طراحی چند تمرین PLC

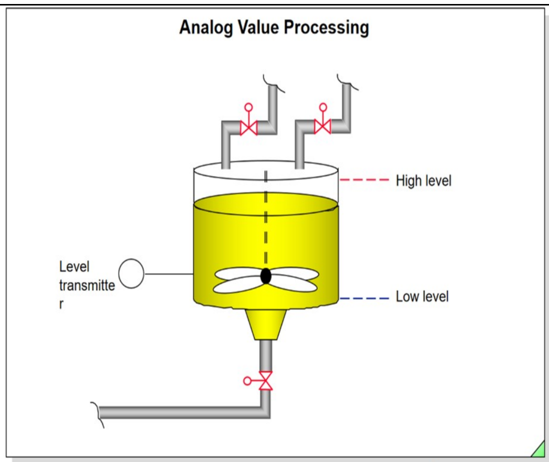
تمرین ۱:

در نرم افزار Micro/Win برنامه کنترلی بنویسید که :

الف) از یک سنسور سطح سنج مجهز به یک مبدل 4-20 mA مقدار مایع داخل مخزن را اندازه گیری نموده و آنرا برحسب لیتر در یک محل حافظه مشخصی ذخیره نماید.

ب) در داخل مخزن دو سنسو سطح سنج یکی به عنوان LL-Sensor و دیگری به عنوان HL-Sensor در بالای مخزن قرار دارد برنامه کنترلی طوری طراحی نمایید که وقتی محلول داخل مخزن به سطح LL می رسد هر دو ورودی بالایی باز شوند و وقتی مقدار مایع داخل مخزن به نصف می رسد (یا توسط یک سنسور دیجیتالی که در وسط منبع قرار داده می شود آشکار سازی انجام می شود یا با استفاده از سنسور آنالوگی آشکار سازی می شود) یکی از شیرهای ورودی بسته شود و وقتی سطح مایع به سنسور HL می رسد شیر دوم هم بسته شود.

ج) این عمل بین دو سطح LL و HL به طور خود کار تکرار شود.



مخزن استونه ای با مقطع دایره ای به شعاع یک متر و ارتفاع مخزن 2.5 متر می باشد.

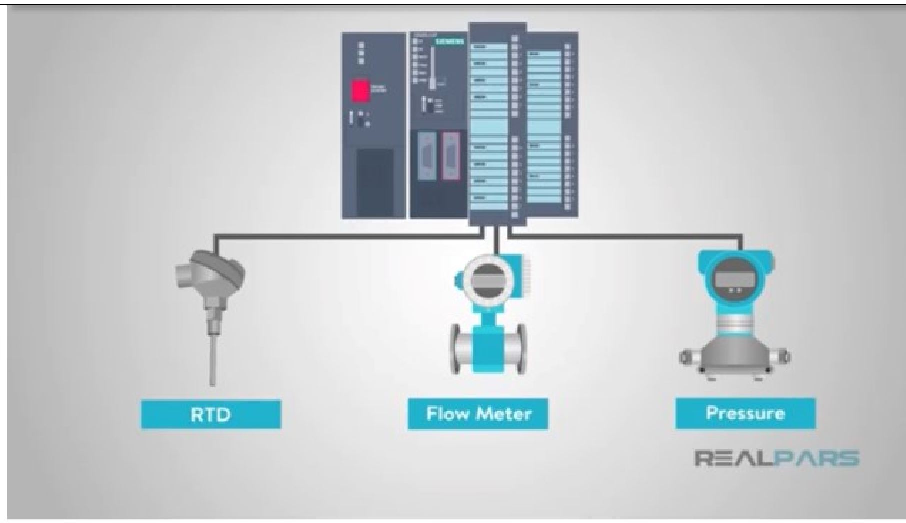
حل: برای حل در ابتدا بایستی خواسته های کنترلی را خوب متوجه بشویم . که در صورت این تمرینات تشریح شده است.

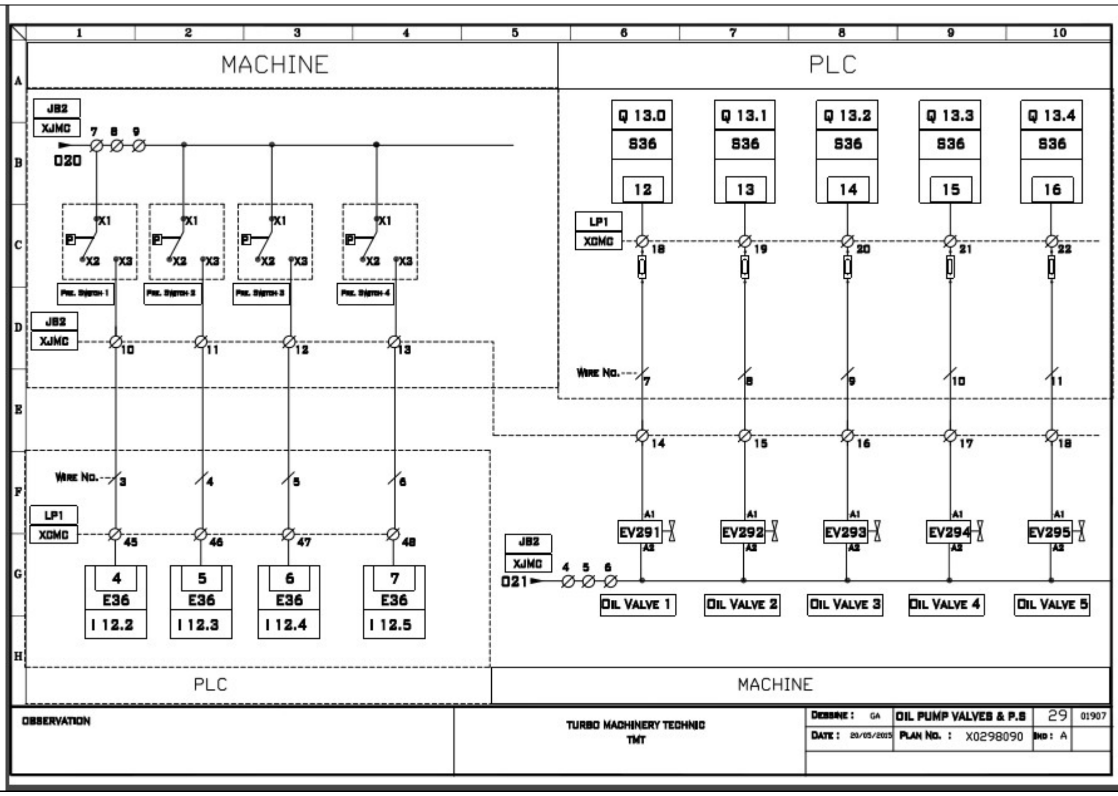
در مرحله بعد نقشه های قدرت و کنترلی را توسط یک نرم افزار نقشه کشی مانند اتوکد رسم نماییم و در آن تمامی سنسورها و محرکها را مشخص نموده و مهمتر از همه اینها جدول آدرسهای ورودی و خروجی را مشخص نماییم.

