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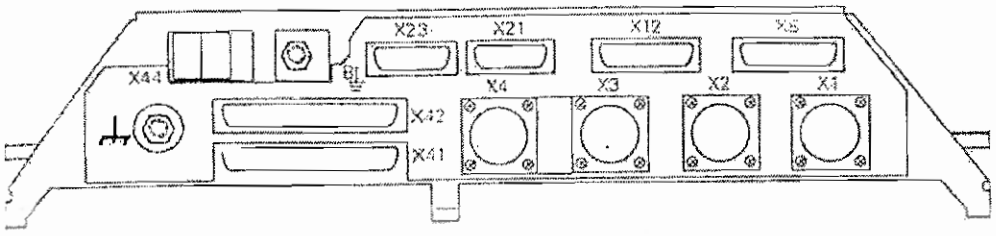
Mounting and Electrical Installation

1. Connection Overview



X1

X2 = Encoder 2 (~)

X3 = Encoder 3 (~)

X4 = Encoder 4 (~)

X8 = Nominal value output 1, 2, 3, 4, 5

X12 = Touch trigger probe

X21 = RS-232-C/V.24 data interface

X23 = Handwheeel

X41 = PLC output

X42 = PLC input

X44 = 24 Vdc power supply for the PLC

X31 = 24 Vdc power supply for the NC (on the main board)

X33 = buffer battery (on the main board)

X39 = "Control on" key (beocath the main board)

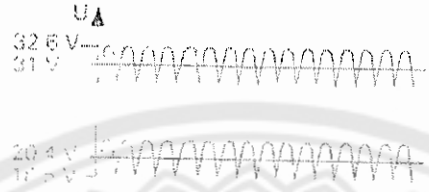
X40 = EMERGENCY STOP button (beneath the main board)

Danger to internal components !

Do not engage or disengage any connections while the unit is under power.

2. Power Supply

Superimposed ac components, such as those caused by a three-phase bridge rectifier without smoothing, are permissible up to a ripple factor of 5% (see DIN 40110/10.75, section 1.2). This results in an upper limit voltage of the greatest absolute value of 32.6 V and for the lower limit the smallest absolute value of 18.5 V. The TNC 310 is proof against voltage surges as prescribed by EN 50 178 overvoltage tolerance class 2.



Maximum Power Consumption

NC: 32 W

PLC: 48 W (when 16 outputs are driven simultaneously)

X 44 PLC Power Supply

Terminals

Terminal	Assignment	Fuse
1	+24 Vdc can be switched off via EMERGENCY STOP	F 3.15 A
2	+24 Vdc cannot be switched off via EMERGENCY STOP	F 2 A
3	0 V	

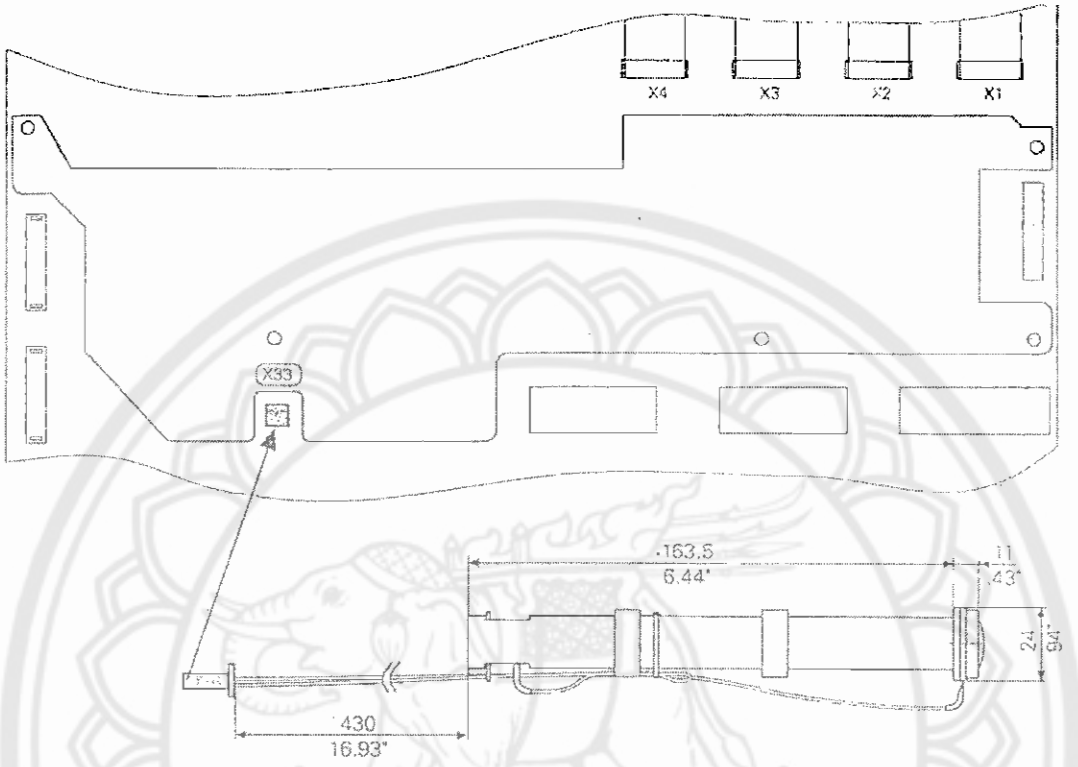
X 31 NC Power Supply

Terminals

Terminal	Assignment	Fuse
+	+24 Vdc	F 4 A
-	0 V	

X 33 Buffer Battery

The TNC is supplied with a battery case with buffer batteries to ensure nonvolatile storage of the NC part programs and machine data in RAM memory. Connect the buffer batteries to the back of the logic board and faster the the battery case in the inside of your operating panel.



3. Measuring Systems

HEIDENHAIN TNC contouring control are designed for use with incremental linear and angular encoders as measuring system linear encoder provide the best solution for linear measurement, but if accuracy requirement permit, you can also measure linear moment by using a rotary encoder in combination with a drivescrew.

HEIDENHAIN recommends using encoder with distance- coded reference marks because they significantly reduce the traverse distance required to establish the absolute position.

The 11μApp signals undergo 100- fold interpolation.

Current consumption per encoder input must not exceed 120 mA

Max. input frequency : 50 kMz/100 kHz

Max. cable length : 60 / 30 m

X1, X2, X3, X4 Encoder 1, 2, 3, 4 (11μAρρ)

Flange socket with female contact (9 – pin)

Pin number	Assignment	Color
1	I_1+	Green
2	I_{1-}	Yellow
3	I_2+	Blue
4	I_2-	Red
5	I_0+	Gray
6	I_0-	Pink
7	+5 V	Briown
8	0 V	White
9	Internal shield	Black
Housing	External shield	

The interface complies with the recommendation in EN 50 178 for separation from line power.

Use only HEIDENHAIN encoder cables, connectors and coupling!

4. Nominal Value Output

The position loop is controlled with a nominal voltage of ±10 V

Maximum loading of the analog outputs: 2 mA

Maximum capacitance: 2 nF

X8 Nominal Value Output

D-sup 15-pin female connector

Logic unit		Cable Id. Nr. 290 109..,290 110..	
Pin number	**Assignment**	**D-sub connector**	**Color**
1	Nominal value output 1	1	Brown
2	Amalog input (0 to 5V)	2	Brown/Green
3	Nominal value output 2	3	Yellow
4	Do not use	4	Red/Blue
5	Nominal value output 3	5	Pink
6	Do not use	6	Grey/Pink
7	Nominal value output 4	7	Red
8	Nominal value output 5	8	Violet
9	0V nominal value output 1	9	White
10	0V analog input	10	White/Gray
11	0V nominal value output 2	11	Green
12	Do not use	12	
13	0V nominal value output 3	13	Grey
14	0V nominal value output 4	14	Blue
15	0V nominal value output 5	15	Black
Housing	External shield	Housing	External shield

The interface complies with the recommendations in EN 50 178 for separation from line power.

