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MSFN NETWORK OPERATIONS PROCEDURES FOR UHF COMMAND SYSTEM

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GODDARD SPACE FLIGHT CENTER GREENBELT, MARYLAND

MSFN

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FOR

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Greenbelt, Maryland

PREFACE

The purpose of this document is to provide the standard operating procedures for the ultra high frequency command systems at the Manned Space Flight Network stations. General characteristics of the equipment, operating instructions, and an equipment prepass checklist are included.

This document will be changed by Document Change Notices (DCN's), printed page changes, or by a complete revision.

All comments, suggestions, and questions should be directed to the Digital Systems Section, Code 822.2, Goddard Space Flight Center, Greenbelt, Maryland, 20771.

DCN CONTROL SHEET

Use this control sheet to record the DCN changes to this document.

| | DTG | Sect.* | Initials | | DTG | Sect.* | Initials |
|---------------|-----|--------|----------|--------|-----|--------|--|
| DCN 1 | | | | DCN 31 | | | |
| DCN 2 | | | | DCN 32 | | | |
| DCN 3 | | | | DCN 33 | | 5 | |
| DCN 4 | | | | DCN 34 | | | |
| DCN 5 | | | | DCN 35 | | | |
| DCN 6 | | | | DCN 36 | | | |
| DCN 7 | | | | DCN 37 | | | |
| DCN 8 | | | | DCN 38 | | | |
| DCN 9 | | | | DCN 39 | | | |
| DCN 10 | | | | DCN 40 | | | |
| DCN 11 | | - | | DCN 41 | | | |
| DCN 12 | | | | DCN 42 | | | |
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| DCN 28 | | | | DCN 58 | | | |
| DCN 29 | | | | DCN 59 | | | |
| DCN 30 | | | | DCN 60 | | | |

*The section(s) affected and initials of the person incorporating a change should be entered on the lines provided when the change has been incorporated into this document.

SECTION 1. GENERAL

The Ultra High Frequency (UHF) command control, radio transmitting system employs a multichannel, frequency modulated transmitter to send command signals from the Manned Space Flight Network (MSFN) stations to a space vehicle. The Radio Frequency (RF) carrier used in the UHF command system ranges from 406 to 549.5 MHz. The RF carrier is modulated by selected tones produced by an audio frequency coder or by a composite 1- and 2-kHz phase-shift keyed signal from the 642B computer via the Updata Buffer (UDB). Transmitted signals are monitored by an internal monitor receiver, and audio decoder, or by the 642B computer via the UDB. A block diagram of a typic UHF command system is shown in figure 1-1. Table 1-1 is a UHF command system equipment summary.



Figure 1-1. Block Diagram of a Typical UHF Command System

1 - 2

| and the second se | | | | | |
|---|--|------------------------------------|--|---|-------------------------------------|
| Station | Antenna (Type and Quantity) | Transmitter (Type and Quantity) | Power Amplifier (Type and Quantity) | Dummy Load (Type and Quantity) | Modulating Sources Available* |
| ACN | UHF Quadhelix array (1) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB |
| BDA | UHF Quadhelix array (2) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB TCS** DRSS |
| CRO | UHF Quadhelix array (2) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB TCS |
| СҮІ | UHF Quadhelix array (2) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB TCS |
| GWM | UHF Quadhelix array (1) | UHF AN/FRW-2A (1) | 240D-2 (1) | 20 kW (1) | UDB |
| HAW | UHF Quadhelix array (2) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB TCS |
| TEX | UHF Quadhelix array (2) | UHF AN/FRW-2A (2) | 240D-2 (2) | 20 kW (2) | UDB TCS |
| VAN | Type 5–1 UHF command antenna (1) | UD-10 (2) | UD-20 (2) | Low-power transmitter (2) High-power amplifier (2) | UDB |

Table 1-1. UHF Command System Equipment Summary

*Explanation of terms:

TCS (Tone Command System [20 IRIG channels]) DRSS (Digital Range Safety System)

**IRIG tones are controlled remotely from Wallops Island via the time division multiplexer and Northern Radio equipment.

2.1 ANTENNA SYSTEM

2.1.1 LAND-BASED STATIONS

The antenna system at land-based stations (except GWM and ACN) consists of two UHF quadhelix arrays mounted on independent pedestals. The UHF arrays are designed to operate over a frequency range from 406 to 549.5 MHz at up to 10 kW Continuous Wave (CW) power. The beam pattern is conical with a 20-degree beamwidth at the 3-dB point and provides a nominal gain of 18 dB. Polarization is left-hand circular. The antennas are normally positioned using azimuth and elevation data received through the acquisition bus from a tracking system such as USB, acquisition aid, or radar. The antennas may also be positioned manually by hand wheels.

