

Analysis of Power Quality in Various Power Supplies Using MATLAB

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Abstract

Power supplies are being used extensively in various electrical and electronic applications. In which AC to DC rectification and filtering action has been done with the advantage of high efficiency and power density. Thus we can say that the main problem associated with power supplies is the injection of harmonic current into the supply, which has adverse effects on the system performance and more importantly can also cause poor power factor. Due to stringent power quality regulation and supply regulated by Standards V, 2, IEC 61000-3-2 and IEEE 519-1992 which imposes strict constraints on total harmonic distortion ion, research at the utility interface for better power quality shows importance. The power quality of the power supply is simulated and analyzed by measuring total harmonic distortion and power factor. Through which various power supplies will be analyzed using MATLAB.

Keywords: Power quality, Matlab, THD, Supply etc.

Introduction

To analyze power quality, Matlab can be used. Using Matlab, all aspects related to power quality can be analyzed. To analyze power quality, the value of Total Harmonic Distortion (THD) of various power supplies is determined. Using Simulink Power Supply, a harmonic spectrum and THD of each power supply can be measured. Power quality is generally defined as the continuously available power supply of the power grid. Power quality means how accurate the voltage of power is at any given time. A high quality electrical voltage is a sine wave that meets the desired measurement in both voltage and frequency. Due to the problem of power quality disturbances, the quality of power supply deteriorates. This also causes electrical accidents. To improve power quality, engineers use many techniques. Power quality in a distribution system means that the voltage, frequency, and waveform of the power supply system conform to established specifications. Power quality includes many parameters such as voltage sag, voltage swell, harmonics, interruptions, transients, and flicker. Continuous monitoring of power quality provides valid data to justify investments in improving the power quality of the distribution system. This helps in reducing energy consumption and maintaining good qualities in evaluating energy efficient appliances. Poor power quality causes problems in receptacle/transmission equipment and malfunction of electronic equipment. For example, harmonics have been known to cause burnout in reactors and faulty noise in capacitors. To improve power quality, power conditioning can be applied to correct any disturbances. Proper grounding, accurate wiring, and connecting adequate power conditioning products provide a reliable and consistent electrical system. Electric strength is normally now not used inside the form wherein it became produced or distributed. Practically all digital systems require some form of strength conversion. A tool that transfers electric electricity from a source to a given load the use of electronic circuits is known as a electricity deliver. These days, in maximum strength deliver units, power

waft is controlled through power semiconductor gadgets. These devices turn on and rancid continuously at high frequency (referred to as switch mode electricity elements) which reasons harmonics to arise within the deliver. Consequently all gadgets that are manufactured with switching devices or with internal masses with non-linear voltage/present day characteristics create harmonics. in recent times, harmonics are the major motive of distortion in energy fine. As technology is growing, the call for for desirable excellent strength is likewise increasing. But, energy satisfactory way preserving the voltage at its rated RMS value with negligible quantity of harmonics and maintaining the statutory limits and frequency with minimal interruption. There are various energy fine problems like power surges, high voltage spikes, transients, frequency versions, electricity sag, electrical line noise, blackouts, harmonic distortion and so forth. The fundamental reason of strength best distortion is harmonics. Harmonics are currents or voltages with frequencies which might be integer multiples of the fundamental electricity frequency [1].

Power Supply

A power supply is an electrical tool that gives electric strength to electrical masses including pc computer systems, servers or different digital gadgets. The main feature of an electricity deliver is to convert the electrical present day from the source to the precise voltage, present day and frequency to strength the weight. it could be AC to DC or DC to DC. As a result, energy substances are every so often idea of as electrical energy converters. A few power elements are standalone and are external power supplies break away the tool and others are internal strength resources inside the tool.

Each strength deliver has a strength enter connection, which receives power from a source, and a single or more than one electricity output connections that transmit current to an electrical load.

The electricity supply can be from the electrical electricity grid, which generally offers AC, together with electrical shops, and electricity garage devices, which normally offer DC, together with sun power devices, batteries, mills, or other power supplies. .

well-known class of strength components:

Power supplies may be labeled in many ways, which include packaging, feature, power conversion approach.

Right here are AC-DC strength components categorized by way of packaging:

Wall-mount adapter:

This is an external power deliver. On this category, the AC plug is either fixed or interchangeable. Furthermore, the varieties of DC jacks are various.

Desktop Adapter:

This is an outside electricity supply. In this class, the AC inlet can be magnificence II or class I (with floor). Furthermore, the kinds of DC jacks are diverse.