Connecting cable: See "Cable Overview" in the Appendix.

The cables to the nominal value outputs must be shielded. Use no more than one intermediate terminal, which must be made in a grounded terminal box. Such a terminal can become necessary if the line is branched to physically separate servo inputs. This is a only possible way to ground the shielding of the leads to the servos. Suitable terminal boxes are available from HEIDENHAIN (Id. Nr.251 249 01).

The housing of terminal box must be electrically connected with the machine housing, and the 0 V connection of the nominal – value - difference inputs must be connected with signal ground. Required cross section ⟨ Ø 6 mm² (see Grounding Diagram)

5. TS 220 Touch Trigger Probe

The TS 220 touch trigger probe with cable connection can be used for workpiece setup and measurement.

X12 Touch Trigger Probe

D-sub 15-pin female connector

Pin number	Assignment
1	0 V
3	Ready
4	Start
5	+ 15 V ± 10 % (Up)
6	+ 5 V ± 5 % (Up)
7	Battery warning
8	0 V (Un)
9	Trigger signal
10	Trigger signal [1)]
2, 11 to 15	Do nt use
Housing	External shield

1) Stylus at rest means logic level High.

Adapter Id. Nr. 274 543			TS 220 Id. Nr. 293 488 ..	
D-sub connector (male) 15-pin		**Coupling on mounting base 6-pin**	**Quick disconnect 6-pin**	
3	Pink	4	4	Grey
5	Grey			
6	Brown/Green	2	2	Brown
7	Gray	3	3	Gray
8	White/Green	1	1	White
9	Green	5	5	Green
10	Yellow	6	6	Yellow
Housing	External shield	Housing	Housing	External shield

6. RS-232-C/V.24 Data Interface

- Maximum cable length 20 meters
- To connect a peripheral device you must install an adapter cable either in the electrical cabinet or on the operating panel. See also the "Cable Overview" section in the Appendix.

X21 RS-232-C/V.24 data interface

D-sub 15-pin female socket

Logic unit		Connecting cable Id. Nr. 286 998			Adapter block Id. Nr. 239 758 01		Connecting cable Id. Nr. 274 545 01		
Pin No.	**Assign ment**	**D-sub connector (male) 9-pin**		**D-sub connector (female) 25-pin**	**D-sub Socket (male) 25-pin**	**D-sub Socket (female 25-pin**	**D-sub Con. (male) 25-pin**		**D-sub Con. (female 25-pin**
1	GND	1	WH/BN External shield	1	1	1	1	WH/BN External Shield	1
3	RXD	2	greeen	3	3	3	3	Yellow	2
2	CTS	3	Yellow	2	2	2	2	Green	3

7	CTS	4	Gray	5	5	5	5	Pink	4
8	RTS	5	Pink	4	4	4	4	Gray	5
6	DTR	6	Blue	20	20	20	20	Brown	6
5	Signal GND	7	Red	7	7	7	7	Red	7
4	DSR	20	Brown	6	6	6	6	Blue	20
				8	8	8	8		8
Housing	External	Housing	External	Housing	Housing	Housing	Housing	External	Housing

The interface complies with the recommendations in IEC 742 EN 50 178 for separation from line power.

7. Handwheel Input

Any of following handwheels can be used:

One **HR 410** portable handwheel

One **HR 130** panel-mounte handwheel or

One **HRA 110** handwheel adapter for connecting three HR 150 panel-mounted handwheels

X23 Handwheel Input

D-sub 9-pin female socket

Pin No.	Assignment
2	0 V
4	+12 V ±0.6 V (Uv)
6	DTR
7	TxD
8	RxD
9	DSR
1, 3, 5	Not used
Housing	External shield

The interface complies with the recommendations in IEC 742 EN 50 178 for separation from line power.

1. HR 410 Portable Handwheel

The HR 410 is a portable electronic handwheel with:

- Five axis-selection keys
- Traverse directiion keys
- Three keys with predefined traverse speeds
- Actual-position-capture key
- Three keys for machine functions to be determined by the machine tool builder
- Two permissive keys
- EMERGENCY STOP button
- Holding magnets

Dummy plug for EMERGENCY STOP circuit (option) Id. Nr. 271 958 03 (See "Dimensions")

Extension cable Id. Nr. 281 429..		
D-sub connector (male) 9-pin		D-sub connector (female) 9-pin
Housing	Shield	Housing
2	White	2
4	Brown	4
6	Yellow	6
7	Gray	7
8	Green	8

Adapter cable Id. Nr. 296 466..		
D-sub connector (male) 9-pin		Coupling on mounting base (female) 18-pin
Housing	Shield	Housing
2	White	E
4	Brown	D
6	Yellow	B
7	Gray	A
8	Green	C
		6
		7
		5
		4
		2
		3
		1

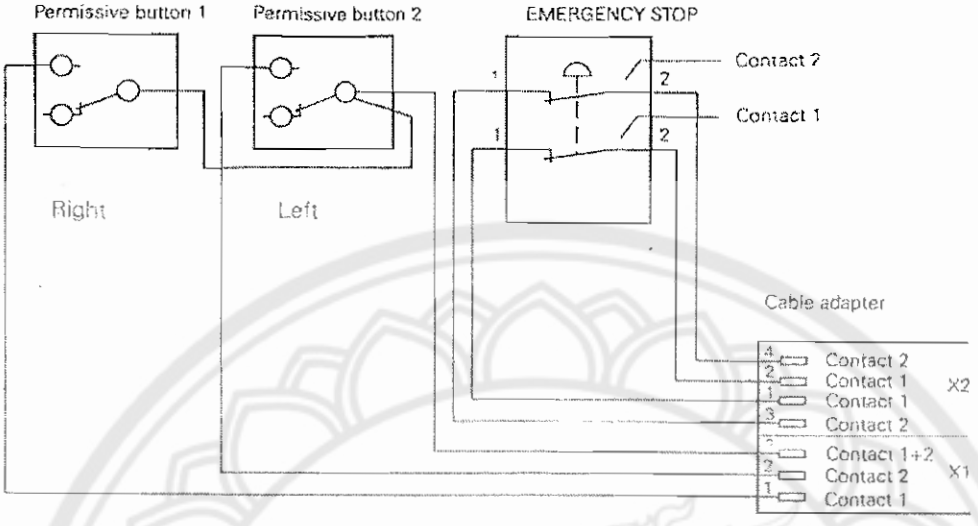
Connecting cable Id. Nr. 296 467 05		
Connector (male) 18-pin		Connector (female) 18-pin
Housing	Shield	Housing
E	White	E
D	Brown	D
B	Yellow	B
A	Gray	A
C	Green	C
6	WH/BK	6
7	YL/BK	7
5	WH/RD	5
4	WH/BL	4
2	WH/GN	2
3	WH/YL	3
1	WH/BN	1

HR 410 Id. Nr. 296 469 01	
Connector (male) 18-pin	
Housing	Shield
E	
D	
B	
A	
C	
6	
7	
5	
4	
2	
3	
1	

WH/BN	3	Contact 1 + 2
WH/YL	2	Contact 2 (left) Permissive button
WH/GN	1	Contact 1 (right)
WH/BL	1	Contact 1
WH/RD	2	Contact 1 EMERGENCY STOP
YL/BK	3	Contact 2
WH/BK	4	Contact 2

The adapter includes plug-in terminal strips for the contacts of the EMERGENCY STOP putton and permissive button (maximum load 1.2 A).

