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Using Multi-Pulse Converters for Supply Current Harmonic Control

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ABSTRACT: Three phase multipulse converters are generated for improving power quality of ac input side, dc output side and ac output side. This paper deal with multipulse configuration. They are performed power quality aspect component selection, latest trends, future development and potential application; the multipulse converter used three phase bridge rectifier and inverter. A transformer for twelve pulse converter and RL load from inverter side. The multipulse present a comparative evaluation of direct ac/dc converter and multipulse source ac/dc converter for providing series compensation of transmission system and provide a detailed discussion of power circuit design issues related to various performance. the phase shifting transformer are used to multipulse supply from three phase ac supply in this transformer the primary winding has star connected and secondary side has two winding one is star connected and another delta connected its arrangement create phase shifting for both secondary side voltage of the transformer and also reduce N+1 order harmonic form supply current where n is no of pulses The operation of multipulse converter will be analyzing directly the harmonic minimization technique. The multipulse converter can be improved in term of supply power factor total harmonic distortion in supply current in dc voltage.

Keywords: AC-DC converters, Multipulse, Total Harmonic Distorson, THD, Ripple Content.

I. INTRODUCTION

In the past few years a lot of work has been done for the reduction of Total Harmonic Distortion using different concepts and applications. This work deals with the reduction of Total Harmonic Distortion using Multi-pulse AC to DC Conversion scheme. The results are obtained for both uncontrolled and controlled converters for RL Load. The three-phase multi-pulse AC to DC conversion system employs a phase-shifting transformer and a three-phase converter between the supply and load side of the system. Every such converter provides 6-pulse AC to Conversion, so in order to produce more sets of 6-pulse systems, a uniform phase-shift is required and hence with proper phase-shifting angle, 12, 18, 24, 30, and higher pulse systems can be produced.

Different rectifiers are used for conversion of AC supply into DC supply. For uncontrolled conversion, diodes have been preferred, while for the controlled conversion, thristers have been implemented. The performance improvement of multi-pulse converter is achieved for total harmonics distortion (THD) in supply current, DC voltage ripples and form factor. All the simulations have been done for similar ratings of RL Load, for all the multi-pulse converters configurations, so as to represent a fair comparison among controlled and uncontrolled continuations of multi-pulse converters.

II. OBJECTIVE OF PRESENT STUDY

The present work is an effort towards analyzing the different multi-pulse AC to DC converters in solving the harmonic problem in a three-phase converter system. The effect of increasing the number of pulses on the performance of AC to DC converters has been analyzed. For performance comparison the major factors considered are the ripple percentage, form factor and the total harmonic distortion (THD). The effects of load variation on multi-pulse AC to DC converters have also been investigated.

A. Multi-Pulse Method

Multi-pulse methods involve multiple converters connected so that the harmonics generated by one converter are cancelled by harmonics produced by other converters. By this means, certain harmonics related to number of converters are eliminated from the power source. In multi-pulse converters, reduction of AC input line current harmonics is important as regards to the impact the converter has on the power system. Multi-pulse methods are characterized by the use of multiple converters or multiple semiconductor devices with a common load. Fig. 4 & Fig. 5 given below depict the various techniques used widely for the reduction of harmonics. This paper is concerning to three phase converters.

B. Three Phase Converter

These three phase converters are used for number of applications in the industrial environment. This project work is dealing with multiple pulse or multi-pulse three phase thyristors converters for high voltage and high power applications. This multi-pulse scheme reduces the harmonics generated in the output voltage so avoids the requirement.

C. What are Multipulse AC-DC Converters

Multi pulse converters are converters providing more than six pulses of DC voltage per cycle from AC input. Or the converter having more steps in AC input current than that of six pulse bridge rectifier supply current. Bridge rectifier is the basic block required for AC- DC conversion, however , full- wave and half wave rectifier are also used up to 120kW ratings. Phase shifting transformers are used to derive multiple phase supply from three-phase AC mains using different combinations of transformer windings such as star, delta, zigzag, fork, polygon, etc.

D. Classification of Three Phase Multi-pulse Converter

The following are multi-pulse converter are:

(1) 6 Pulse Converters
(2) 12 Pulse Converters
(3) 18 Pulse Converters
(4) 24 Pulse Converters

The major breakthrough in the technology of MPCs is due to phase shifting process through transformers to convert from original three-phase ac supply to multipulse ac supply to result in a higher number of pulses in dc output for reducing in ripple and high number of steps in ac mains current to make it close to sinusoidal with reduced and acceptable THD. The concept of zigzag polygon, T connection, tapped winding, plurality of winding transformers and autotransformers is used to achieve the desired phase shift to cancel, eliminate and to reduce harmonics in ac mains feeding ac-dc converters to reduce size, weight, and cost of magnetic (transformer) in MPCs and wide acceptability in a number of additional applications. The optimum value of dc link inductor and leakage reactance of input transformer drastically reduces the values of THD of ac mains current, thus resulting in improved power quality.

