# طراحی چند تمرین PLC

## تمرین ۱:

**در نرم افزار Micro/Win برنامه کنترلی بنویسید که :**

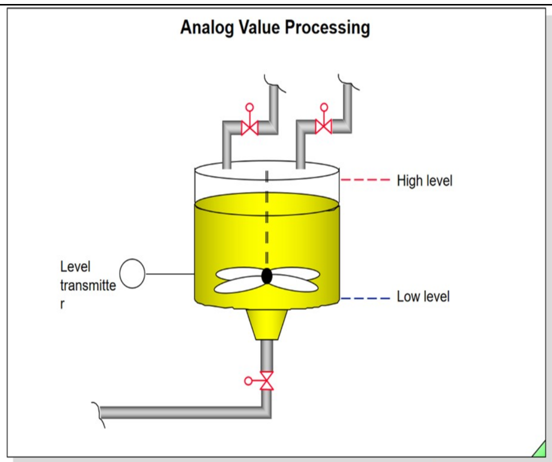
**الف) از یک سنسور سطح سنج مجهز به یک مبدل 4-20 mA مقدار مایع داخل مخزن را اندازه گیری نموده و آنرا برحسب لیتر در یک محل حافظه مشخصی ذخیره نماید.**

**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.**

When the value measured at an analog channel of the module exceeds the overflow range, OB82 is called, as well as when it re-enters the range.

د)




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

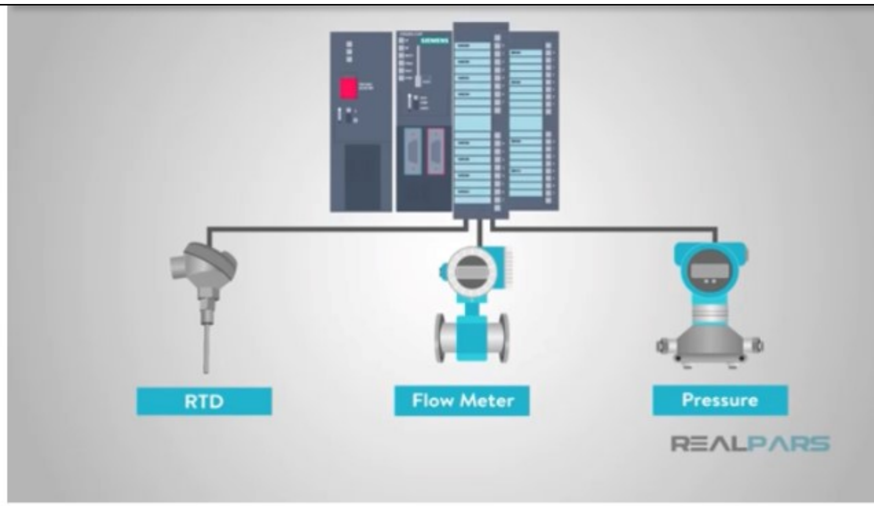
**حل:** برای حل در ابتدا بایستی خواسته های کنترلی را خوب متوجه بشویم . که در صورت این تمرینات تشریح شده است.

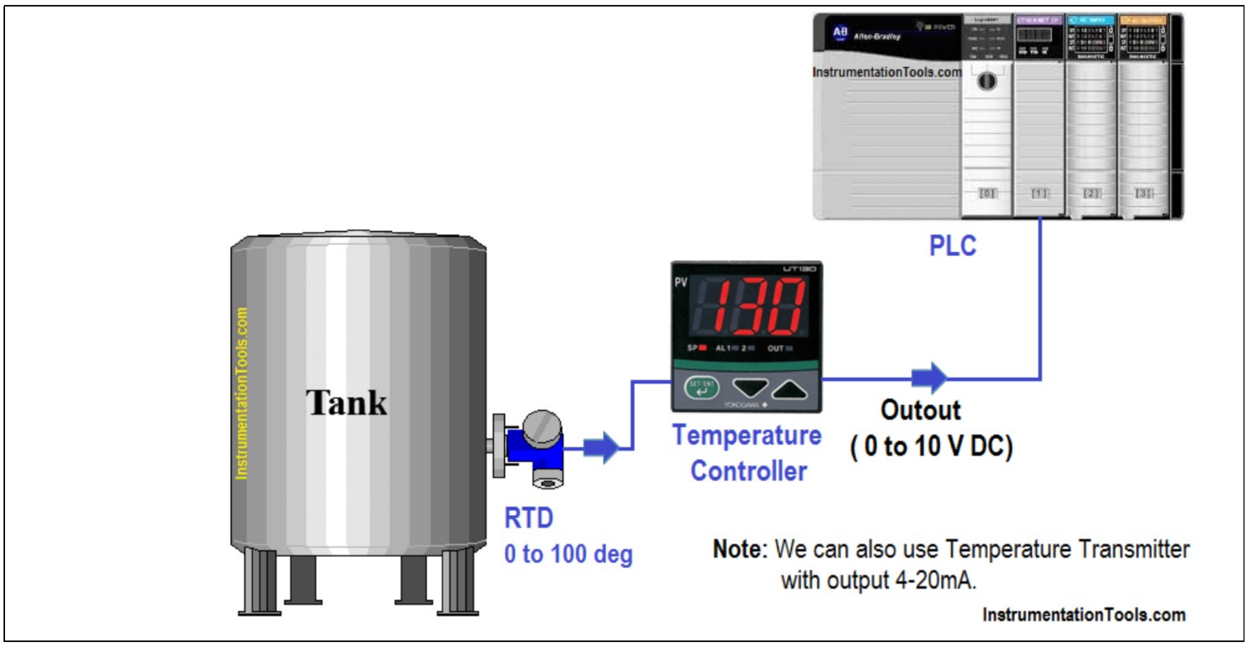
در مرحله بعد نقشه های قدرت و کنترلی را توسط یک نرم افزار نقشه کشی مانند اتوکد رسم نماییم و در آن تمامی سنسورها و محرکها را مشخص نموده و مهمتر از همه اینها جدول آدرسهای ورودی و خروجی را مشخص نماییم.

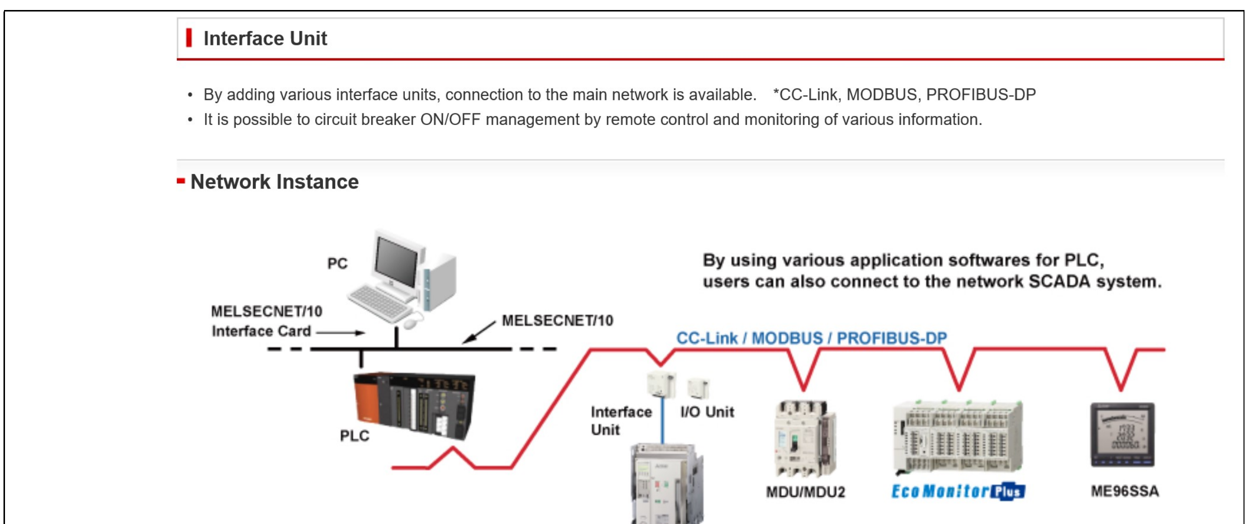
| شرح سنسور یا محرک | آدرس ورودی و خروجی | توضیحات |
|---|---|---|
| سنسور آنالوگ سطح سنج | AI1 OR AIW0 OR PIW 200 | سنسور و ترانسدیوسر از نوع جریانی با خروجی 4-20mA |
| سنسور LL | I 0.0 | این سنسور در ارتفاع ۲۰ سانتی متری از کف مخزن قرار دارد |
| سنسور HL | I 0.1 | این سنسور در ارتفاع ۱۰ سانتی متری از سقف مخزن قرار دارد |
| سنسور وسط ML | I 0.2 | این سنسور در وسط مخزن قرار داده می شود تا وقتیکه سطح مایع به این نقطه رسید فقط یک شیر ورودی باز شود |
| شیر شماره ۱ خروجی | Q 0.0 | |
| شیر شماره 1و2 ورودی | Q0,2– Q 0.1 | |
| آدرس اعلام خطا وقتی سیگنال ورودی سنسور در حالت Overrange است | Q 0.3 | این قسمت وقتیکه در S7-300 و یا S7-400 برنامه نویسی می کنیم انجام می دهیم |

