NEL-SYSTEM

DR / HR8500-III

ROBOT TROUBLESHOOTING MANUAL

Note to Users

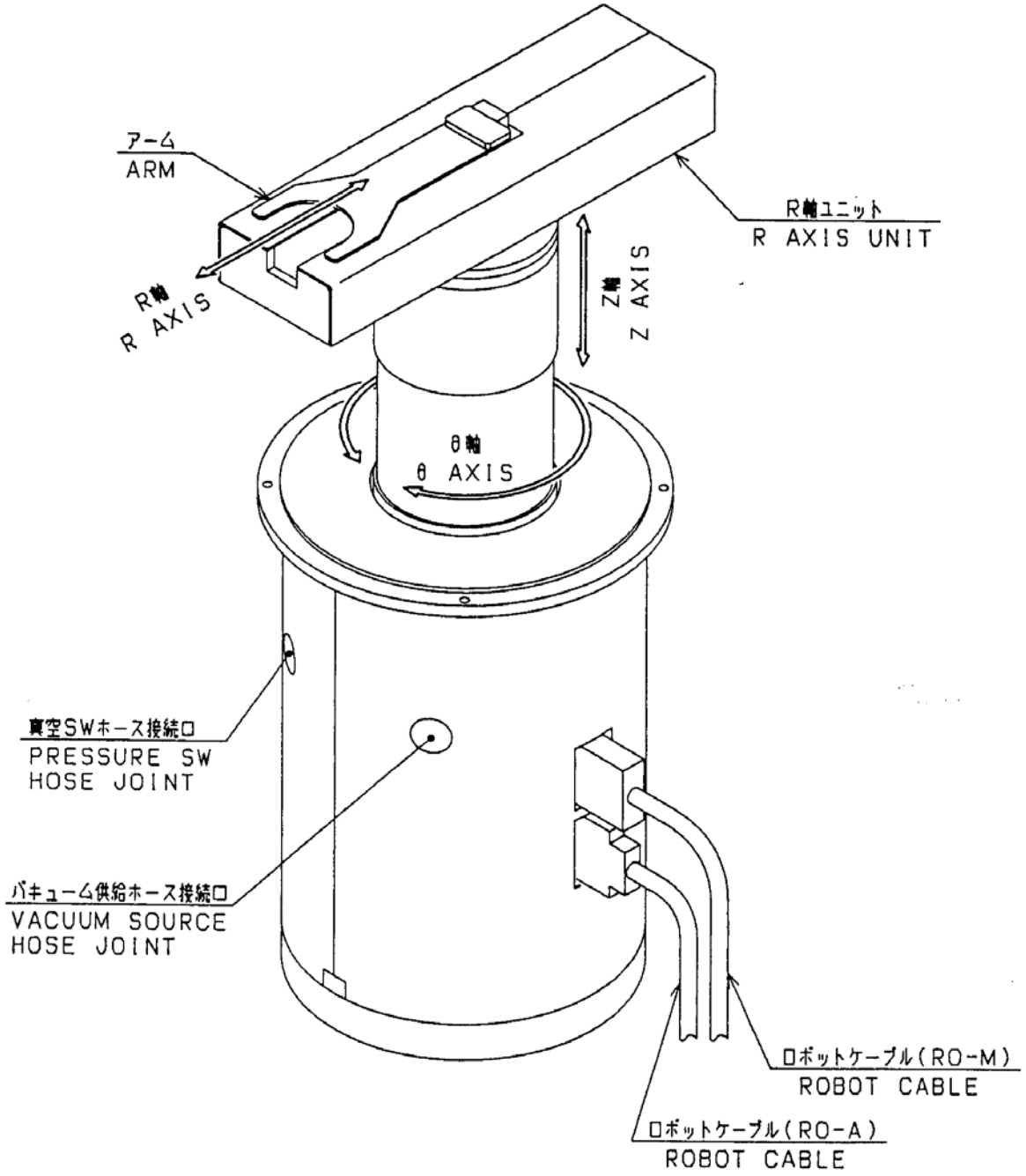
This manual contains explanation for the troubleshooting procedures of Robot.
This manual is written for maintenance engineers.
You must read the DR/HR8500-III instruction manuals and this troubleshooting manual thoroughly before using the machine.

CONTENTS

1. Outline of Robot

1.1 The external view of Robot

The external view is as follows.



1.2 The internal view of Robot

The internal view of Robot is shown on the next page.

The Robot arm moves in R-axis, T-axis and Z-axis directions.

On R-axis, the arm, which is engaged by the timing belt to the R-axis stepping motor, moves on the linear guide.

On T-axis, the arm is moved by the T-axis stepping motor through the medium of T-axis harmonic driver gear.

On Z-axis, the arm, which is engaged by the ball screw and the timing belt to the Z-axis stepping motor, moves on the linear guide.

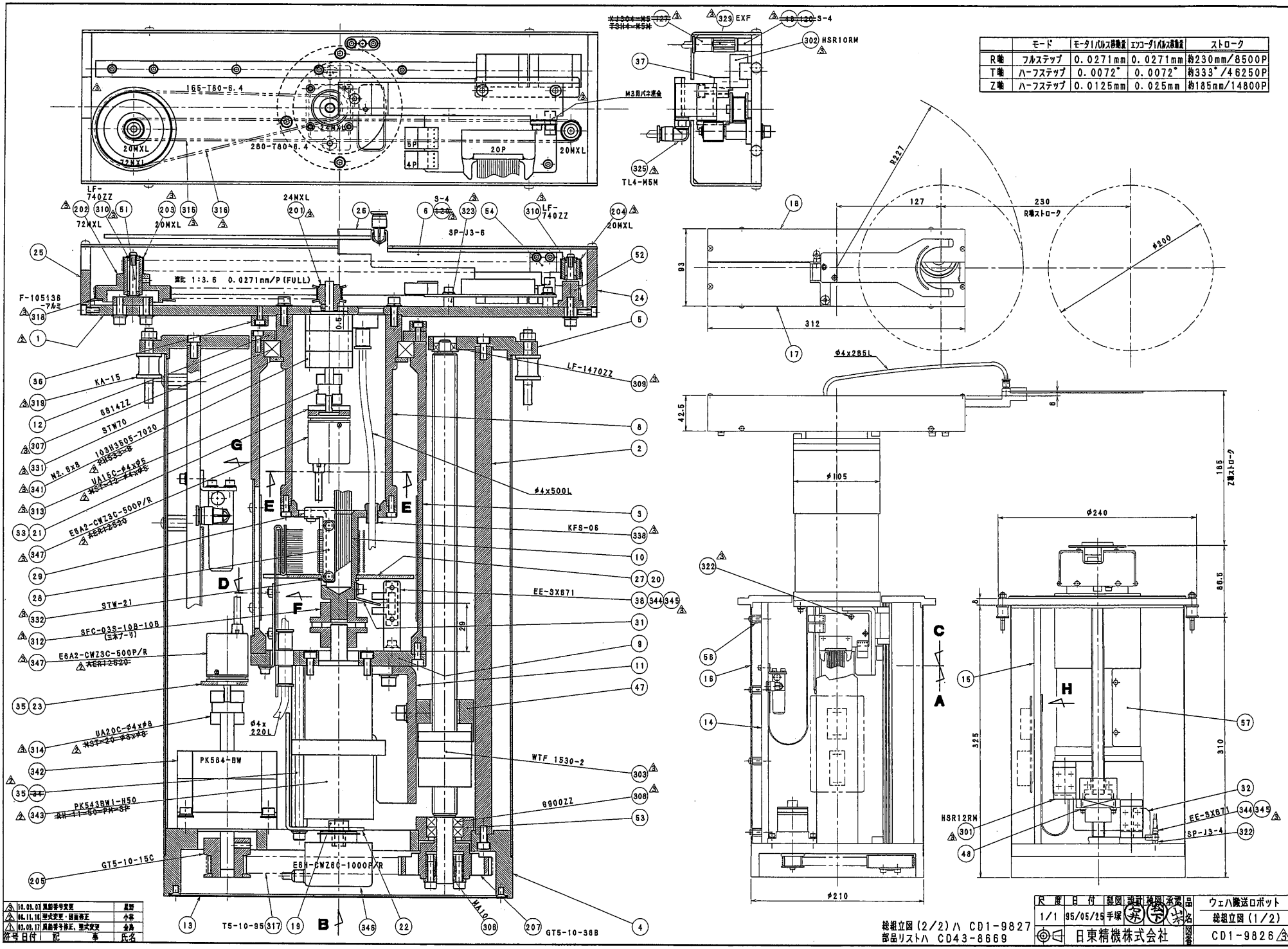
The rotary encoders are connected with each motor.

A wafer is chucked on the chucking pad by two solenoid valves mounted within and without Aligner.

Positioning of R-axis origin is done by R-axis origin sensor.

Positioning of T-axis origin is done by T-axis origin sensor.

Positioning of Z-axis origin is done by Z-axis origin sensor.



	モード	モータ1パルス移動量	エンコーダ1パルス移動量	ストローク
R軸	フルステップ	0.0271mm	0.0271mm	約230mm/8500P
T軸	ハーフステップ	0.0072°	0.0072°	約333°/46250P
Z軸	ハーフステップ	0.0125mm	0.025mm	約185mm/14800P

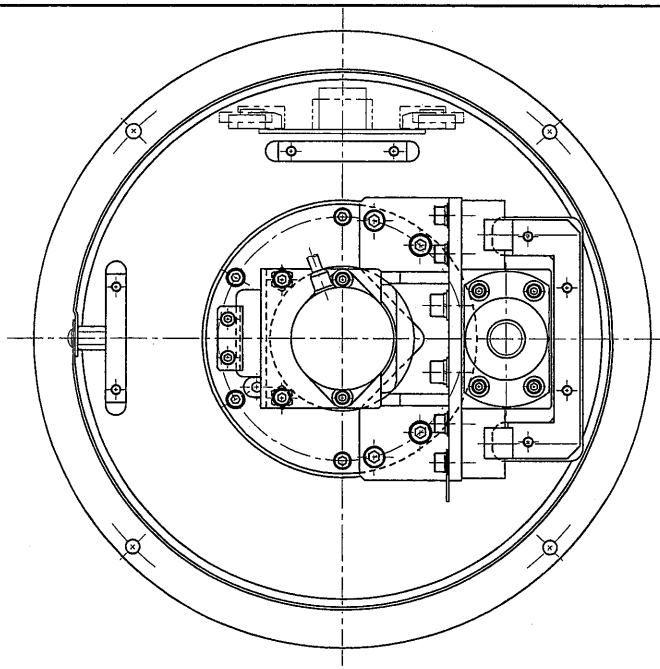
符号	日付	記事	氏名
3	10.03.07	員数等号変更	星野
2	06.11.16	型式変更・図面修正	小林
1	03.09.17	員数等号修正、型式変更	金島

総組立図(2/2)ハ CD1-9827
部品リストハ CD43-8669

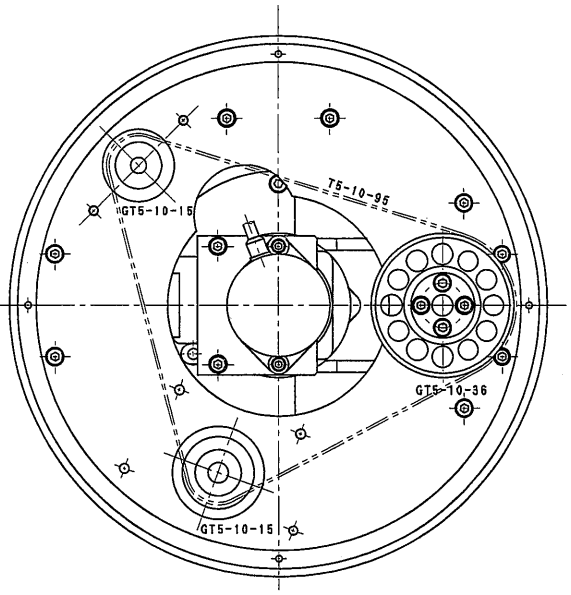
尺度	日付	製図	設計	検図	承認	品名	ウェハ搬送ロボット
1/1	95/05/25	手塚				名称	総組立図(1/2)

日東精機株式会社

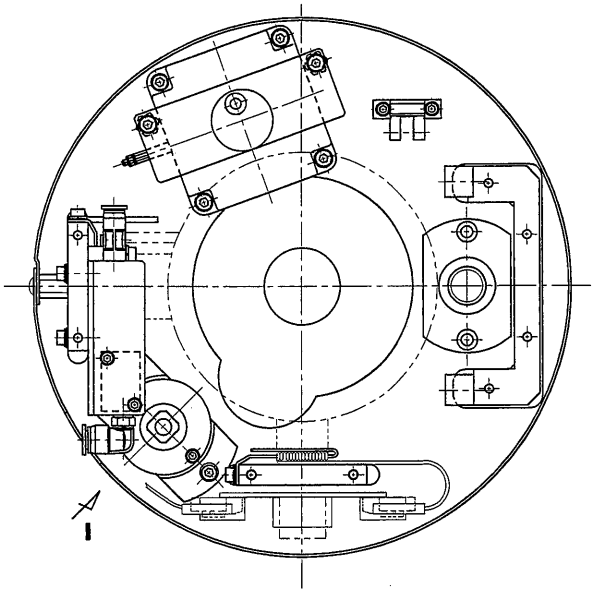
図番 CD1-9826 3



断面 A



矢視 B



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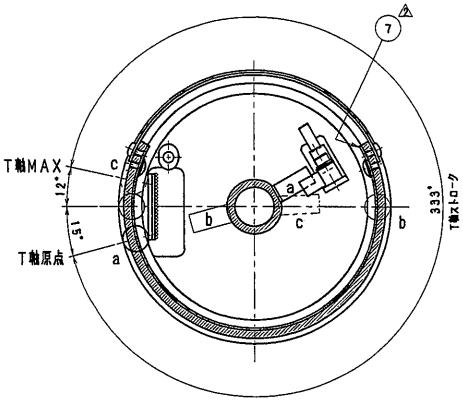
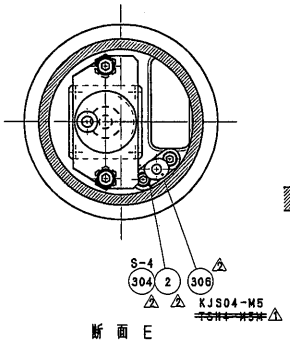
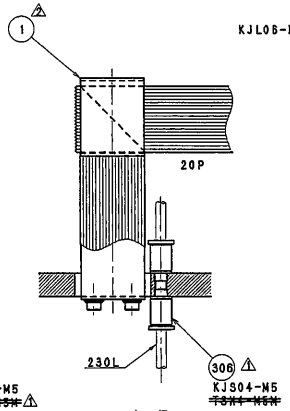


