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COMMUNICATIONS SYSTEM FOR ZERO-G SIMULATION IN WATER

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ABSTRACT

This report presents a description of a two-way communications system connecting nine personnel stations and a public address system. The system includes underwater speakers that can be heard by the safety divers.

Operating instructions for the system are also given.

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MANUFACTURING ENGINEERING LABORATORY
RESEARCH AND DEVELOPMENT OPERATIONS

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COMMUNICATIONS SYSTEM FOR ZERO-G SIMULATION IN WATER

SUMMARY

A system providing communication between personnel conducting underwater neutral buoyancy experiments is described. The communications system connects seven observers, a diver, and a spare station. All communications are broadcast over a public address system which includes underwater speakers.

The feasibility of providing two-way communication between the safety divers and other personnel is currently under investigation.

INTRODUCTION

The Manufacturing Engineering Laboratory of the George C. Marshall Space Flight Center has been conducting tests concerned with fabrication, assembly, maintenance and repair of large structures and associated apparatus under conditions of weightlessness. Zero-G simulation techniques using a water tank and a test subject in an underwater pressure suit are employed in these tests.

The primary safety requirement is to establish and maintain two-way communications between the test subject and personnel in control of life support. Test personnel must be advised immediately of any malfunction in the pressure suit or equipment so that corrective action can be taken.

To avoid delay, a temporary communications system was designed and placed in service. This was a small, portable, 12 volt system with communications between only two people and the man inside the suit. This was considered adequate for testing the suit and for a few minor experiments. All requirements for the neutral buoyancy communications system were established by taking into consideration the following two items:

1. The safety of the diver

2. What was needed to adequately perform any anticipated future experiments.

DESCRIPTION

The system was designed with nine two-way communication stations, and three one-way stations. There is a main audio level control for the system with an individual audio level control for each station. The two-way communication units consist of the following positions:

1. Experiment Conductor
2. Life Support Controller
3. Medical Doctor
4. Data Engineer
5. Deck Safety Man No. 1
6. Deck Safety Man No. 2
7. Video and Tape Recorder
8. Pressure Suit
9. Spare

The pressure suit must have two-way communications at all times. All other stations will be on receiving at all times, with the transmission of any or all positions (except the pressure suit) controlled by the controller at the main panel (Fig. 1). The controller may select any of three modes of operation for any station (Fig. 2): talk, press to talk, or off. In the "talk" mode, the operator may talk at will. In the "press to talk" mode, the operator must first depress a switch before talking over the system. In the "off" mode, the operator can only listen. However, if he wishes to talk, he may depress the "press to talk" switch. This will turn on a light on the main panel indicating which operator would like to speak (Fig. 2). The controller may then switch the station into the system or not, as he so chooses.

