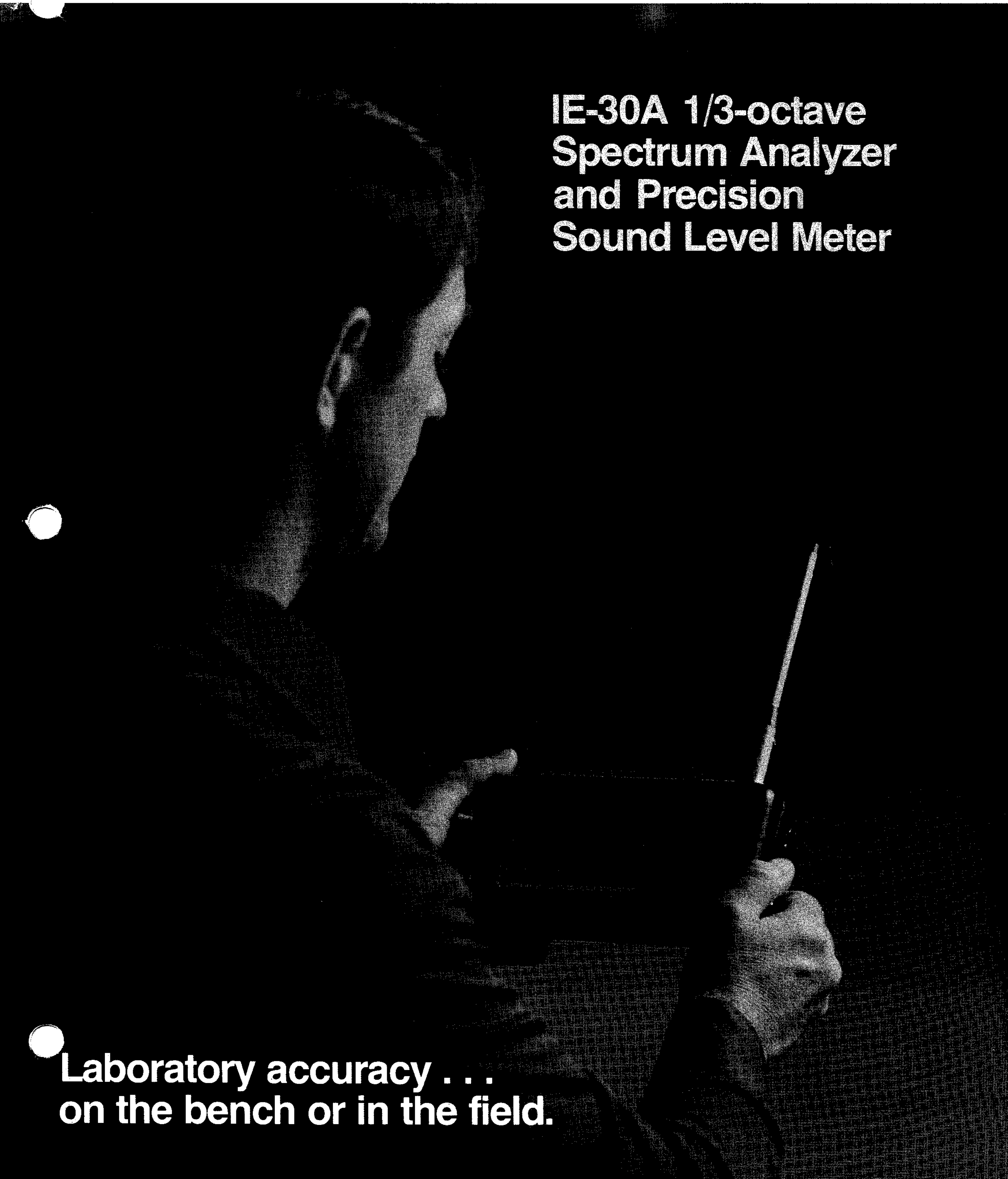
Ivie Technologies, Inc.



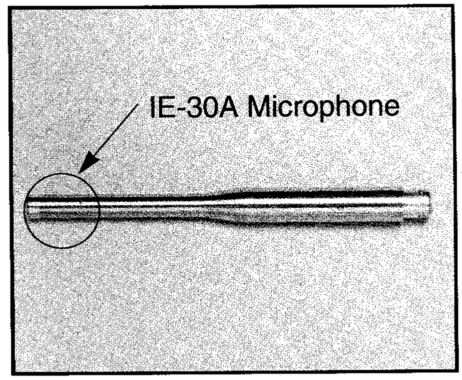
IE-30A 1/3-octave Spectrum Analyzer and Precision Sound Level Meter

Laboratory accuracy . . . on the bench or in the field.

Laboratory accuracy . . .
on the bench or in the field.

For the first time a real time analyzer (full octave / 1/3-octave) and a precision sound level meter have been combined into a truly portable, high-powered package. Calibrated in both dB SPL and dBμV, the IE-30A measures a broad variety of simple and complex signals quickly and accurately: amplifier gain, frequency response, output power, acoustic measurements, weighted or unweighted SPL measurements, peak accumulation, impulse measurement, and distortion analysis.

Whether in the auditorium, recording studio, sound stage, classroom, or laboratory, in the steel mill or factory, the IE-30A provides accuracy and versatility in a rugged package that fits easily in your hand.



The IE-30A comes standard with the IE-2P precision preamplifier, and your choice of the 1133 free field response microphone, or the 1134 random, pressure response microphone. Both mics are laboratory quality, air condenser microphones. The IE-2P is also compatible with other high quality, air condenser microphones such as Brüel and Kjær.

Highly selective three pole-pair filters.

Output connector for oscilloscope display, voice prints or strip chart recorder.

"Alternate" button for comparing memory data with real time display.

Four digit readout with 0.1 dB resolution, calibrated in dB SPL and dBμV. Digital hold feature.

Graticule lights automatically in darkened environments.

Precision Sound Level Meter with A, C or Flat weightings.

Precision low noise preamp with A, C or Flat weighted response characteristics.

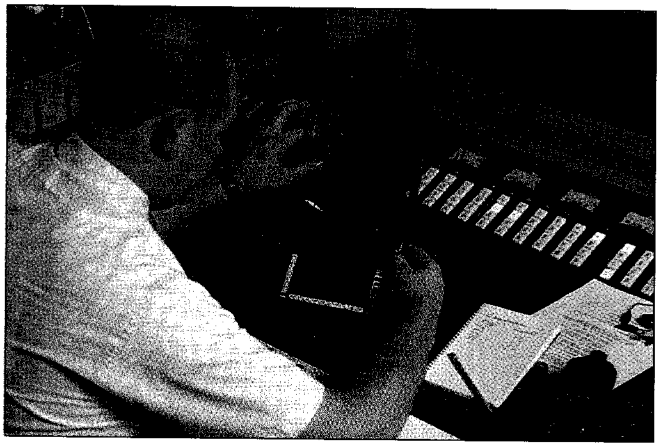
Sound Level Meter provides *Fast, Slow, Impulse* and *Peak* with true RMS and peak detectors.

Display brilliance adjusts automatically for ambient light level.

Dual nonvolatile memories will store or accumulate data.

Up to 45 dB display range with resolutions of 1, 2, or 3dB per step.

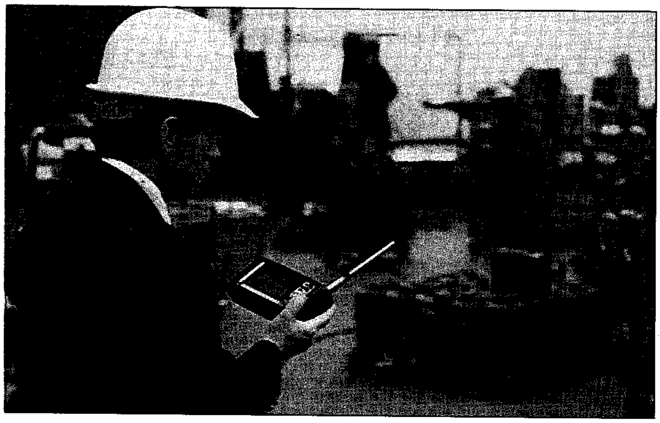
Selectable octave, 1/3-octave, or weighted 1/3-octave display modes.



SOUND SYSTEM MEASUREMENT/EQUALIZATION

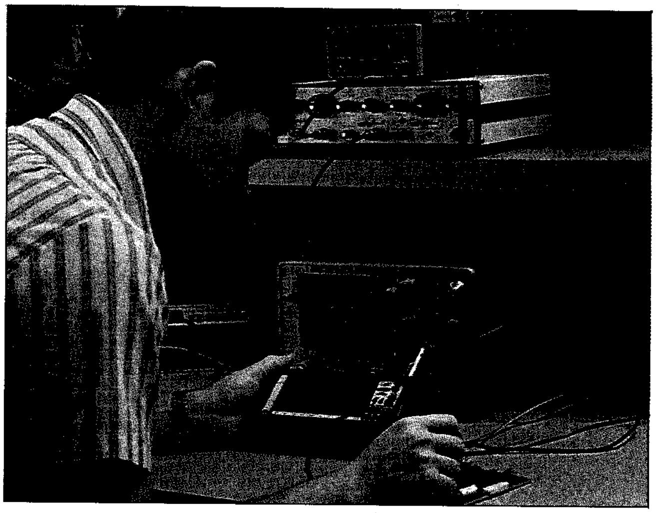
For sound system measurement and analysis, the IE-30A is capable of 1/3-octave, "weighted" 1/3-octave, or full-octave spectral analysis employing its many versatile features. Using the calibrated microphone, sound system response is visible at a glance on the LED matrix display. A digital LED reference window calibrates the display range accurately and allows rapid 10dB incremental shifts up or down from 30dB to 140dB SPL or dBμV. (Actual full-screen measuring range is up to 149dB SPL.) The display has 3 decay times which allow for monitoring, peak readings or pink noise integration.

Two nonvolatile memories will store what is displayed at any given moment, and then recall the display at will, even weeks later. The accumulation mode allows for peak-envelope equalization. A probe accessory permits signal tracing, EQ check out, and allows voltage measurements up to 500 volts.



NOISE SURVEYS AND THE IE-30A

Because the IE-30A combines real time analysis and precision sound level measurements in one package, you can now analyze the sound pressure levels in any environment and simultaneously view the frequency components that make up the sound. True RMS and peak detectors provide accurate readings for *Fast*, *Slow*, *Impulse*, or *Peak* measurements. The digital readout will operate in a continuous sampling mode or in a maximum signal "hold" mode. Selectable filter weights of A, C or Flat can be applied to the SLM and also to the 1/3-octave display. Whether your application is noise surveys, laboratory analysis or speech and hearing measurement, the IE-30A will likely save you considerable time.



THE IE- 30A ON THE TEST BENCH

Using the precision probe accessory that comes standard with the IE-30A, you can measure AC voltages with either true RMS or peak detectors from a few microvolts to hundreds of volts with a resolution of 0.1 dBμV. You can accurately measure any audio signal from a simple sinewave to a complex signal like pink or white noise. The IE-30A will enable you to measure the voltage of the power line, the ripple in a power supply, amplifier gain and true rms output power to a tiny fraction of a watt. And don't forget that you can identify the 1/3-octave frequencies of any audio signal measured. Harmonic distortion of less than 1.0% can be measured directly with the IE-30A due to the excellent selectivity characteristics of the 1/3-octave filters.

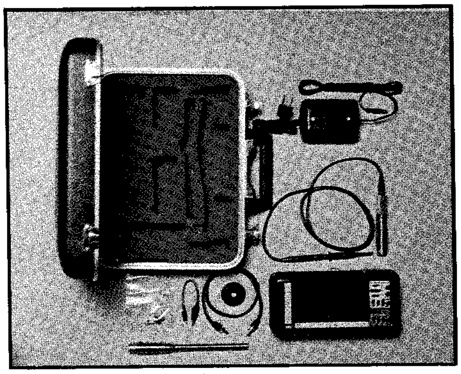
X, Y, Z axis outputs allow interface with storage oscilloscopes, regular oscilloscopes, and various recording systems. The-30A is truly a versatile measurement tool for laboratory, production or maintenance applications.

EQUALIZATION AND ALIGNMENT OF TAPE MACHINES

In the studio, the IE-30A is useful for acoustic measurements as well as electrical signal adjustments. Many equalizer circuits, like those found in tape recording systems, are interactive, and making a single adjustment can cause amplitude changes at more than one frequency. The IE-30A can eliminate tedious hours of tuning audio circuits a single frequency at a time. Using a pink noise tape with the IE-30A enables the technician to evaluate the entire audio band at once. He can see the signal amplitude in every 1/3-octave simultaneously, and can quickly make the necessary adjustments. In a similar manner, the azimuth at the tape head and bias may be adjusted using the high frequency filters in the IE-30A.

IE-30A Real Time Audio Analyzer

Ivie Technologies, Inc.



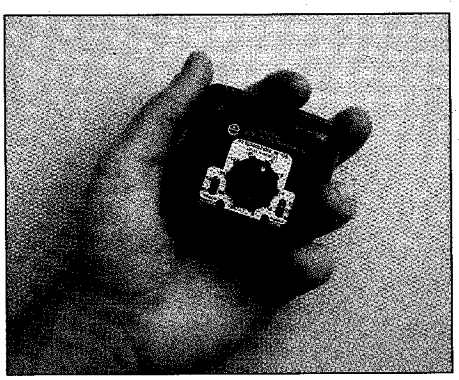
ACCESSORIES

The IE-30A comes with . . .

- "Fast Charge" nickel cadmium batteries.
- Manual with instructions and illustrations.
- CH 30 AC adapter/charger that provides continuous line operation.
- IE-2P Preamp with 1133 or 1134 Microphone Cartridges.
- IE-1036B Test Probe.
- IE-30A Carrying Case.

OPTIONAL ACCESSORIES

- MC-25 Multi-conductor, calibration microphone extension cable in 25 foot to 200 foot lengths.
- 81AD Adapter – 6 pin XLR to 3 pin XLR.
- 82AD Adapter – 6 pin XLR to BNC.
- 83AD Adapter – 6 pin XLR to phono.
- 84AD Adapter – for standard mic cables.



COMPLEMENTARY EQUIPMENT

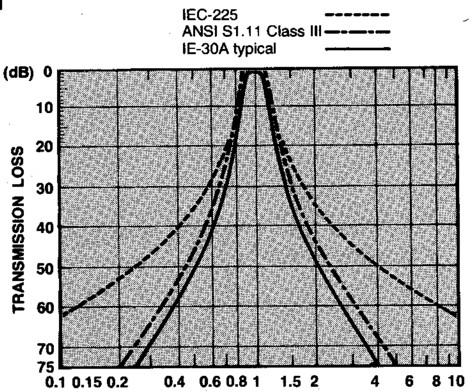
The IE-20B is a state-of-the-art pink and white noise generator, designed to handle the most exacting laboratory requirements. The digital generation techniques used in the IE-20B provide noise that is statistically well defined and very stable.

The calibrated output of the IE-20B provides up to 58dB of attenuation in precise, 2dB increments, making the IE-20B capable of driving a wide spectrum of sound equipment from high power amplifiers to ultra-sensitive preamplifiers.

TECHNICAL DATA:

Real Time Analyzer

- 1/3-octave operation provided from 25Hz to 20KHz in thirty ISO bands.
- Highly selective, three pole-pair filters exceed ANSI S1.11-1966 Class III, B.S. 2475-1964 DIN 45652, and IEC225-1966.
- Relative filter flatness: ±0.5dB.
- 1/3-octave filter display can be "weighted" with A, C or Flat filters.



FREQUENCY RATIO f/fm
(fm = center frequency)

- One-octave operation provided from 25Hz to 20KHz in ten ISO bands.
- Octave filter skirt selectivity satisfies ANSI S1.11-1966 Class II, B.S. 2475-1964, DIN 45652, and IEC 225-1966.
- Dual Memories store or accumulate (max hold) and display pattern.
- Filters are calibrated in dBμV (re1μV).
- Range: -3 to +149dBμV (.7μV to 28V) direct.
- Range: to +174dBμV (500 VAC) with probe.

Sound Level Meter

- Response modes: *Fast*, *Slow*, *Impulse*, and *Peak*.
- Instrument Range: 3dBA SPL to 149dBA SPL ref. 20μ N/M².
- Selectable true rms or peak detectors.
- 20dB crest factor for full scale reading.
- Four digit LED readout with 0.1dB SLM resolution.
- Digital display modes for continuous sample or display hold.
- Overload and underrange indicators.
- Filter weights: A, C and Flat.
- Flat filter bandwidth: 7Hz-35kHz.
- Calibration microphone is remoteable.
- Strip chart recorder outputs.
- Meets requirements of:
  ANSI S1.4-1971 TYPE S1A, S1C
  BS 4197-1967
  DIN 45633 B1.1, B1.2 (Impulse)
  IEC 651-1979

Preamplifier/Attenuator

- 100K ohm input impedance.
- Headroom: +40dB (above display screen) with sine wave input.
- Selectable filter weighting: A, C or Flat
- Bandwidth: 7Hz-35kHz.
- Flatness: ±0.5dB (20Hz-20kHz).
- THD≤0.1% @ 2.0V output level.
- Input damage level: ±100 VDC or 300 VAC (above 20Hz).
- Output short circuit protected.

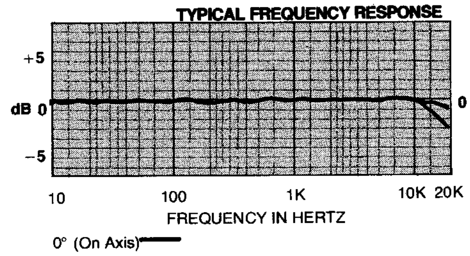
Display

- Thirty channel 480 LED array.
- Display ranges of 15, 30 and 45dB are selectable with resolutions of 1, 2 or 3dB.
- Display intensity adjusts automatically for room brightness.
- Control panel lights up automatically in low-light environments.

Microphone

- Element: Air Condenser.
- 200 VDC Polarization.
- Directional Pattern: Omnidirectional
- Dynamic Range: Greater than 110dB with supplied electronics.
- Response: Either Free Field or Random Response is available.
- Frequency Response: 10Hz to 20kHz, as illustrated.

TYPICAL FREQUENCY RESPONSE



Mechanical

- Dimensions (w x h x d): 203 x 98 x 54 mm (8" x 3 7/8" x 2 1/8").
- Input connector: 6 pin XLR.
- Weight: net 1.2 Kg (2.9 lbs.)
  shipping 3.4 Kg (7.4 lbs.)

Warranty

The IE-30A is warranted against defects in materials and workmanship for one (1) year from the date of purchase. During the warranty period, Ivie will repair or, at its option replace, components which prove to be defective provided the unit is returned, shipping prepaid, to an authorized Ivie service facility. Defects caused by modifications, misuse or accidents are not covered by this warranty. No others warranties are expressed or implied. Ivie is not liable for repairs and information should include the instrument serial number to assure rapid service.

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IE-30A Manual

Table of Contents

Introduction

Congratulations! With your purchase of the Ivie IE-30A, you have one of the most powerful, portable, and accurate analyzers available. The IE-30A combines a full octave and 1/3 octave real time spectrum analyzer with a Type I precision sound level meter. Included with this package is an instrumentation quality, air condenser microphone and preamplifier**.** For years, air condenser microphones have been recognized as the world standard for accuracy.

Additionally, the IE-30A is calibrated both in dB SPL and in dBµV, which makes it suitable for a wide variety of simple and complex measurements, including sound pressure level, amplifier gain, frequency response, output power, peak accumulation, and impulse measurement, just to name a few.

Every IE-30A is built to last. The case is aluminum, coated with a durable, baked enamel, and the internal construction is 100% modular. Every IE-30A is thoroughly and painstakingly tested to assure complete performance. Each unit is then heat tested in an oven for 72 hours at 125^{o}F to assure reliability. Any unit that doesn't measure up doesn't leave the factory.

The following pages of this manual explain the many features and uses of the IE-30A. We suggest that it be read thoroughly.

Getting to Know the IE-30A

With your IE-30A, you should have received the following standard accessories:

* IE-30A equipped with "fast charge" nickel cadmium batteries.
* AC Adaptor/Charger (IE-190B or equivalent)
* Standard phone plug patch cord
* IE-1036A or IE-1036B real time analyzer probe.
* IE-2P precision microphone preamplifier
* 1133 free field, or 1134 random response, air condenser microphone
* IE-30A carrying case and IE-30A owner's manual

Please charge your IE-30A for two hours after it is unpackaged. This will assure two full hours of operating time before recharging is again necessary. Now, let's take a look at the IE-30A accessories, controls and features.

The IE-30A Microphone and Preamp

The IE-30A comes standard with a 1/2 inch air condenser microphone (your choice of a free field or a random response microphone), and the IE-2P Precision Preamplifier. 1/4 inch, 1/8 inch, and 1 inch air condenser microphones are available on a special order basis.

Providing such a quality front-end with your IE-30A is not an inexpensive proposition. You will discover that if you lose your microphone and preamp, it will cost more than a thousand dollars to replace them. However, we feel strongly that an analyzer and sound level meter can not be more accurate or reliable than the microphone that comes with it. If you look at other analyzers on the market today, you will find that many come without microphones, and many others come with relatively inexpensive commercial microphones. Providing laboratory quality microphones and preamplifiers with analyzers is almost exclusive to Ivie.

The IE-30A is a Type I sound level meter, and has the accuracy of Class III filters in the analyzer section (in SLM Types, low numbers are best; in filter Classes, high numbers are best). As long as you use the microphone and preamp that came with your analyzer, its accuracy and performance to specifications is assured. You may easily use other microphones with your IE-30A as long as you remember that all readings are then relative, and are not absolute. You must further remember that the spectral information shown on the analyzer will be colored by the response of the microphone you are using.

Other air condenser microphones which conform to international dimension and thread specifications can be used with your IE-30A by simply removing the microphone cartridge from the end of the IE-2P and replacing it with the air condenser cartridge you wish to use. Many air condenser microphones, including those made by B & K, ACO Pacific, and Rion are compatible with the IE-2P. If a one inch, quarter inch, or eighth inch microphone is to be used, adaptors will be needed to adapt to the half inch barrel of the IE-2P. Some one inch microphones require a polarization voltage of 28 volts instead of the 200 volts which is most common. In this case, the polarization voltage of the IE-2P will need to be switched. Some may require the use of the 20dB pad available in the IE-2P, and, of course, changing the microphone will always require recalibration of the system. (For information on changing polarization voltage, the 20dB pad, and recalibration, refer to the IE-2P manual and the section in this manual entitled "System Calibration for OSHA Measurements," under the heading of "Sound Level Testing."

When using another microphone, it is important to know the frequency response of the microphone in order to interpret the display information of the IE-30A. The typical frequency response of the standard microphones for the IE-30A (the 1133 Free Field and the 1134 Random Response or Pressure Response) are shown below:

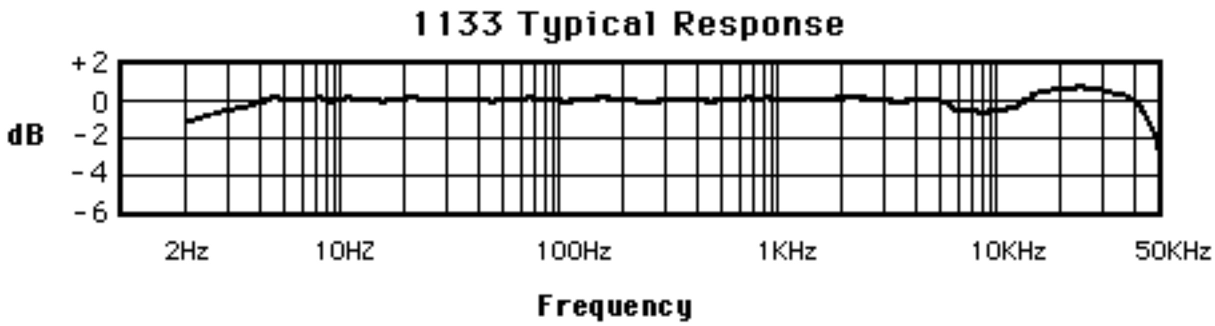


Figure I

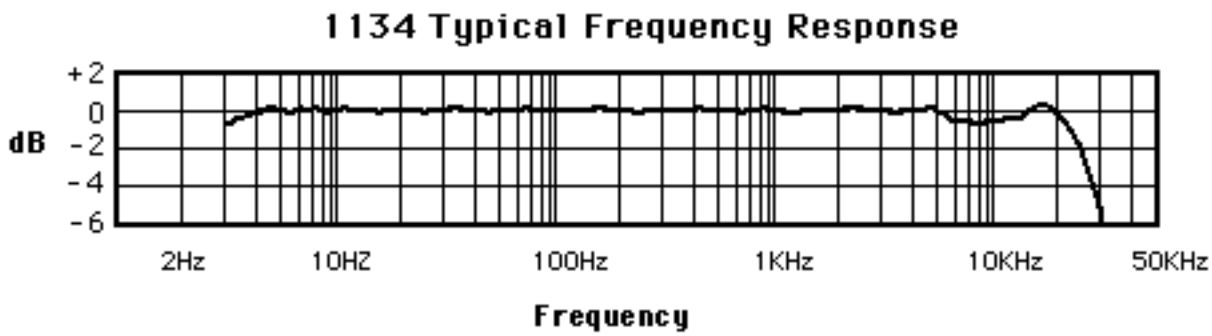


Figure II

As can be seen, these microphones have been chosen for their excellent response characteristics, and their ability to provide maximum accuracy to the measurement capability of the IE-30A. Should you have questions about microphones, or their application in analyzer measurements, please don't hesitate to contact us at the factory.

Inputs and Outputs -The IE-30A Microphone Input Plug and the 7 Pin Input/Output Connector

The Microphone Input Plug

The microphone input plug on the IE-30A is a six pin XLR-type connector. Following is an illustration of the pinout of this connector:

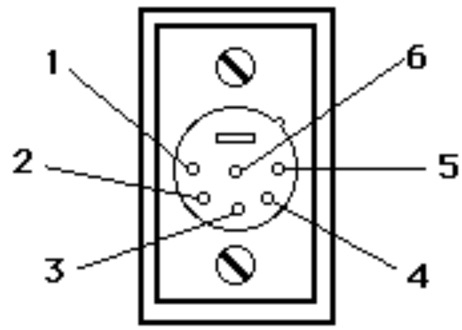


Figure III

Pin 1: Input pin. The input impedance is 100 kΩ. The maximum direct DC input before damage is 100 VDC. The maximum direct AC input is 300 VAC from 20Hz to 4kHz. For frequencies above 4kHz, derate maximum AC input by 6dB/octave (e.g. 150 VAC @ 8kHz, 75 VAC @ 16kHz, 6 VAC @ 20kHz)

Pin 2: Gain Trim pin. Varying the pin voltage between 8.0 VDC and 0.0 VDC varies the gain of the IE-30A over a 15dB range. This pin is not to be used for AGC purposes, but only as a long term gain adjustment for calibration requirements.

Pin 3: No connection.

Pin 4: Power (V_{cc}) for microphone preamplifier. It provides 10mA (maximum current) at 12 VDC.

Pin 5: Calibration pin. Pin 5 is normally tied to pin 4, which sets the IE-30A calibration for dBµV.* IF pin 5 is not tied to pin 4, calibration is set for dB.1µV.†

Pin 6: Ground. (*0dBµV = 1.0µV † 0dB.1µV = 0.1µV)

Microphone Extension Cords

It is helpful to know the microphone input pinout, especially if you plan to make your own microphone extension cord. Extension cables are available from Ivie in lengths from 25 ft. to 200 ft., in 25 ft. increments, but should you choose to make you own cord, that can be easily done using a minimum of three conductor shielded cable, and one male and one female 6 pin XLR-type connector. Pin 1 (signal) must be brought through, as well as pins 2 (gain trim) and 4 (power for the IE-2P Preamplifier). Pin 6 (ground) must also be brought through, and the shield of the cable can be used for this. A highly supple (and therefore, usually expensive) cable is recommended.

The IE-30A 7 Pin Input/Output Connector

The 7 Pin Input/Output Connector is illustrated below:

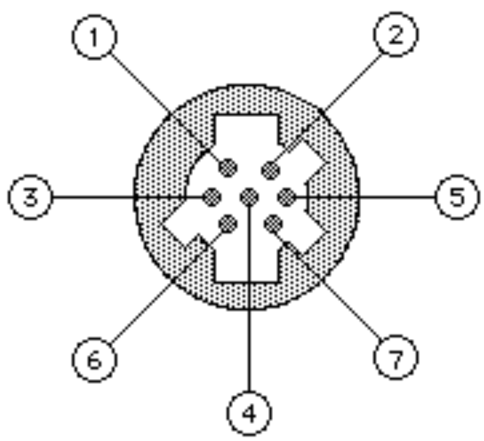


Figure IV

The pinouts are as follows:

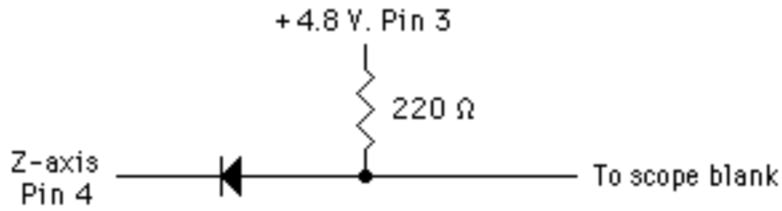
Pin 1. System (analog) ground.

Pin 2. SPL detection. Outputs DC voltage equal to .01 x SPL reading on display. (Output at 100 dB SPL is 1.0 VDC)

Pin 3. 4.8 volts DC. Can power up to 200 mA for use with accessories.

Pin 4. Z- axis: 4.8 volt logic level that is low when a display LED is on. May be used for Z-axis on oscilloscope.

Note: If Pin 4 is pulled low, it will light the display. Use this circuit to prevent 1/3 octave display interference from LO-Z inputs.



Pin 5. X-axis: Sawtooth waveform synchronized with display. May be used for scope display. f_o = ca. 80-100Hz, 0 to 2 volt ramp, 1 kΩ output.

Pin 6. Gate in: When pulled low (TTL or CMOS 5 volt compatible) it interrupts signal through analyzer.

Pin 7. Y-axis: Analog information of 1/3 octave display. With RTA display on dB Reference Line, voltage at Pin 7 is 7.0 VDC. In 3dB/step display mode, output is scaled a .1 V/dB. (1dB/step = .3 V/dB) Output Z = 1 kΩ. (The IE-30A Reference Line is shown in **Figure V** on the following page.)

The IE-30A Preamp Output

The IE-30A contains a very quiet preamplifier that is used in conjunction with the analyzer and SPL meter, or can be used by itself as a stand alone preamp. It provides up to 80dB of gain, or up to 30dB of attenuation, a full 110dB of range, selectable in 10dB increments.

The preamp input is the microphone or probe input, and the output is the phono plug on the side of the IE-30A as shown in **Figure V** on the following page. The preamp follows the weighting of the SPL meter, either A, C, or Flat (unweighted). Gain is adjusted by the Reference Level "Up" and "Down" buttons. Input impedance is 100 kΩ. Now let's look at the IE-30A controls.

The IE-30A Front Panel Controls

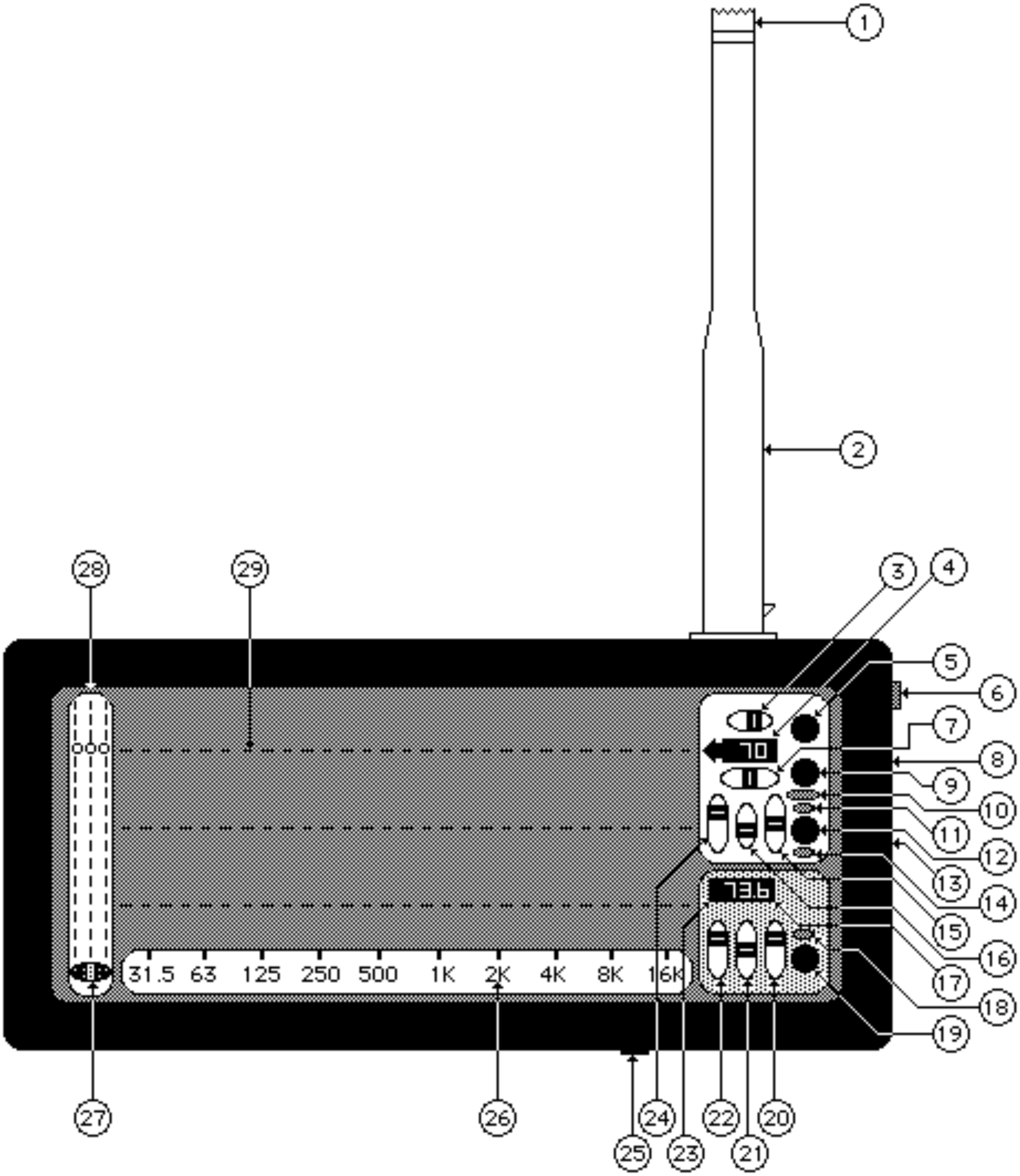


Figure V

You should become familiar with all the IE-30A controls and readouts. They are as follows:

1. 1133 or 1134 Microphone
2. IE-2P Precision Microphone Preamp
3. On/Off Switch
4. Display Reference Window (dB)
5. Reference "Up" Button
6. IE-30A Preamp Output Jack
7. Display Format Selector Switch
8. IE-30A Charger Input Jack
9. Reference "Down" Button
10. Battery & Charge Indicators
11. Real Time Mode Indicator
12. Memory/Real Time Alternate Button
13. 7 Pin Input/Output Indicator
14. Recall Memory Indicator
15. Memory Mode Switch
16. Memory Selector Switch
17. SLM Readout Display (Using Mic)
18. SLM "Freeze" Indicator
19. SLM "Freeze"/Clear Button
20. SLM Mode Switch
21. SLM Response Selector Switch
22. SLM Weighting Selector Switch
23. dBµV Readout Display (Using Probe)
24. Decay Time Selector Switch
25. Tripod Mount Nut
26. ISO Frequency Centers
27. Display Resolution Selector
28. Display Resolution Key
29. Reference Line

Using the IE-30A

Using the IE-30A as an Analyzer

As mentioned earlier, the IE-30A is really two instruments in one - a spectrum analyzer and an SPL meter. We will first discuss using the IE-30A as an analyzer. You will notice that the IE-30A front panel has been color coded so as to help differentiate between the analyzer controls and the SPL meter controls. The analyzer controls and functions are in white fields and the SPL meter controls are in an olive green field.

The first analyzer control that must be used is obviously the ON/Off switch (3). When the IE-30A powers up, it reverts to a preset 60dB setting at the Reference Line (28). This is indicated by the number "60" which will appear in the Display Reference Window (4). The amplitude at the Reference Line can be adjusted up and down in 10dB increments by using the Reference "Up" and Reference "Down" Buttons (5 and 9). The full range available is from 30dB to 140dB. The level at the Reference Line should be adjusted such that the signal being viewed is well up on the IE-30A screen. The screen itself will automatically "edge light" in dim lighting conditions so that it remains readable - even in the dark. Conversely, as the viewing environment becomes more and more bright, the display LED's will become more and more bright such that the IE-30A will remain easily readable in all but the brightest of direct sunlight conditions. The obvious price of bright light situations is battery life. Since the LED's are fed more and more current to remain readable as the environment brightens, battery life between charges is lessened.

It is possible to set the level at the Reference Line such that the signal is either off the bottom of the screen, or is driven above the screen, completely lighting it. Such under or over range signals cannot be accurately processed by the IE-30A. When signals are under or over range, the display and/or the SLM Readout Display (22) will blink indicating that what is displayed is not accurate. This situation is easily cured by adjusting the Reference Level. It should be noted that the IE-30A does have the headroom to accurately measure signals which are somewhat above the display. The headroom is about 40dB for sine wave inputs, or about 20dB for complex wave forms. This means that transient signals which momentarily jump the display off the top of the screen do not necessarily cause inaccuracies in the SPL readout. When this headroom is exceeded, however, display blinking begins and adjustment of the Reference Level is necessary.

The resolution of the the IE-30A display (1, 2, or 3dB per step) is controlled by the Display Resolution Selector (26). An LED will illuminate at the Display Resolution Key (27) to indicate the resolution selected. The columns of numbers in the Display Resolution Key are divided into increments of 1, 2, or 3dB per step. The purpose of these numbers is to determine the amplitude, in dB, that a signal rises of falls below the Reference Line. The column of numbers used is determined by the display resolution selected. If 1dB per step is selected, the dynamic display range of the IE-30A is only 15dB. 3dB per step, on the other hand, will provide a dynamic display range of 45dB. 30dB of dynamic range is provided when 2dB per step on the display is selected.

You will find that most signals will be best viewed in the 3dB per step display resolution. However, for equalization and other applications where finer resolution is desired, it is easily available - but at the cost of reduced dynamic display range.

The next consideration when viewing a signal is the display format. The Display Format Selector Switch (7) allows selection of an octave display, a 1/3 octave display, or a weighted 1/3 octave display. If a weighted display is selected, weighting is controlled by the SLM (Sound Level Meter) Weighting Selector Switch (21). The weightings available are "A," "C," and "Flat" (unweighted). When the display has been weighted, a yellow LED will illuminate in the "arrow" portion of the Display Reference Window to indicate weighting has been applied. It should be noted that the IE-30A preamp output has been weighted as well. (For more information on weighting, weighting curves, etc., consult the section of this manual entitled "Sound Level Testing".)

Another consideration when viewing a signal with the IE-30A is decay time. This is controlled by the Decay Time Selector Switch (23). This affects the averaging time of the detectors and therefore the speed at which the display moves. Three decay times are provided. The fastest, D1, is intended for monitoring work, and is fast enough to catch and display events of fairly short duration. D3, the slowest decay time provided, by contrast will not display short duration events. It is intended for use with pink noise which must be averaged over time to make it appear stable. Trying to view pink noise with the D1 decay time would allow so much display fluctuation, especially at the lower frequencies, that it would be marginally useful at best.

This concludes the discussion of the basic analyzer controls of the IE-30A. Next, let's look at the memory functions and controls.

IE-30A Memory Functions

The IE-30A provides two memories for the storage of spectral information. These memories are involatile and therefore remain in tact when the IE-30A is switched off. Once a spectrum is stored in memory, it can be removed only by overwriting it. The resolution of the data stored in a memory is limited to the resolution setting of the IE-30A at the time the memory was loaded. Spectra stored at a resolution of 3dB, for example, cannot be recalled and displayed at resolutions other than 3dB.

Storing a spectrum in memory is a simple process. The memory to be used, either Memory 1 or Memory 2, is selected by using the Memory Selector Switch (15). Next to the Memory Selection Switch is the Memory Mode Switch (14). It has three positions. Normally it is kept in the center, or "Alternate" position. To store a spectrum into memory, move the Memory Mode Switch to the upper, or "Store" position. To execute storage, press the Memory/Real Time Alternate Button (12). This will write the spectrum on the IE-30A screen into memory. The IE-30A screen will "freeze," demonstrating that a memory is being viewed, and not real time data. Additionally, the Recall Memory Indicator (13) will illuminate, showing that the IE-30A is in the memory display, or "Recall" mode.

