EFFECTIVE VOLTAGE AND LINE CURRENT SENSING DESIGN OF GRID CONNECTED INVERTERS

B.Balachander. R.Mukul Sachdev. K.Vignesh

K.Jayavani

Student of final year(B.E) Electronics and Instrumentation Engineering,

Assistant Professor,

New Prince Shri Bhavani College of Engineering and Technology, Chennai , India.

ABSTRACT

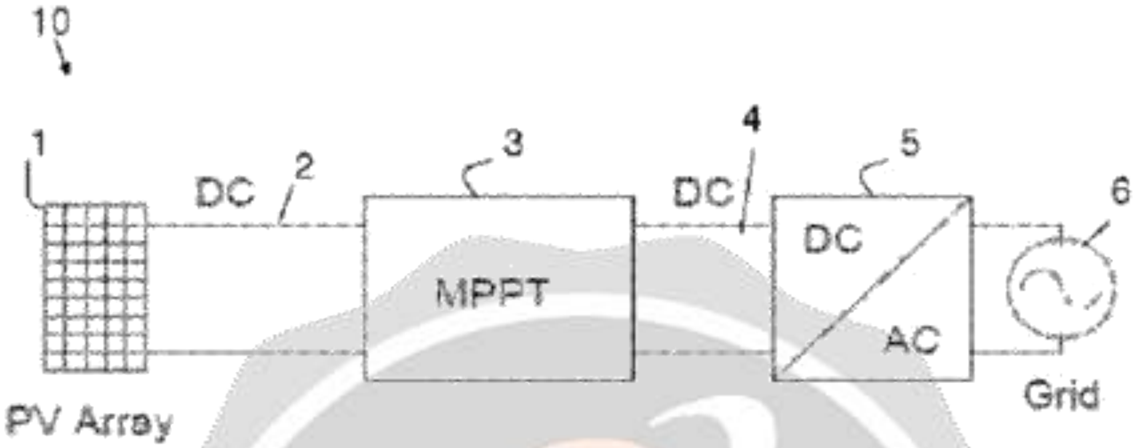
This paper proposes the prototype of grid connected inverters in a PV system for accurate sensing of grid voltage and line current in inverters.Unlike the existing system , the proposed system uses LEM sensor technology for measuring its parameters.The obligation for heavy and bulky current transformers are eliminated with the proposed system.The system uses phase locked loop(PLL) for AC voltage measurements and to determine the zero crossing point and phase angles of the parameter under measurement. The main aim of the project is to synchronize the output signal of the inverter with the reference signal from the EB and it has the ability to adjust the inverter output so that both the phase angles match. The basic components of this are MPPT, DC-DC and DC-AC fly-back converters, PLL, relays, grid. At last combining the above parts, the voltage, the current of the inverter is taken. The final results are extracted after the system optimization.

Key Words : LEM sensor , Phase Locked loop , MPPT

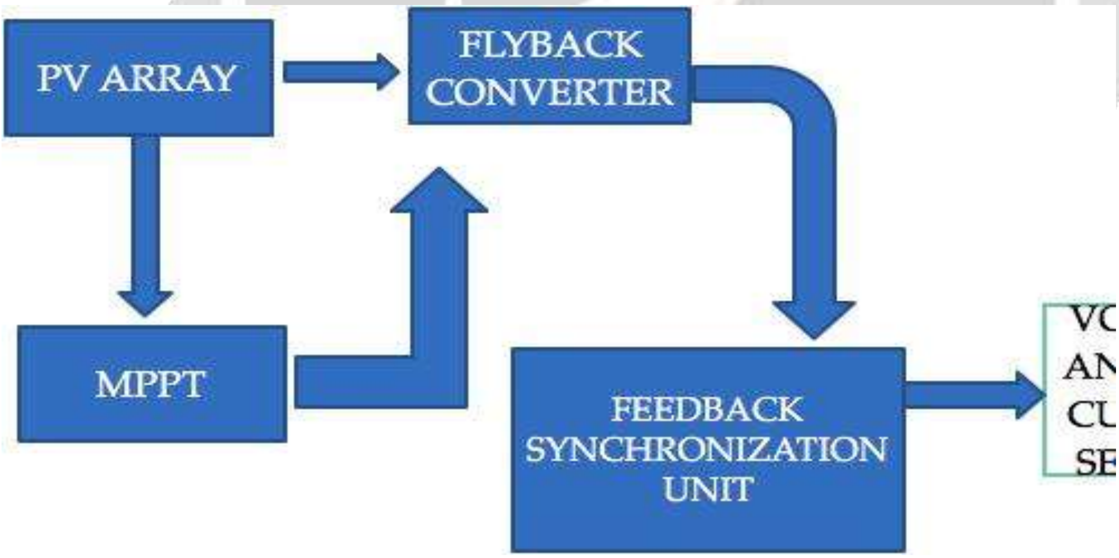
1. INTRODUCTION

In PV system power energy is most useful for the upcoming days. So this paper mainly concentrates on the PV battery storage applications. And also the interleaved operation of buck converter that was used to reduce the high current ripple content in the output current, high step down conversion ratio. MPPT algorithm is used to obtain the higher efficiency.

