Document number: AC-1587 (V3.0)

SPINDLE DRIVE UNIT

MAINTENANCE MANUAL VAC5 (3rd Edition)

Pub No. 5603-E-R1 (SE41-075-R2) Sep. 2010

Approved	Checked	Checked	Checked	Checked	Prepared

Revision History

Version	Date of revision	Description	Applicable section
1st (V1.0)	2008.08.18	Newly created	All
2nd (V2.0)	2009.07.20	(1) Descriptions added for maintenance unit used for conventional units (see below). • VAC3-D11 • VAC4-D11 • VAC1-D3 to D11 • VAC2-D3 to D11 (2) Clerical error corrected (3) Changes made to unit names, etc. • “VAC V”→”VAC5” • “VAC IV”→”VAC4” • “VAC III”→”VAC3”	All
3rd (V3.0)	2010.05.27	(1) Corrections made following completion of development of units below • VAC5-D22-AIF • VAC5-D30-AIF • VAC5-D22 (2) Corrections made to alarm no. table (3) Changes made to unit names, etc. • VAC5-D30→VAC5-D22	All

This manual discloses certain specifications (external drawings, external dimensions) relating to units that are currently under development. Information indicated as being “under development” should be used for reference purposes.

Units currently under development:

- VAC5-D6 (with EX card C1)
- VAC5-D11 (with EX card C1)
- VAC5-D30 (with EX card C1)

- Changes may be made to the specifications without prior notice following unit imp rovements.

SAFETY PRECAUTIONS

The control system that is explained in this manual contains various electric components and units. Please read this manual thoroughly and understand the electric wiring among the electric components, units, and power supply to avoid unexpected bodily injuries and malfunction or burnout of the electric components and units.

(1) Always turn off all the power supplies and discharge the electric charge remaining inside the system before connecting or disconnecting the units. Failure to follow this instruction may result in electric shock or other bodily injury as well as malfunction or burnout of the units.

(2) Check the specifications of the power supply to be connected to the units. Incorrect voltage or electrical polarity may cause unit malfunction or burnout.

(3) Check the inlet connections and outlet connections of all the units. Incorrect connection may cause unit malfunction or burnout.

(4) Always connect the earth wires as well as the PE wires for the magnetic power cabinet. Failure to follow this instruction may result in electric shock or other bodily injury due to an earth leakage.

(5) Set the overcurrent protective device such as circuit breakers or fuses. Failure to follow this instruction may result in fire or burnout of cables and units due to a short circuit.

(6) If you make the cables to connect the units by yourself, always use the cable of the size appropriate for load current especially for power cables. Insufficient current capacity may cause a fire or burnout of the cables due to overheating.

(7) Select the dust-repellent water-proof type of magnetic power cabinet or control box that houses various units. Dust or water may cause electric shock or other bodily injury as well as the unit malfunction or burnout.

(8) Always use thermostats which are built-in the motors and units to protect the mechanical device. Failure to follow this instruction may cause a fire or units burnout.

Following caution signs are used in this manual to draw attention to information of particular importance.

⚠ DANGER This sign is to indicate an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING This sign is to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION This sign is to indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or property damages.

CAUTION This sign is to indicate general instructions for safe operation.

Keep this manual handy for reference.
Information in this document is subject to change without notice due to constant improvements.

Table of Contents

Table of Contents

Table of Contents

SECTION 1 INTRODUCTION

This instruction manual describes how to maintain and inspect maintenance units (VAC1, VAC2, VAC3, VAC4) for spindle drive units (VAC5).
Correspondences between conventional and maintenance units are shown in the table below.

Table 1-1 Conventional units and maintenance units

Conventional unit		Maintenance unit	Remarks
Analog interface	VAC1-D3 VAC1-D6 VAC1-D8 VAC1-D6A VAC1-D8A VAC1-D3B VAC1-D6B VAC1-D8B	VAC5-D8-AIF	*1)
	VAC1-D11 VAC1-D11A VAC1-D11B	VAC5-D11-AIF	
	VAC1-D22A VAC1-D22B	VAC5-D22-AIF	
	VAC1-D30A VAC1-D30B	VAC5-D30-AIF	
Optical interface	VAC2-D6A VAC2-D8A VAC2-D6B VAC2-D8B	VAC5-D8-AIF	*2)
	VAC2-D11A VAC2-D11B	VAC5-D11-AIF	
	VAC2-D22A VAC2-D22B	VAC5-D22-AIF	
	VAC2-D30A VAC2-D30B	VAC5-D30-AIF	
	VAC3-D6 VAC4-D6	VAC5-D6	
	VAC3-D11 VAC4-D11	VAC5-D11	
	VAC3-D22 VAC4-D22	VAC5-D22	

*1) Capacities D3 to D8, D6A to D8A, and D6B to D8B for conventional unit VAC1 have been integrated into the corresponding maintenance unit VAC5-D8-AIF. All capacities are specified by setting the switches on the unit. Refer to Appendix 3 for further details.

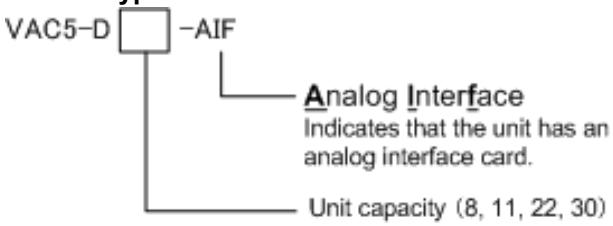
*2) Capacities D6A to D8A and D6B to D8B for conventional unit VAC2 have been integrated into the corresponding maintenance unit VAC5-D8-AIF. All capacities are specified by setting the switches on the unit. Refer to Appendix 3 for further details.

SECTION 2 CONFIGURATION AND CONNECTION

1. Configuration

There are two types of VAC5 drive unit, an analog interface unit and an optical interface unit, with the type dependent on the command form from the NC unit. Each drive unit consists of a control PCB and power unit, and the product line is structured as shown in the table below.

Analog interface unit type



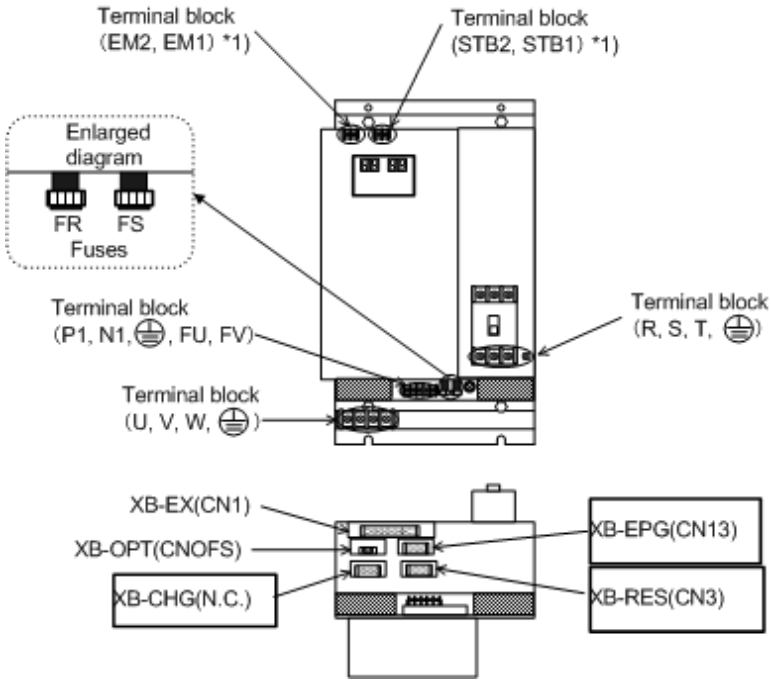
Optical interface unit type

Table 2-1 VAC5 product line structure

	Product code	Product name	Description	Remarks
Analog interface	U1216-0006-003-10	VAC5-D8-AIF	Reworked version of VAC1/II-D3/6/8A	
	U1221-0006-003-10	VAC5-D11-AIF	Reworked version of VAC1/II-D11A	
	U1231-0006-003-10	VAC5-D22-AIF	Reworked version of VAC1/II-D22A	
	U1236-0006-003-10	VAC5-D30-AIF	Reworked version of VAC1/II-D30A	
Optical interface	U1212-0006-001-12	VAC5-D6	Reworked version of VAC3-D6	
	U1222-0006-001-12	VAC5-D11	Reworked version of VAC3-D11	
	U1233-0006-001-12	VAC5-D22	Reworked version of VAC3-D22	

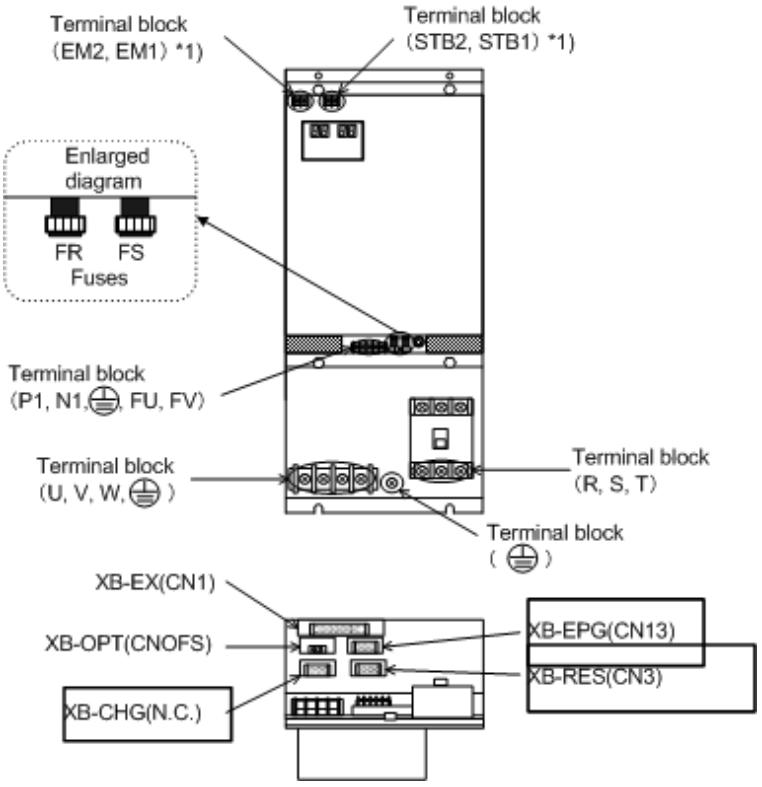
Fig. 2-2 VAC5 with extra cards (EX cards) product line structure

	Product code	Product name	Description	Remarks
Analog interface	TBD	VAC5-D6 with EX card C1	Reworked version of VAC3-D6 with EX card C1	Under development
	TBD	VAC5-D11 with EX card C1	Reworked version of VAC3-D11 with EX card C1	Under development
	TBD	VAC5-D30 with EX card C1	Reworked version of VAC3-D22 with EX card C1	Under development



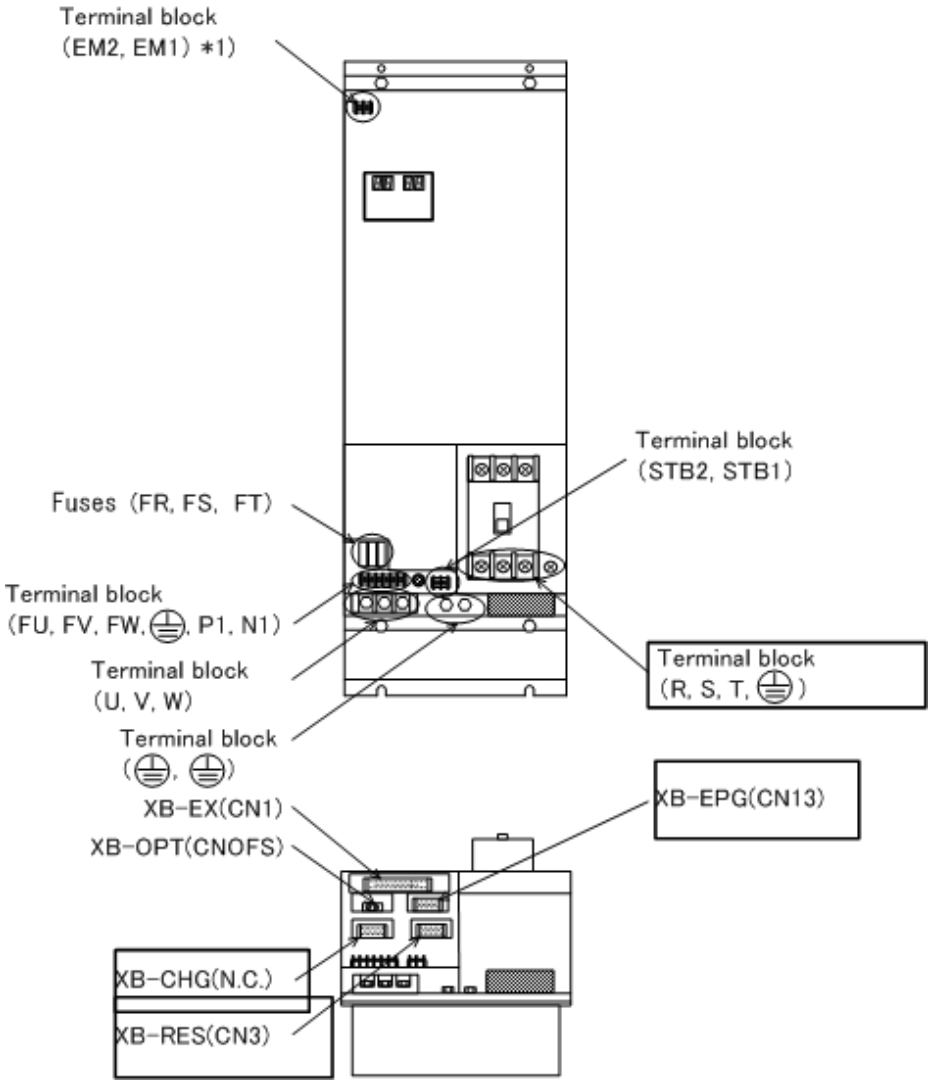
*1) Wires can be connected to the terminal blocks ([EM2, EM1] and [STB2, STB1]) by removing the front cover of the unit.

Fig 2-1. VAC5-D8-AIF Connector layout



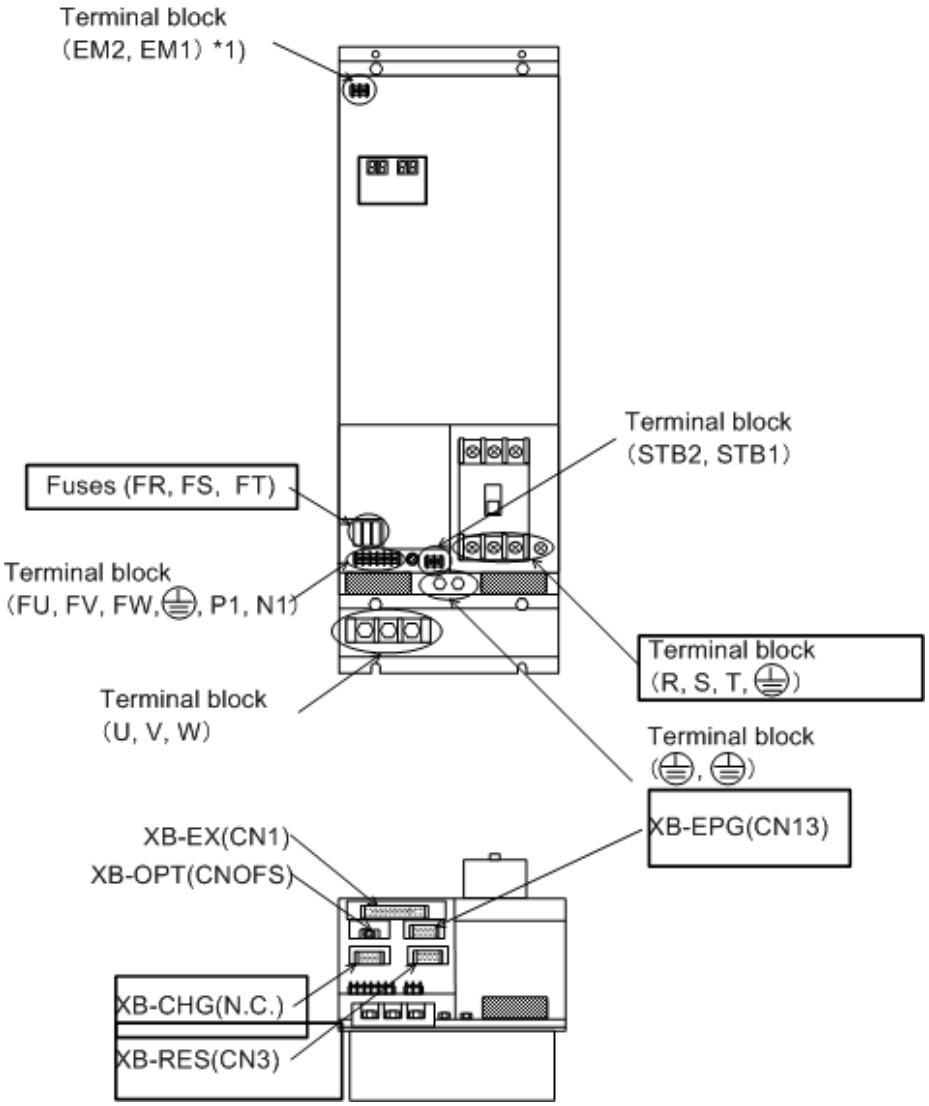
*1) Wires can be connected to the terminal blocks ([EM2, EM1] and [STB2, STB1]) by removing the front cover of the unit.

Fig 2-2. VAC5--D11-AIF Connector layout



*1) Wires can be connected to the terminal blocks (EM2 and EM1) by removing the front cover of the unit.

Fig 2-3. VAC5-D11-AIF Connector layout



*1) Wires can be connected to the terminal blocks (EM2 and EM1) by removing the front cover of the unit.

Fig 2-4. VAC5-D30-AIF Connector layout

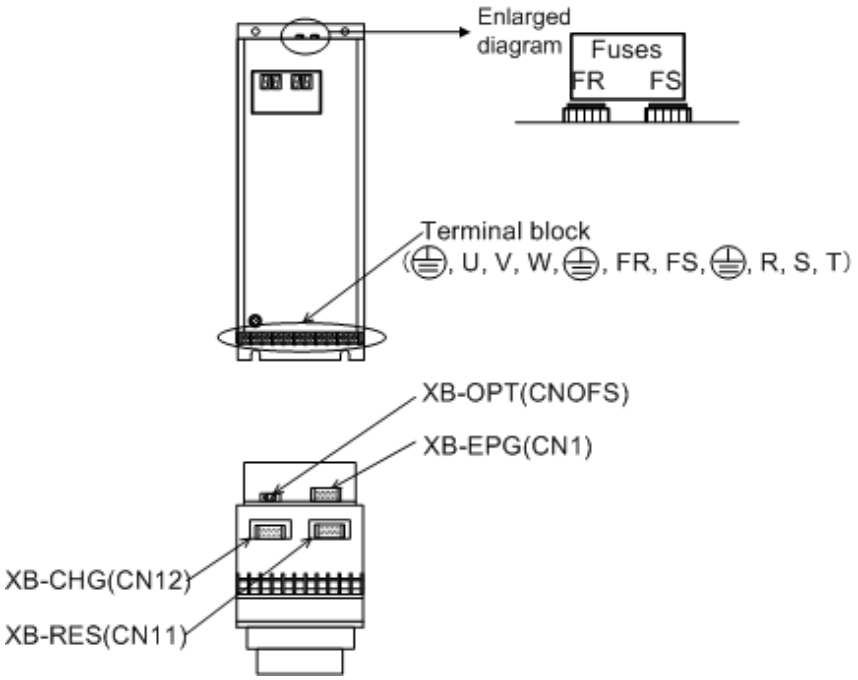


Fig 2-5. VAC5-D6 Connector layout

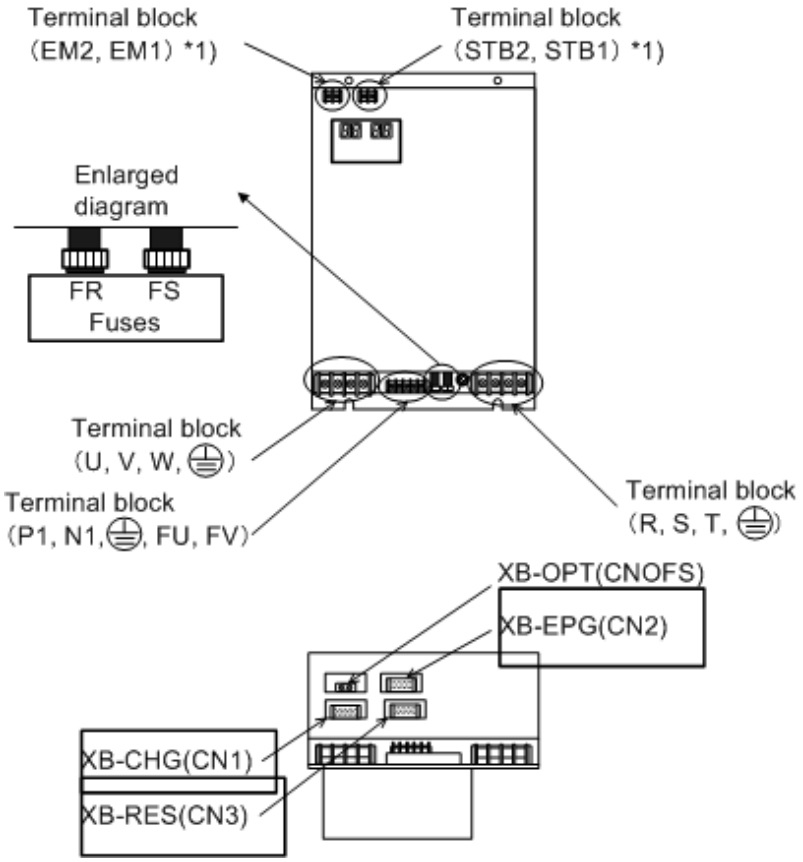
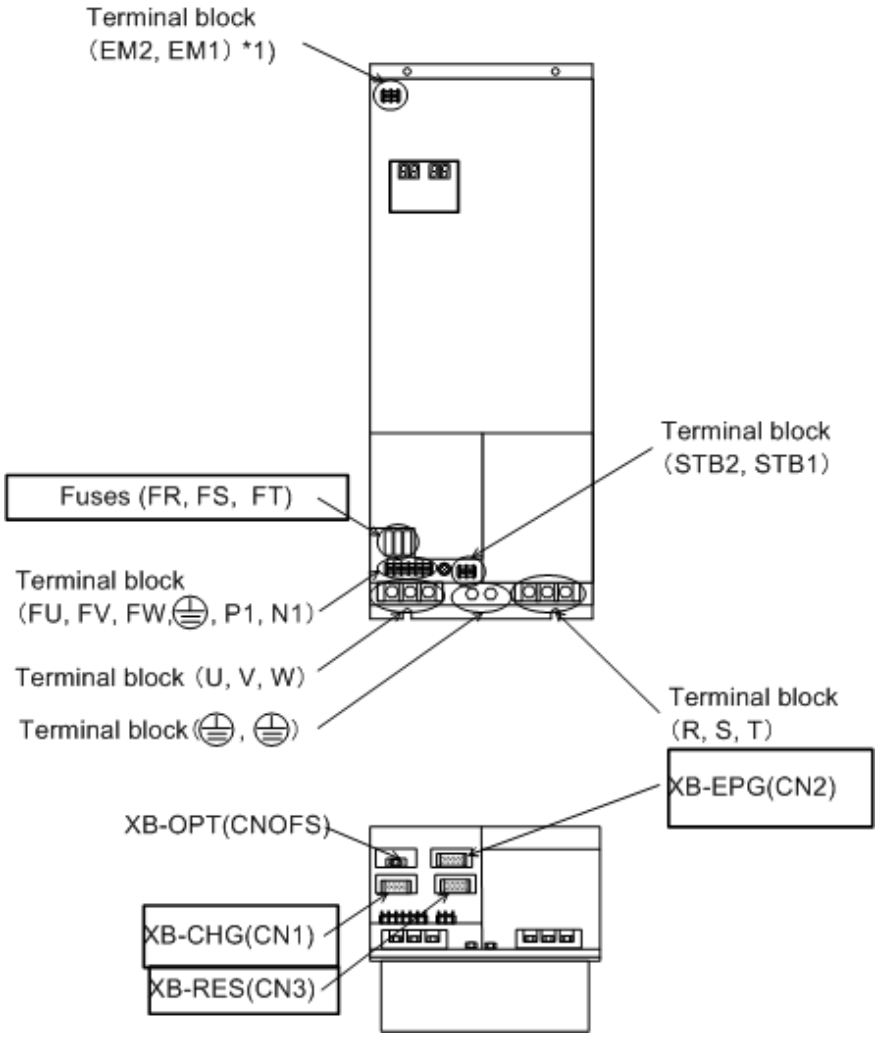


Fig 2-6. VAC5-D11 Connector layout

*1) Wires can be connected to the terminal blocks ([EM2, EM1] and [STB2, STB1]) by removing the front cover of the unit.



*1) Wires can be connected to the terminal blocks (EM2 and EM1) by removing the front cover of the unit.

