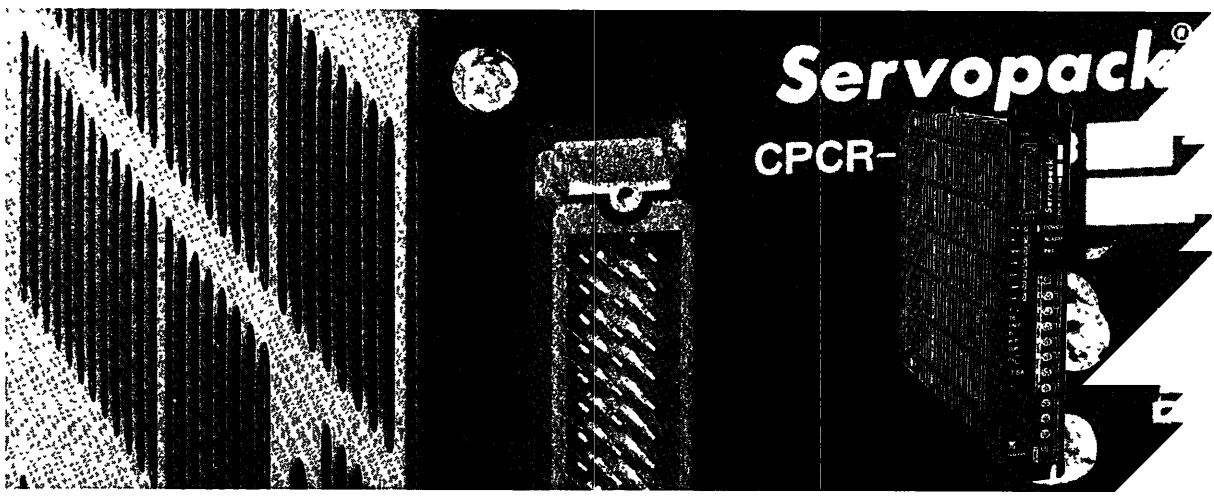
SERVOPACK

DC SERVOMOTOR CONTROLLERS FOR SPEED CONTROL

TRANSISTORIZED PWM CONTROL/REVERSING
TYPE CPCR-FR□□RB

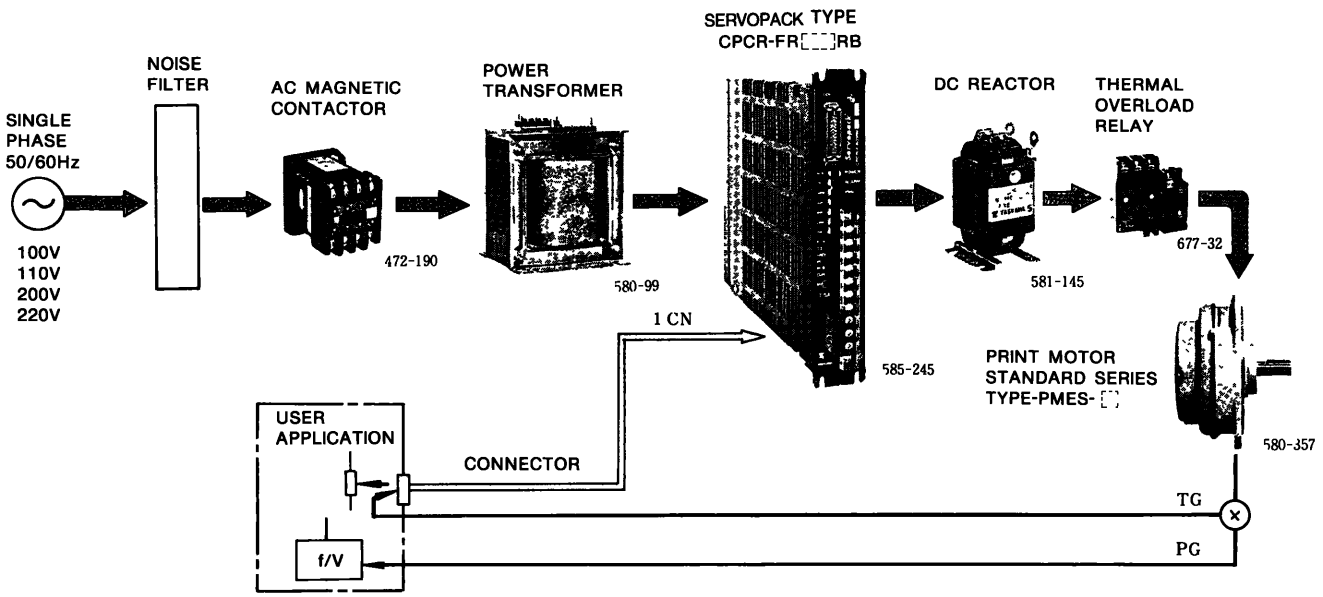


YASKAWA

This manual, in Sections 1 thru 10, provides the designer with the detailed information needed to design control systems utilizing the DC servomotor controller SERVOPACK type CPCR-FR[ ]RB.

Sections 11 to 14 describe the adjustment methods and maintenance of the SERVOPACK.

Details for servomotors, tachometer generators and f/V converters are described in other applicable publications.



Servodrive System using SERVOPACK Type CPCR-FR[ ]RB

CONTENTS

INTRODUCTION

SERVOPACK type CPCR-FR□□RB is a reversible speed controller for DC servomotors for Print Motor Standard Series, Minertia Motor RM Series, Mini Series and Super Series. The speed of these servomotors, forward or reverse, is precisely controlled through a wide range.

The SERVOPACK type CPCR-FR□□RB, thus, is useful for industrial machines in the fields where the following requirements are especially high:

- Wide range of variable speed control (1000:1)
- Frequent start and stop operations (1000 operations/min)
- Frequent reversing operations (1000 operations /min)
- High-speed precise positioning (10 μm or less)
- High-level servo characteristics

Some outstanding features of the SERVOPACK type CPCR-FR□□RB are as follows:

- Compact in size. For example, SERVOPACK type FR01RB, is 55% smaller than present products, due to drastically reduced dimensions.
- Most suitable for multi-axis applications.
- Because each SERVOPACK contains a main circuit power supply, each motor can be driven by suitable voltage for the application by changing the secondary voltage of the power transformer. If trouble in one of main circuit power supply should occur, maintenance is greatly simplified.
- Provides each of the input circuits for base-off reference input, overtravel prevention input, and proportional drive reference input. This allows a wide range of applications.
- SERVOPACK type CPCR-FR□□RB7 can use a speed feedback using an optical encoder and f/V converter.

SERVOPACK type CPCR-PF contains a positioning circuit, overrun detection circuit, and power supply for optical encoder. If the instructions on SERVOPACK type CPCR-PF are required, contact your Yaskawa representative.

Legend of Symbols

1CN-2: Connector 1CN No.2 in SERVOPACK
TG: Tachometer generator
PG: Optical encoder
VR: Potentiometer
LED: Light-emitting diode
GD^2: Inertia
 : Twisted cable

1. RATINGS AND SPECIFICATIONS

1.1 SERVOPACK RATINGS AND SPECIFICATIONS

Table 1.1 SERVOPACK Ratings and Specifications

SERVOPACK Type CPCR-		FR01RB-[ ]	FR02RB-[ ]	FR05RB-[ ]
Max Servomotor Capacity		120W	200W	500W
Control Method		Transistorized PWM control (Power transformer installed separately)		
Power Supply (Primary Side of Power Transformer)[1]	Voltage	Single-phase, 100/200VAC at 50Hz, 110/220VAC at 60Hz, ±10%		
	Capacity	150 to 300VA	500VA	1kVA
Instantaneous Max Output Current[2]		12A ±10%	20A ±10%	20A ±10%
Continuous Output Current/Voltage[2]		5.6A/30V	6.4A/42V	7.5A/81V
Waveform Factor		1.05 max		
Derating Factor[3]		95% min		
Speed Range[4]		1.1000		
Speed Regulation	Load Regulation 0 to 100%	±0.1% max at rated speed, ±0.05% max at 1/1000 rated speed (Supply voltage, speed reference and ambient temperature· constant)		
	Voltage Regulation ±10%	±0.1% max at rated speed, ±0.05% max at 1/1000 rated speed (Speed reference, load and ambient,temperature: constant)		
	Temperature Regulation 20 ±20°C	±0.5% max at rated speed, ±0.1% max at 1/1000 rated speed (Supply voltage, speed reference and load: constant)		
Rated Input Reference Voltage		±6V (Input impedance approx 10.5kΩ)		
Rated Auxiliary Reference Voltage[5]		±2 to ±10V		
Speed Detection	For TG	7VDC/1000rpm (3VDC/1000rpm for types FR02RB3-S03 and -S12)		
	For f/V	6V at rated speed (Negative feedback voltage at plus speed reference)		
Built-in Reference Power Supply[6]		±8V ±0.5V at 0mA (Allowable output current: ±10mA)		
Operation Temperature[7]		0 to +55°C[8]		
Storage Temperature		−20 to +70°C		
Humidity		85% max (non-condensing)		
Applicable Load GD²		Up to 3 times motor GD² (within motor rated speed at max output current)		
Protective Functions		Forward and reverse overtravel base-off, external base-off, overload, overcurrent, heat-sink overheat, blown fuse		
Mounting Method[9]		Rack-mounted or base-mounted type		
Cooling Method		Natural air-cooled [10]	Externally fan-cooled [11]	
Vibration Resistance		0.5G max (for 30 minutes, with no current conduction)		

1 Information on the transformer used in 115/230V will be provided upon request.

2 Limited by motor being used.

3 When servomotor is controlled by SERVOPACK, motor ratings must be reduced due to the effect of the waveform factor of the motor armature current. This reduction ratio is called the derating factor.

4 Shows when a standard series print motor and TG feedback are used. However, TG fluctuation is not included. Speed range may not be applied, depending on the motor being used, load inertia, and speed feedback (especially, when f/V converter is used).

5 This input is used under rated reference voltage other than 6V. It can be adjusted using a potentiometer on the front of the SERVOPACK panel

6 390Ω resistor is connected to ±8V output terminals in SERVOPACK to prevent a short circuit Therefore, if 10mA of current is output, output voltage becomes approximately 4.1V. If a short-circuit protection resistor is not connected to ±8V output terminals, SERVOPACK may be damaged

7 When housed in a panel, the inside temperature must not exceed ambient temperature range.

8 For type CPCR-FR01RB, 100% power (5.6A) can be output continuously at 50°C. When it is used at 55°C, current should be reduced to 4.5A (80%).

9 They are delivered as rack-mounted type.

10 If 3 or more machines are driven by SERVOPACK types CPCR-FR01RB or -FR02RB, forced air cooling is needed.

11 Forced air cooling must be provided by the user. (2ms or more).

NOTE

1. SERVOPACK types depend on servomotors being used as shown in Tables 2.1 and 2.2.
2. Voltages, including variations due to power voltage fluctuation, voltage deviation and regulation of power transformer, should not exceed the values shown in Table 1.2.

Table 1.2 Absolute Max Rated Power Supply Input

SERVOPACK Type CPCR-	Terminals across u and v	Terminals across u6/v6 and 0
FR01RB-[ ]	55VAC	21VAC
FR02RB-[ ]	60VAC	21VAC
FR05RB-[ ]	95VAC	21VAC

3. Speed regulation is generally defined as follows:

$$Speed\ regulation = \frac{No\ load\ speed - Full\ load\ speed}{Rated\ speed} \times 100\%$$

Actually, the calculated resistance value is varied by amplifier drift due to voltage and temperature fluctuations, and such an effect appears as a speed change. The percentage ratio of this speed change to the rated speed is the respective speed regulation due to voltage and temperature fluctuations.

4. SERVOPACK adjustment often differs for TG and f/V SERVOPACK types are shown in Tables 2.1 and 2.2.
5. If PG is used as a speed detector instead of TG, an f/V converter must be installed between PG and SERVOPACK. (The f/V converter type JASP-FV010 is available)

1.2 SERVOMOTOR RATINGS FOR SERVOPACK

Table 1 3 Servomotor Ratings for SERVOPACK

SERVOPACK Type CPCR-	DC Servomotor					
	Type*	Effective Output† W	Rated Speed rpm	Effective Torque† kg cm	Effective Current† A	Allowable GD²‡ kg cm²
FR01RB	PMES-09A2	95	4000	2.3	5.5	5.5
FR01RB-T3S	UGTMEM-03SB	46.8	2000	2.28	3.6	2.82
FR01RB-T3M	UGTMEM-03MB	54.2	1500	3.52	5.6	4
FR01RB-T3L	UGTMEM-03LB	46 8	1000	4.56	4.4	4.46
FR01RB-T6S	UGTMEM-06SB	50.7	1300	3.8	4.8	11.4
FR01RB-T6M	UGTMEM-06MB	58.5	1000	5.7	5.4	12 6
FR01RB-T6L	UGTMEM-06LB	61 5	700	8.55	5 6	21.2
FR01RB-R1S	UGRMEM-01SA	28 5	3000	0 92	2 1	0 55
FR01RB-R2S	UGRMEM-02SA	57	3000	1 85	3 9	1.88
FR01RB-R2M	UGRMEM-02MA	95	3000	3.08	4 5	3.35
FR01RB-R4S	UGRMEM-04SA	114	3000	3 7	5.3	11 5
FR02RB	PMES-12A2	190	3000	6 15	6.4	18
FR02RB-P09	PMES-09A2	95	4000	2.3	5.5	5.5
FR02RB3-S03	UGSMEM-03A	114	4000	2.76	6 7	0.4
FR02RB3-S12	UGSMEM-12B	108	3000	3.52	6 2	0.55
FR02RB-R4M	UGRMEM-04MA	190	3000	6.17	6 2	20.1
FR02RB-M06	UGMMEM-06AA1	165	3000	5 70	6.2	11 4
FR05RB	PMES-16A2	475	2500	18 5	7.3	74 4
FR05RB-R8S	UGRMEM-08SA	285	3000	9 25	7.5	61.2
FR05RB-R8M	UGRMEM-08MB	475	3000	15.3	7.3	66 4
FR05RB-M13	UGMMEM-13AA1	380	3000	12.3	7.4	17

*Servomotor types UGTMEM are for standard types (2 brushes provided except for type UGTMEM-06LB). In case of servomotors provided with 4 brushes (e.g. with optical encoder), values of effective output, effective torque and effective current are 90% of the values in Table 1.3.

†Values are given under the following conditions

- Armature Winding Temperature
  Type PMES: 100°C
  Type UGRMEM 100°C (125°C for type UGRMEN-08M)
  Type UGMMEM· 150°C
  Type UGSMEM 125°C
- Heat Sink
  Type UGTMEM 6×250×250mm, aluminum
  Types UGRMEM-02, -04 6×250×250mm, aluminum
  Type UGRMEM-08 12×300×300mm, aluminum
  Type UGSMEM 6×250×250mm, aluminum
- Ambient Temperature· 40°C or below

‡The values at rated motor speed or below. Load GD² is limited because type CPCR-FR[ ]RB has a limitation for its regenerative processing ability. (When motor speed is constant, regenerative energy of the motor is proportional to GD²)

Note: Cup Motor type UGCMED, Hi-Cup Motor type UGHMED, and Minertia Motor J Series type UGJMED should be used with SERVOPACK type CPCR-MR[ ]

1.3 SERVOMOTOR CHARACTERISTICS FOR SERVOPACK

1.3.1 Instantaneous Maximum Current

Instantaneous maximum current at motor starting is limited by the absolute rating of the SERVOPACK being used, absolute rating of the servomotor, and rectifying characteristics of the servomotor.

Servomotor types UGTMEM and UGRMEM should be used within the current value listed in Table 1.4 due to limitations in the range of acceleration/deceleration of motor speed – torque characteristics. If the current value exceeds that in Table 1.4, it will cause excessive brush wear, motor demagnetization, etc.

Table 1 4 Instantaneous Max Current when Shipping

SERVOPACK Type CPCR-	DC Servomotor Type	Instantaneous Max Current when Shipping 1m ±10%	Limitation
FR01RB	PMES-09A2	12ADC	S*
FR01RB-T3S	UGTMEM-03SB	6	M†
FR01RB-T3M	UGTMEM-03MB	10	M
FR01RB-T3L	UGTMEM-03LB	8	M
FR01RB-T6S	UGTMEM-06SB	10	M
FR01RB-T6M	UGTMEM-06MB	12	M, S
FR01RB-T6L	UGTMEM-06LB	12	M, S
FR01RB-R1S	UGRMEM-01SA	4	M
FR01RB-R2S	UGRMEM-02SA	10	M
FR01RB-R2M	UGRMEM-02MA	10	M
FR01RB-R4S	UGRMEM-04SA	12	M, S
FR02RB	PMES-12A2	20	S
FR02RB-P09	PMES-09A2	15	—
FR02RB3-S03	UGSMEM-03A	20	S
FR02RB3-S12	UGSMEM-12B	20	S
FR02RB-R4M	UGRMEM-04MA	15	M
FR02RB-M06	UGMMEM-06AA1	20	S
FR05RB	PMES-16A2	20	S
FR05RB-R8S	UGRMEM-08SA	20	M, S
FR05RB-R8M	UGRMEM-08MB	20	M, S
FR05RB-M13	UGMMEM-13AA1	20	S

*Limitation due to SERVOPACK
†Limitation due to servomotor.
Note: Instantaneous maximum current at stop may be slightly larger than that at starting. If speed reference is small, current may not reach its instantaneous maximum value

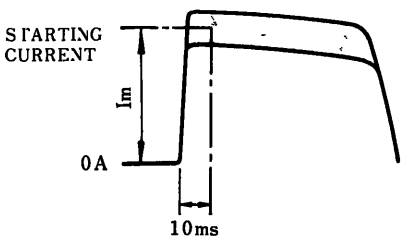


Fig. 1.1 Instantaneous Max Current at Starting

1.3.2 Max Drive Speed

SERVOPACK type CPCR-FR□□RB should be used within rated motor speed. If it has to be driven more than rated speed, refer to the notes in Table 1.5. Table 1.5 shows maximum drive speed when combined with SERVOPACK.

Table 1.5 Max Drive Speed

SERVOPACK Type	Servomotor Type*	Rated Speed rpm	Max Drive Speed† rpm
FR01RB	PMES-09A2	4000	5000
FR01RB-T3S	UGTMEM-03SB	2000	2200
FR01RB-T3M	UGTMEM-03MB	1500	1900
FR01RB-T3L	UGTMEM-03LB	1000	1700
FR01RB-T6S	UGTMEM-06SB	1300	1500
FR01RB-T6M	UGTMEM-06MB	1000	1200
FR01RB-T6L	UGTMEM-06LB	700	1400
FR01RB-R1S	UGRMEM-01SA	3000	4500
FR01RB-R2S	UGRMEM-02SA	3000	4000
FR01RB-R2M	UGRMEM-02MA	3000	4000
FR01RB-R4S	UGRMEM-02SA	3000	4000
FR02RB	PMES-12A2	3000	3700
FR02RB-P09	PMES-09A2	4000	5000
FR02RB-R4M	UGRMEM-04MA	3000	3600
FR02RB-M06	UGMMEM-06AA1	3000	3900
FR05RB	PMES-16A2	2500	2600
FR05RB-R8S	UGRMEM-08SA	3000	4000
FR05RB-R8M	UGRMEM-08MB	3000	3200
FR05RB-M13	UGMMEM-13AA1	3000	3600

*Servomotor type UGTMEM is for standard type (2 brushes provided except for type UGTMEM-06LB).
†The speed at which rated current flows using a transformer as listed in Table 4.2. If power condition is not suitable, the values in the table above cannot be achieved.

Note:

1. Servomotor type UGRMEM is limited by allowable motor speed (except for type UGRMEM-08MB).
2. Servomotor type UGTMEM is limited by the intermittent duty area under rated current of speed-torque characteristics of servomotor.
3. Servomotor type PMES-09A2 is limited by the maximum speed of TG.
4. If servomotor types UGTMEM and UGRMEM are driven under overspeed conditions, starting and stopping current will exceed the range of acceleration/deceleration of motor speed-torque characteristics. In this case, the life of the brush may be shortened.
5. If servomotors are driven under overspeed conditions, values of allowable load GD² shown in Table 1.3 should be amended using the following formula.

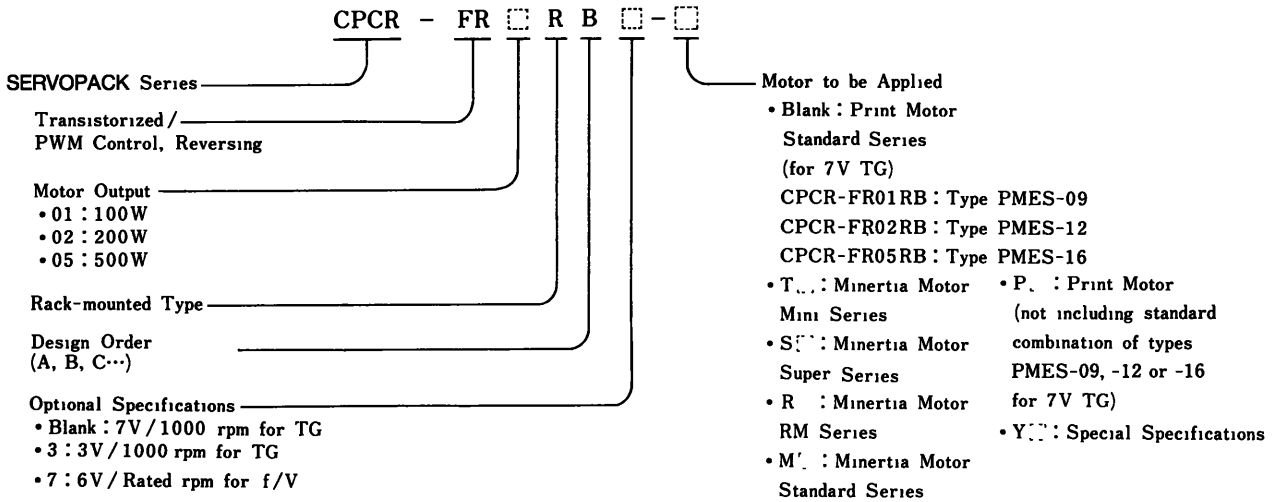
   Allowable Load GD² under Overspeed

   $GD^2 = (N_o/N_m)^2 \times (GD_M^2 + GD_{MAX}^2) - GD_M^2$

   N_o: Rated speed
   N_m: Drive speed (overspeed)
   GD_{MAX}^2 : Allowable load GD² listed in Table 1.3
   GD_M^2: Motor GD²
6. In case of a speed feedback in using PG and f/V converter, the linearity of the f/V converter must be sufficient in the overspeed area (including overshoot time). If linearity is not sufficient, a motor will run uncontrolably.
7. If a motor runs uncontrolably, motor allowable speed and allowable load GD² may exceed the values listed in Tables 1.3 and 1 5 by an excessive amount.
8. If a motor is driven under overspeed conditions, integration of speed amplifier in SERVOPACK may not be effective (mode switch works), so that regulation may suddenly drop.
9. The value of starting current is influenced largely by supply voltage in the overspeed area. Therefore, starting time may change due to various factors.
10. Using SERVOPACK under overspeed conditions may cause excess power and may require replacement of power transformer and fuse.
11. In the overspeed area the use of a thermal overload relay and an overload detection circuit of SERVOPACK may not be sufficient to protect a motor

2. TYPE DESIGNATION

2.1 SERVOPACK TYPE DESIGNATION



NOTE

1. When motors with special specifications are used, the column of motor to be applied may be blank even if the combination of servomotor with SERVOPACK is not standard.
2. If a SERVOPACK is returned to the factory, for repair, it will be repaired according to its type as shown on the nameplate. If any adjustment has been done (e.g. Servomotor type change) after receipt by the user, the factory should be so informed.
3. The factory should be notified of all information as to the type (SERVOPACK type CPCR-FR□ RB□ -□).

2.2 SERVOPACK TYPE FOR SERVOMOTOR WITH TG

Table 2.1 SERVOPACK Type for Servomotor with TG

SERVOPACK Type CPCR-	SERVOPACK Type	TG
FR01RB	PMES-09A2	7V/1000rpm
FR01RB-T3S	UGTMEM-03SB	
FR01RB-T3M	UGTMEM-03MB	
FR01RB-T3L	UGTMEM-03LB	
FR01RB-T6S	UGTMEM-06SB	
FR01RB-T6M	UGTMEM-06MB	
FR01RB-T6L	UGTMEM-06LB	
FR01RB-R1S	UGRMEM-01SAK07	
FR01RB-R2S	UGRMEM-02SA	
FR01RB-R2M	UGRMEM-02MA	
FR01RB-R4S	UGRMEM-04SA	
FR02RB	PMES-12A2	
FR02RB-P09	PMES-09A2	
FR02RB-R4M	UGRMEM-04MA	
FR02RB-M06	UGMMEM-06AA1	
FR05RB	PMES-16A2	
FR05RB-R8S	UGRMEM-08SA	
FR05RB-R8M	UGRMEM-08MB	
FR05RB-M13	UGMMEM-13AA1	
FR02RB3-S03	UGSMEM-03	3V/1000rpm
FR02RB3-S12	UGSMEM-12	

2.3 SERVOPACK TYPE FOR SERVOMOTOR WITH PG

Table 2.2 SERVOPACK Type for Servomotor with PG

SERVOPACK Type CPCR-	Servomotor Type (with Optical Encoder)	f/V Converter*
FR01RB7-P09	PMES-09A2E	JASP-FV010
FR01RB7-T3S	UGTMEM-03SB40E	
FR01RB7-T3M	UGTMEM-03MB40E	
FR01RB7-T3L	UGTMEM-03LB40E	
FR01RB7-T6S	UGTMEM-06SB40E	
FR01RB7-T6M	UGTMEM-06MB40E	
FR01RB7-T6L	UGTMEM-06LB40E	
FR01RB-R1S	UGRMEM-01SAKOE	
FR01RB7-R2S	UGRMEM-02SA20E	
FR01RB7-R2M	UGRMEM-02MA20E	
FR01RB7-R4S	UGRMEM-04SA20E	
FR02RB7-P12	PMES-12A2E	
FR02RB7-P09	PMES-09A2E	
FR02RB7-R4M	UGRMEM-04MA20E	
FR05RB7-P16	PMES-16A2E	
FR05RB7-R8S	UGRMEM-08SA20E	
FR05RB7-R8M	UGRMEM-08MB20E	

*For details, refer to the bulletin (TSE-C717-10.10) for f/V converters.

3. CHARACTERISTICS

3.1 CONTINUOUS OUTPUT CHARACTERISTICS OF SERVOPACK

Fig. 3.1 shows continuous output current values of SERVOPACK type CPCR-FR□RB. In practice, they are limited by cooling conditions, servomotor type, and power transformers being used. Continuous operation beyond the range shown in Fig. 3.1 must not be permitted.

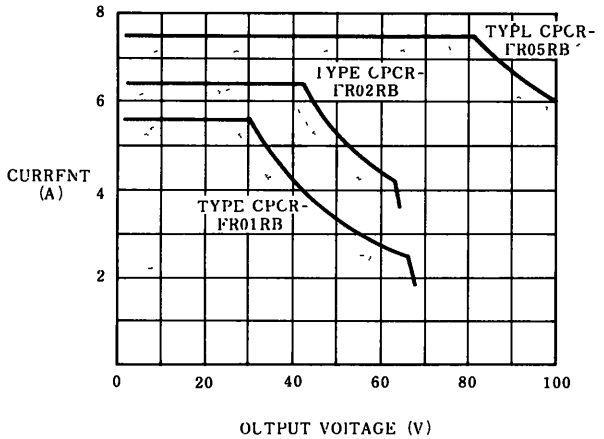


Fig. 3.1 Continuous Output Characteristics of SERVOPACK

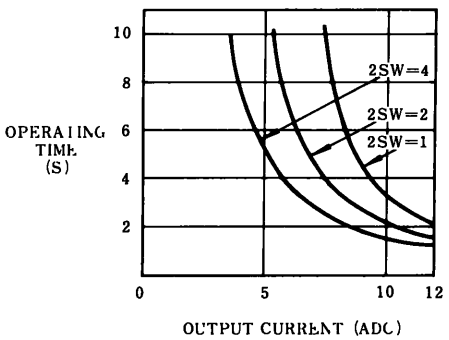
3.2 OVERLOAD DETECTION CHARACTERISTICS

SERVOPACK type CPCR-FR□RB is provided with a built-in overload protective circuit to protect the controller from overload due to malfunctions such as motor lock, etc. Characteristics curve can be divided into 2 or 3 stages (by adjusting switches) depending on the motor being used. Switch (2SW) is preset at the factory to a proper position in accordance with the motor to be applied so that adjustment is not required by user. However, it is recommended that a theraml overload relay be used for complete protection. Motors cannot be protected completely because average value of absolute values of the motor armature current is detected. The actual effective current is not detected. Due to the limitation of SERVOPACK, operating time cannot be longer than the curve shown in Fig. 3.2 (2SW=1).

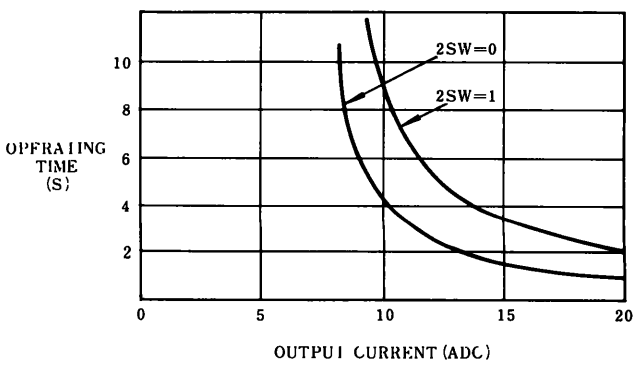
Table 3.1 shows operation starting current and Table 3.2 shows 2SW setting for a motor to be applied.

NOTE

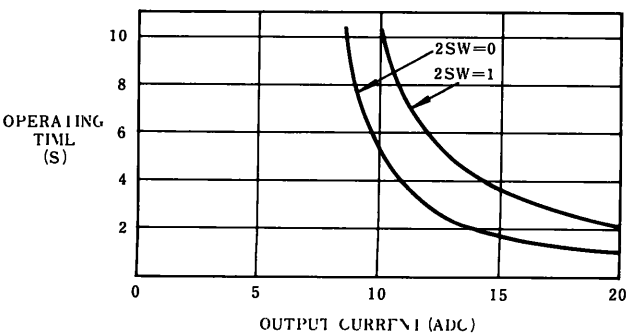
1. If the protective circuit is active, base-off function automatically activates in SERVOPACK and stops power transistor actuation. ALARM LED lights and ALARM output circuit is operated. Alarm status is held until control power is cut off.
2. If overload detection circuit is activated, it will specify the cause, such as motor speed, load GD^2, or load exceeding the allowable range. Remove the cause, then restart the operation. If overload repeatedly occurs, the malfunction maybe due to the deterioration of SERVOPACK main circuit element.
3. Make a sequence so that power is turned off when heat sink overheat detection output circuit is operated. SERVOPACK may be damaged due to heat sink overheat depending on operating conditions and cooling conditions even if overload detection circuit is not operated.
4. Operating time may vary about ±20%.
5. Within the time just after power has been turned on (see Table 3.3), overload detection circuit is operated faster than the time shown in Fig. 3.2.



(a) Type CPCR-FR01RB



(b) Type CPCR-FR02RB



(c) Type CPCR-FR05RB

Fig. 3.2 Overload Detection Characteristics

Table 3.1 Operation Starting Current

SERVOPACK Type CPCR-	2SW	Operation Starting Current ADC
FR01RB	1	6.0
	2	4.1
	4	2.2
FR02RB	0	6.7
	1	6.7
FR05RB	0	7.5
	1	7.5

Table 3.2 Switch 2SW Setting

SERVOPACK Type CPCR-	Servomotor Type	2SW
FR01RB	PMES-09A2	1
FR01RB-T3S	UGTMEM-03SB	2
FR01RB-T3M	UGTMEM-03MB	1
FR01RB-T3L	UGTMEM-03LB	1
FR01RB-T6S	UGTMEM-06SB	1
FR01RB-T6M	UGTMEM-06MB	1
FR01RB-T6L	UGTMEM-06LB	1
FR01RB-R1S	UGRMEM-01SA	4
FR01RB-R2S	UGRMEM-02SA	2
FR01RB-R2M	UGRMEM-02MA	1
FR01RB-R4S	UGRMEM-04SA	1
FR02RB	PMES-12A2	0
FR02RB-P09	PMES-09A2	0
FR02RB-R4M	UGRMEM-04MA	1
FR02RB-M06	UGMMEM-06AA1	1
FR05RB	PMES-16A2	0
FR05RB-R8S	UGRMEM-08SA	1
FR05RB-R8M	UGRMEM-08MB	1
FR05RB-M13	UGMMEM-13AA1	1

Table 3 3 Transition State Time of Overload Detection just after Power on

SERVOPACK Type CPCR-	2SW	Time s
FR01RB	4	1.5
	2	2.3
	1	4.4
FR02RB	0	1.3
	1	2.7
FR05RB	0	1.2
	1	2.5

3.3 STARTING AND STOPPING TIME

The starting time and stopping time of servomotor under a constant load is shown by the formula below. Viscous or friction torque of the motor is neglected.

Starting Time:

$$t_r = 26.8\times10^{-3}\times\frac{N_R(GD_M^2+GD_L^2)}{K_t\cdot I_R\cdot(\alpha-\beta)}\ (\text{ms})$$

Stopping Time:

$$t_f = 26.8\times10^{-3}\times\frac{N_R(GD_M^2+GD_L^2)}{K_t\cdot I_R\cdot(\alpha+\beta)}\ (\text{ms})$$

Where,

N_R : Rated motor speed (rpm)

GD_M^2 : Motor inertia GD^2 (kg·cm^2)

GD_L^2 : Load inertia GD^2 converted to the motor shaft (kg·cm^2)

K_t : Torque constant of motor (kg·cm/A)

I_R : Motor rated current (A)

α $=I_P/I_R$: Acceleration/deceleration current constant

I_P : Acceleration/deceleration current (Acceleration/deceleration current α times the motor rated current) (A)

β $=I_L/I_R$: Load current constant

I_l : Current equivalent to load torque (Load current β times the motor rated current) (A)

3.4 ALLOWABLE FREQUENCY OF OPERATION

The allowable operation frequency of the servomotor varies depending upon the load and the operating condition. The following shows the allowable operation frequency in typical operations.

3.4.1 When the Motor repeats Rated-speed Operation and being at Standstill (Fig. 3.3)

Cycle time(T) should be determined so that RMS value of motor armature current is lower than the motor rated current:

$$T\geqq\frac{I_P^2(t_r+t_f)+I_L^2t_S}{I_R^2}\ (\text{s})$$

Where cycle time(T) is determined, values I_p, t_r, t_f, satisfying the formula above, should be specified.