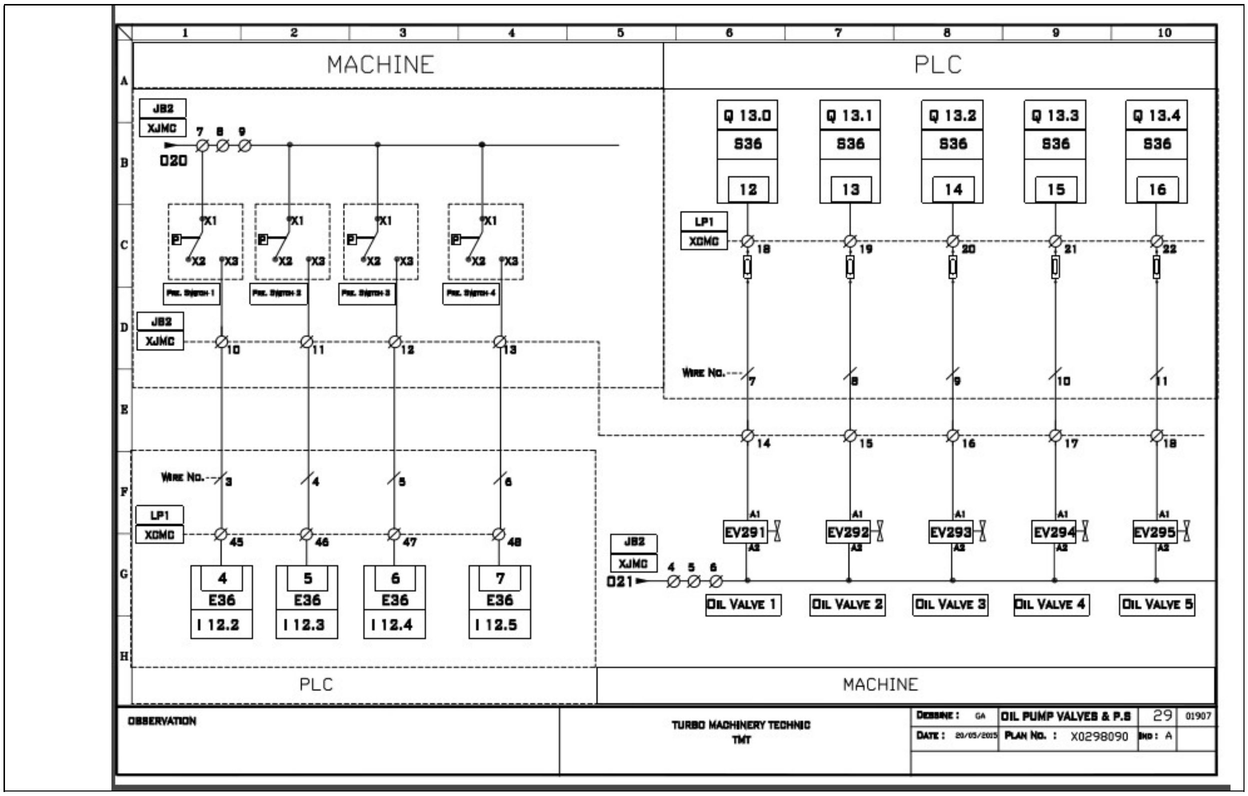
در این مرحله بایستی انتخاب PLC مناسب به لحاظ سخت افزاری و نرم افزاری انجام شود. در خصوص سیستمهای اتوماسیون زیمنس:

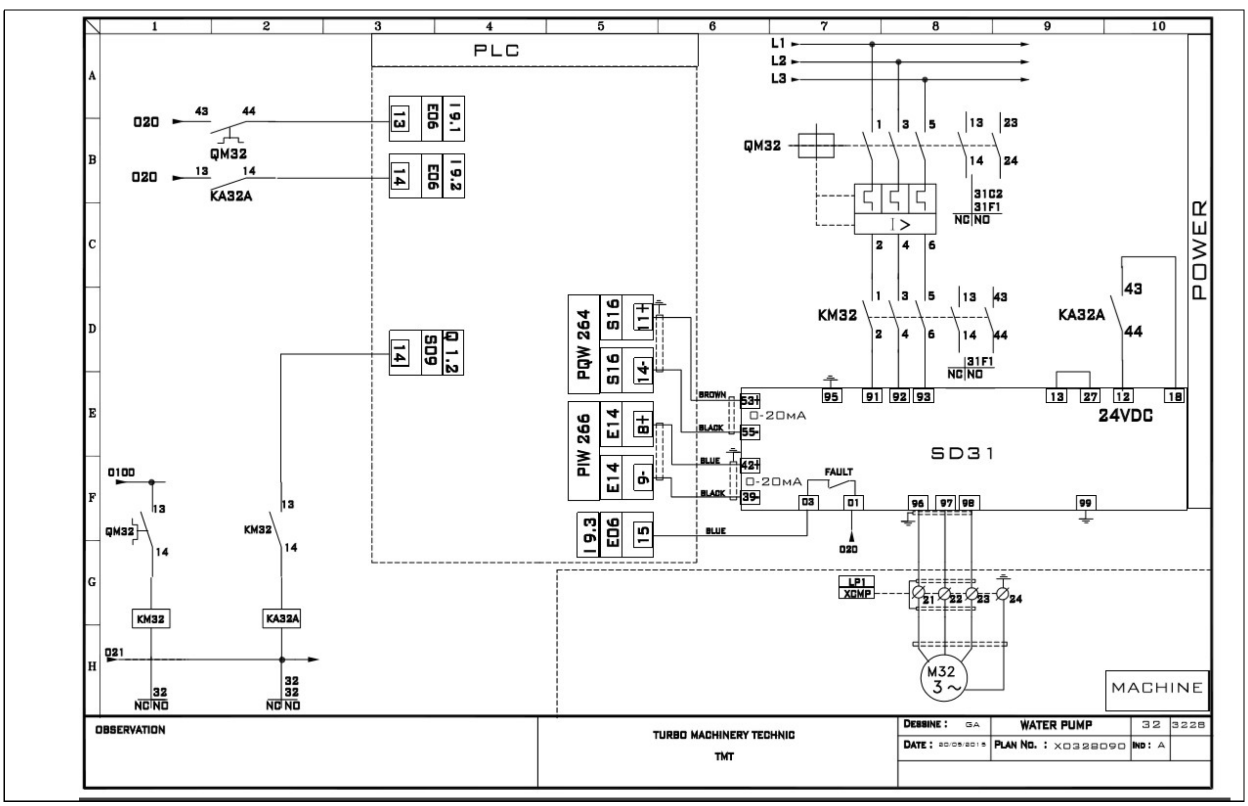
| | |
|---|---|
| نرم افزار LogoComfort V5 | سخت فزار LOGO |
| نرم افزار Micro/Winn | سخت افزار S7-200 |
| نرم افزار Simatic Manager | سخت افزار S7-300 یا S7-400 |

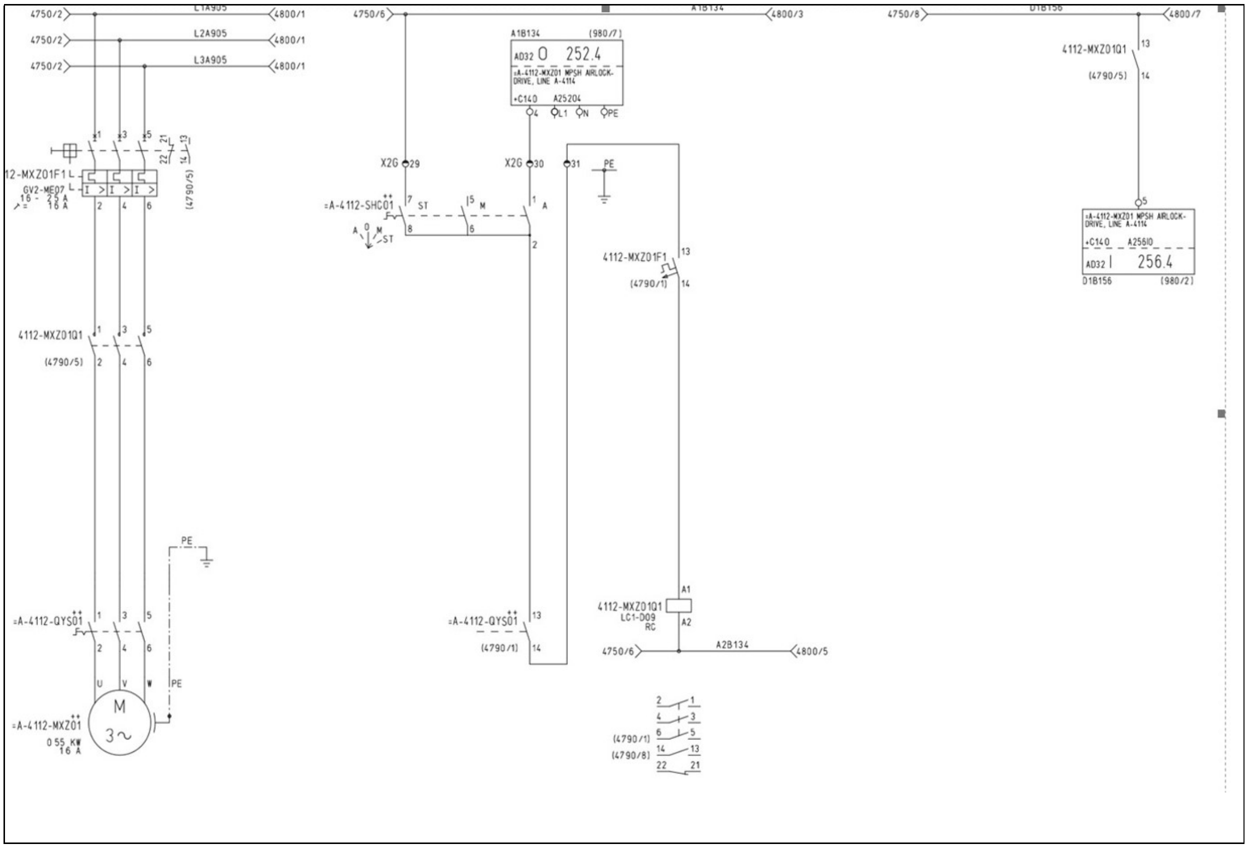

RTD
Flow Meter
Pressure
REALPARS


InstrumentationTools.com
PLC
Tank
InstrumentationTools.com
Temperature Controller
Outout
( 0 to 10 V DC)
RTD
0 to 100 deg
Note: We can also use Temperature Transmitter with output 4-20mA.
InstrumentationTools.com


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
PC
MELSECNET/10 Interface Card
MELSECNET/10
PLC
By using various application softwares for PLC, users can also connect to the network SCADA system.
CC-Link / MODBUS / PROFIBUS-DP
Interface Unit
I/O Unit
MDU/MDU2
EcoMonitorPlus
ME96SSA