III. APPLICATIONS OF THREE PHASE MULTIPULSE CONVERTER

A. Uncontrolled converter

- Front end of switching mode powers like – SMPS, UPS, AC-DC motor drives, dc servo drives.
- Aircraft VSCF (voltage source controlled frequency) systems and aircraft maintenance systems using 60Hz/ 400Hz converter systems.
- Railways working on DC.
- The welding equipment working on high frequency

B. Controlled converter

- DC motor drive system with regenerative capacity
- HVDC system Battery energy storage systems.
- Adjustable speed synchronous motor drive of large ratings for application such as mining
- Air craft

C. Six Pulse Diode Converter

In multiples converters server six pulse diode rectifier all connected eighties in parallel. Each rectifier fed by phase shifted secondary windings voltages of a transformer to shape the primary current close to sinusoidal. As compared to a six-pulse rectifier the transformer primary current in a multi-pulse converter is shaped using time displaced step wave shaped. Current drawn by multiple rectifiers with one rectifier across each of the secondary windings, increasing the number of rectifier raises the number of steps in the primary current wave from & produces a sinusoidal shaped supply current flowing into the transformer primary winding.

For harmonic mitigation multi-pulse uncontrolled converters are very popular due to the absence of any control system for the power diode, however control of output voltage in not possible.

D. Mathematical Model of Six-Pulse Rectifier

A six - pulse diode rectifier feeding on R-L load & pertains to the circuit modal of the six - pulse thyristor rectifier feeding on R-L Load. The three - Phase input supply voltage (Van, Vbn, Vcn) without line impedance drop could be expresses as

$$V_{an} = V_m \sin(\omega t) \quad \text{… (i)}$$

$$V_{bn} = V_m \sin(\omega t - \frac{2\pi}{3}) \quad \text{… (ii)}$$

$$V_{cn} = V_m \sin(\omega t + \frac{2\pi}{3}) \quad \text{… (iii)}$$

The voltage at the input of rectifier (Vsa, Vsb, and Vsc) can be expressed in equation. There are also called the voltage at the point of common coupling PCC.

$$V_{sa} = V_{an} - R_{sisa} - L_s \frac{di_{sa}}{dt} \quad \text{…(iv)}$$

$$V_{sb} = V_{bn} - R_{sisb} - L_s \frac{di_{sb}}{dt} \quad \text{…(v)}$$

$$V_{sc} = V_{cn} - R_{sisc} - L_s \frac{di_{sc}}{dt} \quad \text{…(vi)}$$

Where R & L denote resistance & inductance respectively.

In this circuit when Diode pair D_6D_1 are conducting for each 60^0 interval the value for the phase. Where $i_{sa,}$ $i_{sn,}$ i_{sc} are the rectifier input current & Rs & Ls are the source currents is $a_,$ $i_{sn,}$ i_{sc} are specified as being either Zero. The load current i_L or the negated load current (- i_L).

$$\frac{di_L}{dt} = \frac{V_{LLs} - (2R_s + R_L)i_L}{(2L_s + L_L)} \quad \text{…(vii)}$$

The three phase supply currents ($i_{sa,\ isb,\ isc}$) can be determined for this the input currents for six conduction intervals of diode pairs (D_1D_2, D_2D_3, D_3D_4, D_4D_5, $_{D5}D_6$ and D_6D_1) with 60^0 duration for an interval.

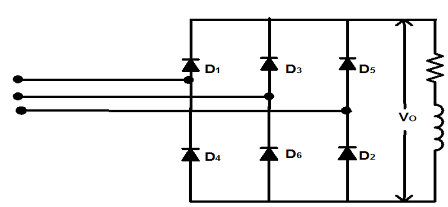


Fig. 1. Three phase six pulse diode converter.

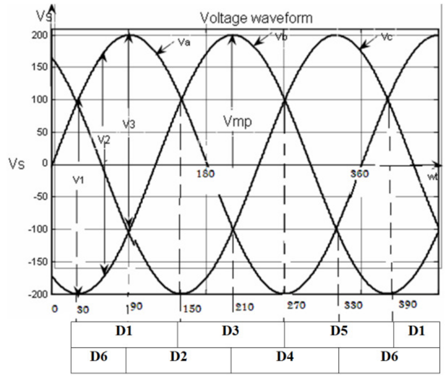


Fig. 2. Voltage waveform for 3-phase 6-pulse converter.

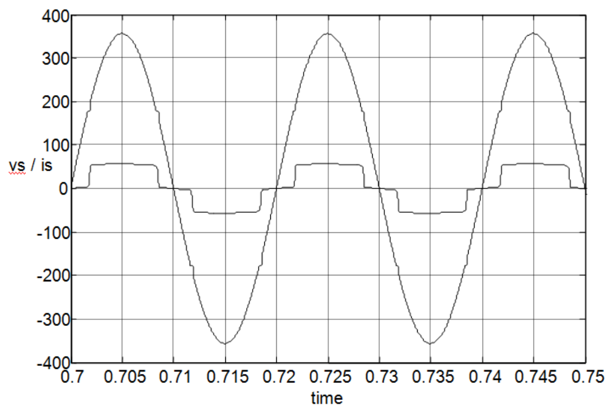


Fig. 3. Phase difference between voltage and current in 6-pulse uncontrolled converter.

IV. SIMULATION AND RESULTS

The simulation block of three-phase six-pulse diode is shown in further figures. It consists of three phase ac source to supply. The line voltages are Vab, Vbc & Vca.