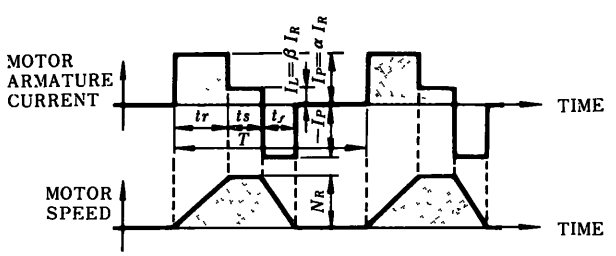


Fig 3.3 Timing Chart of Motor Armature Current and Speed

3.4.2 When the Motor remains at Standstill between Cycles of Acceleration and Deceleration without Continuous Rated Speed Running (Fig. 3.4)

The timing chart of the motor armature current and speed is as shown in Fig. 3.4. The allowable frequency of operation "n" can be calculated as follows:

$$n=1.12\times10^{6}\times\frac{K_t\cdot I_R}{N_R(GD_M^2+GD_L^2)}\times(1/\alpha-\beta^2/\alpha^3)$$

(times/min)

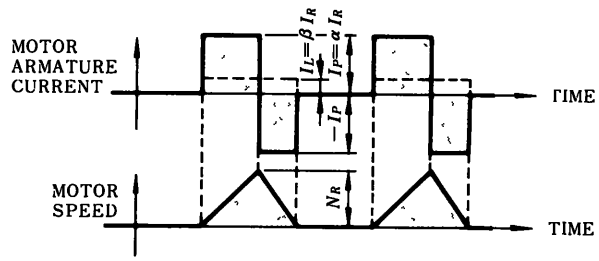


Fig 3 4 Timing Chart of Motor Armature Current and Speed

3.4.3 When the Motor accelerates, runs at Constant Speed, and decelerates in a Continuing Cycle without being at Standstill (Fig. 3.5)

The timing chart of the motor armature current and speed is as shown in Fig. 3.5. The allowable frequency of operation "n" can be calculated as follows.

$$n=1.12\times10^{6}\times\frac{K_t\cdot I_R}{N_R(GD_M^2+GD_L^2)}\times(1/\alpha-\beta^2/\alpha)$$

(times/min)

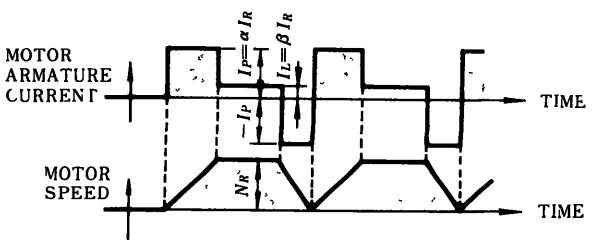


Fig 3 5 Timing Chart of Motor Armature Current and Speed

3.5 SERVOMOTOR FREQUENCY

Servomotor speed amplitude is restricted by the maximum current controlled by SERVOPACK type CPCR-FR□RB.

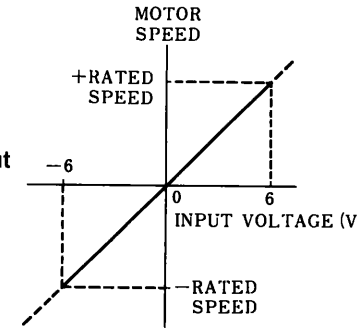
The relation between motor speed amplitude (N) and frequency(f) is shown by the formula below:

$$N=5.95\times10^{3}\alpha\times\frac{K_t\times I_R}{(GD_M^2+GD_L^2)f}\ \text{(rpm)}$$

3.6 MOTOR SPEED–INPUT VOLTAGE CHARACTERISTICS

Fig. 3.6 shows motor speed and input voltage curve when speed reference input terminals 1CN-1 and -2 are used. With auxiliary input terminals, 1CN-9 and -21, motor speed can be set to the rating by adjusting IN-B potentiometer as long as input voltage is within ±2V to ±10V.

(a) When using Input Terminals 1CN-1 and 2



(b) When using Auxiliary Input Terminals 1CN-9 and 21

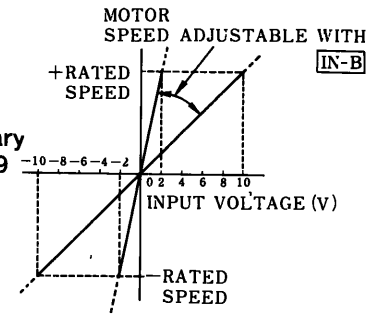


Fig 3.6 Speed—Input Voltage Characteristics

3.7 DIRECTION OF ROTATION

Table 3.4 shows direction of rotation when plus voltage is applied to terminal A (or red lead) of the servomotor.

Table 3.4 Direction of Rotation of Motor

Servomotor Type \ Direction of Rotation	Viewing from Drive End	
	Forward Running	Reverse Running
PMES-□	CCW*	CW†
UGTMEM-□	CW	CCW
UGRMEM-□	CCW	CW
UGMMEM-□	CCW	CW
UGSMEM-□	CW	CCW

*Counterclockwise
†Clockwise
Note Direction of rotation is dependant on the position of the commutator for standard product

4. CONFIGURATION

4.1 COMPONENTS

4.1.1 Combination of SERVOPACK, Servomotor and Optional Components

Table 4 1 Combination of SERVOPACK and Servomotors and Optional Component

SERVOPACK Type CPCR-	Servomotor Type	Power Transformer	Built-in Fuse Type*	DC Reactor	Connector†	f/V Converter Type‡	Magnetic Contactor Type‡	Speed Potentiometer Type#
FR01RB	PMES-09A2	See Table 4. 2.	PL-475 (7.5A)	See Table 4. 2.	Receptacle: MR-34F Case MR-34L	JASP-FV010 (for one-axis)	HI-10E	25HP-10B (2kΩ)
FR01RB-R1S	UGRMEM-01SA							
FR01RB-R2S	UGRMEM-02SA2							
FR01RB-R2M	UGRMEM-02MA2							
FR01RB-R4S	UGRMEM-04SA2							
FR01RB-T3S	UGTMEM-03SB							
FR01RB-T3M	UGTMEM-03MB							
FR01RB-T3L	UGTMEM-03LB							
FR01RB-T6S	UGTMEM-06SB							
FR01RB-T6M	UGTMEM-06MB							
FR01RB-T6L	UGTMEM-06LB							
FR02RB	PMES-12A2		PL-4100 (10A)					
FR02RB-R4M	UGRMEM-04MA2							
FR02RB-M06	UGMMEM-06AA1							
FR02RB3-S03	UGSMEM-03A							
FR02RB3-S12	UGSMEM-12B							
FR05RB	PMES-16A2		PL-4150 (15A)					
FR05RB-R8S	UGRMEM-08SA2							
FR05RB-R8M	UGRMEM-08MB2							
FR05RB-M13	UGMMEM-13AA1							

*Manufactured by Daito Communication Apparatus Co., Ltd.
†Manufactured by Honda Tsushin Co., Ltd.
‡Manufactured by Yaskawa Electric Co., Ltd.
#Manufactured by Sakae Tsushin Kogyo Co., Ltd
Note:
1. SERVOPACK type is shown when TG feedback is used.
2. The f/V converter is used with a motor with optical encoder If f/V converter is used, another power supply is needed. Refer to the bulletin for f/V converters (TSE-C717-10·10) for power supply specifications.
3. Exclusive cables and mounting racks are not provided.
4 Besides the components in the Table 4 1, use proper thermal overload relays depending on motor types. (Refer to Table 8 1.)

4.1.2 Power Transformers and DC Reactors

Table 4.2 shows the list of the combination of one-axis power transformers and DC reactors. Two-axis and three-axis power transformers are provided depending on the type of combination. If necessary, contact your Yaskawa representative. Table 4.3 shows the list of multi-axis power transformers.

Table 4.2 Combination of One-axis Power Transformers and DC Reactors

Power Transformer Type	DC Reactor Type	Servomotor Type	SERVOPACK Type CPCR-
CPT10114 (210VA)	X3064 (1 mH, 8A)	UGRMEM-02SA	FR01RB-R2S
		UGTMEM-03SB	FR01RB-T3S
		UGTMEM-03MB	FR01RB-T3M
		UGTMEM-03LB	FR01RB-T3L
	Not necessary	UGTMEM-06SB	FR01RB-T6S
		UGTMEM-06MB	FR01-T6M
		UGTMEM-06LB	FR01RB-T6L
CPT10115 (310VA)	X3064 (1 mH, 8A)	PMES-09A2	FR01RB
		UGRMEM-02MA	FR01RB-R2M
		UGRMEM-04SA	FR01RB-R4S
		UGSMEM-03A	FR02RB3-S03
		UGSMEM-12B	FR02RB3-S12
CPT10092 (510VA)		PMES-12A2	FR02RB
		UGRMEM-04MA	FR02RB-R4M
		UGMMEM-06AA1	FR02RB-M06
CPT10116 (1010VA)	X5006 (2mH, 8A)	PMES-16A2	FR05RB
		UGRMEM-08SA	FR05RB-R8S
		UGRMEM-08MB	FR05RB-R8M
		UGMMEM-13AA1	FR05RB-M13

Note.
1. Power transformer in Table 4.2 is used for primary voltage of 100/200 V and 110/220 V Please contact your Yaskawa representative if 115/230 V power transformer is needed
2. Secondary voltage of power transformer differs depending on motors to be used. The specified power transformer must be used. Main circuit power is not supplied for multi-axis drive but for one-axis drive individually.
3. DC reactors should be selected from the above table. Even if DC reactors other than the above have the same inductance and current, they may not be used. When type UGTMEM-06 is used and, if heat radiation is not sufficient, connect DC reactor type X3064 Type X5006 can be replaced by type X3064.
4. SERVOPACK type is shown when TG feedback is used.
5. In addition to the listed above transformers, types CPT8570 (210 VA) and CPT8588 (300 VA) can be used for type CPCR-FR01RB, and type CPT10017 (1 kVA) can be used for type FR05RB. Connection between terminals u_3 and v_3 should be opened in this case.

Table 4.3 Multi-axis Transformers for SERVOPACK and Servomotors

SERVOPACK Type CPCR-	Servomotor Type	Power Transformer Type	
		For Two-axis	For Three-axis
FR01RB-□	UGTMEM-□ UGRMEM-02SA	CPT10105	CPT10110
	PMES-09A2 UGRMEM-02MA UGRMEM-04SA	CPT10106	CPT10111
FR02RB-□	PMES-12A2 UGRMEM-04MA UGMMEM-06AA1	CPT10107	CPT10112
FR05RB-□	PMES-16A2 UGRMEM-08SA, 08MB UGMMEM-13AA1	CPT10108	CPT10113
FR01RB-□ + FR01RB-□	UGTMEM-□ UGRMEM-02SA + PMES-09A2 UGRMEM-02MA UGRMEM-04SA	CPT10109	—

4.2 INTERNAL BLOCK DIAGRAM

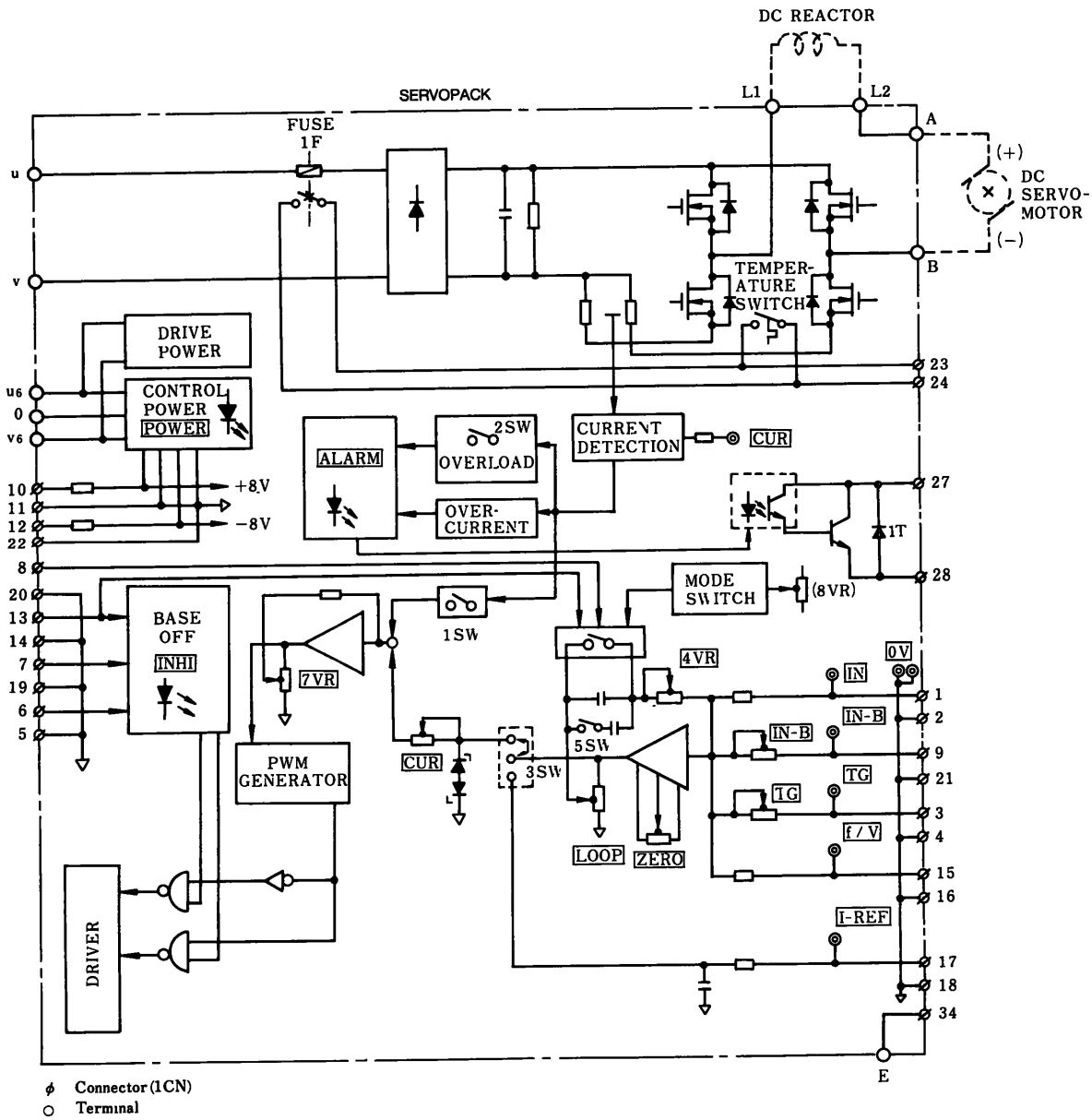


Fig. 4.1 Internal Block Diagram

4.3 EXTERNAL TERMINALS

4.3.1 External Terminals for SERVOPACK Type CPCR-FR[ ]RB

Table 4 4 External Terminals

Terminal Symbol		Name	Description
Main Circuit	u, v	Main Circuit Power Input	Connected to terminals u_1, v_1 of power transformer separately provided. (Refer to Table 5. 20.)
	u_6, o, v_6	Control Circuit Power Input	Connected to terminals u_2, o_2, v_2 of power transformer separately provided. (Refer to Table 5. 20.)
	E	Grounding	Used for shielded wires for TG and input or grounding.
	A, B	Motor Connection	Terminal A connected to motor terminal A (or red lead). Terminal B connected to motor terminal B (or black lead).
	L_1, L_2	DC Reactor Connection	Connected to DC reactor separately provided.
Control Circuit 1CN	1, 2	Reference Input	SG 0V at terminal 2 Rated speed in forward running at +6V.
	3, 4	TG Input	SG 0V at terminal 4. Terminal 3 connected at TG(−) and terminal 4 connected at TG(+). (Refer to Table 5 1 for TG terminals and servomotors.)
	5, 6, 7, 19	Overtravel Base Off	Stops reverse running with terminals 5 and 6 open Stops forward running with terminals 7 and 19 open.
	8, 20	Proportional Drive	0V common at terminal 20. Proportional drive when shortcircuiting across 8 and 20 At this time, set the speed reference to 0V.
	9, 21	Auxiliary Input	Used to provide rated speed at voltages (±2 to ±10V) other than rated reference voltage, ±6V. Terminal 21 is 0V
	10, 11, 12, 22	±8V Output	0V common at terminals 11 and 22. Terminal 10 for +8V at 10mA, terminal 12 for −8V at 10mA. Used for speed setting, etc 390 Ω resistor is connected in series
	13, 14	Base off	SG 0V at terminal 14 Short circuit across terminals 13 and 14 stops transistor function 20 to 40 ms is needed to actuate a transistor after base off is released
	15, 16	f/V Feedback Input	SG 0V at terminal 16. Rated speed at f/V signal ∓6V
	17, 18	Current Reference (Optional)	SG 0V at terminal 18 When used for current control not speed control, [3SW] should be switched Max current at ∓5VDC.
	23, 24	Blown-fuse, Heat Sink Overheat Detection Output	Closed when detecting 30VDC, 50mA max at dry contact.
	27, 28	Alarm Output	Insulated transistor output. 30VDC, 50mA max Transistor is turned on during alarm.
	34	Grounding	Connected to terminal E in SERVOPACK

Note: Speed reference input 0V (1CN-2, 4 or 21) should be grounded to strengthen noise resistance

4.3.2 Connector Terminal (1CN) for Input/Output Signal

For SERVOPACK types CPCR-FR[ ]RB, the connectors for input/output signals used are type MR-34RMA made by Honda Tsushin Co., Ltd. The applicable receptacles are as shown in Table 4.5.

For connection to connectors 1CN, be sure to use the receptacle listed in Table 4.5 and make correct wiring.

The terminal layout of input/output signal connectors (1CN) is shown in Fig. 4.2. The terminal specifications are shown in Table 4.4, and external connection and external signal processing, in Fig. 4.3.

Table 4 5 Specifications of Applicable Receptacles for SERVOPACK Input/Output Signal

Connector Symbol	Connector Type used in SERVOPACK	Applicable Receptacle Type			
		Manufacturer	Soldered Type	Caulking Type	Case
1CN	MR-34RMA (Right Angle 34P)	Honda Tsushin Co., Ltd	MR-34F*	MR-34F01	MR-34L*

*Attached to SERVOPACK when shipping

Pin No. →	1	2	3	4	5	6	7	8	9	10	11	12
	IN	0V (IN)	TG(−)	TG(+) (0V)	R-OT (0V)	R-OT	F-OT	P	IN-B	+8V	0V	−8V
	13	14	15	16	17	18	19	20	21	22		
	BASE OFF	0V	f/V	0V (f/V)	IREF	0V (IREF)	0V (F-OT)	0V (P)	0V (IN-B)	0V		
23	24	25	26	27	28	29	30	31	32	33	34	
F	F			ALM +	ALM −						E	

Note Unused terminals (1CN-25,26,29,30,31,32,33) may be used in SERVOPACK due to SERVOPACK modification without notice These unused terminals should not be used as junction terminals

Fig 4 2 Connector 1CN Layout

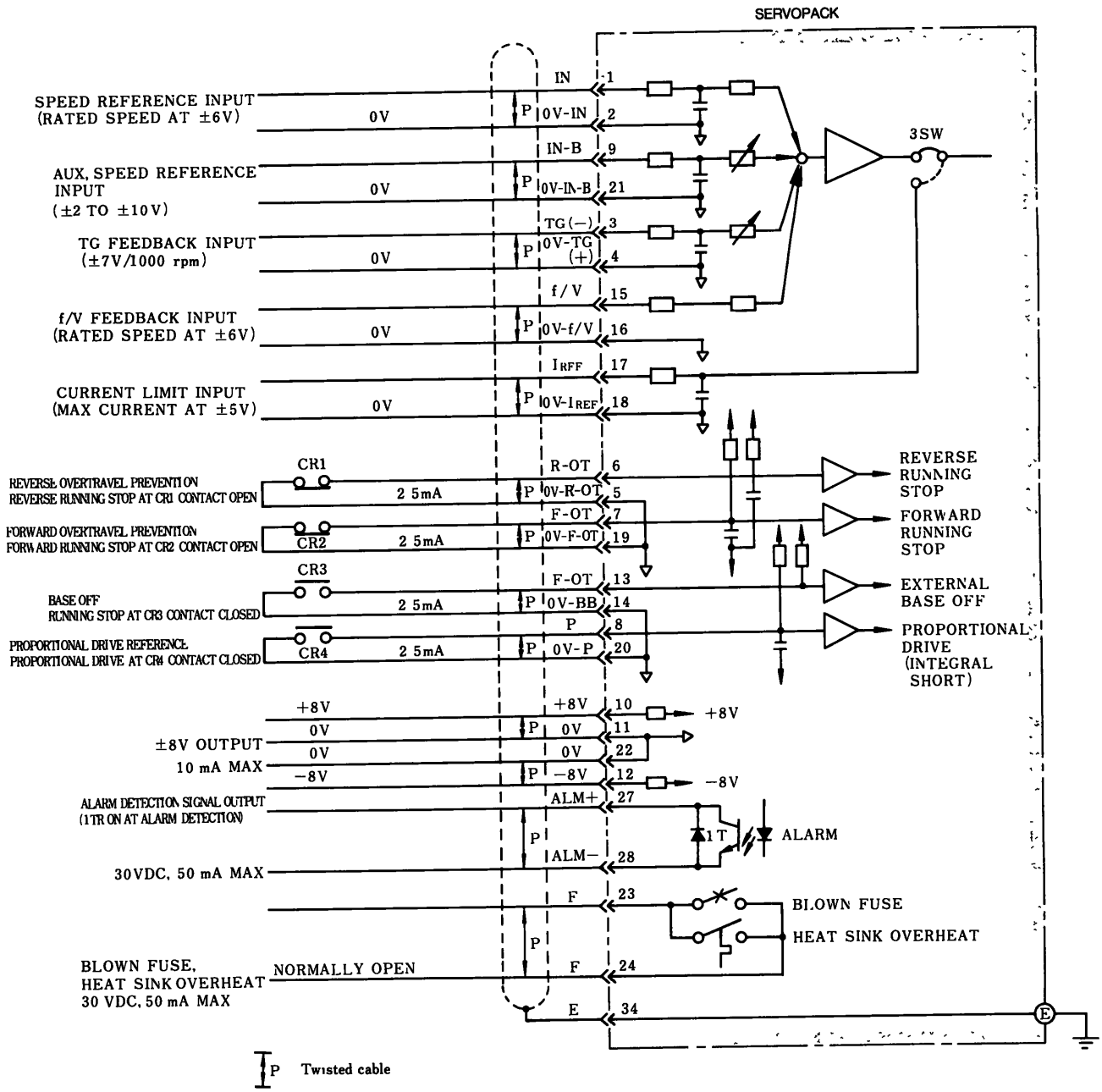


Fig 4.3 I/O Signal Connector 1CN Connection and External Signal Processing

5. OPERATION

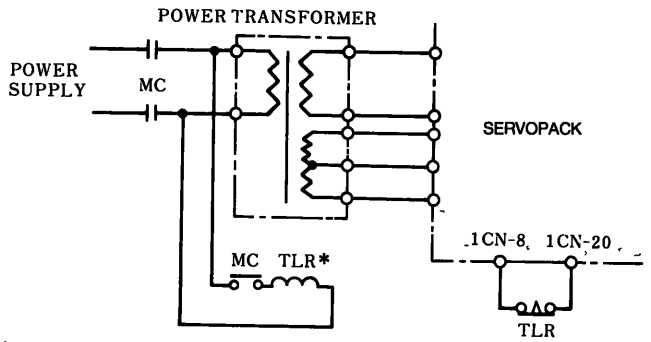
5.1 POWER ON AND OFF

For SERVOPACK type CPCR-FR□□RB, input must be made separately for the main circuit power (u, v terminals) and for the control circuit power (u_6, 0, v_6 terminals).

5.1.1 Inching Prevention at Power ON

Turning on the main and control circuits simultaneously runs the motor by 1/6 revolution (maximum). To prevent the motor from rotating at power ON, connect NC contact of ON delay timer to proportional drive circuit (connector 1CN-8 and -20).

When power is turned off during motor rotation, speed reference must be decreased to 0V.



*TLR(Timer) On Delay type RTSR made by Yaskawa
Note Timer setting should be 100ms or over

Fig. 5 1 Motor Rotation Prevention Circuit at Power ON

5.1.2 Power Cut off during a Failure

Power supply for main circuit should be cut off by SERVOPACK alarm signal, heat sink overheat detection operation, or thermal relay operation. Thermal relay (spring return type) and heat sink overheat detection circuit reset automatically. Alarm output of SERVOPACK is reset by control power supply cut off. It is recommended to make self-holding sequence, such as using a keep relay, to locate the cause immediately after power off.

5.2 SPEED REFERENCE

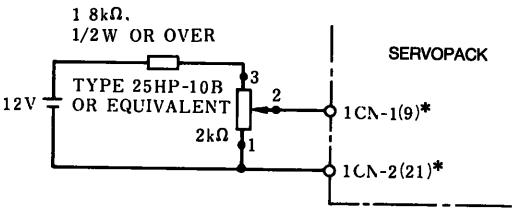
5.2.1 Speed Reference Circuit

Speed reference voltage is given to SERVOPACK connector 1CN-1 and -2 or 1CN-9 and -21 from external power.

The SERVOPACK built-in control power (1CN-10: +8 V, 1CN-11 and -22: 0V, 1CN-12: -8 V) can also be used. Output current limiting resistor (for short-circuit protection) is connected to +8 V and -8 V terminals in SERVOPACK. Therefore, if output current increases due to multi-speed setting, for example, rated reference voltage ±6 V cannot be achieved. In this case, use auxiliary input terminals. If the SERVOPACK built-in control power is used, the motor speed fluctuates with about ±2% of the speed setting value.

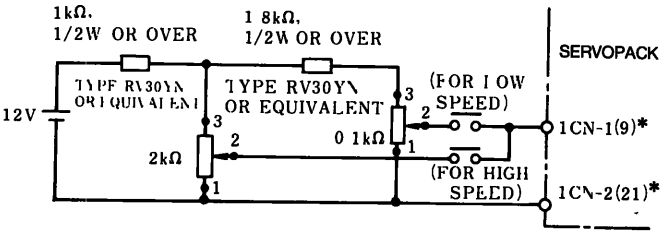
If f/V converter type JASP-FV010 is used for speed feedback, ±12 V power supply used for f/V converter should be prepared for speed reference. Because +8 V output in SERVOPACK is used for base off during power transition. The method for giving speed reference voltage is shown below.

(1) For accurate (inching) speed setting



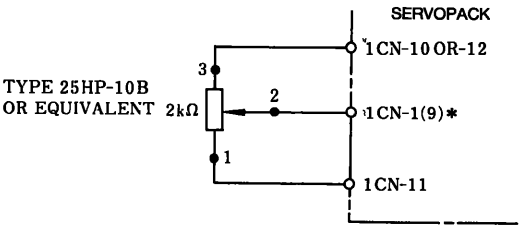
Type 25HP-10B Multiple-rotation type, wire wound variable resistor(with dial MD10-30B4)made by Sakae Tsushin Inco

(a) When Multiple-rotation Type, Wire Wound Variable Resistor is used



Type RV30YN Carbon-film variable resistor made by Tokyo Cosmos Electric
Low- and high-speed relays Reed relay(PG series) made by Nippon Electric or equivalent, or low-level relay(G2A-432) made by Tateishi Electric or equivalent
Note When a carbon resistor is used, a great residual resistance remains, and so the speed control range becomes approximately 500 Ω

(b) When Carbon Variable Resistor is used

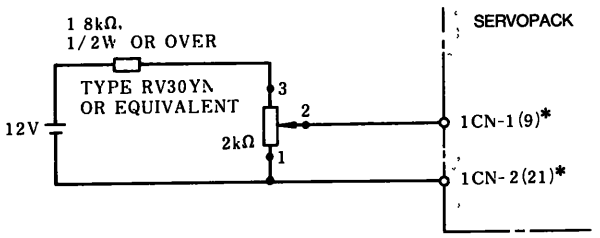


(C) When Built-in Power Supply is used

*For auxiliary input

Fig 5 2 Method for giving Speed Reference Voltage (for Accurate Speed Setting)

(2) For relatively rough speed setting

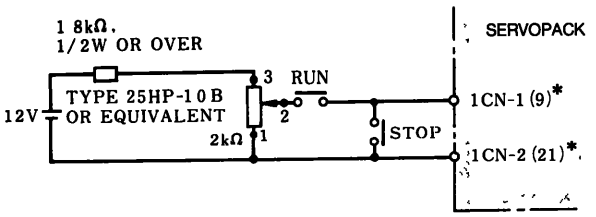


Type RV30YN Carbon-film variable resistor made by Tokyo Cosmos Electric
* For auxiliary input

Fig. 5.3 Method for giving Speed Reference Voltage (for relatively Rough Speed Setting as compared with Fig. 5.2)

5.2.2 Signal Stopping Circuit

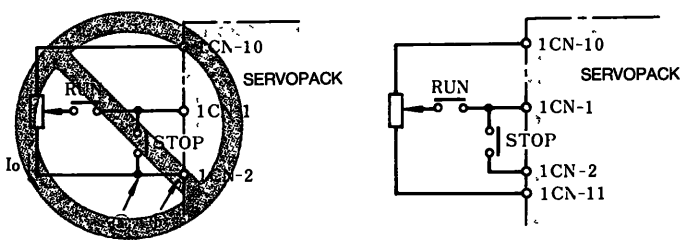
Connect 1CN-1 or -9 to 0 V without opening input circuit.



*For auxiliary input
Note If start/stop operation is repeated by cutting on/off the main circuit power supply while applying speed reference voltage, it may cause SERVOPACK failure

Fig. 5.4 Signal Stopping Circuit

Signal stopping circuit (when SERVOPACK built-in power supply is used) should be made as shown in Fig. 5.5(b). In case of wiring shown in Fig. 5.5(a) motor will rotate slowly, even if stopping signal is given, due to the effect of current (Io) and the impedance across ⓐ and ⓑ.



Note If start/stop operation is repeated by cutting on/off the main circuit power supply while applying speed reference voltage, it may cause SERVOPACK failure

Fig 5 5 Signal Stopping Circuit (when SERVOPACK built-in Power Supply is used)

5.2.3 Speed Reference Input Terminal

To prevent noise, short-circuit either speed reference input 1CN-1 or auxiliary input 1CN-9, whichever is unused, to 1CN-2 or -21 respectively. Speed reference input of other control circuits should not be grounded on signal source side. (Fig. 5.6)

Where grounding is required on signal source side, employ an isolator. (Fig. 5.7)

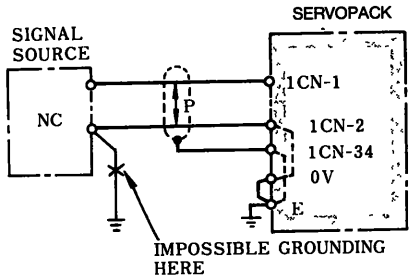
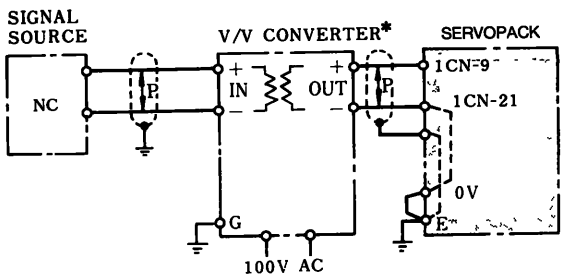


Fig. 5 6 Signal Source insulated from Ground



*Type M3000B-R made by M T T Co

Fig. 5.7 Signal Source Grounded

5.2.4 Auxiliary Input Circuit (±2 to ±10 V)

Auxiliary input circuit is used for application at rated reference voltages other than ±6V.

Adjustment procedures

Between 1CN-9 and -21 (21 is 0 V), input the voltage to be used to set the rated speed, and adjust the potentiometer IN-B so that the rated speed is achieved. See Fig. 3.6(b). The potentiometer IN-B is not adjusted prior to shipping.

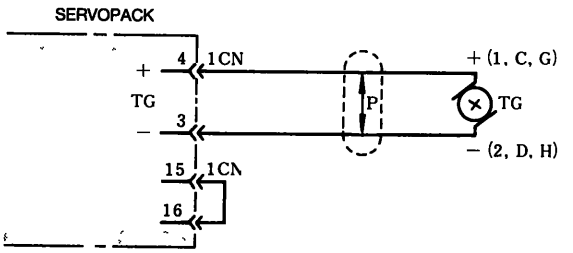
5.3 FEEDBACK INPUT CIRCUIT

5.3.1 TG Feedback

Fig. 5.8 shows the input circuit for TG feedback. Connect ⊕ and ⊖ terminals of TG to 1CN-4 and -3 of SERVOPACK, respectively. Short-circuit across 1CN-15 and -16 (for f/V feedback) to prevent noise.

5.3.1 TG Feedback (Cont'd)

Table 5.1 shows the TG terminals and servomotors.



Note TG terminal symbols differ depending on TG types

Fig. 5 8 Feedback Input Circuit for TG Feedback

Table 5.1 Tachometer-generator Terminals and Servomotors

TG Type	TG Terminals			Output Voltage	Max Speed	Servomotor Type
	Connection Type	Symbol Plus (+)	Symbol Minus (−)			
TG-7SVC	Lead	White	Black	7V ±10%/1000 rpm	5000 rpm	UGRMEM -[ ]
	Screw terminal	1	2			UGTMEM -[ ]
	Cannon connector	G	H			Servomotor with feedback unit*
11TG-027	Cannon connector	C	D	7V ±5%/1000 rpm	5000 rpm	PMES-[ ]
	Lead	1	2			UGMMEM -[ ]
UGTGEM -03X	Lead	1	2	3V ±5%/1000 rpm	—	UGSMEM -[ ]

*Feedback unit types TFUE-[ ]SA, SU, DC7, ZC7, DD7 and ZD7

Note· When positive voltage is applied to motor terminal A (or red lead), plus side terminal shown in Table 5.1 becomes positive

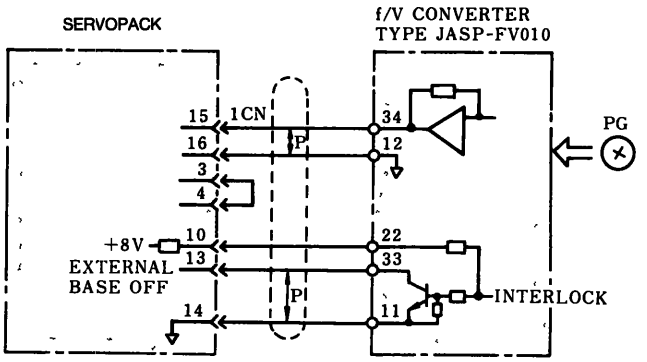
5.3.2 When PG Signals are f/V converted (not using TG)

Fig. 5.9 shows the feedback input circuit when PG signals are f/V converted (not using TG). In this case, observe the following:

- To prevent a motor from overrunning due to abnormal output from f/V converter when power is applied to it, base off should be active until the power to the f/V converter rises.

