

Automatic Synchronization of 210MW Turbo Generator in 230KV Transmission Line

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ABSTRACT: This project focuses on the design and implementation of an automatic synchronizing to automate the synchronization process of a turbo generator to the transformer connected with transmission system. Synchronization of Generator with grid is the process of equating the parameters like magnitude, phase and frequency of the both power sources and connecting the generator with the power system network. There are two types of generator synchronization procedures available in the power plant i.e. Manual synchronization and Automatic Synchronization. Precision rectifier and ZCD (ZERO CROSSING DETECTOR) are used to measure the voltage and frequency of generator and transformer.

KEYWORDS: Generation, Transmission, Synchronization, Microcontroller.

I. INTRODUCTION

In Mettur Thermal Power Plant, the heat energy is obtained by combustion of coal, then that heat energy is converted as a steam energy which is high in pressure and temperature will reach the prime mover (Turbine). The Working of a thermal power station can mainly be Coal Handling Plant, Boiler, Turbine, Generator. [a] Coal Handling Plant: Coal is employed as a main fuel in thermal station. [b] Boiler: Boiler is used for generation of steam for power generation, water tube boilers are used. [c] Turbine: 210 MW turbines are condensing, three cylinder, horizontal, disc and diaphragm type with nozzle.

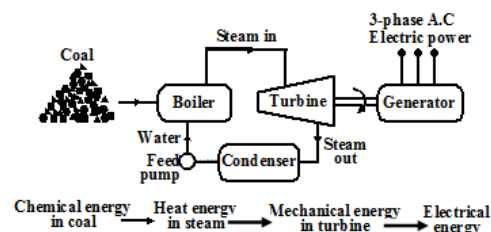


Fig 1.1 Basic Components of Thermal Generating Unit

Boiler produces super-heated steam of pressure 138 Kg/cm² & 540°C temp. This steam enters in turbine and because of the warmth energy of steam, turbine rotates at about 3000 rpm. The rotary engine is directly coupled to the generator rotor. Synchronization is important in overall power sharing process that it ensures quality, reliability and efficiency within the power systems. In this project, automatic synchronization is done to ensure the voltage and frequency of the generator should be match with the grid parameters to deliver the power. In order to reduce the man power, power

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interruption and to increase accuracy, an automatic synchronisation process is done. C.Nagarajan et al [3,5,9] developed the power is generated, the voltage and frequency of the generator should be matched with the grid. Based on demand the power is generated in plant by using pulverized coal. Once the parameters are matched with the reference parameter, the circuit breaker get closed and the power is transferred. In case fault occurs the circuit breaker remains open and the power will not get transferred.

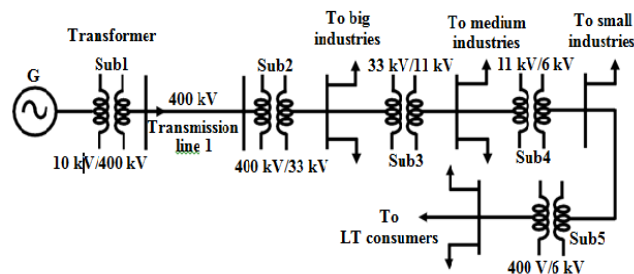


Fig 1.2 single line representation of power systems

II. METHODOLOGY

MANUAL SYNCHRONIZATION OF GENERATOR IN STATION

The Manual synchronization is finished by the plant operator. Here the operator may be a choose united Nations agency decides once to shut the fuse once perceptive the just parameters like phase, frequency and magnitude or in limits. The subsequent steps indicate the manual procedure:

- The Magnitude and frequencies of the two incoming and running frequencies are displayed within in the synchronization panel HMI (Human Machine Interface) for operator reference.
- The frequency distinction is calculated and provided as an input to the measuring instrument (Needle type of rotating LED lights type) and therefore the needle rotates in line with frequency distinction.
- The synchronization check relay provides the permission to shut the fuse once the needle is ± 0.5 from 12 o'clock position.

ADVANTAGES OF MANUAL SYNCHRONIZATION

- The main benefits of manual synchronization simplicity and cost effective.
- During synchronization failure of an automatic data processing system will be avoided.

DISADVANTAGES OF MANUAL SYNCHRONIZATION

- Closing time of the breaker might not be that abundant precise.
- There could also be a optical phenomenon error in adjusting magnitude and frequency.

