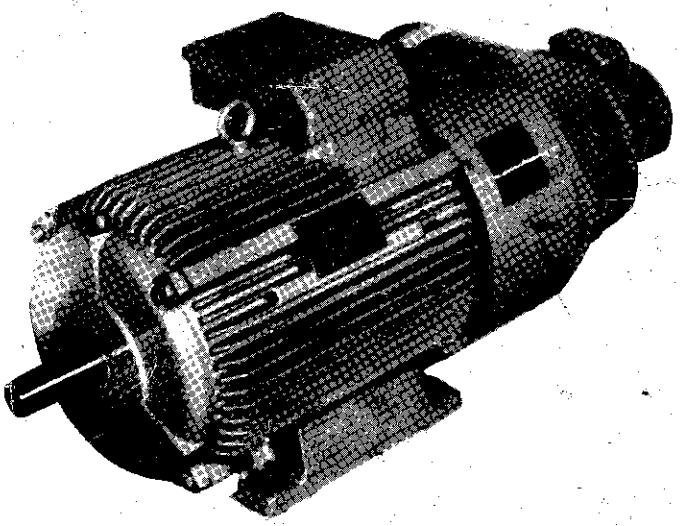
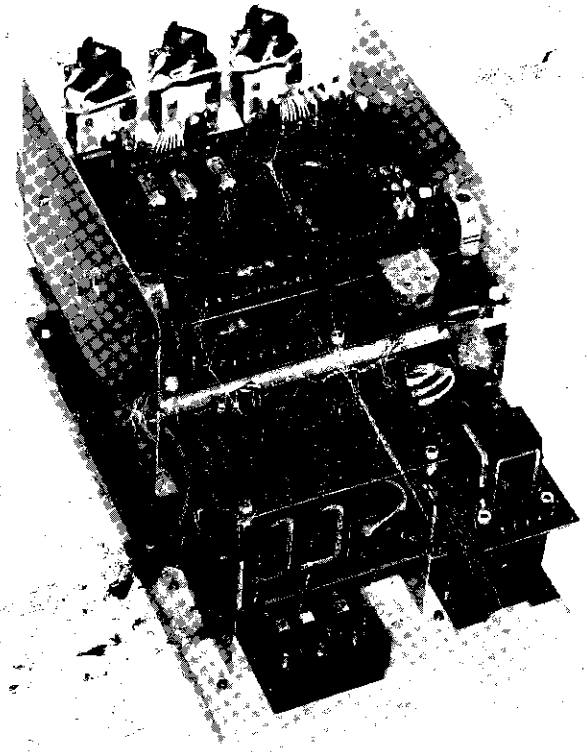
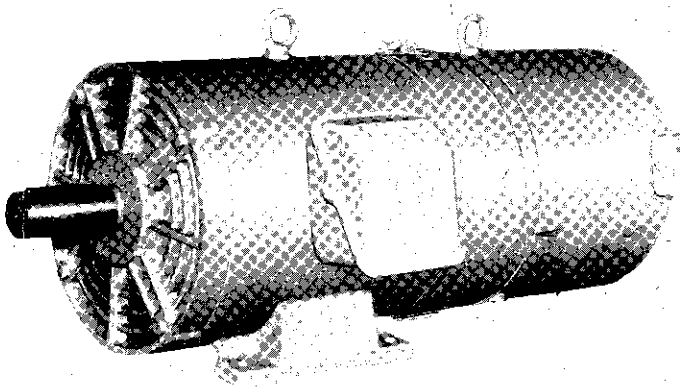
DC MOTOR/DSR-80 Series

Maintenance Manual







Fuji Electric Co.,Ltd.

FUji ELMES CO.,Ltd.

CONTENTS

I. Preface

This maintenance manual is Guide book for finding out trouble and checking equipment (DSR-80 Type Unit, DC Motor). After finishing installation, wiring of electrical appliancees. Our products are inspected completely before shipping out from our factory.

The following 3 items should be examined by each machine tool builder because final confirmation is impossible without combination of motor and machine. But if trouble happen, please confirm and adjust. It is should on the forth item in this manual how to adjust.

(1) Adjustment of the motor max speed.
(To compensate each deflections of T.G. generating voltage.)

(2) Adjustment of the speed meter.
(To adjust deflection of meter)

(3) Adjustment of system response
(To adjust PI setting to optimum on combination with machines)

II. Notes for adjusting and maintain

1. Only trained electrical and electronics personal should maintain this equipment.

2. When working on or near the equipment with power voltage applied, it is recommended that all metal object such as rings, watches and tie clasps be removed.

3. It is heighly recommended that all personal working on this equipment wear rubber soled shoes (insulated).

4. Do not insert or remove printed circuit board from the equipment while power is applied or operating.

III. FSD-D Type unit

1. Structure

We can find fuse, SREG. printed circuit board, auxiliary transformer, regulator, and field regulator on front view of driving convertor unit. On back side of SREG. P.C.B., there are mounted pulse trans printed circuit board and thyristor stack. Option P.C.B. sometimes mounted on SREG. P.C.B. when machine tool builder requested it.

1-1 Thyristor stack

Six module type thyristors are mounted to one piece of the aluminum cooling fins. The thyristor itself is molded, which enables a complete insulation from the fin.

NOTE: On large capacity convertor or 440 V power supply, module type thyristor is no used.

1-2 SREG. printed circuit board

Speed current REGulator printed circuit board is mounted on front side of driving unit base, and has IC logic, LED, lead relay, connector. When providing a control system for stopping at regular position, use an internally and partially modified P.C.B. Depending upon user's specifications, the P.C.B.s are also partially modified. In this case, the basic circuit remains unchanged.

No.	Item	Old type	New type 1	New type 2
1	Model No.	CDPB3CPS-62	CDPB3CPS-82	CDPB3CPS-83
			CDPB3CPS-82-0 (For Orientation)	CDPB3CPS-83-0 (For Orientation)
2	Faults Prevented	o Starting failure, tacho-loss (SFL) o Over-speed (OSL) o Fuse blown (37FL) o Overcurrent in motor cooling fan (88L) o Motor overheat (PTC)	o Starting failure (functions are improved) o Over-Speed o Fuse blown o Overcurrent in motor cooling fan o Motor overheat o Motor overcurrent (OCL)	Same as New type 1
3	Interchange-ability	Old type, New type 1, New type 2, Each board is peplaceable.		
4	TG feedback circuit cont-role range extended.	24.7 to 43.2 V 46.7 to 95.4 V Discontinuous	11 to 91 V Continuously Controllable	Same as New type 1

No.	Item	Old type	New type 1	New type 2
5	Fault terminals	None	Added	Added
6	Contact capaci-ty of fault detecting relay increased.	Resistor load DC24V Max. 0.5A	Resistor load o DC 24V, MAX. 0.5A o AC 250V, MAX. 7.5A Block terminals are extended in parallel with conventional connector terminal CN1.	Same as New type 1.
7	P and N (±15V) power pull-out terminal.	None	Added (load capacity: ±50mA)	Same as New type 1.
8	Coupling for pulse shift P.C.B. with power failuer P.C.B.	None	Jumping wire A18, A19, E10	Short pin SC1.

1-3 Field regulator (FREG-10C) (FREG-10E) (FREG-10D)

There are control printed circuit board on upper side, and diode, thyristor and auxiliary power trans are mounted under side of FREG unit. Adjusting cap for 50 Hz/60 Hz change, rheostat $VR_1 \sim VR_5$, IC, transistor and pulse transformer are arranged on control P.C.B.
(However, FREG-10D has no 50/60 Hz change-over cap.)
For characteristic differences, refer to the previous item.

1-4 Pulse trans. printed circuit board

Difference between pulse trans. P.C.B. for 220V power supply and 440V are shown in photo <P-7> ∿ <P-10>. This P.C.B. has twelve pulse transformers, resistors and capacitors, etc.

Besides, the 200V pulse transformer P.C.B.s are available in new (2 kinds) or old (2 kinds) types, each having the following differences.

No.	Item	Old type	New type	
1	Model No.	CDPD3ZPA-11 and -12	CDPD3ZPA-13	CDPD3ZPA-14
2	Mechanism for preventing gate connector from coming out	None	Included	Included
3	Protective circuit against power failure	None	None	Included
Interchangeability		(Included)	None	None

1-5 Auxiliary transformer for control power source and AVR

Control power source (±15V, +24V) is produced, first by dropping 3ø, 200/220V with auxiliary transformer, and then necessary power source is available with constant voltage device after its rectification. AVR is equipped on the transformer.

The specifications for each component of the power source unit are as follows:

* Three-phase auxiliary transformer

Capacity ; 25VA
Primary voltage ; 210V ± 15%
Secondary voltage, current ;
$U_1 - V_1 - W_1$ 17.8V (650mA) between the cables
$U_2 - V_2 - W_2$ 17.8V (80mA) between the cables
$U_3 - V_3 - W_3$ 7 V (50mA) between the cables

Power source regulator

Type ; EHD ∿ RD 3153PA
Input voltage ; 18.5V
Output voltage ; 15V
Permissible output current ; 500mA

1-6 Current transformer

The current transformer is equipped in order to check motor current at AC side. In its structure, this transformer winds secondary winding to cut core, and it is of a window-type; at the primary side, main circuit connecting bar goes straight through the core and makes one turn.

1-7 Fuse

The fuse is installed between the cables of alternating current U, V, W phases for the purpose of protecting the thyristor from overcurrent. If the fuse is blown off, the white mark of the micro switch installed at the top of the fuse body will protrude, which shows blow-off fuse distinctly. (See Fig. 1)

In case the mark protrudes forward again, replace the fuse. Even if the mark is again pushed in, the exchanged fuse is not used as it is, because the fuse is blown off. The types of the fuse are as follows:

Fuse Types

Drive Unit Type No.	—	—	FSD -18DN43	FSD -22DN43	FSD -30DN43	FSD -37DN43	—	—
	—	—	FSD -11DN33	FSD -15DN33	FSD -18DN33	FSD -22DN33	FSD -30DN33	—
	FSD -5DN23	FSD -7DN23	FSD -11DN23	FSD -15DN23	—	—	—	FSD -18DN23
Fuse Type No.	CS5F-40-G		CS5F-75-G		CS5F-100-G			CS5F 150-G

Drive Unit Type No.	—	—	—	—	FSD -45DN43	FSD -55DN43	FSD -75DN43	FSD -90DN43	FSD -110DN43	FSD -150DN43
	—	—	—	—	FSD -37DN33	FSD -45DN43	FSD -55DN33	—	—	—
	FSD -22DN23	FSD -23DN23	FSD -25DN23	FSD -30DN23	FSD -37DN23	FSD -45DN23	—	—	FSD -55DN23	FSD -75DN23
Fuse Type No.	CS5F-200-G				CS5F-250-G				CS5F-400-G	

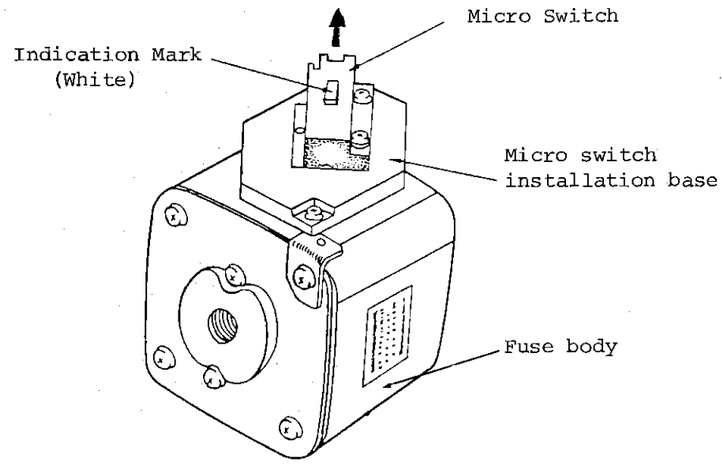
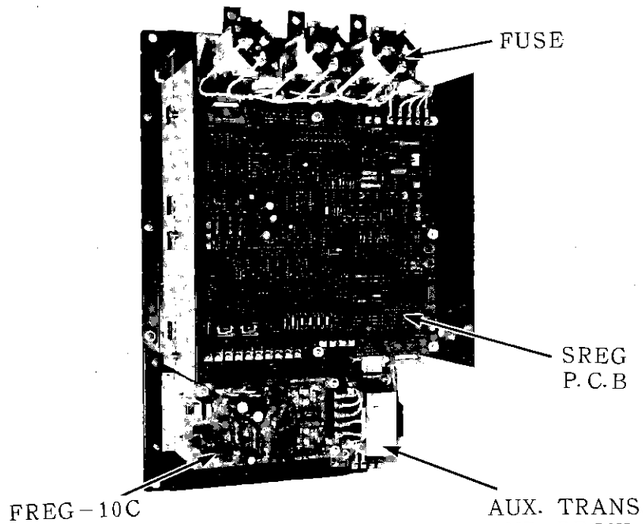


Fig. 1

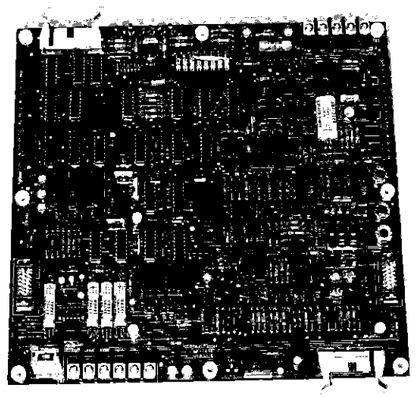
2. Photo

ドライブユニット
DRIVE UNIT
＜P－1＞

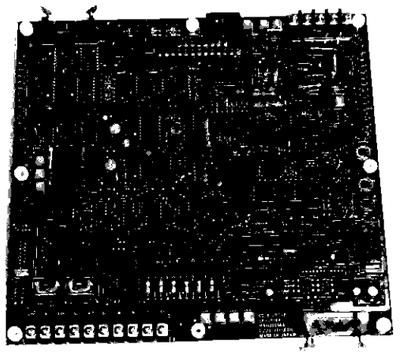


SREGプリント板
SREG. PRINTED CIRCUIT BOAD
＜P－2＞

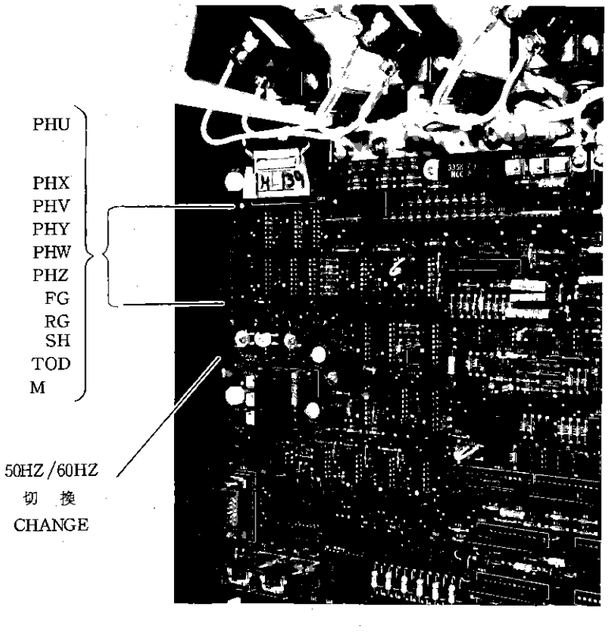
(CDPB3CPS－62)

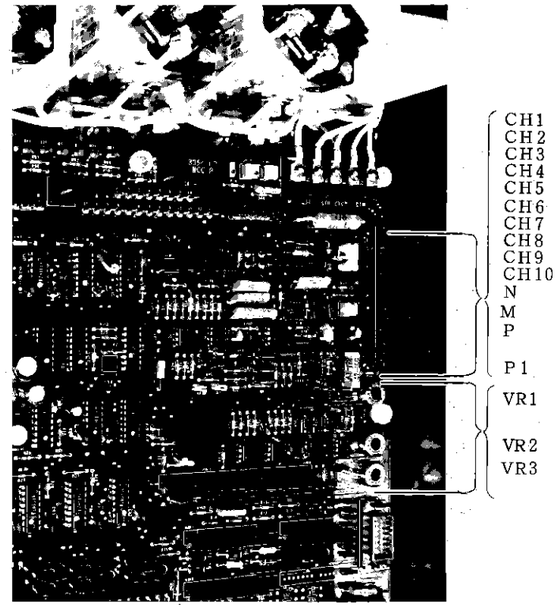


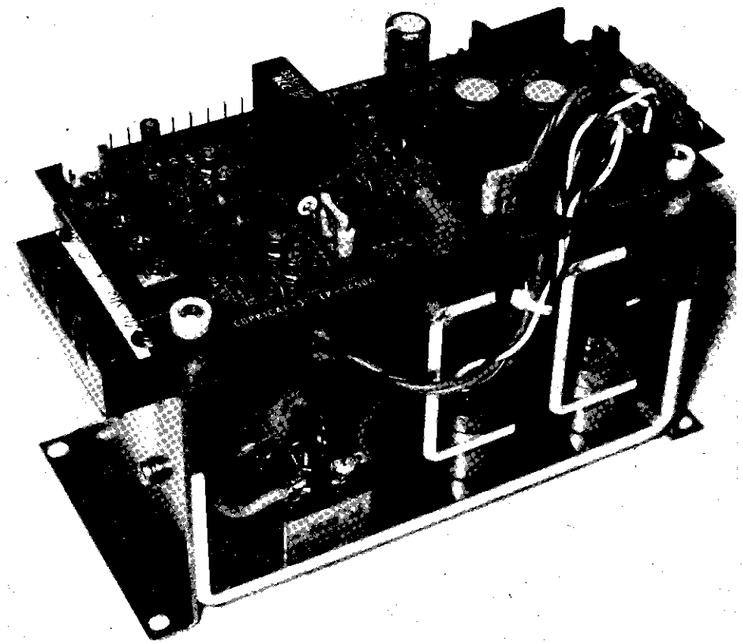
(CDPB3CPS－82)



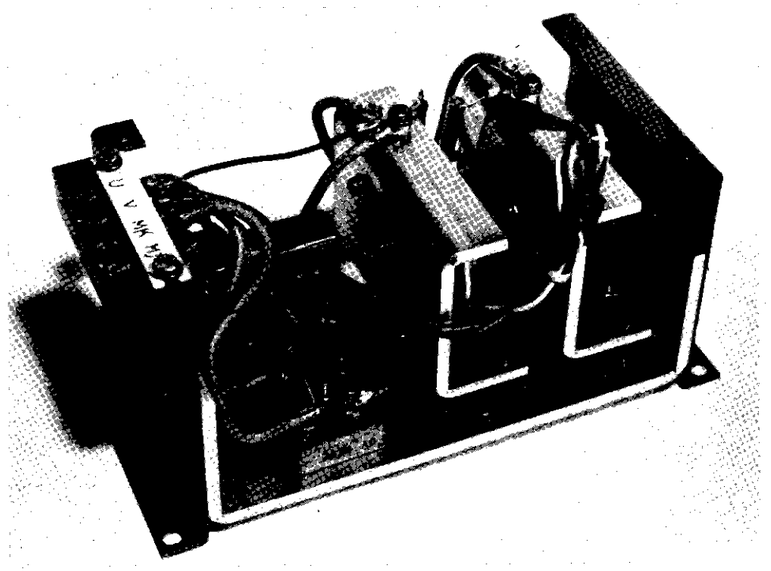
SREG. P板
チェック端子
＜P－3＞

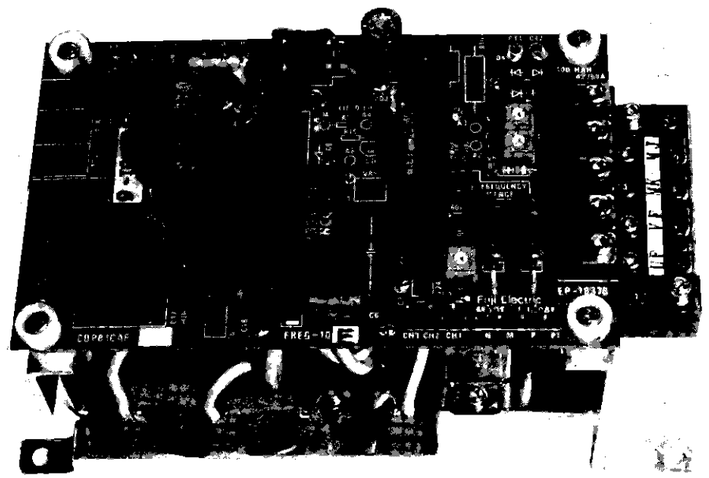




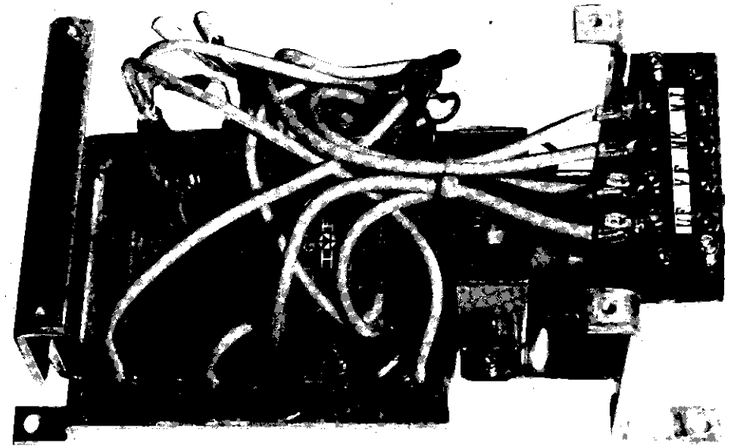


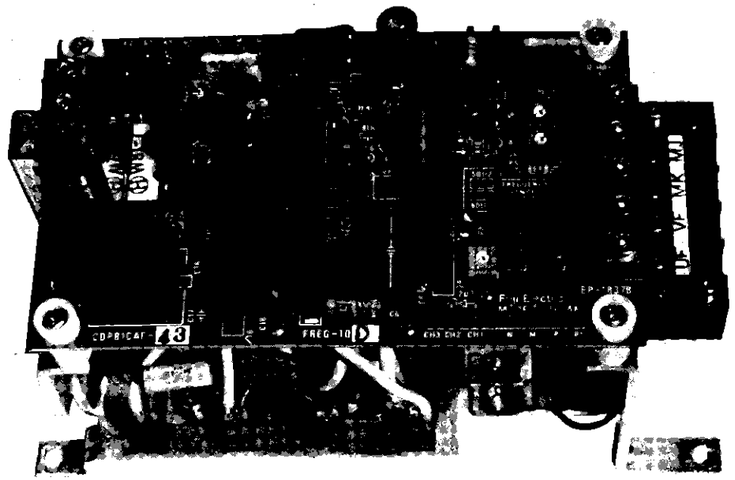
自動界磁調整器
FIELD REGULATOR
(FREG-10C)
<P-4>



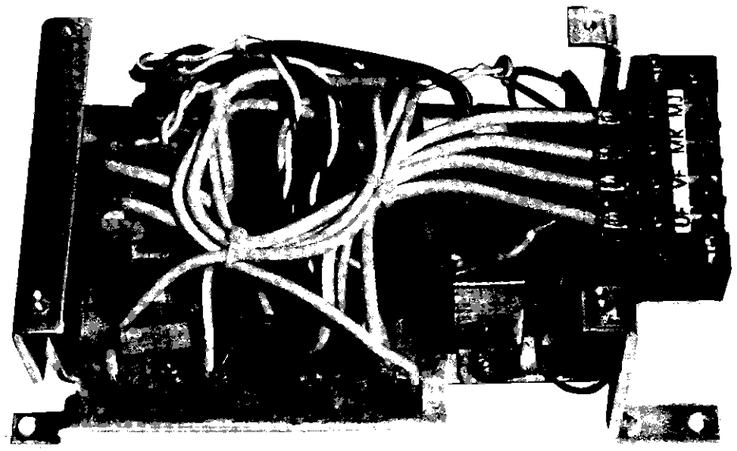


自動界磁調整器
FIELD REGULATOR
(FREG-10E)
<P-5>

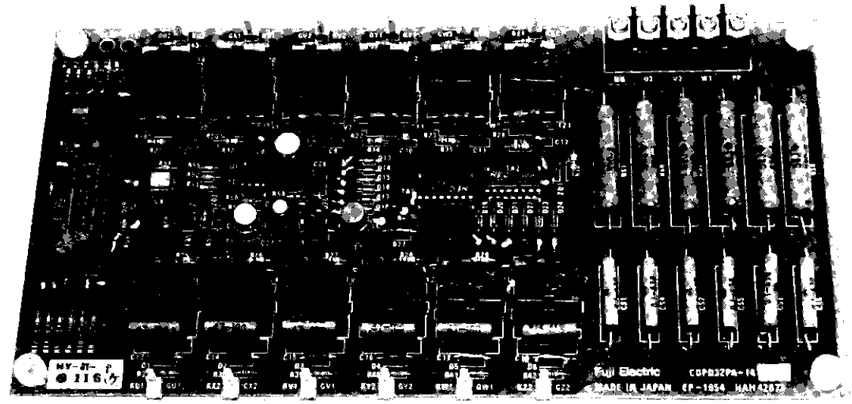




自動界磁調整器
FIELD REGULATOR
(FREG-10D)
<P-6>



パルストランス　P板　　(200V用)
PULSE TRANS. P・C・B (200V)
(CDPD3ZPA-11)
<P-7>



パルストランス　P板　　(200V用)
PULSE TRANS. P・C・B (200V)
(CDPD3ZPA-13)
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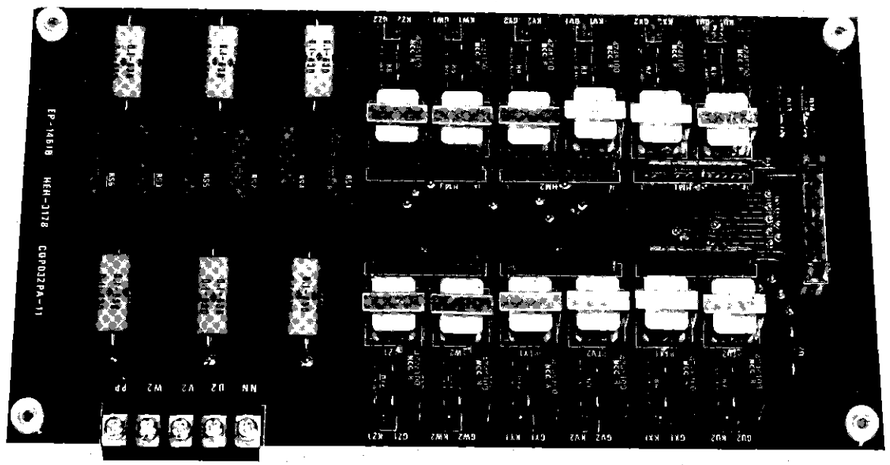
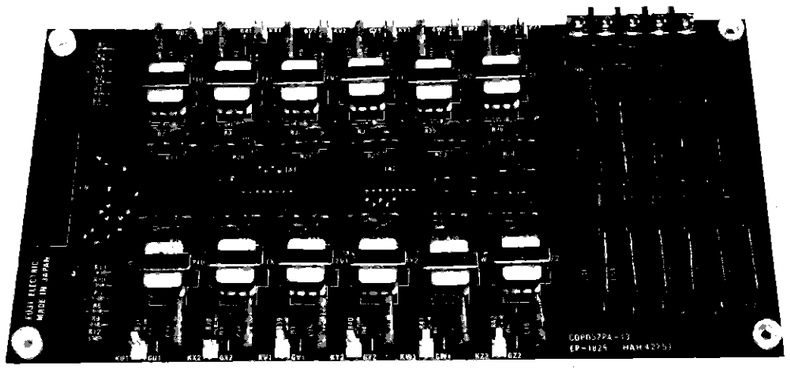


パルストランス　P板　（200V用）
PULSE TRANS. P・C・B（200V）
（CDPD3ZPA−14）
<P−9>



パルストランス　P板　（400V用）
PULSE TRANS. P・C・B（400V）
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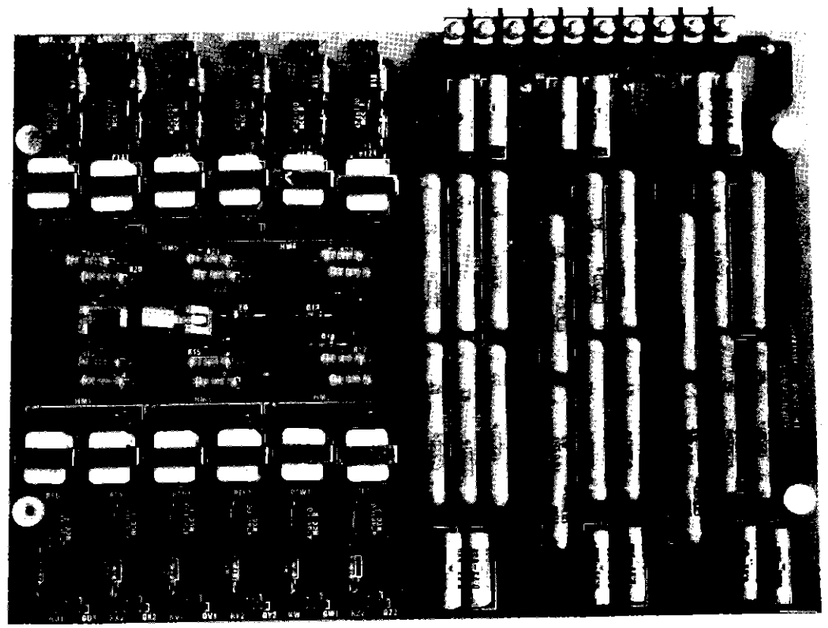
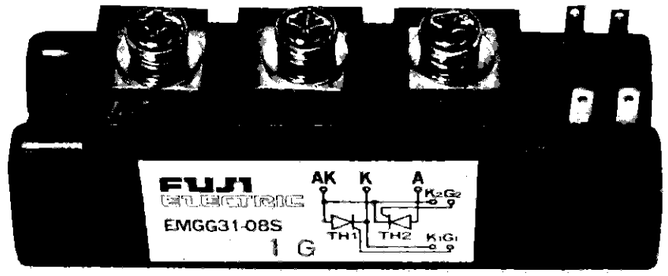