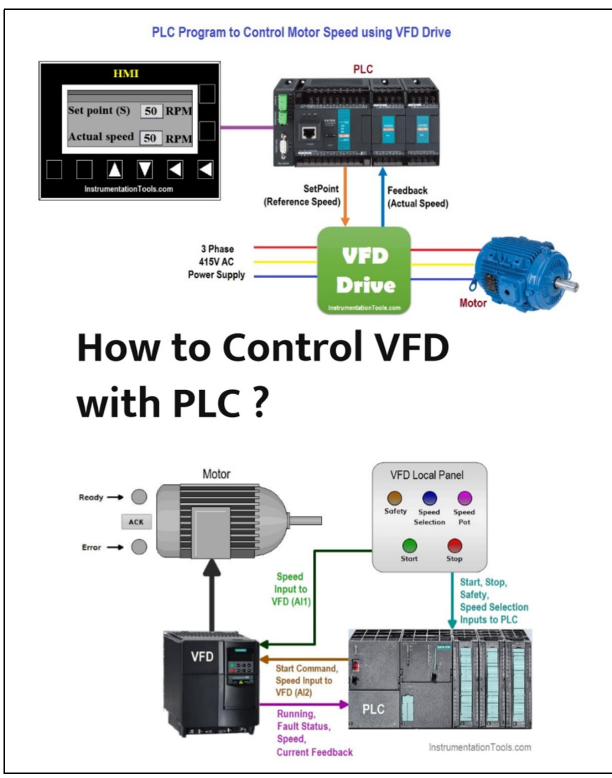

MACHINE
PLC
Q 13.0
Q 13.1
Q 13.2
Q 13.3
Q 13.4
OIL VALVE 1
OIL VALVE 2
OIL VALVE 3
OIL VALVE 4
OIL VALVE 5
EV291
EV292
EV293
EV294
EV295
I 12.2
I 12.3
I 12.4
I 12.5
OBSERVATION
TURBO MACHINERY TECHNIC
TMT
OIL PUMP VALVES & P.S
PLAN NO. : X0298090

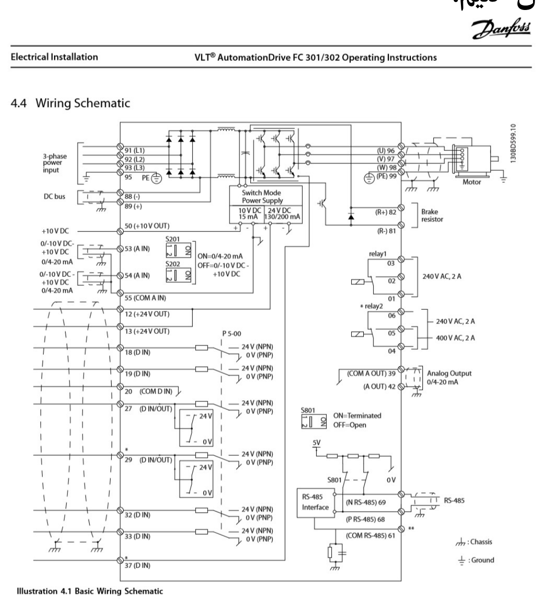

PLC
POWER
MACHINE
QM32
KA32A
KM32
SD31
PQW 264
PIW 266
0-20mA
FAULT
24VDC
M32
OBSERVATION
TURBO MACHINERY TECHNIC
TMT
WATER PUMP
PLAN NO. : X0328090

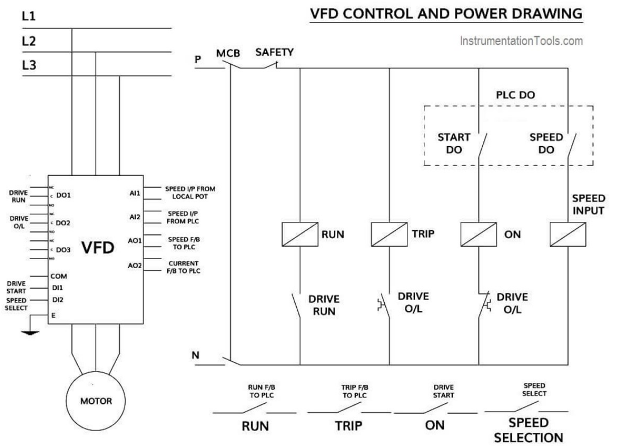


## تمرین ۲:

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






# حل:

| توضیحات | آدرس خروجی | آدرس ورودی | شرح ورودی |
|---|---|---|---|
| شاسی استارت | Q 1.0 | I 1.0 or M1.0 | Start Drive |
| شاسی استپ | | I 1.1 or M 1.1 | Stop Drive |
| ورودی از خروجی درایو به PLC | | I 1.2 | Drive Fault |
| وروری از کلید اتوماتیک محافظ موتور | | I 1.3 | Motor Protection Circuit Breaker |
| آدرس خروجی سیگنال آنالوگی: 4-20mA Or 0-10 V | AQW10 or PQW 100 | | Analoge Output from PLC For Speed Control |
| آدرس ورودی به PLC برای چک کردن سرعت درایو | | AIW10 OR PIW 100 | Analoge Input from Drive For Speed Control |

# شناخت کامل تجهیزات سخت افزاری و نرم افزای PLC های مختلف

Table G-3 Summary of S7-200 CPU Memory Ranges and Features

| Description | | CPU 221 | CPU 222 | CPU 224 | CPU 226 | CPU 226XM |
|---|---|---|---|---|---|---|
| User program size | | 4096 bytes | 4096 bytes | 8192 bytes | 8192 bytes | 16384 bytes |
| User data size | | 2048 bytes | 2048 bytes | 5120 bytes | 5120 bytes | 10240 bytes |
| Process-image input register | | I0.0 to I15.7 | I0.0 to I15.7 | I0.0 to I15.7 | I0.0 to I15.7 | I0.0 to I15.7 |
| Process-image output register | | Q0.0 to Q15.7 | Q0.0 to Q15.7 | Q0.0 to Q15.7 | Q0.0 to Q15.7 | Q0.0 to Q15.7 |
| Analog inputs (read only) | | -- | AIW0 to AIW30 | AIW0 to AIW62 | AIW0 to AIW62 | AIW0 to AIW62 |
| Analog outputs (write only) | | -- | AQW0 to AQW30 | AQW0 to AQW62 | AQW0 to AQW62 | AQW0 to AQW62 |
| Variable memory (V) | | VB0 to VB2047 | VB0 to VB2047 | VB0 to VB5119 | VB0 to VB5119 | VB0 to VB10239 |
| Local memory (L)[1] | | LB0 to LB63 | LB0 to LB63 | LB0 to LB63 | LB0 to LB63 | LB0 to LB63 |
| Bit memory (M) | | M0.0 to M31.7 | M0.0 to M31.7 | M0.0 to M31.7 | M0.0 to M31.7 | M0.0 to M31.7 |
| Special Memory (SM) | | SM0.0 to SM179.7 | SM0.0 to SM299.7 | SM0.0 to SM549.7 | SM0.0 to SM549.7 | SM0.0 to SM549.7 |
| Read only | | SM0.0 to SM29.7 | SM0.0 to SM29.7 | SM0.0 to SM29.7 | SM0.0 to SM29.7 | SM0.0 to SM29.7 |
| Timers | | 256 (T0 to T255) | 256 (T0 to T255) | 256 (T0 to T255) | 256 (T0 to T255) | 256 (T0 to T255) |
| Retentive on-delay | 1 ms | T0, T64 | T0, T64 | T0, T64 | T0, T64 | T0, T64 |
| | 10 ms | T1 to T4, and T65 to T68 | T1 to T4, and T65 to T68 | T1 to T4, and T65 to T68 | T1 to T4, and T65 to T68 | T1 to T4, and T65 to T68 |
| | 100 ms | T5 to T31, and T69 to T95 | T5 to T31, and T69 to T95 | T5 to T31, and T69 to T95 | T5 to T31, and T69 to T95 | T5 to T31, and T69 to T95 |
| On/Off delay | 1 ms | T32, T96 | T32, T96 | T32, T96 | T32, T96 | T32, T96 |
| | 10 ms | T33 to T36, and T97 to T100 | T33 to T36, and T97 to T100 | T33 to T36, and T97 to T100 | T33 to T36, and T97 to T100 | T33 to T36, and T97 to T100 |
| | 100 ms | T37 to T63, and T101 to T255 | T37 to T63, and T101 to T255 | T37 to T63, and T101 to T255 | T37 to T63, and T101 to T255 | T37 to T63, and T101 to T255 |
| Counters | | C0 to C255 | C0 to C255 | C0 to C255 | C0 to C255 | C0 to C255 |
| High-speed counter | | HC0, HC3, HC4, and HC5 | HC0, HC3, HC4, and HC5 | HC0 to HC5 | HC0 to HC5 | HC0 to HC5 |
| Sequential control relays (S) | | S0.0 to S31.7 | S0.0 to S31.7 | S0.0 to S31.7 | S0.0 to S31.7 | S0.0 to S31.7 |
| Accumulator registers | | AC0 to AC3 | AC0 to AC3 | AC0 to AC3 | AC0 to AC3 | AC0 to AC3 |
| Jumps/Labels | | 0 to 255 | 0 to 255 | 0 to 255 | 0 to 255 | 0 to 255 |
| Call/Subroutine | | 0 to 63 | 0 to 63 | 0 to 63 | 0 to 63 | 0 to 127 |
| Interrupt routines | | 0 to 127 | 0 to 127 | 0 to 127 | 0 to 127 | 0 to 127 |
| Positive/negative transitions | | 256 | 256 | 256 | 256 | 256 |
| PID loops | | 0 to 7 | 0 to 7 | 0 to 7 | 0 to 7 | 0 to 7 |
| Ports | | Port 0 | Port 0 | Port 0 | Port 0, Port 1 | Port 0, Port 1 |

1 LB60 to LB63 are reserved by STEP 7-Micro/WIN, version 3.0 or later.

## Accessing Data in the Memory Areas

### Process-Image Input Register: I

The S7-200 samples the physical input points at the beginning of each scan cycle and writes these values to the process-image input register. You can access the process-image input register in bits, bytes, words, or double words:

| | | |
|---|---|---|
| Bit: | I[byte address].[bit address] | I0.1 |
| Byte, Word, or Double Word: | I[size][starting byte address] | IB4 |

### Process-Image Output Register: Q

At the end of the scan cycle, the S7-200 copies the values stored in the process-image output register to the physical output points. You can access the process-image output register in bits, bytes, words, or double words:

| | | |
|---|---|---|
| Bit: | Q[byte address].[bit address] | Q1.1 |
| Byte, Word, or Double Word: | Q[size][starting byte address] | QB5 |

### Variable Memory Area: V

You can use V memory to store intermediate results of operations being performed by the control logic in your program. You can also use V memory to store other data pertaining to your process or task. You can access the V memory area in bits, bytes, words, or double words:

| | | |
|---|---|---|
| Bit: | V[byte address].[bit address] | V10.2 |
| Byte, Word, or Double Word: | V[size][starting byte address] | VW100 |

### Bit Memory Area: M

You can use the bit memory area (M memory) as control relays to store the intermediate status of an operation or other control information. You can access the bit memory area in bits, bytes, words, or double words:

| | | |
|---|---|---|
| Bit: | M[byte address].[bit address] | M26.7 |
| Byte, Word, or Double Word: | M[size][starting byte address] | MD20 |

