I006 - PROCESS CONTROL

TRANSDUCERS, FLOW, PRESSURE, TEMPERATURE MEASUREMENT

SIGNAL CONDITIONING (ANALOG + DIGITAL)

SENSORS, PROCESS CONTROL SYSTEM, ELECTRONICS SIGNAL AND SYSTEM, PROCESS CONTROLLERS,

PLC SYSTEM.

WWW. Power semester 4. Zoomshare.com

Analog Digital Signal conditioning

HOBS_I006 Note 1 sensor 1

_____ 2 Sensor 2

_____ 3 Sensor 3

HOBS_I006 Note 4 control concept 1

_____ Notes 5 _____ 2

HOBS_I006 Note 6 Electronic Signal

_____ Note 8 Process control 9

_____ 9 Process control 2

PLC

PLC Text book 1

PLC Text book 2

PLC Text book 3

PLC 6487 E.ZIP

PLC REFERENCE

TRILOGIC PLC

USER MANUAL

SETUP TL6 Edu

INSTALLATION INSTRUCTION

J001- INSTALL SETUP TRANSDUCERS AND SENSING DEVICES

J002- SOLVE THE PROBLEMS IN PRESSURE MEASUREMENT

J004 - SOLVE THE PROBLEMS IN FLOW MEASUREMENT

J005- SOLVE THE PROBLEMS IN TEMPERATURE MEASUREMENT.

J002 + J004

J002 J004 PRESSURE FLOW PNUEMATIC REFERENCE . ZIP

J005

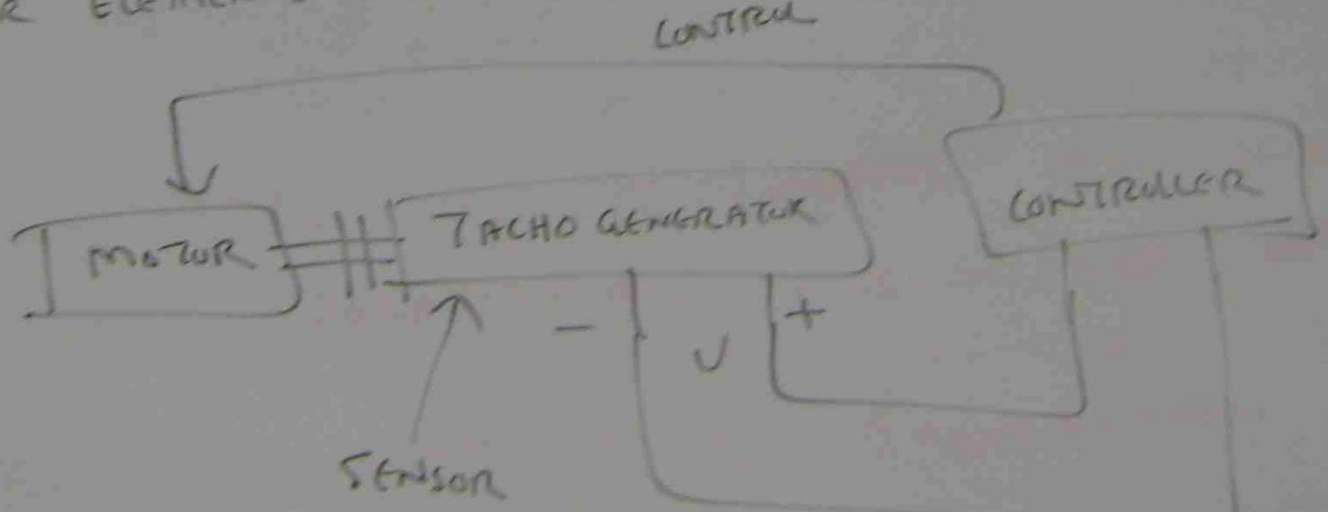
J005 TEMPERATURE MEASUREMENT . ZIP

- FIRST PART - TEMPERATURE LIGHT
- LATER PART - FLOW

PRINCIPLE OF ANALOG SIGNAL CONDITIONING

A SENSOR MEASURES A VARIABLE SIGNAL BY CONVERTING THE INFORMATION ABOUT THAT VARIABLE INTO A DEPENDENT SIGNAL OF EITHER ELECTRICAL (OR) PNUEMATIC NATURE.

ANALOG SIGNAL CONDITIONING PROVIDES THE OPERATION NECESSARY TO TRANSFORM A SENSOR OUTPUT INTO A FORM NECESSARY TO INTERFACE WITH OTHER ELEMENTS OF THE PROCESS CONTROL LOOP.



$y = 2$

CONTROL SIGNAL

- SIGNAL LEVEL CHANGE
- LINEARIZATION

PHOTO CELL

LIGHT → VOLTAGE

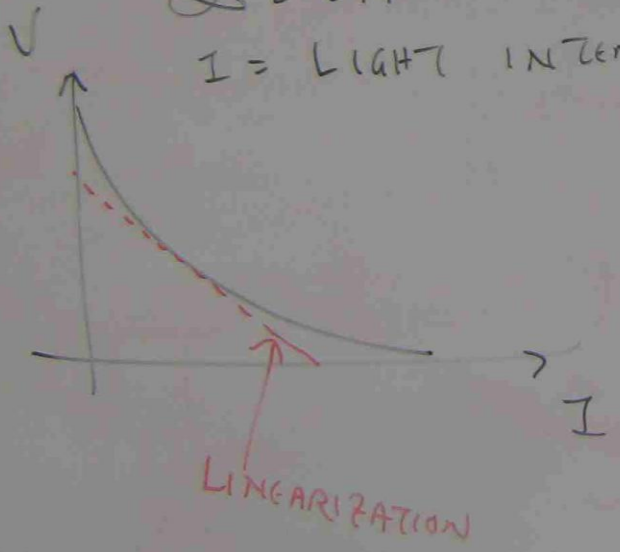
$$V_i = V_0 \, e^{-\alpha I}$$

V_i = OUTPUT VOLTAGE AT INTENSITY I

V_0 = ZERO INTENSITY VOLTAGE

α = EXPONENTIAL CONSTANT

I = LIGHT INTENSITY



SIGNAL CONVERSION

LIGHT → PHOTO CELL → VOLTAGE

GAS → COMPRESSOR → PRESSURE FORCE

MOTION ROTATIONAL FORCE → TACHO GENERATOR → VOLTAGE

HEAT TEMPERATURE → THERMOCOUPLE → MECHANICAL MOVEMENT

SIGNAL TRANSMISSION

THE SIGNAL IS TRANSMITTED OVER ELECTRICAL WIRE, DATA BUSES AND FED TO CONTROLLER.

