CONFIDENTIAL

HITACHI INVERTER

HFC-VWS3 E(H) SERIES

SERVICE MANUAL

HITACHI

REV. 2

C O N T E N T S

1 INVESTIGATION

When trouble happens!

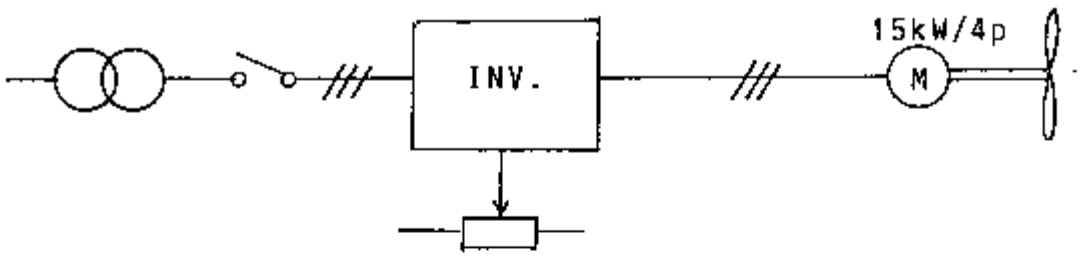
- Investigate the customer's application and phenomenon and fill in them on the trouble report sheet.
- Fill in the setting data of customer on the data setting list.
- Investigate the customer's setting data whether they are proper for the application system.
- Check the inverter
  Which parts have been damaged:See page

* The reason for the trouble is not always inverter's failure. We must check the system and inverter both of them.

WARRANTY REPORT
TROUBLE REPORT

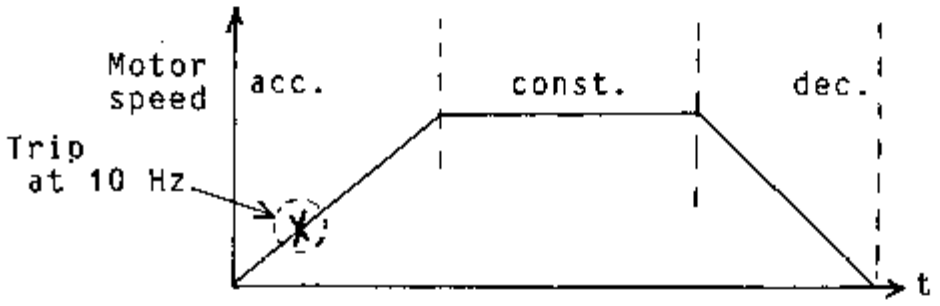
Customer	
Model Type	HFC-VWS 22 HF3E
Serial No.(MFG.No.)	SE 22 HF 3 82C
Date of Purchase	JAN.88
Date of Installation	APR.88
Date of Failure	MAY.88

APLICATION Fan drive



DETAILS OF FAILURE

When the reference signal (0~10V) is feeded to the inverter, over current trip comes.



BROKEN COMPONENTS

Power module

REMARKS

WARRANTY REPORT

TROUBLE REPORT

Customer	
Model Type	
Serial No.(MFG.No.)	
Date of Purchase	
Date of Installation	
Date of Failure	

APLICATION
DETAILS OF FAILURE
BROKEN COMPONENTS
REMARKS

HFC-VWS$_3$ Series DATA SETTING LIST

HFC-VWS inverter has many functions so that the setting data can be changed by customers.
It is recommended to fill the setting data out the following data sheet for service, maintenance and investigation of trouble.

TYPE : HFC-VWS [ ]
MFG. No. : [ ]

Described on spec. label on top cover

• Monitor Mode

Display Sequence	Monitor Name	Initial Display	Standard Setting	Setting Data
1	Output frequency display	FM 000.0Hz	—	
2	Frequency setting command	FS 000.0Hz	—	
3	Frequency command method	F-SET-M Terminal	Terminal	
4	Operation command method	F/R-SW Terminal	Terminal	
5	Motor speed display	RPM 4P 0000RPM	4	
6	Output current display	If----A 1m000.0%	—	
7	Manual torque boost adjustment	V-Boost Code(31)	31	
8	Output voltage gain adjustment	V-Gain 100%	100	
9	Jogging frequency setting	Jogging 00.5Hz	0.5	
10	Fault display		—	—

• Function Mode

Display Sequence	Function Name	Function Mode	Display Contents	Standard Setting	Setting Data
1	V/F pattern setting	F-00	VF1-VC	VF1-VC 050-050	
2	Acceleration time setting	F-01	ACCEL-1	20	
3	Deceleration time setting	F-02	DECEL-1	20	
4	Maximum frequency fine adjustment	F-03	*Fmax.	0	
5	Starting frequency adjustment	F-04	*Fmin.	0.5	
6	Maximum frequency limiter setting	F-05	H-LIM-F	0	
7	Minimum frequency limiter setting	F-06	L-LIM-F	0	
8	Jump frequency 1 setting	F-07	JUMP-F1	0	
9	Jump frequency 2 setting	F-08	JUMP-F2	0	
10	Jump frequency 3 setting	F-09	JUMP-F3	0	
11	Motor noise adjustment	F-10	CF-code	0	
12	Adjustment of frequency stop time at start	F-11	Fstop-T	1.0	
13	Multistage speed 1 setting	F-12	Speed-1	0	
14	Multistage speed 2 setting	F-13	Speed-2	0	
15	Multistage speed 3 setting	F-14	Speed-3	0	
16	DC braking frequency adjustment	F-20	F-DCB	1	
17	DC braking power adjustment	F-21	V-DCB	10	
18	DC braking time adjustment	F-22	T-DCB	5	
19	Electric thermal level adjustment	F-23	E-thermal	100	
20	Linear/S-character curved acceleration selection	F-24	ACCline	Linear	
21	Linear/S-character curved deceleration selection	F-25	DECline	Linear	
22	Start point frequency of external frequency setting	F-26	F-START	0	
23	End point frequency of external frequency setting	F-27	F-END	0	
24	Switch selection	F-28	SWITCH1	00000101	
25	Overload limit time constant setting	F-30	LM.CONS	1.0	
26	Automatic torque boost adjustment	F-32	V-auto	00	
27	Stand-by time setting for restart after instantaneous power failure	F-36	IPE-R-T	1	

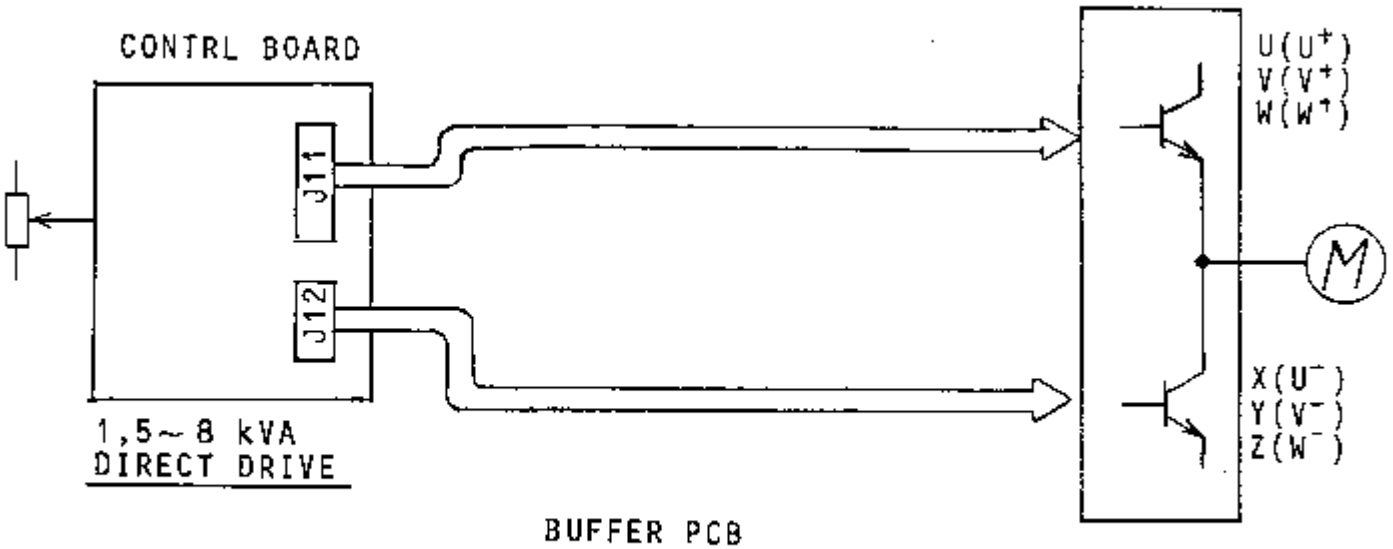
2 KIND OF PRINTED CIRCUIT BOARD

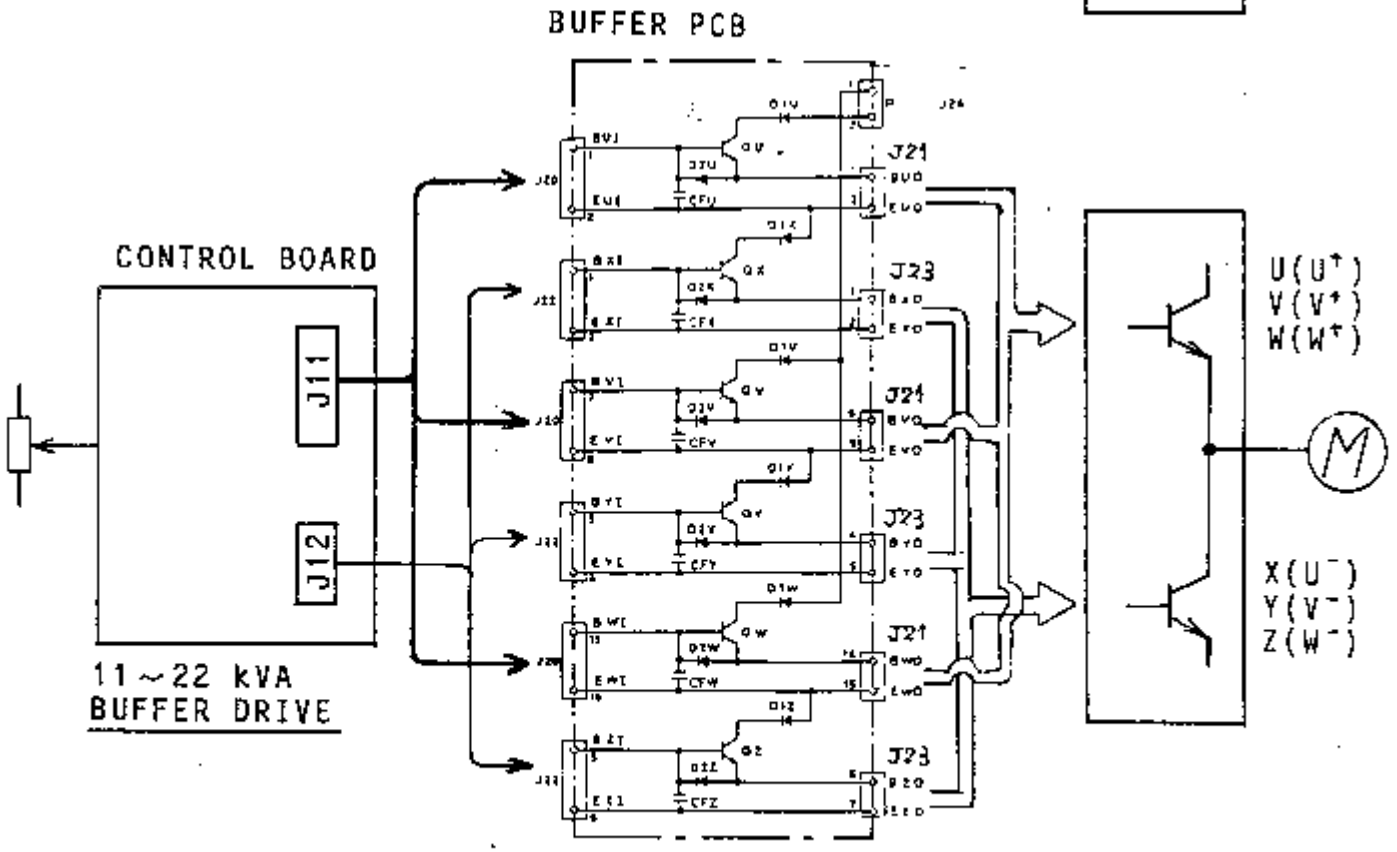
PCB name for VWS3, VWS3E and VWS3EH

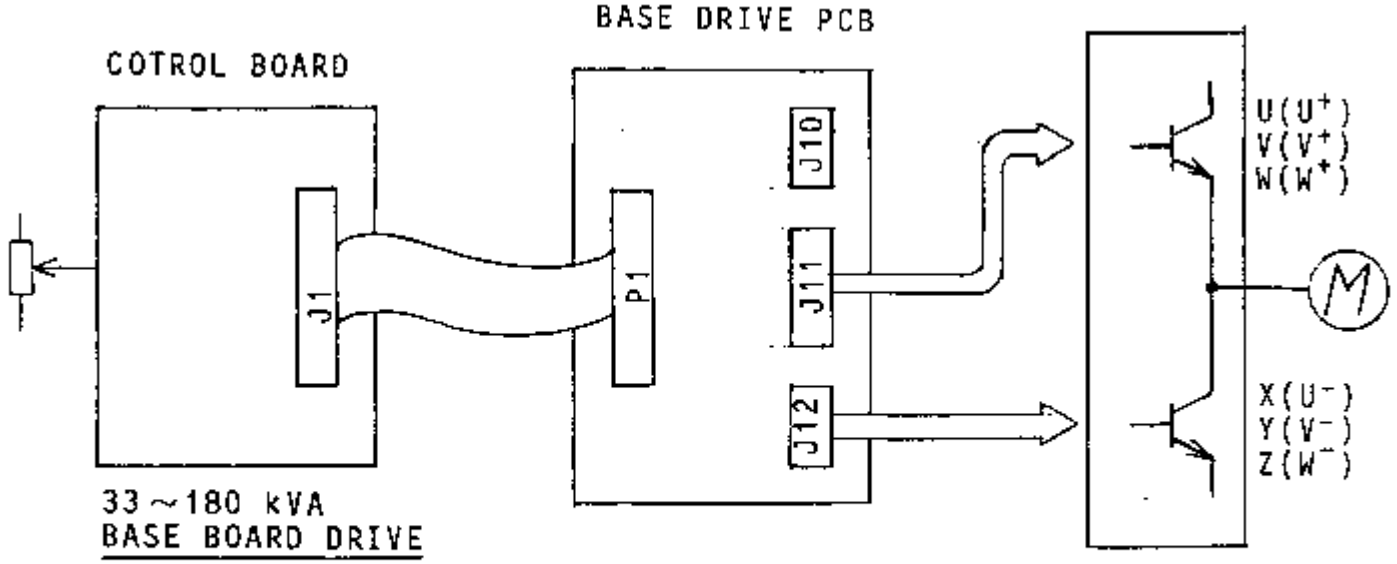
Series	VWS3		VWS3E		VWS3EH	
Use	Control	Base drive /Buffer	Control	Base drive /Buffer	Control	Base drive /Buffer
1.5S			S3EL1SO		GE1L1SO	
2.5S			S3EL2-3SO		GE1L2-3SO	
3.5S			↓		↓	
1L	S3L1-1.5LO					
1.5L	↓					
2.5L	S3L2LO					
3.5L	S3L3-5LO					
5.5L	↓					
8L	S3L8-11LO	S3B8-22LO				
11L	↓	↓				
16L	S3L16LO					
22L	S3L22LO	↓				
33L	S3L33LO	S3B33LO				
40L	S3L40LO	S3B40LO				
50L	S3L50-75LO	S3B50LO				
60L	↓	S3B60LO				
75L	↓	S3B75LO				
2.5H			S3EL2-3HO		GE1L2-3HO	
3.5H			↓		↓	
5.5H	S3L5HO		S3EL5HO		GE1L5HO	
8H	S3L8HO		S3EL8HO		GE1L8HO	
11H	S3L11-16HO	S3B11-22HO	S3EL11-16HO	S3B11-22HO	GE1L11-16HO	S3B11-22HO
16H	↓	↓	↓	↓	↓	↓
22H	S3L22HO	↓	S3EL22HO	↓	GE1L22HO	↓
33H	S3L33-40HO	S3B33HO	GE1L33-40HO	GE1B33HO	GE1L33-40HO	GE1B33HO
40H	↓	S3B40-50HO	↓	GE1B40-50HO	↓	GE1B40-50HO
50H	S3L50-75HO	↓	GE1L50-75HO	↓	GE1L50-75HO	↓
60H	↓	S3B60-75HO	↓	GE1B60-75HO	↓	GE1B60-75HO
75H	↓	↓	↓	↓	↓	↓
100H						
120H						
150H						
180H						
Inv. model	Japanese version		European vesion without GFP		European version with GFP	

Ex) S3 E L 2-3 S 0

- Revision No.
- S: Single phase 220V 1Ø
- L: Three phase 220V 3Ø
- H: Three phase 380V 3Ø
- Suitable inverter capacity (kVA)
- L: Control PCB
- B: Base drive/Buffer PCB
- European version
- S3:
- G: With G.F.P.







METHOD OF TRANSISTOR DRIVE

3 USE AND LEVEL OF CHECKPINS

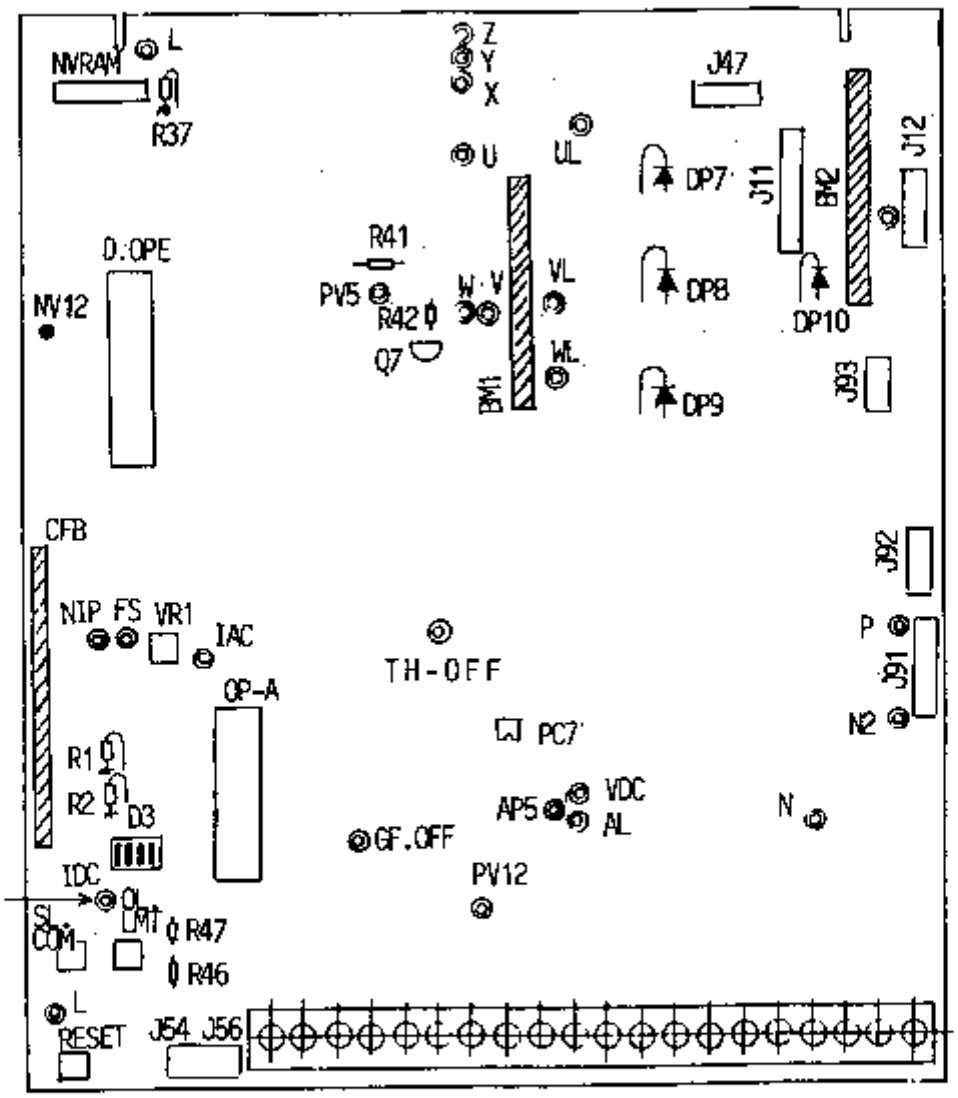
Check pin	Use and level	Address(Location)		
		~22kVA	33~75kVA	100kVA~
PV5	Power source for dig.circuit PV5-L:4.9~5.1 VDC	3C	3E(L) 7G(B)	5E(L)
PV12	Power source for analogue circuit PV12-L:11.76~12.24 VDC	9E	5B(L) 7G(B)	9D(L) 5G(B)
NV12	Power source for analogue circuit NV12-L:-11.76~12.24 VDC	3A	5B(L) 7G(B)	7E(L) 6G(B)
L	Ground for analogue circuit	1A,10A	8A,2E(L) 7G(B)	9E,1E(L) 5G(B)
AP5	Power source for protection circuit AP5-AL:4.9~5.1 VDC	8E	5F(B)	6H(L)
AL	Ground for AP5	8E	—	6H(L)
VDC	Over voltage VDC-AL :3.25 V (Trip level)	8E	6F(B)	6H(L)
P	DC voltage of the intermidiate circuit P-N:approx. 300VDC max. 400VDC	6H	6F(B)	6J(L)
N2	DC current of main circuit N2-N:1.3VDC (Trip level)	7H	—	—
N	Ground for P and N2	8H	6F(B)	7J(L) 5F(B)
UL	Ground for base circuit of U+ DP 7(K)-UL: 6.5~9.5V *1) (1.5~75 kVA) DP31(A)-UL:-6.5~9.5V (33 ~75 kVA)	2F	1F(B)	—
VL	Ground for base circuit of V+ DP 8(K)-VL: 6.5~9.5V *1) (1.5~75 kVA) DP34(A)-VL:-6.5~9.5V (33 ~75 kVA)	3E	2E(B)	—
WL	Ground for base circuit of W+ DP 9(K)-WL: 6.5~9.5V *1) (1.5~75 kVA) DP37(A)-WL:-6.5~9.5V (33 ~75 kVA)	4E	3E(B)	—
XL	Ground for base circuit of X-(U-,V-,W-) DP10(K)-XL: 6.5~9.5V *1) (1.5~75 kVA) DP41(A)-XL:-6.5~9.5V (33 ~75 kVA)	3E	6A(B)	—

*1) Power source of base circuit for 22kVA or less is positive voltage.
Power source of base circuit for 33kVA or more is both positive and negative voltage.

*2) L:PCB for control
B:PCB for base drive

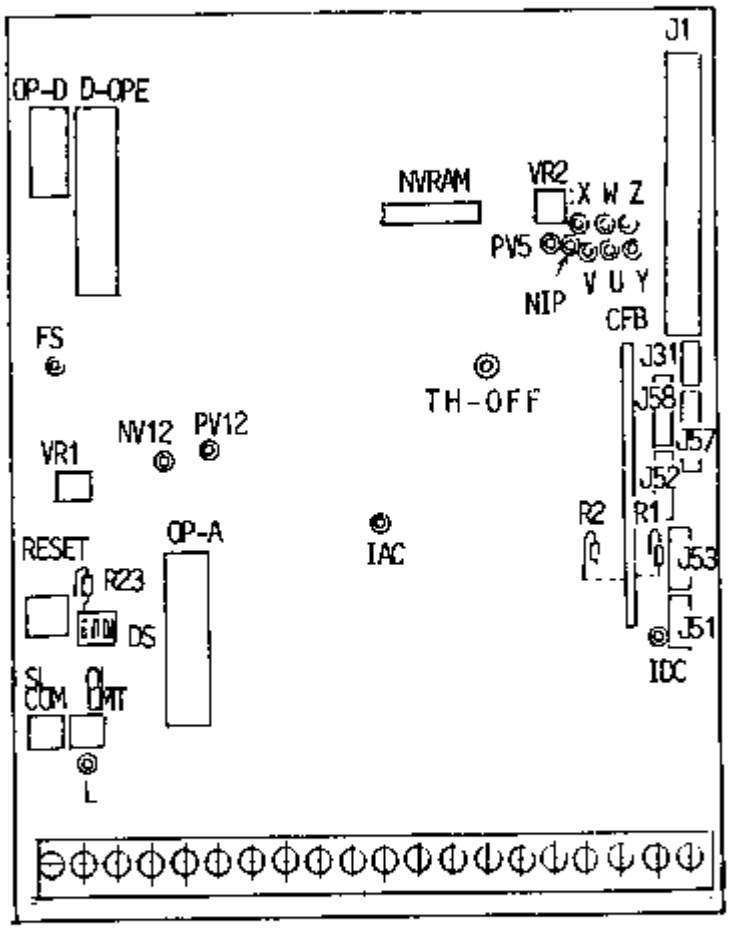
Check pin	Use and level	Address(Location)			See page
		~22kVA	33~75kVA	100kVA~	
U V W X Y Z	PWM signal from control board U+ - L , X(U-) - L V+ - L , Y(V-) - L W+ - L , Z(W-) - L  	2D 3D 3D 1D 1D 1D	3E(L) 3E(L) 2E(L) 2E(L) 3E(L) 2E(L)	1J(L) 1J(L) 1J(L) 1J(L) 1J(L) 1J(L)	
FS	V/F converter output signal FS — L V_{O-L} = 10V (Dip. switch 10V) 5V (Dip. switch 5V) I_{OI-L} = 20mA In case of the above FS-L : approx.390kHz	6A	4A (L)	6A(L)	
IAC	Motor current detecting signal IAC—L	7B	5C(L)	7B(L)	24
IDC	DC-current signal IDC—L	9A	7E(L)	9A(L)	
NIP	Motor speed detecting signal It is used for automatic restart NIP—L  	6A	5E(L)	3E(L)	
TH.OFF	When it is shorted with Ⓛ ,electric thermal and over load limiter function would be stopped	6C	4E(L)	6C(L)	

1,5~22 kVA



8~22kVA ONLY

33~75 kVA

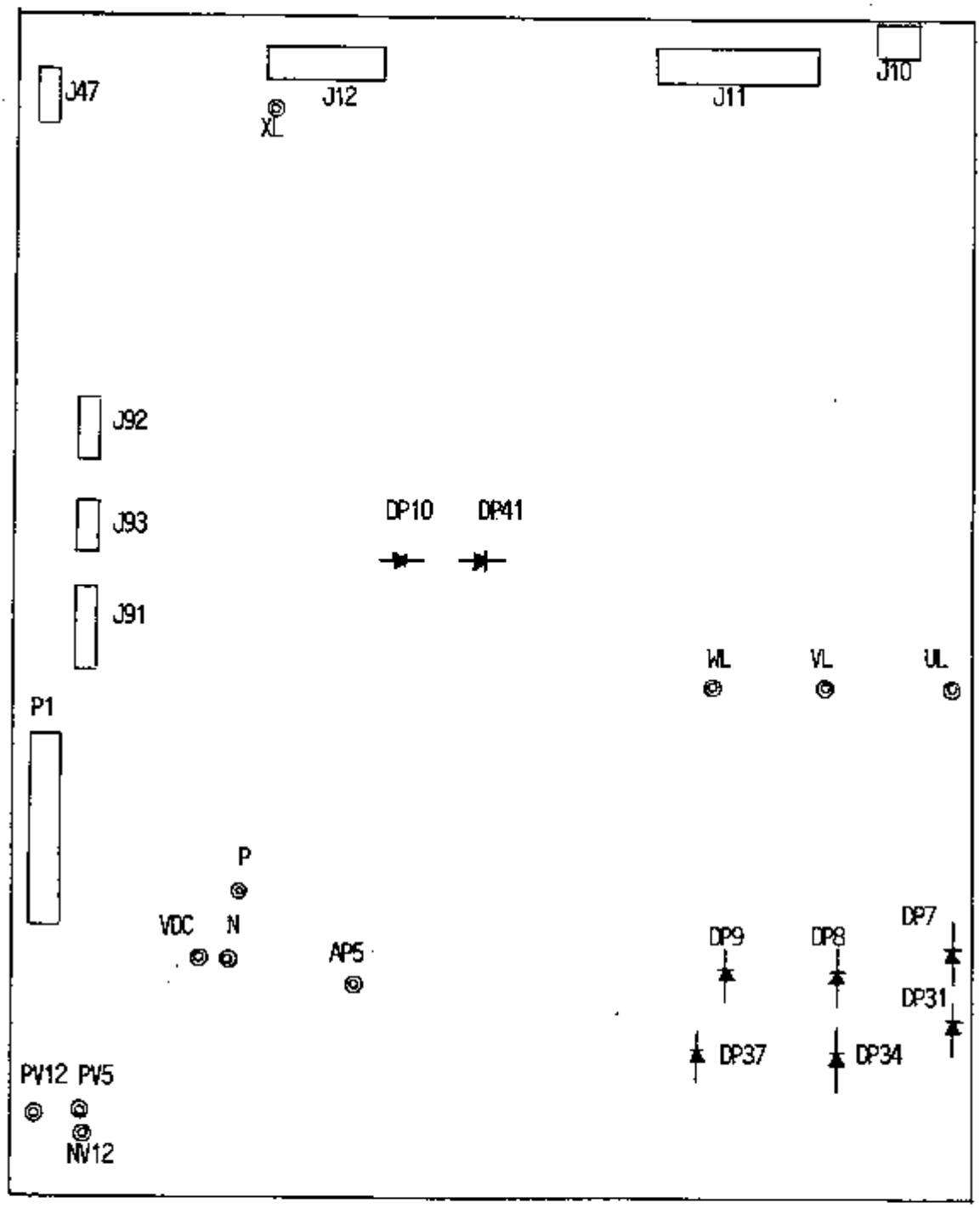


◎ CHECK PIN

● CHECK LAND

PARTS LAYOUT OF CONTROL BOARD

33～75kVA



PARTS LAYOUT OF BASE DRIVE BOARD

4 TROUBLE SHOOTING

4-1 TROUBLE SHOOTING AND MESSAGE CONTENTS

The inverter will operate as shown in Table 10 below if abnormal. Locate the cause and take corrective measures promptly before re-starting operation.

Table Fault Message and Diagnosis

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor Mg	Thermal relay THRY	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
			Over.V	○	DC smoothing circuit - Overvoltage	A	Check for sudden deceleration.	Increase the deceleration time.
							Check that the motor is not rotated from the load side.	The motor cannot be applied to continuous regenerative load.
			OC.Accel	○	Overcurrent during motor acceleration (overcurrent at acceleration)	A	Check for sudden acceleration.	Increase the acceleration time.
							Check for output shortcircuit or ground fault.	Check for the output line (motor) and motor shortcircuit.
							Check that torque boost is not too high.	Reduce the torque boost.
							Check that the motor is not locked.	Check the motor or load.
							Check that jogging frequency is too high.	Reduce the jogging frequency.
			OC.Decel	○	Overcurrent during motor deceleration (Overcurrent at deceleration)	A	Check for sudden deceleration.	Increase the deceleration time.
							Check for output shortcircuit or ground fault.	Check the output line motor shortcircuited.
			OC.Drive	○	Overcurrent during constant operation of motor (Overcurrent during operation)	A	Check for sudden change in load.	Eliminate sudden changes in load.
							Check for output shortcircuit and ground fault.	Check the output line motor shortcircuit.
			Over.L	○	Inverter overload (Overloaded operation)	A	Check that the load is not too heavy.	Reduce the load factor.
							Check that the electronic thermal level is correct (not changed).	Adjust to a proper level.

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit Breaker MCB	Electromagnetic contactor Mg	Thermal relay THNY	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
			OH Fin	o	Temperature significantly increasing (Fin overheat)	A	Check that the cooling fan is rotating.	Replace the cooling fan.
							Check that the ambient temperature is not too high.	
			OVER C.	o	Overcurrent detection just after power ON	A	Check that the detector current circuit is normal.	Check abnormal conditions of current detector and PC board detector circuit.
			Under V.	o	Power supply abnormal (Undervoltage)	A	Check that no voltage drops.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
							Check that power has been turned OFF or instantaneous power failure has occurred during jogging.	Do not turn power OFF during jogging operation.
							Check that 100 msec or less instantaneous power failure has occurred more than 10 times repeatedly for 10 minutes.	Re-check the power supply system.
			Inst.P-F	o	Power supply abnormal (instantaneous power failure)	A	Check that no voltage drop is found.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
			NG-FRS	o	Free-run stop command abnormal	A	Check that the operation command is given during motor free-run, and that no FRS is entered.	Do not enter operation command, FRS during free run.
							With Free-run Stop applied, undervoltage or instantaneous power failure has occurred.	Re-start operation after reset.
							With Free-run Stop applied, power has been cut off.	Re-start operation after reset. With Free-run Stop applied, do not turn power OFF.
							With Free-run Stop applied, power has been turned ON or reset operation has been performed.	