2.1.2 VAN

The VAN antenna system consists of two separate quadhelix arrays (UHF and VHF) mounted on a single pedestal. The VAN UHF antenna is designed to operate over a frequency range from 406 to 450 MHz at up to 15 kW CW power. The beam pattern is conical with a 20-degree beamwidth at the half-power point and provides a nominal gain of 18 dB. Polarization is left-hand circular. Antenna positioning can be accomplished by one of three methods: (1) synchro data inputs from a remote data source such as USB or radar (slave mode), (2) information from an external source, whereby the antenna is manually positioned to follow a positioning indicator (local match mode), or (3) manually (local mode).

2.2 TRANSMITTER SYSTEM

2.2.1 LAND-BASED STATION

The transmitter system at each land-based station consists of an AN/FRW-2A transmitter, and R-669A/URW monitor receiver, and a KY-172/URW audio decoder. Duplicate standby equipment is provided for each station except GWM. The FM transmitter operates on a frequency range from 406 to 595 MHz at 500-watts nominal power output. For low-power operation, the control system is used to switch the transmitter output directly to the antenna; for high-power operation, the transmitter output is coupled through a power amplifier. The monitor receiver is loose-coupled to the transmitter output and operates on the same frequency. The monitor receiver also provides a means of demodulating the transmitted commands for verification. The audio decoders consist of 20 Interrange Instrumentation Group (IRIG) amplifier channels between 7.5 and 73.95 kHz. The output of the tone decoder channels is available for monitoring when tone coded commands are used.

2.2.2 VAN

The VAN transmitting system has essentially the same characteristics as the landbased stations. The VAN employs a UD-10 transmitter which operates from 406 to 500 MHz. Duplicate standby equipment is provided. The VAN monitor receiver and audio decoders also have the same capabilities as land-based stations but are of other manufacture.

2.3 POWER AMPLIFIER SYSTEM

The power amplifier system employs 240D-2 power amplifiers (UD-20 for VAN) and operates on a frequency range from 400 to 500 MHz (406 to 500 MHz for VAN). The power amplifier system nominal power output is 10 kW.

2.4 CONTROL CONSOLES

2.4.1 LAND-BASED STATIONS

The control consoles contain panel units associated with the system control and switching circuits. In addition, the consoles contain two KY-171/URW audio frequency coders for IRIG tone coded commands. At BDA, range safety override and digital range safety interface panels are installed. At all stations (except GWM), a primary and a secondary control console is available. Either the primary system or the standby system can be placed in single system operation or both systems may be placed in dual system operation at the primary console.

2.4.2 VAN

The VAN control console consists of several bays of equipment which have control and monitor functions similar to the land-based station consoles.

SECTION 3. OPERATING INSTRUCTIONS

3.1 RADIATION CLEARANCE

Stations must adhere to applicable command carrier radiation clearance procedures.

3.2 RANGE SAFETY

Stations required to support range safety functions will be provided detailed mission information in the NOP supplements.

SECTION 4. EQUIPMENT PREPASS CHECKLIST

4.1 LAND-BASED STATIONS

4.1.1 SWITCHES AND INDICATORS

| | Unit/Function | Indication/Setting | | |
|--|--|--|--|--|
| a. | PRIME/MANUAL switch | PRIME ONE | | |
| b. | HIGH POWER switch | ON (only when pushbutton is depressed) | | |
| c. | CARRIER switch | OFF | | |
| d. | Both AUTO/DISABLE switches | AUTO | | |
| e. | Antenna control | LOCAL | | |
| f. All units shown in dummy load except 240D-2 No. 1 shown to ANTENNA | | | | |
| g. | All alarm lamps | Extinguished | | |
| h. | S-9 indicating direct drive-in | Green | | |
| i. FR | MANUAL/AUTO switch on both W-2's | AUTO | | |
| j. am | Antenna control units – plidynes ON | ON | | |
| k. on | LOCAL/REMOTE switch 240D-2 | REMOTE | | |

4.1.2 METER READINGS

4.1.2.1 <u>AN/FRW-2A</u>

MeterIndicationa. Exciter grid1 mA (minimum)b. Driver grid9 mA (minimum)c. Driver plate150 to 200 mAd. PA grid25 to 100 mAe. PA screen35 mA (maximum)f. PA plateLess than 500 mA (nominally 220 to 300 mA)

- g. Direct power
- h. Reflected power

4.1.2.2 <u>240D - 2 (Carrier Off)</u>

Meter

- a. Collector current
- b. Beam voltage
- c. Body current
- d. Drive power
- e. Output power
- 4.2 VAN
- 4.2.1 SWITCHES AND INDICATORS

(To be supplied)

- 4.2.2 METER READINGS
- (To be supplied)

600 W

Less than 200 W (nominally 35 W)

Indication (Nominal) 1.5 A 1650 V 40 to 60 mA 28 W 0