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DIGITAL INTERFACE

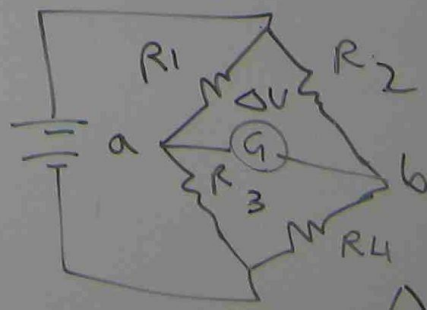
THE USE of COMPUTER IN PROCESS CONTROL REQUIRES CONVERSION of ANALOG SIGNAL IN TO DIGITAL FORMAT BY INTEGRATED DEVICES CALLED ANALOG TO DIGITAL CONVERTER

PASSIVE CIRCUIT

BRIDGE AND DIVIDERS.

DIVIDER

$$V_o = V_i \times \frac{R_2}{R_1 + R_2}$$



$$V_a = \frac{V R_3}{R_1 + R_3}$$

$$V_b = \frac{V R_4}{R_2 + R_4}$$

$$\Delta V = V_a - V_b$$

CONTROL SIGNAL

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- LINEARIZATION

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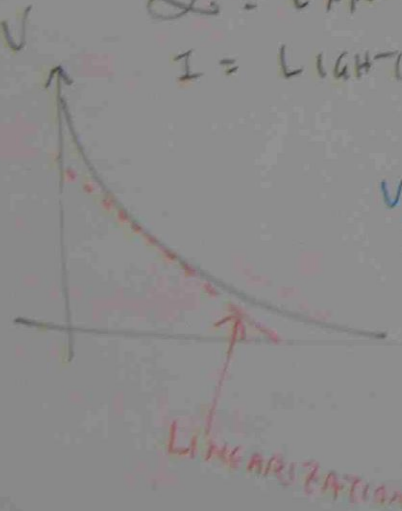

$$V_i = V_0 \log_e e^{-\alpha I}$$

$$V_i = V_0 (-\alpha I)$$

$$dB = 20 \log \frac{V_1}{V_2}$$

SIGNAL CONVERSION

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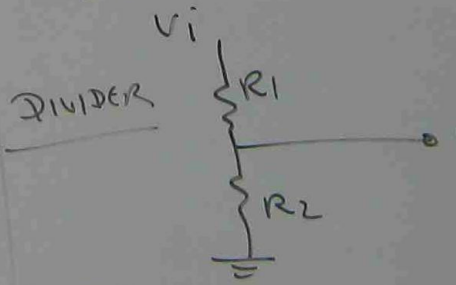
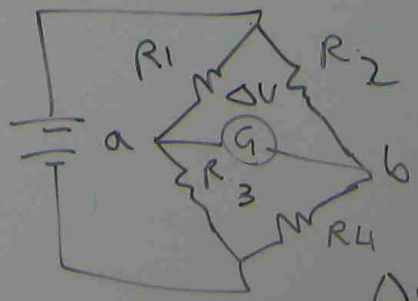
PASSIVE CIRCUIT

BRIDGE AND DIVIDERS.

DIVIDER



$$V_o = V_i \times \frac{R_2}{R_1 + R_2}$$



$$V_a = \frac{V R_3}{R_1 + R_3}$$

$$V_b = \frac{V R_4}{R_2 + R_4}$$

$$\Delta V = V_a - V_b$$

pb

IN GIVEN WHEAT STONE BRIDGE, IF $R_1 = 1000\Omega$

$R_2 = 842\Omega$, $R_3 = 500\Omega$, FIND R_4.

BALANCE

$$R_1 \times R_3 = R_2 \times R_4$$

$$1000 \times 500 = 842 \times R_4$$

$$R_4 = \frac{1000 \times 500}{842} =$$

GALVANOMETER DETECTOR

$$V_{th} = V \frac{R_3 R_2 - R_1 R_4}{(R_1 + R_3)(R_2 + R_4)}$$

$$R_{th} = \frac{R_1 R_3}{R_1 + R_3} + \frac{R_2 R_4}{R_2 + R_4}$$

$$I_G = \frac{V_{th}}{R_{th} + R_G}$$

OFFSET CURRENT

10)

A BRIDGE CIRCUIT HAS $R_1 = R_2 = R_3 =$ 2KΩ RESISTANCES, $R_4 = 2.05$ KΩ

5V SUPPLY. THE BRIDGE IS NULLED. IF A GALVANOMETER WITH 50Ω

INTERNAL RESISTANCE IS USED FIND THE OFFSET CURRENT.

$$V_{th} = V \frac{R_3 R_2 - R_1 R_4}{(R_1 + R_3)(R_2 + R_4)}$$

$$= 5 \frac{(2 \times 2) - (2 \times 2.05)}{(2+2)(2+2.05)}$$

$$= -30.4 \text{ mV}$$

$$R_{th} = \frac{R_1 R_3}{R_1 + R_3} + \frac{R_2 R_4}{R_2 + R_4}$$

$$= \frac{2 \times 2}{2+2} + \frac{2 \times 2.05}{2+2.05}$$

$$= 2.01 \text{ kΩ}$$

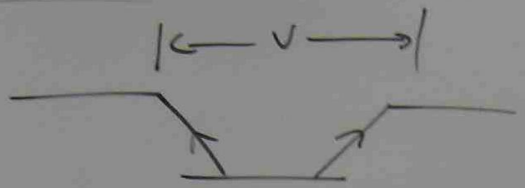
$$I_G = \frac{V_{th}}{R_{th} + R_G}$$

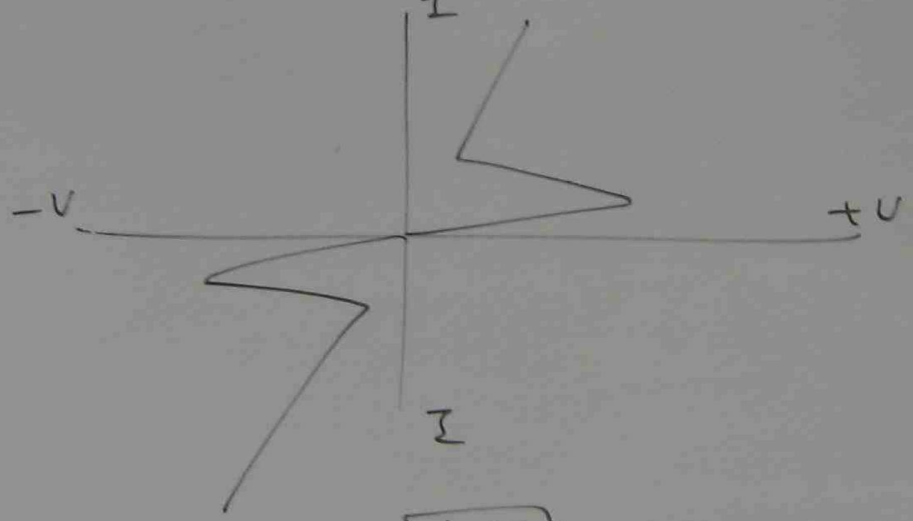
$$= \frac{-30.4 \text{ mV}}{2.01 \text{ kΩ} + 0.05 \text{ kΩ}}$$

