IPASJ International Journal of Electrical Engineering (IIJEE)
Web Site: http://www.ipasj.org/IIJEE/IIJEE.htm
A Publisher for Research Motivation ..... Email:editoriijee@ipasj.org
Volume 6, Issue 3, March 2018 ISSN 2321-600X

Design of single tuned passive filter to provide reactive power compensation and to minimize THD

NileshB. Mirajkar[1],R Dharaskar[2], Swapnil N. Sawant[3], Kolhe[4] P ,M H Tharkar[5]

[1].AssistantProf,Diploma in Fisheries Engineering,Ratnagiri,Dr.BSKKV, Dapoli.

Abstract:*This paper presents Design of single tuned passive filter to provide reactive power compensation and to minimize THD. different an industrial distribution system. The passive in filters considered are the single tuned harmonic filters. In the design of the filters, the passive elements of the filters inductor, capacitor and resistor are derived. Studies are made to investigate the effectiveness of using single filters in reducing harmonic distortions and to provide reactive power compensation. The effects of power factor correction capacitor and lord parameters variation on harmonic distortion are also studied.*

Keyword: Passive filter, Harmonic distortion, power factor,single tuned filter, Power quality.

Introduction:

Now a days, the Extensive use of non-linear loads and electronic switched loads has led to increasing voltage and current harmonic distortions in industrial distributionsystems. These harmonics may cause malfunction andoverheating of equipment's in the system. Other problemsinclude transformer heating and overloading, meter errorsand power cable failures to name a few. To overcome suchproblems, harmonic mitigation is becoming important forboth utilities and customers. Filtering harmonics usingpassive filter is one of the earliest methods used to addressharmonic mitigation issues.

Many studies have been carried out on harmonicmitigation using different types of filters.The problem of harmonics in distribution systems has beenstudied by using passive filters. The design and performanceof single tuned Passivefilter has been discussed. This type of filter has the advantages in terms of lowhardware cost and can be used to improve system powerfactor because it provides reactive power to the powersystem. Passive filters are considered as one of thecheapest and most economical way for mitigatingharmonics. They have also been used extensively in Industrial systems, HVDCsystems, arc-furnace installations, and static Varcompensators installation. This paper shows the effectiveness of single tunedshunt passive filterfor eliminating harmonics in an industrialdistribution system. The effect of the power factorcorrection capacitor on the filter performance is alsoinvestigated and the effect of varying the static loadparameters on the generated harmonics are discussed.

Objective:

The main objective of this paper to Design of single tuned passive filter to provide reactive power compensation and to minimize THD.

Flowchart for Filter Design:

Before any filter scheme is devised, a power factor study should be performed to determineif any reactive compensation requirements exist for the system. If so, the filter will bedesigned to provide the correct kvar. Decision flow charts for filter design are shown in Fig.1

IPASJ International Journal of Electrical Engineering (IIJEE)
Web Site: http://www.ipasj.org/IIJEE/IIJEE.htm
A Publisher for Research Motivation ..... Email:editoriijee@ipasj.org
Volume 6, Issue 3, March 2018 ISSN 2321-600X

