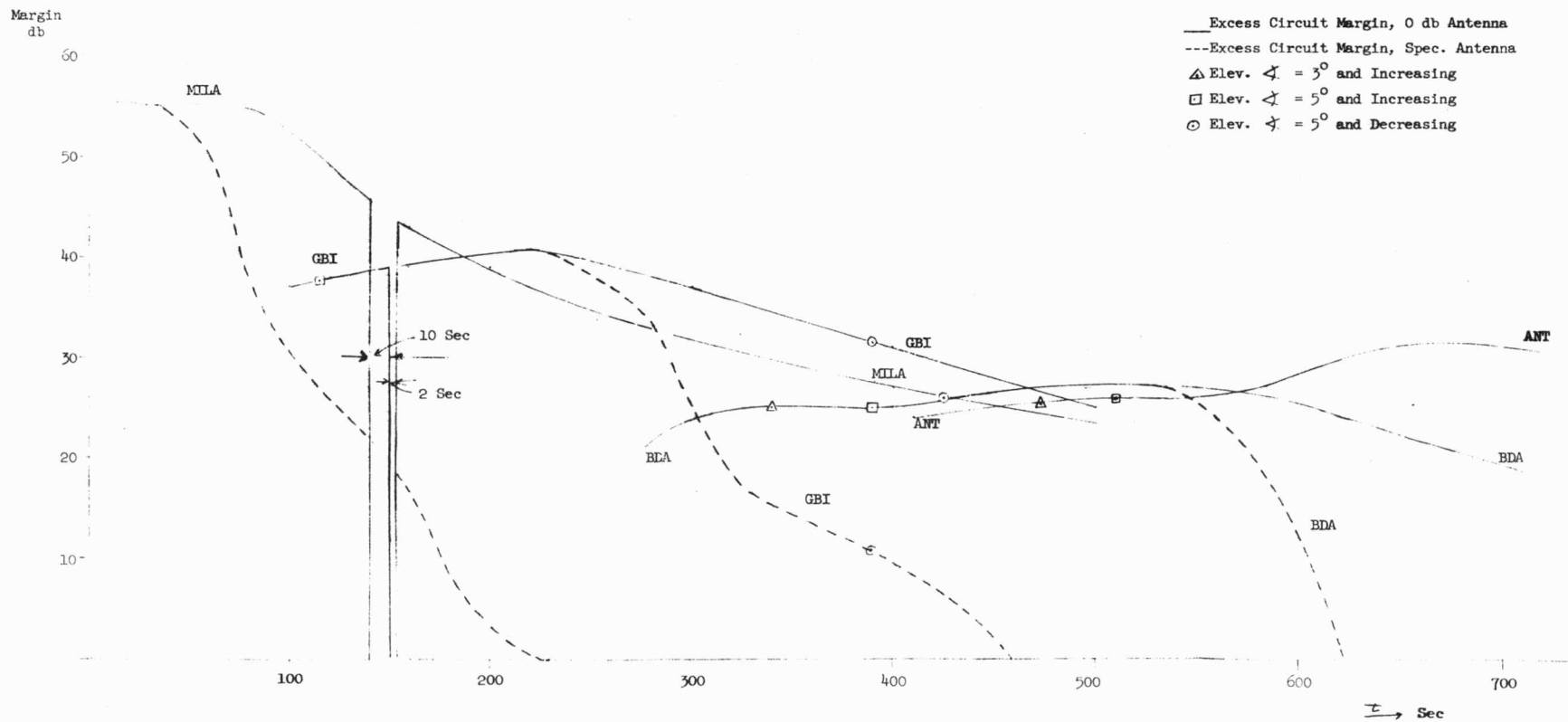
TIME HISTORY OF CIRCUIT MARGINS FROM LAUNCH TO INSERTION  
LAUNCH AZIMUTH =  $72^{\circ}$



DATE..... SUBJECT..... SHEET NO..... OF.....  
 KD. BY..... DATE..... JOB NO.....  
 .....

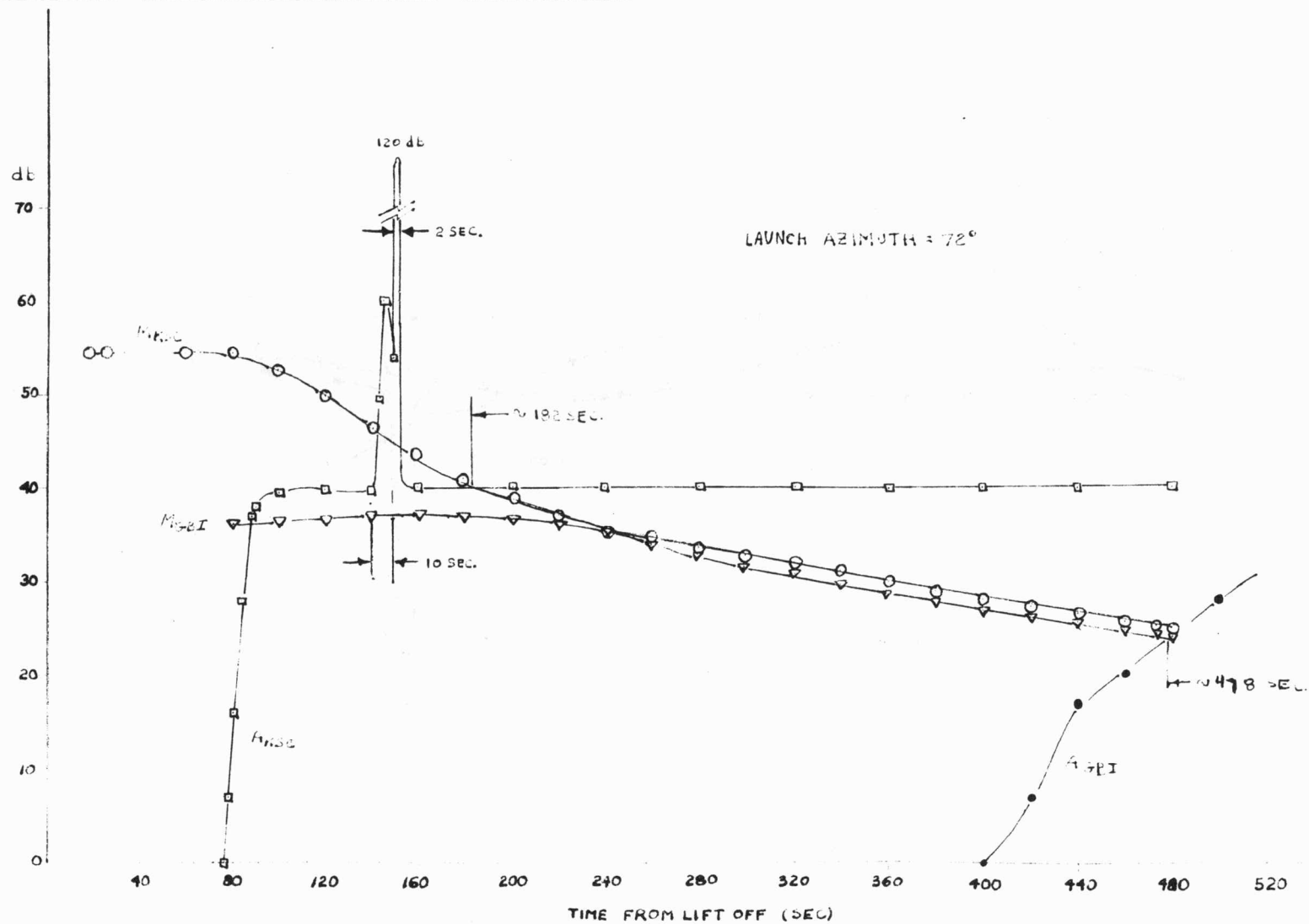
# TIME HISTORY OF CIRCUIT MARGINS FROM LAUNCH TO INSERTION

LAUNCH AZIMUTH =  $105^{\circ}$



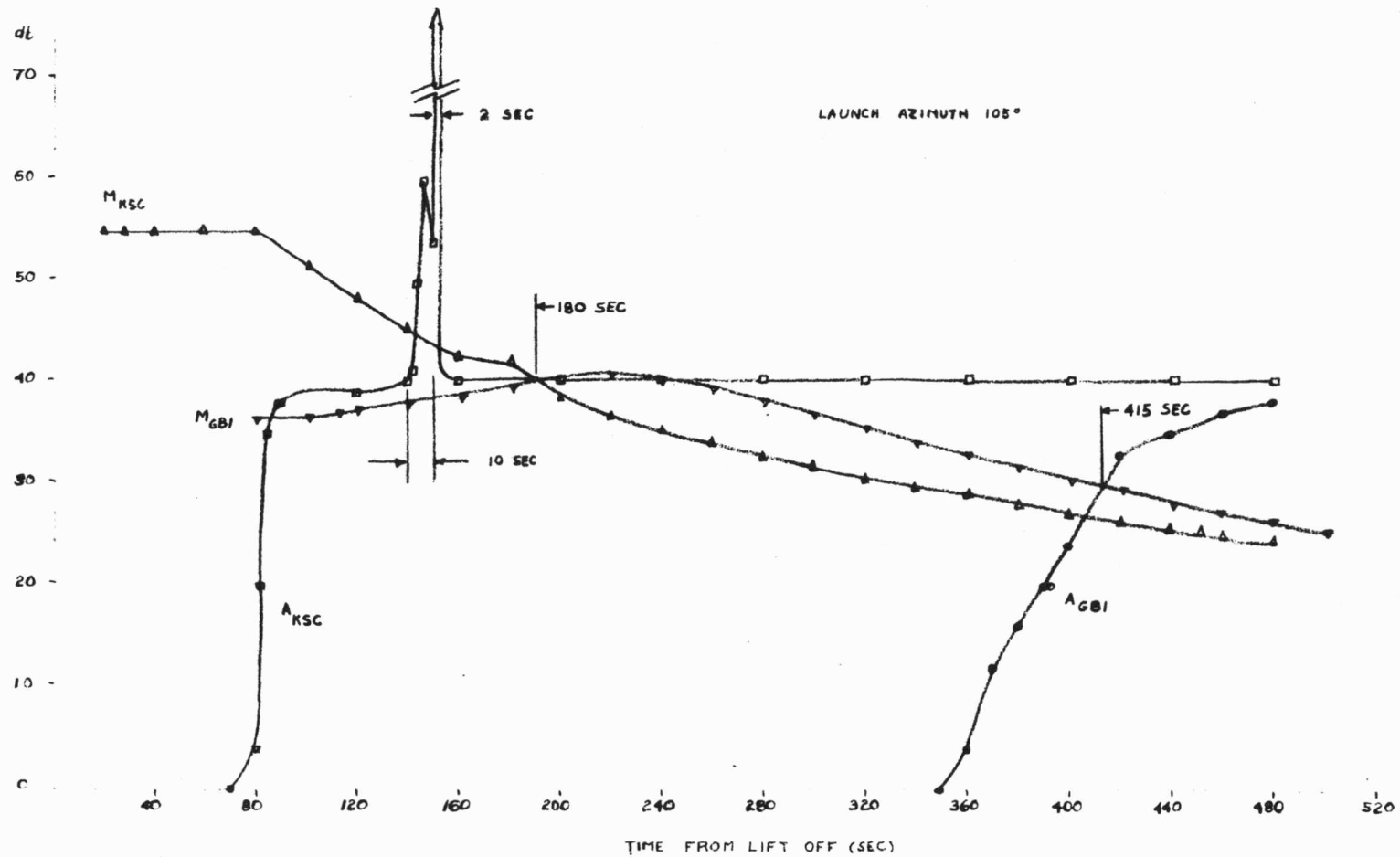
REDA - 1000-000

BY.....DATE..... SUBJECT..... SHEET NO..... OF.....  
 CHKD. BY.....DATE..... JOB NO.....





BY.....DATE..... SUBJECT..... SHEET NO..... OF.....  
 CHKD. BY.....DATE..... JOB NO.....  
 .....



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Washington, D.C.

