SALES SERVICE INFORMATION

Th T chnical Materi l Corporation
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TRIPLE DIVERSITY RECEIVING SYSTEM
MODEL TDRS

The Model TDRS Triple Diversity Receiving System consists of three Hammarlund SP600X communications receivers which have been modified to TMC specifications, assembled in two deluxe 84" racks with all of the necessary associated equipment which have been found most desirable in a triple diversity receiving system.

The Model TDRS is designed to receive radio signals within the range of .54 to 54.0 mcs, modulated in any one of the following manners:

a. Amplitude Modulated broadcast or telephone
b. Phase Modulated broadcast or telephone
c. Frequency shift radio teletype
d. CW
e. MCW

The reception of telephone or broadcast signals may be accomplished in the normal accepted manner or provision has been made to receive these signals on an exalted-carrier basis. A sideband selector dial is provided which allows adjustment of each receiver so that reception depends on only one side band while the other, which may be interfered with, is rejected. Arrangements have been made with the Crosby Laboratories, Inc., to incorporate their exalted-carrier and combining equipment in this diversity receiver. This equipment incorporates the very latest engineering techniques known in the exalted-carrier and combining field, having been designed under the supervision of Murray G. Crosby and his staff after many years of research and field testing. The apparent advantages of the exalted-carrier technique are discussed later in this bulletin.

When receiving frequency shift signals, CW or MCW, very little advantage is gained in the use of a third receiver. Therefore, the TDRS has been designed to receive these signals on a dual diversity basis.

F/S Signals are received with the individual receivers operating with common high frequency, intermediate frequency and beat frequency oscillator voltages. These voltages are derived from the newly designed TMC Model VOX Variable Frequency Oscillator. The Two audio outputs of the receivers are patched into the Model CFA Frequency Shift Converter and diversity combined. The output of the converter may then be fed into a local teleprinter or other external equipment. Local battery is provided by the Model PSP Power Supply.

Reception of CW signals is accomplished in diversity by the individual receivers. These signals are detected at the second detector of the receivers and fed to the combining unit where they are combined in a common diode load. The combined and rectified CW pulses are passed through filtering and biasing circuits to excite a local tone keyer. The keyed audio tone from the tone keyer may be patched to any external receiving device.

For the reception of MCW signals the receivers are operated individually as with frequency shift except that no receiver beat frequency oscillator is utilized. The detected tones from the audio output of each receiver are fed to the combining unit where they are individually rectified and mixed in a common diode load. The detected CW pulses are then used to excite the local tone keyer as in CW reception.

The Automatic Volume Control circuit in this equipment may be operated either individually or connected to a common basis in the combining unit. This method offers maximum flexibility of operation.

The Complete TDRS equipment consists of the following units:

a. Three each Model SP600X Receivers Modified to TMC Specifications.

b. Three each Exalted-Carrier Adaptors Model ECC.

c. One each Diversity Combiner Model DCB.

d. One each Loudspeaker Panel Model LSP.

e. One each Variable Frequency Oscillator Model VOX.

f. One each Visual Monitor Unit Model DVM.

g. One each Patching Panel Model LPP.

h. One each Diversity Combining Unit Model DCU.

i. One each Frequency Shift Converter Model CFA.

j. One each Power Supply Model PSP.

k. One each Power Control Panel DCP.

The following is a brief discussion of the features and advantages of the exalted carrier portion of the TDRS.

Features

1. Complete elimination of selective fading distortion and cross modulation.

2. A new type of selectivity is added which rejects interference within the received channel. This selectivity is over and above that normally produced by the receiver bandpass filters.

3. "Protection" of the automatic frequency control and automatic volume control against jamming and other interference which might upset either one of these controls.

4. Automatic frequency control which holds the receiver exactly in tune for drifts of ± 2000 cycles. Tuning meter reads directly in cycles off tune.

5. Flexible combiner switching system with complete independence of each receiver so that if one of the three diversity receivers fails, the remaining two carry the load without damage from the receiver that has failed.

6. Complete metering and controls provided for easy balancing of the diversity system so that each receiver carries its proper share of the load.

7. Diversity combination with a sharp selection which rejects weaker signals so that their noise is not contributed to the output.

8. Reception of either amplitude modulation (AM) or phase modulation (PM) by simply throwing a switch on each exalted-carrier adapter. Both types of modulation received in the same manner on the diversity combination.

