MERCURY
NETWORK PERFORMANCE ANALYSIS
FOR MA-8

PREPARED BY

MANNED SPACE FLIGHT SUPPORT DIVISION

OCTOBER 24, 1962

NASA

GODDARD SPACE FLIGHT CENTER
GREENBELT, MD.

FOREWORD

This report presents a survey of the performance of the Mercury network for the MA-8 mission that was conducted on October 3, 1962, with Commander Walter M. Shirra as astronaut.

A report of this type naturally requires contributions from many groups, and it is impossible to acknowledge the contributions of all. The four branches (Procedures and Evaluation, Network Operations, Network Engineering, and Data Operations) of the Manned Space Flight Support Division all cooperated, and in particular, a substantial amount of information was taken from the Preliminary Network Performance Report on MA-8, dated October 11, 1962. This report was compiled by Mr. V. F. Gardner of the Network Engineering Branch, who obtained much of his information from the Postlaunch Instrumentation Messages that are prepared by the Network sites and the Communications Branch at Goddard.

In addition to the credits at the beginning of Sections 4 and 5 of this report, acknowledgement is also made for the contributions by the memorandum "Report of CADFISS Support for the MA-8 Mission", dated October 8, prepared by the Data Support Office, GSFC: and by the Test Results of NCG-161, dated September 11, prepared by the IBM Corporation.

The reader of this report may get the impression that the tracking network experienced nothing but continuous equipment malfunctions as evidenced by the long lists of problems encountered and by the brief reference to the major systems that operated with outstanding performance. It is pointed out that the purpose of this report is to review critically the network performance to obtain (as was the case for similar reports of earlier flights) an overall perspective of the capability and reliance that can be placed upon the ground instrumentation. Thus, the report covers all known problems encountered, without a great deal of emphasis on systems that, according to data available at the time of report preparation, appeared to function normally.

MERCURY NETWORK PERFORMANCE ANALYSIS

FOR MA-8

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October 24, 1962

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

SUMMARY

The Mercury network performance was highly successful during the Mercury Atlas-8 mission. The countdown went extremely smooth, and only one hold was encountered, a 15-minute hold because of a radar problem at the Canary Island site. At the time of launch, 12:15:12Z on October 3, 1962, all systems required to support the flight were operational.

The composite of radar data from the network was excellent and comparable to MA-6 and MA-7. The Huntsville and Watertown obtained valid S-band track on orbits 5 and 6, respectively, but the data was not used by the computing center at Goddard Space Flight Center (GSFC). The American Mariner obtained track on orbits 5 and 6, including one minute during RF blackout, but the data was received in unusable form at GSFC. While the capsule beacons were off, no network station obtained track, but the Nike Zeus at White Sands and the Trinidad radar both skin tracked the capsule.

The command subsystem operated in a satisfactory manner during the mission. No command failures were recorded, and only the R- and Z-CAL functions were sent.

Throughout the mission the computing system at GSFC was able to use the network data to supply real-time digital display and plotboard information to the Mercury Control Center (MCC) at Cape Canaveral. The computers quickly established the orbit from early network data and supplied real-time acquisition data to all sites. Retrofire time was computed by using a 32-degree pitch, zero roll, and zero yaw attitudes, capsule weight as adjusted in accordance with the use of consumables, and nominal delta velocity from the retro rockets. The net result was an excellent impact prediction and an uncomplicated recovery.

The automatic acquisition aid subsystem performed as expected during the mission, although multipath continued to be a problem at low elevation angles.

The telemetry subsystem performance was considered good throughout the mission. Generally, all sites received signal from horizon to horizon. A failure of primary power at California during the fifth orbit was the only major problem. This failure disabled the telemetry receivers during this pass, but San Nicholas Island acting in a backup capacity supplied California with telemetry data.

The timing system around the network performed quite satisfactorily. Data serial decimal time and time monitoring capabilities were quite adequate throughout the mission.

The performance of the ground A/G communications equipment can be considered satisfactory although the quality of the A/G reception varied between poor and good. A comparison of the HF and UHF transmissions show that the UHF was the better of the two subsystems. The power failure at California also disabled A/G reception during

the fifth pass, requiring the CapCom to transmit in the blind. Reception by the astronaut was confirmed when the time-of-retrofire display changed in response to the CapCom's request.

Considering the poor propagation forecast for the period of the mission, network ground communications were adequate. Very few communications equipment problems were noted, and the majority of outages were caused by propagation. These problems primarily affected communications to IOS, PCS, HTV, WAT and DMP. When needed, however, the voice and TTY circuits were in and useable.

The overall performance of the Mercury network during the MA-8 mission was considered very good. Some problems were still encountered, as was the case for MA-7, but none was of sufficient magnitude to hinder the performance of the network.

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1. INTRODUCTION

The major functions of the Mercury network for the MA-8 mission were

- To provide ground radar tracking of the spacecraft and transmission of the data to the computers at Goddard Space Flight Center (GSFC).
- To provide launch and orbital computing during the flight with real-time display data transmitted to the Mercury Control Center (MCC) at Cape Canaveral.
- To provide real-time telemetry display data at the sites for flight control purposes.
- To provide capability at various sites for back-up of critical spacecraft control functions.
- To provide voice communications between the ground stations and the spacecraft and voice and teletype communications between the remote sites and MCC.

Since the MA-8 mission was scheduled as 6-orbits rather than 3-orbits, as was the case for the two prior orbital missions, recovery was planned for an area in the Pacific Ocean. Consistent with this plan, three additional ships were assigned to and participated in the MA-8:

- USNS Watertown
- USNS Huntsville
- USAS American Mariner

The positions of these ships for the MA-8 are shown in Figure 1. The job of integrating these ships into the Mercury network presented many problems, which are discussed in later sections of this publication. Also, since the astronaut would have no ground contact between Guaymas and the Indian Ocean Ship on the fifth and sixth orbit if the network were not modified, an air/ground relay was established at the Quito, Equador, Minitrack site.

This report discusses the configuration and the performance of the Mercury network for the MA-8 mission of October 3, 1962. The locations of the sites, the ground paths of the six orbits, and other pertinent data are shown in Figure 1. The various equipments available at each site are listed in Table 1.

TABLE 1. EQUIPMENTS AVAILABLE AT MERCURY SITES

Station	Command Control	Telemetry	Spacecraft Comm.	FPS-16 Radar	Verlort Radar	Acquisition Aid	PBX & Intercom.	HF Pt.-to-Pt.	Teletype	SCAMA	Timing Standard	Computer	Orbit Coverage
Cape Canaveral (CNV & MCC)	x	x	x	x	x	x	x	x	x	x	x	B/GE	1 thru 4
Grand Bahama (GBI)	*	x	x	x	x	x	x	x	***		x		1 thru 4
San Salvador (SSI)	*	x	x	x	x		x	x	***		x		1 thru 4
Grand Turk (GTI)	*	x	x		x	x	x	x	***		x		1 thru 4
Bermuda (BDA)	*	*	*	x	x	x	x		x	x	x	709	1 thru 4
Grand Canary Island (CYI)		x	x		x	x	x		x	x	x		1 and 2
Kano, Nigeria (KNO)		x	x			x	x	x	x	x	x		1 and 2
Zanzibar (ZZB)		x	x			x	x	x	x	x	x		1 and 2
Indian Ocean Ship (IOS)		x	x			x	x	x	x	x	x		2 thru 6
Muchea, Australia (MUC)	x	x	x		x	x	x		x	x	x		1 thru 3
Woomera, Australia (WOM)		x	x	x		x	x		x	x	x		1 and 2
Pacific Ship (PCS)	x	x	x			x	x	x	x	x	x		5 and 6
Canton Island (CTN)		x	x			x	x		x	x	x		1 and 2
Kauai Island, Hawaii (HAW)	x	x	x	x	x	x	x		x	x	x		2 thru 5
Pt. Arguello, Calif. (CAL)	x	x	x	x	x	x	x		x	x	x		1 thru 5
Guaymas, Mexico (GYM)	x	x	x		x	x	x		x	x	x		1 thru 5
White Sands, N. M. (WHS)				x		x	x		x	x	x		1 thru 5
Corpus Christi, Texas (TEX)		x	x		x	x	x		x	x	x		1 thru 5
Eglin, Florida (EGL)		x		x	**	x	x		x	x	x		1 thru 4
Wallops Is. Demon. Site (WLP)		x				x	x		x	x	x		
Goddard Space Flight Center (GSFC)							x		Comm. Center		x	IBM-7090	

* Facility is remoted to CNV

** MPQ-31

*** Re-transmitted thru P. A. F. B.

NOTE: In addition to these usual Mercury sites, several other stations participated in the MA-8 mission:

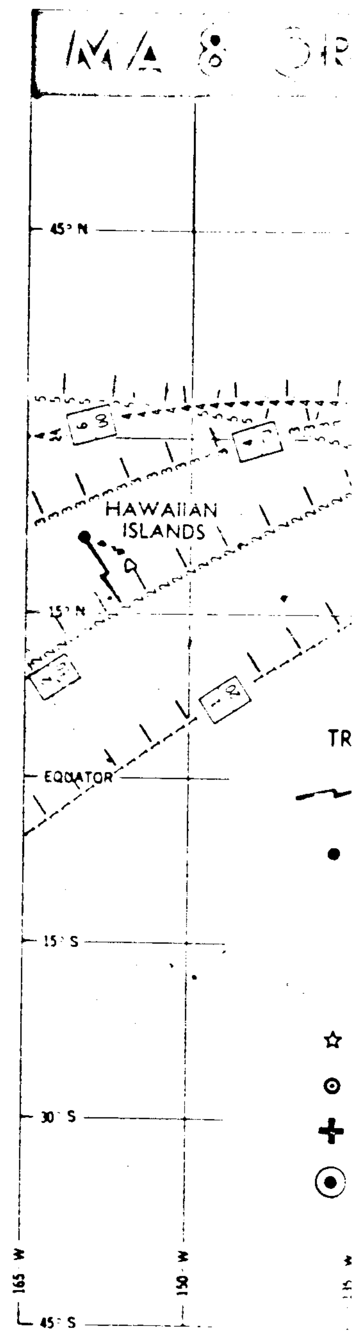
USNS Watertown (WTN) – S-band radar tracking ship

USNS Huntsville (HTV) – S-band radar tracking ship

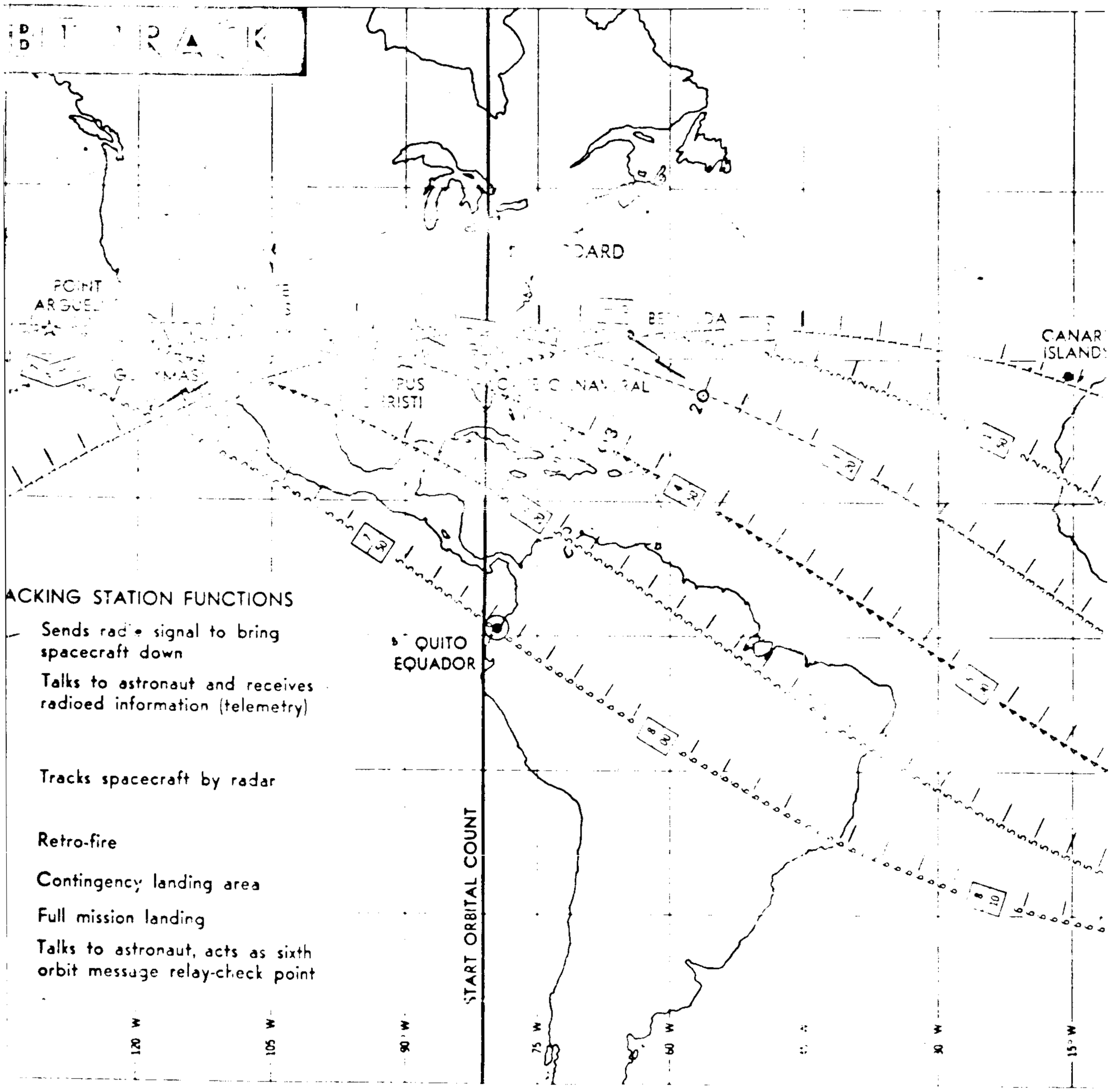
USAS American Mariner (DMP) – C-band radar tracking ship

PMR Range Tracker – remote site functions

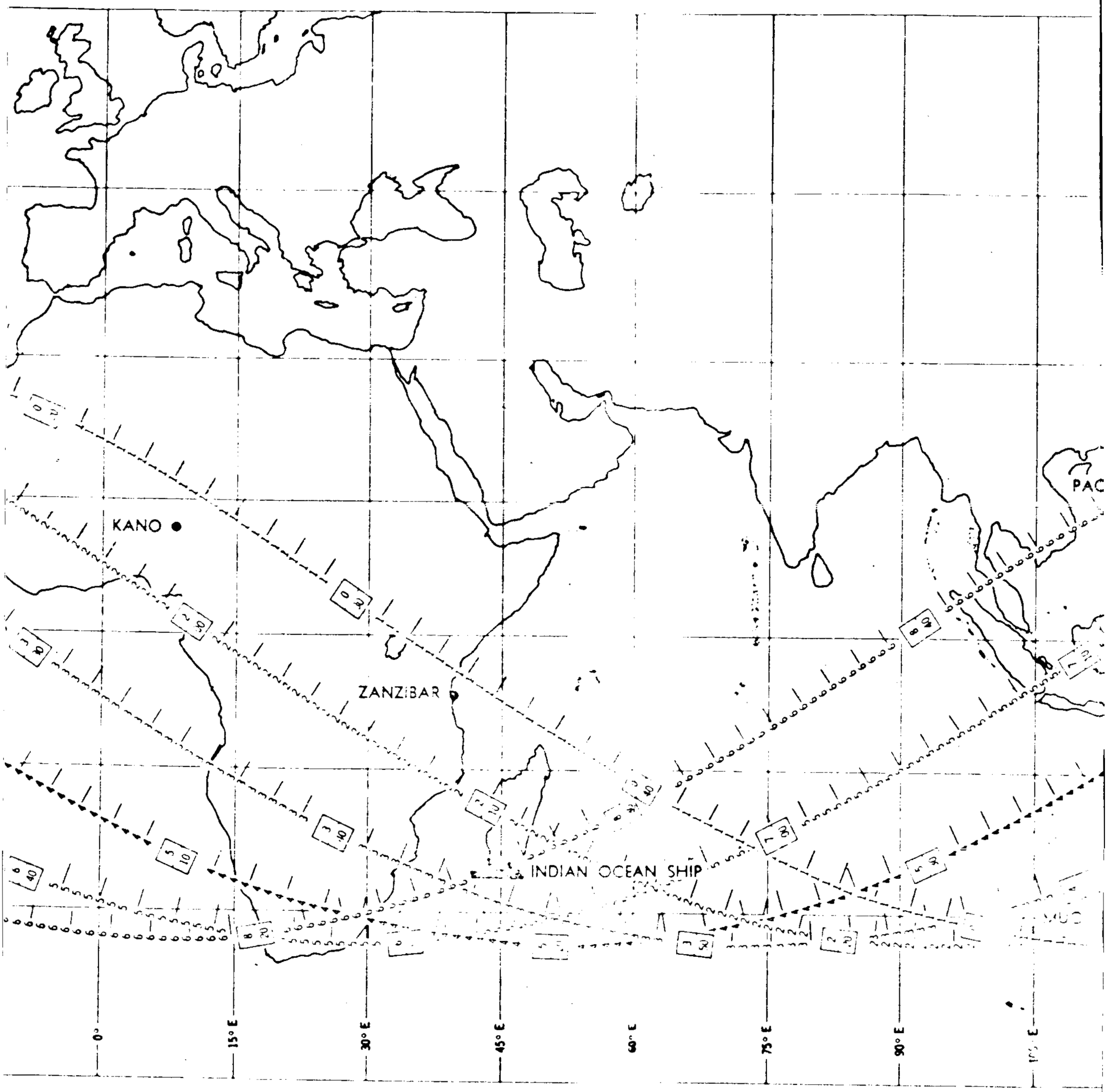
Quito, Equador, Minitrack Station – air-ground relay



#1


ACKING STATION FUNCTIONS
Sends rad e signal to bring spacecraft down
Talks to astronaut and receives radioed information (telemetry)
Tracks spacecraft by radar
Retro-fire
Contingency landing area
Full mission landing
Talks to astronaut, acts as sixth orbit message relay-check point
QUITO
EQUADOR
START ORBITAL COUNT
CANAR
ISLAND
120 W
105 W
90 W
75 W
60 W
30 W
15 W

#2



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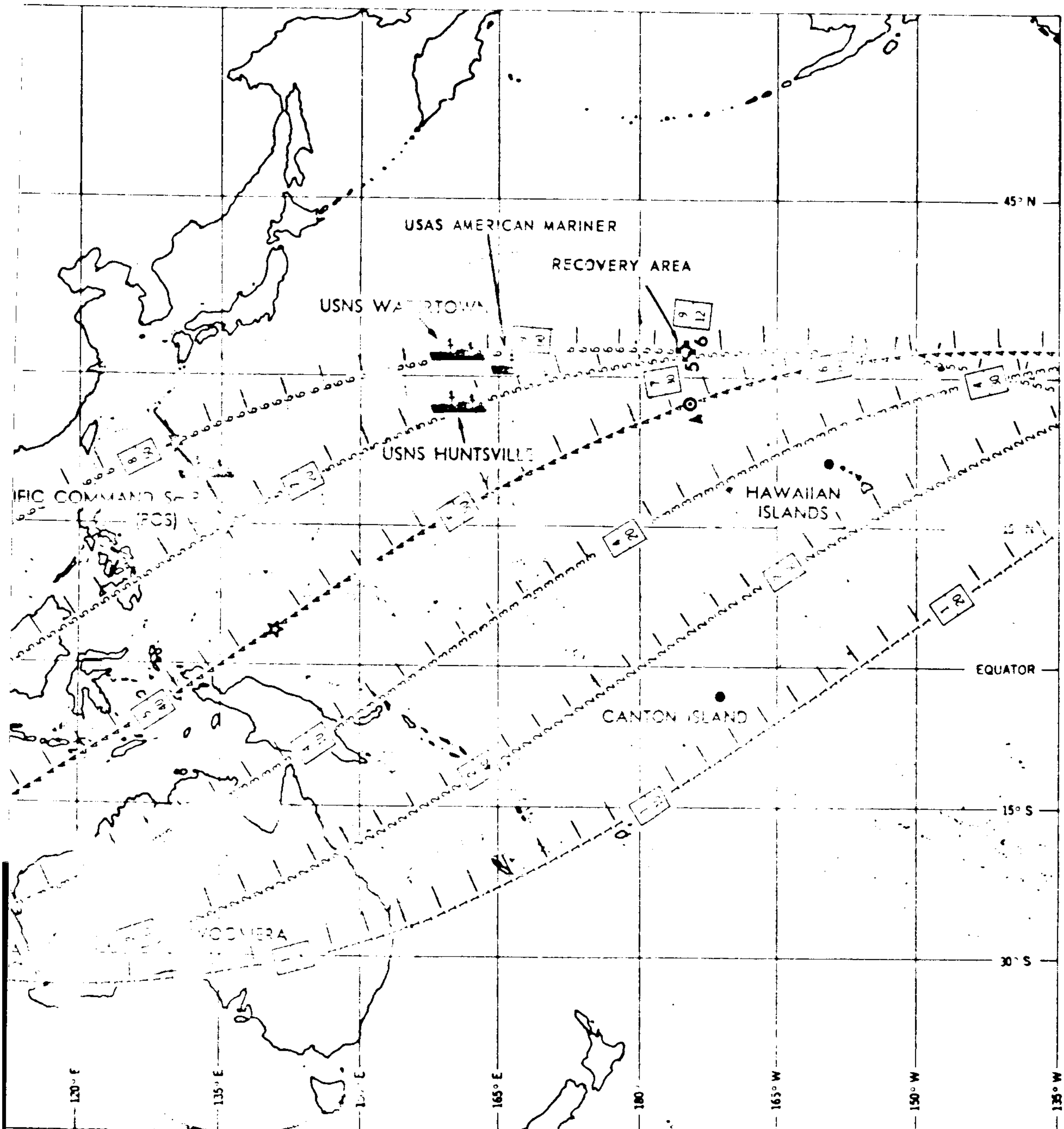

Figure 1. Mercury Network and Orbit Chart

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2. NETWORK STATUS

2.1 NETWORK SCHEDULE FOR MA-8

The MA-8 was first scheduled for launch on September 28, 1962. Because of a selector valve malfunction in the capsule's attitude control system, the flight was rescheduled for October 3, 1962.

Listed below is the NCG (Network Control Group) schedule that was followed to prepare the network for the MA-8 mission:

Date	Test No.	Test Description
Tues., Sept. 25	NCG-199	Data Path Test
	NCG-600	One Day Mission Simulation
Wed., Sept. 26	NCG-600	Continuation of One-Day Mission Simulation
Thur., Sept. 27	NCG-199	Data Path Test
Fri., Sept. 28	NCG-462E	Normal Mission Simulation (Short Count)
Sat., Sept. 29	NCG-462D	Detailed Systems Test
Sun., Sept. 30	NCG-462C	Maintenance
Mon., Oct. 1	NCG-462B	Mission Simulation (Full Count)
Tues., Oct. 2	NCG-462A	Split Countdown and Patch Check
Wed., Oct. 3	NCG-462	MA-8 Mission

Liftoff occurred at 12:15:12Z on October 3, 1962, which was only 15 minutes and 12 seconds after scheduled launch time. ("Z" used after a time reference denotes Greenwich Mean Time.)

2.2 PREMISSION NETWORK EQUIPMENT STATUS

Listed below are equipment status reports for the Mercury network, starting with September 25 and ending with the mission day. Only red conditions are reported ("red" signifies that the equipment is nonoperational, as opposed to green, which indicates the equipment is operational).

Date	Station	Equipment	Problem
Sept. 25	MCC	Command	Defective tone keyer in channel 15, system B, of Bermuda tone remoting system. No ETO (estimated time of operation).
	BDA	A/G	Low sensitivity in one HF receiver. ETO 1300Z, Sept. 25.
		Command	Defect in the emergency voice modulator amplifier. ETO 1300Z, Sept. 25.
		Telemetry	Bad diode in the events buffer. ETO 1045Z, Sept. 25.

Date	Station	Equipment	Problem
	KNO	HF Pt. to Pt.	Defect in standby transmitter. ETO 1200Z, Sept. 25.
		Teletype	Installation of EI 527
	IOS	Timing	Defective GET clock. No ETO
	WOM	FPS-16	Drift in azimuth servo system. ETO 1115Z, Sept. 25.
	CTN	Telemetry	Defect in the indicating synchro of the "T" antenna system. ETO Sept. 26.
	HAW	Command	Defective transmitter. Parts on hand. ETO 1200Z, Sept. 25.
	CAL	Command	Burned out bias voltmeter for the 240D amplifier. Backup equipment available. ETO 2300Z, Sept. 25.
	WHS	FPS-16	Defective klystron in the parametric amplifier. Site is able to support mission, but with reduced skin track capability. ETO 2300Z, Sept. 26.
	DMP	Acquisition	Defective phasing networks in Maltese-cross antenna. Station will track on TLM-LO for the mission because TLM-HI has no crystals.
		Data Processing	Defect in program. ETO Sept. 25.
Sept. 26	MCC	Command	Defective tone keyer still red as reported on 25th.
	KNO	Teletype	Still red for installation of EI 527. ETO 1200Z, Sept. 27.
	IOS	Timing	GET clock still defective. Site capable of supporting mission.
	CTN	Telemetry	Indicating synchro still red. Site able to support mission.
	CAL	Command	Defective voltmeter as reported on 25th.
	WHS	FPS-16	Defective klystron as reported on 25th.
	DMP	Data Processing	Defect in program as reported on 25th.
Sept. 27	CNV	FPS-16	Defect in the 32K-yard identification mode. ETO Sept. 28. Able to support mission.
		Acq Aid	Defective potentiometer in TLM-18, which caused bad elevation data from Tel II. Site able to support mission. ETO Oct. 1.

Date	Station	Equipment	Problem
	MCC	Command	Defective tone keyer as reported on 25th.
	BDA	Timing	Preventative maintenance. ETO 2100Z, Sept. 27.
	KNO	Teletype	Still red for installation of EI 527. ETO 1530Z, Sept. 27.
	WOM	Telemetry	Low threshold in the B-1 receiver. ETO 1300Z, Sept. 29.
	CTN	Telemetry	Indicating synchro still defective as reported on 25th. ETO Oct. 1. Able to support mission.
	CAL	Command	Defective voltmeter as reported on 25th. Required meter on emergency requisition. ETO 2300Z, Sept. 27. Backup equipment available.
	WHS	FPS-16	Klystron still defective as reported on 25th. ETO 2300Z, Sept. 28.
	WTN	Ship/Shore Comm.	Intermittent trouble in transmitter. No ETO.
	HTV	Ship/Shore Comm.	Defective master oscillator in the 150E6 SSB receiver. ETO 1930Z, Sept. 28.
	DMP	Data Processing	Reprogramming as reported on 25th.
Sept. 28	CNV	FPS-16	Identification transfer mode still defective as reported on 27th. ETO 0420Z, Sept. 29.
		Acq Aid	Potentiometer still defective as reported on 27th. ETO Oct. 2.
	MCC	Command	Tone keyer still defective as reported on 25th. No ETO. Able to support.
	BDA	Verlort	Boresight cable problems. ETO 1600Z, Sept. 28.
	KNO	Teletype	Still red for EI 527.
	WOM	Telemetry	Low threshold in B-1 receiver as reported on 27th. ETO 1300Z, Sept. 29.
	CTN	Telemetry	Indicating synchro still defective as reported on 25th.
	CAL	Command	Defective voltmeter as reported on 25th.
	WHS	FPS-16	Klystron still defective as reported on 25th. ETO 2300Z, Oct. 2.

Date	Station	Equipment	Problem
	WTN	Teletype	Teletype red. ETO Sept. 29.
	HTV	Ship/Shore Comm.	Defective oscillator as reported on 27th. ETO Sept. 29.
	DMP	Data Processing	Reprogramming as reported on 25th. ETO Oct. 2.
Sept. 29	CNV	Timing	Power fluctuating. ETO 1600Z. Sept. 29.
		Telemetry	Power fluctuations in the decommutator. ETO 1600Z. Sept. 29.
		FPS-16	Identification transfer mode still defective. ETO 1600Z, Sept. 29.
		Acq Aid	Potentiometer still defective. ETO Oct. 2.
	MCC	Command	Tone keyer still defective.
	KNO	Teletype	Still red for EI 527.
	IOS	Telemetry	Defective rate servo in the decommutator. No ETO, but able to support mission if there are no missing pulses in the PAM wave train.
	CTN	Telemetry	Indicating synchro still defective as reported on 25th.
	CAL	Command	Defective voltmeter. ETO 2300Z, Sept. 29.
	GYM	Timing	Defect in Hermes oscillator. ETO 1700Z, Sept. 30.
	WHS	FPS-16	Klystron still defective. Replacement due Oct. 1.
	WTN	Teletype	Still red as reported on 28th.
	HTV	Ship/Shore Comm.	Defective oscillator as reported on 27th.
	DMP	Data Processing	Reprogramming.
Sept. 30	CNV	FPS-16	Identification transfer made still defective.
	MCC	Command	Tone keyer still defective.
	IOS	Telemetry	Defective rate servo as reported on 29th.
	MUC	Timing	Mission clock out of calibration.
	WOM	Telemetry	Low threshold in B-1 receiver as reported on 27th. ETO 0830Z, Oct. 2.
	CTN	Telemetry	Indicating synchro still defective.
	CAL	Command	Voltmeter still defective.

Date	Station	Equipment	Problem
		Comm.	Marginal UHF receiver. ETO Oct. 1.
Oct. 2	CNV	FPS-16	Identification transfer mode still defective. ETO 1445Z, Oct. 2. Able to support mission.
		Optical IGOR (PAFB)	Frozen slip rings and severed connectors. ETO 1100Z. Oct. 3.
	MCC	Command	Tone keyer still defective. Able to support mission.
	CYI	Telemetry	Recorder input meter still defective. ETO Oct. 7. Able to support with substitute meter.
	PCS	HF Pt. to Pt.	Defect in transmitter No. 2. No ETO, but able to support mission.
	CAL	Command	Meter still defective as reported on 25th. ETO 1900Z, Oct. 2. Able to support mission with substitute meter.
Oct. 3 (Mission Day)	MCC	Command	Tone keyer still defective. Able to support mission.
	BDA	Verlort	Azimuth amplidyne overload problems. Trouble cleared in two minutes.
		Telemetry	Aeromed Sanborn channel No. 1 failed and segment 81 was patched to spare channel No. 4.
	CYI	Telemetry	Recorder input meter defective. ETO Oct. 7. Able to support mission with substitute meter.
		Verlort	Defective driver unit went red at 0840Z. Substitution of spare unit returned equipment to green status at 1136Z. This malfunction caused a 15 minute hold at T-45.

2.3 GROUND EQUIPMENT MALFUNCTIONS DURING LAUNCH AND ORBITAL PHASE

Station	Orbit	Equipment	Malfunction
CNV/ MCC	All 6 orbits	Command	Tone keyer for channel 15, system B, of the BDA remoting system out of specs. Able to support mission. (Prelaunch condition).
GTI	1	Telemetry	There was a low level signal to the subcable. This was caused by an open circuit feeding the subcable at the telemetry building. The open circuit was created by a lack of ground on the telemetry patch panel feeding the cable.

Station	Orbit	Equipment	Malfunction
BDA	1	Display	Aeromed Sanborn recorder calibration drifted due to defective cooling fan. Fan replaced prior to second orbit.
	1	Verlort	Bad output tube in Verlort coder caused the C-band beacon to count down excessively. Tube replaced prior to second orbit.
	1	Timing	Control room GMT clock tens-of-minutes digit No. 2 failed. It was necessary to adjust a relay to correct this situation.
	2	Telemetry	Sanborn recorder at Town Hill tore paper; approximately 20 seconds of data lost.
CYI	All	Air/Ground	UHF No. 2 receiver AGC voltage dropped, affecting calibration but did not affect reception. After the mission an attempt was made to determine the cause for this problem; however, this condition could not be made to reappear.
CYI	All	Telemetry	Bad Ampex recorder input meter. Able to support using VTVM (prelaunch condition).
ZZB	1	Telemetry	Decom power supply No. 2 blew a DC output line fuse. Replaced immediately.
WOM	2	Telemetry	Decom power supply overheated. Shut down for cooling and returned to service prior to third orbit.
WAT	5	Radar	Power failure at 1921Z. System returned to operation at 1923Z.
CTN	All	Air/Ground	A/G intercom loop failed at the flight controller's console during pass. Position worked fine both prior to acquisition and after LOS. Unable to determine cause since the condition cannot be duplicated.
HAW	2	Telemetry	Recorder No. 1 supply reel binding--paper broke.
	2	Air/Ground	UHF signal strength not recorded due to relay failure.
	3	Telemetry	Low output out of receiver B1 occurred between the pre-pass and the postpass calibration. The local oscillator doubler tube was replaced, and the receiver output returned to normal. The data were not affected by this malfunction.

Date	Station	Equipment	Problem
	WHS	FPS-16	Klystron still defective.
	DMP	Data Processing	Reprogramming. ETO Oct. 2.
		Acq Aid	Low sensitivity. ETO Oct. 2.
Oct. 1	CNV	FPS-16	Identification transfer mode still defective.
		7090 Computer	Loading problems. ETO 1700Z, Oct. 1.
	MCC	Command	Tone keyer still defective.
	BDA	Command	Low drive from standby FRW-2 transmitter to the 240D amplifier. ETO 2100Z, Oct. 1.
		Timing	Defective control room GET clock. ETO Oct. 2.
		Tone Remoting	Defect in channel 16 of system B. ETO 1000Z, Oct. 1.
	CYI	Telemetry	Defective Ampex recorder input meter. ETO Oct. 7. Site able to support mission by using VTVM in place of defective meter.
		A/G	No high voltage for the UHF master transmitter. ETO 1000Z, Oct. 1.
	ZZB	Telemetry	Incorrect GET clock readout. ETO 1500Z, Oct. 1.
	IOS	Telemetry	Playback problems in the Ampex recorder. ETO 1200Z, Oct. 1.
	CTN	Telemetry	Indicating synchro still defective. ETO 2300Z, Oct. 1. Able to support mission.
	CAL	Command	Defective meter as reported on 25th. ETO Oct. 1.
		FPS-16	Transmit-receive tube defective. ETO 0930Z, Oct. 1.
		Telemetry	Defective control transformer in the azimuth servo positioning system of the T & C antenna. ETO 1230Z, Oct. 1.
	GYM	Verlort	Master power supply trouble. ETO 1230Z, Oct. 1.
	WHS	FPS-16	Klystron still defective. ETO 2400Z, Oct. 2.
			Inoperative relay (K6375) in the range power supply meter panel. ETO Oct. 1.
	HTV	SPQ-8	Intermittent modulator trigger. ETO Oct. 1.

Station	Orbit	Equipment	Malfunction
	3	Air/Ground	UHF signal strength not recorded due to relay failure.
	4	Radar	Sensitivity pot in FPS-16 Sanborn recorder failed.
	4 & 5	Air/Ground	UHF signal strength not recorded due to relay failure.
CAL	1,2,3,4	Air/Ground	Pen No. 5 in Sanborn recorder No. 1 noisy due to noisy cable. UHF No. 1 was patched to pen No. 8, and HF No. 2 patched to pen No. 5.
	1,2,3,4	Acquisition	Acquisition command bus failed to transfer to FPS-16 due to trouble with FPS-16 manual lock-on circuit in IRACQ. Alternate method employed for duration of mission. An investigation of this problem revealed a bad tube in the D. C. amplifier.
	5	Telemetry	Power failure at telemetry receiver site at 1952Z. A short circuit in a power transformer was caused by range personnel working on A/G equipment without knowledge of Mercury personnel. Generator power came up, but circuit breakers would not stay in because of overheated coils. Commercial power came back at 2004Z. Telemetry back-up was obtained from San Nicolas Island's TLM-18 system.
	5	Air/Ground	The power failure discussed above also knocked out A/G receivers.
GYM	1 & 2	Telemetry	Faulty decom operation prevented valid data from being displayed. After the decom was adjusted the problem was resolved.
	3	Radar	12-μsec reset gate malfunction. Replacement of tube V 33714 and necessary readjustments corrected this situation.
	4	Acq. Aid	Tracked on side lobe.

2.4 MODIFICATION BRIEFING REPORT

The Project Mercury Modification Briefing Report is used to control and reflect the readiness of the Mercury network with respect to equipment modifications. As indicated in Table 2, all Engineering Instruction (EI) modifications required for the MA-8 (these are classified as red status EI's) had been completed by all applicable sites prior to mission day. The remaining modifications (green status EI's) were of a lesser nature, and installation was not required for the MA-8.