OFFICE OF MANNED SPACE FLIGHT  
APOLLO PROGRAM

March 31, 1965

REQUIREMENTS FOR MSFN SUPPORT

Saturn - IB Program

Mission: SA-201  
CSM 009

Unmanned Lob Shot down AMR

Objectives:

Development of Saturn IB launch vehicle and evaluation of CM heat shield ablator performance during high heat rate entry.

Demonstrate compatibility and structural integrity of CSM & Saturn IB launch vehicle.

Nominal Program:

Launch 105 Degrees Azimuth; Suborbital S-IVB C/O.

S-IVB/CSM Pitch to Attitude for SPS Burn.

Separate (SM RCS); Coast thru Apogee (6 minutes).

(APOGEE: 270 n.m.)

Splash, Vicinity Ascension Island

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa tracking  
VHF TM, CSM, S-IVB/IU, and S-IB  
Tone Command, CSM  
ODOP Tracking, S-IB  
VHF voice, CSM (record only)

GBI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU, and S-IB  
Tone Command, CSM  
VHF voice, CSM (record only)

GTI, ANT, and BDA:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
Tone Command, CSM  
Glotrac, S-IBV/IU  
VHF voice, CSM (record only)

ASC:

Dual C-Band tracking, CM and S-IVB/IU (or SM skin track)  
VHF TM, CM and S-IVB/IU  
VHF Voice, CSM (record only)

EGLIN, VERO BEACH, NEW SMYRNA:

VHF TM Signal strength recording only, S-IB and S-IVB/IU

VALKARIA, ELEUTHERA:

Mistram Tracking, S-IVB/IU

CHERRY POINT:

Glotrac, S-IVB/IU

MSFN Support Requirements: (Ships and Aircraft)RKV:

VHF TM, CSM and S-IVB/IU  
Tone Command, CSM  
Modified Gemini Console, CSM & S-IVB/IU  
VHF Voice, CSM (record only)

TRACKING SHIP

Dual tracking, (CM C-Band Beacon; SM-Skin Track)  
VHF TM; CSM

AIRCRAFT: (Reentry-terminal phase)

VHF TM, CM

# SATURN - IB PROGRAM

## Vehicle Frequency Assignment for Mission SA-201

Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
S-IB	240.2		PAM/FM/FM GF-1	All the telemetry systems are on a common antenna system
S-IB	244.3		PAM/FM/FM GF-2	
S-IB	252.4		SS/FM GS-1	
S-IB	256.2		PCM/FM GP-1	
S-IB	960	890	ODOP	
S-IB		450	Command Destruct	
S-IVB	258.5		PAM/FM/FM CF-1	CF-1 and CF-3 are on a common antenna. CF-2, CS-1 and CP-1 are on a common antenna system
S-IVB	253.8		PAM/FM/AM CF-3	
S-IVB	246.3		PAM/FM/FM CF-2	
S-IVB	226.2		SS/FM CS-1	
S-IVB	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
IU	250.7		PAM/FM/FM DF-1	All the telemetry systems are on a common antenna system
IU	245.3		PAM/FM/FM DF-2	
IU	259.7		SS/FM DS-1	
IU	255.1		PCM/FM DP-1	
IU		420	Command	
IU	5000	5060.194	AZUSA	Different Code than beacon on CSM
IU	5765	5690	C-Band Radar	
IU	8216	8148	MISTRAM	
	7960-7952	7892-7884		
CSM	296.8	296.8	Voice Transmit/Receive	Analog Different Code than Beacon on IU Operational System
CSM	10.006	10.006	HF Transmit/Receive	
CSM		450	Updata	
CSM	5765	5690	C-Band Radar	
CSM	237.8		PCM/FM	
CSM	247.3		PAM/FM/FM	
CSM	257.3		PAM/FM/FM	

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EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEQUSLY										
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF		PCM/FM										
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB		PCM	FM	
STATION	CAPE TEL 4 (b)										4	9		3		4	2	
	CAPE TEL 3 (a)										4	9		3				
	MILA CIF (b)										4	9		3		4	2	
	GBI (b)										4	9		3		3		
	GTI (a)										3	7		2		2		
	BDA (b)										3	7		2		3		
	ANT (b)										3	7		2		3		
	ASC										3	7				1		
	DOD "C" BAND TRACKING SHIP (a)										3	7				0		
	RKV (a)										3	7				2		
	REENTRY AIRCRAFT										1	1				0		

(a) Limited to existing capability

(b) Polarization Diversity required on VHF TM

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APOLLO PROGRAM  
REQUIREMENTS FOR MSFN SUPPORT

March 31, 1965

Saturn - IB Program

Mission: SA - 202  
CSM 011

Unmanned, Long Range Lob Shot

Objectives:

Evaluate CM heat shield performance under high heat load entry conditions.

Demonstrate compatibility and structural integrity of CSM & Saturn IB launch vehicle.

Nominal Program:

Launch, 105 Degrees Azimuth; Suborbital S-IVB C/O.  
Separate, CSM Pitch to Required Attitude.  
First SPS Burn (254 Secs.);  $V_1 = 25,700$  fps at C/O.  
Coast, Attitude Hold, 50 Minutes.  
(APOGEE: 600 n.m.)  
Splash; Wake Island Vicinity.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB Checkout station, CSM  
MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa tracking, S-IVB/IU  
VHF TM, CSM, S-IVB/IU, and S-IB  
VHF Voice (record only)  
UHF/DCS Command, CSM  
ODOP Tracking, S-IB

GBI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, and S-IB  
VHF Voice (record only)  
UHF/DCS Command, CSM

GTI and ANT:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
VHF Voice (record only)  
UHF/DCS Command, CSM  
Glotrac, S-IVB/IU

BDA:

USB Evaluation Station, CSM  
C-Band tracking, CSM or S-IVB/IU  
VHF TM stations, CSM and S-IVB/IU  
UHF/DCS Command, CSM  
Glotrac, S-IVB/IU  
VHF Voice (record only)

ASC:

C-Band tracking, CSM  
VHF TM, CSM  
VHF Voice (record only)

ELGIN, VERO BEACH, NEW SMYRNA:

VHF TM Signal Strength recording only, S-IB and S-IVB/IU

VALKARIA, ELEUTHERA:

Mistram tracking, S-IVB/IU

CHERRY POINT:

Glotrac, S-IVB/IU

PRETORIA & MALAGASY:

C-Band tracking, CSM (Pretoria only)  
VHF TM, CSM

CRO:

C-Band tracking, CSM  
VHF TM, CSM  
UHF/DCS Command, CSM  
VHF Voice (record only)  
USB Evaluation station, CSM

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, CSM  
VHF TM, CSM  
VHF Voice (record only)

TRACKING SHIP: (Reentry)

C-Band Beacon tracking, (CM) and Skin tracking (SM)  
VHF TM, CM

AIRCRAFT: (Reentry)

VHF TM Station, CM



# SATURN - IB PROGRAM

## Vehicle Frequency Assignment for Mission SA-202

Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
S-IB	240.2		PAM/FM/FM GF-1	All the telemetry systems are on a common antenna system
S-IB	244.3		PAM/FM/FM GF-2	
S-IB	252.4		SS/FM GS-1	
S-IB	256.2		PCM/FM GP-1	
S-IB	960	890	ODOP	
S-IB		450	Command Destruct	
S-IVB	258.5		PAM/FM/FM CF-1	CF-1 and CF-3 are on a common antenna. CF-2, CS-1 and CP-1 are on a common antenna system
S-IVB	253.8		PAM/FM/AM CF-3	
S-IVB	246.3		PAM/FM/FM CF-2	
S-IVB	226.2		SS/FM CS-1	
S-IVB	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
IU	250.7		PAM/FM/FM DF-1	All the telemetry systems are on a common antenna system
IU	245.3		PAM/FM/FM DF-2	
IU	259.7		SS/FM DS-1	
IU	255.1		PCM/FM DP-1	
IU	5000	5060.194	AZUSA	Different Code than beacon on CSM
IU	5765	5690	C-Band Radar	
IU	8216	8148	MISTRAM	
	7960-7952	7892-7884		
CSM	296.8	296.8	Voice Transmit/Receive	Digital Different Code than Beacon on IU
CSM	10.006	10.006	HF Transmit/Receive	
CSM		450	Updata	
CSM	5765	5690	C-Band Radar	
CSM	2287.5	2106.4	USB	Operational System
CSM	237.8		PCM/FM	
CSM	247.3		PAM/FM/FM	
CSM	257.3		PAM/FM/FM	

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EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS			
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF		PCM/FM			PM + FM			or					PM + FM
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5												
STATION	CAPE TEL 4 (b)											4	9		3		4	2	
	CAPE TEL 3 (a)											4	9		3				
	MILA CIF (b)			1 (d)	1 (d)			1+0		0+1	4	9		3		4	2		
	MILA USB (c)			1 (d)	1 (d)			1+0		0+1									
	GBI (b)										4	9		3		3	0		
	GTI (a)										3	7		2		2	0		
	BDA (b)			1 (d)	1 (d)			1+0		0+1	3	7		2		2	0		
	ANT (b)										3	7		2		3	0		
	ASC										1	2				1	0		
	CRO			1 (d)	1 (d)			1+0		0+1	1	2				1	0		
	PRETORIA (a)										1	2							
	MALAGASY (a)										1	2							

(a) Limited to existing capabilities

(b) VHF Polarization Diversity required on VHF TM

(c) USB Check-out Station in S/C O&C Building will provide MILA Support

(d) Probably signal strength recording only

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EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS			
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF		PCM/FM			PM + FM			or	PM + FM				
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5		2277.5		PM + FM		PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM
STATION	DOD "C" BAND TRACKING SHIP (a)											1	2				0		
	CSQ AND RKV											1	2				1		
	REENTRY AIRCRAFT											1	1				0		

(a) Limited to existing capability

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REQUIREMENTS FOR MSFN SUPPORT

Saturn - IB Program

Mission: SA - 203  
(No CSM)

Unmanned Liquid Hydrogen Orbital Experiment

Objectives:

To place the S-IVB/IU with maximum LH<sub>2</sub> residual into a 105 n.m. circular orbit.

To observe the effects of sloshing, damping fluid transients and liquid/vapor interface.

To record data on the venting system, engine chilldown, heat transfer, tank thermodynamics and ullage requirements for engine restart.

S-IVB and IU checkout in orbit.

Nominal Program:

Launch Azimuth: 72°  
3 orbits; No recovery.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

C-Band Tracking, S-IVB/IU  
Azusa Tracking\*, S-IVB/IU  
ODOP Tracking, S-IB  
UHF Digital Command, S-IVB/IU  
VHF TM, S-IVB/IU and S-IB  
S-Band TV  
S-Band TM

VALKARIA, ELEUTHERA\*:

Mistram Tracking, S-IVB/IU

CHERRY POINT\*:

Glotrak, S-IVB/IU

EGLIN, VERO BEACH, NEW SMYRNA:

VHF TM Signal Strength recording only, S-IB and S-IVB/IU

\* Either Azusa or Mistram will be flown but not both.

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GBI:

C-Band Tracking, S-IVB/IU  
VHF TM, S-IVB/IU and S-IB

Wallops Island:

C-Band Tracking, S-IVB/IU

CTI:

C-Band Tracking, S-IVB/IU  
Glotrac Tracking\*, S-IVB/IU  
VHF TM Stations, S-IVB/IU

ANT, CYI, Pretoria, CRO, HAW:

C-Band Tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
UHF Digital Command, S-IVB/IU (except Pretoria)  
S-Band TV (Hawaii only)

BDA:

C-Band Tracking, S-IVB/IU  
Glotrac Tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
UHF Digital Command, S-IVB/IU  
S-Band TV

PT. ARGUELLO, White Sands:

C-Band Tracking, S-IVB/IU

TEXAS, GYM:

VHF TM Stations, S-IVB/IU  
UHF Digital Command S-IVB/IU (Texas only)

MSFN Support Requirements: (Ships)

Insertion Ship:

C-Band Tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
UHF Digital Command, S-IVB/IU  
Flight Control Consoles

\*Either Azusa or Mistram will be flown but not both.