9. Improved single-receiver performance, due to exalted-carrier reception on either amplitude or phase modulation.

10. Ability to use the individual receivers separately or for the reception of one signal with a dual diversity combination and a second signal with a single receiver.

General

The exalted-carrier detecting system comprises a carrier filter and limiter which feeds a reconditioned carrier to a new type of recombining detector resulting in an audio output of very low distortion and high rejection of the modulation on an interfering signal. Overall modulator and detector distortions of less than two percent at either one hundred percent or two hundred percent amplitude modulation are obtained. The ordinary diode detection produces high degrees of distortion for modulation percentages above about eighty-five percent. The exalted-carrier detecting system effectively removes all harmonic and cross modulation distortion due to selective fading of the carrier component. The result is a clarity of short wave reception which, after being heard once, becomes a new standard of performance.

A feature of the new system is its immunity to interference. The automatic-frequency-control and automatic-volume-control circuits are arranged to be insensitive to signals other than the desired carrier. This prevents an interfering or jamming signal from taking control of either the AFC or the AVC systems. The exalted-carrier detection action, which is brought to a high stage of performance in these units, rejects the detection of modulation on an interfering or jamming signal. This is an additional selectivity against a signal which may be located within the normal received channel. It is a selectivity of a type that ordinary selectivity can not accomplish without impairing the desired signal. As a result, signals may be received which, when received on the ordinary diode detector, may be so completely jammed by an interfering signal that their presence could not have been detected.

A feature of the diversity combining unit, which combines the outputs of the three exalted-carrier detectors, is its simplicity of operation. Three signal-strength meters are provided together with a combined signal-strength indicator. An audio-output level meter is also included. Switching is simplified so that any receiver may be individually tuned without interfering with the diversity output. The diversity output is protected from noises which might be brought about by failure of any individual receiver, by an automatic rejection of the output due to that receiver. As a result the diversity output does not fail until all three receivers have failed.

The diversity combiner has an effectiveness of selecting the desired signal such that, if the weaker signal is 6DB less in strength, it does not contribute to the diversity output. This is a diversity selection which is far beyond the effectiveness of prior systems. It is made possible by a new and novel combining system which is not only highly effective, but simple to operate.

An additional feature of the exalted-carrier detecting system is its ability to receive phase modulation with either the single receiver or diversity combination. This allows the use of a phase modulator at the transmitter with its attendant advantages with respect to elimination of the requirement for an amplitude modulator and all of the other advantages such as increased power output, which are brought about by the use of angle modulation at the transmitter.

The exalted-carrier adapter may be connected to a single receiver to provide a greatly improved reception with respect to the diode reception normally obtained on a single receiver. All of the advantages of rejection of interference and harmonic distortion due to selective fading are obtained on the single receiver as well as on the diversity combination.

In addition to three-receiver and single receiver arrangements, a two-receiver diversity system can be provided which utilizes a combination of horizontal and vertically polarized antennas in place of a spaced-antenna diversity arrangement. Such a system is adapted to situations where space is unavailable. It has been found that this combination is a highly effective and economical system.

EXALTED-CARRIER ADVANTAGES

Selective Fading Distortion Elimination

When signals are received by means of ionospheric transmission, multipath transmission effects produce variations in amplitude of the individual carrier and sideband frequencies to form selective fading. This type of fading will produce a momentary attenuation of any individual frequency which might be either the transmitted carrier frequency or one of the sideband frequencies. Thus, a carrier and two sidebands as shown in Fig. 1 may be transmitted through the ionosphere which has an amplitude-frequency response as shown in Fig. 2. As a result, the normal relative amplitudes of the carrier and sidebands are upset. The result may be as shown in Fig. 3 in which the carrier is received with an amplitude so reduced that, instead of being twice as strong as each individual sideband for the condition of 100% modulation, the carrier may be much weaker than either sideband. The result of this condition, when applied to the ordinary detector is a reduction in the fundamental output of the detector and the introduction of a strong second-harmonic distortion. Consequently, intelligibility is greatly reduced.

The normal mechanism of detector action is a form of heterodyne between the carrier and individual sidebands to form the fundamental output. However, if the carrier component is below normal level, the heterodyne action is between the two sidebands so that a double-frequency harmonic distortion is produced. This condition occurs frequently in short wave (1.5 to 54 megacycles) reception and is responsible for a large amount of the poor quality of reception in this frequency range.