TABLE 2 MODIFICATION BRIEFING REPORT FOR MA-8 (PAGE 1 OF 3)

SHIPPING DATE / INSTALLATION DATE — ● MOD NOT INSTALLED; ▮ MOD COMPLETED; ▨ ALTERNATE MOD

RI No.	TITLE	SYSTEM	EQUIPMENT	STATUS CW	STATUS GN RD	CNV	GTI	GBI	BDA	PCS	CYI	KNO	ZZB	IOS	MUC	WOM	CTN	HAW	CAL	GYM	WHS	TEX	EGL	WLP
2	Modified Branching Networks	Antenna	R,R/T, T,T/R Antenna Arrays	△		3-12 3-29	3-12 3-20	3-12	3-12 4-19	3-12 5-9	3-12 3-16	3-12 3-19	3-12 4-12	3-12 3-16	3-12 5-7	3-12 4-17	3-12 3-28	3-12 3-14	3-12 3-13	3-12 3-27		3-12 3-20		3-12 3-19
42	HF/UHF Receiver Isolation Amplifier	A/G	ComTech Console Voice RCVR Cab.	△		1-18 3-13	9-1	9-1	1-18 3-28	1-18 5-14	1-18 2-27	1-18 2-5	1-18 2-27	1-18 3-1	1-18 3-12	1-18 3-26	1-18 3-2	1-18 2-7	1-18 3-20	1-18 3-30		1-18 3-7		1-18 2-8
45	Mod to Verlort Sanborn Recorder	Radar	Sanborn Recorder	△					1-15 1-19		1-15 2-6				1-15 1-25			1-15 2-1	1-15	1-15 1-21		1-15 1-18		
54	Replacement Mechanical Stops	Antenna	8417 Pedestal	△		3-14 9-5	3-14	3-14	3-14	3-14 4-27	3-14 5-1	3-14 3-28	3-14 3-30	3-14 4-6	3-14 5-1	3-14 5-1	3-14	3-14 4-15	3-14	3-14 4-12		3-14 8-13		3-14 3-21
59	Diversity Combiner Modification	TLM	Diversity Combiner	△		7-12			7-12	5-12 5-14	7-12 8-22	7-12 7-18	7-12	7-12 8-21	7-12 7-25	7-12 8-14	7-12 7-23	7-12 8-8	7-12 9-11	7-12 8-31		7-12 7-31		7-12
64	Addition of DGA-2 Decom Gates	TLM	90/15 Decom	▲					3-22 8-13	3-22 5-25					3-22 4-6			3-22 6-4	3-22 9-6	3-22 6-20				
65	Extension Cable for Meter Module	Decom	DGM-1B Meter Module	▲		4-6 4-25			4-6 4-27	4-6 5-8	4-6 4-13	4-6 4-25	4-6 4-19	4-6 5-28	4-6 5-1	4-6 6-12	4-6 4-17	4-6 5-4	4-6 5-4	4-6 4-23		4-6 4-17		4-6 5-3
66	Wide Band Receivers	TLM	TLM Receiving/ Recording Eqpt.	△			7-11	7-11	7-11	5-12 5-14	7-11 8-17	7-11	7-11	7-11 9-12	7-11	7-11	7-11	7-11	7-11	7-11		7-11		7-11
69	90/90 Decom Gate Generator	TLM	90/90 Decom.		▲				5-29 6-4	5-12 5-25	5-29 8-8	5-29 7-30	5-29 8-2	5-29 7-20	5-29 8-17	5-29 8-14	5-29 8-8	5-29 9-4	5-29 6-29	5-29 8-17		5-29 6-22		5-29
71	IOS Voice Mod	Voice		▲										9-15 9-15										
76	Monitor Selector Switch-Visicorder	TLM	Display Input Control Panel	▲					4-25 8-15	4-25 6-30	4-25 5-15	4-25 5-13	4-25 5-9	4-25 8-30	4-25 5-9	4-25 5-9	4-25 5-2	4-25 5-6	4-25 5-9	4-22 5-9		4-22 5-1		4-25 5-9
78	Aux Decom Gate Output Monitoring Panel	TLM	Portable Meter Box	▲					4-25 4-30	4-25 5-25	4-25 5-7	4-25 5-1	4-25 8-8	4-25 8-30	4-25 5-9	4-25 6-12	4-25 5-1	4-25 5-2	4-25 5-9	4-25 5-7		4-25 6-7		4-25 5-9
82	Transparent Covering For Display Console	Display	Writing Shelf	△						7-25	7-25 9-10	7-25	7-25	7-25	7-25 9-17	7-25	7-25 9-12	7-25 9-11	7-25 9-11	7-25 9-13		7-25 9-18		7-25 9-14
83	RCVR Calibration Osc. to Link Freq. Change	TLM	RCVR Calibration Osc.		▲	5-1 5-16	5-1 5-7	5-1 5-7	5-1 5-9	5-1 5-31	5-1 5-14	5-1 5-23	5-1 8-8	5-1 5-12	5-1 5-16	5-1 6-12	5-1 5-25	5-1 5-10	5-1 5-15	5-1 8-17		5-1 5-21		5-1 5-23
85	SDT Isolation RCDR Events Pens	TLM	Display Console	▲						5-9 6-22	5-9 5-29	5-9 5-31	5-9 5-31	5-9 6-7	5-9 5-28	5-9 6-12	5-9 8-6	5-9 5-27	5-9 5-31	5-9 5-9		5-9 6-13		5-9 6-4
86	Addition of TDA 300 Discriminators	TLM	Discriminators	△		8-6				5-12 5-14	8-6 8-28	8-6	8-6	8-6	8-6	8-6	8-6	8-6	8-6	8-6		8-6		8-6
89	Telesig Tone Eqpt. Mod - ZZB	Comm	TTY Multiplex	△									6-11											
92	Time Stamp Machine Mod	Comm	Time Stamp Machine	△		5-31 6-28			5-31 6-6	5-31 6-21	5-31 6-11	5-31 7-5	5-31 7-4	5-31 6-21	5-31 7-25	5-31 9-18	5-31 8-15	5-31 6-7	5-31 8-16	5-31 6-5	5-31 6-18	5-31 7-20	5-31 7-28	

TABLE 2 MODIFICATION BRIEFING REPORT FOR MA-8 (PAGE 2 OF 3)

SHIPPING DATE (upper) / INSTALLATION DATE (lower)
● MOD NOT INSTALLED
■ MOD COMPLETED
▨ ALTERNATE MOD

EI No.	TITLE	SYSTEM	EQUIPMENT	STATUS CN	STATUS CO RO	CNV	GTI	GBI	BDA	PCS	CYI	KNO	ZZB	IOS	MUC	WOM	CTN	HAW	CAL	GYM	WHS	TEX	EGL	WLP
97	Control Unit Power Panel Cover	Command	Comm Tech Console Pwr Panel	△		6-26 / 7-16 ■			6-26 / 8-13 ■						6-26 / 7-10 ■			6-26 / 8-1 ■	6-26 / 7-21 ■	6-26 / 8-3 ■				6-26 ●
502	Time Conversion Unit Mod	Timing	Milgo 165A	△		●																		
503	Acq Aid Test Facilities & ACC Mod	Acq.	Acq. Aid Receiver	△					8-8 ●	8-8 / 9-18 ■	8-8 / 8-31 ■			8-8 ●	8-8 ●	8-8 ●		8-8 ●	8-8 / 8-22 ■	8-8 / 9-10 ■	8-8 / 9-12 ■	8-8 / 8-27 ■	8-8 / 9-4 ■	8-8 / 8-28 ■
505	Inductor Replacement in Att. Tel. Ckt.	Intercom	274F Inductors	▲		7-12 / 8-6 ■			7-12 / 8-14 ■	7-12 / 8-10 ■	7-12 / 7-18 ■	7-12 / 8-2 ■	7-12 / 7-16 ■	7-12 / 8-30 ■	7-12 / 7-24 ■	7-12 / 7-3 ■	7-12 / 7-16 ■	7-12 / 9-7 ■	7-12 / 7-20 ■	7-12 / 8-13 ■		7-12 / 7-31 ■		7-17 / 7-31 ■
506	RF Pre-amp Improvement	TLM/ A/G	RF Preamp	▲		7-12 / 8-6 ■	7-12 / 8-28 ■	7-12 / 8-3 ■	7-12 / 8-10 ■	7-12 / 8-10 ■	7-12 / 6-7 ■	7-12 / 7-20 ■	7-12 / 7-27 ■	7-12 / 8-30 ■	7-12 / 8-3 ■	7-12 / 8-7 ■	7-12 / 7-23 ■	7-12 / 8-3 ■	7-12 / 9-6 ■	7-12 / 8-8 ■		7-12 / 7-23 ■		7-12 / 8-16 ■
508	Carrier Failure Alarm	Tone Remoting	Northern Radio Eqpt.		▲	7-25 / 8-30 ■			7-25 / 8-13 ■										7-25 / 8-27 ■					
509	Pot. to Visicorder Monitor Switch	TLM	Display Input Control Panel		▲	7-25 / 8-28 ■			7-25 / 8-15 ▨	7-25 / 8-10 ■	7-25 / 8-9 ■	7-25 / 8-6 ■	7-25 / 8-6 ■	7-25 / 8-17 ■	7-25 / 8-14 ■	7-25 / 8-11 ■	7-25 / 8-4 ■	7-25 / 8-1 ■	7-25 / 8-14 ■	7-25 / 8-4 ■		7-25 / 7-31 ■		7-25 / 7-31 ■
512	Display Meter Mod.	Display	Display Meters Type 1145		▲	8-1 / 3-9 ■			8-1 / 8-14 ■	8-1 / 9-4 ●	8-1 / 8-10 ■	8-1 / 8-6 ■	8-1 / 8-13 ■	8-1 / 8-20 ■	8-1 / 9-3 ■	8-1 / 8-14 ■	8-1 / 8-9 ■	8-1 / 8-25 ■	8-1 / 8-29 ■	8-1 / 8-31 ▨		8-1 / 8-15 ▨		8-1 / 8-22 ■
513	Additional Discriminator Modules	TLM	TDA-102, TLC-102, TDC-103	△		8-10 ●			8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●	8-10 ●		8-10 ●		8-10 ●
514	HF Receiving Filters	Pt/Pt	HF Receiving Filters	△						8-29 / 9-1 ■				8-29 ●										
515	Code Ringing Mod	Intercom	220A KTU		▲							8-21 / 9-6 ■	8-21 / 9-10 ■	8-21 / 9-17 ■			8-21 / 8-21 ■							
516	Astronaut Simulator	TLM	Decom Patch Panel		▲				9-5 / 9-17 ■	9-5 / 9-17 ■	9-5 / 9-12 ■	9-5 / 9-12 ■	9-5 / 9-17 ■	9-5 / 9-21 ■	9-5 / 9-17 ■	9-5 / 9-18 ■	9-5 / 9-12 ■	9-5 / 9-14 ■	9-5 / 9-21 ■	9-5 / 9-17 ■		9-5 / 9-12 ■		9-5 / 9-17 ■
517	Radar Data Plotboard	Radar	Milgo 3010 X-Y Recorder	△		9-24 ●					9-24 ●							9-24 ●	9-24 ●	9-24 ●				
518	Simplified Acq. Aid Test Facilities	Acq.	Simplified Acq. Aid RCVR	△								9-4 ●	9-4 ●				9-4 ●							
519	CNV/BDA Tone Remoting Reliability	A/G Command	Tone Remoting Equipment	▲		9-12 / 9-12 ■			9-12 / 9-12 ■															
520	HAW Relay A/G Conference Loop Facility	Intercom	PBX		▲													9-12 / 9-17 ■						
521	Decom Gate Mounting Rack Assy	TLM	Decom Gate Mounting Rack		▲	9-7 / 9-21 ■			9-7 / 9-14 ■	9-7 / 9-10 ■	9-7 / 9-10 ■	9-7 / 9-10 ■	9-7 / 9-10 ■	9-7 / 9-14 ■	9-7 / 9-13 ■	9-7 / 9-18 ■	9-7 / 9-8 ■	9-7 / 9-8 ■	9-7 / 9-10 ■	9-7 / 9-7 ■		9-7 / 9-10 ■		9-7 ●
522	BDA Loop Switchboard Mod	TTY	63C1 Loop Switchboard	▲					4-17 / 9-21 ■															

TABLE 2 MODIFICATION BRIEFING REPORT FOR MA-8 (PAGE 3 OF 3)

Legend: SHIPPING DATE / INSTALLATION DATE — ● MOD NOT INSTALLED; ▮ MOD COMPLETED

EI No.	TITLE	SYSTEM	EQUIPMENT	STATUS (CN)	STATUS (GD / RO)	CNV	GFI	GBI	BBA	PCS	CYI	KNO	ZZB	106	MUC	WOM	JTB	HAW	CAL	GTM	WHS	TEX	EGL	WLP
523	GTM Trunk Key Circuit Mod	Intercom	507B PBX Trunk	▲																9-17 / 9-17 ▮				
524	Radar Anti-Contention Arrangement	TTY	LB 9 Distributor		▲				9-11 / 9-14 ▮		9-11 / 9-18 ▮				9-11 / 9-18 ▮	9-11 / 9-18 ▮				9-11 / 9-17 ▮				
525	Kytoon Transmitter Frequency Change	Acq.	Low Range Transmitter	△					9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 ●	9-28 / 9-28 ▮
526	ASR XMTR/28 RO Interim Mod	TTY	28 RO Power Block "E"		▲				9-13 / 9-14 ▮	9-13 / 9-14 ▮	9-13 / 9-14 ▮	9-13 / 9-14 ▮	9-13 / 9-14 ▮	9-13 / 2-17 ▮	9-13 / 9-14 ▮	9-13 / 9-14 ▮	9-13 / 9-13 ▮			9-13 / 9-13 ▮				
527	Extension of Circuit 7005-21 (KNO)	TTY	Tone Transmitting Terminals		▲							9-14 / 9-28 ▮												
528	Extension of Circuit 7005-21 (ZZB)	TTY	Tone Transmitting Terminals		▲								9-14 / 9-20 ▮											
529	CYI Voice Mod	Intercom	112A Key Intercom Eqpt.	▲							9-28 / 9-28 ▮													

3. INSTRUMENTATION EVALUATION

This section briefly describes the various subsystems (except the ground communications and computer systems) that make up the network configuration and describes the performance of these subsystems for the MA-8. The ground communication system and the computer system are respectively discussed in the following two sections. These two systems are treated separately because of their extensiveness.

All systems required for mission support were operational at liftoff. However a Canary Island Verlort radar problem, which was discussed in the preceding section, did cause a fifteen-minute hold in the count. The network malfunctions that were present during the mission did not materially affect flight monitoring, flight control, or acquisition of data. Generally, the overall performance of the Mercury network was excellent. Power loss for the A/G receivers during the fifth pass at California was the only malfunction that caused some concern. The astronaut received the transmission made in the blind by the CAL CapCom.

3.1 RADAR TRACKING AND ACQUISITION

3.1.1 Introduction

Two principal types of tracking radars are used in the Mercury ground range: the AN/FPS-16 and the Verlort radars. The FPS-16 is a C-band tracking radar with a 12-foot dish. It operates on a frequency of 5500-5900 MC and has a beamwidth of approximately 1.2 degrees. It is the most accurate of the tracking devices. The S-band or Verlort radar is a very long range tracking radar with a 10-foot dish. It operates on a frequency of 2800-3000 MC and has a beamwidth of approximately 2.5 degrees. The redundancy provided by these radar systems provides the computers with sufficient data to determine the orbit if one of the beacons should fail.

The active acquisition aid uses a quadhelix antenna with a broad beamwidth of 20 degrees. It operates at telemetry frequencies (215-265 MC), and normally acquires the target before either of the radars.

The acquisition capability is most critical at sites with FPS-16 radar since the narrow beamwidth of this radar requires precise pointing information to enable it to locate the target. Once the radar has acquired the spacecraft, the radar system begins automatic track and does not require additional acquisition assistance unless the tracking is interrupted.

3.1.2 Acquisition Aid Performance

At low elevation angles, the acquisition aid system experienced multipath problems as happened on previous missions. Otherwise, the acquisition aid subsystem performed exceptionally well at all sites.

3.1.3 Radar Performance

The radar network fulfilled the support requirements adequately, and the computer was provided with sufficient data points to assure capsule location information during the course of the operation. The beacons were turned off after the second orbit, and they were reactivated for part of the third orbit. The beacons were again off during the fourth and part of the fifth orbit. Efforts to skin track the capsule were unsuccessful. No degradation of either C- or S-band beacons were noted after the down periods. Table 3 and Figure 2 (at end of this main section) provide coverage information for the C-band and S-band radars. MA-7 coverage is included in the figure for comparison. Pertinent facts concerning departure from normal performance are listed below, in site sequence.

CNV (FPS-16)–On orbit 1 the radar acquired the target and tracked well within the expected performance standards. A missing bit in the digital data train in the Milgo 1002 was not corrected until the last 90 seconds of track. Data was then acceptable to the computer.

BDA (FPS-16)–On orbit 1 the track was good and the computer accepted all of the data points. The M&O supervisor reported severe cases of amplitude modulation of the beacon return. The track on orbit 2 was good, and the computer accepted most of the data points. The radar parametric amplifier was turned off at mid-pass of this orbit to determine if there would be any degradation of radar performance – none was noted.

BDA (Verlort)–On orbit 1 the radar acquired and tracked for 46 seconds and then lost track because of phasing difficulties. The beacon was reacquired 7 seconds later; it remained in automatic track for 4 minutes and 53 seconds. Track was again lost 5 seconds later. The radar remained in automatic track until LOS, 43 seconds later. This is the first operation that this problem has been experienced. Count down of the beacon return signal was also causing trouble. Replacement of V35205 of RV352 corrected the trouble.

On orbit 2 phasing troubles again caused loss of track for six seconds. Rabbits from the MPQ-31 apparently caused the problem. Beacon count down was observed on this pass also.

CYI (Verlort)–On orbit 1 the signal had to be reacquired once during the pass. The M&O supervisor reported that the loss of track was caused by refraction of the beacon signal.

MUC (Verlort)–On orbit 1 signal losses were noted on three occasions. The M&O supervisor reported that signal losses were probably caused by high wind conditions. The overall track was good on this pass. The computer had 8 minutes and 6 seconds of data available during the pass.

TABLE 3. RADAR COVERAGE DATA

Station	Radar	Time of Auto Track	Time of LOS Track	Mode of Acq.
Orbit 1				
CNV	FPS-16	00:00:16	00:05:10	
BDA	Verlort	00:03:37	00:10:11	Acq. Aid
BDA	FPS-16	00:04:01	00:09:31	Acq. Aid
CYI	Verlort	00:14:32	00:21:25	Pointing Data
MUC	Verlort	00:49:48	00:58:27	
WOM	FPS-16	00:56:47	01:01:03	Aoq. Aid
CAL	Verlort	01:27:42	01:31:04	Acq. Aid
CAL	FPS-16	01:29:15	01:30:05	Acq. Aid
GYM	Verlort	01:27:32	01:30:47	Acq. Aid
WHS	FPS-16	01:31:25	01:33:19	Acq. Aid
TEX	Verlort	01:30:59	01:36:43	Pointing Data
EGL	FPS-16	01:33:48	01:37:44	Acq. Aid
EGL	MPQ-31	01:34:20	01:39:17	Acq. Aid
Orbit 2				
CNV	FPS-16	01:35:03	01:39:55	RACQ
GBI	FPS-16	01:36:35	01:38:10	Acq. Aid
BDA	Verlort	01:37:39	01:43:50	Acq. Aid
BDA	FPS-16	01:38:35	01:43:29	Acq. Aid
CYI	Verlort	01:48:41	01:53:39	Pointing Data
MUC	Verlort	02:23:25	02:32:06	
WOM	FPS-16	02:31:07	02:33:53	Acq. Aid
HAW	Verlort	02:51:10	02:55:41	Acq. Aid
HAW	FPS-16	02:52:19	02:53:49	Acq. Aid
CAL	Verlort	02:59:43	03:04:43	Acq. Aid
CAL	FPS-16	03:02:35	03:04:05	Acq. Aid
WHS	FPS-16	03:03:37	03:07:13	Pointing Data
TEX	Verlort	03:04:32	03:10:15	Pointing Data
EGL	MPQ-31	03:06:25	03:10:12	Acq. Aid
EGL	FPS-16	03:07:31	03:10:12	Acq. Aid
Orbit 3				
CNV	FPS-16	03:08:32	03:10:13	RACQ
GBI	FPS-16	03:10:00	03:10:10	Acq. Aid
BDA	Beacon Off			
GBI	" "			
SSI	" "			
MUC	Verlort	03:58:51	04:05:06	Acq. Aid
HAW	Verlort	04:23:12	04:28:55	Acq. Aid
HAW	FPS-16	04:24:43	04:28:25	Acq. Aid
CAL	Verlort	04:32:04	04:35:19	Acq. Aid
CAL	FPS-16	04:35:07	04:35:27	Verlort
GYM	Beacon Off			
WHS	" "			
TEX	" "			
EGL	" "			

Station	Radar	Time of Auto Track	Time of LOS Track	Mode of Acq.
Orbit 4				
CNV	Beacon Off			
HTV	" "			
HAW	" "			
CAL	" "			
GYM	" "			
WHS	" "			
TEX	" "			
EGL	" "			
Orbit 5				
CNV	Beacon Off			
BDA	" "			
HTV	SPQ-8	07:22:49	07:28:55	
HAW	FPS-16	07:33:19	07:35:43	Acq. Aid
HAW	Verlort	07:33:53	07:35:49	Acq. Aid
CAL	FPS-16	07:41:05	07:45:05	Acq. Aid
CAL	Verlort	07:41:07	07:44:37	Acq. Aid
GYM	Verlort	07:42:28	07:45:07	Acq. Aid
WHS	FPS-16	07:45:31	07:47:13	Acq. Aid
TEX	Verlort	07:50:49	07:51:13	Pointing Data
Orbit 6				
WAT	SPQ-8	08:57:13	08:59:55	Acq. Aid

On orbit 2 the radar signal had some severe fades during the pass. Some of the fades corresponded to changes in pitch and yaw of the capsule, as indicated by the TLM records. The radar performance was good during this pass.

On orbit 3 the radar support was very good. The radar remained slaved to the acquisition bus until the operators were instructed to interrogate the beacon. Over six minutes of data were available to the computer.

WOM (FPS-16)–On orbit 1 the radar experienced heavier modulation on the beacon signal than was noted on either MA-6 or MA-7. The IRACQ lost track but reacquired from the acquisition aid bus.

On orbit 2 the modulation was not as apparent as it was on the first pass. The overall pass appeared to be of the same quality as that of pass 1.

On orbit 3 the radar tracked well, and the track was used as a practice support operation since the capsule was always at a greater distance than 500 miles.

HAW (FPS-16)–On orbit 2 beacon interference was noted. Station personnel felt that it was caused by the PMR Range Tracker. The beacon signal dropped out near PCA (point of closest approach), and no track was obtained at PCA.

On orbit 3 the track was better than on the previous pass. Although the signal was weaker, track was solid and no dropouts were experienced.

On orbit 5, track was made in the second range interval. The radar track was good.

HAW (Verlort)–On orbit 2 the radar acquired the target at a greater range than was predicted from the acquisition message. The track on this orbit was solid.

On orbit 3 acquisition of the target was normal. Several beacon signal dropouts were noted after PCA. Early LOS was caused by a mountain peak which obstructed the signal.

On orbit 5, the beacon was solid. Early LOS was caused by a mountain peak which obstructed the beacon signal.

CAL (FPS-16)–On orbit 1 the radar experienced trouble in acquiring the beacon signal. The acquisition command bus would not transfer to the FPS-16. The trouble was cleared by recycling the IRACQ. During this pass, heavy radar interference caused loss of automatic track. The azimuth and elevation channels of the Sanborn recorder could not be calibrated accurately due to heavy fog and high wind, causing a change in the indicated lock-on point. No PCA was determined on this pass since auto-track was not achieved until after PCA time.

On orbit 2 the acquisition command circuit again failed to transfer to the FPS-16. It was found that the FPS-16 manual lock circuit on the IRACQ was causing the trouble. Since the condition could not be corrected in time for orbit 3, an alternate method was used for the balance of the mission. During this pass the capsule was acquired after PCA.

On orbit 3 there were no problems in acquisition command transfer, but the beacons were turned off prior to PCA. A skin track was attempted, but no skin return was observed at the radar.

On orbit 5, a heavy base line on the beacon signal was observed by the radar operators. The radar was in high power during this pass. No troubles were encountered in transferring the acquisition command to the FPS-16.

CAL (Verlort)–On orbit 1 the radar acquired and tracked the beacon signal in passive mode. No data was furnished the computer since automatic angles and passive track on range was the operational mode during this pass.

On orbit 5 the radar achieved automatic track for approximately 20 seconds, but the beacon faded out, and the radar lost track. The radar went into automatic track for 58 seconds. The astronaut turned the beacon off during this pass.

GYM (Verlort)–On orbit 1 the M&O supervisor reported that the beacon was very good through PCA. Phasing problems were encountered, but the radar furnished the computer approximately 3 minutes and 45 seconds of data during this pass.

On orbit 2 no automatic track was achieved. However, very weak signal returns were observed by the radar operators.

On orbit 5 the radar tracked excellently, and no difficulties were encountered. The radar supplied 4 minutes and 18 seconds of data to the computer.

WHS (FPS-16)–On orbit 1 the beacon signal was acquired in passive mode and was then lost. It was reacquired with Acq Aid and was tracked to the end of the first range interval. The beacon was illuminated for EGL (FPS-16) until they were ready for their first range interval track, at which time the transmitter was turned off. The beacon signal was amplitude modulated during the pass and the frequency of the beacon appeared to be varying by ±1 megacycle. The radar track was good on this pass.

On orbit 2 the beacon signal was acquired from the calculated space point. The radar was phased and then the transmitter was turned on. The radar tracked to the end of the first range interval. The amplitude modulation on the beacon was again observed.

On orbit 5 the beacon signal was acquired and a track was made. The capsule did not come within the first range interval of the radar, so no data was available to the computer on this pass. The M&O supervisor concluded that the amplitude variation could have been due to the wobbulator.

TEX (Verlort)–On orbit 1 the radar operation was satisfactory. The beacon signal, as observed by the radar operator, was good. Approximately 10 to 15 percent count down was observed when the EGL transmitter was turned on. The beacon transponder frequency shifted approximately 2 megacycles immediately after PCA.

EGL (MPQ-31)–On orbit 1 the beacon signal was observed approximately 2 minutes before automatic lock-up could be achieved. Station personnel checked the equipment and could find no reason for the delayed lock-up.

On orbit 5 no radar track was achieved because of an AC power failure at the beginning of the pass, and power did not return to normal until after the pass.

On reentry, the radar provided one minute of data to the computer. A problem was encountered during the track when the radar operators inadvertently locked in at the wrong range interval. The error was approximately 410K yards long. The beacon signal was reported to be erratic during the pass.

HTV (SPQ-8)–On orbit 5 the signal was erratic and difficult to gate. Some interference was noted during the pass which caused loss of track for a short period of time. The radar achieved good solid automatic track from shortly after horizon until LOS. Approximately 5 minutes and 6 seconds of data were available to the computer. (This data was not used.)

On orbit 6 the radar did not make an automatic track. The beacon signal was observed as it was triggered by WAT, but it was not stable enough to get in the gate.

DMP (FPS-16)–On orbit 5 the shipboard equipment operated satisfactorily although the beacon on this pass appeared to count down and the skin presentation was poor. Approximately 1 minute and 5 seconds of data was available, but it was not used by the computer at GSFC.

On orbit 6 the beacon signal fluctuated wildly in amplitude and the skin return was near noise level and fluctuating. Approximately 36 seconds of data was received. However, this data also was not used at GSFC.

GBI (FPS-16)–On orbit 1 the radar track was good. Signal was lost momentarily on two occasions but was reacquired from look angles.

3.2 TELEMETRY AND TIMING

3.2.1 Introduction

The telemetry system provides reception of the aeromedical data for display of the astronaut's pulse, respiration, EKG, blood pressure, and body temperature. It also provides the reception and display of data indicative of spacecraft performance for use by the flight control team at each site. Although not all spacecraft system quantities are displayed at the flight control consoles, all data received is recorded either on magnetic tape or on direct-writing oscillograph recorders. A timing system provides time marks on all records for later verification and also provides time "tags" for the radar data transmitted to the computers.

TABLE 4. TELEMETRY DATA

Station	Telemetry Acq. of Signal	Telemetry Loss of Signal	Decommutator Lock	Decommutator Loss	Estimated Mean Signal Strength (Microvolts) LO Rcvr. Model 1415	LO Rcvr. Model 1434	HI Rcvr. Model 1415	HI Rcvr. Model 1434
Orbit 1								
CNV	N/A	07:47	00:00	07:47				
GBI	00:46	07:09	N/A	N/A				
GTI	03:00	08:00	N/A	N/A				
BDA	03:01	10:37	03:24	10:37	100	100	100	100
CYI	14:16	21:43	14:47	21:34	200	140	200	160
KNO	21:13	28:32	21:29	28:23	150	50	175	80
ZZB	30:00	38:36	30:08	38:29	150	150	150	150
IOS	37:03	41:00	37:43	39:53	20	100	30	80
MUC	00:49:27	00:58:29	00:49:41	00:58:26	190	110	105	155
WOM	00:54:12	01:03:14	00:54:35	01:03:09	310	270	160	320
CTN	01:09:34	01:17:05	01:09:38	01:17:05	95	90	90	100
CAL *	01:25:41	01:31:57	01:25:54	01:31:57	15	40	20	20
GYM	01:26:44	01:33:49	01:27:03	01:33:39	125	125	115	120
TEX	01:29:46	01:36:44	01:29:56	01:36:43	170	165	175	180
EGL **	01:32:24	01:38:00	01:32:30	01:38:00	3	75	60	80
Orbit 2								
CNV	01:33:32	01:40:42	N/A	N/A				
GBI	01:34:23	01:39:15	N/A	N/A				
GTI	01:37:00	01:41:00	N/A	N/A				
BDA	01:36:59	01:44:19	01:36:59	01:44:16	50	50	50	50
CYI	01:48:08	1:54:35	1:48:33	1:54:30	80	110	60	60
KNO	01:55:09	2:01:57	1:55:13	2:01:55	20	20	10	8
ZZB	02:04:30	02:11:39	02:05:44	02:11:36	45	80	70	80
IOS	02:07:26	02:16:10	02:07:34	02:16:06	60	150	75	110
MUC	02:23:14	02:32:09	02:23:29	02:32:04	210	105	110	180
WOM	02:28:09	02:36:22	02:28:16	02:36:15	135	174	64	175
CTN	02:43:28	02:50:15	02:43:28	02:50:15	70	80	55	120
HAW	02:50:35	02:55:49	02:50:59	02:55:46	70	60	40	60
CAL	02:58:39	03:05:59	02:58:41	03:05:59	40	80	50	60
GYM	03:00:29	03:07:28	03:01:01	03:07:18	80	100	100	80
TEX	03:03:49	03:10:27	03:03:59	03:10:20	120	100	80	85
EGL	03:06:15	03:13:23	03:06:18	03:13:18	10	40	25	35
Orbit 3								
CNV	03:07:29	03:14:47	N/A	N/A				
GBI	03:08:09	03:14:52	N/A	N/A				
GTI	03:10:00	03:16:00	N/A	N/A				
BDA	03:10:29	03:17:44	03:10:36	03:17:42	50	50	50	50
IOS	03:40:45	03:49:13	03:40:55	03:49:03	150	175	200	150
MUC	03:57:15	04:05:09	03:57:36	04:05:09	90	55	75	75
WOM	04:03:45	04:07:23	04:04:24	04:07:13	28	41	12	40
HAW	04:22:39	04:29:51	04:22:54	04:29:39	200	150	40	100
CAL	04:31:57	04:39:40	04:31:57	04:39:40	50	85	80	100
GYM	04:34:36	04:[illegible]:17	04:34:39	04:41:11	130	90	50	50
TEX	04:37:28	04:44:37	04:37:36	04:44:35	150	125	100	120
EGL	04:39:40	04:46:50	04:39:43	04:46:45	15	40	27	37
Orbit 4								
CNV	04:40:52	04:48:28	N/A	N/A				
GBI	04:41:35	04:47:39	N/A	N/A				
GTI	04:43:00	04:51:00	N/A	N/A				
BDA	04:44:47	04:50:09	04:44:53	04:49:57	25	25	25	25
IOS	05:14:57	05:23:53	05:15:09	05:23:49	100	110	110	50
MUC	05:34:14	05:35:04			11	6	7	9
HAW	05:57:11	06:02:20	05:58:24	06:02:18	60	35	45	60
CAL	06:05:39	06:12:47	06:05:40	06:12:47	70	80	70	80
GYM	06:08:05	06:15:25	06:08:22	06:15:10	40	60	30	20
TEX	06:11:04	06:18:19	06:11:09	06:18:17	180	200	100	100
EGL	06:13:45	06:19:30	06:13:50	06:19:29	10	20	20	40
Orbit 5								
CNV	06:15:28	06:21:52	N/A	N/A				
GBI	06:15:56	06:21:39	N/A	N/A				
GTI	06:18:00	06:24:00	N/A	N/A				
IOS	06:48:51	06:57:44	06:49:04	06:57:32	40	40	50	20
PCS	07:15:40	07:22:06	07:15:32	07:22:00	30	40	40	40
HTV ***	07:21:58	07:27:19	N/A	N/A	750	750	450	750
WAT ***	07:23:24	07:29:19	N/A	N/A	400	20	400	20
DMP	07:24:00	07:30:00	N/A	N/A				
HAW	07:31:57	07:36:54	07:32:29	07:36:09	30	40	30	20
CAL	07:40:04	07:46:00	07:40:29	07:46:00	60	70	10	15
GYM	07:42:00	07:48:38	07:42:17	07:48:32	85	60	50	70
TEX	07:46:06	07:49:32	07:46:12	07:49:31	110	125	50	45
Orbit 6								
IOS	08:32:28	08:40:59	08:32:10	08:40:45	150	125	200	200
PCS	08:49:15	08:55:45	08:49:26	08:55:52	40	40	30	35
HTV	08:56:01	09:00:44	N/A	N/A	750	750	275	750
WAT	08:55:52	09:00:49	N/A	N/A	400	200	400	50
DMP	08:57:00	09:00:00	N/A	N/A				

* CAL coverage includes input from San Nicolas Island

** Eglin receivers are Nems-Clarke Model 1432

*** HTV and WAT receivers are not Mercury types

3.2.2 Telemetry Performance

Generally, all sites received signal from horizon to horizon, as was the case during previous missions. Range of reception was improved by higher than nominal apogee and perigee. (See Table 4 and Figure 3, which is inserted at the end of this Section 3.)

During the mission, no significant operator or equipment malfunctions prevented any station from supporting mission monitoring and control.

Decom power supply fuse problems at Woomera and Zanzibar were related to a marginal condition caused by the addition of the DGG-2A gate generator. The problem may have been aggravated by corroded fuse holders. This trouble had previously occurred at Hawaii and California and action taken to distribute loading between decom power supplies one and two. An EI related to decom power supplies and decom cooling will be issued in the near future.

Data scatter as reported by summary messages to MCC was generally within 2 percent of full scale meter deflection. This was especially true with oxygen primary, oxygen secondary, auto fuel, and manual fuel parameters. More valid conclusions may be apparent by comparing the ground station data with the onboard tape data.

Signal blackout was apparent from 09:00:40 GET to 09:05:07 GET (Ground Elapsed Time).

3.2.3 Timing Performance

Timing problems experienced during the MA-8 mission were very minor in nature. Data serial decimal time and time monitoring capability were quite adequate throughout the mission.