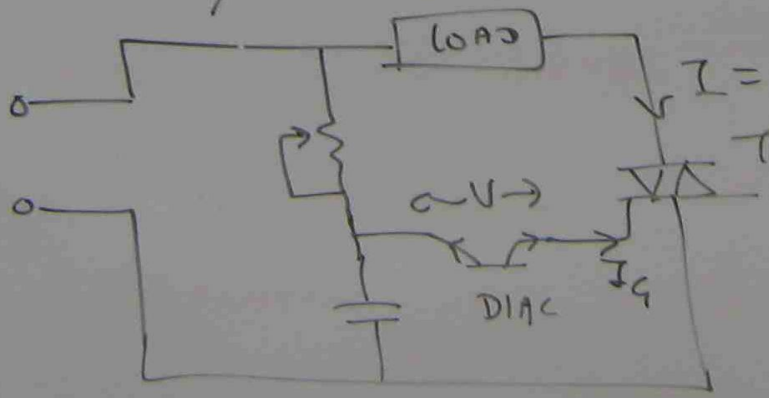
$$= -15 \mu A$$

TRIGGER CONTROL

DIAC







I DEPENDS ON IG

IG DEPENDS ON V

PLC TL31 U3 → INSTRUCTION

SELF STUDY

WEEK
1, 2, 3
4, 5,
6, 7, 8
9, 10
9, 10

PLC TL31 V3

INSTRUCTION

SELF STUDY

WEEK	PERIOD 1 (1→3)	PERIOD 2 (3→4.30)	TOPIC
1, 2, 3	✓	✓	ANALOG SIGNAL CONDITIONING + TEMPERATURE PRESSURE MEASUREMENT
4, 5,	✓	✓	DIGITAL (2)
6, 7, 8	✓	✓	DIGITAL SIGNAL PROCESSING
9, 10	✓		ELECTRONICS SIGNAL
9, 10		✓	PROCESS CONTROL

+U

= LOAD CURRENT

TRIAC

I DEPENDS ON IG

IG DEPENDS ON V

EM

E

GUIDELINES FOR ANALOG SIGNAL CONDITIONING DESIGN

(1) DEFINE THE MEASUREMENT OBJECTIVES

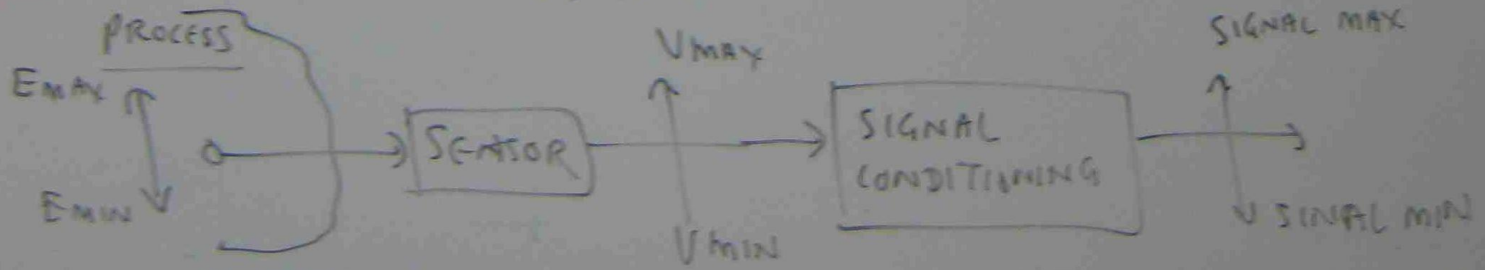
(a) PARAMETER — WHAT IS THE NATURE OF MEASURED VARIABLES: PRESSURE, TEMPERATURE, FLOW, LEVEL, VOLTAGE, CURRENT, RESISTANCE ETC?

(b) RANGE — WHAT IS THE RANGE OF THE MEASUREMENT?

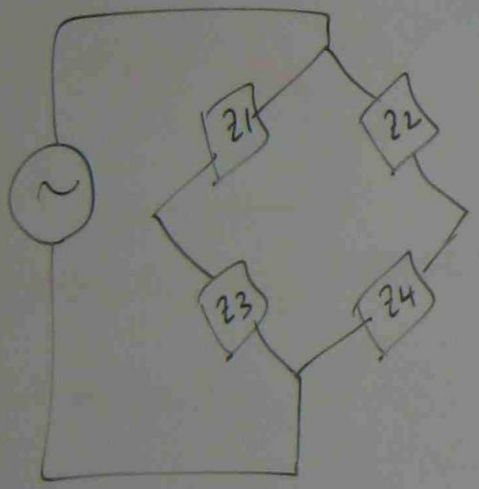
(c) ACCURACY — WHAT IS THE REQUIRED ACCURACY?

(d) LINEARITY — MUST THE MEASUREMENT OUTPUT BE LINEAR?

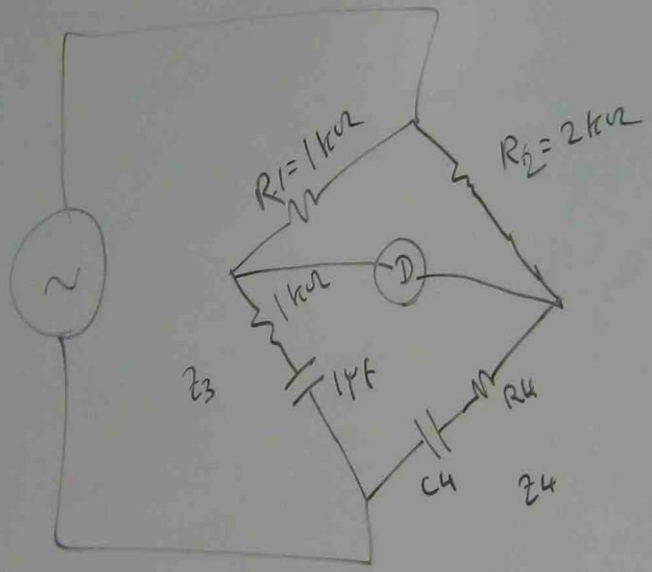
(e) NOISE — WHAT IS THE NOISE LEVEL AND FREQUENCY SPECTRUM OF THE MEASUREMENT ENVIRONMENT?