断面 D



断面 E



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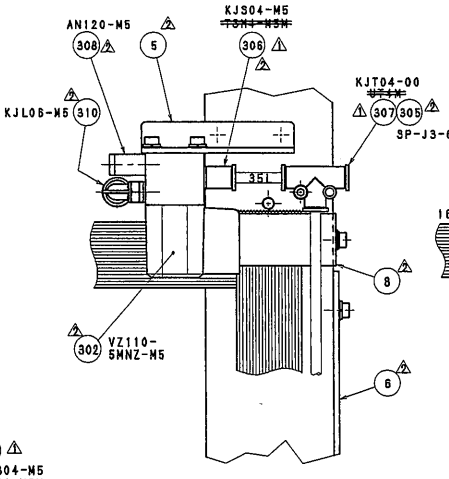

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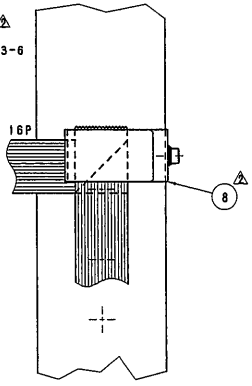

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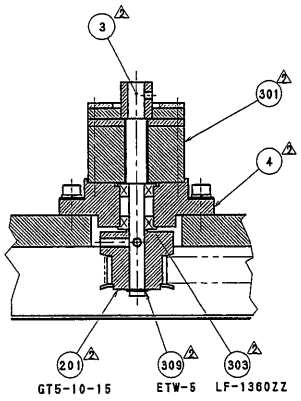

矢視 I 断面

符号	日付	記事	氏名
△	98.09.04	図番号変更	星野
△	98.11.18	型式変更	小林

総組立図(1/2)ハ CD1-9826
部品リストハ CD43-8669

尺度	日付	製図	設計	検図	承認	品名	ウェハ搬送ロボット
1/1	95/05/25	手塚	井上	松下	米山	名	総組立図(2/2)
		日東精機株式会社				図番	CD1-9827 △

Machine Type	DR/HR8500
Unit	ROBOT
Drawing No.	CD1-9826-03

番号 No	部品ｺｰﾄﾞ Part code	部品名 Part Name	図面番号 Drawing Number	項目番号	型式/Model	ﾒｰｶｰ Manufacture	員数 Q.ty	記事/Remarks
001	22794801	ﾌﾟﾚｰﾄ	CD22-7948-01	1		NITTO	1	
002	22140701	ｽﾀﾝﾄﾞ	CD22-1407-01	1		NITTO	1	
003	22141101	ﾊｳｼﾞﾝｸﾞ(B)	CD22-1411A-02	1		NITTO	1	
004	22141201	ﾍﾞｰｽﾌﾗﾝｼﾞ	CD22-1412B-02	1		NITTO	1	
005	22141301	ﾄｯﾌﾟﾌﾗﾝｼﾞ	CD22-1413-01	1		NITTO	1	
006	34866001	ｱｰﾑ	CD34-8660-02	1		NITTO	1	
007	-							
008	34866201	ﾊｳｼﾞﾝｸﾞ(A)	CD34-8662-01	1		NITTO	1	
009	36351701	ﾌﾗﾝｼﾞ	CD36-3517-01	1		NITTO	1	
010	34866401	ﾌﾗﾝｼﾞｼｬﾌﾄ	CD34-8664A-01	1		NITTO	1	
011	34866501	ﾌﾞﾗｹｯﾄ	CD34-8665B-04	1		NITTO	1	
012	34866601	ﾍﾞｱﾘﾝｸﾞ押ｴ	CD34-8666-00	1		NITTO	1	
013	34866701	ﾎﾞﾄﾑﾊﾟﾈﾙ	CD34-8667-00	1		NITTO	1	
014	34867301	ｻｲﾄﾞﾌﾟﾚｰﾄ(A)	CD34-8673A-03	1		NITTO	1	
015	34872801	ｻｲﾄﾞﾌﾟﾚｰﾄ(B)	CD34-8728A-03	1		NITTO	1	
016	34875301	ﾒｲﾝｶﾊﾞｰ	CD34-8753A-02	1		NITTO	1	
017	43745001	ｱｰﾑｶﾊﾞｰ(A)	CD43-7450B-03	1		NITTO	1	
018	43745101	ｱｰﾑｶﾊﾞｰ(B)	CD43-7451A-02	1		NITTO	1	
019	43745201	異径ｱﾀﾞﾌﾟﾀｰ(A)	CD43-7452-01	1		NITTO	1	
020	42000001	T軸部ｽﾄｯﾊﾟｰ	MD42-0000-00	1		NITTO	1	
021	44978101	ｴﾝｺｰﾀﾞ取付板(A)	CD44-9781-01	1		NITTO	1	
022	43745401	ｴﾝｺｰﾀﾞ取付板(B)	CD43-7454A-01	1		NITTO	1	
023	43745501	ｴﾝｺｰﾀﾞ取付板(C)	CD43-7455A-01	1		NITTO	1	
024	43745601	ｴﾝﾄﾞﾌﾟﾚｰﾄ(後)	CD43-7456-00	1		NITTO	1	
025	43745701	ｴﾝﾄﾞﾌﾟﾚｰﾄ(前)	CD43-7457-00	1		NITTO	1	
026	43745801	押ｴﾌﾟﾚｰﾄ	CD43-7458-00	1		NITTO	1	
027	43745901	ｹｰﾌﾞﾙｶﾞｰﾄﾞ	CD43-7459B-03	1		NITTO	1	
028	43746001	ｹｰﾌﾞﾙｸﾗﾝﾌﾟ	CD43-7460-01	1		NITTO	2	
029	43746101	ｹｰﾌﾞﾙﾌﾞﾗｹｯﾄ(A)	CD43-7461A-01	1		NITTO	1	
030	-							
031	43746301	遮光板(A)	CD43-7463A-02	1		NITTO	1	
032	43746401	遮光板(B)	CD43-7464-01	1		NITTO	1	
033	43746601	ｽﾃｰ(A)	CD43-7466B-02	1		NITTO	2	
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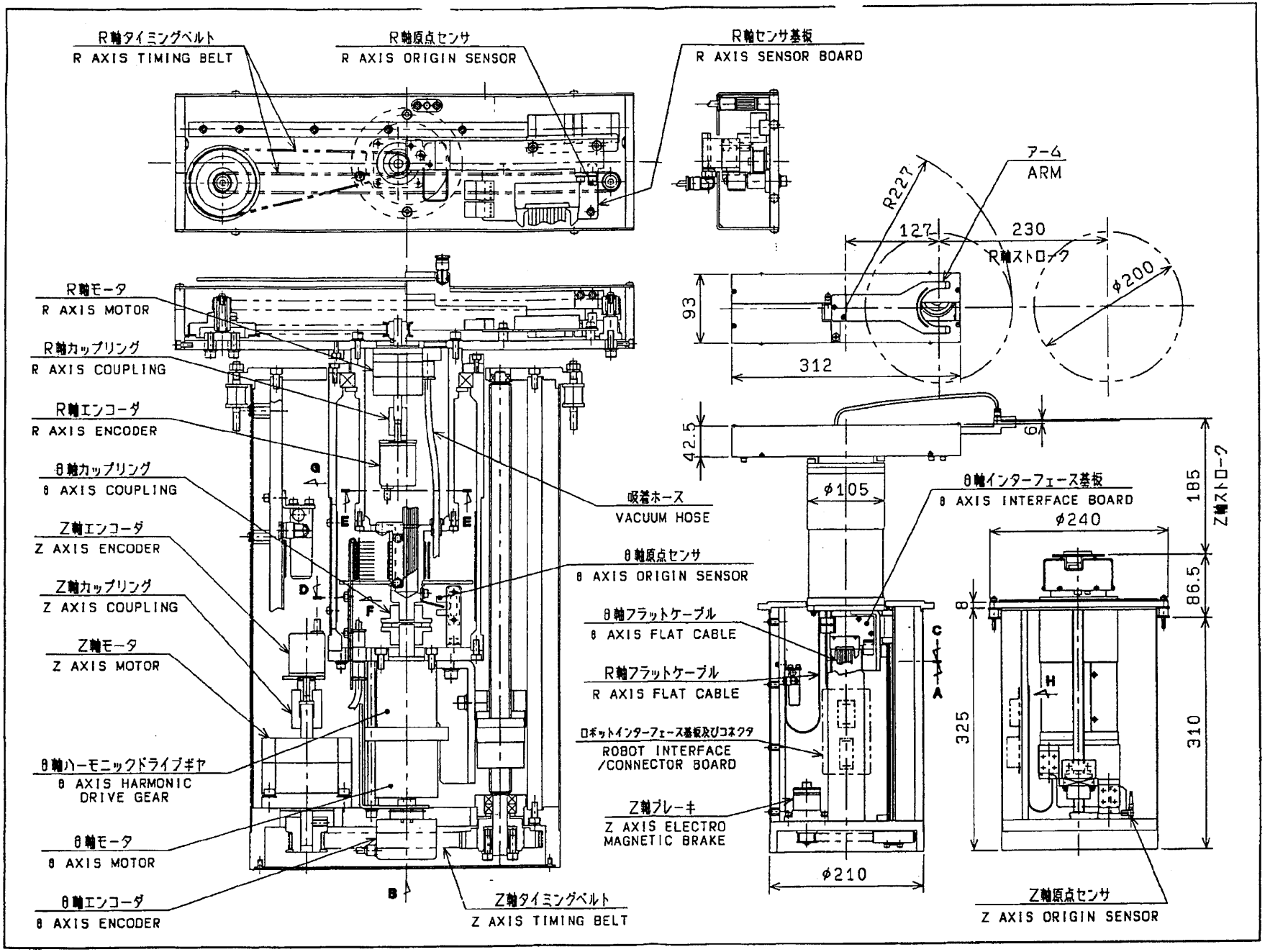
035	43746602	ｽﾃｰ(C)	CD43-7466B-02	3		NITTO	4	
036	43746701	ｽﾄｯﾊﾟｰ	CD43-7467-00	1		NITTO	2	

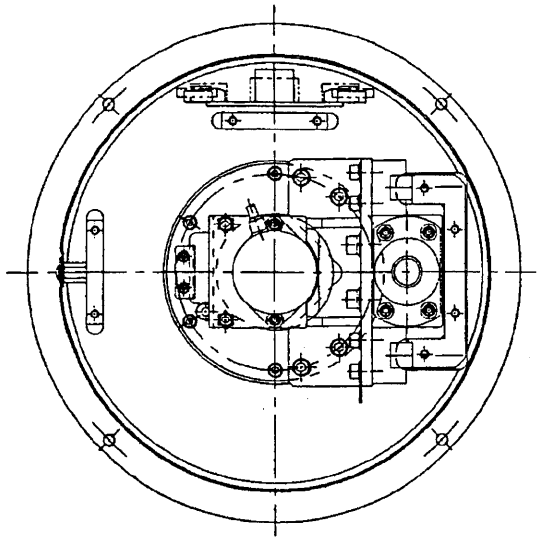
037	43746801	ｽﾗｲﾄﾞﾌﾞﾛｯｸ	CD43-7468A-02	1		NITTO	1	
038	43746901	ｾﾝｻｰﾌﾞﾗｹｯﾄ	CD43-7469A-01	1		NITTO	1	
039	-							
040	-							
041	-							
042	-							
043	-							
044	-							
045	-							
046	-							
047	43747801	ﾎﾞｰﾙﾈｼﾞﾊｳｼﾞﾝｸﾞ	CD43-7478-01	1		NITTO	1	
048	43747901	ﾌﾛｰﾃｨﾝｸﾞｶﾗｰ	CD43-7479-01	1		NITTO	4	
049	-							
050	-							
051	43748201	ﾌﾟｰﾘｰ軸(A)	CD43-7482A-01	1		NITTO	1	
052	43748301	ﾌﾟｰﾘｰ軸(B)	CD43-7483A-00	1		NITTO	1	
053	43748401	ﾍﾞｱﾘﾝｸﾞｹｰｽ	CD43-7484-01	1		NITTO	1	
054	43748601	ﾍﾞﾙﾄｸﾗﾝﾊﾟ	CD43-7486A-01	1		NITTO	1	
055	-							
056	43761101	ｽﾀｯﾄﾞ	CD43-7611-01	1		NITTO	4	
057	43762401	ﾊｳｼﾞﾝｸﾞｶﾊﾞｰ	CD43-7624-01	1		NITTO	1	
201	43747001	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(A)	CD43-7470-01	1	24MXL6.4-B	MITSUBOSHI	1	
202	43747101	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(B)	CD43-7471A-02	1	72MXL100	MITSUBOSHI	1	
203	43747201	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(C)	CD43-7472-01	1	20MXL100	MITSUBOSHI	1	
204	43747301	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(D)	CD43-7473-01	1	20MXL100	MITSUBOSHI	1	
205	43747401	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(E)	CD43-7474A-02	1	GT5-10-15C	MITSUBOSHI	1	
206	-							
207	43747601	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(G)	CD43-7476A-03	1	GT5-10-36B	MITSUBOSHI	1	
301	34865801	LMｶﾞｲﾄﾞ	CD34-8658-00	1	HSR12R1M+287LM	THK	2	
302	34865901	LMｶﾞｲﾄﾞ	CD34-8659-00	1	HSR10R2CSM+295LHM	THK	1	
303	43748701	転造ﾎﾞｰﾙﾈｼﾞ	CD43-7487-00	1	WTF1530-2+325LC8TF	THK	1	
304	-							
305	-							
306	B48002	ﾒｶﾛｯｸ			MA10-23	AISERU	1	
307	B31081	ﾎﾞｰﾙﾍﾞｱﾘﾝｸﾞ			6814ZZ	NACHI	1	
308	B31082	ﾎﾞｰﾙﾍﾞｱﾘﾝｸﾞ			6900ZZ	NACHI	2	
309	A0000784	ﾍﾞｱﾘﾝｸﾞ			DDLF-1470ZZ	NMB	1	
310	A0000783	ﾍﾞｱﾘﾝｸﾞ			DDLF-740ZZ	NMB	4	
311	-							
312	B52067	ｶｯﾌﾟﾘﾝｸﾞ			SFC-030SA2-10B-10B	MIKI	1	
313	B52115	ｶｯﾌﾟﾘﾝｸﾞ	B52116		UA-15C-4-5	SAKAI	1	
314	B52116	ｶｯﾌﾟﾘﾝｸﾞ			UA-20C-4-8	SAKAI	1	