3.3 AIR GROUND VOICE COMMUNICATIONS (HF AND UHF)

3.3.1 Introduction

The HF and UHF receiving and transmitting equipments permit direct voice contact between the astronaut and the flight control team during passes over each successive site. A patching arrangement permits the Control Center to monitor the ground spacecraft communications during periods when the spacecraft is over a tracking site

3.3.2 Performance

For the network, the quality of A/G voice communications during the mission varied between poor and good The capsule HF transmitter system was used extensively from 00:49:00 GET to approximately 01:40:00 GET with fair results noted on the ground Numerous HF transmissions were made by the astronaut in addition to the scheduled HF checks outlined in the flight plan. The capsule UHF transmitter system appeared to be preferred and was used extensively for the remainder

TABLE 5. A/G COMMUNICATIONS COVERAGE DATA

Station	HF Acq.	HF LOS	UHF Acq.	UHF LOS
Orbit 1				
MCC			Liftoff	00:10:23
GBI	00:05:01	00:09:26	00:02:56	00:07:26
GTI			00:03:00	00:08:00
BDA			00:03:12	00:10:23
CYI			00:14:51	00:19:06
KNO			00:21:12	00:26:58
ZZB			00:30:00	00:38:00
MUC	00:48:48	00:56:59		
WOM	00:55:00	01:04:00		
CAL	01:26:58	01:38:00		
GYM	01:27:00	01:39:00		
TEX	01:29:00	01:37:00		
EGL	01:30:00	01:42:00		
Orbit 2				
MCC	01:33:33	01:38:50	01:38:50	01:44:00
GBI	01:32:53	01:38:58		
GTI	01:34:00	01:41:00	01:38:00	01:41:00
BDA	01:33:52	01:37:16	01:39:13	01:41:46
CYI			01:48:58	01:53:50
KNO	01:57:55	02:03:08	01:55:16	01:56:26
IOS			02:10:49	02:14:57
MUC			02:23:28	02:31:59
WOM			02:32:00	02:36:00
HAW			02:51:49	02:55:00
CAL			02:59:13	03:05:22
GYM			03:01:00	03:08:00
TEX			03:04:00	03:09:37
EGL	03:06:00	03:15:00		
Orbit 3				
MCC			03:03:34	03:15:10
GBI	03:01:31	03:17:31		
GTI			03:11:00	03:16:00
BDA			03:10:34	03:16:29
CYI	03:25:42	03:26:52		
KNO	03:32:00	03:33:00		
IOS	03:40:39	03:50:49		
MUC			03:59:07	04:05:08
WOM			04:04:39	04:07:19
HAW			04:23:09	04:29:41
CAL			04:32:17	04:38:53
GYM			04:35:00	04:41:00
TEX			04:38:45	04:45:00
EGL	04:30:00	04:50:00		
Orbit 4				
MCC			04:40:20	04:48:45
GBI	04:42.06	04:48:16	04:42:06	04:49:06
GTI			04:44:00	04:50:00
BDA			04:45:09	04:49:38
IOS			05:15:45	05:23:09
MUC	05:34:23	05:38:09		
PCS	05:42:00	05:48:00		
HAW			05:58:09	06:01:34
CAL			06:05:50	06:13:09
GYM			06:08:00	06:13:00
TEX			06:12:34	06:18:00
EGL	06:13:00	06:19:00	06:15:00	06:16:00
Orbit 5				
MCC			06:15:30	06:24:11
GBI	06:23:16	06:23:16	06:18:26	06:20:16
GTI			06:18:00	06:23:00
IOS			06.49:29	06:57:10
PCS	07:16:00	07:22:00	07:16:00	07:22:00
HAW			07:32:01	07:36:00
GYM			07:42:00	07:48:00
TEX			07:47:00	07:48:00
HTV			07:22:49	07:25:49
Orbit 6				
GBI	07:43:11	07:44:51		
IOS			08:23:49	08:31:49
PCS			08:50:00	08:55:00
HAW *				
WAT			08:58:00	09:00:00
HTV			08:55:59	08:59:49

* Coverage for HAW was extended by using a relay aircraft. A/G communications after blackout were maintained from an altitude of 45,000 feet to recovery of the capsule.

of the flight. See Table 5 and Figure 4 and 5 for coverage information. UHF coverage times were slightly different from predicted nominal times. As in the previous flight, MCC A/G coverage was extended by using the MCC-BDA remoting system. Although not shown on the HF and UHF charts, Quito, Ascension, and Antigua did have A/G coverage.

During the periods of time when the A/G was transferred to the Goddard conference circuit, voice quality, as monitored at MCC, varied from very poor to good. These results can probably be attributed to both ground reception quality and severe propagation conditions experienced on mission day.

After blackout, communication was established between the astronaut and the HAW capsule communicator using the relay aircraft in the terminal landing area. The astronaut was reading the HAW CapCom loud and clear, but the transmissions from the capsule as received by HAW CapCom were very noisy. This communication link was adequate for the HAW CapCom to communicate with the astronaut from an altitude of 45,000 feet to recovery of the capsule.

The power failure at California prior to the fifth orbit prevented the California site from receiving any A/G transmissions during this orbit. This made it necessary for the CAL CapCom to transmit to the astronaut in the blind.

3.4 COMMAND

Dual ground command systems were installed at specific remote sites, which were listed in Table 1. These command sites provide command back-up to critical spacecraft functions such as abort and retrofire. The ground command system also employs a voice modulator that can be used as a voice back-up in the event both the HF and UHF voice systems are inoperative.

A preliminary evaluation of the data shows that all command sites appeared to have slightly less command coverage than noticed on previous missions. The 10KW command sites using the quadhelix antenna had an average of approximately 45 percent better coverage above the 7.5 microvolt level than that of the 600 watt command sites. Coverage became reliable at slant ranges varying from 250 to 650 nautical miles. This large variance is believed to be caused by the spacecraft antenna pattern aspect angles changing while the capsule was in drifting flight.

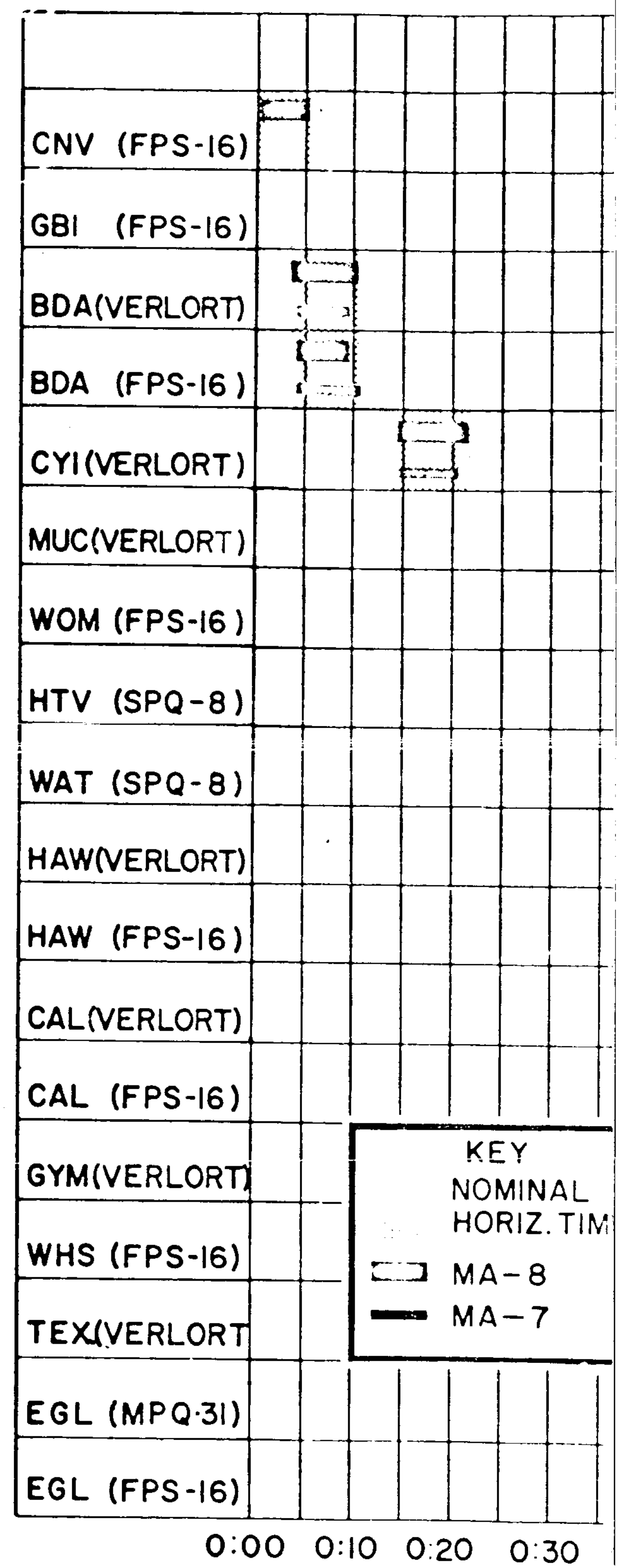
Five messages were transmitted to the command sites during the mission to change the command handover plan. These changes compensated for the overspeed trajectory which altered the best function times slightly more than one minute by the time of the last pass over PCS.

A total of eleven functions were transmitted from the command sites. All of the functions were received successfully even though the telemetry "R" and "Z" calibrations from Guaymas on the fourth pass were received intermittently due to low signal strengths.

3.5 BERMUDA REMOTING SYSTEM

Minor system operations problems were encountered during early simulation exercises due to erratic performance of the associated full period phone circuits. Following a complete alignment on September 21, 1962, however, reliability of these circuits was satisfactory with only momentary signal drop-outs being noted. During the mission on October 3, no drop-outs were noted and composite levels varied over a range of 3 DB, but remained well within established limits. The Cape CapCom maintained transmission through the BDA A/G system at all times when the capsule was within range of the BDA station. TLM events were received from BDA during passes 1, 2, and 3, and remote command capability was available at all times during these passes.

The BDA remoting system was not incapacitated at any time during the flight, and its overall performance can be evaluated as excellent.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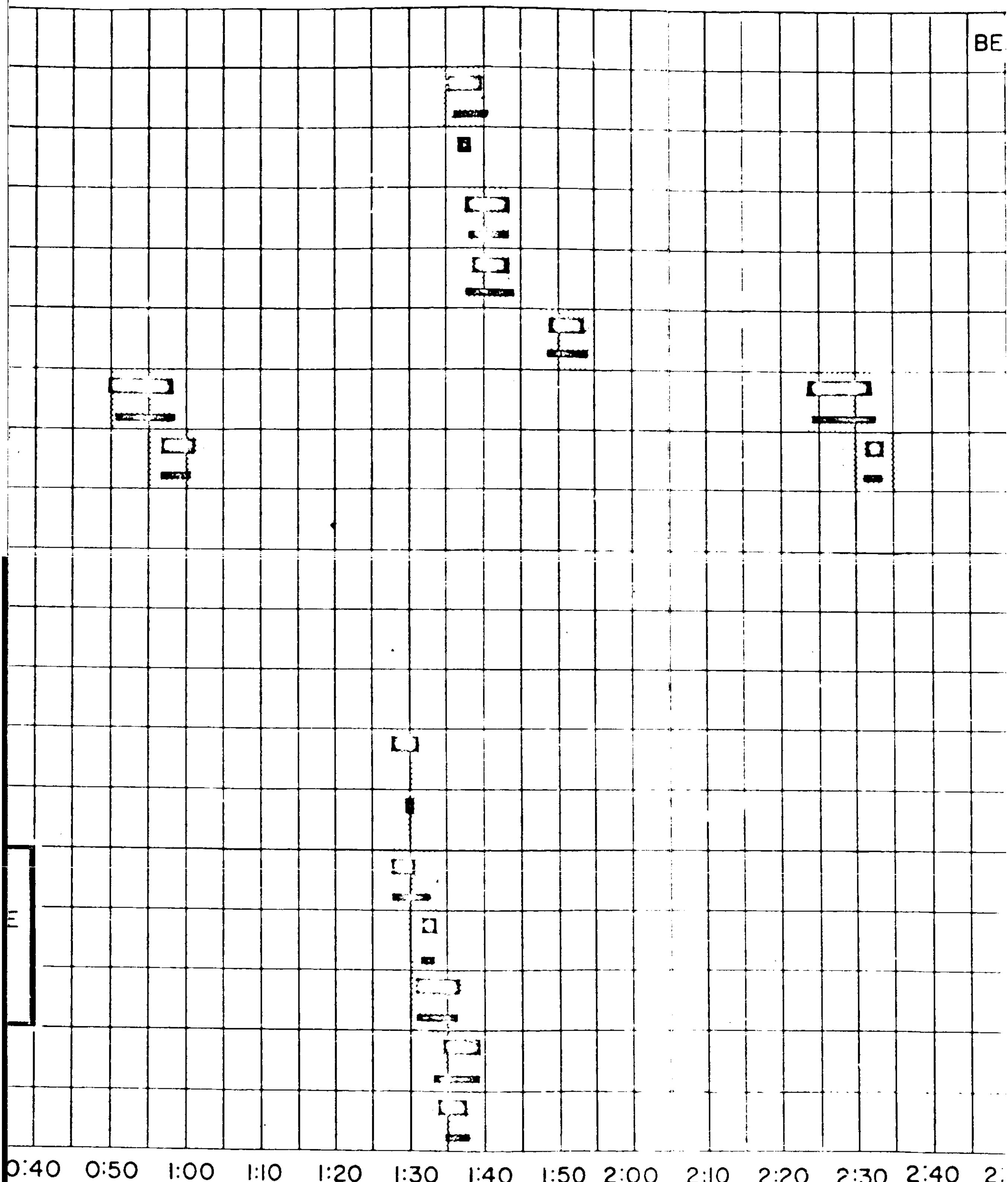
GBI (FPS-16)
BDA(VERLORT)
BDA (FPS-16)
CYI(VERLORT)
MUC(VERLORT)
WOM (FPS-16)
HTV (SPQ-8)
WAT (SPQ-8)
HAW(VERLORT)
HAW (FPS-16)
CAL(VERLORT)
CAL (FPS-16)
GYM(VERLORT)
WHS (FPS-16)
TEX(VERLORT
EGL (MPQ-31)
EGL (FPS-16)
0:00
0:10
0:20
0:30
KEY
NOMINAL
HORIZ. TIM
MA-8
MA-7

#1



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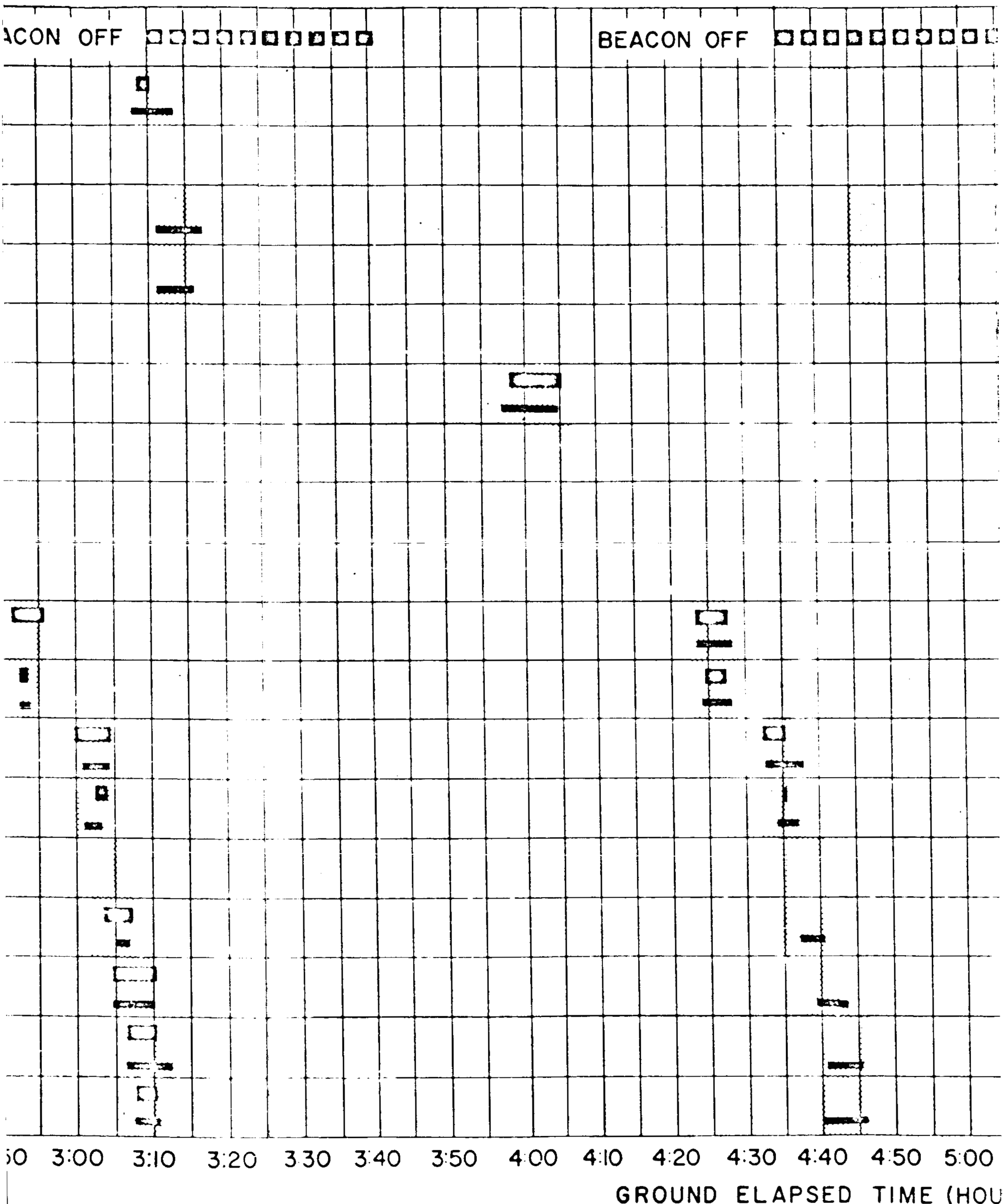
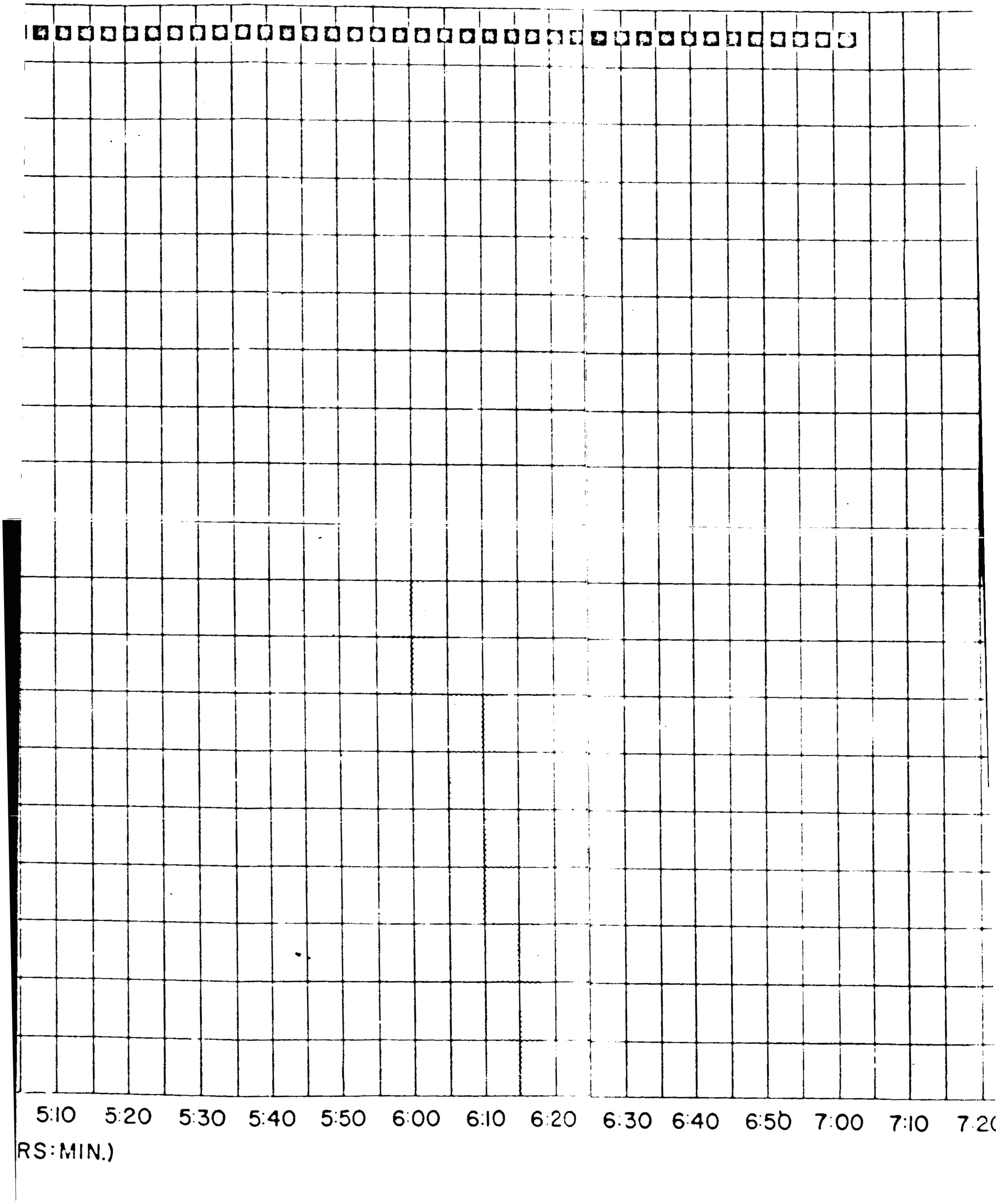


ACON OFF
BEACON OFF
50 3:00 3:10 3:20 3:30 3:40 3:50 4:00 4:10 4:20 4:30 4:40 4:50 5:00
GROUND ELAPSED TIME (HOU

#3



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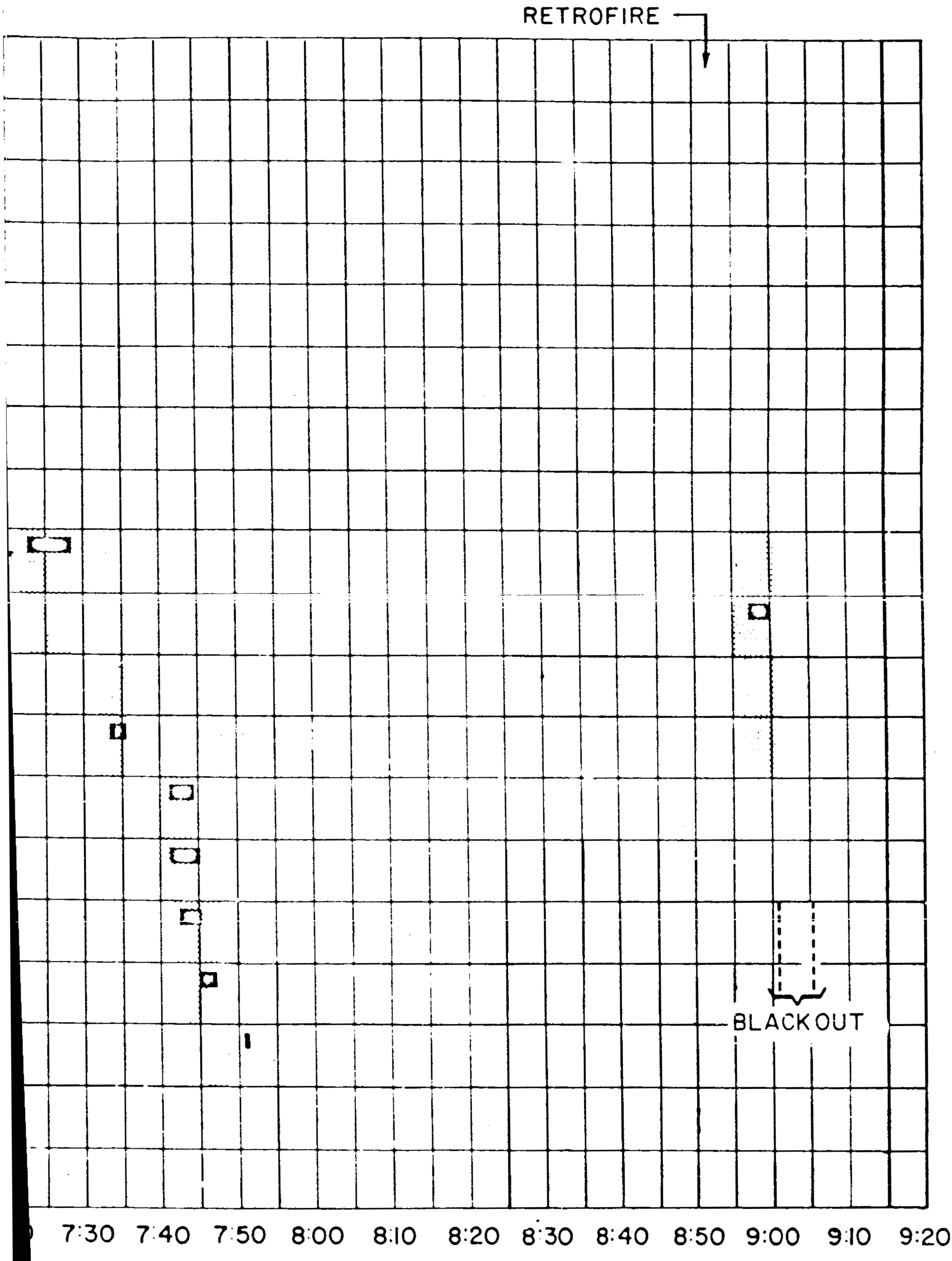
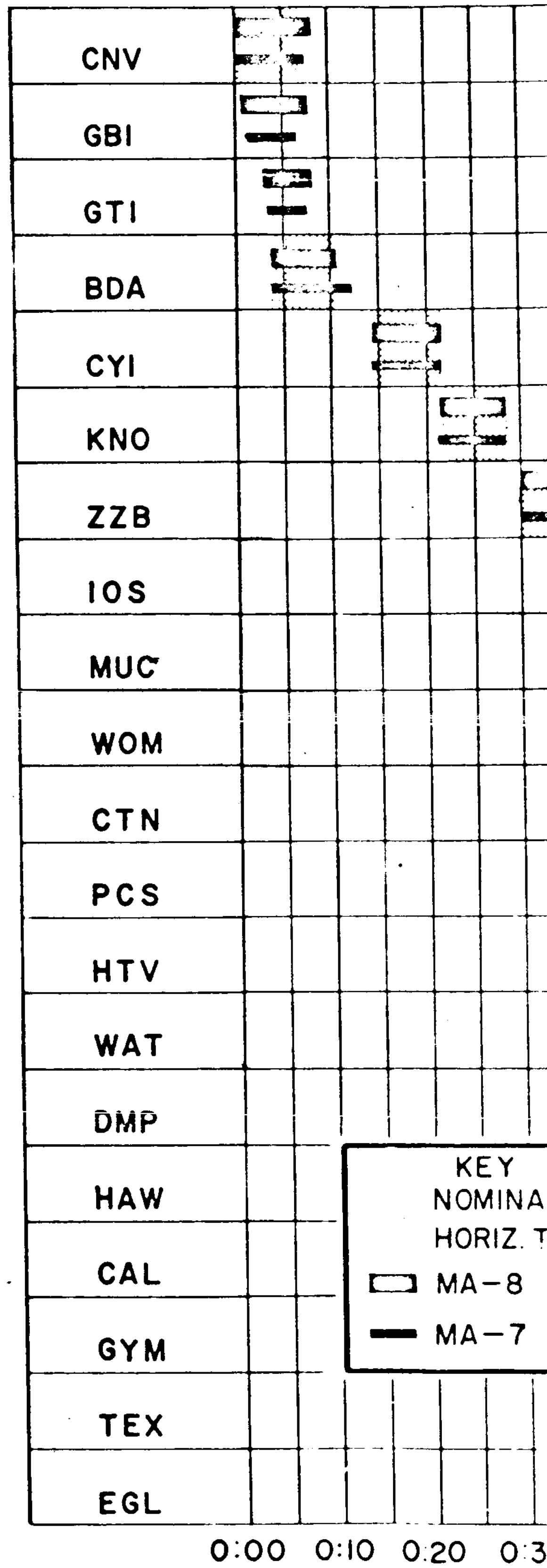


Figure 2. Radar Coverage Chart

#5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GTI
BDA
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KNO
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MUC
WOM
CTN
PCS
HTV
WAT
DMP
HAW
CAL
GYM
TEX
EGL
KEY
MA-8
MA-7
0:00
0:10
0:20

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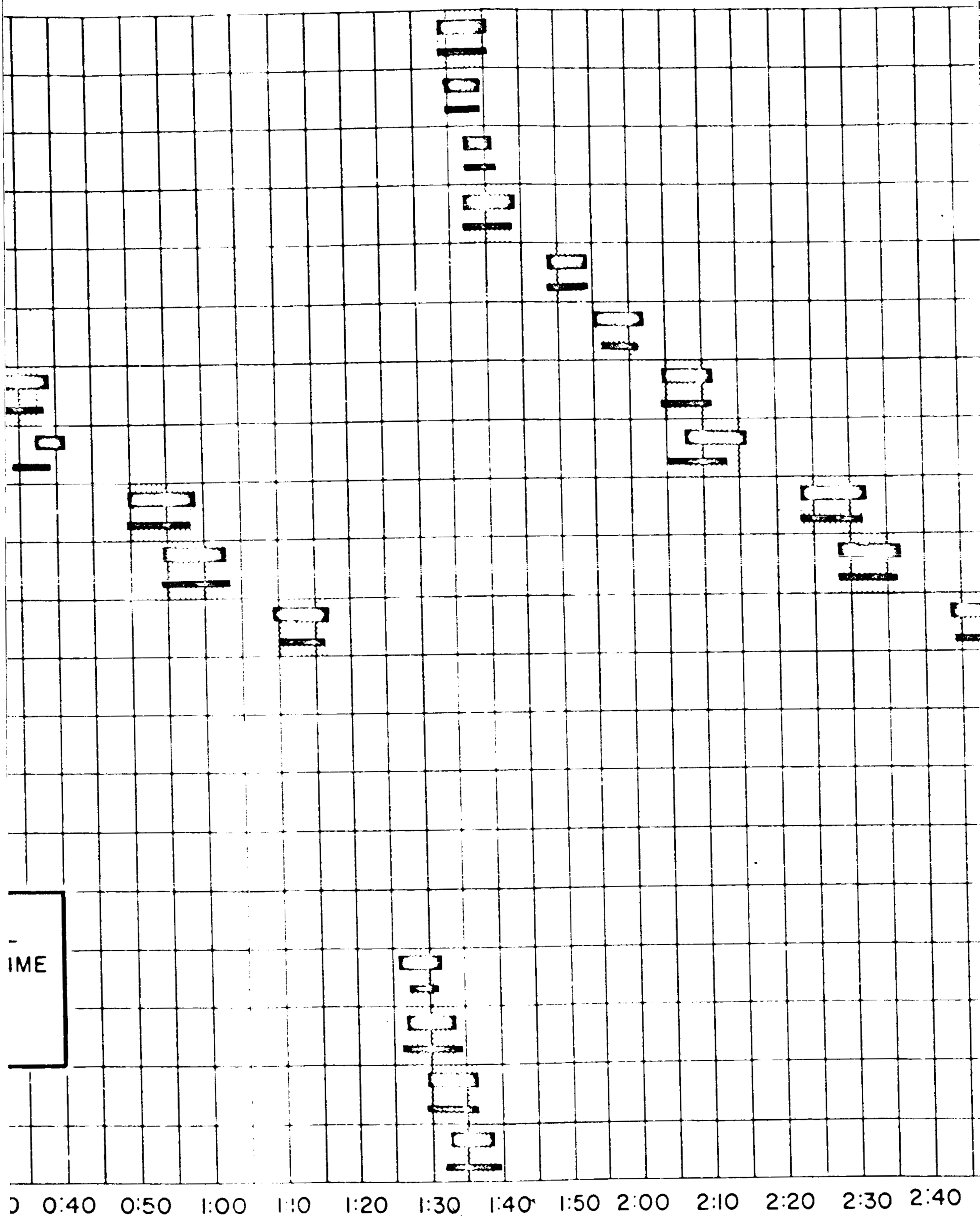

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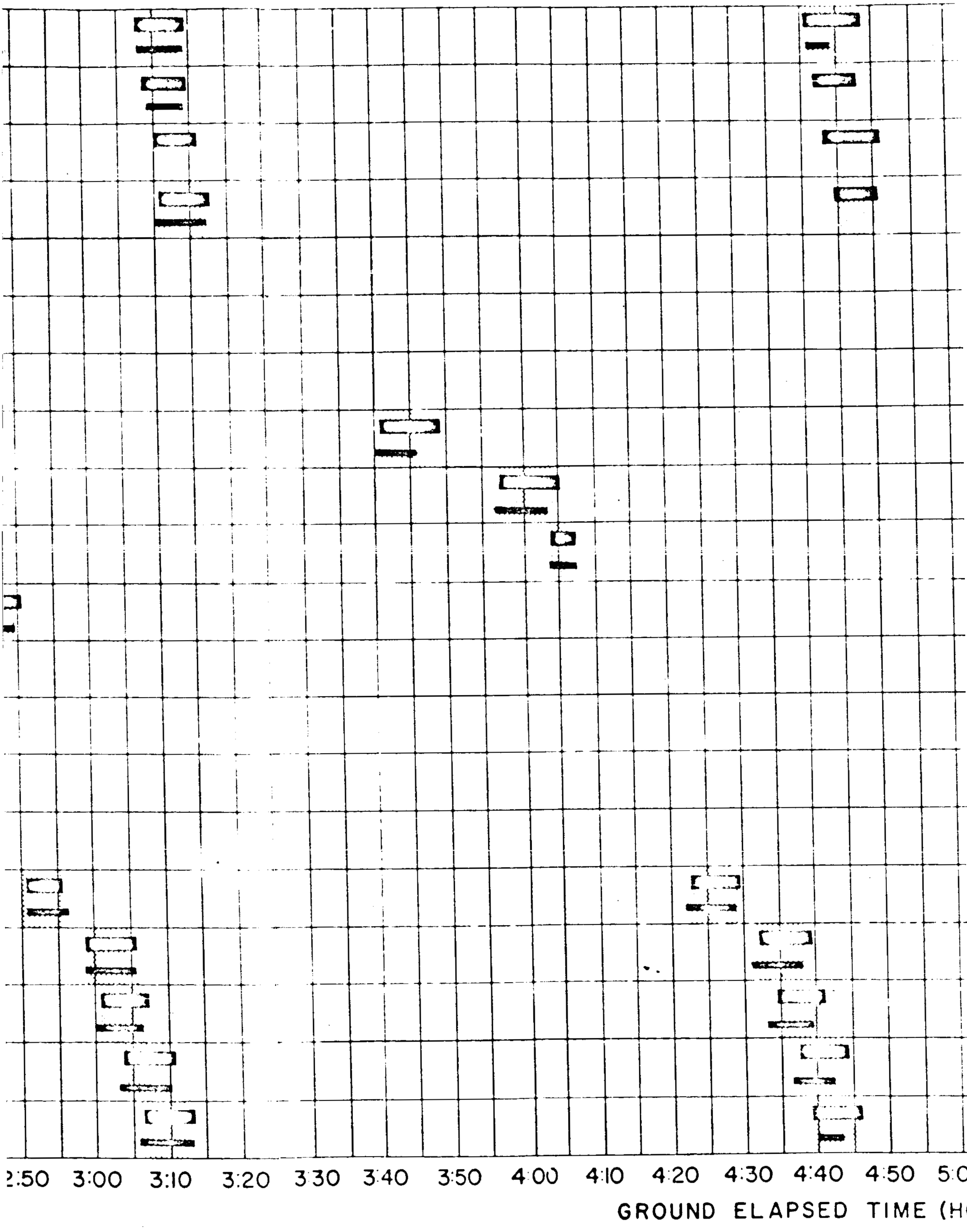
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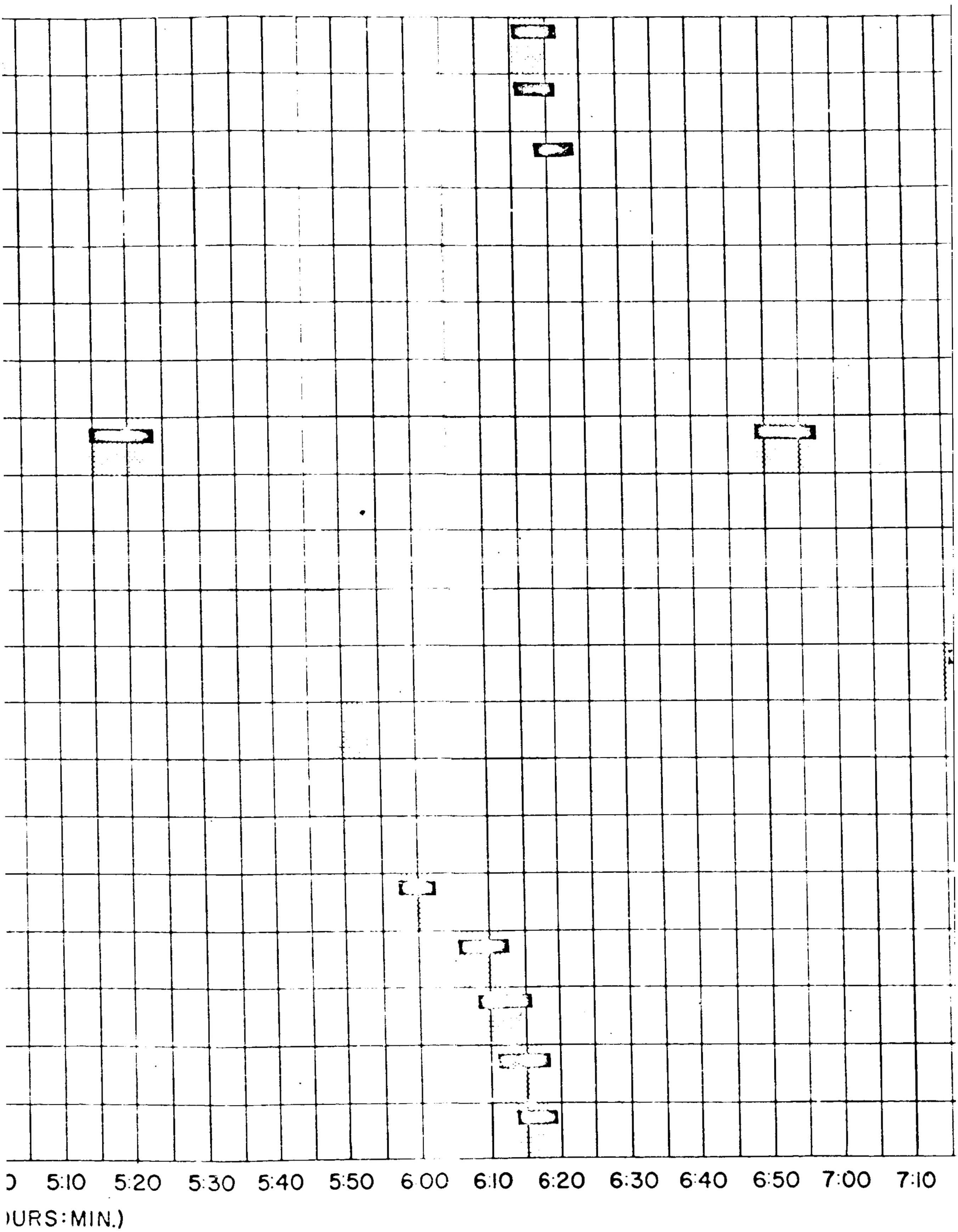
GROUND ELAPSED TIME (H