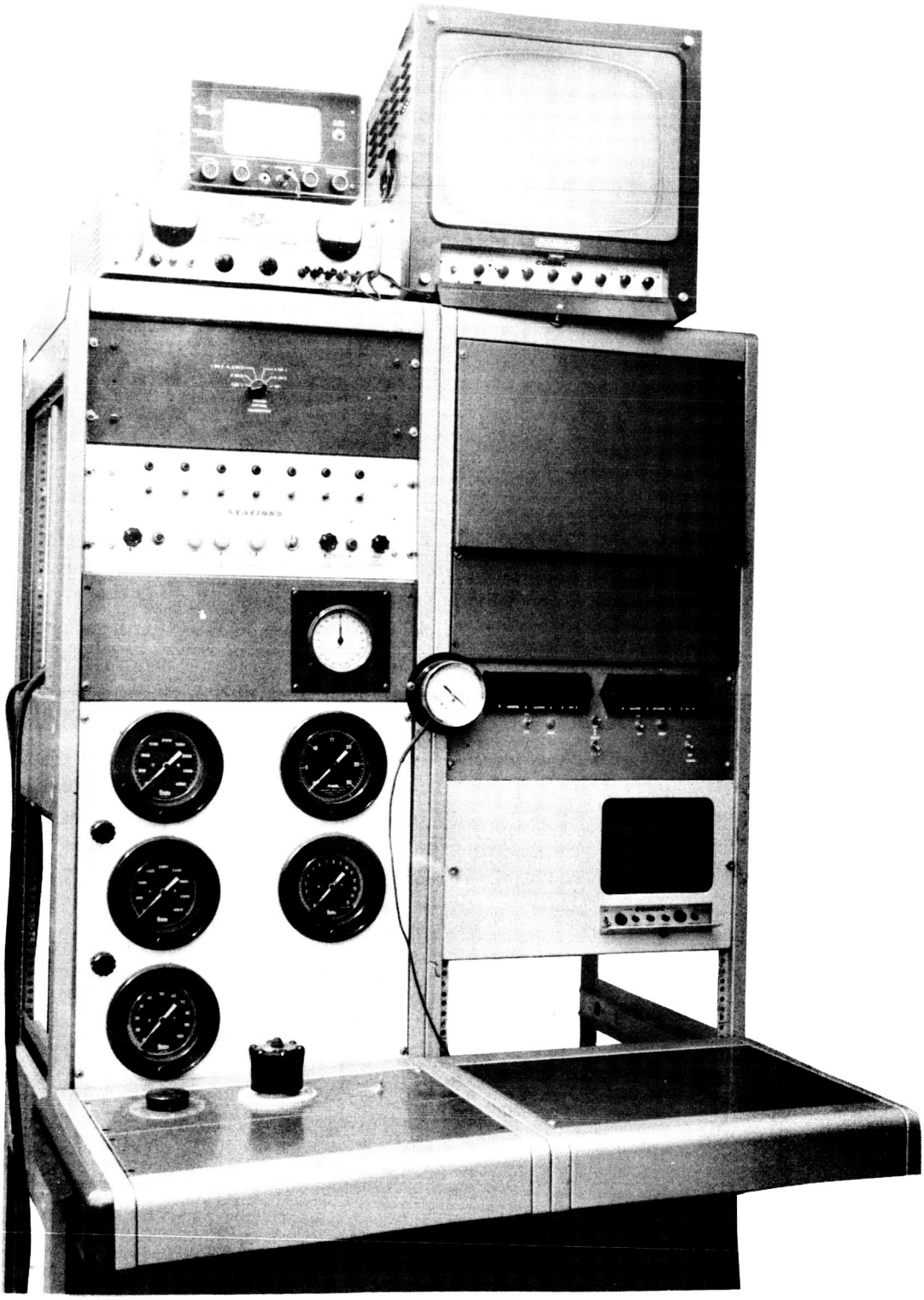


FIGURE 1. LIFE SUPPORT CONTROL CONSOLE

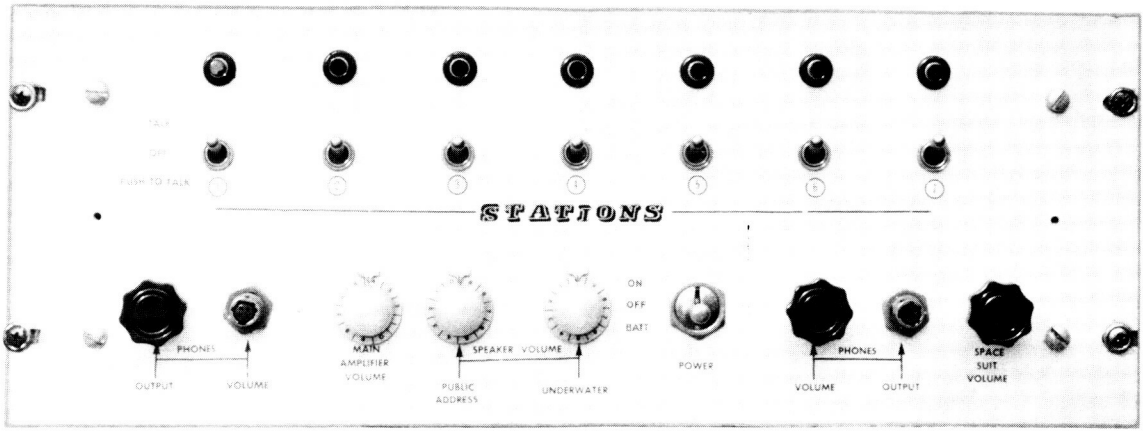


FIGURE 2. MAIN CONTROL PANEL

The one-way stations are a public address speaker system designed to drive 20 watts peak audio power, and an underwater speaker system capable of driving 100 watts audio power. The underwater system consists of two 50-watt amplifiers. Each amplifier may be used to drive two 16-ohm, 25-watt underwater speakers. However, it has been determined that, for the 25-foot diameter, 15-foot deep tank, two 25-watt speakers are adequate. Therefore, the system was designed to switch either amplifier to either set of speakers. This gives a capability of putting 100 watts of audio power into the water if it is needed, and also, during normal operation, furnishes a stand-by amplifier and a set of speakers in the event either stops functioning (Fig. 3). The operation of the underwater speaker system is necessary at all times because the safety divers need to hear all communications and should not be restricted with connecting cables.

The complete system was designed to operate from a 12 volt battery as a stand-by power source. In the event of a power failure, the system may be switched to battery operation by turning the power "ON-OFF-BATT" switch to "BATT."

