Changes for the Better

MITSUBISHI ELECTRIC

Mitsubishi Electric Corporation Industrial Robot

MELFA Technical News

BFP-A6079-0344E

December 2023

Subject: Precautions for replacing the MELFA F series with the FR series

Applicable to: RV-35F/50F/70F series (Controller CR760 series)

Thank you for your continued support of Mitsubishi industrial robot "MELFA". This paper describes in detail the precautions to be taken when replacing a MELFA F series robot with an FR series robot.

CONTENTS

MITSUBISHI ELECTRIC CORPORATION

1. Model Configuration (Replacement Compatible Models)

Compatible models and connected controllers for replacing the conventional RV-F series with the RV-FR series are shown below.

■F series（D type）

Robot Model	Controller
RV-35F-D	CR760-35VD
RV-35FM-D	
RV-50F-D	CR760-50VD-0
RV-50FM-D	
RV-70F-D	CR760-70VD-0
RV-70FM-D	

■FR series (D type)

Robot Model	Controller
RV-35FR-D	CR860-35VD
RV-35FRM-D	
RV-50FR-D	CR860-50VD
RV-50FRM-D	
RV-80FR-D	CR860-80VD
RV-80FRM-D	

■F series（Q type）

Robot Model	Controller
RV-35F-Q	CR760-35VQ（Q172DRCPU）
RV-35FM-Q	
RV-50F-Q	CR760-50VQ（Q172DRCPU）
RV-50FM-Q	
RV-70F-Q	CR760-70VQ（Q172DRCPU）
RV-70FM-Q	

■FR series (Q type)

Robot Model	Controller
RV-35FR-Q	CR860-35VQ（Q172DSRCPU）
RV-35FRM-Q	
RV-50FR-Q	CR860-50VQ（Q172DSRCPU）
RV-50FRM-Q	
RV-80FR-Q	CR860-80VQ（Q172DSRCPU）
RV-80FRM-Q	

■F series（D type）:CE specifications ※1

Robot Model	Controller
RV-35F-D-S15	CR760-35VD-S15
RV-35FM-D-S15	
RV-50F-D-S15	CR760-50VD-S15
RV-50FM-D-S15	
RV-70F-D-S15	CR760-70VD-S15
RV-70FM-D-S15	

■FR series (D type) ※1

Robot Model	Controller
RV-35FR-D	CR860-35VD +2F-ATBOX
RV-35FRM-D	
RV-50FR-D	CR860-50VD +2F-ATBOX
RV-50FRM-D	
RV-80FR-D	CR860-80VD +2F-ATBOX
RV-80FRM-D	

■F series（Q type）:CE specifications ※1

Robot Model	Controller
RV-35F-Q-S15	CR760-35VQ-S15（Q172DRCPU）
RV-35FM-Q-S15	
RV-50F-Q-S15	CR760-50VQ-S15（Q172DRCPU）
RV-50FM-Q-S15	
RV-70F-Q-S15	CR760-70VQ-S15（Q172DRCPU）
RV-70FM-Q-S15	

■FR series (Q type) ※1

Robot Model	Controller
RV-35FR-Q	CR860-35VQ（Q172DSRCPU） +2F-ATBOX
RV-35FRM-Q	
RV-50FR-Q	CR860-50VQ +2F-ATBOX
RV-50FRM-Q	
RV-80FR-Q	CR860-80VQ +2F-ATBOX
RV-80FRM-Q	