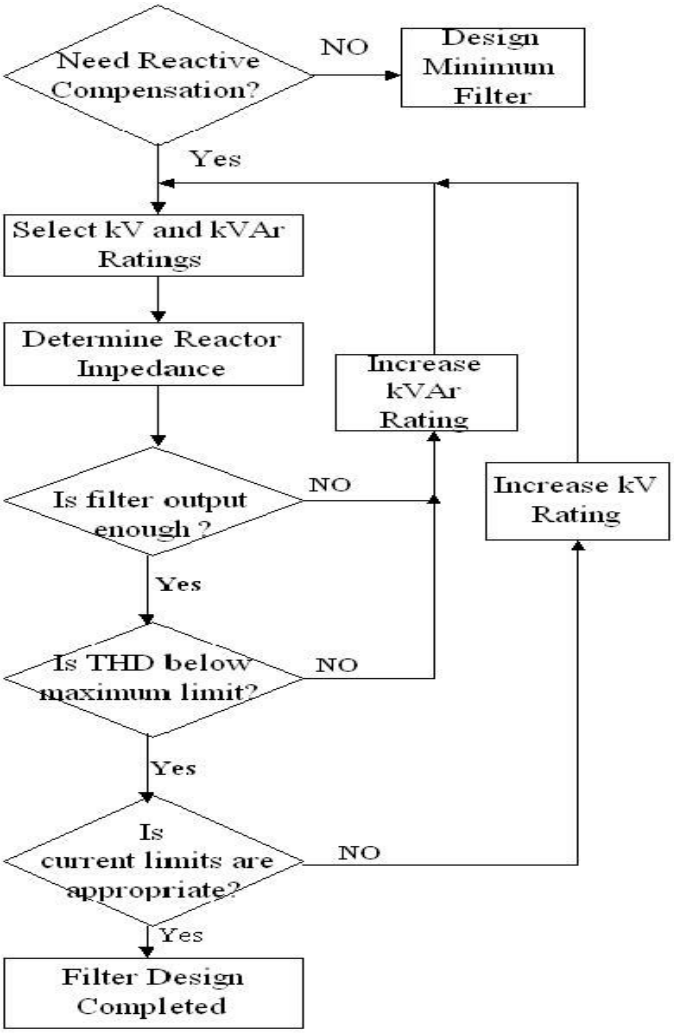

Figure1: Flowchart for Filter Design

Single-Tuned Filter:

The single-tuned filter, also called the band-pass filter, is intended to greatly attenuate a single harmonic component. This type of filter is simplest to design and the least expensive to implement. The general layout of shunt filter is shown in figure.

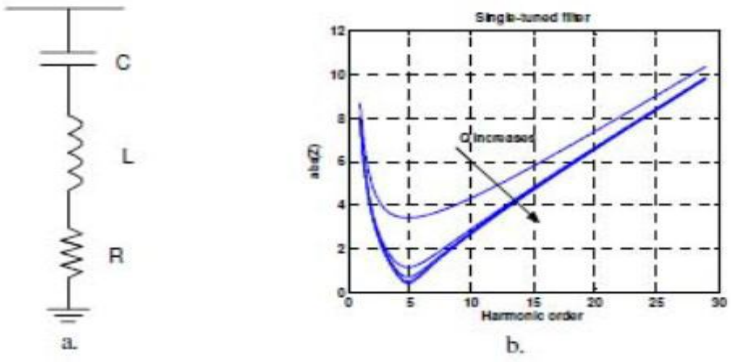

Figure2:Single Tunedshunt filter

IPASJ International Journal of Electrical Engineering (IIJEE)
Web Site: http://www.ipasj.org/IIJEE/IIJEE.htm
A Publisher for Research Motivation ..... Email:editoriijee@ipasj.org
Volume 6, Issue 3, March 2018 ISSN 2321-600X

Single Tuned Passive Filter Design:

Steps for filter design are as follows

1. Reactive Power requirement of the harmonic sources,

$$Qnc = Vnrms \times Inrms$$

2. The capacitors reactance is

$$Xnc = \frac{V^2}{Qnc}$$

To trap the 'n'th harmonic, at resonance,

$$Xnl = Xnc$$

3. Capacitor and inductor value for filter

$$Cn = \frac{1}{2\pi f \times n \times Qnc}$$

$$Ln = \frac{Qnl}{2f\pi \times n}$$

4. The reactors resistance is

$$R = \frac{Xn}{Q}$$

where $Q = \frac{Fn}{BW}$, 30 < Q < 100

and $Xn = \sqrt{Xnc * Xnl}$

Single Tuned Passive Filter Design from Actual Data:

The data is collected for the industry C'Cure Building Products.This three-phase system and single tuned power filter is designed.

The dominant harmonic components are the 5th and the 7th. Therefore, two single tuned shunt filters are designed using the above analysis. These filters parameters are shown in following table

Parameters	Phase 1		Phase 2		Phase 3	
	5^{th}	7^{th}	5^{th}	7^{th}	5^{th}	7^{th}
Qc(kVAr)	8	8	10	10	9	9
Xc(ohm)	8.3786	8.3786	6.6822	6.6822	7.2136	7.2136
C(uF)	379.91	379.91	476.35	476.35	441.25	441.25
Xl(ohm)	0.3351	0.1709	0.2672	0.1363	0.2885	0.1472
L(mH)	1.0668	0.5443	0.85	0.434	0.918	0.4686
R(ohm)	0.04117	0.0294	0.0328	0.0234	0.0354	0.0253
Q	40.7	40.7	40.7	40.7	40.7	40.7

Table 1: Filter Parameters

The frequency-response for 5th and 7th tuned filter impedance magnitude is illustrated in fig 2 .