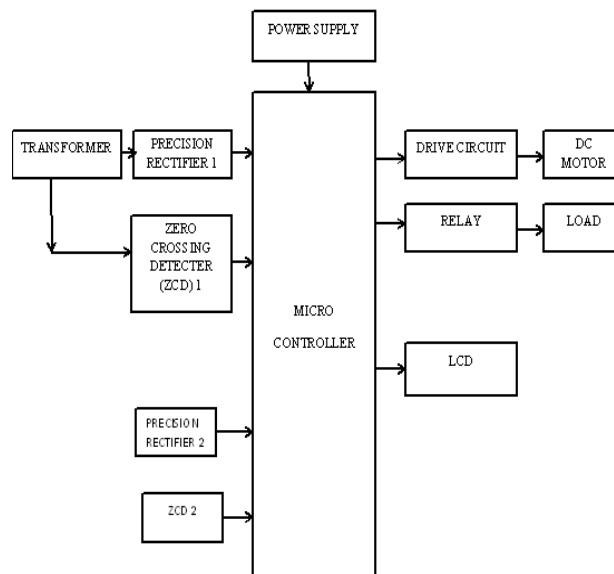
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AUTOMATIC SYNCHRONIZATION OF GENERATOR IN STATION BLOCK DIAGRAM



In growing system automation, synchronization of generator mistreatment automatic system fetches heaps of benefits over manual synchronization. Here the pc plays the role of the operator that exactly judges the closing of the breaker with planned synchronization logic and limit parameters. The following are the steps in automobile synchronization of Generator in station.

- Once each are selected the automobile measuring instrument unit takes the inputs from corresponding logic in step with planned logic for the breaker
- Initially it checks the voltage distinction and compares with style distinction limit.
- Parallely it conjointly checks the frequency distinction.

III. HARDWARE DESCRIPTION

POWER SUPPLY

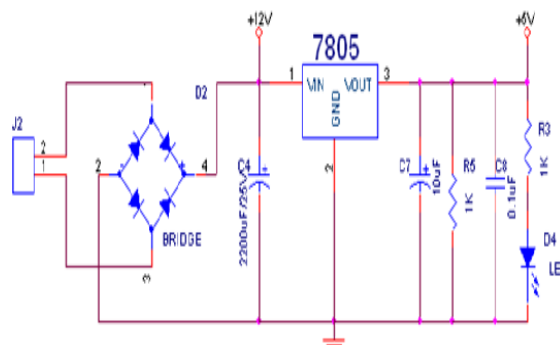


Fig 3.1 Power supply circuit

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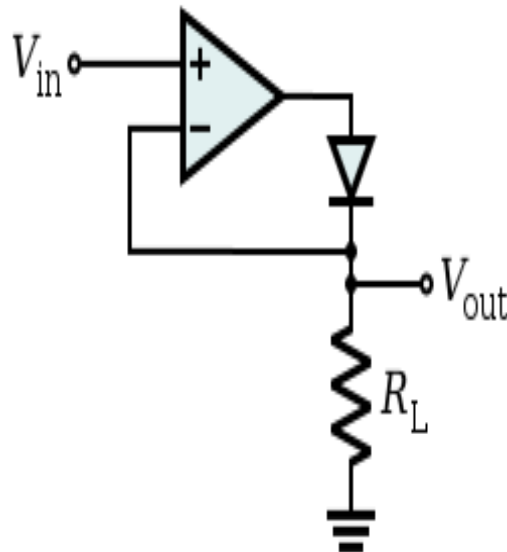
The AC voltage, generally 220 rms, is connected to an electrical device, that steps that ac voltage all the way down to the amount of the specified DC output. A diode rectifier then provides a full-wave corrected voltage that's ab initio filtered by an easy capacitance filter to provide a dc voltage. This ensuing dc voltage typically has some ripple or ac voltage variation. A regulator circuit removes the ripples and conjointly remains an equivalent dc worth although the input dc voltage varies, or the load connected to the output dc voltage changes.

TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, that is built with an assistance of op-amp. The benefits of using precision rectifier are that it will provide peak voltage output as DC; rest of the circuits will provide solely RMS output.

PRECISION RECTIFIER

The preciseness rectifier or super diode is a an arrangement achieved with one or a lot of op-amps (operational amplifiers) so as to own a circuit perform sort of a rectifier and a perfect diode.



Circuit designers have 2 customary strategies for coming up with a preciseness rectifier. They will amplify the AC signal so rectify it, or they'll do each directly with one operational electronic equipment. The latter technique is commonly thought of a far higher thanks to get the task done. once the voltage given this circuit is negative, then there'll be a negative voltage on the diode. Thus this circuit works like an open circuit. It means that there's no flow of current within the load, moreover as output voltage, is zero.