  PG should be connected to f/V converter so that the output of f/V converter becomes minus (plus) when the motor rotates in forward (reverse) direction. Forward direction means direction of rotation when plus voltage is applied to terminal A (or the red lead) of the motor and minus voltage is applied to terminal B (or the black lead).

- To prevent noise, short-circuit across 1CN-3 and -4 for TG using a short cable. (Short-circuit at the bottom of the connector pins.)
- Refer to the bulletin for f/V converter (TSE-C717-10.10) for the connection between f/V converter and power supply or PG.



Note
1 The f/V converter output terminals should not be connected to SERVOPACK TG input terminals 1CN-3 and -4 or auxiliary input terminals 1CN-9 and -21
2 The f/V converter and TG should not be connected to SERVOPACK at the same time Switching use between f/V converter and TG must be avoided.

Fig 5.9 Feedback Input Circuit (When PG Signals are f/V converted not using TG)

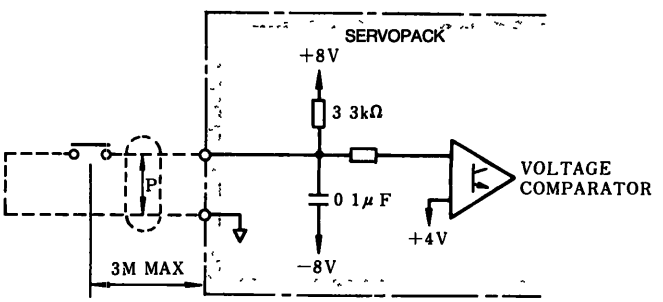
5.4 INPUT/OUTPUT CIRCUIT CONFIGURATION

5.4.1 Input Circuit

Input circuits of Base off, Proportional drive, Overtravel protection circuit (to prevent further rotation of motor in forward or reverse direction) are shown in Fig. 5.10.

(1) In case of circuit with contact

- Contacts of relays being used should be highly reliable.
- When multi-axis machines are controlled at the same contact, noise intrusion may occur.
- If power (100 VAC or 200 VAC) is turned on or off at two adjacent contacts in a same relay, erroneous operation may occur due to noise.

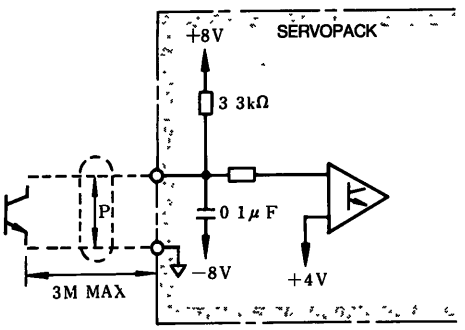


Note Input capacitor 0.1μF is not attached to the base off reference input because delay element during base off release is set

Fig 5.10 In Case of Circuit with Contact

(2) In case of circuit without contact

- Watch for current leakage.
- If current leakage is excessive, input voltage becomes lower than reference voltage even if transistors are turned off so that control will not be effected.
- Wiring should be shortened to avoid erroneous operation.
- If transistors are used, be sure to make independent wiring of an emitter and a collector



*Must be as short as possible.

Fig 5 11 In Case of Circuit without Contact

5.4.2 Output Circuit

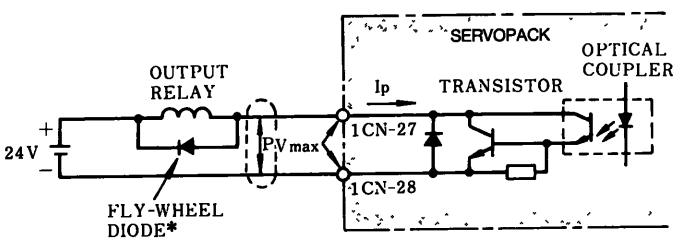
Alarm output and heat sink overheat detection (or blown fuse detection) output are provided in SERVOPACK type CPCR-FR□RE

(1) Alarm output

Alarm output circuit is composed of the circuit using a transistor without contact. Voltage and current specifications are as follows:

Applied voltage (V_{MAX}) ≦30 VDC, when the transistor is ON, (V_{MAX}) ≦ 2 V
Current (Ip) ≦ 50 mA

The transistor is ON when alarm is output (when overload or overcurrent detection circuit is active).



*Direction of fly-wheel diode must be correct

Note
1 Polarity of voltage must be correct
2 During Alarm output, base-off function is automatically operated and held until power is cut off

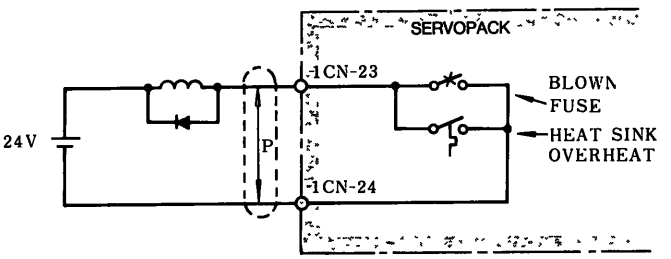
Fig. 5.12 Alarm Output Circuit

(2) Heat sink overheat detection (or blown fuse detection) output

This circuit consists of a thermoswitch and an alarm contact of an alarm fuse. Heat sink overheat detection is reset automatically.

Voltage and current specifications are as follows:

Applied voltage (V max) ≦30 VDC
Current (Ip) ≦ 50 mA



Note During alarm detection, base-off will be automatic in SERVOPACK because the activity of a power transistor has to be stopped immediately However, base-off is not automatic in SERVOPACK during heat sink overheat detection to stop the power transistor at a proper position Therefore, a method which can stop the power transistor within three seconds using this signal is required

Fig 5.13 Heat Sink Overheat and Blown Fuse Detection Circuit

5.5 BUILT-IN FUNCTION

5.5.1 Proportional Drive Reference Circuit (P-CON)

If a position loop is not set for positioning, and after completion of positioning, has been left for quite a long time, the positioned point may have moved due to preamplifier drift. To avoid this, switch the speed amplifier from PI drive to P drive after the positioning and the loop gain in the control system drops and the drift decreases. With several percent of friction load, the motor stops completely.

Making a short circuit across 1CN-8 and -20 generates a proportional drive reference. (Refer to Figs. 4.3 and 5.10.) If proportional drive is not used, 1CN-8 and -20 should be kept open and not shorted.

NOTE

Motor rotates when speed reference is not 0 V even if proportional drive is input.

5.5.2 Overtravel Prevention Circuit (F-OT, R-OT)

The overtravel prevention circuit is used to stop the forward running of the motor and reverse running. This circuit stops output voltage to drive the motor. Therefore, the motor will coast to a stop. If braking is required, set the speed reference voltage to 0 V (When F-OT and R-OT circuits operate at the same time, the motor will coast.) or use the dynamic braking circuit circuit (generator control).

5. 5. 2 Overtravel Prevention Circuit (F-OT, R-OT) (Cont'd)

If connection between 1CN-6 and -5 is opened, then reverse rotation of the motor stops. If connection between 1CN-7 and -19 is opened, forward rotation stops. Therefore, if connection of 1CN is neglected, this circuit becomes active and stops forward and reverse rotations.

If overtravel prevention circuit becomes active, INHI LED in SERVOPACK lights. Speed amplifier performs PI drive while overtravel prevention circuit is active. When overtravel prevention circuit is released, speed reference should be set to 0 V or use proportional drive reference to avoid danger due to instantaneous high-speed rotation.

NOTE

When overtravel prevention circuit is not used, short circuit across 1CN-5 and -6 and across 1CN-7 and -19.

5. 5. 3 Base-off Input Circuit

When speed reference voltage of 0 V is applied for an extensive period in speed control mode (where position feedback is not present), motor cannot be stopped completely due to the effect of drift. By using the base-off input circuit, forward/reverse base-off and proportional drive reference can be executed simultaneously.

- If a short circuit is formed across 1CN-13 and -14, the activity of the main circuit power transistor in SERVOPACK will be stopped completely.
- If base-off is applied during rotation, the motor will coast.
- To avoid abnormal motor rotation in transition state, power should be turned on or off in base-off state. When f/V converter is used, base-off must be applied.
- When motor circuit is disconnected using a magnetic contactor, base-off must be applied.
- When base-off is not applied, connection between 1CN-13 and -14 should be opened.
- If base-off circuit is in operation, PI drive of speed amplifier is automatically switched to proportional drive.
- If base-off circuit is in operation, INHI LED of SERVOPACK lights. If control power in Servopack is in transition, base-off automatically functions until power supply rises sufficiently to protect SERVOPACK. Thus, the indicating lamp INHI will light during control power transition.

Base-off state is kept for 20 to 40 ms after base-off signal is terminated.

5. 5. 4 Protective Circuit

Some functions are provided to protect SERVOPACK and motor from malfunctions. If any trouble is detected, correct the malfunction and restart operation. Table 5.2 shows the trouble detecting functions.

Protection will not be provided in the following. Connections (especially, connectors and power transformer) should be checked carefully. Refer to Par. 13.2.2 Flow Chart.

(1) Motor runs uncontrollably in the following cases:

- TG or PG circuit disconnection
- Short circuit in TG or PG circuit
- TG polarity error
- PG connection error
- TG or f/V converter output connection error
- f/V converter setting error
- Usage out of f/V converter I/O linearity range (i.e. usage in overspeed state)

(2) Following may cause SERVOPACK failure

- Power voltage over
- Power transformer wiring error
- Motor brushes worn
- Motor not meeting specifications
- Condensation present on contacts when power is applied.

Table 5.2 Trouble Detecting Functions

Trouble	Cause	Symptom
Overcurrent (OC)	• Defective insulation of the motor. • Defect in current detection circuit.	• Overcurrent flow in the main circuit.
Overload (OL)	• Overload of driven machine	• Overload condition of motor and SERVOPACK
Heat Sink Overheat (OH)	• Increase of heat generation loss due to defective cooling conditions or defect in main circuit elements.	• Overheat of heat sink
Blown Fuse (FU)	• Defect in main circuit elements	• Blown fuse of SERVOPACK

Note

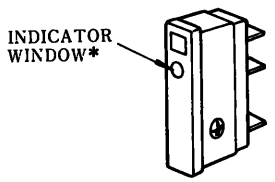
1. If overcurrent or overload is detected, ALARM LED lights, base-off occurs automatically in SERVOPACK, activity of power transistor stops, and alarm is output (Refer to Figs 5 10 to 5.13). These can be reset by disconnecting control power supply
2. Contact output signal will be sent when heat sink overheat and blown-fuse are detected. Signal processing will not be accomplished in SERVOPACK.

5.5.5 Display

SERVOPACK type CPCR-FR□RB is provided with indicating functions as shown in Table 5.3.

Table 5 3 LED Indication Specifications

Indicating Function	LED Name	Indicating Color	Lighting Conditions
Control Power Supply	POWER	Green	Control power is supplied
Trouble	ALARM	Red	• Overload detection circuit operates. • Overcurrent detection circuit operates.
Power Transistor Stopping	INHI	Red (Casing white)	• Base-off is supplied. • Overtravel prevention circuit operates. • ALARM circuit operates. • Control power is in transition state. • Control supply voltage drops. • Main supply voltage excessively high.



*If the fuse is blown, the indicator window on the fuse casing shows white to indicate a blown fuse

Fig 5 14 Indication of Blown Alarm Fuse

5.6 PRECAUTIONS FOR APPLICATION

5.6.1 Minus Load

The motor is rotated by the load; it is impossible, when using type CPCR-FR□RB, to apply brake (regenerative brake) against this rotation and achieve continuous running.

Example: Driving a motor to lower objects (with no counterweight)

Since SERVOPACK has the regenerative brake capability of short time (corresponding to the motor stopping time), for applications of minus loads, contact your Yaskawa representative.

5.6.2 Load Inertia (GD^2)

The allowable load inertia GD^2 converted to the motor shaft is listed in Table 1.3. (Refer to Note 5 of Table 1.5.) If the allowable inertia is exceeded, motor may enter a free-running state during deceleration or SERVOPACK may malfunction. If this occurs, use SERVOPACK type CPCR-MR□C and a regenerative processing unit type JUSP-RG.

When SERVOPACK type-FR□RB is used, take the following actions.

- Decrease the maximum speed.
- Drop the supply voltage for main circuit.

NOTE

If current is decreased, it will increase main circuit voltage resulting in SERVOPACK failure.

5.6.3 High Voltage Line

If supply voltage is other than 100/200 or 110/220 VAC, power transformer should be changed.

5.6.4 Power Line Protection

A fuse is contained in the main circuit AC input of SERVOPACK type CPCR-FR□RB. This fuse protects power line should any trouble occur in SERVOPACK and protects the system from fire. (It is not used for transistor protection.) This fuse is not effective for the trouhles which might occur between power source and power input terminal of SERVOPACK (i.e. Those due to power transformer wiring errors, power transformer failures, or SERVOPACK connection errors).

Therefore, use circuit breakers (MCCB) or fuse depending on the number of SERVOPACKS being used. When a fuse or MCCB is used, a quick-melting fuse cannot be used, because the SERVOPACK type (PCR-FR□RB uses a capacitor-input power supply.

5.6.5 Lightning Surge Protection

Any protection for surge voltage (and current) due to lightning is not provided in SERVOPACK type CPCR-FR□RB. It is recommended that a surge absorber be connected to the primary side of power transformer. Fig. 5.15 shows an example of surge absorber (type ERZ-A25EL441 made by Matsushita Electronic Components Co., Ltd).

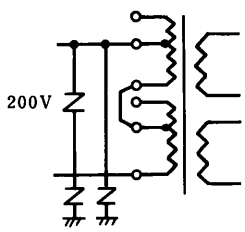


Fig. 5.15 Example of Surge Absorber

5.6.6 Remedy for Radio Frequency Interference

SERVOPACK type CPCR-FR□RB is not provided with protection from radio frequency interference.

If the controller is troubled by radiowaves, connect a noise filter to power supply (single-phase, 100 or 200 VAC). See Table 5.4.

5.6.7 Speed Detector (TG, PG)

If a motor with speed detector is not used, a speed detector must be installed on the motor shaft. If it should be installed on the load shaft, actual motor speed cannot be detected immediately, due to backlash of gears or slipping of belts and shifting of loads, so that normal drive cannot be achieved due to vibration or abnormal movements.

5.6.8 Use of SERVOPACK Type CPCR-MR[ ]C

SERVOPACK type CPCR-MR[ ]C should be used in the following cases:

- When external current control function is required.
- When a motor being used is types UGJMED, UGCMED, or UGHMED.
- When load GD^2 exceeds three times of motor GD^2 (Type JUSP-RG[ ] must be used).
- When a function which prevents motor from running uncontrolably due to TG trouble is required (Type JUSP-PT [ ] must be used).

5.6.9 When Multiple Motors are driven by One SERVOPACK

Different types of motors cannot be driven by one SERVOPACK. To prevent troubles, do not connect two motors in series or in parallel with one SERVOPACK.

5.7 PRECAUTIONS OF OPERATION

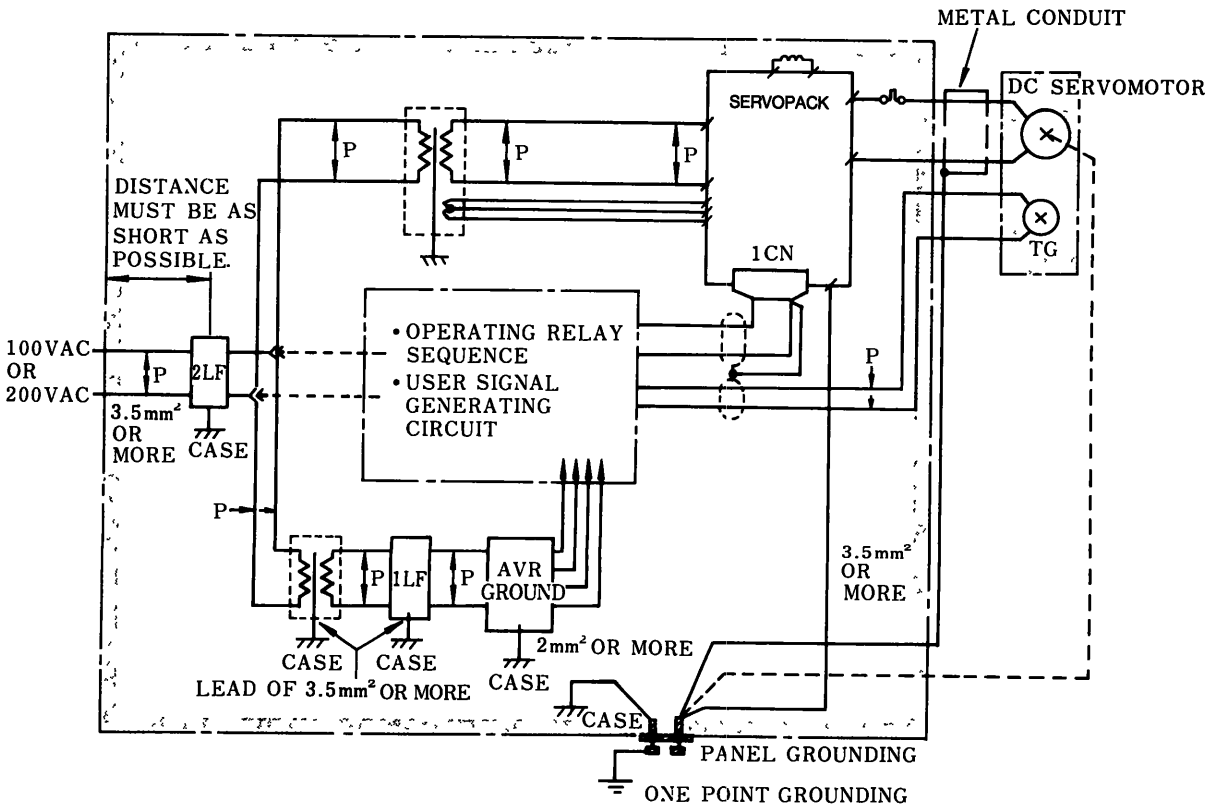
5.7.1 Noise Treatment

SERVOPACK type CPCR-FR[ ]RB uses a power transistor in the main circuit. When these transistors are switched, the effect of $\frac{di}{dt}$ or $\frac{dv}{dt}$ (switching noise) may sometimes occur depending on the wiring or grounding method.

To reduce switching noise as much as possible, the recommended method of wiring and grounding is shown in Figs. 5.16 and 5.17.

For protecting the speed reference circuit from noise, use an isolator.

Example: V/V isolator type M3000B-R, 100VAC±10V input made by M.T.T Ind. Instrument Co.



Note Use wires of 3 5mm^2 or more for grounding to the case (preferably flat-wover copper wire)

Fig. 5.16 Grounding Method

(1) Grounding method

· Motor frame grounding

When the motor is on the machine side and grounded through the frame, $C_f \frac{dv}{dt}$ current flows from the PWM power through the floating capacity of the motor. To prevent this effect of current, the motor frame should be directly grounded.

· SERVOPACK SG 0 V

Noise may remain in the input signal line, so make sure to ground SG 0 V. When motor wiring is contained in metal conduits, the conduits and boxes musut be grounded. The above grounding uses one-point grounding.

· Grounding for multi-axis drives

Ground all ground terminals of the SERVOPACK at one point of the ground panel.

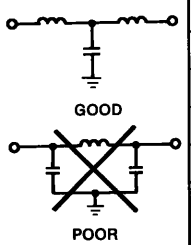
(2) Noise filter installation

When noise filters are installed to prevent noise from the power line, the preventive type must be used. The recommended noise filter is shown in Table 5.4. The power supply to peripherals also needs noise filter.

NOTE

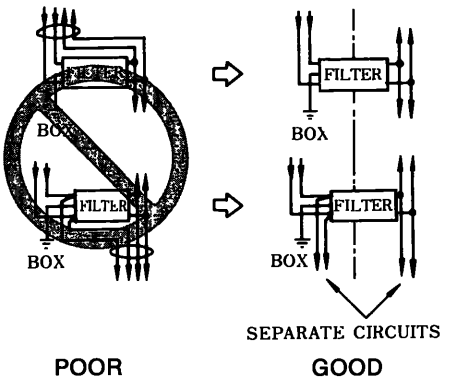
If the noise filter connection is wrong, the effectiveness decreases greatly. Observing the precautions, carefully connect them as shown in Fig. 5.17.

Table 5.4 Recommended Noise Filter

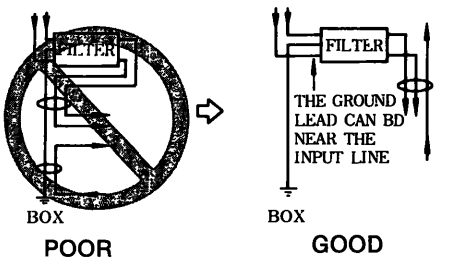
Applicable Noise Filter	Recommended Noise Filter	
	Type	Specifications
	LF-205F	Single phase 200, 100 VAC class 5 A
	LF-210	Single phase 200, 100 VAC class 10 A
	LF-215	Single phase 200, 100 VAC class 15 A
	LF-220	Single phase 200, 100 VAC class 20 A
	LF-230	Single phase 200, 100 VAC class 30 A
	LF-240	Single phase 200, 100 VAC class 40 A
	LF-250	Single phase 200, 100 VAC class 50 A

Note· Noise filter made by Tohoku Kinzoku Ind.,Co.

(a) Separate the input and output leads Do not bundle or run them in the same duct



(b) Do not bundle the ground lead with the filter output line or other signal lines or run them in the same duct.



(c) Connect the ground lead singly to the box or the ground panel.

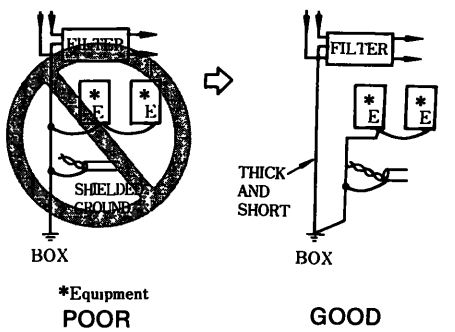
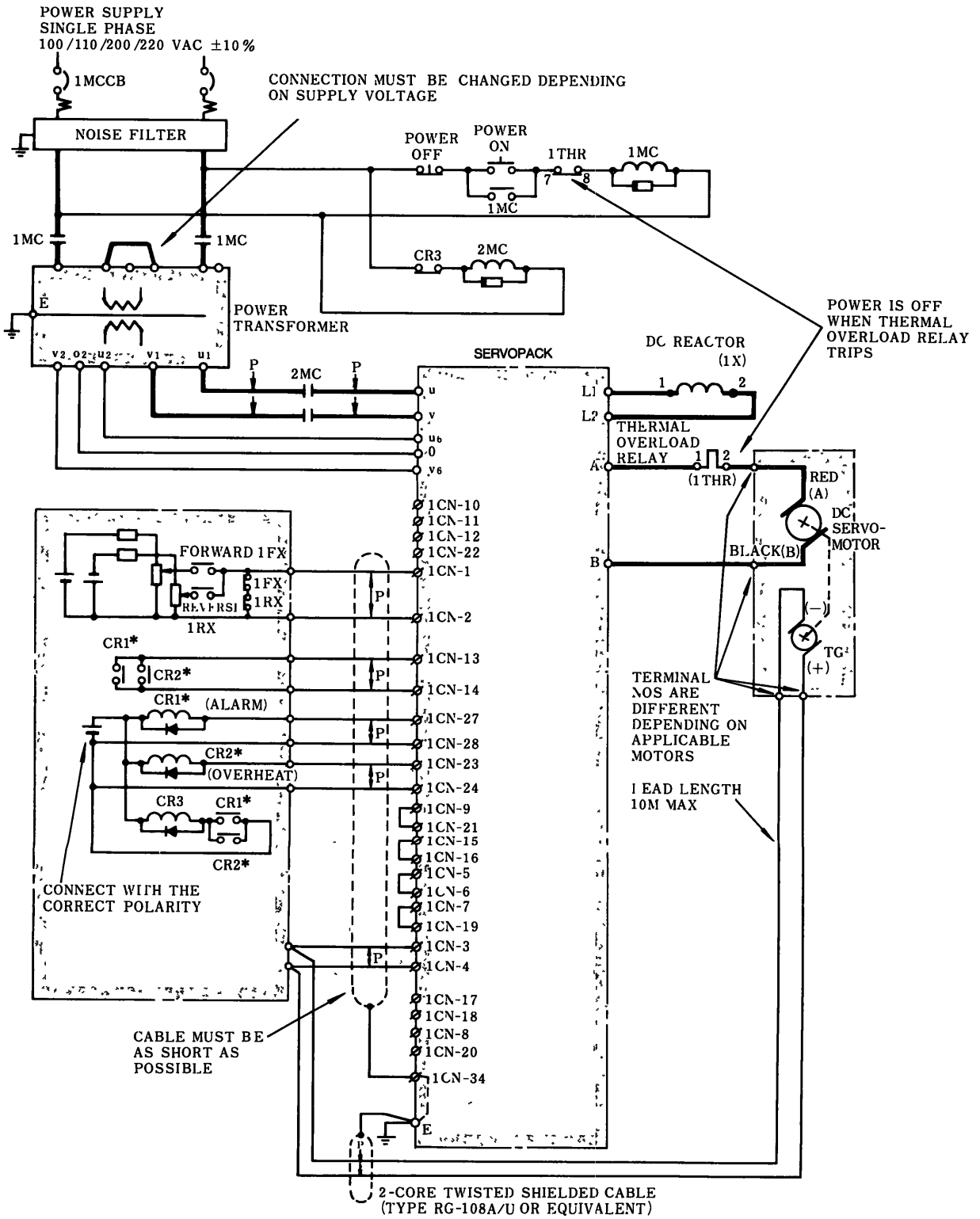


Fig. 5.17 Noise Filter Connection

5.8 CONNECTION DIAGRAM OF SERVOPACK AND PERIPHERAL EQUIPMENT



*Keep relays

Note The above example is shown for TG feedback

Fig. 5.18 Example of Connection Diagram of SERVOPACK Type CPCR-FR[ ]RB with a Servomotor and Peripherals

5.8.1 Power Transformer Connection

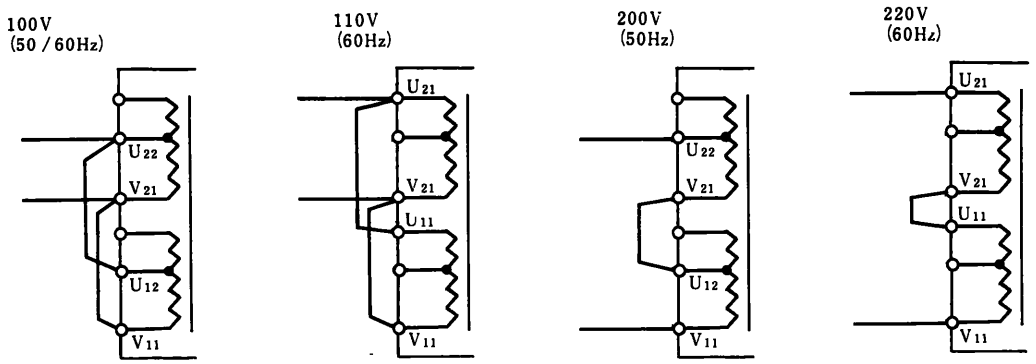
100, 110, 200 and 220 VAC can be connected (using taps) to a standard power transformer.

(1) Connections at primary side of power transformer

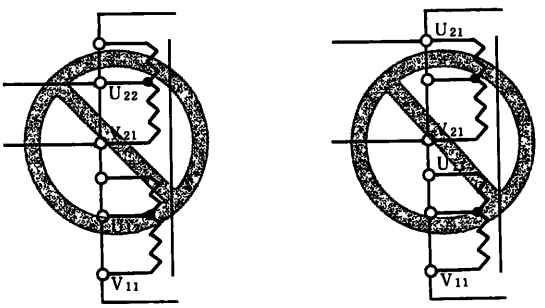
The primary side of the power transformer must be connected, depending on supply voltage, as shown in Fig. 5.19 (a).

CAUTION

If supply voltage is 100 or 110 VAC, connections shown in Fig. 5.19 (c) must be avoided to prevent the transformer from burnout. To prevent the transformer from burnout, never misread transformer terminal numbers as shown in Fig. 5.19 (c). To avoid unexpected troubles, if supply voltage is 200 or 220 VAC, do not take out 10, 100, or 110 VAC from the power transformer using taps of primary winding.

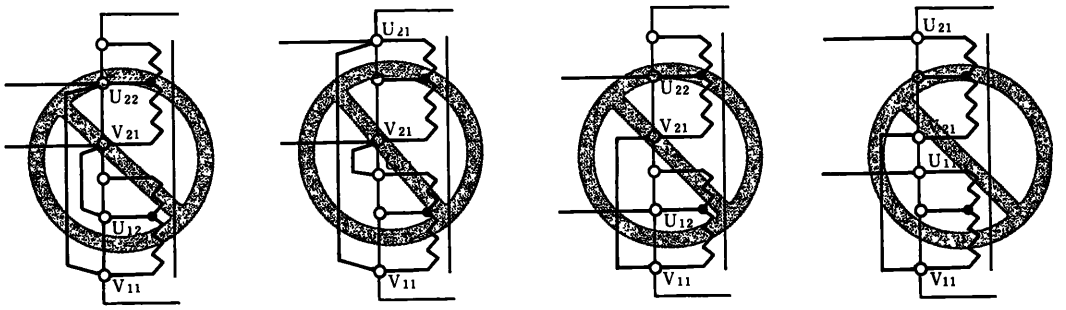


(a) Good Connection



Note Use of only half of the primary side is not allowed

(b) Poor Connection
(When Supply Voltage is 100V or 110V)



(c) Poor Connection
(When Terminal Nos of Power Transformer are Wrong)

Fig. 5.19 Power Transformer Connection

5. 8. 1 Power Transformer Connection (Cont'd)

(2) Connections at secondary side of power transformer

The secondary side of the power transformer for SERVOPACK type CPCR-FR□RB must be connected as shown in Fig. 5.20. Table 5.5 shows the secondary voltage of power transformer.

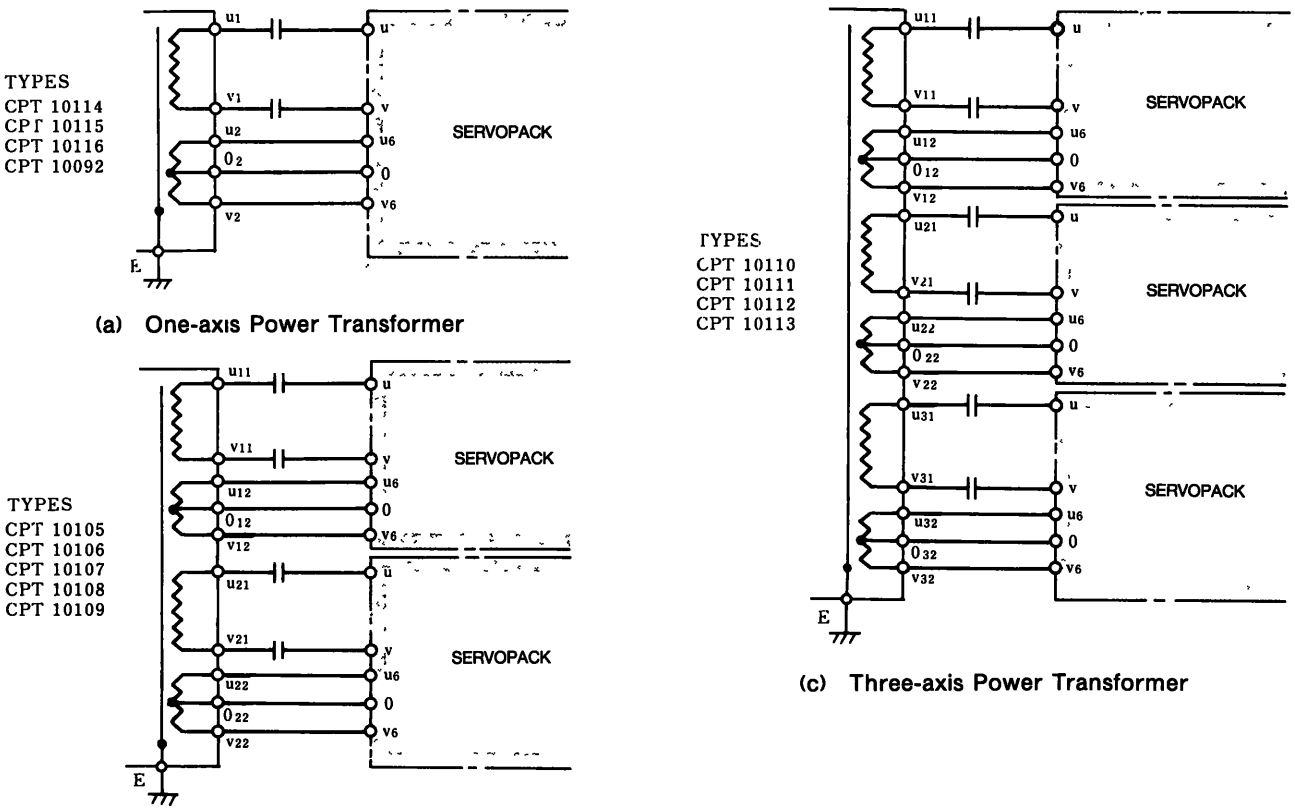


Fig. 5 20 Connections at Secondary Side of Power Transformer

Table 5 5 Secondary Voltage of Power Transformer

Power Transformer Type CPT	u_1–v_1	u_2–0_2–v_2	u_{11}–v_{11}	u_{12}–0_{12}–v_{12}	u_{21}–v_{21}	u_{22}–0_{22}–v_{22}	u_{31}–v_{31}	u_{32}–0_{32}–v_{32}
10114	40V	18-0-18V	—	—	—	—	—	—
10115	45V	18-0-18V	—	—	—	—	—	—
10092	50V	18-0-18V	—	—	—	—	—	—
10116	85V	18-0-18V	—	—	—	—	—	—
10105	—	—	40V	18-0-18V	40V	18-0-18V	—	—
10106	—	—	45V	18-0-18V	45V	18-0-18V	—	—
10107	—	—	50V	18-0-18V	50V	18-0-18V	—	—
10108	—	—	85V	18-0-18V	85V	18-0-18V	—	—
10109	—	—	45V	18-0-18V	40V	18-0-18V	—	—
10110	—	—	40V	18-0-18V	40V	18-0-18V	40V	18-0-18V
10111	—	—	45V	18-0-18V	45V	18-0-18V	45V	18-0-18V
10112	—	—	50V	18-0-18V	50V	18-0-18V	50V	18-0-18V
10113	—	—	85V	18-0-18V	85V	18-0-18V	85V	18-0-18V

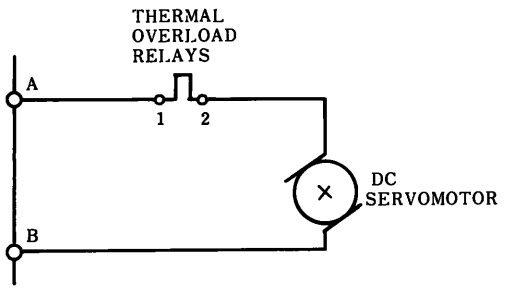
For one-axis
For two-axis
For three-axis

Note: For applications of power transformers, refer to Tables 4 1 and 4. 2.

