INSTRUCTION BOOK
FOR
MODEL 1500-A SERIES
SPECIAL PURPOSE
RECEIVERS

Vitro ELECTRONICS
A DIVISION OF VITRO CORPORATION OF AMERICA
PRODUCERS OF NEMS-CLARKE EQUIPMENT
919 JESUP-BLAIR DRIVE / SILVER SPRING, MARYLAND

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised while operating this equipment.

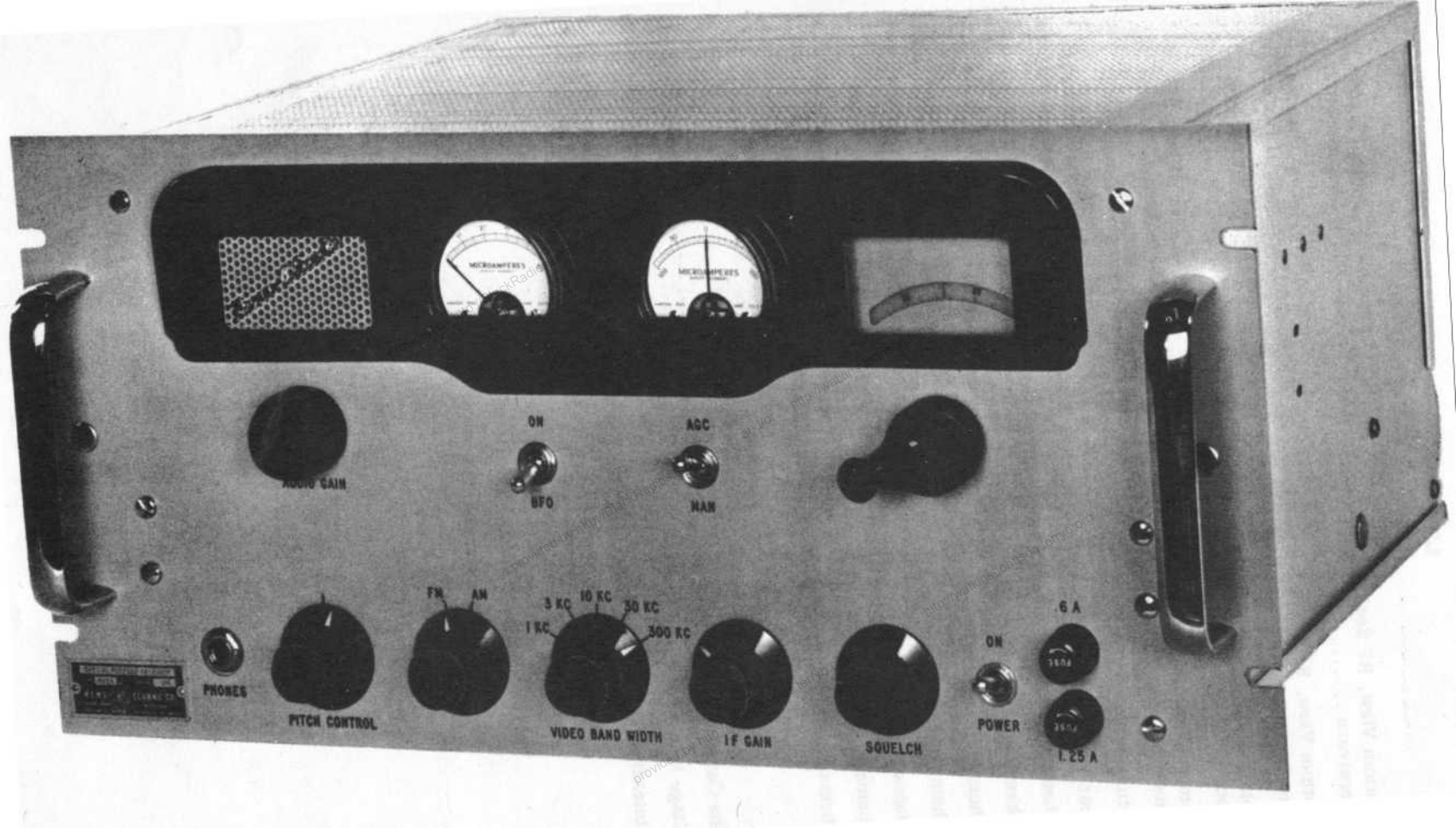
TABLE OF CONTENTS

LIST OF ILLUSTRATIONS (continued)

