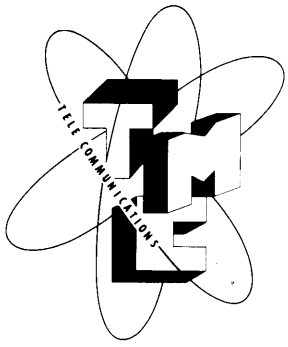
INSTRUCTION BOOK

for

# DUAL DIVERSITY RECEIVER MODEL DDR-2




THE TECHNICAL MATERIEL CORPORATION
Mamaroneck, New York

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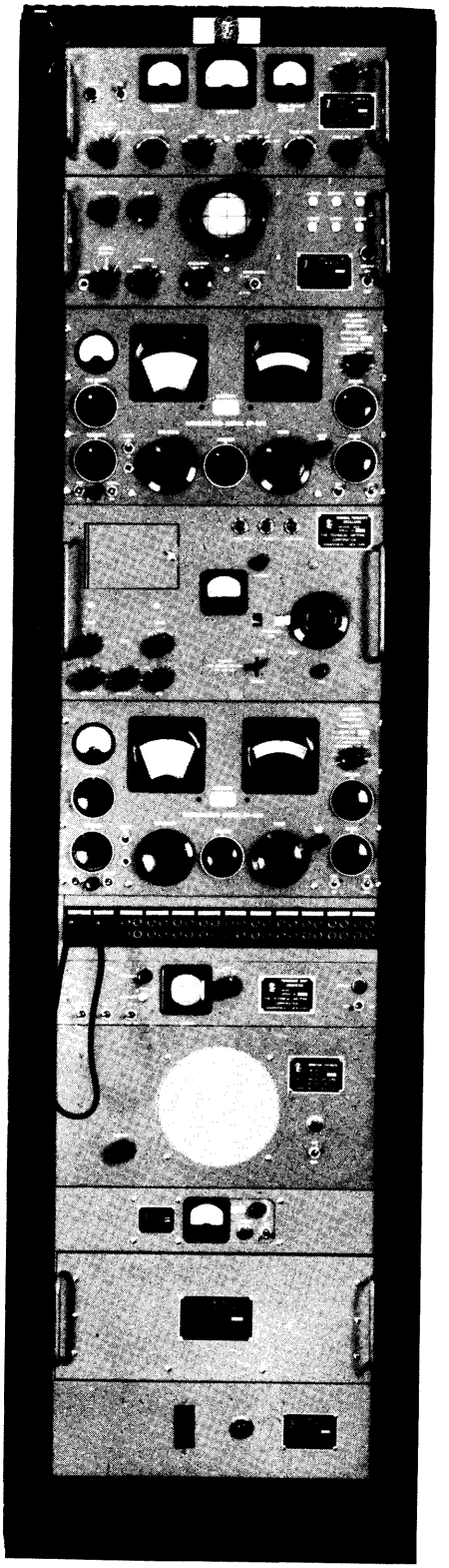


Figure 1-1. Dual Diversity Receiver, Model DDR-2A,
Front View

# SECTION I
# GENERAL DESCRIPTION

## 1. PURPOSE AND BASIC PRINCIPLES

The Dual Diversity Receiver, Model DDR-2 is a space and frequency diversity system designed to receive AM, FS, CW and MCW signals within the range of .54 to 54.0 megacycles. The Model DDR-2 provides visual and audio method of monitoring the receiver tuning, and simple patching arrangements which provide a highly efficient, easy to operate, receiving terminal.

The DDR-2 system permits simultaneous dual reception of an incoming signal of a single transmitting frequency or an incoming signal transmitted on two seperate frequencies. Two complete specially-modified Communication Receivers comprise the input sections and are designed for common oscillator control on a Master-Slave basis or with an external Master Oscillator. The Master-Slave arrangement effects internal common oscillator control, and when operated as such, either one of the receivers supplies HFO, IFO, and BFO injection voltage to itself and to the other receiver for frequency control. These voltages may also be supplied to the receivers by an external source, such as the TMC Variable Frequency Oscillator, Model VOX. Frequency diversity reception may be effected in the DDR-2 system by utilizing both receivers on a master basis (no external oscillator voltages being necessary).

Diversity combination of telephone or broadcast signals is accomplished by the TMC Diversity Combining Unit, Model DCU which provides a common output of both diversity receivers. Reception of CW and MCW signals is also affected by the DCU. The I.F. voltages are applied to this unit, where they are amplified, rectified, and combined in a common load. The resultant D.C. pulses excite a local tone keyer, whose output may be patched for external use. The Automatic Volume Control circuits are combined in the Model DCU, where the AVC time constant is established and controlled by a front panel switch having five different positions.

Radio printer reproduction is effected by the TMC Frequency Shift Converter, Model CFA, which provides electronic neutral keying of local or remote lines. The CFA includes a visual monitor indicator, which permits a constant check of the incoming signal relative to the discriminator center. When receiving frequency shift teleprinter intelligence, the receivers are operated with common HFO, IFO and BFO. The two audio outputs of the receivers are patched into the Model CFA, whose output is then fed into the TMC Teletypewriter Regenerator, Model SFO-2. The SFO-2 is used to correct bias distortions in teletype signals and to regenerate single channel teletype signals for the operation of a teletype printer. Monitoring of the incoming signal is made possible by the TMC Diversity Visual Monitor, Model DVM which permits a quick analysis of the frequency spectrum in the immediate vicinity of the received signal. The TMC Power Supply, Model PSP is used to provide plate power for the current amplifier in the Model CFA and is also connected in series with the Model SFO-2 output to operate a teletypewriter printer.

## 2. DESCRIPTION OF UNIT

The Model DDR-2A consists of the following equipment mounted in a deluxe 84 inch rack type cabinet, complete with all necessary cables and harness. This system provides operation with a teleprinter, on a Master Oscillator, basis and/or on a Master-Slave basis:

1. Two Communication Receivers, Model DMK-*
2. One TMC Diversity Combining Unit, Model DCU.
3. One TMC Diversity Visual Monitor, Model DVM.
4. One TMC Line Patching Panel, Model LPP.
5. One TMC Monitor Speaker, Model LSP.
6. One TMC Power Control Panel, Model DCP.
7. One TMC Variable Frequency Oscillator, Model VOX.
8. One TMC Frequency Shift Converter, Model CFA.
9. One TMC Power Supply Assembly, Model PSP-1.

The front view, figure 1-1 illustrates the above system in its complete form and shows how the units are distributed. Each of the units bears an identifying nameplate. For operating convenience, indicating devices such as diode current meters, level meter, and monitor scope have been positioned for ease of observation, and the controls most frequently used have been placed where they are readily accesible. System wiring is provided by a fool-proof, color-coded cable and harness. Positive connections are insured by the use of barrier type terminals and mating fanning strips. Power line outlet strips running vertically along

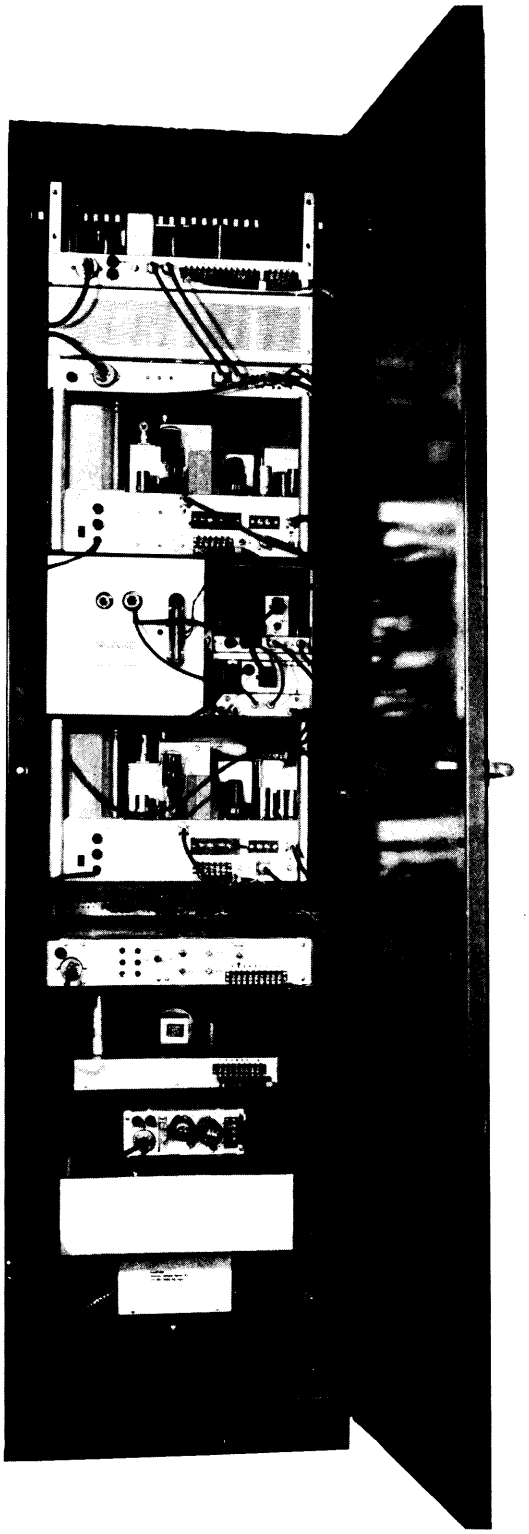


Figure 1-2. Rear View, Dual Diversity Receiver, Model DDR-2A

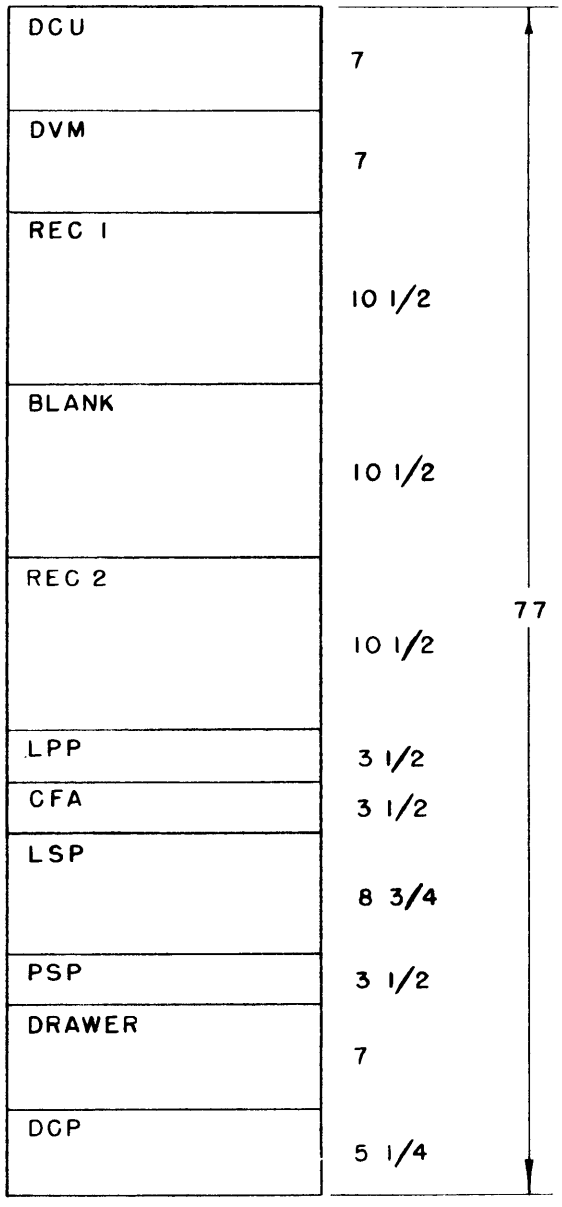



Figure 1-3
Rack Mounting Layout, Model DDR-2B

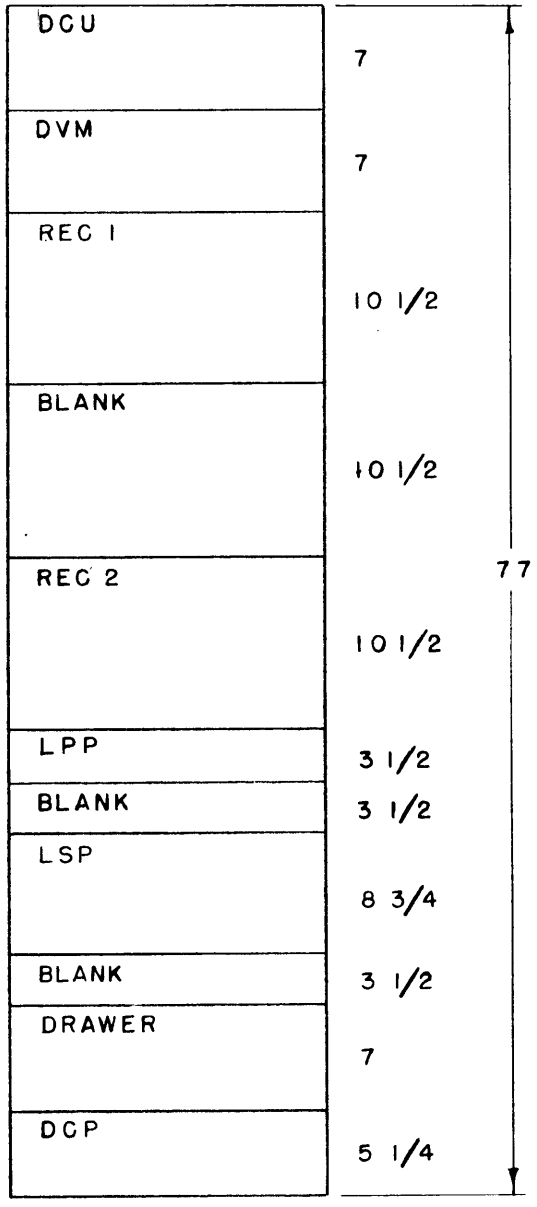



Figure 1-4
Rack Mounting Layout, Model DDR-2C

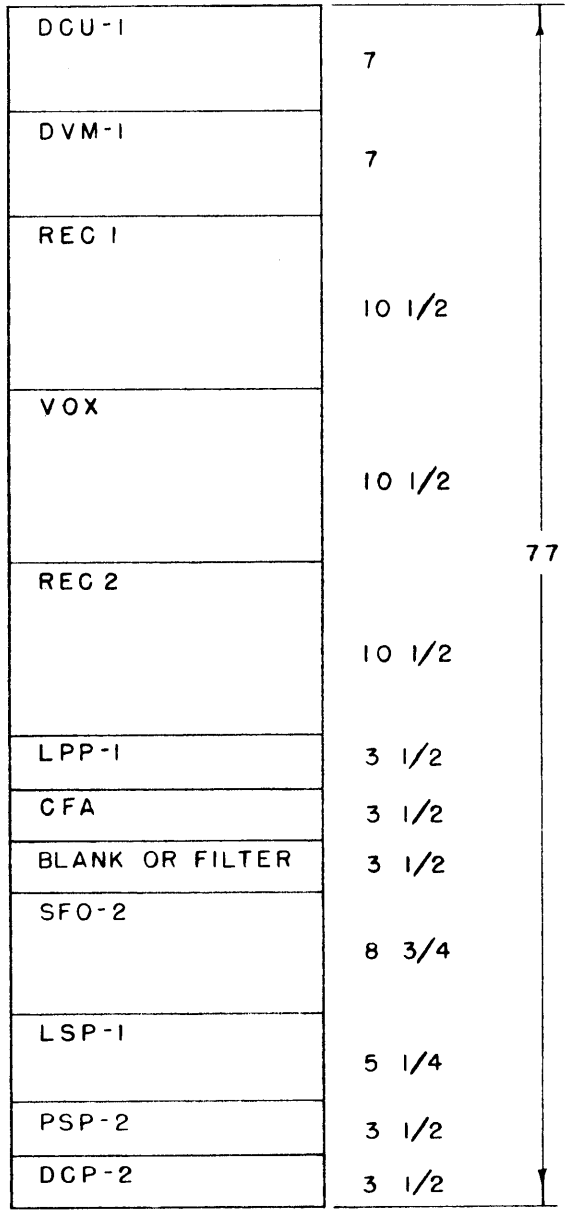



Figure 1-5
Rack Mounting Layout, Model DDR-2D

the rear of the rack deliver A.C. power to the various units. Each unit has its individual dust cover, while the rack as a whole is completely enclosed but accessible through a rear door. Figure 1-2 shows the rear view of the mounted equipment with the rack rear door open. A storage compartment for headphones, patching cords, etc., is mounted near the bottom of the rack.

