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Ashish Gupta[1], Afzal Sikander[2]

[1]Department of Electrical and Electronics Engineering, Eshan College of Engineering Mathura, INDIA
[2]Department of Instrumentation and Control Engineering, NIT Jalandhar, INDIA

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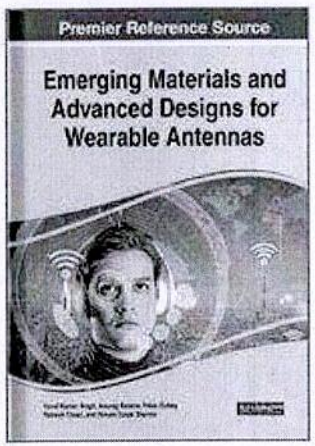

Review on the Development of Solid State Transformer

Bharat Bhushan Khare (Rajiv Gandhi Proudyogiki Vishwavidyalaya, India), Rajeev Shankar Pathak (Eshan College of Engineering, Agra, India), Sanjeev Sharma (New Horizon college of Engineering, India) and Vinod Kumar Singh (SR Group of Institutions, India)

Source Title: Emerging Materials and Advanced Designs for Wearable Antennas
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Abstract

According to future renewable electric energy distribution and management (FREEDM) system, solid state transformers play an important role in smart grid technologies. They have several advantages over conventional transformers such as bi-directional power flow, light in weight, compact size, etc. They also compensate the environmental issues which are created due to transformer oil. Because of various advantages over traditional transformer, SST is preferred widely at the present time. So in this chapter, the various architectures, needs, and applications of solid state transformers are discussed. The global market of SST has continuously improved because it has several applications and benefits.

Design and Analysis of Wearable Antennas (pages 85-97)

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Introduction

Solid state transformer which has the same working principle as conventional transformer with bi-directional power flow, consisted of using several power electronic switching devices and a high frequency transformer (Ronan et al., 2002),(Qin & Kimball, 2009). SST also known by different name such as Intelligent universal transformer (IUT), power electronics transformer (PET) and Energy control centers (ECC) (She et al., 2013). The solid state transformer (SST), which has been regarded as one of the 10 most emerging technologies by Massachusetts Institute of Technology (MIT) (Bowers et al., 1980) in 2010, has gained increasing importance in the future power distribution system. Basically the transformer enables the efficient and long distance transmission (Electronicsforu, n.d.). To overcome the deficiencies of traditional transformer like heavy weight, larger size and current limiting problem, solid state transformer was first introduced by William McMurray in 1970 (McMurray, 1971), but it cannot compete as conventional transformer because it had less efficient as conventional occurred. Figure 1 shows the concept of first electronics transformer.

Figure 1. Principle of Electronic Transformer

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After the development of electronic transformer, the researchers trying to improve the result of solid state devices so that the quality and efficiency of the devices was improved and due to this the efficiency of the electronic transformer also improved. So in this era, in 1980, (Bowers et al., 1980) US Navy sponsored study was conducted to determine the feasibility of replacing electrical power transformer with solid state transformer by J.C. Brows et al.

In 1986, A.L. Goldberg et. al (Goldberg et al., 1987) described the issues related to the design of 1-10 MHz Transformer. They were conduct an analysis of skin and proximity effects in the conductors and measurements of permeability and hysteresis loss in the magnetic material with the computer-assisted study of the relationships between size, efficiency, and frequency.

Pawel M. Gradzki et al proposed a computer-aided tool for design and analysis of high frequency power transformer (Gradzki et al., 1990). This program used a multidimensional minimum search algorithm to design the smallest transformer and size of the magnetic core. The design specification includes current and voltage waveform, desired core shape and material, type of winding etc. the program also calculate the core loss, winding loss, skin effect and proximity effect. Mario Rabinowitz suggested the name of this device as (Rabinowitz, 2003) Compact Transformer.

