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MICROPHONE PRE-AMPLIFIER

A. RATHINAM[1], SAILESHWARAN.S[2], SATHISHKUMAR.R[3], SANJAY.R[4]

1 PROFESSOR 2,3,4 UG SCHOLAR

ELECTRICAL AND ELECTRONICS ENGINEERING

PAAVAI ENGINEERING COLLEGE, TAMILNADU, INDIA

ABSTRACT

A mic preamp is a type of amplifier with the purpose of bringing mic level signals up to line level for use with professional equipment. Microphones output mic level signals and need preamps if they are to be used with mixing consoles, recording devices or digital audio workstations. There's a lot to know about microphone preamplifiers and their role with microphones. In this article, we'll discuss mic preamps in great detail to better your understanding of these largely necessary audio devices. A microphone preamplifier is an active electronic device designed primarily to supply gain to a mic signal and output the signal at line level. Mic level is the typically nominal level outputted by microphones. It ranges greatly between -60 dBV and -20 dBV. Line level is the professional standard for recording/mixing audio with a nominal level of +4dBu (1.78 dBV). A microphone preamplifier is designed to take a microphone signal at its input; apply an appropriate amount of gain (typically adjustable), and output a line-level signal. With the levels mentioned above, a good microphone preamplifier should be able to apply at least 60 dB of gain to bring low-level mic signals (typically from dynamic or ribbon mics) up to line level. Ribbon microphones, which notoriously output very low-level signals, sometimes require their own specialty preamplifiers. These preamps are able to provide a great amount of clean gain so that the ribbon mics can be used effectively.

Keywords: Noise contribution, Dynamic and Ribbon mics, low-level signals and Microphone

1. INTRODUCTION

Transducers such as a microphones produce electric signals that are too small for direct reliable processing and must first be amplified. Microphones have an output impedance of typically 200 ohms and output signal levels around 1 to 10 mV. A preamplifier is used to boost the audio signal level from the microphone to a level suitable for driving the A/D converter (typically to the standard 1 V peak-to-peak). Hence, in function, the preamplifier is simply an audio amplifier 1. However, because the preamplifier is the first gain stage in the system, its noise contribution directly adds to that of the system 2. Therefore, the preamplifier should not introduce any appreciable noise while amplifying the signal. Using a general-purpose op amp in the inverting and noninverting amplifier configurations, may not be quite adequate. First, these op amps generally introduce considerable noise into the amplified signal. Second, audio systems may require gains as large as 60 dB at frequencies in excess of 3 kHz, which might be difficult to achieve using some general-purpose op amps. For example, the classical 741 op amp (discussed in Sections 9.3-9.6 of Sedro & Smith) has an open-loop dc gain of 107.7 dB and a unity- gain frequency of about 1 MHz. Using this op amp in the inverting configuration of Sedra & Smith results in an amplifier with a 3-dB frequency of only 1 kHz (see equation 2.35 in Sedra & Smith). Instead, a good microphone preamp can be made from simple parts available in your lab kit by using a common-emitter BJT configuration, as discussed in Chapter 6.8 of Sedra & Smith 6th Edition. If necessary, after the signal has been amplified to around 100 mV peak-to-peak (or more), a standard op amp in the inverting or noninverting configuration may follow the common emitter amplifier.

2. LITERATURE SURVEY

There are three main technical objectives that must be overcome in order to achieve our design features. The first and most important objective is to produce low overall noise for the microphone pre-amplifier. Low overall noise will be at the core of the design of each of the sub-systems of the microphone pre-amplifier. There are two totally different aspects of this concept in order to achieve the overall goal of low noise. The first aspect is to minimize the Equivalent Input Noise (E.I.N). This is the fundamental or "true" noise of the electronic design based around the internal noise generators, both voltage and current, in all active and non-ideal passive components. Optimizing circuit bias points and source resistances, as well as the use of negative feedback, can aid in meeting low noise goals. The second aspect is to minimize the coupling of external noise sources to the internal amplification circuitry; this includes the 8 use of specialized shielding, grounding, PCB design techniques and balanced differential signaling. The second objective is to ensure feedback stabilized circuitry. Negative feedback at DC will force optimum bias points for transistors and related components. Negative feedback applied at AC will make the circuit gain and bandwidth less sensitive to changes in temperature, transistor variations, and signal levels. The third objective is to establish low distortion from the circuitry. While distortion is sometimes considered a musically pleasing effect, for our design we will primarily try to minimize non-linearity with the hope that the quality of the transformers will be the limiting factor. Transistor linearity will benefit from localized feedback (degeneration) as well as the use of overall, global, negative feedback. There are three main technical objectives that must be overcome in order to achieve our design features. The first and most important objective is to produce low overall noise for the microphone pre-amplifier. Low overall noise will be at the core of the design of each of the sub-systems of the microphone pre-amplifier. There are two totally different aspects of this concept in order to achieve the overall goal of low noise. The first aspect is to minimize the Equivalent Input Noise (E.I.N). This is the fundamental or "true" noise of the electronic design based around the internal noise generators, both voltage and current, in all active and non-ideal passive components.