A six-pulse diode bridge is connected to the three-phase supply. This is universal diode bridge. It consists of six diodes in a bridge manner, which converts the constant ac into the dc. Connectors are used to connect the lines together.

A RL load is connected across the six-pulse diode converter. The result can be visualized through the scope.fig 4(a) to 4(f) show the result of 6-pulse controlled converter and fig 5(a) to 5(f) show the result of 12-pulse controlled converter. The all result are in term of supply current, dc voltage, output current and output voltage.

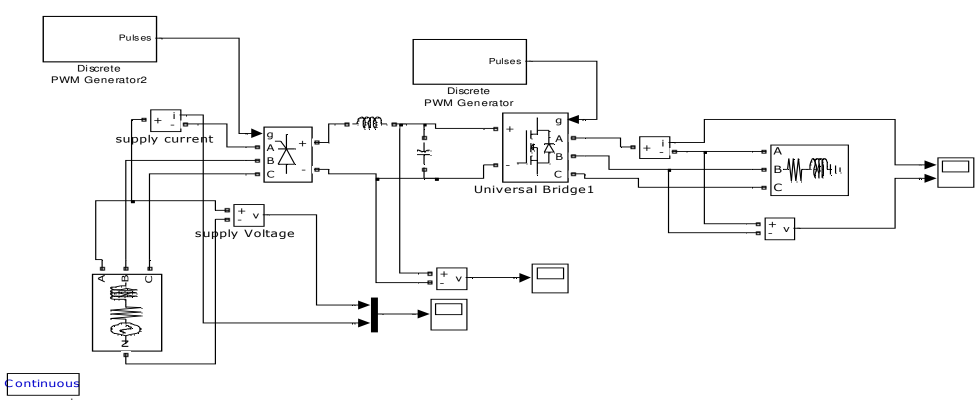


Fig. 4. Three Phase six Pulse controlled Converter.

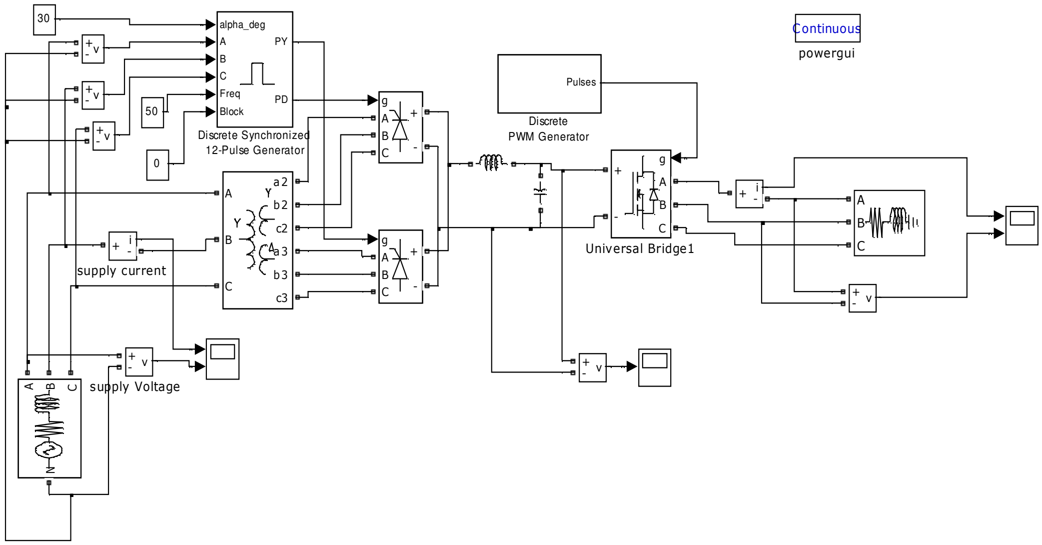


Fig. 5. Three Phase twelve Pulse controlled Converter.

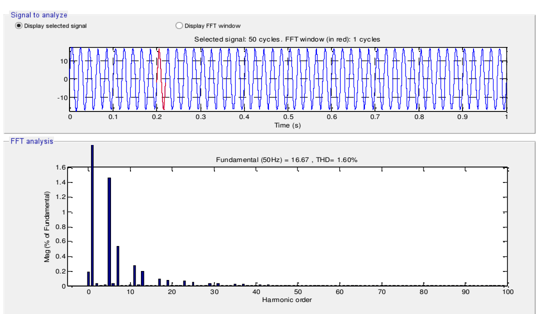
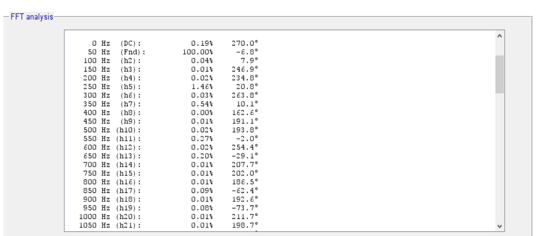


Fig. 4(a). Supply current 16.67, T.H.D = 1.6.