To protect the memory information so that it cannot be accidentally overwritten, return the Memory Mode Switch to the center, or "Alternate" position. The memory will now be protected. Pressing the Memory/Real Time Alternate Button will now allow toggling between the "Real Time" and "Recall" modes. Real Time operation will be indicated by a moving display, and the illumination of the Real Time Mode Indicator (11), while the Recall Mode will be indicated by a frozen display and the illumination of the Recall Memory Indicator.

While in the "Recall" mode, the Memory Selector Switch can be used to toggle back and forth from one memory to the other. By use of the Memory Selector Switch and the Memory/Recall Alternate Button, memories may be compared with each other, or with real time data as desired. It should be noted that only spectral information is written into memory. The screen resolution, Reference Line amplitude, and SPL are not stored. When in the "Recall" mode, the Display Resolution Key, Display Reference Window, and SLM Readout Display will blink indicating that their data may not be accurate.

The Accumulate Mode

The bottom position on the Memory Mode Switch is the "Accumulate" position. In this mode, the IE-30A displays and holds the highest amplitude reading in each channel. The display remains frozen in this "accumulate" position until a higher amplitude comes along to overwrite the screen and push the spectral display higher on the screen. This is a very useful mode. Peak accumulations of data over time can be gathered and stored, and the spectral content of short duration phenomena can be captured, to name just a couple of applications.

When in the "Accumulate" mode, pressing the Memory/Real Time Alternate Button once will stop the accumulating process and write the accumulated data into memory. "Accumulate" is a memory function. Pressing the Memory/Real Time Alternate Button a second time will clear the accumulators and allow the accumulation process to begin again. This is often desirable, especially at the beginning of a measurement. When entering the "Accumulate" mode, usually data will be frozen on the screen and will need to be cleared by pressing the Memory/Real Time Alternate Button twice prior to beginning a measurement.

As in other memory storage, an accumulated memory may be protected by returning the Memory Mode Switch to the center "Alternate" position.

Using the IE-30A as a Sound Level Meter

As mentioned earlier, all the IE-30A sound level meter controls are located in the olive green field at the bottom, right of the front panel. The IE-30A is a Type I sound level meter, and as such, is capable of making all the Type I specified measurements. These include the ability for "Fast," "Slow," "Peak," and "Impulse" measurements. The IE-30A also has weighting available for "A," "C," or "flat" (unweighted) measurements.

"A" weighted, "C" weighted, or unweighted measurements can be selected using the SLM Weighting Selector Switch (21). When weighting is selected for the sound level meter, the output of the IE-30A preamplifier is weighted as well.

Sound level measurements may be continuous, or a measurement "hold" function is provided. When the "hold" function is employed, the highest SPL measured is "frozen" in the SLM Readout Display (22) until a higher reading comes along to displace it. To select either a continuous measurement display, or the "hold" function, the SLM Mode Switch (19) is used. The top position (CT) selects a continuous measurement display, and the bottom position (HD) selects the "hold" function. The center position, (IM) for "Impulse" measurements will be discussed below.

As earlier mentioned, the IE-30A provides "Fast," "Slow," "Peak," and "Impulse" measurements of sound pressure level. To make this selection, the SLM Response Selector Switch (20) is used. The top position (FT) is "Fast," the center position (SW) is "Slow," and the bottom position (PK) is "Peak." All of these measurements are defined by international specifications for type accepted sound level meters. The detectors employed for both "Fast" and "Slow" measurements are true RMS detectors, while the detector for "Peak" measurement is a true peak detector. These three measurements can be made in either the continuous mode, or the "hold" mode.

The selection for "Impulse" measurements is a little unorthodox. To select "Impulse" measurements, the SLM Mode Switch must be in the center (IM) "Impulse" position. Additionally, the SLM Response Selector Switch must be in the top (FT) "Fast" position. This correctly sets up the detectors for "Impulse" measurements. With the SLM Mode Switch set to "Impulse," and the SLM Response Selector Switch set to either "Slow" or "Peak," the IE-30A will still make measurements, but they will be undefined, and therefore less than useful . For proper "Impulse" measurements, the SLM Response Selector Switch must be set to "Fast."

Now that we have examined the controls of the IE-30A, we are ready to look at some measurements in greater depth. Let's begin with sound level measurements.

Sound Level Testing

Introduction

The decibel (dB) scale has been adopted internationally for use with sound level meter testing. The scale begins at a reference of 0 dB in sound pressure level (0 dB SPL) which corresponds to the smallest sound that can be heard by a healthy human ear, and is equal to 2µN/m^2, or perhaps more commonly, 20µPa. Following is a chart which shows some various sound pressure levels (SPL's) relative to typical environmental sounds:

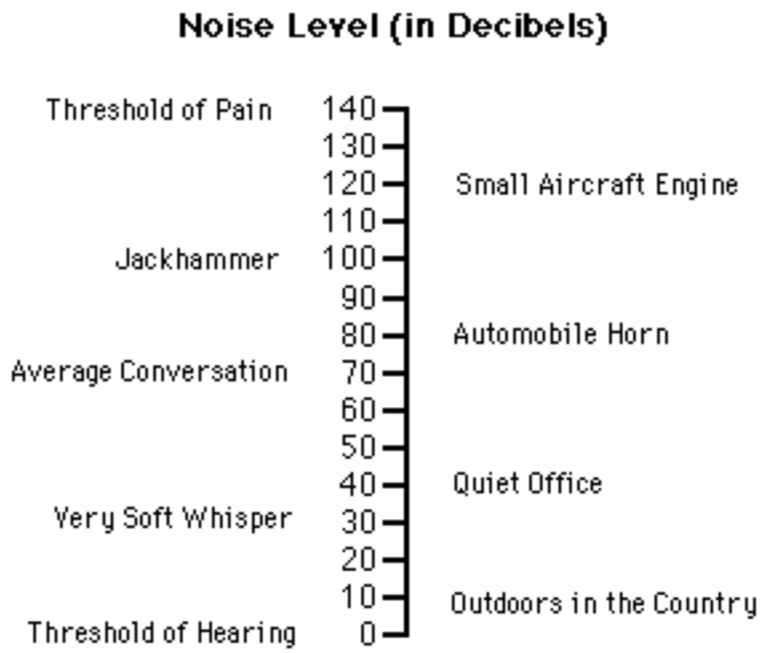


Figure VI

When studying sound level measurements, it is of major importance to understand the response characteristics of the human ear. Our ears do not respond equally to all the frequencies of the audio spectrum - in other words, they are not "flat" in their response. To further complicate matters, the response characteristics of human ears change with different SPL's. At relatively quiet SPL's, our ears attenuate high frequency sounds to some degree, and drastically attenuate low frequency sounds. As SPL's increase, our ears get more efficient at low frequencies and their response to sound becomes more "flat," although they never achieve a totally "flat" response. Following is a set of curves which approximate the hearing response of human ears. The "A" curve shows how ears hear, or perceive sound at low SPL's, while the "C" curve shows how we hear at relatively high SPL's.

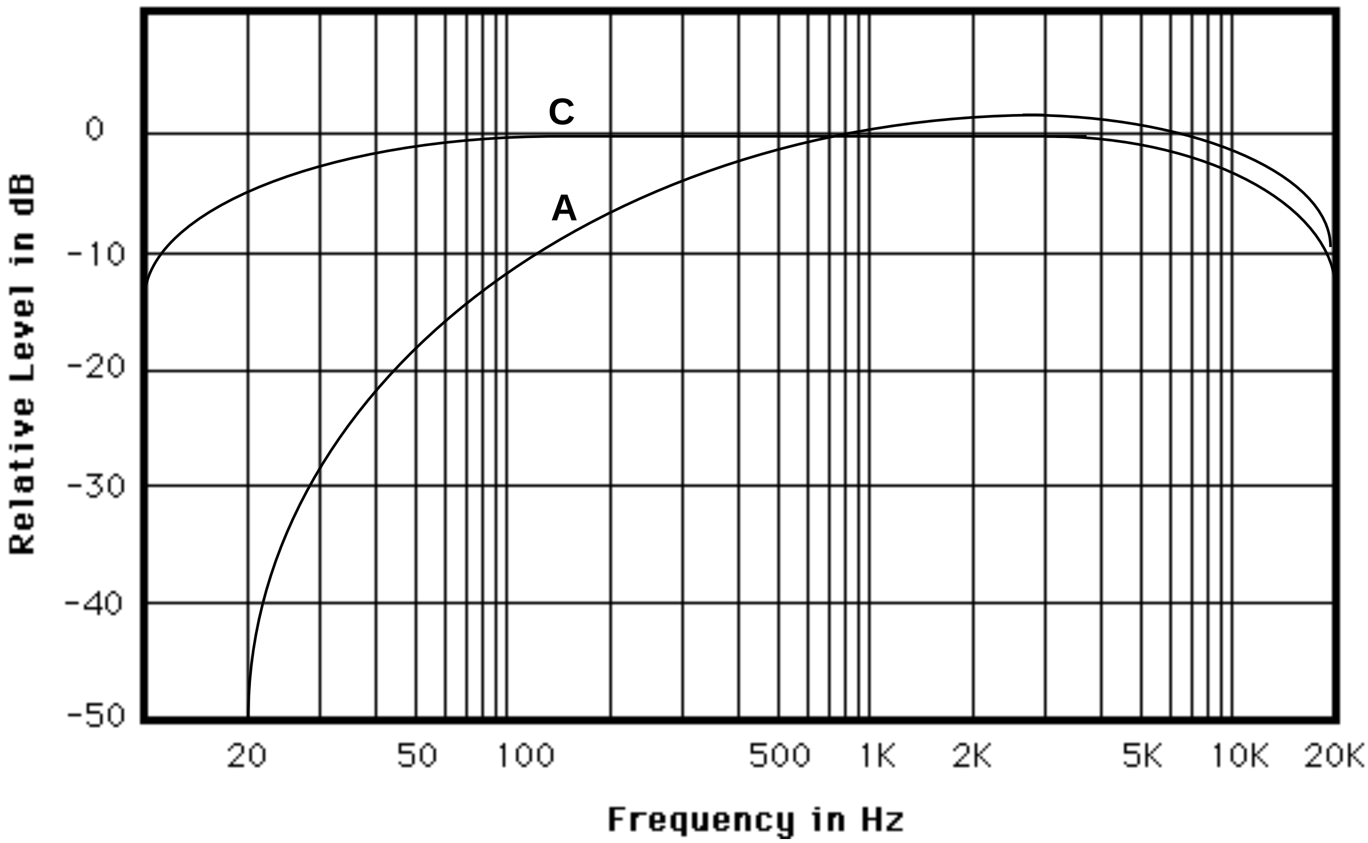


Figure VII

These curves have been integrated into sound level meters for testing sound levels. "A" weighted (dBA) measurements use the "A" curve above, "C" weighted (dBC) use the "C" curve above, and "Flat" (dB SPL) measurements use no weighting at all.

Noise which causes hearing damage has been found to correlate most closely with the "A" curve. Consequently, OSHA requirements, and many other government regulations are generally specified in dBA. The Walsh-Healey Public Contracts Act, for example, specifies the following permissible human exposure levels for industrial noise. Notice that all duration levels are specified in dBA.

Permissible Noise Exposures

Hours Duration Per Day	dBA SPL Slow Response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
.5	110
.25	115

Figure VIII

In addition to being concerned about the weighting we use when we make SPL measurements, we need also to be aware of the measurement environment. Sound environments can range from near-field to free-field to diffuse-field. A free-field environment is one that is free of reflections, and is typical of anechoic chambers (sound absorbing rooms) that have acoustically padded walls, floors, and ceilings.

Diffuse (reverberant) fields are often encountered and are purposely created by reverberation chambers that have been designed to cause as much reflection between ceilings, walls, and floors as possible. A diffuse-field is one in which the sound is uniformly distributed throughout the room. Machine noise tests are more often made in reverberant chambers, as they are less costly to build than anechoic chambers.

Typical sound measurements environments, however, are usually some combination of free-fields and diffuse fields, and great care must be taken with the measurements to help assure that accurate results are obtained. Errors can occur when determining the noise from a single source if tests are made too close (near-field) to the source being measured (See **Figure IX**, page 19). The near-field SPL can change dramatically with small position changes of the sound level meter. <u>To avoid near-field errors, the sound level meter should be located away from the source by at least a distance equal to one wavelength of the lowest frequency</u>

radiated from the source, or more than twice the distance of the largest dimension of the source, whichever distance is greater.

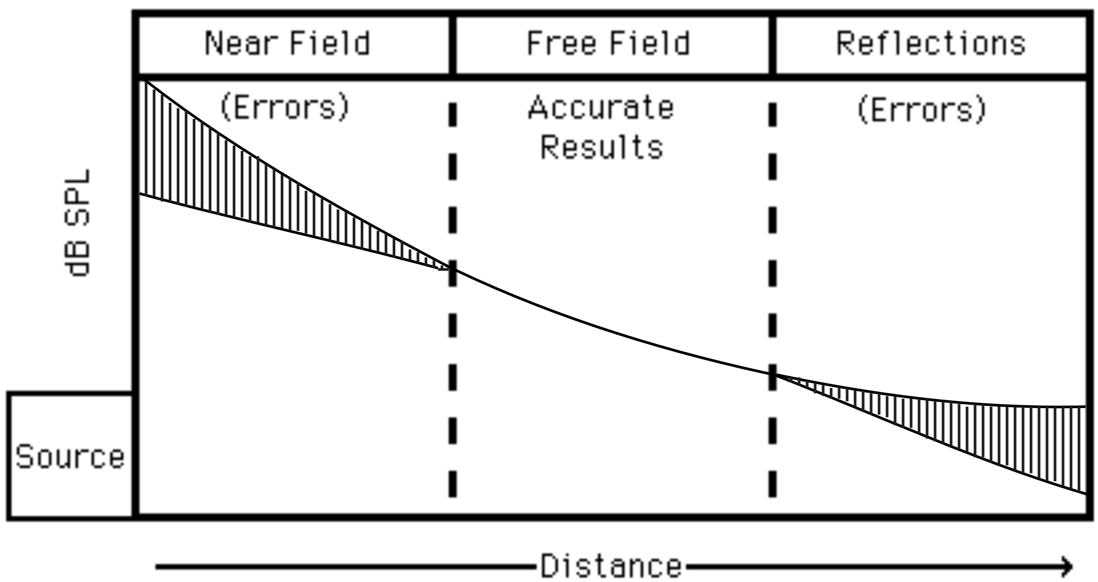
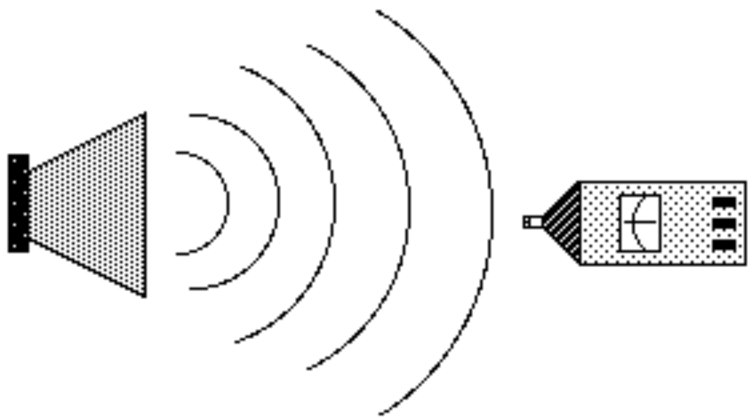


Figure IX

As can be seen from the above illustration, errors can occur not only when we are too close to the source, but also, when we get too far from the source being measured, room reflections and other room noises may interfere with our readings. The most desirable condition for noise testing would be to perform all tests in a reverberant chamber (diffuse-field) or an anechoic chamber (free-field). Since this is usually not possible, the next best alternative is to find a free-field as close to the object being tested as possible. It is easy to identify a free-field because the inverse square law holds true there. The inverse square law describes the relationship between sound pressure level and distance in a free-field. When the distance from the sound source doubles, the SPL will drop by 6 dB. If the distance is doubled again, the SPL will drop by another 6 dB. If this relationship occurs, the sound waves are traveling unobstructed from the source to you, and by definition, you are standing in a free-field.

Free Field vs. Random Response or Pressure Response Microphones

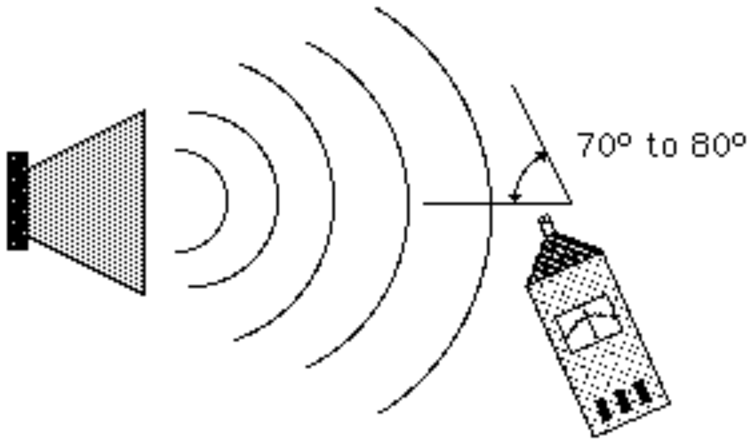
Both free field microphones and random response microphones are used to measure SPL. In Europe and other areas where IEC standards are required, a free field microphone is required. A free field microphone is intended to be used in a free field environment, and should be pointed directly at the sound source as shown below:



Using a Free Field Microphone in a Free Field Environment

Figure X

In the United States and other areas where ANSI specifications are followed, a random response microphone is normally used on a sound level meter. A random response microphone is intended to be used in a diffuse or reverberant field. However, in free field use, a random response microphone can be used to approximate the response of a free field microphone by positioning the microphone at an angle of 70 to 80 degrees to the sound source, as shown on the following page:



Using a Random Response Microphone in a Free Field Environment

Figure XI

Body Effects on Sound Measurements

Something that must be considered when making sound measurements with a hand-held analyzer, is the effect of the operator's body on readings. The operator's body may detract substantially from the accuracy of the measurements. At frequencies near 400 hz, sound reflecting from the body could cause up to 6 dB or error, if measurements are made within three feet of the operator. To minimize this effect, the PC-40 should be positioned as far away from the body as possible. It would also be appropriate to use a microphone extension cable in those instances when it is deemed necessary.

Correcting for Background Noise

Often the need arises to make SPL measurements in the presence of background noise. This can be easily done as long as the SPL of the primary source is at least 3 dB greater than the background noise. Following are the steps for making such a measurement.

1. Measure the total noise. (Background and primary source)

2. Turn off the primary noise source and measure the background noise only. Both tests should be made with the microphone in the same location.

3 Calculate the difference between the two readings measured. If the difference is less than 3 dB, accurate measurements cannot be made. If the difference is between 3 dB and 10 dB, the following chart can be used to make the needed correction.

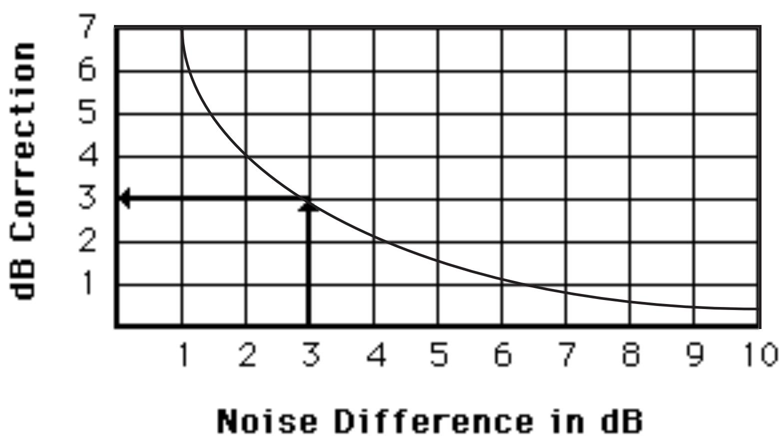


Figure XII

To use the chart, locate the difference of the two measurements on the horizontal axis. From that point, go up to intersect the curve, and then left to the vertical axis. Then subtract the value on the vertical axis from the total noise level first measured.

Example: Total noise = 75 dB. Background noise = 72 dB. Difference = 3 dB. Chart correction = 3 dB. Primary source noise = 75 dB - 3 dB = 72 dB.

There is something very interesting about this example. Notice that the background noise SPL is the same as the source noise SPL, yet when we add those equal noise levels together, the increase is only 3 dB. (72 dB of background noise plus 72 dB of primary source noise equals 75 dB total) 3 dB is only a slight change in the level of "loudness" perceived by the human ear.

This same ratio applies to amplifier power when fed to a speaker. If we double the power (watts) going to a speaker, the change in sound level is only 3 dB, a barely audible change. This gets to be pretty important if we have a huge system using 10,000 watts of power and we decide we want it just a little louder - a mere 3 dB. All we have to do to accomplish this is add another 10,000 watts!

Adding Sound Levels

Since we have just discussed an illustration of adding sound levels together, let's explore the subject further. If two primary sources are measured independently, it is possible to determine what the sound level would be if both sources were operating together. The following chart can be used to determine this, when both tests are made with the IE-30A in the same location.

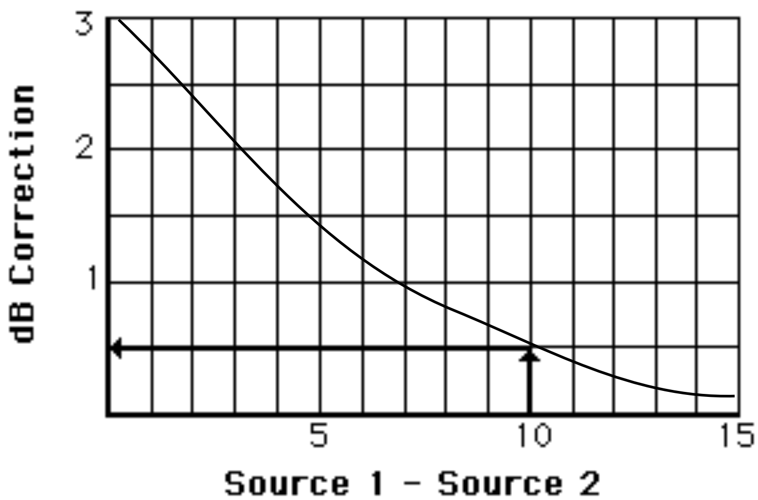


Figure XIII

To use the chart, first measure the levels of the two sources independently and then find the difference between the two levels. Locate the difference on the bottom of the chart. Go up until the curve is intersected, and then go left to the vertical axis. Then add the correction in dB indicated by the vertical axis to the value of the highest reading made. This number indicates the combined SPL of the two sources.

In the example shown above, Source 1 equals 79 dB, and Source 2 equals 69 dB. The difference is 10 dB. Chart correction is .5 dB, so the total noise is 79.5 dB.

System Calibration for OSHA Measurements

OSHA measurements generally require equipment that meets minimum specification standards - at least an ANSI Type II sound level meter, for example. (The IE-30A is a Type I Sound Level Meter, and therefore exceeds OSHA minimum requirements). In addition to the equipment meeting minimum specification standards, it must also be properly calibrated in order for an acceptable OSHA measurement to be made.

What this normally requires is calibration prior to the measurement, and then a recheck of calibration after the measurement is made. In the case of SPL measurements, a calibration device (either a pistonphone or an acoustic calibrator) must be used. The standard IE-30A microphone is a 1/2 inch, air condenser microphone. It's size and thread specifications are the same as other internationally recognized 1/2 inch microphones. Any quality calibration device will work, if it is used properly. Most calibrators are made to accommodate a 1 inch microphone, and they have an insert to adapt them to 1/2 inch microphones. Use the 1/2 inch adapter and make sure the microphone fits snugly inside the insert.

To calibrate for OSHA measurements, fit the calibrator on to the IE-30A microphone and turn on both the calibrator and the IE-30A. Following the directions that come with the calibrator, calibrate the IE-30A to the proper SPL. The IE-30A calibration potentiometer is found in the IE-2P microphone preamplifier. It is recessed inside the IE-2P tube, as shown below, and has to be accessed with a small screw driver.

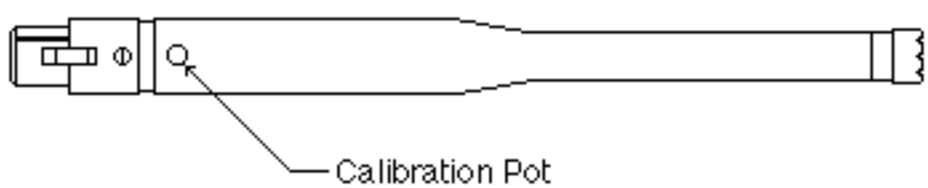


Figure XIV

Electrical Testing with the IE-30A

We have discussed some acoustic measurements with the IE-30A, but one of the most useful functions of the analyzer is the measurement of electrical signals. Since the IE-30A is calibrated in dBµV., it is capable of making a wide range of useful measurements related to audio. Let's examine a few of them. These are by no means all of the measurements that can be made, but they will provide a base which can be expanded to meet many requirements.

Measuring Output Power

Measuring the output power of an amplifier or audio system is nothing more than a simple mathematical extension of measuring voltage. Power is an impedance related measurement. If we know the impedance of the load and also the rms voltage across the load, we can then calculate the power by squaring the voltage and dividing it by the impedance (in ohms) as shown in the following equation:

$$\frac{E^2}{R} = \text{Power rms} = \frac{(\text{Voltage rms})^2}{\text{Load } \Omega} = \text{watts}$$

Amplifier power is normally measured by replacing the speakers with a resistive load capable of handling the rated amplifier power. The input voltage required for the full rated output power is usually specified by the amplifier manufacturer along with a test frequency, or range of frequencies.

The probe which comes with the IE-30A should be used for all power measurements. With its switchable 20 and 40dB attenuation, it is capable of measuring from .3 pico watts ($.3 \times 10^{-12}$) to 31 kilowatts into an 8Ω load, or from 5mv ($r \times 10^{-6}$) to 500 volts.

Let's look at an example. A manufacturer specifies his amplifier output power to be 100 watts rms into a 4 ohm load for a 1 volt rms input signal. The test frequency given is 1 kHz. The test setup is show on the following page:

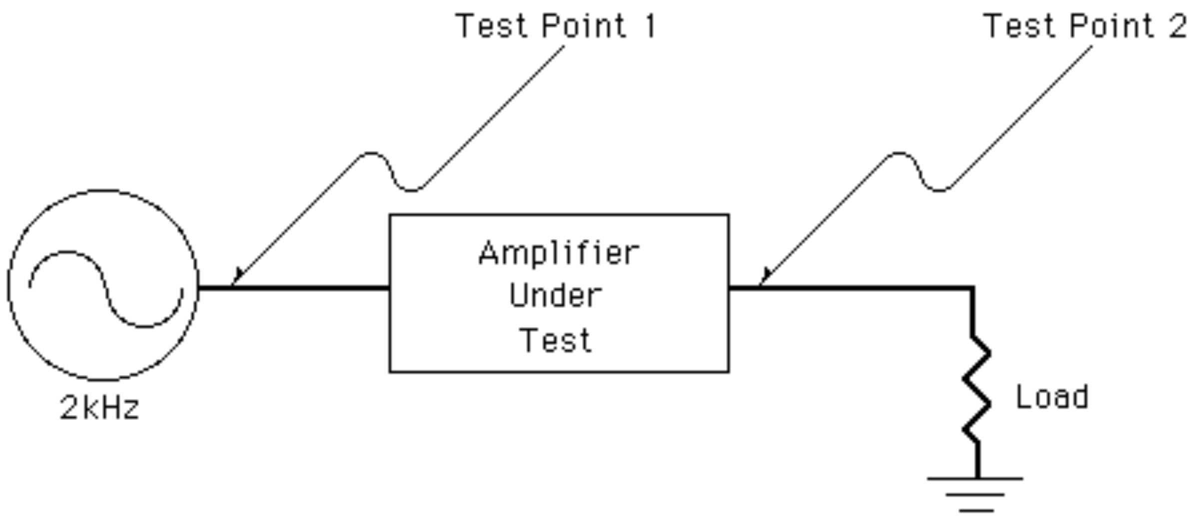


Figure XV

The procedure for making the measurement is as follows:

1. Connect a 100 watt rated 4Ω load to the output terminals of the amplifier.

2. Tune a sine wave function generator to a frequency of 1 kHz and initially set its output voltage to zero. Plug the generator output into the signal input jack of the test amplifier.

3. Connect the probe of the IE-30A to the output of the sine wave generator, (test point 1), and adjust the output signal to a level of 1.0 Vrms (+120dBµV). Remember, when using a 20dB attenuator with the IE-30A, a displayed signal level of 100dBµV is equal to a true signal level of +120dBµV (100dBµV + 20dB). The generator should remain connected to the test amplifier through this step.

4. Next, connect the IE-30A probe to test point 2 and measure the voltage across the 4Ω load at the amplifier's output. (The reading will be in dBµV, but conversion table #1 in the Appendix will convert directly to Vrms).

5. Mathematically square the measured voltage and divide the result by 4Ω. The result will be output power. An even easier approach would be to refer to table #4 in the Appendix and read directly from dBµV to P^4 (power into a 4Ω load).

For this particular example, if we assume that the measured voltage across the 4Ω load is 22.4 Vrms, we read on the table the power into 4 ohms to equal 125 watts. $\left(\frac{21.8^2}{4}\right)$

Measuring Gain and Loss

Gain and loss measurements are usually considered to be relative measurements. That is, gain and loss are not described in absolute units like volts, dBµV, or dB SPL. Gain and loss measurements are comparisons of the output signal divided by the input signal and are usually expressed in dB, a unitless measure.

Using the IE-30A, gain and loss can be measured with either a sine wave generator, or with a pink noise generator. The advantage of using a pink noise generator, like the Ivie IE-20B, is that both gain (or loss) and frequency response are displayed simultaneously.

For now, let's examine some measurements using sine waves. For details on using pink noise for gain and loss testing, consult the section of this manual entitled "Pink Noise Testing."

Perhaps the easiest way to demonstrate gain and loss testing is with specific examples. Let's look at a couple. First Problem: Measure the gain of a preamplifier with a 10 mv input signal at a frequency of 2 kHz. The test setup and procedure is as follows:

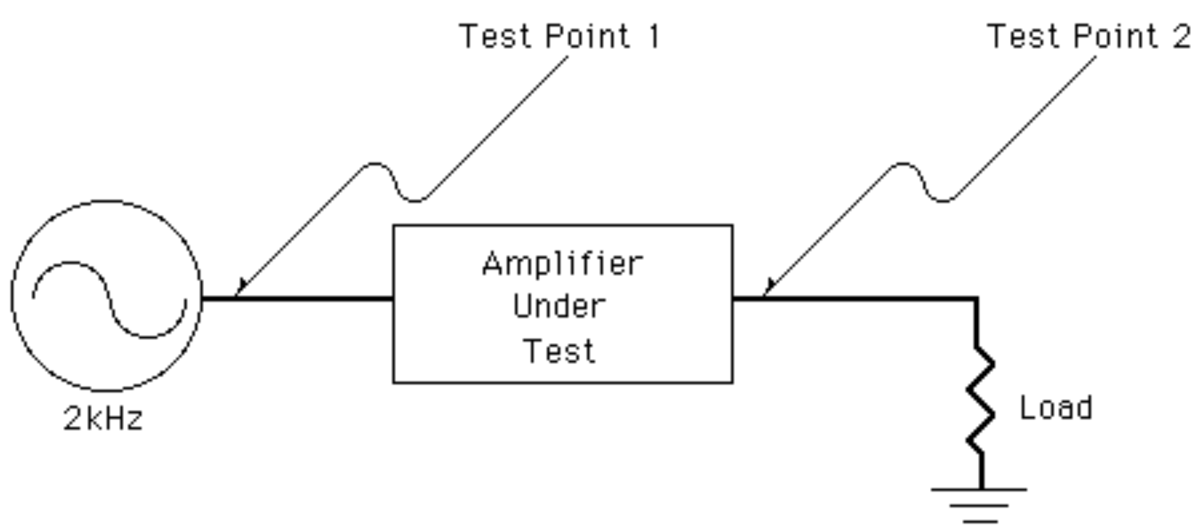


Figure XVI

1. Set up the equipment as shown with the output level of the sine wave generator set to zero.

2. Most preamplifiers have a very low output impedance and do not usually require a terminating load. Power amplifiers should always be terminated with an appropriate load when measuring power, gain, or frequency response.

3. A 10 mv input is equivalent to an IE-30A reading of +80 dBµV as can be seen using table 1 in the Appendix. Connect the IE-30A to test point 1 and adjust the signal source for a +80 dBµV output.

4. Measure the dBµV level at test point 2 at the output of the test amplifier. Let's assume we measure an output equal to 105.8 dBµV. Obviously, the amplifier has gain.

5. Subtract the reading at test point 1 from the reading at test point 2, observing the signs.

$$\text{Gain} = 105.8\text{ dB} - 80\text{ dB} = 25.8\text{ dB}$$

The amplifier gain is 25.8 dB at 2 kHz for the 10 mv input signal.

For gain and loss testing, we are only interested in the difference between the dB readings taken on the IE-30A. It is not correct to say that the gain is equal to 25.8 dBµV. Gain is a relative measurement, not an absolute one, and is normally expressed in dB.

Note: <u>Measuring the gain of amplifiers with output voltages in excess of 2 volts will require external attenuators on the IE-30A It is recommended that the IE-1036 RTA probe which came with the IE-30A be used for these applications.</u>

Second problem: A manufacturer specifies his audio device to have less than 10 dB of insertion loss at a frequency of 1 kHz. Verify his specification.

The test setup is shown on the next page. The difference between this measurement and the last one is that this time we will be looking for loss instead of gain. Additionally, this time we will use the IE-30A analyzer display screen to make our measurement, along with the SLM Readout Display which gives us our dBµV readout.

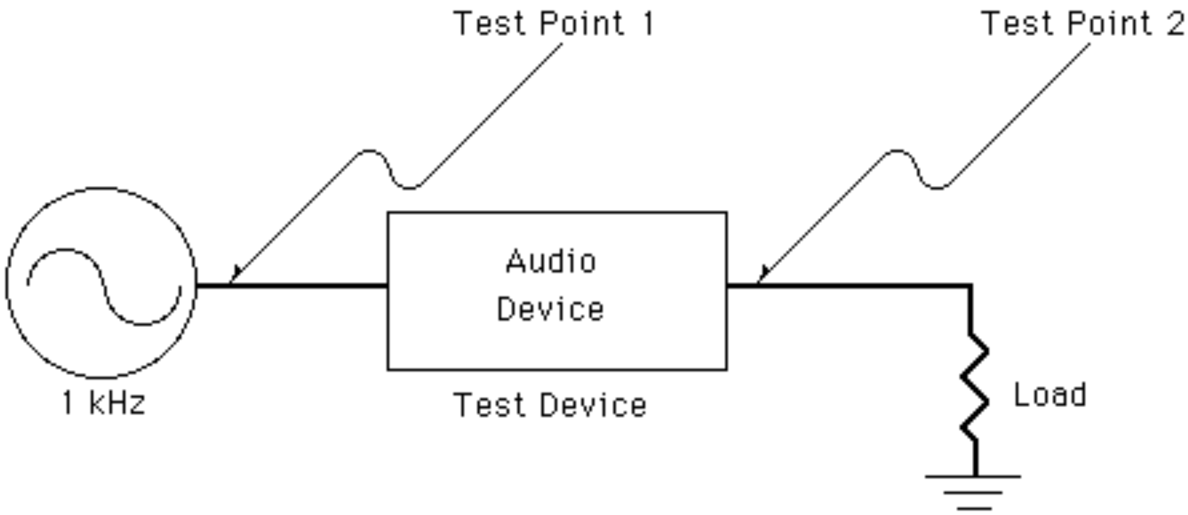


Figure XVII

1. Set up the equipment as shown above.

2. Set the IE-30A to 1dB per step for best resolution. Connect the IE-30A to test point one and adjust the 1 kHz output level of the generator such that the signal on the display of the IE-30A reaches the Reference Line, as shown below.
   Note: An input level of 1 volt rms will raise the display to the Reference Line when the Reference Line is set to 120 dB.

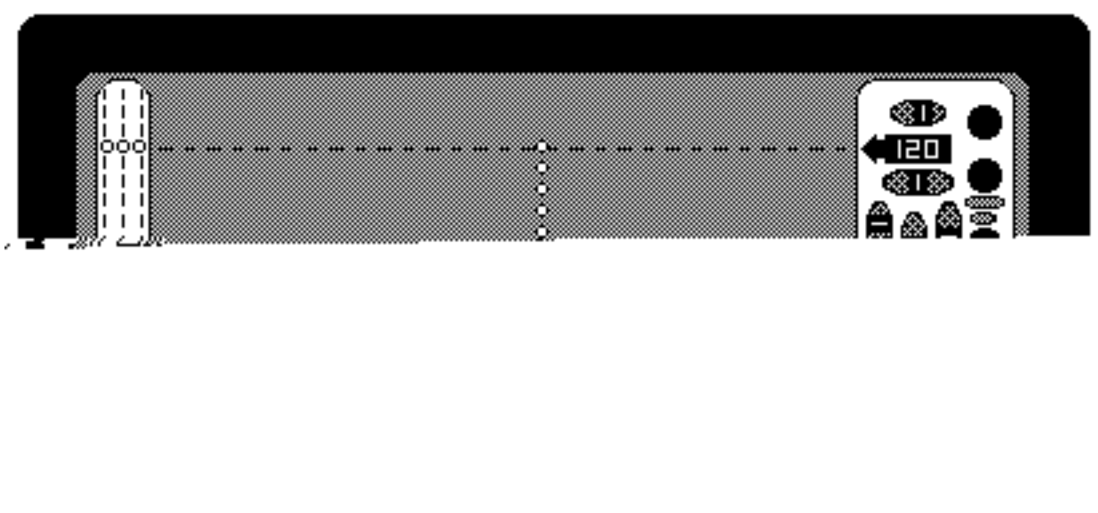


Figure XXIII

3. Move the IE-30A test probe to test point 2 and note the decrease in the signal level. The IE-30A display should then look something like **Figure XIX** on the following page:

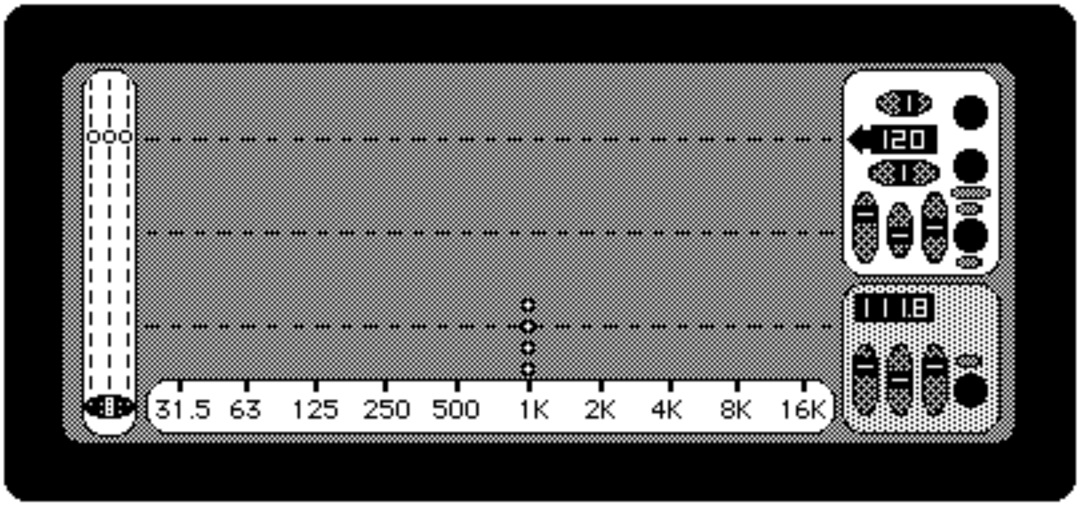


Figure XIX

4. Calculate the insertion loss. In the example above, the display has decreased by 8 dB, and the SLM Readout Display (which has greater resolution) has decreased by 8.2 dB. We would conclude the insertion loss to be 8.2 dB, well within the manufacturer's specification.

From the simple example above, we can begin to see the power of the IE-30A when used for electrical testing. For many applications it becomes even more powerful when used in conjunction with pink noise. Let's next examine in detail some pink noise measurements using the IE-30A and the IE-20B Noise Generator.

Pink Noise Testing with the IE-30A

Introduction - Pink Noise Theory

When is pink noise flat? Never!

There are a few fundamentals that should be understood before doing pink noise testing. Pink noise is random noise that appears flat only after being averaged over time by special detectors on a real-time analyzer, or a true rms voltmeter. On an oscilloscope, or a standard voltmeter, pink noise appears to be a mass of random voltage spikes - which is exactly what it is. However, when averaged over time, the noise appears very flat and the output rms voltage is highly stable. When measuring with pink noise and the IE-30A, the detectors in the IE-30A should always be in the pink noise averaging mode, which is the slowest available (D3).

