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Direct on Line Starter Motor and Reverse System in Allen-Bradley PLC.

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Abstract

Practically there is no point in leave usage of DOL and R-DOL circuits in stations that include different various types of motors due to its importance to start rotation and reverse direction of specific motors. Nevertheless, curry out of DOL and its reverse on synchronous and induction generally need much more works and efforts and it is not easy to implement in general commercial work stations or remote fields. On contrary, applied of DOL and R-DOL in PLC is proposed way to be applied and identify of its components on this work that regard as peripherals to PLC. Pico PLC will be employing to this purpose. Simplify of programming circuit written codes caused by ladder language and applied by software name's Picosoft version 6 for this project case. Many development countries began using PLC in its industrial field in a jiffy. In this article, there is a providing for simulation, circuit diagram and communication for DOL and R-DOL circuit by PLC and its result on board separately.

Key word; DOL, R-DOL, PLC, RS-232 and Picosoft

دائرة تشغيل الخط المباشر ودائرة تشغيل معكوس الاتجاه في جهاز المسيطر المنطقي المبرمج ـ آلن براديلي

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الخلاصة

بصوره عمليه لاجدوى من الابتعاد عن استخدام دائره التشغيل الخط المباشر ودائرة التشغيل معكوس الاتجاه في المحطات التي تحتوي على انواع مختلفة ومتعدده من المحركات نضرا لاهميتها في بدء تحديد اتجاه الحركه او عكس اتجاه الحركه.

تنفيذ دائرة تشغيل الخط المباشر للمحركات ودائرة تشغيل معكوس الاتجاه المحركات الحثيه لو المحركات المتزامنة بصورة عامه تحتاج الى جهد وعمل جدا كبير وهي ليست سهلة التنفيذ في محطات العمل العامة التجارية والحقول الانتاجية الطرفية. ولكن على العكس تطبيق واستعمال دائرة تشغيل الخط المباشر ودائرة تشغيل معكوس الاتجاه في جهاز المسيطر المنطقي المبرمج (PLC) هي الدائره والنمودج المقترح في هذا البحث من حيث التنفيذ و ممثالة المكونات التي تعتبر كوحدات ملحقه بالجهاز السيطر المنطقي. النوع البيكو ضمن المسيطر المنطقي المبرمج سوف يوضف لتنفييذ هذا الغرض. تبسيط كتابة شفرة الدائره البرمجية بسبب لغة السلم والسوفت وير المستخدم هو بيكوسوفت الاصدار السادس . لذلك الكثير من الدول المتطورة بدئت باستخدام جهاز المسيطر المنطقي المبرمج في الحقول الصناعية في فتره سريعة جدا. في هذة المقالة نحن سوف نجهز محاكاة ـ الرسم البياني للدائرة وجهاة الاتصال في دائرة تشغيل الخط المباشر ودائرة تشغيل معكوس الاتجاه ونواتجها عمليا بصوره منفصلة.

الكلمات المفتاحية : دائرة تشغيل الخط المباشر ؛ دائرة تشغيل معكوس الاتجاه ؛ جهاز المسيطر المنطقي المبرمج ؛ نقطة الاتصال المتسلسل-232 ؛ السوفت وير بيكوسوفت.

Introduction

Diverse starting techniques are engaged for beginning induction and synchronous drives since these drives pull more beginning current throughout beginning. To avoid loss to the windings owing to the great beginning current stream, there is an engagement for diverse kinds of beginners. The humble procedure of drive beginner for the induction and synchronous driver is the Direct on Line beginner. Direct on Line (DOL) is to find out the best dependable and useful start process which has the fewer influence worth difficulties. These three simple start techniques which diverge in their individual cabling joining are the best appropriate and commonly used start technique in the manufacturing region owing to its financial details [1]. To begin, the contactor is locked, put on full route voltage to the diver windings. The driver would pull a very great inrush current for an exact small period, the magnetic field in the iron, and then the current would be partial to the Protected Rotor Current of the drive. The drive would develop Protected Rotor Torque and create to hurry to full rotational quickness [2].Circuit theory of DOL [1, 2]. PLC dependable usages [3-7], description of circuit components with details [8-14], there is a describing for the mechanism of interfacing between PC and PLC as well as DOL and R-DOL implementation in Picosost and finally down load this code to PLC.