#3



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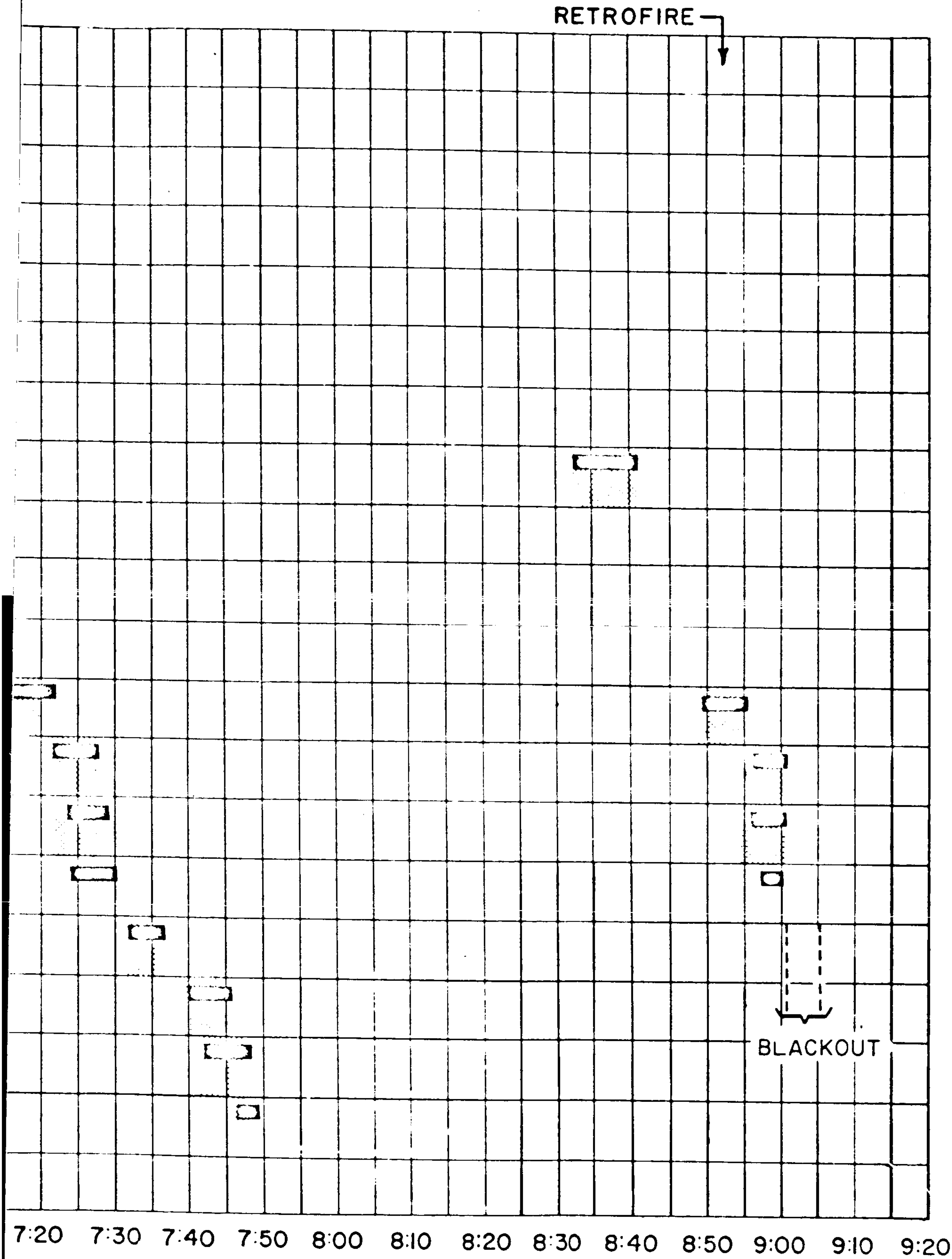
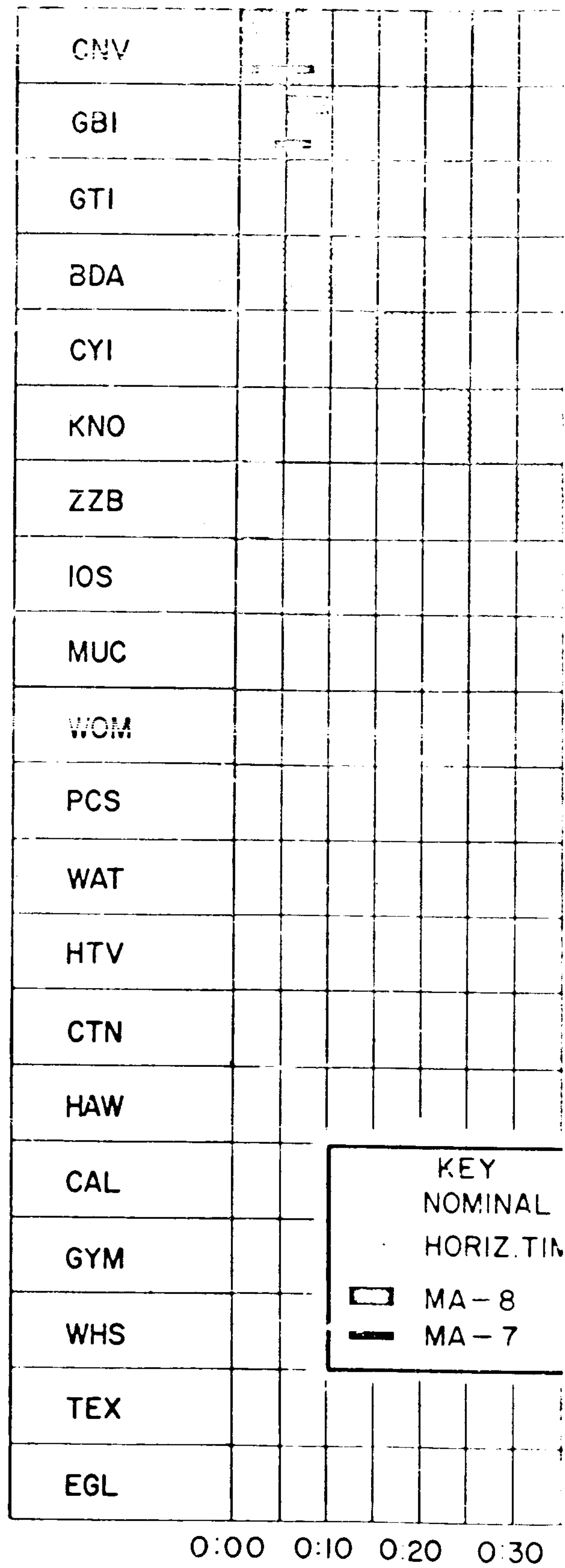


Figure 3. Telemetry Coverage Chart

#5-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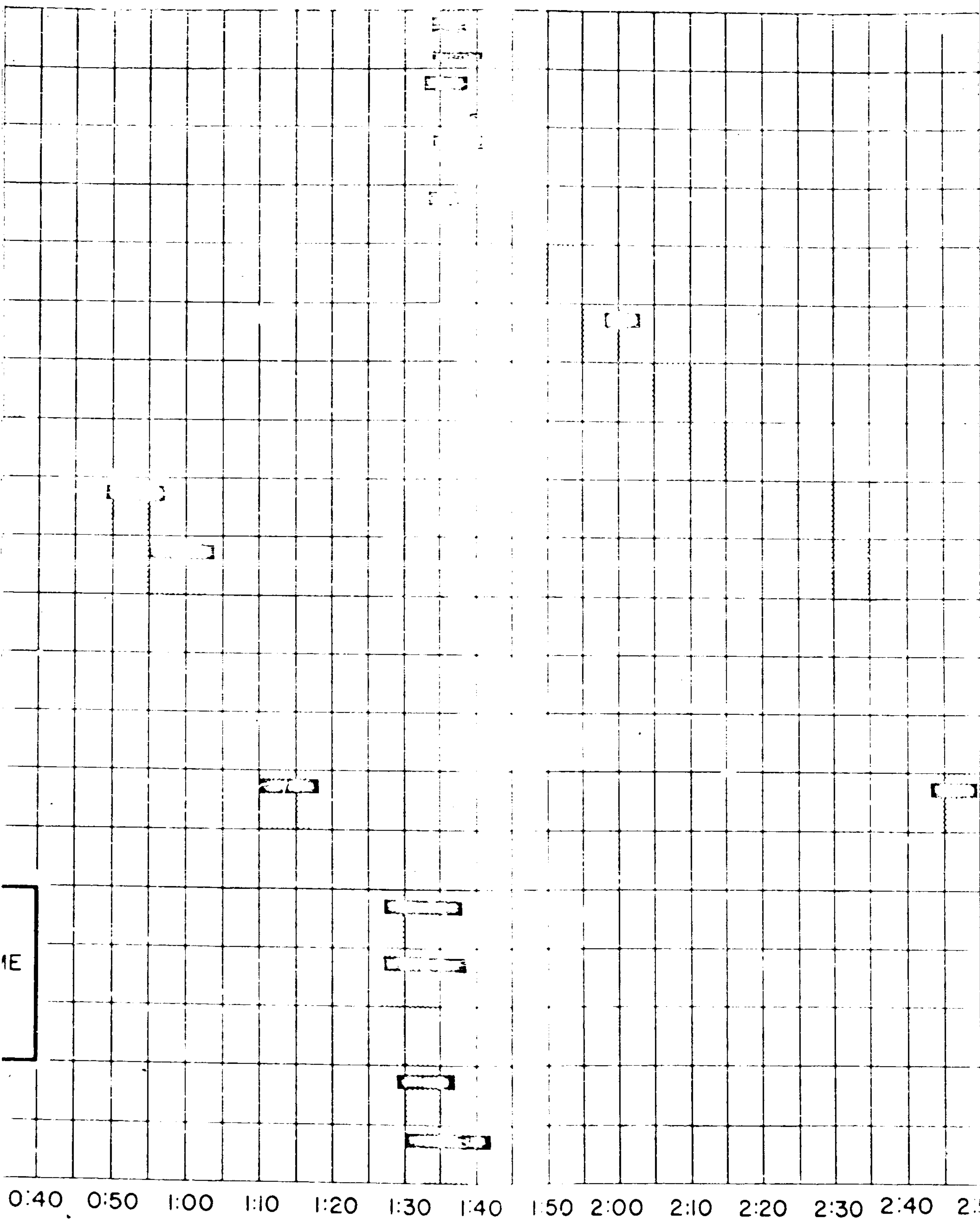
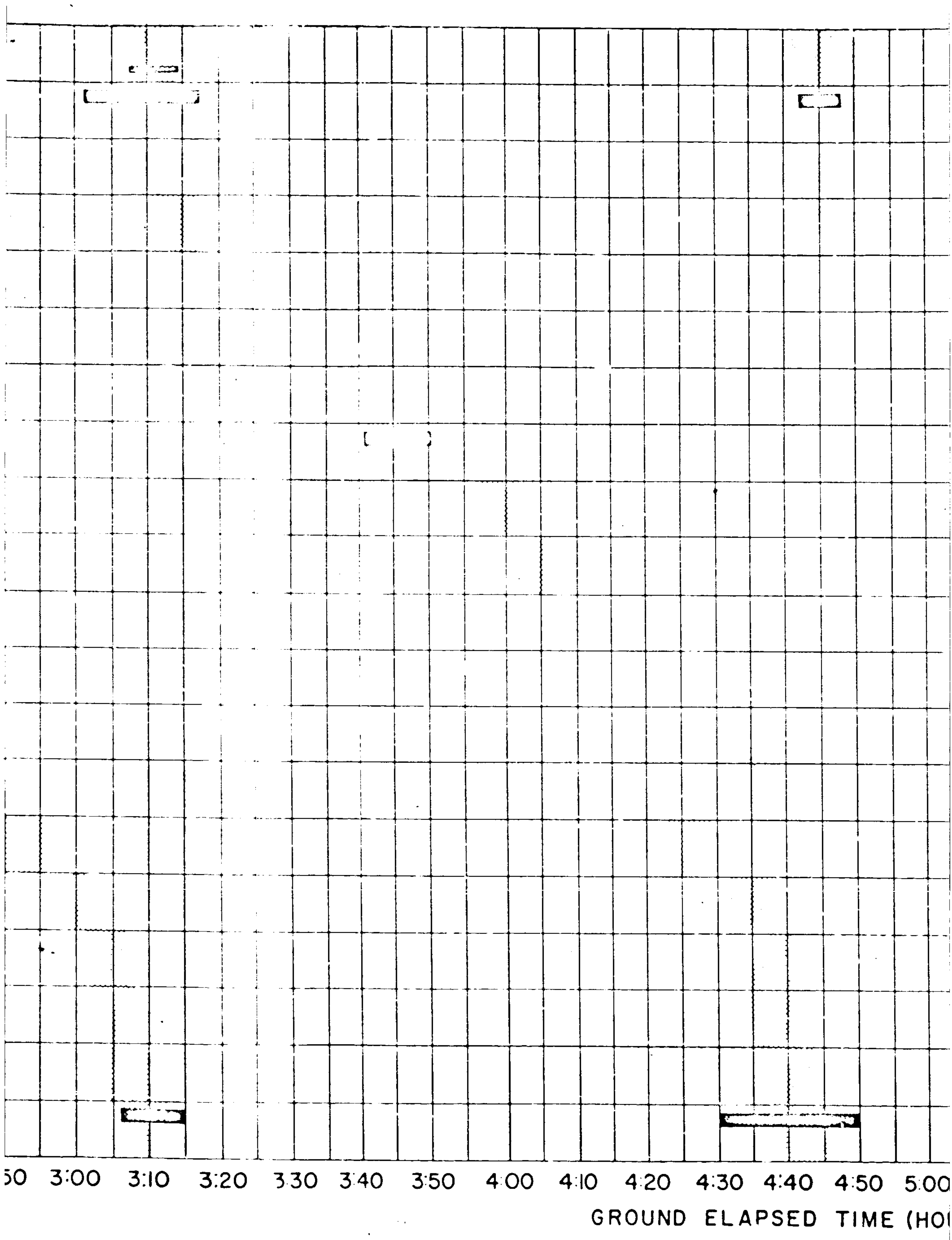
GBI
GTI
BDA
CYI
KNO
ZZB
IOS
MUC
WOM
PCS
WAT
HTV
CTN
HAW
CAL
GYM
WHS
TEX
EGL
KEY
NOMINAL
HORIZ.TIM
MA-8
MA-7
0:00
0:10
0:20
0:30

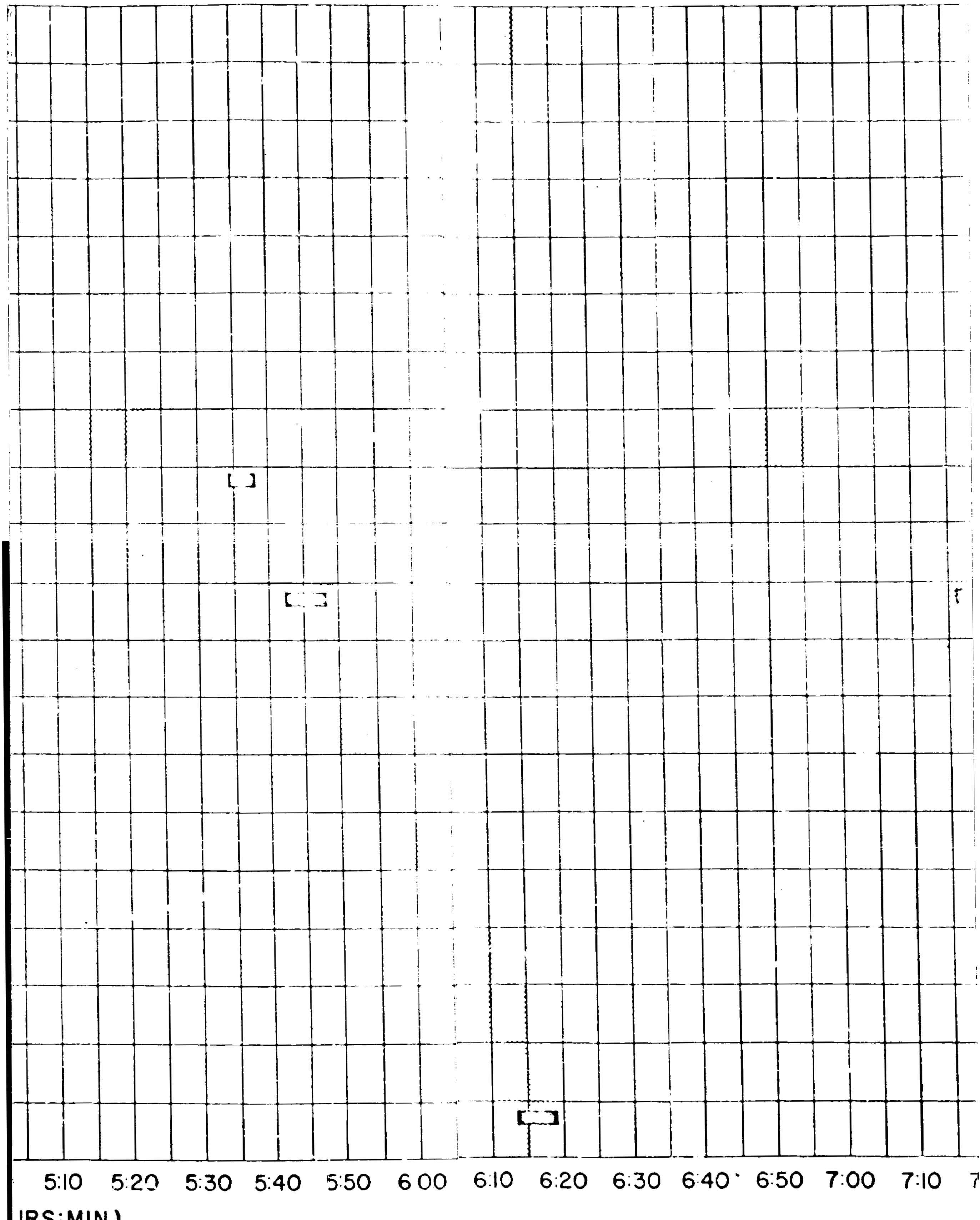
#1



#2


50 3:00 3:10 3:20 3:30 3:40 3:50 4:00 4:10 4:20 4:30 4:40 4:50 5:00
GROUND ELAPSED TIME (HO

#3



#4

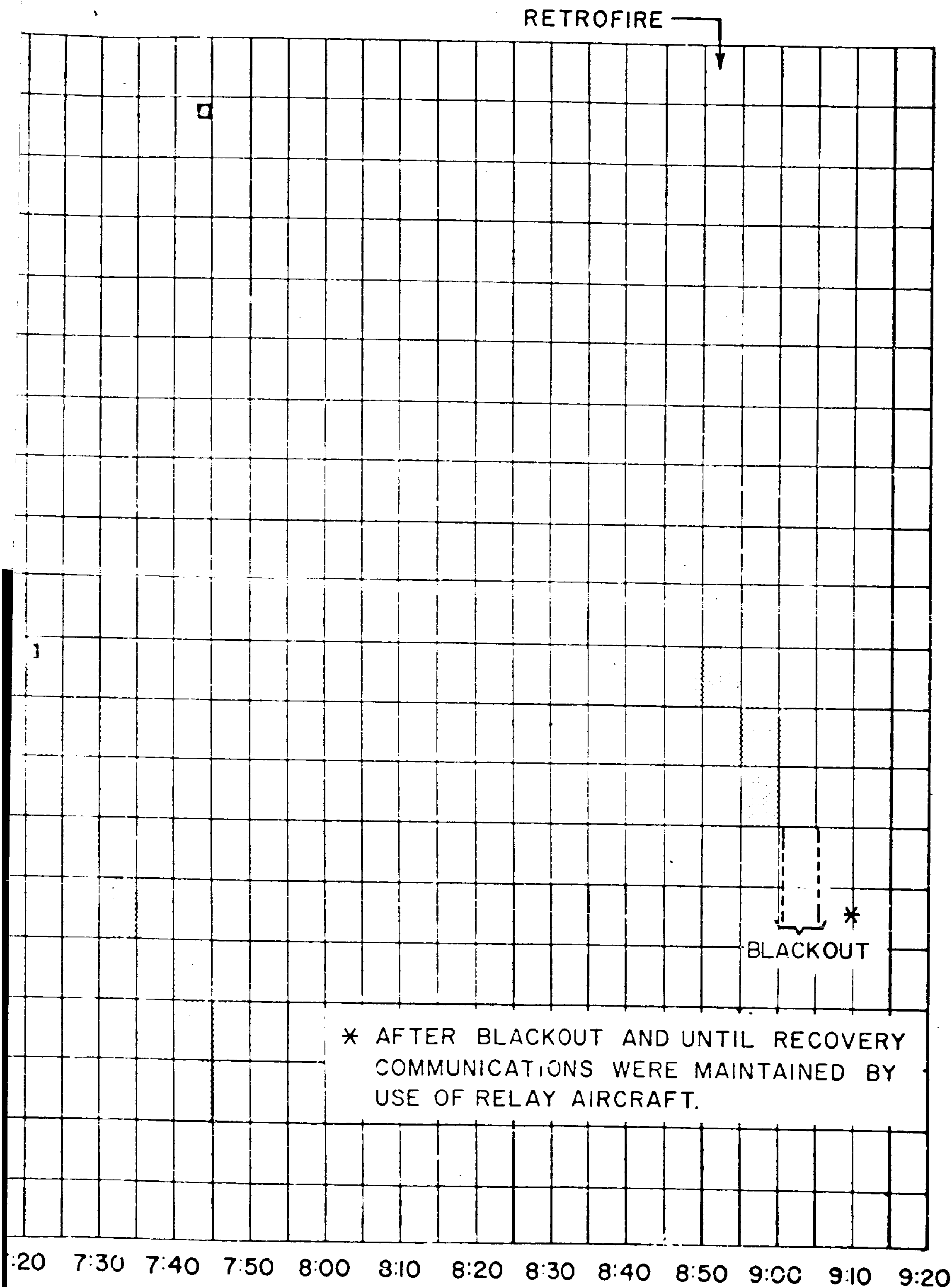
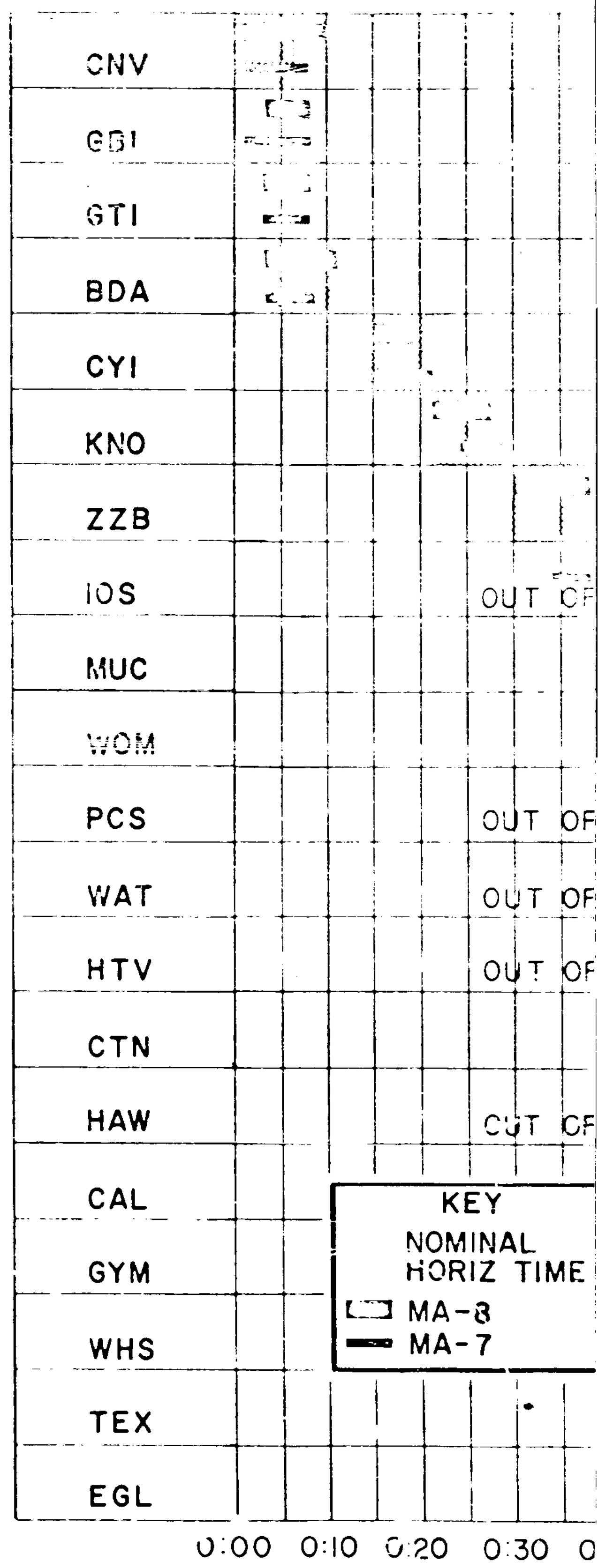
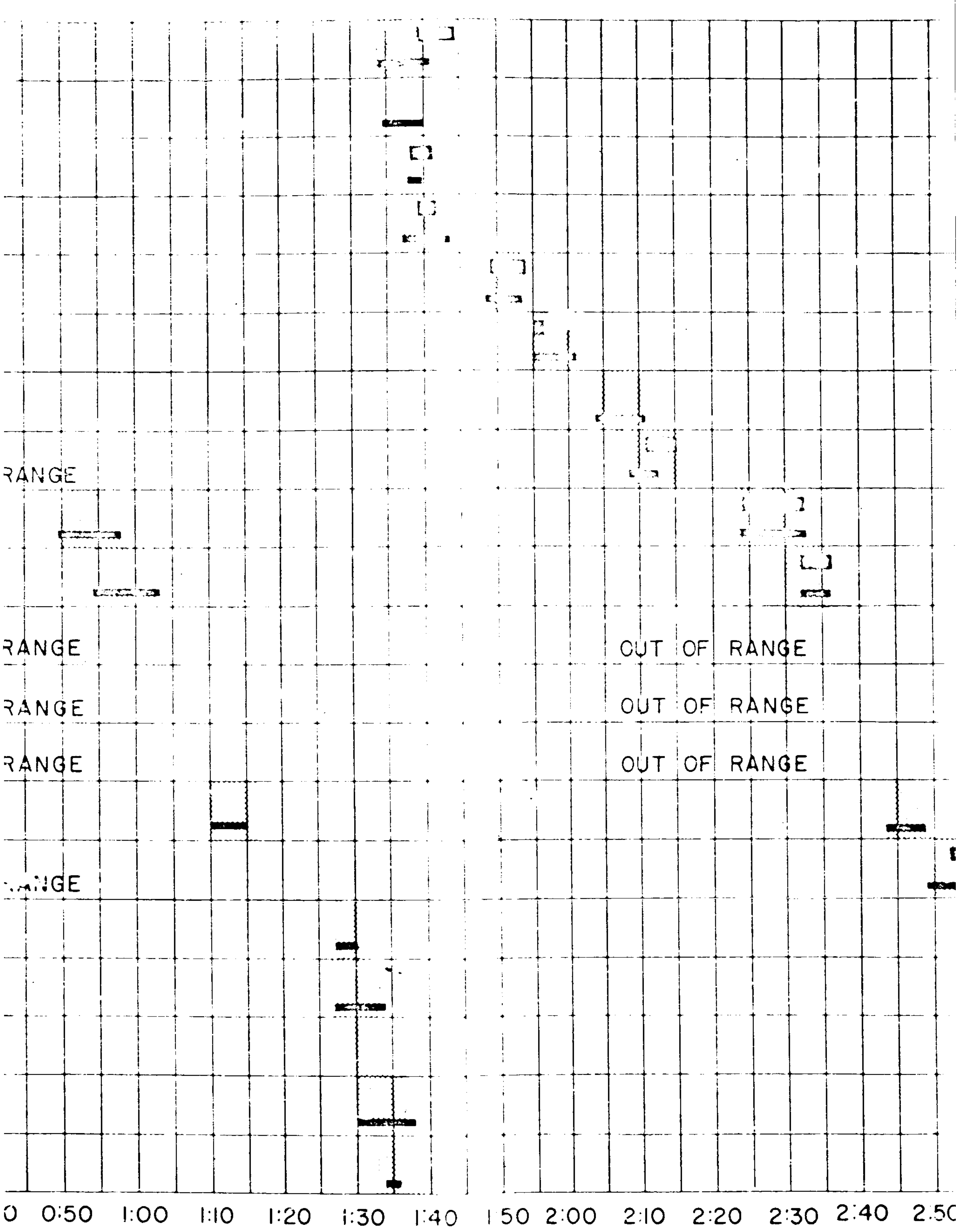


Figure 4. HF Communications Coverage Chart

#5


CNV
GBI
GTI
BDA
CYI
KNO
ZZB
IOS
OUT OF
MUC
WOM
PCS
OUT OF
WAT
OUT OF
HTV
OUT OF
CTN
HAW
OUT OF
CAL
GYM
WHS
TEX
EGL
KEY
NOMINAL
HORIZ TIME
MA-8
MA-7
0:00
0:10
0:20
0:30

#1


RANGE
RANGE
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ANGE
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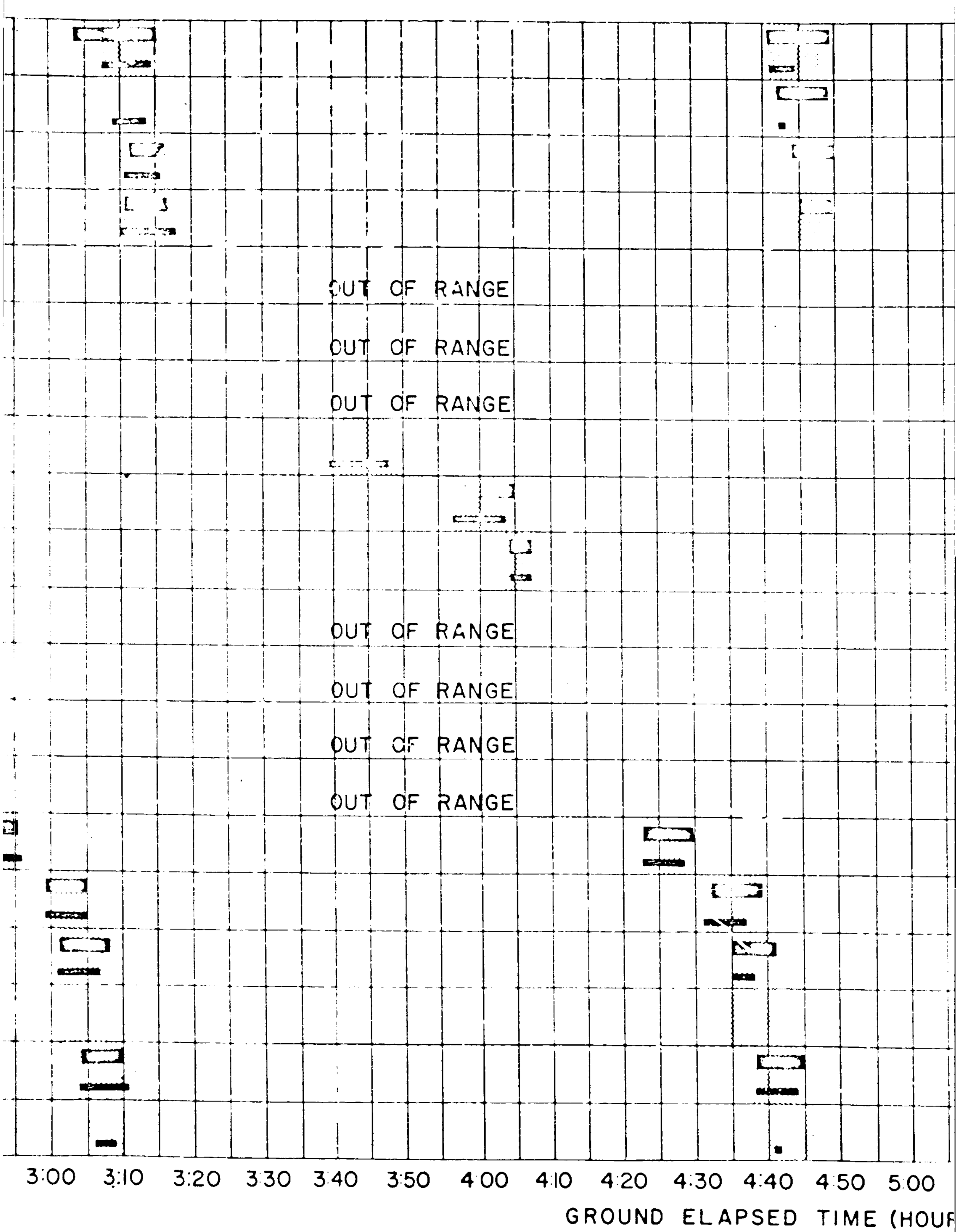
OUT OF RANGE
0 0:50 1:00 1:10 1:20 1:30 1:40 1:50 2:00 2:10 2:20 2:30 2:40 2:50

#2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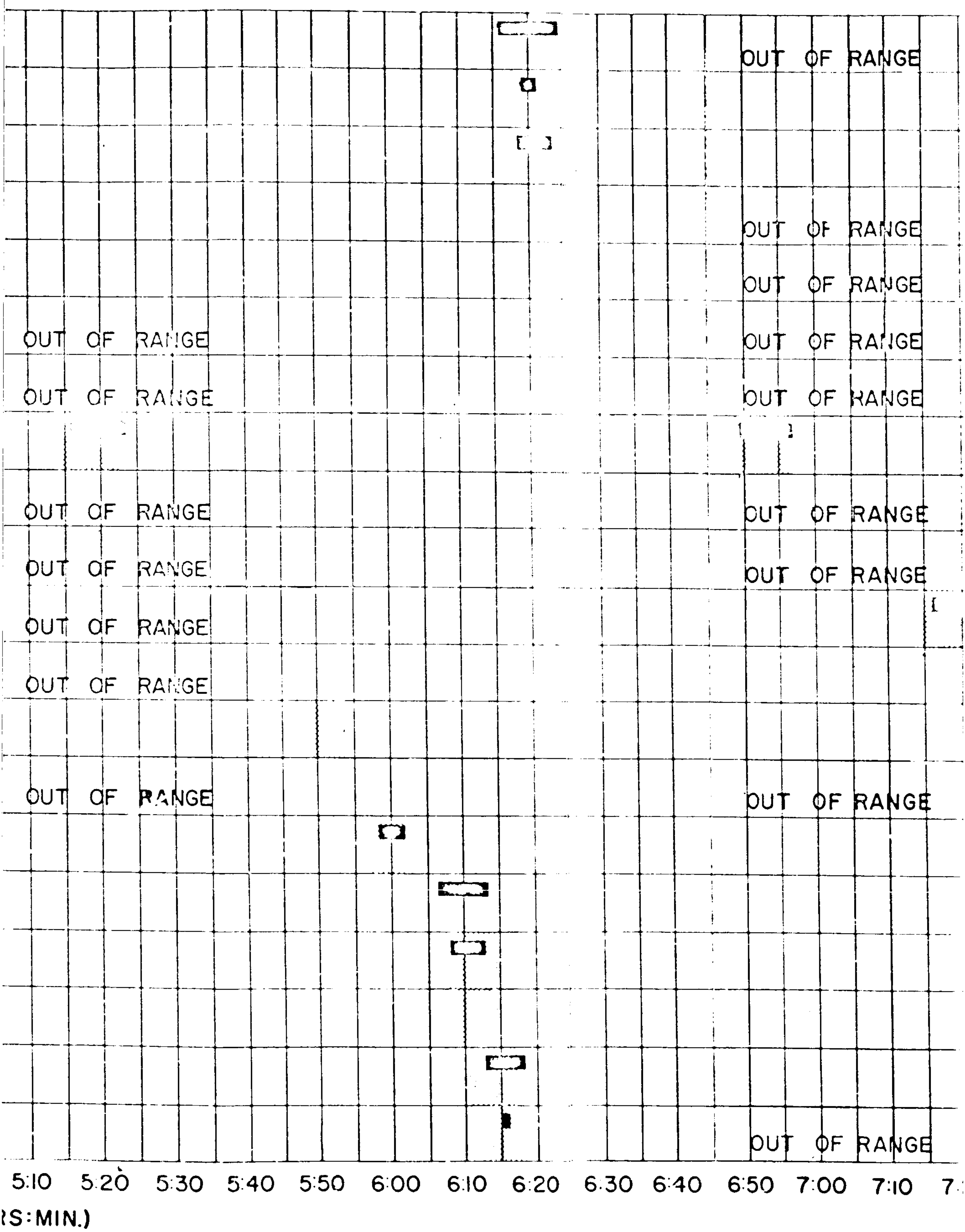
GROUND ELAPSED TIME (HOUR

#3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6:10
6:20
6:30
6:40
6:50
7:00
7:10
RS:MIN.)

