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Design of LNA for IRNSS Receiver using ANN

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ABSTRACT

Paper shows an ANN displaying of microwave LNA for the worldwide situating front end recipient, working at 2.49202 GHz. To plan LNA, multilayer perceptron engineering is utilized. The scrambling parameters of LNA are ascertained utilizing Levenberg Marquardt Back propagation Algorithm for the recurrence go 1.5 GHz to 18 GHz. The data sources given to this design are deplete to source current, deplete to source voltage, temperature and recurrence and the yields are most extreme accessible pick up, clamor figure and diffusing parameters (extent and also point). ANN demonstrate is prepared utilizing Avago ATF 36163 GaAs pHEMT Low Noise Amplifier datasheet and this model shows high relapse.

The smith and polar diagrams are plotted for recurrence go 1.5 GHz to 8 GHz.

Keyword: Scattering Parameters, ANN, MAG and NF

I INTRODUCTION

Satellite correspondence frameworks are built up to give association between coordinate system get to, remote earthbound systems and web administrations utilizing settled or portable terminals [2]. The principal piece of a collector is normally a low commotion speaker (LNA). The focal assignment is to give pick up to the got flag so that commotion of subsequent stages can be overcome. Gallium Arsenide (GaAs) has been utilized extensively due to its propriety for high recurrence transistors and also low misfortune aloof segments. GaAs is picked over others as a result of a few favorable circumstances in microwave recurrence extend [6]. At the point when contrasted with traditional techniques, the upside of Artificial Neural Network (ANN) is that these systems can be displayed effectively to sum up any nonlinear connection between some variables. The use of ANN in the field of microwave gadgets is, in any case, extremely recent. One of the best works ever displayed in writing in [9], the writers have portrayed a well ordered technique for how ANN can be acquired for understanding the conduct of a Radio Frequency (RF) gadget. ANN demonstrating way to deal with investigate commotion figure (NF) of the whole circuit is proposed in [4]. In this procedure, the impacts of information and yield coordinating systems on the NF of circuit are investigated.

II DESIGNING OF LNA USING LNA

IRNSS receiver is use to receive signals from the satellites of IRNSS. IRNSS satellites determine the position and time of any object. Since at the reception side receiver receives the signals from the satellites, so there occurs signals degradation, because the signal received has the less strength due to environmental factors. So to maintain the strength of the signal, LNA is used at very starting end of the receiver.

The purpose of the research work is to design a LNA which is suitable for IRNSS receiver, that means the important parameters of LNA are designed and are optimized at the centre frequency of the IRNSS receiver i.e. 2.4 GHz. LNA design involves considering several parameters, most of which are of contradictory nature. If the LNA performance is improved compared to one parameter, it results in degradation contrast to other.

ANN model is represented as a three layer network, with the first layer being the input layer while the layers of neurons that produce the output representing the output layer of neural model. This layer in the middle of input and output layer is hidden layer, the hidden layer is optimized in terms of number of neurons. Input layer involves of four neurons while the output layer comprises ten neurons. Multilayer perceptron architecture is used for the ANN modeling. Developed model is to be utilized to achieve the NF and gain (both MAG and MSG) at centre frequency.Fig.1 shows the multilayer perceptron.