※1　AC400V input compatible products

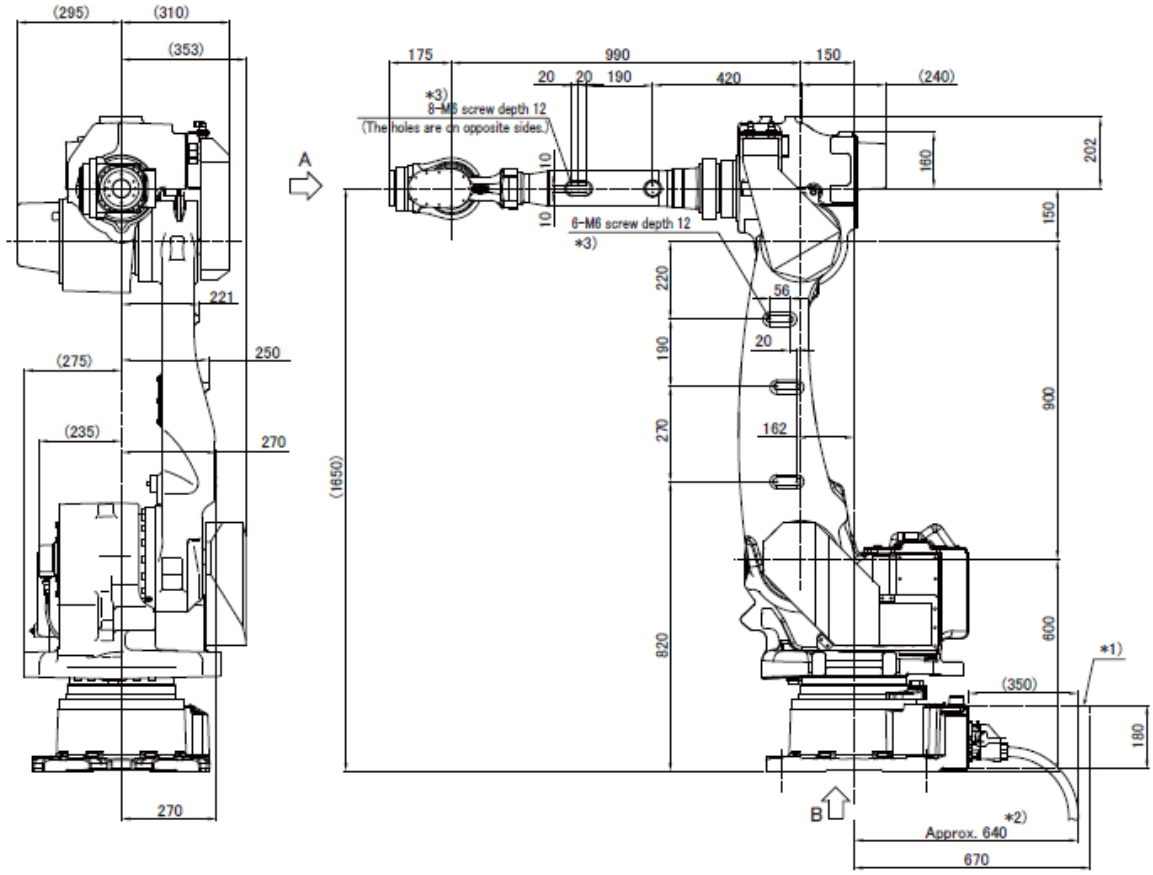
2. Specification Comparison

2.1 Robot Specifications

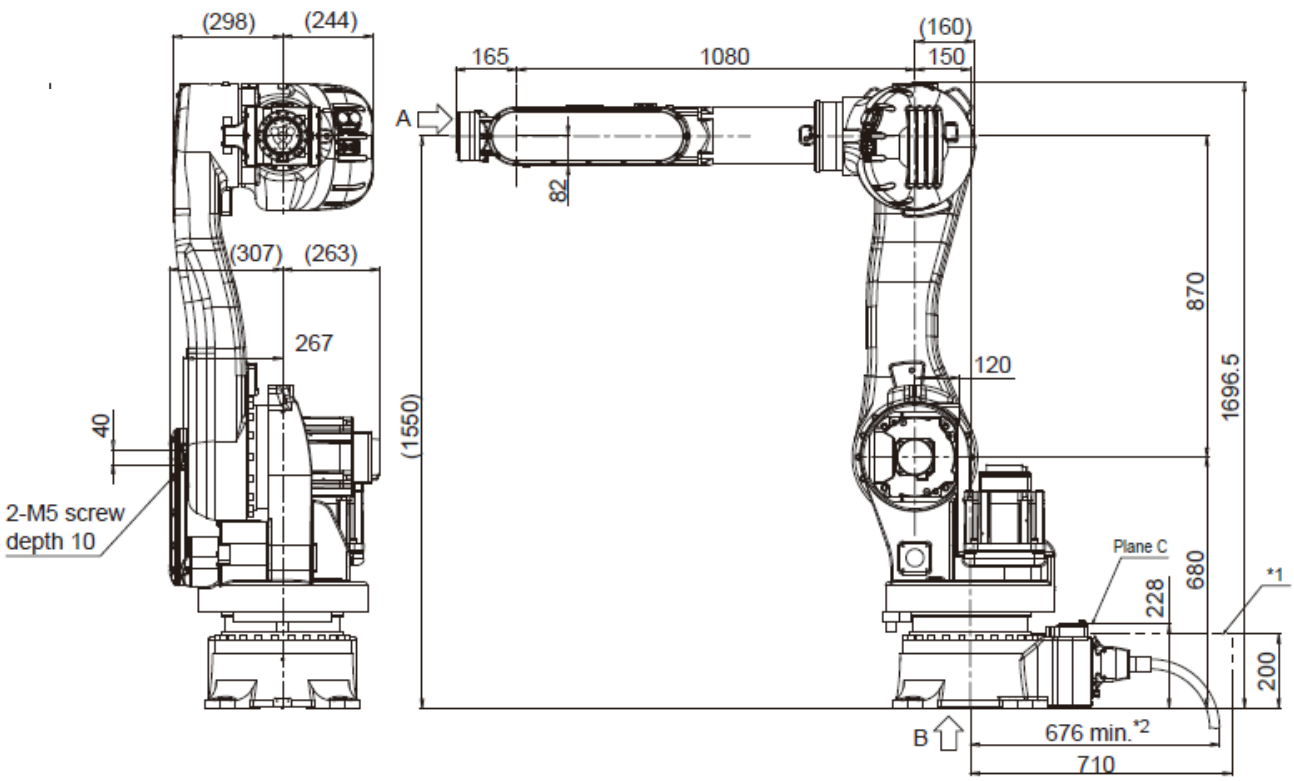
項目		RV-35F	RV-50F	RV-70F	RV-35FR	RV-50FR	RV-80FR
Structure		Vertical articulated robot			Vertical articulated robot		
Degree of freedom		6			6		
Load Rating(kg)		35	50	70	35	50	80
Maximum reach radius(mm)		2050(arm length:900+990)			2100(arm length:870+1080)		
Pose repeatability(mm)		±0.07			±0.06		
Operating range	J1	±165			±180		
	J2	−80～＋135			−105～140		
	J3	−90～＋171			−135～155		
	J4	±360			±360		
	J5	±125			±145		
	J6	±450			±450		
Speed of motion	J1(°/sec)	185	180	175	180	180	180
	J2(°/sec)	180	180	145	180	180	180
	J3(°/sec)	190	180	165	185	185	160
	J4(°/sec)	305	255	235	260	260	185
	J5(°/sec)	305	255	235	260	260	165
	J6(°/sec)	420	370	350	360	360	280
J6 Allowable moment load (Nm)		90	130	150	130	130	194
J6 Allowable inertia (kgm^2)		5	12	12	7.7	11	13.7
Mass(kg)		640			560		
Tool pneumatic Pipes (Primary piping)		φ10x2			φ10x2		
Painting color		Light gray (Equivalent to Munsell: 0.6B7.6/0.2)			Off-white (Equivalent to Munsell: 10GY9/1)		

2．2 Outline of the robot body, installation dimensions, transportation procedure(1/4)

■RV-35F/50F/70F Dimensions of the robot body(1/2)

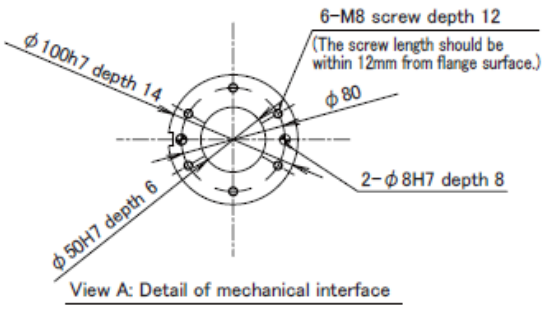


■RV-35FR/50FR/80FR Dimensions of the robot body(1/2)

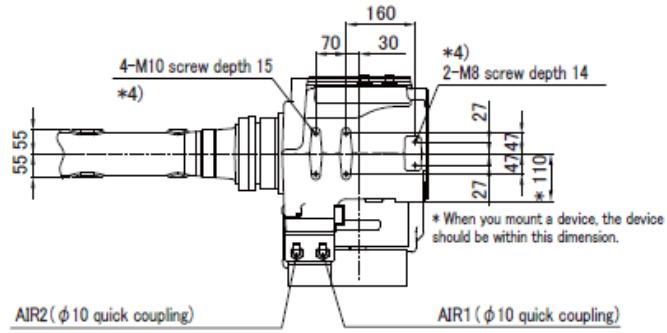


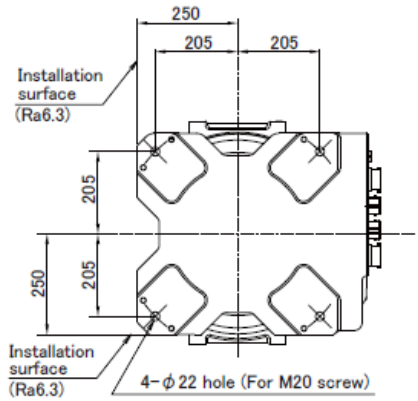
2．2 Outline of the robot body, installation dimensions, transportation procedure（2/4）

