

Repel Total Harmonics Distortion & Distortion Factor in Single Phase Inverter Through Non-Linear Controlled Method

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ABSTRACT

Power Inverters are vast tools to run household instruments from a DC source in areas where there is no electricity. It is a device that is used to convert direct current to alternating current. An inverter circuit which convert a d.c. into an a.c. power at particular output voltage & frequency. The DC power may be solar cell, battery, fuel cell, or other DC source. An ideal inverter waveforms of output voltage should be sinusoidal. Practical inverter waveforms are, however non-sinusoidal. In non-sinusoidal waveforms contain harmonics. The proposed techniques to obviate total harmonics distortion & distortion factor. Finally, simulation waveforms are given

Keywords : - OCC, PWM, single phase inverter, PSPICE

1. INTRODUCTION

Working inverter waveforms are non-sinusoidal. High power high voltage application sinusoidal waveforms, low-distorted are required and square & quasi-square wave may be acceptable for low voltage low power applications. The inverter frequency is determined through semiconductor devices are switched high and low by control circuitry and an adjustable inverter frequency is readily provided. The dynamic spirit of OCC switching converters is studied [1]. One-cycle control (OCC) is a nonlinear control technology. It has spirit response and good performance [9]. In this paper, a new nonlinear control technique one-cycle control is proposed for eliminate total harmonics distortion & distortion factor in single phase inverter

2. OCC METHOD

The OCC inverter as shown Fig 1. A PWM technique is used to reduce seriously the switching losses [7]. A OCC single phase inverter execute to UPS is presented [10]. A nonlinear curb technique OCC is proposed to control the duty-cycle of the switch such that the average value of the switched variable of the switching converter in each cycle is exactly proportional to or equal to the control reference in the steady-state. The conventional one cycle control (OCC) technique rights that the integrator is reboot instantaneously. The integration value is

$$V_{\text{int}} = \frac{1}{T_s} \int_0^{DT_s} V_{\text{switch}} dt$$

Where, frequency of switching is f_s , $1/f_s = T_s$, and T_s is switching cycle. In each cycle, during T_{on} the switch is high and during T_{off} the switch is low and $T_{\text{on}} + T_{\text{off}} = T_s$. The duty ratio $D = T_{\text{on}}/T_s$ is inflected by an analog control reference V_{REF} . When V_{INT} grasps the control reference V_{REF} , a reboot pulse is generated at the gain of the comparator that reboots the rs flip-flop ($q=0$), starting another switching state, switch M_1 is turned high and switch M_2 is turned low as a consequence. The falling tip of the pulse at the q terminal triggers the thin-pulse generator to produce a very thin pulse to reboot the integrator. The integrator renew integration from zero voltage after the reboot. During this switching state, therefore, V_{INT} keeps decreasing up to the approach of the next clock pulse, which starts a new switching cycle. In switching cycle, the integrator value is

$$V_{INT} = \frac{1}{T_s} \int_0^{T_s} V_{switch} dt = V_{REF}$$

It can boost the output waveform aspect, and also can discard the unwanted harmonic contents.

$$DF = \frac{1}{V_{1,rms}} \sqrt{\sum_{n=2}^{\infty} \left(\frac{V_{n,rms}}{n^2} \right)^2}$$

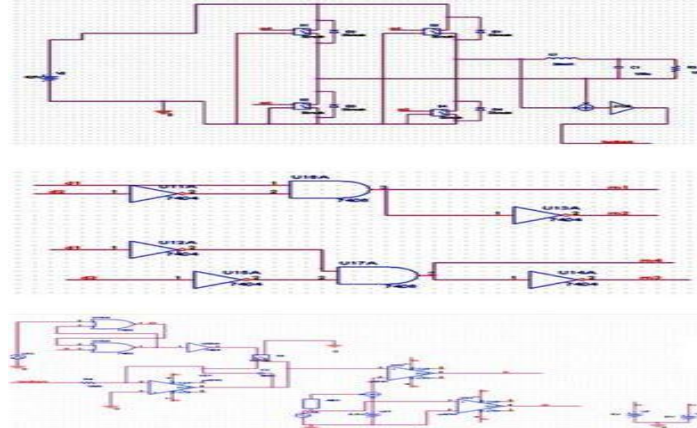


Fig. 1. One Cycle Controlled (OCC) H-bridge in Energy Saving Mode (Closed loop)

3. PERFORMANCE PARAMETERS OF INVERTER

Ideally, an inverter should give a sinusoidal voltage at its output. However, outputs of all practical inverters are non-sinusoidal and may be resolved into fundamental and harmonic components. Performance of an inverter is usually classified in conditions of the following conduct parameters:

A. Total Harmonic distortion (THD)

Total Harmonic Distortion (THD) is a measure to determine the “quality” of a given waveform.