3.1 EMBEDDED SYSTEM

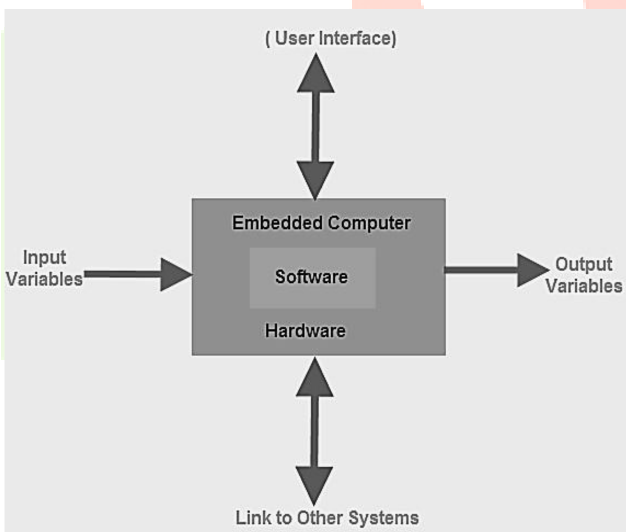


FIG: 1 EMBEDDED SYSTEM

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc. the embedded system. An embedded system is integration of hardware and software, the software used in the embedded system is set of instructions which are termed as a program. The microprocessors or microcontrollers used in the hardware circuits of embedded systems are programmed to perform specific tasks by following the set of instructions. These programs are primarily written using any programming software like Proteus or Lab-view using any programming languages such as C or C++ or embedded C. Then, the program is dumped into the microprocessors or microcontrollers that are used in the embedded system circuits.

3.2 EMBEDDED SYSTEM CLASSIFICATION

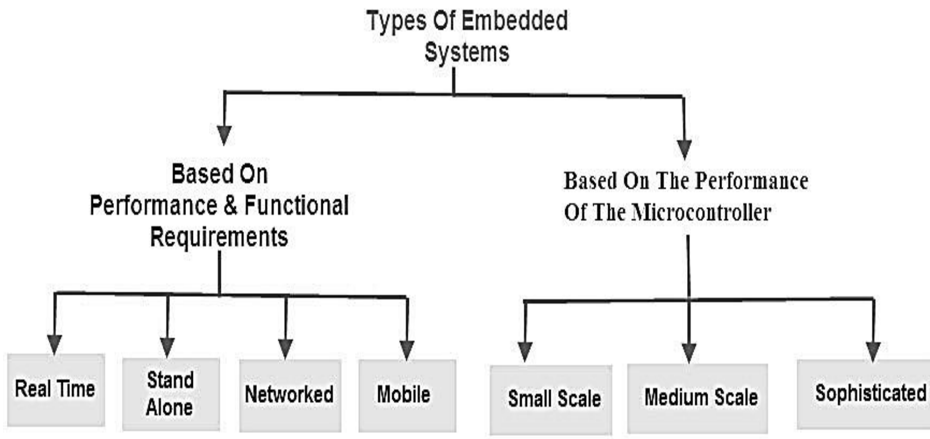


FIG:2 EMBEDDED SYSTEM CLASSIFICATION

Embedded systems are primarily classified into different types based on complexity of hardware & software and microcontroller (8 or 16 or 32-bit). Thus, based on the performance of the microcontroller, embedded systems are classified into three types such as:

Small-scale embedded systems
Medium-scale embedded systems
Sophisticated embedded systems

Further, based on the performance and functional requirements of the system embedded systems are classified into four types such as:

Real-time embedded systems
Stand-alone embedded systems
Networked embedded systems
Mobile embedded systems

3.3 EMBEDDED SYSTEM HARDWARE

An embedded system uses a hardware platform to perform the operation. Hardware of the embedded system is assembled with a microprocessor/microcontroller. It has the elements such as input/output interfaces, memory, user interface and the display unit. Generally, an embedded system comprises of the following

Power Supply
Memory
Processor
Timers
Output/Output circuits
Serial communication ports
SASC (System application specific circuits)

3.4 EMBEDDED SYSTEM SOFTWARE

The software of an embedded system is written to execute a particular function. It is normally written in a high-level setup and then compiled down to offer code that can be stuck within a non-volatile memory in the hardware. Embedded system software is intended to keep in view of the following three limits

Convenience of system memory

Convenience of processor's speed

When the embedded system runs constantly, there is a necessity to limit power dissipation for actions like run, stop and wake up.