System wiring diagrams are presented in the Appendix.

OPERATING INSTRUCTIONS

Operation of the neutral buoyancy tank communication system is simple and straightforward. Instructions for placing the system in operation and shutting it down are presented below.

System Operation

1. Place underwater speakers 18 inches below water surface.

2. Turn power "ON-OFF-BATT" switch to "ON. "

3. Turn underwater speaker and amplifier switch to desired combination (located on amplifier panel).

4. Turn "SUIT VOLUME CONTROL" full clockwise.

5. Increase "MAIN VOLUME CONTROL" for desired audio in suit headset.

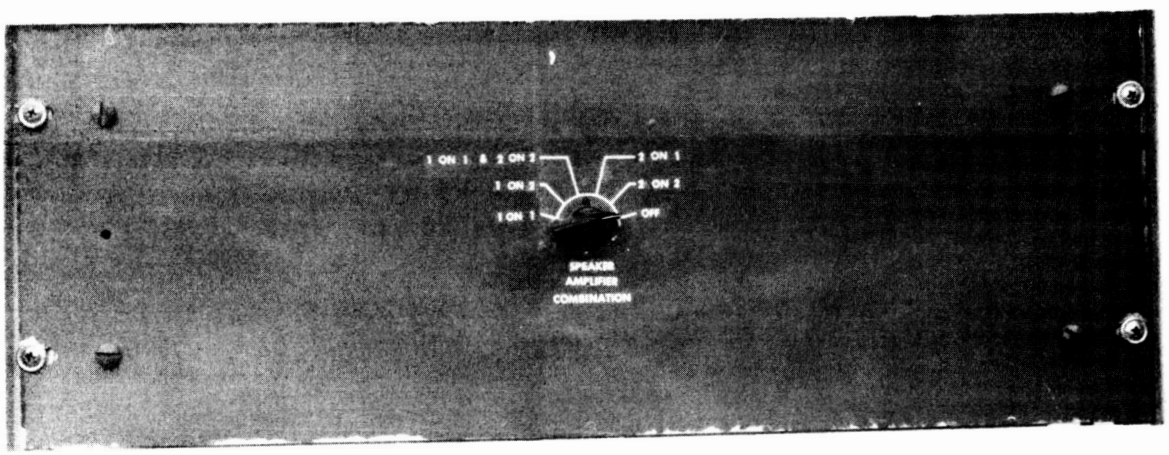


FIGURE 3. AMPLIFIER CONTROL PANEL

6. Adjust "UNDERWATER SPEAKER VOLUME CONTROL" for desired underwater audio level. (If audio level remains low with volume control in full clockwise position, increase main volume control for desired level and then adjust suit volume control.)

7. Select mode of operation for each station, i.e., "TALK," "OFF," or "PRESS TO TALK." The station 5 mode-selector switch controls the station on the left side of the front panel. The station 6 mode-selector switch controls the modes of operation for the station on the right side of the main panel.

8. Adjust public address "SPEAKER VOLUME CONTROL."

9. Adjust each station "VOLUME CONTROL" for desired audio level.

System Shutdown

1. Switch power switch to "OFF."

2. Turn underwater speaker switches to "OFF" (on amplifier panel).

3. Remove underwater speakers from water.

NOTE:

a. In the event of power failure switch power switch to "BATT" position.

b. Main amplifier volume control should be as low as possible for adequate audio level.

c. Underwater speakers should be removed from water when not in use.

RECOMMENDATIONS

From the experience obtained in the zero-G simulation tank, it is felt that two-way communications between the safety divers and the test subject is necessary for maximum safety. At this time the safety divers can only listen. A system is now being designed that will furnish two-way communications between the safety divers, the test subject, and all other stations; and will be in operation by May 1, 1967.