0 Hz	(DC):	0.19%	270.0°
50 Hz	(Fnd):	100.00%	-6.8°
100 Hz	(h2):	0.04%	7.9°
150 Hz	(h3):	0.01%	246.9°
200 Hz	(h4):	0.02%	234.8°
250 Hz	(h5):	1.46%	20.8°
300 Hz	(h6):	0.03%	263.8°
350 Hz	(h7):	0.54%	10.1°
400 Hz	(h8):	0.00%	162.6°
450 Hz	(h9):	0.01%	191.1°
500 Hz	(h10):	0.02%	193.8°
550 Hz	(h11):	0.27%	-2.0°
600 Hz	(h12):	0.02%	254.4°
650 Hz	(h13):	0.20%	-29.1°
700 Hz	(h14):	0.01%	207.7°
750 Hz	(h15):	0.01%	202.0°
800 Hz	(h16):	0.01%	186.5°
850 Hz	(h17):	0.09%	-62.4°
900 Hz	(h18):	0.01%	192.6°
950 Hz	(h19):	0.08%	-73.7°
1000 Hz	(h20):	0.01%	211.7°
1050 Hz	(h21):	0.01%	198.7°

Fig. 4(b). T.H.D table for supply current.

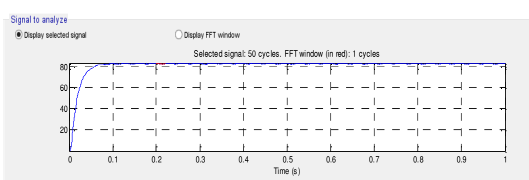


Fig. 4(c). Dc voltage = 82.8volt.

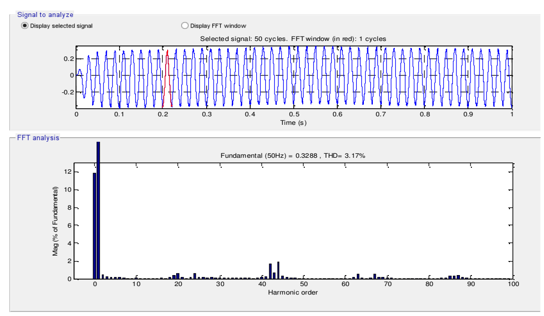
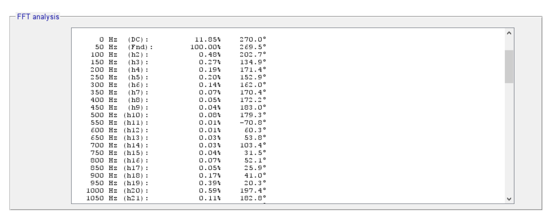


Fig. 4(d). Output supply current 0.3280, T.H.D = 3.17.



0 Hz	(DC):	11.85%	270.0°
50 Hz	(Fnd):	100.00%	269.5°
100 Hz	(h2):	0.48%	202.7°
150 Hz	(h3):	0.27%	134.9°
200 Hz	(h4):	0.19%	171.4°
250 Hz	(h5):	0.20%	152.9°
300 Hz	(h6):	0.14%	162.0°
350 Hz	(h7):	0.07%	170.4°
400 Hz	(h8):	0.05%	172.2°
450 Hz	(h9):	0.04%	183.0°
500 Hz	(h10):	0.08%	179.3°
550 Hz	(h11):	0.01%	-70.8°
600 Hz	(h12):	0.01%	60.3°
650 Hz	(h13):	0.03%	53.8°
700 Hz	(h14):	0.03%	103.4°
750 Hz	(h15):	0.04%	31.5°
800 Hz	(h16):	0.07%	52.1°
850 Hz	(h17):	0.05%	25.9°
900 Hz	(h18):	0.17%	41.0°
950 Hz	(h19):	0.39%	20.3°
1000 Hz	(h20):	0.59%	197.4°
1050 Hz	(h21):	0.11%	182.8°

Fig. 4(e). T.H.D table for supply current.

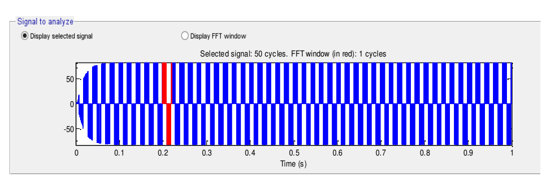


Fig. 4(f). Output voltage = 81volt.

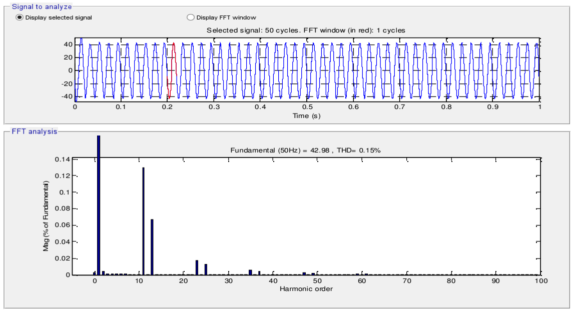


Fig. 5(a). Supply current 42.98, T.H.D = 0.15.