■RV-35F/50F/70F Dimensions of the robot body(2/2)

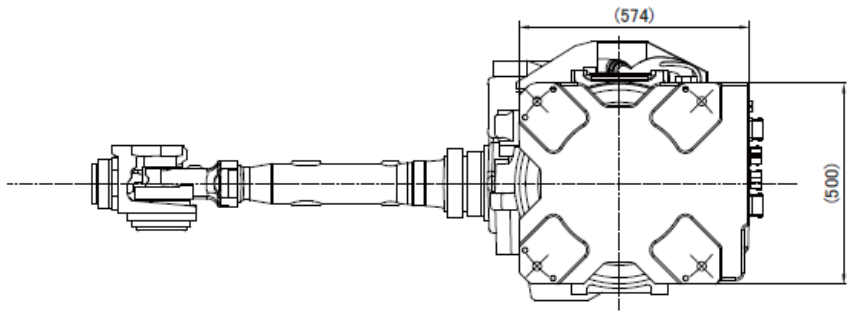


View A: Detail of mechanical interface



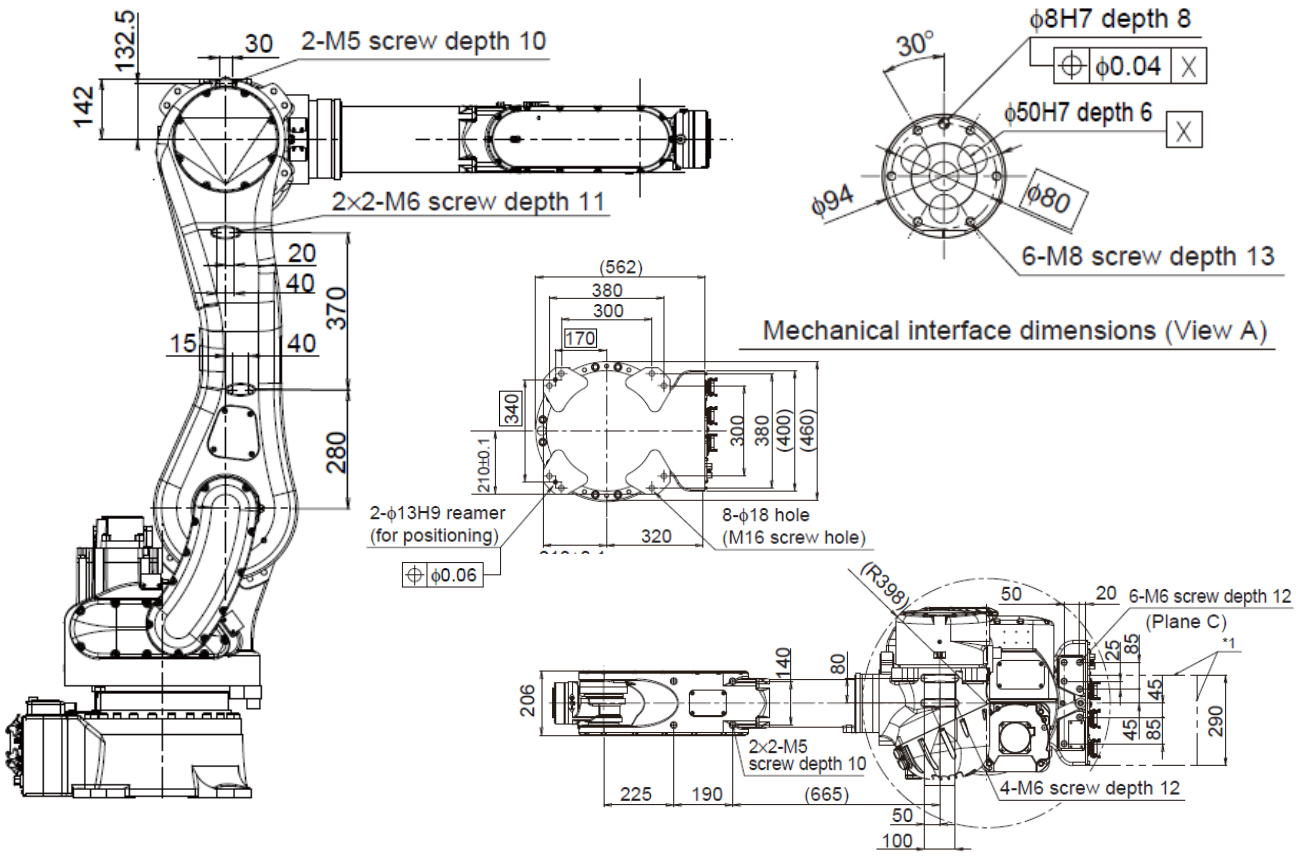


View B bottom view drawing: Detail of installation dimension



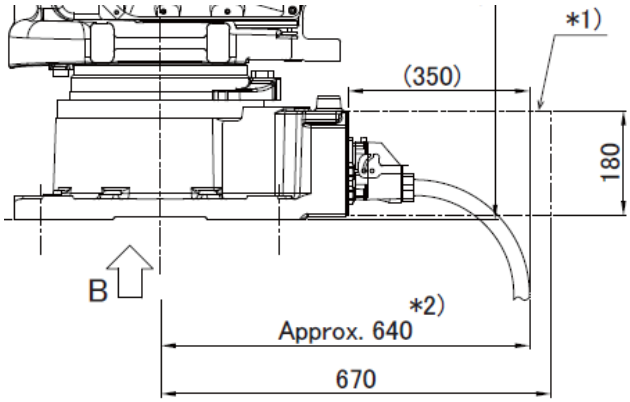
View B: Bottom view drawing

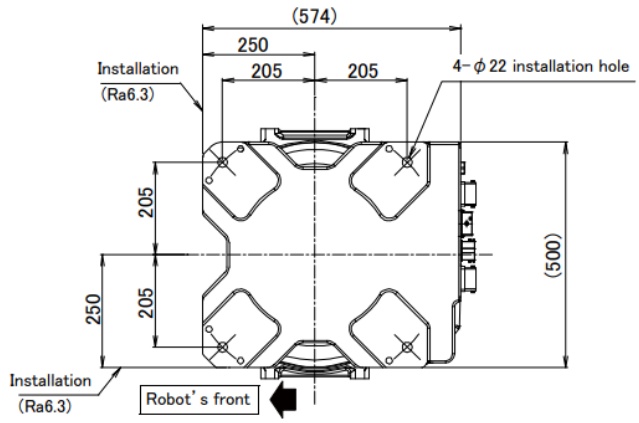
■RV-35FR/50FR/80FR Dimensions of the robot body(2/2)