315	B45085	ﾀｲﾐﾝｸﾞﾍﾞﾙﾄ			165-T80-6.4	MITSUBOSHI	1	
316	B45086	ﾀｲﾐﾝｸﾞﾍﾞﾙﾄ			280-T80-6.4	MITSUBOSHI	1	
317	B45012	ﾀｲﾐﾝｸﾞﾍﾞﾙﾄ			T5-10-95	MITSUBOSHI	1	
318	B44125	ﾌﾟｰﾘｰ用ﾌﾗﾝｼﾞ			F-105136(ｱﾙﾐ)	MITSUBOSHI	1	
319	B20071	ﾎﾞｳｼﾝｺﾞﾑ			KA-15	KURASHIKI	4	
320	-							
321	-							
322	B56015	ﾊﾟｲﾌﾟｽﾍﾟｰｻｰ			SP-J3-4	MISUMI	4	
323	B56016	ﾊﾟｲﾌﾟｽﾍﾟｰｻｰ			SP-J3-6	MISUMI	2	
324	-							
325	B17077	継手(ｴﾙﾎﾞ)			TL4-M5M	KOGANEI	1	
326	-							
327	-							
328	-							
329	B17281	延長継手			EXF	KOGANEI	1	
330	-							
331	B61072	止メ輪			STW-70(SUS)	OCHIAI	1	
332	B61042	止メ輪			STW-21(SUS)	OCHIAI	1	
333	-							
334	-							
335	-							
336	-							
337	-							
338	B11173	ｽﾘｰﾌﾞ			KFS-06	SMC	1	
339	-							
340	-							
341	B06077	ﾛﾎﾞｯﾄR軸ﾓｰﾀｰ			103F3505-7013	SANYO	1	
342	A0000781	ﾛﾎﾞｯﾄZ軸ﾓｰﾀｰ			UPK564BW2	ORIENTAL	1	
343	B06072	ﾛﾎﾞｯﾄT軸ﾓｰﾀｰ			UPK543BW-H50	ORIENTAL	1	
344	E06323	ﾌｫﾄﾏｲｸﾛｾﾝｻｰ			EE-SX671	OMROM	2	
345	E06390	ﾌｫﾄﾏｲｸﾛｾﾝｻｰｿｹｯﾄ			EE-1001	OMROM	2	
346	B06113	ﾛｰﾀﾘｰｴﾝｺｰﾀﾞｰ			E6H-CWZ6C-1000P/R	OMROM	1	
347	E06764	ﾛｰﾀﾘｰｴﾝｺｰﾀﾞｰ			E6A2-CWZ3C-500P/R	OMROM	2	

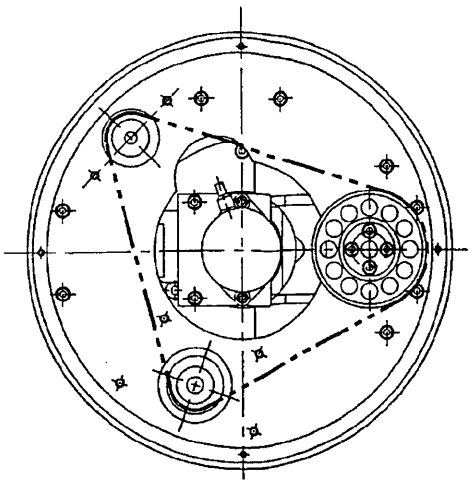
Machine Type	DR/HR8500
Unit	ROBOT
Drawing No.	CD1-9827-02

番号 No	部品ｺｰﾄﾞ Part Number	部品名 Part Name	図面番号 Drawing Number	項目番号 #	型式/Model	ﾒｰｶｰ Manufacture	員数 Q.ty	記事/Remarks
001	43811001	ｹｰﾌﾞﾙﾌﾞﾗｹｯﾄ(B)	CD43-8110-00	1		NITTO	1	
002	43747701	継手取付ﾌﾞﾛｯｸ	CD43-7477-02	1		NITTO	2	
003	43748001	ﾌﾞﾚｰｷ軸	CD43-7480-00	1		NITTO	1	
004	43748101	ﾌﾞﾚｰｷﾌﾗﾝｼﾞ	CD43-7481-01	1		NITTO	1	
005	43761001	ﾊﾞﾙﾌﾞﾌﾞﾗｹｯﾄ	CD43-7610A-01	1		NITTO	1	
006	43748501	ﾁｭｳﾌﾞｶﾞｲﾄﾞ	CD43-7485A-02	1		NITTO	1	
007	43847201	保護ﾌﾟﾚｰﾄ	CD43-8472A-02	1		NITTO	1	
008	43811101	ｹｰﾌﾞﾙﾌﾞﾗｹｯﾄ(C)	CD43-8111-00	1		NITTO	2	
201	43747501	ﾀｲﾐﾝｸﾞﾌﾟｰﾘ(F)	CD43-7475-02	1	GT5-10-15C	MITSUBOSHI	1	
301	B53059	電磁ﾌﾞﾚｰｷ			BXM-02-10 DC24V	MIKI	1	
302	B11067	電磁弁			VZ110-5MNZ-M5	SMC	1	
303	B30138	ﾎﾞｰﾙﾍﾞｱﾘﾝｸﾞ			DDLF-1360ZZ	NMB	2	
304	B20043	O-ﾘﾝｸﾞ			S-4(C0 0501A)	NOK	3	
305	B56016	ﾊﾟｲﾌﾟｽﾍﾟｰｻｰ			SP-J3-6	MISUMI	1	
306	B17704	ｴｱ ﾂｷﾞﾃ			KJS04-M5	SMC	5	
307	B17719	ｴｱ ﾂｷﾞﾃ			KJT04-00	SMC	1	
308	B17303	ﾏﾌﾗｰ			AN120-M5	SMC	1	
309	B61014	Eﾘﾝｸﾞ			ETW-5(SUS)	OCHIAI	1	
310	B17714	ｴｱ ﾂｷﾞﾃ			KJL06-M5	SMC	1	

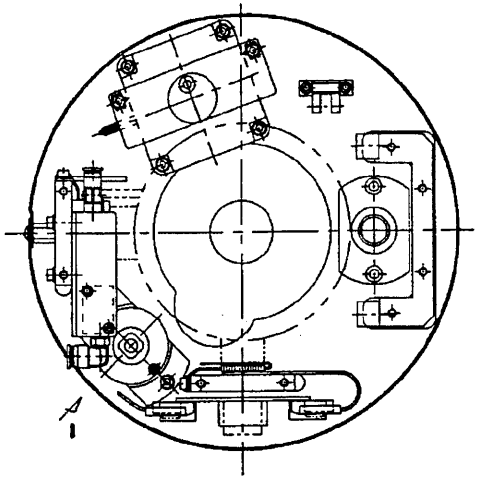

R軸タイミングベルト
R AXIS TIMING BELT
R軸原点センサ
R AXIS ORIGIN SENSOR
R軸センサ基板
R AXIS SENSOR BOARD
アーム
ARM
R227
127
230
R軸ストローク
φ200
93
312
42.5
R軸モータ
R AXIS MOTOR
R軸カップリング
R AXIS COUPLING
R軸エンコーダ
R AXIS ENCODER
θ軸カップリング
θ AXIS COUPLING
Z軸エンコーダ
Z AXIS ENCODER
Z軸カップリング
Z AXIS COUPLING
Z軸モータ
Z AXIS MOTOR
θ軸ハーモニックドライブギヤ
θ AXIS HARMONIC DRIVE GEAR
θ軸モータ
θ AXIS MOTOR
θ軸エンコーダ
θ AXIS ENCODER
吸着ホース
VACUUM HOSE
θ軸原点センサ
θ AXIS ORIGIN SENSOR
θ軸フラットケーブル
θ AXIS FLAT CABLE
R軸フラットケーブル
R AXIS FLAT CABLE
ロボットインターフェース基板及びコネクタ
ROBOT INTERFACE /CONNECTOR BOARD
Z軸ブレーキ
Z AXIS ELECTRO MAGNETIC BRAKE
Z軸タイミングベルト
Z AXIS TIMING BELT
φ105
φ210
θ軸インターフェース基板
θ AXIS INTERFACE BOARD
φ240
185
Z軸ストローク
86.5
8
325
310
Z軸原点センサ
Z AXIS ORIGIN SENSOR
A
B
C
D
E
F
G
H



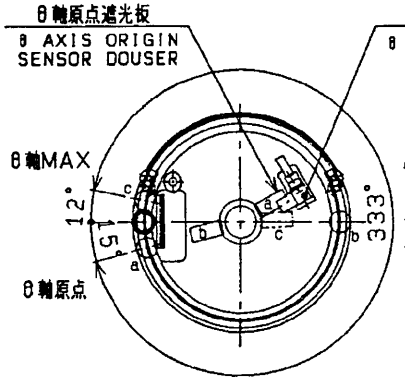
断 面 A



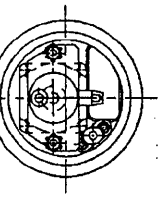
矢 視 B



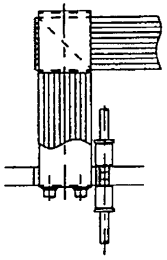
断 面 C



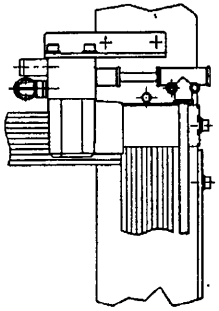
断 面 D



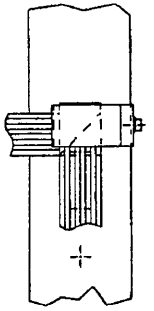
断 面 E



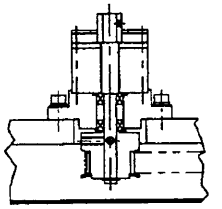
矢 視 F



矢 視 G



矢 視 H



矢 視 I 断 面

1.3 Robot electrical and mechanical data

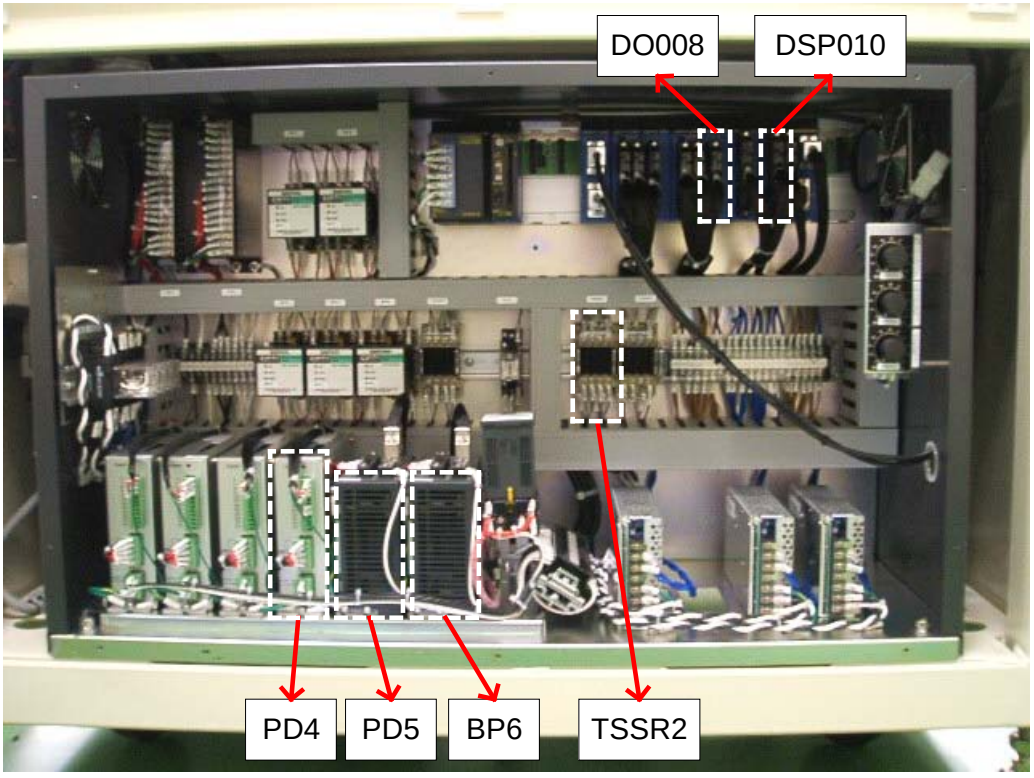
The robot operations are as follows.

	R-axis	Θ-axis	Z-axis
Maximum travel	230mm	333 degrees	185mm
Resolving power per pulse	0.0271mm (FULL)	0.0072 degrees (HALF)	0.0125mm (HALF)
Encoder count per pulse	1 count	1 count	0.5 count
Repeat accuracy	2μm	0.002 degrees	1μm

1.4 Hardware layout

The layout in the control box and the connection between Robot and the control box are as follows.
Block diagram is shown in the page.

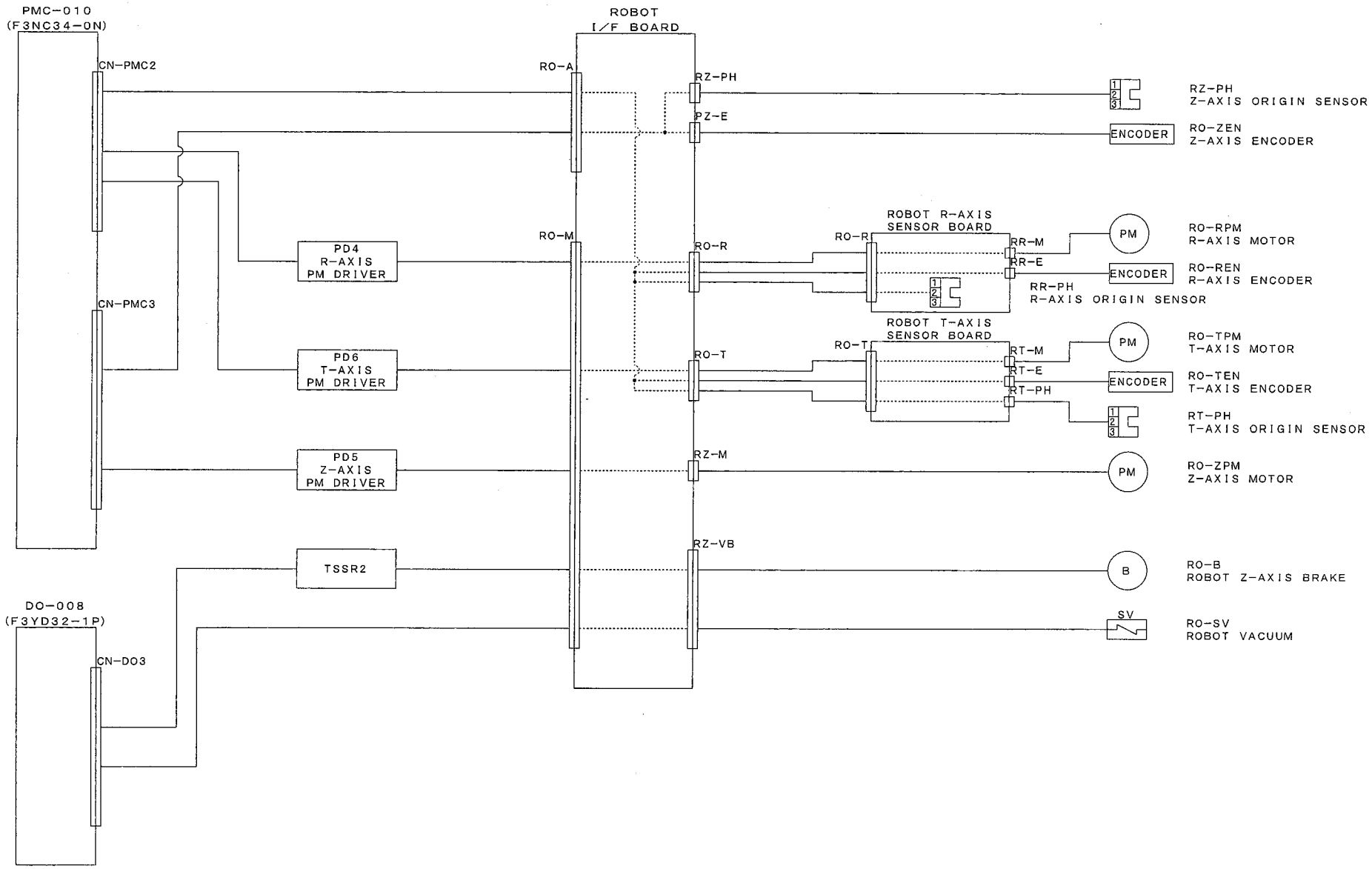
PD4: R-axis driver
PD5: Z-axis driver
PD6: T-axis driver



