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An high performance Ultra-Sound Transducers using BCD technology

Ranjith Maddi
PG Scholar
Department of ECE
Vaagdevi Engineering College
Bollikunta, Warangal

V.Sumalini
Assistant Professor
Department of ECE
Vaagdevi Engineering College
Bollikunta, Warangal

Abstract: ***An electronic amplifier, amplifier, or (informally) amp is an electronic device that increases the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with a larger amplitude. Amplifier design relies on feedback mechanism. Offsets that accumulate in different stages of amplifier are corrected by feedback mechanism. Negative feedback will improve harmonic distortion, decreases output impedance, and increases amplifier stability. In this paper we proposes a BICMOS Ultra Sound Transducer which converts a low voltage to a High Voltage Amplitude region which consists of transconductor stage was designed using TSMC018 technology using Tanner Tools.***

Keywords: ***BICMOS, transconductor, harmonic distortion.***

Introduction

A push pull amplifier is an amplifier which has an output stage that can drive a current in either direction through the load. The output of a typical push pull amplifier consists of two identical BJTs or MOSFETs one sourcing current through the load while the other one sinking the current through the load. Push pull amplifiers are superior as compared to single ended amplifiers (using a single transistor at the output for driving the load) in terms of performance and distortion. A single ended amplifier, how well it may be designed will surely introduce some distortion due to the non-linearity of its dynamic transfer characteristics. Push pull amplifiers are mostly used in situations where low distortion, high power and higher efficiency is required. The basic operation of a push pull amplifier is as follows: The signal to be amplified is first split into two identical signals 180° out of phase. Generally the splitting is done using an input coupling transformer. The input coupling transformer is arranged such that one signal in applied to the input of one transistor and the other signal is applied to the input of the other transistor. The advantages of push pull amplifier are low distortion, cancellation of power supply ripples and absence of magnetic saturation in the coupling transformer core which results in the absence of hum while the disadvantages are the need of two identical transistors and the requirement of bulky and costly coupling transformers.

Power amplifier circuits maybe classified as A, B, AB and C for analog based designs and class D and E for switching designs based on the proportion of each input cycle, during which an amplifying device is passing current. The image of the conduction angle is found by amplifying a sinusoidal signal. If the device is always turned on, the conducting angle is 360°. If it is on for only half of each cycle, the angle is 180°. The angle of flow is closely related to the amplifier power efficiency. The various classes are introduced later, along with a more detailed discussion under their individual headings further down.

Class-B amplifiers only amplify half of the input wave cycle, hence creating a large amount of distortion, but the efficiency is greatly improved and is much better than class A. Class-B amplifiers are also favored in battery-operated devices, such as transistor radios. Class B has a maximum theoretical efficiency of π/4. (i.e. 78.5%) This is because the amplifying element is switched off altogether half the time-period, and so cannot dissipate power. A single class-B element is

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hardly found in practice, though it is being used for driving the loudspeaker in the early IBM Personal Computers with beeps, and it can also be used in RF power amplifier where the distortion levels are of lesser importance. However, class C is more commonly used for this.

In this paper we desiged a The proposed operational amplifier, with Figure. 1, uses a high transconductor, employing thin oxide BiCMOS devices, and a trans-impedance stage using long length, high-voltage, transistors [13]. The proposed design is aimed at maximizing the operating frequency with minimum quiescent power and harmonic distortion.

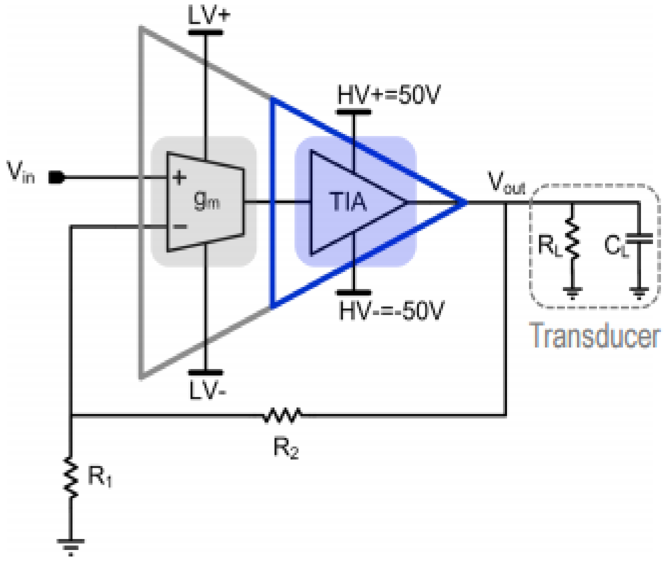

Fig1: Block diagram of the proposed amplifier

Te proposed amplifier consist of Low-V Class-AB gm for high linearity & gain bandwidth product and High-V Class-B TIA for minimum power dissipation.

