DSC동작 특성에 따른 피드백제어를 통한 단상 전원의 안정화에 관한 연구

김 진영[1], 박 성준[2], 정 종진[3], 유 동욱[4], 김 희제[5]

The Study of Single Phase Source Stability consider for The DSC Cell' s Operation Character by controlled Feed-back Circuit

JinYoung Kim, SungJune Park, JongJin Jung, Dongwook Yoo, HeeJe Kim

Key words : DSC, TMS320LF2406, DSP

Abstract : 최근 나노입자를 이용하는 광전 화학전지(PEC, Photoelectrochemical)인 염료감응형 태양전지(DSC)의 효율이 증가함에 따라 DSC 태양광 발전 시스템의 성능 개선 또한 요구되어진다. 본 연구에서는 Fly-Back DC-DC 컨버터(변화비율1:10)를 이용하여 DSC셀의 전압을 DC 300V로 승압시켰다. 또한 풀브릿지 인버터를 사용하여 AC 220V, 60Hz의 출력전압을 얻었다. 연구에서 제안한 회로는 높은 효율의 동작특성과 간단한 제작, 낮은 제조비용, 그리고 안정성을 추구한다. 또 다른 주요점은 부하단에서 Feed back을 받아 동작을 컨트롤 하는 것이다. 부하단의 출력 전압과 전류를 Feed back 받아서 DSP320LF2406을 A/D기능을 사용하여 실시간으로 부하의 변화에 대처하여 컨버터와 인버터의 동작을 제어한다.

1. INTRODUCTION

Recently, with increasing concern about global environmental protection, the need to produce pollution-free natural energy has pointed us towards alternative sources of energy. Solar energy, especially, is a positive choice. The spread of residential photovoltaic (PV) systems connected with electric utility lines are being promoted in Korea.

Among solar cells, DSC (dye-sensitized-solar cells) is a new class of low cost solar cells whose solar energy conversion efficiency is very high.

In this paper, the characteristic of DSC solar energy generation system adapted MOSFET which is high-speed switching device and the DSP high-speed micro-processor, DSC solar energy generation system was simulated by PSIM. According to the result, we make the system and observe operation characteristic.

2. EXPERIMENT

This paper is DSC solar generating system. Like figure 2-1, it composes DSC Cell, Fly-back converter and PWM inverter. I used DSP and switched converter of 30kHz and PWM inverter of 30kHz. And I made up feed-back circuit in output part. And iidentified stability of the output voltage and current value of alternating current which followed in input of DSC solar cell.

In order to confirm the stability of proposed DSC solar energy generation systemin this paper, we make Fly-back converter, Full-Bridge PWM inverter and Feed-back circuit at output port. To show that stability of system was guaranteed by feed-back circuit.

The DC input from the DSC cell (30 VDC) is first converted to a regulated 300 VDC using a Fly-back DC-DC converter switching at 30 kHz. The DC-DC

1) 부산대학교 레이저 및 센서응용 실험실
E-mail : jinminerva@naver.com
Tel : (051)510-2770 Fax : (051)513-0212
2) 부산대학교 레이저 및 센서응용 실험실
E-mail : joonnii7@empal.com
Tel : (051)510-2770 Fax : (051)513-0212
3) 부산대학교 레이저 및 센서응용 실험실
E-mail : jjj7878@hanmail.net
Tel : (051)510-2770 Fax : (051)513-0212

conversion stage consists of a high-frequency transformer. Isolation is provided for safety, system protection. The 300V DC-DC converteroutput is converted to 220V, 60 Hz, single-phase AC by means of a PWM driven inverter stage. To obtain independent single phase outputs, Full bridge inverters operating at 30 kHzswitching frequency are used.

First, simulation was carried by ideal system cinfiguration. Fig 2-1show the main circuit that is used simulation. The main circuit was composed of transformer for boost voltage, 6 MOSFET and 6 FR(Fast Recovery) Diode. An output LC filter is used to harmonize the output voltage.

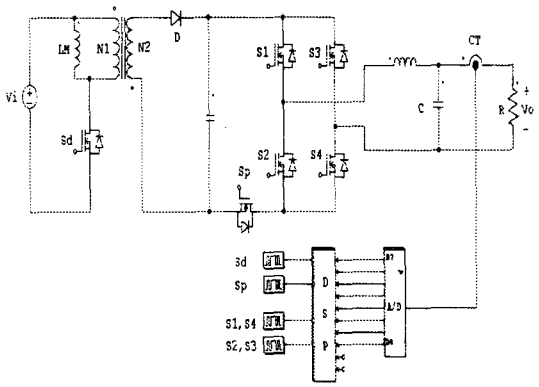

Fig 2-1. Main circuit of PCS

The controller was realized by used TMS320LF2406 becasue of dramatic increase in stability, has a good performence, faster design and build time.

The converter switches are operated at 50% ratioand 30kHz, the inverter PWM switches are opertated at 30kHz. The switching signal S1, S4 of inverter full-bridge are operated at 60Hz and switching signal S2, S3 lag S1, S4 by 180°. The output signal data is obtained by sensing the current at output port. So A/D converter converts analog signal into 8bit digital signal.

The DSP receives this signal. It follows in error signal and controls the Switch Sd. It is a possibility of getting a stable output. The figure 2-2 is showing the simulation waveform of output voltage and current. Like this figure, the output current of inverter with output voltage maintains same angles and it is supplied.