We are often asked, "How flat is your noise generator?" That can be a misleading question, because noise is never flat. As we have said, noise is random in nature, and can be made to "appear" flat only when averaged over a sufficiently long period of time. Noise is a statistical phenomenon, and the averaging time necessary to create a "flat" appearance is mathematically predictable. Far better questions to ask are , "How flat are the filters in your noise generator?" and "What is the averaging time of the detectors in your real-time analyzer?"

To create pink noise, a noise generator first generates white noise. Our white noise generation is accomplished by a statistically accurate, shift register technique. Since white noise is equal energy per frequency, the energy content doubles each time you step up an octave. Such a signal is therefore too "hot" at high frequencies to be used as a sound system test signal. Pink noise, or equal energy per octave, is a much better test signal. To produce pink noise from white noise, we run the white noise through a 3dB per octave roll-off filter. The accuracy, or "flatness" of this filter determines the "flatness" of the pink noise produces. The filters in our noise generators are six pole filters and are very flat, which results in a very flat time-averaged output. The detectors in the IE-30A (the pink noise, or "slow" detectors) are designed to allow a maximum, $\pm$1dB flutter when the analyzer is in the 1dB/step mode. Furthermore, this mild flutter occurs only at the lower frequencies. Since each 1/3 octave bandwidth contains exactly twice as many discrete frequencies as the adjacent 1/3 bandwidth below it, as we increase in frequency, we increase in statistical stability. This means that as we continue to climb in frequency, we need shorter and shorter averaging times to achieve statistical stability. The IE-30A does, in fact, have shorter averaging times for the detectors at the higher frequency bandwidths. Even with these shorter averaging times, the higher frequency bandwidths are slightly more statistically stable than the lower frequency bandwidths.

You can create statistical instability in your measurement by changing the IE-30A detector response from "slow" (D3), to "medium" (D2) or even "fast" (D1). You will notice increased random movement of the display, especially at the lower frequencies. In the "fast" mode, it is virtually impossible to obtain a reasonable pink noise reading at low frequencies. It can easily be seen that making pink noise "flat" is as much a function of a good spectrum analyzer and its chosen integration time, as it is a function of a good noise generator.

What is Crest Factor?

An important aspect of a noise generator is its crest factor. The output of Ivie noise generators is calibrated in volts rms, and crest factor is the ratio of the peak voltage to the rms voltage. If a noise generator had a crest factor of 2, we could expect instantaneous voltage peaks, or spikes (either positive or negative) to reach an amplitude twice our rms output voltage. In other words, an rms voltage output of 1 volt could see peaks as high as 2 volts.

The purpose of pink noise is to provide a reference signal that approximates program material as closely as possible. If the crest factor is too low, we provide a signal with little dynamic range, which will not give us a very clear picture of how our sound system may perform with program material having normal dynamics. If our crest factor is to high, on the other hand, we will provide a signal with such a broad dynamic range that we could be causing clipping. Experimentation has shown that a crest factor of from 3.5 to 4.0 seems to work best and most closely approximate normal program material dynamics. Ivie noise generators have a crest factor of 3.75.

In conclusion, pink noise approximates actual audio signal better than any other type of signal source. It is also one of the best signal sources available for doing rigorous testing of amplifier durability, and transient signal handling capabilities. Pink noise is used in conjunction with a real-time analyzer more widely than any other signal source. Some analyzers have pink noise generators built into them. Ivie has chosen to keep its noise generators separate from its analyzers, even though it is more expensive to do so, because experience has shown that the location where we want to inject pink noise into a system is rarely the same location where we want to have our analyzer. Additionally, having the noise generator in the same box with the analyzer generates the temptation to match one to the other, by "tweaking" the analyzer filters to match the pink noise output. Some manufacturers do in fact do this, which makes the analyzer incompatible with another pink noise source. At Ivie, we believe it is better to have both instruments independently flat, and so that is the approach we use. Any Ivie noise generator will work with any Ivie analyzer.

The last thing we wish to say about pink noise is that it **cannot** be used for gating or pulsing techniques. The random nature of pink noise (which is, in fact, its greatest asset) prevents it from being spectrally complete or repeatable in short bursts. Consistent results cannot be produced.

Room Response Testing

Pink noise is often used in conjunction with a real time analyzer for testing room response and for equalizing sound systems. Preferred equalization curve requirements differ according to the intended use of the sound system and its environment, and there are many opinions as to what those curves should look like. It is not the intent of Ivie to recommend one equalization curve or process over another, but to provide equipment with sufficient flexibility to allow the user to make his own choices.

There are, however, some useful techniques that are quite universal in application. These involve such things as system documentation, electrical testing and trouble-shooting, and measurement of acoustical performance. Some of these techniques are explored in the next section of this manual entitled "Electrical Testing and System Documentation Using Pink Noise." Acoustical testing is touched upon as well, but there is much that is left unexplored. There are many aspects of these techniques about which much has been written and argued - whether to use one microphone, or several; whether to do only time averaging, or do spatial averaging as well - this list goes on and on. The reader is encouraged to study and learn as much about all of these approaches as he can, and to make his own determination as to the techniques he prefers. The IE-30A will accommodate them.

Electrical Testing and System Documentation Using Pink Noise

One of the most useful aspects of the IE-30A Audio Spectrum Analyzer and the IE-20B Pink Noise Generator is their ability to be used in tandem to perform a great variety of of useful electrical measurements. These measurements can not only verify system specifications, but, when properly documented, can also save literally hours in trouble shooting.

The first step in making electrical measurements is calibrating the analyzer to the pink noise generator to establish a reference. The following illustration demonstrates this:

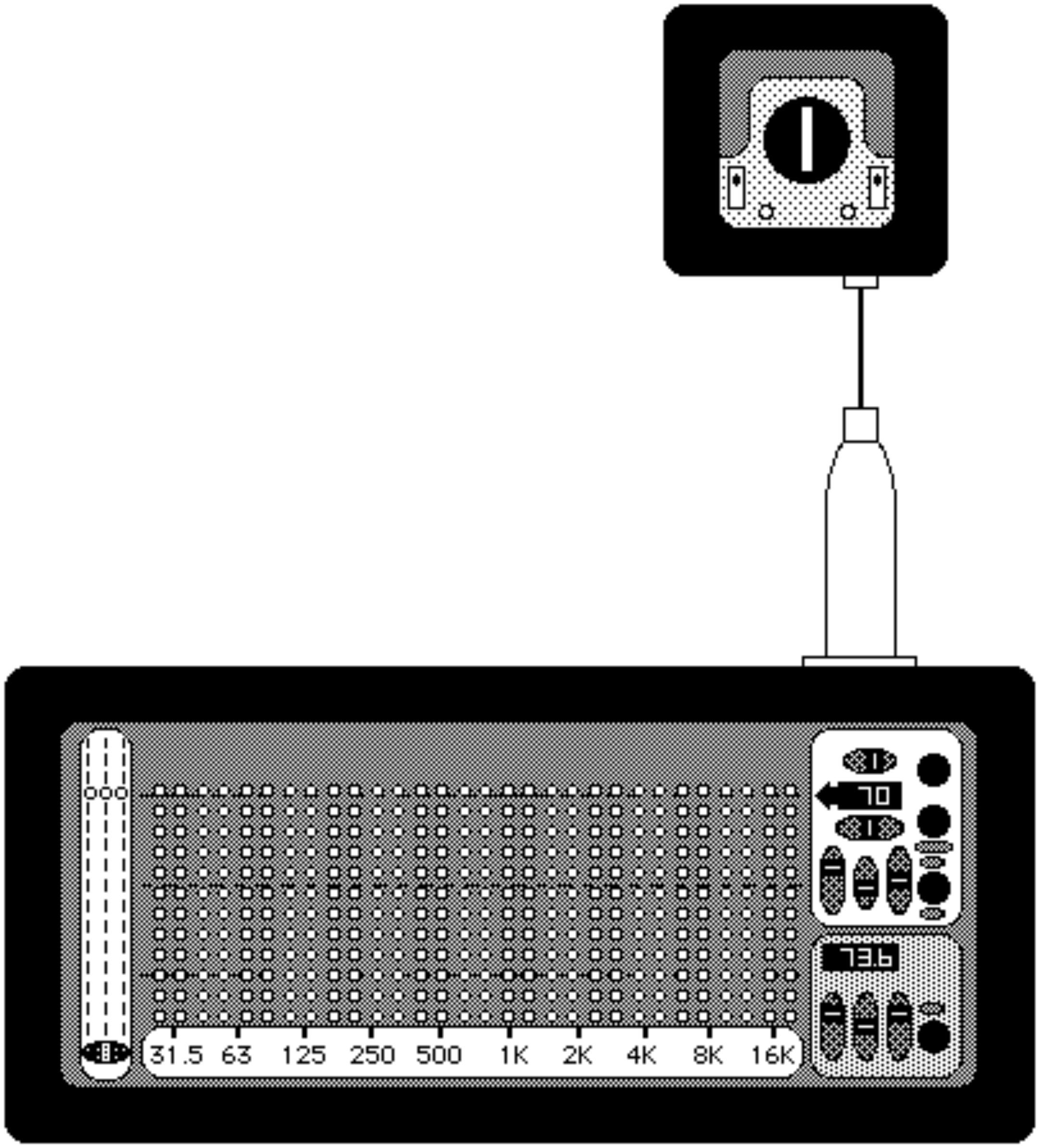


Figure XX

In this example, the pink noise level has been set such that the amplitude of the display reaches the Reference Line. With the analyzer being capable of measuring dB µvolts, an exact signal level can be read directly to a resolution of .1dB. We now have a reference spectral content, amplitude within each 1/3 octave band, and the absolute level of the input signal.

If we now insert an audio device into the circuit between the pink noise generator and the analyzer, we can measure all kinds of parameters. Let's take insertion loss as an example. We insert the device to be tested as shown below:

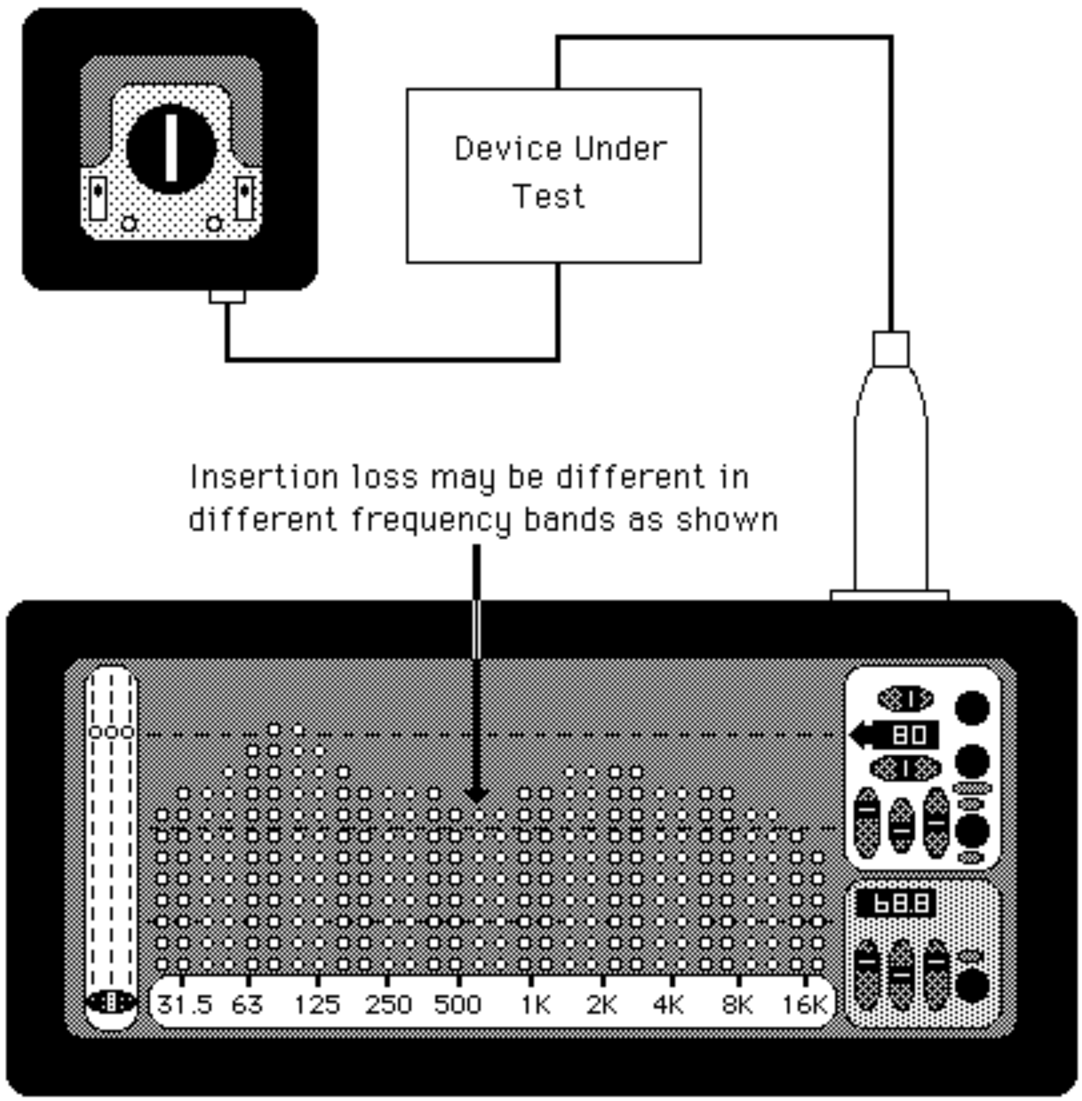


Figure XXI

In this measurement we can see the frequency selective nature of insertion loss. We can also measure, in dB, the exact drop in total signal level.

If our device under test were an amplifier, we could measure its 1/3 octave frequency response, and its voltage gain. If the device under test were a crossover, we could measure its gain or loss, see the frequency response of each leg, view the crossover point, and verify the roll-off associated with the band pass filters. We could measure the gain structure and frequency response of a single filter, or a whole bank of filters such as found in an equalizer.

Let's consider another interesting measurement. We can set it up feeding pink noise into the front end of our sound system. Using the IE-30A probe, we can tap into the output of our amplifier (the amplifier should be loaded) and look at the spectral display of information coming from the amplifier. Setup would be as shown below:

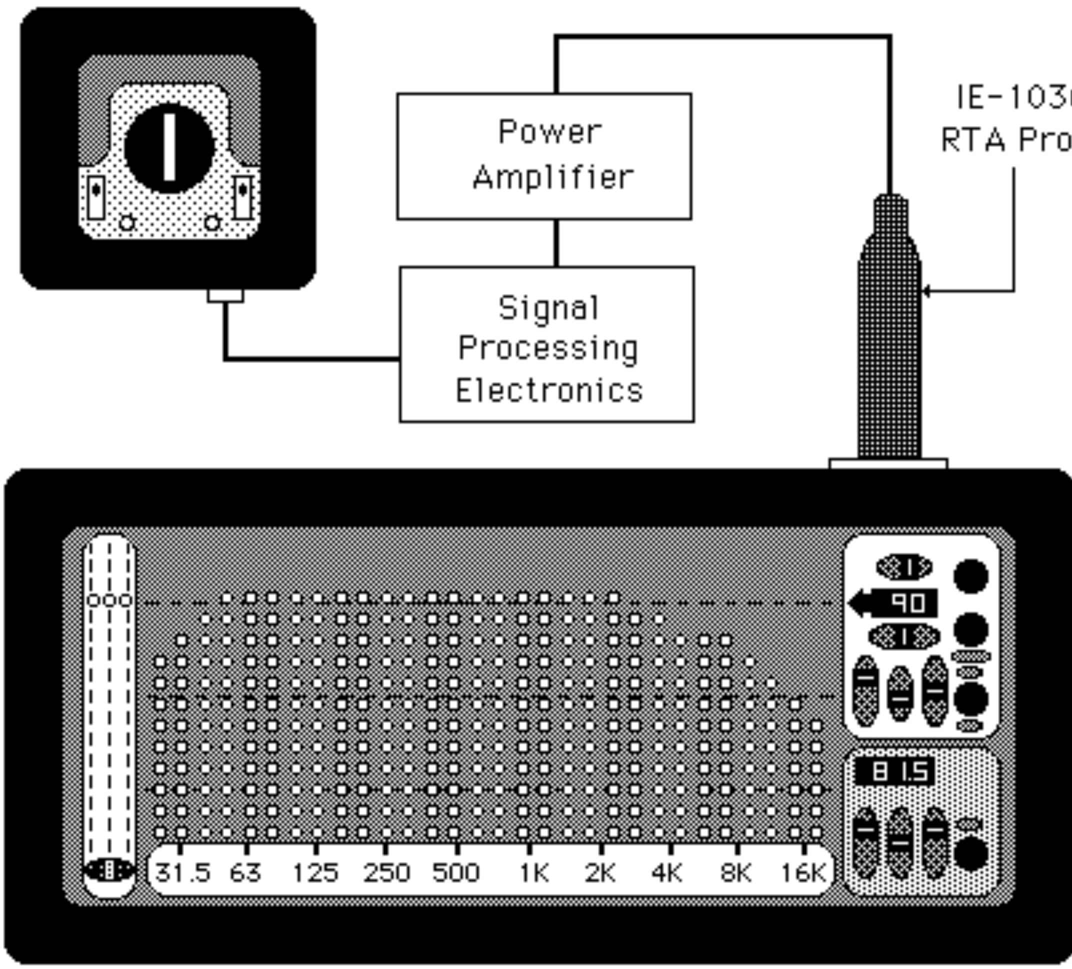


Figure XXII

Again, it would be important in our setup to make certain that the amplifier we are testing has been properly terminated, as shown below:

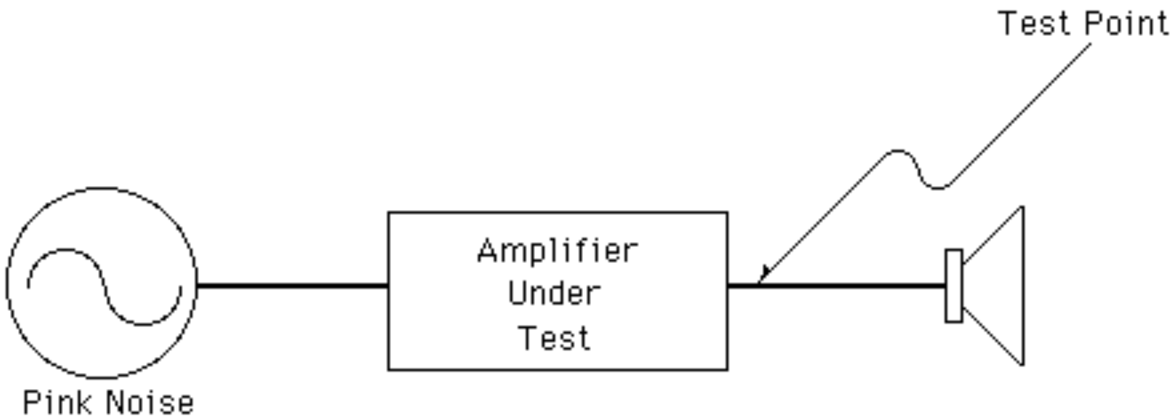


Figure XXIII

Notice that the output from the amplifier has been adjusted with both low and high end rolloff - not unlike we would expect to see. Other than that, the response looks very flat.

Next, for fun, we can look at the acoustic output of the speaker being fed by the amplifier to compare its spectral output with its electrical input. This time, instead of using the IE-30A probe, we plug in the microphone and listen to the speaker without changing our input signal. Any differences in spectral information will reflect the performance of the speaker in its environment. Incidentally, research has shown that the anechoic response of a speaker can quite accurately predict its response in an ordinary room. If we have a plot of the anechoic response, we would expect the response in our room to correlate.

At any rate, our test setup would change as shown on the following page:

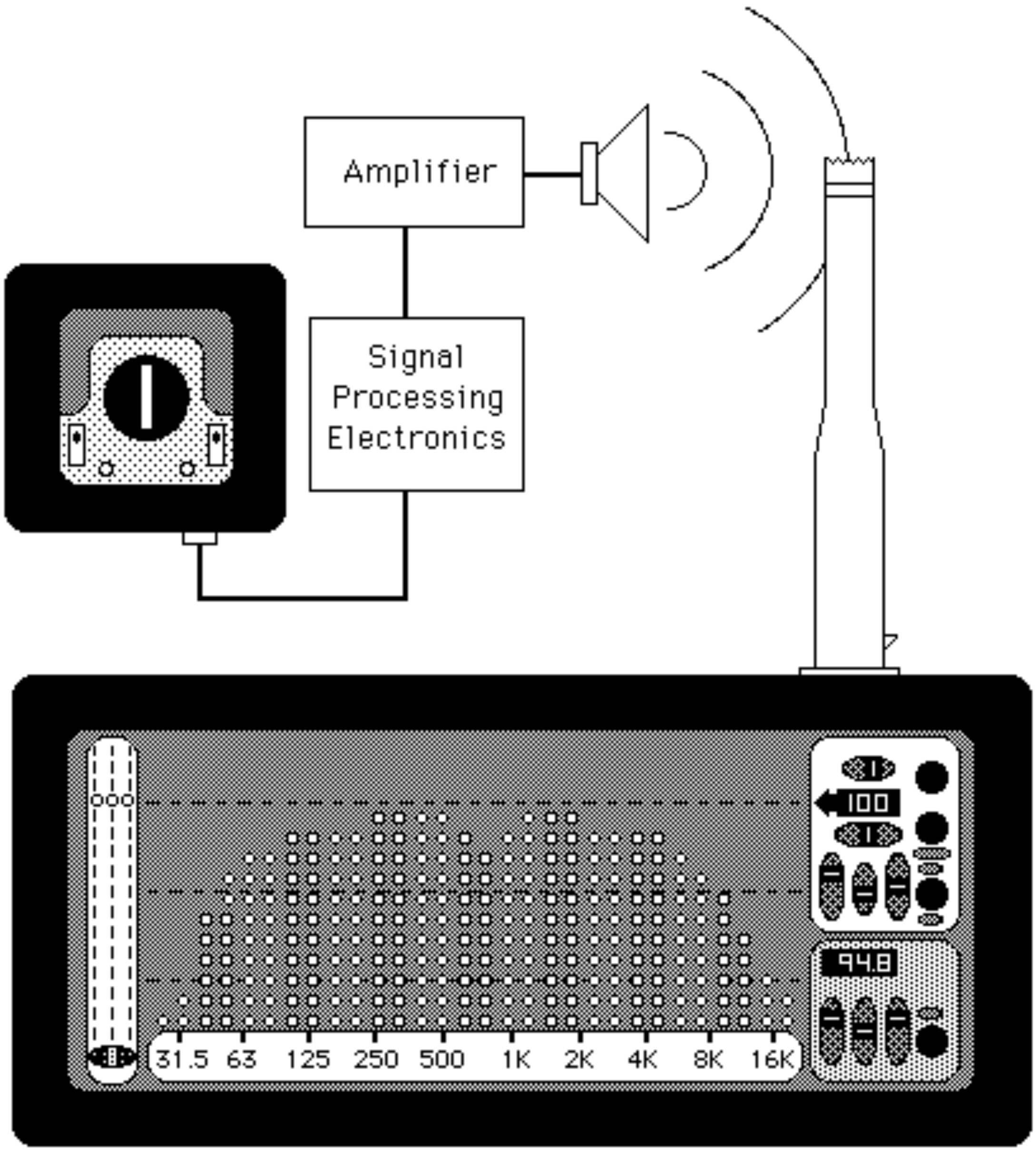


Figure XXIV

Obviously, we would expect to see some differences in response, as this illustration shows.

The power of this simple measurement process should become somewhat evident. By adding simple variations to the above setups, the parameters we can measure or verify are extensive. Let's consider the value of this approach in trouble shooting.

We are called back to a system which is not properly operating. It's a fairly simple system - a four input automatic mixer with an aux channel for music, a 1/3 octave equalizer, a two-way crossover, two one hundred watt amps for bass, and three fifty watt amps driving the high end.

We bring our set of documentation for this job, and we plug our pink noise generator into the music channel of the mixer. Our documentation shows the following:

1. The input level at which we should set our pink noise.

2. The settings on the mixer.

3. The output level and a plot of the spectral response of the mixer (which is also the input information for the equalizer).

4. The output level of the equalizer and a spectral plot of its output.

5. The output level of each of the legs of the crossover, and a spectral plot of each one showing crossover point and filter skirts.

6. The input level, gain, and output spectral plot for each amplifier.

7. A map of the listening area for the system with several points located. For each point, there is a spectral plot and dB SPL referenced.

It is now a quick and simple matter to step through each component of the system with the analyzer and a probe. Any defective component or change in setting can be quickly detected. Setting changes can be speedily corrected. If everything checks out electrically, measurements at the documented points in the listening area can identify speaker problems. Since we know what the output and spectral content of each amplifier is, we can verify that information at the input of a speaker to make certain we have no wiring problems.

Obviously, we have not covered every sound system parameter, but it can be easily seen that spending a little time in system documentation can save a lot of time in trouble shooting and correcting system problems.

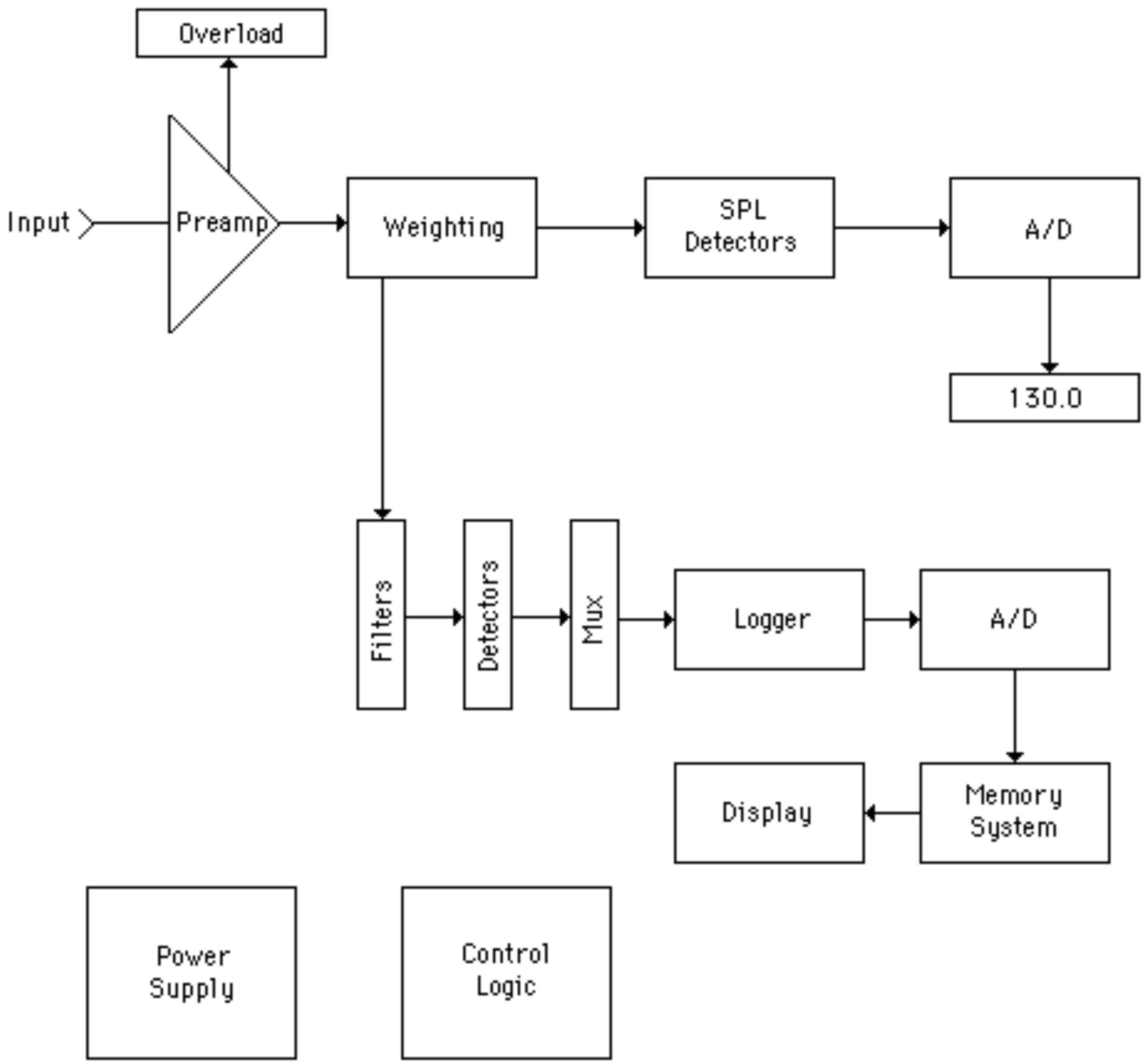
Appendix: Table 1: dBµV to Vrms

dBµv	Vrms	dBµv	Vrms	dBµv	Vrms	dBµv	Vrms
-6	0.5 µv	39	89.1 µv	84	15.8 mv	129	2.82 v
-5	0.56 µv	40	0.1 mv	85	17.8 mv	130	3.16 v
-4	0.63 µv	41	0.112 mv	86	20.0 mv	131	3.55 v
-3	0.71 µv	42	0.126 mv	87	22.4 mv	132	3.98 v
-2	0.70 µv	43	0.141 mv	88	25.1 mv	133	4.47 v
-1	0.89 µv	44	0.158 mv	89	28.2 mv	134	5.01 v
0	1.00 µv	45	0.178 mv	90	31.6 mv	135	5.62 v
1	1.12 µv	46	0.200 mv	91	35.5 mv	136	6.31 v
2	1.26 µv	47	0.22 4mv	92	39.8 mv	137	7.08 v
3	1.41 µv	48	0.25 1mv	93	44.7 mv	138	7.94 v
4	1.58 µv	49	0.282 mv	94	50.1 mv	139	8.91 v
5	1.78 µv	50	0.316 mv	95	56.2 mv	140	10.00 v
6	2.0 µv	51	0.355 mv	96	63.1 mv	141	11.2 v
7	2.24 µv	52	0.398 mv	97	70.8 mv	142	12.6 v
8	2.51 µv	53	0.447 mv	98	79.4 mv	143	14.1 v
9	2.82 µv	54	0.501 mv	99	89.1 mv	144	15.8 v
10	3.16 µv	55	0.562 mv	100	0.1 v	145	17.8 v
11	3.55 µv	56	0.631 mv	101	.112 v	146	20.0 v
12	3.98 µv	57	0.708 mv	102	.126 v	147	22.4 v
13	4.47 µv	58	0.794 mv	103	.141 v	148	25.1 v
14	5.01 µv	59	0.891 mv	104	.158 v	149	28.2 v
15	5.62 µv	60	1.00 mv	105	.178 v	150	31.6 v
16	6.31 µv	61	1.12 mv	106	.200 v	151	35.5 v
17	7.08 µv	62	1.26 mv	107	.224 v	152	39.8 v
18	7.94 µv	63	1.41 mv	108	.251 v	153	44.7 v
19	8.91 µv	64	1.58 mv	109	.282 v	154	50.1 v
20	10.0 µv	65	1.78 mv	110	.316 v	155	56.2 v
21	11.2 µv	66	2.00 mv	111	.355 v	156	63.1 v
22	12.6 µv	67	2.24 mv	112	.398 v	157	70.8 v
23	14.1 µv	68	2.51 mv	113	.447 v	158	79.4 v
24	15.8 µv	69	2.82 mv	114	.501 v	159	89.1 v
25	17.8 µv	70	3.16 mv	115	.562 v	160	100.0 v
26	20.0 µv	71	3.55 mv	116	.631 v	161	112.2 v
27	22.4 µv	72	3.98 mv	117	.708 v	162	125.9 v
28	25.1 µv	73	4.47 nv	118	.794 v	163	141.3 v
29	28.2 µv	74	5.01 mv	119	.891 v	163	158.5 v
30	31.6 µv	75	5.62 mv	120	1.00 v	165	177.8 v
31	35.5 µv	76	6.31 mv	121	1.12 v	166	199.5 v
32	39.8 µv	77	7.08 mv	122	1.26 v	167	223.9 v
33	44.7 µv	78	7.94 mv	123	1.41 v	168	251.2 v
34	50.1 µv	79	8.91 mv	124	1.58 v	169	281.8 v
35	56.2 µv	80	10.0 mv	125	1.78 v	170	316.2 v
36	63.1 µv	81	12.6 mv	126	2.00 v	171	354.8 v
37	70.8 µv	82	12.6 mv	127	2.24 v	172	398.1 v
38	79.4 µv	83	14.1 mv	128	2.51 v	173	446.7 v
						174	501.2 v

Appendix: Table 2: dBμV to dBm

dBμv	dBm	dBμv	dBm
-6	-123.8	39	-78.8
-5	-122.8	40	-77.8
-4	-121.8	41	-76.8
-3	-120.8	42	-75.8
-2	-119.8	43	-74.8
-1	-118.8	44	-73.8
0	-117.8	45	-72.8
1	-116.8	46	-71.8
2	-115.8	47	-70.8
3	-114.8	48	-69.8
4	-113.8	49	-68.8
5	-112.8	50	-67.8
6	-111.8	51	-66.8
7	-110.8	52	-65.8
8	-109.8	53	-64.8
9	-108.8	54	-63.8
10	-107.8	55	-62.8
11	-106.8	56	-61.8
12	-105.8	57	-60.8
13	-104.8	58	-59.8
14	-103.8	59	-58.8
15	-102.8	60	-57.8
16	-101.8	61	-56.8
17	-100.8	62	-55.8
18	-99.9	63	-54.8
19	-98.8	64	-53.8
20	-97.8	65	-52.8
21	-96.8	66	-51.8
22	-95.8	67	-50.8
23	-94.8	68	-49.8
24	-93.8	69	-48.8
25	-92.8	70	-47.8
26	-91.8	71	-46.8
27	-90.8	72	-45.8
28	-89.8	73	-44.8
29	-88.8	74	-43.8
30	-87.8	75	-42.8
31	-86.8	76	-41.8
32	-85.8	77	-40.8
33	-83.8	78	-39.8
34	-82.8	79	-38.8
35	-81.8	80	-37.8
36	-80.8	81	-36.8
37	-78.8	82	-35.8
38	-79.8	83	-34.8

Appendix: IE-30A Block Diagram



IVIE ELECTRONICS INC.

500 WEST 1200 SOUTH
OREM, UTAH 84057
(801) 224-1800
TELEX or TWX 910-971-5884

Piston phones 4230 B+K small
Piston phone 4220 B+K ones

there are 314 connectors in 30

Price List

June 1980

Service Modules and Parts IE-30A

Part Number	Description	Dealer Cost	
00030A-P0110C	Display	605.00	641.30
-P0310B	Master Interconnect	143.00	151.58
-P0410F	Preamp	110.00	116.60
-P0510G	SPL	61.00	64.66
-P0610F	Logger	71.00	75.26
-P0710C	Power Supply	117.00	124.02
-P0810L	Charging Module	99.00	104.94
-P0910F	A Filter 25, 31.5, 40	150.00	159.00
-P1010E	B Filter 50, 63, 80	150.00	"
-P1110E	C Filter 100, 125, 160	150.00	"
-P1210E	D Filter 200, 250, 315	150.00	"
-P1310C	E Filter 400, 500, 630	135.00	143.00
-P1410D	F Filter 800, 1K, 1.25	135.00	$1365
-P1510C	G Filter 1.6, 2K, 2.5	135.00	25.00 exchange
-P1610C	H Filter 3.15, 4K, 5	120.00	127.20
-P1710M	I Filter 6.3, 8K, 10	120.00	"
-P18100	J Filter 12.5, 16K, 20	120.00	"
-P0210C	Memory	315.00	333.90
-F0110A	Nylon Case & Extrusion	50.00	53.00
-M0610A	Graticule	20.00	21.20
-M0710A	Red Filter	12.00	12.72
BT1-4CELL00	Nickel Cadmium Cells (Four)	32.00	~~33.92~~ 34.00
0001PA-A0110A	1A Preamp	~~$75.00~~	NA
MKO-IE1P000	Electret	100.00	106.00
0002DA-A0110A	IEDL 18	20.00	see price list
0002DA-A0210A	IEAL 62	20.00	see price list
A0410A	IEDL 36	20.00	see price list

Order Processing Fee $10.00 Minimum Order $25.00

Ship F.O.B. OREM

0002AA-A0310A	short	
H20-1401001	2P/3P Red Plastic Cap	.50
00030A-F0510A	I/O Connector	~~7.25~~ 7.69
H10-1540004		
H20-9223004	Logotite Case	55.00
H20-9223005	foam inserts top bottom	17.00
H20-0370001	Switch Caps	.10

Boards effected By ECO

5-15-78

30P01

Memory	2	R111 2.2K, R114 $\frac{osc}{1M\Omega}$, ~~R130 15K~~, IC 13 TL062, IC 16 TL064 IC 21 TL064, ~~R150 10K~~ ~~R149 10K~~, R147 1K, R148 1K, ~~R77 8.25K~~, R60 187K ~~R32 4.7K~~, C29 220pf 50v (pin 10+13), C5 .01µ 50v, R14 200K, Q_3 MPSA13, R77 Trim, R32 47K, cut trace pin 13 IC 16 and CR23, (layout mistake) jumper pin 13 to R146 R75, R130 12K, R61 90.9K, add 20K series trim, R141 10K pot, R63 20K, R103 5.11K, R104 5.11K, SPL underrange, IE-17 → cut IC 21-1 to R103 drill #72 hole for R104, R68 100kΩ, C14 100pf, Rewire X axis, cut trace R129 - R123 jump R129 to X5
	3	
Preamp	4	R_7 3MΩ C_3 1000pf
	5	
	6	
	7	
Charger	8	[Remove R23, R25, C3, cut gnd], C_4 47µ 6v, Q_3 emitter pin 6 amphenol, R24 match relay
A	9	C210 4.7µ 10v R221 71.5k, settling CX11 2.2µ 20v (3), CX12 10µ 15v (3)
B	10	C210 4.7µ 10v R221 29.4K
C	11	C210 2.2µf 20v R221 39.2K
D	12	C210 1µf 20v R121 8.66k, R221 29.4k, R321 8.66K,
E	13	R215 38.3K, R315 8.66K
F	14	R115 8.66K, R215 48.7K, R315 8.66K
G	15	R215 42.2K, R315 8.66K
H	16	R115 8.66K, R215 25.5K, R315 8.66K (Octave Response)
I	17	R215 39.2K
J	18	R108 1.21K, R208 1.21K, R308 1.24K, R107 15K, R207 14K, R307 12.7K, R115 8.66K, R215 39.2K, R315 8.66K (Passband flatness)

Cetec Ivie

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Orem, Utah 84057
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TELEX or TWX: 910-971-5884

IE30A SERVICE MANUAL

CONTENT

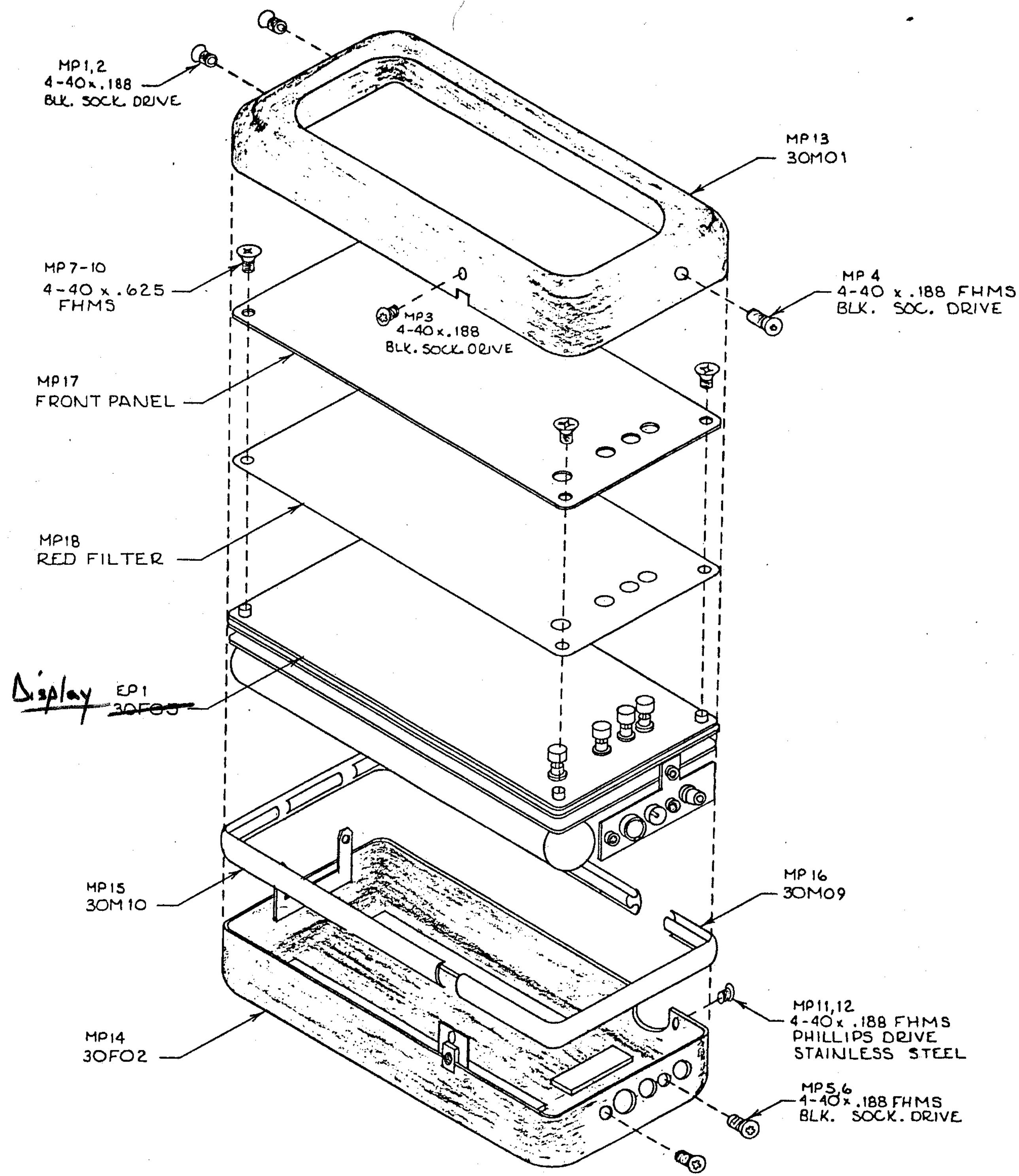
HINTS FOR EXTENDING THE LIFE OF YOUR NICKEL CADMIUM BATTERY

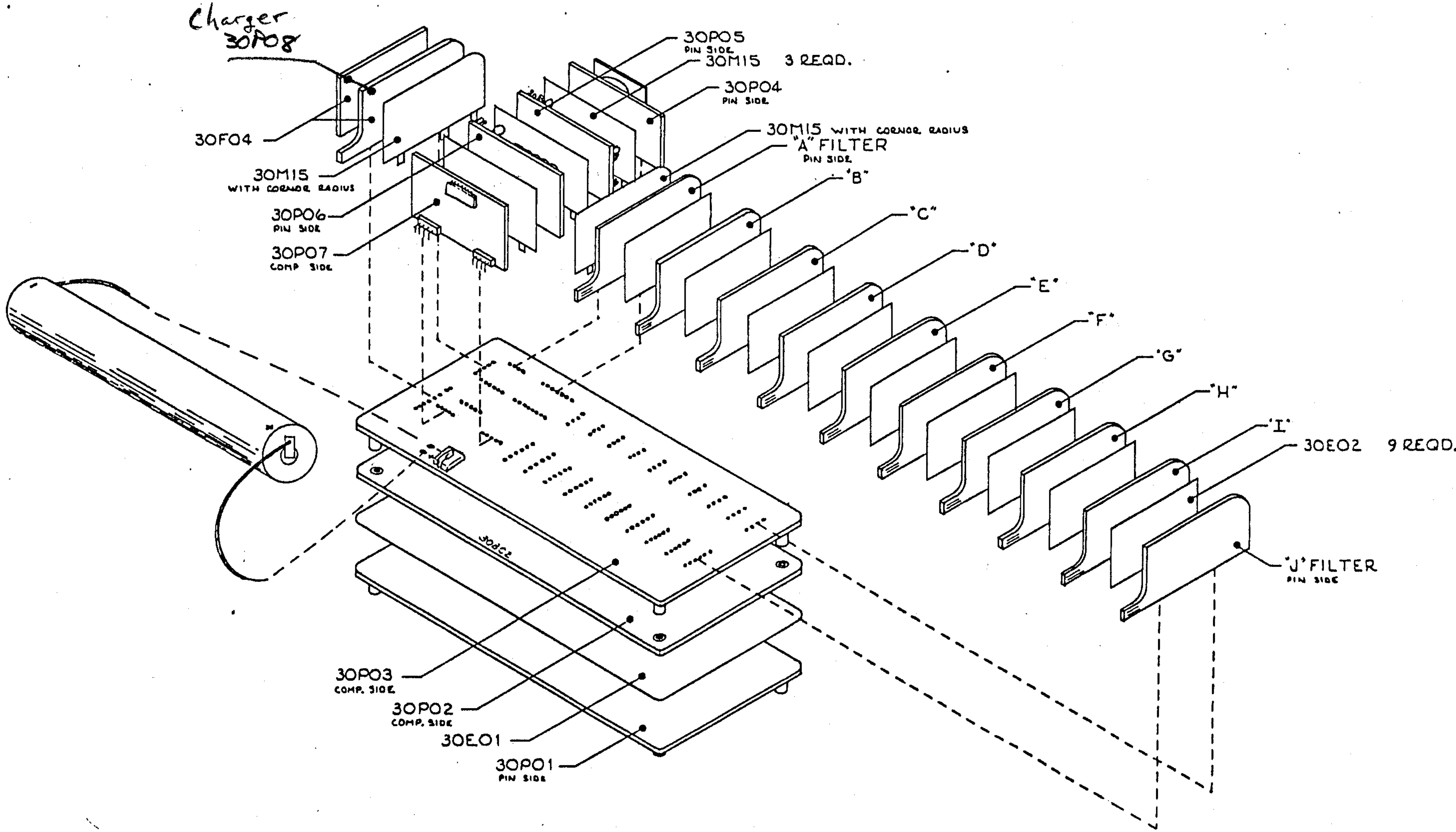
Your unit is equipped with a sophisticated heavy duty nickel cadmium rechargeable battery. It is probably unlike any battery system you have used before.