4. EXISTING SYSTEM

Although a microphone preamplifier and an amplifier both act to boost signal level by applying gain, there is one key difference between the two. A preamp boosts a weaker mic level signal to line level, while an amplifier boosts a line level signal to speaker level. Basically, a preamplifier brings a microphone's output signal up to par with other signals in recordings and other audio equipment. At line level, an outputted signal (of a recording, mixing console, etc.) can be further amplified by an amplifier before being outputted from a speaker.

5. PROPOSED SYSTEM

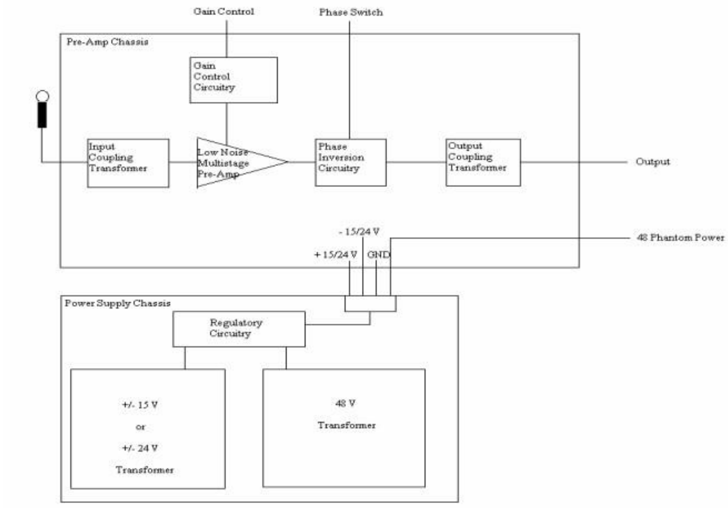
Microphones output mic level signals and need preamps if they are to be used with mixing consoles, recording devices or digital audio workstations. There's a lot to know about microphone preamplifiers and their role with microphones. In this article, we'll discuss mic preamps in great detail to better your understanding of these largely necessary audio devices. A microphone preamplifier is an active electronic device designed primarily to supply gain to a mic signal and output the signal at line level. Mic level is the typically nominal level outputted by microphones. XLR cables are used to carry the balanced audio signal from microphones to mic preamps. A balanced signal requires 3 individual pins/conductors. The XLR is balanced and is set up in the following format.

Pin/line 1: this is the shield/ground wire that acts to protect the audio lines and as a reference point against the audio lines.

Pin/line 2: this is the positive polarity audio wire.

Pin/line 3: this is the negative polarity audio wire.

As we can see from the above description of the XLR design, there are two audio signals in a balanced cable that have opposite polarities. This means that if we were to combine these two signals together, they would cancel each other out, and we would be left with silence. But the engineers that designed the balanced audio cable are clever. The balanced preamp doesn't simply sum the audio signals together. Rather, a differential amplifier within the preamp sums the differences between the two audio conductors (pins 2 and 3), effectively bringing the mic signal back. Cleverer still is that any interference or noise picked up within the balanced XLR cable is common on both pins. The differential amplifier will effectively eliminate this noise via common-mode rejection. Finally, balanced cables are capable of carrying phantom power, which is a smart and safe method of powering active balanced microphones without affecting the audio signal whatsoever. Phantom power sends a standard +48 V DC on pins 2 and 3, so this DC voltage is also eliminated at the differential amp.



6. CONCLUSION

A mic preamplifier, otherwise known as a mic preamp, boosts the signal of a microphone or an instrument (such as an electric guitar) to the standard operating level of most recording equipment. Using a mic preamp is vital. Without one, we would barely be able to hear anything from our microphones. At its most basic, a mic preamp takes the low output from a microphone and amplifies the signal to a higher line level. A preamp is one of those essential items for your studio. If you use a condenser microphone, which requires 48v phantom power to work, you'll need a preamp to provide it! But, of course, any microphone benefits from a good preamp, including ribbon and dynamic mics. The sound contribution of preamps is not so much in its frequency response but in the texture it imparts on the sound. However, a preamp shapes the sound to a much lesser degree than one would think. Usually, its sound character only becomes obvious at high gain settings or when you drive it into distortion.

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