IPB 0134

MODEL 565 PREAMPLIFIER TRANSFORMER INPUT CHARACTERISTICS

DL INSTRUMENTS

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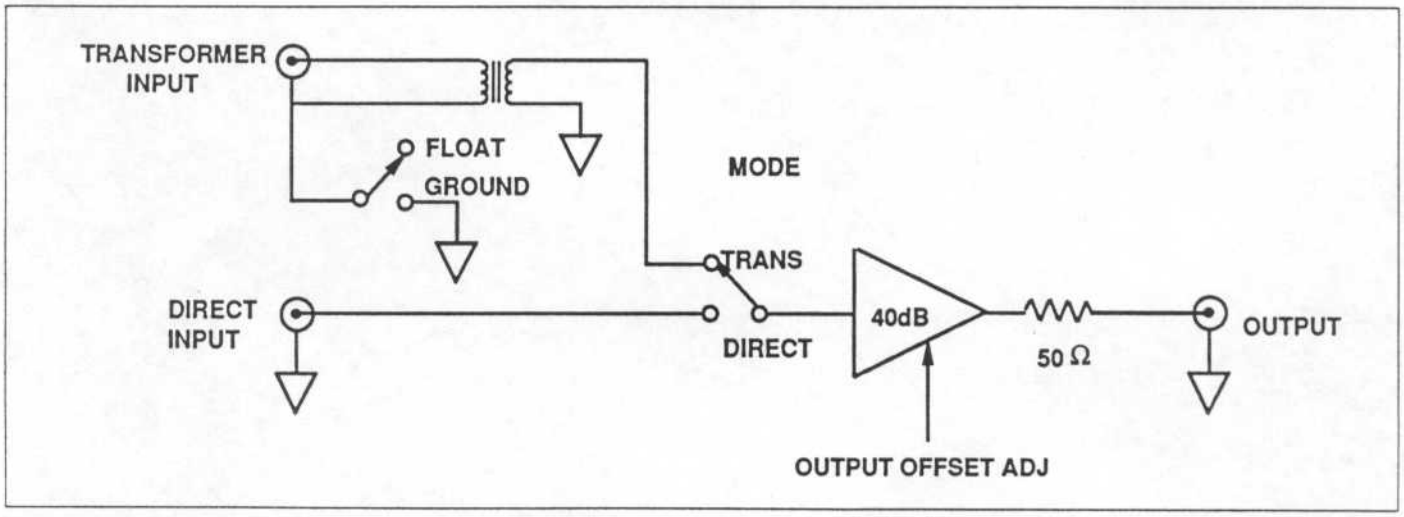
I INTRODUCTION

The 565 is operable in two modes. In the direct mode it yields 40 dB of gain with medium impedance performance similar to the Model 566 Preamplifier. In the transformer mode, it provides truly exceptional noise performance (equivalent to a 1.4Ω resistor at 300°K) by switching in a 20 dB impedance matching transformer ahead of the amplifier stage. Its superior magnetic design also yields very wide bandwidth for source impedances of 10Ω or lower.

CAUTION! The 565 cannot tolerate dc voltage on its transformer input in excess of ±10 millivolts. For ac inputs below 50 Hz riding on the dc bias, the allowable dc level for less than 5% gain error will decrease linearly with frequency. Thus for a 5 Hz signal, only 1 mV of dc input bias would be allowable.

II SPECIFICATIONS

Gain	Transformer Mode: 60 dB Direct Mode: 40 dB
Bandwidth	Transformer: 0.05 Hz–100kHz, with 0.5Ω Source Direct: dc–600 kHz
Input	Transformer: Switchable, floating or grounded Direct: single ended
Max Input Signal	Transformer: 20 mV pp above 0.5 Hz Linearly derate below 0.5 Hz (e.g., 2 mV pp max @ 0.05 Hz)
Input Noise	Transformer: typ 0.15 nV/$\sqrt{Hz}$ Direct: typ. 1.2 nV/$\sqrt{Hz}$
Input dc Impedance	Transformer: 0.4Ω Direct: 100 kΩ
Optimal Source Impedance	Transformer: 0.5 to 50Ω Direct: 50Ω to 10kΩ