サイリスタ
THYRISTOR（FUJI）
<P−11>



サイリスタ
THYRISTOR（FUJI）
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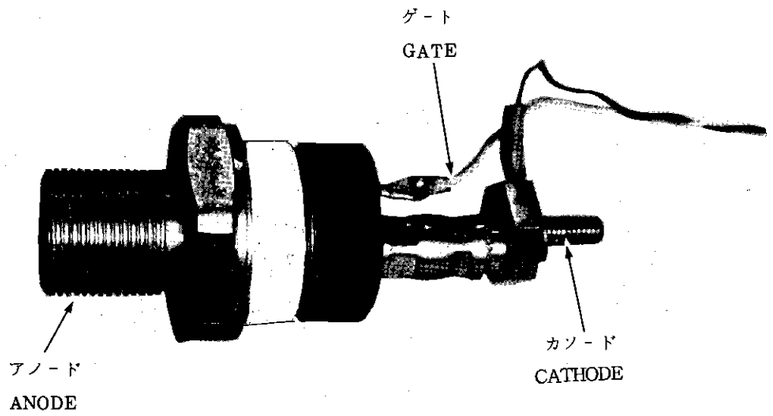
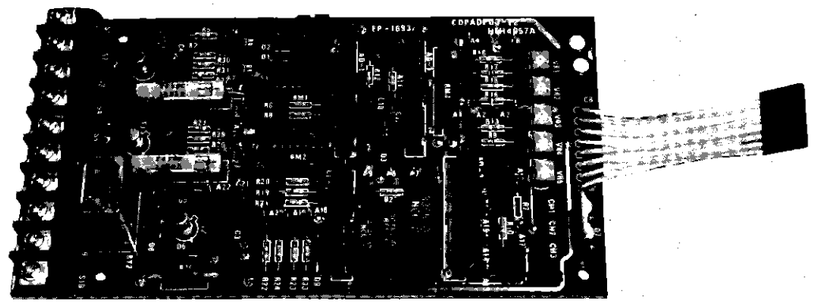
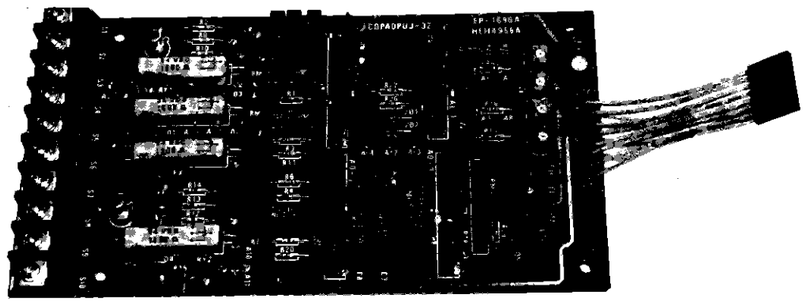


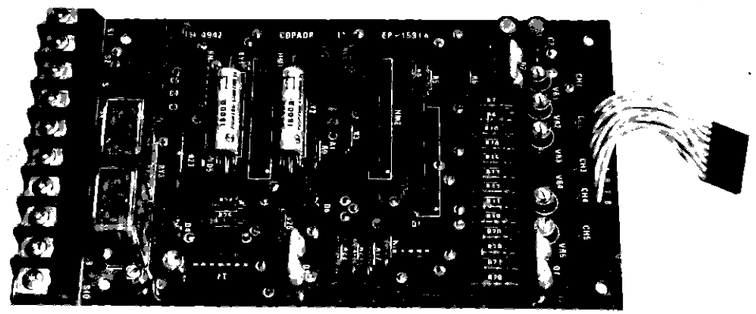
HLR • Comparator P.C.B.
(CDPAOPUJ-22)
<P-13>



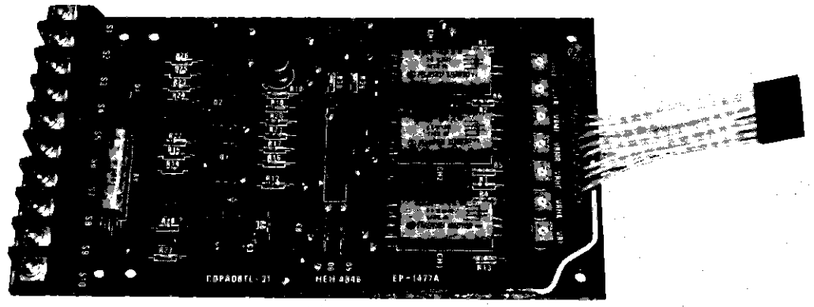
Override with HLR P.C.B.
(CDPAOPUJ-32)
<P-14>



HLR • Speed arrival signal • Comparator P.C.B.
(CDPAOPUJ-41)
<P-15>



Torque limiter • Speed arrival signal P.C.B.
(CDPAOBTL-31)
<P-16>



Torque limiter • Current limit pattern generate P.C.B.
(CDPAOBTL-41)
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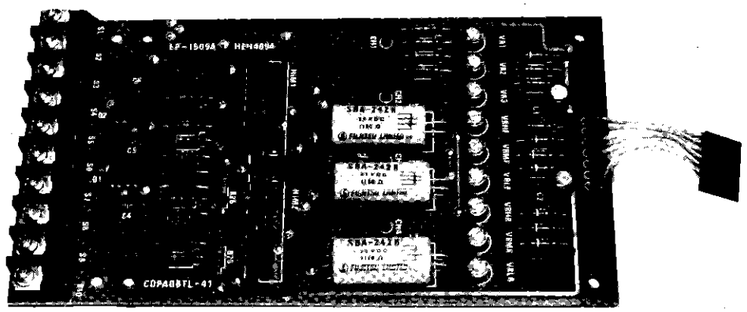

D/A Convertor • Speed arrival signal P.C.B.
(CDPAOTAD-21)
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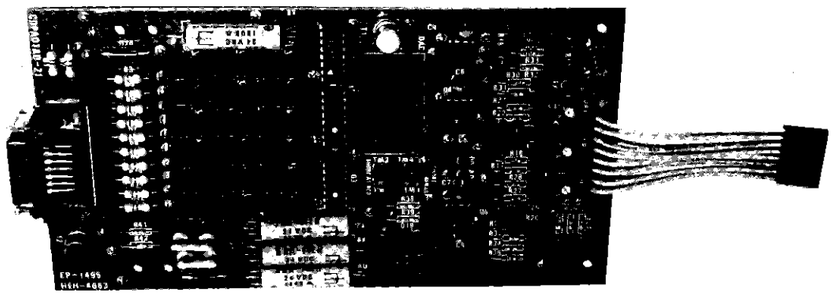
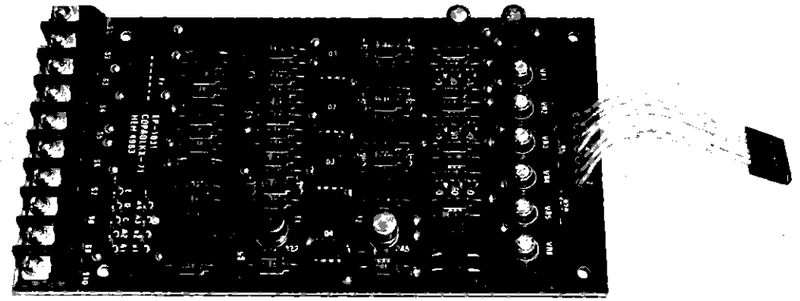
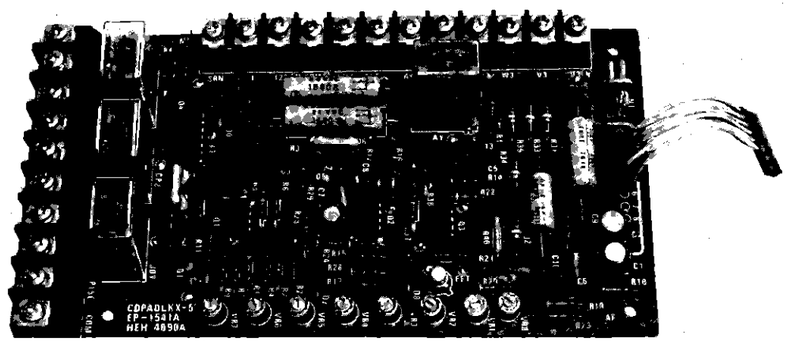


Comparator P.C.B.
(CDPAOLKX-71)
<P-19>



Comparator • SC • Timer • Phase rotation P.C.B.
(CDPAOLKX-52)
<P-20>



Position adjustment P.C.B.
(CDPAOCAP-51)
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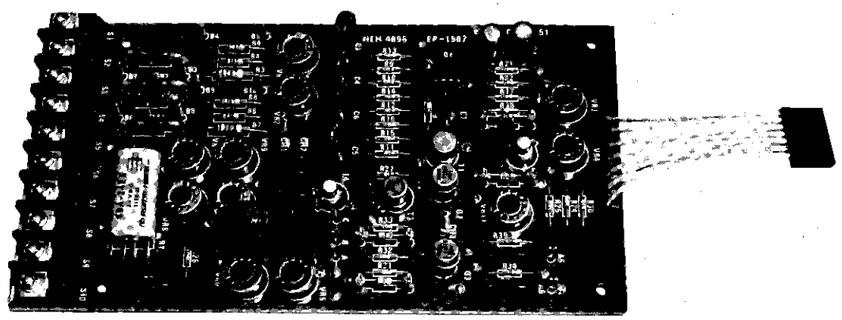
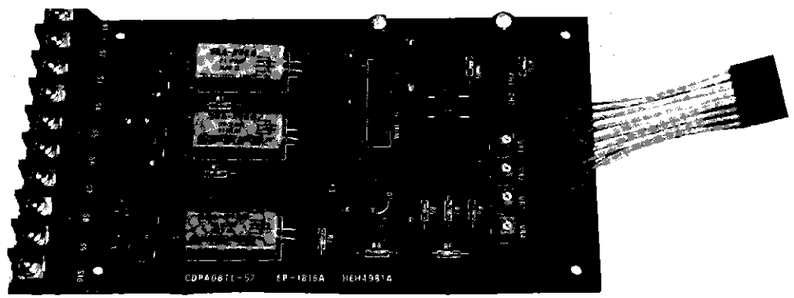
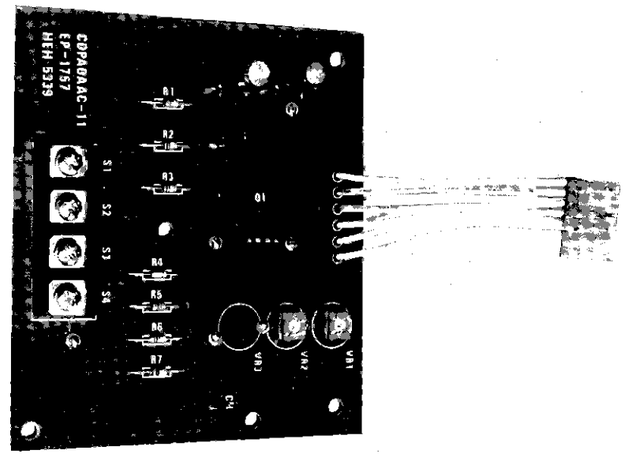


Torque limiter・Load meter P.C.B.
(CDPAOBTL-52)
<P-22>



Load meter P.C.B.
(CDPAOAAC-11)
<P-23>



Speed arrival signal P.C.B.
(CDPAOLKX-41)
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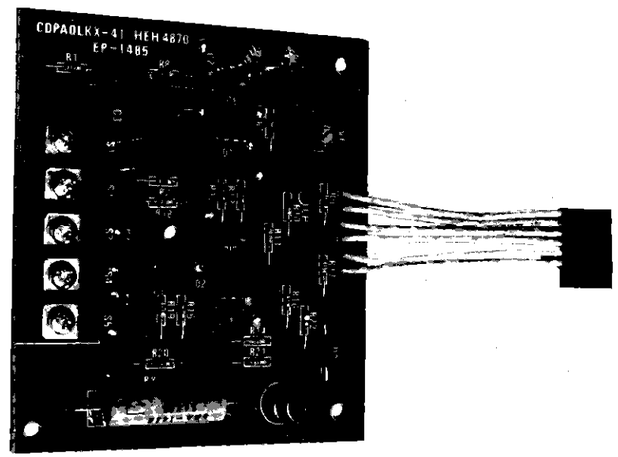
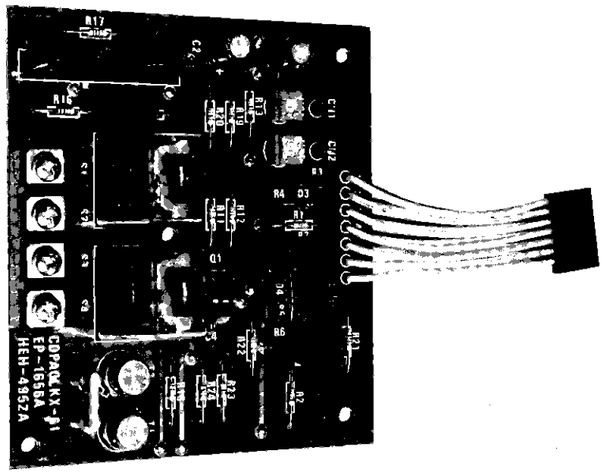


Speed arrival signal・Comparator P.C.B.

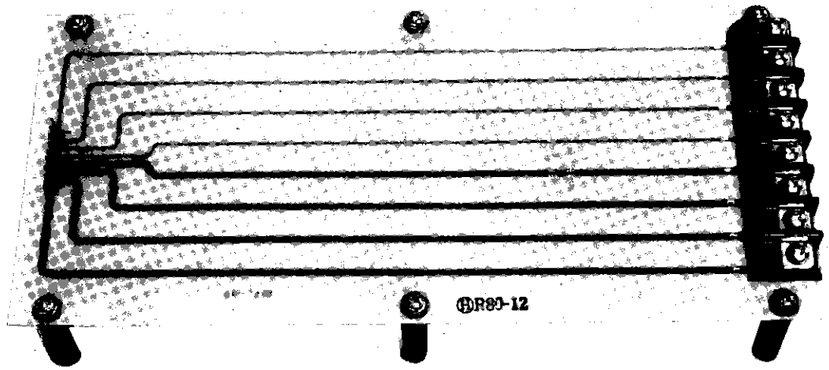
(CDPAOLKX-61)

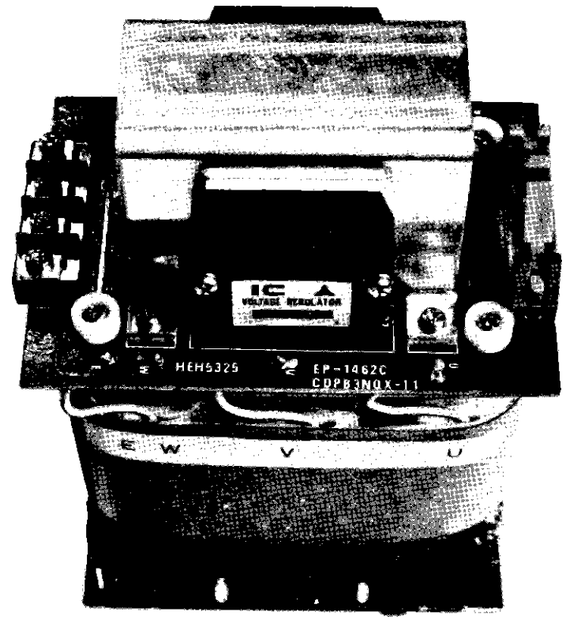
<P-25>



Attachment P.C.B.

<P-26>





<P-27>

補助変圧器及び定電圧装置

AUX. TRANS. AND REGULATOR

3. Drawing

3-1 Standard Whole Drawing (Without Option)

(1)	SREG. (CDPB3CPS-62) + pulse trans (CDPD3ZPA-11) + Field Unit (FREG-10C) + Power Unit + Main Circuit	HEH3179
(2)	SREG. (CDPB3CPS-83-0) + pulse trans (CDPD3ZPA-12) + Field Unit (FREG-10C) + Power Unit + Main Circuit	HAH30607
(3)	SREG. (CDPB3CPS-83) + pulse trans (CDPD3ZPA-12) + Field Unit (FREG-10C) + Power Unit + Main Circuit	HAH30496C
(4)	SREG. (CDPB3CPS-82) + pulse trans (CDPD3ZPA-11) + Field Unit (FREG-10C) + Power Unit + Main Circuit	HAH30496a

3-2 Option P.C.B.

(1)	HLR, comparator (CDPA0PUJ-23)	HEH4957
(2)	Override HLR (CDPA0PUJ-33)	HEH4956
(3)	HLR. speed arrival signal, comparator (CDPA0PUJ-42)	HEH4942
(4)	Speed arrival signal (CDPA0LKX-41)	HEH4870
(5)	Comparator timer, sine change (CDPA0LKX-52)	HEH4890
(6)	Speed arrival signal, comparator (CDPA0LKX-61)	HEH4952
(7)	Speed arrival signal, Torque limiter (CDPA0BTL-31)	HEH4868
(8)	Current limit, Torque limiter (CDPA0BTL-41)	HEH4894
(9)	Torque limiter, Load meter (CDPA0BTL-53)	HEH4981
(10)	D/A convertor (CDPA0TAD-21)	HEH4863
(11)	Orientation (2 sensor) (CDPA0LAC-52)	HAH42999
(12)	Orientation (pulse encoder) (CDPA0LAC-62) (CDPA0LAC-72) (CDPA0LAC-72Z)	HAH42896
(13)	Load meter P.C.B. (CDPA0AAC-11)	HEH5339

HEH3179

HAH30607

HAH30496C

HAH30496a

HEH4957

HEH4956

HEH4942

HEH4870

HEH4870

HEH4890

HEH4952

HEH4868

HEH4894

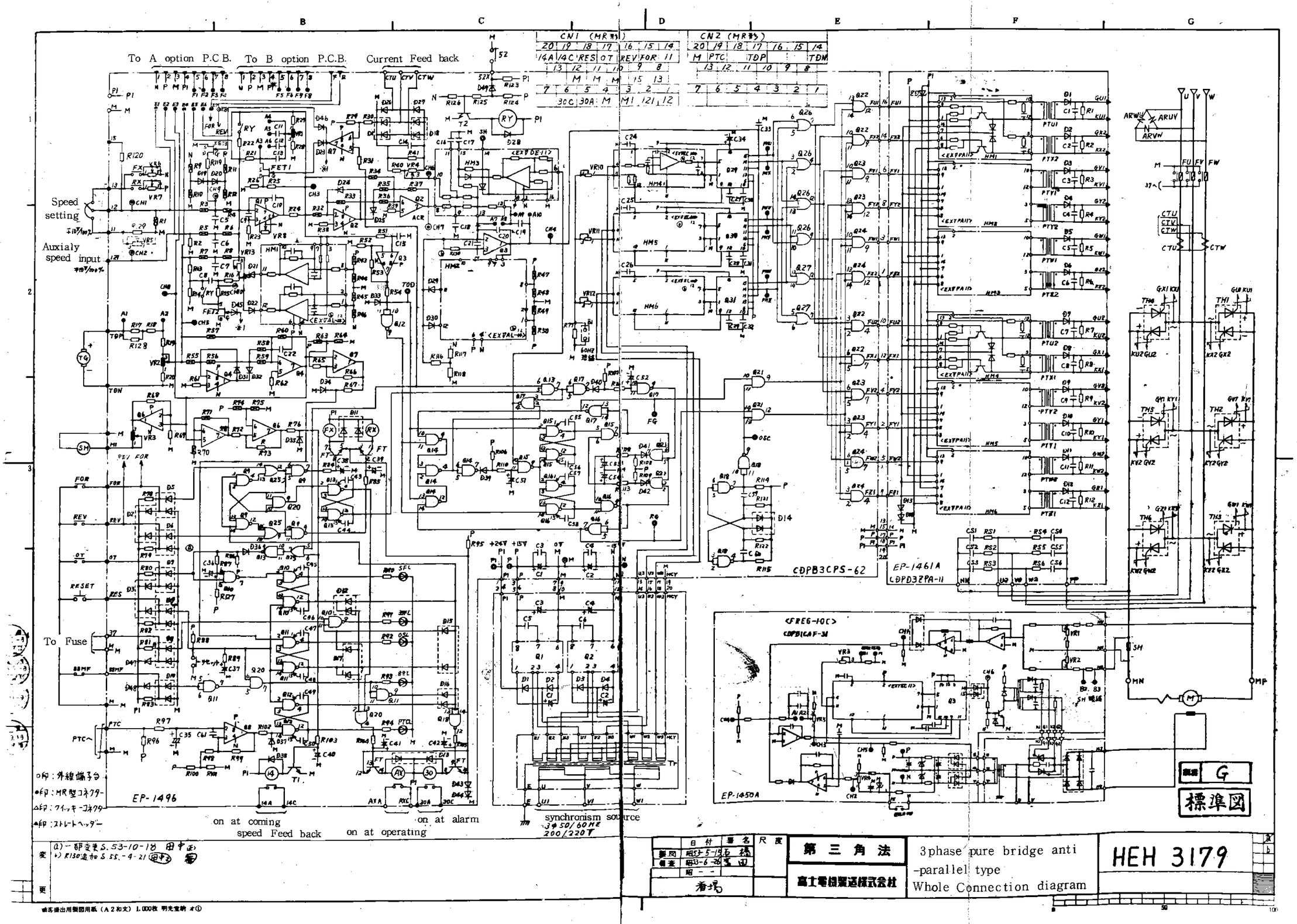
HEH4981

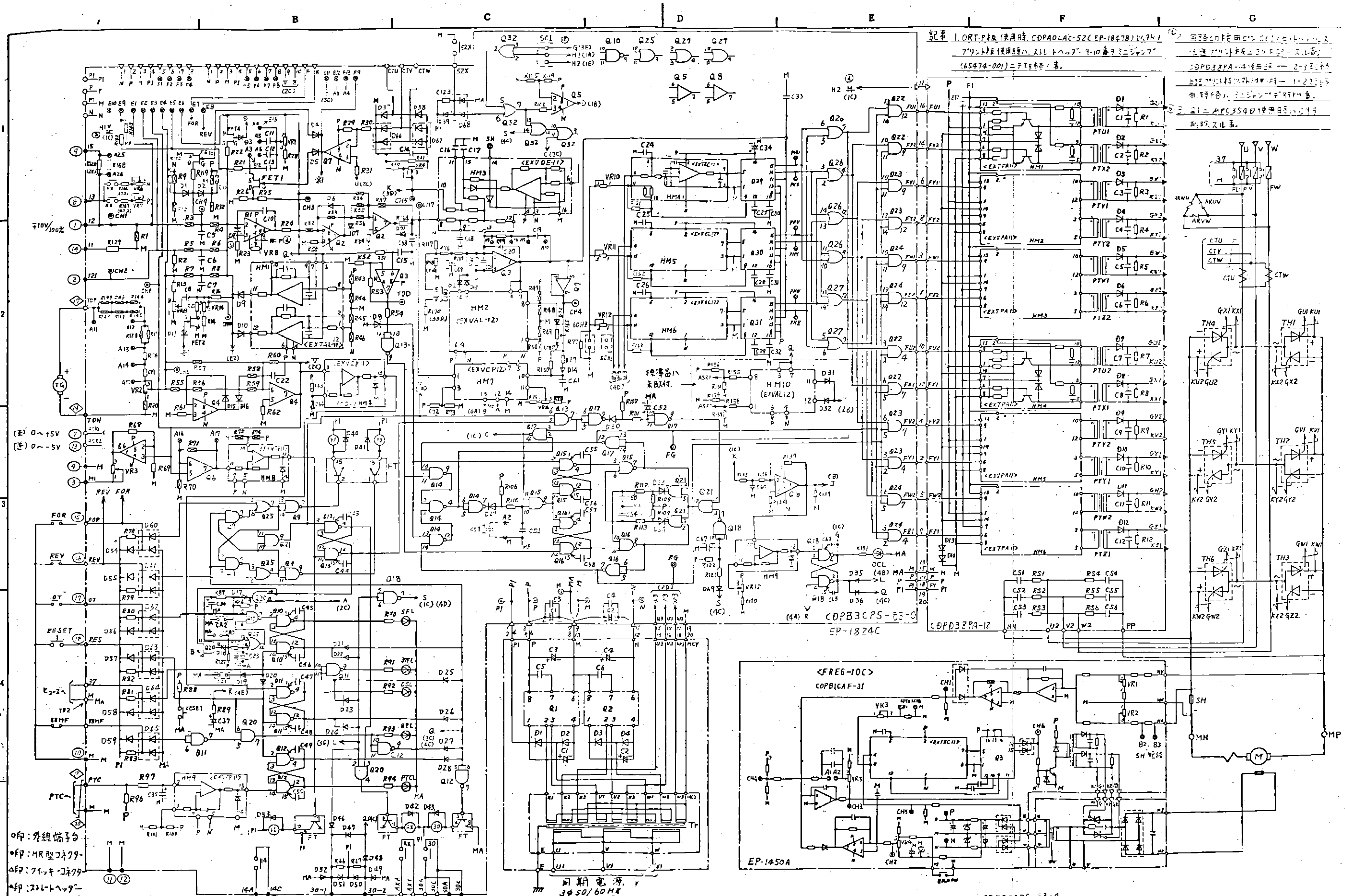
HEH4863

HAH42999

HAH42896

HEH5339





記事 1. ORT-P板使用時, CDPAOLAC-SZ(EP-18478)以外ノプリント板使用時ハ, ストレートヘッダー 9-10番ヲミニジャンプ(65474-001)ニテ短絡ノ事。

