

บรรณานุกรม

ภาษาไทย

- บุษบา แซ่ลิ้ม. การพัฒนาาระบบสร้างภาพสองมิติด้วยไมโครคอมพิวเตอร์จากการส่งผ่านรังสีแกมมา., จุฬาลงกรณ์มหาวิทยาลัย, พ.ศ. 2535.
- มานัส มงคลสุข. พื้นฐานทางฟิสิกส์ ของ CT และ MRI., พิมพ์ที่ไพศาลศิลป์การพิมพ์, 2532.
- สิน กุ้วรารณ. ร.ศ., ทฤษฎีและการประยุกต์ไมโครโปรเซสเซอร์ Z-80., พิมพ์ครั้งที่ 1, พ.ศ. 2532.
- วริทธิ์ อึ้งภากรณ์., ต.ร., ชาญ ฤณรงค์งาน., การออกแบบเครื่องจักร., เล่มที่ 2, พ.ศ. 2535.
- วารสาร เซมิคอนดักเตอร์อิเล็กทรอนิกส์., ฉบับที่ 92 พฤษภาคม-มิถุนายน พ.ศ. 2532.
- หัตถุภษ เนียมอินทร์. การพัฒนาแผ่นวงจรเชื่อมโยงสัญญาณแบบอนเนกประสงค์สำหรับระบบวีดิโนวเคลียร์., จุฬาลงกรณ์มหาวิทยาลัย, พ.ศ. 2535.

ภาษาอังกฤษ

Gary Cornell, Ph.D. Quickbasic 4.5., 1991.

J.H. Hubbell Gaithersburg, W.B. Mann Gaithersburg., Industrial radiation and radioisotope measurement applications., Appl. Radiat. Isotope. vol.41, no.10/11., pp.1013-1018., 1990.