In this paper, firstly the illustration of the DOL and R-DOL in general. Then programming mentioned circuit at PLC. Finally the evaluation of viable and feasible mode is done by PLC.

Concept of Direct on Line (DOL)

Naturally To begin explaining for Direct on Line (DOL) in existing model, the contactor is latched, relating complete route voltage to the drive windings. The drive would properly pull an exact great inrush current for an actual small period, the magnetic field in the hard, and then the current would be imperfect to the Protected Rotor Current of the drive. The drive would grow Protected Rotor Torque and create to quicken to filled quickness.The drive capacity would distress the period occupied for the drive to quicken to filled quickness and thus the period of the great beginning current, but not the magnitude of the beginning current [1]. Providing the torque established by the drive tops the load torque at all quickness during the begin rotation, the drive would spread filled quickness. If the torque carried by the drive is fewer than the torque of the load at any quickness through the begin rotation, the drive would stops quickening. When the beginning torque with a DOL beginner is deficient for the load, the drives have to be changed with a drive which can grow a greater beginning torque [2]

Programmable Logic Controller (PLC) Usage

There is a settled in a rule of automation at its water usage stations. Originally built on hard logic units, the knowledge used was upgraded, upgraded and improved in the late seventies by the liberal and wide use of Programmable Logical Controllers (PLC). The drinking water creation of the wasted area of Paris (1 million dwellers) has been completely automatic (with around 100 PLCs), and unmanned next hours [3]. The refinement of water for internal drinking includes numerous steps of dealing of the raw water which are essential to eliminate postponed objects, color and bacteria previously being supplied to the water delivery system. The viability of automating the control and cleaning of the filters through the request of a suitable PLC founded plan [4]. The skills of Bechtel Water Technology Engineering, in the

request of Programmable Logic Controllers to schemes which were considered and built on behalf of a main water & unused water value [5].

A method for development of such system network using potentials of programmable logic controller (PLC) is a getaway [6]. The FPGA dedicated technique of planning a PLC program printed according to the specifics standard. There is pronounced whole mixture procedure from the package account to hardware employment through planning and development events [7]. Obviously there are almost control fields that PLCs endure and employ in it, like Home Automation Control [8]. Recently it's used for Regulation of power production in power plants for turbine and generator [9] etc…

Execution Circuits Components Description

A programmable logic controller (PLC) or programmable controller is a digital computer employed for automation of normally engineering electro-mechanical procedures, like regulator of equipment on factory gathering outlines, enjoyment rides, or light matches. PLCs are employed in numerous machineries, in numerous businesses. PLCs are planned for several engagements of digital and analog inputs and outputs, lengthy temperature varieties, immunity to electrical noise, and resistance to shaking and impact. Plans to control engine process are naturally kept in battery-backed-up or non-volatile memory. A PLC is a sample of a "hard" real-time system due to output effects have to be created in reply to input situations within a restricted period; else unplanned process would outcome [10, 11, 12].A relay is an electrically activated key. Numerous relays employ an electromagnet to mechanically activate a key, but extra working values are also employed, like solid-state relays. Relays are employed when there is essential to control a circuit by a low-power signal (with whole electrical isolation between control and controlled circuits), or where numerous circuits must be controlled by a lone signal. The first relays were employed in long expanse telegraph circuits as amplifiers: they regular the signal coming in from one circuit and re-transmitted it on another circuit. Relays were employed widely in receiver contacts and quick processers to achieve logical processes. [13].A Normally Open (NO) Impulse Key is an impulse key that, in its evasion public, creates no electrical contact with the circuit. Just if the key is pushed down,

it does make electrical contact with the circuit. If the key is pressed down, the key makes electrical contact and the circuit is now locked. Thus, electricity can now stream to the new portion of the circuit joining to the push key and make the device turn or power on the respective portion. Normally Open Impulse keys are the greatest public kind of push keys used in devices and circuits. A Normally Closed (NC) Impulse Key is an impulse key that, in its evasion national, makes electrical contact with the circuit. When the key is pushed down, the key no longer makes electrical contact and the circuit is now open. Thus, electricity has no longer stream to the added portion of the circuit to turn or power on the respective portion of the circuit the key was made to switch. Normally Closed Push keys are not the greatest public kind of push key used; Normally Open Push Keys are. Nevertheless, they still have general use and request in several strategies [14, 15]. RS-232 stands for Recommend Standard number 232 and C is the latest revision of the standard. The serial ports on most computers use a subset of the RS-232C standard. The full RS-232C standard specifies a 25-pin "D" connector of which 22 pins are used. Most of these pins are not needed for normal PC communications, and indeed, most new PCs are equipped with male D type connectors having only 9 pins [16].

