amber

model 3500

Distortion and Noise Measuring Set

Owner's Manual

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AMBER MODEL 3500

DISTORTION and NOISE

MEASURING SET

Issue 03

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AMBER ELECTRO DESIGN LTD

MONTREAL CANADA

3500 OWNER'S MANUAL

OPERATING and SERVICE MANUAL

Issue 03 January 1981

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AMBER MODEL 3500

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MEASURING SET

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OWNER'S MANUAL

SECTION 1

GENERAL INFORMATION

1. GENERAL INFORMATION

1.1 Instrument Description

The Amber model 3500 Distortion and Noise Measuring Set incorporates in a single compact enclosure an ultra low distortion sine wave generator, a high performance total harmonic distortion measuring system and a wide range, high sensitivity signal level and noise measuring facility.

In addition, a tunable band pass filter is included allowing the system to function as a selective voltmeter. Also provided are two switchable filters for noise and hum rejection.

As an option, the instrument may be also fitted with an additional oscillator and an Intermodulation Distortion measurement facility.

A further available option is a "dB relative" facility. This may be supplied in either a manual or automatic version and allows the user to offset the meter reading to set an arbitrary "0dB" reference.

Variations are possible in meter scales and front panel units designations to accommodate specific applications: dBm scale prominent for broadcast requirements and Watts (across external 8 ohm load) for power amplifier measurement.

The instrument contains a high efficiency power supply and may optionally include an internal rechargeable battery and charger. It may be powered from North American standard 115 VAC mains or, with an option, may be powered from

international voltages from 100V to 240 VAC.

The model 3500 provides a high level of performance in a size several times smaller than conventional instruments yet its performance in virtually every parameter rivals that of the best laboratory instruments. Speed of operation and speed of measurement have been optimized and automatic operation is provided for many functions.

1.2 SPECIFICATION

GENERATOR

FREQUENCY RANGE:

10 Hz to 100kHz in four overlapping ranges. Continuously variable FREQUENCY control provides selection of any frequency.

OUTPUT AMPLITUDE:

+22dBV to -60dBV (open circuit) or +18dBm to -64dBm into 600 ohm load. Ouput level may be monitored on internal meter.

Oscillator OFF switch disconnects output, shuts off oscillator and terminates output in 600 ohms. May be used for signal to noise measurements.

AMPLITUDE FLATNESS (referred to 1kHz):

20Hz to 20kHz: ±0.1dB
10Hz to 100kHz: ±0.5dB

OUTPUT IMPEDANCE:

600 ohms ±1%

OUTPUT CONFIGURATION:

Single ended, floating. Output ground isolated from input ground. Output short circuit protected.

OUTPUT LEVEL CONTROL:

7 steps of 10dB and variable control of 12dB

SIGNAL DISTORTION:

(Load 600 ohms or greater; output amplitude +20dBV or lower)
10Hz to 20kHz <0.0015% (-96.5dB)
20kHz to 50kHz < 0.004% (-88dB)
50kHz to 100kHz < 0.01% (-80dB)

DISTORTION, LEVEL and NOISE METER

FREQUENCY RANGE:

10Hz to 100kHz in four overlapping ranges. Continuously variable FREQUENCY control, simultaneously tunes distortion measuring circuits, frequency selective voltmeter and oscillator.

external signal source, two LED HI and LO indicators provide a fast indication for manual tuning. When the 3500 distortion measuring circuits are tuned to within about 5% of correct frequency, LEDs will extinguish and the instrument will rapidly and automatically null to maximum fundamental rejection. Tuning indicator LEDs are independent of nulling circuit. Automatic nulling circuit will achieve maximum performance over a full ±5% range and track source signal frequency drift within this range.

FREQUENCY SELECTIVE VOLTMETER (NARROW BAND LEVEL):

Inserts a constant percentage bandwidth band pass filter in level meter circuit. Filter is approximately one octave and may be tuned over full frequency range. Generator frequency tracks center frequency of bandpass filter.

Above filter may alternatively be configured as a 2 pole low pass filter (12dB per octave) with corner frequency equal to generator frequency. (Internal strap selects band pass or low pass mode.)

FILTERS (USABLE on all functions):

Standard: High Pass, 400Hz, 3-pole Butterworth, 18dB per octave roll off.

Low Pass, 50kHz, 3-pole Butterworth, 18dB per octave roll off.

Optional: Both filters plug in and may be easily user changed to other frequencies or configurations. Custom filters are available including ANSI "A", CCIR and others.

DISTORTION MONITOR:

Scaled presentation of input signal with fundamental removed. For external oscilloscope or spectrum analysis use. Output level: 100mV ±5% for signals with full scale meter reading in both distortion and level modes. Output source impedance: 990 ohms ±5%.

INPUT MONITOR:

(rear panel) Scaled presentation of input signal. For external oscilloscope observation of fundamental. Output level: 316mV ±5% for signals with full scale meter readings in level mode. Output source impedance: 990 ohms ±5%.

POWER:

Instrument requires approximately 14 VAC at 1A max. An external AC mains transformer is supplied to provide this voltage. The AC mains input is nominally 120 VAC +5, -10%, 60Hz. An optional AC mains transformer can be supplied to operate from international voltage sources of 100, 120, 220 or 240 VAC, 48 to 62Hz.
Power consumption is approximately 10 VA.

DIMENSIONS:

94mm H x 224mm W x 262 mm D
3.7in H x8.8in W x 10.3in D
(not including tilt handle/stand)

WEIGHT:

(including rechargeable battery and AC adapter/charger) 3.2kg, 7 lbs.

OPERATING ENVIRONMENT:

Temperature 0 C to +50 C
Humidity <95%, 0 C to +40 C.

1.3 Options

model 351 Rechargeable battery, AC adapter/charger.

Provides an internal 12V rechargeable battery and a DC to DC inverting power supply to generate the two isolated bi-polar power rails to power the generator and measurement circuits. Power supply also includes a battery charging circuit and voltage level measuring detector to automatically shut off instrument when battery voltage falls to approximately 8V.

model 352A 100,120,220,240 VAC mains adapter/charger.

Replaces 120VAC adapter normally supplied with one suitable for international use.

model 353 Vehicle lighter receptacle 12V cable.

Used with model 351 enabling instrument to be powered from a normal 12V lighter receptacle in a vehicle. (12V DC will power the instrument but not charge the internal battery)

model 354 Weighting network/filter kit

Provides five popular plug in filter networks and five unbuilt headers and covers for custom networks.

model 355 dB relative facility (manual)

Adds a variable control on the rear of

the instrument to allow meter reading to be offset up to +10dB to set any particular reading to 0dB so future readings will be relative to initial level.

model 356 dB relative facility (automatic)

Similar to 355 above but variable control is replaced with a single push button. The first push sets the meter to 0dB with the level present at the time. The second push returns the meter to normal calibrated operation.

model 357 Intermodulation Distortion measurement facility

Provides second (Low frequency) oscillator and combination circuitry to provide twin-tone generator signal and intermodulation distortion measurement filters to be used with 3500 meter ciruits. Can generate SMPTE or DIN standard test signal and measure SMPTE, DIN and CCIF type of IMD distortion. Generator HF component can be varied from 2kHz to 100kHz.

model 358 High Resolution Frequency Meter

This option adds a digital frequency meter to the 3500 to permit accurate measurement of either internal or external signals. A frequency multiplier provides high resolution (0.1Hz) and fast update (100mS) for convenient low frequency use. Auto ranging, input selection and special modes make the 3500 both convenient

and simple to use. Mounts in a one inch overbridge on the 3500 cover. May be retrofitted to existing units.

model 359 Input and Output Balancing Interface

Provides a three terminal balanced input and three terminal balanced output for broadcast and telecommunication applications. Output is a 600 ohm source and may be open or terminated with switch selection. Input is bridging or 600 ohms terminated under switch selection. Additionally, a selector switch connects the meter/analyser to the oscillator output for level measurement and system tests.
Mounts in an enclosure below the 3500. Balanced inputs and outputs are banana jacks while the interface to the 3500 is via attached BNC cables. May be easily retrofitted to existing units.

AMBER MODEL 3500

DISTORTION and NOISE

MEASURING SET

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OWNER'S MANUAL

SECTION 2

OPERATING INSTRUCTIONS

2. OPERATING INSTRUCTIONS

2.0 INTRODUCTION

This section contains detailed operating instructions for use of the model 3500 instrument. It describes the general philosophy of the instrument, description and use of its operating controls, interface to the device under test and any external equipment.

2.1 PREPARATION FOR USE

Since the instrument will normally be used on a table top, the carrying handle can be locked in several positions to serve as a tilt stand to hold the 3500 at a convenient operating angle. To unlock the handle pull both sides of the handle outward about one quarter inch. The handle may be rotated in this outward position and locked in one of several detents by allowing the handle to spring back inward.

Note that the meter pointer normally rests off scale to the left when the instrument is off. This is due to the fact that the meter law is logarithmic. It has been properly factory calibrated for on scale readings under signal stimulus.

There is an abbreviated instruction card on the bottom underside of the instrument as a reminder of various operating functions. The card presumes a familiarity by the user and at least one reading of this general manual.

The rear panel will normally run quite warm to the touch. This is the heat sink area for the power supply and must dissipate five Watts or more.

The external AC mains transformer or an alternate external power source is to be plugged

into the power connector located on rear upper left corner. Conditions for power sources other than that supplied are described in Section 2.12 following and on the rear panel.

The power ON/OFF switch is momentary action and located on the front panel. Certain conditions can cause the instrument to automatically shut off (low battery for example) hence the momentary action.

There are two internal fuses in the instrument. One is on the external power input line. A failure of this fuse will prevent the instrument from turning on unless there is an internal, charged battery. It will also inhibit battery charging. The second fuse is on the INPUT line and should only fail if the input signal exceeds the capabilities of the instrument. This would occur if the INPUT control were set to +10/3V or lower and the input signal level were +30dBV/40V or higher.

2.2 SYSTEM DESCRIPTION

The model 3500 Distortion and Noise Measuring set contains two separate but interlocked sections: a Generator and a Measuring system. As such, it is completely able to perform measurements without the use of additional equipment although an oscilloscope is very useful.

The system will measure wide band signal level, wide band noise, total harmonic distortion, band limited noise and crosstalk. By extension, it can measure frequency response, noise spectrum, distortion versus frequency and distortion versus level.

The instrument contains a precision ultra low distortion sine wave oscillator followed by a power amplifier and output attenuator. This generator is able to generate the test signals for

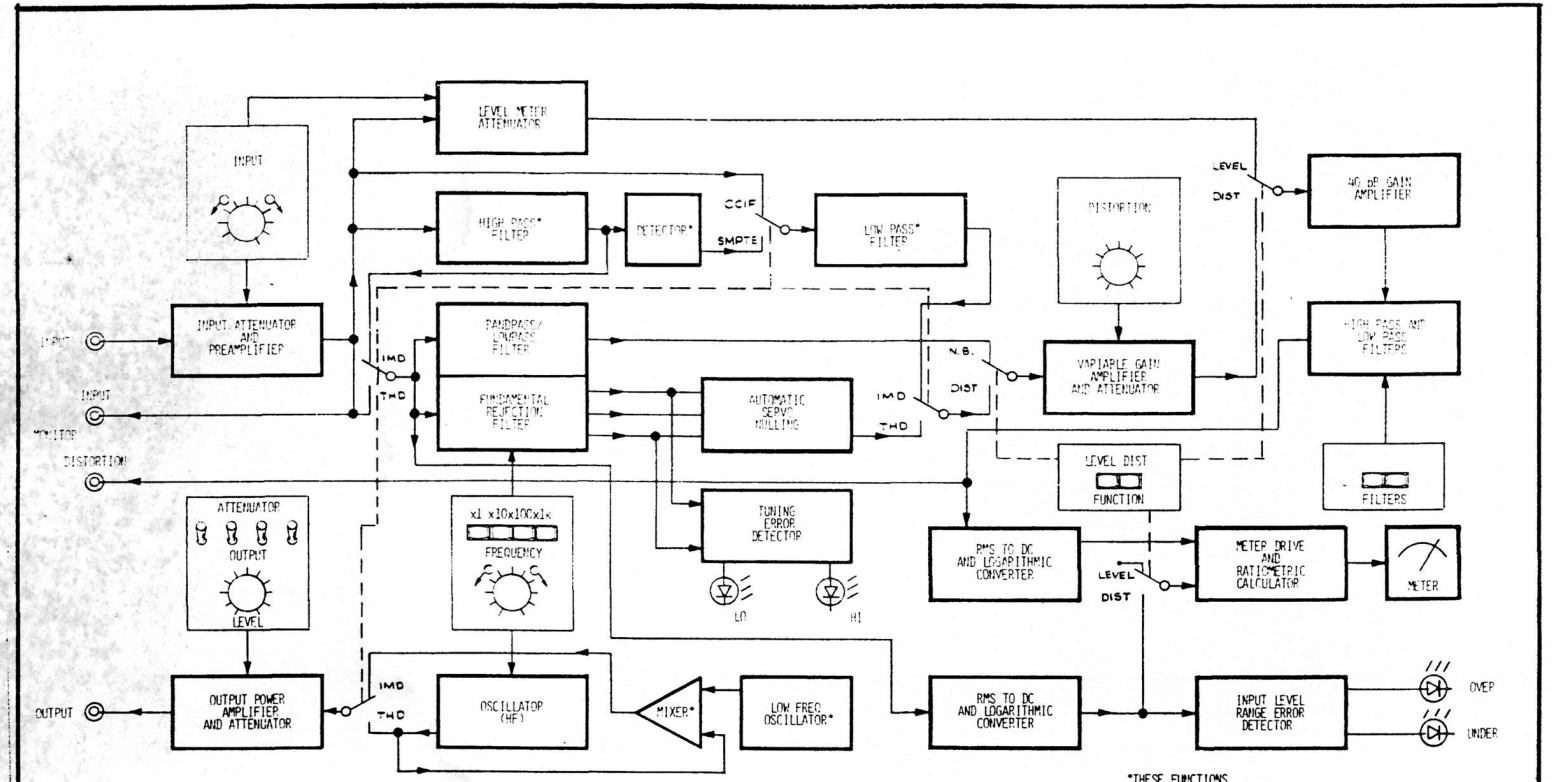

FIG 2-2 MODEL 3500
FUNCTIONAL BLOCK DIAGRAM

*THESE FUNCTIONS
PART OF THE IMD OPTION

all the measurements possible in the measuring system. (An exception is CCIF IMD Section 2.13.3.)

Signal and noise levels are measured by a precision variable gain amplifier followed by a true rms detector and analog meter. It is capable of operation over a wide dynamic range of up to 160dB or 100 million to one.

The primary function of the instrument is to measure total harmonic distortion. In fact, the more precise description of the resulting measurement is "Total Harmonic Distortion plus Noise". It does this by sending an essentially pure single frequency to a device under test, eliminates this fundamental frequency from the received signal out of the device under test, measures everything that is left and presents this amplitude as a ratio of the total received signal.

For example, assume a test frequency of 1kHz. The 3500 will generate this signal with harmonics greater than 100dB down resulting in an essentially pure signal. For simplicity, assume the device under test is unity gain and we wish to measure THD at 0dBV, ie a 1V level. The generator will provide the 1kHz, 0dBV signal to the input of the device under test, the 0dBV signal output will be fed to the input of the 3500. A very deep notch filter (band reject filter) will provide over 100dB of rejection of the 1kHz fundamental. The non-linearities of the device under test will have added components at 2kHz, 3kHz, 4kHz, etc. The RMS meter of the 3500 will measure the amplitude of the sum of these, compare this amplitude to that of the fundamental and display the result as a percentage or dB ratio. If the amplitude of the rms sum of the harmonics were 1 mV in this example, the meter would indicate 0.1% or -60dB.

Since the measuring circuits are measuring

the total bandwidth minus only the small fundamental area, they will also measure noise along with the harmonics. In many cases, the noise will be below the harmonics and the measurement will be very close to the true harmonic distortion. In other cases, the noise will be higher and thus the measurement will actually be noise and not distortion. The use of an oscilloscope to monitor the distortion residual will assist the user in qualifying the measured result. Also see the section on Filters 2.7 following.

2.3 RMS DETECTION

Distortion and noise measurements will generally involve complex waveforms. Average responding meters, which are usually calibrated in rms for a pure sine wave, will give significant errors when attempting to measure these complex waveforms. For this reason, the 3500 employs a precision rms detector in the measurement circuits.

Certain waveforms can yield an error of over 10% when measured with an average responding detector. The rms measuring circuits of the 3500 will provide an accurate measurement of signals with crest factors as high as 3 full scale or 10 at the lower end of the scale. This assures accurate indication of distortion and noise signals.

2.4 SIGNAL GENERATION

The 3500 contains an ultra low distortion sine wave oscillator, an output power amplifier and an output attenuator. Also included are facilities to measure the output signal level using the 3500 meter.

The generator has a frequency range of 10Hz to 100kHz covered in four overlapping decade ranges. It has an amplitude range of +22dBV to -60dBV (or +24dBm to -58dBm open circuit). It provides continuous tuning and continuous level selection over its full operating range. Although ultra low distortion, it exhibits extremely fast settling time even at low frequencies. Output source impedance of the generator is 600 ohms at all attenuator and level settings including OFF. The output low terminal (BNC shell) is isolated from input low and case ground.

Frequency selection is made using the upper left rotary control and four button switch bank in the FREQUENCY area of the panel. Actual frequency is the indication on the rotary control multiplied by the number on the selected range. Some overlap is provided at each end of the rotary control to ensure that all frequencies within the instrument range are available. Where the same frequency appears in two ranges (example 100Hz, 1kHz, 10kHz) the preferred selection is the lower range with the rotary control clockwise. (Example 1kHz found by 10 x 100 rather than 1 x 1k)

Output signal level selection is made using the upper right rotary control and the attenuator switches. Actual output level in dBV relative to 1 Volt into an open circuit is the algebraic sum of

the output level control setting and the attenuator selection. The panel indications on the rotary level control are only a nominal indication. For an accurate reading, release both FUNCTION push buttons (red buttons) and the meter will indicate the accurate output level open circuit in dBV, dBm or volts prior to the attenuator. In this case, add the meter scale reading to the attenuator selection for the absolute open circuit output level.

The source impedance of the generator is 600 ohms so the open circuit output level will be 6dB higher than the output signal level when loaded with 600 ohms. The table below will give the procedure to determine the actual output signal level at the output connector under various conditions.

Output Level open circuit = Meter reading dBV + attenuator selection

Output Level open circuit = Meter reading dBm + attenuator selection

Output Level 600 ohm load = Meter reading dBV + attenuator selection - 6dBV

Output Level 600 ohm load = Meter reading dBm + attenuator selection - 6dBm

An ON/OFF switch provides a convenient means of making signal-to-noise measurements. In the OFF position the output connector is disconnected from the output power amplifier and connected to a 600 ohm resistor. For added safety, the oscillator circuit is disabled to avoid any chance of signal leak through.

2.5 LEVEL MEASUREMENT (VOLTMETER OPERATION)

The 3500 will measure signal level over the frequency range of 10Hz to approximately 300kHz and from +40dBV (100 volts) to -60dBV (1mV) full scale. See Section 2.8 following for signals below -60dBV.

To measure signal level, connect the signal to the INPUT connector, select LEVEL in the function group and turn the INPUT rotary control until the meter reading is on scale. If the INPUT control is set too low (ie, signal too high) the clockwise LED will light suggesting rotation to the right. The CCW rotation LED only functions in the DISTORTION mode so this error indication is only provided by the meter being off scale to the left.

The actual signal level is determined by adding the meter reading in dBV or dBm to the INPUT control selection. Or, to find the reading in volts, use the 1 or 3 scale on the meter as appropriate and the range indicated by the INPUT control. For example, if the INPUT control is pointing to 0.03, use the 3 scale. If the meter pointer shows 2.3, in this example, the actual level is 0.023 Volts or 23mV.

If the instrument is equipped with a Watts meter scale, the power delivered to an external 8 ohm load can be measured. The 3500, of course, only measures voltage but the Watts meter scale is calibrated using Ohms law and presuming the external 8 ohm load. A single scale is provided and panel markings to show the appropriate range. In the above example the meter pointer would indicate 0.65 and the INPUT control would show 0.03/125µ thereby indicating a power of 65 µW.

The input impedance is 100k ohms shunted by 100 pf or less. Thus it will provide a sufficiently high impedance load to most circuits to achieve an accurate reading. If the circuit being measured has a high source impedance (over 1k ohm) a correction factor will have to be used due to the loading of the 100k ohm input impedance.

The input preamp contains an active protection circuit. This is designed to protect the sensitive input components from signal overload and cause the fuse to open. As the instrument must measure very low distortion, conventional simple protection circuits are not useable and a sophisticated active circuit must be used. This circuit achieves all the parameters required but can cause difficulties under a particular (and unusual) circumstance. If the 3500 is turned OFF and connected across a source with a finite output impedance, the 3500 will induce distortion in this source. When the 3500 is not powered, the active protection network ceases to function and the input can look like a non-linear load.