Before usage, recharge your batteries for 14 - 16 hours. Occasionally discharge your battery until your unit fails to operate to insure maximum run time.

Should you not use your unit for several months or more, it is best to first charge the batteries followed by a discharge until your unit fails to operate. Several cycles may be required to bring your battery back to full capacity. Also, when the batteries are not in use, storage in a cool area rather than in a hot one will increase battery life.

While each system is impossible to predict, you should be able to cycle your battery from 300 - 1,000 times over a period of 2 - 3 years before battery failure.


MP1,2
4-40 x .188
BLK. SOCK. DRIVE
MP13
30M01
MP7-10
4-40 x .625
FHMS
MP3
4-40 x .188
BLK. SOCK. DRIVE
MP 4
4-40 x .188 FHMS
BLK. SOC. DRIVE
MP17
FRONT PANEL
MP18
RED FILTER
Display EP1
30F05
MP15
30M10
MP 16
30M09
MP11,12
4-40 x .188 FHMS
PHILLIPS DRIVE
STAINLESS STEEL
MP14
30F02
MP5,6
4-40 x .188 FHMS
BLK. SOCK. DRIVE


Charger 30P08
30P05
PIN SIDE
30M15 3 REQD.
30P04
PIN SIDE
30M15 WITH CORNOR RADIUS
"A" FILTER
PIN SIDE
"B"
"C"
"D"
"E"
"F"
"G"
"H"
"I"
30E02 9 REQD.
"J" FILTER
PIN SIDE
30F04
30M15
WITH CORNOR RADIUS
30P06
PIN SIDE
30P07
COMP SIDE
30P03
COMP. SIDE
30P02
COMP. SIDE
30E01
30P01
PIN SIDE

8

IE-30A DISASSEMBLY

1. Remove 4 black hex head screws from front case half. (1/16th inch hex)

2. Remove 2 black hex head screws near charge jacks in back case half.

3. Remove 2 phillips head screws from audio input connector jack.

4. With IE-30A on its back on soft scratchless pad, lift front half of case off.

5. Pull off black molded extrusion.

6. Tip entire contents out of back case half as though it were hinged at the output and charger jacks. Use care in handling the loose battery.

7. Remove 4 screws from corners of front panel.

8. Any defective modules can now be unplugged for substitution testing.

   CAUTION - When unplugging or plugging in the charger board 30P04, the ambient temperature sensing diode is easily shorted by improper pin alignment.

   See charging circuit temperature sensing calibration.

IE-30A Assembly

1. Assemble modules using caution with charger board 30P08 pin alignment. The ambient temperature sensing diode on 30P03 (under B & C filters) is easily shorted.

2. Turn assembly on - check that LED's light - basic operation.

3. Plug in filtered DC charger. Adjust for 10 mvdc pin 2 & 3 of LM393 comparator IC on 30P08 board using 200Ω cal potentiometer on the PC board. Both temperature sensing diodes must be at room temperature. Visually check pin and socket alignment throughout IE-30A.

4. Place red film on IE-30A display and remove lint.

5. Set graticule on top of red film.

6. Replace and tighten 4 screws in corners of graticule.

7. Place assembly in back half case - as though hinged at charge and output jacks.

8. Place two screws in input connector and tighten. IE-30A can now be electronically tested and calibrated. (See Test and Cal procedure).

9. Place extrusion (black plastic strips) around bottom half of case.

10. Set top half of case over graticule.

11. Replace 6 black case screws.

12. Free sticky buttons by pulling button off through the front panel and centering metal switch body to front panel hole.

IE-30A CALIBRATION AND TEST PROCEDURE rev. A

(With IE-30A module assembly out of the case)

1. Plug DC 7 volt charger into right hand charge jack-current ≤ 1.5 amp.

Red Chg LED on?

1 to 1.5 Amp charging current

No

30 draws ≈ 500mA from battery when on

30 draws ≈ 5uA from battery when off

190A CANNOT BE USED

Set pins 2&3 of LM393 on 30B08 to ≤ 10 mvdc using 200Ω calibration potentiometer on 30B08. Both temperature sensing diodes at room temperature.

Check for shorted diodes:

1) Temp. sensing on foam next to battery
2) Ambient temp. sensor under "B" & "C" filter modules on 30P03 (close to cal pots

Pins 2&3 LM393 on 30B08. Set to ≤10 mvdc

Green CHG LED turns on after batteries become warm (2-6 hrs.)

See above step.

IE-30A dB REF turns on at 60 dB/RT unfroze

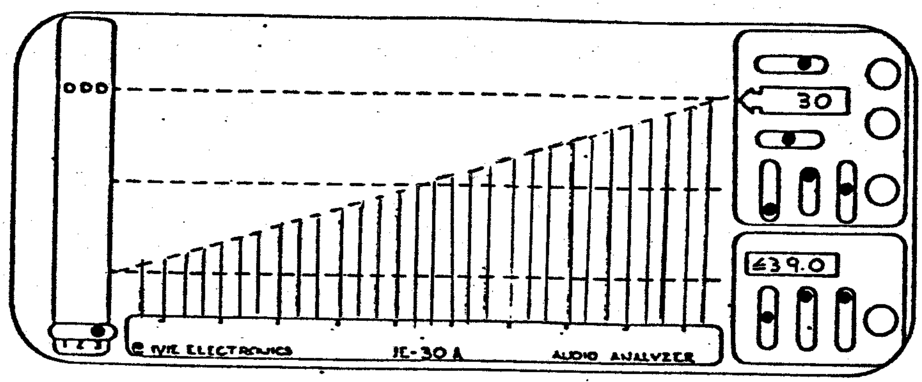
Batteries ≥ 4.6 volts, open fuses. Abnormal DC bias voltages 14 v, 12 v, causes automatic shut-down: typically display goes to 1 LED and then blank. Unit will turn on for approx. 1 sec. intervals only.

Place IE-30A in its case

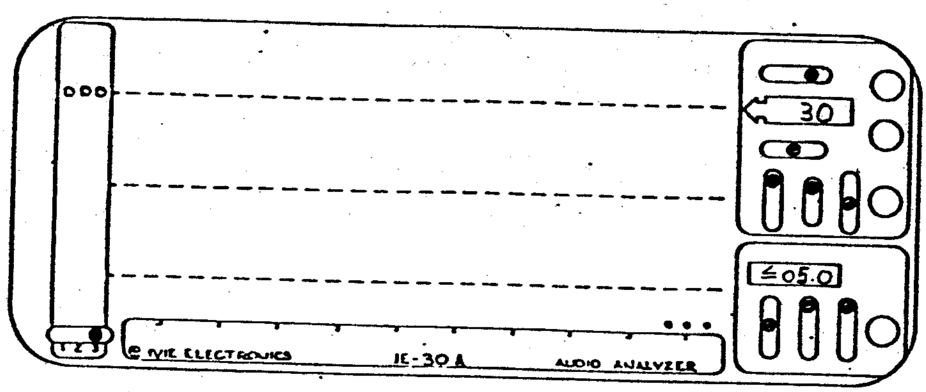
Normal Noise Floors

See next page.

IE-30A Noise Floors



Typical maximum gain, no input noise floor 3 dB/step (input open).



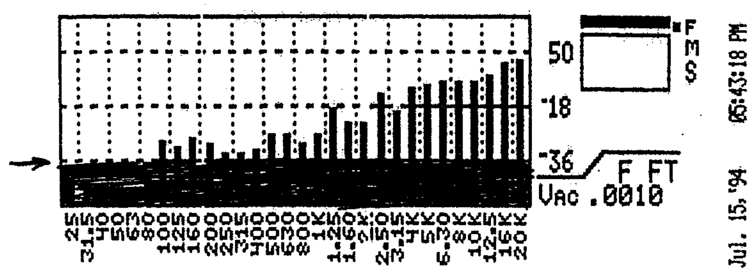
flashing underrange

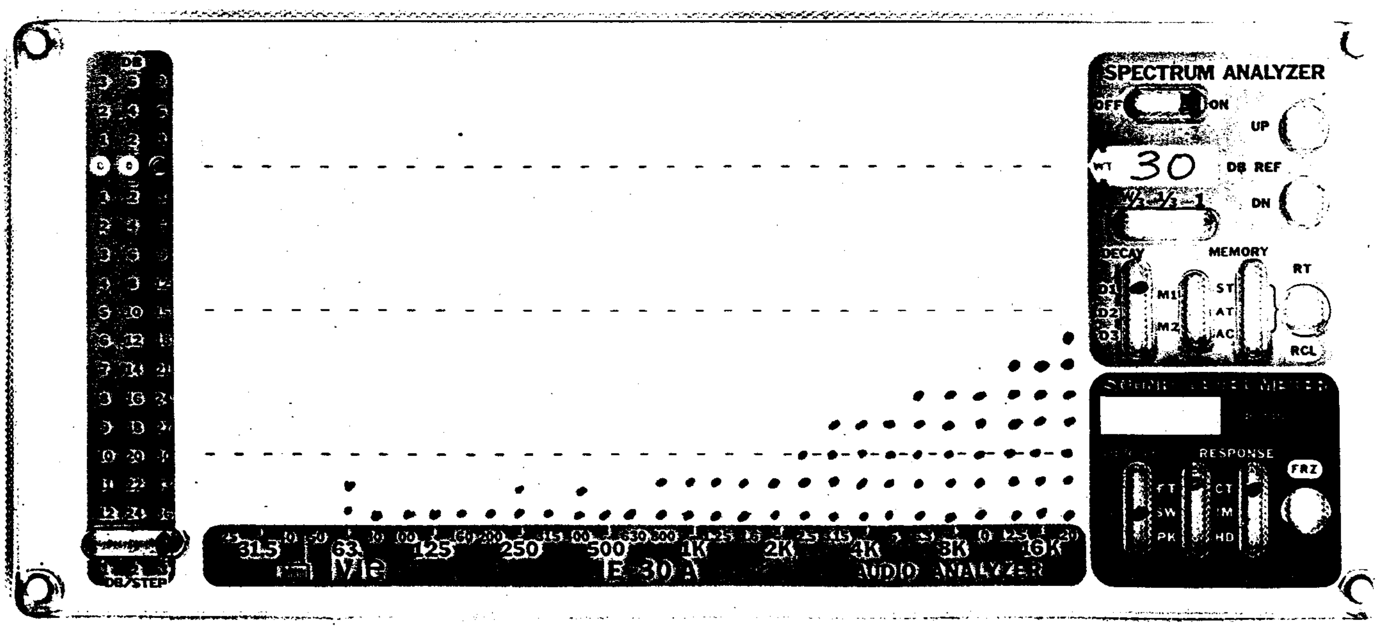
Noise floor with input shorted and Pin 4 shorted to Pin 5. dBuV.

TABLE 4.1 A, B, and C Electrical Weighting Networks for the Sound-level Meter

These numbers assume a flat, diffuse-field (random-incidence) response for the sound-level meter and microphone (see Ref. 2)

Frequency, Hz	A-weighting relative response, dB	B-weighting relative response, dB	C-weighting relative response, dB
10	−70.4	−38.2	−14.3
12.5	−63.4	−33.2	−11.2
16	−56.7	−28.5	−8.5
20	−50.5	−24.2	−6.2
25	−44.7	−20.4	−4.4
31.5	−39.4	−17.1	−3.0
40	−34.6	−14.2	−2.0
50	−30.2	−11.6	−1.3
63	−26.2	−9.3	−0.8
80	−22.5	−7.4	−0.5
100	−19.1	−5.6	−0.3
125	−16.1	−4.2	−0.2
160	−13.4	−3.0	−0.1
200	−10.9	−2.0	0
250	−8.6	−1.3	0
315	−6.6	−0.8	0
400	−4.8	−0.5	0
500	−3.2	−0.3	0
630	−1.9	−0.1	0
800	−0.8	0	0
1,000	0	0	0
1,250	+0.6	0	0
1,600	+1.0	0	−0.1
2,000	+1.2	−0.1	−0.2
2,500	+1.3	−0.2	−0.3
3,150	+1.2	−0.4	−0.5
4,000	+1.0	−0.7	−0.8
5,000	+0.5	−1.2	−1.3
6,300	−0.1	−1.9	−2.0
8,000	−1.1	−2.9	−3.0
10,000	−2.5	−4.3	−4.4
12,500	−4.3	−6.1	−6.2
16,000	−6.6	−8.4	−8.5
20,000	−9.3	−11.1	−11.2


50
18
-36
F FT
VAC .0010
F
M
S
Jul. 15, '94
05:43:18 PM


SPECTRUM ANALYZER
OFF
ON
UP
30
DB REF
DN
DECAY
MEMORY
RT
RCL
M1
M2
ST
AT
AC
RESPONSE
FRZ
31.5
63
125
250
500
1K
2K
4K
8K
16K
AUDIO ANALYZER
DB/STEP

Typical Noise Floors

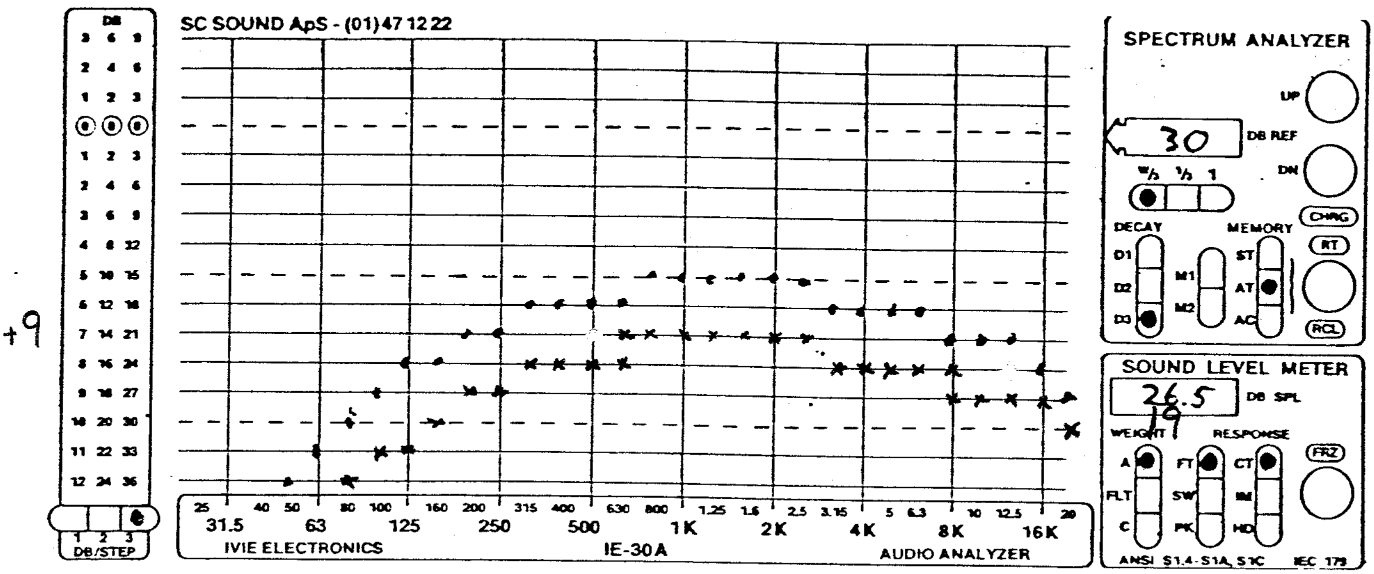
with

Calibrated Ivie Model 1M Microphone

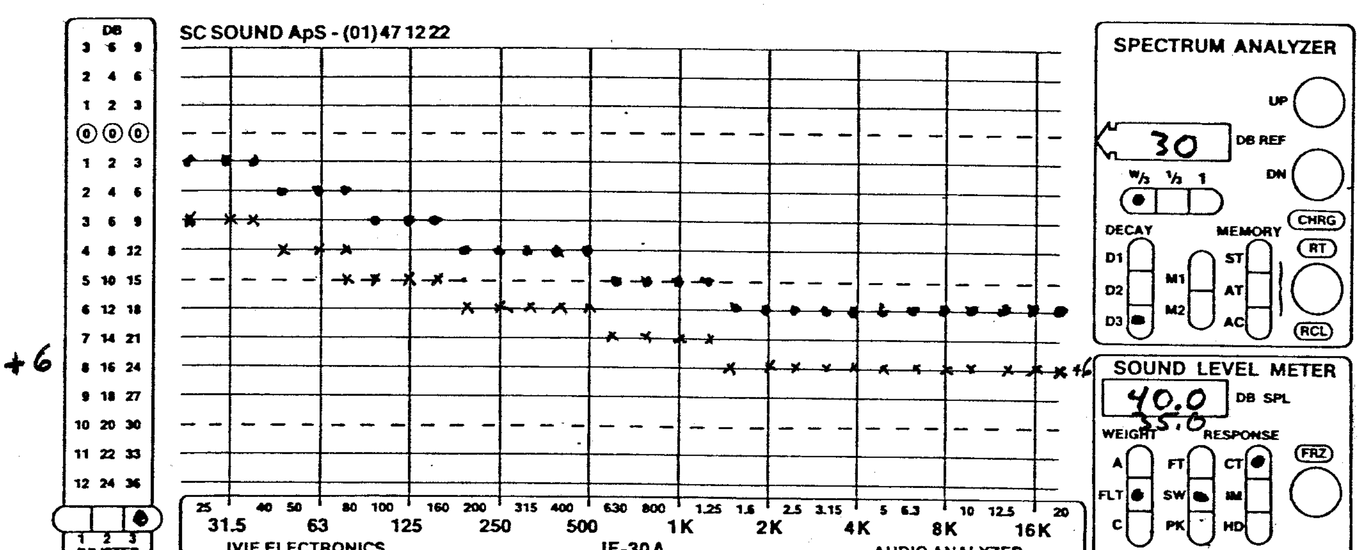
1134 @ 21.7 mV/Pascal

18pf dummy load
16.7pf capsule

A WEIGHTED



FLAT RESPONSE



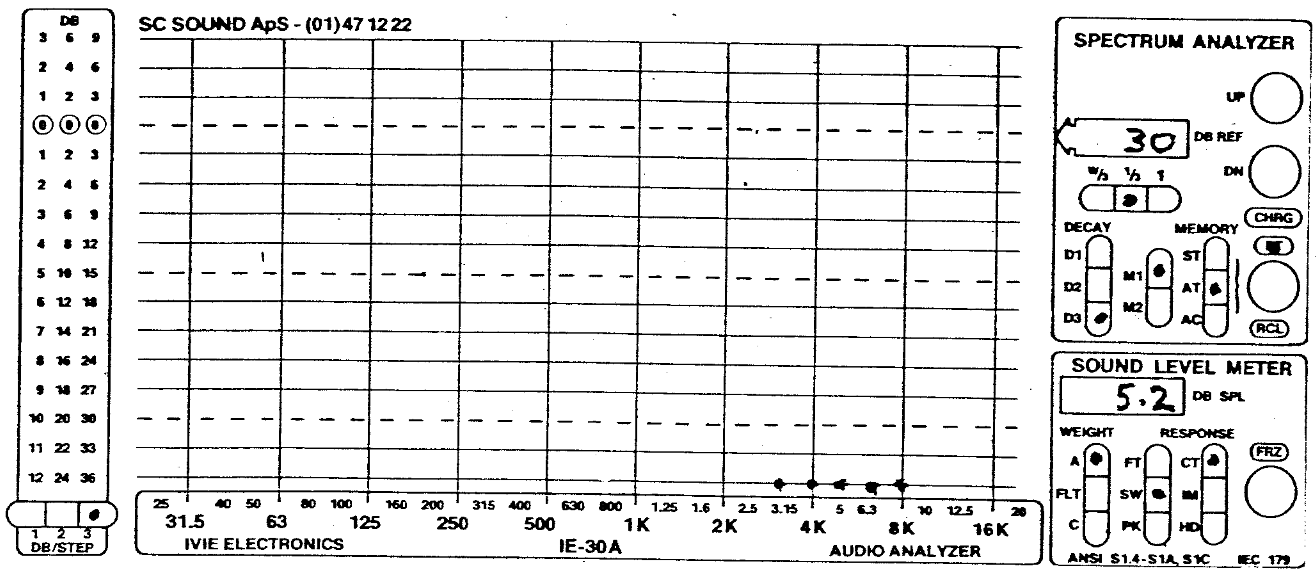
David
7-2-79

Typical Noise Floors

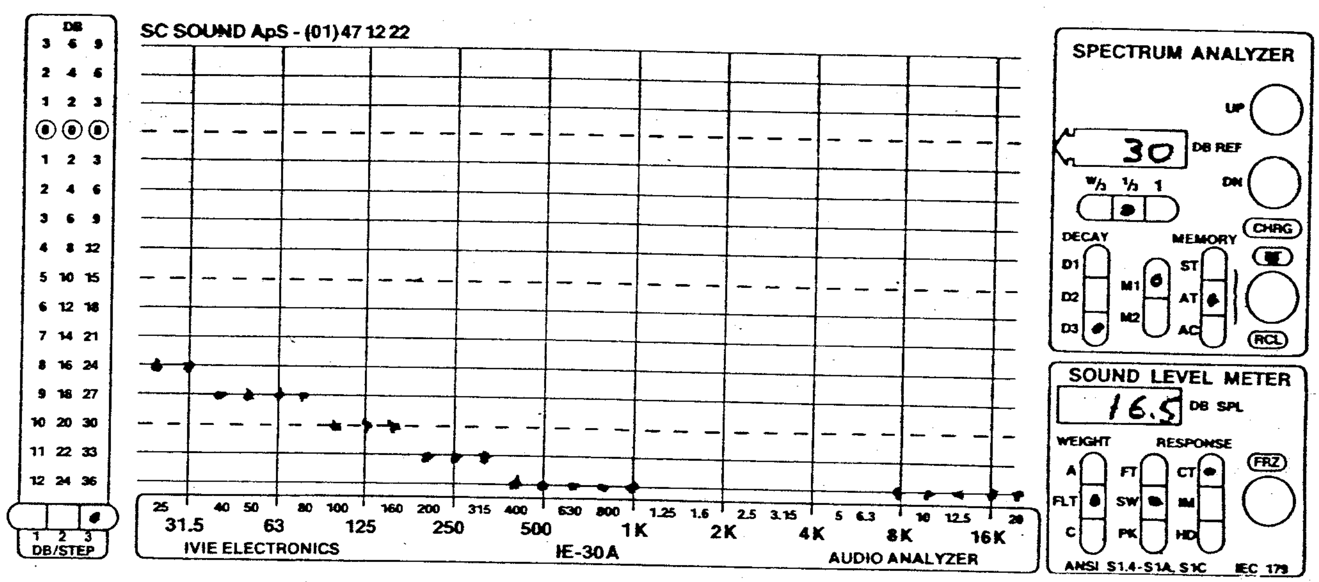
IE-2P

Calibrated One Inch B&K Microphone 4144

A WEIGHTED



FLAT RESPONSE



Dave A
7-19-79

30B02
Top edge view

Realtime Gain	Realtime Ref.	Realtime Offset	SPL Gain	SPL Ref.	20	40	80	10

Calibration Potentiometers

dB REF vs. dB SPL tracking ±.5 dB referenced to 120 dB

Step through DB REF at 1 KHz 1.000 vrms. DB SPL should track ± .5 dB 140-40 dB, referenced to 120 dB SPL.
Re-calibration: Short pins 13 & 14 IC12 on 30B02.

Set dB Ref. to 80 - note one's and tenths digits in dB SPL window.

Set dB Ref. to 70 - adjust 10's to match one's and tenths noted at 80.

Set dB Ref. to 100- adjust 20's to match digits noted when at 80.

Set dB Ref. to 120- adjust 40's to match digits noted when at 80.

Audio out≈ 32 mv at 1.000v in 120 dB

Set dB Ref. to 60 - note one's and tenths digits in dB SPL.

Set dB Ref. to 80 - adjust 80's to match digits noted when at 60.

Check tracking with IC12 still shorted.
Remove the short from pins 13 &14 and recheck tracking. Any deviation is due to 30B06 (Logger) non-linearity

30P04, 30P05

Replacement of 30B01 and modules 30B09-18 does not require re-calibration.

1.000v ac rms 1 KHz gives 120.0 ± 0.5 SPL FLT

Adjust SPL Ref. at 120 dB Ref. with SPL Ref. cal. pot.
Adjust SPL gain at 80 dB Ref. with SPL gain cal. pot.
Controls interact - must be checked & trimmed several times.

PK 123 dB SPL ±1.0 dB

Possible defective

30B06	Logger
30B04	Preamp
30B05	SPL
30B02	Memory module

Real time display agrees with dB SPL FLT 1/3 oct. sine wave

1) Set 1 KHz input to 1.059 vrms (+0.5dB)
Adjust realtime Ref. to +½ LED at 0 Ref. 1dB/st

2) Drop 1KHz to 0.335 vrms (-10dB).
Adjust realtime gain to +½ LED at -10 Ref. 1dB/st

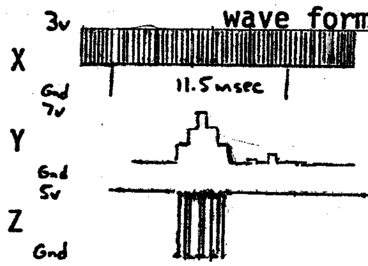
3) Drop 1KHz to 0.0188 vrms (-34.5dB) 3dB/step.
Adjust realtime offset to +½ LED at -33 dB.
3 dB/step (-33 LED flashing).

4) Repeat steps 1-3 the adjustments interact.

Sweep Filters from 25Hz to 20KHz with 1Vrms in
Filters level flat ±.5dB

X,Y,Z
Axis 1 KHz
120 dB 3 dB/step
Pin 5,7,4

wave forms



positive pulse per LED

realtime only

realtime or memory-negative pulse per LED

30B02, 30B08 (30F04)

Gate grounding to pin 1. Interrupts audio thru analyzer
Pin 6

Backwards transistor 2N4401 next to green jack on 30B08.

DC
output phantom power.
Pin 3

Up to 200 ma at battery voltage-30B08.

dB
SPL times .01 equals DVM ±.5
Pin 2

Resistor trims on 30B02 1/4 and 1/8 watt in series.

Pink noise 1 dB/step D3 90 dB Ref.

LED check. Fill realtime display.

All
LED's
On

Replace bad LED's

Cover left
side of front
panel

Photocell

Real
time display
dims, yellow
LED's on

30B01

Suddenly attenuate pink noise
in D3. Repeat for D2 & D1.

Real
time display
drops uniformly
filter A slowest
response time.

Decay response is on filter boards A-J.
Early production had slower decay time on
the A,B, and C filter modules D3.

Set dB Ref. at 100 dB.
Set pink for 100dB on real time
1/3 octave

1/3
octave flat
± 1 LED 100 dB
D3.

Approximately 115 dB SPL FLT.

1 octave
flat ± 1 LED
D3.

Realtime display is 4-5 dB higher than 1/3 octave

A weight realtime & audio out weighted

30P05

Check accuracy with overlay ±1 LED, 1/3 octave.

C weight real time & audio out weighted.

30P05

Check accuracy with overlay ± 1 LED, 1/3 octave.

Attenuate signal -40dB

No LED's on at bottom of realtime

Noisy filter IC
Filter offset too high
Realtime offset adjusted too high.

Calibrate microphone with pistonphone

Type 1 microphone ANSI S1.4 1971
Low frequency bump ≤ 250 Hz is evidence of air leak in cartridge or need rework of 30B04 and 30B05 modules.

SPL FT 200 msec
SPL SW 500 msec
capture rate

Accumulate data into memory 1 store into memory 2

Turn IE-30A off - check involatile memory capability.

Impulse & impulse hold captures abrupt noise SPL

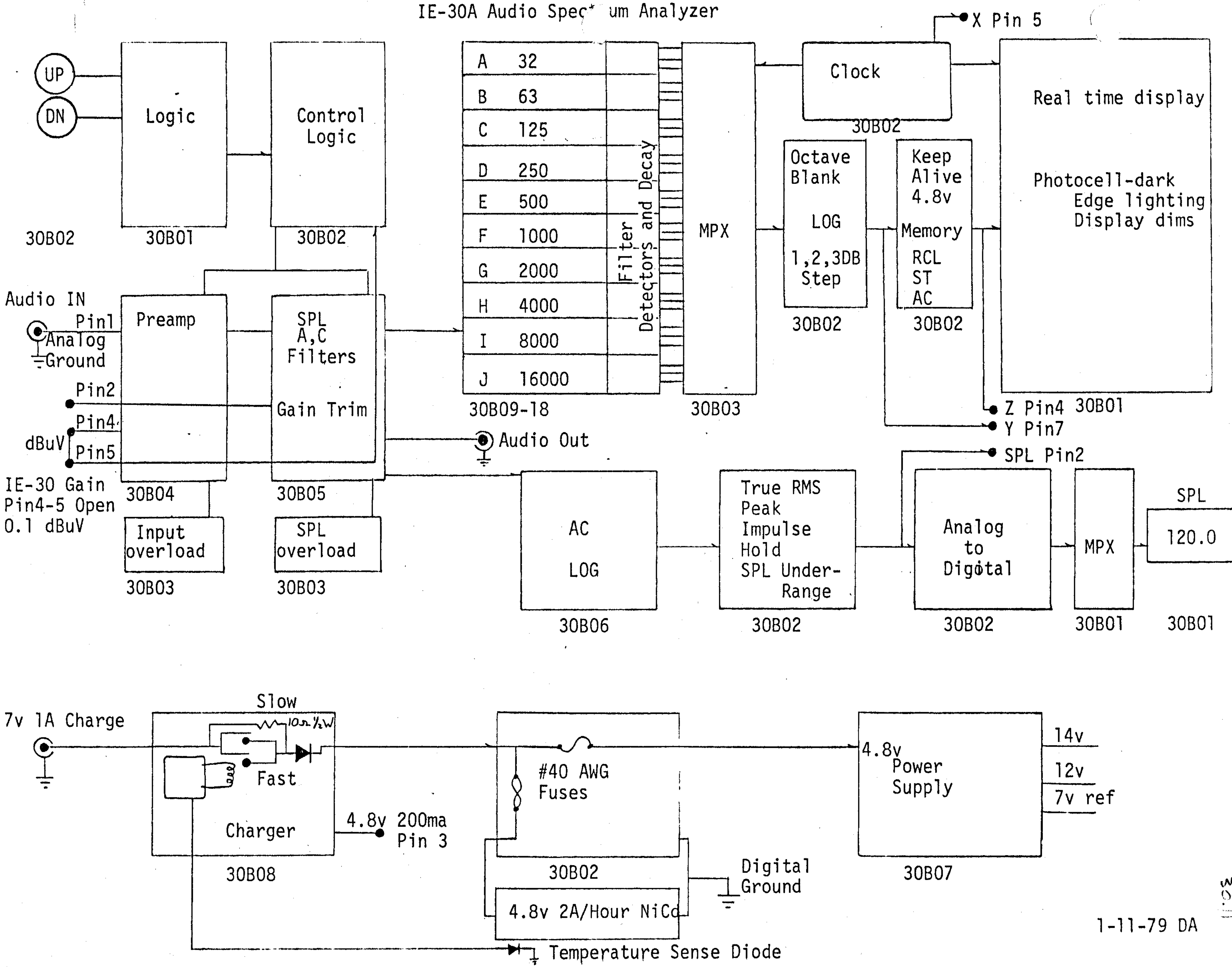
58 msec attack. 2.9 dB/sec decay.
Hand Clap

FRZ freezes SPL Window digits

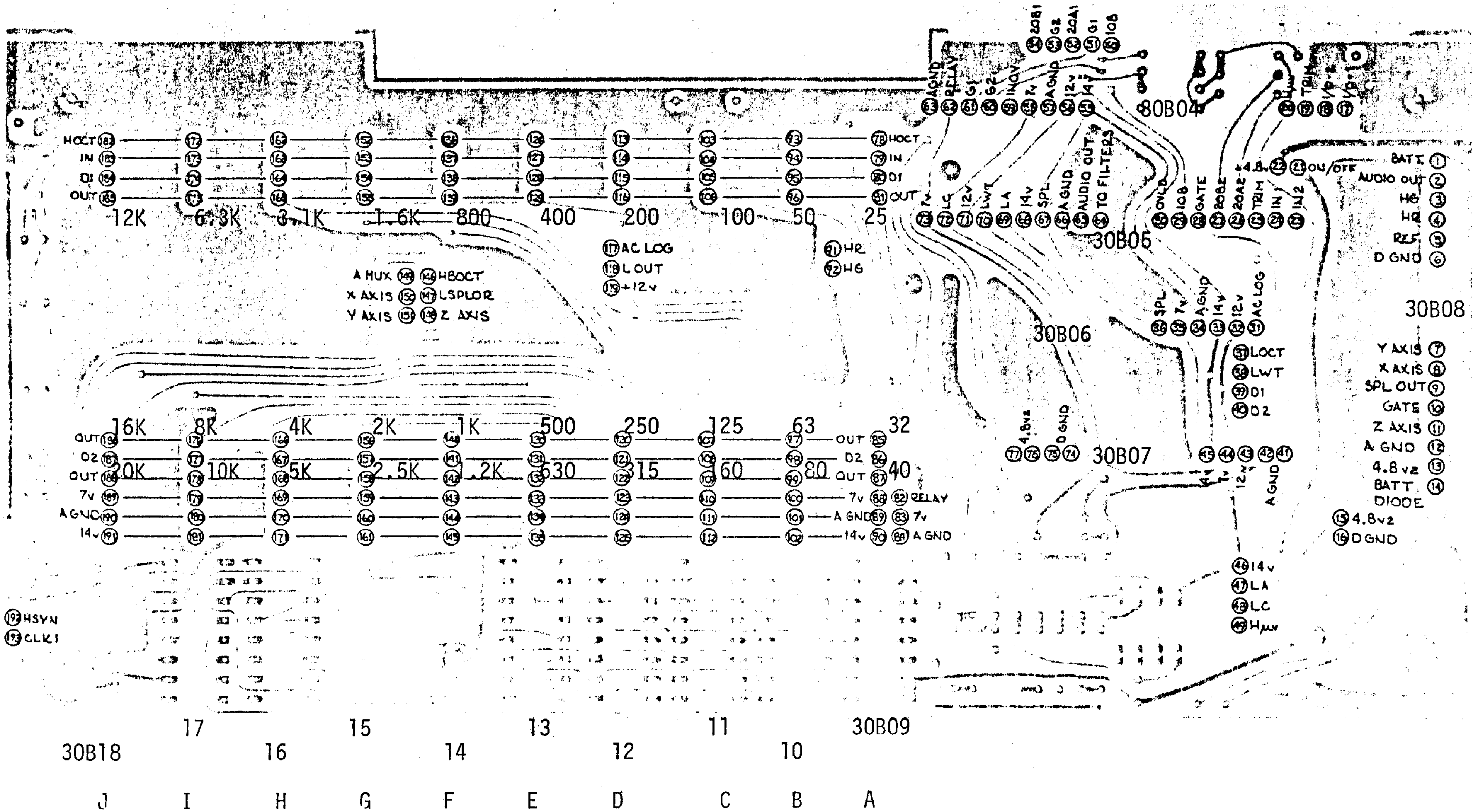
Un FRZ resets impulse hold to ambient level

