Wi-Fi based Speed Control of Three Phase Induction Motor using PLC and SCADA

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Abstract—Three phase induction motor are widely used motor in industry because of its rugged construction and negligible maintenance. To operate this kind of motor, star-Delta starters are used. But, because of its constant speed characteristics many times it is driven with the help of Drive to have reliable operation its performance must be monitored continuously. Design and Fabrication of monitoring and control system for 3 phase induction motor based on Programmable Logic Controller (PLC) technology. Also implementation of a hardware and software for protection and speed control with the result obtained from the test on three phase induction motor performance is provided. The PLC correlates the operational parameters to protect motor and monitor the system during normal operational and under trip condition. Other performance parameters of three phase induction motor can also be monitored by other control devices. AC drives (or VFD) can also use to control motor rotation direction and rotation speed of three phase induction motor. All the required control or protection and motor performance data will be taken to personal computer via PLC for further analysis. Speed control from control side and protection from performance side will be priority. The monitoring, Supervisory Control and Data Acquisition of three phase induction motor done by SCADA software. The personal computer and PLC are connected by Wi-Fi.

Keywords: SCADA (Supervisory Control and Data Acquisition), Programmable Logic Control (P.L.C.), induction motors, Personal Computer (PC), variable frequency drives, Wi-Fi.

I. INTRODUCTION

Protection of induction motor (IM) against possible problem such as overvoltage, over current, overload, over temperature, under voltage, occurring in the course of its operation is very important because of it is used intensively industry as an actuator. IMs can be protected using some components such as timers, contactors, voltage and current relay. This Method is known as classical method that is very basic and involves mechanical dynamic parts.

Computer and Programmable integrated circuit (PIC) based protection method have eliminated most of the mechanical components. However, the computer based protection method requires an analog-to-digital conversion (ADC) card, and the PIC based protection method does not visualize the electrical parameters measured.

In this study, IMs new protection method based on Programmable Logic Controller (PLC) has been introduced. In this method all timers, contactors, relays and conversion card can be eliminated. Moreover, the voltages, currents, speed, temperature value of the motor, the problems occurred in the system are monitored and warning messages are shown on computer screen. PLC provides higher accuracy as well as safe and visual environment.

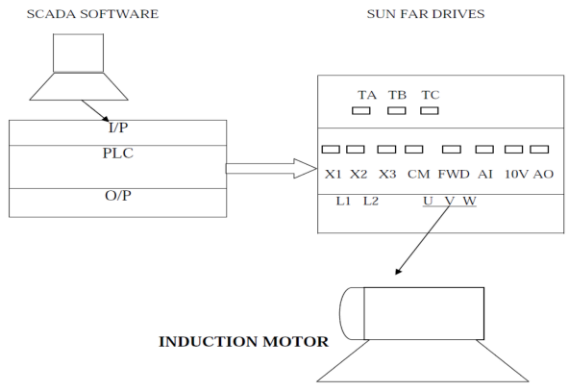

Fig. 1: Layout of Connection

The implementation of a monitoring and control system for the induction motor based on programmable logic controller (PLC) technology is described. Also, the implementation of the hardware and software for speed control and protection with the results obtained from tests on induction motor performance is provided. The PLC correlates the operational parameters to the speed requested by the user and monitors the system during normal operation and under trip conditions. Tests of the induction motor system driven by inverter and controlled by PLC prove a higher accuracy in speed regulation as compared to a conventional V/f control system. The efficiency of PLC control is increased at high speeds up to 95% of the synchronous speed. Thus, PLC proves themselves as a very versatile and effective tool in industrial control of electric drives.

II. PROGRAMMABLE LOGIC CONTROLLER

Programmable Logic Controllers (PLCs), also referred to as programmable controllers, are in the computer family. They are used in commercial and industrial applications. A PLC monitors inputs, makes decisions based on its program, and controls outputs to automate a process or machine. This course is meant to supply us with basic information on the functions and configurations of PLCs.

Originally, PC represented the PLC. As we can imagine, there was some confusion with using the acronym, as PC is today, commonly accepted to represent personal computer. Therefore, PLC is now understood to mean programmable logic controller.

A PLC is user-friendly microprocessor-based specialized computer that carries out control functions of many types and levels of complexity. Its purpose is to monitor crucial process parameters and adjust process operations accordingly. It can be programmed controlled, and operated by a person unskilled in operating computers, but, who is, nonetheless, PLC-literate.

III. DRIVE

The drive is intended as a component for professional incorporation into complete equipment or system. If installed incorrectly, the drive may present a safety hazard. The drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control equipment which can cause injury.

System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and this guide carefully. The STOP and START controls or electrical inputs of the drive must not be relied upon to ensure safety of personnel. They do not isolate dangerous voltages from the output of the drive or from any external option unit.

The supply must bed is connected by an approved electrical isolation device before gaining access to the electrical connections. The drive is not intended to be used for safety-related functions. Careful consideration must be given to the function of the drive which might result in a hazard, either through its intended behavior or through incorrect operation due to a fault.

In any application where a malfunction of the drive or its control system could lead to or allow damage, loss or injury, a risk analysis must be carried out, and where necessary, further measures taken to reduce the risk - for example, an over-speed protection device in case of failure of the speed control, or a fail-safe mechanical brake in case of loss of motor braking.

By using parameter setting of drive, desired function be done like for speed control of motor set it to Minimum or Maximum speed.