Another effect which is encountered as a distortion is cross modulation between individual sideband frequencies of one sideband. Since the carrier may fade to a strength which no longer makes the predominant detector output that of a heterodyne between the carrier and the sideband, individual frequencies of one sideband may heterodyne with one another to cause spurious distortion with a high degree of masking effect upon intelligibility.

The function of the exalted carrier receiver is to exalt the carrier back to its original strength so that the predominant output of the receiver is again a heterodyne between the carrier component and the sidebands. This exaltation must be accomplished in a manner to eliminate heterodyne, or coaction, between individual sideband frequencies and between upper and lower sideband frequencies. Such a function may be accomplished by the system shown in Fig. 4. The carrier component is selected by means of a sharp carrier filter which may employ a quartz crystal. The output of the carrier filter is limited to maintain a constant carrier amplitude, and is fed to a recombining detector. At this recombining detector a branch of original signal energy is available to be recombined with the filtered carrier in proper phase. As a result, the detector may see a new carrier and sidebands as shown in Fig. 5 which may be produced from a signal faded to the condition shown in Fig. 3.

The recombining detector may comprise the ordinary diode detector which merely detects the amplitude modulation on the signal with the exalted-carrier. However, other types of detectors are available which produce the same resultant effect but do not require an actual exaltation in level of the carrier component. These detectors are known as "product detectors". The product detectors usually have two inputs for the application of carrier and signal input. The detected output of a product detector is proportional to the product of the two inputs. It may also be looked upon as the heterodyne between the two inputs. Thus, this detector inherently provides an output which is only proportional to a coaction or heterodyne, between the applied carrier input and the applied signal input. This type of action is that desired for exalted-carrier operation. The filtered carrier component has been placed in a commanding position so that the detector output is only that produced by a heterodyne between that carrier and the sidebands, but in attaining this commanding position, it has not necessarily been raised in level.

The type of detector used in the Crosby exalted-carrier adapters is a form of product detector. This detector is the result of a long period of research which resulted in a simple but highly effective detector capable of low degrees of distortion and cross modulation without critical adjustments. The circuit uses three ordinary triodes.

Interference Rejecting Effects

One of the most effective results of exalted-carrier reception is the added selectivity effect which is produced. This selectivity effect is the rejection of the modulation which would normally be received from an interfering signal which is within the received channel. Thus, in the case shown in Fig. 6, the desired signal is the smaller carrier C and sidebands LS and US. The interfering signal is carrier C' and sidebands LS' and US'. Normally, without exalted-carrier detection, the detector output would be comprised mostly of the detection of the stronger signal C', LS', US'. If the modulation were voice modulation, that voice output would swamp the output due to the weaker signal C, LS, US. Exalted-carrier detection, however, makes the carrier C predominate to control the detected output so that the heterodyne or coaction between C' and sidebands LS', US', is eliminated. As a result, beatnotes and heterodynes are still obtained from the interfering carrier C', and its sidebands LS', US', but the modulation component with its swamping and masking effect is eliminated.

The heterodyne component produced for cases as shown in Fig. 6 will be a heterodyne between carrier C and carrier C'. This will be a fixed frequency beatnote which may be eliminated at the received output by means of sharp band-elimination filters. The monkey chatter produced by the heterodyne between carrier C and sidebands LS', US' is usually negligible.

As a result of the rejection of the modulation component on an interfering signal, the exalted-carrier detection transfers selectivity to the audio low-pass filter. For the case where the interference in the adjacent channel is strong enough to pass the intermediate-frequency selectivity, the modulation component of the interference is rejected by the exalted-carrier action and the beatnote remaining is rejected by the audio low-pass filter. This effect increases the overall adjacent-channel selectivity of the receiver since it is much easier to obtain the sharp selectivity at audio-frequencies than at intermediate frequencies. Usually, the maximum audio-frequency response of the audio circuits is sufficient low-pass filter action, but additional low-pass filters may be inserted if desired. These low-pass filters would determine the steepness of the side of the overall selectivity of the receiving system.