Table 1-1 Comparison of the S7-200 CPU Models

| Feature | CPU 221 | CPU 222 | CPU 224 | CPU 226 | CPU 226XM |
|---|---|---|---|---|---|
| Physical size (mm) | 90 x 80 x 62 | 90 x 80 x 62 | 120.5 x 80 x 62 | 190 x 80 x 62 | 190 x 80 x 62 |
| Program memory | 4096 bytes | 4096 bytes | 8192 bytes | 8192 bytes | 16384 bytes |
| Data memory | 2048 bytes | 2048 bytes | 5120 bytes | 5120 bytes | 10240 bytes |
| Memory backup | 50 hours typical | 50 hours typical | 190 hours typical | 190 hours typical | 190 hours typical |
| Local on-board I/O | 6 In/4 Out | 8 In/6 Out | 14 In/10 Out | 24 In/16 Out | 24 In/16 Out |
| Expansion modules | 0 modules[1] | 2 modules[1] | 7 modules[1] | 7 modules[1] | 7 modules[1] |
| High-speed counters<br>Single phase<br>Two phase | <br>4 at 30 kHz<br>2 at 20 kHz | <br>4 at 30 kHz<br>2 at 20 kHz | <br>6 at 30 kHz<br>4 at 20 kHz | <br>6 at 30 kHz<br>4 at 20 kHz | <br>6 at 30 kHz<br>4 at 20 kHz |
| Pulse outputs (DC) | 2 at 20 kHz | 2 at 20 kHz | 2 at 20 kHz | 2 at 20 kHz | 2 at 20 kHz |
| Analog adjustments | 1 | 1 | 2 | 2 | 2 |
| Real-time clock | Cartridge | Cartridge | Built-in | Built-in | Built-in |
| Communications ports | 1 RS-485 | 1 RS-485 | 1 RS-485 | 2 RS-485 | 2 RS-485 |
| Floating-point math | Yes | | | | |
| Digital I/O image size | 256 (128 in, 128 out) | | | | |
| Boolean execution speed | 0.37 microseconds/instruction | | | | |

1 You must calculate your power budget to determine how much power (or current) the S7-200 CPU can provide for your configuration. If the CPU power budget is exceeded, you may not be able to connect the maximum number of modules. See Appendix A for CPU and expansion module power requirements, and Appendix B to calculate your power budget.

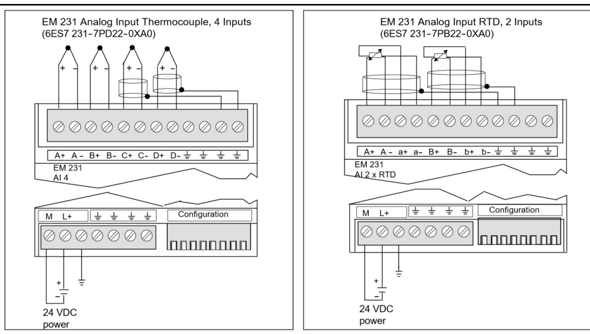



Figure A-19 Connector Terminal Identification for EM 231 Thermocouple and EM 231 RTD Modules

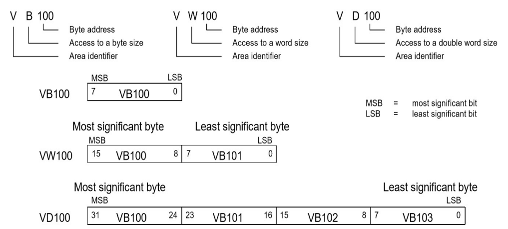



Figure 4-4 Comparing Byte, Word, and Double-Word Access to the Same Address

### Timer Memory Area: T

The S7-200 provides timers that count increments of time in resolutions (time-base increments) of 1 ms, 10 ms, or 100 ms. Two variables are associated with a timer:

- Current value: this 16-bit signed integer stores the amount of time counted by the timer.
- Timer bit: this bit is set or cleared as a result of comparing the current and the preset value. The preset value is entered as part of the timer instruction.

You access both of these variables by using the timer address (T + timer number). Access to either the timer bit or the current value is dependent on the instruction used: instructions with bit operands access the timer bit, while instructions with word operands access the current value. As shown in Figure 4-5, the Normally Open Contact instruction accesses the timer bit, while the Move Word instruction accesses the current value of the timer.

| | | |
|---|---|---|
| Format: | T[timer number] | T24 |

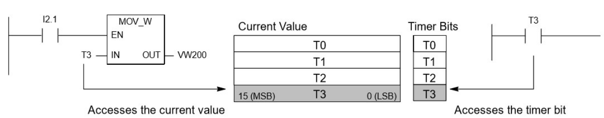



Figure 4-5 Accessing the Timer Bit or the Current Value of a Timer

### Counter Memory Area: C

The S7-200 provides three types of counters that count each low-to-high transition event on the counter input(s): one type counts up only, one type counts down only, and one type counts both up and down. Two variables are associated with a counter:

- Current value: this 16-bit signed integer stores the accumulated count.
- Counter bit: this bit is set or cleared as a result of comparing the current and the preset value. The preset value is entered as part of the counter instruction.

You access both of these variables by using the counter address (C + counter number). Access to either the counter bit or the current value is dependent on the instruction used: instructions with bit operands access the counter bit, while instructions with word operands access the current value. As shown in Figure 4-6, the Normally Open Contact instruction accesses the counter bit, while the Move Word instruction accesses the current value of the counter.

| | | |
|---|---|---|
| Format: | C[counter number] | C24 |

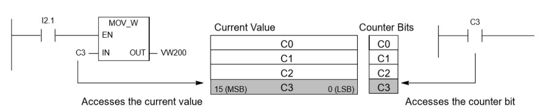



Figure 4-6 Accessing the Counter Bit or the Current Value of a Counter

### Special Memory: SM

The SM bits provide a means for communicating information between the CPU and your program. You can use these bits to select and control some of the special functions of the S7-200 CPU, such as: a bit that turns on for the first scan cycle, a bit that toggles at a fixed rate, or a bit that shows the status of math or operational instructions. (For more information about the SM bits, see Appendix D.) You can access the SM bits as bits, bytes, words, or double words:

| | | |
|---|---|---|
| Bit: | SM[byte address].[bit address] | SM0.1 |
| Byte, Word, or Double Word: | SM[size][starting byte address] | SMB86 |

### Local Memory Area: L

The S7-200 provides 64 bytes of local memory of which 60 can be used as scratchpad memory or for passing formal parameters to subroutines.

> **Tip**
> If you are programming in either LAD or FBD, STEP 7-Micro/WIN reserves the last four bytes of local memory for its own use. If you program in STL, all 64 bytes of L memory are accessible, but it is recommended that you do not use the last four bytes of L memory.

Local memory is similar to V memory with one major exception. V memory has a global scope while L memory has a local scope. The term global scope means that the same memory location can be accessed from any program entity (main program, subroutines, or interrupt routines). The term local scope means that the memory allocation is associated with a particular program entity. The S7-200 allocates 64 bytes of L memory for the main program, 64 bytes for each subroutine nesting level, and 64 bytes for interrupt routines.

The allocation of L memory for the main program cannot be accessed from subroutines or from interrupt routines. A subroutine cannot access the L memory allocation of the main program, an interrupt routine, or another subroutine. Likewise, an interrupt routine cannot access the L memory allocation of the main program or of a subroutine.

The allocation of L memory is made by the S7-200 on an as-needed basis. This means that while the main portion of the program is being executed, the L memory allocations for subroutines and interrupt routines do not exist. At the time that an interrupt occurs or a subroutine is called, local memory is allocated as required. The new allocation of L memory might reuse the same L memory locations of a different subroutine or interrupt routine.

The L memory is not initialized by the S7-200 at the time of allocation and might contain any value. When you pass formal parameters in a subroutine call, the values of the parameters being passed are placed by the S7-200 in the appropriate L memory locations of the called subroutine. L memory locations, which do not receive a value as a result of the formal parameter passing step, will not be initialized and might contain any value at the time of allocation.

| | | |
|---|---|---|
| Bit: | L[byte address].[bit address] | L0.0 |
| Byte, Word, or Double Word: | L[size] [starting byte address] | LB33 |

### Analog Inputs: AI

The S7-200 converts an analog value (such as temperature or voltage) into a word-length (16-bit) digital value. You access these values by the area identifier (AI), size of the data (W), and the starting byte address. Since analog inputs are words and always start on even-number bytes (such as 0, 2, or 4), you access them with even-number byte addresses (such as AIW0, AIW2, or AIW4). Analog input values are read-only values.

| | | |
|---|---|---|
| Format: | AIW[starting byte address] | AIW4 |

### Analog Outputs: AQ

The S7-200 converts a word-length (16-bit) digital value into a current or voltage, proportional to the digital value (such as for a current or voltage). You write these values by the area identifier (AQ), size of the data (W), and the starting byte address. Since analog outputs are words and always start on even-number bytes (such as 0, 2, or 4), you write them with even-number byte addresses (such as AQW0, AQW2, or AQW4). Analog output values are write-only values.

| | | |
|---|---|---|
| Format: | AQW[starting byte address] | AQW4 |

### Sequence Control Relay (SCR) Memory Area: S

SCRs or S bits are used to organize machine operations or steps into equivalent program segments. SCRs allow logical segmentation of the control program. You can access the S bits as bits, bytes, words, or double words.

| | | |
|---|---|---|
| Bit: | S[byte address].[bit address] | S3.1 |
| Byte, Word, or Double Word: | S[size][starting byte address] | SB4 |

## Format for Real Numbers

Real (or floating-point) numbers are represented as 32-bit, single-precision numbers, whose format is described in the ANSI/IEEE 754–1985 standard. See Figure 4-8. Real numbers are accessed in double-word lengths.

For the S7-200, floating point numbers are accurate up to 6 decimal places. Therefore, you can specify a maximum of 6 decimal places when entering a floating-point constant.