Symptom of malfunction						Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor MC	Thermal relay THRY	Display on digital operation panel ("ERROR")	Fault alarm relay					
			CPU	o	(CPU error)	A	Check that no large noise source is found nearby.	Keep the noise source away from the unit.
							Inverter abnormal	Repair
			DB OT	o	(DC braking setting time over.)	A	Check that the DC braking external command input time does not exceed the time preset by F-22 T-DCB.	Re-set the T-DCB time or adjust DC braking external command input time to less than T-DCB.
			NG-JOG	o	(The jogging mode is used inadvertently)	A	Check that power has been turned ON with the jogging mode ON, commercial power supply voltage has been switched or reset operation has been performed.	With the jogging mode ON, do not turn power ON, switch commercial power supply voltage or reset.
o			-	-	-	B	Power supply side shortcircuit and ground fault.	Repair the short-circuit and ground fault.
							Insufficient MCB capacity	Increase MCB capacity.
							Inverter module or converter module damaged.	Repair
	o		-	-	Power failure	B	Check for the power failure.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
		o	-	-	-	C	Overload	Reduce the load factor.
							Thermal relay preset value faulty	Set the preset value to a proper one.
			NG.DB	o	DB terminal was used inadvertently.	A	With DB ON, power has been turned ON or reset operation has been performed.	With DB ON, do not turn power ON or reset.
			UV WAIT	-	Supply voltage abnormal (Undervoltage)	-	When restart function was selected, supply voltage dropped to 100V or less.	Review the power supply system.
			OV.BRD	o	BRH terminal is not connected with L terminal.	A	Check BRH-L short-circuited.	Connect BRH with L.
			*) OV.SEC	o	Overvoltage of input voltage not during deceleration.	A	Check input voltage doesn't exceed rated voltage +10%.	Check the power supply system.

*) 1Ø 220V:283VAC
3Ø 380V:565VAC

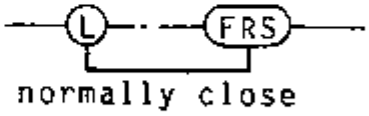
Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor Mg	Thermal relay THRY	Display on digital operation panel (?ERROR)	Fault alarm relay				
			800 Numeral		NVRAM failure	-	Check that no operation is performed after power on.	See page 21,22

○: shows the equipment which seems to operate in general.

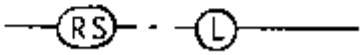
when trouble happens.

No motor rotates

- Check the wiring between inverter and motor.
- Chevk the input voltage whether it is rated voltage or not.
- Check the wiring between (FRS) and (L) on the circuit board
  *They should be shorted



- Check the wiring between (RS) and (L) on the circuit board
  *They should be open.



- Check the operation mode in the monitor mode whether it is set according to application system.

  F-SET-M: OPE-key/Terminal
  F/R-SW : OPE-key/Terminal

- Check the referenc (freq.setting) signal
  - When F-SET-M "OPE-key" is selected,check the FS□□□.□Hz in the monitor mode.
  - When F-SET-M "Terminal" is selected,check the voltage or current signal on the terminal of printed board.

    V_{O-L} :0~10VDC or 0 5VDC
    I_{OI-L}:4~20mA

- Check whether setting frequency is less than minimum frequency.
  *Set the frequency more than minimum frequency.
- Check whether LCD indication is in "Monitor" mode.
  *Select "Monitor" mode.In the function mode,the inverter cannot start.
- Check whether [STOP] key of Dig.Ope is pushed when F/R-SW in "Monitor" mode is selected with "terminal".
  *Once,run command(FW/RV) must be turned off,and then turned on again from the terminal.
- Check the output voltage of U-V,V-W and W-V whether they are balanced or not.
- Check whether setting frequency of "SPEED1"~"SPEED3" is proper value when you use multi stage speed terminal(CF1,CF2).
  * "SPEED1~3" must be set or multi stage speed command (CF1,CF2) must be removed.

FW	ON	OFF	OFF	ON
RV	OFF	OFF	ON	ON
	F	S	R	S

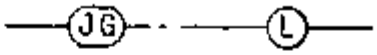
- Check whether [FWD RUN] key and [REV RUN] key of D-OPE are pushed together in "Ope-key" mode.
- Check whether forward operation command and reverse operation command are input together in "Terminal" mode.
  * Only one signal should be input.

No motor accelerates

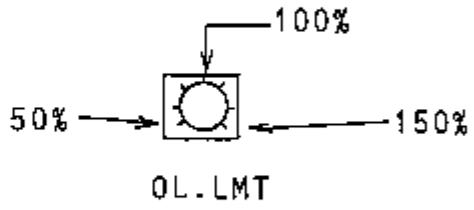
- Check the referenc (freq.setting) signal
  - When F-SET-M "OPE-key" is selected,check the FS□□□.□Hz in the monitor mode.
  - When F-SET-M "Terminal" is selected,check the voltage or current signal on the terminal of printed board.

    V_{O-L} :0~10VDC or 0 5VDC

    I_{OI-L}:4~20mA
- Check the F-05(frequency upper limiter).
- Check whether the preset value of "F-END" in the function mode is more than maximum frequency.
- Check wherther the wiring between (JG) and (L) on the circuit board is open.

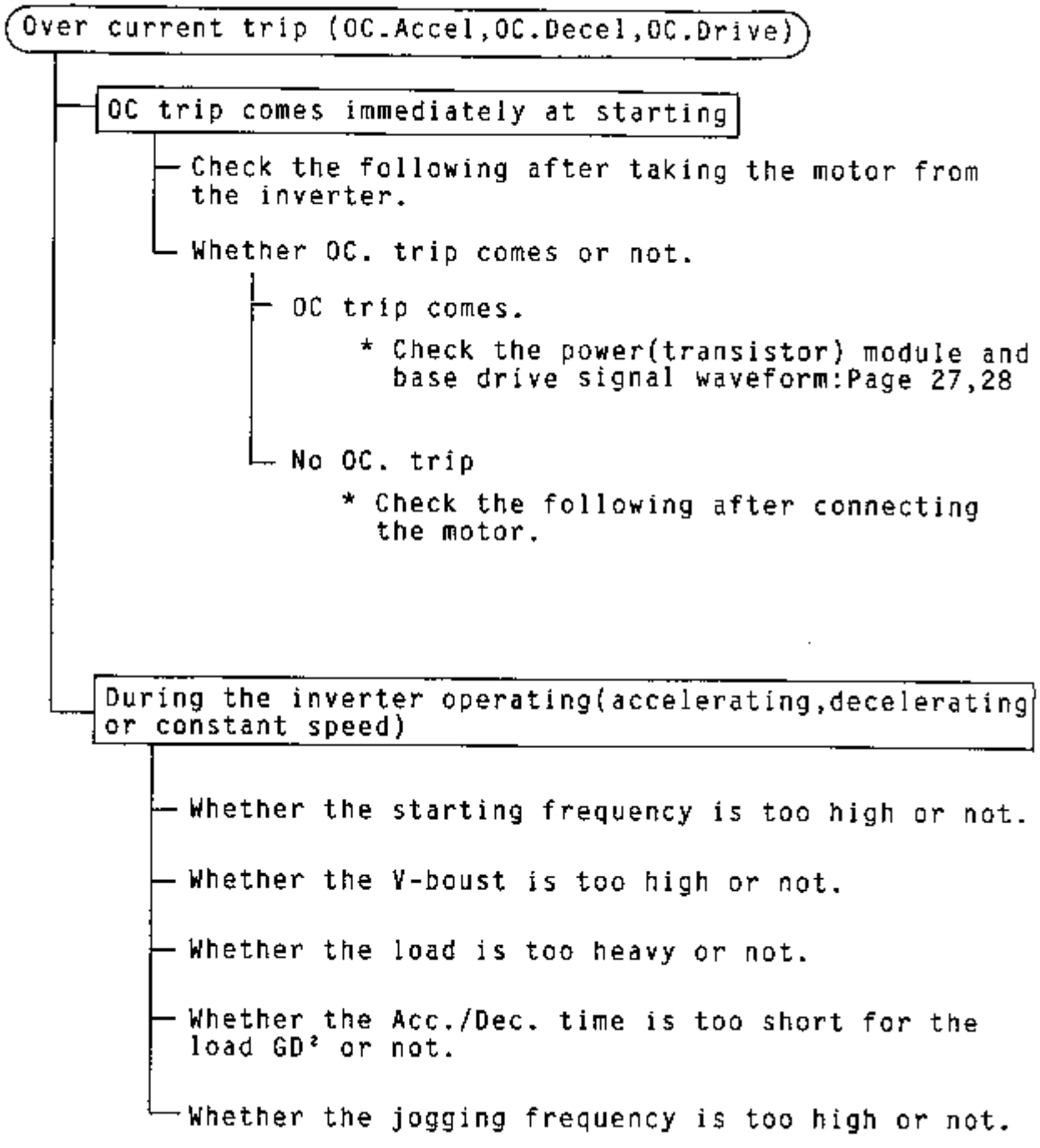


- Check the load whether it is too heavy or not.
  *Reduce the load or adjust the overload limit level by "OL.LMT" (VR) clockwise.



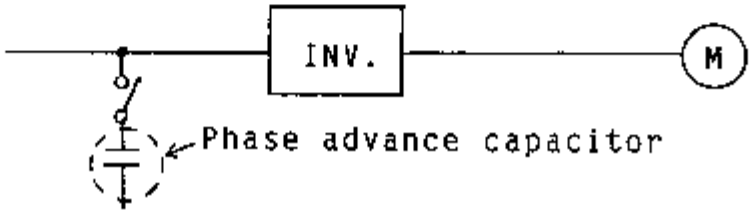
- Check whether setting frequency of "SPEED1"~"SPEED3" is proper value when you use multi stage speed terminal(CF1,CF2).

  * "SPEED1~3" must be set or multi stage speed command (CF1,CF2) must be removed.


Over current trip (OC.Accel,OC.Decel,OC.Drive)
OC trip comes immediately at starting
Check the following after taking the motor from the inverter.
Whether OC. trip comes or not.
OC trip comes.
* Check the power(transistor) module and base drive signal waveform:Page 27,28
No OC. trip
* Check the following after connecting the motor.
During the inverter operating(accelerating,decelerating or constant speed)
Whether the starting frequency is too high or not.
Whether the V-boust is too high or not.
Whether the load is too heavy or not.
Whether the Acc./Dec. time is too short for the load GD² or not.
Whether the jogging frequency is too high or not.

Over voltage trip

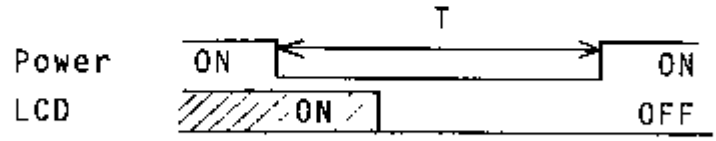
- Check the deceleration time whether it is too short for the GD^2 of load or not.
  - * Prolong the deceleration time.
  - * Use the regenerative braking unit.
- Check the power source network line whether there are phase advance capacitors on it and they are turned on/off during inverter operation or not.



  - * Change the wiring system with the phase advance capacitor.
  - * Put the braking unit in order to suppress the over voltage.

Instantaneous power failure trip

- Check whether power source is turned on again before LCD display is turned off.
  * Power source should be turned on again after LCD display is turned off.



T : 1Ø 220V more than 4.0 sec.
3Ø 380V more than 2.0 sec.

- Check the magnetic contactor on the inverter primary side whether it has chattering or not.

- Did the power failure occur?
  * If the automatic restart function after instantaneous power failure is allowed for the application system,use the automatic restart function in the function mode F-28.

F-28 switch 00[00]0101

00: Not available restart
10: Available restart

Under voltage trip

- Check the power source voltage whether they are less than protection level or not.

1Ø 220V 1.5~3.5kVA : 150~160 VAC
3Ø 380V 2.5~75kVA : 280~320 VAC
3Ø 380V 100~180kVA : 323 VAC

- Check the transient voltage drop by rush current into the smoothing condenser or starting current of the motor.
  * Increase the power source capacity.
  * Use the restart function on the F-28

F-28 switch 00[00]0101

00: Not available restart
10: Available restart

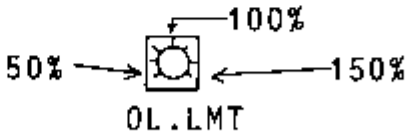
- Check the magnetic contactor whether it has chattering or not.

Overheat trip

- Whether cooling fan in the inverter is rotating or not.
- Whether air inlet and exhaust ports on the panel box is blocked or not.
- Whether the cooling air path is blocked or not.
- Whether the temperature in the panel box is less than specified value or not.
  * If it is too high, improve the cooling.
    :See page 59~62, selection of ventilation

Overload trip

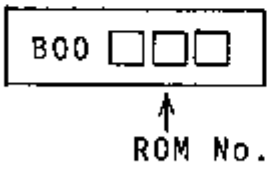
- Check the electronic thermal level in the function made F-23 whether it is proper for the load condition or not.
- Check the overload limiter level whether it is proper for the load condition or not.
  * This level can change with "OL.LMT".



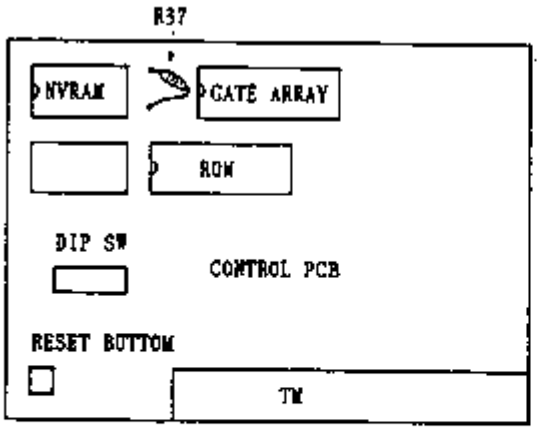
4-3 NVRAM (Non Volatile EEPROM) failure

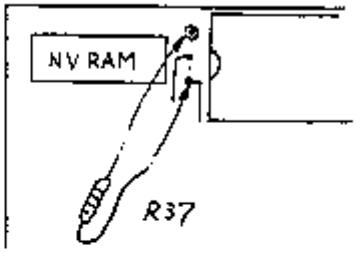
When the following phenomenon has been appeared,replace the NVRAM.

LCD indication on the digital panel is:



And no operation is performed after power on. No operation is performed even forced reset or even when the initial setting is performed.





Solder a resistor R37(10 kΩ 1/3W) if it is not mounted on the PCB.

After replacing the NVRAM,return the setting data to the initial (factory) setting according to "How to return the setting to the initial setting". After that,re-program the data according to customer's setting.

Note: When no data is stored in memory after various operations are performed although the data is set and the [STR] is depressed, it should be noted that this abnormality is due to the following reason.

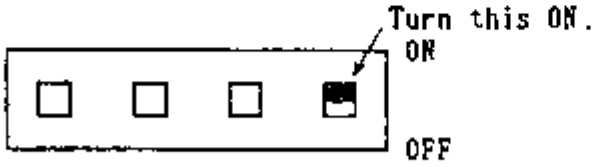
Reason ..... Set the data and press the [STR], then press the [Forced Reset] (or short-circuit RS-L terminals) and cut off the power supply.

Countermeasures ... Set the data and press the [STR] to store it in memory, then turn power OFF once, and store the data in an element to save it even after power OFF.

4-4 HOW TO RETURN THE SETTING TO THE INITIAL SETTING

When retuning the setting to the initial setting for some reason, flolow the steps below.

① Turn power on.
② Set the right side of DIP SW on PCB to "ON".



③ With the [MON] [FUN] [STR] keys on the digital operation panel pressed at the same time, turn the forced reset button ON.

④ After resetting , release these 3 keys pressed in 1 or 2 sec.

At this time, [B O O ▯▯] (ROM NO.) is displayed and operation steps.

If [F M 0 0 0 . 0 H z] is displayed, it means that these 3 keys has been released too early. Repeat steps ② - ④ above again.

NOTE: But NVRAM failure makes [B O O ▯▯] remain displayed even for the above steps.

Good NVRAM : Displays [F M 0 0 0 . 0 H z] by forced reset

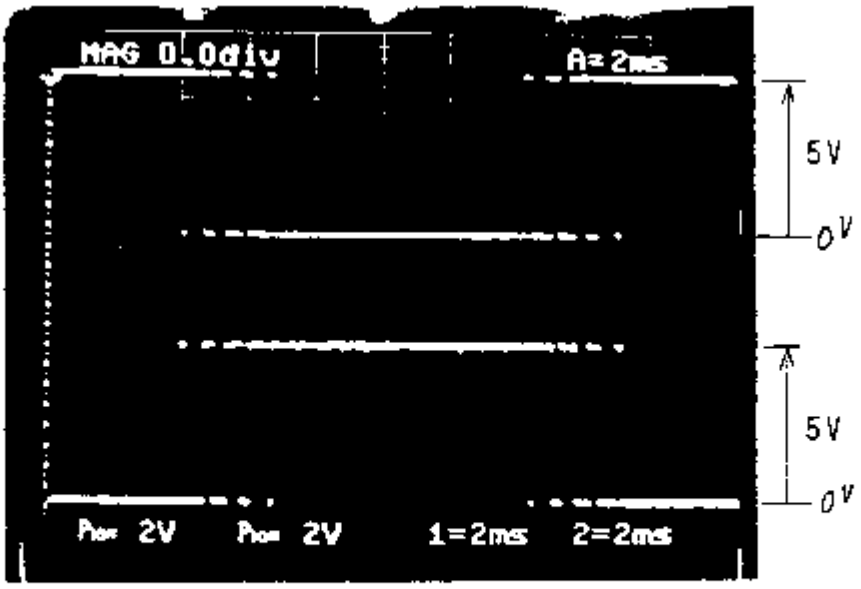
Failed NVRAM : Displays still [B O O ▯▯] by forced reset

⑤ Turn power OFF or turn the forced reset buttom or switch ON.
⑥ Turn DIP SW OFF.
⑦ Turn power ON again, and check that the data corresponds to the standard perset value(factory setting).

5-1 PWM OUTPUT SIGNAL WAVEFORM FROM THE CONTROL BOARD

- The PWM control signal can be checked with the check pins,U~Z, on the control board.
- Check pins and waveform

Pin			Phase
U	←	L	U+
V	←	L	V+
W	←	L	W+
X	←	L	U-
Y	←	L	V-
Z	←	L	W-

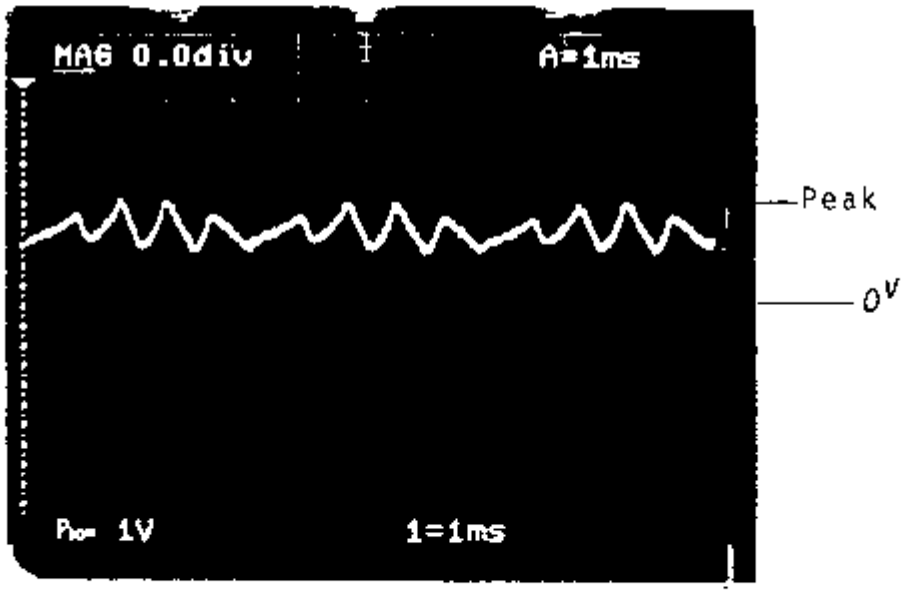


* The pulse number would be changed according to output frequency.
* When the PWM signal is not proper,the control board should be changed.

5-2 MOTOR CURRENT SIGNAL

- The motor current signal which is rectified can be checked with check pins on the control board.
- This signal is used for O.C,O.L and stall prevention detection.
- The signal level is:
  Rated current of the inverter / 2V DC
- Checkpin and waveform

I_{AC} ⟵ L



- Trip level

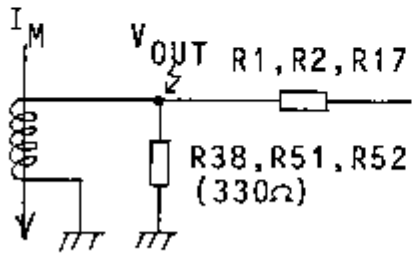
kVA	OC.Accel.	OC.Decel.	OC.Drive	Motor cirrent
1.5～3.5SF3	4.4 V	4.4 V	4.4 V	220%
2.5～5.5HF3	3.88V	3.88V	3.88V	180%
8～180HF3	3.6 V	3.6 V	3.6 V	180%

* THe trip level is the peak value of this signal.

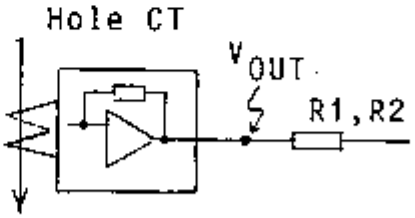
5-3 MOTOR CURRENT WAVEFORM

- The motor current waveform can be checked with resistors on the control board. The signals come from AC/CT of the output.

- AC/CT output



1.5 ~ 22 kVA



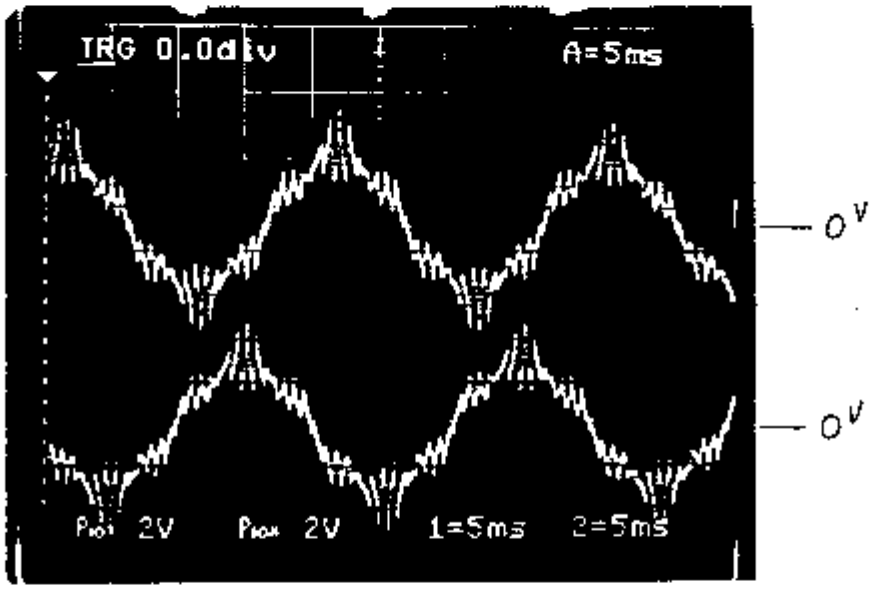
33 ~ 75 kVA

V_{OUT}

100%	Load	: 3.0 V
150%	Load	: 4.5 V
180%	Load	: 5.4 V
200%	Load	: 6.6 V

- Resistors for check and waveform

Resistor	Phase
R1 ⟵ L	U
R2 ⟵ L	W

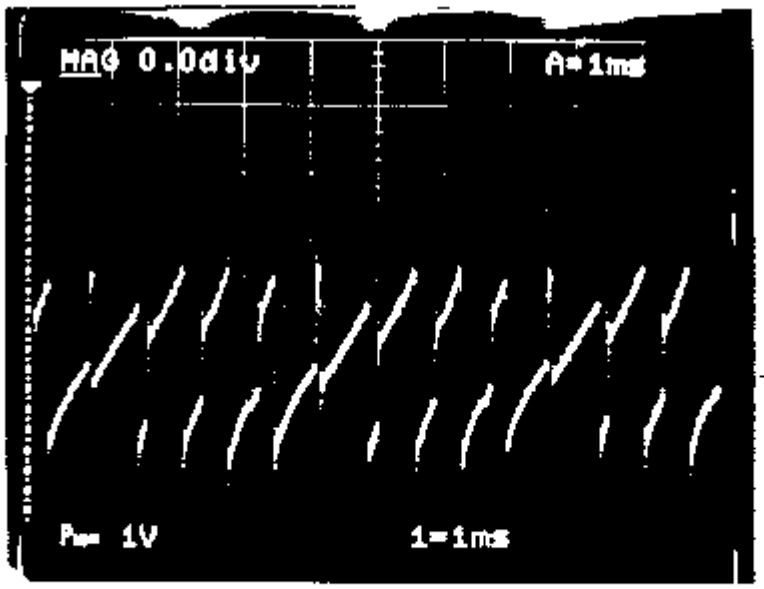


* The waveform would be changed according to output frequency.

5-4 DC-CURRENT SIGNAL

- The DC-current of the intermidiate circuit can be checked with the checkpin on the control board or base drive board.
- The signal is used for O.C trip.
- Checkpin and waveform

  N2 —N (on the control board) : 1.5~ 5.5kVA
  IDC—L (on the control board) : 8 ~ 75 kVA

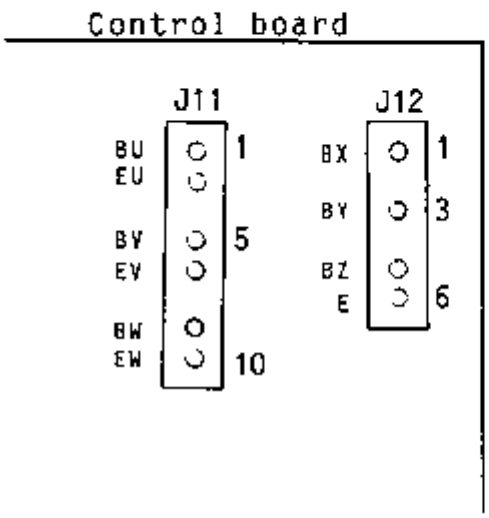


- Trip level

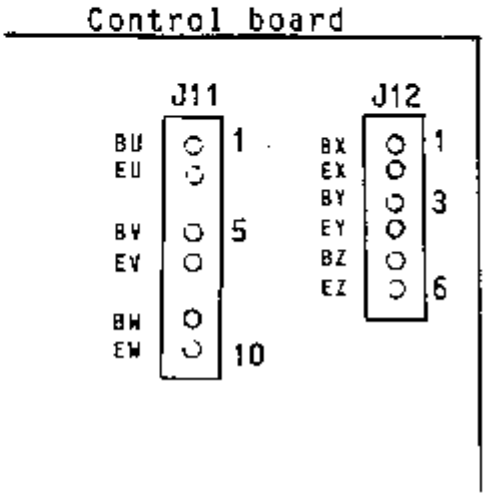
Inv. Model	1.5~3.5SF3 E 2.5~5.5HF3 E	8~33LF3 8~40HF3 E 100~180HF3 E	40LF3	50~75LF3	50~75HF3 E
Trip level	1.3V	6.6V	7.9V	7.6V	7.1V
Checkpin	N2 — N	IDC — L			

5-5 Output signal of base drive

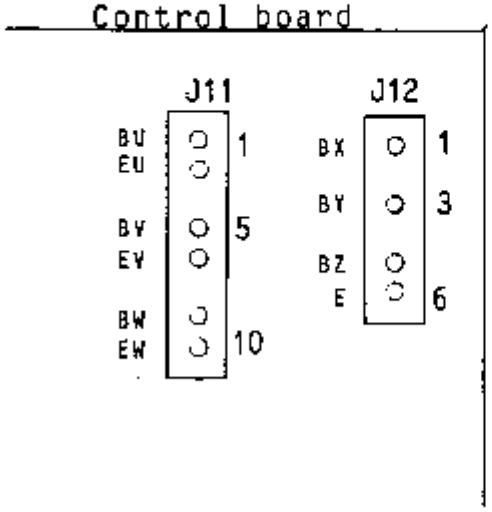
1 1.5,2.5kVA(SF3)

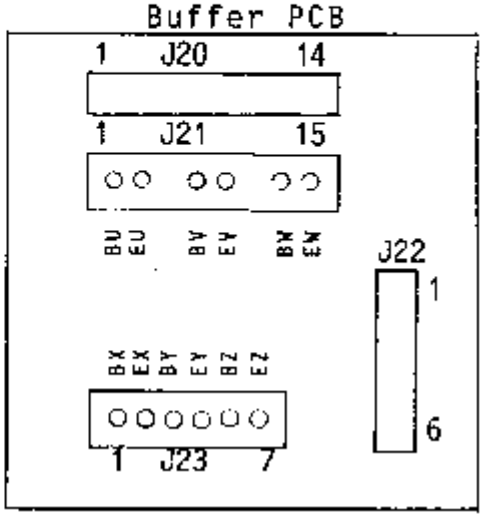


2 3.5kVA(SF3),2.5~8kVA(HF3)

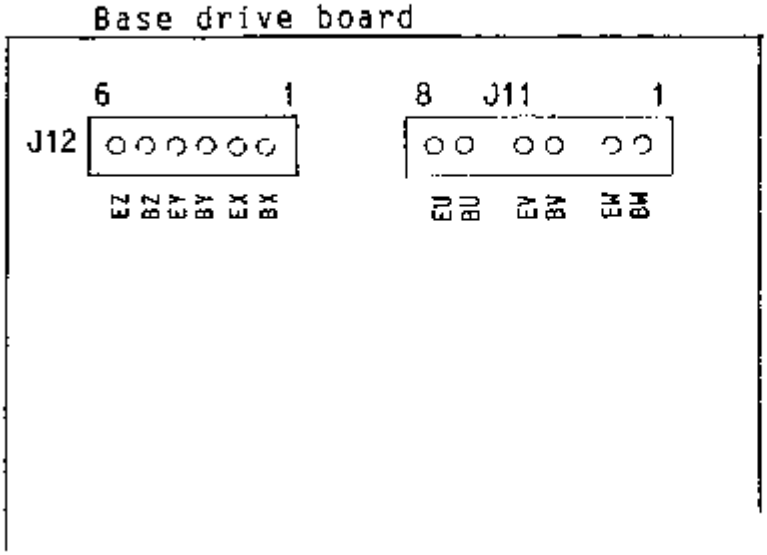


3 11~22 kVA



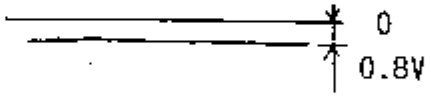


4 33~75 kVA

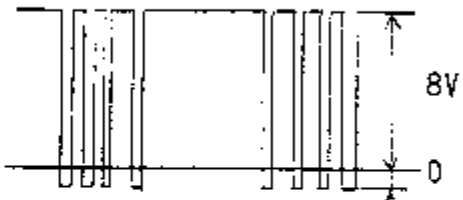


1 1.5,2.5kVA(SF3)

BU — EU (G) (R)	(U+)	J11
BV — EV (V) (R)	(V+)	J11
BW — EW (BL) (R)	(W+)	J11
BX — E (BR) (W)	(U-)	J12
BY — E (Y) (W)	(V-)	J12
BZ — E (O) (W)	(W-)	J12



No operating



Operating

2 3.5kVA(SF3),2.5~8kVA(HF3)

BU — EU (G) (R)	(U+)	J11
BV — EV (V) (R)	(V+)	J11
BW — EW (BL) (R)	(W+)	J11
BX — EX (BR) (W)	(U-)	J12
BY — EY (Y) (W)	(V-)	J12
BZ — EZ (O) (W)	(W-)	J12

Wiring color
B - Black
BL- Blue
BR- Brown
G - Green
O - Orange
V - Violet
R - Red
W - White
Y - Yellow

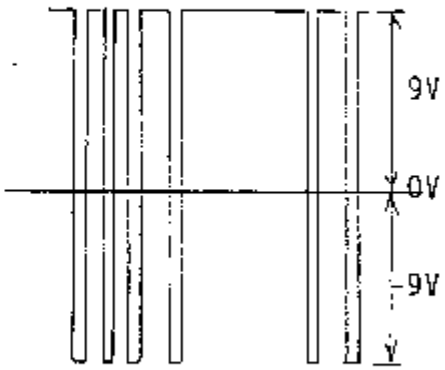
3 11~22kVA

BU — EU (G) (R)	(U+)	J 21
BV — EV (V) (R)	(V+)	J 21
BW — EW (BL) (R)	(W+)	J 21
BX — EX (BR) (W)	(U-)	J 23
BY — EY (Y) (W)	(V-)	J 23
BZ — EZ (O) (W)	(W-)	J 23

4 33~75kVA

BU — EU (G) (R)	(U+)	J11
BV — EV (V) (R)	(V+)	J11
BW — EW (BL) (R)	(W+)	J11
BX — EX (BR) (W)	(U-)	J12
BY — EY (Y) (W)	(V-)	J12
BZ — EZ (O) (W)	(W-)	J12

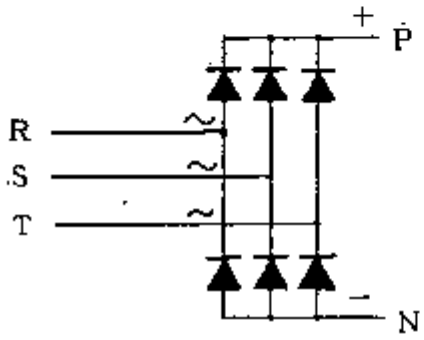
No operating



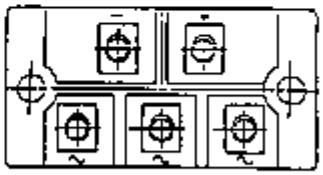
Operating

5-6 How to check converter modules

The converter module can be checked to a certain extent at terminals.