APPENDIX

SYSTEM WIRING DIAGRAMS

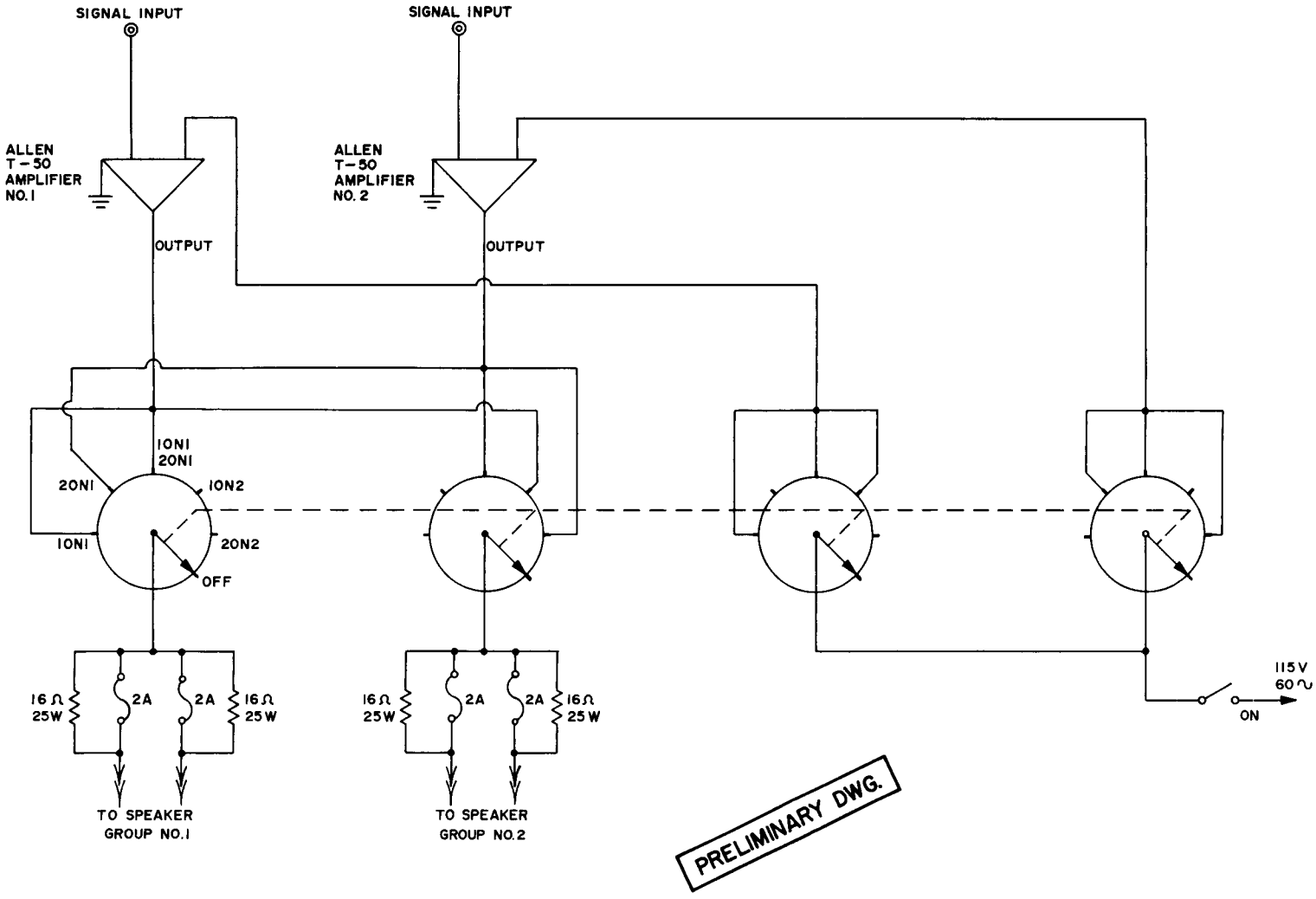


FIGURE A-1. SPEAKER