Other combinations of the basic DDR-2 System are available to suit particular requirements. System DDR-2B consists of the afore listed units with the exception of the TMC Variable Frequency Oscillator, Model VOX, and provides reception on a MASTER - SLAVE basis and diversity combining for frequency shift operation.

System DDR-2C consists of the above named equipments with the exception of the following units, and provides operation on a MASTER - SLAVE basis:

1. The T.M.C. Variable Frequency Oscillator, Model VOX.

2. The T.M.C. Frequency Shift Converter, Model CFA.

3. The T.M.C. Power Supply Assembly, Model PSP-1.

System DDR-2D consists of the above named equipment in addition to the following units, and provides operation with on Master Oscillator and/or on a MASTER-SLAVE basis for reception of AM, FS and CW/MCW signals.

1. The T.M.C. teletypewriter Regenerator, Model SFO-2.

2. The T.M.C. Power Supply Assembly, Model PSP-2. (instead of PSP-1).

Figures 1-3, 1-4 and 1-5, respectively, illustrate the layout and distribution of the individual units for the various systems.

## 3. TECHNICAL SPECIFICATIONS

FREQUENCY RANGE:
.54 to 54 Mcs. in six bands, continuously tuned by means of a single dial calibrated directly in frequency.

MODES OF OPERATION:
CW, MCW, FS, Phone or Broadcast.

PERFORMANCE DATA:

SENSITIVITY:
2.3 microvolts (S/N ratio of 10/1).

IMAGE REJECTION:
Better than 80 db throughout entire frequency range.

IF REJECTION RATIO:
2700/1 (600 kc).

AVC CIRCUIT:
AVC action will maintain output constant within 12 db when input is increased from 2 to 200,000 microvolts. A series of 5 different AVC time constants are available as a front panel adjustment.

OSCILLATOR:
HFO, IFO, and BFO circuits have been modified to provide for: a) External oscillator injection using the TMC Variable Frequency Oscillator, Model VOX. b) Master-Slave operation, the HFO, IFO, and BFO of each receiver provide output voltages for injection into the corresponding stages of a companion diversity receiver.

ANTENNA CIRCUIT:
The receiver inputs are for use with a balanced or unbalanced line of 100 ohms nominal impedance.

OUTPUT FACILITIES:
a) Provision for two outgoing telephone lines available at the patch panel.

b) Each receiver is capable of supplying 2.5 watts of undistorted output from a 600 ohm balanced split winding. Also deliveries 15 milliwatts to an 8,000 ohm resistive load when the audio output to the 600 ohm power load is adjusted to 500 milliwatts.

c) Diversity combined outputs:
1. For CW/MCW operation, either a high impedance output of D.C. pulses or a 600 ohm noise-free tone is available. This tone is fixed at 2125 cps but is obtainable in other frequencies if so desired.

2. For phone operation, the output available is as in part (b) above.

3. For FS operation, the individual audio outputs of each receiver are available for use by an audio type frequency shift converter (TMC Model CFA).

MONITORING FACILITIES:
a) Headphone jacks on each receiver.

b) Loud Speaker Panel, Model LSP for monitoring each receiver output, the diversity combined output, or the tone keyer output.

c) A volume level meter having a range of minus 20 dbm to plus 43 dbm and intended to read the outputs as in (b) above.

d) Two diode current meters which read the contribution of each diversity channel to the combined load.

e) An oscilloscope on the DVM for observing the tuning of each channel and for observing the frequency spectrum adjacent to the received signals.

f) A signal strength meter on each receiver.

g) An oscilloscope (on the CFA) to facilitate centering the audio tone on the discriminator and for observing the degree and direction of drift which may take place.

h) A milliammeter for observing the teleprinter line current. (on the PSP)

POWER REQUIREMENTS:

110/220 volts A.C., 50/60 cps, 450 watts for the basic system; approximately 800 watts when all auxiliary equipment is included.

FUSES:

Each unit has individual fuse protection The rack as a whole (with the exception of the VOX) is covered by a $7\frac{1}{2}$ amp circuit breaker.

DIMENSIONS AND WEIGHT:

7' high x 3' wide x 2' deep, 500 lbs.

TUBE COMPLEMENT:

a. Each component Receiver, Model DMK-*

| | | |
|---|---|---|
| R.F., I.F. and BFO Amplifiers | 7 ea. | 6BA6 |
| HFO, 2nd. Conversion and BFO. | 3 ea. | 6C4 |
| Crystal controlled HFO | 1 ea. | 6AC7 |
| Mixers | 2 ea. | 6BE6 |
| Detector, Rectifier, Noise Limiter | 3 ea. | 6AL5 |
| AF Amplifier and I.F. Output | 1 ea. | 12AU7 |
| Power Output. | 1 ea. | 6V6GT |
| Rectifier. | 1 ea. | 5R4GY |
| Voltage Regulator. | 1 ea. | OA2 |
| R. F. Amplifiers | 1 ea. | 6J6 |

b. Combining Unit, Model DCU

| | | |
|---|---|---|
| I.F. Amplifiers | 2 ea. | 6BA6 |
| Detector | 1 ea. | 6AL5 |
| Noise Limiter, Clamp | 1 ea. | 6AL5 |
| Pulse Amplifier | 2 ea. | 6AU6 |
| Keyer. | 1 ea. | 6C4 |
| Tone Amplifier | 1 ea. | 12AU7 |
| Tone Oscillator | 1 ea. | 6AQ5 |
| Power Supply Rectifier | 1 ea. | 5Y3GT |
| Negative Supply Rectifier. | 1 ea. | 6X4 |
| Voltage Regulators | 2 ea. | OB2 |
| Negative Supply Rectifier. | 1 ea. | OA2 |
| Negative Supply Rectifier. | 1 ea. | OB2 |

c. Variable Frequency Oscillator, Model VOX

| | | |
|---|---|---|
| Rectifier. | 1 ea. | 5V4G |
| Regulator | 1 ea. | OA2 |
| Mixer. | 1 ea. | 6BE6 |
| Audio Amplifier | 1 ea. | 12AU7 |
| BFO and VMO | 2 ea. | 6C4 |
| IFO and Amplifier | 1 ea. | 12AU7 |
| Crystal HFO and R.F. Amplifier | 1 ea. | 6C4 |
| R.F. Amplifier and Multiplier. | 5 ea. | 6AQ5 |
| Crystal Oscillator and Cathode Follower | 1 ea. | 12AU7 |

d. Diversity Visual Monitor Unit, Model DVM

| | | |
|---|---|---|
| 455 kc Oscillator and Amplifier | 2 ea. | 6AG5 |
| Detector-Audio Amplifier | 1 ea. | 6AT6 |
| Mixer. | 1 ea. | 6BE6 |

| | | |
|---|---|---|
| 100 kc Amplifier | 1 ea. | 6AG5 |
| Rectifier Clamp | 1 ea. | 6AL5 |
| Amplifier Cathode Follower | 1 ea. | 12AU7 |
| Sweep Oscillator | 1 ea. | 6J6 |
| Reactance Tube | 1 ea. | 12AU7 |
| Sawtooth Generator | 1 ea. | 884 |
| Horizontal and Vertical Amplifiers | 2 ea. | 12AX7 |
| Visual Monitor | 1 ea. | 3BP1 |
| Low Voltage Rectifier | 1 ea. | 5Y3GT |
| Low Voltage Rectifier | 1 ea. | 6X4 |
| Voltage Regulators | 2 ea. | OB2 |
| High Voltage Rectifier | 2 ea. | 6X4 |

e. Frequency Shift Converter, Model CFA

| | | |
|---|---|---|
| Tone Amplifiers | 2 ea. | 6AU6 |
| Tone Limiters | 2 ea. | 6J6 |
| Tone Power Amplifier | 1 ea. | 12AU7 |
| Discriminator Rectifier | 2 ea. | 6AL5 |
| Clamp | 1 ea. | 6AL5 |
| Pulse Amplifier | 2 ea. | 6AU6 |
| Monitor DC & AC Amplifier | 1 ea. | 12AU7 |
| Pulse Restorer | 1 ea. | 6J6 |
| Oscillator, Cathode Follower | 1 ea. | 12AU7 |
| Pulse Output | 1 ea. | 6Y6G |
| Rectifier | 1 ea. | 6X4 |
| Regulators | 3 ea. | OB2 |
| Regulator | 1 ea. | OA2 |
| Monitor | 1 ea. | 2BP-1 |

f. Power Supply, Model PSP-1

| | | |
|---|---|---|
| Rectifier | 1 ea. | 5Y3GT |
| Current Control | 1 ea. | 6Y6G |

g. Monitor Speaker, Model LSP

| | | |
|---|---|---|
| Amplifier | 1 ea. | 12AU7 |

h. Teletypewriter Regenerator, Model SFO-2

| | | |
|---|---|---|
| Audio Amplifier | 1 ea. | 6SN7GT |
| Series Limiter | 1 ea. | 6H6 |
| Rectifier | 1 ea. | 6H6 |
| Trigger | 1 ea. | 6SN7GT |
| Multivibrators | 4 ea. | 6SN7GT |
| Coincidence Gate | 1 ea. | 6SN7GT |
| Rectifier | 1 ea. | 5U4G |
| Voltage Regulators | 2 ea. | OD3 |
| Voltage Regulators | 2 ea. | OA3 |
| Control | 1 ea. | 6SN7GT |

COMPONENTS AND CONSTRUCTION:

Equipment is manufactured in accordance with JAN specifications where ever practicable.

We reserve the right to make changes in the design of our equipment, consistant with good engineering practice, in order to make improvements in design and to effect economies in manufacture.

# SECTION II
# THEORY OF OPERATION

## 1. OVERALL SYSTEM THEORY

In the Model DDR-2 (Space Diversity), two receiving antennas are to be placed at different locations with substantial spacings relative to the signal wave lengths involved. Fading of the received signals will probably not take place at each site simultaneously, and at least one antenna generally will experience a substantial interception of signal at any given time. The signals are so arranged in the receiving system as to combine in a manner such that the channel carrying the least degraded signal predominates, thus minimizing the likelihood of a complete loss of signal. Further improvement in reception is achieved by suppressing the noise from the degraded channel by action derived from the contributing channel. A common automatic gain control connection between the receivers is the method used to bring about this suppressing action in the system.

Frequency diversity reception constitutes the combining of 2 or more received signals having different carrier frequencies. These signals carry the same intelligence so that a common audio contribution is realized after the demodulation procedure. Since different parts of the radio spectrum are being used, the faults on one channel generally will not occur simultaneously with those of alternate frequency channels. The methods of combining and of arranging the best signal to predominate and suppress degraded signals are similar to those for space diversity. It is possible to operate the DDR-2 in frequency diversity by tuning in different signals on the receivers and combining in the same manner as for space diversity. However, the likelihood of frequency drift in the presence of variable operating conditions is greatly increased in this mode of reception. When operating the DDR-2 in frequency diversity, the cable connections between the IFO's HFO's, and BFO's of the receivers must be disconnected, and each receiver must be set to its MASTER Position.

Combining of the diversity signals takes place at the final demodulators. A common load for the rectification process is used, which in the case of the diode detectors, develops audio signal from whichever diverse source supplies the greatest amplitude at the moment. Rectified carrier direct current in this common load then creates a voltage which acts to delay or gate out the detecting ability of the diodes fed by the channel contributing degraded signal levels, and thus acts to suppress such signals. This D.C. voltage developed across the common load also provides the common automatic gain control potential applied to each channel receiver.

The two receivers operate with common BFO, IFO and HFO voltages, which are supplied by either receiver according to the operator's needs. This Master-Slave connection serves to prevent drift in opposite directions. The Variable Frequency Oscillator, Model VOX is available to supply all three oscillator voltages. The design of the Model VOX provides for crystal control of both the IFO and BFO, while the HFO is supplied by a highly stable, oven controlled variable frequency oscillator.

A simplified block diagram for CW/MCW Operation is illustrated in Figure 2-1. The I.F. voltages enter the Model DVM, where a small portion of the signal is picked off for the operation of this unit, while the full voltage is applied to the Diversity Combining Unit, Model DCU. Here the signal is greatly amplified, then rectified, and both channels combined in a common diversity load. The resultant D.C. pulses are shaped, freed of noise, and then used to key a tone oscillator. The output is a series of dots and dashes of fixed tone frequency, whose envelop is a square wave and whose pulse width may be varied by the operator. In addition, the two AVC's are combined in the Model DCU, where the operator may choose any of a series of time constants according to the prevalent signal conditions.

For Phone Operation (refer to Figure 2-2), the system hook-up is essentially the same as that for CW operation, except that the diversity load output is no longer fed to the pulse amplifiers. Instead, this voltage is patched to either receiver audio amplifier, amplified and returned again to the patch panel for external use.

For Frequency Shift Operation, (refer to Figure 2-3), the audio tone output of each receiver channel is patched into the Frequency Shift Converter, Model CFA. Within the CFA, a separate series of limiters and amplifiers treats each channel before diversity combination takes place at the discriminator rectifier outputs. The combined signal is then amplified, shaped, and fed into the teletypewriter Regenerator, Model SFO-2, which provides the output teletype signals in normal keying form and with less than 5% distortion for the operation of a teleprinter.