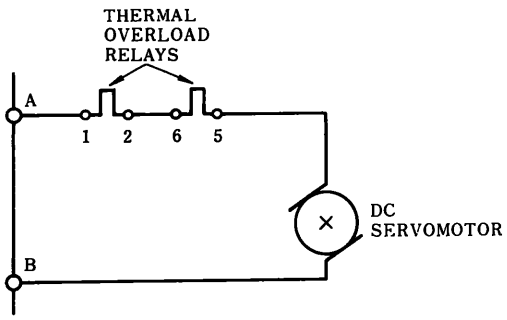
5.8.2 Thermal Overload Relay Connection

If a thermal relay is connected only to the main circuit, it will be ineffective. Make a sequence such that the operation can be stopped at the auxiliary contact of the thermal relay. Note that power supply or motor circuit cannot be directly turned on or off at the auxiliary contact because of small contact capacity.

In case of spring-return type thermal relay, motor may rotate rapidly (depending on the sequence) when the relay is reset. To avoid rapid rotation, speed reference during thermal relay operation should be set to 0V.



(a) For Thermal Overload Relay Type RHP-15/[ ]



(b) For Thermal Overload Relay Type RH-35/[ ]HV

Note Refer to Par 8 2 for terminal symbols of contacts

Fig 5 21 Thermal Overload Relay Connection

5.8.3 DC Reactor Connection

DC reactor is connected across terminals L1 and L2 of SERVOPACK Both terminals 1 and 2 of the DC reactor can be connected to either terminal L1 or L2.

5.8.4 f/V Converter Connection

Refer to the bulletin for f/V converters (TSE-C717-10.10) for the connections of f/V converter, PG, and power supply for f/V converter and PG.

5.9 APPLICATION

5.9.1 Dynamic Braking (DB) Circuit for Emergency Stop

When an external DB circuit for emergency stop is used, make and break the DB circuit in the sequence shown below.

Fig. 5.22 shows DB circuit for emergency stop and Fig. 5.23 shows timing chart when making and breaking DB circuit for emergency stop.

- Input the external base off with an emergency stop signal (short circuit across 1CN-13 and -14).
- Release DC output for DC motor (MC1: OFF).
- Input DB circuit (MDB: OFF).
  (Motor stop, Speed reference: OV)
- Release DB circut (MDB: ON).
- Input DC output for DC motor (MC1: ON).
- Release the external base off (Release across 1CN-13 and -14).

NOTE

1. Arrow ↓ shows a delay time greater than the operating time (10 ms) of one relay.
2. Release the DB circuit after setting the speed reference to 0V.

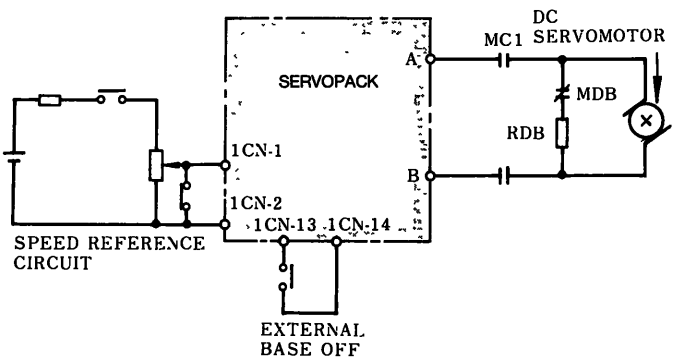
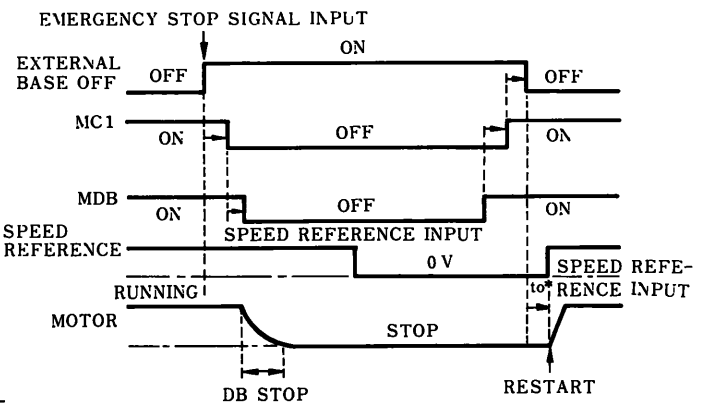


Fig 5.22 DB Circuit for Emergency Stop



*Input speed reference 0.1s or later

Note Arrow → shows a delay time greater than the operating time of one relay

Fig 5 23 Timing Chart when making and braking DB Circuit for Emergency Stop

5. 9. 1 Dynamic Braking (DB) Circuit for Emergency Stop (Cont'd)

(2) DB resistor

Table 5.6 shows an example of DB resistor when it is used within rated speed. In actual application, operating speed, allowable motor current, and allowable rotation by inertia should be considered in selection.

Table 5 6 Example of DB Resistor

Servomotor Type	DB Resistor Type* (RDB)	DB Contactor Type (MDB)
PMES-09A2	QHZ 10W 1Ω × 2p†	RA-6E2TU (made by Yaskawa Electric Co.,Ltd) NC × 3p†
PMES-12A2	QHZ-Y 30W 1Ω	
PMES-16A2	QHY 60W 2Ω	
UGRMEM-01SA	QHZ 10W 1Ω×2p†	
UGRMEM-02SA UGRMEM-02MA UGRMEM-04SA	QHZ 10W 1Ω × 2s‡	
UGRMEM-04MA UGRMEM-08SA	QHY 60 W 2Ω	
UGRMEM-08MB	QHY 60W 2Ω×2s‡	

*Made by Japan Resistor Mfg. Co.,Ltd.
†Parallel connection
‡Series connection

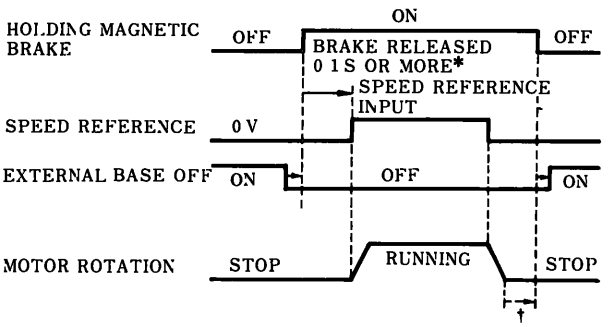
5. 9. 2 Connection for Reverse Motor Running

If the machine construction requires that the normal forward reference is used for reverse motor running and the normal reverse reference for forward running, the following connection should be provided.

- When TG is used, switch the connection of terminals A and B as well as 1CN-3 and 4 of Servopack.
- When PG is used, switch the connection of terminals A and B of SERVOPACK and reverse the f/V converter input (phase A and phase B of PG). Do not switch the connection of f/V converter output (1CN-15 and -16 of SERVOPACK).

5. 9. 3 Use of Servomotor with Holding Magnetic Brake

When servomotor with holding magnetic brake is used, use the following timing for ON and OFF signals. The holding magnetic brake is released by current conduction.



*Input speed reference 0 1s or more after the brake release reference has been input
† Apply brake after the motor has stopped completely (Do not use the brake to decelerate the motor)
Note Arrow → shows a delay time greater than the operating time (10ms) of one relay

Fig 5.24 Holding Magnetic Brake ON-OFF Timing

6. RECEIVING

This unit has been put through severe tests at the factory before shipping. After unpacking, however, check the following:

- SERVOPACK and servomotor ratings meet your requirements. Check the nameplate on servomotor and the SERVOPACK type designation.
- No damage while in transit.
- Bolts or screws are not loose.

If any part of the units is damaged or lost, immediately notify your Yaskawa representative, giving full details and nameplate data.

7. PRECAUTIONS

7. 1 INSTALLATION

SERVOPACK type CPCR-FR□RB can be mounted on a base or a panel. It is mounted on a panel as standard when shipping. To change to base-mounted type, change the support position as shown in Fig. 7.1. Mounting screws of base support are attached to the SERVOPACK.

7. 1. 1 Mounting Direction

Mount the unit vertically on the wall using the mounting holes (4) on the base plate, with main terminals at the bottom. (Fig. 7.1)

NOTE

Spare fuse should not be left dangling to avoid unexpected troubles due to short circuiting.

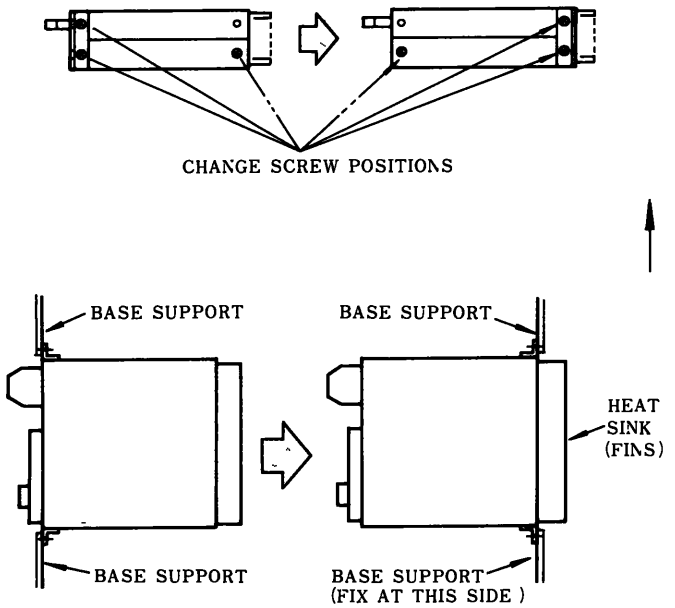


Fig 7.1 Mounting Direction
(When Changing to Base-mounted Type)

7.1.2 Location

(1) When cooled by external fan:

· When one SERVOPACK is installed:

SERVOPACK type CPCR-FR05RB must be cooled by external fan. Direct cooling air, using 125□ fan, from the back or from the bottom of the heat sink. (Fig. 7.2)

· When three or more SERVOPACKS are installed:

When three or more SERVOPACKS are installed, cooling efficiency will be reduced. Install an external fan at the back or at the bottom of the heat sink to cool the SERVOPACK.

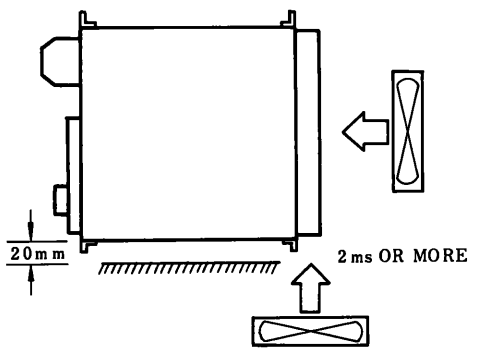


Fig. 7.2 Cooling Method

(2) When installed in a panel:

Keep the temperature around SERVOPACK at 55°C or below. Avoid blowing cooling air directly against the transistors on the printed circuit board. (Fig. 7.3)

For SERVOPACK type CPCR-FR01RB, keep the temperature at 50°C or below. If temperature is 55°C, operating current will be 80% or less of the rated current.

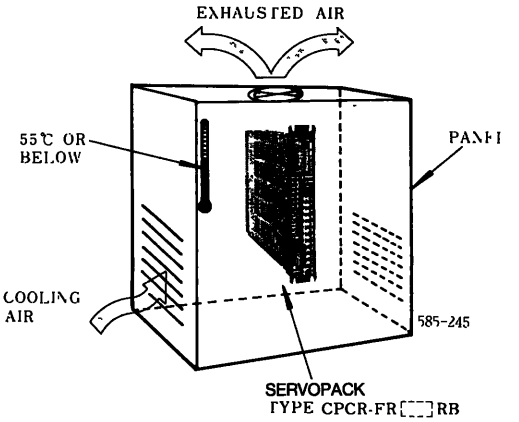


Fig 7 3 Typical Layout for
Panel Mounting

(3) When installed near a heat source:

Keep the temperature around SERVOPACK below 55°C. (Fig. 7.4)

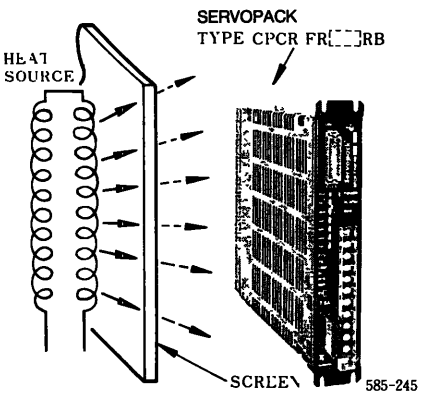


Fig 7 4 Protection against
Heat Radiation

(4) If subjected to vibration:

Mount the unit on shock absorbing material.

(5) If corrosive gases are present:

Avoid the location where corrosive gases exist as it may cause extensive damage with long use, especially:

· Poor commutation of the motor commutator.

· Defective switching operation of contactors and relays.

(6) Under unfavourable atmospheric conditions:

Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust or metallic particles.

7.2 WIRING

7.2.1 Selection of Cable Size

Cable size should be determined according to the rated currents of each SERVOPACK type shown in Table 7.1. Table 7.2 shows recommended cable sizes for the use at ambient temperature of 40°C, with 3 cables harnessed in a bundle, and at the rated current of SERVOPACK, shown in Table 7.1.

Control circuit connector leads should be used as follows:

Soldering type — 0.2 mm leads
Caulking type — 0.2 to 0.3 mm leads

Table 7 1 Rated Current of SERVOPACK Type CPCR-FR□RB

Circuit Terminal		SERVOPACK Type / Terminal Symbol	Rated Current A			AC/DC
			CPCR-FR01RB	CPCR-FR02RB	CPCR-FR05RB	
Main Circuit	AC Power Supply	u, v	7	9	11.5	AC
	Control Circuit Power Supply	u_6, 0, v_6	0.18	0 24	0.24	AC
	Motor and DC Reactor	A, B, L_1, L_2	5.6	6.4	7.5	DC
Control Circuit	Blown Fuse Detecting Circuit	23–24	50mA max, 30V			DC
	ALARM Detecting Circuit	27–28				
	Speed Reference Input	1–2	10mA max			DC
	TG Circuit	3–4	10mA max			DC
	Overtravel Circuit	5–6, 7-19	2.5mA			DC
	Proportional Drive	8–20	2.5mA			DC
	Aux Speed Reference Input	9–21	10mA max			DC
	±8V Output	10–11, 12–22	10mA max			DC
	Base off	13–14	3mA			DC
	f/V Feedback Input	15–16				
	Optional	17–18				

Table 7.2 Recommended Cable Size

Circuit Terminal		Terminal Symbol	Cable Size mm²
Main Circuit	AC Power Supply	u, v	2 0 or more (Heat-resistant cable)
	Motor and DC Reactor	A, B, L_1, L_2	
	Control Circuit Power Supply	u_6, 0, v_6	1.25 or more (Polyvinyl chloride cable)
Control Circuit	Blown Fuse Detecting Circuit	23–24	Two-core twisted shielded cable (Cable greater than 0.3mm² must not be used for connector type MR-34RMA made by Honda Tsushin Co.,Ltd.)
	ALARM Detecting Circuit	27–28	
	Speed Reference Input	1–2	
	Aux Speed Reference Input	9–21	
	f/V Feedback Input	15–16	
	TG Circuit	3–4	
	Overtravel Circuit	5–6, 7–19	
	Base off	13–14	
	Proportional Drive	8–20	
	±8V Output	10–11	
	Optional	12–22	
	Junction Terminal for Grounding	E	2.0 or more (Polyvinyl chloride cable)

Note:
1. For the main circuit, use cables of 600V or more.
2. Where cables are bundled or put in a duct (unplasticized polyvinyl chloride conduit or metallic conduit), determine the cable size considering the current drop rate of the cables.
3 Where the ambient temperature (in the panel) is high (40 to 55°C), use heat-resistant cables
4 For the wiring of TG circuit, use 2-core twisted shielded cables (RG-108A/U or equivalent) through TG to user signal generating circuit unit and use 0.2mm² twisted cables through the unit to SERVOPACK (1CN) after jointing cables.

7.2.2 Wiring Precautions

The following precautions should be taken for wiring.

(1) For DC power line, use cables larger than 2 mm^2. The cable should be as short as possible.

(2) For ground line, cable should be as heavy as possible to provide class 3 ground (ground resistance 100Ω or less). Make sure to ground at one point.

(3) To prevent malfunction due to noise, take the following precautions:

- Place the noise filter and SERVOPACK as near as possible to each other.
- Make sure to insert a surge absorbing circuit into the relay, magnetic contact, and solenoid coils.
- Run the power line and signal line, holding the distance to 30 cm or more; do not run them in the same duct or in a bundle.
- When the same power is used for SERVOPACK, as for an electric welder or electrical discharge machine or when a high-frequency noise source is present in the vicinity, use filters in the power and input circuits.
- The SERVOPACK uses a switching amplifier, and spurious noise may be present in the signal line. Never leave the termination of the analog input wiring open.

(4) Remedy for radio frequency interference (R.F.I)

SERVOPACK is not provided with protected from radio frequency interference. If the controller is adversely affected by radio waves, connect a noise filter to power supply.

(5) The signal line uses cables whose core is extremely fine (0.2 to 0.3 mm^2). Avoid using excessive force which may damage these cables.

(6) Heat sink of type CPCR-FR□RB may be heated up to 90°C. Wiring leads should not come into direct contact with the heat sink.

7.2.3 Power Loss

The power loss of SERVOPACK is shown in Table 7.3.

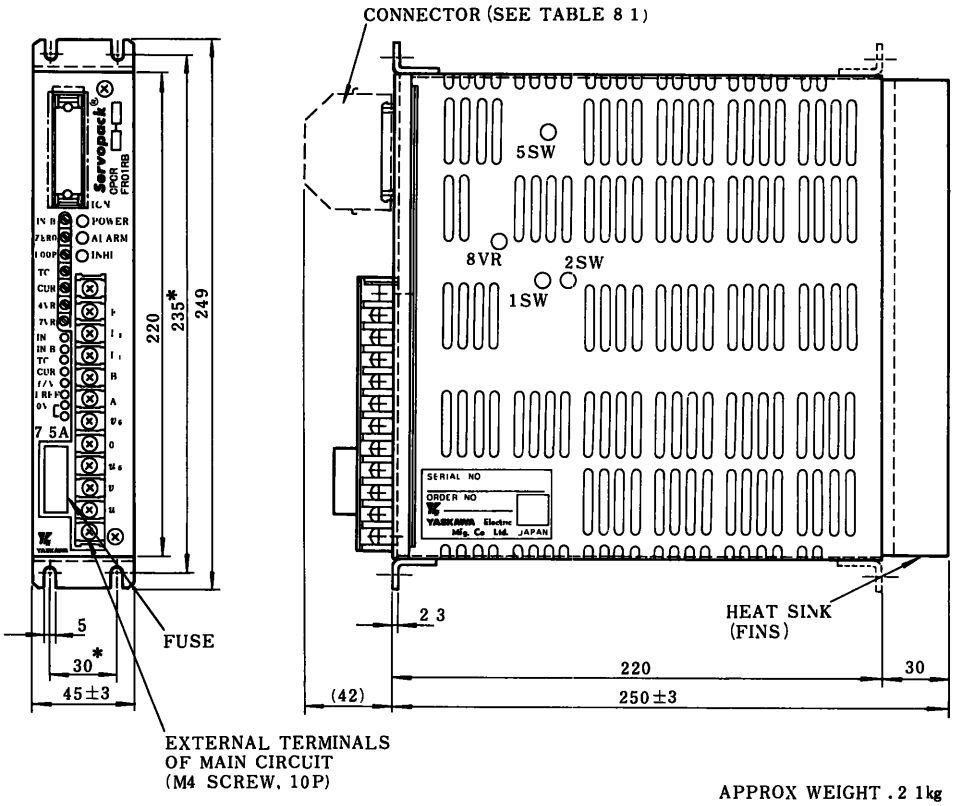
Table 7.3 Power Loss

SERVOPACK				Optional Components		Total Power Loss W
Type CPCR-	Output Current A	Output Voltage V	Power Loss W	Power Transformer W	DC Reactor W	
FR01RB	5.6	30	35	25	11	71
FR02RB	6.4	42	50	37	13	100
FR05RB	7.5	81	100	54	22	176

8. DIMENSIONS in mm

8.1 SERVOPACK

8.1.1 Type CPCR-FR01RB□□



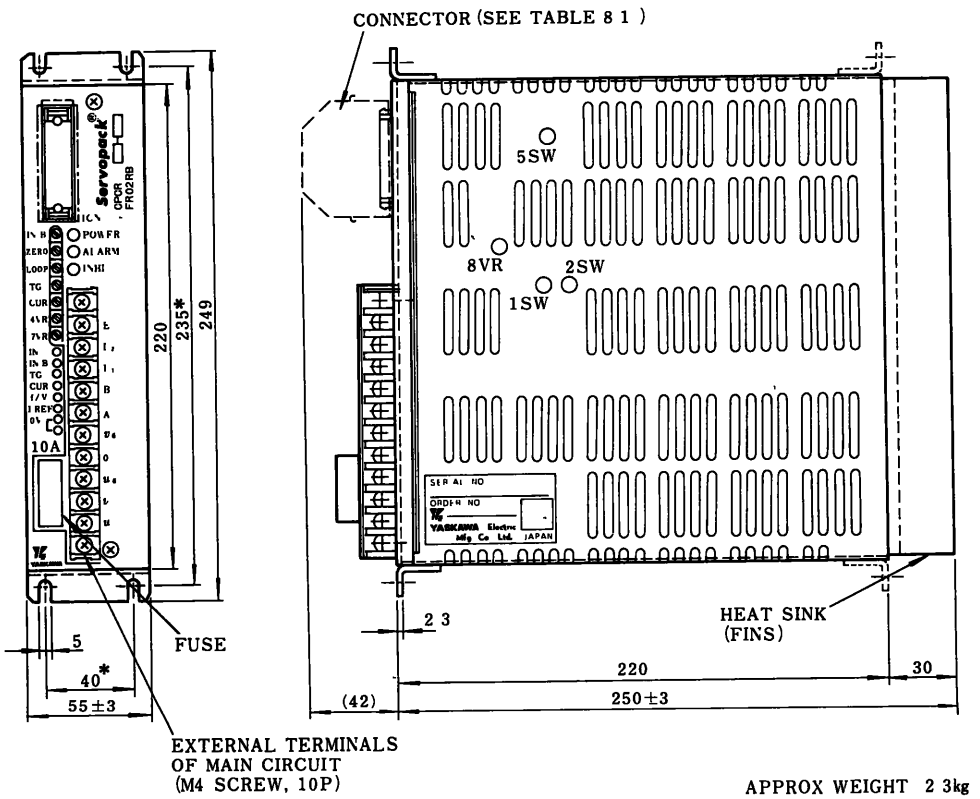
APPROX WEIGHT . 2 1kg

Table 8.1 Connector

Connector Type used in SERVOPACK	Applicable Receptacle Type		
	Manufacturer	Receptacle (Soldered Type)	Case
MR-34RMA (Right angle 34P)	Honda Tsushin Co., Ltd.	MR-34F*	MR-34L*

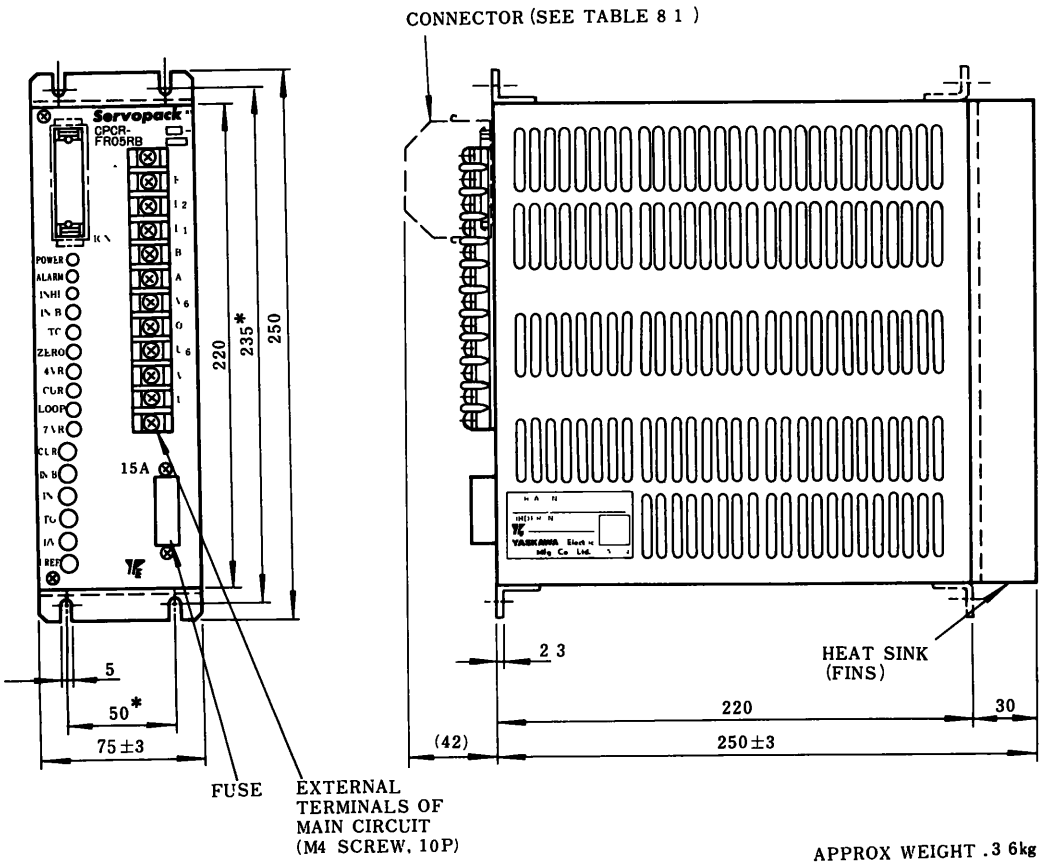
*Attached to SERVOPACK when shipping

8.1.2 Type CPCR-FR02RB□



APPROX WEIGHT 2 3kg

8.1.3 Type CPCR-FR05RB□

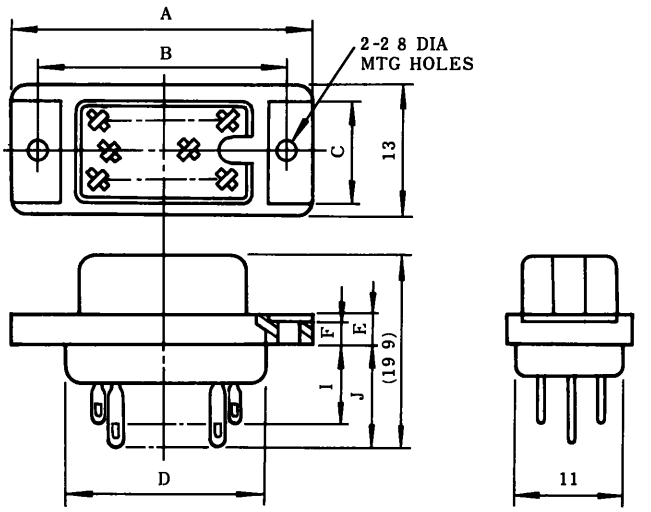


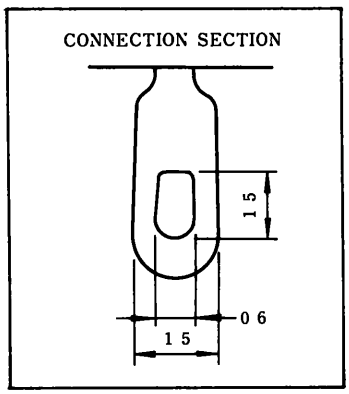
APPROX WEIGHT .3 6kg

8.1.4 Spare Parts

Type MR-34F receptacle, type MR-34L receptacle case, and spare fuse are provided (one for each) for SERVOPACK type CPCR-FR□RB.

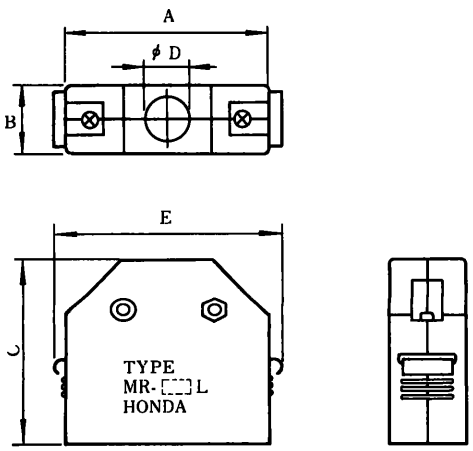
(1) Receptacle (Soldered type)





Type	No of Cores	A	B	C	D	E	F	G	H	I	J
MR-34F	34	45.8	40 8	10	35 3	3	2 4	8 5	6	8.4	10 9

(2) Case

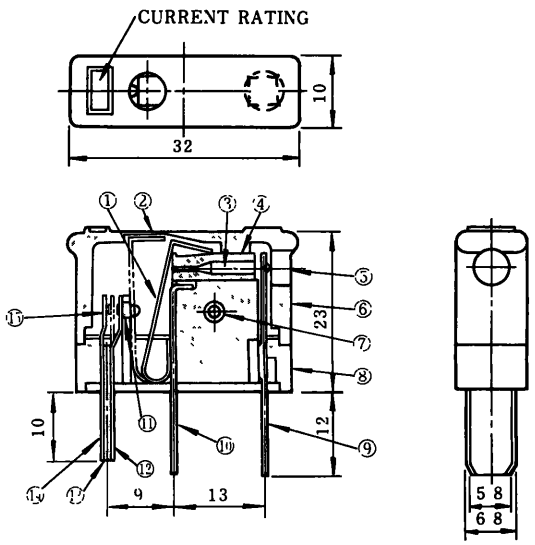


Note Spring lock and screw lock are available

Type	No of Cores	A	B*	C	φD	E
MR-34L	34	52.3	18	40.5	15	(57.9)

*Maximum size

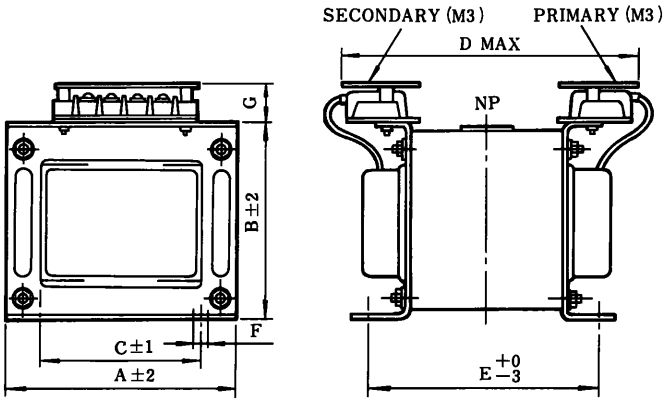
(3) Alarm fuse



APPROX WEIGHT : 9 5kg

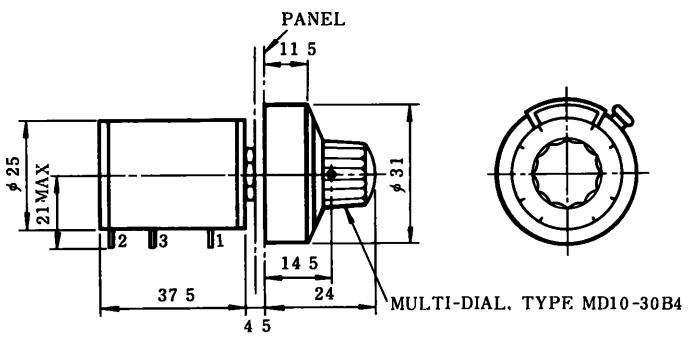
No	Name	No	Name
①	INDICATION SPRING	⑩	LOAD TERMINAL (INDICATION SPRING TERMINAL)
②	INDICATOR WINDOW		
③	FUSE WIRE	⑪	ALARM BUTTON
④	FUSE TUBE	⑫	ALARM SPRING TERMINAL
⑤	EXHAUST PORT HOLE		
⑥	COVER	⑬	ALARM SEPARATOR
⑦	COVER FIXING SCREW	⑭	ALARM TERMINAL
⑧	BODY	⑮	ALARM CONTACT
⑨	POWER TERMINAL (FIXED TERMINAL)		

8.2 POWER TRANSFORMER

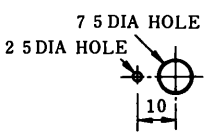


Type	Capacity VA	A	B	C	D	E	F	G	Approx Weight kg
CPT10114	210	115	104	81	135	90	7	30	5.2
CPT10115	310	130	117	90	140	95	7	30	6.2
CPT10092	510	130	117	90	165	120	7	30	9.5
CPT10116	1010	150	160	104	180	125	7	30	16
CPT10105	413	130	117	90	140	95	7	30	6.7
CPT10106	613	130	117	90	165	120	7	30	9.5
CPT10107	1018	150	160	104	170	125	7	30	16
CPT10108	2018	200	192	137.5	200	150	10	30	30
CPT10110	620	150	160	104	150	105	7	30	12.5
CPT10111	920	150	160	104	170	125	7	30	16
CPT10112	1520	185	173	125	200	175	10	30	27
CPT10113	3030	240	195	150	250	200	10	30	50

8.3 SPEED SETTING POTENTIOMETER (TYPE 25HP-10B)

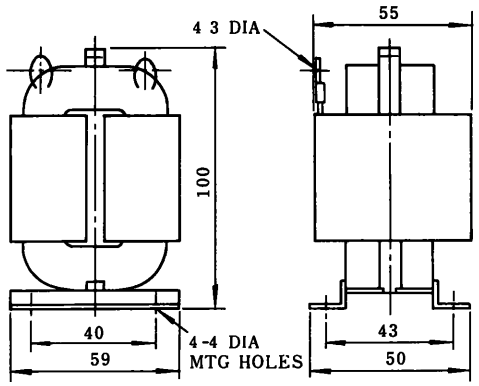


Drilling Plan



8.4 DC REACTOR

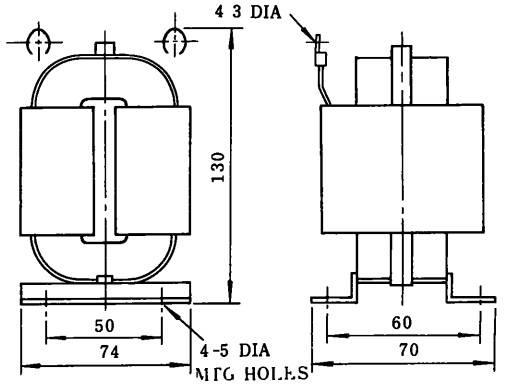
8.4.1 Type X3064



APPROX WEIGHT : 1kg

For SERVOPACK Types CPCR-FR01RB and -FR02RB

8.4.2 Type X5006

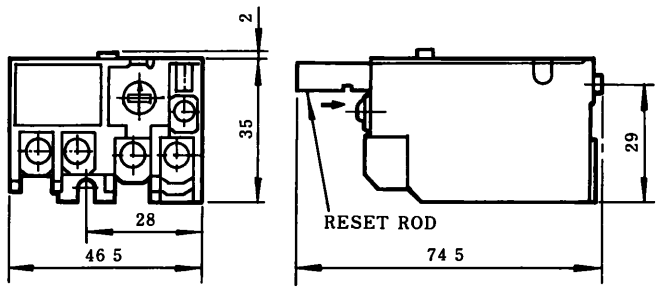


APPROX WEIGHT : 1 3kg

For SERVOPACK Type CPCR-FR05RB

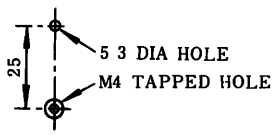
8. 5 THERMAL OVERLOAD RELAY

8. 5. 1 Type RHP-15



APPROX WEIGHT . 0 1kg

Drilling Plan



Terminal Symbol

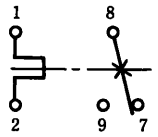
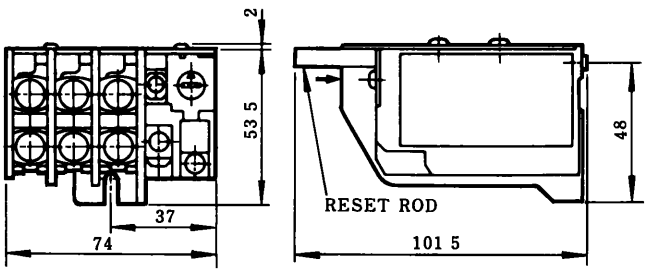


Table 8 2 Thermal Relay Type for Servomotor

Servomotor Type	Thermal Relay Type*
PMES-09A2	RHP-15/5.7
PMES-12A2	RHP-15/6.6
PMES-16A2	RHP-15/7.5
UGTMEM-03SB	RHP-15/3 6
UGTMEM-03MB	RHP-15/5.4F
UGTMEM-03LB	RHP-15/4.4F
UGTMEM-06SB	RHP-15/4.4F
UGTMEM-06MB	RHP-15/5.4F
UGTMEM-06LB	RHP-15/5.4F
UGRMEM-01SA	RHP-15/2.1F
UGRMEM-02SA	RHP-15/3.9F
UGRMEM-02MA	RHP-15/4.5F
UGRMEM-04SA	RHP-15/5.3F
UGRMEM-04MA	RHP-15/6.2F
UGRMEM-08SA	RHP-15/7.5F
UGRMEM-08MB	RHP-15/7.5F
UGMMEM-06AA1	RH-35/6.2HV
UGMMEM-13AA1	RH-35/6.9HV

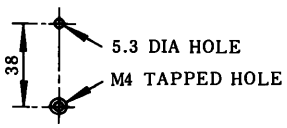
*Type RH-35/[ ]HV is attached to motor. Others are optional.