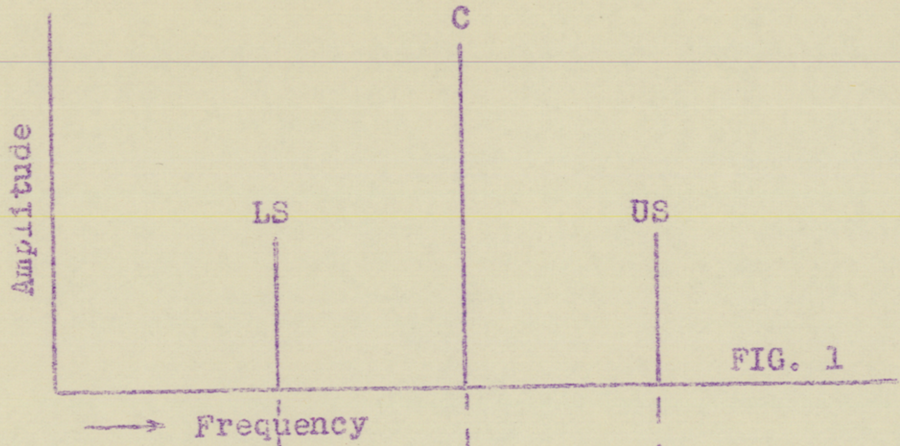


FIG. 1

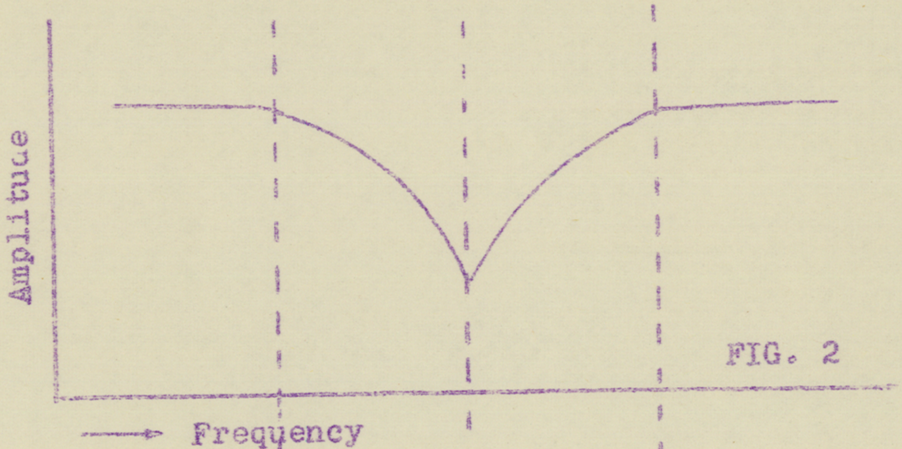


FIG. 2

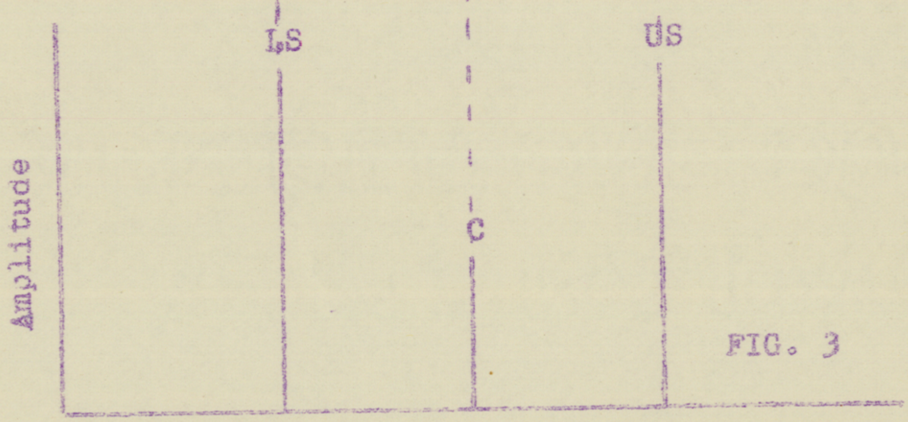
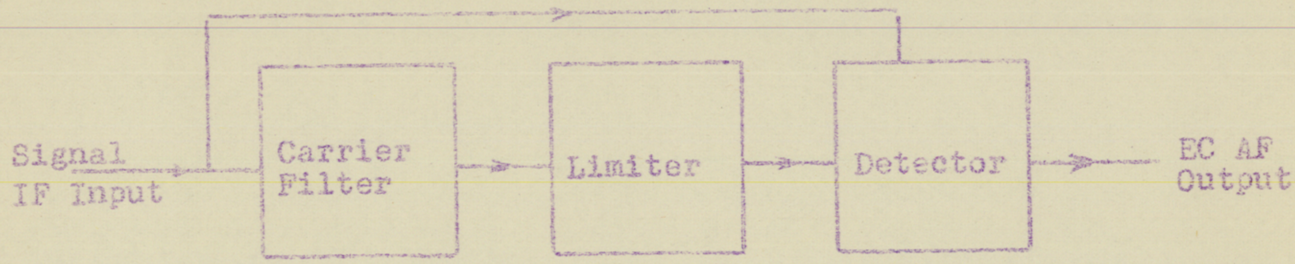
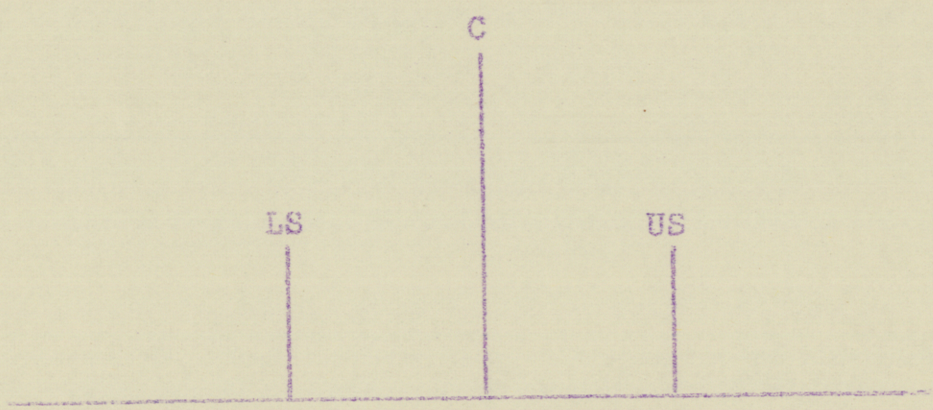