IPASJ International Journal of Electrical Engineering (IIJEE)
Web Site: http://www.ipasj.org/IIJEE/IIJEE.htm
A Publisher for Research Motivation ..... Email:editoriijee@ipasj.org
Volume 6, Issue 3, March 2018 ISSN 2321-600X

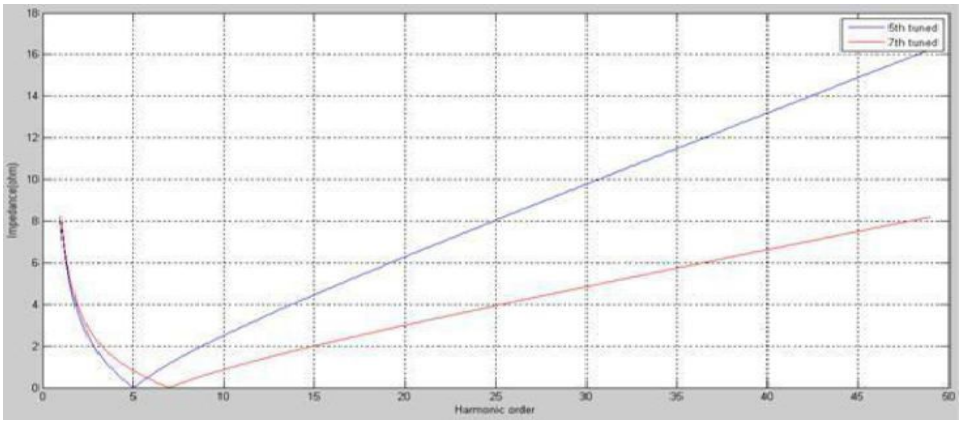

Figure 2: Impedance Magnitude Frequency-response for 5th and 7th Harmonic Order Tuned Filter Designed

Results:

In this section, the system is simulated on the MATLAB. The system parameters are givenabove section.Before filter is on and after filter is on, the current THD, voltage THD and power factor are shownin following table

parameter	Current THD(%)			Voltage THD(%)			Power factor		
Beforefilter turned on	27.4	27.8	26.8	2.8	3.4	3.1	0.738	0.694	0.751
After filter turned on	0.87	0.63	2.85	0.44	0.36	0.95	0.99	0.99	0.99

Table 2: Current THD, Voltage THD and p.f before and after filter is turned on

Conclusion:

From the Result, it is observed that current THD, voltage THD are reduced and power factor is improved after implementation of single tuned harmonic filter. In order to reduce the total harmonic distortion , this paper has presented a practical approach towards the use of passive tuned filters in industrial areas.

References:

1. 'Passive Harmonic Filters for Medium-Voltage Industrial Systems: Practical Considerations andTopology Analysis' by Alexandre B. Nassif, *Student Member, IEEE* and WilsunXu, *Fellow, IEEE*
2. 'Active power filters: A review' by M.El-Habrouk, M.K.Darwish and Pmehta.
3. Fuchs, E.F., Roesler, D.J., and Masoum, M.A.S., Are harmonic recommendations according to IEEE and IEC Trans. Power Delivery, 19(4), Oct. 2004.
4. F .El-Saadany, "Parameters Afkcting Harmonic Propagation and Dislribution Levels in Non-Linear Distribution sysiems," t*ransmission and DisiribtltionCoufereerenceand Exposition, 2002.*
5. ARRILAGA, J., BRADLEY, D.A. and BODGER, P.S.: 'Power system harmonics'
6. D.A. Gonzalez. and J. C. McCaLL, 'Design of Filters to Reduce Harmonic Distortion in Industrial Power Systems' IEEE transactions on indlustry applications, vol. IA-23. no. 3. may/june 1987
7. D.Sutanto,M.Boou-rabee,K.S.Tam,C.S.Chang'Passive and active Harmonic filters for industrial power system'
8. 8 .Gonzalez, D.A. and McCall, J.C., "Design of filicrs to reduce harmonic distortion in industrial power system." *IEEE Trun. On InduswiolApplicorion,* Vol. *3* I ,MaylJan, 1987.
9. A. Domijan, Jr. and E. Embriz-Santander, "A Summary and Evaluation of Recent Developments on Harmonic Mitigation Techniques Useful to Adjustable Speed Drives," ZEEE Trans. on Energy Conversion, vol. 7, no. 1, pp. 6471, March 1992.
10. Georg J.Wakileh'Power System Harmonics'
11. IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems**.** IEEE Std 519-1992.
12. IEEE Guide for Application and Specification of Harmonic Filters. IEEE Std 1531.-2003