Here polycrystalline solar panels are used in which photo diode is used which converts light energy into electrical energy. Then the converted electric energy is sent to the inverter (grid) .Here in the grid the supply from EB(electricity board) and inverter phase are synchronized and then they are used .The inverter starts working only when the input is from (300-1000) voltage .In the inverter the incoming dc voltage is converted into ac voltage and then connected to the load .



2. BLOCK DIAGRAM



In this proposed methodology mainly concentrates on the battery charging application and also maintain the life of the storage battery a long. This block diagram consists of interleaved buck converter, alarm circuit, battery for the storage purpose and the micro-controller (MSP430F5132) that is used to control the pulse width time period of the power MOSFET through the driver circuit.The input dc voltage to the interleaved buck converter is fed from the solar PV panel or array. In between the interleaved buck converter and the solar array there is current sense which one was used to measure the input current and the voltage to the interleaved buck converter. A interleaved buck converter produces the voltage less than the input voltage in it. Because it stores and delivers electrical energy based upon the switch ON an OFF time (pulse width) of the power MOSFET that in the interleaved buck converter by the way of driver circuit through microcontroller that has MPPT algorithm. This algorithm starts with measuring the PV power P at particular reference voltage as V. feedback loop which one was taken from the output side i.e, from the battery terminal that was compared with previous input current and voltage (reference voltage and current). If the present output power increased when compare with previous power so that the new power P is found at the higher voltage level. So this way p_{max} is obtained at the particular point that has the I_{max} and V_{max}.. All thiscontrol and mathematical calculation is done by the microcontroller that produces the error signal to the full bridge driver circuit which is used to drive and decides the pulse width time period of power MOSFET. In additionally driver consists of amplifier circuit that makes the amplified voltage (pulse width) suitable to drive the MOSFET above threshold voltage value. Only above the threshold voltage IBC turns ON condition i.e, the pulse width time period results increase in current. So the power is increased in such way to obtain maximum output from the interleaved buck converter that is stored in the battery.

3. HARDWARE CIRCUIT

CAN.

