CNC SYSTEM

OSP5000L-G

LR Series CNC Lathes

MAINTENANCE MANUAL (1st Edition)

OKUMA

Your single source for machine & control

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Note: To avoid any confusion over the use of the letter "O (oh)" and figure "0 (zero)" in this manual, the numerical value "0 (zero)" is expressed as "Ø" if there is any possibility of misunderstanding.

SECTION 1 SPECIAL FEATURES OF OSP5ØØØ SERIES

Based on the OSP series that has an outstanding production record as a CNC all over the world, the OSP5ØØØ series is a high performance computerized numerical control system that functions as an Intelligent Manufacturing Cell (IMC) forming an operator unattended production system.

(1) A multiprocessor CNC system

The OSP5ØØØ is a multiprocessor CNC system using plural high-performance microprocessors, and features architectures capable of coping of high level NC functions.

(2) Versatility

Through distributed processing by the multiprocessor, the OSP5ØØØL-G provides versatile functions not available on existing NCs, such as alarm monitor data processing, link with high level computers, advanced online automatic programming function, and large capacity part program storage. This CNC is complete also with functions such as diagnostics and operation guides, display of alarm data and display of production control information, by means of the CRT.

(3) Tremendously Expandable, Never Obsolete

The computer software is stored in the bubble memory. Therefore, it is easy to change the software, enabling any addition and alteration of functions in the future, and this OSP5ØØØL-G can be used always as a most up-to-date system ready to meet the customer's application needs.

(4) High Reliability

High reliability is ensured by various kinds of functions such as automatic memory error correction, perfect noise isolation by a photocoupler, high integration of hybrid ICs and LSIs, etc., reduced consumption power and thorough monitoring of CPU power supply, and by a simple structure mounted in the totally enclosed cabinet.

(5) Uniquely Designed for Easy Operation

Since a CRT is provided as standard on an operation panel, it is exceedingly easy to operate.

SECTION 2 SUMMARY OF OPERATION

The OSP5ØØØL-G employs a closed loop system with absolute position feedback. The following is a brief summary of its operation:

The value (command value) which is read into the CNC in the form of taped commands generates path functions (operation value, RCON) within the CNC to produce a commanded tool path at the commanded feedrate.

Meanwhile, the OSP position encoder detects actual position signals (RAPA) of each axis. This RCON and RAPA are continuously compared, the difference (DIFF) between RCON and RAPA is added to the feedrate command and the result is input to the drive unit as motor drive current command (digital value). The drive unit controls the brushless servo motor so that value DIFF will be zeroed.

For details, refer to Section 4-3, "Operation and Structure of the NC".

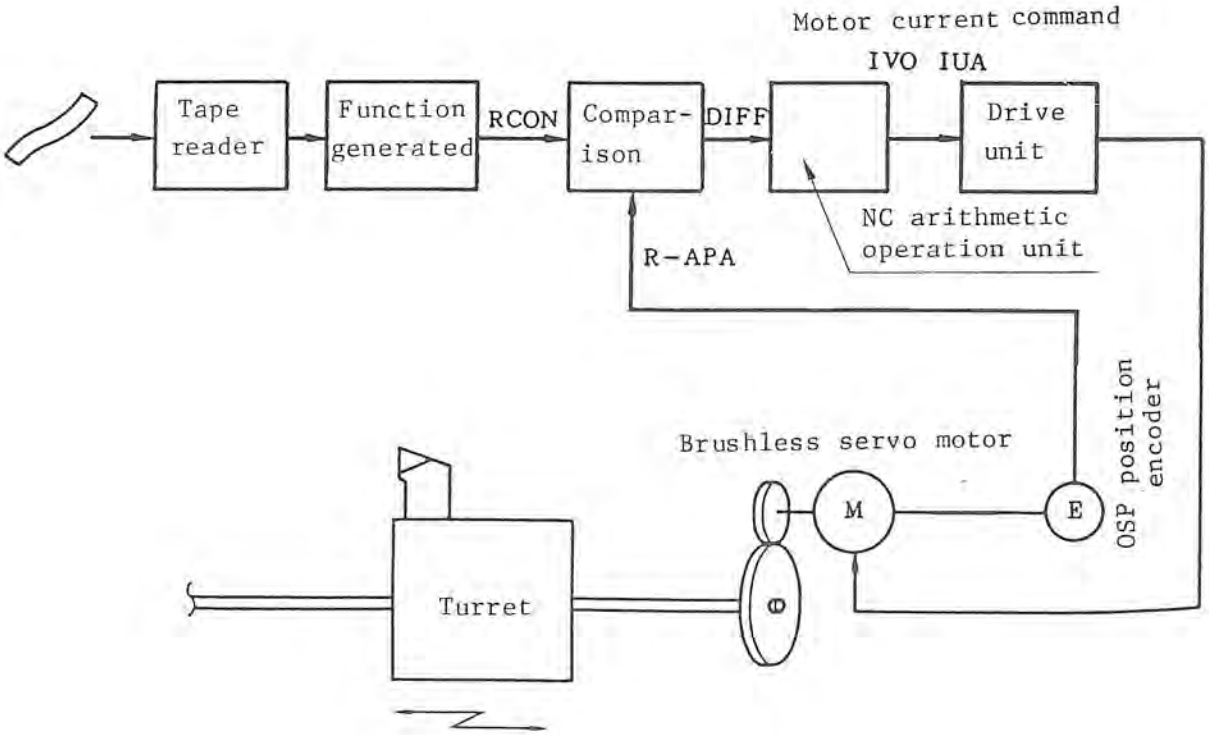


Fig. 2-1 Operation of OSP5ØØØL-G

SECTION 3 STRUCTURE OF OSP5ØØØL-G

This section outlines the overall structure of the OSP5ØØØL-G. For further information, consult the following sections of this manual.

Section 4-3: Operation and Structure of the NC
Section 5 : Trouble and Troubleshooting

3-1. CPU UNIT

This is the heart of the CNC system and consists of the following printed circuit board modules and units:

See Fig. 5-1Ø.

*Printed Circuit Board

MAIN BOARD-IIA
MAIN CARD2-II
BUBBLE CARD

CRP BOARD-II (CRT-9 .... Monochrome Specification)

TIMING CONTROL BOARD-II
SERVO PROCESSOR BOARD-II ..... Axis control processor

EC BOARD ..... EC input/output

The parts listed above are for standard system specifications. For optional specifications, printed circuit boards for selected functions will be added.

*Power Supply Unit

This supplies all the power required for CPU operations.

3-2. SERVO DRIVE UNIT

The servo drive unit receives motor current command (digital value) outputted from the CPU to control brushless servo motors which drive X- and Z-axis. This accurately controls movements of the turret in accordance with the programmed commands.

The servo drive unit consists of the following units:

a) DC power supply

Supplies DC power to the brushless motors.

b) Servo amplifier unit

Controls brushless servo motors in response to the command input from the CPU.

3-3. RELAY AND MAGNET SWITCH CIRCUITS

These circuits are used to control machine-mounted solenoids, electric motors, etc., and also conveys signals from machine-mounted pushbutton switches and limit switches to the CPU.

The following panels are provided:

*MS Panel ..... Panel with magnet switches
*Relay Panel... Panel with control relays

3-4. SPINDLE DRIVE VAC MOTOR CONTROL

The spindle is driven by a VAC motor.

The control unit receives speed command signals given from the CPU, in the form of analog voltage, and controls the motor speed to the commanded speed.

For details of VAC spindle drive unit maintenance, refer to Section 6.

3-5. CONTROL ENCLOSURE

Arranged in a single enclosure are the CPU, drive units, relay and magnet switch circuits, spindle motor drive unit and others.

The totally enclosed construction provides reliable protection against the entry of oil mist, chips, dust and dirt, ensuring stable performance of semiconductors, relays and magnetic switches.

Mounted on the common machine base, this space-saving CNC package forms a compact machine-control combination.

3-6. OPERATION PANEL

All the controls necessary for operating the machine such as operating switches, manual switches and the pulse handle are incorporated into and mounted to this accessible pendant-type operation panel. A large-sized CRT is provided as standard, assuring ease of operation.

3-7. ABSOLUTE POSITION FEEDBACK ENCODERS

To each servomotor for the X- and Z-axis, the absolute position feedback encoder that produces accurate information concerning the instantaneous position of each axis is provided. The output signals from these encoders are fed into the CNC system for accurate positioning of each axis.

Attached to the main spindle is a main spindle pulse generator to detect the spindle speed.

3-8. COOLING UNIT

The cooling unit provided above or at the side of the control box keeps the temperature inside the control enclosure virtually at room temperature level. This provides the CNC system with higher reliability.

3-9. TURRET CONTROL UNIT

A high speed microprocessor is used to ensure quick and stable turret indexing and positioning. For turret control unit maintenance, refer to Section 8.

SECTION 4 MAINTENANCE AND INSPECTION

Daily checks greatly help to keep your CNC operating properly at all times. When any trouble occurs, integrated testing circuits within the CNC system will help you diagnose most malfunctions and pinpoint their location quickly, thus enabling you to reset to normal operation with little inconvenience.

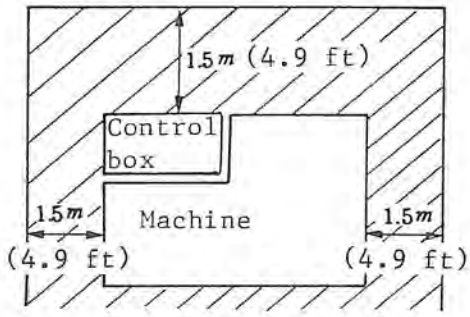
Consult also the following section:

Section 5 Trouble and Troubleshooting

4-1. INSPECTION DURING INSTALLATION

4-1-1. Installation Site

During initial installation, careful consideration should be given to easy access for inspection and maintenance purposes as well as for operation.



Arrange the machine and the machine control unit as shown in the left figure.

Since the machine control unit doors must be opened and some space must be given for maintenance and inspection, install the machine and the machine control unit so that they are not close to a wall.

Fig. 4-1 Layout

4-1-2. Environmental Requirements

Pay attention to the following items:

(1) Do not install the CNC system in a place exposed to direct sunlight.

(2) The CNC system should be kept away from chips, coolant, oil, etc.

(3) The site should be free of excessive vibration.

(4) Ambient temperature should be between Ø°C and 4Ø°C.

(5) The site should be free of large electrical noise sources such as welding machines. (Power should be preferably drawn from the plant power source.)

(6) Avoid dirty and dusty areas.

4-1-3. Power Supply Voltage Inspection

The allowable variance in the input voltage for the CNC system is ±1Ø% of the available input voltage. An excessive voltage drop because of insufficient power capacity in the plant will cause NC malfunctions. It will also be subject to unavoidable influence from other equipment. In such cases, proper measures should sometimes be taken against those sources.

4-2. PERIODICAL INSPECTION

The CNC system incorporates highly advanced electronic circuits which are susceptible to moisture, oil, dirt, dust, and chips present in machine shops. Elevated temperatures within the enclosure may result from clogging of filters in the cooling unit.

Also, it is necessary to inspect motor brushes and the like which are subject to wear.

(1) Weekly Inspection

Tape Reader Light Receiving Surface:

Keep the light receiving glass surface clean at all times.

Clean carefully with gauze or soft cloth so as not to scratch it.

Perforated Tape Inspection:

Dirty, torn or worn out paper tape from excessive use may lead to NC malfunctions and troubles.

Tape Reader Projector Lens Cleaning:

Remove the front cover of the tape reader, and carefully clean the projector and lens with soft cloth so as not to scratch them.

(2) Every Three Months Inspection

Cooling Unit Cleaning:

Make sure that the cooling unit on the control box operates to blow air hard. If the filter mesh screens are clogged, clean.

4-3. OPERATION AND STRUCTURE OF THE NC

To gain an overall understanding of CNC operations, study the following carefully:

4-3-1. Example of Operation

When GØ1 X1ØØ.ØØØ FØ.1 S3ØØ TØ1Ø1 MØ3 CR is given as command data, the unit operates as follows:

(1) Press the CYCLE START button, and the CPU starts running according to the command data stored in memory.

(2) S, T, and M operation starts.

The S, T, M commands read are transferred to the EC relay circuit via the EC board.

The spindle rotation command is converted into the motor speed command, which is then converted into analog voltage on the TIMING CONTROL board. The analog voltage is outputted to the spindle drive motor control unit.

Thus, the spindle starts rotating in the forward direction at 3ØØ rpm. The turret is indexed to select the #1 tool.

After these S, T and M commands have been executed and the commanded states are established, the execution completion signals are given to the CPU.

(3) Operation of Interpolator

After the completion of execution of S, T and M commands, cutting can be started. Therefore, axis movement commands now may be started. Pulse signals from the pulse generator coupled with the spindle is read through the TIMING CONTROL board and functions are generated at the feedrate of FØ.1 mm/rev from a present coordinate point to the commanded coordinate point (X1ØØ.ØØØ) along a GØ1 straight-line path.

(4) Movement of Axes

R-CON the output from the interpolator is compared with the actual position data R-APA given from the position encoder. The difference DIFF between R-CON and R-APA is converted into the motor current value (digital value) and the result is outputted from the servo processor to the servo drive.

The servo drive unit controls the brushless servo motor so that the DIFF input will be zeroed at all times, and as a result, R-CON and R-APA are matched, and positioning to X1ØØ.ØØØ is completed.

4-3-2. Description on Each Major NC Unit

(1) The Power Supply Unit receives AC 200V supply and supplies all the power required for operation of the CPU. It also controls the sequence for power supply ON/OFF. Press the CONTROL ON button on the operation panel, and the Power Supply Unit supplies first voltage to the CPU and drives the CPU. Press the CONTROL OFF button, and this unit cuts off voltage supply to the CPU after stopping CPU operation. Moreover, this unit detects abnormalities such as abnormal drop and rise of output voltage, abnormal drop of input voltage, and elevated temperature within the unit, etc., causes the CPU to stop the operation, cuts off voltage supply and has a monitor function to display the cause of an abnormality on the monitor display. The monitor display is effective even if supply voltage to the CPU is cut off by pressing the CONTROL OFF button on the operation panel, unless power supply to the CNC system is cut off by turning off the main switch (no-fuse circuit breaker).

(2) The CPU Unit is the central controller of the OSP5000L-G and of the multi-processor structure consisting of plural processors.

The standard unit consists of five BOARDs and CARDs annexed to the BOARDs as follows:

a) MAIN BOARD-IIA: Main Processor Board

This consists of the main processor which controls the IC memories, bubble memory, slave processors and interface circuits, and IC memories which store the control software for controlling the processor. The control software stored in IC memories is transferred to the bubble memory when power is turned on.

BUBBLE CARD: Bubble Memory

This is a memory to store taped commands, and control software when power is switched OFF. The operation of writing the control software into the bubble memory is called "loading". Such control software is supplied in floppy disks with all NC systems.

When loading is carried out according to the "Loading" procedure in Section 5-5-3, if required, the contents of the bubble memory can be rewritten.

MAIN CARD 2-II: PTR

The circuit interfacing the tape reader.

b) CRP BOARD-II (CRP-9 Monochrome Specification): Panel

The circuit interfacing the operation panel.

c) TIMING CONTROL BOARD-II

The circuit for generating timing signals required for the servo processor, the interface circuit for the spindle drive.

d) SERVO PROCESSOR BOARD-II

The circuits interfacing the position encoder, the sensor input, the servo drive unit and position encoder, and the circuit interfacing the measuring devices.

e) EC BOARD: Relay, magnet switch circuit input/output

The circuits interfacing the power relays, magnet switches, solenoid valves and limit switches, etc.

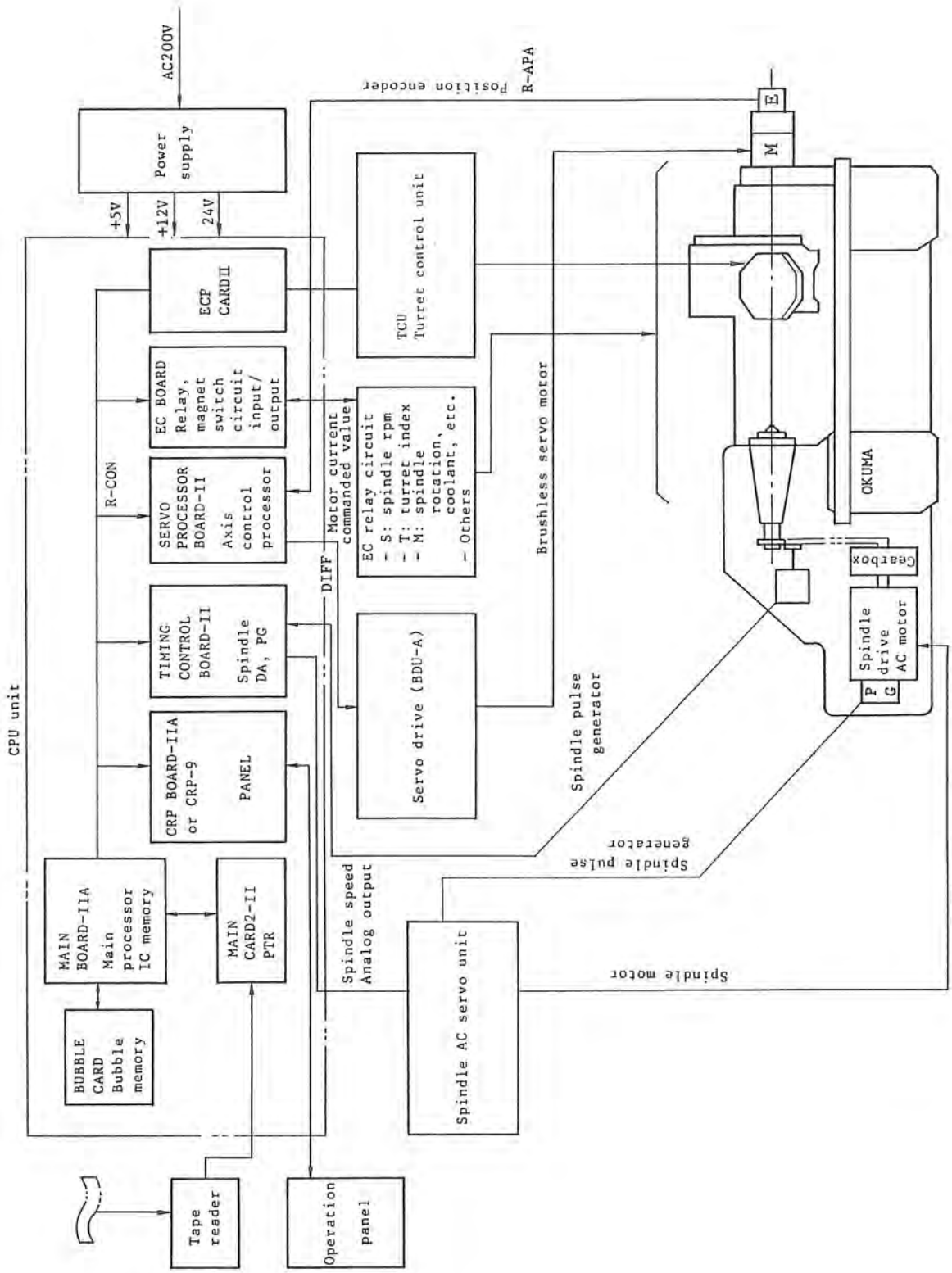


Fig. 4-2 OSP5ØØØL-G System Configuration

4-4. SELF-DIAGNOSTICS

The OSP5ØØØL-G is a sophisticated CNC system that is designed to make the most of its built-in computer capabilities. The self-diagnostic function is one of the advantages a computerized numerical control system can provide. This function is classified into the following two items:

- Check function by alarm display and error display
- Check function by check data display

Check Function by Alarm Display and Error Display:

This function constantly monitors any defect including programming, operational errors and NC malfunctions.

When any defect such as the programming error and NC malfunction requiring stop of the machine operation occurs, the ALARM lamp goes on, the machine is stopped, and the contents of the alarm will be displayed on the CRT. When the defect is an operational error during editing operation, etc. not requiring the machine to be stopped, the ALARM lamp does not go on, but the contents of the error only will be displayed on the CRT. From these displays, the contents of the defect can be judged.

Check Function by Check Data Display:

With check data displayed on the CRT, it is possible to check internal conditions of the CNC, input/output signals of the NC and so on. This is a useful function to adjust and check the CNC.

4-4-1. Alarm Display and Error Display

The CNC constantly monitors the operating conditions of the machine, the program data and the operation of the machine operator. When any problem takes place, it gives the operator a warning by displaying an alarm message or error message.

Alarm Display ... The machine is stopped. The ALARM lamp under NC STATUS goes on. The corresponding alarm message is displayed on the 2nd line of the CRT.

Error Display ... Mainly warning against any of the items input by the operator, and does not cause the machine to be stopped.

The ALARM lamp does not go on and the error message is displayed on the 18th to 22nd line on the CRT.

CPU Alarm ..... This alarm indicates CPU malfunction. When this type of alarm occurs, machine operation cannot be resumed until power supply is turned on again. Naturally, the machine instantly stops.

When the CPU does not function normally, the message is displayed below the central portion on the CRT.

For alarm and error messages, refer to Alarm & Error List for OSP5ØØØL-G (Publication No. 2578-E).

4-4-2. Check Data Display

The CNC constantly monitors internal conditions of the CNC and input/output signals of the NC, and the operator can see these data through check data displayed on the CRT.

Check data displayed on the CRT and its contents are shown in the following pages.

(1) Status Display of EC Input Signal (No. 1)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                   UNIT 1mm
          EC INPUT 01:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   11101111   TCLA CPA/ OPA/  OFA TLAC TLAB TLAA TLA9
      2   00000011   TLA8 TLA7 TLA6 TLA5 TLA4 TLA3 TLA2 TLA1
      3   10000010   TCLB CHP2 CHP1 SPL5 SPL4 SPL3 SPL2 SPL1
      4   00000011   TLB8 TLB7 TLB6 TLB5 TLB4 TLB3 TLB2 TLB1
      5   11000110   SSP/ TSP/  STR  RST DROP SOA/  BOF  BCL
      6   10100000   CCC2 CCC1 TSRT TSLM TSOA TSRF TSA2 TSA1
      7   11011111   IN24 EOF/ SCSF ALM/ APA/ SEA/ LOA/  LA/
      8   11111111   SBA/ SLA/  SA/ TMA/ OHA/ OLA/ CBA/ ECON
      9   11101110   OIL/ IILC TLXF TLZF  SPZ  SPC CHOP CHCL
     10   00000000
     11   11101000   IDC/ TSP/ DROP DRCL CDA/  CDM MANS ESIN
     12   00000000        MNIN EXOR CTIM TRST LOTC TRTC ESUE

=
PROGRAM | ACTUAL | PART | BLOCK |      | TOOL | CHECK |
SELECT  | POSIT | PROGRAM | DATA |      | LAYOUT | DATA | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1		Chuck Pressure Low	Hydraulic Source Pressure Low/	Alarm - Oil Filter Clogged				
2								
3		Chuck Pedal #2	Chuck Pedal #1					
4								
5	External Cycle Stop/	External Slide Hold/	External Cycle Start	External Reset	Door Open Confirmation Switch	Spindle Lubrication Pressure Low/	Slideway Lube Oil Flow	Slideway Lube Oil Level low
6	Chip Cover Close Confirmation Switch 2	Chip Cover Close Confirmation Switch 1	Tailstock Quill Retraction Confirmation Switch	Tailstock Quill Inposition Confirmation Switch	Tailstock Quill Overadvance Confirmation Switch	Tailstock Quill Retraction Foot Switch	Tailstock Quill Advance Foot Switch 2	Tailstock Quill Advance Foot Switch 1
7	External Input 24	Emergency Limit Switch Release	Spindle Orientation Completion	External Alarm/	SMW Chuck Pressure Low/	Alarm - Travel End/	Alarm - LDU Overload/	Alarm - Static Pressure Unit Cooler
8	Alarm - Spindle Brush Wear/	Alarm - Spindle Overload/	Alarm - SDU/	Alarm - CPU Temperature/	Alarm - Transformer Overheat/	Alarm - EC Overload/	Alarm - EC Circuit Breaker/	Emergency Stop
9	External Interlock	Internal Interlock Released	Turret X-axis Free	Turret Z-axis Free	Spindle Zero Speed	Spindle at Constant Speed	Chuck Open Confirmation Switch	Chuck Close Confirmation Switch
1Ø								
11	Index Chuck Completion Limit/	Sensor Protect Limit/	Door Open	Door Close	Coupling Device Alarm/	Interlock Mode	Answer for Aux. M Code	External Spindle Jog
12		Operation Monitor External Input	External Spindle Orientation	Calender Timer Input	CEJ Transfer Start	Lot Completed	Tool Retraction Cycle Interrupt Input	External Start Disabled

(2) Status Display of EC Input Signal (No. 2)

```
AUTO OPERATION A.MIN                                N        0

CHECK DATA                                          UNIT 1mm
          EC INPUT 02:
      no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      13   01030001   TSUC TSCL INCC  M44  M43  M42  M41  M40
      14   00000000   IN18 IN17 IN16 IN15 IN14 IN13 IN12 IN11
      15   00000000             CMPS CDOP SHC/ SHAD SHMP SHSP
      16   00020000   MST1 MDC1          SL14 SL13 SL12 SL11
      17   00030000                 OK1 +OK1 -OK1 +NG1 -NG1
      18   00030000   MST2 MDC2          SL24 SL23 SL22 SL21
      19   00030000                 OK2 +OK2 -OK2 +NG2 -NG2
      20   00000000
      21   00021000   WFAL           RTID CIL/  CFJ  CHJ  CNJ
      22   00130100   EPSS      PAL/  RTI  RTC ROL/ M242 M241
      23   00030000   PN28 PN24 PN22 PN21 PN18 PN14 PN12 PN11
      24   00000000   CLPP OPNP POS5 POS4 POS3 POS2 POS1 CLSP

=
PROGRAM | ACTUAL | PART | BLOCK |        | TOOL | CHECK |
SELECT  | POSIT | PROGRAM | DATA |        | LAYOUT | DATA | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13	Tailstock Joint ON	Tailstock Joint OFF	Spindle Jog Reverse	← Spindle Speed Range →				
				M44	M43	M42	M41	M4Ø
14	External Input 18	External Input 17	External Input 16	External Input 15	External Input 14	External Input 13	External Input 12	External Input 11
15	UVE Air Chuck Open	UVE Air Chuck Close	Chucking Error Pressure Switch	Coupling Device Retraction Position	Optical Sensor Workpiece Detect	Sensor Head Advance Position	Sensor Head Interme-diate Position	Sensor Head Retraction Position
16	Gauging Start	Gauging Data Clear			← Switching Signal (Post-process Gauging 1) →			
17				← Judging Signal →				
				OK1	+OK1	-OK1	+NG1	-NG1
18	Gauging Start	Gauging Data Clear			← Switching Signal (Post-process Gauging 2) →			
19				← Judging Signal →				
				OK2	+OK2	-OK2	+NG2	-NG2
2Ø								
21	Work Abnor-mal Runout Input			Revolving Tool Spindle Orientation	← C-axis →			
					Interlock/	Connect Confirma-tion	Connect Start Con-firmation	Disengaged Confirma-tion
22	External Program Selection Start	External Program Selection Parity	← Revolving Tool →					
			Alarm/	Zero Speed	Constant Speed	Overload/	Gear High	Gear Low
23	← External Program Selection →							
	← 2nd Digit →				← 1st Digit →			
	PN28	PN24	PN22	PN21	PN18	PN14	PN12	PN11
24	Clamp Con-firmation Pressure Switch	← Long Stroke Chuck →						
		Open End	POS 5	POS 4	POS 3	POS 2	POS 1	Close End

(3) Status Display of Extended EC Input Signal (No. 1)

```
AUTO OPERATION A.MIN                                    N        0

CHECK DATA                                              UNIT 1mm
                EC INPUT EXTEND Ø1:
          no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
           1    00000000
           2    00000000
           3    00000000
           4    00000000
           5    00000000
           6    00000000
           7    00000000
           8    00000000
           9    00000000
          10    00000000   PN48 PN44 PN42 PN41 PN38 PN34 PN32 PN31
          11    00000000
          12    00000000   IN48 IN47 IN46 IN45 IN44 IN43 IN42 IN41

=
PROGRAM SELECT | ACTUAL POSIT | PART PROGRAM | BLOCK DATA |  | TOOL LAYOUT | CHECK DATA | [EXTEND]

F1  F2  F3  F4  F5  F6  F7  F8
```

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1								
2								
3								
4								
5								
6								
7								
8								
9								
1Ø	← External Program Selection →							
	← 4th Digit →				← 3rd Digit →			
	PN48	PN44	PN42	PN41	PN38	PN34	PN32	PN31
11								
12	← External Input →							
	48	47	46	45	44	43	42	41

(4) Status Display of Extended EC Input Signal (No. 2)

```
AUTO OPERATION P.MIN                                N          O

CHECK DATA                                                UNIT 1mm
                EC INPUT EXTEND 02:
          no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
          13    00000000
          14    00000000
          15    00000000
          16    00000000
          17    00000000
          18    00000000
          19    00000000
          20    00000000
          21    00000000
          22    00000000
          23    00000000
          24    00000000

=
PROGRAM | ACTUAL | PART    | BLOCK |        | TOOL   | CHECK  |
SELECT  | POSIT  | PROGRAM | DATA  |        | LAYOUT | DATA   | [EXTEND]

F1  F2  F3  F4  F5  F6  F7  F8
```

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13								
14								
15								
16								
17								
18								
19								
2Ø								
21								
22								
23								
24								

(5) Status Display of EC Output Signal (No. 1)