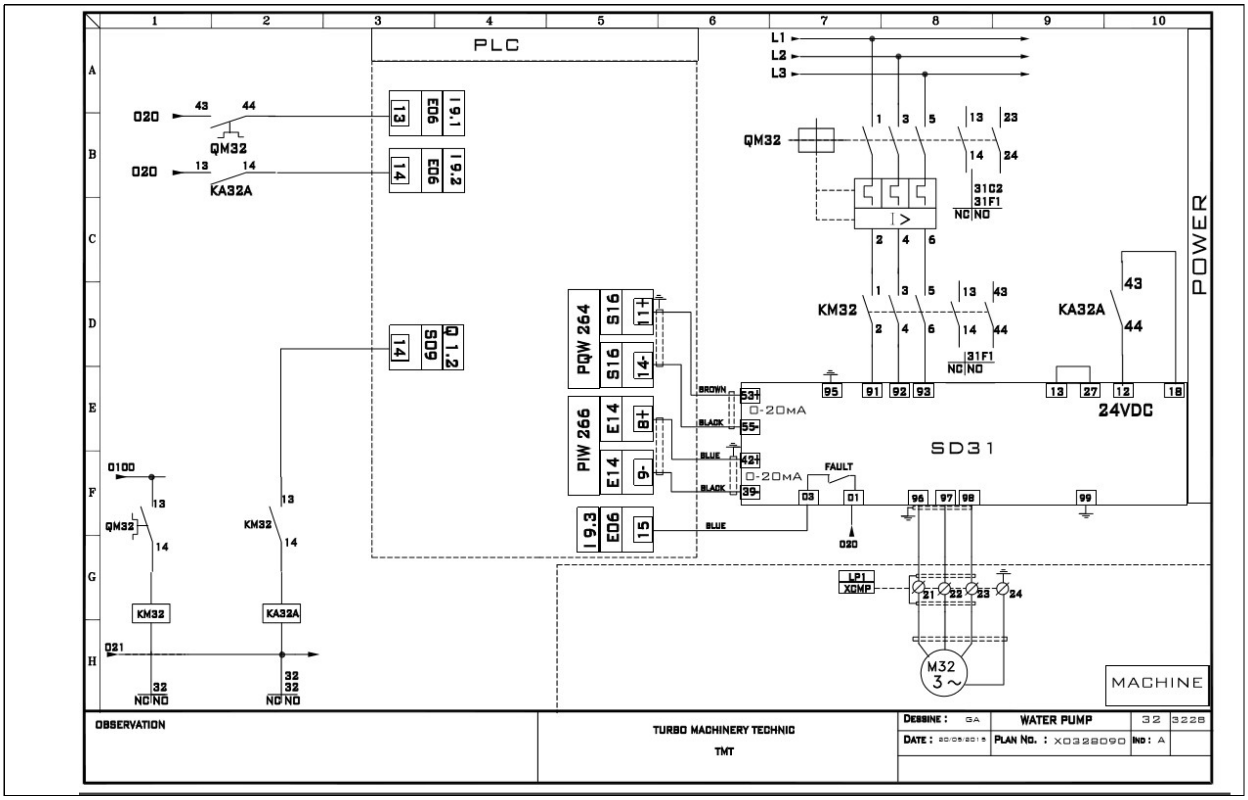
شرح سنسور یا محرک	آدرس ورودی و خروجی	توضیحات
سنسور آنالوگ سطح سنج	AI1 (LOGO) AIW0 (S7-200) PIW 200 (S7-300 OR 400)	سنسور و ترانسدیوسر از نوع جریانی با خروجی 4-20mA
سنسور درجه خرارت از نوع PT100 یا TC	AI2 (LOGO) AIW2 (S7-200) PIW 202 (S-300 OR 400)	سنسور سنجش درجه حرارت از نوع RTD مثلا PT100 یا از نوع ترمو کوپل TC
سنسور LL	I 0.0 (I1)	این سنسور در ارتفاع ۲۰ سانتی متری از کف مخزن قرار دارد
سنسور HL	I 0.1 (I2)	این سنسور در ارتفاع ۱۰ سانتی متری از سقف مخزن قرار دارد
سنسور وسط ML	I 0.2 (I3)	این سنسور در وسط مخزن قرار داده می شود تا وقتیکه سطح مایع به این نقطه رسید فقط یک شیر ورودی باز شود
کلید ON-OFF اصلی	I 0.4 (I4)	
شیر شماره ۱ خروجی	Q 0.0 (Q0)	
شیر شماره ۱و2 ورودی	Q 0.2– Q 0.1 (Q1-Q2)	