ภาคผนวก

ภาคผนวก ก

โปรแกรมควบคุมการทำงานของระบบสแกน เพื่อเก็บข้อมูลโพรไฟล์

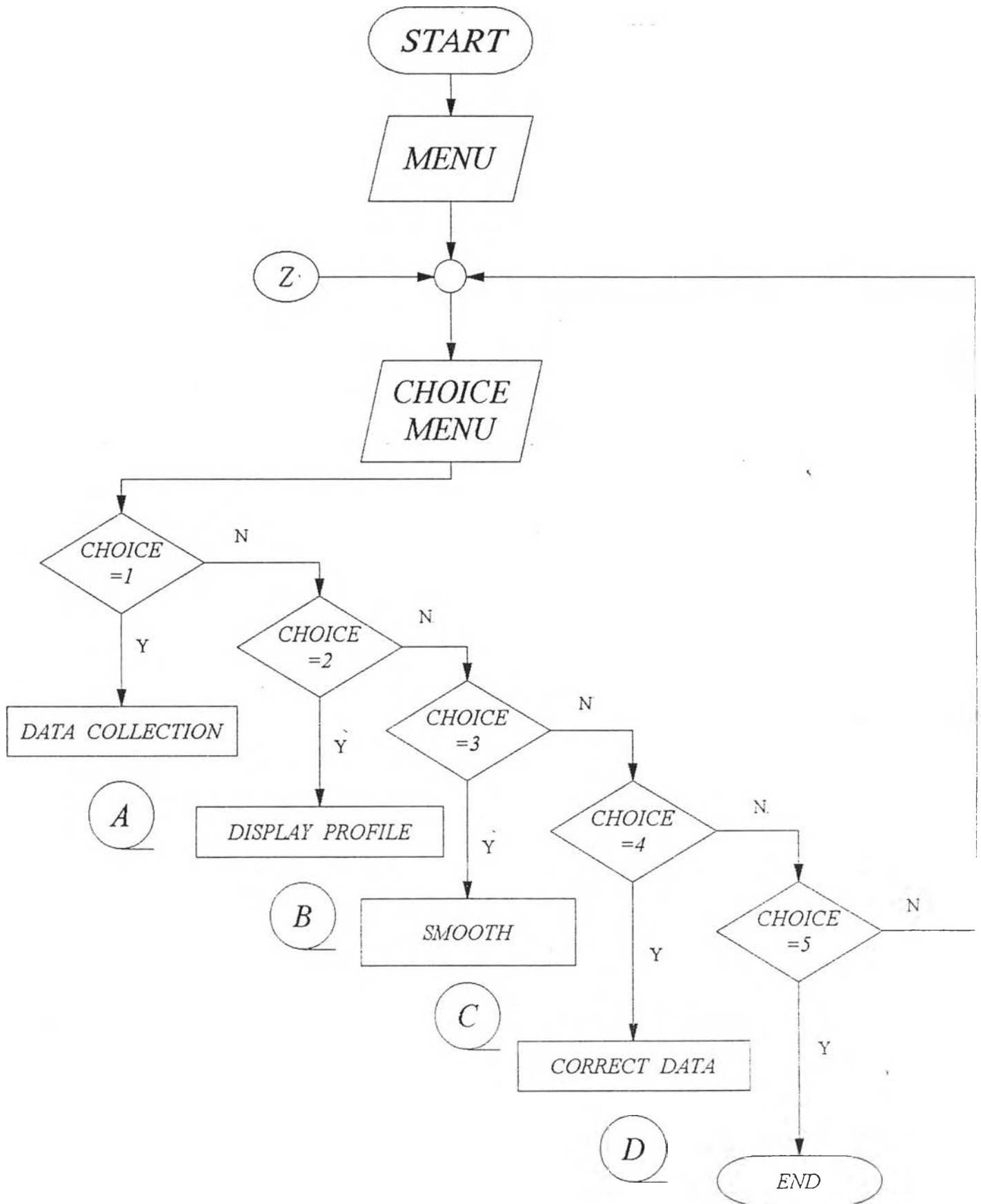
ก.1 โปรแกรม DATA COLLECTION

ก.2 โปรแกรม DISPLAY PROFILE

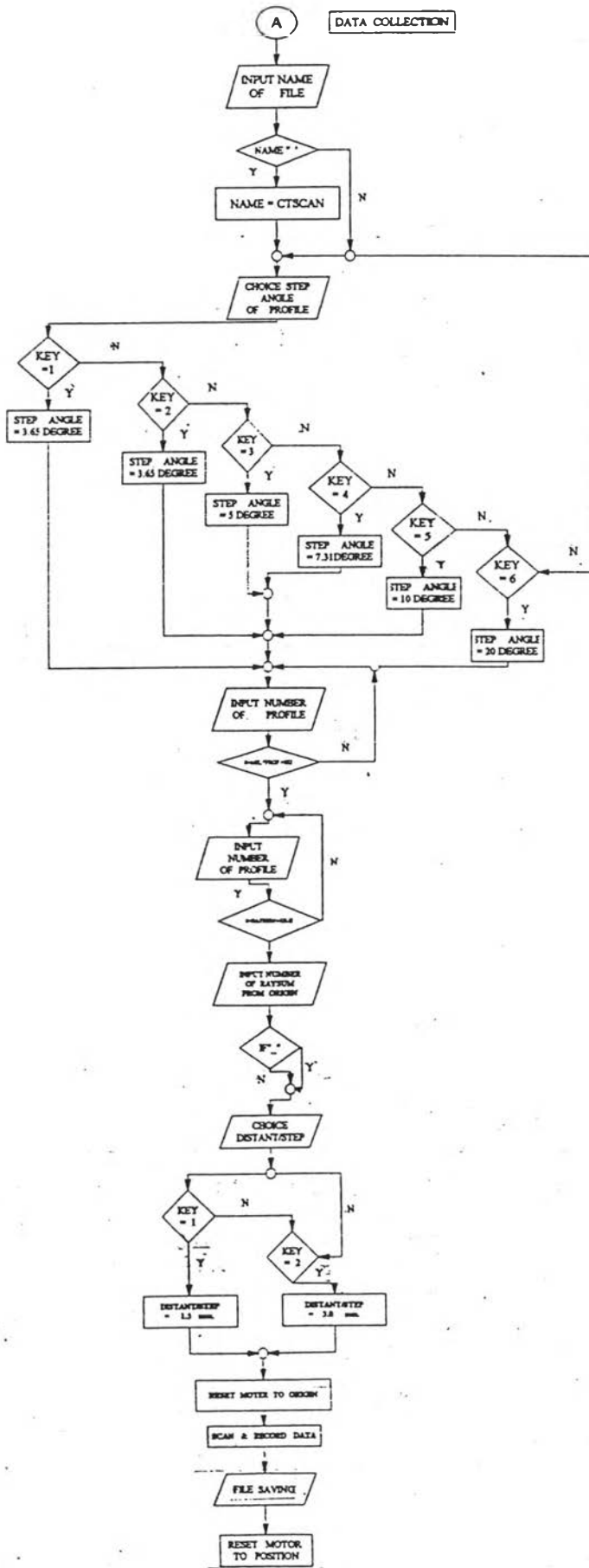
ก.3 โปรแกรม SMOOTH

ก.4 โปรแกรม CORRECT DATA

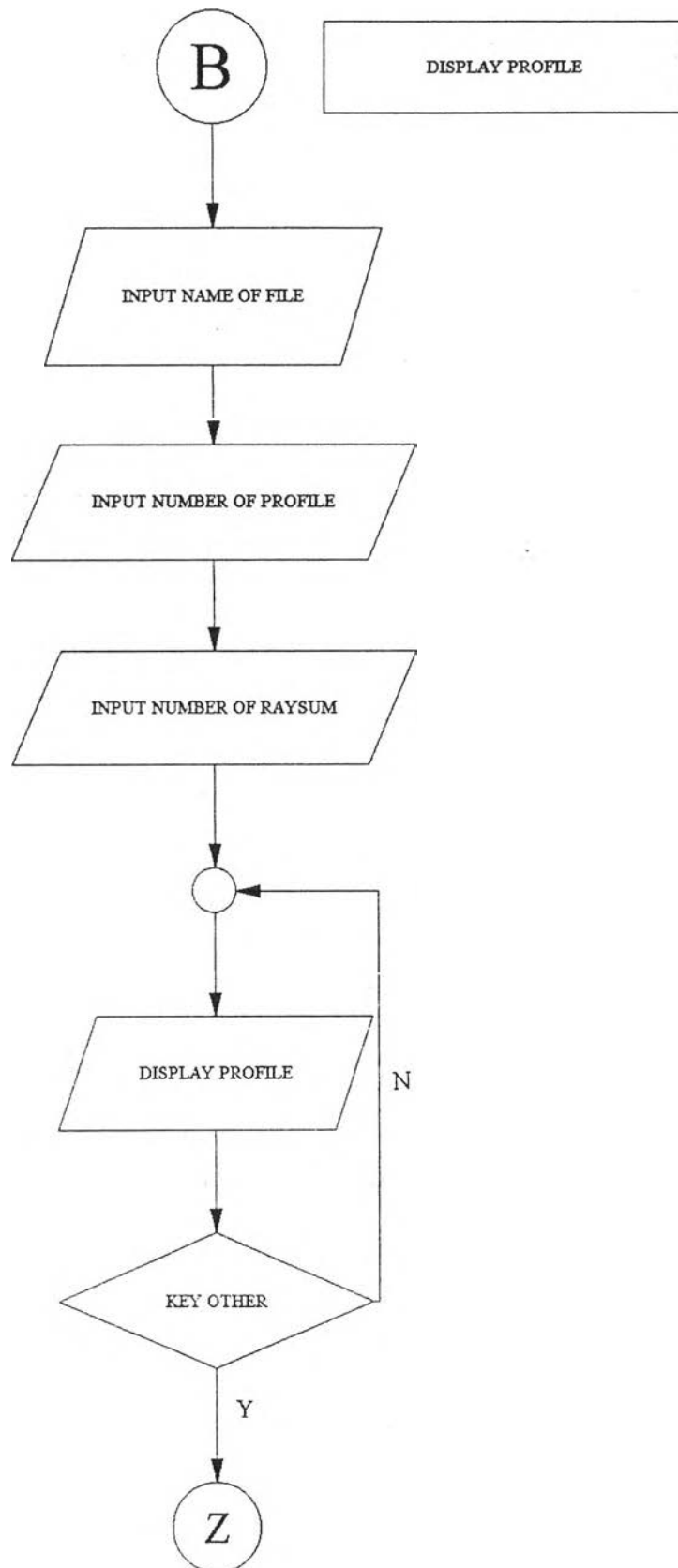
โปรแกรมการทำงานของระบบสแกนด้วยรังสีแกมมา เพื่อเก็บข้อมูลโพรไฟล์สำหรับ
การสร้างภาพโทโมกราฟฟีนั้น เขียนด้วยภาษาเบสิกทั้งหมด



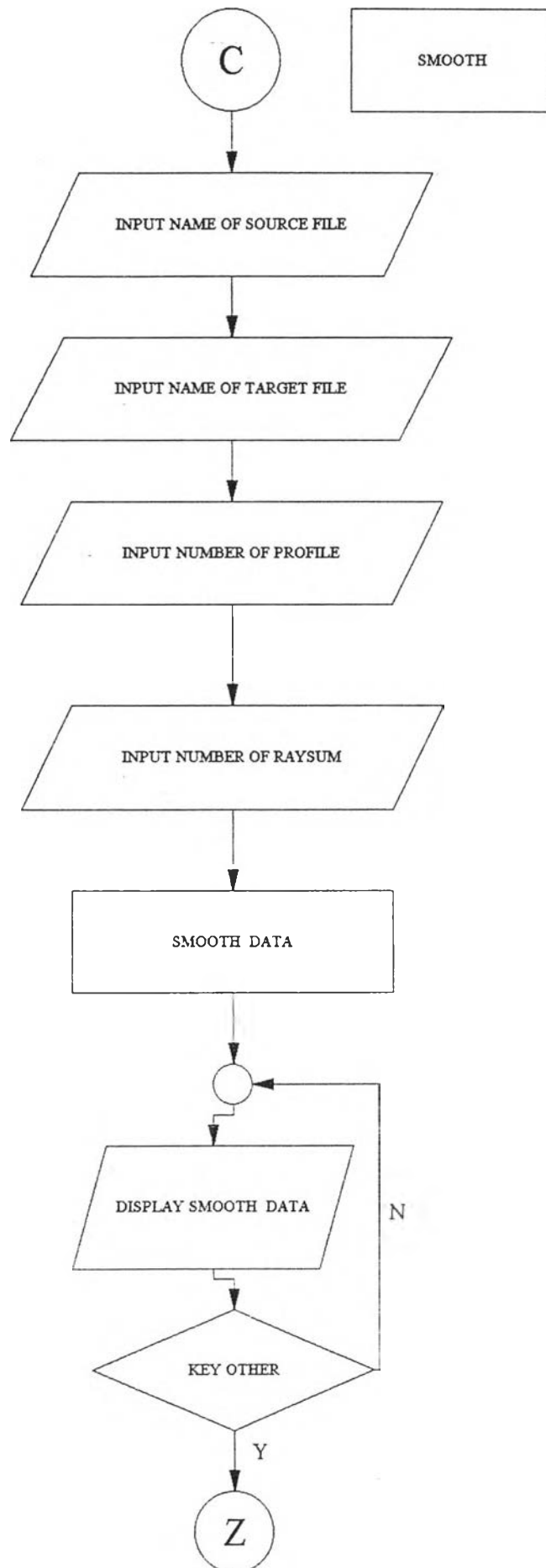
รูปที่ ก.1 แผนภาพการทำงานของโปรแกรมควบคุม