For noise measurements the FILTERS may be used in the LEVEL mode. See Section 2.7 following.

2.6 TOTAL HARMONIC DISTORTION MEASUREMENT

The model 3500 provides a complete THD measurement system capability by combining a low distortion signal source and an automatic distortion measurement facility. The latter may also be used with an external signal source when required.

When making THD measurements using the internal source connect the 3500 and device under test as shown in Fig 2.6. It is suggested that an oscilloscope be used as shown to monitor the signals and verify the validity of the measurement. This will show any excessive noise, oscillation, interference or other source of error in the measurement.

Set the GENERATOR send level to the level required by the device under test using the procedure shown in Section 2.4 previous. Connect the 3500 OUPUT to the input of the device under test and the output of the device under test to the 3500 INPUT.

If it is necessary to first measure the signal level proceed as in Section 2.5 previous. If not, push DISTORTION in the FUNCTION group. Turn the INPUT rotary control the appropriate direction if either of the red LEDs are on. The proper setting is when both of these are extinguished. Next, turn the DISTORTION rotary control until the meter gives an on-scale reading. The instrument will automatically and rapidly null to a final value as the control is rotated counter clockwise. In many cases the nulling will be accelerated by rapidly rotating the DISTORTION control counter clockwise an excessive amount, then

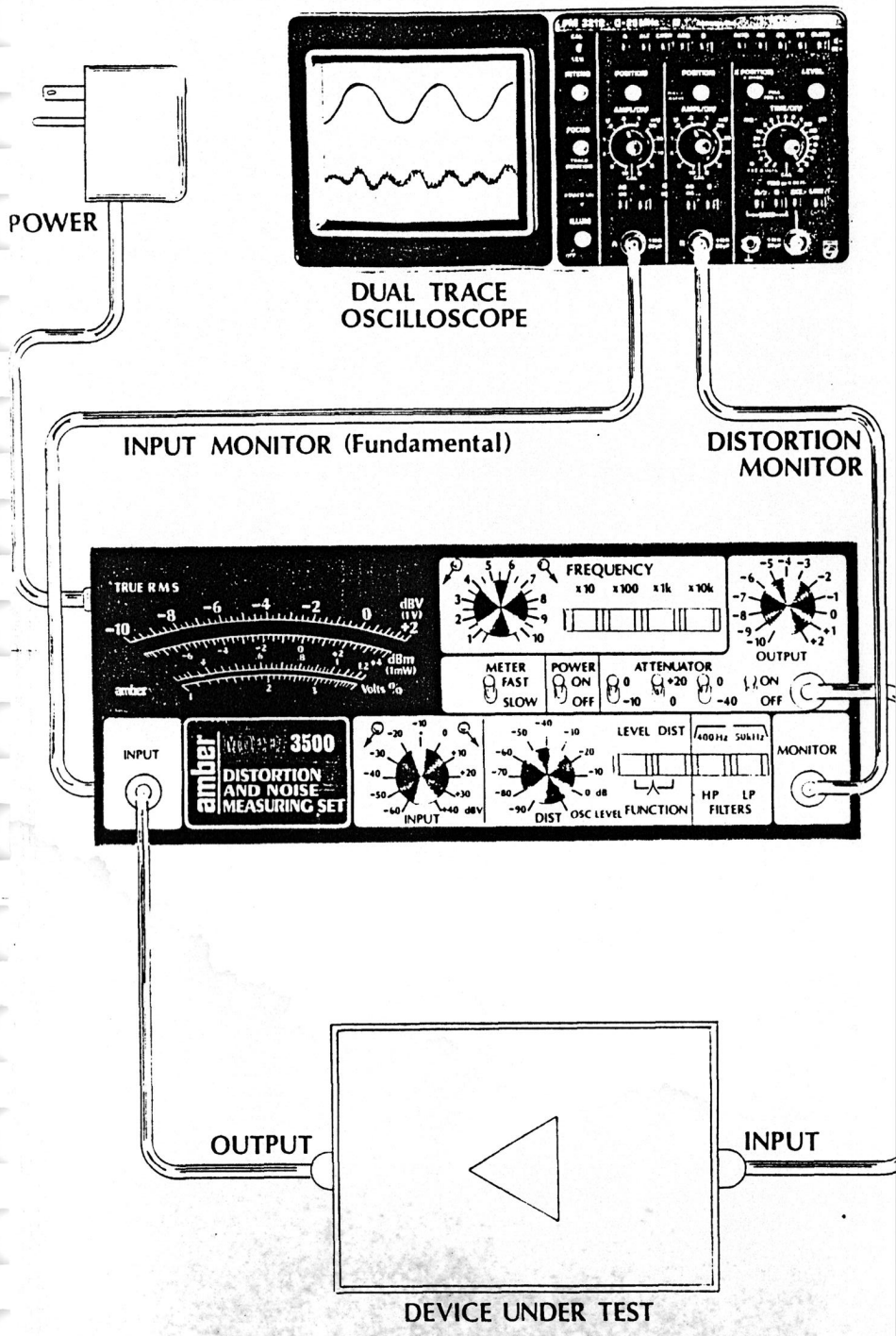

Fig 2·6 TYPICAL TEST SET UP

backing off to the correct value.

Observe the distortion residual components at the front panel MONITOR BNC connector using an external oscilloscope. A typical waveform is one that has a shape close to the second or third harmonic (or a mixture) of the fundamental. A dual trace oscilloscope facilitates this observation. If the waveform exhibits a line synchronous component of 50 or 60Hz there is hum pickup in the test set-up. If a 100 or 120Hz component, it probably indicates an insufficiently filtered power supply in the device under test. See Section 2.7 following. Be cautious of high frequency components indicating RF pickup or device oscillation.

Note that the lowest signal level for distortion measurement is -30dBV/30mV. The lowest effective INPUT control setting is -20dB/100mV. Lower positions (-30 to -60) will not give any increased sensitivity in the distortion mode. If the signal level is too low for distortion measurement (ie below -30dBV/30mV) the low red LED will remain on even when the input control is turned fully CCW.

2.7 USE OF FILTERS

The 3500 contains two front panel selectable filters which can enhance the accuracy of many measurements. For example, if the device under test is picking up mains hum this will influence the measurement and give an erroneous DISTORTION reading. Although it is necessary to be aware of these offending signals, it is useful to be able to separate the DISTORTION and NOISE readings.

HIGH PASS FILTER.

This is an 18dB per octave (60dB per decade) filter useful to eliminate mains hum and other low frequency noise from the measurement. Its 3dB point or corner frequency is 400Hz and it may be used on signals whose fundamental is above 300Hz or so. It will provide approximately 50dB attenuation of 50 or 60Hz interference.

LOW PASS FILTER

This is an 18dB per octave (60dB per decade) filter useful to eliminate RF interference, high frequency oscillation and, in general, to reduce the measurement bandwidth to gain a few dB improvement on the 3500 noise floor. Its 3dB down point or corner frequency is 50kHz so it may be used in the distortion mode with signals whose fundamental is 10kHz or below. With flat "white" noise, reduction of the measurement bandwidth from the wide band (500kHz) condition to 50kHz will provide about a 10dB improvement in noise floor.

Both of these filters may be used in any mode of the instrument although they are particularly useful in the DISTORTION mode. They

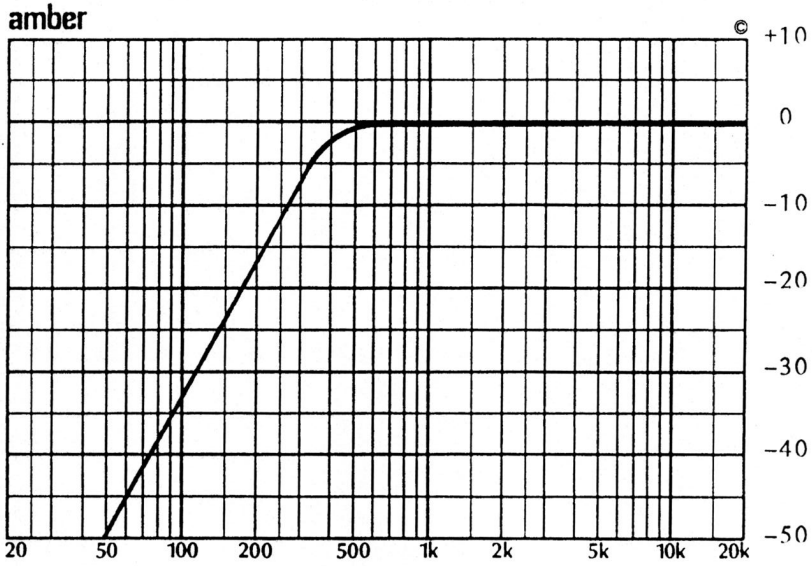

Fig 2.7.1 400Hz High Pass Filter
Slope is 18dB per octave

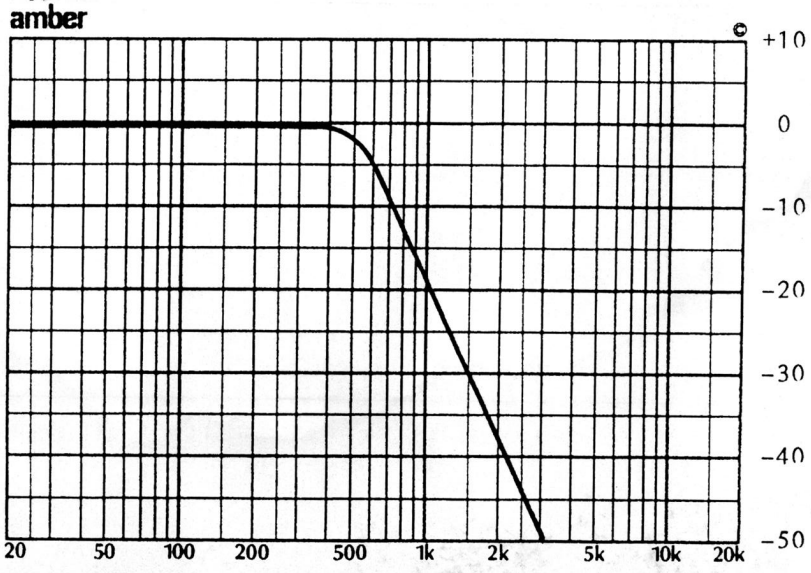

Fig 2.7.2 50kHz Low Pass Filter (freq x 100)
Slope is 18dB per octave

may be also used to restrict the measurement bandwidth during noise measurements.

Both filters are plug-in networks and may be readily changed to other configurations and frequencies. For example, noise measurements are often made using specific bandwidths or weighting curves. Tape recorder noise is often measured using the standard ANSI/IEC "A" weighting curve. Amber can provide several standard plug-in networks for specific applications or the user may construct his/her own by using the instructions in Section 6.5.

2.8 NARROW BAND LEVEL MEASUREMENTS

A unique and very useful feature of the 3500 is the narrow band level measurement capability. This enhances the signal level measurement capability for several measurement situations such as low level noise, crosstalk, signals near the noise floor and acoustic applications.

When both FUNCTION (red) push buttons are pushed IN, a band pass filter is inserted in the level measurement path. This configures the instrument as a frequency selective voltmeter enabling it to read signal or noise level in a particular frequency band. The center frequency of this band pass filter is selected by the FREQUENCY controls and tracks the generator frequency.

The shape of the filter is nominally about one octave. It is constant percentage bandwidth and is a single pole pair configuration. The shape is triangular with 6dB per octave skirts. See Fig 2.8.1.

When using the narrow band mode, both the INPUT and DISTORTION gain controls are effective. The absolute signal level (at the filter frequency center) is the meter reading plus the INPUT control selection plus the DISTORTION control selection with following notation. In this mode (as in the DISTORTION mode) the INPUT control has no greater sensitivity than -20dB. That is the -30, -40, -50 and -60 positions give the same effect as -20. Therefore to measure low level signals first turn the INPUT control to -20 and then the DISTORTION control to the position that gives an on-scale meter reading. For example, if the meter reading is -4.5dBV, the INPUT control is at -20 and the

DISTORTION control at -70, the actual absolute signal level is:

Signal level (dBV) = 4.5 + (-20) +(-70) = -94.5dBV

The 3500 is normally configured with a band pass filter as described above. It may easily be modified to be a low pass filter with all other parameters the same. In this mode the corner frequency is set by the FREQUENCY controls. The filter has a 12dB per octave rolloff. See Fig 2.8.2.

The low pass configuration is particularly useful for noise measurements in a specific bandwidth. For example, to measure the noise in a flat spectrum to 10kHz or 20kHz just tune the FREQUENCY control to that frequency and proceed as above.

A circuit board strap on the top board selects either the band pass or low pass configuration. See Section 5.10

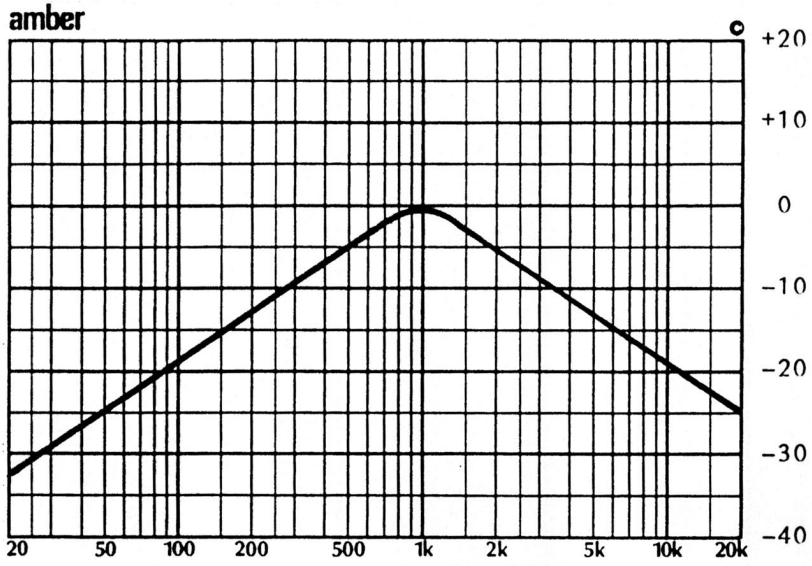

Fig 2.8.1 Band Pass Filter Configuration
Slope is 6dB per octave

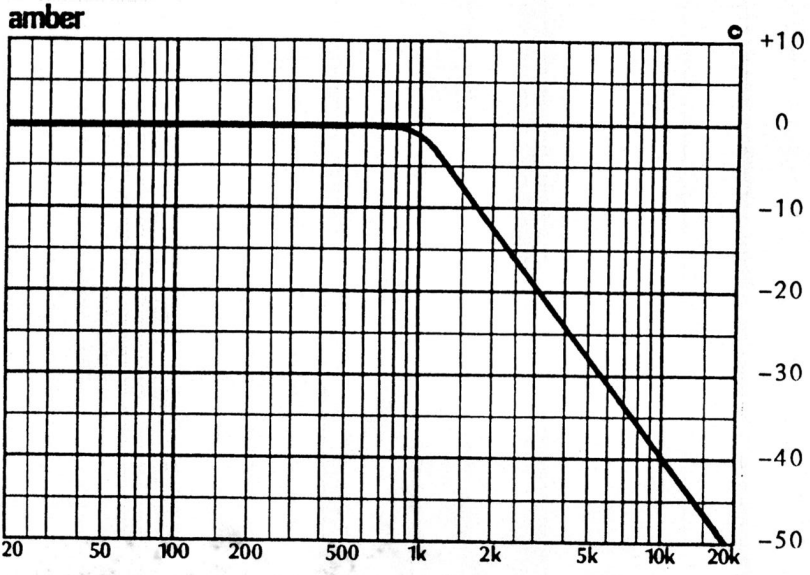

Fig 2.8.2 Low Pass Filter Configuration
Slope is 12dB per octave

2.9 dB RELATIVE MEASUREMENTS (OPTIONAL)

This option adds a rear panel rotary control that can offset the readings by up to + or -10dB. Using this control the current reading can be adjusted to "0dB" so subsequent readings will be in dB, relative to this first one. This control can be used in any mode although in general it will only be used in the LEVEL mode.

For example, to measure frequency response "relative to 1kHz":

a) Set the generator to 1kHz.
b) Select LEVEL and make an on-scale reading as described in 2.5 previously.
c) Adjust the meter pointer to 0dBV using the dB relative rear panel control.
d) Readjust the FREQUENCY control to other frequencies and note the variation in ±dB relative to 1kHz.

Note that an "UNCAL" red LED will be lit in the meter scale area when the dB relative feature is being used as a reminder to return it to the detented off position after use.

2.9.1 SIGNAL TO NOISE MEASUREMENTS

Signal to noise measurements are used to qualify the noise performance of a device under test. They are expressed as a dB figure relating noise floor to normal signal level -- the larger the number, the lower the noise floor and hence the better the performance.

Signal to Noise Measurements (S/N) can be easily made using the 3500. First, it is necessary to establish the signal reference point. This is

based on tradition, manufacturers' choice, a particular standard or other source. For amplifiers it is usually the full power level or clipping point. For processing equipment it is usually the operating level or program level (possibly 10 or more dB below clipping). For tape recorders it is the level that produces a particular amount of distortion, perhaps 3% or 1%. Consult the manual for the device under test or the standard to determine the Reference Signal Level.

The second factor is the measurement bandwidth and any possible bandwidth weighting. These factors can have a very significant effect on the measured figure and it is essential to use the specified procedure. For example, tape recorders are usually measured using ANSI/IEC "A" weighting. Amplifiers and signal paths are often measured using a flat "program weighted" or "audio" bandwidth of 20Hz to 20kHz. Virtually all standard weighting characteristics can be produced by a 3500. Some may require the addition of an accessory in the form of a plug-in network. For example, "A" weighting can be provided as a simple module; "audio" bandwidth by the low pass configuration described in Section 2.8. See Section 6.5 for custom networks.

Having established the proper reference signal level and weighting we can now proceed to the S/N ratio measurement.

Step 1:

With the weighting not selected establish the correct reference signal level at the output of the device under test.

Step 2:

Measure this signal level with the 3500 in the LEVEL mode and the

3500 INPUT connected to the device under test output. Note the level in dBV or dBm.

Step 3:

If the unit does not have a dB relative kit (option 355 or 356) proceed to Step 4. If this is provided, adjust the meter reading to exactly 0dB (dBV or dBm).

Step 4:

Without changing anything in the device under test, turn off the 3500 GENERATOR. Leave the cables connected as before. This will shut off the test signal and correctly terminate the input to the device under test.

Step 5:

Select the appropriate weighting or bandwidth reduction.

Step 6:

Measure the noise level by selecting a lower INPUT setting on the 3500. If the noise is lower than -70dBV absolute (0.3mV) use the extended sensitivity described in Section 2.8. If "dB relative" has been used, do not change the setting to make this reading. Note this measured level in dBV or dBm.

Step 7:

Subtract this noise level from the previously measured reference signal level. The resulting figure is the signal to Noise

Ratio in dB. This can be easily done by noting the meter reading in each case and the number of notches the INPUT (and possibly the DIST) control is turned. Each notch is 10dB.

For example, if the reference signal level is say +8dBm, the meter reading would be -2dBm and the INPUT control would be at +10dBm. If the 20kHz band limited noise was say -64dBm the meter reading would be -4dBm and INPUT control at -60dBm. The S/N ratio would be : +8dBm - (-64dBm) = 72dB

If a dB relative feature had been used the mathematical operations would be easier, simply add the number of notches the INPUT control is turned to the meter reading. In the above example the meter would indicate -2dB and seven notches of the control would give the S/N ratio as -72dB.

2.10 MONITOR OUTPUT

This front panel output provides a signal for external observation. It will normally be connected to an external oscilloscope but can also be connected to an external low frequency spectrum analyser to improve the distortion measurement resolution. The output signal level for full scale meter deflection is approximately 100mV or -20dBV and proportional to other meter readings. The output source impedance is just below 1k ohm.

3500 Instrument Function	MONITOR output Signal
LEVEL	Signal after Hi-Pass, Low-Pass Filters
DISTORTION	Signal with fundamental removed, ie, distortion components
NARROW BAND LEVEL	Signal at output of band pass/low pass filter
OSC LEVEL	Oscillator signal

2.11 INPUT MONITOR OUTPUT

This connector is located on the rear panel and provides a scaled presentation of the signal presented to the INPUT connector. It will normally be connected to an external oscilloscope for observation of the fundamental in conjunction with the distortion monitor described in Section 2.10.

The output signal level for full scale meter deflection is approximately 316mV or -10dBV and proportional to other meter readings. The output source impedance is just below 1k ohm.

