APPLICATION NOTE

AN1513
NE5205: A cascadable amplifier

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ABSTRACT

The NE5205 is a cascadable amplifier. Two or three amplifiers can be connected in series to produce multiple gain. The important concerns are outlined. Some suggestions for improvement for reliable operation in an electronically hostile environment are presented.

INTRODUCTION

Connecting amplifiers in series to increase the over-all gain is an attractive idea. However, there are some basic concerns which should be addressed before one attempts to do this. Good RF layout techniques are required in order to enjoy optimized performance. For example, well by passed power supplies are essential. A 0.1µF mylar in parallel with a 10µF tantalum located as close to the device pins as possible is recommended. Generous use of ground plane on the component side will yield good results. Back side ground plane is desirable. Bear in mind during layout that a circuit trace which runs along a ground plane is distributed capacitance with inductance along its length. The frequency response of the NE5205 will allow the amplifier to react to these minute values. Because of this, extreme care should be taken when routing the signal carrying circuit lines. The power supply should be placed as far away from the signal lines as possible. The shortest lines are the best bet. Additionally, one should use the shortest lines possible from the circuit components as well, for these also exhibit stray capacitances and inductances. Use of “strip line” is desirable, but not required at these frequencies.

Short leads, therefore, are very important in RF layout. The shortest leads which are commercially available in a packaged integrated circuit today are in surface mount packages. Called many names, Small Outline (SO) or Surface Mount Device (SMD), the Philips Semiconductors designator is the “D” package. While other package leads can be trimmed to the desired length, use of the SO package precludes this requirement. This package is recommended for this kind of work. In addition, use of chip components is also recommended. Chip capacitors and resistors are commercially available from a great variety of vendors too numerous to mention here.

DESCRIPTION

The NE5205 is fixed 20dB gain broad band amplifier. The recommended operating voltage is 6V; it will operate quite nicely with a single 5V power supply. Its frequency response is flat to +0.5dB way out to 450MHz. Its -3dB bandwidth is greater than 600MHz. It has a 6dB noise figure in a 50Ω environment. It draws approximately 26mA with 6V applied. It can deliver approximately 1V peak-to-peak into a 50Ω load. One of the truly unique features of this amplifier is its ability to automatically impedance match loads from about 40Ω to 80Ω. What this means to the user is that, for 50Ω and 75Ω systems, matching is accomplished automatically. The net result of these features is that this amplifier is very easy to use. This, combined with low price, makes the NE5205 the preferred amplifier.

CIRCUIT DESCRIPTION

Figure [1] shows the application of the techniques discussed above. The power supply is applied via the upper plane while the ground is served by the lower plane. In order to protect the internal DC quiescent operating conditions, DC blocking capacitors were used. The value of these coupling capacitors is governed by the lowest frequency which the system is required to pass. The coupling capacitors are 0.1µF chip capacitors. The NE5205D is used for the shortest leads possible. By-pass capacitors were distributed along the length of the amplifier chain, although not shown in the photograph. The power supply lines used are shielded coaxial cable. The connectors were soldered directly to the ground plane, again, with very short leads. Measuring a mere 5 by 2.5mm, the over-all size is very small. Although not optimized for size, one can easily see that there is room for further reduction.

The noise measured at the output was approximately 7dB. This was predictable given the noise figure of a single amplifier.

Figure 1 shows the bandwidth of the three cascaded amplifiers. The circuit draws about 75mA. With approximately 60dB of RF broadband gain, the circuit is stable for its pass band. Varying the power supply voltage throughout its recommended range does not significantly deteriorate the performance. The automatic impedance matching is in effect for all amplifiers. Although three amplifiers were used here, two amplifiers can just as easily be used.

IN THE FIELD

While the laboratory performance is indicative of the possible field performance, it is in the field that the applications become fully useful. Electronically adverse environments are common place. Here, shielding becomes important. The most commonly used shield is the commercially available electronic enclosure. Many enclosures are available and most will suit this purpose. A full shielded circuit will perform best under all but the most hostile conditions.

Some interstage shielding may be necessary. This kind of shielding is normally connected to the ground plane and provides further isolation. In addition, some power supply by-passing may be required for each shielded section. RF chokes can be used to further isolate the environment from the circuit as well as to separate by-pass capacitors for each section.

Typical applications where these ideas can be utilized are antenna amplifiers, amplified splitters, signal generators, frequency counters, oscilloscopes, signal analyzers, broadband LANs, fiber optics, modems, mobile radio, CB radio and telecommunications.

Rewritten from a previously unpublished work by Michael Sera, Sales Trainee, and work published in the Philips Semiconductors LOOP number 43 by Louie Burgyan, Design Engineering Manager.

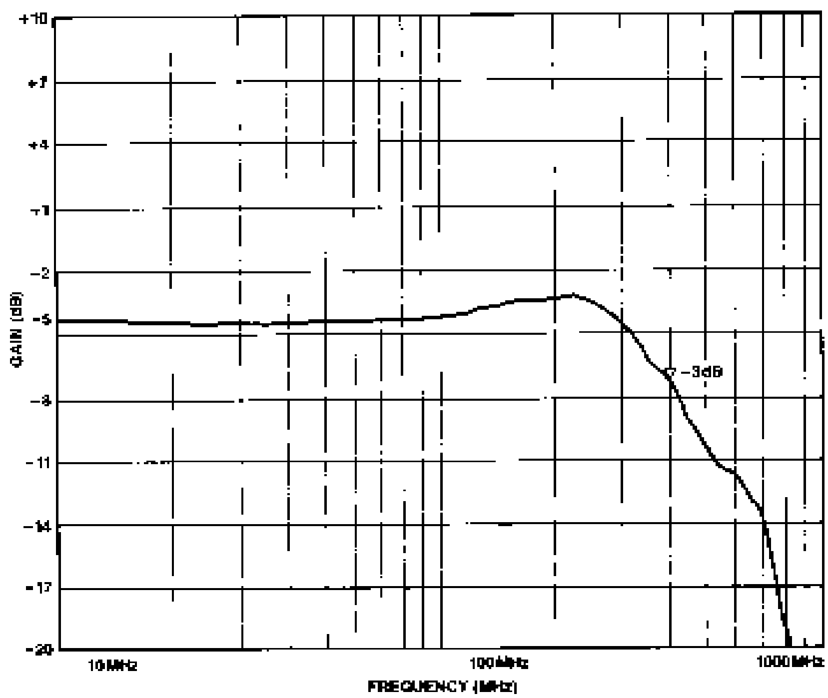

Figure 1. Cascaded Gain vs Frequency