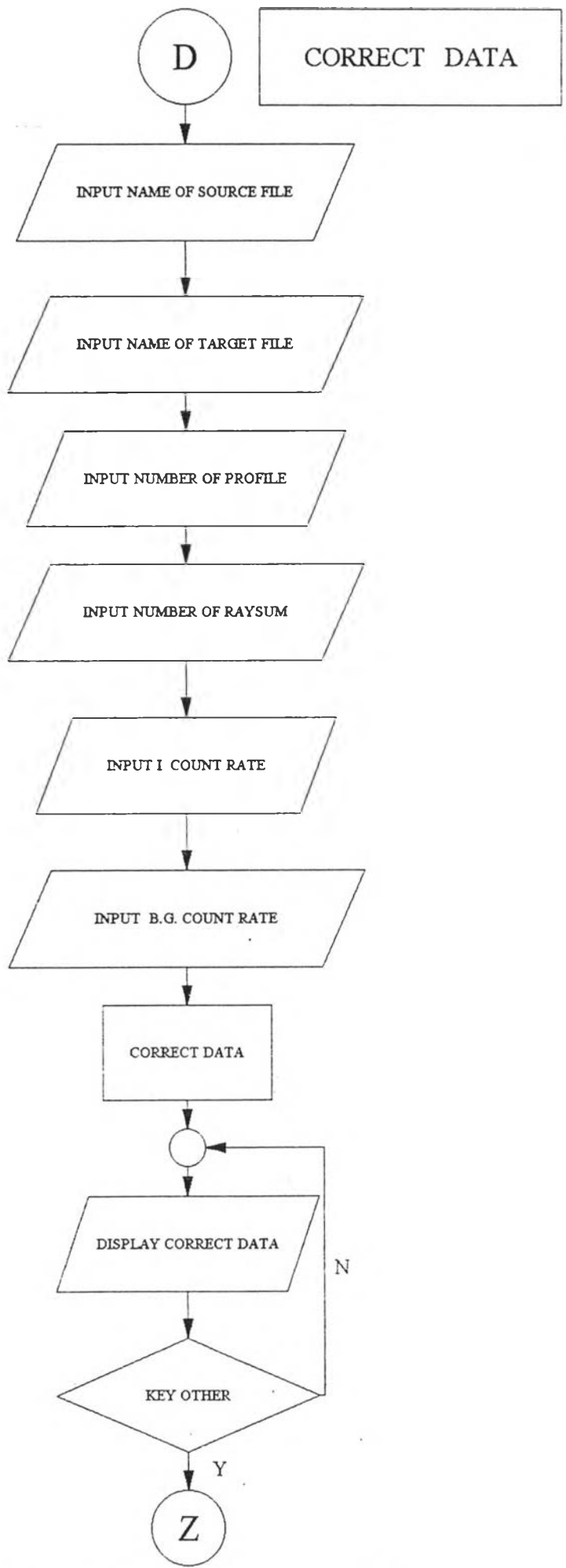
รูปที่ ก.2 แผนภาพการดำเนินงานของระบบสแกน



รูปที่ ก.3 แผนภาพการ DISPLAY PROFILE



รูปที่ ก.4 แผนภาพการ SMOOTH



รูปที่ ก.5 แผนภาพการ CORRECT DATA


```

DIM CR(300, 38)
DIM X(300), Y(300)
DIM P(38, 200)
OUT 771, 137
  N = 80
  C = 7
SCREEN 3
  FOR J = 1 TO 7
    OUT 768, (208 OR X1): OUT 768, (144 OR X1)
  NEXT J
MENU:
  OUT 768, 176: X2 = 176
  CLS
  SCREEN 0
  SCREEN 3
  LOCATE 5, 32: PRINT "COMPUTED TOMOGRAPHY"
  LOCATE 6, 13: PRINT "DEPARTMENT OF NUCLEAR TECHNOLOGY, CHULALONGKORN UNIVERSITY"
  LOCATE 10, 33: PRINT "MAIN MENU"
  LOCATE 12, 30: PRINT "1. DATA COLLECTION"
  LOCATE 13, 30: PRINT "2. DISPLAY PROFILE"
  LOCATE 14, 30: PRINT "3. SMOOTH "
  LOCATE 15, 30: PRINT "4. CORRECT DATA"
  LOCATE 16, 30: PRINT "5. EXIT"
  LOCATE 19, 34: PRINT "CHOOSE:"
  LINE (40, 30)-(600, 100), , B
  LINE (40, 100)-(600, 300), , B
DIK:
  LOCATE 15, 45: PRINT " "
  LOCATE 15, 45: PRINT "", ABC$
  ABC$ = INPUT$(1)
  LOCATE 19, 44: PRINT ABC$: FOR D = 1 TO 200: NEXT D
  ABC = VAL(ABC$): ABC$ = ""
  IF ABC < 1 OR ABC > 5 THEN BEEP: GOTO DIK
  IF ABC = 1 THEN CLS : GOTO START
  IF ABC = 2 THEN CLS : GOTO PROFILE
  IF ABC = 3 THEN CLS : GOTO SMOOTH
  IF ABC = 4 THEN CLS : GOTO CORRECT
  IF ABC = 5 THEN SCREEN 0: END
GOTO DIK
START:
  LINE (40, 30)-(600, 300), , B
  LINE (40, 100)-(600, 100), , B
  LOCATE 5, 20: PRINT "DEVELOPMENT OF A GAMMA RAYS SCANNING SYSTEM"
  LOCATE 6, 15: PRINT "FOR COMPUTED TOMOGRAPHY OF REINFORCED CONCRETE COLUMNS"
  LOCATE 7, 27: PRINT "***MR. MONGKOL WONNAPRAPA***"
  LOCATE 9, 10: PRINT "TARGET FILE NAME [CTSCAN]: "; : INPUT "", F$
  IF F$ = "" THEN F$ = "CTSCAN": LOCATE 9, 39: PRINT F$
  LOCATE 10, 10: PRINT "STEP ANGLE OF PROJECTION :          DEGREE "
  LOCATE 11, 21: PRINT " [1] 3.65 [2] 5 [3] 7.31"
  LOCATE 12, 21: PRINT " [4] 10 [5] 14.61 [6] 20"

```

SAOP:

```

SAOP$ = INPUT$(1)
SAOP = VAL(SAOP$)
IF SAOP < 1 OR SAOP > 6 THEN GOTO SAOP
IF SAOP = 1 THEN U = 156: LOCATE 10, 41: PRINT "3.65"
IF SAOP = 2 THEN U = 214: LOCATE 10, 43: PRINT "5"
IF SAOP = 3 THEN U = 312: LOCATE 10, 41: PRINT "7.31"
IF SAOP = 4 THEN U = 428: LOCATE 10, 42: PRINT "10"
IF SAOP = 5 THEN U = 620: LOCATE 10, 40: PRINT "14.61"
IF SAOP = 6 THEN U = 856: LOCATE 10, 42: PRINT "20"

```

CHECK1:

```

LOCATE 13, 10: PRINT "NUMBER OF PROFILE [25]   : "; : INPUT "", PF
IF PF = 0 THEN PF = 25
IF (PF < 0) OR (U * PF / 44 > 180) THEN GOTO CHECK1 '44=U/ANGLE
LOCATE 13, 36: PRINT PF

```

```

LOCATE 14, 10: PRINT "NUMBER OF RAYSUM FROM ORIGIN TO START POINT [10]: "; : INPUT "", H
IF H = 0 THEN H = 10: LOCATE 14, 59: PRINT H

```

```

LOCATE 15, 10: PRINT "DISTANT/STEP [1] 1.5 OR [2] 3.0 :           mm.";

```

RAS:

```

RAS$ = INPUT$(1)
RAS = VAL(RAS$)
IF RAS < 1 OR RAS > 2 THEN GOTO RAS
IF RAS = 1 THEN F1 = 50: LOCATE 15, 46: PRINT "1.5"
IF RAS = 2 THEN F1 = 100: LOCATE 15, 46: PRINT "3.0"

```

CHECK2:

```

LOCATE 16, 10: PRINT "NUMBER OF RAYSUM [90]   : "; : INPUT "", RS
IF RS = 0 THEN RS = 90: LOCATE 16, 36: PRINT RS
IF (F1 * 1.5 / 50 * RS > 420 - H) OR (RS < 0) THEN GOTO CHECK2
LOCATE 20, 10: PRINT "PLEASE WAIT.....RESET SYSTEM TO ORIGIN"

```

GOSUB RESETT

GOSUB RESETR

```

LOCATE 20, 10: PRINT " PLEASE WAIT...MOVING SYSTEM FROM ORIGIN TO START POINT"

```

```

FOR K = 1 TO H

```

GOSUB TRANSF

```

NEXT K

```

SCREEN 3

```

'***** SCAN *****

```

```

STARTTIME = TIMER

```

```

FOR ROT = 1 TO PF

```

CLS

```

LINE (50, 42)-(620, 310), , B

```

```

LOCATE 1, 50: PRINT "PROJECTION NUMBER: "; ROT

```

```

FOR RAYSUM = 1 TO RS

```

```

CHECK = ROT / 2 - INT(ROT / 2)

