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MODBUS Protocol for Reading Parameter of AC Drive

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ABSTRACT: *This research paper is aimed for reading the parameters of AC Drive by using MODBUS Protocol. This communication protocol is used for Programmable Logic Controller (PLC) and this PLC is handling by controller. Hence in this we have checked and observed the parameters of AC Drive by PIC controller with Docklight Software. Here, Docklight software works exactly as AC Drive to read parameters by MODBUS Protocol. MODBUS module is a TTL to RS485 converter Module.*

Keywords: *AC Drive, Docklight, LCD, Modbus RTU, MPLAB X IDE, PIC18F4550, PIC Microcontroller ,PIC Kit 3*

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I. INTRODCTION

MODBUS protocol is a messaging structure, widely used to established master-slave communication between intelligent devices like AC Drive. A MODBUS message sent from a master to a slave contains the address of the slave, the command. Since MODBUS protocol is just a messaging structure, it is independent of the physical layer. It is traditionally implemented using RS 232, RS422, or RS485.

This MODBUS can be used for PLCs which is ultimately control by any Controller IC. This controller part is nothing but an Embedded System. A programmable Logic Controller (PLC) is a specialized computer used for the control and operation of manufacturing process and machinery in industry. It uses a programmable memory to store instructions and execute different types of functions. An Embedded system is typically a design that uses the power of a small microcontroller, like the PIC microcontroller (MCU) or dsPIC controller (DSC). These microcontrollers combine with a microprocessor unit with some additional circuits on the same chip to make a small control module requiring few other external devices [1].

Here, we used PIC18F4550 Microcontroller to interface with MODBUS module for communication with Docklight software (works as AC Drive). The Modbus RTU is an open, serial (RS-485) protocol derived from the Master/Slave architecture. It is a widely accepted protocol due to its ease of use and reliability. In this project, PIC Microcontroller works as Master and AC Drive (Docklight software) works as slave. RTU Master Command message transmits from the PIC microcontroller and from Docklight software (works as AC Drive) RTU Slave response message will come as parameter of AC Drive with respect to transmitted data. The data which receives from AC Drive (Docklight software) will display on LCD display.

Below figure 1 shows the complete picture of Master and Slave while using Modbus communication. Complete Block diagram of the System is shown in the below figure [1].

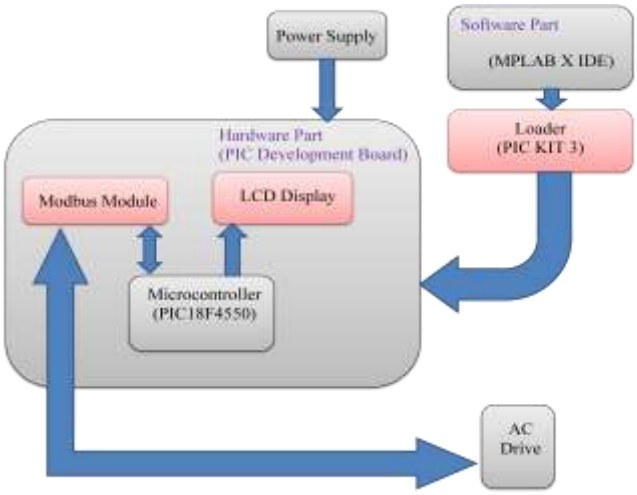

Figure 1: Block Diagram of Complete Project

II. MODBUS PROTOCOL FOR READING PARAMETER OF AC DRIVE

Hardware & Software Details:

In this Project, 5 Volts 1 amp, power supply is needed for embedded development board which is needed for PIC microcontroller IC. The PIC18 has a RISC architecture that comes with some standard features such as

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on-chip program (Code) ROM, data RAM, and data EEPROM, Timers, ADC, USART and I/O ports [2]. This controller is used to interface with MODBUS module, LCD Display.

The main features of PIC18F4550 Controller are below

- 1K byte Dual Port RAM + 1K byte GP RAM
- Full Speed Transceiver
- Streaming Port
- Internal Pull Up resistors (D+/D-)
- 48 MHz performance (12 MIPS)
- Pin-to-pin compatible with PIC16C7X5

MPLAB X IDE is a software program that runs onto a develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment (IDE), because it provides a single integrated "environment" to develop code for embedded microcontrollers.