Test Complete

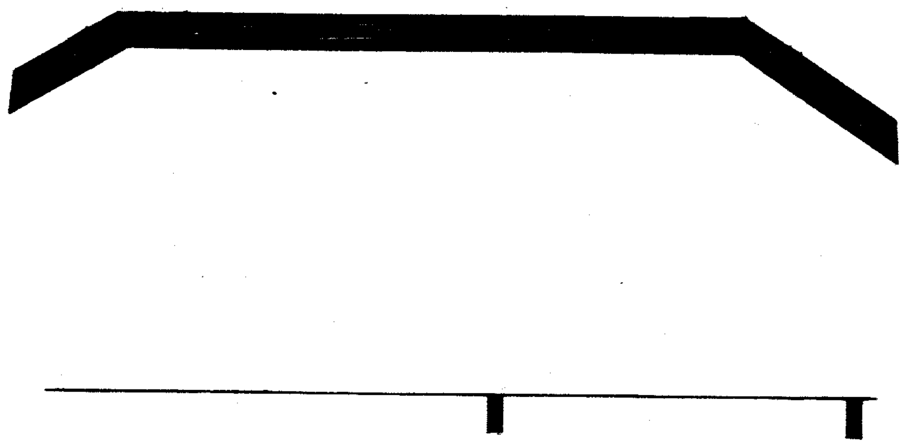
IE-30A Audio Spec* um Analyzer



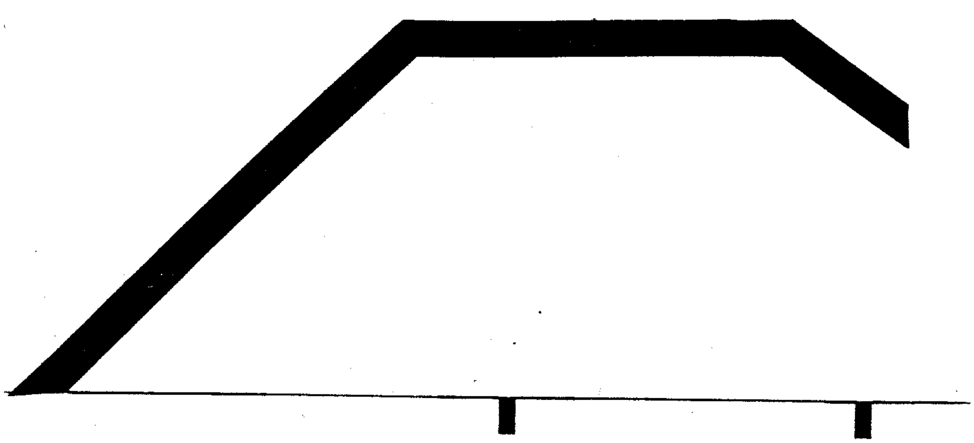
30B03 Interconnect Board



1/3 OCTAVE FILTERS

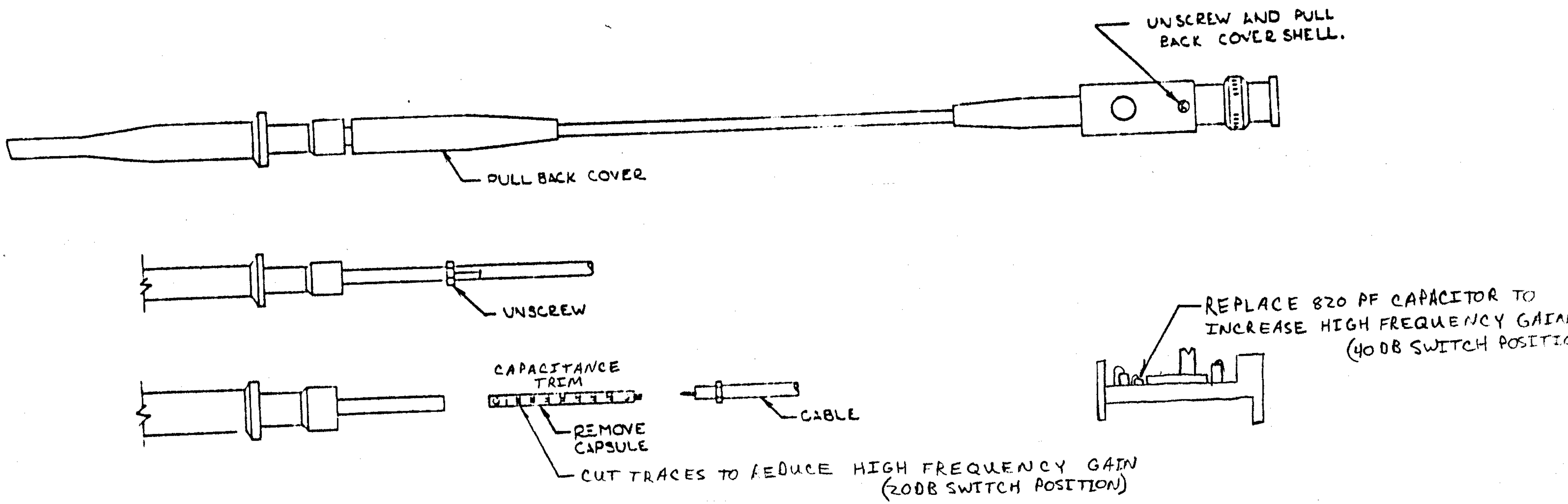


Type 1 C Weight 3 dB/step
Pink Noise D3



Type 1 A Weight 3 dB/step
Pink Noise D3

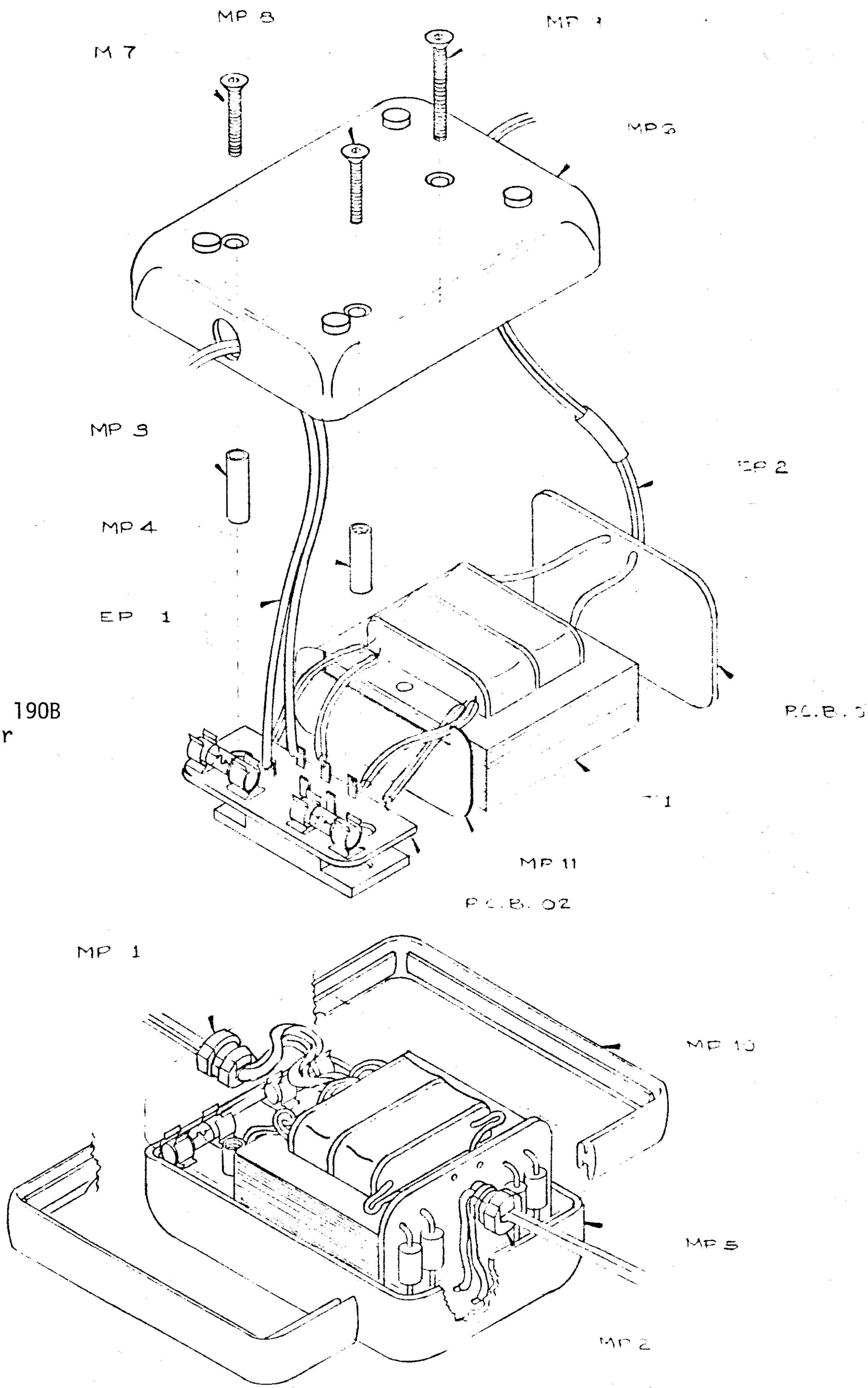
IE-1036A RTA PROBE



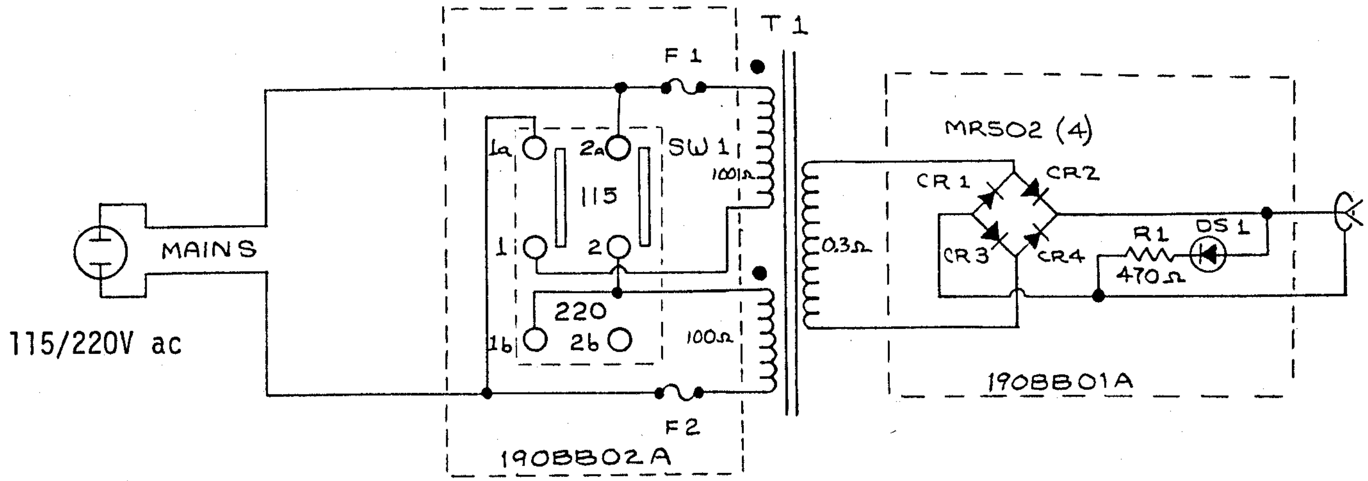
Probe High Frequency Gain Flatness

1. Set probe attenuator to 20 dB.
2. Cut traces on capacitance trim board in probe tip to lower gain above 8K.
3. Set probe attenuator to 40 dB.
4. Replace 820 pf capacitor with 470 pf and parallel additional capacitance across PC traces (to total approximately 600 pf).

IE Model 190B Charger



DATE	SYM	REVISION RECORD	DR.	CK
1/2	B	SWAPED 1a & 2A CONN.		

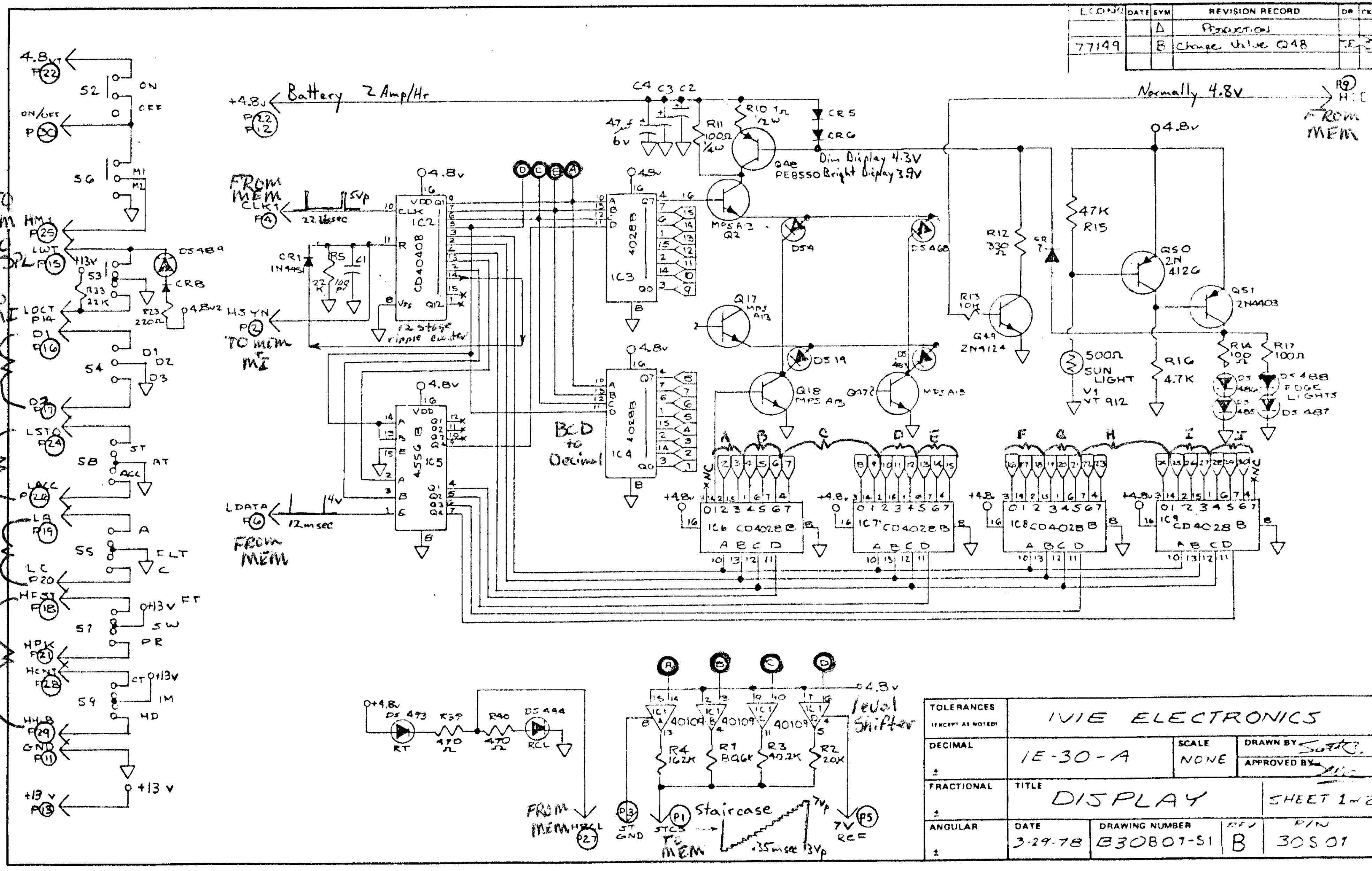


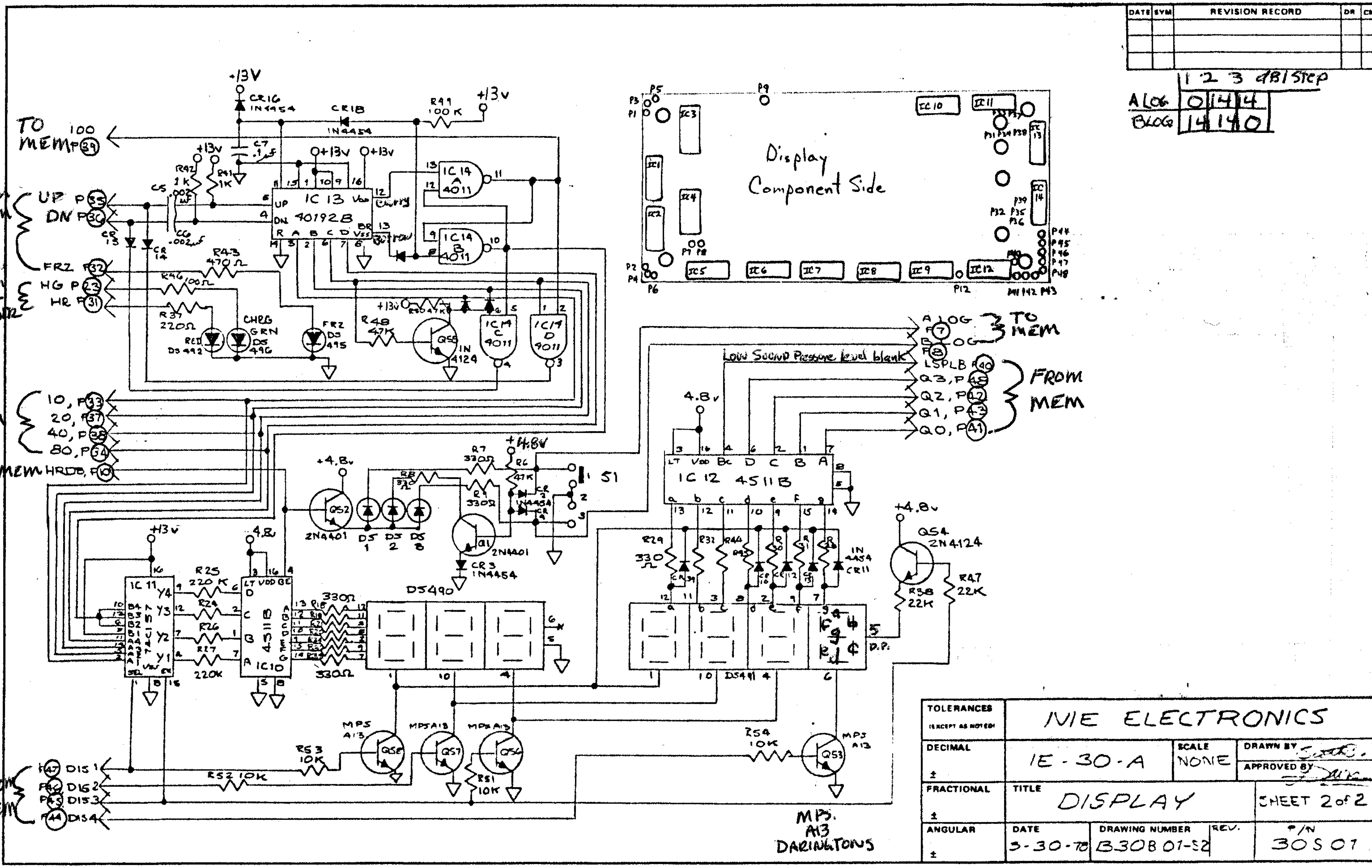
7 vdc output open circuit

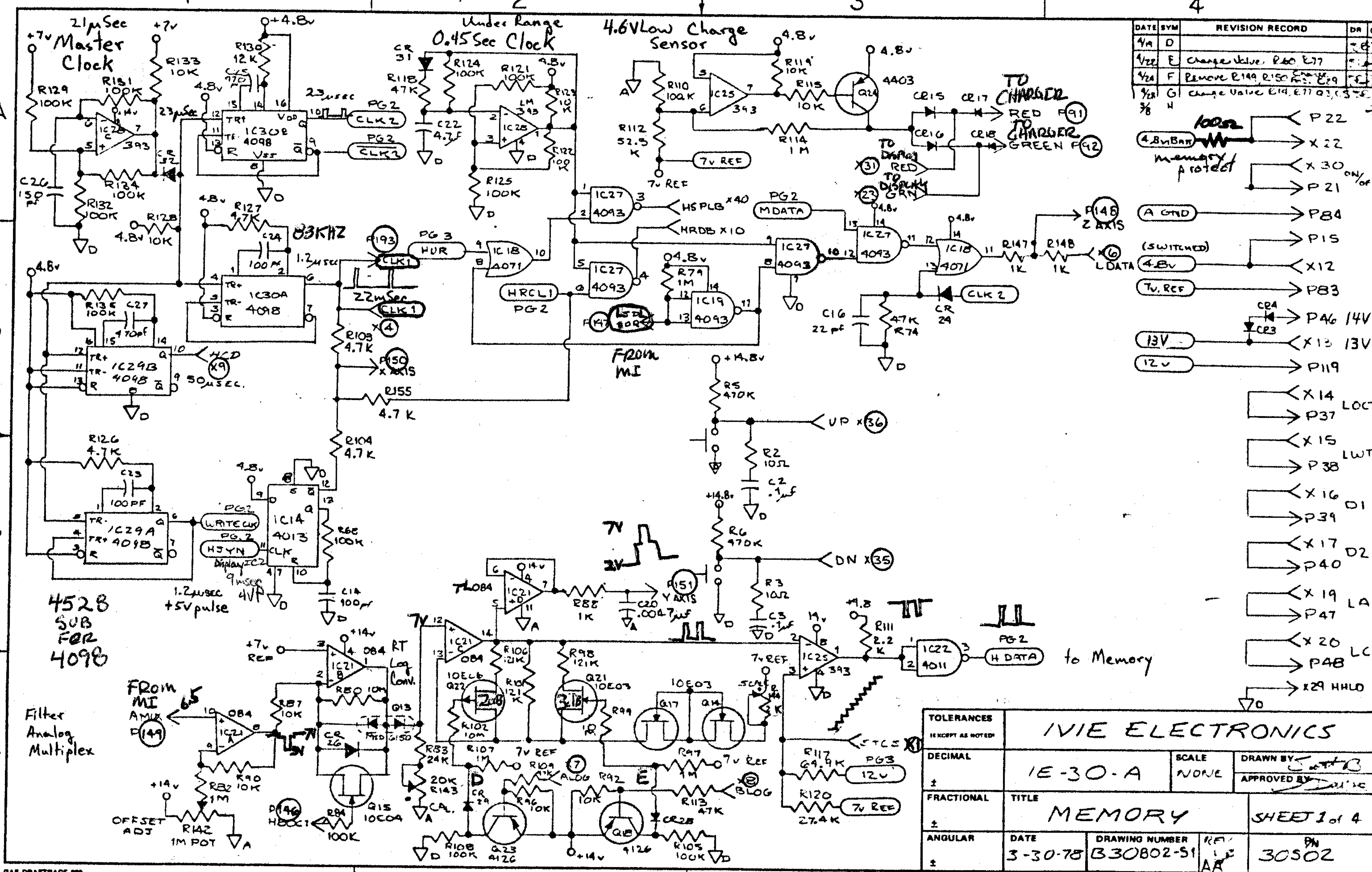
6 vdc into IE-30A at 1 amp

F1/F2 Slow Blo 1/8 Amp Fuse

TOLERANCES (EXCEPT AS NOTED)	IVIE ELECTRONICS			
DECIMAL ±	IE190 B		SCALE NONE	DRAWN BY Scott B. / APPROVED BY Davis
FRACTIONAL ±	TITLE IE 190B SCHEMATIC			
ANGULAR ±	DATE 12-1-78	DRAWING NUMBER 31908-5	REV. B	


IVIE ELECTRONICS
1E-30-A
SCALE NONE
TITLE DISPLAY
SHEET 1 of 2
DATE 3-29-78
DRAWING NUMBER B30807-S1
REV B
P/N 30S01
REVISION RECORD
Δ PRODUCTION
77149 B Change Value Q48
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
DRAWN BY
APPROVED BY
+4.8v Battery 2 Amp/Hr
Normally 4.8V
FROM MEM
Dim Display 4.3V
Bright Display 3.9V
FROM MEM CLK1
12 stage ripple counter
CD4040B
BCD to Decimal
4028B
4556
CD4028B
TO MEM
TO SPL
TO MI
LDATA FROM MEM
HSYN TO MEM MI
level Shifter
40109
Staircase
TO MEM
7V REF
ST GND
FROM MEM HRCL
SUN LIGHT
EDGE LIGHTS
GAF DRAFTRACE 280


DATE | SYM | REVISION RECORD | DR | CK
1 2 3 dB/Step
A LOG 0 14 4
B LOG 14 14 0
Display Component Side
TO MEM 100 P39
FROM MEM UP P35 DN P36
FRZ P32
FROM MEM + CHARGER HG P23 HR P31
+13V
CR16 1N4454
CR18 1N4454
R41 100K
IC 13 40192B
IC14 A 4011
IC14 B 4011
IC14 C 4011
IC14 D 4011
R43 470Ω
R46 100Ω
R37 220Ω
RED DS492
CHRG GRN DS496
FRZ DS495
R48 47K
Q55 2N4124
TO MEM 10, P33 20, P37 40, P38 80, P34
FROM MEM HRDB, P10
A LOG P7 B LOG P8 TO MEM
Low Sound Pressure level blank
LSPLB P40
Q3, P45 Q2, P42 Q1, P43 Q0, P41 FROM MEM
4.8v
IC12 4511B
+4.8v
Q52 2N4401
DS1 DS2 DS3
Q1 2N4401
CR3 1N4454
R7 330Ω
R6 47K
S1
IC 11
R25 220K
R24
R26
R27 220K
IC10 4511B
330Ω
DS490
DS491
Q54 2N4124
R47 22K
R38 22K
MPS A13
MPSA13
R53 10K
R52 10K
R51 10K
R54 10K
Q53
FROM MEM P47 DIS1 P42 DIS2 P45 DIS3 P44 DIS4
MPS A13 DARLINGTONS
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
IVIE ELECTRONICS
IE-30-A
SCALE NONE
DRAWN BY
APPROVED BY
TITLE DISPLAY
SHEET 2 of 2
DATE 3-30-78
DRAWING NUMBER B308 01-S2
REV.
P/N 30S01
GAF DRAFTRACE 250

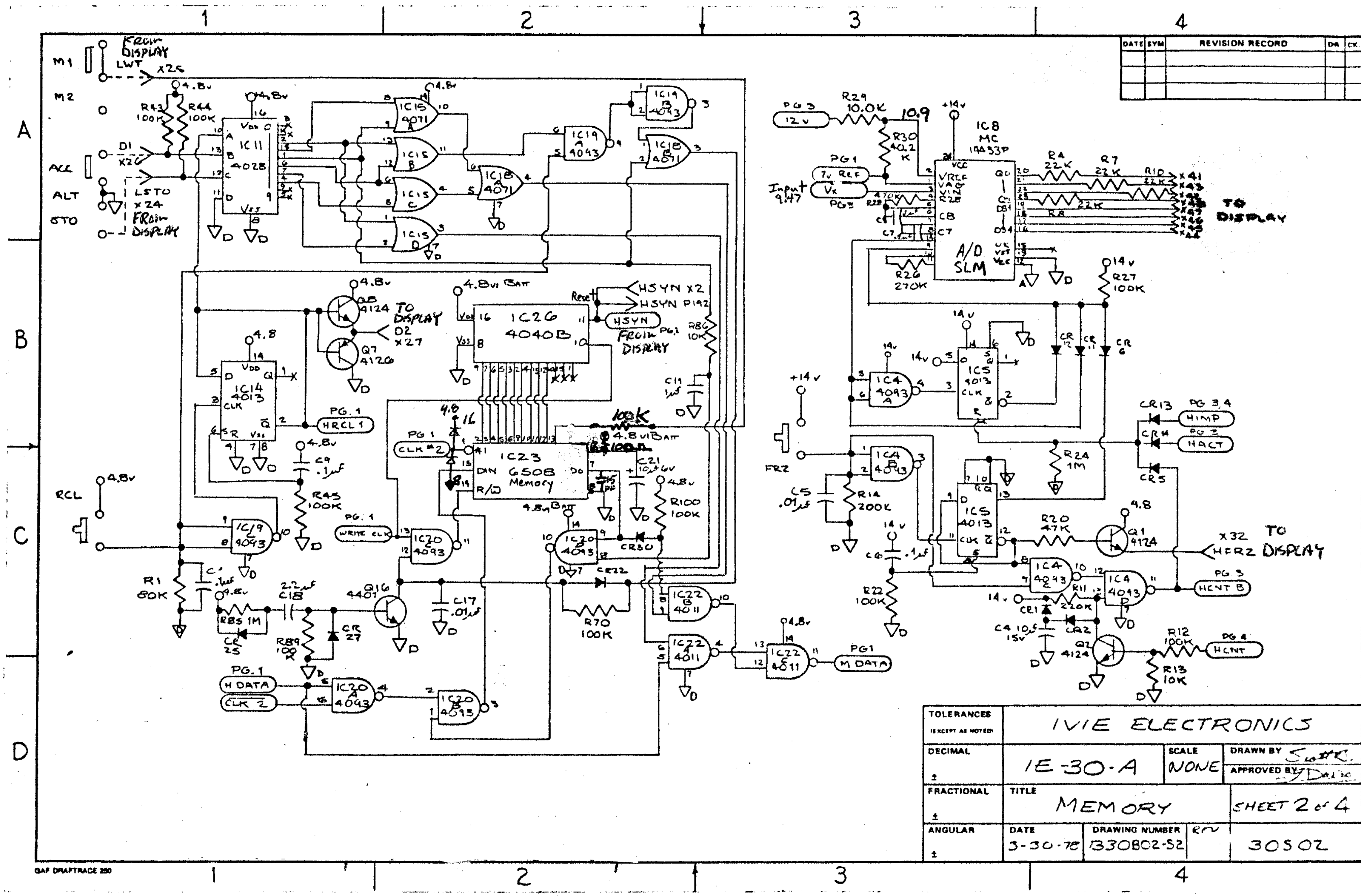


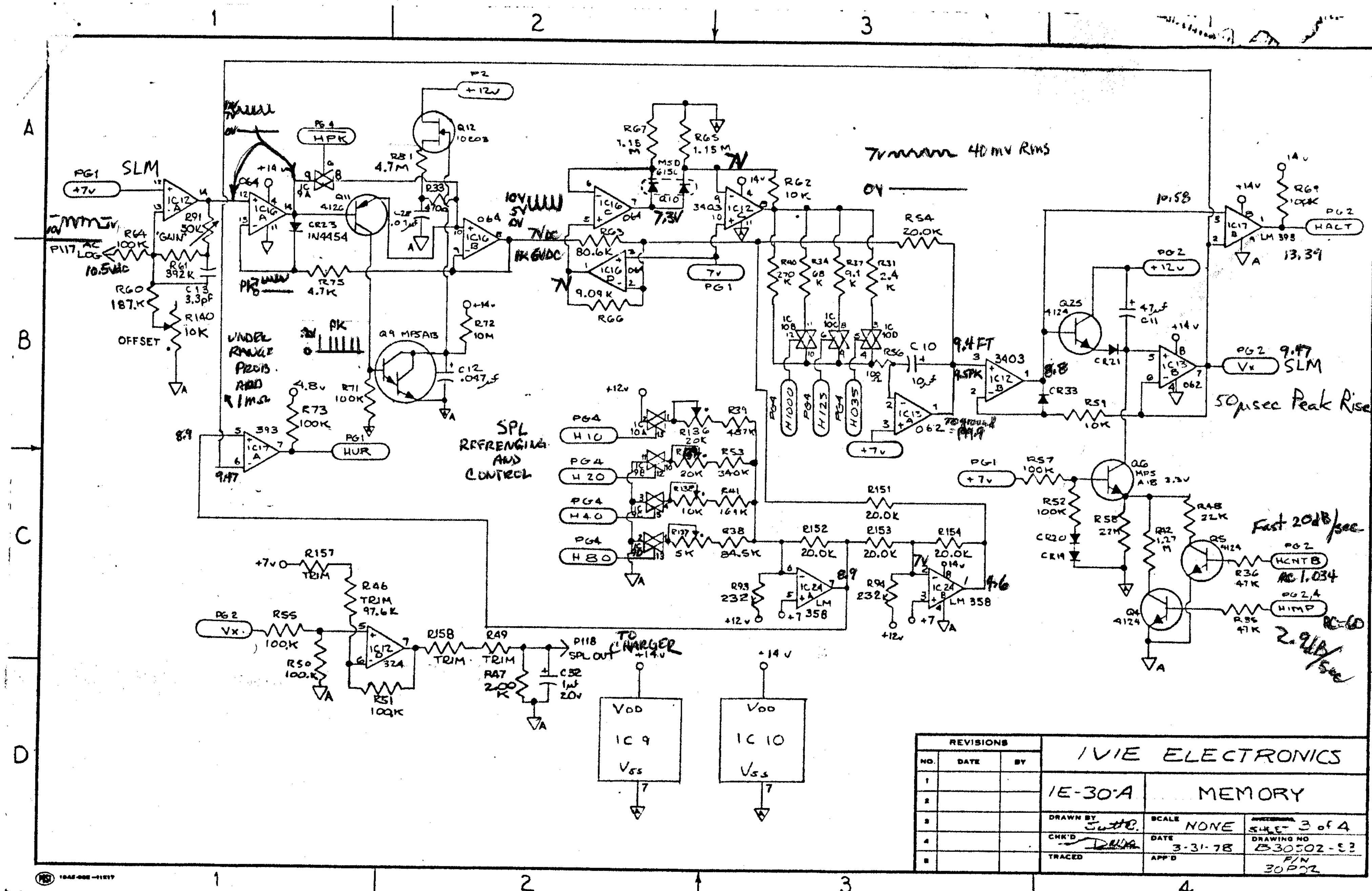
DATE	SYM	REVISION RECORD	DR	CK
4/18	D			
4/22	E	Change Value R60 R77		
4/26	F	Remove R149, R150 Change C29		
4/28	G	Change Value R14, R77 Q3, C3		
5/8	H			

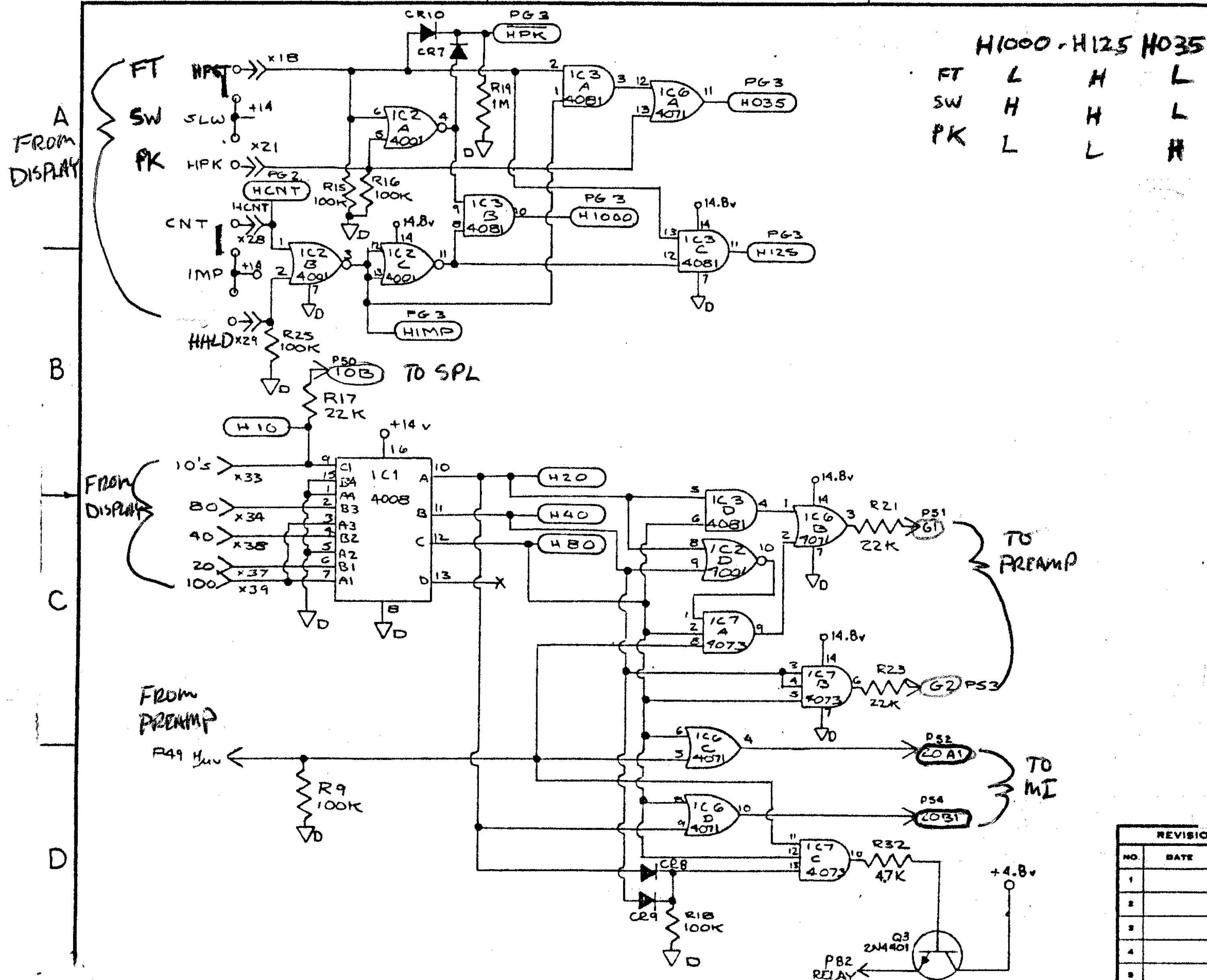
IVIE ELECTRONICS

TOLERANCES (EXCEPT AS NOTED)			
DECIMAL ±	1E-30-A	SCALE NONE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE MEMORY		SHEET 1 of 4
ANGULAR ±	DATE 3-30-78	DRAWING NUMBER B30802-S1	REV AA · PN 30502

	E	D
1	.9	13
2	.9	63
3	63	6.3


REVISION RECORD
IVIE ELECTRONICS
IE-30-A
MEMORY
SCALE NONE
SHEET 2 of 4
DATE 3-30-78
DRAWING NUMBER 1330802-S2
30502
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
DRAWN BY
APPROVED BY
TITLE
IC11 4028
IC14 4013
IC15 4071
IC18 4071
IC19 4093
IC20 4093
IC22 4011
IC23 6508 Memory
IC26 4040B
IC8 MC 14433P A/D SLM
IC4 4093
IC5 4013
TO DISPLAY
FROM DISPLAY
HSYN
FRZ
RCL
M1
M2
ACC
ALT
STO
GAF DRAFTRACE 250


SLM
PG1 +7v
R64 100K
P117 AC LOG
R291 50K GAIN
R61 392K
C13 3.3pF
R60 187.K
R140 10K
OFFSET
IC12 A
IC16 A
064
CR23 1N4454
Q11 4126
PG4 HPK
IC 9A
R81 4.7M
R33 470Ω
Q12 10203
P2 +12V
C28 .01µf
IC16 B
064
R73 4.7K
Q9 MPSA13
R72 10M
C12 .047µf
R71 100K
UNDER RANGE PROB AND ≤1ms
R73 100K
IC17 A 393
PG1 HUR
SPL REFRENGING AND CONTROL
10V 5V 0V
7Vdc
1K 6VDC
R67 1.15M
R65 1.15M
MSD 6150
D10
IC16 C 064
IC16 D 064
R63 80.6K
9.09K R66
7.3V
IC12 3403
R62 10K
7v PG1
7V 40mV RMS
0V
R54 20.0K
R40 270K
R34 68K
R37 9.1K
R31 2.4K
IC 10B
IC 10C
IC 10D
PG4 H1000
PG4 H125
PG4 H035
R56 10Ω
C10 10µf
IC13 A 062
+7v
9.4 FT
3403
IC12 B
CR33
R59 10K
PG4 H10
PG4 H20
PG4 H40
PG4 H80
R136 20K
R39 487K
R53 340K
R138 10K
R41 169K
R137 5K
R38 84.5K
R151 20.0K
R152 20.0K
R153 20.0K
R154 20.0K
R93 232K
R94 232K
IC24 A LM 358
IC24 B LM 358
R157 TRIM
+7v
R46 TRIM 97.6K
PG2 Vx
R55 100K
R50 100K
IC12 D 324
R51 100K
R158 TRIM
R49 TRIM
RA7 200K
C52 1µf 20v
P118 SPL OUT
TO CHARGER
Vdd IC 9 Vss
Vdd IC 10 Vss
+14v
10.58
IC17 B LM 393
R69 100K
PG2 HALT
13.39
PG2 +12v
Q25 4124
C11 47µf
CR21
IC13 B 062
PG2 Vx
9.47 SLM
50µsec Peak Rise
PG1 +7v
R57 100K
Q6 MPS A18
R52 100K
R58 27M
CR20
CR19
R12 1.27M
R48 22K
Q5 4124
PG2 HCNTB
R36 47K
Fast 20dB/sec
AC 1.034
Q4 4124
PG2,4 HIMP
R35 47K
2.9 dB/sec
REVISIONS
NO. DATE BY
IVIE ELECTRONICS
IE-30-A
MEMORY
DRAWN BY
SCALE NONE
SHEET 3 of 4
CHK'D
DATE 3-31-78
DRAWING NO B30502-S3
TRACED
APP'D
P/N 30P22



