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SELF EXCITED INDUCTION GENRATOR USING ARDUINO MEGA 2560

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ABSTRACT:

This paper proposes a Self-Excited Induction Generator voltage regulation scheme by using Arduino Mega 2560 microcontroller. Self-Excited Induction Generator utilizes concept switch series capacitors to maintain output voltage constant. The experimental results are proven that controlled series capacitors maintain constant voltage over wide variety of loads and changes in speed hence it is reliable and cost effective generator voltage controlled system.

1.INTRODUCTION:

Recent developments on distributed power generation have increased the research on suitable generating systems for remote areas using locally available renewable energy sources such as small hydro and wind. Self-excited induction generators (SEIGs) are considered as a viable option due to its specific advantages compared to a conventional synchronous generator, among others, one of the key advantages is the inherent over load protection, at the occurrence of a fault. Current will be limited by the excitation, and the machine voltage will collapse immediately. Self-excited induction generator builds its voltage from residual magnetism, with the help of capacitor bank that provides the required reactive power from the induction machine. These capacitors are connected in parallel with the self-excited induction generator. Self-excited induction generator have their output voltage and frequency varying considerably with speed, load impedance and excitation capacitance.

To reduce this voltage variation of Self-excited induction generator use the series capacitor banks which can controlled by Arduino mega2560 microcontroller.

2. DESIGN OF SEIG SYSTEM:

1.2 SELECTION OF MOTOR AS GENERATOR SYSTEM:

The 3 phase 3 HP inductions motor is selected due to its advantages such as robustness, simple construction, ease of availability and it is cheaper for low power rating. The squirrel cage induction motor is selected over the wound rotor as the wound rotor is more expensive and less robust. Induction generator also has two electromagnetic components: the rotating magnetic field constructed using high conductivity, high strength bars located in a slotted iron core to form a squirrel cage.

2.2 CAPACITOR VALUE DESIGN:

Designing of capacitor value is based on induction motor specification. If capacitor value increases then iron losses increases and if capacitor value decreases then voltage is decreases.

Specification of Induction Machine:

Power: 2238 W, Voltage:415V, Rated current:5A, Efficiency:80%, Speed:1500rpm, Pole:4, PF:0.8,

2.2.1 Shun Capacitor Value Design:

S = $\sqrt{3}$*V*I

S = $\sqrt{3}$*415*5

S = 3594.01 VA

Total power with losses P=2238/0.8

P = 2797.5 W

Q=$\sqrt{(s^2-p^2)}$

Q=$\sqrt{(3594.01^2-2797.5^2)}$

Q=2256.3 VAR

If Delta connected Capacitor bank

Q = 2256.3/3 VAR/phase

Q = 752.81 VAR/phase

Capacitor Current per phase = 752.81/415

= 1.812 A

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Xc = Three phase voltage/capacitor current
=415/1.812
Xc = 228.992 Ω/phase
Xc = 1/(2*π*f*C)
C = 1/(2*π*f*Xc)
=1/(2*π*50*228.992)
C = 10 μF

2.3 ABBREVIATIONS AND ACRONYMS:

S = Apparent power, P = Power, Q = Reactive power, Xc = Capacitive reactance, C = capacitance

3. GENERATOR-CAPACITOR CONFIGURATION:

The delta connected capacitor (fig.1) is used as the star connection of capacitor requires three times capacitance than for delta connection of capacitor. With the star-delta configuration we can get the output power above 300 watts and efficiency up to 67%. With this configuration the winding currents are also within the rated range.

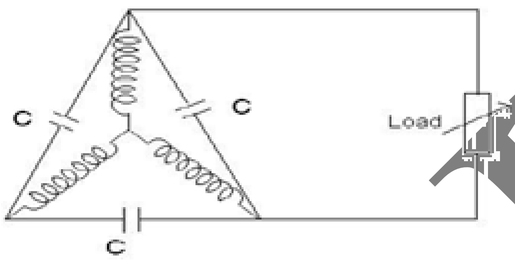

Fig.1: Delta-connected capacitor configuration

4. RESULT:

4.1 WITHOUT SERIES COMPENSATION:

TABLE.1

Sr. No	Load(W)	VL(Volt)	N(rpm)	IL(Amp)	Idc(Amp)
1	300	410	1500	1	6.3
2	360	396	1500	1.2	7.2
3	480	379	1500	1.7	8
4	560	373	1500	1.7	9
5	600	366	1500	1.9	12