```
AUTO OPERATION A.MIN                    N        Ø

CHECK DATA                                   UNIT 1mm
          EC OUTPUT Ø1:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bitØ
      1   00000000   TSRS TSRT TSAD TSIN SMWO SMWC CHOP CHCL
      2   00001000    WKL OT23  INM SEND SPSP  SPW PEND  PSP
      3   01000001    PWS ALM/ SPS7 SPS6 SPS5 SPS4 SPS2 SPS1
      4   03000000   SPWB COOL TCCB TCWB UCLB TCCA TCWA UCLA
      5   00001000   BOMT  WKC SSPP SCSP DROP DRCL TSHP TSLP
      6   00000000
      7   00001000   SARB  ARB TSIC NCAL AUTO  MAN NCST ZLMT
      8   00000000           XLMT NALC CMAO CHIC SHRT SHAD
      9   00000000   CHHP CHLP TSUC TSCL USM4 USM3 USM2 USM1
     10   00000000   OT18 OT17 OT16 OT15 OT14 OT13 OT12 OT11
     11   01000000   CHCL CHLO ATLF BTLF USM8 USM7 USM6 USM5
     12   00000000

*
PROGRAM | ACTUAL | PART | BLOCK |       | TOOL | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |       | LAYOUT | DATA | [EXTEND]

F1 F2 F3 F4 F5 F6 F7 F8
```

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1	Tailstock Quill Advance Reset	Tailstock Quill Retract Reset	Tailstock Quill Advance	Tailstock Quill Advance - inching	SMW Chuck Open	SMW Chuck Close	Chuck Open	Chuck Close
2	Work Lamp	External Output 23	Hour Meter	Schedule End	Spindle in Stop	Spindle Rotation Command	Program End	Program Stop
3	Power Save Command	NC Alarm/	←	Spindle Gear Selection Solenoid				→
4	Spindle CCW Command	Coolant	Turret B Reverse Rotation	Turret B Forward Rotation	Turret B Unclamp	Turret A Reverse Command	Turret A Forward Rotation	Turret A Unclamp
5	Slideway Lubrication Motor	Work Count	Spindle Orientation Pin IN	Spindle Orientation in Execution	Door Open	Door Close	Tailstock Quill Thrust High	Tailstock Quill Thrust Low
6								
7	Spare Air Blower	Air Blower	Tailstock Interlock Neglect	Alarm Lamp	Automatic Mode	Manual Mode	In Operation	Z-axis at Emergency Limit
8			X-axis at Emergency Limit	Alarm Output	Chucking Error Air ON	Chuck Interlock Neglect	Sensor Head Retraction	Sensor Head Advance
9	Chuck High Pressure	Chuck Low Pressure	Tailstock Joint ON (Swing Advance)	Tailstock Joint OFF (Swing Retraction)	M1Ø4	M1Ø3	M1Ø2	M1Ø1
1Ø	External Output 18	External Output 17	External Output 16	External Output 15	External Output 14	External Output 13	External Output 12	External Output 11
11	Chuck Clamp	Chuck Unclamp	Life of Tool on Turret A Expired	Life of Tool on Turret B Expired	M1Ø8	M1Ø7	M1Ø6	M1Ø5
12								

(6) Status Display of EC Output Signal (No. 2)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                   UNIT 1mm
          EC OUTPUT 02:
     no.    data      bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
     13   00030000    WFCM ADCL      RTID CNT2 CMR2 CNT1 CMR1
     14   00000000    PN28 PN24 PN22 PN21 PN18 PN14 PN12 PN11
     15   00030000    EPNR      CSTP  CCF  CCP  CJS  CHB  CLJ
     16   00030000    LCOC LCOS      SABB RRC  RSP  RHS  RLS

=
PROGRAM | ACTUAL | PART | BLOCK |  | TOOL | CHECK |
SELECT  | POSIT | PROGRAM | DATA |  | LAYOUT | DATA | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
13	Workpiece Deflection Detection	Additional Coolant		Revolving Tool Spindle Orientation	CEJ New Tool 2	CEJ Data Transfer Request 2	CEJ New Tool 1	CEJ Data Transfer Request 1
14	← External Program Selection →							
	← 2nd Digit →				← 1st Digit →			
	PN28	PN24	PN22	PN21	PN18	PN14	PN12	PN11
15	External Program Selection, Number Confirmation Request		C-axis Stop	Positioning Complete	C-axis Clamp	C-axis Connect	High Pressure Brake	Low Pressure Connect
16	Long Stroke Chuck Unclamp Stop Release	Long Stroke Chuck Unclamp Stop		Spare Air Blower	Rotation Command	Revolving Tool Spindle Stop	Revolving Tool Spindle High Speed	Low Speed

(7) Status Display of Extended EC Output Signal (No. 1)

```
AUTO OPERATION A.MIN                                N        0

CHECK DATA                                          UNIT 1mm
          EC OUTPUT EXTEND 01:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   00000000
      2   00000000
      3   00000000
      4   00000000
      5   00000000
      6   00000000   PN48 PN44 PN42 PN41 PN38 PN34 PN32 PN31
      7   00000000   USMG USMF USME USMD USMC USMB USMA USM9
      8   00000000
      9   00000000
     10   00000000
     11   00000000
     12   00000000

:=
PROGRAM | ACTUAL | PART | BLOCK |        | TOOL | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |        | LAYOUT | DATA | [EXTEND]

F1  F2  F3  F4  F5  F6  F7  F8
```

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1								
2								
3								
4								
5								
6	← External Program Selection →							
	← 4th Digit →				← 3rd Digit →			
	PN48	PN44	PN42	PN41	PN38	PN34	PN32	PN31
7	M237	M236	M235	M234	M233	M232	M231	M23Ø
8								
9								
1Ø								
11								
12								

(8) Status Display of Extended EC Output Signal (No. 2)

```
AUTO OPERATION A.MIN                    N        3

CHECK DATA                                      UNIT 1mm
          EC OUTPUT EXTEND 02:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
     13   00000000
     14   00000000
     15   00000000
     16   00000000

=
PROGRAM | ACTUAL | PART    | BLOCK |        | TOOL   | CHECK  |
SELECT  | POSIT | PROGRAM | DATA  |        | LAYOUT | DATA   | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13								
14								
15								
16								
17								
18								
19								
2Ø								
21								
22								
23								
24								

(9) Status Display of Machine Operation Panel Input Signal (No. 1)

```
AUTO OPERATION A.MIN                                N          0

CHECK DATA                                                UNIT 1mm
          PANEL INPUT 01:
     no.    data      bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   10000100    CRTC PNAE PNAD TLRT  RET TSP/  STR  RST
      2   00000000    SPSP SPCC SPCW SPIN MNNX MNNZ MNPX MNPZ
      3   00000000    CLTP CLON  BDE  PH1  PHX  PHZ PH50 PH10
      4   00100000    IN22  WKL SSP/                    M4*  M40
      5   00030010     SGB OPSP BTSN ATSN ILOF MION MLCK DRYR
      6   00031000    DRIL  ARB DROP DRCL TSSW  SMW CHIN CHOT
      7   00000000    CHMO TSUC TSCL TSRE SHRT SHAD SARB INCC
      8   00000000    ZAOI ZBOI XAOI XBOI PON/ ROSP LOTC SPRR
      9   01011000     S08  S04  S02  S01  F08  F04  F02  F01
     10   00000000                   IN10 IN10 IN10 IN10 IN10
     11   00000000     IN8  IN7  IN6  IN5  IN4  IN3  IN2  IN1
     12   00000000    OTBP                             TRTC TSSW

=
PROGRAM:| ACTUAL | PART | BLOCK |       | TOOL | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |       | LAYOUT | DATA | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1	CRT OFF	NC Panel Limited Use	NC Panel Disabled	Tool Index	Sequence Restart	Slide Hold	Cycle Start	NC Reset
2	Spindle Stop	Spindle CCW	Spindle CW	Spindle Jog	Slide Jog	Slide Jog	Slide Jog	Slide Jog
3	Coolant Auto	Coolant Manual	Block Delete	Pulse Handle 1/1	Pulse Handle X-axis	Pulse Handle Z-axis	Pulse Handle 5Ø/1	Pulse Handle 1Ø/1
4	External Input 22	Work Lamp	Cycle Stop/				← Spindle Drive Gear → ON	Neutral
5	Single Block	Optional Stop	Individual Operation of Turret B	Individual Operation of Turret A	Interlock	Mid-Auto Manual Operation ON	Machine Lock	Dry Run
6	Door Interlock	Air Blower	Door Open	Door Close	Tailstock Quill, Center Work	SMW Chuck	Chuck ID Gripping	Chuck OD Gripping
7	Chucking Error ON	Tailstock Joint ON	Tailstock Joint OFF	Tailstock Joint Position Return	Sensor Head Retraction	Sensor Head Advance	Spare Air Blower	Spindle Jog Reverse Direction
8	ZA-axis Overload	ZB-axis Overload	XA-axis Overload	XB-axis Overload	Gauging Data Printer ON/	Robot Optional Stop	Lot Completion	Schedule Program Reset
9	←	Spindle Speed Override		→	←	Feedrate	Override →	
1Ø				←		External	Input 1Ø →	
11	External Input 38	External Input 37	External Input 36	External Input 35 Broken Tool Detection Cycle	External Input 34 Data Read-out Cycle	External Input 33 First Part Gauging Cycle ON	External Input 32 Work Gauging Cycle ON	External Input 31 Master Ring Gauging Cycle ON
12	External Output 31-38 Reset						Tool Retraction Cycle Interrupt Input	External Program Selection Strobe

(1Ø) Status Display of Machine Operation Panel Input Signal (No. 2)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                  UNIT 1mm
          PANEL INPUT 02:
      no.   data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      13   00000000  PN28 PN24 PN22 PN21 PN18 PN14 PN12 PN11
      14   00000000  MNPC MNNC MNCP MNUC  MOP  PHC       GSER
      15   00000000  ACTP ACON OMAT OMON CSNX CSNZ CSPX CSPZ
      16   00000000                                RMON CMOB
      17   00000000  PN48 PN44 PN42 PN41 PN38 PN34 PN32 PN31
      18   00000000
      19   00000000  NGFN OKFN MAFN FWFN SCST INTM CDCM CMOC
      20   00000000                                NCPT
      21   00000000
      22   00000000
      23   00000000
      24   00000000

PROGRAM | ACTUAL | PART | BLOCK |      | TOOL | CHECK | [EXTEND]
SELECT  | POSIT  | PROGRAM | DATA |      | LAYOUT | DATA |
```

F1 F2 F3 F4 F5 F6 F7 F8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13	External Program Selection							
	2nd Digit				1st Digit			
	PN28	PN24	PN22	PN21	PN18	PN14	PN12	PN11
14	C-axis							
	Manual +C	Manual -C	Manual Clamp	Manual Unclamp	MOP OFF	Pulse Handle C-axis		Revolving Tool Spindle Selection
15	Additional Tape	Coolant ON	Overload Monitor Auto-set	Overload Monitor ON	Touch Setter			
					Cycle Start -X	Cycle Start -Z	Cycle Start +X	Cycle Start +Z
16							DNC-B Remoto Mode ON	DNC-B Communi-cation ON
17	External Program Selection							
	4th Digit				3rd Digit			
	PN48	PN44	PN42	PN41	PN38	PN34	PN32	PN31
18								
19	DNC-C							
	Cycle Completion NG	Cycle Completion OK	Work Setup Complete	First Part Machining Complete	Schedule Start	FMS INT.	FMS Auto Start	FMS ON
2Ø							DNC-C Reverse Communi-cation	
21								
22								
23								
24								

(11) Status Display of Machine Operation Panel Input Signal (No. 3)

```
AUTO OPERATION A.MIN                                   N        0

CHECK DATA                                             UNIT 1mm
                PANEL INPUT 03:
          no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
          25    00000000
          26    00000000
          27    00000000
          28    00000000
          29    00000000
          30    00000000
          31    00000000
          32    00000000
          33    00000000
          34    00000000
          35    00000000
          36    00000000
          37    00000000

=
PROGRAM | ACTUAL | PART | BLOCK |        | TOOL | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |        | LAYOUT | DATA | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
25								
26								
27								
28								
29								
3Ø								
31								
32								
33								
34								
35								
36								
37								

(12) Status Display of Machine Operation Panel Output Signal (No. 1)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                   UNIT 1mm
          PANEL OUTPUT 01:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   00000000   OT22 OT21 BTSN ATSN              M44  M40
      2   01000000   CHCL CHLO CHAR BOLA BOFA SPPA  OPA  WKF
      3   00100000   ATTL BTTL TSRT TSFM TSOA CMAL TSUC TSCL
      4   00000000    OT8  OT7  OT6  OT5  OT4  OT3  OT2  OT1
      5   00000000   TLBC TLBB TLBA TLB9 TLAC TLAB TLAA TLA9
      6   00000000   TLA8 TLA7 TLA6 TLA5 TLA4 TLA3 TLA2 TLA1
      7   00000000   TLB8 TLB7 TLB6 TLB5 TLB4 TLB3 TLB2 TLB1
      8   00000000   ZAOL ZBOL ATOC BTOC SEN3 SEN2 SEN1 SEN0
      9   00000000   PN28 PN24 PN22 PN21 PN18 PN14 PN12 PN11
     10   00000000   XAOL XBOL              EPRA FMTO FMCM
     11   00000000   WPMA RMON CMOB CAUC CACP CAJC  PHC GSSR
     12   00000000        TMTO MARQ FWRQ INTM IDMD CDCM CMOC

=
PROGRAM | ACTUAL | PART | BLOCK |  | TOOL | CHECK |
SELECT  | POSIT | PROGRAM | DATA |  | LAYOUT | DATA | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1	Input Touch Setter Sensor Input	Gauging NG Ignore ON	Individual Operation of Turret B	Individual Operation of Turret A			—Spindle Drive Gear— ON	Neutral
2	Chuck Clamp	Chuck Unclamp	Chuck Air Pressure Low	Alarm - Slideway Lube Oil Level	Alarm - Slideway Lube Oil Flow	Alarm - Spindle Lubrication Pressure Low	Alarm - Hydraulic Pressure Low	Operation End Lamp
3	Tool Life A	Tool Life B	Tailstock Quill Retraction	Tailstock Quill In-position	Tailstock Quill Over-advance	Chucking Error Alarm	Tailstock Joint OFF	Tailstock Joint ON
4	External Output 8	External Output 7	External Output 6	← -NG	Gauging Result Output → -OK	OK	+OK	+NG
5	← Tool Life Turret B 9 - 12 →				← Tool Life Turret A 9- 12 →			
6	← Tool Life Turret A 1 - 8 →							
7	← Tool Life Turret B 1 - 8 →							
8	ZA-axis Overload	ZB-axis Overload	Turret A Monitoring	Turret B Monitoring	Turret B Tool Gauging Sensor Input	Turret B Touch Sensor Input	Turret A Tool Gauging Sensor Input	Turret A Touch Sensor Input
9	← External Program Selection →							
	← 2nd Digit →				← 1st Digit →			
1Ø	XA-axis Overload	XB-axis Overload				External Program Selection Answer	FMS Cycle Time Over	FMS Data Transfer
11	Work Pushing Error Alarm	DNC-B Remove Mode ON	DNC-B DNC ON	C-axis Unclamp	C-axis Clamp	C-axis Connect	Pulse Handle C-axis	Revolving Tool Spindle Selection
12		← DNC-C →						
		Data Transfer	Setup Change Request	First Part Machining	FMS INT.	FMS Independent	FMS Automatic	FMS ON

* 1, 11 for flat panel specification

(13) Status Display of Machine Operation Panel Output Signal (No. 2)

```
AUTO OPERATION A.MIN                                N        0
CHECK DATA                                          UNIT 1mm
                PANEL OUTPUT 02:
          no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
          13   00000000   OT48 OT47 OT46 OT45 OT44 OT43 OT42 OT41
          14   00000000
          15   00000000
          16   00000000
          17   00000000
          18   00000000
          19   00000000
          20   00000000   PN48 PN44 PN42 PN41 PN38 PN34 PN32 PN31
          21   00000000
          22   00000000
          23   00000000
          24   00000000

PROGRAM | ACTUAL | PART | BLOCK |       | TOOL   | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |       | LAYOUT | DATA  | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13	External Output 38	External Output 37	External Output 36	External Output 35 Broken Tool Detection Cycle	External Output 34 Data Read-out Cycle	External Output 33 First Part Gauging Cycle ON	External Output 32 Work Gauging Cycle ON	External Output 31 Master Ring Gauging Cycle ON
14								
15								
16								
17								
18								
19								
2Ø	← External Program Selection →							
	← 4th Digit →				← 3rd Digit →			
	PN48	PN44	PN42	PN41	PN38	PN34	PN32	PN31
21								
22								
23								
24								

(14) Status Display of Machine Operation Panel Output Signal (No. 3)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                   UNIT 1mm
          PANEL OUTPUT 03:
      no.   data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      25   00000000
      26   00000000
      27   00000000
      28   00000000  CTLP CLON  BDE  PH1  PH[illegible]  PHZ PH50 PH10
      29   00101010   SGB OPSP CRTC  WKL ILOF MION MLCK DPYR
      30   00000000
      31   00000000
      32   00000000
      33   00000000
      34   00000000
      35   00000000
      36   00000000
      37   00000000

=
PROGRAM | ACTUAL | PART | BLOCK |  | TOOL | CHECK |
SELECT  | POSIT | PROGRAM | DATA |  | LAYOUT | DATA | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
25								
26								
27								
28	Coolant Auto	Coolant Manual	Block Delete	Pulse Handle 1/1	Pulse Handle X-axis	Pulse Handle Z-axis	Pulse Handle 5Ø/1	Pulse Handle 1Ø/1
29	Single Block	Optional Stop	CRT OFF	Work Lamp	Interlock Release	Manual Int. ON	Machine Lock	Dry Run
3Ø								
31								
32								
33								
34								
35								
36								
37								

(15) Display of Specification Code (No. 1)

```
AUTO OPERATION A.MIN                                N          0

CHECK DATA                                                UNIT 1mm
                SPEC CODE Ø1:
        no.     data      bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
         1    00000000   IDC  LSCH 2SWC OLC  ROBT TATS SPRH SPID
         2    00000100   OMB1 OMCA TSC  MSPR CEJ  XMS  NSMS TCSN
         3    00000000   CMK  SMW  IEC  IECD DRIB ECE3 ECE2 ECE1
         4    00000001   ACPC CMTR ATC  TSS  CCM  MIRR 2S   SC
         5    00000000   PBCD FIBM CTIM MOP  SORS OWKC TDIO PRIF
         6    00000000   CACB THDC CALC MTCL B60S TOF3 TOF2 THSP
         7    01000100   OABV CREF COCO AXCM SHOT TLFC RMNI WKMN
         8    01111111   CNVT IGFC IGF  CLGR UTSK INML NRC  LAP
         9    00000000   CD8  CD7  CD6  CD5  CD4  CD3  CD2  CD1
        10    00010000   DRS  UVE  THCR TLRT RATC OMB2 NCLD TMPS
        11    00000000                             SRIC EBCD ALMC
        12    00000000   DNC3 DNC2 DNC1 DNCB DNCA BCDO EBST EBIT

=
PROGRAM | ACTUAL | PART | BLOCK |        | TOOL | CHECK |
SELECT  | POSIT  | PROGRAM | DATA |      | LAYOUT | DATA | [EXTEND]

F1  F2  F3  F4  F5  F6  F7  F8
```

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1	Index Chuck	Long Stroke Chuck	2-saddle Work Catcher	Overload Detect	Okuma Robot	Programmable Tailstock	Orientation (Electric)	Orientation (Pin/Brake)
2	Load Monitor-B1	Load Monitor-A	Touch Setter	Gauging Data Print	CEJ Matic Gauging	Post-process Gauging	Tool Gauging	Touch Sensor Gauging
3	Chucking Error Alarm	Air Chuck	IEC Chuck	IEC Door	Door Interlock B	EC Board (Card) Addition 3	EC Board (Card) Addition 2	EC Board (Card) Addition 1
4	AC Motor Pole Change	Comb-type Turret	ATC	Tailstock Swing	Multi-Machining	Mirror Image	4-axis 2-saddle	Center Work
5	Coupling External Device Program Selection	Floppy Input/Output (IBM)	Calendar Timer	MOP	Edit Interlock	External Work Counter	Tape Data Input/Output	Robot Request (Special)
6	C-axis Connect (high-speed B)	Thread Cutting Phase Matching	C-axis Connect (low-speed)	Cycle Time Calculation	Buffer 6Ø m	Tool Offset 96 Sets	Tool Offset 64 Sets	G34/G35 Slide Hold
7	Arbitrary Angle Chamfering	Profile Generation	Coordinate System Conversion	Pitch Error Compensation	Operation Hour Reduction Function	Tool Life Management	NC Operation Monitor	NC Work Counter
8	Tape Convert	IGF Convert	IGF	Graphic	User Task 2	Inch/Metric Switchable	Nose R 2B	LAP3
9	Coupling Spec. 8	Coupling Spec. 7	Coupling Spec. 6	Coupling Spec. 5	Coupling Spec. 4	Coupling Spec. 3	Coupling Spec. 2	Coupling Spec. 1
10	Door Open/Close (Special)	Front Drive Air Chuck	Arc Thread Cutting	Tool Retraction Cycle Interrupt Input	LR15M-ATC	Load Monitor-B2	NC Loader	Thermal Displacement Compensation
11						Max. Spindle Speed Interlock Release	External Program Selection C2	Alarm C Output
12	DNC-C3	DNC-C2	DNC-C1	DNC-B	DNC-A	← External Program Selection C	B	A →

(16) Display of Specification Code (No. 2)

```
AUTO OPERATION A.MIN                    N        0

CHECK DATA                                   UNIT 1mm
          SPEC CODE 02:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
     13   00001100   DBTL PNLS SPSS TLSB ECB  1PG  VACO 2SP
     14   00001011   OMI            OMCH MCGR 9CRT FLMP NCMS
     15   00000000                                      AXIC
     16   00000000   IDXB IDZB IDXA IDZA INDC

=
PROGRAM | ACTUAL | PART    | BLOCK   |         | TOOL   | CHECK  |
SELECT  | POSIT | PROGRAM | DATA    |         | LAYOUT | DATA   | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
13	Double Tooling	Operation Panel Position (Special)	Spindle Stop (Special)	Tool Index Type B	EC Bus Spec.	1-phase Pulse Generator	VAC Runout	2-spindle
14	OMI Message Display			Monochrome Character Display (Current)	Monochrome Graphic Display	OSP5ØØL-G Operation panel	Operation Panel with Flat Key	NC Master
15								Inductosyn Compensa-tion
16	←		Inductosyn		→			

(17) Display of Machine Code

```
AUTO OPERATION A.MIN                                N        0

CHECK DATA                                          UNIT 1mm
          MACHINE CODE
     no.    data      bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   00000010   LH55 LH35 LS30 LC50 LC40 LC30 LC20 LC10
      2   00000000   LR40 LR30 LR15 LP15 LB15 LB10 LB8  LB6
      3   00000000                             LB12 LP6  LPC4
      4   00000000

=
PROGRAM | ACTUAL | PART    | BLOCK |       | TOOL   | CHECK  |
SELECT  | POSIT | PROGRAM | DATA  |       | LAYOUT | DATA   | [EXTEND]
```

F 1 F 2 F 3 F 4 F 5 F 6 F 7 F 8

bit / No.	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1	LH55	LH35	LS3Ø	LC5Ø	LC4Ø	LC3Ø	LC2Ø	LC1Ø
2	LR4Ø	LR3Ø	LR15	LP15	LB15	LB1Ø	LB8	LB6
3						LB12	LP6	LPC4
4								
5								
6								
7								
8								

(18) Display of Machine Spec Code

```
AUTO OPERATION A.MIN                                  N          0

CHECK DATA                                            UNIT 1mm
              MACHINE SPEC CODE
        no.     data      bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
         1    00030001    XBR  ZBR  XAR  ZAR  PUL  LHSR GR4S GR2S
         2    00000100    DAIV VAC  NS   PGR  01MC BLSM MR   CAR
         3    00000010                             MDAI MG2S SMSC
         4    00000200

=
PROGRAM | ACTUAL | PART    | BLOCK |        | TOOL   | CHECK |
SELECT  | POSIT. | PROGRAM | DATA  |        | LAYOUT | DATA  | [EXTEND]