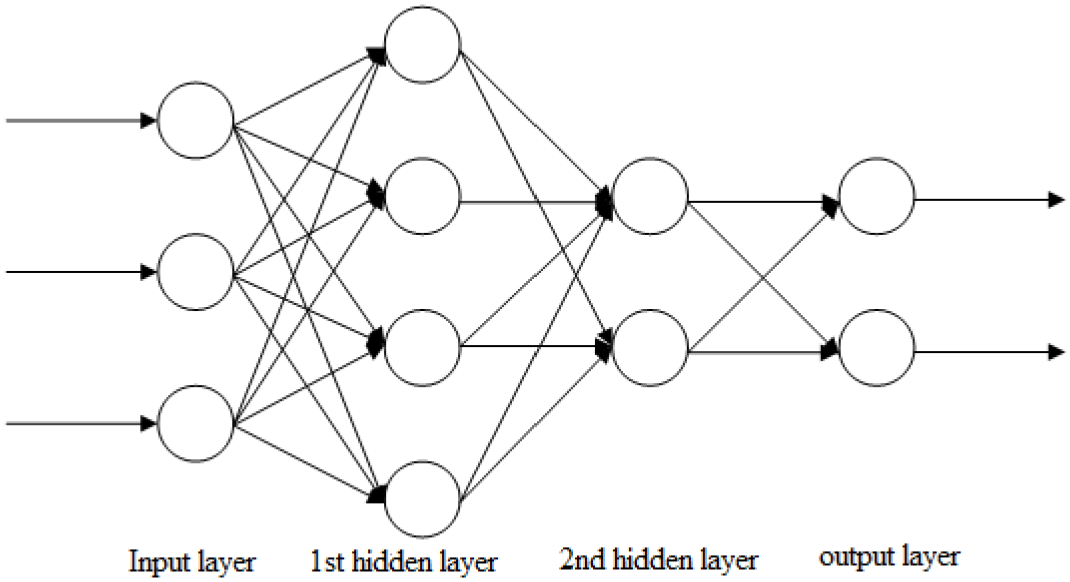

Fig. 1 Multilayer Perceptron

III PROPOSED METHODOLOGY

The LNA design parameters are obtained using the MATLAB ANN tool box. A multilayer perceptron architecture is designed in the ANN tool box which is executing the back propagation algorithm. Utilizing back propagation algorithm, the neural model modifies the weight and bias of the multilayer perceptron architecture such that the error among the actual parameter values and the models outputs are minimized. Learning of the neural model is made by Levenberg Marquardt back propagation algorithm which is the default algorithm in the MATLAB. Fig.1 shows the ANN modeling strategy

In the present research work, the performance of LNA is evaluated using the scattering parameters. These parameters are plotted against the frequency for discrete values and the closeness of the same is to be considered by comparing it with plots provided by an industrial standard LNA specification sheet. Simulation is to be done using the MATLAB ANN tool box. The datasheet used for training and validation of the neural network model is opted to be that of Avago ATF 36163 Low Noise Pseudomorphic HEMT amplifier. Scattering parameters are to be plotted using the polar and smith charts.

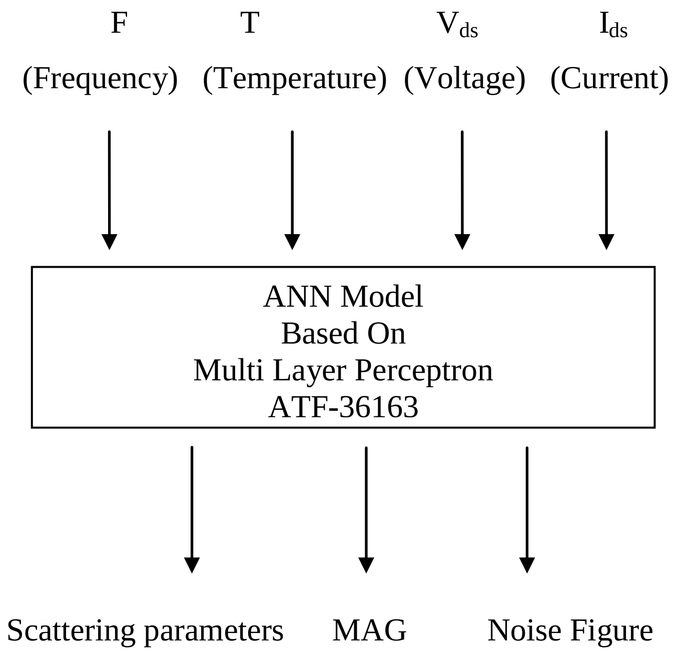

Fig. 1.2 ANN Modeling Strategy

IV SIMULATED RESULTS

Four scattering parameters are used to model the performance of the device. Fig. 3 and Fig. 4 show S_{12} and S_{21} deviations respectively in polar graphic representation. The transmission gain of the microwave device is quantified as S_{12} and S_{21} scattering parameters. The former is the reverse while other is forward transmission gain. All the ANN model values on the polar chart vary clockwise as the operating frequency is increased in the above stated range.

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Same neural models are used to obtain the magnitude plot of the device scattering parameters as well. Fig. 5 and Fig. 6 are smith charts for S_{11} and S_{22} respectively. In both the smith charts, points move along the clockwise direction as the operating frequency is increased from MHz to GHz. Fig. 7 shows the return loss of the low noise amplifier which is -40 dB. This graph is important as the designation of the amplifier's gain exhibits this term.

