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Two Stage High Gain Small Signal Amplifier with Sziklai pair and Darlington pair

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ABSTRACT
Present paper introduces a two-stage audio power amplifier in which first stage is a composite of BJTs whose output serves as input to the second stage hybrid unit with PSpice modelled MOSFET and user defined JFET. The proposed amplifier circuit shows faithful amplification for signals in frequency range 10Hz to 23.913KHz which covers entire audio range. The maximum voltage gain for proposed amplifier is 1158.7, maximum current gain is 10.711, power gain is 12410.835 dB-Watt and T.H.D is 2.465% which enables this amplifier to be a better audio amplifier with 61.27 dB gain which can drive electronic musical instruments, loudspeakers, electronic devices such as Television and radio receivers, robots etc.

Keywords **-** Composite Darlington Amplifiers, MOSFET Amplifiers, High Gain Audio Amplifiers.

I. INTRODUCTION

Darlington pair amplifiers have specific feature of extremely high input impedance, extremely low output impedance and high current gain (β1*β2*β3). The only disadvantage of darlington pair amplifiers is that they show poor response problem at higher frequencies and the output rises exponentially with the input voltage [1-5]. So in order to improve it's performance at higher frequencies and making the output more linear, sziklai pair amplifiers with mosfet and jfet can be used at the output stage which has high linearity , higher switching speed, wider bandwidth and half base turn-on voltage as compared to darlington pairs[6-11]. Thus a novel amplifier circuit is proposed which is a unique combination of darlington and sziklai pair amplifiers with darlington pair amplifier at the input stage and sziklai pair amplifier at the output stage. The output produced shows high voltage gain and power gain which can amplify signals of audio frequency range[12-20].

II. CIRCUIT DESCRIPTION

Present investigation introduces a new circuit which includes a combination of PNP Sziklai and a compound NPN Sziklai at first stage in which user defined three BJTs are used with opposite polarities among which the emitter of first BJT (PNP) is connected to the base of the second BJT(NPN) of opposite polarity and the emitter of second BJT (NPN) is connected to the base of the third BJT(PNP) which is again of opposite polarity[19-20]. At the second stage PSpice modeled nMOSFET(L=0.1µ W=50µ) is placed at the driver position and user defined PJFET is used at the follower position. The BJT is used in common emitter mode, where collector resistance and load resistance of first stage are replaced by capacitive load C2 and drain resistance and coupling capacitor are replaced by RL. The source of MOSFET and

JFET are kept grounded. The input signal is fed at the base of BJT(PNP) of composite triple darlington amplifier whereas the output is withdrawn at the load of second stage i.e RL. The proposed amplifier circuit is RC coupled and potential devider biasing is applied for faithful amplification and stabilization. The required circuit diagram for proposed amplifier is shown in Fig.1. Present investigation includes study of performance parameters with variation of various biasing elements, determination of performing range for each parameter, and behavior of amplifiers under different conditions

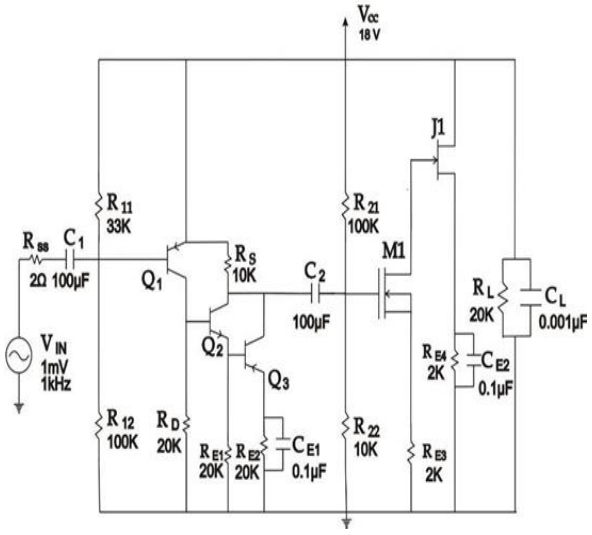

Fig.1 – Circuit Diagram of Proposed Amplifier

III. RESULTS AND DISCUSSION

Present paper introduces a novel two stage audio amplifier circuit whose frequency response curve at room temperature is shown in Fig. 2 whereas Table 1 denotes the parameters used in simulating the proposed circuit.

