International Journal of Pure and Applied Mathematics
Volume 117 No. 15 2017, 667-674
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue
ijpam.eu

Dark soliton generation using N-Channel MOSFET

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Abstract:

A periodic train of short duration pulses are used in number of applications such as high speed sampling, wide band radars and RF high power generation. Solitons are a special type of pulse, dumb bell shaped waves that propagate without changing their wave shape in a medium. A balancing mechanism between non linearity and dispersion (linearity) is responsible for the soliton phenomena. In this paper, we have presented a very simple method to generate a train of pulse (bright solitons) using the inherent parameters of the p-channel MOSFET.

Keywords: Electrical dark soliton; NonLinear Transmission Line (NLTL)

1 Introduction

An Electrical (Dark, Bright) Soliton pulses are characterized by how far its maintaining the wave shape and size i.e unchanged during transmission through the medium. Continuous research work is going on for the generation of dark and bright electrical soliton pulses that are very useful for understanding the concept of nonlinear system [1,2,3]. The electrical soliton can be produced when the effect of dispersion and nonlinearity perfectly balancing each other [4,5,6]. Soliton pulse used as a carrier signal in communication system it will provide less noise and more efficient than square pulse [4,5].To different methods are existing to generate the soliton pulse but that is complicated by using CMOS amplifier and nonlinear transmission line (varactor, inductor) [7,8,9,15.].

In this paper we are generating the dark soliton pulse in very simple manner by utilizing the inherent parameter of N-Channel MOSFET. Normally any continuous signal (Sinusoidal Signal) is operated on the nonlinear region of N- Channel and P-Channel MOSFET transfer curve and its input signal will spilt into different frequency components. In connection with this for P-Channel MOSFET bright solitons (+ve peaking) pulses and for N-Channel MOSFET dark soliton pulses (-ve peaking) are generated. NLTL is constructed with parallel combination of inductor and capacitor, inductor will provide dispersion (linearity) and capacitor will provide nonlinearity. At a particular value of Gate Source voltage (V_{GS}) the effect of dispersion and nonlinearity balances each other then only soliton pulses are formed [10,11,12].

2. Methodology

Our methodology is derived from Fig 1 shows the channel structure of MOSFET the parallel combination of capacitance and resistance will provide the channel between drain and source.

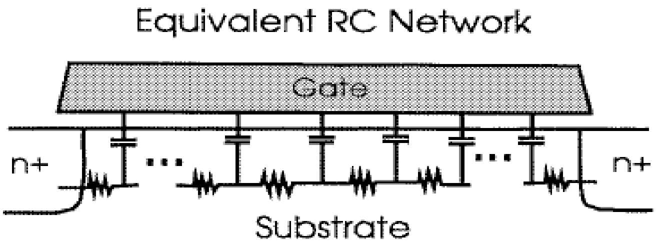

Figure 1: channcel structure of MOSFET

The delayed periodic arrangement of resistor and capacitor is equivalent effect of parallel combination of inductance and capacitance [14,15] so the channel will become nonlinear transmission line.

$$Q= C(v) \text{ ---- } \quad \text{Eqn (1)}$$

The gate oxide capacitance has a nonlinear dependence on the applied gate voltage. Fig. 3 shows the transfer curve of MOSFET, in that curve the nonlinear region is highlighted. By changing the V_{GS} it may be operated in the nonlinear region as per relation given in the equation 1. For a particular voltage V_{GS} the effect of inductance and capacitance balancing each other, during the time only soliton pulses (bright and dark) are generated.

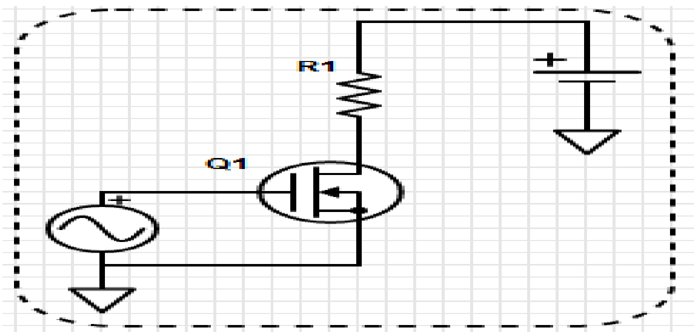

Figure 2 circuit diagram with N-Channel MOSFET

The proposed simple circuit diagram shown in fig.2, and the characteristics curve shown in fig.3. When the applied sinusoidal signal operated nearby the V_{GS} threshold voltage it lies on the nonlinear region of the curve and it is highlighted. When it is operated on the nonlinear region the output waveform looks like a pulse, for a particular value of V_{GS} the capacitance effect and inductance effect balances each other, the pulse look like a soliton pulse and its corresponding

FFT is exponentially decreasing. The fundamental frequency component is equal to the applied input signal frequency.