PLC to PC Connection and Interfacing

The period logic is employed since the programming is mainly concerned with applying logic and changing processes. Input devices such as switches, and output devices such as drives, being controlled are connected to the PLC and then the controller displays the inputs and outputs agreeing to the machine or process. Originally PLCs were planned as an extra for hard-wired relay and timer logic control systems. (Hard-wiring means that all of the components were manually connected by wires). PLC contains of two parts i.e. the PLC hard ware and programming [17].

The proposed device using is Programmable Logic Control (PLC) from Rock Well Allen-Bradly, it specific model is (Pico 1760-L12 AWA-ND) as displayed in Fig.1

Fig.1 PLC / Pico 1760-L12 AWA-ND

Firstly there are two usages groups of bush button like normally open (N.O) in green color and normally close (N.C) in red color, and it is represented to input signal. Where these bush button is wiring to PLC inputs. PLC Allen - Bradley from Rock-well is working on 220 v directly so that it is employ to this function properly. The proposed circuit panel also contains 220 v relay coil that is wiring also to PLC output, this is control circuit on output. There are three color Signal light bulbs and it represents to output and it connected to power circuit on output as displayed in Fig.2

Fig.2 Electrical Control Panel

Next, the proposed software usage is Picosoft vision 6 that let us to program PLC by using Ladder Language due to it is specific software for this version of PLC/Pico. RS 232 connector and its cable are to make Simulink and download connection between PC and PLC. Finally the connection between PLC and PC is done by using serial port and RS 232 cable physically.

Execution Proposed of Direct on Line Starter (DOL) Logically

The ladder language has made a good job for it obliviously since it did not interested in difficulty of diagram but it make them easier more and more. By sound of it there is no point in leave ladder language and it not is bound to any limit. By using ladder language, it has been accomplished the programming the Direct on Line (DOL) circuit. Explain circuit diagram is consisting of 3 logical switches.

Logical Switch number 1 at Picosoft Software is normally close (N.C) and it is used for re-set the circuit to let it start over again. whereas it is N.C so as to it let power through it directly as soon as it has not power signal from outside switch that connect to position 1 in PLC. On contrary, when this logical switch get signal power from position 1 in PLC it would cut circuit off. Logical Switch number 2 at Picosoft Software is normally open (N.O) is used for start the system and get output. Whereas it is N.O so as to let power through it directly as soon as it get signal power from position 2 in PLC. On contrary, this logical switch prevents the signal power to through it when there is no signal power from output switch that connected in position 2 in PLC.

Logical output number 1 at Picosoft Software is normally open (N.O) is used for continuation of signal power so that it has output logical address. Whereas it is N.O so as to let power through is directly as soon as it get signal power form logical output at Picosoft Software. In contrary, this logical switch prevents the signal power to through when it flows from logical switch number 1.

