Hybrid Power Supply System Based on Quasi-Z-Source Network

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***Abstract*- The fossil fuel consumption in the production process is a key point for my hybrid system. By using fossil fuels the carbon emission rate increases for reducing this we are introducing renewable resources here. In the sense of the reduction of carbon emission we are introducing hybrid system which intend makes very eco-friendly and efficient as well.**

For this we are using Quasi-Z-source network to provide an efficient means of power conversion between the source and load in wide range of electric conversion applications. In addition, the anode effect is a peculiar phenomenon in aluminum electrolysis production. It means a situation where too many gas bubbles form to the bottom of the anode and join together forming a layer. This increases the resistance of the cell when smaller areas of the electrolyte touch the anode. Thus, when anode effect occurs, voltage rises sharply, which can up to 50 V or higher and the voltage of dc bus is raised.

Abbreviation—AC–DC integrate controller, aluminum electrolysis, hybrid power supply system (HPSS), quasi-Z source (Q-Z-S) converter, two-layer control algorithm. P and O algorithm

Nomenclature

- **Q-Z-S Quasi-Z-source.**
- **Q-Z-R Quasi-Z-rectifier controller**
- **HPSS Hybrid power supply system**
- **Q-Z-C Quasi-Z-source dc–dc converter**
- **P and o perturb and observe**

I. INTRODUCTION

ALUMINUM electrolysis production, who has always become the largest centralized industrial dc load in power system, features enormous energy consumption. a medium-scale aluminum manufacturer uses about 3 billion kW. the power supply for aluminum electrolysis production relies largely on power grid and 70% of the grid's electric power is produced by thermal power generation the anode effect is a peculiar phenomenon in aluminum electrolysis production. It means a situation where too many gas bubbles form to the bottom of the anode and join together forming a layer. This increases the resistance of the cell when smaller areas of the electrolyte touch the anode. Thus, when anode effect occurs, the cell voltage rises sharply, which can up to 50 V or higher and the voltage of dc bus is raised to mitigate negative effects caused by anode effect is crucial to aluminum electrolysis production. a multi pulse rectifier system for aluminium smelting load, as well as the open-loop response of aluminum smelters to short time interval feeding and their response to the adjustment of saturable reactors and tap changers are discussed. A conceptual harmonic-filter-design procedure for the filters required for grid-connected aluminum smelting plant is presented in, in which the aluminium smelting load is supplied by utility grid with a number of diode rectifiers and step-up transformers. Since the aluminum smelter loads are all supplied by ac grid with rectifier system, the issue on fossil fuel consumption is not addressed fundamentally.

One solution is to partly supply aluminum smelter load switch photovoltaic (PV) power. PV technology is practical and cost efficient at the megawatt level, and its dc characteristics could increase the overall efficiency by reducing the number of power conversion stages. Thus, an hybrid power supply system (HPSS) consisted of ac-system and PV-system is proposed in this paper. The HPSS has the following three significant advantages.

1) The carbon emission is significantly reduced with integrated PV penetration levels as high as 30%.

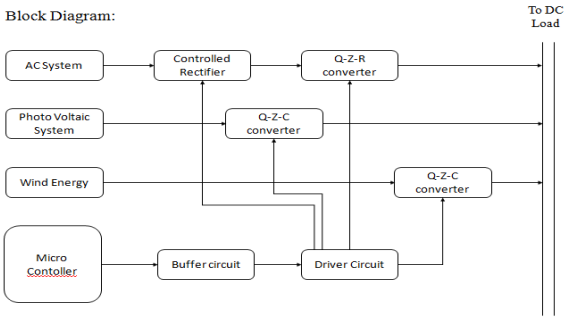
2) Compared the PV inverter power system, the PV-system in this paper eliminate inverting and rectifying process, thus reducing the energy loss.
3) The PV resources geographically match with aluminum resources in China, so the issue of large-scaled PV used locally is addressed, which avoids the loss of long-distance transmission. However, power balance is the most critical technical issue in the HPSS. This issue becomes even more severe in high percentage of PV power is integrated. Stepped PV power outputs may result in significant over/under power deviations, which cannot satisfy the strict power quality requirements of aluminum electrolysis production. What's more, the demand power of aluminum electrolysis loads increases while occur anode effect.