F1 F2 F3 F4 F5 F6 F7 F8
```

No. \ bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
1					Pulley Change	LH5Ø Standard Spindle	Gear 4 steps	Gear 2 steps
2	Spindle DA Output Reversal	VAC Motor	Minor Change	Pulse Generator Reverse Rotation	Ø.1 μ Control	Brushless Servo Motor	ATC Magazine Position Encoder Reverse	C-axis Position Encoder Reverse
3						M-axis DA Output Reversal	Revolving Tool Gear 2 Steps	Slideway Lubrication Motor Soft Control
4								
5								
6								
7								
8								

SECTION 5 TROUBLE AND TROUBLESHOOTING

The purpose of this section is to minimize downtime of the machine through speedy detection and remedies of the cause of any trouble that might occur.

It is extremely important to make detailed checks on the condition of the machine and CNC system when the trouble arose and to carry out various kinds of tests described in this section. Thus, the customer himself will be able to fix the machine in most cases. The test results reported to your local Okuma representative will be a great help in determining the nature and extent of the trouble and the remedies to be applied.

Generally, check the following matters:

(1) When trouble occurs,

- o Mode of operation
- o Current position and command position
- o What STATUS display lamp is going on?
- o Is the ALARM lamp on?

  When the ALARM lamp is on, the cause of the alarm can be known from the contents of the alarm message given on the CRT.

(2) After resetting the CNC system,

- o Does the trouble occur at the same situation repeatedly?
- o Does the same trouble occur in other modes of operation?
- o How about frequency of the trouble?
- o Does the trouble arise regularly in terms of time, temperature, etc.?

This section covers the basic troubleshooting procedures, along with structure, operation and method of inspection for the major CNC component parts such as the CPU, servo drive units, relays in the machine control unit and the spindle control unit.

When any trouble occurs, see Section 4 "Maintenance and Inspection" together with this Section 5 and carry out necessary checks in accordance with the instructions.

5-1. ANALYSIS OF TROUBLE

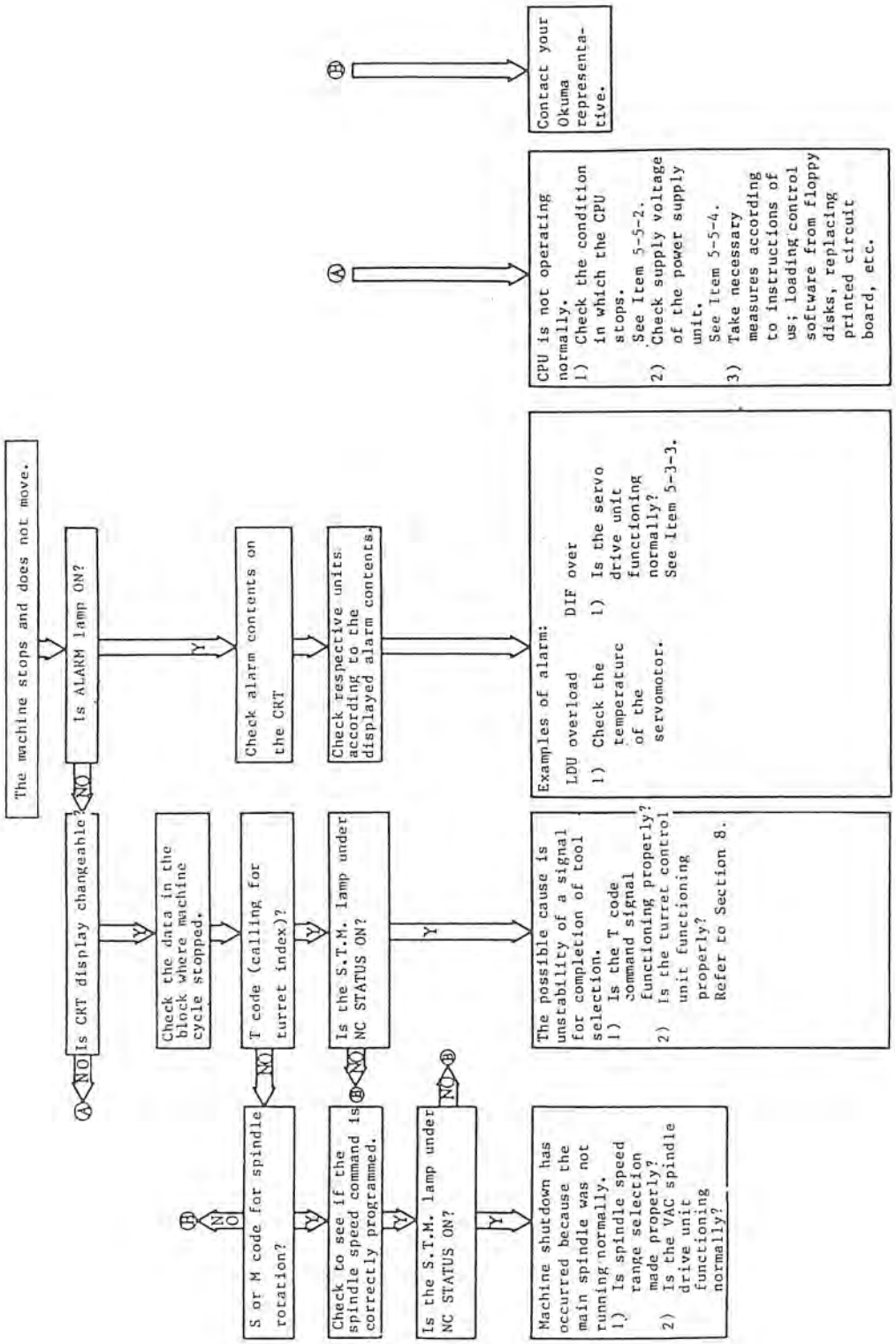


Fig. 5-1 Locating Problems

5-2. MACHINE-MOUNTED ELECTRICALS

Mounted on the machine are limit switches, solenoids, motors and other electro-mechanical components. See Appended Figure (2) Layout Diagram of Machine-Mounted Electricals for their location. As these machine-mounted electricals are placed in a very severe environment affected by chips, coolant, oil, dirt and dust, careful consideration has been given in design to protect these components from excessive moisture, dirt and dust. Nevertheless, electrical trouble causes a high rate of the NC troubles.

However, most of the electricals are relatively simple in their operation and can be easily checked and repaired if required by the customer's maintenance technicians. The checking procedures given under Section 5-6, "Relays and Magnet Switch Circuits" should be also consulted for solving electrical problems.

This Section describes the practical method to inspect limit switches. For other machine-mounted electricals, check in a similar way.

5-2-1. Checking Limit Switch with Multi-tester

Limit switches are used to detect the axis travel end positions, etc.

Example: Checking XA-axis travel end limit switch

See the electrical circuit diagrams delivered with the machine. The XA-axis travel end LS is connected to the A-saddle terminal box (refer to Appended Figure (2) Layout Diagram of Machine-Mounted Electricals).

Open the terminal box, and line numbers 3 and 79 will be found in the terminals. These two wires are connected to the LS in question.

Check the LS with a multi-meter as illustrated in Fig. 5-2.

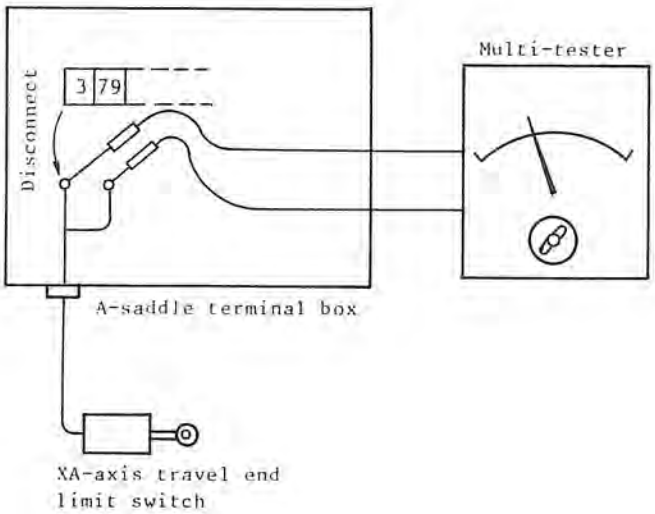


Fig. 5-2 Checking XA-axis Travel End LS

Checking Procedure:

1) Turn off power supply to the machine.

2) Select the resistance range.

3) Disconnect the LS wiring from the terminal block.

4) Apply the test probes of the multi-meter to the wire ends to check resistance.

Since contact B type LS is used for the detection of axis travel end, resistance is zero while the LS is not actuated. When it is actuated, the multi-tester should show infinite value for resistance.

5-2-2. Inspection of Limit Switches and Proximity Switches using Self-diagnostic Function

As explained in 4-4, "Self-diagnostics", input and output signals of the NC can be checked using the CRT display on the operation panel.

Example: Checking spindle speed range gear change proximity switches

The following proximity switches should be actuated in response to the commanded spindle speed ranges.

M41 ..... LS1S
M42 ..... LS2S

Check these LS's in the following manner.

1) Display the CHECK DATA EC INPUT Ø1 screen.

2) Bit Ø and bit 1 of No. 2 on the screen shows the ON/OFF status of LS1S and LS2S, respectively.

No. 2 bit Ø ..... Ø
No. 2 bit 1 1

The status above indicates that M42 is selected.

The same checking method can be used for checking limit switches.

5-3. BRUSHLESS SERVO MOTOR DRIVE UNIT

The brushless servo motor drive unit BDU-A was developed by Okuma to drive its brushless servo motors, especially those used for machine tool axis drive. The brushless servo motor is another product of Okuma, one of the major suppliers of mechatronics technology in the world. The major features of the BDU-A are listed below:

(1) The use of a brushless servo motor eliminates the need for inspection and replacement of commutator brushes, which is a must with DC motors.

(2) The transistor PWM system assures smooth and quick response.

(3) It promises good acceleration/deceleration characteristics.

(4) The high-resolution OSP position encoder directly coupled to the motor detects both the motor speed and position. Therefore, control and construction are quite simple.

(5) Various measures to protect the motor are provided. They include:

- motor overload detection
- no-fuse breaker
- overcurrent alarm
- input voltage detection
- circuit failure

5-3-1. Configuration of BDU-A

The BDU-A consists of the DC power supply and the servo amplifier unit. A DC power supply can supply power to multiple servo amplifiers and one brushless servo motor requires one servo amplifier. Fig. 5-3 shows the configuration of the BDU-A. Fig. 5-4 shows the external view of DC power supply and Fig. 5-5 shows that of servo amplifier.

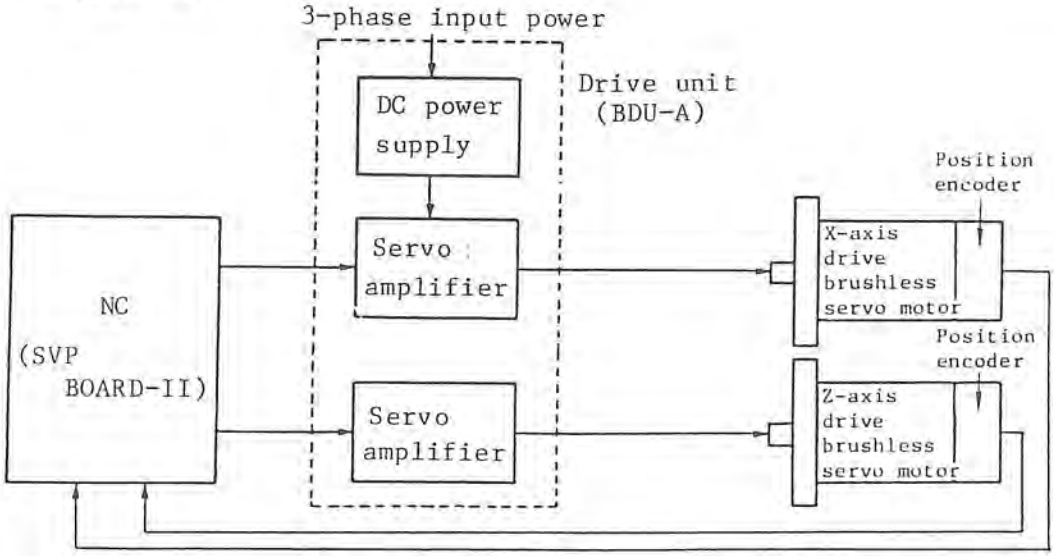


Fig. 5-3 BDU-A Configuration

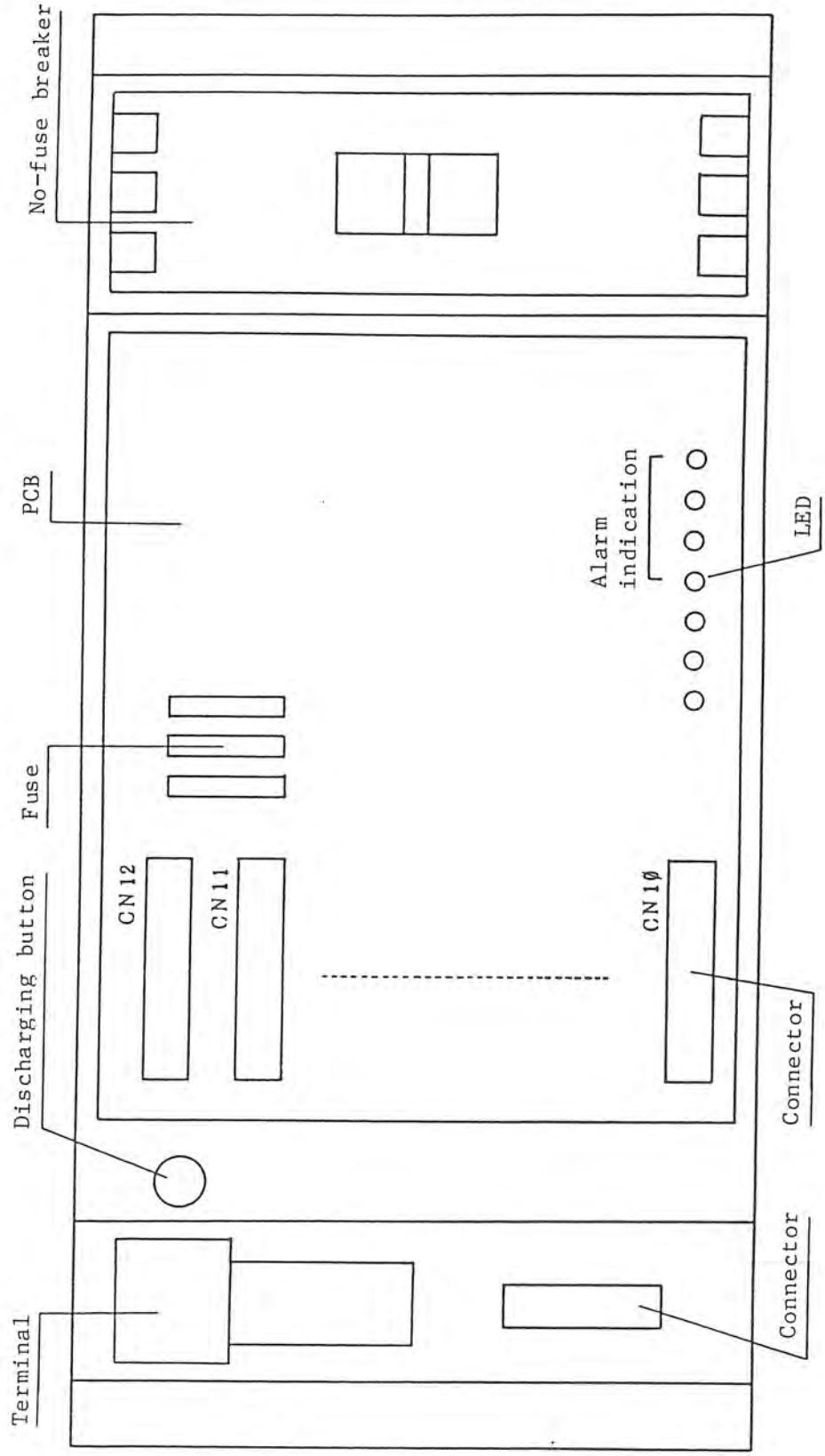


Fig. 5-4 External View of DC Power Supply

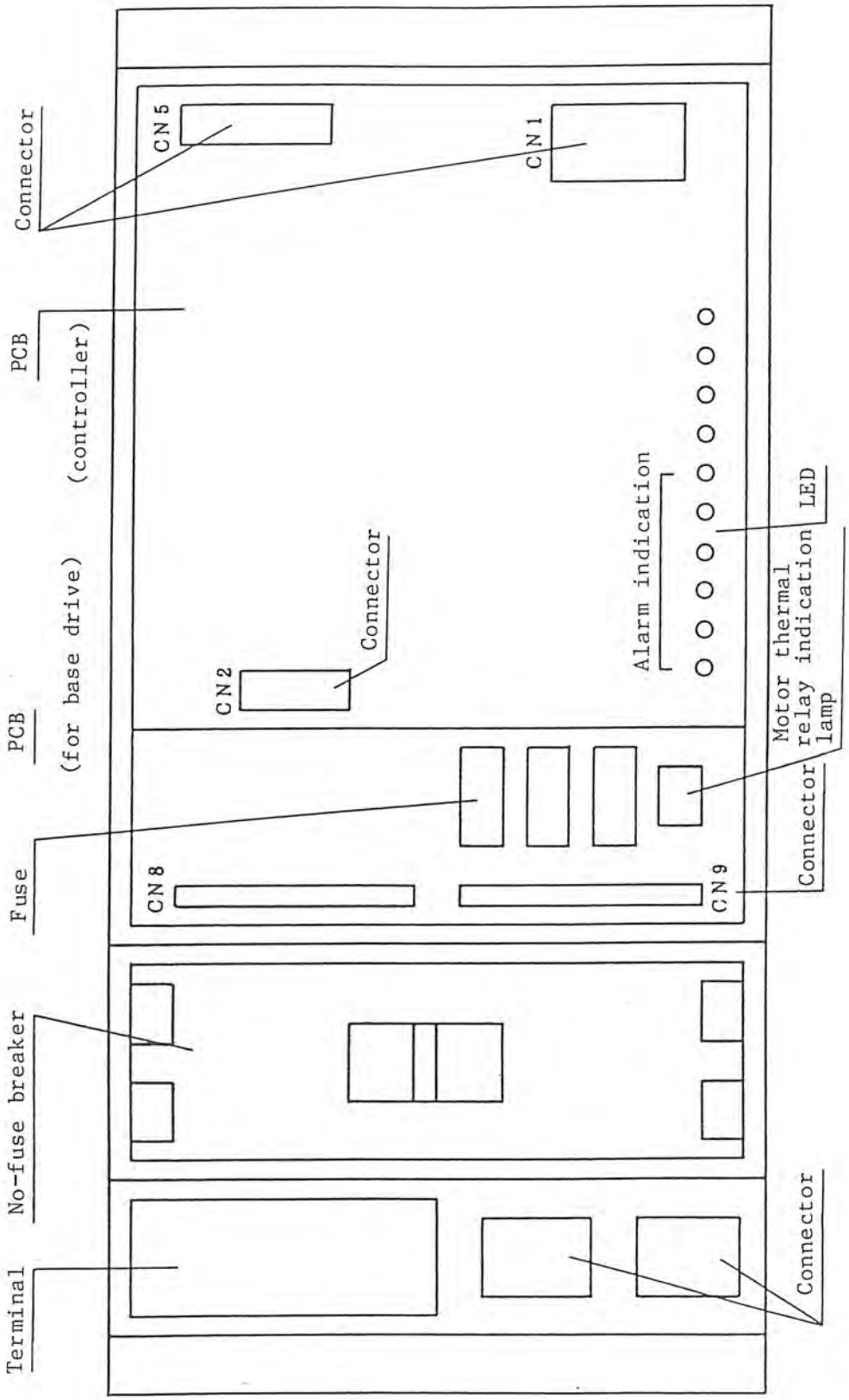


Fig. 5-5 External View of Servo Amplifier

5-3-2. BDU-A Protection Function and Alarm Indication

(1) Protection Function

The BDU-A has protection functions indicated in Table 5-1.

Table 5-1

Protection Function	Indication	Contents
Fuse	Fuse element is blown out. See item (3) in 5-3-2.	It protects the BDU-A from short of load connected to the control circuit of DC power supply and servo amplifier.
No fuse breaker	The no-fuse breaker lever is turned to the OFF position.	It protects the BDU-A from short of load connected to the power line or grounding of power line of DC power supply and servo amplifier.
Overload	Indication lamp	This detects the overload of motor.
Alarm of: overcurrent over voltage low voltage phase loss circuit alarm	LED	Refer to item (2) of 5-3-2.

(2) Alarm Indication and Alarm Contents

a) DC power supply

The printed circuit board in the DC power supply has light emitting diodes to indicate alarm occurrence as summarized in Table 5-2. If one of these red LEDs is illuminated, the magnet switch in the DC power supply is turned off, thus disabling the control of the brushless servo motor.

Table 5-2

LED	Alarm Name	Contents of Alarm and Points to Check
LV	Low voltage	DC output voltage has dropped excessively. Check the servo amplifier.
HV	High voltage	DC output voltage has risen excessively. Check the DC power supply or servo amplifier.
PH	Phase loss	Phase loss in 3-phase input. Check fuses for blown out.
OVER DIS	Overdischarging	The discharging circuit for the regenerating voltage worked for a duration longer than the specified length. Check the DC power supply.

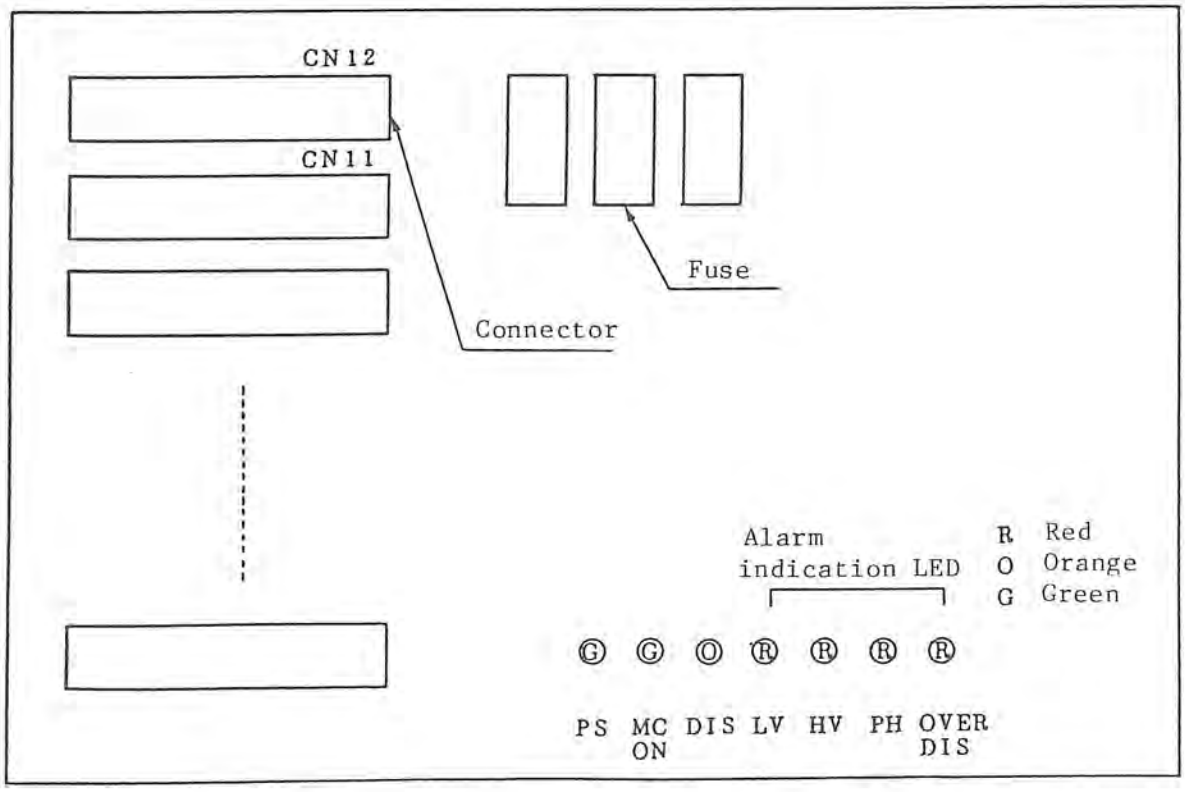


Fig. 5-6 Printed Circuit Board in DC Power Supply

b) Servo amplifier

The printed circuit board in the servo amplifier has light emitting diodes to indicate alarm occurrence as summarized in Table 5-3. If one of these red LEDs is illuminated, the base signal of a transistor in the servo amplifier is blocked and the alarm signal is outputted to the OSP at the same time.

Table 5-3

LED	Alarm Name	Contents of Alarm and Points to Check
PH	Phase loss	Phase loss in 3-phase input. Check fuses for blown out.
VR	Control power alarm	±12 V power in the control circuit has dropped below the specified level. Check the printed circuit board in the servo amplifier.
IOC-M	Instantaneous over current	Overcurrent flowing through the motor. Check the brushless servo motor for burning and insulation. Check the servo amplifier.
IOC-S	Short	Excessive current flowing through the transistor bridge. Check the servo amplifier.
LV	Low voltage	DC power supply voltage has dropped excessively. Check the no-fuse breaker of the servo amplifier for tripping. Check the servo amplifier.
HV	High voltage	DC power supply voltage has risen excessively. Check the DC power supply or the servo amplifier.

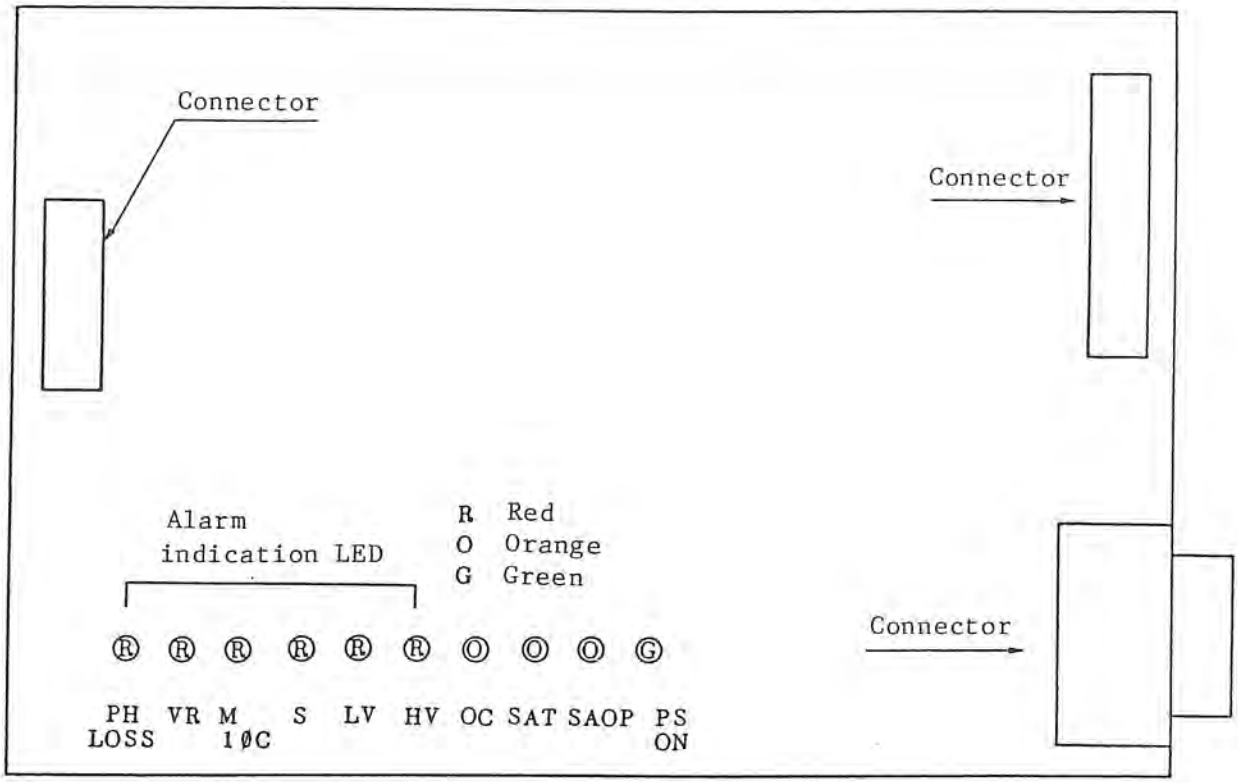


Fig. 5-7 Printed Circuit Board in Servo Amplifier

(3) Resetting Alarm and Replacing Fuse

When any of the alarm indicated above has occurred, first turn off the no-fuse breaker on the EC panel.

Glass-tube filled fuses are as illustrated in Fig. 5-8 and blowing out of the fuse element can be visually checked.

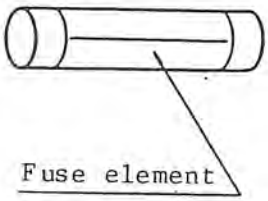


Fig. 5-8 Glass-tube Filled Fuse Element

5-3-3. Trouble and Troubleshooting

(1) Checkups after occurrence of a problem

If a problem occurs with the BDU-A, carry out checkups referring to Table 5-4 below.

Table 5-4

Item	Phenomenon	Checkups
1	The BL motor fails to rotate even when axis movement commands are given.	Is the no-fuse breaker of the DC power supply tripped? Is the no-fuse breaker of the servo amplifier tripped? Is any of the alarm indicating LEDs on the printed circuit board of the DC power supply or the servo amplifier illuminated?
2	An alarm state occurs when the BL motor starts.	Check load current. Is it too large?
3	The PH lamp comes on.	Is a fuse blown?

(2) Precautions for maintenance

If the no-fuse breaker of the DC power supply or the servo amplifier has tripped, turn off the no-fuse breaker on the EC box before re-setting the tripped no-fuse breaker.

Before replacing printed circuit boards and fuses, and checking looseness of the terminals, turn off the no-fuse breaker on the control box and hold down the discharging button for about 1Ø seconds. See Fig. 5-9.

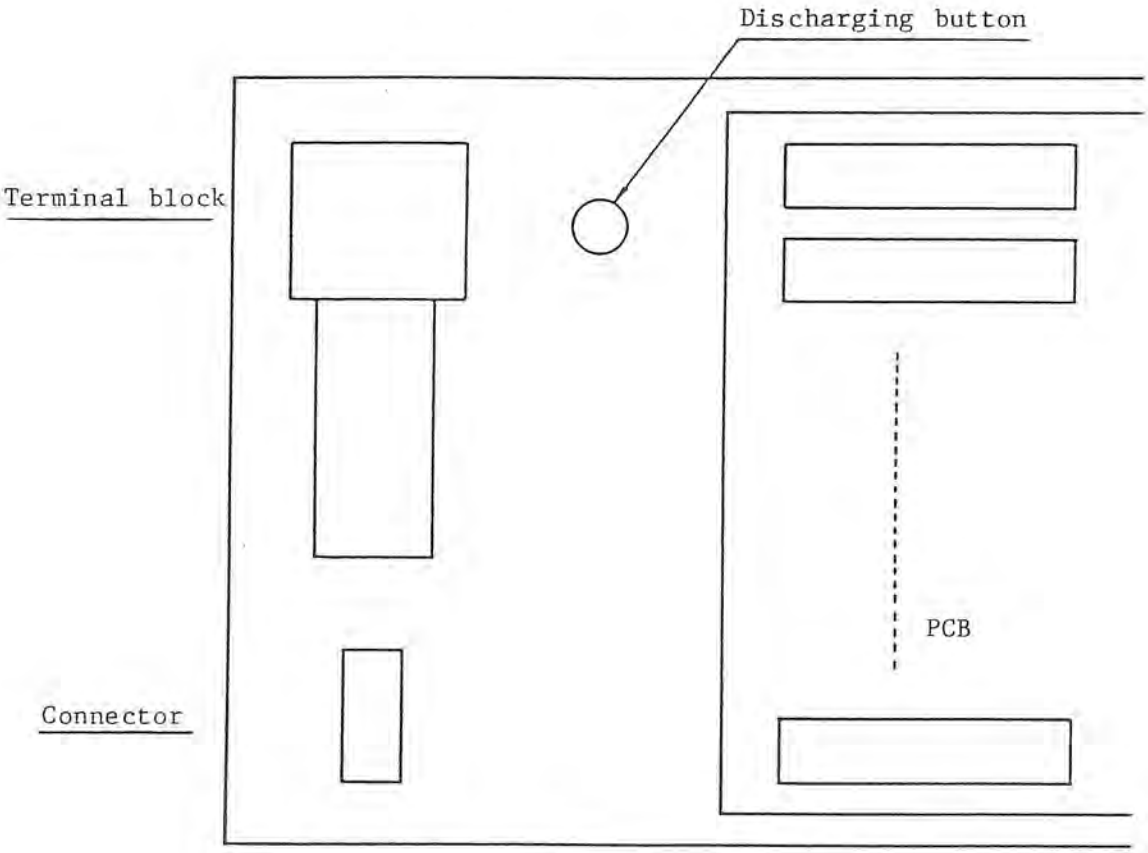


Fig. 5-9 Discharging Button on DC Power Supply

5-3-4. Spare Parts of BDU-A

Fuses indicated in Table 5-5 are supplied as spare parts of the BDU-A.

Table 5-5

Unit Name	Part Name	Q'ty	Maker	Okuma Part No.
DC Power Supply	Fuse No.1Ø65 AC 2ØØV 2A	3	Satoh Parts	E2442-29Ø-1Ø6
Servo Amp.	Fuse No.1Ø65 AC 2ØØV 2A	3	Satoh Parts	E2442-29Ø-1Ø6

5-4. INSPECTION OF POSITION ENCODER

The position encoder detects the present position of each axis accurately. Any fault in this encoder prevents the present position from being found easily, which will result in any of the following troubles.

- o Rough cut surface
- o Hunting
- o APA pattern data alarm, APA speed alarm and APA check data alarm

Checking The Position Encoder:

While moving each axis slowly with the pulse handle, check that the output value from the position encoder changes smoothly by the following procedures.

(1) Obtain the CHECK DATA *NC AXIS DATA* page on the CRT.

(2) Then, the position detected value of each axis, R-APA, operational value R-CON, and the difference R-DIF can be monitored. Here, note the R-APA, the position detection value of the axis to be checked.

(3) Switch the mode to MANUAL, and move the axis slowly with the pulse handle.

- o Check that the value changes from the smaller digit slowly.
- o Check that no value is omitted and that no value repeats.
- o Check that the digit carry is done properly.

Normal case:

18 → 19 → 2Ø → 21 → 22 .....

Abnormal case:

18 → 2Ø → 21 → 22 .....
18 → 19 → 21 → 2Ø .....

If the value and change are not normal, it can be assumed that there is a fault in the encoder. In addition, there is a possibility that there is a fault in the connector contact or the SVP BOARD-II of the CPU printed circuit boards.

5-5. CPU

This section describes matters related to the CPU. The complete operation of the NC machine is described in 4-3, "Operation and Structure of the NC", and should be referred to.

5-5-1. Operation and Structure of the CPU

Refer to Fig. 4-2.