FIG. 3



Signal
IF Input
Carrier
Filter
Limiter
Detector
EC AF
Output

FIG. 4



C
LS
US

FIG. 5

Technical Specifications:
(by individual component units)

Model SP-600X Receiver (Modified)

Frequency Range:	.54 to 54.0 mcs in six bands, continuously var.
Maximum Undistorted Output:	2.5 Watts (approximately).
Output Impedance:	600 ohms balanced split windings Phonejack winding; delivers 15 milliwatts to an 8000 ohm resistive load, when the audio output to the 600 ohm power load is adjusted to 500 milliwatts.

Power Supply Requirements:

Line Rating:	95, 105, 117, 130, 190, 210, 234 and 260 volt taps, 50/60 cycle.
Power Consumption:	130 watts, 1.25 amps at 117 volts-maximum.

Tube Complement: (Total 20)

7 ea.	6BA6	RF, IF and BFO Amplifiers.
3 ea.	6C4	HF, 2nd Conversion and BFO Osc.
1 ea.	6AC7	Crystal controlled HF Oscillators
2 ea.	6BE6	Mixers.
3 ea.	6AL5	Detector, "C" Bias Rectifier, & Noise Limiter & meter rectifier.
1 ea.	12 AU7	AF Amplifier and IF Output.
1 ea.	6V6GT	Power Output.
1 ea.	5R4GY	Rectifier.
1 ea.	OA2	Voltage Regulator.

Physical Dimensions: 19" wide x 10½" high x 16½" deep. Weight is 66 pounds net.

Performance Data:

Sensitivity:	2.3 microvolts (s/N ratio of 10:1)
Image rejection:	Better than 80 db throughout freq. range.
IF rejection ratio:	(600 kc) 2700:1

AVC Circuit: Provides time constants as follows:

Slow	.5 seconds
Medium	.1 "
Fast	.01 "

Oscillator Circuits: The HFO, BFO and second conversion oscillator circuits are modified to provide for
a) external oscillator injection.
b) Slave operation (Rec #1 oscillators supply receivers #1 and #2).

Components & Construction: Equipment is manufactured in accordance with JAN specifications wherever practicable.

We reserve the right to make engineering changes in these specifications when required.

Essential Circuit Functions of EC Adapter

A block diagram of the essential functions of the exalted-carrier adapter unit is shown in Fig. 7. Referring to Fig, 7, the IF output of the communications receiver is fed to converter, 1, which, together with oscillator, 2, converts to a new intermediate frequency of 200 kc. This new intermediate frequency is fed to carrier filter, 3, which is a crystal filter capable of removing the sidebands and passing only the carrier component. The converter oscillator is maintained in tune by means of automatic-frequency-control at a frequency which holds the 200 kc output accurately in tune with the sharp carrier filter. This is done by means of a crystal automatic-frequency-control discriminator and detector system, 4, which is fed from the output of the carrier filter. The detected AFC potential is fed to reactance tube and oscillator, 2, through the proper time-constant circuits. The result of the automatic-frequency-control is such as to allow a drift of as much as 2000 cycles in the intermediate-frequency input fed to the adapter, with only about one or two cycles shift in the 200 kc intermediate frequency.