در این مرحله بایستی انتخاب PLC مناسب به لحاظ سخت افزاری و نرم افزاری انجام شود. در خصوص سیستمهای اتوماسیون زیمنس:

نرم افزار LogoComfort V5	سخت فزار LOGO
نرم افزار Micro/Winn	سخت افزار S7-200
نرم افزار Simatic Manager	سخت افزار S7-300 یا S7-400

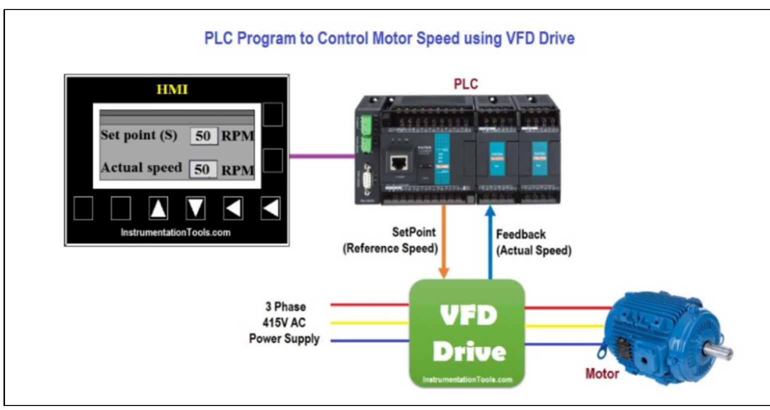

RTD
Flow Meter
Pressure
REALPARS


MACHINE
PLC
Q 13.0
Q 13.1
Q 13.2
Q 13.3
Q 13.4
S36
JB2
XJMC
LP1
XCMC
Wire No.
EV291
EV292
EV293
EV294
EV295
Oil Valve 1
Oil Valve 2
Oil Valve 3
Oil Valve 4
Oil Valve 5
E36
I 12.2
I 12.3
I 12.4
I 12.5
PLC
MACHINE
OBSERVATION
TURBO MACHINERY TECHNIC
TMT
OIL PUMP VALVES & P.S
PLAN No. : X0298090

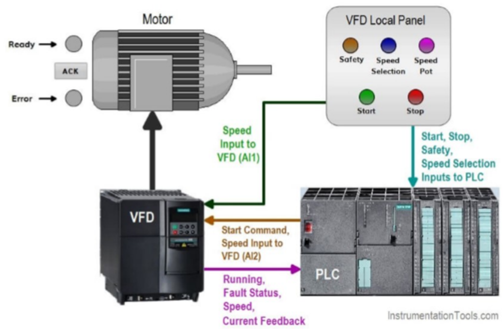


تمرین ۲:

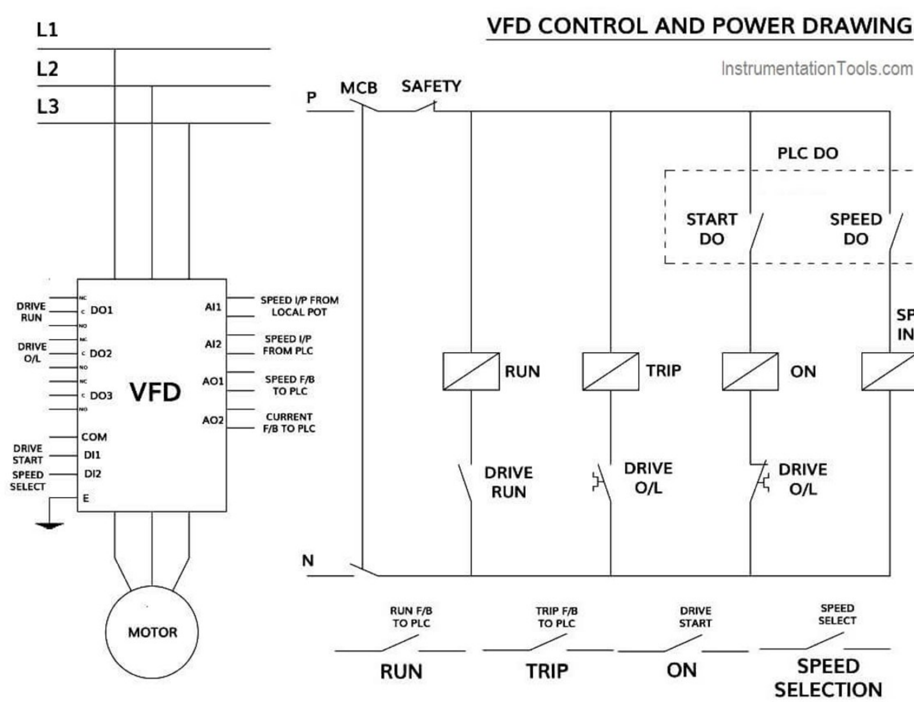
چگونه یک درایو ماشین AC یا DC را توسط PLC کنترل کنیم:

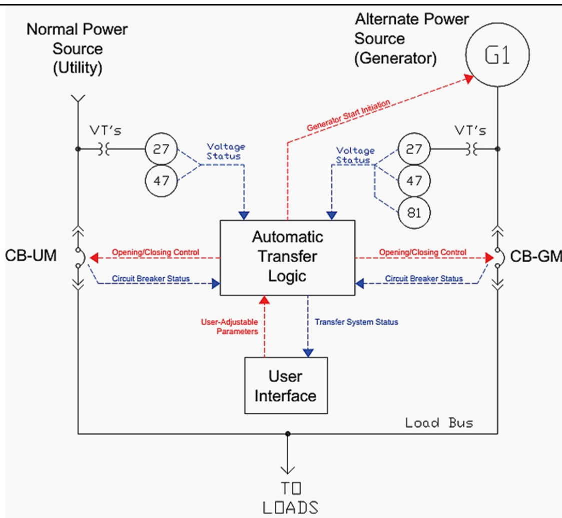


How to Control VFD with PLC ?