Consequently, in the systemic connection using this system, I estimate that it maintains power factor 1 and supplies a stable output. Also the delay of systemic power doesn't generate between output power of inverter and systemic power.

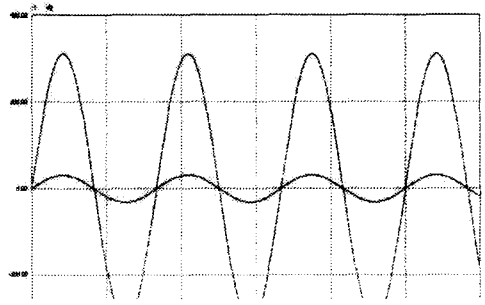

Fig 2-2. Simulation waveform of output Voltage and Current

3. RESULTS

Fig 3-1 shows that the main switches operating. The converter switchs are operated at 50% ratio and 30kHz, the inverter PWM switches are opertated at 30kHz. The switching signal S1, S4 of inverter full-bridge are operated at 60Hz and switching signal S2, S3 lag S1, S4 by 180°.

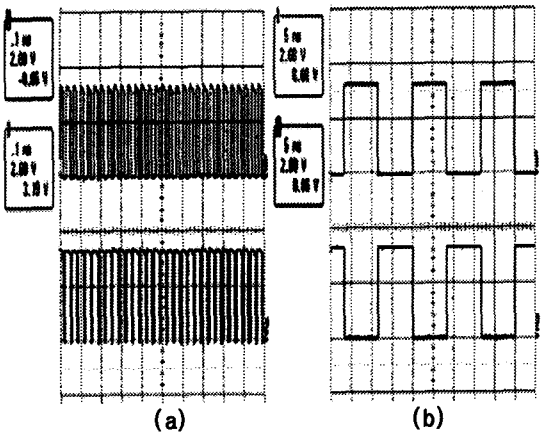

Fig 3-1 (a) Waveform of Full-Bridge Inverter S1, S4 and S2, S3 switching signal
(b) Waveform of Flay-back switching signal

Fig 3-2 showsthe output voltage and current wave in the DSC solar cell system without the feed-back circuit.

On the other hand, Fig 3-3 showsthe output voltage and current wave in the DSC solar cell system with the feed-back circuit.

Fig 3-3 shows the efficiency of output power according to input power. We know that stable output was supplied

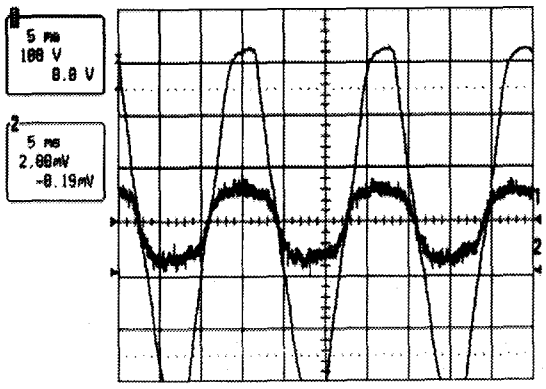

Fig 3-2 Experimental waveform of output voltage and current without Feed-back circuit.

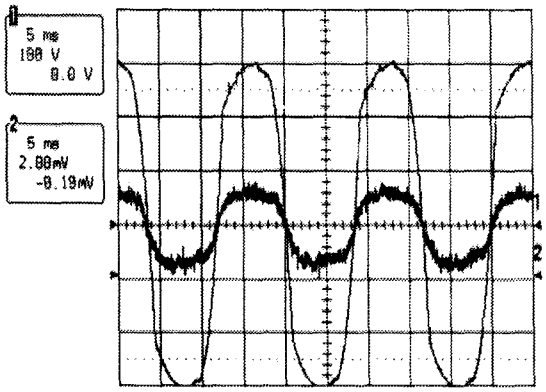

Fig 3-3 Experimental waveform of output voltage and current with Feed-back circuit.

In conclusion, Fig3-2 has more stability of output than Fig3-3 and an efficiency of 90% was obtained at full load condition.

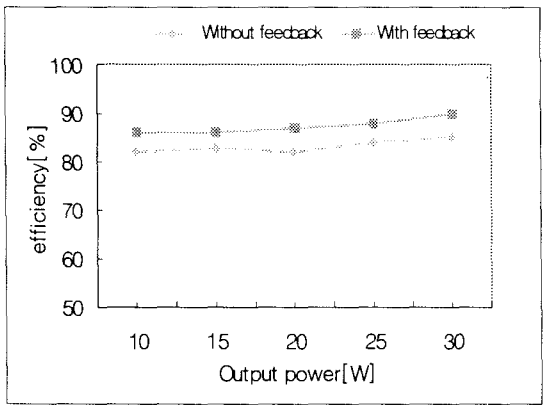

Fig 3-3 The efficiency of output power According to input power

4 Conclusions

In this paper, We can see the propriety of the circuit that DSC solar energy generation system PWM PCS which uses the MOSFET is a high-speed switching device and the DSP micro processor and adapted feed-back circuit.

1) Gate singal of the MOSFET it applied the DSP, Itwas comfirmed that the PCS was stable operated at switching ferquency 30kHz by PSIM smulation and experimnet.

2) The change of DSC's output and load port 's current adjusts by Feed-back circuit, The PCS's efficiency is improved about 5% and the stability is improved.

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