AC BRIDGES



$$Z_1 Z_4 = Z_3 Z_2$$



CALCULATE R4 & C4

$$Z_1 Z_4 = Z_3 Z_2$$

$$R_1 \left(R_4 - j\frac{1}{\omega C_4}\right) = R_2\left(R_3 - j\frac{1}{\omega C_3}\right)$$

$$R_1 R_4 - j\frac{R_1}{\omega C_4} = R_2 R_3 - j\frac{R_2}{\omega C_3}$$

$$R_1 R_4 = R_2 R_3$$

$$1\,k\Omega)\,(R_4) = (2\,k\Omega)\,(1\,k\Omega)$$

$$R_4 = \frac{2 \times 1}{1} = 2\,k\Omega$$

$$-\int \frac{R1}{\omega C4} = -\int \frac{R2}{\omega C3}$$

$$\frac{R1}{\omega C4} = \frac{R2}{\omega C3}$$

$$\frac{R1}{C4} = \frac{R2}{C3}$$

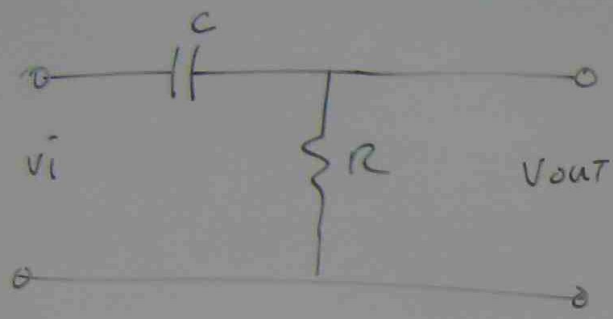
$$\frac{1\,k\Omega}{C4} = \frac{2\,k\Omega}{1\,\mu F}$$

$$C4 = \frac{1\,k\Omega \times 1\,\mu F}{2\,k\Omega}$$

$$= \frac{1\,\mu F}{2}$$

$$= 0.5\,\mu F$$

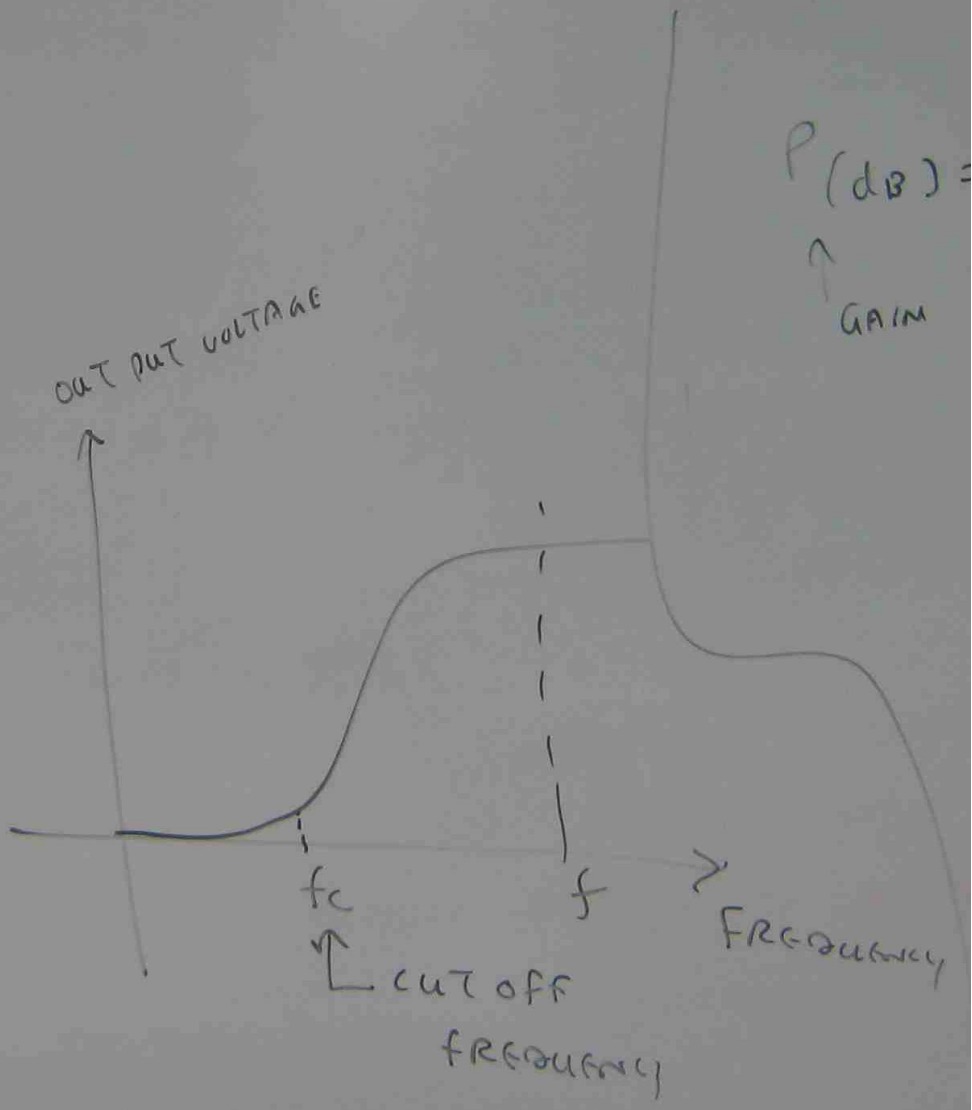
HIGH PASS RC FILTER



$$\frac{V_{OUT}}{V_{IN}} = \frac{f/fc}{\sqrt{1+\left(\frac{f}{fc}\right)^2}}$$

f = ANY FREQUENCY

f_c = CUT OFF FREQUENCY



$$P_{(dB)} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

↑ GAIN IN DECIBEL UNIT (dB)

pb / PULSES FOR STEPPING MOTOR ARE BEING TRANSMITTED AT 2000 HZ DESIGN A FILTER TO REDUCE 60 HZ NOISE, BUT REDUCE THE PULSES BY NO MORE THAN 3 dB

$$P(dB) = 20 \log \frac{V_{OUT}}{V_{IN}}$$

$$-3dB = 20 \log_{10} \frac{V_{OUT}}{V_{IN}}$$

$$-\frac{3}{20} = \log_{10} \frac{V_{OUT}}{V_{IN}}$$

$$-0.15 = \log_{10} \frac{V_{OUT}}{V_{IN}}$$

$$\frac{V_{OUT}}{V_{IN}} = 10^{-0.15}$$

$$\frac{V_{OUT}}{V_{IN}} = 0.707$$

> FREQUENCY

$$\frac{V_{OUT}}{V_{IN}} = \frac{f/f_c}{\sqrt{1+\left(\frac{f}{f_c}\right)^2}}$$

$$\frac{V_{OUT}}{V_{IN}} = \frac{60/2000}{\sqrt{1+\left(\frac{60}{2000}\right)^2}}$$

$$= 0.03$$

ONLY 3% OF 60HZ NOISE REMAIN

IF INPUT VOLTAGE IS REDUCED TO 70.7%, NOISE WILL BE 3dB

IF INPUT VOLTAGE IS REDUCED TO 3%, NOISE CAN BE ELIMINATED.