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SATURN - IB PROGRAM

Vehicle Frequency Assignment for Mission SA-203

Location	Frequency MHz	Xmtr	Rec.	System	Remarks
S-IB	240.2			PAM/FM/FM GF-1	All the telemetry systems are on a common antenna system
S-IB	244.3			PAM/FM/FM GF-2	
S-IB	252.4			SS/FM GS-1	
S-IB	256.2			PCM/FM GP-1	
S-IB	960		890	ODOP	
S-IB			450	Command Destruct	
S-IVB*	258.5			PAM/FM/FM CF-1	CF-1 and CF-3 are on a common antenna. CF-2, CS-1 and CP-1 are on a common antenna system
S-IVB*	253.8			PAM/FM/FM CF-3	
S-IVB*	246.3			PAM/FM/FM CF-2	
S-IVB	226.2			SS/FM CS-1	
S-IVB*	232.9			PCM/FM CP-1	
S-IVB			450	Command Destruct	
IU*	250.7			PAM/FM/FM DF-1	All the telemetry systems are on a common antenna system
IU*	245.3			PAM/FM/FM DF-2	
IU	259.7			SS/FM DS-1	
IU*	255.1			PCM/FM DP-1	
IU			450	Udata	} Only one of these will be carried
IU	8216		8148	MISTRAM	
IU	7960-7952		7892-7884		
IU	5001		5061	AZUSA	
IU	5765		5690	C-Band Radar	
IU	2277.5			TV	Parallel system to DP-1 (Experimental System only)
IU	2250			PCM/FM DP-2	

\* Left on in orbit

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EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT				VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM  AND WIDE BAND "S" BAND TV (10MCS)					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF		PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2250.0	PM	FM	or	PM	FM	PCM	PAM/ FM	FM	SSB	"S" 2277.5	PCM	FM
STATION	CAPE TEL 4 (b)											3	7		3		3	2	
	CAPE TEL 3 (a)											3	7		3				
	MILA CIF (b)						1					3	7		3		3	2	
	MILA USB						1 (c)									1			
	GBI (b)											3	7		3		2		
	GTI (a)											2	5		2		2		
	BDA (b)						1 (c)					2	5		2	1	2		
	ANT						1 (c)					2	5				2		
	CYI											2	5				2		
	CRO						1 (c)					2	5				2		
	PRETORIA (a)											2	5						
	HAW						1 (c)					2	5			1	2		

- (a) Limited to existing capability  
(b) VHF polarization Diversity required on VHF TM  
(c) If capability exists. Experimental System

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EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM AND WIDE BAND "S" BAND TV (10 Mc/s)					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2250	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	"S" 2277.5	PCM	FM	
STATION	GYM										2	5				2		
	TEX						1 (c)				2	5				2		
	INSERTION SHIP						1 (c)				2	5				2		

(c) If capability exist. Experimental System



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REQUIREMENTS FOR MSFN SUPPORT

Saturn IB Program

Mission: SA - 204  
CSM 012

First Manned CSM Flight. Open-ended, up to 14 Days

Objectives:

Evaluate Man/System Interfaces.

Demonstrate Crew/CSM/Ground Systems performance for extended mission.

S-IVB/IU checkout in orbit. "

Nominal Program:

Launch 72 Degrees Azimuth; inject into 104 n.m. circular orbit.  
Water Landing.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB evaluation station, CSM  
MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa tracking\*, S-IVB/IU  
VHF TM, CSM, S-IVB/IU & S-IB  
UHF/DCS Command, CSM or S-IVB/IU  
ODOP tracking, S-IB  
S-Band Telemetry, S-IVB/IU  
VHF and HF Voice, CSM

GBI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU and S-IB  
UHF/DCS Command, CSM or S-IVB/IU  
S-Band TM, S-IVB/IU  
VHF Voice, CSM

ANT:

USB evaluation station, CSM  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
S-Band TM, S-IVB/IU  
VHF and HF Voice, CSM  
Glotrac\*, S-IVB/IU

\* Either Azusa or Mistran will be flown, but not both.

GTI:

C-Band tracking, CSM or S-IVB/IU  
 VHF TM, CSM, S-IVB/IU  
 UHF/DCS Command, CSM or S-IVB/IU  
 Glotrac\*, S-IVB/IU  
 VHF Voice, CSM

BDA:

USB evaluation station, CSM  
 C-Band tracking, CSM and S-IVB/IU  
 VHF TM, CSM and S-IVB/IU  
 UHF/DCS Command, CSM or S-IVB/IU  
 Glotrac\*, S-IVB/IU  
 VHF and HF voice, CSM  
 S-Band TM, S-IVB/IU

CYI:

C-Band tracking, CSM or S-IVB/IU  
 VHF TM, CSM and S-IVB/IU  
 UHF/DCS Command, CSM or S-IVB/IU  
 VHF and HF voice, CSM  
 Flight Control Consoles

ASC:

USB evaluation station, CSM  
 C-Band tracking, CSM and S-IVB/IU  
 VHF TM, CSM and S-IVB/IU  
 VHF and HF voice, CSM  
 Flight Control Consoles

PRE:

C-Band tracking, CSM  
 VHF TM, CM  
 VHF and HF voice, CSM

MALAGASY:

VHF TM, CSM  
 VHF and HF voice, CSM

CRO:

USB evaluation station  
 C-Band tracking, S-IVB/IU or CSM  
 VHF TM, S-IVB/IU, CSM  
 UHF/DCS Command, S-IVB/IU or CSM  
 VHF and HF voice, CSM  
 Flight control Consoles  
 S-Band TM S-IVB/IU

\* Either Azusa or Mistram will be flown, but not both.

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CANTON ISLAND:

VHF TM, CSM  
VHF and HF voice, CSM

HAW:

USB evaluation station  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF voice, CSM

GYM:

VHF TM, CSM and S-IVB/IU  
VHF and HF voice, CSM  
Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU  
VHF and HF voice, CSM

CORPUS CHRISTI, TEXAS:

USB evaluation station  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF voice, CSM

WHS:

C-Band tracking, CSM or S-IVB/IU

EGLIN:

C-Band tracking, CSM or S-IVB/IU

VALKARIA\*, ELEUTHERA\*:

Mistram tracking, S-IVB/IU

CHERRY POINT\*:

Glotrac, S-IVB/IU

\* Either Azusa or Mistram will be flown, but not both.

WALLOPS ISLAND:

C-Band tracking, S-IVB/IU

KNO:

VHF and HF voice, CSM  
VHF TM, CM

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
VHF and HF voice, CSM

TRACKING SHIP: (Reentry)

C-Band tracking, CM  
VHF voice, CM  
VHF TM, CM

INSERTION SHIP:

USB station, CSM  
C-Band tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU and CSM  
UHF/DCS Command, S-IVB/IU or CSM  
VHF and HF voice  
Flight Control Consoles

INJECTION SHIP:

USB station, CSM  
C-Band tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU and CSM  
UHF/DCS Command, S-IVB/IU or CSM  
VHF and HF voice  
Flight Control Consoles

ONE APOLLO PECULIAR INSTRUMENTATION AIRCRAFT FOR EVALUATION:

VHF TM, CSM and S-IVB/IU  
S-Band TM, S-IVB/IU  
VHF and USB Voice T/R, CSM  
USB TM, CSM

REENTRY AIRCRAFT:

VHF TM, CM  
VHF voice, CM

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OFFICE OF MANNED SPACE FLIGHT  
APOLLO PROGRAM

SATURN - IB PROGRAM

Vehicle Frequency Assignment for Mission SA-204

Location	Frequency		System	Remarks
	Xmtr MHz	Rec.		
S-IB	240.2		PAM/FM/FM GF-1	All the telemetry systems are on a common antenna system.
S-IB	244.3		PAM/FM/FM GF-2	
S-IB	252.4		SS/FM GS-1	
S-IB	256.2		PCM/FM GP-1	
S-IB	960	890	ODOP	
S-IB		450	Command Destruct	
S-IVB*	258.5		PAM/FM/FM CF-1	CF-1 and CF-3 are on a common antenna. CF-2, CS-1, and CP-1 are on a common antenna system
S-IVB*	253.8		PAM/FM/FM CF-3	
S-IVB*	246.3		PAM/FM/FM CF-2	
S-IVB	226.2		SS/FM CS-1	
S-IVB*	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
IU*	250.7		PAM/FM/FM DF-1	All the telemetry systems are on a common antenna system Parallel system to DP-1 (Experimental System only) Only one of these will be carried
IU*	245.3		PAM/FM/FM DF-2	
IU	259.7		SS/FM DS-1	
IU*	255.1		PCM/FM DP-1	
IU*	2277.5		PCM/FM DP-2	
IU*		450	Udata	
IU	8216	8148	MISTRAM	}
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	
IU*	5765	5690	C-Band Radar	Different code than beacon on spacecraft
CSM*	296.8	296.8	Voice Transmit/Receive	
CSM*	10.006	10.006	HF Transmit/Receive	
CSM*		450	Udata	
CSM*	237.8		PCM/FM	
CSM*	5765	5690	C-Band Radar	
CSM*	2287.5	2106.4	USB-PCM/PM/PM or PCM/PM/PM	
CSM*	257.3		Recorded PCM/FM Dump	

\* Systems left on in orbit

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Washington 25, D. C.

OFFICE OF MANNED SPACE FLIGHT

# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS			
		USB:    PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER/ OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM				PM + FM	or	PM + FM	PCM	PAM/ FM				FM
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5												
STATION	MISSION: SA-204 Sheet 1 of 3																		
	CAPE TEL 4 (b)											4	7		3		4	2	
	CAPE TEL 3 (a)											4	7		3				
	MILA CIF (b)			1	1		1	1+1		0+2	4	7		3		4	2		
	MILA USB			1	1		1 (c)	1+1		0+2						2			
	GBI (b)						1 (c)				4	7		3		3	0		
	GTI (a)										4	5		2		2	0		
	BDA (b)			1	1		1 (c)	1+1		0+2	4	5		2		3	0		
	ANT (b)			1	1		1 (c)	1+1		0+2	4	5				2	0		
	CYI										4	5		0		2	0		
	ASC			1	1						4	5				2	0		
	CRO			1	1		1 (c)	1+1		0+2	4	5		0		2	0		
GUAM																			

(a) Limited to existing capability

(b) Polarization Diversity required on VHF TM

(c) Experimental System only. Reception desirable but not mandatory of all stations.

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OFFICE OF MANNED SPACE FLIGHT

# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME				
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS				
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM									
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF													PCM/FM	
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5												PM + FM	or
STATION	HAW			1	1		1 (c)	1+1		0+2	4	5				2				
	GYM			1	1		1 (c)	1+1		0+2	4	5				2				
	TEX			1	1		1 (c)	1+1		0+2	4	5				2				
	KNO (a)										2					0				
	PRETORIA (a)										2					0				
	MALAGASY (a)										2					0				
	CANTON ISLAND (a)										2					0				
	INSERTION SHIP			1	1		1 (c)	1+1		0+2	4	5		2		2				
	INJECTION SHIP			1	1		1 (c)	1+1		0+2	4	5				2				
	CSQ (a)										4	4				1				
	RKV (a)										4	4				1				

(a) Limited to existing capabilities.

(c) Experimental System only. Reception desirable but not mandatory of all stations.

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS			
		USB:    PCM/PM/PM or PCM/PM/FM		CCS				MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF					PCM/FM								
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5		2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	DOD C - BAND REENTRY SHIP (a)											2					0		
	APOLLO INSTRU- MENTATION AIRCRAFT			1	1		1	1+1		0+2		4	4				0		
	REENTRY AIRCRAFT											1					0		

(a) Limited to existing capabilities.

(c) Experimental system only. Reception desirable but not mandatory of all stations.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
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OFFICE OF MANNED SPACE FLIGHT  
APOLLO PROGRAM  
REQUIREMENTS FOR MSFN SUPPORT

March 31, 1965

Saturn - IB Program

Mission: SA-205  
CSM 014

Manned CSM Long Duration Mission

Objectives:

Evaluate Man/System Interfaces.

Demonstrate Crew/CSM/Ground Systems performance for extended mission.

S-IVB/IU Checkout in Orbit.