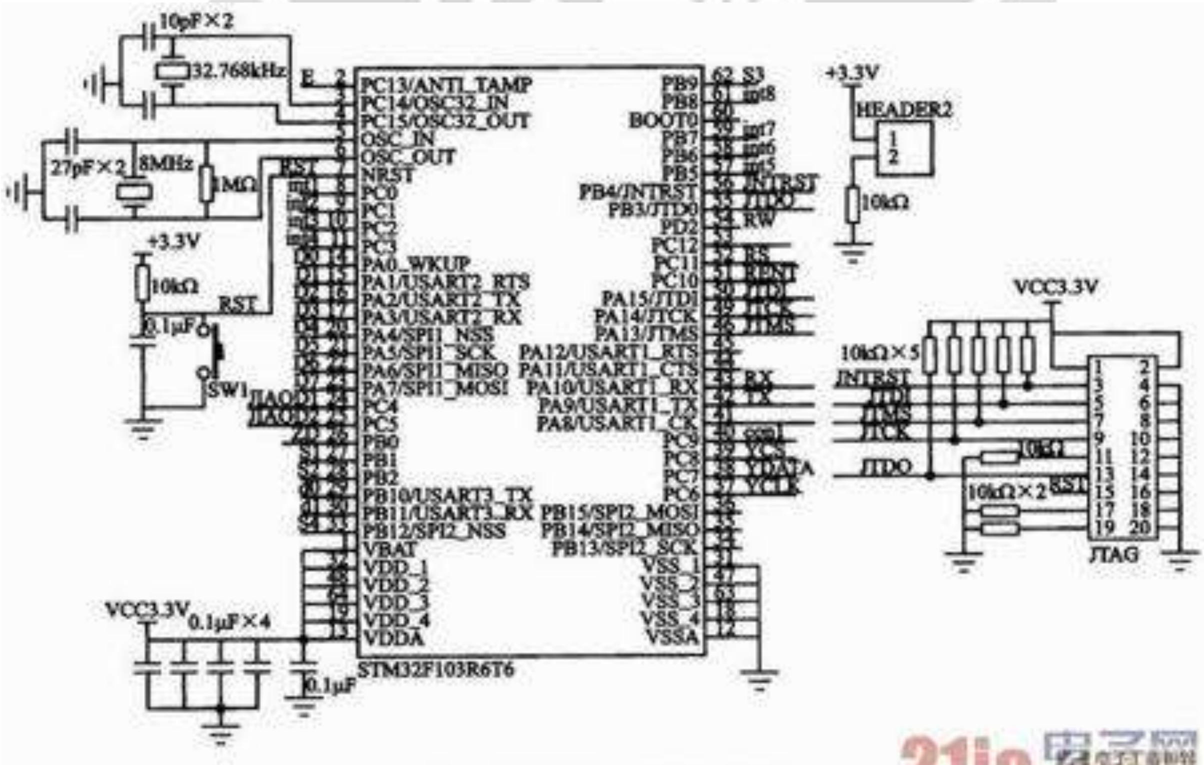


图 2 STM32F103 最小系统电路图

STM32F103 devices use the Cortex-M3 core, with a maximum CPU speed of 72 MHz. The portfolio covers from 16 Kbytes to 1 Mbyte of Flash with motor control peripherals, USB full-speed interface and CAN.

4. SYSTEM EFFICIENCY

Rated output power**:** This value is provided in watts or kilowatts. For some inverters, they may provide an output rating for different output voltages. For instance, if the inverter can be configured for either 240 VAC or 208 VAC output, the rated power output may be different for each of those configurations.

Output voltage(s): This value indicates to which utility voltages the inverter can connect. For smaller inverters that are designed for residential use, the output voltage is usually 240 VAC. Inverters that target commercial applications are rated for 208, 240, 277, 400, 480 or 600 VAC and may also produce three phase power.

Peak efficiency: The peak efficiency represents the highest efficiency that the inverter can achieve. Most grid-tie inverters on the market as of July 2009 have peak efficiencies of over 94%, some as high as 96%. The energy lost during inversion is for the most part converted into heat. Consequently, in order for an inverter to output its rated power it will require a power input that exceeds its output. For example, a 5000 W inverter operating at full power at 95% efficiency will require an input of 5,263 W (rated power divided by efficiency). Inverters that are capable of producing power at different AC voltages may have different efficiencies associated with each voltage.

CEC(california energy commission) weighted efficiency: This efficiency is published by the California Energy Commission on its GoSolar website. In contrast to peak efficiency, this value is an average efficiency and is a better representation of the inverter's operating profile. Inverters that are capable of producing power at different AC voltages may have different efficiencies associated with each voltage.

Maximum input current: This is the maximum amount of direct current that the inverter can use. If a system, solar cells for example, produces a current in excess of the maximum input current, that current is not used by the inverter.

Maximum output current: The maximum output current is the maximum continuous alternating current that the inverter will supply. This value is typically used to determine the minimum current rating of the over-current protection devices (e.g., breakers and fuses) and disconnects required for the output circuit. Inverters that are capable of producing power at different AC voltages will have different maximum outputs for each voltage.

Peak power tracking voltage: This represents the DC voltage range in which the inverter's maximum point power tracker will operate. The system designer must configure the strings optimally so that during the majority of the year, the voltage of the strings will be within this range. This can be a difficult task since voltage will fluctuate with changes in temperature.

Start voltage: This value is not listed on all inverter datasheets. The value indicates the minimum DC voltage that is required in order for the inverter to turn on and begin operation. This is especially important for solar applications, because the system designer must be sure that there is a sufficient number of solar modules wired in series in each string to produce this voltage. If this value is not provided by the manufacturer, system designers typically use the lower band of the peak power tracking voltage range as the inverter's minimum voltage.

5. TEST DATA

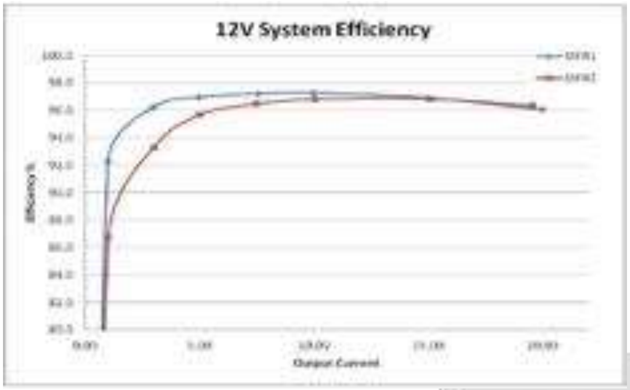
5.1 12v SYSTEM PERFORMANCE

Table 1 show the 12v system performance, this system is used to charging the 12V battery storage. In this 12V system, the efficiency is above 96%.