FFT analysis

0 Hz	(DC):	0.00%	270.0°
50 Hz	(Fnd):	100.00%	192.4°
100 Hz	(h2):	0.00%	151.5°
150 Hz	(h3):	0.00%	185.3°
200 Hz	(h4):	0.00%	183.2°
250 Hz	(h5):	0.00%	182.3°
300 Hz	(h6):	0.00%	182.1°
350 Hz	(h7):	0.00%	181.8°
400 Hz	(h8):	0.00%	181.6°
450 Hz	(h9):	0.00%	180.4°
500 Hz	(h10):	0.00%	178.3°
550 Hz	(h11):	0.13%	187.5°
600 Hz	(h12):	0.00%	178.0°
650 Hz	(h13):	0.07%	205.5°
700 Hz	(h14):	0.00%	179.9°
750 Hz	(h15):	0.00%	183.4°
800 Hz	(h16):	0.00%	182.2°
850 Hz	(h17):	0.00%	181.6°
900 Hz	(h18):	0.00%	182.0°
950 Hz	(h19):	0.00%	181.4°
1000 Hz	(h20):	0.00%	182.1°
1050 Hz	(h21):	0.00%	181.5°

Fig. 5(b). T.H.D table for supply current.

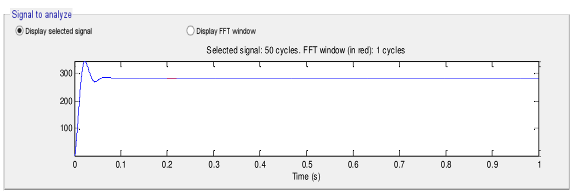


Fig. 5(c). Dc voltage = 283.

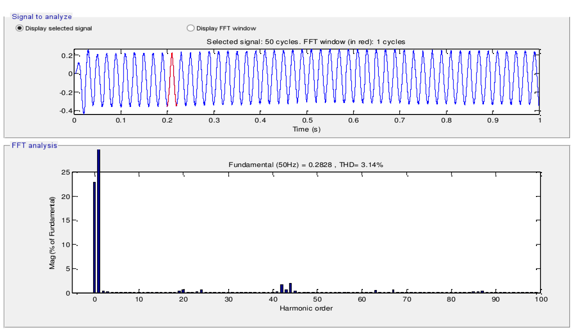


Fig. 5(d). Output supply current 0.288, T.H.D = 3.14.

FFT analysis

0 Hz	(DC):	22.78%	270.0°
50 Hz	(Fnd):	100.00%	269.5°
100 Hz	(h2):	0.36%	202.3°
150 Hz	(h3):	0.24%	125.2°
200 Hz	(h4):	0.16%	162.8°
250 Hz	(h5):	0.17%	156.1°
300 Hz	(h6):	0.10%	157.6°
350 Hz	(h7):	0.04%	155.4°
400 Hz	(h8):	0.04%	187.5°
450 Hz	(h9):	0.02%	176.5°
500 Hz	(h10):	0.06%	178.8°
550 Hz	(h11):	0.03%	-39.3°
600 Hz	(h12):	0.01%	29.0°
650 Hz	(h13):	0.04%	53.9°
700 Hz	(h14):	0.03%	98.3°
750 Hz	(h15):	0.05%	16.1°
800 Hz	(h16):	0.07%	43.9°
850 Hz	(h17):	0.07%	36.4°
900 Hz	(h18):	0.17%	32.4°
950 Hz	(h19):	0.40%	15.9°
1000 Hz	(h20):	0.58%	196.2°
1050 Hz	(h21):	0.11%	183.6°

Fig. 5(e). T.H.D table for supply current.

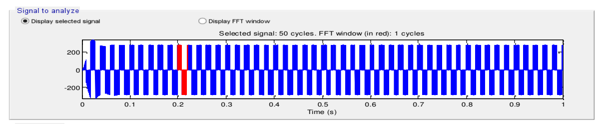


Fig. 5(f). Output voltage = 283volt.

V. SIMULATION OF UNCONTROLLED MULTIPULSE PULSE CONVERTER

A. Six pulse converter

In multiples converters server six pulse diode rectifier all connected eighties in parallel. Each rectifier fed by phase shifted secondary windings voltages of a transformer to shape the primary current close to sinusoidal. As compared to a six - pulse rectifier the transformer primary current in a multipulse converter is shaped using time displaced step wave shaped. Current drawn by multiple rectifiers with one rectifier across. Each of the secondary windings. Increasing the number of rectifier raises the number of steps in the primary current wave from & produces a sinusoidal shaped supply current flowing into the transformer primary winding.

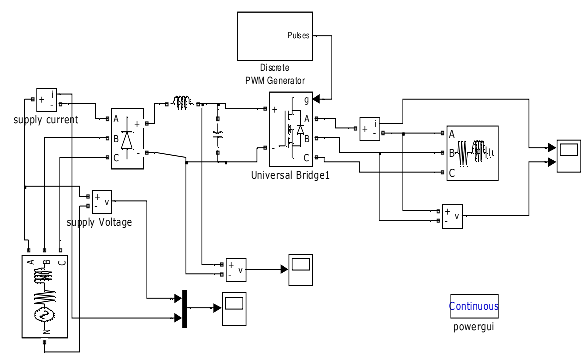


Fig. 6. Six pulse uncontrolled converter.

VI. SIMULATION AND RESULT

The simulation block of three-phase six-pulse diode is shown in further figures. It consists of three phase ac source to supply .The line voltage are Vab, Vbc & Vca. A six-pulse diode bridge is connected to the three-phase supply. This is universal diode bridge. It consists six diode in a bridge manner, which converts the constant ac into the dc. Connectors are used to connect the lines together. A RL load is connected across the six-pulse diode converter. The result can be visualized through the scope. It can be observed by seeing waveform that the distorted input current waveform is obtained from this converter. It is not pure sinusoidal.