Due to logical output number 1 at Picosoft Software is connected to logical switch number 2 in parallel connection to let the power to through in it when logic switch number 2 is cut it off and has ability of continuation on output as Displayed in Fig.3
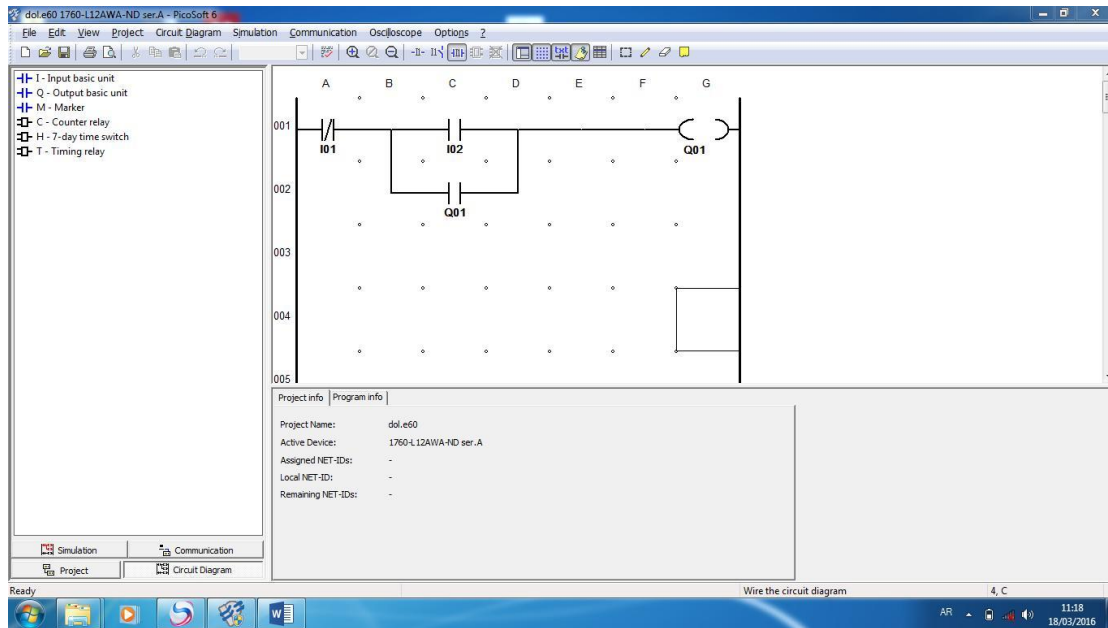
Fig.3 DOL diagram by Picosoft's

Operation simulations and simulation page at Picosoft Software and see power position stop, before logical switch number 2 and after switch number 1, as displayed in Fig.4
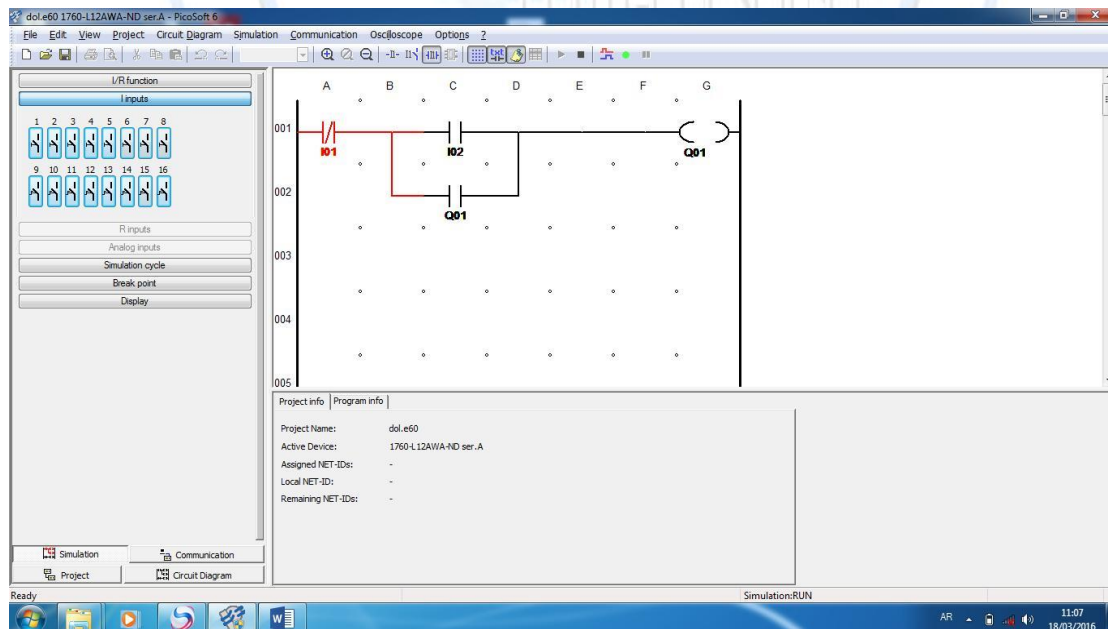