Internal wiring of contacts to permissive buttons and EMERGENCY STOP button of the HR 410:



The plug-in terminal strips are included in delivery with the adapter cable.If you have an immediate need for these terminal strips before the adapter cable, they can be ordered separately:

Plug-in terminal strip, 3-pin Id. Nr. 266 364 06

Plug-in terminal strip, 4-pin Id. Nr. 266 364 12

2. HR 130 Panel-Mounted Handwheel

The HR 130 is avaiable in various versions (standard cable length 1 meter):

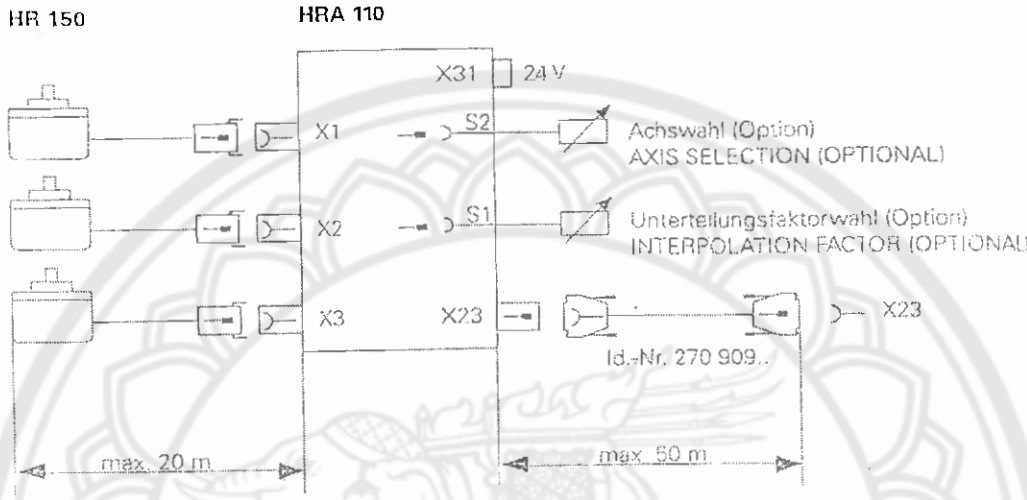
- Small knob, axial cable outlet: Id. Nr. 254 040 01
- Small knob, radial cable outlet: Id. Nr. 254 040 02
- Large knob, axial cable outlet: Id. Nr. 254 040 03
- Large knob, radial cable outlet: Id. Nr. 254 040 04
- Ergonomic knob, radial cable outlet: Id. Nr. 254 040 05

(See also the "section in the Appendix)

Extension cable Id. Nr. 281 429 ..			HR 130 Id. Nr. 254 040 ..	
D-sub connector (male) 9-pin		D-sub connector (female) 9-pin	D-sub connector (male) 9-pin	
Housing	Shield	Housing	Housing	Shield
2	White	2	2	White
4	Brown	4	4	Brown
6	Yellow	6	6	Yellow
8	Green	8	8	Green
7	Gray	7		

3.8.3 HRA 110 Handwheel Adapter

The HRA 110 handwheel adapter enables you to connect two or three HR 150 panel-mounted handwheels to the TNC. The first and second handwheel are permently assigned to the X and Y axes. The third handwheel can be assigned to the X, Y, Z or lvth axis, either by a step switch (option) or with MP7645 (See "Machine Integration").



An additional step switch (option) provides such functions as the selection of the handwheel interporpolation factors. You must evaluate the current setting of the step switch in the PLC and then activate the corresponding interpolation factor with Module 9036.

X1, X2, X3 Handwheel Inputs for HR 150

Flange socket with female contact (9-pin)

HRA 110	
Pin No.	**Assignment**
1	I_1+
2	I_1-
3	I_2+
4	I_2-
5	I_0+
6	I_0-

7	+5 V
8	0 V
9	Internal shield
Housing	External shield

X23 Connection to Logic Unit

D-sub 9-pin male contact

HR 110	
Pin no.	**Assignment**
1	RTS
2	0 V
3	CTS
4	+12V +0.6 (Uv)
5	Do not use
6	DSR
7	RxD
8	TxD
9	DTR
Housing	External shield

X31 Power Supply

HRA 110	
Terminal	**Assignment**
1	+ 24 Vdc
2	0 V

Power supply: 24 Vdc VDE 0160, basic insulation

Max. current consumption: 200 mA

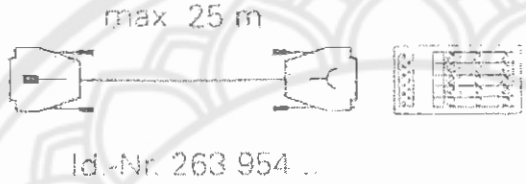
Do not use the power supply for the PLC to also supply the HRA 110. If you do, you may bypass the metallic isolation of the PLC inputs/outputs.

8. PLC Inputs/Outputs

Connecting the PLC Inputs/Outputs

The cable length between TNC and the switched components is limiting 25 meters (8.3 ft).

HEIDENHAIN recommends installing a transfer unit with terminal block in the electrical cabinet.



If you work without a transfer unit, use the HEIDENHAIN cable Id.-Nr. 244 055...

If you wish to assemble the connector on-site, order a 37-pin solderable connector from HEIDENHAIN (Id.-Nr. 315 650 07)

1. PLC Input

The PLC inputs I0 to I23 are located on connector X42 (PLC input).

The PLC inputs I128 to I143 are permanently assigned to the machine keys on the keyboard.

	Voltage Ranges Ui	Current ranges Ii
"1" signal	13 V to 30.2 V	3.8mA to 8.9 mA
"0" signal	-20 V to 3.2 V	1.0 mA at Ui = 3.2 V

X42 PLC input

D-sub 37-pin female socket

Logic unit		VB Id.-Nr 244 005 .. Id.-Nr. 263 954	
Pin No.	Assignment	Connector (male)	
1	I0	1	Gray/Red
2	I1	2	Brown/Black
3	I2	3	White/Black
4	I3 Acknowledgment for control-is-ready signal	4	Green/Black
5	I4	5	Brown/Red
6	I5	6	White/Red
7	I6	7	White/Green
8	I7	8	Red/Blue
9	I8	9	Yellow/Red
10	I9	10	Gray/Pink
11	I10	11	Black
12	I11	12	Pink/Brown
13	I12	13	Yellow/Blue
14	I13	14	Green/Blue
15	I14	15	Yellow
16	I15	16	Red
17	I16	17	Gray
18	I17	18	Blue
19	I18	19	Pink
20	I19	20	White/Gray
21	I20	21	Yellow/Gray
22	I21	22	Green/Red
23	I22	23	White/Pink
24	I23	24	Gray/Green
25	*Do not use*	25	Yellow/Brown
26	*Do not use*	26	Gray/Brown
27	*Do not use*	27	Yellow/Black
28	*Do not use*	28	White/Yellow
29	*Do not use*	29	Gray/Blue
30	*Do not use*	30	Pink/Blue
31	*Do not use*	31	Pink/Red
32	*Do not use*	32	Brown/Blue
33	*Do not use*	33	Pink/Green
34	*Do not use*	34	Brown
35	0 V test output (PLC); *Do not use*	35	Yellow/Pink
36	0 V test output (PLC); *Do not use*	36	Violet
37	0 V test output (PLC); *Do not use*	37	White
Housing	External shield	Housing	External shield

PLC inputs for machine keys on the keyboard

PLC input	Key
I128	Spindle stop
I129	NC stop (NC 0)
I130	Spindle start (M03 or M04)
I131	NC start (NC I)
I132	Axis direction Z'–
I133	Axis direction Y+
I134	Spindle brake
I135	Spindle counterclockwise (M04)
I136	Axis direction X'+
I137	Spindle clockwise (M03)
I138	Axis direction X'–
I139	Rapid traverse
I140	Axis direction Y–
I141	Axis direction Z'+
I142	Unclamp tool
I143	Coolant

3.9.2 PLC Output

Connector X41 contains the PLC outputs O0 to O22 and the control-is-ready output.