3. Q1 = MPC3540 使用時ハ C[illegible] 削除スル事。

変更	④ Q1定更及 SC1追加 S.58.3.7. 田中(正)/山口
	⑥ C9削除 S.58.7.1 田中(正)/山口

	日付	氏名	尺度
製図	S.56-12-1	田中(正)	
調査	昭		
	昭 - -		
		山口	

第三角法

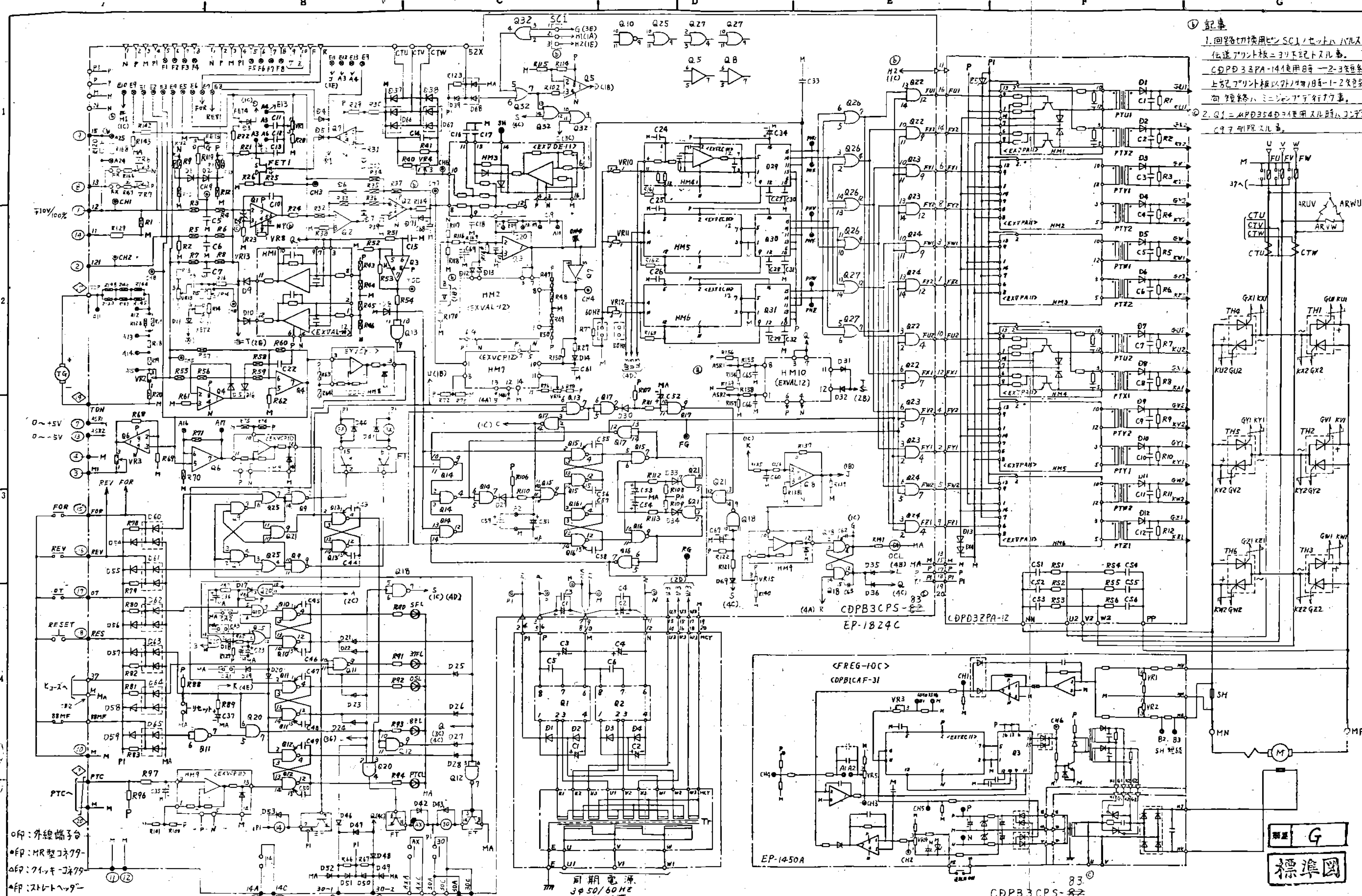
富士電機製造株式会社

3phase pure bridge anti-parallel type

Whole Connection diagram

HAH 30607

標準



変更	
ⓐ	HM7ノ一部削除 S.55.9.11. 田中 山口
ⓑ	ダイオード交換 S.58.5.10 田中 山口
ⓒ	C9削除 S.58.7.1 田中 山口

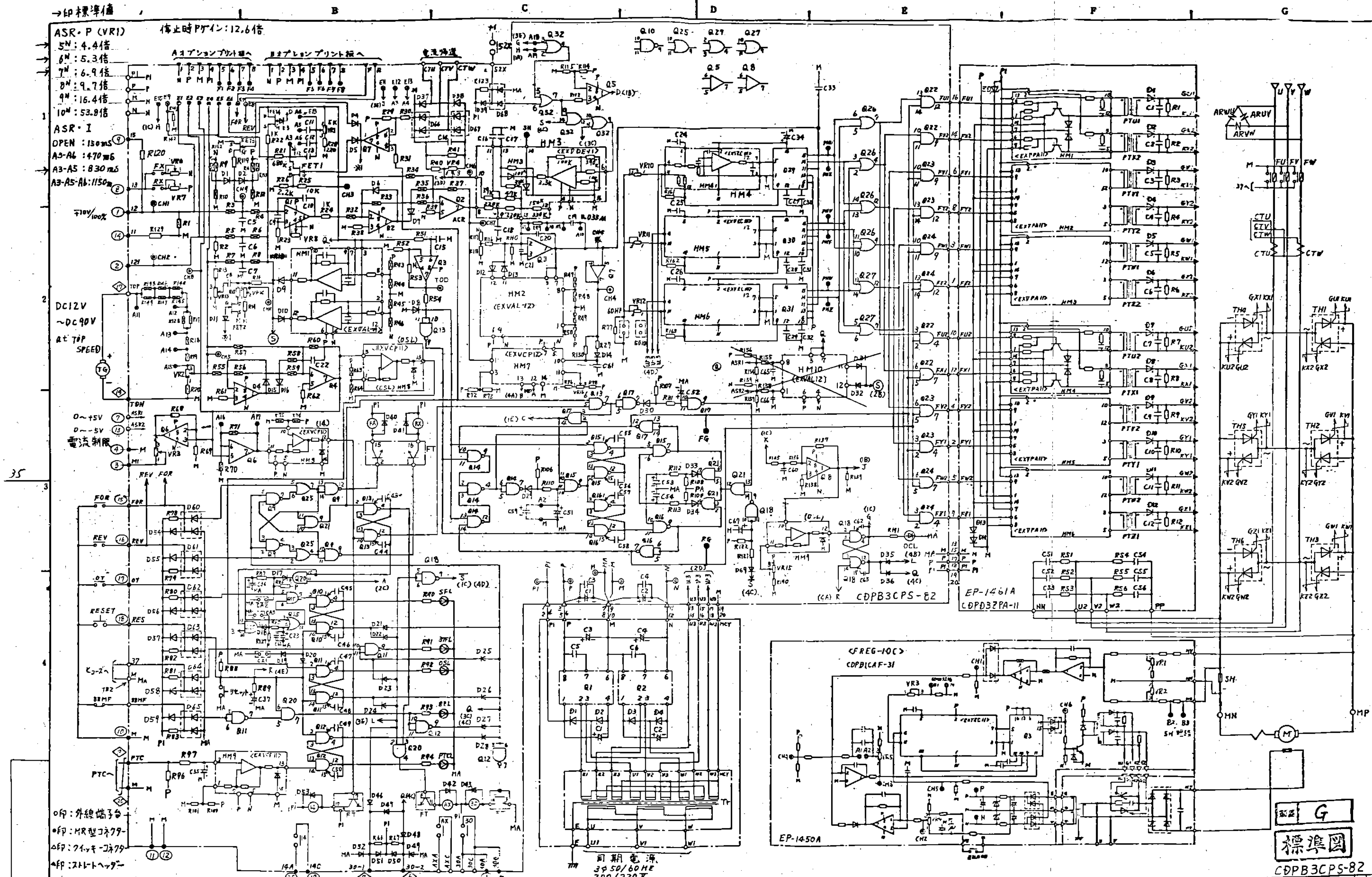
	日付	署名	尺度
製図	昭55-3-22		
調査	昭		
	昭 - -		

第三角法

富士電機製造株式会社

3phase pure bridge anti-parallel type Whole Connection diagram

HAH30496



	日付	署名	尺度
製図	昭55-5-23		
調査	昭		
	昭 - -		

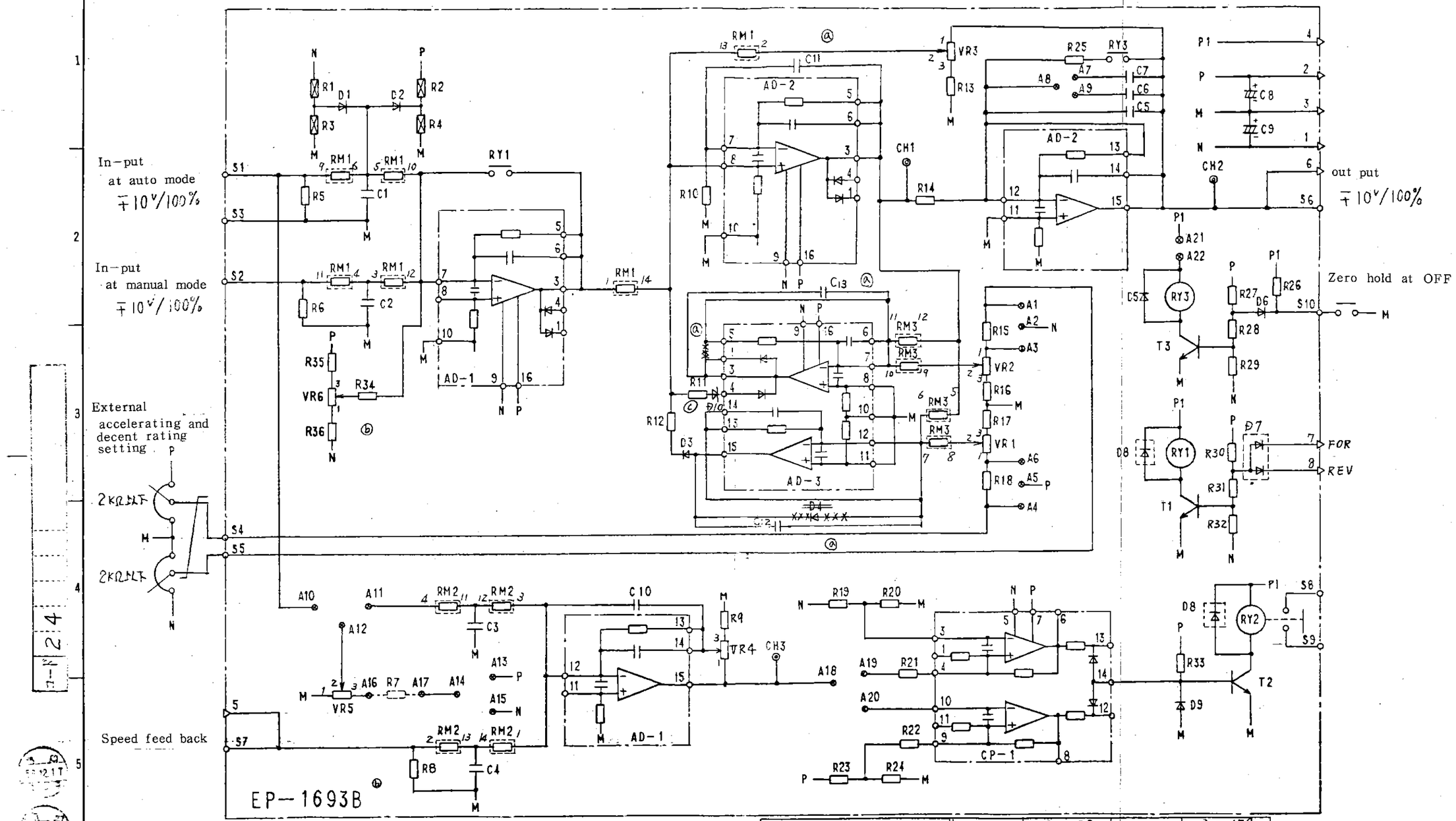
第三角法

富士電機製造株式会社

3phase pure bridge anti-parallel type
Whole connection diagram

HAH30496

標準図
CDPB3CPS-82



Inter Accel. Deccel. time					
A1 A2 A3	A7 A8 A9	0.3 ～ 20 (0.5 ～ 30)	A7 A8 A9	3 ～ 170 (3 ～ 250)	
A6 A5 A4	A7 A8 A9	1 ～ 60 (1 ～ 90)	A7 A8 A9	3 ～ 210 (4 ～ 300)	

部品要目表 HAH57932a

Revisions		Date	Name
a. ダイオードD4削除，マイクロサーキットAD-3の④開放，コンデンサC11～C13 追加，部品要目表変更 S55-2-18 (村上)/(富田)	Drawn	54-9-25	村上
b. S.56-11-5 オフセット回路用 抵抗追加 (R34～R36，VR6) 他	Checked	54-10-13	富田
c. ダイオードD10追加 S.56.12.9 田中			

Fuji Electric Co.,Ltd.

Title: CDPAO PUJ − 23
HLR, Comparator diagram

Dwg.No. HEH4957
Ref 標準

○ Terminal Brock (MT90-10) △ Mini PV Terminal

override limit	± 50 %	± 25 %	+ 20 % − 40 %
VR1 gain	0.5	0.75	0.6
VR4 value	0	2 kΩ	1 kΩ

∓10V/100%

Speed In−put ±10V/100%

Speed In−put ∓10V/100%

Override setting

External accel. Deccel time setting

Less than 2 kΩ

Less than 2 kΩ

out−put ∓10V/100%

"OFF"デ ゼロホールド

P1 (+24 V)

P (+15 V)

M (0 V)

N (−15 V)

EP-1686B

Inner accel. Deccel time limit(sec)	A12 A13 A14	0.3 ~ 20	A12 A13 A14	3 ~ 170
	A12 A13 A14	1 ~ 60	A12 A13 A14	3 ~ 210

Ⓑ

HAH 58093b

部品要目表 HAH57904a

Revisions		Date	Name
a. ダイオードD6削除, マイクロサーキットAθ-3 ①-⑤ 間放, コンデンサC10~C11	Drawn	54-9-20	村上
追加, 部品要目表変更 S55-2-18 (村上)/(高田) 変	Checked	54-10-13	高田
b. 56-11-5 オフセット回路用抵抗追加 (R28~R33, VR5, VR6) 他 村上			

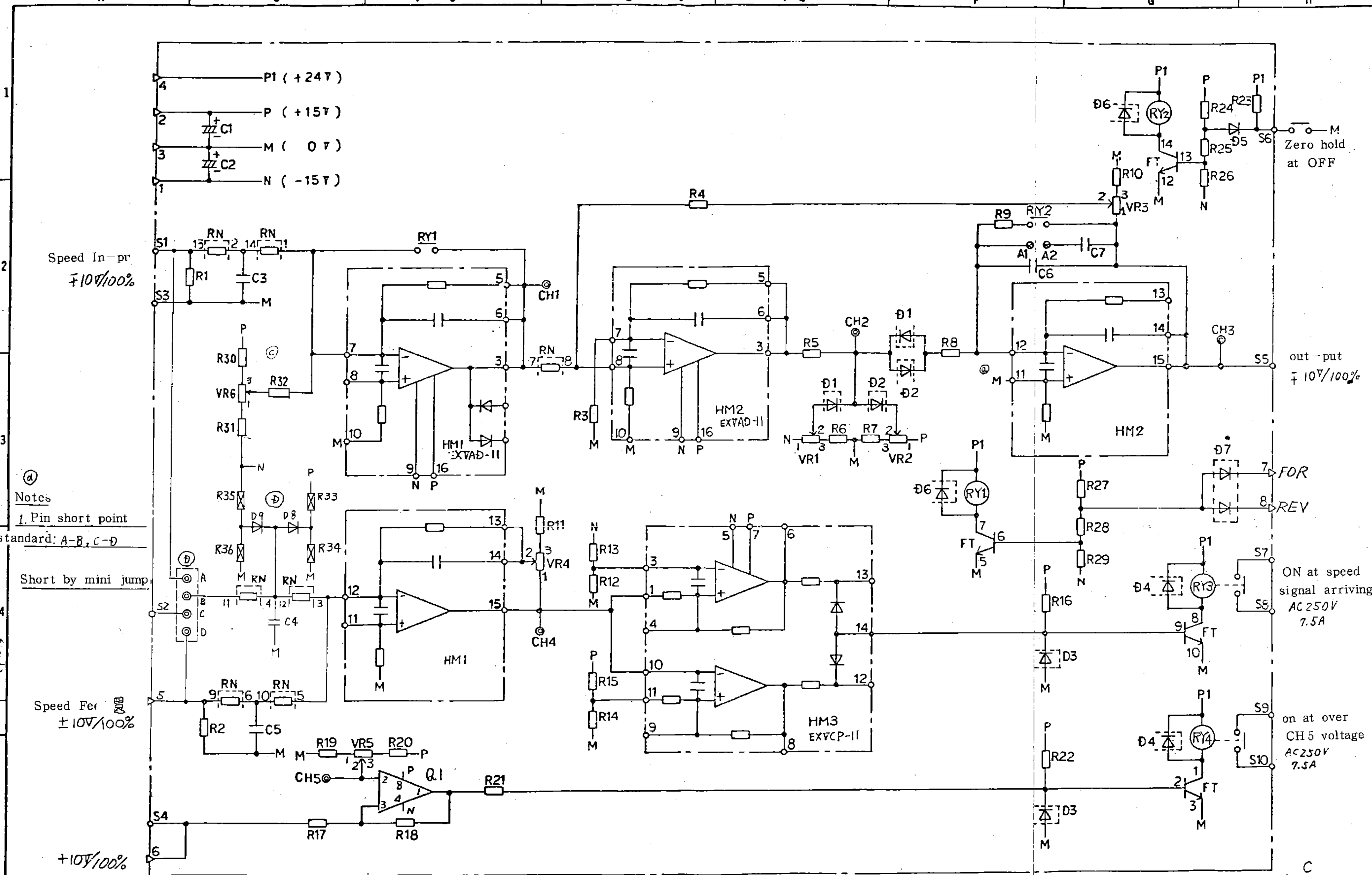
Fuji Electric Co.,Ltd.

Title: Override HLR diagram

CDPAOPUJ-□□33

Dwg.No. HEH4956

Ref 標準



部品要目表 HAH 58094 bc HAH 576301

ⓓ 入力切換回路追加 及び入力リミッタ回路 変更 S.56.12.1.

REVISION		DATE	NAME
a) HM2-⑪ 7M二接続 S54.3.23	DRN.	54-1-29	
b) EP番号 変更 S.55.9.5.	GHD.	54-2-6	石橋
c) S.56-11-5 オフセット回路, リミッタ回路削除, ダイオード追加他 (R30~R36, VR6, D8, D9)			

Fuji Electric Co.,Ltd.

CDPAOPUJ-- 742

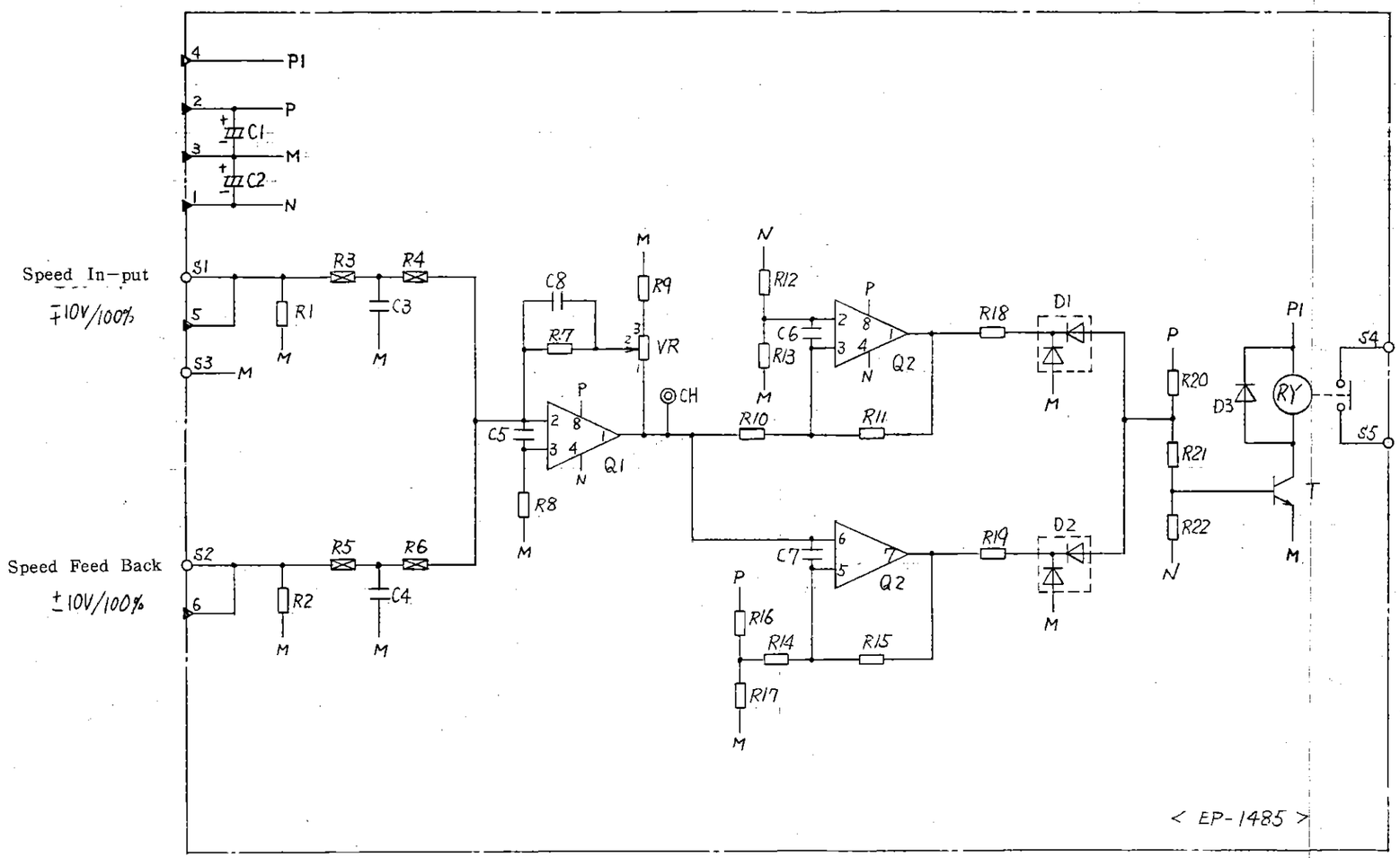
HLR · Speed arrival signal

Conparator diagram

HEH 4942

標準

EP-1591



53.7.26

類番 G

標準図

部品要目表 HAH 57208

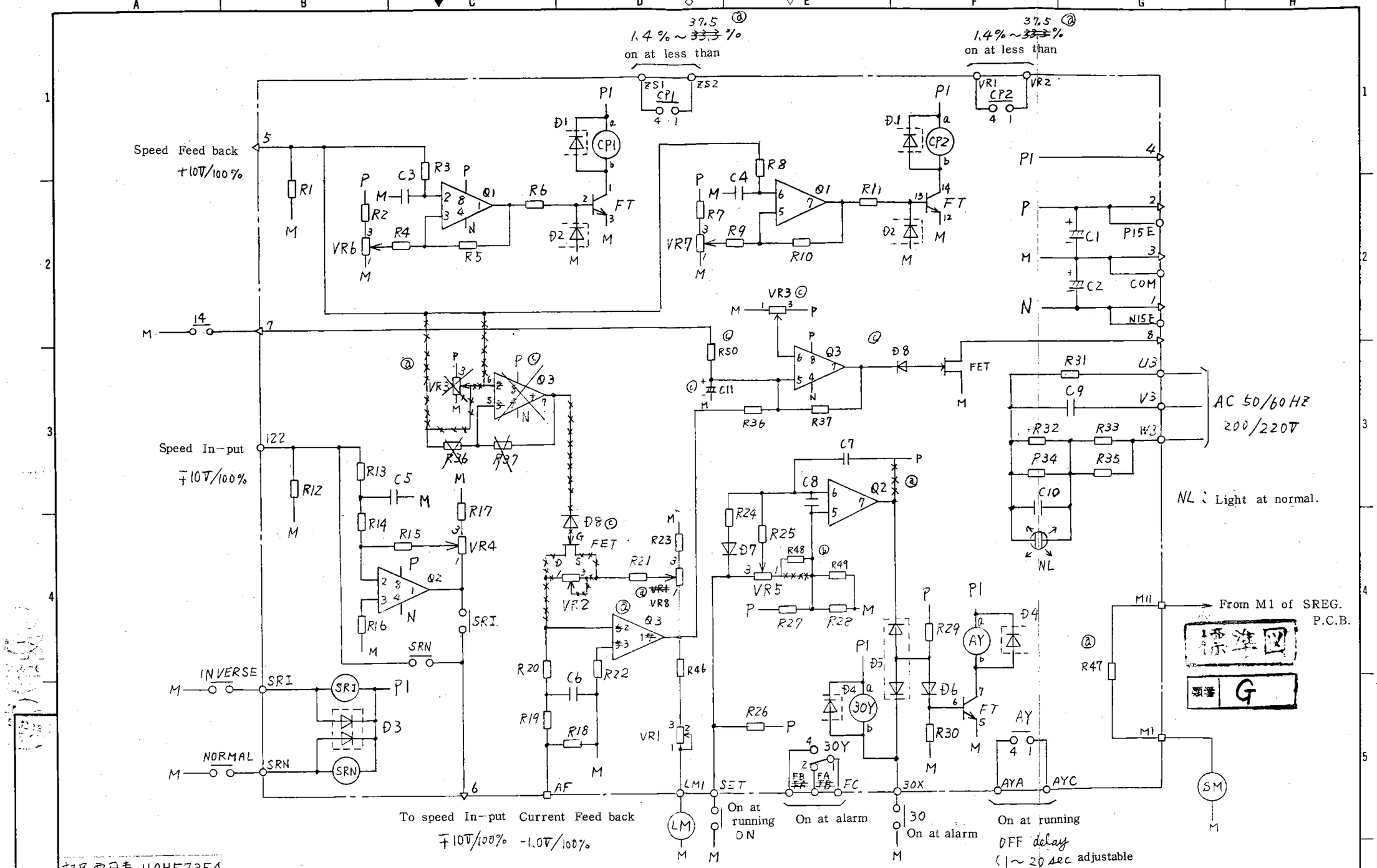
REVISION		DATE	NAME
	DRN.	53-4-27	高宮
	GHD.	53-5-19	石橋
			富田

FUJI ELECTRIC CO.LTD.

CDPA0LKX-41

Speed arrival signal diagram

HEH 4870



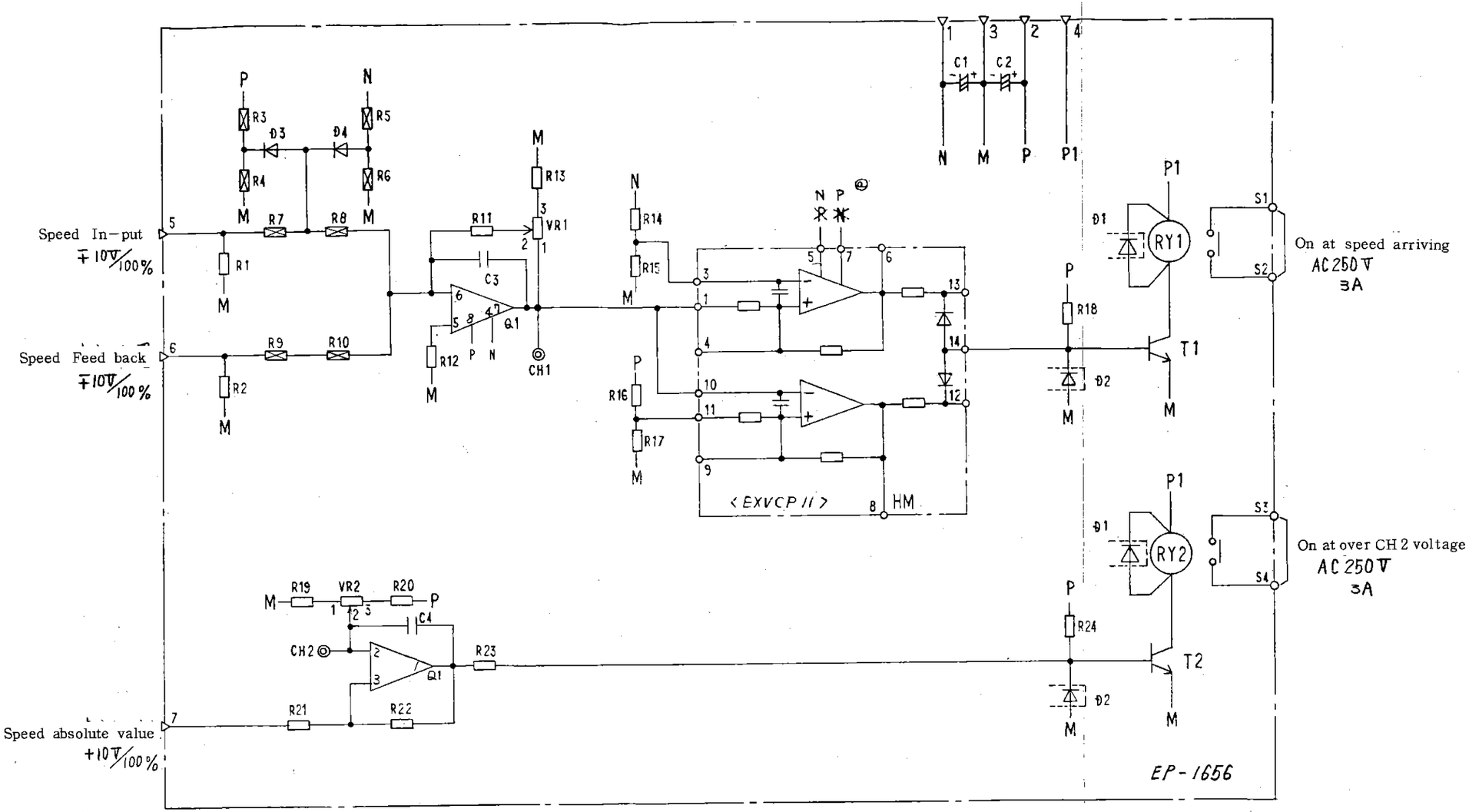
部品要目表 HAH57354b

REVISION		DATE	NAME
ⓑ S53-11-16 回路変更 田中(正)			
ⓒ S54-3-31 回路変更 田中(正)	DRN.	— —	
ⓓ Q3の回路変更 S57.12.14 田中(正)	GHD.	53-8-2	

FUJI ELECTRIC CO.LTD.