PARTS LIST

rev.	Symbol	Description	Model	Maker	QTY	Parts No
	PMC-010	位置決めﾓｼﾞｭｰﾙ	F3NC34-0N	横河	1	E01711
	CN-PMC2	圧着ｺﾈｸﾀﾊｳｼﾞﾝｸﾞ	FCN-363J048	富士通	2	E09539
		ｺﾈｸﾀｶﾊﾞｰ	FCN-360C048-B	富士通	2	E09540
	RO-M	1600ｼﾘｰｽﾞ	SC-1620	ﾋﾛｾ	3	E09147
		ﾌﾟﾗｸﾞｹｰｽ	P-1620-CA(20)	ﾋﾛｾ	1	E09149
		ｺﾝﾀｸﾄ	SC-1600-112	ﾋﾛｾ	20	E09151
	RO-A	ｺﾈｸﾀ	HDBB-25P	ﾋﾛｾ	1	E09123
		D-SUBｶﾊﾞｰ	HDB-CTF	ﾋﾛｾ	1	E11056
	RO-R	ｺﾈｯｸﾀ	PS-20SM-D4PI-ID	日本航空電子	2	E09069
	RR-M, RT-M	ｿｹｯﾄﾊｳｼﾞﾝｸﾞ	IL-5S-S3L-(N)	日本航空電子	3	E09067
	RZ-M					
	RR-E, RT-E	ｿｹｯﾄﾊｳｼﾞﾝｸﾞ	IL-4S-S3L-(N)	日本航空電子	4	E09042
	RZ-E, RZ-VB					
	RT-PH, RZ-PH	ｿｹｯﾄﾊｳｼﾞﾝｸﾞ	IL-3S-S3L-(N)	日本航空電子	2	E09041
		ｿｹｯﾄｺﾝﾀｸﾄ	IL-C2-1-1	日本航空電子	37	E09043
	RO-T	ｺﾈｸﾀ	PS-16SM-D4PI-ID	日本航空電子	2	E09070
	RO-TEN	ｴﾝｺｰﾀﾞｰ	E6A2-CWZ3C-500P/R	ｵﾑﾛﾝ	1	E06764
	RO-REN,ZEN	ｴﾝｺｰﾀﾞｰ	E6H-CWZ6C-1000P/R	ｵﾑﾛﾝ	2	E06801
	RZ-PH, RT-PH	ﾌｫﾄﾏｲｸﾛｾﾝｻｰ	EE-SX671	ｵﾑﾛﾝ	2	E06323
		ﾌｫﾄﾏｲｸﾛｾﾝｻｰｿｹｯﾄ	EE-1001	ｵﾑﾛﾝ	2	E06390
		内作ﾛﾎﾞｯﾄｲﾝﾀｰﾌｪｰｽ基板	INTERFACE BOARD	日機	1	E02012
		ﾛﾎﾞｯﾄT軸ｾﾝｻｰ基板	T AXIS BOARD	日機	1	E02015
		ﾛﾎﾞｯﾄR軸ｾﾝｻｰ基板	R AXIS BOARD	日機	1	E02016
	PD4	ｽﾃｯﾋﾟﾝｸﾞﾓｰﾀｰﾄﾞﾗｲﾊﾞｰ	KR-525M	Kﾌﾟﾛｼﾞｪｯﾄ	1	E04554
	PD5	ｽﾃｯﾋﾟﾝｸﾞﾓｰﾀｰﾄﾞﾗｲﾊﾞｰ	UDK5114NW2	ｵﾘｴﾝﾀﾙ	1	E04555
	PD6	ｽﾃｯﾋﾟﾝｸﾞﾓｰﾀｰﾄﾞﾗｲﾊﾞｰ	UDK5107NW2	ｵﾘｴﾝﾀﾙ	1	E04556
	DO-8	出力ﾓｼﾞｭｰﾙ	F3YD32-1P	横河	1	E01727
	CN-DO3	圧着ｺﾈｸﾀﾊｳｼﾞﾝｸﾞ	FCN-363J040	富士通	1	E09541
		ｺﾈｸﾀｶﾊﾞｰ	FCN-360C040-B	富士通	1	E09542

Type ; DR8500III / HR8500III		Ver ;
MDNo. ;	Section ; Robot(1/1)	DATE ; 2011/1/6



符号	日付	来歴	訂正	検図
1				

日付(YY/MM/DD)	承認	検図	設計	製図	尺度 SCALE
11/01/06	綿木	池田	小島	小島	NTS

品名	図番
DR/HR8500Ⅲ STANDARD	P4A-3873-00
ELECTRIC WIRING DIAGRAM OF ROBOT SCHEMATIC PAGE 1/1	日東精機株式会社 NITTO SEIKI CO.,LTD

2. The principle of Robot

2.1 Resetting procedure

(1) Connect Teach pendant to the machine.

(2) Press the [Q. STOP] key on the operation panel.

(3) Press the [BZ.STOP] key on the operation panel.

(4) Press the [MAINTENANCE] key on the Teach pendant.

(5) Press the [AUTO/TEACH] key on the Teach pendant.
(The Robot mode switches to TEACH mode.)

(6) Press the [RESET] key on the Teach pendant, and Robot is performed resetting.
By resetting, the Robot arm moves to the origin of each axis, and encoder count is cleared.
After resetting, “RANDOM REAET DONE” is displayed on the Teach pendant.
If any one origin sensors of R-axis, T-axis or Z-axis is not detected, an error occurs, and “MOTOR FAULT” is displayed on the Teach pendant.

(7) When you try to reset again, press the [AUTO/TEACH] key, and then press the [RESET] key.

The TEACH mode switches to Automatic operation mode.
(8) Press the [MAINTENANCE] key.
(9) Press the [RESET] key on the operation panel.

2.2 Operating check

Perform the operating check of Robot by using Teach pendant.

(1) Connect the Teach pendant to the machine.

(2) Press the [Q.STOP] key.

(3) Press the [BZ.STOP] key.

(4) Press the [MAINTENANCE] key.

(5) Press the [AUTO/TEACH] key, the mode switches to TEACH mode.

(6) Press the [RESET] key on the Teach pendant.
The encoder value of each axis is reset after pressing the key.

(7) Press the [AUTO/TEACH] key to switch TCHRBT mode.

(8)-1 Operating check of R-axis.
Press the [◀1] key, and Robot arm extends in the R-axis directions.
Press the [READ POSITION] key, and record the encoder count of R1.
Check that the encoder count of R1 increases.
When the arm extends to maximum travel (230mm), the encoder count is 8487.
However, the actual maximum encoder count is 8450. This is because cannot extend outward the position specified with the MAX POSITION.

Press the [◀1] key until the arm finishes itself moving, and check that the encoder count is 8450.
Press the [1▶] key until the arm retracts in the R-axis directions, and check that the encoder count of R1 decreases.
By these checks, it is ascertained that T-axis encoder is correct.

(8)-2 Operating check of T-axis.

Press the [↷] key, and Robot arm turns clockwise.
Press the [READ POSITION] key, and record the encoder count of T.
Check that the encoder count of T increases.
Press the [↶] key, and Robot arm turns counterclockwise.
Press the [READ POSITION] key, and record the encoder count of T.
Check that the encoder count of T decreases.
When the arm turns to maximum travel (333 degrees), the encoder count is 46250. However, the actual maximum encoder count is 46000. This is because the 46000 is specified with the MAX POSITION; therefore, the arm cannot turn more than the position specified with the MAX POSITION.

Press the [↷] key until the arm finishes itself moving, and check that the encoder count is 8450.
Press the [↶] key, and Robot arm turns counterclockwise, and check that the encoder count of R1 decreases.
By these checks, it is ascertained that T-axis encoder is correct.

(8)-3 Operating check of Z-axis.

Press the [↑] key, andRobot arm ascends.
Press the [READ POSITION] key, and record the encoder count of Z.
Check that the encoder count of Z increases.
Press the [↓] key, and Robot armdescends.
Press the [READ POSITION] key, and record the encoder count of Z.
Check that the encoder count of Z decreases.
When the arm ascends to maximum travel of Z (185mm), the encoder count is 7400. However, the actual maximum encoder count is 7300. This is because the 7300 is specified with the MAX POSITION; therefore, the arm cannot ascend more than the position specified with the MAX POSITION.

Press the [↑] key until the arm finishes itself moving, and check that the encoder count is 7300.
Press the [↓] key, and Robot arm descends, andcheck that the encoder count of Z decreases.
By these checks, it is ascertained that R-axis encoder is correct.

(8)-4 Operating check of [FREE] key

Press [FREE] key of the Teach pendant makes the excitation current value 0, and then the operator can move the robot arm by hand.

(8)-5 Operating check of [VAC] key

Press [VAC] key of Teach pendant turns on the vacuum chucking valve inside of the Robot unit.

2.3 Teaching data check

Make sure that Teaching data is correct by using [PAR+], [PAR-], [REV], [FWD], [PRV], and [NXT] keys.

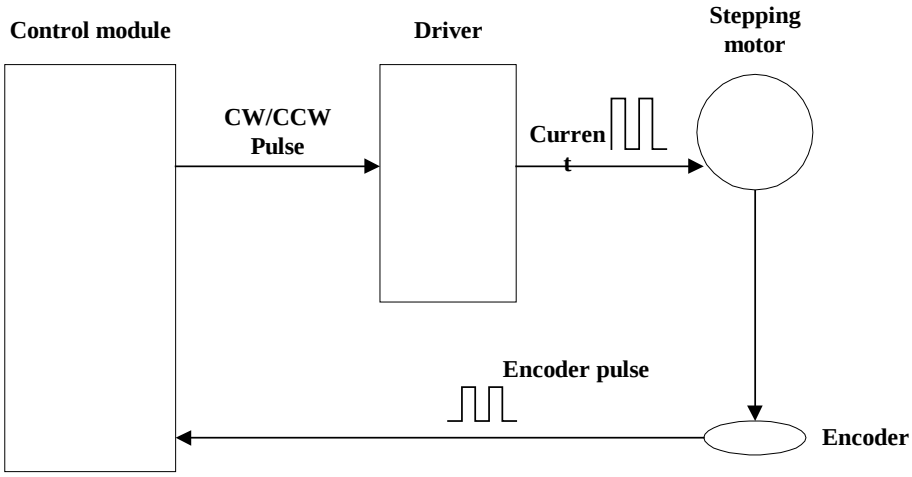
Refer to Robot Manual for how to use these keys and Teaching data.

If approximately 10 years have passed since this machine’s power was turned off, the data stored in the CP and Module is erased with the discharge from the capacitor.

Therefore, in such a case, check the teaching data.

2.4 Loss of synchronism detecting process

The Robot is controlled by stepping motor control module (hereinafter referred to as control module), driver, stepping motor and encoder.



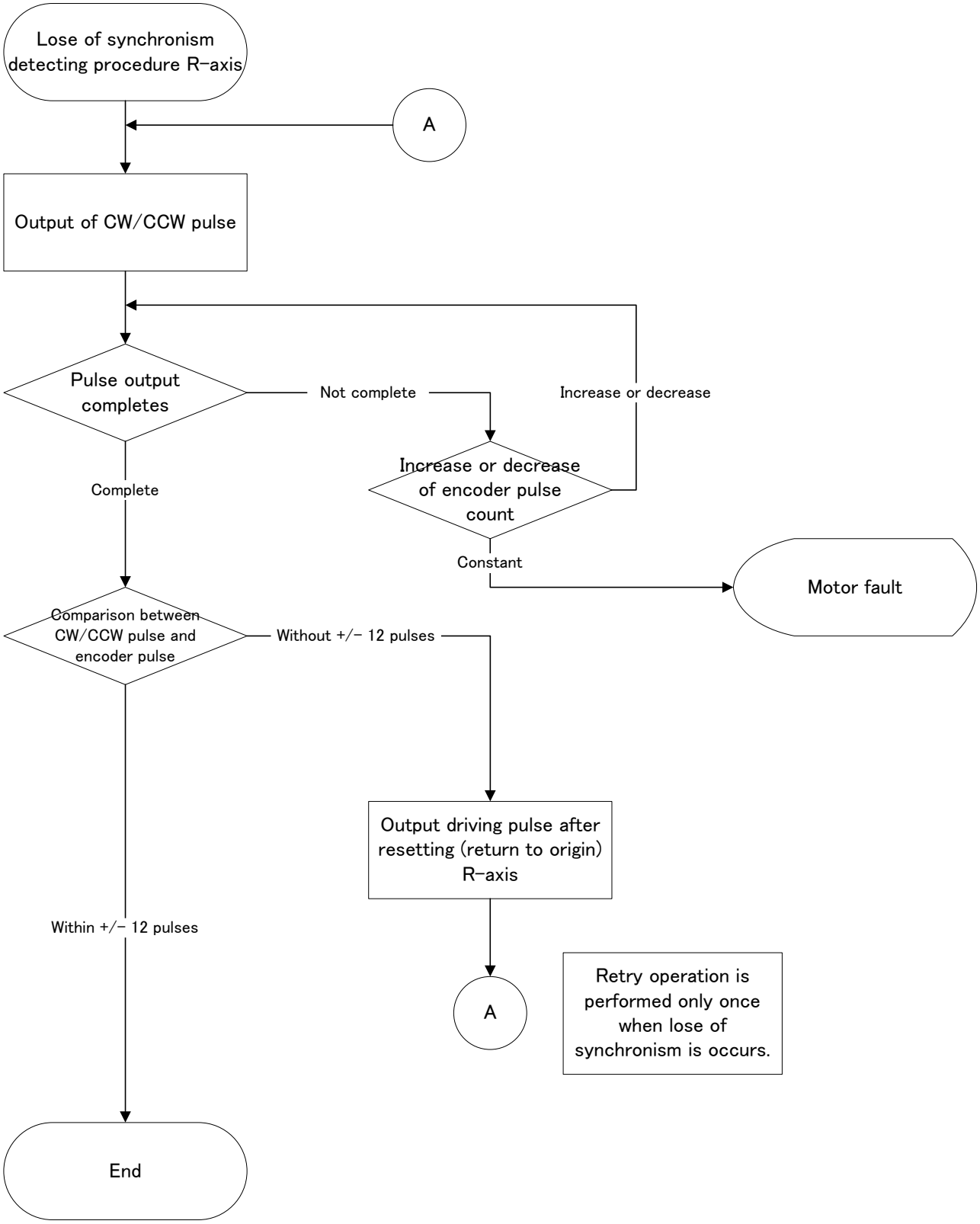
The control modules create CW / CCW pulse according to the setting, and send the signal to the driver.
The driver supplies the optimum current to the stepping motor.
The stepping motor rotates according to the current.
The encoder detects the rotating of the stepping motor, creates the encoder pulse, and sends the encoder pulse to the control module.

