

model 565T
LITTLE DIPPER



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I. INTRODUCTION

The Universal Audio Model 565 Filter Set introduces to the recording studio and motion picture sound department an effective tool for "saving" problem tracks, and for creating innovative special effects.

Replacing obsolete, difficult-to-use "dip filters", the Model 565 employs modern active filter circuits, for a fresh approach to sound signal processing. As a point of interest, the 565 circuitry was designed with the use of a computer. This technique, called COMPUTER AIDED DESIGN, allows solution of the complex formulas and simultaneous equations which could not otherwise be efficiently solved.

The Universal Audio 565 contains FOUR separate, continuously tunable filters, which may be cascaded to provide:

- A. Low Cutoff filter, tunable from 20 Hz to 200 Hz;
- B. TWO band REJECT (dip) filters, each of which may optionally be switched to become a band PASS filter; tunable from 20 Hz to 20 kHz
- C. A High Cutoff filter, tunable from 2 kHz to 20 kHz

The 565 is completely self-contained (with power supply) and is designed for no-loss insertion in program circuits.

II. TECHNICAL DATA

LOW CUTOFF FILTER

SLOPE: 18 dB/octave (60 dB/decade).
FREQUENCY RANGE: 3 dB down point continuously tunable from 20 Hz to 200 Hz.
CONTROL: TUNING DIAL 20 - 200 Hz.

HIGH CUTOFF FILTER

SLOPE: 18 dB/octave (60 dB/decade).
FREQUENCY RANGE: 3 dB down point continuously tunable from 2 kHz to 20 kHz.
CONTROL: TUNING DIAL 2 kHz to 20 kHz.

NOTCH/PASS FILTERS (two in set)

NOTCH DEPTH: 50 dB minimum.

FREQUENCY RANGE: Continuously tunable from 20 Hz to 20 kHz.

NOTCH WIDTH: SELECTABLE 5%, 10%, or 50% of center frequency at 3 dB points.

BAND PASS Q: Switch selectable 1.2, 5, or 10.

BAND PASS GAIN: Unity $\pm$ 1 dB at peak.

CONTROLS: FREQUENCY DIAL, FREQUENCY MULTIPLIER, NOTCH BALANCE, FINE FREQUENCY VERNIER, NOTCH WIDTH, FILTER BYPASS.

GENERAL SPECIFICATIONS

INPUT IMPEDANCE: 10K ohms or 600 ohms (switch on rear panel) unbalanced.

OUTPUT IMPEDANCE: Designed to drive 600 ohm load. May be operated into any load 600 ohms or greater.

GAIN: Unity $\pm$ 1 dB.

HUM & NOISE: Equivalent to an input signal of:
-70 dB, high level input.
-90 dB, low level input.

MAXIMUM INPUT LEVEL: +20 dBm or 0 dBm, switch selectable.

DISTORTION: .15% maximum 20 Hz to 20 kHz at maximum input level. (.5% maximum with output transformer, Model 565T).

POWER SOURCE: 110 - 120 V.A.C. 50 - 60 Hz or 220 - 240 volt 50 - 60 Hz, selectable with rear panel switch.

CONNECTORS: Front panel tip-ring-sleeve jacks, normalled to rear panel barrier strip.

FREQUENCY RESPONSE: + .5 dB 30 Hz to 15 kHz
(-3 dB at 20 Hz and 20 kHz)

STANDARD: Output repeat coil.

FINISH: Black anodized panel brushed horizontally.

SIZE: 19" X 5 1/4" X 9"

WEIGHT: 13 pounds

III. TYPICAL APPLICATIONS

1. Remove or Reduce Noise.

Often a recording which is made under adverse conditions such as remote pickup or location filming will later be found to contain undesirable "coherent" noises. In most cases the recording cannot be redone. The 565 Filter Set is an invaluable tool for processing material of this type. Whistles, heterodynes, hum, and other coherent sounds can be filtered out with absolutely no audible effect on the sound quality of music or voice. This is because of the extreme sharpness of the band reject characteristic. Semi-coherent sounds such as motion picture camera noise, fluorescent fixture "buzz" etc. can be substantially reduced. Sounds of an incoherent nature such as jet aircraft, white noise produced by amplifiers, and general background noise can be filtered quite effectively using the low cutoff and high cutoff characteristics with or without the band reject characteristics.

2. Special Effects.

The notch filters can be used to produce "phasing" or "flanging" effects similar to those produced by two tape machines playing the same material at slightly different speeds. A double phasing effect may be produced by using both notch filters simultaneously.