2.12 POWER SUPPLY

The rear enclosure of the 3500 contains the regulated power supply and optional battery and charger.

This supply operates from a nominal 14V AC and produces the two isolated bipolar supply rails required by the instrument. (+15V for the measurement circuits and +20V for the generator circuits). It contains a high efficiency switching

type inverter using state of the art techniques such as VMOS transistors and operates outside the measurement bandwidth (approx. 700kHz) to avoid interference.

An external mains transformer is supplied to provide the nominal 14V AC to the power input connector. Alternatively, a DC source could be provided to power the instrument. The voltage of this DC source should be 10 to 16V for instrument operation and 18 to 20V for internal battery charging. This source may be provided at either polarity.

2.12.1 OPTIONAL RECHARGEABLE BATTERY

If this option is supplied, an internal rechargeable battery is provided in addition to the above described power supply.

The supply also includes a battery charging circuit and battery voltage detector circuit. During operation from the battery (or external power source) the 3500 will automatically switch off when the battery (or external source) falls below approximately 8 Volts. This will avoid total discharge of, and consequent damage to, the battery.

A BATTERY TEST push button switch is located on the rear panel. This uses the front panel meter to indicate battery voltage. Mid-scale corresponds to approximately 8V and is indicated by a reading of -4dBV or 2 on the Volts/% scale. A fully charged battery will indicate approximately +1dBV or 3.5 on the V/% scale under load (ie 3500 operating).

2.12.2 BATTERY CHARGING CONDITIONS

To charge the battery, connect the

external mains transformer (or a user supplied source of 14V AC or 18V DC) to the 3500 power input connector. The battery will charge in 6 to 12 hours with this source and the instrument turned off. It will not charge with the instrument turned on (nor will the battery be discharged). Do not charge the battery for longer than 20 to 24 hours. The charger is not a float type charger and should not be left on indefinitely (unless the instrument is operating).

Do not allow a discharged battery to sit for an extended period (more than a few days) prior to recharging.

2.12.3 BATTERY DISCHARGE CONDITIONS

A fully charged battery should give slightly more than one hour of continuous use before automatic shut off. If it is not used continuously, the total discharge time can be extended beyond this time.

If the instrument is allowed to run until shut off, then left to sit for several hours, it should be possible to obtain additional time before recharging. However, if possible, avoid this procedure as this deep discharge operation will shorten battery cycle life.

Under proper conditions, a single battery will give 300 to 500 charge/discharge cycles. Good battery care includes recharging as soon as possible after discharge, avoiding overcharge conditions (greater than 20 hours), and avoiding deep discharge conditions (repeated deep discharge prior to recharge).

2.12.4 INTERNATIONAL VOLTAGE OPERATION

For international AC mains

operation, the 352A option is provided. This is a small box that provides 14 VAC and a cable with the required power connector for the 3500. For mains connection, a power cord with an IEC mains connector on one end is provided to mate with an IEC mains receptacle on the 352A. This connector also contains a means of setting the mains voltage to 100V, 120V, 220V or 240V to accommodate various mains conditions. It will operate from 48 to 62Hz without change. A fuse is also included. The fuse value should be as follows:

Mains Voltage	100 120	220 240
Fuse	0.25A	0.125A

2.13 IMD Distortion Measurement (OPTIONAL)

Option 357 adds IMD measurement and generation capability. The noticeable difference on the front of the instrument is the addition of a DISTORTION MODE selection toggle switch in place of the previous METER FAST/SLOW switch (the meter is preset to FAST but may be internally set to SLOW). The internal changes include the addition of a second oscillator and the IMD measurement circuits. These additional facilities share the input, output and metering functions of the basic instrument.

2.13.1 SMPTE/CCIF Selector

The front panel switch selects the normal THD mode or two IMD modes: SMPTE or CCIF. The SMPTE mode involves the use of two sine waves, one a low frequency of typically 60Hz and the second a high frequency (7kHz for the normal SMPTE specification) mixed in a 4 to 1 amplitude ratio. The CCIF mode involves the use of two high frequency signals with a small frequency separation, for example 10kHz and 10.5kHz.

2.13.2 SMPTE IMD

The 3500 generates the SMPTE type of signal by adding a 60Hz LF sine wave to the existing oscillator with the LF amplitude being 12dB higher than the HF. The frequency of the HF signal is set by tuning the front panel FREQUENCY control. Any frequency in the range from 2kHz to 100kHz may be used including, of course, the 7kHz SMPTE standard. The amplitude of this composite signal is internally calibrated to have the same peak amplitude as the equivalent THD sine wave signal. This peak calibration will ensure no clipping at

high signal levels but will show a different RMS value on the LEVEL meter.

Measurement of the distortion of the LF + HF signal is identical to the THD measurement described in Section 2.6 of this manual. The INPUT and DISTORTION controls are set as in THD and the INPUT and DISTORTION MONITOR connectors provide oscilloscope outputs. The FILTERS should not be used in the IMD mode. The 50kHz Low Pass filter is redundant and will show no significant change. The 400Hz High Pass filter would incorrectly eliminate the distortion components which may apppear at 60Hz, 120Hz, etc.

To repeat: use the instrument in the same way as THD but be sure the FREQUENCY is above 2kHz and don't use the filters.

2.13.3 CCIF IMD

The 3500 does not generate the CCIF test signal. This requires using two external oscillators mixed with equal value resistors for a 1 to 1 amplitude mix. The test signals should have a minimum value of 2kHz and a maximum frequency separation of 1kHz.

The 3500, when switched to CCIF, will measure the difference frequency component and express its amplitude as a percentage of the RMS sum of the two HF signals. It is somewhat equivalent to a highly sensitive voltmeter with a 1kHz low pass filter at the input. As above, do not use the FILTERS in this mode.

2.14 PROBLEMS?

If you experience difficulty with the 3500 check the following instructions.

2.14.1 No Oscillator Output:

Is power on? (Look for green LED in meter scale). Is output attenuator at the correct setting? Is oscillator turned ON? Does OSC LEVEL meter function work? (If so, this indicates the oscillator and power amplifier are functional but not necessarily the OUTPUT Attenuator.)

2.14.2 No LEVEL Measurement Function:

Is LEVEL mode selected (red button)? Are both RED LEDs extinguished? If meter is all the way to the left and the INPUT control fully CCW the input signal may be too low to measure in the LEVEL mode (see Narrow Band level measurements).

There is an input fuse in the input signal line. It is a fast acting 1/16A fuse and will blow if a gross signal overload is presented to the input. See Section 2.1 of the manual.

2.14.3 No DISTORTION Measurement Function:

Is there signal present at the INPUT Connector? (Use LEVEL function to verify.) Are both orange tuning LEDs and both red level LEDs extinguished? Is signal frequency between 10Hz and 100kHz? Are filters not selected for signals below 500Hz or above 10kHz?

2.14.4 Unusual Distortion Reading:

Connect a dual trace oscilloscope to the two monitor outputs. Is the distortion residual at the front panel monitor a second or third order product? If it is, the distortion is probably correct. Be sure the 3500 input is not overloaded (the RED LED would show this). If the distortion residual has a predominant fundamental component or noise or oscillation there is an invalid condition.

2.14.4.1 Fundamental Present:

The 3500 is not nulling. Is it tuned correctly? (The Orange LEDs should indicate this.) The signal level may be too low (the RED LEDs should indicate this). There may be a high level interference signal present causing the nulling circuit to exhibit an error.

2.14.4.2 Large Amount of Hum (50 or 60Hz or 100, 120Hz, etc):

Check for ground loops in the test setup, open grounds in the cables, large power transformers or motors inducing hum in the 3500 or the device under test (where is the 3500 wall plug mains transformer?). Is the AC mains voltage too low? (Lower than 90% of the rated value.)

2.14.4.3 Large Amount of High Frequency Noise:

Is the noise a steady frequency? (Use oscilloscope on monitor output to see.) Is this frequency generated by anything in the area? (The 3500 power supply operates at 500 to 700kHz.) Is the circuit under test oscillating?

2.14.4.4 Erratic Signals or Noise:

Is the signal RF interference -- CB, Amateur Radio, TV, etc? How is the RF being picked up -- try shielding, grounding, etc. The 3500 itself has excellent RFI rejection.

2.14.5 Unit Won't Turn On:

With Battery:

Check charge on battery using battery test switch. It should remain above the BATT OK level as the unit is turned on. Try operation on an external supply, for example, the supplied AC wall plug transformer.

No Battery:

Does the unit turn on for a second or so then turn off? The problem is either a low AC input or an internal current draining fault. If it won't turn on at all suspect the internal power fuse or the AC wall plug transformer.

2.14.6 Slow Distortion Nulling:

The instrument nulls slower at high distortion readings than low ones and at lower frequencies. Try it with the output connected directly to the input (for a self distortion check) at 1kHz. At high distortion readings the speed can be enhanced by turning the DISTORTION control CCW during the nulling then backing off for an on-scale meter reading after nulling. Observe the oscilloscope residual signal.

2.14.7 Unusually Good Distortion Readings:

Are the filters incorrectly selected? Is the

signal present? Check the character of the residual components using the MONITOR output.

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DISTORTION and NOISE

MEASURING SET

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OWNER'S MANUAL

SECTION 3

FUNCTIONAL VERIFICATION

3. FUNCTIONAL VERIFICATION

3.0 INTRODUCTION

This section contains information on how to verify instrument functional operation. See Section 4, Performance Test, for information on accuracy and performance verification.

3.1 OSCILLATOR VERIFICATION

Equipment required: Oscilloscope

This procedure checks basic oscillator operation.

Connect the Oscilloscope to the OUTPUT connector. Turn all six toggle switches to the up position. Turn the OUTPUT LEVEL control fully clockwise. Select x 100 range and turn the FREQUENCY control fully clockwise. The oscilloscope should have a sine wave of about 1kHz and a peak amplitude of at least 17.6 volts (+22 dBV (rms) into no load). Rotate the FREQUENCY control end to end and note that the frequency of the sine wave varies over slightly more than a ten to one range. Also note that the amplitude remains within a few percent (after oscillator settling).

In succession, select each of the three other FREQUENCY ranges (x 1, x 10, x 1k) and rotate the FREQUENCY control end to end. Verify that the level remains within a few percent of the nominal 17.6 Volts peak and remains a sine wave. Verify, using the oscilloscope time base, that the frequency range is at least 10Hz to 100 kHz. (10 Hz period = 100 mS, 100kHz period = 10 μS).

Return to a mid band frequency (approximately 1kHz). Turn the OUTPUT level control end to end. The amplitude on the oscilloscope should change by about a four to one ratio (ie, 17.6V peak to 4.4V peak). The mid point of the pot should produce about half the level available at the maximum.

Return the OUTPUT control to the maximum level (nominal 17.6V peak). Turn the right-most toggle down (OFF). Turn up the gain of the oscilloscope to maximum and verify that no evidence of the oscillator sine wave is present.

Turn the oscillator back on and set to the maximum level. Try each output attenuator toggle switch in sequence. The -10dB switch should give about a three to one reduction (ie, 17.6V peak to 5.6V peak). The 20dB attenuator a ten to one reduction (ie, 17.6V to 1.76V) and the 40dB attenuator a one hundred to one reduction (17.6V to 176 mV).

Connect the 3500 OUTPUT to the oscilloscope as above but use a cable or adapter that permits access to both output terminals (shell and center conductor of the OUTPUT BNC connector). Be sure no other cables, except power, are connected to the 3500. Select a frequency of about 1kHz and a level of about 0dBV (1V). Alternately short each side of the output line to any of the other BNC connectors on the 3500. The sine wave on the oscilloscope should remain unchanged. This verifies the output floating integrity.

With the signal displayed on the oscilloscope as above, connect a precision 600 ohm resistor across the 3500 output terminals. The signal on the oscilloscope should reduce to about one half its former value. This verifies the OUTPUT source impedance is 600 ohms.

This completes the verification of oscillator functional operation.

3.2 AC LEVEL METER VERIFICATION

Equipment required: Oscillator (the one in the 3500 may be used if functional)
Oscilloscope

This procedure checks basic level meter (voltmeter) functional operation.

Connect the oscilloscope to the MONITOR on the front panel. Connect the oscillator OUTPUT to the 3500 INPUT. Select LEVEL with the red FUNCTION buttons. Set the oscillator FREQUENCY to a mid band frequency (approximately 1kHz). Set an oscillator level of approximately +20dBV (10Vrms, 14V peak). Select the 10V/+20 position on the INPUT control. Adjust the oscillator level control for a full scale meter deflection to 1 or 0dB. Reduce the oscillator level by 10dB using the OUTPUT ATTENUATOR switch. Reduce the INPUT control by 10dB (to 3/+10) and note that the meter reading returns to full scale (1V or 0dB). Continue to reduce the oscillator level by 10dB steps and the INPUT level by 10dB steps in sequence and note the meter deflection remains at approximately the same level. This will work to as low as the -50dB/0.003 position on the INPUT control at which level the maximum attenuation of the OUTPUT attenuator will be selected. At this position, turn the first attenuator switch (-10dB) to the 0 (up) position and rotate the OUTPUT level control CCW to its approximate end point to again achieve a 0dB/1 full scale meter deflection. Then turn the INPUT control CCW to its last position (-60/0.001) and the OUTPUT attenuator switches all down (ie the

first switch to -10). The meter should again return to full scale 0dB deflection.

Verification of the 30V/+30dB and 100V/+40dB INPUT positions requires the use of a high output level oscillator or an external booster amplifier if the internal 3500 oscillator is being used. Alternatively, the following procedure can be used.

Set the INPUT control to 10V/+20 and the oscillator to an output level of 10V. Adjust the fine level control for a convenient reference level on the oscilloscope. Turn the INPUT control to 100V/+40 and note that the oscilloscope level has reduced by a factor of about ten to one (10% of the previous level). Turn the INPUT control to 30V/+30 and reduce the oscillator level by 10dB using the OUTPUT ATTENUATOR. The oscilloscope level should remain approximately the same as the previous step. Turn the INPUT control to 10V/+20 and reduce the oscillator level a further 10dB. Again the oscilloscope level should remain essentially constant.

Return to the previous oscillator and INPUT level of 10V/+20 and adjust the oscillator fine level adjustment for exactly 0dB on the meter. Be sure both FILTER buttons are out (not selected). Sweep the oscillator FREQUENCY over the range 10Hz to 100kHz and note that the meter reading remains at 0dB ±0.5dB (after oscillator and meter settling).

3.3 FILTER VERIFICATION

This section presumes that the standard 400Hz High Pass and 50kHz Low Pass filters are installed.

Equipment required: Frequency Counter

3.2.1 LEVEL METER CHECK TABLE

STEP	OUTPUT 0 / -10	ATTENUATOR +20 / 0	ATTENUATOR 0 / -40	VARIABLE OUTPUT LEVEL	INPUT CONTROL	METER INDICATION (±0.5dB)
1	0	+20	0	0	+20/10V	0dB/1V
2	-10	+20	0	0	+10/3V	0dB/1V
3	0	0	0	0	0/1V	0dB/1V
4	-10	0	0	0	-10/0.3	0dB/1V
5	0	+20	-40	0	-20/0.1	0dB/1V
6	-10	+20	-40	0	-30/0.03	0dB/1V
7	0	0	-40	0	-40/0.01	0dB/1V
8	-10	0	-40	0	-50/0.003	0dB/1V
9	0	0	-40	-10	-50/0.003	0dB/1V
10	-10	0	-40	-10	-60/0.001	0dB/1V
11	0	+20	0	0	+20/10V	0dB/1V
12	0	+20	0	0	+30/30V	-10dB/.316V
13	0	+20	0	0	+40/100V	Off scale

Note : Set oscilloscope connected to monitor output to a reference level in Step 11.

See one third (approx) oscilloscope level in Step 12 and one tenth level in Step 13.

Connect the OUTPUT to the INPUT of the 3500. Select OUTPUT and INPUT levels of +20dB and an approximate FREQUENCY of 1kHz. Adjust the OUTPUT fine control for a meter reading of 0dB. Connect the Frequency Counter to the front panel monitor BNC connector.

Push the 400Hz HP filter. The level should change by less than 0.5dB. Change the FREQUENCY to 400Hz. The level should be -3dB (±1dB). Rotate the FREQUENCY control to lower frequencies and verify that the meter travels off scale to the left. Then return to a frequency of 1kHz.

Push the 50kHz LP filter. The level at 1kHz should change by less than 0.5dB. Change the FREQUENCY to 50kHz. The level should be -3dB (±1dB). Rotate the FREQUENCY control to higher frequencies and verify that the meter travels off scale to the left.

This completes the functional test of the filters.

3.4 RESIDUAL DISTORTION MEASUREMENT VERIFICATION

Equipment required: Dual trace oscilloscope

This procedure checks the complete system -- Generator and Analyser. An independent check may be made of each sub system by using a second 3500.

Connect the OUTPUT to the INPUT. Connect the INPUT MONITOR (rear) and the MONITOR (front) to the two inputs respectively of the oscilloscope.

Select a FREQUENCY range of x 100 and control setting of 10 (ie, 1kHz). Set an OUTPUT and INPUT

level of +10dBV. Push DISTortion on the FUNCTION buttons (red). Push both filter buttons in. Turn the DISTORTION rotary control to 0.003%/-90dB. The meter reading should be below 0.0015% or -96dB. Change the FREQUENCY range to x 10 (100Hz). Turn off the 400Hz HP filter. Verify that the distortion reading is also below 0.0015% or -96dB.

Again using the x 10 range and with the LP filter (50kHz) pushed in turn the FREQUENCY control to 1 for 10Hz. Verify that the distortion settles to -93/0.0022% or better. Select the x 1k range and turn the FREQUENCY control to 10 (ie 10kHz). Turn both filters on. Verify that the distortion is 0.0015%/-96dB or better. Turn off the LP filter (50kHz) and push the x 10k range (100kHz). Select the -80/0.01 range on the DISTortion control and verify that the distortion is below -80dB or 0.01%.

3.5 AUTOMATIC SET LEVEL or RATIOMETRIC FUNCTION VERIFICATION

Connect the 3500 oscillator output to the INPUT connector. Set an oscillator and INPUT level of +20dBV (10V rms). Set the FREQUENCY control to 1kHz. Select LEVEL on the function push buttons. Adjust the oscillator level for a meter reading of 0dB (or +20dBV absolute). Move the DISTORTION rotary control to TEST (fully CW). Push DISTortion in the function push buttons. The meter should continue to indicate 0dB ±0.5dB. Change the oscillator level by 10dB. The meter reading should remain at 0dB ±0.5dB.

3.6 DISTORTION AMPLIFIER GAIN TEST

Equipment required: None

Connect the OUTPUT to the INPUT and select a

3.6.1 DISTORTION AMPLIFIER GAIN TEST TABLE								
STEP	FUNCTION LEVEL	DIST	OUTPUT ATTEN 0 / -10	+20 / 0	0 / -40	VARIABLE OUTPUT LEVEL	INPUT CONTROL	DIST CONTROL	METER INDICATION ±0.5dB
1	IN	OUT	0	+20	0	0	+20/10V	--	0dB/1V
2	IN	IN	0	+20	0	0	+20/10V	0/100%	0dB/1V
3	IN	IN	-10	+20	0	0	+20/10V	-10/30%	0dB/1V
4	IN	IN	0	0	0	0	+20/10V	-20/10%	0dB/1V
5	IN	IN	-10	0	0	0	+20/10V	-30/3%	0dB/1V
6	IN	IN	0	+20	-40	0	+20/10V	-40/1%	0dB/1V
7	IN	IN	-10	+20	-40	0	+20/10V	-50/0.3%	0dB/1V
8	IN	IN	0	0	-40	0	+20/10V	-60/0.1%	0dB/1V
9	IN	IN	-10	0	-40	0	+20/10V	-70/0.03%	0dB/1V
10	IN	IN	-10	0	-40	0	+30/30V	-80/0.01%	0dB/1V
11	IN	IN	-10	0	-40	0	+40/100V	-90/0.003%	0dB/1V

FREQUENCY of 1kHz. Select a level of +20dBV and, with LEVEL selected, adjust for a meter reading of 0dB. Select 100%/0dB on the DISTortion control. Push both FUNCTION buttons in. The meter reading should remain at 0dB ±0.5dB. Using the OUTPUT attenuator reduce the OUTPUT level by 10dB and the DISTORTION level by 10dB. Verify that the meter reading remains at 0dB ±0.5dB. Continue to reduce the OUTPUT and DISTortion levels in 10dB steps and verify that the meter remains at 0dB ±0.5dB. When the OUTPUT attenuator has no further positions available, use the INPUT control to achieve attenuation. That is, increase the INPUT control by 10dB to 30V/+30 and 20dB to 100V/+40 for the lowest DISTORTION control settings.

3.7 IMD GENERATOR VERIFICATION (OPTIONAL)

Equipment Required: Oscilloscope

Before performing this verification, follow procedure 3.1 OSCILLATOR VERIFICATION.

