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Flexible AC Transmission Using TSR

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ABSTRACT-

The project aims at achieving FACTS by using TSR (Thyristor Switch Reactance). It is done when there is very low or minor load at receiving end while charging the transmission line. Since the presence of low load, small

current flows through transmission line therefore the shunt capacitance becomes more prominent. Due to this voltage amplification or Ferranti Effect occurs and the voltage at receiving end increases two times than the voltage at sending end. For this reason, to compensate, shunt inductors are automatically connected across the transmission line.

1. INTRODUCTION

1.1 Introduction

Flexible AC Transmission Systems (FACTS) refer to a family of technologies that enhance the efficiency, controllability, and stability of electrical power transmission and distribution systems. One of the key technologies within FACTS is the Thyristor-Controlled Series Reactor (TSR). TSR plays a significant role in improving the performance of power systems by controlling the impedance of transmission lines.

The primary purpose of TSR is to regulate the line impedance and thus the line voltage of a transmission system. It consists of a series reactor connected in line with the transmission network and thyristor-based switching devices that control the reactor impedance. By adjusting the impedance, TSR allows the system operators to manage power flow, voltage regulation, and stability.

A thyristor switched reactor is used in electrical power transmission systems. It is a reactance connected in series with a bidirectional thyristor value. The value of thyristor is phase-controlled, which allows the value of delivered reactive power to be adjusted to meet changing system conditions.

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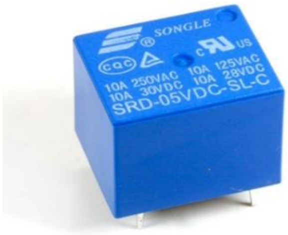
2. METHODOLOGY

2.1 Hardware implementation

This step involves material and component selection, hardware installation, and prototyping design. This project consists of using several electronic components. The main components used are Relay, Relay DriverULN2003, Transformer, Microcontroller At89S52, Thyristor, LCD, Inductive Load, etc.

2.1.1 Relay

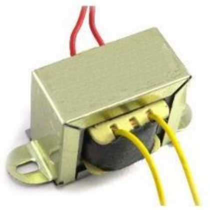
A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.



2.1.2 Transformer

The transformer is an electric device which transfers energy by inductive coupling between its windings.

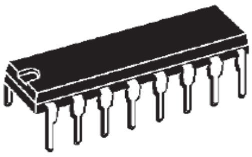
The transformer gives output of 12V, 12V and 0V. This transformer acts as a step-down transformer. The transformer core is made with the high permeability silicon steel.



2.1.3 Relay Driver ULN2003

The ULN2001A, ULN2002A, ULN2003 and

ULN2004A are high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel rated at 500mAand can withstand peak currents of 600mA.Suppressiondiodesare included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.



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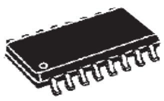

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2.1.4 Microcontroller AT89S52

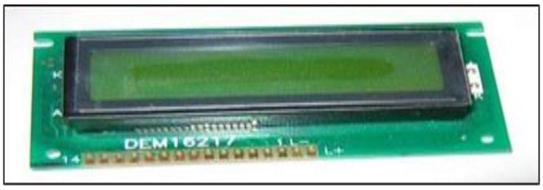
The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high- density nonvolatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in- system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

2.1.5 Thyristor [TSR]

A silicon-controlled rectifier (or semiconductor-controlled rectifier) is a four-layer solid state device that controls current. The name "silicon controlled rectifier" or SCR is General Electric's trade name for a type of thyristor. The SCR was developed by a team of power engineers led by Gordon Hall and commercialized by Frank W. "Bill" Gutzwiller in 1957.

2.1.6 Liquid Crystal Display {LCD}

The 44780 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The user may select whether the LCD is to operate with a 4-bit data bus or an 8-bit data bus. If a 4-bit data bus is used the LCD will require a total of 7 data lines (3 control lines plus the 4 lines for the data bus). If an 8-bit data bus is used the LCD will require a total of 11 data lines (3 control lines plus the 8 lines for the data bus).



2.1.7 Inductive Load

A load that is predominantly inductive, so that the alternating load current lags behind the alternating voltage of the load. Also known as lagging load. Any devices that have coils of wire in there manufacture can be classed as inductive loads. E.g. motors, solenoids and contactor coils are a few. Example of resistive loads can be baseboard heaters, filament light bulbs, toasters and stove top elements.

2.2 Research Design

Provide an overview of Reduction of losses in transmission line and the need for advanced monitoring and control systems. The next path that unravels is firstly the method to be adopted the system to reduce the losses at its maximum level which further. The project called “FLEXIBLE AC TRANSMISSION USING TSR’’.

Culminating towards making the said project in its utilization several components have been unleashed, some of which are mentioned so

1. Relay
2. Relay Driver
3. ULN2003
4. Transformer
5. Microcontroller At89S52
6. Thyristor

7. LCD
8. Inductive Load

The project requires an operational amplifier that generates lead time between zero voltage pulse and zero current pulse. This lead time is given to two interrupt pins of microcontroller of 8051 families. The programmed microcontroller then initiates shunt reactors for compensating the voltage. SCRs arranged in series interfaced with microcontroller through optical isolation are used for switching reactor.