CDPA0LKX-52
Comparatar timer・Sine change diagram

HEH・4890



○ : Outside line terminal

△ : Mini PV terminal

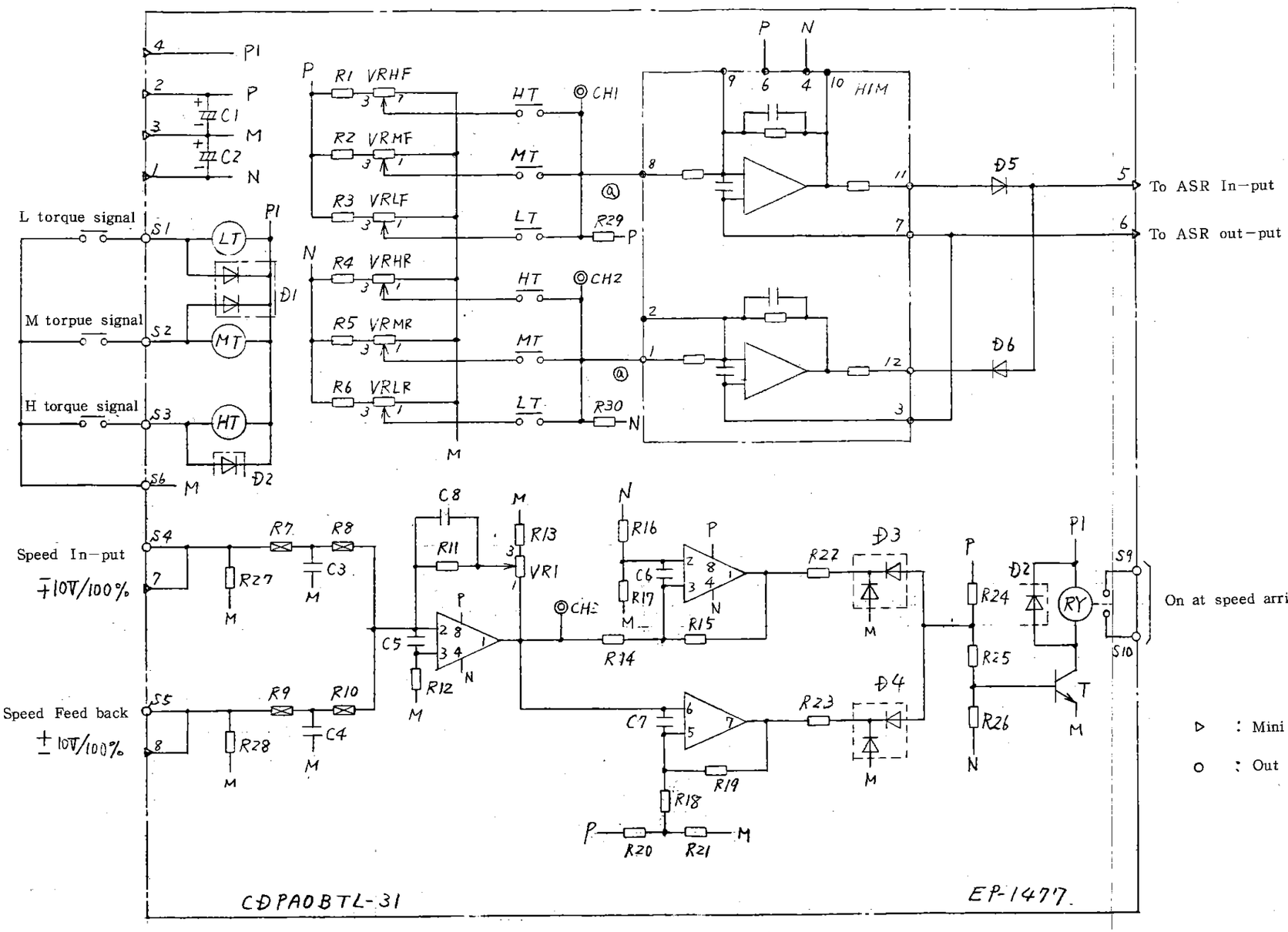
標準図

REVISION		DATE	NAME
(a) 54.7 シーケンス一部変更 (高岳)(石橋)	DRN.	— —	
	GHD.	54-7-25	石橋

Fuji Electric Co.,Ltd.

CDPAOLKX-~~51~~61
Speed arriral signal
Comparator diagram

HEH 4952



類番 G

標準図

部品要目表 HAH57193

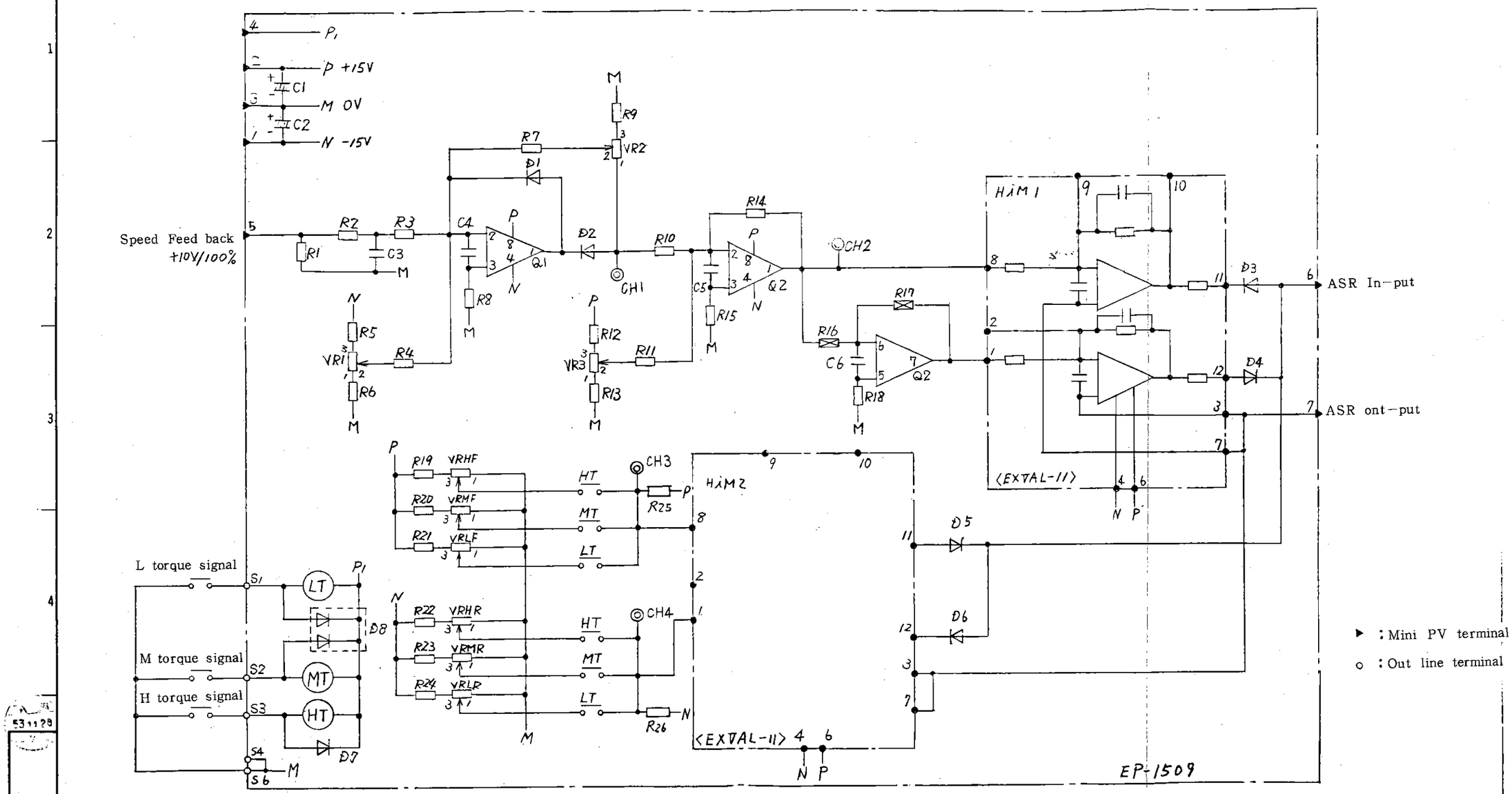
REVISION			DATE	NAME
Ⓚ S-53-9-4 一部変更 (石橋)		DRN.	— —	
		GHD.	53-4-12	石橋
				富田

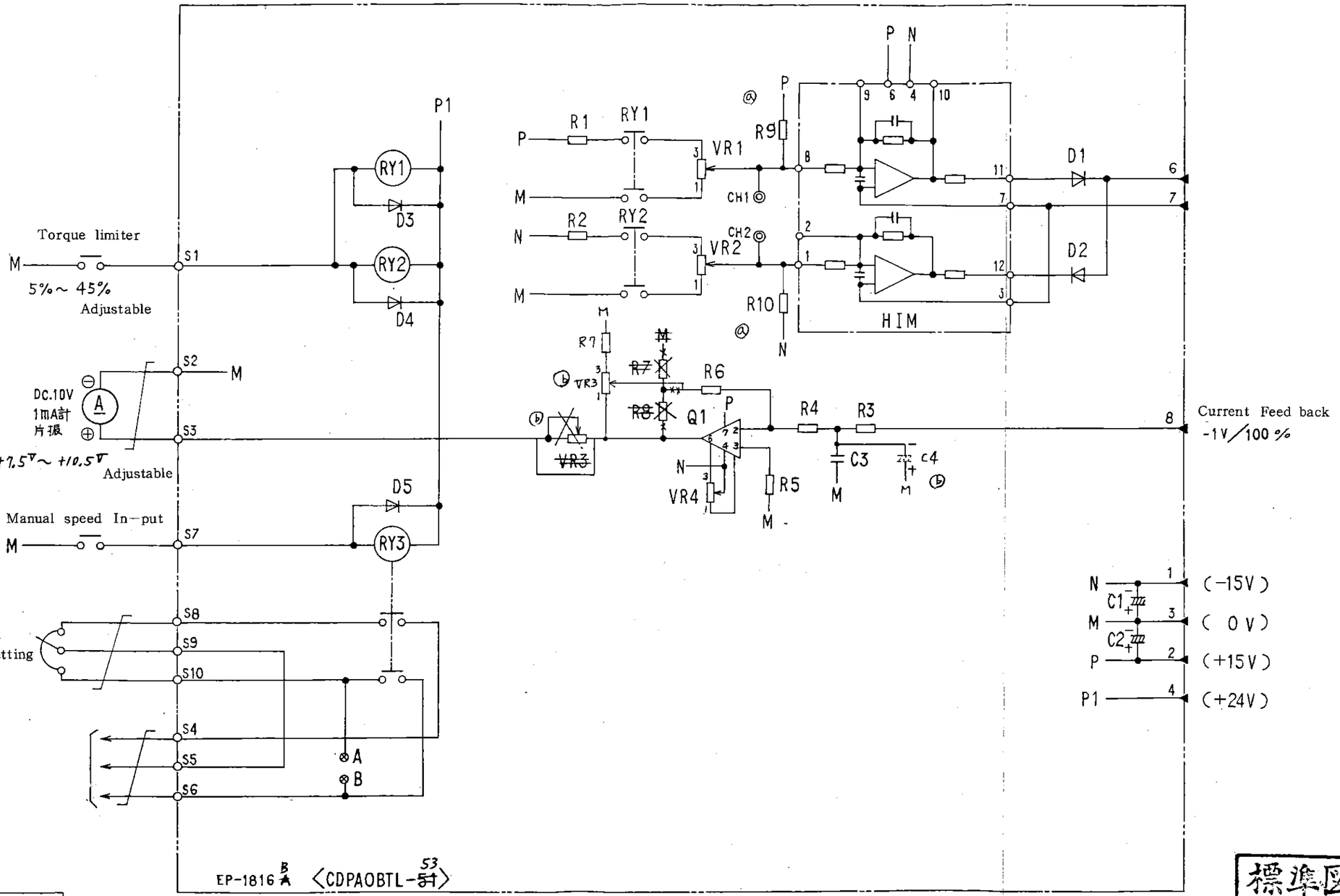
番場

FUJI ELECTRIC CO.LTD.

Torque limiter, Speed arrivol diagram

HEH 4868


P1
P +15V
C1
M 0V
C2
N -15V
Speed Feed back
+10V/100%
R1
R2
R3
C3
C4
R7
R9
VR2
D1
D2
R10
CH1
R14
C5
R15
CH2
R16
R17
C6
R18
R8
R5
VR1
R4
R6
R12
VR3
R11
R13
HAM1
D3
D4
ASR In-put
ASR ont-put
<EXTAL-11>
HAM2
D5
D6
R19 VRHF
R20 VRMF
R21 VRLF
R22 VRHR
R23 VRMR
R24 VRLR
HT
MT
LT
CH3
CH4
R25
R26
L torque signal
M torque signal
H torque signal
S1
S2
S3
S4
S6
D8
D7
EP-1509
▶ : Mini PV terminal
○ : Out line terminal
A : VR 1 adjustable 2.5V~5V (10V/100%)
B : VR 3 adjustable 2.5V~10V (5V/100%)
C : VR 2 adjustable G 0.25~1 Times
標準図
部品要目表 HAH57361
REVISION
DRN.
GHD. 53-11-22 石橋
DATE
NAME
FUJI ELECTRIC CO.LTD.
CDPA0BTL-41
Current limit, Torque limiter diagram
HEH-4894
元図 HF 404006



部品要目表	HAH 58091

Revisions		Date	Name
ⓐ 5.55.5.13 R9, R10 追加, 石井 (秀)	Drawn	55-3-3	石井
ⓑ 3rd所変更 S.57.1.18 (田中正) 山口	Checked	— —	

Fuji Electric Co.,Ltd.

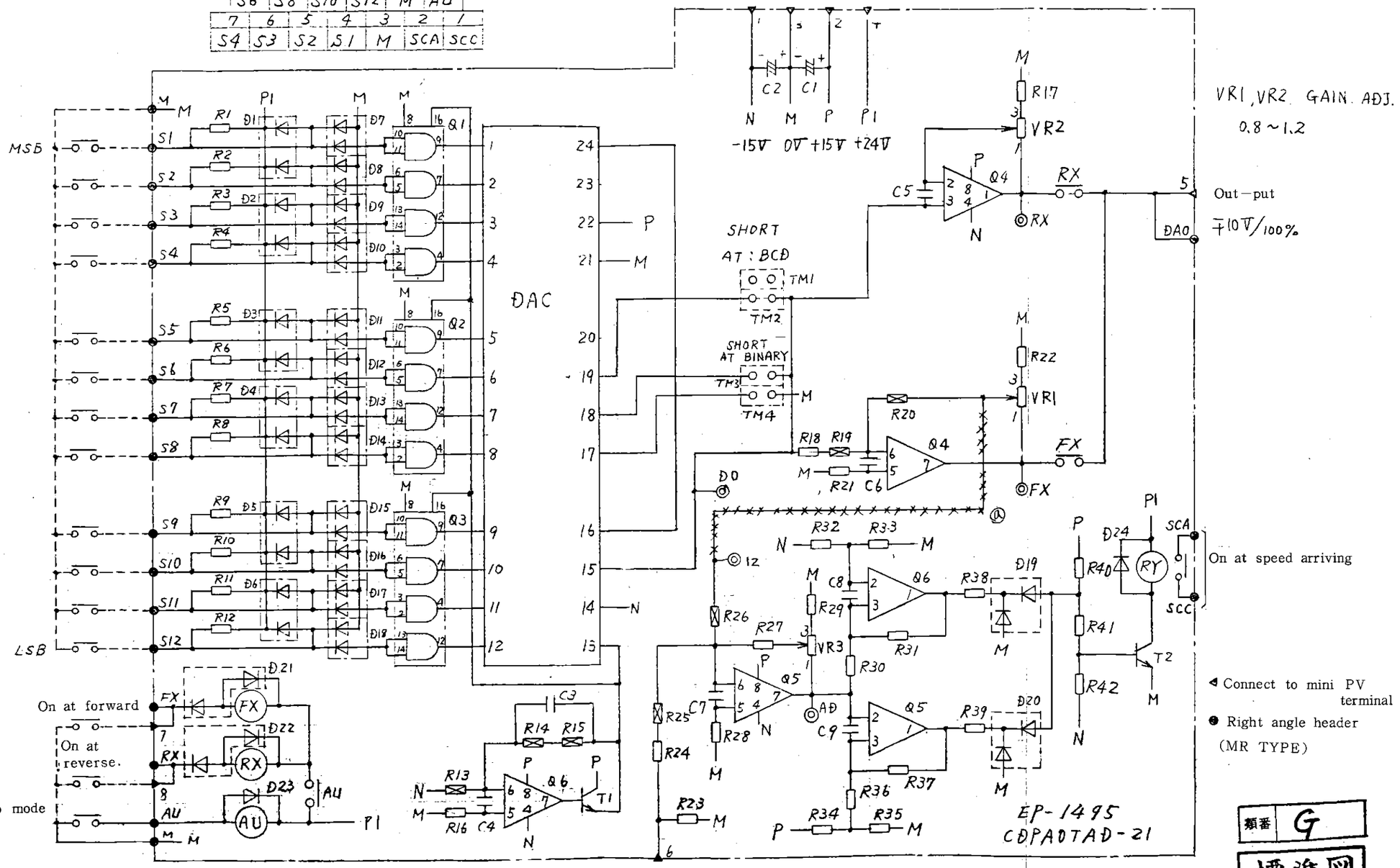
Title: Torque limiter · Load meter diagram
D/A Convertar diagram

Dwg.No. HEH 4981

Ref

57.2.04
55.5.25
55.4.15

MR形 コネクター端子配列						
20	19	18	17	16	15	14
S5	S7	S9	S11	ĐA0	FX	RX
13	12	11	10	9	8	
S6	S8	S10	S12	M	AU	
7	6	5	4	3	2	1
S4	S3	S2	S1	M	SCA	SCC



部品要目表	HAH-57154

REVISION		DATE	NAME
ⓐ 5·53·6·14 一部変更(石橋)	DRN.	53-5-19	石橋
	CHD.	53-6-19	富田

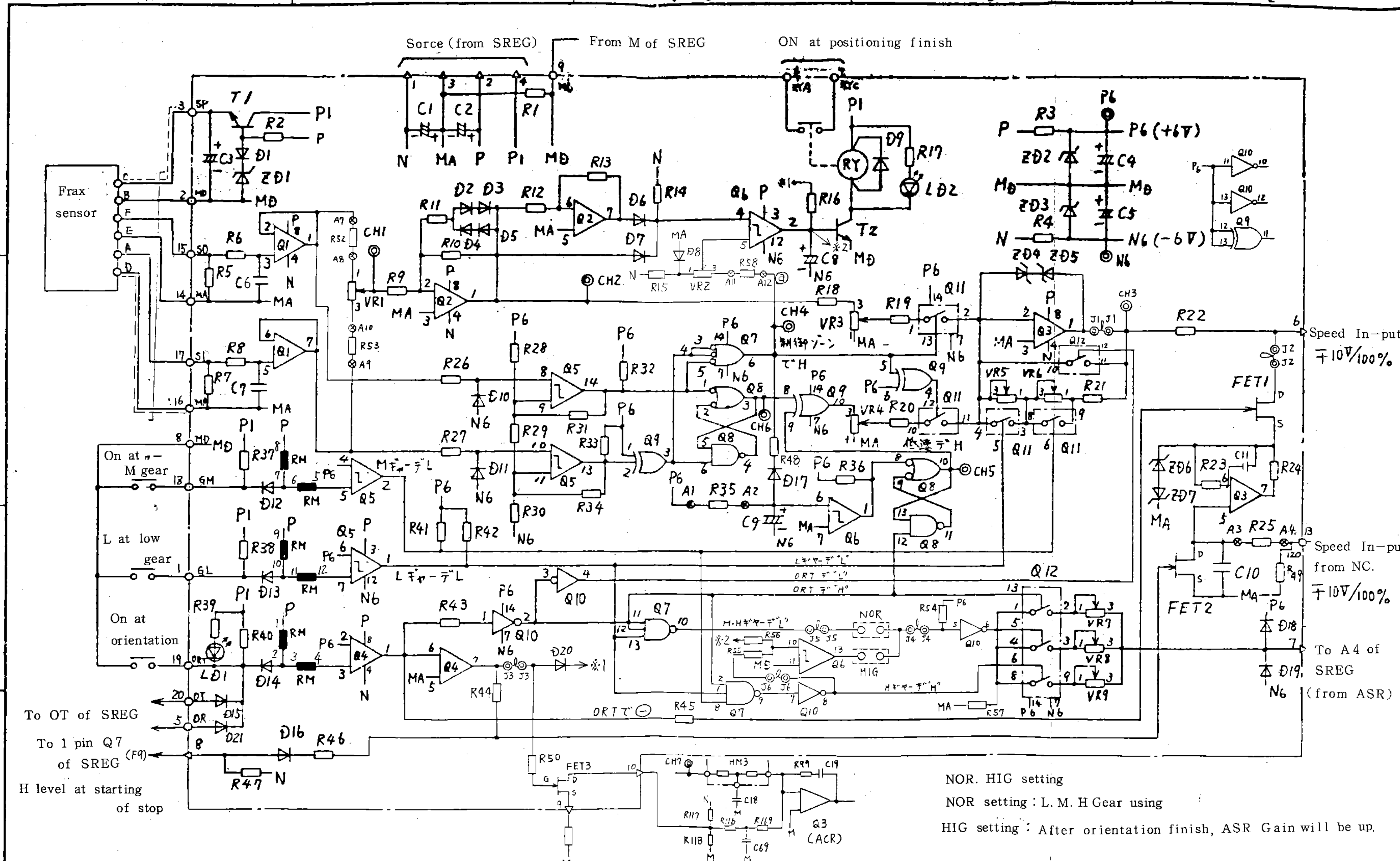
FUJI ELECTRIC CO.LTD.

12 Bit BINARY . 12 Bit BCD D/A Convertor diagram

HEH 4863

頻番 G

標準図



NOR. HIG setting

NOR setting : L. M. H Gear using

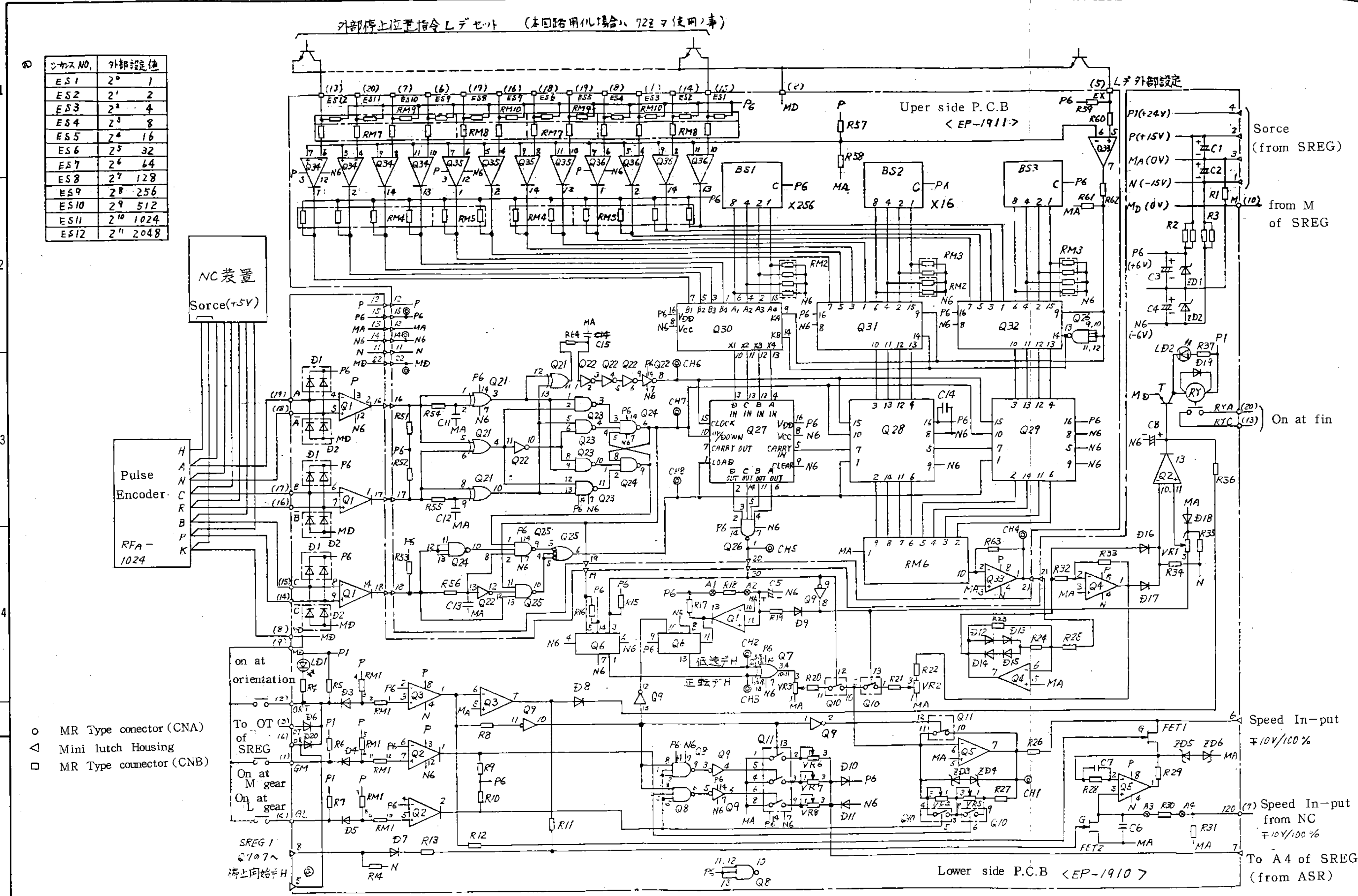
HIG setting : After orientation finish, ASR Gain will be up.

REVISIONS	② R58, A11, A12 追加 S.57.10.12		
DRAWN	S.56-11-11		
CHECKED			
3 RD ANGLE METHOD			
TITLE	CDPA0LAC-52 (EP-1847C)	Orientation diagram	
DRAWING NO.	HAH 42999		
REF.	標準		

Fuji Electric Co.,Ltd.

A3CE-1S

シーケンスNO.	外部設定値
ES1	2^0 1
ES2	2^1 2
ES3	2^2 4
ES4	2^3 8
ES5	2^4 16
ES6	2^5 32
ES7	2^6 64
ES8	2^7 128
ES9	2^8 256
ES10	2^9 512
ES11	2^{10} 1024
ES12	2^{11} 2048



○ MR Type conector (CNA)
◁ Mini lutch Housing
□ MR Type counector (CNB)

REVISION		DATE	NAME
	DRN.	55-12-24	
	GHD.	— —	長谷川

Fuji Electric Co.,Ltd.

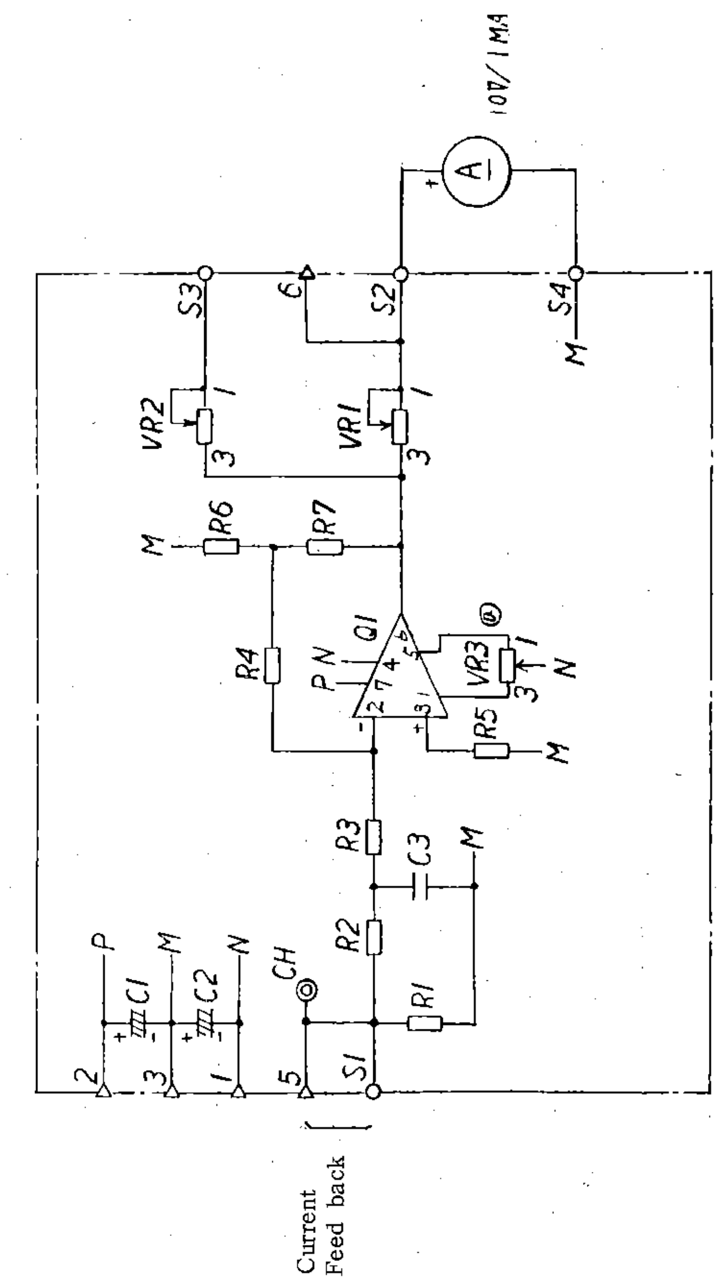
CDPAOLAC-62, 72, 72Z

Pulse encoder type orintation diagram

HAH42846

標準

元図 HAH 42829



標準図

部品要目表	11AH58033a

変更	ⓐ VR3 実装する. S.56.6.12.	CDPA0AAC-11 Lood meter diagram

	日付	署名		
製図	昭55-1-5		第三角法	HEH 5339 a
調査	昭 - -		富士電機製造株式会社	
	昭 - -			

4. Adjusting and maintenance

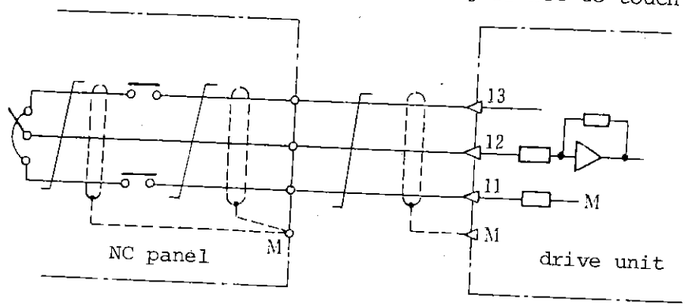
4-1 Confirmation of Outer Wirings

(1) Connections and species of wires are correct or not according to the "total circuit diagram"

(2) Especially, the sign in drawings means shielded or twisted wires

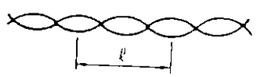
cf) Sufficiently note the treatment of the shielded wire ends

- Don't make loop in shielding parts and connect them to the M terminal of the D.S.R. unit. The opposite of shielding parts are to be treated so as not to be grounding or not to touch other wires.



When twisting pitch of wires are too long, it is not effective

Example



Sectional Area mm^2	Twisted 2	Twisted 3
0.3	16 ∿ 24 mm	21 ∿ 29
1.25	30 ∿ 45	39 ∿ 54

(3) It is possible to examine the resistances of armature, field, TG and PTC windings according to the specification.

