# Matrix Converter for Frequency Changing Power Supply device

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***ABSTRACT***

***The indirect matrix converter is a converter with no energy storage dc-link. The lack of energy storage components in the dc-link is one of the advantages of the matrix converter. Furthermore, the matrix converter features full four-quadrant operation and sinusoidal input current. The output voltages ratio is limited to 0.866 of the input voltage. The indirect matrix converter needs six bidirectional switches in the rectification stage to connect with six unidirectional switches in the inversion stage. Bidirectional switches are not available on the market today and need to be constructed from semiconductor devices.***

***Keywords- Matrix converter, DC link, Frequency control***

## *1. INTRODUCTION*

This project is concerned with the design and invented of a Matrix Converter for Frequency Changing Power Supply device. Normally such units are used to convert between 50/60Hz supplies available in airports to a 400Hz one for aircraft supply when they are parked in their bays. This progress will consider the simulation of various matrix converter tswitching system, A Matrix Converter is a device used for converting directly AC energy into AC energy; the main theame of this matrix converter is to convert the magnitude as well as the frequency of the feed into a required magnitude and frequency of the output with an "all-silicon" solution. Generally, a Matrix Converter consists of nine bi-directional switches, which are required to be blocked in the right way and sequence in order to reduce losses and produce the required output with a great quality input and output waveforms. After the controlled rectifiers were invented in the early 1930's, it was surprised that this provided the chance of generating alternating currents of variable frequency directly from a fixed frequency AC supply, the positive rectifier supplying the positive half cycles of current and the negative rectifier the negative half cycles. This system was called cycloconverter at its early stage and this proved to be so appropriate that nowadays it is still used in some high power applications because of high power requirements and the Matrix Converter technology is still not available widely.

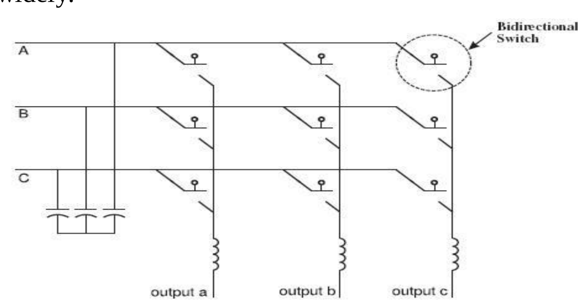


Figure 1.Structure of matrix converter.

## 2. TOPOLOGIES OF BI-DIRECTIONAL SWITCHES

Bi-directional switches capable of blocking voltage and flowing current in all directions are required by the Matrix Converter. Unfortunately these devices are not widely available. Hence, analog devices are used to make suitable bi-directional switch cells and fulfill those requirements. The choice of bi-directional switches also dictates which current commutation methods can be used. This division explains some possible bi-directional switch configurations and the merit and demerit of each arrangement. In the discussion below it has been assumed that the switching device would be an IGBT (insulated gate bipolar transistor) but other devices such as MOSFETs, MCTs and IGCTs can be used in the equal way.

### 2.1 DIODE BRIDGE TOPOLOGY

The diode bridge system is the most reliable bi-directional switch structure. This system make by using of an IGBT at the middle of a single phase diode arm arrangement, illustrated in Figure 2. The main profit of this system is that only one active device is require, decresed the cost price of the power circuit and the difficulty of the control/gate drive circuits. In every flowing path it produce high losses with the three devices. The main demerit is that the direction of the current passes by the switch cannot be controlled. Many of the new commutation techniques described laterally on self control of the current in both direction.

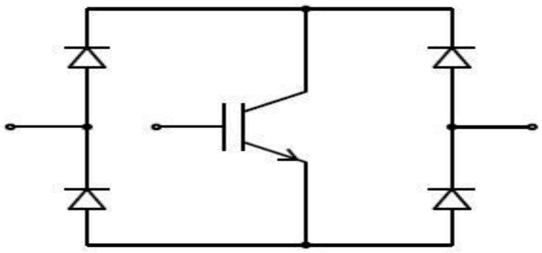

Figure 2.1 Diode Bi-directional Switch

### 2.2 IGBT WITH ANTI-PARALLEL DIODE TOPOLOGIES

There are so many different configurations for bi-directional switches which use IGBTs with anti-parallel diodes switch. Such system are mentioned below.