4.2 WITH SERIES COMPENSATION:

TABLE.2

Sr. No	Load(w)	C(μF)	VL(V)	N(rpm)	IL(A)	Idc(A)
1	300	12.5	306	1522	0.8	5
2	360	18.75	302	1514	1.15	6.5
3	480	20	282	1510	1.28	7
4	560	25	286	1510	1.64	8.5
5	600	30	330	1524	1.03	12

5. INTERPRETATION FROM RESULT AND PROPOSED SYSTEM:

From the table no I and II, we can conclude that while taking readings without series compensation the voltage decreases but for with series compensation readings the voltage remain constant as the load increases. We have to maintain the voltage constant. A microcontroller and relay circuit is used for keeping the voltage constant at a particular value in case of load variation.

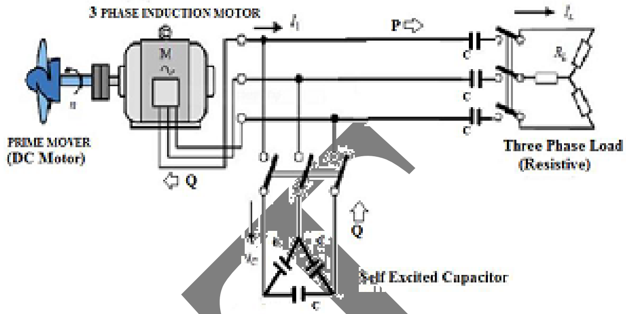

Fig. 2 Self-Excited Induction Generator

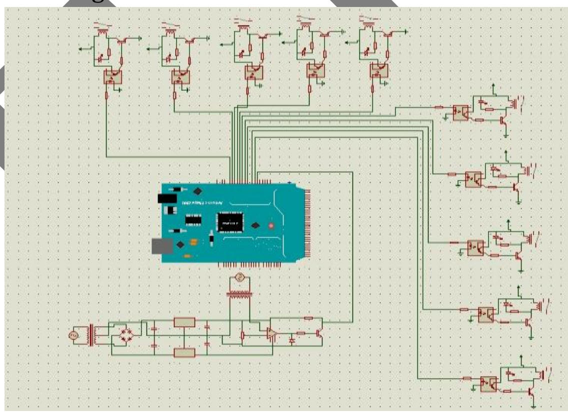

Fig. 3 Automatic operation Self-Excited Induction Generator

The reference voltage is set into the arduino mega 2560 through the program. The reference voltage is compared with the generator output voltage and according to that the arduino mega 2560 will switch the capacitors to the generator terminals by using the relay circuit. The terminal voltage is displayed on monitor by the arduino mega 2560. The simulation and physical hardware of the capacitor switching circuit of the same circuit is shown in fig. (2) and fig. (3) fig. (4) respectively.

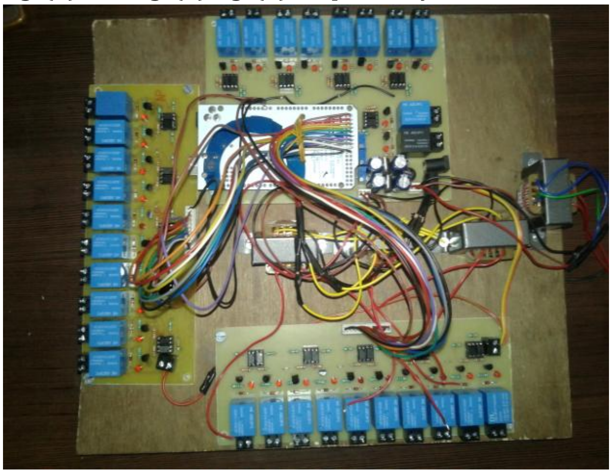

Fig. 4 Hardware Circuit of arduino-based relay operated capacito switching

Fig. 5 Hardware setup SEIG

6. CONCLUSION:

The results obtained from experiment clearly indicate that with the increase in load, the voltage profile of the system is decreases. The arduino based relay operated capacitor switching scheme can be implemented for given experimental set up for smooth variation of capacitors for variable load conditions thereby allowing using induction machine as a generator in system. The same can be implemented for variable speed input systems with little changes in arduino mega 2560 code. The system applicable for resistive load. The voltage profile constant for different load.

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