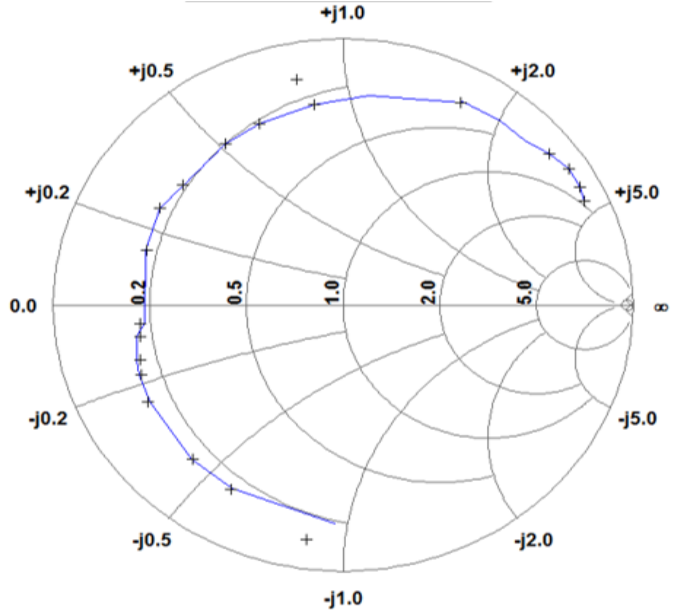


Fig 3 Smith Chart of S_{11}

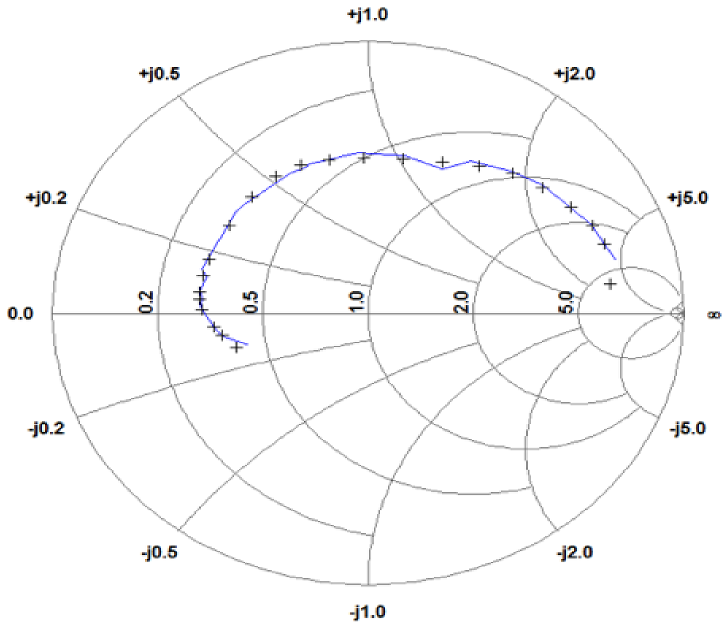


Fig.4 Smith Chart of S_{22}

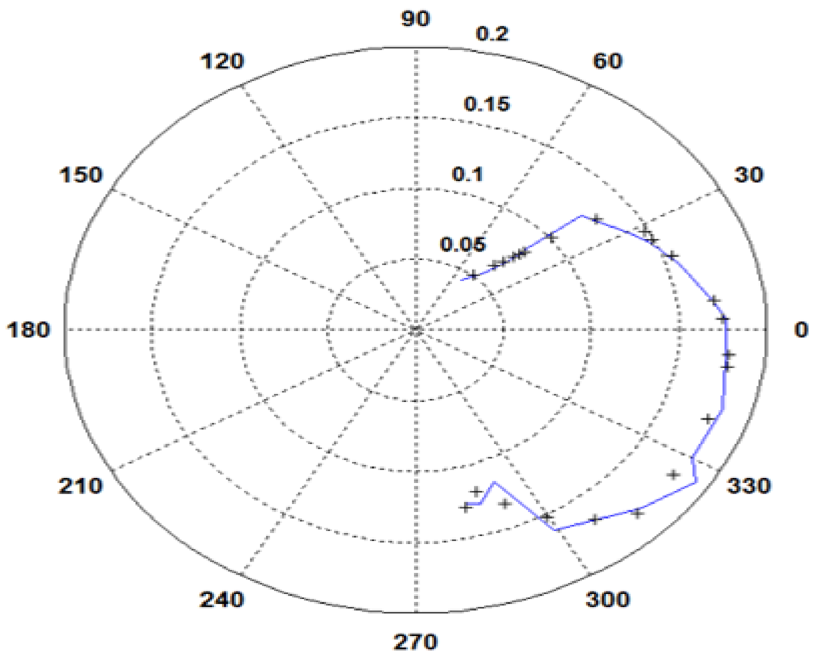


Fig. 5 Polar Chart of S_{12}

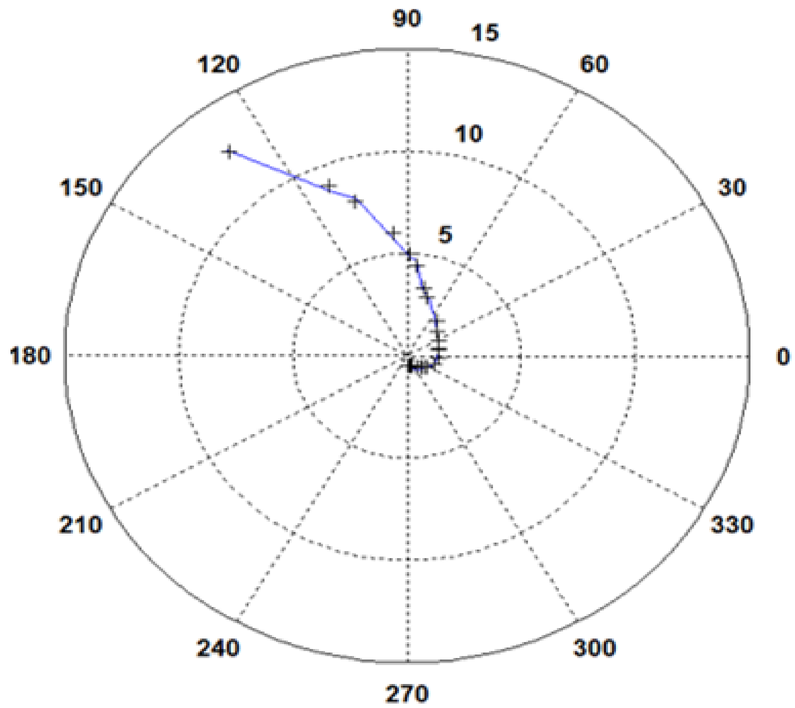


Fig. 6 Polar Chart of S_{21}