The order of resistance values is following

armature resistance < field resistance
< TG winding's resistance < PTC resistance

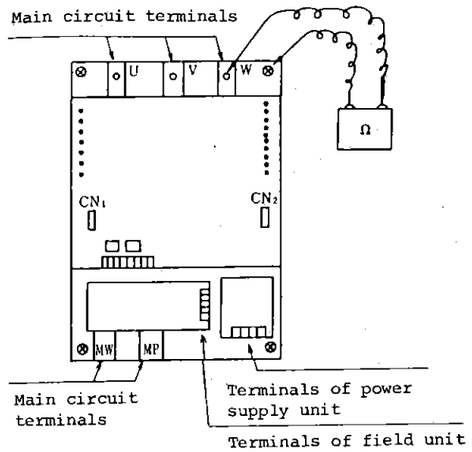
cf) Checking the P.T.C. circuit, use DIGITAL METER,
Don't use MULTIMETER (TESTER), it'll be burn out

(4) Separate wires of the speed setting circuit and the tacho generator from main circuits and other's power supply windings as far as possible not to accept electrical noise influences.

(5) Insert spark killers into all noise generating sources, such as relays, coils of magnetic valves, auxiliary motors and fluorescent lamps.

(6) Don't connect the M terminals of the SREG P.C.B. and the field regulating P.C.B.

(7) Check the circuits without three phase main power supply not to be in earth.



Check points (the following terminals to earth)

1. Main circuit terminals
   UVM, MP, MN
2. Terminals of power supply unit
   U_1 V_1 W_1
3. Terminals of field unit
   UF VF MJ MK
4. Check pins on the SREG P.C.B.
   P_1 P M N

Check them with TESTER and confirm their values over 500 kΩ, it is necessary to examine their causes and to certify the hindrance of operation.

cf) Don't use the insulation resistance meter of DC 500 V.

Usually insulation resistance meter of DC 500 V is used for measurement of insulation resistance. But without special cases avoid it because of destroy of electronic parts by using it and applying the big voltage to the electronic circuits.

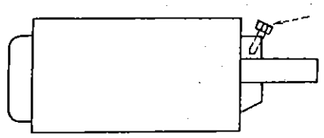
4-2 Confirmation of the Motor Preparation

(1) To make sure, check the conditions of brushes contact.

(2) Sufficiently take care of the conditions of the loaded machine to keep the safety of motor rotation.

(3) Confirm there is an alien or not in the motor (oil dust etc.)

(4) Take care the rocking screw of middle capacity motor (over 20 kW) for safe transportation.



Take off the red mark screw and change another be attached to

(5) Confirm items (1) and (3) about the tacho generator, too.

About others, refer to "motor manuals" in detail.

4-3 Confirmations of Power Supply Capacity and Voltage

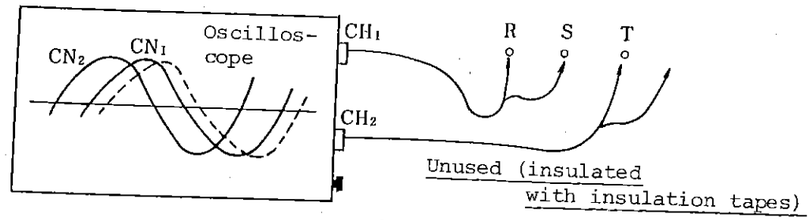
(1) Minimum of power supply capacity is follows.

Power supply capacity (KVA) $\geqq$ twice of motor rating output (kW)

(2) Confirm the power supply voltage within ±10% of rated voltage.

4-4 Confirmations of Power Supply Phase Rotation and Frequency

(1) Confirm the phase rotation at the power supply terminals with phase detector. Without phase detector, it is possible to use oscilloscope as below. When the wave form of CH_1 is delayed from those of CH_2.

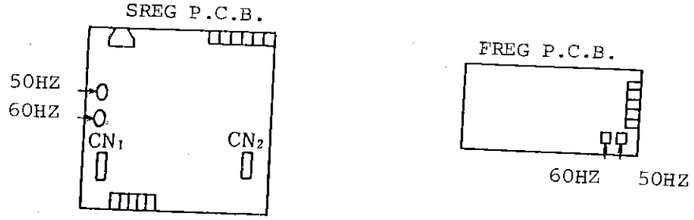


Don't ground the oscilloscope chassis to earth

cf) 1) When discriminating above clearly, it is easy to see to shift one of the waves a little as to be shown in dotted line.

cf) 2) Insulate one of the G lines without fail or the serious short circuiting fault of power supply are occured by connecting both G lines to S and T phase in error.

(2) Change over the switch on the P.C.B. according to power supply.



To change over the switch for 50 or 60 Hz frequency using, replace the mini jump socket from one side to another (The mini jump socket, what is called a switch, is used for frequency changing).

4-5 Examine Terminals, Loosen Screws and Existances of Something Aliens in the Contactors and Others.

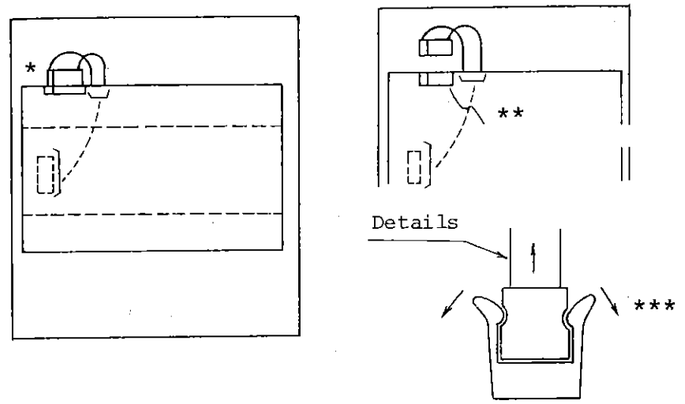
Especially in the case of exportations, take care of rusting.

4-6 Confirmations before the Motor Operation

4-6-1 Preparations

(1) Separate the ends of amature circuit from D.C. out put terminals (outside terminals) or from connection terminals on the terminal box so as not to rotate the motor.

Another mean, not to rotate the motor is to take off the flat cables on the SREG P.C.B. those are connected to the pulse trans P.C.B. (In the case of recovery, check carefully correct insertion of cables or the pulse trans P.C.B. will be burn out)



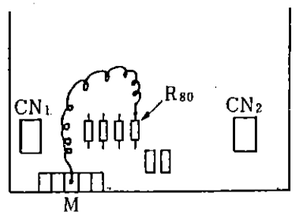
* Align correctly the red marks

** It shows the condition of taking out, and consists of locking mechanism

*
** Open the both locks and pull the flat cable towards the arrow mark

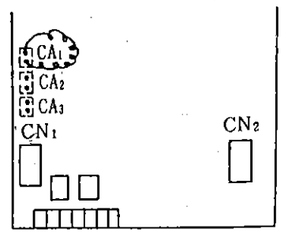
(2) Surpress the start-up-delay circuit on the SREG P.C.B. so as not to to display the start-up-delay fault (Sometimes necessity of above depends upon the outer circuit)

A. CDPB3CPS-62



Make short circuit with the jumping wire between the end of R80 and the M terminal as illustrated on the left.

B. CDPB3CPS-82, 83



Make short circuit the pins CA_1 with a jumping wire as illustrated on the left.

With the mini jump that is used for frequency changing, it is also possible for short circuiting CA.

4-6-2 Power acceptance (to throw the magnetic contactor in a Service Wire)

Confirmation of input voltage in the unit (It is unnecessary to do when there is no voltage change by transformers)

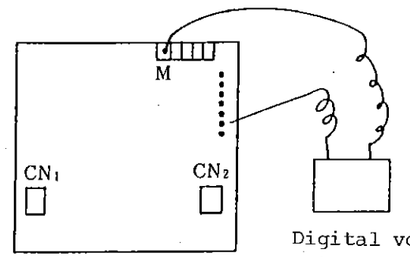
A. Main circuit terminal voltage (U-V, V-W, W-U) within ±10% of standard voltage

B. Syncronous power supply voltage (U_1-V_1, V_1-W_1,W_1-U_1)
ditto

C. Field power supply voltage (UF-VF)
ditto

4-6-3 Confirmation of power supply for the P.C.B.

Check voltages below, if abnormal, promptly throw off the magnetic contactor in a service wire, and examine the wiring of the control.



Digital volt meter

between P_1 and M, DC + 22∿26 V

between P and M, DC + 14.8∿15.2 V

between N and M, DC - 14.8∿15.2 V

4-6-4 Confirmation of circuit sequences

(1) Confirmation of the motor cooling fan rotation direction. On the motor there is the name plate indicating the cooling fan rotation direction.

(2) Confirmations of sequence relations between running, stopping, jogging and forward, reverse rotation setting.

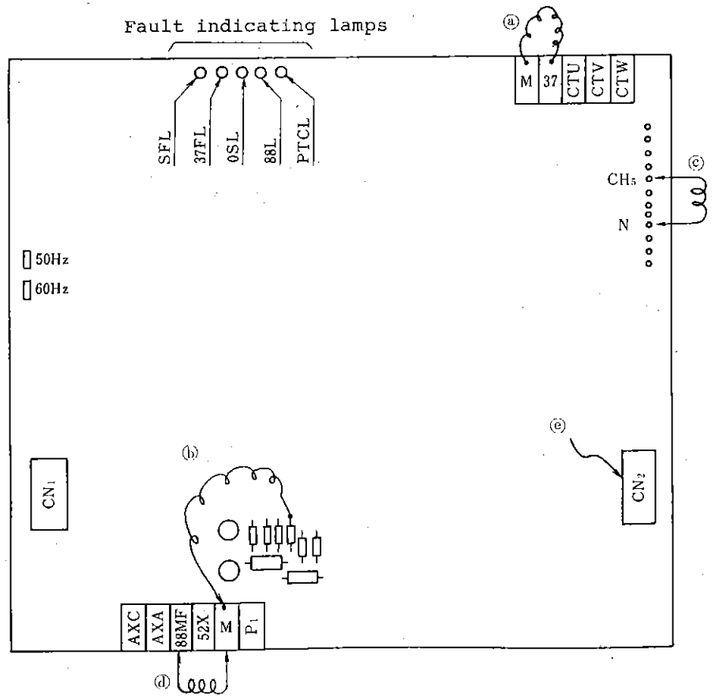
(3) Confirmation of the faulty circuit

On the running condition, confirm the faulty circuit when the fault indicating lamps on the SREG P.C.B. are lit on, the relay 30 also on the SREG P.C.B. are acted (At that time, the contactor for outer usage 30A-30C areon) and the main contactor in the electric cubicle are off.

Check the faults of the circuits as follows:

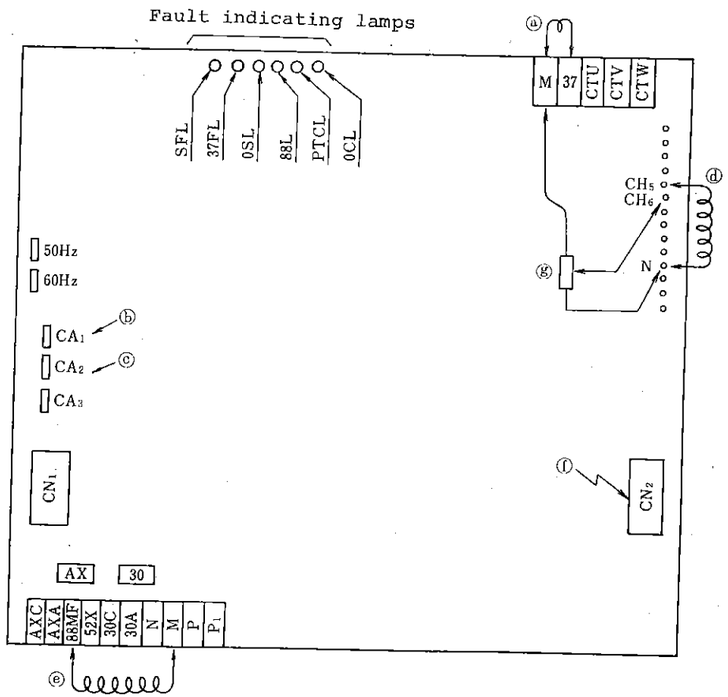
A. CDPB3CPS-62

Items	Fault indicating lamps	How to check (refer to the SREG P.C.B. below)
a	37FL	Make short circuit between Terminals 37 and M on the SREG P.C.B.
b	SFL	Take out the jumping wire of the item 3-1-(2) (It puts on about 1.0 second later)
c	OSL	Make short circuit check pins between N and CH5 (It puts on at 115 ∿ 120% of rated speed)
d	88L	Make short circuit the terminals between 88 MF and M
e	PTCL	Take out the connector CN_2 from the SREG P.C.B. (It puts on at 3.2 ∿ 3.8 kΩ and recovers at about 2.0 KΩ of the PTC resistance.



B. CDPB3CPS-82
(CDPB3CPS-83)

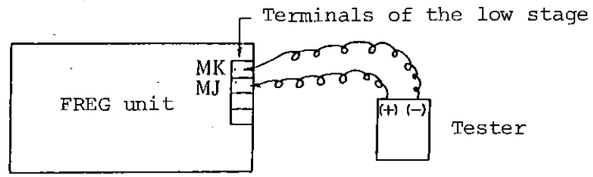
Items	Fault indicating lamps	How to check (refer to the SREG P.C.B. below)
a	37FL	Make short circuit between terminals 37 and M on the SREG P.C.B.
b	SFL	Take out the jumping wire and operate the DSR unit (to give it the forward or reverse and speed setting voltage). This lamp puts on about 0.2 second later
c	SFL	Make short circuit CA2 and operate it (to give it the forward or reverse and speed setting voltage). This lamp puts on about 2 to 10 second later.
d	OSL	Make short circuit between check pins N and CH5 (This lamp puts on at 115 ∿ 120% of the rated speed.
e	88L	Make short circuit the terminals between 88 MF and M
f	PTCL	Take out the connector CN_2 from the SREG P.C.B. (It puts on at 3.2 ∿ 3.8 kΩ and recovers at about 2.0 kΩ of the PTC resistance)
g	OCL	Supply over -2 volt to the pin CH6 (It puts on.)



4-6-5 Confirmation of field current

(1) Confirm the field current in accordance with the motor test report (or the motor specification)

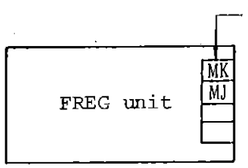
A. FREG-10C and -10E



As the field voltage is calculated as to multiply the normal field current by the field resistance of hot condition and regulated, the current of cold windings or of just power supply's throwing-in condition is up by 10 to 30% more than the rated current.

Don't touch the regulating volume resistance VR_4 on the FREG P.C.B. and the initial current becomes the normal one in accordance with the temparature rise of filed windings. Refer to the specification, page 18.

B. FREG-10D



As the field voltage is regulated with current, this is the value of multiplying the normal field current by the present field resistance.

Don't touch the regulating volume resistance VR_4 on the FREG P.C.B. despite the difference, 10 to 30% of the voltage between hot and cold conditions.

Example DC Spindle drive system manufacturing specification

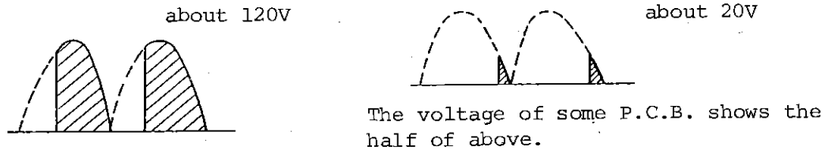
Orderer	Messrs JIS, JEC JEM technical standards	Mfg. No. numbers
Warranty term	Within 1 year after shipping of the factory	

Specifications

	Items	Specification	Remarks
Mechanical specifications	Machine name	____ type NC lathe	
	usage	Main spindle	
	Range of load variation	10 ∿ 100%	
	load GD^2	$kg\text{-}m^2$	Converted into the value at the motor axis
	Starting frequency		
	base torque	kg-m	
	Load counter torque	kg-m	
	The name of system	FSD- ____ D	
Motor specifications	Type	GGN 3138G	
	Output power	5.5 kW/cont. 7.5 kW/30 30 Min	
	Base speed/maximum speed	1150 RPM/3450 R.P.M.	
	Range of speed controlling	34.5 ∿ 3450 R.P.M.	
	Voltage controlling	34.5 ∿ 1150 R.P.M.	
	Field controlling	1150 ∿ 3450 R.P.M.	
	Armature voltage	DC 220V'	
	Armature current	31A/5.5kW 42A/7.5kW	
	Armature resistance	1.26Ω at 75°C	
	Field voltage	112V at 1150 RPM	3.7A x 30.3 = 112Ω
	Field current	Max 43A normal 3.7A at 1150 RPM Nor 0.92A at 3450 RPM Min 0.78A (say)	
	Field resistance	30.8Ω at 75°C	
	Cooling fan	87/120W, 200/220V 50/60Hz, 0.42/0.47A	
	Tacho generator	KGD-03C DC20V at 1000 RPM PFM 25/1.2-24 AC 115V at 1800 R.P.M.	
	P.T.C. thermister	Existence (standard) Nonexistence	
	GD^2	0.45 $kg\text{-}m^2$	

(2) Observation with a oscilloscope

When terminals M and FS of FREG unit are "on", the output voltage is about 120 volt. When "off", it is about 20 volt



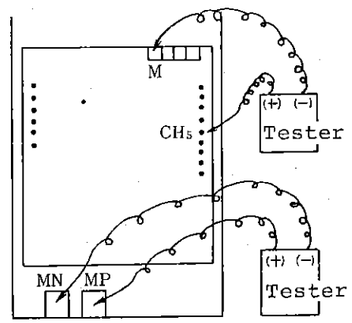
The voltage of some P.C.B. shows the half of above.

It is also unnecessary to adjust the other VR_s on the FREG P.C.B.

cf) When the field winding resistance of a motor is more than 100 KΩ, connect the resistance for discharge between terminals MJ and MK.

4-6-6 Checking of generated voltage polarities of motor and T.G.

For above, measure the generated voltage, when the rotor is rotated towards one side by hands.



The portion of motor generated voltage measurement	measuring range
between MP and MN	DC about 10V
The portion of T.G. generated voltage measurement	measuring range
between CH5 and M	DC about 1V

It is correct the poralities MP of motor generated voltage and CH5 of T.G. generated voltage are same.

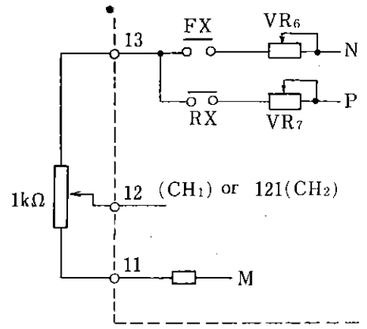
When the polarities are different, the motor runs away and is uncontrollable.

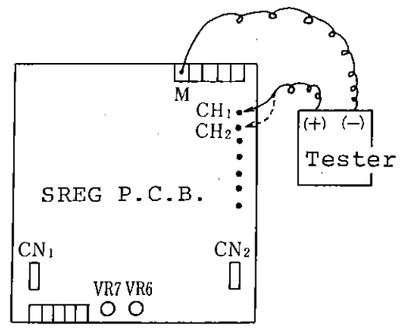
4-6-7 Confirmation of speed setting input voltage

(1) Confirm the speed setting input voltages of manuals, automatics (using D/A converter, NC equipment) and jogging, between M and CH_1 or M and CH_2, when operating (forward and reverse). (Refer to sequences which the terminal CH_1 or CH_2 is used.)

The voltage shows about 10V at the max. speed written in the manufacturing specification. (If correct, it is between ±9.95 and ±10.05V) Other rotating speeds are proportional to the speed setting input voltage.

Example.
If the rotating speed is 3000 RPM, and speed setting input voltage is 10.0V, it shows 5.0V when 1500 RPM. and RPM shows 1.0V.





When the power supply for speed setting is illustrated above, the fine adjustments of max. speeds are regulated with VR_6 for forward and VR_7 for reverse.

To the contrary in the case of a D/A connector or NC equipment those input comes from the out side, ajust it on the outside. Refer to the items of options, when options are equipped on the D.S.R. unit.

(2) When the over ride P.C.B. is equipped, confirm the speed setting voltage variation of percentage against the original one.

4-6-8 Confirmation of the basic behaviors of P.C.Bs.

(1) Confirm the behavior of each part according to the reference "the voltage and wave form on check pins".

(2) Confirmation of α min, γ min of the phase shifter (with an oscilloscope)

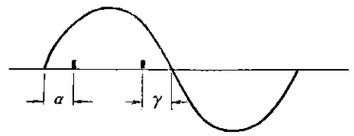
In operation α min is from 18 to 25°
In stoppage γ min is from 28.5 to 31.5°

Basic waveforms and VRs for ajustment are as follows.

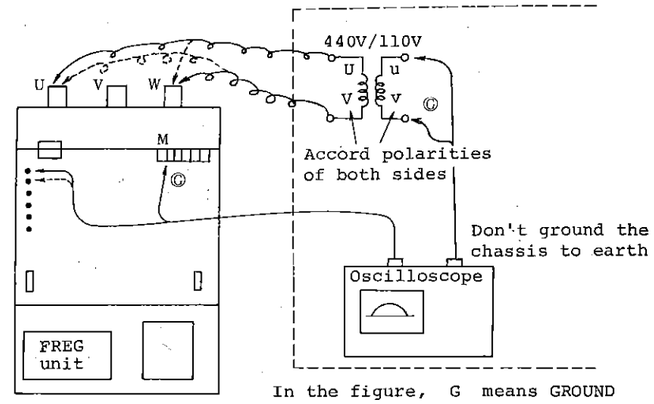
VR10 is for standard wave forms of U phase between U and W ,also for standard wave forms of X phase between W and V

VR11 is for standard wave forms of V phase between V and U ,also for standard wave forms of Y phase between U and V

VR12 is for standard wave forms of W phase between W and V ,also for standard wave forms Z phase between V and W



cf) To confirm the phases of the phase shifter, insulate the standard wave forms with the insulation transformer.



Example. The connection shows confirmation of a V phase pulse with real lines (With dotted lines shows a x phase pulse.)

Moreover refer to the reference data page 31 ∿ 34 of check pins behaviors on the SREG P.C.B. and the FREG P.C.B.

4-6-9 Recoveries

(1) Conduct operations after throwing off the power supply (throwing off the contactor for the service line)

(2) Recover the preparating operations of both items 3-1-(1) and 3-1-2 (2) to the original conditions.

4-7 Motor Operations

4-7-1 Confirmation of the motor rotation direction

(1) Confirm the rotation direction, when jogging and setting manuals.

(Low sheed setting)

- When the rotation direction is incorrect, reverse the porarities both connections field windings MJ-MK and tacho generator windings.
- When the speed is abnormally up, stop the motor immediately and examine TG circuits (3-5-(3)). If not recoveres, it is nece-sar ssary to examine again according to the trouble shooting.

(2) Confirm whether speed controlling is correct or not against the speed setting, on the low speed range.

4-7-2 Confirmation of motor max. speed

(1) When indicating the max. voltage value (10.0V), adjust VR2 on the S.R.E.G. P.C.B to become the maximum speed in accordance with the specification.

cf) With measuring the motor speed on the machine side, by turning VR_2 gradually, take care of the over speed coming from the pullywheel ratio, gear ratio and belt slip. etc.

(Reference)

When there is the difference between forward and reverse speed, (although the accuracy of speeds is within ±1% of max. speed if wanted the accordance of reverse and forward speed), conduct as follows.

(Example)

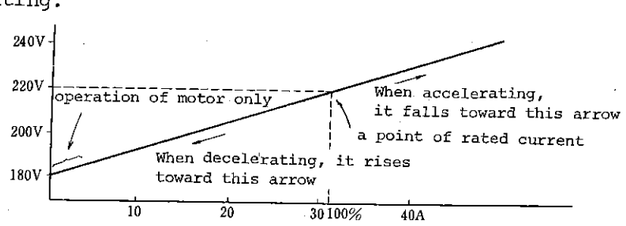
If 3450 rpm at -10.00V of forward speed setting and 3420 rpm at +10.00V of reverse speed setting, adjust VR_2 as to be 3450 RPM in the condition (see 3-6-(1)) that forward speed setting becomes max. -9.95V at 3420 RPM.

4-7-3 Confirmation of the speed meter

After finishing the fine adjustment of the max. speed, correct VR_3 on the SREG P.C.D. in the max. speed state. Naturally do above both directions. (Already equipped the adjusting VR in the speed meter, it allows to correct either of them.) Adjusting band width of the speed meter is from 7 to 10.5V.

4-7-4 Confirmation of the motor terminal voltage

(1) Confirm the terminal voltage in the conditions of max. speed and light load.
Motor terminal voltage ≒ motor rated voltage - IR drop at 100% of rating.



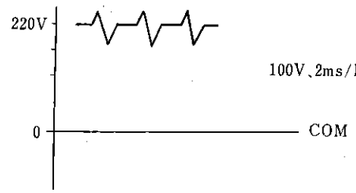
(Example)

If the case of the motor in accordance with the manufacturing specification for reference, above figure shows the relation voltage to current Equation is,

$$220V - (31A \times 1.26\Omega) \fallingdotseq 181V$$

The answer means off load to the motor and then current is approximately OA at 31A of rated current, the voltage rises to 220V. Even if there is an error ±5% of voltage. Practically it is not problem. Adjust the terminal voltage with VR_1 on the FREG P.C.B.

(2) Confirm the output figures on an oscilloscope.



100V.2ms/DIV

The figure on an oscilloscope shows an operation at DC 220V.

4-7-5 Confirmations of the current limit value and IR compensation

(1) These are already set in the factory, therefore, confirm the current limit value with an ampere meter, when starting and stopping.

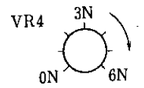
A. When the accelerating time is short, try to repeat from forward max. speed to reverse max. one and vice versa or open circuit between terminals FS and M and repeat start and stop, it becomes clear. (Don't forget to restore the latter)

B. If there is not an ampere meter, measure and calculate the voltage between outer terminals MM and MA on the FREG unit with an oscilloscope or a igital volt meter.

Example, in the motor case in accordance with the manufacturing specification for reference. By the Shunt resistance 50A/60mV and and the current limit value 46.5V.

$$\frac{46.5}{50A} \times 60mV = 55.8mV$$

C. When changing the current limit value, turn VR_4 on the SREG P.C.B.



The current limit value decreases with turning VR_4 to right (toward 6N)

(2) Confirmation of the output wave form on an oscilloscope

In the case off load operation

In the case the current limiting or on load operation

4-7-6 Confirmation of system responses

(1) Change the speed setting rapidly as follows
(From min low speed to max. high speed and vice versa,

stop ⟷ max high speed

stop ⟷ discretional speed ⟷ other discretional speed ⟷ max. high speed, forward ⟷ reverse, etc.)

(2) Don't touch the VR of normal standard setting value for system response on the FREG unit.

on FREG-10C	VR_5 is 2^N
on FREG-10A	there is normally no VR for adjustment (VR_3)
on FREG-10E	ditto

cf) When requiring especially high accuracy and response of pseed, it does not satisfy the specifications without changing constant numbers on P.C.Bs, the VR_1 notch and the accuracy of mo motor and tachogenerator all the more.

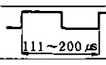
4-7-7 Others

Confirm the full satisfactions with the actions of optional P.C.Bs when there are optional P.C.Bs on the D.S.R. unit.

4-8 Voltage figures of check pins

SREG Printed Circuit Board

The voltages and wave forms on checkpins (motor stops) - (take out the flat cable connected to the pulse P.C.B.)

Check point \ Operation Modes	Stop	Forward in acceleration (Changing the setting)	Steady state in forward	Forward in deceleration (Changing the setting)	Reverse in acceleration (Changing the setting)	Steady state in reverse	Reverse in deceleration (Changing the setting)
CH1 Standard input voltage	o usually 0V o 0 to 10 V depending	-0.1V ∿ 10.1V standard 10.0V/100%	S.A.L.	S.A.L.	+0.1V ∿ 10.1V	S.A.L.	S.A.L.
CH2 Auxiliary input Voltage	upon machines				standard 10.0V/100%		
CH3 ASR output	0V	+5V (4.7 ∿ 5.25)	S.A.L.	S.A.L.	-5V (4.75 ∿ 5.25V)	S.A.L.	S.A.L.
CH4 ACR output for crientation for O.T	+7.5 (7.2 ∿ 7.8) +6.3V (6.0 ∿ 6.6)	+1.1V (1.0 ∿ 1.2)	S.A.L.	S.A.L.	+1.1V (1.0 ∿ 1.2)	S.A.L.	S.A.L.
CH5 Speed feedback	0V	Same as left	S.A.L.	S.A.L.	0V	S.A.L.	S.A.L.
CH6 Current feedback	0V	S.A.L.	S.A.L.	S.A.L.	0V	S.A.L.	S.A.L.
CH7 ASR output (rectification)	0V	+5V (4.75 ∿ 5.25)	S.A.L.	S.A.L.	+5V (4.75 ∿ 5.25)	S.A.L.	S.A.L.
CH8 Speed feedback (rectification)	0V	S.A.L.	S.A.L.	S.A.L.	0V	S.A.L.	S.A.L.
CH9 Standard input (limiter)	0V	-0.05V ∿ 5.4V	S.A.L.	S.A.L.	+0.05V ∿ 5.4V	S.A.L.	S.A.L.
CH10 Speed feedback (auxiliary)	0V	S.A.L.	S.A.L.	S.A.L.	0V	S.A.L.	S.A.L.
PHU , Pulse signal PHZ	band width is 500 μs 		S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
FG Logic output choice of forward	forward → stop "L" reverse → stop "L"	"H" about 14V	S.A.L.	S.A.L.	"L"	S.A.L.	S.A.L.
RG Logic output choice of reverse	forward → stop "L" reverse → stop "L"	"L" about 0V	S.A.L.	S.A.L.	"M"	S.A.L.	S.A.L.
* OSC Oscillation frequency		S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
SM γ shift	-7V ∿ -9V	0V ∿ 1V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
TOD IC output for torque discrimination	forward → stop "L" reverse → stop "H"	"L" about 0V	S.A.L.	S.A.L.	"H"	S.A.L.	S.A.L.