حل:





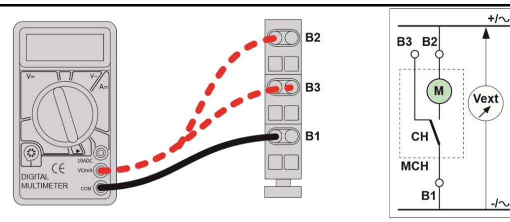
تمرین ۳: طراحی یک سیستم کنترل اتوماتیک چنج – اور برق شهر و ژنراتور اضطراری توسط PLC

مراحل حل:

۱ – شناخت دقیق اجرای تشکیل دهنده این سیستم

۲–

Air Circuit Breaker External Labels

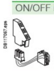


CH: spring charged limit switch

Indication contacts and remote operation

Indication contacts

ON/OFF indication contacts (OF)

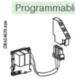


Changeover contacts (6 A - 240 V)	4 (standard)
1 low-level OF to replace 1 standard OF (4 max.)	**LV847339**

"Fault trip" indication contacts (SDE)

Changeover contact (6 A - 240 V)	1 (standard)
1 additional SDE (6 A - 240 V)	**LV847340**
1 additional low-level SDE	**LV847341**

Programmable contacts (programmed via MicroLogic X control unit)



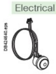
2 contacts (M2C) (5 A - 240 V)	**LV847403**

Remote operation

"Ready to close" contact (1 max.)

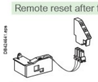
	PF
1 changeover contact (5 A - 240 V)	**LV847342**
1 low-level changeover contact	**LV847343**

Electrical closing pushbutton



	BPFE
1 pushbutton	**LV847512**

Remote reset after fault trip



Electrical reset	RES
100/130 V AC	**LV847344**
200/240 V AC	**LV847345**
Automatic reset	RAR
Adaptation	**LV847346**

en The MCH gear motor charges the closing springs automatically after the device closes.

1. Verify the continuity between terminals B1 and B2.
2. Charge the closing spring manually.
3. Verify the continuity between terminals B1 and B3.
4. Connect the MCH gear motor to the power supply on B1 and B2.
5. Close circuit breaker.
6. Motor automatically charges the closing spring.
7. Remove the power supply.
8. Verify the continuity between terminals B1 and B3.

ANSI 27 – Undervoltage

Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer. Works with phase-to-phase voltage.

ANSI 47 – Negative sequence overvoltage

Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage.

Frequency protection functions

ANSI 81H – Overfrequency

Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality.

ANSI 81L – Underfrequency

Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality. The protection may be used for overall tripping or load shedding. Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage by a restraint in the event of a continuous decrease of the frequency, which is activated by parameter setting.

ANSI 81R – Rate of change of frequency

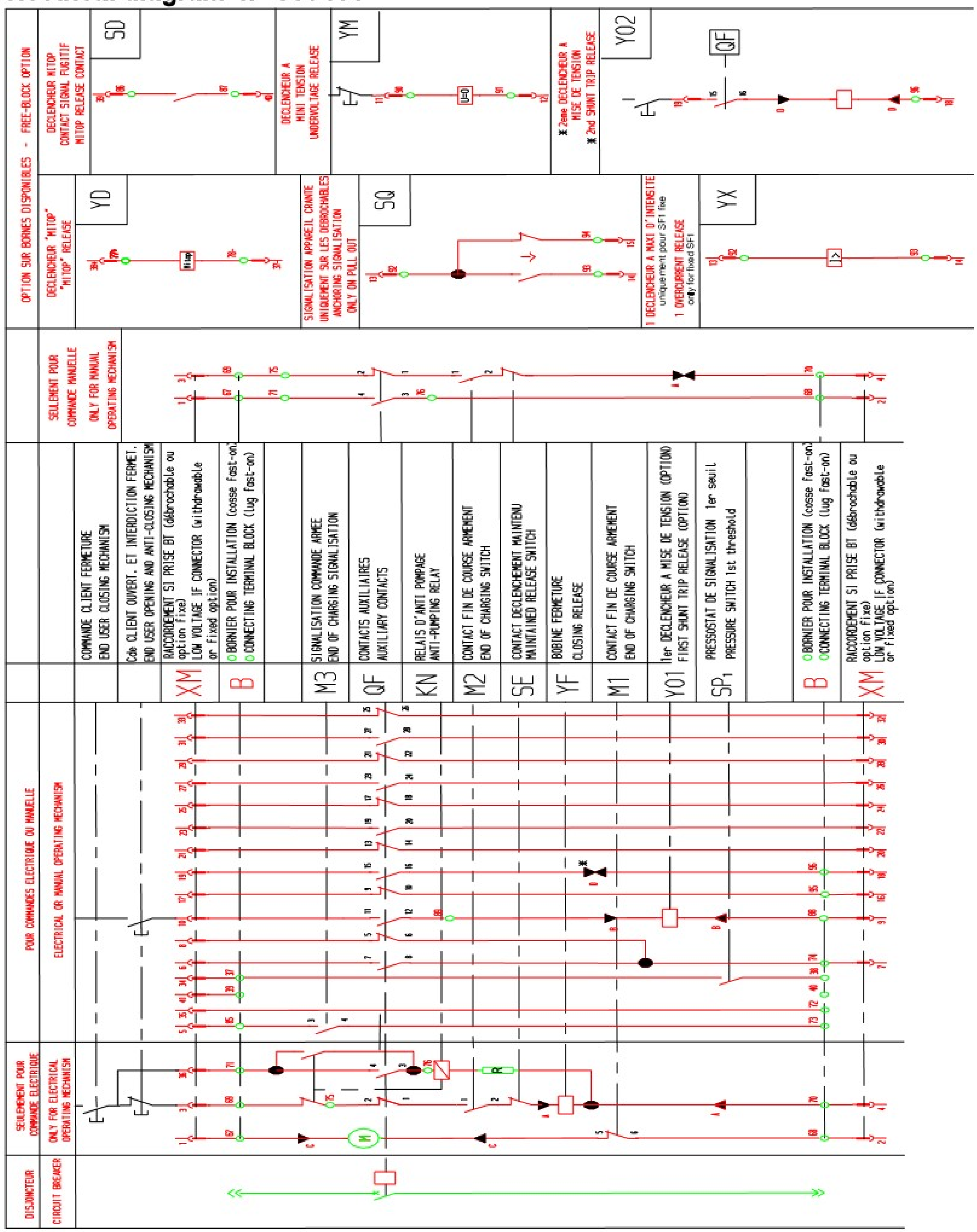
Protection function used for fast disconnection of a generator or load shedding control. Based on the calculation of the frequency variation, it is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function.