The solid state transformer was introduced by William McMurray in 1970, but still there is a gap between 1970 to present time in the sense of commercialized application of SST. Because in 1970, this is not technical feasible (McMurray, 1971),(NITC, n.d.) and not comparable with conventional transformer in cost and efficiency. Efficiency is directly related to the ratio of thyristor blocking voltage to the voltage drop during conduction. So initially, it was used in special application (Bowers et al., 1980),(Energy, n.d.) where cost and efficiency are secondary to size and weight. The researchers worked to improve the quality of

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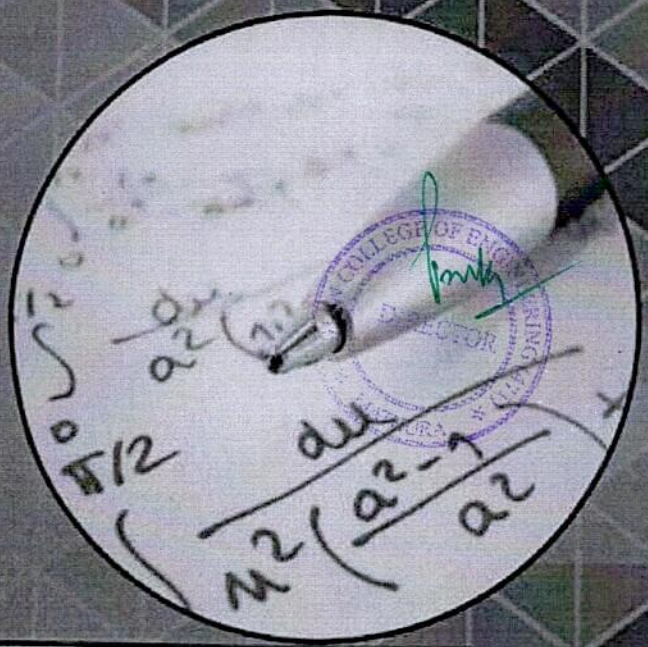

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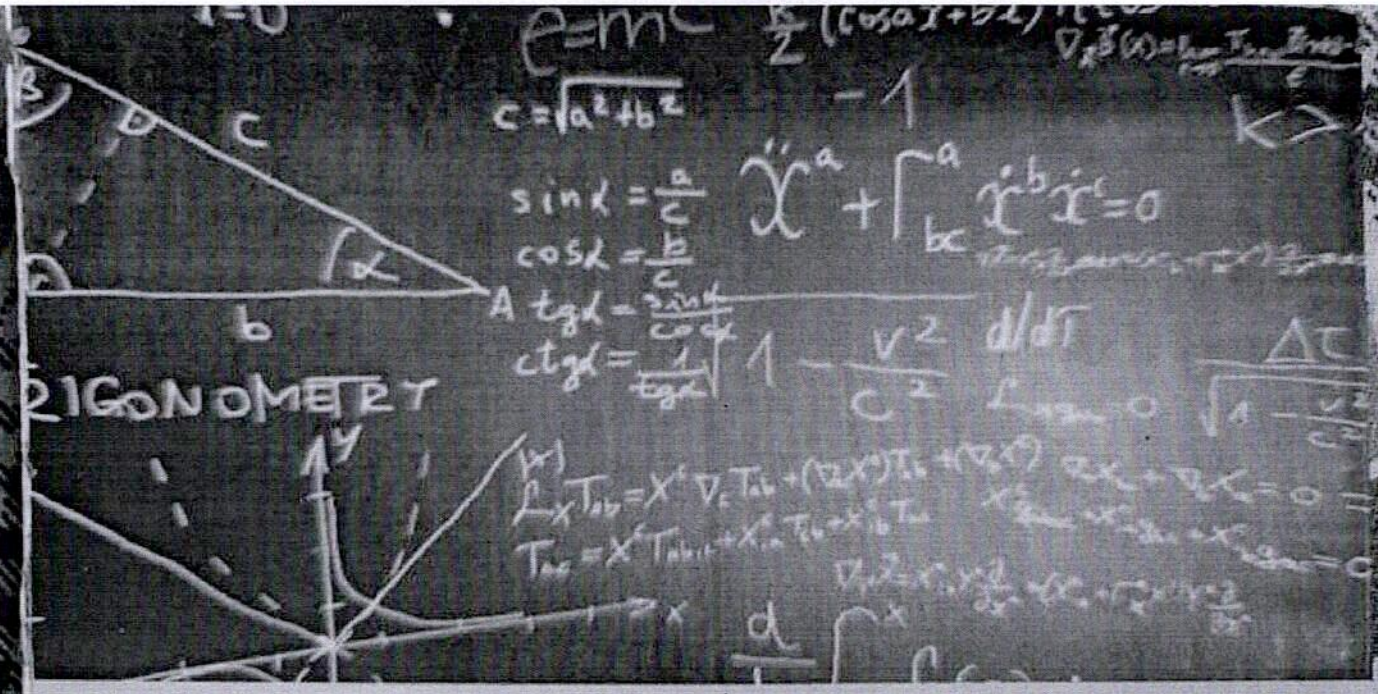

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Mr. Manish Kumar is currently working as Assistant Professor in the Department of Applied Science at Eshan College of Engineering & Technology, Farah, Mathura. His specialization in Mathematics. He has completed his graduation from Agra College, Agra in 2000 and Post graduation (M.Sc. In Maths) from Institute of Basic Science, Khandari Agra in 2004. He completed his B.Ed. Course 2006. He has started his carrier as lecturer in 2007 from Sai Nath Institute of Technology, Agra in 2007. He has ten years experience as a lecturer. He has participated various seminar at National level. He engaged in Noble Group for writing Books & study material from last seven years.