IV. TERMINAL CONNECTION OF VFD

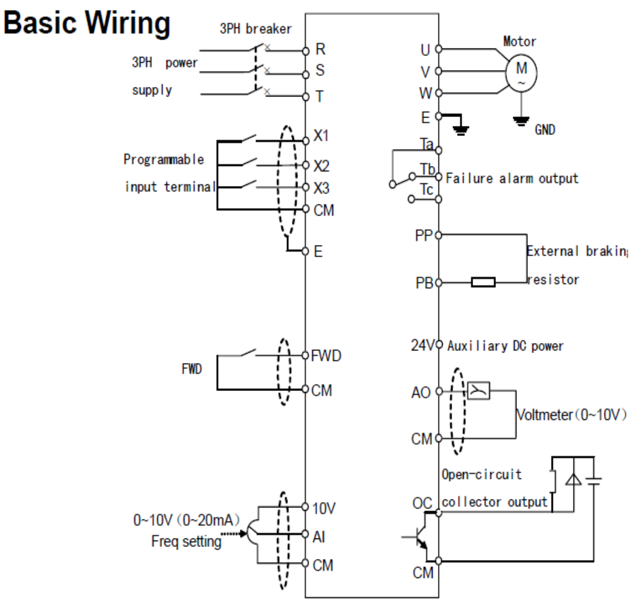

Fig. 1: terminal connection of VFD

V. PARAMETER LIST

Function	Code	Name	Setting range	Minimum Unit	Manufacture Setting	Modify Limit
Basic operation parameter unit	F0. 0	Freq input channel / mode selection	0: Digital setting 1: External input signal (0~10V / 0~20mA) 2: Serial communication terminal (1) 3: Panel potentiometer 4: External terminal selection	1	3	
	F0. 1	Freq digital setting	0.00 ~ upper freq	0.1	0.0	
	F0. 2	Operation channel and mode selection	1st part of LED: Operation channel selection 0: Control by keypad 1: Control by external terminal 2: Serial communication terminal (1) 2nd part of LED: Operation mode selection 0: Two-line mode 1 1: Two-line mode 2 2: Three-line mode 3rd part of LED: Reversal avoidance 0: Invalid 1: Valid 4th part of LED: Self-startup when power-on 0: Prohibit 1: Allow	1	1000	
	F0. 3	Lower freq	0.0 Hz ~ [F0.4]	0.1	0.0	
	F0.4	Upper freq	[F0.3] ~ 1000 Hz	0.1	50.0	
	F0.5	Acc time	0.1 ~ 600.0 S	0.1	10.0	
	F0.6	Dec time	0.1 ~ 600.0 S	0.1	10.0	
	F0.7	Acc/ dec characteristics parameter	0: Linear acc/ dec 1: S curve acc/ dec	1	0	
	F0.8	Carrier wave freq	1.5 ~ 12.0 Khz	0.1	8.0	
	F0. 9	Modulate mode	0: Asynchronism 1: Synchronization	1	0	×
	F0. 10	Parameter read-in protection	1: Only allow to modify parameter F0.1 and this parameter 2: Only allow to modify this parameter Other data: all parameter can be allow to modify	1	0	
	F0. 11	Torque boost	0.0 ~ 20.0 (%)	0.1	6.0	
	F0. 12	Basic running freq	5.0 Hz ~ upper freq	0.1	50.0	
	F0. 13	Max output volt	25 ~ 250V, 50 ~500V	1	220, 440	
I/O Parameter Unit	F1. 0	AI input lower volt	0.0V ~ [F1.1]	0.1	0.0	
	F1. 1	AI input upper volt	[F1.0] ~ 10.0V	0.1	10.0	
	F1. 2	Min setting freq	0.0 Hz ~ [F1.3]	0.1	0.0	
	F1. 3	Max setting freq	[F1.2] ~ 1000 Hz	0.1	50.0	
	F1. 4	Analog output selection	0: Output freq 1: Output current 2: Output volt	1	0	
	F1. 5	AO output lower limit	0.0V ~ [F1.6]	0.1	0.0	
	F1. 6	AO output upper limit	[F1.5] ~ 10.0V	0.1	10.0	
	F1. 7	Function selection of input terminal 1 (0 ~ 12)	0: Control terminal idle 1: Multi-speed control 1 2: Multi-speed control 2 3: Multi-speed control 3 4: FWD jog control 5: REV jog control 6: Freq setting channel selection 1 7: Freq setting channel selection 2 8: Free stop control 9: Three-line mode running control 10: DC braking control 11: REV control 12: Failure reset	1	11	×
	F1. 8	Function selection of input terminal 2 (0 ~ 12)		1	1	×
	F1. 9	Function selection of input terminal 3 (0 ~ 12)		1	2	×
	F1. 10	Reserved				
	F1. 11	Output terminal OC function selection	0: During inverter running 1: Freq reach 2: Freq level check (FDT) 3: Overload check out 4: Freq reaches upper limit 5: Freq reaches lower limit 6: During zero speed running 7: Low-volt stop 8: Inverter failure	1	0	
	F1. 12	Relay output TA/TB/TC function selection		1	8	

Table. 1: parameter list

VI. SCADA SOFTWARE

As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules. SCADA systems are used not only in most industrial processes: e.g. steel making, power generation (conventional and nuclear) and distribution, chemistry, but also in some experimental facilities such as nuclear fusion. The size of such plants range from a few 1000 to several 10 thousands input/output (I/O) channels. However, SCADA systems evolve rapidly and are now penetrating the market of plants with a number of I/O channels of several 100 K: we know of two cases of near to 1 M I/O channels currently under development. SCADA systems used to run on DOS, VMS and UNIX; in recent years all SCADA vendors have moved to NT. One product was found that also runs under Linux.

VII. CONCLUSION

From our project “WI-FI BASED SPEED CONTROL OF THREE PHASE INDUCTION MOTOR USING PLC AND SCADA’’ , we conclude that automatic and manually control of variable speed of motor using PLC and SCADA. We can easily changing in hardware compare to microcontroller.

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