Fig.4 operation simulation without power signal output

Logical switch normally open has address number 2 is connected on electrical panel with push button normally open has address number 2 due to it is connected to position 2 in PLC. Thus when the worker press push button number 2 on electrical panel, it let the power to through and get out put on other hand nosh button switch number 2 on electrical panel give power signal to logic switch number 2 on Picosoft software as displayed in Fig.5.
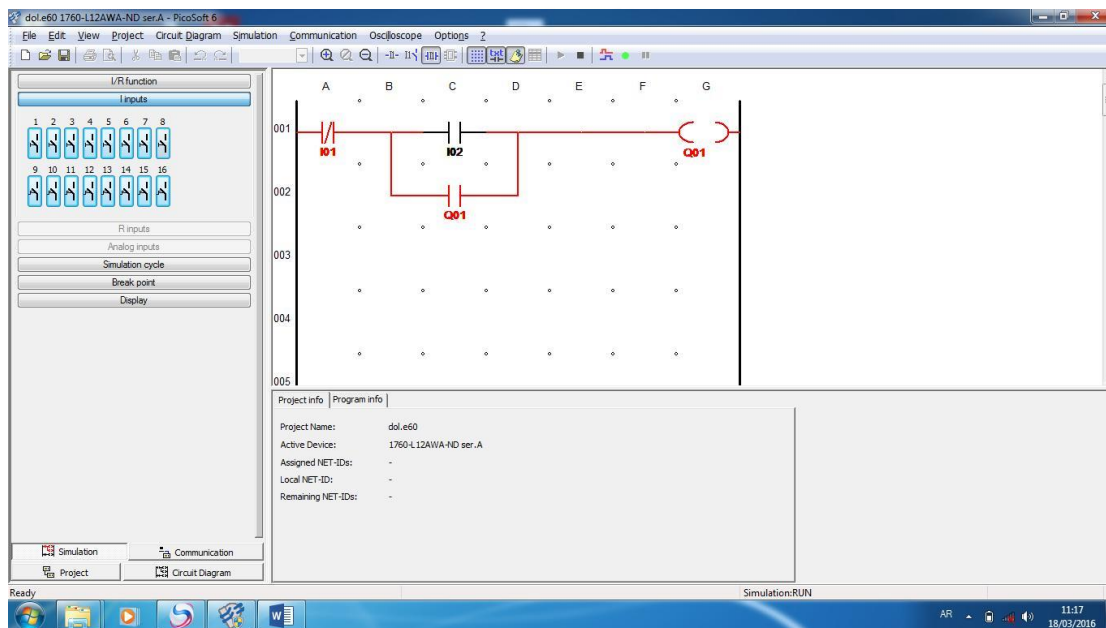

Fig.5 operation simulation with power signal output

Logical switch normally close has address number 1 is connected on electrical panel with push button normally open has address number 1 due to it is connected to position 2 in PLC. Thus when the worker press push button number 1 on electrical panel, it let the power to be cut off instantaneously and reset the circuit as displayed in Fig. 3 now the worker can return the circuit operation again, press switch number 2 on electrical panel to start then press switch number 1 on electrical panel to reset and return all operations as the worker need.