	H1000	H125	H035
FT	L	H	L
SW	H	H	L
PK	L	L	H

	30	40	50	60	70	80	90	100	110	120	130	140
#10	X		X		X		X		X		X	
#20			X	X			X	X			X	X
#40	X	X	X	X					X	X	X	X
#80					X	X	X	X	X	X	X	X
10	X		X		X		X		X		X	
20	X			X	X					X	X	
40		X	X	X	X							X
80						X	X					
100								X	X	X	X	X
20B₂	/	/	X	X	X	X	X	X	X	X	X	X
20A₁			/	/	X	X	X	X	X	X	X	X
10S	X		X		X		X		X		X	
RELAY							/	/	/	/	/	/
G₂									X	X	X	X
G₁					/	/	X	X			X	X

REVISIONS		
NO.	DATE	BY
1		
2		
3		
4		
5		

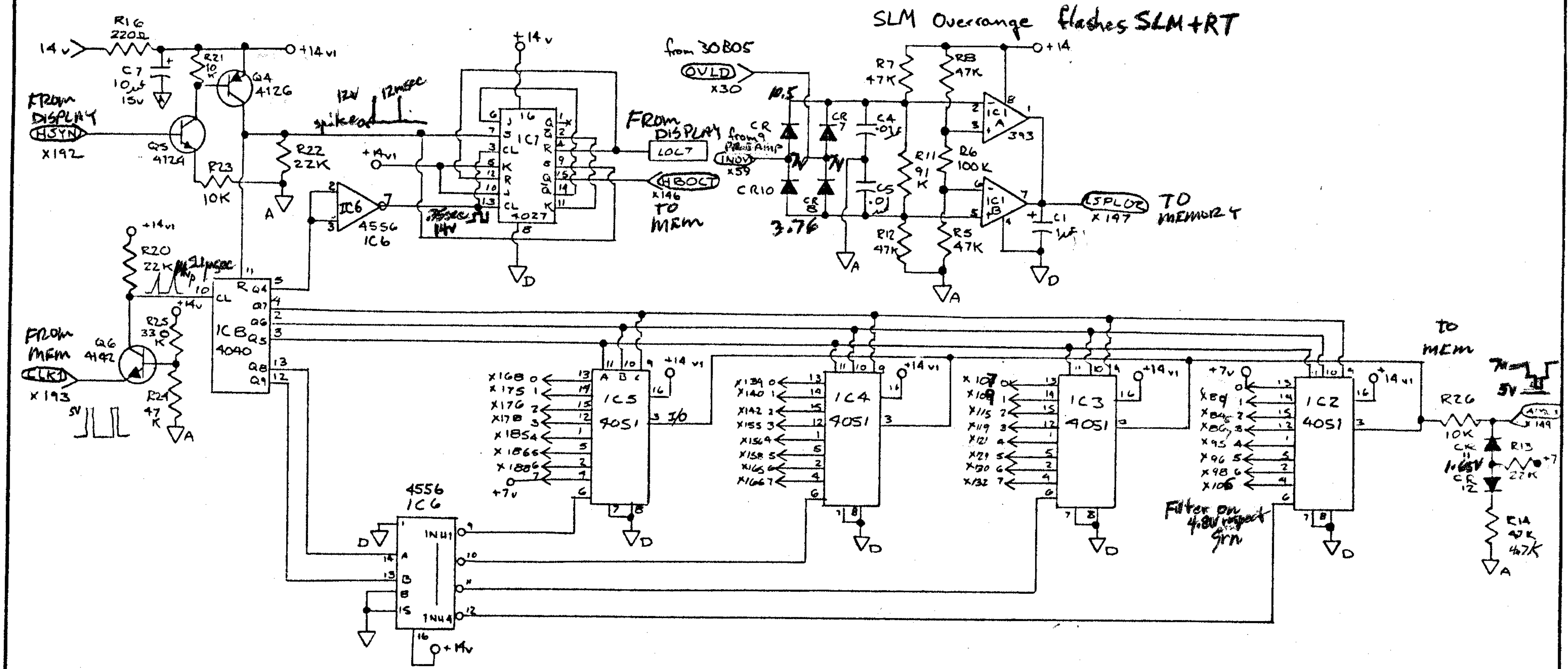
IVIE ELECTRONICS

IE-30-A MEMORY

DRAWN BY Scott 23 | SCALE NONE | SHEET 4 of 4

CHK'D Dan | DATE 3-31-78 | DRAWING NO B30502-S4

TRACED | APP'D | P/N 30P02



32 bits multiplexed in 12msec
first and last bits non-data

REVISIONS		
NO.	DATE	BY
A		
B	10-6-78	SR
3		
4		
5		

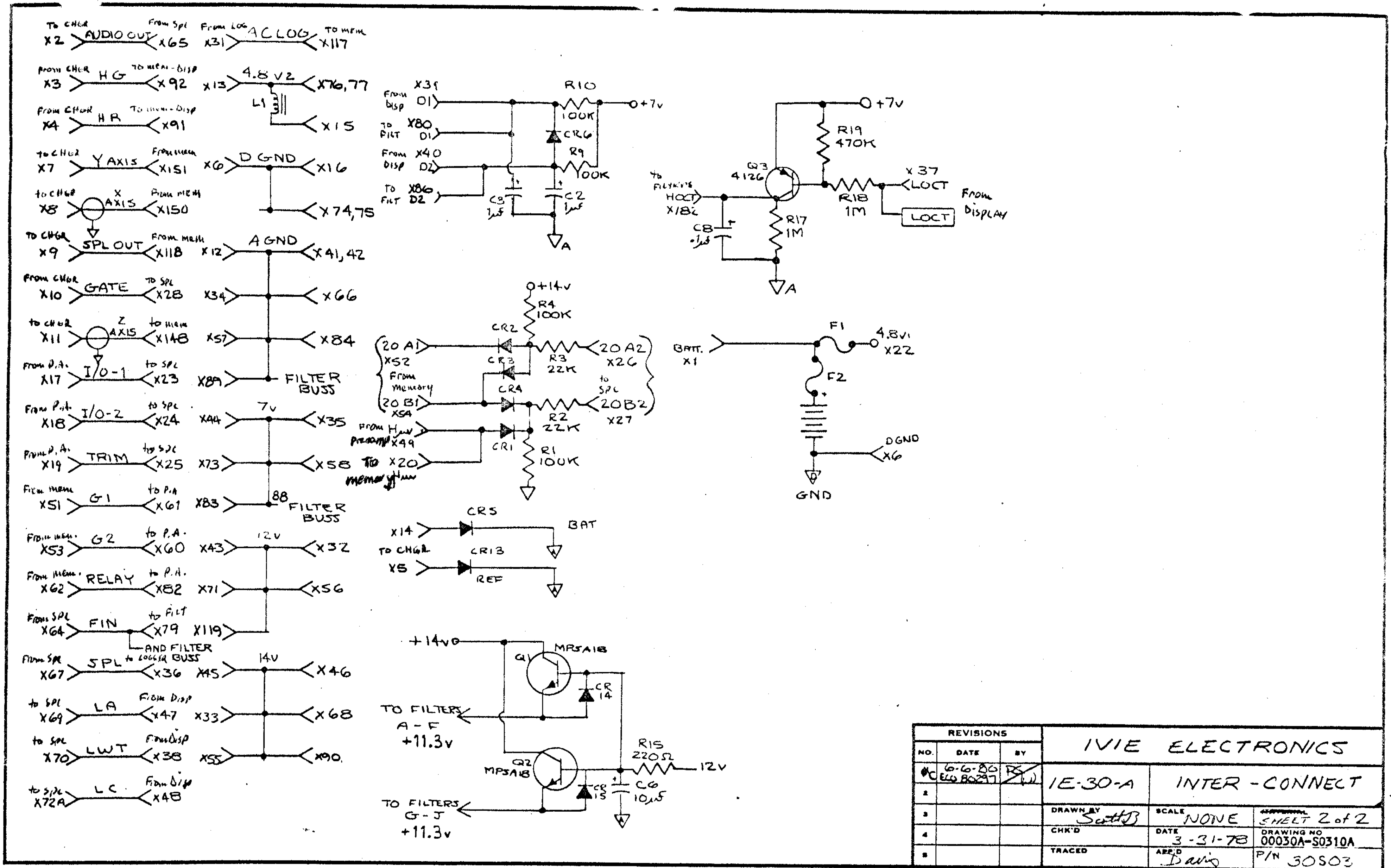
IVIE ELECTRONICS

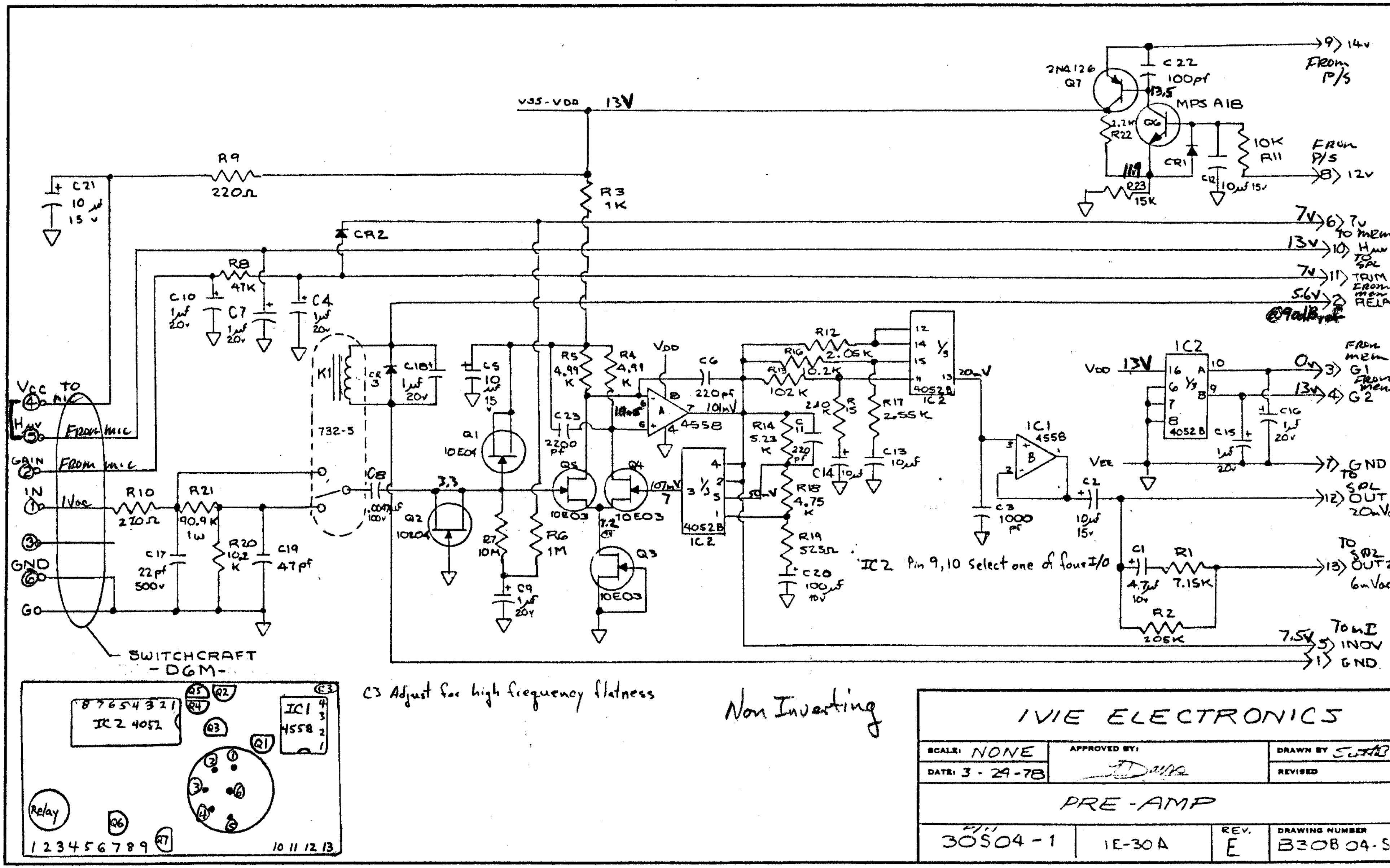
1E-30-A INTER-CONNECT

DRAWN BY: [illegible] | SCALE: NONE | SHEET 1 of 2

CHK'D | DATE: 3-31-78 | DRAWING NO: B32803-5?

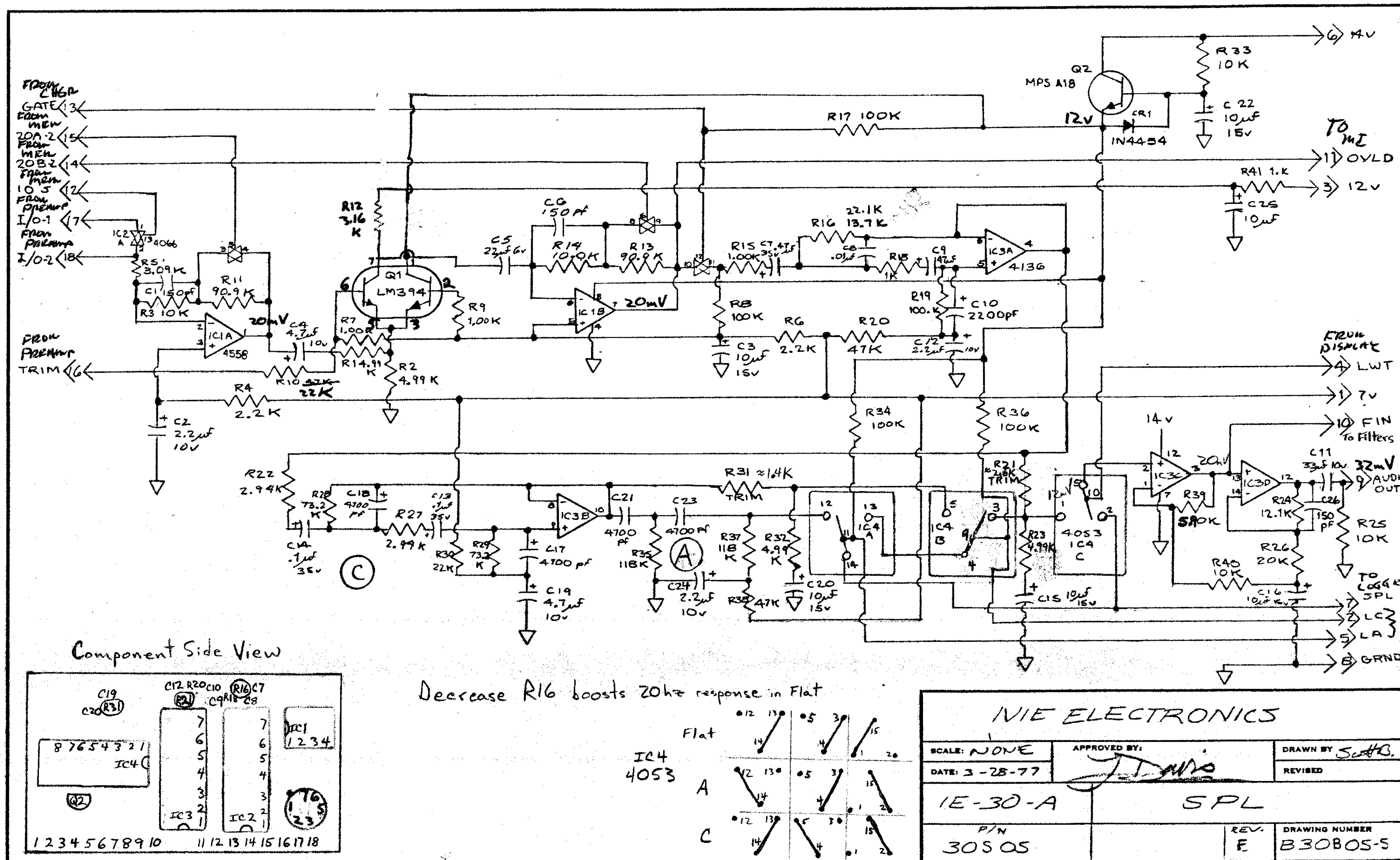
TRACED | APP'D: [illegible] | 30S03


X2 AUDIO OUT X65
X31 ACLOG X117
X3 HG X92
X13 4.8 V2 X76,77
L1
X15
X4 HR X91
X7 Y AXIS X151
X6 D GND X16
X8 X AXIS X150
X74,75
X9 SPL OUT X118
X12 A GND X41,42
X10 GATE X28
X34 X66
X11 Z AXIS X148
X57 X84
X17 I/O-1 X23
X89 FILTER BUSS
X18 I/O-2 X24
X44 7v X35
X19 TRIM X25
X73 X58
X51 G1 X61
X83 88 FILTER BUSS
X53 G2 X60
X43 12v X32
X62 RELAY X82
X71 X56
X64 FIN X79
X119
AND FILTER BUSS
X67 SPL X36
X45 14v X46
X69 LA X47
X33 X68
X70 LWT X38
X55 X90
X72A LC X48
R10 100K
+7v
CR6
R9 100K
C9
C2
Q3 4126
R19 470K
R18 1M
X37 LOCT
From Display
LOCT
R17 1M
C8
+14v
R4 100K
CR2
CR3
R3 22K
CR4
R2 22K
CR1
R1 100K
BATT. X1
F1
4.8v X22
F2
DGND X6
GND
CR5
X14
BAT
TO CHGR X5
CR13
REF
+14v
Q1 MPSA18
CR14
TO FILTERS A-F +11.3v
R15 220Ω
12v
Q2 MPSA18
CR15
C6 10µf
TO FILTERS G-J +11.3v
REVISIONS
NO. DATE BY
C 6-6-80 ECO 80297
IVIE ELECTRONICS
IE-30-A INTER-CONNECT
DRAWN BY Scott B
SCALE NONE
SHEET 2 of 2
CHK'D
DATE 3-31-78
DRAWING NO 00030A-S0310A
TRACED
APP'D Davis
P/N 30S03



11X17 PRINTED ON NO. 1000H CLEARPRINT

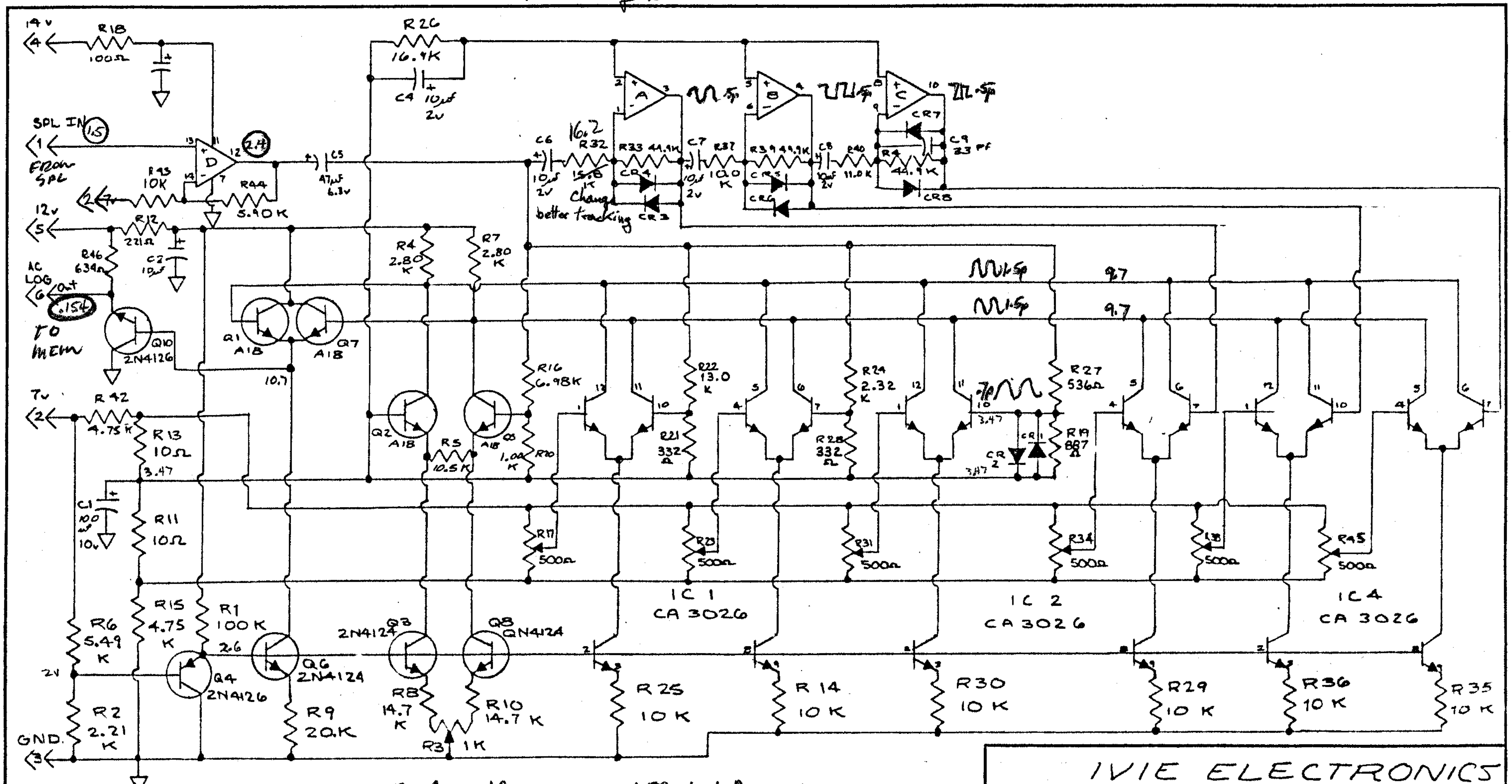
Component Side View

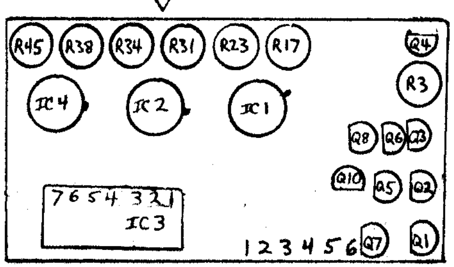


11X17 PRINTED ON NO. 1000H CLEARPRINT

50.29

100 typ Low
R32 bring down 120 130



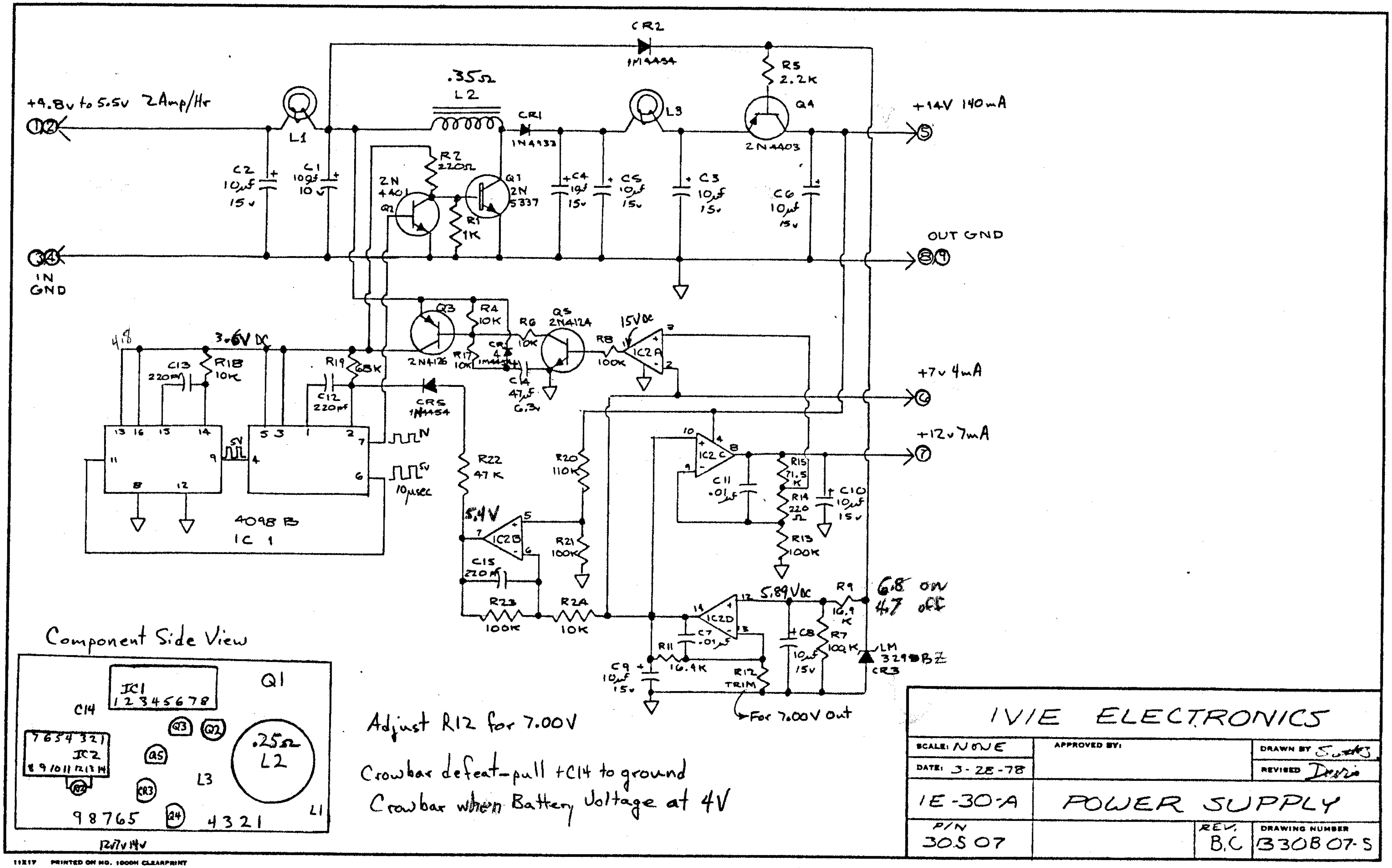


30A 80dB 1.23V in = 1.50 V at Pin1 on Logger = 2Vp Pin6

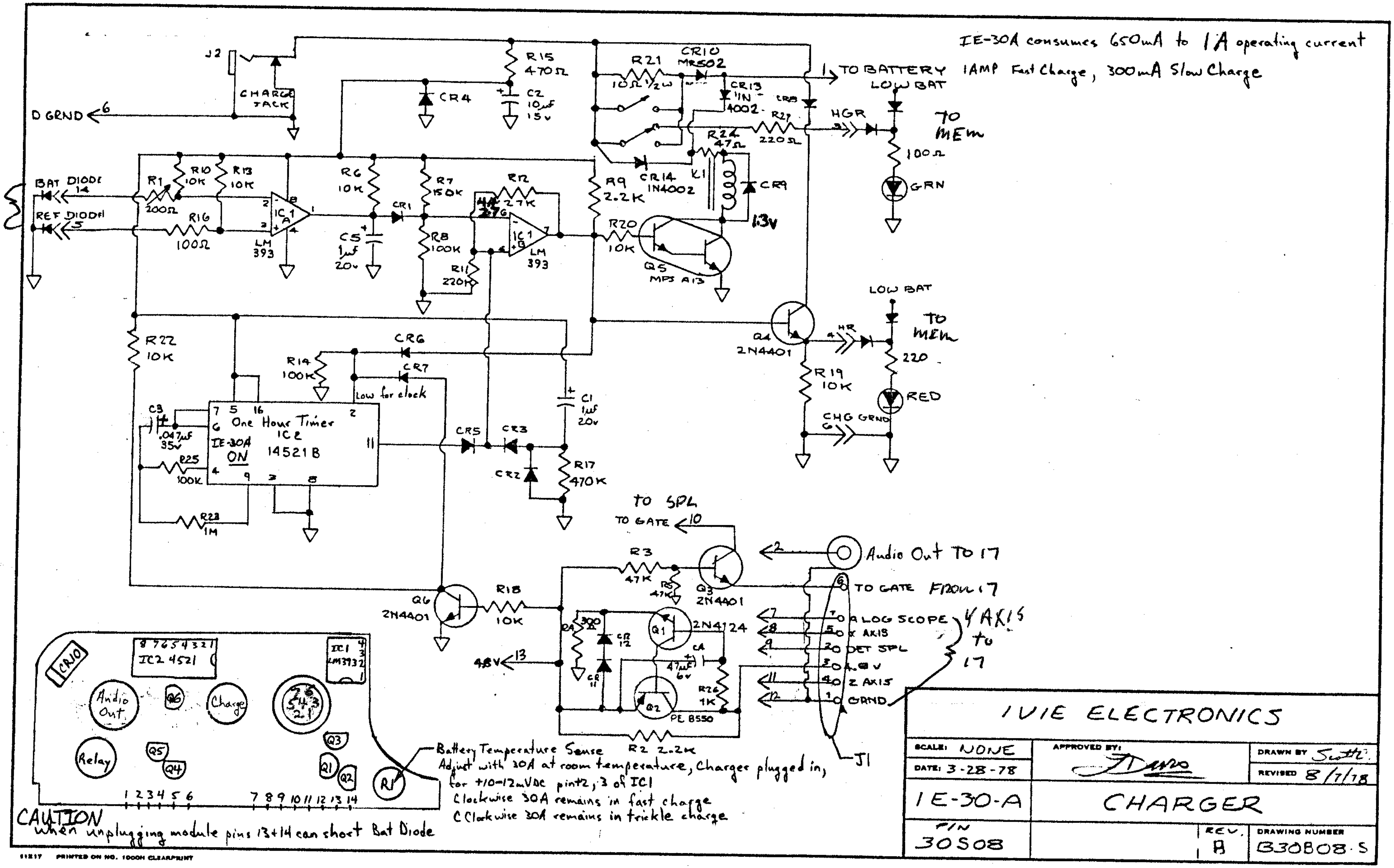
Logger Calibration

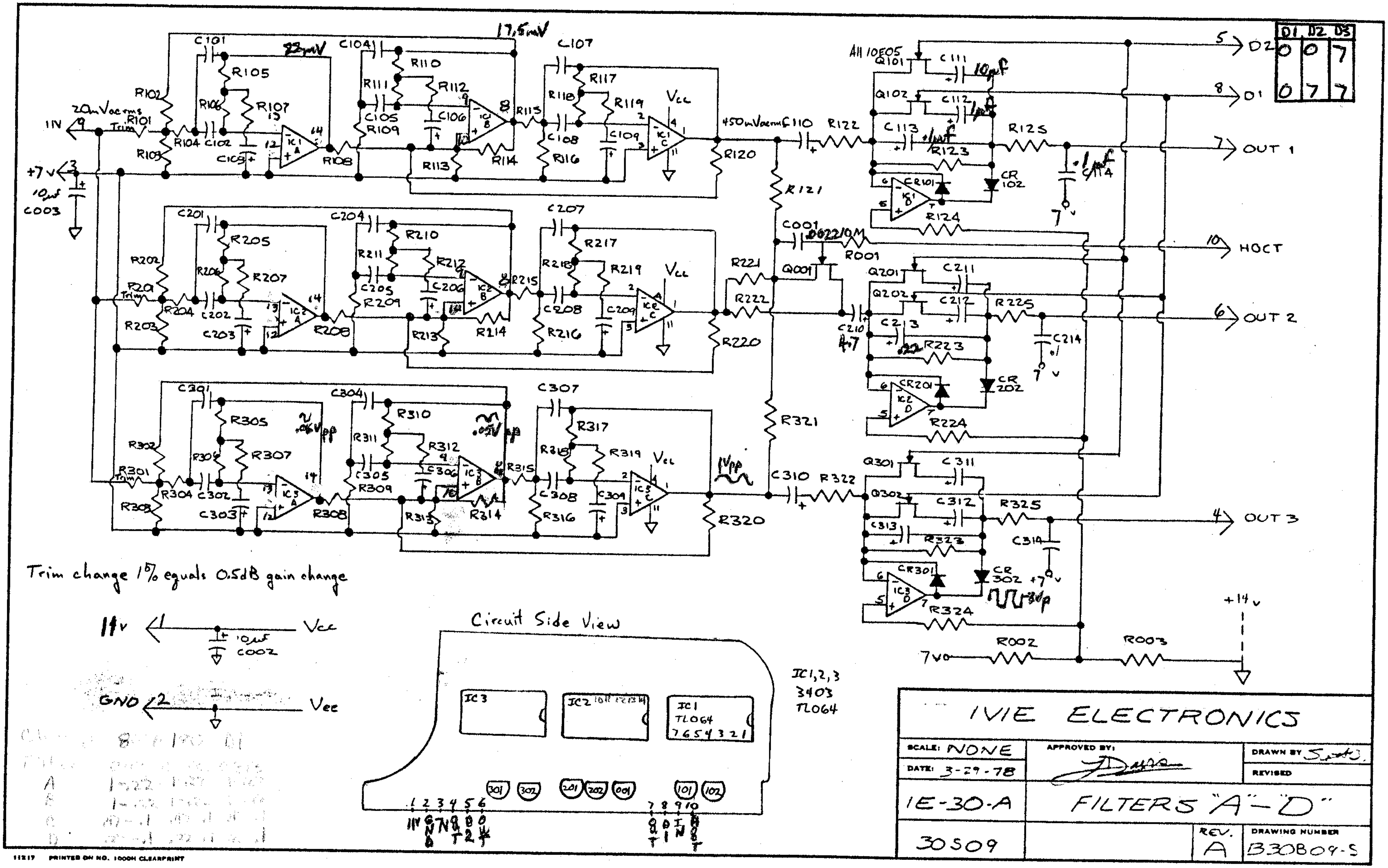
1. Input 1kHz 1.5Vrms to pin 1
2. Observe pin 6 Output on oscilloscope
3. Adjust R3 to eliminate separation between peaks
4. Attenuate input 14dB
5. Repeat step 3 and 4 for R17, R23, R31, R34, R38, and R45 respectively.
6. Double check output for all seven voltage steps. R3 1.5V; R17 299mV; R23 59.6mV; R31 11.9mV; R34 2.4mV; R38 0.47mV; R45 0.09mV

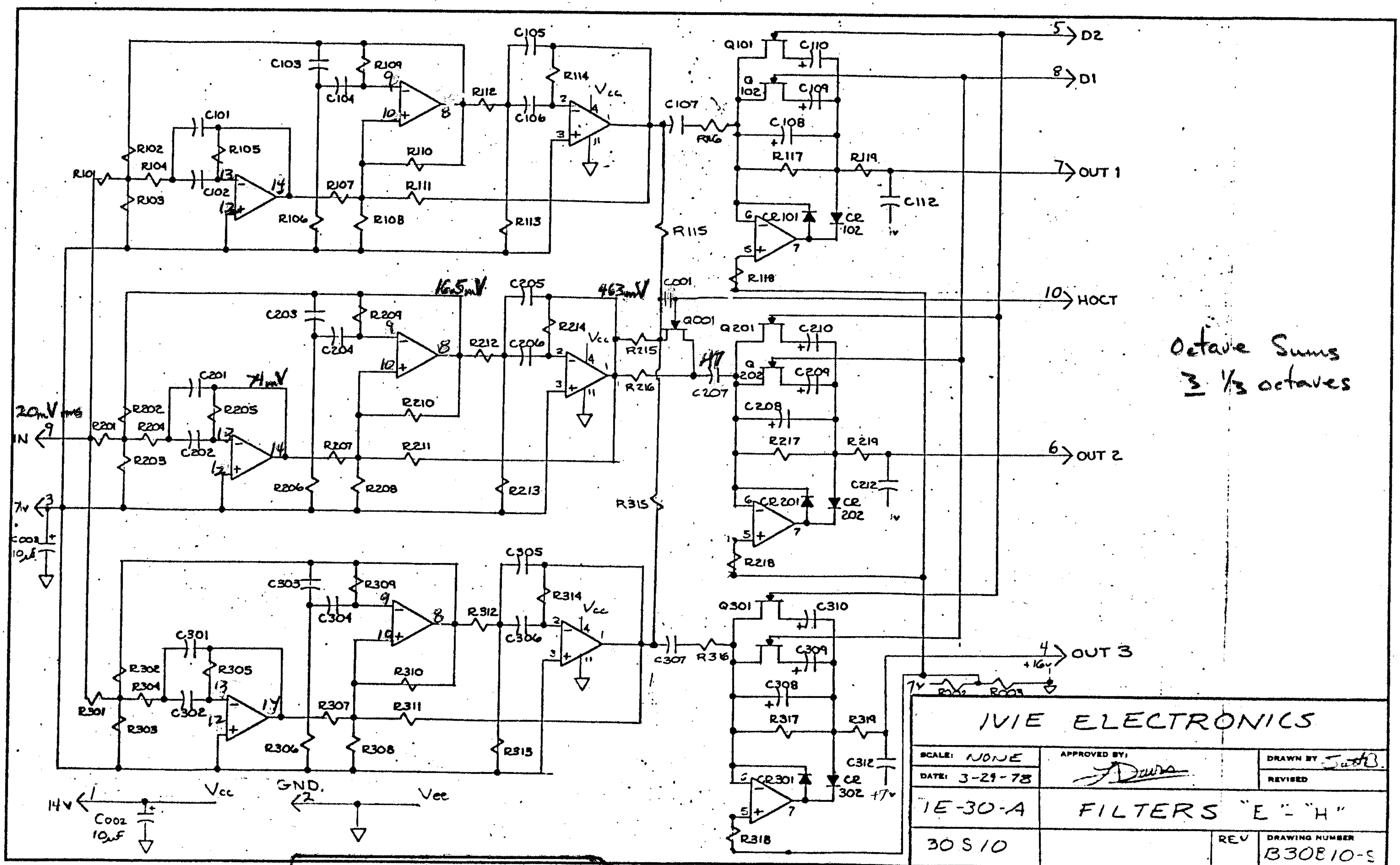
IVIE ELECTRONICS			
SCALE: NONE	APPROVED BY:		DRAWN BY
DATE: 3-28-78			REVISED
LOGGER			
P/N 30S06	IE-30 A	REV. E	DRAWING NUMBER B30B06-S



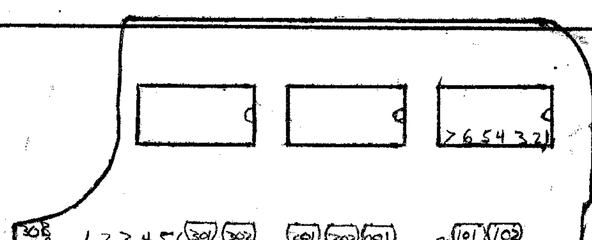
+4.8v to 5.5v 2Amp/Hr
IN GND
OUT GND
+14V 140mA
+7v 4mA
+12v 7mA
CR2 1N4454
R5 2.2K
.35Ω L2
CR1 1N4933
L1
L3
Q4 2N4403
C2 10µf 15v
C1 100µf 10v
R2 220Ω
Q1 2N5337
2N4401 Q2
R1 1K
C4 10µf 15v
C5 10µf 15v
C3 10µf 15v
C6 10µf 15v
Q3 2N4126
R4 10K
R6 10K
Q5 2N4124
R17 10K
R8 100K
15VDC
IC2A
C14 47µf 6.3v
3-6V DC
C13 220pf
R18 10K
R19 68K
C12 220pf
CR5 1N4454
4098B IC1
10µsec
R22 47K
5.4V
IC2B
C15 220pf
R23 100K
R24 10K
R20 110K
R21 100K
IC2C
C11 .01µf
R15 71.5K
R14 220Ω
R13 100K
C10 10µf 15v
IC2D
5.89VDC
R9 16.9K
6.8 ON
4.7 OFF
C7 .01µf
R11 16.4K
C9 10µf 15v
R12 TRIM
C8 10µf 15v
R7 100K
LM 329BZ CR3
For 7.00V Out
Component Side View
IC1 1 2 3 4 5 6 7 8
Q1
C14
7 6 5 4 3 2 1
IC2
8 9 10 11 12 13 14
.25Ω L2
L3
L1
9 8 7 6 5
4 3 2 1
12v 7v 14v
Adjust R12 for 7.00V
Crowbar defeat—pull +C14 to ground
Crowbar when Battery Voltage at 4V
IVIE ELECTRONICS
SCALE: NONE
DATE: 3-28-78
APPROVED BY:
DRAWN BY
REVISED
IE-30-A
POWER SUPPLY
P/N 30507
REV. B,C
DRAWING NUMBER B30807-S
11X17 PRINTED ON NO. 1000H CLEARPRINT


