STM JOURNALS

International Journal of
Electrical Power and Machine Systems

Volume 3, Issue 1, 2025
January—June
DOI (Journal): 10.37591/IJEPMS

https://journals.stmjournals.com/ijepms

Review IJEPMS

Self-Starting Diesel Generator

Divya K. Pai*

Abstract

Power outages can happen to anyone, and they are a lot more frequent than the major outages that make the evening news on TV. Being prepared for a blackout goes beyond beans, batteries and bullets. Having a source of alternative energy to power your devices, both small and medium, can make all the difference. Larger devices can be powered, but you would need some serious generators to make sure you can still use your bigger kitchen appliances, washer and dryer or even a water heater. Generators are excellent for powering almost everything in a modest house. Generators are a great option for keeping things running during a blackout, but they come with some considerations. First, you will need to store fuel and regularly maintain the generator's engine. For instance, gasoline can deteriorate over time, so it is critical to rotate your fuel supply. To make sure your generator runs when you need it most, regular engine maintenance is essential. This includes inspecting spark plugs, cleaning air filters, and changing the oil. Power outages are a common occurrence, and while major outages often make the news smaller, more frequent blackouts can be just as disruptive. Preparing for these events goes beyond having canned food, batteries, and water; it is also important to have a backup energy source to power essential devices. Another downside of generators is the noise. They can be pretty loud, which can be annoying, especially if you are trying to get some rest or if you are in a residential area. Luckily, quieter options like inverter generators are available, but they tend to be more expensive. While larger appliances like washers, dryers, and water heaters require bigger generators, having a smaller generator can make a huge difference for basic needs like lighting, phones, and refrigerators. They can even give you a source to get lights going around the home. Almost anything in a basic home can be powered by a generator. The amount of power you will require is a crucial consideration when selecting a generator. Smaller, portable generators are great for powering basic devices, but for larger appliances, you will need a more powerful model. Some people also consider solar-powered generators as an alternative, as they are eco-friendly, quieter, and do not require fuel, though they can be costly upfront. They can even give you a source to get lights going around the home. We need to store fuel and maintain the engine. They are very loud, but they work.

Keywords: Diesel generator, microcontroller, voltage sensor, temperature sensor, automation

INTRODUCTION

A diesel generator is a device that produces electricity by combining a diesel engine with an electric generator, usually an alternator. An electric generator, also known as an alternator, and a diesel engine work together to create electricity in a diesel generator. Essentially, it is a type of engine generator. Diesel engines are commonly designed to run on fuel oil, though some models can be adapted to use other liquid fuels or natural gas. This instance of engine-generator is unique. Although certain models are modified to work on natural gas or other liquid fuels, diesel compression-ignition engines are typically built to run on fuel oil [1]. Diesel generators are frequently utilized in places without access to the main power grid because they offer a

***Author for Correspondence**
Divya K. Pai
E-mail: divyap@sjec.ac.in

Assistant. Professor, Department of Electrical and Electronics Engineering, St. Joseph Engineering College, Vamanjoor, Mangalore, Karnataka, India

Received Date: March 06, 2025
Accepted Date: March 28, 2025
Published Date: April 07, 2025

Citation: Divya K. Pai. Self-Starting Diesel Generator. International Journal of Electrical Power and Machine Systems. 2025; 3(1): 17–21p.

reliable supply of electricity in isolated areas. They are also a popular choice for backup power when the grid goes down, offering a reliable solution to maintain power during outages. In addition to their emergency role, these generators are used for more specialized purposes, such as managing peak electricity demand (known as peak-lopping), supporting the power grid, and sometimes even supplying electricity back into the grid. Diesel generators' dependability and efficiency are two of their key benefits [2]. They can deliver a consistent power supply, making them ideal not just for residential or emergency use but also for larger industrial and commercial applications. These generators are known for their ability to operate efficiently over long periods and under demanding conditions, making them a popular choice for a wide range of power needs. Diesel generator sets are utilized in locations without grid connectivity, as a backup power source in the event of a grid outage, and for more sophisticated uses including peak-lopping, grid support, and exporting to the grid.

TYPES OF DIESEL GENERATOR

For more complicated uses like peak-lopping, grid support, and export to the power grid, diesel generator sets are utilized in locations without access to the grid or as a backup power source if the grid fails. Voltage regulators play a key role in maintaining a consistent output voltage, ensuring that the generator's power supply remains steady even as demand fluctuates. Meanwhile, governors help regulate the speed of the engine, which in turn ensures that the generator operates at the correct frequency [3]. By keeping both voltage and frequency stable, synchronous generators can deliver reliable and predictable power, making them ideal for applications where consistent performance is critical. This level of control makes synchronous generators a popular choice for various industries, particularly in settings where the quality of electrical power must be tightly regulated, such as in grid systems, large-scale facilities, and critical infrastructure. Their ability to maintain stable power supply under varying loads and conditions sets them apart from other types of generators, making them a trusted solution for high-demand and precision applications.