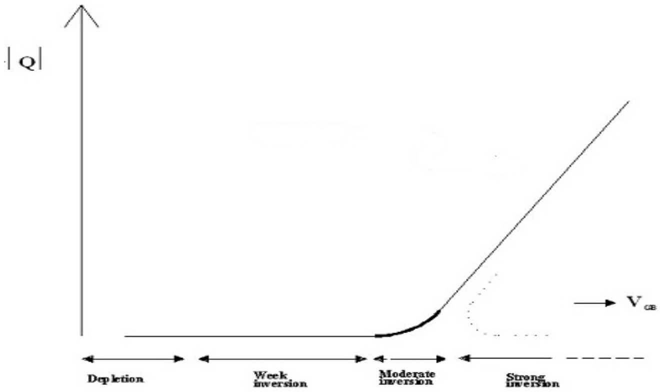

Figure 3: Characteristic curve of N-Channel MOSFET

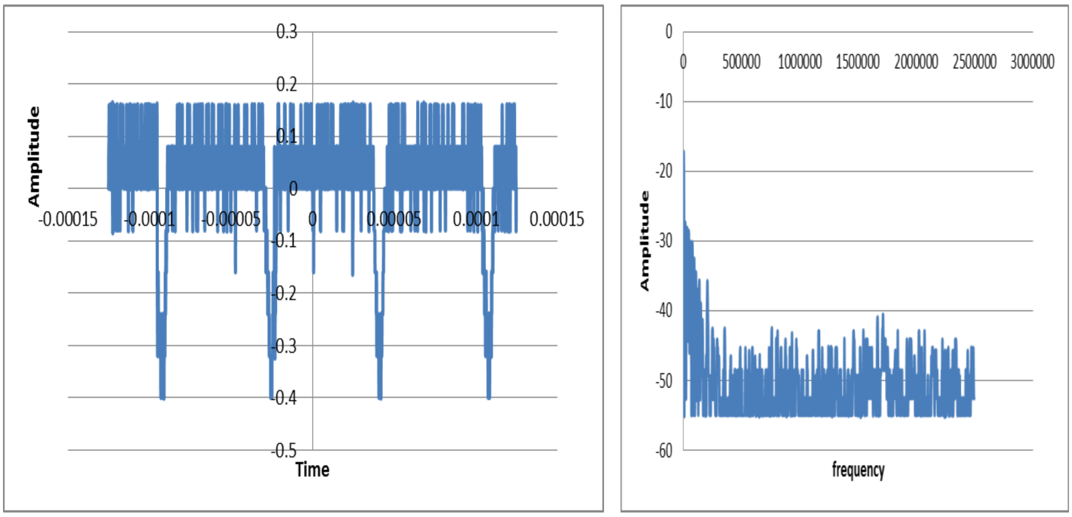

Figure 4: V_{GS} = 6.5 v (p-p) pulse and its corresponding FFT

Figure 4 the device get into the conducting state and amplitude of the pulse and harmonic component are very less. Figure 5 the device is working in the nonlinear region amplitude of the dark soliton pulses and harmonic components are better. Fiugre 5,6 this voltage is exactly balancing the dispersion and nonlinearity with each other, the waveform looks like a sharp pulse with larger amplitude. The above mentioned three voltages are closely balancing the effect of nonlinearity and linearity. Due to this the FFT spectrum of the above three harmonic components are exponentially reduced.