IE-30A consumes 650mA to 1A operating current
1AMP Fast Charge, 300mA Slow Charge
TO BATTERY
LOW BAT
TO MEM
TO MI
BAT DIODE 14
REF DIODE 5
D GRND 6
J2
CHARGE JACK
R15 470Ω
C2 10µf 15v
CR4
R21 10Ω 1/2W
CR10 MR502
CR13 1N4002
CR8
R27 220Ω
R24 47Ω
HGR
100Ω
GRN
R1 200Ω
R10 10K
R13 10K
R16 100Ω
IC1 A LM 393
R6 10K
CR1
C5 1µf 20v
R7 150K
R8 100K
R11 220K
R12 27K
IC1 B LM 393
R9 2.2K
CR14 1N4002
K1
CR9
13v
R20 10K
Q5 MPS A13
Q4 2N4401
HR
220
RED
R19 10K
CHG GRND 6
R22 10K
CR6
R14 100K
CR7
Low for clock
C3 .047µf 35v
One Hour Timer IC2 14521B
IE-30A ON
R25 100K
R23 1M
CR5
CR3
CR2
C1 1µf 20v
R17 470K
TO SPL
TO GATE 10
R3 47K
R5 47K
Q3 2N4401
Audio Out TO 17
TO GATE FROM 17
LOG SCOPE
Y AXIS to 17
X AXIS
DET SPL
Z AXIS
GRND
J1
Q6 2N4401
R18 10K
48V 13
R4 300
CR12
CR11
Q1 2N4124
C4 47µf 6v
Q2 PE 8550
R26 1K
R2 2.2K
IC2 4521
IC1 LM393
CR10
Audio Out
Charge
Relay
Battery Temperature Sense
Adjust with 30A at room temperature, Charger plugged in, for +10-12mVDC pin 2, 3 of IC1
Clockwise 30A remains in fast charge
CClockwise 30A remains in trickle charge
CAUTION when unplugging module pins 13+14 can short Bat Diode
IVIE ELECTRONICS
SCALE: NONE
DATE: 3-28-78
APPROVED BY:
DRAWN BY Scott
REVISED 8/7/78
IE-30-A
CHARGER
P/N 30S08
REV. B
DRAWING NUMBER B30808-S
11X17 PRINTED ON NO. 1000H CLEARPRINT

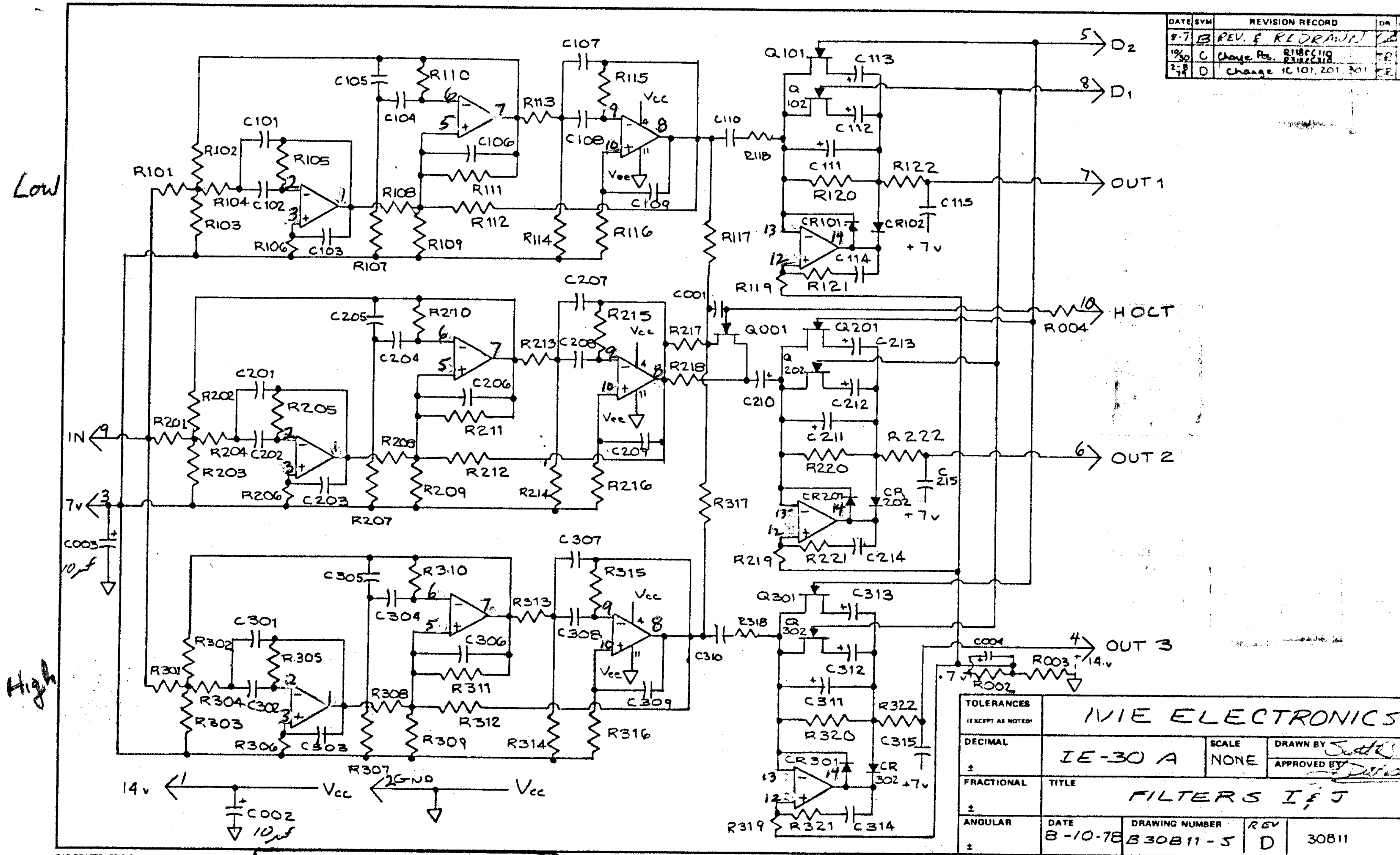

IVIE ELECTRONICS
SCALE: NONE
DATE: 3-29-78
APPROVED BY:
DRAWN BY
REVISED
1E-30-A
FILTERS "A"-"D"
30509
REV. A
DRAWING NUMBER B30809-S
Trim change 1% equals 0.5dB gain change
Circuit Side View
IC1,2,3
3403
TL064
14v
Vcc
10uF
C002
GND
Vee
IN
+7v
10uF
C003
20mVac rms
Trim
17.5mV
450mVac rms
All 10E05
10uF
OUT 1
OUT 2
OUT 3
HOCT
D1
D2
D1 D2 D3
+14v
7v
R002
R003
1Vpp
11217 PRINTED ON NO. 1000H CLEARPRINT

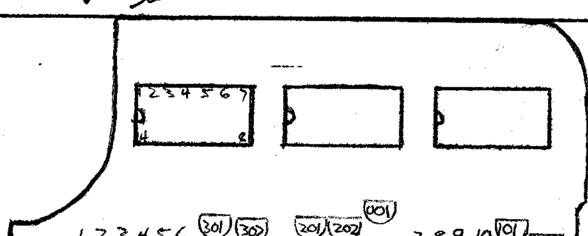


11X17 PRINTED ON NO. 1000H CLEARPRINT

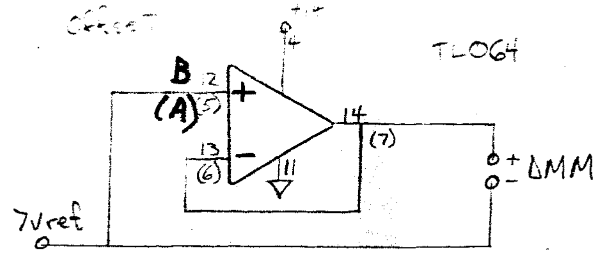


circuit Side
TL064
3403





circuit side
TL064, 74

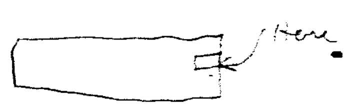


Part Description 3403P / LM324 / TL064 / TL084 / TL074

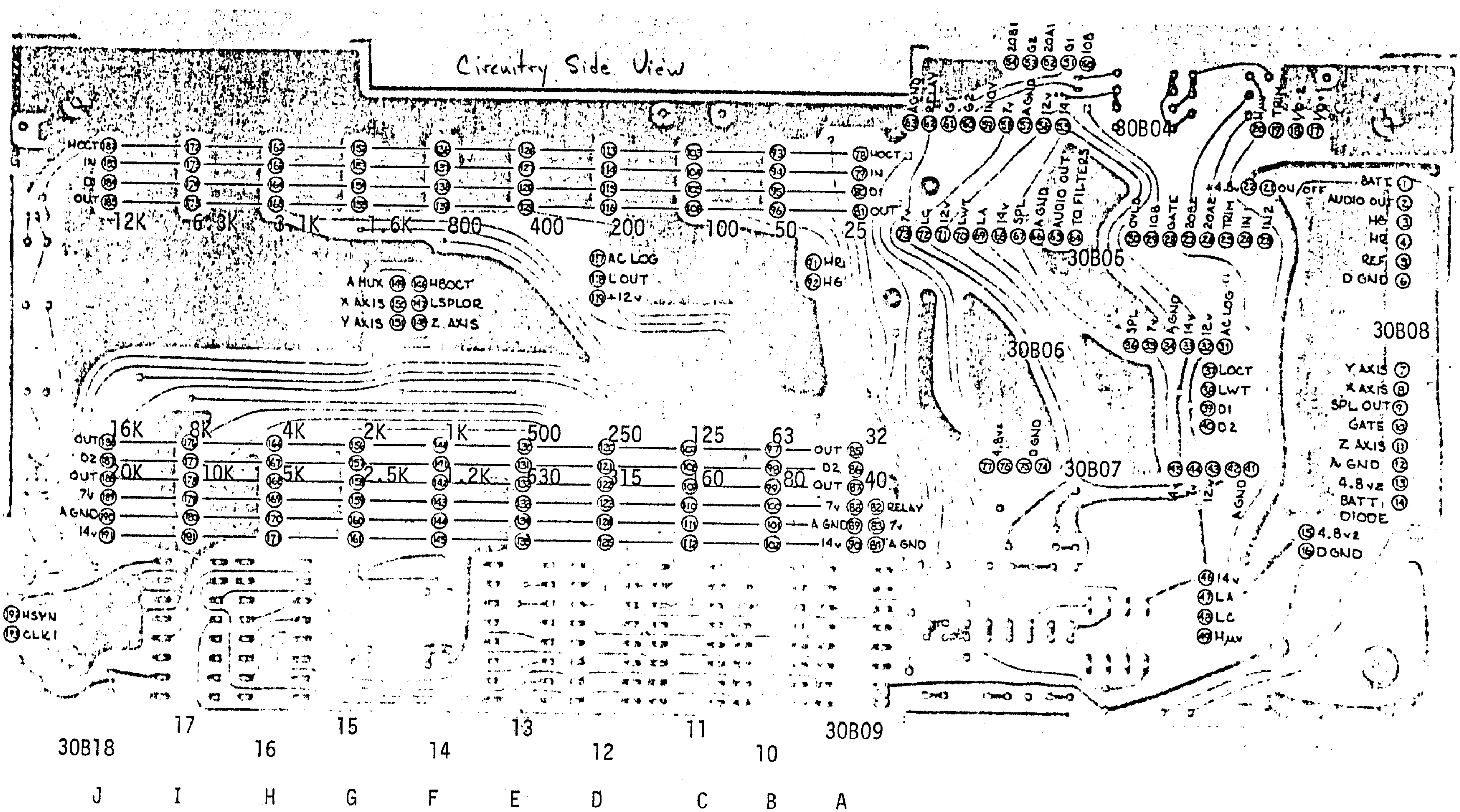
Sort No.	Color Code	Sort Range	ECO/Dwg No.
−4	Green/White	−8.9 mv to −7.0 mv	−.0089 to −.0070
−3	Yellow/White	−6.9 mv to −5.0 mv	−.0069 to −.0050
−2	Orange/White	−4.9 mv to −3.0 mv	−.0049 to −.0030
−1	Red/White	−2.9 mv to −1.0 mv	−.0029 to −.0010
0	Red	−0.9 mv to 1.0 mv	−.0009 to .0010
1	White	1.1 mv to 3.0 mv	.0011 to .0030
2	Orange	3.1 mv to 5.0 mv	.0031 to .0050
3	Yellow	5.1 mv to 7.0 mv	.0051 to .0070
4	Green	7.1 mv to 9.0 mv	.0071 to .0090
5	Blue	9.1 mv to 11.0 mv	.0091 to .0110

for sort A — NO white mark on end Pin 5,6,7

for sort B - White mark on end Use "B" Socket on jig Pin 12,13,14

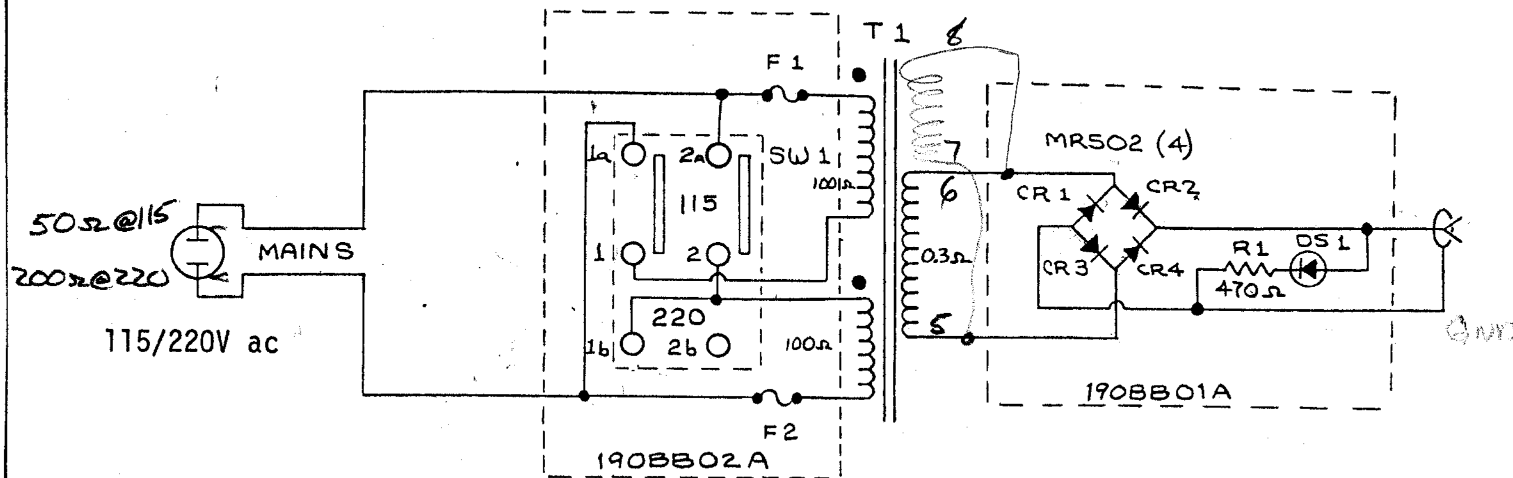


30B03 Interconnect Board



1/3 OCTAVE FILTERS

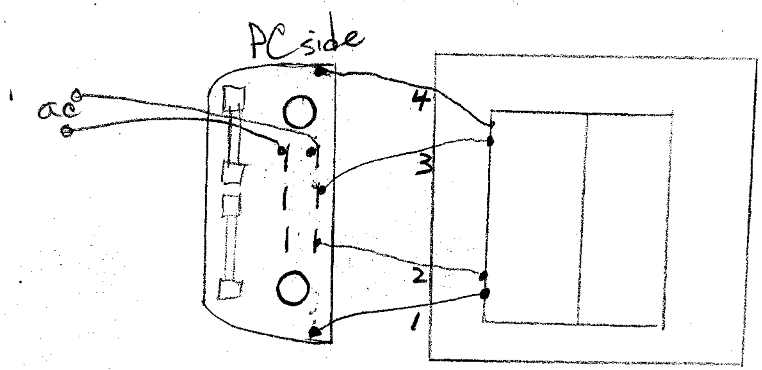
DATE	SYM	REVISION RECORD	DR.	CK.
1/2	B	Swaped 1a & 2A Conn.		



7 vdc output open circuit

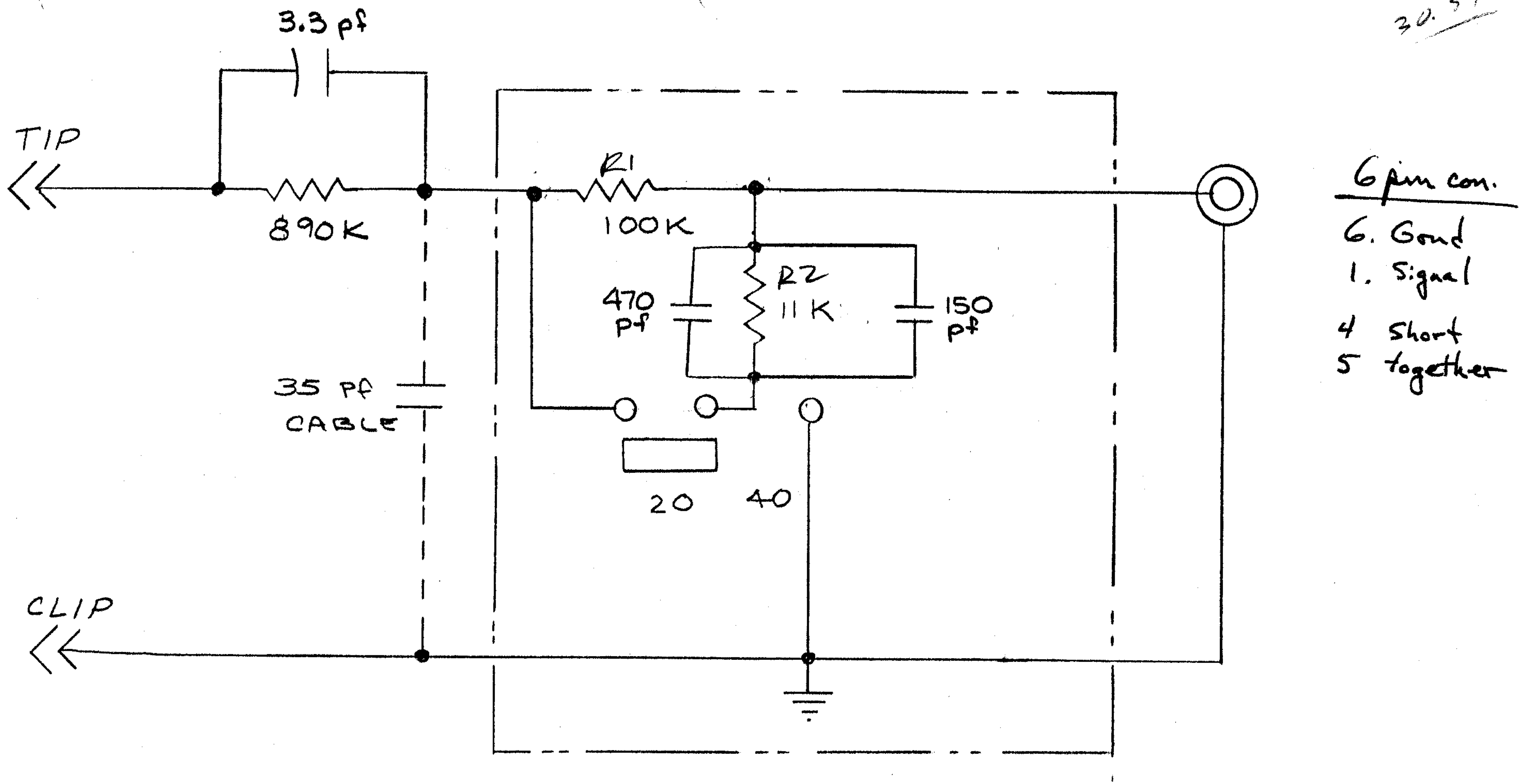
6 vdc into IE-30A at 1 amp

F1/F2 Slow Blo 1/8 Amp Fuse



TOLERANCES (EXCEPT AS NOTED)	IVIE ELECTRONICS		
DECIMAL ±	IE190 B	SCALE NONE	DRAWN BY Scott B. / APPROVED BY Davis
FRACTIONAL ±	TITLE IE 190B SCHEMATIC		
ANGULAR ±	DATE 12-1-78	DRAWING NUMBER B190B-S	REV. B

30.54

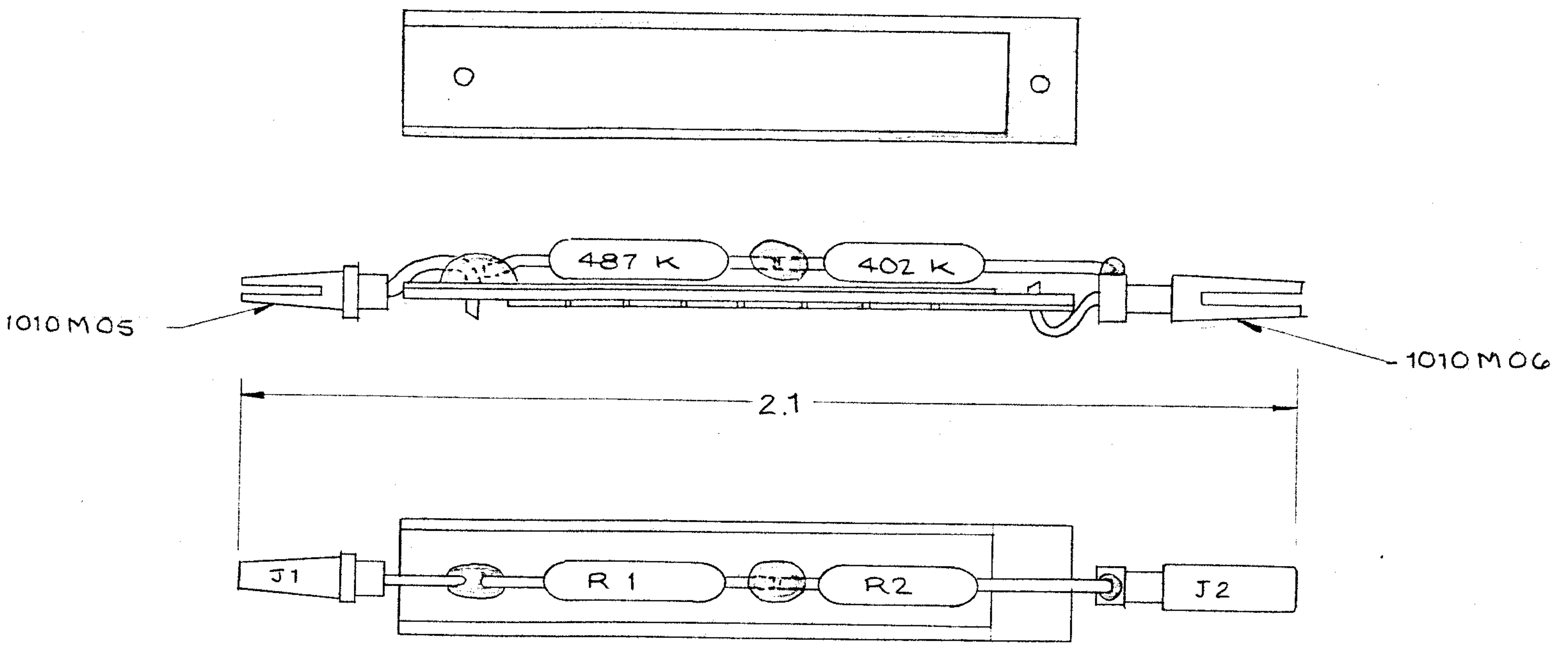


OBSOLETE

IVIE ELECTRONICS		
SCALE: NONE	APPROVED BY: [illegible]	DRAWN BY Scott B
DATE: 3-22-78		REVISED
IE-1036A PROBE		
PART NUMBER 1036B01	REV. B	DRAWING NUMBER A1036B01-S

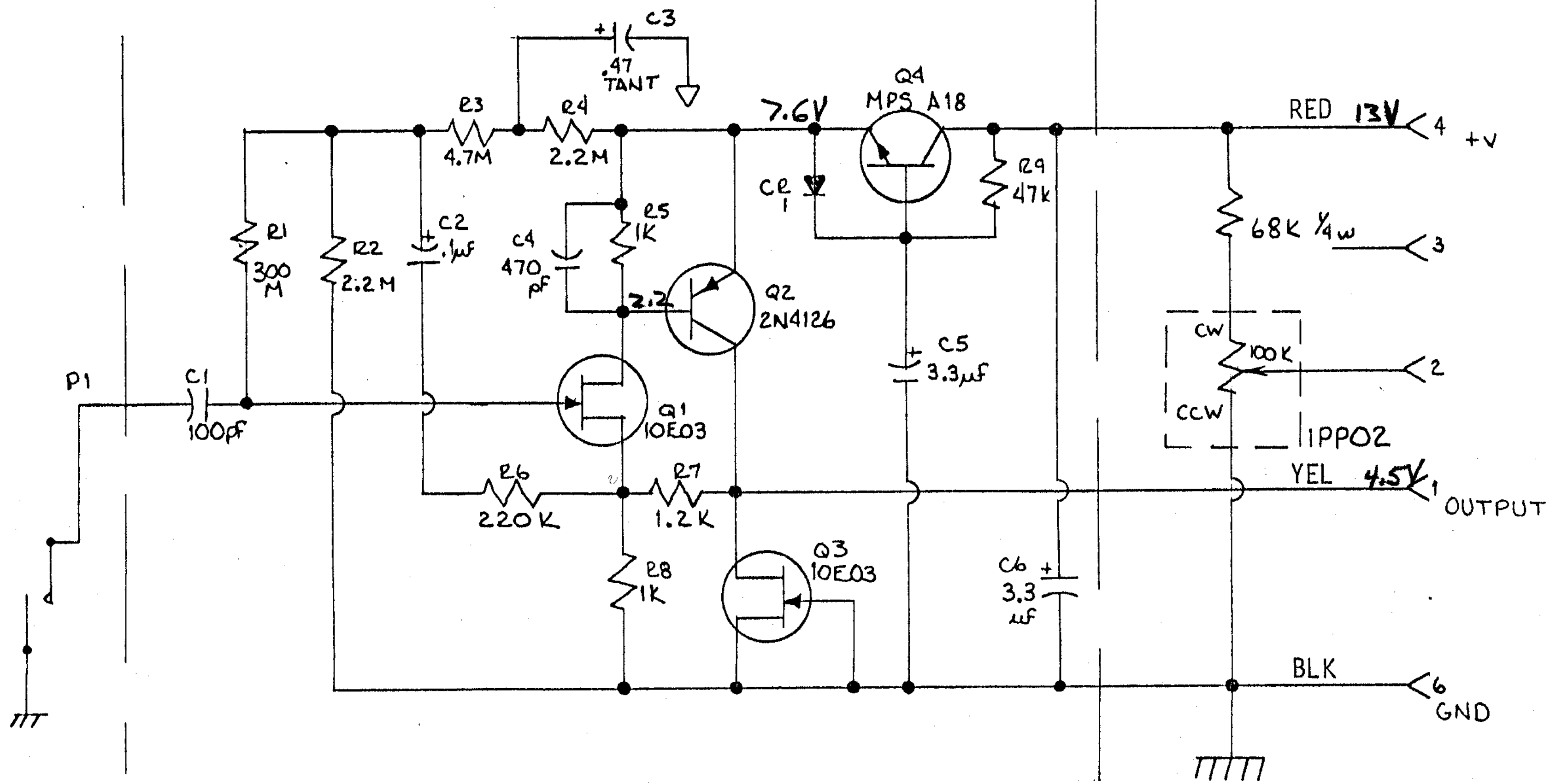
DATE	SYM	REVISION RECORD	DR.	CK.

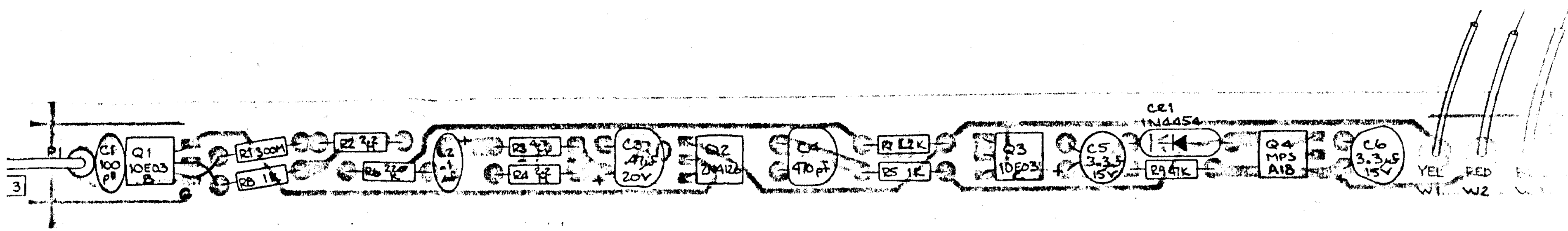
COMPONENT VIEW



TOLERANCES (EXCEPT AS NOTED)	IVIE ELECTRONICS			
DECIMAL ±	SCOPE PROBE	SCALE NONE	DRAWN BY Scott B. / APPROVED BY JWI	
FRACTIONAL ±	TITLE 30 SCOPE PROBE TIP			
ANGULAR ±	DATE 6-21-78	DRAWING NUMBER 1036B02P	REV. A	P/N 1036P02

GAF DRAFTRACE 250





Voltage Gain 6.4 dB

0dBm Input - Cal gain max yields 144.7 SPL

With 8.6pf [illegible] A weight Noise Floor ([illegible]) 47.5 dBA

TABLE IV. Random incidence relative response level as a function of frequency for various weightings

Nominal frequency[a] Hz	Exact frequency[a] in	A Weighting dB	B Weighting dB	C Weighting dB
10	10.00	−70.4	−38.2	−14.3
12.5	12.59	−63.4	−33.2	−11.2
16	15.85	−56.7	−28.5	−8.5
20	19.95	−50.5	−24.2	−6.2
25	25.12	−44.7	−20.4	−4.4
31.5	31.62	−39.4	−17.1	−3.0
40	39.81	−34.6	−14.2	−2.0
50	50.12	−30.2	−11.6	−1.3
63	63.10	−26.2	−9.3	−0.8
80	79.43	−22.5	−7.4	−0.5
100	100.0	−19.1	−5.6	−0.3
125	125.9	−16.1	−4.2	−0.2
160	158.5	−13.4	−3.0	−0.1
200	199.5	−10.9	−2.0	0
250	251.2	−8.6	−1.3	0
315	316.2	−6.6	−0.8	0
400	398.1	−4.8	−0.5	0
500	501.2	−3.2	−0.3	0
630	631.0	−1.9	−0.1	0
800	794.3	−0.8	0	0
1000	1000	0	0	0
1250	1259	+0.6	0	0
1600	1585	+1.0	0	−0.1
2000	1995	+1.2	−0.1	−0.2
2500	2512	+1.3	−0.2	−0.3
3150	3162	+1.2	−0.4	−0.5
4000	3981	+1.0	−0.7	−0.8
5000	5012	+0.5	−1.2	−1.3
6300	6310	−0.1	−1.9	−2.0
8000	7943	−1.1	−2.9	−3.0
10 000	10 000	−2.5	−4.3	−4.4
12 500	12 590	−4.3	−6.1	−6.2
16 000	15 850	−6.6	−8.4	−8.5
20 000	19 950	−9.3	−11.1	−11.2

[a]Nominal frequencies are as specified in ANSI S1.6–1967 (R1976), American National Standard Preferred Frequencies and Band Numbers for Acoustical Measurements. Exact frequencies are given above to four significant figures and are calculated from frequency equals $10^{0.1N}$, where N is an integer band number from 10 to 43 (1 hertz corresponds to $N=0$).

5.3 Level-Range-Control Tolerance Limits

When a level range control is included, it shall introduce errors less than those given in Table VI for all settings with reference to the calibration range.

5.4 Level Range Overlap

When a manual level range control is included in a sound level meter, ranges shall overlap by at least 5 decibels if the step of the level range control is 10 decibels and by at least 10 decibels if the step is greater.

5.5 Crest Factor

The amplifier shall have a crest factor capability sufficient to meet the requirements of 6.2. For type 0 and type 1 instruments, and any impulse sound level meter, overload detectors shall be placed in the amplifier output chain and shall indicate when the crest factor capability has been exceeded see (8.3.1). An overload detector should also be incorporated in type 2 instruments.

TABLE V. Tolerance limits on relative response levels for sound at random incidence measured on an instrument's calibration range.

Nominal frequency Hz	Type 0 dB	Type 1 dB	Type 2 dB
10	+2, −5	±4	+5, −∞
12.5	+2, −4	±3.5,	+5, −∞
16	+2, −3	±3	+5, −∞
20	±2	±2.5	+3
25	±1.5	±2	±3
31.5	±1	±1.5	±3
40	±1	±1.5	±2
50	±1	±1	±2
63	±1	±1	±2
80	±1	±1	±2
100	±0.7	±1	±1.5
125	±0.7	±1	±1.5
160	±0.7	±1	±1.5
200	±0.7	±1	±1.5
250	±0.7	±1	±1.5
315	±0.7	±1	±1.5
400	±0.7	±1	±1.5
500	±0.7	±1	±1.5
630	±0.7	±1	±1.5
800	±0.7	±1	±1.5
1000	±0.7	±1	±1.5
1250	±0.7	±1	±1.5
1600	±0.7	±1	±2
2000	±0.7	±1	±2
2500	±0.7	±1	±2.5
3150	±0.7	±1	±2.5
4000	±0.7	±1	±3
5000	±1	±1.5	±3.5
6300	+1, −1.5	+1.5, −2	±4.5
8000	+1, −2	+1.5, −3	±5
10 000	+2, −3	+2, −4	+5, −∞
12 500	+2, −3	+3, −6	+5, −∞
16 000	+2, −3	+3, −∞	+5, −∞
20 000	+2, −3	+3, −∞	+5, −∞

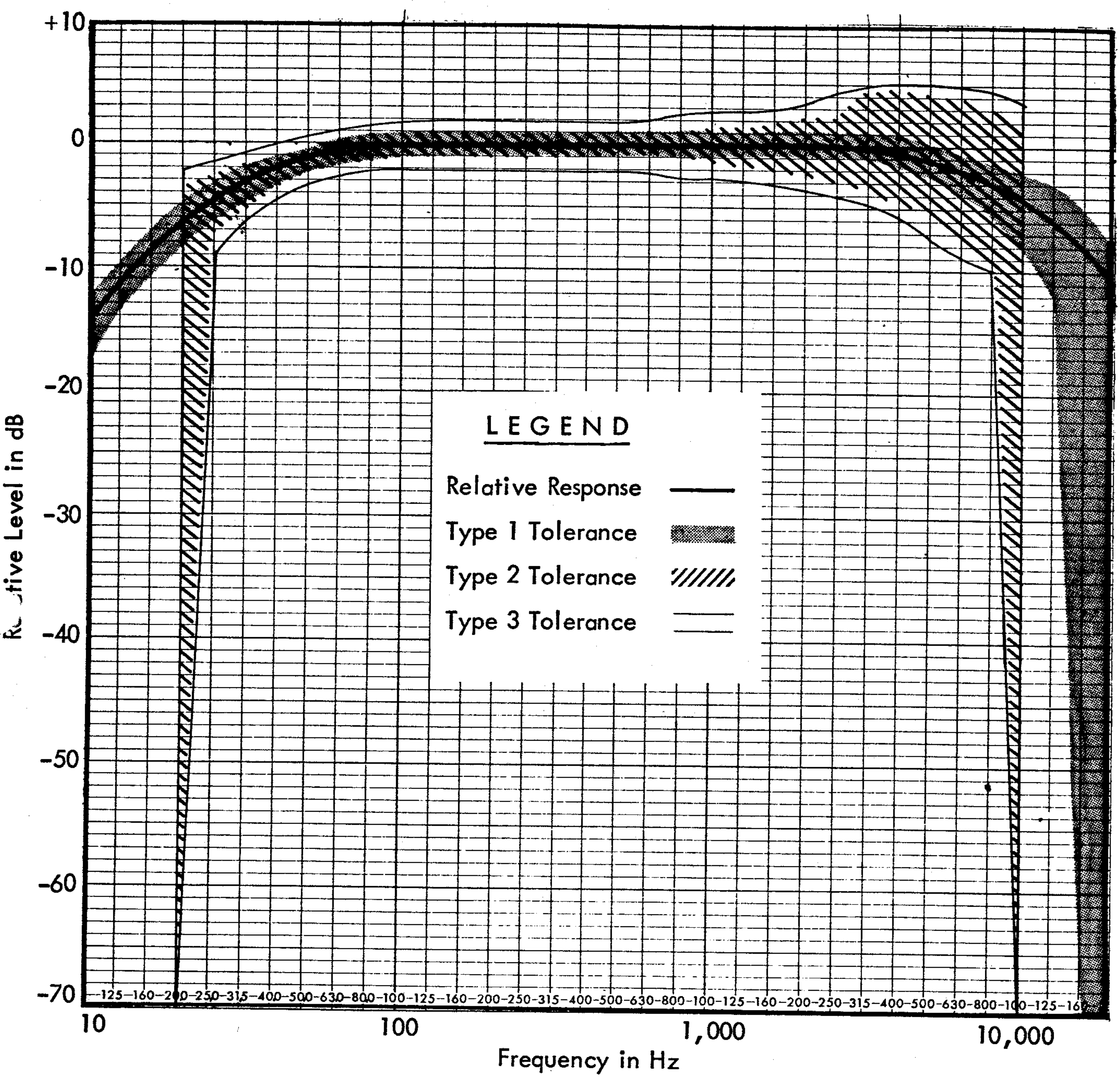


Fig. 1
Illustration of C Weighting and Tolerances for Sound at Random Incidence for Three Types of Sound Level Meters

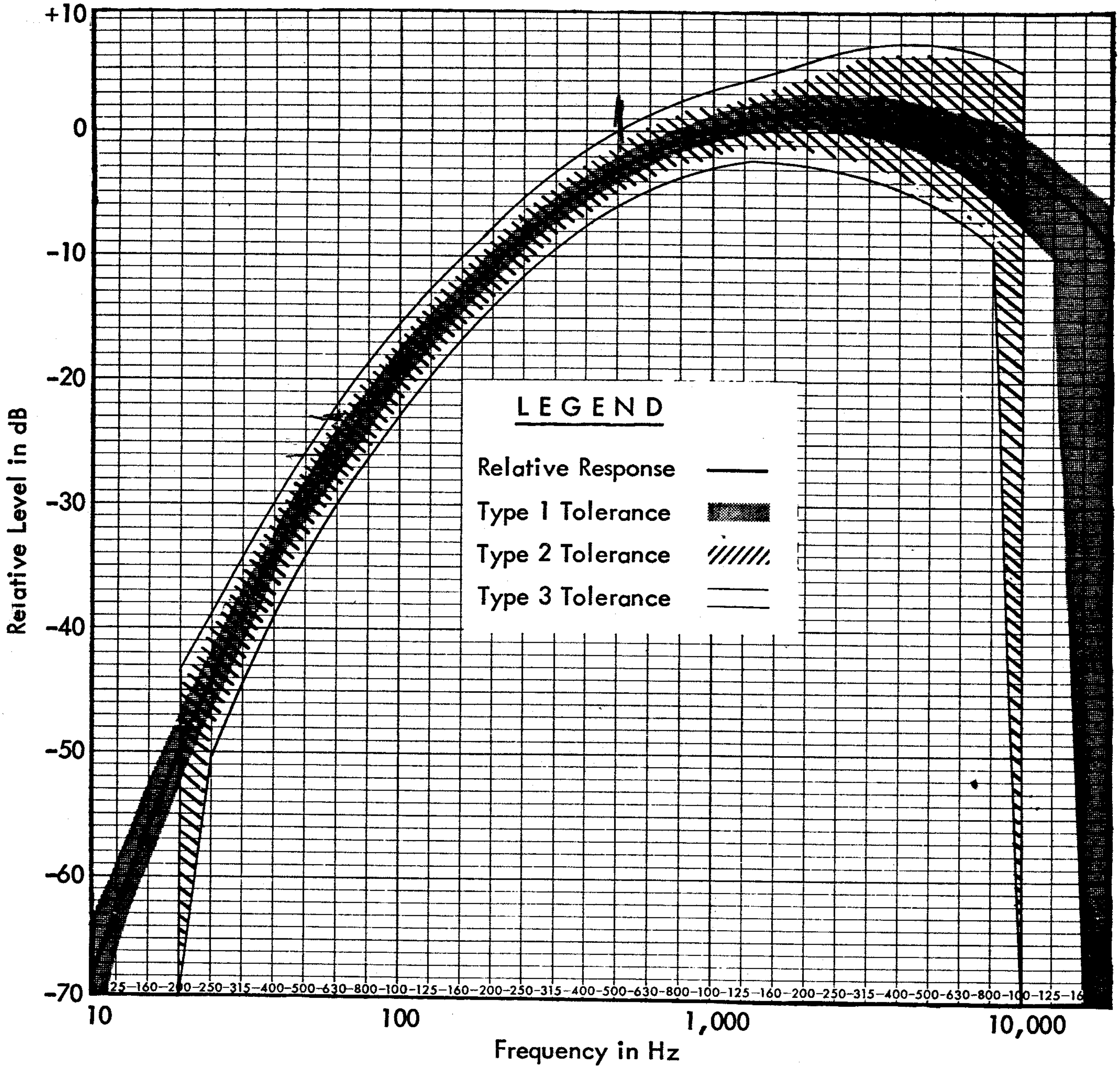


Fig. 3
Illustration of A Weighting and Tolerances
for Sound at Random Incidence
for Three Types of Sound Level Meters

Table 3
Total Tolerance Limits for Sound at Random Incidence for Type 2 Sound Level Meter

Frequency Hz	A Weighting dB	B Weighting dB	C Weighting dB
20	+5.0, −∞	+4.0, −∞	+3.0, −∞
25	+4.0, −4.5	+3.0, −3.5	+2.0, −2.5
31.5	+3.5, −4.0	+2.5, −3.0	+1.5, −2.0
40	+3.0, −3.5	+2.0, −2.5	+1.0, −1.5
50	±3.0	±2.0	±1.0
63	±3.0	±2.0	±1.0
80	±3.0	±2.0	±1.0
100	±2.5	±2.0	±1.0
125	±2.5	±2.0	±1.0
160	±2.5	±1.5	±1.0
200	±2.5	±1.5	±1.0
250	±2.5	±1.5	±1.0
315	±2.0	±1.5	±1.0
400	±2.0	±1.5	±1.0
500	±2.0	±1.5	±1.0
630	±2.0	±1.5	±1.0
800	±1.5	±1.5	±1.0
1000	±2.0	±2.0	±1.5
1250	±2.0	±2.0	±1.5
1600	±2.5	±2.5	±2.0
2000	±3.0	±3.0	±2.5
2500	+4.0, −3.5	+4.0, −3.5	+3.5, −3.0
3150	+5.0, −4.0	+5.0, −4.0	+4.5, −3.5
4000	+5.5, −4.5	+5.5, −4.5	+5.0, −4.0
5000	+6.0, −5.0	+6.0, −5.0	+5.5, −4.5
6300	+6.5, −5.5	+6.5, −5.5	+6.0, −5.0
8000	+6.5, −6.5	+6.5, −6.5	+6.0, −6.0
10 000	+6.5, −∞	+6.5, −∞	+6.0, −∞

Table 4
Total Tolerance Limits for Sound at Random Incidence for Type 3 Sound Level Meter

Frequency Hz	A Weighting dB	B Weighting dB	C Weighting dB
20	+6.0, −∞	+5.0, −∞	+4.0, −∞
25	+5.0, −6.0	+4.0, −5.5	+3.0, −4.5
31.5	+4.5, −5.0	+3.5, −4.0	+2.5, −3.0
40	+4.0, −4.5	+3.0, −3.5	+2.0, −2.5
50	±4.0	±3.0	±2.0
63	±4.0	±3.0	±2.0
80	±3.5	±3.0	±2.0
100	±3.5	±3.0	±2.0
125	±3.0	±2.5	±2.0
160	±3.0	±2.5	±2.0
200	±3.0	±2.5	±2.0
250	±3.0	±2.5	±2.0
315	±3.0	±2.5	±2.0
400	±3.0	±2.5	±2.0
500	±3.0	±2.5	±2.0
630	±3.0	±2.5	±2.0
800	±3.0	±3.0	±2.5
1000	±3.0	±3.0	±2.5
1250	±3.0	±3.0	±2.5
1600	±3.5	±3.5	±3.0
2000	±4.0	±4.0	±3.5
2500	±4.5	±4.5	±4.0
3150	±5.0	±5.0	±4.5
4000	±5.5	±5.5	±5.0
5000	±6.5	±6.5	±6.0
6300	±7.0	±7.5	±7.0
8000	±7.5	±7.5	±7.0
10 000	+7.5, −∞	+7.5, −∞	+7.0, −∞

-43

Table 2
Total Tolerance Limits for Sound at Random Incidence for Type 1 Sound Level Meter

Frequency Hz	A Weighting dB	B Weighting dB	C Weighting dB
10	±4	±3	±2.5
12.5	±3.5	±2.5	±2
16	±3	±2	±2
20	±2.5	±2	±2
25	±2	±2	±1.5
31.5	±1.5	±1.5	±1.5
40	±1.5	±1.5	±1
50	±1	±1	±1
63	±1	±1	±1
80	±1	±1	±1
100	±1	±1	±1
125	±1	±1	±1
160	±1	±1	±1
200	±1	±1	±1
250	±1	±1	±1
315	±1	±1	±1
400	±1	±1	±1
500	±1	±1	±1
630	±1	±1	±1
800	±1	±1	±1
1000	±1	±1	±1
1250	±1	±1	±1
1600	±1	±1	±1
2000	±1	±1	±1
2500	±1	±1	±1
3150	±1	±1	±1
4000	±1	±1	±1
5000	+1.5, -2	+1.5, -2	+1.5, -2
6300	+1.5, -2	+1.5, -2	+1.5, -2
8000	+1.5, -3	+1.5, -3	+1.5, -3
10 000	+2, -4	+2, -4	+2, -4
12 500	+3, -6	+3, -6	+3, -6
16 000	+3, -∞	+3, -∞	+3, -∞
20 000	+3, -∞	+3, -∞	+3, -∞

level that the sound level meter is intended to measure. The rated lowest level may be different for each weighting.