As described in 4-3, the main component of the OSP5ØØØ is the CPU, which consists of five BOARDs and CARDs added to the BOARD. The CPU employs "Multi-processing system" in which the brushless servo motor control processor and other interfaces on the SVP BOARD-II function under the control of the main processor on the MAIN BOARD-IIA. For each processor, a high performance microprocessor is used and for the IC memory, a high-speed very large scale IC memory is used in order to accomplish high-grade NC functions. In addition to the IC memory, a bubble memory for storing machining programs and control program (control software) storage is provided. The bubble memory is a read/write memory, allowing stored data to be altered as needed. Its memory capacity is up to 4 M byte.

Signals are communicated between each processor and external equipment (tape reader, position encoder, operation panel, servo drive, etc.) through the interface circuit contained in the BOARD.

The OSP5ØØØ is a computer NC with control programs (control software) designed specially to each user's specifications, and delivered as control tapes with each NC system. The operation to store control software into the bubble memory is called software loading.

When the specifications are changed or a bubble memory is replaced, loading is required.

The power supply unit supplies all power required for the CPU. An AC 2ØØV input direct switching method is employed because it gives high efficiency and causes less heat generation.

Refer to Fig. 5-1Ø for CPU and Power Supply Unit.

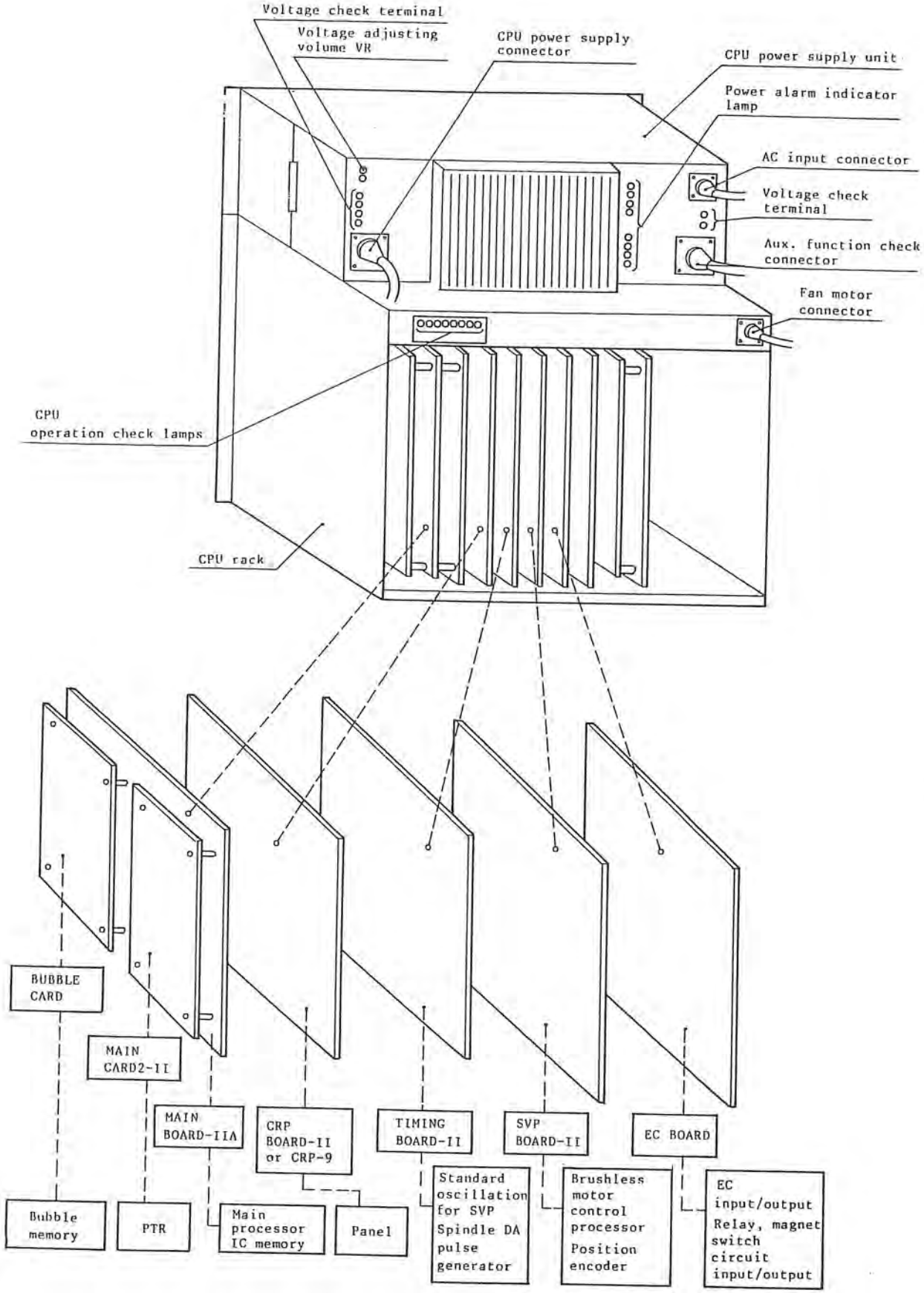


Fig. 5-1Ø CPU and Power Supply Unit

5-5-2. Checking CPU Operations

Simple checking for proper computer functioning can be carried out by checking if the indication on the CRT screen operates properly. For example, try to change the page indicated on the CRT screen. If the page is actually changed, it can be assumed that the computer works well. In order to check what condition the computer remains in, make a check by the CPU operation check indication on the CPU unit. Refer to Figs. 5-1Ø and 5-11.

Indication Contents

- POWER ..... Power supplied to CPU
- RUN ..... CPU running.
- BUS ERROR ..... More than two errors occur at same time. CPU stops running.
- ECC ERROR ..... Error in more than two bits are caused in the main memory.
- DIA ERROR ..... Errors occur in self diagnostics.
- LOOP ERROR ..... Errors occur when the control software execution is looped.
- CYCLE ERROR .... Errors occur if the control command of the control software is not completed within a specified time.
- WPRT ERROR ..... Errors occur if the control software enters memory address area not yet defined.

Fig. 5-11 CPU Operation Check Indication

- Two lamps, POWER and RUN, light in normal condition.

- When errors occur

  For any error except BUS ERROR:

  The CPU continues running and processes errors, and the CRT screen on the operation panel indicates the contents of the errors.

  For BUS ERROR:

  The RUN lamp goes off and CPU operation stops.

- Error indication means abnormality in the computer and will not go off when the OSP5ØØØL-G is reset.

- To start NC operation again, switch OFF the power and then switch ON again. The computer starts RUN automatically and goes into NC operation several tens of seconds later.

- If the abnormality is continuous, the error occurs again and the computer stops. When the computer carries out normal NC operation, continue using it and observe the operation.

5-5-3. Loading Control Software through Floppy Disk

Loading the control software through the floppy disk can store the necessary information for controlling the OSP5ØØØL-G in the bubble memory. This loading operation is required when changing the control specifications or after replacing bubble memory due to an occurrence of problems with the bubble memory.

The floppy disk storing the control software (to be referred to as the control floppy disk, hereafter) is supplied with the control system in a case.

The control floppy disk stores information necessary for initializing bubble memory, the NC control programs, and the data required for executing the NC control programs.

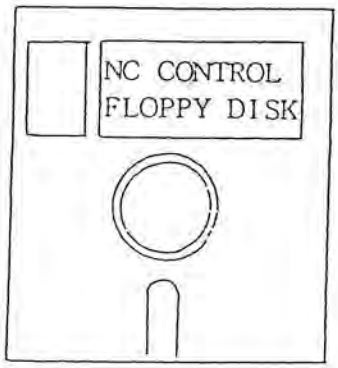


Fig. 5-12 Control Floppy Disk

Loading Procedure:

1) Turn off power supply and connect the portable floppy disk drive to the OSP5ØØØL-G as shown in Fig. 5-13.

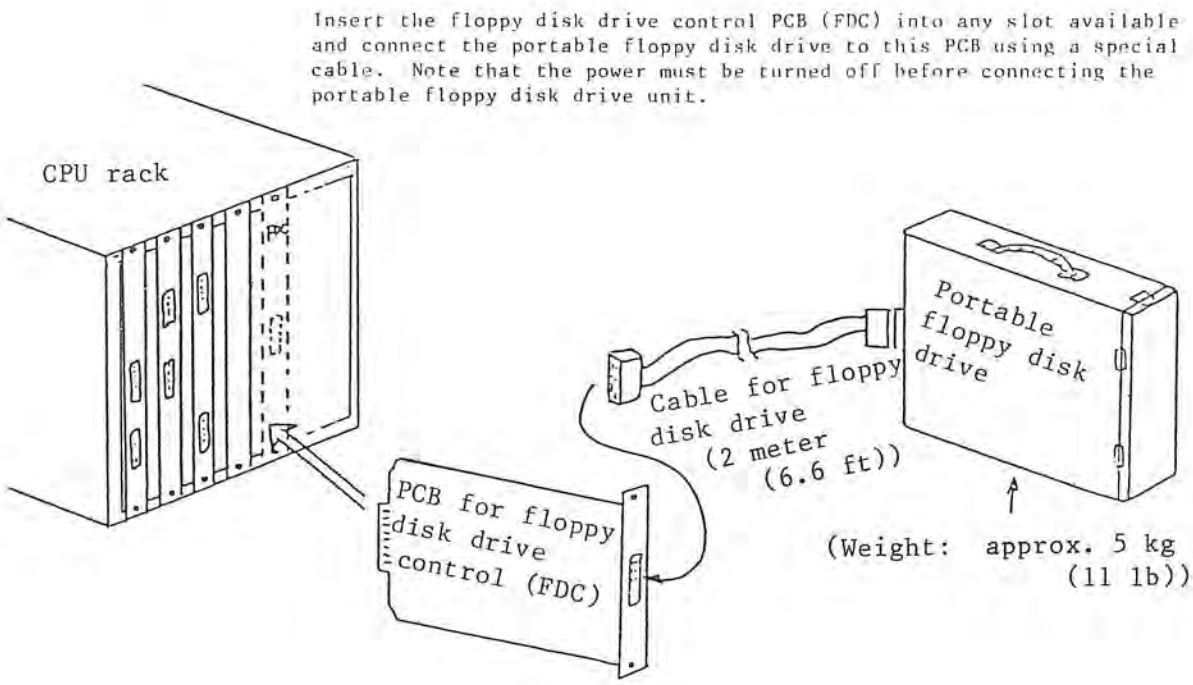


Fig. 5-13 Connection of Portable Floppy Disk Drive

Remark: When there is no empty slot for inserting the FDC, remove any board such as EC board, except the main board to insert the FDC.

2) Connect the portable tape reader.

3) Turn on power.

4) Turn the CONTROL PROGRAM LOAD ON/OFF switch on the portable tape reader to the ON position.

5) Press the SYSTEM RESET button. The OSP5ØØØL-G is placed in the loading wait condition and the CRT will display the message "control floppy loading wait".

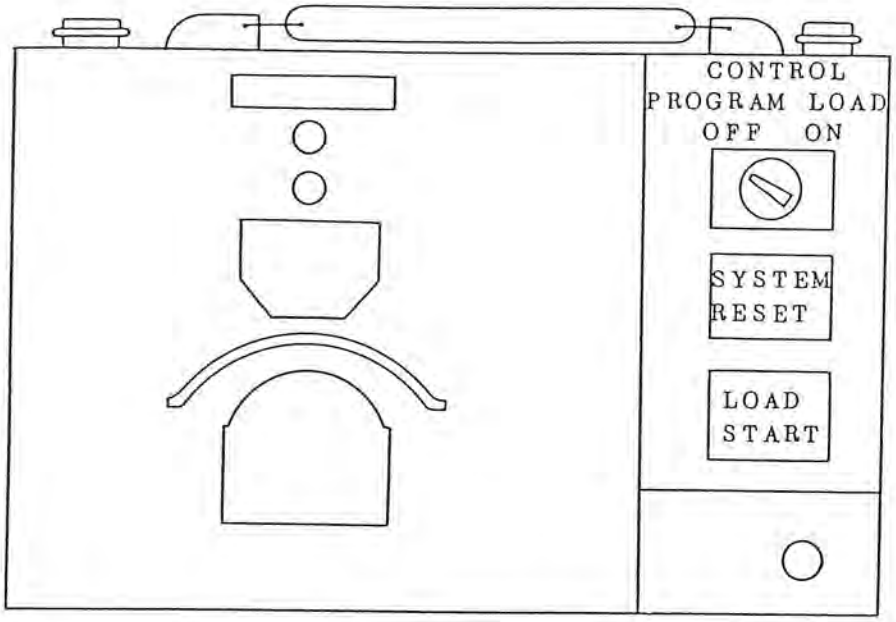


Fig. 5-14 Portable Tape Reader

6) After making sure the display on the CRT, insert the control floppy disk into the portable floppy disk drive.

7) Press the LOAD START button.

   The floppy disk drive starts and the control software on the floppy disk is read into the OSP5ØØØL-G. The CRT will first display the message "**control floppy loading start**" and then the program name being read.

   After all programs on the control floppy disk have been loaded, the message "**control floppy loading end**" appears and the message "**control floppy loading wait**" will be displayed below it.

8) After all control software programs have been loaded, turn the LOAD switch OFF and press the CONTROL ON button after turning off power by pressing the CONTROL OFF button. The OSP5ØØØL-G will start operation automatically and after an elapse of about several tens of seconds it starts the NC control in accordance with the loaded control software.

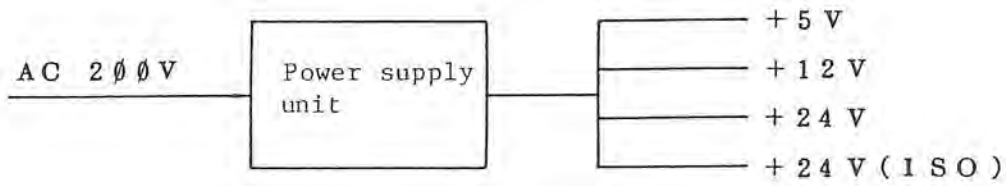
Warning:

1. Never turn on and off power with the control floppy disk set in the floppy disk drive. The information on the floppy disk will become unreliable.

2. After the completion of the loading be sure to keep the control floppy disk in the floppy disk case after removing it from the floppy disk drive.

5-5-4. CPU Power Supply

The power supply for the CPU has the arrangement shown here.



AC 2ØØV is input into the power supply unit and this supplies the voltage required for the CPU. This unit is mounted on the CPU unit as shown in Fig. 5-1Ø. For the connection with the CPU unit, input of AC 2ØØV, and for connection with other devices, dedicated cated cables and connectors are used. Each output voltage is supplied for the following destinations.

+5V : Power supply for IC's in CPU unit

+12V : Bubble memory, position encoder, main spindle pulse generator, manual pulse generator

+24V : Bubble memory, tape reader

ISO+24V: Power supply for EC input/output isolator

Voltage check terminals for each output are provided to check these output voltages. A variable resistor to adjust the voltage is provided for +5V. Refer to Fig. 5-1Ø.

This power supply has the function that continuously monitors input/output voltage and temperature. When an abnormality occurs, the cause is indicated by the power supply alarm indicating lamps shown in figure below, and CPU operation stops.

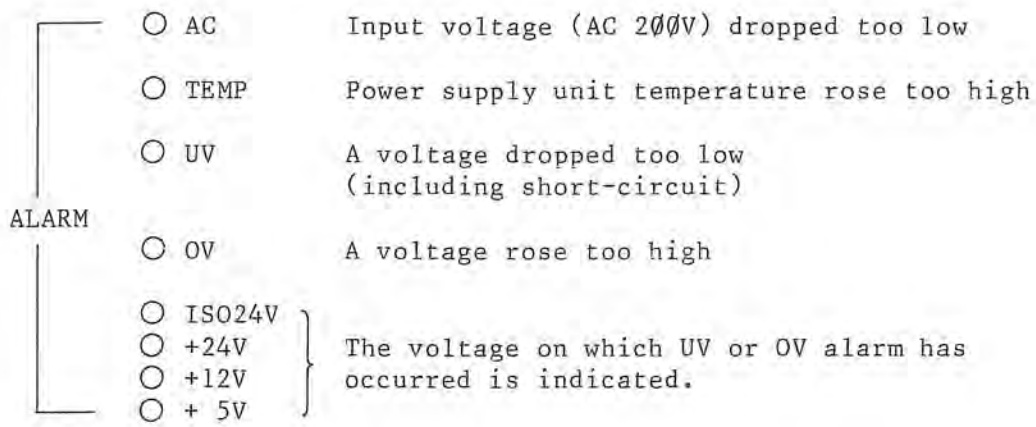


Fig. 5-15 Power Supply Alarm Indication

- When any of these alarm lamps lights, power supply to the CPU is turned OFF and the CPU stops running.

- This alarm indicates an abnormality in the power supply unit or in the input and output parts. In this case, all power supplies in the NC system, including the operation panel, are cut off.

- To start the NC operation again, turn OFF the AC input to the NC system once (switch OFF the main breaker), and turn back ON the main breaker after confirming that the alarm indication disappears several tens of seconds later. Then press the POWER ON button. The CPU starts running automatically and the OSP5ØØØL-G starts operation.

- If the abnormality is continuous, the power supply alarm comes on again, but if the CPU runs normally, continue using it and observe the operation.

5-6. RELAY AND MAGNET SWITCH CIRCUITS

The relay and magnet switch circuits control devices requiring high voltage which cannot be controlled by semiconductors, such as motors, clutches, and solenoids. Since the relays and magnet switches can be checked visually, the operation check is relatively easy. Check according to the relay circuit diagrams provided for each machine.

5-6-1. Operation and Structure of a Relay and Magnet Switch Circuit

The same operation principle applies to all magnet relays.

When an energizing voltage is charged at both ends of the coil (a) and (b), an attractive force is generated in the coil and turns ON contact point A which is normally open (NO contact), and turns OFF contact point B which is normally closed (NC contact).

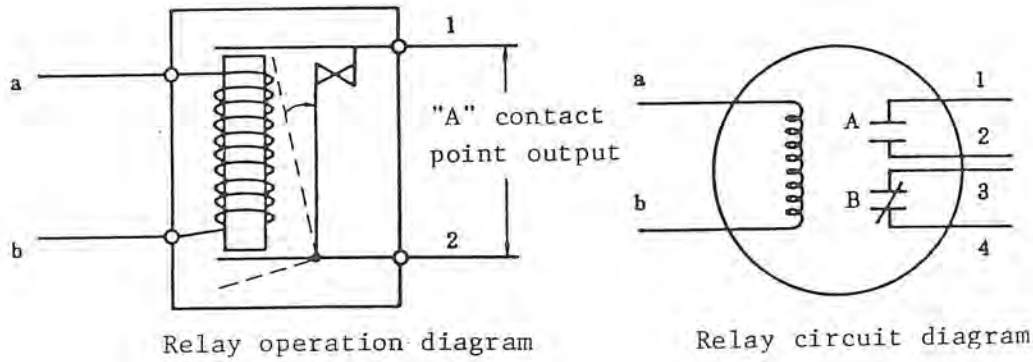


Fig. 5-16 Relay Operation

When the coil is energized, NO contact is closed and NC contact is opened.

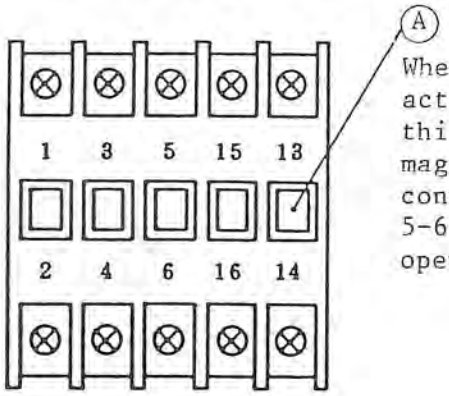
On the other hand, when the coil de-energized, NO contact is opened and NC contact is closed. The coil will be energized by either DC voltage or AC voltage. Generally, most small relays are energized by direct current, while most large relays by alternating current.

With the LR series CNC lathes, most of the relay control circuits are replaced by computer software, and only the absolutely necessary number of relays are used. For arrangement of the relays, consult the Appended Figure (3) Internal Layout of OSP5ØØØL-G CNC Unit.

5-6-2. Inspection of a Relays and Magnet Switches

Large relays are called magnet switches. They are mainly used to control motors.

(1) Operation check of a magnet switch (MS)



When a magnet switch is actuated (coil is energized), this part is pulled in. When a magnet switch is actuated, all connections such as 1-2, 3-4, 5-6, etc., are closed (ON) or opened (OFF).

Fig. 5-17 Magnet Switch

When the magnet switch is actuated:

If the connection between 1-2 is closed, it is called contact point "A", and indicated in a circuit diagram by the symbol (1).

(1)

If the connection between 1-2 is opened, it is called contact point "B", and in a circuit diagram by the symbol (2).

(2)

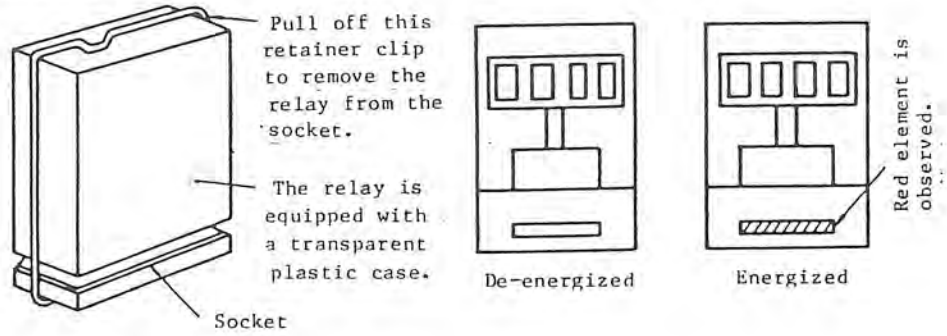
Sometimes troubles of a relay are caused. When the coil is energized, a contact point may fail to open and close (due to poor contact or foreign matter clogging), or the Part (A) may occasionally remain pulled in (fused, etc) even when the coil is not energized.

The LR series CNC lathes use two types of miniature relays: G2A relays for controlling relay logic and LY relays for controlling low level of power.

(2) Operation check of relay (CR)

The operation and work of the relay is the same as for the magnet switch. For contact point (A) and (B), it is also the same.

G2A Relay



LY Relay

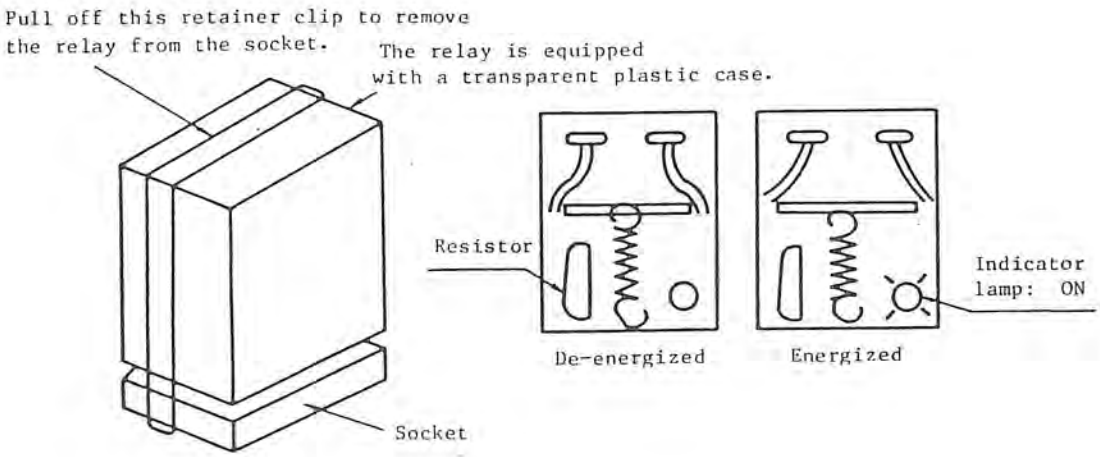


Fig. 5-18 Relay Switch

(3) Inspection of overload protection relays and fuses

For protecting motors and solenoids, etc., from overcurrent and overload, an overload relay is used.

To reset the tripped relay, push in the reset rod. Note that pushing in the reset rod right after the relay has been tripped, cannot reset the relay. Allow the switch to cool before resetting it.

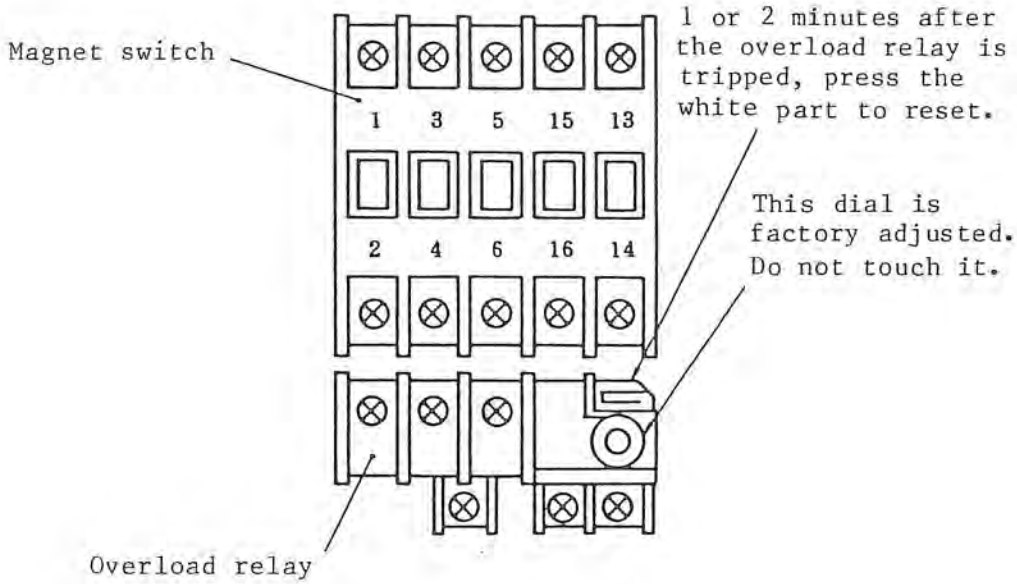


Fig. 5-19 Overload Relay

The circuit breaker and fuses prevent overcurrents from surging through the control circuit.

With circuit breakers, functions of the circuit can be recovered by simply resetting the tripped breaker. With cartridge type fuses, it is necessary to replace fuse elements if blown.

SECTION 6 SPINDLE DRIVE UNIT FOR VAC MOTOR (OKUMA MAKE)

6-1. OUTLINE

This manual is prepared for Okuma's VAC motors and VAC drive units. Okuma's VAC motors are built especially for driving machine tool spindles and feature high reliability, wide constant output range and compact construction.

Okuma's VAC drive units adopt the vector control method using a 16 bit microprocessor to promise excellent response and stable control.

6-2. MAINTENANCE AND INSPECTION

VAC motors and VAC drive units do not require special regular inspection. However, inspection and cleaning on the following points in every six months are recommended to maintain their designed performance.

However, if they are contaminated heavily, check them more frequently than specified.

Table 6-1 Inspection Items

Inspection Point	Inspection Procedure	Measures
VAC motor VAC drive unit Cooling fan Fan guard (screen) Ventilation holes	Check for dust and dirt accumulation.	Remove dust and dirt by compressed air or vacuum cleaner.

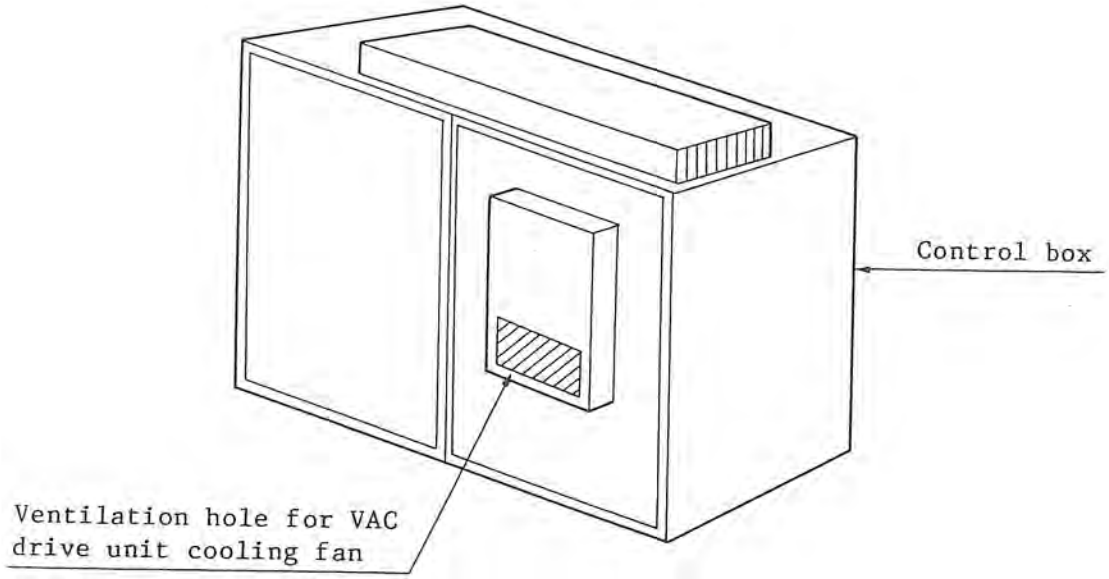


Fig. 6-1 VAC Drive Unit

6-3. TROUBLES AND TROUBLESHOOTING

6-3-1. VAC DRIVE UNIT CONSTRUCTION

Arrangement of parts which will require checkup when a problem has occurred is shown in Figs. 6-2, 6-3, 6-4 and 6-5.

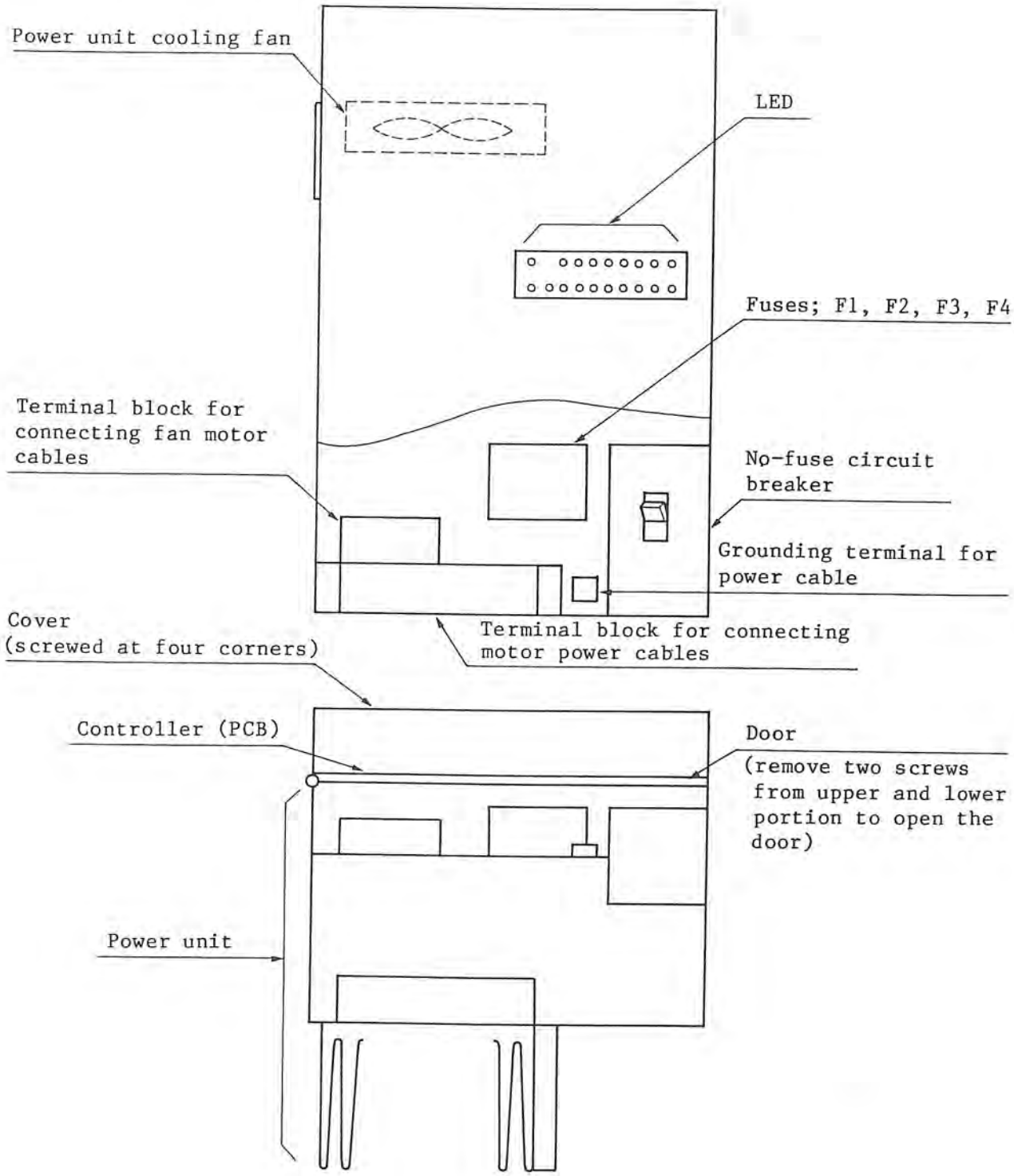


Fig. 6-2 Arrangement of Major Component Parts of D3/D6

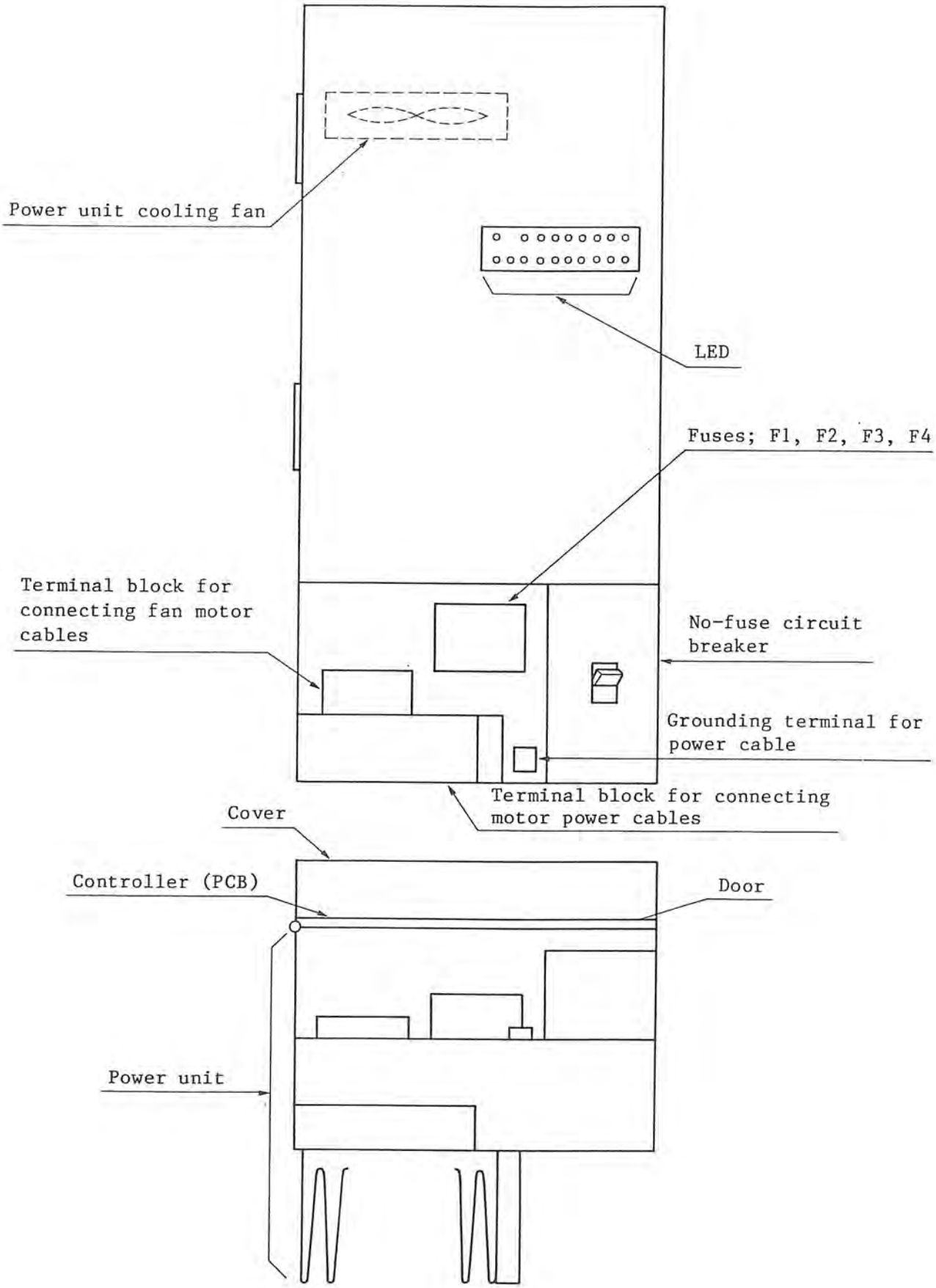


Fig. 6-3 Arrangement of Major Component Parts of D11

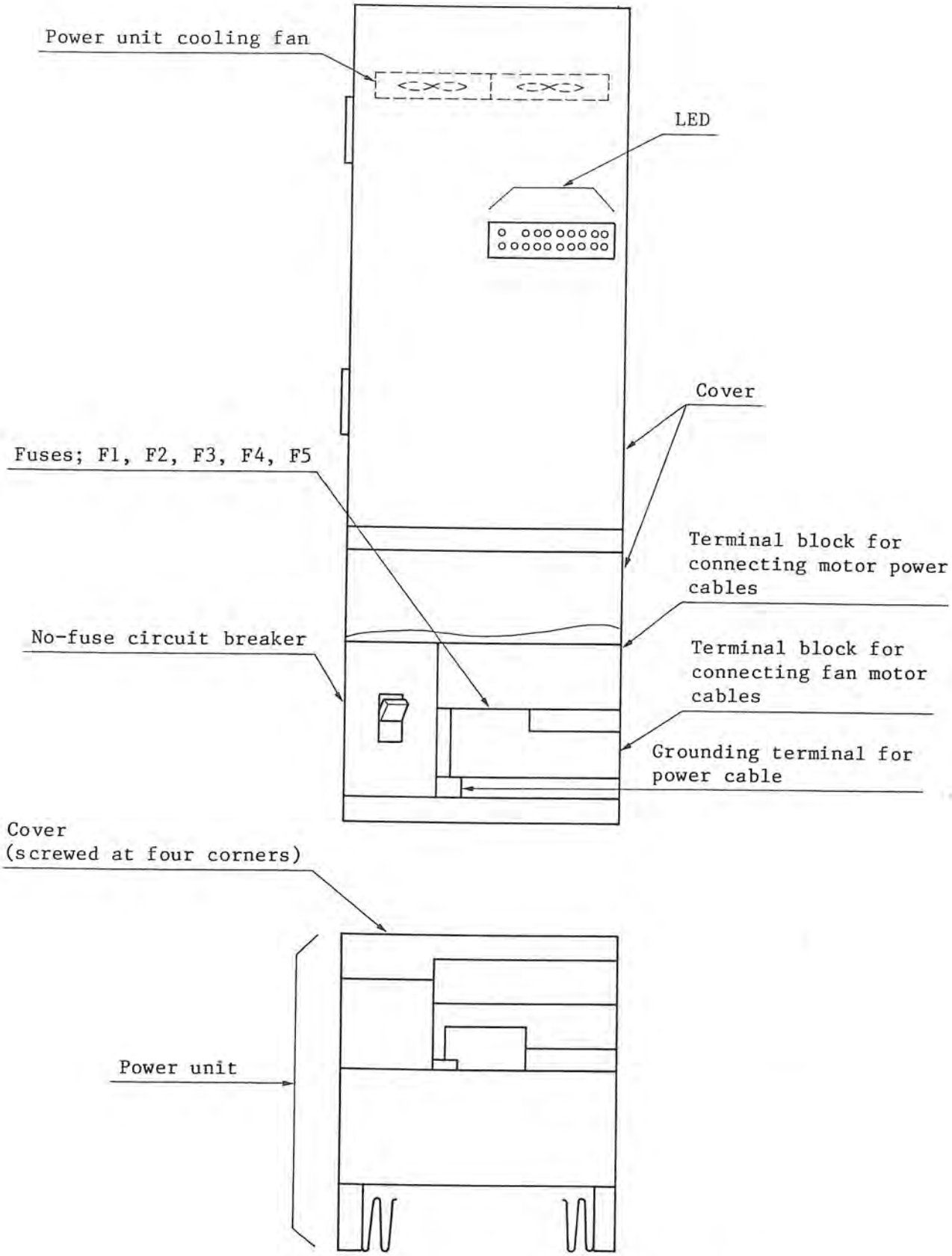


Fig. 6-4 Arrangement of Major Component Parts of D22

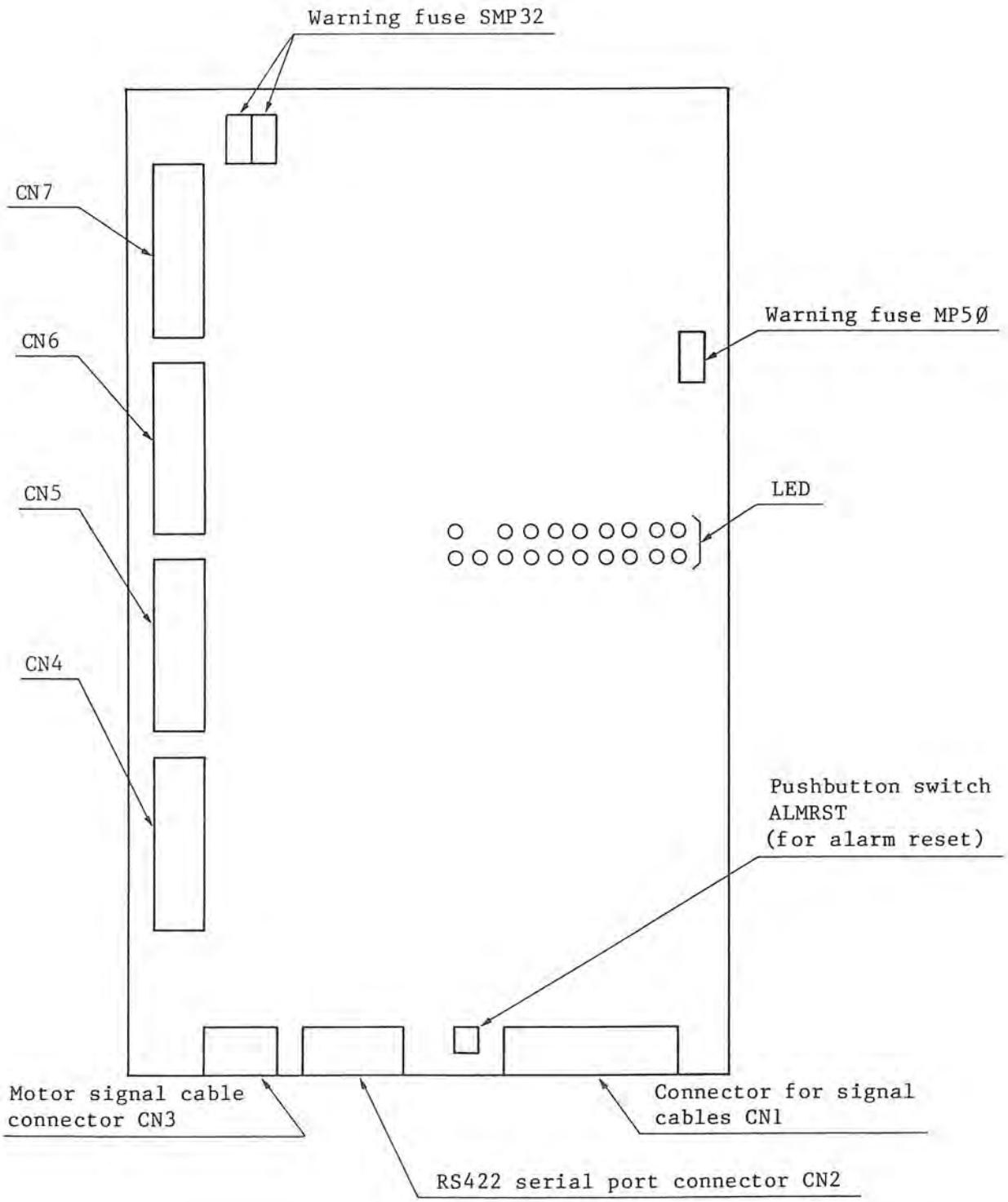