#9

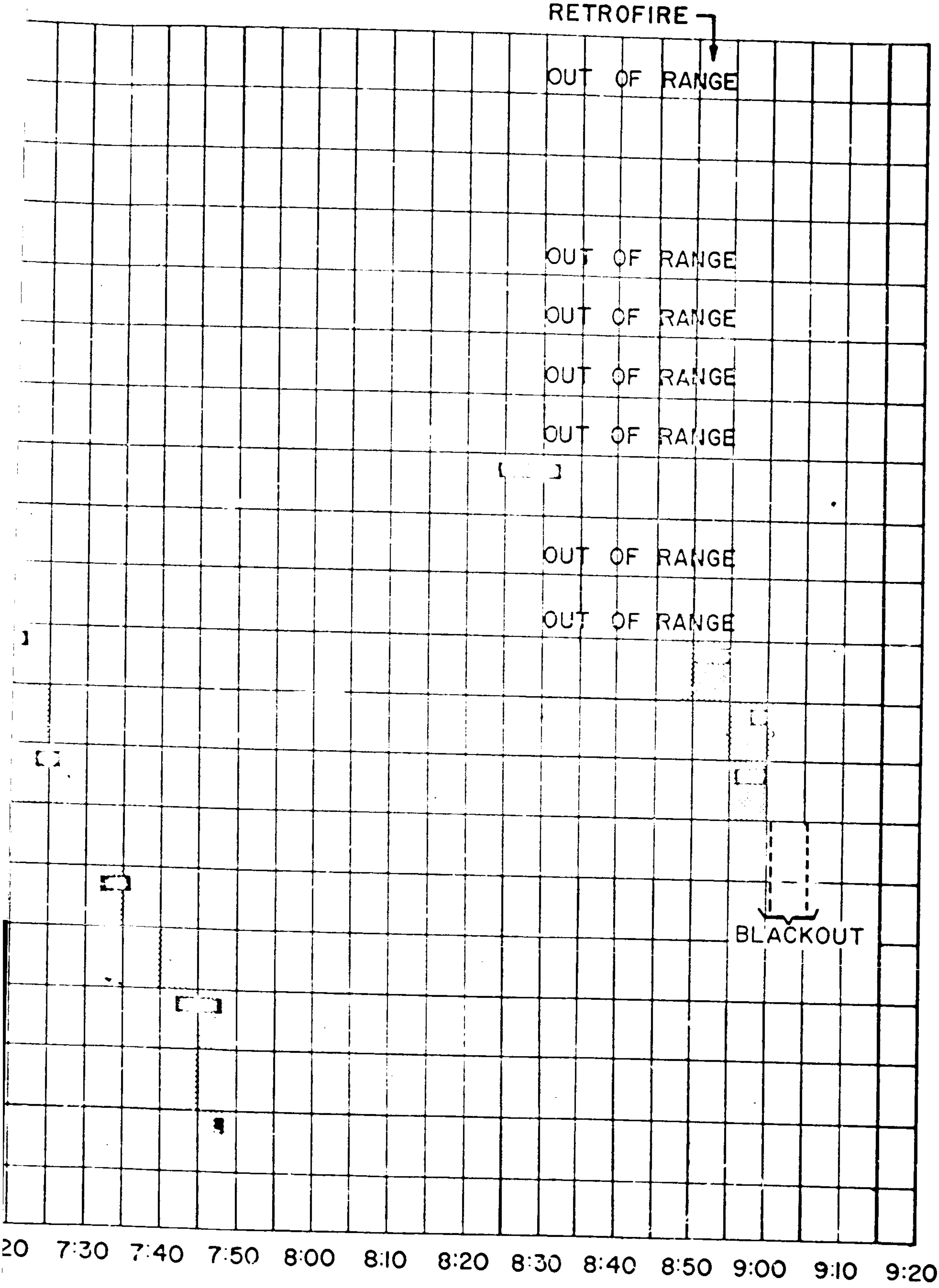


Figure 5. UHF Communications Coverage Chart

#5

4. GROUND COMMUNICATIONS SYSTEM

This section of the report was prepared from Project Mercury Ground Communications Initial Report on Observations During MA-8 Mission, dated October 11, 1962, prepared by the Bell Telephone Laboratories on behalf of the Western Electric Co.

4.1 GENERAL

Goddard Space Flight Center is the communications center for Project Mercury. See Figure 6 at the end of this section for the network configuration. Voice communications circuits tie together the communication center, the control center, and the remote sites, providing a direct and rapid means of communications between them. Teletype circuits are utilized for flight control message traffic and for radar data from radar tracking sites to the Goddard computers.

All regular, part-time, and alternate circuits of the communications networks were in support of the mission. Critical coverage was in effect during the preflight countdown as well as for the flight period. Observer coverage was at GSC, MCC, LDN (London), HON (Honolulu), MUC, CYI, and ZZB.

The following major changes have been made in the communication facilities of the Mercury range since the MA-7 mission of May 24, 1962:

a. The location of the Indian Ocean Ship (IOS) was moved to better serve a six-orbit mission. In its new position, the primary path for voice and teletype communications was via ZZB. Alternate teletype communications were provided via Bassendean, Australia.

b. Two additional tracking ships, the Huntsville (HTV) and the Watertown (WAT), were located in the Pacific to aid in tracking after retrofire. These ships had both voice and teletype service by HF radio out of Hawaii with the WAT relaying the HTV radar data inward to Honolulu.

c. An additional ship, the American Mariner, was provided to track after blackout. It also was served by a teletype HF radio link to Hawaii.

d. The former ATS was moved to a position near the Phillipine Islands and re-equipped to serve as the Pacific command ship (PCS). Voice and teletype service was provided by HF radio link to Hawaii. A backup link was also available via Guam for TTY service.

e. Voice capability was added to the HON-CTN link, the LDN-KNO link, the KNO-ZZB link, and the ZZB-IOS link. This gave complete voice coverage to all sites in the range.

f. Additions were also required and provided at the HON and LDN communication centers to join the new services into the Mercury networks.

g. A second HON-GSC voice circuit was added to the network (part-time) to join the new voice links (CTN, PCS, WAT, HTV, and DMP) with Goddard.

h. Besides the addition of voice capability on the CTN-HON radio link, its performance was also significantly improved by relocating its receiver site on the Hawaiian Islands and by providing a good transmission facility from that point to the HON communication center.

i. A change in the teletype circuitry at Goddard was made to improve the service for broadcasted messages generated at the sites. This was done to improve the flexibility in handling broadcasted messages.

4.2 RADIO PROPAGATION

The high frequency radio links of the Mercury communications networks are subject to disturbances in transmission continuity due to variations in radio propagation losses. The actual propagation experience during previous missions has been very favorable and this has been no small factor in the success of these missions. The propagation perspective as assessed during the MA-8 live countdown was not optimistic (W-4) and yet, not sufficiently serious for a hold to be called. The subsequent experience, however, during the flight period showed substantial propagation disturbance intervals particularly for the dawn transitional periods over the radio paths in the Pacific area. Outages for the IOS, the PCS, and the tracking ships were reported. Fortunately, transmission returned solid shortly in advance of the vital retrofire and recovery operations.

4.3 TELETYPE SYSTEM

4.3.1 System Performance

The overall performance of the circuits and equipment, coupled with the operator performance in properly preparing message headings, resulted in a generally satisfactory operation of the overall teletype system.

The teletype circuits in the network provided service continuity for more than 99 percent of the total available circuit minutes of network time. The total available circuit minutes is the product of the number of circuits and the mission length in minutes. The small portion of circuit outage time reported, occurred principally to the circuits serving the Pacific ships.

4.3.2 Traffic Loading

The flow of teletype traffic throughout the six orbits was quite smooth. It has been found necessary to control the traffic on the network by doctrine and operating procedures regulating the offered traffic. These controls have been established through previous live missions and a series of simulated missions. It was evident during the MA-8 that this attention to operating procedures was fruitful because the network was, in general, neither overloaded nor underloaded.

The monitoring capability at Goddard during this mission was improved to offer the opportunity for real-time assessment of traffic flow and transmission delays on the teletype system. This permitted a compilation of the message traffic loads and the delays experienced to be prepared promptly at the close of each simulated exercise and the live mission. For the MA-6 these statistics are as follows:

a. In the inward direction, there were some 300 messages from the sites, flowing to the Mercury Control Center (MCC) at Cape Canaveral. Of these, 87% had no delay at all, 3% had slight delays of up to about thirty seconds, and 10% had delays not exceeding two minutes.

b. In the outward direction to the sites, there were some 7000 messages flowing on the network. Of these, about 75% were not delayed at all, 20% had slight delays of up to about 50 seconds, 4% up to 3 minutes, and 1% up to 6 minutes.

c. There was, however, a period at the beginning of the sixth orbit when a heavy volume of offered traffic resulted in transmission delays, some in the order of 5 minutes. The system quickly absorbed this backlog and was again functioning on a real time basis within about 15 minutes.

4.4 RADAR DATA

Thirty-two transmissions of radar data were received from landbased sites during the six orbits of capsule flight. These contained 1,865 lines of data or 63,410 characters. The count of the observed errors as detected in examining the teletype page monitors at Goddard shows a total of 47 errors. The error rate is approximately 1 in 1330 characters.

Radar data was also received from tracking ships in the Pacific Recovery Area. The Watertown and the Huntsville had been deployed some two hundred miles apart to track during reentry. These ships delivered their data in teletype characters, but in a binary form. The transmission path was from the Watertown to HON to Goddard. The Huntsville delivered its data via the Watertown. Goddard routed the transmission to CAL for processing into the standard Mercury radar data format, and in this form it was returned to Goddard for delivery to the computer. Though this operation was cumbersome it served its purpose as an expedient. It was not possible to keep the computers abreast of the capsule progress in near real time because the ships had to accumulate their tapes from the full tracking sequence before release to the transmission lines. Furthermore, the nature of the teletype signals offered to the line in the binary code made these signals appear as though garbling was occurring when viewed on a page printer. This feature hampers monitoring and operations activities for all the communications carriers on the route.

The <u>American Mariner</u> was another tracking ship deployed to track after blackout. Its data was also dispatched via HON but its data format was of still different form. This was delivered to the Goddard "C" computer for which a program had been prepared to process this data. The format was usable for monitoring and servicing operations by the communications carriers along the route.

The communications links from these ships, though experiencing difficulties earlier in the mission, offered good transmission performance during the recovery interval. Examination of the teletype monitor printouts does not reveal any errors which can be attributed to the transmission facilities.

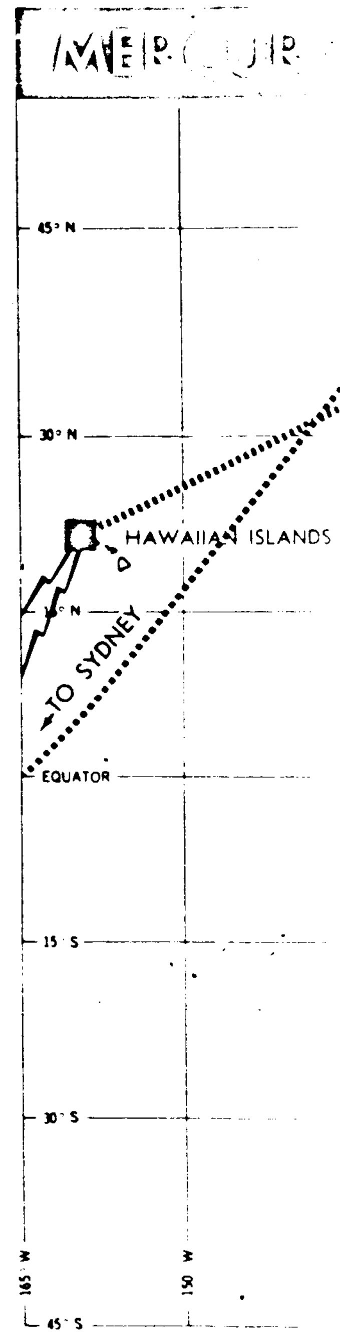
4.5 VOICE SYSTEM

The performance of the Mercury ground voice communications network was good during the MA-8. During the 12 hour period between T-2:30 hours and mission termination, 292 voice contacts were observed on the Goddard conference circuit. During this period only two unsatisfactory voice contacts were noted. These were with IOS at approximately 1600Z and PCS at approximately 1915Z. The outages occurred near the day/night transition period when propagation problems may have existed.

For this report voice contacts are defined as continuous exchanges of information between MCC and remote site personnel. The astronaut's air-to-ground when patched to the Goddard Conference Circuit was considered as one voice contact.

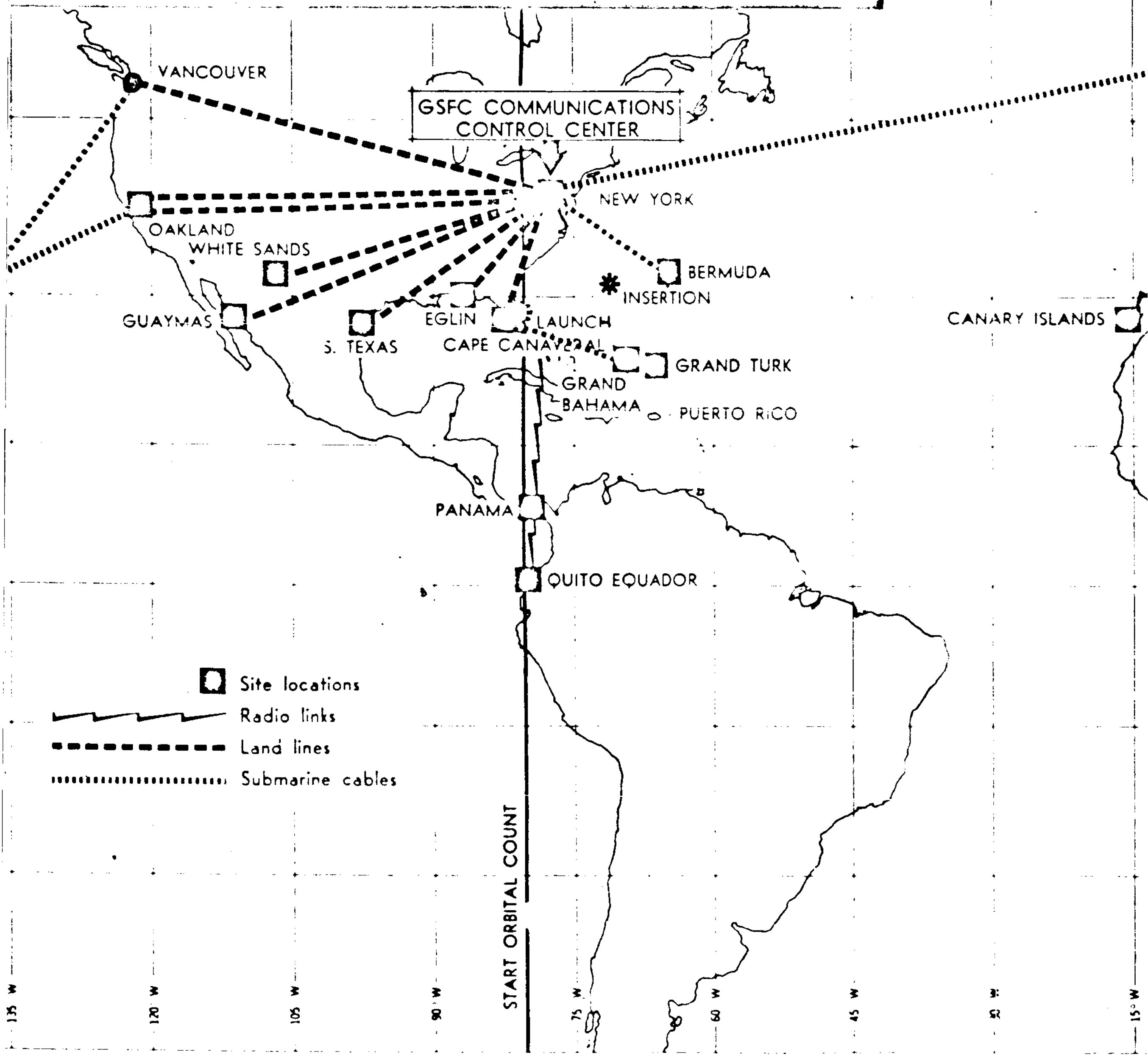
4.6 HIGH-SPEED DATA SYSTEMS

The performance of the high-speed data systems between GSC and MCC as well as between GSC and BDA was very satisfactory. All transmission circuits were functioning on their assigned facilities, and the communication carrier supplied critical coverage. No troubles were reported during the complete live mission period plus the preflight countdown.

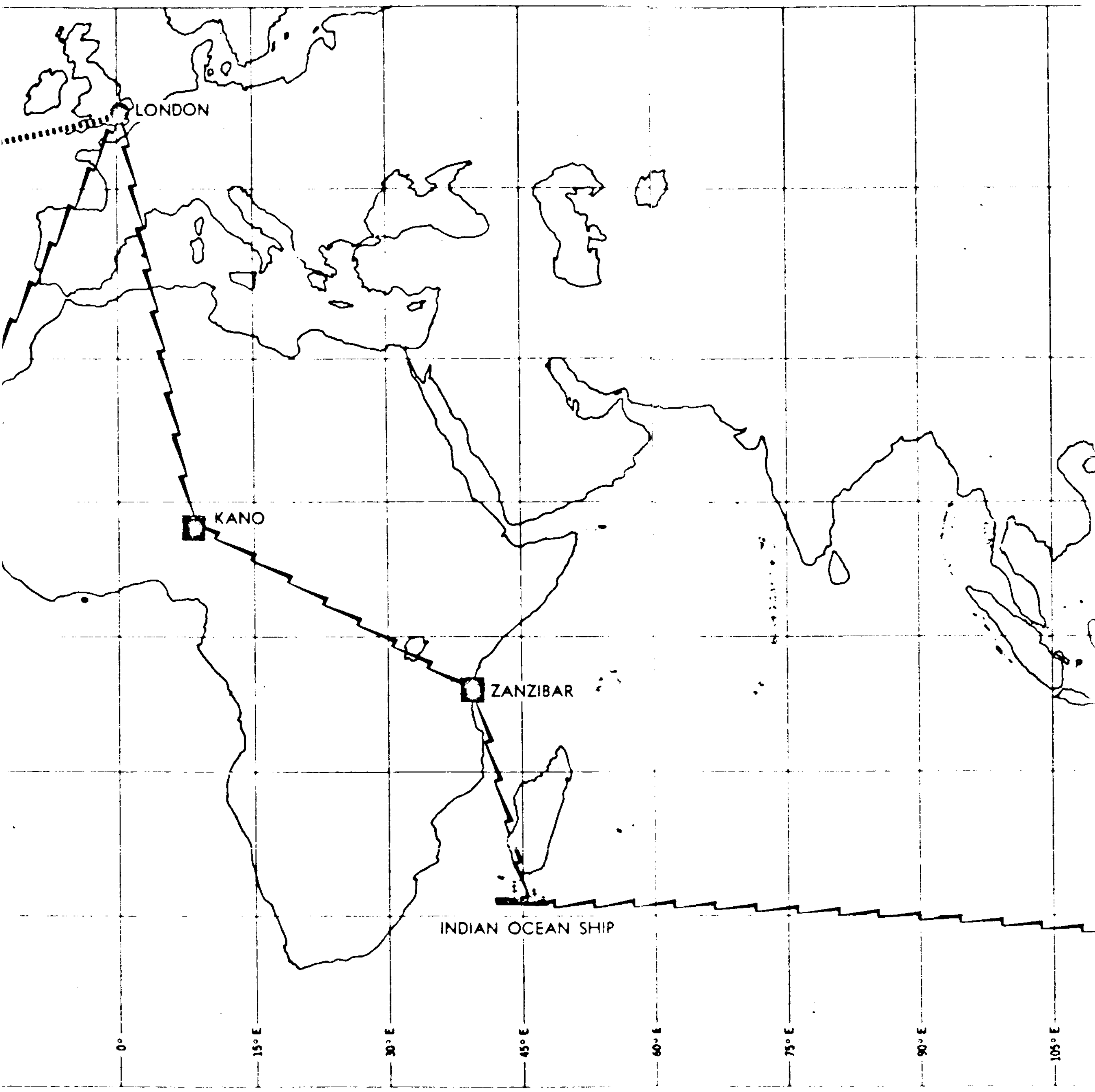

45° N
30° N
HAWAIIAN ISLANDS
TO SYDNEY
EQUATOR
15° S
30° S
165° W
150° W
45° S

#1

COMMUNICATIONS NETWORK



#2


LONDON
KANO
ZANZIBAR
INDIAN OCEAN SHIP
0°
15° E
30° E
45° E
60° E
75° E
90° E
105° E

#3

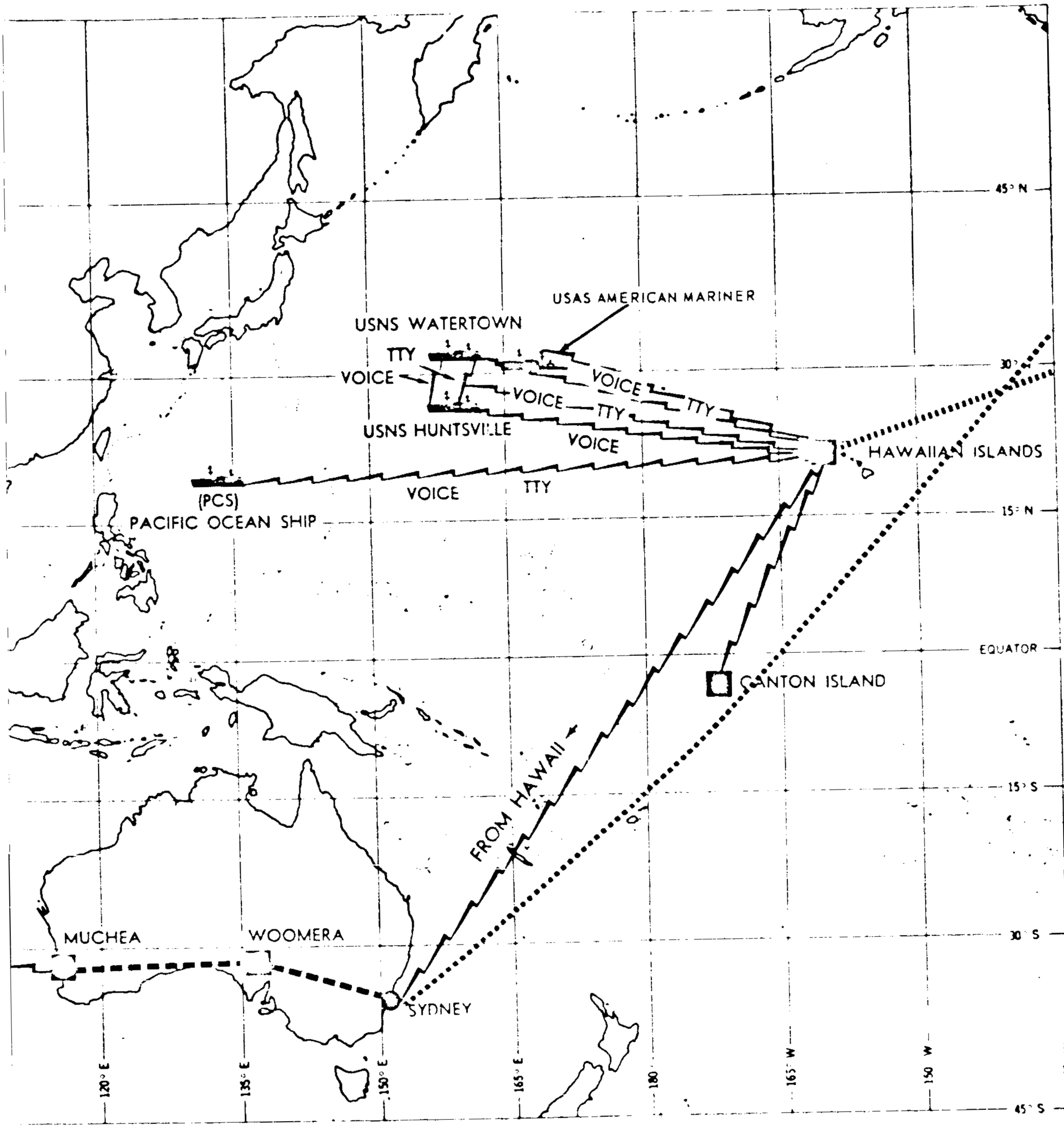


Figure 6. Mercury Communications Network

#4

5. COMPUTER SYSTEM

This section of the report was prepared from Computing Notes on Mercury Mission MA-8, dated October 10, 1962; prepared by the Data Operations Branch of the MSFSD; GSFC report number X-554-62-173.

5.1 INTRODUCTION

The computing and communications center at Goddard provides the required computing operations during a mission and serves as the communications link between the remote stations and the Mercury Control Center. Operating in parallel, two IBM 7090 computers installed at Goddard determine powered flight trajectory parameters and moment-to-moment positions of the spacecraft. They continuously predict future spacecraft position and provide constant acquisition data for all sites. The computers also calculate for transmission to Cape Canaveral the quantities needed for display purposes.

5.2 PERFORMANCE SUMMARY

The countdown on MA-8 began at Goddard at 0400Z on Wednesday, October 3, 1962. The in-house computer checks, in-house equipment checks, interface (GSC, BDA, MCC) checks, CADFISS roll call, and trajectory confidence runs all went smoothly. One problem uncovered during the trajectory confidence run was a sticky relay in New York which permitted only four frames of Bermuda low-speed data to enter the computer. This circuit had checked out satisfactorily prior to this time. The difficulty was repaired, and a retransmission checked out the circuit.

The only significant item that occurred during the countdown was a brief hold for the Canary Island Verlort radar caused by a problem in the magnetron driver unit. The driver unit was replaced and the radar then gave excellent tracking data to the computers during the mission.

Liftoff occurred at 12:15:12Z. The launch during the early stages was high in flight-path angle. BECO (booster engine cutoff) occurred early and SECO (sustainer engine cutoff) occurred late. The Burroughs/GE source was noisy during the last 10 seconds before SECO. A strong computer-recommended GO decision was indicated by all three sources of launch data (Burroughs/GE, IP-7090, and Bermuda). Insertion height and velocity were higher than predicted and resulted in a higher perigee and apogee than nominal.

In the orbit phase, during the periods when the capsule C- and S-band beacons were on, the tracking data received from the network sites was excellent. No usable skin track data was received at the Goddard computers during the beacons-off period. Spacecraft weight changes due to fuel usage were manually inserted into the computers.

Range ships equipped to provide tracking data to the Goddard computers were used for the first time as part of the network to support a Mercury flight. An analysis of the ship tracking data is now being made at Goddard and a report will be available at a later date. During the MA-8 mission, no usable data in real time was received at the Goddard computers from the Huntsville, Watertown, or American Mariner.

The retrosequence time recommended by the Goddard computers was 21:06:40Z and retrofire time was 21:07.10Z. Retrofire actually occurred at 21:07:11Z. The impact point prediction transmitted to MCC from the Goddard computers was a latitude of 32°6'N and a longitude of 174°32'W. (The actual IP was 32°5'N and 174° 28.5'W.) No reentry radar data was used to refine the impact point. Since the spacecraft landed so close to this poisition, apparently the spacecraft achieved nominal retrofire conditions.

During the entire mission the computers, the launch subsystem, and the high-speed lines between Goddard and MCC all performed well. The MA-8 computing program functioned normally and automatically. A quick-look analysis of the data indicates that the tracking and computing system performed their primary tasks normally.

5.3 PRELAUNCH PHASE

At 11:58:12Z both computers were loaded with the operational program and were ready to cycle. At 11:59:00Z, the "A" computer was selected as the output computer and remained in this mode except for a few output cycles on the "B" computer in the third orbit.

5.4 LAUNCH PHASE

Liftoff was at 12:15:12Z, and injection was at 12:21:40Z. All data sources—the B/GE, the IP-7090, and Bermuda—indicated a strong GO condition. The B/GE position and velocity vectors were selected for the orbit determination phase.

The listing below shows that a total of 10 data messages and 6 TLM messages were bad or missing on the B/GE lines during the time interval between liftoff and the end of the GO-NO GO; 15 data messages and 6 TLM messages were not valid over the same time interval on the IP-7090 lines. On the Bermuda high-speed lines, all data transmitted between capsule separation plus two seconds and the receipt of the orbit-phase signal was valid except for the first two transmissions.

Time Tag (Sec. After Liftoff)		No. of Messages Missing or Garbled Data	Telemetry
		B/GE	
17.96		2	2
54.46		2	2
158..96		2	2
230.96		2	0
302.96		2	0
	Total	10	6
		IP-7090	
31.8		2	0
104.2		2	0
123.0		1	1
140.2		1	0
194.6		1	0
212.6		1	1
231.4		2	1
267.0		2	1
284.2		2	2
303.0		1	0
	Total	15	6
		Bermuda	
320.0		2	

The listing below shows that the B/GE data became free of flags at T+ 68.96 seconds and remained free of flags until 2.5 seconds after the termination of the GO-NO GO. It appears that if the GO-NO GO interval had ended three or more seconds later than it actually did, the B/GE data would have become unreliable.

B/GE Data Quality

Time Tag (Sec. After Liftoff)	Number of Flags
68.96	Start of flag-free data
131.96	1
329.96	1
330.46	2
333.96 (and continuously thereafter	4

Azusa data showed no bad data indicator bits prior to the end of the GO-NO GO, except near liftoff when the selected source was being switched from FPS-16 to Azusa and back to FPS-16.

Azusa Time Tags of Vectors Containing
Bad Data Indicator

12.6 seconds - 14.6 seconds

16.2 - 20.6

27.8

337.4 and intermittently thereafter.

The Bermuda on-track bits indicated that both FPS-16 and Verlort radars were continuously on-track during the time interval between capsule separation plus two seconds and the orbit-phase signal.

Table 6 shows the time tags of discrete and TLM events for both the B/GE and IP-7090 input lines. No posigrade TLM was noted. However, three posigrades are locked into the Goddard launch program for computation of capsule velocity after capsule separation.

TABLE 6. LAUNCH PHASE EVENTS RECEIVED AT GODDARD

Event	Event Time		
	B/GE Line	IP-7090 Line	Nominal Time
Liftoff (TLM message arrival time)	12:15:12.63Z	12:15:12.58Z	
Liftoff (Discrete message arrival time)	12:15:13Z		
Selected Source:	Times shown below are time tags in seconds since liftoff:		
FPS-16		0	
Azusa		12.6	
FPS-16		15.0	
Azusa		16.2	
FPS-16		21.0	
Azusa		27.8	
FPS-16		28.2	
Azusa		42.2	
B/GE	68.96	69.4	
Booster Engine Cutoff	126.46		129.8
Tower Separation	155.46	153.4	153.0
Sustainer Engine Cutoff	313.96		305.05
Abort Initiate	315.96	316.6	
Capsule Separation	318.96	319.4	307.05
Orbit Phase	354.96	355.8	

The results of the GO-NO GO computations on B/GE and IP-7090 data and of the first Bermuda solution are shown in Table 7. Although the Bermuda results appear to differ considerably from the other two sources, the Bermuda solution was based on the first nine seconds of data collected. Calculations showed that the Bermuda solution at the time when the orbit switch was thrown agreed very well with the actual orbit parameters.

TABLE 7. RESULTS OF GO-NO GO COMPUTATIONS

	B/GE	IP7090	BDA
Number of Data Points	20	24	-
Recommendation	Go	Go	Go
Retrofire	12:31:52Z	12:31:40Z	12:28:07Z
Inertial Velocity (ft/sec)	25746.641	25762.007	25781.931
Inertial Gamma (deg)	-0.028130888	-0.12050315	+0.19156533
$V_{avg} - V_{go}$ (ft/sec)	133.29003	146.24145	164.00903
Vector	12:20:35Z	12:20:35Z	12:20:36Z

Strip chart calculations indicated that the flight path angle reached a maximum of approximately 2.5 degrees above nominal during the first stage boost.

5.5 ORBIT PHASE

The B/GE vectors gave a perigee of 87 nautical miles and an apogee of 147.6 nautical miles, which is slightly higher than nominal. (When the BDA low-speed radar data was differentially corrected, a higher apogee of 151.5 nautical miles was indicated.) The orbit was well established when first-orbit data from BDA, CYI, MUC and WOM were added to the computation. At no time was it necessary to override the computer decisions on rejection of radar stations in orbit determination. No refinement of the orbit was attempted after California reported in the third orbit (both S- and C-band beacons were turned off until the fifth orbit). Both computers were manually inhibited from correcting after this point since all further data were below 10-degree elevation and at maximum range and would therefore only degrade the solution.

Throughout the mission MCC requested manual insertion of capsule weight loss. Also, impact areas were inserted to obtain time-to-fire retrograde rockets.

5.6 REENTRY PHASE

The computer-recommended retrofire of 21:07:10Z was inserted in the "A" computer at 21:08:09Z. The off-line computer was entered into the reentry phase at 21:10:41Z with the differential correction (DC) procedure manually inhibited. The plan was to accept the first reporting reentry station and DC in the "A" computer. The second reporting station would be used in the "B" computer, thus giving independent im-

TABLE 8 . SUMMARY OF RADAR DATA AND COMPUTATIONS

Site	Radar	Total Obs.	Valid Obs.	Non-Valid Obs.	Obs. Used	Standard Deviation Range (yds)	Standard Deviation Azimuth (mils)	Standard Deviation Elevation (mils)	Apogee (N. M.)	Perigee (N. M.)	$\Delta \bar{r}$ (yds)	$\Delta \bar{v}$ (ft/sec)	No. of DC's
BDA	16	43	43	0	42	62.5	1.21	.99	151.5	87.0	1046.57	17.9318	1
BDA	V	89	73	16	-	108.5	2.16	2.45					
CYI	V	82	57	25	45	13.4	1.79	2.32	151.3	87.3	1328.34	6.2671	1
MUC	V	87	81	6	50	13.6	1.88	2.37	150.5	86.9	2010.51	7.4708	1
WOM	16	62	38	24	38	6.57	.16	.33	150.4	86.9	220.62	2.2389	2
WHS	16	35	20	15	20	6.19	.17	.25	150.4	87.0	205.76	0.8168	1
GYM	V	68	39	29	34	50.9	1.05	1.32			19.31	2.1315	0*
TEX	V	67	55	12	48	65.5	1.81	.83			104.53	0.5313	0**
EGL	16	39	39	0	39	8.82	.19	.26	150.4	87.1	198.30	0.8910	2
EGL	V	26	15	11	-	40.8	1.17	1.51					
CNV	16	57	14	43	10	5.5	.34	.68	150.4	87.1	33.32	0.2712	1
BDA	16	50	48	2	46	14.4	.29	.48	150.4	87.1	99.29	0.5900	1
BDA	V	9	6	3	-	102.8	1.27	3.45					
CYI	V	61	48	13	38	9.22	2.17	1.27	150.4	87.5	98.51	0.5766	1
MUC	V	89	75	14	50	15.8	1.57	1.26	150.1	87.0	347.05	0.9550	2
WOM	16	77	27	50	27	4.52	.16	.18	150.1	87.0	151.88	0.4629	2
HAW	16	14	13	1	13	16.1	.29	.18	150.2	87.0	740.76	1.501	1
HAW	V	41	30	11	-	16.2	.67	.87					
CAL	16	9	9	0	9				150.2	87.0	141.87	0.5204	2
CAL	V	51	43	8	-	13.1	.69	.81					
WHS	16	42	37	5	37	14.7	.20	.69	150.2	87.2	609.54	2.7172	2
TEX	V	63	49	14	45	11.5	.67	.84	150.1	87.2	38.45	0.2570	2
EGL	16	38	27	11	27	6.15	.54	.22			27.40	0.2307	0*
EGL	V	13	11	2	-	99.2	1.46	1.45					
CNV	16	29	14	15	14	6.02	.34	.25	150.1	87.2	23.76	0.1696	1
MUC	V	66	62	4	50	9.36	.74	.43	149.6	87.1	677.54	2.5113	1
HAW	16	37	37	0	37	7.83	.17	.42	150.0	87.0	2529.88	6.2146	2
HAW	V	32	16	16	-	22.2	.97	1.30					
CAL	V	21	12	9	11	19.4	.38	.40	150.2	87.3	161.71	1.2050	1
CAL	F	39	0	39	-								
EGL	F	31	0	31	-								
WHS	F	31	0	31	-								
SSI	F	50	12	38	-								
HTV		58	49	9	-								
HAW	V	37	20	17	-								
CAL	V	51	34	17	-	15.3	1.73	1.48					
GYM	V	65	43	22	-	65.7	2.19	1.51					
TEX	V	4	0	4	-								
Retrofire at 21: 07: 10 - I. P. at 32. 10° N. Latitude and 174. 53° W. Longitude													
WTN		46	12	34	12								***

* Late Reporting Station
** Reject (Data Quality Excellent)
*** Rejected

pacts per station. This step never materialized since the Watertown data was rejected, and the American Mariner data was not inserted into the computers.