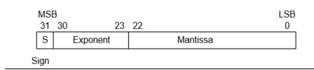



Figure 4-8 Format of a Real Number

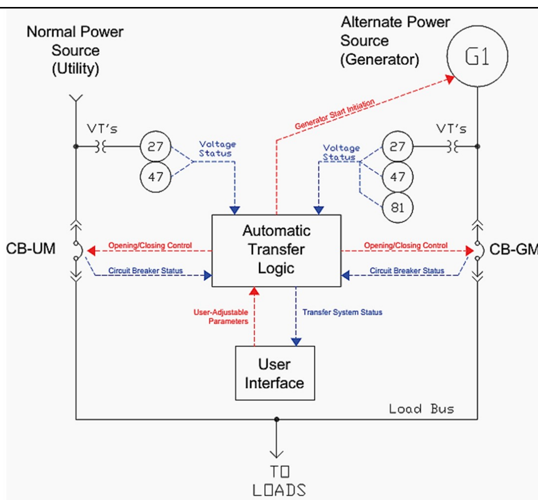
## تمرین ۳: طراحی یک سیستم کنترل اتوماتیک چنج – اور برق شهر و ژنراتور اضطراری توسط PLC

مراحل حل:

۱-شناخت دقیق اجزای تشکیل دهنده این سیستم

۲-شناخت دقیق رله های حفاظتی و کنترلی

۳-شناخت دقیق مکانیزم های شارژ و قطع و وصل کلیدهای اتوماتیک

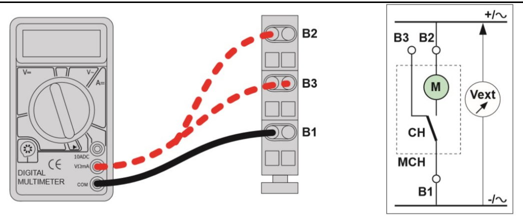



**بعد از شناخت کامل فرایند جدول ورودیها و خروجیها را مشخص می کنیم**

| شرح ورودی | آدرس ورودی | آدرس خروجی | توضیحات |
|---|---|---|---|
| Hand/Auto CB O/C | I 2.0 or M2.0 | - | کلید H-0-A برای مشخص کردن وضعیت اتوماتیک و دستی |
| START/STOP UTILITY C.B | I 2.1 , I 2.2 OR M 2.1 OR M2.2 | | شاسی استپ و استارت کلید اتوماتیک برق شهر |
| START/STOP GENERATOR C.B | I 2.3 , I2.4 OR M 2.1 OR M2.2 | | شاسی استپ و استارت کلید اتوماتیک برق ژنراتور |
| CB1 MOTOR CHARGING COMPLTION | I 2.5 | | اطمینان از شارژ کامل کلید اتوماتیک برق شهر |
| CB2 MOTOR CHARGING COMPLTION | I 2.6 | | اطمینان از شارژ کامل کلید اتوماتیک برق ژنراتور |
| N.O CONTACT OF CITY C.B. | I 2.7 | | کنتاکت کمکی کلید اتوماتیک برق شهر |
| N.O CONTACT OF GENERATOR C.B. | I 3.0 | | کنتاکت کمکی کلید اتوماتیک برق ژنراتور |
| Under/Over Voltage U Net | I 3.1 | | ورودی دیجیتال از رله ولتاژ کم و زیاد از شبکه برق شهر |

| شرح ورودی | آدرس ورودی | آدرس خروجی | توضیحات |
|---|---|---|---|
| Under/Over Generator Voltage | I 3.2 | | ورودی دیجیتال از رله ولتاژ کم و زیاد از شبکه برق ژنراتور |
| Phase Sequence Input Digital Address Of City Net | I 3.3 | | رله توالی فاز برق شهر |
| Phase Sequence Digital Address Of Gen. Net | I 3.4 | | رله توالی فاز برق ژنراتور |
| Gen. Under Frequency Relay Input Address | I 3.5 | | آدرس ورودی دیجیتال رله فرکانس کم ژنراتور |
| Utilkity C.B. Fault Input Digital Add. | I 3.6 | | آدرس ورودی دیجیتال از کنتاکت فالت تریپ کلید برق شهر |
| Gen. C.B. Fault Input Digital Add. | I 3.7 | | آدرس ورودی دیجیتال از کنتاکت فالت تریپ کلید ژنراتور |
| Output Command For Openning U.C.B | – | Q 2.0 | فرمان خروجی برای قطع کلید برق شهر |
| Output Command For Openning G.C.B | – | Q 2.1 | فرمان خروجی برای قطع کلید برق ژنراتور |
| Output Command For Closing U.C.B | – | Q 2.2 | فرمان خروجی برای وصل کلید برق شهر |
| Output Command For Closing G.C.B | – | Q 2.2 | فرمان خروجی برای وصل کلید برق ژنراتور |
| CONTROL SIGNAL FOR STARTING DISEL GENERATOR | - | Q 2.3 | فرمان به طرف ژنراتور برای استارت دیزل ژنراتور |

**Air Circuit Breaker External Labels**




CH: spring charged limit switch

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

## 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.

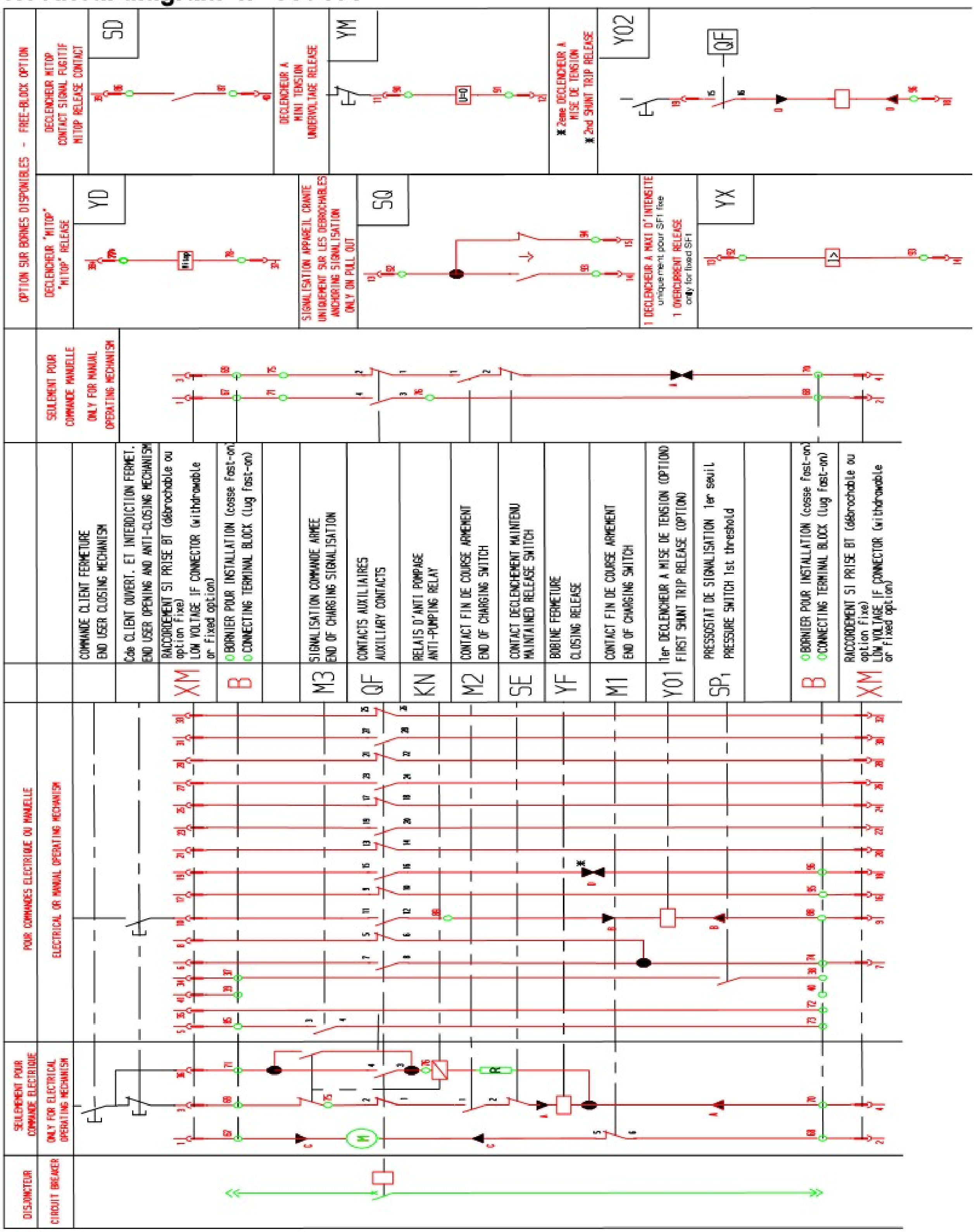
**ANSI 81R – Rate of change of frequency**

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**

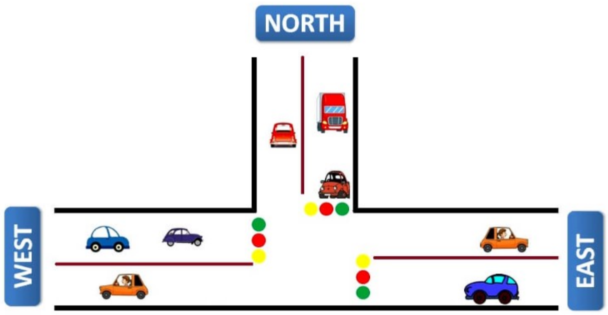
Voltage and Frequency anagement and Protection Relays electrical diagram n° 889461