```

```

IF CHECK = 0 THEN GOSUB TRANSR ELSE GOSUB TRANSF

```

```

GOSUB DIGITIN

```

```

GOSUB ADCIN

```

```

    IF CHECK = 0 THEN CR(RS + 1 - RAYSUM, ROT) = COUNTS ELSE CR(RAYSUM, ROT) = COUNTS
    STOPTIME = TIMER
    LOCATE 2, 30: PRINT "SCAN TIME: "; INT(STOPTIME - STARTTIME)
NEXT RAYSUM
    IF CHECK = 0 THEN GOSUB TRANSR ELSE GOSUB TRANSF
    IF ROT <> PF THEN GOSUB ROTAC
    FINALLTIME = TIMER
    LOCATE 3, 20: PRINT "*****TOTAL SCAN TIME*****"; INT(FINALLTIME - STARTTIME)
    LOCATE 3, 55: PRINT "SEC"
NEXT ROT
' ***** FILE SAVING *****
FILESAVE:
    LOCATE 10, 10: PRINT "PLEASE WAIT.....SAVING DATA"
    OPEN F$ FOR OUTPUT AS #1
    FOR ROT = 1 TO PF
    FOR RAYSUM = 1 TO RS
    WRITE #1, CR(RAYSUM, ROT)
    NEXT RAYSUM
    NEXT ROT
    CLOSE 1

' ***** RESET SYSTEM TO ORIGINAL POSITION *****
    PFF = INT(.5 + PF * U / 312)
    LOCATE 10, 10: PRINT "PLEASE WAIT.....RESET SYSTEM TO ORIGINAL POSITION"
    IF PFF > C THEN
        M = PFF - C
        FOR K = 1 TO M
            GOSUB ROTC
        NEXT K
    ELSE
        M = C - PFF
        FOR K = 1 TO M
            GOSUB ROTAC
        NEXT K
    END IF
    GOTO MENU
END

'***** TRANSLATION MOTER *****
TRANSF:
    FOR J = 1 TO F1
        OUT 768, (3 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (9 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (12 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (6 OR X2): FOR I = 1 TO 2: NEXT I
    NEXT J
    RETURN
TRANSR:
    FOR J = 1 TO F1
        OUT 768, (3 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (6 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (12 OR X2): FOR I = 1 TO 2: NEXT I
        OUT 768, (9 OR X2): FOR I = 1 TO 2: NEXT I
    NEXT J
    RETURN

```

'***** ROTATION MOTER *****'

ROTAC:

```
FOR J = 1 TO U
  OUT 769, 3: FOR I = 1 TO 2: NEXT I
  OUT 769, 6: FOR I = 1 TO 2: NEXT I
  OUT 769, 12: FOR I = 1 TO 2: NEXT I
  OUT 769, 9: FOR I = 1 TO 2: NEXT I
NEXT J
RETURN
```

ROTC:

```
FOR J = 1 TO U
  OUT 769, 3: FOR I = 1 TO 2: NEXT I
  OUT 769, 9: FOR I = 1 TO 2: NEXT I
  OUT 769, 12: FOR I = 1 TO 2: NEXT I
  OUT 769, 6: FOR I = 1 TO 2: NEXT I
NEXT J
RETURN
```

RESETR:

```
OUT 769, 3: FOR I = 1 TO 2: NEXT I
  A = (32 AND INP(770)): IF A = 32 THEN RETURN
OUT 769, 9: FOR I = 1 TO 2: NEXT I
  A = (32 AND INP(770)): IF A = 32 THEN RETURN
OUT 769, 12: FOR I = 1 TO 2: NEXT I
  A = (32 AND INP(770)): IF A = 32 THEN RETURN
OUT 769, 6: FOR I = 1 TO 2: NEXT I
  A = (32 AND INP(770)): IF A = 32 THEN RETURN
GOTO RESETR
```

RESETT:

```
OUT 768, (3 OR X2): FOR I = 1 TO 2: NEXT I
  A = (16 AND INP(770)): IF A = 16 THEN RETURN
OUT 768, (6 OR X2): FOR I = 1 TO 2: NEXT I
  A = (16 AND INP(770)): IF A = 16 THEN RETURN
OUT 768, (12 OR X2): FOR I = 1 TO 2: NEXT I
  A = (16 AND INP(770)): IF A = 16 THEN RETURN
OUT 768, (9 OR X2): FOR I = 1 TO 2: NEXT I
  A = (16 AND INP(770)): IF A = 16 THEN RETURN
GOTO RESETT
```

'***** ADC INPUT *****'

ADCIN:

```
SUM = 0
LOCATE 2, 20: PRINT " "
FOR D = 1 TO 800: NEXT D
  FOR COUNTS = 1 TO N
    A = INP(772)
    SUM = SUM + A
  FOR D = 1 TO 5
  NEXT D
  NEXT COUNTS
  COUNTS = SUM / N
LOCATE 1, 8: PRINT "RAYSUM: "; RAYSUM
LOCATE 2, 8: PRINT "COUNT RATE: "; COUNTS
LOCATE 2, 48: PRINT "s TOTAL PROFILE: "; PF
LOCATE 1, 30: PRINT "TOTAL RAYSUM: "; RS
```

```

IF CHECK = 0 THEN PSET (589 - 500 * RAYSUM / RS, 300 - 255 * COUNTS / IO)
ELSE PSET (81 + 500 * RAYSUM / RS, 300 - 255 * COUNTS / IO)
RETURN
DISKCHECK:
  ERRORNUMBER = ERR
  BEEP
  SELECT CASE ERRORNUMBER
    CASE 61
PRINT "THE DISK IS FULL ..PLEASE REPLACE DISK"
    CASE 71
PRINT "THE DRIVE DOOR IS OPEN.. PLEASE CHECK"
    CASE 64
PRINT "BAD FILE NAME"
PRINT "PRESS ANY OTHER KEY TO CONTINUE$"
    CONTINUE$ = INPUT$(1)
GOTO FILESAVE
  END SELECT
CLS
SCREEN 3
'***** DIGITAL INPUT *****
DIGITIN:
  FOR D = 1 TO 5: NEXT D
  X1 = (INP(768) AND 15)
  OUT 768, (160 OR X1)
  FOR I = 1 TO 10: NEXT I
  OUT 768, (176 OR X1)
TIMEST:
  TS = (INP(770) AND 64)
  IF TS = 0 THEN OUT 768, (144 OR X1): GOTO DIGIT
  GOTO TIMEST
DIGIT:
  FOR D = 1 TO 5: NEXT D
  FOR NN = 1 TO 7
    OUT 768, (208 OR X1): OUT 768, (144 OR X1)
    D(NN) = (INP(770) AND 15)
  FOR D = 1 TO 5: NEXT D
  NEXT NN
  COUNTS = D(1) * 100000 + D(2)
  * 10000 + D(3) * 1000 + D(4) * 100 + D(5) * 10 + D(6)
  IF RAYSUM = 1 AND ROT = 1 THEN IO = COUNTS
  FOR D = 1 TO 2: NEXT D
  OUT 768, (176 OR X1)
  LOCATE 1, 8: PRINT "RAYSUM: "; RAYSUM
  LOCATE 2, 8: PRINT "COUNT RATE: "; COUNTS
  LOCATE 2, 48: PRINT "s TOTAL PROFILE:"; PF
  LOCATE 1, 30: PRINT "TOTAL RAYSUM:"; RS
  IF CHECK = 0 THEN PSET (589 - 500 * RAYSUM / RS, 300 - 255 * COUNTS / IO)
  ELSE PSET (81 + 500 * RAYSUM / RS, 300 - 255 * COUNTS / IO)
RETURN

```

'***** VIEW PROFILE *****'

SCREEN 3

PROFILE:

MAX = -9000; MIN = 9000

LOCATE 12, 25: LINE INPUT "FILE NAME : ", SFN\$

LOCATE 13, 25: LINE INPUT "No. of Profile : ", NP\$

NP = VAL(NP\$)

LOCATE 14, 25: LINE INPUT "No. of ray-sum : ", MAT\$

LOCATE 19, 40: PRINT "LOADING.....PLEASE WAIT"

MAT = VAL(MAT\$)

OPEN SFN\$ FOR INPUT AS #1

FOR I% = 1 TO NP

FOR J% = 1 TO MAT

INPUT #1, A\$

P(I%, J%) = VAL(A\$)

NEXT J%

NEXT I%

CLOSE #1

CLS

FOR II% = 1 TO NP

FOR JJ% = 1 TO MAT

IF P(II%, JJ%) > MAX THEN MAX = P(II%, JJ%)

IF P(II%, JJ%) < MIN THEN MIN = P(II%, JJ%)

NEXT JJ%

NEXT II%

YM = MAX

LINE (50, 15)-(550, 175), , B

FOR I = 1 TO 15

LINE (48, 175 - 10 * I)-(50, 175 - 10 * I)

NEXT I

FOR J = 1 TO 10

LINE (50 + 50 * J, 178)-(50 + 50 * J, 175)

NEXT J

VIEW (51, 16)-(549, 174)

GOTO KEYP

'***** SMOOTH DATA *****'

SMOOTH:

LOCATE 10, 30: PRINT "SMOOTHING METHOD"

LOCATE 12, 25: LINE INPUT "SOURCE FILE NAME : ", SFN\$

LOCATE 13, 25: LINE INPUT "TARGET FILE NAME : ", TFN\$

LOCATE 14, 25: LINE INPUT "No. of Projections : ", NP\$

NP = VAL(NP\$)