Some very interesting effects are obtained by using the filters in the band pass mode. Extremely sharp enhancement of any frequency in the audio spectrum is possible in this mode. Combinations of high cutoff, low cutoff, band-pass, and -notch with variable frequency can be used to the limit of the engineer's or the producer's imagination.

3. Note By Note "Sweetening".

The very sharp filtering characteristics of the 565 allow manipulation of a single note within a chord structure or a piece of music. If a given note is obtrusive it can be selectively dropped in level without any degradation of the music. The two notches may be tuned to the fundamental and a harmonic of any tone in the audio spectrum.

4. Harmonic Distortion Filter.

The low distortion of the 565 and its deep notch allows its use as a distortion measurement filter. The fundamental of any frequency from 20 Hz to 20 kHz may be removed and the remaining harmonics read to allow computation of total harmonic distortion.

5. Harmonic Wave Analysis.

The individual harmonics of complex waves may be selected using the band pass filter, allowing precise harmonic structure analysis.

IV. INSTALLATION

1. Power Line

The Filter Set is factory wired for 110 - 120 V.A.C., and the line fuse is 1/8A. For 220 - 240 V.A.C. operation a switch is provided at the rear panel. The fuse should be changed to 1/16A.

2. Audio Connections

The front panel tip-ring-sleeve jacks are normalled to the rear panel barrier strip. If the Filter Set is permanently wired into a circuit using the rear terminals, insertion of a PJ-051 type patch plug into the input and output jacks will disconnect the external circuit, allowing the Filter Set to be patched into an alternate circuit.

3. Input Impedance

A switch at the rear panel selects high or low input impedance. The 10K ohm position is used to bridge low impedance lines while the 600 ohm input is preferable to terminate low impedance lines.

4. Input Level

Two different input sensitivities are provided, selectable by a switch on the rear panel. The +20 dB position is used for input signals averaging 0 dBm, with peaks not exceeding +20 dBm. The 0 dB position accepts signals with 0 dBm peaks and -20 dBm average level, and optimizes signal-to-noise ratio for these lower level applications.

V. OPERATION

1. Eliminating coherent noise from program material.

Example: A.C. Hum

1.1. Using the Low Frequency Cutoff filter will result in an attenuation of 18 dB per octave. If tuned to 120 Hz, 60 Hz hum will be reduced more than 20 dB. This method is most useful where loss of low frequency program material is unimportant or desirable.

1.2. To avoid the loss of low frequency program material it is better to use the selective characteristic of the notch filter.

1.2.1 Tune the #1 notch filter to 60 Hz:

Set frequency range switch to "X1" position and mode selector to wide peak position. Turn frequency dial while measuring or listening for maximum 60 Hz output signal. (The narrow peak width positions allow more precise tuning and are especially useful if the frequency of the noise is stable).

1.2.2. Switch to notch function of filter and observe the reduction in hum. Adjust the balance and fine frequency controls alternately until maximum noise rejection is achieved.

If the filter characteristic is narrowed with the mode selector switch to the 10% or even 5% notch width only those frequencies which are very close to the tuned center frequency will be affected, and no change in tonality of the program material will be apparent.

- 1.2.3. If higher order harmonics of AC hum are also present, i.e. 120 Hz, the second notch filter should be tuned to that frequency and be used in addition to the first filter.
- 1.3. The above method may be employed whenever coherent noise is present in the recorded material.

It is always helpful to find the offending frequency in the peak mode of the filter and then switch to notch mode for rejection.

- 1.4. If more than 2 different frequencies or harmonics are to be filtered out, the program material may be re-recorded and passed through the Dip Filter repeatedly, each time eliminating different components of the noise.

CAUTION:

WHEN THE USE OF THE LOW FREQUENCY AND HIGH FREQUENCY CUTOFF FILTERS IS NOT DESIRED, BE SURE THEIR DIALS ARE ROTATED SO THE WORD "OFF" APPEARS AT THE WHITE INDEX POSITION. (ON EARLY MODELS, THE DIALS SHOULD BE SET TO THE 20 Hz AND 20 kHz POSITIONS).

2. Semicoherent or Incoherent Noise.

In most cases, these consist of several discrete frequencies and random noise. Examples of this category are jet aircraft and other engine sounds, fluorescent fixture "buzz" and air conditioning noises.

Judicious use of the various filter sections will result in optimizing the apparent signal-to-noise ratio with least effect on program material.