The output of the carrier filter is fed through limiters, 5 and 6, and thence to phase shifter, 7, which adjusts the phase of combination produced between the filtered carrier and the carrier from the signal which is fed to the recombining detector, 8. A switch is provided on the front panel to shift the phase of the reintroduced carrier so that it is proper for either AM or PM reception. For the AM condition, the carrier is adjusted to the in-phase position with respect to the carrier in the original signal. For the PM condition, a shift of 90° is obtained between the two carriers. The output of the recombining detector is fed to the output terminals through low-pass filter, 9, and audio-frequency amplifier, 10.

For diversity combination of exalted-carrier adapter outputs, it is desired to have an output of filtered carrier, which is provided by cathode-follower, 11, and detected audio output which is provided by cathode-follower, 12. These two outputs are fed to the combiner.

Diversity Combiner Model DCB

The general function of the diversity combiner is to combine the outputs of the three exalted-carrier adapters, which are fed by the three receivers, so that an output signal is obtained which corresponds to the best signal received on the three antennas which drive the three receivers. The most desirable type of combination would be one which continuously chose the strongest signal and rejected the weaker signals. This type of choice selection is desirable since, if the receiver audio outputs are merely added, the weaker signals contribute noise which is in accordance with their poorer signal-to-noise ratio. By choosing the strongest signal at all times, a signal-to-noise ratio is obtained which is in accordance with the stronger signal. Improved overall signal-to-noise ratio is thereby obtained.

The diversity combining system used in the Crosby exalted-carrier receiving system employs a method in which the incoming signal is reconstituted to an amplitude-modulated signal which may be later combined in the diode-detector type of diversity-combining system. The reconstituted signal is obtained by the use of a modulator which generates a new amplitude-modulated wave having a carrier comprised of the filtered carrier from the incoming signal, and a modulation input comprised of the exalted-carrier detector audio output. As a result, a new amplitude-modulated wave is formed from each incoming signal, which has a strength proportional to the incoming signal carrier, and a modulation envelope which is cleanly modulated without distortion by the output of the exalted-carrier detector. Combination of the individual channels of the diversity system then may be made in the usual method using common diode connections. Consequently, the desired choice selection is obtained such that the signal with the strongest carrier, produces the predominant output and the weaker signals are rejected. It has been found that this selection is highly effective and that a 6 db difference is all that is necessary to completely reject a weaker signal.

The general result of the combination of three exalted-carrier detecting systems is to provide an improved signal-to-noise ratio and also to iron out the volume variations which normally are produced due to the carrier fading. The improved signal-to-noise ratio is obtained by virtue of the choice of the stronger carrier. The smoothing of audio volume variations is effected as a result of the elimination of contributions from the receivers having signals undergoing a carrier fade. The usual result of a carrier fade is an increase in the effective percentage of modulation which will greatly raise the audio volume output of the receiver. However, with the combining system which rejects weaker carriers, the output of the receiver which is undergoing a carrier fade, is completely rejected. As a result, the diversity system omits the particular condition which causes the "volume burst" resulting from carrier fades. This results in a marked reduction in volume variations.

Fig. 8 shows a block diagram of the arrangement of the diversity combining unit. Two inputs are obtained from the exalted-carrier adapter. One of these is the audio frequency output of the exalted-carrier adapter detector which is fed to AF amplifier, 20, and acts as a modulation input to AM modulator, 21. The carrier source for the AM modulator is taken from the carrier filter output of the exalted-carrier adapter. The AM modulator is a triple-triode recombining detector used in the exalted-carrier adapter. It provides an amplitude modulation with an amplitude of output directly proportional to the carrier input voltage and a percentage of modulation dependent only upon the audio input voltage received from the exalted-carrier detector. By means of carrier neutralization, extremely low distortion is obtained in this modulator. As a result, a cleanly modulated amplitude modulated wave is constructed which is directly proportional in amplitude to the amplitude of the carrier received on that particular receiver. The output of the modulator is set at approximately 30% amplitude modulation so that detector distortion in the subsequent diode detector is minimized.