Specifications

Transistor output with current limitation

Mininum output voltage for "1" signal: 1.6 V below operating voltage

Rated operational current per output: 0.1 A

No more than one output may be shorted on the logic unit at ant time. Short circuiting of **one** output does not cause an overload.

Danger to internal components!

Inductive loads are permitted only with quenching diode parallet to the inductance.

X41 PLC Output

D-sub 37-pin female socket

Logic unit		Connecting cable Id.-Nr 244 005 .. / Id.-Nr. 263 954 ..	
Pin No.	Assignment	Connector (male)	
1	O0	1	Gray/Red
2	O1	2	Brown/Black
3	O2	3	White/Black
4	O3	4	Green/Black
5	O4	5	Brown/Red
6	O5	6	White/Red
7	O6	7	White/Green
8	O7	8	Red/Blue
9	O8	9	Yellow/Red
10	O9	10	Gray/Pink
11	O10	11	Black
12	O11	12	Pink/Brown
13	O12	13	Yellow/Blue
14	O13	14	Green/Blue
15	O14	15	Yellow
16	O15	16	Red
17	O16[1]	17	Gray
18	O17[1]	18	Blue
19	O18[1]	19	Pink
20	O19[1]	20	White/Gray
21	O20[1]	21	Yellow/Gray
22	O21[1]	22	Green/Red
23	O22[1]	23	White/Pink
24	*Do not use*	24	Gray/Green
25	*Do not use*	25	Yellow/Brown
26	*Do not use*	26	Gray/Brown
27	*Do not use*	27	Yellow/Black
28	*Do not use*	28	White/Yellow
29	*Do not use*	29	Gray/Blue
30	*Do not use*	30	Pink/Blue
31	*Do not use*	31	Pink/Red
32	Test output; *Do not use*	32	Brown/Blue
33	Test output; *Do not use*	33	Pink/Green
34	Control-is-ready signal	34	Brown
35	Test output; *Do not use*	35	Yellow/Pink
36	Test output; *Do not use*	36	Violet
37	Test output; *Do not use*	37	White
Housing	External shield	Housing	External shield

1) Cannot be switched on via EMERGENCY STOP; power supply via X44, pin 2

9. Machine CONTROL VOLTAGE ON Key

The keyboard includes a normally open contact with integrated lamp as an indicator for the control-voltage-on conditiion.

X39 Connecting terminals for the controls-voltage-on condition

Terminal strip, 5-line

Pin No.	Assignment
1	Normally open terminal 1
2	Normally open terminal 2
3	Lamp 24 Vdc
4	Lamp 0 V
5	Do not use

10. EMERGENCY OFF Key

The operating panel includes an EMERGENCY OFF button

X40 Connecting terminals for the EMERGENCY OFF key

Terminal strip, 3-line

Pin No.	Assignment
1	Normally closed terminal 1
2	Normally closed terminal 2
3	Do not use

Basic PLC-Program TNC 310

Standard layout :

PLC Inputs X42 (I0-I23)

I_reference_end_posit_X	I0
I_reference_end_posit_Y	I1
I_reference_end_posit_Z	I2
I_control_operational	I3
I_reference_end_posit_4	I4
I_key_axis_4_plus	I5
I_key_axis_4_minus	I6
I_feed_release	I7
I_drives_operational	I8
I_spindle_operational	I9
I_S_actuaI_equal_nominal_rpm	I10
I_S_actuaI_Iower_nominal_rpm	I11
I_gear_range_I	I12
I_gear_range_2	I13
I_lubrication_oil_leveI_low	I14
I_key_lublication_axes	I15
I_lublication_oil_level_low	I16
I_TS_not_in_spindle	I17
I_clamped_axis_Z	I18
I_clamped_axis_4	I19
I_open_loop	I20
I_Quit_GS_Strobe	I21
I_Quit_M_Strobe	I22
	I23 (SPARE)

Keys on the control panel (I128-I143)

I_key_spindle_stop	I128
I_key_NC_stop	I129
I_key_spindle_start	I130

I_key_NC_start	I131
I_key_axis_Z_minus	I132
I_key_axis_Y_plus	I133
I_key_spindle_brake	I134
I_key_spindle_M04	I135
I_key_axis_Z_plus	I136
I_key_spindle_M03	I137
I_key_axis_X_minus	I138
I_key_rapid_traverse	I139
I_key_axis_Y_minus	I140
I_key_axis_X_plus	I141
I_key_tool_unclamping	I142
I_key_coolant_M08	I143