Typical Block Diagram:

One point that the block diagram may not convey adequately is the degree of duplication of functions in today's systems For example, in systems with 128 processing channels, there will usually be 128 pulsers, 128 transmit/receive switches (T/R switches), and so forth. In such systems the use of large-scale integration and application specific integrated circuits (ASIC's) is highly important for cost and space reduction. For the most part, the block diagrams for digital and analog beam formers are quite similar, although there will usually be a large number of additional support circuitry required for synchronization, interpolation, and decimation of the sampled waveforms, and so forth. Depending on the particular system implementation, the full RF bandwidth will be retained through the top part of the block diagram on a typical analog design. The class of heterodyned systems performs frequency mixing at the beam former level, and the signal spectrum is shifted to either an intermediate frequency or all the way to the baseband. With digital beam formers, A/D conversion occurs after the variable gain stages. The digital beam former systems can be designed with similar heterodyning approaches, although there are many different approaches to delay generation. In addition to the digital and analog forms of beam formers, it is also possible to use charge-coupled devices for this purpose and these, in fact, are receiving considerable attention at the present time.

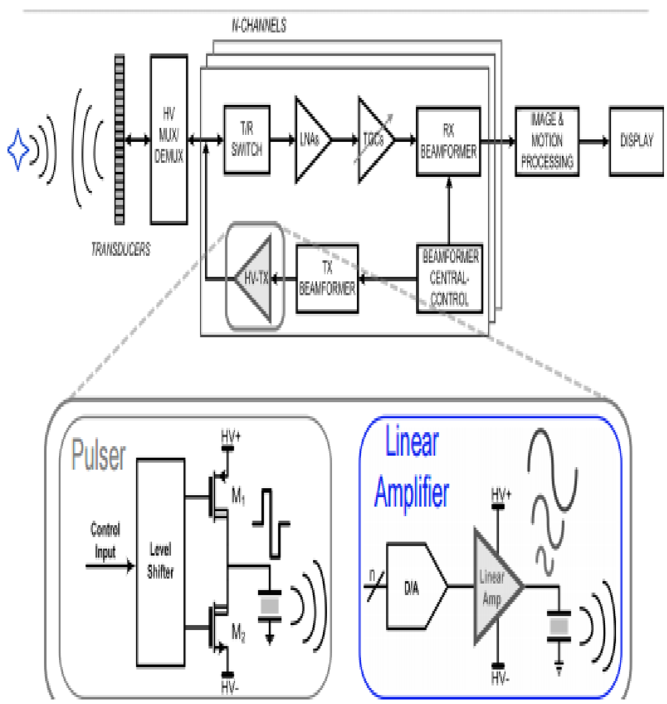

Fig: Block Diagram of Ultra Sound Syystem

Tran conductor Stage:

Tran conductance is a property of certain electronic components. Conductance is the reciprocal of resistance; transconductance is the ratio of the current variation at the output to the voltage variation at the input.

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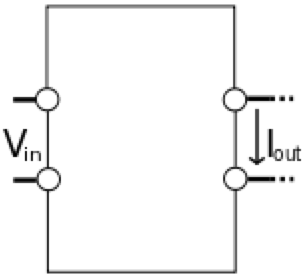

Fig: Transconudtor Block Diagram

The input transconductor is in class-AB, with peak output currents larger than biasing current to meet the tight slew rate requirements with limited power dissipation. The input transconductor is in class-AB, with peak output currents larger than biasing current to meet the tight slew rate requirements with limited power dissipation. The combination of pMOSa nd npn devices (M1 and Q1, M2and Q2) replaces pnp, not available in this technology After voltage to current conversion, signal currents are mirrored to the output. Cascodes rise the output impedance maximizing current injection into the M21-M22 trans-impedance stage, even at low signal levels.