Connect the 3500 OUTPUT to the oscilloscope input. Set the 3500 FREQUENCY controls to approximately 5kHz. With the DISTORTION mode toggle switch in the THD mode, a 5kHz sine wave should be visible on the oscilloscope. Move the toggle switch to each IMD position (SMPTE and CCIF) and the oscilloscope should show a low frequency signal of approximately 60Hz and the 5kHz signal mixed in a 4 to 1 ratio. That is, the 60Hz signal will be approximately 12dB higher than the high frequency signal. The peak to peak amplitude of this composite waveform should be the same as the peak to peak amplitude of the THD sine wave.

Change the FREQUENCY control and range switch to vary the HF component over the range of 1kHz to 100kHz and verify that the HF component amplitude remains essentially constant.

3.8 IMD ANALYSER VERIFICATION

Equipment Required: Dual trace Oscilloscope

Connect the rear panel INPUT monitor and the front panel MONITOR connectors to the two oscilloscope inputs. Connect the 3500 OUTPUT to the INPUT.

Set a FREQUENCY of about 7kHz and select SMPTE IMD with the DISTORTION mode switch. Set a generator level of approximately +10dBV and the INPUT control to +10/3V. Select DISTortion with the red FUNCTION push button. Turn the DISTortion control to -90/0.003%. Turn off both filters. The meter should indicate about -90dB/0.003% or less. Turn the FREQUENCY control lower. At about 2kHz, the red LO LED will come on. Turn the FREQUENCY control higher and use the range switch to set the HF frequency to 100kHz. The distortion reading should not exceed -60dB/0.1%.

Select the CCIF IMD mode (middle position) on the DISTORTION toggle switch. Set an HF FREQUENCY of approximately 5kHz. Set the DISTortion control to 0dB/100%. Be sure both filters are off. The meter should indicate between -1 and -2dB/80% to 90%. (This is not a correct measuring mode as the source is not a CCIF signal but does verify the measuring circuits).

On the INPUT MONITOR the oscilloscope trace should be the LF + HF composite waveform. On the MONITOR trace should be the LF component only. As the HF FREQUENCY is varied from about 2kHz to 100kHz the meter reading and MONITOR trace should remain constant. As the HF FREQUENCY goes below 2kHz, the reading will increase slightly and the MONITOR trace will show the HF component added to the LF component.

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SECTION 5

MAINTENANCE and CALIBRATION

5. MAINTENANCE and CALIBRATION

5.0 INTRODUCTION

The model 3500 contains a number of internal calibrations and adjustments. These fall into two categories: those requiring calibration to an external standard and those requiring adjustment for best performance. The former require the use of high precision calibration equipment not usually available in the average shop. A reasonable level of calibration, though below the 3500 specification, can be done using a high quality AC level meter as the external reference.

5.1 DISASSEMBLY

All trim adjustments are located on one of the three circuit boards: Filter/Oscillator, Input/Meter and Power Supply. The two signal boards are located in the plane of the top or bottom cover while the power supply is located in the rear panel enclosure. The Filter/Oscillator board is on the top of the instrument, with components accessible by removing the top cover. The Input/Meter board is located on the bottom with its components accessible by removing the bottom cover.

In general either the top or the bottom cover should be removed at a time. With both removed at the same time, the side members will have no support and the boards and other structure will become quite unwieldy.

To remove the top or the bottom cover adjust the handle to its full forward position and lay the instrument on a flat, protected surface upside

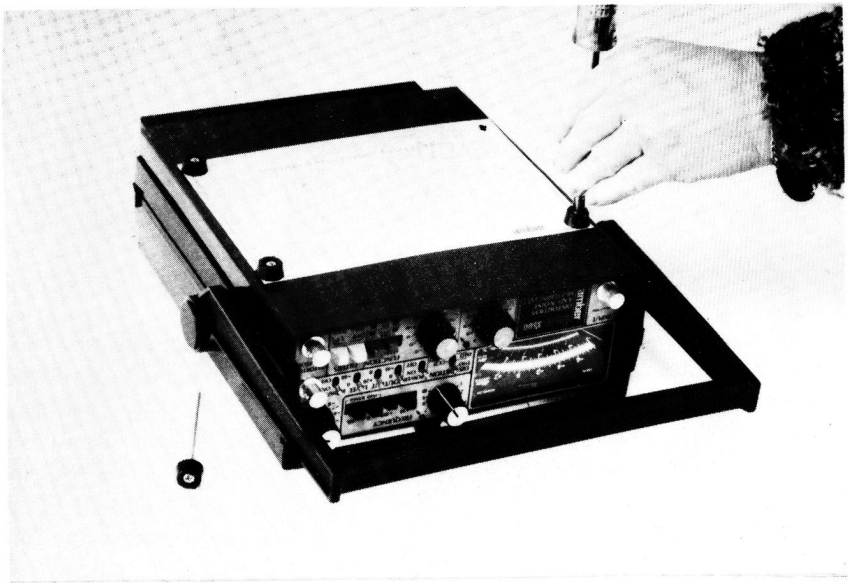


Fig 5.1.1 Removal of cover hold down screws.

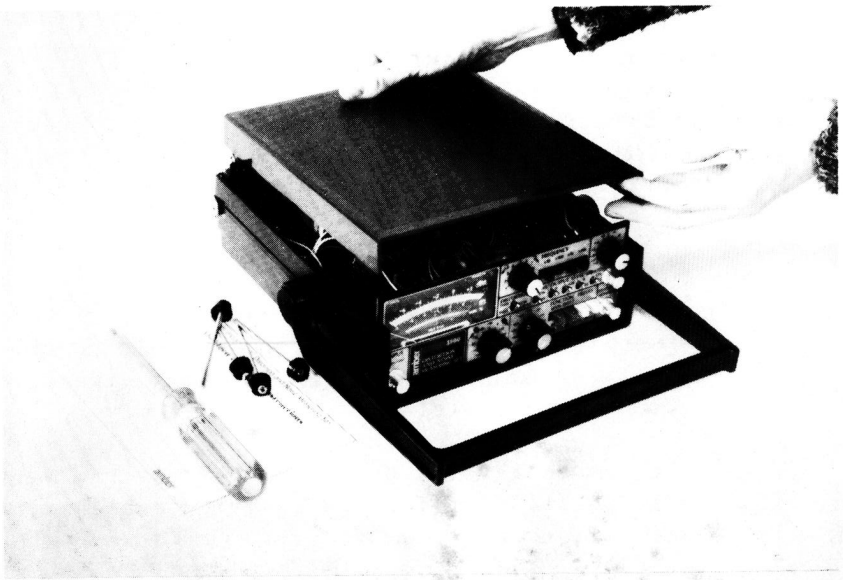


Fig 5.1.2 Removal of top cover

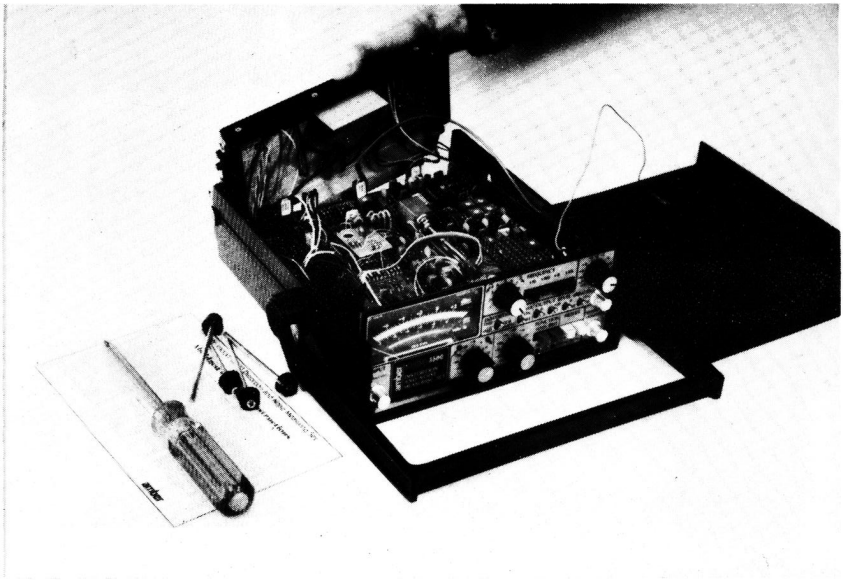


Fig 5.1.3 Power Module Removal

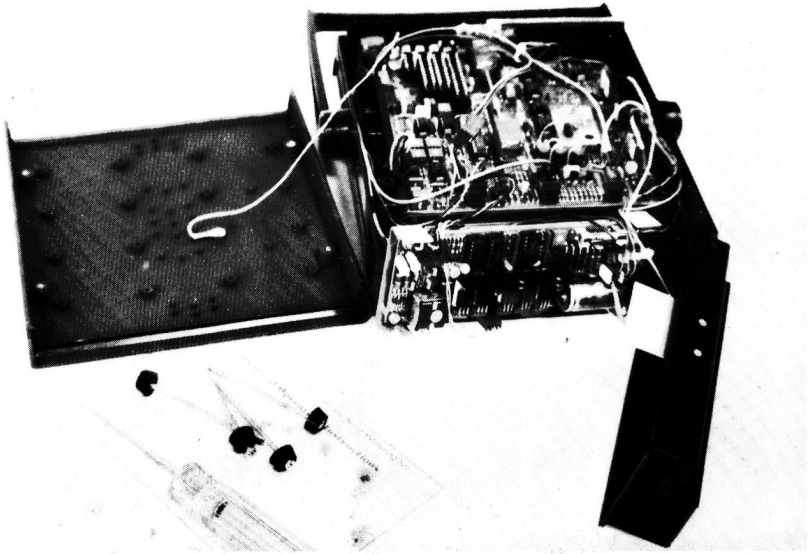


Fig 5.1.4 Power Module Disassembled

down, that is on its top cover. Remove the four screws holding the four vinyl feet in place. The bottom cover can now be lifted upward and removed. Or, to remove the top cover, remove the four screws, grasp the instrument securely to hold both covers in place, turn it right side up and lift off the top cover.

A word of caution in replacing either top or bottom cover. Be careful to ensure that the necessary items are guided to their correct slots. The covers fit into slots in both side members and the front and rear panels fit into slots in the top and bottom covers. Pay particular attention to the front panel as it is a laminate of a rigid underlay and a thin plastic overlay. If the panel doesn't correctly fit the groove provided it can be permanently damaged as pressure is applied to fit the covers in place. As the cover is pressed into place check the fit of the front and rear panels and if necessary run a finger along the groove area to cause the panel to properly slip into the slot.

The power supply is best accessed by removing the top cover and lifting the whole power supply assembly up and out of the rear slots. Then remove six Phillips drive screws, two on the bottom, two on the top and two on the lip near the serial number. The circuit board and chassis should slip out of the black enclosure giving full access to the adjustments and components.

When reassembling the power supply and the top/bottom cover ensure no cables become pinched. Pay particular attention to the heat sink in the power supply and the four posts through which the four long mounting screws travel that hold the top and bottom covers together.

5.2 OSCILLATOR LEVEL CALIBRATION

Equipment Required: Accurate signal level meter calibrated in dBV or Volts.

VR109 is located on the Filter/Oscillator board (top). It controls the absolute output level of the oscillator and hence the maximum output level possible from the generator output.

With the OUTPUT level control at maximum (fully clockwise) and the attenuators set for +12dBV output (ie -10, +20, 0) adjust VR109 for a level of +12dBV (4.0Vrms) at the OUTPUT connector into an open circuit. Be sure the output is not clipped during the measurement. If it is refer to Section 5.11 below.

5.3 OSCILLATOR DISTORTION NULL ADJUSTMENT

Equipment Required: Oscilloscope

VR105, VR106, VR107 and VR108 are trims to adjust the degree of second harmonic distortion cancellation in the oscillator. They are adjusted by observing the distortion at the output of the generator and trimming for lowest second harmonic.

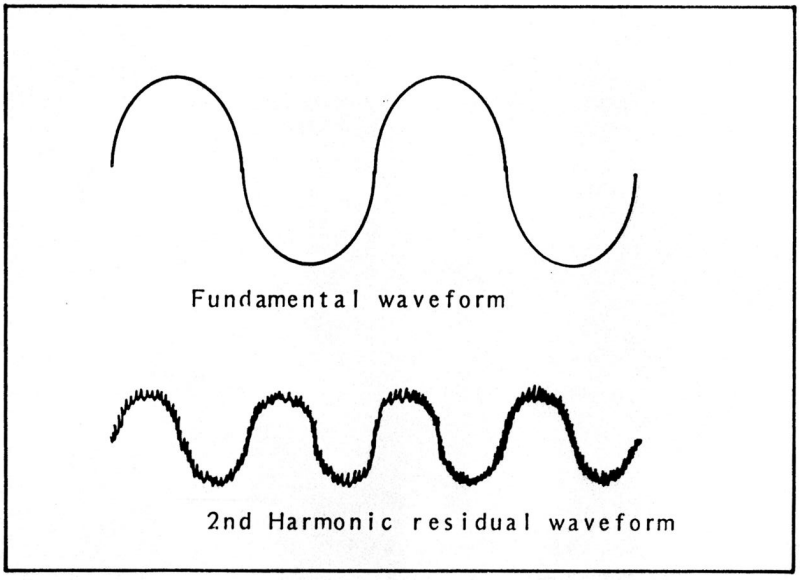
Connect the OUTPUT to the INPUT, select a level of about +10dBV and a frequency of about 1kHz by using the x100 range and 10 on the FREQUENCY control. Set the controls for distortion and monitor the INPUT and DISTORTION on an external oscilloscope. Trim VR106 and VR108 for minimum second harmonic as observed on the oscilloscope and lowest reading on the meter. Use the high pass and

low pass filters to increase the sensitivity of the adjustment. It may be necessary to iterate back and forth between the two trims to obtain the best result.

Next change the frequency to about 60kHz and adjust VR105 and VR107 for lowest second harmonic. Iterate between both for best reading. Be sure to turn off the low pass filter.

Recheck the adjustments at 1kHz.

Remember that these adjustments only affect the second harmonic components and are ineffective for odd harmonics.



5.4 OSCILLATOR HI-FREQUENCY COMPENSATION ADJUSTMENT

Equipment Required: DC Voltmeter or Oscilloscope

The oscillator uses a state variable filter as the resonant element. This filter, like most active filters, begins to deviate from ideal performance above 10kHz as the gain-bandwidth product of the op amps becomes significant. The op amp limitations, stray capacitance , etc. will cause a phenomenon known as "Q enhancement" to take place at high frequencies. This effect is compensated to a large extent by a single capacitor whose value is trimmed by VR104.

Connect a DC voltmeter or oscilloscope to pin 7 of U116B. Set the oscillator to 100kHz and adjust VR104 for a reading of approximately +5V. The adjustment is not critical.

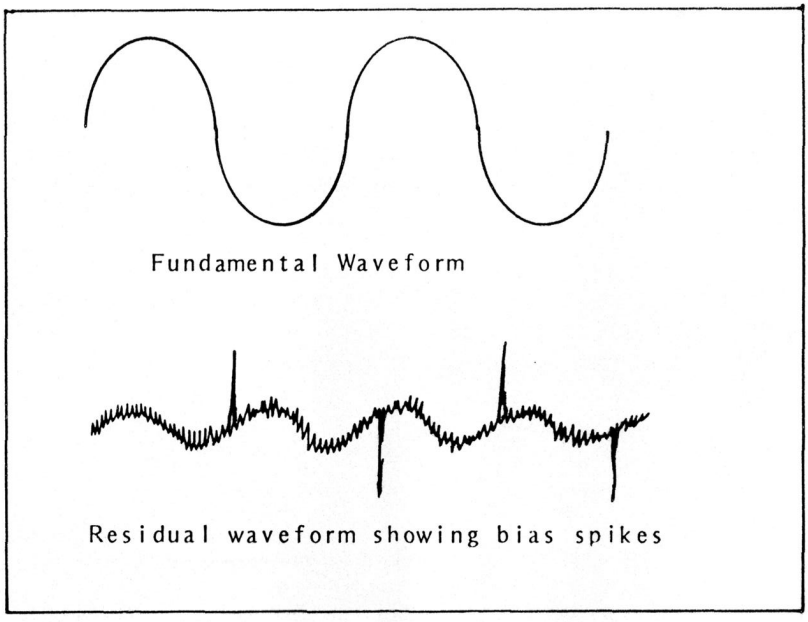
5.5 POWER AMPLIFIER BIAS ADJUSTMENT

Equipment Required: Oscilloscope

Set up the 3500 to measure its own distortion and connect the external oscilloscope to observe the distortion waveform. Choose a frequency of about 100kHz and a level of +10dRV (3V). Turn VR110 fully clockwise. Sharp spikes will be observed in the distortion residual waveform. Slowly rotate VR110 counter clockwise to reduce the spikes. A point will be reached where the spikes are almost completely absent. Continue

to turn CCW and a small increase in spikes followed by a second lower null will be observed. The start of this second null is the correct setting. The adjustment is sensitive -- turn too far CCW and excessive current will be drawn into the output transistors which could cause their destruction and lower battery life. To repeat: as VR110 is slowly rotated CCW the spikes will be slowly nulled out then slightly increase then a lower null. Stop turning CCW when this second null is just reached.

The output transistors (Q100 & Q102) will run quite warm with proper bias adjustment.



5.6 LEVEL METER CALIBRATION

Equipment Required: Precision AC calibrator such as Fluke model 5200A.

Alternative equipment: If a precision AC calibrator is not available, use an accurate AC level meter and the Generator of the 3500. The accuracy of the adjustment will then be only as good as the accuracy of the meter used and may produce some anomalous results.

Note that the mechanical "zero" of the meter is set to cause the pointer to rest on the left end stop with no signal on the meter (3500 turned off). This is due to the fact that the meter law is logarithmic.

Because various meter scales and panel options are available, the units used to describe various readings and control settings may differ. The following table shows the correspondence.

Meter Reading	dRV	dRm	3 FS	1 FS	Watts
"Full Scale"	0	+2.2	3.2	1	1.3
Maximum Reading	+2	+4.2	4	1.3	2
Minimum Reading	-10	-7.8	1	3.2	0.13

INPUT CONTROL SETTINGS		
dBm/dRV	Volts	Watts
+40	100	1250
+30	30	125
+20	10	12.5
+10	3	1.25
0	1	125m
-10	300mV	12.5m
-20	100mV	1.25m
-30	30mV	125µ
-40	10mV	12.5µ
-50	3mV	1.25µ
-60	1mV	.125µ

Test Signal Levels		
dRV (ref 1V)	dBm (ref 0.775V)	Volts
+20	+22.218	10V
+10	+12.218	3.16V
0	+2.218	1V
-10	-7.782	316mV
-20	-17.782	100mV

Connect the AC calibrator to the 3500 INPUT and select the LEVEL function. Set the INPUT control to +10dB/3V. Adjust the AC calibrator to exactly 1.000V AC at some midband frequency, 1kHz preferred. Adjust VR201 so the meter points to -10dBV or 1 on the 3FS Volt/% scale.

Turn the INPUT control to 0dB/1V and adjust VR202 so the meter points to 0dBV or 1V. Check the -10dBV reading with the INPUT control at +10dB again and if necessary iterate back and forth between the 0 and +10dB positions of the INPUT control and VR201 and VR202 to achieve the correct result.

5.7 RATIOMETRIC CALIBRATION

Equipment Required: See 5.6 above

Connect the AC calibrator as in 5.6 above and turn the DISTORTION control fully clockwise to TEST. Select the DISTortion function.

Set INPUT control to 0dB (again using the 1.000V AC source). Adjust VR200 for a 0dBV meter indication. Set the INPUT control to +10dB and adjust VR203 for a 0dBV meter indication. Repeat the VR200, 0dB and VR203, +10dB adjustments if required to achieve a constant 0dBV meter indication as the INPUT control is switched between 0 and +10 with a constant input level of 1.000V.

5.8 ANALYSER NULLING ADJUSTMENT

Equipment Required: Oscilloscope

Set up the 3500 to measure its own distortion with a FREQUENCY of 1kHz and an OUTPUT level of +10dBV. Turn on both the high pass and low pass filters. Observe the INPUT and DISTORTION waveforms on an external oscilloscope. Turn the INPUT control to +20dB. The LO LED may light but ignore it. Adjust VR111 and VR112 for minimum fundamental as observed on the oscilloscope and the 3500 meter. Tune both trims for the best null.

5.9 FILTER HI-FREQUENCY COMPENSATION ADJUSTMENT

Equipment Required: None

Connect the 3500 OUTPUT to the INPUT. Select an OUTPUT level of +10dBV and an INPUT sensitivity of +10dB. Turn the DISTORTION control to 0dB and select the narrow band FUNCTION (both LEVEL and DISTORTION pushed). Select a FREQUENCY of 1kHz and trim the OUTPUT level control for a meter reading of 0dBV.