2．2 Outline of the robot body, installation dimensions, transportation procedure（3/4）

■ Mounting Dimensions（RV-35F/50F/70F series）

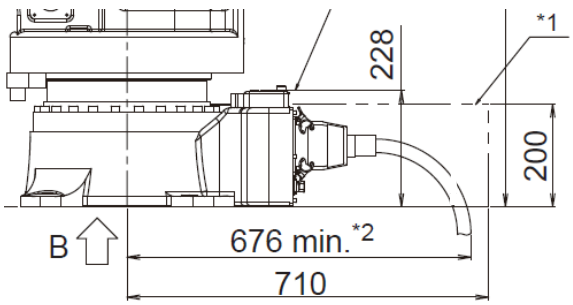


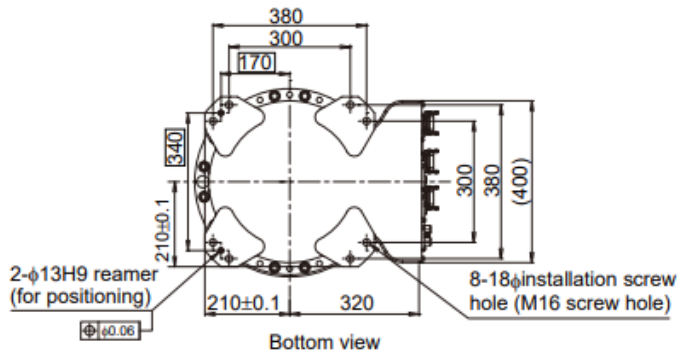


＊1 Provide enough space to connect the machine cable and to perform maintenance.
＊2 Dimensions including the minimum bending radius for the machine cable

Installation hole size	4-φ22
Installation bolt（attachment）	M20 hexagon socket head cap screw
Recommended tightening Torque	560N・m

■ Mounting Dimensions（RV-35FR/50FR/80FR series）



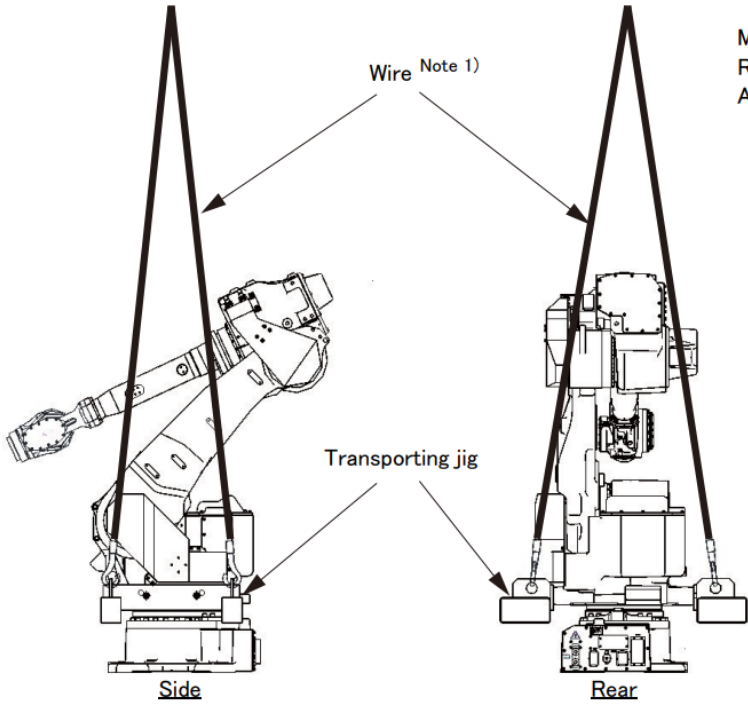


＊1 Provide enough space to connect the machine cable and to perform maintenance.
＊2 Dimensions including the minimum bending radius for the machine cable

Installation hole size	8 - Φ18
Installation bolt（attachment）	M16 hexagon socket head cap screw
Recommended tightening Torque	240N・m

2．2 Outline of the robot body, installation dimensions, transportation procedure（4/4）

■transportation procedure（RV-35F/50F/70Fseries)

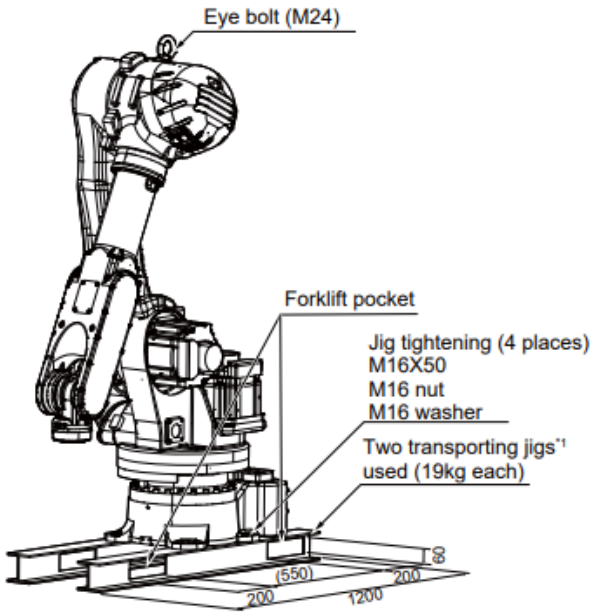


Mass
RV-35F/50F/70F series:
Approx. 670kg

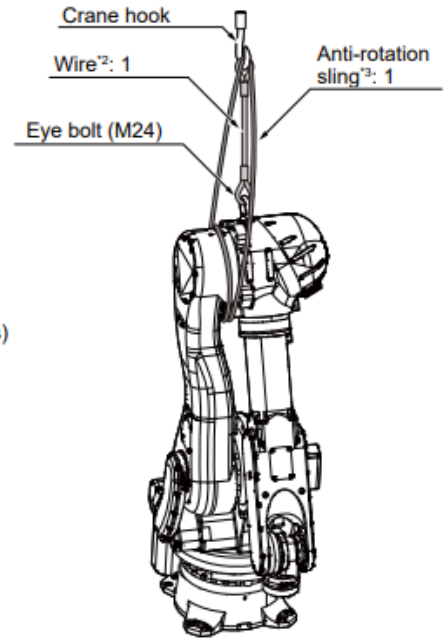
Note 1) Use wires that are 3000 mm or more.