Unit 23 comprises the diode detector together with its associated drive tube. It is arranged in a switching system which will allow connection of the diode to its own separate resistor on the monitor position. Hence, the signal may be tuned, using the AVC system of that particular receiver, without interfering with the signal that is on the diversity bus. Meters M1, M2 and M3 indicate the diode detector currents of the three receiver channels.

Units 24, 25, 26 and 27, 28, 29 are identical to units 20, 21, 23 respectively. In this way, the three channels are combined to produce an output which appears across the common diode resistor, 32. M4 indicates the combined diode current.

Two audio frequency amplifiers are provided in the diversity combining unit. One of these is permanently connected to the diversity bus which is the common diode output resistor. The other is a monitor amplifier which may be used for tuning purposes and may be connected to any one of the receivers individually, or to the diversity bus. Also, two signals could be accommodated in the receiving system by putting one of the receivers in the monitor condition and connecting the monitor amplifier to that particular receiver for output. The other two receivers could be maintained in diversity operation using the diversity amplifier.

Circuits are arranged so that the AVC systems may be operated individually or from the diversity bus. An AVC gate is provided to prevent adjustment of the IF level control to the condition of positive voltage on the AVC bus. Slow and fast time constant of the AVC may be chosen by means of switches at the rear of the chassis.

If it is desired to receive phase modulation, no change is required other than switching the AM-PM switches on each exalted-carrier adapter, to the PM position.

Model DCU Diversity Combining Unit

The Diversity Combining Unit, Model DCU which is designed for use in the Model DDR-2 receiver, provides facilities for (2) combining IF voltages of the two receivers in common diode load for keying of self contained single frequency tone keyer; (b) combining IF voltages of two receivers in common load for diversity mixing in detection of audio and broadcast signals; (c) connecting the IF outputs or the audio outputs of the two receivers to a frequency shift converter; (d) detection and diversity combination of MCW signals for keying self-contained tone keyer.

Metering is provided for indication of signal level of each receiver. Combining facilities are provided for control of AVC voltages of the two receivers. A VU meter is provided for monitoring the audio level of the audio circuits.

IF Input:	455 Kcs IF from each receiver.
Audio Input:	600 ohm audio from each receiver.
Control Input:	AVC voltage from each receiver.
Output:	1. 455 Kcs IF to IF converters. 2. Single frequency tone for feeding a line or ink-tape recording equipment from a CW or MCW signal, 600 ohms. 3. 600 Ohm audio from each receiver. 4. 600 Ohm audio from combined diversity load. 5. Combined AVC voltage.
Metering:	1. Two meters in series with separate diodes to indicate signal level from each receiver. 2. One VU meter to indicate level from all audio circuits.
Controls:	1. Primary power switch. 2. AVC bias switch. 3. CW-MCW bias adjust. 4. CW-MCW threshold control. 5. Level meter range switch. 6. Level meter selector switch. 7. Speed control.
Tubes:	All JAN miniature types.
Size:	19" wide x 14" deep x 7" high.
Primary Power:	110/220 volt 50/60 cps.
Components & Construction:	Equipment is manufactured in accordance with JAN specifications wherever practicable.

We reserve the right to make engineering changes in these specifications when required.

Model DVM Diversity Visual Monitor Unit

This unit provides a calibrated oscilloscopic presentation on a 3" cathode ray tube showing a circular pattern with the received signal indicated as a pip on this pattern. Visual indication of the background noise and adjacent channel interference is also shown. The frequency of the desired signal is indicated with respect to the center of the pass band of the picture.

Input:	Three 70 Ohms coaxial connectors to accomodate three receivers with 455 Kc IF. (Any one to be selected by front panel switch).
Input Level:	10 millivolts across 70 ohms mimimum.
Output:	1. Visual indication of signal condition and receiver tuning on 3" CRT tube. 2. Signal of sufficient level for earphones, available at phone jack.
Components & Construction:	Equipment is manufactured in accordance with JAN specifications wherever practicable.

We reserve the right to make engineering changes in these specifications when required.

Model DCP Power Control Panel

Size:	$3\frac{1}{2}$" high x 19" wide x 5" deep.
Contents:	1. $7\frac{1}{2}$" amp circuit breaker. 2. Pilot light terminal block. 3. Two convenience outlets.