Fig 2-7. VAC5-D22 Connector layout

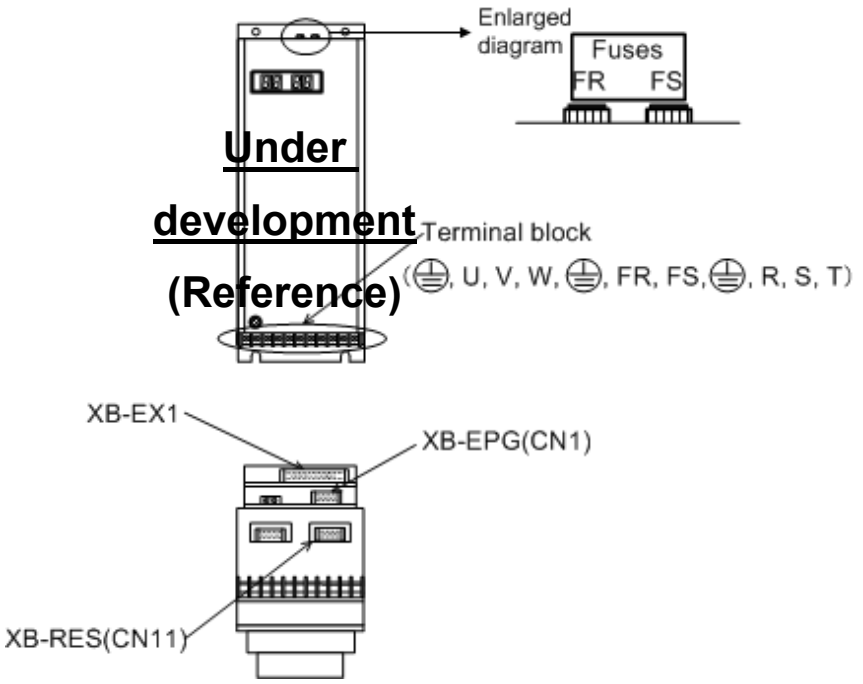


Fig 2-8. VAC5-D6 (with EX card C1) Connector layout

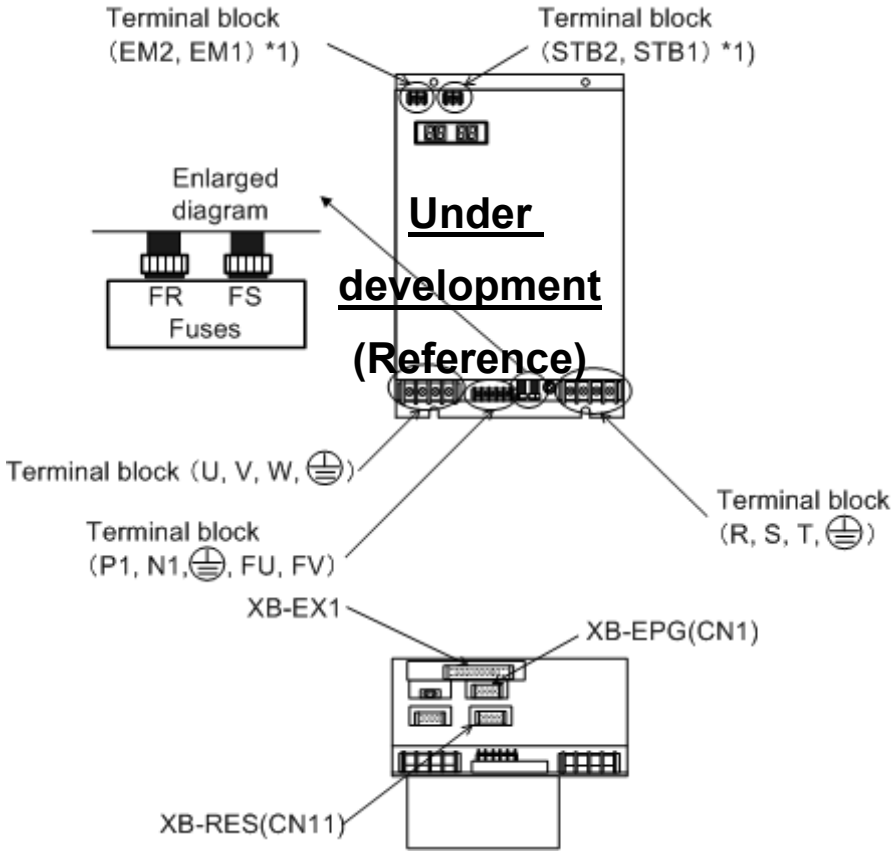


Fig 2-9. VAC5-D11 (with EX card C1) Connector layout

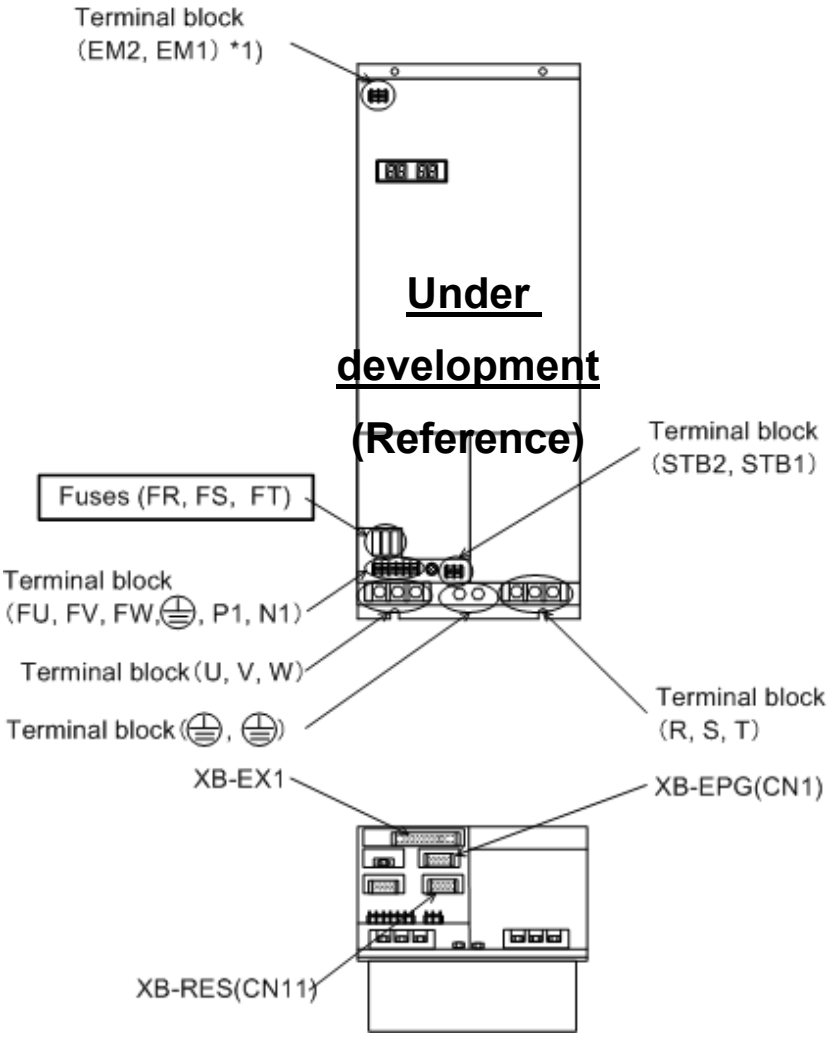


Fig 2-10. VAC5-D30 (with EX card C1) Connector layout

2. Connection

2-1. General connection diagram

(1) When using VAC1 system

If using the VAC5 analog interface unit for the VAC1 system (analog interface), connection for the entire unit will be as shown in the following diagram.

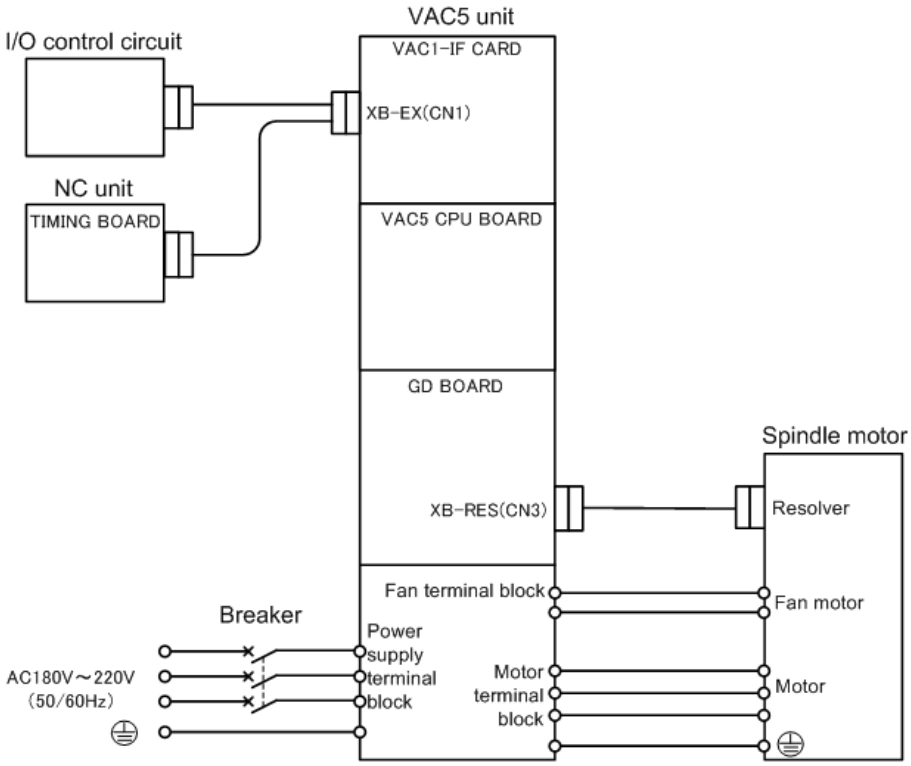
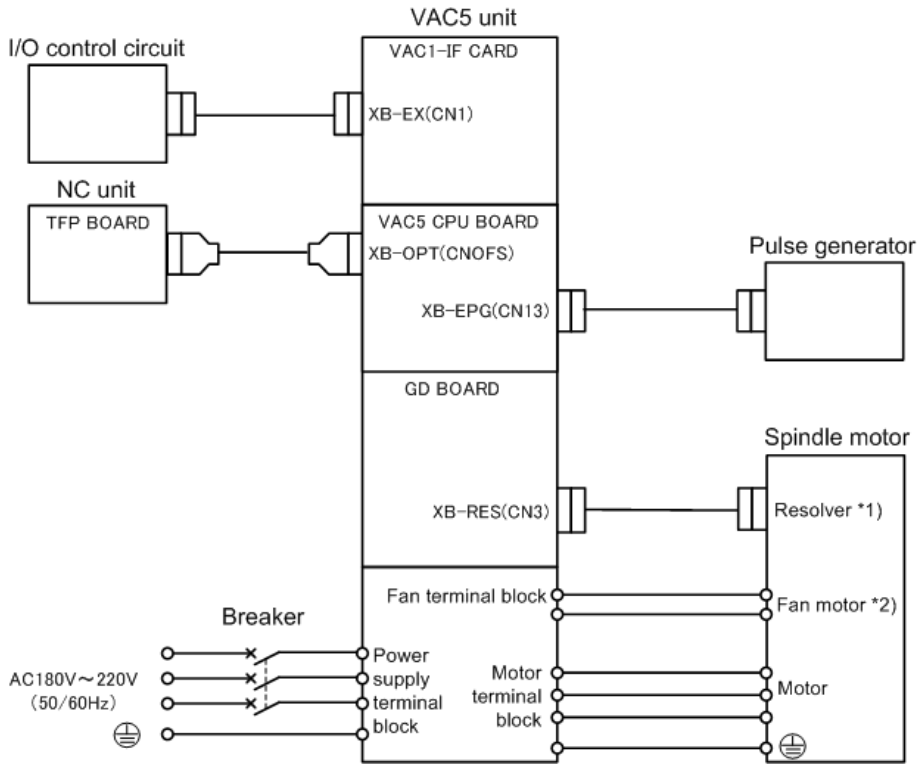


Fig 2-11. Complete connection diagram when using VAC1 system

(2) When using VAC2 system

If using the VAC5 analog interface unit for the VAC2 system (optical interface), connection for the entire unit will be as shown in the following diagram.



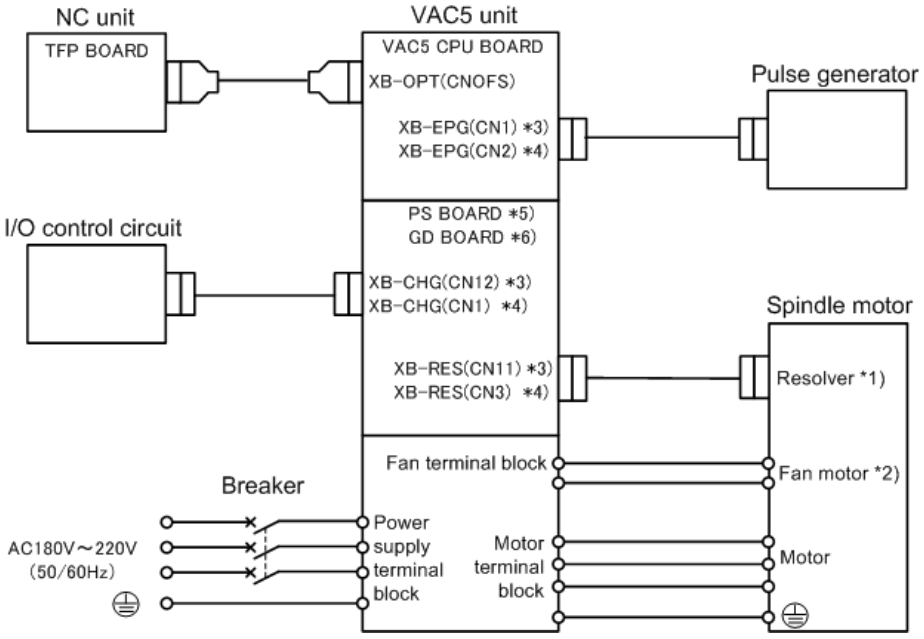
*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

Fig 2-12. Complete connection diagram when using VAC2 system

(3) When using VAC3 system

If using the VAC5 optical interface unit for the VAC3 system (optical interface), connection for the entire unit will be as shown in the following diagram.



*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Connector name when VAC5-D6 unit

*4) Connector name when VAC5-D11, VAC5-D22 unit

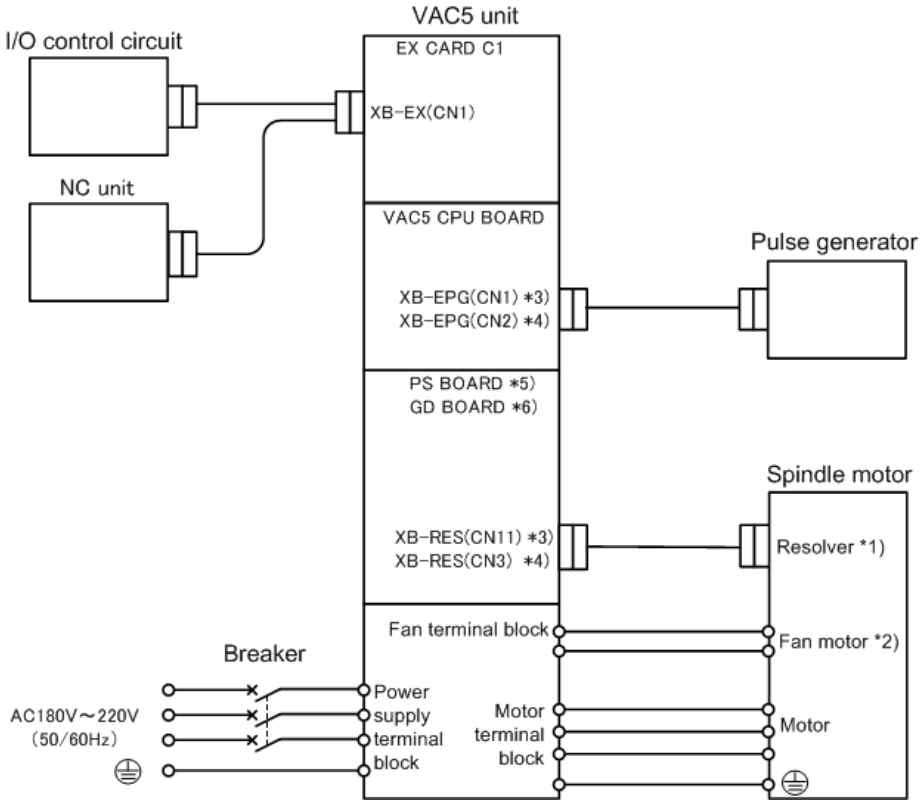
*5) Control print board name when VAC5-D6 unit

*6) Control print board name when VAC5-D11, VAC5-D22 unit

Fig 2-13. Complete connection diagram when using VAC3 system

(4) When using externally sold system

If using the VAC5 unit (with EX card C1) for an externally sold system, connection for the entire unit will be as shown in the following diagram.



*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Connector name when VAC5-D6 unit (with EX card C1)

*4) Connector name when VAC5-D11, VAC5-D30 unit (both with EX card C1)

*5) Control print board name when VAC5-D6 unit (with EX card C1)

*6) Control print board name when VAC5-D11, VAC5-D30 unit (both with EX card C1)

Fig 2-14. Complete connection diagram when using externally sold system

2-2. Connection diagram (standard type)

(1) When using VAC1 system

If using the VAC5 analog interface unit for the VAC1 system (analog interface), connection for the unit will be as shown in the following detailed diagram.

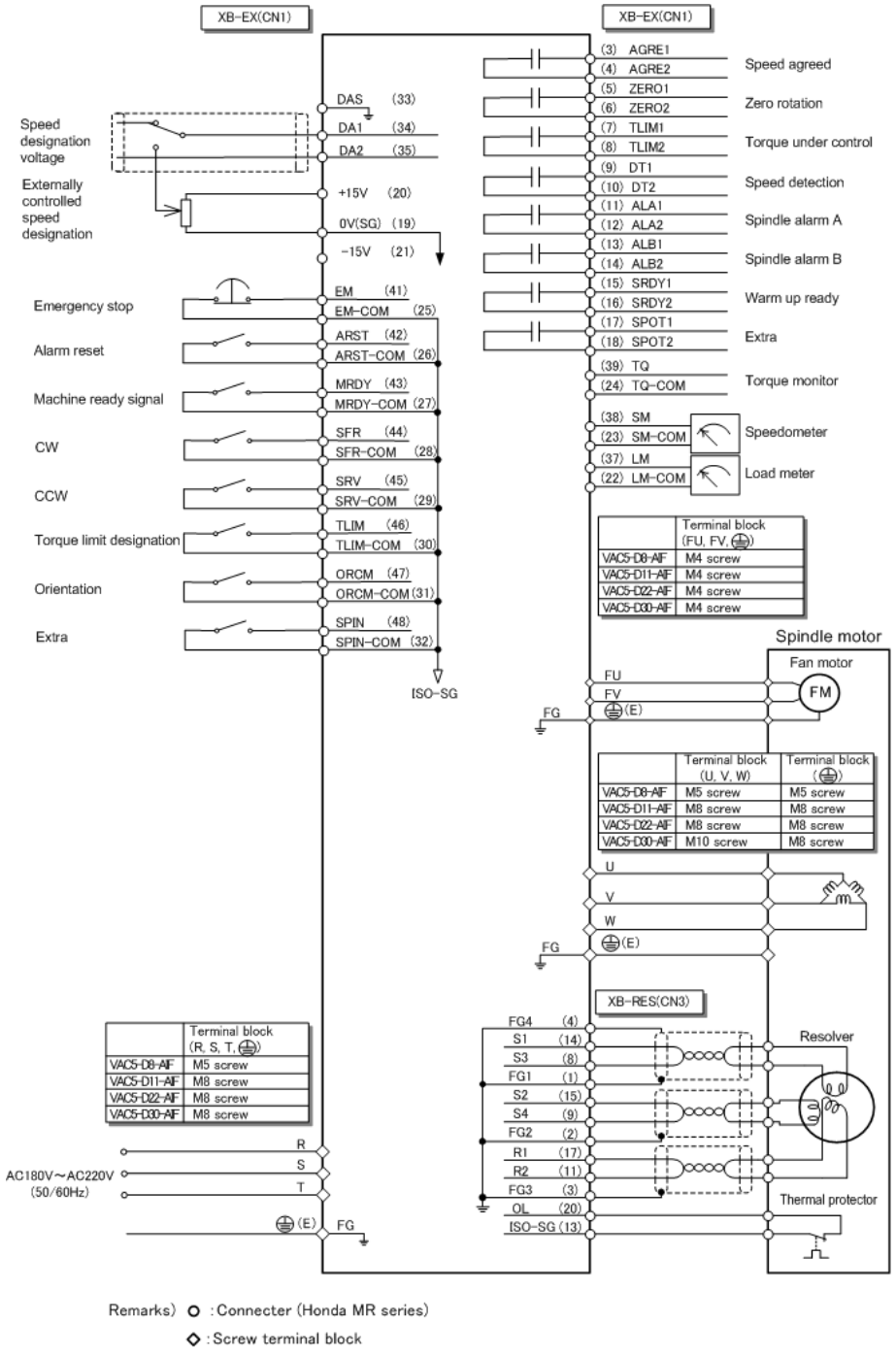
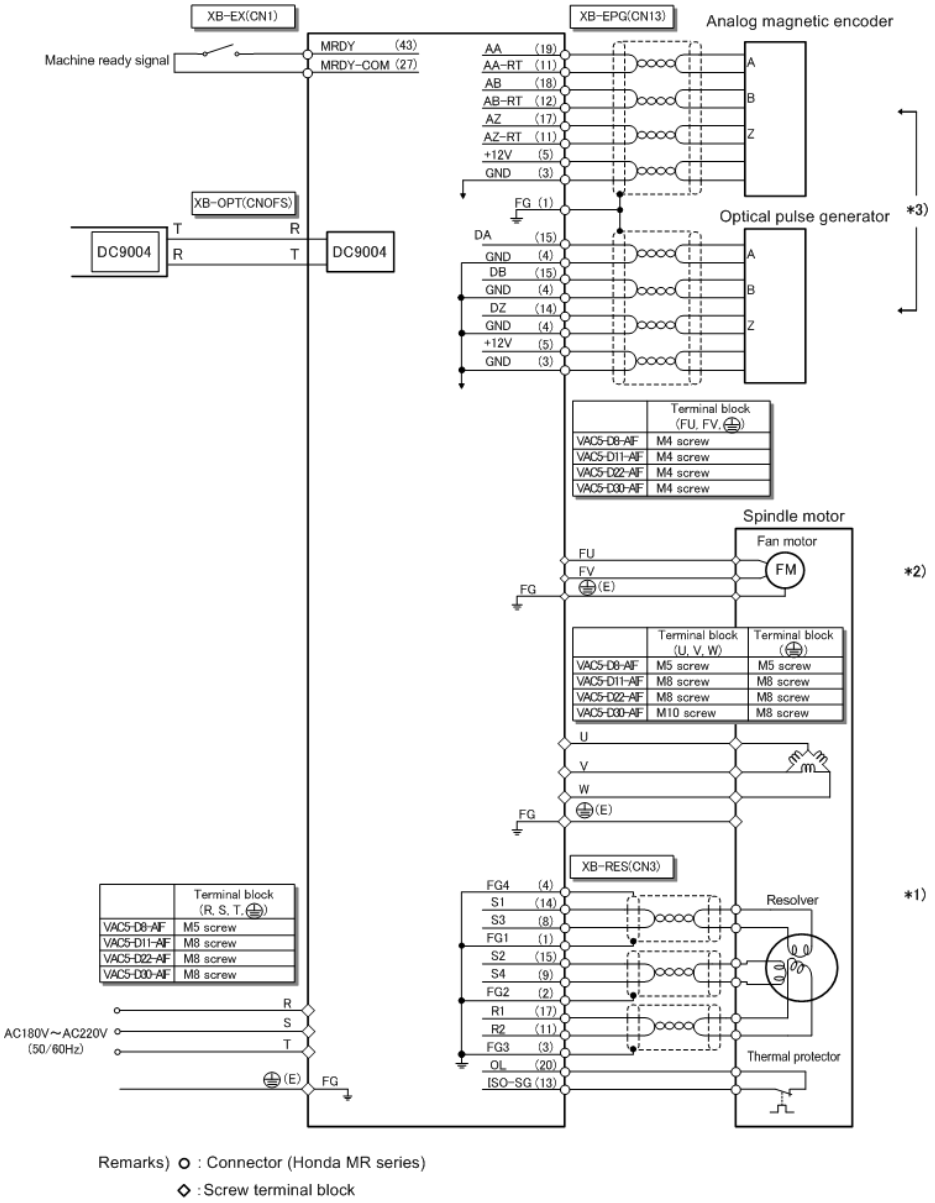


Fig 2-15. Detailed connection diagram when using VAC1 system (standard type)

(2) When using VAC2 system

If using the VAC5 analog interface unit for the VAC2 system (optical interface), connection for the unit will be as shown in the following detailed diagram.



*1) For a built-in motor, no resolver is used.

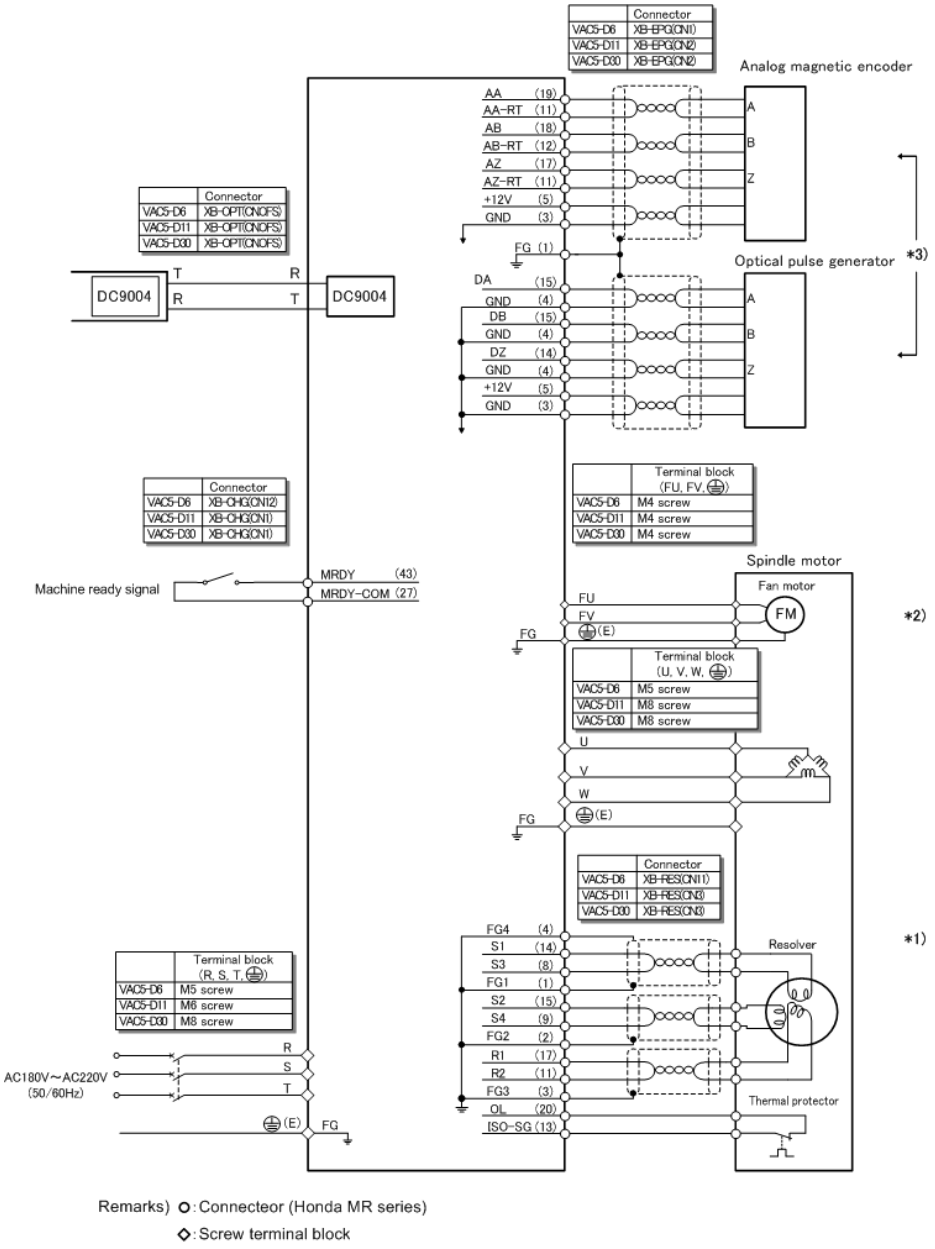
*2) For a built-in motor, no fan motor is used.

*3) Connection varies between the standard type and winding changeover type.

Fig 2-16. Detailed connection diagram when using VAC2 system (standard type)

(3) When using VAC3 system

If using the VAC5 optical interface unit for the VAC2 system (optical interface), connection for the unit will be as shown in the following detailed diagram.



