IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676, p-ISSN: 2320-3331, Volume 17, Issue 2 Ser. I (Mar. – Apr. 2022), PP 53-55
www.iosrjournals.org

Pressure Sensor RF- Transmitter under Influence of Intermodulation In The Vicinity Of Emi

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Abstract
Measuring, processing and transmitting the performance parameters of the switchgear system to the control room in the power substations without physical connection is big challenge, but the recent technology,the wireless sensor playing dominant role in the power substations especially in the hybrid power grid power substations. The hybrid grids are connected with multi generation system with many electronic devices and high voltage equipment's. These devices and equipment's are susceptible and generation electromagnetic interference (EMI) signal to each other. The wireless pressure sensor module which is used in the switchgear system consists of sensor element, differential amplifier, buffer, chopper, Radio frequency (RF) transmitter. The operation of pressure sensor modules under EMI environment undergoes many technical issues. The present work focusses on analysis and simulation of RF stage under the influence of intermodulation with the presence of EMI is carried out using PYHTON.

Keywords: *SiC(Silicon Carbide) RF amplifier, Intermodulation, Electromagnetic Interference(EMI).*

Date of Submission: 08-03-2022 Date of Acceptance: 24-03-2022

I. Introduction

The present technology choppers are based the solid-state operational amplifiers. These choppers are analysed and tested with linear and nonlinear EMI with elimination of ripple [1].The time domain nonlinear analysis of susceptibility to EMI for CMOS chopper circuit is carried and new chopper circuit is designed for resistance of 1V peak-peak 50MHz EMI signal[2].The Voltage controlled oscillator(VCO) is also on of sub circuit in the RF stage. It consists of oscillator and varactor diode. The intermodulation is one of the problems when we are using the varactor diode. The nonlinear parameter analysis on 2^{nd} and 3^{rd} order intermodulation and its compensation in the tuning varactor diode is presented[3].The intermodulation is depended on the type of varactor diode, frequency tuning range and DC operating voltage of diode in the RF circuit[4].The performance of voltage controlled oscillator (VCO) in the presence of time varying interferencesignal is analysed and modelled with approximation is carried out[5].The high quality factor with low distortion varactor diode configurations are address for the 2GHz RF wireless applications[6].The concept of puling, phase locked loop, amplitude and phase deviation in the differential VCO and other oscillator under the vicinity of EMIare addressed in[7],[8],[9] and [10]. Usually at the RF stage signal distortion due to internal and external random noises, EMI. The intermodulation noise is also one of them that degrades the performance of the amplifier. But with the presence of EMI the average intermodulation will increases to maximum level. The analysis intermodulation under the presence of EMI and its reduction are one of the challenges in the design of wireless pressure. In this paper the analysis and simulation of RF stage under the influence of intermodulation with the presence of EMI is presented.

Analysis of SiC-JFET RF amplifier under EMI

The schematic of SiC-JFET pressure sensor RF amplifier used in the high temperature environment [11] is depicted in figure-1.

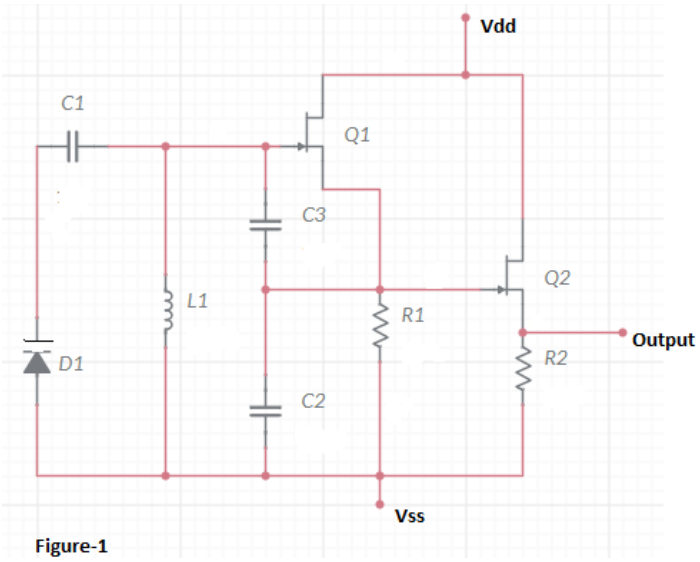

Figure-1 Schematic circuit of SiC-JFET RF amplifier

Mathematical Modelling

The intermodulation noise is due to the presence of nonlinearity. The nonlinearity may be expressed in terms of power series of the nonlinearinput admittances[12].

