ERROR AMPLIFIER. A classic circuit for calculating the error is a summing op amp. In the controller, XOP1 performs the error calculation. Remembering that the summing amp is an inverting amp, we calculate its output using R1 = R2 = R3 = 10 kΩ.

$$\begin{aligned} Verr &= -\,(Vset / R1 + Vsensor / R2) \cdot R3 \\ &= (Vset + Vsensor) \cdot (10\,k / 10\,k) \\ &= -\,(\,Vset + Vsensor\,) \end{aligned}$$

But how does the summer calculate a difference? Well, it does require that your sensor circuit produce a negative output voltage. Assuming that *Vsensor* is the negative of the actual sensor voltage *Vsensor = -Vsens*, you get the difference.

$$Verr = -(\,Vset - Vsens\,)$$

You can look at the error amp's function this way. When *Vsensor* is exactly the negative of *Vset*, the currents through R1 and R2, equal and opposite, cancel each other as they enter the op amps's summing junction. You end up with zero current through R3 and of course 0V, or zero error, at the output. Any difference between Vset and -Vsensor, results in an error voltage at the output that the PID controller can act upon.

OP AMP PID CONTROLLER. How do we get the PID terms from the error voltage *Verr*? We enlist three simple op amp circuits.

Term	Op Amp Circuit Function	
P	Amplifier:	$Vo = (RP2 / RP1) \cdot Verr$
I	Integrator:	$Vo = 1/(RI \cdot CI) \cdot \int Verr\, dt$
D	Differentiator:	$Vo = RD \cdot CD \cdot dVerr / dt$

Lastly, we need to add the three PID terms together. Again the summing amplifier XOP5 serves us well. Because the error amp, PID and summing circuits are inverting types, we need to add a final op amp inverter XOP6 to make the final output positive, given a positive *Vset*.

OUTPUT PROCESS. EOUT represents a very simplified model of a process to be controlled, such as motor velocity for example. The gain of 100 could represent an output transfer function of 100 RPM / V. To include the effects of the motor's inertia, we've added some time delay into the output using two cascaded RC filters. Although Vout is simulated in volts, we know it really represents RPM.

SENSOR. The sensor tells you the actual velocity at the motor, 1 V / 100 RPM for this tachometer. ESENSOR models this feedback device. Note, this sensor block actually produces a negative output voltage, the proper input polarity for your error amplifier as mentioned above.

SIEMENS
S5-100U
CPU 103
SIMATIC S5-100U
PS 930
VOLTAGE SELECTOR
230V
115/230V AC
24V DC 1A
6ES5 930-8MD11
L1
N
24V DC
M
F 3A
BATTERY OFF/ LOW
RUN
STOP
RUN STOP COPY
L+
24V DC
M
6ES5 103-8MA02
OUT
DIGITAL
32 x DC 24 V
IN
SIEMENS
SIMATIC S5
BUS MODULE
6ES5 700-8MA1
MADE IN GERMANY
0.7
0.6
0.5
0.4
1.5
1.4
I/O PATCHING
2.7

SIEMENS
SIMATIC S5
BUS MODULE
6ES5 700-8MA11
1 2 ☒ 4 5 6
MADE IN GERMANY
LISTED 74D7
IND. CONT. EQ.
L+
M
.0
.1
.2
.3
.4
.5
.6
.7
DIGITAL OUTPUT
8×24V DC/0.5A
6ES5 441-8MA11
1 2 3 ☒ 5 6
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
+
DIGITAL INPUTS
−

2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
+
DIGITAL INPUTS
–
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
+
DIGITAL OUTPUTS
–
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0

0000
0000
QW 64
IW 64

SIEMENS
SIMATIC S5-100U
CPU 102
Battery
3,4V
850mAh
BATTERY
OFF/
LOW
I
O
RUN
STOP
RUN
STOP
COPY
L+
24VDC
M
6ES5 102-8MA02
3 4 5 6
SIEMENS
SIMATIC
BUS M
MADE IN G
LISTED
IND. CONT
L+
M
.0
.1
.2
.3
.4
.5
.6
.7
DIGITAL OUTPUT
8x24V DC/0.5A
6ES5 441-8MA11
1 2 3 5 6
INPUTS
I/O PATCHING
0.7
0.6
0.5
0.4
1.7
1.5
1.4

SIEMENS
SIMATIC S5
BUS MODULE
6ES5 700-8MA11
1 2 ☒ 4 5 6
MADE IN GERMANY
LISTED 74D7
IND. CONT. EQ.
1 L+
2 M
.0 4
.1 3
.2 6
.3 5
.4 8
.5 7
.6 10
.7 9
5
DIGITAL OUTPUT
8x24V DC/0.5A
6ES5 441-8MA11
IMPERIAL EASTMAN TUBING 44-P-1/4

INPUTS
I/O PATCHING
0.7
0.6
0.5
0.4
0.3
1.7
1.5
SIEME

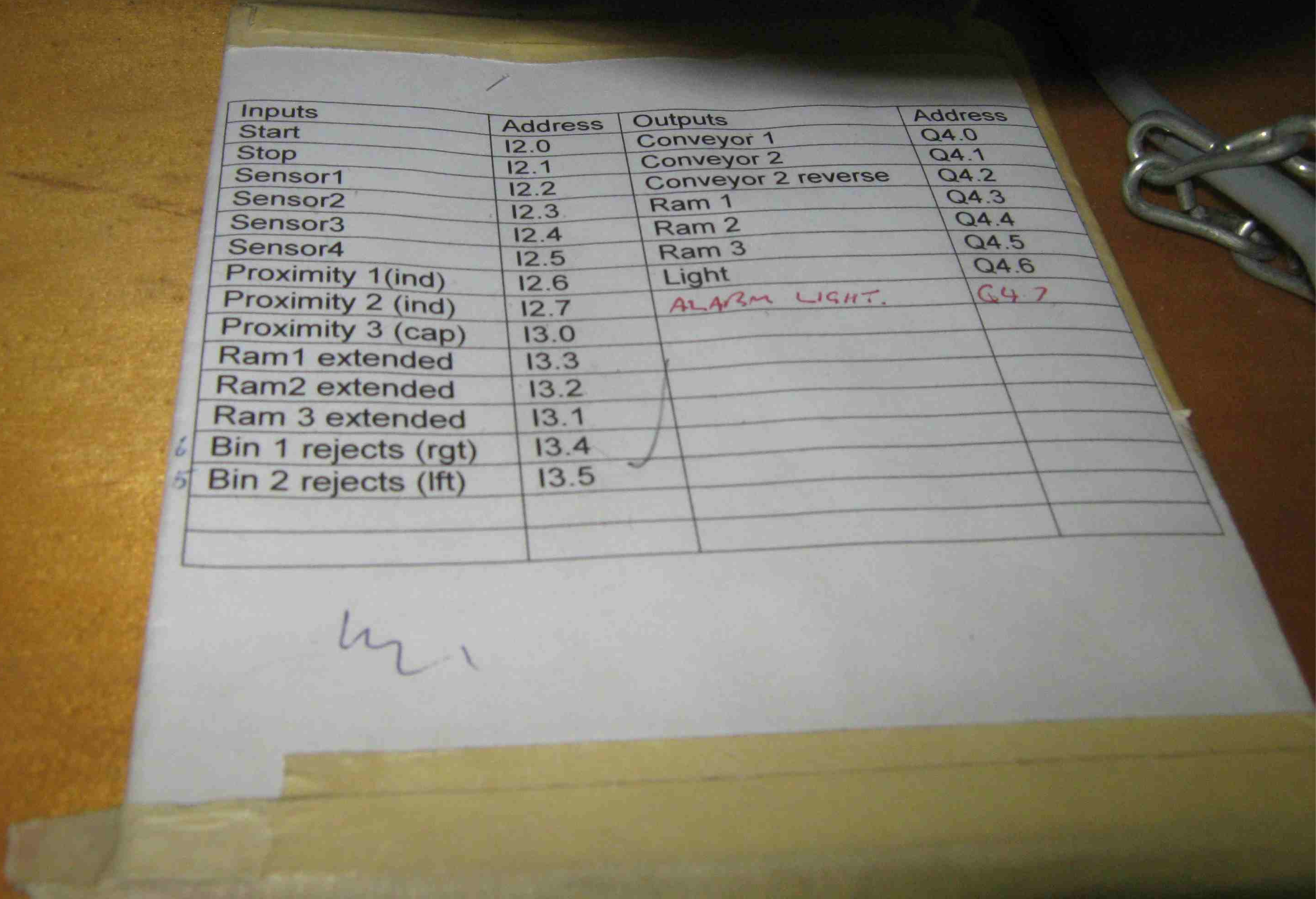
M
5 102-8MA02
3 4 5 6
+24V.DC
SUPPL
COMMON
INPUTS
I/O PATCHING
OUTPU
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1.7
1.6

TUBING 44-P-1/4
LPA

SIEMENS
SIMATIC S5-95U
RUN
STOP
RUN STOP COPY
ANALOG IN/OUT
BATTERY OFF/LOW
24V DC
6ES5 095-8MA01
SIEMENS
SIMATIC S5
BUS MODULE
6ES5 700-8MA11
IN
OUT
SIMULATOR
INPUT/OUTPUT
6ES5 788-8MA11
SIMULATOR
INPUT/OUTPUT
6ES5 788-8MA11
DIGITAL OUTPUT
8×24V DC/0.5A
6ES5 441-8MA11
DIGITAL OUTPUT
QB5
0000
0050
QB32
QB33
B32
IB33
QW32
IW32
DIGITAL
+
3.7
3.6
3.5
3.1
4.7
4.6
4.5
4.4
DIGITAL
+
5.7
5.6
5.5
5.3
5.2

TO P.C. INPUTS
OPTO SENSOR 1
(Nearest)
OPTO SENSOR 2
OPTO SENSOR 3
OPTO SENSOR 4
(Farthest)
INDUCTIVE SENS
INDUCTIVE SENS
E SEN
RAM 1 EXTENDED
(Farthest)
RAM 2 EXTENDED
RAM 3 EXTENDED
(Nearest)
SCRAP NON - METAL
BIN MICRO (Left)
SCRAP METAL BIN
MICRO (Right)
START BUTTON
STOP BUTTON
COMMON
TO P.C. OUTPUTS
INDICATION LAMP
RAM 1 (Large part)
RAM 2 (Medium part)
RAM 3 (Small part)
CONVEYOR 2 (Right)
CONVEYOR 2 (Left)
CONVEYOR 1
COMMON

SOLENOID INTERFACE
PNEUMATIC SEQUENCE MODULE
AIR REGULATOR
OUTPUT
M3-24H
START
STOP
Telemecanique
VR1
VR2



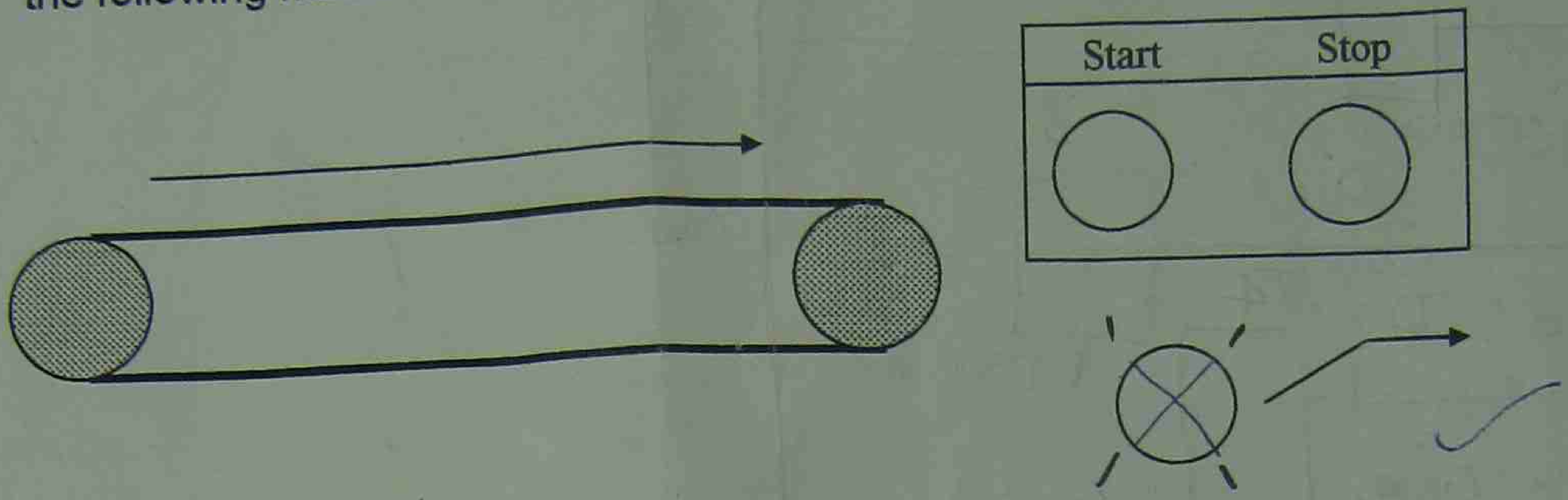
Inputs	Address	Outputs	Address
Start	I2.0	Conveyor 1	Q4.0
Stop	I2.1	Conveyor 2	Q4.1
Sensor1	I2.2	Conveyor 2 reverse	Q4.2
Sensor2	I2.3	Ram 1	Q4.3
Sensor3	I2.4	Ram 2	Q4.4
Sensor4	I2.5	Ram 3	Q4.5
Proximity 1(ind)	I2.6	Light	Q4.6
Proximity 2 (ind)	I2.7	ALARM LIGHT.	Q4.7
Proximity 3 (cap)	I3.0		
Ram1 extended	I3.3		
Ram2 extended	I3.2		
Ram 3 extended	I3.1		
6 Bin 1 rejects (rgt)	I3.4		
5 Bin 2 rejects (lft)	I3.5		

10am

NAME: HCN.

Assignment - Timers 6.

Create a ladder program and enter it into the PLC and demonstrate it's operation for the following machine description.



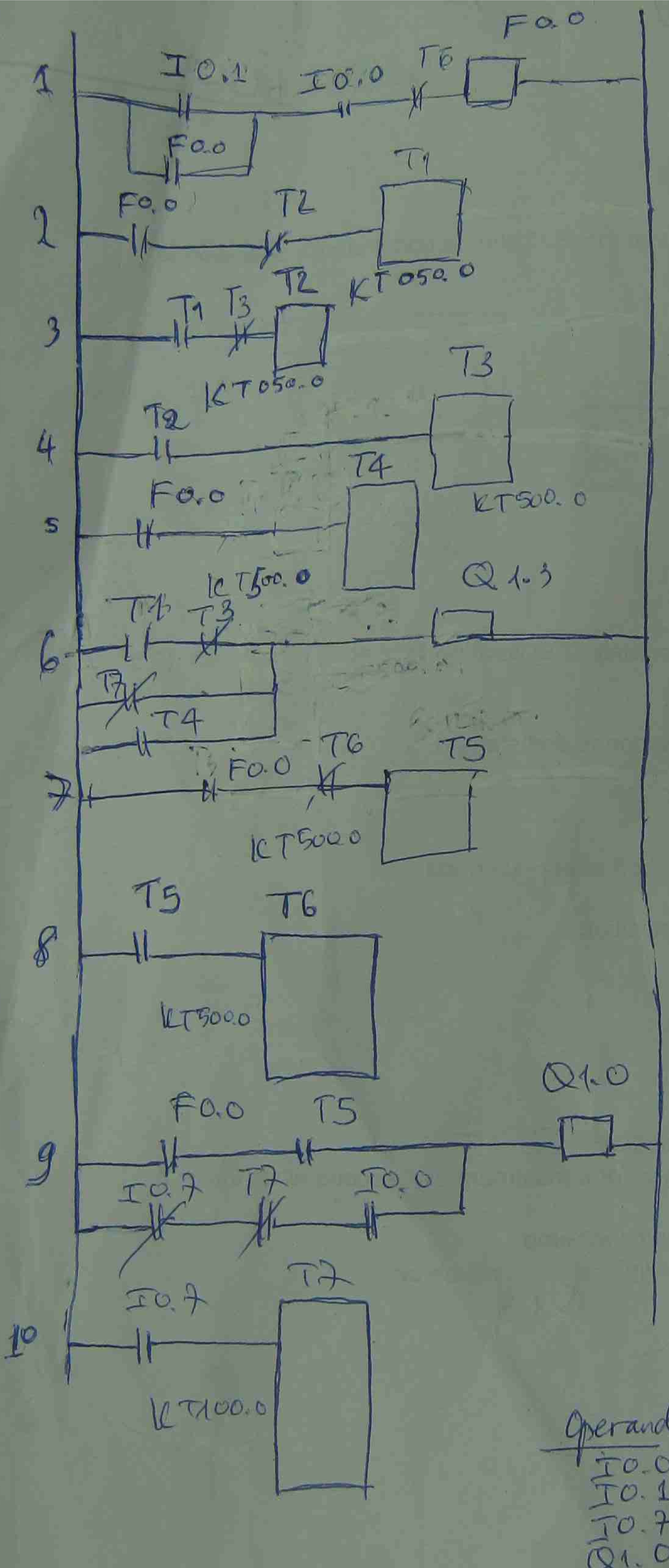
Part A - 30 Marks

- When start I0.1 is pressed momentarily , the warning light at Q1.3 will flash .(0.5 seconds on/off)
- The light will stop flashing after 5 seconds and stay on.
- The motor will now start Q1.0
- The motor and light will be switched off after 5 seconds.
- A stop button at I0.0 will stop all operation.

Part B -20 Marks

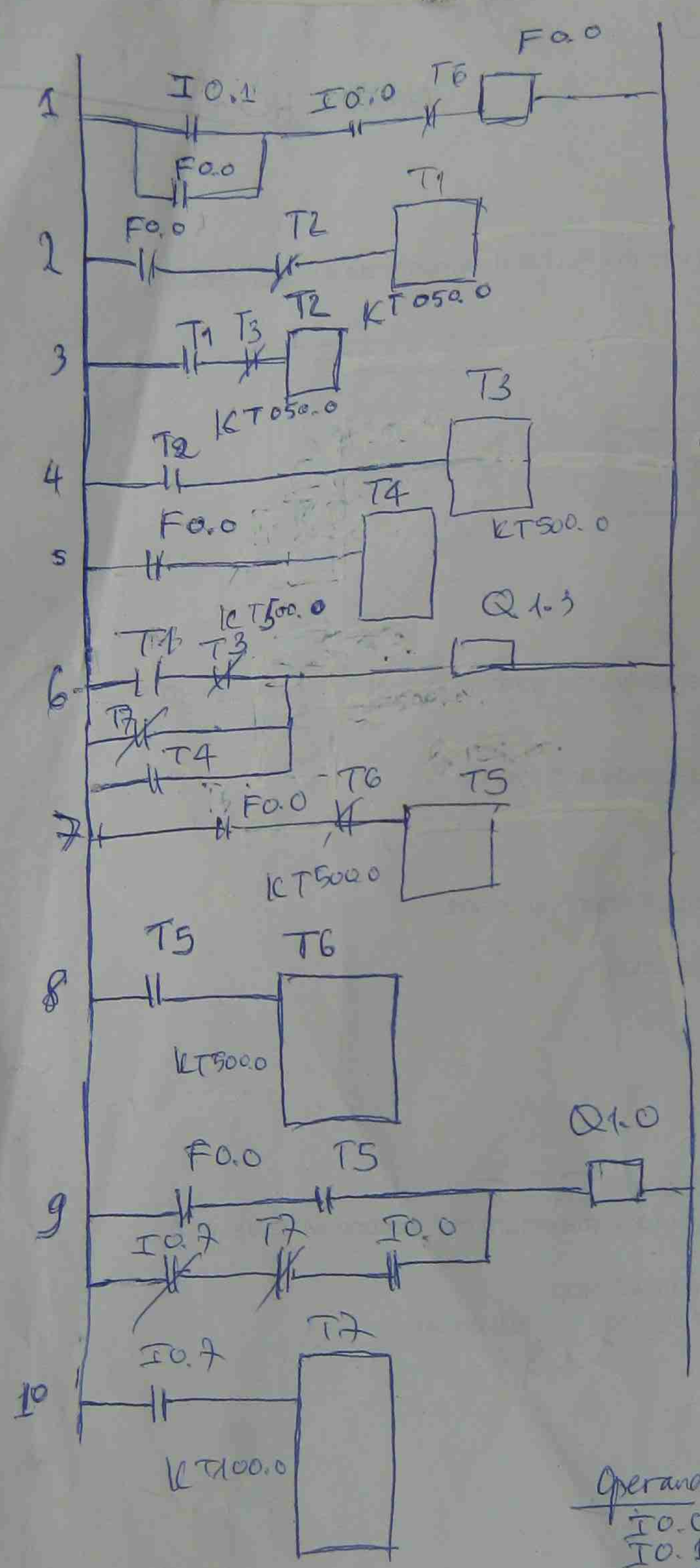
Add this to your original program

- A second "inch" button is to be added at I0.7
- This inch button will run the conveyor for a maximum of 1 second while the inch button is pressed.
- If the inch button is released the motor will stop.
- While the motor is being inched the light at Q1.3 will be on.
- Stop will override the inch button.



Symbolic Table

Operand	Comment
I0.0	STOP SYSTEM
I0.1	START SYSTEM
I0.7	INCH BUTTON
Q1.0	Conveyor motor
Q1.3	Warning light
F0.0	Flag
T1	THE Light on 0,5 s
T2	THE LIGHT OFF 0,5s
T3	LIGHT STOP AFTER 5s
T4	WARNING LIGHT ON
T5	START MOTOR
T6	MOTOR & LIGHT STOP AFTER 5s
T7	CONVEYOR RUN MAXIMUM 1s



Symbolic Table

Operand	Comment
I0.0	STOP system
I0.1	START SYSTEM
I0.7	INCH BUTTON
Q1.0	Conveyor MOTOR
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F0.0	Flag
T1	THE Light on 0,5 s
T2	THE LIGHT OFF 0,5s
T3	LIGHT STOP AFTER 5s
T4	WARNING LIGHT ON
T5	START MOTOR
T6	MOTOR & LIGHT STOP AFTER 5s
T7	CONVEYOR RUN MAXIMUM 1s

Q1

A) Sketch a block diagram with explanatory arrows and notes clearly illustrating the Siemens S5-95U programmable controller cycle scanning process.

B) Explain the procedure of scanning the PLC inputs and of accessing inputs during the application program execution for the siemens S5-95U programmable controller.

C) Explain the procedure of updating the physical outputs from the PLC to the external hardware devices for the siemens S5-95U programmable controller.

D) Explain why it is necessary for the PLC to utilize the process input image (PII) and the process output image (PIQ) storage areas during cycle scanning

Q2
For the siemens S5-95U programmable controller, write the address for:

A) the 16 bit digital outboard.
i) Inputs IW 32
ii) Outputs QW 32

B) An 8 bit digital module in slot 3 labeled as:
i) Input IB 3
ii) Output QB 3

C) Bit 7 of an 8 bit digital module in slot 9 labeled as:
i) Input I 89.7
ii) Output Q 89.7

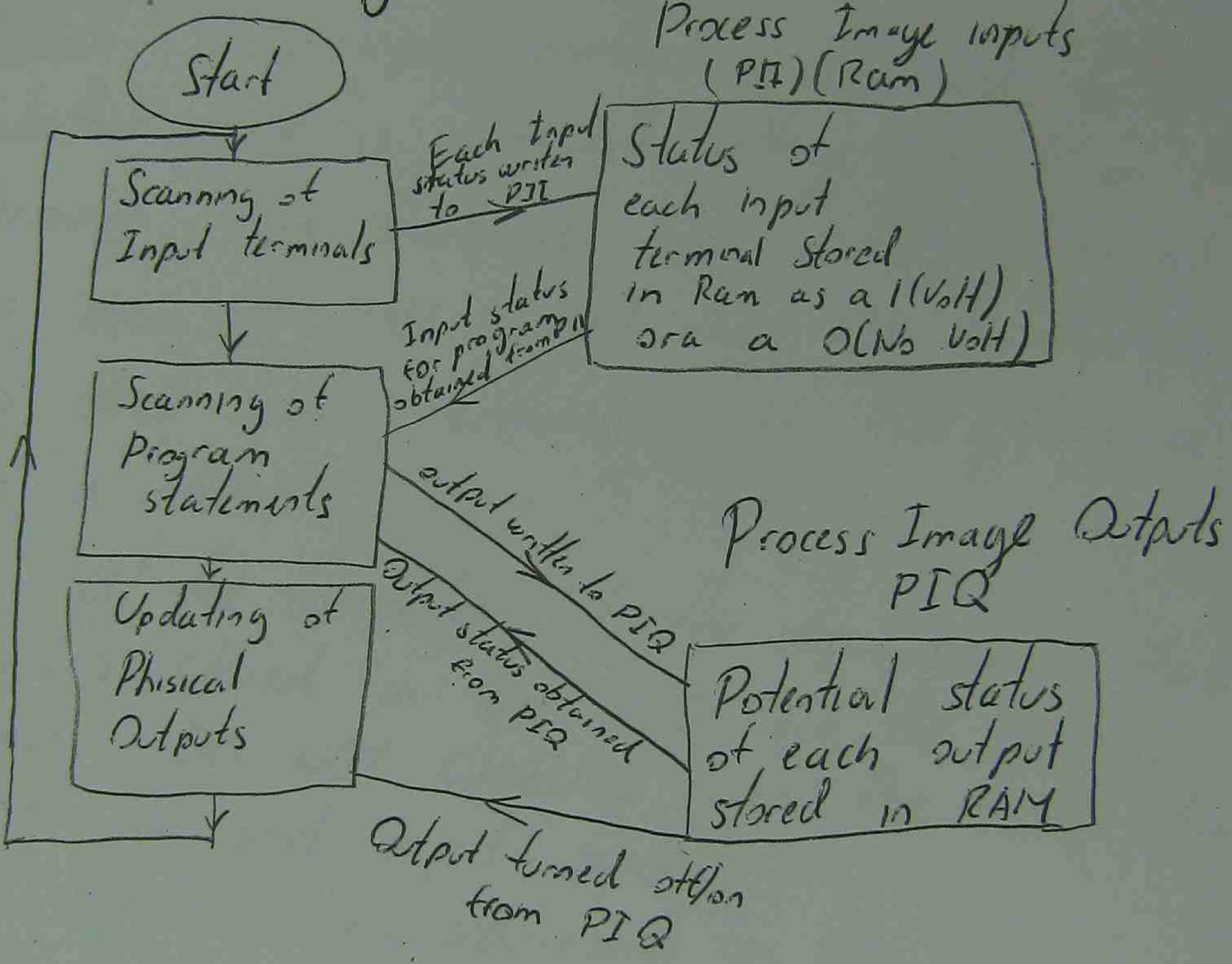
D) A 16 bit digital module in slot 0 labeled as:
i) Input IW 64
ii) Output QW 64

E) Bit 3 of an 8 bit digital module inserted into the slot adjacent to the processor module labeled as
i) Input I 0.3
ii) Output Q 0.3

Q3
Sketch the following for Direct On Line (DOL) starting of a 3 phase motor

a) the software diagram in ladder format using a self latch arrangement
b) The ladder Diagram
c) If the output address to the motor contactor is Q4.0 and the self latch instruction is Q4.0, explain what happens & whether the software diagram is satirfactory where the output connection from the PLC to the motor contactor is loose so that it is touching & un-touching repeatedly due to vibration and state how the software diagram should be connected

Q1(a) Sketch a block diagram with explanator arrows & notes clearly illustrating the Siemens S5-95U programmable controlled cyclic scanning process.


Start
Scanning of Input terminals
Scanning of Program statements
Updating of Phisical Outputs
Process Image inputs (PII)(Ram)
Status of each input terminal Stored in Ram as a 1(VoH) or a 0(No VoH)
Each Input status written to PII
Input status for program obtained from PII
output written to PIQ
Output status obtained from PIQ
Process Image Outputs PIQ
Potential status of each output stored in RAM
Output turned off/on from PIQ

Q1 cont'd

(b) Explain the procedure of scanning the PLC inputs and of accessing inputs during the application program execution for the Siemens S5-95U programmable controller.

Eeach PLC input terminal is scanned to determine whether there is sufficient voltage present on the terminal. If there is, then a "I" is stored in an area of RAM called the PII Corresponding to that input terminal. If not then a "0" is stored.

At the completion of the input scan, the values stored in the PII for the various inputs DO NOT CHANGE (evenif the inputs change) until the next input scan.

Input values addressed in the program scan are obtained from the PII, not from the input terminals.

Q1 cont'd.

(c) Explain the procedure of updating the physical outputs from the PLC to external hardware devices for the Siemens S5-95U programmable controller.

Output values addressed in the program scan are written to the PIQ. The physical outputs status of the voltage on the output terminal DOES NOT CHANGE.

There are updated during the updating output scan where each output terminal is adjusted to on or off determined by whether a "I" or a "O" is stored in the PIQ.

(d) Explain why it is necessary for the PLC to utilise the Process Input Image (PII) and the Process Output Image (PIQ) storage areas during cycle scanning.

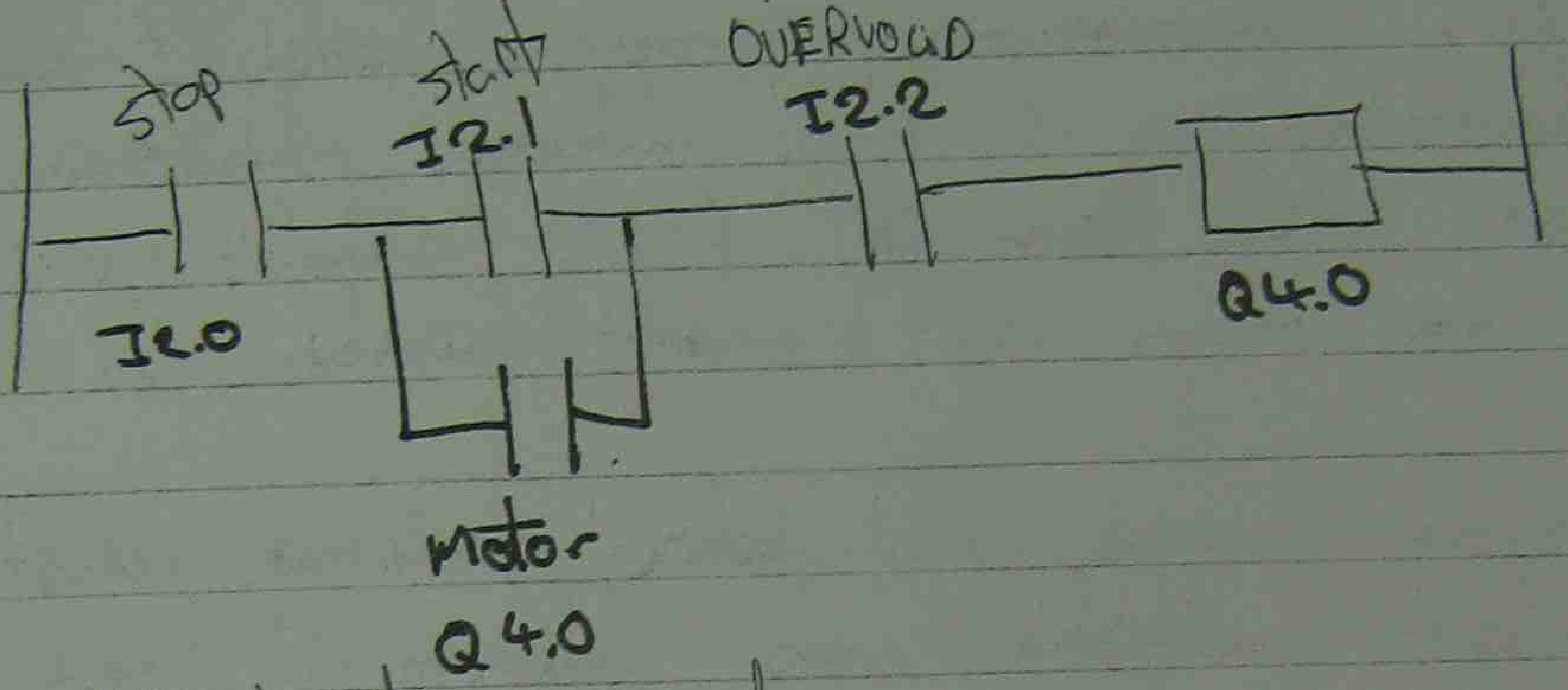
by storing inputs during the input scan, this photograph of the status of inputs is stored in the PII. These values in the PII Cannot change during the program scan, this provides for consistant/predictible outputs from the PLC which otherwise might procedure inconsistant outputs producing a disaster in the operating machinery controlled by the PLC.

The physical outputs should not be changed during the program scan as more than 1 change could occur during the program scan.