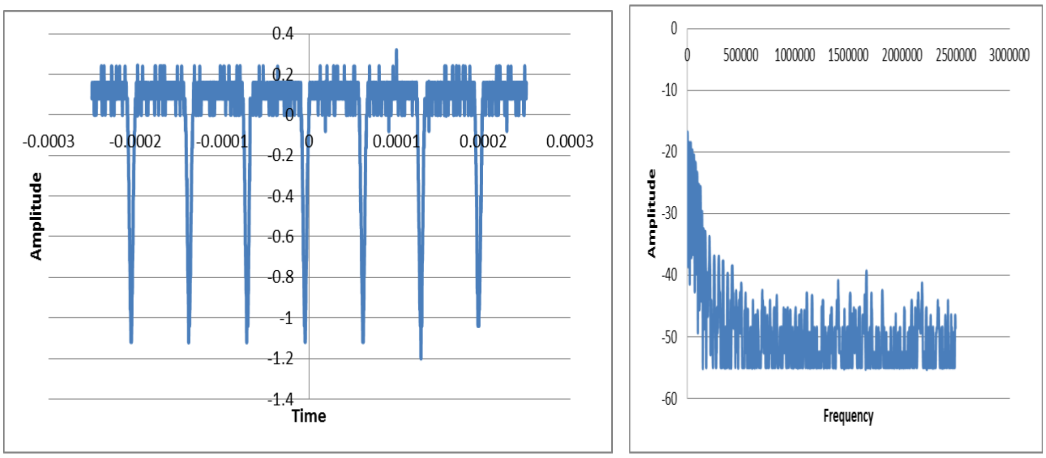

Figure 5: V_{GS} = 6.75 v (p-p) pulse and its corresponding FFT

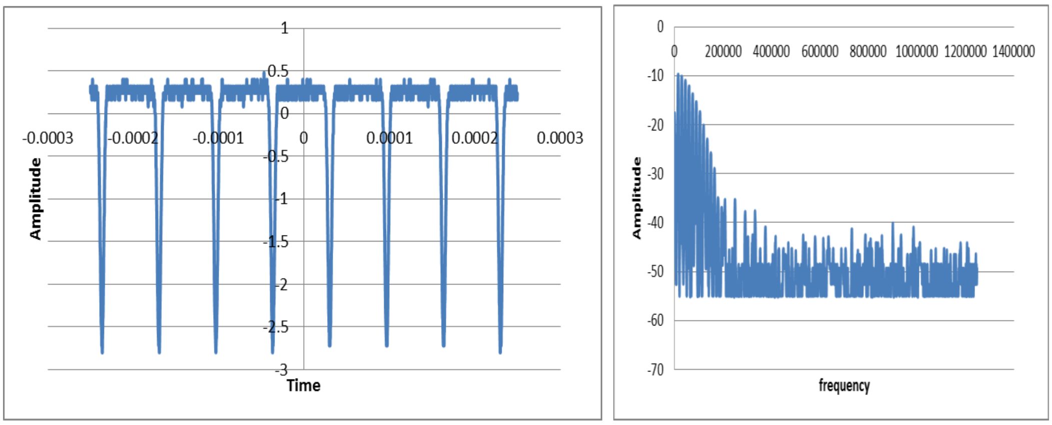

Figure 6: V_{GS} = 7 v (p-p) pulse and its corresponding FFT.