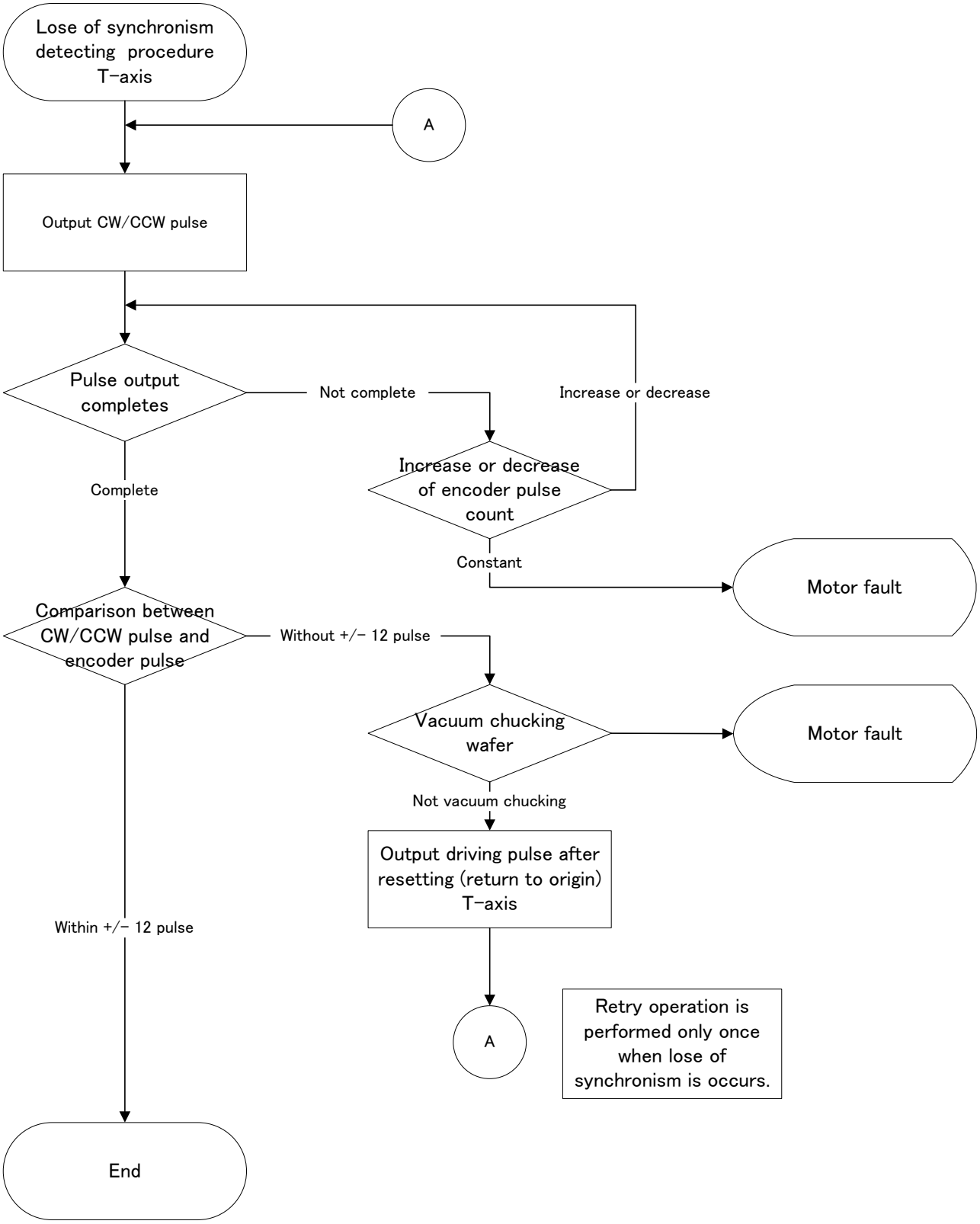
Loss of synchronism detecting is performed during the CW / CCW pulse signal is outputting and after the outputting.

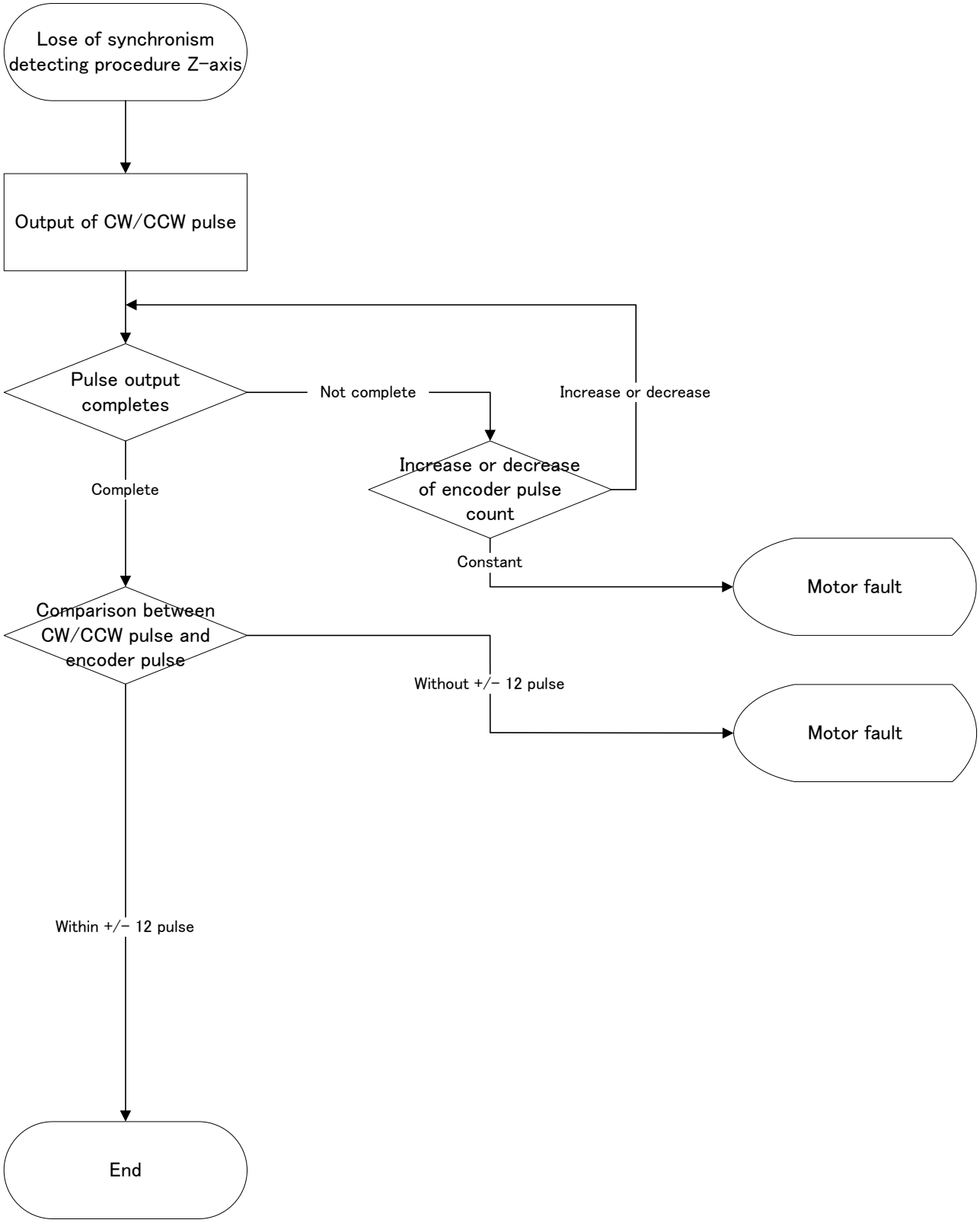
(1) During the outputting
The Control module checks the increase or decrease of the encoder pulse count.
(2) After the outputting (Ver. 1.7)
The control module counts the difference between the CW / CCW pulse and the encoder pulse.
In Z-axis, if the difference is without tolerance (+/- 12 pulses), the control module judges that Z-axis stepping motor loses the synchronism.
In R-axis, if the difference is without the tolerance (+/- 12 pulses) and within +/- 200 pulses, in order to correct the difference, R-axis value is reset (Retry) and then the control module outputs pulse signal again.
In T-axis, if the difference is without the tolerance (+/- 12 pulses) and within +/- 200 pulses and without vacuum chucking wafer, in order to correct the difference, T-axis value is reset (Retry) and then the control module outputs pulse signal again.
If the difference is not within the tolerance yet, the control module judges that the stepping motor loses the synchronism.
When Loss of synchronism occurs, “MOTOR FAULT” displays on the operation panel and Teach pendant.

The travel on each axis in the tolerance (+/- 12 pulses), is as follows.

R-axis +/-0.32mm	(0.027mm ×12 pulses)
T-axis +/-0.086 degrees	(0.0072 degrees ×12 pulses)
Z-axis +/- 0.3mm	(0.0125mm ×12 pulses)


Lose of synchronism detecting procedure R-axis
A
Output of CW/CCW pulse
Pulse output completes
Not complete
Increase or decrease
Increase or decrease of encoder pulse count
Complete
Constant
Motor fault
Comparison between CW/CCW pulse and encoder pulse
Without +/- 12 pulses
Output driving pulse after resetting (return to origin) R-axis
Within +/- 12 pulses
A
Retry operation is performed only once when lose of synchronism is occurs.
End


Lose of synchronism detecting procedure T-axis
A
Output CW/CCW pulse
Pulse output completes
Not complete
Increase or decrease
Increase or decrease of encoder pulse count
Complete
Constant
Motor fault
Comparison between CW/CCW pulse and encoder pulse
Without +/- 12 pulse
Vacuum chucking wafer
Motor fault
Not vacuum chucking
Output driving pulse after resetting (return to origin) T-axis
Within +/- 12 pulse
A
Retry operation is performed only once when lose of synchronism is occurs.
End


Lose of synchronism detecting procedure Z-axis
Output of CW/CCW pulse
Pulse output completes
Not complete
Increase or decrease
Increase or decrease of encoder pulse count
Complete
Constant
Motor fault
Comparison between CW/CCW pulse and encoder pulse
Without +/- 12 pulse
Motor fault
Within +/- 12 pulse
End

3. Electrical Hardware

3.1 Pulse control board

Each axis stepping motors of Robot and Aligner are controlled by F3NC32-0N module (Yokogawa).
A manual for F3NC32-0N is shown on the next page.

User's Manual

Positioning Modules (with Pulse Output)

IM 34M6H56-02E

Applicable Modules:

Model Code	Model Name
F3NC32-0N	Positioning Module (with Pulse Output)
F3NC34-0N	Positioning Module (with Pulse Output)

YOKOGAWA ◆
Yokogawa Electric Corporation

IM 34M6H56-02E
2nd Edition

Applicable Product:

- **Range-free Multi-controller FA-M3**

  - Model code : F3NC32-0N, F3NC34-0N
  - Name : Positioning Module (with pulse output)

The document number and document model code for this manual are given below.

Refer to the document number in all communications; also refer to the document number or the document model code when purchasing additional copies of this manual.

- Document No. : IM 34M6H56-02E
- Document Model Code : DOCIM

Media No. IM 34M6H56-02E (YK) 2nd Edition : Jul., 2007 (AR)

Important

■ About This Manual

- This Manual should be passed on to the end user.
- Before using the controller, read this manual thoroughly to have a clear understanding of the controller.
- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.
- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
- The contents of this manual are subject to change without prior notice.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Precautions when Using/Maintaining the Product

- The following safety symbols are used on the product as well as in this manual.

Danger. This symbol on the product indicates that the operator must follow the instructions laid out in this instruction manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument. Where indicated by this symbol, the manual describes what special care the operator must exercise to prevent electrical shock or other dangers that may result in injury or the loss of life.

Protective Ground Terminal. Before using the instrument, be sure to ground this terminal.

Function Ground Terminal. Before using the instrument, be sure to ground this terminal.

Alternating current. Indicates alternating current.

Direct current. Indicates direct current.

The following symbols are used only in the instruction manual.

WARNING

Indicates a "Warning".

Draws attention to information essential to prevent hardware damage, software damage or system failure.

CAUTION

Indicates a "Caution"

Draws attention to information essential to the understanding of operation and functions.

TIP

Indicates a "TIP"

Gives information that complements the present topic.

SEE ALSO

Indicates a "SEE ALSO" reference.

Identifies a source to which to refer.

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.
- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.
- If component parts or consumable are to be replaced, be sure to use parts specified by the company.
- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, air navigation facilities, aviation facilities or medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.
- Do not attempt to modify the product.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

■ Software Supplied by the Company

- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.
- Use the software with one computer only. You must purchase another copy of the software for use with each additional computer.
- Copying the software for any purposes other than backup is strictly prohibited.
- Store the original media, such as CD-ROM, containing the software in a safe place.
- Reverse engineering, such as decompiling of the software, is strictly prohibited.
- No portion of the software supplied by Yokogawa Electric may be transferred, exchanged, or sublet or leased for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 Controller

- **Avoid installing the FA-M3 controller in the following locations:**
  - Where the instrument will be exposed to direct sunlight, or where the operating temperature exceeds the range 0°C to 55°C.
  - Where the relative humidity is outside the range 10 to 90%, or where sudden temperature changes may occur and cause condensation.
  - Where corrosive or flammable gases are present.
  - Where the instrument will be exposed to direct mechanical vibration or shock.
  - Where the instrument may be exposed to extreme levels of radioactivity.

- **Use the correct types of wire for external wiring:**
  - Use copper wire with temperature ratings greater than 75°C.

- **Securely tighten screws:**
  - Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.
  - Tighten terminal block screws with the correct tightening torque as given in this manual.

- **Securely lock connecting cables:**
  - Securely lock the connectors of cables, and check them thoroughly before turning on the power.

- **Interlock with emergency-stop circuitry using external relays:**
  - Equipment incorporating the FA-M3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

- **Low impedance grounding:**
  - For safety reasons, connect the [FG] grounding terminal to a Japanese Industrial Standards (JIS) Class D Ground*1 (Japanese Industrial Standards (JIS) Class 3 Ground). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

    *1 Japanese Industrial Standard (JIS) Class D Ground means grounding resistance of 100Ω max.

- **Configure and route cables with noise control considerations:**
  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**
  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the "Hardware Manual" (IM34M6C11-01E).

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is only valid in the EU.)