CONTROL COMMUNICATIONS SYSTEM
FOR ZERO-G SIMULATION IN WATER MR & TsK 1070-2

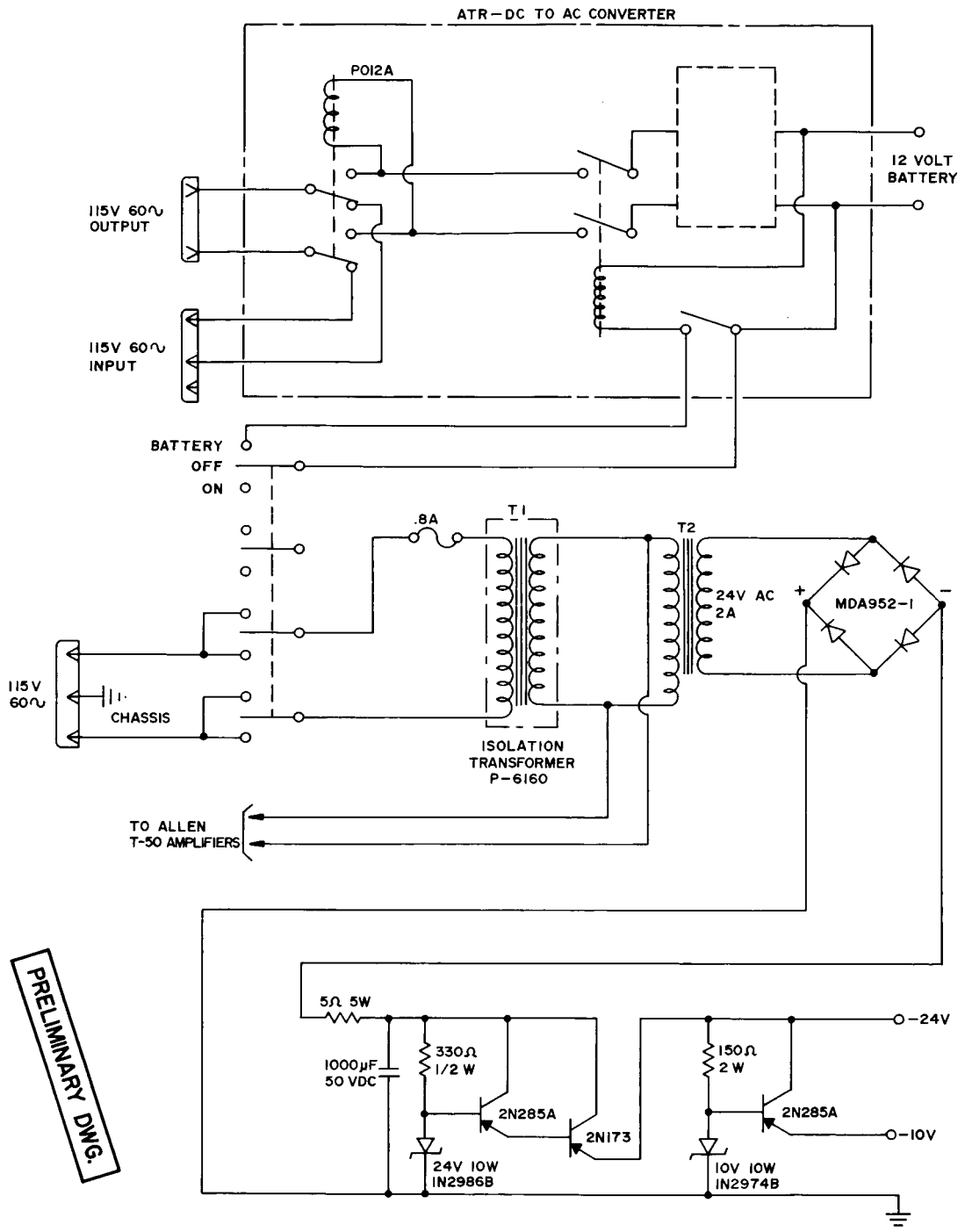