- 2.1. First, determine if there are significant discrete frequencies within the desired minimum program bandwidth. Switch the Notch Filters to peak mode and slowly tune through their range as described in 1.2.1. The noise will appear to become louder at dial positions where coherent frequencies are present. Switching to notch mode will then attenuate these portions of the noise.
- 2.2. Then, the Low Frequency Cutoff filter may be used to reduce the lower portion of the random noise, adjusting its dial for maximum noise rejection with minimum loss of desired low

frequencies. The High Frequency Cutoff filter is similarly effective for the upper portion of the noise spectrum, above the highest necessary program bandwidth.

- 2.3. Keying the BYPASS switch in and out while making the adjustments in 2.1. and 2.2. will allow instant comparison of the filtered and unfiltered sound, to assist in optimizing the settings for best noise rejection with least affect on program sound.
3. Microphone Ringing and Feedback Control.
 - 3.1. Microphone ringing in a recording is associated with discrete frequencies. Following the previously described method, it is recommended to detect these frequencies in the peak mode of the filter and then switch to notch mode for rejection of the ringing frequency.
 - 3.2. Feedback is a common problem in sound reinforcement systems. The 565 effectively reduces the sensitivity to acoustic feedback if tuned to the two major feedback modes. The gain in usable level is generally more than 6 dB.
 - 3.2.1. The volume of the system is increased until oscillation just begins. In the peak mode, the filter is tuned to this frequency and then switch to notch mode and carefully adjusted for maximum rejection as the microphone gain is increased. In most cases the 5% notch width can be used.
 - 3.2.2. Further increase of the volume of the system may cause a different feedback mode to occur. This can be eliminated with the second notch filter, in the same manner as in 3.2.1.
 - 3.2.3. It should be pointed out that the elimination of "ring modes" in sound reinforcement systems with this method is only fully effective for one position of the microphone or microphones. If microphones (or speakers) are moved, retuning may be required for optimum feedback suppression.

4. Special Effects.

4.1. Telephone simulation.

This effect may be created either during recording or during playback. Although various effects can be obtained, a typical filter setting might be:

Low Frequency Cutoff at maximum position (CW), i.e. @ 200 Hz.

Notch Filter 1 tuned to 250 Hz and 50% notch width

Notch Filter 2 tuned to 300 Hz and 50% notch width

High Frequency Cutoff at 2.5 kHz.

4.2. "Phasing"

This effect is produced while varying the tuning of the filter. As an example this procedure may be followed:

Notch Filter in notch mode with 50% width and range switch in X100 position. This filter and the High Frequency Cutoff filter are then tuned simultaneously back and forth with variable speed to produce the desired effect. Experimentation will develop many interesting variations and techniques.

5. Enhancement.

In the band pass (peak) mode, only the tuned frequency will have unity gain, while all other frequencies (depending on the selected width of the filter characteristic) are attenuated.

5.1. In most cases it is not desirable to use the full peak height of the filter. Portions of the input signal may be mixed with the output signal, using standard mixing console techniques, to achieve the desired degree of enhancement. If mixing facilities are unavailable, the following method may be employed:

5.1.1. Switch input impedance to 600 ohms and connect the common terminals of input and output.

Mix the input signal with the output signal in a 10K ohm linear potentiometer (see Figure 1). The wiper becomes the output terminal and its position determines the maximum enhancement (or attenuation), for example, if a difference between the enhanced frequency and the remaining program material should not exceed 6 dB, the position would be midpoint.

NOTE: The output is high impedance and should be bridged to avoid signal loss.

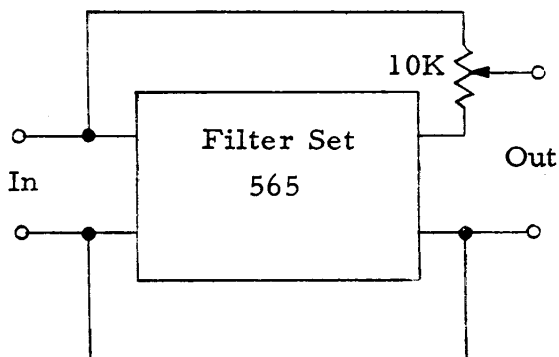


Figure 1

- 5.1.2. In the above described enhancement mode, (i.e. peak position of Notch/Peak Filter) all frequencies are attenuated according to the selected resistor ratio except for the tuned frequency, which has unity gain. The same bypass circuit can be employed in the notch mode. This results in a selectable depth of rejection for the tuned frequency while the remaining program material is not affected.