Fig. 6-5 Arrangement of Major Component Parts on Printed Circuit Board

6-3-2. OPERATION STATUS DISPLAY

Operation status of the VAC drive unit is indicated with the LED's at the PCB.

The LED's illuminating conditions can be observed through the hole in the cover (See Figs. 6-2, 6-3 and 6-4.).

LED's nomenclature is shown in Fig. 6-6.

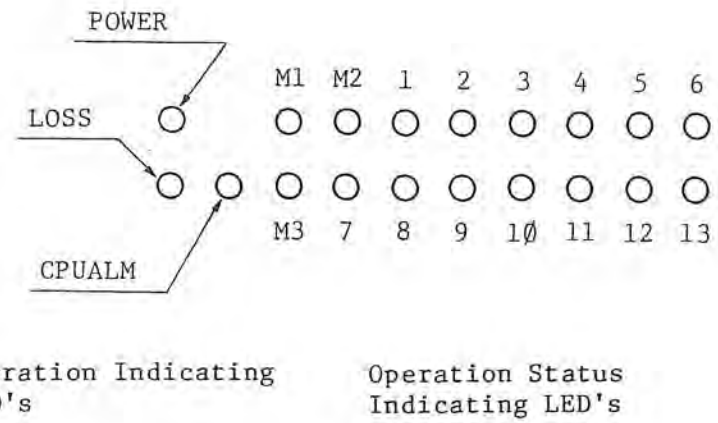


Fig. 6-6 LED's Nomenclature

6-3-2-1. Operations Indicating LED's

These three LED's indicate the operation condition of the VAC drive unit. Functions of them are summarized in Table 6-2.

Table 6-2 Function of Operation Indicating LED's

LED Name	Color	Function	Remark
POWER	Green	Indicates that power supply for control circuit of the VAC drive unit is being supplied.	If this LED is OFF while power supply to the VAC drive unit is ON, it indicates failure of the unit.
LOSS	Red	Indicates that voltage being applied to the operation circuit in the VAC drive unit is outside the specification.	If this LED lights up, it indicates that the operation circuit is not functioning correctly.
CPUALM	Red	Indicates that the operation circuit in the VAC drive unit is faulty.	Contents of failure are indicated by the operation status indicating LED's.

6-3-2-2. Operation Status Indicating LED's

A total of 16 LED's are used to indicate the operation status of the VAC drive unit and the VAC motor. There are two operation status indication modes such as "failure operation status indication" and "normal operation status indication".

Under the failure operation status:

a) LED's M1 and M2 flash at the same time
b) LED M1 lights up
c) LED M2 lights up

Other LED's light up corresponding to the failure conditions to indicate the contents of failure.

In any of these cases, normal operation of the VAC drive unit and the VAC motor is impossible.

Table of failure operation status indications is given in Table 6-3.

Figs. 6-7, 6-8 and 6-9 indicate the contents of failure.

Under the normal operation status:

The LED's indicate the input/output conditions of the input/output signals.

Fig. 6-1Ø shows the contents of indication. Input/output signals are explained in Section 6-6.

Table 6-3 LED Lighting Conditions when Failure Occurs

LED Lighting Conditions				Contents of Failure	
M1	M2	M3	Failure Cause Indicating LED		
Flash	Flash	OFF	1	RES	Resolver faulty
			2	AD	A/D access error
			3	PAR	RAM parity error
			4	ACC	Microcomputer access error
			5	LOOP	INT6 loop error
			6	WDOG	Watch dog error
		ON	7	IOCM	Overcurrent of power transistor
			8	IOCS	Short of power transistor
			9	IOCR	Short of power transistor at regeneration unit
			1Ø	OV	Over-voltage
			11	UV	Under-voltage
			12	PH	Phase loss
			13	LOSS	Loss of power supply at operation circuit
ON	OFF	OFF	1	OS	Over-speed
			2	READ	Speed command read error
			3	UVP	Power circuit under-voltage
			4	RAER	RAM faulty
			5	DSE	DIP switch setting error
			7	LOOP4	INT4 loop error
			8	LOOP1	INT1 loop error
OFF	ON		1	OH	Heat sink over-heat
			2	OL	Motor over-load

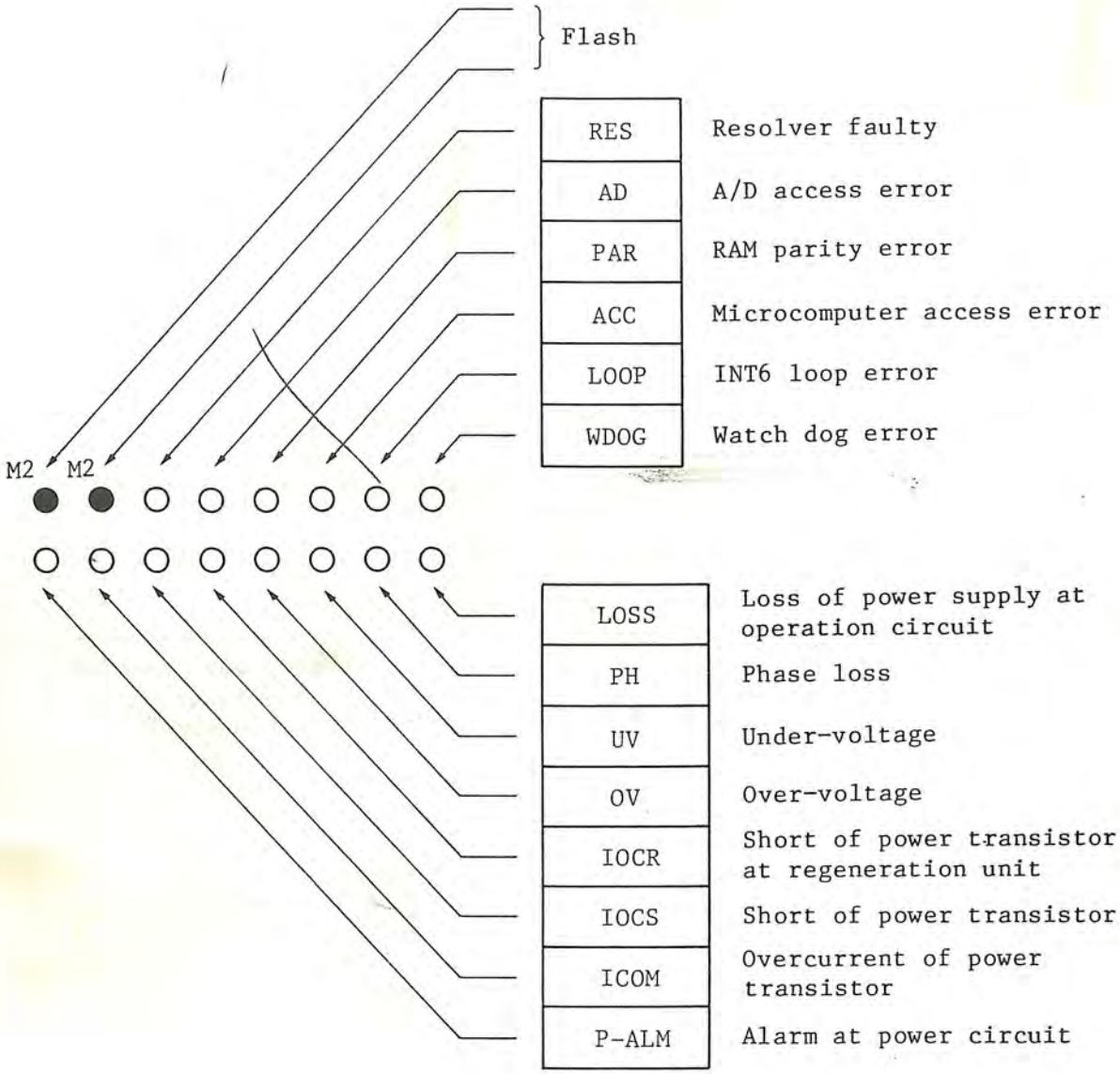


Fig. 6-7 Failure Indication by LED
(with M1 and M2 LED's flashing)

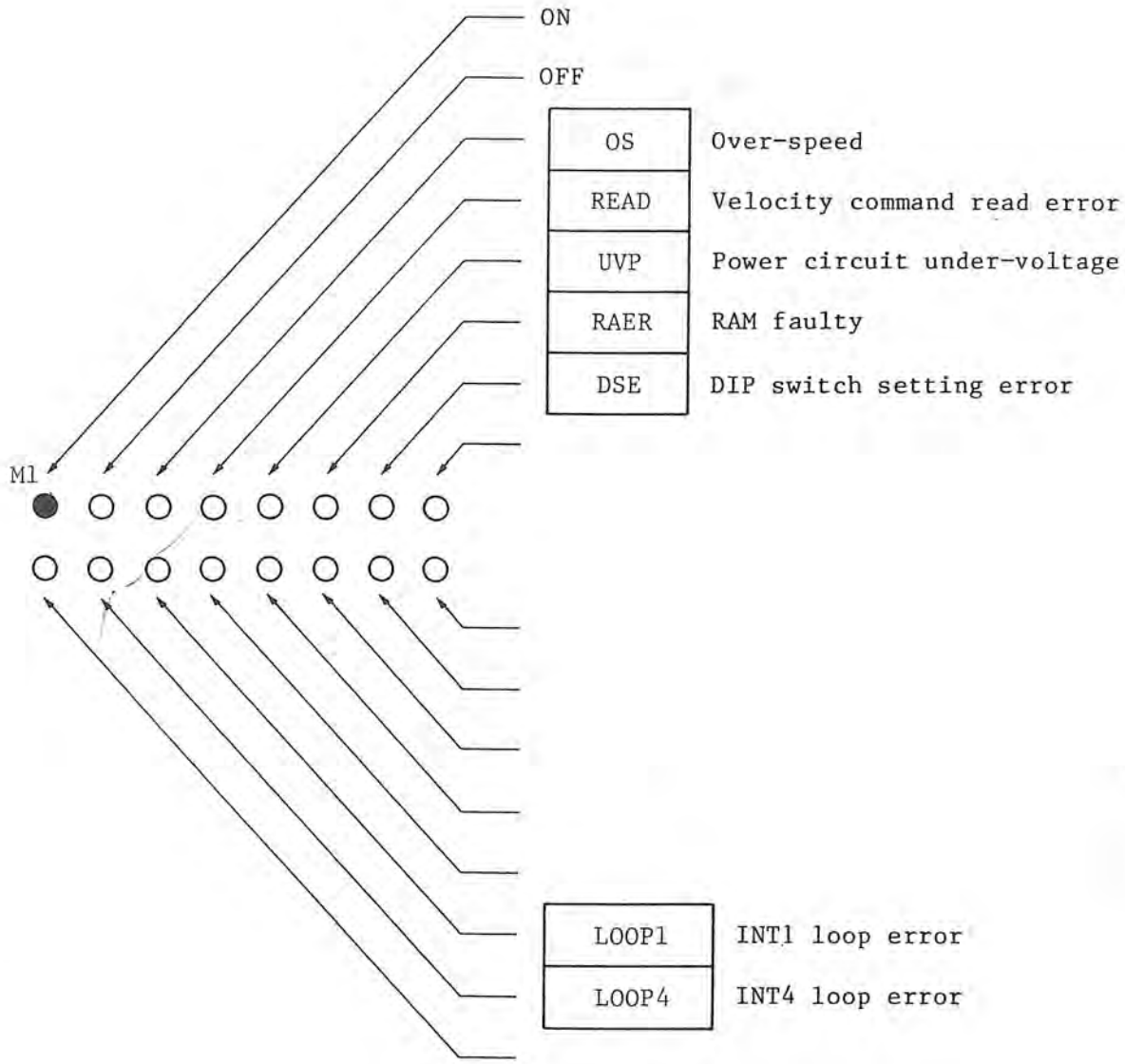


Fig. 6-8 Failure Indication by LED (with M1 ON)

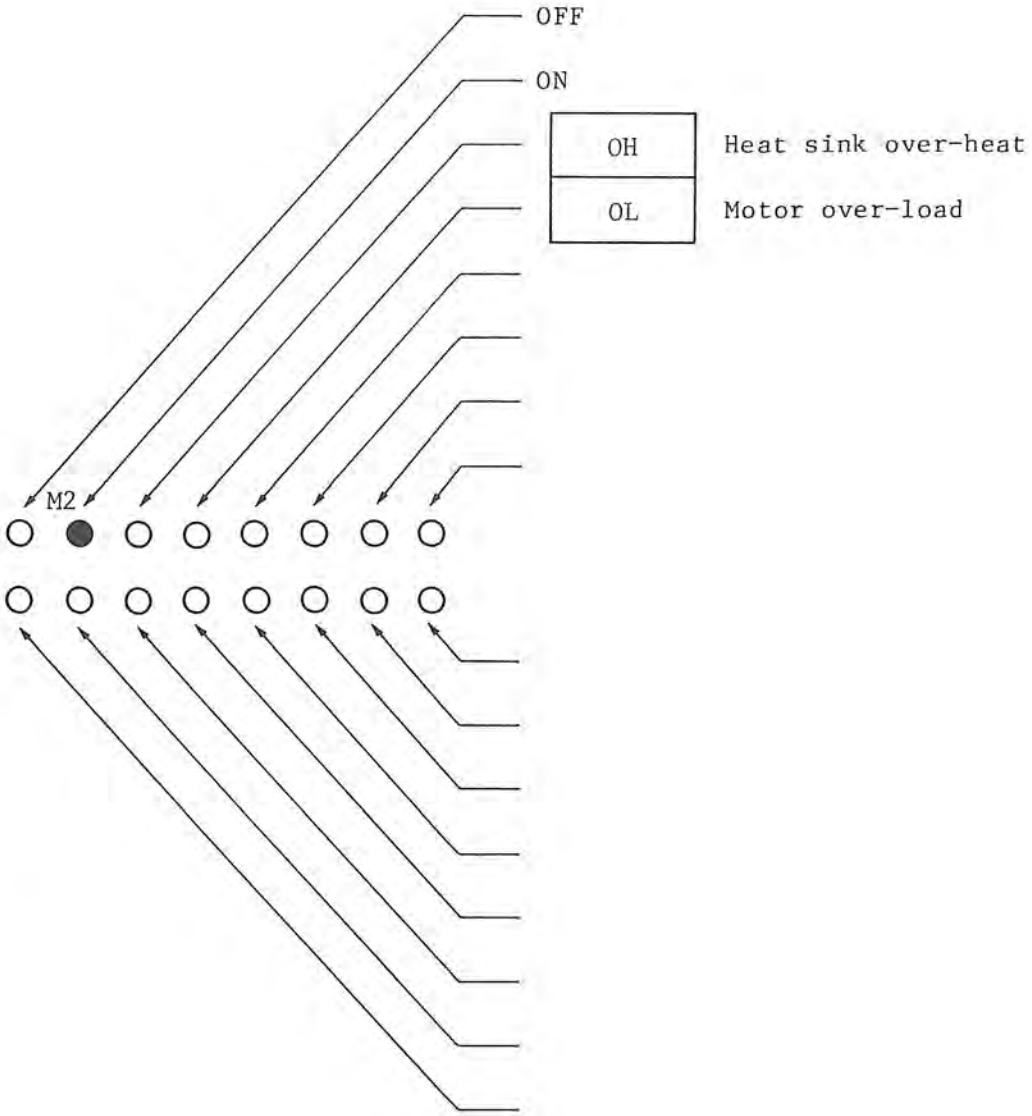


Fig. 6-9 Failure Indication by LED (with M2 ON)

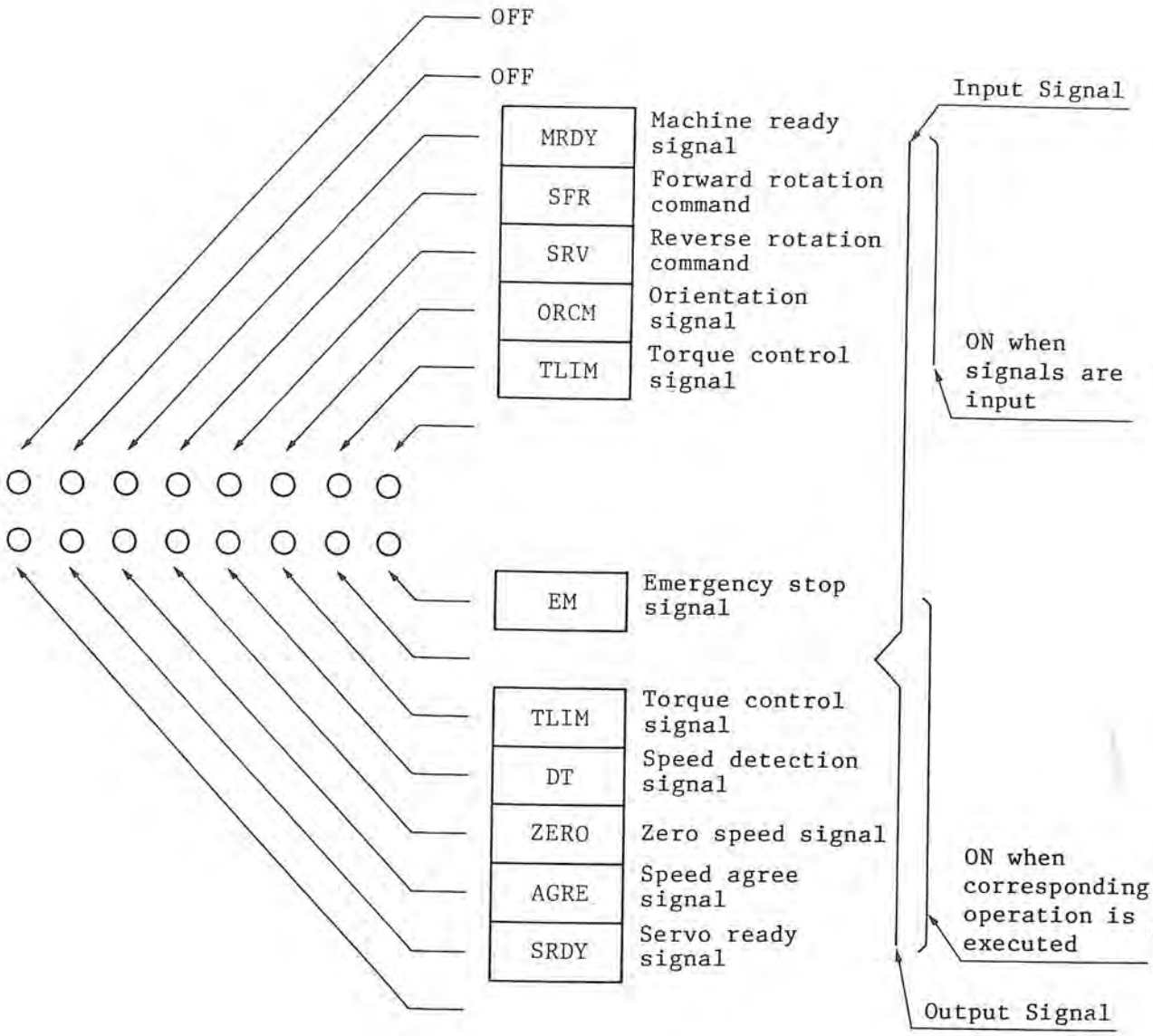


Fig. 6-1Ø Signal Indicated by LED during Normal Operation Status

6-3-3. MEASURES TO TAKE

Measures to take after an occurrence of failure are explained in 6-3-3-1 and 6-3-3-2. Arrangement of component parts is shown in Section 6-3-1.

Since high voltage is applied to the VAC drive unit, first record the number of LED illuminating and turn off power supply to the VAC drive unit before attempting to touch inside the unit.

6-3-3-1. Confirmation of Power Supply, Connectors and Signals

Before proceeding to checkups and taking necessary measures as explained in 6-3-3-2, check power supply, connectors and signals in accordance with Table 6-4.

Table 6-4 Confirmation of Power supply, Connectors and Signals

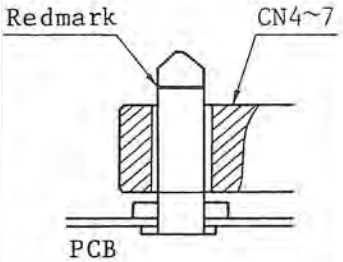
Item	Confirmation	Measures
Power supply	Measure input voltage at input terminals R, S and T of no-fuse breaker to make sure that input voltage is within the allowable range. Allowable input voltage range: AC 3-phase, 17Ø - 24ØV 5Ø/6Ø Hz 1%	Make necessary adjustments so that input voltage is within the specified range.
Connectors	Make sure that MR connectors (CN1 through CN3) are securely clamped in place with screws. Make sure that red mark of the connector guide is at the front side of the PCB side connector (for PCB connectors CN4 through CN7).	Correct connection. 
Signal	When the LED's are indicating normal operation conditions, make sure that the LED's light up corresponding to the input signals.	Refer to Table 6-5.

Table 6-5 Measures to Take when LED Fails to Turn ON in Response to Input Signals

Cause of Failure	How to Check	Measures
Open of control signal circuit	Disconnect the signal cables and carry out continuity check.	Replace the control signal cable.
Cause of failure lies at the machine side	Refer to the operation manual for the machine.	Refer to the operation manual for the machine.
Others	Make sure that all items above are correct.	Contact your local Okuma service representative.

6-3-3-2. Classification of Failure Occurrence Conditions and Measures

When a failure occurs, take measures following the steps indicated in Table 6-6.

For the confirmation of fuses, refer to Section 6-4, "Fuse Replacement".

Note that locations and the number of fuses used in type D22 VAC drive unit differ from other types of VAC drive units. Therefore, for type D22, change the information related with the fuse numbers as indicated below:

Fuses F1 and F2 ⟶ Fuses F1, F2 and F3
Fuses F3 and F4 ⟶ Fuses F4 and F5
(D3, D6, D11) (D22)

Table 6-6 Classification of Failures

Failure	Reference Item
POWER LED does not light up.	(1)
LOSS LED lights up.	(1)
LED's show failure occurrence condition.	(2)
Commanded motor speed cannot be obtained.	(3)
Motor does not rotate.	(3)
Low cutting performance	(4)
Long acceleration and deceleration time	(5)
Spindle orientation cannot be correctly performed.	(6)
Excessive vibration and noise while the motor is rotating	(6)
Others	(6)

(1) POWER LED does not light up.

LOSS LED lights up.

Table 6-7

Cause of Failure	How to Check	Measures
Input power supply is abnormal.	Refer to Table 6-4.	Refer to Table 6-4.
Fuse F3 or F4 is blown.	Check the fuses whether they have been blown or not.	Replace blown fuse, F3 or F4. (Refer to Figs. 6-2, 6-3, 6-4 and 6-5.)
Warning fuse SMP32 or MP5Ø is blown.		
Connector CN7 for the printed circuit board is not inserted properly.	Check to be sure that the red mark on the connector guide can be seen at the surface of the connector on the printed circuit board.	Insert the connector properly.
Others	Make sure that all the items above are correct.	Contact your local Okuma service representative.

(2) LED's show failure occurrence condition.

If the LED's are indicating the failure occurrence status, first check the contents of failure and follow the measures as indicated in Table 6-8.

Table 6-8

Contents of Failure	Reference Item	Contents of Failure	Reference Item
RES	(a)	PH	(e)
AD	(b)	LOSS	(f)
PAR		OS	(g)
ACC		READ	
LOOP		UVP	(h)
WDOG		RAER	(i)
IOCM	(c)	DSE	
IOCS	(d)	LOOP4	
IOCR		LOOP1	
OV		OH	(j)
UV	(e)	OL	(k)

Remarks: If the LED which does not correspond to the failure content indicated lights up, follow the steps indicated in (1).

a) RES lamp is ON.

Table 6-9

Cause of Failure	How to Check	Measures
Loose connection of the connectors of motor signal cables.	Check whether connector CN3 and the connector in the VAC motor terminal block are inserted properly.	Insert them properly.
Open of motor signal circuit	Disconnect the signal cables and carry out continuity check.	Replace the control signal cable.
Others	Make sure that all items above are correct.	Contact your local Okuma service representative.

b) AD, PAR, ACC, LOOP or WDOG lamp is ON.

Contact your local Okuma service representative.

c) IOCM lamp is ON.

Table 6-1Ø

Cause of Failure	How to Check	Measures
Loose connection of motor power cables at terminal block	Check motor power cable connection at the terminal block of the motor and the VAC drive unit.	Connect the cables correctly.
Motor power cables are broken.	Check continuity.	Replace the cables.
Others	Make sure that all items above are correct.	Contact your local Okuma service representative.

d) IOCS, IOCR or OV lamp is ON.

Contact your local Okuma service representative.

e) UV or PH lamp is ON.

Table 6-11

Cause of Failure	How to Check	Measures
Input power supply is abnormal.	Refer to Table 6-4.	Refer to Table 6-4.
No-fuse breaker is in the OFF position.	Check the no-fuse breaker.	Turn the no-fuse breaker ON.
Connector CN6 for the printed circuit board is not inserted properly.	Refer to Table 6-4.	Insert them properly.
Others	Make sure that all the items above are correct.	Contact your local Okuma service representative.

f) LOSS lamp is ON.

Follow the measures as indicated in Table 6-7.

g) OS or READ lamp is ON.

Contact your local Okuma service representative.

h) UVP lamp is ON.

Follow the measures as indicated in Table 6-11.

i) REAR, DSE, LOOP4 or LOOP1 lamp is ON.

Contact your local Okuma service representative.

j) OH lamp is ON.

Table 6-12

Cause of Failure	How to Check	Measures
Fuse F1 or F2 is blown.	Check the fuses whether they have been blown or not.	Replace the blown fuse, F1 or F2.
Cooling fan and heat sink are contaminated by dust and dirt.	Check contamination of the coolant fan, heat sink, etc.	Remove dust and dirt by compressed air or vacuum cleaner.
Overload	Confirm the reading of the load meter.	Examine the cutting conditions.
Connector CN5 for the printed circuit board is not inserted properly.	Refer to Table 6-4.	Insert the connector properly.
Input power supply is abnormal.	Refer to Tabel 6-4.	Refer to Tabel 6-4.
Others	Make sure that all the items above are correct.	Contact your local Okuma service representative.

k) OL lamp is ON.

Table 6-13

Cause of Failure	How to Check	Measures
Overload	Confirm the reading of the load meter.	Examine the cutting conditions.
Cooling fan, fan guard, and ventilating holes are contaminated by dust and dirt.	Check contamination of the cooling fan, fan guard, ventilating holes, etc.	Remove dust and dirt by compressed air or vacuum cleaner.
Loose connection of fan motor cables at terminal block.	Check fan motor cable connection at the terminal block of the motor and the VAC drive unit.	Connect the cables correctly.
Fan motor cables are broken.	Check continuity.	Follow the measures as indicated in Table 6-9.
Others	Make sure that all the items above are correct.	Contact your local Okuma service representative.

1) The LED which does not correspond to the failure content indicated lights up.

Contact your local Okuma service representative.

(3) Commanded motor speed cannot be obtained, motor does not rotate.

Motor does not rotate.

Table 6-14

Cause of Failure	How to Check	Measures
Drive unit and motor are faulty.	When rotation command is issued, the LED's at the printed circuit board light up indicating the failure status.	Refer to item (2).
Failure with the control signal cables or with the machine	Check whether the LED's at the printed circuit board light up in response to the input contact signal when rotation command is issued.	Refer to Table 6-5.
Others	Make sure that all items above are correct.	Contact your local Okuma service representative.

(4) Low cutting performance

Table 6-15

Cause of Failure	How to Check	Measures
Torque limit command is provided.	Check the pertaining signal. TLIM lamp lights up. (Fig. 6-1Ø)	
Loose drive belts	Check the tension of the belts.	Replace the belt.

(5) Long acceleration and deceleration time

Table 6-16

Cause of Failure	How to Check	Measures
Torque limit command is provided.	Check the pertaining signal. TLIM lamp lights up. (Fig. 6-1Ø)	
Others		Contact your local Okuma service representative.

(6) Spindle orientation cannot be correctly performed.

Excessive vibration and noise while the motor is rotating

Others

Contact your local Okuma service representative.

6-3-4. RECOVERY FROM FAILURE STATUS

When LED's indicate the failure status, it is necessary to remove the cause of failure first and then reset the alarm state to recover the operations of the VAC drive unit.

To reset the alarm,

1) Turn off power supply to the VAC drive unit, or

2) Press the ALMRST button at the printed circuit board.

Note that correct operations are impossible unless the cause of the failure has been removed.

If the cause of the failure is 1) blown fuse, or 2) tripping of the no-fuse breaker, other causes must also be checked since such abnormal status is caused by some types of malfunctions of the VAC drive unit.

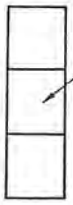
If the same failure recurs due to the same cause, contact your local Okuma service representative.

6-4. FUSE REPLACEMENT

6-4-1. FUSE BLOWN STATE

Blown state of the fuses used in the VAC drive unit is indicated in Table 6-17.

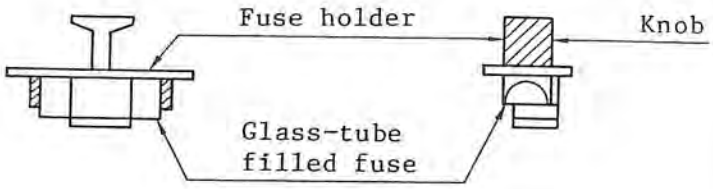