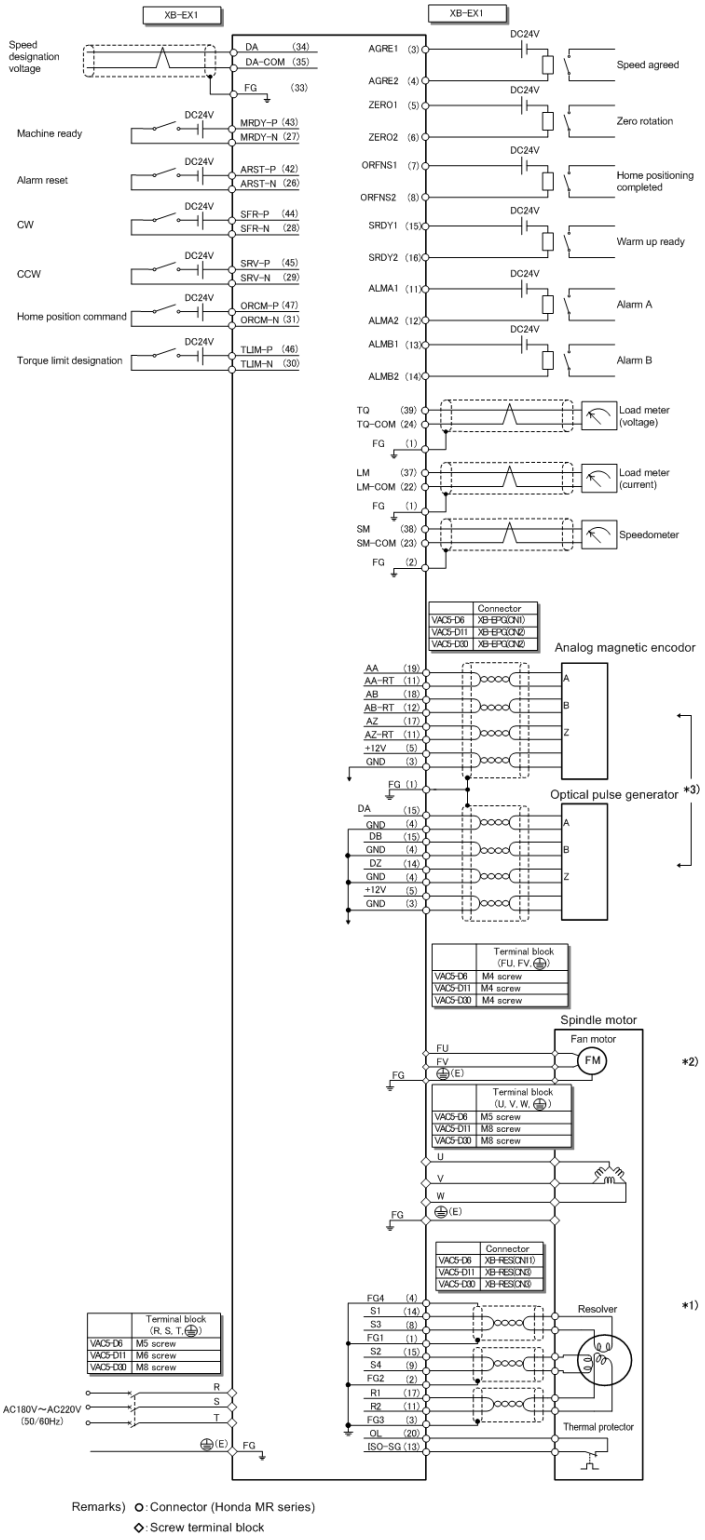
*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Connection varies between the standard type and winding changeover type.

Fig 2-17. Detailed connection diagram when using VAC2 system (standard type)

(4) When using externally sold system



*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Connection varies between the standard type and winding changeover type.

Fig 2-18. Detailed connection diagram when using externally sold system (standard type)

2-3. Connection diagram (winding changeover type)

(1) When using VAC1 system

If using the VAC5 analog interface unit for the VAC1 system (analog interface), winding connection will be as shown in the following detailed diagram.

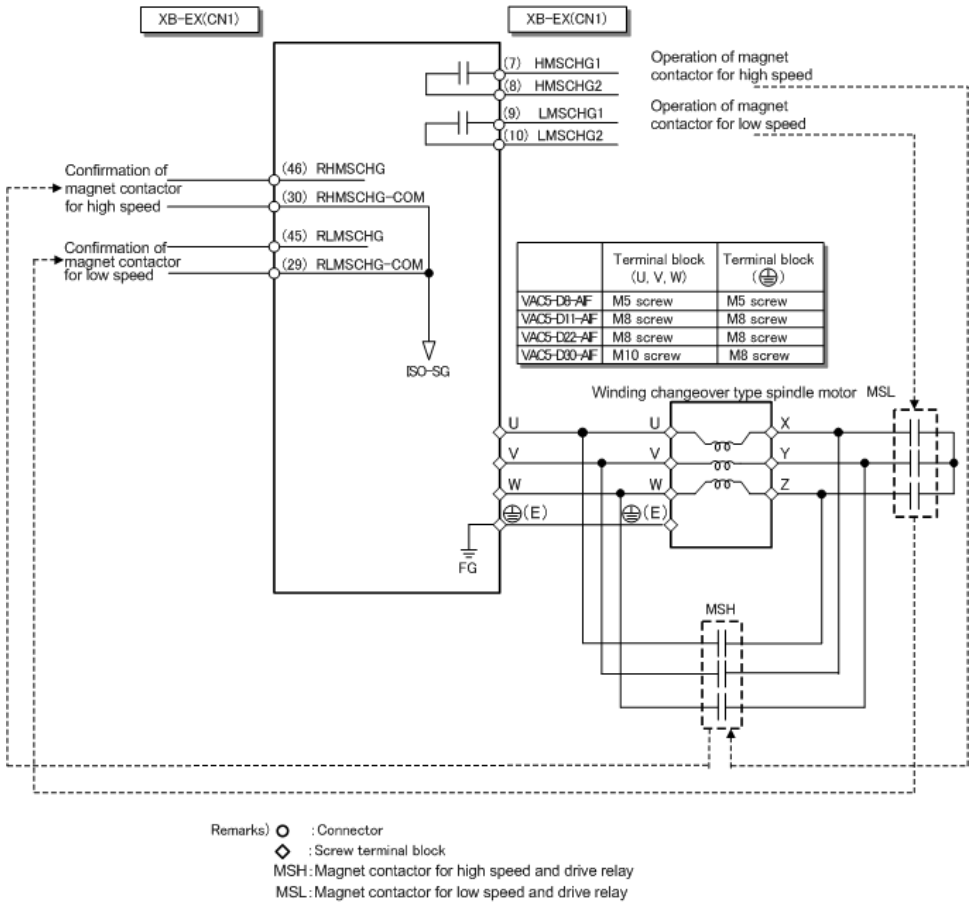


Fig 2-19. Detailed connection diagram when using VAC1 system (winding changeover type)

(2) When using VAC2 system

If using the VAC5 analog interface unit for the VAC2 system (optical interface), winding connection will be as shown in the following detailed diagram.

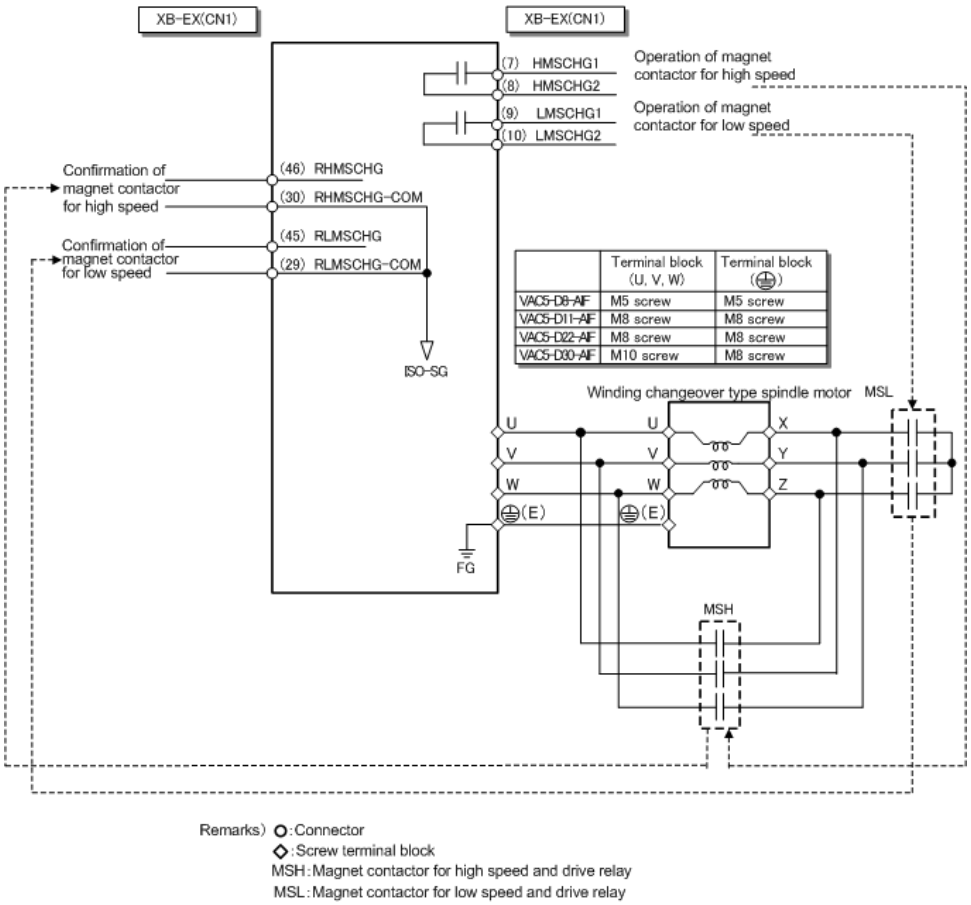


Fig 2-20. Detailed connection diagram when using VAC2 system (winding changeover type)

(3) When using VAC3 system

If using the VAC5 optical interface unit for the VAC3 system (optical interface), winding connection will be as shown in the following detailed diagram.

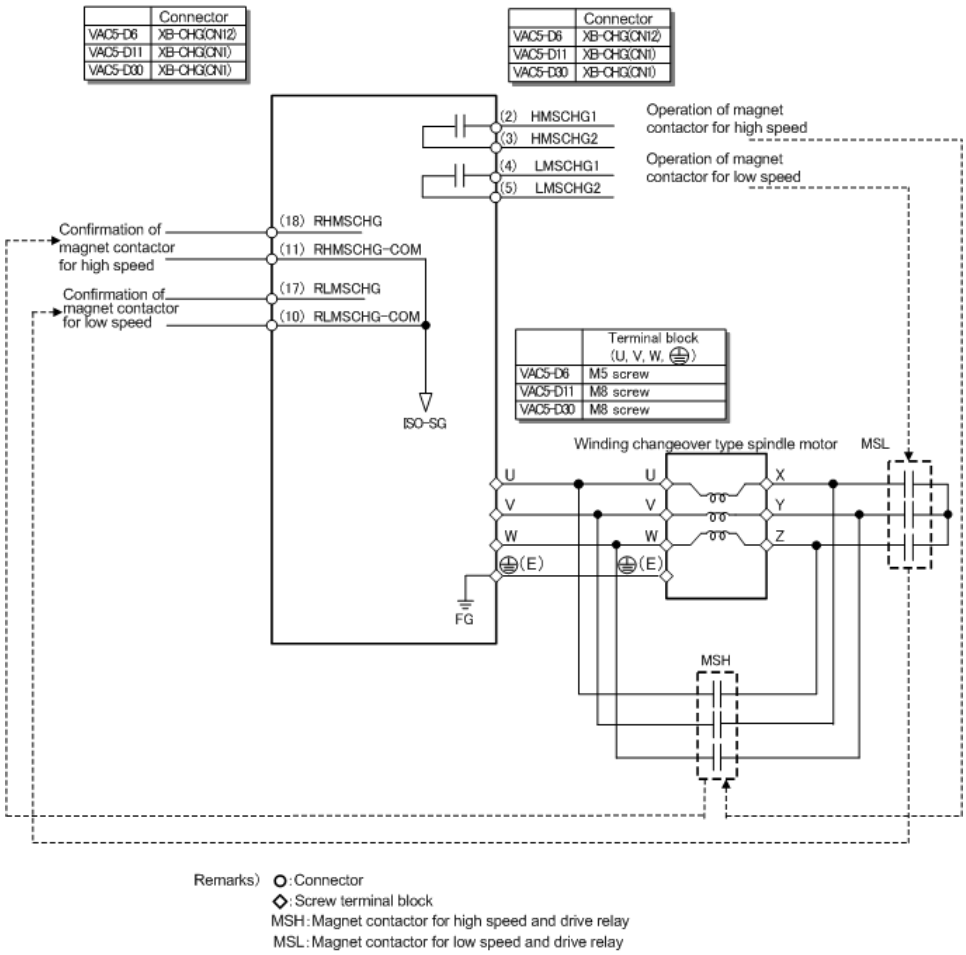
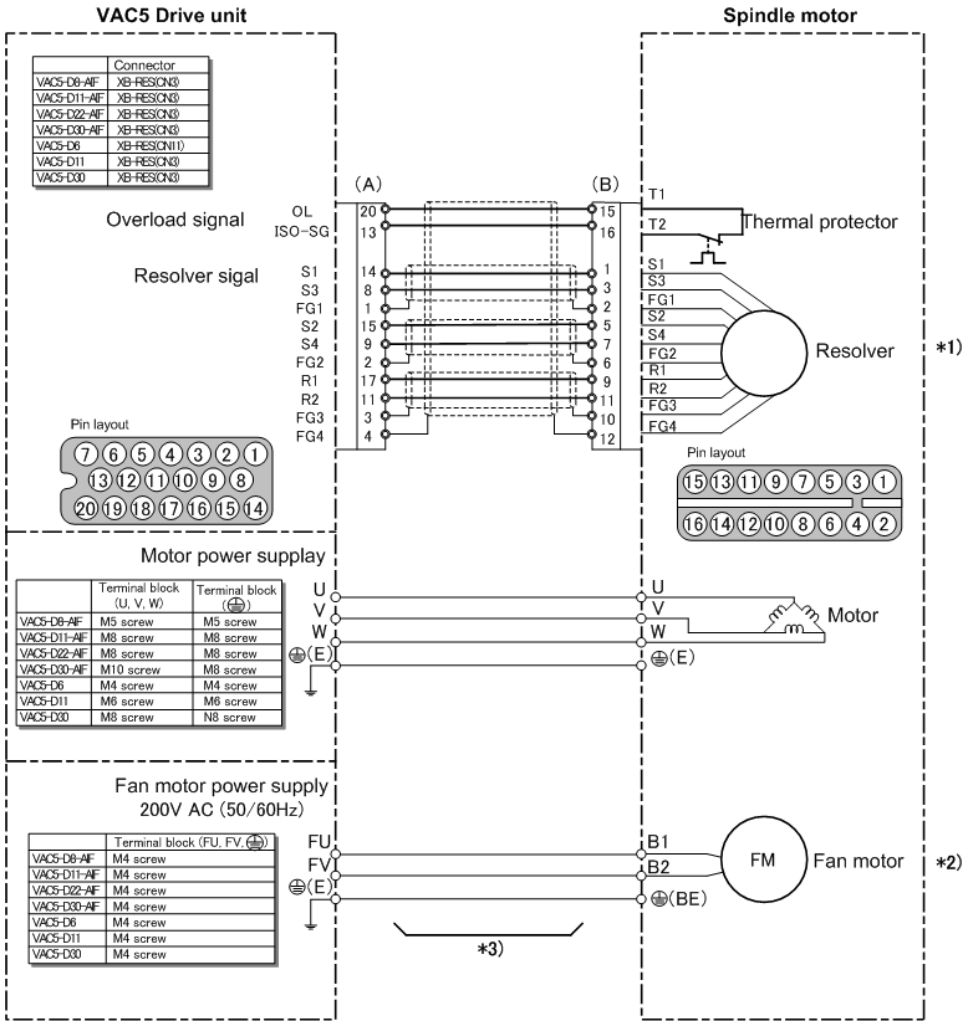


Fig 2-21. Detailed connection diagram when using VAC3 system (winding changeover type)

2-4. Spindle motor connection diagram

(1) (When a 16-pin universal MATE-N-LOK connector is used)



		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3701-082-005	1-480438-0	Tyco Electronics AMP
	Contact	E3761-082-001	61314-6	

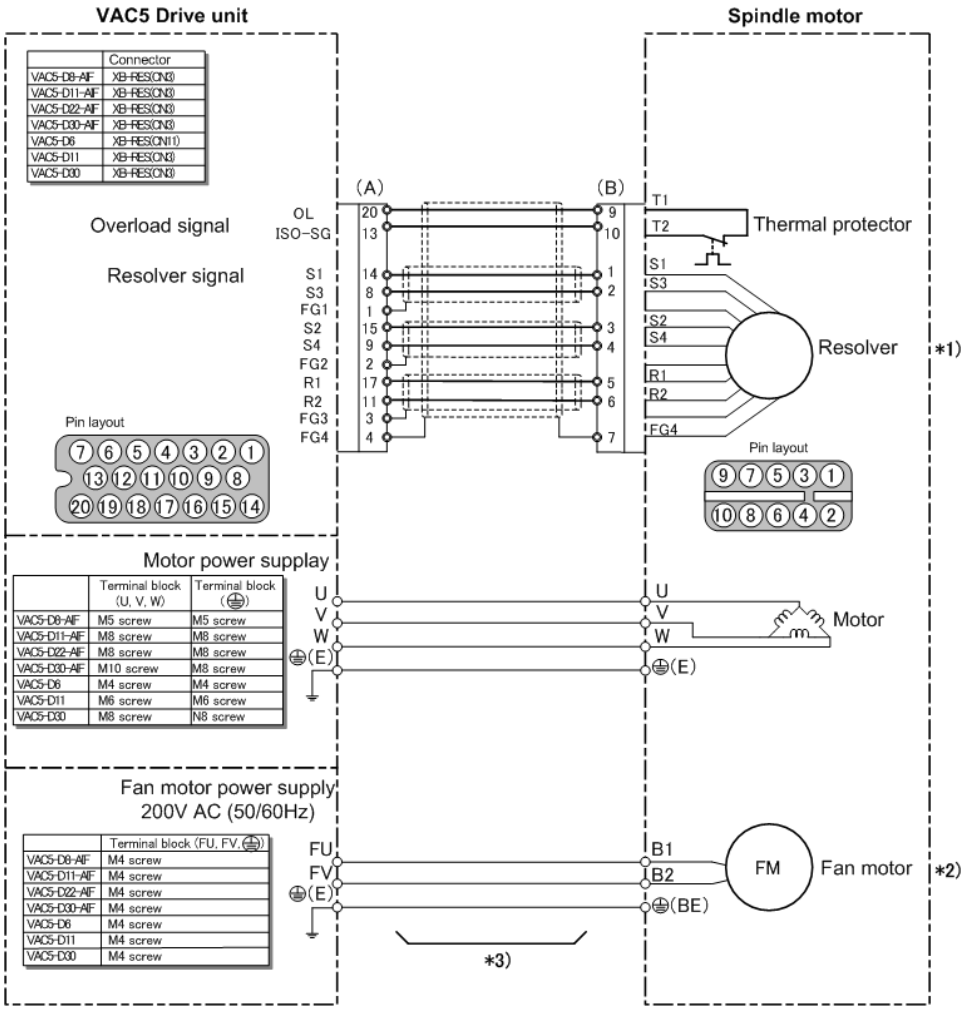
*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-22 Spindle motor connection diagram
(When a 16-pin universal MATE-N-LOK connector is used)

(2) When a 10-pin universal MATE-N-LOK connector is used



		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3701-082-059	1-480285-0	Tyco Electronics AMP
	Contact	E3761-082-001	61314-6	

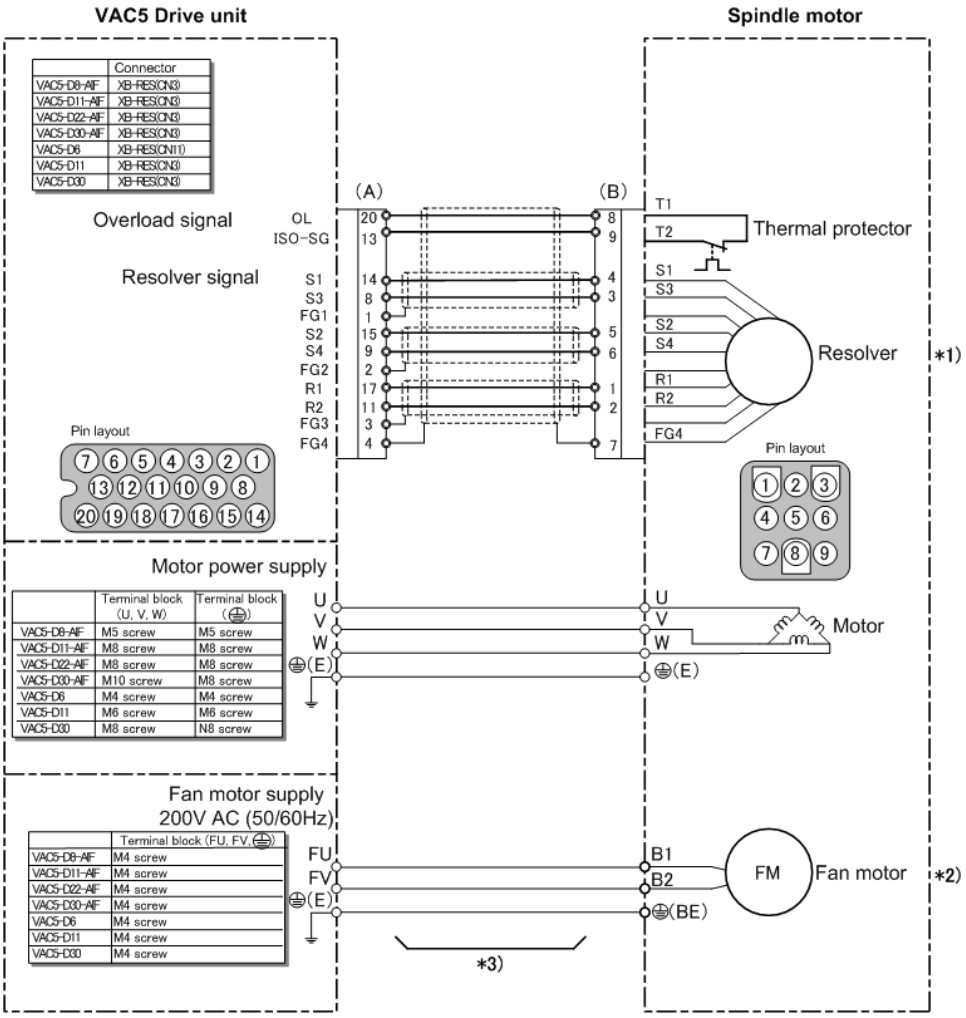
*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-23 Spindle motor connection diagram
(When a 10-pin universal MATE-N-LOK connector is used)

(3) When a 9-pin universal MATE-N-LOK connector is used



		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3703-082-010	350720-1	Tyco Electronics AMP
	Contact	E3708-082-164	350689-7	

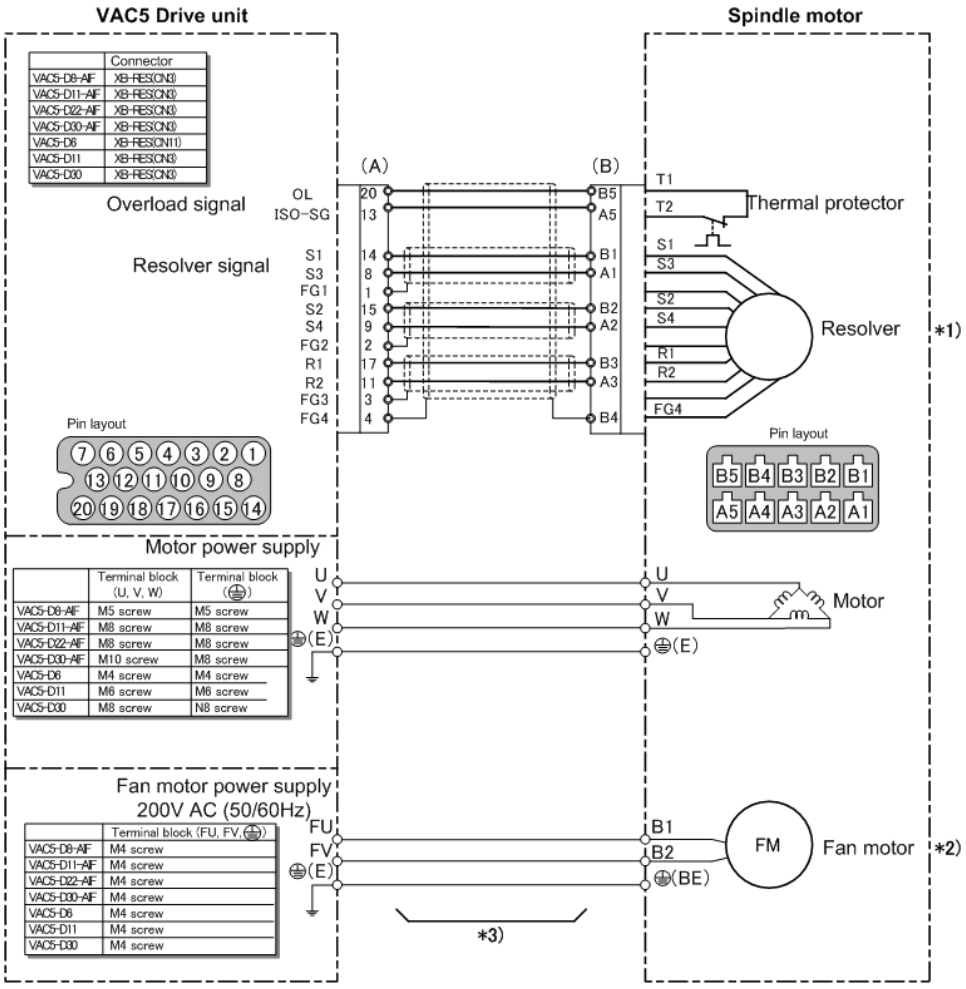
*1) For a built-in motor, no resolver is used.

*2) For a built-in motor, no fan motor is used.

*3) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-24 Spindle motor connection diagram
(When a 9-pin universal MATE-N-LOK connector is used)

(4) When a dynamic connector is used



		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3702-082-040	178289-5	Tyco Electronics AMP
	Contact	E3708-082-178	1-175217-2	

*1) For a built-in motor, no resolver is used.

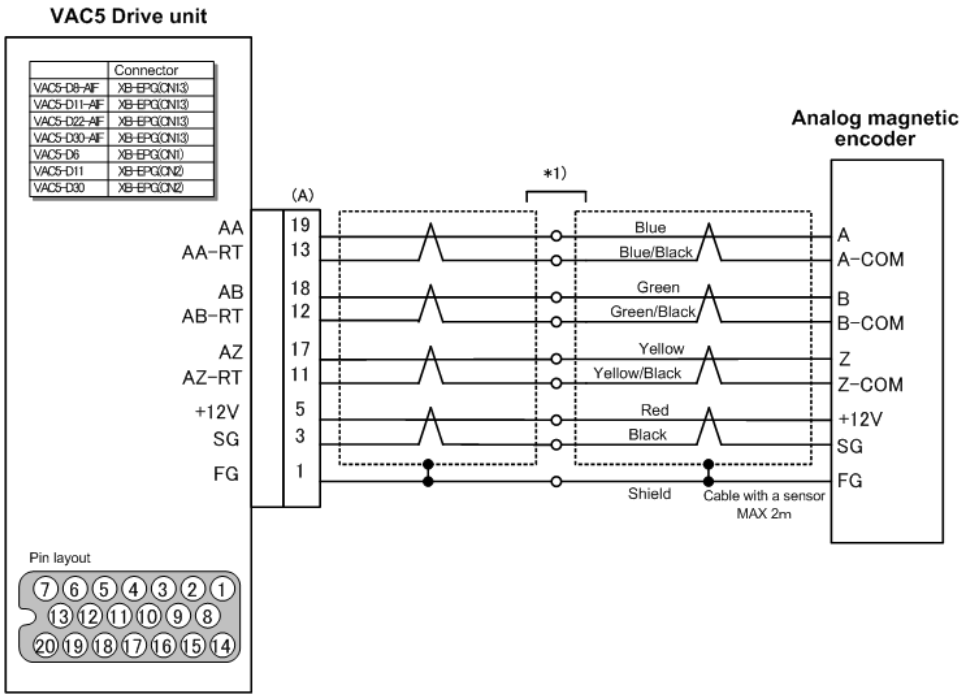
*2) For a built-in motor, no fan motor is used.