OPERATION PROCEDURE FOR PLC

TL 31 V3 SOFTWARE

PLC 6487E.ZIP

DOWN LOAD ZIP FILE & EXTRACT THE FILES.

DIRECTORY

TL31 ← (ENTER)

YOU CAN ACCESS THE
PLC PROGRAM
MAIN PAGE

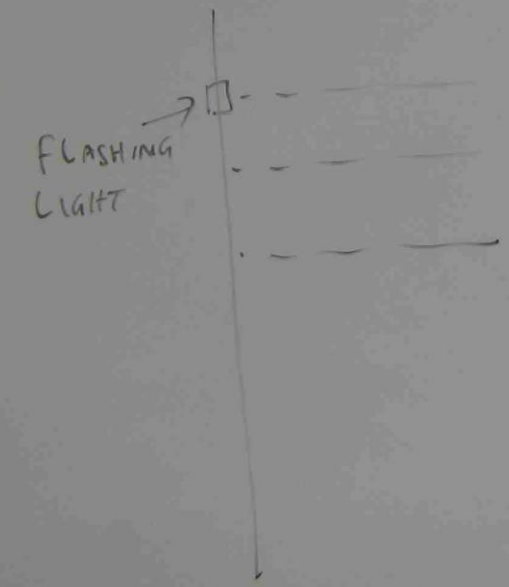
PRESS ANY KEY

To START THE PROGRAM

FILE - LOAD - PC 3 - SELECT PC3 <ENTER>

YOU CAN REACH MAIN PROGRAM PAGE

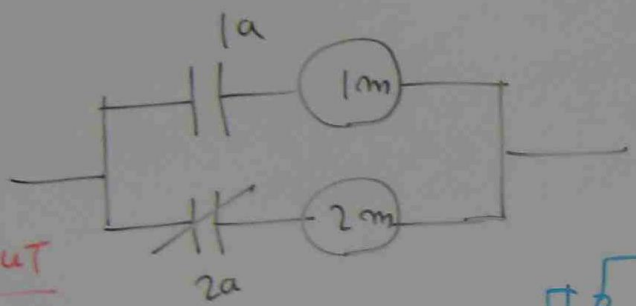
TO DRAW LADDER DIAGRAM



PAGE

TO DRAW PLC CONTROL PROGRAM

IT IS REQUIRED TO ALLOCATE INPUT, OUTPUT, RELAY, TIMER AND COUNTER.