Table 6-17 Fuse Blown State

Name	Blown State
Fuses F1, F2, F3, F4 (F5 only for type D22)	 Neon tube lighting up Viewing from the front, the neon tube lights up as illustrated at the left.
Warning fuse SMP32 MP5Ø	 White Viewing from the front, white fuse blown indication is observed at the upper part of fuse holder as illustrated at the left.

6-4-2. FUSE REPLACEMENT

The procedure to replace the fuses used in the VAC drive unit are indicated in Table 6-18 below.

Table 6-18 Fuse Replacement

Name	Replacement Procedure
Fuses F1, F2, F3, F4 (F5 only for type D22)	 1) Pull out the fuse holder with the fuse by holding the knob. 2) Remove the glass-tube filled fuse from the fuse holder. 3) Set a new glass-tube filled fuse to the fuse holder. 4) Set the fuse holder to the VAC drive unit. For types D3 and D6, replace the fuses with the door open. For type D22, replace the fuse with the lower cover of the drive unit removed.
Warning fuse SMP32 MP5Ø	1) Remove the drive unit cover. 2) Pull the fuse out of the fuse holder. 3) Set a new fuse in the holder. 4) Replace the cover.

6-5. SPARE PARTS LIST

The VAC drive units have the following spare parts as indicated in Table 6-19.

Table 6-19 Spare Parts List

Part Name	Type	Okuma Part No.	Qty
Fuse (F1, F2, F3, F4, F5)	2ØØV 5A F7161	E2442-29Ø-124	2
Warning fuse (SMP32)	SMP32 3.2A Daito Tsushin	E2445-392-228	2
Warning fuse (MP5Ø)	MP5Ø 5A Daito Tsushin	E2445-392-215	1

6-6. INPUT/OUTPUT SIGNALS

(1) INPUT SIGNALS

Signal Name	Connector Pin No.	When Activated	Contents
Machine Ready Signal MRDY	CN1 [43 27]	Close	When this signal is input after power supply to the VAC drive unit has been turned on, spindle speed command can be received.
Forward Rotation Command SFR	CN1 [44 28]	Close	The SFR and SRV commands can be received after the output contact point signal SRDY is closed (ON).
Reverse Rotation Command SRV	[45 29]		After the SFR and SRV commands are received with the corresponding contact point closed (ON), the motor begins rotating in accordance with the spindle speed command.
Orientation Signal ORCM	CN1 [47 31]	Close	When the orientation signal ORCM is turned on (contact point closed), the spindle speed control loop gain, controlled by the controller, is increased establishing the spindle orientation enabled condition.
Torque Control Signal TLIM	CN1 [46 3Ø]	Close	When the torque control signal TLIM is turned on (contact point closed), the motor is placed in the torque limited state.
Emergency Stop Signal EM	CN1 [41 25]	Open	When the emergency stop signal EM is turned on (contact point opened), the motor is braked (regeneration braking) and stopped. Then, current to the motor is interrupted to stop power supply to the motor.

(2) Output Signals

Signal Name	Connector Pin No.	When Activated	Contents
Torque Limit Signal TLIM	CN1 [7 8]		This signal is output when the motor shaft output torque is limited with the torque limit signal input.
Speed Detection Signal DT	CN1 [9 1Ø]	Close	This signal is output when the motor output shaft speed has dropped below the preset value.
Zero Speed Signal ZERO	CN1 [5 6]	Close	This signal is output when the spindle speed is lowered to zero speed conditions (below 30 rpm).
Speed Agree Signal AGRE	CN1 [3 4]	Close	This signal is output when the motor output shaft speed falls within the predetermined range with respect to the commanded speed.
Servo Ready Signal SRDY	CN1 [15 16]	Close	This signal is output when the status in which the speed command signal may be received after the reception of the MRDY signal.

SECTION 7 COOLING UNIT

The cooling unit is provided on the top of or at the side of the control unit box to prevent the temperature rise in the control box, thus improving the reliability of the CNC system.

7-1. MAINTENANCE AND INSPECTION

Check the following items at least once every three months to keep the cooling unit functioning normally.

(1) Check for clogging in the air suction opening. Clogging will raise the temperature in the control box to degrade the reliability of the CNC system. Always make sure there is good ventilation.

(2) Check that the cooling fan is rotating normally.

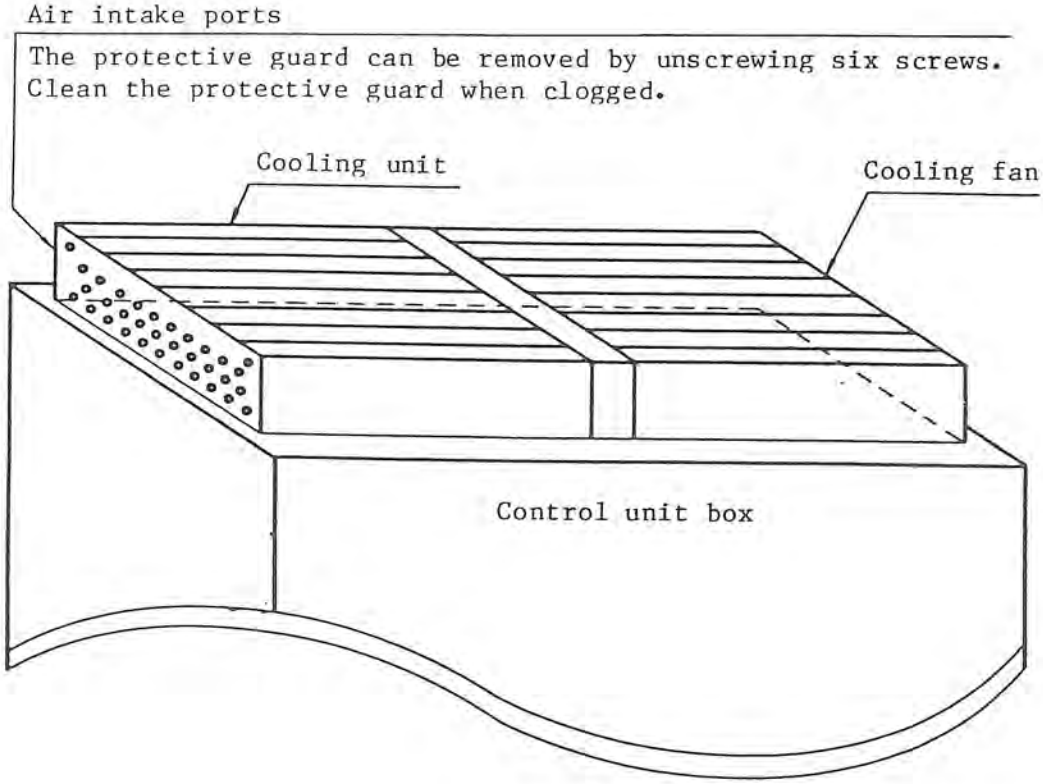


Fig. 7-1 Cooling Unit

SECTION 8 TURRET CONTROL UNIT (TCU)

8-1. GENERAL

The turret control unit (TCU) controls the indexing direction, speed, and position of the turret. The TCU has the following features:

(1) Accurate and speedy control of the indexing direction, speed, and position of the turret, that is the result of constant monitoring of its speed and position.

(2) Reliable and stable control that is unaffected by oil temperature, tool mounting balance, etc. the TCU has learning functions for maintaining the optimum control conditions, and a re-try function for executing operations after an initial failure. All of the functions are under the control of a high-speed microprocessor.

(3) One TCU can control the turret having two axes.

8-2. COMPOSITION

The TCU controls a turret control system as shown in Figure 8-1.

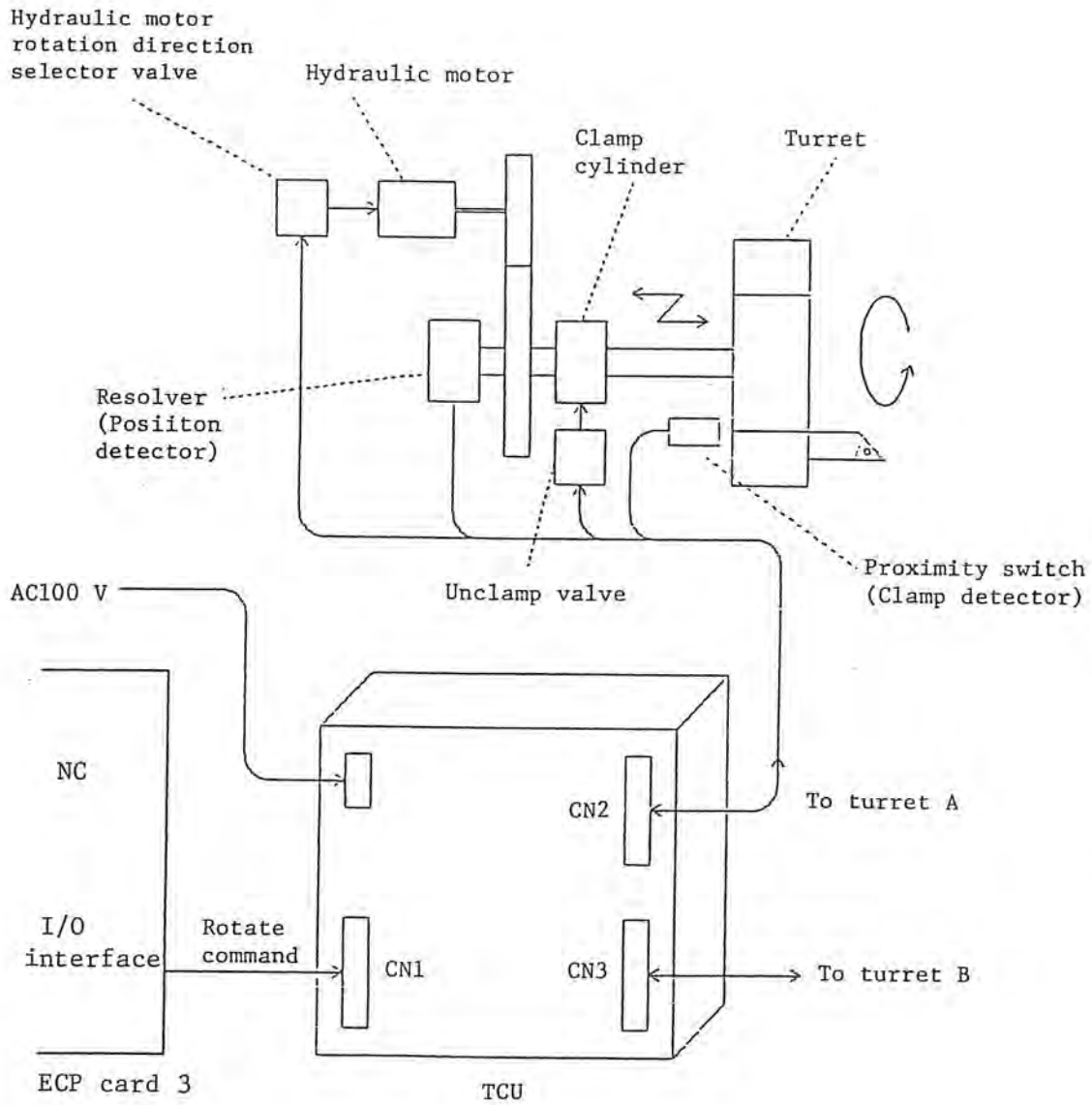


Fig. 8-1 Composition of Turret Control System

8-3. LED INDICATIONS

The TCU operation status and fault status are indicated by 8 LEDs located on the PCB in the unit as shown in Figure 8-2. The function of the LEDs are shown in Table 8-1.

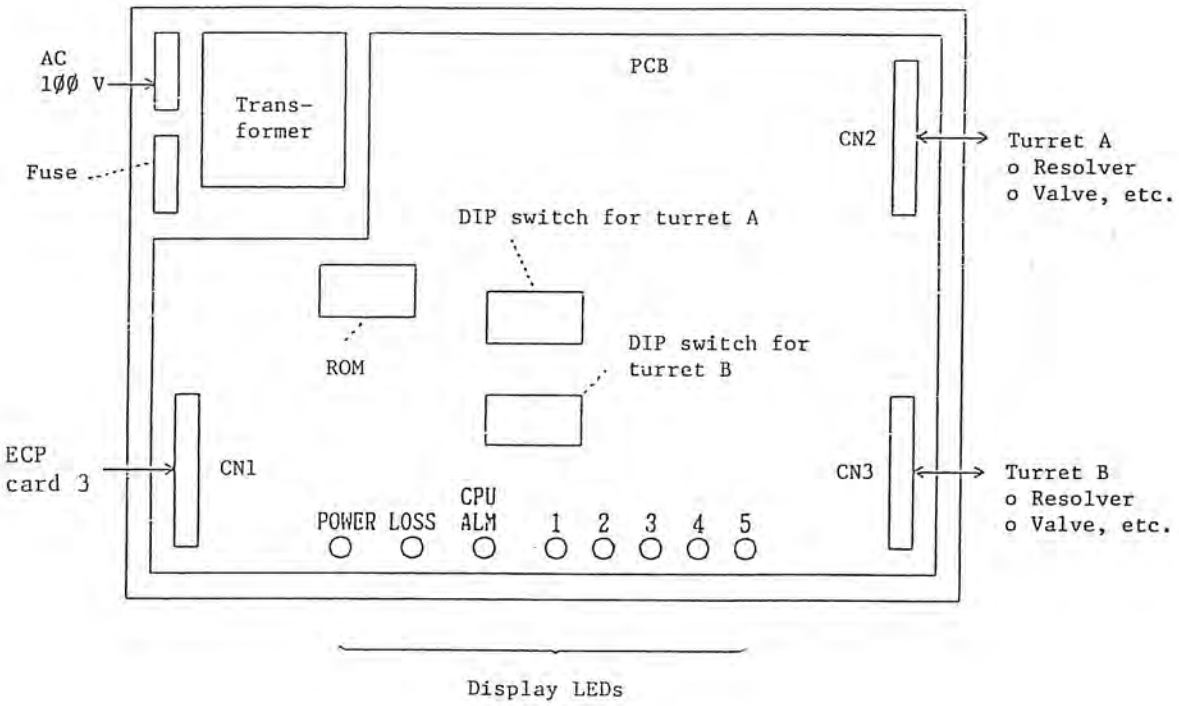


Fig. 8-2 TCU Components Layout

LED	Color	Function
POWER	Green	Energize control circuit
LOSS	Red	Low control circuit voltage to alarm level
CPU-ALM	Red	Faulty operation status of TCU microprocessor
1	Red	Faulty TCU operation causing alarm
2	Green	° While LED 1 is off, indicates TCU operation status ..... Refer to Table 8-2 ° While LED 1 is on, indicates error status ..... Refer to Table 8-3
3	Green	
4	Green	
5	Green	

Table 8-1 LED Functions

As indicated in Table 1, the functions of LEDs 2 ∿ 5 are different depending on the on-off status of LED 1 as shown in Table 8-2 below.

8-3-1. INDICATION OF LED's 1 ~ 5 IN NORMAL OPERATION STATUS

When the TCU is operating normally, LED 1, LOSS and CPU-ALM are off.

LED Number					Operations
1	2	3	4	5	
●	●	☼	X	X	Turret A is clamped.
●	☼	●	X	X	Turret A indexing command is input.
●	X	X	●	☼	Turret B is clamped.
●	X	X	☼	●	Turret B indexing command is input.

Table 8-2 LED On-Off Operations

● ... Off

☼ ... On

X ... Irrelevant

8-3-2. INDICATION OF LEDs 1 ~ 5 UNDER ERROR STATUS

When an error status is present in the system, LED 1 is on or flickers. When LED 1 flickers, turret A is faulty, and when it is on, turret B is faulty. LEDs 2 ∿ 5 indicate the error conditions by the lighting patterns shown in Table 8-3.

8-4. TROUBLESHOOTING

When the TCU fails to operate properly, check the LED indication by referring to Tables 8-1 and 8-3.

- If POWER LED is off, check the fuse in the TCU, and if it has blown, replace it according to the instructions in Section 8-5.
- When an alarm status is displayed by the red LEDs, or when replacing the fuse does not restore proper operation, identify the error code by referring to Tables 8-1 and 8-3. Notify the nearest Okuma representative of the error code and the fault conditions that have occurred.

8-5. REPLACING FUSE

The TCU has a fuse in the upper left hand area as shown in Figure 8-2. Its type name and Okuma part number are as follows.

Note 1 When placing an order with our representative, give the Okuma part number.

Type (Maker)	Rating	Okuma part number
GNB1A (Asahi)	125 V 1 A	E2442-ØØ3-1Ø5

Be sure to use fuse with the correct rating to ensure the protective function.

Note 2 The alarm code suffixes (A) and (B) indicate the turret affected.

Alarm code	LED indication: Power Loss	LED indication: CPU 1 2 3 4 5	Alarm name	Alarm description	Main cause
-		X X X X X	Power supply low voltage	Control power supply voltage too low	° Poor contact in power supply line connection ° Voltage drop in power supply (1ØØ V AC) ° TCU defect
	○ ● ○	X X X X X	CPU alarm	Faulty operation of microprocessor in TCU	° TCU defect ° ROM faulty
1 (A)	○ ● ●	○ ● ● ● ○	-	Reserve	-
1 (B)	○ ● ●	○ ● ● ● ○			
2 (A)	○ ● ●	○ ● ● ○ ●	Unclamp time over	° Unclamping disabled ° Unclamping is slow	° Proximity switch not properly adjusted ° Hydraulic pressure is too low ° Unclamping valve malfunction
2 (B)	○ ● ●	○ ● ● ○ ●			
3 (A)	○ ● ●	○ ● ● ○ ○	Acceleration time over	Indexing speed does not reach 15 rpm within preset time	° High-speed indexing is not properly adjusted ° Hydraulic pressure is too low ° Incorrect setting of DIP switch ° Hi-low speed select valve malfunction
3 (B)	○ ● ●	○ ● ● ○ ○			
4 (A)	○ ● ●	○ ● ○ ● ●	Indexing speed over	Speed exceeds 50 rpm	° High speed indexing is not properly adjusted ° Hydraulic pressure is too high ° Resolver signal line received noise
4 (B)	○ ● ●	○ ● ○ ● ●			

Table 8-3 (1) LED Error Indications

○ ... ON ⊙ ... Flickers

● ... OFF X ... Irrelevant

Alarm code	LED indication: Power Loss	LED indication: CPU 1 2 3 4 5	Alarm name	Alarm description	Main cause
5 (A)	○ ● ●	◐ ● ○ ● ○	Index time over	Indexing time is too long	° High indexing speed is not properly adjusted (slow) ° Hydraulic pressure is too low ° Strong friction against turret swiveling
5 (B)	○ ● ●	○ ● ○ ● ○			
6 (A)	○ ● ●	◐ ● ○ ○ ●	Wrong indexing direction	Turret indexes opposite to command	° Incorrect setting of DIP switch ° Incorrect wiring of hydraulic valve ° Incorrect wiring of resolver
6 (B)	○ ● ●	○ ● ○ ○ ●			
7 (A)	○ ● ●	◐ ● ○ ○ ○	Deceleration time over	Indexing speed does not go below 5 rpm within preset time	° Low speed indexing is not properly adjusted ° Hydraulic pressure is too high ° Hi-low speed select valve malfunction
7 (B)	○ ● ●	○ ● ○ ○ ○			
8 (A)	○ ● ●	◐ ○ ● ● ●	Creep time over	Too much time required to reach clamping position after deceleration	° Low speed indexing is not properly adjusted ° Hydraulic pressure is too low ° Strong friction against turret rotation
8 (B)	○ ● ●	○ ○ ● ● ●			
9 (A)	○ ● ●	◐ ○ ● ● ○	Mis-clamping	Clamping failure	° TCU not properly adjusted (Resolver offset) ° Proximity switch is not properly adjusted ° DIP switch setting wrong ° The accuracy of resolver is at fault
9 (B)	○ ● ●	○ ○ ● ● ○			

Table 8-3 (2) LED Error Indications

○ ... ON ◐ ... Flickers

● ... OFF X ... Irrelevant

Alarm code	LED indication (Power Loss, CPU 1 2 3 4 5)	Alarm name	Alarm description	Main cause
A (A)	○ ● ● ◐ ○ ● ○ ●	Position detector fault I	Clamping disabled despite clampable position	° TCU not properly adjusted (Resolver offset) ° Proximity switch not properly adjusted ° DIP switch setting wrong ° The accuracy of resolver is at fault
A (B)	○ ● ● ○ ○ ● ○ ●			
B (A)	○ ● ● ◐ ○ ● ○ ○	Position detector fault II	Clamping effected despite clamping disable position	° TCU not properly adjusted (Resolver offset) ° Proximity switch not properly adjusted ° Resolver lead wire not making contact ° The accuracy of resolver is at fault
B (B)	○ ● ● ○ ○ ● ○ ○			
C (A)	○ ● ● ◐ ○ ○ ● ●	Reserve	–	–
C (B)	○ ● ● ○ ○ ○ ● ●			
D (A)	○ ● ● ◐ ○ ○ ● ○	DIP switch setting fault	Incorrect setting of DIP switch	
D (B)	○ ● ● ○ ○ ○ ● ○			
E (A)	○ ● ● ◐ ○ ○ ○ ●	Communication failure	NC gave improper commands	Wiring from NC is defective
E (B)	○ ● ● ○ ○ ○ ○ ●			
F (A)	○ ● ● ◐ ○ ○ ○ ○	Reserve	–	–
F (B)	○ ● ● ○ ○ ○ ○ ○			

Table 8-3 (3) LED Error Indications

○ ... ON ◐ ... Flickers

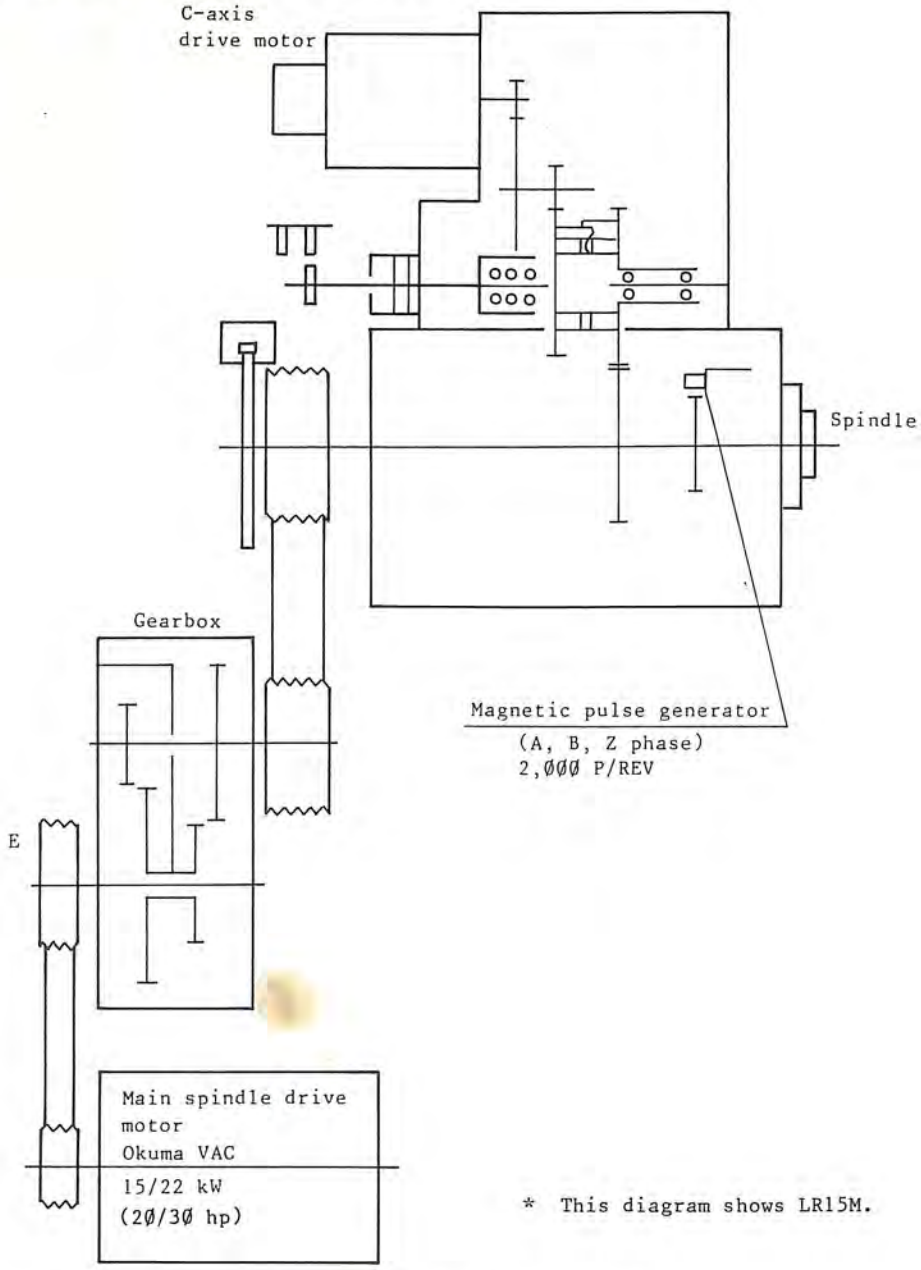
● ... OFF X ... Irrelevant

SECTION 9 C-AXIS OF MULTIPLE-MACHINING MODEL

A rotary axis defined on the plane established in right angles to Z-axis is called C-axis. On multiple-machining models, spindle rotation is controlled as C-axis. Different motors are used to drive the spindle for conventional turning operations and to drive the C-axis spindle for multiple-machining. This means that selection of the motor meeting the machining requirements becomes necessary.

9-1. C-AXIS JOINT MECHANISM

The operation to switch the spindle drive motor from conventional spindle drive motor for turning to C-axis drive motor is called C-axis joint, which is executed by M11Ø command.



* This diagram shows LR15M.

Fig. 9-1 C-axis Joint Mechanism

9-2. C-AXIS JOINT METHODS

For all LR series models, C-axis joint is executed by M11Ø command. However, joint operations differ depending on models due to difference in mechanism and control software.

These include the following three methods:

a) Spindle driven by C-axis during C-axis joint
b) High speed C-axis joint A
c) High speed C-axis joint B

As stated above, the same command (M11Ø) is used to execute C-axis joint for any C-axis joint method. However, preparations for C-axis joint and troubleshooting process for a problem arising during C-axis joint differ in each joint method.

This section covers the method to check the C-axis joint method used on your model, and joint processes of each joint method. In the next section, preparations for C-axis joint and troubleshooting procedure are discussed.

9-2-1. Checking C-axis Joint Method

To check the C-axis joint method used on your model, display the SPECIFICATION CODE screen of the CHECK DATA display screens.

The procedure to display the required SPECIFICATION CODE screen is explained in detail in 4-1-7, "CRT Display while in operation" in the Operation Manuals for OSP5ØØØL-G (Publication No. 2446-E).