* There is none on the P.C.B. CDPB3CPS-82.

SREG P.C.B.

The voltages and wave forms on check pins (motor runs)

Check point \ Operation Modes	Stop	Forward in acceleration (Changing the setting)	Steady state in forward	Forward in deceleration (Changing the setting)	Reverse in acceleration (Changing the setting)	Steady state in reverse	Reverse in deceleration (Changing the setting)
CH1 Standard input voltage	o usually 0V o 0 to 10 V depending	-0.1V ∿ 10.1V	S.A.L.	S.A.L.	+0.1V ∿ +10.1V	S.A.L.	S.A.L.
CH2 Auxiliary input voltage	upon machines						
CH3 ASR output	0V	0V ∿ +5.25V	S.A.L.	0V ∿ -5.25V	S.A.L.	S.A.L.	0V ∿ +5.25V
CH4 ACR output for orientation for O.T	+7.2V ∿ +7.8V +6.3V (6.0 ∿ 6.6)	min. +1.1V ∿ 7.8V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
CH5 Speed feedback	0V	+0.1V ∿ 10.1V	S.A.L.	S.A.L.	-0.1V ∿ -10.1V	S.A.L.	S.A.L.
CH6 Current feedback	0V	max. 0 ∿ -1.0V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
CH7 ASR output (rectification)	0V	0V ∿ +5.25V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
CH8 Speed feedback (rectification)	0V	+0.1V ∿ +10.1V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
CH9 Standard input (limiter)	usually 0V	-0.05V ∿ 5.4V	S.A.L.	S.A.L.	0.05V ∿ +5.4V	S.A.L.	S.A.L.
CH10 Speed feedback (auxiliary)	0V 0V	+0.01V ∿ +1.1V	S.A.L.	S.A.L.	-0.01V ∿ -1.1V	S.A.L.	S.A.L.
PHU Pulse signal PHZ	 about 500 μS	between α min↔γ min 	between α:90° ↔ α min 	between α min ↔ γ min	S.A.L.	between α:90° ↔ α min	between α min γ min
FG Logic output choice of forward	"L" level	"H" level	S.A.L.	"L" level	S.A.L.	S.A.L.	"H" level
RG Logic output choice of reverse	"L" level	"L" level	S.A.L.	"H" level	S.A.L.	S.A.L.	"L" level
* OSC Oscillation frequency	5 ∿ 9 kHz	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
SH shift	-7V ∿ -9V	0 ∿ +1V	S.A.L.	S.A.L.	S.A.L.	S.A.L.	S.A.L.
TOD IC output for torque discrimination	"L" or "H" level	"L" level	S.A.L.	"H" level	S.A.L.	S.A.L.	"L" level

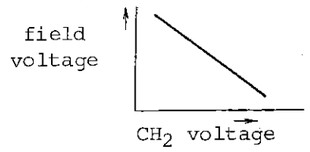
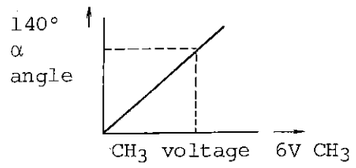
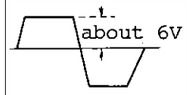
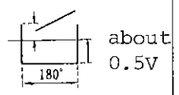
* There is non on the P.C.B. CDPB3PCS-82.

Controlling power supply on P.C.Bs

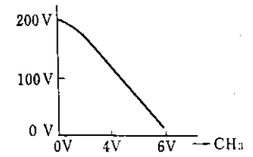
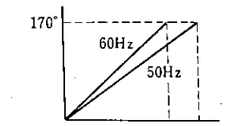
	P_1 - M	P - M	N - M
SREG P.C.B. CDPB3CPS-62	+22 ∿ 26V	+14.8 ∿ 15.2V	-14.8 ∿ 15.2V
" -82	"	"	"
FREG P.C.B. CDPB1CAF-31	-	+15.0 ∿ 17.5V	-15.0 ∿ 17.5V
" -42	+21 ∿ 30V	+11.2 ∿ 13.1V	-11.2 ∿ 13.1V
" -	"	"	"

The voltage wave forms of checkpins on FREG P.C.B.

A. CDPB1CAF-31

	Stop	Operation	Remarks
CH1 Comparation of voltage weakening circuit	0V	0 ∿ -12V	detections of armature voltage and current
CH2 Setting volt voltage of strengthening the field (at VR_4)	+1 ∿ 6.5V min 10 ∿55V max 160∿180V	same as left column	the voltage changes according to the field voltage setting value 
CH3 AFR output	+1 ∿ 8V	same as left	at standard 6V α = 140° 
CH4 Standard voltage of weakening circuit	+10 ∿ 12V	same as left	
CH5 Syncronous signal			
CH6 Pulse signal	about 0.2V 	same as left	

B. CDPB1CAF-43

	Stop	Operation	Remarks
CH1 Comparison of voltage weakening circuit (armature voltage and current feed back)	0V	0 ∿ 6V	about -6V/100%
CH2 Input voltage of current feed back	Strengthened current about -5V/100%	-5 ∿ 0V	
CH3 Phase regulating voltage	Strengthened current 1.5 ∿ 3.5V (different in each motor specification)	0 ∿ 8V	 α angle  about 6V about 8V

4-9 List of Adjusting Volumes and Their Usage

SREG P.C.B. (CDPB3CPS-82)
(" -62)
(" -83)

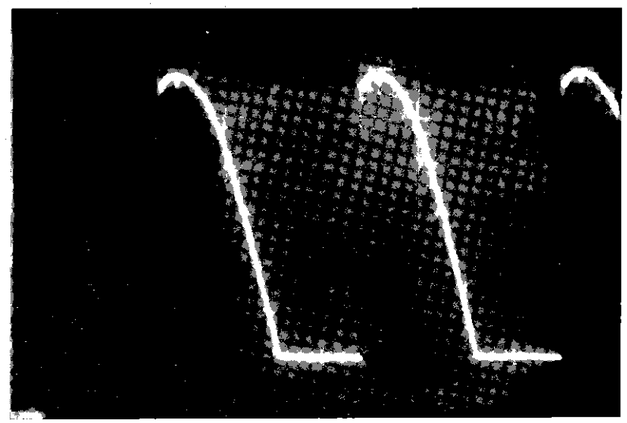
Sym-bols	Usage	Standard setting	Remarks
VR1	ASR gain for adjustment	5∿7N	It varies with optimum value of each machine.
VR2	Speed feed back "	-	It differes in each specification
VR3	Speed meter "	7.5∿9N	When an meter has full scale of 10V
VR4	Current limiting "	-	It differs in each specification
VR5	Not used	-	Usually not used
VR6	Upper limit of forward speed setting "	3∿4.5N	Use 1KΩ for adjustment, when max 10V is set.
VR7	Upper limit of reverse speed setting "	3∿4.5N	"
VR8	ASR 0 point adjustment	0∿6V	
VR9	Not used	-	-
VR10	Phase shift angle (U, X phase) "	0∿6N	-
VR11	" (V, Y phase) "		-
VR12	" (W, Z phase)		-
VR13	Adjustment of speed feed back quantity	6N	
VR14	"	0∿6N	
VR15	Detective point of over current for adjustment	2∿4N	
VR16	Detective angle of tacho loss "	2∿4N	

Without o marked VRs don't touch them because of finishing setting

cf) On the P.C.B. CDPB3CPS-62 type there is not VR_{14}, VR_{15} and VR_{15}.

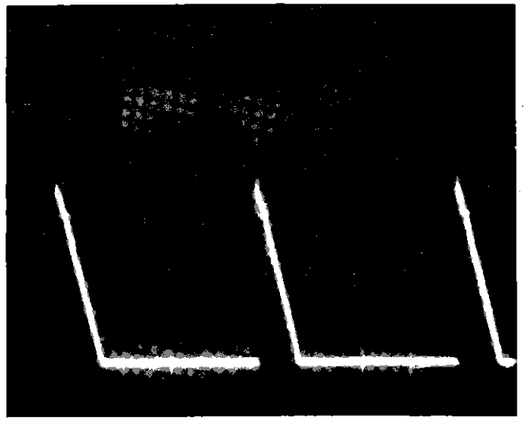
4 —10 Voltage wave form of each point

FIELD VOLTAGE (Ca 120V)
界磁電圧 (約120V時)



50V, 2ms／DIV

FIELD VOLTAGE (WEAK FIELD)
界磁電圧 (M—FS間オープン)

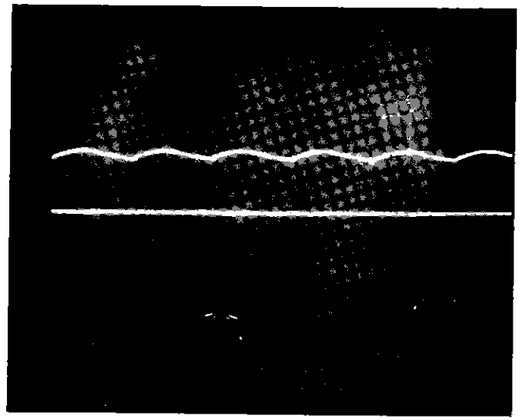


50V, 2ms／DIV

NOTE : MEASURE BETWEEN TERMINAL J AND K
注 : J, K間で測定

FIELD CURRENT (3A)

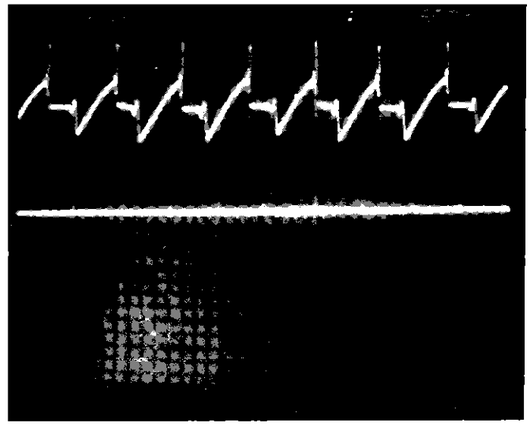
界磁電流 (3A流通時)



0.5V (0.2Ω), 5ms/DIV

MOTOR VOLTAGE, FORWARD DIRECTION (220V)

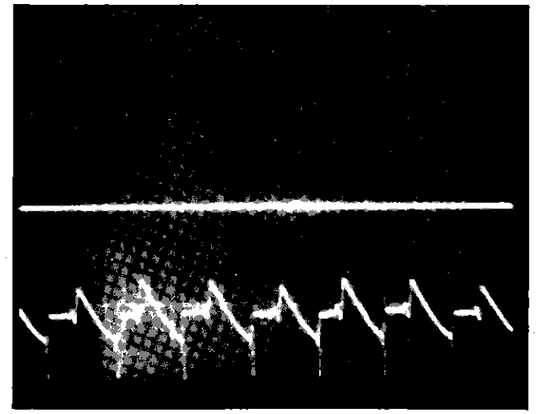
電機子電圧 正転220V



100V, 2ms/DIV

MOTOR VOLTAGE, REVERSE DIRECTION (220V)

電機子電圧 逆転220V

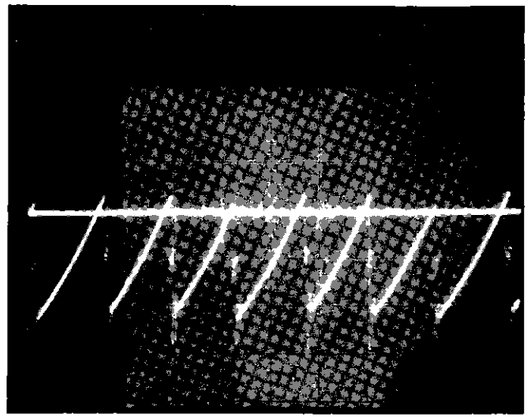


100V, 2ms/DIV

NOTE : MEASURE BETWEEN TERMINAL MP AND MN

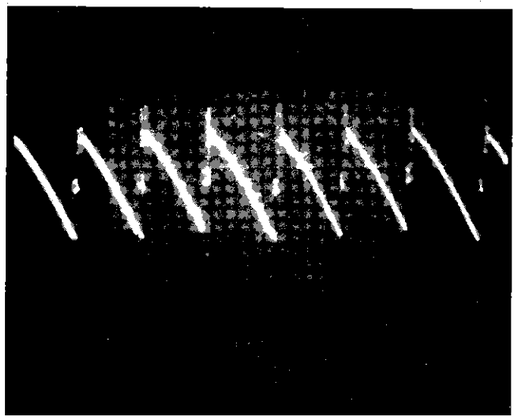
注 : 端子MP, MN間で測定

UNDER RE-GENERATING
MOTOR VOLTAGE FOR → REV.
回生中
電機子電圧　正転から逆転に設定変更した途中



100V, 2ms／DIV

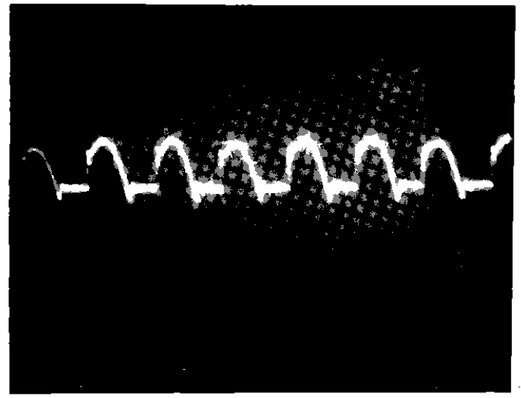
UNDER RE-GENERATING
MOTOR VOLTAGE REV.→ FOR.
回生中
電機子電圧　逆転から正転に設定変更した途中



100V, 2ms／DIV

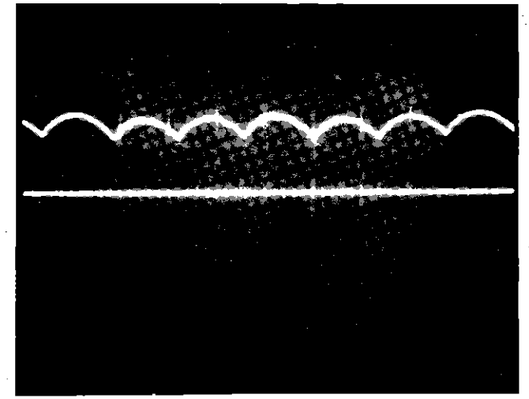
NOTE : MEASURE BETWEEN TERMINAL MP AND MN
注　　: 端子MP, MN間で測定

MOTOR CURRENT, NO LOAD
電機子電流（無負荷運転）



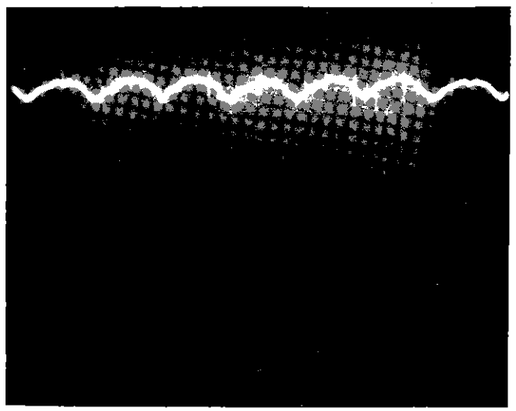
1V, 2ms／DIV

MOTOR CURRENT, ON LOAD
電機子電流（負荷）



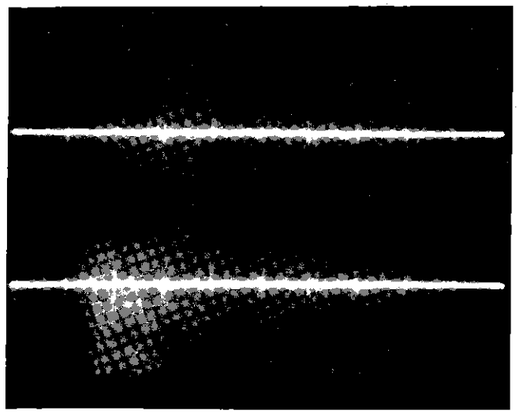
10V, 2ms／DIV

BETWEEN TERMINAL P1 AND M
ON SREG. P·C·B
P1電源（SREGプリント板P1−M）



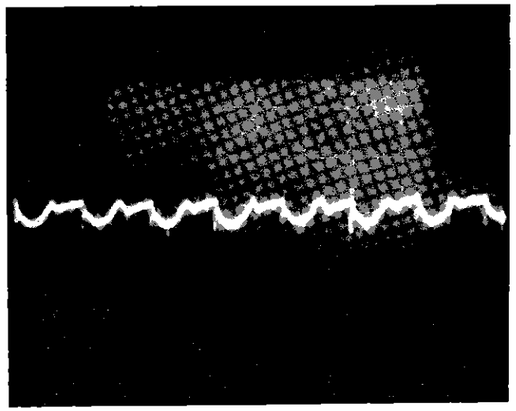
10V, 2ms／DIV

BETWEEN TERMINAL P, N AND M
ON SREG. P·C·B
P. N電源（SREGプリント板P−M, N−M）



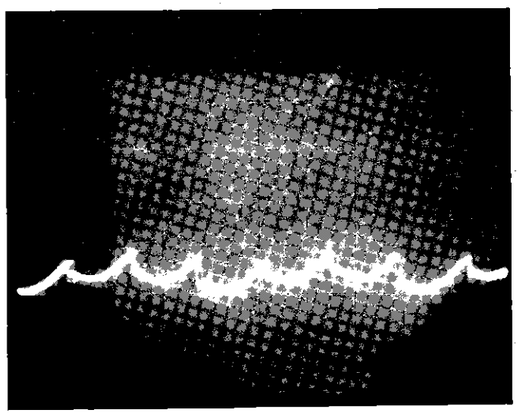
10V, 2ms／DIV

BETWEEN CHECK TERMINAL CH_6 AND M
ON NO LOAD (ON SREG. P·C·B)
無負荷運転（SREGプリント板 CH_6−M）



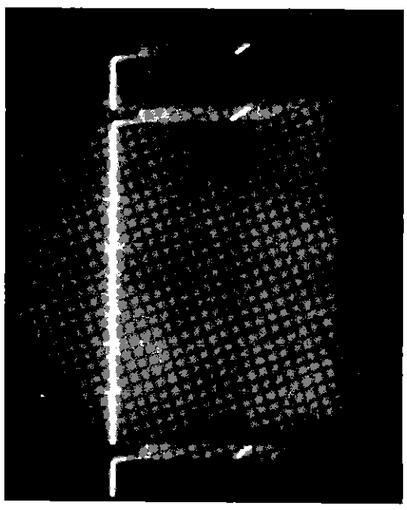
0.1V, 2ms／DIV

BETWEEN CHECK TERMINAL CH_6 AND M
ON ACCELERATING (ON SREG. P·C·B)
電流制限加速中（SREGプリント板 CH_6−M）



0.5V, 2ms／DIV

GATE PULS (AT GATE OPEN)
ゲートパルス（サイリスタゲートオープン）GU1-KU1



2V, 2ms/DIV

5. Trouble shootings

Fault conditions	Check points	Check items	Judgement of failures	Treatments
Motor doesn't move	Wire connections	Is there wrong connections?	Certify wire connections.	Correct wire connections
	D.C. alarm	Is D.C. alarm LED on?	Refer to the item of D.C. alarm check points.	Same as left
	Thyristor convertor unit	Is the aux. control voltage normal?	Check the voltage between check pins N, P, P_1 and M terminal. N-M -15V±1.5V P-M +15V±1.5V P_1-M +24V±2.0V	Power supply
		Is the field current applied?	Is the voltage between MJ and MK DC 105 ∿ 120V?	Power supply
		Is the speed setting signal in?	Check the voltage between check pins CH_1, CH_2 and M terminal. DC±10V is max. speed - sign means forward rotation + sign does reverse rotation	Speed setting circuit. (around a NC equipment or V.R.)
Motor rotates but the speed is not uncontrollable	Wire connections	Is there wrong connections?	Certify wire connections.	Correct wire connections
	Drive unit	Is the speed setting voltage normal?	Is the voltage between check pins CH_1, CH_2 and M terminal changeable according to the speed setting voltage? DC±10V is max. speed - sign means forward rotation + sign does reverse rotation	Speed setting circuit (around a NC equipment or V.R.)
For the speed setting voltage, the motor speed is considerably unproportional	Drive unit	Is the adjustment of VR_2 slipped off?	Turning VR_2 to the right, it becomes slow, and to the left, it does high.	Adjustment
	Motor	Tacho generator	How about the abrasion of brushes of T.G.?	Changing brushes
	Drive unit	Changing over- 50 - 60Hz	Is it correct in the drive unit?	Changing over
	Power supply	Phase order	Is the power supply phase order R-S-T correct?	Changing wire connections
		Phase lack	Is the three phases of power supply applied?	Power supply
Actual speed and meter indication are different.	Wire connections	Is there wrong connections?	Certify wire connections.	Correct wire connections
	Drive unit	Adjustment of VR_3	Turning VR_3 to the right, meter indication value becomes high, and to the left, it does low.	Adjustment

6. Alarm

1) LED (Light Eliminate Diode) for indicator of D.C. spindle alarm.

Thyristor convertor unit have 6 LED, and each LED light at such a following troubles.

- o SFL (Start-up delay circuit)
  Start up delay is to protect over speed in case there was no feedback voltage of tacho generator (for example connecting wire is link-out), and to detect field current loss due to field burn-out.

- o 37FL (Thyrisfuse blowing out)
  The fuse is blown out due to some case; short-circuit, thyristor fault and commutation failure or thyristor misfiring.

- o OSL (Motor over speed)
  Over speed detector circuit act at the motor speed more than 115% of rating.

- o 88L (Motor cooling fan overload)
  In case of overload of the cooling fan for the reason that bearings are in abnormal position, fan impellers are touching some portion, or something like that, thermal relay connected with cooling fan motor in series operate immediately, and turn off D.C. spindle motor.

- o PTCL (Motor overheat)
  In case of continuous overload of the motor or its locking state, motor winding temperature may rise and insulation may be deteriorated in some cases. In order to prevent these cases, thermistors are to be added to the stator side inside the motor, and the temperature rise is to be detected.

- o OCL (Over current)
  Over current detecting circuit act at 200% over load of spindle motor rating.

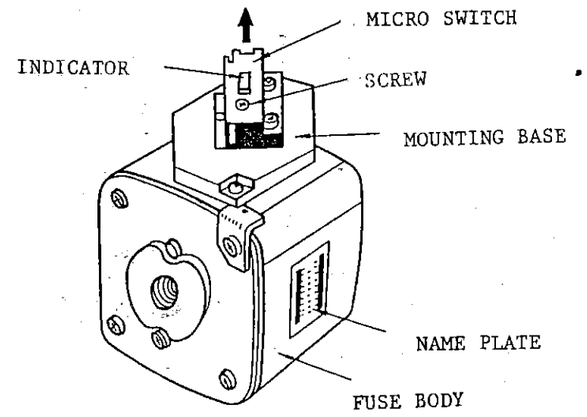
Above 6 LED are mounted on printed circuit board shown in Fig. 1 [11].

2) How to check when LED lights

2)-1 SFL

	CHECK POINT	TREATMENT
1	Does field current flow or not, you can check field voltage instead of current between thermal MJ and MK mounted on field regulator. Standard value of field voltage is 105V ∿ 120V.	Make sure AC power source. It's usual, the voltage between terminal UF and VF is 190V ∿ 240V.
2	Tacho-brushes turn out.	Change brushes according to turn out condition.
3	Is the spindle, connected to a motor, locked by over biting of bite with work.	Reset
4	Tacho-loss by linking out of lead wire.	Correct connection.

2)-2 37FL



The fuse is connected between S.C. power source, U, V, and W phase, and thyristor in series to protect the thyristor from heavy current. If the fuse is blown out, indicator of micro switch installed at the top of the fuse body shows trouble. In above case, you have to change the fuse. Though the fuse is pushed on the mark, it is of no use against blowing off. (When changing fuse, please make sure current and type of fuse appeared on label covered fuse body.

	CHECK POINT	TREATMENT
1	Make sure frequency change 50Hz or 60 Hz.	Set the correct frequency. (Refer to Fig. 2 and Fig. 3)
2	Is the AC power source's phase rotating correct? (R → S → T).	Make sure and connect correctly.
3	Is there a lack of a phase?	
4	Is the A.C. power supply voltage kept at normal value?	
5	Does an electricity failure occur?	Change fuse.
6	Is there short circuit? Put off the power supply, check the terminals of the unit main circuit over 500 kΩ. Check points between U and V, V and W, W and U, U and MP (MN), V and MP (MN), W and MP (MN), U and ground, W and ground, MP and ground, MN and ground.	Repair the short circuit. Changing the thyristor because of it's failure. Change fuses.

2)-3 OSL

	CHECK POINT	TREATMENT
1	Is lead wire of tacho-generator or motor's filed connected in correct polarity.	
	1 Put off the power supply [breaker] and take off the secondary wire connections of a main magnet contactor 52. 2 Put on the power supply [breaker] and certify the fan motor rotation. [Don't apply the start signal.] 3 Under the conditions 2 , certify the accordance of two polarities by checking the output terminal MP and the check pin CH_5 with a tester by rotating the motor manually. When the polarities are different, change the connections MJ and MK of a field unit after putting off power supply.	When the motor rotating direction is wrong, change the connections MJ - MK and TDP - TDN of T.G.

2)-4 88L

	CHECK POINT	TREATMENT
1	Is the thermal setting value of the cooling fan motor for spindle motor correct?	Thermal reset.
2	Is the blade of a cooling fan struck or rubbed anywhere?	Removal of an alien substance.
3	Is single phase operation occured?	
4	Is power supply normal?	
5	Is the resistances of fan motor balanced?	Change fan motor.

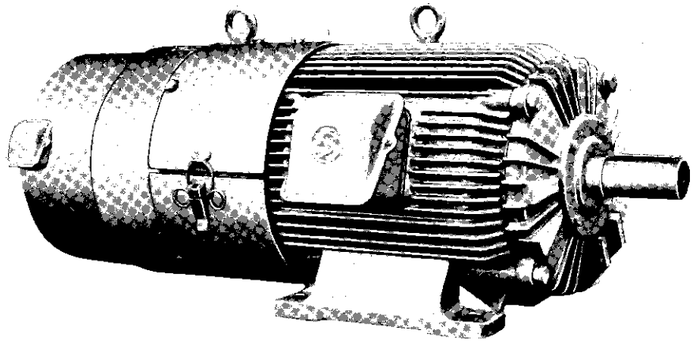
2)-5 PTCL

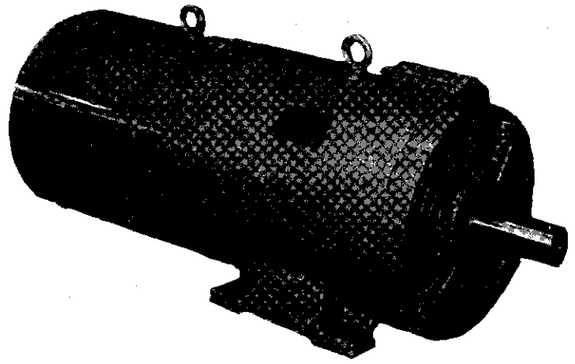
	CHECK POINT	TREATMENT
1	Is motor frame in very hot condition? (If PTCL light at motor frame cooling condition, it may be trouble on linking out of lead wire of PCT thermistor element. In this case, please make shorted circuit it's lead wire.)	Over load.
2	Is the rotating direction of fan motor correct.	
3	Is ventilation inlet of cooling fan motor dusty.	Clean up.

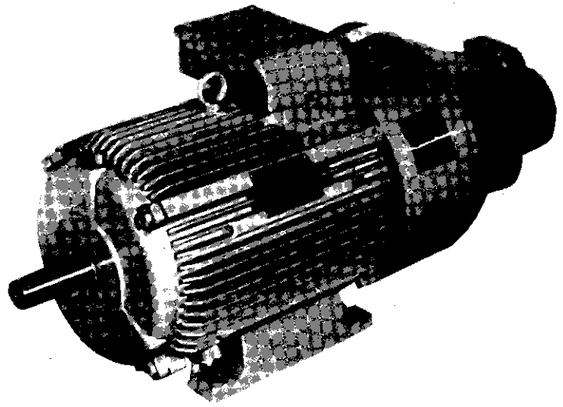
2)-6 OCL

	CHECK POINT	TREATMENT
1	Is the adjusting volume VR_1 set at extreme max. position?	Turn it to the left.
2	Others are same as the cases of 37FL.	Refer to the table of 37FL.