Execution proposed of Reverse - Direct on Line Starter (R-DOL) Logically

Reverse direct on line is change the direction of motor in safety mode. Whereas, logical output address 1 at Picosoft Software is represented direct on line and logical output number 2 at Picosoft software is represented to reverse direct on line as displayed in Fig.6
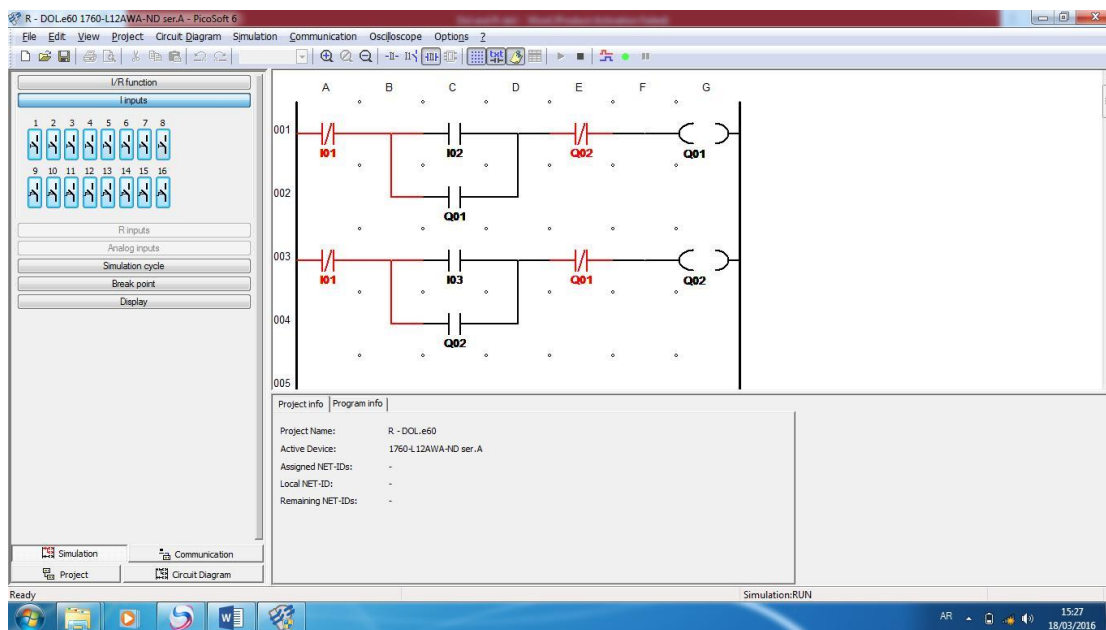

Fig.6 operation diagram at safety mode by Picosost Software

As mentioned before, logical switch number 2 at Picosoft software is used for start the DOL circuit and logical switch number 1 at Picosoft software is used for re-set the circuit, as displayed in Fig.7
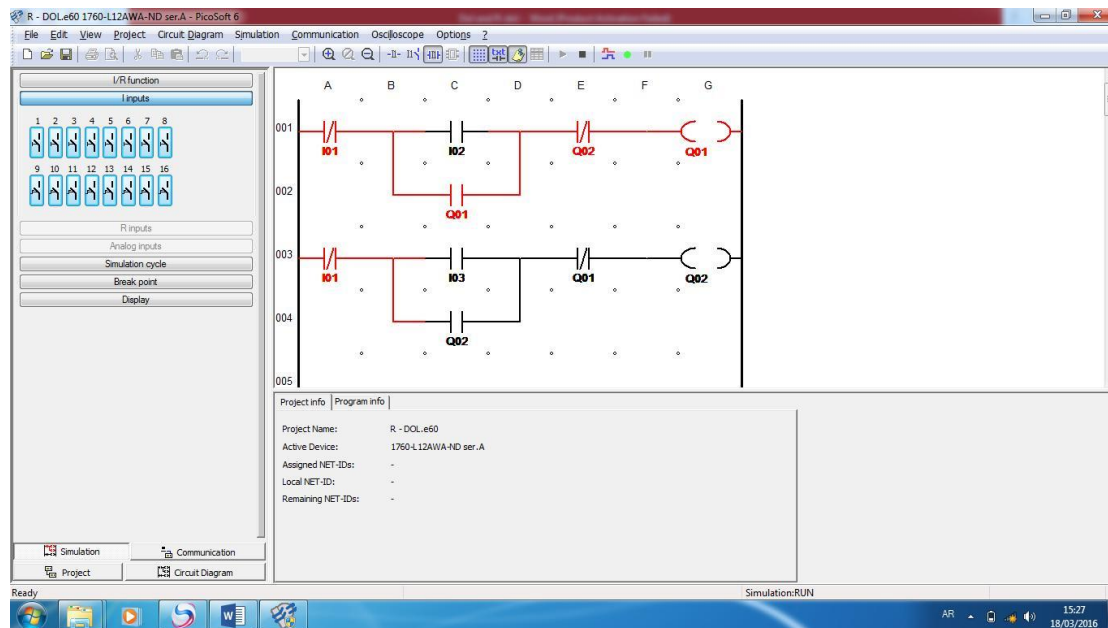
Fig.7 operation simulation for DOL power signal output