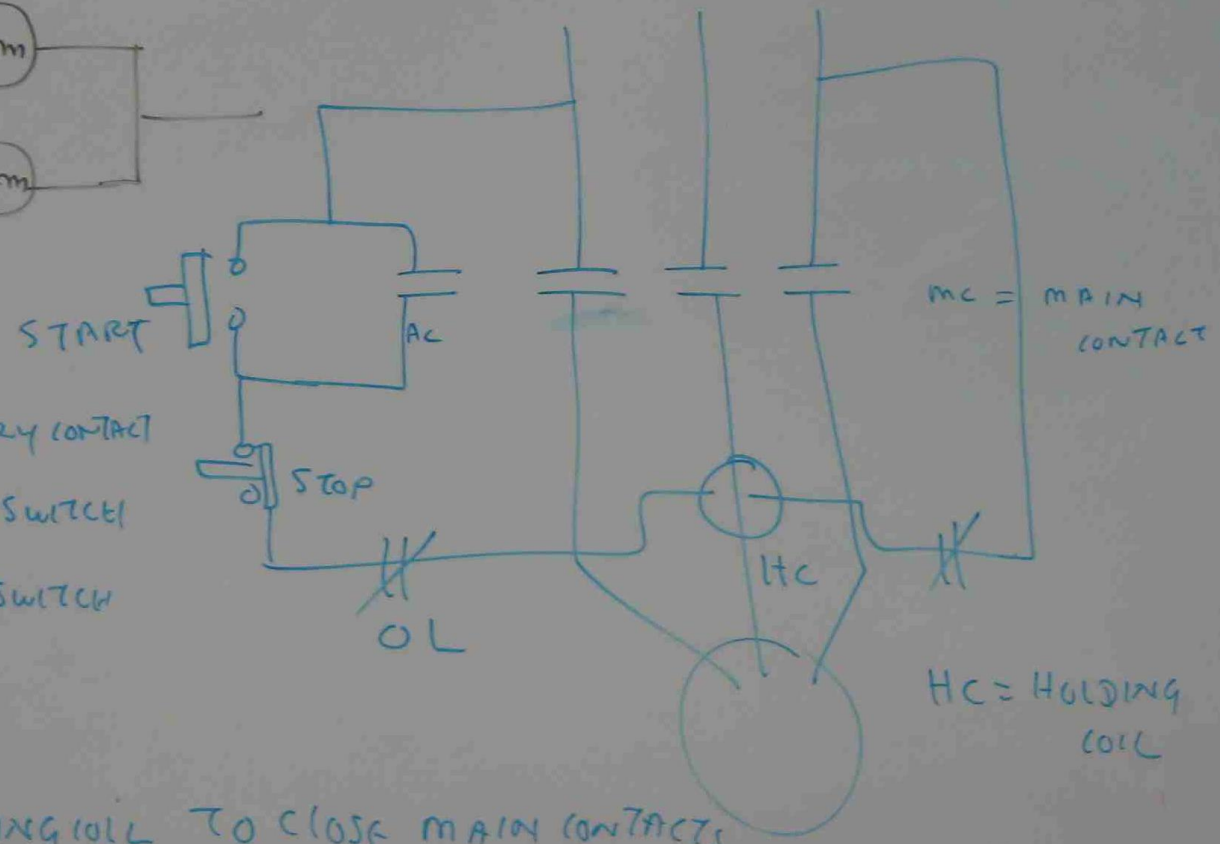
INPUT

1a, 2a

OUTPUT

1m, 2m

INPUT = AUXILIARY CONTACT
START SWITCH
STOP SWITCH
OL



OUTPUT = HOLDING COIL TO CLOSE MAIN CONTACTS

TL 31

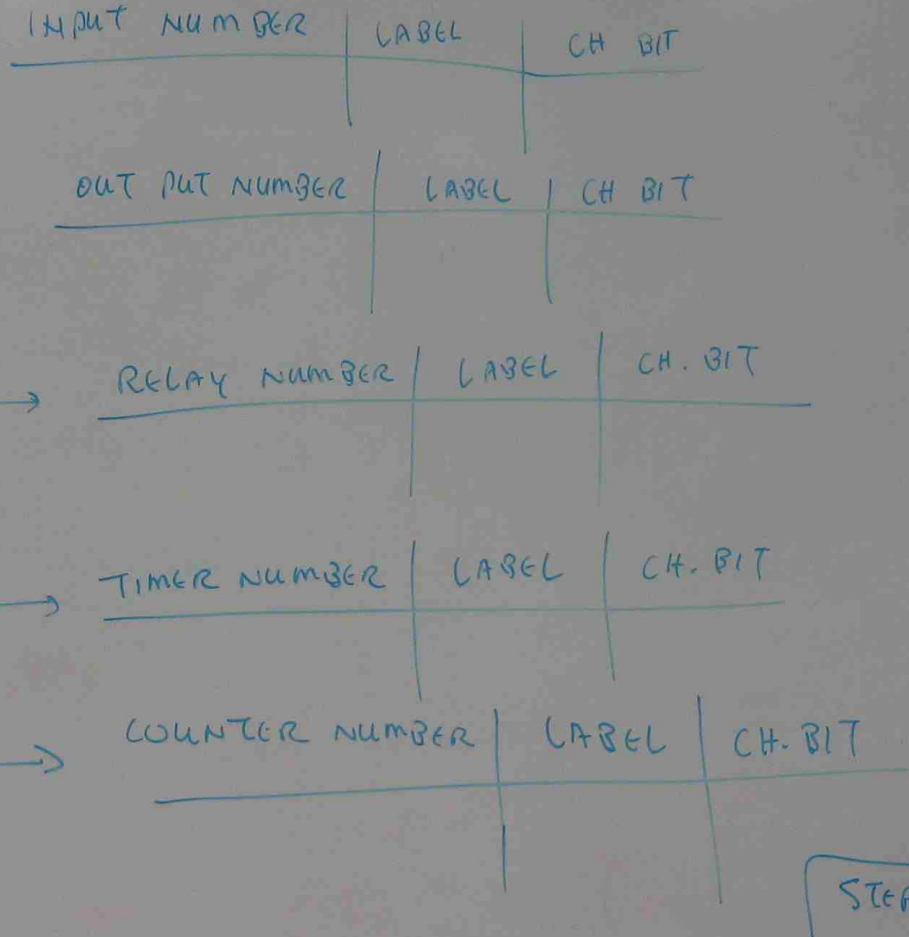
INPUT — PRESS F2

OUTPUT — PRESS F3

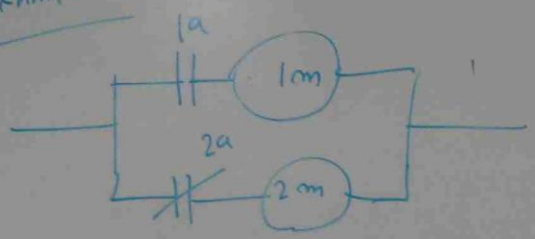
RELAY — PRESS F4

TIMER — PRESS F5

COUNTER PRESS F6



EXAMPLE



CLOSE 1a, 1m ENERGIZED

THEN 1m OPENS 2a

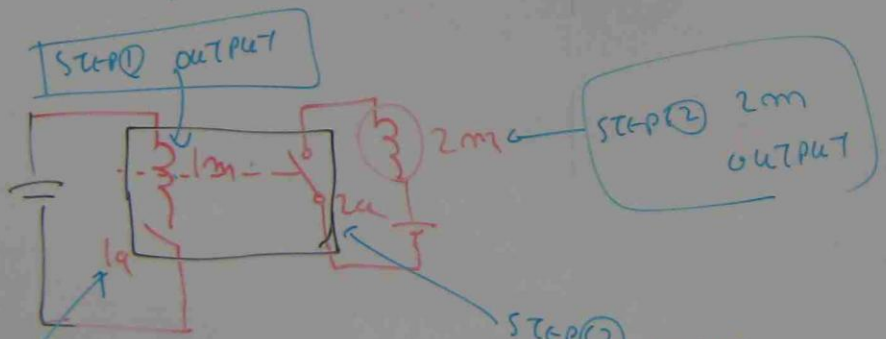
THEN 2m IS DE ENERGIZED

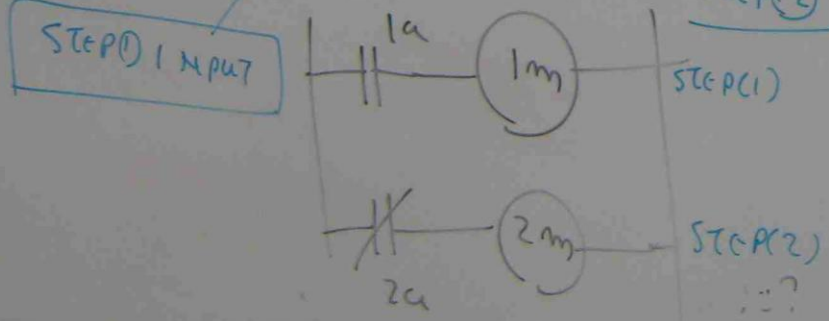
INPUT

1a, 2a