BRIEF DESCRIPTION ABOUT DIESEL GENERATORS

Diesel generator sizing, which is challenged by contemporary electronics, particularly non-linear loads, is essential to preventing low load or a power shortfall. Even at these power levels, diesel arrays are occasionally chosen over open cycle gas turbines for regular part-loading because of their superior efficiencies. In size ranges of about 50 MW and above, an open cycle gas turbine is more efficient at full load than an array of diesel engines, and it is also much more compact, with comparable capital costs. Diesel generators are advantageous as they are very fuel efficient, and they turn out to be very cost effective [4].

The features that various manufacturers offer in their units' control panels vary. In other cases, the manufacturer builds the generator with the ability to start and stop electrically. For example, auto-start control panels can monitor your generator while it is operating, start it automatically in the event of a power outage, and automatically shut it off when it is no longer needed. Numerous engine data, including oil pressure, coolant temperature, battery voltage, engine rotation speed, and operating time, can be monitored by the diesel generator. When any of these metrics surpass their appropriate threshold levels, the generator can be automatically shut down thanks to continuous measurement and monitoring of these parameters.

AN INSIGHT TO THE STUDY

In this study, the diesel generator will automatically be switched on in cases like power outage, overvoltage, under voltage etc. It gives us indications if the fuel levels are less.

The temperature sensor checks the temperature of the generator and shuts it down when the temperature exceeds a set value. All these parameters are checked and programmed using a microcontroller [5].

BLOCK DIAGRAM AND THEORETICAL DESCRIPTION

Theoretical Description

The block diagram as shown in Figure 1 gives us a brief description of the circuit used in the study. It also talks about the microcontroller used in this prototype. 230/12 V transformer is used to step down the voltage from 230 V mains to 12 V. Bridge rectifier is used which converts ac to dc which is suitable for the microcontroller. 7805 voltage regulator is used so as to get a constant output voltage of 5 V. Capacitors are used for filtering purpose. 5 V supply is used to power up the microcontroller and the temperature sensing unit.

The control circuit is used to switch between main supply and the supply from the generator when the main supply is absent. Any two of the micro controller's digital pins can be connected to the control circuit. For the IC circuit, the output of regulator is connected to VDD pin of the micro controller. The ground is connected to the VSS pin. The oscillator pins are connected to 20 MHz crystal oscillator to get time delay. An LED is connected to the pin 37 of the microcontroller. LCD display is connected to six digital pins of the micro controller. This investigation uses a variety of sensors. These include fuel level sensor and temperature sensor. The PIC microcontroller used is PIC16f877A [6].

Working Principle

The voltage sensor will identify a change in the mains when there is a power outage. The voltage sensor used in this prototype is a simple voltage divider. For a diesel generator to run smoothly, it needs to meet a few important conditions. One of the main requirements is the voltage level, which must be below 200 V for the generator to start working properly. Another critical factor is temperature. The prototype uses an LM35 temperature sensor to monitor the generator's temperature, and it is set to shut down automatically if the temperature exceeds 50°C to avoid any damage. The diesel generator will operate considering predefined conditions. The microprocessor is configured so that in the event of an overvoltage or undervoltage in the mains, the diesel generator will start. Once all these conditions: appropriate voltage, safe temperature, and sufficient fuel, are met, the relay is activated. Initially, the relay is in the normally closed (NC) state. When the generator is ready to operate, the relay switches to a normally open (NO) position, which then powers the DC motor. This motor acts as a crank to get the generator running. In this prototype, over voltage levels are set to above 250 V and the under-voltage levels are set to below 200 V for the generator to start operating normally.