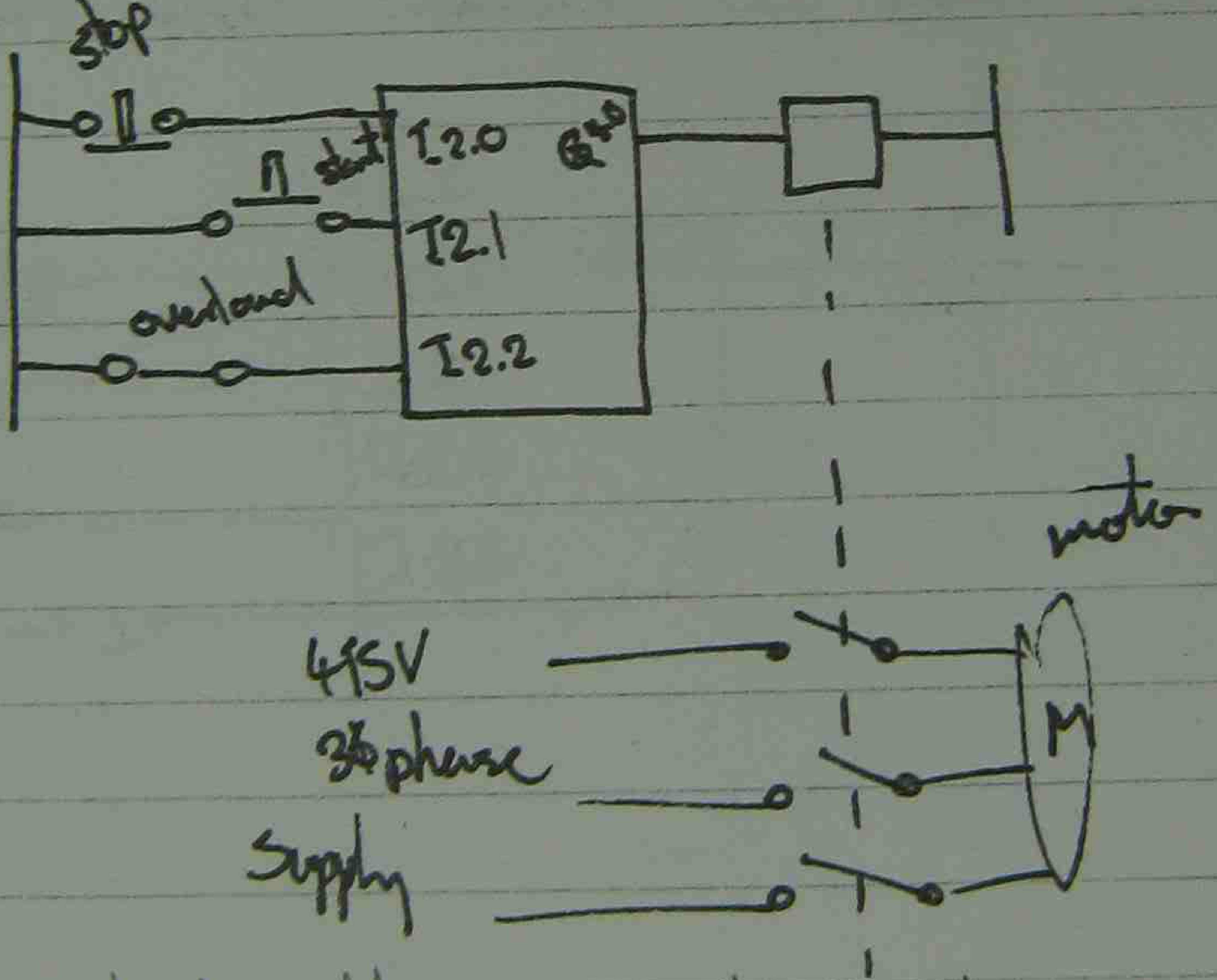
3. Sketch the following for a Direct on line (DOL) starting of a 3 phase motor

ⓐ the software diagram in ladder using a self latch arrangement

Motor ~~contactor~~



ⓑ the hardware diagram



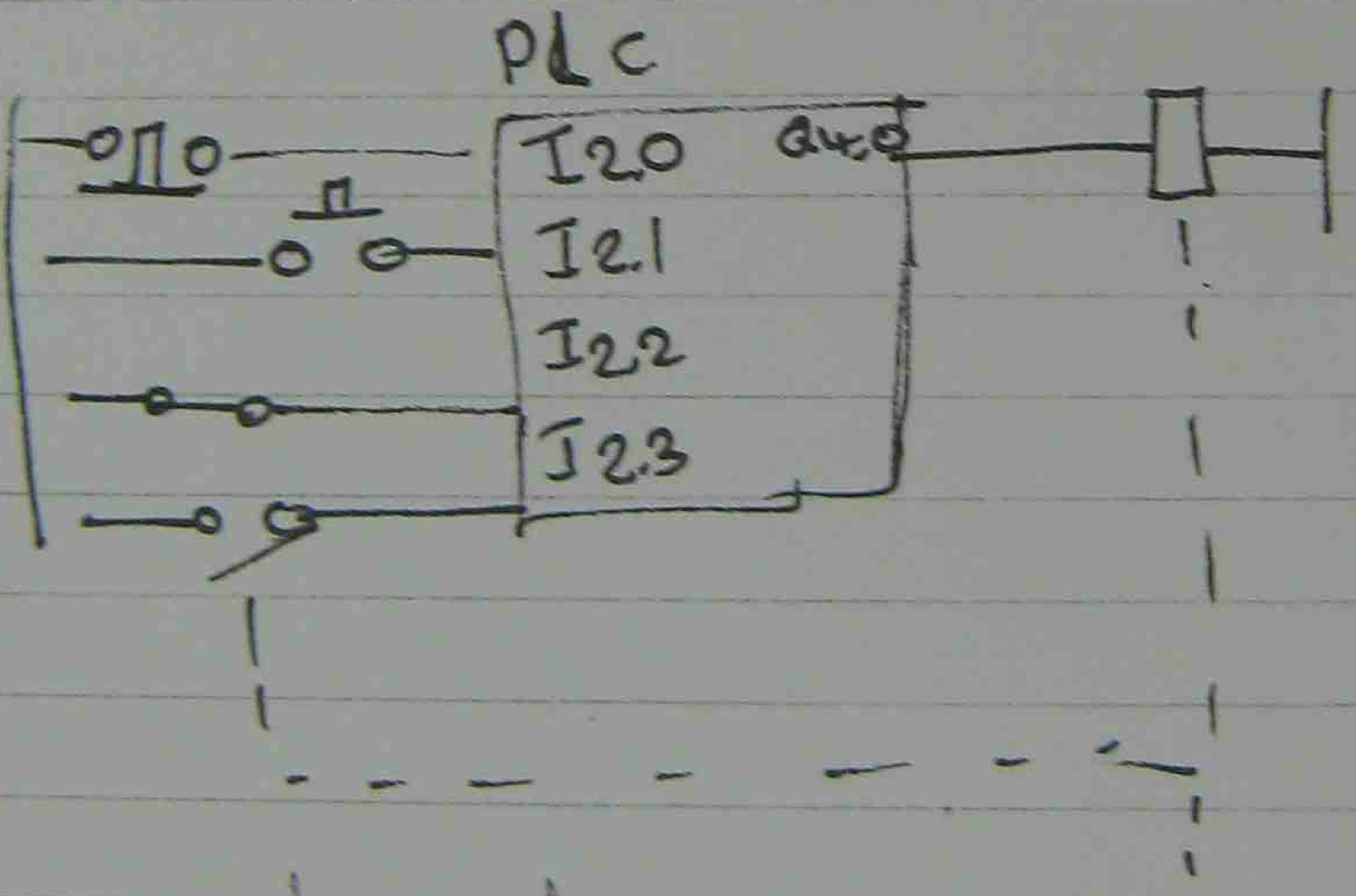
If the output address to the motor is Q4.0 and the self latch instruction is $\overset{Q4.0}{\dashv\vdash}$

explain what happens & whether the software diagram is satisfactor where the output connection from the PLC to the motor contact is loose so that it is touching & untouching repeatedly due to vibration & state how the software diagram should be corrected

The self latch Q4.0 remains ON whether the motor contactor is open or closed

Hence the motor contactor would repeatedly open & close causing considerable arcing & eventually possibly lead to a conflagration (big factory fire) The self latch needs to be derived from the motor contactor.

Now auxiliary (extra) low current contact is used to provide an additional input to the PLC This input address is used to provide the self latch which removes the above unsafe possibility



4.5 One of practice exercises

Prac N# 2

Two at a time

Prac N# 3

Auto start conveyor

Forward & Reverse conveyor

Flasher & Delayed start

-| |-
-|/|-
-( )-
T
∃
-(RTO)-
-(RTF)-
-(CTU)-
-(CTD)-
-(RST)-
-(L)-
-(U)-
-(SQI)-
-(SQO)-
-(ZCL)-
-(MCR)-
PRT
PROG
ON
FORCE
ADDRESS
RUNG/ERR
DATA
MODE
OFF
ON
FRC OFF 0
FRC ON 1
A 2
B 3
C 4
D 5
E 6
F 7
EVENT 8
TIME 9
MODE
PRT UNPRT
REMOVE
INSERT
LAST
SEARCH
-(SQO)- -(CTU)-
-(SQI)- -(CTD)-
-(ZCL)- -(MCR)-
NEXT
RUNG
-(L)- T
-(U)- ∃
-(RTF)- -(RTO)-
SHIFT
CANCEL CMD
-| |-
-(RST)- -|/|-
-( )-
ENTER

PSDIRECT
CitectSCADA Driver for Siemens S5 and S7 and TI PLCs

User information and design

CitectSCADA

DEFAULT.SIS

Driver version history

Version	Modified By	Details
2.00	JFP	2.0 is the Stable version after Initial development
2.01	JFP	Fixed problem with S5 LONGS Fixed S7 I PI & PE addresses Improved some sections & troubleshooting
2.2	JFP	• Added extra DCB validity checks everywhere & made sure of potential string overflows • Compiled against the CTDDK V6 (dont seem to be any major changes) • Added support for Siemens S7 "STRING" Datatype (new feature, not supported by S7NT)
2.1	JFP	Added S7-200 support to backend
2.2	JFP	Added some more FAQ's & updated status addresses
3	JFP	• Increased number of IO devices to 128 • Increased blocksize to CiTect max of 2048 bits, only useful for those using big arrays • Now allow multiple channels, but still recommend only one • New Status register addresses to monitor backend redundant address status • Now allow multiple Citect IO devices connecting to one backend IO Device • Substantial work on the IEC 870 protocol
	JFP	• Fixed problem with S7 strings @ max block length • Fixed problem with S5 strings • Completely re-tested & re-vamped the TI profile • Added support for Square D driver
2	JFP	

Contents

1 User information

1.1 Application notes for PSDIRECT CitectSCADA Front-end Interface

Type	Detail
Manufacturer	www.ProSCADA.com
Device name	Siemens S5 and S7 and TI PLCs
Communications method	Direct DLL interface into driver poll cache

The following CitectSCADA Drivers may be replaced by this Driver

S7NT	- Siemens Softnet systems
S7NTSP	- Siemens misaligned real addressing
SINEC	- Siemens TF Systems for S5
Applicom	- Layer 4 for S5
TINECWIN,TINECNT, TIDIRECT	– Simatic TI via CP1434 H1 card
SQUARED	- Square D Ethernet

1.2 Introduction

In large applications where CitectSCADA has to talk to many Siemens PLC's, a need has arisen to have a higher performance Siemens Driver interface. Simatic Net has a lot of limitations on the number of PLCs it can connect to and also the performance of the Siemens API has been an issue. CitectSCADA also needed a way to optimise the way the it communicates to the PLCs, particularly if the user attempted to poll large configurations of Function block instance DB's directly (User Defined types).

The PSDIRECT CitectSCADA direct interface driver is a front-end / back-end driver, meaning that the driver consists of two parts:

- The back-end server polls the data from the PLC's at configurable intervals. The back-end puts the data in a memory cache.
- The front-end is a native CitectSCADA driver that reads the data from the cache instantly with 0 delay (does not poll the PLC's).

1.3 Advantages over the traditional CitectSCADA Drivers

This has the following advantages:

1. The Polling of the data is completely **de-coupled** from the rate at which the clients are requesting it, which means the clients cannot choke up the IO server with requests - no matter how badly the system is configured.
2. With a traditional CitectSCADA Driver, all polling is Dynamic & client driven. With this driver **each block of data has an individual poll time**. This allows each block of data to be optimised to poll as SLOW as is acceptable for that sub-application. This then leaves more resources available for other data that needs to be faster. For example: poll analogs at 5 second interval, setpoints & run-hours at 30 second interval. **Operator perception of speed** is associated to digital status and alarm inputs. These can be polled at 0.5 seconds intervals.
3. The data is already available when a client polls it and data is displayed immediately without delay. For example popup screens open instantly with data from the cache.
4. The back-end polls raw blocks of data from the PLC. The front-end can then request any data type from this one polled block. This results in substantial efficiencies when you have many mixed data types in close address proximity. For example: Siemens Instance DB's (User Defined types) like the PID loop DB's are very complicated structures containing floats, words & bits. The CitectSCADA S7NT driver would generate a poll for each data type whereas this driver would read the information in **one network poll** block of bytes to be stored in the cache, the Front end driver then processes a **CitectSCADA Driver request for each data type** from the same cached data.
5. Communications can be configured and debugged outside CitectSCADA.

1.4 Advantages over the Siemens Softnet Solutions

This section refers to the Siemens Ethernet back-end.

To setup Siemens Simatic Net on a PC and to test the communication can be very tedious. Multiple IO servers have to be used to communicate to more than 20 PLC effectively.

The PSDIRECT driver will take 5 minutes to install. The driver works with any standard 10MB, 100MB or 1GB Ethernet card. To date more than 50 PLCs on a single system have been tested with one standard 100Mb card. Multiple Ethernet cards can be used to communicate to PLCs, however there are no real performance or reliability gains. The driver works equally well sharing CitectSCADA, Windows workgroups, & Siemens ISO thru 1 Ethernet card. A good Ethernet switch handles different link speeds & network node isolation & redundancy.

The PLC's are the bottlenecks & the total Ethernet bandwidth used by the Ethernet card is < 5% typically. This driver maximises the communication to all the PLC's on you network by implementing a multithreaded parallel polling strategy.

This driver supports up to 64 PLC's on one Network. It has been proven on a system with 50 PLC's & 80 000 IO.

2 Structure of the driver

The different protocol levels are displayed in the table below:

Citect32.EXE
PSDirect.DLL (standard Citect driver)
<xxx>STSR.DLL (depends on protocols)
Driver Poll Cache Memory mapped file
SIXSPOLL.EXE (back end polling)
Siemens H1 ISO Transport OR TCP/IP

The flow of information in the driver starts at the network protocol "Siemens H1 ISO Transport". This protocol is supplied with the driver. No Siemens hardware or software is required at the CitectSCADA side.

The Polling of Blocks of data from the PLC is performed by the hidden application <xxx>SPOLL.EXE. This application is started whenever client applications request data. On start-up, the last configuration file used is opened. The application copies the configuration file into a memory mapped file (MMF/CACHE) and then updates all polled data to the MMF.

The tag interface DLL SIXSTSR.DLL converts IO address strings into internal references to find the data in the MMF.

The PSDirect.DLL is a standard CitectSCADA Array block driver which reads the tags using Native PLC address references. This means you can configure an IO Server with a minimal "Comms" project and run different tag projects on the Display Clients as per normal CitectSCADA conventions.

3 Setup guide

3.1 Step 1 Install the PSDIRECT CitectSCADA front-end driver

This is provided as a standard CitectSCADA Driver install package, just run the Setup.exe provided and make sure you choose the correct install directory for the version of CitectSCADA. ✓

****Note After installing, It is recommended that you copy CitectSCADA\Bin\PROTDIR.DBF to both the user\<project>\Include AND the main or Comms Projects. (ref KB Q2546)**

3.2 Step 2 – Install the Back-end Driver

Install the Siemens Ethernet Driver by running the setup.exe provided.

The recommended install location is the **Citect\Bin** Directory. ✓

Recommended Program Group on the Start menu is "CitectSCADA".

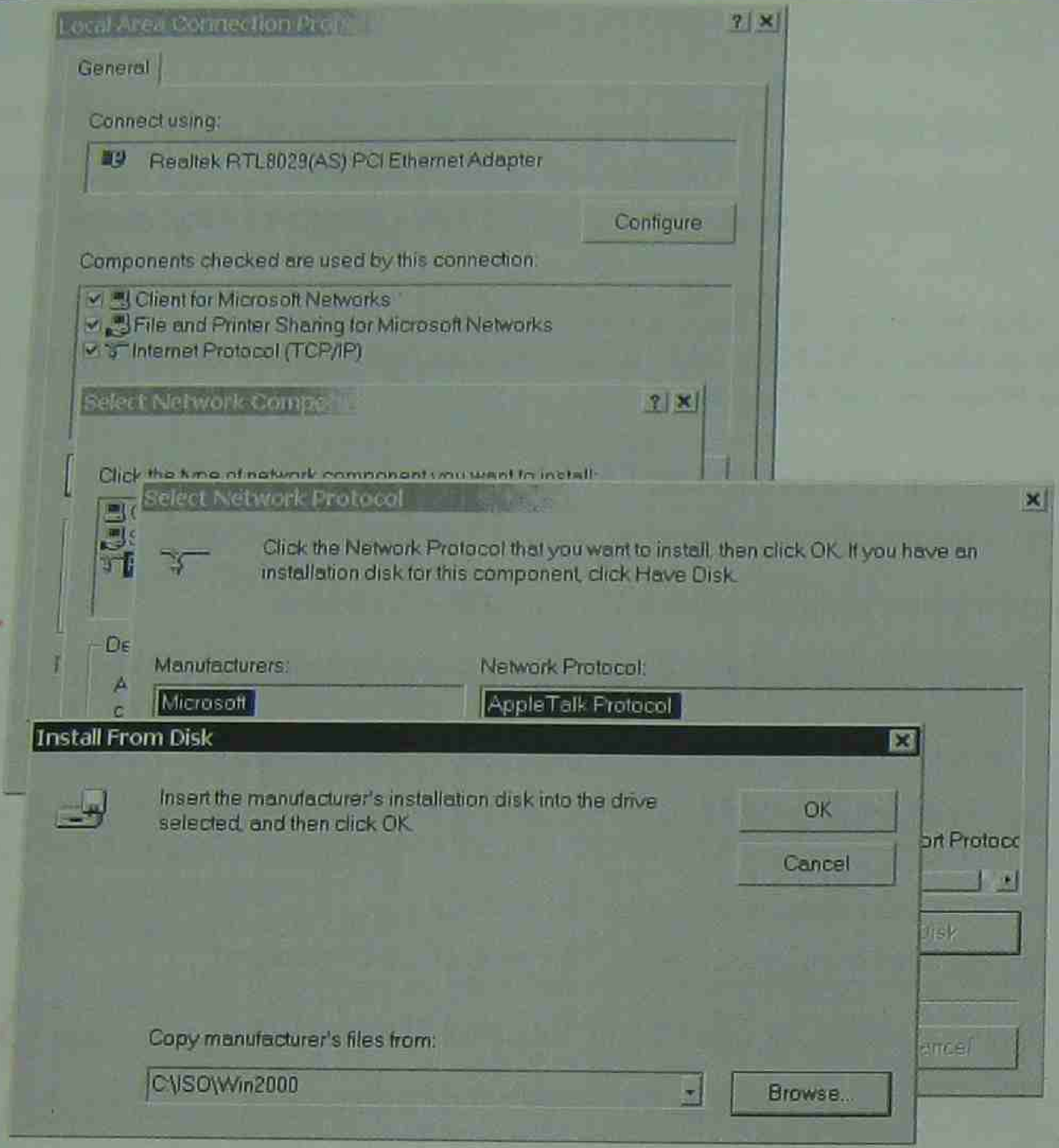
*3.2.1 Step 3 – Install "Siemens H1 ISO transport" (***Not used for TCP/IP)*

*This step is **optional**, depending on the protocols used to talk to the PLC's, if you are using TCP/IP you DO NOT Require the ISO transport – Please go to Section 4 Setting up the driver.

Now you need to install the low level "Siemens H1 ISO transport"

This installation is only required for the Siemens Ethernet Driver. ✗

1. Open the "Settings | Control Panel"
2. Open the "Local Area Network Properties" Settings
3. Go to the "Protocols" tab
4. Press "Add"
5. Press "Have Disk"
6. Enter or browse to the following path "<Install disk>\ISO\WIN2000 & XP\"



Connect using:
Realtek RTL8029(AS) PCI Ethernet Adapter

Components checked are used by this connection:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ Internet Protocol (TCP/IP)

Click the type of network component you want to install:

Click the Network Protocol that you want to install, then click OK. If you have an installation disk for this component, click Have Disk.

Manufacturers: Microsoft

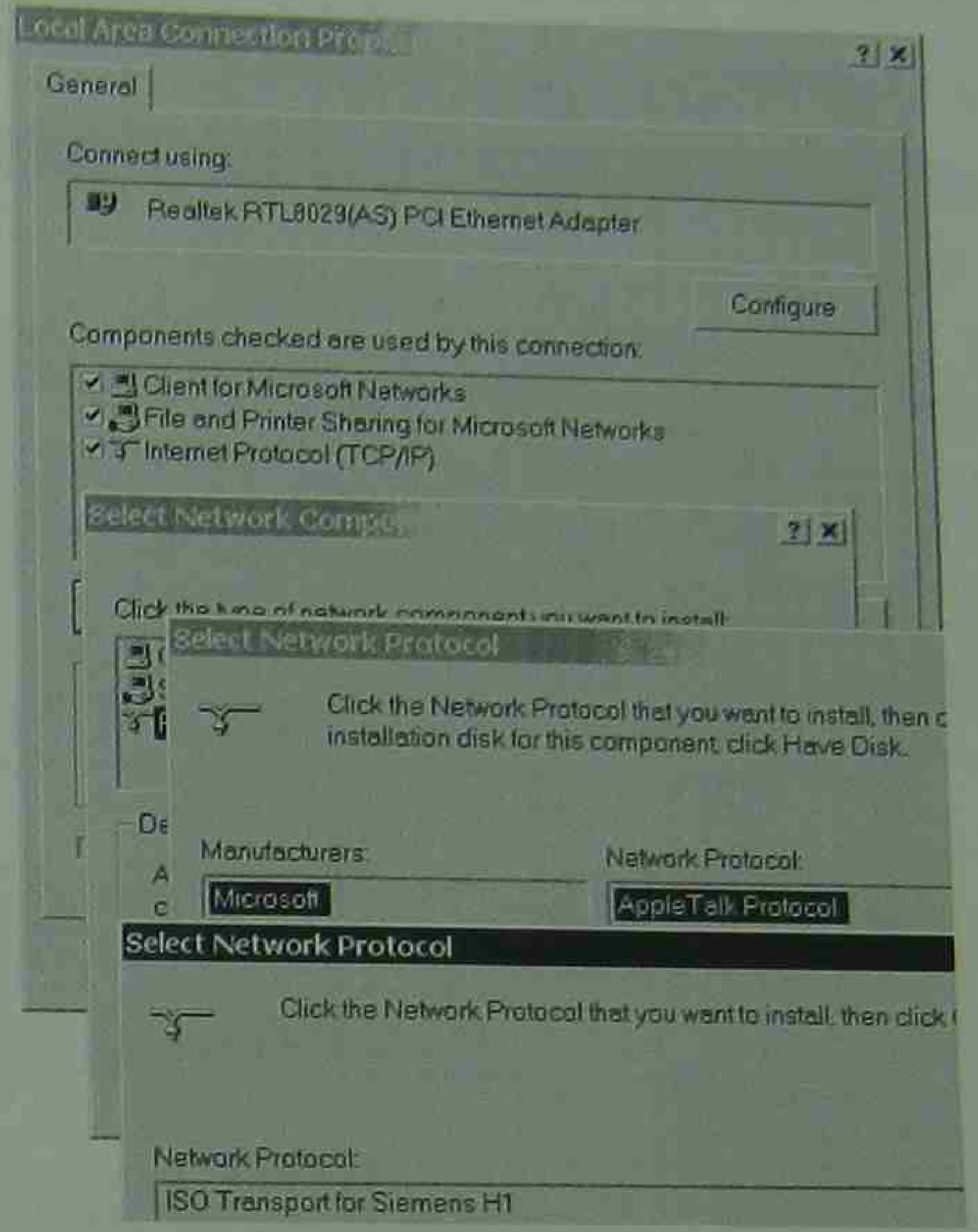
Network Protocol: AppleTalk Protocol

Insert the manufacturer's installation disk into the drive selected, and then click OK.

Copy manufacturer's files from:
C:\ISO\Win2000

7. Press "OK"

8. You will see a prompt "ISO transport for Siemens H1"



Connect using:
Realtek RTL8029(AS) PCI Ethernet Adapter

Components checked are used by this connection:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ Internet Protocol (TCP/IP)

Click the type of network component you want to install:

Click the Network Protocol that you want to install, then c installation disk for this component, click Have Disk.

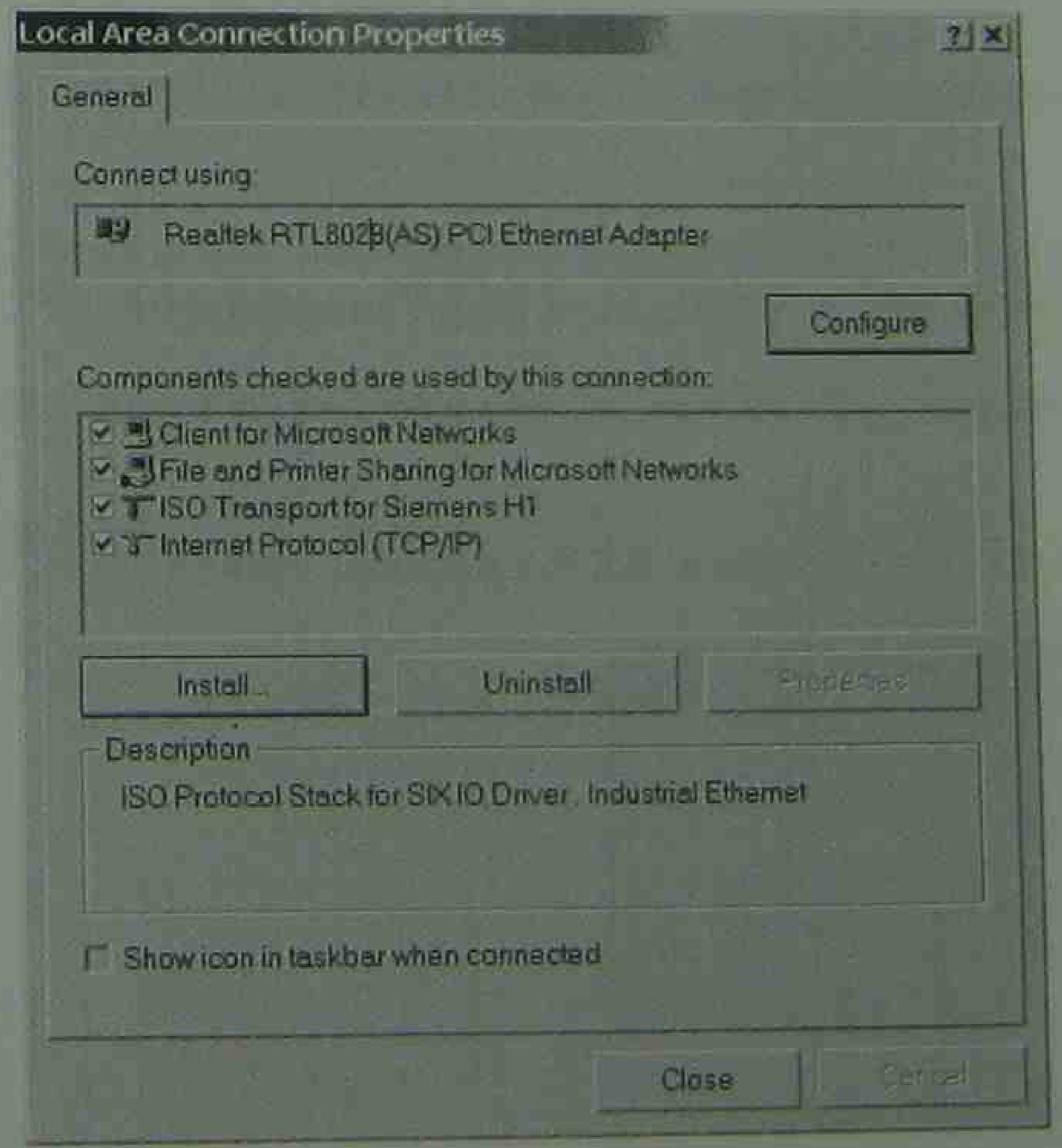
Manufacturers: Microsoft

Network Protocol: AppleTalk Protocol

Click the Network Protocol that you want to install, then click

Network Protocol:
ISO Transport for Siemens H1

9. Press "OK"



Connect using:
Realtek RTL8029(AS) PCI Ethernet Adapter

Components checked are used by this connection:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ ISO Transport for Siemens H1
- ☑ Internet Protocol (TCP/IP)

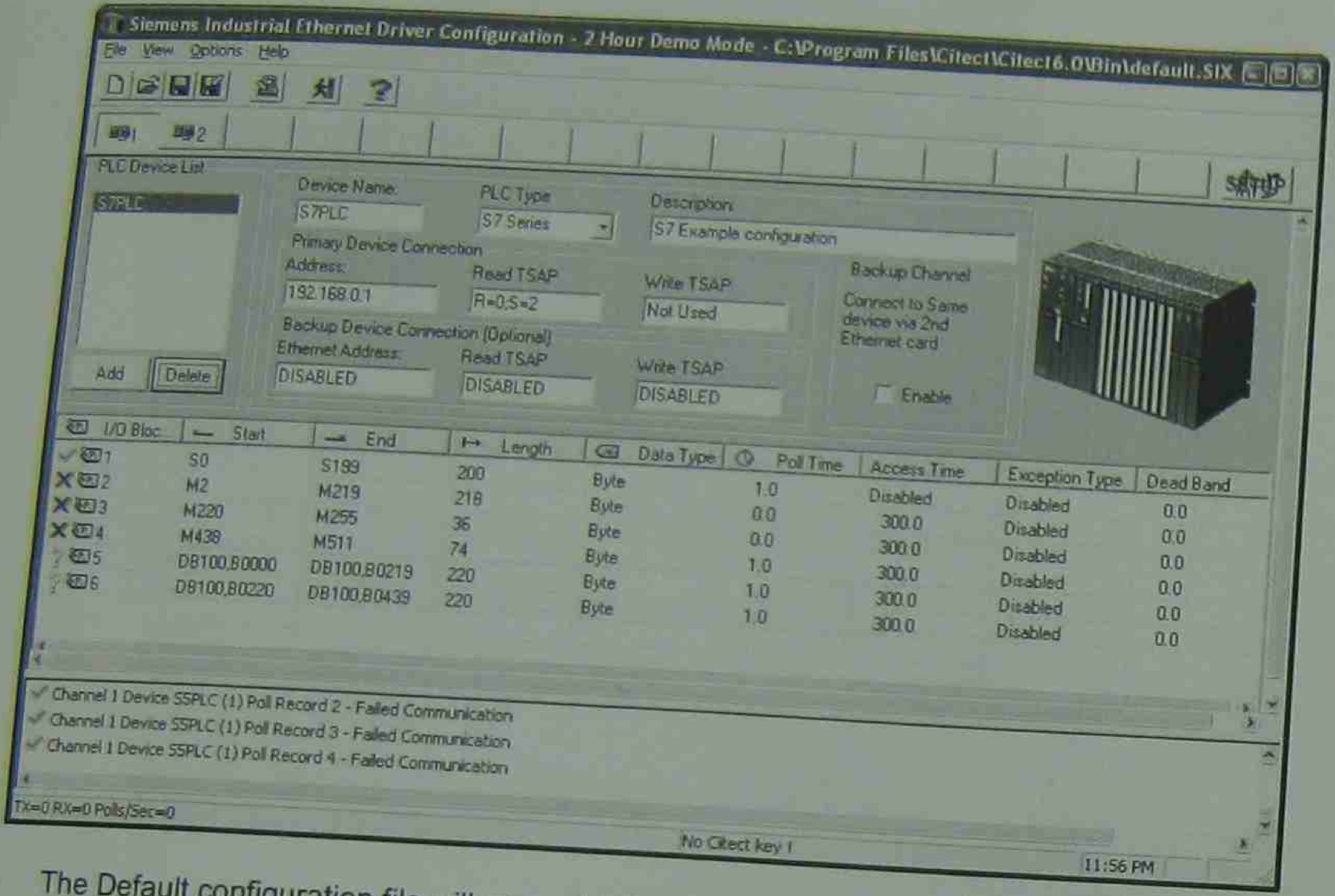
Description
ISO Protocol Stack for SIX IO Driver, Industrial Ethernet

☐ Show icon in taskbar when connected

10. Close and restart the computer

4 Setting Up the driver

Run the "Siemens Industrial Ethernet Driver Configurator"



Siemens Industrial Ethernet Driver Configuration - 2 Hour Demo Mode - C:\Program Files\Citect\Citect6.0\Bin\default.SIX

Device Name: S7PLC

PLC Type: S7 Series

Description: S7 Example configuration

Primary Device Connection

Address: 192.168.0.1

Read TSAP: R=0;S=2

Write TSAP: Not Used

Backup Device Connection (Optional)

Ethernet Address: DISABLED

Read TSAP: DISABLED

Write TSAP: DISABLED

Backup Channel

Connect to Same device via 2nd Ethernet card

□ Enable

I/O Bloc	Start	End	Length	Data Type	Poll Time	Access Time	Exception Type	Dead Band
✓ 1	S0	S199	200	Byte	1.0	Disabled	Disabled	0.0
✗ 2	M2	M219	218	Byte	0.0	300.0	Disabled	0.0
✗ 3	M220	M255	36	Byte	0.0	300.0	Disabled	0.0
✗ 4	M438	M511	74	Byte	1.0	300.0	Disabled	0.0
? 5	DB100,B0000	DB100,B0219	220	Byte	1.0	300.0	Disabled	0.0
? 6	DB100,B0220	DB100,B0439	220	Byte	1.0	300.0	Disabled	0.0

```
Channel 1 Device S5PLC (1) Poll Record 2 - Failed Communication
Channel 1 Device S5PLC (1) Poll Record 3 - Failed Communication
Channel 1 Device S5PLC (1) Poll Record 4 - Failed Communication
```

TX=0 RX=0 Polls/Sec=0

No Citect key !