Nominal Program:

Not yet established. Probably similar to SA-204, i.e.:

Launch Azimuth  $72^{\circ}$ . Earth Orbital.  
Separation after  $1\frac{1}{2}$  orbits.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB Evaluation station, CSM  
MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa\* tracking  
VHF TM, CSM, S-IVB/IU, and S-IB  
UHF/DCS Command, CSM and S-IVB/IU  
ODOP Tracking, S-IB  
VHF and HF Voice, CSM

GBI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU and S-IB  
UHF/DCS Command, CSM or S-IVB/IU  
VHF Voice, CSM

ANT:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
USB Evaluation station, CSM  
VHF and HF Voice, CSM  
Glotrac \*

\*Either Azusa or Mistrum will be flown, but not both.

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GCI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF Voice, CSM  
Glotrac\*, S-IVB/IU

BDA:

C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM  
USB Evaluation station, CSM  
Glotrac\*, S-IVB/IU

CYI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM  
Flight Control Consoles

PRE:

C-Band tracking, CSM  
VHF TM, CSM  
VHF and HF voice, CSM

MALAGASY:

VHF TM, CSM  
VHF and HF voice, CSM

ASC:

C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
USB Evaluation station, CSM  
VHF and HF Voice, CSM  
Flight Control Consoles

CRO:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM  
USB Evaluation station, CSM  
Flight Control Consoles

\*Either Azusa or Mistran will flown, but not both.

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APOLLO PROGRAM

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GUAM:

USB Evaluation station, CSM  
VHF TM, CSM and S-IVB/IU  
VHF and HF Voice, CSM

CANTON ISLAND:

VHF TM, CSM  
VHF and HF Voice, CSM

HAW:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM  
USB Evaluation station, CSM

GYM:

USB Evaluation station, CSM  
VHF and HF Voice, CSM  
VHF TM, CSM and S-IVB/IU  
Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU  
VHF and HF Voice, CSM

WHITE SANDS:

C-Band tracking, CSM or S-IVB/IU

CORPUS CHRISTI, TEXAS:

USB Evaluation station, CSM  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM

VALKARIA\*, ELEUTHERA:

Mistram Tracking, S-IVB/IU

CHERRY POINT\*:

Glotrac Tracking, S-IVB/IU

\*Either Mistram or Azusa will be flown, but not both.

WALLOPS ISLAND:

C-Band tracking, S-IVB/IU

KNO:

VHF TM, CSM  
VHF and HF voice remoting, CSM

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
VHF and HF Voice, CSM

INSERTION SHIP:

USB Station, CSM  
C-Band tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU and CSM  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF Voice, CSM  
Flight Control Consoles

2 INJECTION SHIPS: (will be used for orbit and reentry support.)

USB station, CSM  
C-Band tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU and CSM  
UHF/DCS Command, S-IVB/IU or CSM  
Flight Control Consoles

APOLLO PECULIAR INSTRUMENTATION AIRCRAFT: (Two or three required for orbit and reentry coverage.)

VHF TM, CSM and S-IVB/IU  
USB and VHF Voice T/R, CSM  
HF voice T/R  
USB TM, CSM

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APOLLO PROGRAM

SATURN - IB PROGRAM

Vehicle Frequency Assignment for Mission SA-205

Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
S-IB	240.2		FM/FM GS-1	
S-IB	256.2		PCM/FM GP-1	
S-IB	960	890	ODOF	
S-IB		450	Command Destruct	
S-IVB*	246.3		FM/FM CF-2	
S-IVB*	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
IU*	250.7		FM/FM DF-1	
IU*	255.1		PCM/FM DP-1	
IU*		450	Updata	
IU**	5765	5690	C-Band Radar	
IU	8216	8148	MISTRAM	) Only one of these ) will be carried. )
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	
CSM*	296.8	296.8	Voice Transmit/ Receive	
CSM*	10.006	10.006	HF Transmit/Receive	
CSM*		450	Updata	
CSM*	237.8		PCM/FM	
CSM*	5765	5690	C-Band Radar	Different code than beacon on launch vehicle
CSM*	2287.5	2106.4	USB/PCM/PM/FM or PCM/PM/FM	
CSM*	257.3		Recorded PCM/FM Dump	

\* Will be left on in orbit

\*\* May be left on in orbit depending upon mission of S-IVB/IU.

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM							
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	CAPE TEL 4 (b)										4		3			4	2	
	CAPE TEL 3 (a)										4		3			0	0	
	MILA CIF (b)			1	1			1+0		0+1	4		3			4	2	
	MILA USB			1	1			1+0		0+1						1	0	
	GBI (b)										4		3			3	0	
	GTI (a)										4		2			2	0	
	BDA (b)			1	1			1+0		0+1	4		2			3	0	
	CYI										4		2			2	0	
	ANT (b)			1	1			1+0		0+1	4		2			2	0	
	ASC			1	1			1+0		0+1	4		2			2	0	
	CRO			1	1			1+0		0+1	4		2			2	0	
	GUAM			1	1			1+0		0+1	4		2			2	0	

(a) Limited to existing capability

(b) Polarization Diversity required on VHF TM

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS			
		USB:    PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM												
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	LEM is OFF 2282.5		2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	HAW			1	1			1+0		0+1	4		2			2	0		
	GYM			1	1			1+0		0+1	4		2			2	0		
	CORPUS CHRISTI TEXAS			1	1			1+0		0+1	4		2			2	0		
	PRETORIA (a)									1	2		0			0	0		
	CANTON ISLAND (a)										2		0			0	0		
	MALAGASY (a)									1	2		0			0	0		
	KANO (a)										2		0			0	0		
	INSERTION SHIP			1	1			1+0		0+1	4		2			2	0		
	INJECTION SHIPS (2)			1	1			1+0		0+1	4		2			1	0		
	CSQ & RKV (a)										4		2			1	0		
	INSTRUMENTATION AIRCRAFT			1	1			1+0		0+1	4		2			0	0		

(a) Limited to existing capabilities

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APOLLO PROGRAM

March 31, 1965

REQUIREMENTS FOR MSFN SUPPORT

Saturn - IB Program

Mission: SA - 206  
LEM (No CSM)

LEM Development (unmanned launch)

Objectives:

Evaluate LEM SC

Demonstrate LEM/Ground Systems performance for extended mission.

Nominal Program:

Launch 72 Degrees Azimuth; Inject into 105 n.m. circular orbit.  
No recovery.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB evaluation station, LEM  
MILA C-Band tracking, LEM  
PAFB C-Band tracking, S-IVB/IU  
Azusa tracking\*, S-IVB/IU  
VHF TM, LEM, S-IVB/IU & S-IB  
UHF/DCS Command, S-IVB/IU, LEM  
ODOP Tracking, S-IB  
VHF voice, LEM (record only)

GBI:

C-Band Tracking, LEM or S-IVB/IU  
VHF TM, LEM and S-IVB/IU and S-IB  
UHF/DCS Command, LEM  
VHF voice, LEM (record only)

ANT:

C-Band tracking, LEM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, LEM or S-IVB/IU  
USB Evaluation station, LEM  
VHF voice, LEM (record only)  
Clotrac\*, S-IVB/IU

\* Either Azusa or Mistran will be flown, but not both.



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APOLLO PROGRAM

2.

OCI:

C-Band Tracking, LEM or S-IVB/IU  
VHF TM, LEM, S-IVB/IU  
UHF/DCS Command, LEM or S-IVB/IU  
Glotrac\*, S-IVB/IU  
VHF Voice, LEM (record only)

DBA:

USB Evaluation station, LEM  
C-Band tracking, LEM and S-IVB/IU  
VHF TM, LEM & S-IVB/IU  
UHF/DCS Command, LEM, S-IVB/IU  
Glotrac\*, S-IVB/IU  
VHF Voice, LEM (record only)

OME:

C-Band tracking, LEM or S-IVB/IU  
VHF TM, LEM and S-IVB/IU  
UHF/DCS Command, LEM and S-IVB  
VHF Voice, LEM (record only)  
Flight Control Consoles

ASC:

USB station evaluation, LEM  
C-Band tracking, LEM and S-IVB/IU  
VHF TM, LEM and S-IVB/IU  
VHF voice, LEM (record only)  
Flight control consoles

EME:

C-Band tracking, LEM  
VHF TM, LEM  
VHF Voice, LEM (record only)

ORO:

C-Band Tracking, S-IVB/IU or LEM  
VHF TM, S-IVB/IU, LEM  
UHF/DCS Command, S-IVB/IU and LEM  
VHF voice, LEM (record only)  
Flight Control Consoles  
USB Evaluation station, LEM

\* Either Asusa or Mistram will be flown, but not both.

CANTON ISLAND:

VHF TM, CSM  
VHF and HF voice, CSM

HAW:

USB evaluation station, CSM  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF voice, CSM  
S-Band TM, S-IVB/IU

GYM:

USB Evaluation station, CSM  
VHF TM, CSM and S-IVB/IU  
VHF and HF voice, CSM  
Flight Control Consoles  
S-Band TM, S-IVB/IU

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU  
VHF and HF voice, CSM

CORPUS CHRISTI, TEXAS:

USB evaluation station, CSM  
VHF TM, CSM and S-IVB/IU  
UHF/DCS Command, CSM or S-IVB/IU  
VHF and HF voice, CSM  
S-Band TM, S-IVB/IU

WHS:

C-Band tracking, CSM or S-IVB/IU

EGLIN:

C-Band tracking, CSM or S-IVB/IU

VALKARIA\*, ELEUTHERA\*:

Mistram tracking, S-IVB/IU

CHERRY POINT\*:

Glotrak, S-IVB/IU

\* Either Azusa or Mistram will be flown, but not both.

WALLOPS ISLAND:

C-Band Tracking, S-IVB/IU

MALAGASY, KNO:

VHF TM, LEM and S-IVB/IU  
VHF voice, LEM (record only)

EGLIN:

C-Band tracking, LEM or S-IVB/IU

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, LEM  
VHF TM, LEM and S-IVB/IU  
VHF Voice, LEM

INSERTION SHIP:

USB station, LEM  
C-Band Tracking, S-IVB/IU or LEM  
VHF TM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU and LEM  
VHF Voice  
Flight Control Consoles

2 INJECTION SHIPS (May also be used for re-entry coverage)

USB station, LEM  
C-Band Tracking, S-IVB/IU or LEM  
VHF TM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU and LEM  
VHF Voice  
Flight Control Consoles

RE-ENTRY SHIPS:

USB Station  
C-Band Tracking  
VHF TM  
VHF Voice

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APOLLO PROGRAM

5.

INSTRUMENTATION AIRCRAFT (APOLLO) FOR EVALUATION: (as available)

VHF TM, LEM and S-IVB/IU  
VHF Voice, LEM  
USB TM, LEM

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APOLLO PROGRAM

SATURN - IB PROGRAM

Vehicle Frequency Assignment for Mission SA-206

Location	Frequency MHz		System	Remarks
	Xmitr	Rec.		
S-IB	240.2		FM/FM GF-1	
S-IB	256.2		PCM/FM GP-1	
S-IB	960	890	ODOP	
S-IB		450	Command Destruct	
S-IVB*	246.3		FM/FM CF-2	
S-IVB*	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
IU*	250.7		FM/FM DF-1	
IU*	255.1		PCM/FM DP-1	
IU*		450	Udata	
IU**	5765	5690	C-Band Radar	Different Code than beacon on spacecraft.
IU	8216	8148	MISTRAM	Only one of these will be carried.
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	
LEM*	241.5		PAM/FM/FM	
LEM*	257.3		PAM/FM/FM	
LEM*	247.3		PAM/FM/FM	
LEM*	237.8		PCM/FM	
LEM*	230.9		Constant Bandwidth System (FM/FM)	
LEM*	5765	5690	C-Band Radar	
LEM*		450	Udata	
LEM*	296.8	296.8	Voice Transmit/ Receive	
LEM*	2282.5	2101.8	USB - PCM/PM/PM or PCM/PM/FM	
LEM*	259.7	259.7	Voice Transmit Back- up (LEM to CSM) Biomed and Voice Receive	Will be transmitted to ground as a test
LEM*	279.0	279.0	Voice Transmit (Inter- CSM-LEM)	

\* Will be left on in orbit

\*\* May be left on in orbit depending upon mission of S-IVB/IU.