Phase Sequence Relay, 17.5mm, 600PSR

MiCOM P92x

Voltage and Frequency
anagement and Protection
Relays

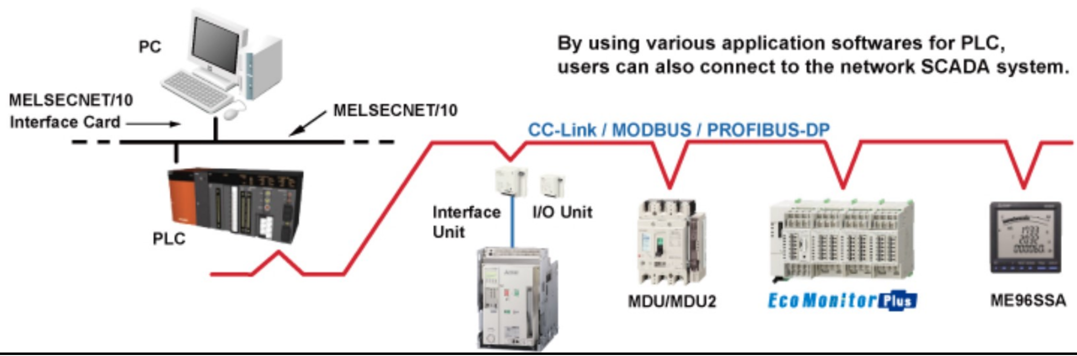
electrical diagram n° 889461



Interface Unit

- By adding various interface units, connection to the main network is available. *CC-Link, MODBUS, PROFIBUS-DP
- It is possible to circuit breaker ON/OFF management by remote control and monitoring of various information.

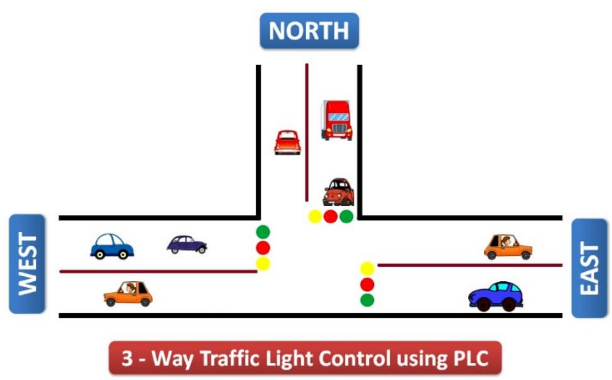
Network Instance



تمرین ٤:

طراحی سیستم کنترل اتوماتیک چراغ راهنمایی توسط PLC

Traffic Light Control using PLC



List of Inputs and Outputs for Traffic Control System

S.no	Address	Name	Input/Output
1	I:0/0	Start	Input
2	I:0/1	Stop	Input
3	B3.0	Memory	Memory
4	O:0/0	West Green	Output
5	O:0/1	East Red	Output
6	O:0/2	North Red	Output
7	O:0/3	East yellow	Output
8	O:0/4	East Green	Output
9	O:0/5	West Red	Output
10	O:0/6	North Yellow	Output
11	O:0/7	North Green	Output
12	O:1/0	West Yellow	Output

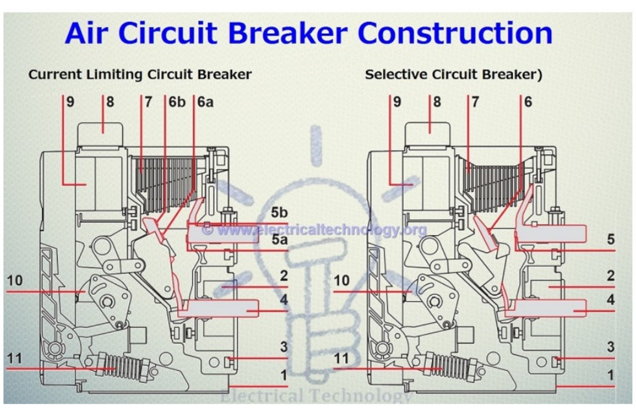
Below tabular column gives the Steps or sequence of outputs to turn ON.