11:56 PM

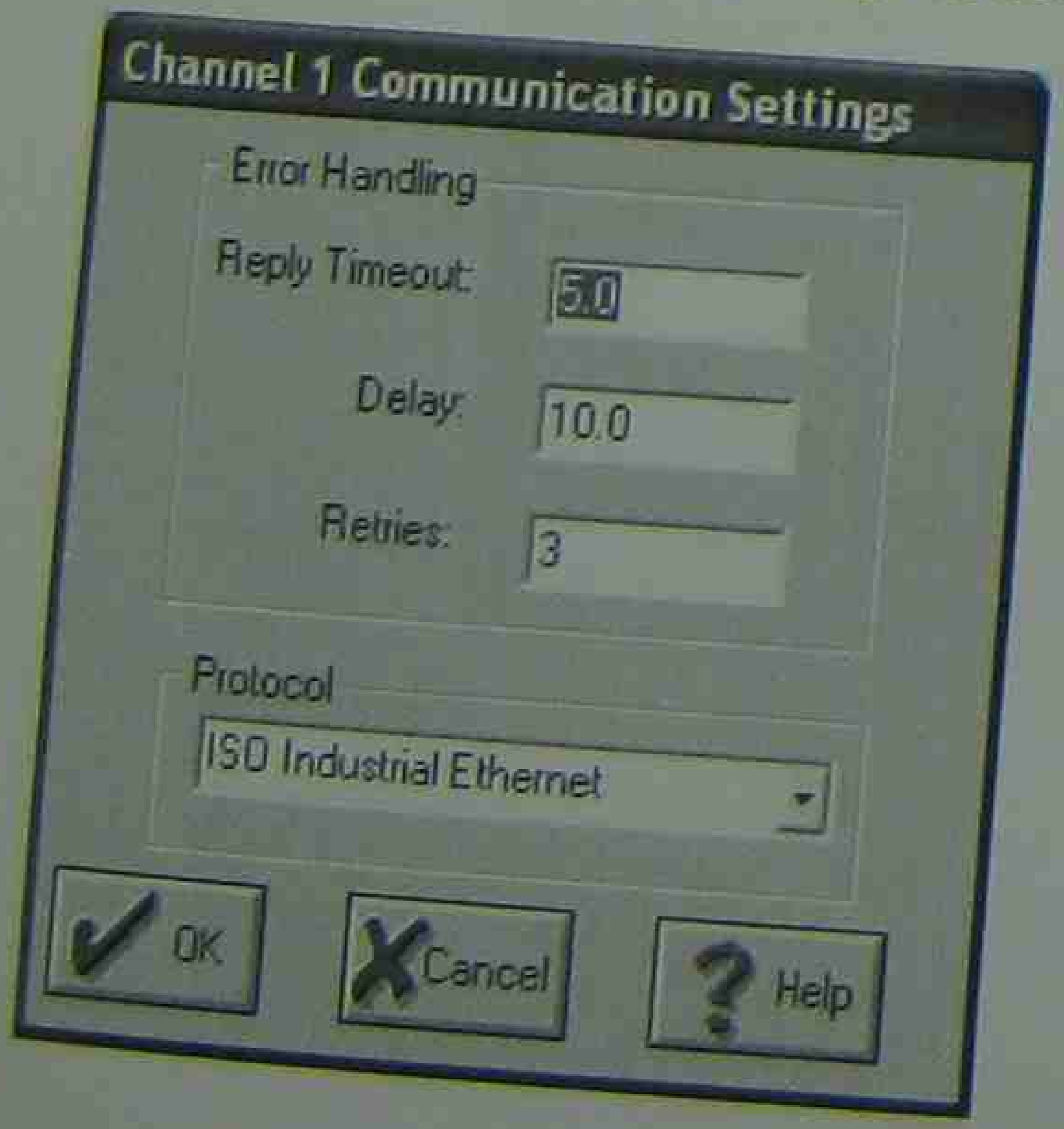
The Default configuration file will open, this includes 3 PLC's an S5, S7 & TI.

Since you will probably be using an S7 select the S5 PLC & press delete, do the same for the TI PLC

The S7 example configuration is setup to poll M0-M99; this address exists in all S7 PLC's so it should poll correctly without setting up a Step 7 program on the PLC.

Before setting addresses etc. please set the protocol type in the channel settings

- Open the channel settings to set the protocol – press the Setup button



Channel 1 Communication Settings

Error Handling

Reply Timeout: 5.0

Delay: 10.0

Retries: 3

Protocol: ISO Industrial Ethernet

You have a choice between TCP/IP and ISO. If ISO is chosen then the ISO transport must be installed (supplied with the driver).

- Set the PLC's address, for ISO this is a 12 digit Hexadecimal MAC address, for TCP/IP this is of the form 0.0.0.0
- Now press ok to go back to the main device settings

The read TSAP setting defaults to "R=0;S=2" which means read the CPU in Rack 0 Slot 2. This is Correct for an S7-300. On a S7-400 with 2 slot power supply, meaning the CPU is in Slot 3, this should be R=0;S=3. **Note the Slot is the slot number of the CPU, NOT the CP 443 card!

***For the S7-200 PLC Set the read TSAP to "CP243" because the S7-200 does not comply with the rack & slot system.

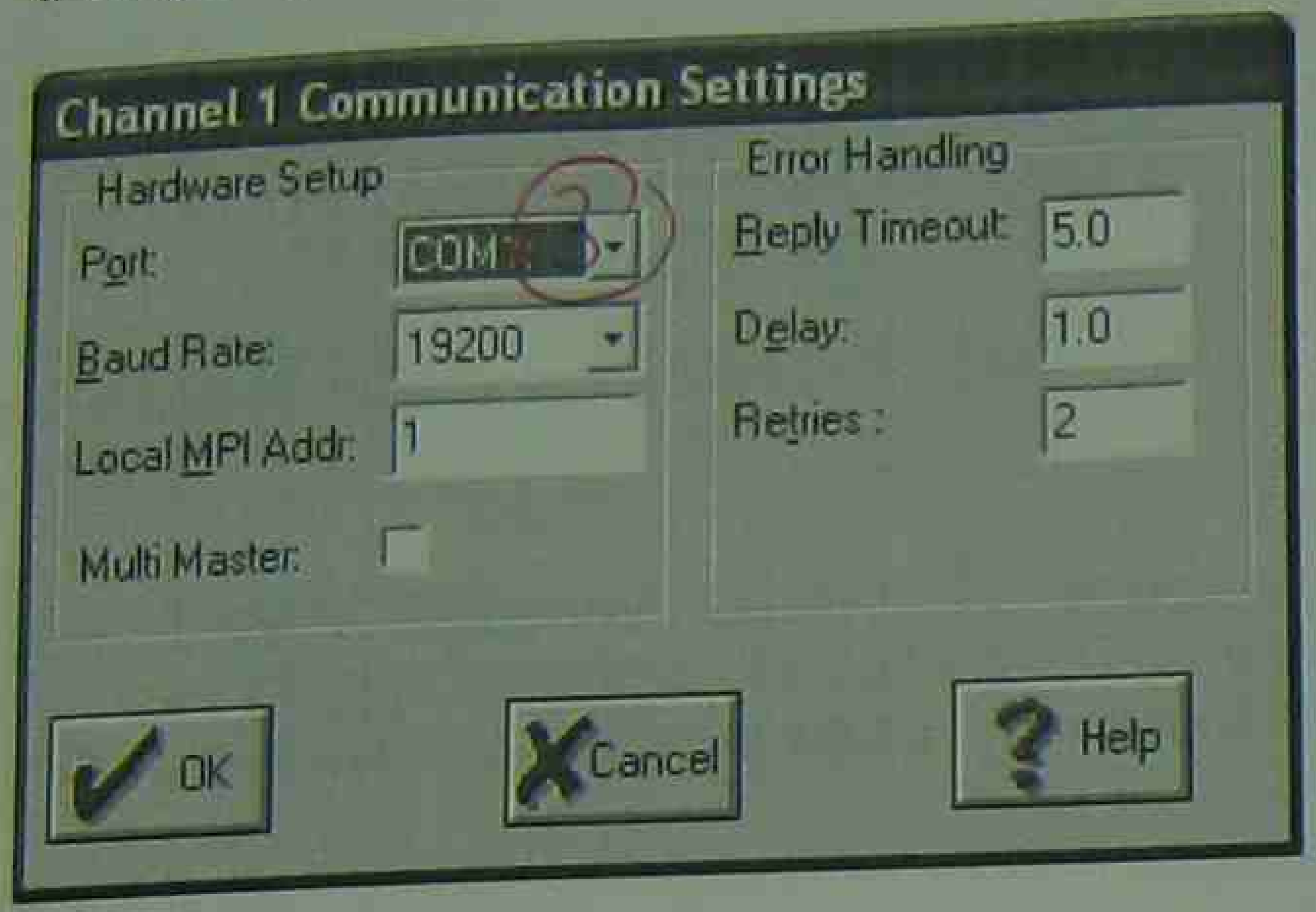
Now "Reload" the configuration by pressing the button. This is IMPORTANT; always reload any configuration change changes. The configurator works on the configuration file on disk, the reload command loads that into memory, briefly interrupting the polling as it does so

Now check that you have communications. The transmit and receive counters at the bottom of the window should increment

The Status of the M0 block should change to a ✓

4.1 Setting Up using the serial MPI

The Serial S7 Driver uses a different Backend driver to the Ethernet however the configuration is almost identical. The main difference is the Channel settings where you setup the com port & baud rates. The Local MPI address is normally 1, if you have 2 SCADA's on the network then you need to set SCADA a to 1 & SCADAB to 2 (No PLC may then use 2) & enable the Multi master setting.



Channel 1 Communication Settings

Hardware Setup

Port: COM[illegible] 3

Baud Rate: 19200

Local MPI Addr: 1

Multi Master: □

Error Handling

Reply Timeout: 5.0

Delay: 1.0

Retries : 2

5 Quick start Simple CitectSCADA configuration

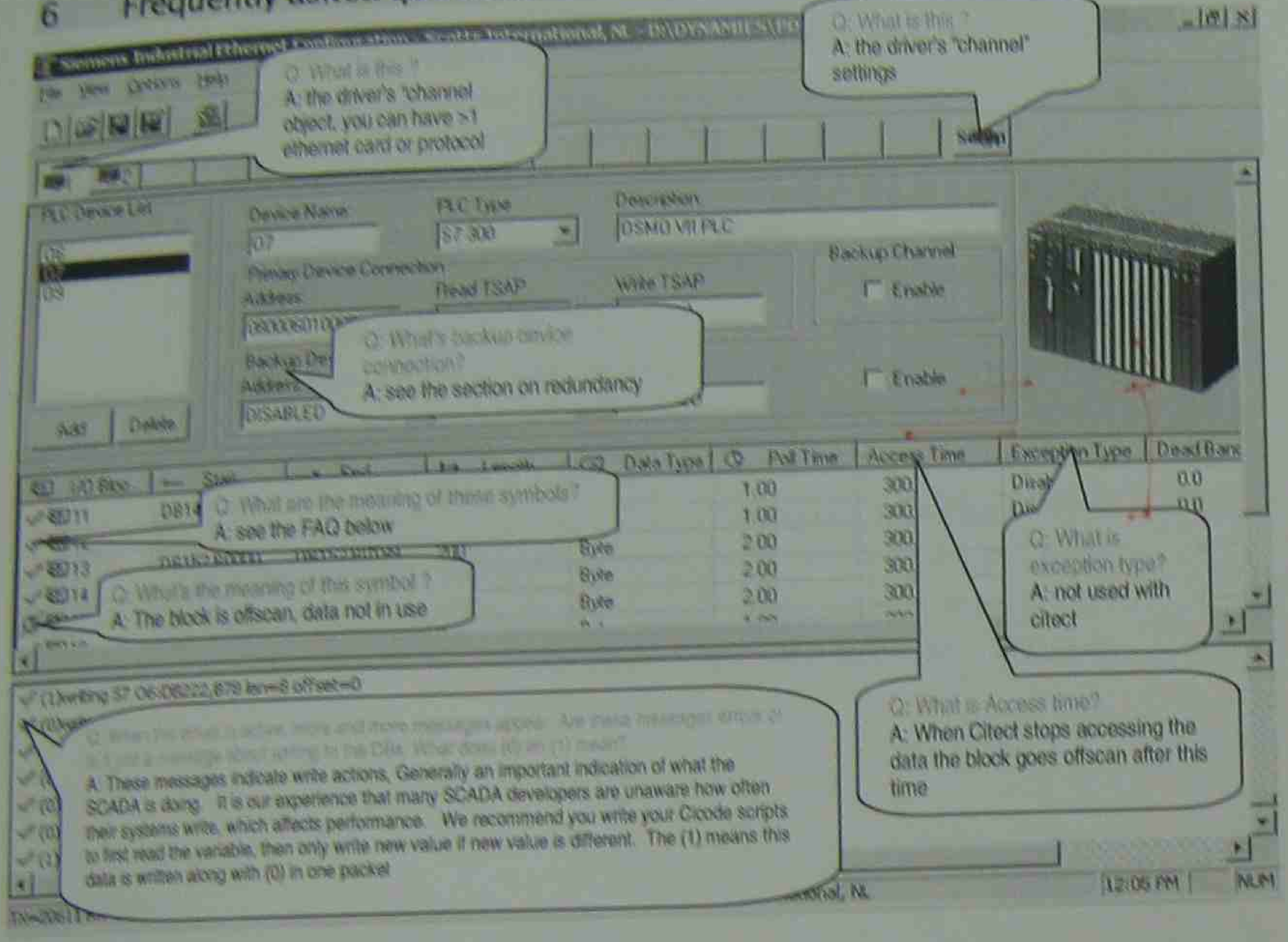
Follow the following steps to configure a CitectSCADA application to the sample above.

** there is an example CitectSCADA project installed with the PSDIRECT Front end driver in "C:\Program Files\Citect\CitectSCADA\PSDIRECT Sample"

Read more about it in The Appendices at the end of this document. The following is a simple Fresh setup.

- Create a new CitectSCADA Project
- DO NOT create a **Boards** object
- Add a **Port** & Call it "PS_PORT" (set address to 0, all other fields blank incl. the board) ✓
- Add an IO device call it "S7PLC" connect to the port "PS_PORT" ✓
- Set the address to "S7;Ethernet" or "S7;MPI" for serial ✓
- Set the Protocol to "PSDIRECT1" ✓
- Add a Tag with IO device "S7PLC" & IO Address "M0" data type set to INT. ✓
- Put the tag on a mimic; compile the application and start CitectSCADA.
- Verify the correct data is displayed on the mimic.

6 Frequently asked questions & troubleshooting



Q: What is this ?
A: the driver's "channel" settings

Q: What is this ?
A: the driver's "channel object, you can have >1 ethernet card or protocol

Q: What's backup device connection?
A: see the section on redundancy

Q: What are the meaning of these symbols?
A: see the FAQ below

Q: What's the meaning of this symbol ?
A: The block is offscan, data not in use

Q: What is exception type?
A: not used with citect

(1)writing S7 06:DB222,878 len=8 offset=0

Q: When the driver is active, more and more messages appear. Are these messages errors ? Is it just a message about writing to the DBs. What does (0) an (1) mean?
A: These messages indicate write actions, Generally an important indication of what the SCADA is doing. It is our experience that many SCADA developers are unaware how often their systems write, which affects performance. We recommend you write your Cicode scripts to first read the variable, then only write new value if new value is different. The (1) means this data is written along with (0) in one packet

Q: What is Access time?
A: When Citect stops accessing the data the block goes offscan after this time

Q: The latest version 7.9.52 has PLC options for S7-300 & S7-400, what has changed since I note that my old configurations still work & have defaulted to S7-300

A: The protocol is indentical, the S7-400 can handle larger block sizes than the S7-300 and is therefore faster – so it is a performance optimisation.

Q: I have REAL or LONG tags where some are displaying correctly, others not

A: This is a standard Citect driver issue, Citect always reads arrays of data so if you variables are not aligned to each other on 4 byte boundaries it will get invalid data. For example DB12,10 & DB12,18 are 4 byte aligned, however 18-32 are not. The driver has built in an option to read data in blocks of 32 bits which normally solves this issue. To apply this simply change the IO device protocol from PSDIRECT1 to PSDIRECT6 then recompile (remember to recompile the clients). The only disadvantage is that you loose STRING[ ]s & arrays which need to be on PSDIRECT1 on a separate IO device :-(

I 124 → I 126

8

Q: What do the Icons in the configurator mean ?

A:

✓	The block is healthy & contains current data
✕	Communications failure
⊘	The block is currently not in use, it is off poll, all the blocks on a standby server should be in this state (clock with green slash)
?	This block is newly configured & is not currently being polled. You need to reload the configuration to activate. **note if Citect uses this address it will cause the NIO-*Address errors until configuration reload

Q: The driver configurator us using all my PC's CPU time and the whole machine is slow, what is wrong ?

A: You have many error messages flooding the bottom window of the configurator, this is caused by all the scrolling

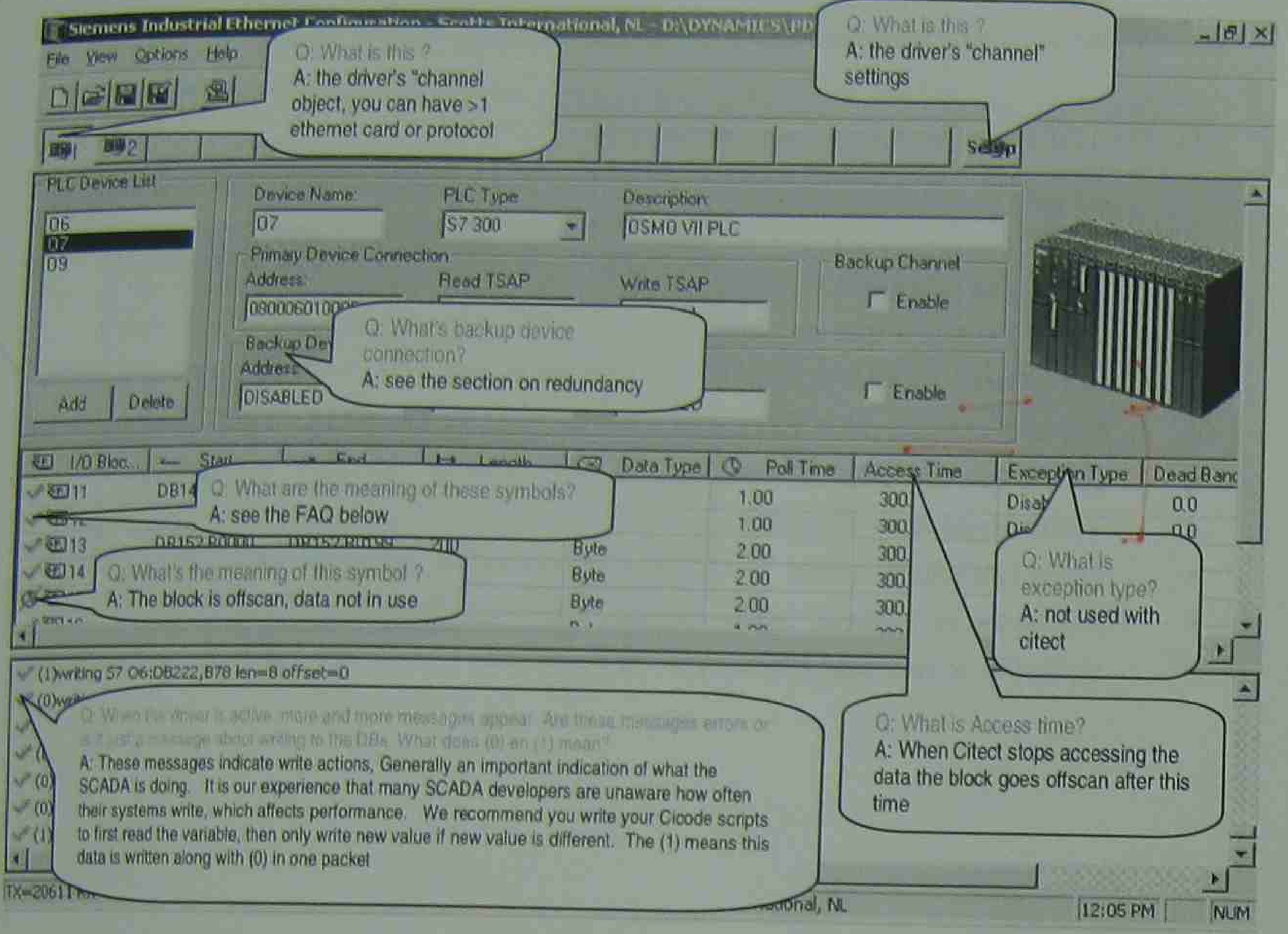
- Pull the horizontal splitter down to close the bottom window, this reduces CPU time
- Use "Menu>Options>Learn addresses" to solve the NIO-*Address... errors, then driver reload

Q: Why do I see messages like "Nio-*Address Error DB15,W248" in the bottom window of the configurator ?

A: This means that Citect is reading that address however this address is not configured for polling in the backend.

- **It is Crucial to Fix this issue**, before doing any other testing
- Note that this issue may occur with I & Q addresses where you have many small discontigous poll blocks in the backend. What is occurring is that Citect is aggregating address blocks. The only possible solution is to use the small blocksize version of the front end driver- this means changing the Citect IO device protocol from PSDIRECT1 to PSDIRECT6. This change may still not eliminate the reporting of the errors however Citect will get valid data.
- You only see these errors when Citect tries to access the data, so seldom used addresses may not be noticed.
- There are 2 Semi automatic methods of solving this
  - By selecting Menu>Options>Learn addreses, the configurator uses those error messages to stretch existing blocks or add new ones.
  - By selecting Menu>Options>Import Addresses. The configurator can add / stretch blocks by using a VARIABLE.DBF or VARIABLE.RDB file. This works better than the learn address method because you get ALL the addresseses in the project. If you open a UNITS.DBF file it will add IO Devices to the backend.

6 Frequently asked questions & troubleshooting



Device Name: 07

PLC Type: S7 300

Description: OSMO VII PLC

Address: 08000601000

Backup Device Address: DISABLED

I/O Bloc...	Start	End	Length	Data Type	Poll Time	Access Time	Exception Type	Dead Band
✓ 11	DB14				1.00	300	Disab	0.0
✓ 12					1.00	300	Dis	0.0
✓ 13	DB152,B0000	DB152,B0199	200	Byte	2.00	300		
✓ 14				Byte	2.00	300		
				Byte	2.00	300		

✓ (1)writing S7 06:DB222,B78 len=8 offset=0

✓ (0)wri

Q: What is this ?
A: the driver's "channel object, you can have >1 ethemet card or protocol

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A: the driver's "channel" settings

Q: What's backup device connection?
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A: The protocol is indentical, the S7-400 can handle larger block sizes than the S7-300 and is therefore faster – so it is a performance optimisation.

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I 124 → I 126

28

Q: What do the Icons in the configurator mean ?

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A: You have many error messages flooding the bottom window of the configurator, this is caused by all the scrolling

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- Use "Menu>Options>Learn addresses" to solve the NIO-*Address… errors, then driver reload

Q: Why do I see messages like "Nio-*Address Error DB15,W248" in the bottom window of the configurator ?

A: This means that Citect is reading that address however this address is not configured for polling in the backend.

- **It is Crucial to Fix this issue**, before doing any other testing
- Note that this issue may occur with I & Q addresses where you have many small discontigous poll blocks in the backend. What is occurring is that Citect is aggregating address blocks. The only possible solution is to use the small blocksize version of the front end driver- this means changing the Citect IO device protocol from PSDIRECT1 to PSDIRECT6. This change may still not eliminate the reporting of the errors however Citect will get valid data.
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- There are 2 Semi automatic methods of solving this
  - By selecting Menu>Options>Learn addreses, the configurator uses those error messages to stretch existing blocks or add new ones.
  - By selecting Menu>Options>Import Addresses. The configurator can add / stretch blocks by using a VARIABLE.DBF or VARIABLE.RDB file. This works better than the learn address method because you get ALL the addresseses in the project. If you open a UNITS.DBF file it will add IO Devices to the backend.

***Note this only changes the edited file in disk you need to "reload" to make it active in the Background polling program. Then you should see fewer address errors, you then need to Learn addresses again. Read more

Q: Why do I see "Nio- Address Error DB15,W248" in the bottom window when DB15,W248 is not used in any tag.

A: You have tags above & below DB15,W248 and the Citect block optimiser is aggregating them. The PSDIRECT Driver is unable to figure out which addresses are used & which not. You have to build backend blocks spanning the entire DB not missing a single byte. This may be a problem with I & Q addresses, which cannot span unconfigured IO. A Partial solution is to use the 32 bit PSDIRECT8 protocol.

Q: I am unable to get communication, what are the most common problems?

A: If using ISO protocol Check that the siemens ISO transport is installed, if you see the message in the bottom window "failed to open ISO channel 1" then the ISO transport is not correctly installed OR there may be a problem in the registry and the driver is not using the correct Ethernet card.

The read TSAP setting defaults to "R=0;S=2" which means read the CPU in Rack 0 Slot 2. This is Correct for an S7-300. On a S7-400 with 2 slot power supply, meaning the CPU is in Slot 3, this should be R=0;S=3. **Note the Slot is the slot number of the CPU, NOT the CP 443 card!

If you have 2 CitectSCADA's communicating to a S7-300 the third CitectSCADA connection will fail. By default the S7-300 has 8 communication channels – 2 for step 7, 2 for SCADA, 4 for PLC-PLC. This configuration can be changed in later model CPU's

Q: How do I update the configuration after making changes ? Or Why do newly added blocks show a ? status

A: Remember the configurator is not actually polling the PLC's The background polling program sixspoll.exe is doing that. Save the file then Select "File|Reload" off the menu, or press . This saves the configuration and tells the background polling program to stop & reload it's configuration into memory. During this process you may see #COM in Citect.

Q: I have problems reading Direct S7 IO (I,Q,PI etc.) what do I do ?

A: You need to make sure that the poll blocks exactly match the configuration in the PLC. The PLC WILL NOT allow you to poll across an address for which no IO cards exist. You need to break this up into smaller blocks. **Note Citect Does not recommend writing directly to outputs for safety reasons.

Q: How do I setup the IO server to enable redundant CitectSCADA IO Servers ?

A: The driver behaves like all Citect drivers in this regard eg. The same as S7NT.

- Set the INI file parameter "AlwaysReturnNoError" = 0 (this is default, so this parameter need not exist)
- The poll block S0->S199 must be defined in the driver backend poll configuration. Being a frontend / backend driver reading from it needs status information about the communincation status of the backend, these variables are in the S addresses and are used internally for Unit Status by the front end

- Now if the driver loses communication to the PLC the Unit status will go bad & CitectSCADA's redundancy system will switch over to the backup IO Server
- **Note The "AlwaysReturnNoError"=1 is intended for debugging only. When set you will see correct values only if the driver is successfully polling, if not INVALID data may be displayed & no redundancy failovers will occur.

Q: My communications are Slow, WHY ?

A: Please Note the following, typical performance achievable

- This driver polls as fast as the PLC allows, the PLC is the bottleneck(slow side), the figures below are per PLC, the driver performance scales linearly per PLC.
- S7-315 CPU typically achieves 15-20 polls per second (We believe it is crippled)
- S7-416 CPU typically achieves upto 150 polls per second (10 x faster). This is with 2 IO Devices talking to the same PLC.
- A Vipa PLC typically achieves upto 40 polls per second with default settings, if communications resources are increased this can reach 100+
- The driver has a Built in Limit of 100 polls per second per IO Device, so in some cases you can get better performance by splitting your data into 2 IO Devices. However we do not recommend this as, the spare PLC resources should be reserved for Writing data & PLC-PLC communications & other Citect IO servers.
- From version 7.9.52 performance has been increased substantially over the above the difference is more noticeable for configurations of lots of small blocks

Q: The communications are Slow, how do I make it faster ?

A: read the section about optimisation of the driver & try some of the following modifications at the PLC side.

Q: How do I configure communications to an S5 PLC ?

A: This is far more complicated than an S7 PLC. Please read the Driver help file (SIXHLP.DOC) section "Setting up the hardware" for Full instructions. In addition there are example S5 PLC programs & CP card setup files in the backend distribution in the "PLC" directory.

Q: I keep getting an error "Nio-niomap() different from map popup box ?

A: You are using more than one IO Channel device on the IO server, please put all IO Devices including different PLC types under one single Citect IO Channel object. **Note as of PSDIRECT 2.3 it is more tolerant of multiple channels.

Q: With the S7NT driver objects like, PID set point sliders operate smoothly, however with PSDIRECT it sometimes briefly jumps back to old position before assuming new position.

A: The PSDIRECT is actually faster here !!!, remember the Display is reading from the PSDRIECT cache & displaying at the Citect screen refresh rate, with S7NT it was actually stalling the screen refresh until the readback occurred.

Q: I have redundant PLC's can I configure redundancy at a lower level than the Citect level ? ie use a single Citect IO device but 2 IP addresses in the backend.

OR Does the driver support the S7-400H hotstandby PLC ?

A: Yes simply configure the second IP addresses & rack & slot in the Backup fields, read more in Configuring for Redundancy

Q: How do I debug the operation of the low level backend redundancy

A: read the section on Using the Special Debug addresses

Q: Is the PSDIRECT Configurator designed to import addresses from arrays?. E.g. in Citect you can define an integer tag array with an address that looks something like DB10,0[20]. However the import functionality does not work with arrays in the back-end.

A: Arrays are supported, the data has to be polled in the backend, so if DB10,0[20] is a LONG or REAL (all examples assume 32bit) the poll block has to be at least DB10,0 to DB10,79. As of Backend 7.9.51.005 the database import now supports Arrays. You can however solve this problem online in seconds during runtime.

- if you open the Driver configurator while Citect is running & open a page with address references that are not currently being polled, you will see in the bottom window messages like

  NIO-*Address error DB10,D4

  NIO-*Address error DB10,D8

  ...

- Now off the options menu select, "Learn Addresses", you should see DB10,0 to DB10,3 change to DB10,0 to DB10,79 (you may have to go to another PLC & back)

- What it has done is use the NIO-* messages to stretch the block, this configuration then needs to be made active by "Reloading the configuration". During reload the driver stops & has to re-start which causes momentary #COM but when it stabilises again you should be polling all data and the process only takes seconds of work. Read more

7 Reference: Required components

7.1 CitectSCADA

- CitectSCADA V5.41 or higher.
- CitectSCADA V5.50 has the most installations at this time.
- CitectSCADA V6.0 has been successfully tested
- CitectSCADA V6.1 has been successfully tested

7.2 Operating Systems

- Windows NT4 SP4 or later
- Windows 2000 (Pro or Server)
- Windows XP SP1&2
- Windows 2003 Server
- Windows 9x, Millennium NOT SUPPORTED for ISO protocol

7.3 Recommended System

P3 or higher with recommended memory for the Operating system

- Windows NT4 SP4 – 128MB
- Windows 2000 Pro – 256MB
- Windows 2000 Server – 512MB
- Windows XP Pro SP1 – 512MB

7.4 Network Card

Any NDIS compatible card should work. Named brands are recommended for best performance.

*** NOTE NO SIEMENS SOFTWARE OR HARDWARE REQUIRED

***NOTE when using the ISO protocol DO NOT install any siemens software on the machine.

***NOTE Some problems have been encountered with Broadcom cards, recommend Intel

8 Reference: Communications Forms

8.1 Boards Form

This driver does not require a BOARDS object for Later versions of Citect. Some people have reported problems omitting the board on this driver if they use other drivers that require boards.

**Note Adding The Board object WILL NOT cause problems, however you may see error messages at startup, these can be ignored.

8.2 Ports Form (channel)

Note: Unlike the S7NT driver, **only 1 port is compulsory on the IO server**; performance is just as good with only 1 because it is reading instantly from a cache. Please note this includes the case where you have both S7 & S5 PLC's Only use one Channel. If you use Both the Ethernet & Serial drivers put the serial devices on a separate port.

**Note from V2.3 the driver no longer reports errors when multiple channels are used, however we still recommend using only 1 channel

Field	Default	Allowable values
Port Name	This field is user defined and is not used by the driver.	
Port number	0	Any value, other than ""
Board name	Leave blank	Board is not required
Baud rate	Leave blank	
Data bits	Leave blank	
Stop bits	Leave blank	
Parity	Leave blank	
Special Opt	Leave blank	
Comment	This field is user defined and is not used by the driver.	

8.3 I/O Devices Form

The Address AND Protocol refers to the Address format of the tags & also specifies the type, the combination is used to decide which Driver DLL to load & what address format to Use. The following table lists the allowable combinations.

PROTOCOL	Address	Comment
PSDIRECT1	S7;ETHERNET[;N=xx]	Siemens Industrial Ethernet S7 PLC's
PSDIRECT1	S7;MPI[;N=xx]	Siemens Serial MPI
PSDIRECT2	S5;ETHERNET[;N=xx]	Siemens Industrial Ethernet S5 PLC's
PSDIRECT3	Conet[;N=xx]	OmniFlex Conet with timestamping
PSDIRECT4	TI[;N=xx]	Texas Instruments H1
PSDIRECT5	IEC;<common addr>[;N=xx]	IEC 870-5-101, with common address
PSDIRECT6	S7;ETHERNET[;N=xx]	Same as PSDIRECT1 with 32 bit blocksize. S7NTSP replacement
PSDIRECT6	S7;MPI[;N=xx]	Same as PSDIRECT1 with 32 bit blocksize. S7NTSP replacement
PSDIRECT7	Blank	Square D emulates SQUARED

The **Address** field is used to specify which backend driver to use & which protocol. The ";N=xx" is [optional] (do not type [ ]) and if this parameter is supplied the xx must be the IO device name in the backend.

The **Name** of the IO device is by default used to connect to the backend device of the same name. Unless the ";N=xx" parameter is supplied in which case THIS overrides the name. The ";N=xx" may therefore be used if IO device names Longer than 11 characters are required OR Multiple Citect IO devices connected to 1 backend IO device are required.