Select the x10kHz range and turn the FREQUENCY control from 10kHz to 100kHz. Adjust VR113 for maximum level flatness over the 10kHz to 100kHz frequency range.

5.10 NARROW BAND/LOW PASS STRAPS

The narrow band mode (both FUNCTION buttons pushed in) is normally set to be a band pass filter shape. It may optionally be user modified to a low pass configuration.

The left side of the FILTER/OSCILLATOR board (top) has a soldered loop near P100 and P101. When the loop is connected from the middle pad to

the top pad the filter is configured to a band pass mode, when the middle pad is connected to the lower pad it is configured to a low pass mode.

5.11 POWER SUPPLY OUTPUT VOLTAGE

Equipment Required: DC Voltmeter or Oscilloscope

VR401 on the power supply board adjusts the voltage of both supply rails. It is adjusted to give sufficient output voltage so the generator will not clip at maximum output level.

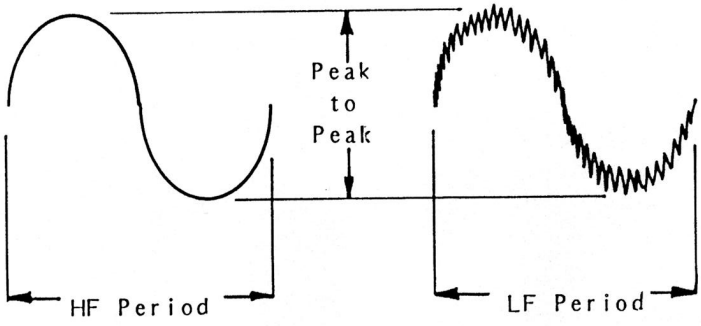
It is necessary to measure the +20V rail as it leaves the power supply or on the Oscillator/Filter board. Use C405 and C406 on the power supply board or the red (+), black (-) and green (GND) wire solder pads as measuring points. Adjust VR401 so the voltage on these capacitors is + or - 20.5V (within 10%).

5.12 IMD LF OSCILLATOR (OPTIONAL)

VR601 is located on the IMD board which, if supplied, is located under the top FILTER/OSCILLATOR board. This trim control is easily accessible by lifting out the power supply module and accessing from the rear. It is not necessary to remove any boards or cables.

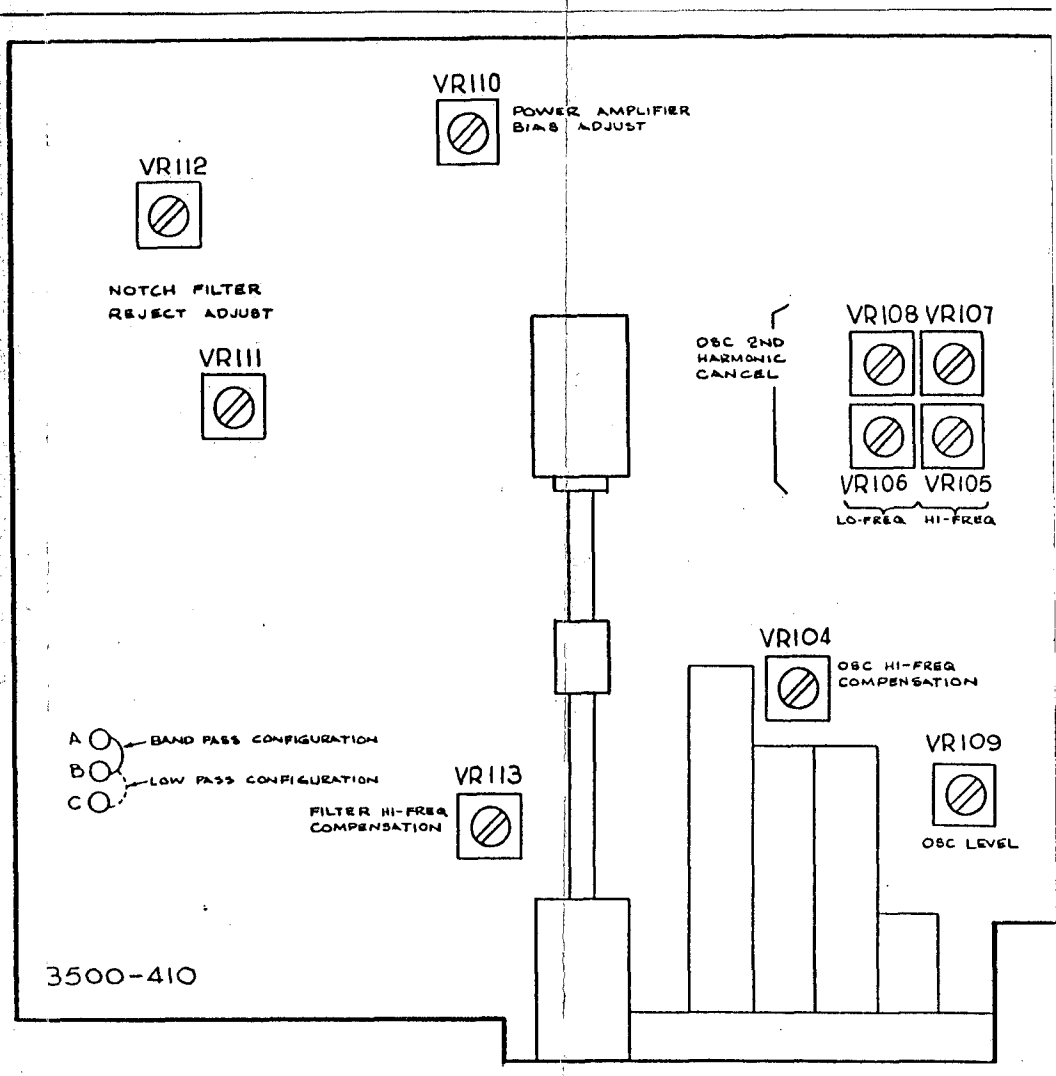
VR601 adjusts the amplitude of the low frequency oscillator. The amplitude of the high frequency oscillator should first be adjusted using procedure 5.2 previous. The relative amplitudes of the LF and HF oscillator are permanently set to a four to one ratio by precision resistors.

Select the THD mode with the 3 position toggle. Set the HF oscillator to about 5kHz and observe the OUTPUT on an oscilloscope. Adjust the OUTPUT and oscilloscope controls so the peak to peak amplitude exactly fills the entire vertical scale of the screen. Now switch to either of the IMD positions. The single 5kHz sine wave will be replaced with a nominal 60Hz sine wave with a 5kHz smaller signal superimposed. Adjust VR601 so the peak to peak amplitude of this composite waveform is the same as the single 5kHz waveform seen previously.



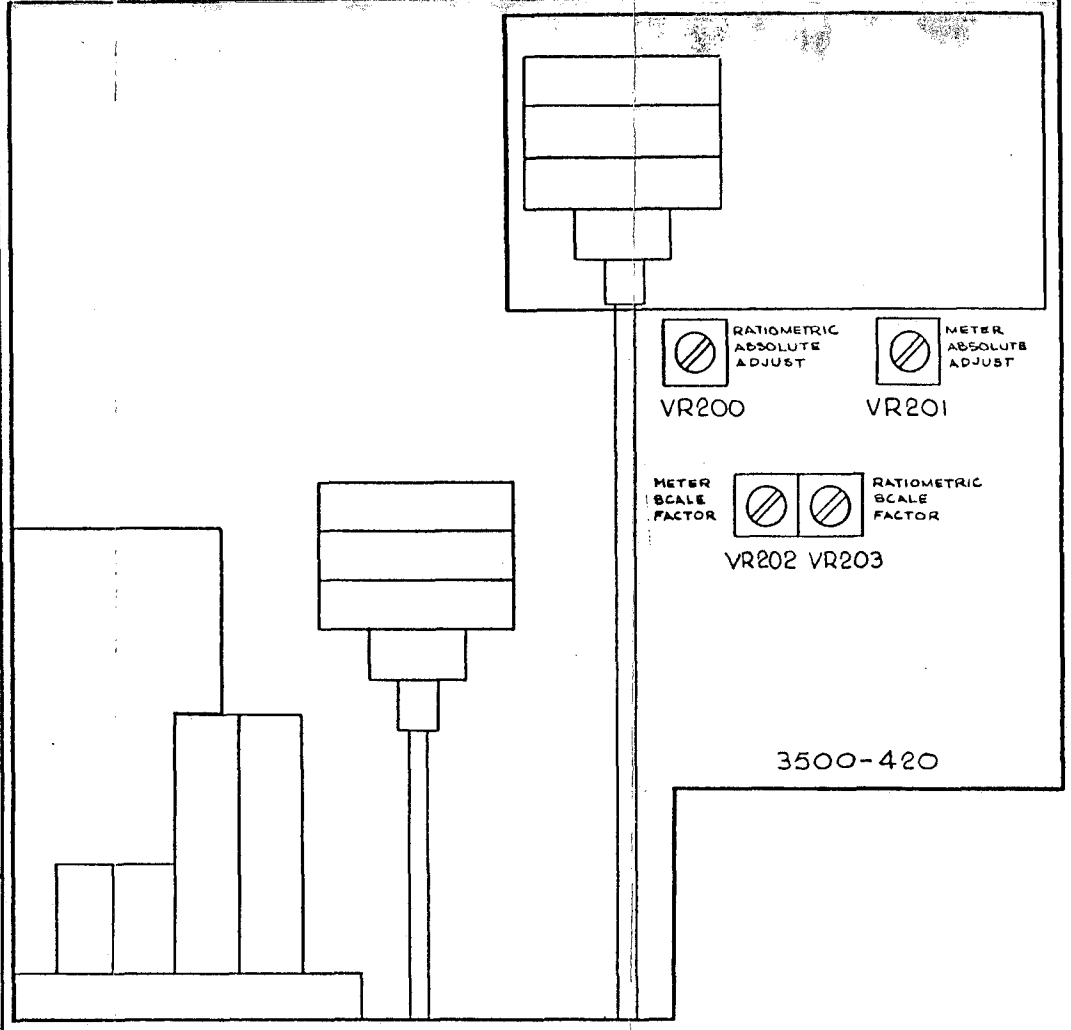
Peak to peak amplitude of THD and IMD waveforms should be equal.

ADJUSTMENT/CALIBRATION SUMMARY		
TRIM	FUNCTION	CALIBRATION PROCEDURE
VR104	OSC Hi-Freq Compensation	Adjust for +5V DC level at Pin 7 of U116B while oscillator is at 100kHz
VR105, VR107	Hi-Freq 2nd Harmonic Null	Adjust for minimum second harmonic at oscillator output in 10kHz to 100kHz range
VR106, VR108	Lo-Freq 2nd Harmonic Null	Adjust for minimum second harmonic at oscillator output at 1kHz
VR109	Oscillator Level	Adjust for +22dRV at final output with level control at maximum
VR110	Power Amplifier Bias	Adjust to eliminate crossover distortion at final output at 100kHz
VR111, VR112	Notch Filter Null Adjust	Adjust for minimum fundamental in analyser with low input signal
VR113	Filter Hi-Freq Compensation	Adjust for best filter response flatness in 10kHz to 100kHz range

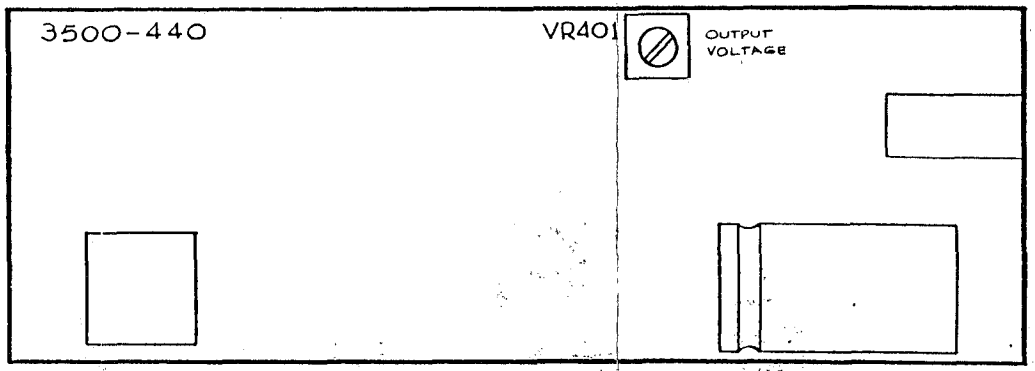


FILTER/OSCILLATOR BOARD

ADJUSTMENT/CALIBRATION SUMMARY		
TRIM	FUNCTION	CALIBRATION PROCEDURE
VR200	Ratiometric Absolute Cal	With DIST control in "Test" position, adjust for 0dBV meter indication as input level varied over full range
VR201	Meter Absolute Cal	With calibrated input signal in level mode, adjust for proper absolute meter reading
VR202	Meter Scale Factor Cal	With calibrated input signal in level mode, adjust for proper meter scale factor
VR203	Ratiometric Scale Factor	With DIST control in "Test" position, adjust for 0dBV meter indication as input level varied over full range



ADJUSTMENT/CALIBRATION SUMMARY		
TRIM	FUNCTION	CALIBRATION PROCEDURE
VR401	Output Voltage	Adjust for +20.5V on oscillator power rails



AMRER MODEL 3500

DISTORTION and NOISE

MEASURING SET

Issue 03
January 1981

OWNER'S MANUAL

SECTION 7

PARTS LIST

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
R101	32033-56000	RESISTOR C F 1/4W	560	5%	CMPR	911-14W-5T	1
R102	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	931-14W-5T	6
R103	32035-20030	RESISTOR M F 1/4W	200K	1%	CMPR	931-14W-1T	2
R104	32035-24930	RESISTOR M F 1/4W	249K	1%	CMPR	931-14W-1T	2
R105	32035-20030	RESISTOR M F 1/4W	200K	1%	CMPR	931-14W-1T	0
R106	32035-24930	RESISTOR M F 1/4W	249K	1%	CMPR	931-14W-1T	0
R107	32035-24900	RESISTOR M F 1/4W	249	1%	CMPR	931-14W-1T	4
R108	32035-71510	RESISTOR M F 1/4W	7K15	1%	CMPR	931-14W-1T	4
R109	32035-24900	RESISTOR M F 1/4W	249	1%	CMPR	931-14W-1T	0
R110	32035-71510	RESISTOR M F 1/4W	7K15	1%	CMPR	931-14W-1T	0
R111	32033-10010	RESISTOR C F 1/4W	1K0	5%	CMPR	911-14W-5T	2
R114	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	5
R115	32033-15000	RESISTOR C F 1/4W	150	5%	CMPR	911-14W-5T	2
R116	32033-15000	RESISTOR C F 1/4W	150	5%	CMPR	911-14W-5T	0
R117	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	7
R118	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R119	32033-10010	RESISTOR C F 1/4W	1K0	5%	CMPR	911-14W-5T	0
R120	32035-49910	RESISTOR M F 1/4W	4K99	1%	CMPR	931-14W-1T	2
R121	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	0
R122	32035-49910	RESISTOR M F 1/4W	4K99	1%	CMPR	931-14W-1T	0
R123	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R124	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	4
R125	32035-14390	RESISTOR M F 1/4W	14R3	1%	CMPR	931-14W-1T	1
R126	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R127	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R128	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R130	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R131	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	4
R132	32033-39040	RESISTOR C F 1/4W	3M9	5%	CMPR	911-14W-5T	1
R133	32033-15020	RESISTOR C F 1/4W	15K	5%	CMPR	911-14W-5T	5
R134	32033-15020	RESISTOR C F 1/4W	15K	5%	CMPR	911-14W-5T	0
R135	32033-33020	RESISTOR C F 1/4W	33K	5%	CMPR	911-14W-5T	2
R136	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	0
R137	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	9
R138	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	0
R139	32033-15010	RESISTOR C F 1/4W	1K5	5%	CMPR	911-14W-5T	1
R140	32035-75010	RESISTOR M F 1/4W	7K50	1%	CMPR	931-14W-1T	2
R141	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R142	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R143	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R144	32035-71510	RESISTOR M F 1/4W	7K15	1%	CMPR	931-14W-1T	0
R145	32035-71510	RESISTOR M F 1/4W	7K15	1%	CMPR	931-14W-1T	0
R146	32035-24900	RESISTOR M F 1/4W	249	1%	CMPR	931-14W-1T	0
R147	32035-24900	RESISTOR M F 1/4W	249	1%	CMPR	931-14W-1T	0
R148	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R149	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R150	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R151	32033-33040	RESISTOR C F 1/4W	3M3	5%	CMPR	911-14W-5T	1
R152	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R153	32033-15020	RESISTOR C F 1/4W	15K	5%	CMPR	911-14W-5T	0
R154	32033-56020	RESISTOR C F 1/4W	56K	5%	CMPR	911-14W-5T	1

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
R155	32033-22020	RESISTOR C F 1/4W	22K	5%	CMPR	911-14W-5T	2
R157	32033-47010	RESISTOR C F 1/4W	4K7	5%	CMPR	911-14W-5T	3
R158	32033-47010	RESISTOR C F 1/4W	4K7	5%	CMPR	911-14W-5T	0
R159	32033-47010	RESISTOR C F 1/4W	4K7	5%	CMPR	911-14W-5T	0
R160	32033-22020	RESISTOR C F 1/4W	22K	5%	CMPR	911-14W-5T	0
R161	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R162	32033-15020	RESISTOR C F 1/4W	15K	5%	CMPR	911-14W-5T	0
R163	32033-15020	RESISTOR C F 1/4W	15K	5%	CMPR	911-14W-5T	0
R164	32033-33020	RESISTOR C F 1/4W	33K	5%	CMPR	911-14W-5T	0
R165	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	0
R166	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R167	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	0
R168	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	0
R169	32033-56010	RESISTOR C F 1/4W	5K6	5%	CMPR	911-14W-5T	1
R170	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	0
R171	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R172	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R173	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	931-14W-5T	4
R174	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	0
R175	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	0
R176	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	0
R177	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	6
R178	32035-60400	RESISTOR M F 1/4W	604	1%	CMPR	931-14W-1T	1
R179	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	0
R180	32033-10090	RESISTOR C F 1/4W	10	5%	CMPR	911-14W-5T	2
R181	32033-10090	RESISTOR C F 1/4W	10	5%	CMPR	911-14W-5T	0
R182	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	0
R183	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	0
R184	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	0
R185	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	0
R186	32033-22000	RESISTOR C F 1/4W	220	5%	CMPR	911-14W-5T	0
R187	32038-46400	RESISTOR M F 1/4W	464	0.1%	AR	RN-55E	1
R188	32038-41710	RESISTOR M F 1/4W	4K17	0.1%	AR	RN-55E	1
R189	32035-37410	RESISTOR M F 1/4W	3K74	1%	CMPR	931-14W-1T	1
R190	32035-75010	RESISTOR M F 1/4W	7K50	1%	CMPR	931-14W-1T	0
R191	32035-30120	RESISTOR M F 1/4W	30K1	1%	CMPR	931-14W-1T	1
R192	32035-28720	RESISTOR M F 1/4W	28K7	1%	CMPR	931-14W-1T	1
R193	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R194	32035-24910	RESISTOR M F 1/4W	2K49	1%	CMPR	931-14W-1T	1
R195	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	0
R196	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R197	32033-10040	RESISTOR C F 1/4W	1MO	5%	CMPR	911-14W-5T	1
R198	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	0
R201	32035-46400	RESISTOR M F 1/4W	464	1%	CMPR	931-14W-1T	4
R202	32038-10010	RESISTOR M F 1/4W	1K00	0.1%	AR	RN-55E	5
R203	32038-31610	RESISTOR M F 1/4W	3K16	0.1%	AR	RN-55E	4
R208	32033-10010	RESISTOR C F 1/4W	1KO	5%	CMPR	911-14W-5T	2
R209	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	2
R210	32035-46400	RESISTOR M F 1/4W	464	1%	CMPR	931-14W-1T	0
R211	32035-10010	RESISTOR M F 1/4W	1K00	1%	CMPR	931-14W-1T	3
R212	32033-10050	RESISTOR C F 1/4W	10M	5%	CMPR	911-14W-5T	2