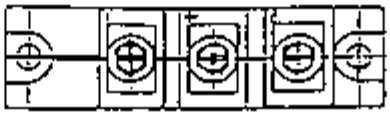


200V class:Less than 3.5kVA

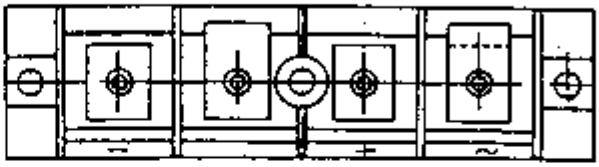


400V class:11～22kVA

400V class:5.5～8KVA



400V class:33～100kVA



400V class:120～180kVA

Converter module circuit diagram and top views

Turning off power source,make sure that voltage between P and N is below 15V before operation.
Remove the wirings connected to the converter module and check it alone.
Measure with the tester set to 1Ω range.

Colors of tester terminals Black--------Red			Resistance value
R(～)	⟶	S(～)	50kΩ or more
S(～)	⟶	T(～)	
R(～)	⟶	T(～)	
P(+)	⟶	R(～)	50kΩ or more
P(+)	⟶	S(～)	
P(+)	⟶	T(～)	
R(～)	⟶	P(+)	50Ω or less
S(～)	⟶	P(+)	
T(～)	⟶	P(+)	
N(-)	⟶	R(～)	50Ω or less
N(-)	⟶	S(～)	
N(-)	⟶	T(～)	
R(～)	⟶	N(-)	50kΩ or more
S(～)	⟶	N(-)	
T(～)	⟶	N(-)	

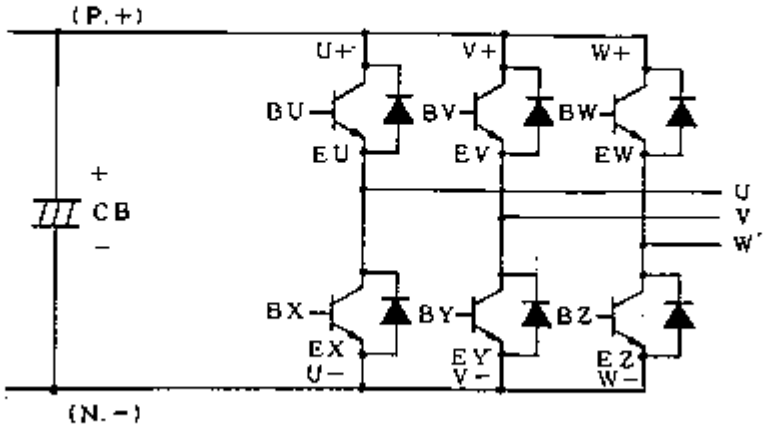
～:alternation terminal

If the resistance value is not proper,replace the diode module.

* Failure symptom : MCB trip (shortcircuit of Power module)

5-7 How to check inverter modules

The inverter module can be checked to a certain extent at terminals.



Inverter module circuit diagram

Turning off power source, make sure that voltage between P and N is below 15V before operation.
Measure with the tester set to 1Ω range.

(Easy method to check inverter module without disassembly)

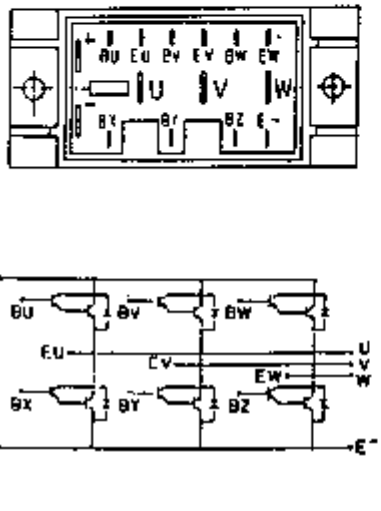
Color of tester terminals Black----------Red			Resistance value	Check spot
P	→	U	50kΩ or more	U+
P	→	V		V+
P	→	W		W+
N	→	U	50Ω or less	U−
N	→	V		V−
N	→	W		W−
U	→	P	50Ω or less	U+
V	→	P		V+
W	→	P		W+
U	→	N	50kΩ or more	U−
V	→	N		V−
W	→	N		W−

(Check after disassembly)

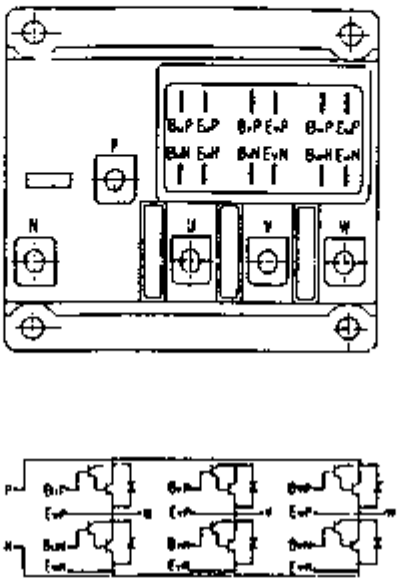
Color of tester terminals Black----------Red			Resistance value	Check spot
BU	→	U	100Ω or less	U+
BV	→	V		V+
BW	→	W		W+
BX	→	U	100Ω or less	U−
BY	→	V		V−
BZ	→	W		W−
U	→	BU	50～200Ω or more	U+
V	→	BV		V+
W	→	BW		W+
U	→	BX	50～200Ω or more	U−
V	→	BV		V−
W	→	BZ		W−

* Failure symptom : Over current trip causes without connected to a motor.

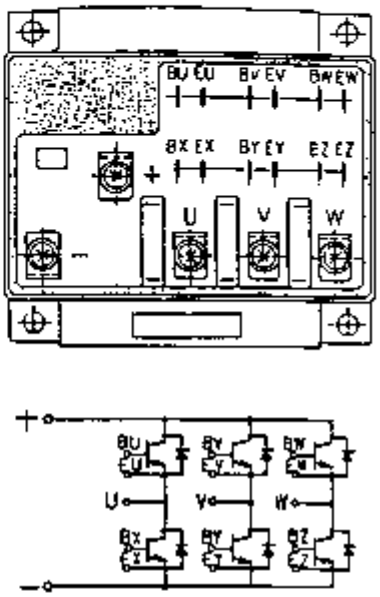
Top views of inverter modules



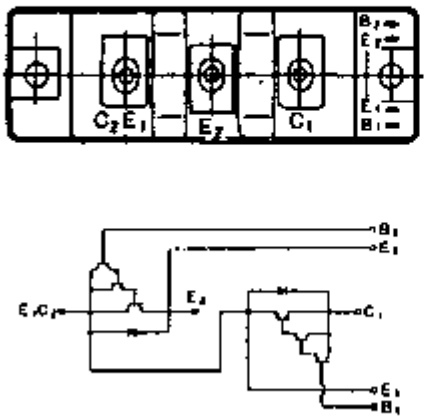
200V class:Less than 2.5kVA



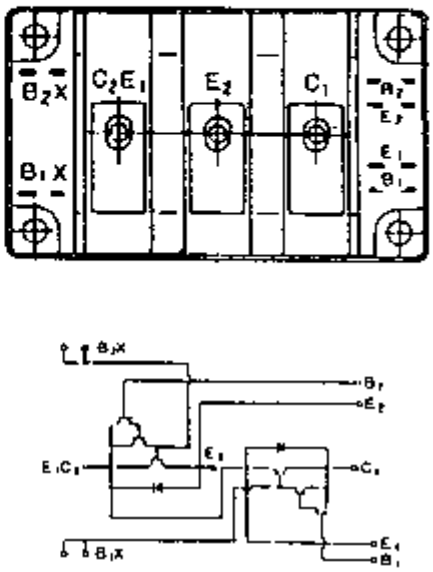
200V class:3.5kVA



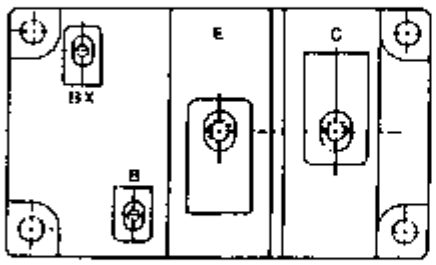
400V class:5.5kVA



400V class:8～16kVA



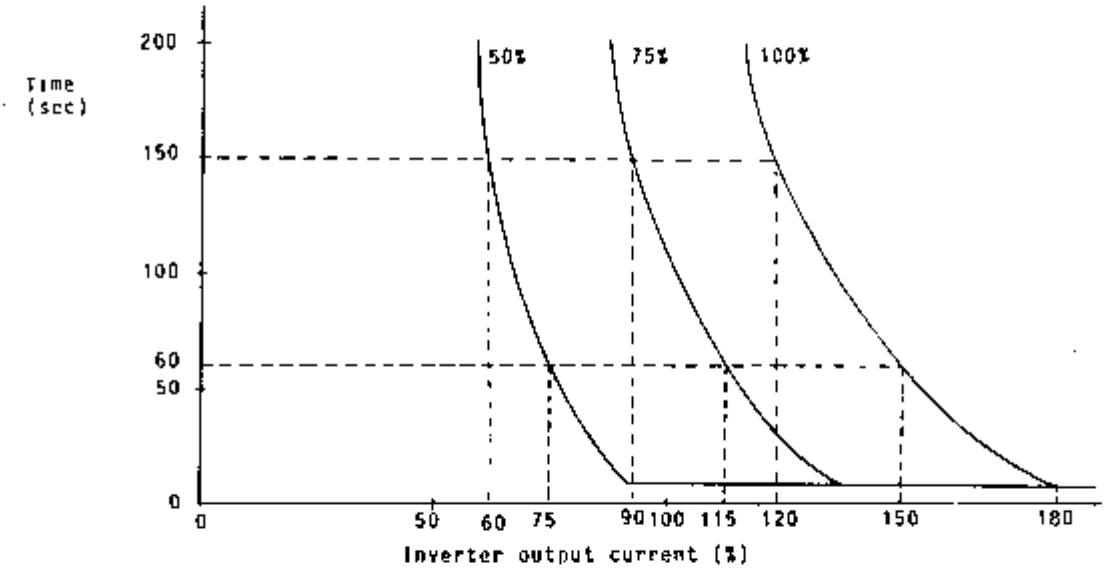
400V class:22～40kVA

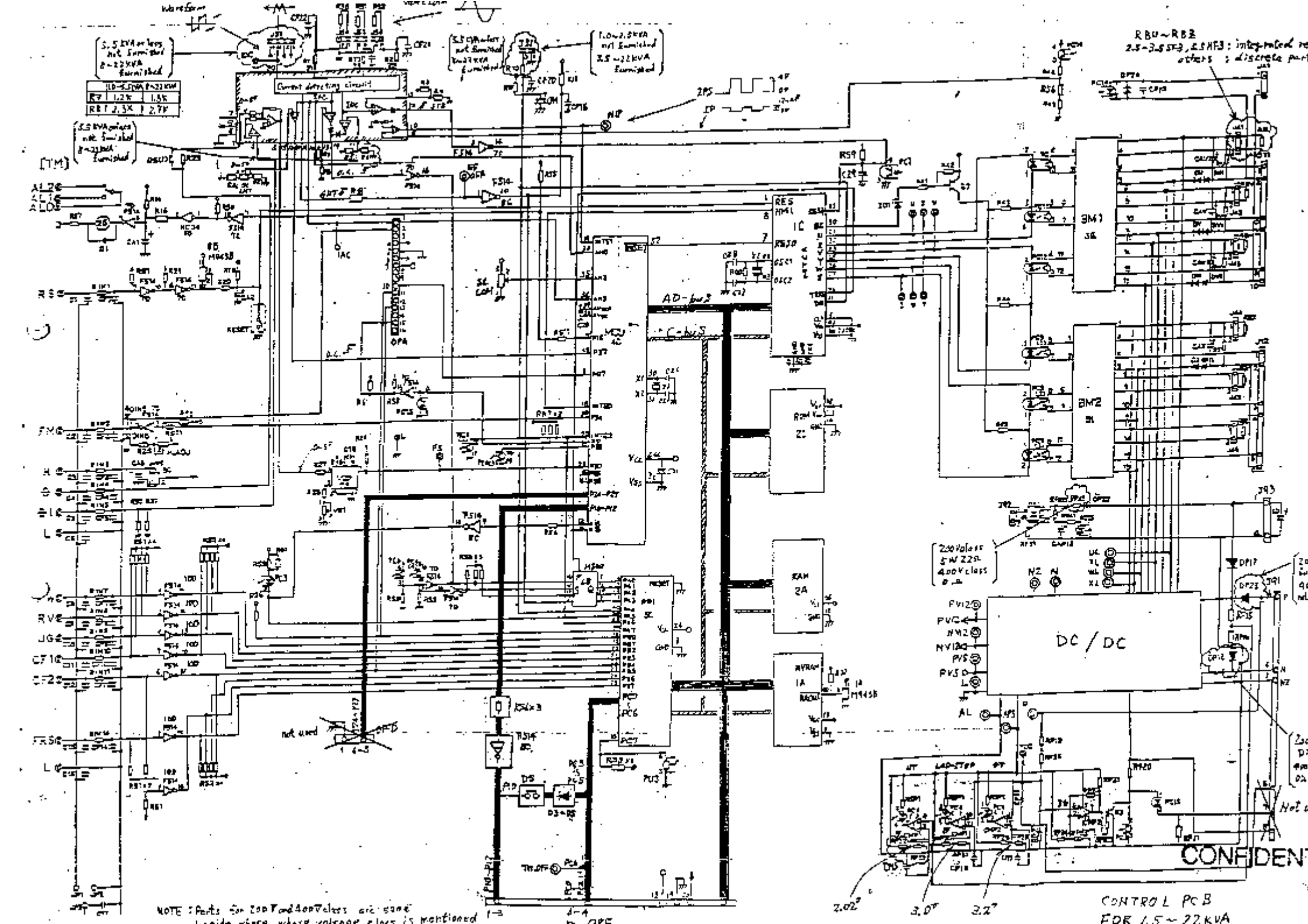


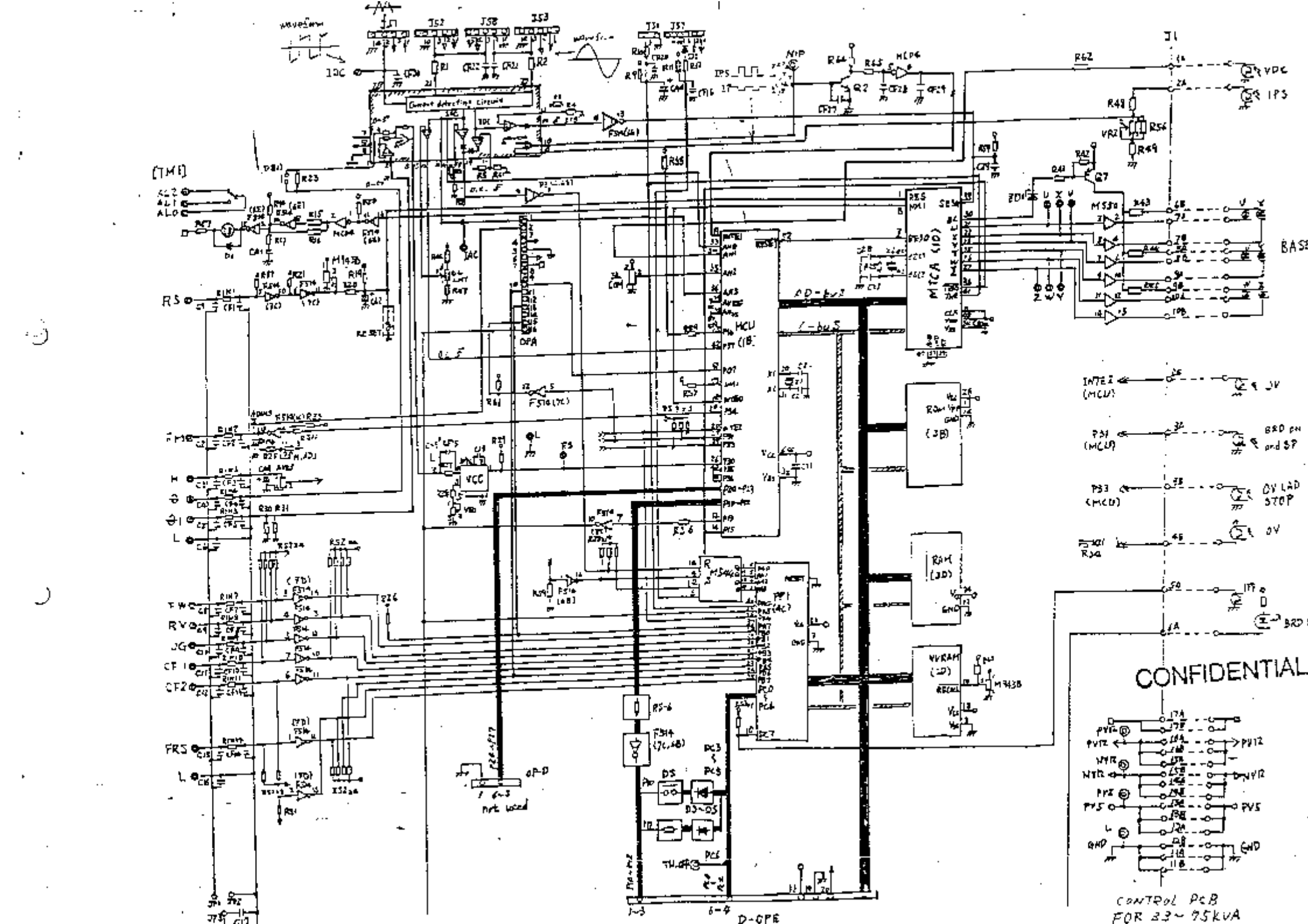
400V class:50～180kVA

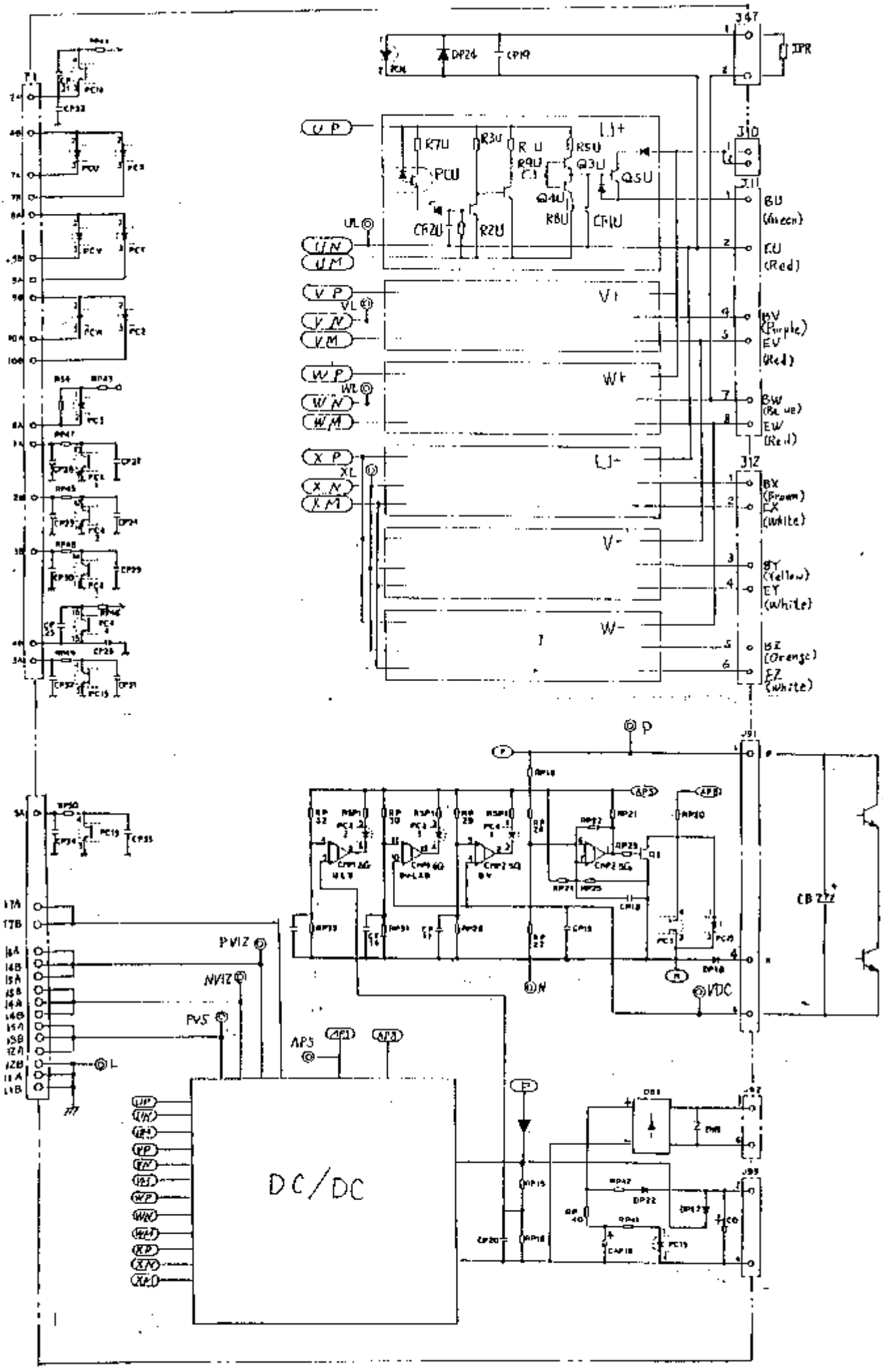
6-1 E-THERM FUNCTION (F-23)

The protection characteristics of the electronic thermal can be changed by OPE-key.
The characteristics is approximately as follows:




AD-bus
C-bus
DC / DC
CONFIDEN
CONTROL PC B
FOR 4.5 ~ 22 KVA


CONFIDENTIAL
CONTROL PCB
FOR 33~75kVA

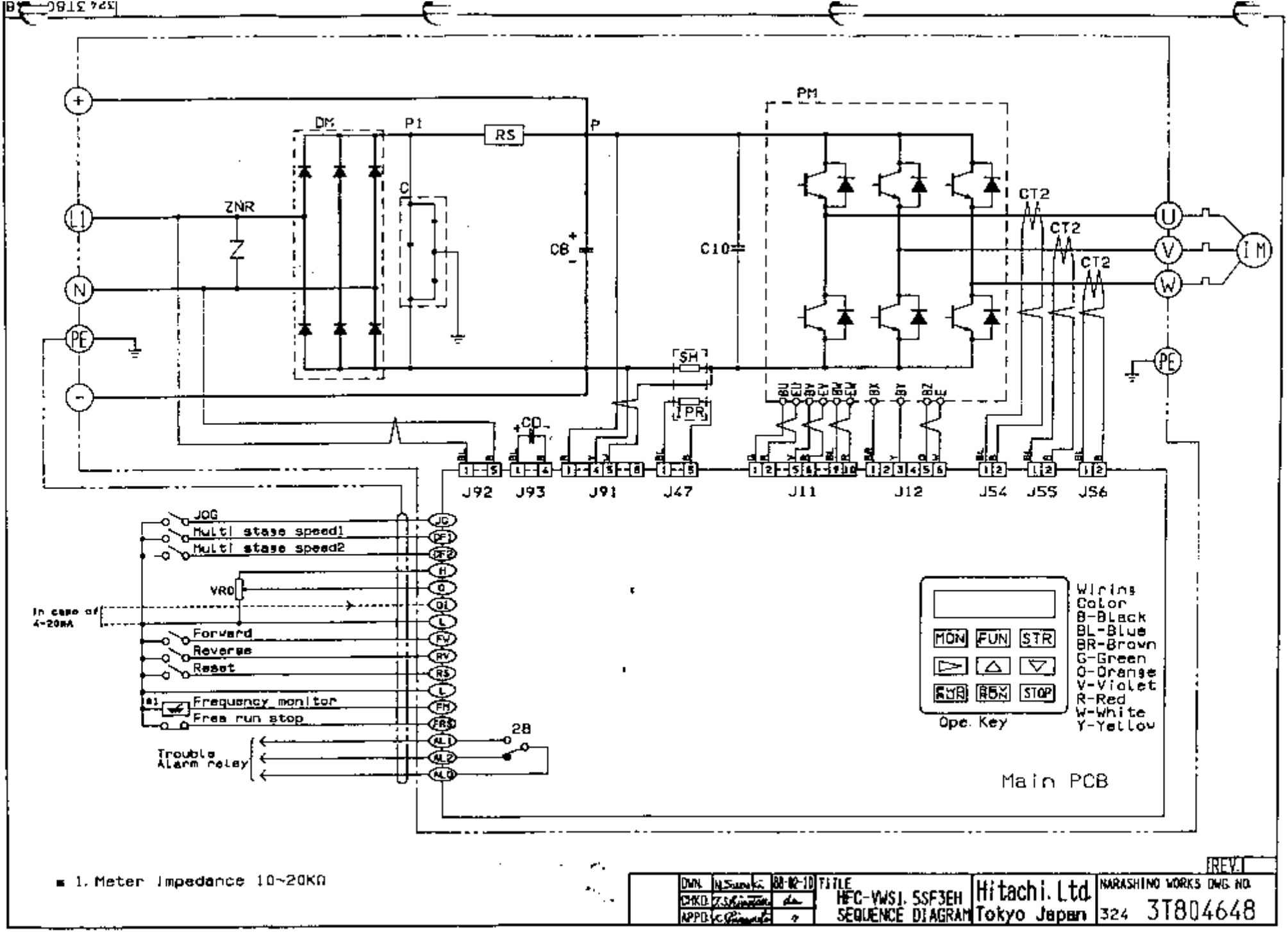


CONFIDENTIAL

Base drive board

5E

33 ~ 75 kVA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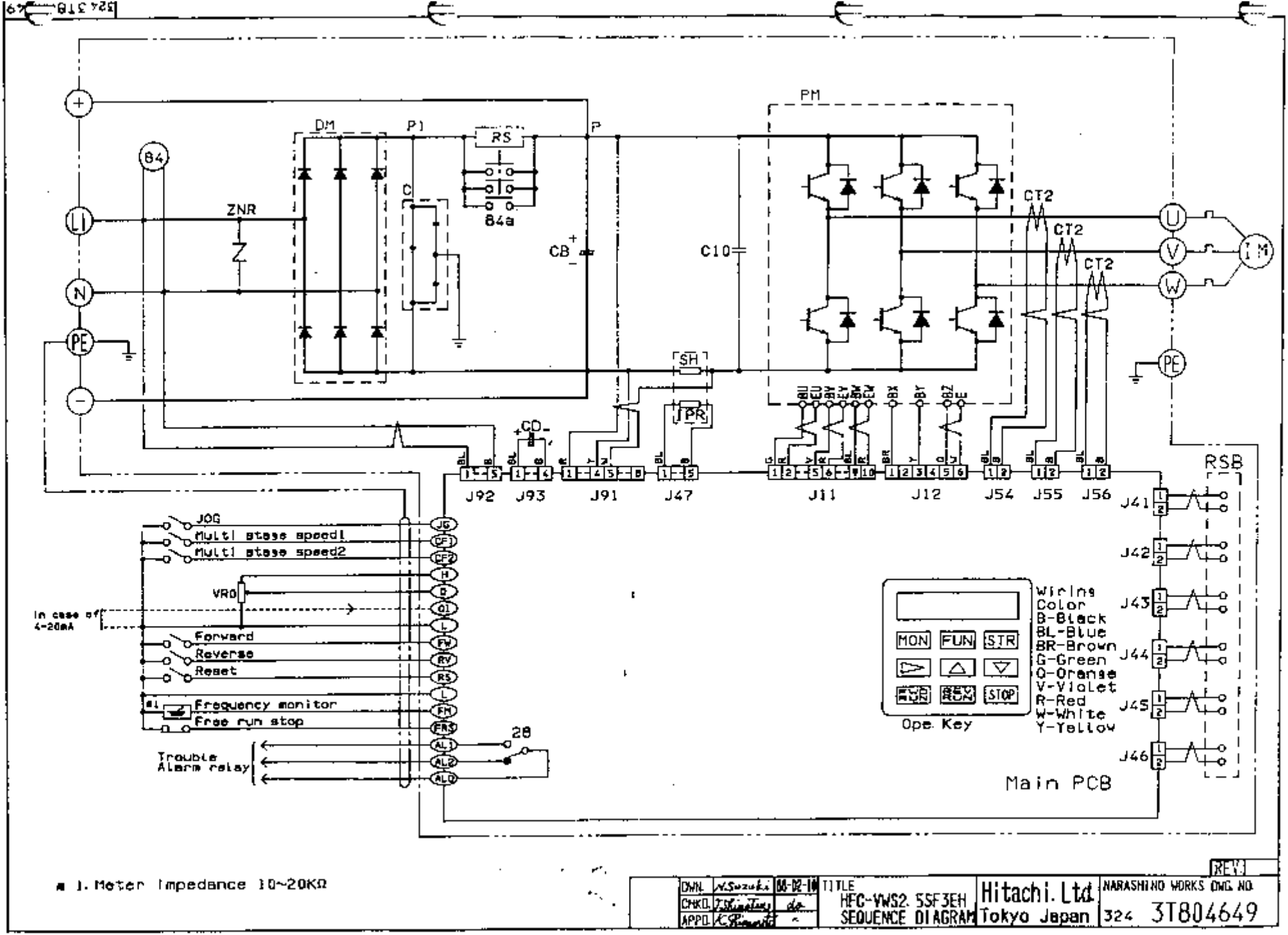
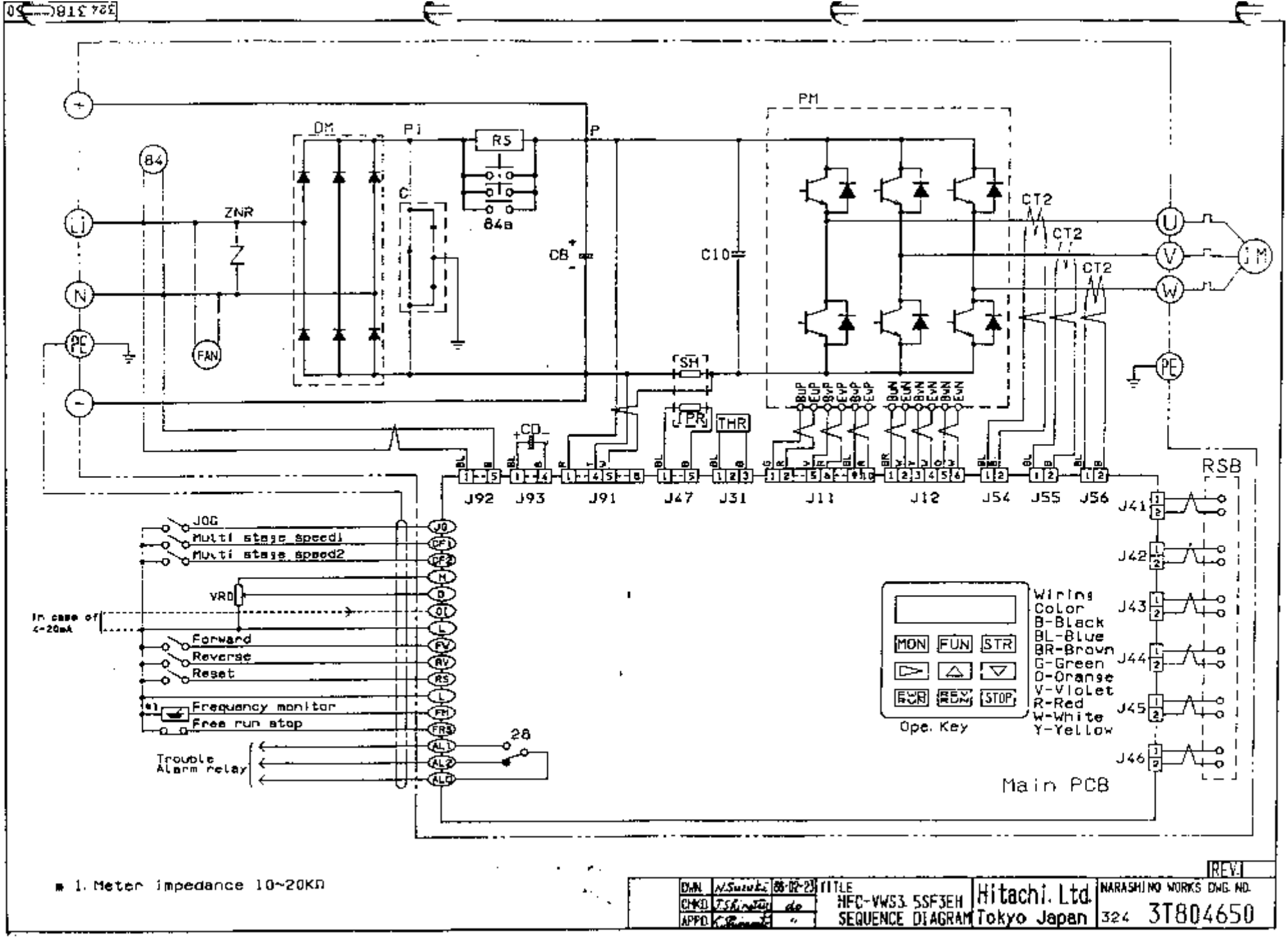
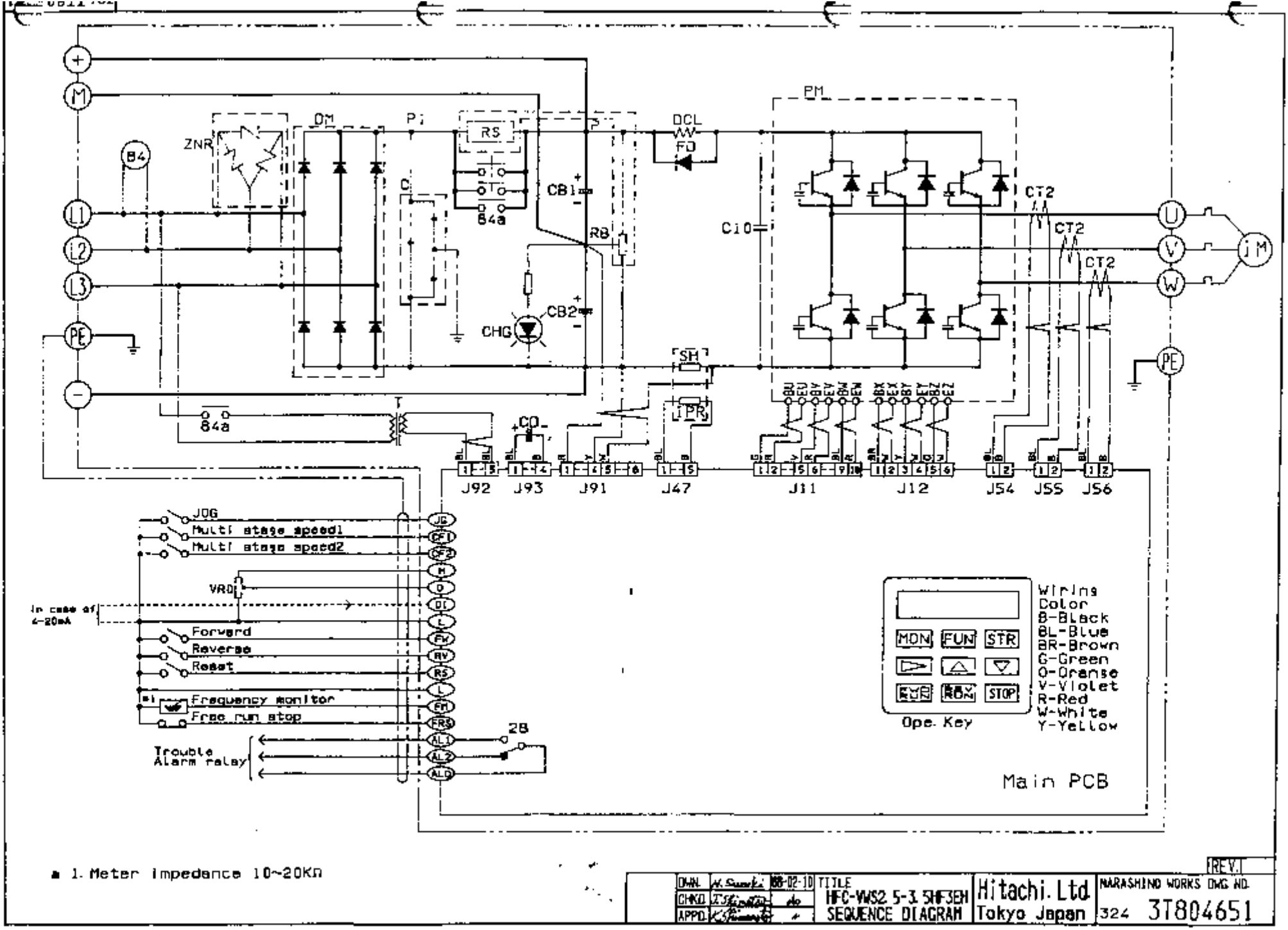
N
PE
DM
P1
RS
P
PM
ZNR
Z
C
CB
C10
CT2
CT2
CT2
U
V
W
IM
PE
SH
PR
CD
J92
J93
J91
J47
J11
J12
J54
J55
J56
JOG
Multi stase speed1
Multi stase speed2
VRO
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
STOP
Ope. Key
Wirins Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Orange
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
1. Meter Impedance 10~20KΩ
DWN
CHKD
APPD
88-02-10
TITLE
HFC-VWS1.5SF3EH
SEQUENCE DIAGRAM
Hitachi.Ltd
Tokyo Japan
HARASHINO WORKS DWG NO.
324 3T804648
REV.