LIST OF CHARTS & TABLES

LIST OF ILLUSTRATIONS (continued)

LIST OF CHARTS & TABLES


MICROAMPERES
MICROAMPERES
AUDIO GAIN
ON
BFO
AGC
MAN
FM
AM
3 KC
10 KC
30 KC
1 KC
300 KC
.6 A
ON
PHONES
PITCH CONTROL
VIDEO BAND WIDTH
I F GAIN
SQUELCH
POWER
1.25 A

SECTION I

GENERAL DESCRIPTION

1. Purpose of Equipment.

The Special Purpose Receivers of the Model 1500-A Series, consisting of Models 1501-A, 1502-A, 1503-A, 1509-A, 1510-A, 1511-A and 1512-A have been specifically designed to meet the requirements of a highly stable, extremely sensitive AF-FM-CW receiver for critical application in the 40-260 mc range. The receivers have self-contained power supplies and are capable of operation from a power source of 115/230 volts, ±10%, 50-60 cps ±5%, single phase, alternating current. Long life and dependability are assured by the use of Silicon Junction semiconductor rectifiers in the power supply. Selection of primary voltage is accomplished by a two-position toggle switch located on the rear apron of the chassis. The switch is equipped with a locking device which prevents accidental switching to an improper voltage range.

Among the special features of the receivers in the Model 1500 series are audio squelch with adjustable threshold, FM reception with very low distortion, AM reception, BFO for CW reception, a separate high quality 600 ohm output, and a DC voltage proportional to input signal strength suitable for use with a Dual Diversity Unit. The video output signal passes through a variable low-pass filter, allowing a greatly improved S/N ratio when the full video bandwidth is not required.

For further details concerning the capabilities and special features of the receivers of the Model 1500-A series, see Figure 2-1.

2. Description of Equipment.

The Special Purpose Receivers of the Model 1500-A Series are 8-23/32 inches high by 14-1/4 deep by 19 inches wide. They occupy approximately 1.6 cubic feet. Models 1501-A, 1503-A and 1509-A weigh approximately 32 lbs. Models 1502-A and 1510-A weigh approximately 37 lbs. Panel and chassis are of aluminum construction, and the panel is finished in smooth gray-blue enamel. The panel is designed for standard 19-inch relay rack mounting, although the receivers are equipped with dust covers and louvered side panels, and may be used independently on a shelf or table. The IF Amplifier and RF tuner are built as completely shielded subassemblies in all receivers, with most of the audio and video components mounted on two terminal boards on the underside of the main chassis.

Figure 1-1 shows a front view of a typical Model 1500-A series receiver, and Table 1-1 shows the tube complement. The primary differences in the various models is in the tuning range and IF bandwidth; consequent minor mechanical and electrical differences are fully explained and illustrated in the appropriate sections of the book.

The major differences in the various type of 1500 series Receivers are found in the tuning range, the RF amplifier, and the band-width of the IF amplifier. A low-noise grounded-grid RF amplifier, employing a 6J4, is common to all types, and an additional grounded-grid amplifier, using a 416B planar triode, is employed to precede the 6J4 in Types 1502-A, 1510-A and 1511-A where extreme sensitivity is demanded. All 1500 series Receivers provide excellent tracking throughout tuning range, gain controlled IF amplifier, dual limiters, squelch circuit with adjustable threshold, and extremely linear video-frequency response up to 300 kc. Video band-width can be switched from 1 kc to 300 kc in five steps from front panel, thus allowing an improved signal-to-noise ratio when full bandwidth is not needed. A BFO is included to facilitate reception of CW signals. Temperature compensation is incorporated in IF and discriminator transformers to insure high stability.

Two indicators are mounted on front panel. One is a zero-center meter for accurate tuning and the other is a signal strength meter indicating relative signal voltage across input terminals of receiver. Signal strength meter is so arranged that remote indicators can be connected. All receivers equipped with output provision for use with Nems-Clarke Spectrum Display Unit 200-2.