8.4 Driver Caching

This driver has its own cache, it is therefore not necessary to cache data on CitectSCADA side the recommended cache enabled setting is **FALSE** (default is blank-which is TRUE). This setting is not critical, but performance will be at least 300 ms faster than the defaults.

8.5 I/O Devices form settings

Field	Default	Allowable values
Name	Set to the same as the Device name in the Driver Configurator Unless a ";N=xx" is supplied in which case the xx is used instead.	
Number	Must be blank or unique, but is not used by the driver.	
Address	**See above**	Specifies addressing & back-end driver
Protocol	**PSDIRECT<n>**	See table above
Port name	Refers to the port previously defined in 'ports' form.	
Comment	This field is user defined and is not used by the driver.	
Enable Caching	**FALSE**	
Cache time	Not used – no cacheing300 but set cache to FALSE	

8.6 Reference: Data types

Note: This driver is designed to mimic other CitectSCADA drivers & should supply all the same addresses & data types as the equivalent CitectSCADA driver does.

***Note the PSDIRECT6 32bit blocking protocol does not support STRINGS & Arrays

8.6.1 Reference – Tag Addressing

This driver supports many different Addressing formats depending on the device in use.

8.6.1.1 Siemens S7 Addressing

The S7 addressing is designed to be compatible with that used by the Standard Citect S7NT Driver.

Address Format	**CitectHMI/SCADA Data Type**
DB<no>,<index>[.<bitno>]	Digital, Byte, INT, BCD, LONG, LONG_BCD, REAL, STRING
DI<no>,<index>[.<bitno>]	Digital, Byte, INT, BCD, LONG, LONG_BCD, REAL, STRING
A<index>[.<bitno>]	INT, BYTE, Digital
Q<index>[.<bitno>]	INT, BYTE, Digital
E<index>[.<bitno>]	INT, BYTE, Digital
I<index>[.<bitno>]	INT, BYTE, Digital
M<index>[.<bitno>]	Digital, Byte, INT, BCD, LONG, LONG_BCD, REAL, STRING
PA<index>[.<bitno>]	INT, BYTE, Digital
PQ<index>[.<bitno>]	INT, BYTE, Digital
PE<index>.<bitno>	INT, BYTE, Digital
PI<index>.<bitno>	INT, BYTE, Digital
T<index>(10ms)	BCD (PLC s5time format)
T<index>(100ms)	BCD (PLC s5time format)
T<index>(1s)	BCD (PLC s5time format)
T<index>(10s)	BCD (PLC s5time format)
Z<index>	BCD
TDB<no>,<index >	REAL,INT (PLC s5time format - See note 1 below)
TDI<no>,<index >	REAL,INT (PLC s5time format - See note 1 below)
TM<index >	REAL,INT (PLC s5time format - See note 1 below)
SDB<no>,<index>[string len]	Siemens STRING datatype (See note 5 below), string len compulsory
V<index>[.<bitno>]	S7-200 V memmory area see S7200

Syntax:

The syntax is defined as follows (case insensitive)

DB<no>	<index>
DI<no>	<index>.<bitno>

Where:

DB or DI	data block or instance block
<no>	number of the data block or instance block
<area>A	output
Q	output
E	input
I	input
M	bit memory
PE	peripheral input
PI	peripheral input
PA	peripheral output
PQ	peripheral output
<index>	element number relative to start of block
<bitno>	bit within the element number

NOTES:

1. Addressing format T, TDB, TDI, TM: When one of these address formats is used, the driver will convert a time value (from CitectHMI/SCADA Real to Siemens S5Time or vice versa) using the smallest time base it can fit in. Range: 0 - 9990.00 seconds. (0 <= Values < 0.01 will be truncated to 0 and Values > 9990.01 will generate an Alarm). Precision may suffer in the conversion, e.g. 10.01 will be converted to 10.00 (1100 S5Time format). **Note having 1 timer value in a DB recommended datatype is REAL. However for >1 you MUST set datatype to INT this means you loose subseconds (unfortunately)

2. Addressing: DB, DI, A, E, M, PA , PE, TDB, TDI, and TM are using byte addressing. T, C, and Z are using word (two bytes) addressing. They are the same as in STEP7.

3. STRING data type: CitectHMI/SCADA STRING data type is not the same as Siemens' STRING data type. It is equivalent to Siemens' CHAR Array data type. A NULL terminator (Siemens' BYTE data type, value = 0) is required by Citect. If Siemens' STRING needs to be accessed, use the SDB Address.

4. the TDB & TM S5 timer datatypes are supported, however note the following caveat. If the tag datatype is INT the value returned is in seconds, the address in the PLC is a 16 bit int and arrays function normally. If the datatype is REAL the value is also in seconds & subseconds but addresses must be on 4 byte boundaries – skipping blank word addresses in the PLCCitectSCADA S7 Drivers.

5. S7 STRING datatype is supported using the SDB address. The values may be written from Citect & the string length byte (in the PLC) will be set by the driver. The string will only read/write upto the max string len(in the PLC).**There are serious limitations however**

   a. ONLY 1 STRING is supported per DB, or at least block size apart (1st byte & last byte of adjacent strings must be >256 bytes apart).

   b. The Citect array size MUST be < 127 bytes. Always set Citect Array size==PLC string len

6. The following addresses are not supported:

- T Siemens Timer
- C Siemens Counter

*Note: Siemens Timer & counters in TM & TDB memory IS supported

**An Additional Address the SW addresses is available for status & debugging please read Using the Special Debug addresses

8.6.1.2 Siemens S5 Addressing

The Siemens S5 Addressing is designed to emulate the "SIEMENS.DBF" protocol. This may differ from the TF/Sinec or applicom addressing. The address format is almost identical to that used in the Step 5 programming software.

Data Types	Address Format	CitectHMI/SCADA Data Type
DATA WORDS	D<data block>:<word>	BCD / DIGITAL / INT / LONG / LONGBCD / REAL / STRING
DIGITALS	D<data block>:<word>.<bit>	DIGITAL
DATA WORDS	DX<data block>:<word>	BCD / DIGITAL / INT / LONG / LONGBCD / REAL / STRING
DIGITALS	DX<data block>:<word>.<bit>	DIGITAL
Timer	TDB<data block>:<word>	INT,REAL

EXAMPLES:

Data Type	DIGITAL
Address	D010:001.14
Comment	Digital - Block Number 10 : Word Number 1.Bit Number 14
Data Type	INT
Address	D0010:002
Comment	Data Word - Block Number 10 : Word Number 2

8.6.1.2.1 Note on converting SINEC addresses

The Sinec TF system Has an extra layer of abstraction that names memory objects to TF names. Normally in CiTect projects these memory variables are arrays of 16 bit words. To convert these addresses :

- Look in the TF configuration and find the Data block address of each TF array
- Search & replace the VARIABLE.DBF file with <TF array name> replace with D<dbn>:<add DB offset to TF array index>.<bit>

8.7 Driver reference

	Detail
Driver name	PSDIRECT
Maximum array size PSDIRECT1	2048 Bits
Maximum array size PSDIRECT6	32 Bits

8.8 Driver generated error codes

- PROSCADA_ERR_NO_TAGS 0x100
- PROSCADA_ERR_BAD_OID 0x101
- PROSCADA_COMMS_ERROR 0x102
- PROSCADA_BAD_DATA_TYPE 0x103
- PROSCADA_UNSUPORTED_CITECT_TYPE 0x104
- PROSCADA_BAD_IOADDRESS 0x105
- PROSCADA_BAD_SIGNALCOND 0x106
- PROSCADA_BAD_HWOPT 0x107
- PROSCADA_DLL_LOAD_FAIL 0x108
- PROSCADA_WRITE_FAIL 0x109
- PROSCADA_ISO_NOT_CONNECTED 0x10A
  - Backend is not connected to the PLC – comms fail, unit offline
- PROSCADA_ADDRESS_ERROR 0x10B
  - Address does not exist on backend
- PROSCADA_UNDEFINED_PROTOCOL 0x10C
  - The Unit address settings were not recognised
- PROSCADA_HEARTBEAT_FAILED 0x10D
  - PLC is in Stop mode OR heartbeat monitoring is enabled but the variable is not changing.
- PROSCADA_BACKEND_NOT_RUNNING 0x10E
  - The backend driver SIXSPOLL.EXE has stopped running

8.9 Parameters, options, and settings

8.9.1 Standard Parameters

Parameter	Default	Allowable values
Block (bits)	2048	8-2048 (PSDIRECT6=32)
Delay (mS)	30000	1000-60000
MaxPending	8	Not critical with this driver, it replies instantly
Polltime (mS)	1000	Not critical but do not change, used for unit status
Timeout (mS)	Not used	
Retry	Not used	
WatchTime (Sec)	10	(rate at which offline IO devices are checked)

8.9.2 Driver Specific Parameters

Parameter	Default	Allowable values
AlwaysReturnNoError	0	0 Should be selected for Backup failover & displaying #COM on screen. It is useful to set this to 1 when testing with no PLC then you can use the learn address feature even if you have no PLC.
ValueIfCommsErr	0	Value to display on screen if Communications to PLC fail, set to something like '888' to make it obvious
HeartBeatAddress_<devname>	No Hb	The S7 driver continues polling normally when the PLC is in Stop mode resulting in frozen values on the screen. To force #COM when the PLC is in stop mode requires configuration of Heartbeat monitoring read more about it in Heart beat monitoring section of this document

To add these parameters to the CITECT.INI file use the following format

```
[PSDIRECT]

AlwaysReturnNoError=1
```

**Note setting the AlwaysReturnNoError to 1 like this is only useful for testing or engineering purposes.

9 Analysis & Trouble Shooting

Things to do on a call out to the IO server:

- Check to see if there are any popup dialogs from CitectSCADA or the Driver indicating a problem, if so write down the message displayed.
- Open the kernel & View the Driver's page
- Check the "Driver Errors" & "Timeouts" counters
- If these two counters are incrementing then CitectSCADA variables are addressing variables not configured in the back-end driver.
- Check which IO devices (PLC's) are offline in CitectSCADA
- Open the CitectSCADA kernel and go to the IO Servers page
- The statuses on the left indicate what is happening on this IO server, the statuses on the right indicate the status of the IO Server currently in use.

10 Using the Special Debug addresses

This driver is a cached Front End / Back End driver, so the standard CitectSCADA driver statistics are not very useful. This section describes the Special Tag addresses available for debugging purposes. All datatypes are INT

ST0	Connection	current connection number an Internal value, this is normally static, is only meaning full when backup addresses are used
ST2	Conn State	0 means trying to connect to PLC, 2 means Connected
ST24	Reconnections	Increments every time the driver attempts to reconnect after the connection failure. If this is going up, you have a bad network
ST26	Pollrecs per sec	Poll rate for this PLC - useful for checking optimisation. The rate shown at the bottom status block of the configurator should be the sum of these.
ST28	Disconnect Req's	Increments when PLC sends Disconnect Request. This Means that your Network is OK but the CP143 setup is not. The PLC is refusing connection requests.
ST32	PDU size	PLC request block size, 240 or 480 bytes
ST40	Primary connection	Connection number of primary connection
ST42	Primary connection state, =2 means connected	
ST80	Backup connection	Connection number of primary connection
ST82	backup connection state, =2 means connected	

When using the Backup IP address, the following logic may be used to indicate which connection is active.

ST0= =ST40 means that the Primary IP address is being polled

ST0= =ST80 means that the Backup IP address is being polled

10.1 For the S5 & TI PLC the Status addresses are as follows

ST1	Conn State	0 means trying to connect to PLC, 2 means Connected
ST12	Reconnections	Increments every time the driver attempts to reconnect after the connection a failed. If this is going up, you have a bad network
ST13	Pollrecs per sec	Poll rate for this PLC - useful for checking optimisation. The rate in mission control should be the sum of these.
ST14	Disconnect Req's	Increments when PLC sends Disconnect Request. This Means that your Network is OK but the CP143 setup is not. The PLC is refusing connection requests.
ST21	Write Connection state. 2 means connected	

11 Migration from S7NT driver systems

This is a brief summary of the steps required to migrate an existing S7NT system to the PSDIRECT Ethernet driver.

**Note Citect's behaviour is undefined if you forget to compile ALL clients to PSDIRECT, to avoid this issue change the IO Device numbers as part of the upgrade.

11.1 Communication forms

- No Boards form required
- **Delete all but 1 ports** set all fields to blank, address to "0"
- In IO devices (UNITS.DBF)
  - Make sure name is less than 11 characters (limitation of backend)
  - Set port name to the 1 port
  - Set Protocol to "PSDIRECT1" or "PSDIRECT6" for S7NTSP
  - Set Address to "S7;Ethernet"

11.2 Back-end Configuration

11.2.1 Backend IO devices

The Back-end configuration may be edited in bulk using excel & File Save As *.CSV. Save the default configuration to .CSV, and then edit it in Excel and copy data from the UNITS.DBF file above.

- From the Options Menu Select "Import Variables"
- In the file dialog select the user\<comms project> directory and open UNITS.DBF
- If you have a redundant system it will have imported 2 devices per PLC, delete all duplicates.
- Make sure each Device has a ST0 to ST200 IO block THIS IS NOT A PLC ADDRESS – it is used by the front end to check unit status.
- You will need to manually set the Adresses for each PLC
- Remember to Save & Reload to make the configuration active

11.2.2 Backend IO Blocks

Each Citect tag must be contained inside a backend poll block. The datatype of each block is "BYTE" any Citect datatype tag can be read from these blocks. If Citect attempts to read from a address that is not currently polled you will get an NIO* IO address error in the bottom window of the configurator. There are 2 methods of semi automatically creating these blocks.

1. From the Options menu select "Import Variables"
   - In the file dialog select the user\<root project> directory and open VARIABLE.DBF or _VARIABL.RDB
   - Remember to Save & Reload to make the configuration active
2. After creating the Backend devices you can remove any address errors by selecting "Learn Addresses" from the options menu. This only functions while Citect is running and the Address errors are flooding the bottom window.
   - Note that to make the new added, or stretched blocks active you need to save & reload the configuration.

- When this is done there may still be address errors, select "Learn Addresses" again & reload again.
- This process is not perfect you may still have to edit some manually

To achieve optimum performance you may still need to optimised the poll times of each block (see next section). You should at least sort the poll blocks in excel to tidy up.

12 Communication Optimisation

12.1 *note on performance in new version 7.9.52

This version can reads multiple block simultaneously, and when upgrading you should notice an improvement in the backend driver poll rate. This new version requires no additional changes, it will open existing configuration files. To take full advantage of this the only change to the configuration required is to set the PLC type to "S7-400" in the PLC type. The greatest performance improvement will be seen with configurations with large numbers of small poll blocks.

12.2 How to Measure Driver Performance

- Create a minimal backend configuration with 1 poll block, 1 variable and a poll time of 0.0 seconds
- Note how many polls per sec you get in the configurator status at the bottom
- After measuring the speed, you can calculate the update time of your full configuration. e.g. If you get 10 pps (Pollblocks per second), you can have
    - 1 pollblock updating 10 times a second or
    - 10 pollblocks updating at 1.0 seconds
    - 5 pollblocks updating at 1.0 seconds + 10 pollblocks updating at 2 seconds

If you configure more pollblocks, no errors will occur but you are not actually achieving your configuration update time. In this case the driver just processes each block in turn. This is not a problem most of the time but as you add more blocks your system will slow down & if you need faster update on a specific block, changing its polltime will achieve little.

12.3 Optimisation Techniques

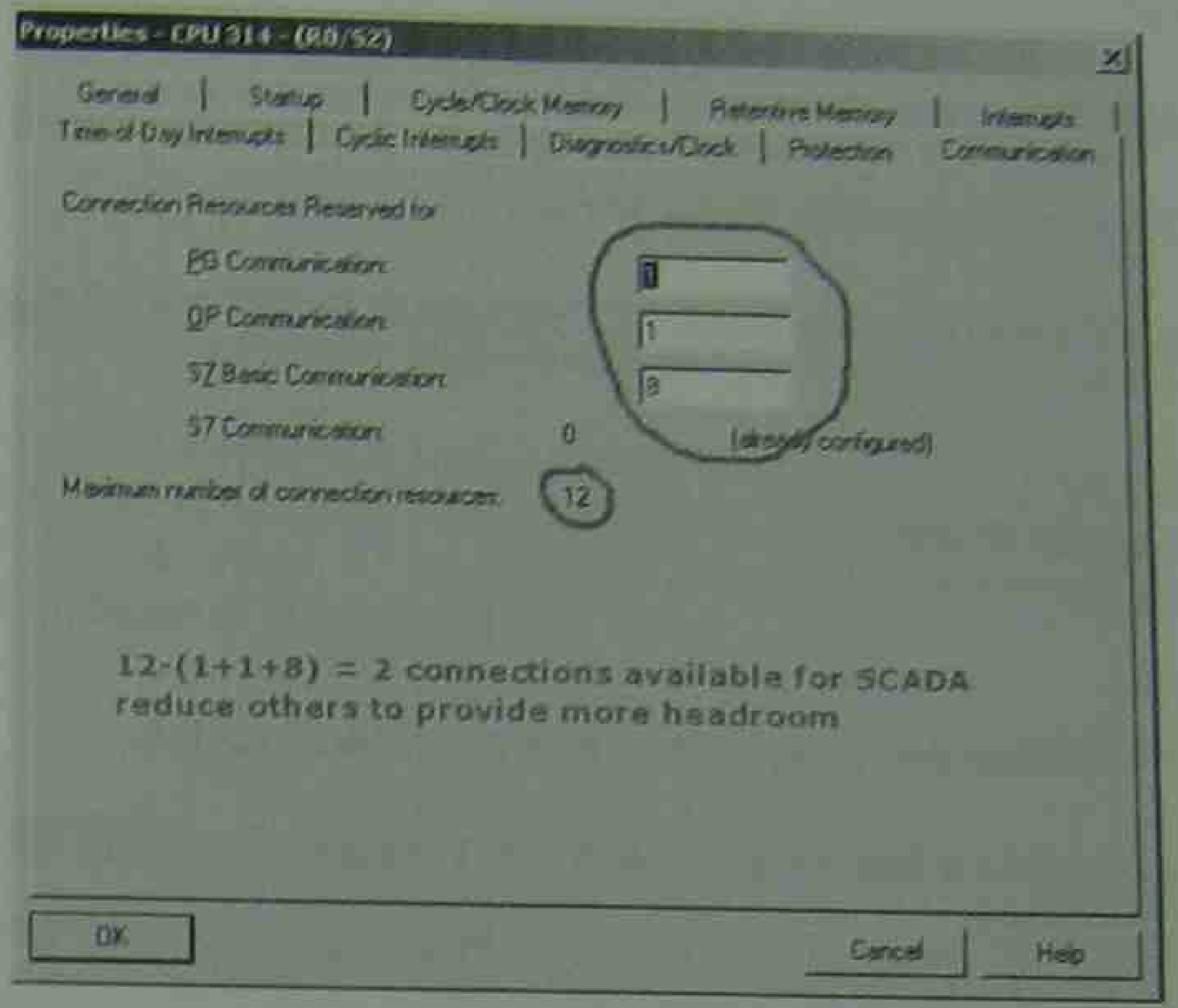
To make a limited bandwidth system appear faster, you have to **slow down** the updating of less critical data to give more bandwidth to the critical data. (Increasing the pollrate of a block when the system is already at full stretch will have no effect) The basic principle is - poll only the data that the operator needs for a given picture & at the minimum rate he is prepared to accept. It is usually better to set slow polltimes at the start of a project which leaves plenty of room to expand, this sets a lower expectation and if you need more speed later you have spare bandwidth resources.

- Setpoints, Outputs, controls or any value that never changes in the PLC (only changes when modified from the SCADA) can be setup so that they hardly use any channel bandwidth at all. Set the polltime to a large value like 60 seconds. If a value is written the driver automatically forces the block to update so the user does not notice the slow poll times.
- Prioritize your data; find out how fast the data changes in the PLC. Do not poll faster than necessary especially while you are constructing your system. You can always speed up certain blocks later once your system is fully configured. Generally analog values can be polled slower e.g. 5 sec but Digital Inputs may need 1 sec.

12.4 PLC Optimisation

12.4.1 Number of Network connection resources(CPU properties)

Resources available for the driver on the S7-300 is Two(2) by default, which can be changed this means 2 IO servers can connect but the third will fail, unless you change this configuration in Step 7. The S7-400 allows 4-8 connections by default.



Connection Resources Reserved for

PG Communication: 1

OP Communication: 1

S7 Basic Communication: 8

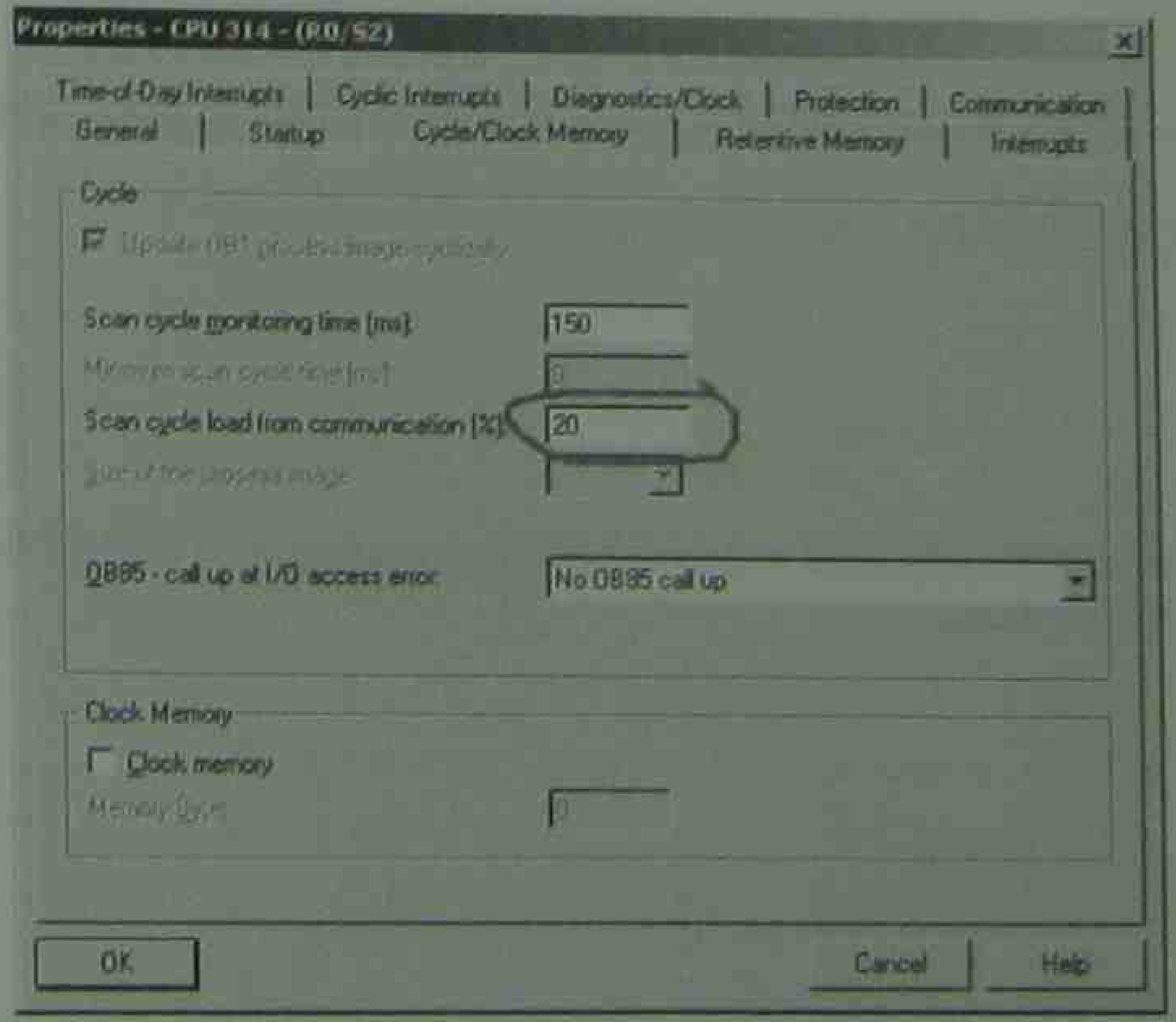
S7 Communication: 0 (already configured)

Maximum number of connection resources: 12

12-(1+1+8) = 2 connections available for SCADA
reduce others to provide more headroom

12.4.2 CPU communication load priority (CPU properties)

You can try increasing communication priority



☑ Update OB1 process image cyclically

Scan cycle monitoring time [ms]: 150

Minimum scan cycle time [ms]: 0

Scan cycle load from communication [%]: 20

Size of the process image:

OB85 - call up at I/O access error: No OB85 call up

☐ Clock memory

Memory Byte: 0

12.4.3 Block size (CP card properties)

Some CP cards (not all) have an option in the options tab for large PDU block size – set this.

13 Using the Stress test example project

An example CitectSCADA project installed with the Front end driver in

C:\Program Files\Citect\CitectSCADA\PSDIRECT Sample\PROSCADA_test.ctz

To use this setup you need

- An S7 PLC 400 or 300 with Ethernet CP card
- Step 7 with siemens NCM to configure the PLC CP card
- A CitectSCADA machine networked to the PLC, NO SIEMENS SOFTWARE Required

Probably the easiest protocol to use is TCP/IP

- Setup the PLC with an IP address and ping to test from the CitectSCADA
- NO Step 7 program is required or if one exists it MAY NOT modify m0-m511 OR simply put the PLC in STOP mode.
- Set the backend driver's channel protocol to TCP/IP
- Set the device "S7PLC" 's IP address
- File|reload the configuration
- Check that you have transmits & receives and the status of the blocks goes good
- Import the project into CitectSCADA, compile & run
- Open test page 1

The stress test writes huge amounts of data and reads it back comparing it to that written, any mismatches increment the error counters.

14 Setting Up Heartbeat monitoring

The S7 driver continues polling normally when the PLC is in Stop mode resulting in frozen values on the screen. To force #COM's when the PLC is in stop mode requires configuration of the Heartbeat monitoring feature..

For each IO device (Unit) configured, a parameter of the following form is entered into the Citect.INI file

HeartBeatAddress_<devname>=<address>

Where <devname> is the name of the IO device in CitectSCADA and in the backend driver

And <address> is a PLC address of a variable that MUST change very 5 seconds at least if the PLC is running. A simple way of achieving this is to increment an integer in OB1 of the PLC scan cycle. ** the address format here is the same as the OPC server so you specify W for Integer & D for longs etc.

Examples

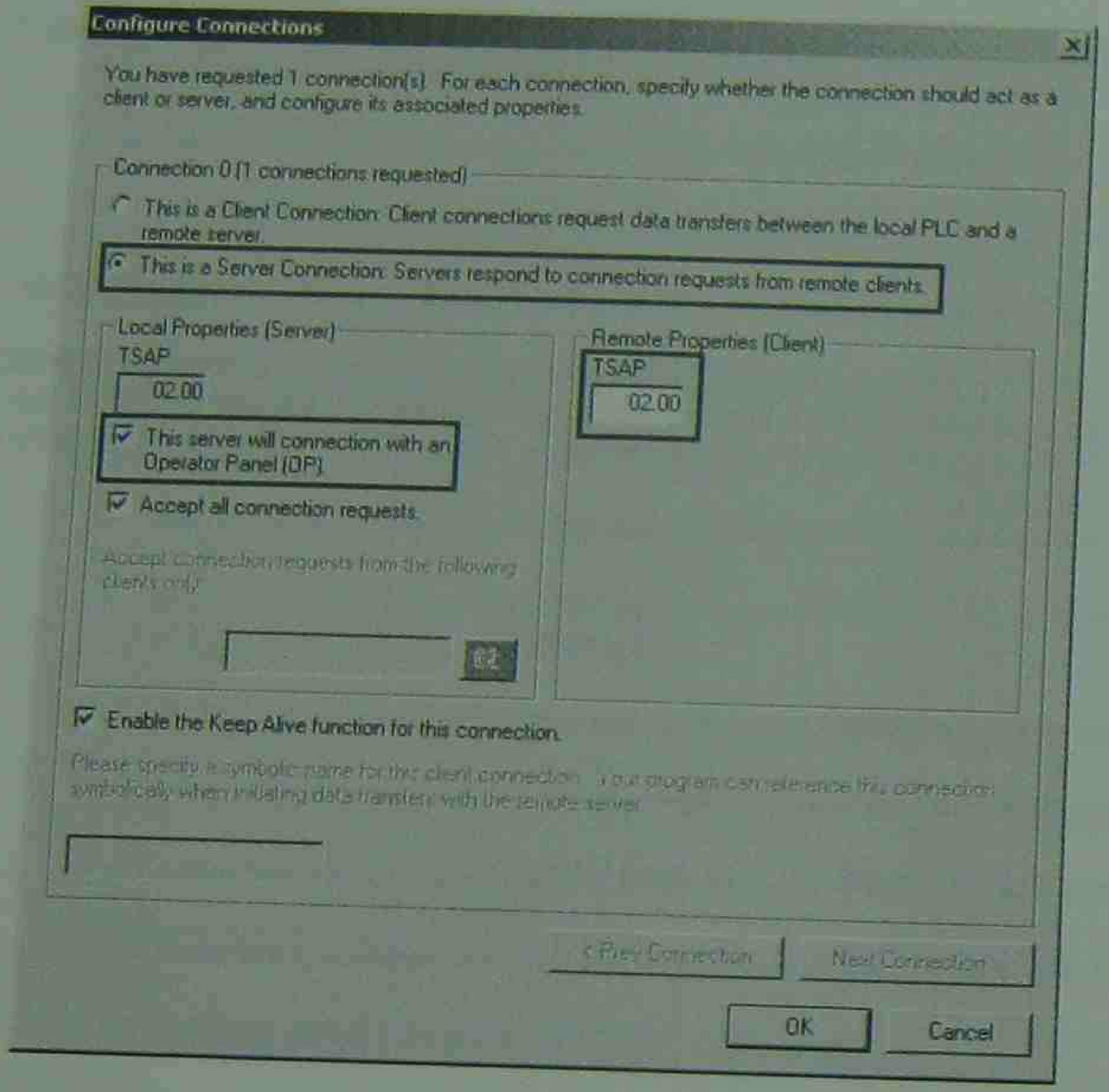
HeartBeatAddress_S7PLC=MW0

HeartBeatAddress_PumpHouse=DB100,W44

HeartBeatAddress_Furnace2=DB130,D44 (long integer)

15 S7 200 Setup

1/ Run the Micro Win Ethernet Wizard
2/ We recommend that the CP243 be installed in position 0
3/ Set the CP243's Ethernet address
4/ Configure a New connection & set it as follows



Configure Connections

You have requested 1 connection(s). For each connection, specify whether the connection should act as a client or server, and configure its associated properties.

Connection 0 (1 connections requested)

○ This is a Client Connection: Client connections request data transfers between the local PLC and a remote server.

● This is a Server Connection: Servers respond to connection requests from remote clients.

Local Properties (Server)
TSAP: 02.00

☑ This server will connection with an Operator Panel (OP).

☑ Accept all connection requests.

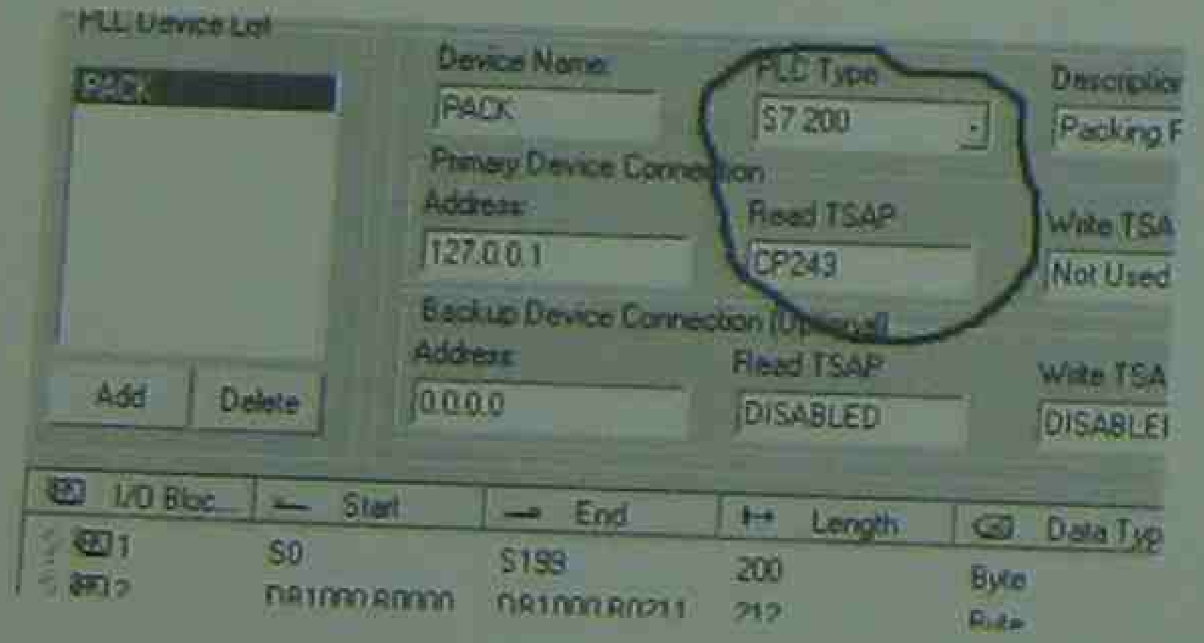
Accept connection requests from the following clients only:

Remote Properties (Client)
TSAP: 02.00

☑ Enable the Keep Alive function for this connection.

Please specify a symbolic name for this client connection. Your program can reference this connection symbolically when initiating data transfers with the remote server.