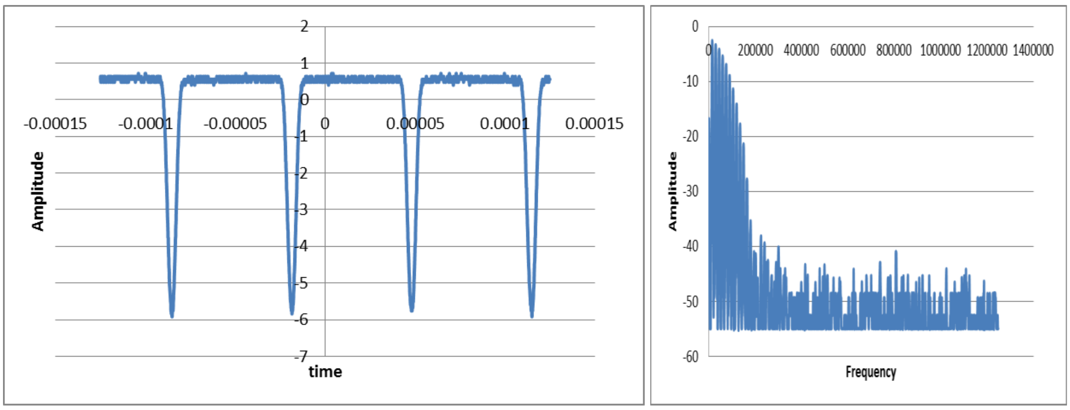

Figure 7: V_{GS} = 7.25 v (p-p) pulse and its corresponding FFT

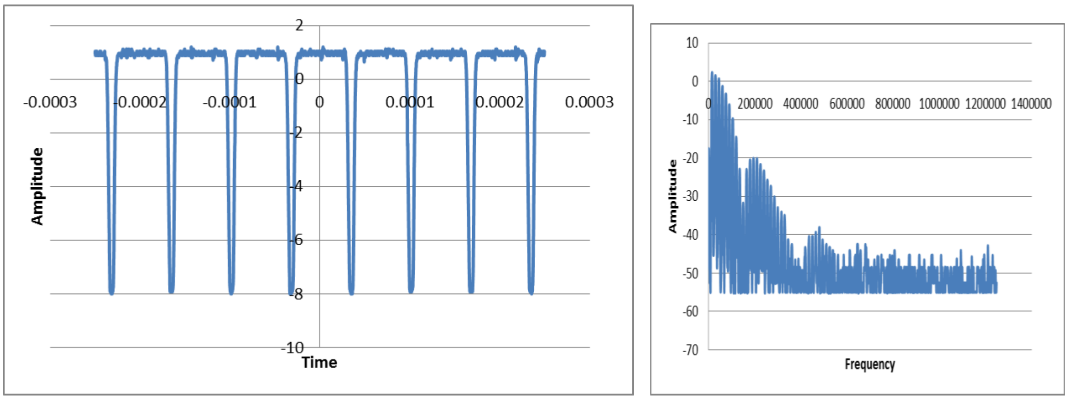

Figure 8: V_{GS} = 7.5 v (p-p) pulse and its corresponding FFT

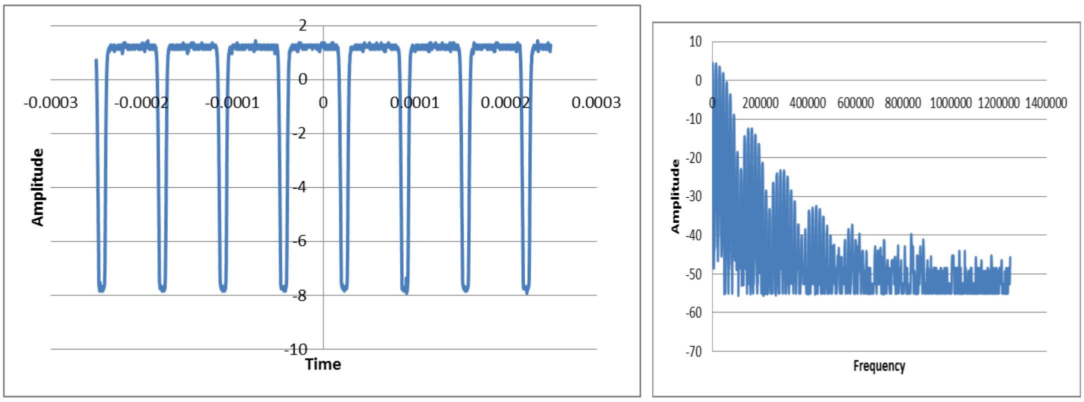

Figure 9: V_{GS} = 7.75 v (p-p) pulse and its corresponding FFT

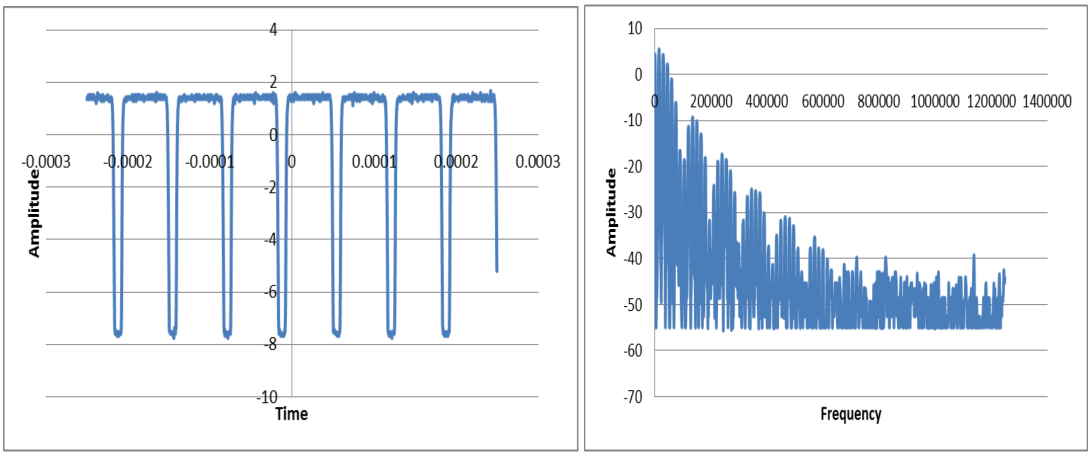

Figure 10: V_{GS} = 8 v (p-p) pulse and its corresponding FFT

Figure 7,8,9,10 VGS is more than 7.25 to 8 v it is getting into saturation region so the pulse width are widened and more number of harmonic components are generated.