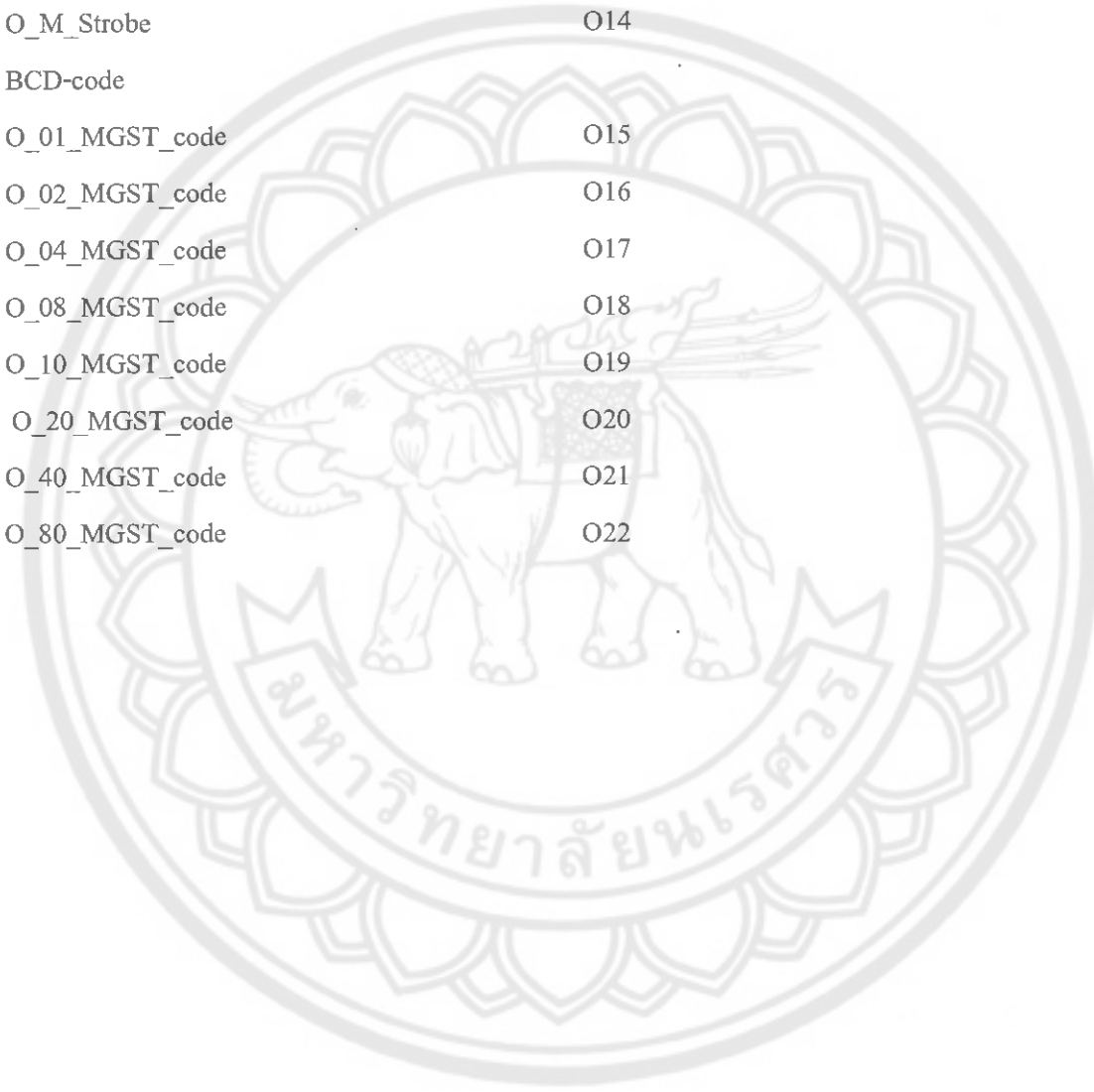
PLC outputs X41

(O0-O15, O16-O22 not switched off via EMERGENCY STOP)

O_servo_drive_release_X	O0
O_servo_drive_release_Y	O1
O_servo_drive_release_Z	O2
O_servo_drive_release_4	O3
O_servo_drive_release_S	O4
O_unclamping_Z	O5
O_unclamping_4	O6
O_tool_unclamping	O7
O_coolant_M08_on	O8
O_lubrication_on	O9
O_spindle_breake_release	O10

Analog spindle (MP3010 > 2):

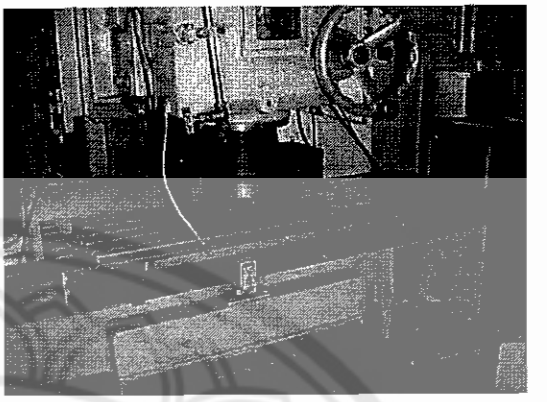
O_gear_range_1	O11
O_gear_range_2	O12
Coded spindle (MP3010 = 1 or 2):	
O_spindle_M03	O11
O_spindle_M04	O12
O_GS_Strobe	O13
O_M_Strobe	O14
BCD-code	
O_01_MGST_code	O15
O_02_MGST_code	O16
O_04_MGST_code	O17
O_08_MGST_code	O18
O_10_MGST_code	O19
O_20_MGST_code	O20
O_40_MGST_code	O21
O_80_MGST_code	O22



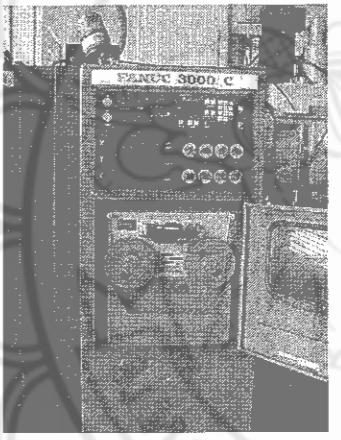
ภาคผนวก ข

รูปภาพการดำเนินงาน

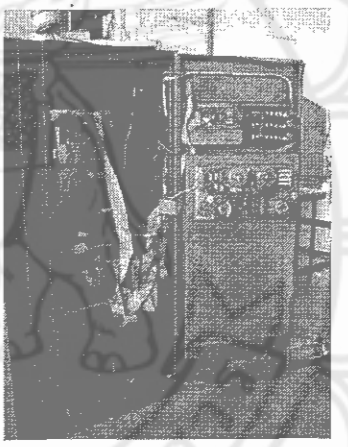
ลักษณะรูปร่างของเครื่องจักร



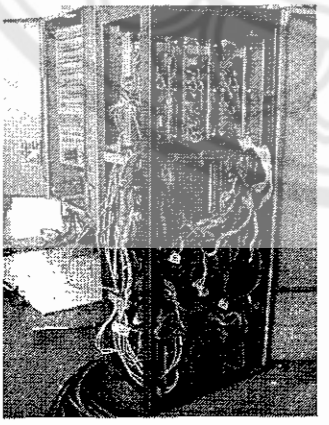
machine table



Control Unit เดิม (fanuc 3000 C)

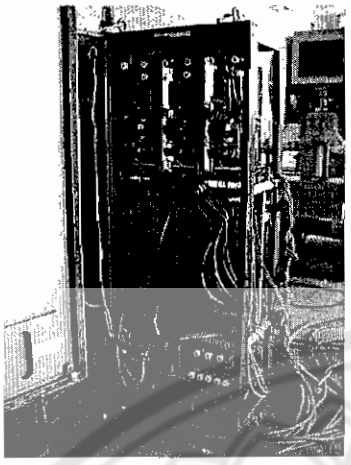


ภายใน Control Unit



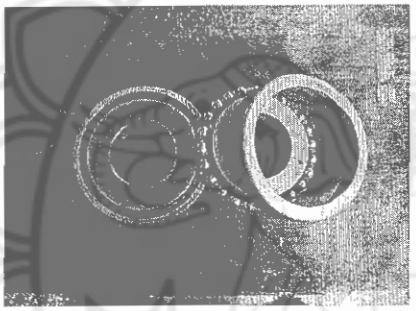
ภายในของตู้ Control

สภาพสายไฟฟ้าก่อนทำการปรับปรุง

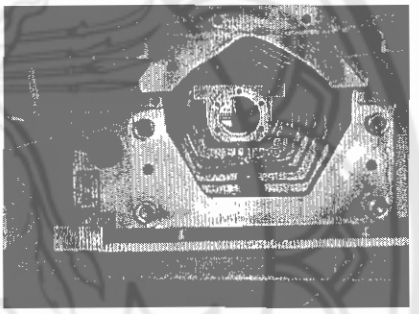


สภาพด้านหลังของตู้ Control

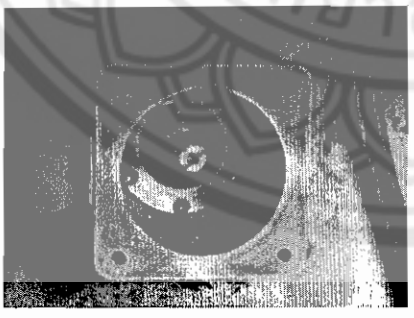
ตำแหน่งของ Ballscrew แกน Xเมื่อทำการถอดออก