In view of this, the power deviations caused by the PV-system and anode effect should be dynamically compensated in real time, which is a challenge for ac controller.

Although considerable methods have been proposed to address the fluctuation problems of PV-system, these methods are unsuitable for industrial aluminum electrolytic production. In case of, the proposed converters are based on boost model, which have limitation in boost capability and cannot satisfy the wide input voltage variation range of the PV-system in this paper. Besides, the industrial operating condition of aluminum electrolytic production is harsh that the electromagnetic induction intensity in production workshop is up to Tesla level.

Necessitating a power conversion system that has a wide input voltage and load regulation range, and high immunity is needed. In recent decade, there has been an increasing interest in the study on quasi-Z-source (Q-Z-S) converters. The converters designed based on Q-Z-S are immune to EMI noise, have high dc voltage gain and wide input voltage capability and thus, is very well suited for industrial aluminum electrolytic production. Although recent studies revealed that the efficiency of the Z-source inverter is low when compared with the two-stage converter using the voltage-source inverter or the neutral-point-clamped inverter the more emphasis is laid on the necessity of Q-Z-S converters to aluminum electrolysis application in this paper.The high immune to EMI and wide input voltage and load regulation range are the main reasons to employ the Q-Z-S converters.

This paper employed a Q-Z-C and Q-Z-R in the proposed HPSS and an ac–dc integrate controller with two layers of power control is proposed to deal with transient power deviation issues. The contribution here is to use the power deviation as an information carrier to control the output of ac cells, and thus, the dynamic power compensation of the HPSS is achieved. Note that this control scheme can solve power deviation issues caused by sudden changes of the power consumption of the aluminum electrolytic loads or the output power of PV arrays. Therefore, the power fluctuation problem caused by the PV-system and anode effect can be addressed.



Maximum power traction method

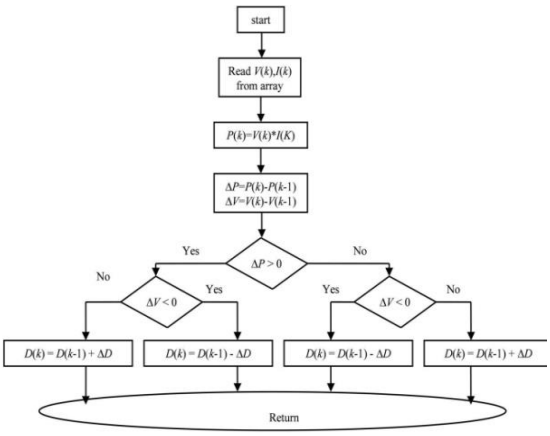
Maximum power point tracking (MPPT or sometimes just PPT is a technique used commonly with wind turbines and photovoltaic (PV) solar systems to maximize power extraction under all conditions.

Here we compare the power and calculate the maximum power. Here we use perturb and observer-

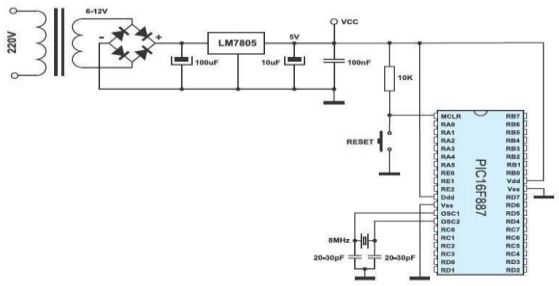
In this method the controller adjusts the voltage by a small amount from the array and measures power; if the power increases, further adjustments in that direction are tried until power no longer increases. This is called the perturb and observe method and is most common, although this method can result in oscillations of power output.

