Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 3, March-2018

SIMULATION AND ANALYSIS OF VARIABLE SPEED CONSTANT REQUENCY CONVERTER FOR ALTERNATOR

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Abstract-A Paper is proposed based on the DC- Link VSCF AC-DC-AC electrical power system converter for the aircraft with transport category. This Project presents the Design of D.C link Converter which can be used for high frequency applications. The D.C link converter, which is composed of one unidirectional rectifier and one bidirectional inverter, is used to convert variable input frequency to a constant output frequency of 400Hz in the aircraft generator. Here we are using 12 Transistors/IGBT as a switching device. IGBT power transistors are used for medium level power conversion at a faster rate. Proposed method eliminates zero-crossing distortion caused by the use of diodes. Additionally, the control strategy permits the converter to operate with same dc-link voltage value required for the conventional six-switch converter. The Simulated and experimental results are presented. Simulation model can be designed using multisim software. Contemporary production airplanes already use VSCF as a major source or backup of electrical power. Prior system had a few problems with the VSCF systems and now the systems are considered to be safe integrated and replace existing constant-speed hydraulic transmissions powering CSCF AC generators and utilizing VSCF offers flexibility, redundancy, and reliability.

Keywords: electrical DC-link VSCF power systems, transport-category aircraft electrical power systems, power inverters, pulse-width-modulation, insulated gate bipolartransistors.

INTRODUCTION

The Aircraft electrical system uses a three-phase 400 HZ AC bus supplied, by engine driven generators. Constant frequency power generation is required, even though the aircraft engine speed can vary over a wide range. This results in voltage magnitude and frequency changes of the generator output. In order toprovide constant speed generator operation it is a common practice to use a hydro mechanical constant speed drive (CSD) to couple the output of the engine to the input of the generator. This system is very expensive, complex and must be located close to the engine. However, recently, developments in both power electronics and microprocessor technology have led to the electrical variable speed constant frequency (VSCF) systems becoming a viable alternative to the CSD. The VSCF electrical systems are proving to be far more flexible in contrast to CSD mechanical system, which must be located close to the engine. As essential components, these former systems can be distributed throughout the aircraft. In addition, maintenance and replacement of these VSCF systems are far easier compared with the CSD system. The PWM inverter is the essential part of the static frequency converter. This paper will discuss the basic concepts of switch-mode dc-to-ac inverters. Particular emphasis will be placed on the PWM in three-phase voltage-source inverter. Next, the selection of both the amplitude ratio and the frequency ratio will be considered. Finally pulse width modulation techniques are reviewed. The section 1 explains the

preliminaries and the section 2 explains the working procedure and 3 says the related works and 4 gives the conclusion.

1. PRELIMNARIES

1.1DC LINK CONVERTER

In recent years, aircraft with the availability of high voltage, high-power transistors, it has become practical that there is a DC-Link VSCF electrical systems. In these systems the variable frequency generator output is rectified to provide an intermediate DC power link. This power is then inverted to a fixed AC output by means of a three-phase PWM inverter, the three-phase PWM inverter is the most critical item in the DC-Link VSCF electrical system. Both the cycloconverters and the DC-Link VSCF electrical system have specific advantages over the constant speed drive (CSD). When replacing the mechanical/hydraulic CSD with a solid state power converter, the reliability of the generating system is improved. Since the DC-Link VSCF system output frequency is crystal controlled, the output frequency variations inherent with CSD drives are eliminated. When high voltage is available, high-power transistors, DC-Link converters having a variable input frequency but a constant output frequency now provide a viable alternative to the constant-speed mechanical drive as a means of providing a constant frequency power supply from an aircraft generator. The ability to locate the components of the electrical system throughout the aircraft, the reduction in servicing needs, and the ease of replacement and repair all combine to bring about a considerable reduction in the maintenance time. The generator is driven directly by the engine, so its speed and output frequency will vary as engine speed varies. It is represented by the Fig.1. The system employs a generator whose variable-frequency power and variable speed would not be suitable for power needs in an aircraft system. The variable-frequency power is converted to constant frequency power by means of solid-state circuitry, and this makes the power suitable for the aircraft use. The variable three-phase power is fed to the full-wave diode rectifier, where it is converted to direct current and filtered. This direct current is fed to the conversion circuitry, to produce three-phase 400 HZ alternating current. The DC-link system may be physically separated or integrated into one package.