	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
RV-35F/50F/70F	0°	-45°	+160°	0°	0°	0°

■transportation procedure（RV-35FR/50FR/80FRseries)



Transportation using a forklift (with transporting jigs*1)
RV-35FR/50FR/80FR weight: 600kg

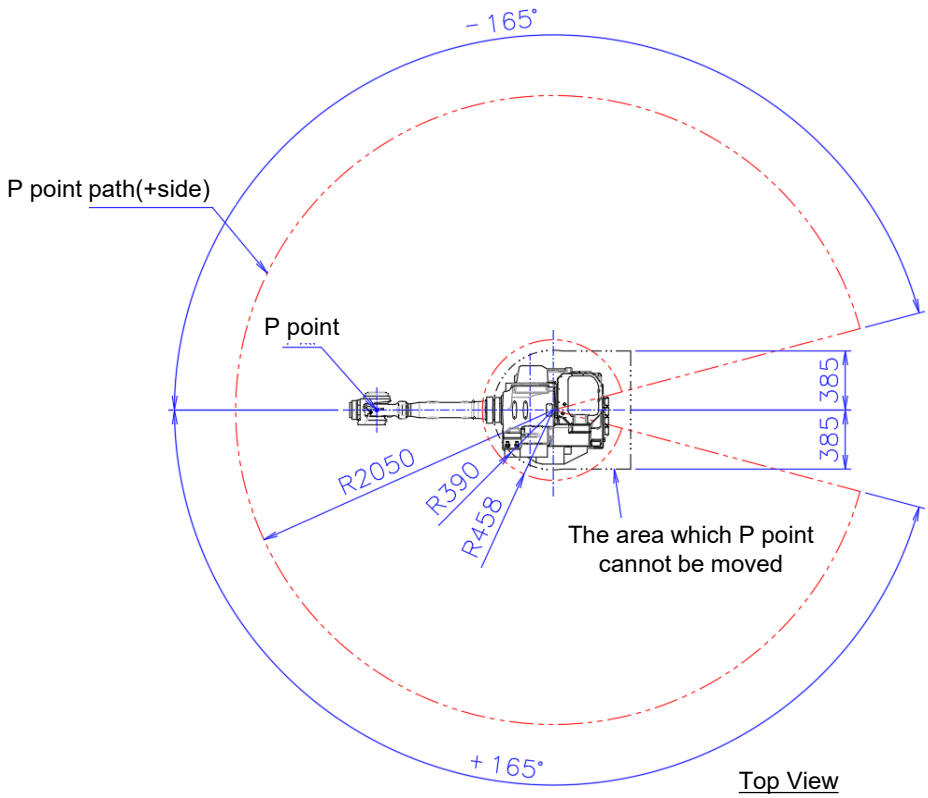


Transportation using a crane*4
RV-35FR/50FR/80FR weight: 560kg

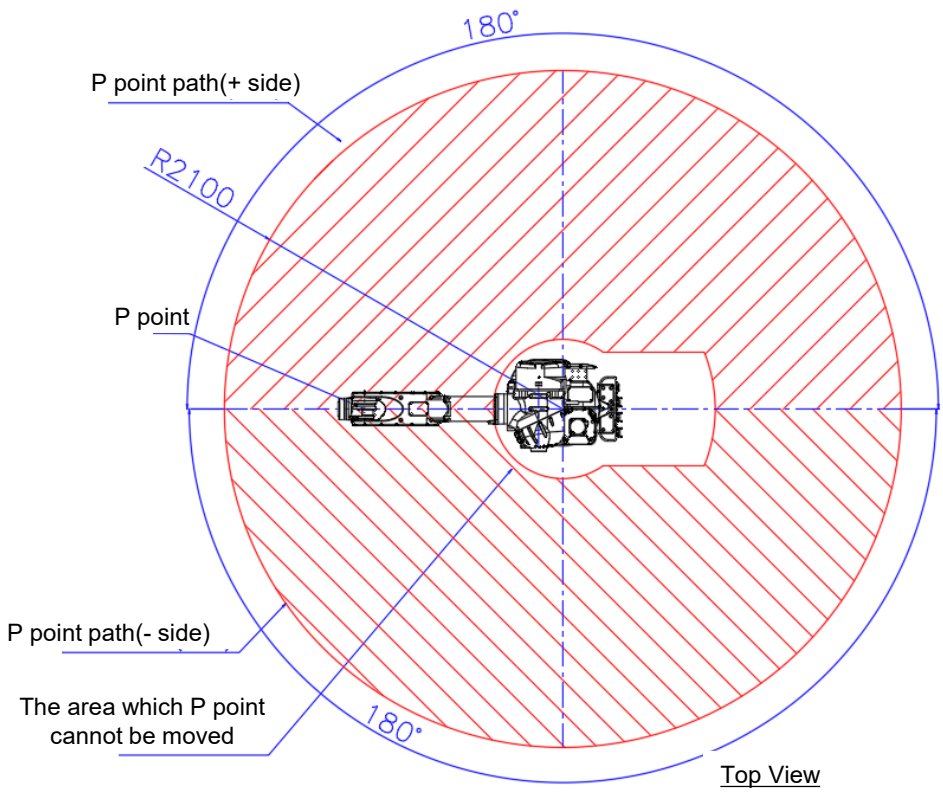
	J1 axis	J2 axis	J3 axis	J4 axis	J5 axis	J6 axis
RV-35FR/50FR/80FR	0°	0°	+155°	0°	+25°	0°