PM
DM
P1
RS
P
84a
C
ZNR
CB
C10
SH
JPR
CD
CT2
CT2
CT2
U
V
W
IM
PE
84
L1
N
PE
RSB
J92
J93
J91
J47
J11
J12
J54
J55
J56
J41
J42
J43
J44
J45
J46
JOG
Multi stage speed1
Multi stage speed2
VR0
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
STOP
Ope. Key
Wiring Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Orange
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
* 1. Meter Impedance 10~20KΩ
DWN. M.Suzuki 88-02-10
CHKD. T.Shintani do
APPD. K.Funatsu "
TITLE
HFC-VWS2 5SF3EH
SEQUENCE DIAGRAM
Hitachi. Ltd.
Tokyo Japan
HITACHI WORKS DWG. NO.
324 3T804649
REV.


PM
DM
PI
P
RS
84
84a
ZNR
C
CB
C10
CT2
CT2
CT2
U
V
W
M
PE
FAN
SH
PR
THR
CD
BUP
EUP
BVP
EVP
BWP
EWP
BUN
EUN
BVN
EVN
BWN
EWN
J92
J93
J91
J47
J31
J11
J12
J54
J55
J56
RSB
J41
J42
J43
J44
J45
J46
JOG
Multi stage speed1
Multi stage speed2
VRO
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
EVR
REV RDN
STOP
Ope. Key
Wiring Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Orange
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
* 1. Meter impedance 10~20KΩ
REV.
DWN. M.Suzuki 88-12-23
CHKD. T.Shinoda do
APPD. K.Ryuzaki "
TITLE
HFC-VWS3 5SF3EH
SEQUENCE DIAGRAM
Hitachi, Ltd.
Tokyo Japan
HARASHINO WORKS DWG. NO.
324 3T804650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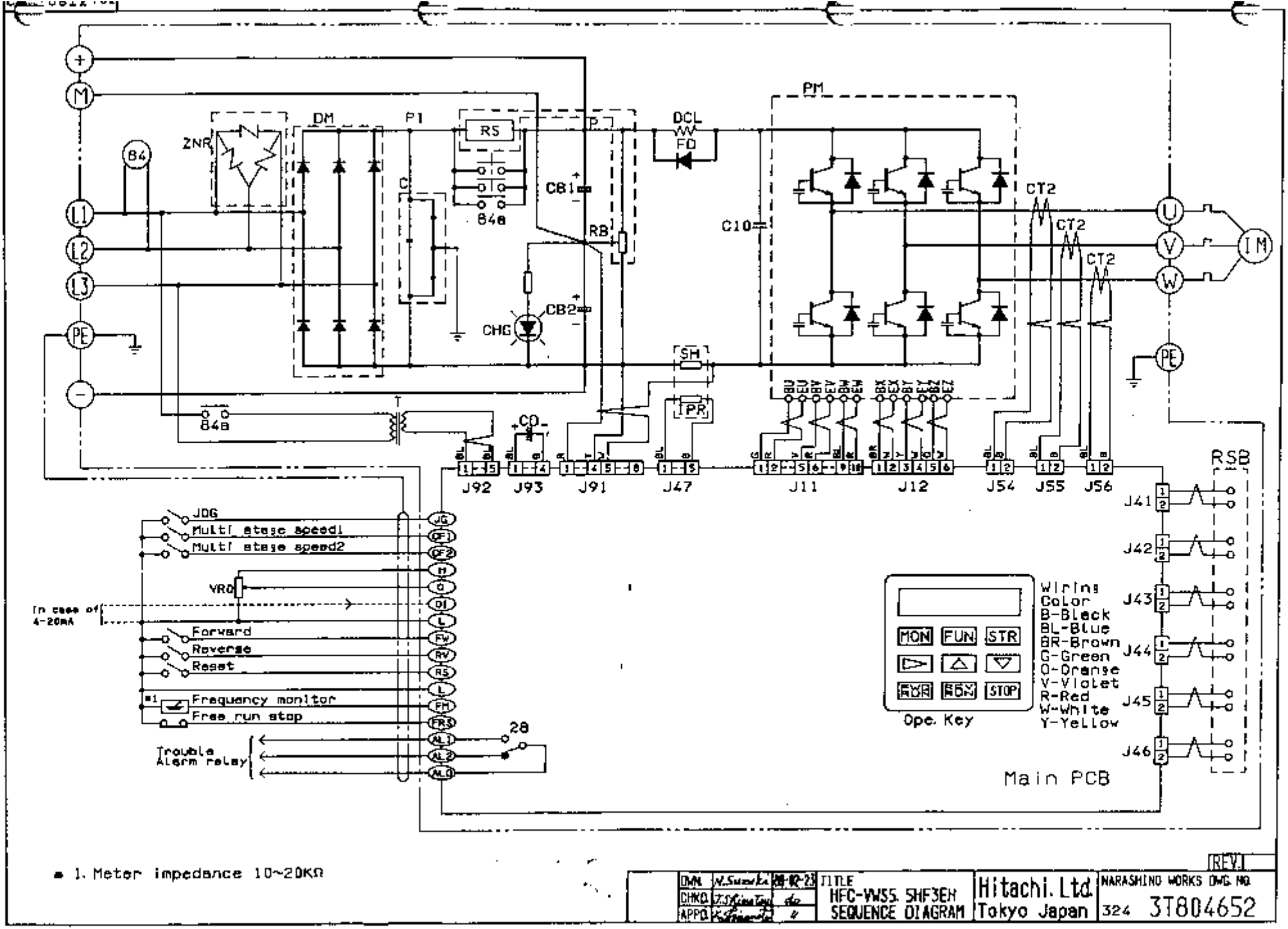
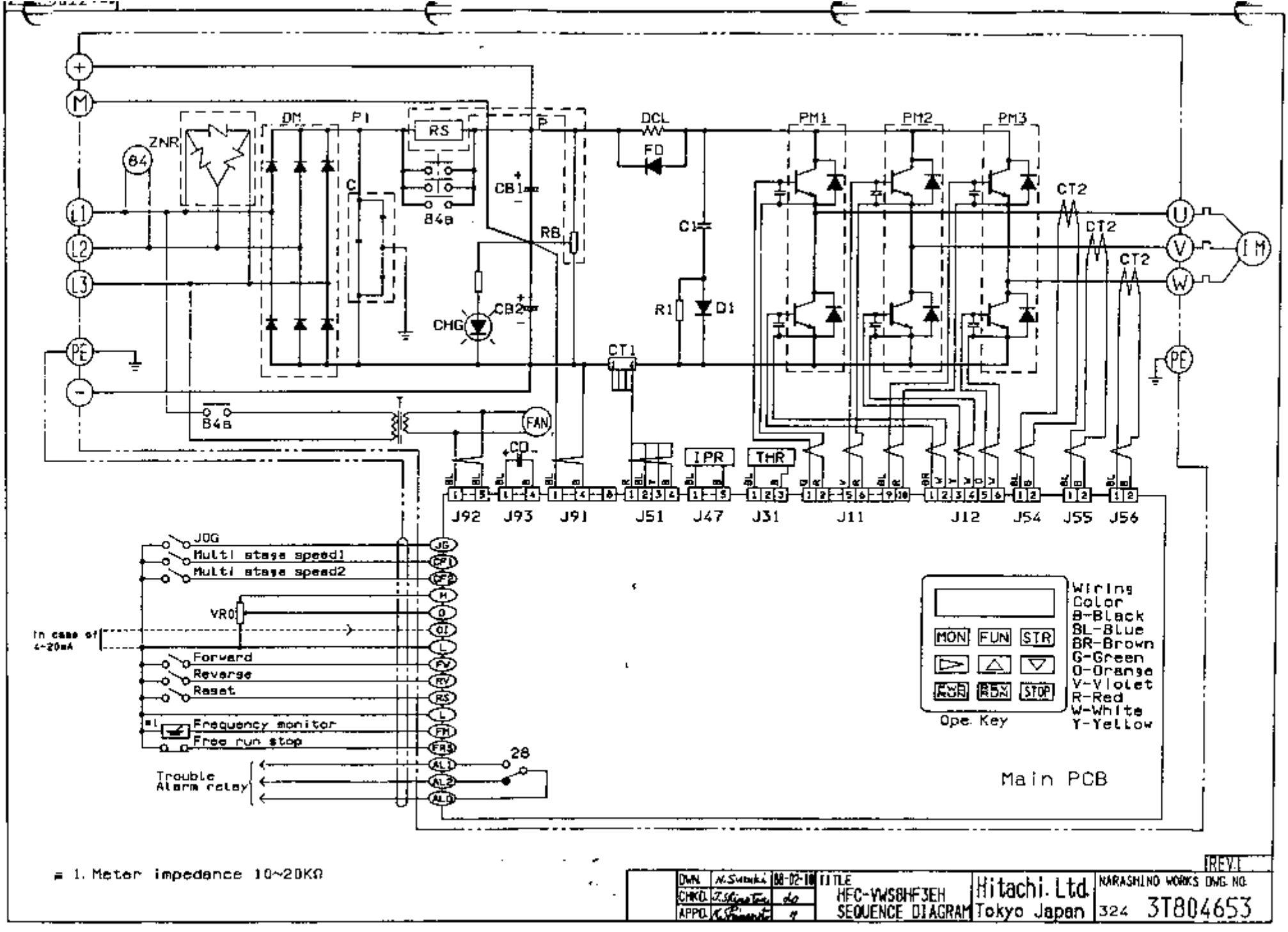
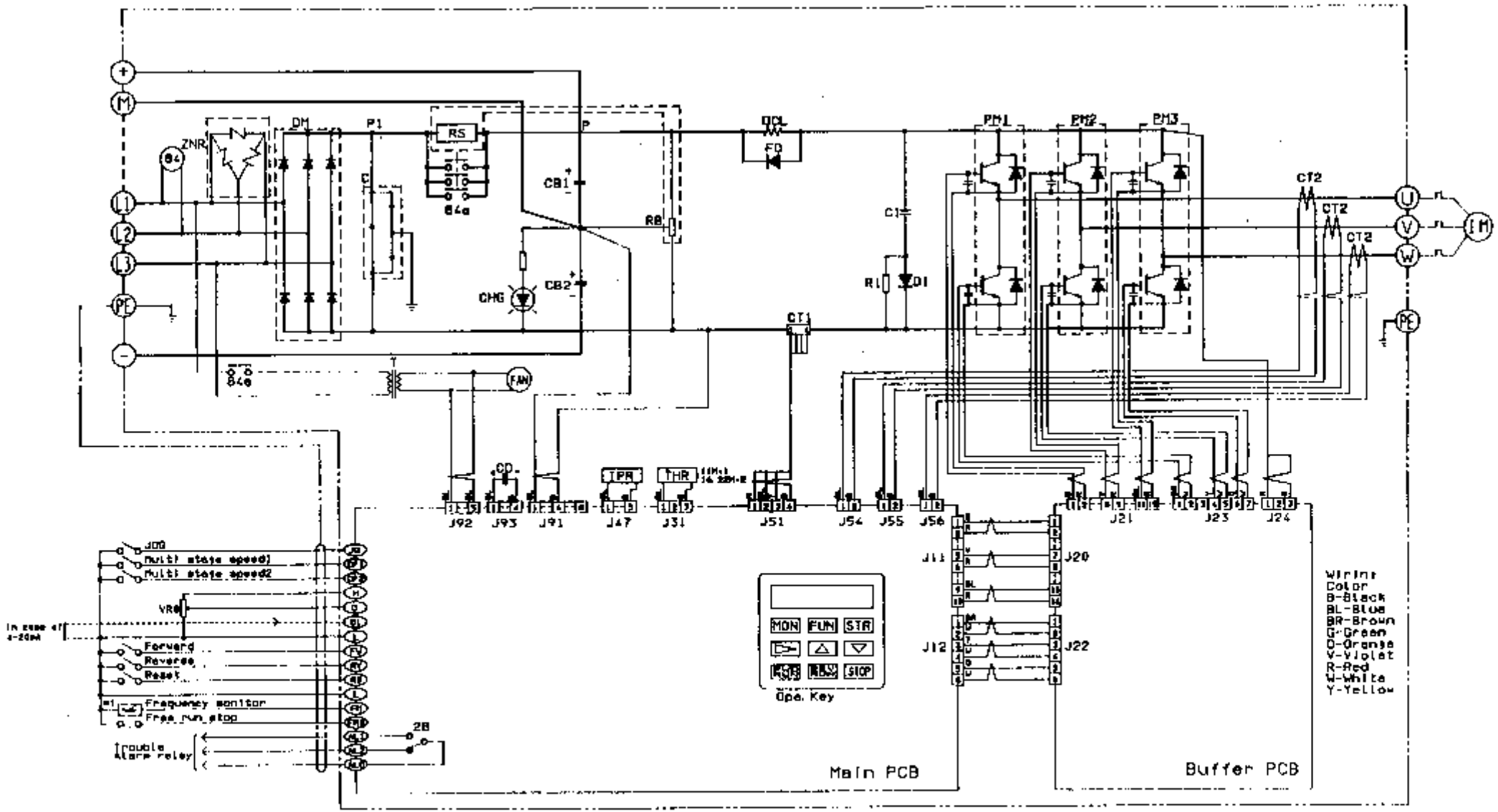
DM
P
RS
DCL
FO
ZNR
B4
C
CB1
B4a
RB
C10
CT2
CT2
CT2
U
V
W
IM
PE
CHG
CB2
SH
T
84a
CO
JPR
J92
J93
J91
J47
J11
J12
J54
J55
J56
JOG
Multi stage speed1
Multi stage speed2
VRD
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
RUN
STOP
Ope. Key
Wirins Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Oranse
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
1. Meter impedance 10~20KΩ
DWN.
CHKD
APPD.
88-02-10
TITLE
HFC-VWS2 5-3 SHF3EH
SEQUENCE DIAGRAM
Hitachi. Ltd
Tokyo Japan
HARASHINO WORKS DWG NO.
324 3T804651
REV.


+
M
L1
L2
L3
PE
−
B4
ZNR
DM
P1
RS
84B
C
CB1
CB2
CHG
P
RB
DCL
FD
PM
C10
CT2
CT2
CT2
U
V
W
IM
PE
SH
IPR
T
84B
+CO-
J92
J93
J91
J47
J11
J12
J54
J55
J56
RSB
J41
J42
J43
J44
J45
J46
JOG
Multi stage speed1
Multi stage speed2
VRO
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
RUN
STOP
Ope. Key
Wiring Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Orange
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
1. Meter impedance 10~20KΩ
REV.
DWN
CHKD
APPD
TITLE
HFC-VWS5 SHF3EH
SEQUENCE DIAGRAM
Hitachi. Ltd.
Tokyo Japan
HARASHINO WORKS DWG NO.
324 3T804652

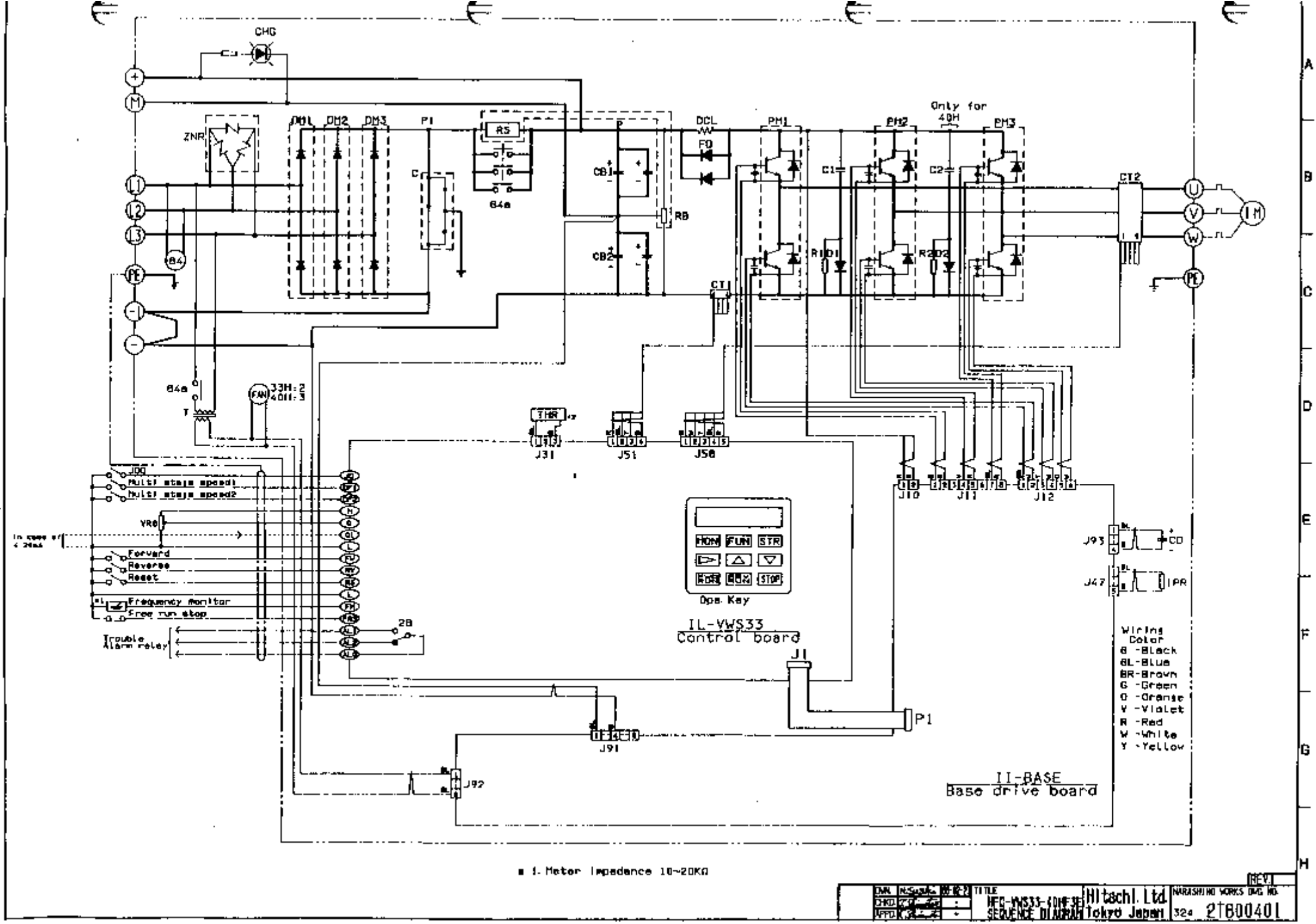

DM
P1
RS
P
DCL
FD
PM1
PM2
PM3
ZNR
84
C
CB1
84B
RB
C1
CT2
CT2
CT2
R1
D1
CHG
CB2
CT1
U
V
W
IM
L1
L2
L3
PE
B4B
FAN
CD
IPR
THR
J92
J93
J91
J51
J47
J31
J11
J12
J54
J55
J56
JOG
Multi stage speed1
Multi stage speed2
VRO
In case of 4-20mA
Forward
Reverse
Reset
Frequency monitor
Free run stop
Trouble Alarm relay
28
MON
FUN
STR
RSR
RSN
STOP
Ope. Key
Wiring Color
B-Black
BL-Blue
BR-Brown
G-Green
O-Orange
V-Violet
R-Red
W-White
Y-Yellow
Main PCB
1. Meter impedance 10~20KΩ
REV.I
DWN. M.Suzuki 88-02-10
CHKD. T.Shimotsu do
APPD. K.Shimada "
TITLE
HFC-VWS8HF3EH
SEQUENCE DIAGRAM
Hitachi. Ltd.
Tokyo Japan
HARASHINO WORKS DWG NO.
324 3T804653

41



* 1. Meter Impedance 10~20KΩ

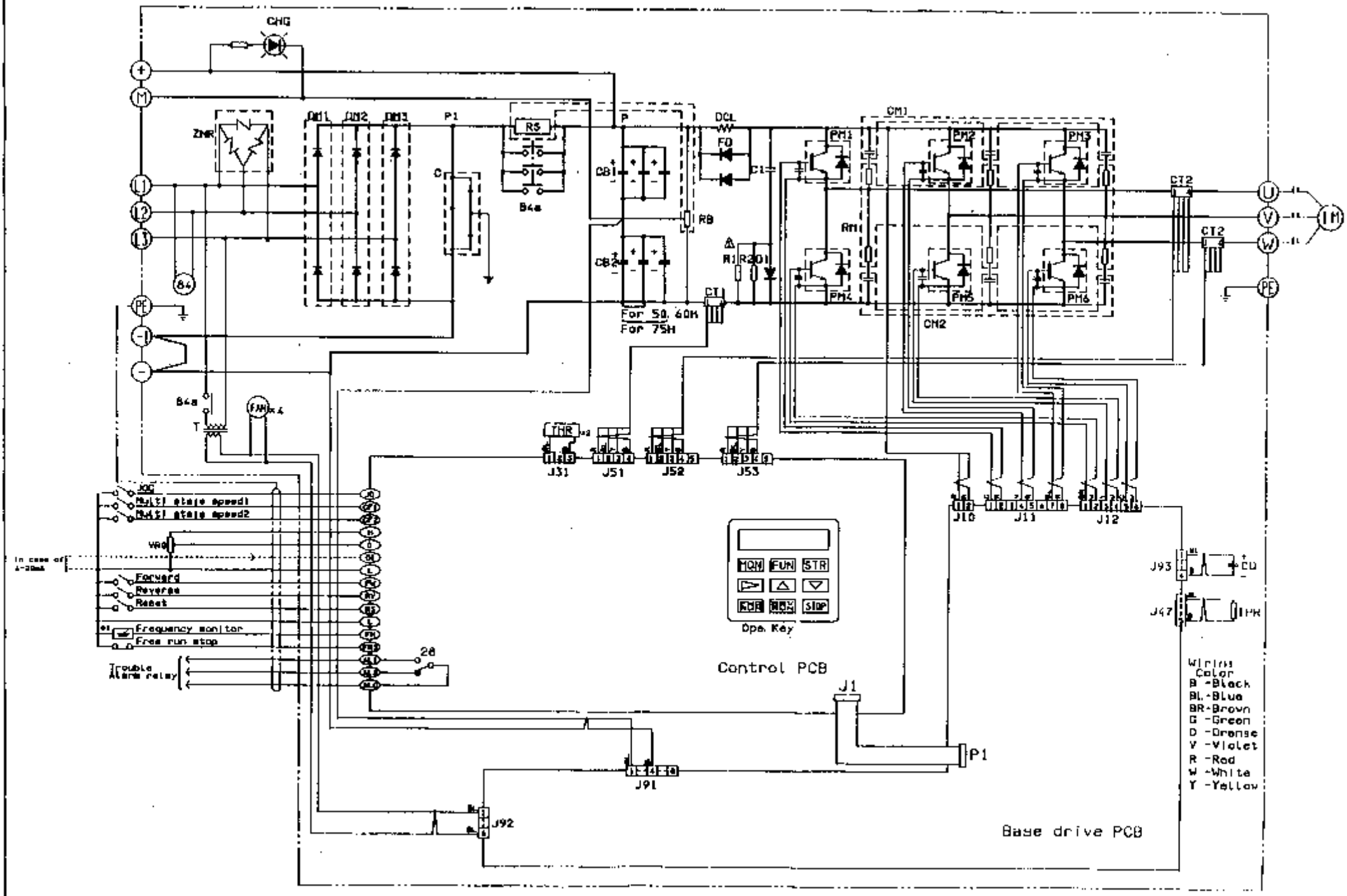
DWN		TITLE	Hitachi, Ltd. Tokyo Japan	HARASHINO WORKS DWG NO.	REV
CKD		NFC-VW511-22HF SEQUENCE DIAGRAM		324 21B00403	
APPD					



■ 1. Motor impedance 10~20KΩ

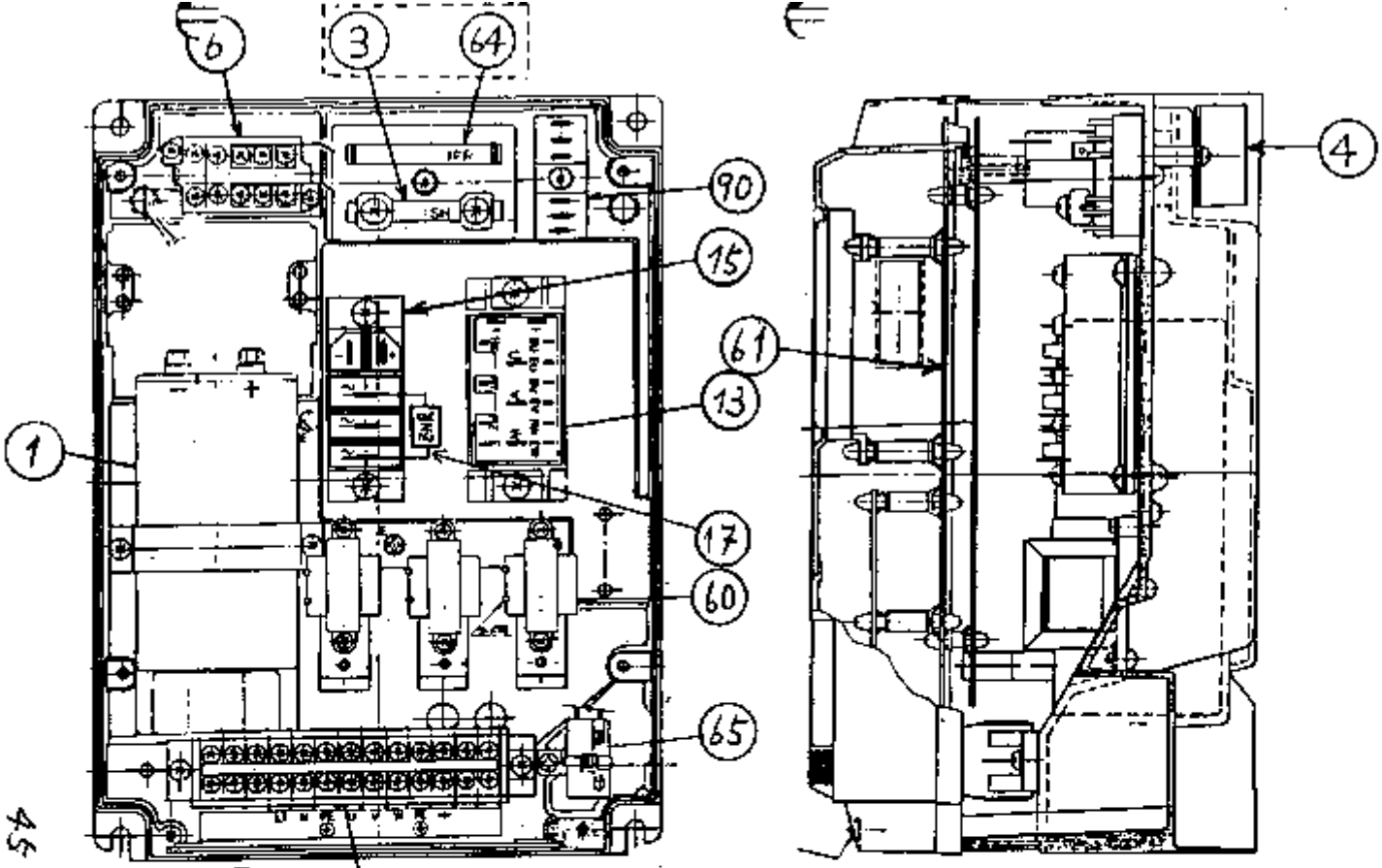
DWN			TITLE	Hitachi. Ltd.	HARASHINO WORKS DWG NO.
CHKD			NES-VWS33-(0HF3E) SEQUENCE DIAGRAM	Tokyo Japan	324 2T600401
APPD					