## تمرین ٤:

**طراحی سیستم کنترل اتوماتیک چراغ راهنمایی توسط PLC**

**Traffic Light Control using PLC**



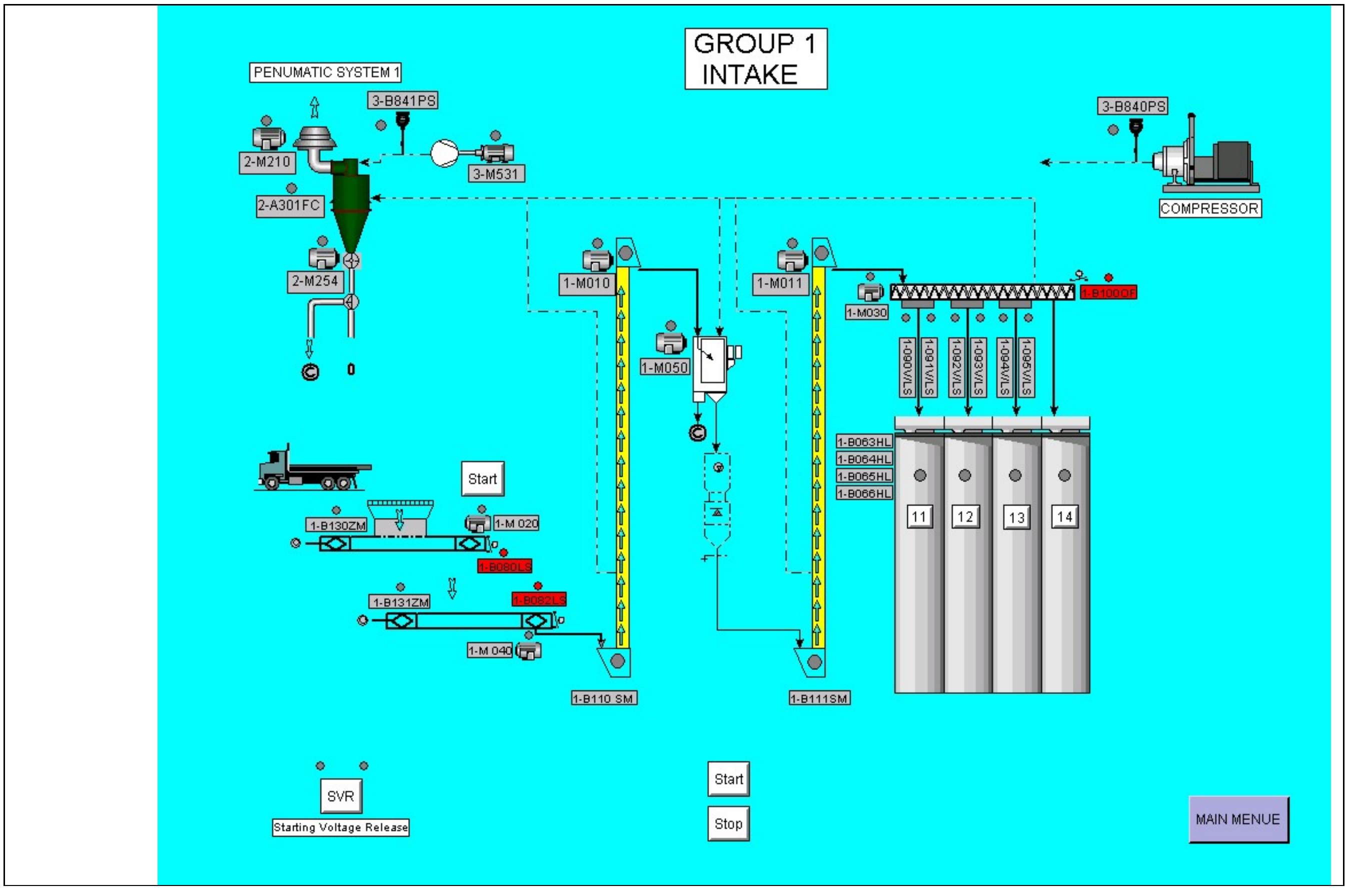

3 - Way Traffic Light Control using PLC

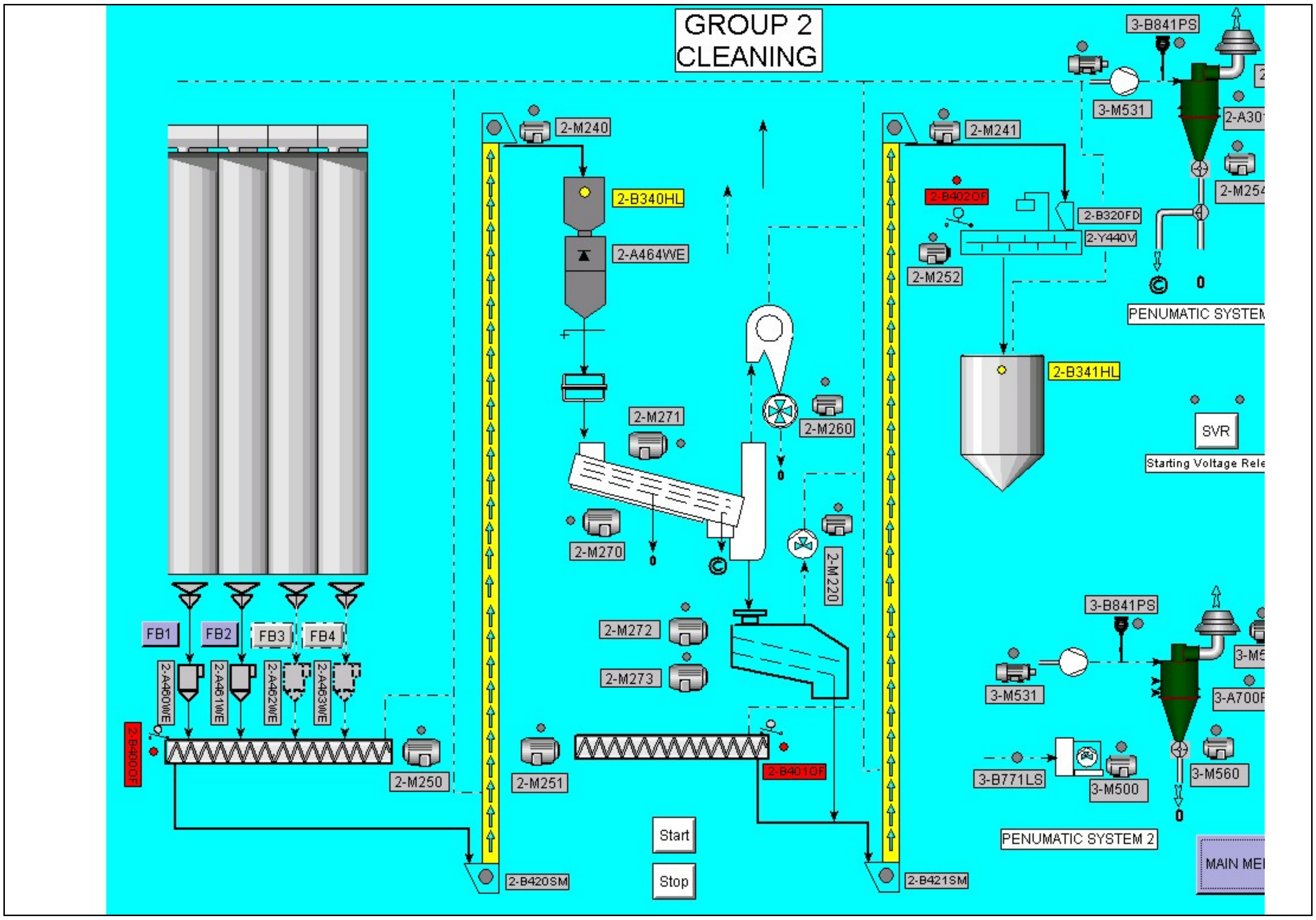
**List of Inputs and Outputs for Traffic Control System**

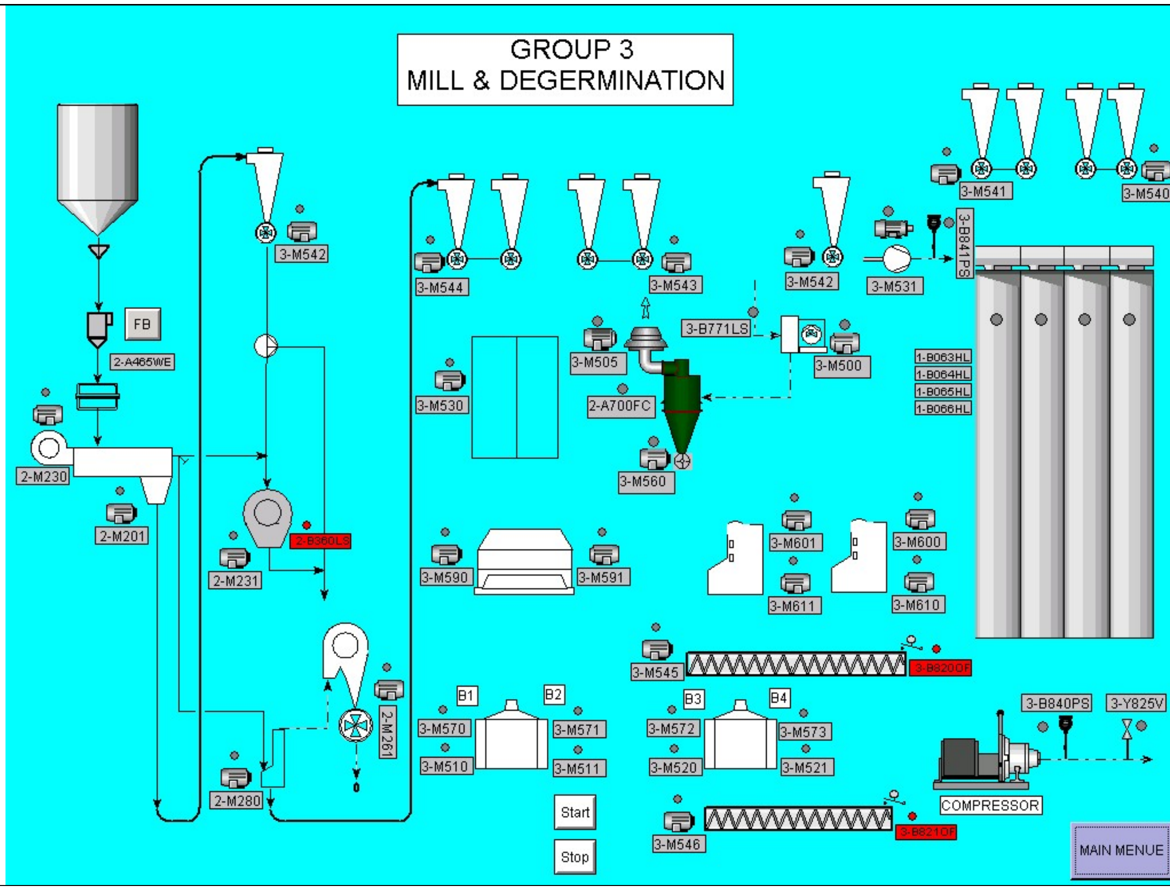
| S.no | Address | Name | Input/Output |
|---|---|---|---|
| 1 | I:0/0 | Start | Input |
| 2 | I:0/1 | Stop | Input |
| 3 | B3.0 | Memory | Memory |
| 4 | O:0/0 | West Green | Output |
| 5 | O:0/1 | East Red | Output |
| 6 | O:0/2 | North Red | Output |
| 7 | O:0/3 | East yellow | Output |
| 8 | O:0/4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