VOLTAGE REGULATORS

Voltage regulators comprise a category of wide used ICs. Regulator IC units contain the electronic equipment for reference supply, comparator electronic equipment, and overload protection bushed one IC. IC units offer regulation of either a hard and fast positive voltage, a hard and fast negative voltage, or associate degree adjustable set voltage. The regulators may be designated for operation with load currents from many m amp to tens of amperes, resembling power ratings type milli watts to 10 watts .A fixed three-terminal voltage regulator has an unregulated dc input voltage, V_i , applied to one input terminal, a regulated dc output voltage, V_o , from a second terminal, with the third terminal connected to ground.

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PIC MICROCONTROLLER

The PIC16F887 is one of the latest products from Microchip. It features all the components which modern microcontrollers normally have. For its low price, wide range of application, high quality and easy availability.

E.1 FEATURES OF PIC16F877A:

1. RISC architecture
2. Operating frequency 0-20 MHz
3. Precision internal oscillator
 - Factory calibrated
 - Software selectable frequency range of 8MHz to 31KHz
4. Power supply voltage 2.0-5.5V
5. Power-Saving Sleep Mode
6. Brown-out Reset (BOR) with software control option
- 7.33 input/output pins
 - High current source/sink for direct LED drive
 - software and individually programmable pull-up resistor
 - Interrupt-on-Change pin
- 8.8K ROM memory in FLASH technology
9. In-Circuit Serial Programming Option
10. 256 bytes EEPROM memory
11. Data can be written more than 1.000.000 times
12. 368 bytes RAM memory
13. A/D converter:
 - 14-channels
 - 10-bit resolution
14. 3 independent timers/counters
15. Watch-dog timer
16. Analogue comparator module
17. PWM output steering control
18. Enhanced USART module
 - Supports RS-485, RS-232 and LIN2.0
 - Auto-Baud Detect
19. Master Synchronous Serial Port (MSSP)

E.2 PIN DIAGRAM AND DESCRIPTION

Features:

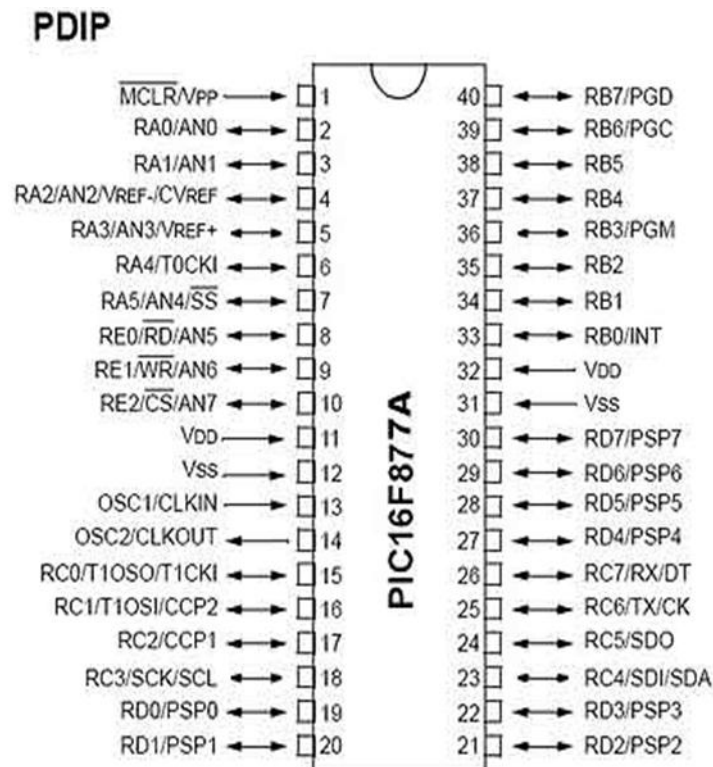
- 5 x 8 dots with cursor
- built-in controller (ks 0066 or equivalent)
- + 5v power supply (also available for + 3v)
- 1/16 duty cycle
- b/l to be driven by pin 1, pin 2 or pin 15, pin 16 or a.k (led)
- n.v. optional for + 3v power supply

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RELAY

Relay is an electromagnetic device which is employed to isolate two circuits electrically and connect them magnetically. They are very useful devices and permit one circuit to switch another one while they are completely separate.

IV. CONCLUSION

This paper has proposed the concept of auto-synchronization, in which synchronization of a turbo Generator in thermal power plant with the transmission lines and makes the process easier, safer, cost-effective and reliable by automation process. The safety and reliability of the whole scheme is ensured by damping any mechanical oscillations through power system stabilizer (PSS) and by providing the protection schemes. Protection schemes have been designed against over-current, under-voltage, overvoltage, over-frequency and under-frequency conditions of the synchronous generator.

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