The output voltage waveform contains the ripple in greater amount & the THD of supply current also in greater amount .To modify these waveforms & remove the harmonics, number of pulse is to increased. The simulation result shown in fig 6(a) to 6(f).

B. Twelve pulse uncontrolled converter

In the proposed converter circuits Multiples rectifiers could be connected either in parallel or in series. The choice of series or parallel connection depends upon the load voltage requirement. To connect multiple rectifier units in a multiples converter circuit, a transformer with a single primary and multiple isolated secondary winding is needed. A configuration (simple, zigzag, and/or multiple sections) of secondary windings in the transformer magnetic cores ensures windings produces leading voltage and the remaining half produces logging voltage with respect to that of primary winding voltage. The windings are divided into two equal numbers to produce the desisted leading & lagging voltage with respect to primary winding voltage.

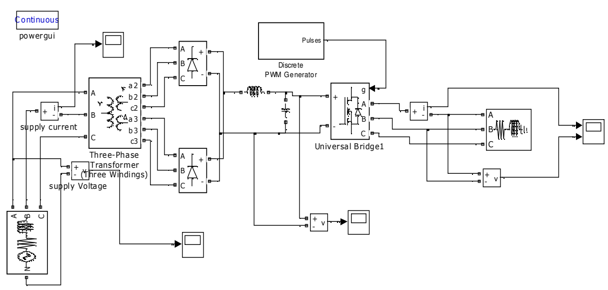


Fig. 7. Twelve pulse uncontrolled converter.

The simulation of multipulse AC - DC diode converter feeding on R-L loads An 12 - pulse converter requires 2 rectifiers. Here 12 is the pulse number and 2 is the total number of rectifiers. Each rectifier is placed in parallel with the others and connected to one of the multiple secondary windings of the transformer. The current flowing into the primary winding of the Trans former is the phase or sum of multiple six-step wave-shapes. With different time-scales. For multiuse wave shaping of the current through the transformer primary winding, the secondary windings voltages should be phase displaced with respect to the primary winding voltage. In this investigation, it is established that the voltage phase shift of the secondary windings with respect to the primary voltage is selected using the following. The simulation result shown in Fig. 7 (a) to 7(f).

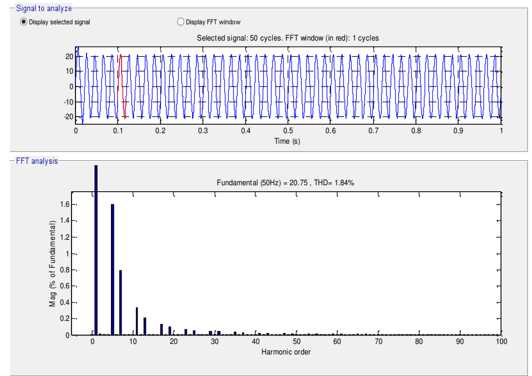


Fig. 6(a). Supply current20.75,T.H.D = 1.84.

FFT analysis

0	Hz	(DC):	0.00%	90.0°
50	Hz	(Fnd):	100.00%	-23.1°
100	Hz	(h2):	0.01%	208.1°
150	Hz	(h3):	0.01%	192.0°
200	Hz	(h4):	0.01%	180.1°
250	Hz	(h5):	1.60%	168.0°
300	Hz	(h6):	0.00%	94.0°
350	Hz	(h7):	0.79%	59.3°
400	Hz	(h8):	0.00%	219.3°
450	Hz	(h9):	0.00%	201.8°
500	Hz	(h10):	0.00%	192.9°
550	Hz	(h11):	0.34%	213.5°
600	Hz	(h12):	0.00%	115.0°
650	Hz	(h13):	0.21%	104.9°
700	Hz	(h14):	0.00%	238.9°
750	Hz	(h15):	0.00%	218.2°
800	Hz	(h16):	0.00%	213.5°
850	Hz	(h17):	0.13%	243.4°
900	Hz	(h18):	0.00%	138.6°
950	Hz	(h19):	0.10%	134.9°
1000	Hz	(h20):	0.00%	257.8°
1050	Hz	(h21):	0.00%	227.9°
1100	Hz	(h22):	0.00%	229.5°

Fig. 6(b). T.H.D table for supply current.

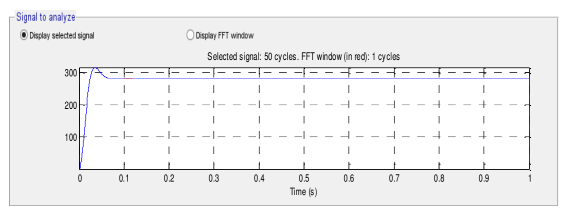


Fig. 6(c). Dc voltage = 286.

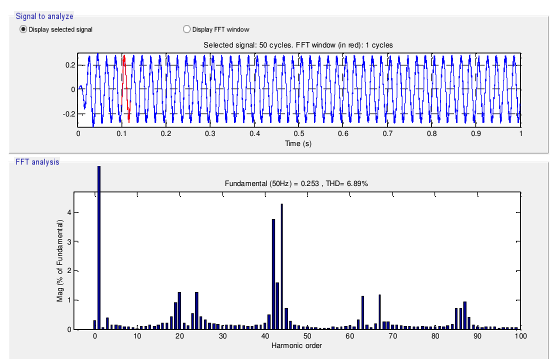


Fig. 6(d). Output supply current 0.253.T.H.D = 6.89.