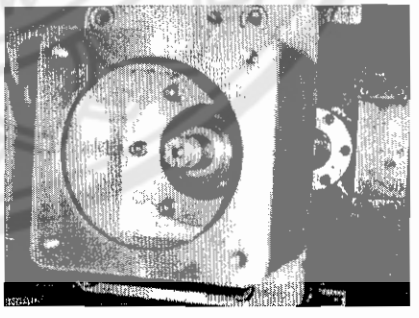


ตลับลูกปืนในชุด Ballscrew

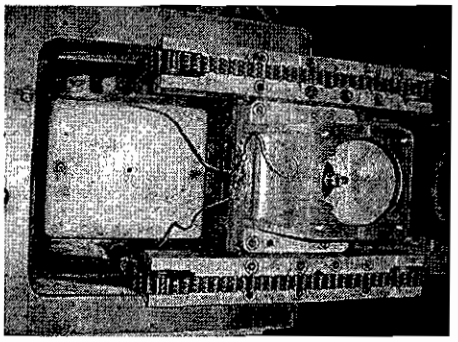


ภายในรางใส่ Ballscrew แกน X

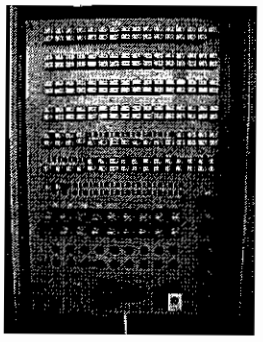




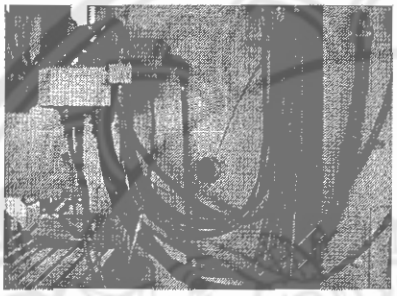
ตำแหน่งใส่Motor เข้ากับปลาย Ballscrew



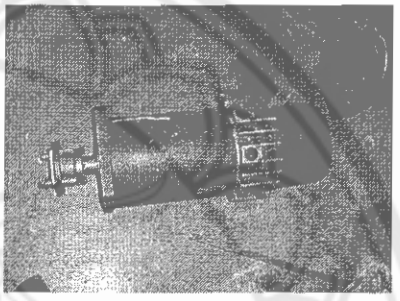
ฐานวางมอเตอร์แกน Z เป็นด้านบนสุดของเครื่อง



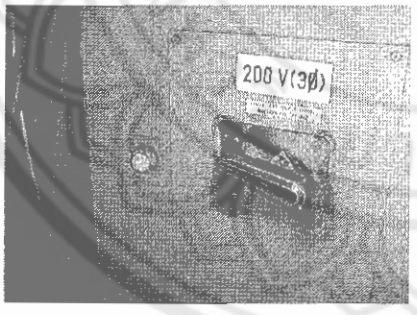
แผงRelayควบคุมการทำงานของLimitswitch



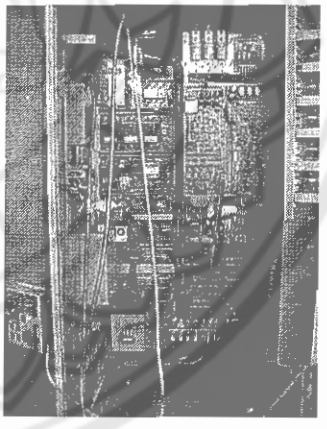
สายไฟฟ้าและสายสัญญาณต่างๆ



มอเตอร์ที่ใช้ในการขับเคลื่อน Machine table



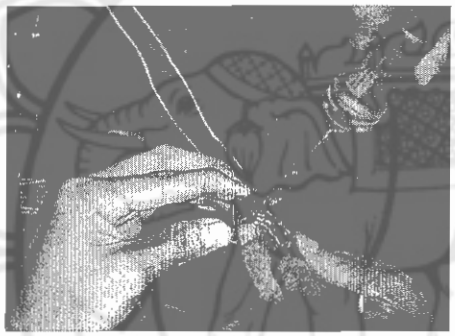
Breaker สำหรับจ่ายไฟฟ้าให้กับระบบ



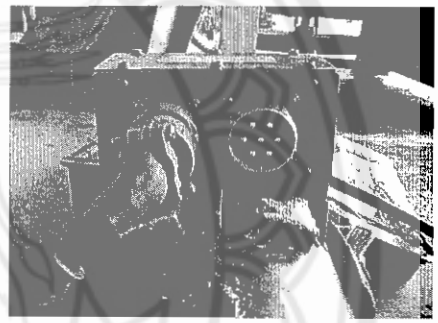
ระบบไฟฟ้าและวงจรต่างๆ(ด้านหลังเครื่อง)

ระบบไฟฟ้าส่งเข้าเลี้ยง Drive X, Y, Z

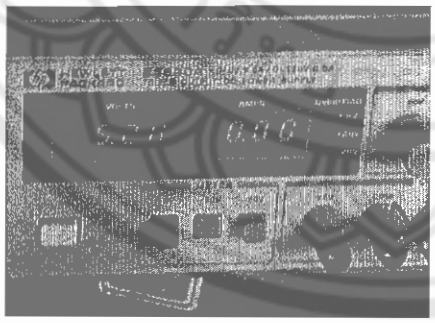
การทดสอบ Driveและมอเตอร์ (X, Y, Z)