TABLE 1-1. SEMI-CONDUCTOR & TUBE COMPLEMENT

Symbol	Type	Function
V-301	6DC6	1st IF Amplifier
V-302	6DC6	2nd IF Amplifier
V-303	6CB6	3rd IF Amplifier, AM 1st Limiter, FM
V-304	6AK5	AM Detector, AM 2nd Limiter, FM
V-305	6AL5	Discriminator
V-111	6CB6	BFO
V-113	0A2	Voltage Regulator
V-114	0A2	Voltage Regulator
V-115	12AU7	Squelch
V-116	12AU7	Audio Amplifier
V-117	12AU7	1st Video Amplifier and tuning meter bridge
V-118	12AU7	Video Cathode follower output
V-201*	416B	1st RF Amplifier
V-202	6J4	2nd RF Amplifier
V-203	6AK5	Mixer
V-204	6AF4A	Local Oscillator
CR-101	1N539	1/4 Bridge Rectifier
CR-102	Same as CR-101	
CR-103	Same as CR-101	
CR-104	Same as CR-101	
CR-105	1N457	AGC Delay Diode

*

SECTION 2

THEORY OF OPERATION

1. Analysis, Model 1500-A Series Receivers.

A Block diagram of the Model 1500-A series receivers is shown in Figure 2-1. The circuit, with the function switch in the AM or FM position, is a single superheterodyne with an IF operating at a frequency of 21.4 mc.

The tuner is designed to produce the lowest possible noise figure consistent with the type tube used (Models 1501-A, 1503-A, 1509-A and 1512-A use a type 6J4 first RF amplifier, and models 1502-A, 1510-A and 1511-A use a type 416B first RF amplifier) and a practicable tuning structure capable of tuning 55 to 260 mc,(40 to 180 mc for the Model 1503,) with reasonably uniform performance over the band.

The IF amplifier, with the function switch in the FM position, uses two stages of amplification, cascade limiters, and a phase-shift discriminator. With the function switch in the AM position, AGC voltage is applied to the first two stages, and the second limiter becomes the AM detector.

The output signal of the IF strips (AM or FM) is fed through a variable low-pass filter, thus providing the maximum S/N ratio when the full video bandwidth is not needed. The output of the filter drives a two-stage direct-coupled video amplifier with cathode follower output A portion of the follower output drives a four stage squelch-audio amplifier circuit.

2 Model 1501-A, 1503-A, 1509-A and 1512-A Receivers only.

A. Antenna - The input impedance of the receiver is approximately 75 ohms over the frequency range of 55 to 260 mc. (40 to 180 mc for the Model 1503-A). The input signal is applied through a type "N" coaxial receptacle located on the rear apron of the chassis. This is UG-593/U connector, J-106.

B. RF Stage - The input signal is applied to the cathode of the 6J4 grounded grid amplifier V-202 across L-201A, one section of the Mallory type S-4 spiral inductuner. This inductuner is the basic tuning element of the entire RF section, and L-201/A is broadly resonated at the required input frequency to tune the first RF amplifier. Cathode resistor method of obtaining self-bias is utilized in this stage, 150 ohm resistor R-201 developing the bias, and capacitor C-217 providing cathode by-passing. The RF amplifier is operated at maximum gain at all times to insure optimum S/N ratio and minimum Noise Figure.

The plate of the 6J4 RF amplifier V-202, is coupled to the grid of the 6AK5 mixer, V-203, across a double-tuned band-pass filter. A capacity "T" is used to provide coupling between the primary and secondary tuned circuits of the band-pass filter. The shunt capacitive element C-224, of the capacity "T" coupling net work is adjustable, thus providing a control over the interstage bandwidth. A small iron core inductor L-202, is provided across the variable capacitor, C-224, causing the shunt element of the capacity "T" to approach parallel resonance at the low end of the tuning range, thus increasing the coupling at the low end and providing a more uniform coupling over the entire tuning range.

C. Mixer. - A 6AK5 pentode, V-203, is used as a mixer. The local oscillator signal is injected into the grid circuit across R-205 and through R-204, developing an operational grid bias proportional to the amplitude of the local oscillator output. This minimizes effects on receiver operation due to variations in local oscillator amplitude. A decoupled test point, TP-201, at the junction of the mixer grid resistors, R-204 and R-205, provides a convenient means of observing the response of the RF circuits. The signal input from the first RF stage is applied from the double-tuned band-pass filter through the blocking capacitor, C-227, to the control grid of the mixer.