See Table 8 for the quantity of radar data received, a summary of the standard deviations of the low-speed radar data (which are above 3-degree elevation), the $\Delta \bar{r}$ and $\Delta \bar{v}$ corrections applied at each site, and the number of DC's applied per site.

5.7 SUMMARY OF BERMUDA PERFORMANCE

The Bermuda system functioned well during the MA-8. It confirmed the Cape decision with a solid GO indication. Since the beacon was turned off over Bermuda after the second pass, Bermuda had no valid radar track after this pass. A listing of significant events follows:

Liftoff	12:15:11
First Verlort	12:18:49
First FPS-16	12:19:11
First computed output	12:19:29
Capsule separation	12:20:32
First GO-NO GO recommendation	12:20:36
Orbit parameters	12:20:44

5.8 SHIPS PERFORMANCE

The Huntsville transmitted 67 data points in near real-time on orbit 5. Transmission was interrupted by a power failure on the Watertown, which was acting in a relay capacity. This data was not used in real-time. Postflight tests showed that if the data had been used it would have caused a position change of over 9000 yards and a velocity change of over 1000 feet/second in the estimate of the orbit.

The eleven frames of American Mariner data received during orbit 5 does not fit the Mercury orbit. Eight of the points show a 3-degree bias.

On orbit 6 the Watertown regained power and was able to supply 12 data points. Radar operator problems, according to a report from the Watertown, caused a range error of 410,000 yards, and this data was not usable. The American Mariner provided six data points on reentry. This data was not used in real-time. Off-line tests showed the reentry orbit would have been changed over 14,000 yards in position and over 400 feet/second in velocity.

Further investigation is under way to correlate all available information, and a comprehensive report of ship performance will be made available.

TABLE 9 DST/BST SUBSYSTEM TEST AVERAGES

Test	Average For MA-[illegible]	Test Limits	Remarks
S-band Radar, DST/BST 101-1			
Coder Pulse Off			EGL has MPQ-31 type radar.
PRF #1	51.2 DBM	Min. 49.2 DBM	
PRF #2	51.2 DBM	Min. 50.2 DBM	
PRF #3	52.4 DBM	Min. 50.7 DBM	
Coder Pulse On			
PRF #1	53.4 DBM	Min. 52.2 DBM	
PRF #2	54.1 DBM	Min. 53.2 DBM	
PRF #3	54.6 DBM	Min. 53.7 DBM	
Beacon Receiver Sensitivity	-105.4 DBM	Min. -103 DBM	
Main Radar Receiver Sensitivity	-104.9 DBM	Min. -103 DBM	
Aux. Radar Receiver Sensitivity	-104.8 DBM	Min. -103 DBM	
C-band Radar, DST/BST 101-2			
Receiver Sensitivity	-83.6 DBM	Min. -87 DBM	1. Issue 3N of DST/BST used.
Dynamic Lock-On	-88.1 DBM	Min. -85 DBM	2. EGL below min. requirements with
Dynamic Release	-93.4 DBM	Min. -88 DBM	-83 DBM for dynamic lock-on sensitivity.
Transmitter Power	325 KW	Min. 250 KW	3. BDA reported high valves for dynamic
AZ Noise Figure	9.6 DB	Max. 11 DB	lock-on (-95 DBM) and dynamic release
EL Noise Figure	9.4 DB	Max. 11 DB	(-99 DBM).
Ref. Noise Figure	10.4 DB	Max. 11 DB	
A/G Comm., DST/BST 102			
UHF Receivers Sensitivity	2.19 µV	Max. 5.0 µV	CTN reported low power output (126 watts)
HF Receivers Sensitivity	1.74 µV	Max. 3.4 µV	from the master transmitter for the DST
UHF Transmitters Power	130 watts	Min. 100 watts	but was corrected and within specifications
HF Transmitters Power	155 watts	Min. 140 watts	for BST.
UHF VSWR	1.24:1	Max. 1.5:1	
HF VSWR	1.25:1	Max. 1.5:1	
Command, DST/BST 103			
FRW-2 Transmitters			
VSWR Master	1.25:1	Max. 1.5:1	1. FRW-2 transmitters adjusted for 600 watts
VSWR Standby	1.24:1	Max. 1.5:1	nominal.
Power Master	600 watts	See remarks 1.	2. 240D-2 amplifiers adjusted for 10-KW
Power Standby	600 watts	See remarks 1.	output nominal.
240D-2 Amplifier			
VSWR	1.24:1	Max. 1.5:1	
Power	10 KW	See remarks 2.	
Telemetry, DST/BST 106			
Receiver Sensitivity			1. CYI exceeded max. requirements
1434 Receiver	3.3 µV	Max. 4.0 µV	on one 1434 receiver by less than
1415 Receiver	2.8 µV	Max. 4.0 µV	0.5 µV.
System Sensitivity			2. WOM exceeded max. requirements
A1	-114.7 DBM	See remarks 5	on one 1415 receiver by less than
A2	-113.0 DBM	See remarks 5	0.5 µV.
A1 + A2	-114.0 DBM	See remarks 5	3. CYI, KNO, WOM, and GYM reported
B1	-113.2 DBM	See remarks 5	max. limits on some of their receivers.
B2	-114.8 DBM	See remarks 5	4. MUC used test procedures given in
B1 + B2	-114.7 DBM	See remarks 5	MUT-106 for all receivers (values not
Decom/Discrim. Threshold			considered in network averages).
90/30 Ch. A	-103 DBV	See remarks 6	5. Minimum limits have not been definitely
90/90 Ch. A	-108 DBV	See remarks 6	established but is tentatively set at
90/90 Ch. B	-106 DBV	See remarks 6	-113.0 DBM.
			6. No established limits. Site values
			vary from -92 DBV to -122 DBV
Acquisition, DST/BST 110			
Sum Ch. Threshold			Max. difference should not exceed
TLM-LO	-123.2 DBM	Min. -120 DBM	1.0 DB (on an individual site basis).
TLM-HI	-123.5 DBM	Min. -120 DBM	All sites met specifications except EGL
Error Ch. Threshold			whose TLM-LO values exceeded TLM-
TLM-LO	-121.8 DBM	Min. -118 DBM	HI values by 4.5 DB.
TLM-HI	-121.4 DBM	Min. -118 DBM	
TLM-LO VCO Threshold			
MOF + 40 KC	-128.0 DBM	See remarks	
MOF - 40 KC	-127.9 DBM	See remarks	
TLM-HI VCO Threshold			
MOF + 40 KC	-127.7 DBM	See remarks	
MOF - 40 KC	-127.8 DBM	See remarks	

6. EVALUATION OF TESTS

6.1 NETWORK SIMULATIONS

Prior to MA-8 there were six network simulations conducted to prepare the network for the mission. For a list of the simulations conducted see the schedule in Section 2.

The one-day mission simulation (NCG 600) started on September 25 and ended the next day. In general, this simulation went extremely well. One problem complicated the test, i. e., site acquisition and LOS times on the documentation did not agree. Simulation personnel used times based on one vector to tabulate data, and the computers at GSC used a different vector.

Although this simulation identified a number of problems, it also indicated that no major problem areas exist for providing network support for a one-day mission. A more complete report on this test will be published later.

6.2 SYSTEM TESTS

The readiness of station equipment to support a mission is determined primarily by conducting comprehensive tests on each subsystem. These tests, known as Detailed System Tests (DST's) and Brief System Tests (BST's), are performed during specified periods preceding a flight. DST's are conducted about 72 hours prior to the mission day, providing sufficient time for site personnel to correct deficiencies, thus bringing the tracking equipment up to maximum performance standards. The BST's are conducted as a part of the mission countdown, and the results contribute to the network status information.

Table 9 shows test value averages obtained for the network. The corresponding minimum or maximum limit for each test is also given for comparison. Test results reported by sites not using the standard procedures in the DST's were excluded from the network-average computation. Also, results from ZZB, IOS, and PCS were not received in time for inclusion. It is worthwhile to note that the network as a whole met the DST/BST requirement for every subsystem evaluated. The requirements of the DST/BST's appear to be realistic, considering the fact that network averages do not exceed the test limits greatly. DST/BST's used by CNV, GBI and GTI do not conform to the same procedures as other sites in the network.

A few sites failed to meet requirements for some of the DST checks, but these were corrected prior to the BST check. In no instance, however, was the deficiency large enough to jeopardize successful tracking support.

All subsystems except the C-band radar were checked using revised DST/BST procedures (Issue 4). Because many of the procedures and requirements in the new issue were changed, no valid comparison with the previous missions can be readily made.

The values of individual tests as taken from the site reports are given in bar graph form as Appendix A to this report.

6.3 HIGH-SPEED DATA TRANSMISSION TEST, NCG-161

Test NCG-161 is normally conducted twice a week. It is designed to check the terminating equipment at Canaveral data select, B/GE buffer, IP buffer and the equipment at Bermuda. To perform these checks a group of programs has been compiled, and the IBM 7090 computers at Goddard are used to check the transmission equipment. To further check the phone line system, the zero DB signal is varied ±6 DB on the Cape circuits to assure that the lines are not marginal. Prior to MA-8, this test was conducted on September 5 and 11, 1962, the results of which are given below.

September 5

The Bermuda circuits operated error-free during the checkout. A problem was found in the Bermuda high-speed transmitter data line amplifier. A photo-cell was found to be out of mechanical adjustment. No rerun was performed because computer time was not available.

The B/GE high-speed data lines northbound operated error-free during the nominal and the ±6 DB level. The IP high-speed data lines northbound operated very well with an occasional error at the -6 DB level with a "false computer word" pattern. All other patterns operated error-free.

During the southbound transmission, all circuits operated error free at the ±6 DB level on an "all ones" pattern.

September 11

The Bermuda high speed data circuits continued to operate error-free during the tests. No failures were recorded.

The B/GE high-speed lines northbound operated error-free at the nominal ±6 DB points. The IP lines operated very well with the exception of the "all ones" pattern which failed occasionally at the -6 DB point.

All four southbound circuits operated error-free at the nominal and the ±6 DB level.

The circuits were operating very well and were ready at this time to support a mission.

6.4 CADFISS TESTS

CADFISS (Computation And Data Flow Integrated Subsystem) tests are designed to prove the ability of the computer-related parts of the Mercury system to perform their functions accurately. These tests are of two types: site tests and simulated flight tests.

The site tests provide a brief confidence check of the readiness of the Mercury system for an operational flight or for a simulated flight. When used periodically, they provide a means of determining the adequacy of system maintenance and a means of finding areas of the system where design improvements are required or desired. The results of many such tests can be used to determine the reliability of many parts of the Mercury system, such as high-speed and low-speed data flow paths.

The simulated flight tests exercise the Mercury network under conditions that are as realistic as practicable. Test input data as similar as possible to operational data are fed into the system, and the resulting data and data displays are compared with expected data.

Twenty-one CADFISS test runs were performed in support of the MA-8. Of these test runs, eight were specifically set up to test the Huntsville and Watertown tracking ships.

Listed below is a breakdown of these test runs:

September 22

Run 1 - Test with the HTV and WAT

Run 2 - Short roll call test

Run 3 - Radar data flow test

September 24 MA-8 Recycled

Run 1 - Test with the HTV and WAT

September 25 One-Day Mission Simulation

Run 1 - Short roll call test

Run 2 - Short roll call--Reruns of CAL and WOM

September 28

Run 1 - Test with the HTV and WAT

Run 2 - Short roll call test

Run 3 - Short roll call--Reruns of BDA, CYI, WOM, and GYM

October 1

Runs 1 and 2 - Test with the HTV and WAT

Run 3 - Short roll call test

Run 4 - Short roll call--Reruns of WHS and GYM

Run 5 - Radar data flow test including IP, BDA, CAL, and GYM reruns

October 2

Run 1 - Test with HTV and WAT

October 3 Mission Day

Six CADFISS test runs were performed in support of the MA-8 launch-day countdown. These runs were as follows:

Run 1 - At T-300 minutes a radar data flow test was conducted with HTV and WAT, using the Point Arguello IBM 7090 computer to reformat the ship data from the Datex (binary) code to the Mercury format.

Run 2 - At T-240 minutes a radar data flow test was conducted with HTV and WAT, using the Point Mugu 7090 computer to reformat the ship data from the Datex code to the Mercury format.

Run 3 - At T-205 minutes a CADFISS short roll call test with the entire Mercury network was conducted using normal test limits.

Run 4 - At T-157 minutes a special CADFISS test was conducted with the IP-7090 computer and the CYI radar and its associated peripheral equipment.

Run 5 - At T-95 minutes a CADFISS radar data flow test was conducted with all Mercury radar sites except those of the Atlantic Missile Range. Extended CADFISS test limits were used, except for those tests which failed during the CADFISS short roll call period.

Run 6 - At T-22 minutes a special CADFISS test was run with the CYI radar and its associated peripheral equipment.

All CADFISS tests were started on time without any Goddard computer troubles and finished in the allotted time in the countdown. Because of the short time allowed for training of HTV and WAT personnel, the first successful data flow tests were not performed with these ships until 15 hours prior to launch time. As a result of these CADFISS tests, with the exception of the ships, a high level of confidence was established that the Mercury network was able to support the mission.

6.5 DYNAMIC TESTS ON PMR SHIPS

Dynamic tests were conducted on the PMR tracking ships Watertown and Huntsville prior to MA-8. The following are the results of these tests, which were performed between August 23 and September 9:

August 23

WAT - Data errors of EL+1.2° AZ+2.2°, S/Range +2366 yards.

HTV - Pt. Mugu computer revealed high errors on first observation. Data was noisy, so no evaluation was performed.

August 24

HTV - Radar test results from film evaluation revealed a standard deviation of six mils. This test did not include interface from the radar to computer readout.

August 25

WAT - Pt. Mugu computed readout results were the same as August 23.

HTV - Pt. Mugu computer revealed high errors on first observation. The data was noisy, so no evaluation was performed. A film analysis confirmed the 6 mil standard deviation found on August 24.

August 28

WAT - Range accuracy showed improvement over data of August 23 and 25 from 2366 yards to 455 yards.

August 30

HTV and WAT - Study was performed on the effect of shipboard obstructions on data accuracy. 300° AZ to 350° AZ was found to be free of shipboard obstructions which would affect data accuracy.

September 1

WAT - Sensitivity tests performed with favorable results of AGAVE, TLM, and radar system. UHF sensitivity was poor -- the trouble was located and repaired at a later date.

HTV - Confidence check performed on all subsystems with favorable results -- sensitivity tests only were performed.

September 3

HTV - Dynamic tracking tests were performed resulting in errors as follows: EL 0.2°, AZ 5.0°, Range -4000 yards to +2800 yards.

September 5

HTV - Dynamic tracking tests revealed a marked improvement over September 3 tests. Results were as follows: EL 0.2°, AZ 0.2°, Range 237 yards.

September 6

WAT - Dynamic tracking test revealed errors as follows:

Run	EL	AZ	Range
3	±0.14°	±0.24°	±45 yards
4	±0.15°	±0.1°	-167 yards
5	±0.16°	±0.2°	-243 yards
6	±0.18°	±0.16°	±85 yards

HTV - Dynamic tracking tests revealed errors as follows:

Run	EL	AZ	Range
2	+0.18°	-0.56°	+465 yards
3	+0.22°	-0.17°	+462 yards
4	+0.18°	-0.53°	+476 yards
5	+0.1°	-0.17°	+445 yards

September 7

WAT and HTV - Tracking tests at sea. Results were as follows:

WAT	Run	EL	AZ	Range
	1	±0.72°	±0.66°	-157 yards
	2	±0.5°	+0.60°	-102 yards
	3	±0.5°	+0.78°	-118 yards
	4	±0.5°	+0.73°	-132 yards

HTV	Run	EL	AZ	Range
	1	+2.7°	+0.76°	+1000 yards
	2	+1.0°	+3.3°	+652 yards

September 8

WAT and HTV - Dockside tracking test results were as follows:

WAT - EL +0.27°, AZ +0.22°, Range 110 yards.

HTV - EL +4.2°, AZ +10.2°, Range 195 yards.

September 11

HTV and WAT - Dockside tracking tests were run this date. Results were as follows:

HTV - EL +0.25°, AZ -0.35°, Range +192 yards.

WAT - EL + 0.16°, AZ +0.25°, Range +135 yards.

September 12

HTV - Tracking tests performed at sea with the following results: EL +0.22, AZ +1.0°, Range +185 yards.

September 19

DMP - Fly-by tests revealed only the capability of the ship to track the C-band beacon and receive TLM. Refined testing could not be performed due to the proximity of the MA-8 mission.

The tracking tests performed on the HTV and WAT ships did not meet Mercury requirements to a confidence level desired for MA-8. The DMP ship could not be thoroughly tested due to lack of time, but was committed to MA-8 support on the merit of past performance.

7. GENERAL TOPICS

7.1 ECHO SIGHTING PLAN

After Goddard received the liftoff time, the Operations and Support Division made computations as to when and where the Echo I balloon satellite would be visible to the astronaut. The following information was passed to the Cape via a long-distance telephone call and transmitted from there to the astronaut: "At 1423Z, look at an azimuth of 312° and an elevation of 83°, which will occur over the African Continent. At 1730Z look at an azimuth of 99° and an elevation of 9° which will occur over South America."

No attempts were made by the astronaut to see Echo at either time.

Similar computations had been made for MA-6 and MA-7. For MA-6, the time of liftoff was such that the Echo satellite was not visible to the astronaut at any time during the flight. During MA-7, the two periods of possible sighting were so soon after liftoff and so close to time of retrofire, respectively, that no attempt was made to pass the sighting times on to the astronaut.

Since there can be no firm provisions made in the flight plan for the sighting activity because the sighting periods are entirely dependant upon liftoff time, some consideration should be given to whether the Echo sighting calculations should be performed for future missions.

7.2 DOCUMENTATION

All documents used in support of the MA-8 mission were generally good. The primary difficulty with documentation was the lateness in arrival on site of the Data Acquisition Plan. One reason for this was the late publication and distribution date. This document is released as late as possible prior to a mission in order to get all of the last minute changes incorporated. As a result, if a mission goes on schedule or without much delay, the Data Acquisition Plan will not arrive at all sites on time for premission activity. Therefore, it may be desirable in the future to have this document published and distributed earlier even though more ISI's may be required to incorporate last minute changes.

During the premission period, documents were updated by the issuance of ISI's whenever it became necessary to make a change to a document. However, the number of ISI's issued were far less than for previous missions. This in itself reflects an improvement in documentation over earlier missions. The 24 ISI's issued prior to MA-8 are listed below. The ISI messages identified by an asterisk represent items that will be incorporated in the appropriate network document.

1. General (Mission Status)
*2. Changes to COP-1 (Communication Operations Procedure) and FCH-1 (Flight Controllers Handbook)
3. Site manning

* 4. Changes to BST/DST-106
5. Astronaut checklist changes for SEDR 204-16
* 6. Changes to Data Acquisition Plan
* 7. Changes to BST/DST-111
• 8. Changes to Operations Directive 61-1
• 9. Changes to Data Acquisition Plan
10. Radar ship tracking procedures
11. Changes to Flight Plan Revision "A"
12. Changes to Mission Rules
12A. Changes to Mission Rules
*13. Changes to Network Count
14. A/G system operation
15. Changes to SEDR-204-16
16. Correction to ISI 15
•17. Changes to BST/DST-111
18. T/M calibrations
19. Time since retro indication
20. Event and clock levels
*21. Instrumentation reference failure: Emergency reporting procedure
*22. Changes to Data Acquisition Plan
23. Correction to ISI 19
24. Addition to Flight Plan

7.3 WALLOPS ISLAND PARTICIPATION

The Wallops Island Training Site participated in a passive manner during the MA-8 mission. The acquisition aid, telemetry, timing, and A/G communications subsystems were used, and good data were received during the first four orbits. Station personnel received invaluable operational training benefits from this exercise.

The acquisition system status was green and functioned properly throughout the mission. Good signals were received on the first four orbits for a total tracking time of 22 minutes and 32 seconds. A summary of the acquisition aid tracking is shown below:

Orbit	Acq.	AZ	EL	LOS	AZ	EL
1	12:17:38Z	208°	1°	12:23:58Z	106°	4°
2	13:50:22Z	242°	3.5°	13:57:22Z	107°	1°
3	15:23:42Z	255°	2°	15:30:14Z	128°	4°
4	15:58:20Z	230°	0°	17:01:49Z	171°	1°

The telemetry subsystem operated satisfactorily throughout the mission and had a total coverage time of 22 minutes. There were no malfunctions in the telemetry system, but the data recorded was affected by the malfunction in the timing system, which is discussed below. A summary of the minute-by-minute TLM signal strength is tabulated below:

	GMT Time	Signal Strength (microvolts)			
1st Pass		A1	A2	B1	B2
	12:17:44 (Acquisition)	8	10	NA	NA
	12:18:44	60	80	NA	NA
	12:19:44	20	25	NA	NA
	12:20:44	35	40	NA	NA
	12:21:44	55	75	NA	NA
	12:22:33	25	30	NA	NA
	12:23:29 (LOS)	3	4	NA	NA
2nd Pass		A1	A2	B1	B2
	13:50:20 (Acquisition)	6	4	3	3
	13:51:20	45	20	5	15
	13:52:20	50	5	7	18
	13:53:20	80	30	25	20
	13:54:20	75	40	35	20
	13:55:20	60	75	75	40
	13:56:20	7	20	7	19
	13:56:50 (LOS)	4	3	3	3
3rd Pass		A1	A2	B1	B2
	15:24:04 (Acquisition)	35	15	60	15
	15:25:04	60	50	70	40
	15:26:04	70	18	8	7
	15:27:04	80	20	80	8
	15:28:04	140	70	40	50
	15:29:04	120	20	60	25
	15:30:04 (LOS)	10	6	4	3
4th Pass		A1	A2	B1	B2
	16:58:22 (Acquisition)	15	7	7	3
	16:59:22	30	30	20	20
	17:00:22	25	35	40	50
	17:01:22	12	12	16	3.5
	17:01:46 (LOS)	6	5	4.5	3

The timing system functioned satisfactorily during the mission with one exception: Postmission analysis of data disclosed that the numerical nine in the serial decimal unit (minutes) was recorded as a numerical eight. This trouble has been corrected by replacing a tube in the decade counter of the binary time code generator.

TABLE 10. RF INTERFERENCE

Site	Date/Time of Interference	Interfering Station	System Frequency	Measured Frequency	Bandwidth	Type of Interfering Signal	Signal Strength	Bearing of Interfering Station
				PREMISSION				
BDA	03/1017Z	KB Beacon	TM III	528KC	-90 to -95KC	CW	-146 DBW	316°
ZZB	03/1130Z	Unknown	TM LO	-94	-94 ± 10KC	Voice	130 DBW	250°
	25/1207Z	Unknown	HF Voice	MOF + 5KC	5KC	A-4	10 DB	-
	25/2125Z	SAC	HF Voice	MOF	10KC	A-3	-20 DB	-
	28/1000Z	Unknown	HF Voice	MOF	-5, + 5KC	A-1	-10 DB	-
	01/1215Z	Unknown	HF Voice	MOF	-5, + 5KC	A-1	0 DB	-
	03/0938Z	Unknown	HF Voice	MOF	-10, + 10KC	A-1	0 DB	-
HAW	03/1017	Unknown	C-band transponder	25MC	30MC	Radar	-54 DBM	152°
				POSTLAUNCH				
BDA	03/1653Z	USS Pawtucket	C-band beacon receiver	Nominal	-	Pulsed	60 DB +	37°
ZZB	03/1751Z	Unknown	TM LO	-100KC	-100KC±10KC	FSK	-140 DBW	248°
	03/1233Z	Unknown	HF Voice	MOF	+2, -2KC	A-1	-4 DB	-

HF communication reception was fairly good for the first three orbits.

Since the UHF communication equipment was on loan to Quito, a temporary receiver was improvised. However, only one UHF transmission was received.

7.4 RF INTERFERENCE

The table on the opposite page lists the RF interference reports received during the mission status periods.

8. DATA ANALYSIS

A detailed analysis of the Mercury network data using the MA-8 mission records is being made and will be published as an addendum to this report. This supplement will contain a more detailed analysis than has been previously undertaken. It will point out specific areas where problems occurred and determine whether they were specific site problems or network problems.

APPENDIX A

SYSTEM TEST CHARTS

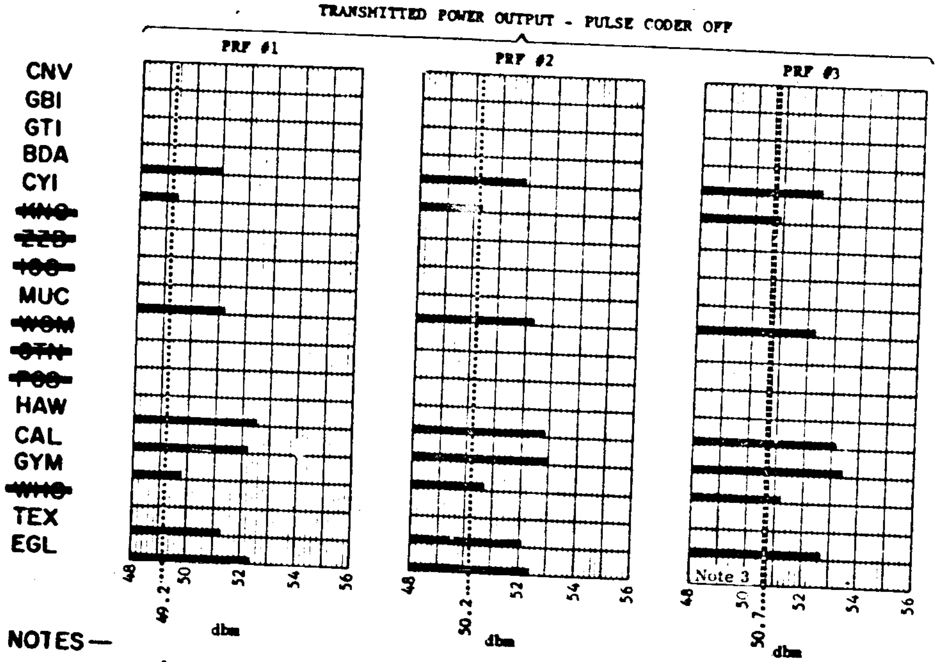
The following charts show the actual values recorded by the sites for the Detailed System Tests (DST's) and Brief System Tests (BST's).

The presentation gives the relationship between the actual measured values and the established minimum or maximum limits given in the system test procedures. By using these charts, the overall network condition can be readily seen since all applicable sites are plotted on a single graph for a particular test.

The charts are divided into two groups, first the DST's and then the BST's. The DST group contains network average values in the notes below each chart. These averages can be of significant value in establishing a practical norm for a particular subsystem test.

The BST group shows the values obtained from checks conducted during the countdown period. A part of each chart is headed "DST RELATION", which indicates the amount of test improvement or deterioration that occurred since the DST check was made.

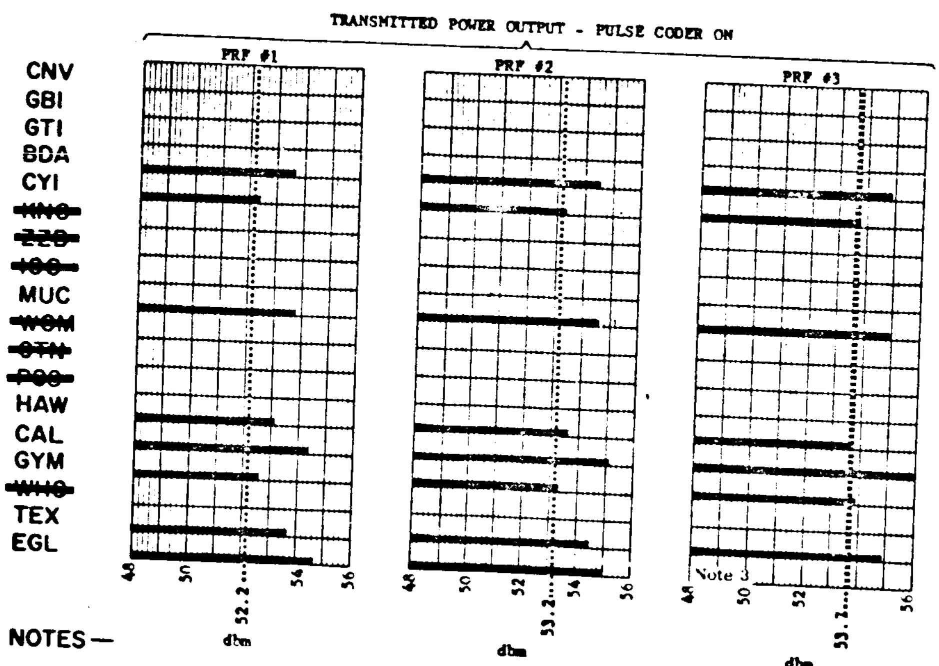
S-BAND RADAR
Detailed System Test (DST 101-1)
MCG-462 Mission



NOTES —

1. Minimum limit ....
2. Average network value
   PRF #1 51.2 dbm
   PRF #2 51.2 dbm
   PRF #3 52.4 dbm
3. EGL is equipped with an MPQ-31 Radar

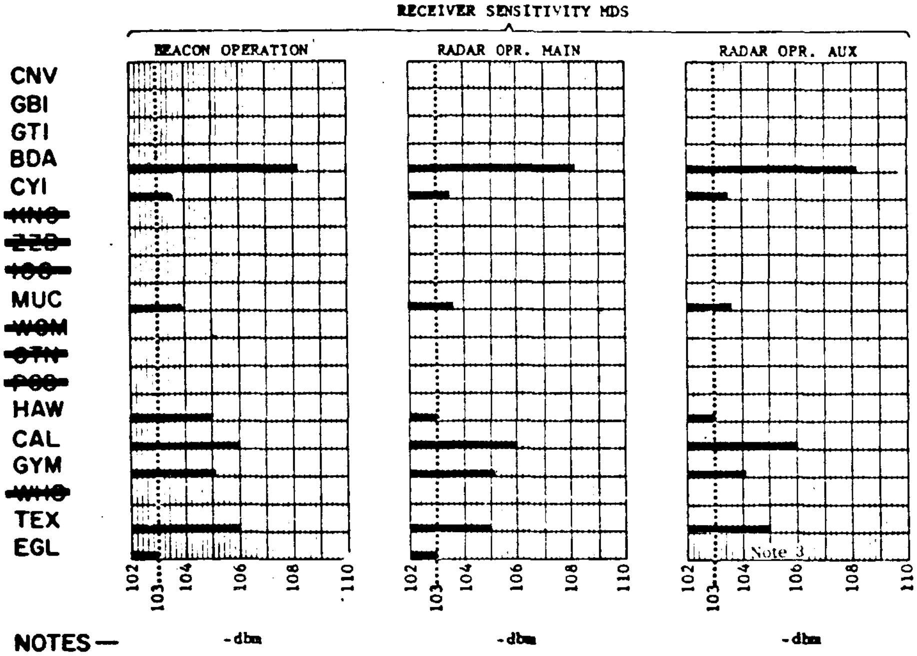
S-BAND RADAR
Detailed System Test (DST 101-1)
MCG-462 Mission



NOTES —

1. Minimum limit ....
2. Average network value
   PRF #1 53.4 dbm
   PRF #2 54.1 dbm
   PRF #3 54.6 dbm
3. EGL is equipped with an MPQ-31 Radar

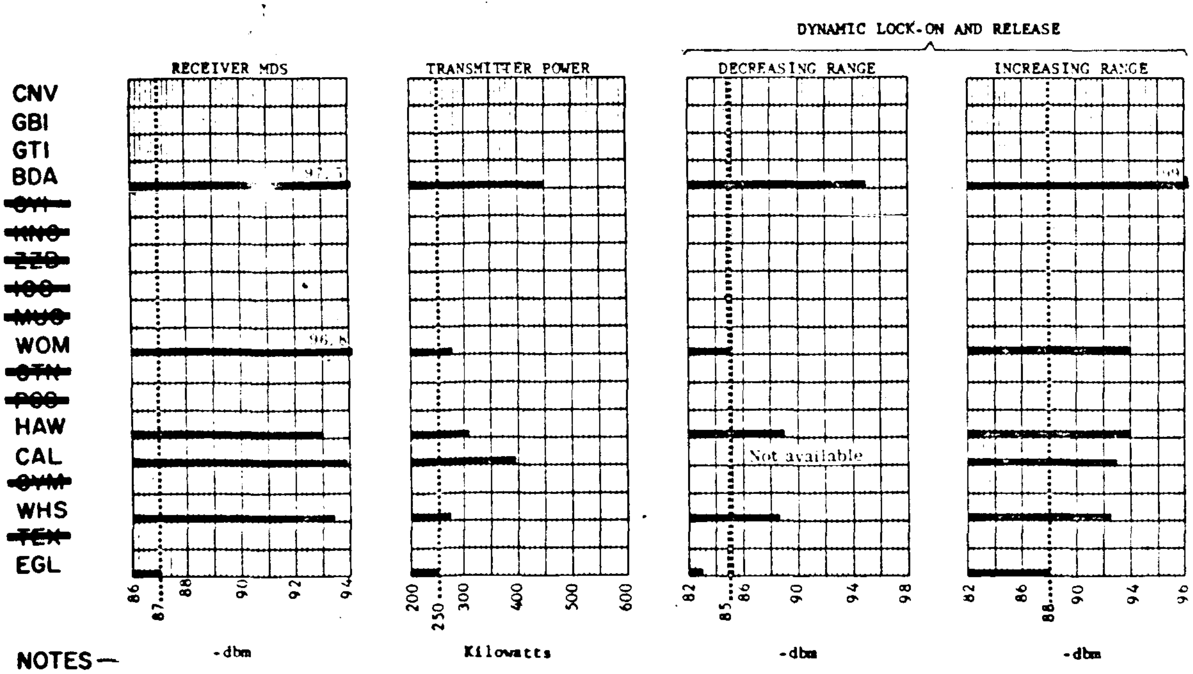
S-BAND RADAR
Detailed System Test (DST 101-1)
NCG-462 Mission



NOTES—

1. Minimum limit ......
2. Average network value
   - Beacon operation 105.4 -dbm
   - Radar operation main 104.9 -dbm
   - Radar operation auxiliary 104.8 -dbm
3. EGL is equipped with an MPQ-31 Radar

C-BAND RADAR
Detailed System Test (DST 101-2)
NCG-462 Mission

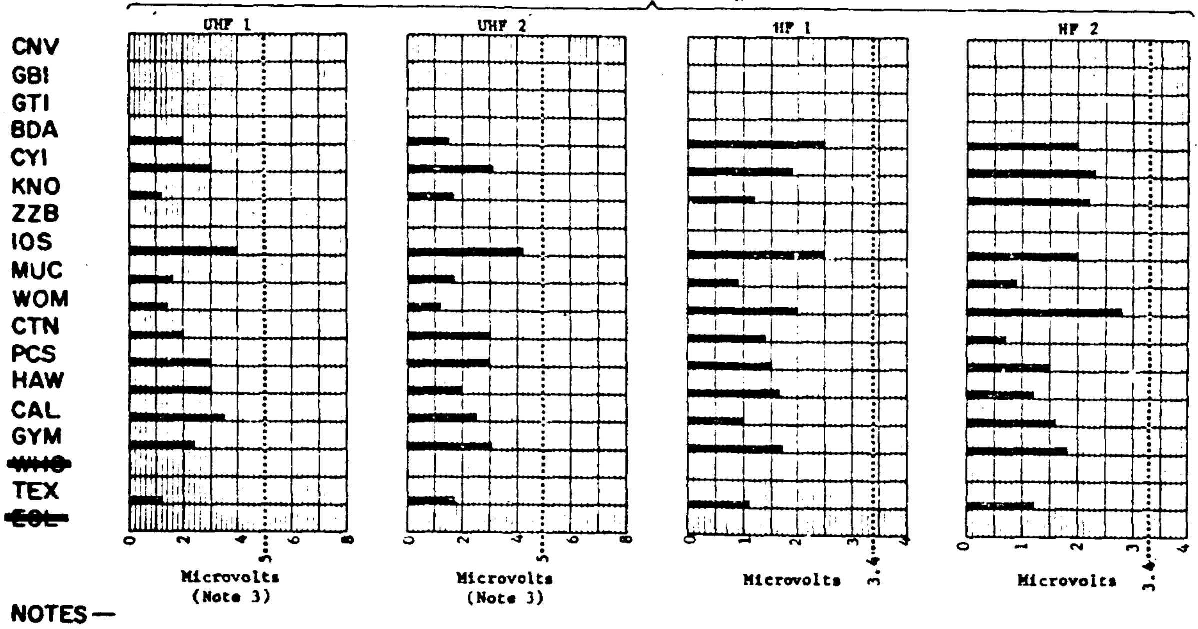


NOTES—

1. Minimum limit ....
2. Network average
   - Receiver MDS -93.6 dbm
   - Transmitter power 325 Kw
   - Decreasing range -88.1 dbm
   - Increasing range -93.4 dbm

AIR/GROUND COMMUNICATIONS
Detailed System Test (DST 102)
MCG-462 Mission

RECEIVER SENSITIVITY FOR $\frac{S+N}{N}$ OF 10 DB

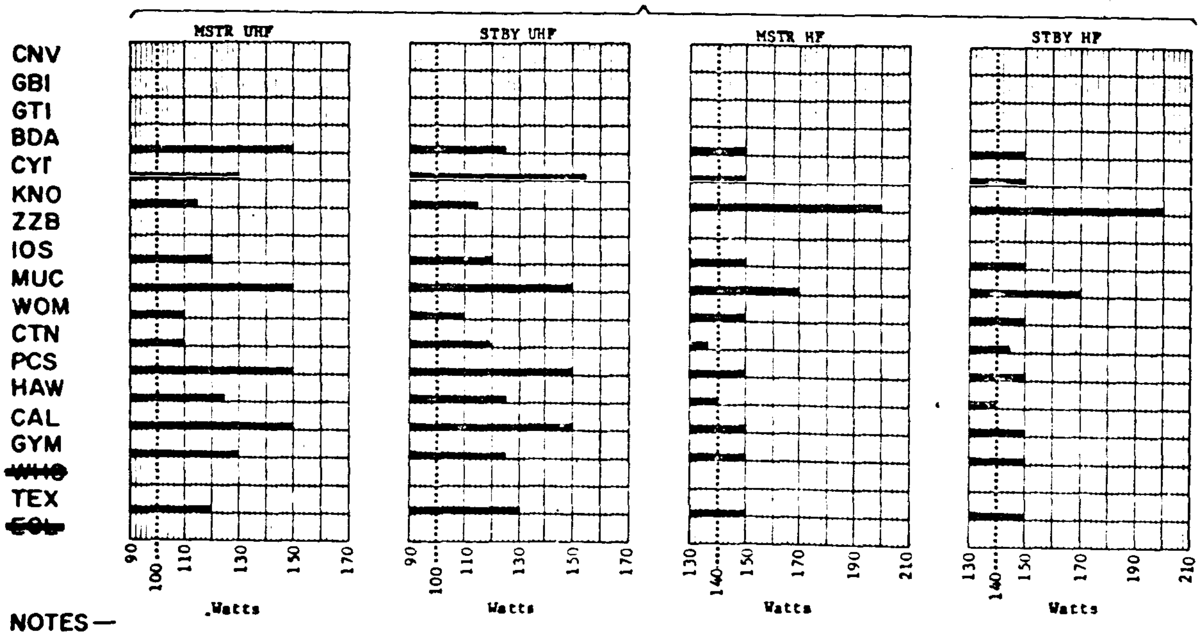


NOTES—

1. Maximum limits ....
2. Network average
   UHF Rcv'r. 2.19 Microvolts
   HF Rcv'r. 1.74 Microvolts
3. Channel 5 of the UHF receiver. Channel 4 and 6 values are available in MSFSD.