In the Driver polling configuration set the Read TSAP field to "CP243"



PLC Device List: PACK

Device Name: PACK
PLC Type: S7 200
Description: Packing F

Primary Device Connection
Address: 127.0.0.1
Read TSAP: CP243
Write TSA: Not Used

Backup Device Connection (Optional)
Address: 0.0.0.0
Read TSAP: DISABLED
Write TSA: DISABLEI

I/O Bloc...	Start	End	Length	Data Typ
1	S0	S199	200	Byte
2	DB1000.B0000	DB1000.B0211	212	Byte

You can poll the following data from an S7-200

M0-M32 (S7-200 has very small M area)
DB1,0->x is equivalent to the "V" mem area e.g. VW8 == Citect block type INT address DB1,8
I0 len 2 (Built in I inputs)
Q1 len 1 (Built in Q outputs)

16 Configuring for Redundancy

16.1 Standard Citect redundancy

This driver is designed to emulate the traditional S7NT driver and it also emulates the error & UNIT status modes of the S7NT driver. This means that Citect IO device level redundancy failovers work in the traditional Citect way. Normally this is simply twin Citect IO servers with the same IO devices configured on both using the same IO device number. The backend configurations are identical. Normally for load sharing the PLC's are divided in two groups, one group primary on server A & Standby on Server B. Primary & standby devices Vice versa on IO server B.

16.1.1 Notes

- The Backend status of the pollblocks is ∅ meaning Citect is not currently using the data, the backend is actually polling the data every 60 seconds
- **Differences to standard Citect Drivers**, the main difference is when switching over, the pollblock is in the ∅ mode on the standby IO server, the every first scan of Citect data may contain data up to 60 seconds old until the driver polls the new data (<1 second typically).

16.2 Using Backend redundancy with S7-400H systems OR >1 CP card in the PLC

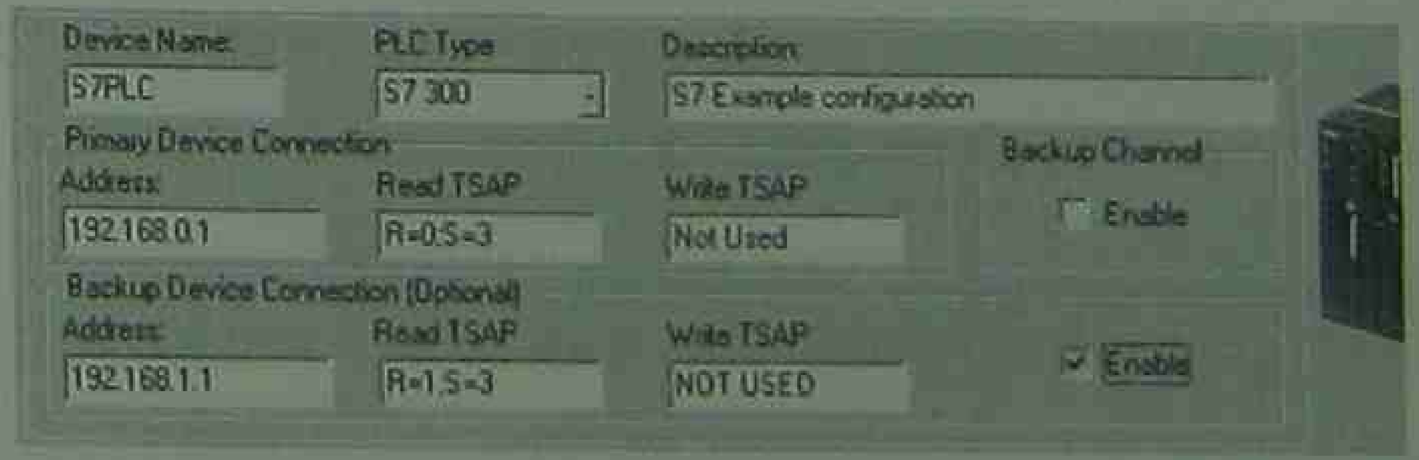
The driver at the backend level has a backup address per IO Device, typically on a S7-400H system you setup as follows: *(***Note redundancy at the backend level means a single Citect level IO device)*

Primary address:

IP 192.168.0.1 Read TSAP = "R=0;S=3"

Backup address:

IP 192.168.1.1 Read TSAP = "R=1;S=3" (check enable backup address)



Device Name: S7PLC
PLC Type: S7 300
Description: S7 Example configuration

Primary Device Connection
Address: 192.168.0.1
Read TSAP: R=0;S=3
Write TSAP: Not Used

Backup Channel
□ Enable

Backup Device Connection (Optional)
Address: 192.168.1.1
Read TSAP: R=1;S=3
Write TSAP: NOT USED

☑ Enable

*Note** the Rack number of the backup CPU is "1", note I specifically gave the IP addresses different subnets (Ethernet cards in the IO server) you probably have twin Ethernet networks.*

16.2.1 Notes

- A potential issue is that the Citect Frontend IO device takes 2x longer to failover while the Backend is doing its failover sequence. The timers that affect this are the settings in the channel setup (backend) We recommend settings (do not set any lower)
  - timeout time = 3 sec
  - Delay = 30 sec

  - Retries = 1

- You can monitor which connection the backend is using via the debug addresses
- Unfortunately you cannot at present force the backend to switch over manually
- Read more about monitoring the status in Using the Special Debug addresses

17 Using the S7 Simulator application

17.1 What is it ?

The small console application "S7simulator.exe" may be downloaded from a link on

http://www.proscada.com/Citect.htm

17.2 Introduction - why a PLC simulator ?

We originally wrote this as a simple application to regression test the driver particularly to test hard to find PLC's like old S5 models. We soon realised that others would also find it useful for quick test & setup without having to have to setup a *real* PLC. As such it lowers the barriers to using the PSDIRECT Driver. We would not want to pretend that it is a "Full" emulation in particular it has not been tested against Siemens software like the OPC server or WinCC. It certainly does not emulate the protocol fully but is sufficient for the ProScada Siemens Driver. It is a low priority project for us, with minimal support.

17.3 Capabilities

- Emmulates Both S5 & S7 PLC's (TI sort of…)
- Only Supports TCP/IP
- Automatically emulates any datablock you poll with the DB's initialised to ▯0, any data written is stored, like a PLC with no program running. Emulates 4kb DB's upto DB 1999. M,I,Q memory areas are emulated as DB0
- Supports 2 incoming connections so you can setup a redundant pair of SCADA IO Servers.
- Only Supports Rack 0 Slot 2 (deliberate for training purposes)
- DB 1 & DB15 contain some forced values

17.4 Installation

run from the command line or explorer there are no parameters.

The program simply listens for Incoming connections. Being a TCP/IP server you need to unblock any firewall systems. *Note it is receiving connections on TCP port 102.

When run on the same PC as the IO Server you can use the IP address 127.0.0.1(local loop back) in the driver

17.5 Forced variables

DB15 is in S5 format

DB15:0 increments up infinitely every 10msec

DB15:1 increments to pi * 1000

DB15:2 is sin(DB15:1)

DB1 is in S7 format

DB1,2 increments upto 100 every 10msec

DB1,0 increments everytime DB1,2 gets to 100 aprox every second

STRING SDB1,128[32] contains "Hello there"

Pseudo code for S7

```
IF DB1,4.0=1 THEN
    DB1,5.6 =1
ELSE
    DB1,5.6 =0
END

IF DB1,4.1 AND DB1,4.2 THEN
    DB1,5.7 =1
ELSE
    DB1,5.7 =0
END

DB1,4.3 blink every 1 sec.
```

Pseudo Code for S5

```
IF DB15,4.0=1 THEN
    DB15,4.14 =1
ELSE
    DB15,4.14 =0
END

IF DB15,4.1 AND DB1,4.2 THEN
    DB15,4.15 =1
ELSE
    DB15,4.15 =0
END

DB15,4.3 blink every 1 sec.
```

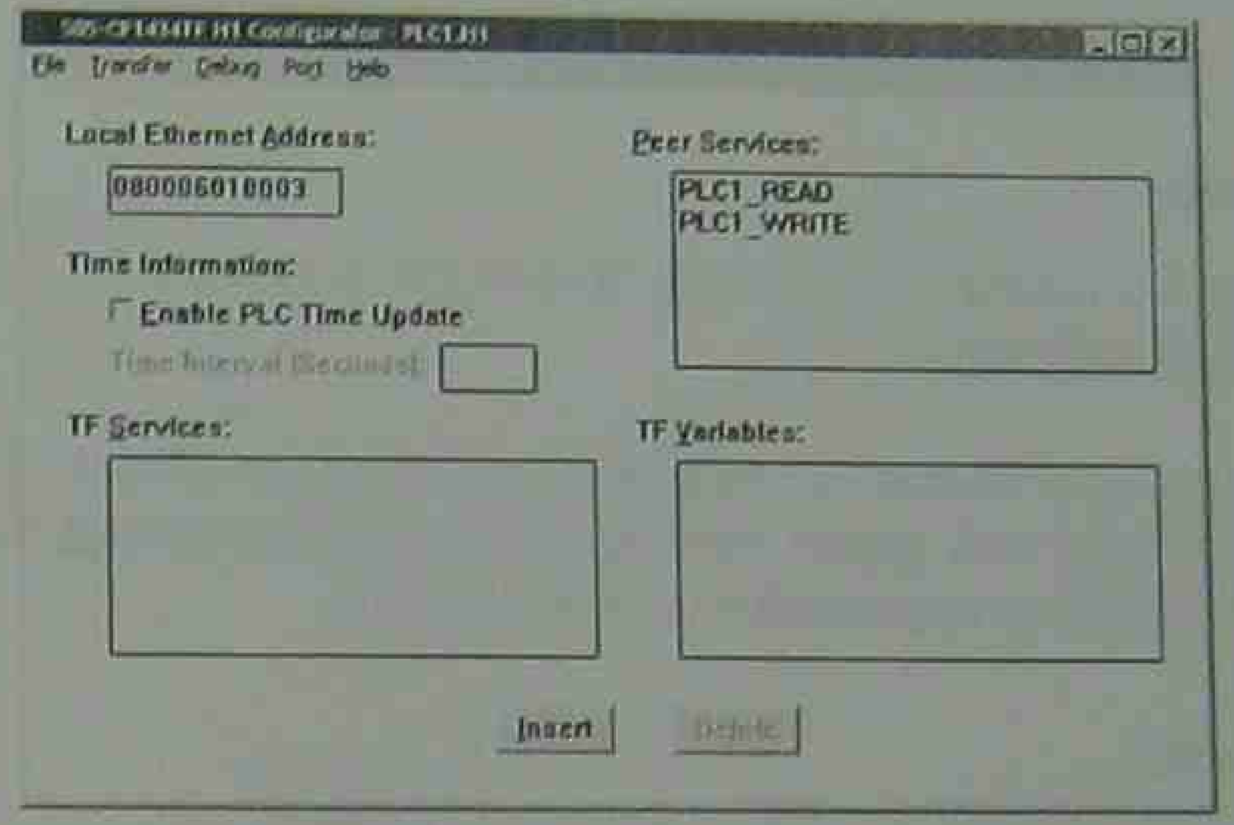
18 Setting up the Simatic TI

The PSDIRECT Driver replaces the TINECNT & TINECWIN Drivers. The TINEC drivers use the Siemens TF interface via the CP1413 card. The ProScada Ethernet backend can talk to the PLC via ISO or TCP/IP protocols, however note that it does NOT support TF. The Siemens TF system is little more than an unnecessary abstraction layer and in reality it is quite easy to transfer the system.

The PSDIRECT Installation installs a example project in "Citect\bin\PSDIRECT samples"

The steps to migrating an existing system are as follows:

18.1.1 *Step 1: Adding peer-peer jobs to the PLC CP card setup. You can leave the old TF Jobs in place simply add these new ones.*


505-CP1434TF H1 Configurator - PLC1.H1
File Transfer Debug Port Help
Insert
Delete

Local Ethernet Address: 080006010003

Time Information:

☐ Enable PLC Time Update

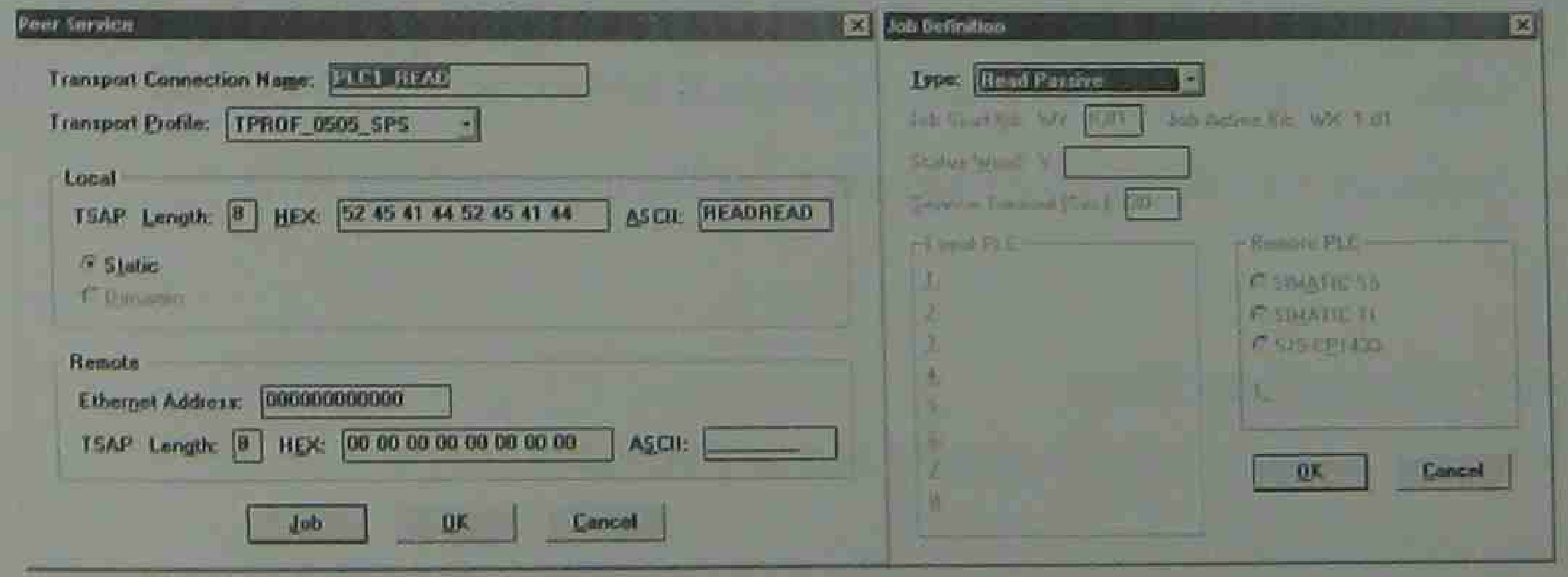
Time Interval (Seconds):

Peer Services:
PLC1_READ
PLC1_WRITE

TF Services:

TF Variables:

They look like this



Transport Connection Name: PLC1_READ

Transport Profile: TPROF_0505_SPS

Local

TSAP Length: 8 HEX: 52 45 41 44 52 45 41 44 ASCII: READREAD

● Static

○ Dynamic

Remote

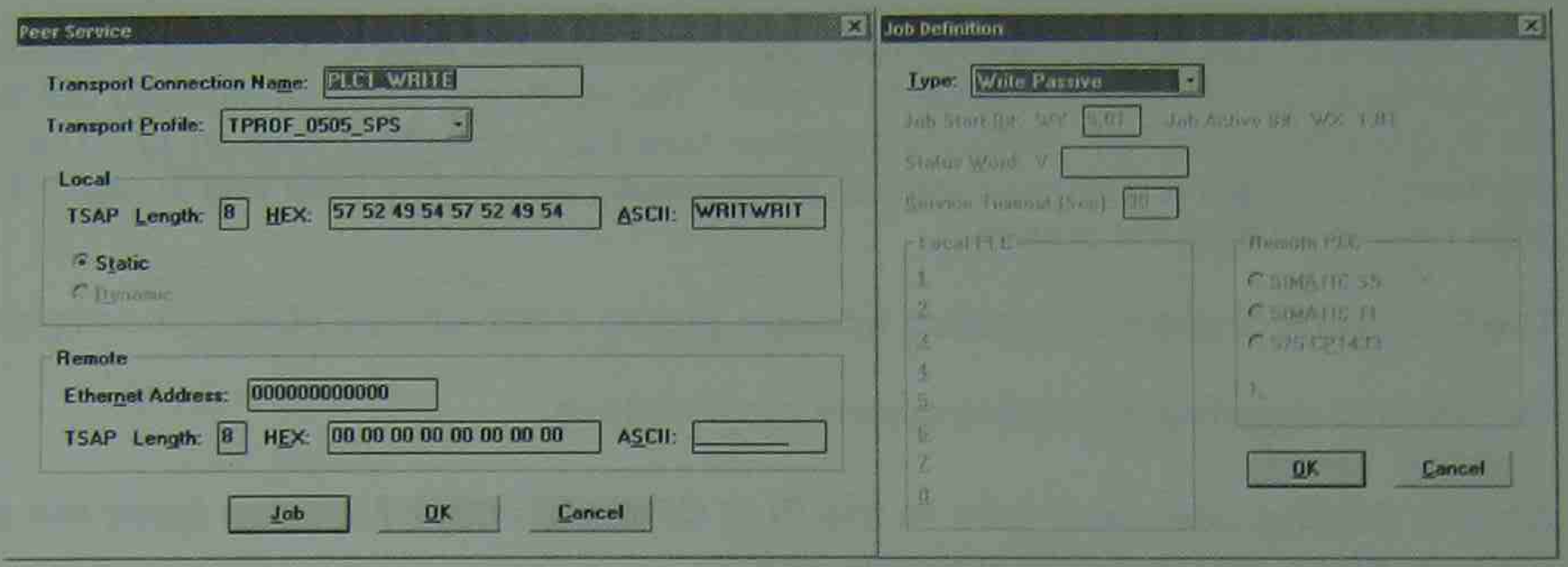
Ethernet Address: 000000000000

TSAP Length: 8 HEX: 00 00 00 00 00 00 00 00 ASCII:

Type: Read Passive

- Local TSAP must be 8 chars
- Remote Ethernet address should be "0000" – accepts any incoming
- This should be a read Passive job

- The Write job should be a Write passive



Peer Service

Transport Connection Name: PLC1_WRITE

Transport Profile: TPROF_0505_SPS

Local

TSAP Length: 8 HEX: 57 52 49 54 57 52 49 54 ASCII: WRITWRIT

● Static

○ Dynamic

Remote

Ethernet Address: 000000000000

TSAP Length: 8 HEX: 00 00 00 00 00 00 00 00 ASCII:

Job Definition

Type: Write Passive

18.1.2 Step 2: Configure the backend driver

- Setup the Siemens ISO transport in the newtwork settings, this is the same as for the S7 & S5 PLC's described earlier in this document

- Check that you have communications, you should do this before setting up Citect. Simply setup 1 block of "V" registers. You should see green ticks & blocks per second at the bottom of the configurator window indicating successful communication

18.1.3 Step 3: Configure the backend blocks

- Set the name of the backend IO device the same as the IO device in Citect

- Open the project variable.dbf file in excel, filter on IO device & sort on IO Address. Then manually add equivalent blocks in the backend. ****Note the backend addressing is slightly different, it has ":" between blocktype & address eg. V1000->V:1000

- At present there are no Learn address & variable import features for TI.

18.1.4 STEP 4 : Configure Citect

- Remove all TINECNT ports, Just add 1 port for PSDIRECT
- In the IO Device fields
  - Set PROTOCOL to PSDIRECT4
  - Set address to "TI"
  - Set ALL IO devices port to the common port for PSDIRECT

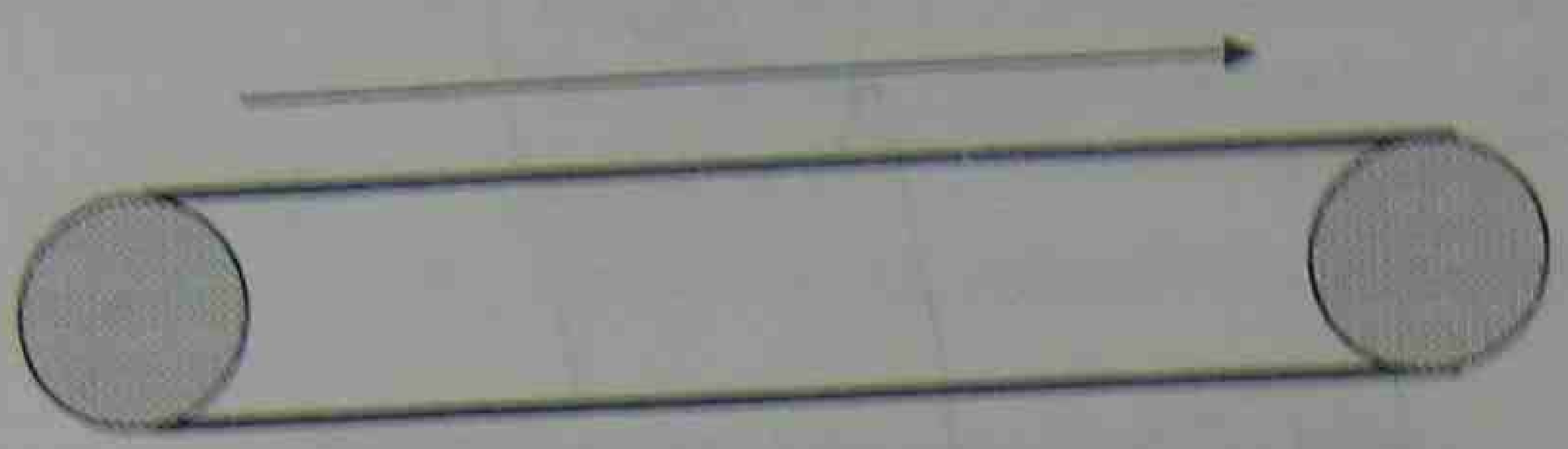
SIEMENS
SIMATIC S7-300
N.S.W. TAFE COMMISSION
I124.0 Q124.0
I124.1 Q124.1
I124.2 Q124.2
I124.3 Q124.3
I124.4 Q124.4
I124.5 Q124.5
I124.6 Q124.6
I124.7 Q124.7
I125.0 Q125.0
I125.1 Q125.1
I125.2 Q125.2
I125.3 Q125.3
I125.4 Q125.4
I125.5 Q125.5
I125.6 Q125.6
I125.7 Q125.7
I126.5 126.6 126.7
UNIT - 1
IB 124
Q125.0
I126.3
I126.4
Q125.4
Q125.5
I126.1
I126.2
IB 124
QB 124

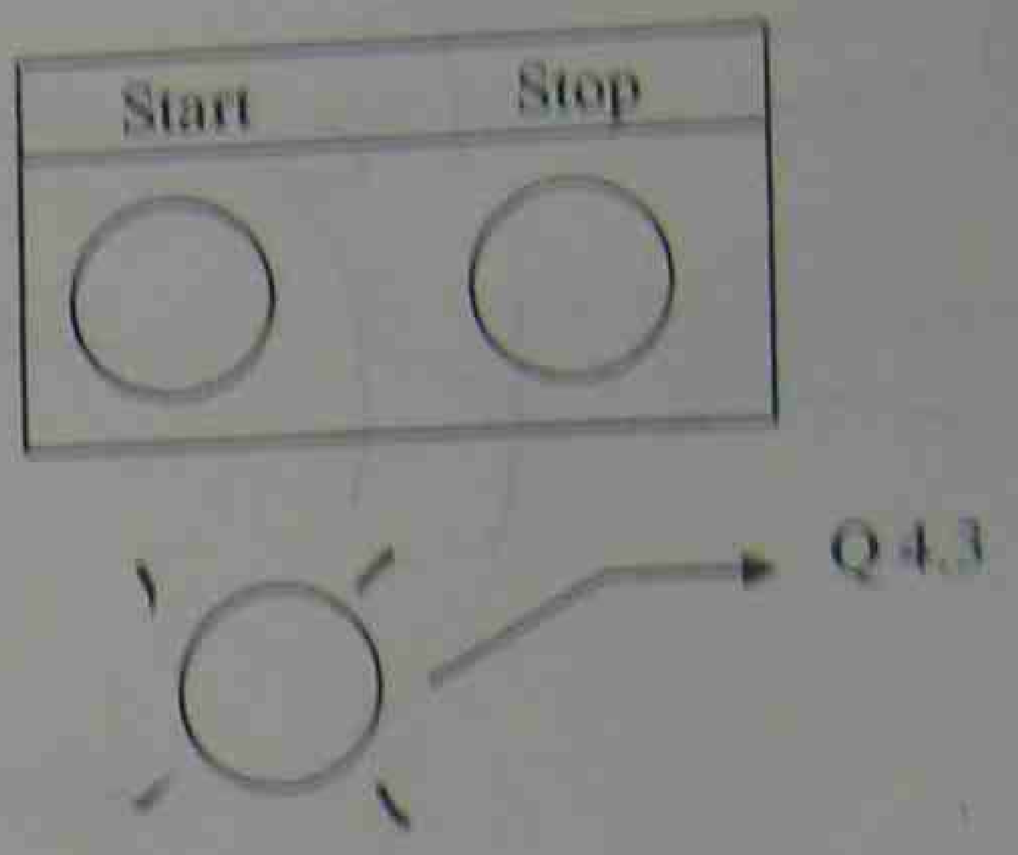
SIEMENS
SIMATIC S5-100U
SIMULATOR
INPUT/OUTPUT
6ES5 788-8MA11
DIGITAL OUTPUT
QB4
DIGITAL OUTPUT
8×24V DC/0.5A
6ES5 441-8MA11
DIGITAL INPUTS
+
-
3.7 3.6 3.5 3.4 3.3 3.2 3.1
4.7 4.6 4.5 4.4 4.3 4.2 4.0
QW 64
IW 6
TR-202
M 1.24

NAME: ANDREW.

Assignment - Timers 6

Create a ladder program and enter it into the PLC and demonstrate it's operation for the following machine description.



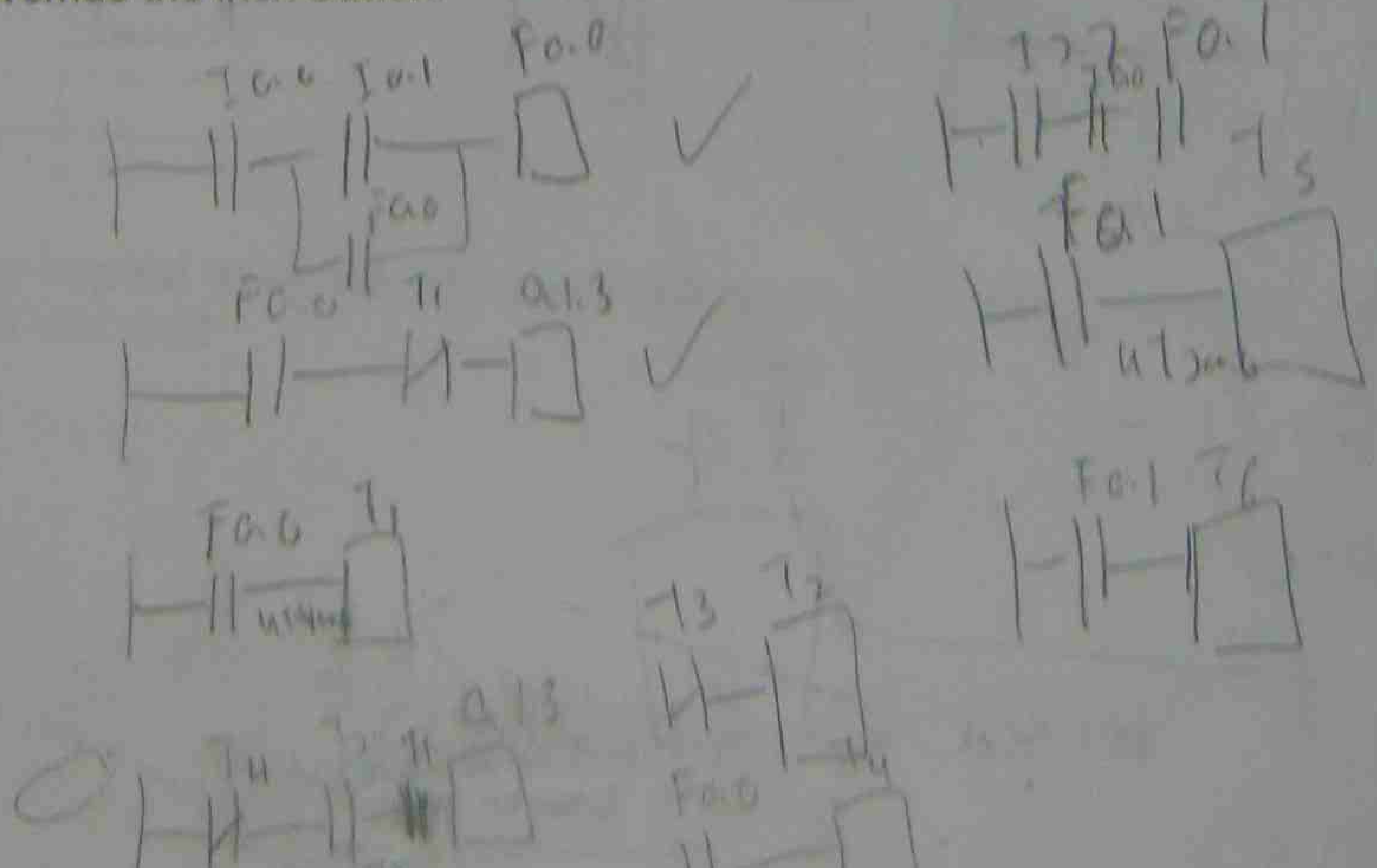


Part A --30 Marks

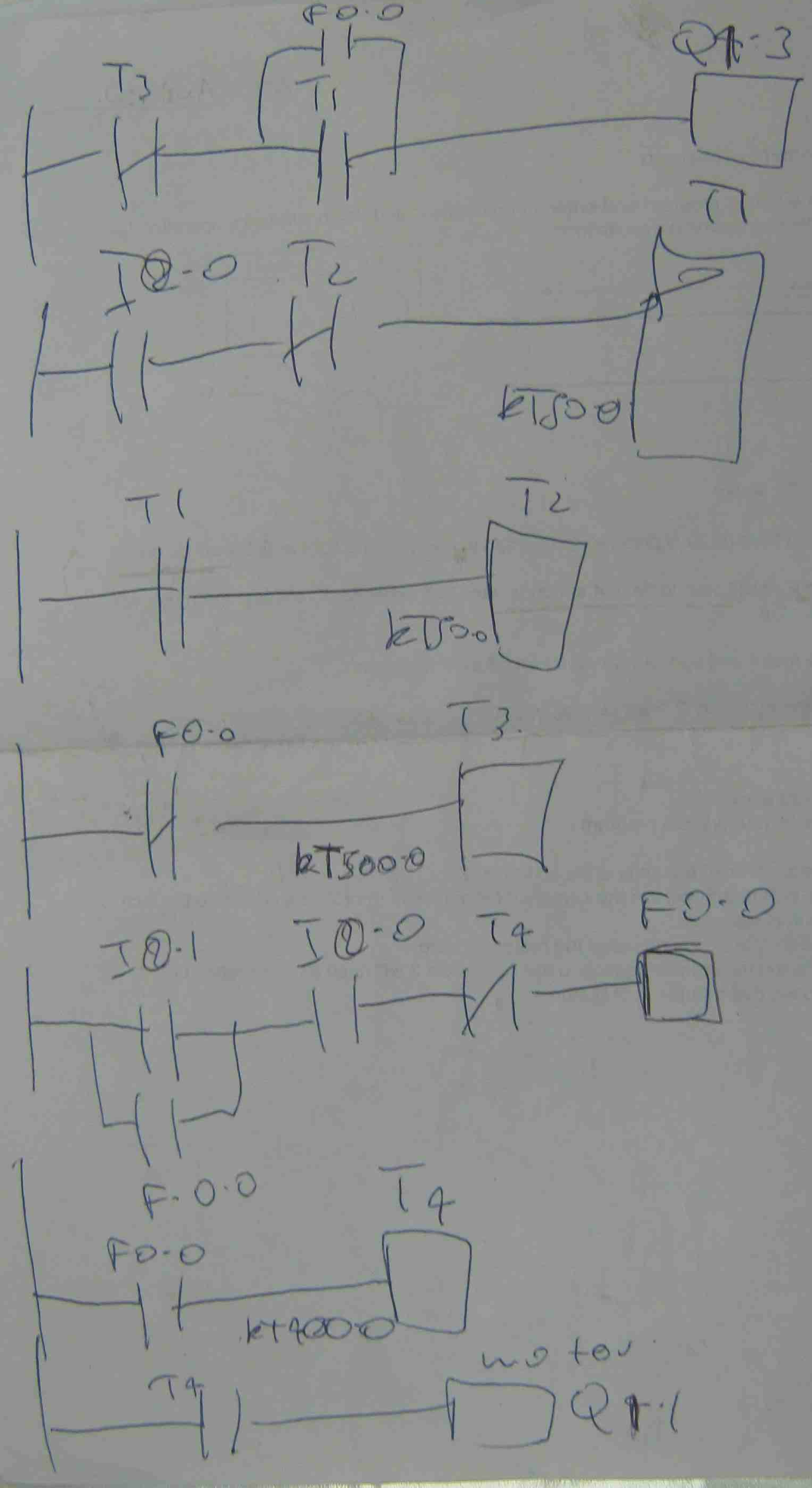
- When start (I2.0) is pressed momentarily , the warning light at Q4.3 will be on
- The light will start to flash 4 seconds later (0.5 seconds on/off) and the motor will now start.
- The motor and light will be switched off after 5 seconds.
- A stop button at I2.1 will stop all operation.

Part B -20 Marks
Add this to your original program

- A second "inch" button is to be added at I2.7
- This inch button will run the conveyor for a maximum of 2 seconds while the inch button is pressed.
- If the inch button is released the motor will stop.
- While the motor is being inched the light at Q4.3 will flash (0.25 seconds on/off)
- Stop will override the inch button.