Note: (Auto transformer or voltage regulator may be mounted in base of rack, if required).

Model LSP Loudspeaker Panel

Speaker:	8" diameter.
Input:	High impedance bridging amplifier with volume control.
Tubes:	1 - 6X5. 1 - 12AU7
Power:	110 volts, 50/60 cycles, 25 watts.
Size:	19" wide x 8 3/4" high x 5" deep.

Model LPP Patching Panel

Jacks:	48 closed circuit jacks.
Patch Cords:	Sufficient for operation and spares.
Size:	19" wide x 8" deep x $3\frac{1}{2}$" high.

The Variable Frequency Oscillator, Model VOX, is a precision direct reading variable frequency device, designed to provide high frequency and medium frequency oscillator injection voltage for the control of one or more receivers or transmitter exciters with extremely high stability.

This oscillator will provide the following:

High frequency R.F. output voltage continuously variable over the range of 2 to 54 megacycles.

Crystal controlled high frequency voltage over range of 2-54 megacycles.

Crystal controlled BFO voltage, plus 3500 KC crystal control voltage for dual conversion superheterodynes such as the Hammarlund 600 series.

Sufficient output is available from any of the foregoing to control up to three receivers in diversity, or the usual requirement of transmitter exciters.

The VOX incorporates a highly stable variable frequency oscillator with an extremely accurate counter type dial. All frequency determining elements are contained in a temperature stabilized oven, and these components are carefully selected for high stability operation.

In addition to the variable frequency feature, provision is made for up to three crystal controlled positions for high frequency injection. Additional crystal oscillators provide crystal controlled beat frequency oscillator voltage for use with receivers, and a 3500 KC Crystal controlled RF output for dual conversion receivers.

The direct reading calibration of the unit enables the operator to set the output frequency to within 20 cycles per megacycle of any desired frequency within the range of the unit, and the unit is resettable to the same tolerance. A self-contained 100 KC crystal temperature controlled provides 50 KC check points for calibration of the VFO. All units are isolated with buffer amplifiers where necessary to prevent interaction. The output is controllable from approximately .1 to 2 watts.

HF Oscillator

Frequency Range:	2 to 54 megacycles continuous.
Output Impedance:	75 ohms coaxial.
Output Level:	2 watts throughout basic range of 2 to 4 megacycles and 0.5 watts 4 to 54 megacycles, adjustable.
Output Connections:	Three ~~Amphenol 83-1R.~~
Crystal Frequencies:	2 to 4 megacycles for output frequencies of 2 to 54 megacycles.
Crystal Holders:	Miniature JAN, three positions.
Output Voltage:	Sinusoidal with no spurious frequencies.
Stability:	20 cycles per megacycle for 0 to 50 degrees change in ambient temperature.
Calibration:	Direct reading calibration.
Readability:	20 cycles per megacycle.
Resettability:	20 cycles per megacycle to a calibrated frequency.
Line Voltage Change Effects:	10 cycles for plus/minus 10% change in Line Voltage.
Humidity Effects:	No appreciable change for 50 to 95% humidity.
High Frequency Oscillator Calibration:	Against 100 kc crystal oscillator at 50 kc points.

Beat Frequency Oscillator

Frequency Range:	~~450~~ to 457 Kcs.
Output Level:	6 volts across 1000 ohms with output level control.
Output Connections:	Three ~~Amphenol 83-1R.~~
Crystal Holders:	Miniature JAN.

2nd Conversion Oscillator

Frequency Range:	Fixed 3500 Kcs.
Output Level:	2 volts in 75 ohms.
Output Connections:	Three ~~Amphenol 83-1R.~~ BNC TYPE UG

General

Controls:	1. Primary power switch. 2. HFO Crystal/Mo/off switch. 3. Multiplier switch. 4. Meter Selector Switch. 5. BFO Crystal Selector switch. 6. 3500 kc oscillator on/off switch. 7. Main Frequency Control Dial. 8. Output Tuning. 9. Calibrator level control.
Metering:	Oscillator Plate currents, Output levels.
Primary power:	110/220 volts 50/60 cycles approximately 150 watts.
Dimensions:	19" x 10½" x 14".
Weight:	Approximately 50 pounds.
Mounting:	WE Relay Rack mounting.
Tube Complement:	All JAN approved miniature or octal types.
Components & Construction:	Equipment is manufactured in accordance with JAN specifications wherever practicable.

We reserve the right to make engineering changes in these specifications when required.