CIRCUIT DESCRIPTION

The major differences in the various types of 1500 Series Receivers are found in the tuning range, the RF amplifier, and the band-width of the IF amplifier. A low-noise grounded-grid RF amplifier, employing a 6J4, is common to all types, and an additional grounded-grid amplifier, using a 416B planar triode, is employed to precede the 6J4 in Types 1502-A, 1510, and 1511, where extreme sensitivity is demanded. All 1500 Series Receivers provide excellent tracking throughout tuning range, gain controlled IF amplifier, dual limiters, squelch circuit with adjustable threshold, and extremely linear video-frequency response up to 300kc. Video band-width can be switched from 1kc to 300kc in five steps from front panel, thus allowing an improved signal-to-noise ratio when full band-width is not needed. A BFO is included to facilitate reception of CW signals. Temperature compensation is incorporated in IF and discriminator transformers to insure high stability. Two indicators are mounted on front panel. One is a zero-center meter for accurate tuning, and the other is a signal-strength meter indicating relative signal voltage across input terminals of receiver. Signal strength meter is so arranged that remote indicators can be connected. All receivers equipped with output provision for use with Nems-Clarke Spectrum Display Unit 200-2.

SPECIFICATIONS

	TYPE 1501-A	TYPE 1502-A	TYPE 1503-A	TYPE 1509	TYPE 1510	TYPE 1511	TYPE 1512
Tuning Range	55mc to 260mc	55mc to 260mc	40mc to 180mc	55mc to 260mc	55mc to 260mc	55mc to 260mc	55mc to 260mc
Input Impedance	75 ohms, nominal	50 ohms, nominal	75 ohms, nominal	75 ohms, nominal	50 ohms, nominal	50 ohms, nominal	75 ohms, nominal
Noise Figure	11db maximum	6db maximum	13db maximum	11db maximum	6db maximum	6db maximum	11db maximum
IF Rejection	70db minimum	70db minimum	50db minimum	70db minimum	70db minimum	70db minimum	70db minimum
Image Rejection	Not less than 40db below 130mc; 30db minimum at any frequency	58db minimum	40db minimum	Not less than 40db below 130mc; 30db minimum at any frequency	58db minimum	58db minimum	Not less than 40db below 130mc; 30db minimum at any frequency
IF Band-width	300kc	300kc	300kc	175kc	500kc	175kc	500kc
AM Output	7-15v rms for 5mv input modulated 50% at 1kc	7-15v rms for 500uv input modulated 50% at 1kc	7-15v rms for 5mv input modulated 50% at 1kc	7-15v rms for 5mv input modulated 50% at 1kc	7-15v rms for 500uv input modulated 50% at 1kc	7-15v rms for 500uv input modulated 50% at 1kc	7-15v rms for 5mv input modulated 50% at 1kc
FM Output Stability	Varies less than 2db for voltages above 4uv	Varies less than 2db for voltages above 1uv	Varies less than 2db for voltages above 4uv	Varies less than 2db for voltages above 4uv	Varies less than 2db for voltages above 1uv	Varies less than 2db for voltages above 1uv	Varies less than 2db for voltages above 4uv
Sensitivity Measured without Band-restricting Filters	8uv produces at least 23db s/n with 100kc deviation, 1kc modulation	4uv produces at least 23db s/n with 100kc deviation, 1kc modulation	10uv produces at least 23db s/n with 100kc deviation, 1kc modulation	8uv produces at least 23db s/n with 75kc deviation, 1000cps modulation	4uv produces at least 21db s/n with 125kc deviation, 1000cps modulation	4uv produces at least 23db s/n with 75kc deviation, 1000cps modulation	8uv producer at least 21db s/n with 125kc deviation, 1000cps modulation
Power Input	115/230v, 50-400cps, approximately 100w	115/230v, 50-60cps, approximately 127w	115/230v, 50-400cps, approximately 100w	115/230v, 50-400cps, approximately 100w	115/230v, 50-60cps, approximately 127w	115/230v, 50-60cps, approximately 127w	115/230v, 50-400cps, approximately 100w
Weight	32 pounds (approximate)	37 pounds (approximate)	32 pounds (approximate)	32 pounds (approximate)	37 pounds (approximate)	37 pounds (approximate)	32 pounds (approximate)

SPECIFICATIONS COMMON TO ALL 1500 SERIES RECEIVERS

Type Reception — A.M, FM, CW.

IF — 21.4mc.

Video Response — 10cps to 300kc.

Video Band-width Control — 5 positions — 1, 3, 10, 30, and 300kc.

FM Output—0.10v peak-to-peak per kc of deviation (approximate).

AM Output Stability — Varies not more than 7db for an input change of 40db.

Outputs Provided — **1. Signal:** wide band for supplying high-impedance load (internal impedance approximately 500 ohms). **2. Monitor:** panel-mounted speaker, headphones, or 600 ohms balanced output for external use.

Spectrum Display Unit — Provisions for connecting a 21.4mc Spectrum Display Unit (NEMS-CLARKE CO., TYPE SDU-200-2).