OUTPUT

1m, 2m





PROGRAM IN

PRESS F2

TYPE 1a

TYPE 2

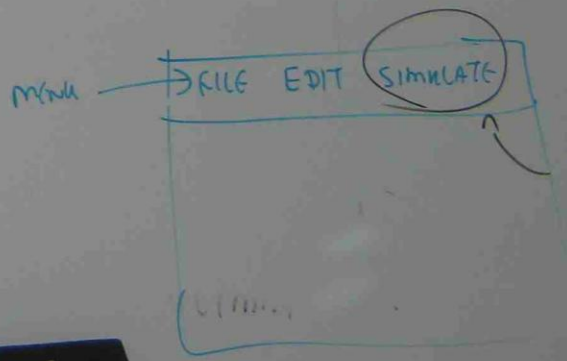
E

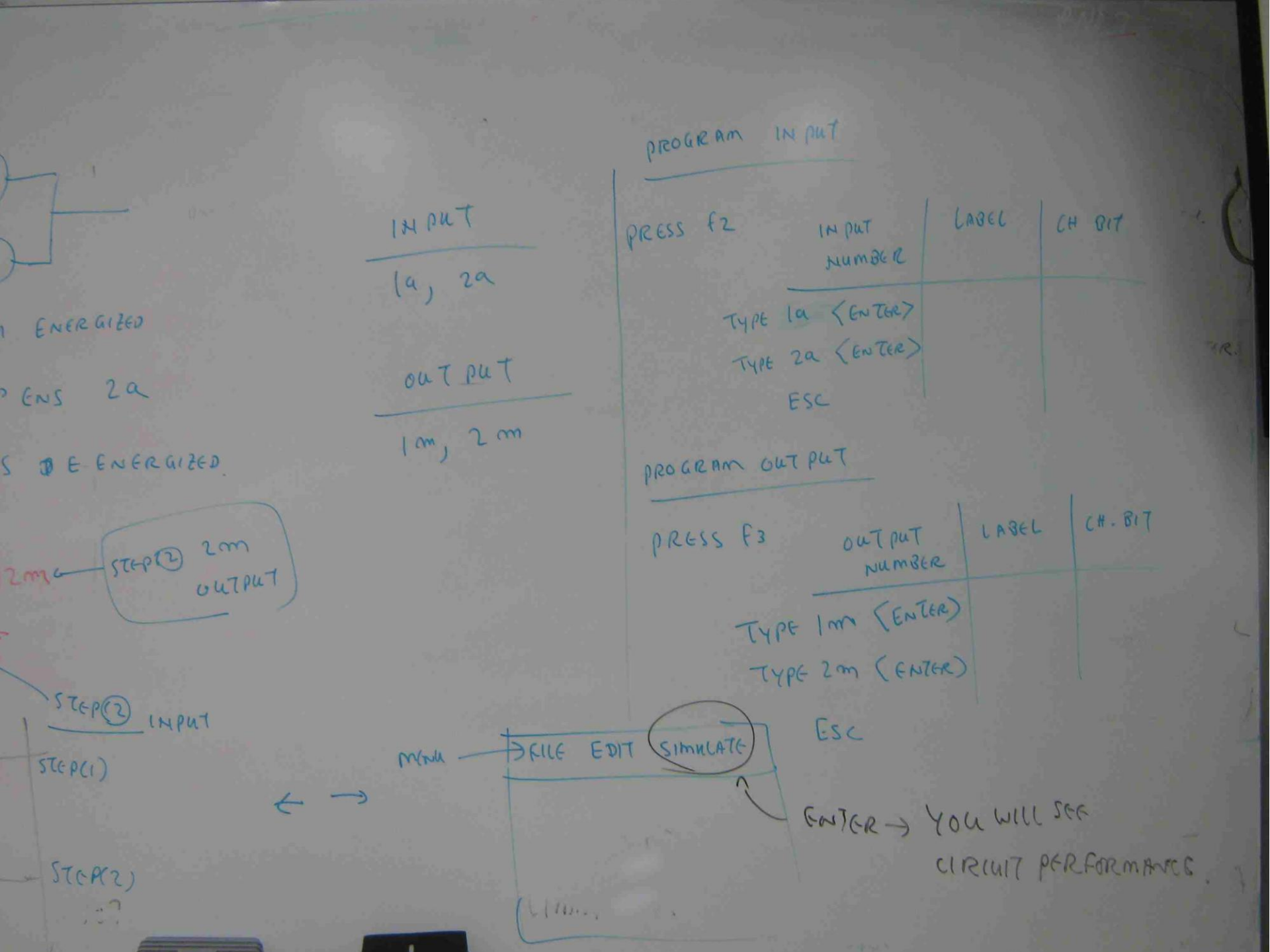
PROGRAM OUT

PRESS F3

TYPE

TYPE




ENERGIZED
ENS 2a
E ENERGIZED
STEP(2) 2m OUTPUT
STEP(2) INPUT
STEP(1)
STEP(2)
INPUT
1a, 2a
OUTPUT
1m, 2m
PROGRAM INPUT
PRESS F2
INPUT NUMBER
LABEL
CH BIT
TYPE 1a (ENTER)
TYPE 2a (ENTER)
ESC
PROGRAM OUTPUT
PRESS F3
OUTPUT NUMBER
LABEL
CH. BIT
TYPE 1m (ENTER)
TYPE 2m (ENTER)
ESC
MENU
FILE EDIT SIMULATE
ENTER → YOU WILL SEE CIRCUIT PERFORMANCE.