*3) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-25 Spindle motor connection diagram (When a dynamic connector is used)

2-5. Encoder and connection diagram

(1) Analog magnetic type encoder connection diagram

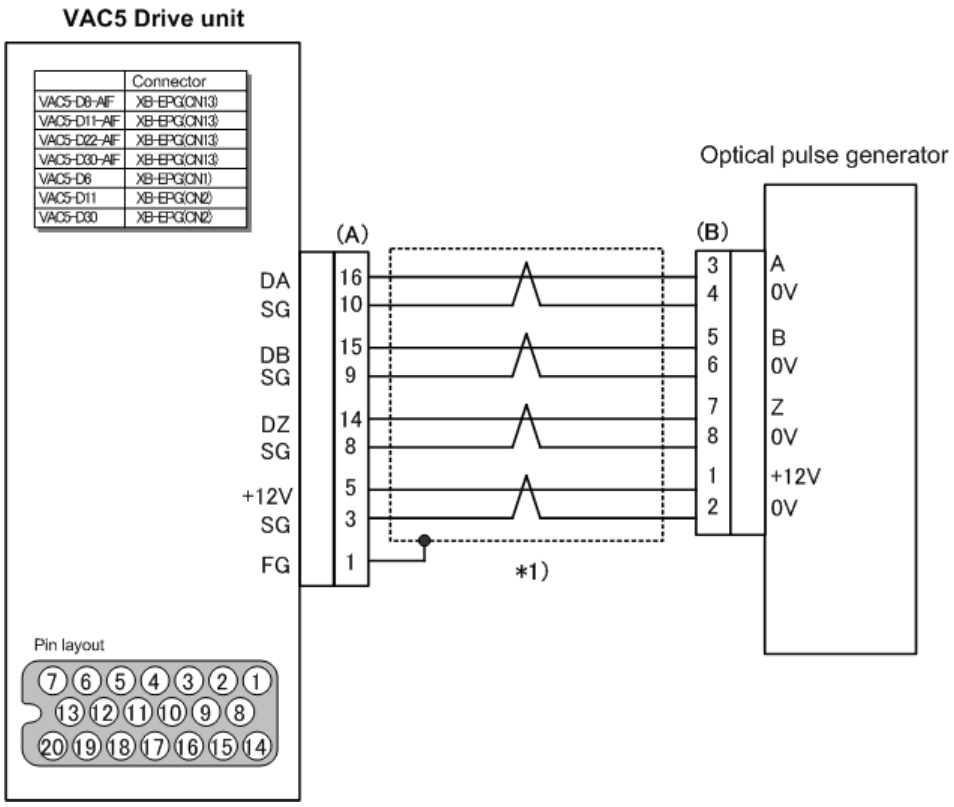


		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

*1) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-26. Analog magnetic type encoder connection diagram

(2) Optical pulse generator



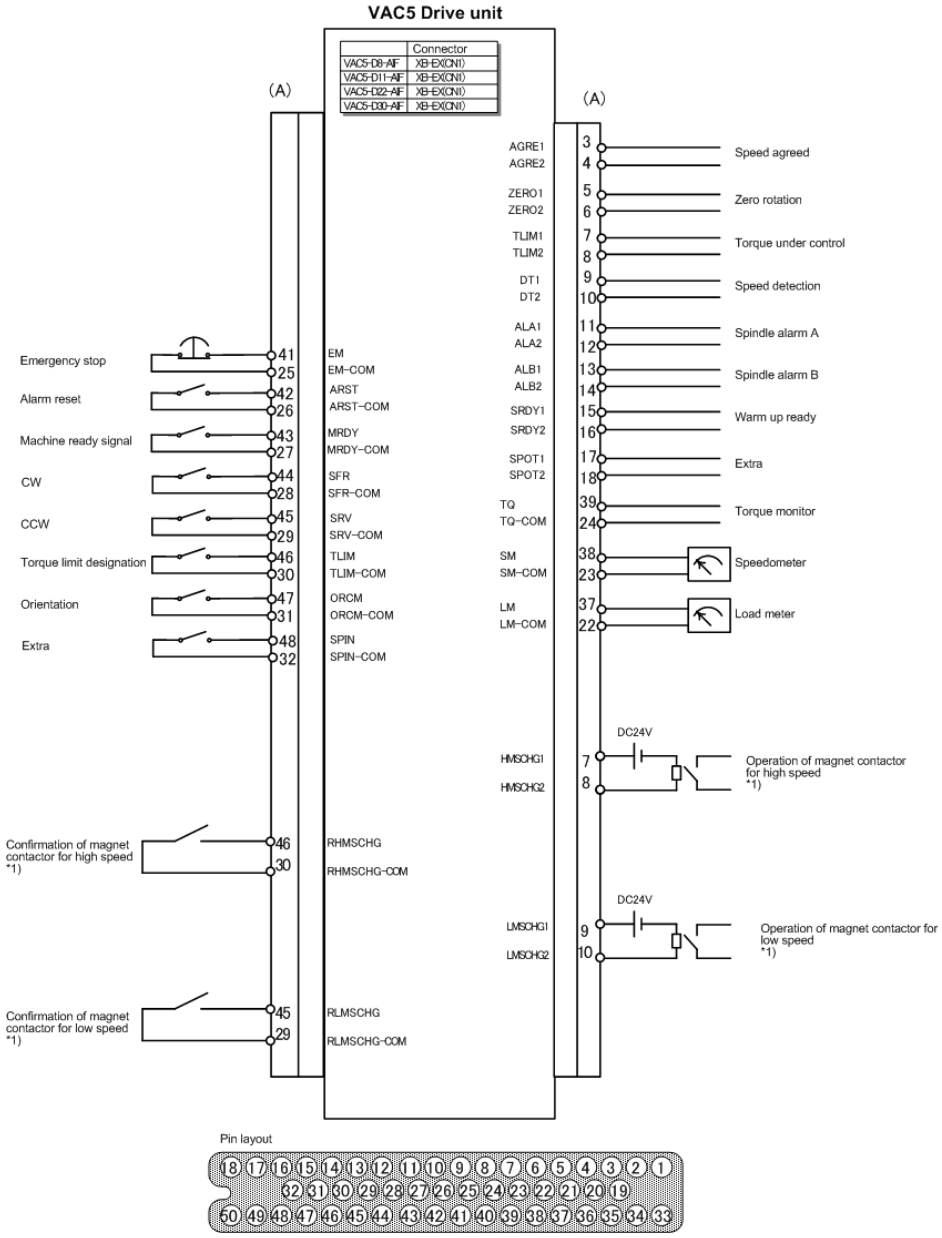
		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3702-701-003	RM15WTP-8S	Hirose Electric

*1) Depending on the machine specifications, an intermediate terminal (intermediate connector) may be present in the wiring.

Fig 2-27 Optical pulse generator

2-6. I/O control circuit connection diagram

(1) When using VAC1 system

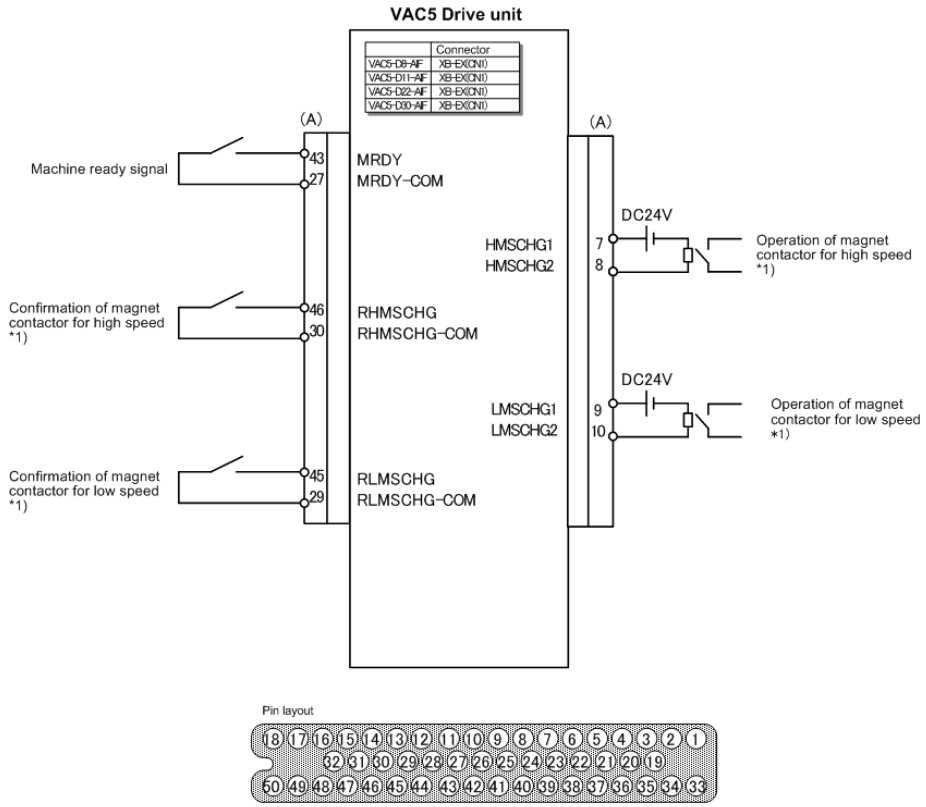


		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-012	MRP-50F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

*1) winding changeover type only

Fig 2-28. Connection diagram for I/O control circuit when using VAC1 system

(2) When using VAC2 system

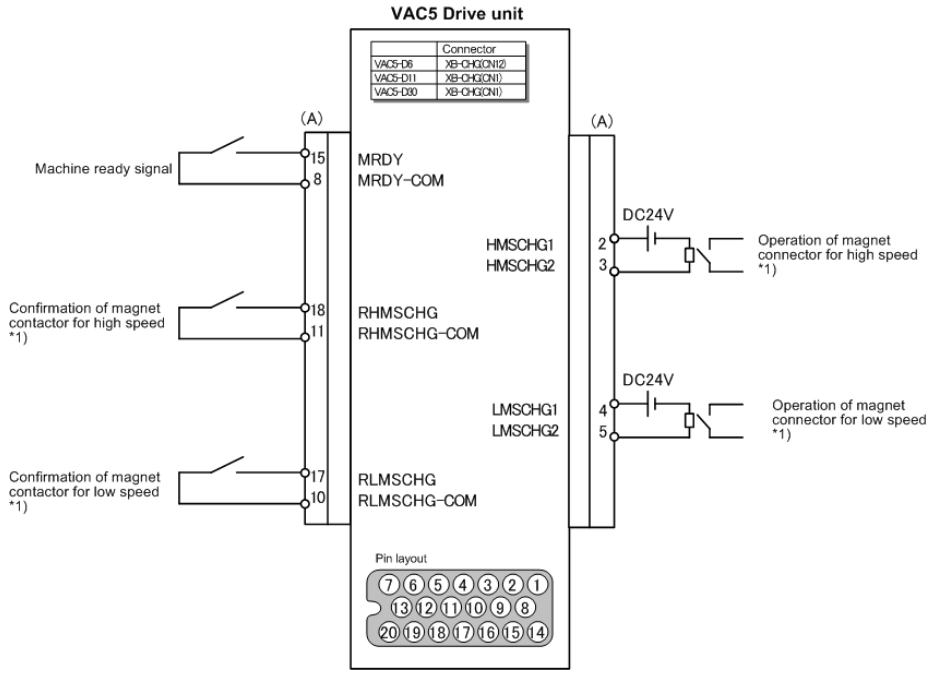


		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-012	MRP-50F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

*1) winding changeover type only

Fig 2-29. Connection diagram for I/O control circuit when using VAC2 system

(3) When using VAC3 system

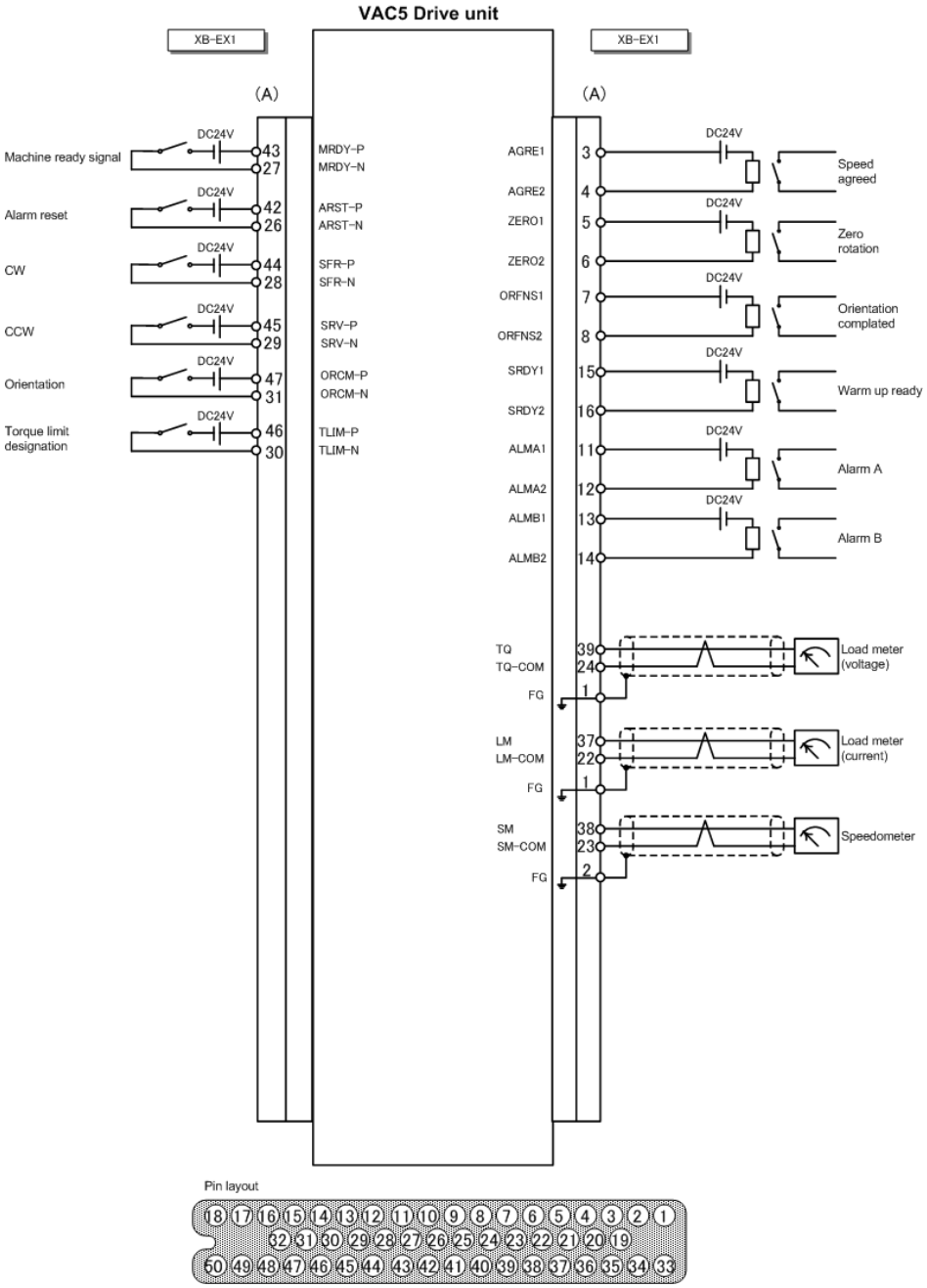


		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

*1) winding changeover type only

Fig 2-30. Connection diagram for I/O control circuit when using VAC3 system

(4) When using externally sold system

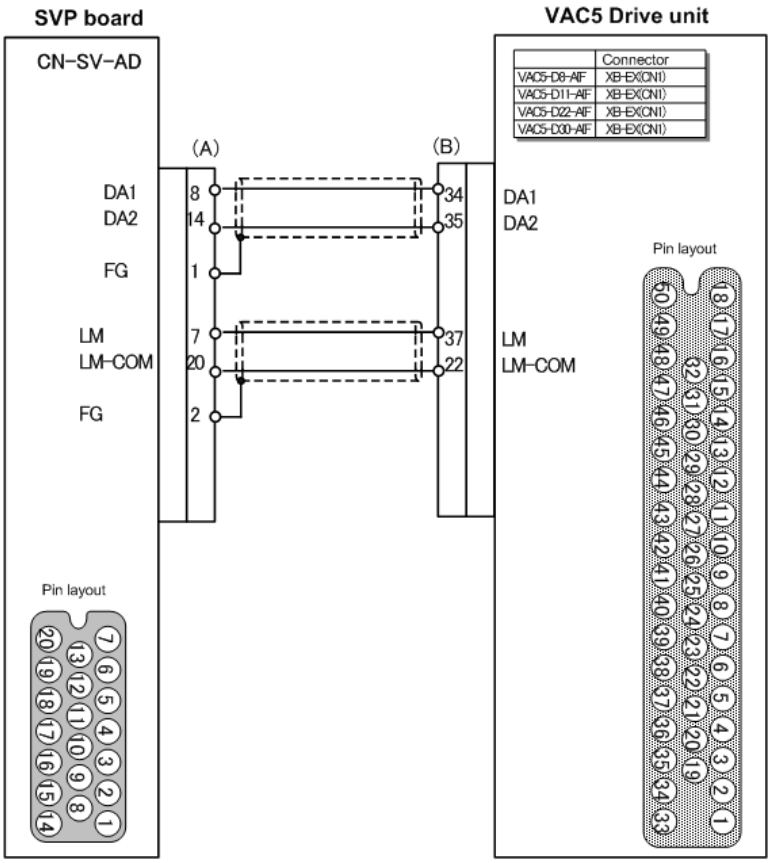


		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-012	MRP-50F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

Fig 2-31. Connection diagram for I/O control circuit when using externally sold system

2-7. NC unit connection diagram

(1) When using VAC1 system



		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-010	MRP-20F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	
(B)	Connector	E3702-791-012	MRP-50F01	
	Contact	E3761-791-001	MRPF102	

Fig 2-32. Connection diagram when using VAC1 system

(2) When using VAC2 system

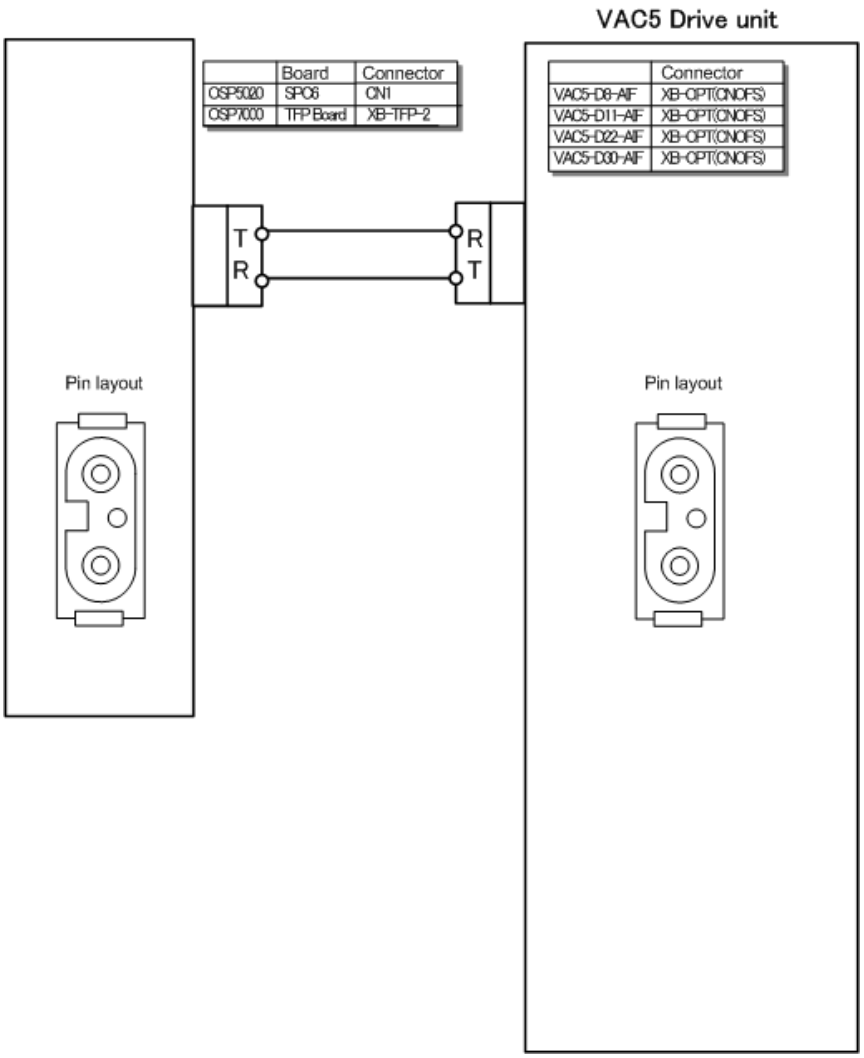


Fig 2-33. Connection diagram when using VAC2 system

(3) When using VAC3 system

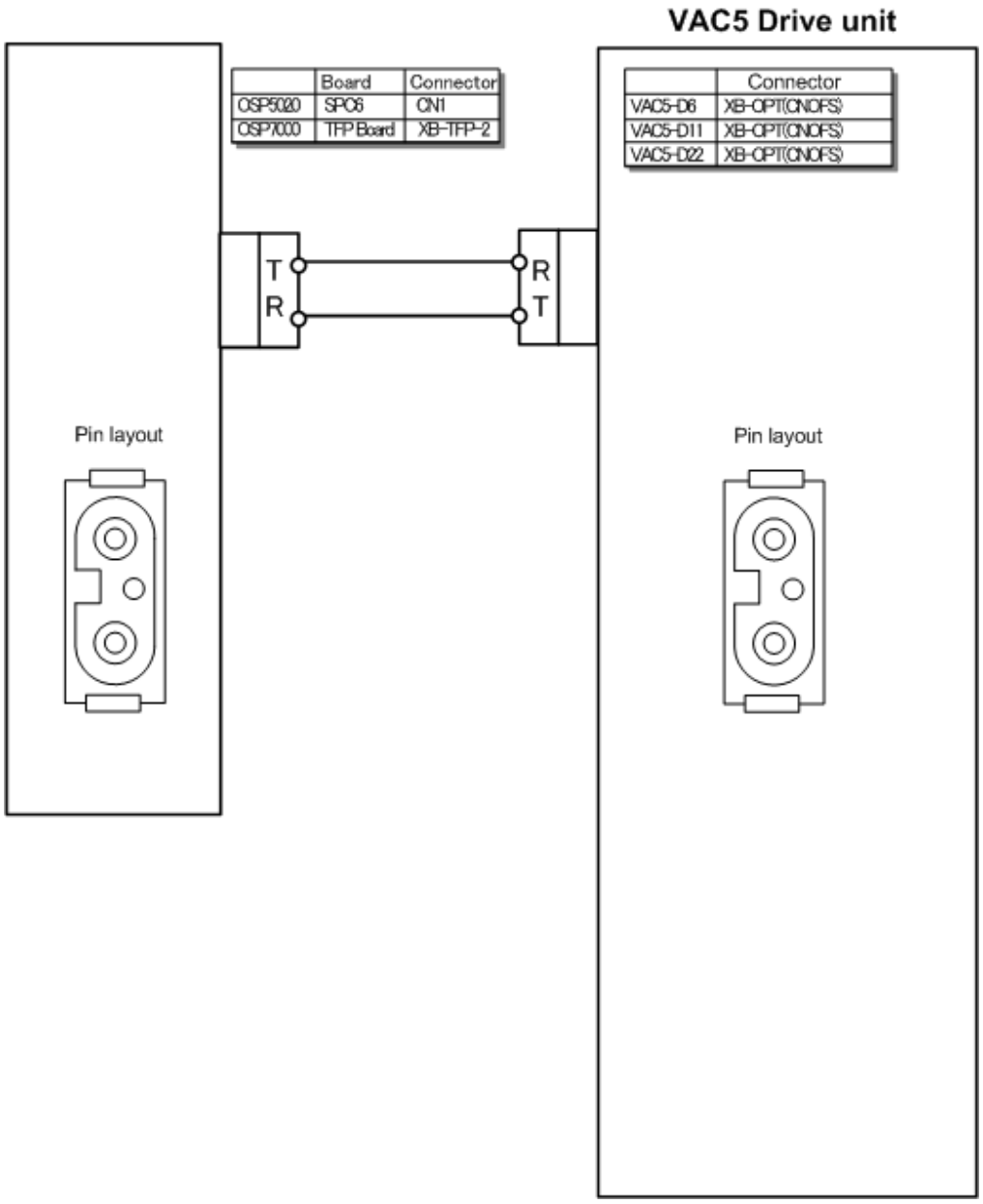
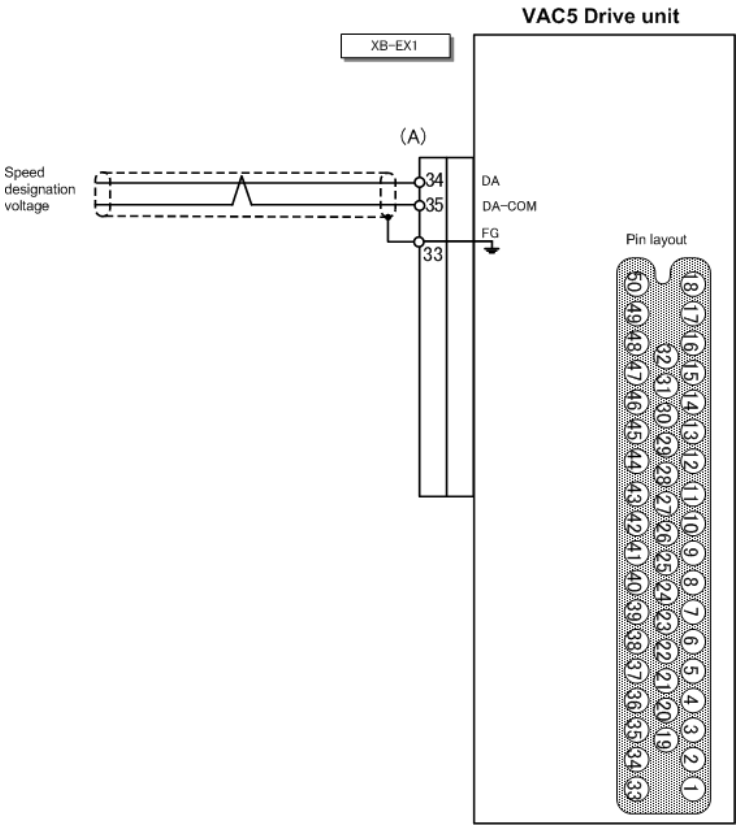


Fig 2-34. Connection diagram when using VAC3 system

(4) When using externally sold system



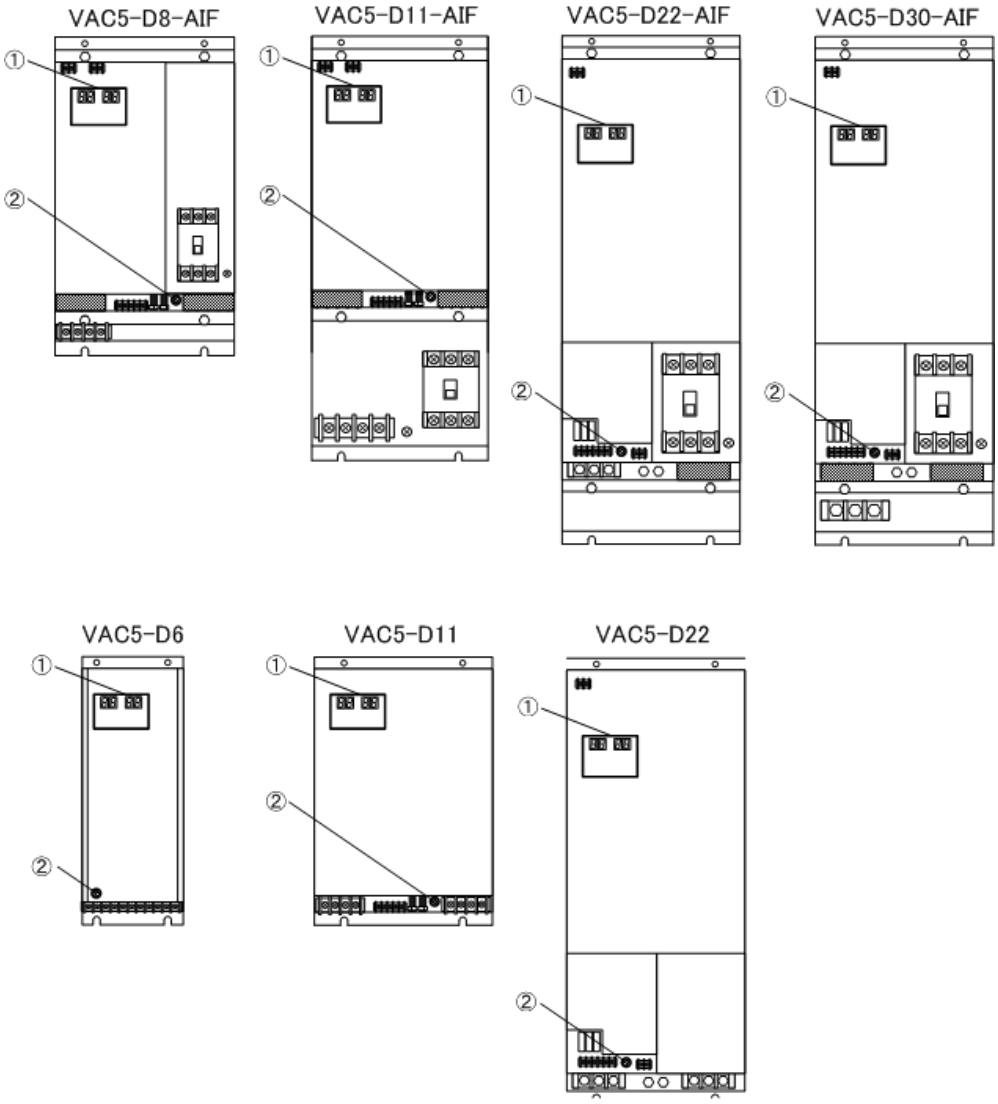
		OKUMA Part No.	Type	Maker
(A)	Connector	E3702-791-012	MRP-50F01	Honda Tsushin Kogyo
	Contact	E3761-791-001	MRPF102	

Fig 2-35. Connection diagram when using externally sold system

SECTION 3 OPERATION STATUS DISPLAY

The VAC5 drive unit displays operation/error status on the seven-segment LED displays (green) on its front face. LED display has two display modes: normal operation mode and error status mode. In the latter mode, the cause of a pending alarm can be estimated from the displayed error number.
VAC5 drive units with firmware VAC4113 or a later version* installed are capable of displaying both control and winding statuses in normal operation mode. For instructions about how to identify the firmware version, see Appendix 6.
A lit LED; DC CHARGE (Orange) on the front face of the unit indicates that the main circuit (high-voltage portion) is charged.