Name: ANDREW



F0.0
T3
T1
Q1.3
T1
IQ-0
T2
KT500
T1
T2
KT50.0
F0.0
T3.
KT500.0
IQ.1
IQ-0
T4
F0.0
F.0.0
T4
F0.0
KT400.0
wo tov
T4
Q1.1

Name: ANDREW DAOUD.

Date Submitted :

Programmable logic controllers

Work place simulation – Conveyor project.

Task

To design implement and test a PLC program for a given industrial application.

Procedure

- Examine the project task and create an assignment list.
- Design a PLC program to perform the task.
- Test your project using the simulator and PLC workplace simulation conveyor.
- Submit your project for grading.

Submit your project for grading.

You must submit the following for marking.

- Hand written copy of your program
- Assignment list.
- Copy of your program with symbolic table
- These question sheets.

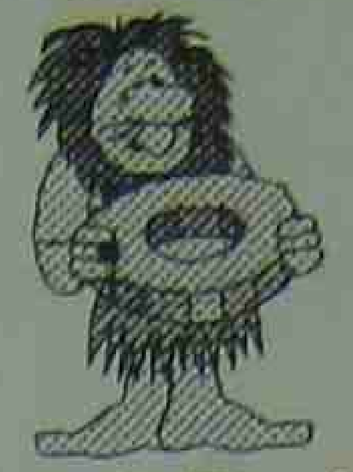
You must <u>test your program yourself</u> , when satisfied that the project is working , submit your project for grading.

Assignment List					
Inputs	**Address**	**Outputs**	**Address**	**Internals**	**Address**
~~I 0.0stop~~	~~I0.0~~	~~Q1.0~~		Flag1	F0.0.
~~I0.1start~~	I0.1	~~Q1.3~~		flag2	F0.1.
~~I0.2sen1~~	I0.2	~~Q1.6~~		Timer 7	T1
~~I0.3~~sen2	I0.3.	~~Q1.7~~.		Tim2.	T2
				Tim3.	T3.
Stop	I0.0.	fwo.	Q1.0	Tim4	T4.
start	I0.1.	SYSTEMon	Q1.3.	Tim5.	T5.
sensor1	I0.2	CPA.	Q1.6.	Tim6.	T6.
sensor2.	I0.3.	RPA.	Q1.7.	Tim7	T7.

Note : Any copied work will receive a fail result. Do your own work , you have been warned!

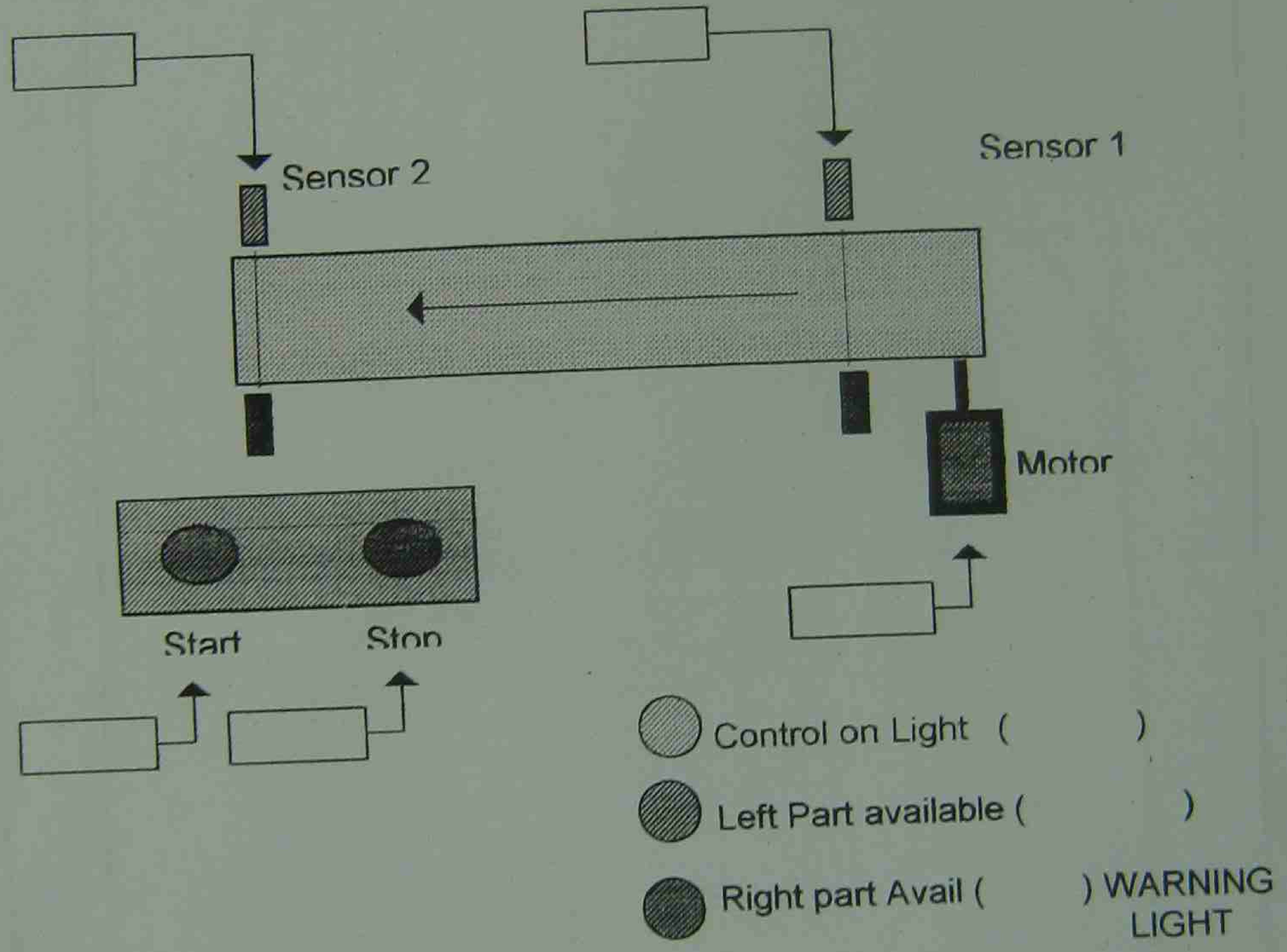
FILE NAME: ____________ NAME: ____________

Practical exercise



Flasher and Delayed start

Aim
to design a program to auto start the conveyor after a set time and indicate conditions using flashing lights



Procedure

1) Create and assignment list using the I/O's given in the machine layout above
2) Design a ladder program to perform the following tasks use symbols in your program.

- Press start and a control on Light will flash (0.5 seconds on 0.5 seconds off)
- After the control is started , a part is placed at sensor A and the motor will start
- while the part is travelling along the conveyor the warning light will flash (0.5 sec on 0.5 sec off)
- The conveyor will run until the part travels to sensor 2 and stops the conveyor.
- If the part is not removed after 2 seconds the warning Left Part Available light will flash (0.25 seconds on 0.25 seconds off)
- If the part is removed the conveyor will be started again by a part at sensor 1
- The stop button will stop all operation and the system on light will turn off.

PLCProgramListing

sheet of

Program I.D System Designer Date

PLCProgramListing

sheet of

Program I.D. System Designer Date

	1	2	3	4	5	6	7	8	9	
Rung#	Contact Instructions							Block Instructions	Output Instructions	Comments

Name: VU

Date Submitted :

Programmable logic controllers
Work place simulation – Conveyor project.

Task
To design implement and test a PLC program for a given industrial application.

Procedure

- Examine the project task and create an assignment list.
- Design a PLC program to perform the task.
- Test your project using the simulator and PLC workplace simulation conveyor.
- Submit your project for grading.

Submit your project for grading.
You must submit the following for marking.

- Hand written copy of your program
- Assignment list.
- Copy of your program with symbolic table
- These question sheets.

You must test your program yourself , when satisfied that the project is working , submit your project for grading.

Assignment List					
Inputs	**Address**	**Outputs**	**Address**	**Internals**	**Address**
Start	I0.1	Motor	Q1.0	Timer 1	T1
Stop	I0.0	Control on	Q1.9	Timer 2	T2
		LPA	Q1.6		T3
		RPA	Q1.7		T4
					T5
					T6
				Sensor A	T7

Note : Any copied work will receive a fail result. Do your own work , you have been warned!

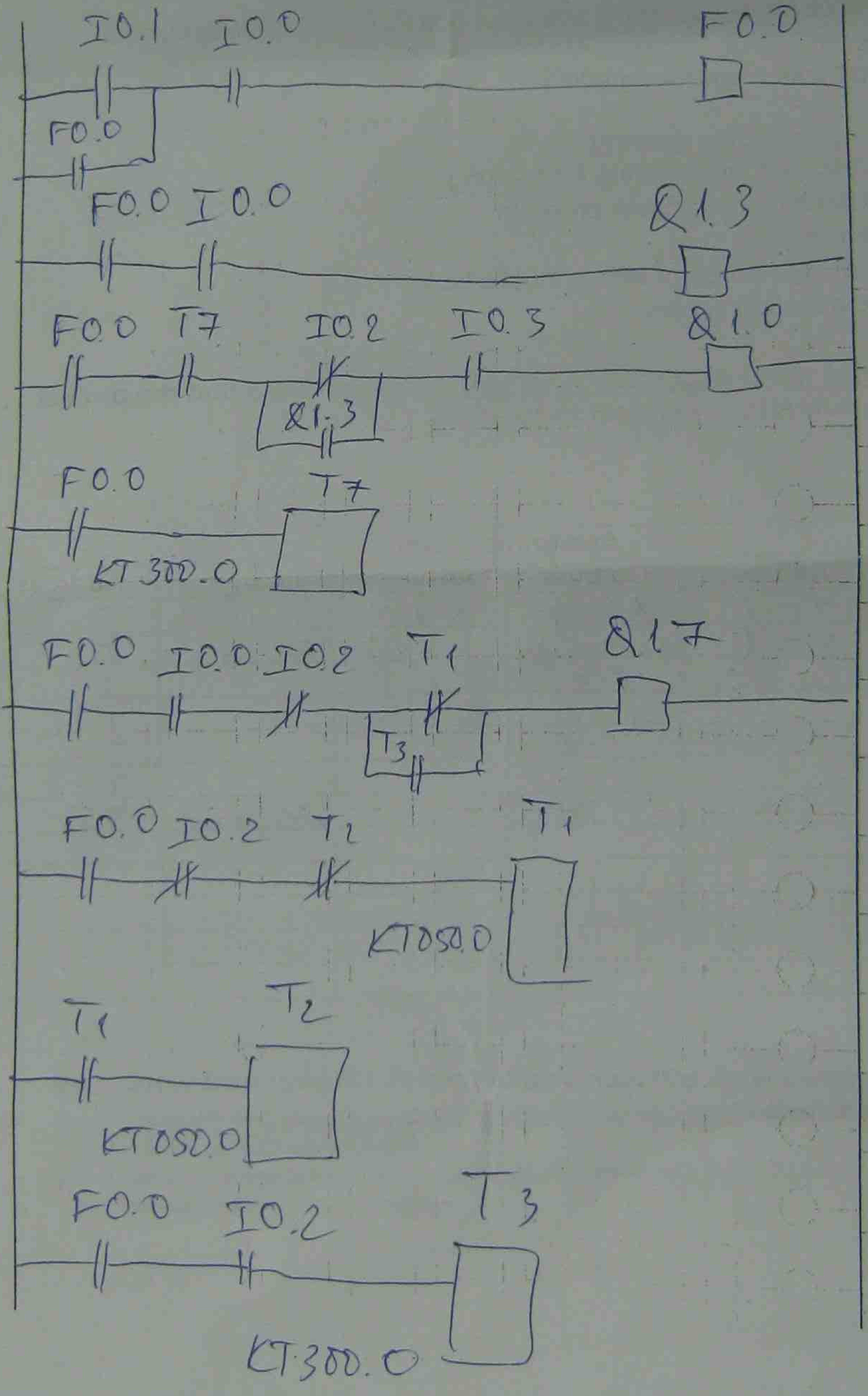
sheet of

Program I.D System Designer Date

PLCProgramListing

Program I.D. System Designer Date sheet of

Rung#	1	2	3	4	5	6	7	8	9	Comments
	Contact Instructions							Block Instructions	Output Instructions	



PLCProgramListing

sheet of

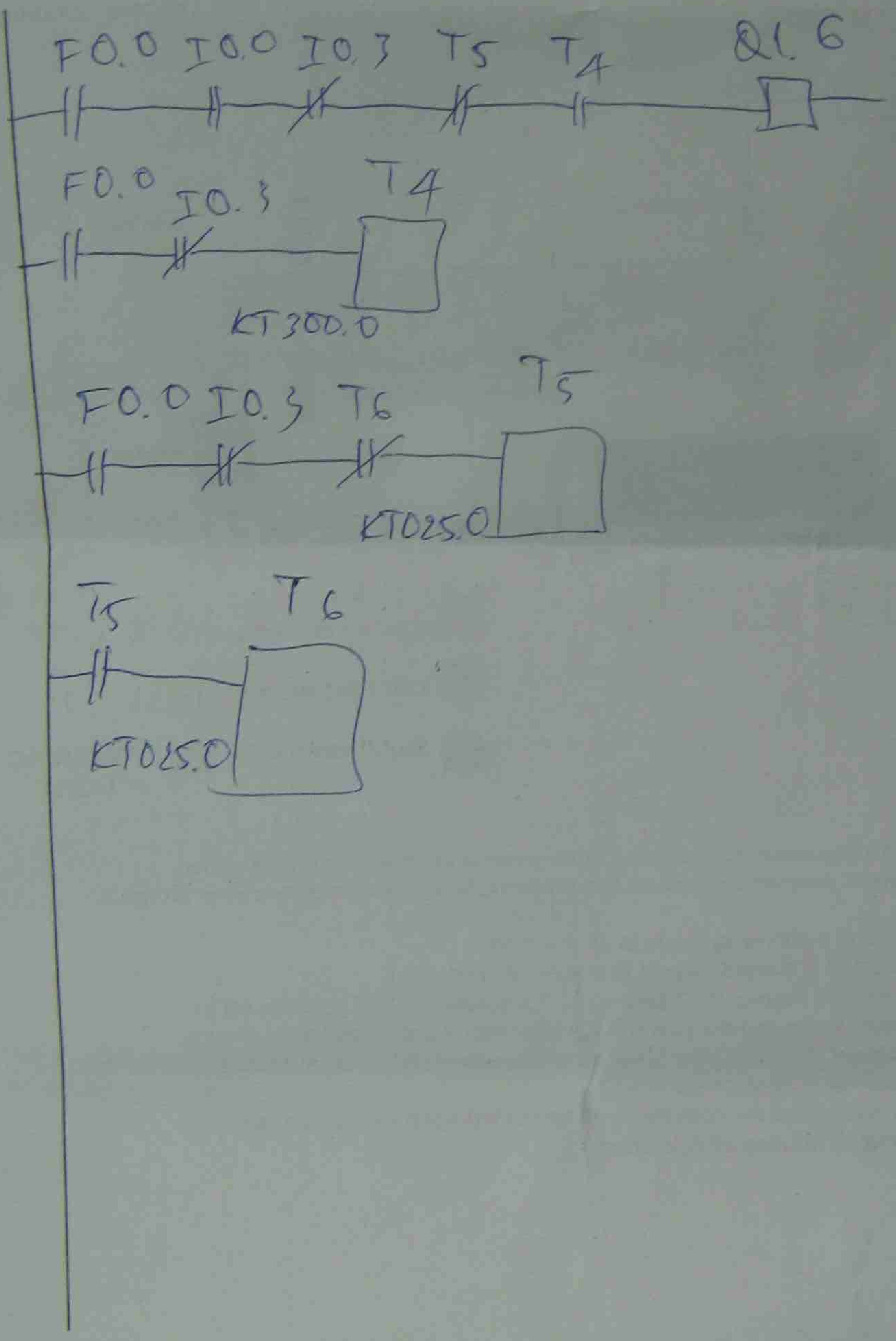
Program I.D System Designer Date

PLCProgramListing

sheet of

Program I.D. System Designer Date

Rung#	1	2	3	4	5	6	7	8	9	Comments
	Contact Instructions							Block Instructions	Output Instructions	



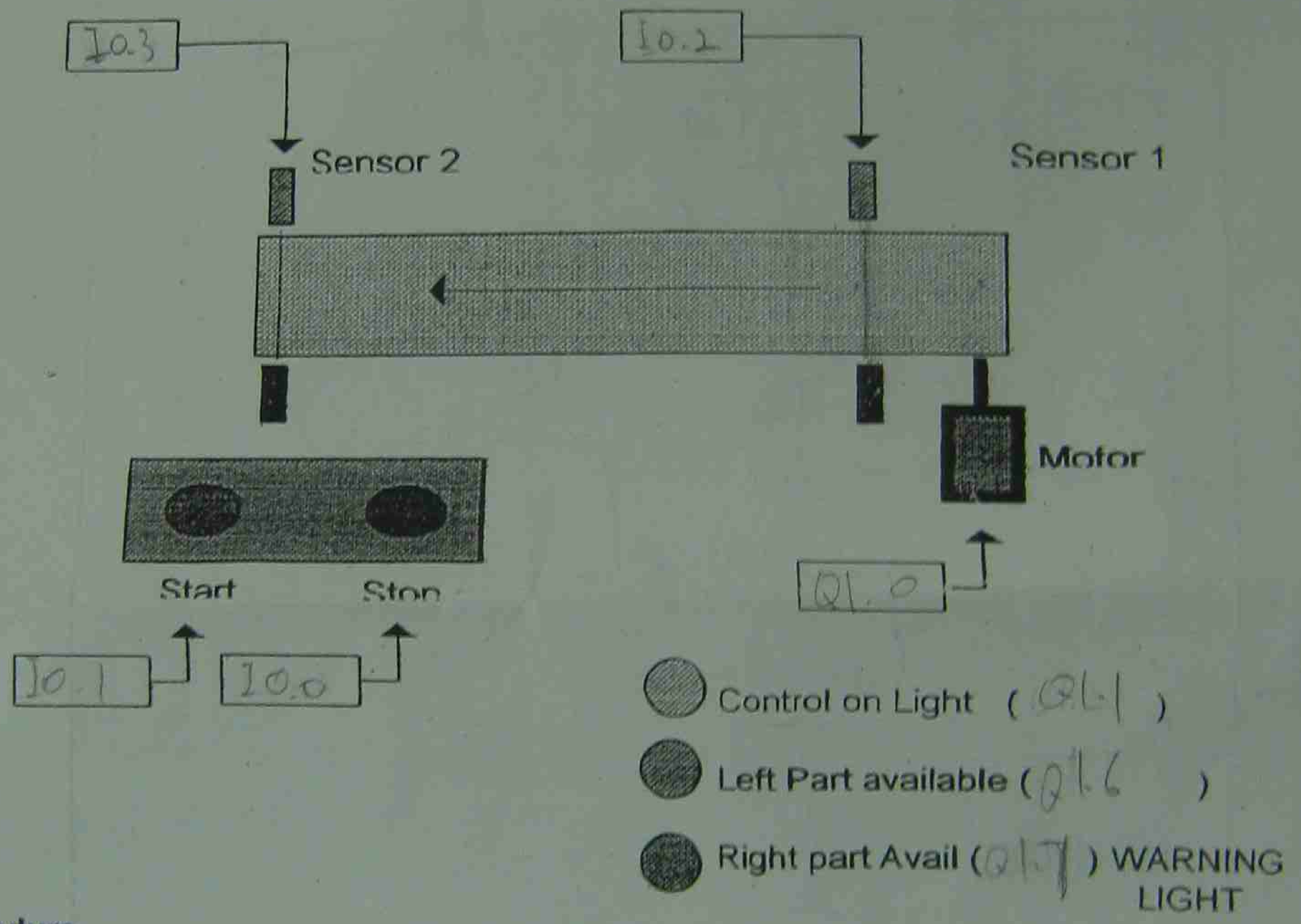
FILE NAME: ____________ NAME: ____________

Practical exercise

55

Flasher and Delayed start

Aim
to design a program to auto start the conveyor after a set time and indicate conditions using flashing lights


I0.3
I0.2
Sensor 2
Sensor 1
Motor
Start
Stop
Q1.0
I0.1
I0.0
Control on Light (Q1.1)
Left Part available (Q1.6)
Right part Avail (Q1.7) WARNING LIGHT

Procedure

1) Create and assignment list using the I/O's given in the machine layout above
2) Design a ladder program to perform the following tasks use symbols in your program.

- Press start and a control on Light is illuminated
- After the control is started , a part is placed at sensor A
- The warning light flashes for 3 seconds (0.5 seconds on 0.5 seconds off)
- The conveyor starts and the part travels to sensor 2 and stops the conveyor.
- If the part is not removed after 3 seconds the warning Left Part Available light will flash (0.25 seconds on 0.25 seconds off)
- If the part is removed the conveyor will be started again by a part at sensor 1
- The stop button will stop all operation

Name: LUIS CARO

SCADA theory Assignment/Quiz

1. What does S.C.A.D.A. stand for ?
Supervisory, Control AND DATA Acquisition of Industrial Processes

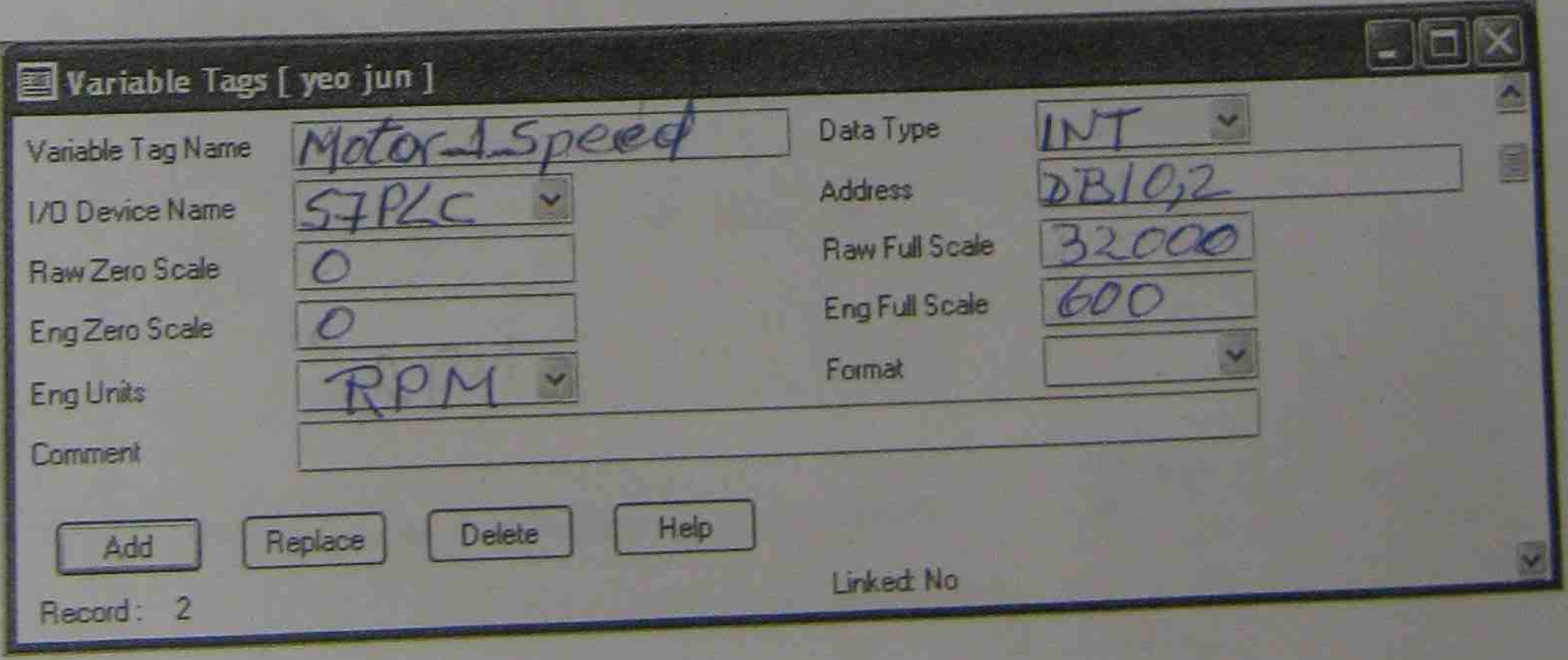
2. What is a TAG ? is a Dialog Box or a form where you can store information that will make your proyect easier and faster to design configure, commision and maintain

3. What is the difference between a Digital Tag and an Analog Tag ?
the difference between both is Data type: Digital tag - is Digital
Analog tag - is INT

4. What is a TREND ?
is a graphical representation of the changing values of a plant-floor variable (or expression), or a number of variables

5. Give an example of where you used a trend in one if your projects,
To monitor the temperature of the Tank, to monitor the water level of the tank

6. Fill out the following TAG entry dialog box for an Analog TAG that is the speed of a motor connected to an I/O device called "S7PLC" , the Address is DB10,2 and is an integer scaled from 0 to 32000 in the PLC (Raw data) , the actual data will be scaled 0 to 600.

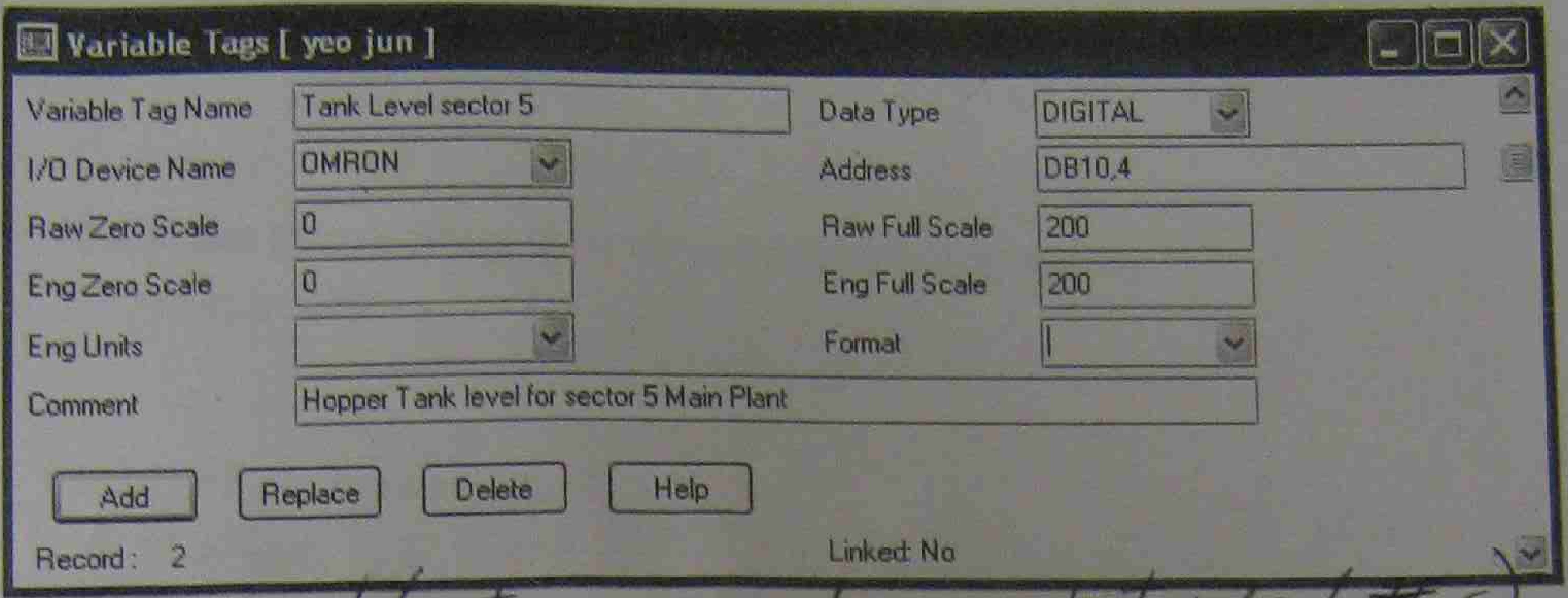

Variable Tags [yeo jun]

Variable Tag Name	Motor_1_Speed	Data Type	INT
I/O Device Name	S7PLC	Address	DB10,2
Raw Zero Scale	0	Raw Full Scale	32000
Eng Zero Scale	0	Eng Full Scale	600
Eng Units	RPM	Format	
Comment			

Record : 2

Linked: No

7. The Following TAG has come up as a fault when the project was compiled , what is the problem with this tag ?



Variable Tag Name	Tank Level sector 5	Data Type	DIGITAL
I/O Device Name	OMRON	Address	DB10,4
Raw Zero Scale	0	Raw Full Scale	200
Eng Zero Scale	0	Eng Full Scale	200
Eng Units		Format	|
Comment	Hopper Tank level for sector 5 Main Plant		

Record : 2

Linked: No

Variable tag name (space between letter)

8. List the steps that you would follow when creating a new project.

- 1 Create the proyect using the Citec Explore
- 2 Set up communication
- 3 Define Variable tags
- 4 Create graphics page using Graphic Builder.
- 5 Configure any features that are not page-based in the Proyect Editor this includes alarms, reporting events logging, and so on

1 or 0

9. Explain the meaning/purpose of "Digital Alarm"

Digital alarm is when active is 1 or 0

Triggered by a state change in a digital Variable. Use these alarms when a process has only one of two states. You can use either the ON (1) state or OFF (0) state (of a digital variable) to Trigger the Alarm.

10. Explain the meaning of setpoint when applied to ALARMS.

the alarms will triggered only when analog variable riches a specific value only for analog Alarms

11. Explain the meaning of "AND" when applied to alarms.

Means:
ANALOG and Digital

12. What is an Accumulator ?

A citec SCADA facility that allows you to track incremental runtime data such as motor run hours, power consumption and downtime

13. Give an example of where you might use an Accumulator ?

Proyect power consumption control
Proyect run hours
Motor speed, corrent consumpsion

14. Define what an Event is in Citect SCADA.

event is a serie of instruccions that can be executed when a process riches a certain stage. or is an instruction to trigger an action

15. Give an example of where you would use an event ?

To operate a conveyor (Time to start and stop)
water Treatment

16. What is the importance of security , give an example of where have you used security in one of your projects ?

To protect a program (project) and safety Reason

Restrict Access ⇒ to comands that should not be Available to all operator

the water treatment Project
Bottling Plant
conveyor and Mixer

17. Define what a report is and give an example of where you might use one in one of your projects.

is an information indicating a fault condition or the state of the process

in My Project I should use it when the Mixer Motor of the waste treatment TANK over heat or Heater element is faulty

Name: Luis Caro

Date Submitted : 25-6-09

Programmable logic controllers

Work place simulation – Conveyor project.

Task

To design implement and test a PLC program for a given industrial application.

Procedure

- Examine the project task and create an assignment list.
- Design a PLC program to perform the task.
- Test your project using the simulator and PLC workplace simulation conveyor.
- Submit your project for grading.

Submit your project for grading.

You must submit the following for marking.

- Hand written copy of your program
- Assignment list.
- Copy of your program with symbolic table
- These question sheets.

You must <u>test your program yourself</u> , when satisfied that the project is working , submit your project for grading.

Assignment List					
Inputs	**Address**	**Outputs**	**Address**	**Internals**	**Address**
STOP	I 0.0	Motor	Q 1.0	FLAG	F0.0
START	I 0.1	MCL	Q 1.3	FLAG	F0.1
Sensor	I 0.2	Light LPA	Q 1.6	FLAG	F0.6
Sensor	I 0 3	Light RPA	Q 1.7	Timer	T1
		Master Flg	Q 4.0	Timer	T2
		Master Flg	Q 4.3	Timer	T3
				Timer	T4
				Timer	T5
				Timer	T6
				Timer	T7
				Timer	T8
				Counter	C1

Comparator

Note : Any copied work will receive a fail result. Do your own work , you have been warned!

Program I.D. Second

System Designer

Date

PLC Program Listing

~~First~~ Project

sheet of

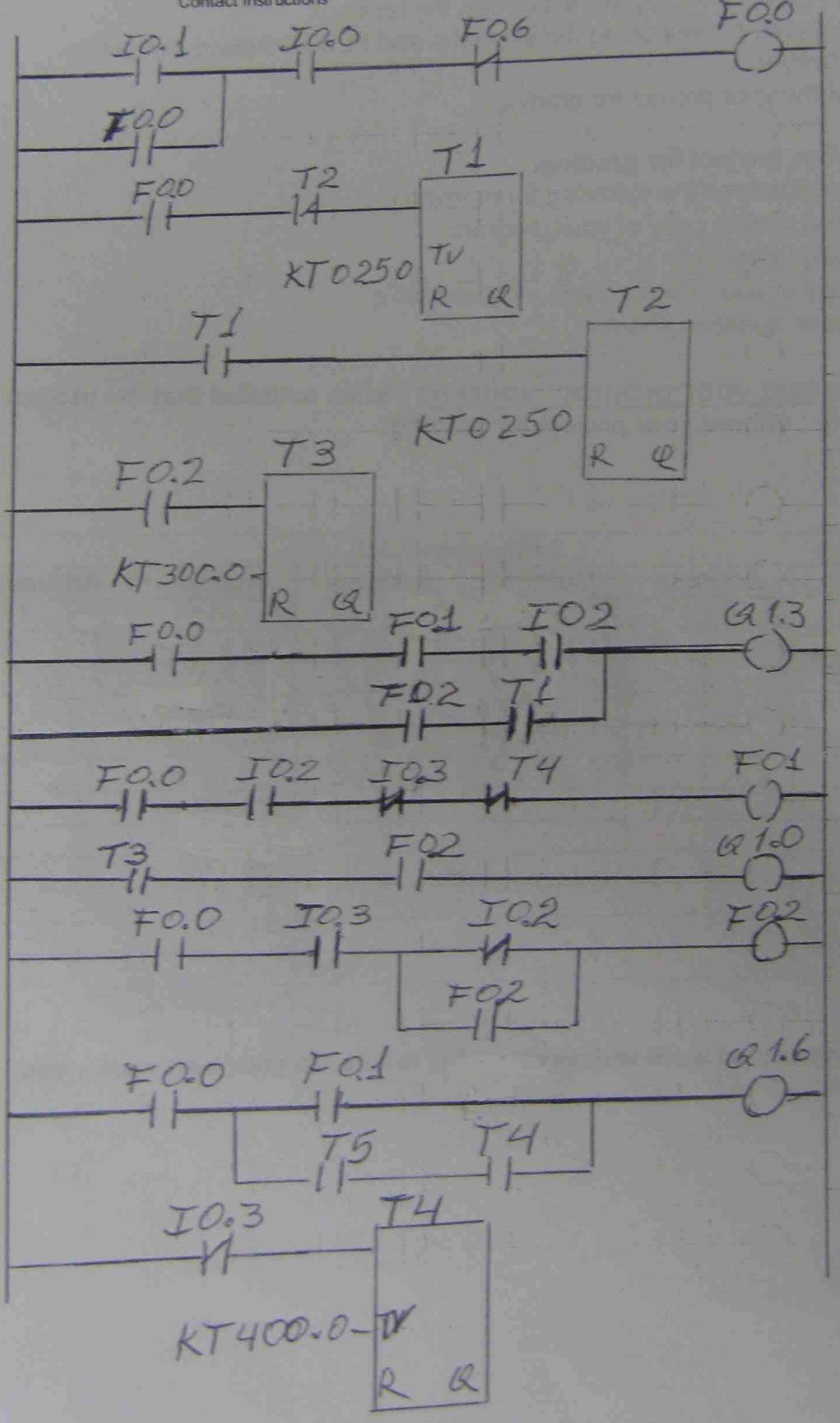
Program I.D.