This product complies with the WEEE Directive (2002/96/EC) marking requirement.
The following marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category
With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product.
Do not dispose in domestic household waste.
When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

Introduction

■ Overview of the Manual

This manual describes the specifications and functions of the positioning modules (model F3NC32-0N and F3NC34-0N) to be installed in an I/O slot of the FA-M3, as well as information required for operating these modules.

■ Setup Tool for Positioning Modules

A setup tool is available for configuring the positioning modules. It allows a user to easily perform parameter setup, action testing and monitoring of the positioning modules using a windows interface.
For details on the setup tool, read ToolBox for Positioning Modules User's Manual (IM34M6Q31-01E)

■ Related Instruction Manuals

The manuals to be read depend on the CPU module to be used.
You should read the latest versions of the following instructions manuals, as required.

- **F3SP28, F3SP38, F3SP53, F3SP58, F3SP59**

  For information on sequence CPU functions, refer to:
  - Sequence CPU Instruction Manual - Functions (for F3SP28-3N/3S, F3SP38-6N/6S, F3SP53-4H/4S, F3SP58-6H/6S and F3SP59-7S) (IM34M6P13-01E)

  For information on sequence CPU instructions, refer to:
  - Sequence CPU Instruction Manual - Instructions (IM34M6P12-03E)

  For information on creating ladder programs, refer to:
  - FA-M3 Programming Tool WideField2 (IM34M6Q15-01E)

- **F3SP21, F3SP25, F3SP35, F3SP05, F3SP08**

  For information on sequence CPU functions, refer to:
  - Sequence CPU Instruction Manual - Functions (for F3SP21, F3SP25 and F3SP35) (IM34M6P12-02E)

  For information on sequence CPU instructions, refer to:
  - Sequence CPU Instruction Manual - Instructions (IM34M6P12-03E)

  For information on creating ladder programs, refer to:
  - FA-M3 Programming Tool WideField2 (IM34M6Q15-01E)

- **F3BP20, F3BP30**

  BASIC CPU Modules and YM-BASIC/FA Programming Language (IM34M6Q22-01E)

- **For specifications, functions and operation procedure of the ToolBox for Positioning Modules software:**
  - FA-M3 ToolBox Manual (IM34M6Q30-01E)
  - FA-M3 ToolBox for Positioning Modules (IM34M6Q31-01E)

- **For the FA-M3 specifications and configurations*1, installation and wiring, test run, maintenance, and module installation restrictions for the whole system:**

  *1: Refer to the relevant product manuals for specifications except for power supply modules, base modules, input/output modules, cables and terminal units.

  - Hardware Manual (IM 34M6C11-01E)

Copyrights and Trademarks

■ Copyrights

■ Trademarks

1. Overview

The F3NC32-0N and F3NC34-0N positioning modules are advanced I/O modules to be mounted onto the base module of an FA-M3 range-free controller. It generates a position control path according to commands from the CPU module and outputs position reference as pulse trains.

It comes in two models: F3NC32-0N and F3NC34-0N, which can simultaneously control up to two and four axes respectively.

With position reference pulse output, the module is suitable for driving servomotors or drivers, as well as stepper motors or drivers in position control applications.

1.1 Features

The module has the following features:

- **Fast and accurate positioning control**
  - High speed position reference pulse output at 5 Mpps max. for servomotors and 1 Mpps max. for stepper motors provides comfortable margin for driving linear, DD and other high speed, high precision motors.
  - Short startup time of 0.15 ms for one axis, and 0.5 ms for either four axes under linear interpolation or two axes under circular interpolation allows synchronization with high-speed peripheral devices.
- **Rich positioning control functions**
  - A full range of positioning control functions enable easy implementation of any positioning control application. Available positioning control modes include: position control (PTP, CP and indexing), speed control, speed control to position control switchover, and position control to speed control switchover. Interpolation systems include linear, circular and helical.
  - Two operation modes are provided: pattern operation and direct operation. Pattern operation uses preset action patterns for easier operation. Direct operation uses a ladder program to set up target position and target speed for each positioning action.
- **Pulse counter and general purpose I/O contacts**
  - A 5-Mpps pulse counter (supporting absolute encoders) is provided for each axis. As the pulse counter can serve as motor position feedback, the module can check the current position, detect position shift, and by itself implement closed-loop position control for increased positioning accuracy.
  - Six general-purpose inputs and three general-purpose outputs are provided for each control axis. When connected to a motor/driver, these I/O contacts can serve as various control signals: driver alarm, positioning completed, servomotor on, driver reset, etc.
- **Parameter setup, action monitoring and action testing using setup tool for positioning modules**
  - A setup tool known as "ToolBox for Positioning Modules (SF662-ECW)" is available for easier module configuration and debugging. It can be used to set up registered parameters, action patterns and position data, as well as perform action monitoring and testing.

1.2 Concept of Position Control

This positioning module generates a position control path according to commands (with specified target position, speed, acceleration/deceleration time, etc.) from the CPU module and outputs position reference values as pulse trains. The number of output pulses determines the angle through which a motor rotates and the frequency of output pulses determines the speed at which a motor rotates.

The module supplies control pulses to a servo motor/driver so that an axis is driven by a motor to a target position at a target speed in closed-loop control using the control pulses as reference and the encoder pulses as feedback.

In closed-loop control, the difference in pulse count between reference pulses and feedback pulses controls the behavior of a motor, that is, when the difference reduces, the motor slows down, and when the difference becomes zero, the motor stops.

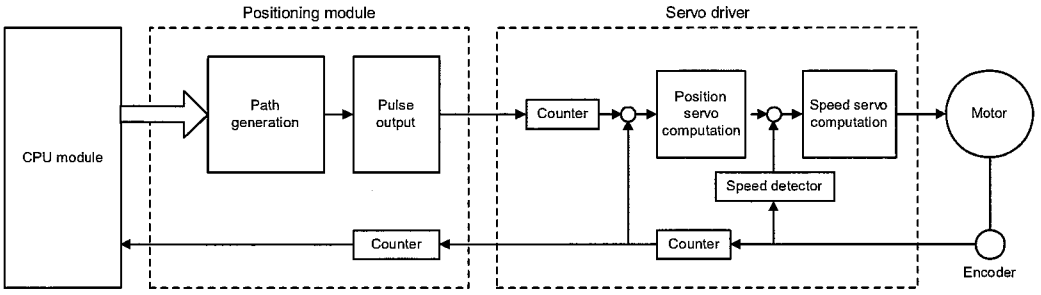


Figure 1.1 Operating Principle of Positioning Module

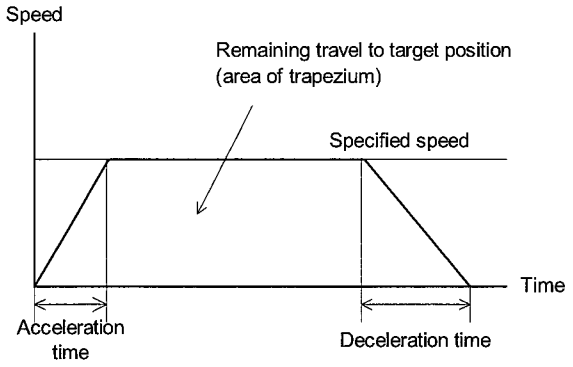


Figure 1.2 Path Generation

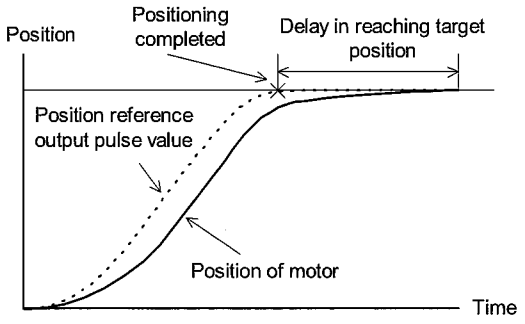


Figure 1.3 Position Reference Output Pulses and Servomotor Movement

DANGER

An external emergency stop circuit should be built in, according to the motor manufacturer's recommendations, for turning off the power supply and stopping the motor immediately if it operates in an unexpected manner due to machine fault or misoperation.

CAUTION

- When connecting a servomotor to the positioning module, choose a position-control servo driver. Speed-control or torque-control servo drivers cannot be used with the positioning module.
- The maximum pulse output rate is 1 Mpps for stepper motors. If the Maximum Speed Selection parameter is set to 5 Mpps for stepper motors, operation cannot be guaranteed.
- The module does not allow the startup speed to be specified when performing interpolated positioning. Therefore, interpolated positioning is not allowed for stepper motors that require startup speed to be specified.

1.3 Operation Mode

The positioning module provides two modes of operation: direct operation and pattern operation.

■ Direct Operation

In direct operation, the module dynamically controls the position, speed and acceleration/deceleration of axes according to real-time commands from the CPU module.

Direct operation is suitable for dynamic control applications where target position and speed are specified just in time based on external information (correction data from an image processing device, etc.), or target position and speed differ for each positioning action.

In direct operation mode, positioning actions can be coded using a program, thus enabling sophisticated operations such as change in target position or speed during positioning.

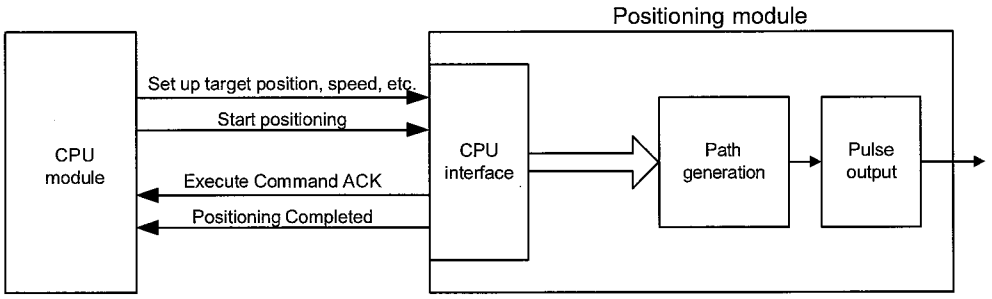


Figure 1.4 Direct Operation

■ Pattern Operation

In pattern operation, the module performs positioning according to pre-stored action patterns and position data. You can use a setup tool, ToolBox for Positioning Modules (SF662-ECW), to store the action patterns and position data in the module. In this type of operation mode, positioning can be initiated simply by specifying an action pattern number from the CPU module. Up to four action patterns can be executed concurrently.

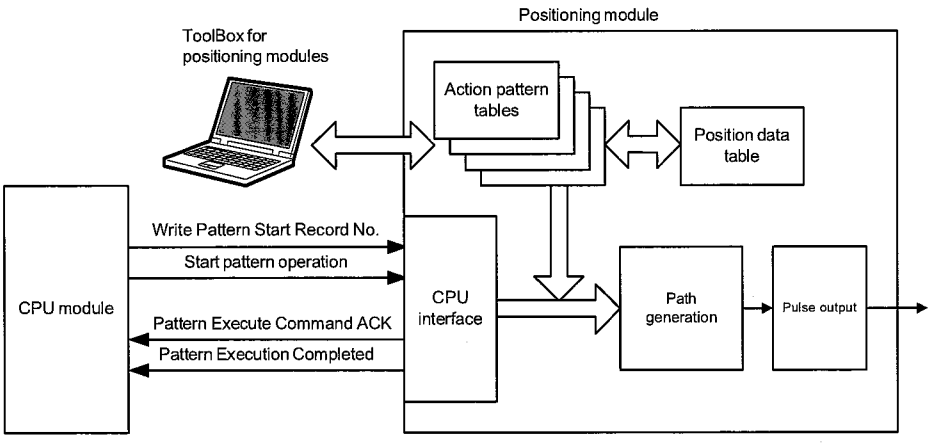


Figure 1.5 Pattern Operation

1.4 Control Mode

Three control modes are provided: position control mode, speed control mode and manual pulse generator mode. Available movements and functions differ in each mode so you should switch between these modes as required during operation.

Position control mode supports normal control and index control, which can be configured using axis registered parameters.

The following figure shows the control modes and available functions of the modules.

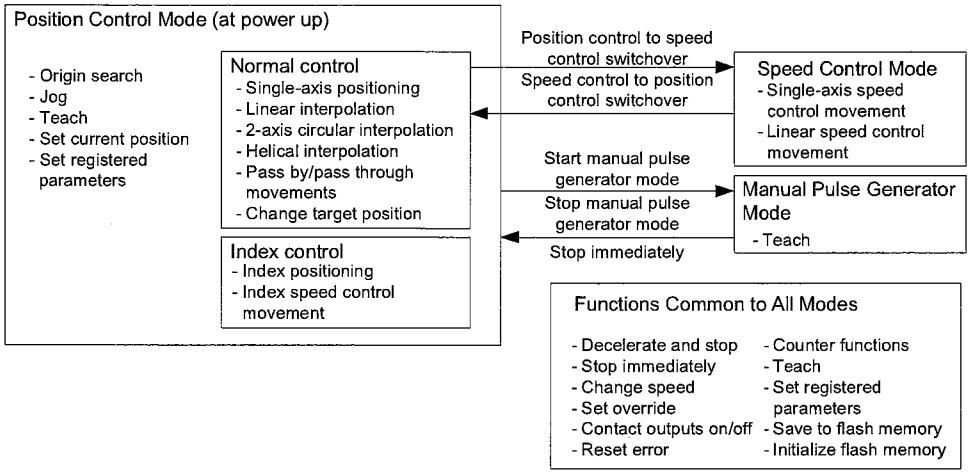


Figure 1.6 Control Modes and Available Functions

■ Position Control Mode

Position control moves individual axis or axes to a specified target position according to specified speed, acceleration time and deceleration. The module also supports continuous path movement (linear interpolation, circular interpolation, helical interpolation) whereby multiple axes move in tandem along an interpolated path, pass-by and pass-through movements whereby the axes continue to the next target position, passing by or passing through but without stopping at the original target position, as well as change in target position during positioning. In addition, the module can be configured to perform index positioning within a specified index range (e.g. 0 to 360°) taking the shortest path. All axes default to position control mode when the module is powered on.

■ Speed Control Mode

Speed control moves a set of axes in the same direction according to a specified speed, acceleration time or deceleration time. The specified speed can be changed during speed control movement, if required.

You can use the Position Control to Speed Control command and the Speed Control to Position Control command to switch between position control mode and speed control mode.

You can switch from speed control to position control even during speed control movement to bring a set of axes to a specified target position.

■ Manual Pulse Generator (MPG) Mode

A manual pulse generator can be connected to the module to manually operate a motor in manual pulse generator mode.

You can switch from position control mode to MPG mode using a Start Manual Pulse Generator Mode command, and then switch back to position control mode using a Stop Manual Pulse Generator Mode command or a Stop Immediately action.

1.5 ToolBox for Positioning Modules (SF662-ECW)

ToolBox for Positioning Modules (SF662-ECW) is a Windows software tool for configuring positioning modules. After connecting the FA-M3 and a PC using RS-232-C, Ethernet or FL-net, you can use the ToolBox software to set up registered parameters, action patterns and position data for a positioning module, run action tests, perform action monitoring and perform tuning. The ToolBox software can be run concurrently with the FA-M3 Programming Tool WideField2 software (SF620-ECW).