8. 5. 2 Type RH-35/[ ]HV

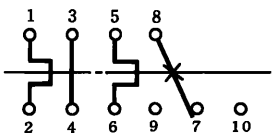


APPROX WEIGHT : 0 24kg

Drilling Plan

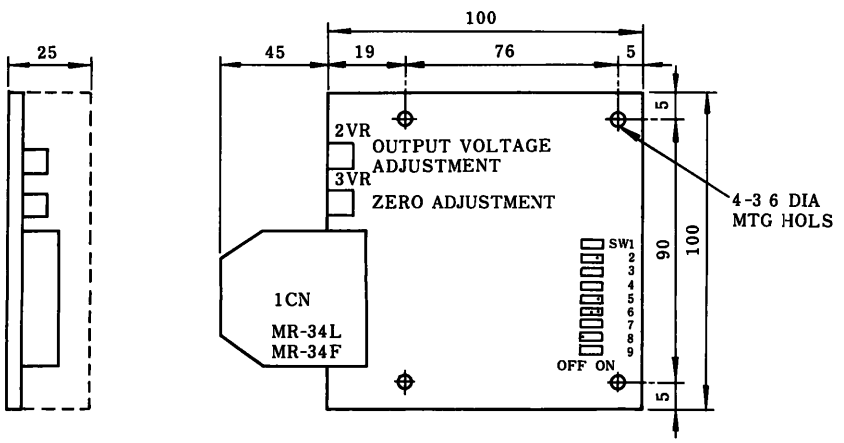


Terminal Symbol

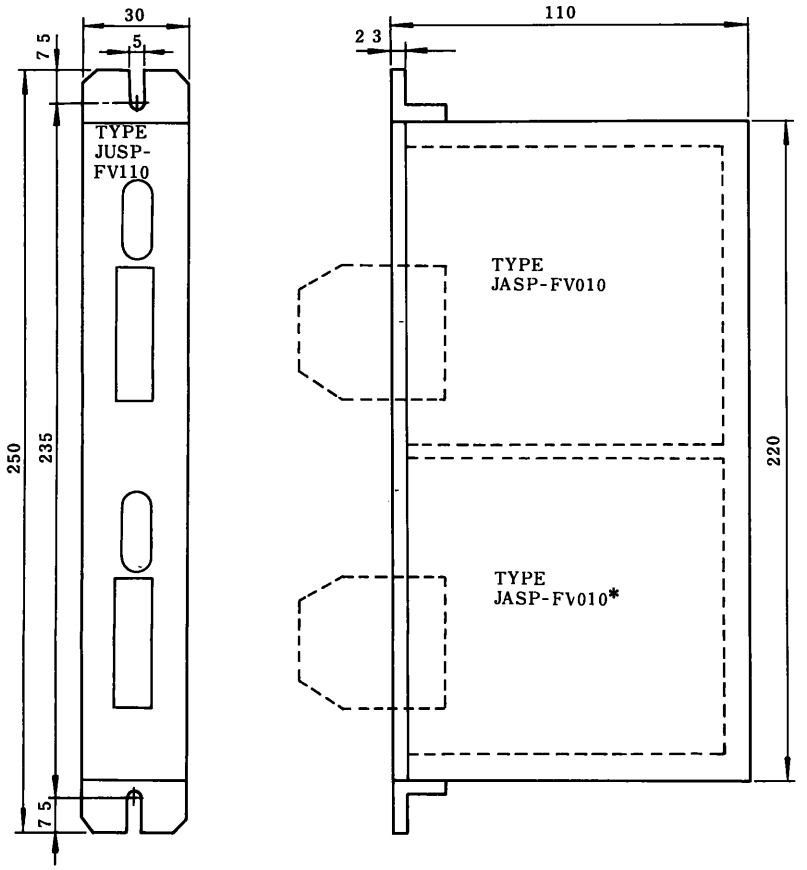


8. 6 f/V CONVERTER

8. 6. 1 Type JASP-FV010 (For One Axis)



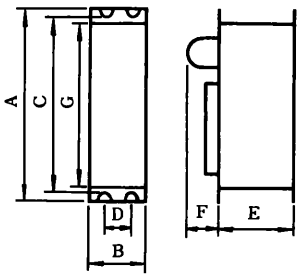
8. 6. 2 Type JUSP-FV110 (For One Axis), Type JUSP-FV210 (For Two Axes)



*Furnished only for type JUSP-FV210

9. COMPARISON WITH EXISTING PRODUCT

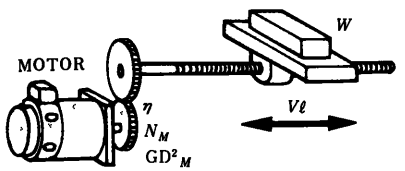
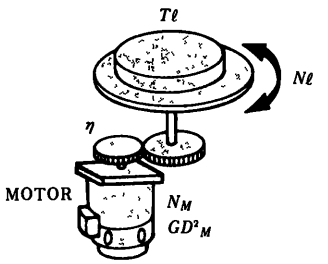
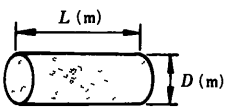
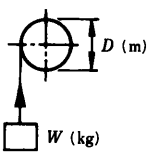
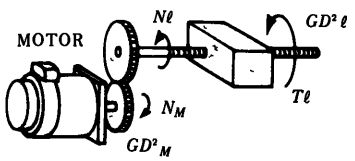
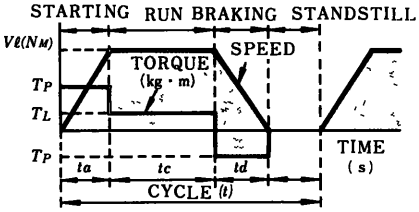
Table 9 1 Comparison with Existing Product

SERVOPACK Type CPCR-		FR□RB	FR□RA	FR01B, FR02B, FR05C
Mounting Method		Base-mounted or rack-mounted type	Rack-mounted type	Base-mounted type
Dimensions in mm				
		Type FR01RB: A 250, B 45, C 235, D 30, E 250, F (45), G 220 Type FR02RB: A 250, B 55, C 235, D 40, E 250, F (45), G 220 Type FR05RB: A 250, B 75, C 235, D 50, E 250, F (45), G 220	Type FR01RA: A 250, B 60, C 235, D 40, E 310, F (45), G 220 Type FR02RA: A 250, B 60, C 235, D 40, E 330, F (45), G 220 Type FR05RA: A 250, B 80, C 235, D 60, E 330, F (45), G 220	Type FR01B: A 230, B 100, C 220, D 30, E 160, F (20) Type FR02B: A 230, B 100, C 220, D 30, E 160, F (20) Type FR05C: A 230, B 150, C 220, D 100, E 160, F (20)
Peripheral Equipment	DC Reactor	Installed separately	Built-in	Installed separately
	Power Transformer	Installed separately		
Terminal	Main Terminal	M4 screw		
	Control Terminal	MR-34RMA (Right angle 34P)	MR-20RMA (Right angle 20P)	M4 screw
Main Power Input Terminals	40V, 45V, 50V, 85V	ⓤ-ⓥ	ⓤ-ⓥ	ⓤ1-ⓥ1
Control Power Input Terminals	18V-0V-18V	ⓤ6-⓪-ⓥ6	ⓤ6-⓪-ⓥ6	ⓤ2-⓪-ⓥ2
Driver Power Input Terminals	10V (100V)	—	ⓤ5-ⓥ51 (Type FR05RA ⓤ5-ⓥ52)	ⓤ3-ⓥ3 (Type FR05C ⓤ3-ⓥ4)
Cooling Method		Type CPCR-FR05RB must be cooled by external fan.	Type CPCR-FR05RA must be cooled by external fan.	Type CPCR-FR05C has built-in fan.
Power Supply	±8V 10mA	390Ω ⑩ ⑪ ㉒ ⑫ 390Ω +8V 0V −8V	⑤ ⑫ ⑬ ⑥ +8V 0V −8V	⑩ ⑪ ⑫ +8V 0V −8V
Speed Reference Input	±6V	①-② 0V	①-⑧ 0V	①-② 0V
Aux Input Reference		⑨-㉑ 0V	②-⑨ 0V	⑨-② 0V
TG Input	7VTG	③-④ 0V	TG ⊖-⊕ 0V	③-④ 0V
f/V Input	±6V	⑮-⑯ 0V	③-⑩ 0V	—
Overtravel Prevention Input		• Reverse rotation stop: Open across ⑤ and ⑥. • Forward rotation stop: Open across ⑲ and ⑦	• Reverse rotation stop: Open across ⑮ and ⑭. • Forward rotation stop Open across ⑯ and ⑰.	• Reverse rotation stop Open across ⑤ and ⑥. • Forward rotation stop: Open across ⑤ and ⑦.
Proportional Drive Reference Input		⑧-⑳ 0V	④-⑪ 0V	⑧-⑪ 0V
Blown Fuse, Heat Sink Overheat		㉓-㉔. Connector, normally open, 30VDC, 50mA	Ⓒ3-Ⓒ1: M4 screw, normally open, 200VAC, 1A 30VDC, 1A	Ⓒ3-Ⓒ4 M4 screw, normally open, 200VAC, 1A 30VDC, 1A
Overload Protection		㉗ ㉘ ON when detected overload and overcurrent. Open collector, emitter output.	⑦-⑫ ⑬ 0V ON when detected by open collector.	—
Overcurrent Protection			—	
Reset		Reset power OFF	Resetbutton	—
LED Indication		POWER(Green), ALARM(Red); INHIBIT(White or Red)	POWER(Green), OL(Red)	POWER(Red)
Current Control Input	∓5V	⑰-⑱ 0V	—	—
Base-off Input		⑬-⑭ 0V	④-⑪ 0V	—

10. SELECTION GUIDE

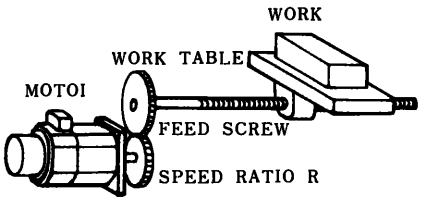
10.1 DYNAMICS FORMULA FOR ELECTRIC FORCE

The drive system calculation is possible by knowing the efficiency of the inlet (motor), the outlet (load), and intermediate (reduction gear), etc.

	Item	Linear Motion	Rotating Motion
Basic Dynamics Formula	Reference Figure		
	Load Constant Power	$Po = \frac{\mu \cdot W \cdot V\ell}{6120 \cdot \eta}$	$Po = \frac{T\ell \cdot N\ell}{973 \cdot \eta}$
	Load Accelerating Power	$Pa = \frac{GD\ell^2 \cdot N\ell^2}{365 \times 10^3 \times ta}$	$Pa = \frac{GD\ell^2 \cdot N\ell^2}{365 \times 10^3 \times ta}$
	Load Torque	$T_L = \frac{\mu \cdot W \cdot V\ell}{2\pi \cdot N_M \cdot \eta}$	$T_L = \frac{N\ell}{N_M \cdot \eta} \cdot T\ell$
	Load GD²	$GD^2_L = W \cdot \left(\frac{V\ell}{\pi \cdot N_M}\right)^2$	$GD^2_L = \left(\frac{N\ell}{N_M}\right)^2 \cdot GD^2\ell$
	Starting Time	$ta = \frac{(GD^2_M + GD^2_L) \cdot N_M}{375\,(T_P - T_L)}$	$ta = \frac{(GD^2_M + GD^2_L) \cdot N_M}{375\,(T_P - T_L)}$
	Braking Time	$td = \frac{(GD^2_M + GD^2_L) \cdot N_M}{375\,(T_P + T_L)}$	$td = \frac{(GD^2_M + GD^2_L) \cdot N_M}{375\,(T_P + T_L)}$
Optimum Reduction Ratio	Solid Cylinder GD²	$GD^2_L = 125\,\pi\rho\,LD^4$ $(\rho = 7\ 866\ g/cm^3)$	
	Linear Motion Body Equivalent GD²	$GD^2_L = W \cdot D^2$	
	Optimum Speed Ratio	$Ro = \sqrt{\frac{\frac{GD^2\ell \cdot N\ell}{375 \cdot ta} + T\ell}{\frac{GD^2_M \cdot N\ell}{375 \cdot ta}}}$	SPEED RATIO 1/Ro 
	Torque RMS Value	$Trms = \sqrt{\frac{T_P^2 \cdot ta + T_L^2 \cdot tc + T_P^2 \cdot td}{t}}$	

P_o.	Constant power (kW)	μ.	Friction coefficient	T_L	Load torque (kg·m=100kg·cm)
P_a	Accel power (kW)	W	Weight of linear motion part (kg)	T_P:	Average motor start torque (kg·m=100kg·cm)
$N\ell$:	Driven motor speed (rpm)	GD^2_ℓ·	Load GD² (kg·m²=10000kg·cm²)	T_{rms}	Effective average torque (kg·m=100kg·cm)
N_M:	Motor speed (rpm)	GD^2_l:	Load GD² (kg·m²=10000kg·cm²)	t_a:	Starting time(s)
V_ℓ·	Load speed (m/min=100cm/min)	GD^2_M:	Motor GD² (kg·m²=10000kg·cm²)	t_c:	Running time (s)
η·	Speed reducer efficiency	$T\ell$:	Load torque (kg·m=100kg·cm)	t_d.	Braking time (s)

10. 2 SERVOMOTOR SELECTION EXAMPLE

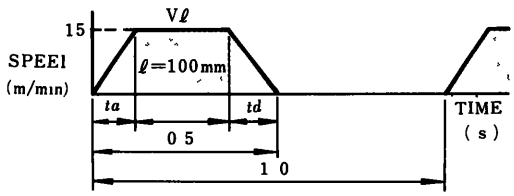


· Weight of moving part	W = 100kg	· No. of positionings	60 cycles/min
· Speed of moving part	V_ℓ = 15m/min	· Positioning time	0.5s or below
· Friction of coefficient	μ = 0.2	· Feed screw length	L = 1000mm
· Reduction gear efficiency	η = 80%	· Feed screw diameter	D = 20mm
· Motion per cycle	ℓ = 100mm	· Feed screw lead	P = 10mm

(1) Speed diagram

Assume the figure below. From the figure, required starting time is:

$$t_a \fallingdotseq t_d = 0.5 - \frac{\ell}{\frac{1000\ V_\ell}{60}} = 0.1\ \text{s}$$



(2) Feed screw shaft speed:

$$N_\ell = \frac{1000\ V_\ell}{P} = 1500\ \text{rpm}$$

(3) Load GD² (converted to motor shaft)

Assuming the motor shaft speed to be 3000 rpm (R=2)

· Moving part GD²

$$GD_{L1}^2 = W \cdot \left(\frac{V_\ell}{\pi \cdot N_M}\right)^2 \fallingdotseq 2.5\times10^{-4}\ \text{kg}\cdot\text{m}^2$$

· Feed screw GD²

$$GD_{L2}^2 = 125\ \pi\rho LD^4 \left(\frac{1}{R}\right)^2 \fallingdotseq 1.24\times10^{-4}\ \text{kg}\cdot\text{m}^2$$

· Reduction gear GD²

$$GD_{L3}^2 \cdots (\text{estimation}) \cdots \fallingdotseq 3.5\times10^{-4}\ \text{kg}\cdot\text{m}^2$$

$$\text{Total GD}^2\ (GD_L) = 7.24\times10^{-4}\ \text{kg}\cdot\text{m}^2$$

(4) Required running power

$$P_o = \frac{\mu \cdot W \cdot V_\ell}{6120\ \eta} = 0.061\ \text{kW}$$

(5) Required acceleration power

$$P_a = \frac{GD_L^2 \cdot N_M^2}{365\times10^3 \times t_a} = 0.18\ \text{kW}$$

(6) Required running torque

$$T_L = \frac{\mu \cdot W \cdot V_\ell}{2\pi \cdot N_M \cdot \eta} \fallingdotseq 0.02\ \text{kg}\cdot\text{m}$$

(7) Temporary servomotor selection

Selection condition is as below.

- $GD_L^2 \leqq 3GD_M^2$
- $P_a + P_o \simeq$ (1—2) × Rated motor output

From the above condition, Minertia motor standard series 180W or Print motor standard series 200W can be applied. Here, the Print motor standard series 200W is temporarily selected.

Rated output = 200 W
Rated speed = 3000 rpm
Rated torque = 0.065 kg·m
$GD^2 = 6\times10^{-4}\ \text{kg}\cdot\text{m}^2$

(8) Required starting torque: T_{P1}

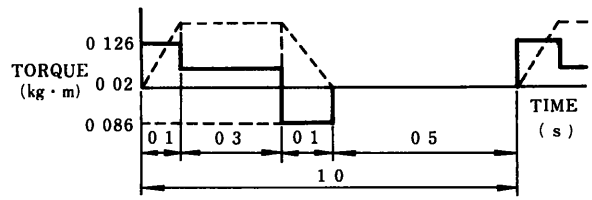
$$T_{P1} = \frac{(GD_M^2 + GD_L^2) \cdot N_M}{375 \cdot t_a} + T_L = 0.126\ \text{kg}\cdot\text{m}$$

(9) Required deceleration torque: T_{P2}

$$T_{P2} = \frac{(GD_M^2 + GD_L^2) \cdot N_M}{375 \cdot t_d} - T_L = 0.086\ \text{kg}\cdot\text{m}$$

(10) Torque cycle

The following diagram shows the calculation.



(11) Effective torque value checking

$$T_{rms} = \sqrt{\frac{T_{P1}^2 \cdot t_a + T_L^2 \cdot t_c + T_{P2}^2 \cdot t_d}{t}}$$

$$= \sqrt{\frac{0.126^2\times0.1 + 0.02^2\times0.3 + 0.086^2\times0.1}{1.0}}$$

$$\fallingdotseq 0.049\ \text{kg}\cdot\text{m}$$

(12) Final selection of servomotor

From the above result, assume a use of combination of Print motor standard series type PMES-12 with SERVOPACK type CPCR-FR02RB (wave factor: 1.05) This gives:

$$T_{rms}' = 0.049\times1.05 \fallingdotseq 0.051\ \text{kg}\cdot\text{m}$$

This means the use at the rate of

$$\frac{0.051}{0.065}\times100 = 78.5\ \%$$

load to the rated torque, and therefore the use is acceptable.

In conclusion, the basic specification is satisfied by the use of combination of Print motor standard series type PMES-12 with SERVOPACK type CPCR-FR02RB.

11. TEST RUN

Before test run, check the following. Correct any deficiency.

11.1 CHECK ITEMS BEFORE TEST RUN

11.1.1 Servomotor

Before test run, check the following. If the test run is performed after long storage, see section 13. Inspection and Maintenance.

- Connection to machines or devices, wiring, fuse connection, and grounding are correct.
- Bolts and nuts are not loose.
- For motors with oil seals, the seals are not damaged and oil is properly lubricated.

11.1.2 SERVOPACK

Before starting test run, confirm the following:

(1) SERVOPACK has been adjusted in accordance with the servomotor to be applied. (See Tables 2.1 and 2.2)

(2) Supply voltage should be 100/110 V ±10% or 200/220V ±10%.

(3) The primary side of the power transformer should be connected in accordance with the specified voltage as shown in Fig. 5.19.

(4) A thermal overload relay and the motor should be connected in series across terminals A and B of SERVOPACK type CPCR-FR□RB, connecting the motor terminals A (or red lead) and B (or black lead) to terminals A and B of SERVOPACK type CPCR-FR□RB, respectively (for forward rotation).

(5) The positive TG terminal (+) and the negative terminal (-) should be connected to 1CN-4 and -3 of SERVOPACK type CPCR-FR□RB (for forward rotation, using TG). See Tables 3.4 and 5.1.

(6) When PG and f/V converter is used, wiring of PG (phase A or B), power supply for PG (5 V or 12 V), setting of f/V converter, and the wiring of SERVOPACK should be checked again. If there is any error, the motor will run uncontrollably.

(7) Actuation of the thermal overload relay or the blown-fuse detection circuit (or heat sink overheat detection circuit) must turn off the main power supply.

(8) The shields used for the TG circuit and the speed reference circuit and 0 V (1CN-2) should be grounded.

(9) The speed reference voltage should be 0 V. (Speed reference circuit is shortcircuited.)

(10) If IN-B (1CN-9), IN (1CN-1), TG (1CN-3) or f/V (1CN-15) is not used, it should be connected to 0 V (1CN-21, -2, -4, or -16, respectively) to form a short circuit.

11.2 TEST RUN PROCEDURES

CAUTION

During test run, loads should not be applied to the servomotor. If it is necessary to start with the driven machine connected to the motor, confirm that the driven system has been ready for emergency stop at any time.

After checking items in para. 11.1.1, turn on the power supply. When the power is correctly supplied, POWER LED (green) lights. Start test run, increasing the speed reference voltage gradually from 0 V.

11.3 INSPECTION DURING TEST RUN

The following items should be checked during the test run.

- Unusual vibration
- Abnormal noise
- Excessive temperature rise

If any abnormality is found, take corrective actions according to Section 14. At a test operation, the load and machine may not fit well at first and result in overload.

12. ADJUSTMENT

12.1 SETTINGS AND CHARACTERISTICS AT THE TIME OF DELIVERY

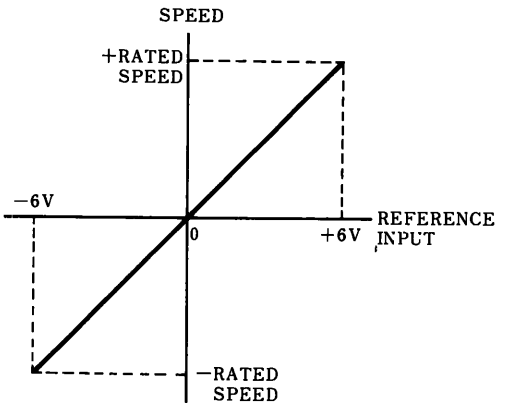
12.1.1 Settings at the Time of Delivery

The SERVOPACK has been factory-adjusted as shown in Table 12.1. Potentiometer field-set positions are shown in Table 12.2.

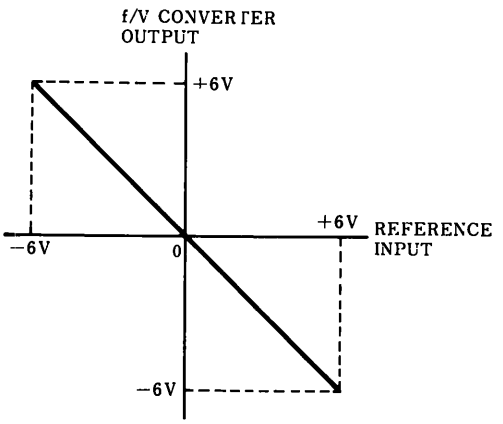
Table 12 1 Switch (SW) Settings

SERVOPACK Type CPCR-	Servomotor Type	Feedback	1SW	2SW	3SW
FR01RB	PMES-09 A2	7V TG	1	1	1-2
FR01RB-T3S	UGTMEM-03 SB	7V TG	4	2	1-2
FR01RB-T3M	UGTMEM-03 MB	7V TG	2	1	1-2
FR01RB-T3L	UGTMEM-03 LB	7V TG	4	1	1-2
FR01RB-T6S	UGTMEM-06 SB	7V TG	2	1	1-2
FR01RB-T6M	UGTMEM-06 MB	7V TG	1	1	1-2
FR01RB-T6L	UGTMEM-06 LB	7V TG	1	1	1-2
FR01RB-R1S	UGRMEM-01SA	7V TG	8	4	1-2
FR01RB-R2S	UGRMEM-02 SA	7V TG	2	2	1-2
FR01RB-R2M	UGRMEM-02 MA	7V TG	2	1	1-2
FR01RB-R4S	UGRMEM-04 SA	7V TG	1	1	1-2
FR01RB7-R2S	UGRMEM-02 SA	f/V	2	2	1-2
FR01RB7-R2M	UGRMEM-02 MA	f/V	2	1	1-2
FR01RB7-R4S	UGRMEM-04 SA	f/V	1	1	1-2
FR02RB	PMES-12A2	7V TG	1	1	1-2
FR02RB-R4M	UGRMEM-04 MA	7V TG	2	0	1-2
FR02RB7-R4M	UGRMEM-04 MA	f/V	2	0	1-2
FR05RB	PMES-16 A2	7V TG	1	1	1-2
FR05RB-R8S	UGRMEM-08 SA	7V TG	1	1	1-2
FR05RB-R8M	UGRMEM-08 MB	7V TG	1	1	1-2
FR05RB7-R8S	UGRMEM-08 SA	f/V	1	1	1-2
FR05RB7-R8M	UGRMEM-08 MB	f/V	1	1	1-2

12.1.2 Characteristics at the Time of Delivery



(a) Type CPCR-FR[ ]RB[ ] (For TG Feedback)



(b) Type CPCR-FR[ ]RB7-[ ] (For f/V Feedback)

Note
1 In case of TG feedback, type CPCR-FR[ ]RB-[ ] has been adjusted by [TG] potentiometer in accordance with the motor being used
2 In case of f/V feedback, type CPCR-FR[ ]RB7-[ ] has the characteristics shown in Fig 12 1(b) Potentiometers for adjustment are not included If fine adjustment is required, output voltage adjustment of f/V converter should be used

Fig. 12 1 Characteristics at the Time of Delivery

Table 12 2 Potentiometer Field-set Positions

SERVOPACK Type CPCR-	Feedback	IN-B	ZERO	CUR	TG	LOOP	4VR	7VR	M-SW
FR[ ]RB-[ ]	7V TG	*	3 to 6/10	4 to 6/10	†	0 to 6/10	0 to 10/10	2 to 7/10	5 to 7/10
FR[ ]RB7-[ ]	f/V	*	3 to 6/10	4 to 6/10	*	0 to 5/10	0 to 5/10	2 to 7/10	5 to 7/10

*Potentiometers has not been set at the time of delivery.
†At rated speed of servomotor
Note·
1. [CUR] is adjusted to the starting current of motor being used. (See Table 1. 4).
2. In the Table above, [ ]/[ ] shows approximate scale of potentiometer. For example,  indicates 7/10 scale.

12. 2 READJUSTMENT

The SERVOPACK has been adjusted at the factory to obtain optimum characteristics, and readjustment is normally unnecessary. If adjustment is required depending on the use, readjust the SERVOPACK referring to Table 12.4. (Do not tamper with potentiometers.)

Readjustment for changing the motor being used and feedback must be done at the factory. (Some parts of SERVOPACK have to be changed depending on the motor.) When a component is returned to the factory, overhaul, inspection or adjustment will be accomplished in accordance with the specifications on the SERVOPACK nameplate. If the specifications have been changed, or if special adjustment is needed, notify the factory of such.

12. 2. 1 Readjustment of the Starting Current

If starting current has to be changed, use 1SW and CUR potentiometer. Values in Table 12.3 can be gained by using only 1SW without activating CUR potentiometer. Actual current does not have to be measured during the adjustment since the adjustment is done by the switch.

If values other than those of Table 12.3 are desired, set 1SW to the nearest value desired, then adjust using CUR potentiometer.

CAUTION

Values of current should not exceed those in Table 1.4

Table 12 3 Current Adjustment by 1SW*

SERVOPACK Type CPCR- / 1SW Scale	Current A		
	FR01RB	FR02RB	FR05RB
1	12	20	20
2	10	15	12
4	8	10	10
8	4	5	5

*Cannot be applied to non-standard type CPCR-FR[ ]RB-Y[ ] and type CPCR-FR01RB[ ]-T 3S Sometimes, with SERVOPACK types other than those in Table 1. 4, the above adjustment may not apply.

Note:

1. When current is decreased by 1SW, current gain becomes larger, resulting in oscillation initiation. In this case, turn LOOP and 7VR potentiometers to the left (counterclockwise) till the oscillation stops.
2. 1SW should be operated while power is off. If CUR potentiometer is mistakenly turned to the right (clockwise) more than 6/10 of scale, the overcurrent detection circuit may activate.

12. 2. 2 Change of Overload Detection Characteristics

Switch 2SW is used to change the characteristics in accordance with Fig. 3.2. Characteristics other than those in Fig. 3.2 can not be realized.

12. 3 ADJUSTMENT PROCEDURES

Fig. 12.2 shows the position of potentiometers and check terminals of SERVOPACK type CPCR-FR01RB.

Table 12.4 shows the type and general adjustment specifications of the potentiometers of the SERVOPACK. Table 12.5 shows the description of the check pin (CH).