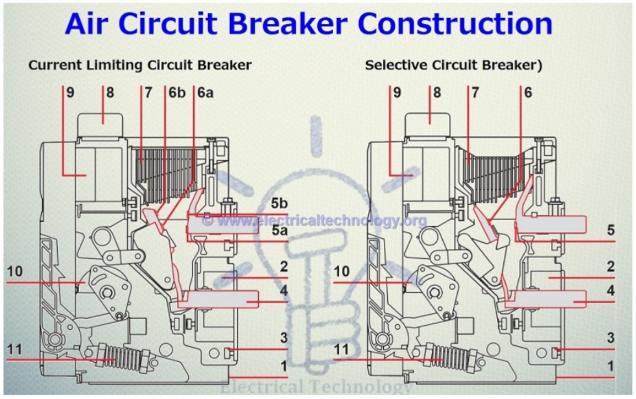

GROUP 1
INTAKE
PENUMATIC SYSTEM 1
3-B841PS
2-M210
3-M531
2-A301FC
2-M254
3-B840PS
COMPRESSOR
1-M010
1-M011
1-M030
1-M050
1-090VLS
1-091VLS
1-092VLS
1-093VLS
1-094VLS
1-095VLS
1-B063HL
1-B064HL
1-B065HL
1-B066HL
11
12
13
14
Start
1-B130ZM
1-M 020
1-B131ZM
1-M 040
1-B110 SM
1-B111SM
SVR
Starting Voltage Release
Start
Stop
MAIN MENUE


GROUP 2
CLEANING
3-B841PS
3-M531
2-A301
2-M254
2-M240
2-M241
2-B340HL
2-A464WE
2-B402OF
2-B320FD
2-Y440V
2-M252
PENUMATIC SYSTEM
2-B341HL
2-M271
2-M260
SVR
Starting Voltage Rele
2-M270
2-M220
2-M272
2-M273
FB1
FB2
FB3
FB4
2-A460WE
2-A461WE
2-A462WE
2-A463WE
2-B400OF
2-M250
2-M251
2-B401OF
3-B841PS
3-M531
3-A700F
3-B771LS
3-M500
3-M560
PENUMATIC SYSTEM 2
Start
Stop
2-B420SM
2-B421SM
MAIN ME




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

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

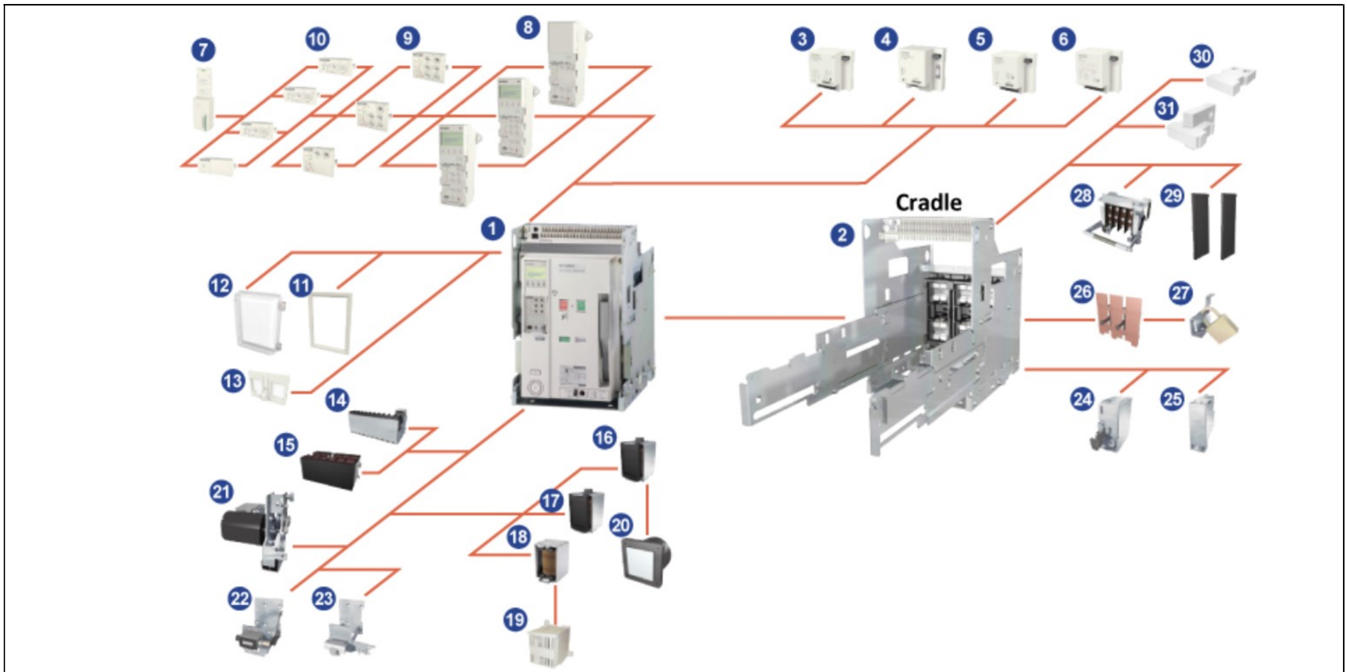



- 1. Sheet Steel Supporting Structure
- 2. Current Transformer for Protection Trip Unit
- 3. Pole Group insulating box
- 4. Horizontal rare terminals
- 5a. Plates for fixed main contacts
- 5b. Plates for fixed arcing Contacts
- 6a. Plates for Main moving contacts
- 6b. Plates for Moving Arcing contacts
- 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

- **By setting the ACB to Draw-out type, it is possible to pull out the main body and maintain it.**

**Fix type**

**Draw-out type**




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.

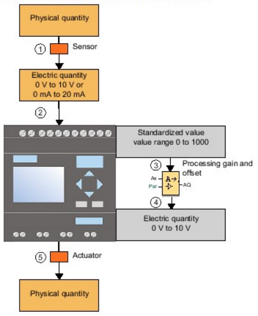
LOGO! reads in the electric quantity and, with further processing, converts it into a standardized value within the range 0 to 1000. This value is then used in the circuit program as the input of an analog special function.

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.

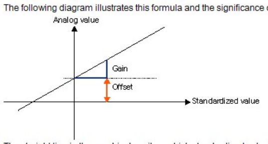
Using this parameter you can move the zero point of the electric quantity; hence, this parameter is called the "zero point offset".

**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

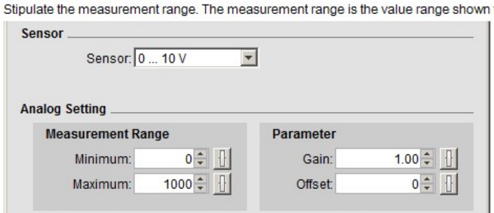
**Sensor**

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.

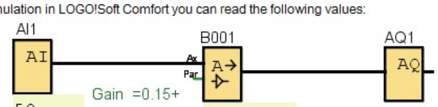
If you wish to set the offset, enter values between -10000 and 10000.

**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, p
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.

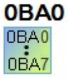
LOGO! converts the 5.0 V to the standardized value 500.

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<br>5 V<br>10 V | 0<br>500<br>1000 | 0.01 | 0 | 0<br>5<br>10 |
| | 4 mA<br>12 mA<br>20 mA | 0<br>500<br>1000 | 10 | 0 | 0<br>5000<br>10000 |
| | 0 mA<br>10 mA<br>20 mA | 0<br>500<br>1000 | 1 | 50 | 50<br>550<br>1050 |
| 1000 mbar<br>3700 mbar<br>5000 mbar | O V<br>6.75 V<br>10 V | 0<br>675<br>1000 | 4 | 1000 | 1000<br>3700<br>5000 |
| -30 °C<br>0 °C<br>70 °C | 0 mA<br>6 mA<br>20 mA | 0<br>300<br>1000 | 0.1 | -30 | -30<br>0<br>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 = $[max_{Sensor} / (gain \times 100)] - max_{norm}$