2.3 Hardware Testing

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open".

Devices that can be used to perform continuity tests include multi meters which measure current and specialized continuity testers which are cheaper, more basic devices, generally with a simple light bulb that lights up when current flows.

An important application is the continuity test of a bundle of wires so as to find the two ends belonging to a particular one of these wires; there will be a negligible resistance between the "right" ends, and only between the "right" ends.

This test is the performed just after the hardware soldering and configuration has been completed. This test aims at finding any electrical open paths in the circuit after the soldering. Many a times, the electrical continuity in the circuit is lost due to improper soldering, wrong and rough handling of the PCB, improper usage of the soldering iron, component failures and presence of bugs in the circuit diagram. We use a multi meter to perform this test. We keep the multimeter in buzzer mode and connect the ground terminal of the multi meter to the ground. We connect both the terminals across the path that needs to be checked. If there is continuation, then you will hear the beep sound.

Power On Test:

This test is performed to check whether the voltage at different terminals is according to the requirement or not. We take a multi meter and put it in voltage mode. Remember that this test is performed without microcontroller. Firstly, we check the output of the transformer, whether we get the required 12 v AC voltage.

Then we apply this voltage to the power supply circuit. Note that we do this test without microcontroller because if there is any excessive voltage, this may lead to damaging the controller.

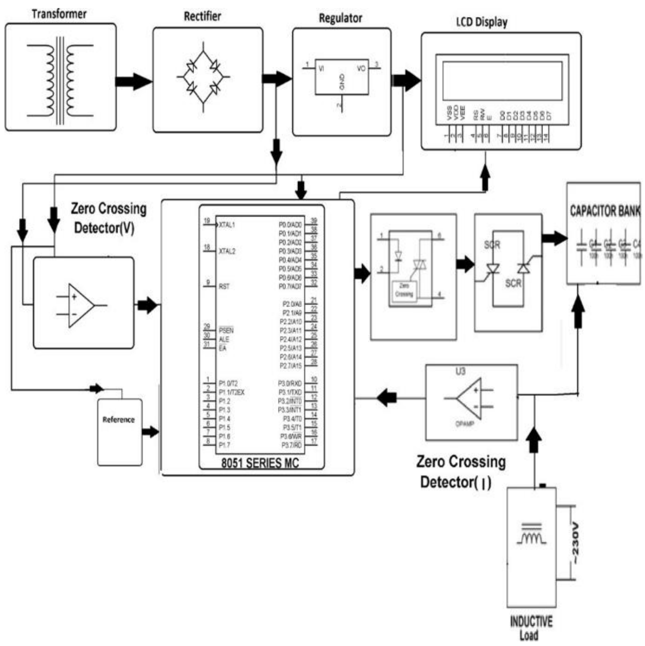


Figure 2.2: Block diagram

Advantages

- FACTS increase the reliability of AC grids.

- They reduce power delivery costs.
- They supply inductive or reactive power to the grid and improve transmission quality and efficiency of power transmission.
- There is fast voltage regulation.

Applications

- Grid integration of renewable power.
- Implementation of HVDC converter terminal performance.
- Load compensation.
- Alleviation of voltage instability.
- Limit short circuit current.
- Mitigation of sub synchronous resonance.
- Improvement of system transient stability limit.

Pitfalls

- Complexity and Cost
- High Initial Investment
- Limited Voltage Control Range
- Maintenance and Reliability

3. SCREEEN SHOT

Figure 3.1: Complete Setup of Flexible AC Transmission Using TSR

3.2. Software Requirements

Keil Micro Vision (IDE)

Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulators for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families.

Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development. When starting a new project, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.

Keil is a cross compiler. So first we have to understand the concept of compilers and cross compilers. After then we shall learn how to work with keil.

Concept of Compiler

Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors. I.E the programs written in one of the HLL like 'C' will compile the code to run on the system for a particular processor like x86 (underlying microprocessor in the computer). For example compilers for Dos platform is different from the Compilers for Unix platform So if one wants to define a compiler then compiler is a program that translates source code into object code.

The compiler derives its name from the way it works, looking at the entire piece of source code and collecting and reorganizing the instruction. See there is a bit little difference between compiler and an interpreter. Interpreter just interprets whole program at a time while compiler analyses and execute each line of source code in succession, without looking at the entire program.

Concept of Cross Compiler

A cross compiler is similar to the compilers but we write a program for the target processor (like 8051 and its derivatives) on the host processors (like computer of x86). It means being in one environment you are writing a code for another environment is called cross development. And the compiler used for cross development is called cross compiler. So the definition of cross compiler is a compiler that runs on one computer but produces object code for a different type of computer.

4. CONCLUSION, FUTURE SCOPE

4.1 Conclusion

- Future system can be expected to run at higher stress level.
- FACTS could provide means to control and alleviate stress.
- Reliability of existing systems minimize risk but not risk free.
- Interaction between facts devices need to be studied.
- More demonstration needed.
- R&D needed on avoiding security problems.
- Energy storage can significantly enhance facts controller performance.

4.2 Future Scope

- large scale grid integration of renewable energy sources.
- implementation of small grids.
- to provide reliable quality power at minimum cost.
- it will be more cost efficient to investigate the performance of combination of UPFC and FACTS using TSR in large network.

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