2．3　Operating range（1/3）

■Operating range diagram（RV-35F/50F/70F Top View）

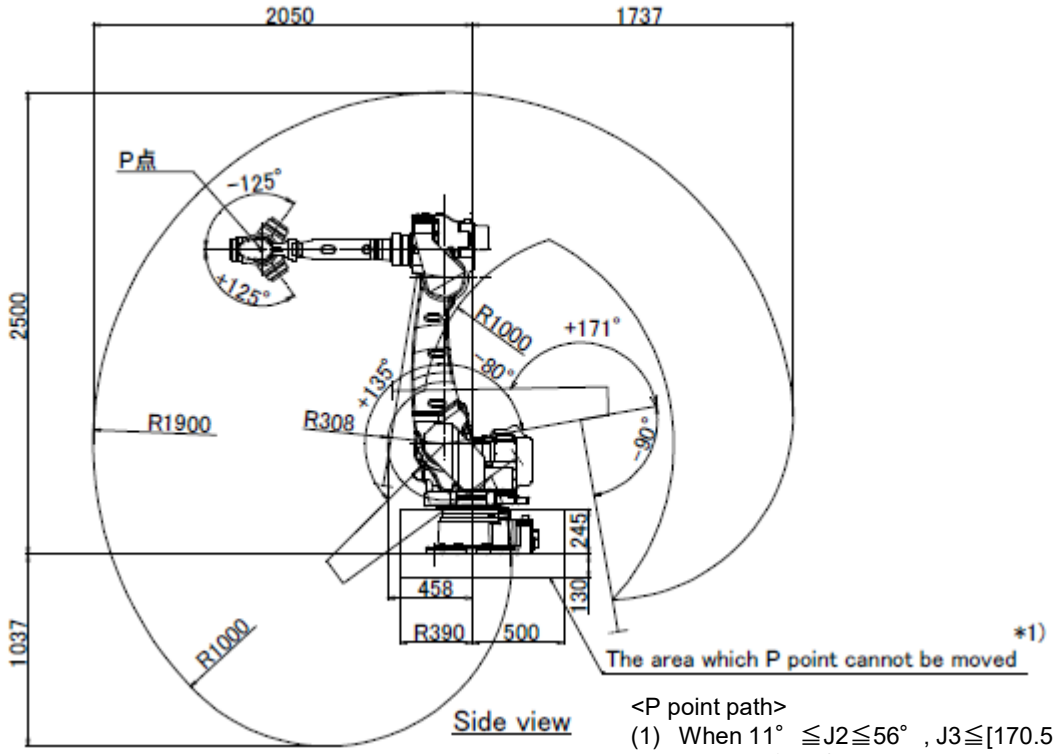


■Operating range diagram（RV-35FR/50FR/80FR Top View）



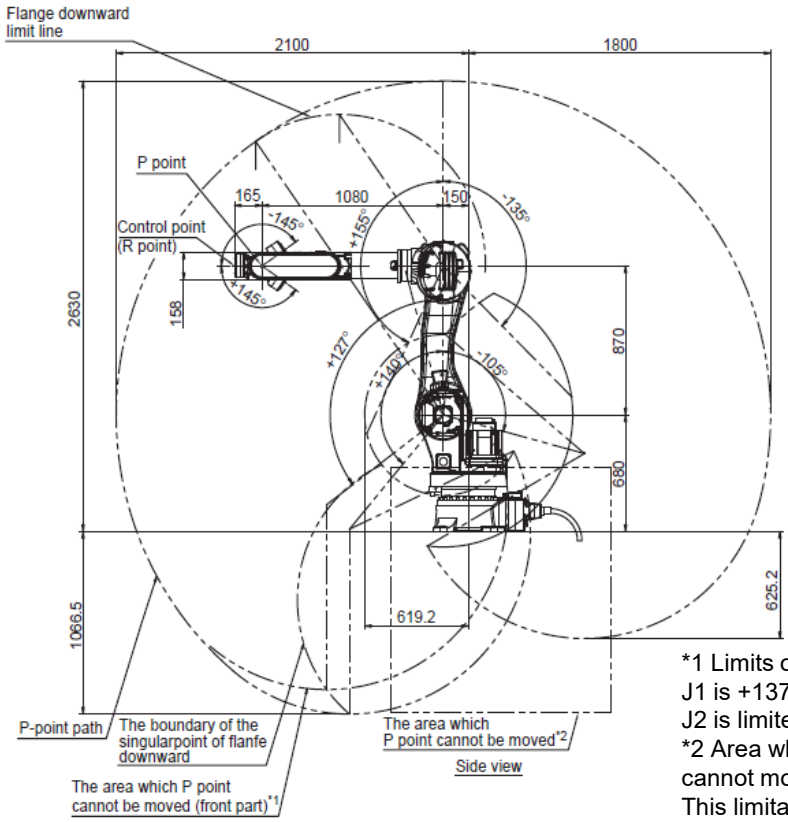
2．3　Operating range（2/3）

■Operating range diagram（RV-35F/50F/70F Side View）



<P point path>
(1) When 11° ≦J2≦56°, J3≦[170.5－{(1/6)×(J2-8}]°
(2) When J2≧56°, P point does not move to the operating range limitation area.
(3) When J3≧162.5° J2≦1031－6×J3°
(4) When J2≧130°, J1≦110°
or When J1＞110°, J2≦130°

■Operating range diagram（RV-35FR/50FR/80FR Side View）



*1 Limits of the front operating range: If the angle of J1 is +137 degrees □ J1 or J1 □ -137 degrees, then J2 is limited to J2 □ +127 degrees.
*2 Area which P point cannot be moved: P point cannot move to the area shown in the diagram. This limitation can be released by parameter MELTEXS. This limitation is valid at factory shipping.

