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FREQUENCY CONVERTER FOR HINDUSTAN AERONAUTICS LTD

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Abstract - In this world of development today, there are various tools that the electrical or electronics engineer can use to get his desired output. The reason being that there has been such a lot of improvement in the field of technology that just about everything is feasible these days. Probably the most key components that an engineer has up his sleeve is termed the static frequency converter that is simply the core of the contemporary equipment. Static frequency converters were initially called on when engineers needed to run equipment on differing alternative current frequencies

1.INTRODUCTION

A frequency changer or frequency converter is an electronic device that converts alternating current (AC) of one frequency to alternating current of another frequency. The device may also change the voltage, but if it incidental to its principle does, that is purpose.
Traditionally, these devices were electromechanical machines called a motor-generator set. Also devices with mercury arc rectifiers or vacuum tubes were in use. With the advent of solid state electronics, it has become possible to build completely electronic frequency changers. These devices usually consist of a rectifier stage (producing direct current) which is then inverted to produce AC of the desired frequency. The inverter may use Thyristors, IGBTs. If voltage conversion is desired, a transformer will usually be included in either the ac input or output circuitry and this transformer may also provide galvanic isolation between the input and output ac circuits. A battery may also be added to the dc circuitry to improve the converter's ride-through of brief outages in the input power. Frequency changers vary in power-handling capability from a few watts to megawatts.

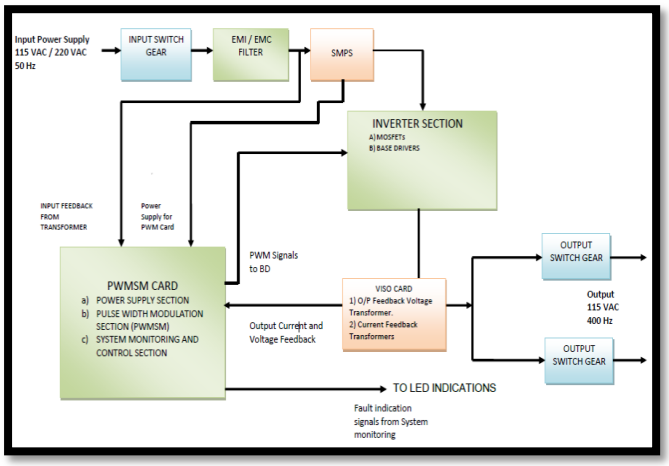
2.SYSTEM ARCHITECTURE

2.1Brief description of the Equipment and Sub-Assembly:

Input Supply:-
Frequency converter can work with two Input AC supplies.

- Voltage: 220VAC (+/-10%) Current : 1.5A
- Voltage: 115VAC (+/-10%) Current : 3A

Input Switchgear:-



Input Switchgear section comprises of Input controlling fuses and switches used to turn ON input supply to the Frequency Converter which is then provided to input transformer of the Inverter.

Figure No. 2.1Sytem Architecture

EMI/EMC Filter:-
The Output from the Transformer is provided to an EMI/EMC Filter which is used to reduce or eliminate any unwanted Electromagnetic interferences present in Input Supply

Switching Mode Power Supply:-
SMPS used in Frequency Converter Works in the range of 100VAC to 250VAC and provides constant Voltage of 24VDC.The SMPS used provides Supply Voltages to all the cards Used. It also provides 24VDC to MOSFETs at Collector- Emitter which is then switched to get 400Hz AC.

Inverter Section:-
The Inverter Section is the main section of Frequency Converter it consists of the following Components:

MOSFETs:
MOSFETs are used in Frequency Converter as a Switching Device. By Controlling the Gate emitter Pulses of MOSFETs with the help of PWM Signal coming from PWMSM Section the Frequency Conversion is carried out.

Base Driver Section:
A Base Driver is specially designed to drive MOSFETs for their Switching Operation. The base Driver Forwards the PWM pulses arriving from PWMSM section to MOSFETs, It also protects MOSFETs from Short-Circuit

and Overload by Blocking the Pulses reaching MOSFETs during abnormal Conditions.

Output Transformer:-

The output Transformer is of High Frequency Step-up type with primary and secondary ratings as Follows:

Primary : 0-12.5V,400Hz
Secondary : 0-117V/3A,400hz

Filter Circuit:-

Filter Circuit Comprises of Capacitors and a Choke to Form a LC filter Circuit to eliminate ripples.

VISO Card:-

VISO Card provides Output Voltage & Current Feedbacks to PWMSM card. It comprises of Following

Voltage Feedback Transformer:

The Voltage Feedback Transformer provides output voltage feedback to PWMSM section. PWMSM card Monitors the output Voltage and protects the frequency converter in case of High Output Voltage.

Current Feedback Transformer:

A current Feedback Transformer is used to provide output Current Feedback to PWMSM section which by monitoring the Output Current Protects the Frequency Converter in Case of Short-Circuit or Overload.

PWMSM Section:-

Pulse Width Modulation and System Monitoring Section is the main Section of Frequency Converter, It comprises of Following Sections;

Power Supply Section:

The Power Supply Section Provides Required Power to Every Circuit present in Frequency Converter.

Pulse Width Modulation Section:

The Pulse Width Modulation Section Comprises of a Microcontroller circuit. It generates the Pulse Width Modulated signal which controls the Gate-Emitter Pulses Reaching MOSFETs for Switching Operation.

System Monitoring Section:

This is also a Microcontroller based Circuit which continuously Monitors the Feedback of Voltage and Current From Output and Protects the panel by tripping it during abnormal Operation of the Frequency Converter.

Output Switchgear:-

Output Switchgear section comprises of Output controlling fuses and switches used to turn ON output supply.

2.2Key features of SFC

- The input and output are isolated via isolation transformer.
- The output voltage regulation can be stable up to 0.2%.
- The output frequency can be very stable up to 0.01 Hz.
- Suitable for indoor application with air conditioned ambience
- Compact in size which save space for installation.

Technical Specifications:

Electrical Power Supply : 220/115V AC (+/- 10%)

Insulation : Class “H” as per IS-1271

Temperature : +55°C(Operating)/ +70°C (Storage)

Enclosure Protection : IP-23 (As per IS 12063).

Mounting : Deck mounting on shock mounts (04 Nos.

Weight : ≤ 30Kg. (Max.)

Dimension : 320 (L) * 450 (B) * 200 (H) mm

Duty : Continuous

Protections.

Overload
Short circuit
Input Over-Voltage
Output Over-Voltage

Software Required:

OrCad Tool

Capture CIS for Schematic
Layout Plus for Layout

2.3 Result and Experiment

The equipment design employs a PWM full bridge inverter circuit, with MOSFETs as the switching device. The PWM technique has very high efficiency and a fast response. The input AC supply is converted to DC voltage via a full bridge rectifier circuit. This DC voltage is converted to AC supply of desired frequency via the full bridge inverter. Varying the duty cycle of the switching transistors controls the output voltage.

The system has many operational benefits such as:

Good output voltage regulation.
Fast dynamic response.
Higher system efficiency over total output power range.
Higher reliability.
Reduced system size and weight.

3.CONCLUSION

Implementation of this system or the medium frequency (400 Hz) power systems supply energy to the critical system and loads in aerospace, airplane and vessel, where space and weight are at a premium. The converters are demanded to obtain 400 Hz power from civil 50/60 Hz power systems. There are mainly two types of existing converters: solid state frequency converter (SSFC) and rotary frequency converter (RFC). Now, we are using MOSFET based Frequency Converter and the result of this system shows that the system has fast dynamic response and Stable Output.

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