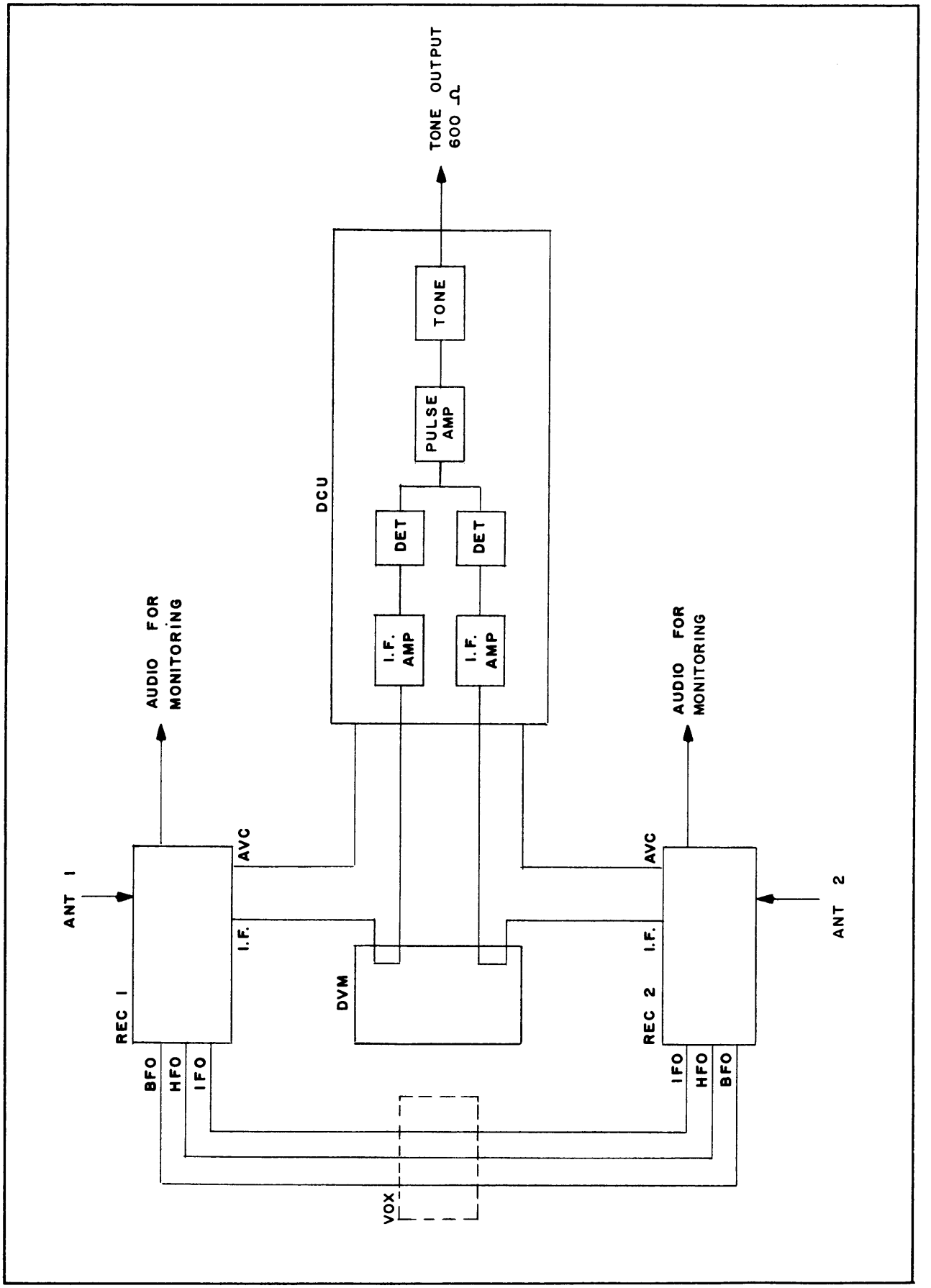



Figure 2-1. Block Diagram for CW/MCW Operation

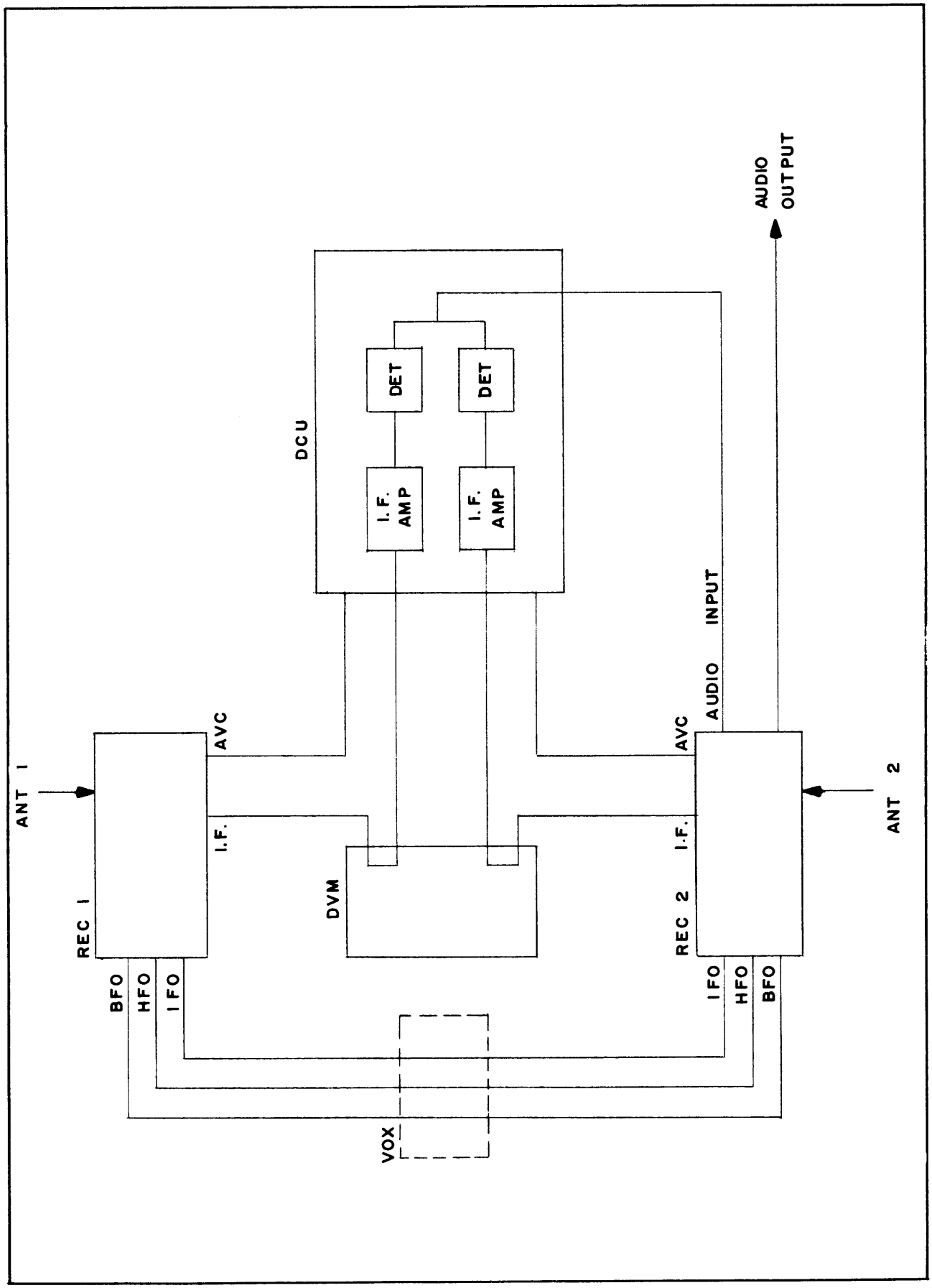



Figure 2-2. Block Diagram for Phone Operation

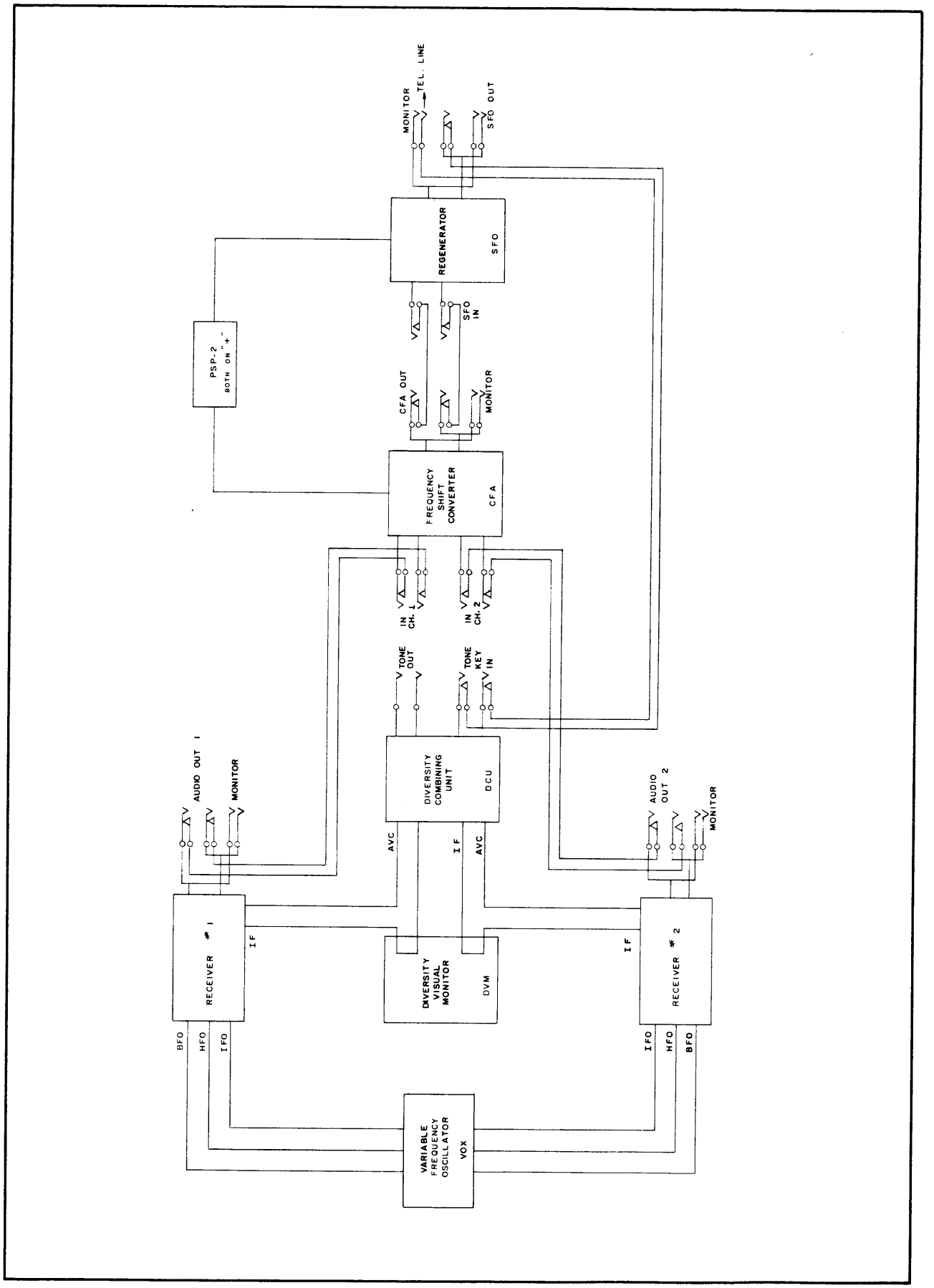
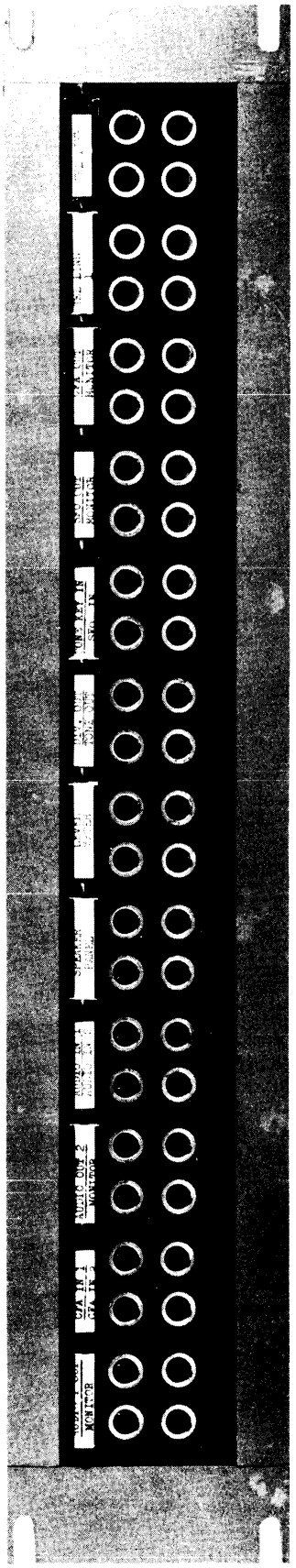



Figure 2-3. Block Diagram for Frequency Shift Operation



Line Patching Panel, Model LPP-1. Front View.

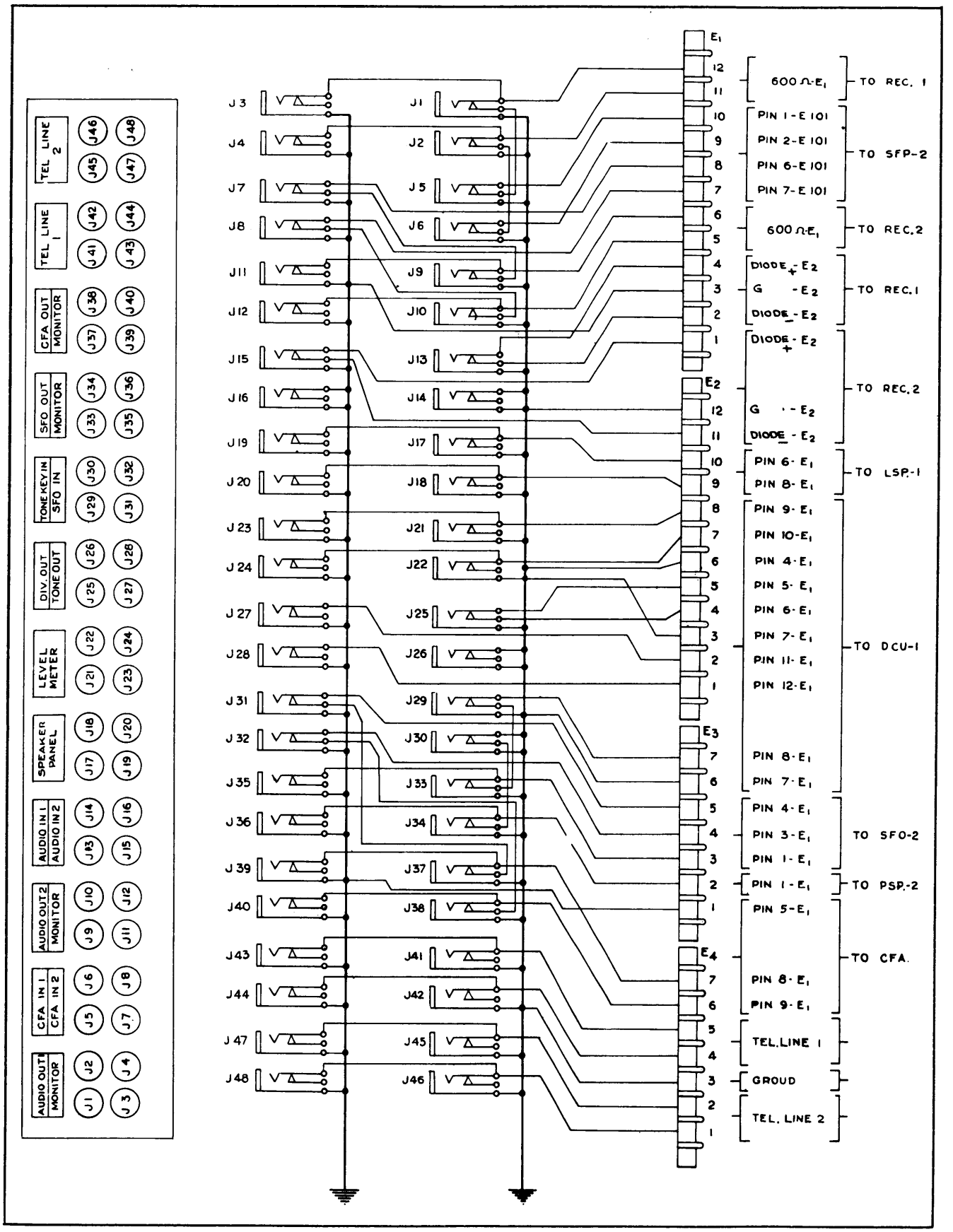



Figure 2-4. Schematic Diagram for Line Patching Panel, Model LPP. (Horizontal Patching)



CK-10006/B

## 2. UNIT THEORY

### A. RECEIVERS (Model DMK-*)

The two identical communication receivers comprising the input sections of the System are modified to meet TMC diversity reception specifications. These are superheterodynes covering incoming signal frequencies from 0.54 to 54 Mcs. in 6 individual overlapping ranges. Single heterodyne conversion is used from 0.54 to 7.4 Mc using an I.F. of 455 kc, and double conversion is used from 7.4 Mc up employing an I.F. of 3.955 Mc. preceding the 455 kc I.F. Included in the appendix to this manual is the manufacture's instruction manual for the receiver units.

The HFO, IFO and BFO have been made to facilitate Master-Slave operation, so that the two receivers will be locked together and thus prevented from drifting in opposite directions. Under these conditions, either receiver supplies all three oscillator injection voltages to itself and to the other receiver for frequency control. The choice of which receiver is the Master or Slave can easily be made by the operator through the manipulation of front panel controls.

The AVC's are also brought out, so that they may be combined in the DCU. Similarly, each detector output is extracted but re-enters the receiver and feeds its respective audio amplifier by being normalized through the Line Patch Panel, Model LPP. In this manner, by plugging a patch cord into the audio input jack on the patch panel, either audio amplifier is isolated from its receiver and made available for external use. In order to accomplish diversity combination, the receiver I. F.'s are brought out through amplifiers and applied to the DCU.

### B. DIVERSITY COMBINING UNIT, MODEL DCU.

The Diversity Combining Unit is used to combine the output of the receiver units used in the complete diversity system. The AVC buses are tied together here, and the AVC time constant is established through a front panel control having five different positions. The diode output of the receivers is presented to a common load. As the diode outputs are negative voltages, the stronger signal will place a negative bias on the controlled stages of the other receiver, which will stop conduction in these stages.

The I.F. voltage from each receiver enters the DCU, where amplification, detection, and diversity combination in a common load take place. Each detector contains a microammeter so that its contribution to the common diversity load may be observed by the operator. The output is then brought out to the Patch Panel and normalized back into the DCU. Thus, if the operator plugs into DIVERSITY OUTPUT at the patch panel, he will have available the detected modulation for radio telephone or broadcast operation. He may then utilize the audio amplifier in either receiver for power amplification of the signal.