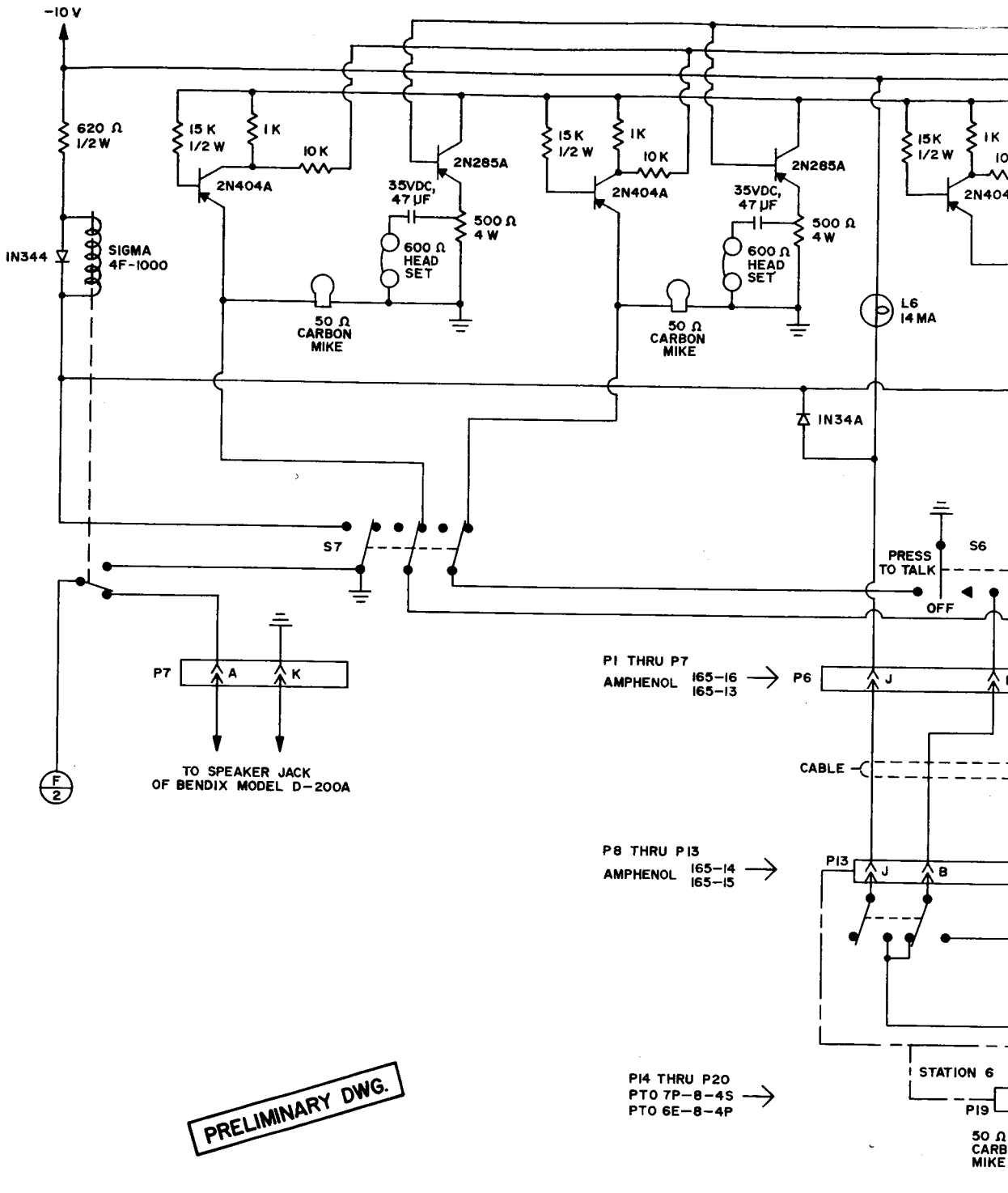
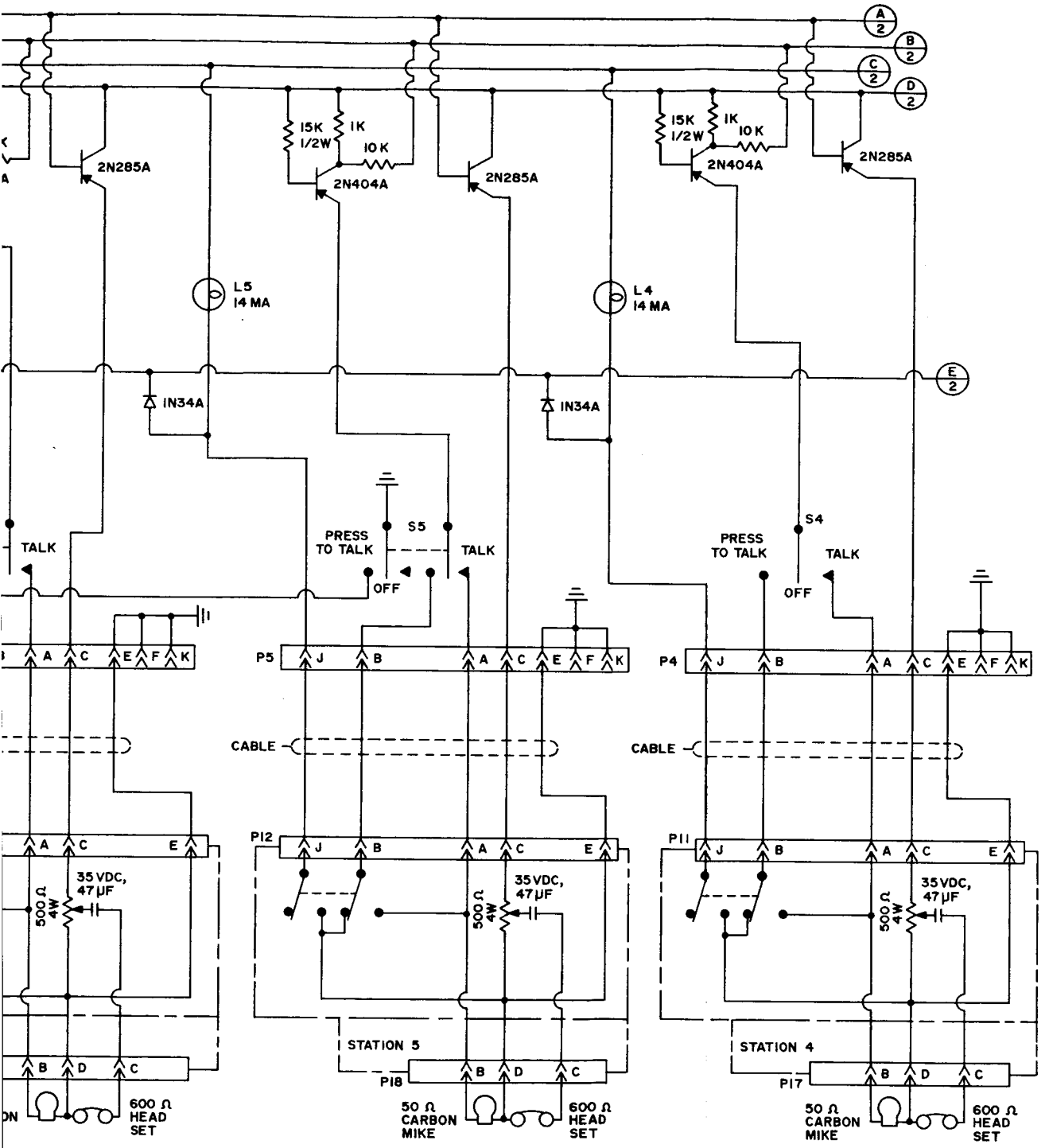