For details on the specifications, function and usage of the ToolBox for Positioning Modules (SF662-ECW) software, see the "FA-M3 ToolBox Manual" (IM34M6Q30-01E) and "FA-M3 ToolBox for Positioning Modules User's Manual" (IM34M6Q31-01E).

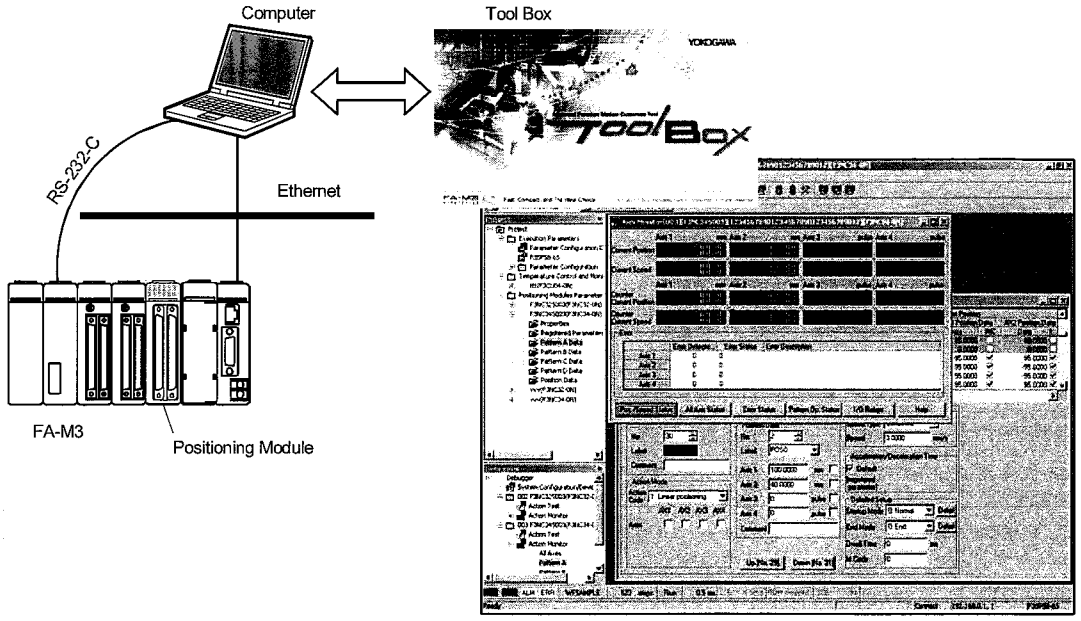


Figure 1.7 ToolBox for Positioning Modules (SF662-ECW)

CAUTION

The ToolBox for Positioning Modules (SF662-ECW) software is intended for short-term monitoring and operation of positioning modules for the purpose of tuning. It should not be used and is not guaranteed to work properly as an operation control panel for extended operation in a production environment.

2. Specification

2.1 Models and Suffix Codes

Table 2.1 Models and Suffix Codes

Model	Suffix Code	Style Code	Option code	Description
F3NC32	-0N	–	–	2-axis control, 5 Mpps (for driving servo motor)/1 Mpps (for driving stepper motor) pulse rate, 2 counters for input from encoder (including absolute encoder), PTP and CP (linear and circular interpolation), direct and pattern operation
F3NC34	-0N	–	–	4-axis control, 5 Mpps (for driving servo motor)/1 Mpps (for driving stepper motor) pulse rate, 4 counters for input from encoder (including absolute encoder), PTP and CP (linear, circular, and helical interpolation), direct and pattern operation

2.2 Compatible CPU Modules

The modules are compatible with the following CPU modules.

Table 2.2 Compatible CPU Modules

CPU Modules	Style Code and ROM Rev
F3SP28-3N F3SP38-6N F3SP53-4H F3SP58-6H	Rev.7 or higher
Other CPU modules	Any

2.3 General Specifications

Table 2.3 General Specifications

Item		Specifications	
		F3NC32-0N	F3NC34-0N
Control	Number of controlled axes	2	4
	Control method	Open-loop control using position reference pulse output	
	Output pulse type	RS-422A compliant differential line driver (AM26C31 or equivalent); Pulse type selectable for each axis: CW/CCW pulse, travel/direction pulse, and phase A/phase B pulse	
	Output pulse rates	- Using servo motor / - Using stepper motor CW/CCW: 5,000,000 (pulse/s) / 1,000,000 (pulse/s) Travel/direction : 5,000,000 (pulse/s) / 1,000,000 (pulse/s) Phase A/B (x4) : 5,000,000 (pulse/s) / 1,000,000 (pulse/s) Phase A/B (x2) : 2,500,000 (pulse/s) / 500,000 (pulse/s) Phase A/B (x1) : 1,250,000 (pulse/s) / 250,000 (pulse/s)	
Counter	Number of channels	2	4
	Input pulse type	- Incremental encoder (phase A/B) - Absolute encoder (See Section 2.4, "Compatible Absolute Encoders" for details)	
	Input pulse rate	Phase A/B (x 4) : 5,000,000 (pulse/s) Phase A/B (x 2) : 2,500,000 (pulse/s) Phase A/B (x 1) : 1,250,000 (pulse/s)	
External contact input		6 inputs per axis (origin input, forward limit input, reverse limit input, driver alarm input, external trigger input, and general-purpose input 6); 1 emergency stop input	
External contact output		3 outputs per axis (deviation pulse clear signal, general output 2 and general output 3), and 1 SEN signal per axis	
Positioning functions	Units of measurement	mm, degrees and pulses	
	Control modes	Position control (PTP, CP and index); Speed control, position control to speed control switchover, and speed control to position control switchover	
	Interpolation modes	Single axis movement; 2-axis linear interpolation; 2-axis circular interpolation	Single axis movement; 2-, 3-, and 4-axis linear interpolation; 2-axis circular interpolation, 3- and 4-axis helical interpolation
	Operation modes	Pattern operation and direct operation	
	Pattern operation	PTP movement, CP normal movement, CP pass-by movement, and CP pass-through movement; Number of action pattern records: 2000 max. (500 actions each for 4 patterns) Number of position data records: 2000 max per axis	
	Position reference	Absolute/incremental position reference -2,147,483,648 to 2,147,483,647 (pulses) -214,748.3648 to 214,748.3647 (mm) -21,474.83648 to 21,474.83647 (degrees)	
	Speed reference	1 to 5,000,000 (pulses/s) 0.0001 to 214,748.3647 (mm/s) 0.00001 to 21,474.83647 (degree/s)	
	Acceleration/deceleration curve	Automatic trapezoidal acceleration/deceleration (configurable startup speed); Automatic S-shape acceleration/deceleration (startup speed not configurable)	
	Acceleration/deceleration time	0 to 32,767 (configurable independently for acceleration and deceleration)	
	Others	Change in target position during movement Change in target speed during movement	
Origin search		Two types of automatic origin search; Manual origin search (any combination of external contact inputs may be used)	
Manual operation		Jog operation and manual pulse generator mode	
Other functions		Electronic gear, teaching, current position setup; M code output, override, software limit switch; Counter coincidence or zone coincidence detection	
Data backup		Flash ROM (100,000 times rewritable)	
Startup time*1		0.15 ms for single axis positioning 0.16 ms for 2-axis linear interpolation 0.41 ms for 2-axis circular interpolation	0.15 ms for single axis positioning 0.17 ms for 4-axis linear interpolation 0.41 ms for 2-axis circular interpolation
Current consumption (at 5 V DC)		450 mA	540 mA
External power supply (24 V DC)		80 mA	120 mA
External wiring		One 48-pin connector	Two 48-pin connectors
External dimensions		28.9 (W) x 100 (H) x 83.2 (D) mm*2	
Weight		160 g	180g

*1: Up to 1 ms delay may be added if another axis is in motion.

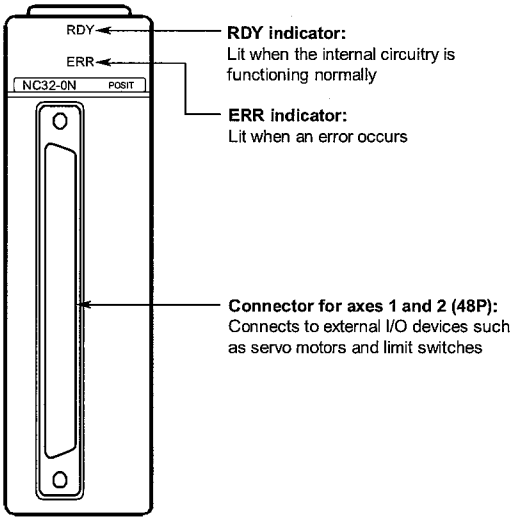
*2: Not including protrusions (see the external dimension diagram for details)

2.4 Compatible Absolute Encoders

- **Absolute encoders from Yaskawa Electric or equivalent:**
  - Yaskawa Electric's Σ-III and Σ-II series for AC servo motor drive
- **Absolute encoders (1 Mbps, Manchester coding) from SANYO Electric or equivalent:**
  - SANYO Electric's ABS-E and ABS-RII absolute sensors (installed with RA062M) for use with the Q-series and P-series AC servo systems

2.5 Components and Their Functions

- **F3NC32-0N (with 2 axes)**



- **F3NC34-0N (with 4 axes)**

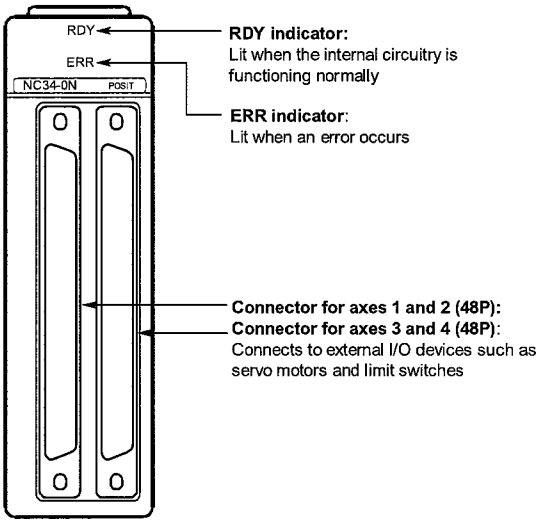


Figure 2.1 Front View of F3NC32-0N and F3NC34-0N Modules

2.6 External Dimensions

Unit: mm

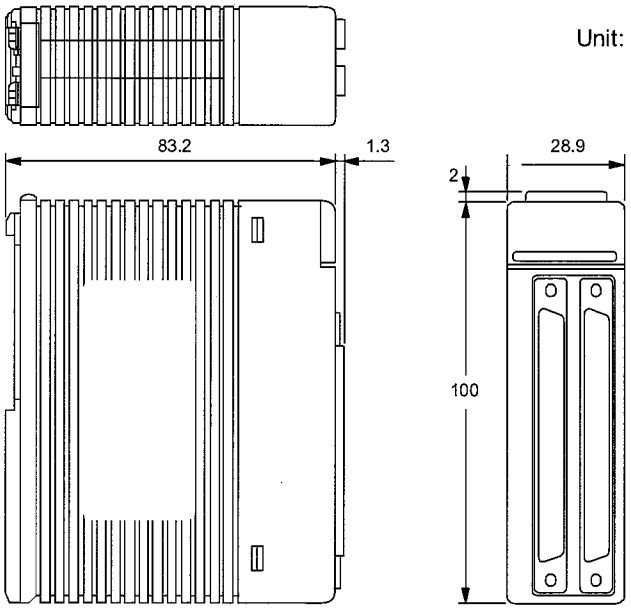


Figure 2.2 External Dimensions Diagram

2.7 Compatible External Interface Connectors

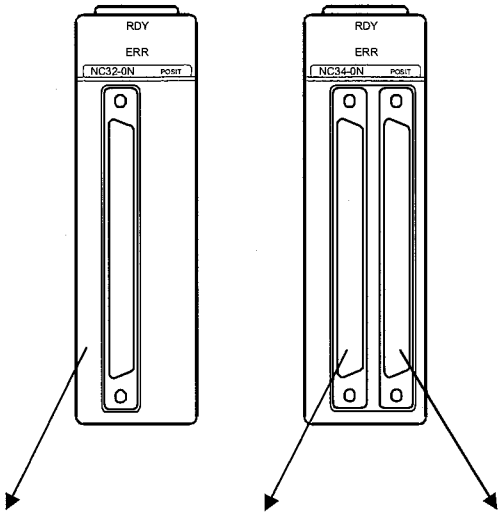
Table 2.4 Compatible External Interface Connectors

Connection	Compatible Connector	Remarks
Soldered	FCN-361J048-AU connector, and FCN-360C048-B connector cover from Fujitsu Limited	To be purchased separately.
Crimp-on	FCN-363J048 housing, FCN-363J-AU contacts, and FCN-360C048-B connector cover from Fujitsu Limited	
Pressure-welded	FCN-367J048-AU/F from Fujitsu Limited	

2.8 External Connection Diagram

The external connection diagram is shown below. For details on external connection signals, see Chapter 11, "Connections and Wiring".