### COMMON EMITTER BI-DIRECTIONAL SWITCH

This switch is construct with the help of two diodes and two IGBTs as shown in Figure 2.2. The diodes are contained to show the opposite blocking ability. The reverse blocking capability is a poor of the early IGBT technology. There are various advantages in using this switch when compared to the diode bridge switch. The first advantage is that it is possible to self control the direction of the current. Flowing losses are also decreased as only two devices carry the current at any one time. As with the diode bridge switch every bi-directional switch cell require an insulate power supply.

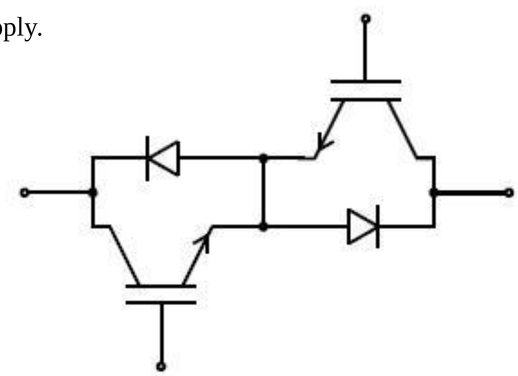

Figure 2.2 Common Emitter Bi-directional Switch

***COMMON COLLECTOR BI-DIRECTIONAL SWITCH.***

This switch is similar to the arrangement presented in the previous arrangement. The difference is common collector configuration is made with help of IGBTs switch as shown in Figure 3.3. The flowing losses are the similar as the common emitter configuration. One possible merit of the common collector configuration is that only six isolated power supplies are required to supply the gate drive signals.

This is possible if the inductance between the devices sharing the same isolated power supply is low. This is the case for Matrix Converter strategies where all bi-directional switches are combined in single package. However, as the power levels rise, the stray inductance of the single bi-directional switches becomes more necessary. Therefore at greater power converters it is required to package the IGBTs into single bi-directional switches or complete output . Hence the common emitter configuration is mostly preferred for higher power levels circuit.

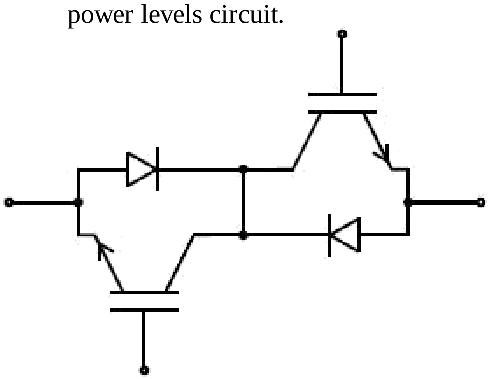

Figure 2.3 Common Collector Bidirectional Switch

***3. INPUT FILTER***

Power electronics circuits switch on and off large amounts of current at high voltages and thus can generate unwanted harmonic electrical signals that destroy the other electronic systems. In daily life, the magnitudes of the higher-order harmonics can also be regularly affected by the current spikes caused by the countable number of slopes of the switching transitions. In consequence, it is every time required that a filter be added at the power input of a power converter for reducing the harmonics. With the help of attenuating the switching harmonics that are presented in the current waveform, the input filter enter compliance with regulation that limit created electromagnetic interference. The input filter can also prevent the converter and its load from transients that appear in the input voltage, thereby reforming the system stability.

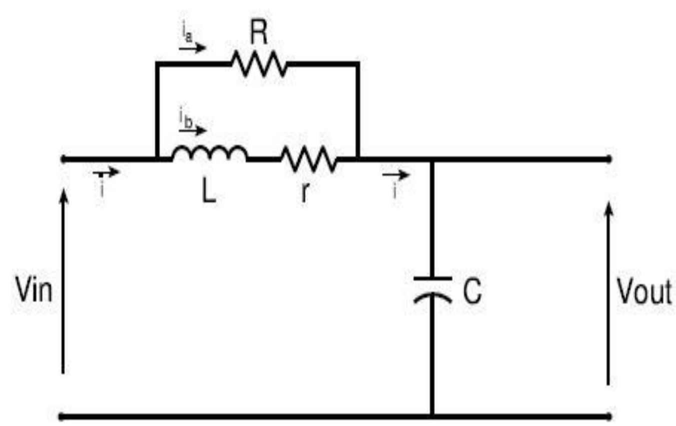


Figure 3.1 Diagram to calculate transfer function of input FILTER.