To Test & Simulate Protocol, the Docklight software is used. Docklight can send out user-defined sequences according to the protocol used and it can react to incoming sequences. This makes it possible to simulate the behavior of a serial communication device, which is particularly useful for generating test conditions that are hard to reproduce with the original device.

Microchip's PICkit™ 3 In-Circuit Debugger/Programmer uses in-circuit debugging logic incorporated into each chip with Flash memory to provide a low-cost hardware debugger and programmer. In-circuit debugging offers these benefits:

- Low cost
- Minimum of additional hardware needed for debug

III. WORKING OF THE SYSTEM

In this Project PIC Controller is used to interface with MODBUS (TTL to RS485 converter) module, LCD Display. Once the 5V supply is given to the system, the Development board will be initialized. The different respond delay can be set through drive's parameters to adapt to different needs. For RTU mode, the response delay should be not less than 3.5 bytes interval.

0x03	Read inverter's function parameter and status parameters
0x06	Write single function parameter or command parameter to inverter

Table 3.1: Modbus Protocol supports commands

Once the program is loaded by PIC kit 3 to the PIC controller, Controller sends command automatically by the program. Here, Controller works as transmitter and AC Drive (Docklight) works as Receiver.

START	T1-T2-T3-T4
ADDR	01H
CMD	03H
High bit of the start bit	00H
Low bit of the start bit	03H
High bit of data number	00H
Low bit of data number	02H
CRC low bit	34H
CRC high bit	0BH
END	T1-T2-T3-T4

Table 3.2: RTU master command message (From Controller to Drive)

Once AC Drive (Here, Docklight Software) receives the command from Controller, as a response AC Drive will send command to the controller. This received data is a parameter of AC Drive received by MODBUS protocol. In actual scenario, the drive is a slave in the network which communicates in "point to point" master slave mode.

START	T1-T2-T3-T4
ADDR	01H
CMD	03H
Byte number	04H
Data high bit of address 0004H	13H
Data low bit of address 0004H	88H
Data high bit of address 0005H	13H
Data low bit of address 0005H	88H
CRC CHK low bit	73H
CRC CHK high bit	CBH
END	T1-T2-T3-T4

Table 3.3: RTU Slave response message (From Drive to Controller)

IV. EXPERMINETAL SET UP

The Docklight Software required project setting which is shown in below figure 4.1.

Figure 4.1: Project setting in Docklight Software

The following Hardware connections are required to read the parameter of AC Drive by MODBUS protocol. Here, PIC18F4550 controller board is used which is interfaced with MODBUS & LCD display. This MODBUS module is connected with AC Drive. Here Docklight software works as AC Drive.

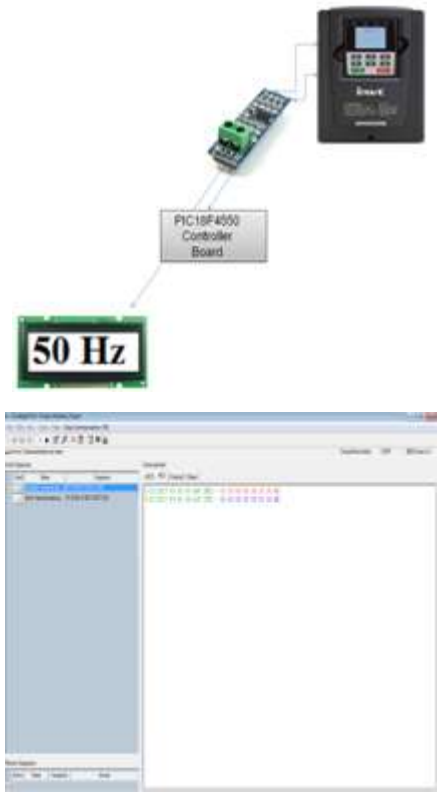

Figure 4.2: Complete Embedded system with result at the Docklight software

As shown in above figure, LCD will show the response of Drive. Here, RTU master command message (From Controller to Drive) is request of current frequency. Hence, RTU Slave response message (From Drive to Controller) is response of current frequency.

V. CONCLUSION

In this paper, we used an industrial oriented MODBUS communication protocol with PIC controller to read parameter from Drive. This complete system has been designed in order to obtain the predicted results which are shown in section IV. From this method, industrial establishments get the advantage of MODBUS RTU communication protocol compatibility.

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