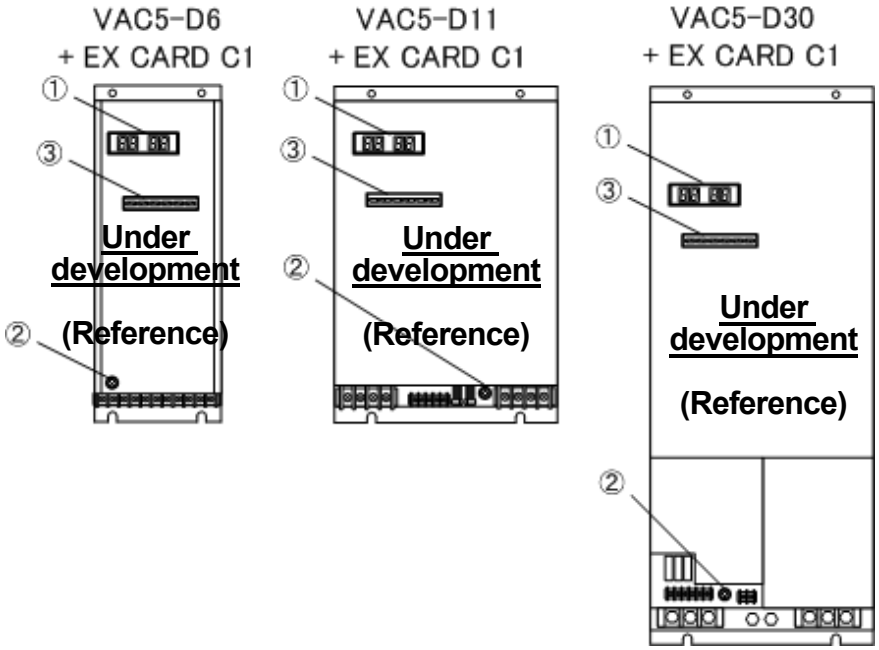
*This also applies to firmware version VAC5100 and later.



(1) Seven-segment LED (green)
(2) DC charge LED (orange)

Fig 3-1 VAC5 unit status indicator LED allocation

With the VAC5 unit (with EX card C1), however, LEDs EX1 to EX6 (green) are used in addition to the seven-segment LED and DC charge LED described on the previous page to indicate the sequence status during spindle home position stoppage.

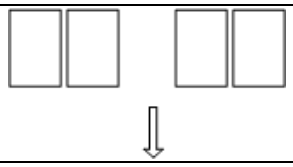
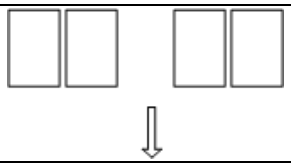
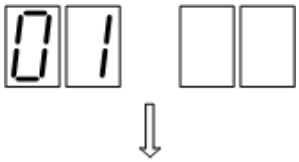
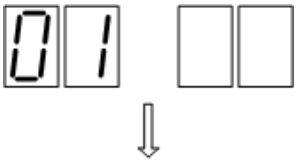
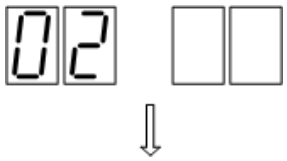
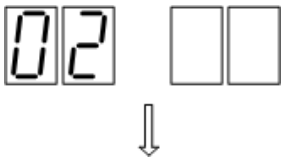
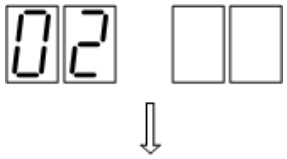
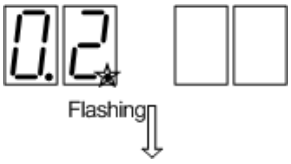


(1) Seven-segment LED (green)
(2) DC charge LED (orange)
(3) LED EX1 to EX6 (green)

Fig 3-2 VAC5 unit status indicator LED allocation

1. Display variations until operation preparations are completed

Table 3-1. Display variations until operation preparations are completed

	Firmware version VAC4112 or earlier version	Firmware version VAC4113 or later version
Before turning on the power		
Just after the power is turned on		
When the NC unit is launched		
During the charging of the main circuit		
Operation preparations completed		

With the VAC1 system, however, “01” will change to “02” immediately after turning ON the power.

2. Display in normal operation mode (Control mode)

Control modes include spindle control mode, spindle/C-axis switching mode, and C-axis control mode. The control status in each of these modes is displayed on the left seven-segment LED display.

On a winding changeover type, the right seven-segment LED displays a winding changeover command and a winding status. In the case of a standard type, it is kept unlit. For further information, see Section 3.

This display function is available with firmware VAC4113 or a later version.

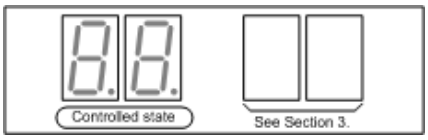
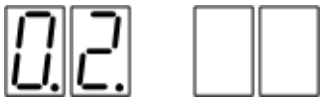
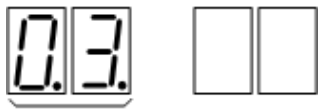
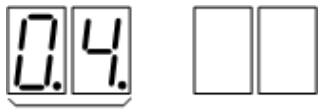
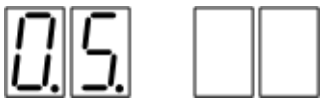
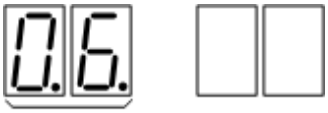


Table 3-2. Display in the normal operation mode (control mode)

	Display on the seven-segment LED display	Remarks
When a zero rotation command is issued		- When the spindle is at rest, “02” is displayed.
When a CW rotation command is issued	 * Flashing (during acceleration/deceleration) Lit (at constant speed)	- During acceleration or deceleration, the “03” display flashes. - When the spindle rotates at a constant speed, “03” stops flashing and remains lit.
When a CCW rotation command is issued	 * Flashing (during acceleration/deceleration) Lit (at constant speed)	- During acceleration or deceleration, the “04” display flashes. - When the spindle rotates at a constant speed, “04” stops flashing and remains lit.
When an indexing command is issued		
When a C-axis control command is issued	 * Flashing (during shift to control mode) Lit (in C-axis control mode)	- When the mode is shifted from the spindle control mode to the C-axis control mode, the “06” display starts flashing. - After the NC enters the C-axis control mode, the “06” display stops flashing and remains lit.

3. Display in normal operation mode (Winding status)

On a winding changeover type, the right seven-segment LED displays a winding changeover command and a winding status. In the case of a standard type, it is kept unlit. Shown below are the seven-segment display variations in conjunction with a winding changeover command.
The left seven-segment LED display indicates the control status of the control mode. For further information, see Section 2.
This display function is available with firmware VAC4113 or a later version.

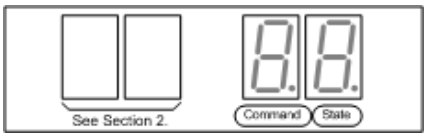


Table 3-3. Display variations for a winding changeover command
(low speed high speed)

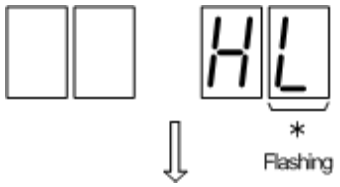
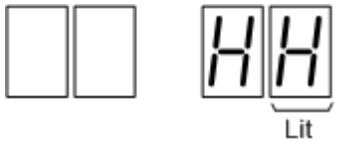
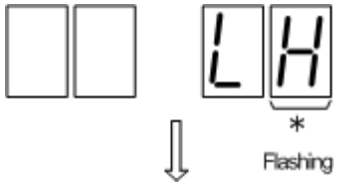
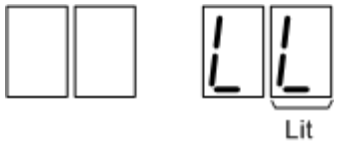
	Display on the seven-segment LED display	Remarks
During winding changeover (low speed high speed)		- "H" is displayed on the command indicator seven-segment LED display. - The entire status indicator seven-segment LED display flashes.
When winding changeover is completed		- When changing to the high-speed winding is completed, the status indicator seven-segment LED display stops flashing, and illuminates the solid "H".

Table 3-4. Display variations for a winding changeover command
(high speed low speed)

	Display on the seven-segment LED display	Remarks
During winding changeover (high speed low speed)		- "L" is displayed on the command indicator seven-segment display. - The entire status indicator seven-segment LED display flashes.
When winding changeover is completed		- When changing to a low-speed winding is completed, the status indicator seven-segment LED display stops flashing and illuminates the solid "L".

4. Display in error status mode

The left seven-segment LED display indicates “AL” standing for an alarm, and the right one shows the alarm number.

Table 3-5. Display in the error status mode

	Display on the seven-segment LED display	Remarks
Location of the alarm is displayed.		- For alarm numbers and their descriptions, see 2-2 in Section 2.

SECTION 4 TROUBLESHOOTING

Troubleshooting is described in the subsections 1 and 2, and procedures for recovery from errors are shown in the subsection 3.

⚠ WARNING Do not touch the high-voltage portions. They are dangerous.

Before inspecting or repairing the power unit, record the codes indicated on the seven-segment LED display.
Then, turn off the power and make sure that the DC CHARGE LED is turned off before inspecting or repairing the power unit.

1. Check points

Before taking actions described in the subsection 2, check the points in the following table.

Table 4-1. Check points

Checkpoint	Check method	Action
Power-supply voltage	Verify that the input power-supply voltage is within the permissible range at input terminals R, S and T of the drive unit. Permissible range: 180 to 220V AC (50/60 Hz)	Adjust the input power-supply voltage to the permissible range.
Connector connection	Check that the connectors *1 connected to the drive unit are connected to the correct locations.	Properly connect the cables.
	Check that the connectors *2 connected to the drive unit are securely screwed.	Tighten the screws to securely connect the connectors.

*1, *2 The connectors connected to the unit are as follows for systems VAC1 to VAC3.

	Connector *1	Connector *2
When using VAC1 system	XB-EX(CN1) XB-RES(CN3)	XB-EX(CN1) XB-RES(CN3)
When using VAC2 system	XB-EX(CN1) XB-OPT(CNOFS) XB-EPG(CN13) XB-RES(CN3)	XB-EX(CN1) XB-EPG(CN13) XB-RES(CN3)
When using VAC3 system	VAC5-D6: XB-OPT(CNOFS) XB-EPG(CN1) XB-CHG(CN12) XB-RES(CN11) VAC5-D11, VAC5-D22: XB-OPT(CNOFS) XB-EPG(CN2) XB-CHG(CN1) XB-RES(CN3)	VAC5-D6: XB-EPG(CN1) XB-CHG(CN12) XB-RES(CN11) VAC5-D11, VAC5-D22: XB-EPG(CN2) XB-CHG(CN1) XB-RES(CN3)

2. Errors and their classifications

In case of a failure, take proper actions against it referencing to the subsection indicated in the table below.
For procedures for inspecting and replacing the components, see “5. MAINTENANCE AND INSPECTIONS.”

Table 4-2. Error classifications

Subsection to refer to	Error
2-1	Display on the seven-segment LED display
2-2	Seven-segment LED display does not light.Display on the seven-segment LED display
2-3	Seven-segment LED display is indicating an error.
2-4	The motor does not run at the specified speed, or the motor does not rotate.
2-5	The cutting force has dropped.
2-6	The acceleration or deceleration time has increased.
2-7	Vibration or noise is strong when the motor is running.
2-8	The motor decelerates suddenly and stops although no alarm has occurred.

2-1. Seven-segment LED display does not light.

Table 4-3

Cause	Check method	Action
The input power is not being supplied.	Check whether input power terminal breaker is OFF.	Turn ON the breaker.
	Check whether the input power terminal breaker has tripped.	An earth fault has occurred inside the unit. Replace the unit.
	Check whether the input power terminal bolts or screws are loose.	Turn OFF the power and fully tighten the bolts and screws.
The power voltage is unusually low or high.	See “Table 4-1. Check points.”	See Table 4-1.
Power is not being supplied to the control PCB inside the power unit.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
The control PC board is faulty.		

⚠WARNING Do not touch the high-voltage portions. They are dangerous.

If checking the input power terminal bolt and screw tightness, first turn OFF the power and ensure that the DC CHARGE LED has gone out.

⚠WARNING Do not touch the high-voltage portions. They are dangerous.

Pay sufficient attention to checking the power voltage.

2-2. Seven-segment LED display is indicating an error.

If the seven-segment LED display is indicating an error, refer to "4. Display in error status mode" in Section 3 to check what alarm is pending, and take proper actions according to the Table 4-4.

Table 4-4 (1/14)

Alarm No.	Alarm name	Cause	Check method	Action
1	PG count error	The gap between the magnetic encoder and detection gear is too large.	Turn the spindle by hand to check the output signal from the magnetic encoder.*1	Adjust the gap between the magnetic encoder and detection gear.
		The magnetic encoder sensor or detection gear is defective.	Turn the spindle by hand to check the output signal from the magnetic encoder.*1	When the magnetic encoder output signal VZ1 ≠ VZ2: • Replace the magnetic encoder sensor. • Detection gear (Z phase disc) external dimensions defect
				When the magnetic encoder output signal t1 ≠ t2: • Replace the magnetic encoder sensor. • Detection gear AB phase gear and Z phase disc assembly accuracy defect
		Noise is superimposed on the magnetic encoder signal wire.	Check whether the magnetic encoder signal wire shield is properly connected.	Replace the magnetic encoder signal wire.
		The magnetic encoder Z phase signal has been lost.	Perform a magnetic encoder signal wire continuity check.	Replace the magnetic encoder signal wire.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

*1 For the method for checking output signals from the magnetic encoder, see Appendix 2.

Table 4-4 (2/14)

Alarm No.	Alarm name	Cause	Check method	Action
2	Motor overspeed	The resolver is defective.	Turn the motor by hand to check the output signal from the resolver. *2	Replace the motor.
		The gap between the magnetic encoder and detection gear is too large.	Turn the spindle by hand to check the output signal from the magnetic encoder. *3	Adjust the gap between the magnetic encoder and detection gear.
		The magnetic encoder sensor or detection gear is defective.	Turn the spindle by hand to check the output signal from the magnetic encoder. *3	When the magnetic encoder output signal VZ1 ≠ VZ2: • Replace the magnetic encoder sensor. • Detection gear (Z phase disc) external dimensions defect
				When the magnetic encoder output signal t1 ≠ t2: • Replace the magnetic encoder sensor. • Detection gear AB phase gear and Z phase disc assembly accuracy defect
		Noise is superimposed on the magnetic encoder signal wire.	Check whether the magnetic encoder signal wire shield is properly connected.	Replace the magnetic encoder signal wire.
		The connector of the resolver or magnetic encoder signal wire has a contact failure.	Check whether the connector*4 is properly connected to the unit and the motor.	Properly connect the connector.
		The connector of resolver or magnetic encoder signal wire has a contact failure.	Disconnect the resolver or the magnetic encoder signal wire and perform a continuity check	Replace the resolver or magnetic encoder signal wire.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

*2 For the method for checking output signals from the resolver, see Appendix 2.
*3 For the method for checking output signals from the magnetic encoder, see Appendix 2.
*4 Connector names are as shown below.

	Connector name	Connector name
VAC5-D8-AIF	XB-RES(CN3)	XB-EPG(CN13)
VAC5-D11-AIF		
VAC5-D22-AIF		
VAC5-D30-AIF		
VAC5-D6	XB-RES(CN11)	XB-EPG(CN1)
VAC5-D11	XB-RES(CN3)	XB-EPG(CN2)
VAC5-D22		

Table 4-4 (3/14)

Alarm No.	Alarm name	Cause	Check method	Action
3	APA speed (spindle overspeed)	The gap between the magnetic encoder and detection gear is too large.	Turn the spindle by hand to check the output signal from the magnetic encoder.*5	Adjust the gap between the magnetic encoder and detection gear.
		The magnetic encoder sensor or detection gear is defective.	Turn the spindle by hand to check the output signal from the magnetic encoder.*5	When the magnetic encoder output signal VZ1 ≠ VZ2: • Replace the magnetic encoder sensor. • Detection gear (Z phase disc) external dimensions defect
				When the magnetic encoder Z phase signal is incorrect. • Detection gear Z phase disc has a scratch.
		Noise is superimposed on the magnetic encoder signal wire.	Check whether the magnetic encoder signal wire shield is properly connected.	Replace the magnetic encoder signal wire.
		The connector of the magnetic encoder has a contact failure.	Properly connect the connector*6.	Properly connect the connector.
		The connector of magnetic encoder signal wire is damaged.	Disconnect the magnetic encoder signal wire and perform a continuity check	Replace the magnetic encoder signal wire.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
4	CON speed	The feed unit quantity is incorrect.	Check the setting of the feed unit.	Correct the set value.
5	DIFF over	The machine is overloaded.	Check for any improper cutting conditions and errors in mechanical components, such as a lubrication unit.	Review the cutting conditions, or remove the cause of the mechanical system error.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

*5 For the method for checking output signals from the magnetic encoder, see Appendix 2.

*6 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-EPG(CN13)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-EPG(CN1)
VAC5-D11	XB-EPG(CN2)
VAC5-D22	

Table 4-4 (4/14)

Alarm No.	Alarm name	Cause	Check method	Action
6	Resolver error	The connector of the resolver is inserted into a wrong position on the control PC board.	Check which of the connectors*7 on the control PC board the connector is connected to.	Connect the connector into the correct position.
		The connector of the resolver has a contact failure.	Check whether the connector*7 is properly connected to the unit and the motor.	Properly connect the connector.
		The connector of resolver or magnetic encoder signal wire has a contact failure.	Disconnect the resolver and perform a continuity check	Replace the resolver.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The resolver is faulty.	Make sure that the same alarm number is displayed with a new unit.	Replace the motor.
8	Communicatio n error	The contact of the connector of the optical fiber is incomplete.	Verify that the connector is properly inserted into the connector for optical fiber on the control PC board XB-OPT(CNOFS).	Properly connect the connector.
		Optical fiber cable is damaged.	Check whether the optical fiber cable is damaged*8.	Replace the optical fiber cable.
		NC unit board*9 is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the NC unit board.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

*7 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-RES(CN3)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-RES(CN11)
VAC5-D11	XB-RES(CN3)
VAC5-D22	

*8 For the method for checking optical fiber cable, see Section 5, subsection 9.

*9 OSP5020: SPC6, OSP7000: TFP board

Table 4-4 (5/14)

Alarm No.	Alarm name	Cause	Check method	Action
9	Command error	An undefined or inexecutable command was sent.	Check communication causing the alarm.	Correct the NC software.
10	Motor wire overcurrent	The contact between the motor power wire and the terminal block is incomplete.	Verify that the terminal screws are securely tightened.	Securely tighten the terminal screws.
		The motor power wire is broken, short-circuited, or grounded.	Perform a continuity check with the motor power wire disconnected from the drive unit and the motor.	Replace the motor power wire.
		The connector of the resolver has a contact failure.	Check whether the connector*10 is properly connected to the unit and the motor.	Properly connect the connector.
		The motor is faulty.	Measure the insulation between the power wire terminal of the motor and the frame.	Replace the motor.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The power unit is faulty.		

*10 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-RES(CN3)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-RES(CN11)
VAC5-D11	XB-RES(CN3)
VAC5-D22	

Table 4-4 (6/14)

Alarm No.	Alarm name	Cause	Check method	Action
11	Inverter bridge short	The motor power wire is broken, short-circuited, or grounded.	Perform a continuity check with the motor power wire disconnected from the drive unit and the motor.	Replace the motor power wire.
		The motor is faulty.	Measure the resistance between the power wire terminal of the motor and the frame with a Megger tester.	Replace the motor.
		(Winding changeover type) The magnet switch for winding changeover or the relay for magnet switch drive is faulty.	Inspect the magnet switch or the relay according to the maintenance manual for the machine.	Replace the magnet switch or the relay for magnet switch drive.
		The control PC board or power unit is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
12	Regenerator IGBT short	An instantaneous power failure occurred when the motor was turned off.	Check the power supply.	Turn on the motor after resetting.
		The control PC board or unit is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
13	Power circuit abnormal voltage	The power voltage is unusually high.	See Table 4-1.	See Table 4-1.
		The power wire terminal screw is loose.	Turn off the power. Verify that the power wire terminal screw is securely tightened.	Securely tighten the screws.
		The motor data selection is incorrect.	Check the switch SW1 setting.	Set the switch SW1 correctly.
		The regenerative circuit on the control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The windings inside the motor have shorted.	Measure the resistance between the motor windings.	Replace the motor.
		The power supply impedance is high. (The power supply wiring route is too long.) (The customer has insufficient power supply capacity.)	Verify that alarm 13 is displayed only when the motor decelerates	Shorten the power supply wiring route to the machine. Optimize the power supply capacity.

Table 4-4 (7/14)

Alarm No.	Alarm name	Cause	Check method	Action
14 (15)	Input voltage drop or open phase	The power voltage is low, or an open phase occurs.	See Table 4-1.	See Table 4-1.
		One or more of the fuses F1R to F3T is blown.	Check the fuses for blowing.	Replace the blown fuse(s).
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The power unit is faulty.		
		The power supply impedance is high. (The power supply wiring route is too long.) (The customer has insufficient power supply capacity.)	Make sure that alarm 14 or 15 is displayed only during the acceleration or deceleration of the motor.	Shorten the power supply wiring route to the machine. Optimize the power supply capacity.
17	Power circuit low voltage	The power voltage is low.	See Table 4-1.	See Table 4-1.
		The power unit is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

Table 4-4 (8/14)

Alarm No.	Alarm name	Cause	Check method	Action
19	Motor overload	The machine is overloaded.	Check the motor temperature.	Review the operation program.
		The contact between the fan power wire and the terminal block is incomplete.	Turn OFF the power and check the terminal block connections at the unit side and motor side.	Properly connect the wires.
		The fan motor wire is damaged.	Turn OFF the power and conduct a continuity check for the fan motor wire.	Replace the motor.
		The motor cooling fan is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the motor cooling fan.
		Dust is accumulated at the motor cooling fan, fan guard, ventilating hole, etc.	Check for dust.	Use the air blast or a vacuum cleaner to remove the dust.
		The connector of the resolver has a contact failure.	Check whether the connector*10 is properly connected to the unit and the motor.	Properly connect the connector.
		The connector of resolver or magnetic encoder signal wire has a contact failure.	Disconnect the resolver and perform a continuity check	Replace the resolver.
		Thermal protector built in the motor is faulty.	Measure the resistance between the connector inside the motor terminal box and the thermal protector terminal. If the measured resistance is □, the thermal protector is faulty.	Replace the motor.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

*11 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-RES(CN3)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-RES(CN11)
VAC5-D11	XB-RES(CN3)
VAC5-D22	

Table 4-4 (9/14)

Alarm No.	Alarm name	Cause	Check method	Action
20	Heat sink overload	The heat sink cooling fan is faulty.	Verify that the heat sink cooling fan starts working when the power is turned on.	Replace the unit.
		The heat sink cooling fan is contaminated with dust.	Check the back of the power unit for contamination.	Clean the heat sink cooling fan by air blowing or using a vacuum cleaner.
		The machine is overloaded.	—————	Review the cutting conditions and tools.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The power unit is faulty.		
21	VAC data settings	VAC PBU data file or NC online parameter values are faulty.	Check VAC PBU data or online change parameters.	Correct wrong data.
22	Excessive in-VAC speed command	Mechanical error	Verify that the mechanical system is in normal condition.	Remove error elements, if any.

Table 4-4 (10/14)

Alarm No.	Alarm name	Cause	Check method	Action
23	Magnetic PG error	The connector of the magnetic encoder signal wire is connected into a wrong position on the control PC board.	Check which of the connectors*12 the control PC board the connector is connected to.	Connect the connector into the correct position.
		The contact of the magnetic encoder signal is incomplete.	Check if the connector*12 is properly connected.	Properly connect the connector.
		The gap between the magnetic encoder and detection gear is too large.	Turn the spindle by hand to check the output signal from the magnetic encoder.*13	Adjust the gap between the magnetic encoder and detection gear.
		Noise is superimposed on the magnetic encoder signal wire.	Check whether the magnetic encoder signal wire shield is properly connected.	Replace the magnetic encoder signal wire.
		The connector of magnetic encoder phase A and B signal wire is damaged.	Disconnect the signal wire and perform a continuity check	Replace the magnetic encoder signal wire.
		Magnetic encoder sensor is faulty.	Turn the spindle by hand to check the output signal from the magnetic encoder.*13	• Replace the magnetic encoder sensor.
24	Magnetic PG marker latch data error error	The magnetic encoder sensor or detection gear is defective.	Turn the spindle by hand to check the output signal from the magnetic encoder.*13	Replace the magnetic encoder sensor or detection gear.