Meters — Approximate signal strength indicator and zero-center tuning indicator.

Beat Frequency Oscillator — Adjustable front panel pitch control.

Squelch — Operates on monitor circuit.

Gain — Automatic or manual control.

Size — 8¾"x19"x15⅝".

Panel Finish — Gray enamel, MIL-E-15090; Color #26329 Federal Standard 595.

We reserve the right to make changes in specifications

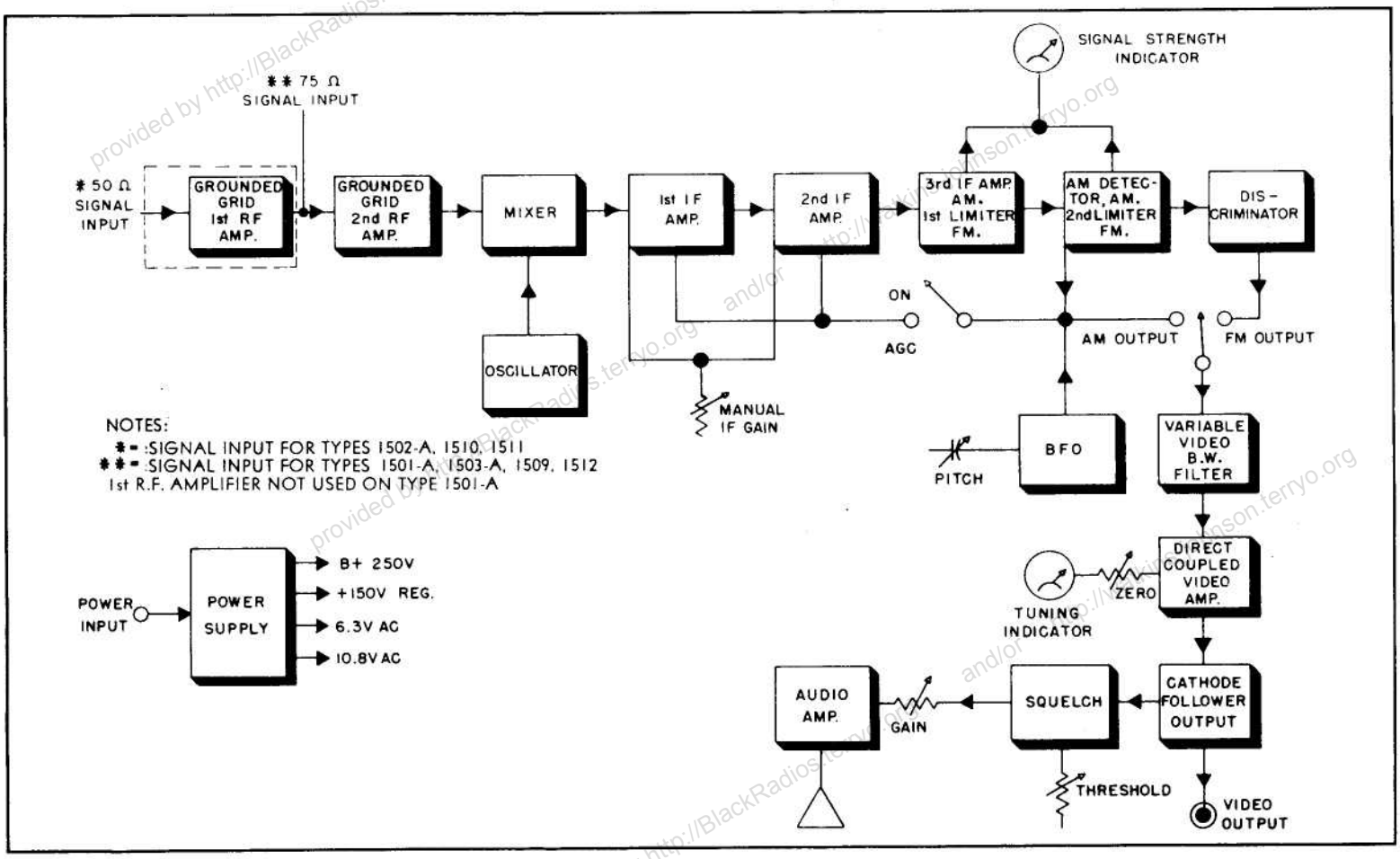


Figure 2-1. Block Diagram and Performance Specifications, 1500-A Series Special Purpose Receivers