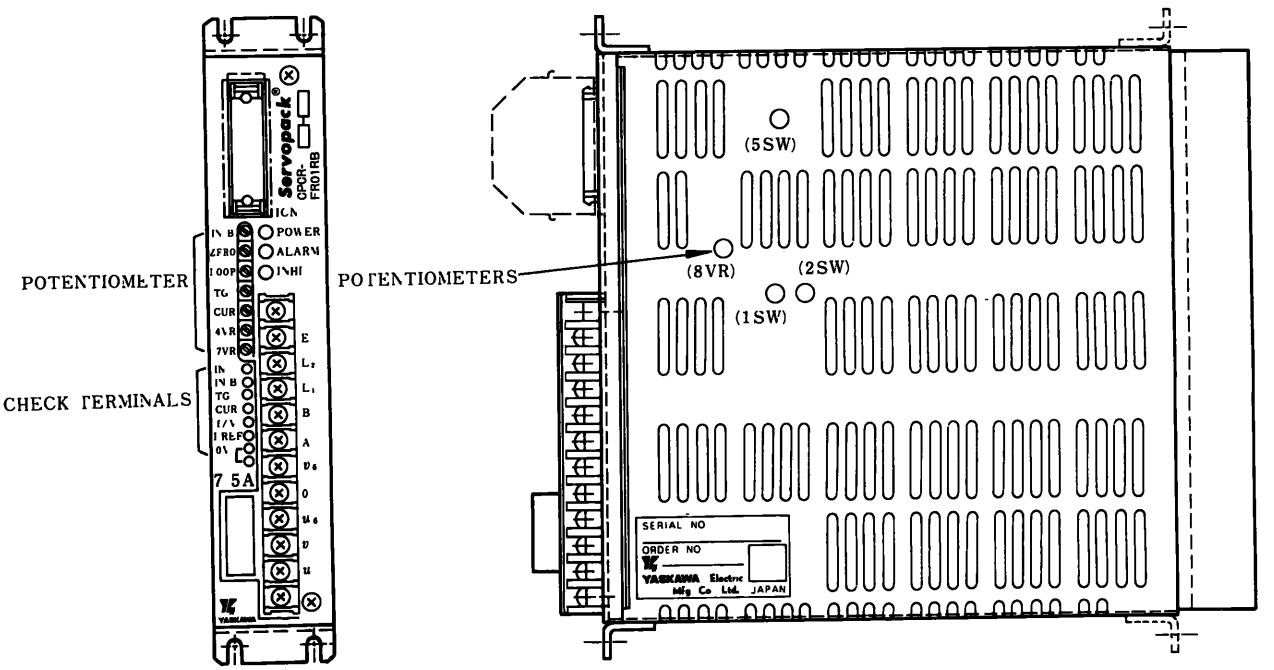
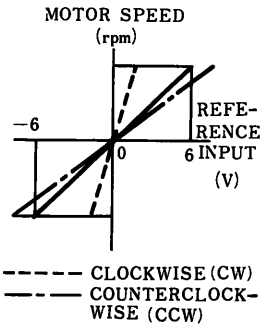
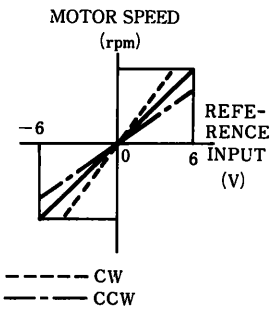
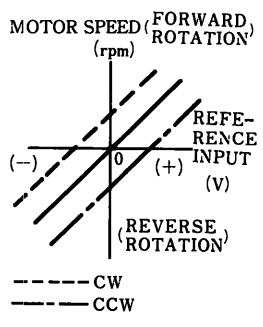
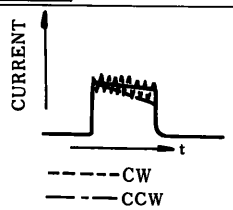
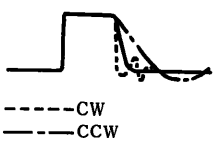
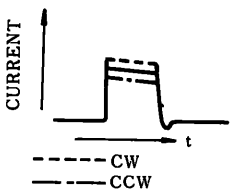
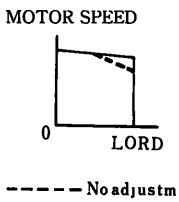


Fig. 12.2 Position of Potentiometers and Check Terminals of SERVOPACK Type CPCR-FR01RB

12. 3 ADJUSTMENT PROCEDURES (Cont'd)

Table 12. 4 Potentiometer Adjustment

Potentiometer	IN-B	TG	ZERO	LOOP
Functions	Auxiliary input adjustment	TG speed adjustment	Zero drift adjustment	Speed loop gain adjustment
How to Adjust	To be adjusted only when the rated reference voltage (±2 to ±10V) is other than ±6V. Turn IN-B only to get the rated speed and do not operate other VRs.	To be adjusted to get the rated speed when ±6V is applied across terminals 1 and 2. Turning TG CW increases the speed, and CCW decreases the speed.	To be adjusted so that the motor does not turn at the speed reference voltage 0V. Turning ZERO CW allows the motor to be finely adjusted in forward rotation, and CCW in reverse rotation.	To increase gain, turn LOOP CW.
Characteristics				If hunting, turn LOOP CCW to prevent it
Adjustment	○	○	○	○

Potentiometer	7VR	4VR	CUR	8VR
Functions	Current loop gain adjustment	Proportional gain adjustment	Starting current adjustment	Mode switch level adjustment
How to Adjust	Turning 7VR CW increases current loop gain. Increase the gain until starting current just before starts hunting, observing the waveform at CUR-M of check terminal.	Adjust 4VR to obtain the TG waveform shown below at motor starting. 	Turning CUR CCW decreases the starting current.	To be so adjusted that the load variation meets the specifications at the rated speed and the rated load (Load variation −0 1% or less).
Characteristics				
Adjustment	○	○	△	×

Adjustment Directions

Mark ○ : Potentiometer should be adjusted in accordance with specifications and application.

Mark △ : Potentiometer should not be adjusted except special cases.

Mark × : Do not adjust.

Table 12. 5 Check Terminals (CH)

Check Terminals	Description
IN	Connected to 1CN-1. Used to check input reference voltage.
IN-B	Connected to 1CN-9. Used to check auxiliary input voltage.
TG	Connected to 1CN-3. Used to check TG feedback voltage.
f/V	Connected to 1CN-15. Used to check f/V feedback voltage.
I-REF	Connected to 1CN-17. (Usually, not used.)
CUR	Current monitor, approx 0 05V/A
0V	0V common. Measured by connecting to above check terminals. (For types CPCR-FR01RB and -FR02RB)

Note
1. Values may change depending on the impedance of the measuring instrument used for checking.
2. Attention should be paid to the noise from the measuring instrument and the measuring lead. Values may change depending on the polarity of the instrument and the method of grounding.
3 Two 0V s are equipped so that 2 points can be measured at the same time (for types CPCR-FR01RB and -FR02RB). For type CPCR-FR05RB, measure by connecting to external terminal 0.
4. For checking, use a 2mm-dia tester jack
   If a current shunt is used, it should be connected in series with the motor. Shunts other than non-inductive shunts may pick up switching noises. If a terminal of a shunt touches 0V or groundings, SERVOPACK may be damaged Shunt connections are shown in Fig. 12. 2.

If a current shunt is used, it should be connected in series with the motor. Shunts other than non-inductive shunts may pick up switching noises. If a terminal of a shunt touches 0V or groundings, SERVOPACK may be damaged. Shunt connections are shown in Fig. 12.2

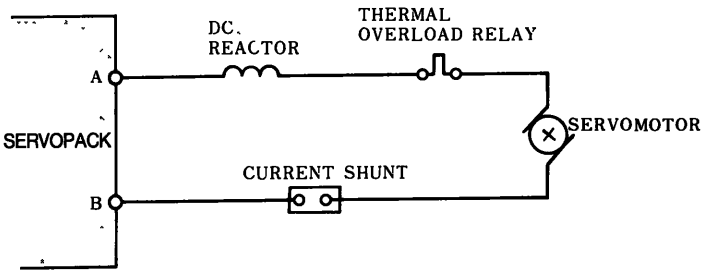


Fig. 12 3 Shunt Connections

13. MAINTENANCE

13.1 INSPECTION AND MAINTENANCE

13.1.1 SERVOPACK

The SERVOPACK is of contactless construction so that no special maintenance is required. Remove dust and tighten screws periodically.

If SERVOPACK fuses are blown, rectify the cause and replace fuses. Fuse specifications are shown in Table 13.1.

CAUTION

Be sure to turn off the power before replacing fuse.

13.1.2 Servomotor

General inspection of servomotor is shown in Table 13.2.

As for specific inspection method of each servomotor, see the instruction manual provided for the motor.

Table 13.1 Fuse Specifications

SERVOPACK Type CPCR-		FR01RB	FR02RB	FR05RB
Fuse	Type	PL475	PL4100	PL4150
	Capacity	7.5A	10A	15A
	Manufacturer	Daito Communication Apparatus Co.,Ltd.		

Table 13.2 Inspection Schedule of Servomotors

		Inspection Items
With Motor at Rest	Installation	• Any loose bolts and nuts • Any damaged parts • Coupling out of balance • Contaminated parts with dust or oil
	Electrical	• Injury to leads and terminals • Vertical slide of brush in brushholder not smooth • Excessive brush wear • Injury to brush section • Insulation resistance • Roughened, solid, discolored, or deformed commutator surface
With Motor Running	Commutator	• Excessive commutation sparks • Vibration of brush and brushholder
	Current	• Measurement of RMS value of armature current with AC ammeter • Current above rated
	Mechanical	• Abnormal noise due to vibration • Thrust load from driven machine • Poor ventilation due to clogging of air filter

13.2 TROUBLESHOOTING

13.2.1 Examples of Service Diagnosis

If 2 or more failures are present, each corresponding flow chart should be referred to. Two or more causes occasionally exist. Checking should be done up to the end of the flow chart for safety.

(1) POWER LED does not light when power on. (Fig. 13.1)

(2) INHI LED keeps on. (Fig. 13.2)

(3) Motor does not rotate when speed reference input. (Fig. 13.3)

(4) Speed reference is zero, but motor rotates at high-speed when power on. (Fig. 13.4)

(5) Speed reference is zero, but motor rotates at low-speed when power on. (Fig. 13.5)

(6) Rated reference voltage is applied, but motor does not reach rated speed. (Fig. 13.6)

(7) ALARM LED lights. (Fig. 13.7)

(8) Current oscillates. (Fig. 13.8)

(9) Fuse is blown. (Fig. 13.9)

13.2.2 Precautions

- The main circuit capacitor retains DC voltage for a few minutes even after the power is off from SERVOPACK type CPCR-FR□RB. POWER LED indicates the presence of control power supply. Therefore, if control power supply is turned off and power is on to the main circuit, POWER LED does not light. Avoid electrical shock.

- Heat sink unit of SERVOPACK, DC reactor, and motor may be heated to a high temperature. Avoid burning accident.

- If internal signals in SERVOPACK have to be measured, contact your Yaskawa representative. Careless contact during operation may damage SERVOPACK.

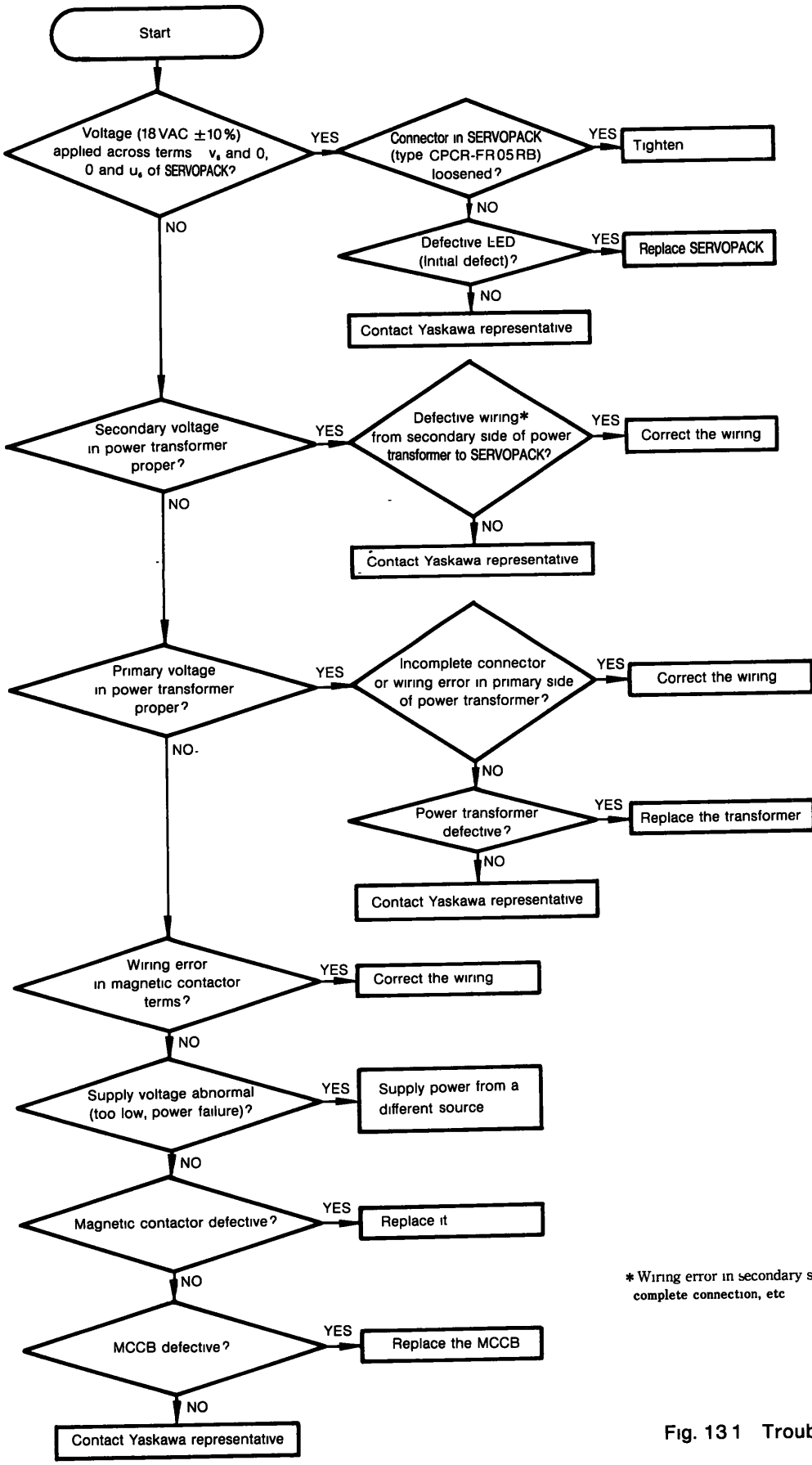
- If a malfunction cannot be corrected after following troubleshooting given in the flow chart, contact your Yaskawa representative giving the following information: the sections which have been checked, measuring instruments used, and measuring results (i.e. voltage).

- In case of a non-standard product, shipping of a substitute product and repair may require a longer time. It is desirable to prepare necessary spare SERVOPACK.

- Internal circuit diagram, parts list, and internal circuit diagram of hybrid IC of SERVOPACK type CPCR-FR□RB are not be provided.

- When a product is returned to the factory for repair, give the following information: the cause of trouble, trouble conditions, etc.

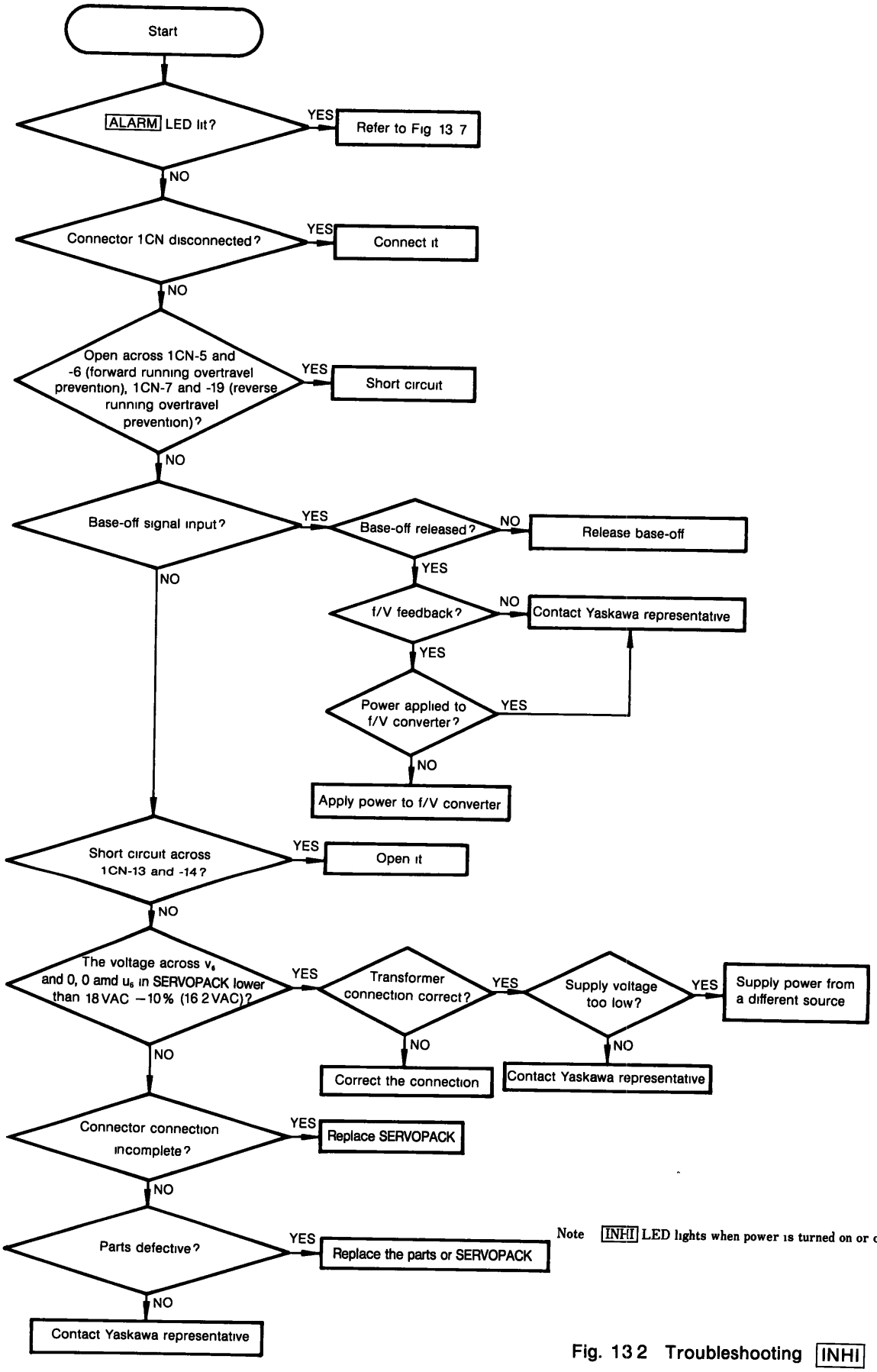
(1) POWER LED does not light when Power on



* Wiring error in secondary side of transformer or in SERVOPACK terminals, incomplete connection, etc

Fig. 13 1 Troubleshooting POWER LED

(2) INHI LED (Red) keeps on



Note INHI LED lights when power is turned on or off This is not a failure

Fig. 13 2 Troubleshooting INHI LED

(3) Motor does not rotate when Speed Reference Input

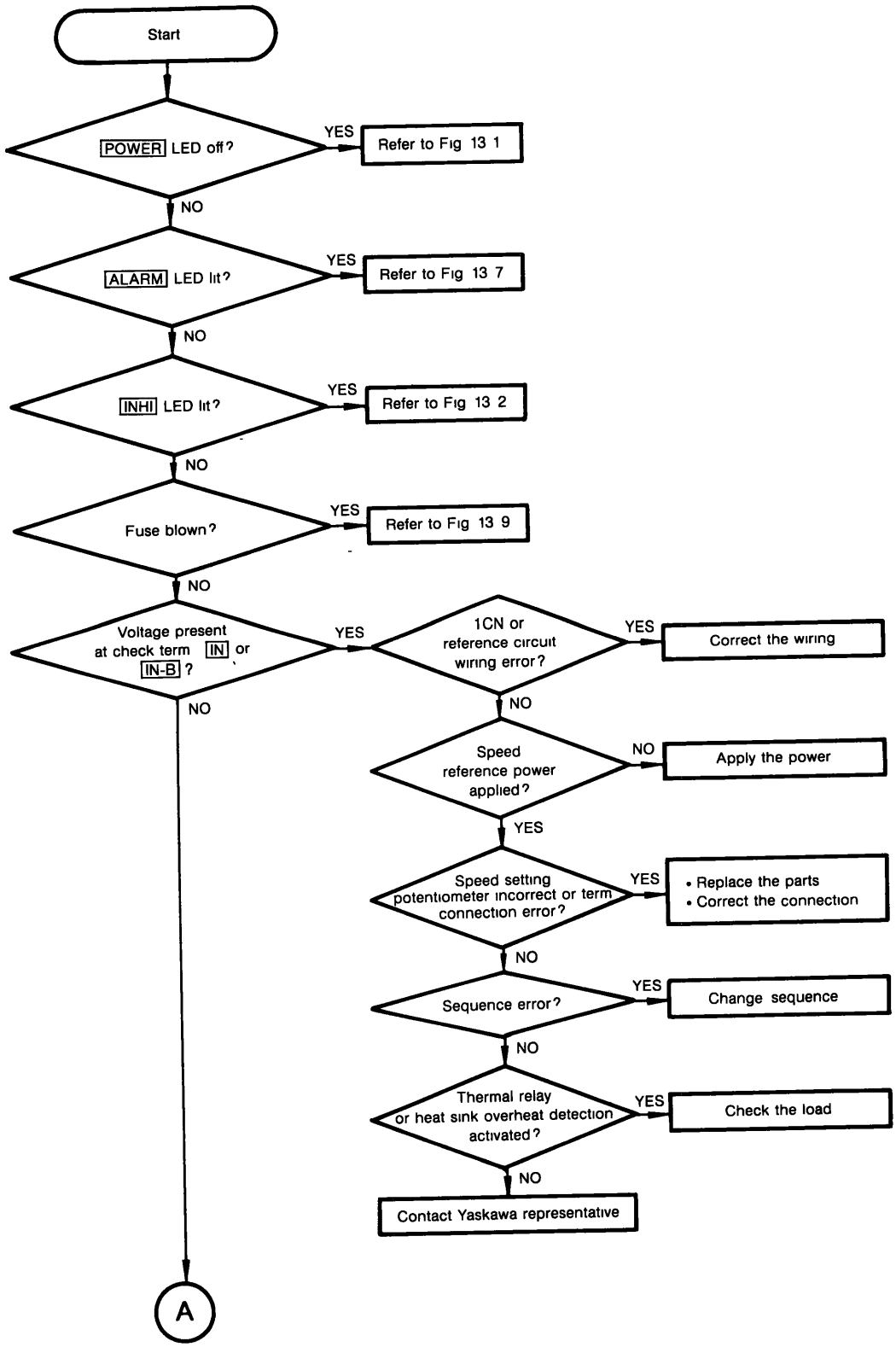


Fig 13 3 Troubleshooting Motor Defective Rotation

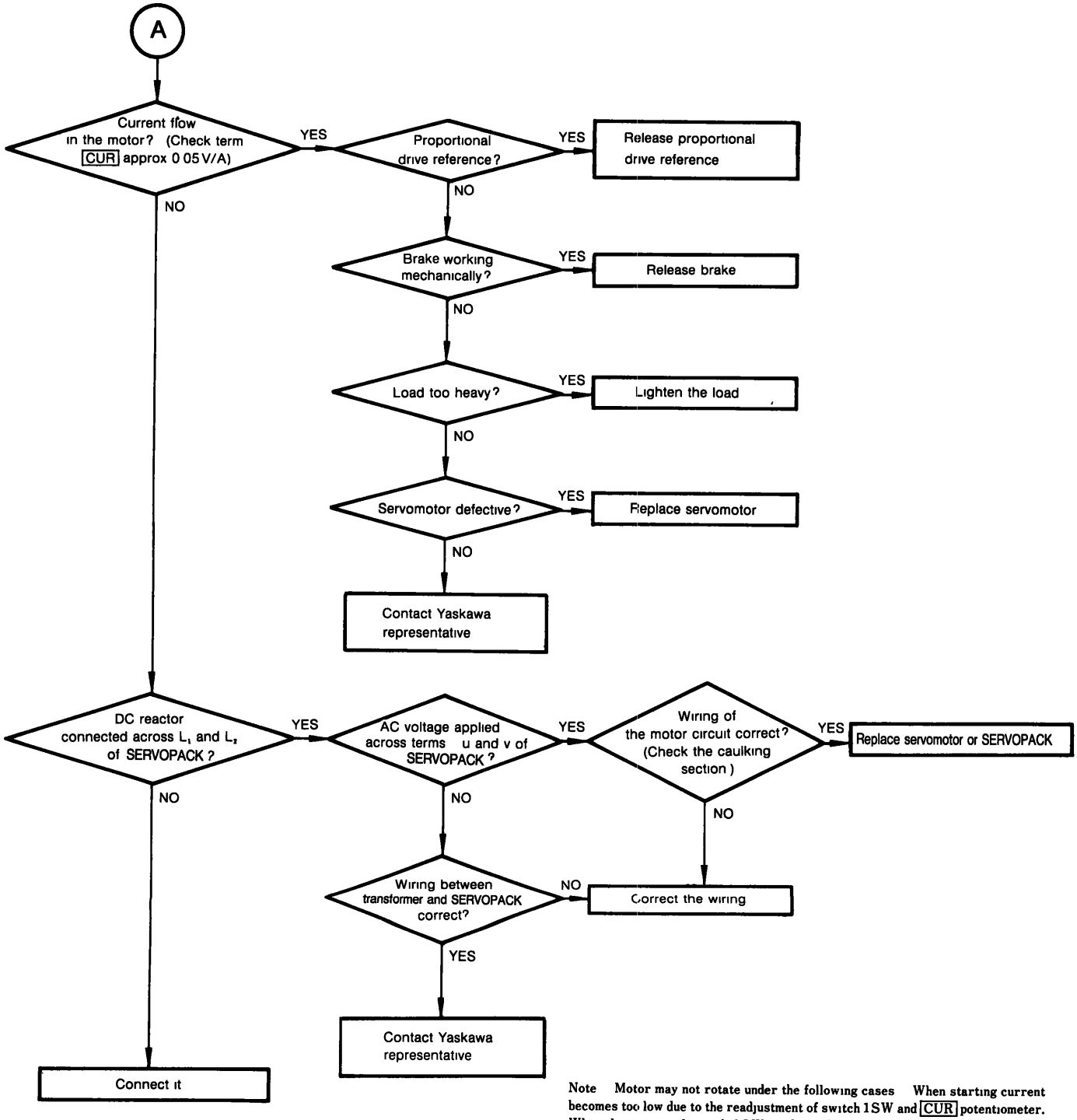


Fig. 13 3 Troubleshooting Defective Motor Rotation (Cont'd)

(4) Speed Reference is Zero, but Motor rotates at High-speed when Power on

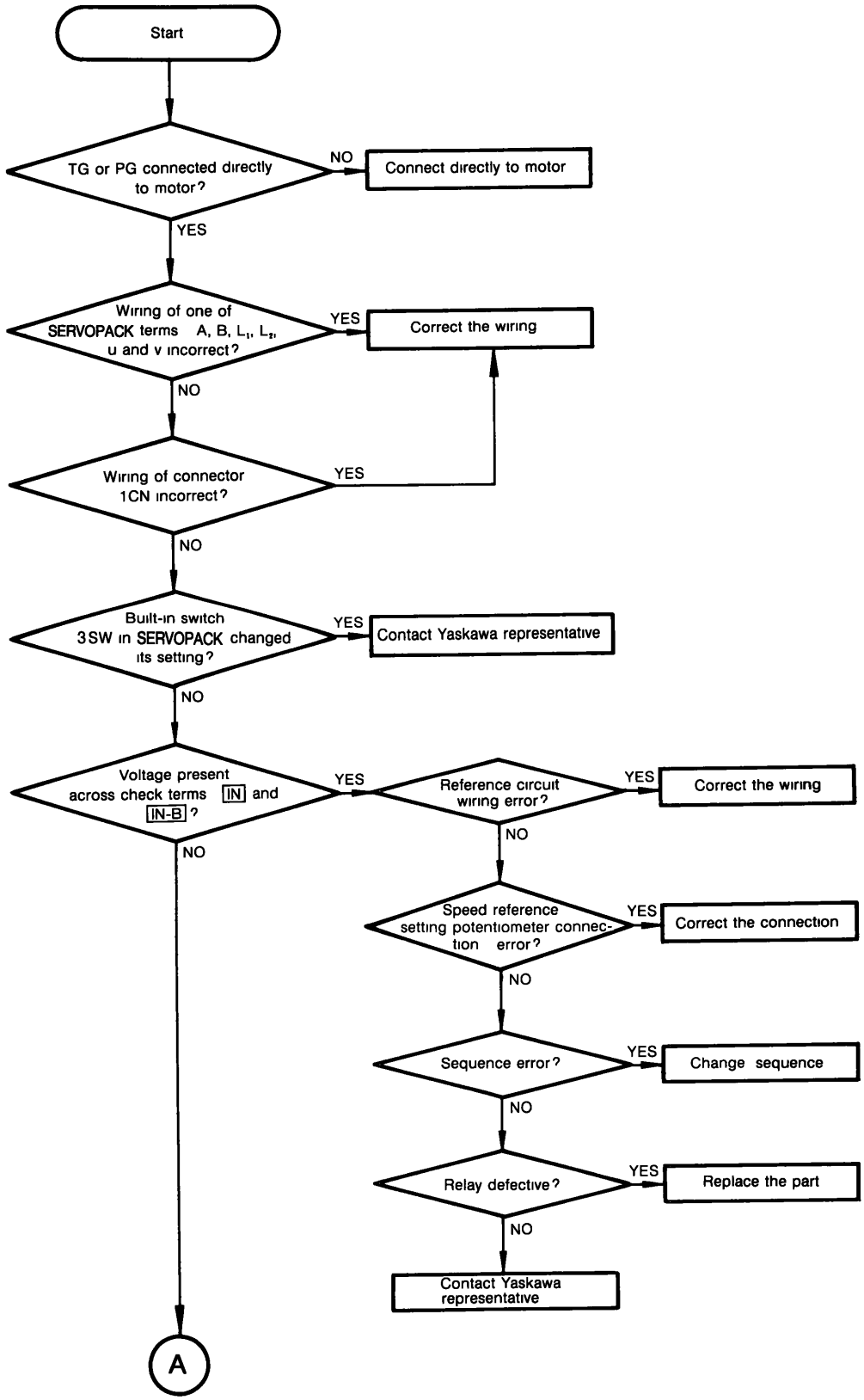


Fig 13.4 Troubleshooting Motor Rotation at High-speed

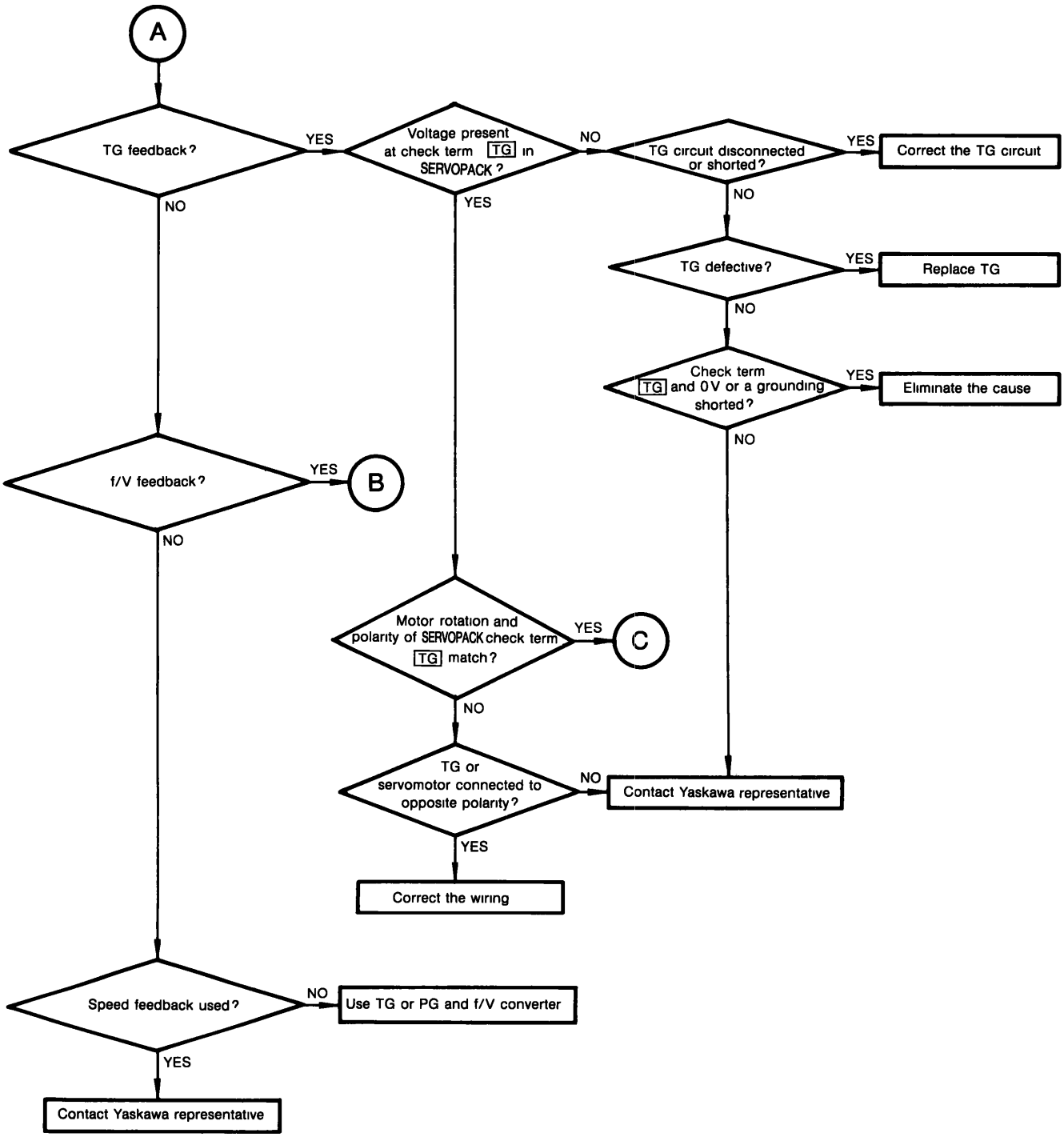


Fig 13 4 Troubleshooting Motor Rotation at High-speed (Cont'd)

(4) Speed Reference is Zero, but Motor rotates at High-speed when Power on (Cont'd)

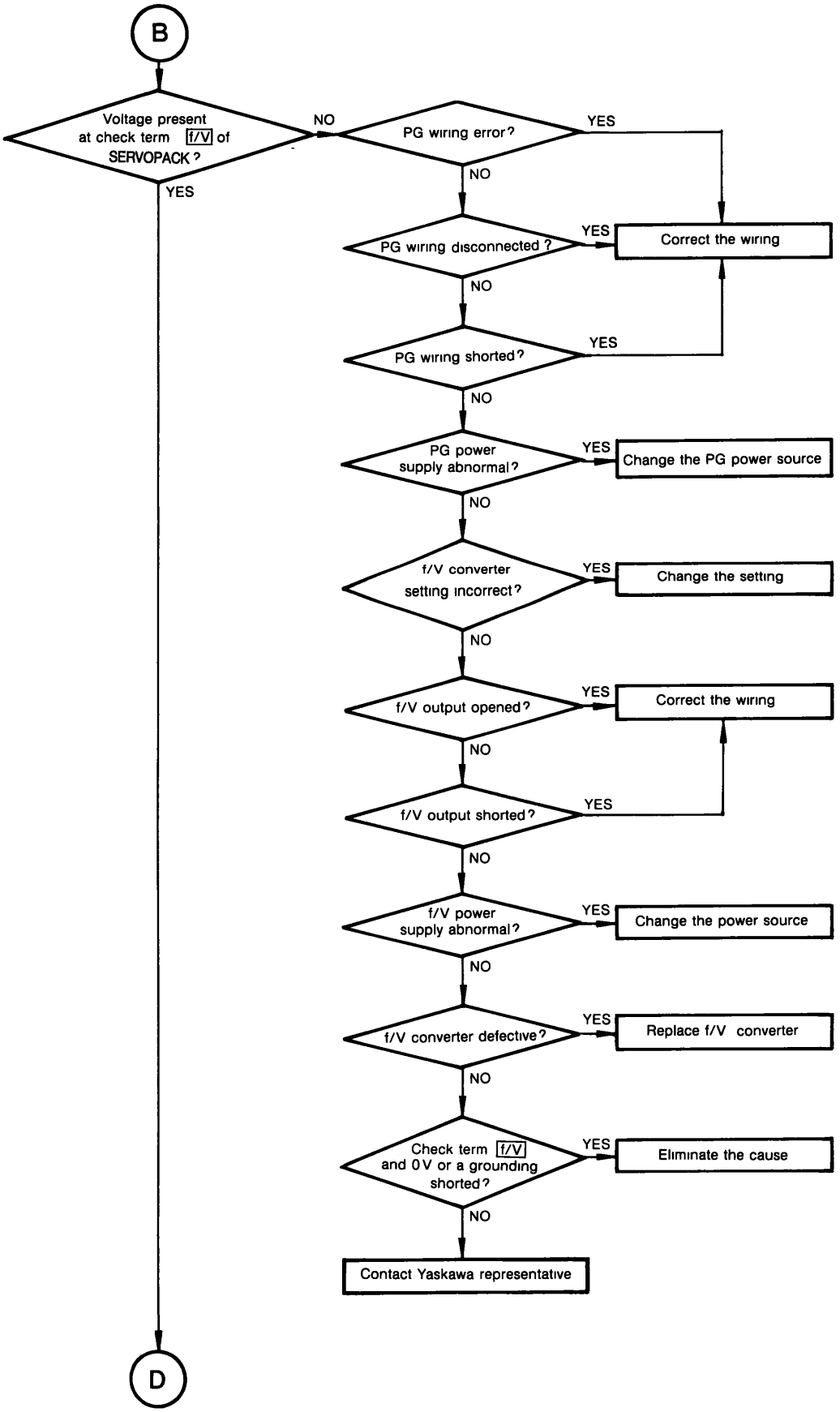


Fig. 13 4 Troubleshooting Motor Rotation at High-speed (Cont'd)