*12 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-EPG(CN13)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-EPG(CN1)
VAC5-D11	XB-EPG(CN2)
VAC5-D22	

*13 For the method for checking output signals from the magnetic encoder, see Appendix 2.

Table 4-4 (11/14)

Alarm No.	Alarm name	Cause	Check method	Action
30	Excessive speed deviation	Cutting load is too great.	Check whether the cutting tool cut into the workpiece and stopped during heavy cutting.	Review the cutting conditions and tools.
		The motor power wire is damaged or has a contact failure or the wiring is incorrect.	Check the motor power wire.	Properly connect the motor power wire.
		The resolver signal wire is broken or has a contact failure.	Check the resolver signal wire.	Properly connect the resolver signal wire.
		The magnetic encoder signal wire is broken or has a contact failure.	Check the magnetic encoder signal wire.	Properly connect the magnetic encoder signal wire.
		The motor data selection is incorrect.	Check the switch SW1 setting.	Set the switch SW1 correctly.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The power unit is faulty.		
		The motor is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the motor.
		(Winding changeover type) (Winding changeover type)The winding changeover magnet contactor or drive relay is faulty.	Refer to the maintenance manual provided with this machine and perform an inspection.	Replace the winding changeover magnet switch or drive relay.
31	Winding changeover error	Winding changeover magnet contactor or drive relay error	Refer to the maintenance manual provided with this machine and perform an inspection.	Replace the winding changeover magnet switch or drive relay.
		The I/O control circuit signal wire is damaged or has a contact failure.	Check I/O control circuit signal wire.	Properly connect the wire.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
32	RAM error	The control PC board is faulty.	—————	Replace the unit.
41	Converter link error	The power unit is faulty.	—————	Replace the unit.

Table 4-4 (12/14)

Alarm No.	Alarm name	Cause	Check method	Action
42	Abnormal inverter DC bus voltage	The power voltage is unusually high.	See Table 4-1.	See Table 4-1.
		The power wire terminal screw is loose.	Turn the power OFF and verify that the power wire terminal screw is securely tightened.	Securely tighten the screws.
		The power supply impedance is high. (The power supply wiring route is too long.) (The customer has insufficient power supply capacity.)	Verify that alarm 42 is displayed only when the motor decelerates	Shorten the power supply wiring route to the machine. Optimize the power supply capacity.
		The power voltage is low, or an open phase occurs.	See Table 4-1.	See Table 4-1.
		The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
		The power unit is faulty.		
47	Unit settings	Unit settings are faulty.	Check the switch settings.	Set the switches correctly.
48	Motor data settings	Motor data settings are faulty.	Check the switch settings.	Set the switches correctly.
49	Unit/motor data settings	The unit settings and data settings do not match.	Check the switch settings.	Set the switches correctly.
50	Self-diagnosis error	The control PC board is faulty.	—————	Replace the unit.

Table 4-4 (13/14)

Alarm No.	Alarm name	Cause	Check method	Action
51	Control board error	The control PC board is faulty.	—————	Replace the unit.
		One or more of the board-to-board connectors connecting the control PC board and the power unit is improperly inserted.		
52	Abnormal control voltage ±12 V/+24 V	The control PC board is faulty.		
53	OPF error			
58	Abnormal power for magnetic encoder			
59	Abnormal power for encoder			
60	Abnormal control power + 3.3 V			
61	Abnormal control power 5 V			
62	Gate signal error			
70	IR1 MAIN loop error			
71	IR2 MAIN loop error			
72	INT4 loop error			
73	INT3 loop error			
74	INT2 loop error			
75	IR3 MAIN loop error			
76	Access error			
78	Parity error			
79	Watchdog error			

Table4-4 (14/14)

Alarm No.	Alarm name	Cause	Check method	Action
80	IRQ7 interrupt IRQ4 interrupt	The control PC board is faulty.	—————	Replace the unit.
81	NMI interrupt			
82	General imparity command			
83	Slot imparity command			
84	CPU address error			
85	DMA address error DMAC/DTC address error			
86	Undefined trap command			
87	Undefined interrupt			
88	DMAC			
89	ITU MTU			
90	SCI			
91	REF BSC			
92	A/D			
93	System reserve			
94	User break			
95	DTC			
96	CMT			
97	I/O			

2-3. The motor hunts

Table 4-5

Cause	Check method	Action
The resolver signal wire has a contact failure or is connected to a incorrect terminal.	Check the resolver signal wire.	Properly connect the resolver signal wire.
The motor power wire has a contact failure or is connected to a incorrect terminal.	Check the motor power wire.	Properly connect the motor power wire.
The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
The power unit is faulty.		
(Winding changeover type) The motor power wire is not properly connected to the magnet contactor for high speed/low speed.	Refer to the maintenance manual provided with this machine and inspect the magnet contactor.	Replace the magnet contactor.
(Winding changeover type) The motor power wire is not properly connected to the magnet contactor for high speed/low speed.	Refer to the electric drawing provided with this machine and inspect the magnet contactor related wiring.	Properly connect the magnet contactor related wiring.

2-4. The motor does not run at the specified speed, or the motor does not rotate.

Table 4-6

Cause	Check method	Action
The machine ready complete signal has been lost.	Check if the connector*1 is properly connected.	Properly connect the connector.
	Check the signal (MRDY, MRDY-COM) continuity.	Replace the signal cable.
An alarm occurred at the unit.	Seven-segment LED shows an error if a rotation command is specified.	See subsection 2-2.
The motor power wire is damaged or has a contact failure or the wiring is incorrect.	Check the motor power wire.	Properly connect the wire.
The resolver is faulty.	Check the signal from the resolver.*2	Replace the motor.
The magnetic encoder unit is faulty.	Check the output signal from the magnetic encoder.*3	Replace the magnetic encoder sensor.
The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
The power unit is faulty.		
(Winding changeover type) The winding changeover magnet switch or drive relay is faulty.	Refer to the maintenance manual provided with this machine.	Replace the winding changeover magnet switch or drive relay.

*1 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-EX(CN1)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-CHG(CN12)
VAC5-D11	XB-CHG(CN1)
VAC5-D22	

*2 For the method for checking output signals from the resolver, see Appendix 2.

*3 For the method for checking output signals from the magnetic encoder, see Appendix 2.

CAUTION For the winding changeover type, issue a winding command and speed command within the permissible rotation range for both the high-speed winding and low-speed winding.

High-speed winding: 0 – max. no. of motor rotations

Low-speed winding: 0 – max. no. of rotations for low-speed winding

Refer to the instruction manual provided with the machine for more specific values.

2-5. The cutting force has dropped.

Table 4-7

Cause	Check method	Action
A torque limit command is applied.	———————	Cancel the torque limit command.
The cause of the problem exists close to the spindle of the machine.	Refer to the maintenance manual provided with this machine.	Refer to the maintenance manual provided with this machine.
The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.

2-6. The acceleration or deceleration time has increased.

Table 4-8

Cause	Check method	Action
The load is heavy.	Check the load (value) displayed on the NC screen.	Remove the cause of the heavy load.
A torque limit command is applied.	———————	Cancel the torque limit command
The power voltage is high.	See Table 4-1.	See Table 4-1.
The motor power wire is damaged or has a contact failure.	Check the motor power wire.	Properly connect the wire.
The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
The power unit is faulty.		
The power supply impedance is high.	Only the deceleration time increases. Refer to the instruction manual provided with the machine.	Shorten the power supply wiring route to the machine. Optimize the power supply capacity.

2-7. Vibration or noise is strong when the motor is running.

As a method for locating whether the cause of a problem is present in the electric or mechanical system, run the motor free (uncontrolled state). Follow the procedure described below to run the motor free.
If “vibration or noise is still strong” even if the motor is running free, the cause of the problem lies in the mechanical system, not the electric system.

(1) Run the motor with a rotation command given to it.
(2) Disconnect the optical fiber connector XB-OPT (CNOFS) of the drive unit.
(3) A communication error alarm is issued, and the motor starts to run free.

Table 4-9

Cause	Check method	Action
The mounting of the motor is improper.	Check the motor to see if it is properly mounted and coupled with the spindle.	Mount or couple the motor with the spindle from the beginning.
The resolver signal wire is broken or has a contact failure.	Check the resolver signal wire.	Replace the resolver.
When using VAC1 system Noise is superimposed on the magnetic encoder signal wire.	Check the control signal wire shielding.	Replace the control signal wire.
The control PC board is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the unit.
The power unit is faulty.		
The motor is faulty.	Verify that all of the check points above are showing the proper values or properly set.	Replace the motor.

⚠ DANGER When the motor is running in neutral (uncontrolled state), stay away from the rotating part of the motor.

CAUTION Exercise care not to apply excessive force to the root of the optical fiber connector XB-OPT (CNOFS) of the drive unit when disconnecting it. Failure to follow this instruction will cause the optical fiber to break.
Failure to follow this instruction will cause the optical fiber to break.

2-8. The motor decelerates suddenly and stops even although no alarm has occurred.

Table 4-10

Cause	Check method	Action
The machine ready complete signal has been lost.	Check if the connector*1 is properly connected.	Properly connect the connector.
	Check the signal (MRDY, MRDY-COM) continuity.	Replace the signal cable.

*1 Connector names are as shown below.

	Connector name
VAC5-D8-AIF	XB-EX(CN1)
VAC5-D11-AIF	
VAC5-D22-AIF	
VAC5-D30-AIF	
VAC5-D6	XB-CHG(CN12)
VAC5-D11	XB-CHG(CN1)
VAC5-D22	

3. Recovery from errors

If the seven-segment LED display is indicating an error, it is necessary to remove the cause of the error and reset the alarm to recover from that error status.
Alarms are classified into four levels shown in the table below according to the processing in case of an alarm and the recovering method.

Table 4-11

Alarm level	Processing in case of alarm	Recovering method	Nature of alarm
Level 1a	The unit goes into alarm level 1 mode. [Immediately shutoff]	Turn the machine power supply breaker OFF and then ON again, and start up the NC.	An alarm, such as that detected by the CPU itself (exception), that requires hardware initialization.
Level 1b	The unit goes into alarm level 1 mode. [The shutoff of the current after deceleration to a stop is standard processing.]	Turn off the NC power, and turn it on again to restart the NC.	An alarm that requires the initialization of parameters, etc.
Level 2	The unit goes into an alarm status in the main mode*1 in which the alarm was issued. [The processing depends on the main mode in which an alarm is issued.]	Press the reset button on the NC operation panel. [A reset command will be issued in each mode.]	An alarm that may occur under certain cutting conditions, such as DIFF over.
Level 3	The unit informs the NC of the issuance of alarm level 3, remains in normal operation for 30 seconds, and goes into alarm level 2.	Press the reset button on the NC operation panel. [A reset command will be issued in each mode.]	An overload-related alarm.

*1 “Main mode” means velocity control mode (the mode executed with a regular S command) or position control mode (the mode for C-axis control).

SECTION 5 MAINTENANCE AND INSPECTIONS

1. Maintenance tools

The following table shows the instruments to be used for maintenance and inspections.

Table 5-1 Maintenance Tools

Name	Specification	Application	Remarks
AC voltmeter	300 V	Unit power voltage measurement	
Analog tester	Commercial tester	Fuse resistance check	
Screwdriver	Large	Motor wire, power wire disconnection	
	Medium	Unit cover removal	
		Motor wire, power wire disconnection	
	Small	Connector securing screw removal	
Box wrench	5 mm	Unit motor wire, power wire disconnection	
	8 mm	Unit motor wire, power wire disconnection	
		Unit power wire disconnection	
	10 mm	Unit motor wire disconnection	
Hex wrench	6 mm	Unit removal	*1
	8 mm	Unit motor wire, power wire disconnection	
		Unit removal	*1
	10 mm	Unit motor wire, power wire disconnection	

*1) A T-wrench (L: approx. 300 mm) is recommended for removing the unit securing bolts at the back of the control panel.

2. Procedures for inspecting and replacing fuses

The check and replacement methods for the fuses used in the respective drive units are shown in Table 5-2 below. Use the rated fuses shown in Table 5-3.

Table 5-2 Fuse Check/Replacement Methods

Step	Details	Check Items
1	Turn OFF the power.	Ensure that the unit DC CHARGE LED has gone out.
2	Remove the fuse from the fuse holder.	Check whether the fuse element is blown.
3	Measure the resistance at both ends of the fuse with a tester.	Normal: 0 [Ω] Blow: ∞[Ω]
4	Replace the fuse if blown.	Check the rated current of the blown fuse.
5	Insert the fuse in the fuse holder.	If the holder has a cover, do not forget to replace it.

⚠ DANGER

Step 1

After turning OFF the power, always ensure that the unit DC CHARGE LED has gone out before disconnecting the motor and power wires. Failure to do so may result in electric shock.

Table 5-3 Fuse Ratings

Unit Type	Rated Current	Remarks
VAC5-D8-AIF	FR=5.0 [A] FS=5.0 [A]	
VAC5-D11-AIF		
VAC5-D22-AIF	FR=5.0 [A] FS=5.0 [A] FT=5.0 [A]	
VAC5-D30-AIF		
VAC5-D6	FR=5.0 [A] FS=5.0 [A]	
VAC5-D11		
VAC5-D22	FR=5.0 [A] FS=5.0 [A] FT=5.0 [A]	

3. Procedures for replacing the whole drive unit

The following table shows the procedure for replacing the drive unit.

Table 5-4 Procedure for replacing the whole unit

Step	Description	Check Items
1	Turn off the power.	Ensure that the unit DC CHARGE LED has gone out.
2	Disconnect the optic fiber connector	Only when using the optical interface unit
3	Loosen the screws securing the connectors, and then disconnect the connectors.	Ensure that the connection location is indicated on each connector.
4	Disconnect the motor and power wires.	Ensure that the power wire number to which each power wire is to be connected is indicated on each wire. Take a record of the power wire numbers and corresponding unit terminal block names.
5	Replace the drive unit.	Ensure that the unit type is correct.
6	Remove the cover and set the switches on the drive unit.	Refer to Appendices 3 and 4.
7	Connect the motor and power wires.	Check the power wire numbers and unit terminal block names recorded at step 4.
8	Connect each connector and tighten the securing screws.	Ensure that each connector is connected to the correct corresponding connector.
9	Attach the optic fiber.	Only when using the optical interface unit
10	Perform a trial run.	

⚠ DANGER **Step 1**
After turning OFF the power, always ensure that the unit DC CHARGE LED has gone out before disconnecting the motor and power wires. Failure to do so may result in electric shock.

CAUTION **Step 2**
Avoid applying to much force to the base when handling the optical fiber connector. Failure to do so may result in the optic fiber being broken, and the NC will not start up when turning ON the power following unit replacement.

⚠ CAUTION **Step 5**
The drive unit is very heavy, and it is therefore recommended that a crane or similar device be used to suspend the unit during removal or attachment.

4. Procedures for inspecting the optical fiber cable (only when using VAC2, VAC3 system)

As shown in the figure below, expose either optical fiber connector to light. The cable is functioning if the other connector is lit.

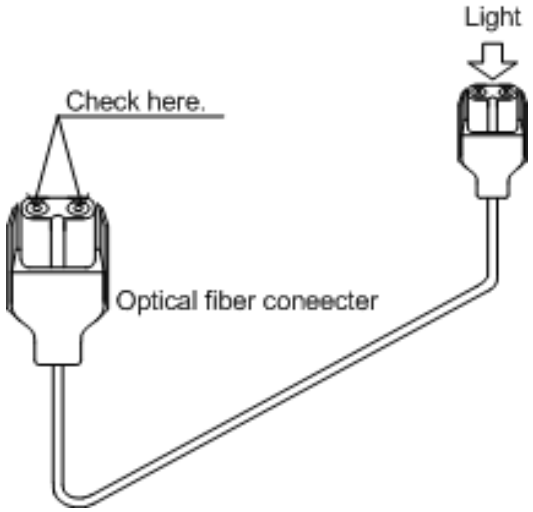


Fig 5-1

CAUTION Exercise care not to apply excessive force to the root of the optical fiber connector. Failure to do so may result in the optic fiber being broken, and the NC will not start up when the power is turned ON.

5. Procedures for conducting a trial run

Follow the procedure shown in the table below to conduct a trial run after replacing the unit.

Table 5-5 Procedures for conducting a trial run

Step	Description	Remarks
1	Ensure that the unit type and switch settings are correct.	Refer to Appendices 3 and 4.
2	Turn ON the power (machine main breaker) with the Emergency Stop button pushed.	
	Ensure that the unit heat sink fan motor and motor cooling fan motor rotate.	If the fan motor does not rotate, refer to “Section 4 Troubleshooting”.
	Ensure that the unit seven-segment LED displays “01”.	Refer to Section 3.
3	Turn ON the operation power and ensure that the NC starts up.	If an alarm occurs and the NC does not start up, refer to Section 4.
	Ensure that the unit seven-segment LED displays “02”.	Refer to Section 3.
4	Release the Emergency Stop button and ensure that the unit DC CHARGE LED (orange) is illuminated. Issue rotation commands to check the clockwise and counterclockwise rotations.	If the DC CHARGE LED (orange) does not illuminate, refer to Section 4.
5	Check for a noise when the electromagnetic contactor inside the unit activates.	If the electromagnetic contactor does not activate, refer to Section 4.
6	Issue a rotation command (low speed) with the spindle override lowered in MDI mode to check the spindle clockwise and counterclockwise rotations. Gradually raise the spindle override and check the performance across the entire speed range and in position control mode.	If there is significant vibration or noise during spindle rotation, refer to Section 4.

⚠ DANGER **Step 1**

Always ensure that the switch settings are correct.
The motor will be damaged during a trial run if the settings are incorrect.

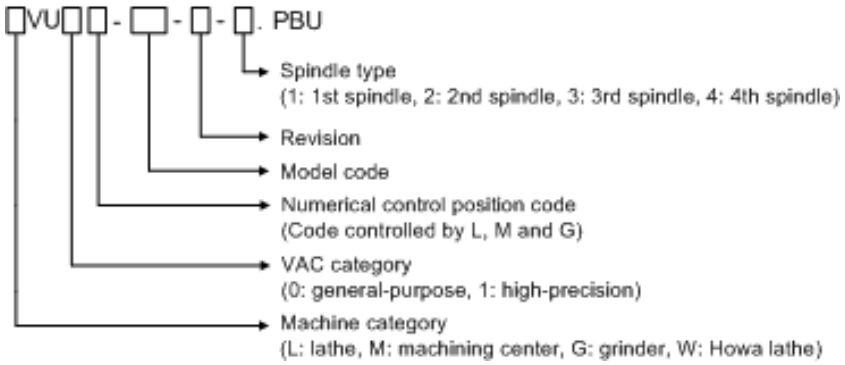
⚠ DANGER **Step 6**

When performing an operation check, ensure that the attachment, chuck and claws on the spindle clutch are properly secured. The attachment, chuck or claws may fly from the spindle if not secure during rotation, representing a potential danger to those in the vicinity. Furthermore, take care to prevent the spindle chuck colliding with the attachment or jig when rotating the spindle.

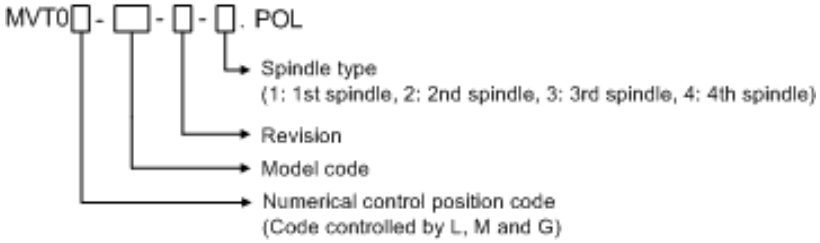
APPENDIX 1 FILES STORED ON CONTROL FLOPPY DISK

The parameters for spindle motor control are stored in the files shown below.

- Common file
  The parameters for spindle indexing, motor data, gear ratios, etc. are set in this file.
  This file also holds parameters set by users (for example, parameters for spindle indexing). Periodically make a backup copy of these parameters on floppy disk B.



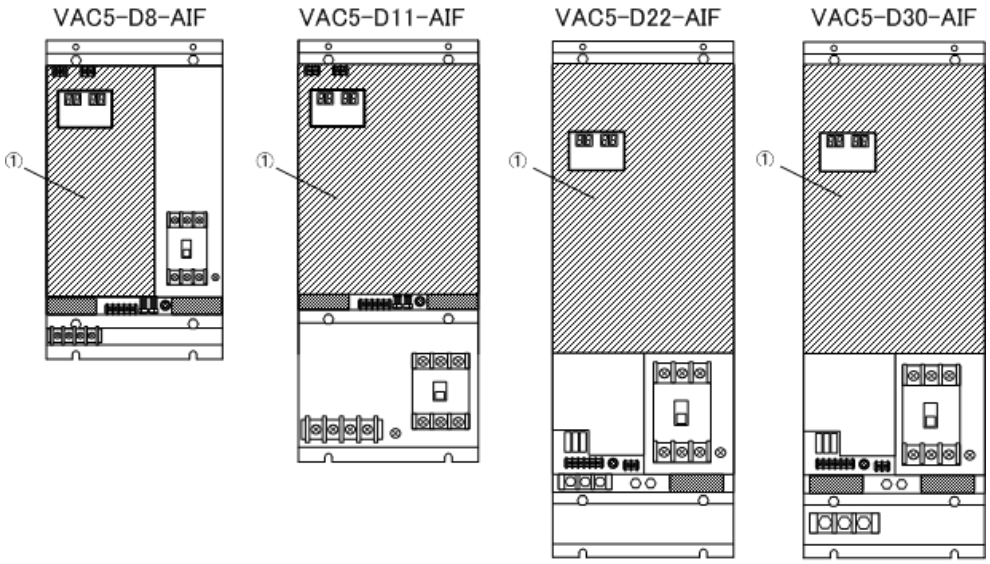
- File for synchronized tapping specifications
  The parameters for synchronized tapping, the number of gear steps, the permissible synchronized tapping speed range in each gear, etc.

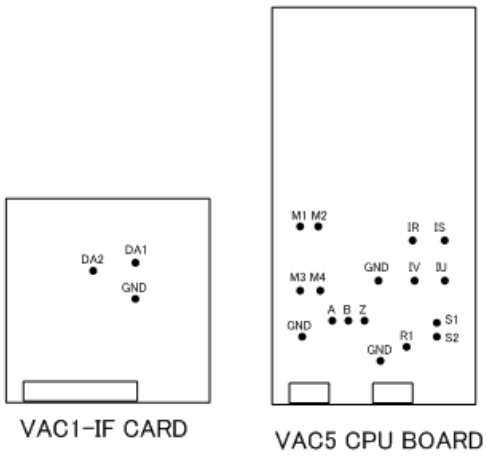


APPENDIX 2 DESCRIPTION OF MONITOR TERMINALS

The waveform of the VAC5 can be observed by connecting an oscilloscope to the monitor terminals.

1. Monitor terminal layout (if using analog interface unit)





VAC1-IF CARD　　VAC5 CPU BOARD

M1: Motor rotation count
M2: Motor output torque
M3: None
M4: None

A: Magnetic encoder A phase signal
B: Magnetic encoder B phase signal
Z: Magnetic encoder Z phase signal

R1: Resolver return signal
S1: Resolver excitation signal
S2: Resolver excitation signal

IS: DC bus P side current
IR: DC bus N side current

IU: Motor current phase U
IV: Motor current phase V

GND: Connect oscilloscope common

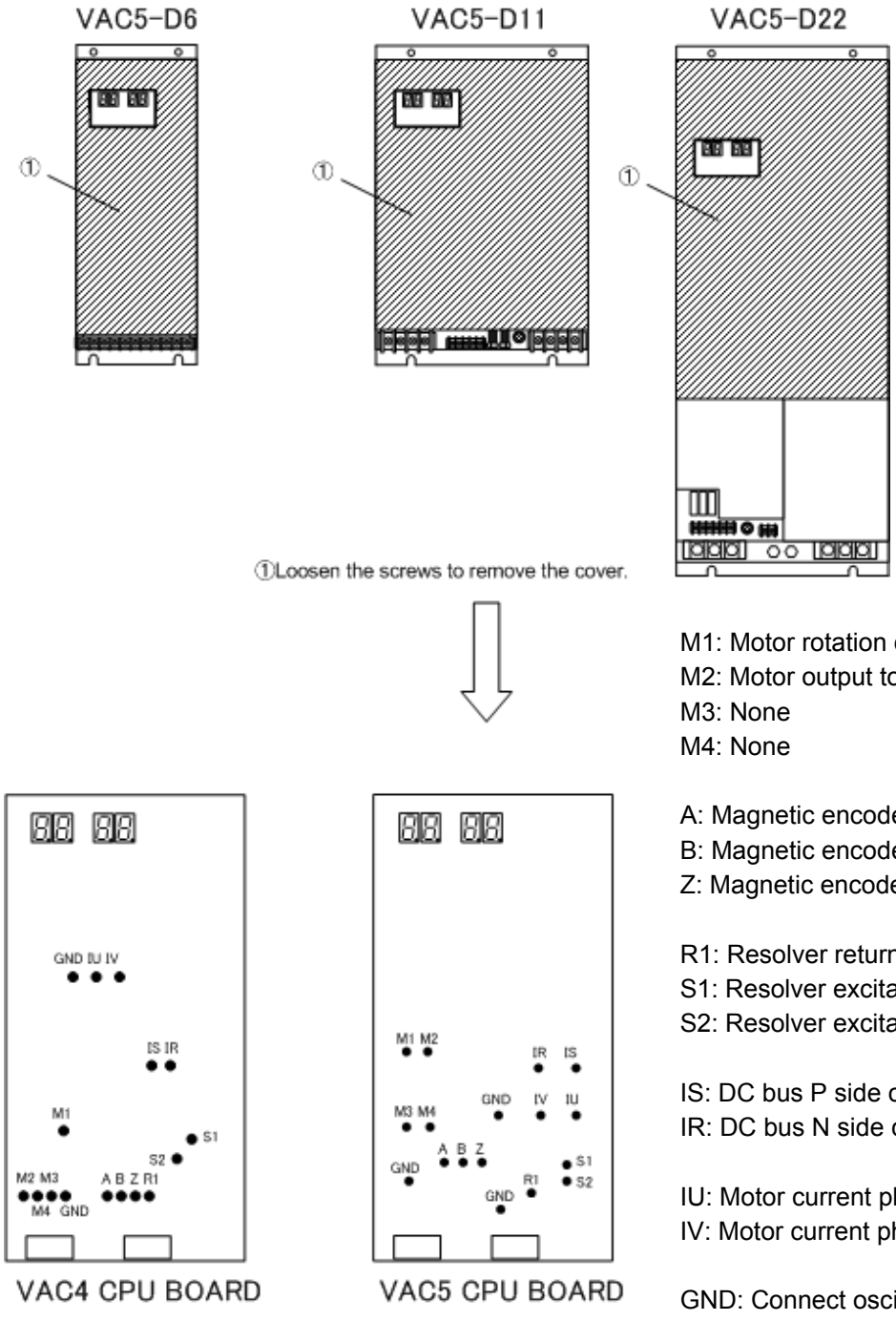
CAUTION **Precautions when observing waveforms from the VAC5 CPU BOARD monitor terminals.**

The VAC5 CPU BOARD (hereafter referred to as “BOARD”) is equipped with a VAC1-IF CARD (hereafter referred to as “CARD”), and therefore observation is not possible with the unit cover removed.

When monitoring waveforms from the monitor terminals, turn OFF the power, ensure that the DC CHARGE LED is out, remove the CARD, place the measurement probe against the BOARD monitor terminals, and then observe the waveforms after inserting the CARD again.