FFT analysis

0	Hz	(DC):	0.29%	90.0°
50	Hz	(Fnd):	100.00%	-27.1°
100	Hz	(h2):	0.06%	259.5°
150	Hz	(h3):	0.37%	117.0°
200	Hz	(h4):	0.14%	153.4°
250	Hz	(h5):	0.12%	172.6°
300	Hz	(h6):	0.11%	107.9°
350	Hz	(h7):	0.08%	8.0°
400	Hz	(h8):	0.07%	-68.3°
450	Hz	(h9):	0.05%	-61.3°
500	Hz	(h10):	0.00%	132.0°
550	Hz	(h11):	0.08%	-41.1°
600	Hz	(h12):	0.08%	15.5°
650	Hz	(h13):	0.13%	44.8°
700	Hz	(h14):	0.08%	39.4°
750	Hz	(h15):	0.14%	32.9°
800	Hz	(h16):	0.20%	34.1°
850	Hz	(h17):	0.21%	28.9°
900	Hz	(h18):	0.41%	36.1°
950	Hz	(h19):	0.92%	19.4°
1000	Hz	(h20):	1.25%	200.9°
1050	Hz	(h21):	0.21%	203.1°

Fig. 6(e). T.H.D table for supply current.

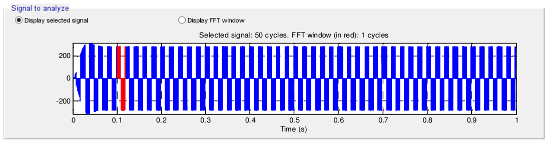


Fig. 6(f). Output voltage 282.5.

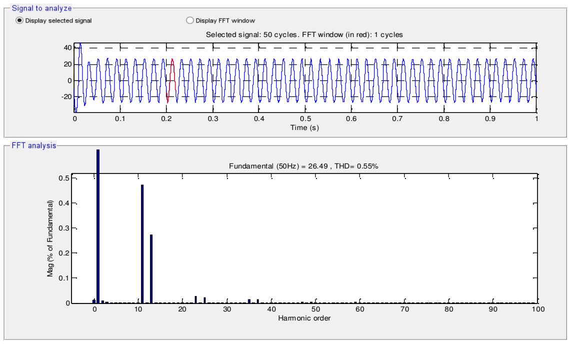
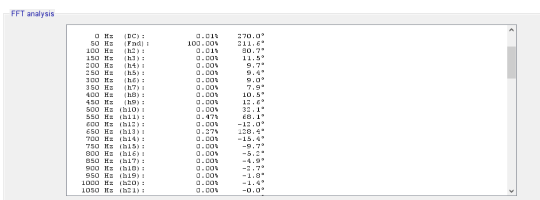


Fig. 7(a). Supply current 26.49,T.H.D = 0.55.


FFT analysis

0 Hz	(DC):	0.01%	270.0°
50 Hz	(Fnd):	100.00%	211.6°
100 Hz	(h2):	0.01%	80.7°
150 Hz	(h3):	0.00%	11.5°
200 Hz	(h4):	0.00%	9.7°
250 Hz	(h5):	0.00%	9.4°
300 Hz	(h6):	0.00%	9.0°
350 Hz	(h7):	0.00%	7.9°
400 Hz	(h8):	0.00%	10.5°
450 Hz	(h9):	0.00%	12.6°
500 Hz	(h10):	0.00%	32.1°
550 Hz	(h11):	0.47%	68.1°
600 Hz	(h12):	0.00%	-12.0°
650 Hz	(h13):	0.27%	128.4°
700 Hz	(h14):	0.00%	-15.4°
750 Hz	(h15):	0.00%	-9.7°
800 Hz	(h16):	0.00%	-5.2°
850 Hz	(h17):	0.00%	-4.9°
900 Hz	(h18):	0.00%	-2.7°
950 Hz	(h19):	0.00%	-1.8°
1000 Hz	(h20):	0.00%	-1.4°
1050 Hz	(h21):	0.00%	-0.0°

Fig. 7(b) T.H.D table for supply current.

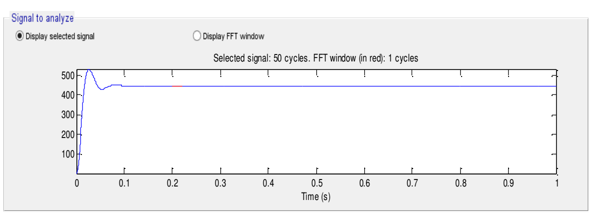


Fig. 7(c) Dc voltage = 448.