For CW/MCW operation, the detected carrier re-enters the DCU, where it initially passes through a low pass filter and is then amplified, shaped, and freed of its noise content. A clamp and threshold control combination prevents the breaking through of noise peaks between dots and dashes and during stand-by periods. The final pulse is utilized to ON/OFF key a tone amplifier, which is fed from a highly-stable tone oscillator. Bias on the grids of both sections of the push-pull tone amplifier is adjusted so that unless a signal voltage is added to "key" the output of the tone oscillator, the amplifier will be biased to cut-off. The audio tone is available from the secondary of a conventional output transformer, whose output windings have been designed to match a 600 ohm load. Facilities have also been provided so that the tone oscillator may be keyed by an external voltage source (fed through the patch panel) of approximately minus ten volts or greater.

A front panel volume level meter and range switch permits reading of low impedance audio levels in any part of the diversity system appearing at the patch panel. This range of this instrument is from minus 20 dbm to plus 43 dbm.

### C. DIVERSITY VISUAL MONITOR, MODEL DVM.

The Diversity Visual Monitor, Model DVM is designed to permit accurate and simple receiver tuning on any type of incoming signal. The Model DVM provides extremely accurate visual tuning to the center frequency of an incoming signal carrier. This accuracy is accomplished by a calibrated 3 inch oscilloscope screen, which presents a positive picture of the signals reflected in the I.F. sections of the receiver units. Front panel selection switches provide monitoring facilities for three receivers and four functions of the Model DVM.

A stable 455 kc crystal is used as a standard reference and permits accurate calibration of the oscilloscope face. The presence of an I.F. signal and its relation to the I.F. center frequency is presented on the screen. Any incorrectly tuned signal can be quickly recognized and corrected to proper frequency. The unit acts to sweep the I.F. frequency spectrum continuously. Sweep ranges of ±1 kc and ±5 kc may be selected by a front panel switch.

The IF output of each receiver is fed to the Model DVM, where it is mixed with a voltage whose frequency is swept at a rate determined by an internal saw tooth generator. The difference-frequencies are passed through a very sharp crystal filter, amplified, rectified, re-amplified, and finally appear as a vertical pulse on the face of the oscilloscope. The horizontal sweep is provided by the same saw tooth generator, which determines the rate at which the I.F. signal is swept. Either of two observable bandwidths (1 kc or 5 kc) can easily be selected. As an added convenience, an internal BFO detector and audio amplifier provide the operation with an audio monitoring position.

D. VARIABLE FREQUENCY OSCILLATOR, MODEL VOX.

Ideally, the most desirable operating system would be one in which both receivers operate as SLAVES and are controlled by a highly stable MASTER oscillator. To provide stable, tunable oscillator voltages common to the two receiver units, the Variable Frequency Oscillator, Model VOX is included in the system. This unit contains frequency determining elements under rigid temperature control and features a continuously tunable, finely calibrated dial system having a degree of resetability and stability over the entire range of operating conditions. Provision for three fixed, crystal-controlled, output frequencies also is included in this unit. In addition, crystal controlled BFO and IFO voltages are also supplied so that the receiver's oscillator needs are completely filled. These three simultaneously available sources of oscillator voltages are injected through coaxial cables to each receiver.

The master oscillator of the Model VOX is enclosed in a finely engineered double oven and is a highly stable frequency determining device. A series of four multipliers multiply the fundamental 2 - 4 Mc frequency range continuously up to 64 Mc. All of these stages are gang-tuned and prealigned. The IFO is a frequency source with a permanently installed 3.5 Mc crystal. The BFO is also a crystal oscillator and operates in the frequency range of 450 to 457 kcs. Contained within the oven enclosure is a highly stable 100 kc crystal oscillator, which is used for calibration of the master oscillator. The Model VOX contains its own plate and filament supply section powered through a fused connection to the AC line. Pilot lights are provided for indicating connection to line power and for indicating the crystal oven heating element cycles.

E. FREQUENCY SHIFT CONVERTER, MODEL CFA.

The Model CFA is an audio-type dual channel converter for use in radio-teletype frequency shift systems. It converts the "mark" and "space" tones from the output of the diversity receivers into DC pulses capable of operating a teletypewriter, tape recorder or any other device requiring make or break input signals.

The CFA is, in its own right, a diversity combining unit for frequency shift. Each channel has its own series of limiters, amplifiers, discriminator and discriminator rectifiers. The rectified resultants are combined in a common load, thus producing diversity action. Beyond this point, the pulse is shaped by D.C. amplifiers and so treated that the "mark" to "space" ratio may be established by the operator through a front panel control. In this manner, it is possible to compensate for rather large amounts of fixed bias distortion which may originate in either the transmitting station or be inherent in the teleprinter being used.

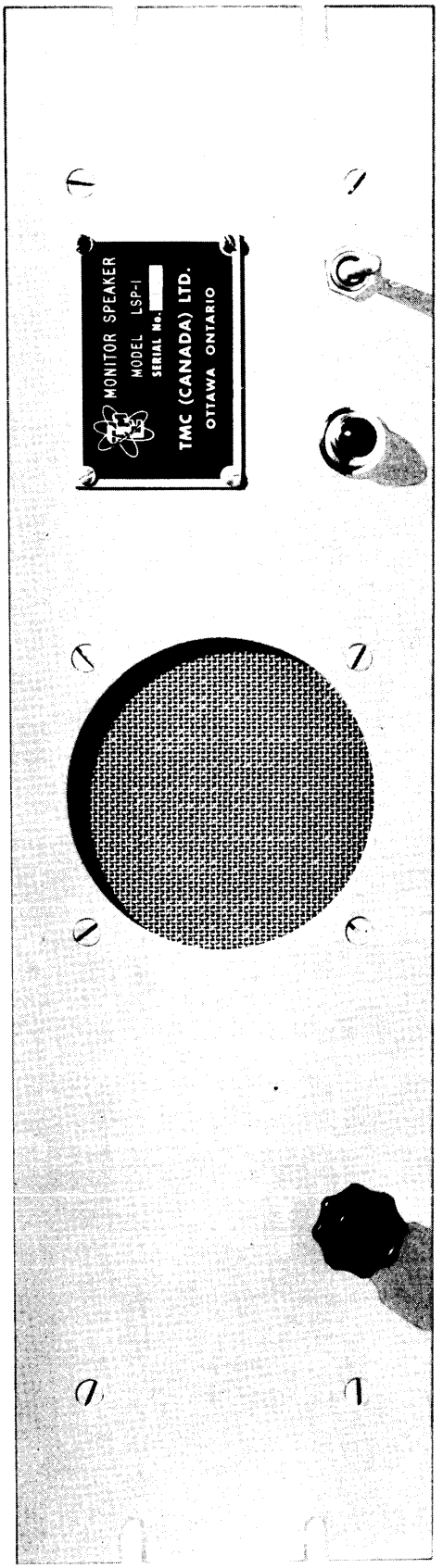
The D.C. amplifiers are followed by an oscillator to which a rectifier is electromagnetically-coupled, so that D.C. isolation exists between the output section and the remainder of the CFA. The oscillator is keyed on and off by intelligence being received, and its rectified output is used to control the final cathode follower, which "floats" with respect to ground.

To facilitate simple and rapid tuning of the incoming signal relative to the discriminator center, a front panel oscilloscope is employed. This instrument enables the operator to determine when his signal is properly centered or if drift occurs, the direction and approximate degree of drift.

F. POWER SUPPLY ASSEMBLY, MODEL PSP-1.

The Power Supply Assembly, Model PSP-1 provides a source of D.C. current for use when a D.C. battery is used for keying relays, teleprinter equipment or any other similar terminal equipment. The Model PSP-1 has been designed to provide a steep wave front when keyed to promote more positive action or relay or magnet operated equipment.

In order to retain the complete D.C isolation of the Model CFA output stage, this stage must be energized by an external floating power supply. The Model PSP-1 is used to provide plate power for the current amplifier in the Model CFA. The PSP-1 provides a sharp rising wave front which then decays to the proper voltage necessary to produce the rated relay current. The initial wave front is the impulse which ensures positive and rapid relay action.




Monitor Speaker, Model LSP-1. Front View.

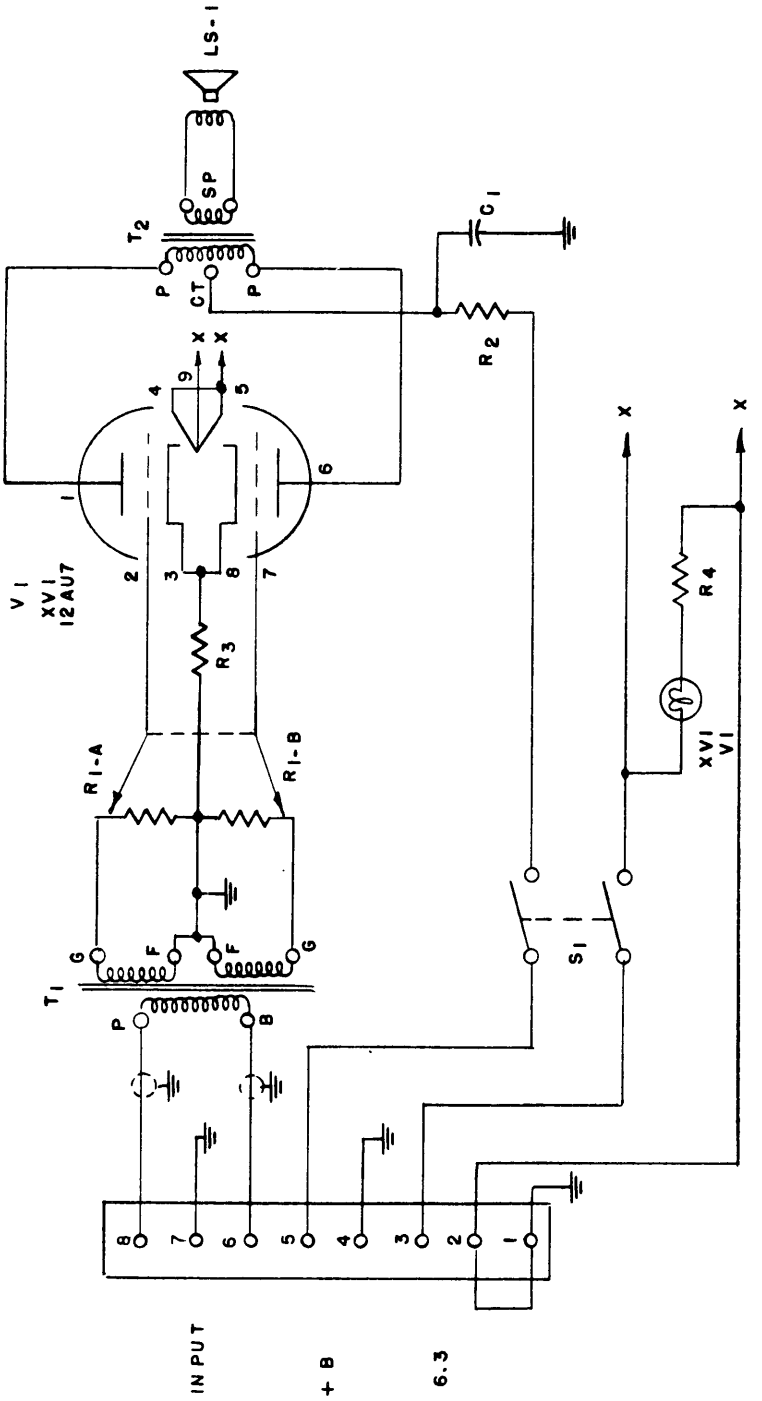



Figure 2-5. Schematic Diagram, Monitor Speaker Model LSP-1.

## ELECTRICAL PARTS LIST

POWER CONTROL PANEL, MODEL DCP-2

| SYM. | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| E1 | BOARD, terminal: 3 contact; general purpose barrier type. | Input terms | TM-10001-3/4W |
| E2 | BOARD, terminal: 3 contact; general purpose barrier type. | Output terms | TM-10001-3/4W |
| I1 | LAMP, incandescent: | Power ind. | BI-10001-1 |
| K1 | CIRCUIT BREAKER: $7\frac{1}{2}$ ampere | Cir Breaker | SW-10001 |
| K2 | CIRCUIT BREAKER: $7\frac{1}{2}$ ampere | Cir Breaker | SW-10001 |
| R1 | RESISTOR, fixed: wire wound; 2500 ohms. | 220 volt op bleeder | RW-111-25 |

## ELECTRICAL PARTS LIST

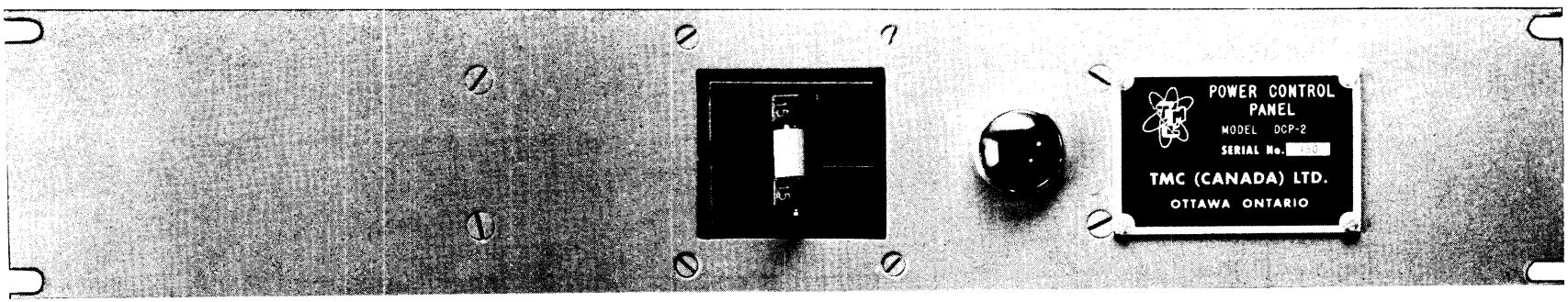
PATCHING PANEL, MODEL LPP-1

| SYM. | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| J1 thru J48 | PANEL, jack; 48 normally closed jacks | Patching Jacks | JJ-124 |
| E1 | BOARD, terminal: 12 contact; general purpose barrier type. | Terminal Boards | TM-100-12 |
| E2 | BOARD, terminal: 12 contact; general purpose barrier type. | Terminal Boards | TM-100-12 |
| E3 | BOARD, terminal: 7 contact; general purpose barrier type. | Terminal Boards | TM-100-7 |
| E4 | BOARD, terminal: 7 contact; general purpose barrier type. | Terminal Boards | TM-100-7 |
| W1,2, 3 | CORDSET, patching: twin type, w/3 ft. cord. | Patching Cordset | CA-130-3 |
| W4,5 | CORDSET, patching: twin type, w/2 ft. cord. | Patching Cordset | CA-130-2 |
| W6 | CORDSET, patching: twin type, w/1 ft. cord. | Patching Cordset | CA-130-1 |

## ELECTRICAL PARTS LIST

MONITOR SPEAKER, MODEL LSP-1

| SYM. | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C1 | CAPACITOR, fixed: paper dielectric, 4 mfd, +20, -10%, 600 wvdc; oil-filled and impregnated; hermetically sealed metal case. | Filter Condenser | CP40C2DF405V |
| E1 | BOARD, terminal: general purpose barrier type; eight 6-32 binding head machine screws. | Terminal Board | TM-100-8 |
| I1 | LAMP, incandescent; 6-8 volts; .25 amp; T-3-1/4 clear bulb. | Pilot Lamp | BI-101-44 |
| LS-1 | LOUDSPEAKER, 4 inch: 3-4 ohms, 2 watts; 5'' o.d., x 3-1/2'' i.d., x 2'' dp. | Loudspeaker | LS-101 |
| R1 | RESISTOR, variable: composition; dual unit; 50,000 ohms, ±10% ea. sect; 2 watts. | Audio Input Level Control | RV-101 |
| R2 | RESISTOR, fixed: composition; 4700 ohms, ±10%; 1 watt. | Cathode Bias Resistor | RC30GF472K |
| R3 | RESISTOR, fixed: composition; 470 ohms, ±10%; 1 watt. | B± Dropping Resistor | RC30GF471K |
| R4 | RESISTOR, fixed: composition; 12 ohms, ±10%; 2 watts. | Pilot Lamp Series Resistor | RC40GF120K |
| S1 | SWITCH, toggle: DPST; 6 amps, 250 volts. | Power on/off | ST22K |
| T1 | TRANSFORMER, AF; pri 15,000 ohms, sec 135,000 ohms; CT; $2\frac{1}{2}$'' high x $1\frac{1}{2}$'' dia. case. | Audio Transformer | TF-113 |
| T2 | TRANSFORMER, output: pri 12,000 ohms, sec 25,000 ohms; CT; 3 watts 2-3/8'' wd x 1-1/4'' dp. x 1-3/8'' high. | Output Transformer | TF-121 |
| V1 | TUBE, electron: 12AU7, dualtriode, min. 9 pin. | Audio Amplifier | 12AU7 |
| XI1 | LIGHT, indicator: red frosted lens; min. bayonet base; T-3-1/4 bulb. | Socket for I1 | TS-106-1 |
| XV1 | SOCKET, tube: 9 pin min. | Socket for V1 | TS103P01 |




Power Control Panel, Model DCP-2.