It is referred to as a hill climbing method, because it depends on the rise of the curve of power against voltage below the maximum power point, and the fall above that point. Perturb and observe is the most commonly used MPPT method due to its ease of implementation.

Perturb and observe method may result in top-level efficiency, provided that a proper predictive and adaptive hill climbing strategy is adopted.



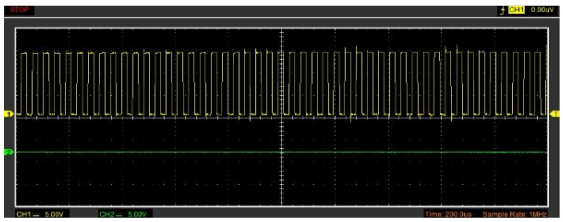
POWER SUPPLY CIRCUIT



All the electronic component starting from diode to Intel IC's only work with a DC supply rating form ±5V to ±12V. We are utilizing for the same, the cheapest and commonly available energy sources of 230V-50Hz supply and
stepping down, rectifying, filtering and regulating the voltage, depending upon over requirements. Fig 4.1 shows the circuit diagram for power supply say 5V and 12V as per requirements.

DRIVE

It is a power amplifier that accepts a low power input from a controller IC and produces a appropriate high current gate drive for MOSFET switch. In other words, a driver IC regulates the current through a MOSFET switch. A gate driver is used when a PWM controller cannot provide the output current required to device the gate capacitance of the associated MOSFET. In this project IR2110 is used as a gate driver IC for MOSFET switches

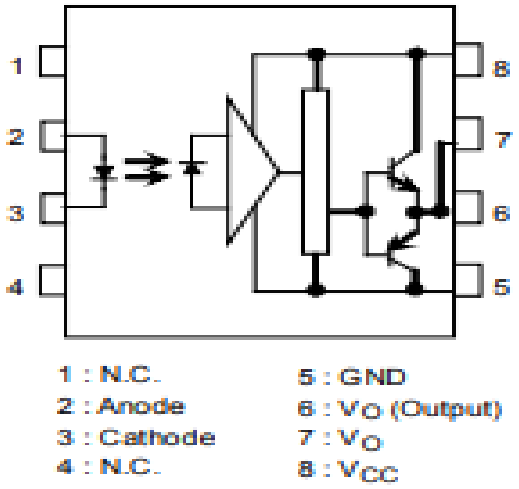


DRIVER CIRCUIT

TLP250

TLP250 of a GaAlAs light emitting diode and a integrated photodetector. This unit is 8-lead DIP package. TLP250 is suitable for gate driving circuit of IGBT or power MOSFET

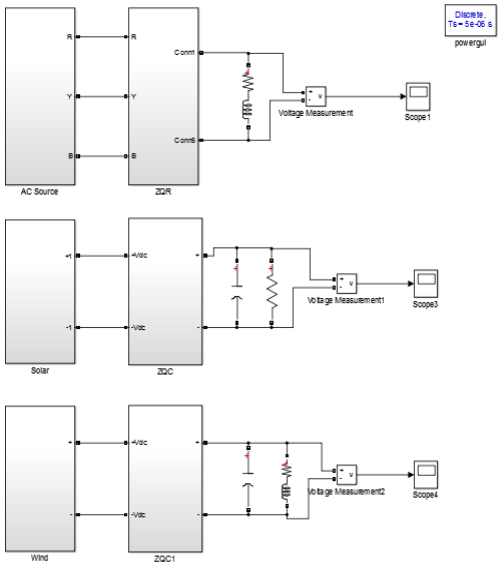
- Input threshold current: 5mA(max)
- Supply current : 11mA(max)
- Supply voltage : 10-35V
- Output current : ±1.5A (max)
- Switching time tpLH/tpHL): 0.5μs(max)
- Isolation voltage: 2500Vrms(min)
- UL recognized: UL1577, file No.E67349
- c-UL approved : CSA Component Acceptance Service No. 5A, File No.E6734
- c-UL approved : CSA Component Acceptance Service No. 5A, File No.E67349