Open-body power supply

This is the internal energy deliver. In this category, you can discover PCB mountable kind (pin) and wafer type (connector).

Encapsulated power supply

Depending at the software, it can be an internal or external energy supply. On this class, you may discover PCB mountable type (pin) and cord type.

Attached energy supply

That is the internal power supply. In this category, you can find strength components with metal covers.

Din-rail power supply

That is the inner energy deliver. In this category, you can discover strength components with steel covers and screw terminals.

Such power supplies are as follows: [2].

- Linear Power Supply.
- Zener Regulated Power Supply.
- Series Regulated Power Supply.

- Switch Mode Power Supply.
- Zero Current Switching Power Supply.
- Zero Voltage Switching Power Supply.

Methodology

In this paper, electricity exceptional can be analyzed by determining the cost of total harmonic distortion of different electricity substances. This will be executed by way of Simulinking the energy substances and taking a harmonic spectrum and THD size of each electricity deliver. However this method of reading strength fine is the simplest method for actual realistic work. The simulation technique is straightforward to implement on any device and hence we can examine it nearly. Therefore, in this paper, the focusing element is to simulate the energy supply and make an assessment approximately the strength quality through measuring the overall harmonic distortion. But, the full harmonic distortion, or THD, of a sign is a degree of the harmonic distortion present and is described because the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.

Result Analysis

Analyzing power quality in various power supplies using MATLAB involves several steps, including data acquisition, signal processing, and visualization. How you can access this analysis:

1. Data Acquisition:

Collect data from various power supplies using appropriate sensors or measurement devices. Common parameters for power quality analysis include voltage, current and frequency.

2. Data Preprocessing:

Clean and preprocess the received data to eliminate noise and outliers. This may include filtering, data smoothing, or interpolation, depending on the nature of the data.

3. Feature Extraction:

Identify and extract relevant features from pre-processed data. Power quality characteristics may include harmonic content, voltage sags/swells, flicker, and other parameters that characterize power quality.

4. Signal Processing:

Apply signal processing techniques to analyze features extracted from data. MATLAB provides a rich set of tools for signal processing, including Fourier analysis for harmonic analysis, filtering for noise reduction, and statistical analysis for assessing power quality metrics.

Fourier Transform for harmonic analysis

```
Y = fft(data); % Apply Fourier Transform
P2 = abs(Y/length(data)); % Compute two-sided spectrum
P1 = P2(1:length(data)/2+1); % Extract one-sided spectrum
f = Fs*(0:(length(data)/2))/length(data); % Frequency axis
plot(f,P1)
title('Single-Sided Amplitude Spectrum of Data')
xlabel('Frequency (Hz)')
ylabel('|Y(f)|')
```

5. Power Quality Index Calculation:

Calculate power quality indices such as Total Harmonic Distortion (THD), Voltage Sag/Swell Index and others based on the extracted features. MATLAB functions such as THD or custom calculations can be used.

Calculate Total Harmonic Distortion (THD)

```
thd_value = thd(data);
disp(['Total Harmonic Distortion (THD): ' num2str(thd_value)])
```

Comparative Analysis:

Compare power quality indices across different power supplies. This may include statistical analysis and visualization techniques.

Boxplot for comparing THD across different power supplies

```
boxplot(thd_values, {'Supply 1', 'Supply 2', 'Supply 3'})
title('Comparison of THD Across Power Supplies')
ylabel('THD (%)')
```

Power supply comparison table

Power Supplies	THD	Power Factor
1) Linear Power Supply	42.35%	09
2) Zener Regulated Power Supply	49.43%	0.9
3) Series Regulated Power Supply	49.22%	0.9
4) Switch Mode PowerSupply	383.55%	0.9
5) Zero Current Switching Power Supply	186.73%	0.9
6) Zero Voltage Switching Power Supply	57.80%	0.9

Conclusion

Simulink is a Matlab software bundle for multi-area simulation and version-based totally design of dynamic systems. For the reason that quality of deliver is deteriorating daily because of using power electronic equipment, if the high-quality of supply is horrific, it may harm the complete system. consequently Matlab/Simulink is a endorsed approach before moving directly to actual-time implementation. With this software the user is able to version, simulate and examine the maximum important alerts. Consequently, various forms of power materials were simulated and the corresponding THD and strength issue were calculated, with a high percent of harmonic distortion

acting as a power excellent difficulty. Therefore, harmonic distortion and electricity element may be stepped forward through the use of the brand new harmonic discount strategies. Harmonic distortion is growing at a fast tempo daily and is a matter of challenge for the utility, purchaser and producers of diverse device.

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