FIGURE A-2. POWER SUPPLIES FOR COMMUNICATIONS SYSTEM - ZERO-G SIMULATION IN WATER MR & TsK 1070-1



A-3a

FIGURE A-3a. COMMUNICATION SYSTEM FOR ZERO-G SIMULATION IN WATER MR&TsK 1070-0



NOTES:

1. SEE MR & T sk 1070-18-2 FOR WIRING DIAGRAM ON POWER SUPPLIES AND SPEAKER CONTROLS.

A-3a

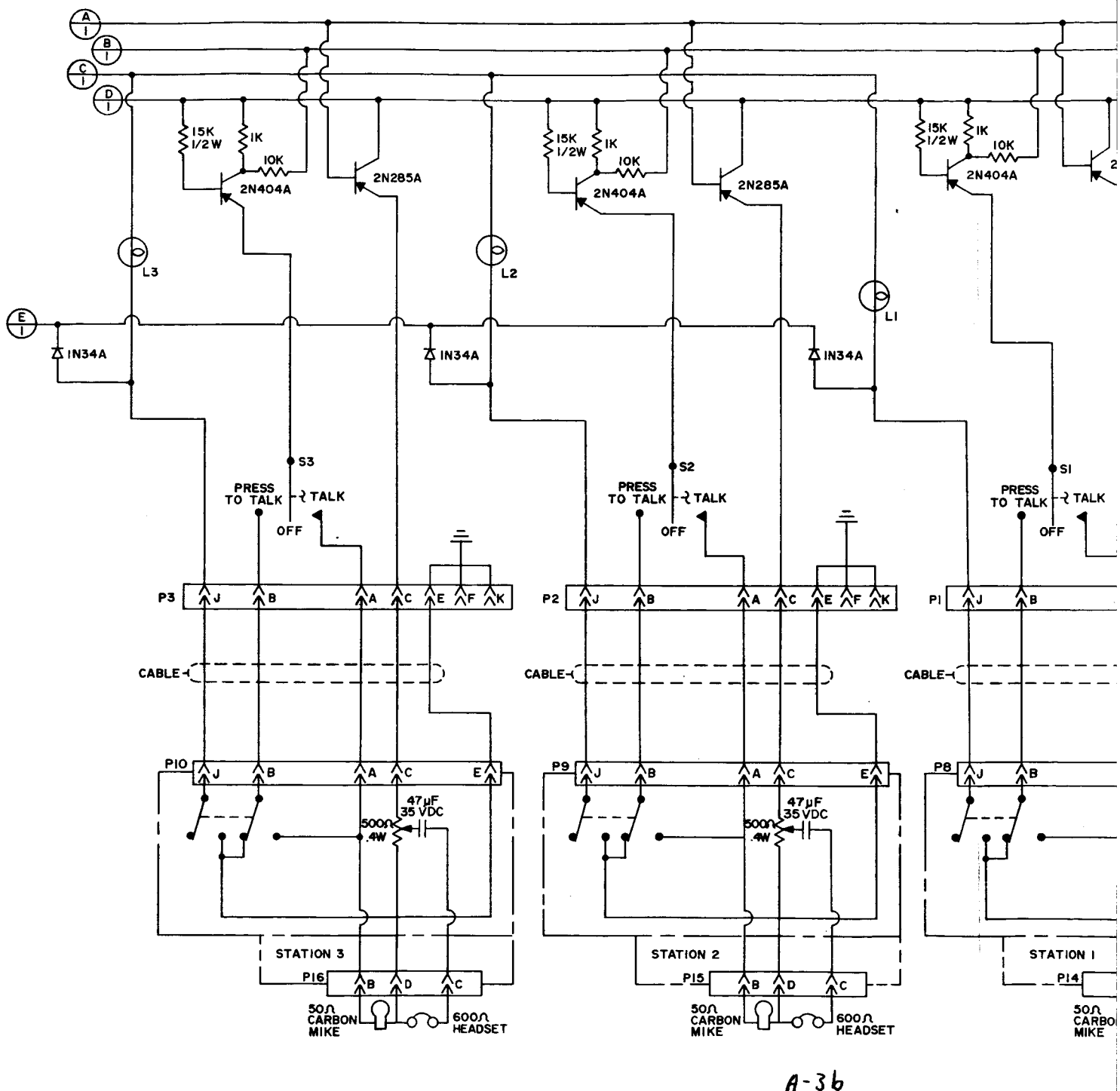


FIGURE A-3b. COMMUNICATION SYSTEM FOR ZERO-G SIMULATION IN WATER MR&TsK 1070-0

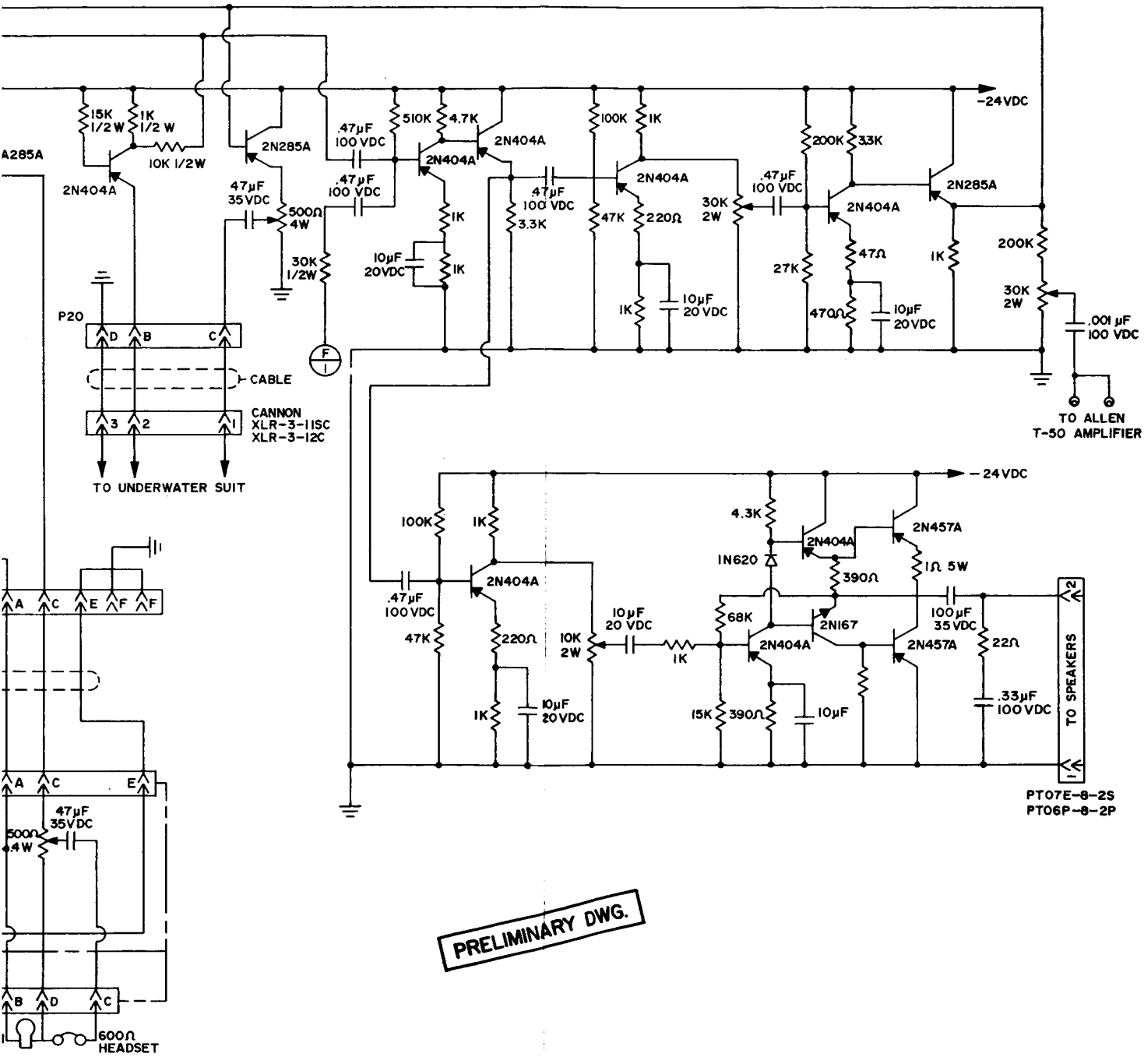


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FIG. A-36 PAGE 15