43



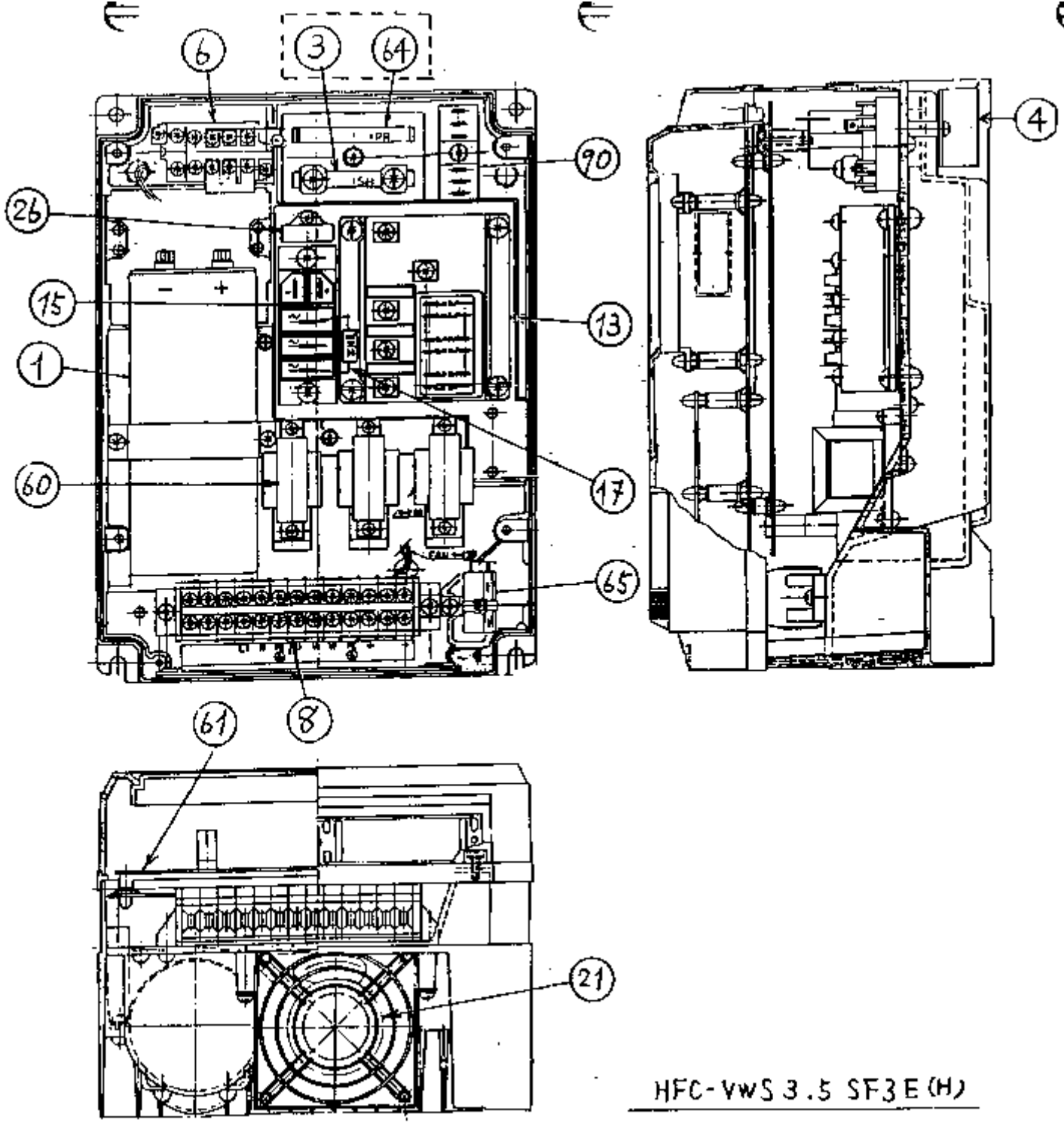
* 1. Motor impedance 10-20KΩ

DWN			TITLE	Hitachi, Ltd	HARASHINO WORKS DWG NO.
CH			NFC-VW550-75HF3E	Tokyo Japan	21800402
APP			SCHEMATIC DIAGRAM		



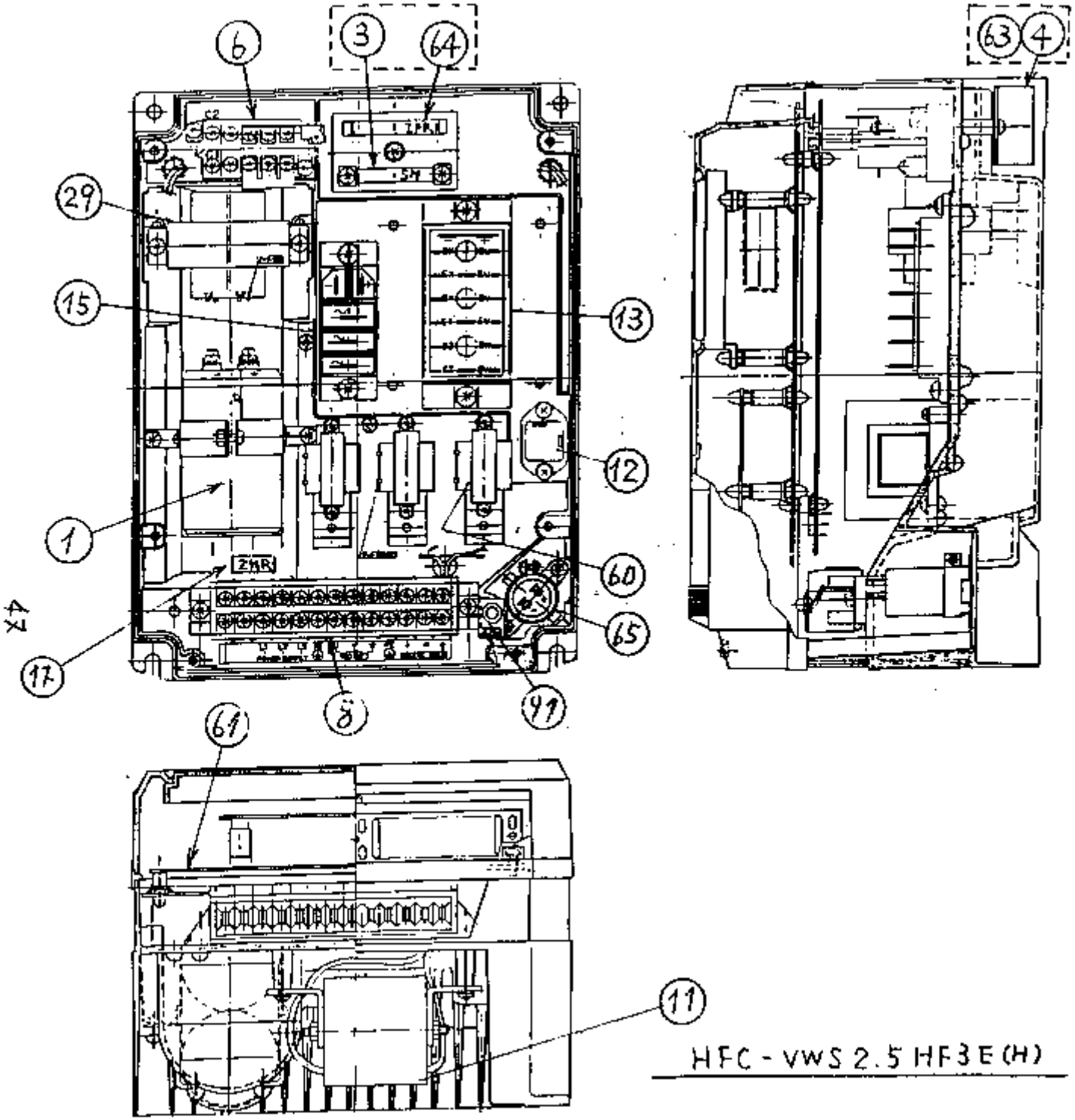
NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	1
3	SH	SHUNT RESISTOR	1
4	RS	CURRENT LIMITING RES.	1
6	8M	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	
		only 2.5 SF3E(H)	
13	PM	TRANSISTOR MODULE	1
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSORBER	1
60	CT2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD (Control)	1
64	IPR	RESISTOR	1
65	CD	CONDENSER	1
90	RSB	BASE DRIVE RESISTOR	1
		only 2.5 SF3E(H)	

HFC-VWS 1.5, 2.5 SF3E (H)



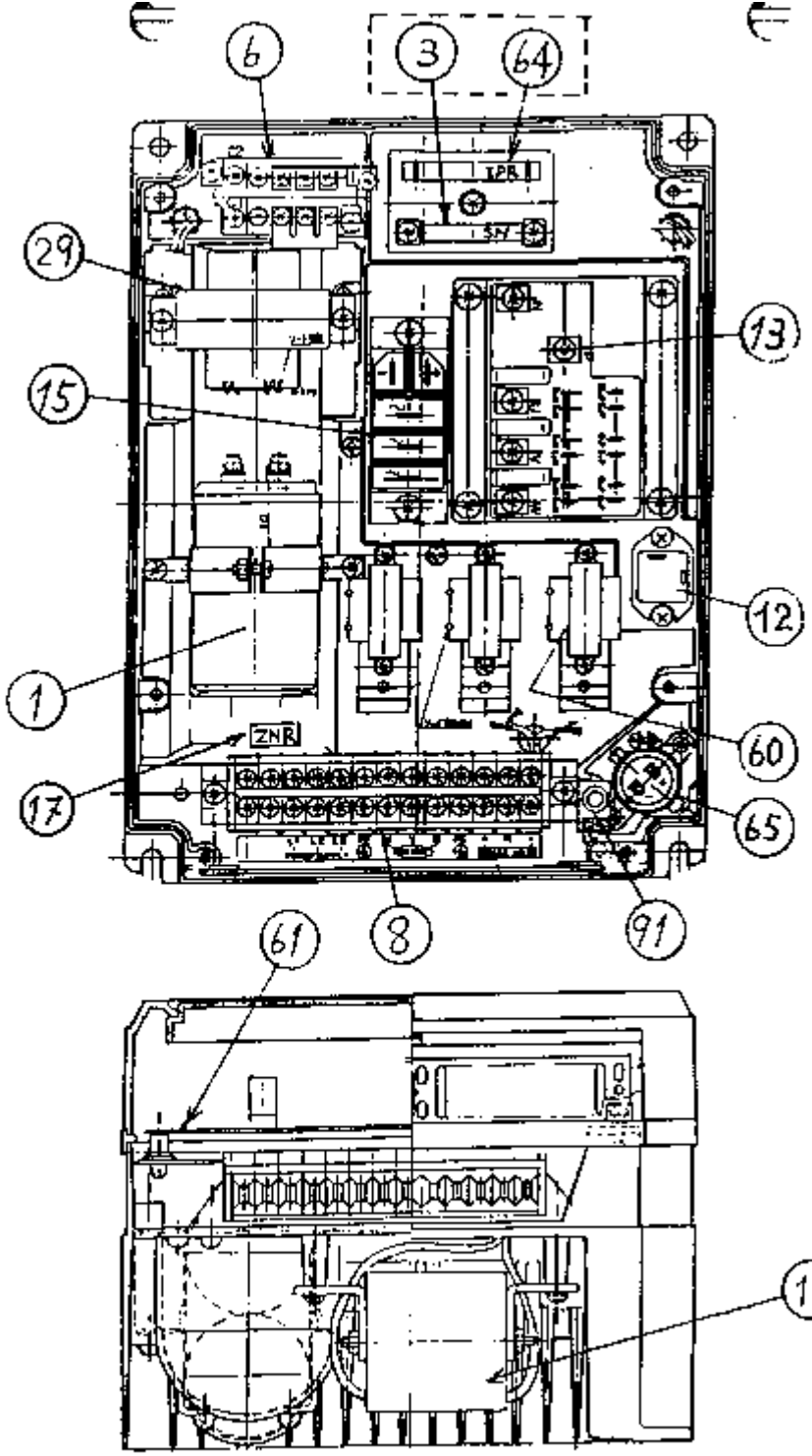
HFC-VWS 3.5 SF3E(H)

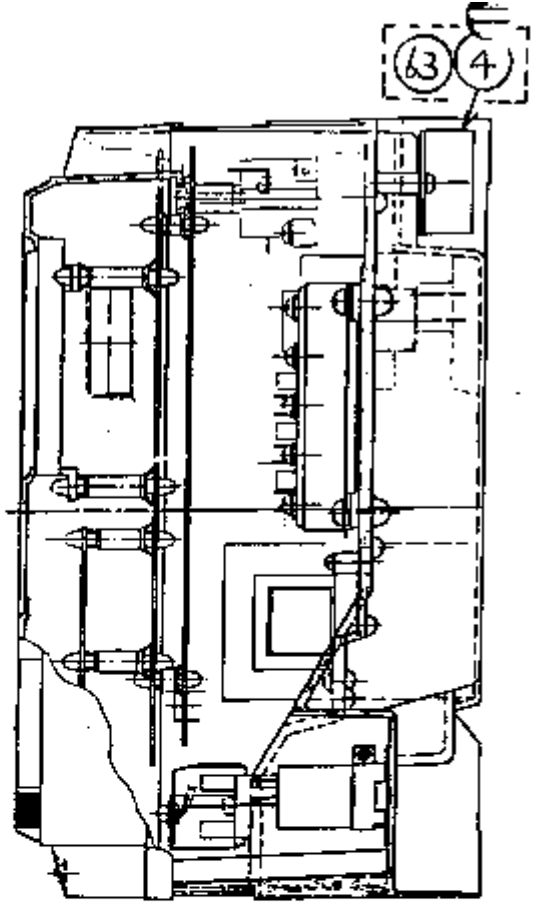
NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	1
3	SH	SHUNT RESISTOR	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TH	TERMINAL	1
13	PM	TRANSISTOR MODULE	1
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSOBBER	1
21	FAN	COOLING FAN	1
26	THR	THERMAL RELAY	1
60	CT 2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD (control)	1
64	PR	RESISTOR	1
65	CD	CONDENSER	1
90	RSB	BASE RESISTOR	1



HFC - VWS 2.5 HF3E (H)

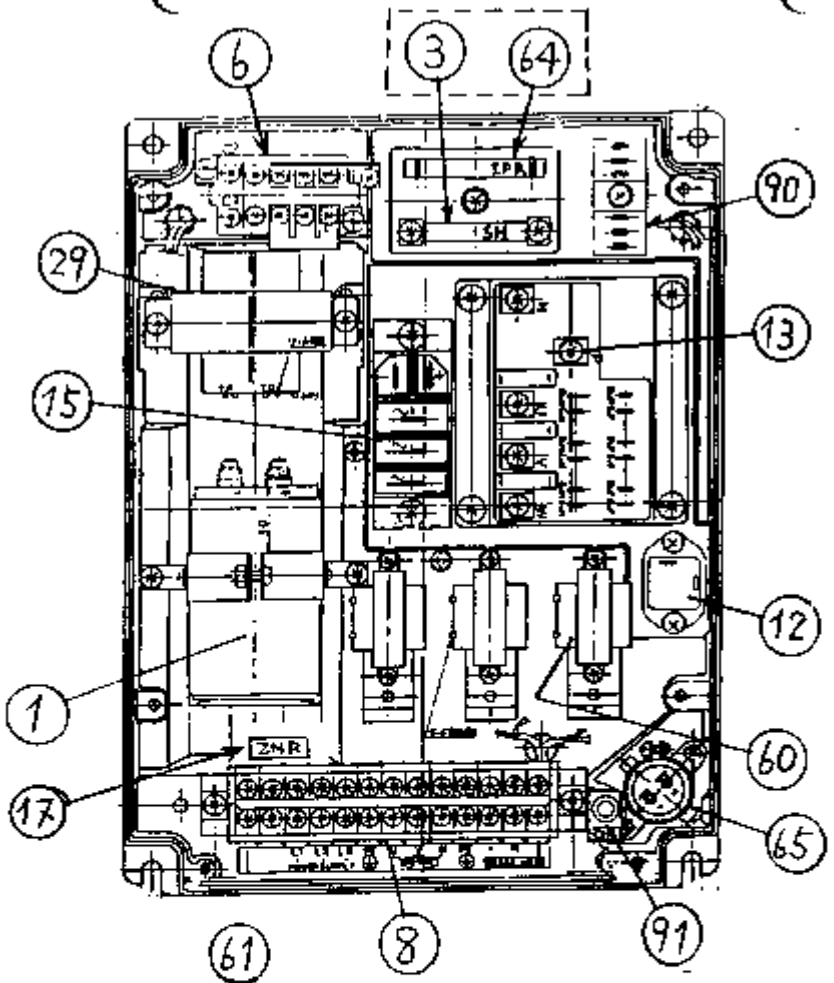
NO	MARK	PARTS NAME	q'ty/UNIT
1	CB	SMOOTHING CONDENSER	2
3	SH	SHUNT RESISTOR	1
4	RS	CURRENT LIMITING RES.	1
6	B4	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	1
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSORBER	1
29	T	TRANSFORMER	1
60	CT 2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD (Control)	1
63	RB	BALANCE RESISTOR	1
64	PR	RESISTOR	1
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1

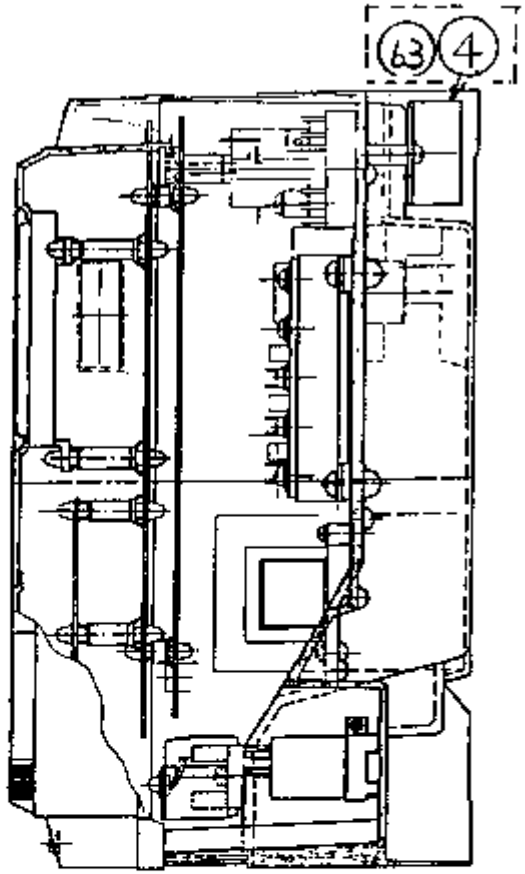


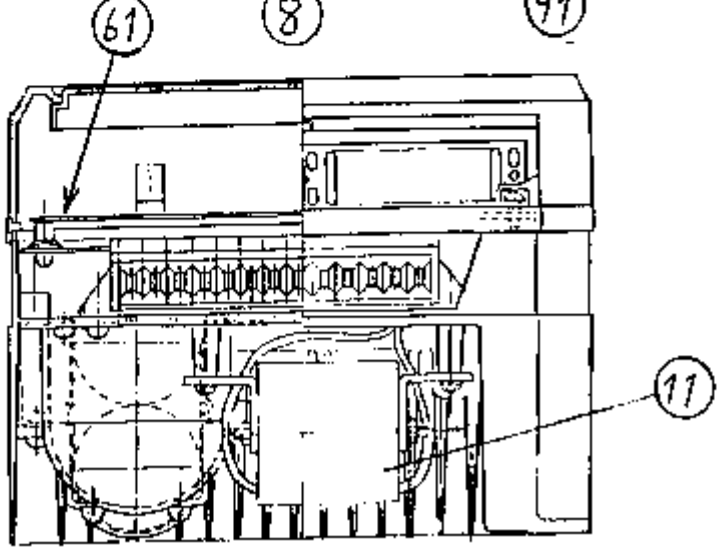


NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	2
3	SH	SHUNT RESISTOR	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	1
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSORBER	1
29	T	TRANSFORMER	1
60	CT 2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD (Control)	1
63	RB	BALANCE RESISTOR	1
64	IPR	RESISTOR	1
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1

HFC-VWS 3.5 HF3E(H)

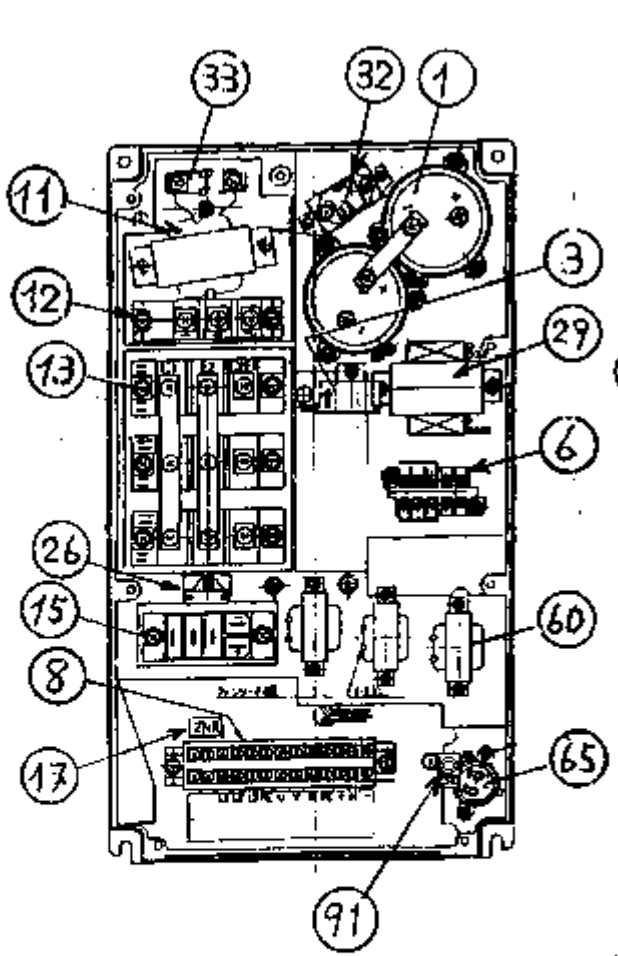


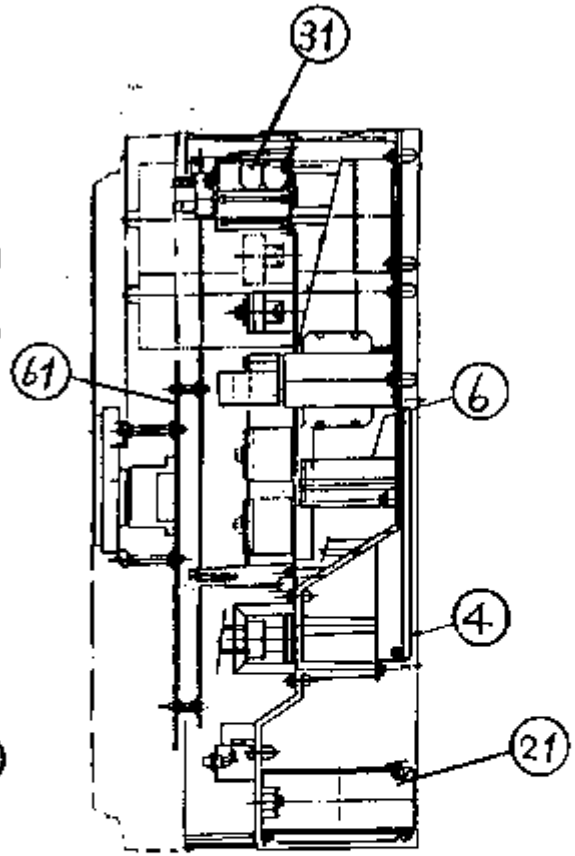


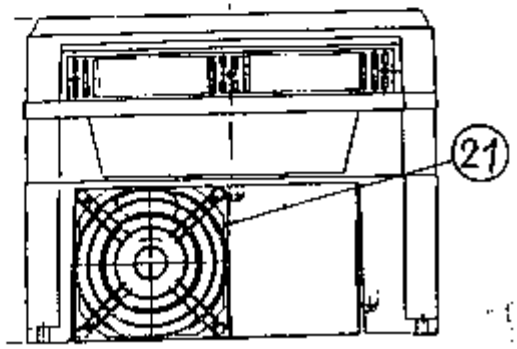


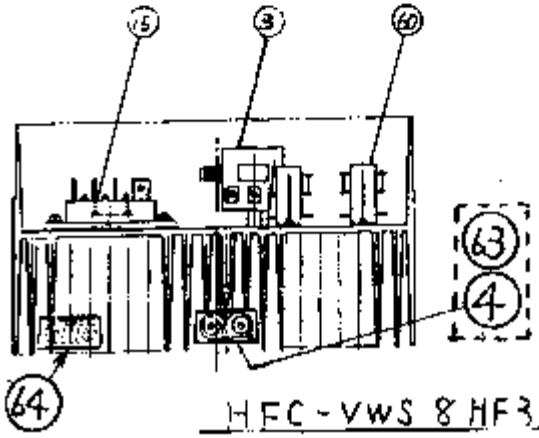
HFC-VWS5.5HF3E(H)

NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	2
3	SH	SHUNT RESISTOR	1
4	RS	CURRENT LIMITING RES.	1
E	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	1
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSOBBER	1
29	T	TRANSFORMER	1
60	CT2	CURRENT TRANSFORMER	2(3)
61	PCB	PRINTED BOARD (control)	1
63	RB	BALANCE RESISTOR	
64	IPR	RESISTOR	1
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1
90	RSB	BASE RESISTOR	1



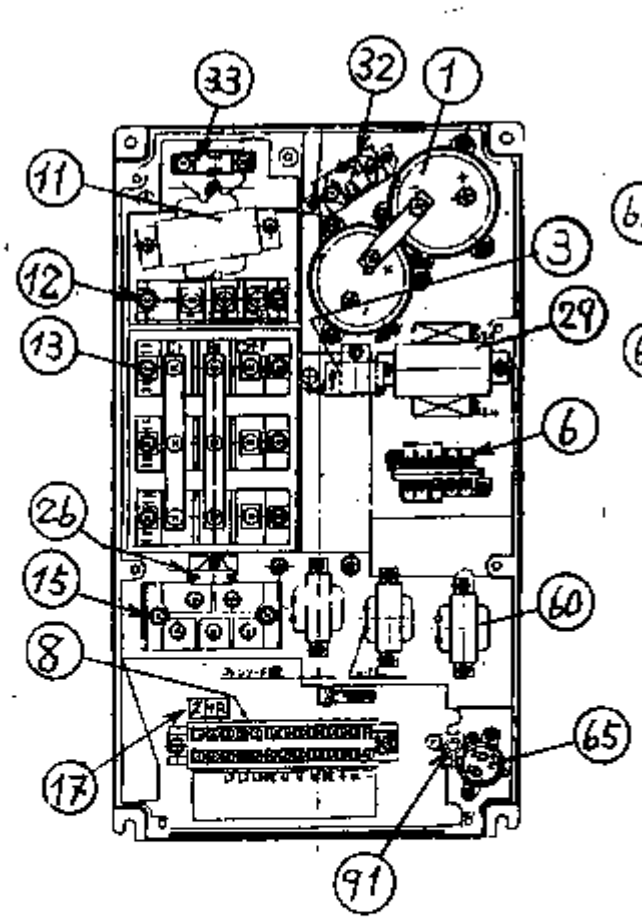


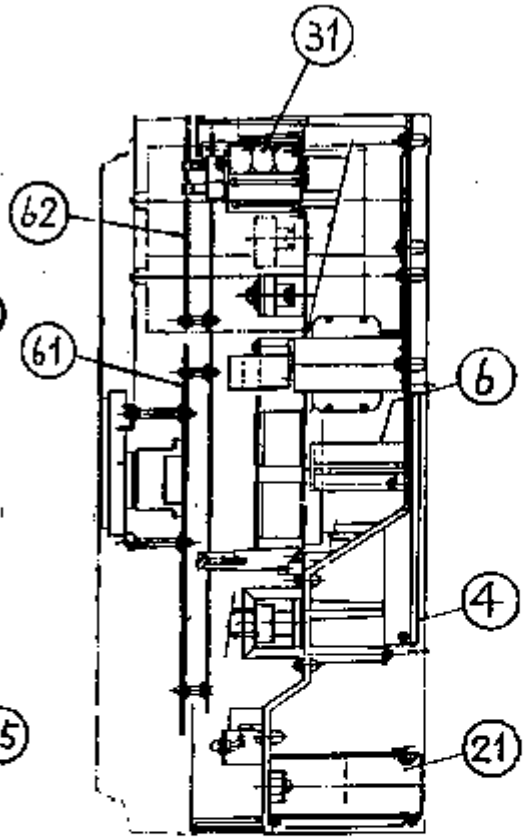


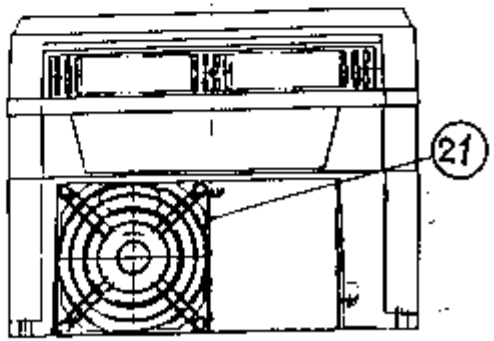


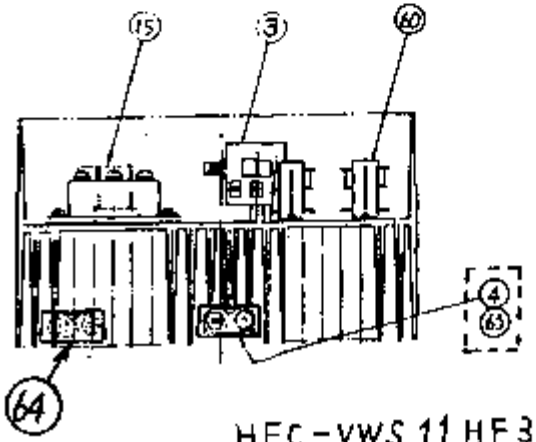
NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	2
3	CT 1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	B4	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	3
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSOBBER	1
21	FAN	COOLING FAN	1
26	THR	THERMAL RELAY	1
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	2
32	D1	SNUBBER DIODE	1
33	R1	SNUBBER RESISTOR	1
60	CT 2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD(Control)	1
63	RB	BALANCE RESISTOR	1
64	IPR	RESISTOR	1
65	CC	CONDENSER	1
91	CHG	CHARGING LAMP	1

HEC-VWS 8HP3E(H)



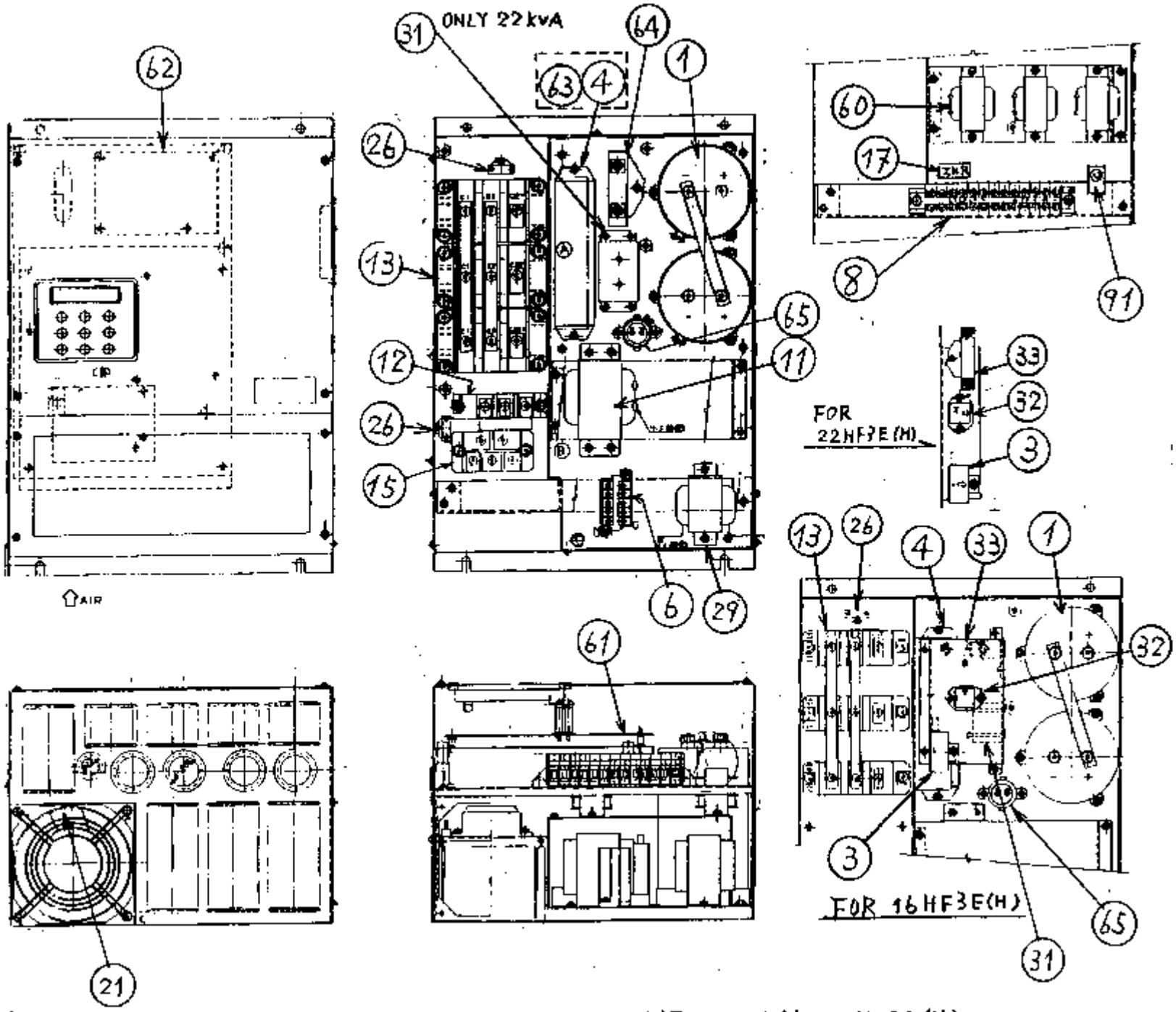






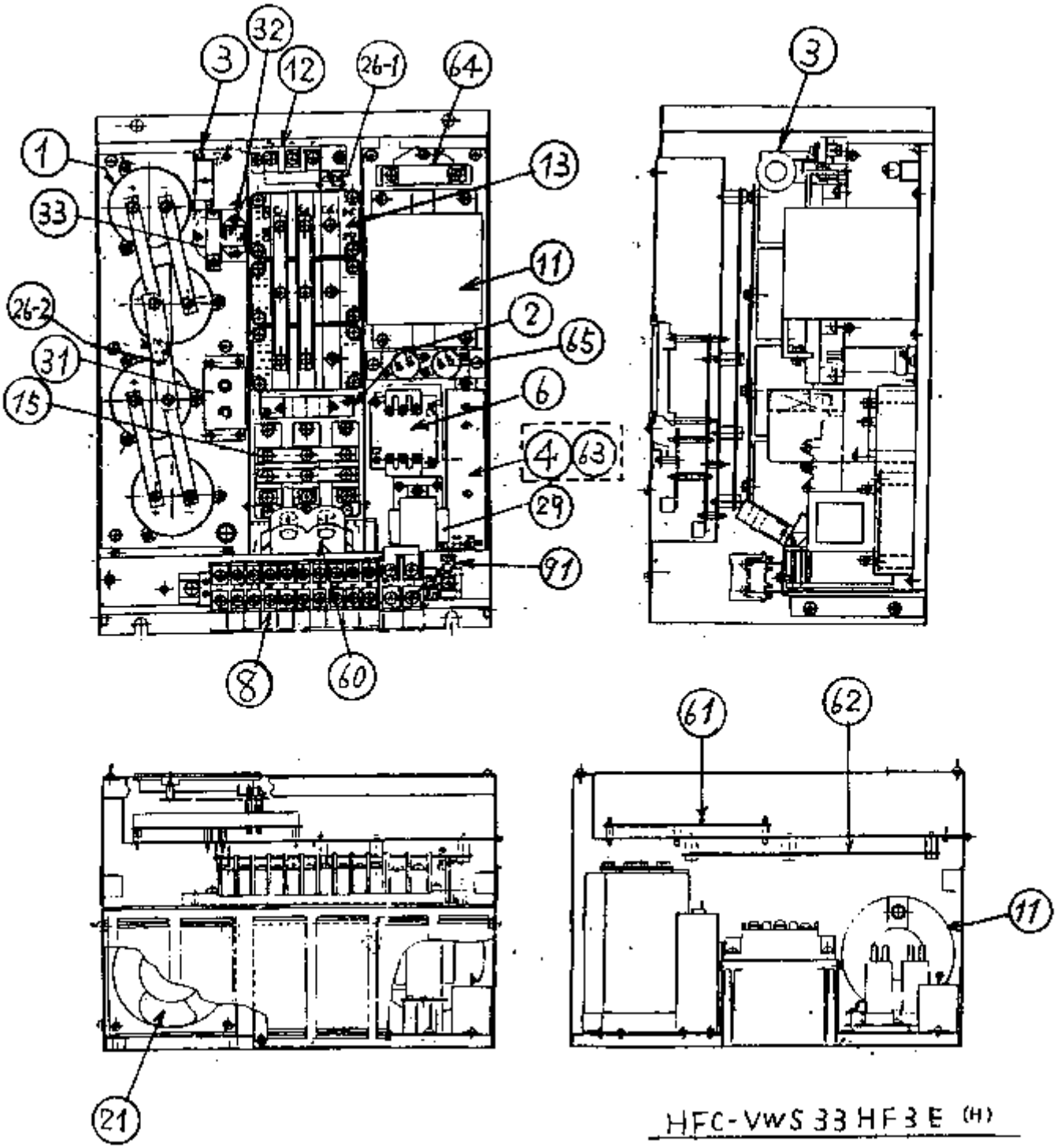
NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	2
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TH	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	3
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSOBBER	
21	FAN	COOLING FAN	1
26	THR	THERMAL RELAY	1
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	3
32	D1	SNUBBER DIODE	1
33	R1	SNUBBER RESISTOR	1
60	CT2	CURRENT TRANSFORMER	1
61	PCB	PRINTED BOARD(control)	1
62	PCB	BUFFER PCB	1
64	IPR	RESISTOR	1
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1
63	RB	BALANCE RESISTOR	1