Table 2.5 External Connection Diagram



24b	Axis 2 counter Phase B Input (-)	24a	Axis 1 counter Phase B Input (-)
23b	Axis 2 counter Phase B Input (+)	23a	Axis 1 counter Phase B Input (+)
22b	Axis 2 counter Phase A Input (-)	22a	Axis 1 counter Phase A Input (-)
21b	Axis 2 counter Phase A Input (+)	21a	Axis 1 counter Phase A Input (+)
20b	Axis 2 encoder Z-phase input (-)	20a	Axis 1 encoder Z-phase input (-)
19b	Axis 2 encoder Z-phase input (+)	19a	Axis 1 encoder Z-phase input (+)
18b	Axis 2 SEN signal output	18a	Axis 1 SEN signal output
17b	Axis 2 SEN signal output (GND)*1	17a	Axis 1 SEN signal output (GND)*1
16b	Axis 2 general output 3*4	16a	Axis 1 general output 3*4
15b	Axis 2 general output 2*4	15a	Axis 1 general output 2*4
14b	Axis 2 deviation pulse clear output *4	14a	Axis 1 deviation pulse clear output *4
13b	Contact input COM*2	13a	Contact input COM*2
12b	Axis 2 general input 6*4	12a	Axis 1 general input 6*4
11b	Axis 2 external trigger input *4	11a	Axis 1 external trigger input *4
10b	Axis 2 driver alarm input *4	10a	Axis 1 driver alarm input *4
9b	Axis 2 reverse limit input *4	9a	Axis 1 reverse limit input *4
8b	Axis 2 forward limit input *4	8a	Axis 1 forward limit input *4
7b	Axis 2 origin input *4	7a	Axis 1 origin input *4
6b	Axis 2 pulse output B (-) (CCW/direction/phase B)	6a	Axis 1 pulse output B (-) (CCW/direction/phase B)
5b	Axis 2 pulse output B (+) (CCW/direction/phase B)	5a	Axis 1 pulse output B (+) (CCW/direction/phase B)
4b	Axis 2 pulse output A (-) (CW/travel/phase A)	4a	Axis 1 pulse output A (-) (CW/travel/phase A)
3b	Axis 2 pulse output A (+) (CW/travel/phase A)	3a	Axis 1 pulse output A (+) (CW/travel/phase A)
2b	Emergency stop input (GND)*3	2a	Emergency stop input *3
1b	24-V external power supply input (GND)*3	1a	24-V external power supply input *3

24b	Axis 4 counter Phase B Input (-)	24a	Axis 3 counter Phase B Input (-)
23b	Axis 4 counter Phase B Input (+)	23a	Axis 3 counter Phase B Input (+)
22b	Axis 4 counter Phase A Input (-)	22a	Axis 3 counter Phase A Input (-)
21b	Axis 4 counter Phase A Input (+)	21a	Axis 3 counter Phase A Input (+)
20b	Axis 4 encoder Z-phase input (-)	20a	Axis 3 encoder Z-phase input (-)
19b	Axis 4 encoder Z-phase input (+)	19a	Axis 3 encoder Z-phase input (+)
18b	Axis 4 SEN signal output	18a	Axis 3 SEN signal output
17b	Axis 4 SEN signal output (GND)*1	17a	Axis 3 SEN signal output (GND)*1
16b	Axis 4 general output 3*4	16a	Axis 3 general output 3*4
15b	Axis 4 general output 2*4	15a	Axis 3 general output 2*4
14b	Axis 4 deviation pulse clear output *4	14a	Axis 3 deviation pulse clear output *4
13b	Contact input COM*2	13a	Contact input COM*2
12b	Axis 4 general input 6*4	12a	Axis 3 general input 6*4
11b	Axis 4 external trigger input *4	11a	Axis 3 external trigger input *4
10b	Axis 4 driver alarm input *4	10a	Axis 3 driver alarm input *4
9b	Axis 4 reverse limit input *4	9a	Axis 3 reverse limit input *4
8b	Axis 4 forward limit input *4	8a	Axis 3 forward limit input *4
7b	Axis 4 origin input *4	7a	Axis 3 origin input *4
6b	Axis 4 pulse output B (-) (CCW/direction/phase B)	6a	Axis 3 pulse output B (-) (CCW/direction/phase B)
5b	Axis 4 pulse output B (+) (CCW/direction/phase B)	5a	Axis 3 pulse output B (+) (CCW/direction/phase B)
4b	Axis 4 pulse output A (-) (CW/travel/phase A)	4a	Axis 3 pulse output A (-) (CW/travel/phase A)
3b	Axis 4 pulse output A (+) (CW/travel/phase A)	3a	Axis 3 pulse output A (+) (CW/travel/phase A)
2b	*5	2a	*5
1b	24-V external power supply input (GND)*3	1a	24-V external power supply input*3

*1: SEN signal output (GND) pins for all axes are connected internally. They may be used as the GND pin for pulse outputs.

*2: Contact input COM pins for all axes are connected internally (even across different connectors).

*3: The single emergency stop input and 24-V external power supply input are used for all axes. The 24-V external power supply input pins are connected together internally across different connectors.

*4: I/O contacts can be configured as normally-open (NO contact) or normally-closed (NC contact) using registered parameters for each axis.

Origin input, forward limit input, reverse limit input, driver alarm input, and external trigger input may be configured as general inputs, while deviation pulse clear output may be configured as a general output using registered parameters for each axis. There are some restrictions on the specifications of contact inputs. Be sure to check contact inputs against the CAUTION given in Chapter 11 (Subsection 11.2.4, "External Contact Inputs") before use.

*5: Absolutely do not wire these pins.

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3.3 Stepping motor driver

KR-525M (Techno Drive) is used for R, Z, and T-axis of the Robot pulse driver.
Also UDK5114NW2 (Oriental Motor) is used for Z-axis, and UDK5107NW2 (Oriental Motor) is used for T-axis.
The pulse motor switches and volumes are indicted in the list below.
* Do not change the switches and volumes.

（PD4~6） Setting value

No,	M1	M2	RUN	STOP	DIP-SWITCH
R-AXIS PD4	0 STEP ANGLE 0.76°	0 STEP ANGLE 0.76°	3 RUN CURRENT 0.75A	5 STOP CURRENT 50%	 M.SEL : ON(Moter Select) L/HV : ON(High Speed, High Torque) CD : ON(Current Down) 2/1CK : OFF(2Clock) TEST : OFF
Z-AXIS PD5			F RUN CURRENT 1.4A	9 STOP CURRENT 50%	
T-AXIS PD6			F RUN CURRENT 0.75A	9 STOP CURRENT 50%	2P/1P : 2 P (2Pulse) F/H : H(Half Step) A.C.O/OFF : A.C.O (Automatic Current Off) NC : (NO USE)

4. Error list

Code	Error name	Internal code	Remarks
163	Wafer carry unit memory fault	163	-
164	Wafer carry unit R1 motor fault	164	-
166	Wafer carry unit T-axis motor fault	166	-
167	Wafer carry unit Z-axis motor fault	167	-
168	Wafer carry unit command error	168, 171, 172, 176, 177, 181, 182, 186, 191, 194, 197, 201, 204, 207, 179, 141, 144, 148, 151, 625	-
169	Wafer carry unit not response from robot time out	169, 626	-
170	Wafer carry unit line busy no line access to Robot time out	170, 175, 178, 180, 185, 190, 193, 196, 200, 203, 206, 143, 147, 150	-
183	Wafer carry unit vacuum failure wafer still vacuumed though carried to other section	183, 184, 198, 208	-
195	Wafer carry unit vacuum failure during wafer pick up from cassette	195, 205, 146	-
210	Wafer carry unit vacuum check error wafer still vacuumed before touching wafer	210, 211, 212, 143	-
215	Wafer carry unit vacuum failure before carrying wafer to other section	215, 216, 217	-
620	Wafer carry unit command error	620, 621, 631, 633, 635	-
622	Wafer carry unit vacuum failure wafer still vacuumed though carried to other section	622	-
623	Wafer carry unit line busy no line access to robot time out	623, 624, 634, 636, 637	-

163 / Wafer carry unit memory fault

<Cause>

Robot teaching data stored in the CPU module is incorrect.

<Countermeasures>

Connect the Teach pendant to the machine.

164 / Wafer carry unit R1 motor fault

<Cause>

(1) Although the CW / CCW pulse is outputting, the increase or decrease of the encoder pulse count is not detected.

(2) The difference between the CW / CCW pulse and encoder pulse count goes out of tolerance (+/- 12 pulses).

<Countermeasures>

(1) In automatic operating, when the error occurs, connect the teach pendant to the machine. Next, press the [READ POSITION] key, and the encoder pulse count is displayed.

Compare the pulse count with the Teaching data, and make sure whether or not the difference is within the tolerance (12 pulses).

(2) If the arm touches the machine, there is incorrect data in the teaching data.

(3) If the speed of R-axis is zero, there is incorrect data in the teaching data.

(4) Check the resetting of Robot by using Teach pendant.

(5) Check the increase or decrease of encoder pulse count according to “2.2 Operating check”.

(6) Check the connection of cable (CN-PMC2) between PMC module (PMC010) and driver, and check each connector.

(7) Check the connection of cable (RO-M) between driver and Robot, and check each connector.

(8) Check the connection of R-axis flat cable (RO-R) wired in Robot, and check that the cable is free from the damage.

(9) Check the connection of motor connector (RR-M) for R-axis sensor module.

(10) Check the connection of encoder connector (RR-E) for R-axis sensor module.

(11) Check that no wire breaks about five coils connected in the R-axis stepping motor.

(12) Check the setting value of the current setting switch (RUN and STOP) for the driver.

(13) Check the setting value of each DIP switch for the driver.

(14) Check that the driver is supplied the power (R11-S10, 100V).

(15) Check the tension and wear of the timing belt between the R-axis stepping motor and the arm.

(16) Check that the arm slides in the R-axis direction smoothly.

(17) Check that the pulley is fixed tight to the R-axis stepping motor.

166 / Wafer carry unit T-axis motor fault

<Cause>

(1) Although the CW / CCW pulse is outputting, the increase or decrease of the encoder pulse count is not detected.

(2) The difference between the CW / CCW pulse and the encoder pulse count goes out of tolerance (+/- 12 pulses).

<Countermeasure>

(1) In automatic operating, when the error occurs, connect the teach pendant to the machine. Next, press the [READ POSITION] key, and the encoder pulse count is displayed.
Compare the pulse count with the Teaching data, and make sure whether or not the difference is within the tolerance (12 pulses).

(2) If the arm touches the machine, there is incorrect data in the teaching data.

(3) If the speed of T-axis is zero, there is incorrect data in the teaching data.

(4) Check the resetting of Robot by using Teach pendant.

(5) Check the increase or decrease of encoder pulse count according to “2.2 Operating check”.

(6) Turn the T-axis motor by your hand, and make sure that the turn is free from the rattle, de-centering and resistance.

(7) Check the connection of cable (CN-PMC2) between pulse control module and driver, and check each connector.

(8) Check the connection of cable (RO-M) between driver and Robot, and check each connector.

(9) Check the connection of T-axis flat-cable (RO-T) wired in Robot, and check that the cable is free from the damage.

(10) Check the connection of motor connector (RT-M) for T-axis sensor module.

(11) Check the connection of encoder connector (RT-E) for T-axis sensor module.

(12) Check that no wire breaks about five coils connected in the T-axis stepping motor.

(13) Check the setting value of the current setting switch (RUN and STOP) for the driver.

(14) Check the setting value of each DIP switch for the driver.

(15) Check that the driver is supplied the power (R11-S10, 100V).

167 / Wafer carry unit Z-axis motor fault

<Causes>

(1) Although the CW / CCW pulse is outputting, the increase or decrease of the encoder pulse count is not detected.

(2) The difference between the CW / CCW pulse and the encoder pulse count goes out of tolerance (+/- 12 pulses).

<Countermeasures>

(1) In automatic operating, when the error occurs, connect the teach pendant to the machine. Next, press the [READ POSITION] key, and the encoder pulse count is displayed.
Compare the pulse count with the Teaching data, and make sure whether or not the difference is within the tolerance (12 pulses).

(2) If the arm touches the machine, there is incorrect data in the teaching data.

(3) Check the resetting of Robot by using Teach pendant.

(4) Check the increase or decrease of encoder pulse count according to “2.2 Operating check”.

(5) Check the connection of cable (CN-PMC3) between pulse control module and driver, and check each connector.

(6) Check the connection of cable (RO-M) between driver and Robot, and check each connector.

(7) Check the connection of motor connector (RZ-M) for Z-axis sensor module.

(8) Check the connection of encoder connector (RO-ZE) for Z-axis sensor board.

(9) Check the connection of Z-axis solenoid brake connector (RO-ZB).

(10)Check that no wire breaks about five coils connected in the Z-axis stepping motor.

(11) Check the setting value of the current setting switch (RUN and STOP) for the driver.

(12) Check the setting value of each DIP switch for the driver.

(13) Check the driver is supplied the power (R11-S10, 100V).

(14) Check that there is not slip between the motor and the encoder.

(15) Check that the motor pulley is free from slip.

168 / Wafer carry unit command error

<Causes>

(1) DR/HR 8500IIIare controlled by the machine's software and Aligner/Robot software.

As the machine's software sent an incorrect command to Aligner/Robot software, Aligner/Robot software replies that the command cannot be received.

The arm moves to the position of a pulse count more than the pulse count specified by MAX POSITION.

Each Tops of STAGE 2, 6, 7and 8 must be equal, otherwise, this error occur.

<Countermeasures>

Find and remove all of the bug in the software.

Check the MAX POSITION, PITCH and SLOT of the Teaching data.

Make T-axis position of STAGE 2, 6, 7 and 8 equal.

169 / Wafer carry unit response from robot time out

<Causes>

When the machine's software issued a command to Robot, if Robot did not reply within the specified time, this error occurs.

After carrying out the countermeasure, if the same error occurs, the system maybe incorrect.

<Countermeasures>

(1) Connect Teach pendant, and switch the mode to MAINTENANCE mode. If the switching cannot be carried out, Aligner/Robot software does not start up correctly.

(2) Check that PMC module (PMC010) is inserted into the base module.

(3) If the ERR LED (Red) located in the upper part of module unit lights up, it indicates error condition.

170 / Wafer carry unit line busy no line access to robot time out

<Causes>
When the machine make an inquiry about Robot state, Robot does not become a standby state within the specified time.

<Countermeasures>
Restore the error according to the error restoration procedure (Press [RESET] key and then press [START] key).

183 / Wafer carry unit vacuum failure wafer still vacuumed though carried to other section.

<Causes>
Although the arm has carried a wafer to other section, wafer chuck checking sensor remains ON.

<Countermeasures>
(1) Check the sensitivity of vacuum switch.
(2) Make sure that the solenoid valve attached in the Robot is turned off.
(3) DI module (DI006) LED (for vacuum Sw.) is turned off.
LED for vacuum Sw.: PSW00607
(4) Check the teaching data.

195 / Wafer carry unit vacuum failure during wafer pick up from cassette
<Causes>
Although the arm chucks a wafer, the vacuum switch does not become ON.

<Countermeasures>
(1) Check the sensitivity of the vacuum switch.
(2) Check the connection of air hose for Robot.
(3) Check the connection of air hose for the vacuum switch.
(4) Check the power supply for vacuum switch.
＋12V : Blown
GND : Blue
Signal : Black
(5) Make sure that the solenoid valve (SV00747) attached out of the Robot is ON.
(6) Make sure that the LED (for vacuum Sw.) for DI module (DI006) monitor is turned on.
LED for vacuum Sw.: PSW00607

210 / Wafer carry unit vacuum check error wafer still vacuumed before touching wafer
<Causes>
When the arm carries a wafer, the vacuum sensor is OFF.

<Countermeasures>
(1) Check the sensitivity of the vacuum switch.
(2) Make sure that the solenoid valve attached in the Robot is OFF.
(3) Make sure that the LED (for vacuum Sw.) for DI module (DI006) monitor is turned off.
LED for vacuum Sw.: SW00607

215 / Wafer carry unit vacuum failure before carrying wafer to other section

<Causes>
When the arm carried a wafer, the vacuum sensor is OFF.

<Countermeasures>
(1) Check the sensitivity of the vacuum switch.
(2) Check the connection of air hose for Robot.
(3) Check the connection of air hose for the vacuum switch.
(4) Check the power supply for vacuum switch.
＋12V : Blown
GND : Blue
Signal : Black
(5) Make sure that the solenoid valve (SV00747) attached out of the Robot is ON.
(6) Make sure that the LED (for vacuum Sw.) for DI module (DI006) monitor is turned off.
LED for vacuum Sw.: SW00607

620/ Wafer carry unit command error

This error's causes and countermeasures are the same way as error 168.

622 / Wafer carry unit vacuum failure wafer still vacuumed though carried to other section

This error's causes and countermeasures are the same way as error 183.

623 / Wafer carry unit line busy no line access to robot time out

This error's causes and countermeasures are the same way as error170