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
R214	32033-10050	RESISTOR C F 1/4W	10M	5%	CMPR	911-14W-5T	0
R215	32038-31610	RESISTOR M F 1/4W	3K16	0.1%	AB	RN-55E	0
R216	32038-10010	RESISTOR M F 1/4W	1K00	0.1%	AB	RN-55E	0
R217	32038-31600	RESISTOR M F 1/4W	316	0.1%	AB	RN-55E	2
R218	32038-10000	RESISTOR M F 1/4W	100	0.1%	AB	RN-55E	2
R219	32038-31690	RESISTOR M F 1/4W	31R6	0.1%	AB	RN-55E	2
R220	32038-14790	RESISTOR M F 1/4W	14R7	0.1%	AB	RN-55E	2
R221	32033-10010	RESISTOR C F 1/4W	1K0	5%	CMPR	911-14W-5T	0
R223	32038-31610	RESISTOR M F 1/4W	3K16	0.1%	AB	RN-55E	0
R224	32038-68110	RESISTOR M F 1/4W	6K81	0.1%	AB	RN-55E	1
R225	32038-41710	RESISTOR M F 1/4W	4K17	0.1%	AB	RN-55E	1
R226	32035-10000	RESISTOR M F 1/4W	100	1%	CMPR	931-14W-1T	1
R227	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	4
R228	32035-46400	RESISTOR M F 1/4W	464	1%	CMPR	931-14W-1T	0
R229	32033-33030	RESISTOR C F 1/4W	330K	5%	CMPR	911-14W-5T	0
R230	32038-21520	RESISTOR M F 1/4W	21K5	0.1%	AB	RN-55E	1
R231	32038-68120	RESISTOR M F 1/4W	68K1	0.1%	AB	RN-55E	1
R232	32035-11010	RESISTOR M F 1/4W	1K10	1%	CMPR	931-14W-1T	2
R233	32038-10010	RESISTOR M F 1/4W	1K00	0.1%	AB	RN-55E	0
R234	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R235	32038-31610	RESISTOR M F 1/4W	3K16	0.1%	AB	RN-55E	0
R236	32038-10010	RESISTOR M F 1/4W	1K00	0.1%	AB	RN-55E	0
R237	32038-31600	RESISTOR M F 1/4W	316	0.1%	AB	RN-55E	0
R238	32038-10000	RESISTOR M F 1/4W	100	0.1%	AB	RN-55E	0
R239	32038-31690	RESISTOR M F 1/4W	31R6	0.1%	AB	RN-55E	0
R240	32035-11010	RESISTOR M F 1/4W	1K10	1%	CMPR	931-14W-1T	0
R241	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	1
R242	32035-41230	RESISTOR M F 1/4W	412K	1%	CMPR	931-14W-1T	2
R243	32033-91000	RESISTOR C F 1/4W	910	5%	CMPR	911-14W-5T	1
R244	32035-34830	RESISTOR M F 1/4W	348K	1%	CMPR	931-14W-1T	1
R245	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	3
R246	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	0
R247	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	0
R248	32038-10010	RESISTOR M F 1/4W	1K00	0.1%	AB	RN-55E	0
R249	32038-10030	RESISTOR M F 1/4W	100K	0.1%	AB	RN-55E	2
R250	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	2
R251	32038-10030	RESISTOR M F 1/4W	100K	0.1%	AB	RN-55E	0
R252	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	1
R256	32035-39230	RESISTOR M F 1/4W	392K	1%	CMPR	931-14W-1T	1
R257	32035-28720	RESISTOR M F 1/4W	28K7	1%	CMPR	931-14W-1T	2
R258	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R259	32035-10010	RESISTOR M F 1/4W	1K00	1%	CMPR	931-14W-1T	0
R260	32035-61990	RESISTOR M F 1/4W	61R9	1%	CMPR	931-14W-1T	1
R261	32035-41230	RESISTOR M F 1/4W	412K	1%	CMPR	931-14W-1T	0
R262	32035-29410	RESISTOR M F 1/4W	2K94	1%	CMPR	931-14W-1T	1
R263	32035-80600	RESISTOR M F 1/4W	806	1%	CMPR	931-14W-1T	1
R264	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	
R265	32038-14790	RESISTOR M F 1/4W	14R7	0.1%	AB	RN-55E	0
R266	32035-49900	RESISTOR M F 1/4W	499	1%	CMPR	931-14W-1T	1
R267	32033-10000	RESISTOR C F 1/4W	100	5%	CMPR	911-14W-5T	0
R268	32035-27410	RESISTOR M F 1/4W	2K74	1%	CMPR	931-14W-1T	1

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R269	32035-82500	RESISTOR M F 1/4W	825	1%	CMPR	931-14W-1T	1
R270	32035-27400	RESISTOR M F 1/4W	274	1%	CMPR	931-14W-1T	1
R271	32035-10010	RESISTOR M F 1/4W	1K00	1%	CMPR	931-14W-1T	0
R272	32035-46400	RESISTOR M F 1/4W	464	1%	CMPR	931-14W-1T	0
R273	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	1
R280	32035-20010	RESISTOR M F 1/4W	2K00	1%	CMPR	931-14W-1T	3
R281	32035-20010	RESISTOR M F 1/4W	2K00	1%	CMPR	931-14W-1T	0
R282	32035-20010	RESISTOR M F 1/4W	2K00	1%	CMPR	931-14W-1T	0
R283	32035-11320	RESISTOR M F 1/4W	11K3	1%	CMPR	931-14W-1T	1
R284	32035-28720	RESISTOR M F 1/4W	28K7	1%	CMPR	931-14W-1T	0
R285	32035-19630	RESISTOR M F 1/4W	196K	1%	CMPR	931-14W-1T	1
R300	32038-11510	RESISTOR M F 1/4W	1K15	0.1%	AB	RN-55E	2
R301	32038-85600	RESISTOR M F 1/4W	856	0.1%	AB	RN-55E	1
R302	32038-11510	RESISTOR M F 1/4W	1K15	0.1%	AB	RN-55E	0
R303	32038-73200	RESISTOR M F 1/4W	732	0.1%	AB	RN-55E	2
R304	32038-29810	RESISTOR M F 1/4W	2K98	0.1%	AB	RN-55E	1
R305	32038-73200	RESISTOR M F 1/4W	732	0.1%	AB	RN-55E	0
R306	32038-61200	RESISTOR M F 1/4W	612	0.1%	AB	RN-55E	2
R307	32038-30120	RESISTOR M F 1/4W	30K1	0.1%	AB	RN-55E	1
R308	32038-61200	RESISTOR M F 1/4W	612	0.1%	AB	RN-55E	0
R309	32035-60400	RESISTOR M F 1/4W	604	1%	CMPR	931-14W-1T	1
R401	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	2
R402	32033-10040	RESISTOR C F 1/4W	1M0	5%	CMPR	911-14W-5T	2
R403	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	2
R404	32033-10040	RESISTOR C F 1/4W	1M0	5%	CMPR	911-14W-5T	0
R405	32033-33010	RESISTOR C F 1/4W	3K3	5%	CMPR	911-14W-5T	0
R406	32033-10030	RESISTOR C F 1/4W	100K	5%	CMPR	911-14W-5T	1
R407	32033-10020	RESISTOR C F 1/4W	10K	5%	CMPR	911-14W-5T	0
R408	32033-10010	RESISTOR C F 1/4W	1K0	5%	CMPR	911-14W-5T	1
R409	32033-47090	RESISTOR C F 1/4W	47	5%	CMPR	911-14W-5T	1
R410	32033-47009	RESISTOR C F 1/4W	0.47	5%	CMPR	911-14W-5T	1
R411	32035-24900	RESISTOR M F 1/4W	249	1%	CMPR	931-14W-1T	1
R412	32035-29410	RESISTOR M F 1/4W	2K94	1%	CMPR	931-14W-1T	1
R413	32035-16220	RESISTOR M F 1/4W	16K2	1%	CMPR	931-14W-1T	1
R414	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	2
R415	32033-22010	RESISTOR C F 1/4W	2K2	5%	CMPR	911-14W-5T	0
R601	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	15
R602	32035-82520	RESISTOR M F 1/4W	82K5	1%	CMPR	931-14W-1T	1
R603	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R604	32035-12120	RESISTOR M F 1/4W	12K1	1%	CMPR	931-14W-1T	2
R605	32035-12120	RESISTOR M F 1/4W	12K1	1%	CMPR	931-14W-1T	0
R606	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R607	32035-47500	RESISTOR M F 1/4W	475	1%	CMPR	931-14W-1T	1
R608	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	3
R609	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	0
R610	32035-10030	RESISTOR M F 1/4W	100K	1%	CMPR	931-14W-1T	0
R611	32035-33220	RESISTOR M F 1/4W	33K2	1%	CMPR	931-14W-1T	1
R612	32035-33230	RESISTOR M F 1/4W	332K	1%	CMPR	931-14W-1T	2
R613	32035-33230	RESISTOR M F 1/4W	332K	1%	CMPR	931-14W-1T	0
R614	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R615	32035-40220	RESISTOR M F 1/4W	40K2	1%	CMPR	931-14W-1T	2

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
R616	32035-20020	RESISTOR M F 1/4W	20K0	1%	CMPR	931-14W-1T	1
R617	32035-49910	RESISTOR M F 1/4W	4K99	1%	CMPR	931-14W-1T	1
R618	32035-38310	RESISTOR M F 1/4W	3K83	1%	CMPR	931-14W-1T	1
R621	32035-78710	RESISTOR M F 1/4W	7K87	1%	CMPR	931-14W-1T	1
R622	32035-80610	RESISTOR M F 1/4W	8K06	1%	CMPR	931-14W-1T	1
R623	32035-66510	RESISTOR M F 1/4W	6K65	1%	CMPR	931-14W-1T	1
R624	32035-95310	RESISTOR M F 1/4W	9K53	1%	CMPR	931-14W-1T	1
R625	32035-44210	RESISTOR M F 1/4W	4K42	1%	CMPR	931-14W-1T	1
R626	32035-14320	RESISTOR M F 1/4W	14K3	1%	CMPR	931-14W-1T	1
R627	32035-15410	RESISTOR M F 1/4W	1K54	1%	CMPR	931-14W-1T	1
R628	32035-40220	RESISTOR M F 1/4W	40K2	1%	CMPR	931-14W-1T	0
R629	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R630	32035-51120	RESISTOR M F 1/4W	51K1	1%	CMPR	931-14W-1T	1
R631	32033-10050	RESISTOR C F 1/4W	10M	5%	CMPR	911-14W-5T	1
R632	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R633	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R634	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R635	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R636	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R637	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R638	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R639	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R640	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0
R641	32035-10020	RESISTOR M F 1/4W	10K0	1%	CMPR	931-14W-1T	0

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
C100	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	26
C101	45041-22030	CAP PLASTIC FILM	0.22	20%	WIMA	MKS2/0.22	2
C102	45041-22030	CAP PLASTIC FILM	0.22	20%	WIMA	MKS2/0.22	
C103	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C104	41031-10000	CAP CERAMIC DISC	100P	20%	ARCO	CCD-101	3
C105	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C106	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C107	45049-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	4
C108	45049-22020	CAP PLASTIC FILM	0.022	SEL	WIMA	MKS2/0.022	4
C109	41535-20010	CAP CERAMIC NPO	2000P	1%	VIT	VK28BA202F	4
C110	41535-22000	CAP CERAMIC NPO	220P	1%	VIT	VK28BA221F	4
C112	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C113	47121-47040	CAP TANTALUM 25V	4.7	20%	ITT	4.7M25	2
C114	47121-22050	CAP TANTALUM 25V	22	20%	ITT	22M25	2
C116	41031-10000	CAP CERAMIC DISC	100P	20%	ARCO	CCD-101	
C117	41535-22000	CAP CERAMIC NPO	220P	1%	VIT	VK28BA221F	
C118	41535-20010	CAP CERAMIC NPO	2000P	1%	VIT	VK28BA202F	
C119	45049-22020	CAP PLASTIC FILM	0.022	SEL	WIMA	MKS2/0.022	
C120	45049-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	
C121	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C122	41031-22090	CAP CERAMIC DISC	22P	20%	ARCO	CCD-220	5
C123	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C124	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C126	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	2
C127	41031-22090	CAP CERAMIC DISC	22P	20%	ARCO	CCD-220	
C128	45049-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	
C129	45049-22020	CAP PLASTIC FILM	0.022	SEL	WIMA	MKS2/0.022	
C130	41535-20010	CAP CERAMIC NPO	2000P	1%	VIT	VK28BA202F	
C131	41535-22000	CAP CERAMIC NPO	220P	1%	VIT	VK28BA221F	
C132	45049-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	
C133	45049-22020	CAP PLASTIC FILM	0.022	SEL	WIMA	MKS2/0.022	
C134	41535-20010	CAP CERAMIC NPO	2000P	1%	VIT	VK28BA202F	
C135	41535-22000	CAP CERAMIC NPO	220P	1%	VIT	VK28BA221F	
C136	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C137	41031-10000	CAP CERAMIC DISC	100P	20%	ARCO	CCD-101	
C138	41031-22090	CAP CERAMIC DISC	22P	20%	ARCO	CCD-220	
C140	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C141	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C142	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C143	41031-15000	CAP CERAMIC DISC	150P	20%	ARCO	CCD-151	1
C144	41031-30090	CAP CERAMIC DISC	30P	20%	ARCO	CCD-300	1
C145	41031-22090	CAP CERAMIC DISC	22P	20%	ARCO	CCD-220	
C146	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C147	41031-47090	CAP CERAMIC DISC	47P	20%	ARCO	CCD-470	3
C148	41031-47090	CAP CERAMIC DISC	47P	20%	ARCO	CCD-470	
C149	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C150	47121-47040	CAP TANTALUM 25V	4.7	20%	ITT	4.7M25	
C151	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C152	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C153	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C154	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	

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C155	47121-22050	CAP TANTALUM 25V	22	20%	ITT	22M25	
C156	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C157	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C158	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C159	45041-10020	CAP PLASTIC FILM	0.01	20%	WIMA	MKS3/0.01	1
C160	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C161	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C162	41031-10010	CAP CERAMIC DISC	1000P	20%	ARCO	CCD-1000	1
C163	45042-10030	CAP PLASTIC FILM	0.1	10%	WIMA	MKS3/0.10	1
C164	41031-33080	CAP CERAMIC DISC	3.3P	20%	ARCO	CCD-339	1
C165	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C166	45041-10010	CAP PLASTIC FILM	1000P	20%	WIMA	FKC3/1000	1
C167	45042-68020	CAP PLASTIC FILM	0.068	10%	WIMA	MKS3/0.068	1
C168	45041-10000	CAP PLASTIC FILM	100P	20%	WIMA	FKC3/100	2
C169	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C170	41031-47090	CAP CERAMIC DISC	47P	20%	ARCO	CCD-470	
C171	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C172	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C174	45041-22030	CAP PLASTIC FILM	0.22	20%	WIMA	MKS2/0.22	1
C175	45042-68030	CAP PLASTIC FILM	0.68	10%	WIMA	MKS3/0.68	1
C176	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	4
C177	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C178	41031-22090	CAP CERAMIC DISC	22P	20%	ARCO	CCD-220	
C179	45041-10000	CAP PLASTIC FILM	100P	20%	WIMA	FKC3/100	
C180	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C181	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C200	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	6
C201	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	16
C202	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C203	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C204	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	11
C205	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C206	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C207	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C208	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C210	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C211	45043-22010	CAP PLASTIC FILM	2200P	5%	WIMA	FKC3/2200	2
C212	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C213	45042-68030	CAP PLASTIC FILM	0.68	10%	WIMA	MKS3/0.68	2
C214	45041-47030	CAP PLASTIC FILM	0.47	20%	WIMA	MKS3/0.47	1
C215	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C216	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C217	41033-47090	CAP CERAMIC NPO	47P	5%	KEMET	C312-C470	1
C218	45042-68030	CAP PLASTIC FILM	0.68	10%	WIMA	MKS3/0.68	
C219	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C220	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C221	41033-51080	CAP CERAMIC NPO	5.1P	5%	KEMET	C312-C51[illegible]	1
C223	45042-10040	CAP PLASTIC FILM	1.0	10%	WIMA	MKS3/1.0	1
C224	48211-22060	CAP ELECTROLYTIC 16V	220	20%	SIEM	81000-220/16	2
C225	48211-22060	CAP ELECTROLYTIC 16V	220	20%	SIEM	81000-220/16	
C226	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
C227	47121-15040	CAP TANTALUM 25V	1.5	20%	ITT	1.5M25	2
C228	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C229	41033-24090	CAP CERAMIC NPO	24P	5%	KEMET	C311-C240	1
C230	41033-39090	CAP CERAMIC NPO	39P	5%	KEMET	C311-C390	1
C231	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C232	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C233	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C234	45041-10010	CAP PLASTIC FILM	1000P	20%	WIMA	FKC3/1000	2
C235	45043-15030	CAP PLASTIC FILM	0.15	5%	WIMA	MKS3/0.15	1
C236	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C239	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C240	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C241	45042-22020	CAP PLASTIC FILM	0.022	10%	WIMA	MKS3/0.022	1
C242	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C243	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C244	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C245	41031-10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C248	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C249	45041-10010	CAP PLASTIC FILM	1000P	20%	WIMA	FKC3/1000	
C250	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C251	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C252	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C253	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C254	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C256	47121-15040	CAP TANTALUM 25V	1.5	20%	ITT	1.5M25	
C258	45043-10030	CAP PLASTIC FILM	0.1	5%	WIMA	MKS3/0.10	1
C259	47121-22050	CAP TANTALUM 25V	22	20%	ITT	22M25	2
C260	47121-22050	CAP TANTALUM 25V	22	20%	ITT	22M25	
C261	47121-15050	CAP TANTALUM 25V	15	20%	ITT	15M25	2
C262	47121-15050	CAP TANTALUM 25V	15	20%	ITT	15M25	
C280	45043-10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	3
C281	45043-10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C282	45043-10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C283	45043-33000	CAP PLASTIC FILM	330P	5%	WIMA	FKC3/330	1
C284	44043-22010	CAP PLASTIC FILM	2200P	5%	WIMA	FKC3/2200	
C285	45043-56010	CAP PLASTIC FILM	5600P	5%	WIMA	FKC3/5600	1
C401	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	6
C402	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C403	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	7
C404	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C405	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C406	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C407	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C408	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C409	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C410	41031-30090	CAP CERAMIC DISC	30P	20%	ARCO	CCD-300	2
C411	41033-47090	CAP CERAMIC NPO	47P	5%	KEMET	C312-C470	1
C412	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C414	41031-30090	CAP CERAMIC DISC	30P	20%	ARCO	CCD-300	
C415	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C416	42031-10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
C417	48211-22070	CAP ELECTROLYTIC 25V	2200	20%	SIEM	81000-2200/2	1
C418	47121-10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C601	45043-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	2
C602	45043-22030	CAP PLASTIC FILM	0.22	SEL	WIMA	MKS2/0.22	
C603	45042-47020	CAP PLASTIC FILM	0.047	10%	WIMA	MKS3/0.047	1
C604	45042 22030	CAP PLASTIC FILM	0.22	10%	WIMA	MKS3/0.22	1
C605	47121 10050	CAP TANTALUM 25V	10	20%	ITT	10M25	2
C606	47121 10050	CAP TANTALUM 25V	10	20%	ITT	10M25	
C607	41031 10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	3
C608	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	10
C609	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C610	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C611	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C612	41031-47090	CAP CERAMIC DISC	47P	20%	ARCO	CCD-470	1
C621	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	9
C622	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C623	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C624	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C625	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C626	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C627	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C628	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C629	41031 10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C630	41031 10090	CAP CERAMIC DISC	10P	20%	ARCO	CCD-100	
C631	45043 15020	CAP PLASTIC FILM	0.015	5%	WIMA	MKS3/0.015	4
C632	45043 15020	CAP PLASTIC FILM	0.015	5%	WIMA	MKS3/0.015	
C633	45043 15020	CAP PLASTIC FILM	0.015	5%	WIMA	MKS3/0.015	
C634	45043 15020	CAP PLASTIC FILM	0.015	5%	WIMA	MKS3/0.015	
C635	45043 22020	CAP PLASTIC FILM	0.022	5%	WIMA	MKS2/0.022	1
C636	45043 10020	CAP PLASTIC FILM	0.01	5%	WIMA	MKS3/0.01	
C637	45043 68010	CAP PLASTIC FILM	6800P	5%	WIMA	FKC3/6800	1
C638	45063 33020	CAP PLASTIC FILM	0.033	5%	WIMA	MKS3/0.033	1
C639	45043 22010	CAP PLASTIC FILM	2200P	5%	WIMA	FKC3/2200	2
C640	45043-10030	CAP PLASTIC FILM	0.1	5%	WIMA	MKS3/0.1	1
C641	47121-10040	CAP TANTALUM 25V	1.0	10%	ITT	1M25	1
C642	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C643	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C644	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C645	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C646	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C647	42031 10030	CAP MONOLYTHIC 50V	0.1	20%	KEMET	C330C104M5U	
C648	44043-22010	CAP PLASTIC FILM	2200P	5%	WIMA	FKC3/2200	
C649	45043-10010	CAP PLASTIC FILM	1000P	5%	WIMA	FKC3/1000	1
C650	45043-22000	CAP PLASTIC FILM	220P	5%	WIMA	FKC3/220	1