LOCATE 15, 25: LINE INPUT "No. of ray-sum : ", MAT\$

MAT = VAL(MAT\$)

LOCATE 19, 40: PRINT "LOADING.....PLEASE WAIT"

MAT = VAL(MAT\$)

```

OPEN SFN$ FOR INPUT AS #1
  FOR I% = 1 TO NP
    FOR J% = 1 TO MAT
      INPUT #1, A$
      P(I%, J%) = VAL(A$)
    NEXT J%
  NEXT I%
CLOSE #1
FOR I% = 1 TO NP
  FOR J% = 1 TO 2
    OD(I%, J%) = P(I%, J%)
  NEXT J%
  FOR J% = 3 TO MAT - 2
    OD = P(I%, J% - 2) + P(I%, J% - 1)
    * 4 + P(I%, J%) * 6 + P(I%, J% + 1) * 4 + P(I%, J% + 2)
    OD(I%, J%) = OD / 16
  NEXT J%
  FOR J% = MAT - 1 TO MAT
    OD(I%, J%) = P(I%, J%)
  NEXT J%
NEXT I%
LOCATE 19, 40: PRINT "SAVING .....PLEASE WAIT"
OPEN TPN$ FOR OUTPUT AS #2
  FOR I% = 1 TO NP
    FOR J% = 1 TO MAT
      IF OD(I%, J%) < 0 THEN OD(I%, J%) = 0
      WRITE #2, OD(I%, J%)
    NEXT J%
  NEXT I%
CLOSE #2
GOTO KEYP

```



'***** CORRECT DATA *****'

CORRECT:

```

LOCATE 12, 25: LINE INPUT "SOURCE FILE NAME : ", SFN$
LOCATE 13, 25: LINE INPUT "TARGET FILE NAME : ", TPN$
LOCATE 14, 25: LINE INPUT "No. of Projections : ", NP$
NP = VAL(NP$)
LOCATE 15, 25: LINE INPUT "No. of ray-sum : ", MAT$
LOCATE 16, 25: LINE INPUT "Io COUNT RATE : ", io$
io = VAL(io$)
LOCATE 17, 25: LINE INPUT "B.G. COUNT RATE : ", BG$
BG = VAL(BG$)
LOCATE 19, 40: PRINT "LOADING.....PLEASE WAIT"

```

```

MAT = VAL(MAT$)
OPEN SFN$ FOR INPUT AS #1
  FOR I% = 1 TO NP
    FOR J% = 1 TO MAT
      INPUT #1, A$
      P(I%, J%) = VAL(A$)
    NEXT J%
  NEXT I%
CLOSE #1

```

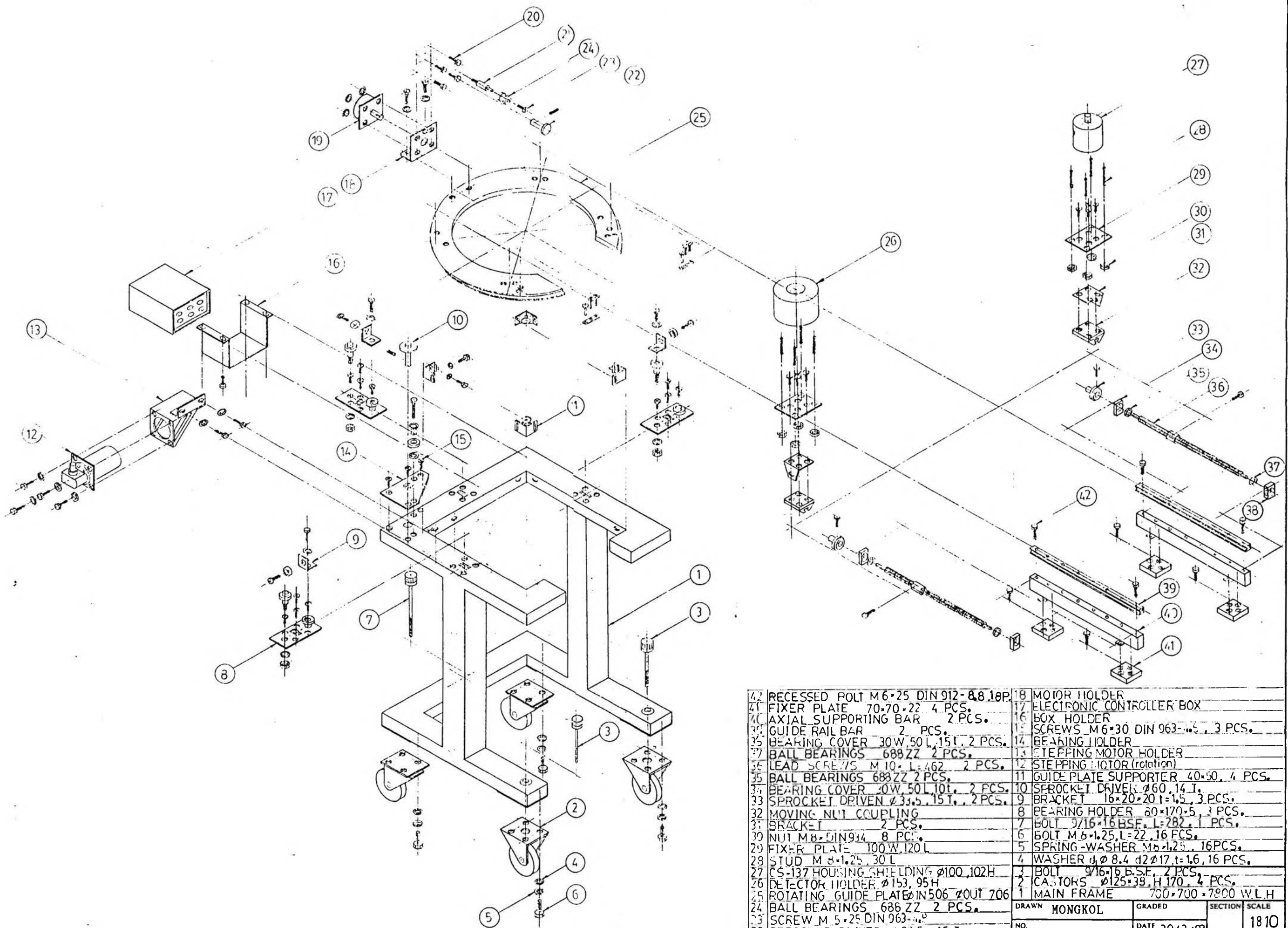
```
FOR I% = 1 TO NP
  FOR J% = 1 TO MAT
    P = (P(I%, J%) - BG) / (io - BG)
    P(I%, J%) = (-1) * LOG(P)
  NEXT J%
NEXT I%
OPEN TFN$ FOR OUTPUT AS #2
FOR I% = 1 TO NP
  FOR J% = 1 TO MAT
    IF P(I%, J%) < 0 THEN P(I%, J%) = 0
    WRITE #2, P(I%, J%)
  NEXT J%
NEXT I%
CLOSE #2

KEYP:
  LOCATE 20, 10: PRINT "PRESS ANY KEY CONTINUE"
  ST$ = INPUT$(1)
  IF ST$ = "" THEN GOTO KEYP
GOTO MENU
```