Fig A2-1 Monitor terminal arrangement (if using analog interface unit)

2. Monitor terminal layout (if using optical interface unit)



M1: Motor rotation count
M2: Motor output torque
M3: None
M4: None

A: Magnetic encoder A phase signal
B: Magnetic encoder B phase signal
Z: Magnetic encoder Z phase signal

R1: Resolver return signal
S1: Resolver excitation signal
S2: Resolver excitation signal

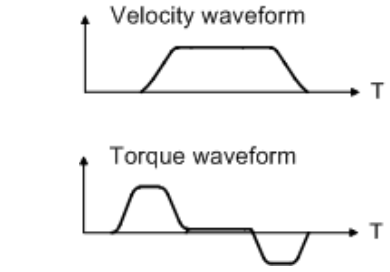
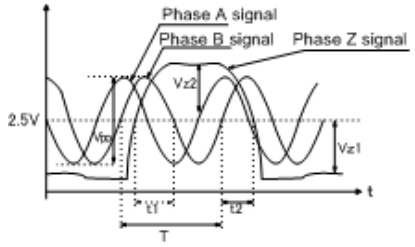
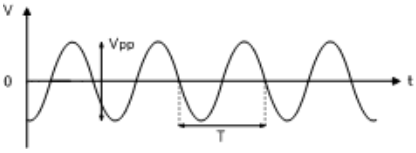
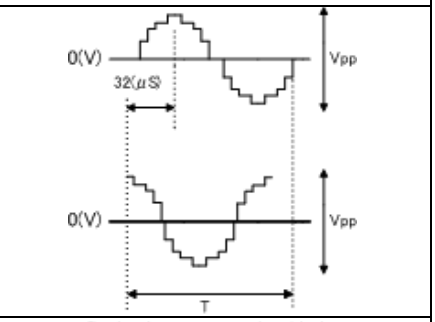
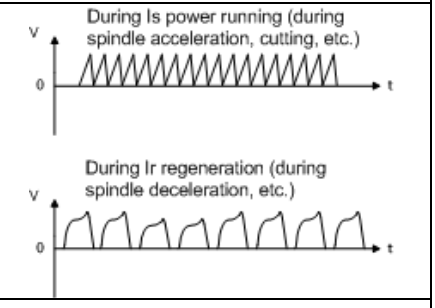
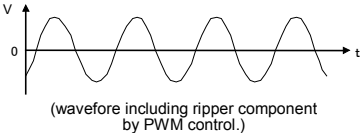
IS: DC bus P side current
IR: DC bus N side current

IU: Motor current phase U
IV: Motor current phase V

GND: Connect oscilloscope common

Fig A2-2 Monitor terminal arrangement (if using optical interface unit)

3. Description of monitor terminal signals

Monitor terminal	Description	Waveform (example)
M1	Motor output torque Output voltage range: -10 to +10 V Unit: Motor peak torque in 10 V	
M2	Motor rotation count Output voltage range: -10 to +10 V Unit: Top speed (set in PBU) in 10 V	
A	Magnetic encoder phase A signal Vpp in right figure: 2.6 to 4.6V (3.3 V when gap is properly adjusted)	
B	Magnetic encoder phase B signal Vpp in right figure: 2.6 to 4.6V (3.3 V when gap is properly adjusted)	
Z	Magnetic encoder phase Z signal Vz1 in right figure:1.4 V or over Vz2 in right figure: 0.5 V or over t1 and t2 in right figure: 0.1 to 0.4T (T varies according to the speed.)	
R1	Resolver signal Vpp in right figure: 6.0 V (typ) T in right figure::Approx. 0.128ms (7.81kHz) (T slightly varies according to the speed.)	
S1 S2	Resolver magnetization signal Vpp in right figure: Approx.17.6 V T in right figure: 128 μs	
IS IR	DC bus current Unit: A	
IU IV	Motor current Unit: A	

APPENDIX 3 SWITCH AND VOLUME SETTINGS

The switches are volume trimmers are located on the VAC5 drive unit control PCB. The switch and volume settings are shown in the following table.

Table A3-1 Switch and Volume Settings

Item	Setting Location	Setting Details	Remarks
Switch	**SW1**	Select the motor data. When using VAC1 system: → Specify the VAC BOARD SW1 (8 pole) setting as is. When using VAC2/VAC3 system: → All OFF	*1)
	SW2	Select the motor data. When using VAC1 system: → Specify the VAC BOARD SW2 1 to 4 settings as is. When using VAC2/VAC3 system: → All OFF	
	SW3	Set the current limit. When using VAC1/VAC2 system: → Specify the VAC BOARD SW3 1 to 4 settings as is. When using VAC3 system: → All OFF	
	SW4	Set all auxiliary functions. (Normal: All OFF)	
	SW5	All OFF	
	SW6	Set the firmware write mode. (Normal: All OFF)	
	SW7	Set the current limit. When using VAC1/VAC2 system: → Specify the VAC BOARD SW3 5 and 6 settings as is. When using VAC3 system: → All OFF	
	SW8	1 - 3: Set the motor current detection constant. 4 : OFF	
Volume	**VR1**	Set the torque limit level.	*2)
	VR2	Set the speed amp gain for fixed position stoppage.	*2)
	VR3	Set the speed amp gain for speed control.	*2)

*1) If the VAC BOARD SW1 setting is unknown, determine the setting from the “VAC Properties Table” in “VAC Drive Unit Related Materials” (Japanese only) found by accessing the following URL.
FA System Div. home page:
http://160.188.34.150/CNC/servo/default.htm

*2) Used if equipped with EX card when using the VAC1 system.

⚠CAUTION Specify the switch and volume settings correctly.

APPENDIX 3 SWITCH AND VOLUME SETTINGS

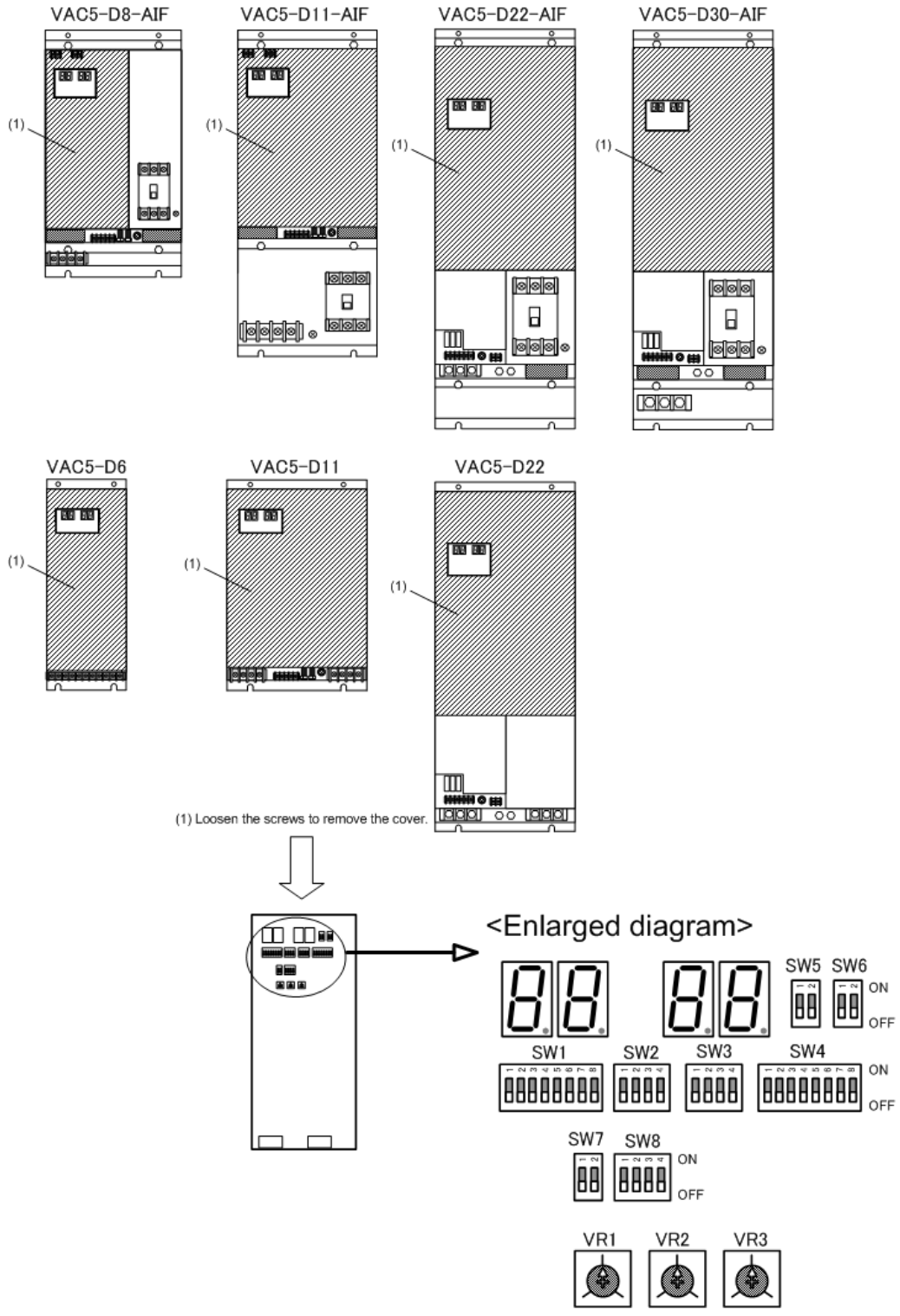
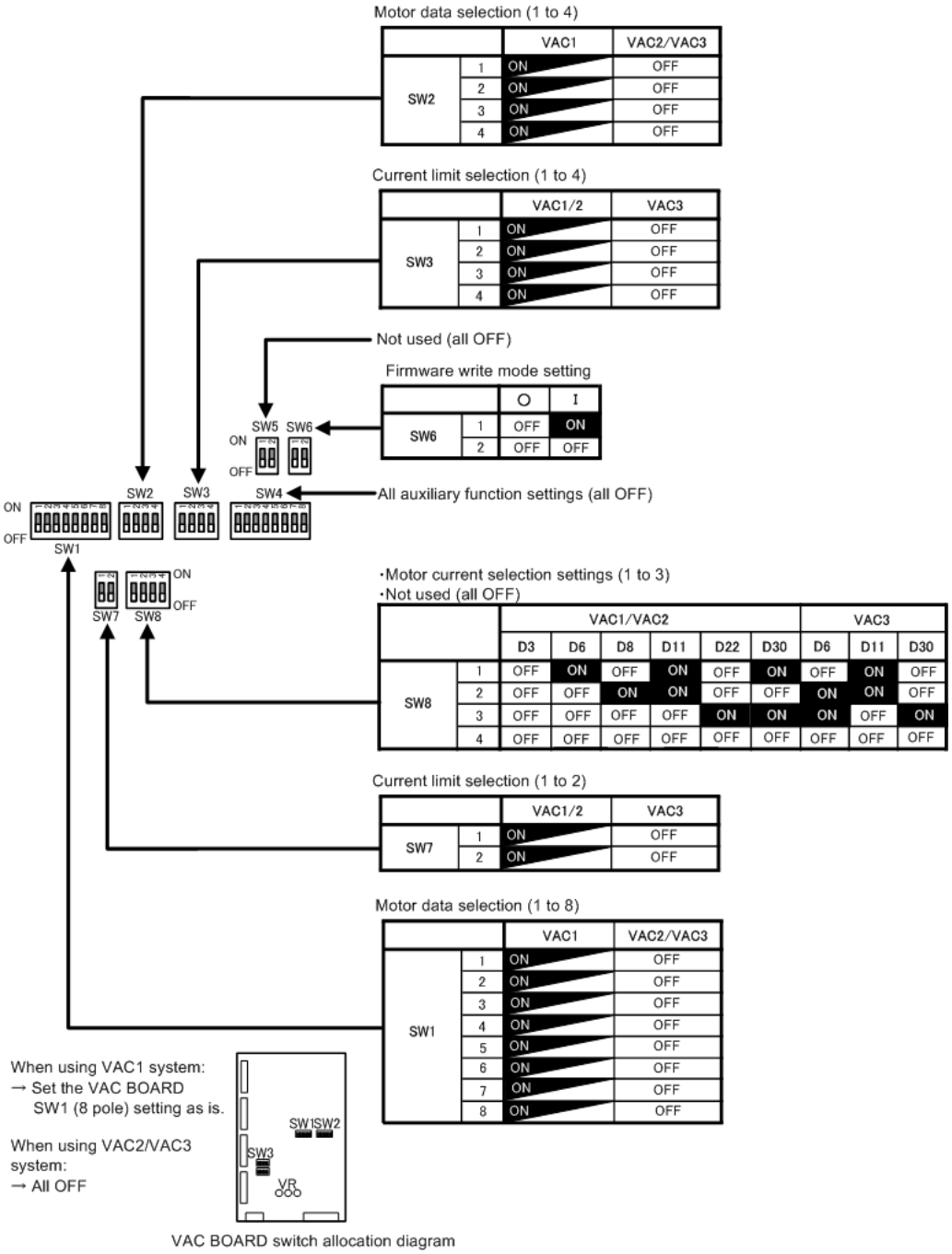


Fig. A3-1 Switch and volume setting locations

APPENDIX 3 SWITCH AND VOLUME SETTINGS



VAC BOARD switch allocation diagram

Fig. A3-2 Switch allocation and settings

APPENDIX 4 SWITCH AND VOLUME SETTINGS WHEN EQUIPPED WITH EX CARD

⚠ CAUTION Support for the VAC5 drive unit EX card is currently under development.
The relevant content in this manual will be disclosed once support for the EX card is complete.

APPENDIX 5 APPEARANCE AND WEIGHT OF UNIT

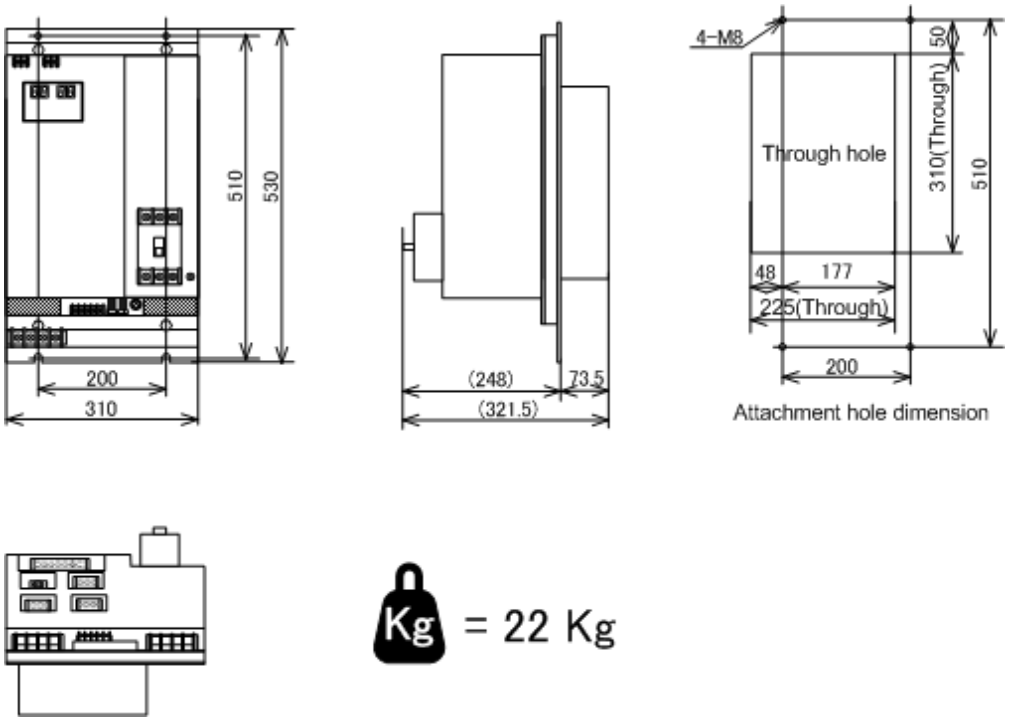


Fig A5-1 VAC5-D8-AIF unit external drawing

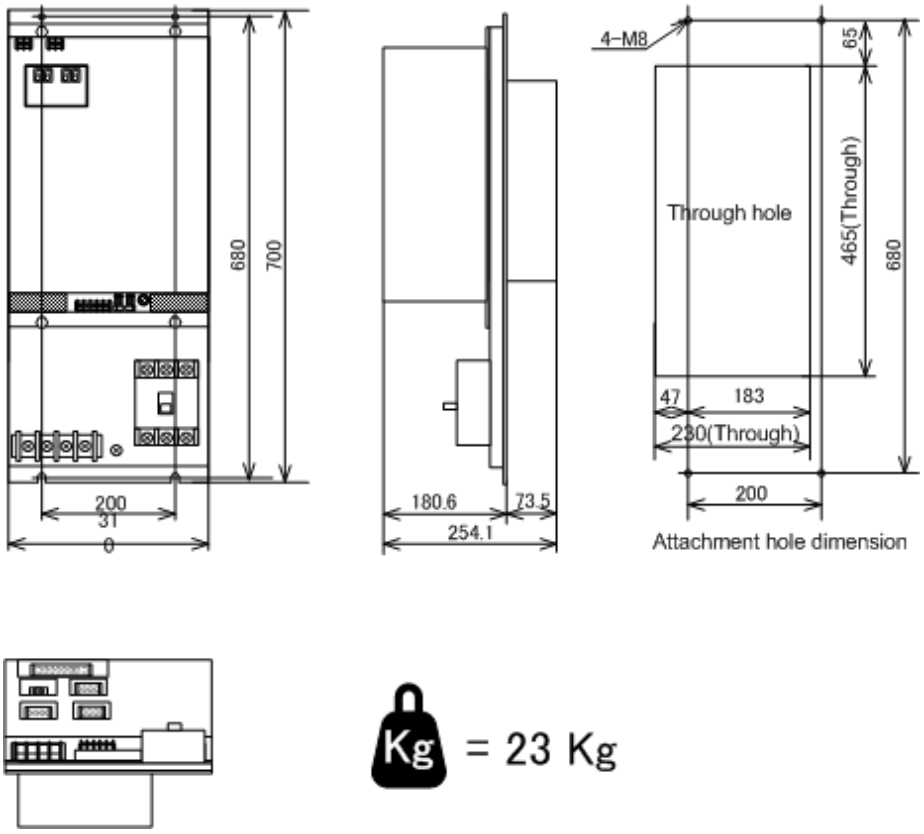


Fig A5-2 VAC5-D11-AIF unit external drawing

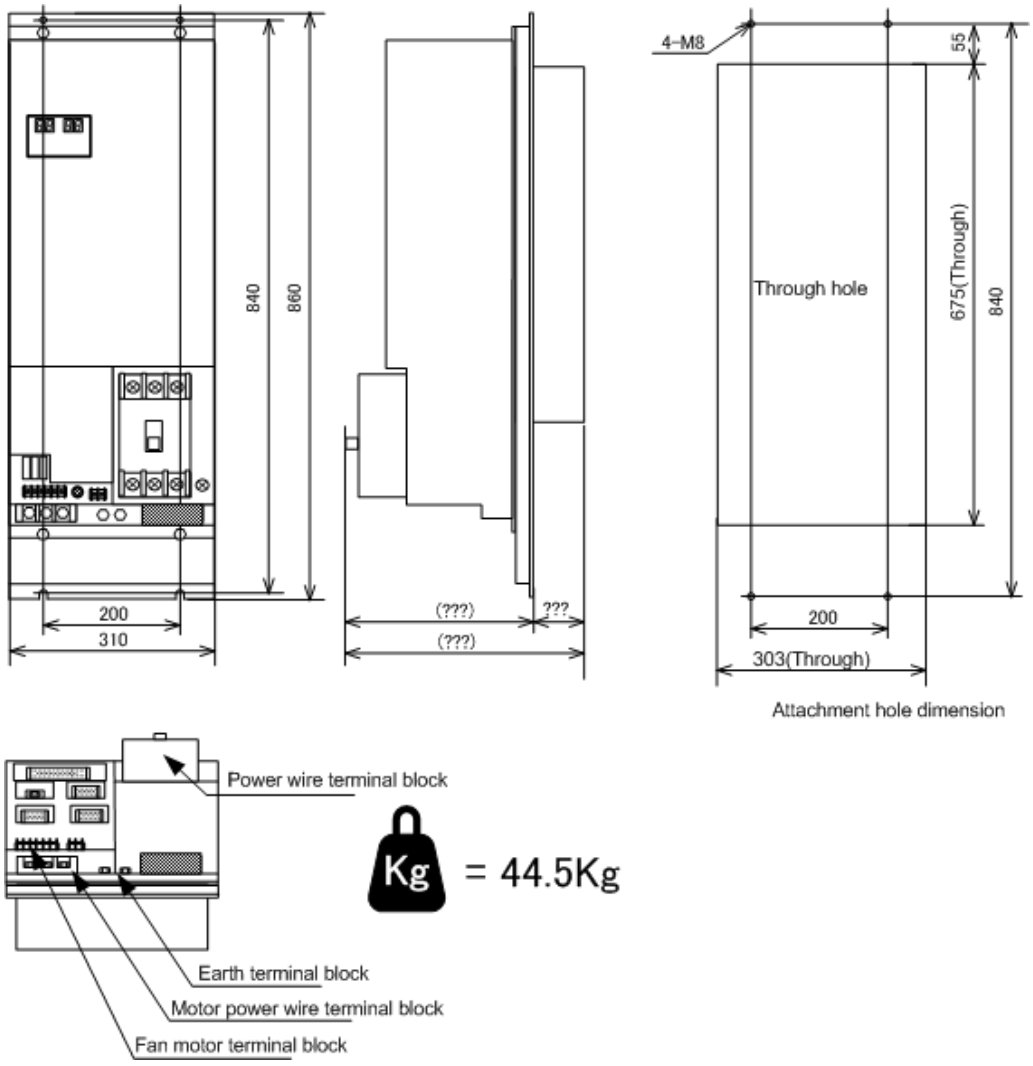


Fig A5-3 VAC5-D22-AIF unit external drawing

APPENDIX 5 APPEARANCE AND WEIGHT OF UNIT

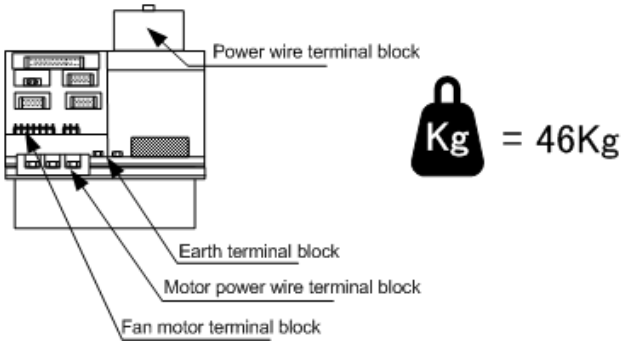


Fig A5-4 VAC5-D30-AIF unit external drawing

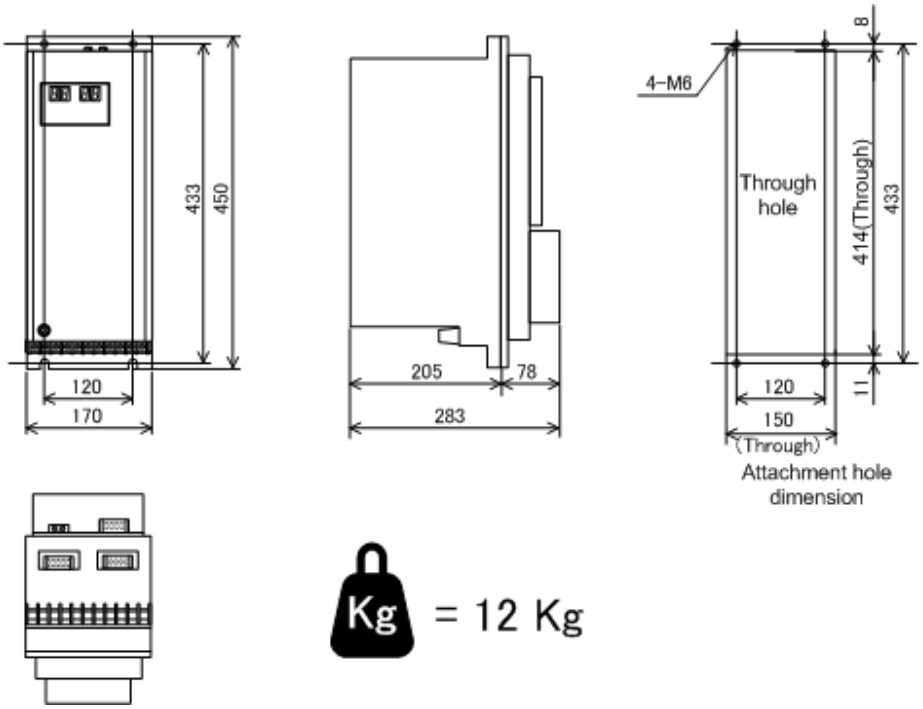


Fig A5-5 VAC5-D6 unit external drawing

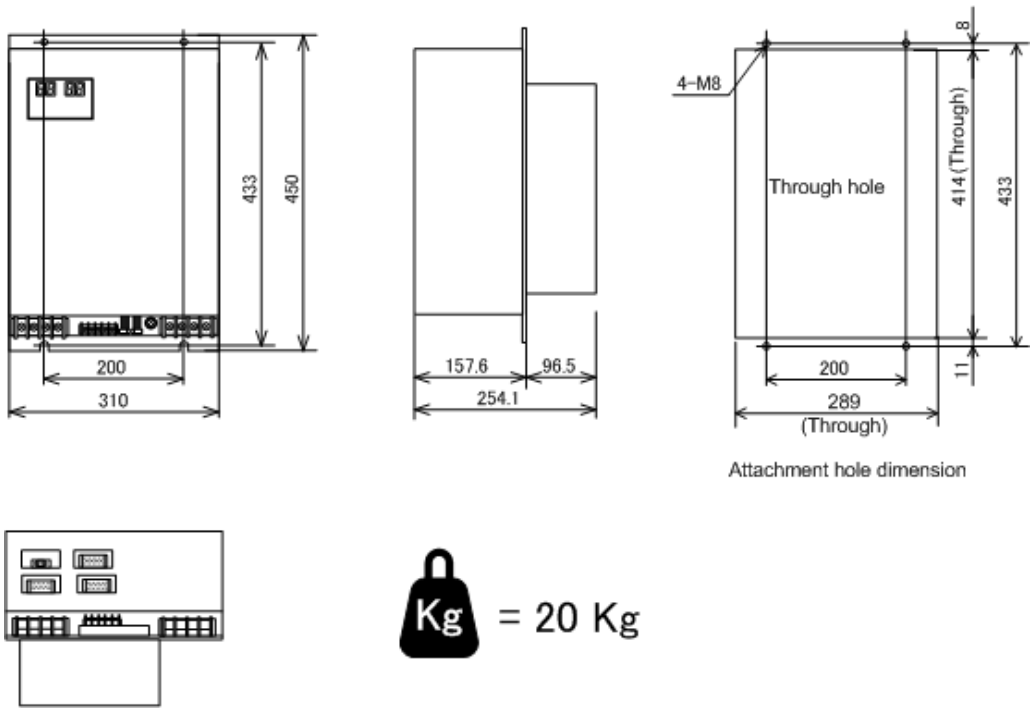
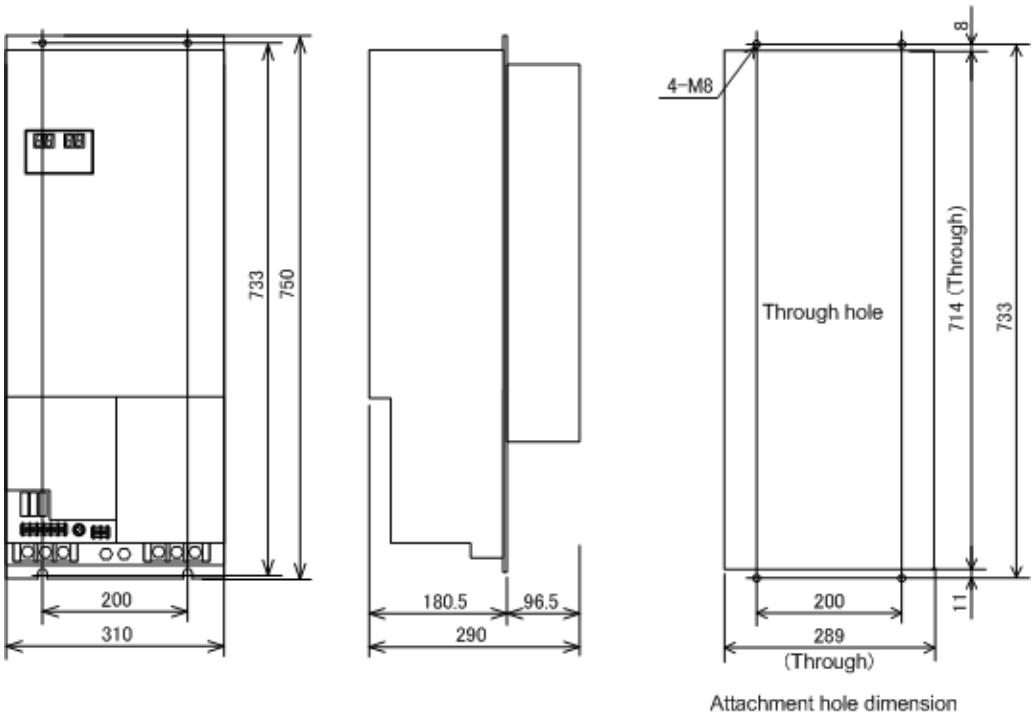