S.NO	EAST	WEST	NORTH
1	R	G	R
2	Y	G	R
3	G	R	R
4	G	R	Y
5	R	R	G
6	R	Y	G

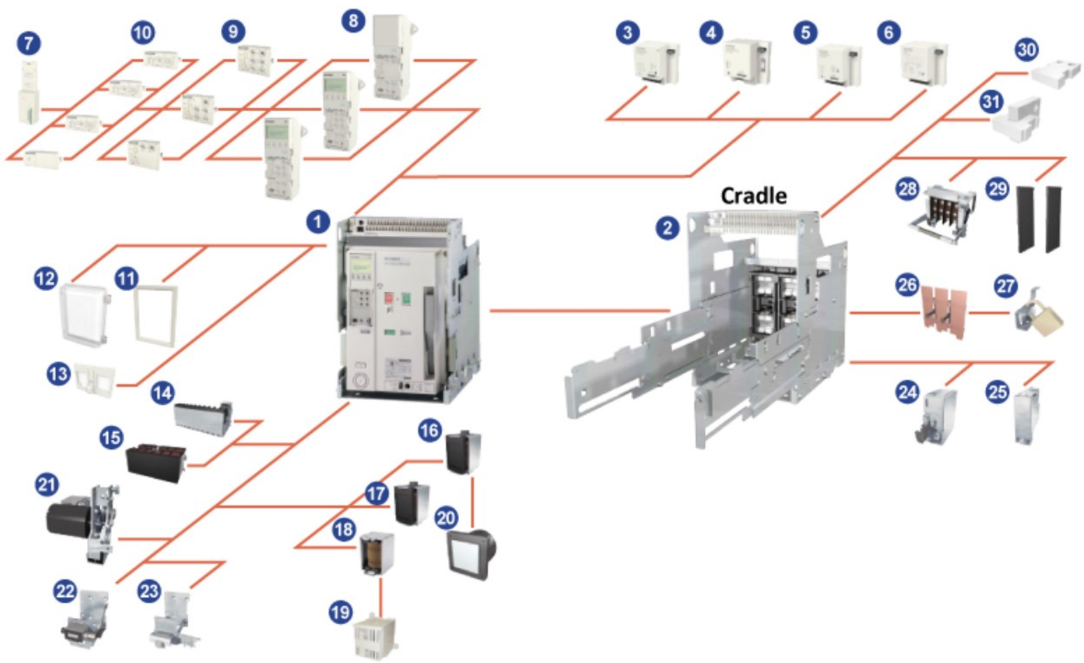
Air Circuit Breaker External Labels

1. OFF button (O)
2. ON button (I)
3. Main contact position indicator
4. Energy storage mechanism status indicator
5. Reset Button
6. LED Indicators
7. Controller
8. "Connection", "Test" and "isolated" position stopper (the three-position latching/locking mechanism)
9. User-supplied padlock
10. Connection "," Test "and" separation "of the position indication
11. Connection (CE) Separation, (CD) Test (CT) Position indication contacts
12. Rated Name Plate
13. Digital Displays
14. Mechanical energy storage handle
15. Shake (IN/OUT)
16. Rocker repository
17. Fault trip reset button

The following fig shows the **Internal Construction of Air Circuit Breaker**



- 1. Sheet Steel Supporting Structure
- 2. Current Transformer for Protection Trip Unit
- 3. Pole Group insulating box
- 4. Horizontal rare terminals
- 5a. Plates for fixed main contacts
- 5b. Plates for fixed arcing Contacts
- 6a. Plates for Main moving contacts
- 6b. Plates for Moving Arcing contacts
- 7. Arcing Chamber
- 8. Terminal box for fixed version – Sliding Contacts for withdrawable version
- 9. Protection Trip Unit
- 10. Circuit breaker Closing and Opening Control
- 11. Closing Springs



1. Air circuit breaker
2. Cradle
3. CC-Link® Interface unit
4. PROFIBUS-DP Interface unit
5. MODBUS® Interface unit
6. I/O unit
7. Extension module
8. ETR unit
9. Main setting module
10. Optional setting module
11. Door frame (DF)
12. Dust cover (DUC)
13. Push button cover (BC-L)
14. Auxiliary switch standard (AX)
15. Auxiliary switch high capacity type (HAX)
16. Shunt trip device (SHT)
17. Closing coil (CC)
18. Under voltage trip device (UVT)
19. UVT-controller (U-CON)
20. Condenser trip device (COT)
21. Motor charging device (MD)
22. Counter (CNT)
23. Cylinder lock (CYL)
24. Door interlock (DI)
25. Mechanical interlock (MI)
26. Safety shutters (SST)
27. Safety shutter lock (SST-LOCK)
28. Cell switch (CL)
29. Interphase Barrier (BA)
30. Horizontal terminal
31. Vertical terminal

Basics

Analog and digital
An analog signal is a physical quantity, which, within a given range, can adopt any value - any continuous intermediate value. The opposite of analog is *digital*. A digital signal knows just two states: 0 and 1 or "off" and "on".

From electrical signal to analog value
Basic order of events

Several steps are required for LOGO! to process physical quantities:

LOGO! can read in electric voltages from 0 V to 10 V or electric currents from 0 mA to 20 mA to one analog input.

The physical quantities (for example, temperature, pressure, speed etc.) must therefore be converted into one electric quantity. This conversion is performed by an external sensor.