TL 31

INPUT — PRESS f2

OUTPUT — PRESS f3

RELAY — PRESS f4

TIMER — PRESS f5

COUNTER PRESS f6

INPUT NUMBER	LABEL	CH BIT

OUT PUT NUMBER	LABEL	CH BIT

RELAY NUMBER	LABEL	CH. BIT

TIMER NUMBER	LABEL	CH. BIT

COUNTER NUMBER	LABEL	CH. BIT

EXAMPLE

CLOSE

THEN

THEN

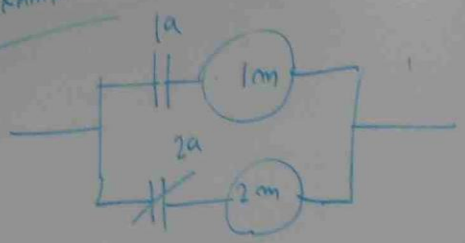
STEP(1) OUTP

STEP(1) INPUT

1a

2a

EXAMPLE



CLOSE 1a, 1m ENERGIZED

THEN 1m OPENS 2a

THEN 2m IS DE ENERGIZED

INPUT

1a, 2a

OUTPUT

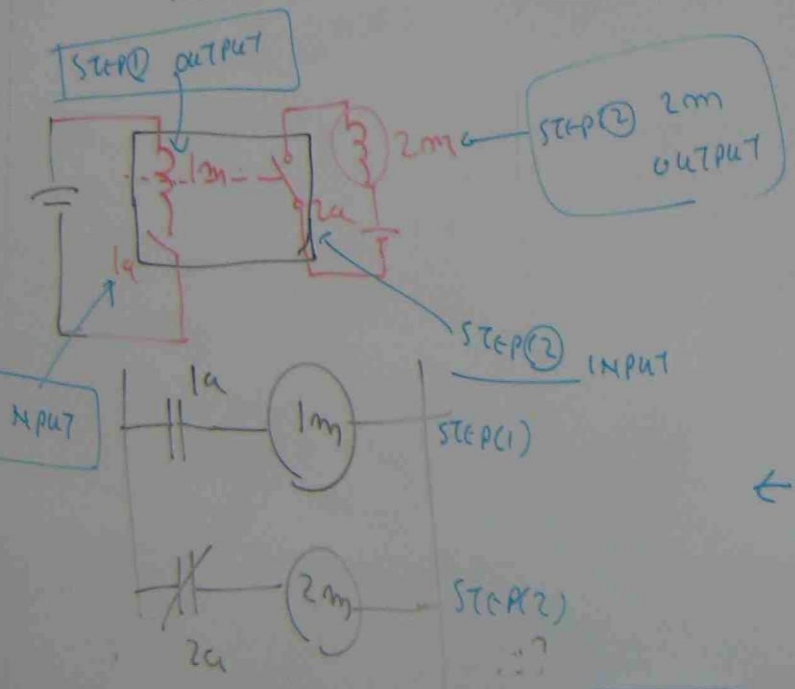
1m, 2m

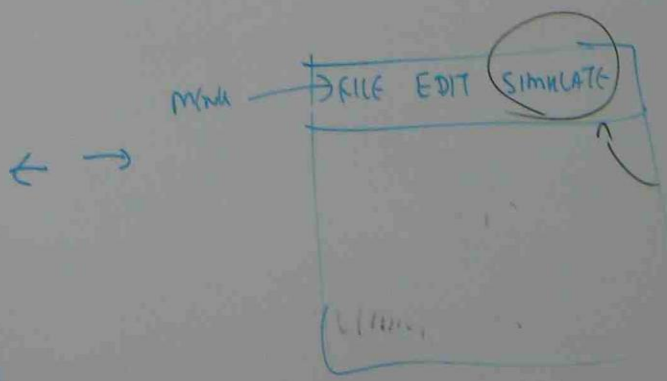
PROGRAM INPUT

PRESS F2	INPUT NUMBER	LABEL	CH BIT
TYPE 1a <ENTER>			
TYPE 2a <ENTER>			
ESC			

PROGRAM OUTPUT

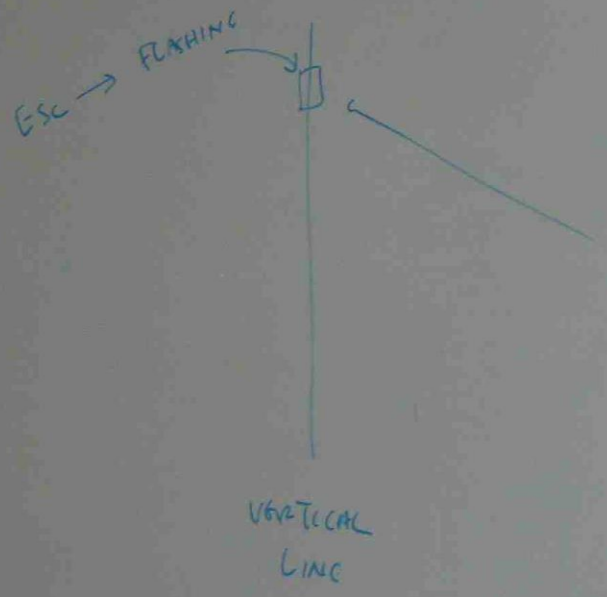
PRESS F3	OUTPUT NUMBER	LABEL	CH. BIT
TYPE 1m (ENTER)			
TYPE 2m (ENTER)			
ESC			



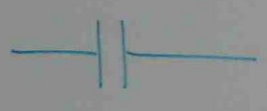


LADDER DIAGRAM

PRESS ESC UNTIL FLASHING OCCURS ON VERTICAL MARGIN LINE FOR DRAWING

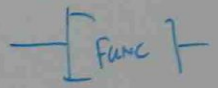


WHEN FLASHING HAPPENS, PRESS SPACE BAR TO INSERT COMPONENTS FOR DRAWING


PRESS 1


PRESS 2

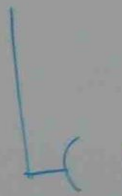

PRESS 3



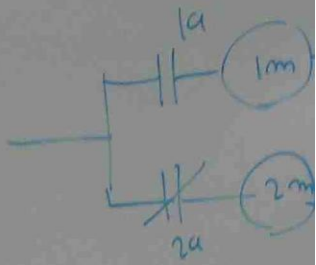

PRESS 4


PRESS 5


PRESS 6


PRESS 7

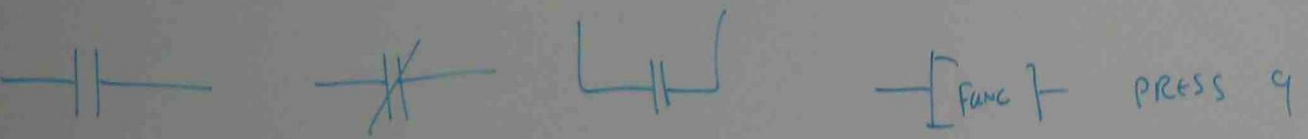
- FLASHING OCCURS ON VERTICAL
- DRAWING



ESC - FLASHIN

WHEN FLASHING HAPPENS, PRESS SPACE BAR

TO INSERT COMPONENTS FOR DRAWING



PRESS 1 PRESS 2 PRESS 3 PRESS 4

PRESS 5 PRESS 6 PRESS 7

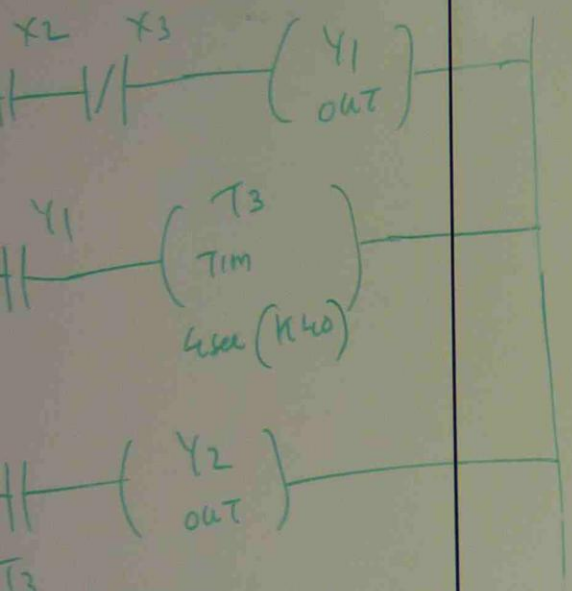
TO INSERT 1a

TO INSERT 1m

TO INSERT 2

TO SIMULATE - ESC

TO CLOSE THIS FILE



UT X_2
X_3

TPUT Y_1
Y_2

MER T_3 4sec

SIMULATE

I

$X_2 = 0$	$Y_1 = 0$
$X_3 = 0$	$Y_2 = 0$

II

$X_2 = 1$	$Y_1 = 1$
	THEN 4Sec
$X_3 = 0$	$Y_2 = 1$

III

$X_2 = 1$	$Y_1 = 0$
$X_3 = 1$	$Y_2 = 0$