Ⅳ. D.C. Motor



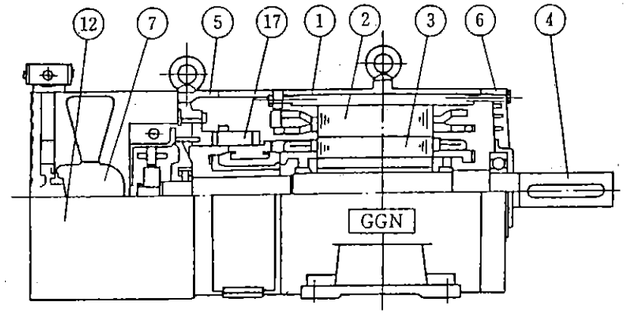




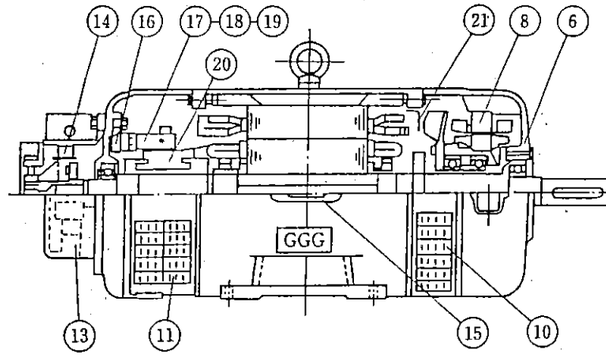
1. Structure

1-1 Open Type Motor

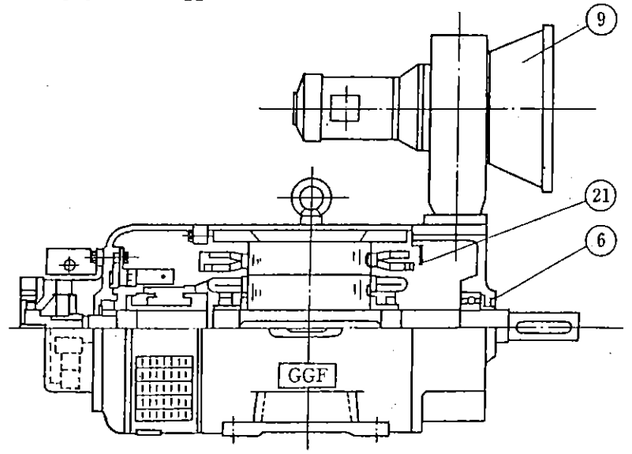
[1] GGN type: with axcial fan



[2] GGG type: with build-in fan



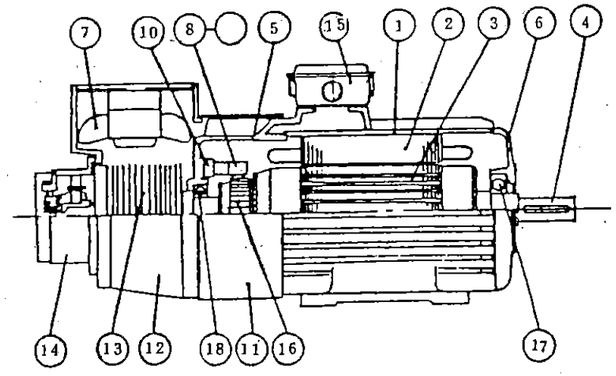
[3] GGF type: with mount fan



No.	Part list
1	Frame
2	Stator
3	Armature
4	Shaft
5	Commutator side shield
6	Drive side shield
7	Axcial Fan
8	Build-in Fan
9	Mount Fan
10	Ventilation cover
11	Inspection cover
12	Fan cover
13	A.C. Tacho-Generator
14	D.C. Tacho-Generator
15	Terminal Box
16	Brash rocker
17	Brush spindle
18	Brush holder
19	Brush
20	Commutator
21	Air guide

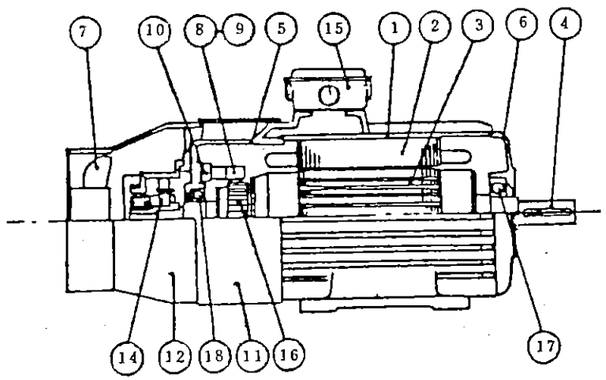
1-2 Close Type Motor

D.C. MOTOR TYPE I.
GHP6138 GHP6166 GHP6168
GHP6184 GHP6188



D.C. MOTOR TYPE II.

GHP6134
GHP6164



No.	Part list
1	Frame
2	Stator
3	Armature
4	Shaft
5	Commutator side shield
6	Drive side shield
7	Axcial Fan
8	Brush holder
9	Brush
10	Brush rocker
11	Inspection cover
12	Fan cover
13	Cooling Fin
14	D.C. Tacho Generator
15	Terminal Box
16	Commutator
17	Drive side bearing
18	Commutator side bearing

2. 外形寸法図

2—1 Open type (G3TYPE) Motor

Mount Foot Type (F 11)

Diagram A

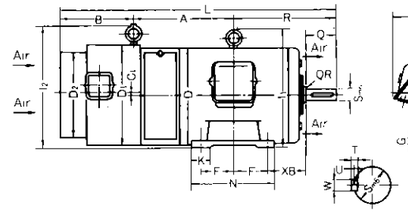
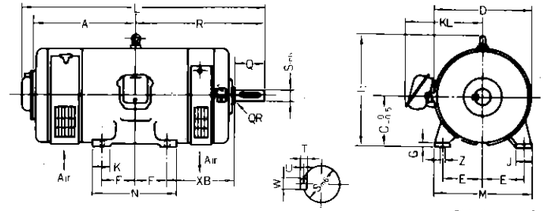


Diagram B



[Unit: mm]

Type	A	B	C	C1	D	D1	D2	E	F	G	I1	I2	J	K	KL	L*	M	N	R	XB	Z	Q	QR	S	T	U	W	Bearing DS	Bearing BS	Wt. (kg)	GD² (kgm²)	Fan motor Capacity (W)	Fan motor Power voltage (V)	Fan motor Poles	Diagram
GGN3134A	216	301	132	0	260	265	214	108	70	17	311	311	45	50	210	756	250	180	239	89	12	80	1	32	8	4.5	10	6307ZZ	6207ZZ	80	0.13	80/120	200/220	2	A
GGN3138A	235								89							794		212	258											95	0.17				
GGN3164A	304.5	276	160	0	310	315	315	127	105	18	376	376	50	63	275	903.5	300	250	323	108	15	110	1	42	8	4.5	12	6310ZZ	6208ZZ	135	0.38	50/80	200/220	4	A
GGN3168A																								48						155	0.45				
GGN3184A	343	298	180	7.5	350	365	365	139.5	120.5	20	425	425	75	75	295	992.5	350	292	351.5	121	15	110	2	55	10	5	15	6312ZZ	6209ZZ	210	0.81	80/120	200/220	4	A
GGN3188A	362								139.5							1030.5		330	370.5											235	0.91				
GGN3204A	428.5	306	200	12.5	400	415	415	159	152.5	22	475	475	80	85	390	1160	390	360	425.5	133	19	140	2	60	10	5	15	6213ZZ	6211ZZ	310	1.6	150/220	200/220	4	A
GGN3208A																														340	1.9				
GGG3226A	456.5	–	225	–	450	–	–	178	178	30	526	–	80	92	420	1190	436	430	623	305	19	140	1.5	65	12	6	18	6314ZZ	6212ZZ	460	2.8	260/450	200/220	4	B
GGG3228A																														495	3.2				

Flange type (L 51)

Diagram C

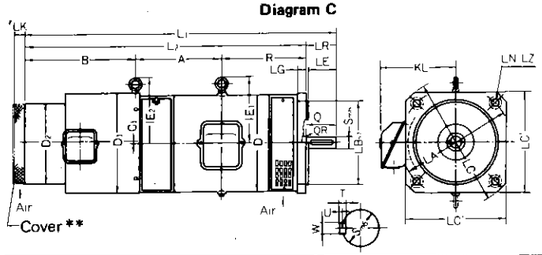
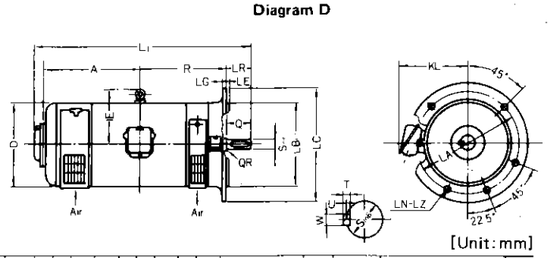


Diagram D



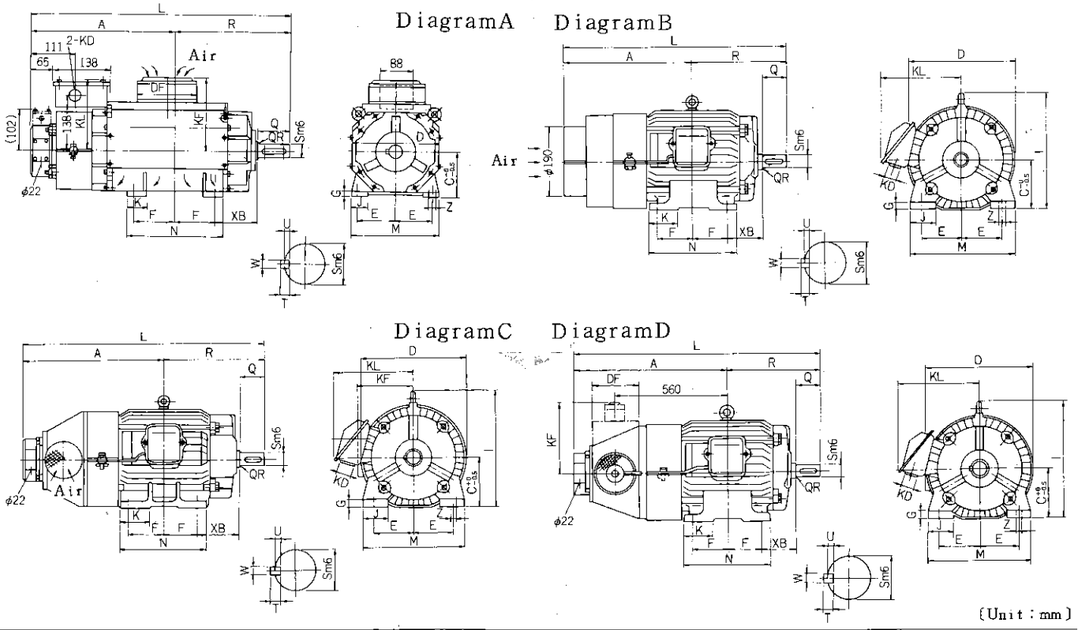
[Unit: mm]

Type	LA	LB	LC	LC'	D	D1	D2	A	B	C1	R	LR	L1*	L2*	IE1	IE2	KL	LZ	LN (ea.)	LG	LE	Q	QR	S	T	U	W	LK	Bearing DS	Bearing BS	Wt. (kg)	GD² (kgm²)	Fan motor Capacity (W)	Fan motor Power voltage (V)	Fan motor Poles	Diagram
GGN3134G	300	230	350	270	260	265	214	216	301	0	212.5	80	809.5	729.5	178.5	178.5	202	19	4	25	4	80	1	32	8	4.5	10	11	6209ZZ	6207ZZ	85	0.13	80/120	200/220	2	C
GGN3138G								235			231.5		847.5	767.5																	100	0.17				
GGN3164G	350	280	400	320	310	315	315	304.5	305	0	267.5	110	987	877	205	205	267	19	4	25	5	110	1	42	8	4.5	12	7	6310ZZ	6208ZZ	145	0.38	50/80	200/220	4	C
GGN3168G																								48							170	0.45				
GGN3184G	400	350	450	380	350	365	365	343	303	7.5	286	110	1042	932	245	245	282	19	4	25	5	110	2	55	10	5	15	130	6312ZZ	6209ZZ	225	0.81	80/120	200/220	4	C
GGN3188G								362			305		1080	970																	250	0.91				
GGN3204G	450	400	500	430	400	415	–	428.5	–	12.5	362.5	140	1242	1102	–	275	390	24	4	25	5	140	2	60	10	5	15	120	6213ZZ	6211ZZ	325	1.6	150/220	200/220	4	C
GGN3208G																															355	1.9				
GGG3226G	500	450	550	–	450	–	–	456.5	–	–	483	140	1154	–	301	–	420	19	8	22.5	140	1.5	65	12	6	18	–	6314ZZ	6212ZZ	460	2.8	260/450	200/220	4	D
GGG3228G																														495	3.2				

Notes : L dimension of mount foot type, L_1, L_2 and flange type L_1, L_2 are included tachogenerator (KGD−02C)

2－2　Close type (G6TYPE) Motor

Mount Foot Type

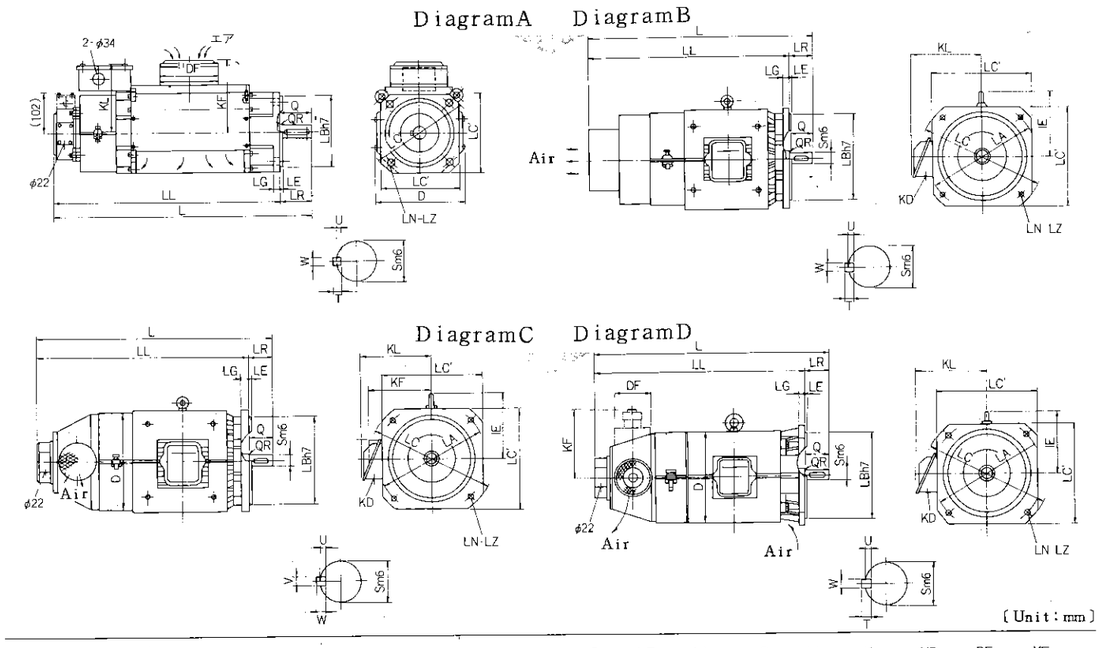


〔Unit：mm〕

Type	A	C	D	E	F	G	I	J	K	KD	DF	KF	KL	L	M	N	R	XB	Z
GHP6114A	314	112	234	95	70	12	—	40	50	34	120	164	178	572	224	175	258	108	12
GHP6116A	372.5	112	234	95	101.5	12	—	40	50	34	120	164	178	662	224	238	289.5	108	12
GHP6118A	372.5	112	234	95	101.5	12	—	40	50	34	φ150	182	178	662	224	238	289.5	108	12
GHP6133A	412.5	132	273	108	89	17	311	45	50	34	—	—	212	700.5	250	212	288	89	12
GHP6137A	497.5	132	273	108	89	17	311	45	50	34	197	175	212	785.5	250	212	288	89	12
GHP6163A	476	160	320	127	105	18	376	50	63	48	—	—	272	799	300	250	323	108	15
GHP6165A	561	160	320	127	105	18	376	50	63	48	197	185	272	884	300	250	323	108	15
GHP6167A	626	160	320	127	127	18	376	50	63	48	225	200	272	971	300	300	345	108	15
GHP6183A	675	180	380	139.5	120.5	22	433	75	83	48	225	210	307	1026.5	350	292	351.5	121	15
GHP6187A	675	180	380	139.5	120.5	22	433	75	83	48	225	210	307	1103.5	350	292	428.5	168	15
GHP6205A	773	200	410	159	152.5	25	468	80	85	48	228	300	340	1198.5	390	360	425.5	133	19

Type	Q	QR	S	T	U	W	Bearing DS	Bearing BS	Wt (kg)	GD² (kgm²)	Fan motor Capacity	Fan motor Power Voltage	Fan motor Poles	Dia gram	Frame
GHP6114A	80	1	32	8	4.5	10	6307ZZ	6206ZZ	75	0.092	20	1φ 200/220	2	A	112M-6
GHP6116A	80	1	32	8	4.5	10	6307ZZ	6206ZZ	91	0.12	20	1φ 200/220	2	A	112B-6
GHP6118A	80	1	32	8	4.5	10	6307ZZ	6206ZZ	92	0.13	40	1φ 200/220	2	A	112B-6
GHP6133A	110	0.5	42	8	4.5	12	6309ZZ	6009ZZ	100	0.2	80	1φ 200/220	2	B	132M-3
GHP6137A	110	0.5	42	8	4.5	12	6309ZZ	6009ZZ	115	0.2	80	1φ 200/220	2	C	132M-3
GHP6163A	110	1	55	10	5	15	6312ZZ	6212ZZ	155	0.55	80	1φ 200/220	2	B	160M-3
GHP6165A	110	1	55	10	5	15	6312ZZ	6212ZZ	170	0.61	80	1φ 200/220	2	C	160M-3
GHP6167A	110	1	55	10	5	15	6312ZZ	6212ZZ	200	0.7	100	1φ 200/220	2	C	160L-3
GHP6183A	110	1	55	10	5	15	6312ZZ	6215ZZ	270	1.4	100	1φ 200/220	2	C	180M-3
GHP6187A	140	1	65	12	6	18	6314ZZ	6215ZZ	300	1.6	100	1φ 200/220	2	C	180M-6
GHP6205A	140	1	65	12	6	18	6314ZZ	6215ZZ	400	2.2	80/120	3φ 200/220	2	D	200L-3

Flange type



〔Unit：mm〕

Type	LA	LB	LC	LC	D	IE	L	LL	LR	LZ	LN	LG	LE	KL	KD	DF	KF
GHP6114G	215	180	250	200	234	—	572	492	80	15	4	18	5	178	—	120	164
GHP6116G	215	180	250	200	234	—	662	582	80	15	4	18	5	178	—	120	164
GHP6118G	215	180	250	200	234	—	662	582	80	15	4	18	5	178	—	φ150	182
GHP6133G	300	230	350	270	273	179	700.5	590.5	110	19	4	25	4	201	34	—	—
GHP6137G	300	230	350	270	273	179	785.5	675.5	110	19	4	25	4	201	34	197	175
GHP6163G	350	280	400	320	320	216	799	689	110	19	4	25	5	262	48	—	—
GHP6165G	350	280	400	320	320	216	884	774	110	19	4	25	5	262	48	197	185
GHP6167G	350	280	400	320	320	216	971	861	110	19	4	25	5	262	48	225	200
GHP6183G	400	350	450	380	380	253	1026.5	916.5	110	19	4	25	5	300	48	225	210
GHP6187G	400	350	450	380	380	253	1103.5	963.5	140	19	4	25	5	300	48	225	210
GHP6205G	450	400	500	430	415	268	1243	1103	140	19	4	25	5	340	48	228	300

Type	Q	QR	S	T	U	W	Bearing DS	Bearing BS	Wt (kg)	GD² (kgm²)	Fan motor Capacity	Fan motor Power Voltage	Fan motor Pole	Dia gram	Frame
GHP6114G	80	1	32	8	4.5	10	6307ZZ	6206ZZ	75	0.092	20	1φ 200/220	2	A	112M-6
GHP6116G	80	1	32	8	4.5	10	6307ZZ	6206ZZ	91	0.12	20	1φ 200/220	2	A	112B-6
GHP6118G	80	1	32	8	4.5	10	6307ZZ	6206ZZ	92	0.13	40	1φ 200/220	2	A	112B-6
GHP6133G	110	0.5	42	8	4.5	12	6309ZZ	6009ZZ	105	0.2	80	1φ 200/220	2	B	132M-3
GHP6137G	110	0.5	42	8	4.5	12	6309ZZ	6009ZZ	120	0.2	80	1φ 200/220	2	C	132M-3
GHP6163G	110	1	55	10	5	15	6312ZZ	6212ZZ	165	0.55	80	1φ 200/220	2	B	160M-3
GHP6165G	110	1	55	10	5	15	6312ZZ	6212ZZ	180	0.61	80	1φ 200/220	2	C	160M-3
GHP6167G	110	1	55	10	5	15	6312ZZ	6212ZZ	210	0.7	100	1φ 200/220	2	C	160L-3
GHP6183G	110	1	55	10	5	15	6312ZZ	6215ZZ	280	1.4	100	1φ 200/220	2	C	180M-3
GHP6187G	140	1	65	12	6	18	6314ZZ	6215ZZ	310	1.6	100	1φ 200/220	2	C	180M-6
GHP6205G	140	1	65	12	6	18	6314ZZ	6215ZZ	420	2.2	80/120	3φ 200/220	2	D	200L-3

3. Fan, Brush, Brushholder Aplication

D.C. Motor for Machine tools	Brush / Fan } Aplication Table	GHP6 Type (close series)

GHP6 (as usual type)				GHP6 (New type)				Brush		Brush holder	
Type	Output (kW) 1150 rpm. 200V class	Output (kW) 1150 rpm. other class	Fan type	Type	Output (kW) 1150 rpm. 200V class	Output (kW) 1150 rpm. other class	Fan type	Qty.	Type	Qty.	Type
-	-	-	-	GHP6114	2.2	-	TOBISHI HS4556L (1ø)	4	R8-A	4	3R8
				GHP6116	3.7	-					
				GHP6118	5.5	-	TOBISHI #6550 (1ø)				
GHP6134	3.7	-	TOBISHI 175P5 (1ø)	GHP6133	3.7	-	TOBISHI 175P5 (1ø)	4	R12.5-A	4	3R12.5
GHP6138	5.5	-		GHP6137	5.5	-					
GHP6164	7.5	7.5		GHP6163	7.5	7.5					
GHP6166	11	11		GHP6165	11	11					
GHP6168	15	15	special Fan (PS 8") (3ø)	GHP6167	15	15	TOBISHI 200959 (1ø)	8	R12.5-A	4	3R12.5
GHP6184				GHP6183	18.5	18.5					
GHP6188				GHP6187	22	22				4	7R212.5
-	-	-	-	GHP6205	-	30	special Fan (P6.8") (3ø)	12	R12.5A	4	7R312.5
				GHP6205	30	-					

D.C. Motor for Machine Tool	Brush / Fan } Aplication Table	GGG3 Type (open build in Fan)

Type	Output (kW) 1150 rpm 200 V class	Output (kW) 1150 rpm other class	Fan Type (build-in Fan)	Brush Q'ty	Brush type	Brush holder Q'ty	Brush holder type
GGG3132	2.2	-	aPRK41/1.9-2 (ø205)	4	R12.5-A	4	7R12.5
GGG3134	3.7	-					
GGG3138	5.5	-					
GGG3164	7.5	-	aPRK61/1.9-2 (ø220)				
GGG3168	-	11					
	11	-					
GGG3184	15		aPRK81/1.9-2 (ø250)	8	R12.5-A	4	7R212.5
GGG3188	18.5	18.5					
GGG3222	22	-	aPRK131/1.9-4 (ø350)	8	T16-A	8	7T16
GGG3224	30	-					
GGG3226	37	-					
GGG3228	-	45					
	45			12		12	7T16

D.C. Motor for machine tool	Brush / Fan } Aplication Table	GGG3 Type (open axcial Fan)

Type	Output (kW) 1150 rpm		Fan Type (axcial Fan)	Brush		Brush holder	
	200 V class	other class		Q'ty	Type	Q'ty	Type
GGN3134	3.7	-	Special Fan	4	R12.5-A	4	7R12.5
GGN3138			(8" for PS)				
GGN3164	7.5	-	Outor Rotor VAS303 (8" for PS)				
GGN3168	-	11					
	11	-		8	R12.5-A	4	7R212.5
GGN3184	15	-	VAS355 (Outor Rotor)				
GGN3188	18.5	18.5					
GGN3204	-	22	VAS405 (Outor Rotor)				
	22	-		12	R12.5-A	4	7R312.5
GGN3208	30	30					

D.C. Motor for machine Tool	Brush / Fan } Aplication Table	GGF3 Type (open mount Fan)

	Output (kW) 1150 rpm		Fan Type (mount Fan) (3ø)	Brush		Brush holder	
	200 V class	other class		Q'ty	Type	Q'ty	Type
GGF3134	3.7	-	CS-A1-MK or VCM1202S	4	R12.5-A	4	7R12.5
GGF3138	5.5	-					
GGF3164	7.5	-	VCM1202S or special Fan (8" for PS)				
GGF3168	-	11					
GGF3184	15	-		8	R12.5-A	4	7R212.5
GGF3188	18.5	18.5	VCM1252S				
GGF3204	22	22		12	R12.5-A	4	7R312.5
GGF3208	30	30					
GGF3226	37	-		8	T16-A	8	7T16
GGF3228	-	45					
	45	-		12	T16-A	12	7T16

4. Instruction of motor (open and close)

4-1 General

To operate the motors efficiently, be sure to carefully read every page of these instruction.

4-2 Confirming the Product

When the motors are delivered to the site, check the following.

1) Check the motors for rated output, voltage, speed, rating, mounting method, and dimension.
2) Check the motors for any damage possibly incurred during shipment.
3) Should the motors be stored over a long period, isolate the commutator surface from the brushes with paper to protect the commutator against corrosion. (Fig. 1)

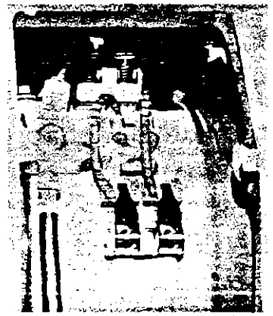


Fig. 1

4-3 Installation

A. Location

1) Exhaust air should never be recircled to the suction side.
2) Provide space of over 50 cm between the motor and wall surface.
3) When the space of over 50 cm cannot be provided, provide ventilation hole on the wall.
4) Don't provide a cover to disturb ventilated air.

B. Foundation

Preferably, the motor should be installed on a concrete foundation. Where a concrete foundation is not possible due to the driven machine and the environmental condition, the motor base should be mounted on a reinforcing bar with foundation bolts.
When installing the motor directly on a floor surface, the motor base should be slightly raised over the floor surface to facilitate water discharge.

C. Coupling with driven machine

1) Direct-coupling operation
When the motor is directly coupled with the driven machine, both shafts must be correctly centered as follows.
   a) Insert the liners below the motor base to adjust the shaft center height.
   b) Connect with a single bolt the both half couplings in order to run them together and provide checking mark on the coupling surfaces.
   c) Firmly set a dial guage feeler against one half coupling surface (see Fig. 2B).
   d) Bring the checking mark of the coupling to the top, and measure size "g" and "h" shown on Fig. 2 at four points evenly spaced around the circumference and record the results.
   e) Turn the couplings at an interval of 90° and measure as stated in Item d).
   f) Continue measurements until the checking mark appears again on the top.
   g) Conduct adjustments with liners so that the difference between the maximum and the minimum measurements can be held, with 0.03 mm for size "g" and "h".

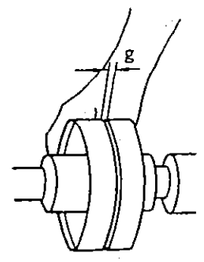


Fig. 2A

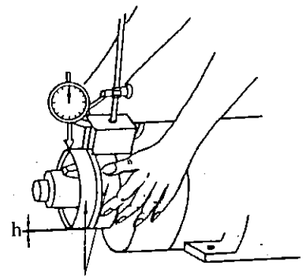


Fig. 2B

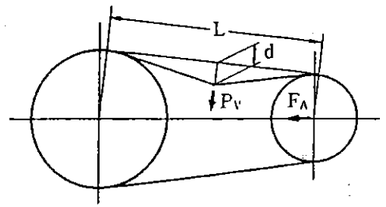


Fig. 3

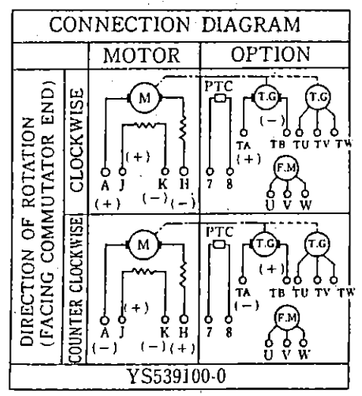
Velt Type	Recommended Belt Tension	
	Belt Center Depressing Force Pv (kg)	Deflection (d)
A	4	(0.039∿0.046)L
B	4	(0.028∿0.031)L
C	4	(0.016∿0.019)L
D	8	(0.019∿0.028)L
E	8	(0.015∿0.018)L

Table 1

4-4 Electrical Connection

A. Motor

Connect the supply cable conductors in accordance with the diagram shown in the terminal box. (Fig. 4)



B. Grounding

Since a ground terminal is provided within the terminal box, be sure to correctly install a ground cable to prevent a shock hazard.

C. Fan motor

Provide an appropriate sequence so that the fan motor is actuated prior to switch on the motor and is interrupted after switching off the motor.

D. Tachogenerator

A tachogenerator must be connected with a shield cable. The shield cable should never be installed within the same duct as a power cable which carries a heavy current. When the motor rotates counterclockwise viewed from the load side, positive voltage of the D.C. tachogenerator is applied to terminal TA, and negative voltage is applied to terminal TB, be sure to correctly connect.