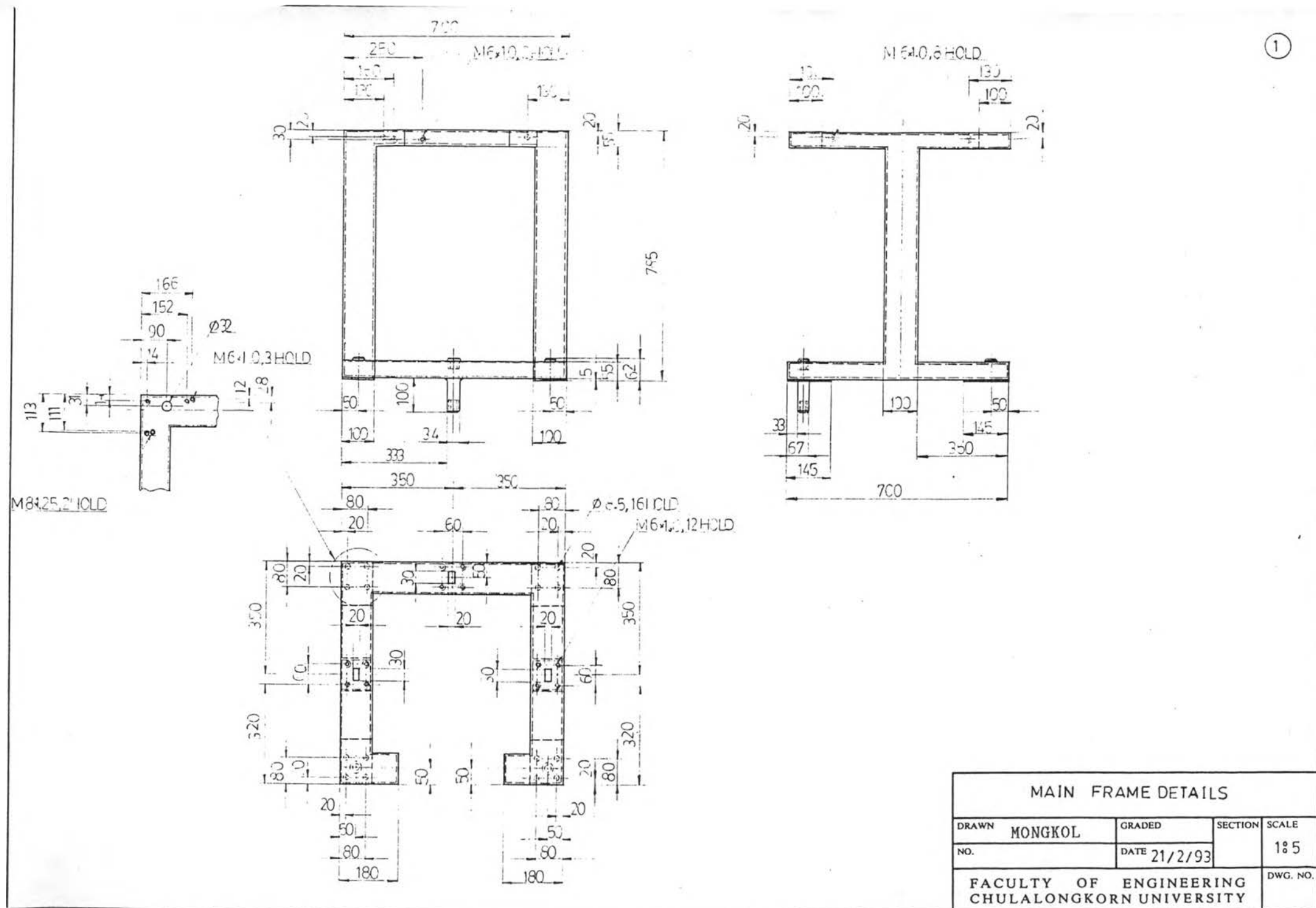

ภาคผนวก ข

แผนภาพแสดงสเกลของระบบสแกน

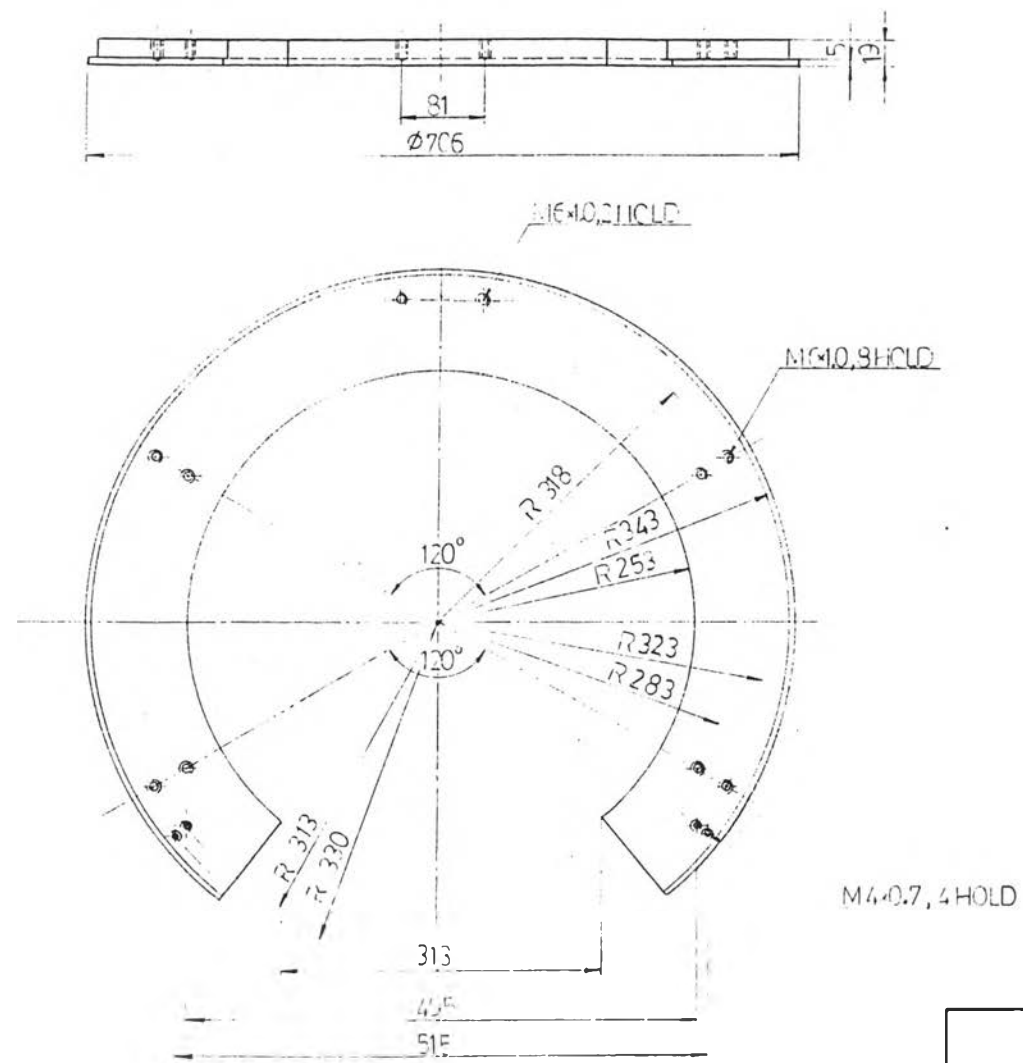
- ข.1 แสดงสเกลของระบบสแกนด้วยรังสีแกมมา
- ข.2 แสดงสเกล MAIN FRAME DETAILS
- ข.3 แสดงสเกล ROTATING DRIVER DETAILS
- ข.4 แสดงสเกล LINEAR DRIVER DETAILS (RIGHT)
- ข.5 แสดงสเกล LINEAR DRIVER DETAILS (LEFT)