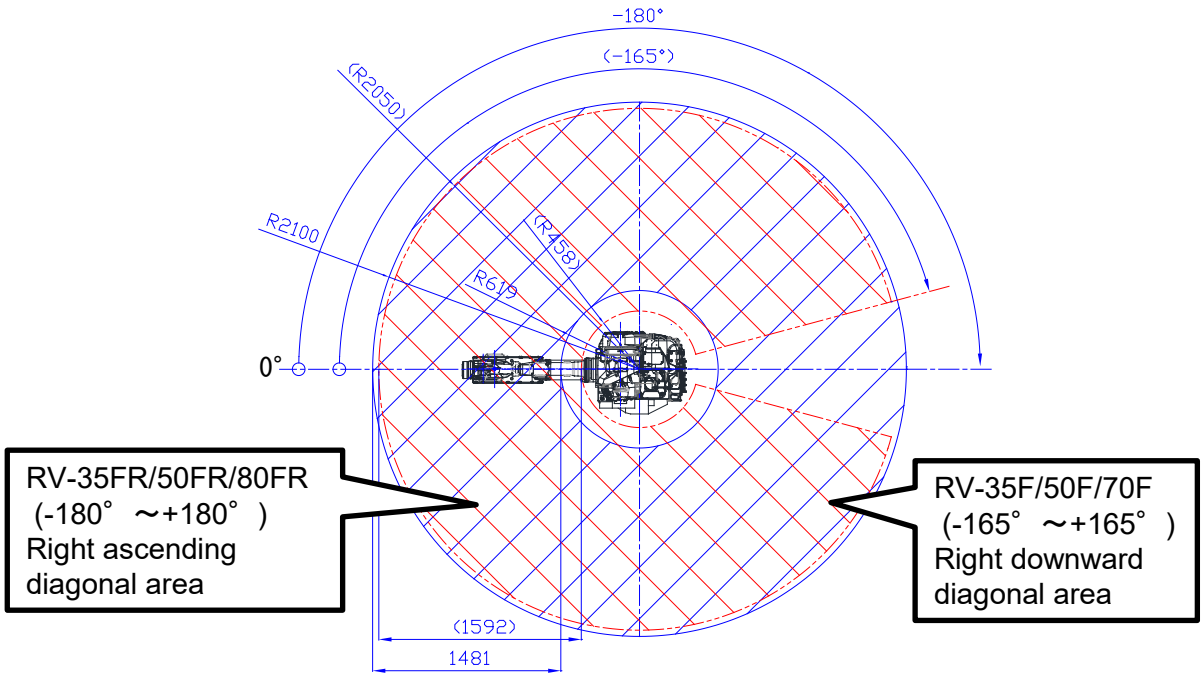
2．3　Operating range（3/3）

■Operating range diagram

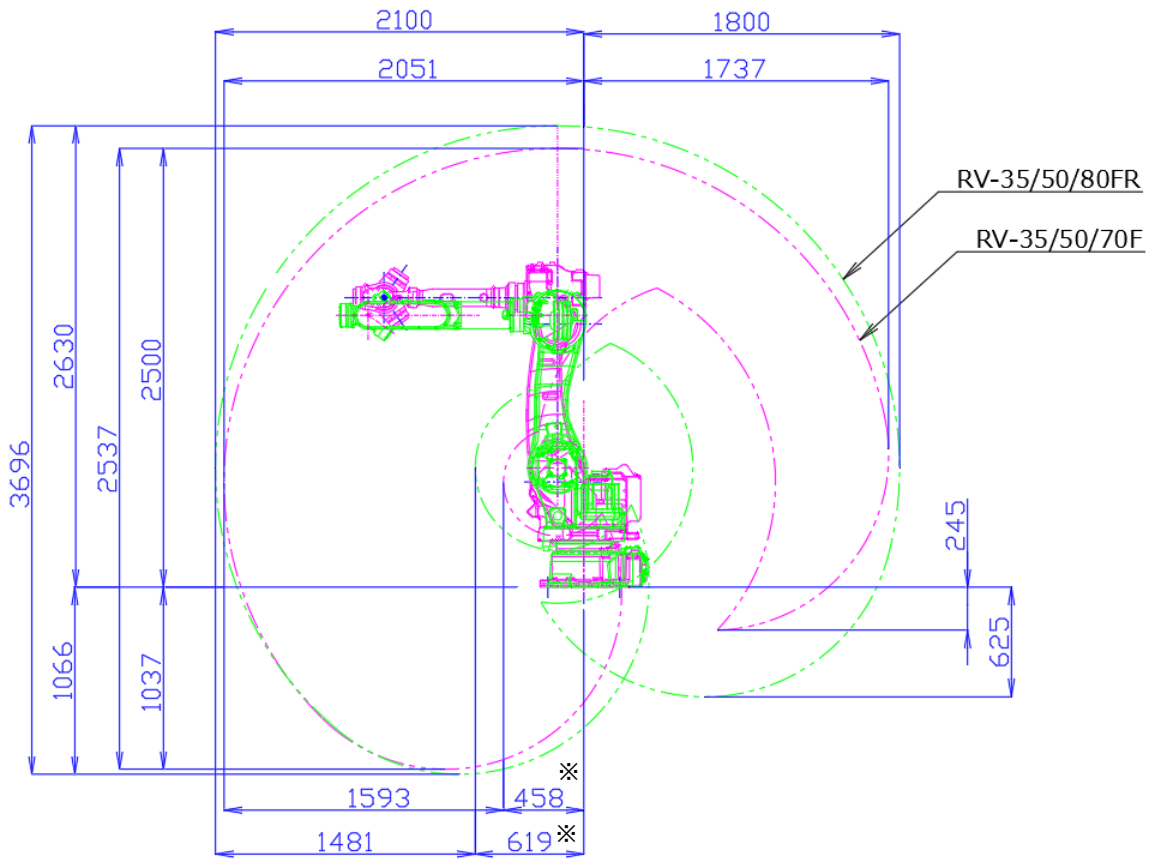
(RV-35F/50F/70F and RV-35FR/50FR/80FR　Overlaid illustration)

The motion range of RV-35F/50F/70F is within the motion range of RV-35FR/50FR/80FR, so they can be replaced.

However, the RV-35F/50F/70F have a wider operating range in the front pocket of the robot, so there are areas that cannot be operated by the RV-35FR/50FR/80FR.（※）