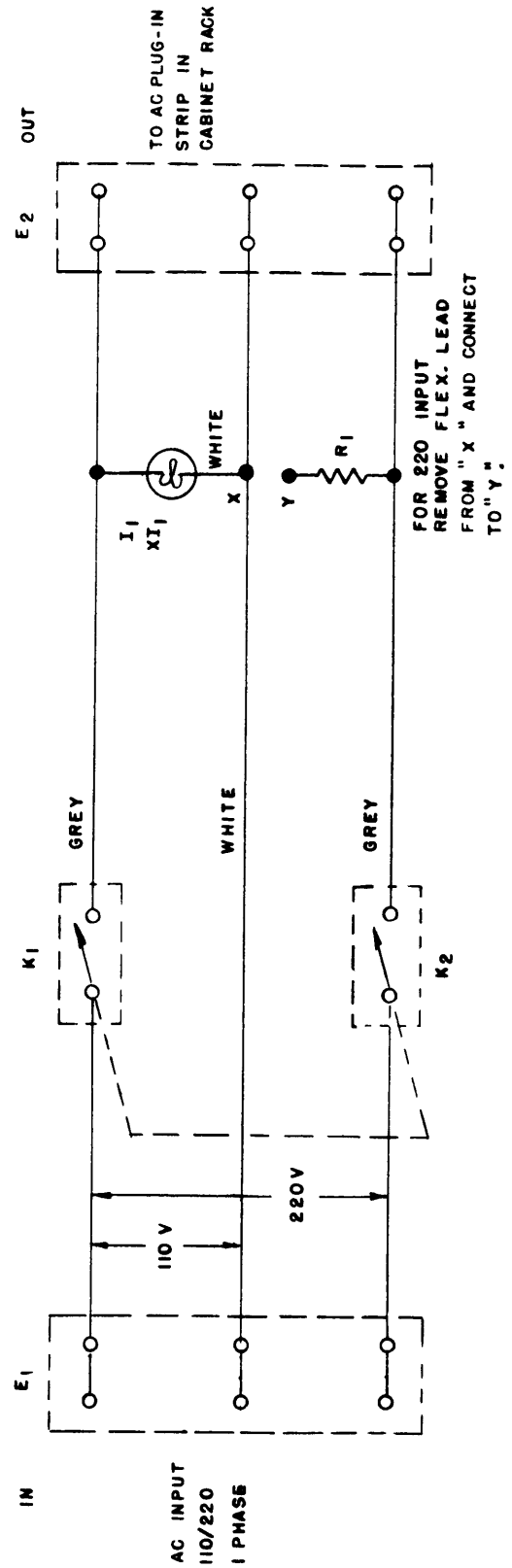



Figure 2-6. Schematic Diagram, Power Control Panel, Model DCP-2.



CK-189

The unit delivers a variable, well-filtered current up to 75 ma into a load of 2000 ohms. A meter in the output circuit monitors the current, which can be adjusted by a front panel control to any desired value.

G. LINE PATCHING PANEL, MODEL LPP.

The Line Patching Panel, Model LPP provides flexible handling of input and output circuits of each individual section of the DDR-2 system. All of the individual units having necessarily accessible inputs and outputs are tied together through the LPP. The wiring has been so designed that no patching is necessary for CW/MCW operation, and for FS operation, which are considered to be the "normalized" condition.

Provision has been made for bringing in two pairs of external telephone lines, and each pair has been provided with a double set of jacks so that the various monitoring facilities may be paralled with the output. Figure 2-4 illustrates the Model LPP schematically.

H. MONITOR SPEAKER, MODEL LSP.

The Monitor Speaker, Model LSP is provided for audio monitoring of the incoming signals. It has a high impedance (approximately 10,000 ohms) balanced input so it will not appreciably load the audio circuits to which it is connected.

Connections for monitoring each receiver output, the diversity combined output, and tone keyer output are made available through the Line Patching Panel, Model LPP. The Model DCU supplies the plate and filament power to the unit, which contains a push-pull amplifier feeding a loudspeaker. Figure 2-5 illustrates the LSP schematically.

I. POWER CONTROL PANEL, MODEL DCP.

The Power Control Panel, Model DCP is provided for the DDR-2 to handle the input primary voltage source and includes a $7\frac{1}{2}$ amp. circuit breaker, pilot light, and primary power terminal box. Figure 2-6 illustrates the DCP schematically.

J. TELETYPEWRITER REGENERATOR, MODEL SFO-2

The Model SFO-2 accepts teletypewriter signals in audio or direct current form having up to 45% bias distortion and regenerates the signal to have less than 5% bias distortion at the output. Sampling pulses are generated in the Regenerator to synchronize with the center of each teletype pulse. If a sampling pulse coincides with a "mark", the pulse operates a relay circuit to produce a regenerated "mark" at the Regenerator output. If a sampling pulse coincides with a "space", the relay circuit will produce a "space" of proper duration at the Regenerator output. Since the output of the Regenerator is in the form of relay contacts, the Power Supply Assembly, Model PSP-2 is connected in series with the output to operate the teletypewriter printer. Two SFO-2 Regenerators may be used to receive a Diplex teleprinter signal, when one Regenerator is set to produce the leading diplex signal and the other set to produce the lagging diplex signal. In each case, the signal output coincides with standard simplex timing. Provision has been made for a front panel SPEED switch to be set to the speed of the incoming signal, and for an oscilloscope jack to monitor the various stages of the unit.

# SECTION III
# INSTALLATION

## 1. FLOOR SPACE REQUIREMENTS

The installation of the DDR-2 System properly should begin with the consideration of a space where the equipment will be placed. The System dimensions are as follows:

1. Width: 3 feet
2. Depth: 2 feet
3. Height: 7 feet
4. Weight: 500 lbs.

The actual floor space occupied by the cabinet rack is approximately 12 square feet, allowing for opening of the two-foot back door to a 90 degree angle stop. In addition to this, it is recommended that a minimum of 3 feet for the rear and 2 feet along the sides be allowed for work space.

## 2. ANTENNA, POWER INPUT, REMOTE CABLE CONNECTIONS.

Once the floor space has been decided upon, and

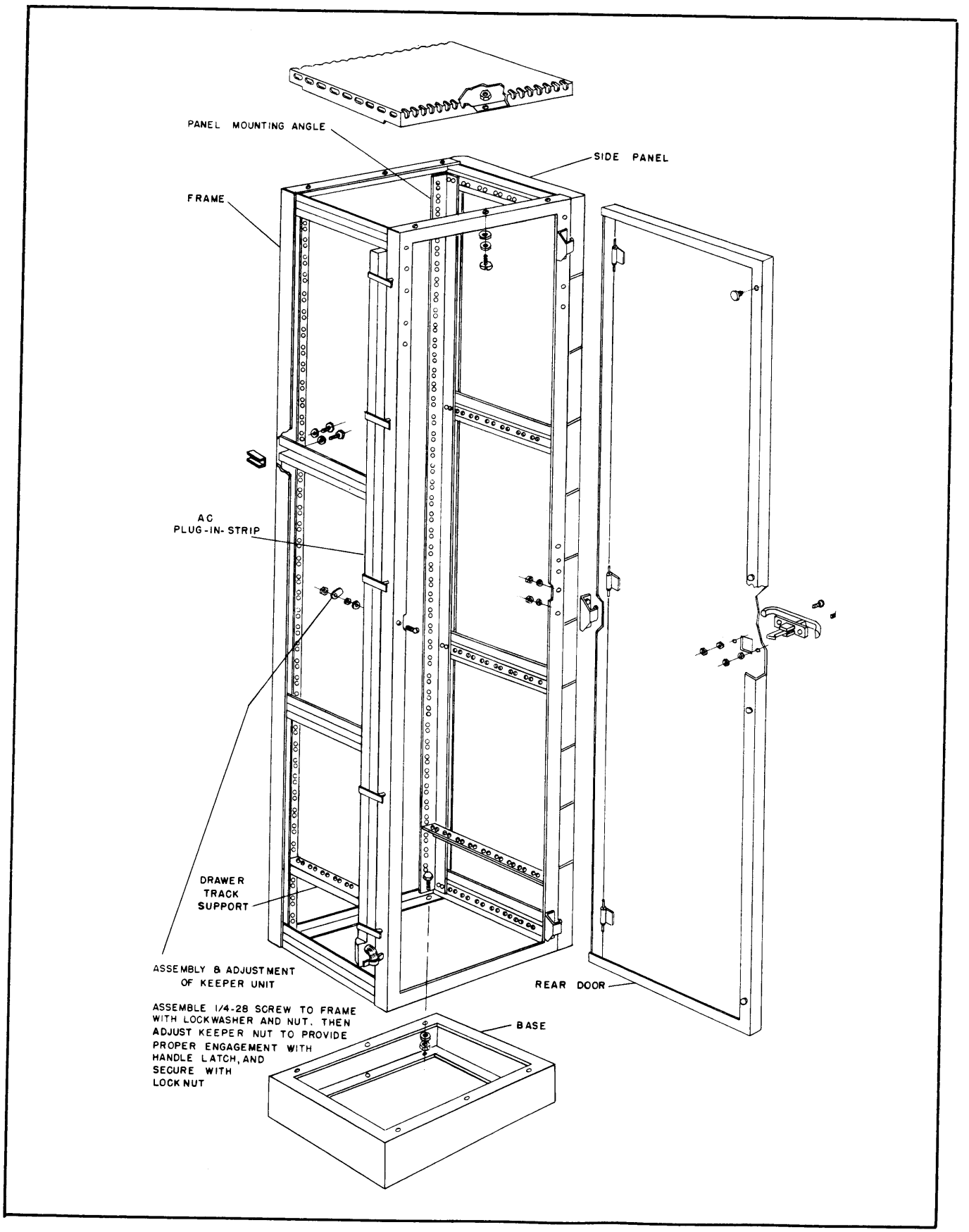



Figure 3-1. Assembly Diagram, DDR-2 Cabinet Rack

before erecting the rack in this space, consideration should be made for electric power input, the antennae cable, and telephone or program lines. The power lines and keying lines can be run beneath the floor and come up through the floor inside the rack, or through holes placed in the lower rear apron of the rack base. Antennae input lines should enter through the bottom or lower rear apron of the rack base. However, it is suggested that the antennae cables be fed through the top cover of the rack, if convenient.

The equipment in the rack requires a 110/220 volt, 50/60 primary power source. When 110 volts AC power is available, the power lines can be directly connected to the Power Control Panel, Model DCP. However, should only 220 volts AC power be available, it will be necessary to remove the jumper from across the pilot light dropping resistor, as shown in the schematic diagram of the Model DCP, Figure 2-6, and to change the power transformer primary taps of the individual sectional units.

Standard wiring of power input source is recommended, using $\frac{1}{2}$" conduit or armored BX cable with two-conductor No. 14 AWG wire.

## 3. UNPACKING AND ASSEMBLY

The DDR-2 major sectional units have been individually packaged. Prior to unpacking, reference should be made to the packing list to check receipt of the individual units comprising the DDR-2 System. Upon placing the rack frame in its operating position, all sectional units should now be unpacked and inspected for possible damage, Before installing the various units into the rack, inspect the units for possible damage during shipment and check all fuses and tubes. If desired, the rack can be fastened to the floor. There are six holes in the rack base which can be used for this purpose.

Using Figure 3-4 as a guide, assemble the various units and drawer into the racks with the hardware supplied, according to the following assembly procedure. For assembly of DDR-2B, DDR-2C, and DDR-2D Systems, Refer to Figures 1-3, 1-4, and 1-5, Respectively.

a. Install the base on the rack frame, referring to Figure 3-1 for assembly details.

b. Install the BX Cable to the AC plug-in strip base terminal through the BX connector. Refer to Figure 3-2.

c. Place the side panels of the rack on the frame of the rack.

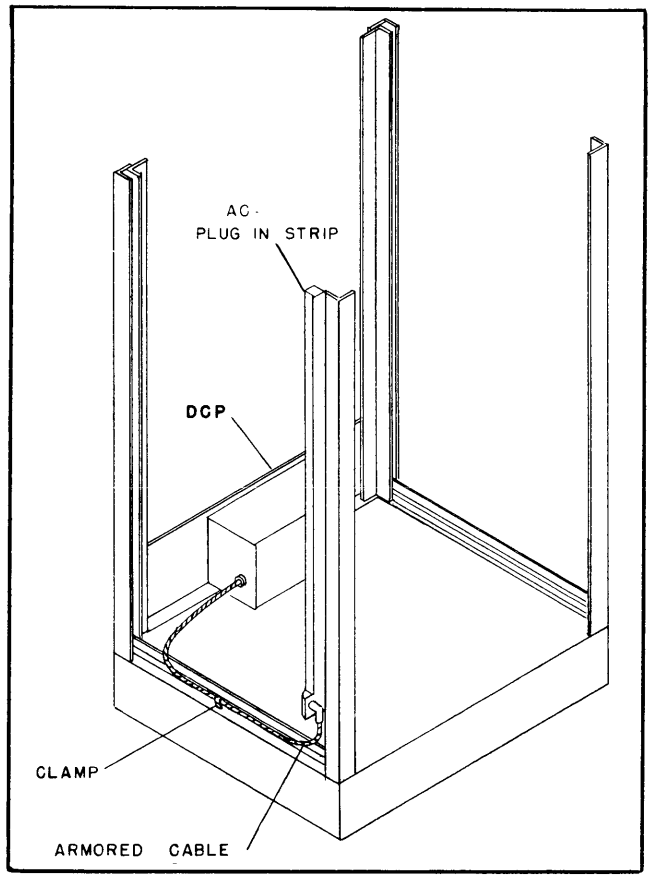



Figure 3-2. Installation, Power Control Panel

d. Mount front panel mounting angles on to frame of rack.

**NOTE**

Side panels of rack can be mounted to the race frame, using steel clips, after installing units and cables. If screws and bolts are used for side panels, then side panels must be mounted before installing units and cable.