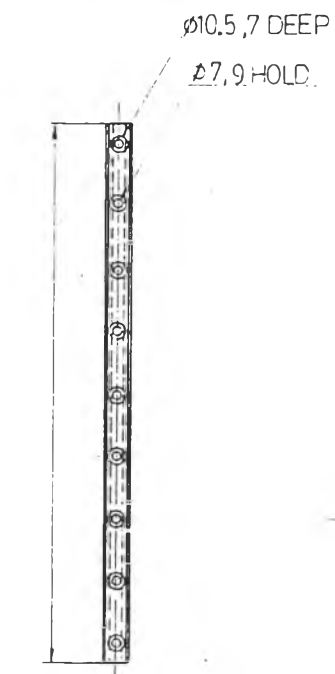
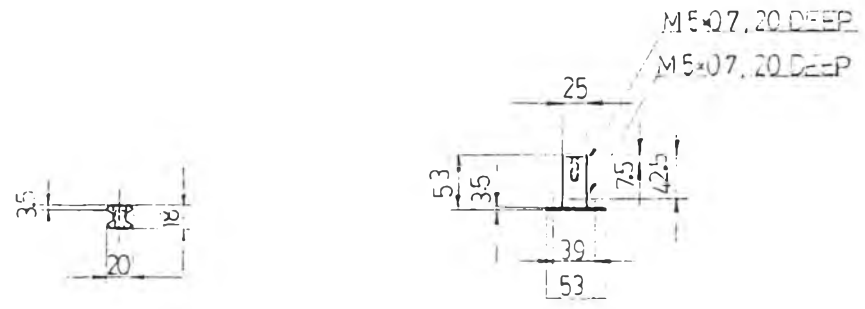
42	RECESSED FOLT M6*25 DIN 912-8.8 18P.	18	MOTOR HOLDER
41	FIXER PLATE 70*70*22 4 PCS.	17	ELECTRONIC CONTROLLER BOX
40	AXIAL SUPPORTING BAR 2 PCS.	16	BOX HOLDER
39	GUIDE RAIL BAR 2 PCS.	15	SCREWS M6*30 DIN 963-4.8 3 PCS.
38	BEARING COVER 30W,50L,15T, 2 PCS.	14	BEARING HOLDER
37	BALL BEARINGS 688 ZZ 2 PCS.	13	STEPPING MOTOR HOLDER
36	LEAD SCREWS M10 L=462 2 PCS.	12	STEPPING MOTOR (rotation)
35	BALL BEARINGS 688 ZZ 2 PCS.	11	GUIDE PLATE SUPPORTER 40*50, 4 PCS.
34	BEARING COVER 30W,50L,10t, 2 PCS.	10	SPROCKET DRIVER Ø60, 14 T.
33	SPROCKET DRIVEN Ø33.5, 15 T., 2 PCS.	9	BRACKET 16*20*20 t=1.5, 3 PCS.
32	MOVING NUT COUPLING	8	BEARING HOLDER 60*170*5, 3 PCS.
31	BRACKET 2 PCS.	7	BOLT 9/16*16 B.S.F. L=282, 1 PCS.
30	NUT M8-DIN934 8 PCS.	6	BOLT M6*1.25, L=22, 16 PCS.
29	FIXER PLATE 100W,120L	5	SPRING-WASHER M6*1.25, 16PCS.
28	STUD M8*1.25, 30 L	4	WASHER d Ø 8.4 d2 Ø 17 t=16, 16 PCS.
27	CS-137 HOUSING SHIELDING Ø100, 102H	3	BOLT 9/16*16 B.S.F. 2 PCS.
26	DETECTOR HOLDER Ø153, 95H	2	CASTORS Ø125*38, H170, 4 PCS.
25	ROTATING GUIDE PLATE IN 506 ØOUT 706	1	MAIN FRAME 700*700*7800 W.L.H
24	BALL BEARINGS 688 ZZ 2 PCS.		
23	SCREW M 5*25 DIN 963-4.8	DRAWN	MONGKOL
22	SPROCKET DRIVER Ø 33.5, 15 T.	GRADED	
21	LEAD SCREW COUPLING	SECTION	
20	BOLT M6*80 TO DIN933-8.8, 4 PCS.	SCALE	1810
19	STEPPING MOTOR (axial)	NO.	DATE 20/2/03
		FACULTY OF ENGINEERING CHULALONGKORN UNIVERSITY	
			DWG. NO.



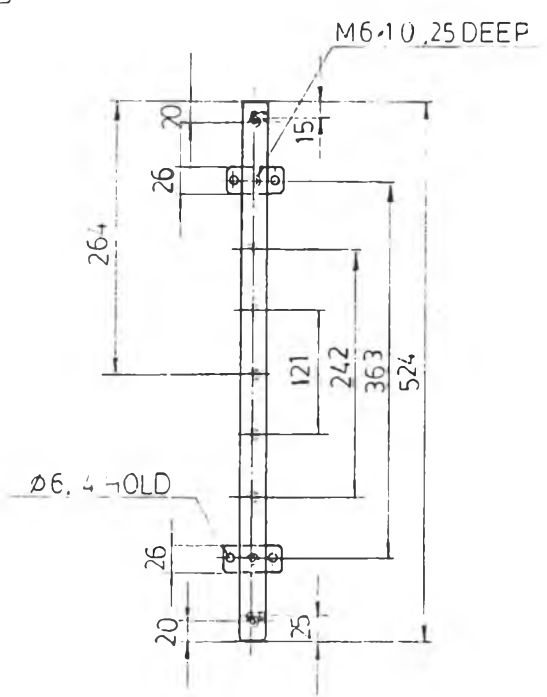
MAIN FRAME DETAILS			
DRAWN	MONGKOL	GRADED	SECTION
NO.		DATE 21/2/93	SCALE 1:5
FACULTY OF ENGINEERING CHULALONGKORN UNIVERSITY			DWG. NO.



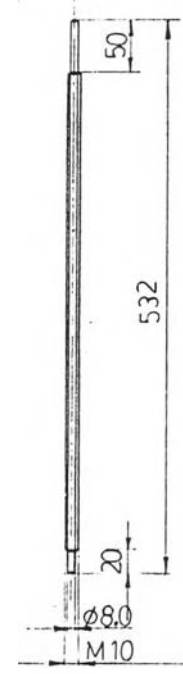
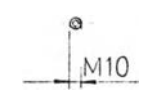
ROTATING DRIVER DETAILS			
DRAWN	MONGKOL	GRADED	SECTION
NO.		DATE 22/2/93	SCALE 1:5
FACULTY OF ENGINEERING CHULALONGKORN UNIVERSITY			DWG. NO.



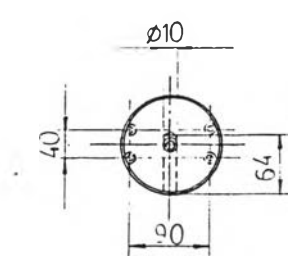
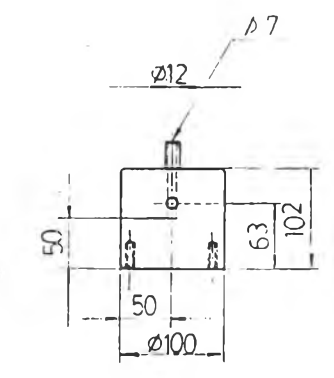
36



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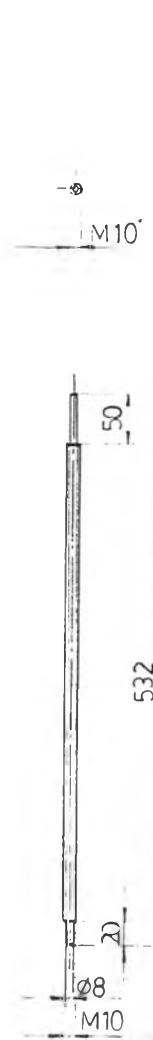


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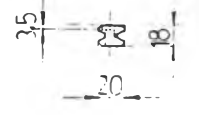
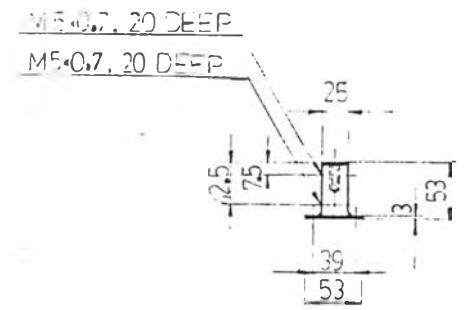


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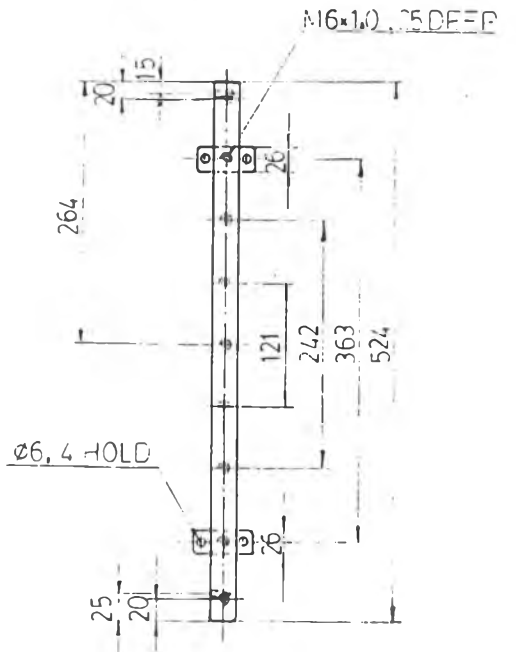
LINEAR DRIVER DETAILS (RIGHT)			
DRAWN	MONGKOL	GRADED	SECTION
NO.		DATE	23/2/93
FACULTY OF ENGINEERING CHULALONGKORN UNIVERSITY			SCALE 1:5
			DWG. NO.