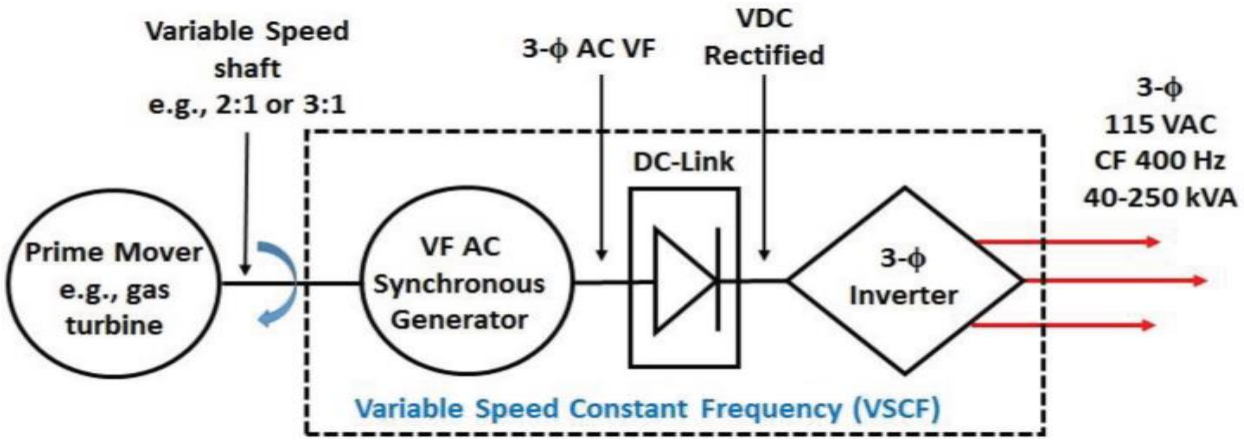

Fig1. The picture explains the working of a VSCF and the conversion into a 400Hz Alternating Current.

1.2. CONVERTER

An ac-ac converter converts a fixed voltage, fixed frequency ac input supply to obtain a variable voltage ac output. In ac-ac converter by coupling a pulse width modulation (PWM) rectifier and a PWM inverter to a dc link the sinusoidal input currents and bidirectional power flow can be achieved. The DC link quantity is an energy storage element which is a capacitor C for the voltage dc link and the inductor for the current dc link. Here the paper is a direct ac-ac converter for achieving high frequency for applications. In conventional design due to the input current harmonics, a low frequency power gets across the load and hence it takes less heating time. The need for an additional filter requirement is eliminated in the proposed model where Direct ac-ac converter is free from the conduction loss.

1.3. PWM INVERTER

The inverters based on PWM technology are superior in many factors as compared to other inverters which are designed using conventional technologies. The inverters are based on PWM technology has lots of protection and control circuits as compared to the traditional inverters.
We can further sub-divide PWM inverters into different types including:
1. Sinusoidal PWM.
2. Adaptive current control PWM.
3. Phase-shift PWM.
The type of inverter, used here, is a three-phase sinusoidal PWM inverter. This inverter is used to convert the rectified output from a wild frequency generator to the constant frequency that is 400 HZ AC supply which is basically required by the aircraft.

1.4. RECTIFIER

Rectifiers are used to convert the AC voltage into DC. A DC link is a connection which connects a rectifier and an inverter. These links are found in converter circuits and in VFD circuits. The AC supply of a specific frequency is converted into DC. This DC, in turn, is converted into AC voltage. The DC link is the connection between these two circuits. The DC link usually has a capacitor known as the DC link Capacitor. This capacitor is connected in parallel between the positive and the negative conductors. The DC capacitor helps prevent the transients from the load side from going back to the distributor side. It also serves to smoothen the pulses in the rectified DC.

2. WORKING PROCEDURE

Rectifiers are used to convert the AC voltage into DC. A DC link is a connection which connects a rectifier and an inverter. The inverters based on PWM technology are superior in many factors as compared to other inverters which are designed using conventional technologies. An ac-ac converter converts a fixed voltage, fixed frequency ac input supply to obtain a variable voltage ac output. . This power is then inverted to a fixed AC output by means of a three-phase PWM inverter, the three-phase PWM inverter is the most critical item in the DC-Link VSCF electrical system. Both the cycloconverters and the DC-Link VSCF electrical system have specific advantages over the constant speed drive (CSD). When replacing the mechanical/hydraulic CSD with a solid state power converter, the reliability of the generating system is improved. The Engine and the AC generators are used and the basic input given is converted to a high voltage 400Hz. The output of the AC generator is supplied as an input to both the Rectifier and the Voltage Regulator. The PWM inverter is used to convert the input voltage to a 400HZ AC supply. The Procedure is described in the Fig.2 as follows.