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS			
		USB: PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH								
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM												
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	LEM is OFF 2282.5	2277.5												PM + FM
STATION	CAPE TEL 4 (b)											4	3	3		1	4	2	
	CAPE TEL 3											4	3	3		1			
	MILA CIF (b)											4	3	3		1	4	2	
	MILA USB	1	1					1+0		0+1							1	0	
	GBI (b)											4	3	3		1	3	0	
	GTI (a)											3	3	2		1	2	0	
	BDA (b)	1	1					1+0		0+1	3	3	2		1	3	0		
	ANT (b)	1	1					1+0		0+1	3	3	2		1	2	0		
	CYI											3	3	2		1	2	0	
	ASC	1	1					1+0		0+1	3	3	2		1	2	0		
	CRO	1	1					1+0		0+1	3	3	2		1	2	0		
	GUAM	1	1					1+0		0+1	3	3	2		1	2	0		

(a) Limited to existing capabilities

(b) Polarization Diversity required on VHF TM

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT				VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF		PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM		
STATION	HAW	1	1					1+0		0+1	3	3	2		1	2	0		
	GYM	1	1					1+0		0+1	3	3	2		1	2	0		
	TEX	1	1					1+0		0+1	3	3	2		1	2	0		
	PRETORIA (a)										1	3			1	0			
	CANTON ISLAND (a)										1	3			1	0			
	MALAGASY (a)										3	3	2		1	0			
	KNO (a)										3	3	2		1	0			
	INSERTION SHIP										3	3	2		1	2	0		
	NO. 1 & NO. 2 INJECTION SHIP	1	1					1+0		0+1	3	3	2		1	2	0		
	CSQ & RKV (a)										3	3	2		1	2	0		
	REENTRY SHIPS (c)	1	1					1+0		0+1	3	3	2		1	2	0		

(a) Limited to existing capability  
(c) If available

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APOLLO PROGRAM

March 31, 1965

REQUIREMENTS FOR MSFN SUPPORT

Saturn - IB Program

Mission: SA-207  
CSM & LEM  
101 #2

First Manned CSM/LEM Flight. Open-ended after 3 days

Objectives:

Evaluate Man/System Interfaces and Manned LEM separation & operations.

Demonstrate Crew/CSM/LEM Ground Systems performance for extended mission.

CSM Block II subsystem verification.

S-IVB/IU checkout in orbit.

Nominal Program:

Launch 72 Degrees Azimuth; Inject into 104 n.m. circular orbit.  
Water Landing.

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB Station CSM & LEM  
MILA C-Band tracking, CSM or LEM  
PAFB C-Band tracking, S-IVB/IU  
Azusa tracking\*, S-IVB/IU  
VHF TM, CSM, LEM, S-IVB/IU & S-IB  
UHF/DCS Command, LEM, or S-IVB/IU  
ODOP Tracking, S-IB  
VHF and HF Voice, CSM & LEM

GBI:

USB Station, CSM (under consideration)  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, LEM, S-IVB/IU and S-IB  
UHF/DCS Command, LEM  
VHF Voice, CSM & LEM

ANT:

C-Band tracking, CSM or S-IVB/IU or LEM  
VHF TM, CSM, LEM, and S-IVB/IU  
UHF/DCS Command, S-IVB/IU or LEM  
USB station, CSM or LEM  
VHF and HF Voice, CSM and LEM  
Glotrac\*, S-IVB/IU

\* Either Azusa or Mistram will be flown, but not both.



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GTL:

C-Band Tracking, CSM or S-IVB/IU or LEM  
VHF TM, CSM, LEM and S-IVB/IU  
UHF/DCS Command, LEM or S-IVB/IU  
Glotrac\*, S-IVB/IU  
VHF Voice, CSM

BDA:

USB station, CSM or LEM  
C-Band tracking, CSM and S-IVB/IU or LEM  
VHF TM, CSM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU or LEM  
Glotrac\*, S-IVB/IU  
VHF and HF Voice, CSM & LEM

CTL:

USB station, CSM or LEM  
C-Band tracking, CSM or S-IVB/IU or LEM  
VHF TM, CSM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
Flight Control Consoles

ASC:

USB station, CSM & LEM  
C-Band tracking, S-IVB/IU and LEM  
VHF TM, S-IVB/IU, LEM & CSM  
VHF voice, CSM & LEM  
Flight Control Consoles

PRE:

C-Band tracking, CSM  
VHF TM, CM & LEM  
VHF and HF Voice, CSM & LEM & S-IVB/IU

MALAGASY:

VHF TM, CSM & LEM & S-IVB/IU  
VHF and HF voice

CRO:

C-Band tracking, S-IVB/IU or CSM or LEM  
VHF TM, S-IVB/IU, CSM, AND LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
Flight Control Consoles  
USB Station, CSM & LEM

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CANTON ISLAND:

VHF TM, CSM & LEM  
VHF and HF Voice, CSM & LEM

HAW:

C-Band tracking, CSM or S-IVB/IU or LEM  
VHF TM, CSM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
USB station, CSM & LEM

GYM:

USB Station, CSM or LEM  
VHF TM, CSM, S-IVB/IU and LEM  
VHF and HF Voice, CSM & LEM  
Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM

CORPUS CHRISTI, TEXAS:

VHF TM, CSM, S-IVB/IU and LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
USB station, CSM or LEM

WHS:

C-Band tracking, CSM or S-IVB/IU or LEM

EGLIN:

C-Band tracking, CSM or S-IVB/IU or LEM

VALKARIA\*, ELEUTHERA:

Mistram Tracking, S-IVB/IU

CHERRY POINT:\*

Glotrac, S-IVB/IU

WALLOPS ISLAND:

C-Band Tracking, S-IVB/IU

KNO:

VHF and HF Voice, CSM  
VHF TM, CM

\*Either Azusa or Mistram will be flown but not both.

CANBERRA, GOLDSTONE:

USB Station, CSM or LEM

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, LEM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU and LEM  
VHF and HF Voice, CSM & LEM

INSERTION SHIP:

USB station, CSM & LEM  
C-Band Tracking, S-IVB/IU or CSM or LEM  
VHF TM, S-IVB/IU, CSM & LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
Flight Control Consoles

2 INJECTION SHIPS: (may also be used for reentry coverage)

USB station, CSM & LEM  
C-Band tracking, S-IVB/IU or CSM or LEM  
VHF TM, S-IVB/IU, CSM & LEM  
UHF/DCS Command, S-IVB/IU or LEM  
VHF and HF Voice, CSM & LEM  
Flight Control Consoles

REENTRY SHIPS (2):

USB station  
C-Band tracking  
VHF TM  
VHF and HF Voice

INSTRUMENTATION AIRCRAFT (APOLLO) FOR EVALUATION & REENTRY COVERAGE:

VHF TM, CSM, S-IVB/IU & LEM  
VHF and USB Voice T/R, CSM  
USB TM, CSM & LEM

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Vehicle Location	Frequency MHz Xmtr.	Rec.	System	Remarks
S-IB	240		FM/FM	CF-1
S-IB	256.2		PCM/FM	GP-1
S-IB	960	890	ODOP	
S-IB		450	Command Destruct	
S-IVB *	246.3		FM/FM	CF-2
S-IVB *	232.9		PCM/FM	CP-1
S-IVB		450	Command Destruct	
IU *	250.7		FM/FM	DF-1
IU *	255.1		PCM/FM	DP-1
IU **	5765	5690	C-Band Radar	Will use a different code than beacons on spacecraft.
IU	8216	8148	MISTRAM	Only one of these will be carried
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	
CSM *	10.006	10.006	Recovery voice transmit/receive	
CS *	259.7	259.7	Biomed, voice and LEM data receive, Voice Transmit	
CSM *	279.0	279.0	Voice Transmit/Receive	
CSM *	2287.5	2106.4	USB (PCM/FM/FM)	
CSM *	2272.5		S-Band Transmit (PCM/FM/FM)	
CSM *	5765.0	5690	C-Band Radar	
CSM *	296.8	296.8	Voice Transmit/Receive	
CSM	228.2		PAM/FM/FM	
LEM *	230.9		Constant Bandwidth System	
LEM *	237.8		PCM/FM	
LEM *	247.3		PAM/FM/FM	
LEM *	241.5		PAM/FM/FM	
LEM (1)	259.7	259.7	Same as on CSM	
LEM (1)	279.0	279.0	Same as on CSM	
LEM (1)	296.8	296.8	Voice Transmit/Receive	
LEM *		450	Updata	
LEM (1)	2282.5	2101.8	USB (PCM/FM/FM or PCM/FM/FM)	
LEM (1)	5765.0	5690	C-Band Radar	

\* Will be left on in orbit

\*\* May be left on in orbit depending upon mission of S-IVB/IU

(1) Will only be turned on after CSM-LEM separation

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM  CONSTANT BANDWIDTH					MAXIMUM NUMBER OF CHANNELS		
		USB: PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM <u>ON</u> when LEM is <u>OFF</u>					PCM/FM							
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	CAPE TEL 4 (b)										4	3	3		1	4	2	
	CAPE TEL 3 (a)										4	3	3		1			
	MILA CIF (b)	1	1	1	1			1+2		2+1	4	3	3		1	4	2	
	MILA USB **	1	1	1	1			1+2		2+1						2		
	GBI (b) *	1	1	1	1			0+2		2+0	4	3	3		1	3	0	
	GTI (a)										3	3	2		1	2	0	
	BDA (b) *	1	1	1	1			0+2		2+0	3	3	2		1	3	0	
	ANT (b) *	1	1	1	1			0+2		2+0	3	3	2		1	2	0	
	CYI *	1	1	1	1			0+2		2+0	3	3	2		1	2	0	
	ASC **	1	1	1	1			1+2		2+1	3	3	2		1	2	0	
	GRO **	1	1	1	1			1+2		2+1	3	3	2		1	2	0	
	GUAM **	1	1	1	1			1+2		2+1	3	3	2		1	2	0	

- (a) Limited to existing capability  
(b) Polarization Diversity required on VHF TM  
\* Single USB Capability  
\*\* Dual USB Capability

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME					
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS					
		USB: PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH										
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF	PCM/FM														
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5												PM + FM	or	PM + FM
MISSION: SA-207 Sheet 2 of 2																					
STATION	HAW **	1	1	1	1			1+2		2+1	3	3	2		1	2					
	GYM *	1	1	1	1			0+2		2+0	3	3	2		1	2					
	TEX *	1	1	1	1			0+2		2+0	3	3	2		1	2					
	PRETORIA (a)										3	3	2		1						
	MALAGASY (a)										3	3	2		1						
	KANO (a) & CTN (a)										3	3	2		1						
	GOLDSTONE (c) **	1	1	1	1			1+2		2+1						2					
	CANBERRA (c) **	1	1	1	1			1+2		2+1						2					
	REENTRY SHIP (c) *	1	1	1	1			0+2		2+0	3	3	2		1	2					
	INSERTION SHIP **	1	1	1	1			1+2		2+1	3	3	2		1	3					
	NO. 1 AND NO. 2 INJECTION SHIP **	1	1	1	1			1+2		2+1	3	3	2		1	3					
	INJECTION AIRCRAFT (3) (a)							0+2		2+0	3	3	2		1						

(a) Limited to existing capability

(c) If available

\* Single USB capability

\*\* Dual USB capability

## REQUIREMENTS FOR MSFN SUPPORT

Saturn V Program

Missions: SA-501  
(CSM-017)  
(LEM FTA #1)

SA 502  
(CSM-020)  
(LEM FTA #2)

### Objectives:

Development of Saturn V launch vehicle and CM lunar return reentry verification.

### Nominal Program:

Launch Azimuth 72°.

Near circular 100 n.m. earth parking orbit at about T + 3 hours.

S-IVB second burn inserts CSM into 12,000 n.m. apogee ellipse.

Acceleration to full reentry speed to simulate lunar return is then achieved on the return leg by SPS burns.

Water landing.