HFC-VWS 11 HF3 E (H)



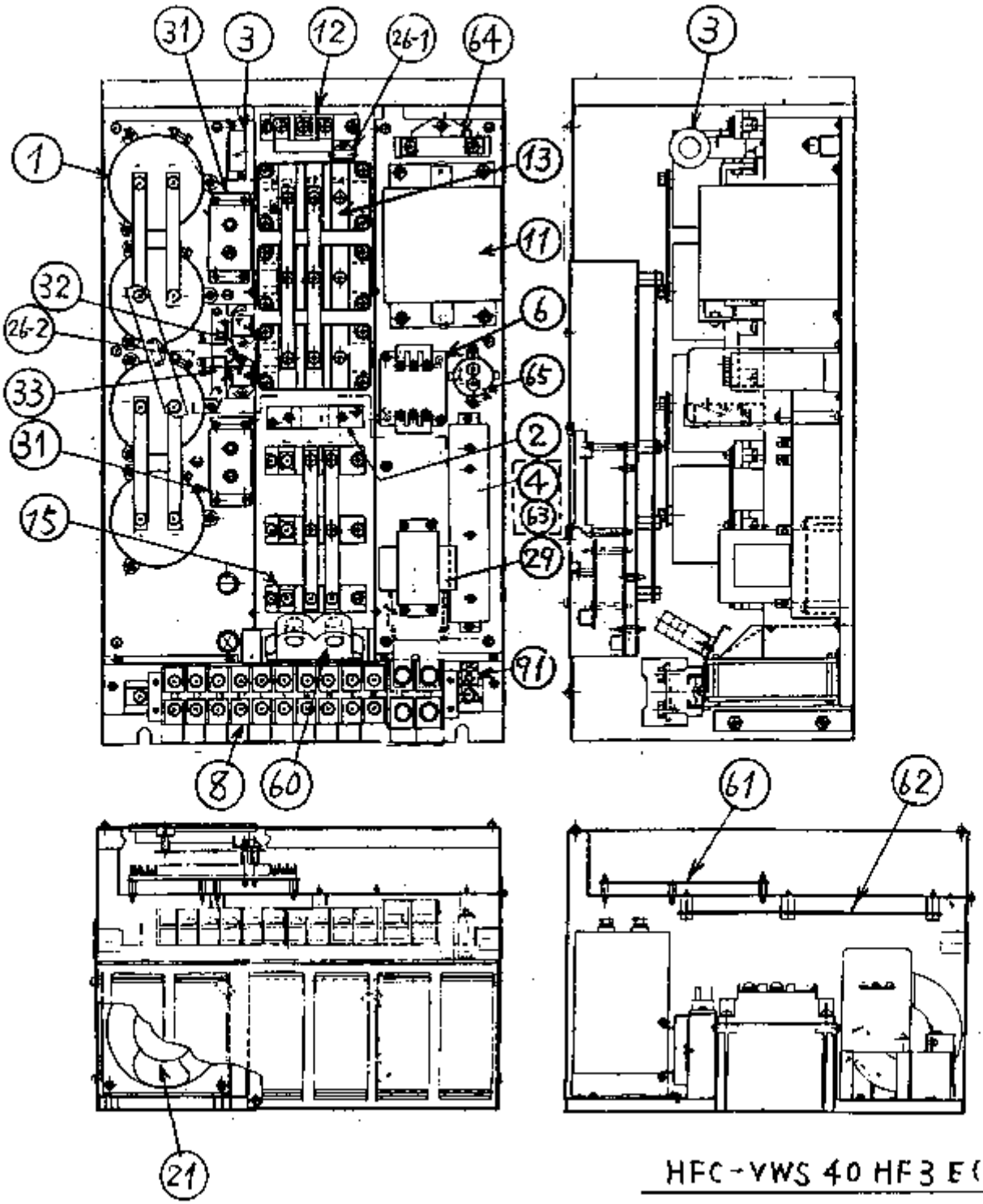
NO	MARK	PARTS NAME	Y'K / U
1	CB	SMOOTHING CONDENSER	2
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	3
15	DM	DIODE MODULE	1
17	ZNR	SURGE ABSORBER	1
21	FAN	COOLING FAN	1
26	THR	THERMAL RELAY	2
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	1
32	D1	SNUBBER DIODE	1
33	R1	SNUBBER RESISTOR	1
63	RB	BALANCE RESISTOR	1
60	CT2	CURRENT TRANSFORMER	2 (3)
61	PCB	PRINTED BOARD(control)	1
62	PCB	BUFFER PCB	1
64	IPR	RESISTOR	
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1

HFC-VWS16,22HF3E(H)



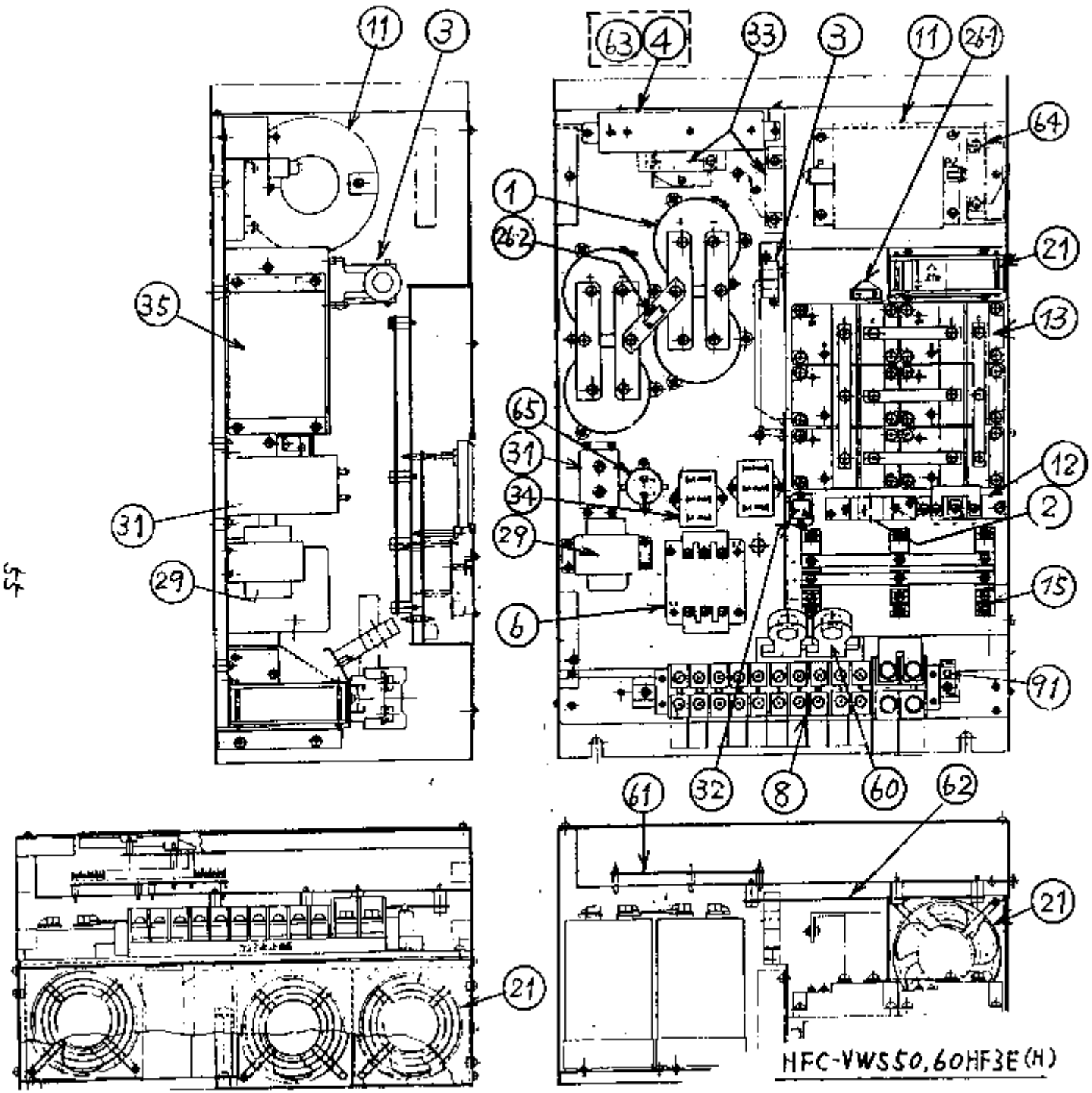
HFC-VWS 33 HF3E (H)

NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	4
		ONLY 33HF3EH	
2	ZCT	CT FOR G.F.P	0 (1)
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	3
15	DM	DIODE MODULE	3
17	ZNR	SURGE ABSORBER	1
21	FAN	COOLING FAN	2
26-1	THR	THERMAL RELAY (100℃)	1
26-2	THR	THEMAL RELAY(80℃)	1
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	1
32	D1	SNUBBER DIODE	1
33	R1	SNUBBER RESISTOR	1
63	RB	BALANCE RESISTER	1
60	CT2	CURRENT TRANSFORMER	1
61	PCB	PRINTED BOARD (control)	1
62	PCB	BASE DRIVE PCB	1
64	IPR	RESISTOR	1
65	CD	CONDENSER	2
91	CHG	CHARGING LAMP	1

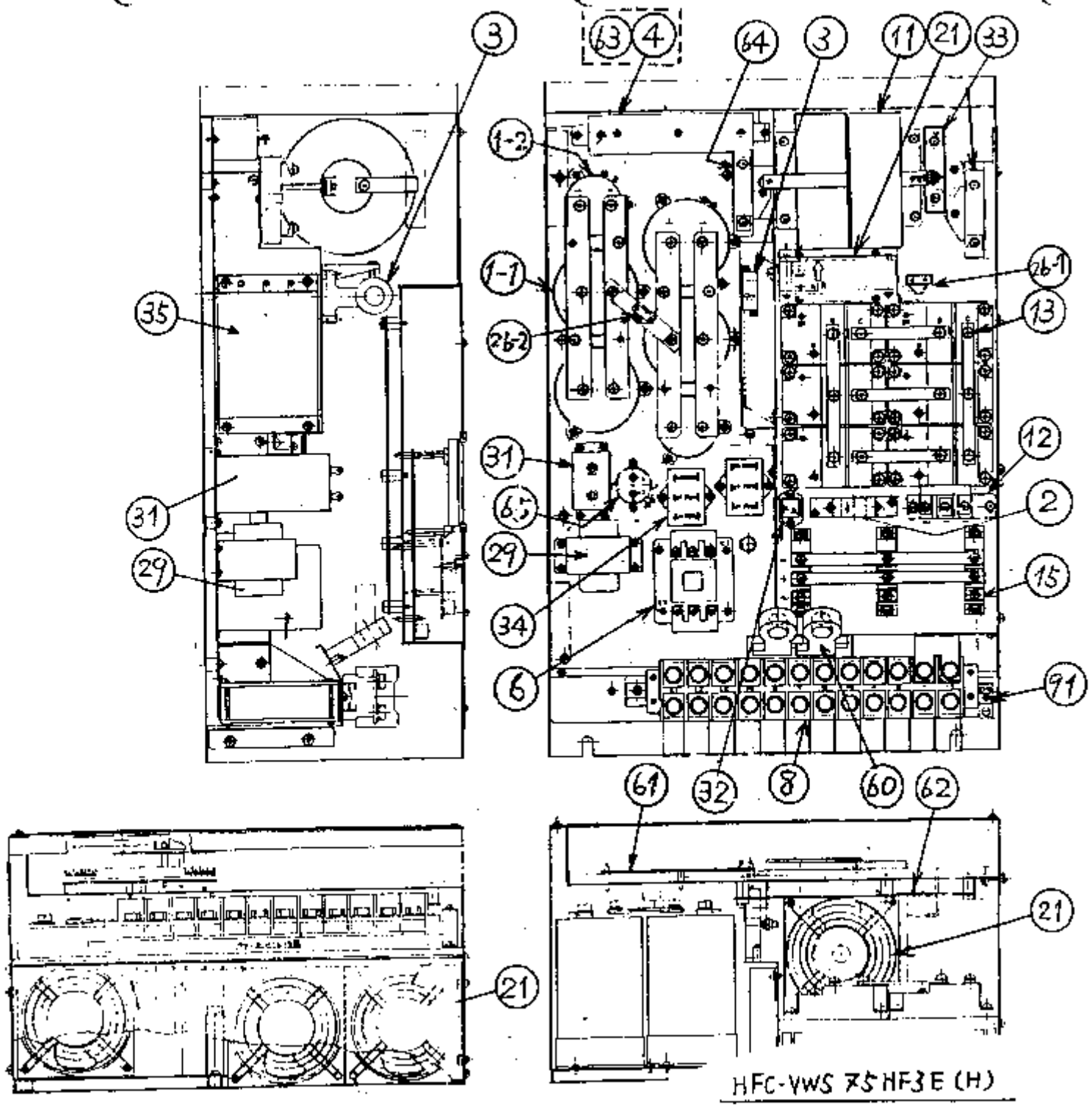


HFC-VWS 40 HF3 E(H)

NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	4
		ONLY 40HF3EH	
2	ZCT	CURRENT TRANSFORMER	0(1)
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	3
15	DM	DIODE MODULE	3
17	ZNR	SURGE ABSORBER	
21	FAN	COOLING FAN	3
26-1	THR	THERMAL RELAY (100°C)	1
26-2	THR	THERMAL RELAY (80°C)	1
29	T	TRANSFORMER	1
31	C1, C2	SNUBBER CONDENSER	2
32	D1, D2	SNUBBER DIODE	2
33	R1, R2	SNUBBER RESISTOR	2
63	RB	BARANCE RESISTOR	1
60	CT2	CURRENT TRANSFORMER	1
61	PCB	PRINTED BOARD(CONTROL)	1
62	PCB	BASE DRIVE PCB	1
64	IPR	RESISTOR	1
65	CO	CONDENSER	1
91	CHG	CHARGING LAMP	1

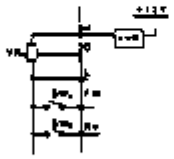
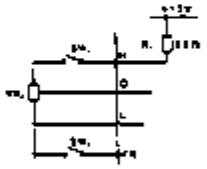
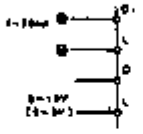
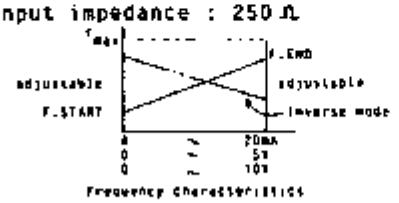
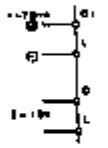
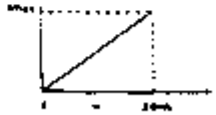
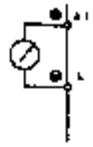


NO	MARK	PARTS NAME	Q'TY/UNIT
1	CB	SMOOTHING CONDENSER	4
2	ZCT	CURRENT TRANSFORMER	0 (1)
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	84	MAGNETIC CONTACTOR	1
8	TM	TERMINAL	1
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	6
15	DM	DIODE MODULE	3
16	C	CONDENSER	
17-1	ZNR	SURGE ABSORBER	
21	FAN	COOLING FAN	4
26-1	THR	THERMAL RELAY (100℃)	1
26-2	THR	THERMAL RELAY (80℃)	1
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	1
32	D1	SNUBBER DIODE	1
33	R1, R2	SNUBBER RESISTOR	2
34	CM	SNUBBER CONDENSER	2
35	RM	SNUBBER RESISTOR	1
60	CT2	CURRENT TRANSFORMER	2
61	PCB	PRINTED BOARD (control)	1
62	PCB	BASE DRIVE PCB	1
64	IPR	RESISTOR	1
65	CD	CONDENSER	1
91	CHG	CHARGING LAMP	1
63	RB	BALANCE RESISTOR	



NO	MARK	PARTS NAME	QTY/UNIT
1-1	CB	SMOOTHING CONDENSER	4
1-2	CB	SMOOTHING CONDENSER	2
2	ZCT	CURRENT TRANSFORMER	0(1)
3	CT1	CURRENT TRANSFORMER	1
4	RS	CURRENT LIMITING RES.	1
6	B4	MAGNETIC CONTACTOR	1
8 *	TM	TERMINAL	1
	*		
11	DCL	DC REACTOR	1
12	FD	FLY WHEEL DIODE	1
13	PM	TRANSISTOR MODULE	6
15	DM	DIODE MODULE	3
17	ZNR	SURGE ABSOBBER	1
21	FAN	COOLING FAN	4
26-1	THR	THERMAL RELAY (100℃)	1
26-2	THR	THERMAL RELAY (80℃)	1
29	T	TRANSFORMER	1
31	C1	SNUBBER CONDENSER	1
32	D1	SNUBBER DIODE	1
33	R1.R2	SNUBBER RESISTOR	2
34	CM	SNUBBER CONDENSER	2
35	RM	SNUBBER RESISTOR	1
60	CT2	CURRENT TRANSFORMER	2
61	PCB	PRINTED BOARD (control)	1
62	PCB	BASE DRIVE PCB	1
64	IPR	RESISTOR	1
65	CO	CONDENSER	1
91	CHG	CHARGING LAMP	1
63	RB	BALANCE RESISTOR	1

Comparison of function of terminals

I/O signal	Terminal symbols	VWS3 series	Terminal symbols	VWS2,VWS1 series
Start/stop operation command Forward operation command(FW) Reverse operation command(RV)	H O L FW RV	Frequency is set in "Monitor mode" and START/STOP command is selected in "Terminal mode" by D-OPE.  SWF {ON .Forward rotation {OFF :Reverse rotation SWR {ON :Reverse rotation {OFF :Stop When SWF and SWR are ON at the same time,output turns off.	H O L FR	 SW1 {ON :Forward rotation {OFF :Stop SW2 {ON :Reverse rotation {Off :Forward rotation
Frequency setting command (Voltage input)	O L	When the voltage between O and L is 10V,frequency becomes maximum. ⓐ The voltage between H and L is regulated as 10V (AVR). ⓑ 500~2kΩ resistor is available for VRO because of AVR. When the analogue command(O-L) is applied,the gain and bias of frequency can be adjusted by means of D-OPE(F-26(F-START),F-27(F-END)). F_{max} can be adjusted by F-3($+f_{max}$)	O L	When the voltage between O and L is 10V,frequency becomes maximum. ⓐ The voltage between H and L is 10v. ⓑ When the value of VRO is 500Ω, the voltage(H-L) is 10V. ⓒ When the value of VRO is 1kΩ, the voltage becomes as follows: $\frac{1000}{1082} \times 12^{V} = 11^{V}$ VRO mustn't be set as more than 90% because the voltage exceeds normal voltage by 10%, when 1kΩ used.
Frequency setting command (current input)	OI L	 Input impedance : 250Ω  Frequency characteristics The start(F.START) and end (F.END) of the output frequency can be adjusted by F-26 and F-27 against the input current(4~20mA). The inverse mode can be set.	OI L	 Input impedance : 500Ω BI-NVI2 shortcircuited : 4~20mA open : 0~16mA  Frequency characteristics
Frequency monitor signal (Current input)	FM L	The frequency monitor signal(FM) can be transmitted by selecting 2 types of signals.Selection is done by D-OPE(F-28,switch 3) Monitor for analogue meter ⓐ 0~10V Full scale (Load resistance:10~22kΩ 1mA max) ⓑ This monitor outputs the duty (t/T) proportional to the output frequency. ⓒ Adjust the variable resistor (M.ADJ) and the variable resistor of frequency counter itself so that the meter is maximum at the highest frequency. Digital monitor for frequency counter The monitor output is as follows  	AI L	Analogue meter is available.  0~10V Full scale (Load resistance:10~22kΩ 1mA max)
Fault reset	RS L	Reset is possible after 1.5 10sec have passed since power supply turns off. (The time depends on models.) RS-L isclosed.	RS L	Reset is possible after 0.5 2 sec have passed since power supply turns off. (The time depends on models.) RS-L isclosed.

6-6 CABINET VOLUME/SURFACE AREA TO HOUSE HFC-VWS UNITS

(IP55)

(CONDITIONS)

1.Ambient Temp. of OUTSIDE ;max.40°C

2.Ambient Temp. of INSIDE ;max.50°C

3.Heat radiation efficiency ; $\varepsilon \fallingdotseq 0.92$

4.Ratio of dimensions of cabinet ; 9 (Width) : 6 (Depth) : 16 (Hight)

5.INVERTER generation loss ;$P = 0.05 \times INV(kVA) \times 10^3(W)$

6.Location of cabinet(Worst case) ;IN AIR

(FORMULA)

Heat loss by CONVECTION: $Pc = 1.86 \times \Delta Ts^{1.25} \times Sc(W)$

Heat loss by RADIATION : $Pr = 5.67 \times 10^{-8} \times \varepsilon \times ((T + \Delta Ts)^4 - T^4)) \times Sr(W)$

$$P = Pc + Pr$$

where to;

ΔTs ;Temp.rise on the surface of cabinet(°C)

T ;Ambient Temp.(°K)

Sc, Sr ;Effective surface area(m^2)

Then,

$T = 273 + 40 = 313(°K)$

$\Delta Ts = (50-40)/2 = 5(°C)$

$Pc = 13.9 \times Sc$, $Pr = 32.8 \times Sr$

if $Sc = Sr$,

$P = 46.7 \times Sc$

(RESULT)

INV.(kVA)	INV.LOSS(W) P	SURFACE(m^2) Sc	CABINET DIMENSIONS(m) W x D x H
1.5	75	1.61	0.47 x 0.31 x 0.84
2.5	125	2.68	0.61 x 0.41 x 1.08
3.5	175	3.75	0.72 x 0.48 x 1.28
5.5	275	5.89	0.90 x 0.60 x 1.60
7.5	375	8.03	1.05 x 0.70 x 1.87
11	550	11.8	1.28 x0.85 x 2.27
15	750	16.1	1.49 x 1.00 x 2.64
22	1100	23.6	1.80 x 1.20 x 3.20
33	1650	35.3	2.21 x 1.47 x 3.92
40	2000	42.8	2.43 x 1.62 x 4.32
60	3000	64.2	2.97 x 1.98 x 5.28
70	3500	74.9	3.21 x 2.14 x 5.71

NOTE : After building cabinet,Temp.rise should be tested.
If cooling fins are put on cabinet ,dimensions have to be smaller.

This CALUCULATION is only for REFERENCE at your own DESIGHN WITHOUT Hitachi GUARANTEE.

(FOR YOUR REFERENCE)

(IP23)

6-7 SELECTION OF VENTILATING FAN OF INVERTER BOX

When the inverter unit shall be received in the box, it is necessary to keep the ambient temperature as follows:

Enclosed wall mount type(A,& B type)	Not exceed 40°C
Open wall mount type(C type)	Not exceed 50°C

Then please install ventilating fan to ventilate well.

1 Inverter capacity, necessary ventilation and ventilating hole area

1. The calculation examples are given in the list below. [Q is in case of 10°C at temperature (ΔT=10°C)]

Inverter capacity (kVA)	Inverter generation loss(approx. value)(KW)	H Inverter calorific value (Kcal/hr)	Q Necessary ventilation T=10 C (m3/min)	S Ventilating hole area (minimum) (m2)
1.5	0.075	64.5	0.37	0.004
2.5	0.13	108	0.62	0.005
3.5	0.18	151	0.87	0.010
5.5	0.28	237	1.37	0.015
7.5	0.38	322	1.87	0.02
11	0.55	473	2.74	0.03
15	0.75	645	3.73	0.04
22	1.1	946	5.47	0.06
33	1.7	1419	8.21	0.09
40	2.0	1720	9.95	0.11
50	2.5	2150	12.4	0.14
60	3.0	2580	14.9	0.16
70	3.5	3010	17.4	0.20
100	5.0	4300	24.9	0.28
120	6.0	5160	29.9	0.33
150	7.5	6450	37.3	0.42

2. Calculation formula

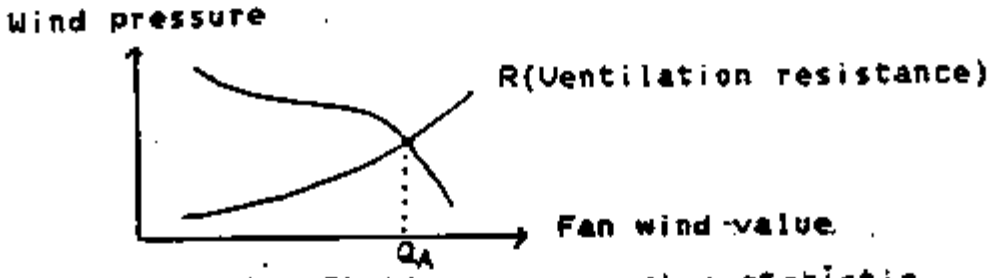
$$Q = \frac{H}{K \times \Delta T \times 60} \quad (m^3/min)$$

Q: Necessary ventilation (m^3/min)
H: Inverter calorific value (Kcal/hr)
Total value if having other heating power
K: Constant
$\gamma \cdot Cp = 0.29$(Kcal/m^3C)
[γ: Specific gravity of air=1.2(kg/m^3)
Cp: Specific heat of air=0.24(Kcal/kg°C)]
ΔT: Allowable temperature rise(°C)
Remarks: 1KW=860Kcal/hr

2 Consideration of fan selection

Necessary ventilation Q shall be calculated in the way above mentioned. Fan shall be chosen considering the following matters.

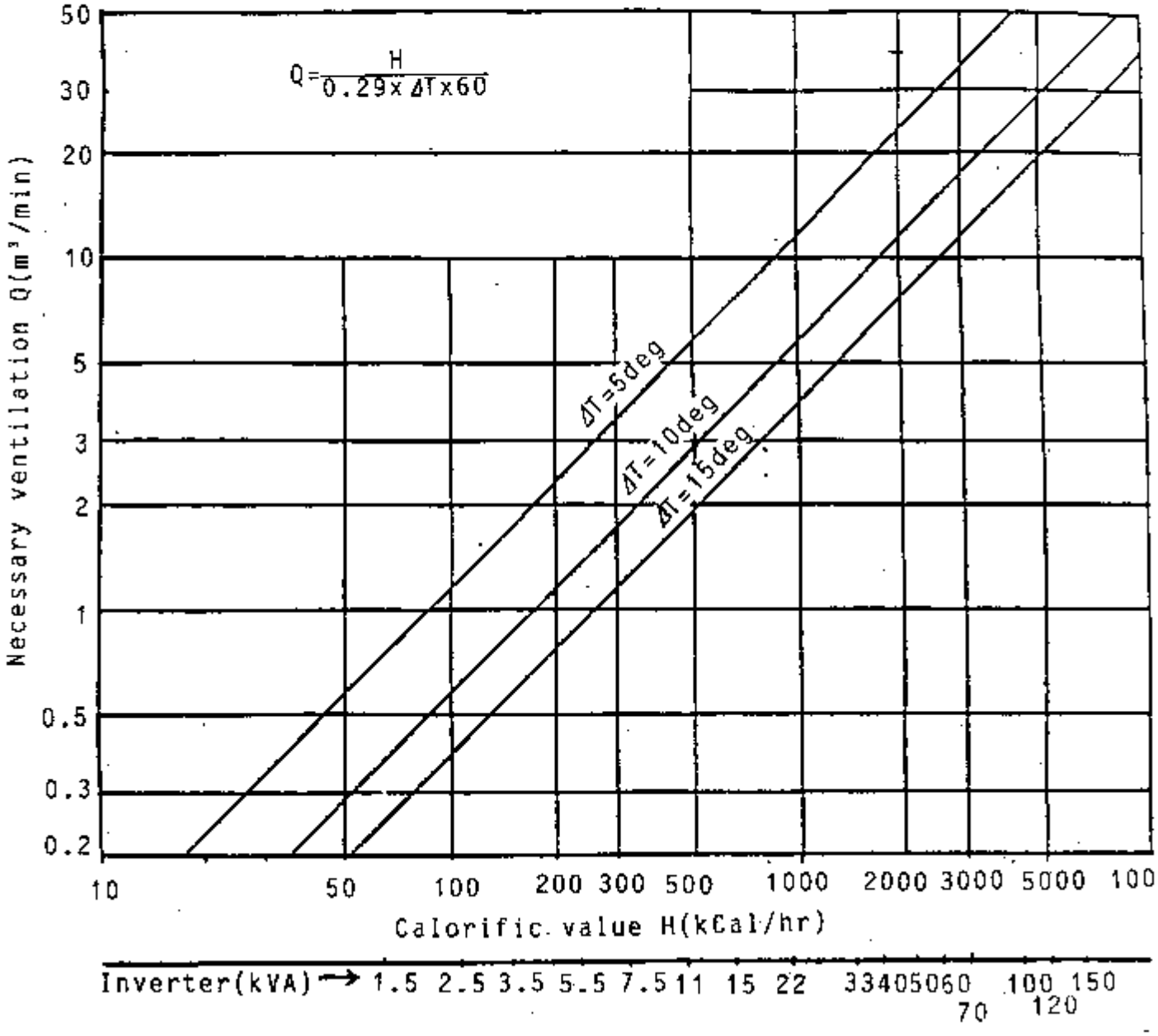
1. In case of mounting the filter at the ventilating entrance, operating point QA shall be calculated according to Q-H curve of the fan.