Install a blank panel at the top of the panel mounting angle before securely attaching the angles to the rack frame. Now tighten the mounting angles on frame, make certain that the top of the blank panel is flush with edge of the top of rack frame. This is necessary to correctly line up the mounting angle holes for panel mount.

e. Mount the lower DCP panel unit into the rack and connect the BX Cable into the output terminal board of the DCP unit. Note Figure 3-2.

f. Install the side angles track support of the drawer mount. This installation is perform-

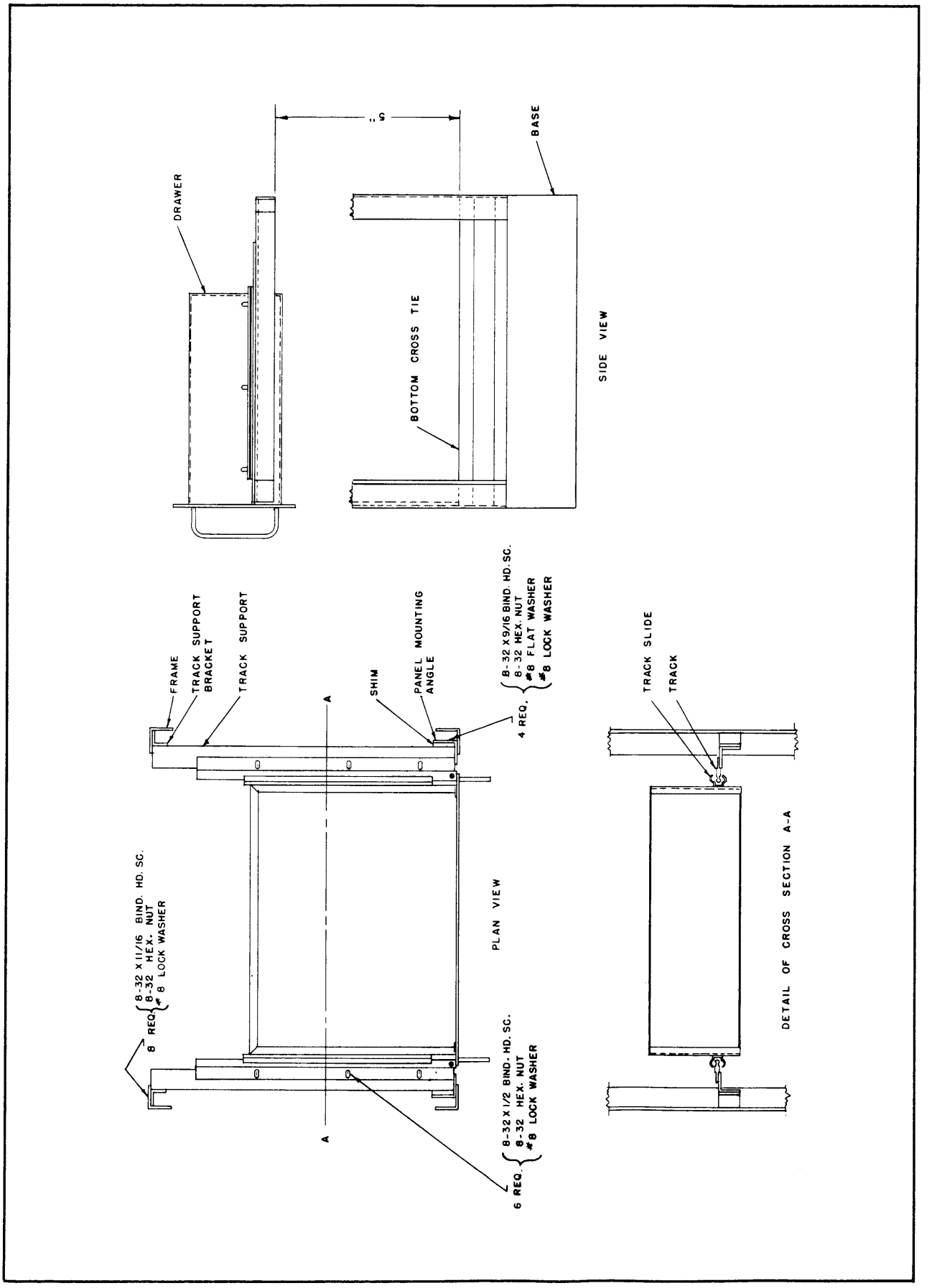



Figure 3-3. Utility Drawer Assembly

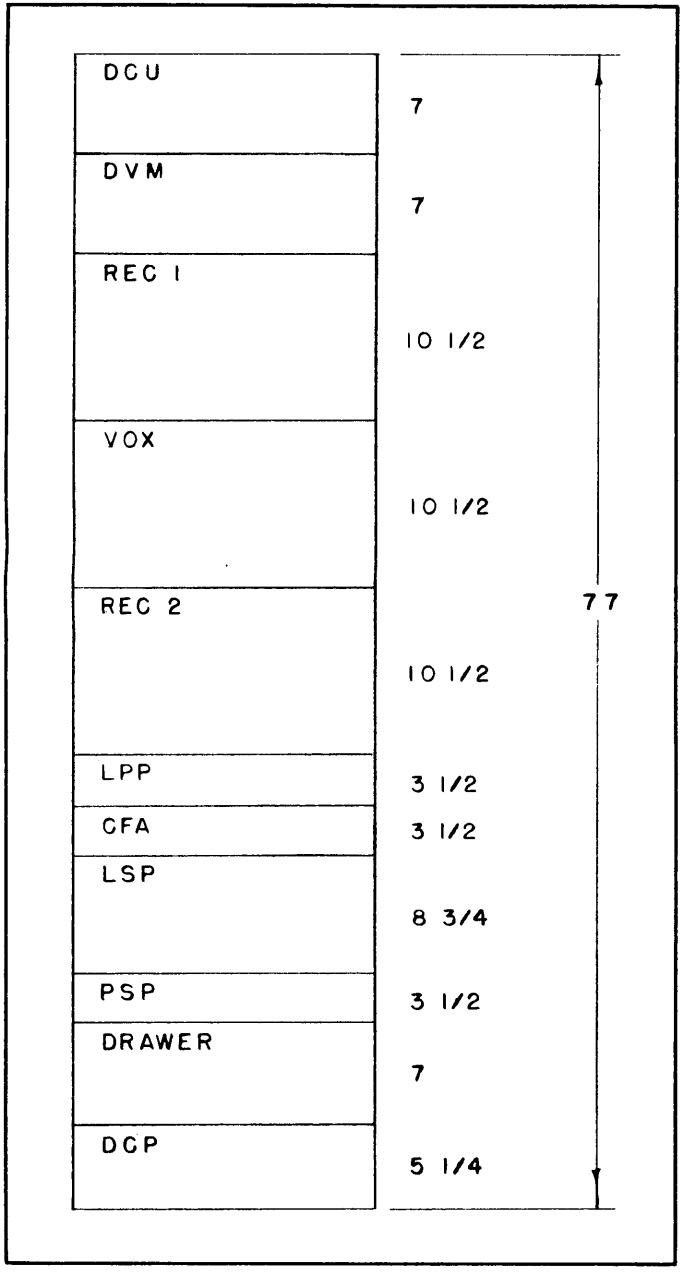



Figure 3-4. Rack Mounting Layout

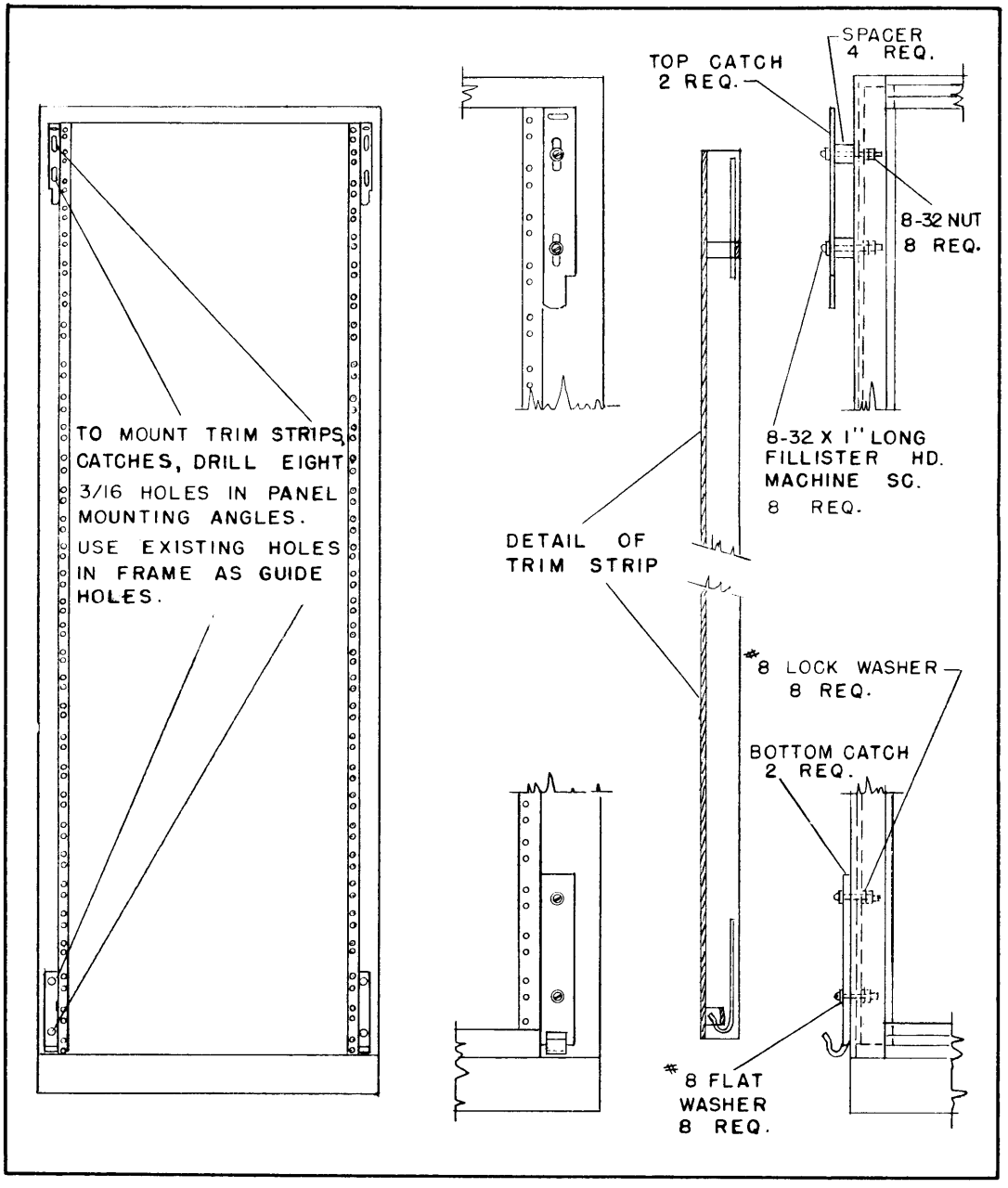



Figure 3-5. Mounting of Trim Strip Catches

ed from the front on rear of the rack, as the side panels have been previously installed as per step No. C above. Refer to Figure 3-3.

g. Mount the drawer track on the track support angle. Refer to Figure 3-3. Slotted holes are provided in the slides for horizontal adjustment.

h. Insert the drawer on the track. Slotted holes are provided for vertical adjustment.

i. Continue with the mounting of the blank panel or PSP panel unit above the drawer section and the subsequent LSP sectional unit and other succeeding units as shown in Figure 3-4. Continue the mounting of other sections working from bottom of rack to top of rack. Due to the heavy upper section equipment, it is advisable to install rack equipment from the bottom to the top, to avoid tipping of the rack.

j. After all the sectional units are mounted as per Figure 3-4, install the rack trim stripe as per Figure 3-5.

k. Proceed with installation of the interconnecting cable harness to the proper terminals of the various DDP-2 units on sections as indicated on Figure 3-6 or Figure 3-7, according to the mode of operation.

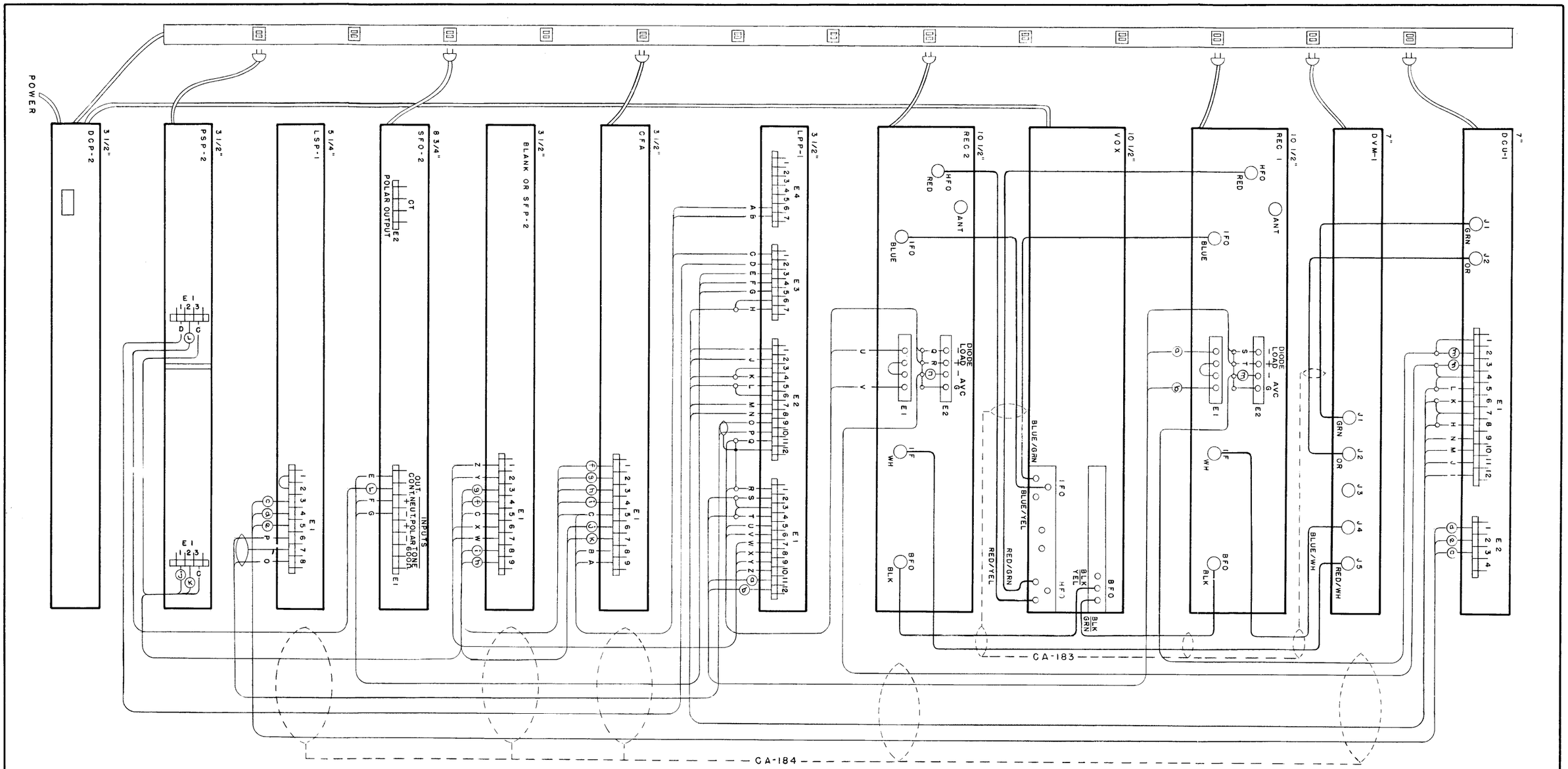
l. The rear door of the rack is of the universal type and is reversible, so that it can be arranged to open either to the left or right, the direction of opening being optional with the user.

Once the Model DDR-2 system is installed and set up for operation, the AC primary power input to the rack should not be turned off but left on continuously. Should maintenance of equipment or removal of a particular section necessitate the throwing off of the circuit breaker, thereby removing all primary power from the DDR-2 system, the VARIABLE FREQUENCY OSCILLATOR, MODEL VOX, should not be turned off.

**WARNING**

IT IS IMPORTANT TO MAINTAIN CONTINUOUS AC POWER INPUT TO THE VOX UNIT AND OVEN FOR OSCILLATOR STABILITY. THE MODEL VOX SHOULD NEVER BE SHUT OFF UNLESS DETAILED MAINTENANCE OF THE VOX IS ESSENTIAL.

Therefore, it is recommended that the Model VOX be connected to the AC source especially provided for it on the rear of the Power Control Panel, Model DCP. This plug by-passes the main circuit breaker and places the VOX directly on the incoming power line.




**NOTE:**

If the SFP-2 filter panel is not used, connect jumper wires between terminals 1 & 4, 6 & 9, 2 & 3, and 7 & 8 on loose fanning strip. Tape to prevent shorting.