Fig A5-6 VAC5-D11 unit external drawing



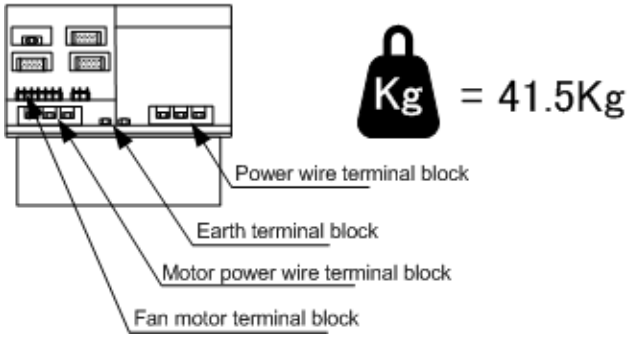


Fig A5-7 VAC5-D22 unit external drawing

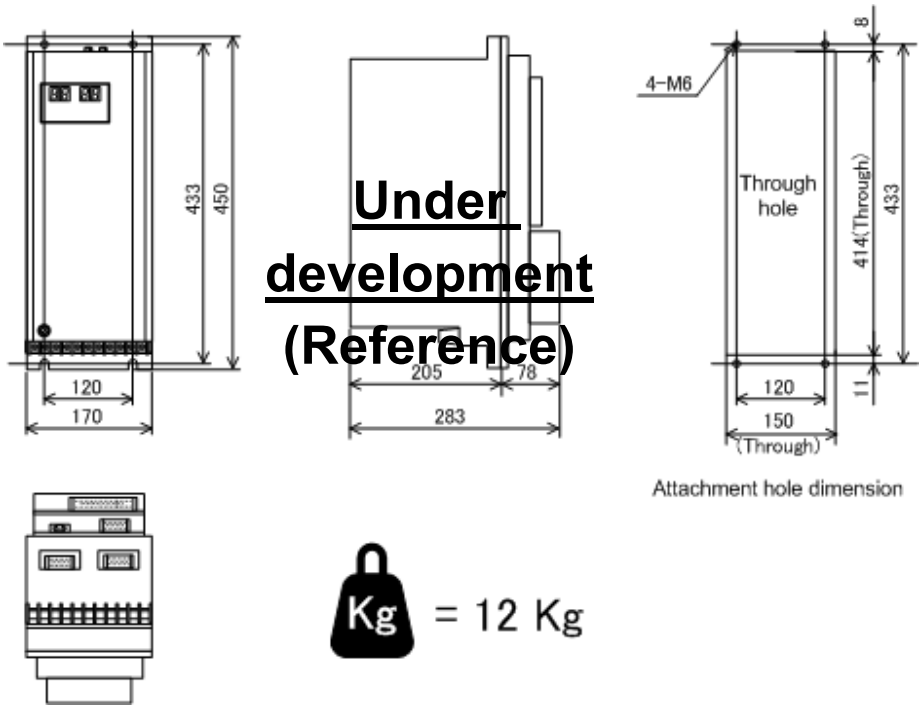


Fig A5-8 VAC5-D6 unit (with EX card C1) external drawing

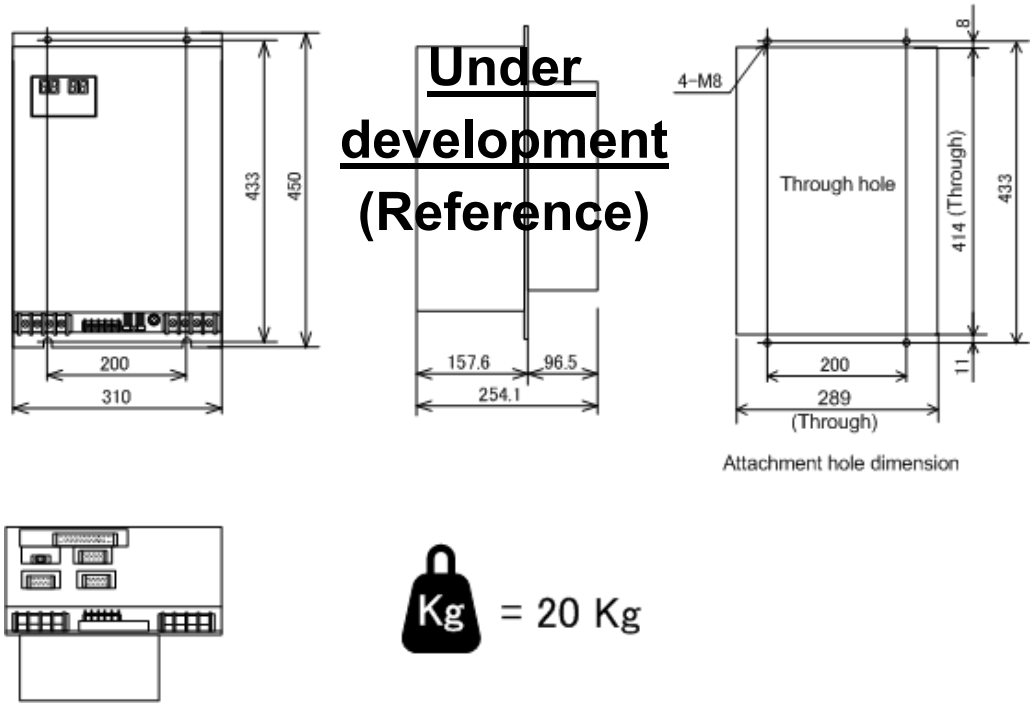


Fig A5-9 VAC5-D11 unit (with EX card C1) external drawing

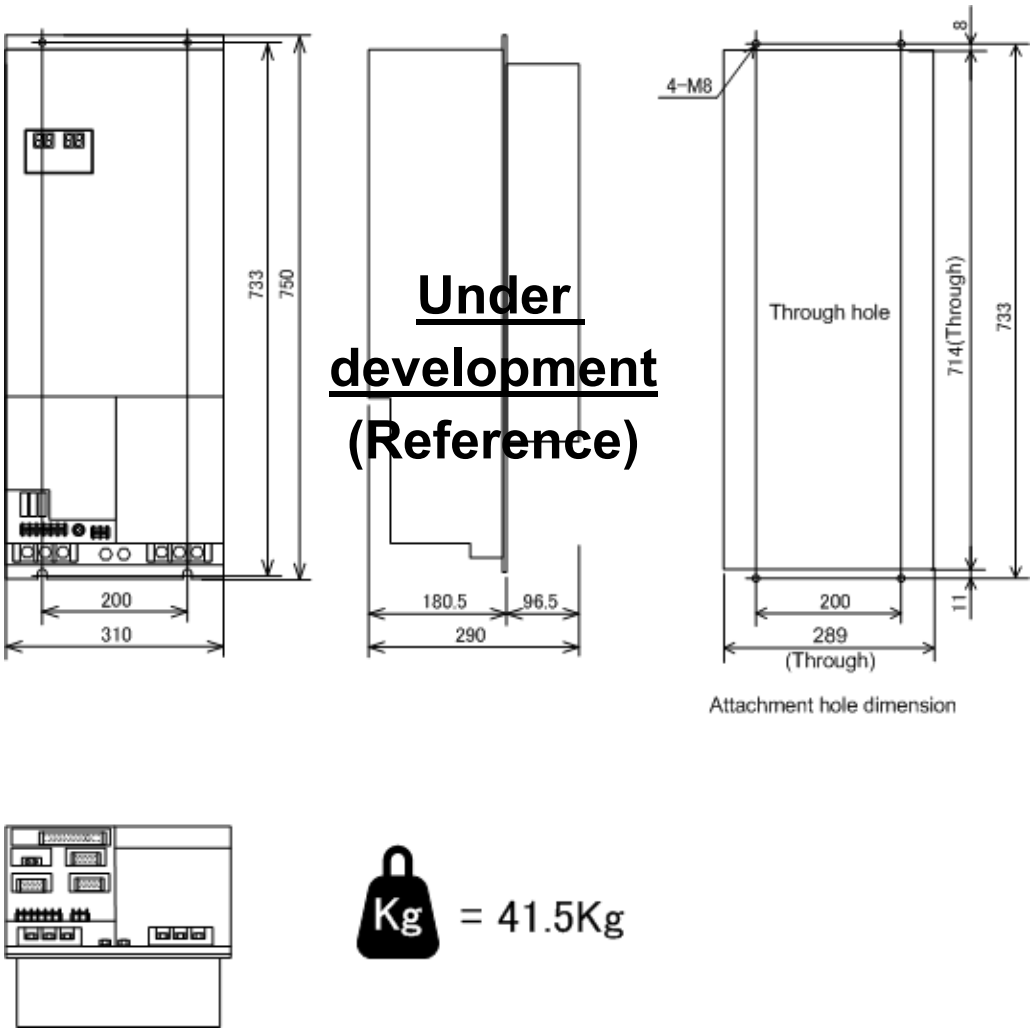


Fig A5-10 VAC5-D30 unit (with EX card C1) external drawing

APPENDIX 6 IDENTIFICATION OF FIRMWARE VERSION

This appendix describes how to identify the version of the firmware installed in the VAC5drive unit.
First, remove the front cover and find the stickers attached to the control PC board shown below. The version of the firmware is printed on these stickers.
Please note that the firmware version will be updated following improvements or the addition of functions. Refer to the "VAC Drive Unit Related Materials" (Japanese only) found by accessing the following URL to see the firmware update history.

FA System Div. home page:
http://160.188.34.150/CNC/servo/default.htm

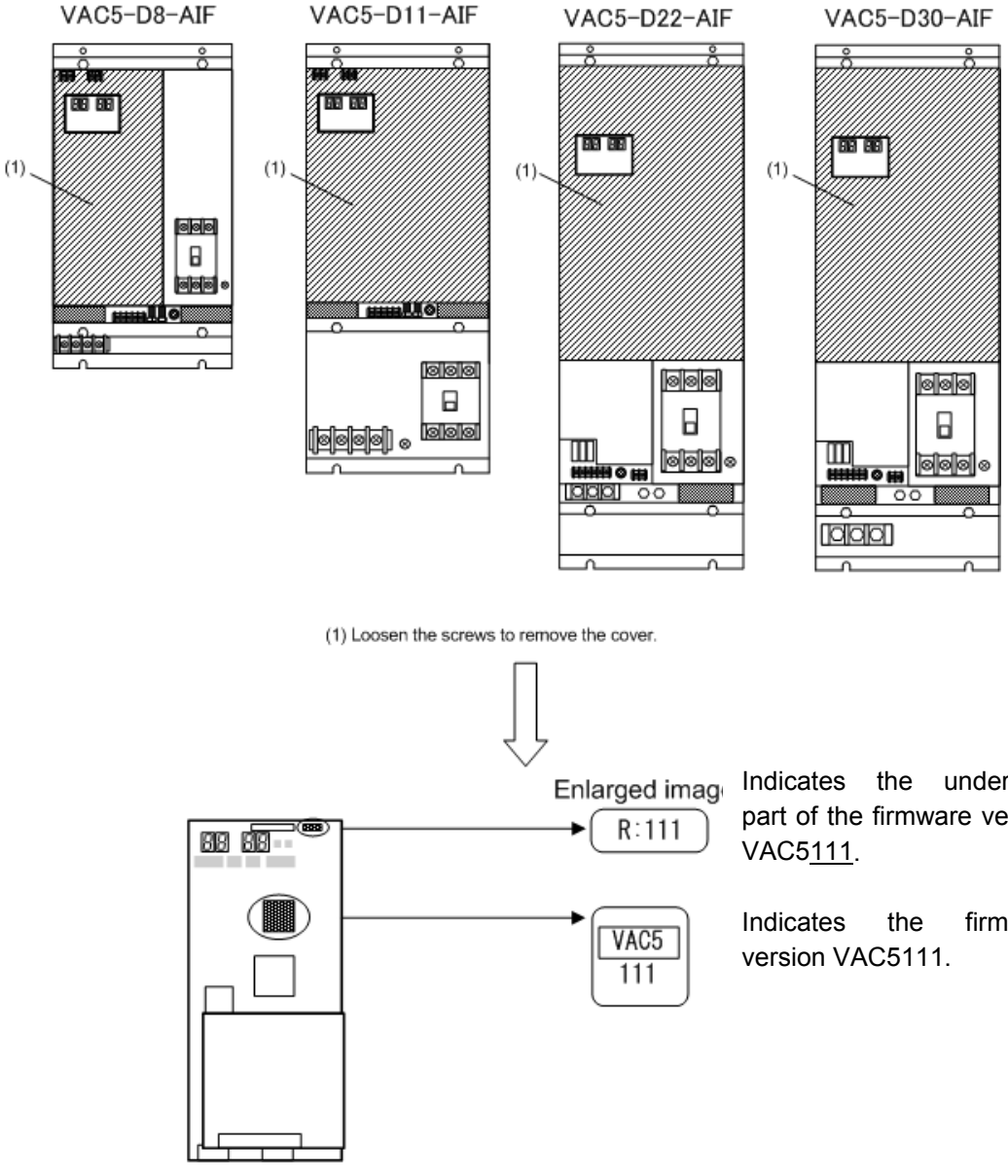
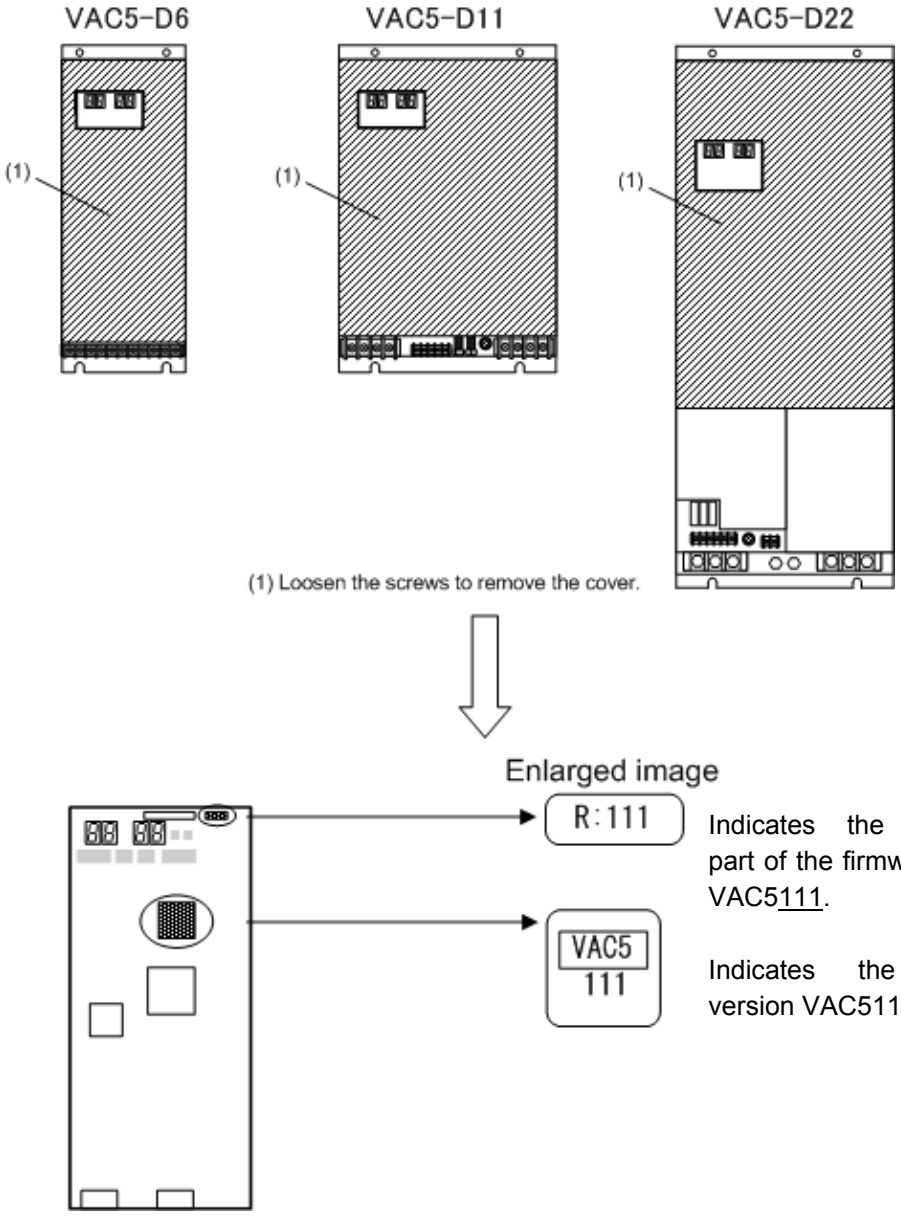


Fig A6-1 Firmware version indicator locations (if using analog interface unit)

APPENDIX 6 APPEARANCE AND WEIGHT OF UNIT



Indicates the underlined part of the firmware version VAC5111.

Indicates the firmware version VAC5111.

Fig A6-2 Firmware version indicator locations (if using optical interface unit)

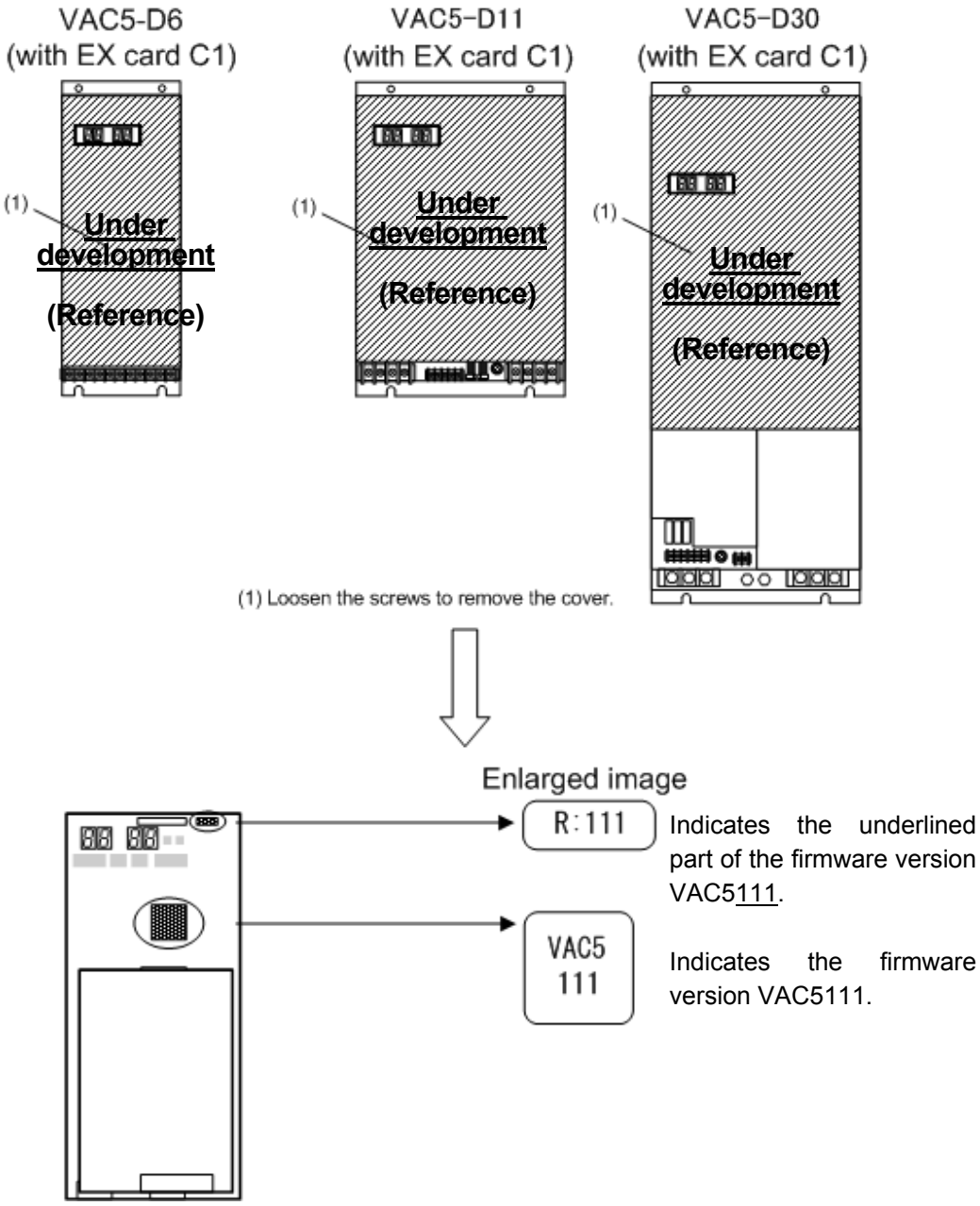


Fig A6-3 Firmware version indicator locations (if using unit with EX card C1)

APPENDIX 7 COMPATIBILITY TABLE

The following table shows spindle drive unit (VAC1, VAC2, VAC3, VAC4, VAC5) compatibility.
Please note that replacement is only possible by replacing the entire unit (set replacement).

1. When using VAC1 system

Table A7-1 Drive Unit Compatibility Table (when using VAC1 system)

				Spoiled unit																			Remark
				1 VAC1-D3	2 VAC1-D6	3 VAC1-D8	4 VAC1-D6A	5 VAC1-D8A	6 VAC1-D3B	7 VAC1-D6B	8 VAC1-D8B	9 VAC5-D8-AIF	10 VAC1-D11	11 VAC1-D11A	12 VAC1-D11B	13 VAC5-D11-AIF	14 VAC1-D22A	15 VAC1-D22B	16 VAC5-D22-AIF	17 VAC1-D30A	18 VAC1-D30B	19 VAC5-D30-AIF	
Replacement	1	A006-1200, 1100	VAC1-D3	△					△			△1											
	2	A006-1210, 1100	VAC1-D6		△		△			△		△1											
	3	A006-1215, 1100	VAC1-D8			△		△			△	△1											
	4	U1211-0006-001-10	VAC1-D6A		○		△			△		△1											
	5	U1216-0006-001-10	VAC1-D8A			○		△			△	△1											
	6	U1601-0006-001-10	VAC1-D3B	○					○			△1											
	7	U1611-0006-001-10	VAC1-D6B		○		○			○		△1											
	8	U1616-0006-001-10	VAC1-D8B			○		○			○	△1											
	9	U1216-0006-003-10	VAC5-D8-AIF	○	○	○	○	○	○	○	○	○											
	10	A006-1220, 1100	VAC1-D11										△	△	△	△							
	11	U1221-0006-001-10	VAC1-D11A										○	△	△	△							
	12	U1621-0006-001-10	VAC1-D11B										○	○	○	△							
	13	U1221-0006-003-10	VAC5-D11-AIF										○	○	○	○							
	14	U1231-0006-001-10	VAC1-D22A														△	△	△				
	15	U1631-0006-001-10	VAC1-D22B														○	○	△				
	16	U1231-0006-003-10	VAC5-D22-AIF														○	○	○				
	17	U1236-0006-001-10	VAC1-D30A																	△	△	△	
	18	U1636-0006-001-10	VAC1-D30B																	○	○	△	
	19	U1236-0006-003-10	VAC5-D30-AIF																	○	○	○	

○ : Compatible
▲ : Compatible, but not substituted for one another in actual operations.
▲1 : Compatible, but not substituted for one another in actual operations.
When determining the model of substitute units, check the control panel through hole dimensions (see APPENDIX 4).

2. When using VAC2 system

Table A7-2 Drive Unit Compatibility Table (when using VAC2 system)

				Spoiled unit														Remark
				1 VAC2-D6A	2 VAC2-D8A	3 VAC2-D6B	4 VAC2-D8B	5 VAC5-D8-AIF	6 VAC2-D11A	7 VAC2-D11B	8 VAC5-D11-AIF	9 VAC2-D22A	10 VAC2-D22B	11 VAC5-D22-AIF	12 VAC2-D30A	13 VAC2-D30B	14 VAC5-D30-AIF	
Replacement	1	A006-1106-01-010	VAC2-D6A	△		△		△1										
	2	U1216-0006-002-10	VAC2-D8A		△		△	△1										
	3	U1611-0006-002-10	VAC2-D6B	○		○		△1										
	4	U1616-0006-002-10	VAC2-D8B		○		○	△1										
	5	U1216-0006-003-10	VAC5-D8-AIF	○	○	○	○	○										
	6	U1221-0006-002-10	VAC2-D11A						△	△	△							
	7	U1621-0006-002-10	VAC2-D11B						○	○	△							
	8	U1221-0006-003-10	VAC5-D11-AIF						○	○	○							
	9	U1231-0006-002-10	VAC2-D22A									△	△	△				
	10	U1631-0006-002-10	VAC2-D22B									○	○	△				
	11	U1231-0006-003-10	VAC5-D22-AIF									○	○	○				
	12	U1236-0006-002-10	VAC2-D30A												△	△	△	
	13	U1636-0006-002-10	VAC2-D30B												○	○	△	
	14	U1236-0006-003-10	VAC5-D30-AIF												○	○	○	

○ : Compatible
▲ : Compatible, but not substituted for one another in actual operations.
▲1 : Compatible, but not substituted for one another in actual operations.
When determining the model of substitute units, check the control panel through hole dimensions (see APPENDIX 4).

3. When using VAC3 system

Table A7-3 Drive Unit Compatibility Table (when using VAC3 system)

				Spoiled unit									Remark
				VAC3-D6	VAC4-D6	VAC5-D6	VAC3-D11	VAC4-D11	VAC5-D11	VAC3-D22	VAC4-D22	VAC5-D22	
				1	2	3	4	5	6	7	8	9	
Replacement	1	U1212-0006-001-10	VAC3-D6	△	△	△							
	2	U1212-0006-001-11	VAC4-D6	△	△	△							
	3	U1212-0006-001-12	VAC5-D6	○	○	○							
	4	U1222-0006-001-10	VAC3-D11				△	△	△				
	5	U1222-0006-001-11	VAC4-D11				△	△	△				
	6	U1222-0006-001-12	VAC5-D11				○	○	○				
	7	U1232-0006-001-10	VAC3-D22							△	△	△	
	8	U1233-0006-001-11	VAC4-D22							△	△	△	
	9	U1233-0006-001-12	VAC5-D 22							○	○	○	

○ : Compatible
▲ : Compatible, but not substituted for one another in actual operations.
▲1 : Compatible, but not substituted for one another in actual operations.
When determining the model of substitute units, check the control panel through hole dimensions (see APPENDIX 4).