Table 1: 12V System performance

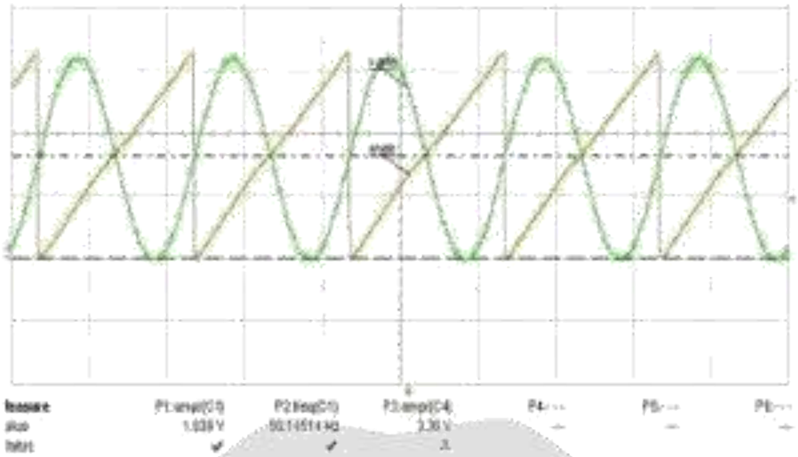
Vi (V)	Ii (A)	Vo (V)	Io (A)	Pi (W)	Po (W)	Efficiency (%)
17.70	0.01	0.00	0.00	0.14	0.00	0.0
17.01	0.76	12.01	0.99	12.93	11.93	92.3
17.16	2.19	12.05	3.00	37.58	36.17	96.2
17.27	3.61	12.09	5.00	62.34	60.46	97.0
17.52	5.40	12.15	7.57	94.61	91.98	97.2
17.42	7.20	12.20	10.00	125.42	122.03	97.3
17.33	11.00	12.32	15.00	190.63	184.79	96.9
17.19	15.06	12.44	20.00	258.88	248.70	96.1

5.2 12V SYSTEM EFFICIENCY GRAPH

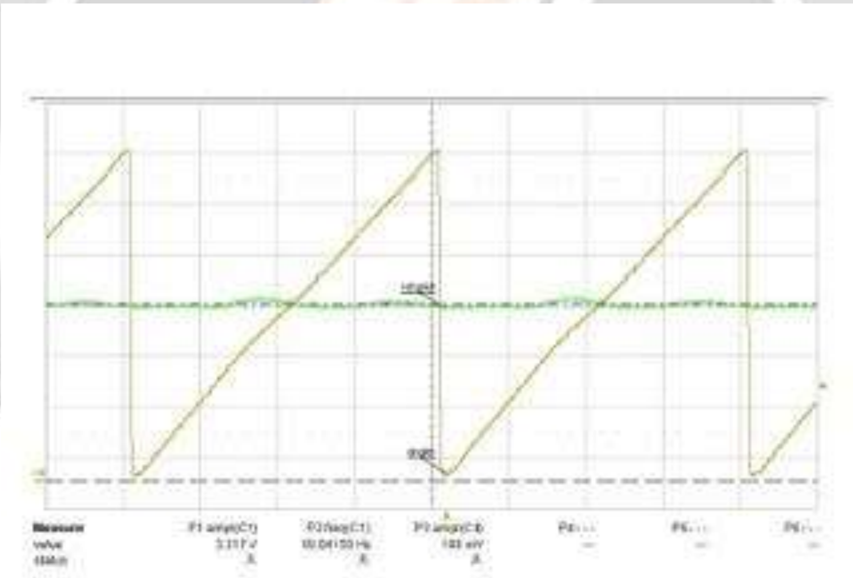


6. OUTPUT WAVEFORM

6.1 Grid angle and Vd component



6.2 Grid angle and grid voltage



7. CONCLUSION

To enhance the economic feasibility in DG(direct generation) systems without loss of reliability, this project presents a voltage- sensorless control scheme for grid connected inverters using PLL. It requires voltage measurements to detect the correct phase angle of grid voltages. To obtain this information without using voltage sensors, the proposed system employs a PLL based technique to estimate grid voltage from current measurements and reference signals. The phase angle of grid voltage can be completely restored even if the phase angle of the grid is initially unknown. To verify the feasibility of the proposed system, a 3KVA prototype grid connected inverter has been constructed.

8. REFERENCES

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