Figure 3-6. Cabinet Wiring Diagram, DDR-2D

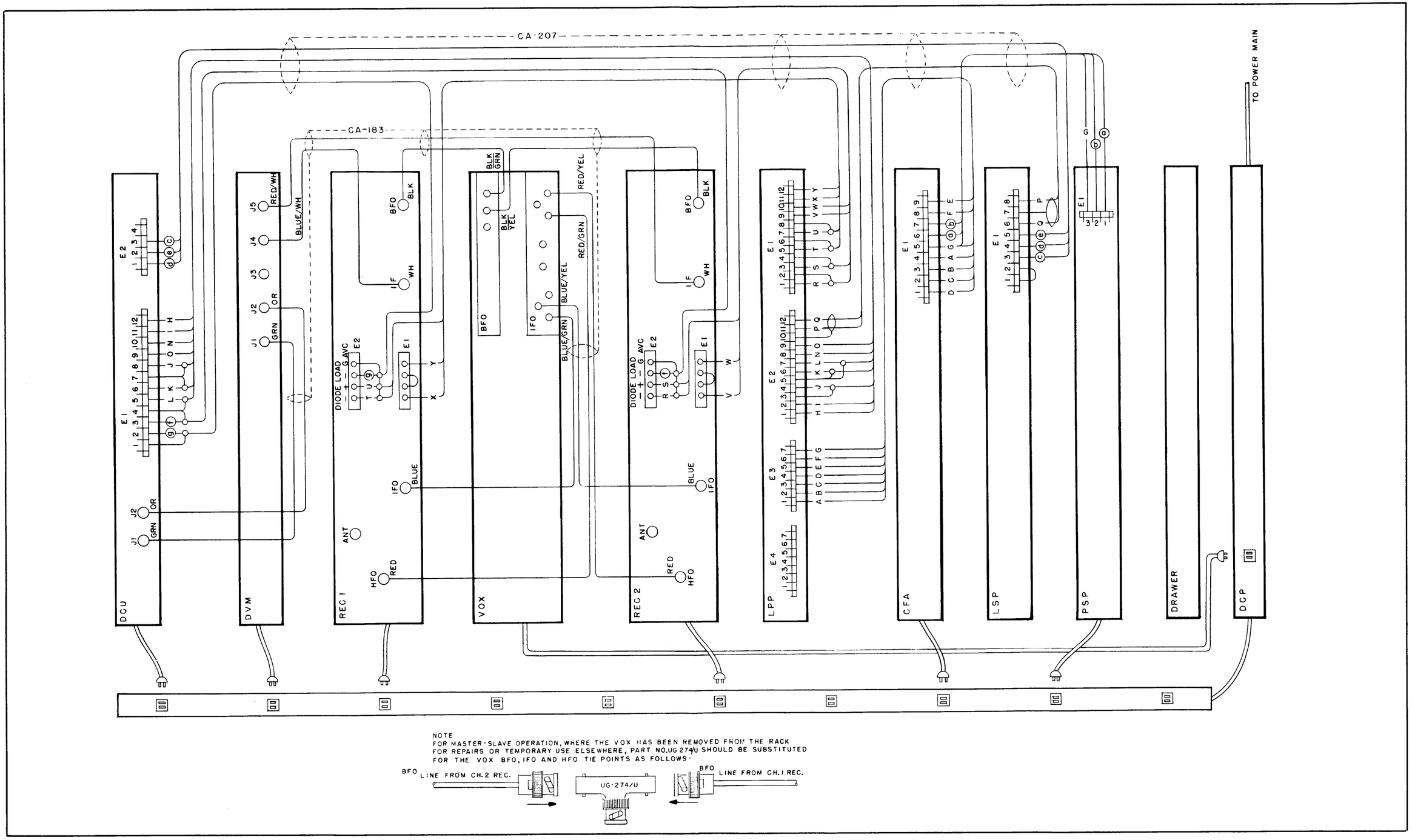



Figure 3-7. Cabinet Cabling Diagram, Master Oscillator Operation

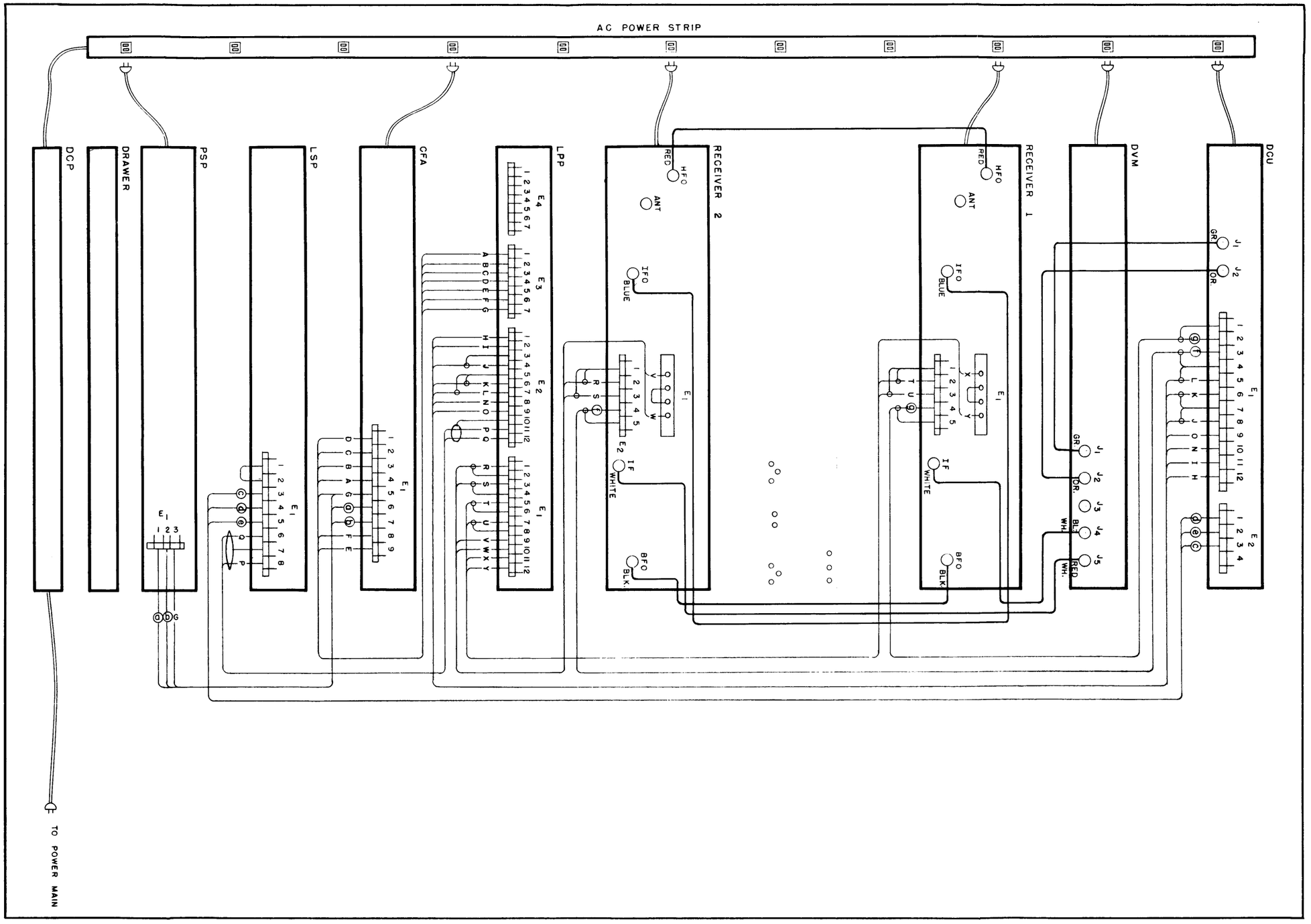



Figure 3-8, Cabinet Cabling Diagram, Master-Slave Operation. Models DDR-2B and DDR-2C.

# SECTION IV
# OPERATION

## 1. GENERAL

In setting up the DDR-2 system to receive an incoming signal, certain operations must be performed independent of the character of the intelligence to be received. Thus, receiver tuning is essentially the same whether the information takes the form of CW, FS, or arrives as a modulated radiotelephone carrier. For this reason, if the instructions as discussed under CW/MCW operation are followed, useful information pertaining to all types of operation will be found.

In using the patch cord sets with the LPP section, polarity of patching plugs must be maintained at all times. Note that one side of the black bakelite cover of the plugs on each patch cord set has a rough or corrigated edge. As an aid to maintaining proper polarity, this corrigated edge of plug core must always be on the left side when the plug is in the horizontal position, in the patching panel jacks.

Figure 4-1 refers to the patch connection diagrams for the various DDR-2 systems and the types of operation desired.

## 2. CW/MCW OPERATION

The CW/MCW mode of operation is one of the so called "normalized" condition of operation for the DDR-2 system. That is, the wiring is so designed that no patching operations are necessary other than to bring the system output to a telephone line or to utilize the various monitoring devices. Figure 4-2 illustrates the proper Patch Panel connection for this type of operation.

### A. MASTER-SLAVE OPERATION

With all the sections of the DDR-2 installed properly in the rack, all antenna and interconnecting unit cables connected, proceed to throw the power switches to their ON positions on the following units:

The Power Control Panel, Model DCP
Receivers One and Two, Model 600-DMK-*
Diversity Visual Monitor, Model DVM
Diversity Combining Unit, Model DCU
Loud Speaker Panel, Model LSP

The operator must then designate which receiver he chooses to make Master and which one Slave. The choice is purely arbitrary and for convenience, Receiver #1 shall be referred to here as Master. Receiver front panel controls for M-S operation are provided as follows: 1) The HFO Master-Slave control is located on the upper right portion of the receiver panel. 2) The IFO Master-Slave control on the lower left portion of the receiver panel. 3) The BFO Master-Slave control is the CW/MOD. switch, located on the lower right portion of the receiver panel.

The first step is to turn the HFO and IFO switches to the Master or -M- position on the Master receiver, and to position Slave or -S- on the Slave receiver. The BFO control of the Master receiver is placed in either the CW or MOD position, depending upon the type of operation involved. The CW/MOD switch BFO control of the Slave receiver is placed in the MOD position, regardless of the type of operation.

The CW-MOD switch of the Slave receiver must never be used in the CW position, as this will turn on the BFO, and the Slave receiver beat note can disrupt the functions of the Master receiver.

Proceed to tune in each receiver according to the instructions set forth in the receiver instruction book in the Appendix in this manual. The design of the receivers for the DDR-2 system is

| OPERATION | SYSTEM | | | |
|---|---|---|---|---|
| | DDR-2A | DDR-2B | DDR-2C | DDR-2D |
| CW/MCW | 4-2 | 4-2 | 4-2 | 4-2 |
| PHONE | 4-3 | 4-3 | 4-3 | 4-3 |
| FREQUENCY SHIFT | 4-5 | 4-5 | — | 4-4 |

Figure 4-1. Patching Scheme

such that when either or both AVC switches are in the manual position, the AVC bus between the receivers is automatically opened. When both switches are in the AVC position, the R.F. Gain controls are tied together so that either one is effective in determining the gain of both receivers. For this reason, it is recommended that the Slave receiver R.F. gain control be left in the full open position, while its counterpart on the Master receiver be used for gain regulation.

Patch the Speaker Panel to the Audio Output of Receiver #1. This will permit an audio monitoring of the signal. It is now necessary to place the Diversity Visual Monitor into operation so that visual monitoring and tuning will be possible.

1. DVM ADJUSTMENTS... Throw the Sweep Range switch to the 5 kc position and the Monitor switch to the Calibrate position. Then, by rotating the Calibration Zero set control, place the sharp pulse on the centerline of the oscilloscope face. However, it may be necessary to adjust the R.F. Gain control for optimum picture amplitude. These operations serve to line the DVM with the IF channel center so that receiver tuning may then be accomplished.

Throw the Monitor switch to the PAN position and the Receiver Selector switch to the position marked #1. The DVM is now prepared for the monitoring of Receiver #1.

Tune the Slave receiver to the approximate station frequency. Now, while observing the DVM oscilloscope, tune Receiver #1 (the Master) to the station frequency. Proper tuning will be indicated when the pulse representing the carrier coincides with the oscilloscope center line where the calibrating pip formerly appeared.

Throw the Receiver Selector switch to the position marked #2. Observing the oscilloscope face once again, tune Receiver #2 for maximum pulse amplitude. It should be remembered that, since no oscillators are being used within the Slave unit, its tuning must necessarily be rather broad.

The receivers are now properly adjusted. If the operator desires to do so, he may patch the Speaker Panel to either audio output. However, he will not be listening to the signal in its final form as it is fed to the telephone lines. The receivers' IF output must first pass through the Model DCU.

2. DCU ADJUSTMENTS... Initially, adjust the controls as follows:

a. Turn the CW/Phone switch to the CW position.

b. Set the Pulse Width control near the center of its rotational extremes.

c. The Speed switch must be placed in the appropriate position.

d. Set the Test switch to the Mark position.

e. Rotate the Threshold control fully clockwise.

f. Turn the Level Meter switch to 40 VU.

g. Patch (on the LPP) the Tone Output to one of the telephone lines, and parallel the Level Meter and Loud Speaker Panel across the same point. (refer to Figure 4-2)

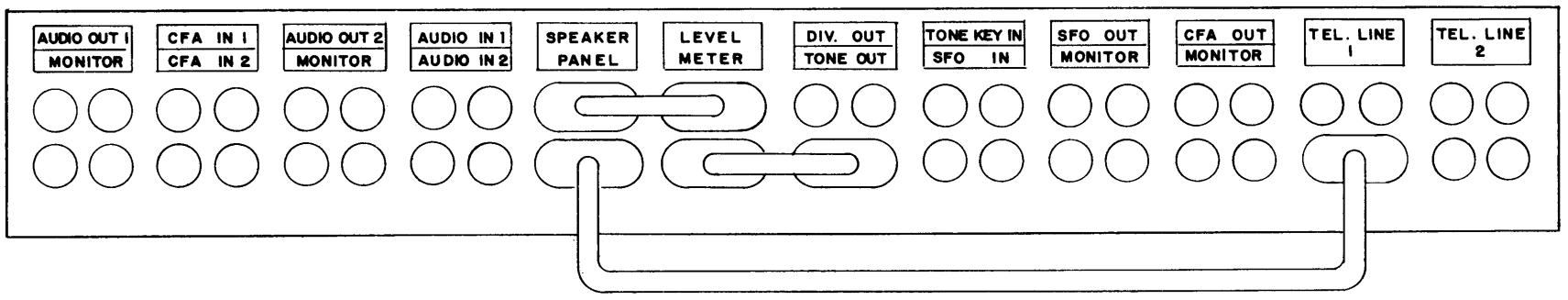
The operator may now set the tone output gain control (marked R-43 on the DCU rear apron) against the Level Meter reading as per his telephone line requirements. If the Test switch is returned to the Line position, the DCU will then be prepared to copy CW/MCW for reasonably strong signals. For weaker stations, it is necessary to turn down the Threshold control until good copy is made.

It is recommended that the receiver R.F. Gain controls be left in the full clockwise position so that maximum IF signal reaches the DCU. It is also suggested that maximum Threshold be used consistent with good copy. This will tend to prevent noise and adjacent channel breakthrough during signal standby periods and in-between dots and dashes.

To obtain an output pulse width which he considers satisfactory, the operator simply varies the Pulse Width control. It should be remembered, however, that the Threshold control also has a minor effect on the pulse width, so that a slight readjustment of the Pulse Width Control may be necessary with variations of threshold.

It will be obvious to the operator that by observing the diode current meters for both channels, he can see just which receiver is making the larger contribution to the diversity load. If, by chance, Receiver #1 happens to be delivering the stronger signal, it will tend to bias out its partner until a fade takes place, at which time Receiver #2 will take over.

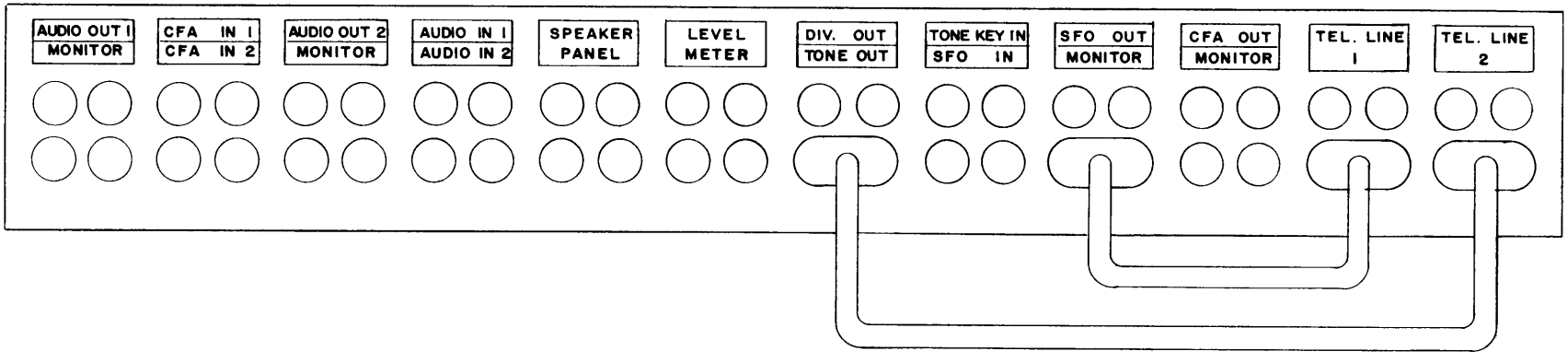
As an additional feature, the system has been provided with a variable AVC time constant (marked AVC Time on the DCU front panel). By use of this control, the operator can make a compromise between noise and fade conditions for a marginal signal until he has obtained optimum performance. A more detailed discussion is contained in the Appendix section devoted exclusively to the DCU.