### MSFN Support Requirements: (Ground Stations)

#### CAPE KENNEDY:

USB evaluation station, CSM and S-IVB/IU  
MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa\* tracking  
VHF TM; CSM, S-IVB/IU, S-II S-IC, and FTA  
UHF/DCS Command, CSM  
ODOP Tracking, S-IC  
VHF and HF Voice, CSM

#### GBI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, S-II, S-IC and FTA  
UHF/DCS Command, CSM  
VHF Voice, CSM

#### ANT:

USB evaluation station, CSM and S-IVB/IU  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU  
UHF/DCS Command, CSM  
VHF and HF Voice, CSM  
Glotrac\*, S-IVB/IU

\* Either Azusa or Mistran will be flown, but not both.

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GTI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM S-IVB/IU, S-II and FTA  
UHF/DCS Command, CSM  
VHF voice, CSM  
Glotrac\*, S-IVB/IU

BDA:

C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU, S-II and FTA  
UHF/DCS Command, CSM  
VHF and HF voice, CSM  
USB evaluation station, CSM and S-IVB/IU  
Glotrac\*, S-IVB/IU

CYI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU and FTA  
UHF/DCS Command, CSM  
VHF and HF voice, CSM  
Flight Control Consoles

PRE:

C-Band tracking, CSM  
VHF TM, CSM, S-IVB/IU and FTA  
VHF and HF voice remoting, CSM

MALAGASY:

VHF TM, CSM, S-IVB/IU and FTA  
VHF and HF voice, CSM

ASC:

USB evaluation station, CSM and S-IVB/IU  
C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU, and FTA  
VHF and HF voice, CSM  
Flight Control Consoles

CRO:

USB evaluation station, CSM and S-IVB/IU  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU and FTA  
UHF/DCS Command, CSM  
VHF and HF voice, CSM  
Flight Control Consoles

\* Either Azusa or Mistram will be flown, but not both.



CANBERRA:

USB evaluation station, CSM

GUAM:

USB evaluation station, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU and FTA  
VHF and HF voice, CSM

CANTON ISLAND:

VHF TM, CSM  
VHF and HF voice, CSM

HAW:

USB evaluation station, CSM and S-IVB/IU  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, and FTA  
UHF/DCS Command, CSM  
VHF and HF voice, CSM

GYM:

USB evaluation station, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU and FTA  
VHF and HF voice, CSM  
Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU  
VHF and HF voice, CSM

GOLDSTONE:

USB evaluation station, CSM

WHITE SANDS, EGLIN:

C-Band tracking, CSM or S-IVB/IU

CORPUS CHRISTI, TEXAS:

USB evaluation station, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU and FTA  
UHF/DCS Command, CSM  
VHF and HF voice, CSM

VERO BEACH, NEW SMYRNA, EGLIN:

VHF TM Signal Strength recording only (launch vehicle)

VALKARIA\*, ELEUTHERA\*:

Mistram tracking, S-IVB/IU

CHERRY POINT\*:

Glotrak tracking, S-IVB/IU

WALLOPS ISLAND:

C-Band tracking, S-IVB/IU

KNO:

VHF TM, CSM

VHF and HF voice remoting, CSM

MSFN Support Requirements: (Ships and Aircraft)CSQ and RKV:

UHF/DCS Command, CSM

VHF TM, CSM, S-IVB/IU and FTA

VHF and HF voice, CSM

INSERTION SHIP:

USB station, CSM and S-IVB/IU

C-Band tracking, S-IVB/IU or CSM

VHF TM, S-IVB/IU, CSM and FTA

UHF/DCS Command, CSM

VHF and HF voice, CSM

Flight control consoles

2 INJECTION SHIPS: (Will be used for orbit injection and reentry support.)

USB station, CSM and S-IVB/IU

C-Band tracking, S-IVB/IU or CSM

VHF TM, S-IVB/IU, CSM and FTA

UHF/DCS Command, CSM

Flight Control Consoles

REENTRY SHIPS (2):

USB station

C-Band tracking

VHF TM

VHF and HF voice

\* Either Azusa or Mistram will be flown, but not both.

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APOLLO PECULIAR INSTRUMENTATION AIRCRAFT: (Two or Three required  
for orbit, injection, and reentry coverage.)

VHF TM, CSM, S-IVB/IU and FTA  
USB and VHF voice, CSM  
HF voice

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D. C.

## OFFICE OF MANNED SPACE FLIGHT APOLLO PROGRAM

SA 501 and 502

Vehicle Location	Frequency MHz		Rec.	System	Remarks
	Xmtr				
S-IC	231.9			PAM/FM/FM AF-3	AF-3, AF-1 and AS-1 are on a common antenna system. AF-2, AS-2 and AP-1 are on a common antenna system.
S-IC	252.4			PAM/FM/FM AF-2	
S-IC	240.2			PAM/FM/FM AF-1	
S-IC	235.0			SS/FM AS-1	
S-IC	256.0			SS/FM AS-2	
S-IC	244.3			PCM/FM AP-1	
S-IC	960	890		ODOP	
S-IC		450		Command Destruct	
S-II	241.5			PAM/FM/FM BF-1	BF-1, BR-2 and BS-1 are on a common antenna system. BF-3, BS-2 and BP-1 are on a common antenna system.
S-II	234.0			PAM/FM/FM BF-2	
S-II	229.9			PAM/FM/FM BF-3	
S-II	248.6			PCM/FM BP-1	
S-II	227.2			SS/FM BS-1	
S-II	236.2			SS/FM BS-2	
S-II		450		Command Destruct	
S-IVB*	258.5			PAM/FM/FM CF-1	CF-1 and CF-3 are on a common antenna. CF-2, CS-1, and CP-1 are on a common antenna system.
S-IVB*	253.8			PAM/FM/FM CF-3	
S-IVB*	246.3			PAM/FM/FM CF-2	
S-IVB*	226.2			SS/FM CS-1	
S-IVB*	232.9			PCM/FM CP-1	
S-IVB		450		Command Destruct	
IU*	250.7			PAM/FM/FM DF-1	All telemetry is on the same antenna system.
IU*	245.3			PAM/FM/FM DF-2	
IU	259.7			SS/FM DS-1	Parallel system to DP-1 Command and Communication System Different Code than beacon on S.C. Only one of these will be carried.
IU*	255.1			PCM/FM DP-1	
IU*	2277.5			PCM/FM DP-2	
IU*	2282.5	2101.8		CCS/PCM/PM/FM	
IU	5765	5690		C-Band Radar	
IU	8216	8148		MISTRAM	
	7960-7952	7892-7884			
IU	5001	5061		AZUSA	

\* Systems left on in orbit.

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CSM*	296.8	296.8	Voice Transmit/ Receive
CSM*		450	Updata
CSM*	5765	5690	C-Band Radar
CSM*	2287.5	2106.4	USB/PCM/PM/PM or PCM/PM/FM
CSM*	10.006	10.006	HF Transmit/ Receive
CSM	220.2		PAM/FM/FM
FTA*	257.3		Constant Bandwidth
FTA*	247.3		PAM/FM/FM
CSM*	237.8		PCM/FM
FTA*	230.9		Constant Bandwidth

\* Systems left on in orbit.

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Washington 25, D. C.

OFFICE OF MANNED SPACE FLIGHT

# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT MISSION: SA-501 SA-502  Sheet 1 of 3	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	CAPE TEL 4 (b)										5	13		6	2	4	0	
	CAPE TEL 3 (a)										5	13		6	2			
	MILA CIF (b)			1	1	1	1	2+1		1+2	5	13		6	2	4	0	
	MILA USB **			1	1	1	1	2+1		1+2						2	0	
	GBI (b) *										5	13		6	2	3	0	
	GTI (a)										4	10		4	2	2	0	
	BDA (b) *			1	1	1	1	2+0		0+2	4	10		4	2	3	0	
	ANT (b) *			1	1	1	1	2+0		0+2	4	10		4	2	2	0	
	CYI *			1	1	1	1	2+0		0+2	3	7			2	2	0	
	ASC **			1	1	1	1	2+1		1+2	3	7			2	2	0	
	CRO **			1	1	1	1	2+1		1+2	3	7			2	2	0	
	GUAM **			1	1	1	1	2+1		1+2	3	7			2	2	0	

(a) Limited to existing capabilities

(b) Polarization Diversity required on VHF / TM

\* Single USB capability

\*\* Dual USB capability

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT MISSION: SA-501 SA-502 Sheet 2 of 3	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF		PCM/FM										
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5	PM + FM	or	PM + FM				PCM	PAM/ FM			
STATION	HAW **			1	1	1	1	2+1		1+2	3	7			2	2		
	GYM *			1	1	1	1	0+2		2+0	3	7			2	2		
	TEX *			1	1	1	1	0+2		2+0	3	7			2	2		
	PRETORIA (a)										3	7			2			
	KANO (a)										3	7			2			
	MALAGASY (a)										3	7			2			
	GOLDSTONE (c) **			1	1			0+1		1+0						2		
	CANBERRA (c) **			1	1			0+1		1+0						2		
	INSERTION SHIP (a) **			1	1	1	1	2+1		1+2	3	7			2	2		
	NO. 1 AND NO. 2 ** INJECTION SHIP (a)			1	1	1	1	2+1		1+2	4	10			4	2		
	NO. 1 AND NO. 2 * REENTRY SHIPS (a)(c)			1	1			1+0		0+1	1	1				1		

(a) Limited to existing capability

(c) If available

\* Single USB capability

\*\* Dual USB capability

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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT MISSION: SA-501 SA-502 Sheet 3 of 3	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH							
		LEM PM or FM (not both)		CSM PM or FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2287.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	INJECTION AIRCRAFT (3) (a)			1	1	1	1	0+2		2+0	3	5			2			
	CSQ (a)										3	7			2	2		
	RKV (a)										3	7			2	2		

(a) Limited to existing to existing capability



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
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APOLLO PROGRAM  
REQUIREMENTS FOR MSFN SUPPORT

March 31, 1965

Saturn V Program

Mission SA-503  
CSM 102  
LEM #3

Objectives:

First manned Saturn V. Lunar Mission simulation in earth orbit. Duration: approximately 10 days.

Nominal Program

Launch Azimuth 72°  
100 N.M. earth parking orbit  
Transfer to higher orbit with plane changes using SPS,  
45° N.M. apogee. Separation between LEM & CSM culminating  
in CSM-LEM rendezvous and docking.  
Water landing (CM).

MSFN Support Requirements: (Ground Stations)

CAPE KENNEDY:

USB station, CSM & LEM or S-IVB/IU  
MILA C-Band tracking, CSM  
PAFB C-Band tracking, S-IVB/IU  
Azusa\* tracking  
VHF TM; CSM, S-IVB/IU, S-II, S-IC, and LEM  
UHF/DCS Command, LEM  
ODOP Tracking, S-IC  
VHF and HF voice, CSM

GBI:

USB station being considered for CSM  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, S-II, S-IC, and LEM  
VHF Voice, CSM  
UHF/DCS Command, LEM

ANT:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU & S-II and LEM  
UHF/DCS Command, LEM  
USB station, CSM or LEM or S-IVB/IU  
VHF and HF Voice, CSM  
Glotrac\*, S-IVB/IU

\* Either Azusa or Mistran will be flown, but not both.

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GTI:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, S-II and LEM  
UHF/DCS Command, LEM  
VHF Voice, CSM  
Glotrac\*, S-IVB/IU

BDA:

C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU, S-II and LEM  
UHF/DCS Command, LEM  
VHF and HF Voice, CSM  
USB station, CSM or LEM or S-IVB/IU  
Glotrac\*, S-IVB/IU

CXI:

USB station, CSM or S-IVB/IU or LEM  
C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU, and LEM  
UHF/DCS Command, LEM  
VHF and HF Voice, CSM  
Flight Control Consoles

PRE:

C-Band tracking, CSM  
VHF TM, CSM  
VHF and HF voice, CSM

MALAGASY:

VHF TM, CSM  
VHF and HF voice, CSM

ASC:

C-Band tracking, CSM and S-IVB/IU  
VHF TM, CSM, S-IVB/IU and LEM  
USB station, CSM and S-IVB/IU or LEM  
VHF and HF Voice, CSM  
Flight Control consoles

CRO:

C-Band tracking, CSM or S-IVB/IU  
VHF TM, CSM, S-IVB/IU and LEM  
UHF/DCS Command, LEM  
VHF and HF Voice, CSM  
USB station, CSM and S-IVB/IU or LEM  
Flight Control Consoles

\* Either Mistram or Azusa will be flown, but not both.