Whereas the second output is represent to reverse direct on line (R-DOL). It is used to change direction of motor connection to PLC circuit. Logical switch normally open has address number 3 is at Picosoft software connected on electrical panel with push button normally open has address number 3 due to is connected to position 3 in PLC . Thus when the worker presses push button number 3, it let the power to through and get output. In this paper, There has making a security mode by use 2 logical switch normally close put it before output at Picosoft software. First one has the address of output 2 so as to be cut power off on output 1 when output 2 is work on, second one has the address of output 1 so as to be cut power off on output 2 when output 1 is work on, as displayed in Fig.8.
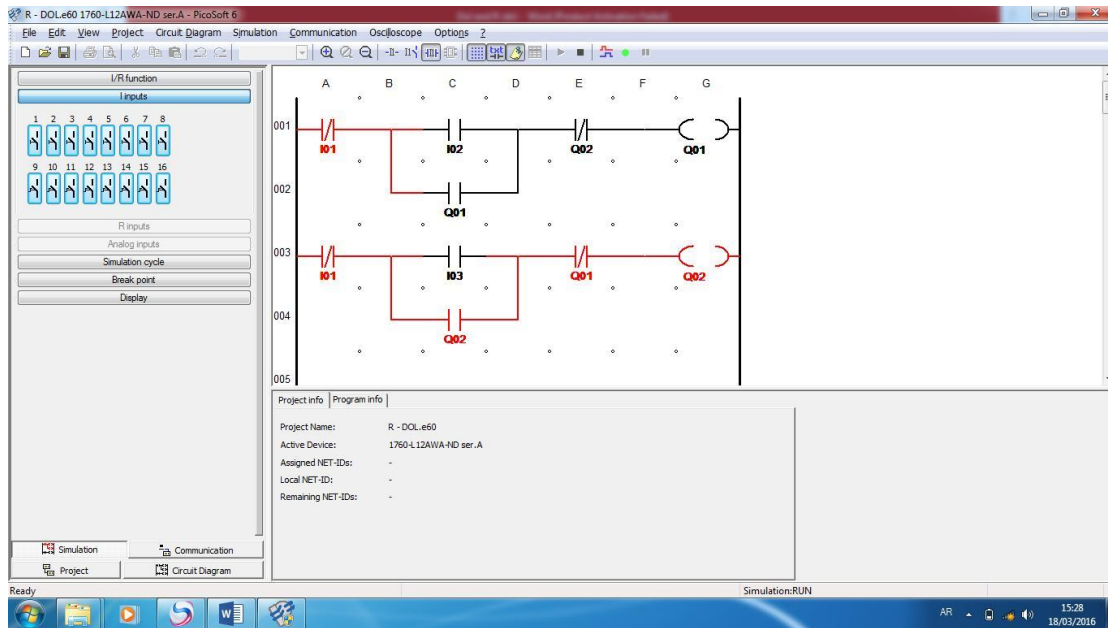
Fig.8 operation simulation for R-DOL power signal output

Result and Discussion

There are an important alarm checking for accreted connection properly between PLC and PC and check the right code downloaded thorough it by note blink yellow bulb at middle of PLC. When the worker start power on, the motor is stand by, in safety mode and don't rotate. Whereas the worker can notice bulb for first output and second output is signaling and indicating to power off, as displayed in Fig.9
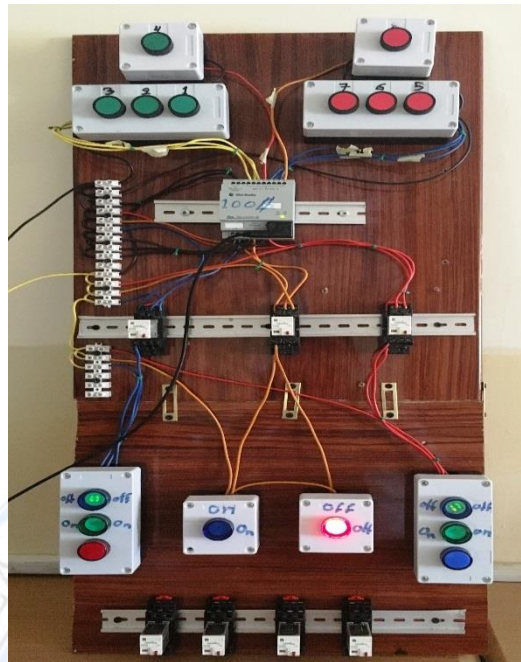
Fig.9 electrical control panel interfacing at safety mode