```
MDI  OPERATION                                   N        0

CHECK DATA                                     UNIT 1mm
          SPEC CODE 01:
     no.    data     bit7 bit6 bit5 bit4 bit3 bit2 bit1 bit0
      1   00000010   IDC  LSCH 2SWC OLC  ROBT TATS SPRH SPID
      2   00000000   OMB1 OMCA TSC  MSPR CEJ  XMS  NSNS TCSN
      3   00000000   CMK  SMW  IEC  IECD DRIB ECE3 ECE2 ECE1
      4   00001000   ACPC CMTR ATC  TSS  CCM  MIRR 2S   SC
      5   00000000   PBCD FIBM CTIM MOP  SQRS OWKC TDIO PRIF
      6   00010000   CACB THDC CALC MTCL B60S TOF3 TOF2 THSP
      7   11111111   OABV CREF COCO AXCM SHOT TLFC RMNI WKMN
      8   00111111   CNVT IGFC IGF  CLGR UTSK INML NRC  LAP
      9   00000000   CD8  CD7  CD6  CD5  CD4  CD3  CD2  CD1
     10   00000000                             OMB2      TMPS
     11   00000000
     12   00000000   DNC3 DNC2 DNC1 DNCB DNCA EBCD EBST EBIT

=
DATA   | ACTUAL | PART    | BLOCK  |        |        | CHECK  |
INPUT  | POSIT  | PROGRAM | DATA   |        |        | DATA   | [EXTEND]
```

F1 F2 F3 F4 F5 F6 F7 F8

Check bit data of No. 6 at SPECIFICATION CODE Ø1 screen:

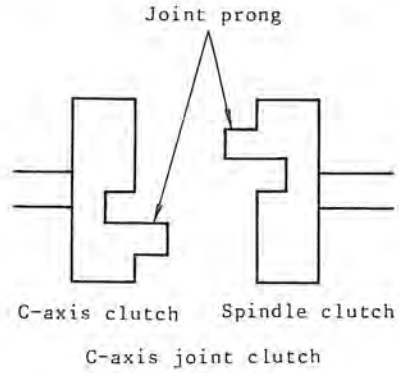
No. 6 bit 5 CALC	bit 7 CHCB	
1	Ø	Spindle driven by C-axis during C-axis joint
Ø	1	C-axis high speed joint B
Ø	Ø	C-axis high speed joint A

The example CRT display above indicates that the C-axis high speed joint A is used.

9-2-2. Spindle Driven by C-axis During C-axis Joint

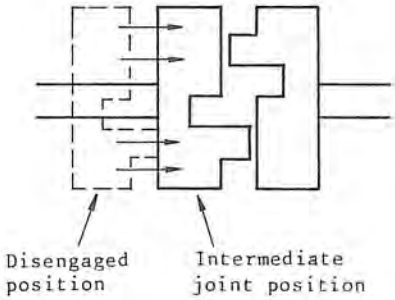
(1) Outline

The C-axis clutch moves forward to the intermediate point for joint, where C-axis rotates to find the joint prong with the spindle clutch.

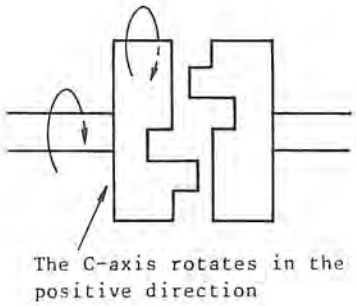


(2) Axis joint process

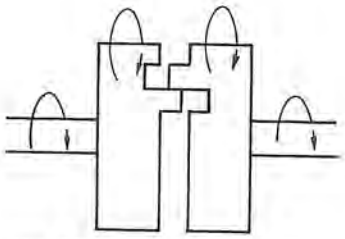
a) When the C-axis joint command (M11Ø) is executed, the C-axis clutch advances to the joint intermediate position from the clutch disengaged position.



b) The C-axis rotates to find the joint prong of the spindle clutch; the C-axis always rotates in the positive direction.

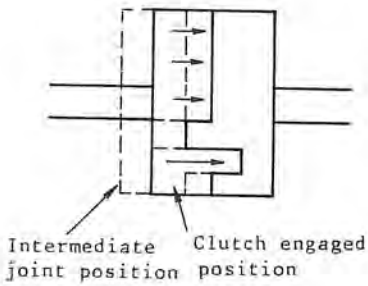


c) From the point where the joint prong of the C-axis clutch contacts the joint prong of the spindle clutch, the C-axis rotates 9Ø° further. This condition is called "spindle driven by C-axis during C-axis joint".

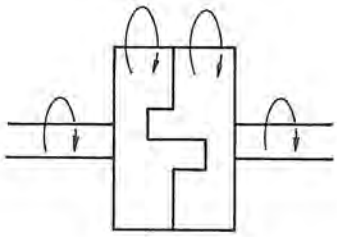


The spindle is driven by C-axis by more than 9Ø° during C-axis joint.

d) After the spindle is driven by C-axis by 9Ø° during C-axis joint, the C-axis clutch moves forward to the clutch engaged position.



e) After the confirmation of C-axis joint, C-axis rotates to the programming zero (position where actual position display is Ø), then C-axis joint is completed. Note that C-axis always rotates in the positive direction during C-axis joint operation.



(3) Supplements

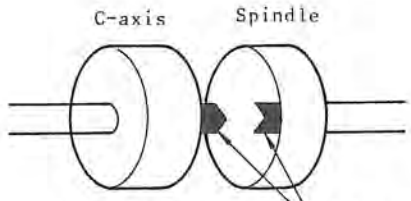
Spindle driven by C-axis during C-axis joint is possible only while the spindle drive gears are in the neutral position. If the gear range is not neutral when the C-axis joint command (M11Ø) is executed, the gear range is automatically placed in the neutral position.

9-2-3. High Speed C-axis Joint A

(1) Outline

In this joint method, C-axis and the spindle are both positioned at the predetermined position to joint the C-axis. The C-axis joint position is 33Ø° position of C-axis (on program coordinate system).

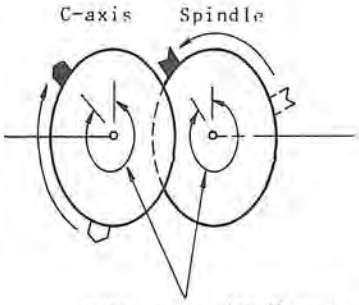
(2) Joint Process



(mechanical construction is the same as high speed C-axis joint B)

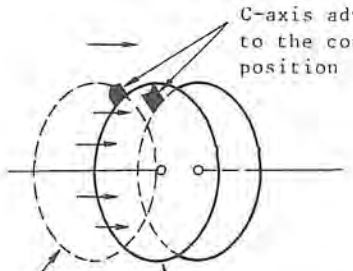
a) When the C-axis joint command (M11Ø) is executed, the C-axis and the spindle are located at the joint position (33Ø° position of C-axis on the program coordinate system): C-axis at a rapid rotation speed and the spindle by spindle orientation.

Both the C-axis and the spindle are positioned following the respective shorter paths.



Joint angle (33Ø° on the C-axis program coordinate system)

b) The C-axis clutch advances to the clutch connection position. After the completion of advancement, the spindle drive gear is placed in the neutral position.



C-axis advances to the connection position

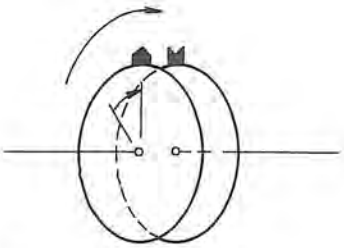
C-axis clutch disengaged position

C-axis clutch engaged position

c) The spindle is disconnected from the drive mechanism for turning operation and controlled as the C-axis.

After the joint, the C-axis carries out positioning at the programming zero (actual position display of C-axis Ø), then C-axis joint process completes.

In this zero return operation of the C-axis, the C-axis rotates from 33Ø° position to Ø° position in the positive direction.



Zero return of C-axis by the C-axis positive direction rotation

(3) Supplements

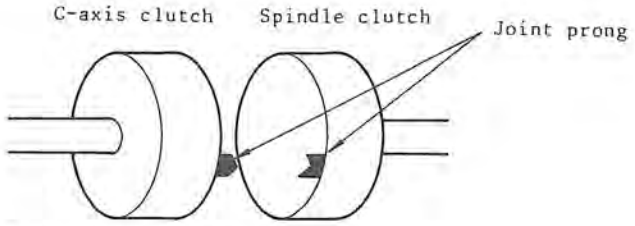
In step a) above, the spindle is positioned at the joint position by the spindle orientation operation. This spindle orientation is conducted in the gear range selected when the C-axis joint command (M11Ø) is executed. However, if the spindle drive gear range is neutral at this time, M41 range is automatically selected to carry out spindle orientation.

9-2-4. High Speed C-axis Joint B

(1) Outline

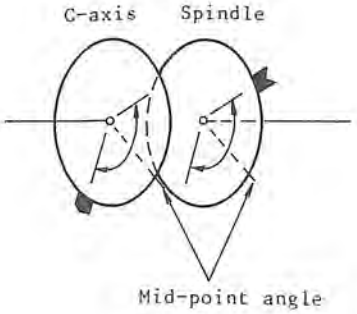
Both the C-axis and the spindle carry out positioning at the position closest to both of them, i.e., at the mid-point between them when the C-axis joint command is executed.

(2) Joint process

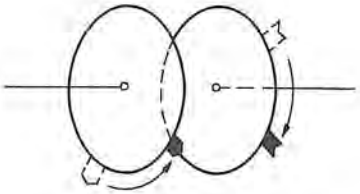


C-axis joint clutch
(mechanical construction is the same as high speed C-axis joint A)

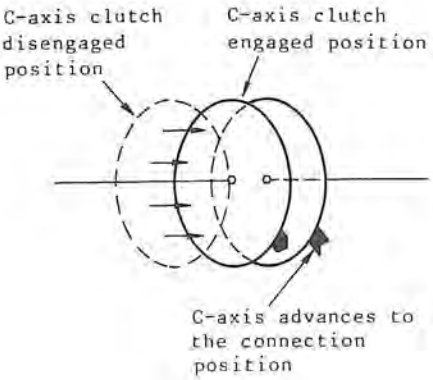
a) The mid-point angle of the C-axis and the spindle actual angular positions is calculated when the C-axis joint command (M11Ø) is executed. This joint position varies depending on the positions of the C-axis and the spindle when the C-axis joint command is executed.



b) Positioning of the C-axis and the spindle occurs at the calculated mid-point; C-axis at a rapid rotation speed and the spindle by the spindle orientation.



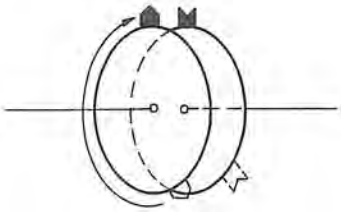
c) The C-axis clutch advances to the clutch connection position. After the completion of advancement, the spindle drive gear is placed in the neutral position.



d) The spindle is disconnected from the drive mechanism for turning operation and controlled as the C-axis.

After the joint, the C-axis carries out positioning at the programming zero (actual position display of C-axis Ø), then C-axis joint process completes.

In this zero return operation of the C-axis, it rotates from 33Ø° position to Ø° position in the positive direction.



Zero return of C-axis by the C-axis positive direction rotation

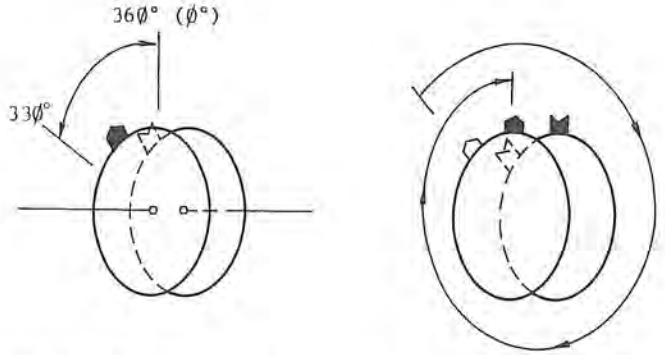
(3) Supplements

a) To calculate the mid-point in process a) above, the C-axis position is calculated from the position encoder output and the spindle position from the feed pulse value.

b) The feed pulse value is not reliable under the condition that the spindle has not been rotated after power ON. If C-axis joint is commanded in such a state, the spindle position is assumed to be at feed pulse Ø position for the calculation of the mid-point.

c) In step b) above, the spindle is positioned at the joint position by the spindle orientation operation. This spindle orientation is conducted in the gear range selected when the C-axis joint command (M11Ø) is executed. However, if the spindle drive gear range is neutral at this time, M41 range is automatically selected to carry out spindle orientation.

d) If the mid-point value calculated is within a range of 33Ø° to 36Ø° (Ø°) on the C-axis programming coordinate system, zero return in step d) above is carried out after one full turn of the C-axis.



If the calculated mid-point is within a range of 33Ø° to 36Ø°, C-axis first carries out one full turn before carrying out spindle orientation.

9-2-5. Supplements to Joint Method Explanations

Operations common to the three C-axis joint methods are explained below.

(1) After the completion of C-axis joint (M11Ø), the spindle drive gear range is placed in the neutral position. However, the range previous selected is registered in memory and after the completion of C-axis release command (M1Ø9), the spindle speed range previously selected is recovered.

(2) After the completion of C-axis joint, backlash in C-axis movement is zero for positive direction movements. Backlash is zeroed by the following operations in each of the joint methods.

a) Spindle driven by C-axis during C-axis joint

Spindle driven by C-axis by more than 9Ø° during C-axis joint in step c)

b) C-axis high speed joint A

Zero return rotation from 33Ø° to 36Ø° (Ø°) position on the C-axis program coordinate system in step c)

c) C-axis high speed joint B

Zero return rotation over 3Ø° from the mid-point (joint angle) in step d)

If angular distance from the mid-point to the zero position is less than 3Ø°, the C-axis rotates additional one full turn.

(3) If control power is turned off with C-axis in the joint state, the C-axis joint control is cleared and is placed in the joint release state.

9-3. C-AXIS JOINT PARAMETERS

Parameters related with C-axis joint operation are indicated below:

a) Spindle orientation position parameter
b) Spindle orientation zero point in C-axis joint

These parameters are factory-set to the optimum values before shipment. However, since it will become necessary to change them during a long term operation of the machine, parameter setting methods are explained below.

Note that for the models using the spindle driven by C-axis during C-axis joint method, setting of parameters is not necessary.

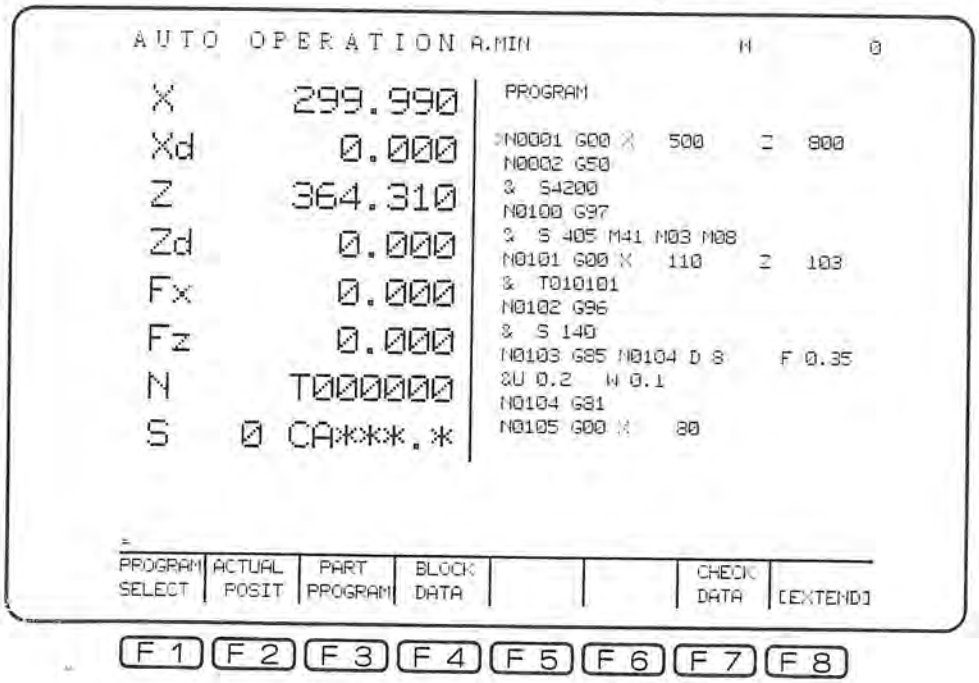
9-3-1. Spindle Orientation Position Parameter

The spindle orientation position parameter is set for individual models at the optimum value when the control software is loaded from the floppy disk. However, it might be necessary to change the set value before starting machining operation, meeting the workpiece shape, chuck shape, etc.

Allowance in spindle orientation is ±4°, and if spindle orientation is not accomplished within this allowable range, C-axis joint might not be carried out correctly. Therefore, after the change of setup, it is necessary to check the orient stop position of the spindle by executing the M19 command.

For the parameter setting procedure, refer to the Special Functions Manuals for OSP5ØØØL-G (Publication No. 2465-E).

Accuracy in spindle orientation operation can be checked on the actual position display screen on which program is also displayed.



For the procedure to display the screen above, refer to 4-1-7, "CRT Display while in Operation" in the Operation Manuals for OSP5ØØØL-G (Publication No. 2446-E).

Carry out the spindle orientation command M19 in the MDI mode. In this spindle orientation, the target is Ø° position.

The angular position data of the orient stop position is displayed at parameter CA on the screen above. Check if accuracy ±4° is secured.

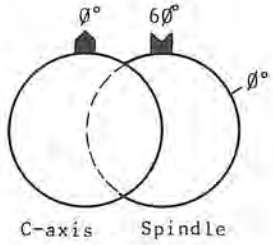
9-3-2. Zero Position in Spindle Orientation for C-axis Joint

(1) Zero position in spindle orientation for C-axis joint

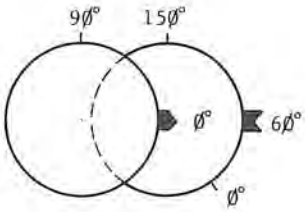
This position is calculated in a relative value in reference to the target position of C-axis* for C-axis joint operation carried out in C-axis high speed joint method A or B.

* 33Ø° position on the program coordinate system for method A, mid-point for method B

Once this value is calculated, the target position of the spindle can be calculated wherever the positioning point for C-axis is taken.



Assume that when the C-axis is at the Ø° position on the machine coordinate system, joint is possible by positioning the spindle at 6Ø° position on the machine coordinate system.



If C-axis joint is attempted at 9Ø° position of the C-axis on the machine coordinate system, C-axis joint is possible by positioning the spindle at 15Ø° position (6Ø° + 9Ø°).

The relative angular position of the spindle in reference to the C-axis is "the zero position in spindle orientation for C-axis joint".

(2) Cases which require the setting of zero position in spindle orientation for C-axis

The parameter data is factory-set before shipment and thus it is not necessary to re-set them after machine installation.

However, the setting becomes necessary in the following case:

a) When control software is loaded from floppy disk

In this case, write down the data before loading the software and set it after the software loading.

b) When spindle pulse generator or C-axis position encoder is replaced

In this case the data previously set becomes ineffective and setting new data after adjustments will be necessary.

For the procedure to set the new data, refer to 9-3-3, "How to Set Zero Position of Spindle Orientation for C-axis Joint".

Zero position data:

The zero position data is set at optional parameter (word) No. 52.

Parameter (word) No. 52 Spindle orientation angle for C-axis connection

Unit : Ø.1°
Initial value: Ø
Minimum value: Ø
Maximum value: 3,599

For the procedure to set the parameter (word), refer to 4-3-5, "Optional Parameter (word)" in the Operation Manuals for OSP5ØØØL-G (Publication No. 2446-E).

9-3-3. How to Set Zero Position of Spindle Orientation for C-axis Joint

When software is loaded from the floppy disks, the zero position data is initialized to zero (Ø). However, the data set before shipment is recorded on the management card and thus setting the same data restores the original state as set at the time of delivery.

If a C-axis position encoder or a spindle pulse generator is replaced, the data set at shipping becomes invalid and it becomes necessary to calculate the required setting data.

The procedure to calculate it is explained below:

1) Remove the top cover at the C-axis clutch so that the joint portion between the C-axis and the spindle will be exposed.

2) Place the spindle drive gears in the neutral position to release* the spindle.

   * Spindle can be rotated by hand.

3) Clear the C-axis zero offset to Ø.

4) Turn the spindle slowly by hand so that the spindle clutch is brought to the joint position.

5) Read the C-axis actual position data and the number of spindle feed pulses when the joint portion of the spindle is brought to the joint portion of the spindle.

   For the spindle feed pulse value, use the QSPPC data which is displayed at the check data display, AXIS DATA screen. For QSPPC, the identical data is displayed for X, and Z, or for XA, XB, ZA and ZB.

6) Use the following equation to calculate the set value.

$$A = \frac{(16ØØ \text{ or } 2ØØØ) - (\text{spindle feed pulses})}{(16ØØ \text{ or } 2ØØØ)} \times 36Ø + 3Ø$$

$$+ (\text{C-axis actual position data})$$

Setting value = A x 1Ø ..... Set only integer by rounding decimal fraction

If value A is greater than 36Ø°, subtract 36Ø from A so that value A is smaller than 36Ø. Note that value A must be positive.

9-4. TROUBLE AND TROUBLESHOOTING FOR C-AXIS JOINT OPERATION

If a problem arises during C-axis joint or release operation (M11Ø, 1Ø9), an alarm occurs and C-axis joint cannot be performed.

If an alarm occurs, refer to the alarm chart using the alarm message or alarm code number. Although the chart provides the contents of the trouble, it is sometimes necessary to check the machine conditions.

The procedure to check the machine conditions and the measures to take are explained in what follows.

For the EC INPUT/OUTPUT screens, refer to the screens provided in 4-4-2, (1) - (18).

9-4-1. Machine Condition Checking Procedure

The CHECK DATA screens provide the machine operation conditions.

a) Has the spindle orientation been completed?
b) What commands have been and are commanded?
c) Actual machine status for individual commands

For the items above, they are explained below one by one. For the procedure to display the screens, refer to 4-1-7, "CRT Display while in Operation" in the Operation Manuals for OSP5ØØØL-G (Publication No. 2446-E).

(1) Has the spindle orientation been completed?

With the spindle driven by C-axis during C-axis joint method, spindle orientation is not carried out. But, spindle orientation is the first operation to be carried out when the C-axis joint is commanded by C-axis high speed joint method A or B.

Unless the spindle orientation has not been completed, the control is placed in the response waiting condition without generating an alarm. In this case, C-axis joint operation does not complete.

Check No. 5 bit 4 (spindle orientation in Execution (SCSP)) of EC OUTPUT signal state display (No. 1) in 4-4-2, (1). If this signal is ON, it indicates that the spindle orientation has not been completed.

(2) What commands have been and are commanded?

The status which has been commanded can be known from the EC output bits for C-axis.

Bit Ø through bit 5 of No. 15 of EC OUTPUT signal status display (No. 2) (4-4-2, (6)) are the EC output bits for C-axis. Among these output bits, bit Ø through bit 2 indicate the command output at the time of C-axis joint.

Bit Ø ..... Low pressure joint
Bit 1 ..... High pressure brake
Bit 2 ..... Joint only

Output bits for commands:

Output bits for commands vary depending on joint methods.

a) Spindle driven by C-axis during C-axis joint method

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
No. 15	EPNR		CSTP	CCF	CCP	CJS	CHB	CLJ

C-axis joint output
High pressure brake output
Low pressure joint output

By the combination of these outputs, the following operation conditions are indicated.

CJS	CHB	CLJ	Output / Operation command output
OFF	OFF	OFF	Retraction to C-axis release position, or C-axis release
OFF	ON	ON	C-axis advance to intermediate position
ON	ON	ON	C-axis advance to joint position
ON	OFF	ON	C-axis joint completion

Output patterns other than those indicated above are not provided.

b) C-axis high speed joint method A, B

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
No. 15	EPNR		CSTP	CCF	CCP	CJS	CHB	CLJ

C-axis joint output

Low pressure brake output

By the combination of these outputs, the following operation conditions are indicated.

CJS	CLJ	Output / Operation command
OFF	OFF	Retraction to C-axis release position, or C-axis release
ON	OFF	C-axis advance to joint position
ON	ON	C-axis joint completion

(3) Actual machine status for individual commands

The actual machine status can be known from the EC input bits for C-axis.

Bit Ø through bit 4 of No. 21 of EC INPUT signal status display (No. 2) (4-4-2, (2)) are the EC input bits for C-axis. Among these input bits, bit Ø through bit 2 indicate the status input at the time of C-axis joint.

Bit Ø ..... C-axis released confirmation
Bit 1 ..... C-axis intermediate connection confirmation
Bit 2 ..... C-axis joint confirmation

Status indicating input bits:

Status indicating input bits vary depending on joint methods.

a) Spindle driven by C-axis during C-axis joint

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
No. 21				RTID	CIL/	CFJ	CHJ	CNJ

C-axis joint confirmation input

C-axis intermediate joint confirmation input

C-axis released confirmation input

The C-axis status is indicated by the following LS input patterns.

Status \ LS	CFJ	CHJ	CNJ
C-axis released (retraction end)	ON	ON	ON
C-axis at intermediate position	ON	OFF	OFF
C-axis joint (advance end)	OFF	OFF	OFF

b) C-axis high speed joint method A, B

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit Ø
No. 21				RTID	CIL/	CFJ	CHJ	CNJ

C-axis advance end input

C-axis retraction end input

The C-axis status is indicated by the following LS input patterns.

Status \ LS	CFJ	CNJ
C-axis released (retraction end)	OFF	ON
C-axis joint (advance end)	ON	OFF

9-4-2. Troubles and Troubleshooting

Causes, examples and measures to take for alarms which occur during the execution of C-axis joint are explained below.

(1) Cause of troubles and troubleshooting

The alarm message which is displayed at an occurrence of a problem during C-axis joint process is

Alarm A 16Ø C-axis connect command

The code numbers under this alarm state, causes and measures to take are explained below.

a) Code numbers

1 ..... The command (M11Ø, M1Ø9) is designated while the spindle is not at zero speed.

2 ..... The command (M11Ø, M1Ø9) is designated while the spindle is not at a still.

3 ..... The command (M11Ø, M1Ø9) is designated while the spindle rotation command is active.

This alarm occurs when C-axis joint (M11Ø) or C-axis release (M1Ø9) is commanded while the spindle is rotating. If the spindle is rotating (forward or reverse), be sure to stop the spindle before carrying out the C-axis joint. There are examples of alarm occurrence causes as explained below:

Example 1: M1Ø9 or M11Ø is specified while the spindle is rotating due to inertia after turning off spindle inching while the spindle was being rotated at a relatively high inching speed.