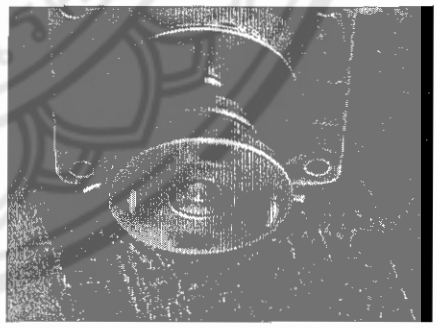
การต่อ Connectorของ Drive



ลักษณะ Connector ที่ตัวมอเตอร์

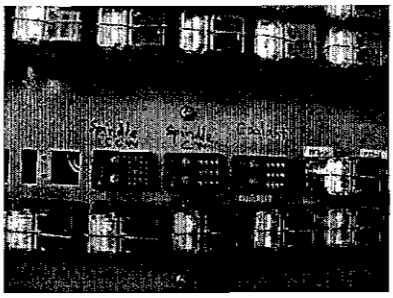


เมื่อป้อนกระแสไฟฟ้าที่ 5.2 V ขณะทำการทดสอบ Drive

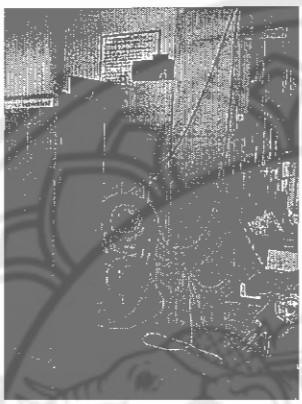


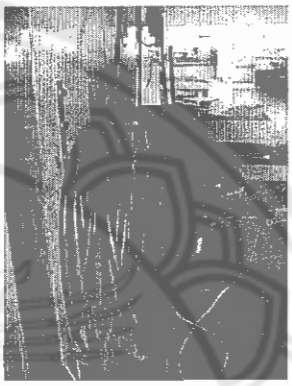
มอเตอร์หมุนขณะทำการทดสอบ

Rclay Enable X, Y, Z, Spindle

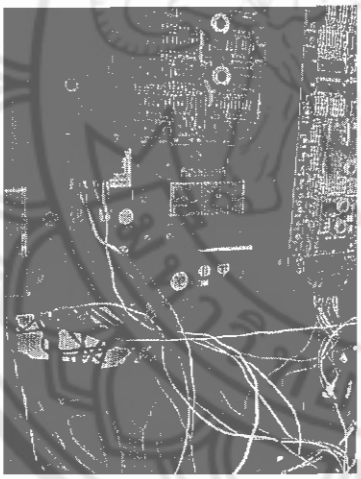


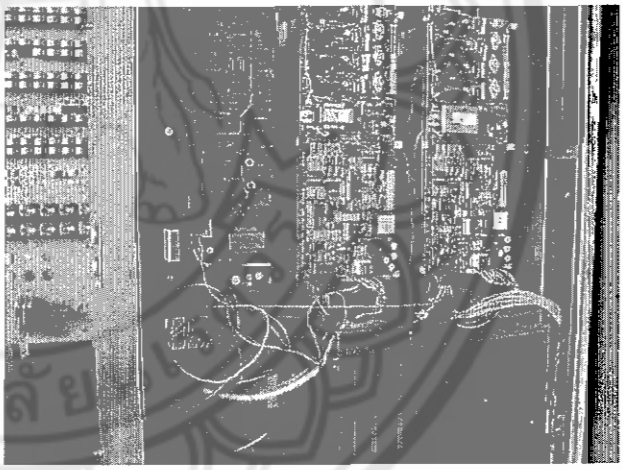
Relay Enable Spindle and Coolant





ภาพหลังทำการแก้ไข ดัดแปลง และติดตั้ง Controller

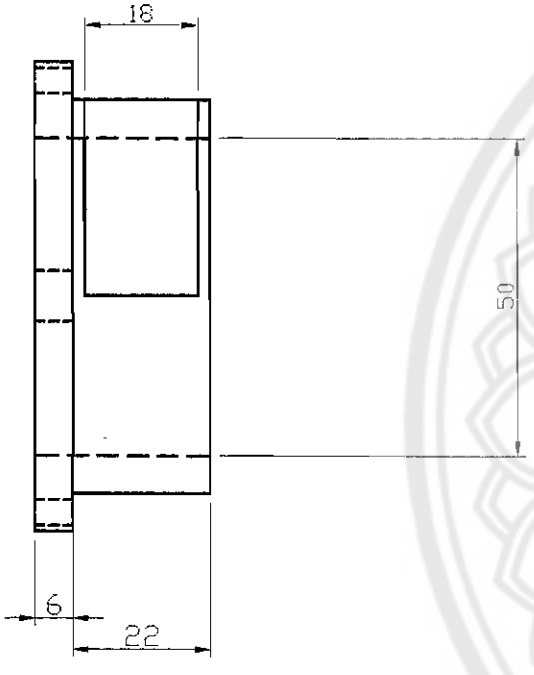


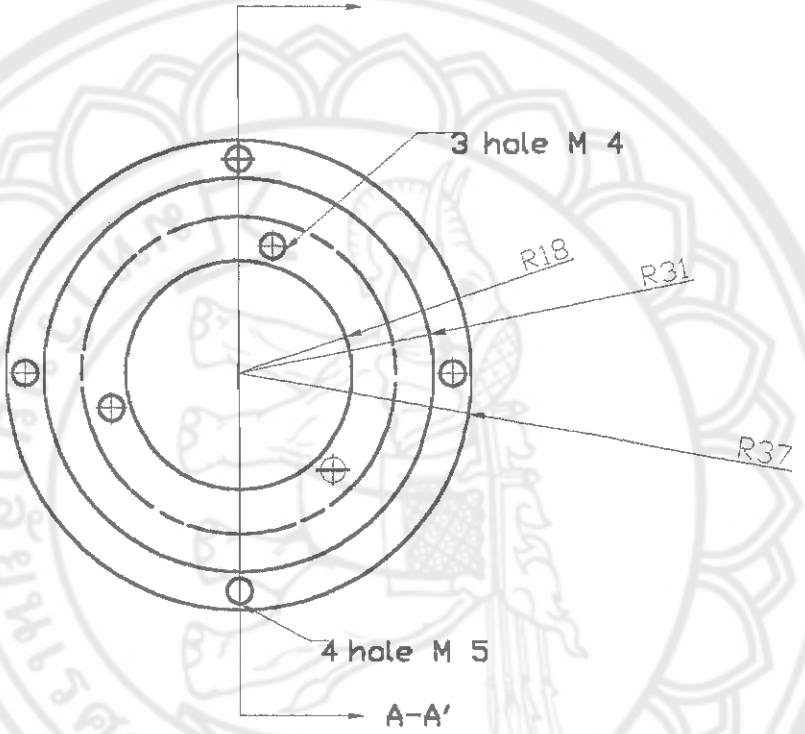


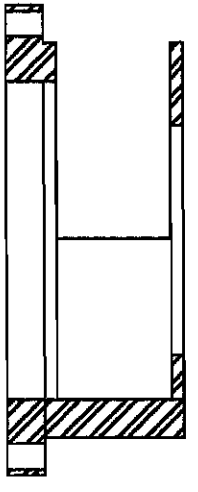
การเชื่อมต่อของ Connector Drive X, Y, Z,

ภาคผนวก ค

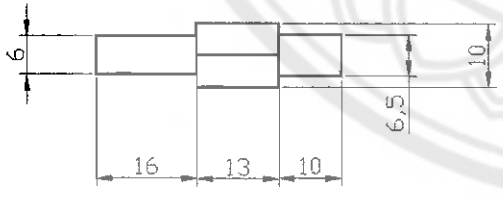
Drawing ชุดคลัปปลิงและตู้ Controller







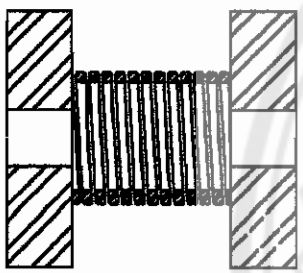
SECTION A-A'



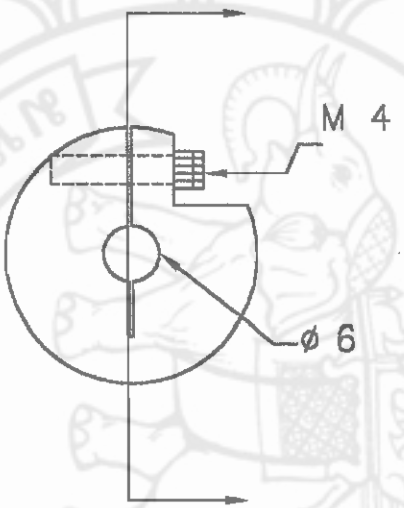
ชิ้นส่วนฐานรอง
Encoder

Scale in MM.