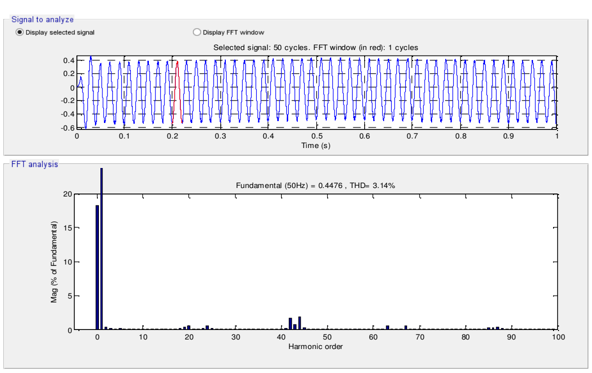
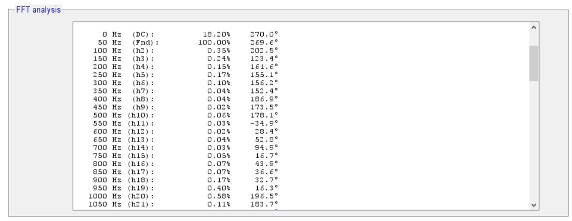


Fig. 7(d) Output supply current0.4470, T.H.D = 3.14.


FFT analysis

0 Hz	(DC):	18.20%	270.0°
50 Hz	(Fnd):	100.00%	269.6°
100 Hz	(h2):	0.35%	202.5°
150 Hz	(h3):	0.24%	123.4°
200 Hz	(h4):	0.15%	161.6°
250 Hz	(h5):	0.17%	155.1°
300 Hz	(h6):	0.10%	156.2°
350 Hz	(h7):	0.04%	152.4°
400 Hz	(h8):	0.04%	186.9°
450 Hz	(h9):	0.02%	173.5°
500 Hz	(h10):	0.06%	178.1°
550 Hz	(h11):	0.03%	-34.9°
600 Hz	(h12):	0.02%	28.4°
650 Hz	(h13):	0.04%	52.8°
700 Hz	(h14):	0.03%	94.9°
750 Hz	(h15):	0.05%	16.7°
800 Hz	(h16):	0.07%	43.9°
850 Hz	(h17):	0.07%	36.6°
900 Hz	(h18):	0.17%	32.7°
950 Hz	(h19):	0.40%	16.3°
1000 Hz	(h20):	0.58%	196.5°
1050 Hz	(h21):	0.11%	183.7°

Fig. 7(e) T.H.D table for supply current.

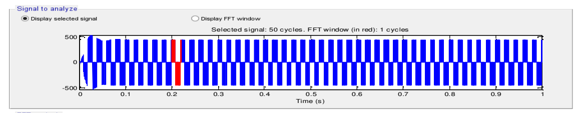


Fig. 7(f) Output voltage 450.

VII. FUTURE SCOPE

A back-to-back asynchronous tie comprised of VSC converters employing PWM may well represent the ultimate HVDC system. Besides controlling the through power flow, it can supply reactive power and provide independent dynamic voltage control at its two terminals. The two converters can be paralleled to double the reactive power capability supplied to one side or the other. The back-to-back converters can be used for black start or to supply a passive load. Higher voltage designs can be used with transmission lines or cables to form point-to point or multi-terminal transmission links. More sophisticated controls can be used to provide additional network benefits. With the Eagle Pass project, CSW has realized the system advantages of deploying a VSC based back-to-back asynchronous Tie with standby dynamic voltage control during network contingencies. The controlled power transfer capability allows the exchange of power between the two networks while the voltage control stabilizes the voltage following line outages especially during peak load periods. The future scope of work could be the simulation of 6, 12, 18, 24, 30, 36, 48 multi pulse converter topologies in closed loop. With this technique, this work can be further extended to: i. Number of pulses can be increased. Even higher pulse converters can be used for high voltage and high power applications such as HVDC conversion. ii. Closed Loop Multi-pulse conversion can be worked out for enhanced controlling and efficiency. iii. Other method of increasing the pulses can be used in place of phase shifting transformers as to derive multiphase supply from three phase AC mains using different combinations of transformer windings star, delta, zigzag, fork, polygon, etc.

VIII. CONCLUSION

The main objective of the present work is CONTROL THE HARMONIC OF SUPPLY CURRENT to USING the controlled and un-controlled multi-pulse converters. These converters are studied in terms of harmonic spectrum of supply current, dc voltage, output current and output voltage ac mains current, THD, distortion factor, it is concluded therefore that in general with increase in number of pulses in multi-pulse case the performance parameters of these converters are remarkably improved.It is necessary to limit the harmonic content of the current absorbed by the on-board converters by means of suitable technique. Such as

In this dissertation following objectives are fulfilled:

The various characteristics of multipulse converter are obtained from the simulation. With increase in the number of pulses, harmonics in AC input quantities are reduced considerably. This has been obtained from the simulation. Compared to six pulse Thyristor/ Diode converter in twelve pulse Thyristor/Diode converter

- The ripple in V_d is decreased
- The Total Harmonics Distortion in i_s (supply current) , V_s (supply voltage) , V_o(output voltage) , i_o(output current) is decreased
- Shape of the primary current changes from non- sinusoidal to closed sinusoidal

The objective of the present work is to investigate the performance of controlled and uncontrolled multi-pulse converters. These converters are studied in terms of harmonic spectrum of AC supply current. Total Harmonic Distortion, Ripple Content & form factor in the AC mains. It is concluded therefore that in general with increase in number of pulses in multi-pulse case the performance parameters of these converters are remarkably improved.

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