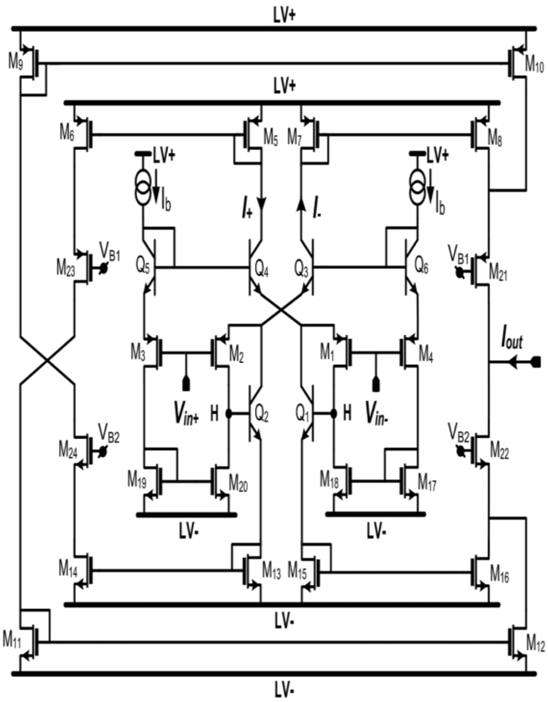

Fig. . Schematic of the transconductor.

The transconductor works in class-A up to relatively large input signals and the analysis of the frequency response is rather straightforward. On the contrary, the analysis of the class-B trans-impedance stage, where signals have amplitudes much larger than standing values, is challenging because mathematical tools used in linear circuits can not be automatically invoked.

High-voltage trans-impedance stage.

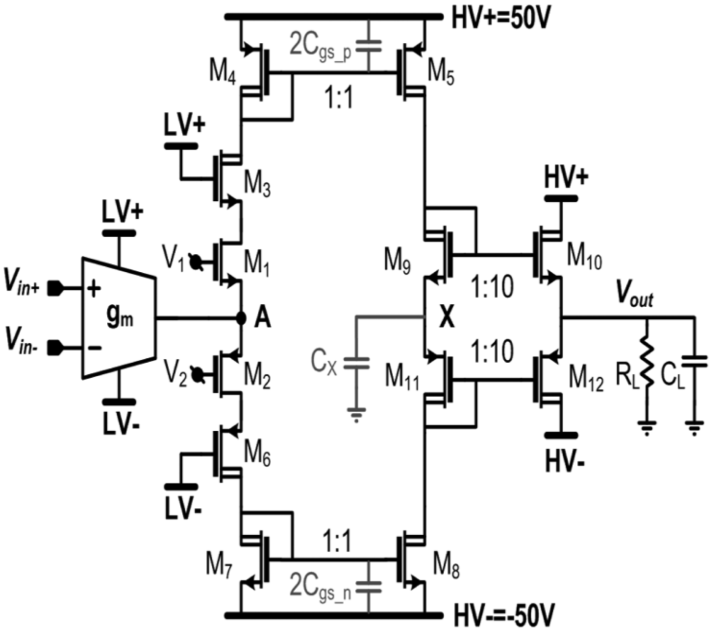

Fig: Schematic of high-voltage trans-impedance stage.

The details of the trans-impedance stage areNode A bridges the two circuit sections: half positive and negative sinusoids of current injected from the transconductor are absorbed by common-gate devices M1 and M2. M2 and M4 to shield the drain of M1 and M2 and sustaining the large voltage drop. Transistors M4 and M5 and (M8 and M7) mirror the half-sinusoid signal current with unity gain so as to develop the high voltage swing at node X.

A complementary source-follower (M10 to M12) drives the off-chip load making the amplifier robust against variations of the load resistor Rl and capacitor Cl . All devices are high-voltage DMOS-Fets, except M1 and M2 and which are thin-oxide devices for minimum input impedance. Confirmed by simulations, voltages across all the devices don’t exceed the safe operating limits, both during operation and power up/down.

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Two batteriesprovide a level shift equal to the threshold voltage of M10, M12 emulating the role of diode connected devices in M9,M11 Fig. 3. The buffer is required to provide low output impedance making the overall amplifier response robust against variations of the load made by the parallel combination of 100 resistor and 150 pF capacitor. The output transistors have to be sized wide enough to deliver the required peak output current to the load while keeping the applied voltage within safe operating limits.