DIVERSITY CONNECTION FOR CW/MCW OPERATION

SINCE THE SYSTEM HAS BEEN NORMALIZED FOR THIS MODE OF OPERATION ONLY THE PATCHING TO THE TELEPHONE IS NECESSARY. THE SPEAKER PANEL AND LEVEL METER ARE SIMULTANEOUSLY USED FOR MONITORING THE TONE OUTPUT.

Figure 4-2. CW/MCW Patch Connections.




DIVERSITY CONNECTION FOR F.S. OPERATION

THE SYSTEM IS NORMALIZED THROUGH FOR THIS TYPE OF OPERATION, ONLY THE PATCHING FROM THE SFO OUT TO TELEPHONE LINE 1 IS REQUIRED. A TONE SIGNAL MAY BE OBTAINED BY PATCHING TONE OUT TO TELEPHONE LINE 2 FOR DISTANT TRANSMISSION; SEE BLOCK DIAGRAM FOR MORE COMPLETE FUNCTIONAL EXPLAINATION. ( FIG. NO. )

FOR OPERATION WITHOUT SFO

PATCH "CFA OUT" TO "TELEPHONE LINE" AND "CFA MONITOR" TO "TONE KEY IN".

Figure 4-3. FS Patch Connections

B. MASTER OSCILLATOR OPERATION.

It is important that all the preceeding operating instructions be read, even though there is no intention of using Master-Slave operation. The aforementioned portion of the instructions contains general information also applicable when a master oscillator is used.

Referring to the front panel on the Model VOX, the operator should perform the following functions:

a. Turn the Power switch to its ON position.
b. Turn the BFO switch to its ON position.
c. Turn the IFO switch to its ON position.
d. Turn the Meter switch to the Zero Beat position.
e. Turn the Volume control fully clockwise.
f. Plug a headset into the jack marked phones.

**WARNING**

IF EXTREME STABILITY IS TO BE DEMANDED OF THE VOX, ITS INITIAL WARMUP PERIOD MUST CONSIST OF AT LEAST FORTY-EIGHT HOURS OF CONTINUOUS DUTY. THEREAFTER, THE UNIT SHOULD NEVER BE TURNED OFF UNLESS DETAILED REPAIRS BECOME NECESSARY.

Since the receivers are either double or single conversion units, depending upon the frequency of operation, then the VOX must be set accordingly. Below 7.4 Mcs. the HFO must be 455 kc above the desired carrier, but above 7.4 Mcs. the HFO must be 3.955 Mcs. above the desired carrier. The following table will serve to minimize the small bit of arithmatic involved.

The operator should observe the Master Oscillator frequency dial, which is marked directly in CPS, and tune either by hand or by use of the motor drive, until he reads an approximate frequency as prescribed above. He may then shift up or down to the nearest 100 kc check point. For accurate calibration and resettability, care must be taken to rotate the dial in the same direction (preferably from a lower dial reading to a higher), in order to prevent any error due to backlash. Then, by varying the Calibrate control, a zero beat indication will be obtained in the headset and on the front panel milliameter. The VOX has now been properly corrected for the dial region to be used and should be returned to the needed frequency setting.

Once the calibration procedure has been concluded, the operator must be sure to place the Volume control in the 100 KC OFF position. At the same time, the Meter switch should be turned to the HFO position and the HFO switch to the ON position.

Now, by again referring to Table 4-1, the Band switch can be properly set. Rotate the Tuning knob to a position roughly approximating the Master Oscillator Frequency Dial, at which point a reading on the front panel milliameter will be observed. The Tuning knob will have been properly set when the highest milliameter reading is obtained. Then vary the Output control to any desired value of output.

TABLE 4-1

| Received Signal (fr) Frequency | VOX HFO OUTPUT | VOX BAND | VOX MO DIAL SETTING |
|---|---|---|---|
| Below 7.4 Mcs. | fr ± 455 kc | 2-4 Mcs. | fr + 455 |
| | fr ± 455 kc | 4-8 Mcs. | $\frac{fr + 455}{2}$ |
| | fr ± 3.955 Mcs. | 8-16 Mcs. | $\frac{fr + 3.955}{4}$ |
| Above 7.4 Mcs. | fr ± 3.955 Mcs. | 16-32 Mcs. | $\frac{fr + 3.955}{8}$ |
| | fr ± 3.955 Mcs. | 32-64 Mcs. | $\frac{fr + 3.955}{16}$ |

To complete the diversity system tuning, the operator must turn the IFO and HFO controls on both receivers to the Slave position and tune them to the approximate station frequency. In all probability, it will be necessary to slightly readjust the VOX because of small errors which frequently exist in the receiver first I.F., second I.F., and the transmitter frequency. The readjustment should be made against the DVM in either of its PAN positions, just as described in the previous paragraphs devoted to this unit.

The VOX will have been properly set when the incoming carrier is properly centered on the DVM oscilloscope face. Likewise, the receivers will have been properly set when maximum carrier amplitude is observed at this same point.

**CAUTION**

THE MASTER OSCILLATOR FREQUENCY-COUNTER MUST NOT BE PERMITTED TO TRAVEL BEYOND THE LIMITS OF 1.95 AND 4.05 MCS.

## 3. FREQUENCY SHIFT OPERATION

The needed equipment which must be turned on will now be:

a. The Power Control Panel, Model DCP.
b. Receivers One and Two, Model 600-DMK-*
c. Diversity Visual Monitor, Model DVM.
d. Diversity Combining Unit, Model DCU.
e. Loud Speaker Panel, Model LSP.
f. Frequency Shift Converter, Model CFA.
g. Power Supply, Model PSP-1
h. Teletypewriter Regenerator, Model SFO-2.

### A. RECEIVER TUNING IN MASTER-SLAVE.

The operator must refer once again to Section IV, 2A for initial receiver tuning. The receivers' IF outputs are already connected to the DCU section, where diversity action of the incoming signals can be observed on the DCU channel diode ammeters. The receivers' audio outputs are fed through the patching panel to the CFA, where they are combined and processed through the CFA circuits. Refer to Section 3 of the CFA instruction manual in the Appendix for a more detailed discussion of BFO adjustment and operation instructions.

### B. PATCHING

Diversity connections for frequency-shift operation in the DDR-2D System is shown in Figure 4-3 with some exceptions, depending upon the circuit needs. The system illustrated is one which provides both a tone and pulse output simultaneously. Generally, no tone output is required, and the patching cord connecting Tone Output with Tel Line can be dispensed with. For monitoring purposes, the Speaker Panel may be patched to the master or slave receivers' audio output.

Patching for FS operation in DDR-2 Systems which do not include the Teletypewriter Regenerator, Model SFO-2 is illustrated in Figure 4-5. This patching differs from the DDR-2D system in that there is no patching from the CFA to the SFO-2 and from the SFO-2 to the DCU tone keyer input. The operator must remember to turn the TEST switch on the DCU panel to the EXT position whenever the DCU tone keyer is externally excited.

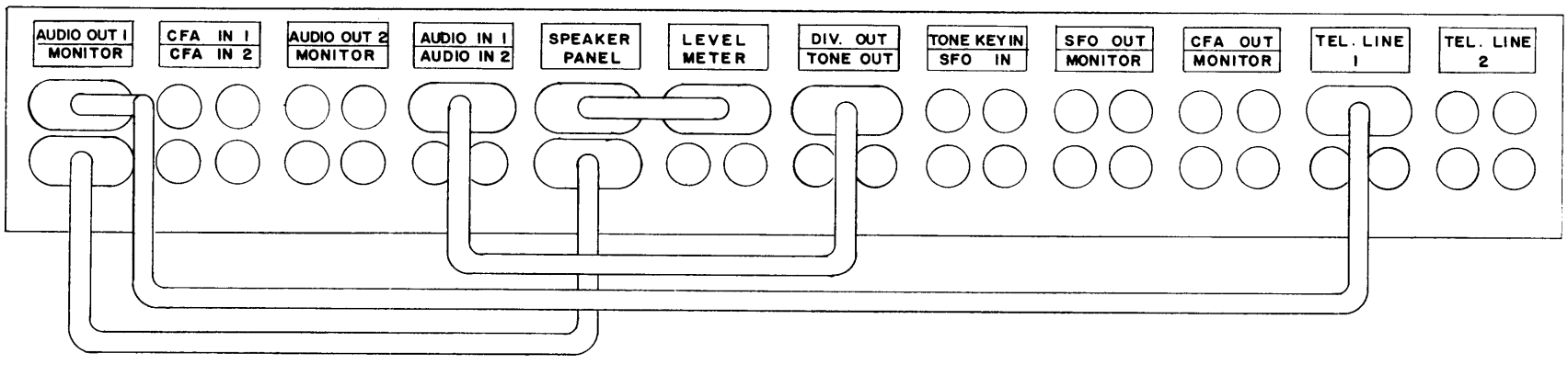
### C. THE DVM

Calibrate the DVM in the 5 kc position, and then observe the Master receiver frequency spectrum, as was previously done in Section IV-2. When the FS signal appears, it will consist of two distinct "pips", the one to the right being "mark" and its left counterpart being "space". These two must be set symmetrically with the center of the oscilloscope, where the calibrating "pip" formerly appeared.

Once the Master receiver is nearly "on frequency", a more exact picture may be obtained by recalibrating on the 1 kc sweep range. In this position a horizontal distance from the center line of one inch represents 1 kc in frequency. A common situation which is frequently encountered is one in which the transmitting station stands-by on "mark" to give the receiving operator an opportunity to tune his equipment. In this case, the Master receiver would be tuned so that the "mark" pip is set 425 cps, or one-half the total shift, to the right of the DVM oscilloscope centerline.

### D. THE SFO-2

After an input signal is applied to the unit, and the remote output power supply is connected and powered, allow the Regenerator sufficient time to warm up and stabilize. Determine the speed of the incoming signal, and set the front panel SPEED selector switch to the correct position (60, 75, or 100 wpm). Set the three keying switches behind the front panel access door and S-7 located on the rear chassis for operation of the input signal used. Since the type of teletype signal is DC Simplex Neutral, the NORMAL/REVERSE toggle switch is set to NORMAL, the Tone/DC switch to DC and the SIMPLEX NEUTRAL/DIPLEX, POLAR




DIVERSITY CONNECTION FOR PHONE OPERATION

THE AUDIO AMPLIFIER OF RECEIVER 1 IS USED HERE TO INCREASE THE AUDIO POWER IN THE RECEIVED DIVERSITY SIGNAL AND TO PROVIDE A LOW IMPEDANCE OUTPUT FOR COUPLING TO THE TELEPHONE LINE. THE SPEAKER PANEL AND LEVEL METER ARE BOTH MONITORING THE AUDIO INTO THE TELEPHONE LINE.

Figure 4-4. Phone Patch Connections

switch is set to SIMPLEX NEUTRAL. Since the input is positive with respect to ground, S-7 is set to positive ground.

Connect a low frequency sweep oscilloscope to the oscilloscope jack behind the access door. The oscilloscope monitor switch indicates the various circuits to which the oscilloscope is connected. Thus, the gate cycle, trigger voltage, and the output voltage to the teletypewriters may be observed.

Advance the INPUT ATTENUATOR clockwise from the infinity ( ) position, until the front panel neon lamp first begins to blink (trigger point). Advance this control clockwise 6 steps beyond this point. Set the RANGE control to 50. The remote teletype printer to which the Regenerator is connected should now be operating. If this teletypewriter is too distant for observation, connect a monitor teletype printer to the MONITOR jack on the front panel, and check that the monitor teletypewriter is printing correctly. If it is not printing correctly, operational checks and adjustments should be performed by applying an undistorted repeated character telegraph test signal to the Regenerator, as discussed in Section 3 of the Regenerator instruction manual in the Appendix.

### 4. PHONE OPERATION

With few exceptions, the setup procedure for phone operations is accomplished in essentially the same way as for CW operation. The Receivers and DVM are treated precisely as before. However, only part of the DCU is utilized.

Referring to the DCU, the operator should set the Phone/CW switch to the Phone position and adjust the AVC Time for best results. The meters in this unit may continue to be used, but the remaining controls should be disregarded.

For patching, reference should be made to Figure 4-4. This illustrates a condition where the Level Meter on the DCU and the Loud Speaker are both used to monitor the output signal. The patching jack mark DIV OUT is not to be fed directly to the telephone lines. The audio amplifiers of one of the receivers is used to increase the audio power in the diversity signal and to provide a low impedance output for coupling to the telephone line.

# SECTION V
# MAINTENANCE

### 1. GENERAL

Since the DDR-2 Dual Diversity Receiver is made up of ten completely independent components, maintenance problems are greatly simplified. Any impaired operation can be rapidly traced to the faulty component merely by taking the output of each unit individually. The DDR-2 has been designed to provide long term, trouble free, continuous 24 hour a day operation. It is recommended that any maintenance to the equipment be performed by a competent maintenance technician.

### 2. OPERATOR'S MAINTENANCE

Servicing adjustments and repairs should not be attempted by unqualified or unauthorized persons. Satisfactory operation depends partly upon several external mechanical conditions. In case of trouble, look over all the external equipment before taking any units from the rack. For example, examine the following items to see that the apparatus is in good mechanical condition, that connections are good and made correctly, and that all plugs and sockets are clean.

a. Antenna and lead-in or transmission line.

b. Ground.

c. Earphones or speaker, including cord and plug.

d. Power cable and plug.

e. Line fuse.

Any abnormal or erratic operation of the system, or failures of any unit to operate, should be immediately investigated and corrected. In addition, routine checks should be made at regular intervals. With the set in operation, check the indicator lamps. If they are not lighted, check the lamps and fuses. Replace burned out fuses and lamps. If the fuse continues to blow, investigate the unit for trouble. Under no circumstances replace a fuse with one of higher rating.

Standard types of vacuum tubes are used throughout the design of the system. The location

of all tubes in the DDR-2 units are indicated in the individual section illustrations of this manual. The tubes may be checked visually for filament operation, abnormal color, or for warmth. When necessary, the tubes should be carefully removed and tested, and when replaced, care should be taken to install tube shields.

## 3. PREVENTATIVE MAINTENANCE

In order to prevent actual failure of the equipment due to corrosion, tube failures, dust or other destructive ambient conditions, it is recommended that the following preventative maintenance be performed.

a. Remove the equipment from the rack, and thoroughly inspect the insides of the chassis for signs of dirt, dampness, moulding, charring and corrosion. Correct any defect found. A recommended cleaning agent is clean carbon tetrachloride applied with a soft brush.

b. Test all DC and AC voltages as indicated on the respective tube voltage sheets, and investigate any serious discrepancies.

c. Test vacuum tubes regularly and replace any showing low characteristics. Loss of sensitivity, noisy operation and certain other deviations from normal performance frequently can be traced to worn out or defective tubes. Do not undertake an alignment check without first making certain that normal performance cannot be restored with a good set of tubes.

d. When replacing the sectional equipments in the rack, be certain that all terminal strip screw connections at the rear of the equipment are tight.

## 4. CORRECTIVE MAINTENANCE

Detailed corrective maintenance procedures have been incorporated in the sectional instruction books in the appendix of this manual. In general, troubles concerning power supply and distribution are traced with the DC voltmeter and ohmmeter, while troubles concerning signal are traced with an AC vacuum tube voltmeter, oscilloscope, and sweep frequency signal generator.