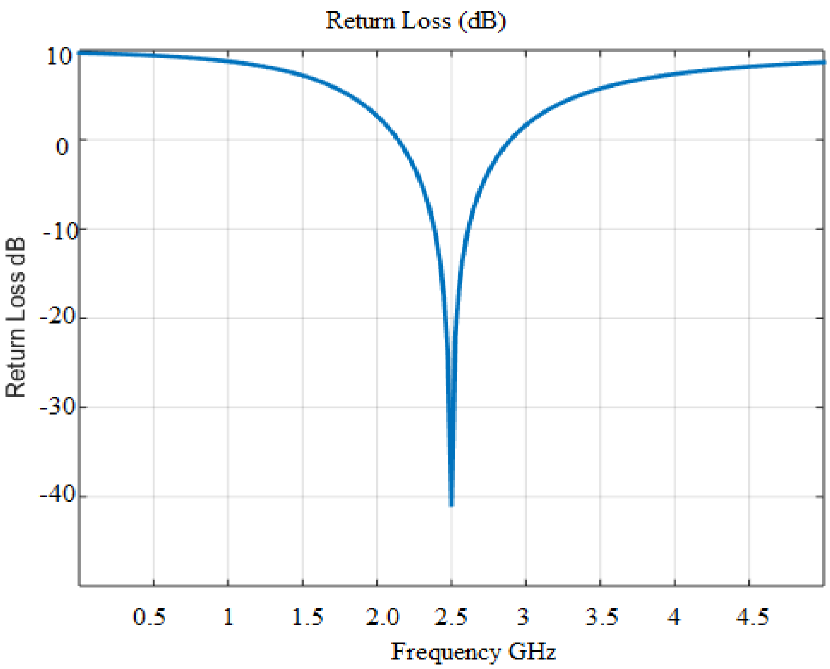


Fig. 7 Return Loss of LNA

MAG is an important design parameter in perspective of the LNA design. Neural network is optimized to yield the variation of MAG in the range starting from 1.5 to 18 GHz. The plot of MAG vs frequency is shown in the Fig. 8