T **3.3.3** With the indicating instrument replaced by an equivalent impedance, the response to electrical sine waves in the frequency range 22.4 to 11 200 Hz shall be linear within 1.0 decibel up to 10 decibels above the voltage equivalent to the maximum scale reading for Type 1 and Type 2 instruments. The response of the Type 3 instruments in the frequency range 63 to 8000 Hz shall be linear within 1.0 decibel up to 8 decibels above the voltage equivalent to the maximum scale reading.

T **3.3.4** The maximum sound level for which linearity exists within 1.0 decibel shall be stated as a function of frequency for each weighting network provided, or suitable overload indicator(s) shall be provided.

4. Omnidirectional Response and Tolerances

4.1 Omnidirectional Response. Response to sound of random incidence is used as the measure of omnidirectional response. It may be measured in a diffuse sound field or calculated from free-field responses to sound arriving in different directions. The free-field calibration should be accomplished by comparison, under the general principles set forth in 7.2.1 of American National Standard Method for the Calibration of Microphones, S1.10-1966, except that sound level is to be measured instead of microphone free-field response level. One of the various methods of measurement and calculation is given in Appendix A.

Table 1
Sound Level Meter Random-Incidence Relative Response Level As a Function of Frequency for Various Weightings

Frequency Hz	A Weighting Relative Response dB	B Weighting Relative Response dB	C Weighting Relative Response dB
10	-70.4 (dB with respect to max)	-38.2	-14.3
12.5	-63.4 -64.7	-33.2	-11.2
16	-56.7 -58	-28.5	- 8.5
20	-50.5 -51.8	-24.2	- 6.2
25	-44.7 -46	-20.4	- 4.4
31.5	-39.4 -40.7	-17.1	- 3.0 *
40	-34.6 -35.9	-14.2	- 2.0
50	-30.2 -31.5	-11.6	- 1.3
63	-26.2 -27.5	- 9.3	- 0.8
80	-22.5 -23.8	- 7.4	- 0.5
100	-19.1 -20.4	- 5.6	- 0.3
125	-16.1 -17.4	- 4.2	- 0.2
160	-13.4 -14.7	- 3.0	- 0.1
200	-10.9 -12.2	- 2.0	0
250	- 8.6 -9.9	- 1.3	0
315	- 6.6 -7.9	- 0.8	0
400	- 4.8 -6.1	- 0.5	0
500	- 3.2 -4.5	- 0.3	0
630	- 1.9 -3.2	- 0.1	0
800	- 0.8 -2.1	0	0
1000	0 -1.3	0	0
1250	+ 0.6 -.6	0	0
1600	+ 1.0 -.2	0	- 0.1
2000	+ 1.2 -.1	- 0.1	- 0.2
2500	+ 1.3 0	- 0.2	- 0.3
3150	+ 1.2 -.1	- 0.4	- 0.5
4000	+ 1.0 -.2	- 0.7	- 0.8
5000	+ 0.5 -.7	- 1.2	- 1.3
6300	- 0.1 -1.4	- 1.9	- 2.0
8000	- 1.1 -2.4	- 2.9	- 3.0 *
10 000	- 2.5 -3.8	- 4.3	- 4.4
12 500	- 4.3 -5.6	- 6.1	- 6.2
16 000	- 6.6 -7.9	- 8.4	- 8.5
20 000	- 9.3 -10.6	-11.1	-11.2

within the following tolerance limits with respect to the setting for 80 decibels. (If no 80 decibel setting is provided, the tolerance limits shall apply with respect to a reference setting stated by the manufacturer.)

Type 1

within ± 0.5 dB 22.4 to 11 200 Hz

Type 2

within ± 0.5 dB 63 to 2000 Hz
within ± 1.0 dB 22.4 to 11 200 Hz

Type 3

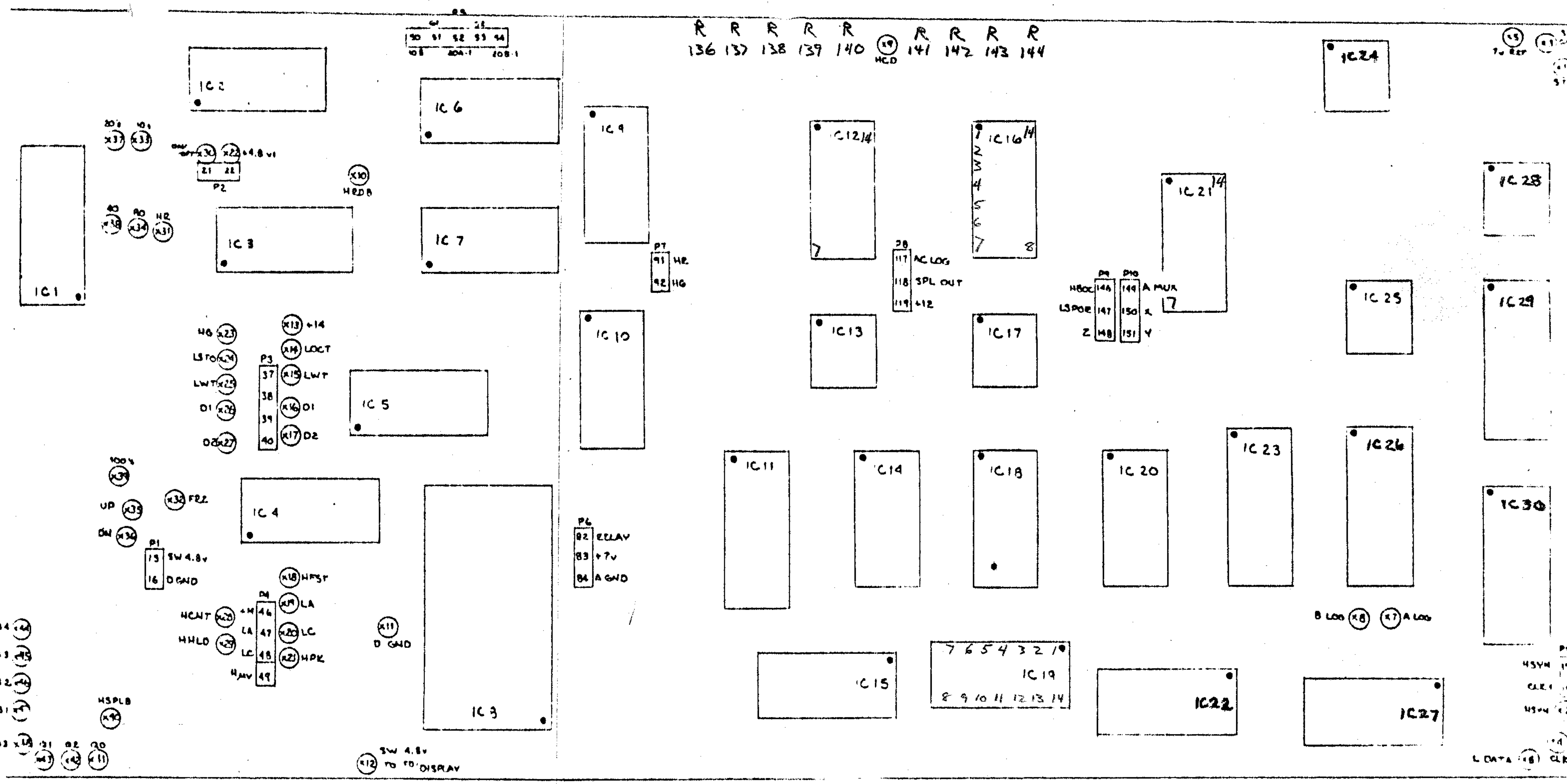
within ± 1.0 dB 63 to 4000 Hz
within ± 2.0 dB 31.5 to 8000 Hz

If more than one sensitivity range is provided, it is recommended that the attenuator steps be at 10 decibel intervals.

3.3 Internal Noise and Distortion (Dynamic Range)

3.3.1 In an environment in which the sound level meter is free of observable extraneous influences, the internal noise of the sound level meter shall be specified by bands no wider than octave bands and stated in equivalent sound level for all attenuator settings. It is intended that this measurement be made at the amplifier output with an acoustically shielded microphone in place. In addition, for Type 1 and Type 2 instruments, the internal noise equivalent sound level for all attenuator settings 30 decibels or more above the maximum sensitivity setting shall be at least 40 decibels below the maximum scale reading when measured in octave bands.

3.3.2 When the microphone is replaced by an equivalent electrical impedance, the background noise level presented to the indicating instrument shall be at least 5 decibels below the lowest sound



TOLERANCES (EXCEPT AS NOTED)	IVIE ELECTRONICS INC.			
DECIMAL ±	IE-30 A	SCALE NONE	DRAWN BY	APPROVED BY
FRACTIONAL ±	TITLE MEMORY PIN CALLOUTS			
ANGULAR ±	DATE 6 23 73	DRAWING NUMBER C 30502 F2	A	

New proposed IEC specs, not released yet

Table V

Tolerances* on Weighting Characteristics Given in Table IV

Nominal Frequency Hz	Tolerances in dB			
	Type 0**	Type 1	Type 2	Type 3
10	+2, -∞	+3.0, -∞	+5, -∞	+5.0, -∞
12.5	+2, -∞	+3.0, -∞	+5, -∞	+5.0, -∞
16	+2, -∞	+3.0, -∞	+5, -∞	+5.0, -∞
20	±2	±3.0	±3	+5.0, -∞
25	±1.5	±2.0	±3	+5.0, -∞
31.5	±1	±1.5	±3	±4.0
40	±1	±1.5	±2	±4.0
50	±1	±1.5	±2	±3.0
63	±1	±1.5	±2	±3.0
80	±1	±1.5	±2	±3.0
100	±0.7	±1.0	±1.5	±3.0
125	±0.7	±1.0	±1.5	±2.0
160	±0.7	±1.0	±1.5	±2.0
200	±0.7	±1.0	±1.5	±2.0
250	±0.7	±1.0	±1.5	±2.0
315	±0.7	±1.0	±1.5	±2.0
400	±0.7	±1.0	±1.5	±2.0
500	±0.7	±1.0	±1.5	±2.0
630	±0.7	±1.0	±1.5	±2.0
800	±0.7	±1.0	±1.5	±2.0
1000	±0.7	±1.0	±1.5	±2.0
1250	±0.7	±1.0	±1.5	±2.5
1600	±0.7	±1.0	±2.0	±3.0
2000	±0.7	±1.0	±2.0	±3.0
2500	±0.7	±1.0	±2.5	±4.0
3150	±0.7	±1.0	±2.5	±4.5
4000	±0.7	±1.0	±3.0	±5.0
5000	±1	±1.5	±3.5	±6.0
6300	+1, -1.5	+1.5, -2.0	±4.5	±6.0
8000	+1, -2	+1.5, -3.0	±5	±6.0
10000	+2, -3	+2.0, -4.0	+5, -∞	+6.0, -∞
12500	+2, -3	+3.0, -6.0	+5, -∞	+6.0, -∞
16000	+2, -3	+3.0, -∞	+5, -∞	+6.0, -∞
20000	+2, -3	+3.0, -∞	+5, -∞	+6.0, -∞

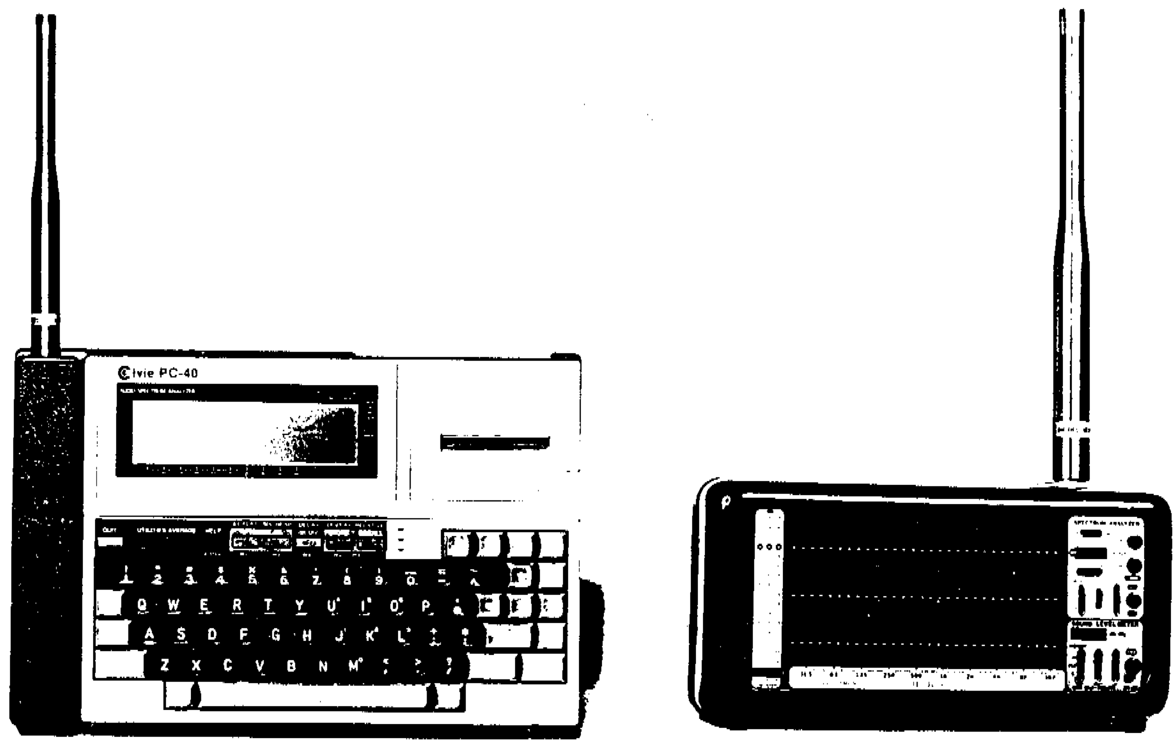
*Tolerances are the same for all weighting characteristics. The tolerance is zero at the reference frequency which must be in the range from 200 - 1000 Hz.

**Frequency response curves shall be provided (See Clause 11).

Ivie
Technologies, Inc.

IVIE
TECHNOLOGIES, INC.

IE-2P MANUAL



Operation and Owners Manual for the
IE-2P Precision Preamplifier
for the IE-30A and the PC-40

Printed in U.S.A.

Introduction

The IE-2P is a power supply/preamplifier specifically designed to operate with Ivie, Brüel and Kjœr, ACO Pacific and other laboratory quality condenser microphones following the international thread standard and requiring a 200 volt, or 28 volt DC polarization (bias) voltage. The IE-2P plugs directly into the Ivie IE-30A and the Ivie PC-40, and accepts a 1/2 inch cartridge.

When microphones other than Ivie are used, they must operate with either 200 volt or 28 volt polarization voltages. One half inch microphones will screw directly to the IE-2P, but one eighth inch, one quarter inch and one inch microphones will require adaptors to adapt them to the standard one half inch threads of the IE-2P. These adaptors are normally available directly from the manufacturer of the microphone used. Most 1/8, 1/4 and 1/2 inch microphones require a 200 volt DC bias voltage, while some 1 inch microphones require 28 volts DC. The IE-2P can be switched to supply either of these voltages, and draws power from the IE-30A or PC-40 regulated, 12 volt power supply.

The IE-2P can be used as a microphone preamplifier separate from the IE-30A or the PC-40 if a power source is provided. This could be as simple as a small box containing batteries and the proper connectors to accept both the IE-2P and the input cable from the equipment being used with the IE-2P. The Appendix of this manual contains a circuit diagram for such a box.

Before Operation

Note: Due to the very high impedance/low capacitance of this device, certain precautions must be taken to protect the input circuitry. These include:

1. Do not remove the microphone cartridge when the IE-2P is on. When the circuitry is active, removal of the cartridge can cause shorting of the power supply to the spring loaded cartridge electrode. Damage will result. *It may also zap the operator with a full 200 volts. Even with the very low current involved, this is an unpleasant experience.*

2. Wait at least ten seconds after turning off the IE-2P before removing the cartridge. This allows a full discharge of the supply voltage.

3. The several giga ohm input impedance of the IE-2P renders it susceptible to static discharge damage. Care should be taken when handling the IE-2P to see that no static discharge reaches the spring loaded input electrode.

Using the IE-2P

The IE-2P comes from the factory adjusted for 200 volt bias operation, and with the Sensitivity Switch (see IE-2P drawing in Appendix of this manual) set for -0dB attenuation. The -0dB attenuation setting is intended for use with most 1/2 inch and all 1/4 and 1/8 inch microphones. Some very sensitive 1/2 inch, and most 1 inch microphones will require the -20dB attenuation setting to allow them to be properly calibrated to the IE-30A or the PC-40.

If the IE-2P must be disassembled in order to change the attenuation setting or the bias voltage, disassemble it in the following manner:

1. Loosen the Housing Lock Screw (see Appendix for IE-2P drawing). Once the screw is loosened, grasp the exposed end of the connector and firmly draw it straight back with a smooth motion, until the miniature rocker switches are exposed. Care should be taken while the PC board is extended out of the case so that the board is not allowed to bend or flex excessively, damaging solder joints or breaking the board itself.

2. Set the Bias Voltage Switch and the Attenuation Switch as necessary, depending on the requirements of the microphone being used.

3. Carefully slide the connector/PC board back into the housing, and secure with the Housing Lock Screw.

Calibration

Once a microphone cartridge has been connected to the IE-2P, plug it into the IE-30A or PC-40. Attach a calibrating device such as a pistonphone to the microphone cartridge and adjust the Calibration Control (see Appendix for IE-2P drawing and location of Calibration Control) to obtain the proper SPL. Make sure the Attenuation Switch and Bias Voltage Switch are in their proper positions as discussed above. After calibration, the IE-2P and microphone are ready for use.

Further Instructions and Cautions

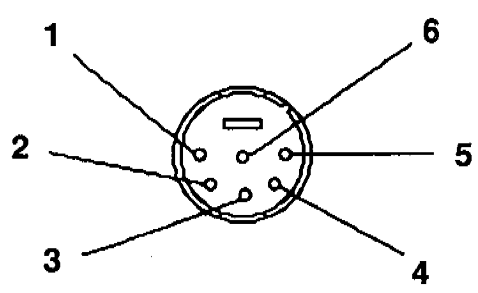
Ivie 1/2 inch microphones and similar microphones from other manufacturers are capable of accurately responding to SPL's in excess of 140 to 150dB (check each manufacturer's specifications for exact limits). However, the signal levels these microphones generate at these high SPL levels are excessive for the IE-2P. Ivie microphones used with the IE-2P can measure SPL's up to approximately 130dB. *Subjecting the Ivie microphone/IE-2P combination to SPL's higher than 130dB can cause damage to the IE-2P.* This damage shows up as a permanent loss in sensitivity. The higher the SPL to which the IE-2P is subjected, the more severe the sensitivity loss.

Avoiding such damage is a simple matter. If it is known that very high levels of SPL are going to be encountered, it is a simple thing to add an attenuation pad. These are available from Brüel and Kjœr and others. Readings will then need to be adjusted for the proper SPL reading. If such a pad is not available, the 20dB pad in the IE-2P can be switched in. This will, of course, require that a 20dB adjustment be added to each SPL reading. Another option is to offset the calibration of the IE-30A or PC-40 by 20dB. If a calibration device such as a pistonphone generates 124dB, for example, the analyzer can be set for 104dB. Then, of course, a 20dB correction is added to the SPL of each measurement taken.

If measurement offsets are undesirable, a 1/4 or 1/8 inch microphone can be used instead of a 1/2 microphone. The signal level they generate at higher SPL levels is significantly less than 1/2 inch microphones generate, so the IE-2P will not be damaged. These smaller microphones can be exactly calibrated to Ivie analyzers, requiring no adjustment in SPL readings.

IE-2P Output Pin Assignments

The output pin configuration of the IE-2P is shown below:



Pin assignments are:

Pin 1. Audio Output (less than 25Ω)
Pin 2. Gain Trim. Activates gain trim circuit in IE-30A or PC-40 to allow for level calibration.
Pin 3. No connection.
Pin 4. Power input (6 to 12 VDC at 7Ma).

Pin 5. Attenuation pin. IE-2P Sensitivity Switch shorts this pin to pin 4, providing -20dB of attenuation.

Pin 6. Ground

Specifications

Input Capacitance: ---------- <.25 pf

Input Impedance: ---------- 2 giga Ω at 100 Hz

Dynamic Range: ---------- See Appendix, Figure 1

Bandwidth: ---------- See Appendix, Figure 2

Flatness: ---------- See Appendix, Figure 2

Supply Voltage Range: ---------- +6 to +12 VDC

Current Drain: ---------- 7 Ma

Frequency Response: ---------- See Appendix, Figure 2

Polarization Voltage: ---------- 200 VDC, or 28 VDC (±1%)

Output Impedance: ---------- <25 Ω

Temperature Range:

Operating: ---------- -10 deg. C to +50 deg. C

Storage: ---------- -30 deg, C to +65 deg. C

Attenuation and Gain:

Insertion: ---------- +6.85 ±.5dB

Switch: ---------- 0 or -20dB

Preamplifier Noise:

Capacitance Cartridge	Noise (Linear)	Noise (A Weighted)
60pf (1 inch)	8.0μV 18.06dBμV	2.0μV 6dBμV
18pf (1/2 inch)	20.0μV 26.02dBμV	4.5μV 13.06dBμV
6pf (1/4 inch)	40.0μV 32.04dBμV	13.0μV 22.28dBμV
3.5pf (1/8 inch)	55.9μV 35.9dBμV	20.0μV 26.02dBμV
dead short	2.6μV 8.3dBμV	1.2μV 1.58dBμV

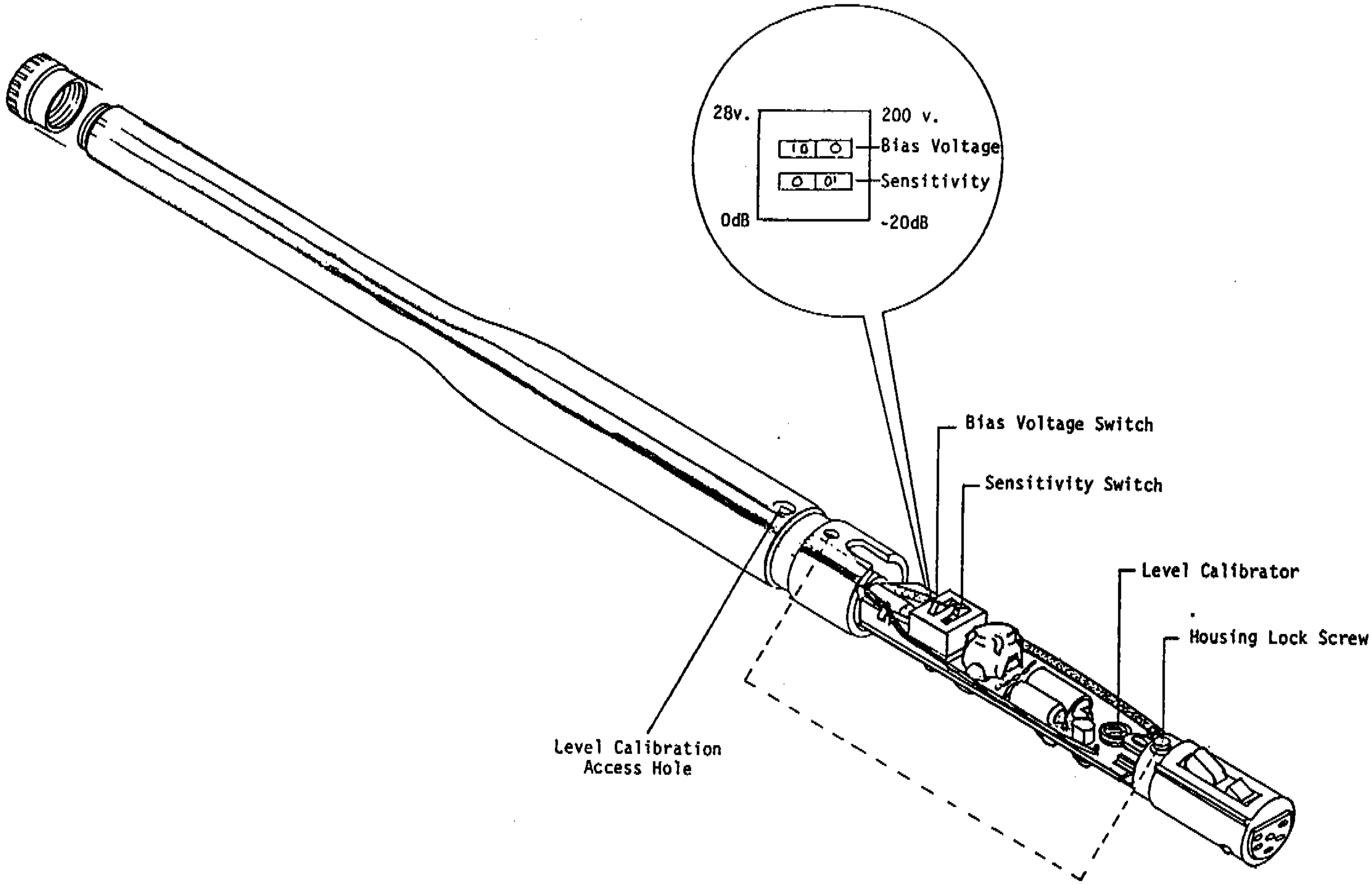
Dimensions: ----------Length: 8.2" (20.8cm); Max. Diameter: .75" (19mm)

Connector Type: ---------- Switchcraft A6F 6 Pin

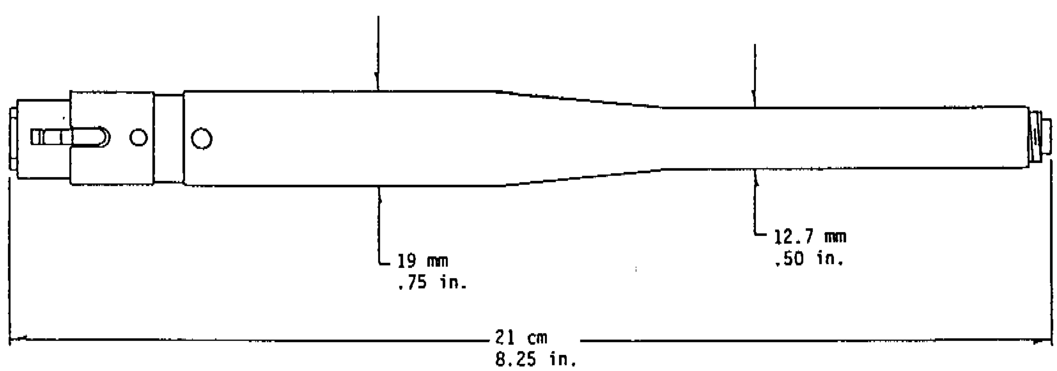
Weight: ---------- 5 ounces (139 grams)

Accessories Available: ---------- Model DL 18, 18pf dummy load (1/2 inch)
Model DL 60, 60Pf dummy load (1 inch)
Model DLZ, shorting dummy load (1/2 inch)

Appendix



28v.
200 v.
Bias Voltage
Sensitivity
0dB
-20dB
Bias Voltage Switch
Sensitivity Switch
Level Calibrator
Housing Lock Screw
Level Calibration
Access Hole



19 mm
.75 in.
12.7 mm
.50 in.
21 cm
8.25 in.

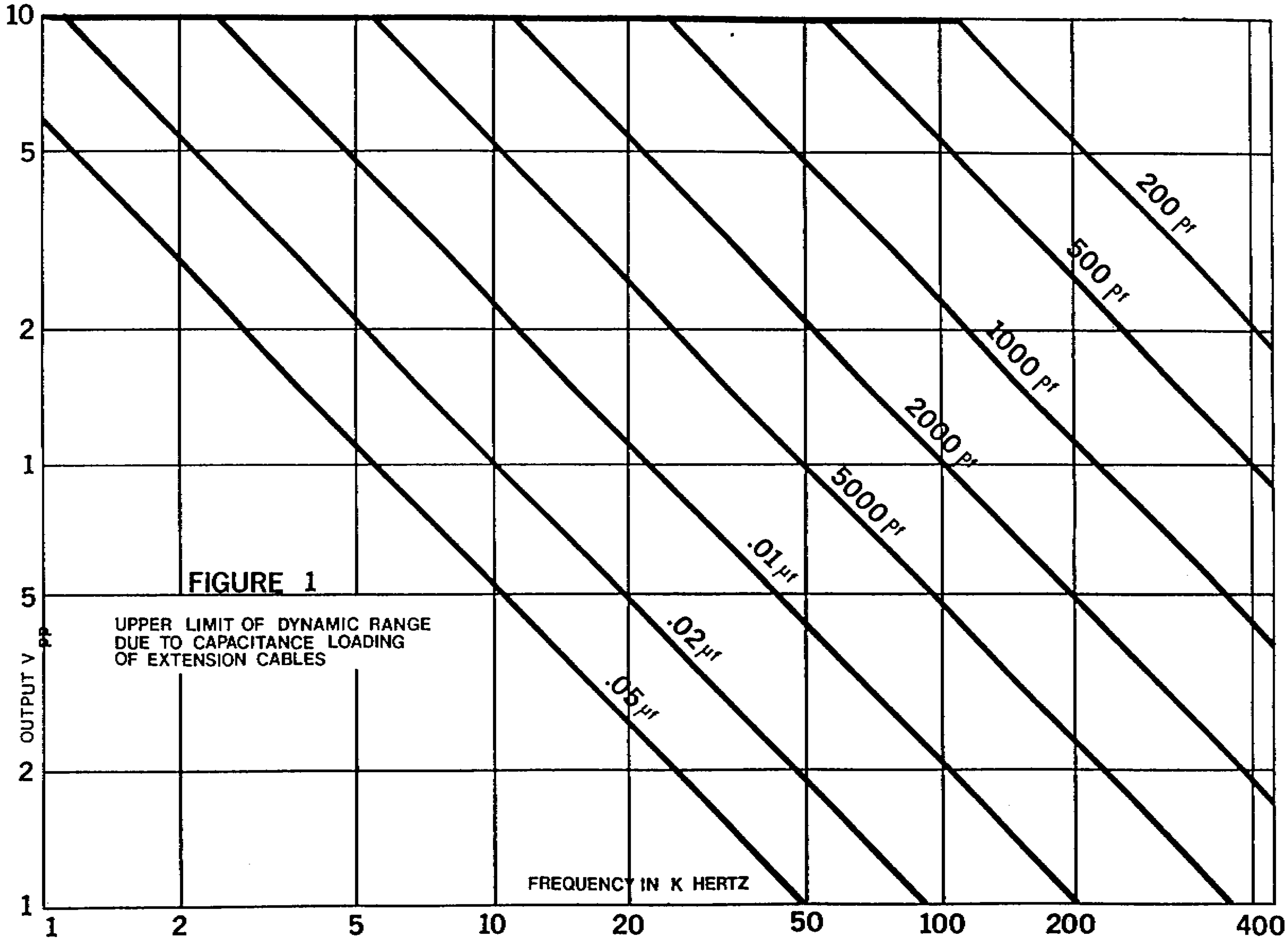


FIGURE 1

UPPER LIMIT OF DYNAMIC RANGE DUE TO CAPACITANCE LOADING OF EXTENSION CABLES

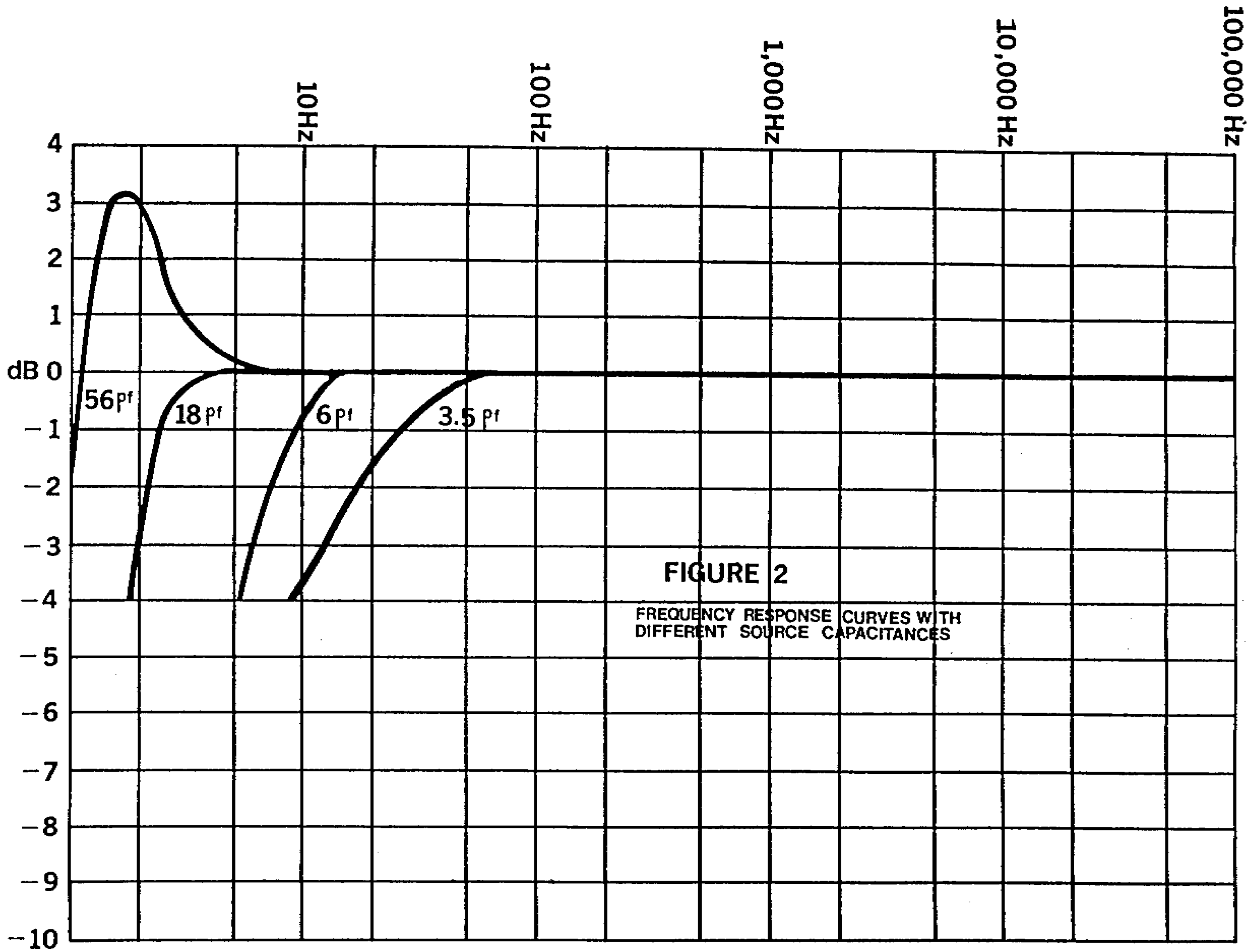


FIGURE 2

FREQUENCY RESPONSE CURVES WITH DIFFERENT SOURCE CAPACITANCES

Power Supply for the IE-2P

Since the IE-2P Precision Preamplifier will accept most air condenser microphones including Ivie, Brüel and Kjœr, ACO Pacific, Rion, and others which conform to international size and thread specifications, it may sometimes be desirable to use the IE-2P for the front end of an instrument other than an Ivie instrument.

To accomplish this, a simple, external power supply is required. Below is a diagram of how this power supply should be interfaced with the IE-2P. In addition to the power supply, appropriate cables and connectors would be required. The IE-2P and Ivie microphone extension cables use Switchcraft A6F and A6M, six pin connectors.