Wind value-Static pressure characteristic

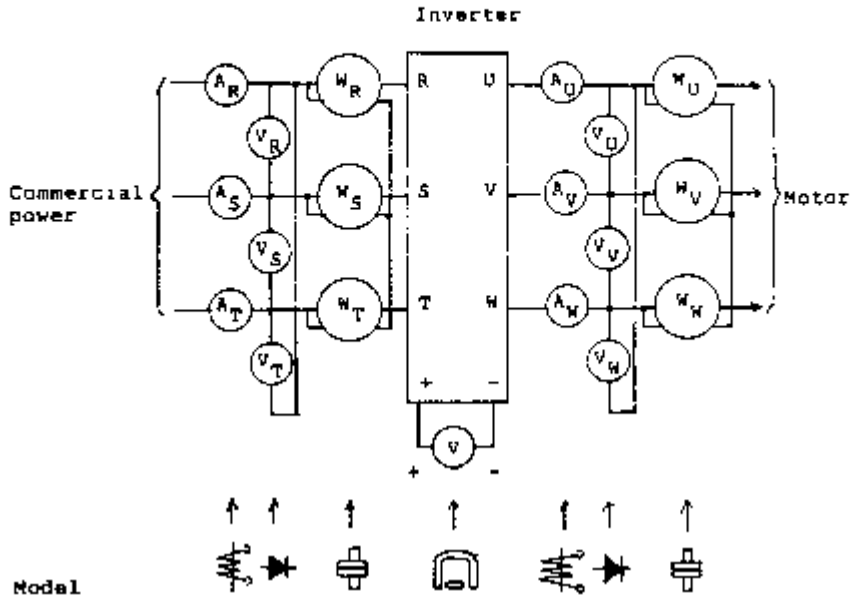
2. In case of bad ventilation because of fully mounting in the box, it is also the same as the mentioned above.

The relation between calorific value and necessary ventilation



6-8 HOW TO MEASURE THE VOLTAGE, CURRENT AND POWER

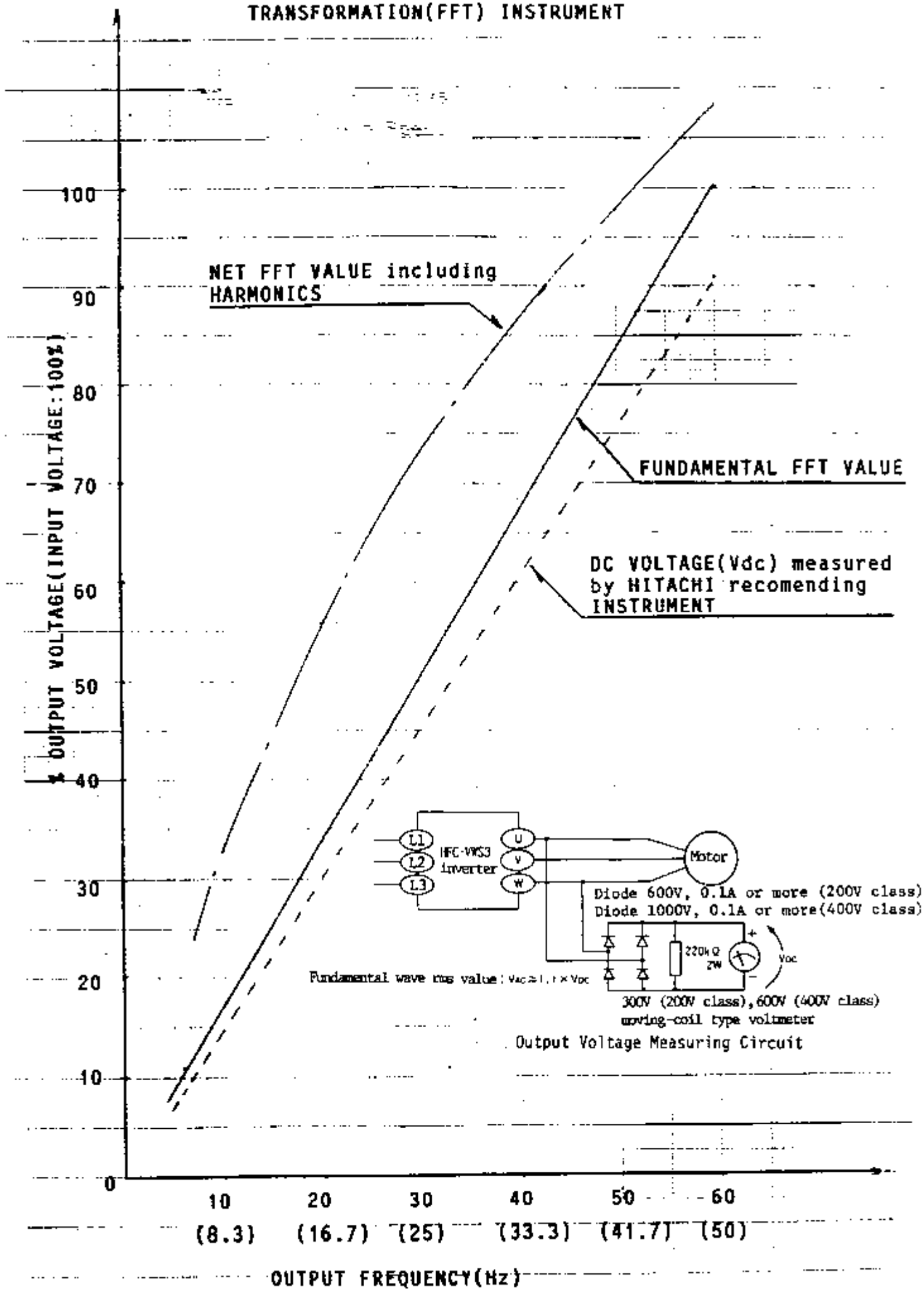
MEASURING INSTRUMENTS AND MEASURING POINTS



Modal

Measuring items	Measuring points	Measuring instruments	Remarks (Measuring value)
Input voltage V1	Between R-S, S-T, T-R	Moving iron-type or Rectifier-type	Commercial power 50Hz 180~230V 60Hz 180~230V
Input current I1	R, S, T (Line current)	Moving iron-type	
Input power P1	R, S, T or R-S, S-T, T-R	Electro-dynamic-type	$P1=W_R+W_V+W_T$ (Use 3 same type units)
Input power factor P_{f1}	Calculate according to the following formula. $P_{f1}=\frac{P1}{\sqrt{3}\,V1\cdot I1}\times 100\ (\%)$		
Output voltage V2	Between U-V, V-W W-U	Rectifier-type (Not moving iron-iron-type)	
Output current I2	U, V, W	Moving iron-type	
Output power P2	U, V, W U-V, V-W; W-U	Electro-dynamic-type	$P1=W_U+W_V+W_W$ (Use 3 same type units)
Output power factor P_{f2}	Calculate as well as input power factor. $P_{f2}=\frac{P2}{\sqrt{3}V1\cdot I1}\times 100\ (\%)$		
Converter output V_{CB}	Between ⊕ and ⊖	Moving iron-type (Tester is O.K.)	

OUTPUT VOLTAGE CALUCULATED BY FAST FOURIER TRANSFORMATION(FFT) INSTRUMENT



Output Voltage Measuring Circuit

(1) Output voltage

When you measure the fundamental harmonic effective value of output voltage,you can use a rectifier type voltmeter. There are many type voltmeters such as moving-iron type and thermoelectric type. The rectifier type voltmeter indicates the nearest value of the fundamental harmonic effective value.

Fig. shows the measurement characteristics of output voltage of PWM inverter by using each instrument and Fig. shows those of PAM inverter. The indication of the rectifier type shows a good lineality against the operating frequency and an approximate value of the fundamental harmonic effective value (FFT).

You can get more approximate value of it by using a rectifier type voltmeter with connecting a filter to output terminals like Fig. when you measure the output voltage of PWM inverter which generates reverse voltage between output terminals eachtime PWM switches.

Fig. Measurement characteristics of output voltage of PWM inverter by using each instrument

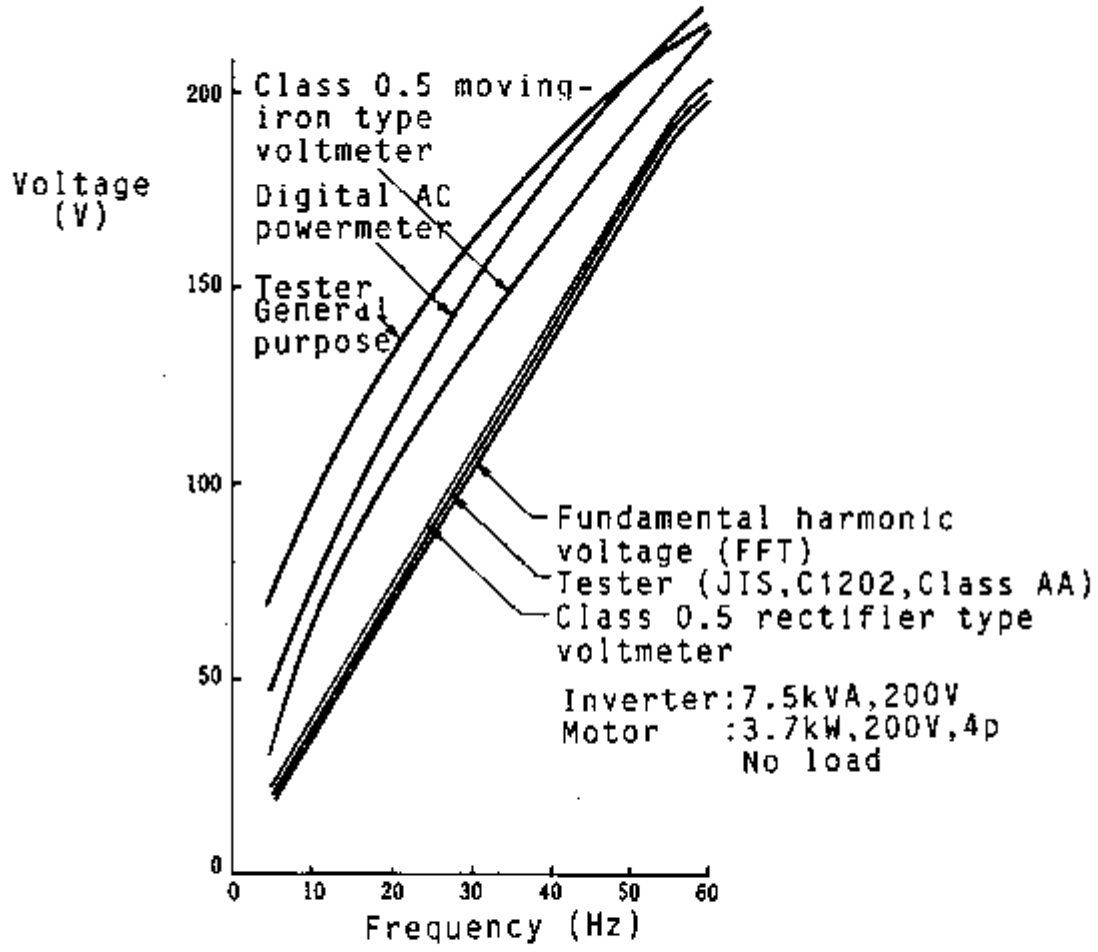


Fig. Measurement characteristics of output voltage of PAM inverter by using each instrument

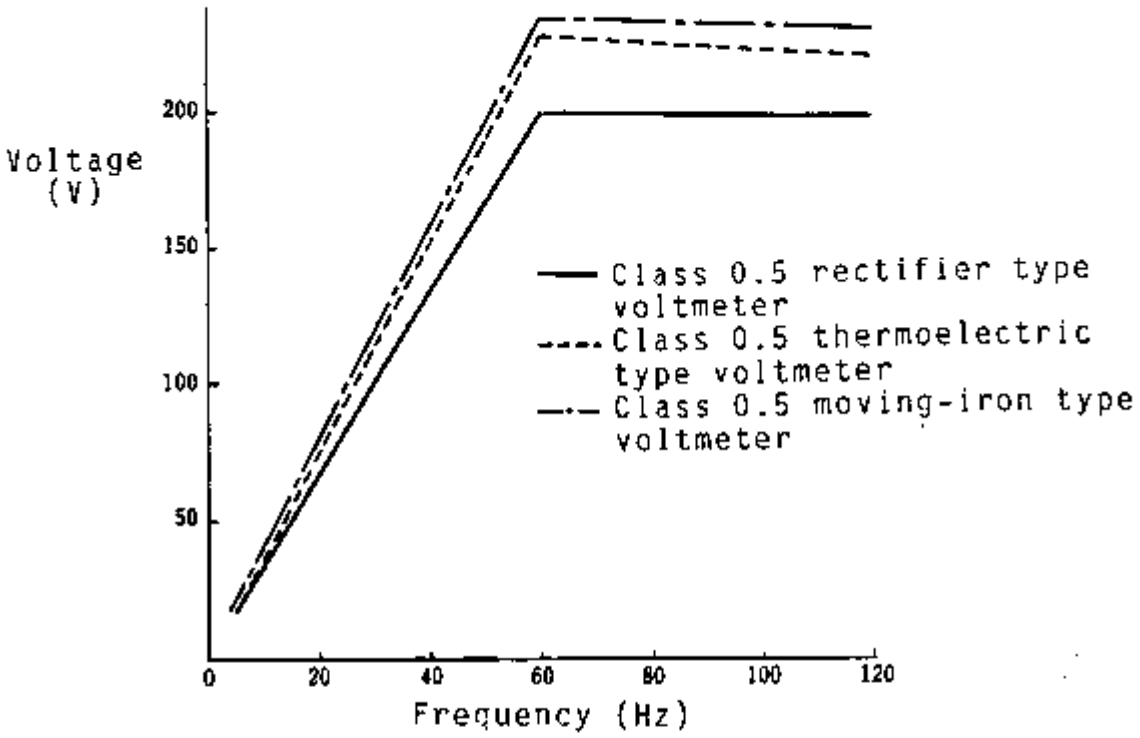
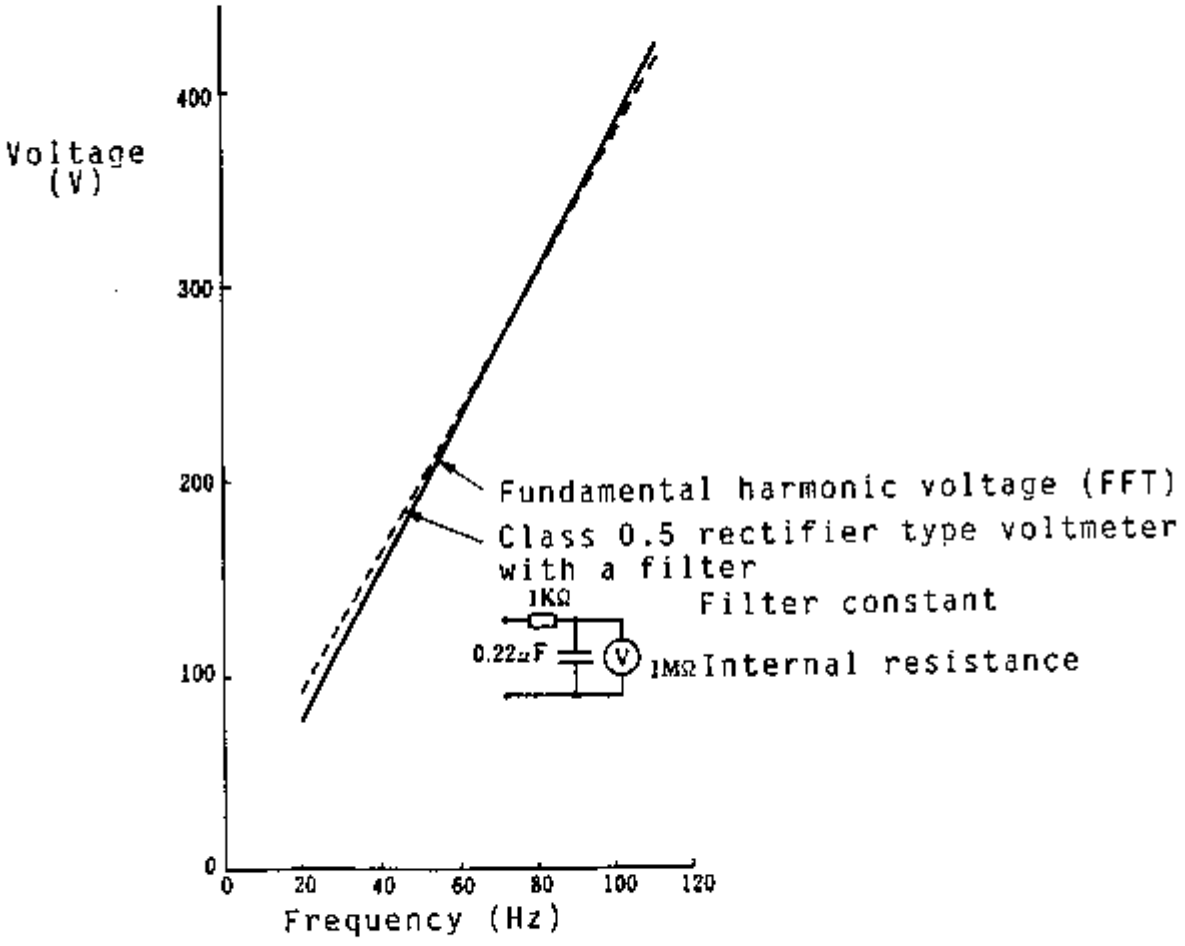


Fig. Measurement characteristics by using a rectifier type voltmeter with a filter



(2) Output current

When you measure the output current,you can use a moving-iron amperemeter because of necessity for the measurement of total effective current.

In case of the measurement of the effective current a thermoelectric type amperemeter is also available,but in many cases a moving-iron amperemeter is used due to ease to treat. Fig shows the comparison betwen measurement characteristics of the thermoelectric type amperemeter with resistance load and that of the moving-iron type amperemeter. (There is a little difference between the fundamental harmonic current and total effective current in case of an actual motor load.)

It is necessary to check the capacity of the current transformer when you use it because some current transformer saturate themselves in low frequency.

Fig. shows the saturation curves of current transformers in low frequency.

Fig. Measurement characteristics of output current by using each instrument

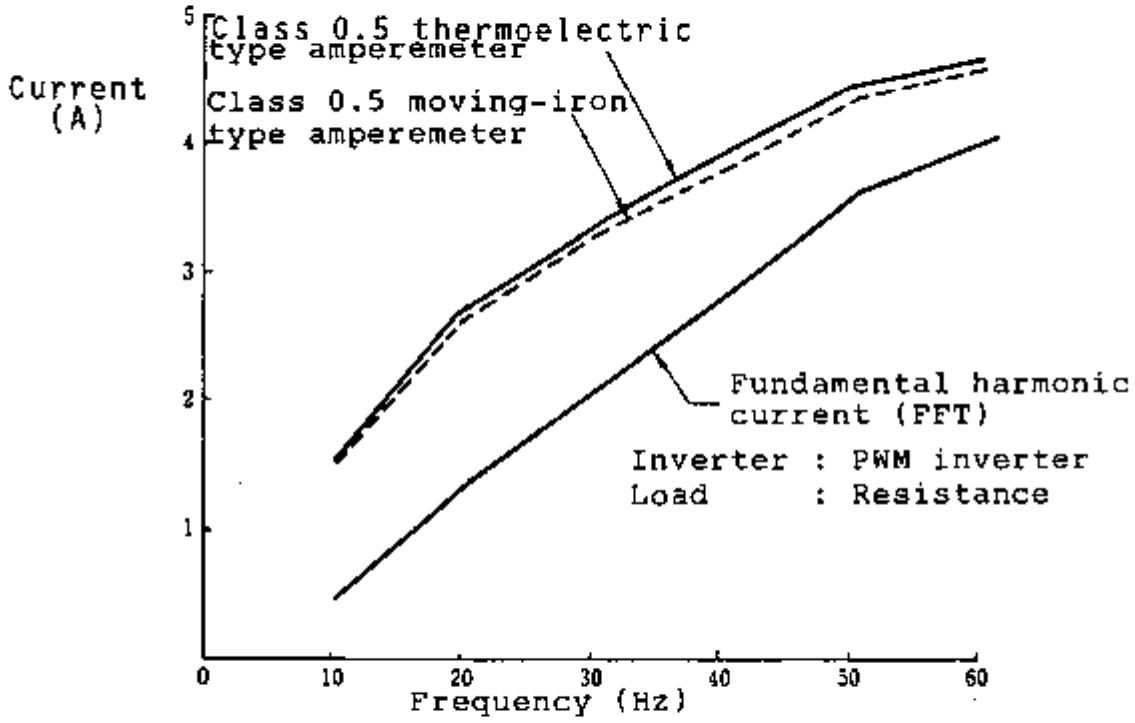
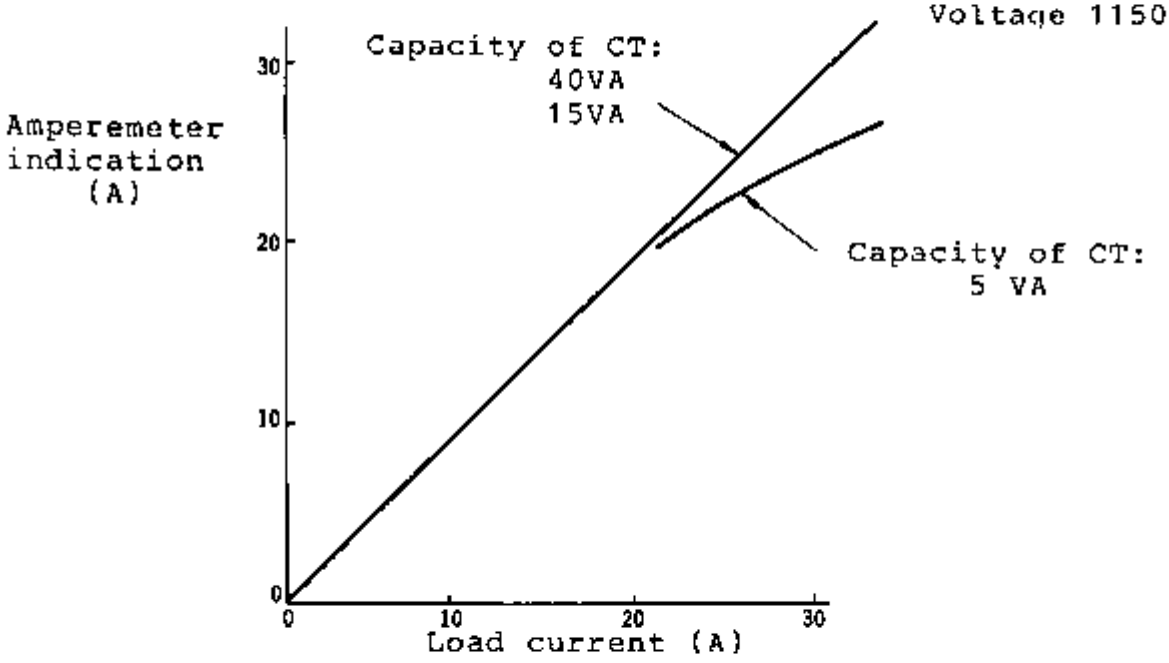


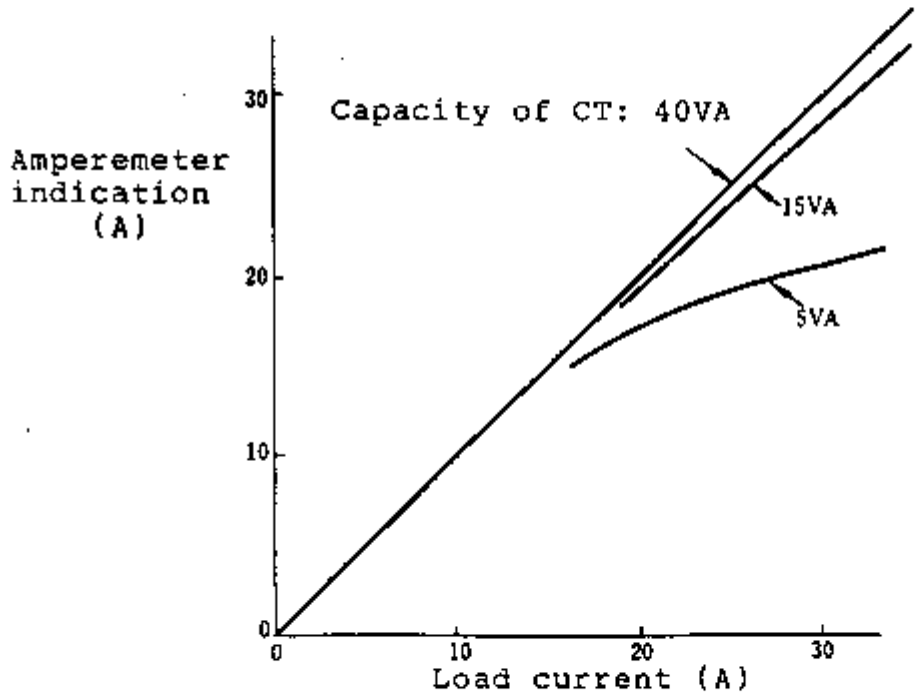
Fig Saturation curves of current transformers

Inverter
Current transformer : 50/5A Through type
Error class 1.0
Over current rating
more than 3
Voltage 1150V

(a) Inverter frequency
at 7.5Hz



(b) Inverter frequency
at 5Hz



(3) Output power

The double wattmeters method and the triple wattmeters method are available for the measurement of the output power, and the double wattmeters method is often used because of ease to treat.

It is desirable to use the triple wattmeters method when the imbalance of the phase current is remarkable like the measurement of the input power.

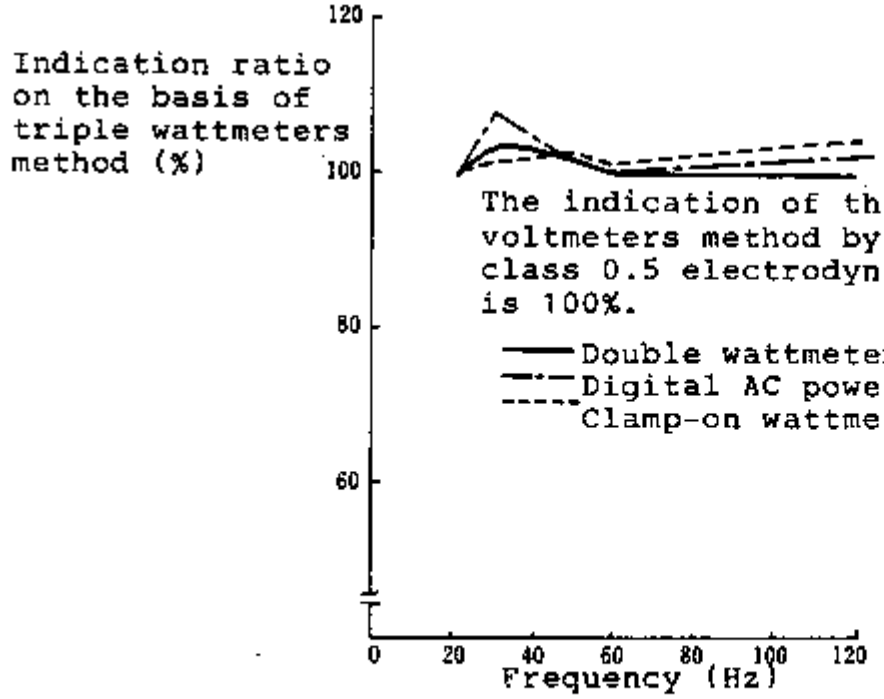
There are two types of wattmeters such as the thermoelectric type and electrodynamometer type is useful because of the accuracy and the ease to obtain it.

Fig. shows the comparison of the indication ratio between the double wattmeters method and other wattmeters on the basis of the the triple wattmeters method.

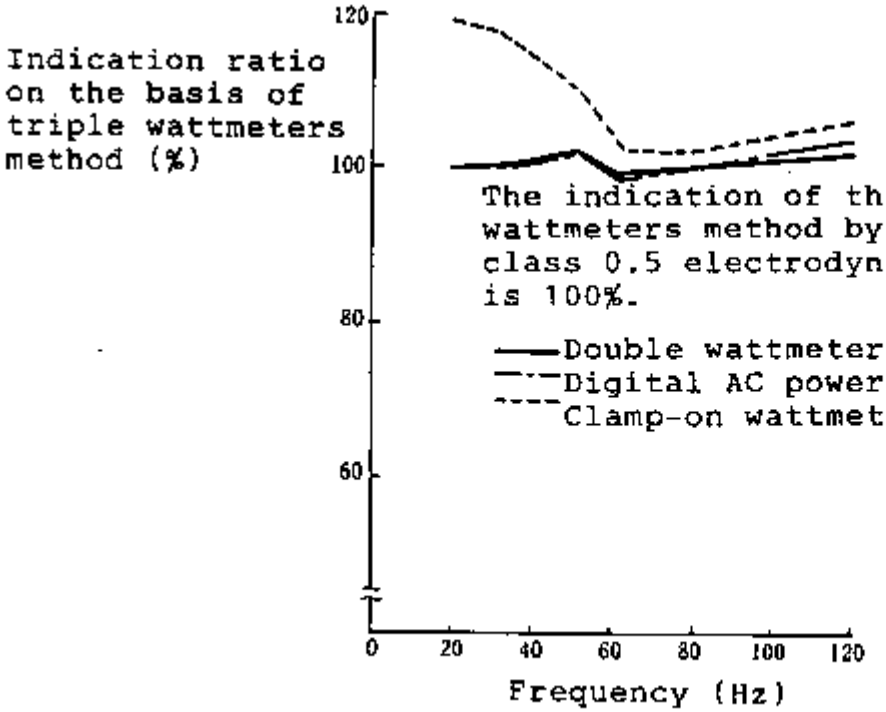
Fig Measurement characteristics by using each wattmeter

(a) PAM inverter

Inveter: PAM, PWM
5kVA 200V
Motor : 3.7kW 200V
4poles



(b) PWM inverter



NOTE : Both (a) and (B) show the indication ratio as the indication of the triple wattmeters method is 100% while the torque is constant from 0Hz to 60Hz and the power is constant for more than 60Hz.

(4) Power factor of inverter

It is impossible to measure the power factor of the inverter by a powe. factor meter because the output frequency changes.

NOTE: It is possible to calculate the power factor through the output voltage,the output current and the output power. But there is difference between the power factor as is usually expressed and that which is obtained by calculation because of the difference of the measurement of higher harmonics. So the power factor of the inverter isn't ordinarily measured.

(5) Measured efficiency of inverter

The measured efficiency of the inverter is defined as the ratio of the output active power and the input active power of the inverter.

$$\text{Measured efficiency (\%)} = \frac{\text{Output active power}}{\text{Input active power}} \times 100\ (\%)$$

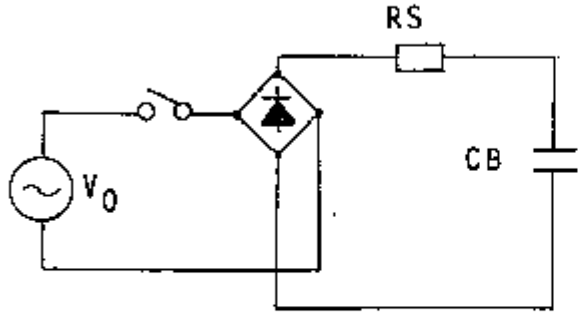
(6) Output frequency

In many cases the output frequency of the inverter is output from the inverter as the analogeue voltage or the pulse signal of frequency control. So the output frequency is not measured directly by the output voltage but measured by the frequency control signal.

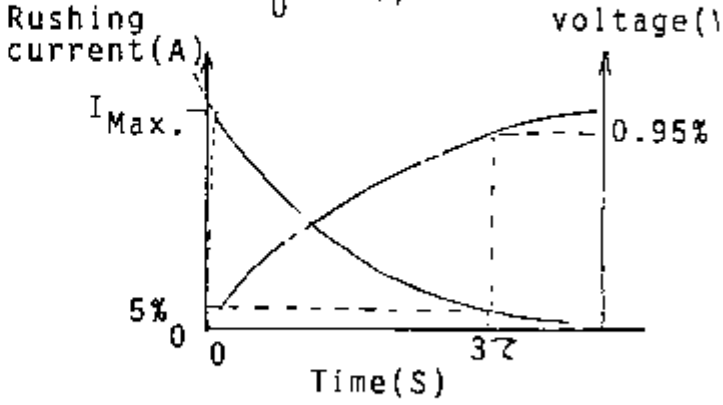
The pulse signal is measured by a counter. The ratio of the pulse signal and the output frequency is different among the manufacture. When you measure it,it is necessary to ask the manufacturter.