### *4. SIMULATION RESULTS*

## *Simulation Result for 12.5 Hz*

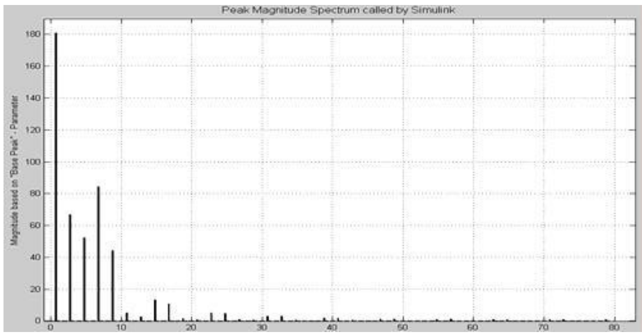


Fig 4.1 Harmonics without filter

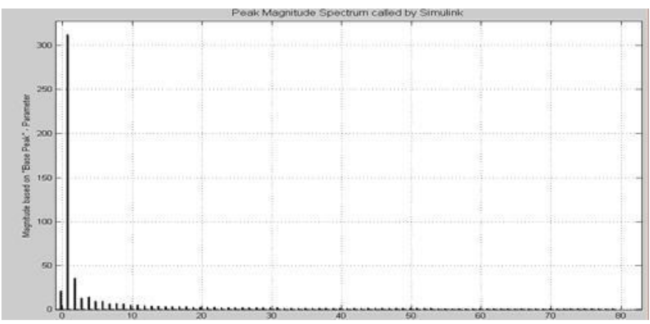


Fig 4.2 Harmonics
after filtration

### *INPUT AND OUTPUT WAVEFORM*

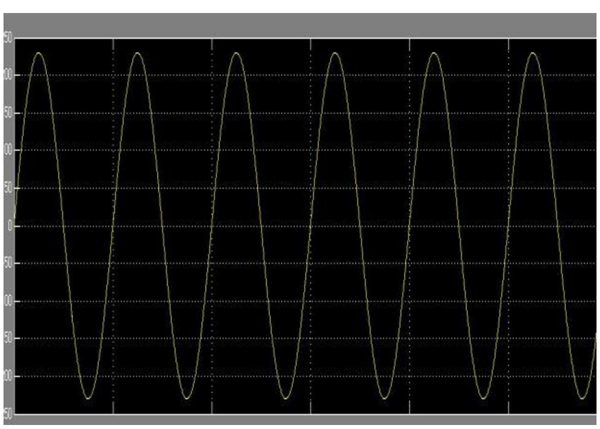

Fig 4.3 Input waveform of 50Hz

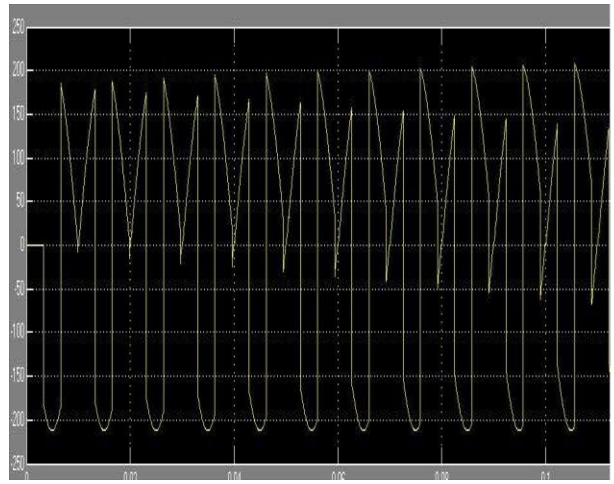

Fig 4.4 Output frequency of 150Hz without filter

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