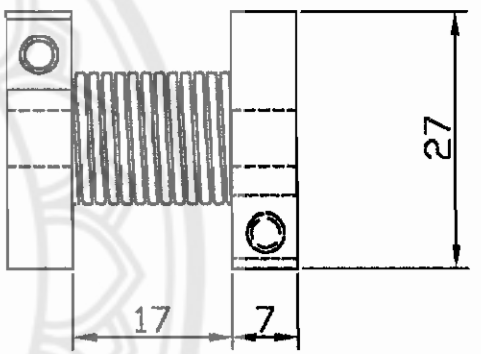
ภาพที่ 1/4



SECTTION
A–A'



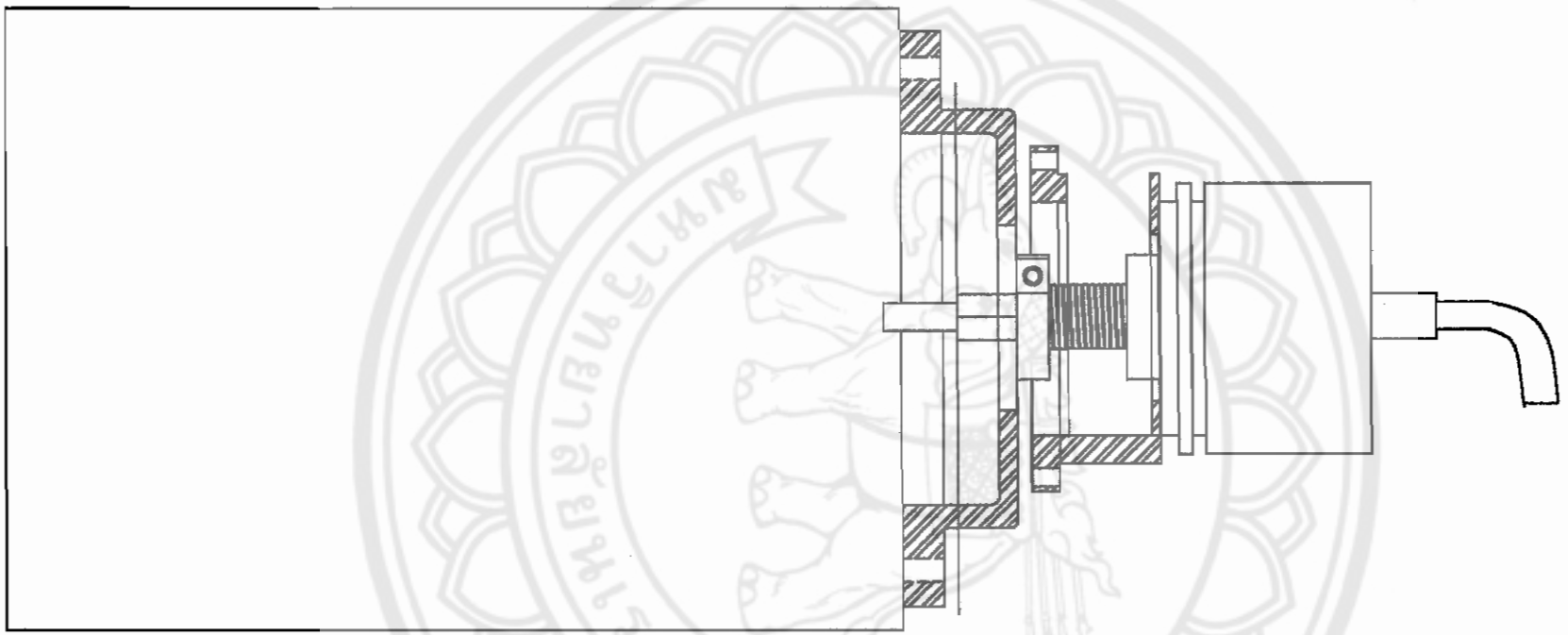
A–A'



คลัปปลิงต่อแกน
Encoder

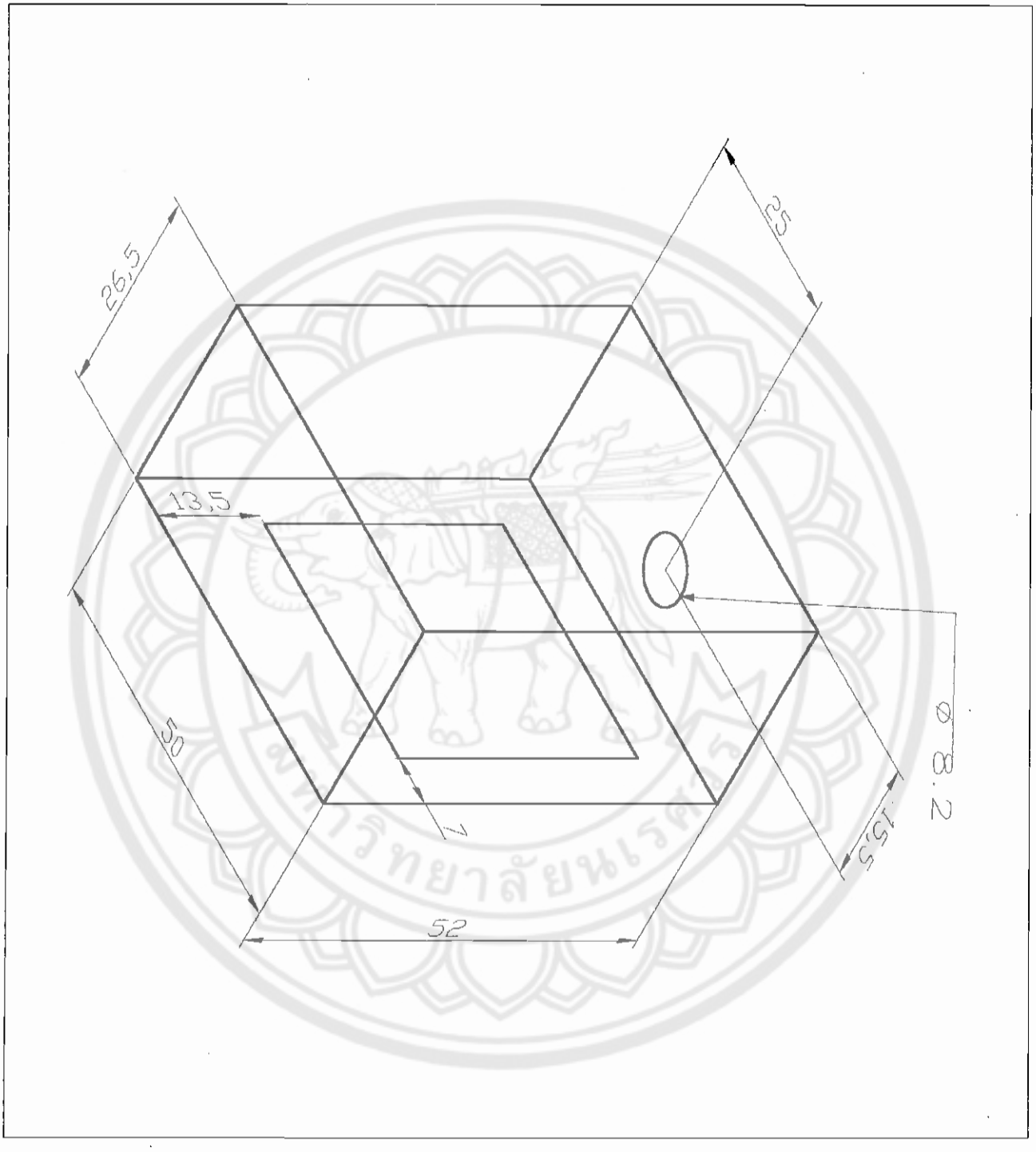
Scale in MM.

ภาพที่ 2/4



การประกอบชุด Encoder
เข้ากับ Motor

Scale in MM. ภาพที่ 3/4


26,5
25
13,5
50
52
7
Ø8,2
15,5