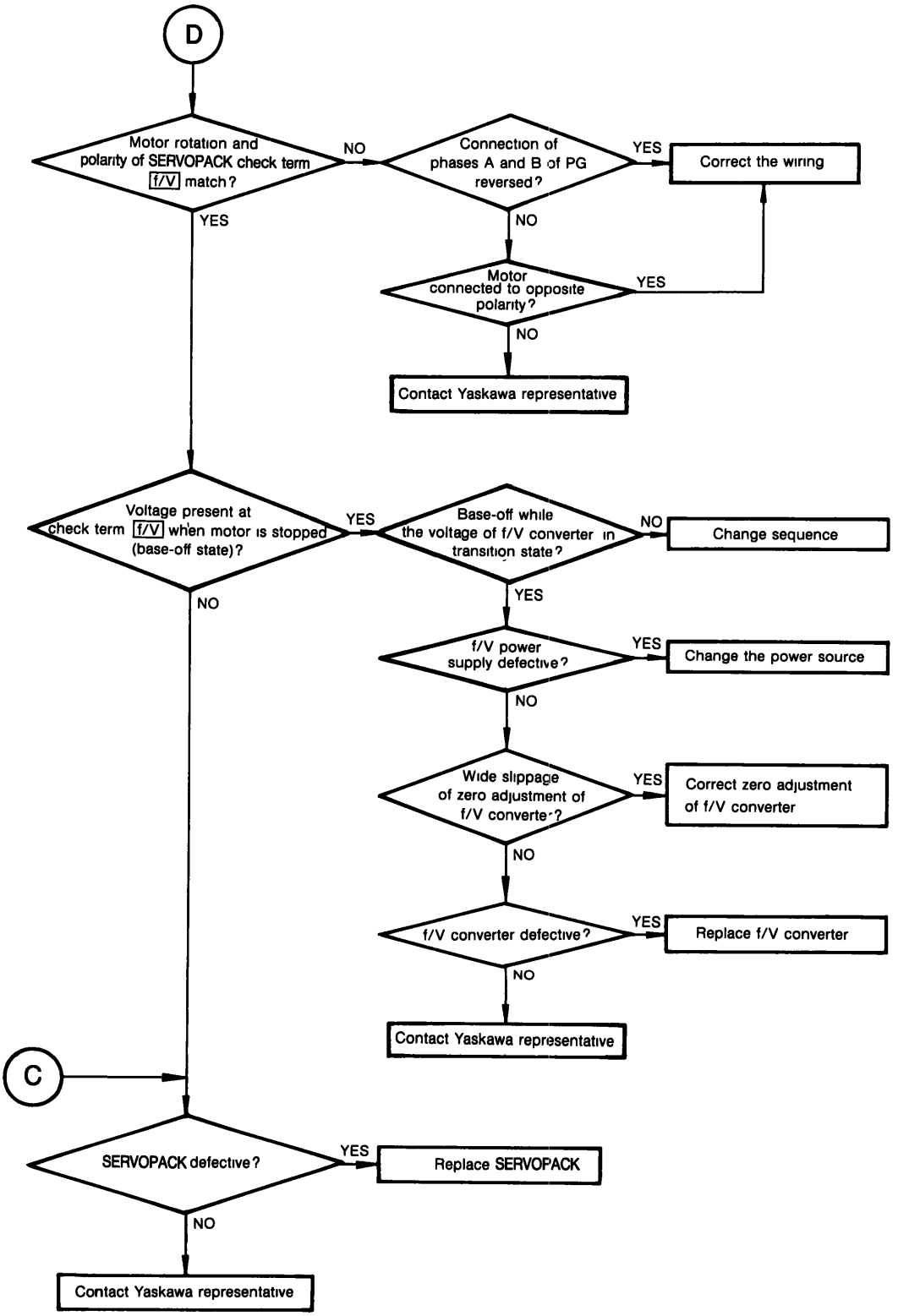
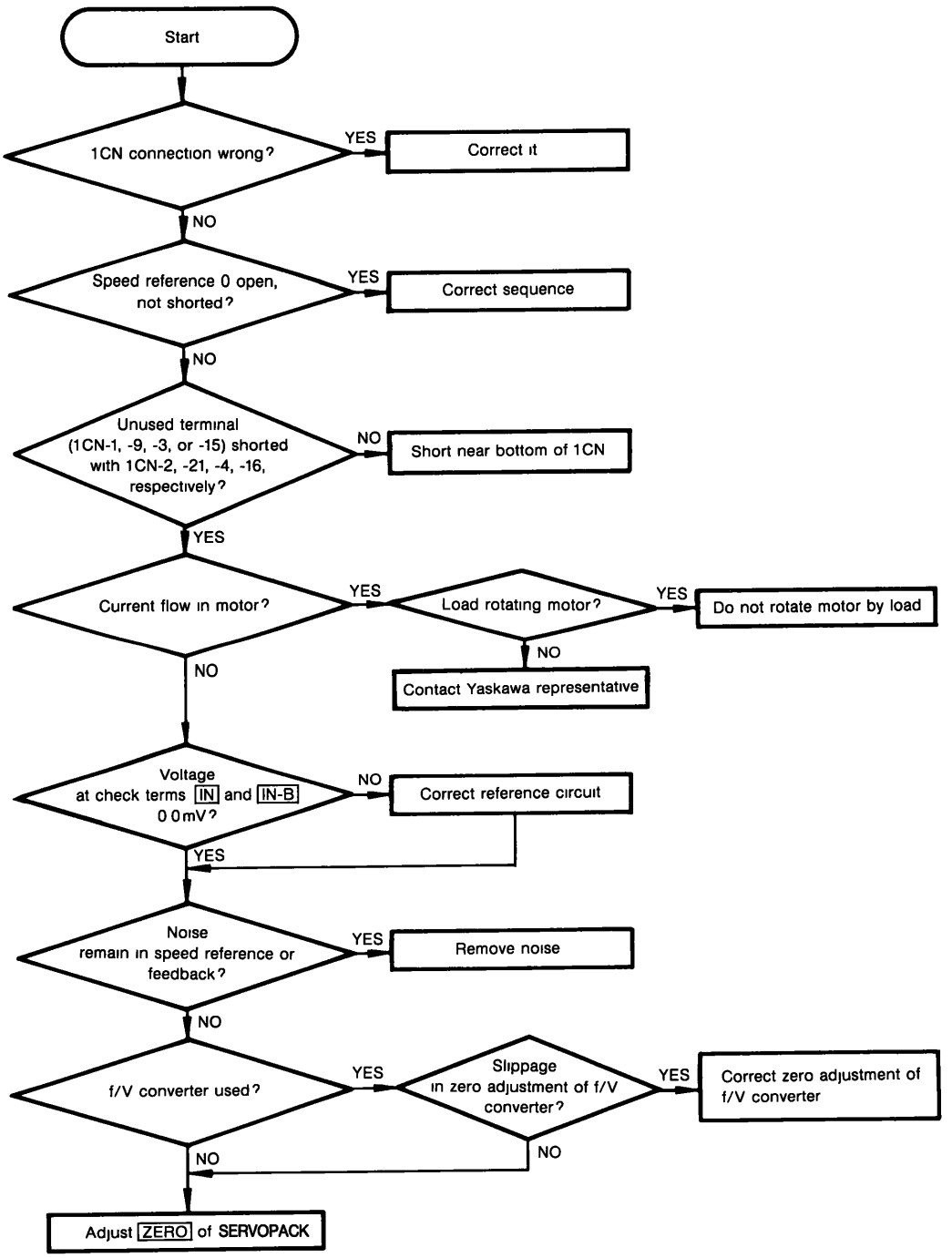


Fig. 13.4 Troubleshooting Motor Rotation at High-speed (Cont'd)

(5) Speed Reference is Zero, but Motor rotates at Low-speed when Power on



Note
1 Motor does not stop completely due to the drift of preamplifier If P drive reference is given immediately, I drive in the PI drive of speed amplifier is controlled, loop gain in control system decreases, and the amount of drift decreases The motor will be stopped if a small amount of friction load is present
2 Zero adjustment of SERVOPACK may shift slightly because of adjusting IN-B and TG of SERVOPACK In this case, it can be adjusted by ZERO of SERVOPACK

Fig. 13 5 Troubleshooting Motor Rotation at Low-speed

(6) Rated Reference Voltage is applied, but Motor does not reach Rated Speed

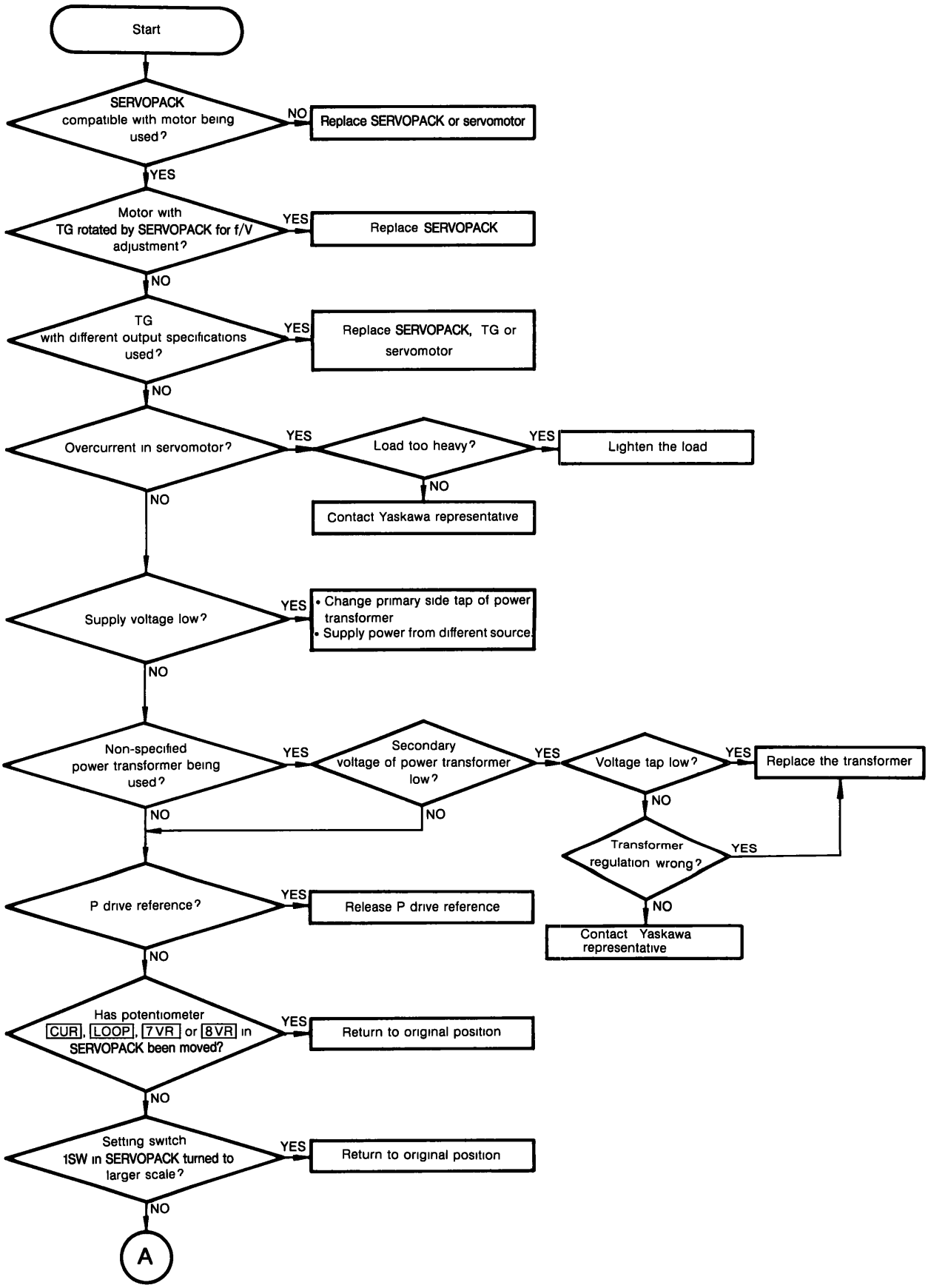


Fig. 13 6. Troubleshooting Defective Rated Speed

(6) Rated Reference Voltage is applied, but Motor does not reach Rated Speed (Cont'd)

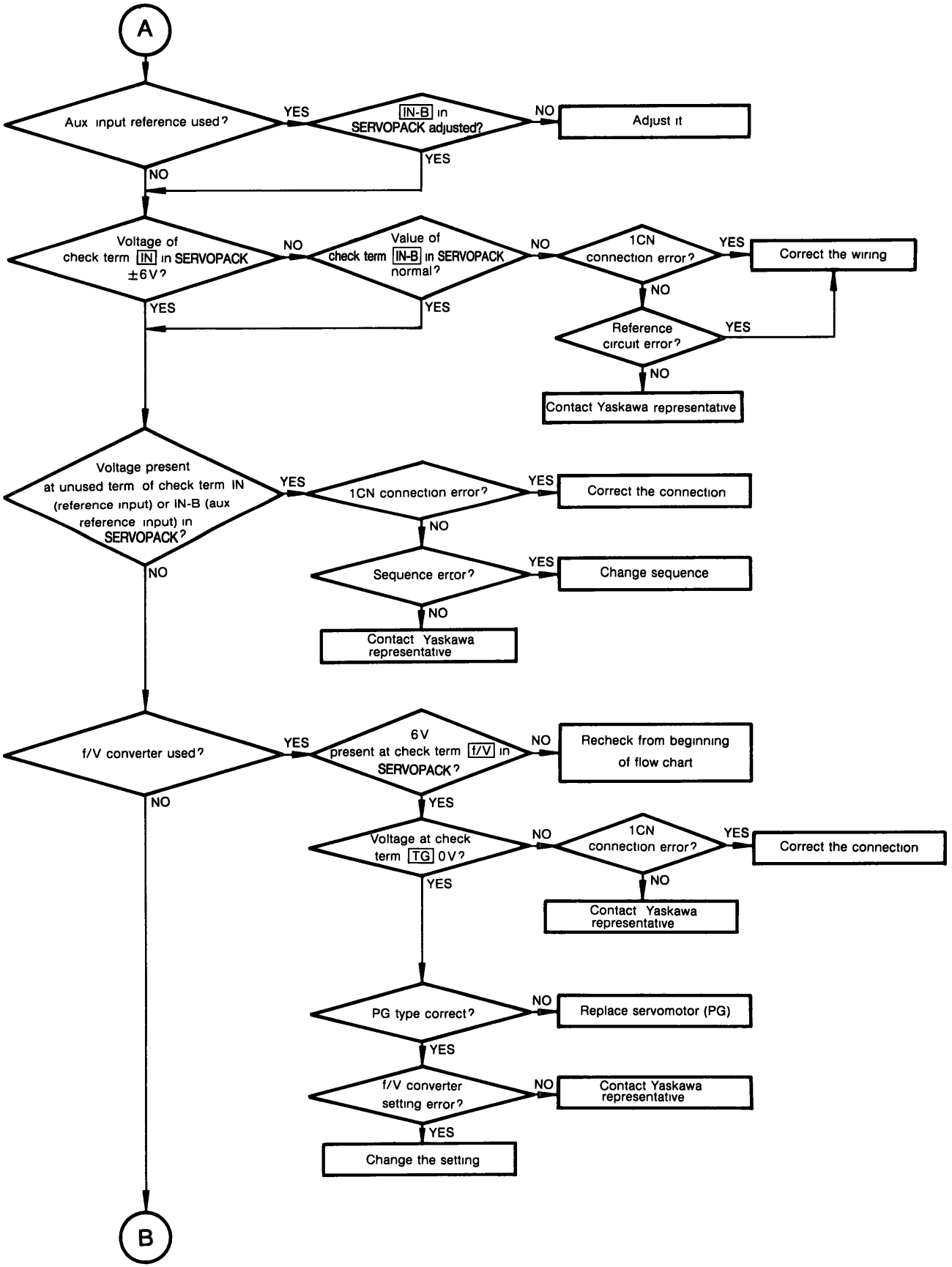
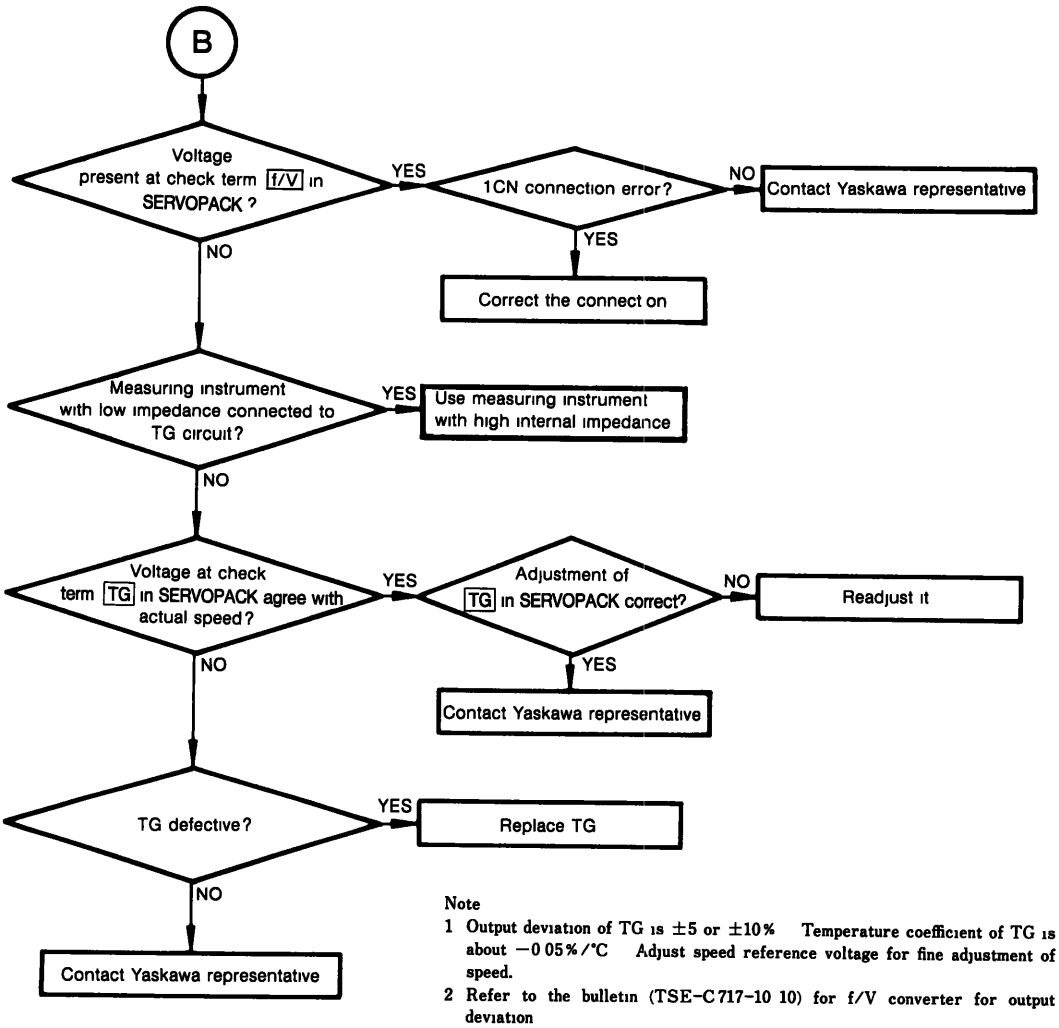


Fig 13 6 Troubleshooting Defective Rated Speed (Cont'd)



Note
1 Output deviation of TG is ±5 or ±10% Temperature coefficient of TG is about −0 05%/°C Adjust speed reference voltage for fine adjustment of speed.
2 Refer to the bulletin (TSE-C717-10 10) for f/V converter for output deviation

Fig. 13.6 Troubleshooting Defective Rated Speed (Cont'd)

(7) ALARM LED lights

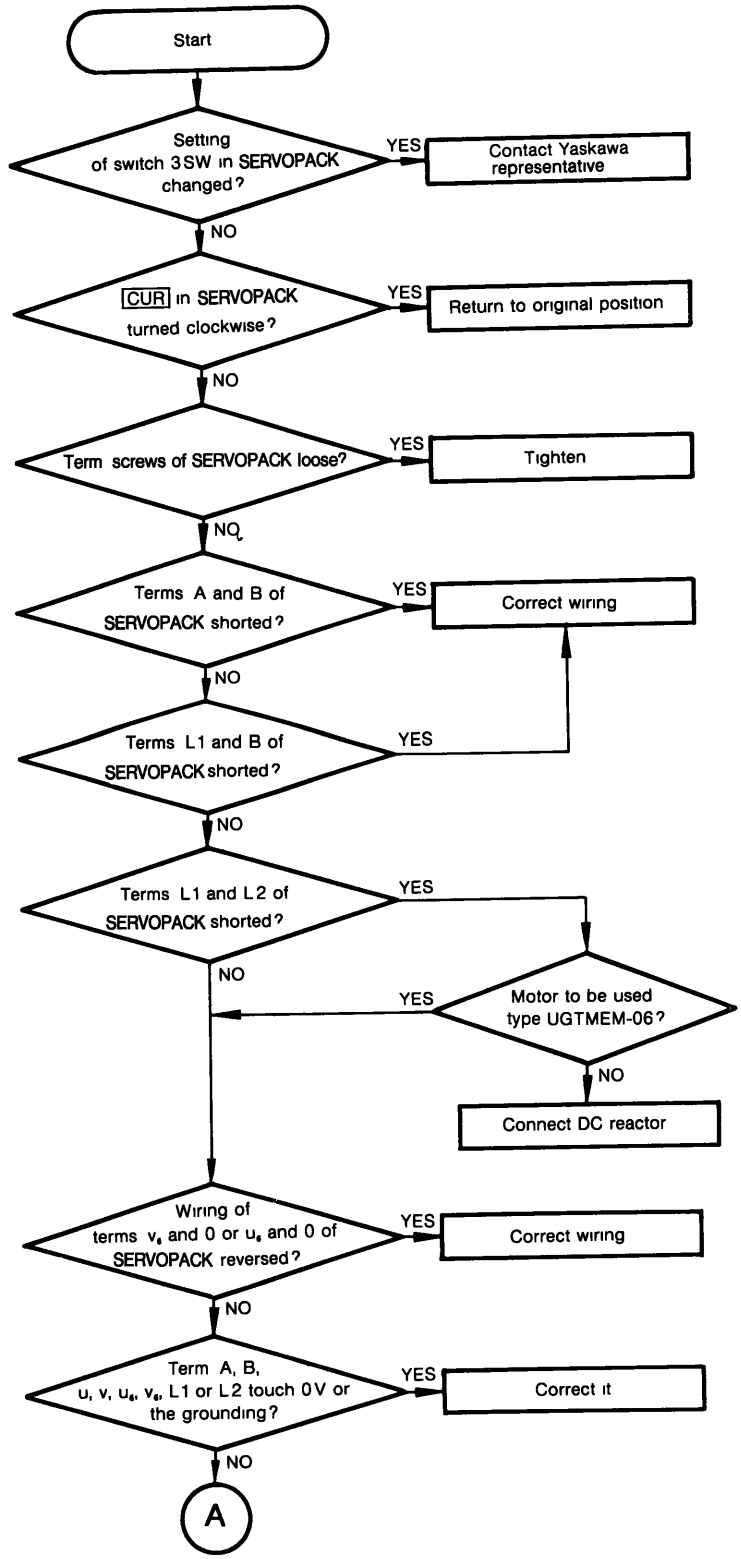


Fig. 13 7 Troubleshooting ALARM LED

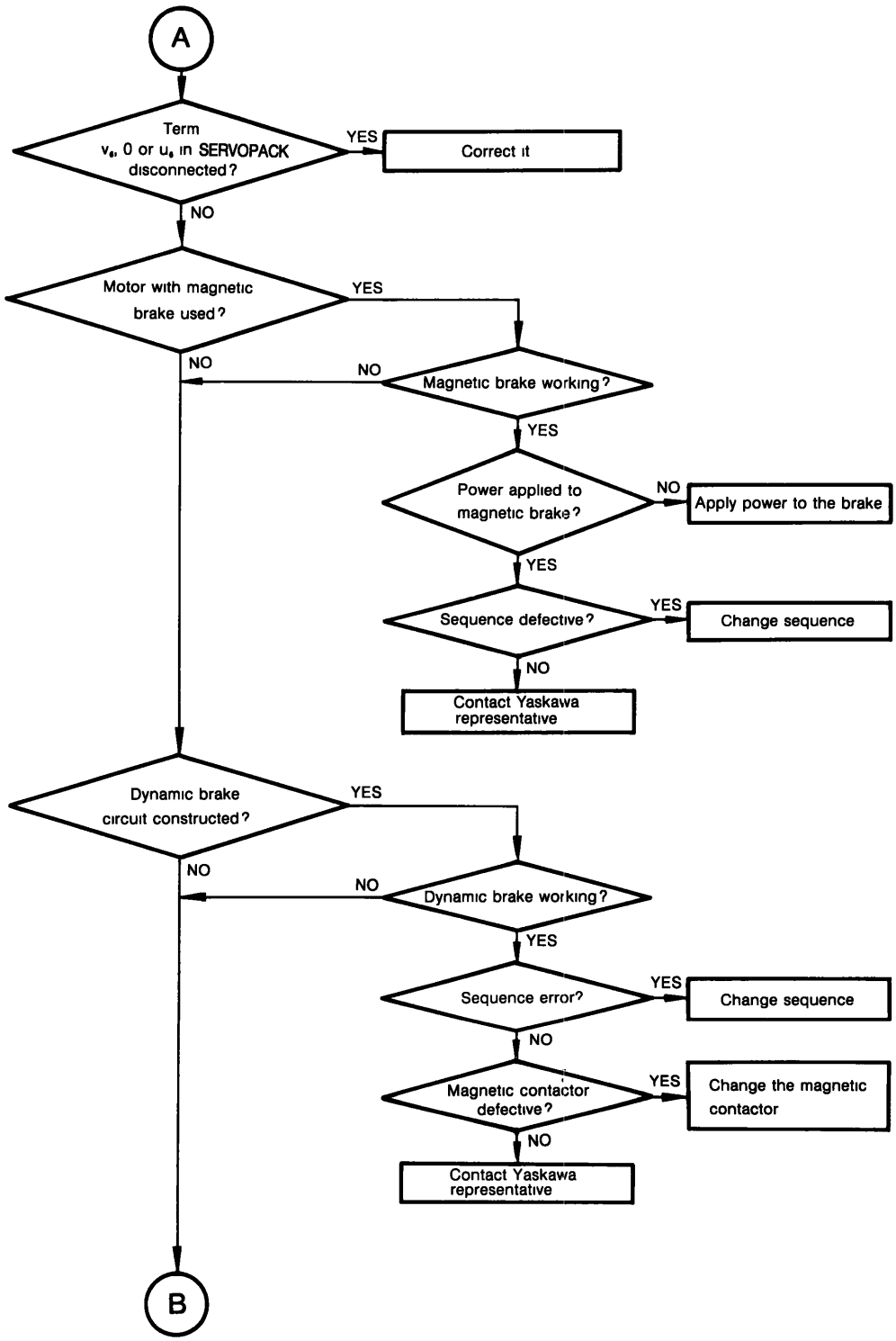


Fig 13 7 Troubleshooting ALARM LED (Cont'd)

(7) ALARM LED lights (Cont'd)

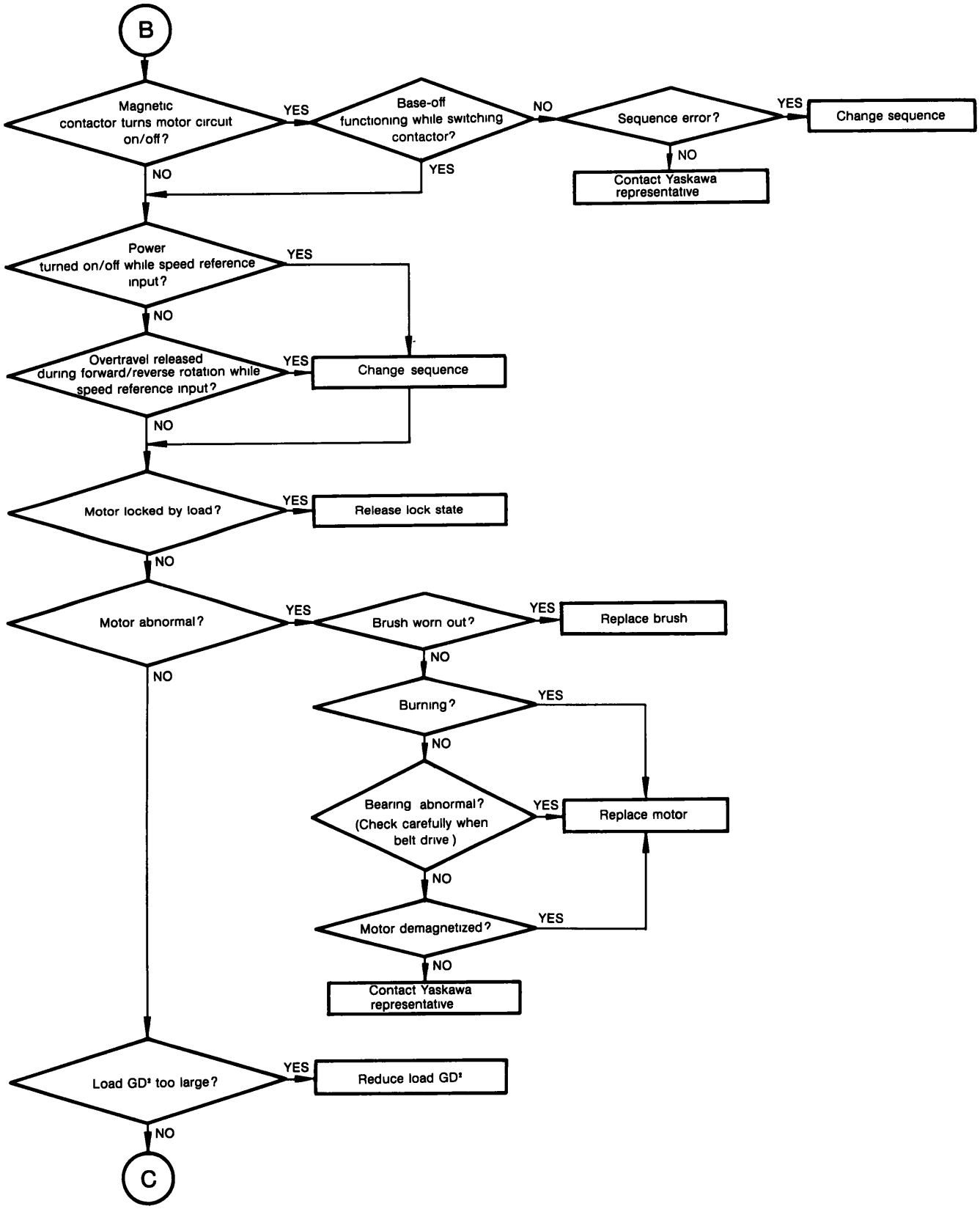
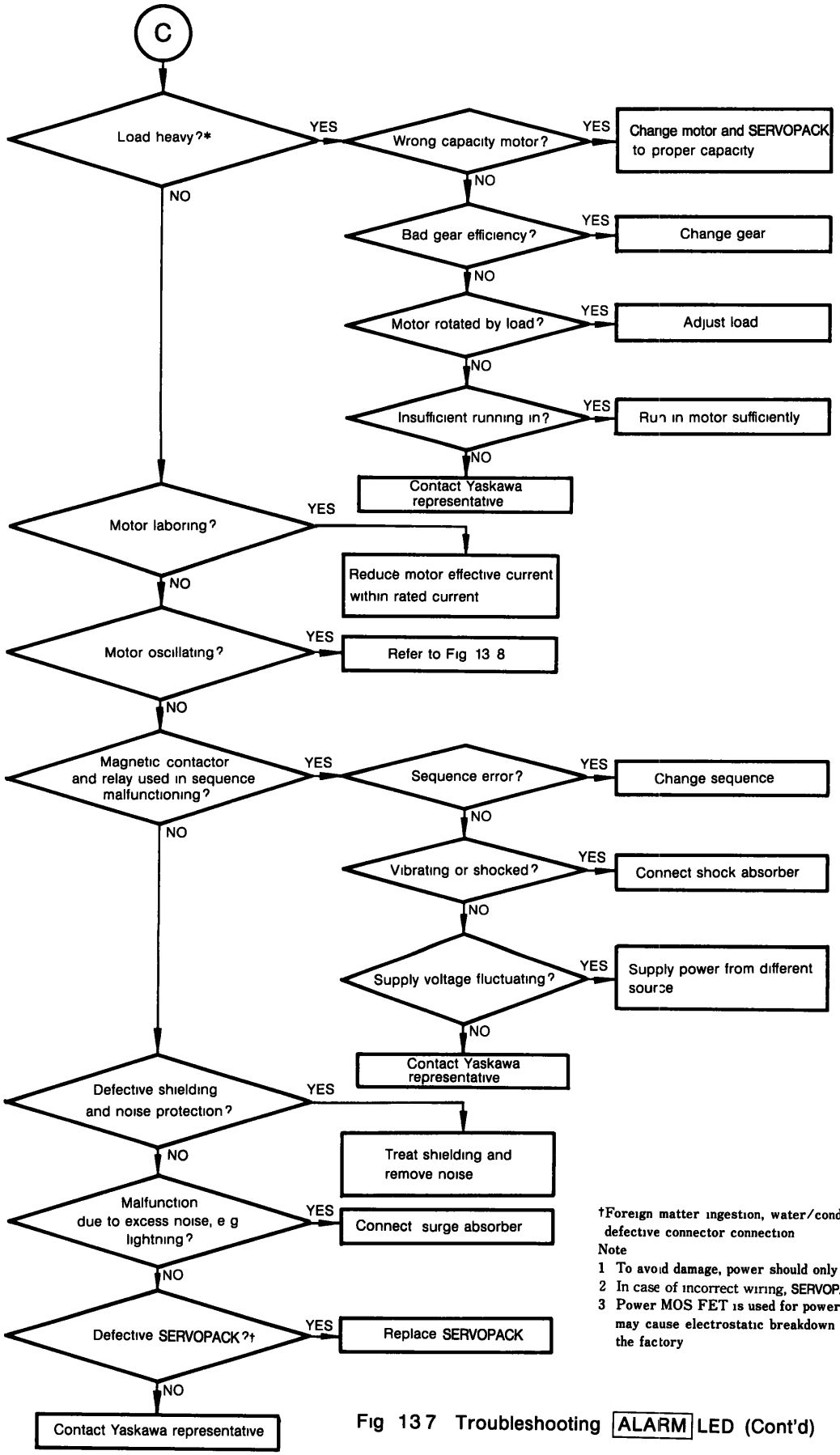