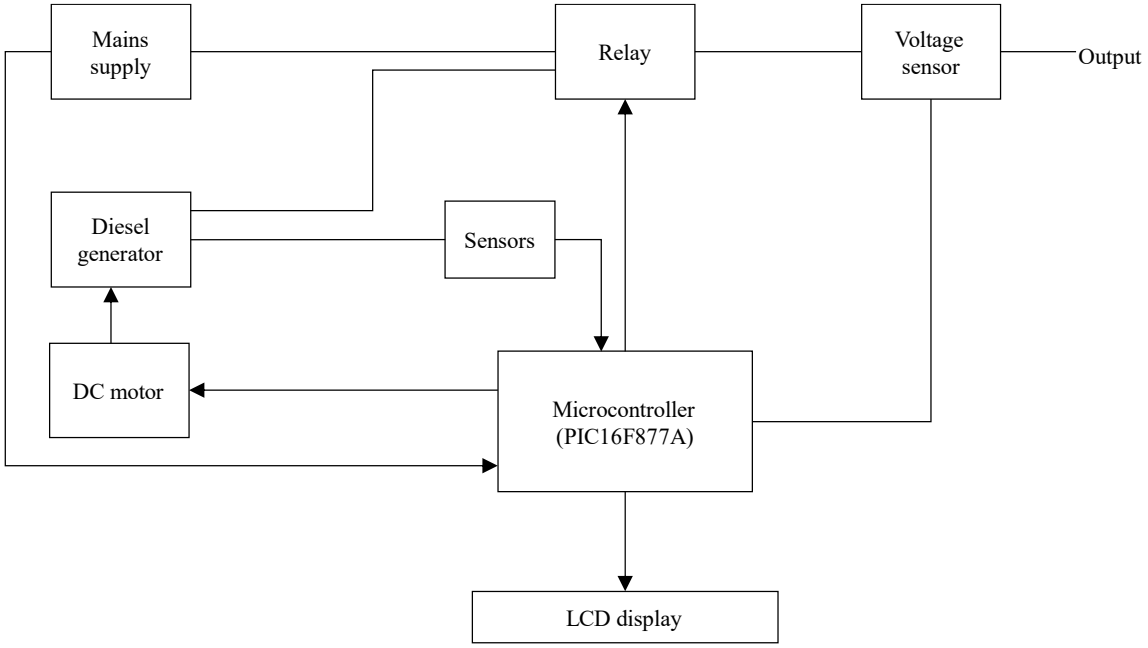

Figure 1. Block diagram of automatic start of diesel generator using microcontroller.

For the diesel generator to operate at requisite conditions, it needs to satisfy some predefined conditions. One of the parameters to be satisfied is the temperature limit. The temperature sensor that we use in this prototype is LM35. The temperature is set to a maximum limit of 50°C in this prototype for the diesel generator to operate. The diesel generator will promptly cut off if the temperature rises over the set threshold. The diesel engine's fuel supply is the next requirement to be met. We use a float sensor to indicate different levels of fuel. The diesel generator will operate when there is satisfactory supply of fuel. The microcontroller is programmed such that if there is no fuel, the diesel generator fails to start. After all these parameters are checked and the respective conditions are satisfied, the relay operates. Initially, the relay is in NC position. When the diesel generator operates, the position of the relay changes from NC to NO, thereby operating the DC motor which is used as a crank to make the diesel generator operate.

BLOCK DIAGRAM AND BRIEFING

Explanation of the Block Diagram

To send the files to be edited and other related files to the language tools for compilation or assembly, and eventually to a linker, the study manager arranges them (Figure 2). Placing the object code pieces from the assembler, compiler, and libraries into the appropriate memory regions of the embedded controller is the linker's responsibility. It also makes sure that the modules are correctly connected by resolving symbol references, adjusting memory addresses, and generating a final executable file that the embedded system can run [7].

The source files are text documents created in accordance with the compiler's or assembler's specifications. They are transformed by the compiler and assembler into placeholders for function references and data storage as well as intermediate machine code modules [8, 9]. These placeholders are fixed by the linker, which then merges all the modules into an executable machine code file. Additionally, the linker generates a debug file that enables the MPLAB IDE to connect the running machine codes to the original files. The code is written with a text editor. It is an editor made especially for creating code for Microchip MCUs, not just any text editor. It can identify the text's components and color-coded different elements, including comments, C language constructs, and instruction mnemonics. Finding matching braces in C, commenting and uncommenting code blocks, finding text in different files, and adding custom bookmarks are just a few of the common tasks that the editor offers while creating source code. The editor uses the other tools to show code execution in the debugger once the code is written [10, 11].