Simulation:

These circuits are designed using S-Edit and calculation are carried on using T-spice using Tanner EDA tool

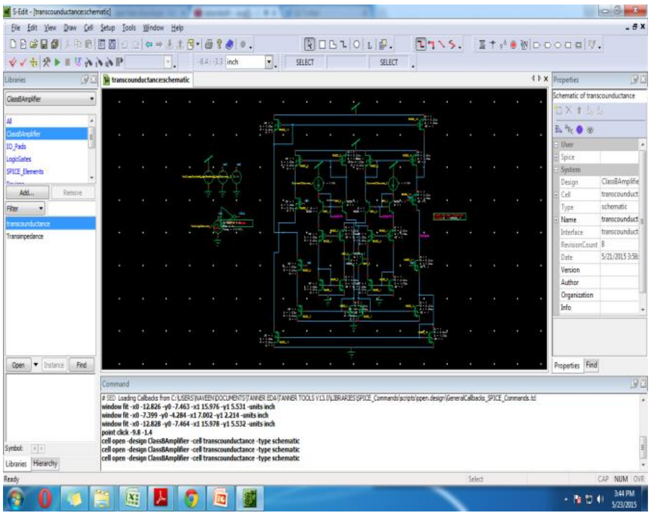

Fig: Transconductance Circuit design

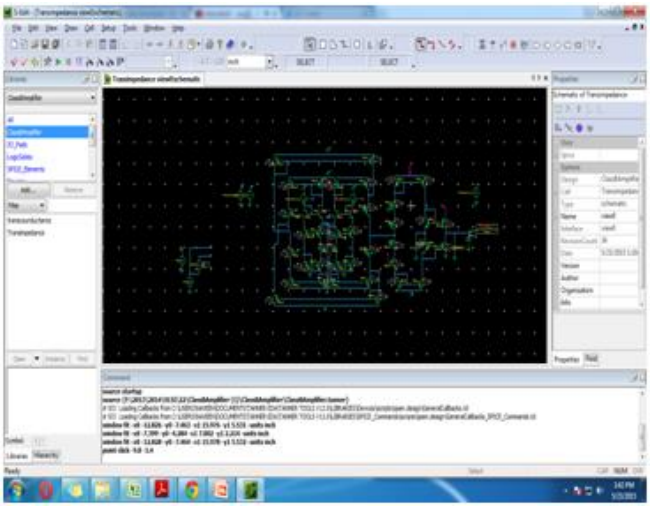

Fig: Amplifier S-Edit Design

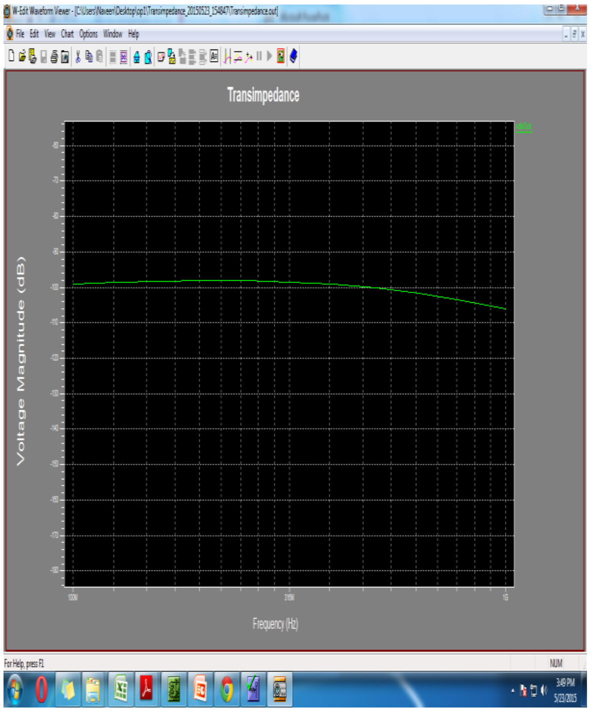

Fig: Waveform in W-edit:

Conclusion: ***The proposed Amplifier was deisned using BICMOS technology which manly reduces the area and increases the gain of the amplifier. The transcondutor and trans impedence stage are designed and their simulation results are shown effective one.***

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Author Details:

Mr.Ranjith Maddi Pursuing M tech in Vaagdevi engineering college, bollikunta, Warangal, Telangana, India.

V.Sumalini working as Assistant professor in dept of ECE Vaagdevi engineering college, Bollikunta, Warangal, Telangana, India. Interested area of working is Embedded systems.