```
 :
M89        }  Air blower (inching) for one
GØ4  F1    }  second
M88        }
M11Ø           C-axis joint designation
 :
```

The spindle might be rotating even after the air blower (inching) has been turned off if inching speed is set at a high speed. If such a problem occurs, lower the inching speed.

Example 2: When an irregular shape workpiece is clamped in the chuck, the spindle might rotate if range is set at neutral. If M11Ø is programmed under such a condition, an alarm occurs.

```
 :
M4Ø
M11Ø
 :
```

The spindle might rotate due to imbalance of the workpiece. In this case, it is necessary to orient-stop the spindle at a position where the spindle will not rotate if imbalance exists.

Example 3: This alarm will occur if M1Ø9 and M11Ø are specified in succession.

```
 :
M11Ø
M1Ø9
M11Ø
M1Ø9
 :
```

The final operation step of M11Ø is the zero return of C-axis as stated before. In the final zero return operation, the C-axis will be moving even after the function generation has finished because actual axis movement has a delay due to presence of DIFF. An alarm occurs if M1Ø9 is programmed under such situation.

Do not program M11Ø and M1Ø9 in succession.

b) Code number 4 ..... The command (M11Ø, M1Ø9) is designated while C-axis is clamped.

While the C-axis is being clamped, C-axis feed is impossible. Always place the C-axis in the unclamp state before programming M1Ø9 and M11Ø.

c) Code number 5 ..... The command (M11Ø, M1Ø9) is designated while C-axis is interlock input is OFF.

The C-axis interlock input is turned off when external conditions are not satisfied. For instance, input signals are forcibly turned off if the loader is working inside the lathe so that the C-axis joint and release commands will not be executed.

d) Code number none ... C-axis clutch fails to advance.

An alarm occurs if the C-axis clutch fails to advance to the intermediate joint position for spindle driven by C-axis during C-axis specification or to the the joint position for C-axis high speed joint method A or B.

Whether or not the C-axis clutch has advanced is checked by the status of EC input bits.

The cause of this alarm is that the joint portions are not in engaged condition when the C-axis has advanced.

Possible reasons of faulty engagement of C-axis and spindle clutches are poor spindle orientation accuracy or wrong spindle orientation stop zero position data in C-axis joint.

If accuracy of spindle orientation position for C-axis joint is poor, this problem can be easily confirmed by simply commanding the spindle orientation command (M19). An error within ±4° is allowed for C-axis joint operation. Re-set the spindle orientation stop position parameter data so that orient stop position falls within ±4° range from the commanded position.

If zero position for C-axis joint has been offset, make adjustment if offset amount is small. In case it is too large and adjustment is impossible, then set the zero position again.

(2) Processing after occurrence of alarm

If an alarm occurs, the C-axis clutch retracts to the retraction end and the C-axis is in the released condition. The alarm indication will be cleared by the reset operation. However, the internal condition of the NC is neither C-axis joint nor C-axis release, and it is in the joint operation in progress state (C-axis joint lamp on the operation panel flickering). Under such conditions, neither spindle operation nor C-axis operation is possible. To escape such conditions, it is necessary to specify the C-axis release command (M1Ø9). When M1Ø9 command is designated the status indicating lamp is turned off, allowing the spindle operation.

(3) Other trouble

If any trouble not covered by this manual occurs, contact your local Okuma service representative.

ELECTRICAL SPARE PARTS LIST

(1) LR15 (OSP5ØØØL-G) - Spindle Drive Motor 11/15 kW, 15/22 kW

T1ØØ-153-Ø12 SPL-ØØ1-5

Name of Part	Part No.	Rated	Q'ty	Maker	Remarks
Control relay	E32Ø2-397-ØØ6	G2A-432A DC24V 4T	2	Tateishi	For relay unit
Power relay	E3212-397-ØØ3	LY2N DC24V 2T	2	Tateishi	For relay unit
Reten-tive relay	E3231-397-ØØ3	G2AK-232A DC24V	1	Tateishi	For relay unit
Fuse	E2442-29Ø-1Ø6 (AØØ6-125Ø)	No. 1Ø65 2A Glass tube fuse element	15	Satoh Parts	For X-, Z-axis drive motor unit
Fuse	E2445-392-228 (AØØ6-125Ø)	SMP32 3.2A Fuse element	2	Daito	For AC spindle servo drive unit
Fuse	E2445-392-215 (AØØ6-125Ø)	MP5Ø 5A Fuse element	1	Daito	For AC spindle servo drive unit
Fuse	E2442-29Ø-124 (AØØ6-125Ø)	F7161 AC125V 5A Glass tube fuse element	2	Satoh Parts	For AC spindle servo drive unit
Terminal	E5521-Ø82-Ø78	17Ø33Ø-1	1Ø	AMP	Terminal
Terminal	E5521-Ø82-Ø79	17Ø332-1	1Ø	AMP	Terminal
Terminal	E5521-Ø82-Ø8Ø	172Ø74-1	2Ø	AMP	Terminal
Fuse	E2442-ØØ3-1Ø5	GNB1A 125V 1A	1	Asahi	For turret positioning unit

An accessory of Tape Reader

Lens cleaner	PTR accessory		1		For PTR cleaning

NC-LATHE RATED POWER DATA (1/4)

(1) Table of Power Requirements for LR15-2S (220/440 V, 380 V, 415 V, 600 V)

Model	Power required by main motor kW (hp)	Power required by auxiliary equipment drive motor kW (hp)	Axis drive motor kW (hp)	NC unit	Apparent power KVA	Rated power (Note 5) kW (hp)	Rated current of main circuit breaker Amp.	Facility to be prepared by user (Note 1)	
								Branch circuit breaker or fuse Amp.	Cable size mm^2
LR15 -2S	VAC 22/15 (30/20) 24 KVA	Oil hydraulic motor 2.2 (2.9) Coolant 0.25 (0.33) Lubrication 0.025 (0.033) Spindle lubrication 0.075 (0.1) Total 2.55 (3.4) 3.1 KVA	XA-axis 1.5 (2) ZA-axis 2 (2.7) XB-axis 1 (1.3) ZB-axis 2 (2.7) Total 6.5 (8.7) 8.5 KVA	1.5 KVA	37.1	29.7 (39.6)	125	(220 V) 100	30 or more
							100	(380 V) 75	22 or more
								(415 V) 75	
								(440 V) 50	14 or more
								(600 V) 50	
								(220 V)	50 or more
								(380 V)	22 or more
								(415 V)	
								(440 V)	22 or more
								(600 V)	16 or more

Note:

1. Facilities to be prepared by the user should conform to the applicable regulations and this only indicates the values for reference.
2. VA = 1.4 x kW (for DC motor) and VA = 1.3 kW (for axis drive motor BL-ACT)
3. VA = 1.2 x kW (for AC motor)
4. VA = 1.6 x Continuous rated power (kW) (for spindle drive motor (VAC))
5. Rated power = Apparent power x power-factor cosø where, cosø = 0.8

NC-LATHE RATED POWER DATA (2/4)

(2) Table of Power Requirements for LR22-2S (220/440 V, 380 V, 415 V, 600 V)

Model	Power required by main motor kW (hp)	Power required by auxiliary equipment drive motor kW (hp)	Axis drive motor kW (hp)	NC unit	Apparent power KVA	Rated power (Note 5) kW (hp)	Rated current of main circuit breaker Amp.	Facility to be prepared by user (Note 1)	
								Branch circuit breaker or fuse Amp.	Cable size mm^2
LR22 -2S	30/22 (40/30) 35.2 KVA	Oil hydraulic motor 2.2 (2.9) Coolant 0.25 (0.33) Lubrication 0.025 (0.033) Spindle lubrication 0.075 (0.1) Total 2.6 (3.5) 3.1 KVA	XA-axis 2 (2.7) ZA-axis 4 (5.3) XB-axis 1.5 (2) ZB-axis 4 (5.3) Total 11.5 (15.3) 15.0 KVA	1.5 KVA	54.8	43.8 (58.4)	150	(220 V) 150	50 or more
							100	(380 V) 100	30 or more
								(415 V) 100	
								(440 V) 75	22 or more
								(600 V) 75	
								(220 V)	50 or more
								(380 V)	22 or more
								(415 V)	
								(440 V)	22 or more
								(600 V)	16 or more

Note:

1. Facilities to be prepared by the user should conform to the applicable regulations and this only indicates the values for reference.
2. VA = 1.4 x kW (for DC motor) and VA = 1.3 kW (for axis drive motor BL-ACT)
3. VA = 1.2 x kW (for AC motor)
4. VA = 1.6 x Continuous rated power (kW) (for spindle drive motor (VAC))
5. Rated power = Apparent power x power-factor cosø where, cosø = 0.8

NC-LATHE RATED POWER DATA (3/4)

(3) Table of Power Requirements for LR22-M-2S (220/440 V, 380 V, 415 V, 600 V)

Model	Power required by main motor kW (hp)	Power required by auxiliary equipment drive motor kW (hp)	Axis drive motor kW (hp)	NC unit	Apparent power KVA	Rated power (Note 5) kW (hp)	Rated current of main circuit breaker Amp.	Facility to be prepared by user (Note 1)	
								Branch circuit breaker or fuse Amp.	Cable size mm^2
LR22-M-2S	30/22 (40/30) 35.2 KVA	Oil hydraulic motor 2.2 (2.9) Coolant 0.25 (0.33) Lubrication 0.025 (0.033) Spindle lubrication 0.075 (0.1) Total 2.6 (3.5) 3.1 KVA	XA-axis 2 (2.7) ZA-axis 4 (5.3) XB-axis 1.5 (2) ZB-axis 4 (5.3) C-axis 2 (2.7) Total 13.5 17.6 KVA	1.5 KVA	57.4	45.9 (61.2)	150	(220 V) 150	50 or more
							100	(380 V) 100	30 or more
								(415 V) 100	
								(440 V) 100	
								(600 V) 75	22 or more
								(220 V)	50 or more
								(380 V)	22 or more
								(415 V)	
								(440 V)	22 or more
								(600 V)	16 or more

Note:

1. Facilities to be prepared by the user should conform to the applicable regulations and this only indicates the values for reference.
2. VA = 1.4 x kW (for DC motor) and VA = 1.3 kW (for axis drive motor BL-ACT)
3. VA = 1.2 x kW (for AC motor)
4. VA = 1.6 x Continuous rated power (kW) (for spindle drive motor (VAC))
5. Rated power = Apparent power x power-factor cosø where, cosø = 0.8

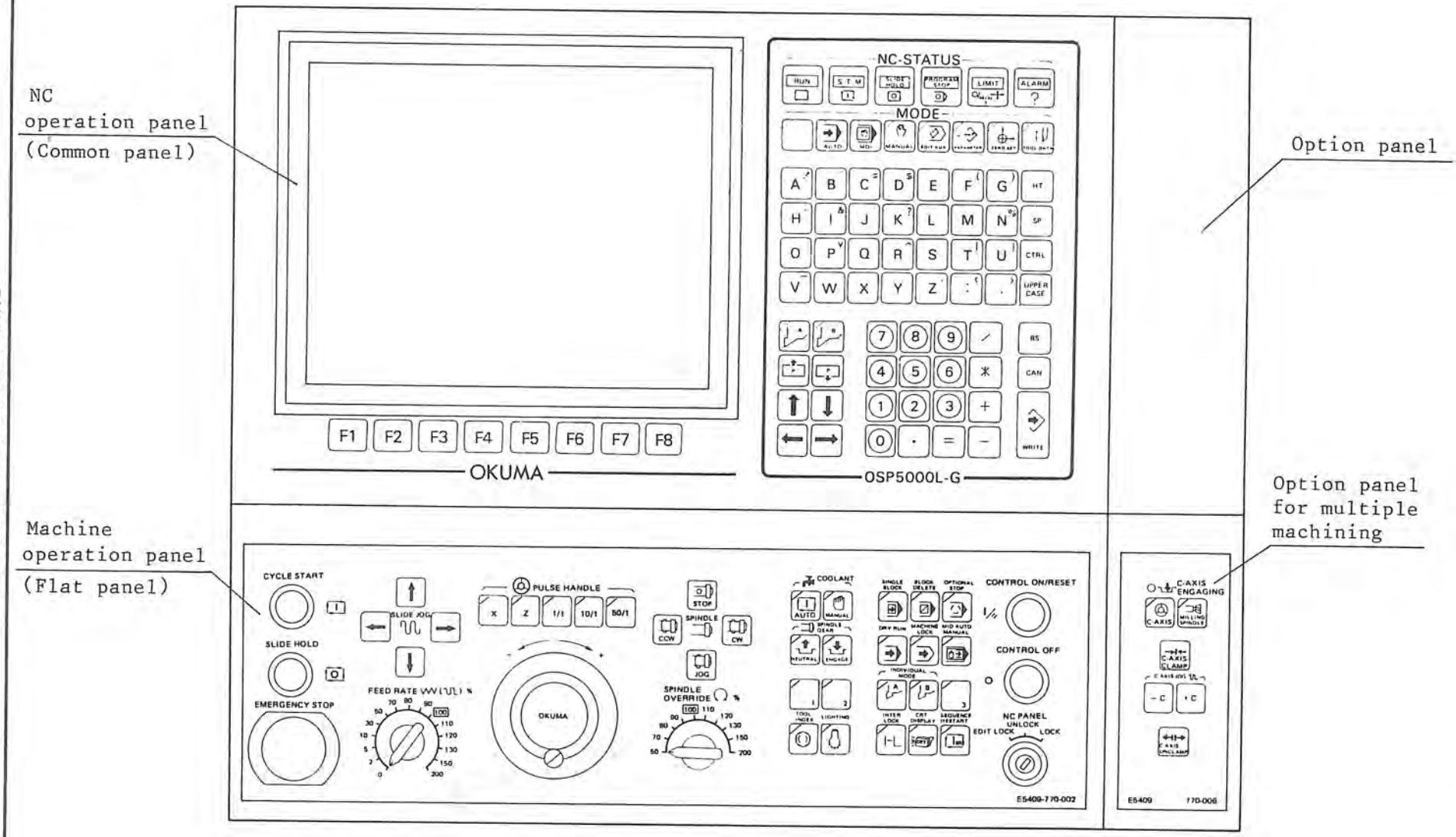
NC-LATHE RATED POWER DATA (4/4)

(4) Table of Power Requirements for LR15-M-2S (220/440 V, 380 V, 415 V, 600 V)

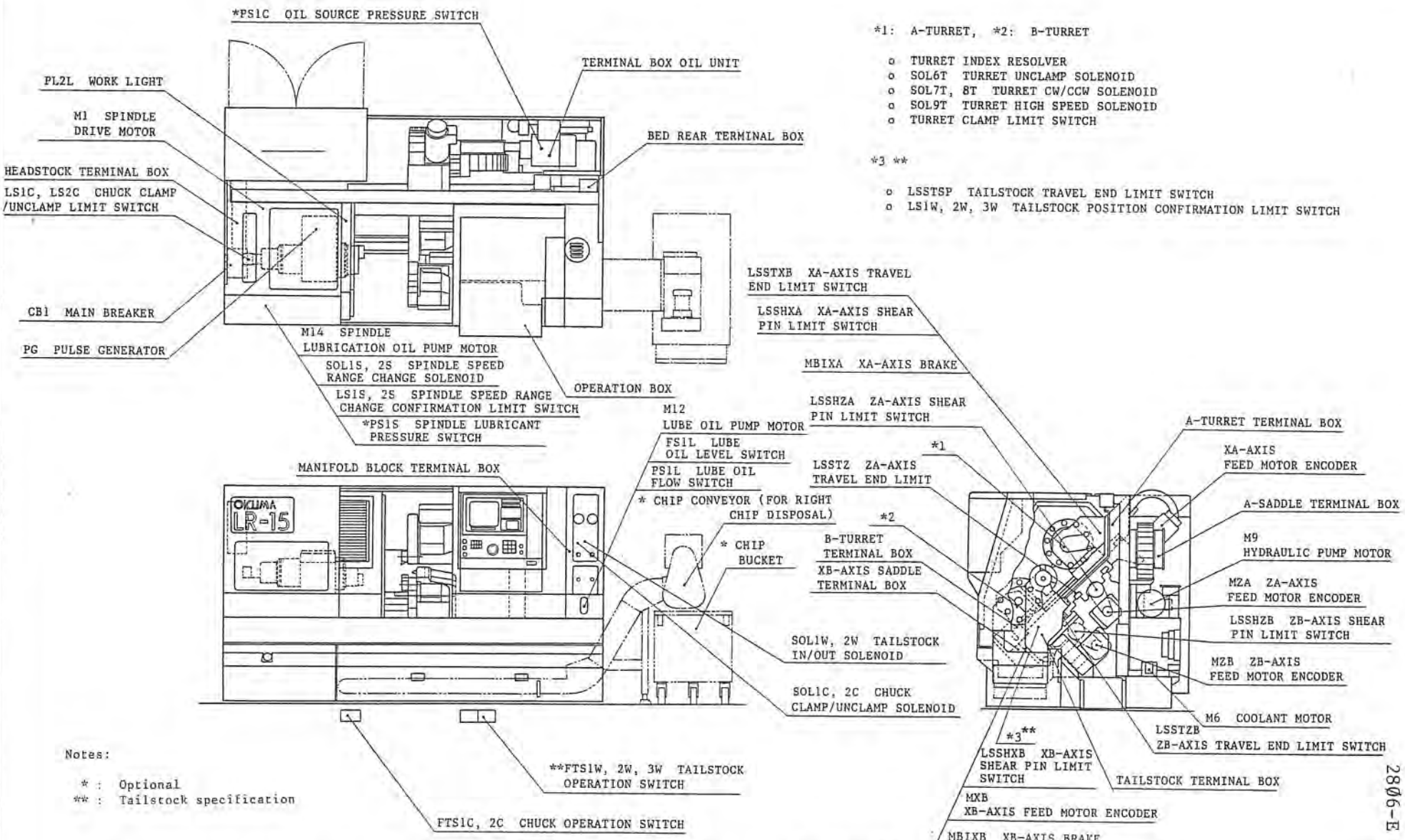
Model	Power required by main motor kW (hp)	Power required by auxiliary equipment drive motor kW (hp)	Axis drive motor kW (hp)	NC unit	Apparent power KVA	Rated power (Note 5) kW (hp)	Rated current of main circuit breaker Amp.	Facility to be prepared by user (Note 1)	
								Branch circuit breaker or fuse Amp.	Cable size mm^2
LR15-M-2S	VAC 22/15 (30/20) 24 KVA	Oil hydraulic motor 2.2 (2.9)	XA-axis 1.5 (2)		39.7	31.8 (42.4)	125	(220 V) 125	38 or more
		Coolant 0.25 (0.33)	ZA-axis 2 (2.7)				100	(380 V) 75	22 or more
								(415 V) 75	
								(440 V) 75	
		Lubrication 0.025 (0.033)	XB-axis 1 (1.3)					(600 V) 50	14 or more
		Spindle lubrication 0.075 (0.1)	ZB-axis 2 (2.7)					(220 V)	50 or more
			C-axis 2 (2.7)					(380 V)	22 or more
								(415 V)	
		Total 2.55 (3.4)	Total 8.5 (11.3)					(440 V)	22 or more
		3.1 KVA	11.1 KVA	1.5 KVA				(600 V)	16 or more

Note:

1. Facilities to be prepared by the user should conform to the applicable regulations and this only indicates the values for reference.
2. VA = 1.4 x kW (for DC motor) and VA = 1.3 kW (for axis drive motor BL-ACT)
3. VA = 1.2 x kW (for AC motor)
4. VA = 1.6 x Continuous rated power (kW) (for spindle drive motor (VAC))
5. Rated power = Apparent power x power-factor cosø where, cosø = 0.8



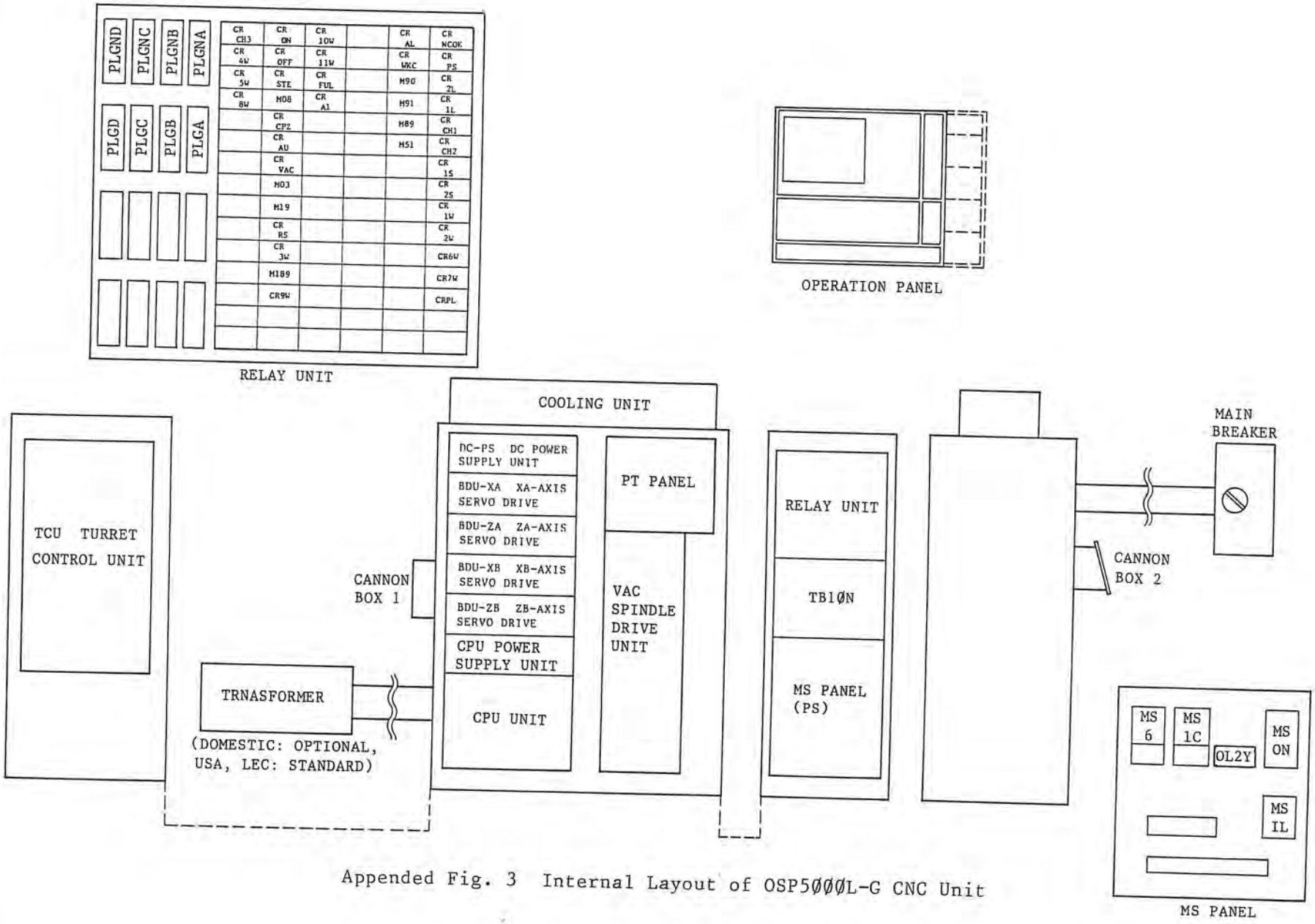
Appended Fig. 1 Operation Panel



Notes:

* : Optional
** : Tailstock specification

Appended Fig. 2 Layout Diagram of Machine-mounted Electricals (LR15)



Appended Fig. 3 Internal Layout of OSP5ØØØL-G CNC Unit