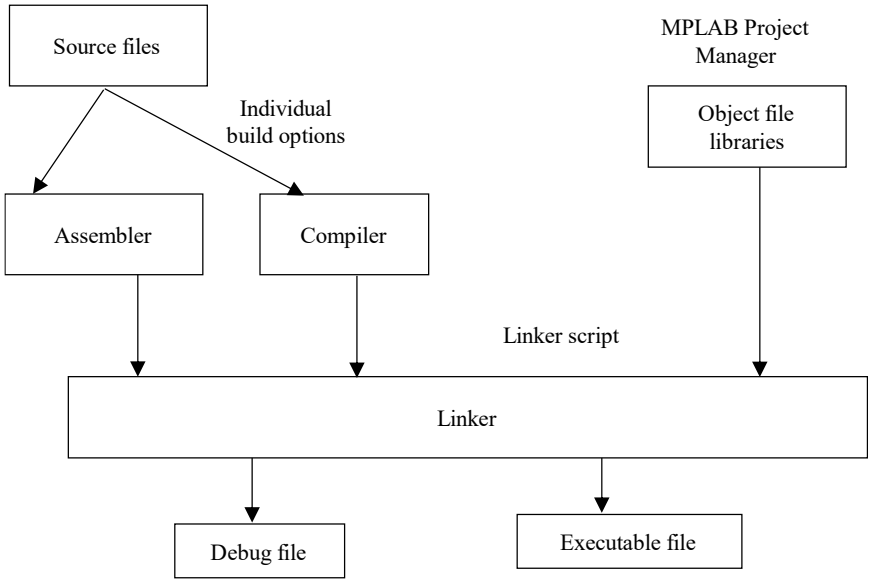

Figure 2. Block diagram of the proposed system.

CONCLUSION AND FUTURE SCOPE

In this study, a very efficient way to start a diesel generator is achieved. Here, various features like temperature sensing, over voltage and under voltage detection and fuel level sensing have been taken into consideration while starting a diesel generator using PIC microcontroller. Failure of constraints like fuel level and temperature can lead to the shutdown of the generator using PIC microcontroller. The results of this study demonstrate that the system provides highly accurate readings, ensuring reliability in its measurements. Automated operation of the generator is achieved using microcontroller which makes it more reliable and efficient. The voltage sensor is used to detect faults in the mains thus protecting the equipment from any harm. In this study, uninterruptable power can be supplied during outage of main supply. In future work, this study can be used to sense harmful gases and to monitor the pressure and shut down the unit in case it exceeds a predetermined level. Using high end microcontroller with high flash memory increases programming capability and also increases the number of functions needed.

REFERENCES

1. Gong C, Cai H, Zhang B, Wang W, Zhao R, Zhang D, Lin Y. Modeling and Analysis of Typical Generator Self-starting and Research on Black Start Capability Index Evaluation System in Urban Power Grid. In 2021 IEEE Power System and Green Energy Conference (PSGEC). 2021 Aug 20; 118–112.
2. Zhao W, Tang W, Lin Z, Xin Y. Cooperative control strategy for offshore wind farm black-start based on diesel generator. In 2022 IEEE 7th Asia Conference on Power and Electrical Engineering (ACPEE). 2022 Apr 15; 1528–1532.
3. Alsebai A, Afghan S. Designing and Implementing Control panel for Diesel generator. In IOP Conf Ser: Mater Sci Eng. 2019 Jul 1; 568(1): 012107. IOP Publishing.
4. Annaswamy AM, Amin M. Smart Grid Research: Control Systems. IEEE Vision for Smart Grid Controls: 2030 and Beyond. IEEE vision for smart grid controls: 2030 and beyond. 2013 Jun 20; 1–68.
5. Septian B, Rakesh P, Dhora SR. Iot based power monitoring system for diesel generator. In 2020 5th IEEE international conference on recent advances and innovations in engineering (ICRAIE). 2020 Dec 1; 1–4.
6. Mobarra M, Tremblay B, Rezkallah M, Ilinca A. Advanced control of a compensator motor driving a variable speed diesel generator with rotating stator. Energies. 2020 May 2; 13(9): 2224.
7. Mushiri T, Hungwe R, Mbohwa C. An artificial intelligence based model for implementation in the petroleum storage industry to optimize maintenance. In 2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM). 2017 Dec 10; 1485–1489.
8. Xia YQ, Li KK, David AK. Adaptive relay setting for stand-alone digital distance protection. IEEE Trans Power Deliv. 1994 Jan; 9(1): 480–91.
9. Friman M, Waller KV. A two-channel relay for autotuning. Industrial & engineering chemistry research. 1997 Jul 2; 36(7): 2662–71.
10. Al_Issa HA, Thuneibat S, Abdesalam M. Sensors application using PIC16F877A microcontroller. American Journal of Remote Sensing (AJRS). 2016; 4(3): 13–8.
11. Yee NK, Theingi KT. Fuel Monitoring and Electronics control of Dispenser for Fuel Station. International Journal of Engineering and Techniques (IJET). 2015 Jul; 1(4): 71–76.