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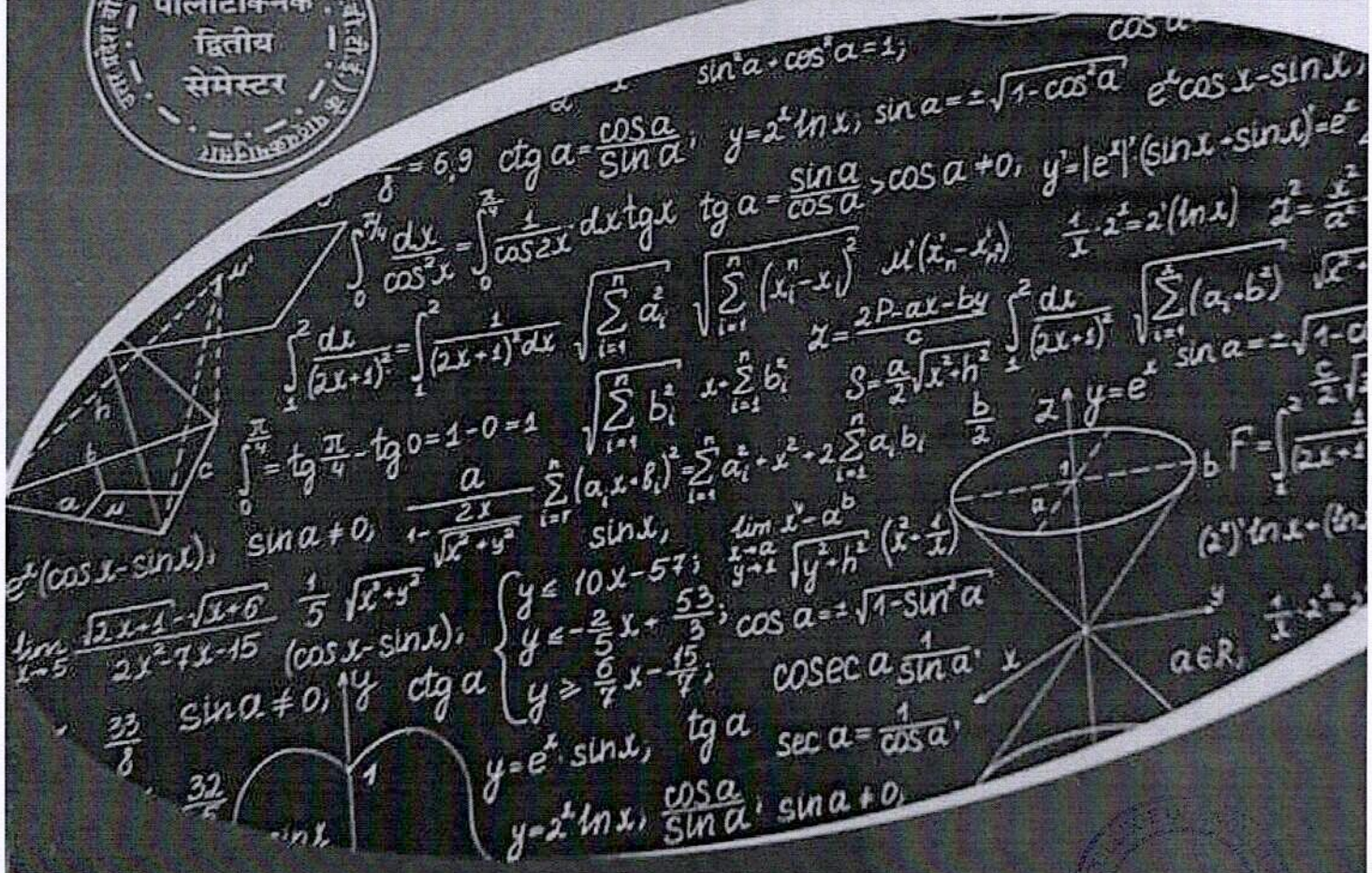

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