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
D100	21035-41500	DIODE G P 500MW				1N4150	7
D101	21035-41500	DIODE G P 500MW				1N4150	
D102	21035-41500	DIODE G P 500MW				1N4150	
D103	21035-41500	DIODE G P 500MW				1N4150	
D104	21035-41500	DIODE G P 500MW				1N4150	
D105	21035-41500	DIODE G P 500MW				1N4150	
D106	21200-07461	ZENER G P 250MW	3.3V	5%		1N0746A	1
D107	21207-07571	ZENER G P 250MW	9.1V	5%		1N0757A	1
D108	21035-41500	DIODE G P 500MW				1N4150	
D111	21207-07551	ZENER G P 250MW	7.5V	5%		1N0755A	1
D112	21207-07591	ZENER G P 250MW	12V	5%		1N0759A	2
D113	21207-07591	ZENER G P 250MW	12V	5%		1N0759A	
D200	21035-41500	DIODE G P 500MW				1N4150	11
D201	21035-41500	DIODE G P 500MW				1N4150	
D202	21207-07591	ZENER G P 250MW	12V	5%		1N0759A	2
D203	21207-07591	ZENER G P 250MW	12V	5%		1N0759A	
D206	21035-41500	DIODE G P 500MW				1N4150	
D207	21035-41500	DIODE G P 500MW				1N4150	
D208	21035-41500	DIODE G P 500MW				1N4150	
D209	21035-41500	DIODE G P 500MW				1N4150	
D210	21035-41500	DIODE G P 500MW				1N4150	
D220	21035-41500	DIODE G P 500MW				1N4150	
D221	21035-41500	DIODE G P 500MW				1N4150	
D222	21207-08211	ZENER REF 250MW	6.2V	5%		1N0821A	1
D223	21035-41500	DIODE G P 500MW				1N4150	
D224	21035-41500	DIODE G P 500MW				1N4150	
D225	21207-07571	ZENER G P 250MW	9.1V	5%		1N0757A	2
D226	21207-07571	ZENER G P 250MW	9.1V	5%		1N0757A	
D401	21035-41500	DIODE G P 500MW				1N4150	16
D402	21035-41500	DIODE G P 500MW				1N4150	
D403	21035-41500	DIODE G P 500MW				1N4150	
D404	21035-41500	DIODE G P 500MW				1N4150	
D405	21035-41500	DIODE G P 500MW				1N4150	
D406	21035-41500	DIODE G P 500MW				1N4150	
D407	21035-41500	DIODE G P 500MW				1N4150	
D408	21035-41500	DIODE G P 500MW				1N4150	
D409	21035-41500	DIODE G P 500MW				1N4150	
D410	21035-41500	DIODE G P 500MW				1N4150	
D411	21035-41500	DIODE G P 500MW				1N4150	
D412	21035-41500	DIODE G P 500MW				1N4150	
D413	21035-41500	DIODE G P 500MW				1N4150	
D414	21207-07551	ZENER G P 250MW	7.5V	5%		1N0755A	1
D415	21035-41500	DIODE G P 500MW				1N4150	
D416	21035-41500	DIODE G P 500MW				1N4150	
D417	21207-07511	ZENER G P 250MW	5.1V	5%		1N0751A	1
D418	21135-40010	RECTIFIER 1A				1N4001	1
D419	21035-41500	DIODE G P 500MW				1N4150	
D420	21107-54040	RECTIFIER	3/400			1N5404	4
D421	21107-54040	RECTIFIER	3/400			1N5404	
D422	21107-54040	RECTIFIER	3/400			1N5404	
D423	21107-54040	RECTIFIER	3/400			1N5404	

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
D501	21551-52742	LED GREEN T-1			GI	MV5274B	1
D502	21531-51742	LED ORANGE T-1			GI	MV5174B	2
D503	21531-51742	LED ORANGE T-1			GI	MV5174B	
D504	21521-57742	LED RED T-1			GI	MV5774B	2
D505	21521-57742	LED RED T-1			GI	MV5774B	
D601	21035-41500	DIODE G P 500MW				1N4150	6
D602	21035-41500	DIODE G P 500MW				1N4150	
D603	21035-41500	DIODE G P 500MW				1N4150	
D604	21307-08211	ZENER REF 250MW	6.2V	5%		1N0821A	1
D605	21207-07481	ZENER G P 250MW	3.9V	5%		1N0748A	2
D606	21207-07481	ZENER G P 250MW	3.9V	5%		1N0748A	
D610	21035-41500	DIODE G P 500MW				1N4150	
D611	21035-41500	DIODE G P 500MW				1N4150	
D613	21035-41500	DIODE G P 500MW				1N4150	
Q100	22292-44030	TRANSISTOR G P PNP				2N4403	4
Q101	22292-44030	TRANSISTOR G P PNP				2N4403	
Q102	22192-44010	TRANSISTOR G P NPN				2N4401	8
Q103	22192-44010	TRANSISTOR G P NPN				2N4401	
Q104	22292-44030	TRANSISTOR G P PNP				2N4403	
Q105	22192-44010	TRANSISTOR G P NPN				2N4401	
Q106	22192-44010	TRANSISTOR G P NPN				2N4401	
Q107	22292-44030	TRANSISTOR G P PNP				2N4403	
Q108	22192-44010	TRANSISTOR G P NPN				2N4401	
Q109	22192-44010	TRANSISTOR G P NPN				2N4401	
Q110	22192-44010	TRANSISTOR G P NPN				2N4401	
Q111	22192-44010	TRANSISTOR G P NPN				2N4401	
Q401	23722-52010	FET VMOS PWR N-CH			INT	IVN5201CND	2
Q402	23722-52010	FET VMOS PWR N-CH			INT	IVN5201CND	
Q403	22192-44010	TRANSISTOR G P NPN				2N4401	3
Q404	22622-15029	TRANSISTOR PWR PNP	8A50W		MOT	MJE15029	2
Q405	22622-15029	TRANSISTOR PWR PNP	8A50W		MOT	MJE15029	
Q406	22192-44010	TRANSISTOR G P NPN				2N4401	
Q407	22192-44010	TRANSISTOR G P NPN				2N4401	
Q601	22318-48610	FET N-CH				2N4861	1
U100	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	1
U101	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	8
U103	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U104	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U105	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U106	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U107	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U108	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	
U109	25121-14940	LINEAR MULTIPLIER			MOT	MC1494P	3
U110	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	2
U111	25121-14940	LINEAR MULTIPLIER			MOT	MC1494P	
U112	25121-14940	LINEAR MULTIPLIER			MOT	MC1494P	
U113	38434-33020	RESISTOR NETWORK	33K	2%	BOURN	4116R001333	1
U114	38434-22020	RESISTOR NETWORK	22K	2%	BOURN	4116R001223	1
U115	21914-25100	DIODE ARRAY			FSC	FSA2510	1
U116	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	
U117	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

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DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
U118	25992-32015	REGULATOR NEG 15V	15V-		NSC	LM320LZ-15	1
U119	25992-34015	REGULATOR POS 15V	15V+		NSC	LM340LAZ-15	1
U200	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	1
U201	25311-31800	OP AMP WIDE BW			NSC	LM318N	3
U202	25311-31800	OP AMP WIDE BW			NSC	LM318N	
U203	25211-07200	OP AMP DUAL BIFET			TI	TL072CP	1
U204	25311-31800	OP AMP WIDE BW			NSC	LM318N	
U205	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	1
U206	25311-31000	OP AMP BUFFER			NSC	LM310N	1
U207	25000-53601	RMS TO DC CONV			AD	AD536AJD	2
U208	25000-53601	RMS TO DC CONV			AD	AD536AJD	
U209	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	3
U210	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	
U211	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	
U401	24031-40490	CMOS HEX INVERTER				CD4049UBE	1
U402	24031-40270	CMOS DUAL J K FF				CD4027B	1
U403	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	1
U404	25311-31700	REGULATOR ADJUSTABLE				LM317T	1
U600	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	4
U601	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	
U602	25511-55341	OP AMP LOW NOISE			SIG	NE5534AN	1
U603	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	
U604	25211-06200	OP AMP LO PWR DUAL			TI	TL062CP	
U605	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	4
U606	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	
U607	38434-22020	RESISTOR NETWORK	22K	2%	BOURN	4116R001223	1
U608	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	
U609	25211-08200	OP AMP DUAL BIFET			TI	TL082CP	
Y100	20005-85000	LED/PHOTO RESISTOR			CRX	CLM8500	3
Y101	20005-85000	LED/PHOTO RESISTOR			CRX	CLM8500	
Y102	20005-85000	LED/PHOTO RESISTOR			CRX	CLM8500	

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
A008	71008-20839	SOCKETS DIL 8 PIN			AUGAT	208-AG39D	22
A014	71014-21439	SOCKETS DIL 14 PIN			AUGAT	214-AG39D	3
A016	71016-21639	SOCKETS DIL 16 PIN			AUGAT	216-AG39D	8
A202	67620-10206	FUSE CLIPS			LTTLF	102069	4
A205	71216-00000	16 PIN HEADERS					2
A207	67120-00250	SOLDER LUG POTS			SPNR	WT-27	3
A210	71916-00000	HEADER COVERS			PMC		2
A501	13500-62301	SHIELD PREAMP			AMBER		1
A502	13500-62402	SHIELD FILTER			AMBER		1
A503	13500-63006	FRONT PANEL UNDERLAY			AMBER		1
A504	13500-63205	METER HOUSING			AMBER		1
A505	13500-63303	METER BRACKET			AMBER		1
A506	13500-63404	SWITCH CHASSIS			AMBER		1
A507	13500-63703	PANEL BRACKETS			AMBER		2
A508	13500-64003	FRONT PANEL MTR LENS			AMBER		1
A509	13500-64103	SHIELD			AMBER		1
A510	13500-64402	INSULATOR			AMBER		2
A511	13500-64502	FRONT PANEL OVERLAY			AMBER		1
A512	13500-64601	PCB BRACKET			AMBER		1
A513	13500-65102	CHASSIS PWR SPLY			AMBER		1
A514	13500-65202	REAR COVER			AMBER		1
A516	13500-65302	BATTERY BRACKET			AMBER		1
A517	13500-78001	PLASTIC CASE			AMBER		1
A518	13500-79002	INSTRUCTION CARD			AMBER		1
A519	13500-65602	HEAT SINK			AMBER		1
A530	61600-69050	SHAFT COUPLER AL	0.125		AMBER		2
A531	61600-99050	SHAFT COUPLER INSUL			AMBER		1
A532	61700-89125	SHAFT EXTENSION	0.125		AMBER		1
A533	61700-89125	SHAFT EXTENSION	0.125		AMBER		1
A550	61111-13025	4-40 PH PHIL	0.25		VAR		4
A551	61111-13050	4-40 PH PHIL	0.5		VAR		4
A552	61111-14038	6-32 PH PHIL	0.375		VAR		5
A553	61113-13019	4-40 FH PHIL	0.187		VAR		8
A554	61113-13025	4-40 FH PHIL	0.25		VAR		22
A555	61113-13038	4-40 FH PHIL	0.375		VAR		2
A556	61200-13000	4-40 HEX NUTS	0.25		VAR		2
A557	61200-14000	6-32 HEX NUT			VAR		5
A558	61500-13000	#4 INT TH LK WASH			VAR		9
A559	61500-14000	#6 INT TH LK WASH			VAR		2
A560	61620-33187	SPACER THREADED	0.187		AMTOM	8210-R-0440	4
A561	61620-33375	SPACER THREADED	0.375		AMTOM	8213-R-0440	6
A562	61620-33500	SPACER THREADED	0.50		AMTOM	8215-R-0440	4
A565	62110-22600	WASHER FLAT NO 4			SPNR	W-22F	6
A566	62110-28600	WASHER FLAT MTR			SPNR	W-28F	2
A567	62110-36600	WASHER FLAT BNC			SPNR	W-36F	5
A568	62110-38600	WASHER FLAT PWR			SPNR	W-38F	1
A569	62110-40600	WASHER FLAT BNC			SPNR	W-40F	2
A570	62130-77600	WASHER SHOULDER MTR			SPNR	W-77F	2
A571	62130-79600	WASHER SHOULDER PWR			SPNR	W-79F	1
A572	62130-80600	WASHER SHOULDER BNC			SPNR	W-80F	5
A573	62230-22000	WASHER SHOULDER 220					5

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
A574	62580-22000	WASHER MICA TO-220					5
A581	63313-15125	KNOB BLACK ROUND			SIFAM	S151-250	1
A582	63333-15113	KNOB BLACK WING			SIFAM	SB151-125	2
A584	63803-15100	CAP ORANGE			SIFAM	C151	2
A586	63803-15100	CAP YELLOW			SIFAM	C151	2
A588	63313-15113	KNOB BLACK ROUND			SIFAM	S151-125	1
A588	63803-15101	NUT COVER BLACK			SIFAM	N151	4
A590	67120-14970	SOLDER LUG BNC			SMITH	1497	5
A591	67120-26000	SOLDER LUG MTR	#10		SPNR	WT-26	2
A592	67120-40000	SOLDER LUG GND #4					
B400	59582-12150	BATTERY RECHARGEABLE			EAGLE	12V 1.5	1
F200	85312-06210	FUSE 3 AG FAST	63MA		LTTLF	312062	1
F400	85313-00200	FUSE 3 AG SLO BLO	2A		LTTLF	313002	1
G100	13500-41004	PCB FIL/OSC			AMBER	3500-410-04	1
G200	13500-42004	PCB INPUT/MTR			AMBER	3500-420-04	1
G400	13500-44004	PCB PWR SPLY			AMBER	3500-440-04	1
G600	13500-46002	PCB IMD OPTION			AMBER	3500-440-04	1
J001	78501-27590	CRIMP PINS SEL GOLD	2759		MOLEX	08-55-0102	24
J100	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	10
J101	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J102	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J103	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J104	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J106	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J107	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J108	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J109	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J110	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J200	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	13
J201	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J202	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J203	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J204	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J205	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J206	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J207	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J208	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J209	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J210	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J211	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J212	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J400	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	3
J401	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J402	73104-20410	CONN, 4 PIN HEADER	6410		MOLEX	22-29-2041	
J403	73204-20451	SOCKET TO-220	6471		MOLEX	22-01-2045	5
J410	77001-79131	BNC CONN			KINGS	KC-79-131	4
J412	77502-71210	POWER CONN			SWC	712A	1
J501	77001-79131	BNC CONN			KINGS	KC-79-131	
J502	77001-79131	BNC CONN			KINGS	KC-79-131	
J503	77001-79131	BNC CONN			KINGS	KC-79-131	
J605	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	6

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 — JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
J606	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	
J608	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	
J612	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	
J613	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	
J623	73104-20440	CONN, 4 PIN HEADER			MOLEX	22-12-2044	
L401	53102-22090	INDUCTOR	22UH	20%	NYT	90537-29	4
L402	53102-22090	INDUCTOR	22UH	20%	NYT	90537-29	
L403	53102-22090	INDUCTOR	22UH	20%	NYT	90537-29	
L404	53102-22090	INDUCTOR	22UH	20%	NYT	90537-29	
L405	53102-00190	INDUCTOR	0.1UH	20%	NYT	90537-13	2
L406	53102-00190	INDUCTOR	0.1UH	20%	NYT	90537-13	
M500	55381-00192	METER 0-1MA			MODUT		
N201	11201-40101	PLUG IN NETWORK	400HZ		AMBER		1
N202	11202-50302	PLUG IN NETWORK	50KHZ		AMBER		1
N401	39734-10030	R NET SIP	100K		BRNS	4308R102104	2
N402	39734-33010	R NET SIP	3.3K		BRNS	4308R102332	1
N403	39734-10030	R NET SIP	100K		BRNS	4308R102104	
N501	58420-00100	1 COND SHIELDED			COL	C1359	1
N502	58420-00200	2 COND SHIELDED			COL	C1349	1
N503	58420-00300	3 COND SHIELDED			COL	C1339	1
N504	58680-12500	HEAT SHRINK 0.125 DI	0.5		VAR		21
N505	58820-01000	RIBBON CABLE 10 COND	10"		VAR		1
P100	73204-20451	CONN, 4 PIN HOUSING	6471		MOLEX	22-01-2045	11
P200	73204-20451	CONN, 4 PIN HOUSING	6471		MOLEX	22-01-2045	13
P400	73204-20451	CONN, 4 PIN HOUSING	6471		MOLEX	22-01-2045	3
S100	83841-10800	SWITCH PUSHBUTTON			SCHDW	FX108UGR	1
S101	83641-10600	SWITCH PUSHBUTTON			SCHDW	FX106UGR	
S102	83641-10600	SWITCH PUSHBUTTON			SCHDW	FX106UGR	
S103	83241-10200	SWITCH PUSHBUTTON			SCHDW	FX102UGR	
S200	83241-10200	SWITCH PUSHBUTTON			SCHDW	FX102UGR	1
S201	83241-10200	SWITCH PUSHBUTTON			SCHDW	FX102UGR	
S202	83641-10600	SWITCH PUSHBUTTON			SCHDW	FX106UGR	
S203	83641-10600	SWITCH PUSHBUTTON			SCHDW	FX106UGR	
S204	81392-31301	ROTARY SW 3 POLE	11POS		RCL	31-X30-M-11	2
S205	81392-31301	ROTARY SW 3 POLE	11POS		RCL	31-X30-M-11	
S300	87112-57113	TOGGLE SW SP3T MOM			DIALC	571131101010	1
S301	87212-57121	TOGGLE SW DPDT			DIALC	571211101010	5
S302	87212-57121	TOGGLE SW DPDT			DIALC	571211101010	
S303	87212-57121	TOGGLE SW DPDT			DIALC	571211101010	
S304	87212-57121	TOGGLE SW DPDT			DIALC	571211101010	
S305	87212-57121	TOGGLE SW DPDT			DIALC	571211101010	
S400	83641-10201	SWITCH PUSHBUTTON			SCHDW	2U-0A	1
S600	87412-74110	TOGGLE 4 POLE 3 POS			C&K	7411SYZG	1
T001	13500-53504	TRANSFORMER 115	12V		AMBER		1
T002	13500-53604	TRANSFORMER 115/230	12V		AMBER		1
T400	53511-23753	TRANSFORMER PWR			FLTRN	TEP2375-3	1
V100	51126-25010	POT COND PLASTIC	2.5K	1%	BOURN	87C2AE28N12/	1
V101	51126-25010	POT COND PLASTIC	2.5K	1%	BOURN	87C2AE28N12/	
V102	51126-25010	POT COND PLASTIC	2.5K	1%	BOURN	87A2AZ28B0A/	1
V103	51126-25010	POT COND PLASTIC	2.5K	1%	BOURN	87A2AZ28B0A/	
V104	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386P-1-103	5

PARTS LIST

AMBER MODEL 3500 DISTORTION & NOISE MEASURING SET

ISSUE 06 JANUARY 1981

DESIG	AMBER PN	DESCRIPTN	VALUE	TOL%	MFG	MFG PN	QTY
V105	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	5
V106	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	
V107	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	
V108	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	
V109	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	
V110	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386P-1-103	
V111	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386P-1-103	
V112	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386P-1-103	
V113	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386P-1-103	
V200	51515-10020	TRIM POT CERMET MT	10K	10%	BOURN	3299W-1-103	2
V201	51515-10020	TRIM POT CERMET MT	10K	10%	BOURN	3299W-1-103	
V202	51515-50000	TRIM POT CERMET MT	500	10%	BOURN	3299W-1-501	2
V203	51515-50000	TRIM POT CERMET MT	500	10%	BOURN	3299W-1-501	
V401	51415-50020	TRIM POT CERMET	50K	10%	BOURN	3386P-1-503	1
V501	51116-50010	POT CNDCTV PLSTC	5KLIN	10%	BRNS	91C1AD24B13	1
V601	51415-10020	TRIM POT CERMET	10K	10%	BOURN	3386W-1-103	1
W200	37035-10011	THERMISTOR +3500PPM	1K00	1%	TLRS	Q81	2
W201	37035-10011	THERMISTOR +3500PPM	1K00	1%	TLRS	Q81	