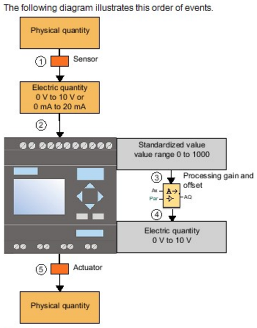
LOGO! reads in the electric quantity and, with further processing, converts it into a standardized value within the range 0 to 1000. This value is then used in the circuit program as the input of an analog special function.

In order to adapt the standardized value to the application, LOGO! uses an analog special function, while taking into consideration the gain and offset, to calculate the analog value. The analog value is then evaluated by the special function (for example, analog amplifier). If an analog special function has an analog output, then the value is used as the output of the special function.

With the LOGO! you can also convert analog values back into an electric voltage. In doing so, the voltage can adopt values between 0 V and 10 V.

Using this voltage, LOGO! can control an external actuator, which converts the voltage and also the analog value back into a physical quantity.

The following diagram illustrates this order of events.



Gain
The standardized value is multiplied with a parameter. Using this parameter you can boost the electric quantity; hence, this parameter is called the "gain".

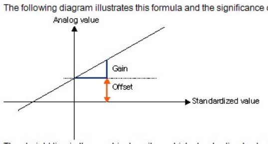
Zero point offset
You can add or subtract a parameter to or from the boosted standardized value.

Using this parameter you can move the zero point of the electric quantity; hence, this parameter is called the "zero point offset".

Gain and offset
The analog value is therefore calculated as follows:

Analog value = (standardized value x gain) + offset

The following diagram illustrates this formula and the significance of gain and offset:



The straight line in the graphic describes which standardized value is being converted into which analog value. Gain corresponds to the slope of the straight line and offset to the movement of the zero point of the straight line on the y-axis.

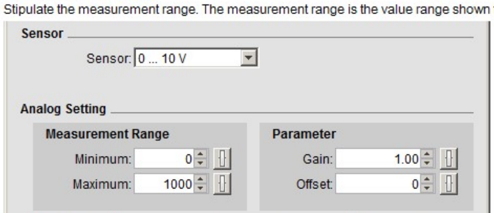
Analog output
If you connect a special function (that has an analog output) to a **real** analog output, then note that the analog output can only process values from 0 to 1000.

Possible settings with LOGO!Soft Comfort

Sensor
Set your sensor type. (0 V to 10 V; 0 mA to 20 mA; 4 mA to 20 mA; PT100/PT1000; no sensor)

With sensor type 4 mA to 20 mA the value range for the standardized value is 200 and 1000.

Measurement range
Stipulate the measurement range. The measurement range is the value range shown for the analog value.



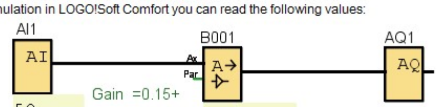
LOGO!Soft Comfort then automatically calculates the gain and offset from this.

Gain and offset
If you want to set the gain, you can enter values between -10.00 and 10.00. The value 0 makes no sense, as, irrespective of the applied analog value, you will always obtain the value 0 as a result.

If you wish to set the offset, enter values between -10000 and 10000.

Rounding error
LOGO!Soft Comfort calculates the gain and zero point offset with utmost precision, while LOGO! calculates internally using whole numerical values; therefore, not all parameter combinations are possible on LOGO!. In this case,
value range.

Simulation in LOGO!Soft Comfort
With simulation in LOGO!Soft Comfort you can read the following values:



Example

Prerequisites

Sensor: temperature sensor, measuring range: -50 °C to 100 °C

Temperature to be measured: 25 °C

Order of events with LOGO!Soft Comfort

The sensor converts the temperature from 25 °C to a voltage value of 5.0 V.

LOGO!Soft Comfort converts the 5.0 V to the standardized value 500.

Using the sensor and measurement range data, LOGO!Soft Comfort calculates and ascertains the value 0.15 for the gain and the value -50 for the offset.

According to the formula:
Analog value = (standardized value × gain) + offset
LOGO!Soft Comfort calculates as analog value:
Analog value = (500 × 0.15) - 50 = 25

Order of events with LOGO!

The sensor converts the temperature from 25 °C to a voltage value of 5.0 V.

LOGO! converts the 5.0 V to the standardized value 500.

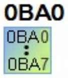
From the sensor and measuring range data, you must establish the values for gain and offset.
According to the formulas:
Gain = $(max_{Sensor} - min_{Sensor}) / (max_{norm} - min_{norm})$
and
Offset = $min_{Sensor} - (Gain \times min_{norm})$
it follows that
Gain = (100 – (-50)) / (1000 – 0) = 0.15
Offset = -50 – (0.15 × 0) = -50

According to the formula
Analog value = (standardized value × gain) + offset
LOGO! calculates as analog value:
Analog value = (500 × 0.15) - 50 = 25

Additional examples

Physical quantity	Electric quantity of sensor	Standardized value	Gain	Offset	Analog value
	0 V 5 V 10 V	0 500 1000	0.01	0	0 5 10
	4 mA 12 mA 20 mA	0 500 1000	10	0	0 5000 10000
	0 mA 10 mA 20 mA	0 500 1000	1	50	50 550 1050
1000 mbar 3700 mbar 5000 mbar	O V 6.75 V 10 V	0 675 1000	4	1000	1000 3700 5000
-30 °C 0 °C 70 °C	0 mA 6 mA 20 mA	0 300 1000	0.1	-30	-30 0 70

0BA0 to 0BA4



Restriction for device family 0BA4

The Gain cannot be a negative value.

Calculation with the device families 0BA0 to 0BA3

With LOGO! devices from these device families, LOGO! adds or subtracts the parameter offset to or from the standardized value **before** multiplying the value with the parameter gain.