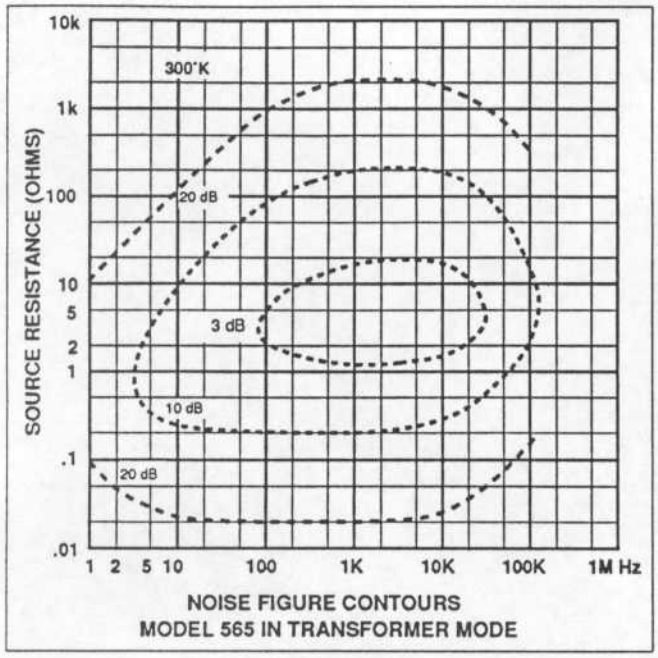


Figure 1

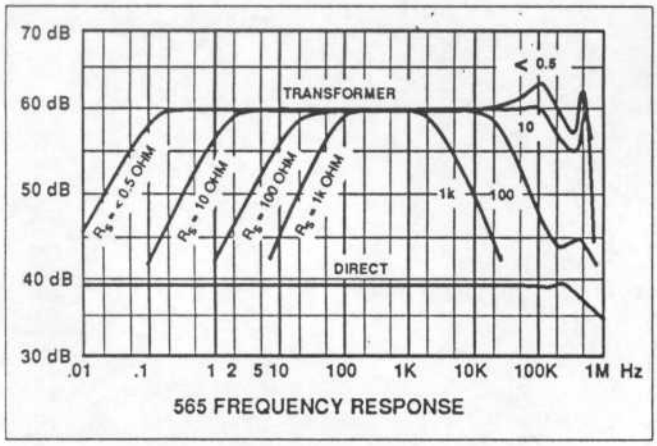


Figure 2

III AC INPUT IMPEDANCE

This can be estimated by examination of the (somewhat idealized) frequency response curves in Figure 2. The low frequency rolloff is source resistance dependent. The –6 dB point occurs where the mainly resistive input impedance approximately equals the source resistance. Thus we can see that the ac input impedance is approximately 1KΩ at 30 Hz, 100Ω at 7 Hz, etc.

In the passband region above the low frequency cutoff the input impedance is several tens of kilohms.The exact value varies quite a bit, depending on the input impedance of the bipolar op–amp stage which follows the transformer. (The op–amp input impedance is in the range of several megohms and the transformer affords a 100:1 impedance step–down).

The high frequency rolloff is dominated by the capacitive loading on the transformer secondary.

IV 10 mV BIAS LIMIT

Beyond 10 mV dc bias on the transformer primary, signal distortion becomes significant due to core saturation. The effect worsens below 5 Hz due to the reduction of relative μ caused by dc currents.

V INPUT DAMAGE THRESHOLDS

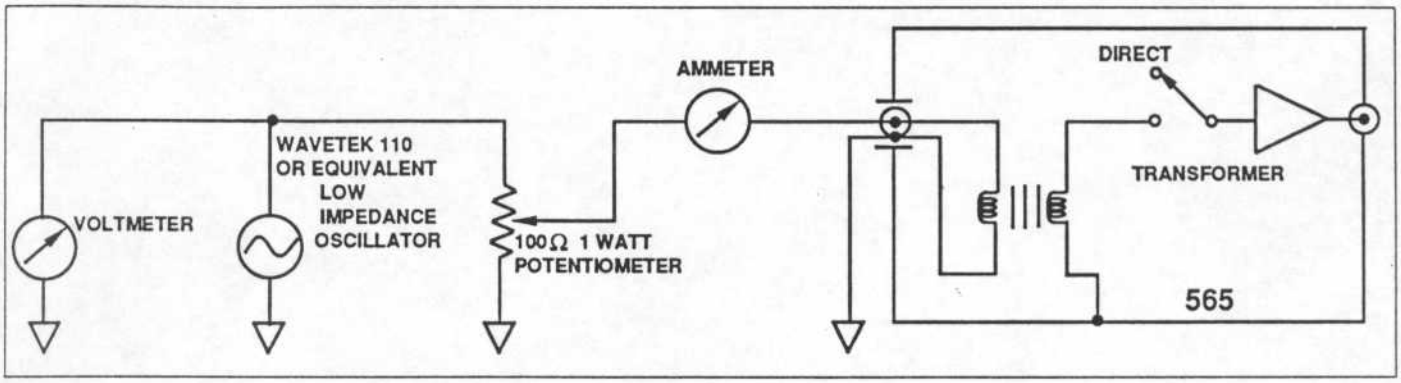
Two types of damage can occur, one reversible and on catastrophic.

a) At dc currents above 500 mA (200 mV dc input), the heavy saturation of the core will magnetize it, changing its signal properties for the worse. The core can be demagnetized as described below. In cases where there is a danger of input overcurrent, it is recommended that the customer fuse the input at 500 mA or lower to prevent magnetization from occurring in the first place.

b) At approximately 5A (2V dc input), the transformer primary winding will be destroyed.

VI TRANSFORMER SHIELDING

The input transformer is torroidally wound to render it insensitive to stray fields. Additionally, it is completely encased in mu–metal to shield against magnetic pickup. The aluminum case of the 565 Preamplifier affords a further shielding effect against electric fields.



VII TRANSFORMER DEMAGNETIZATION

Core magnetization can be easily recognized by a relatively dramatic loss in gain below the normal 60 dB figure in transformer mode. Restoration of the demagnetized state can be accomplished using an ac oscillator, ac voltmeter, potentiometer and ac current meter as shown below.

1. Use the "direct" switch position on the 565 to protect the op–amp stage from damage.

2. With the potentiometer set to the MAX position, adjust the oscillator output to approximately 5V rms @ roughly 500 Hz.

3. Now connect the signal to the 565 transformer input.

4. Decrease the input frequency until the input current rises to approximately 200 mA as shown on the ammeter. This may occur below 10 Hz.

5. Finally, ***very slowly*** turn the potentiometer to reduce the current to zero. Turn off the oscillator. The procedure is completed.