AIR/GROUND COMMUNICATIONS
Detailed System Test (DST 102)
MCG-462 Mission

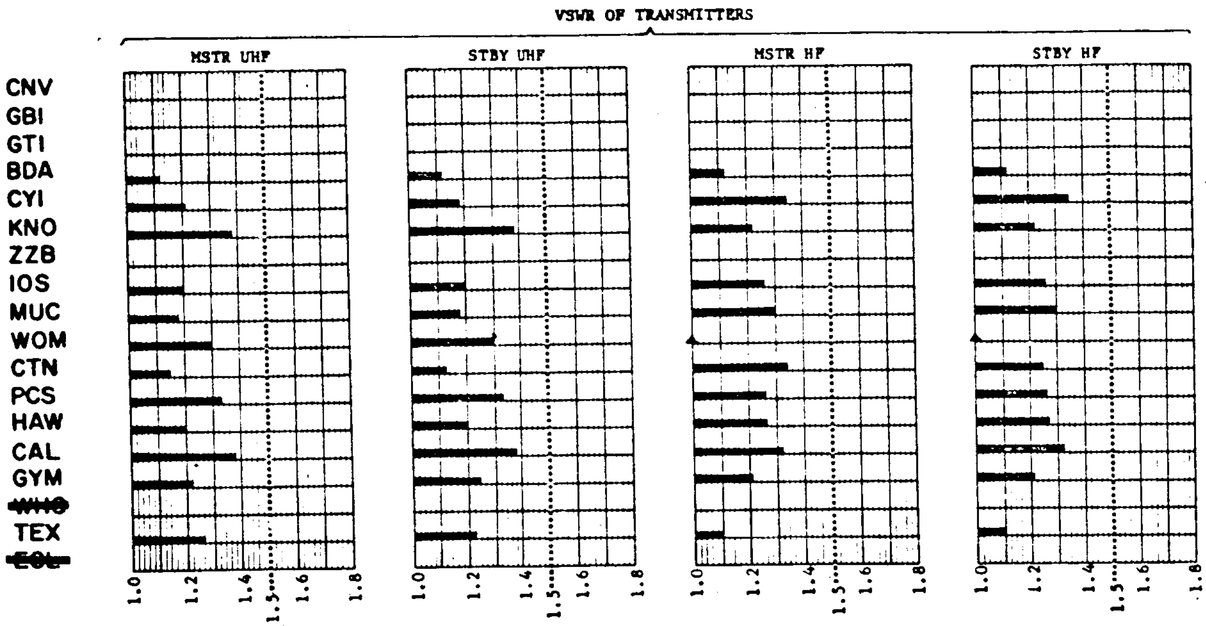
TRANSMITTED POWER OUTPUT



NOTES—

1. Minimum limit ....
2. Network average
   UHF Transmitters 130 Watts
   HF Transmitters 155 Watts

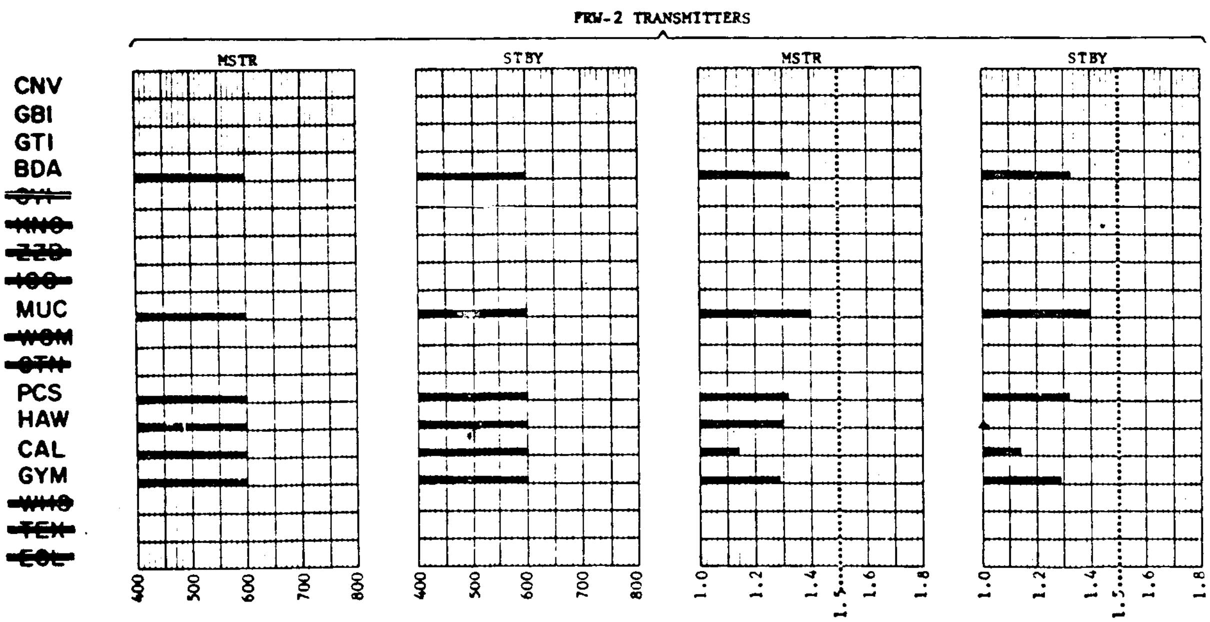
AIR/GROUND COMMUNICATIONS
Detailed System Test (DST 102)
NCG-462 Mission



NOTES—

1. Maximum limit ....
2. Network average
   UHF XMTR'S 1.24:1
   HF XMTR'S 1.25:1
3. All values referenced to unity

COMMAND CONTROL TRANSMITTERS
Detailed System Test (DST 103)
NCG-462 Mission



NOTES—

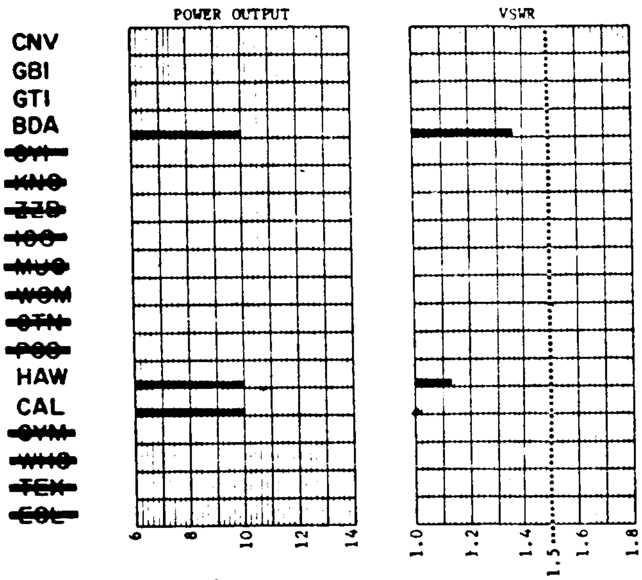
Power Output in Watts
(Note 3)

VSWR

1. Maximum limit ....
2. Network average
   Mstr. 1.25 VSWR
   Stby. 1.24 VSWR
3. The power output is adjusted to 600 watts nominal.

COMMAND CONTROL TRANSMITTERS
Detailed System Test (DST 103)
NCG-462 Mission

240 D-2 POWER AMPLIFIER



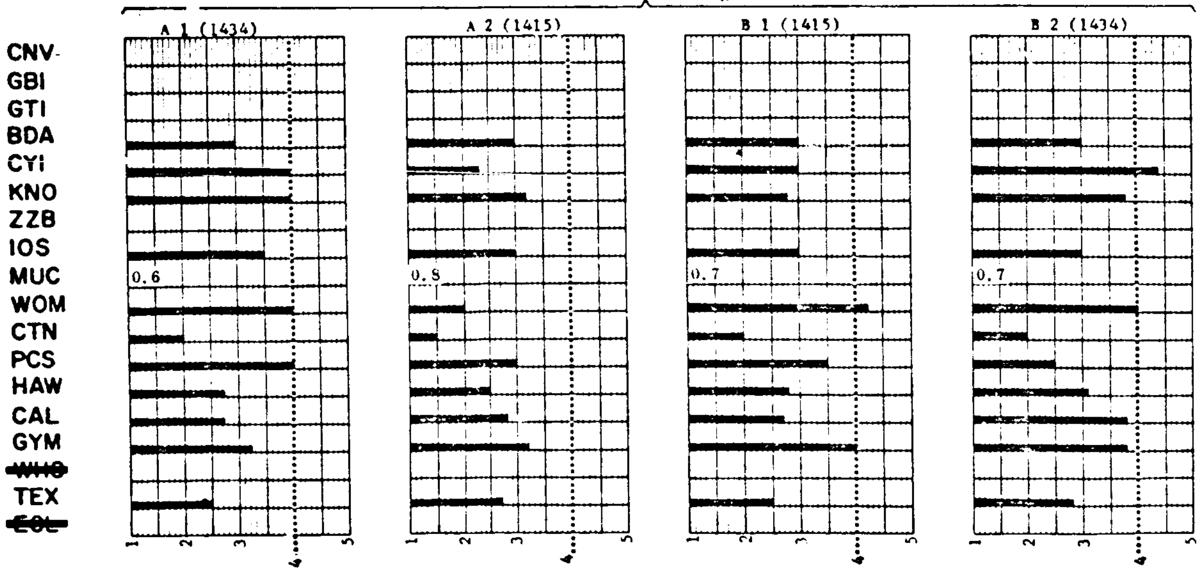
COMMENTS

CAL - MSTR 240D-2 was red during DST check

NOTES—
1. Maximum limit --------
2. Network average of VSWR 1.24
3. Power output adjusted for 10 KW nominal.

TELEMETRY
Detailed System Test (DST 106)
NCG-462 Mission

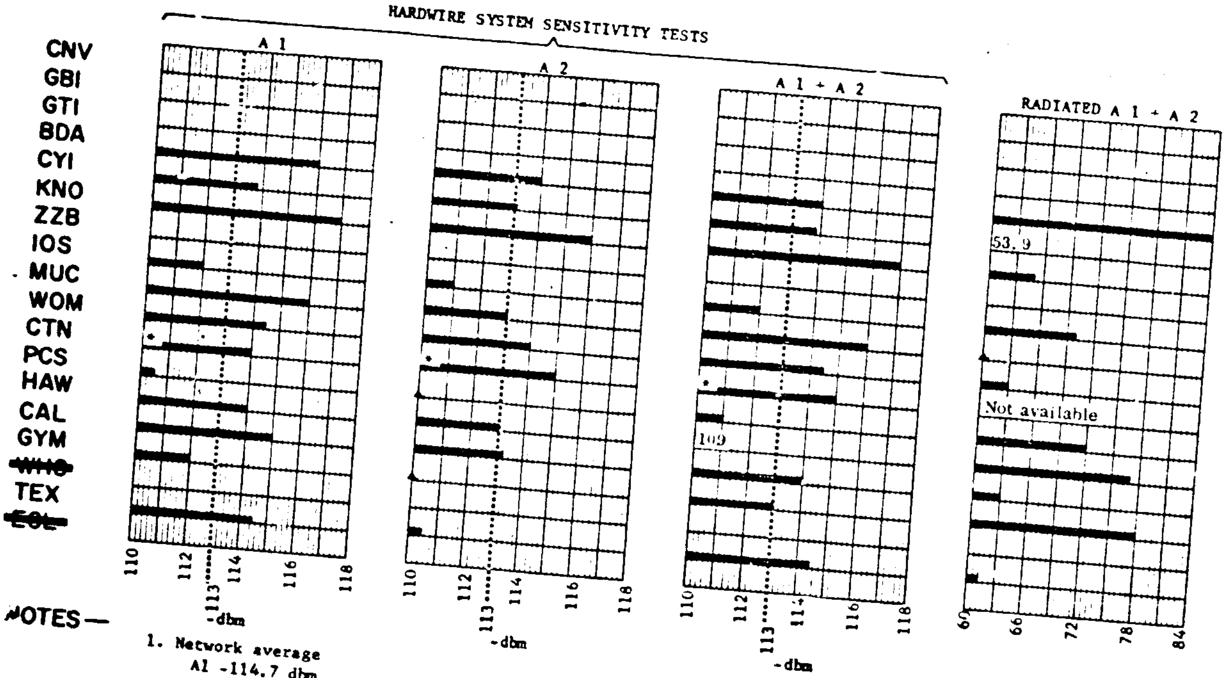
RECEIVER SENSITIVITY FOR $\frac{S+N}{N}$ OF 20 DB



NOTES—
1. Maximum limit -------
2. Network average
1434 receivers 3.3 microvolts
1415 receivers 2.8 microvolts

Comments: MUC used test procedure described in MUT 106. Values omitted from network averages.

TELEMETRY
Detailed System Test (DST 106)
NCG-462 Mission



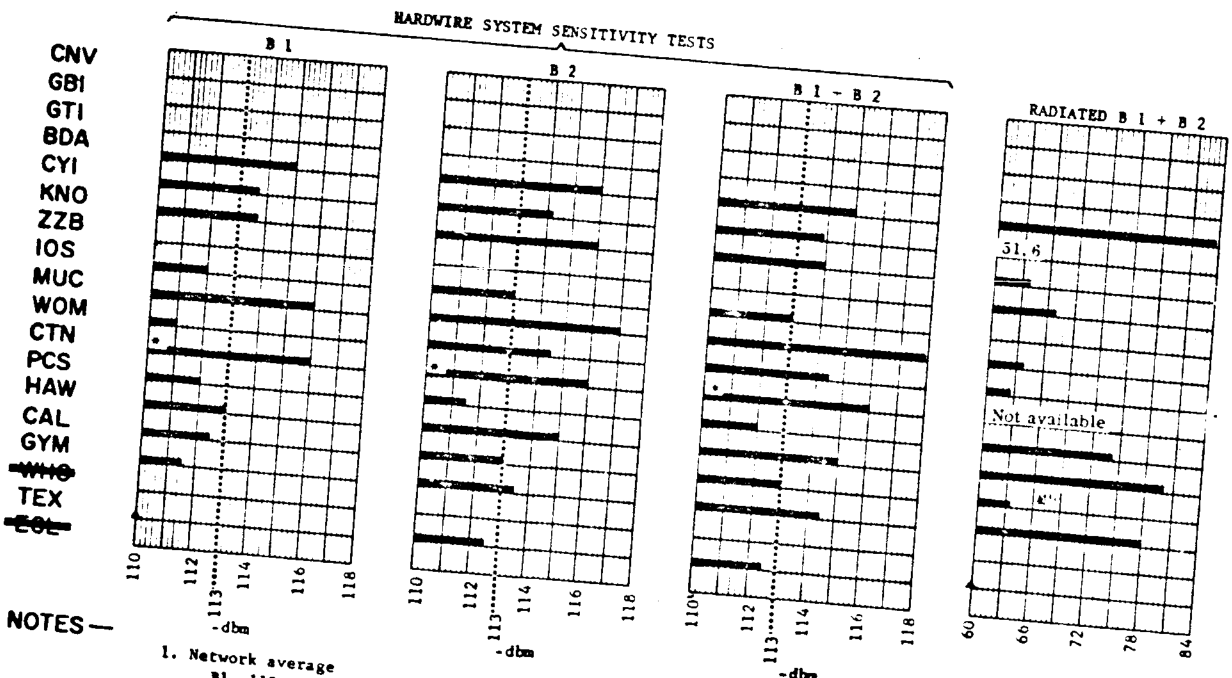
-dbm
(Note 2)

NOTES —

1. Network average
   A1 -114.7 dbm
   A2 -113.0 dbm
   A1 & A2 -114.0 dbm
2. Space loss = Hardwire minus radiated A1 + A2.
3. Minimum limit .... (not definately established).

*Correction factor of 20 added to all figures

TELEMETRY
Detailed System Test (DST 106)
NCG-462 Mission



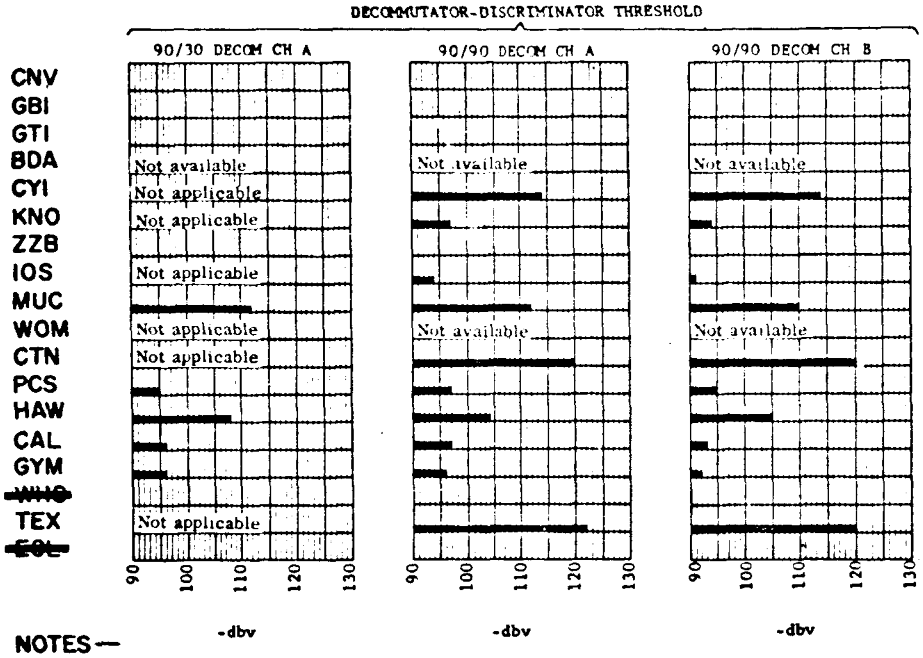
NOTES —

1. Network average
   B1 -113.2 dbm
   B2 -114.8 dbm
   B1 & B2 -114.7 dbm
2. Space loss = Hardwire minus radiated B1 + B2.
3. Minimum limit .... (not definately established).

-dbm
(Note 2)

*Correction factor of 20 added to all figures.

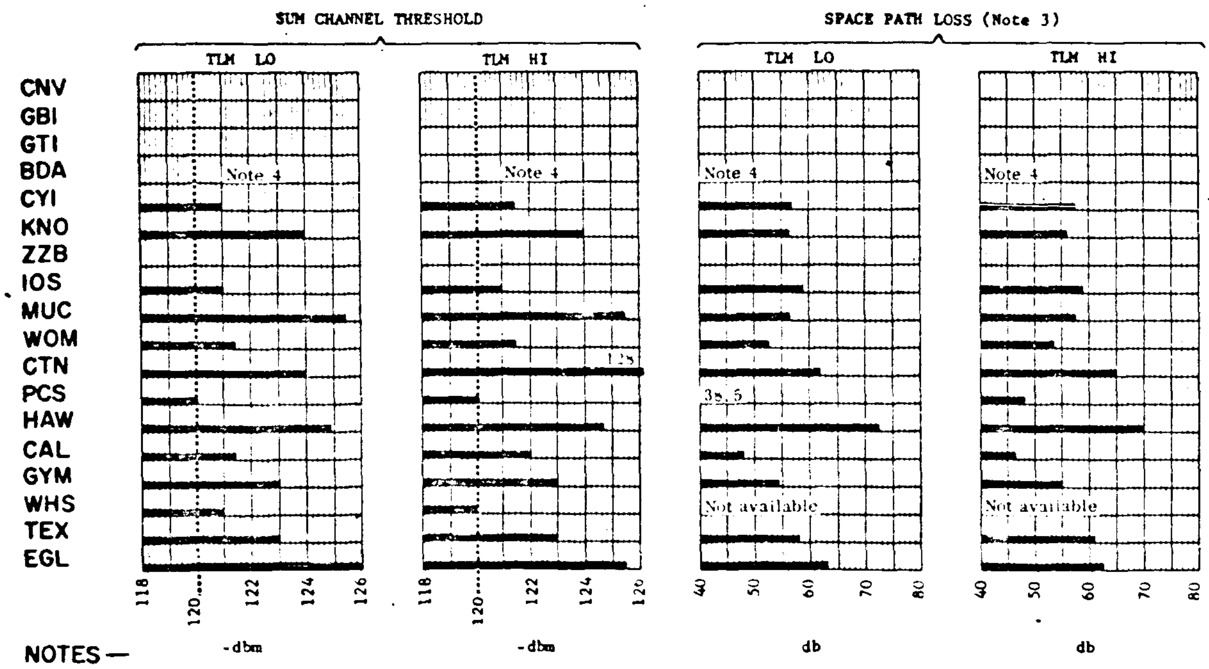
TELEMETRY
Detailed System Test (DST 106)
NCG-462 Mission



NOTES—

1. Network average
   - 90/30 Decom Ch A 103 -dbv
   - 90/90 Decom Ch A 108 -dbv
   - 90/90 Decom Ch B 106 -dbv
2. No established limits.

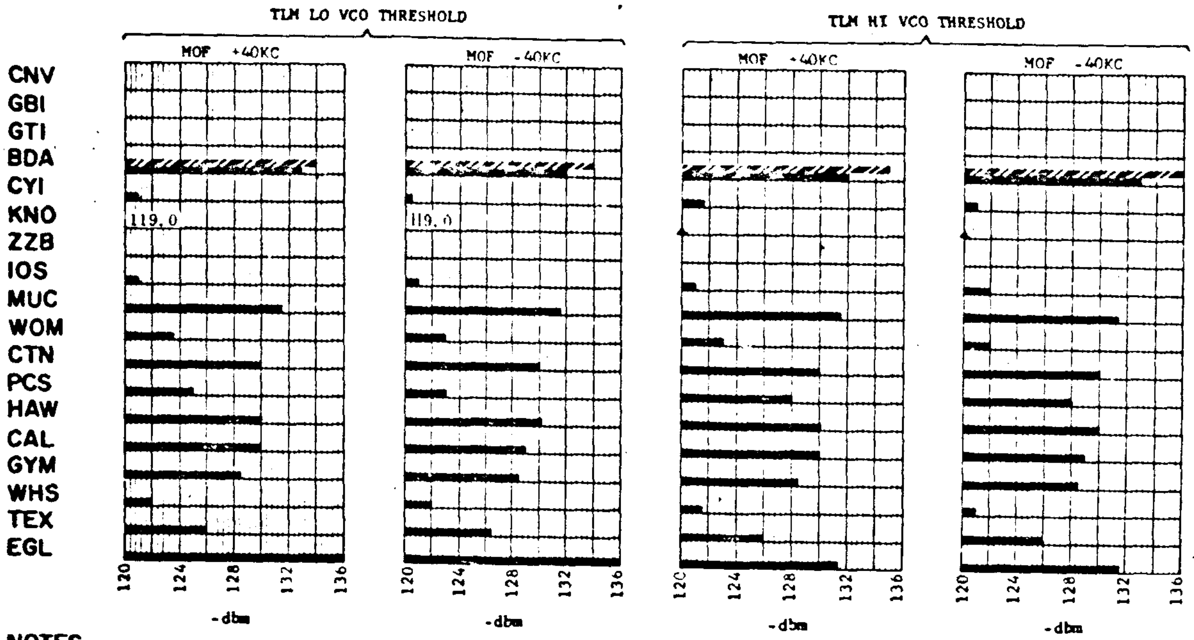
ACQUISITION
Detailed System Test (DST 110)
NCG-462 Mission



NOTES—

1. Minimum limit ....
2. Network average
   - TLM HI -123.2 dbm
   - TLM LO -123.5 dbm
3. Values indicate characteristics of individual sites for reference only.
4. Test procedure does not conform to this presentation.

ACQUISITION
Detailed System Test (DST 110)
NCG-462 Mission

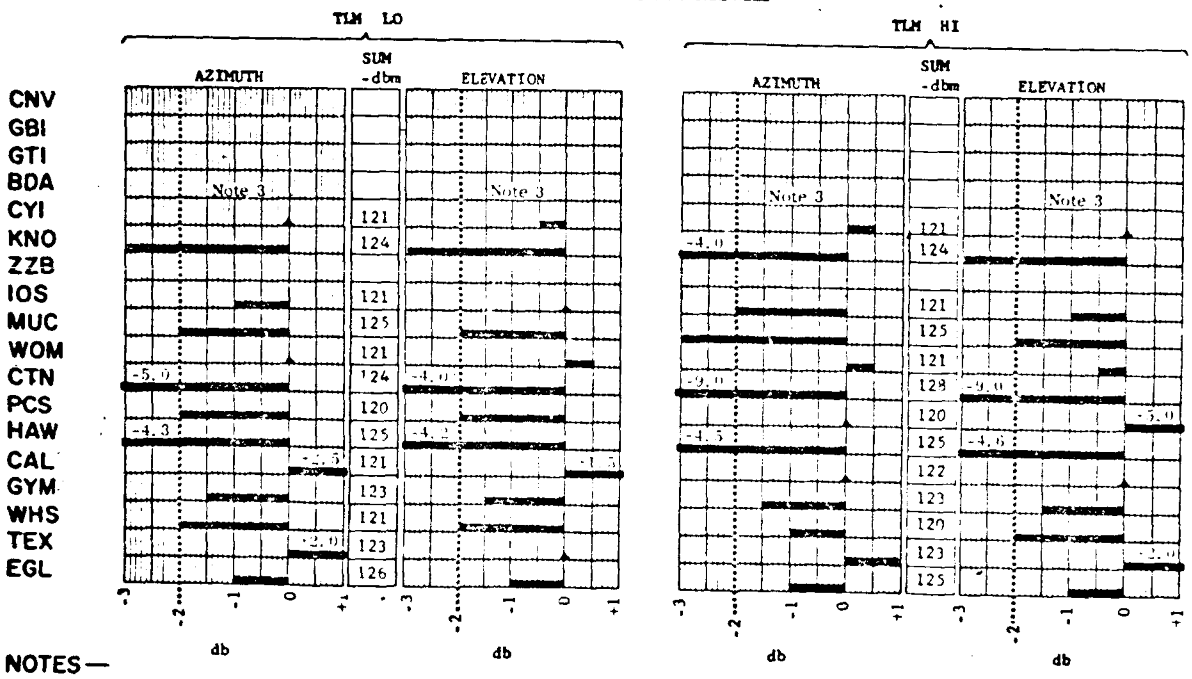


NOTES—

1. Maximum limits: MOF -40KC within ± 1.0 db of MOF +40KC.
2. Town Hill ▰▰▰ Coopers Island ▬▬▬
3. Network averages provides no evaluation criteria.

ACQUISITION
Detailed System Test (DST 110)
NCG-462 Mission

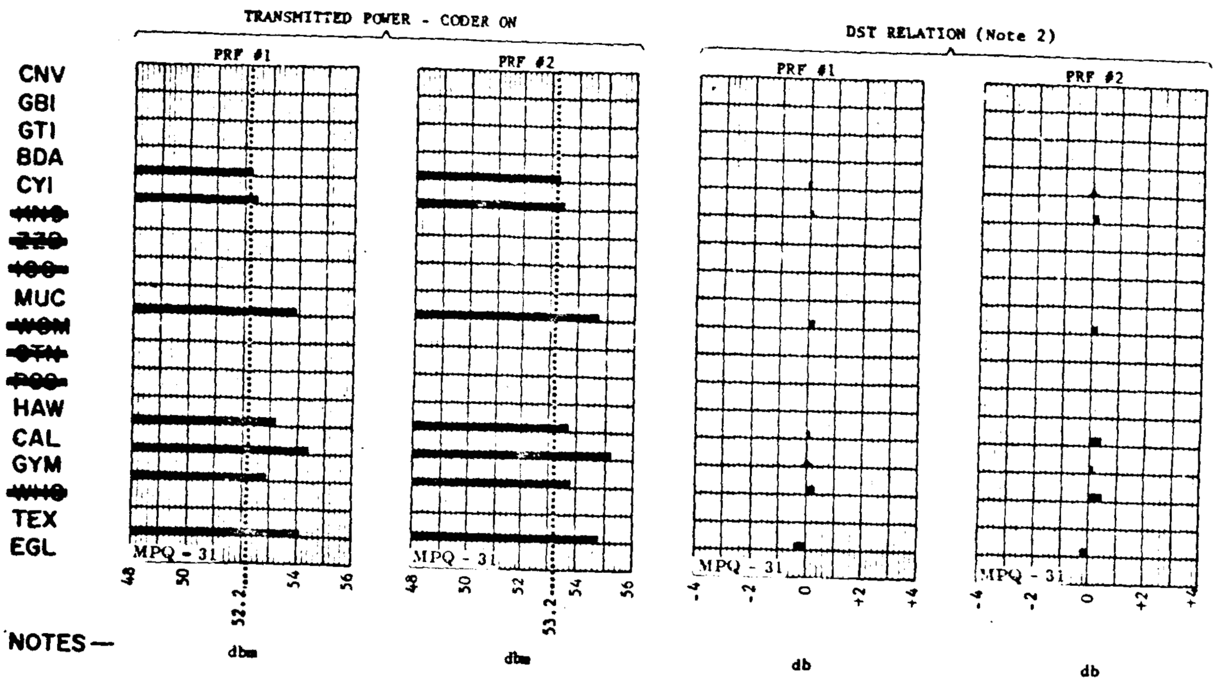
THRESHOLD OF ERROR CHANNELS



NOTES—

1. Minimum limit not more than -2.0 db of sum channel
2. Network average
   TLM LO -121.8 dbm Azimuth & Elevation
   TLM HI -121.4 dbm Azimuth & Elevation
3. Test Procedure does not conform to this presentation

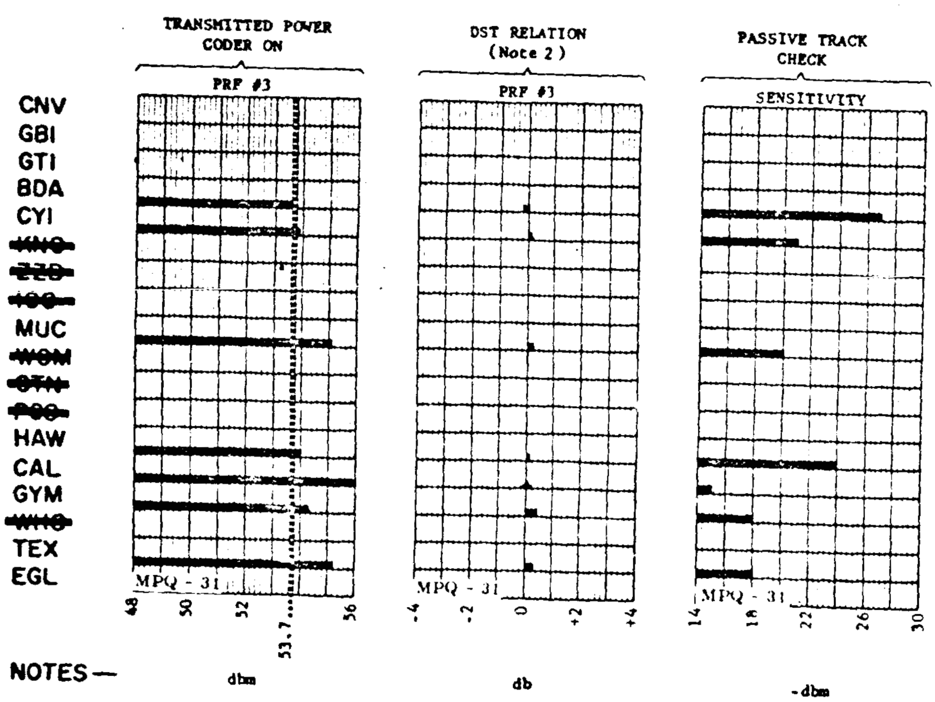
S-BAND RADAR
Brief System Test (BST 101-1)
NCG-462 Mission



NOTES—

1. Minimum limit ....
2. Values represent increase or decrease from measurements of the DST

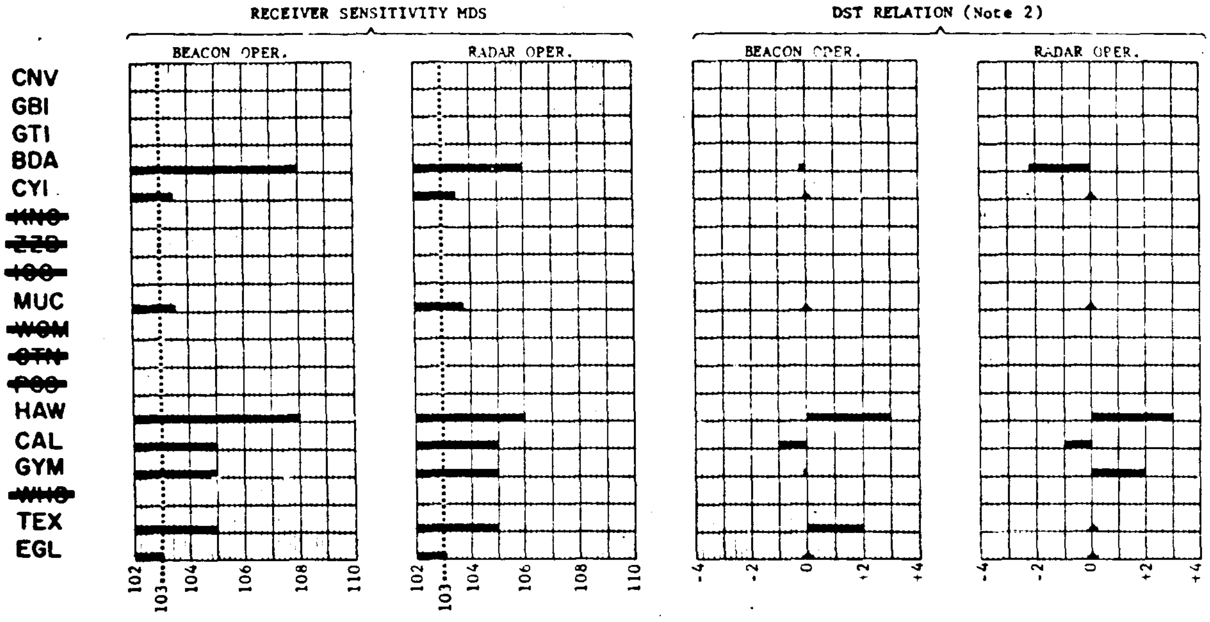
S-BAND RADAR
Brief System Test (BST 101-1)
NCG-462 Mission