Therefore, the following formulas apply:

Analog value = (standardized value + offset) x (gain x 100)

Gain (in percent) = $(max_{Sensor} - min_{Sensor}) / [(max_{norm} - min_{norm}) \times 100]$

Offset = $[(min_{Sensor} \times max_{norm}) - (max_{Sensor} \times min_{norm})] / (max_{Sensor} - min_{Sensor})$

Gain (in percent) = $min_{Sensor} / [(min_{norm} + offset) \times 100]$

Offset = $[max_{Sensor} / (gain \times 100)] - max_{norm}$

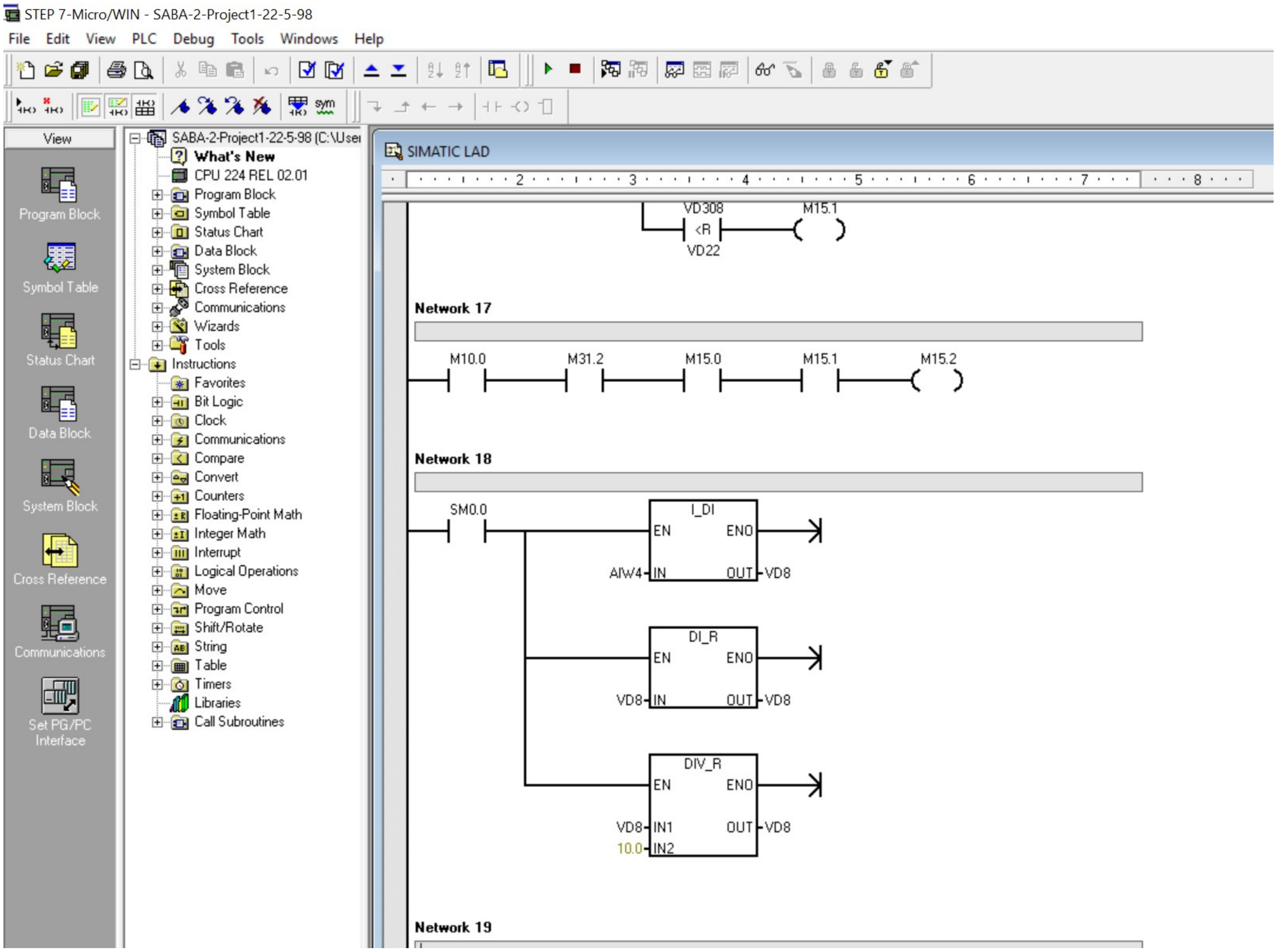
Gain

This parameter is given in %.

The Gain cannot be a negative value.

Zero point offset

You can enter values between -999 and +999 for the zero point offset.


STEP 7-Micro/WIN - SABA-2-Project1-22-5-98
File Edit View PLC Debug Tools Windows Help
View
Program Block
Symbol Table
Status Chart
Data Block
System Block
Cross Reference
Communications
Set PG/PC Interface
SABA-2-Project1-22-5-98 (C:\User
What's New
CPU 224 REL 02.01
Program Block
Symbol Table
Status Chart
Data Block
System Block
Cross Reference
Communications
Wizards
Tools
Instructions
Favorites
Bit Logic
Clock
Communications
Compare
Convert
Counters
Floating-Point Math
Integer Math
Interrupt
Logical Operations
Move
Program Control
Shift/Rotate
String
Table
Timers
Libraries
Call Subroutines
SIMATIC LAD
VD308
<R
VD22
M15.1
Network 17
M10.0
M31.2
M15.0
M15.1
M15.2
Network 18
SM0.0
I_DI
EN
ENO
AIW4
IN
OUT
VD8
DI_R
EN
ENO
VD8
IN
OUT
VD8
DIV_R
EN
ENO
VD8
IN1
10.0
IN2
OUT
VD8
Network 19