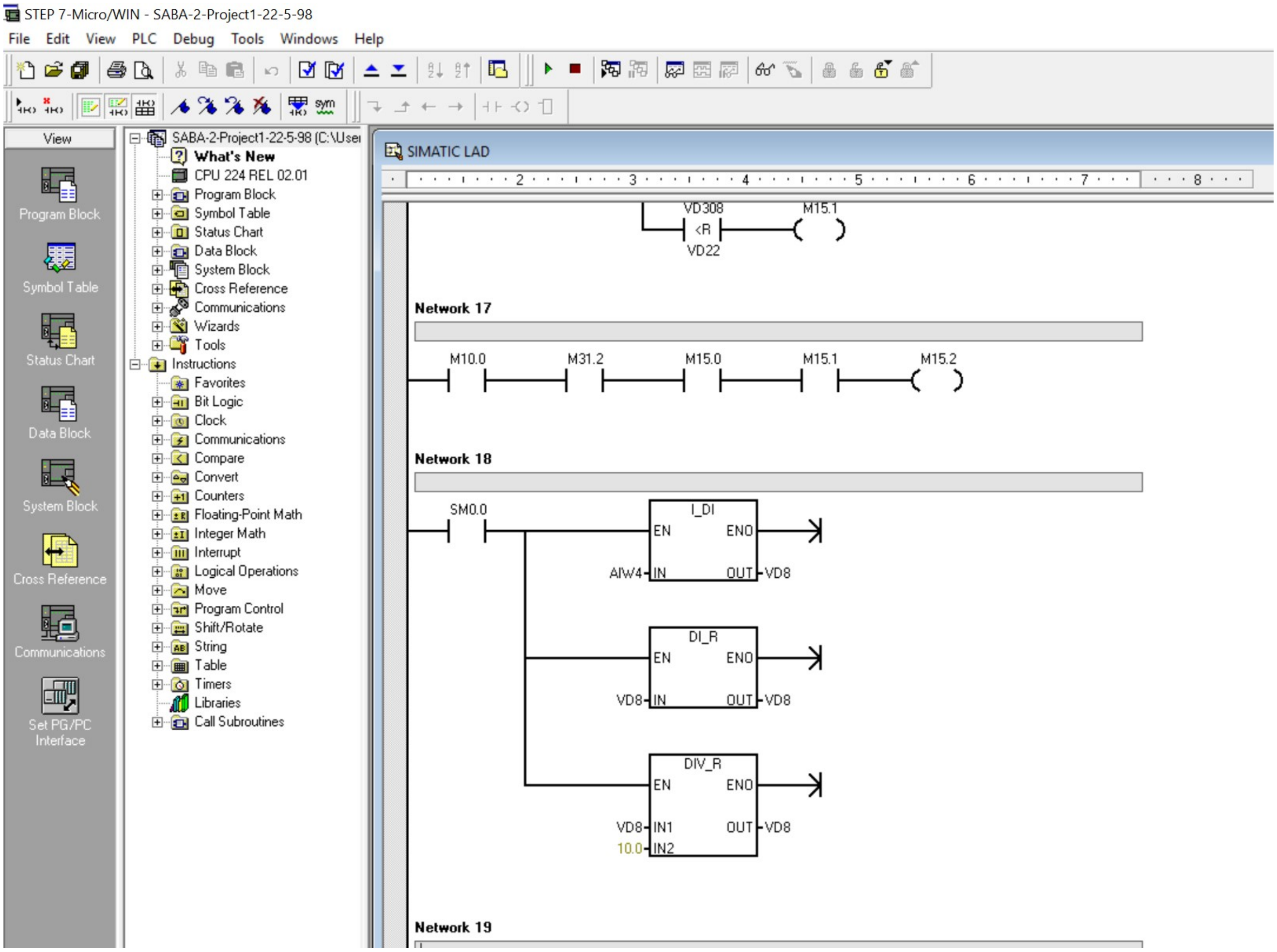
### Gain

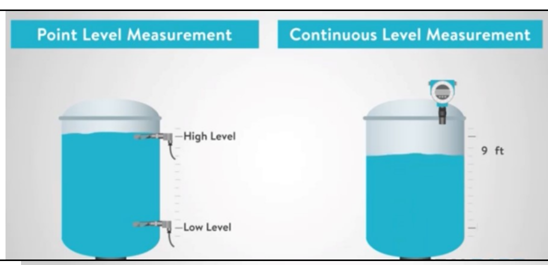
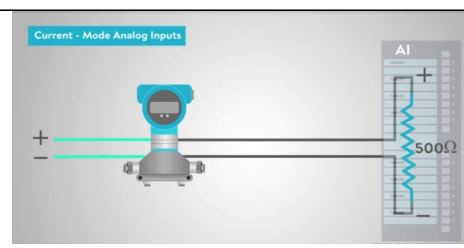
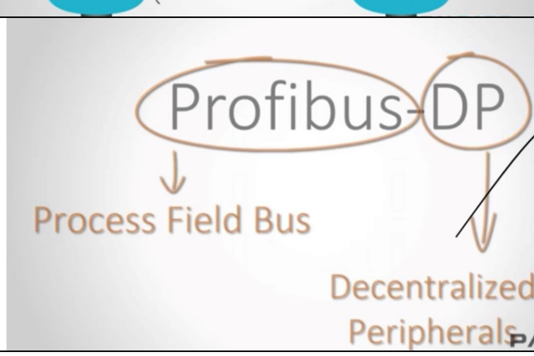
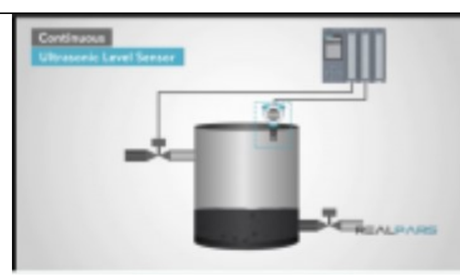
This parameter is given in %.

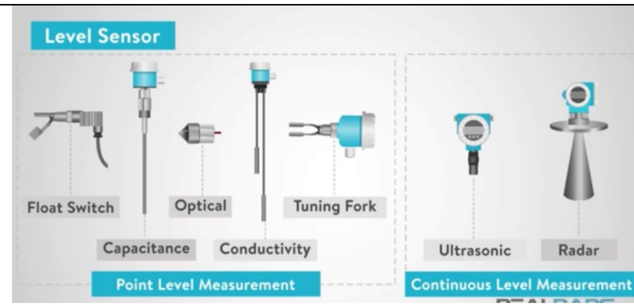
The Gain cannot be a negative value.

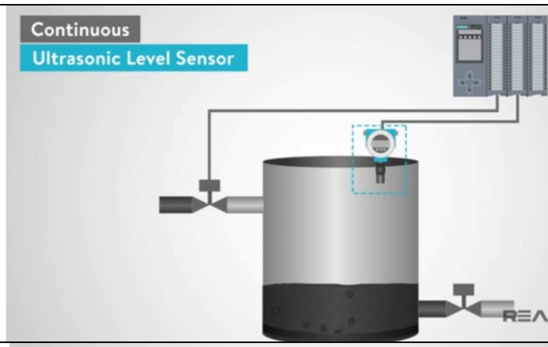
### Zero point offset

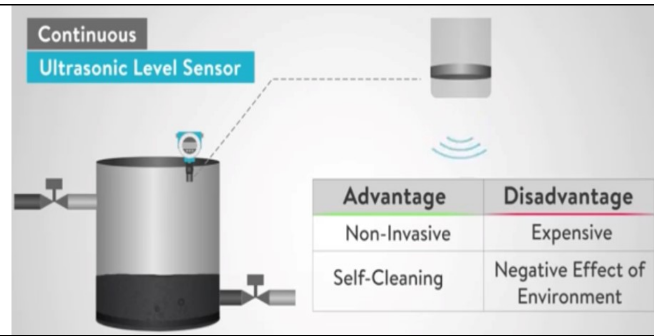
You can enter values between -999 and +999 for the zero point offset.

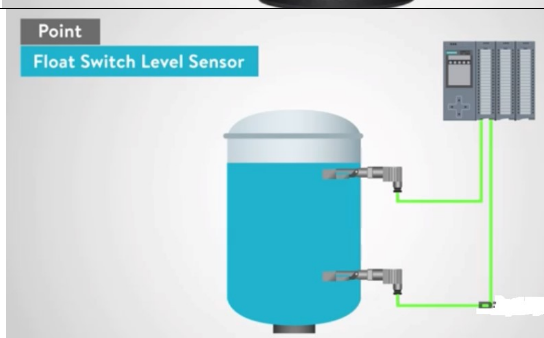

STEP 7-Micro/WIN - SABA-2-Project1-22-5-98
File Edit View PLC Debug Tools Windows Help
View
Program Block
Symbol Table
Status Chart
Data Block
System Block
Cross Reference
Communications
Set PG/PC Interface
SABA-2-Project1-22-5-98 (C:\User
What's New
CPU 224 REL 02.01
Program Block
Symbol Table
Status 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

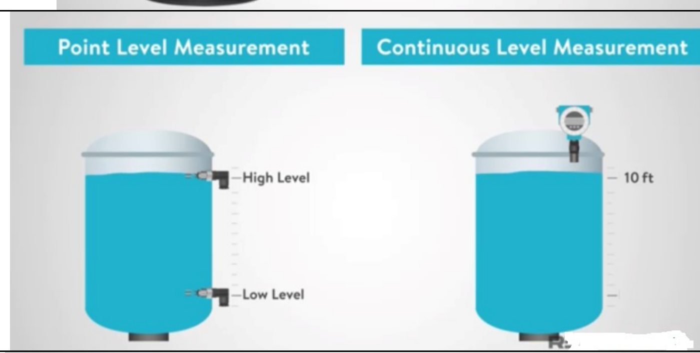
| | |
|---|---|
| Point Level Measurement<br>Continuous Level Measurement<br>High Level<br>Low Level<br>9 ft | Current - Mode Analog Inputs<br>AI<br>+<br>−<br>500Ω |
| Profibus-DP<br>Process Field Bus<br>Decentralized<br>Peripherals |  |

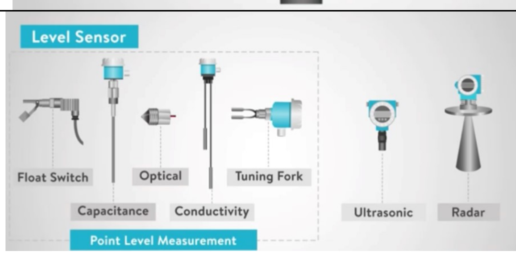

Level Sensor
Float Switch
Optical
Tuning Fork
Capacitance
Conductivity
Point Level Measurement
Ultrasonic
Radar
Continuous Level Measurement

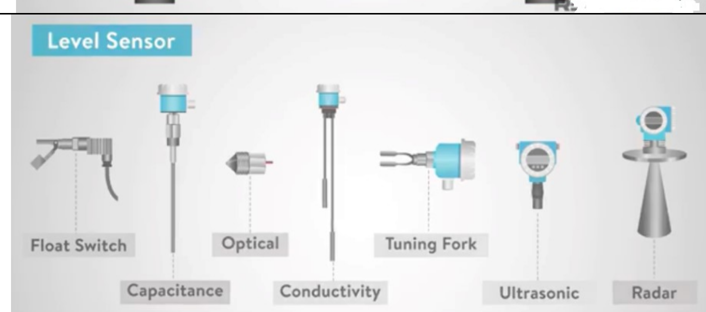

Continuous
Ultrasonic Level Sensor

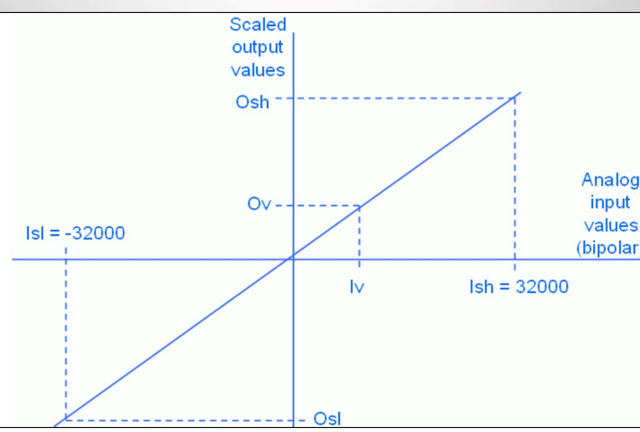

Continuous
Ultrasonic Level Sensor
Advantage
Disadvantage
Non-Invasive
Expensive
Self-Cleaning
Negative Effect of Environment


Point
Float Switch Level Sensor


Point Level Measurement
Continuous Level Measurement
High Level
Low Level
10 ft


Level Sensor
Float Switch
Optical
Tuning Fork
Capacitance
Conductivity
Point Level Measurement
Ultrasonic
Radar


Level Sensor
Float Switch
Optical
Tuning Fork
Capacitance
Conductivity
Ultrasonic
Radar


Scaled output values
Osh
Ov
Isl = -32000
Analog input values (bipolar)
Iv
Ish = 32000
Osl



| | |
|---|---|