System Designer

Date

1 2 3 4 5 6 7 8 9

Rung# Contact Instructions Block Instructions Output Instructions Comments



PLCProgramListing

sheet of

Program I.D. System Designer Date

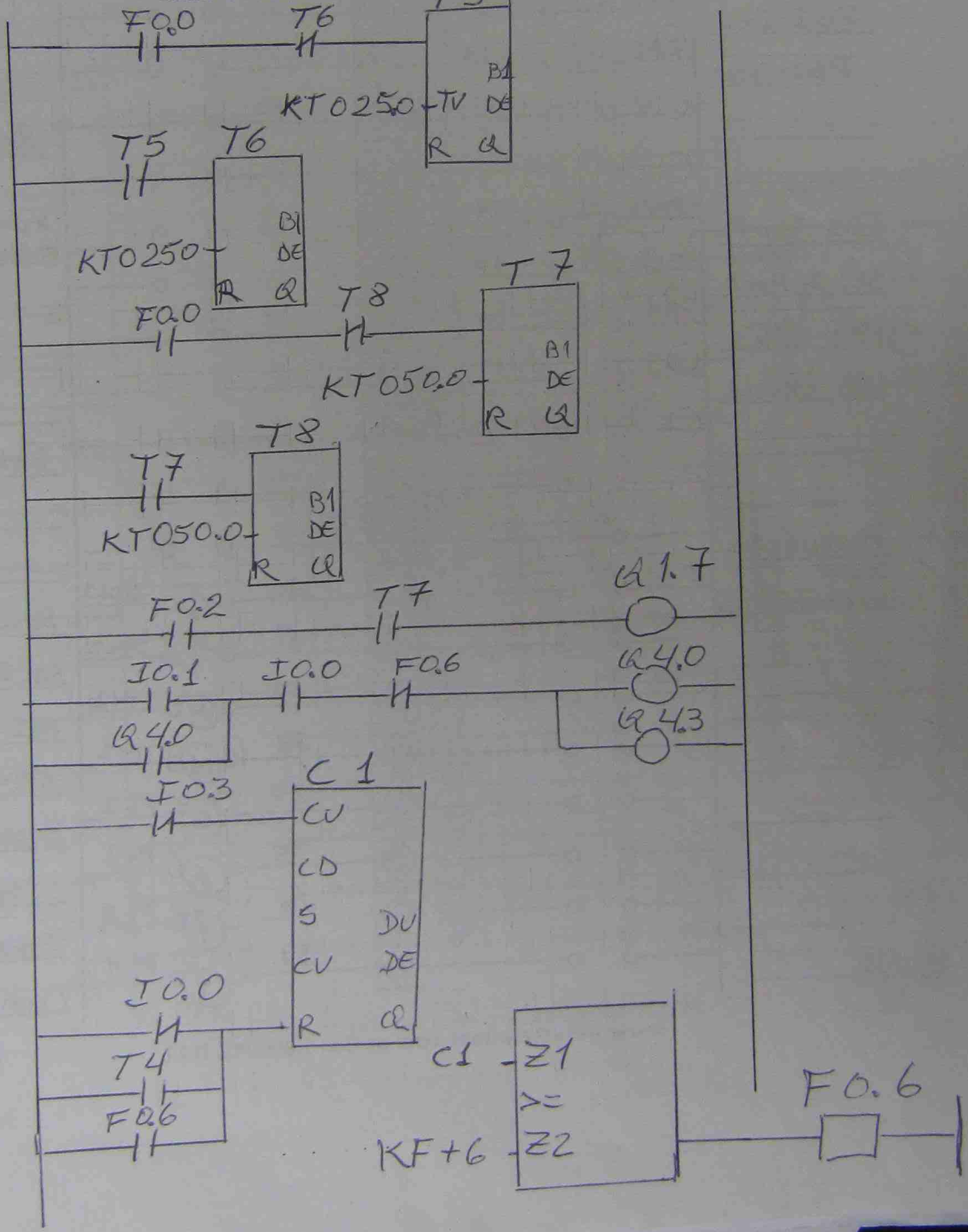
PLCProgramListing

sheet of

Program I.D. System Designer Date

1 2 3 4 5 6 7 8 9

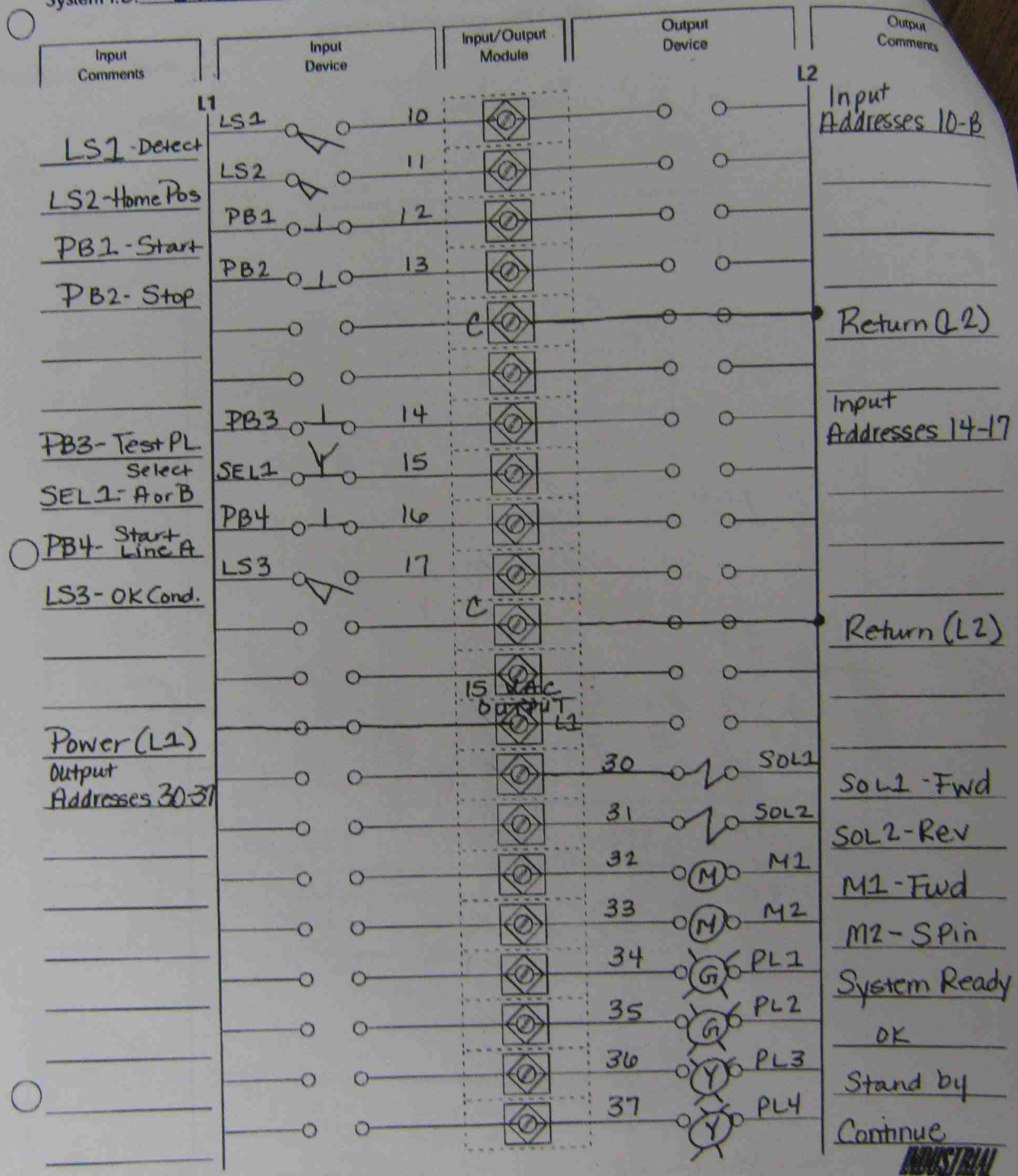
Rung# Contact Instructions Block Instructions Output Instructions Comments



Input/Output Listing

sheet 1

System I.D. SAMPLE System Designer PAUL Date MAY 3



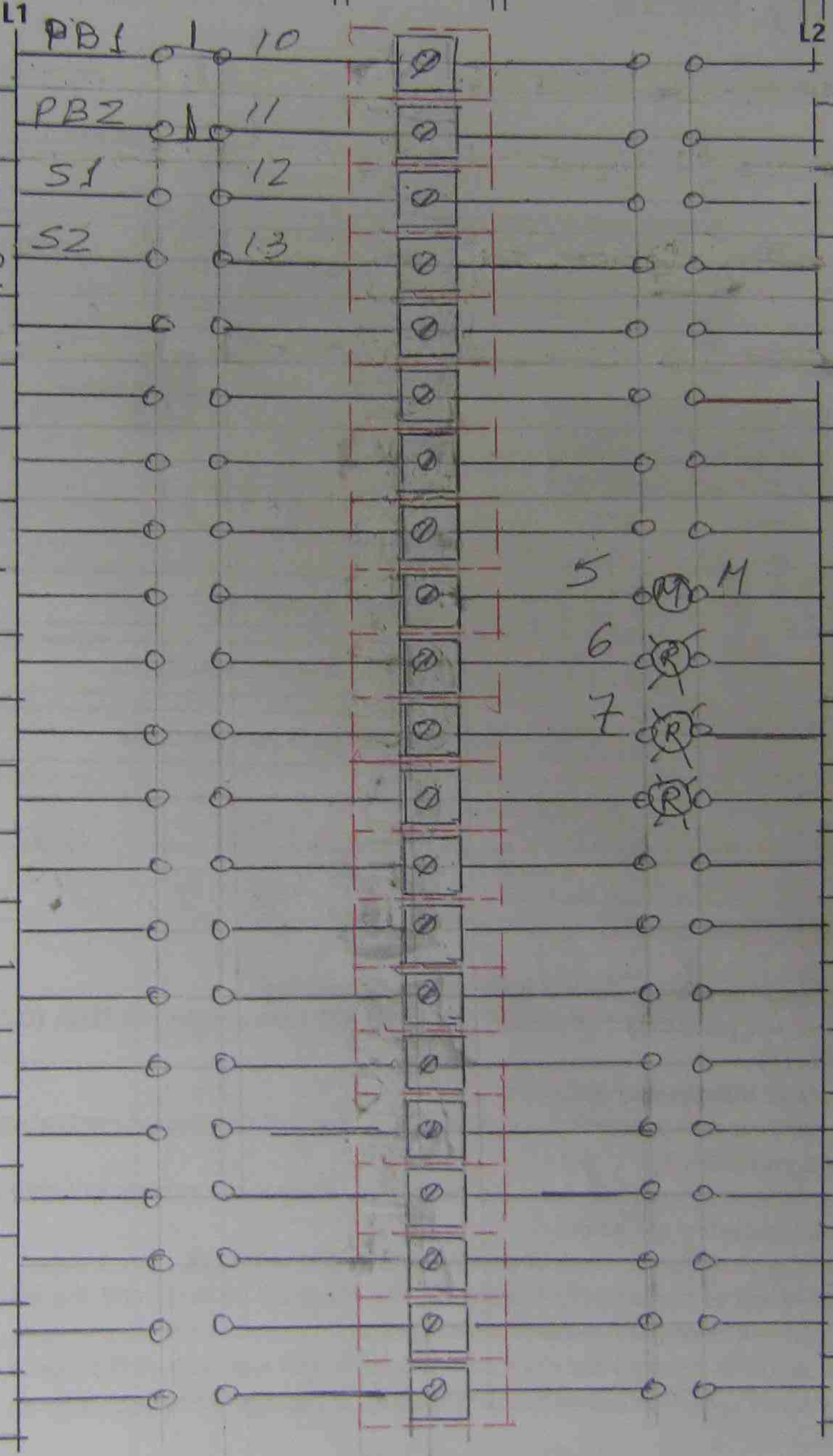
Input Comments	Input Device	Input/Output Module	Output Device	Output Comments
	L1		L2	
LS1-Detect	LS1 10			Input Addresses 10-B
LS2-Home Pos	LS2 11			
PB1-Start	PB1 12			
PB2-Stop	PB2 13			
		C		Return (L2)
PB3-Test PL	PB3 14			Input Addresses 14-17
Select SEL1- A or B	SEL1 15			
PB4- Start Line A	PB4 16			
LS3- OK Cond.	LS3 17			
		C		Return (L2)
		15 VAC OUTPUT		
Power (L1)		L1		
Output Addresses 30-37			30 SOL1	SOL1-Fwd
			31 SOL2	SOL2-Rev
			32 M1	M1-Fwd
			33 M2	M2-Spin
			34 PL1	System Ready
			35 PL2	OK
			36 PL3	Stand by
			37 PL4	Continue

Input/Output Listing

sheet 1 of 1

System I.D.______ System Designer Luis C Date______

Input Comments	Input Device	Input/Output Module	Output Device	Output Comments
PB1 START	PB1 10			INput
PB2 STOP	PB2 11			ADDRESSES
Sensor1	S1 12			10-13
Sensor2	S2 13			
				output
Power				ADDRESS 5-7
output			5 M	Motor
ADDRESS 5-7			6 R	MCL (Light)
			7 R	LPA-Light
			R	RPA-Light



www.industrialtext.com or Call 1.800.PLC.TEXT

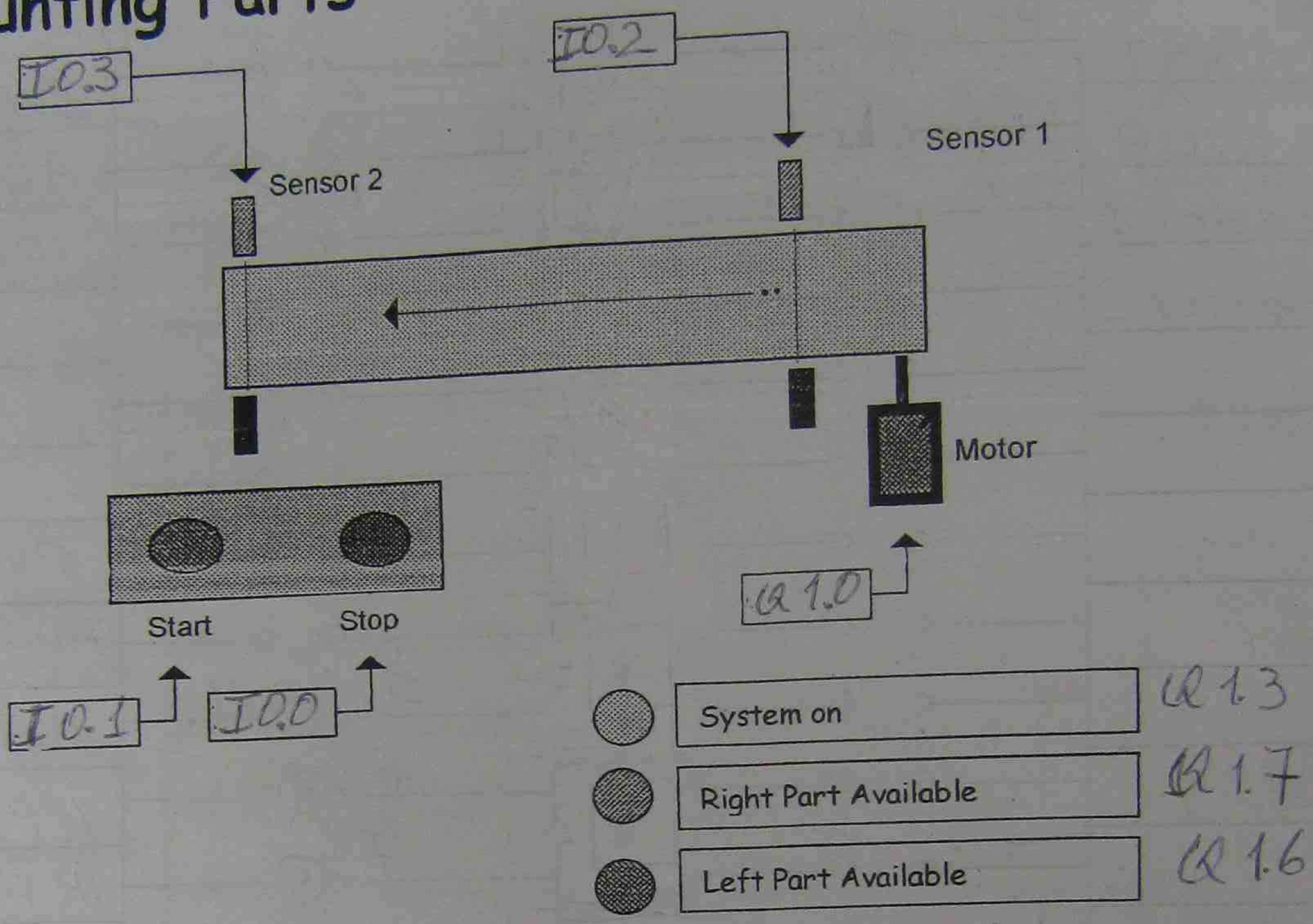
INDUSTRIAL &

8

NAME: ____________

FILE NAME: ____________

Counting Parts



Sequence of operation

- Press start and the Master Control light will be illuminated
- The operator will place a part at sensor 1 , the Master control light will flash (0.25 seconds on/off)
- After 3 second the conveyor will start.
- When the part reaches sensor 2 the conveyor will stop and the master control will stop flashing and stay on.
- When 6 parts have successfully traveled along the conveyor the system will shut down and the master control will be off.
- While a part is at sensor 2 , the left part available light will be on.
- If the part is left at sensor 2 for 4 seconds , the count will be reset and the left part available light will flash (0.25 seconds on/off)
- While the part is at sensor 1 the right part available light will flash (0.5 seconds on/off)
- Stop will stop all operation and no function allowed if the master control is no on.

Note: "SUCCESSFULLY" MEANS THE PART HAS BEEN PICKED UP AT SENSOR 2

Counting Parts simbolic Table

operand	Symbol
I0.0	STOP
I01	start
I0.2	sensor 1
I0.3	sensor 2
Q1.0	Motor-FWD
Q1.3	Master control light
Q1.6	L.P.A. warning Light
Q1.7	R.P.A. warning Light
Q4.0	Master Flag
Q4.3	Master Flag
F0.0	Master control Flag
F0.1	Auxiliary Flag
F0.2	Auxiliary Flag
F0.6	Auxiliary Flag
T1	OSC.I (0.25 sec. off)
T2	OSC II (0.25 sec. on)
T3	osc III (3 sec on)
T4	osc IV (4 sec on)
T5	osc V (0.25 sec. off)
T6	osc VI (0.25 sec. on)
T7	osc VII (0.5 sec. off)
T8	osc. VIII (0.5 sec. on)
C1	counter 1
OB1	OB1

Comment

I0.0	stop
I0.1	start project and Master contrd light will be illuminated
I0.2	Part Placed infront of sensor 1. Master control light flash, motor start
I0.3	Part reaches sensor 2 Conveyor stop, M.C.L. stop flashing and stay on
Q1.0	Motor run Forward
Q1.3	when press start button, the Master control light will flash
Q1.6	Left Part Available warning light
Q1.7	Right Part Available warning Light
Q4.0	Master flag to operate counter 1
Q4.3	Master flag to operate the comparator
F0.0	Master control flag of the project
F0.1	This flag operate the L.P.A. warning Light
F0.2	This flag assist to operate the motor and the master control Light
F0.6	This flag assist to reset the Counter and the project itself
T1	oscillator I make master control to flash.
T2	oscillator II make master controC to flash,
T3	oscillator III start the motor after 3sec.
T4	oscillator IV Conect the L.P.A. warning light to flash and reset the counter

Continuous →

comment

T5	Oscillator V Time the L.P.A. warming light to flash
T6	Oscillator VI Time the L.P.A. warning Light to flash
T7	oscillator VII Time the R.P.A. warning Light to flash
T8	Oscillator VIII time the R.P.A. warning Light to flash
C1	After 6 parts counted the system will shutdown, counter 1 operate the comparator
OB1	O B 1

CONTROL CONCEPTS REPORT AND HARDWARE
Handed in on 25/06/09 to Joe at 17:30

PID Report - Page 1 Tom O'Neill

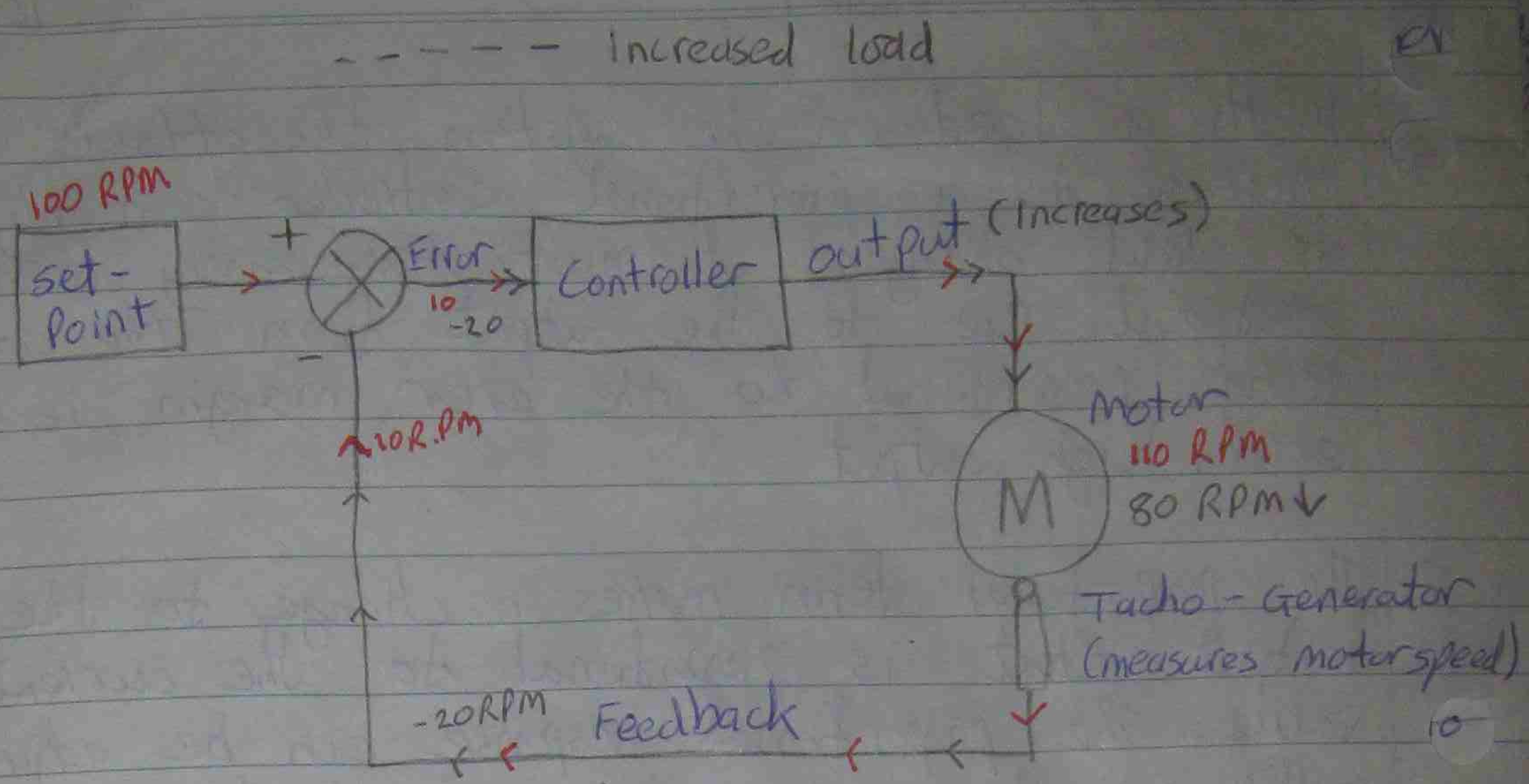
1 With a load on the system, the offset will increase. As a proportional controller can only respond to load changes, it must move away from the setpoint. Due to the output from the controller being proportional to the error margin, ie high error, high output

2. The proportional term makes a change to the output that is proportional to the current error value. The proportional response can be adjusted by multiplying the error by a constant known as proportional gain. A high proportional gain results in a large change in the output for a given change in the error. A small gain results in a small output response to a large input error.

3. The main advantage is stability which results in a smoother control. Proportional controls are designed to eliminate the continual cycling associated with on/off control. This results in less 'overshooting' of the setpoint and allows the system to approach the setpoint more slowly and maintain stability

4. With a medium gain the output would be relatively close to the setpoint, as with this gain setting the error is not too large or small and subsequently won't produce a large output or one that is too slow to respond.

5.



When the system has an increase in load, the motor slows down which in turn leads to the feedback going down. Due to this the error increases which results in the output increasing also.

6 If the tacho generator became uncoupled, the system would lose its ability to measure the motor speed and hence the feedback mechanism. This would result in the motor speeding up due to the output becoming saturated.

7. There will be no output, so therefore zero voltage.

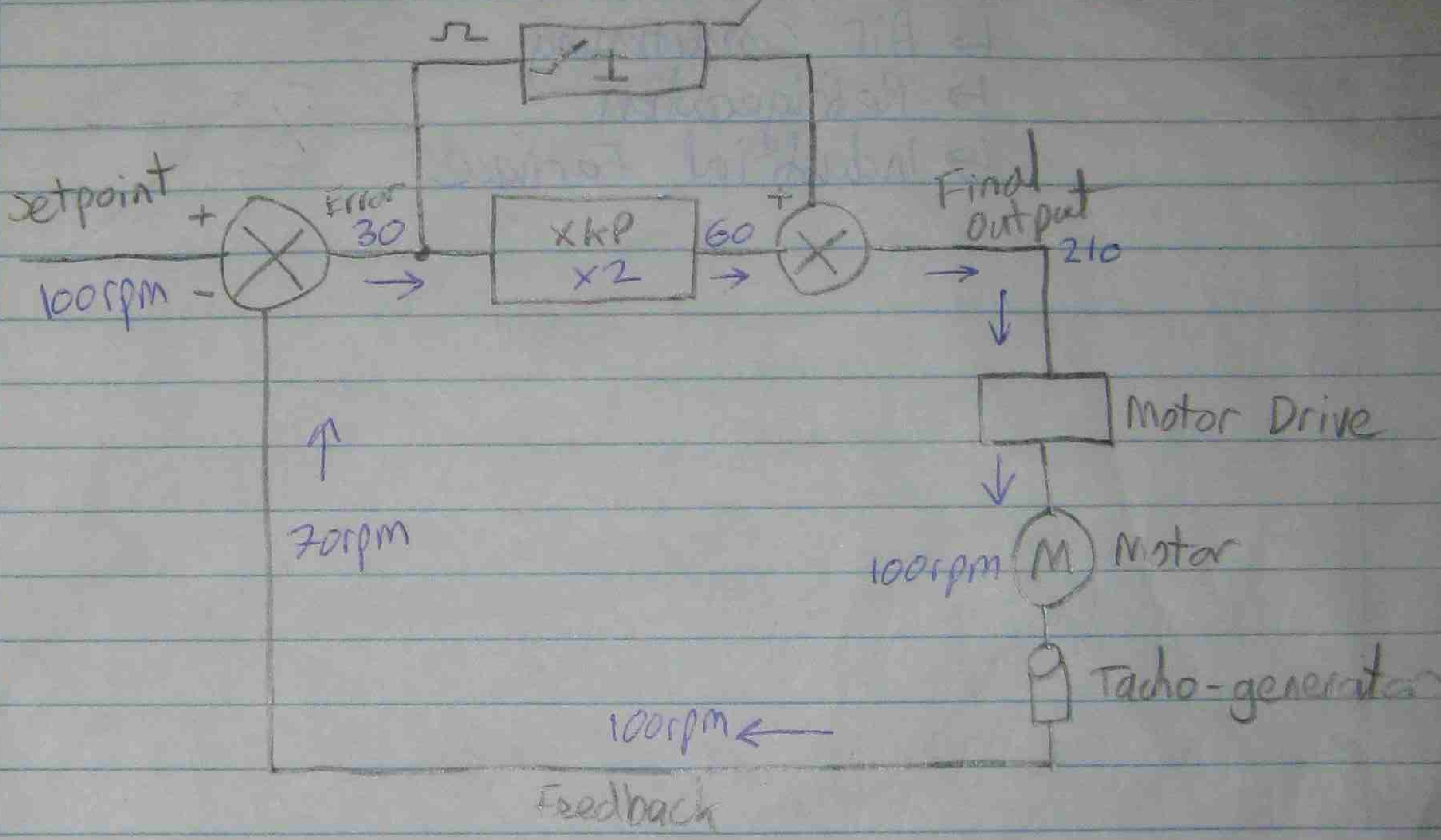
8. When a load is introduced to the system, the output will increase due to the elimination of the offset.

PID Report - Page 2 TOM ONEIL

9. Output voltage was measured to be 5v. This must have been due to the proportional action as the integral action should have corrected the output to the setpoint of 3v.

10. Integral actions main advantage is that it removes offset so the setpoint can be reached.

11.

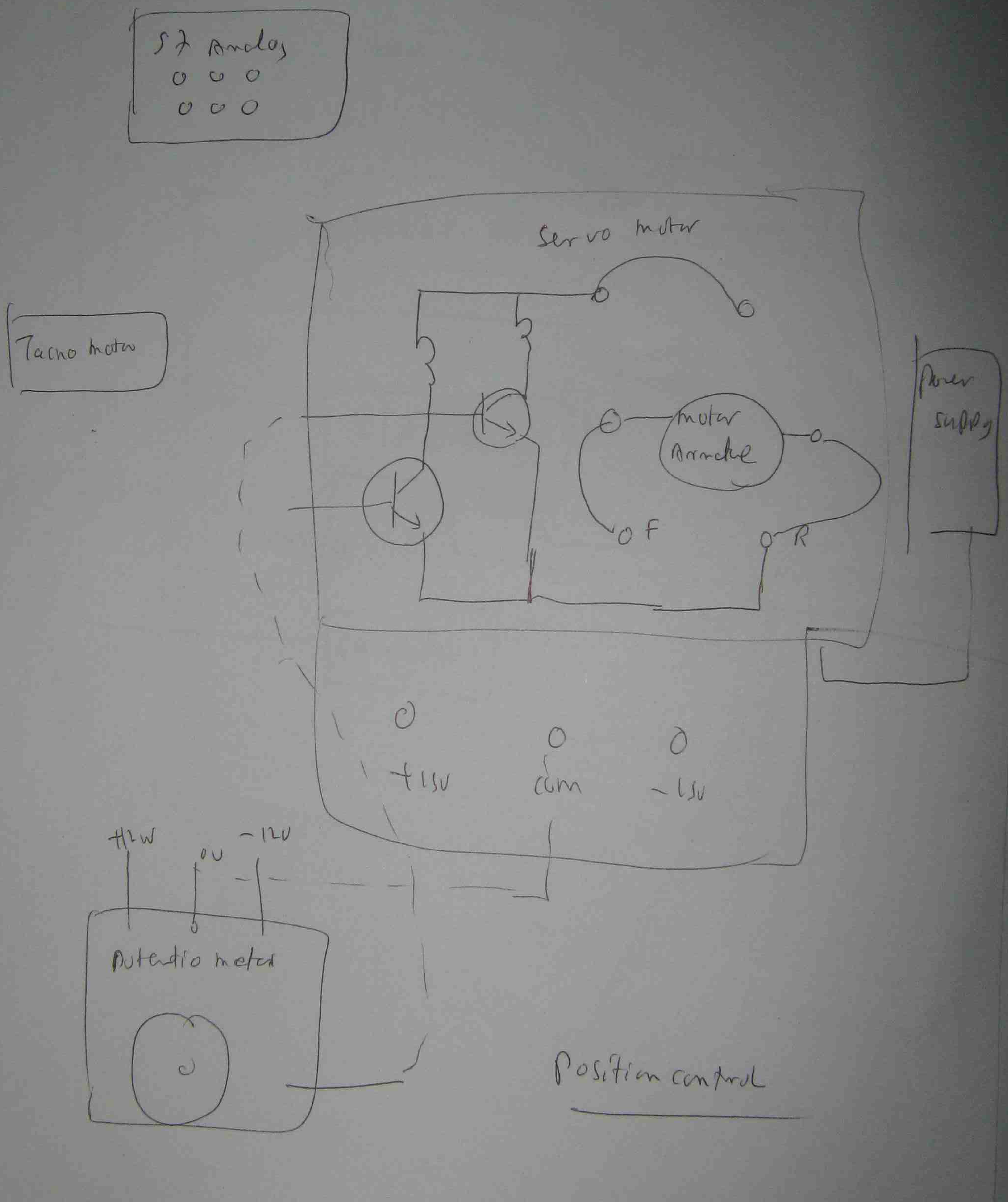


The proportional action provides an output to correct for the change in load.