6-9 RUSHING CURRENT WHEN POWER SUPPLY IS TURNED ON

Model	Rushing current Max.(A)	Charging time 3τ (mSEC)	
HFC-VWS3 1.5 SF3E			
2.5 SF3E	404	3.78	
3.5 SF3E	404	5.67	
2.5 HF3E	283	3.36	
3.5 HF3E	283	4.92	
5.5 HF3E	283	6.00	
8 HF3E	283	6.60	
11 HF3E	435	5.28	
16 HF3E	435	9.18	
22 HF3E	808	5.88	
33 HF3E	1414	4.68	
40 HF3E	1414	5.64	
50 HF3E	1414	5.64	
60 HF3E	1414	6.72	
75 HF3E	1414	9.96	



(Where 200V class: V_0=200V
400V class: V_0=400V)



$$I=\frac{\sqrt{2}V_0}{RS}EXP(-\frac{t}{CB\cdot RS})$$

τ=CB·RS(time constant)

ENGINEERING SHEET

番号 SE NO.	ES0459X	頁 SHEET	1/4

納先 CUSTOMER		訂正回数 REV. No.	日付 DATE
		⚠	11. Mar. '96
品名 EQUIPMENT	HFC-VWS100 to 150HF3EA	2	
		3	
題名 SUBJECT	Strustual Drawing		

This enginnering sheet is attached the structual drawings for HFS-VWS100 to 150HF3EA

Drawing number;

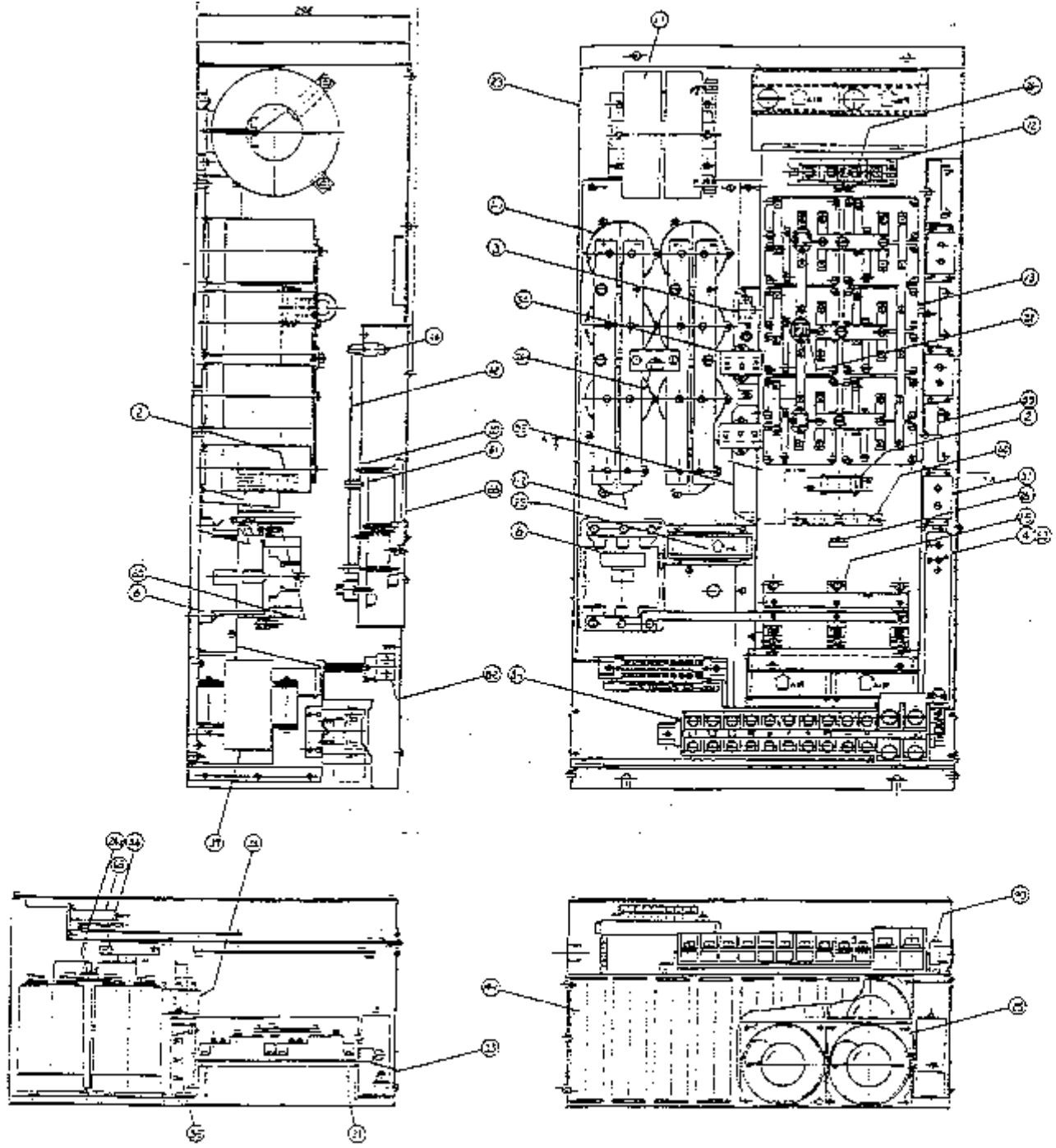
3T816113 : for VWS100HF3EA

3T816114 : for VWS120HF3EA

3T816115 : for VWS150HF3EA

⚠ 3T816479 : for VWS180HF3EA

用途	発行先 DISTRIBUTION			担当部課 ISSUED BY	Inverter Gr
□ 承認用 FORAPPROVAL	HAS-SN / NELCO	1		作成日 DATE	21, Feb, 1996
☑ 参考用 FORINFORMATION				担当 PREPD	M. ISOGAI
□ 検討用 FORREVIEW				審査 CHKD	
□ 確認用 FORCONFIRMATION					M. ISOGAI
□				承認 APPD	T. Kamikawa



Parts No.	Short title	Parts name	QTY/ unit
1-1	CB	Smoothing capacitor	6
1-2	CB	Smoothing capacitor	2
2	ZCT	Current transformer	1
3	CT	Current transformer	1
4	RS	Current limiting RES.	1
6	84	Magnetic contactor	1
8-1	TM	Main circuit terminal block	1
8-2	TM	Control circuit terminal block	1
11	DCL	DC Reactor	1
12	FD	Flywheel diode	1
13	PM	Transistor module	12
15	DM	Diode module	3
16	C	Capacitor	1
17	ZNR	Surge absorber	1
19-1	CV	Cover	1
19-2	CV	Cover	1
19-3	CV	Cover	1
23	CS	Case	1
25	FAN	Cooling fan	7
26-1	THR	Thermal relay (150°C)	2
26-2	THR	Thermal relay (80°C)	1
31	C1	Snubber capacitor	3
32	D1	Snubber diode	3
33	R1	Snubber resistor	6
34	CM	Snubber capacitor	2
35	RM	Snubber resistor	1
36	DB	Diode module for base drive PCB	1
37	T	Transformer	1
60	CT	Current transformer	2
61	PCB	Printed board (control)	1
62	PCB	Base drive PCB	1
63	RB	Balance resistor(Same as 41	1
64	IPR	Resistor	1
65	CD	Capacitor	1
66	PANEL	Digital operator	1
90	LED	Charging lamp	1

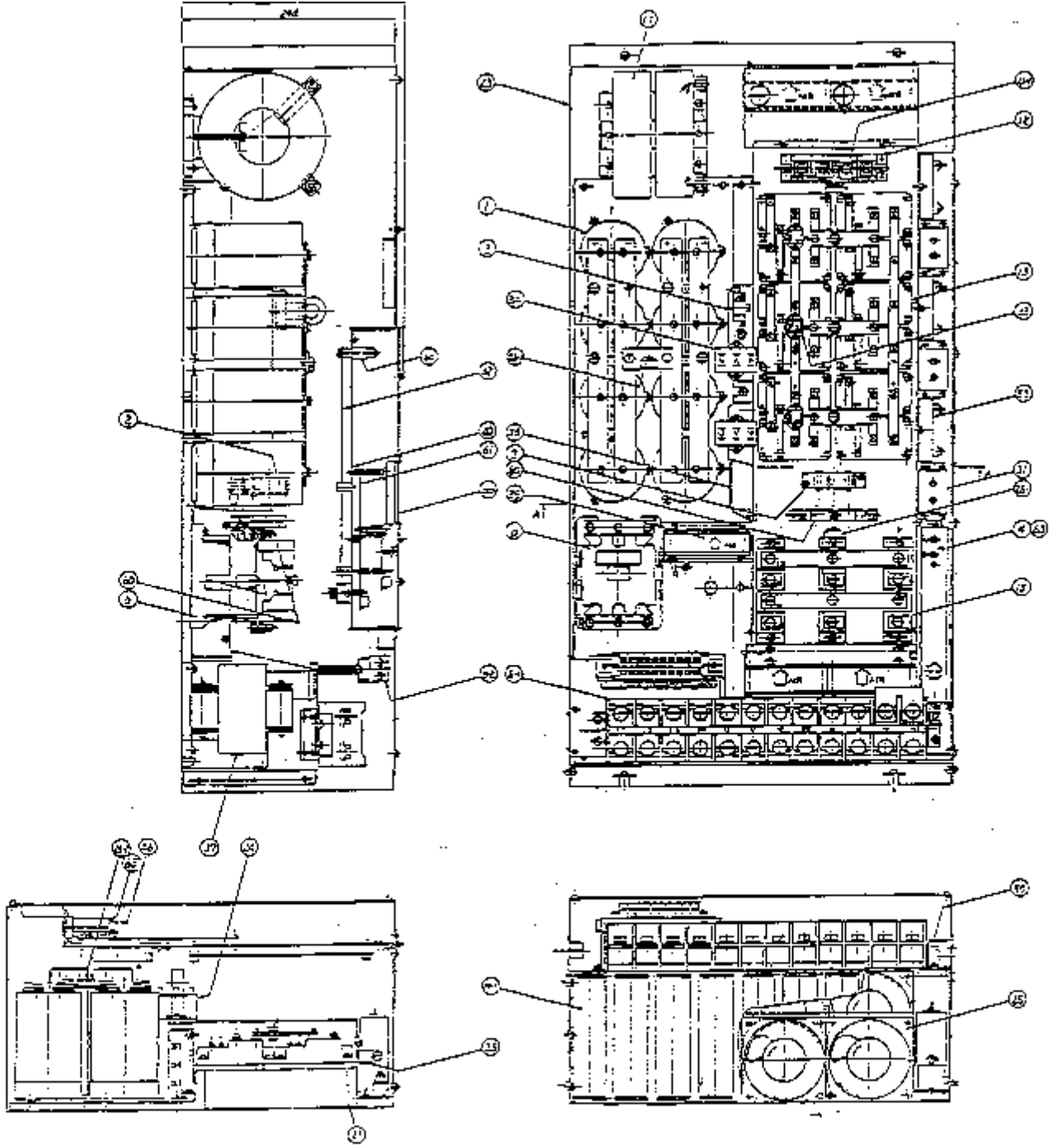
DWN	M. ISOGAI	13-Feb-96	
CHKD	M. ISOGAI	" "	
APPD	T. KAWAHARA	" "	

TITLE
HFC-VWS100HF3
Structural drawing

Hitachi, Ltd.
Tokyo Japan

NARASHINO WORKS DWG. NO.
324 3T816113
SH. DP

REV



Parts No.	Short title	Parts name	QTY/ unit
1	CB	Smoothing capacitor	8
2	ZCT	Current transformer	1
3	CT	Current transformer	1
4	RS	Current limiting RES.	1
6	84	Magnetic contactor	1
8-1	TM	Main circuit terminal block	1
8-2	TM	Control circuit terminal block	1
11	DCL	DC Reactor	1
12	FD	Flywheel diode	1
13	PM	Transistor module	12
15	DM	Diode module	3
16	C	Capacitor	1
17	ZNR	Surge absorber	1
19-1	CV	Cover	1
19-2	CV	Cover	1
19-3	CV	Cover	1
23	CS	Case	1
25	FAN	Cooling fan	7
26-1	THR	Thermal relay (100°C)	2
26-2	THR	Thermal relay (80°C)	1
31	C1	Snubber capacitor	3
32	D1	Snubber diode	3
33	R1	Snubber resistor	6
34	CM	Snubber capacitor	2
35	RM	Snubber resistor	1
36	DB	Diode module for base drive PCB	1
37	T	Transformer	1
60	CT	Current transformer	2
61	PCB	Printed board (control)	1
62	PCB	Base drive PCB	1
63	RB	Balance resistor (Same as 4)	1
64	PR	Resistor	1
65	CD	Capacitor	1
66	PANEL	Digital operator	1
90	LED	Charging lamp	1

DWN	M. ISOGAI '91 Feb. 15	TITLE HFC-VWS120HF3 Structural drawing	Hitachi, Ltd. Tokyo Japan	HARASHINO WORKS DWG. NO. 324 3T816114 SH. 07	REV. 17V
CHKD	M. ISOGAI				
APPD	T. KAMBARA				

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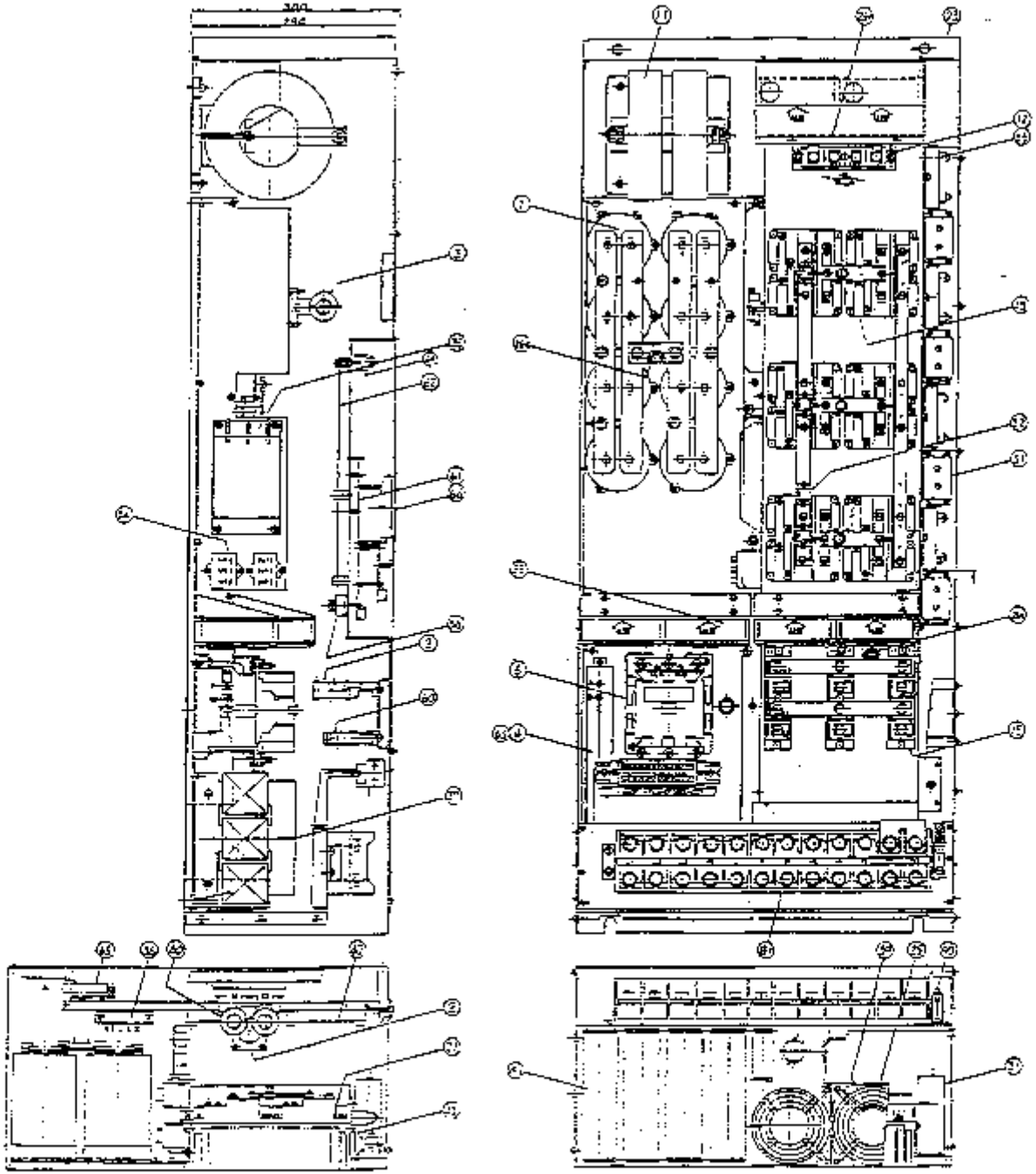


Parts No.	Short title	Parts name	QTY/unit
1	CB	Smoothing capacitor	8
2	ZCT	Current transformer	1
3	CT	Current transformer	1
4	RS	Current limiting RES.	1
6	84	Magnetic contactor	1
8-1	TM	Main circuit terminal block	1
8-2	TM	Control circuit terminal block	1
11	DCL	DC Reactor	1
12	FD	Flywheel diode	1
13	PM	Transistor module	12
15	DM	Diode module	3
16	C	Capacitor	1
17	ZNR	Surge absorber	1
19-1	CV	Cover	1
19-2	CV	Cover	-
19-3	CV	Cover	-
23	CS	Case	-
25	FAN	Cooling fan	8
26-1	THR	Thermal relay (100°C)	2
26-2	THR	Thermal relay (80°C)	1
31	C1	Snubber capacitor	4
32	D1	Snubber diode	4
33	R1	Snubber resistor	8
34	CM	Snubber capacitor	2
35	RM	Snubber resistor	1
36	DB	Diode module for base drive PCB	1
37	T	Transformer	1
60	CT	Current transformer	2
61	PCB	Printed board (control)	1
62	PCB	Base drive PCB	1
63	RB	Balance resistor (Same as 4)	1
64	IPR	Resistor	1
65	CD	Capacitor	1
66	PANEL	Digital operator	1
90	LED	Charging lamp	1

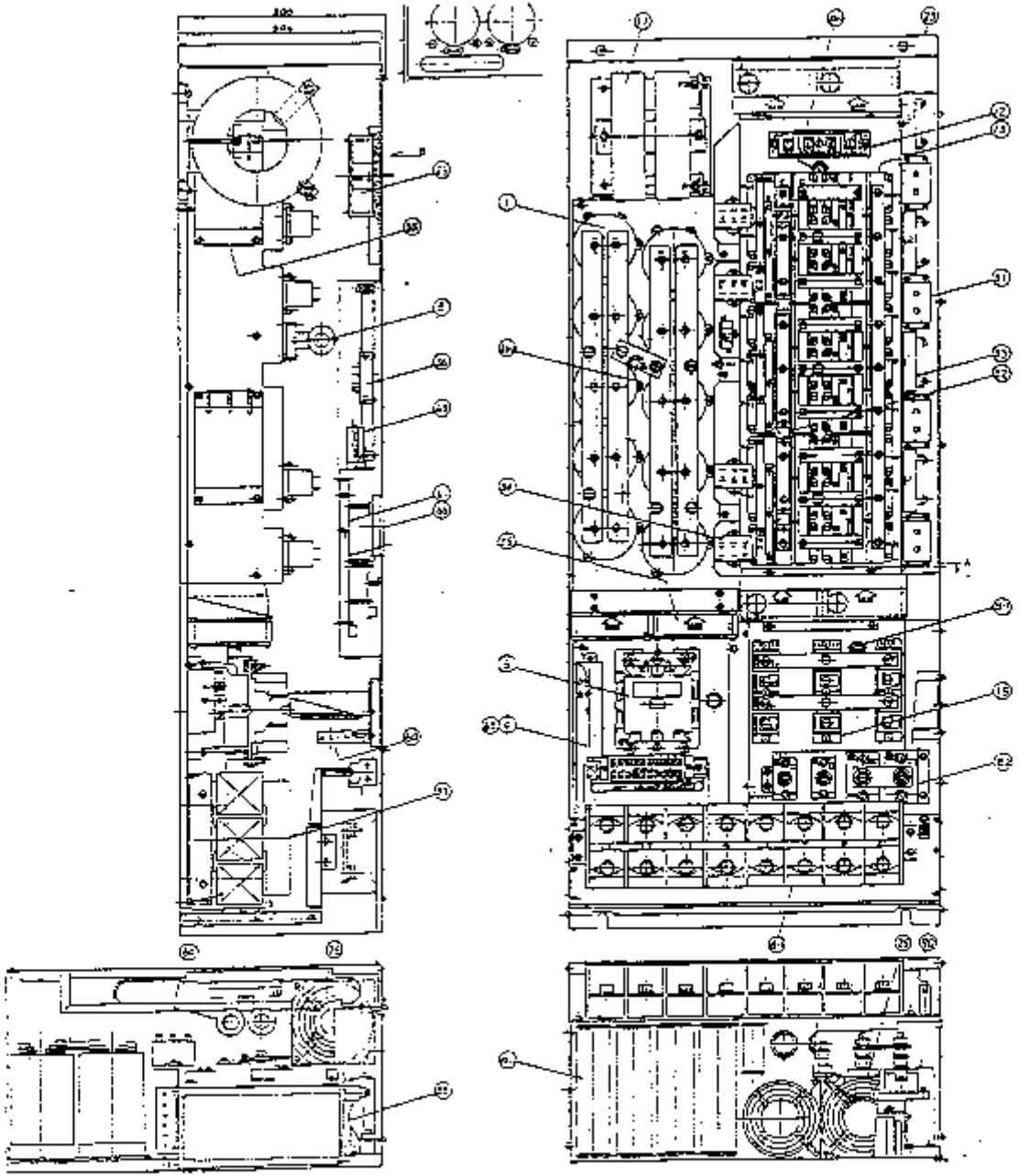
DWN	M. ISOGAI	13-Feb-98	
CHKD	[illegible]	" "	
APPD	T. KAMBARA	" "	

TITLE
HFC-VWS150HF3
Structural drawing

Hitachi, Ltd.
Tokyo Japan

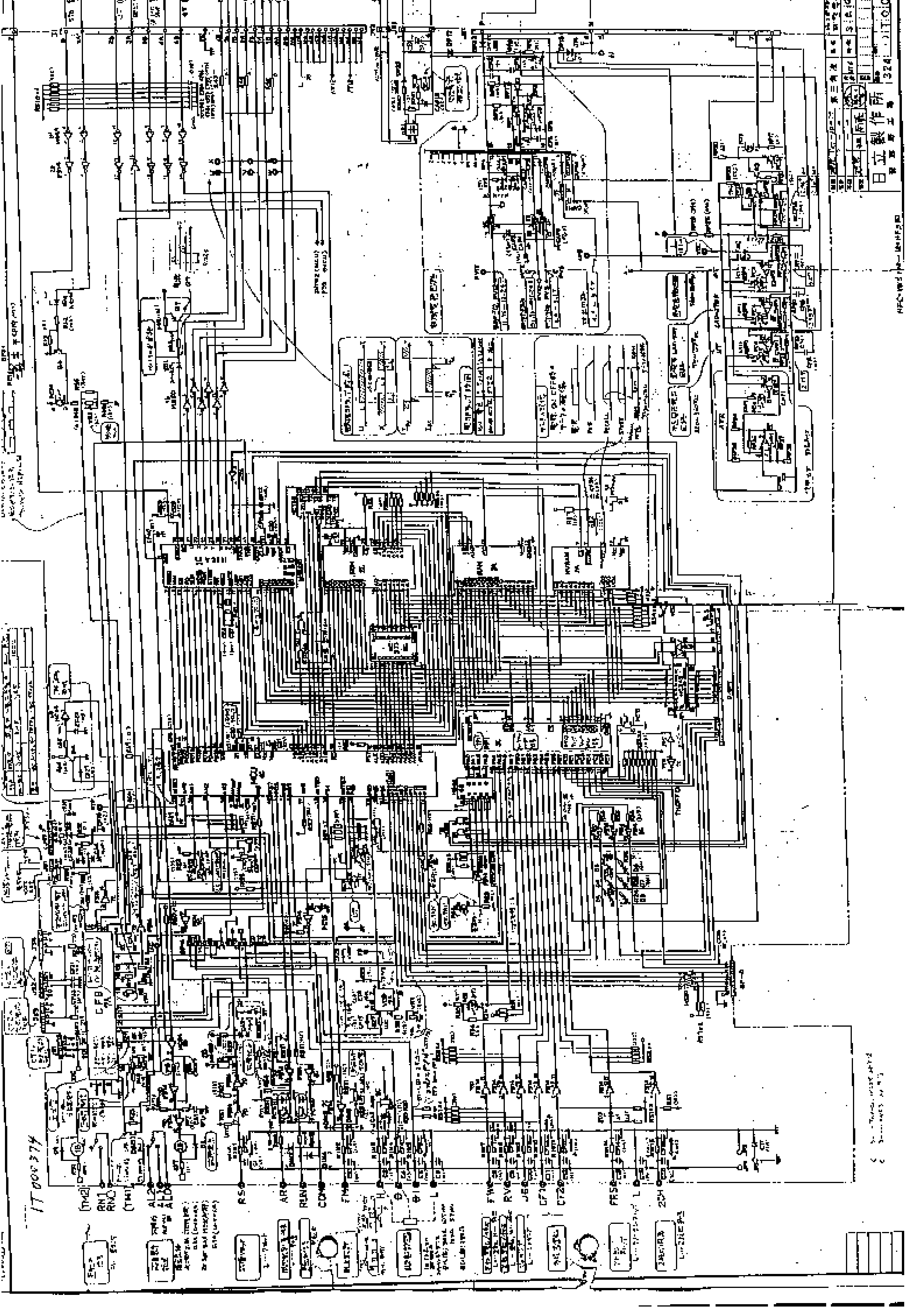
NARASHINO WORKS DWG. NO.
324 3T816115
SH. 07

REV



Parts No.	Short title	Parts name	QTY/ unit
1	CB	Smoothing capacitor	10
2	ZCT	Current transformer	1
3	CT	Current transformer	1
4	RS	Current limiting RBS	1
6	84	Magnetic contactor	1
8-1	TM	Main circuit terminal block	1
8-2	TM	Control circuit terminal block	1
11	DCL	DC Reactor	1
12	FD	Flywheel diode	1
13	PM	Transistor module	18
15	DM	Diode module	3
16	C	Capacitor (not shown in drawing)	1
17	ZNR	Surge absorber (not shown in drawing)	1
19-1	CV	Cover	1
19-2	CV	Cover	1
19-3	CV	Cover	1
23	CS	Case	1
25	FAN	Cooling fan	11
26-1	THR	Thermal relay (100°C)	2
26-2	THR	Thermal relay (80°C)	1
31	C1	Snubber capacitor	4
32	D1	Snubber diode	4
33	R1	Snubber resistor	8
34	CM	Snubber capacitor	4
35	RM	Snubber resistor	2
36	DB	Diode module for base drive PCB	1
37	T	Transformer	1
60	CT	Current transformer	2
61	PCB	Printed board (control)	1
62	PCB	Base drive PCB	1
63	RB	Balance resistor (Same as 4)	1
64	IPR	Resistor	1
65	CD	Capacitor	1
66	PANEL	Digital operator	1
90	LED	Charging lamp	1

DWN	K. ISOZAKI	11 Nov '96	TITLE	Hitachi, Ltd. Tokyo Japan	HARAHINO WORKS DWG. NO.
CHKD	H. SAGAI	" "	HFC-VWS180HF3 Structural drawing		324 3T816479
APPD	T. Kawa	" "			SH. UP



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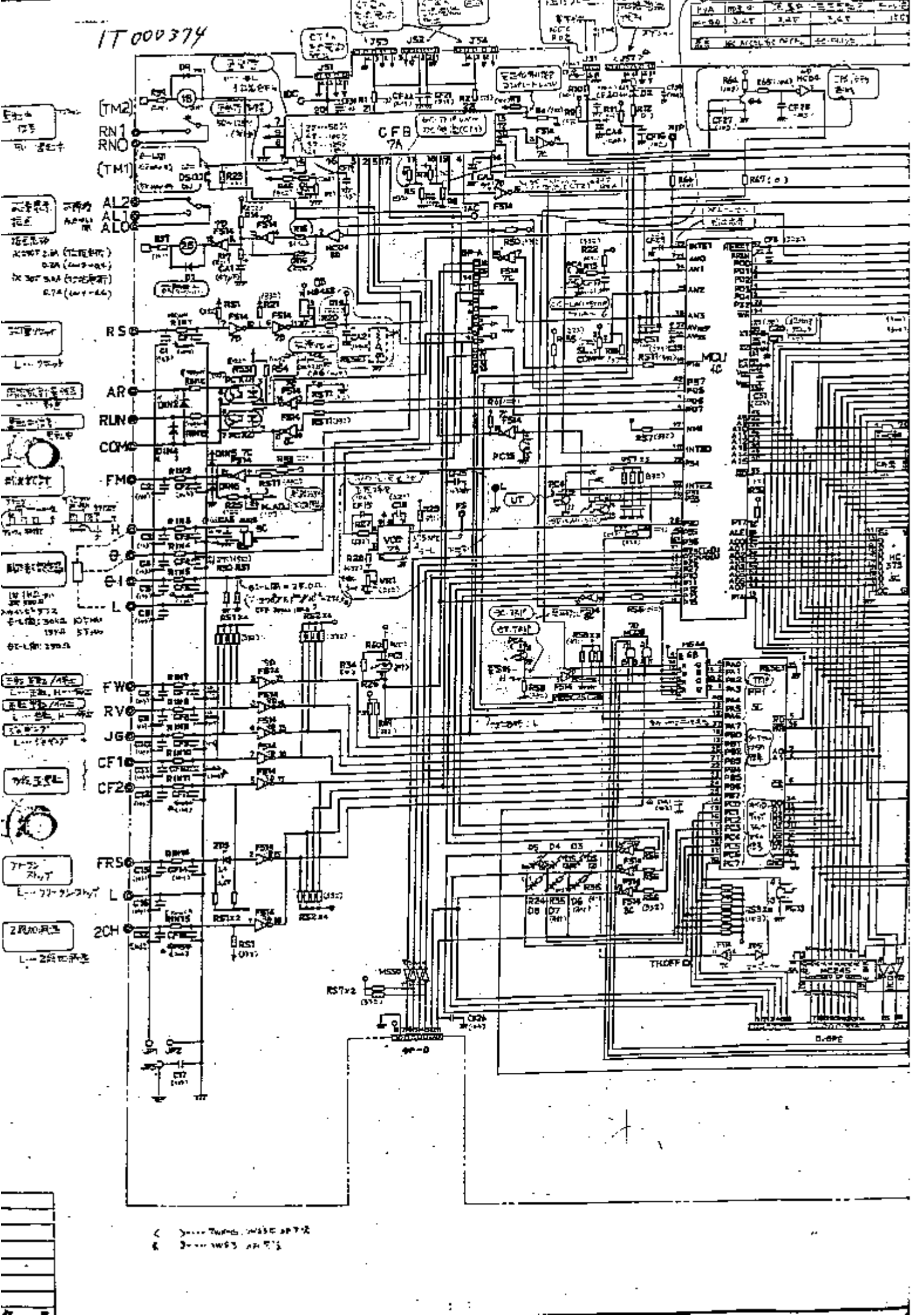
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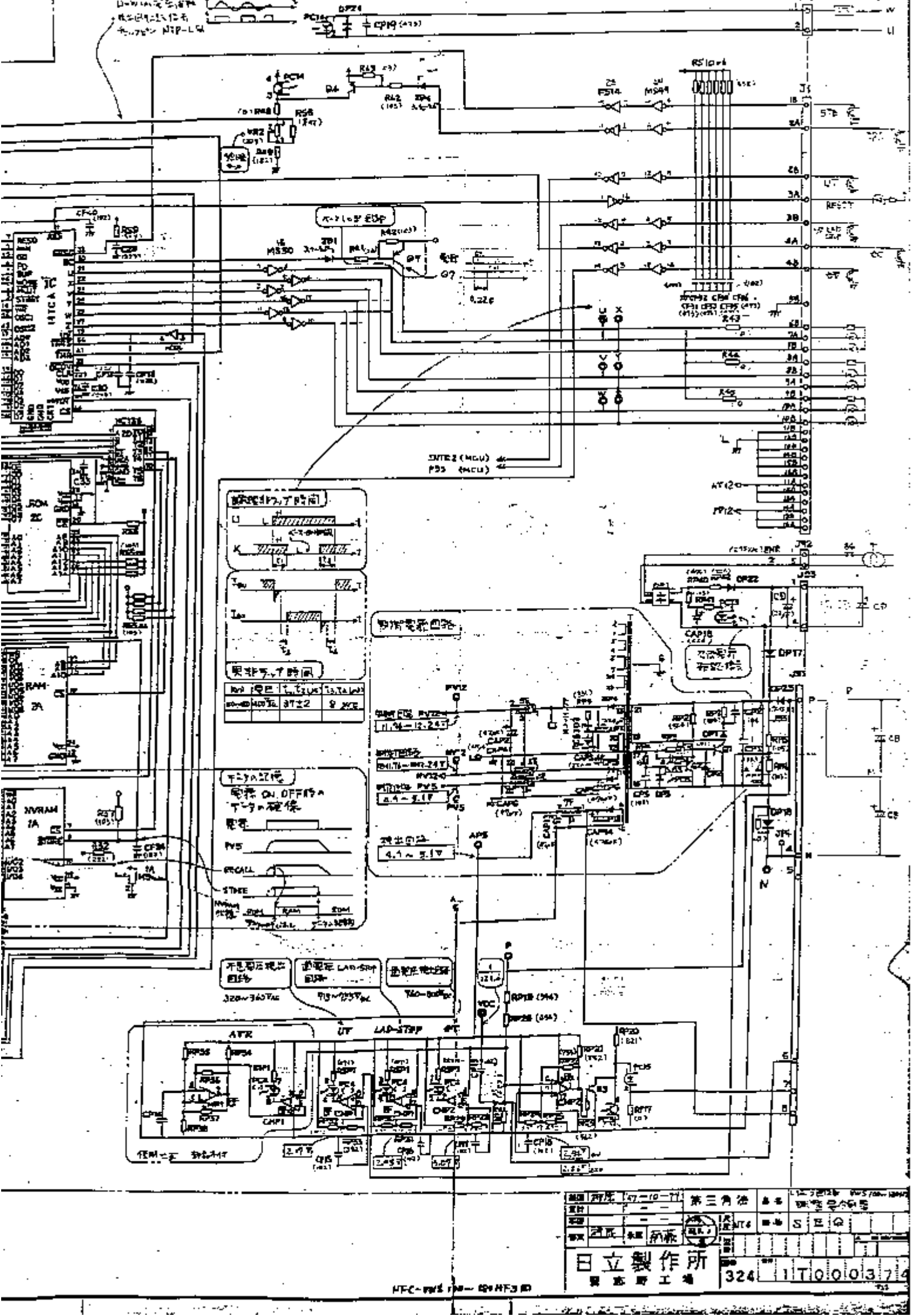
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