Components	**Proposed Amplifier**
Active components	Q2N2222, Q2N2907A, Q2N3906,MMOD1.JMOD
Rss (input source resistance)	2Ω
R11 (biasing resistance)	33K
R12 (biasing resistance)	100K
R21 (biasing resistance)	100K
R22 (biasing resistance)	10K
R_D(additional resistance)	20K
R_{E1}(emitter resistance)	20K
R_{E2}(emitter resistance)	20K
R_{E3}(emitter resistance)	2K
R_{E1}(emitter resistance)	2K
Rs (source resistance)	10K

Table-1 Component Details of The Circuit

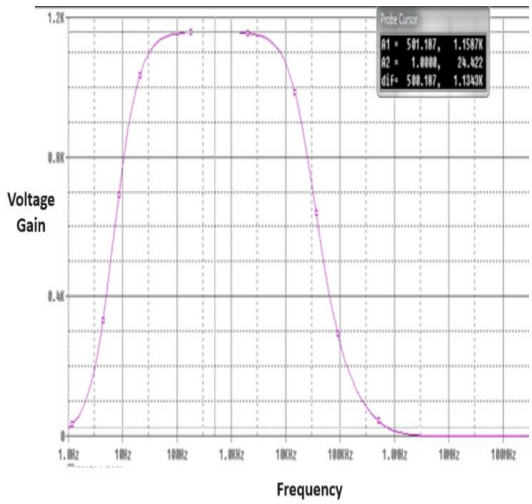

Fig. 2 Frequency Response Curve of Proposed Amplifier

Variation of parameters of the amplifier with various resistances has also been studied. It is found that he minimum value of R11 is 15K(1.0972) which on increasing gives the maximum voltage at 100k(1.2012) whereas minimum value for R12 is 20K(2.925) which on increasing gives maximum voltage at 100K (1.587K). Also, variation of voltage

gain with R21 R22 and RL shows that On increasing both resistances R21 and R22 , the voltage gain decreases till unity with minimum value 35K whereas on increasing load resistance RL the voltage gain increases with decrease in bandwidth, current gain and T.H.D. It can be explained as R21 and R22 follows Ohm's law whereas RL shows the maximum voltage drop across it. This behaviour of amplifier is quite in accordance with small signal Sziklai and Darlington pair amplifiers[2-5,10,17,19-20].

Variation of voltage gain with DC supply voltage shows that on increasing supply voltage, the voltage gain of proposed amplifier increases with constant current gain and bandwidth. Moreover, on increasing the value of emitter resistances and source resistances voltage gain decreases with constant current gain. Similarly, on increasing the values for C1 and C2 the voltage gain and bandwidth increases with constant current gain. But for load capacitance CL, on increasing the value the value of voltage gain, current gain and bandwidth decreases. Table 2 shows the Performance Parameters of The Reference and Proposed Amplifiers.

Table-2 Performance Parameters of The Reference and Proposed Amplifiers

Parameters	**Proposed Amplifier**
Avg (voltage gain)	1158.7
Aig (current gain)	10.711
F_L(lower cut-off frequency)	10Hz
F_H(higher cut-off frequency)	23.913KHz
Bandwidth	23.903KHz
Vo(peak output voltage)	1.116V
Io (peak output current)	58.775µA
T.H.D	2.465%
Power Consumption	4.25E-02
Input Noise	1.000E-30
Output Noise	1.000E-30
Power Gain	12410.835
Input Signal Voltage	1mV-1KHz
Permissible range of input signal voltage	1ηV- 3mV

Present paper investigates the performance of a two-stage audio amplifier having input stage of a combination of PNP Sziklai and a compound NPN Sziklai and an output stage of MOSFET driver and JFET follower. The output achieved from such a unique combination has high voltage gain of 1158.7, high power gain of 12410, current gain of 10.711 and T.H.D of 2.465% which makes it very feasible to be used in output stages of televisions, radio receivers etc.

IV. CONCLUSION

Present paper is a short overview of two stage audio amplifier with unique combination of three BJTs, one MOSFET and one JFET. The results show very high values for voltage gain, power gain and peak output voltage with moderate values for current gain, peak output current bandwidth , low values for input and output noise and permissible value for T.H.D . This proves to be used as a good audio amplifier as it covers the entire audio range frequency and thus can be used in devices like radio receivers, televisions, home stereo systems, electronic musical instruments, robots etc.

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