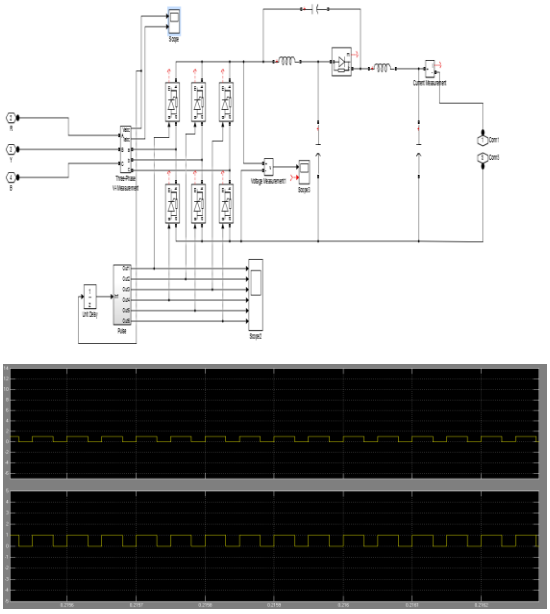
IR2110

The IR2110/IR2113 are high voltage, high speed power MOSFET and IGBT drivers with independent high and low side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. Logic inputs are compatible with standard CMOS or LSTTL output, down to 3.3V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use in high frequency applications. The floating channel can be used to drive an N-channel power MOSFET or IGBT in the high side configuration which operates up to 500 or 600 volts