GUAM:

USB station, CSM and S-IVB/IU or LEM  
 VHF TM, CSM, S-IVB/IU and LEM  
 VHF and HF Voice, CSM

HAW:

C-Band tracking, CSM or S-IVB/IU  
 VHF TM, CSM, S-IVB/IU and LEM  
 UHF/DCS Command, LEM  
 VHF and HF Voice, CSM  
 USB station, CSM & S-IVB/IU or LEM

GYM:

USB station, CSM or S-IVB/IU or LEM  
 VHF TM, CSM, S-IVB/IU, and LEM  
 VHF and HF Voice, CSM  
 Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, CSM or S-IVB/IU  
 VHF and HF Voice, CSM

WHITE SANDS, EGLIN:

C-Band tracking, CSM or S-IVB/IU

CORPUS CHRISTI, TEXAS:

USB station, CSM or S-IVB/IU or LEM  
 VHF TM, CSM, S-IVB/IU and LEM  
 UHF/DCS Command, LEM  
 VHF and HF Voice, CSM

VERO BEACH, NEW SMYRNA, EGLIN:

VHF TM Signal Strength recording only. (Launch Vehicle)

GOLDSTONE, CANBERRA, MADRID:

USB station, CSM and S-IVB/IU or LEM.

VALKARIA\*, ELEUTHERA:

Mistram Tracking, S-IVB/IU

CHERRY POINT\*:

Glotrak Tracking, S-IVB/IU

\* Either Azusa or Mistram will be flown, but not both.

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Wallops Island:

C-Band Tracking, S-IVB/IU

KNO:

VHF TM, CSM  
VHF and HF voice remoting, CSM

MSFN Support Requirements: (Ships and Aircraft)

CSQ and RCV:

UHF/DCS Command, LEM  
VHF TM, CSM, S-IVB/IU and LEM  
VHF and HF Voice, CSM

INJECTION SHIP:

USB station, CSM and S-IVB/IU or LEM  
C-Band tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU, CSM, and LEM  
UHF/DCS Command, LEM  
VHF and HF Voice, CSM

INSERTION SHIPS: (Will be used for orbit and reentry support).

USB station, CSM and S-IVB/IU or LEM  
C-Band Tracking, S-IVB/IU or CSM  
VHF TM, S-IVB/IU, CSM and LEM  
UHF/DCS Command, LEM

APOLLO PECULIAR INSTRUMENTATION AIRCRAFT: (As available for orbit and reentry coverage.)

VHF TM, CSM, S-IVB/IU and LEM  
USB and VHF Voice T/R, CSM  
HF voice T/R

REENTRY SHIPS (2)

USB Station  
C-Band Tracking  
VHF TM  
VHF & HF Voice

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March 31, 1965

SA-503

Vehicle Location	Frequency MHz	Xmtr.	Rec.	System	Remarks
S-IC	231.9			PAM/FM/FM AF-3	AF-3, AF-1 and
S-IC	252.4			PAM/FM/FM AF-2	AS-1 are on a
S-IC	240.2			PAM/FM/FM AF-1	common antenna
S-IC	235.0			SS/FM AS-1	system. AF-2,
S-IC	256.0			SS/FM AS-2	AS-2, and AP-1 are
S-IC	244.3			PCM/FM AP-1	on a common an-
S-IC	960		890	ODOP	tenna system.
S-IC			450	Command Destruct	
S-II	241.5			PAM/FM/FM BF-1	BF-1, BF-2 and
S-II	234.0			PAM/FM/FM BF-2	BS-1 are on a
S-II	229.9			PAM/FM/FM BF-3	common antenna
S-II	248.6			PCM/FM BP-1	system. BF-3
S-II	227.2			SS/FM BS-1	BS-2 and BP-1 are
S-II	236.2			SS/FM BS-2	on a common an-
S-II		450		Command Destruct	tenna system.
* S-IVB	258.5			PAM/FM/FM CF-1	CF-1 and CF-3 are
* S-IVB	253.8			PAM/FM/FM CF-3	on a common an-
* S-IVB	246.3			PAM/FM/FM CF-2	tenna. CF-2, CS-1,
S-IVB	226.2			SS/FM CS-1	and CP-1 are on a
* S-IVB	232.9			PCM/FM CP-1	common antenna
S-IVB			450	Command Destruct	system.
* IU	250.7			PAM/FM/FM DF-1	All telemetry is on
* IU	245.3			PAM/FM/FM DF-2	the same antenna
IU	259.7			SS/FM DS-1	System.
* IU	255.1			PCM/FM DP-1	
* IU	2277.5			PCM/FM DP-2	Parallel system to
* IU	2282.5		2101.8	CCS/PCM/FM/FM	DP-1
* IU	5765		5690	C-Band Radar	Command and Com-
IU	8216		8148	MISTRAM	munication System
IU	7960-7952		7892-7884		Different Code than
IU	5001		5061	AZUSA	beacon on S.C.
					Only one of these
					will be carried

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SA-503 (Cont'd)

Vehicle Location	Frequency MHz	Xmtr	Rec.	System	Remarks
*CSM		296.8	296.8	Voice Transmit/ Receive	
*CSM		279.0	279.0	Voice Transmit/ Receive	
*CSM			259.7	Voice, Biomed and LEM T/M	IU's DS-1 will be off when these fre- quencies are used.
*CSM	259.7			Voice Transmit	
*CSM	5765		5690	C-Band Radar	
*CSM	2287.5		2106.4	USB/PCM/FM/FM	
*CSM	2272.5			S-Band Transmitter/ PCM/FM/FM	High bit rate system
*CSM	10.006		10.006	HF Transmit/Receive	
*CSM	228.2			PAM/FM/FM	
*LEM(1)	296.8		296.8	Voice Transmit/ Receive	
*LEM(1)	279.0		279.0	Voice Transmit/ Receive	
*LEM(1)	259.7		259.7	TM/Voice Transmit Biomed and Voice Receive	
*LEM(1)	2282.5		2101.8	USB/PCM/FM/FM or FM	Shares frequency with IU's CCS
*LEM	257.3			PAM/FM/FM	
*LEM	247.3			PAM/FM/FM	
*LEM	237.8			PCM/FM	
*LEM	230.9			Constant Bandwidth	
*LEM			450	Updata	
*LEM	5765		5690	C-Band Radar	

\*Systems left on in orbit.

(1) Will not be turned on until some fixed point after insertion.

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**APOLLO PROGRAM**

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT  MISSION: SA-503  Sheet 1 of 3	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM CONSTANT BANDWIDTH							
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	CAPE TEL 4 (b)										5	14		6	1	4		
	CAPE TEL 3 (a)										5	14		6	1			
	MILA CIF (b)	1	1	1	1	1	1	2+2		1+3	5	14		6	1	4		
	MILA USB **	1	1	1	1	1	1	2+2		1+3								
	GBI (b) *	1	1	1	1	1	1	2+0		0+2	5	14		6	1	3		
	GTI (a)										4	11		4	1	2		
	BDA (b) *	1	1	1	1	1	1	2+0		0+2	4	11		4	1	3		
	ANT (b) *	1	1	1	1	1	1	2+0		0+2	4	11		4	1	3		
	CYI *	1	1	1	1	1	1	2+0		0+2	3	7			1	2		
	ASC **	1	1	1	1	1	1	2+2		1+3	3	7			1	2		
	CRO **	1	1	1	1	1	1	2+2		1+3	3	7			1	2		
	GUAM **	1	1	1	1	1	1	2+2		1+3	3	7			1	2		

- (a) Limited to existing capability  
(b) Polarization Diversity required on VHF TM  
\* Single USB capability  
\*\* Dual USB Capability

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MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM  CONSTANT BANDWIDTH					MAXIMUM NUMBER OF CHANNELS		
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF		PCM/FM										
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	MISSION: SA-503 Sheet 2 of 3																	
	HAW **	1	1	1	1	1	1	2+2		1+3	3	7			1	2		
	GYM *	1	1	1	1	1	1	2+0		0+2	3	7			1	2		
	TEX *	1	1	1	1	1	1	2+0		0+2	3	7			1	2		
	PRETORIA (a)										3	7			1			
	MALAGASY (a)										3	7			1			
	KANO (a)										3	7			1			
	GOLDSTONE **	1	1	1	1	1	1	2+2		1+3						2		
	CANBERRA **	1	1	1	1	1	1	2+2		1+3						2		
	MADRID **	1	1	1	1	1	1	2+2		1+3						2		

(a) Limited to existing capability

\* Single USB capability

\*\* Dual USB capability



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# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM  CONSTANT BANDWIDTH					MAXIMUM NUMBER OF CHANNELS			
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY											
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF		PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM				PCM	PAM/ FM				FM
STATION	MISSION: SA-503 Sheet 3 of 3																		
	INSERTION ** SHIP (a)	1	1	1	1	1	1	2+2		1+3	3	7			1	2			
	NO. 1 & NO. 2 ** INJECTION SHIP (a)	1	1	1	1	1	1	2+2		1+3	3	7			1	2			
	NO. 1 & NO. 2 * REENTRY SHIP (a)	1	1	1	1			2+0		0+2	3	7			1	1			
	AIRCRAFT (8) (a)	1	1	1	1	1	1	2+0		0+2	3	7			1	0			

(a) Limited to existing capability

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Washington, D. C.  
OFFICE OF MANNED SPACE FLIGHT  
APOLLO PROGRAM

March 31, 1965

REQUIREMENTS FOR MSFN SUPPORT

Saturn V Program

Mission: SA - 504

CSM - 104

LEM - 4

And Mission: SA - 505, 506

Objective:

Provide lunar landing Mission Capability (SA-504)

MSFN Support Requirements: (Ground Stations)

CASPER KENNEDY:

USB station, CSM and S-IVB/IU or LEM  
MILA C-Band tracking  
PATB C-Band tracking, S-IVB/IU  
Azusa\* tracking  
VHF TM: S-IVB/IU, S-II, and S-IC  
ODOP Tracking, S-IC  
VHF and HF Voice, CSM

GBI:

USB station, CSM (under consideration)  
C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU, S-II, and S-IC  
VHF Voice, CSM

ANT:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU and S-II  
USB station, CSM or S-IVB/IU or LEM  
VHF and HF Voice, CSM  
Glotrac\*, S-IVB/IU

CHI:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU and S-II  
VHF Voice, CSM  
Glotrac,\*S-IVB/IU

\* Either Azusa or Mistrum will be flown, but not both.

ATTACHMENT (10)

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PDA:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU and S-II  
VHF and HF Voice, CSM  
USB station, CSM or S-IVB/IU or LEM  
Glotrac\*, S-IVB/IU

CYE:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
VHF and HF Voice, CSM  
Flight Control Consoles

PRE:

C-Band tracking, S-IVB/IU  
VHF and HF voice, CSM

MALAGASY:

VHF and HF voice, CSM

ASC:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
USB station, CSM and S-IVB/IU or LEM  
VHF and HF Voice, CSM  
Flight Control Consoles

CRO:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
VHF and HF Voice, CSM  
USB station, CSM and S-IVB/IU or LEM  
Flight Control Consoles

COM:

USB station, CSM and S-IVB/IU or LEM  
VHF TM, S-IVB/IU  
VHF and HF Voice, CSM

\* Either Azusa or Mistram will be flown, but not both.