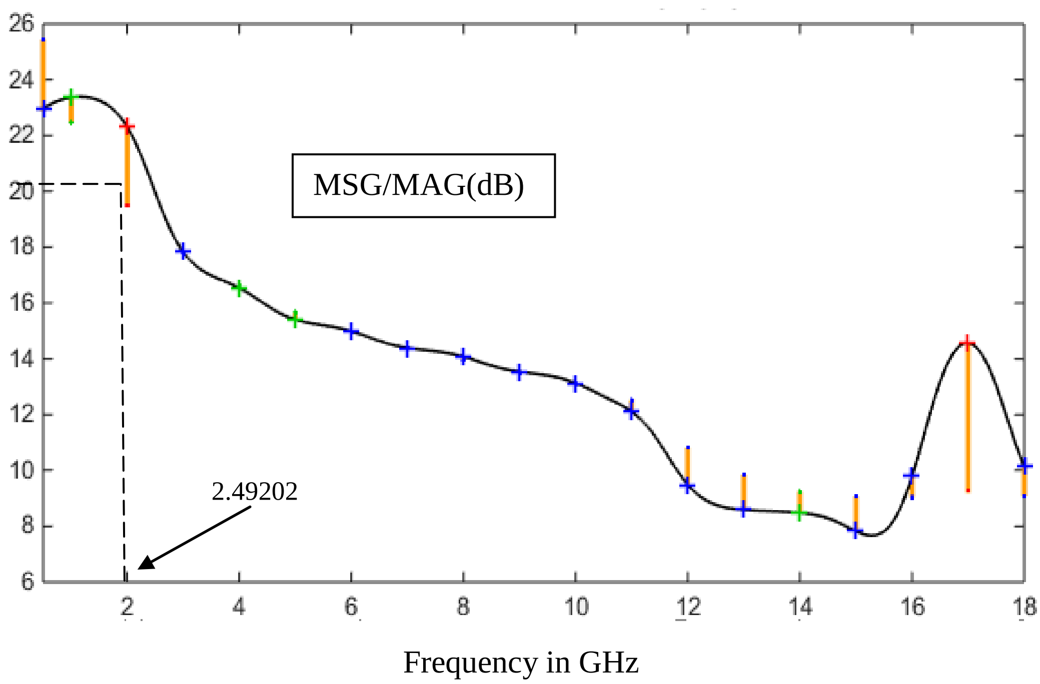
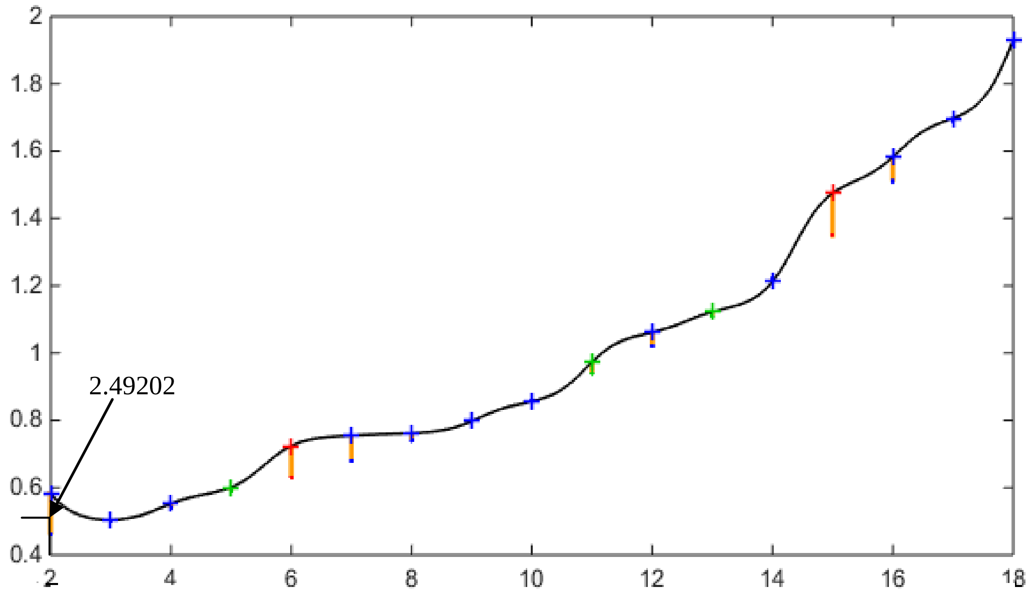


Fig. 8 MAG Variation with Frequency

Another important parameter for LNA design is the NF. ANN model for NP is prepared and the values are obtained in the frequency range starting from 1.5 GHz to 18 GHz are plotted in Fig. 9. NF values keep on increasing when the functional frequency is increased. Experimental data as presented in [6] are plotted alongside with ANN models output as in Fig. 9. and model is employed to achieve the value of NF at the carrier center frequency.



Frequency in GHz

Fig. 9 NF Variation with Frequency

V RESULTS

Table 1 Achieved results of present work

S.No	Parameters	Achieved Results
1.	Frequency	2.49202GHz
2.	MAG	20.812dB
3.	NF_{min}	0.5dB

VI CONCLUSION

The purpose of present research work is to explore the signal strength issues in the IRNSS receiver. In order to overcome signal loss in MSS systems, the mobile receiver front end section must be equipped with an efficient LNA. Present research work has utilized all the LNA design principles to achievable a neural model representing an amplifier with desired specifications. These parameters are plotted against the frequency for discrete values and the closeness of the same is to be considered by comparing it with plots provided by an industrial standard LNA specification sheet.

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