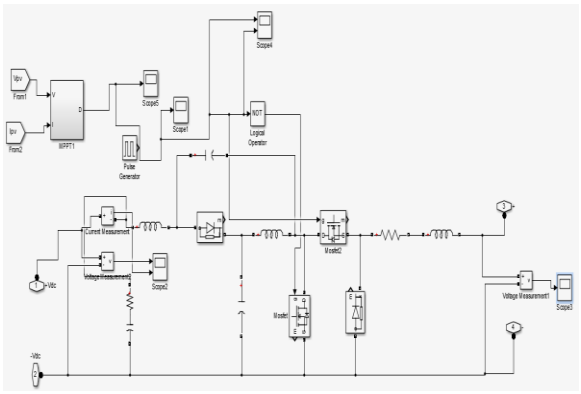
SIMULATION

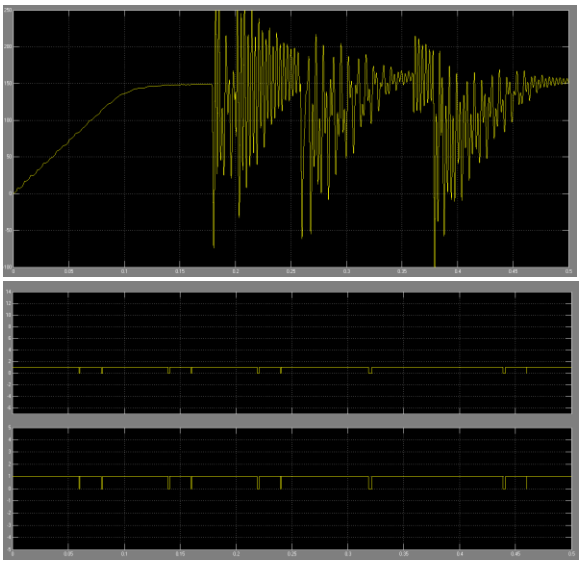


SIMULATION RESULT OF ZQR

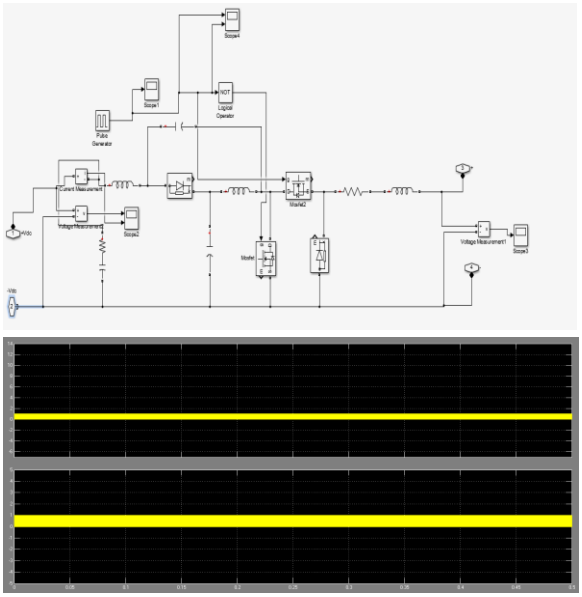


SIMULATION RESULT OF SOLAR





SIMULATION RESULT OF WIND



HARDWARE IMPLEMENTATION

Thus we can say that the above proposed system is mainly used for reducing the power consumption and also increase the efficiency of the output .

And also by using a combined hybrid system of wind and solar we can ensure a continuous power supply with reduced cost.

APPLICATION

- High power energy conversion applications.

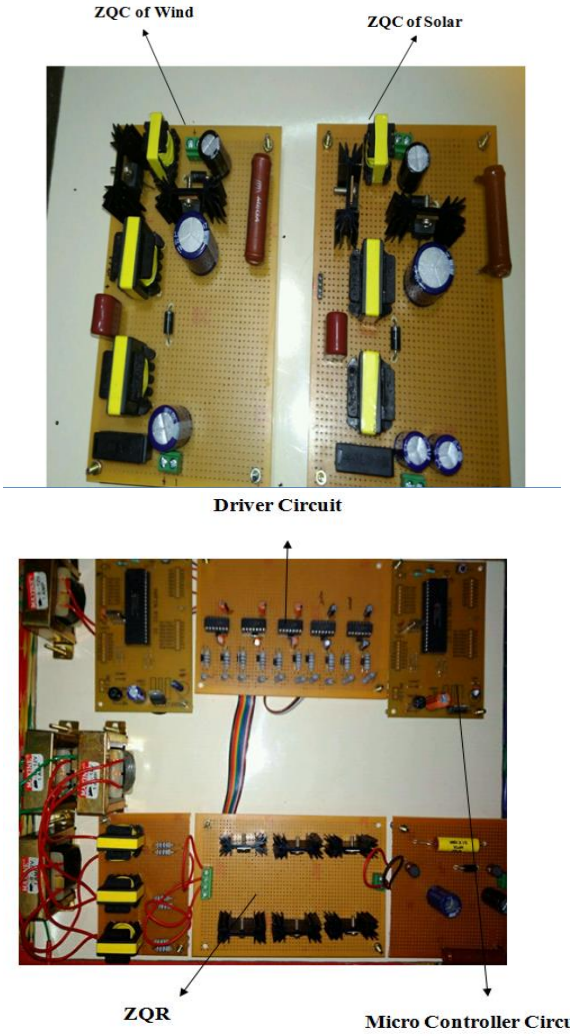
ADVANTAGES

- thus reducing stress on utility grid especially during peak time.

- The Q-Z-S converters can improve the reliability and safety of HPSS under harsh industrial aluminum electrolytic operating conditions.

FUTURE SCOPE

We can use the system even more effectively by combining any other power source or renewable energy sources .and also efficiency can be further more increased by use of any other maximum power traction method.



CONCLUSION

Thus we can conclude that by using the quasi z source in the hybrid power system for aluminum electrolysis process the aluminium manufacturing company is very much benefited by the reduced cost and more efficiency.and also we can concluded that normally for a small scale AL plant we need 35000 kw/hr of power so if only grid is used for power supply then cost of AL will be very much raised which is reduced by this proposed method

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