4-5 Precaution to be Effected Prior to Operation

Prior to switch on the motor, be sure to check the following items.

1) Decouple the motor from the driven machine, turn the motor shaft by hand, and make sure that the rotating parts do not graze with the stator parts.

2) Check the connection between the motor and the power supply, polarity of the tachogenerator, and grounding condition.

3) Check the sequence circuit for normal operation

If all of the above-mentioned items are satisfactory, independenly operate the motor to check on vibration, noise, and rotating direction. Then couple the motor with the driven machine.

4-6 Inspection and Maintenance

To ensure long term, trouble-free motor operation, periodically inspect and maintain the motor.

Frequency	Inspection items	Check points
Monthly	1. Abnormal noise	Check the motor as to whether or not any abnormal noise is audible from the motor bearing.
	2. Commutator and brushes	a) Check whether or not sparks producted during commutation are larger than those of the precious inspection. b) Check the commutator surface for gloss color, threading, dirt, and/or abrasion. c) Check the brushes for excessive abrasion. (Check the lower-limit stopper provided with a brush as to whether or not it is liable to contact the brush holder. Fig. 5) If the stopper is liable to contact a brush holder, replace the brush. (In this case, record the intervals of replacing defective brushes for future reference.)

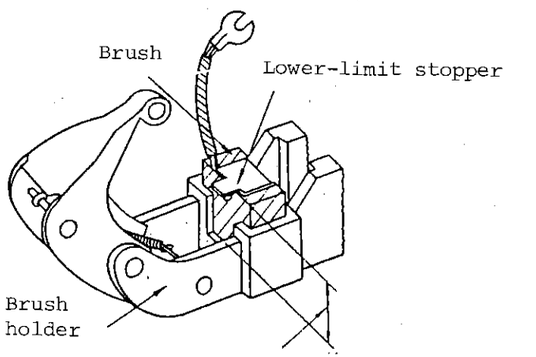


Fig. 5

Frequency	Inspection items	Check points
Monthly	2. Commutator and brushes	d) Check brushes as to whether or not they are smoothly actuated within brush holders. e) For further detailed inspection, refer to item VII (Maintenance Procedures for brushes and commutator.)
	3. Cleaning	Since deposited dirt may deteriorate the cooling effect, spray dry compressed air into the motor interior --- specifically the commutator and filter --- to remove deposited dirt, or clean the motor interior with a vacuum cleaner.
	4. Cooling fan	Check the cooling fan for smooth operation.
Yearly		Inspect all items of the monthly inspection. Check all screws and bolts for secure tightening.

List of Various Accidents for D.C. Motor (1)

Causes \ Accidents	Motor doen not work.	Motor speed uncontrollable.	When loaded speed remarkably reduced.	Current & Operating speed fluctuate, especially when field current is weaked.	Motor is overheated.	Bearing is overheated.	Bearing chatters.	Bearing makes rubbing noise.
Over load.	o	o	o	o	o	o		
Controller trouble.	o	o	o	o				
Misconnection with controller.	o	o						
Line cable or armature circuit is broken.	o							
Brushes are not provided. Brush abrasion has reached limit.	o							
Shunt field is too weak. Broken or wrong connection of shunt field.	o							
Short-circuit of layer in armature coil or shunt field.	o	o	o	o				
Broken of tacho generator.		o		o				
Too low terminal voltage.			o					
Brush locker largely shifts from neutral point.			o	o				
Abnormal cooling fan motor. Clogged air circuit within motor interior. Temperature of cooling air is too high.					o	o		
Clearance of bearing is too small.						o		o
Clearance of bearing is too large.							o	
Defect on bearing rotating surface.							o	
Improper assembling.							o	o
Improper installation of motor. Belt tension is too high.					o			
Foreign matter is in bearing.							o	

4-7 Maintenance Procedures for Brushes and Commutator

Unlike other electrical machines, appropriate maintenance is specifically required for brushes and commutator incorporated in DC motors to attain long-term, trouble-free operation. Improper handling may cause wrong commutation, abnormal brush abrasion, threadings on the commutator, thus occuring heavy accidents such as flashover, eventually results in stoppage of the machine for a long period for repair.

A. Maintenance procedures for brushes

1) Brush materials

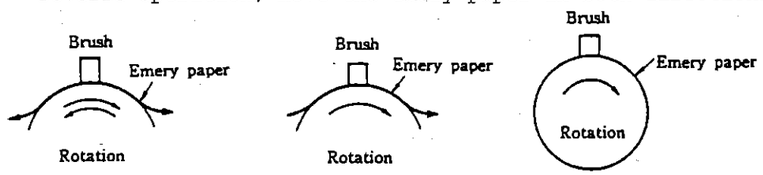
The brush materials have largely effect on the commutation and the condition of commutator surface.

To prevent serious trouble, be sure to use the specified brushes. Commutation and brush abrasion depend slightly upon the operating condition and the environmental condition. When the motor cause wrong commutation by such condition, contact Fuji Electric Co., Ltd. to select suitable brush material. When the brushes are used at mixed materials, the use of the current of brushes may cause unbalance resulting in burnt brushes or pigtails, wrong commutation, and rough commutator surfaces. To prevent such trouble, be sure to use proper brushes.

2) Brush replacing procedures

If brush abrasion reaches the limit, replace the brushes with spares. Since the sliding surface of new brushes is flat, new brushes should be bedded to fit the curved commutator surface. In this case, use a rough emery paper (#120) cut to the same width as that of the commutator. Then, insert the emery paper between the commutator and brush. Subsequently, shift the emery paper along the commutator surface. (See Fig. 6) To sinish the grinding surface, apply fine emery paper (#300 or #400) to the brush surface.

In this case, if the motor is designed for only forward operation, move the emery paper in single direction. (For motor accepting reverse operation, move the emery paper in both directions.)



(A) Both direction (B) Single direction (C) Small D.C. motor

Fig. 6

When replacing all brushes used for small capacity DC motor, it is recommended wrapping emery paper around the entire commutator surface. (See Fig. 6-C)

3) Operation for bedding

After completing the ginding procedures by using emery paper, fully clean the interiors of the motor and the brush holders to remove brush particles and emery dust. Then effect operation for bedding. In this case, effect the on-load operation for 1 to 2 hours, then slightly increase the load while operating the motor. After confirming that over 80% of the entire brush surface contacts the commutator, increase the load to full load.

B. Commutator maintenance procedures

1) Maintenance for commutator surface

The commutator surface appears as a smooth, lustrous, chocolate color under normal condition, covered by lubricating film termed "oxidizing film."

The color of this film turns from copper to chocolate color according to the period of time elapsed. However, the color slightly varies depending upon the brush materials, temperatures, and various other environmental conditions. This film shall never be removed. Also, always keep the commutator surface clean and smooth without subjecting it to oil or chemical vapors. Should the commutator surface appear as lusterless black or partially black bars to sparks produced during commutation, wipe the surface with a dry cloth.

2) Grinding with emery paper or stone

When slight damage, black bars, or sports caused by sparks are observed on the commutator surface, correct with emery paper or grinding stone.

Repairable damage is as follows:

Emery paper: Damage up to approximately 0.3 mm deep.

When repairing a defective commutator surface, use a separate driving machine at approximately the DC motor rated speed. In this case, be sure to lift all brushes. When no appropriate driving machine is available, please grind it rotating after self-started and switch off the source. After applying emery paper or grinding stone, fully remove the copper powder and emery dust deposited on the commutator surface, under-cut portion, brush holders, and brushes.

3) Cutting

When eccentricity, high bars, low bars, and damage due to arcing are observed on commutator surface, repair the commutator surface with a cutting tool. The cutting tool used and their suitable speed, feeding and cutting depth are shown in Table 3. In case vibration is extremely large when touching the brush through insulating material during rotation, at first a dial guage feeler is attached on the commutator surface to inspect eccentricity, high bar or low bar of the commutator, rotating the rotor slowly. Deflection is in general, limited below 0.03 mm in FUJI Electric.

Kinds of cutting tools	Peripheral speed of commutator [m/mm]	Feeding [mm/revolution]	Cutting depth [mm]
Superhardness alloy tool	60 ∿ 200	0.1 ∿ 0.15	0.05 ∿ 0.20
Diamond tool	300 ∿ 2000	0.05 ∿ 0.15	0.05 ∿ 0.15

Table 3

4) Undercutting and chamfering

When depths of the slots on the commutator surface are excessively reduced due to abrasion or machining, undercut the segment micas of the commutator. Also, when chamfers have been used up, chamfer the segements. For undercutting, use a tool utilizing a metal saw as shown in the front in the Fig. 7-A. In this instance, initially the segement slots are to be cut without giving a force so much and after the slots have attained to a certain depth, they shall be normally cut, then under-cutting shall be performed comparatively easy without injuring the commutator surface. According it is recommended that under-cutting is made before the slots have become extremely shallow due to wearing of the commutator. As a tool for chamfering, a tool which has both blades as shown in the behind in Fig. 7-A, is used, and the commutator segements arechamfered as shown in Fig. 7-B. For recommended undercutting depths and chamfering dimensions, refer to Fig. 7-C.

Fig. 7-A

Fig. 7-B

Fig. 7-C

Table 3 List of Various Accidents for D.C. Motor (2)

Accidents of brush and commutator / Causes	Excessive brush abrasion.	Commutator and brushes are overheated.	Commutator surface is scratched.	Brush chattering (Causes big noise, broken edge or broken connecting lead).	Inurious commutator spark (Surface of commutator becomes black or is damaged).
Over load	▨	▨			▨
Defect of armature or interpole winding.	▨				▨
Wrong position of brush rocker.					▨
Heavy vibration of machine.					▨
Improper sliding of brush. On a commutator sliding surface oil is attached or copper is exposed. Brush sticks.	▨	▨	▨	▨	▨
Unsuitable quality of brush. Mixture of different kinds of brushes.	▨	▨	▨	▨	▨
Wear of brush holder. Brush pressure spring is unsteady. Distance to commutator surface is too large. (1.5~2 mm max.)	▨		▨	▨	▨
Axial position of brush holder is wrong.			▨	▨	▨
Commutator surface is unever, not round. Mica is high. The angle of commutator segment is sharpened.	▨	▨	▨	▨	▨
Brush rocker is not fastened. Brush is hold too loose.					▨
Humidity, dirt, oil, vapor, active gas or steam.	▨	▨	▨	▨	▨
Dirt between commutator space.	▨	▨	▨	▨	▨
Long-time no load operation. Dry atomosphere or air containing oxidized iron.			▨	▨	▨
Long-time light load operation.			▨	▨	▨
Brush chattering.	▨	▨	▨	▨	▨

5. Maintenances and inspectors of a D.C.tacho-generator

A tachogenerator is a most important equipment in order to control the revolution of a D.C. motor. Therefore, please carry out the following periodical maintenances and inspections.

5-1 Instructions Every One Month

1) Make sure whether the screws of the speed feedback circuit are loosen and lead wires including those of the tachogenerator are braken or not. (Then, carry out after confirmation of shutting off power supply)
2) Make sure of keeping properly the relation between output voltage of the tachogenerator and the revolution of the motor. (or between command speed and actual one)
3) In the case, it arises the discord between command speed and actual one, firstly inspect the 1) and 2) of item 1 again. But, it has not yet been improved, so, carry out the following item 2 immediately.

5-2 Inspections and Cleanings Every Six Months

This component has the structure which allows cleaning with compressed air (for factory use) without disassembling.

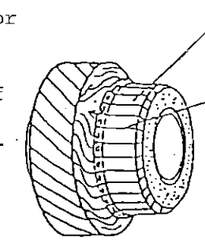
Take off the cover of the tachogenerator on the rear of the motor and clean the tachogenerator every six months. And comfirm below.

1) Is the brush in the brush holder moved smoothly or not?
2) Does the sliding surface area of each brush increase and reach more than 80% of each perfection.
3) Does the brush abrasion reach its limit? When not reaching, change the brush. Record the lengths of brushes at the periodical inspection and determine the intervals of replacing defective brushes for future reference.

5-3 Phenomena, cause by tachogenerator defects

A defect in the tachogenerator will be revealed in the bad operation of the motor. It is cause by poor condition of the brush-contacting section of the tachogenerator. The followings are conceivable as detailed causes. If the following troubles should occur, then inspect and clean the tachogenerator.

1 Electrical shortening between the commutator segments due to worn fragments or poweder from the brush.
2 Movement of the brush in the guide holde of the brush holder has stiffened because of fragments or powder from the brush, resulting in poor contact between the brush and the commutator (the brush is not moved smoothly in the brush holder)
3 A film layer of carbon adheres to the commutator surface thickly, causing electrical contact resistance and ripple to inclease.



4 Cutting oil or other fluid adheres to the commutator surfaces, casuing electrical contact resistance and ripple to inclease also. Those defects from above are eleminated by cleaning the tachogenerator. In the same case mentioned in the head of (4) and if a large amount of oil enters, then it would be able to remove the oil completely. Therefore, the tachogenerator should be replaced by new one.
5 If the commutator surface is rough or rough threadings are appeared on it, the tachogenerator should be done as is mentioned above.

5-4 Changing Brushes

1) Change the short brushes for new spare ones, when raching the limit of their length. (see the table below)

Tachogenerator type	Limit of length
TG - 20	Under 6.5 mm
TG - 21	
TGD - 02C	Under 7 mm
KGD - 03B	

Use the brushes recognized by us without fail, because the qualities of a brush affect commutating and the commutation surface.
2) The sliding surface of a new brush is similar to the one of the commutator in its curvature. But the fitness between both surfaces is not always good, when assembled.
Therefore, carry out running for fitness.
After confirming that the sliding surface are of each brush increases and reaches more than 80% of each perfection, begin to rotate the motor on full road.
3) At 100 rpm speed of the motor shaft, forward and reverse runnings for fitness should be done more than 3 times by turns. Each running should be continued for about 10 seconds.

(Defects of Command speed)

In case of N.C output (S-command) and D/A converter defects, it may be afaid of causing the discords between the command speed and actual one. Therefore, inspect them, also.

6. Motor application in cases where acceleration and decceleration modes are frequency

Recently, there is a tendency that working cycle is short time, Because robots are introduced for manufucturing. Then, owing to infulence of business mark, working goods are changing from small size goods to big ones. Motor might be runned on seveier temparature condition for amature, because of accelerating and decceleratıng motor current.

As result of heating motor amature, insullation will be bad, and will be dieelectric breakdown or make to short on life time, Therefore, take care the following point for operating motor.

6-1. Limit

Example

- o Accelerating & decceleratıng time : tl (sec) = 30 sec.
- o Cutting time : t2 (sec) = 60 sec.
- o Stopping time : t3 (sec) = 1 sec.
- o Accelerating, Deccelerating Current : Is = 63A (150%)
- o Cutting current : I_L = 21A (50%)
- o Motor rated current : Ia = 42A
- o Load Current Effective Value : Irms

$$I\,rms = \sqrt{\frac{I S^2 \times t1 + I L^2 \times t2}{t1 + t2 + t3}} = 40A$$

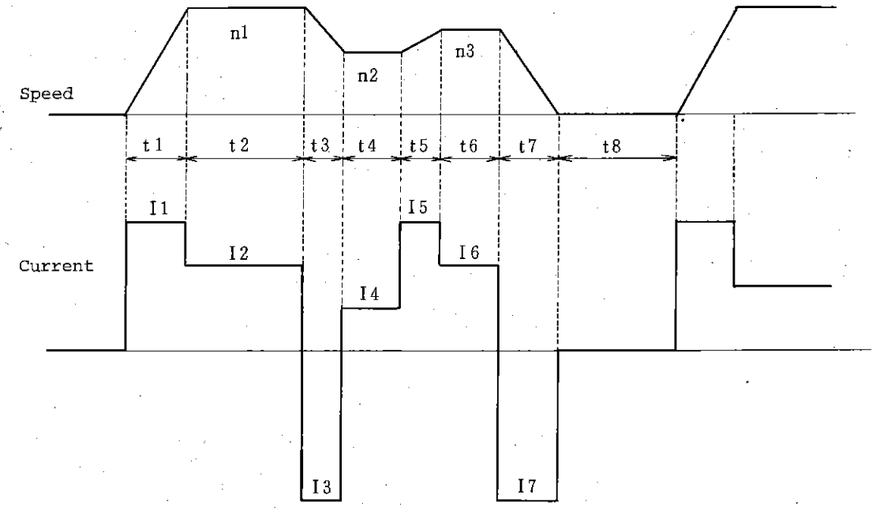
$$(I\,rms / Ia) \times 100 = \frac{40}{42} \times 100 = 95\% > 80\%$$

In this case, The program must be changed because margine for heating is too little so as to be less than 80%.
(tl should be shorter, t3 should be longer, ex. tl : 18 sec, t3 : 7 sec. → 80%)

It depend on parameter of tl, t2 and IL. Then need to calculate it each time.

Pay attention to do it for protecting motor.

Following is general graphic



I1, I5: accelerative current
I2, I4, I6: Load current
IR: rated current

I3, I7: deccelerative current
Irms: Load Current Effective Value

$$I\,rms = \sqrt{\frac{I1^2 \cdot t1 + I2^2 \cdot t2 + I3^2 \cdot t3 + I4^2 \cdot t4 + I5^2 \cdot t5 + I6^2 \cdot t6 + I7^2 \cdot t7}{t1 + t2 + t3 + t4 + t5 + t6 + t7 + t8}} \leqq 0.8\,IR$$

Therefore, load current effective value should be less than 80% of rated current.

6-2. Maintenance

Forced cooling fan is mounted on in order to cool motor. There are filter in air entrance. The filter protect from invading.

7. Disassembling and reassembling

7-1 Open Type Motor

A. Disassembling

1. When disassembling the motor, be sure to check the following.
   a) Disassemble the motor in a location free from dirt, moisture, rain drops, oil, and chips.
   b) Safely keep small parts such as bolts, nuts, and washers in an appropriate box.

2. Disassembling procedures
   a) Disconnect all lead wires from the motor
   b-1) Remove the fan cover from the motor. (GGN Type: with axial fan)
   b-2) Remove the ventilation cover on the driven side. (GGG Type: with built-in fan) (Fig. 8-2)
   b-3) Remove the mount fan from the motor. (GGF Type: with mount fan) (Fig. 8-3)

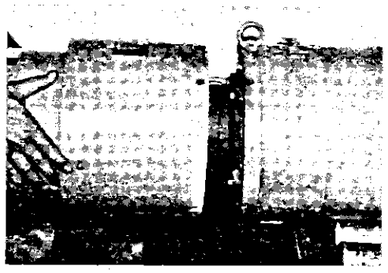


Fig. 8-1

Fig. 8-2

Fig. 8-3

   c) Remove the commutator inspection cover from the motor. (Fig. 8-4)
   d) Pull out brushes from the brush holders and remove the main circuit cables from the brush spindles. (Fig. 8-5)
   e) Wrap thick paper around the commutator surface to protect the commutator surface to protect the commutator against damage. (Fig. 8-6).

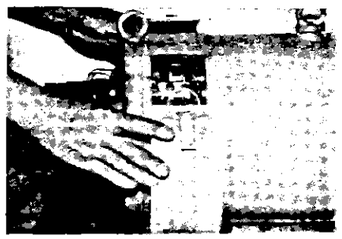


Fig. 8-4

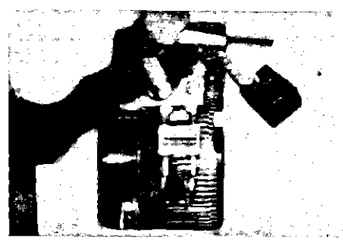


Fig. 8-5

Fig. 8-6

   f) Disassembling the tacho generator.

      i) DC tacho generator
      - Remove the inspection cover from the tacho generator and withdraw the brushes from the brush holders.
      - Wrap thick paper around the commutator surface of the tacho generator.
      - Remove the bolts securing the stator of the tacho generator and the motor shield, and remove the stator of the tacho generator. (Since a permanent magnet utilized at the stator tends to attract the rotor, be sure to carefully handle the stator to protect the winding and commutator against damage.)
      - Losen the setscrew and withdraw the rotor while tightening the jack bolt (M12 x 100) by using the tapped hold on the inner surface of the rotor boss (Fig. 8-7).

      ii) AC tacho generator
      - Remove the bolts securing the stator of the tacho generator and the motor shield, and remove the stator while protecting the winding against damage. (Since a permanent magnet utilized at the rotor tends to attract the stator, be sure to carefully handle the stator to protect the winding against damage.)
      - Loosen the setscrew and withdraw the rotor while applying a puller to the boss. (Never apply the puller to the permanent magnet.) (Fig. 8-8)

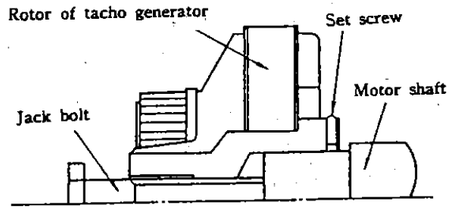


Fig. 8-7

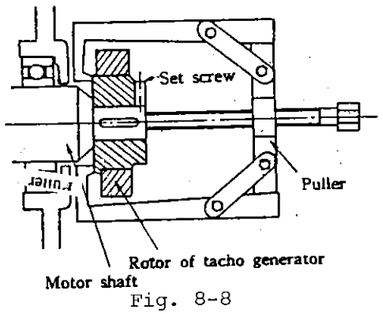


Fig. 8-8

   g) Remove the bolts securing the shield on the driven side.
   h) Insert a screwdriver into the gap between the shield on the driven side and the frame to remove the faucet, and then withdraw the shield from the frame. (Fig. 8-9)
   i) Apply a wooden plank to the shaft end on the commutator side and top the wooden plank with a wooden hammer to remove the rotor from the commutator shield. Subsequently withdraw the rotor from the frame. (Fig. 8-10)
   j) Remove the shield provided on the commutator side in the same manner as that provided on the driver side.
   k) The bearings will be taken away from the shaft by means of a special tool (Puller). (Fig. 8-11)
   l) Completely disassembled.

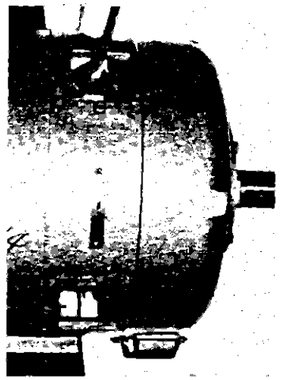


Fig. 8-9

Fig. 8-10

Fig. 8-11

8—12

B. Reassembling

1. When reassembling the motor, be sure to check the following.
   a) Arrange all component parts in the order of reassembling procedures.
   b) Correctly align the checking marks provided on the parts to be reassembled.

2. Reassembling procedures
   Effect reassembling procedures in reverse order to that of disassembling procedures.
   a) Insert the built-in-fan into the main rotor. (GGG type: with built-in-fan).
   b) Insert the bearings into the shaft.
   c) Reassemble the shield provided on the commutator side with the frame. (While aligning the checking mark.)
   d) Reassemble the air guide with the frame of the built-in-fan side in the correct direction as shown in Fig. 8-12. (GGG type: with built-in-fan).
   e) Insert the rotor into the frame.
   f) Reassemble the shield on the driven side with the frame.
   g) Reassembling the tacho generator.
      - o Insert the rotor of the tacho generator into the main motor shaft and secure the rotor with setscrew.
      - o Wrap thick paper around the commutator surface. (DC tacho geneator).
      - o Insert the stator of the tacho generator and bolt it securely to the motor shield. (Since the permanent magnet is liable to attract the core, be sure to carefully handle the stator to protect the winding and commutator against damage.)
      - o Remove the thick paper from the commutator and reassemble the brushes with the brush holder. (DC tacho generator).
      - o Reassemble the brush inspection cover. (DC tacho generator).

   h) Remove the thick paper from the commutator.
   i) Reassemble the main circuit cables with the brush spindles.
   j) Reassemble the brushes with the brush holders while keep the lower limit stopper of the brush in same direction as shown in Fig. 5.

7-2 Closed Type Motor

A. Disassembling

1. When diassembling the motor, be sure to check the following.
   a) Disassemble the motor in a location free from dirt, moisture, rain drops, oil, and chips.
   b) Safely keep small parts such as bolts, nuts, and washers in an appropriate box.

2. Disassembling procedures
   a) Disconnect all lead wires from the motor.
   b) Remove the covers of the commutator inspection part from the motor (Fig. 8-1).
   c) Remove the commutator inspection plates from the motor. (Fig. 8-2)
   d) Pull out brushes from the brush holders and remove the main circuit-cables from the brush holders. (Fig. 8-3)
   e) Wrap thick paper around the commutator surface to protect the commutator against damage. (Fig. 8-4)

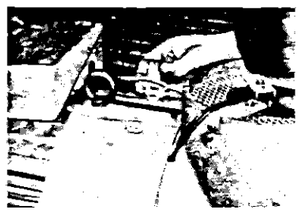


Fig. 8-1

Fig. 8-2

Fig. 8-3

Fig. 8-4

f) Pull out the cables of the cooling fan from the main terminal box. (Fig. 8-4)

g) Disassembling the tacho generator.

i) Remove the inspection cover from the tacho generator and withdraw the brushes from the brush holders.

ii) Wrap thick paper around the commutator surface of the tacho generator.

iii) Remove the bolts securing the stator of the tacho generator and the motor shield, and remove the stator of the tacho generator. (Since a permanent magnet utilized at the stator tends to attract the rotor, be sure to carefully handle the stator to protect the winding and commutator against damage.)

iv) Loose the setscrew of the rotor of the tacho generator and withdraw the rotor.

cf) In the case of type-DCM (GHP 6134 and 6164), after finishing item h) the TG of a DCM shall be taken off.

h) Remove the fan cover from the motor. [Motor type I (GHP6138, 6166, 6168, 6184, 6188)]. (Fig. 8-6)

i) Loosen the setscrew of the cooling fin and take away the cooling fin from the shaft by means of a poller. (Fig. 8-6), (Fig. 8-7)

Fig. 8-5

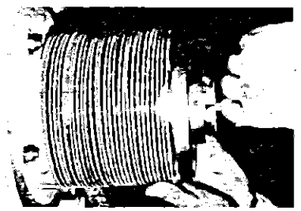


Fig. 8-6

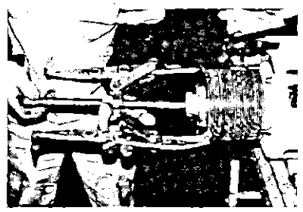


Fig. 8-7

j) Remove the bolts securing the shield on the driven side.

k) Insert a screwdriver into the gap between the shield on the driven side and the frame to remove the faucet, and then withdraw the shield from the frame. (Fig. 8-8)

l) Apply a wooden plank to the shaft end on the commutator side and top the wooden plank with a wooden hammer to remove the armature from the commutator shield. Subsequently withdraw the rotor from the frame. (Fig. 8-9)

m) Remove the shield provided on the commutator side in the same manner as that provided on the driving side.

n) The bearings will be taken away from the shaft by means of a puller. (Fig. 8-10)

o) Completely disassembled.

Fig. 8-8

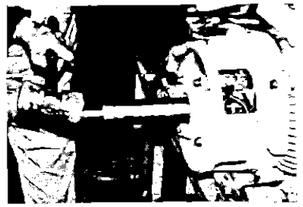


Fig. 8-9

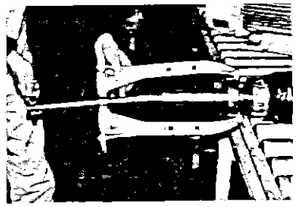


Fig. 8-10

B. Reassembling

1. When reassembling the motor, be sure to check the following.

a) Arrange all component parts in the order of reassembling procedures.

b) Correctly align the checking marks provided on the parts to be reassembled.

2. Reassembling procedures

Effect reassembling procedures in reverse order to that of disassembling procedures.

a) Insert the dust guarded plates and the bearing into the shaft.

b) Reassemble the commutator side shield with frame. (Fig. 8-11)

c) Wrap the thick paper around the commutator surface.

d) Insert the armature into the frame from the driving side.

e) Reassemble the driving side shield with the frame.

f) Insert the cooling fin with the shaft of the commutator side. [Motor type I (GHP6138, 6166, 6168, 6184, 6188)]

g) Reassemble the fan cover with the motor.

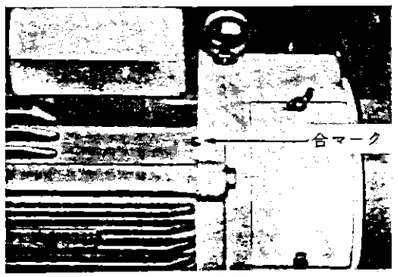


Fig. 8-11

h) Reassembling the tacho generator.

i) Insert the rotor of the tacho generator into the main motor shaft and secure the rotor with setscrew.

ii) Wrap thick paper around the commutator surface.

iii) Insert the stator of the tacho generator and bolt it securely to the motor shield. (Since the permanent magnet is liable to attract the core, be sure to carefully, handle the stator to protect the winding and the commutator against damage.)

iv) Remove the thick paper from the commutator and reassemble the brushes with the brush holders.

v) Reassemble the commutator inspection cover.

vi) Connect the cables with the tacho generator terminales from the terminal box of the main motor and set the terminal cover of the tacho generator.
[Motor type II (GHP6134, 6164)]

i) Insert the cables of the cooling fan with the main terminal box and connect.

j) Remove the thick paper from the commutator.

k) Reassemble the main circuit cables with the brush holders.

l) Reassemble the brushes with the brush holders while keep the lower limit stopper of the brush in same direction as shwon in Fig. 5.

m) Reassemble the commutator inspection plates and covers.

n) For installation, wiring, and operating procedures, refer to item III, IV, and V.

o) Completely reassembled.