Fig 13 7 Troubleshooting ALARM LED (Cont'd)



†Foreign matter ingestion, water/condensation, oil, corrosion, defective parts, defective connector connection

Note

1 To avoid damage, power should only be supplied from marked with*

2 In case of incorrect wiring, SERVOPACK may be damaged

3 Power MOS FET is used for power transistor Contact with FET terminal may cause electrostatic breakdown Replacement must be accomplished at the factory

Fig 13 7 Troubleshooting ALARM LED (Cont'd)

(8) Current oscillates

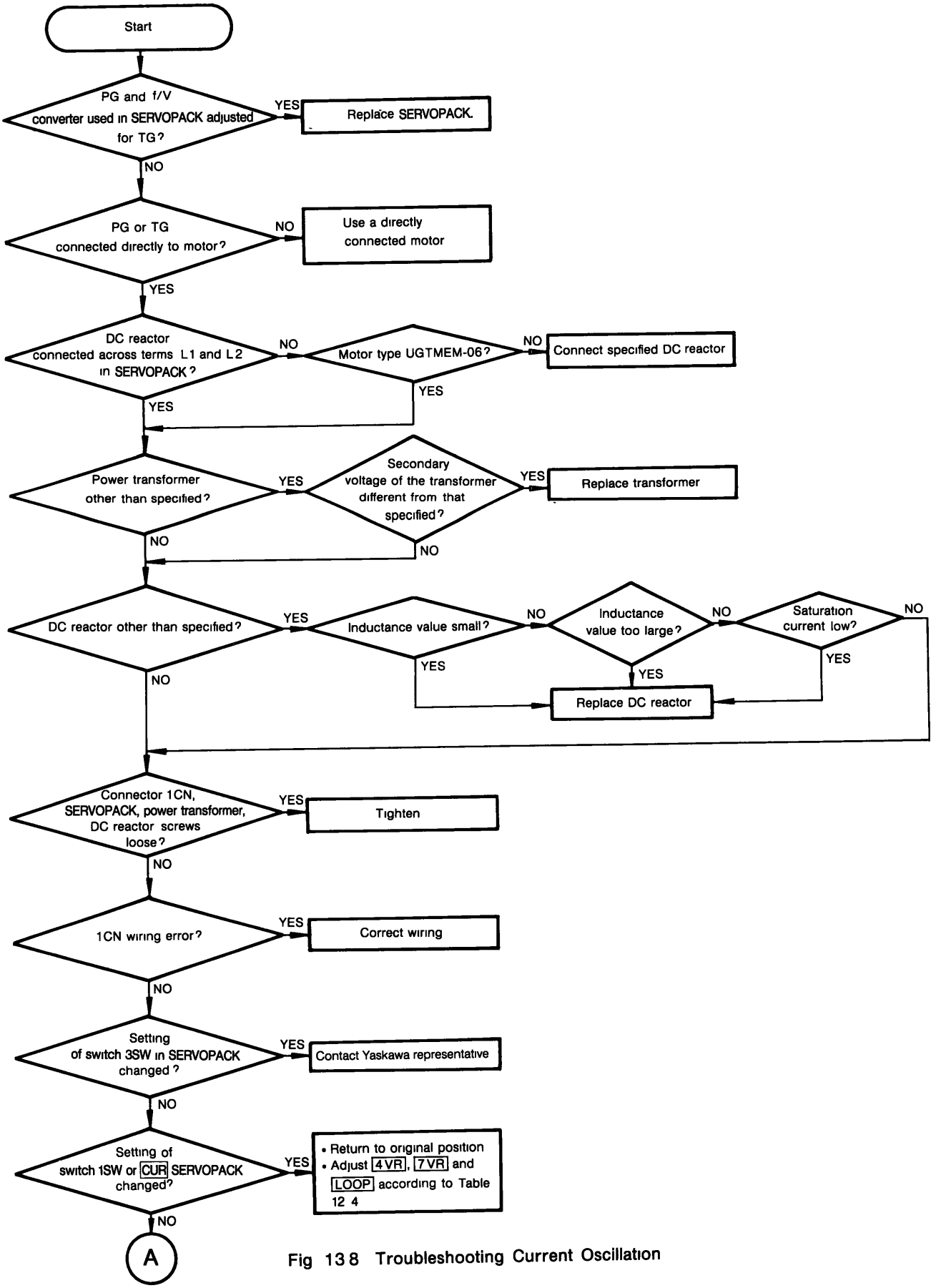


Fig 13 8 Troubleshooting Current Oscillation

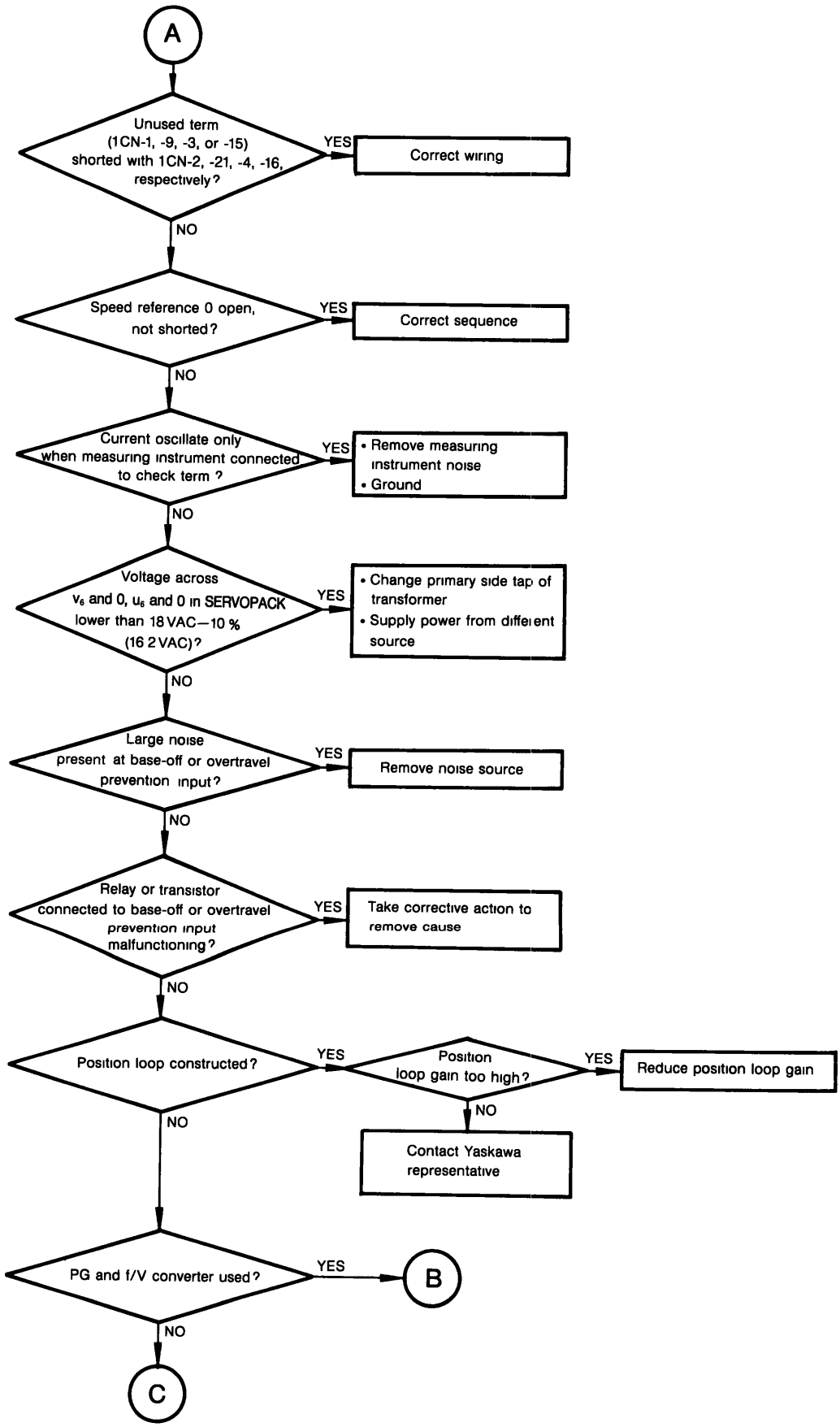
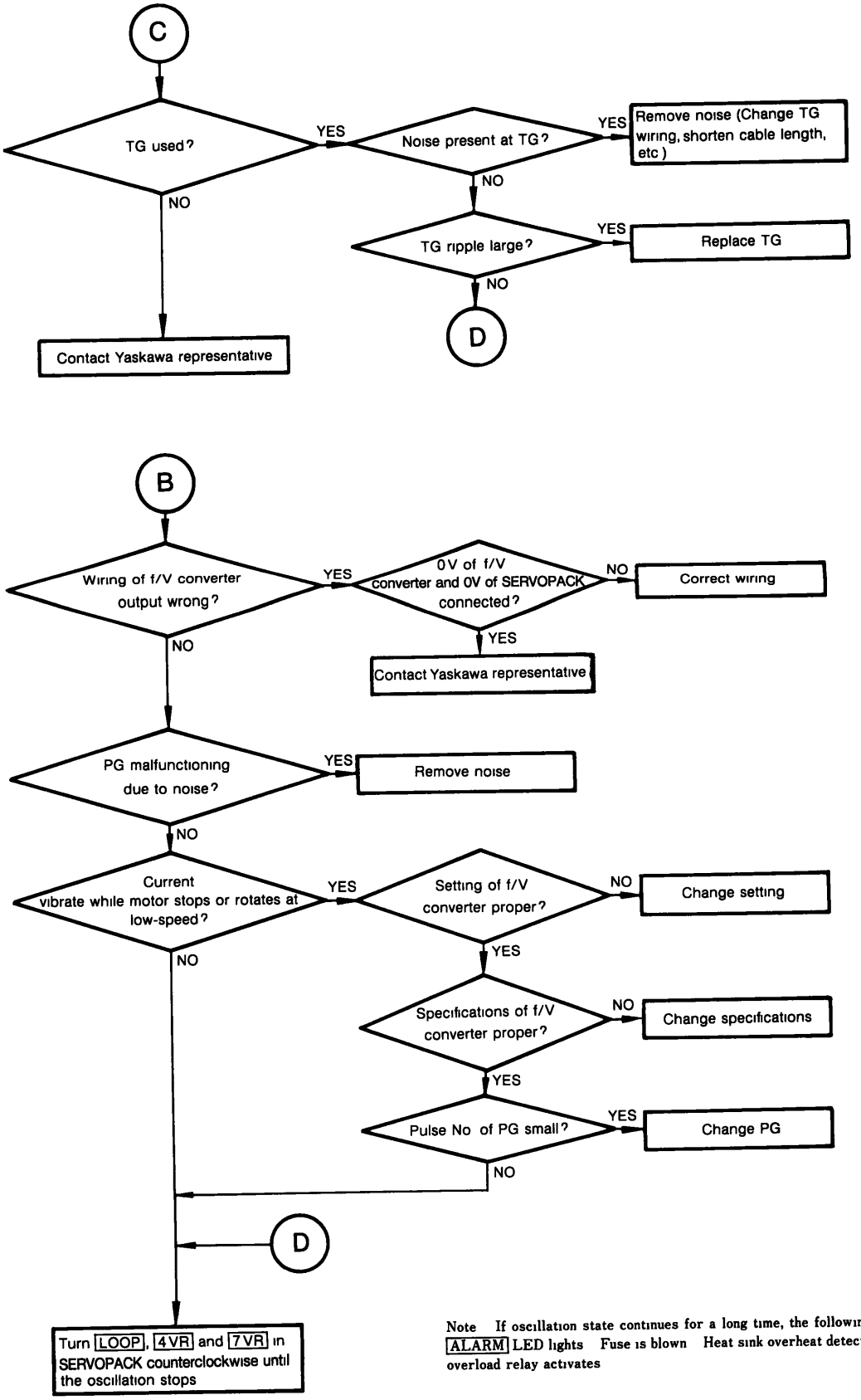


Fig 13.8 Troubleshooting Current Oscillation (Cont'd)

(8) Current oscillates (Cont'd)



Note If oscillation state continues for a long time, the followings may occur ALARM LED lights Fuse is blown Heat sink overheat detection or thermal overload relay activates

Fig 13 8 Troubleshooting Current Oscillation (Cont'd)

(9) Fuse is blown

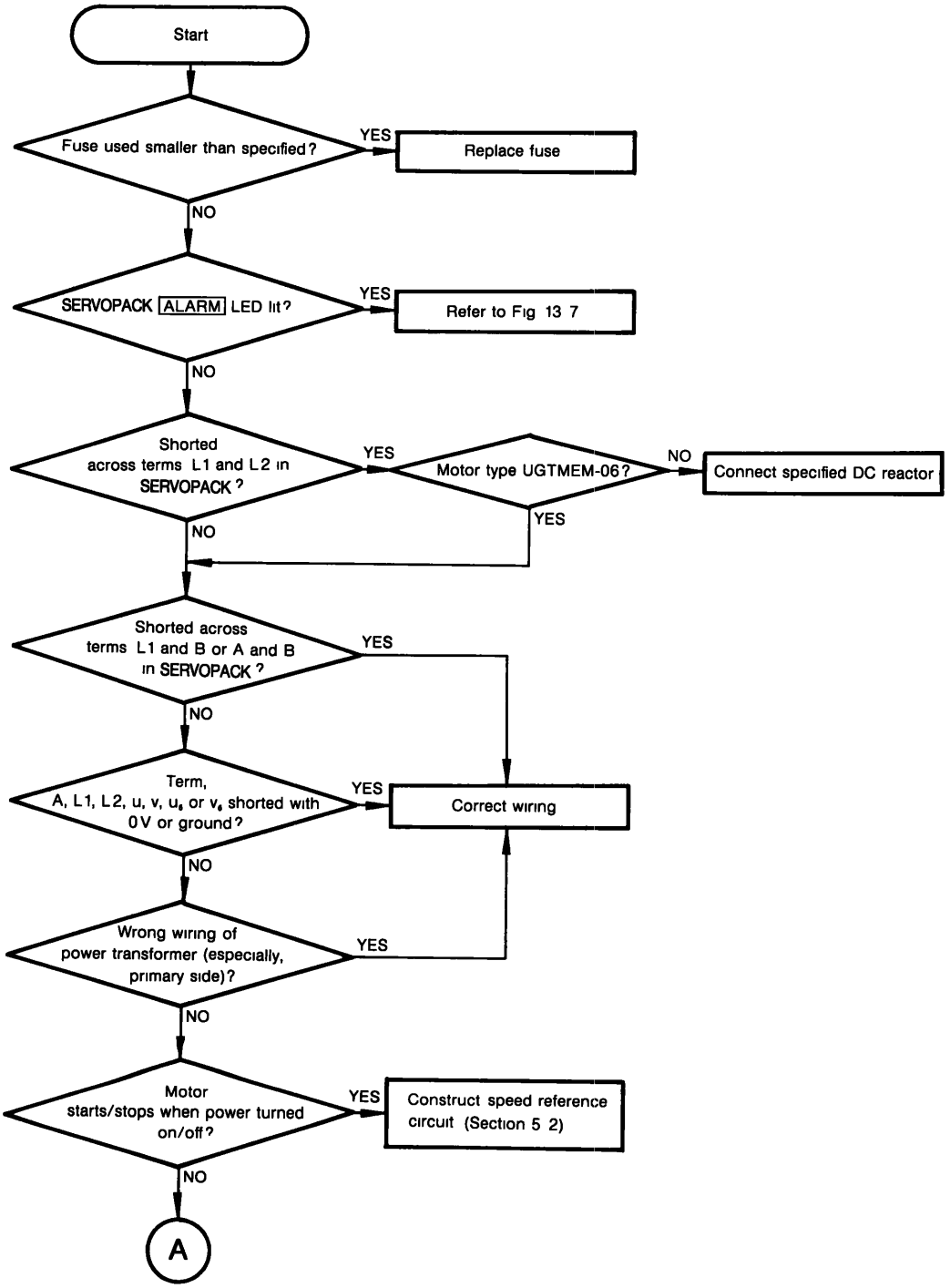


Fig 13.9 Troubleshooting Blown Fuse

(9) Fuse is blown (Cont'd)

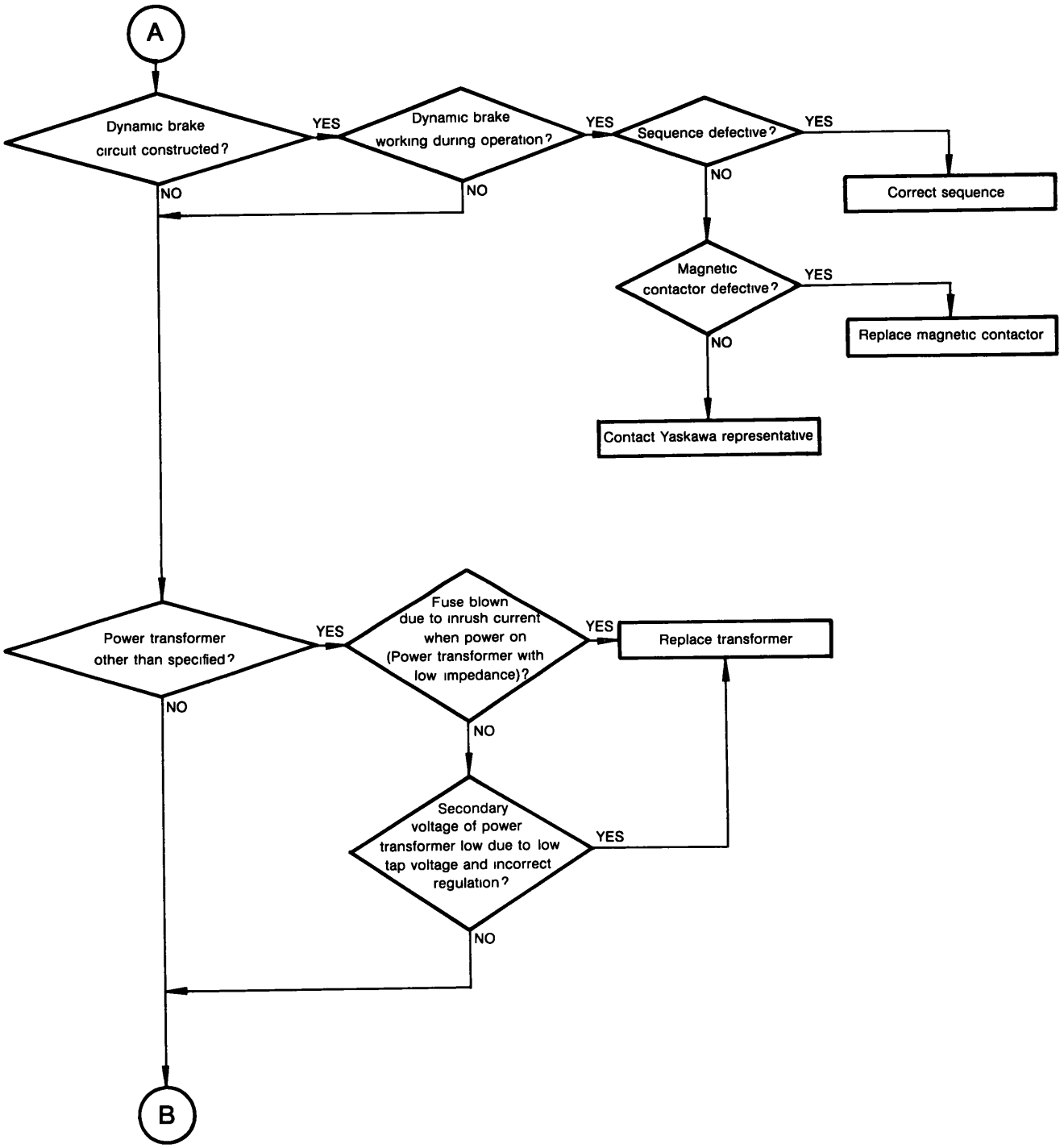


Fig 13.9 Troubleshooting Blown Fuse (Cont'd)

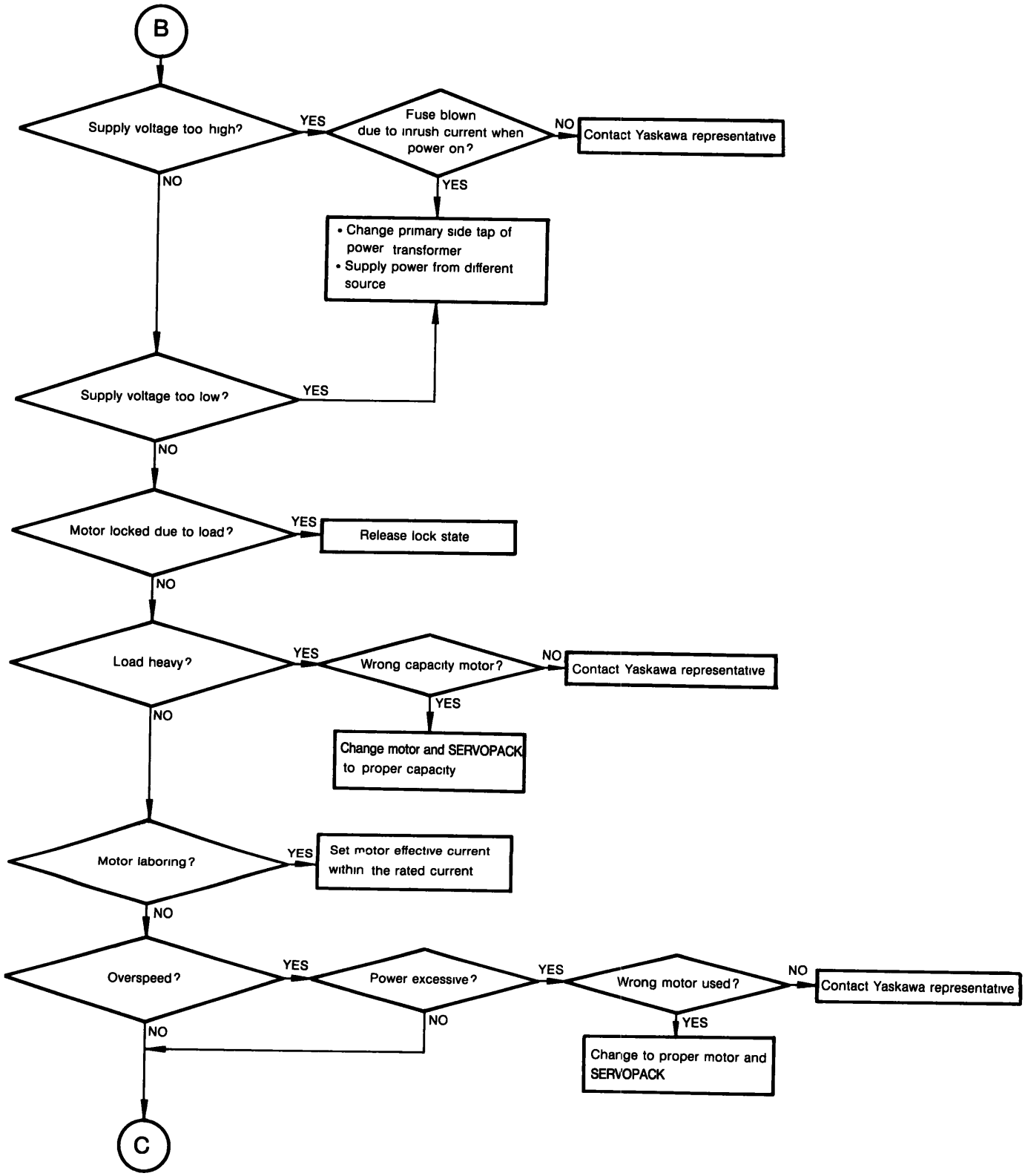


Fig 139 Troubleshooting Blown Fuse (Cont'd)

(9) Fuse is blown (Cont'd)

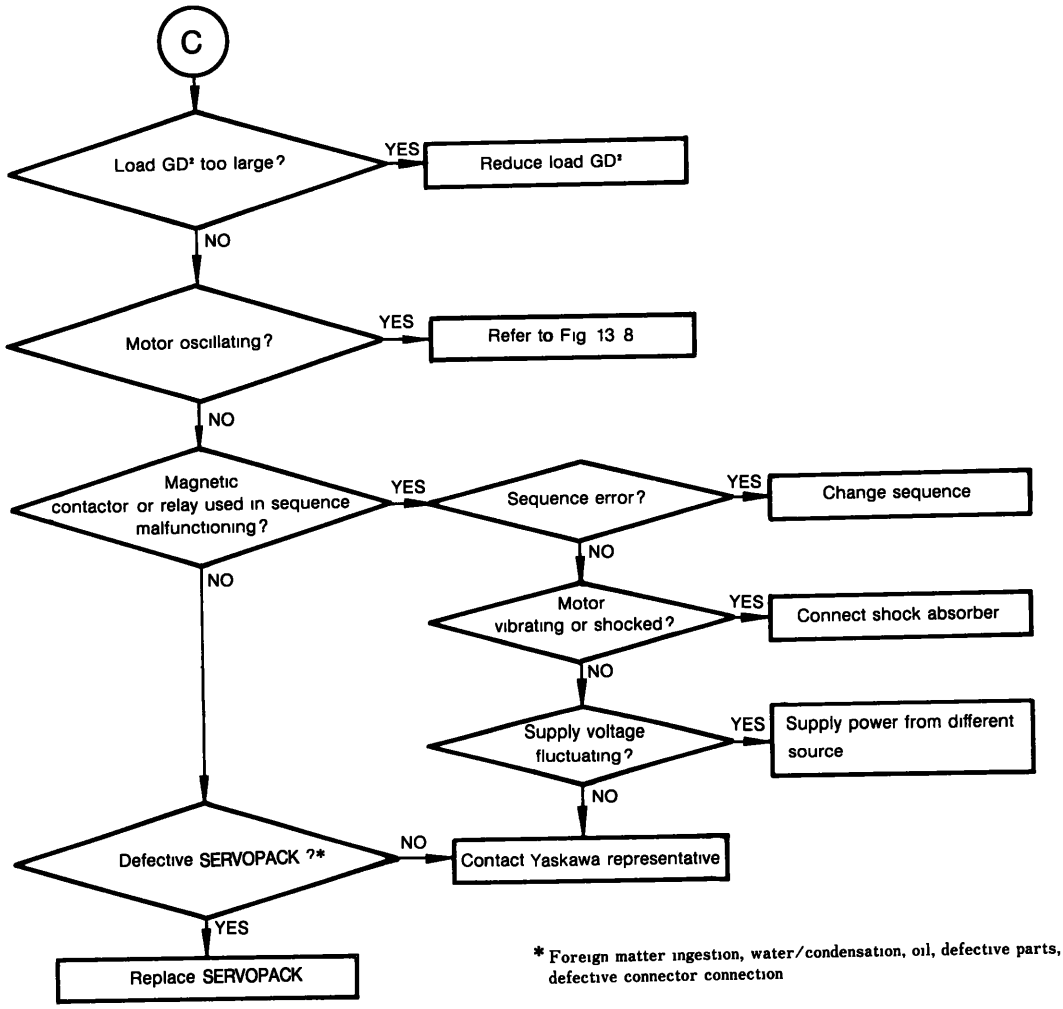


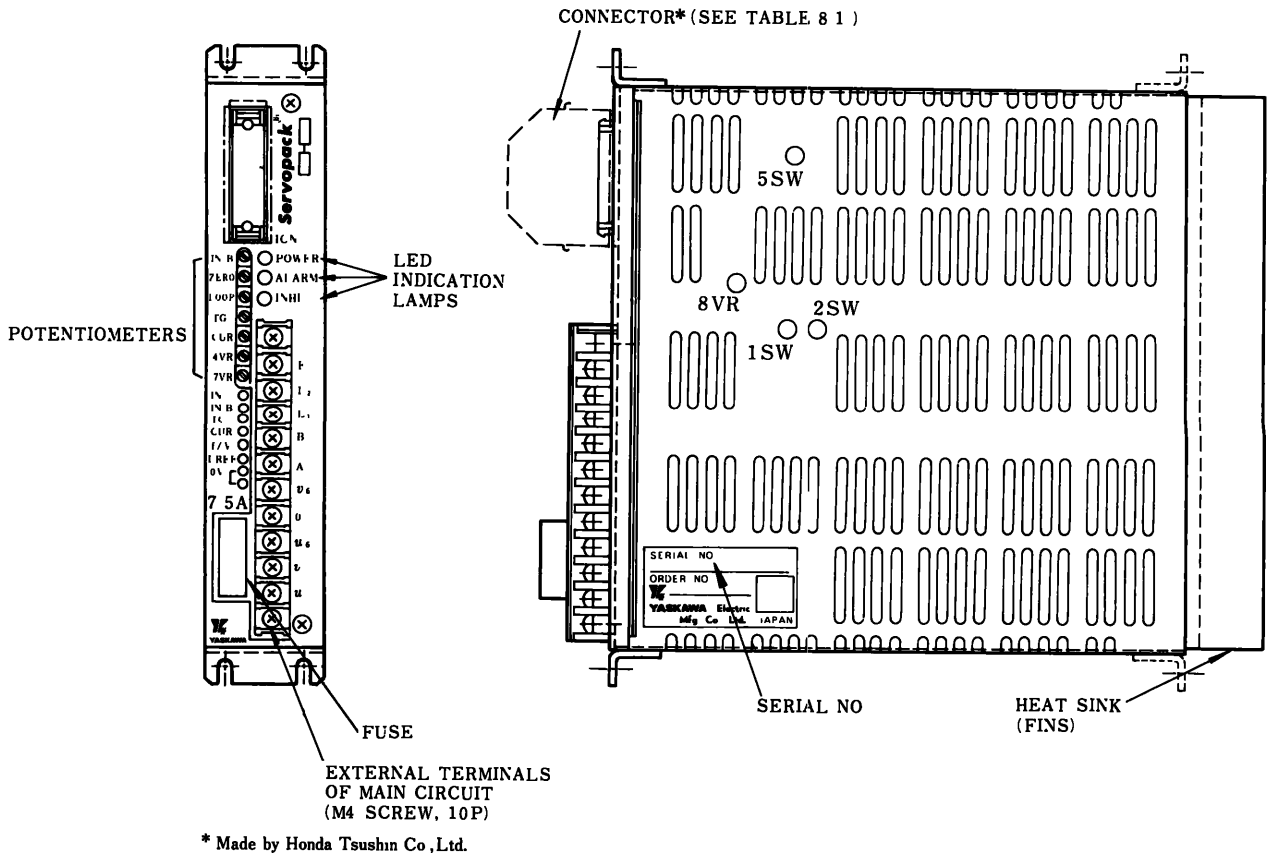
Fig. 13.9 Troubleshooting Blown Fuse (Cont'd)

13. 2. 3 Examples of Service Diagnosis for Incomplete Adjustment

Table 13. 3 Examples of Service Diagnosis for Incomplete Adjustment

Trouble	Cause	What to do
Motor rotates even if the speed reference voltage is 0V	Incomplete [ZERO] potentiometer adjustment.	Adjust [ZERO] potentiometer correctly.
Motor does not come up to rated speed, even though the rated reference voltage (±6V) is applied	Incomplete [TG] potentiometer adjustment.	Turning [TG] potentiometer clockwise (CW) increases the speed, and counterclockwise (CCW) decreases.
Motor vibrates after the power is turned on or the reference voltage is applied	LOOP gain too high	Turn [LOOP] potentiometer CCW to decrease the loop gain
Motor speed overshoot is too large at starting or stopping	• Level of mode switch too high • LOOP gain too high	• Turn [8VR] potentiometer CCW to decrease the level • Turn [LOOP] potentiometer CCW to decrease the loop gain.
Regulation is poor Though low speed regulation is good, the high is bad	• Current limit excessive • Level of mode switch too low	• Turn [CUR] potentiometer CW to increase the current limit value. • Turn [8VR] potentiometer CW to increase the level.

14. SERVOPACK COMPONENT LAYOUT



* Made by Honda Tsushin Co ,Ltd.

Component Layout of SERVOPACK
Type CPCR-FR01RB

SERVOPACK

DC SERVOMOTOR CONTROLLERS FOR SPEED CONTROL

TRANSISTORIZED PWM CONTROL/REVERSING

TYPE CPCR-FR□□RB

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805 Liberty Lane West Carrollton, OH 45449, U S A
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YASKAWA ELÉTRICO DO BRASIL COMÉRCIO LTDA
Rua Conde Do Pinhal 8-5°, Andar Sala 51 CEP 01501-São Paulo-SP, Brasil
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YASKAWA ELECTRIC (SINGAPORE) PTE LTD
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YATEC ENGINEERING CORPORATION
Shen Hsiang Tang Sung Chiang Building 10F 146 Sung Chiang Road, Taipei, Taiwan
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YASKAWA ELECTRIC CORPORATION

YASKAWA

TSE-C717-10 1D