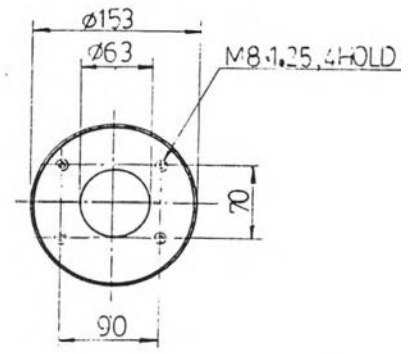
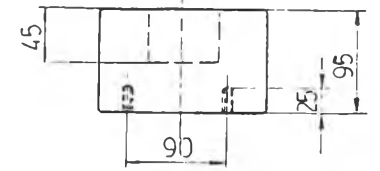
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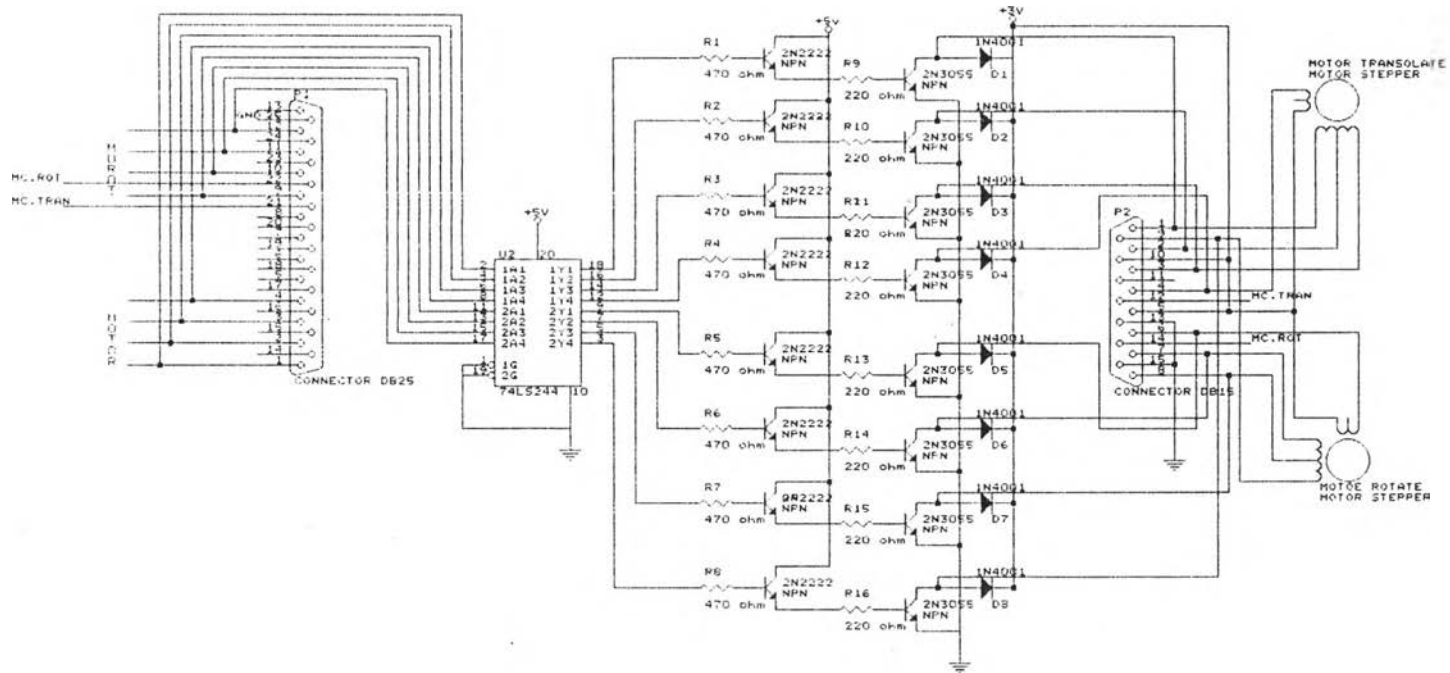
LINEAR DRIVER DETAILS (LEFT)			
DRAWN	MONGKOL	GRADED	SECTION
NO.		DATE 23/2/93	SCALE 1:5
FACULTY OF ENGINEERING CHULALONGKORN UNIVERSITY			DWG. NO.

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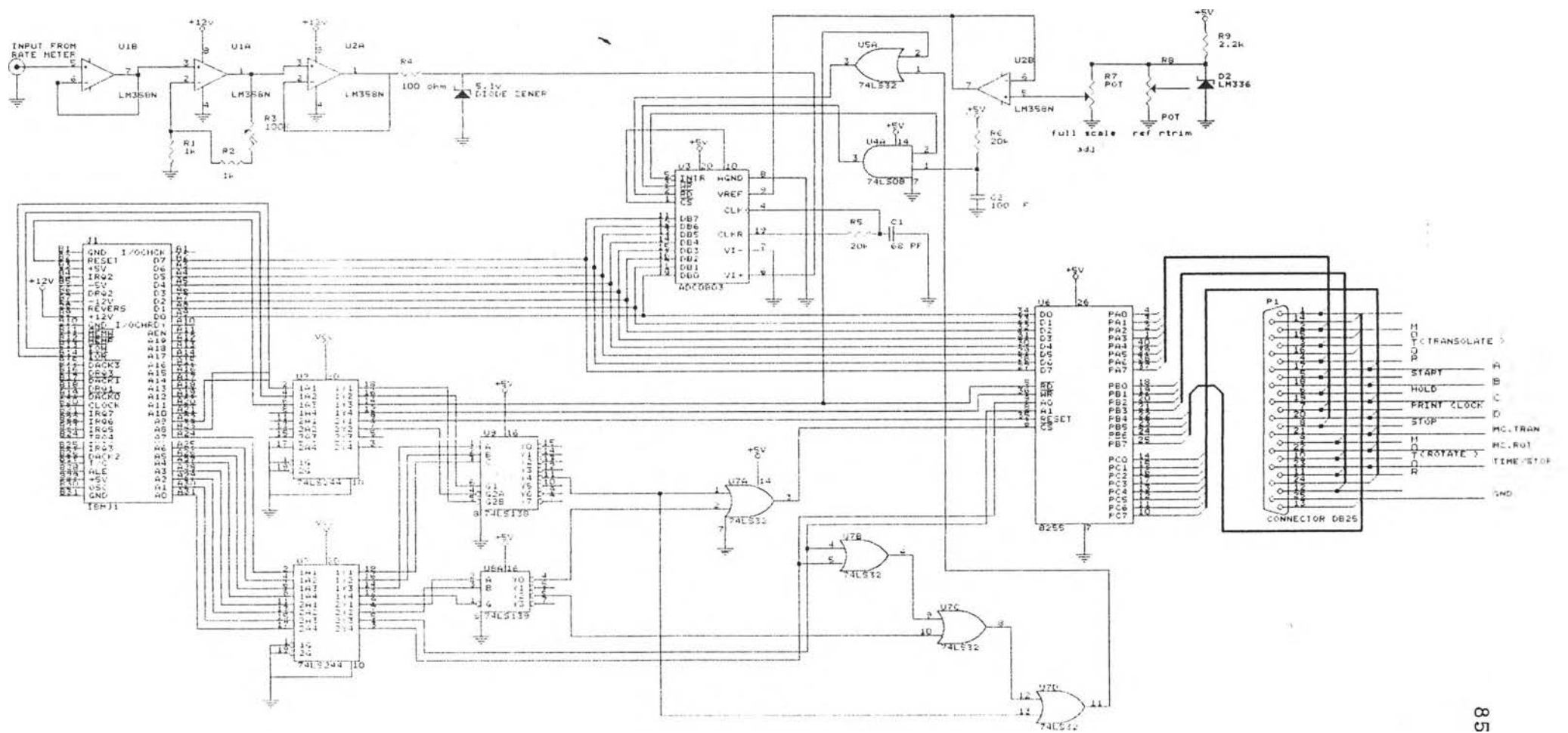
วงจรถ่ายทอดการทำงานของระบบสแกนร่วมกับไมโครคอมพิวเตอร์

ค.1 วงจรขับสแต็ปมอเตอร์

ค.2 วงจร INTERFACE ระหว่างระบบสแกนกับไมโครคอมพิวเตอร์ และระบบ
นิวเคลียร์กับไมโครคอมพิวเตอร์



รูปที่ ค.1 วงจรกับสแต็ปมอเตอร์



รูปที่ ๑.๒ วงจร INTERFACE

ประวัติผู้เขียน

นายมงคล วรณประภา เกิดเมื่อวันที่ 5 มกราคม พ.ศ. 2508 ที่จังหวัดสระบุรีสำเร็จการศึกษาวิทยาศาสตร์บัณฑิต สาขาฟิสิกส์ จากมหาวิทยาลัยรามคำแหง เมื่อปี พ.ศ. 2529 เข้าศึกษาต่อที่ภาควิชาวิศวกรรมเทคโนโลยี คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย เมื่อปี พ.ศ. 2533 ปัจจุบันรับราชการที่ กรมวิทยาศาสตร์การแพทย์