$y_i = y_{i0} + y_{i1} v_i + y_{i2} v_i^2 + y_{i3} v_i^3$ (1)

The timevariant total reflected intermodulation signa of with respect to two different interference frequencies with same voltage magnitude, 1st and 3rd intermodulation can be expressed as

$v_R(t) = v_{R1}\{Cos\omega_1(t) + Cos\omega_2(t)\} + v_{R3}\{\{Cos(2\omega_1 - \omega_2)t\} + \{Cos(2\omega_2 - \omega_1)t\}\}$

Where $v_{R1} = \frac{Z_s}{2\,Re(Z_s)}\left\{(1 - y_{i0}Z^*_s)vi - \frac{9}{4}y_{i2}\,Z^*_s v_i^3\right\}$ (2)

$v_{R3} = \frac{Z_s}{2\,Re(Z_s)}\left[-\frac{3}{4}y_{i2}\,Z^*_s v_i^3\right]$ (3)

And Z_S = Source impedance.

The reflected power can be expressed as

$P_R = \frac{|v_R|^2}{2\,Re(Z_s)}$ (4)

II. Simulation Result

The simulation is performed on SiC-JFET pressure sensor RF stage with the presence of interference signal of two different frequency with same magnitude. The variation of reflected intermodulation power for 67MHz to 75MHz frequency are obtained using PYHTON programming language is as shown in figure-2. It is observed that the highest power level at 70 MHz interference is around -3 dB with other components of reflected intermodulation powers. The 3rd intermodulation powers around 6.99 MHz and 7.001 MHz .

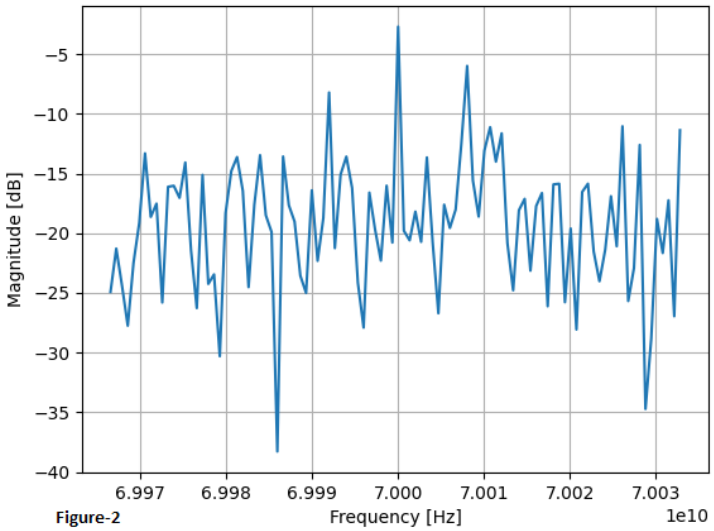

Figure-2 Reflected power under influence of EMI

III. Conclusion

This paper emphasizes the importance the analysis of the EMI for RF stages of wireless pressure sensor. The simulation tool is very important in the analysis of EMI due to the cost of the EMI measuring instruments and test set up. The EMI and RF stage analysis results will give the main purpose of the design consideration of RF stage of wireless pressure sensor and to deal with the minimization EMI at the RF stage or at the system level. In the simulation-based analysis is also is based on the software.

Future work

The analysis and designing RF-transmitterfor wireless pressure sensor as per the Electromagnetic compatibility (EMC) Standards.

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