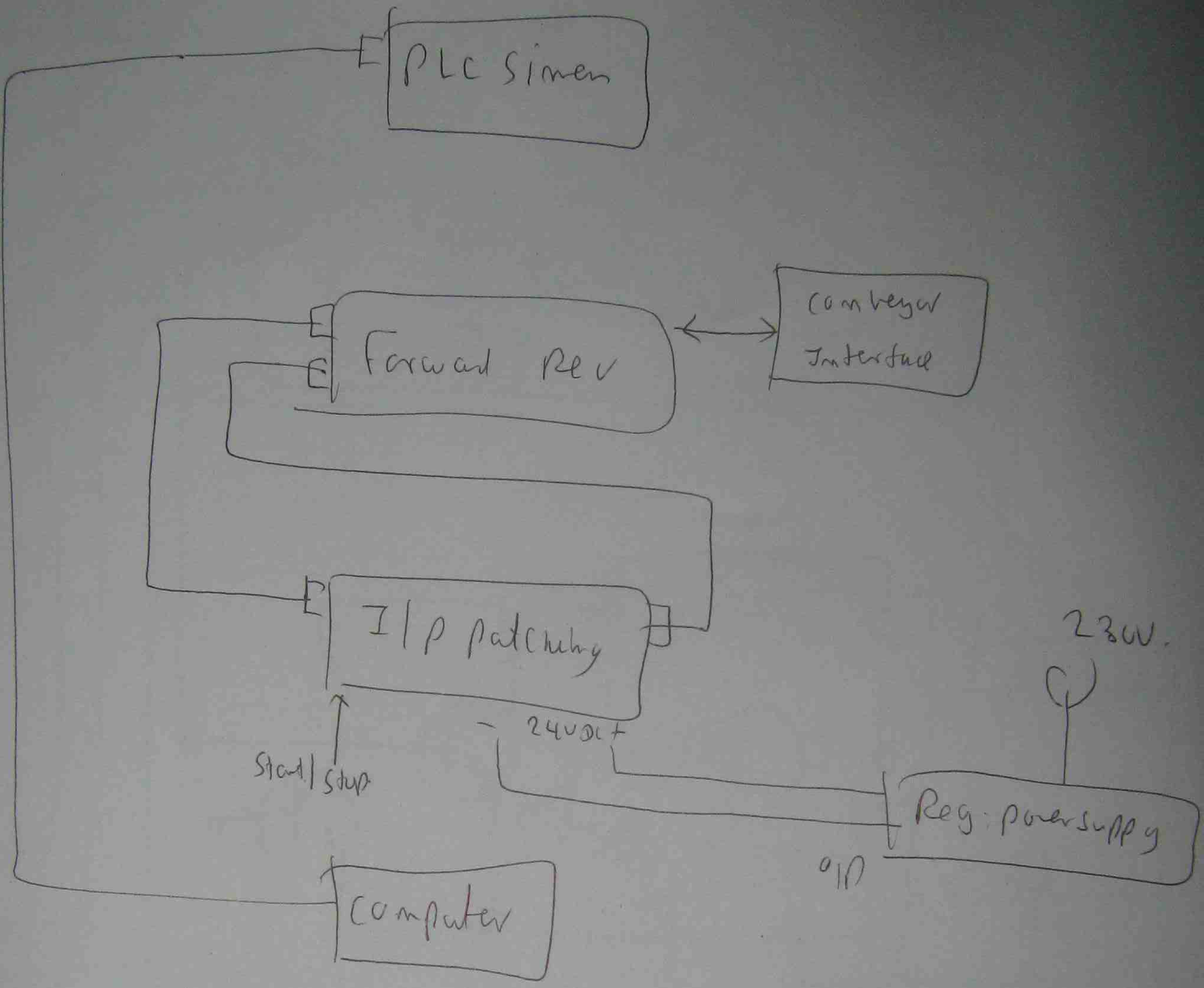
12. The derivative action slows the rate of change of the controller output. It is used to reduce the magnitude of the overshoot produced by the integral action and to improve the combined controller - process stability.

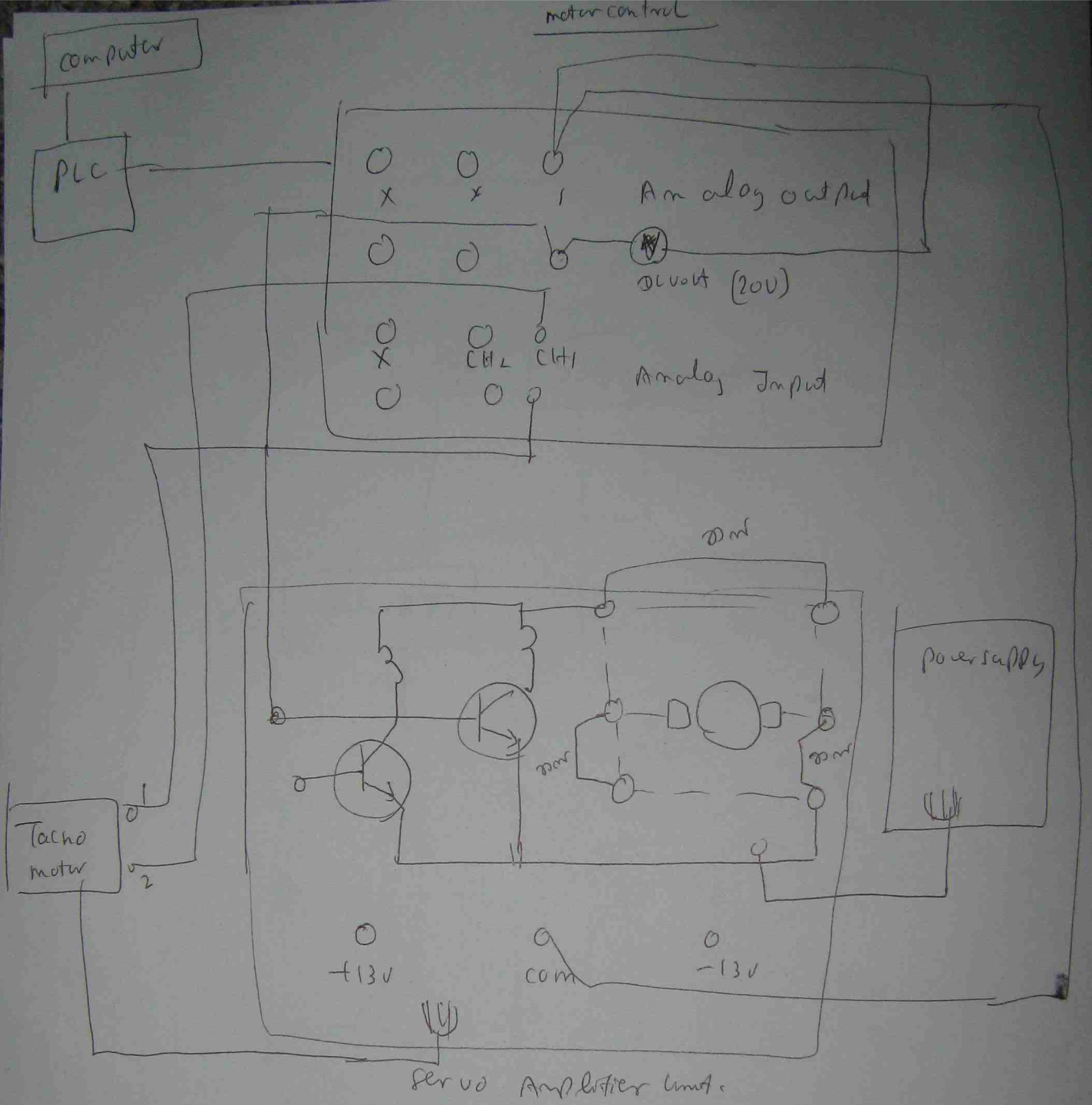
B. Practical examples of closed loop control systems using PID control

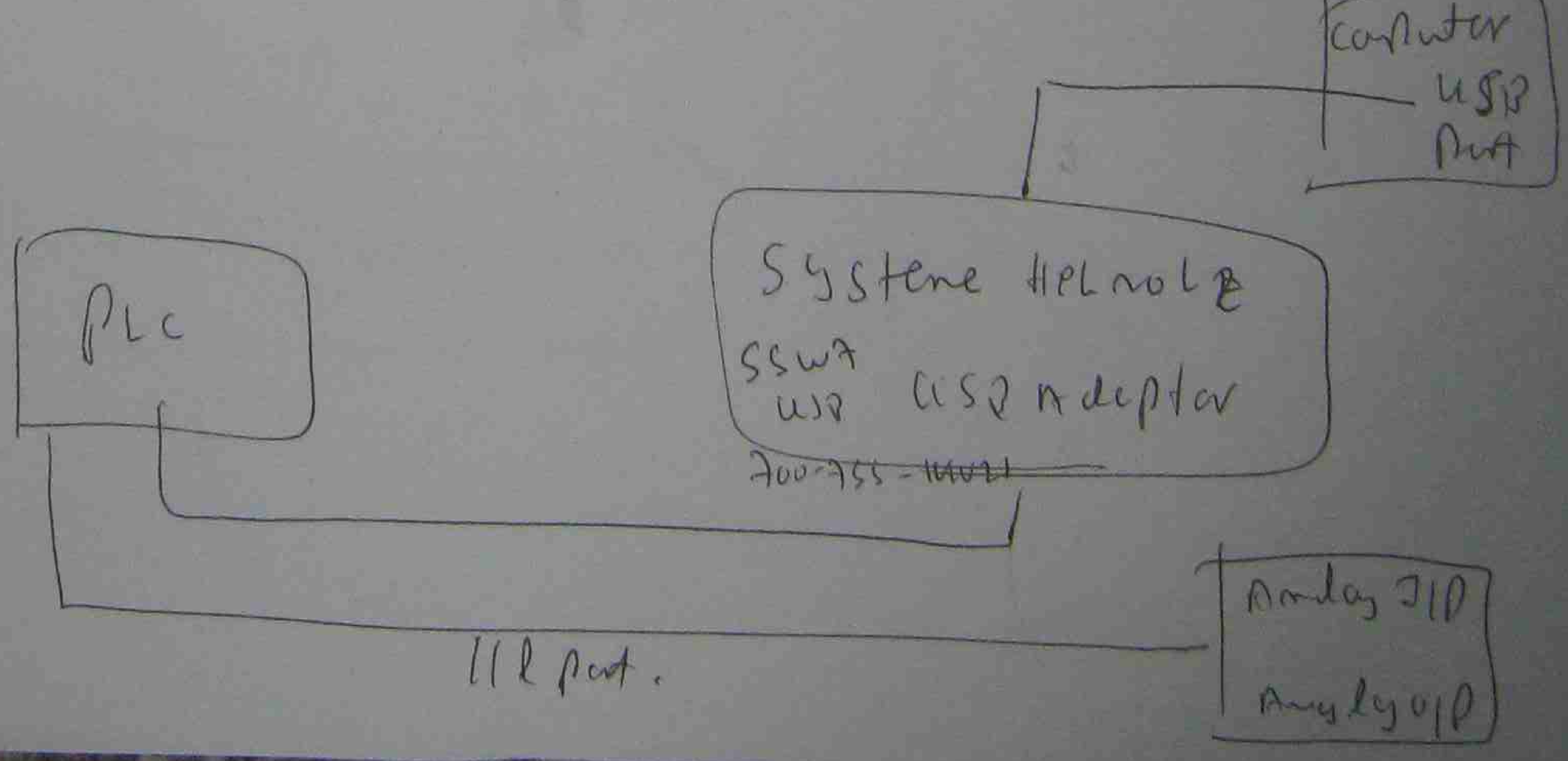
- Robotics
- Aircraft cruise control
- DC motor
- Temperature control systems
  - ↳ Electric Heater
  - ↳ Air conditioning
  - ↳ Refrigeration
  - ↳ Industrial Furnace



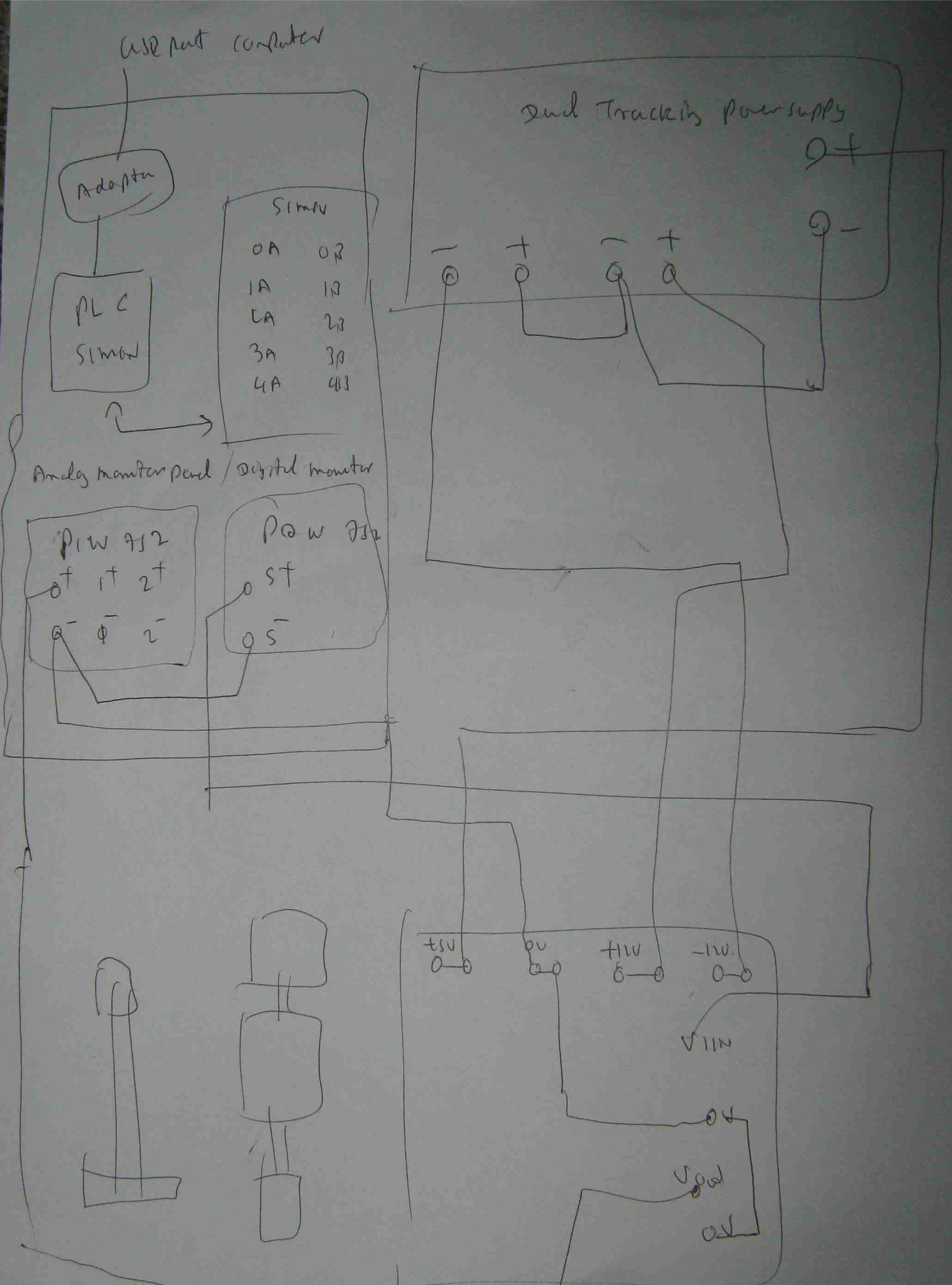
Position control


PLC Simen
Forward Rev
conveyor Interface
I/P patching
-
24vDC +
Start/Stop
230V.
Reg: powersuppy
O/P
Computer


motor control
computer
PLC
X
x
1
Analog output
20 volt (20V)
X
CH2
CH1
Analog Input
Tacho motor
1
2
powersupply
+13v
com
-13v
servo Amplifier unit.

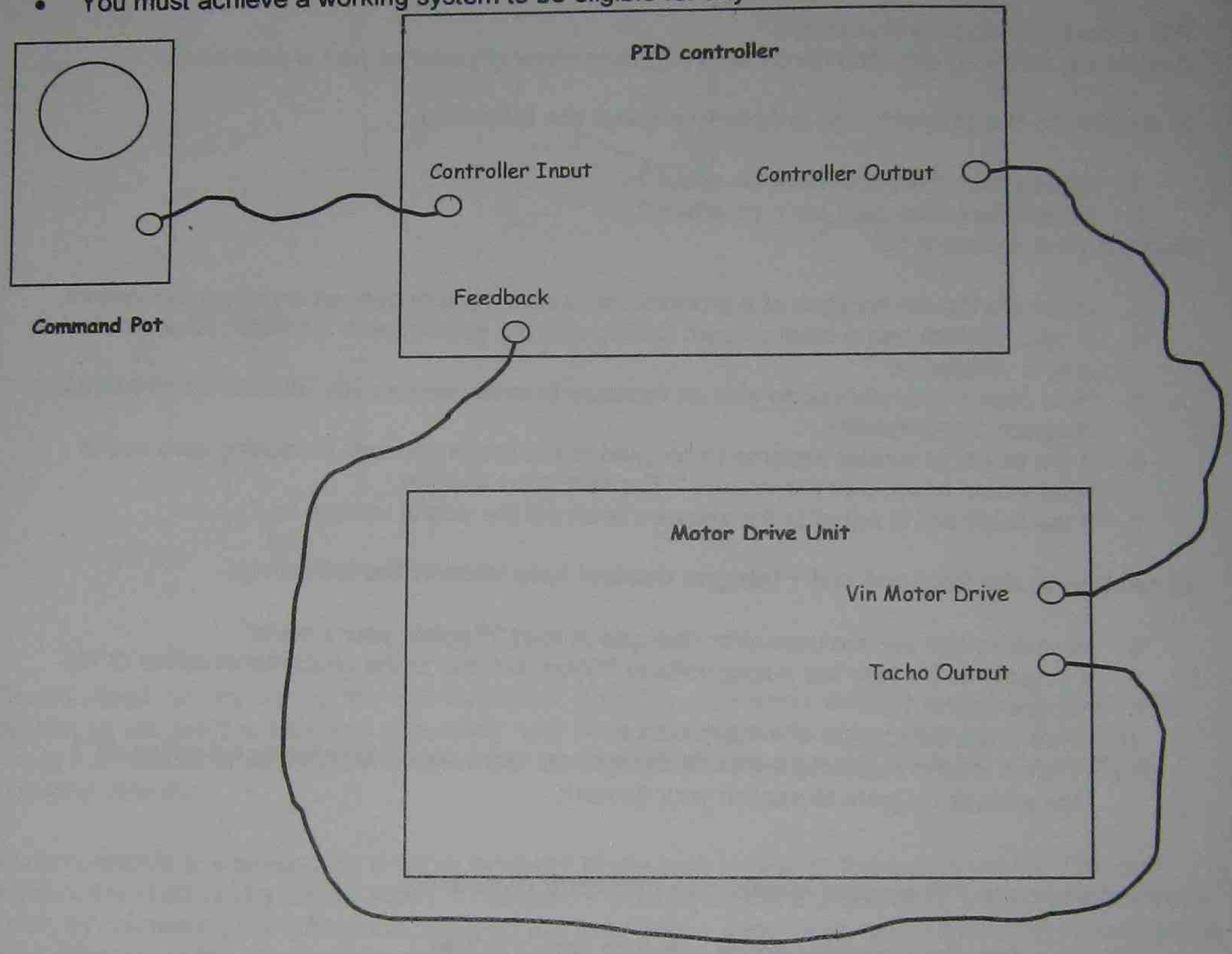

computer USB port
PLC
Systeme Helnolz
SSWA USB
USB Adeptor
700-755-
Analog I/P
Analog O/P
I/O port.

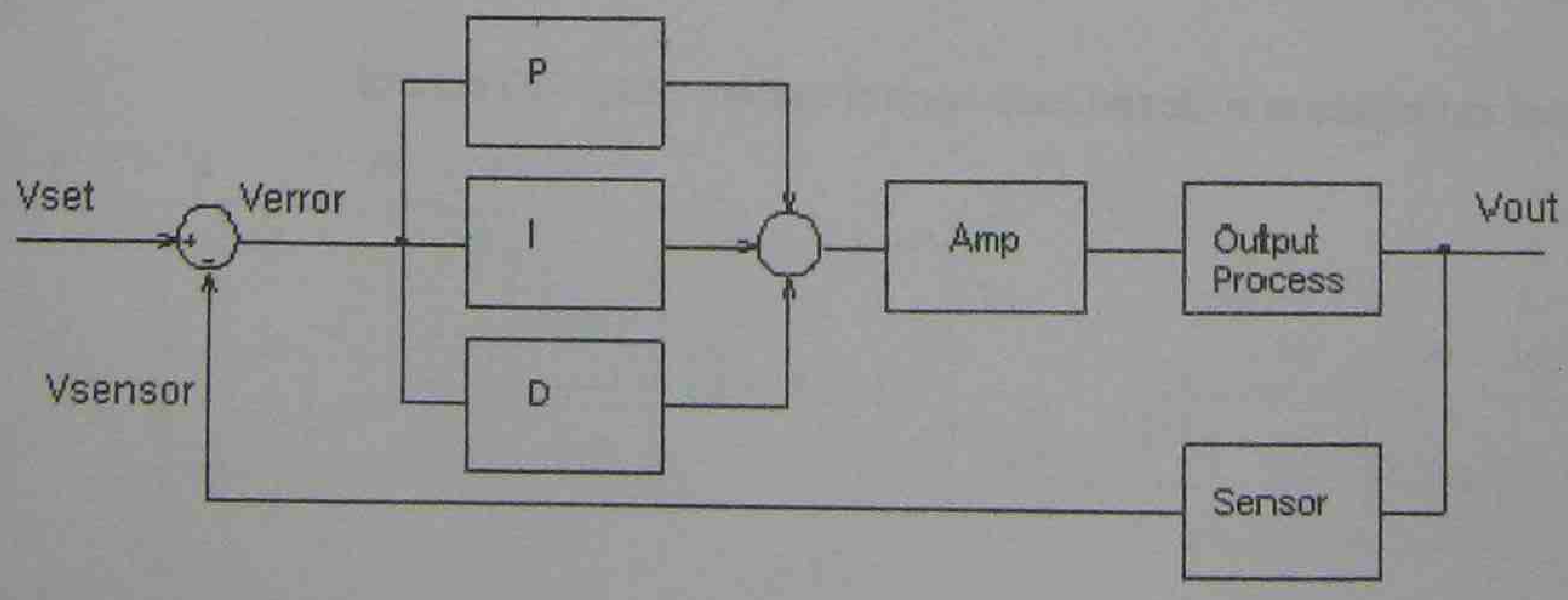
computer usb port
Siren
PLC
USB Adaptor
Green
Red.
Yellar
Tacho
1
2
3
4
5
6
7
8
Power Supply
com


USB port computer
Adapter
PLC
Simon
Simon
0A 0B
1A 1B
2A 2B
3A 3B
4A 4B
Dual Tracking power supply
+
-
-
+
-
+
Analog monitor panel / Digital monitor
PIW 752
0+ 1+ 2+
0- 1- 2-
PQW 752
5+
5-
+5V
0V
+15V
-15V
V1IN
0V
Vout
0V

PID Control Practical Project

- You are to build or program a PID controller to control the speed of the DC motor system.
- You will be given some practical experience in using the DC motor speed control system.
- Your project will be marked on how well it controls the motor speed for changes in load and your report on how the system works.
- See the attached examples
- You must achieve a working system to be eligible for any marks.





PID report Conclusion Questions

Answer the following question neatly on a separate sheet of paper as part of your report.

In relation to the proportional only loop answer the following.

1. What affect does load have on offset ?
2. What affect does gain have on offset ?

Explain your answers !!!!

3. What are the advantages of a proportional control system over an on/off control system.
4. If your system had a medium gain setting and the setpoint was 2.5 volts , what would the output voltage be ?
5. How does the system cope with an increase in load , explain your answer using a block diagram of the system.
6. If the tacho generator became uncoupled to the motor and was producing zero output , what would happen to the system ? **Explain your answer.**
7. If the feedback is equal to the setpoint what will the output voltage be ?

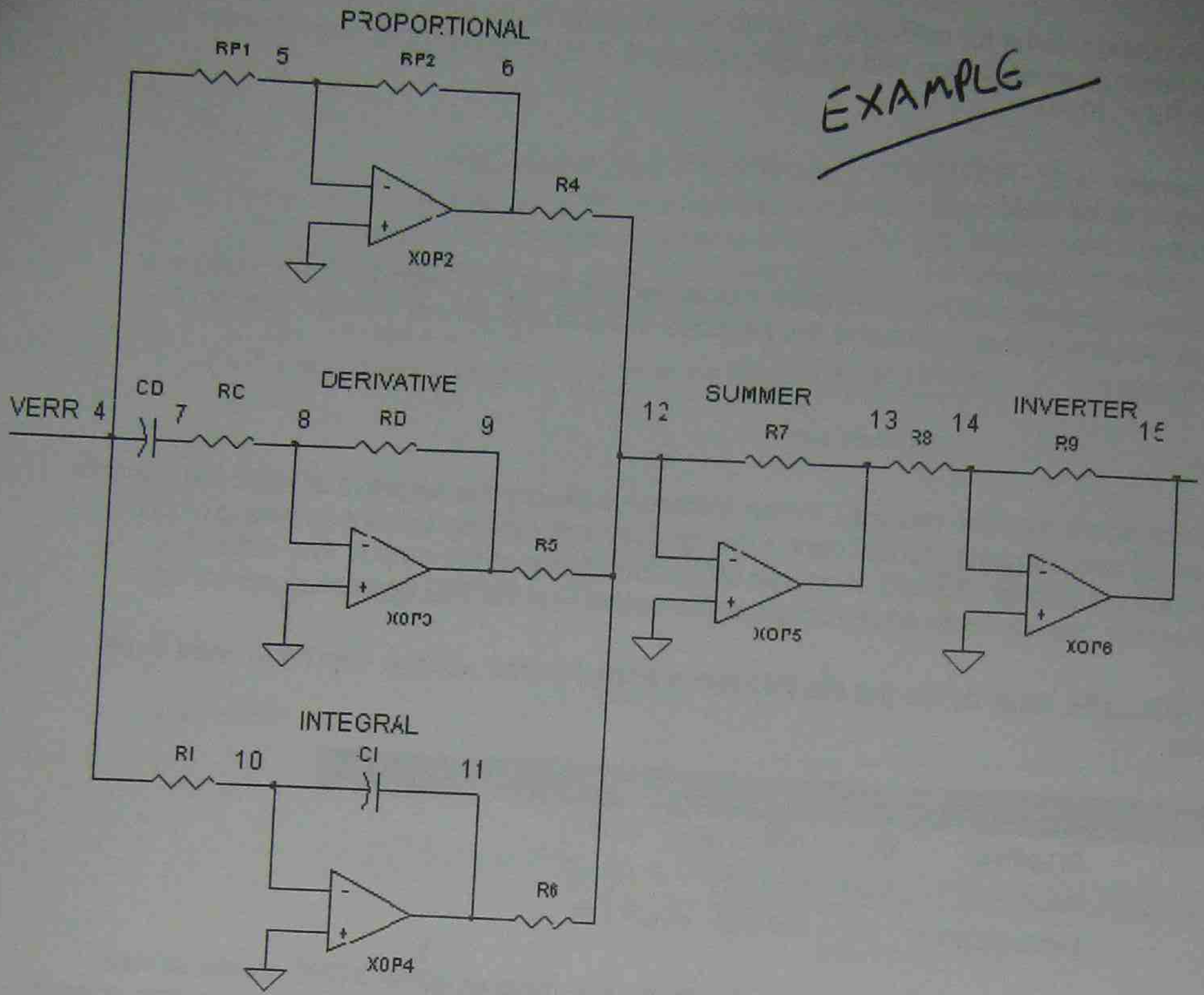
In relation to the Proportional + Integral Control loop answer the following:-

8. How does the system cope with changes in load ?Explain your answer.
9. If setpoint is 3V was the output voltage ? Was this due to the proportional action or the integral action ?
10. What is the advantage of integral action ?
11. When a load is suddenly added to the system, what does the proportional action do ? Use a block diagram to explain your answer.

In relation to the PID system answer the following questions

12. How does the derivative action help with load changes ?

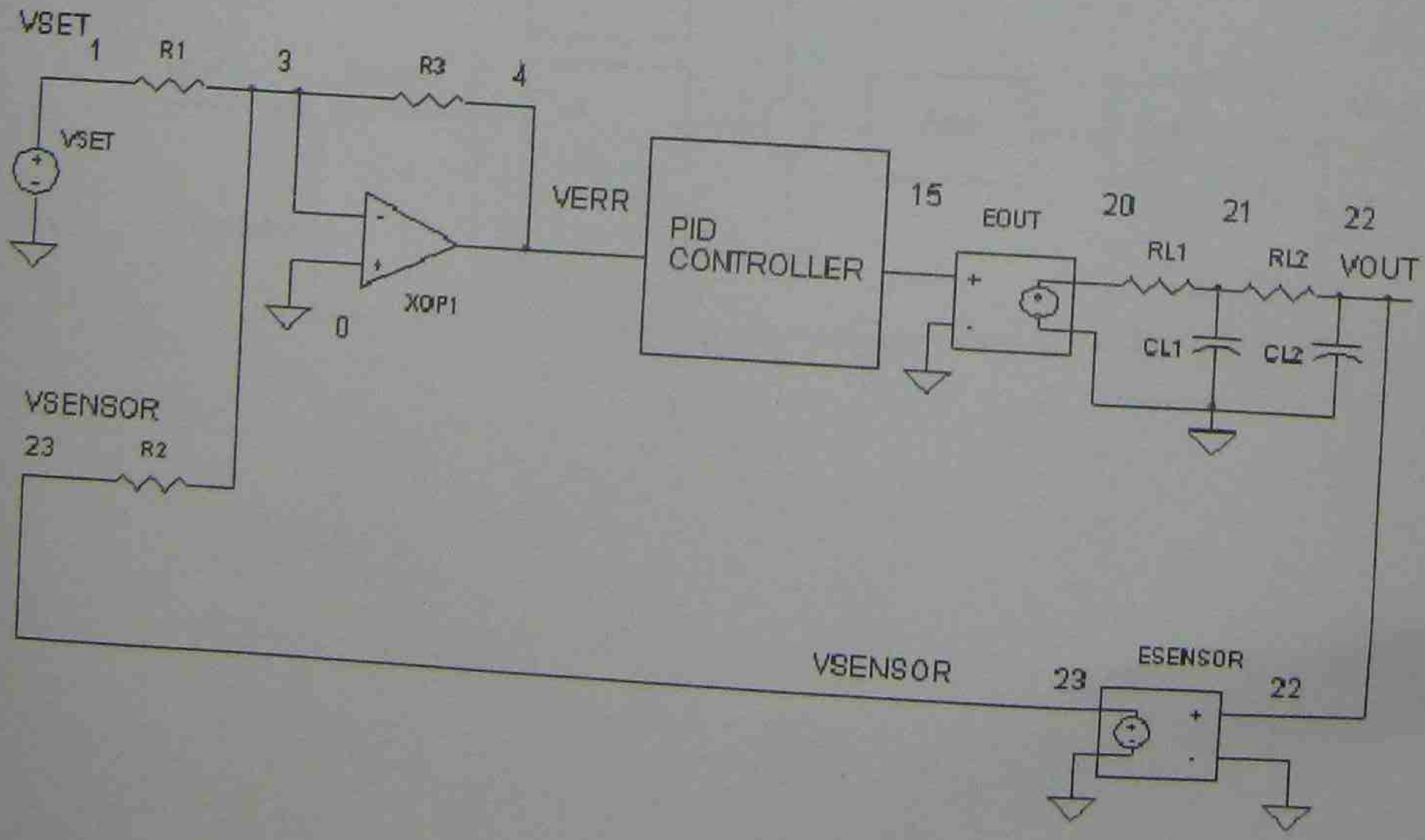
13. List 5 practical examples of a closed loop control system using PID control.



EXAMPLE

We've all heard about the wonders of the PID controller, bringing a system's output - temperature, velocity, light - to its desired set point quickly and accurately. But now, your boss says okay, design one for us. Although there's a number of ways to do it, the circuit above nicely separates the three terms into three individual op amp circuits.

What basic components are needed for a servo system? Many look similar to the circuit below. The error amp gives you a constant reality check. How? It compares where you want to go, *Vset*, with where you're at now, *Vsensor*, by calculating the difference between the two, *Verr = Vset - Vsensor*. The PID controller takes this error and determines the drive voltage applied to the process in an attempt to bring *Vset = Vsensor* or *Verr = 0.*


VSET
1
R1
3
R3
4
VSET
VERR
PID
CONTROLLER
15
EOUT
20
RL1
21
RL2
22
VOUT
CL1
CL2
XOP1
0
VSENSOR
23
R2
VSENSOR
23
ESENSOR
22