3 Conclusions:

Dark soliton pulses are generated by very simple method using the inherent parameters of N-Channel MOSFET. Square wave based carrier signals are affected by the infinite number of harmonics and the pulse shape also changed at high frequency this problem faced in wireless communication application. So, cost effective dark soliton based carrier signal can be used in the wireless communication application effectively.

Acknowledgements

The author acknowledges SASTRA University for providing research facilities.

References

[1] Amiri IS, Alavi SE, Idrus SM. Soliton coding for secured optical communication link. 1st ed. Singapur, Springer-Verlag; 2015, pp. 41-56.
[2] Hirota R. The direct method in soliton theory. 1st ed. UK, Cambridge university press 2004.
[3] Filippov AT. The versatile soliton. 1st ed. USA, Springer science and business media, 2000.
[4] Kivshar YS, Agrawal G. Optical solitons, From fibers to photonic crystals.1st ed. USA, Academic Press, 2013, pp. 540.
[5] Porsezian K, Ganapathy R, Hasegawa A, Serkin V N. Non autonomous soliton dispersion management. IEEE J Quantum Electron, Mexico, 2009, 45(12), pp. 1577-83.
[6] Ganapathy R. Soliton dispersion management in nonlinear optical fibers. Communications in nonlinear science and numerical simulation 2012, 17(5), pp. 4544-50.
[7] Yildirim OO, Ricketts DS, Ham D. Reflection soliton oscillator. IEEE Trans. Microwave Theory and Technique 2009, 57(1), pp. 2344-53.
[8] Li X, Ricketts DS, Ham D. Solitons in electrical networks. McGraw-Hillyearbook of science and technology, 2008.
[9] Ricketts DS, Li X, Sun N, Woo K, Ham D. On the self-generation of electrical soliton pulses. IEEE J.Solid-State Circuits 2007, 42(8), pp. 1657-68.
[10] Ham D, Li X, Denenberg S, Lee TH, Ricketts DS. Ordered and chaotic electrical solitons, communication perspectives. IEEE Communications Magazine 2006, 44(12), pp. 126-35.
[11] Ricketts DS, Ham D. Electrical solitons, theory, design and applications. USA, CRC Press, 2011, pp.1-46.
[12] Remoissenet M. Waves called solitons, Concepts and Experiments. 1st ed. USA, Springer science and business media, 1994, pp. 103-142.

[13] Ytterdal T, Cheng Y, Fjeldly T. Device modeling for analog and RF CMOS circuit design. UK, John Wiley and Sons Ltd, 2003. Inverter 4069 CMOS Inverter Data Sheet, http://category.alldatasheet.com/index.jspsSearchword=INVERTER 4069 CMOS Date accessed: 21/10/ 1987.

[14] [15] J.PonArasu and R.Tharani, "Reduction Of Peak - To - Average Power Ratio For OFDM Signals", International Journal of Innovations in Scientific and Engineering Research (IJISER), Vol.1, no.3, pp.208-211.

[15] Rajesh, M., and J. M. Gnanasekar. "Annoyed Realm Outlook Taxonomy Using Twin Transfer Learning." International Journal of Pure and Applied Mathematics 116 (2017): 547-558.

[16] Rajesh, M. & Gnanasekar, J.M. Wireless Pers Commun (2017),https://doi.org/10.1007/s11277-017-4565-9

[17] Rajesh, M., and J. M. Gnanasekar. "GCCover Heterogeneous Wireless Adhoc Networks." Journal of Chemical and Pharmaceutical Sciences (2015): 195-200.

[18] Rajesh, M., and J. M. Gnanasekar. "CONGESTION CONTROL IN HETEROGENEOUS WANET USING FRCC." Journal of Chemical and Pharmaceutical Sciences ISSN 974: 2115.

[19] Rajesh, M., and J. M. Gnanasekar. "GCCover Heterogeneous Wireless Ad hoc Networks." Journal of Chemical and Pharmaceutical Sciences (2015): 195-200.

[20] Rajesh, M., and J. M. Gnanasekar. "CONGESTION CONTROL USING AODV PROTOCOL SCHEME FOR WIRELESS AD-HOC NETWORK." Advances in Computer Science and Engineering 16.1/2 (2016): 19.

[21] RAJESH, M. "TRADITIONAL COURSES INTO ONLINE MOVING STRATEGY." The Online Journal of Distance Education and e-Learning 4.4 (2016).

[22] Rajesh, M. "Object-Oriented Programming and Parallelism."

[23] Rajesh, M., K. Balasubramaniaswamy, and S. Aravindh. "MEBCK from Web using NLP Techniques." Computer Engineering and Intelligent Systems 6.8: 24-26.