6. Harmonic Distortion Filter.

If the Notch Filter is tuned to the frequency to be analyzed the fundamental will be rejected and the remaining portion of the signal constitutes harmonic distortion (and/or noise). The filter must be tuned carefully with

Fine Frequency and Balance controls, using 50% or 10% notch width. The difference between input signal and filtered output may be expressed in dB or in % where:

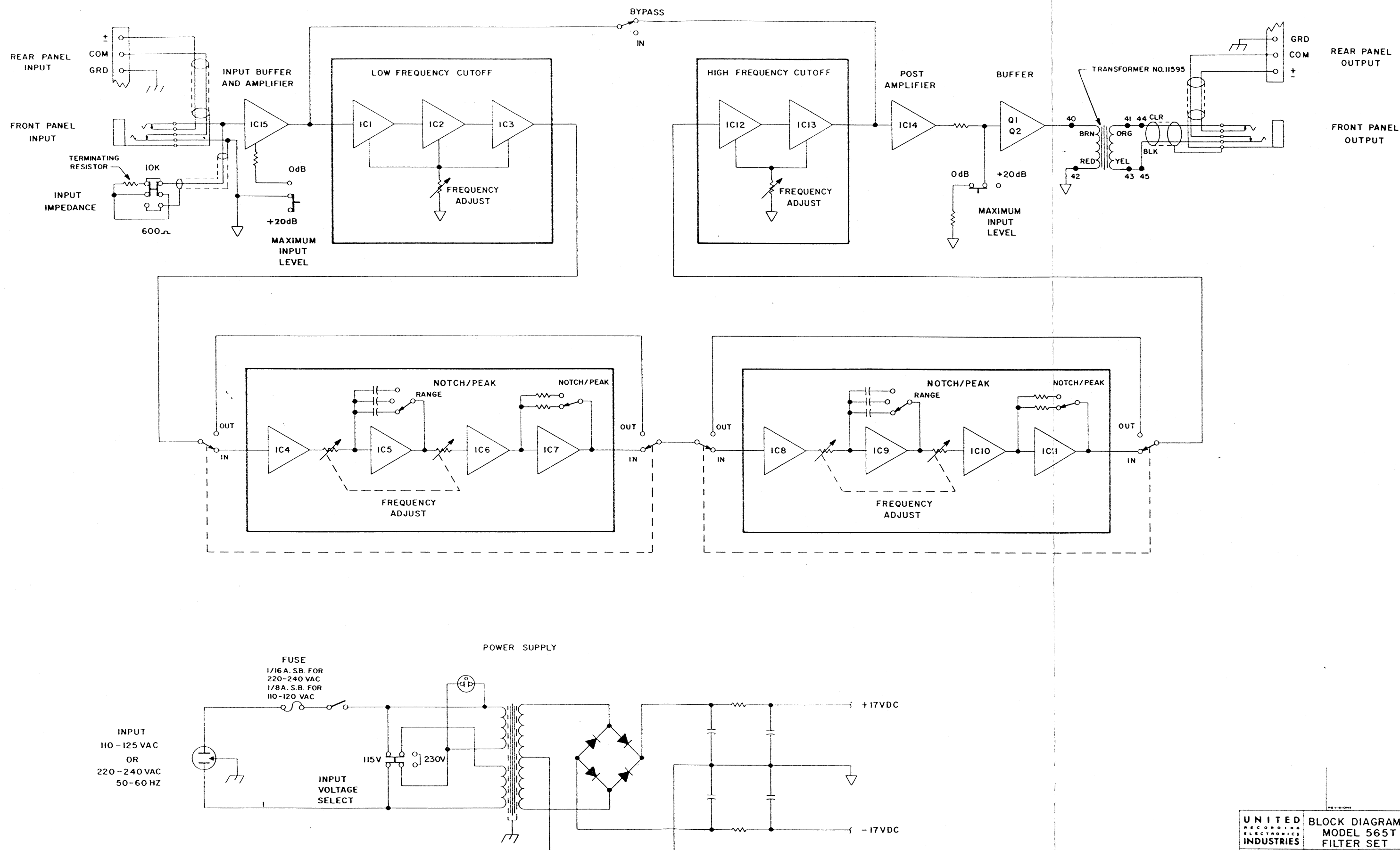
-20 dB equals 10% T.H.D.
-40 dB equals 1% T.H.D.
-60 dB equals .1% T.H.D.

A general formula is:

$$\text{T.H.D.} = \frac{\text{Signal out}}{\text{Signal in}} \times 100\% \text{ where}$$

"Signal out" is the signal level with the filter switched out, and

"Signal in" is the signal level with the filter switched in.



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