HAW:

C-Band tracking, S-IVB/IU  
VHF TM, S-IVB/IU  
VHF and HF Voice, CSM  
USB station, CSM and S-IVB/IU or LEM

GYM:

USB station, CSM or S-IVB/IU or LEM  
VHF TM, S-IVB/IU  
VHF and HF Voice, CSM  
Flight Control Consoles

PT. ARGUELLO:

C-Band tracking, S-IVB/IU  
VHF and HF Voice, CSM

WHITE SANDS, EGLIN:

C-Band tracking, S-IVB/IU

CORPUS CHRISTI, TEXAS:

USB station, CSM or S-IVB/IU or LEM  
VHF TM, S-IVB/IU  
VHF and HF voice, CSM

GOLDSTONE, CANBERRA, MADRID:

USB station, CSM, S-IVB/IU or LEM

VALKARIA\*, ELEUTHERA:

Mistram Tracking, S-IVB/IU

CHERRY POINT\*:

Glotrak, S-IVB/IU

WALLOPS ISLAND:

C-Band Tracking, S-IVB/IU

KNO:

VHF and HF voice, CSM

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MSFN Support Requirements: (Ships and Aircraft)

CSQ and RKV:

VHF TM, S-IVB/IU  
VHF and HF Voice, CSM

INJECTION SHIP:

USB station, CSM and S-IVB/IU or LEM  
C-Band tracking, S-IVB/IU  
VHF TM, CSM  
VHF and HF Voice, CSM  
Flight Control Console

INSERTION SHIPS: (Will be used for orbit and reentry support.)

USB station, CSM and S-IVB/IU or LEM  
C-Band Tracking, S-IVB/IU  
VHF TM, CSM  
VHF and HF voice, CSM  
Flight Control Console

REENTRY SHIPS: (2)

USB station.  
C-Band tracking  
VHF TM  
VHF and HF Voice

APOLLO PECULIAR INSTRUMENTATION AIRCRAFT:

"S" Band and VHF TM, S-IVB/IU  
USB and VHF Voice T/R, CSM  
USB TM, CSM  
HF voice T/R

\* Either Azusa or Mistrum will be flown, but not both.

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SA-504 and 505

Vehicle Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
S-IC (2)	231.9		PAM/FM/FM AF-3	AF-3, AF-1 and AS-1
S-IC (2)	252.4		PAM/FM/FM AF-2	are on a common
S-IC	240.2		PAM/FM/FM AF-1	antenna system.
S-IC (2)	235.0		SS/FM AS-1	AF-2, AS-2 and AP-1
S-IC (2)	256.0		SS/FM AS-2	are on a common
S-IC	244.3		PAM/FM AP-1	antenna system.
S-IC (1)	960	890	QOP	
S-IC		450	Command Destruct	
S-II (2)	241.5		PAM/FM/FM BF-1	BF-1, BF-2 and
S-II	234.0		PAM/FM/FM BF-2	BS-1 are on a common
S-II (2)	229.9		PAM/FM/FM BF-3	antenna system.
S-II	248.6		PCM/FM BP-1	BF-3, BS-2 and BP-1
S-II (2)	227.2		SS/FM BS-1	are on a common
S-II (2)	236.2		SS/FM BS-2	antenna system.
S-II		450	Command Destruct	
*S-IVB	258.5		PAM/FM/FM CF-1	CF-1 and CF-3 are
*S-IVB (2)	253.8		PAM/FM/FM CF-3	a common antenna
*S-IVB (2)	246.3		PAM/FM/FM CF-2	CF-2, CS-1 and CP
" (2)	226.2		SS/FM CS-1	are on a common
*S-IVB	232.9		PCM/FM CP-1	antenna system.
S-IVB		450	Command Destruct	
*IU	250.7		PAM/FM/FM DF-1	All telemetry
IU (2)	245.3		PAM/FM/FM DF-2	are on the same
IU (2)	259.7		SS/FM DS-1	antenna system
*IU	255.1		PCM/FM DP-1	
*IU	2277.5		PCM/FM DP-2	Parallel Syst
				DP-1
*IU	2282.5	2101.8	CCS PCM/FM/PM	
*IU	5765	5690	C-Band Radar	
IU	8216	8148	MISTRAM	Only one of will be ca
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	

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SA 504 and 505 (Cont'd)

Vehicle Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
*CSM	296.8	296.8	Voice Transmit/Receive	
*CSM	279.0	279.0	Voice Transmit/Receive	
*CSM	259.7	259.7	Comm. System with LEM	DC-1 will be off.
*CSM	2287.5	2106.4	USB PCM/PM/PM	
*CSM	2272.5		S-Band Transmitter PCM/PM/FM	High bit rate telemetry
*CSM	10.006	10.006	HF Transmit/Receive	
*LEM (3)	296.8	296.8	Voice Transmit/Receive	
*LEM (3)	279.0	279.0	Voice Transmit/Receive	
*LEM (3)	259.7	259.7	Comm. System with CSM	
*LEM (3)	2282.5	2101.8	USB PCM/PM/PM or FM	Shares frequency with CCS

- ) Possibility of requirement being fulfilled by the CCS.  
Possibility of being eliminated. R&D Instrumentation will be removable..  
Will not be turned on until some fixed point after insertion.  
Systems on in orbit.

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SA-506 and Sub.

Vehicle Location	Frequency MHz		System	Remarks
	Xmtr	Rec.		
S-IC	240.2		FM/FM AF-1	
S-IC	244.3		PCM/FM AP-1	
S-IC		450	Command Destruct	
S-IC (1)	960	890	ODOP	
S-II	234.0		FM/FM BF-2	
S-II	248.6	P	PCM/FM BP-1	
S-II		450	Command Destruct	
S-IVB*	246.3		FM/FM CF-2	
S-IVB*	232.9		PCM/FM CP-1	
S-IVB		450	Command Destruct	
*IU	250.7		FM/FM/ DF-1	
*IU	255.1		PCM/FM DP-1	
*IU	2277.5		PCM/FM DP-2	Parallel system to DP-1
*IU	2282.5	2101.8	CCS PCM/PM/PM	
*IU	5765	5690	C-Band Radar	
IU	8216	8148	MISTRAM	
	7960-7952	7892-7884		
IU	5001	5061	AZUSA	Only one of these will be carried.
*CSM	296.8	296.8	Voice Transmit/Receive	
*CSM	279.0	279.0	Voice Transmit/Receive	
*CSM	259.7	259.7	Comm. System with LEM	
*CSM	2287.5	2106.4	USB PCM/PM/PM	
*CSM	2272.5		S-Band Transmitter	High bit rate telemetry
			PCM/PM/FM	
*CSM	10.006	10.006	HF Transmit/Receive	
*LEM	296.8	296.8	Voice Transmit/Receive	
*LEM	279.0		Voice Transmit/Receive	
*LEM	259.7	259.7	Comm. System with CSM	
*LEM	2282.5	2101.8	USB PCM/PM/PM or FM	Shares frequency with CCS

(1) Possibility of requirement being fulfilled by the CCS.

(2) Will not be turned on until after CSM/LEM separation.

\* Systems left on in orbit.



# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT MISSION: SA-504 SA-505 Sheet 1 of 2	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS		
		USB: PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY										
		LEM PM or FM (not both)		CSM PMan&FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB		PCM	FM	
STATION	CAPE TEL 4 (b)										4	11		6		4		
	CAPE TEL 3 (a)										4	11		6				
	MILA CIF (b)	1	1	1	1	1	1	2+2		1+3	4	11		6		4		
	MILA USB **	1	1	1	1	1	1	2+2		1+3								
	GBI (b) *	1	1	1	1	1	1	2+0		0+2	4	11		6		3		
	GTI (a)										3	8		4		2		
	BDA (b) *	1	1	1	1	1	1	2+0		0+2	3	8		4		3		
	ANT (b) *	1	1	1	1	1	1	2+0		0+2	3	8		4		3		
	CYI *	1	1	1	1	1	1	2+0		0+2	2	4				2		
	ASC *	1	1	1	1	1	1	2+2		1+3	2	4				2		
	CRO **	1	1	1	1	1	1	2+2		1+3	2	4				2		
	GUAM **	1	1	1	1	1	1	2+2		1+3	2	4				2		

(a) Limited to existing capability

(b) Polarization Diversity required on Vh VHF/TM

\* Single USB capability

\*\* Dual USB capability

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MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT  MISSION: SA-504 SA-505  Sheet 2 of 2	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS		
		USB: PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM							
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5	PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM	
STATION	HAW **	1	1	1	1	1	1	2+2		1+3	2	4				2		
	GYM *	1	1	1	1	1	1	2+0		0+2	2	4				2		
	TEX *	1	1	1	1	1	1	2+0		0+2	2	4				2		
	GOLDSTONE **	1	1	1	1	1	1	2+2		1+3						2		
	CANBERRA **	1	1	1	1	1	1	2+2		1+3						2		
	MADRID **	1	1	1	1	1	1	2+2		1+3						2		
	CSQ AND RKV										2	4				2		
	INSERTION ** SHIP (a)	1	1	1	1	1	1	2+2		1+3	2	4				2		
	NO. 1 & NO. 2 ** INJECTION SHIP (a)	1	1	1	1	1	1	2+2		1+3	2	4				2		
	NO. 1 & NO. 2 * REENTRY SHIP (a)	1	1	1	1			2+0		0+2	2	4				1		
	AIRCRAFT (8) (a)	1	1	1	1	1	1	2+0		0+2	2	4				0		

(a) Limited to existing capability

\* Single USB capability

\*\* Dual USB Capability

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MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME		
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF  PCM/FM, PAM/FM/FM FM/FM, SSB/FM					MAXIMUM NUMBER OF CHANNELS		
		USB:    PCM/PM/PM or PCM/PM/FM				CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY  .										
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM <u>ON</u> when LEM is <u>OFF</u>	PCM/FM											
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5		PM + FM	or	PM + FM	PCM	PAM/ FM	FM	SSB	CB	PCM	FM
STATION	CAPE TEL 4 (b)										4		4			4		
	CAPE TEL 3 (a)										4		4					
	MILA CIF (b)	1	1	1	1	1	1	2+2		1+3	4		4			4		
	MILA USB **	1	1	1	1	1	1	2+2		1+3						2		
	GBI (b) *	1	1	1	1	1	1	0+2		2+0	4		4			3		
	GTI (a)										3		3			2		
	BDA (b) *	1	1	1	1	1	1	0+2		2+0	3		3			3		
	ANT (b) *	1	1	1	1	1	1	0+2		2+0	3		3			3		
	CYI **	1	1	1	1	1	1	0+2		2+0	2		2			2		
	ASC **	1	1	1	1	1	1	2+2		1+3	2		2			2		
	CRO **	1	1	1	1	1	1	2+2		1+3	2		2			2		
	GUAM **	1	1	1	1	1	1	2+2		1+3	2		2			2		

(a) Limited to existing capability  
(b) Polarization Diversity required on VHF/TM  
\* Single USB capability

# APOLLO PROGRAM

MARCH 23, 1965

EQUIPMENT	TELEMETRY GROUND SUPPORT	RECEIVE/RECORD														REAL TIME			
		POSSIBLE SOURCE						ACTUAL REQUIREMENT			VHF					MAXIMUM NUMBER OF CHANNELS			
		USB:		PCM/PM/PM or PCM/PM/FM		CCS		MAXIMUM NUMBER OF S-BAND LINKS TO BE SUPPORTED SIMULTANEOUSLY			PCM/FM, PAM/FM/FM FM/FM, SSB/FM								
		LEM PM or FM (not both)		CSM PM and FM		PCK/PM/PM ON when LEM is OFF	PCM/FM												
		2282.5 PM	2282.5 FM	2287.5 PM	2272.5 FM	2282.5	2277.5												PM + FM
STATION	MISSION: SA-506 Sheet 2 of 2																		
	HAW **	1	1	1	1	1	1	2+2		1+3	2	2					2		
	GYM *	1	1	1	1	1	1	0+2		2+0	2	2					2		
	TEX *	1	1	1	1	1	1	0+2		2+0	2	2					2		
	GOLDSTONE **	1	1	1	1	1	1	2+2		1+3							2		
	CANBERRA **	1	1	1	1	1	1	2+2		1+3							2		
	MADRID **	1	1	1	1	1	1	2+2		1+3							2		
	CSQ AND RKV (a)										2	2					2		
	INSERTION ** SHIP	1	1	1	1	1	1	2+2		1+3	2	2					2		
	NO. 1 AND NO. 2 ** INJECTION SHIP	1	1	1	1	1	1	2+2		1+3	2	2					2		
	NO. 1 AND NO. 2 REENTRY SHIP *	1	1	1	1			0+2		2+0	2	2					1		
AIRCRAFT (8)(a)	1	1	1	1	1	1	0+2		2+0	2	2					0			

(a) Limited to existing capability

\* Single USB capability

\*\* Dual USB capability