NOTES—

1. Minimum limit ....
2. Values represent increase or decrease from measurements of the DST

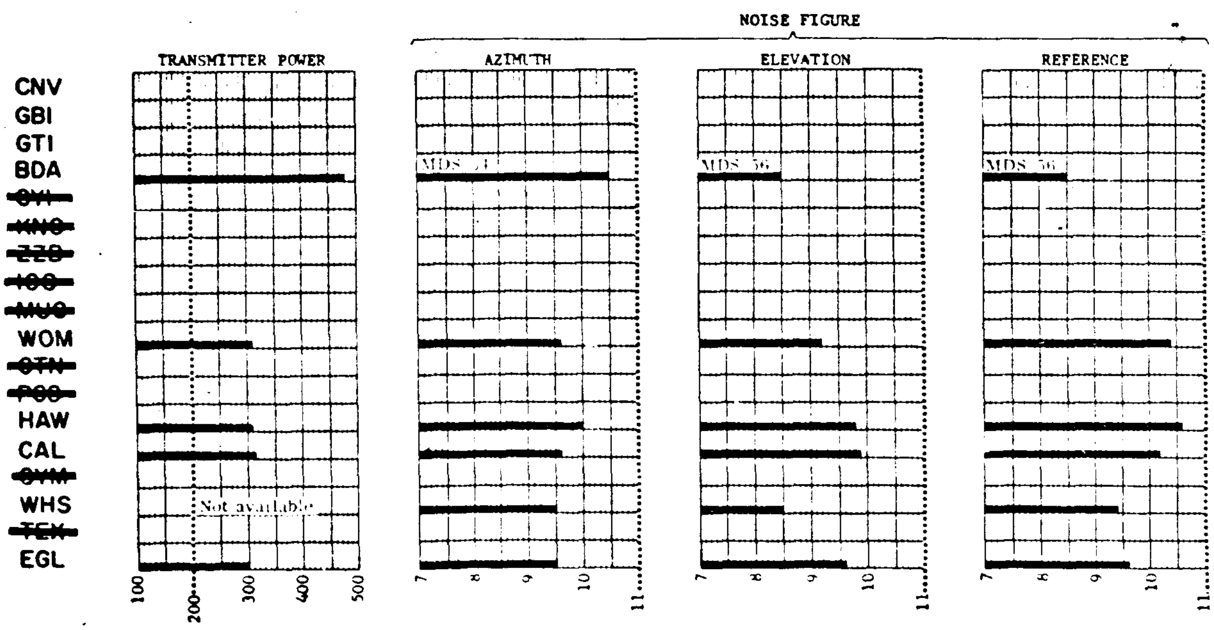
S-BAND RADAR
Brief System Test (BST 101-1)
NCG-462 Mission



NOTES —

1. Minimum limit ·······
2. Values represent increase or decrease from measurements of the DST

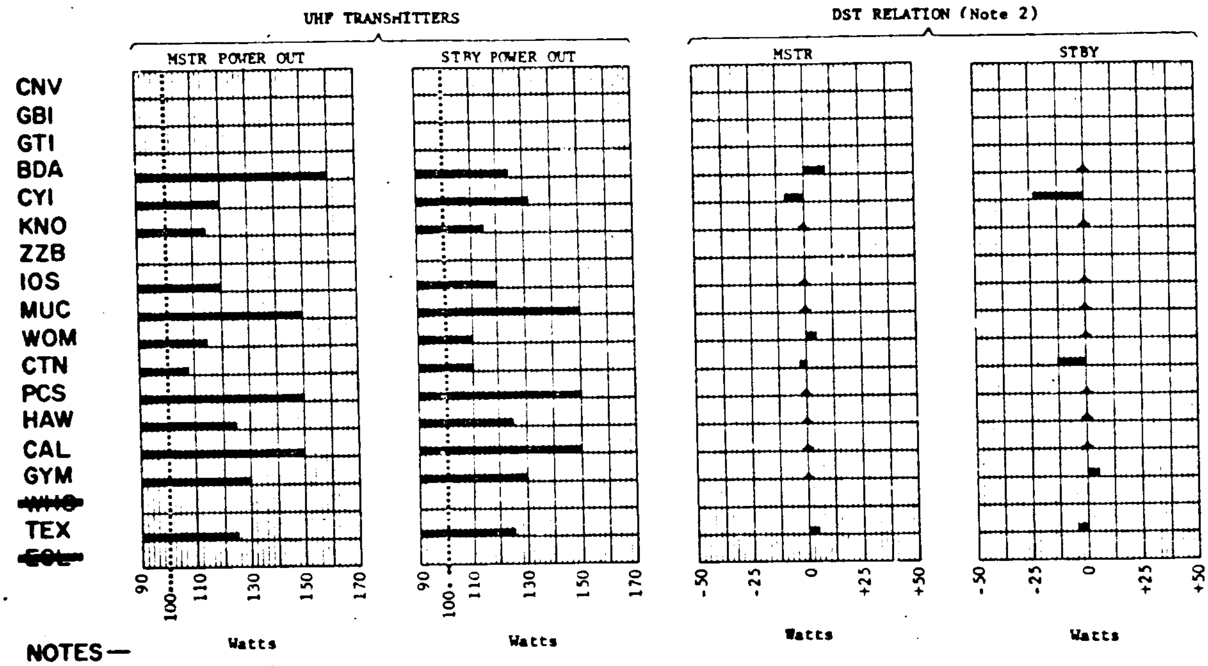
C-BAND RADAR
Brief System Test (BST 101-2)
NCG-462 Mission



NOTES —

1. Minimum level of Transmitter power ·········
   Maximum level of Noise figure ·········

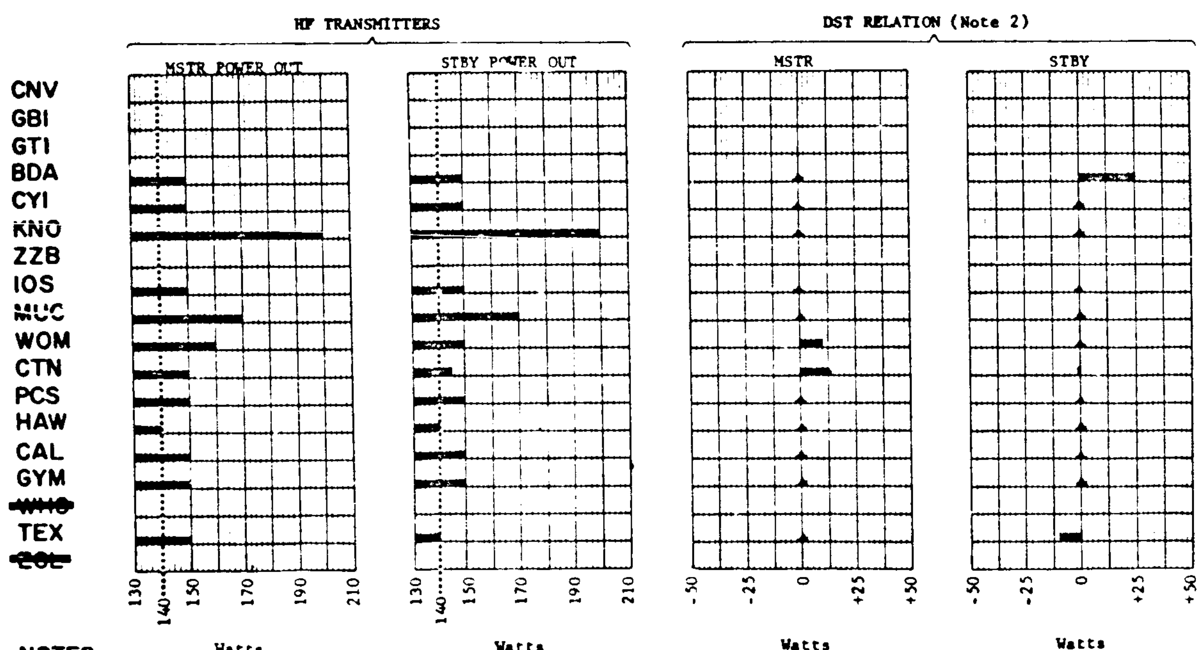
AIR/GROUND COMMUNICATIONS
Brief System Test (BST 102)
NCC-462 Mission



NOTES —

1. Minimum limit ....
2. Value represents increase or decrease from measurements of the DST

AIR/GROUND COMMUNICATIONS
Brief System Test (BST 102)
NCC-462 Mission

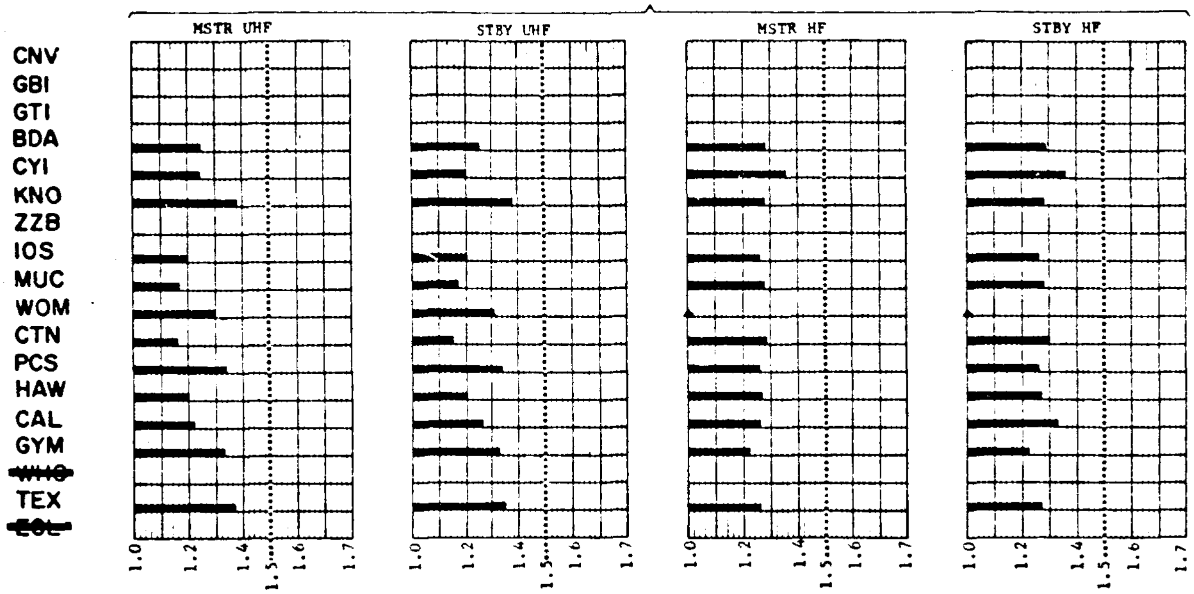


NOTES —

1. Minimum limit ....
2. Value represents increase or decrease from measurements of the DST

AIR/GROUND COMMUNICATIONS
Brief System Test (BST 102)
NCG-462 Mission

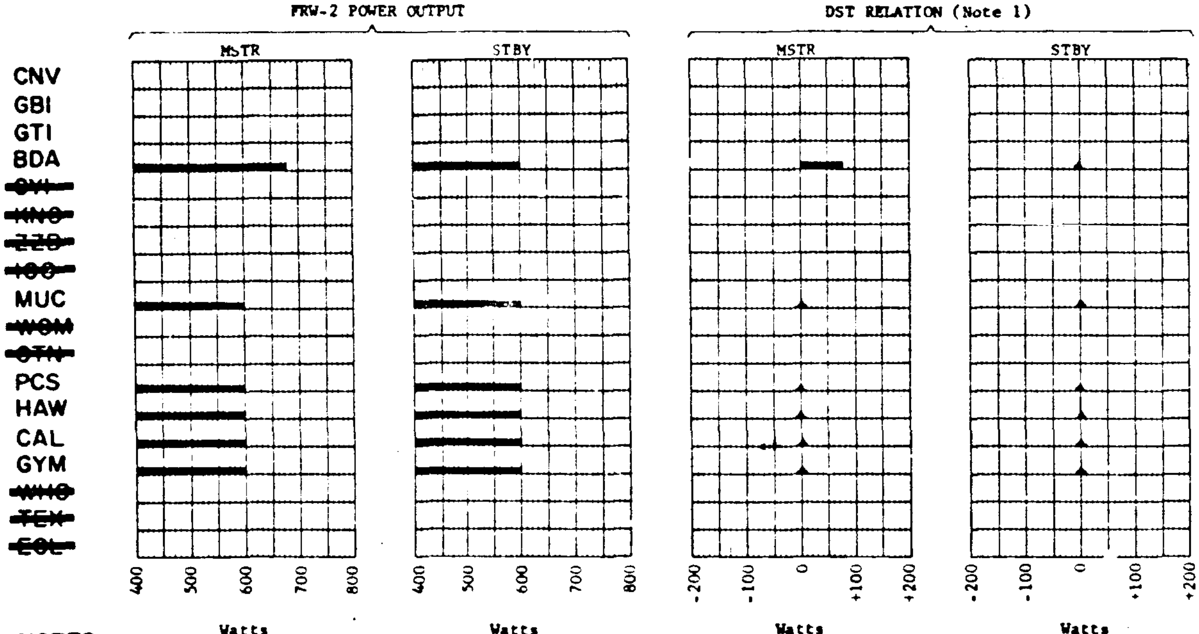
VSWR OF TRANSMITTERS



NOTES—

1. Maximum limit --------
2. All values referenced to unity

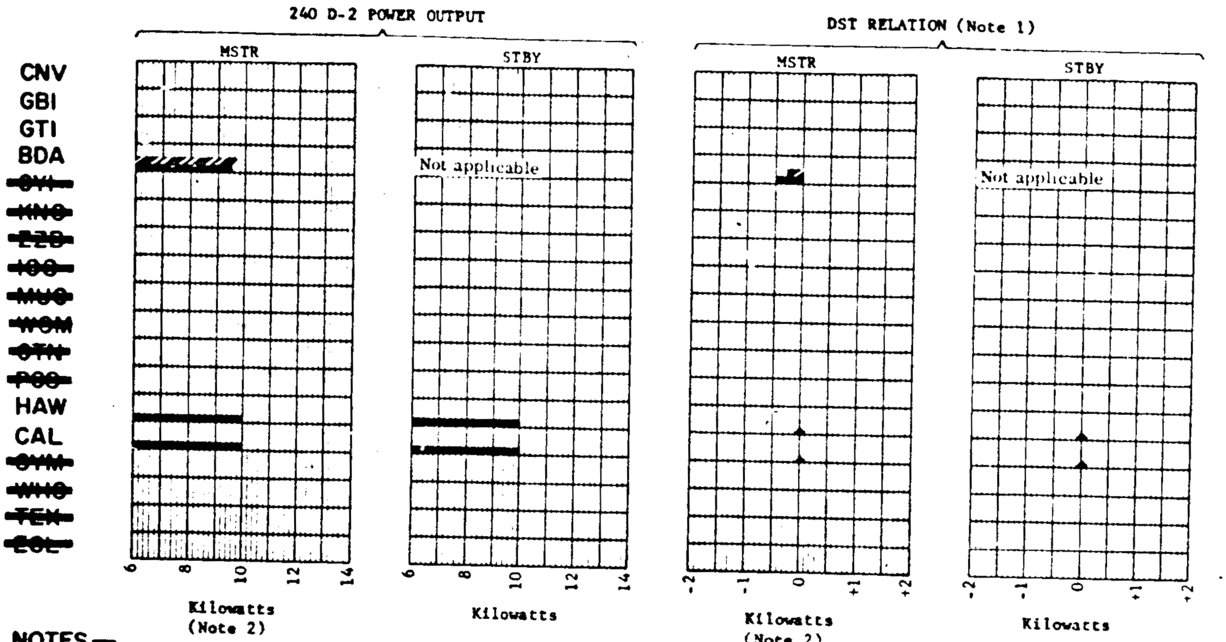
COMMAND CONTROL TRANSMITTERS
Brief System Test (BST 103)
NCG-462 Mission



NOTES—

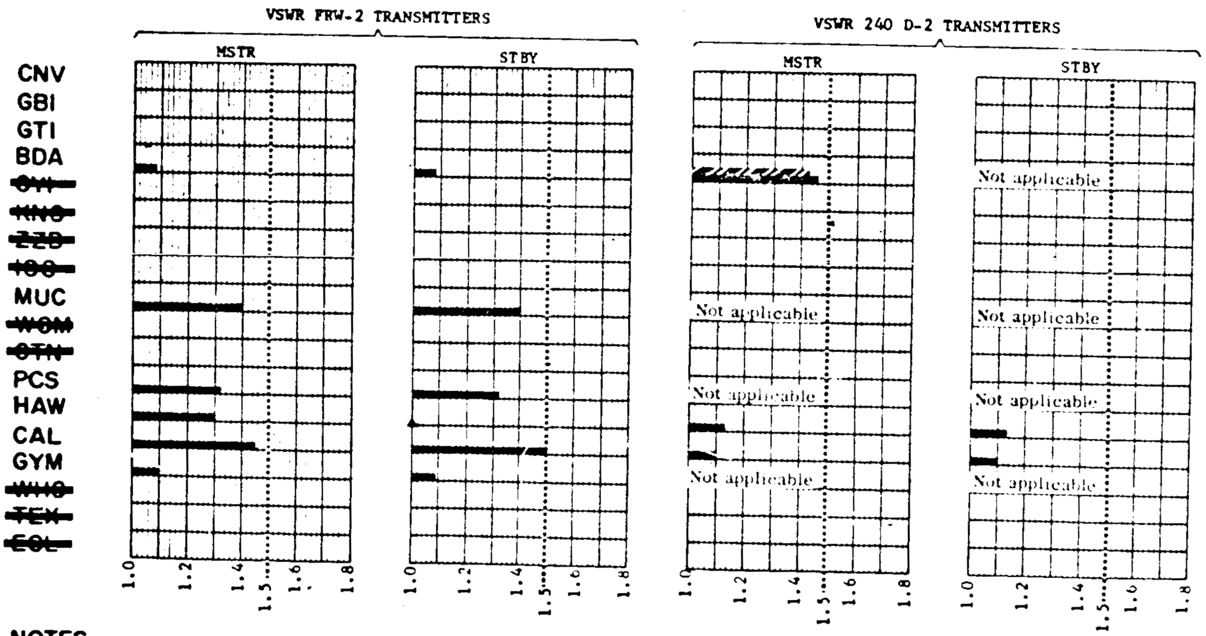
1. Values represent increase or decrease from measurements of the DST

COMMAND CONTROL TRANSMITTERS
Brief System Test (BST 103)
NCG-462 Mission



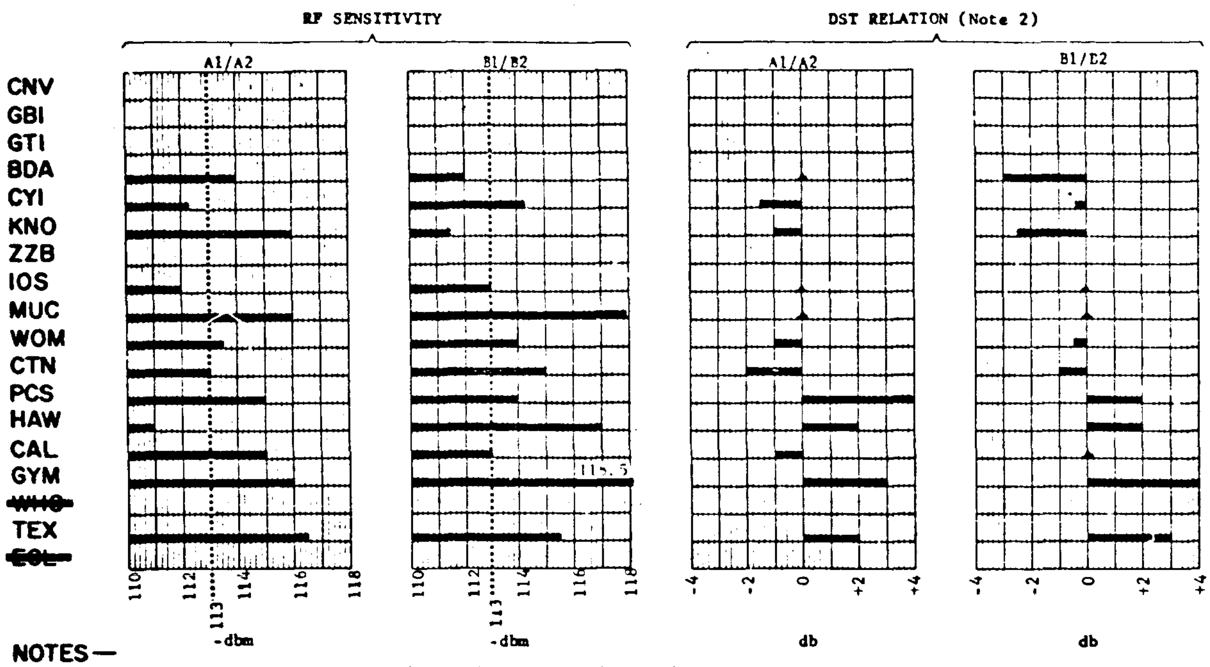
NOTES—
1. Values represent increase or decrease from measurements of the DST
2. Antenna No. 2

COMMAND CONTROL TRANSMITTERS
Brief System Test (BST 103)
NCG-462 Mission



NOTES—
1. Maximum limit ....
2. Antenna No. 2

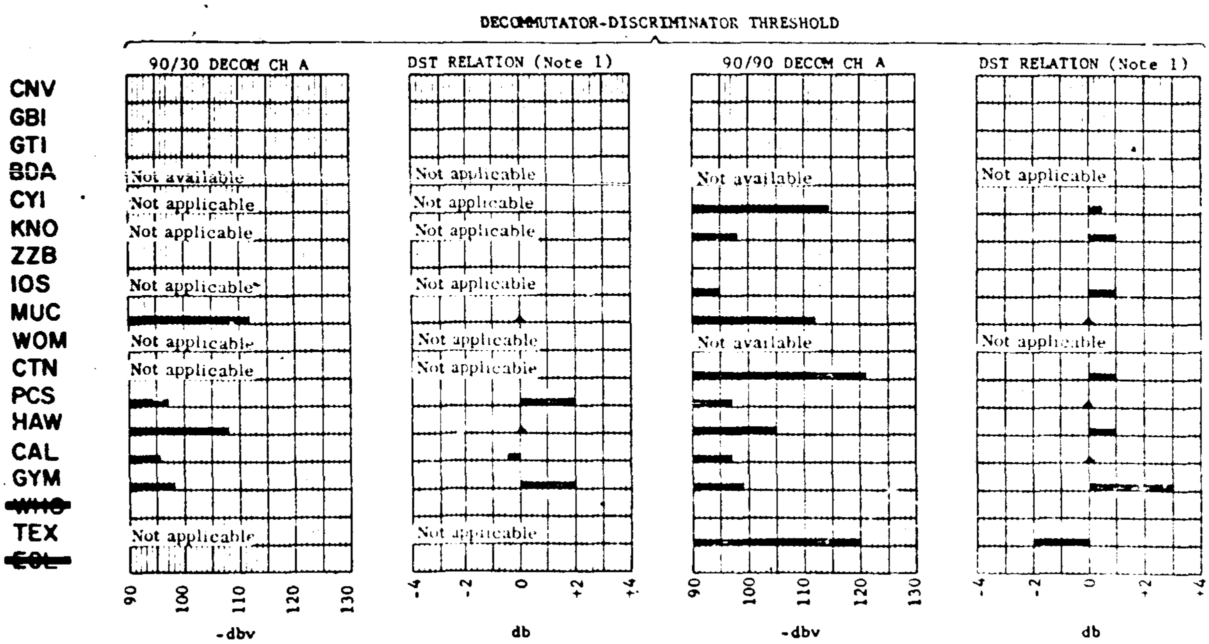
TELEMETRY
Brief System Test (BST 106)
NCG-462 Mission



NOTES—

1. Minimum limit ··········· (not definitely established)
2. Values represent increase or decrease from measurements of the DST

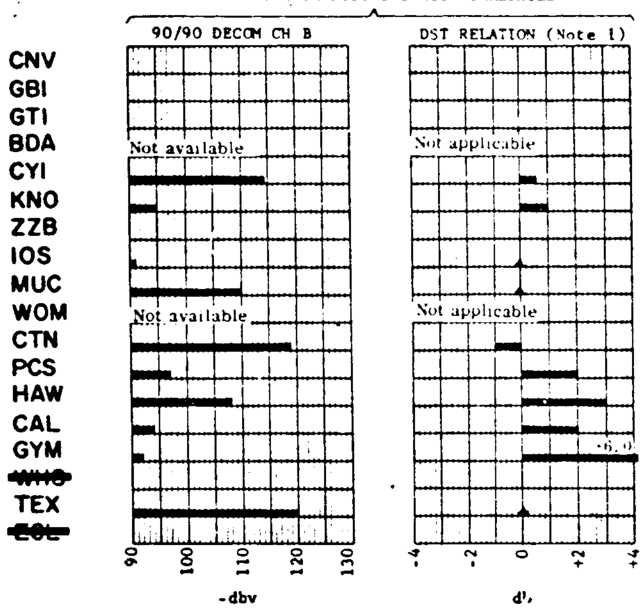
TELEMETRY
Brief System Test (BST 106)
NCG-462 Mission



NOTES—

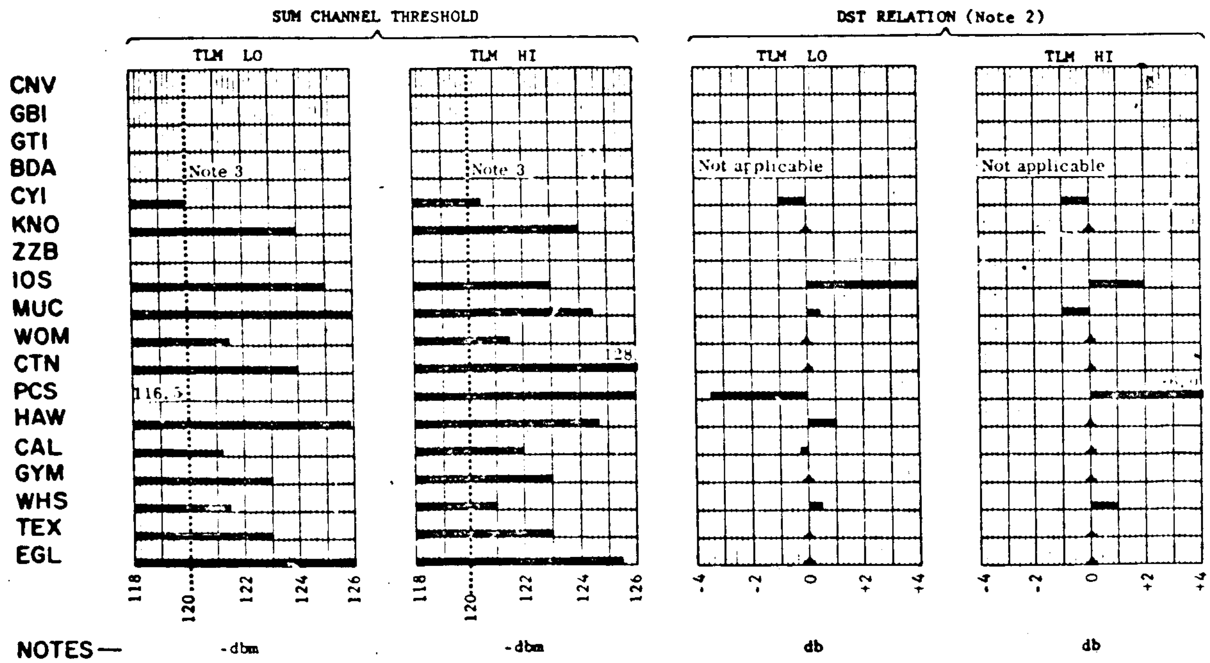
1. Values represent increase or decrease from measurements of the DST

TELEMETRY
Brief System Test (BST 106)
NCG-462 Mission



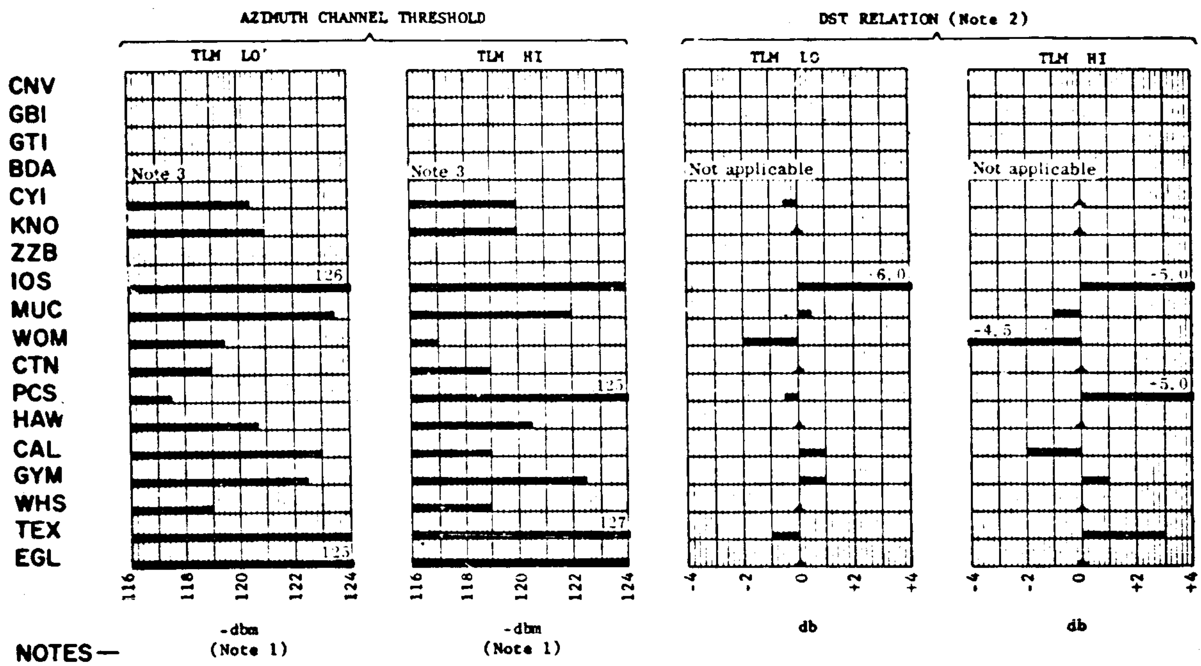
NOTES— 1. Values represent increase or decrease from measurements of the DST

ACQUISITION
Brief System Test (BST 110)
NCG-462 Mission



NOTES—
1. Minimum limit ......
2. Values indicate BST difference from the previous DST measurement and should not exceed ± 2.0 db.
3. Test procedure does not conform to this presentation.

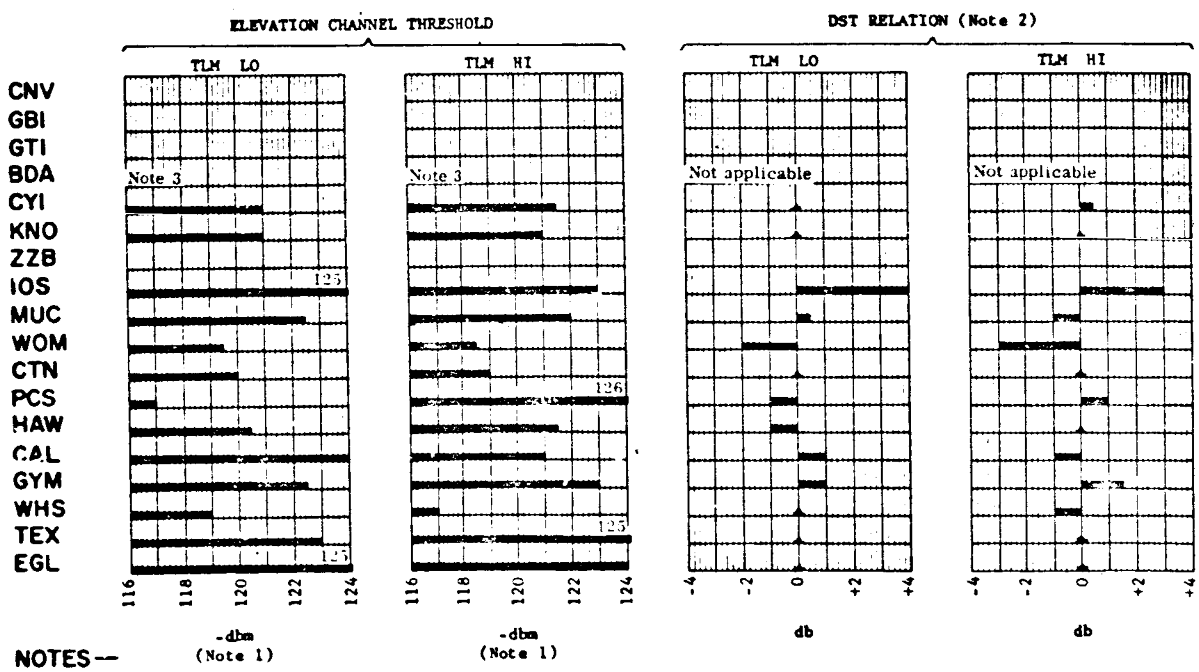
ACQUISITION
Brief System Test (BST 110)
NCG-462 Mission



NOTES—

1. Requirement: Not more than -2.0 db below sum channel
2. Values indicate BST difference from the previous DST measurement and should not exceed ± 2.0 db.
3. Test procedure does not conform to this presentation.

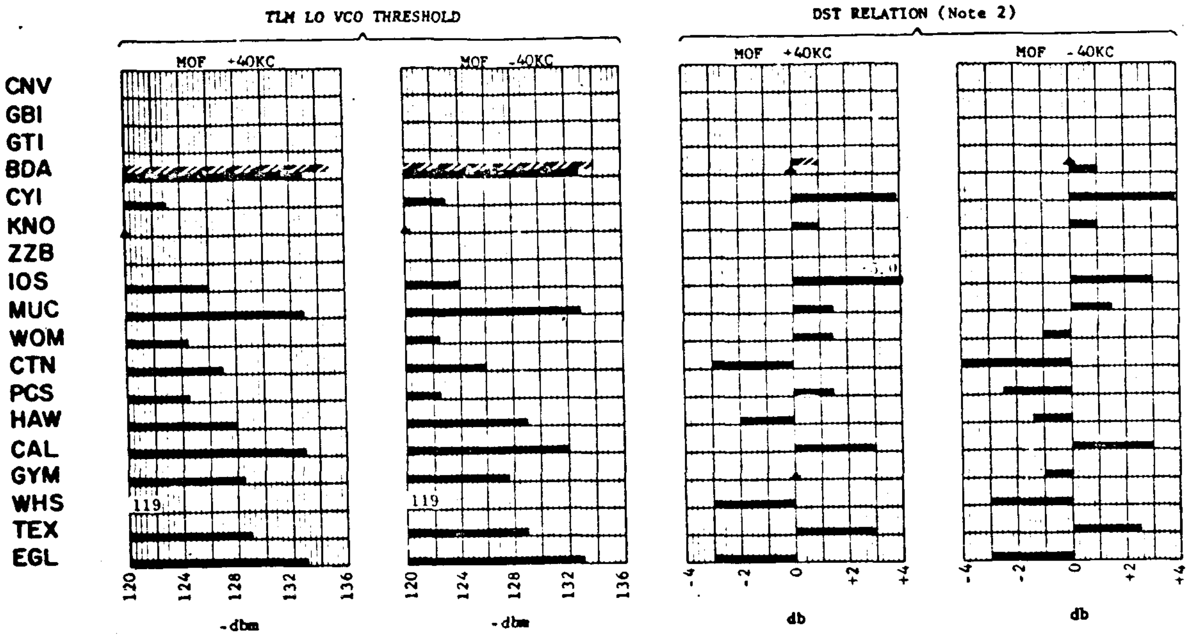
ACQUISITION
Brief System Test (BST 110)
NCG-462 Mission



NOTES—

1. Requirement: Not more than -2.0 db below sum channel
2. Values indicate BST difference from the previous DST measurement and should not exceed ± 2.0 db.
3. Test procedure does not conform to this presentation.

ACQUISITION
Brief System Test (BST 110)
MCG-462 Mission



NOTES—

1. Maximum limits: MOF +40KC within ± 2.0 db of MOF -40KC.
2. Values indicate BST difference from the previous DST measurement and should not exceed ± 2.0 db.
3. Town Hill ▬ Coopers Island

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BTL	Bell Telephone Laboratories Whippany Road Whippany, New Jersey Attn: Mr. C. Schramm	2
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PMR	Pacific Missile Range Code 3216 Point Mugu, California Attn: Mercury Area Coordinator	6
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