AMBER MODEL 3500

DISTORTION and NOISE

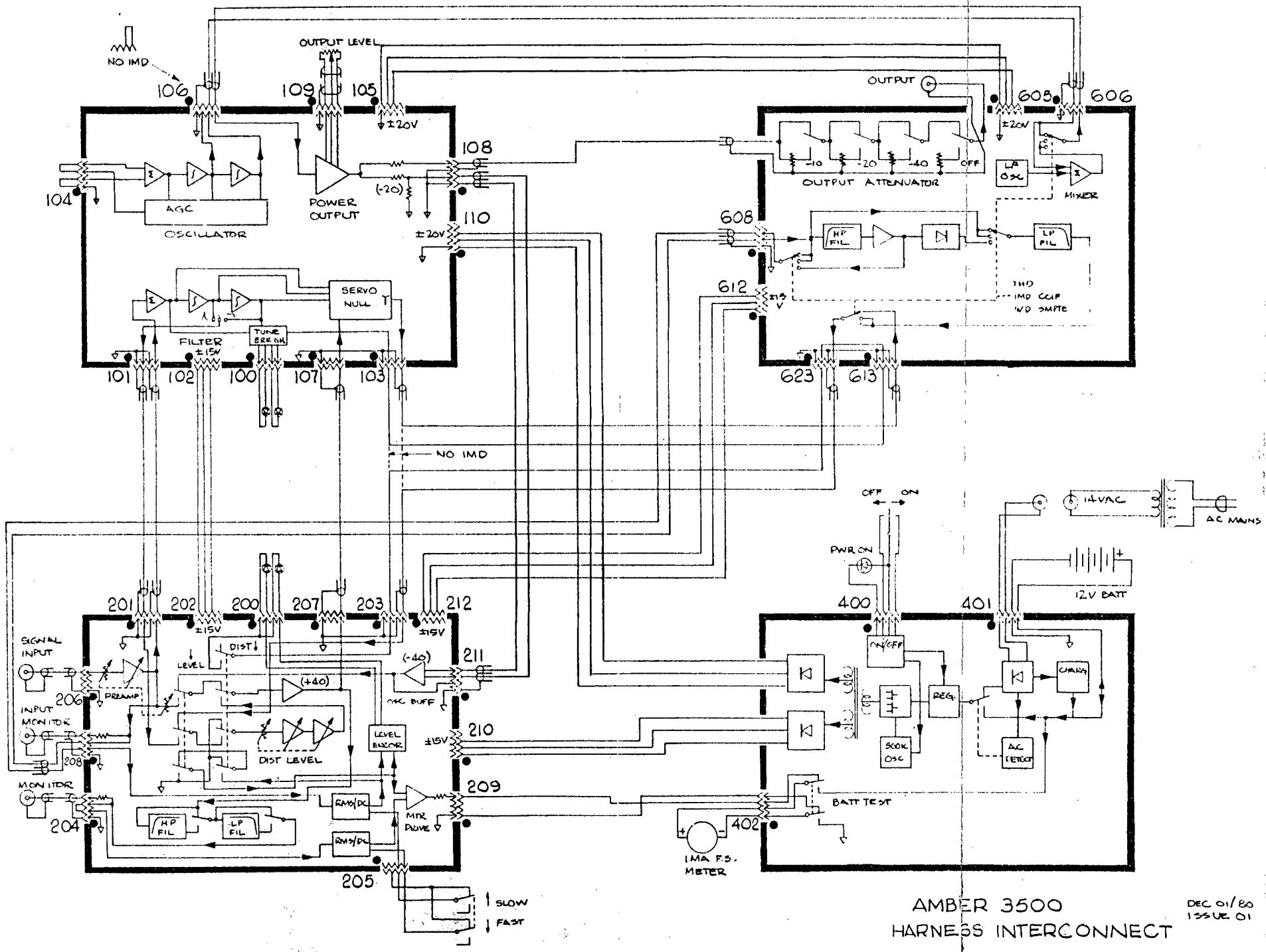
MEASURING SET

Issue 03
January 1981

OWNER'S MANUAL

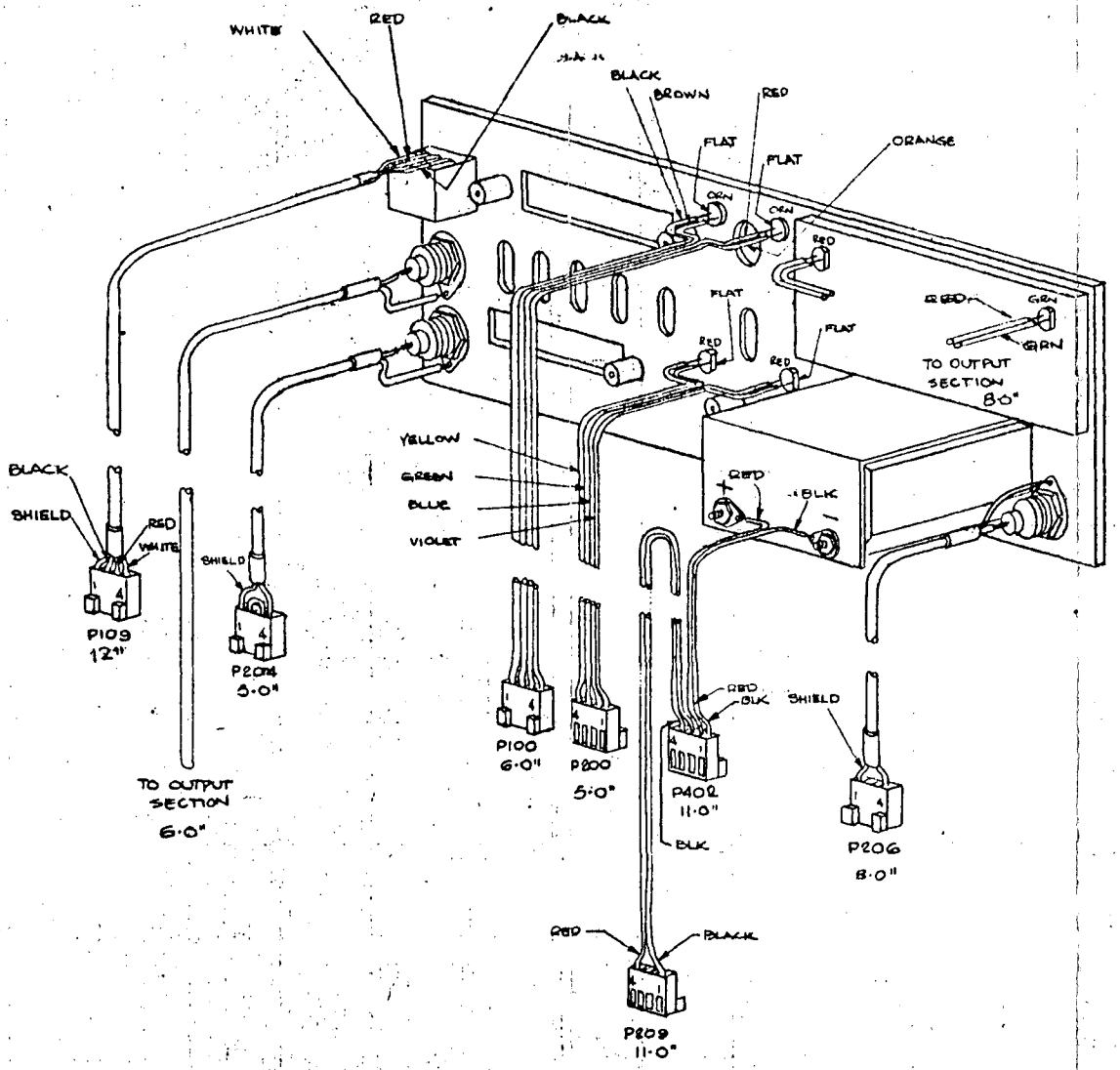
SECTION 8

SCHEMATICS & COMPONENT LAYOUTS



AMBER 3500
HARNESS INTERCONNECT

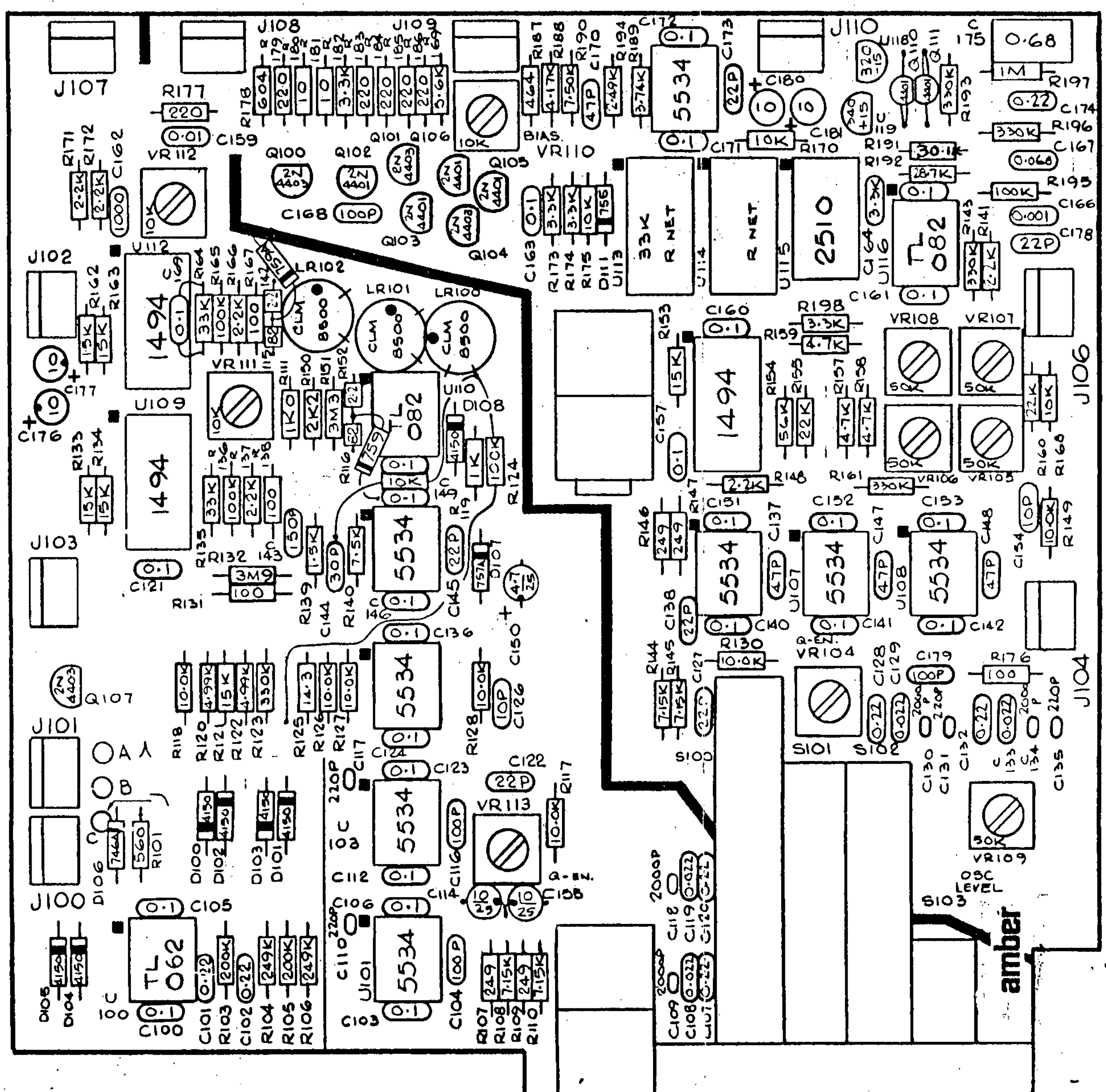
DEC 01/80
ISSUE 01

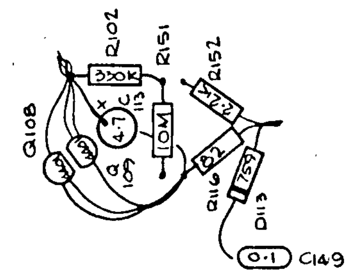


AMBER ELECTRO DESIGN LTD

3500 FRONT PANEL HARNESS

DWN WJ Dec 19/75 | 3500 C 250-03





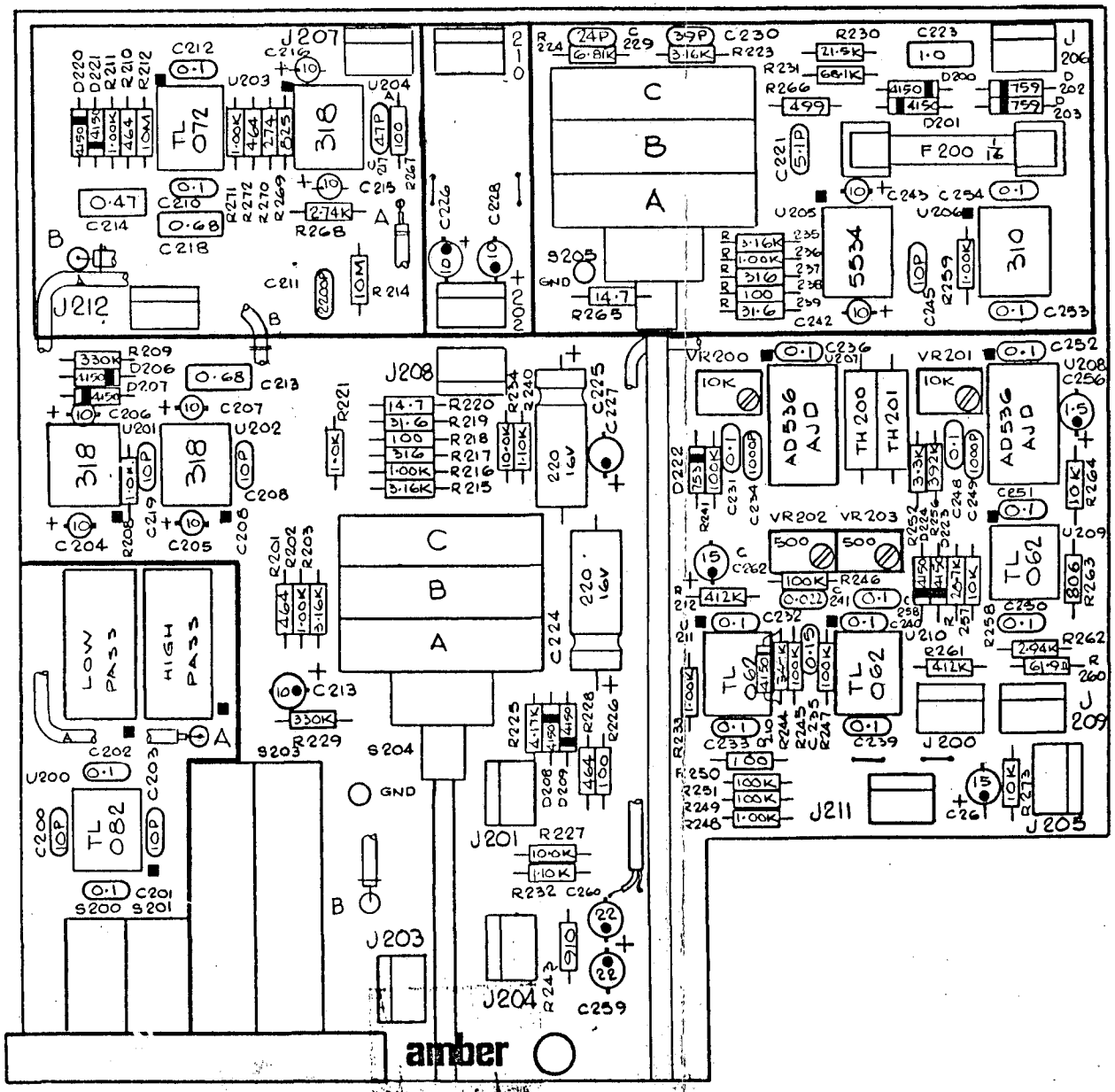
DETAIL A

AMBER ELECTRO DESIGN LTD

3500 FILTER/OSCILLATOR

PCB COMPONENT LAYOUT

DWN WJ [illegible] 9 REVISED JA [illegible]/80	3500C415-06

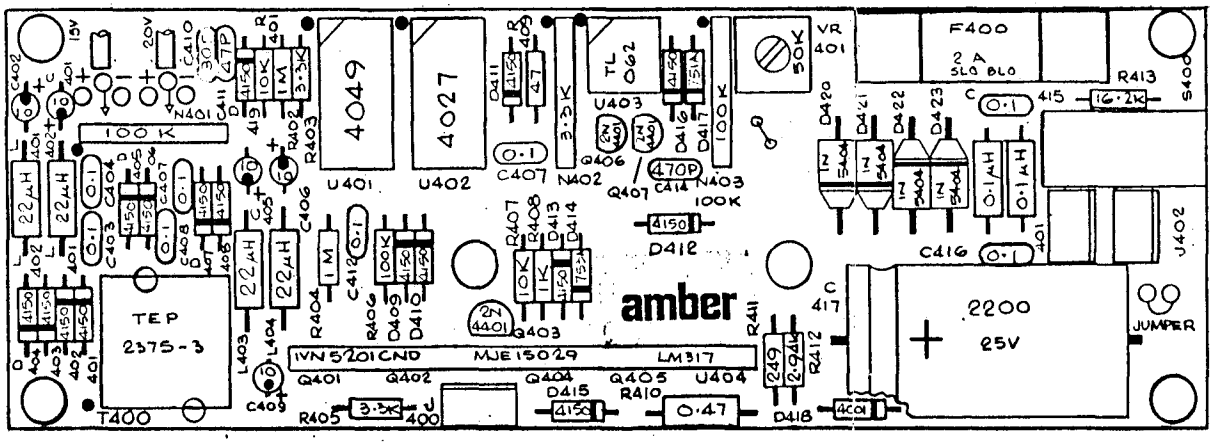


AMBER ELECTRO DESIGN LTD

3500 INPUT & METER PCB COMPONENT LAYOUT

DWN WJ DEC 1979
REV JAN 20/80

3500C425-06



AMBER ELECTRO DESIGN LTD	
3500 POWER SUPPLY PCB COMPONENT ASS'Y	
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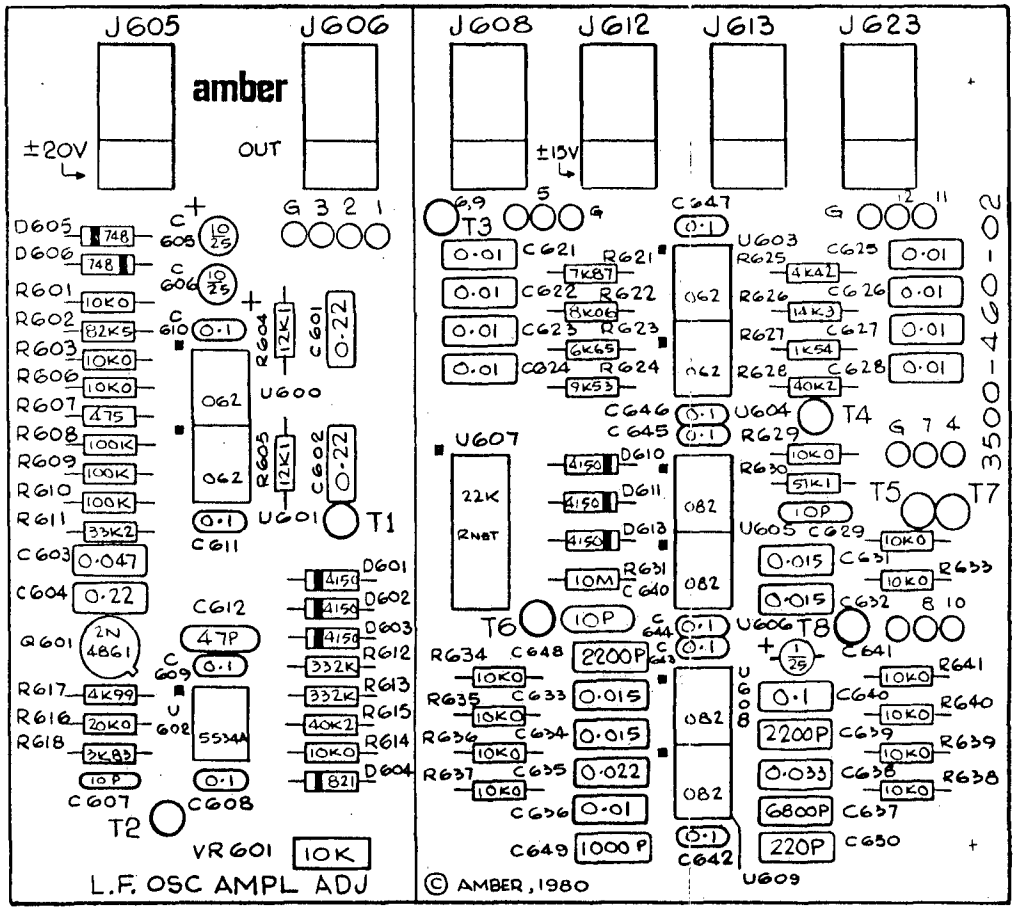

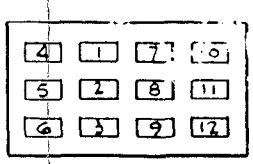

TOGGLE SWITCH REAR VIEW

AMBER ELECTRO DESIGN LTD	
IMD BOARD SCREEN ART	
JUNE 16/80 WJ	3500C643-03