Voltage THD: If V_n is the n th harmonic voltage

$$THD = \frac{\sqrt{\sum_{n=2}^{\infty} (V_{n,rms})^2}}{V_{1,rms}}$$

If the rms voltage for the waveform is known,

$$THD = \frac{\sqrt{\sum_{n=2}^{\infty} (V_{n,rms})^2 - (V_{1,rms})^2}}{V_{1,rms}}$$

Current THD

$$THD = \frac{\sqrt{\sum_{n=2}^{\infty} (I_{n,rms})^2}}{I_{1,rms}}$$

$$I_n = \frac{V_n}{Z_n}$$

Z_n is the impedance at harmonic frequency

B. Distortion Factor (DF)

THD gives the total harmonic content but the level of each harmonic does not indicate. If a filter is used at the output of inverter, the higher order harmonics would be constricted more effectively. Therefore, scoop of both the magnitude and frequency of each harmonic is important. The DF expresses the lot of harmonic distortions that

remains in a particular waveform after the harmonics of that waveform have been subjected to a second order attenuation (i.e. divided by n^2). Thus, DF is a measure of effectiveness in reducing unwanted harmonics without having to specify the values of a second-order load filter and is defined as

$$DF = \frac{1}{V_{1,rms}} \sqrt{\sum_{n=2}^{\infty} \left(\frac{V_{n,rms}}{n^2} \right)^2}$$

4. H-BRIDGE SPECIFICATIONS

TABLE I

Switching Frequency	Input Voltage	Output Voltage	Output Frequency	Output Power
$f_s = 20\text{kHz}$ ($T_s = 50\mu\text{s}$)	$V_G=425\text{VC}$	$V=220\text{VRMS}$ ($V_{\text{peak}}=311$)	50 Hz	$P_{\text{OUT}} = 5\text{kW}$

TABLE II Total Harmonic Distortion (THD)

Switching Frequency	Input Voltage	Output Voltage	Output Frequency	Output Power
$f_s = 20\text{kHz}$ ($T_s = 50\mu\text{s}$)	$V_G=425\text{VC}$	$V=220\text{VRMS}$ ($V_{\text{peak}}=311$)	50 Hz	$P_{\text{OUT}} = 5\text{kW}$

TABLE III Distortion Factor (DF)

S. No.	OCC	Before Filter	After Filter
1.	Open loop	3.2%	1.57%
2.	Closed Loop	3.0%	1.40%

5. EXPERIMENTAL RESULTS

An experiment results are as follows Fig. 2 shows output voltage. Fig. 3 shows Harmonics of Closed loop OCC (Before Filter). Fig. 4 shows Harmonics of Closed loop OCC (After Filter). Total harmonic distortion and Distortion factor as shown in table II and table III

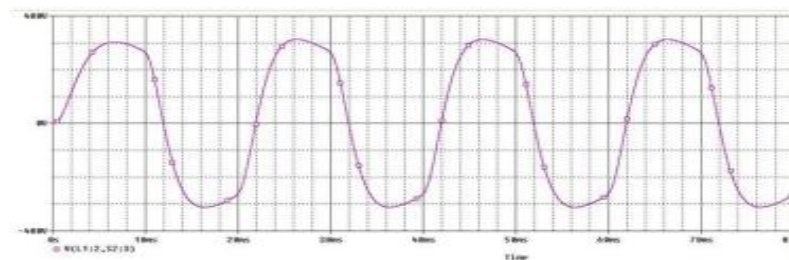


Fig. 2. Output voltage waveform

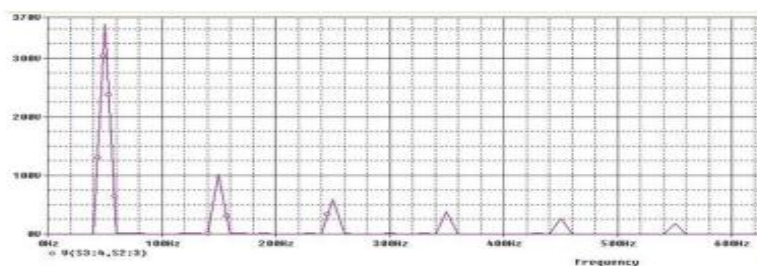


Fig. 3. Harmonics of Closed loop OCC (Before Filter)

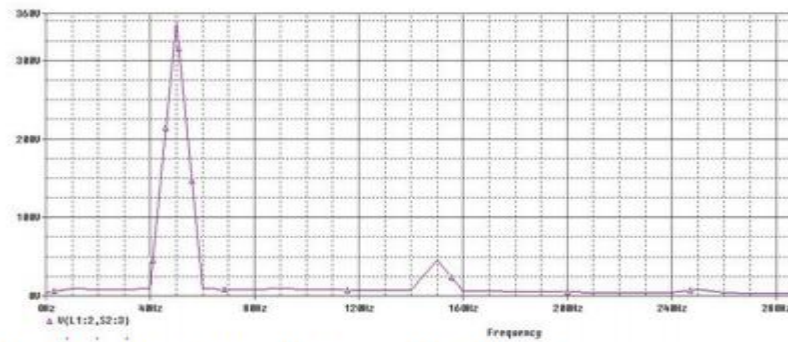


Fig. 4. Harmonics of Closed loop OCC (After Filter)

6. CONCLUSION

One-cycle control method have been presented through simulations and experiments. Simulations and experiments show that one-cycle control can abate the undesired Total harmonic distortion and Distortion factor. One cycle control can approximate arbitrary waveforms which can be DC, AC or those strange waveforms without any regulation such as transient fault voltages in power systems. The generality of one-cycle control is also tightly connected to its high-speed response.

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