When the worker press bush button 2 on electrical panel, the motor is start rotation in a one direction. Whereas the worker can notice bulb for first output is indicating to power on and bulb for second output is signaling to power off, as displayed in Fig.10
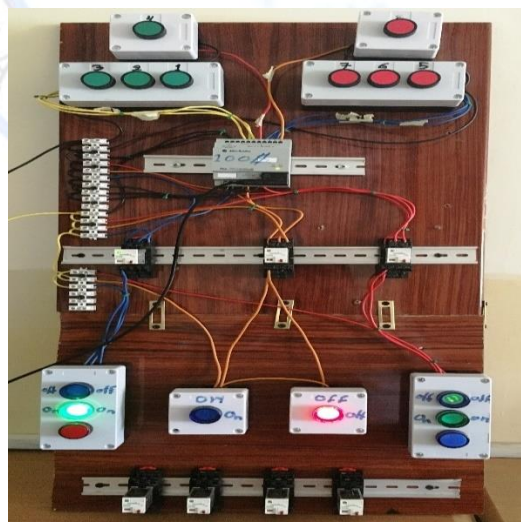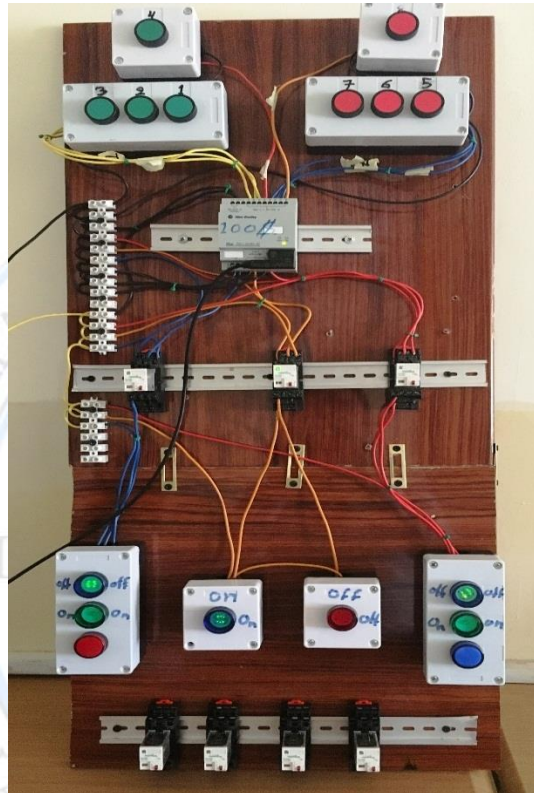

Fig.10 DOL power signal output

Then, the worker should press bush button 1 on electrical panel to reset circuit, as displayed in Fig.9. When the worker press bush button 3 on electrical panel, the motor is start rotation in reverse direction in safety mode. Whereas anyone can notice bulb for first output is indicating to power off and bulb for second output is signaling to power on, as displayed in Fig.11.

Fig.11 R-DOL power signal output

Then, the worker press bush button 1 to reset circuit, as displayed in Fig.9 and then returns the previous operation respectively as the worker need.

In general DOl starter is need a lot of expensive components such as coils, conductor, gear box and overload, etc. this means its circuits would be exorbitant as well as have a time and more effort to finish but not with proposed circuit by PLC. Whereas it just needs software and little cheap components to finish.

Conclusion

In the past and up to now direct on line (DOL) control circuit is used on starter induction and synchronous drive. Implementation is done obviously but it is not satisfactory due to load and loss of current at beginning start. Therefor ones have to looking forward to new method and new theory to get rid of this loss of current. General components that employed to curried out control and power circuit is at cheap range to any factory. PLC results for dol and R-dol experiment are much too worth. Picosoft usually works on all windows versions and gives amazing results. It is executed logic language like ladder easily. By sound of it, there is no point in leaving PLC applications for future works.

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