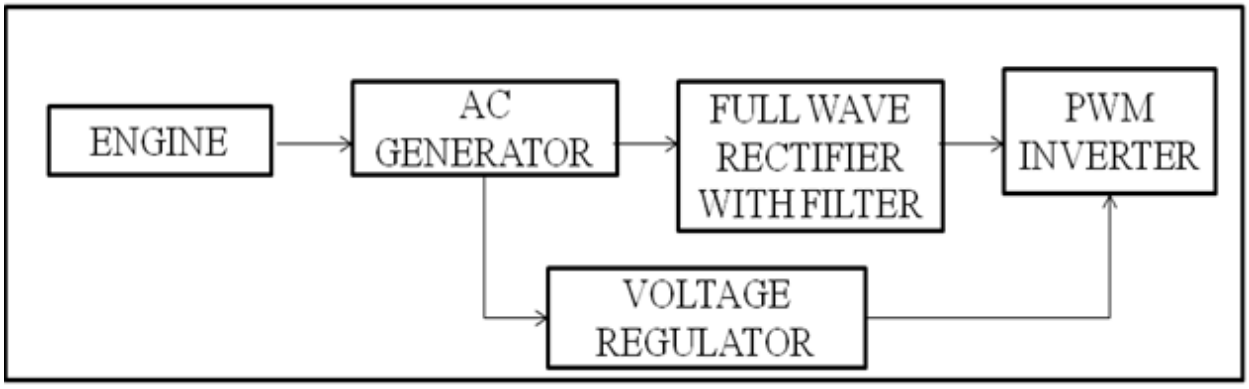

Fig.2 The image represents the entire working procedure of the paper and it contains all the basic elements needed for the AC voltage generation.

3.RELATED WORKS

A high frequency link single stage pwm inverter for high frequency ac voltage using cycloconverter, Mr.S.Vignesh, Mr.J.Vigneswaran, Mrs.S.Santhanlaksmi, Mr.M.Sudhakaran This paper presents a single-stage bidirectional HFT link DC/AC converter topology for a three-phase adjustable magnitude and frequency PWM AC drive. This type of converters find wide range of applications including UPS systems, drives involving renewable energy sources and energy storage systems. HFT results in reduction in cost and weight along with a considerable increase in power density. Adverse effects of common-mode voltage are well known in this kind of applications. The proposed topology along with a modulation technique reduces common-mode voltage to practically zero and generates high quality output voltage waveform comparable to Conventional Space Vector PWM. No need for any auxiliary circuits with passive components Almost complete recovery of the leakage energy Soft switching of the output side converter for all load conditions and Minimization of common-mode voltage switching due to commutation.

Comparison of Three Phase Voltage Back to Back Converter and Matrix Converter C.Kalaiselvi, M.Bhuvaneswari, A.Divya Vinoth Raja This paper presents a comparative evaluation of three phase VBBC and three phase MC fed Induction Motor IM drive. These two topologies are developed using SVM technique and simulated in ATLAB/SIMULINK. Both the topologies are functionally equivalent in terms of input power quality and energy regeneration capabilities but need to be compared in terms of performance as well as complexity due to the high number of switches involved in these two converters

Design of DC-Link VSCF AC Electrical Power System for the Embraer 190/195 Aircraft Nihad E. Daidzic A proposed novel DC-Link VSCF AC-DC-AC electrical power system converter for Embraer 190/195 transport category airplane is presented. The proposed converter could replace the existing conventional system based on the CSCF IDGs. Usually cycloconverter are used for generating constant frequency. Cycloconverter are used for low speed application. In cycloconverter switching devices are thyristor. In cycloconverter we are using 36 switches.

4. CONCLUSION

DC-Link frequency converter has been shown to be a viable alternative to the constant-speed mechanical drive as a means of providing a constant frequency power supply from an aircraft generator. The ease of replacement and repair, the reduction in servicing needs, and the ability to locate the components of the electrical system throughout the aircraft all combine to bring about a considerable reduction in the maintenance time which is required. The most important part in the DC-Link converter is the three-phase PWM inverter, which was designed and tested. The design objective of operating this inverter at constant frequency of 400 HZ, was achieved satisfactorily.

ACKNOWLEDGEMENT

This work was supported in part by grants from A.Hariharan, K.Pemkumar, B.Masthanayya Sai, Students of Panimalar Institute of Technology and also supported by, Mr.J.Navarajan M.E(Phd) Associate Professor (Project Guide), Mr.L.Ashok KumarM.E (PhD) & Mrs.K.Chitra M.E., PhD., Head of Electronic communication and Engineering Department, Panimalar Institute of Technology, helped us during preparation and also provided valuable feedback for guidance.

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