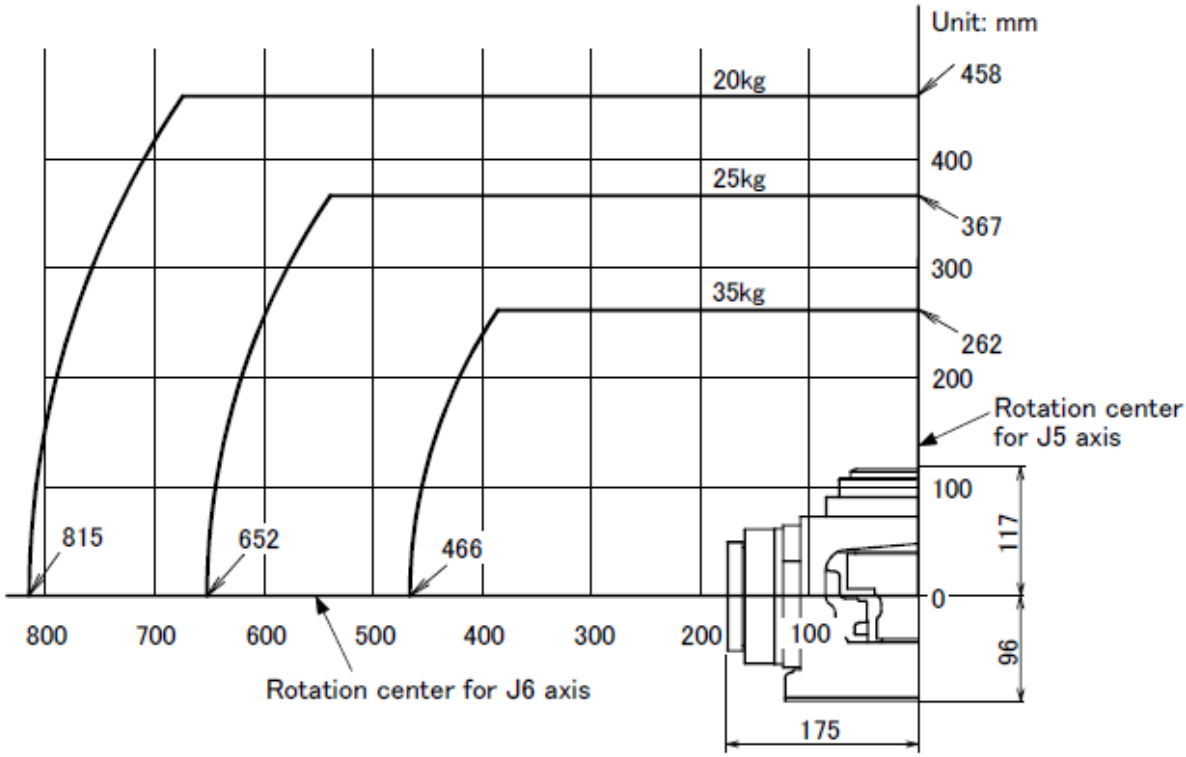
Top View



Side View

2．4　Load center of gravity position（1/3）

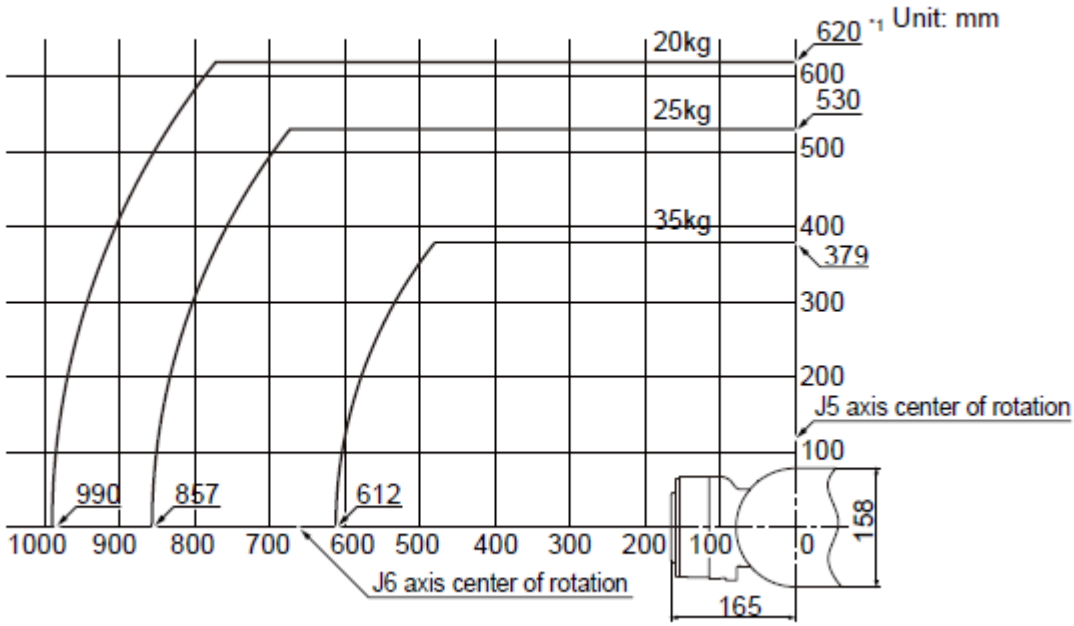
■Load center of gravity position（RV-35F series)



Position of center of gravity for loads (for loads with comparatively small volume): RV-35F

■Load center of gravity position（RV-35FR series）

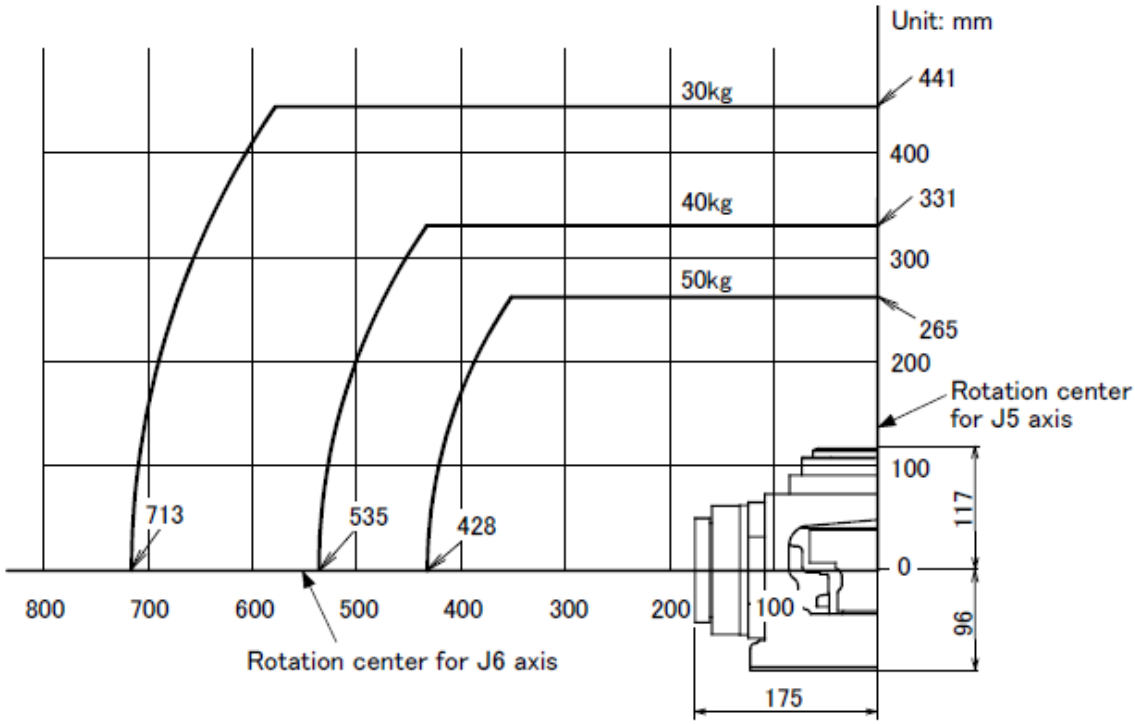
- RV-35FR (for the loads with comparatively small volume)



*1　The range for the mass of 20kg is specified so that it does not exceed the permissible inertia.

2．4　Load center of gravity position（2/3）

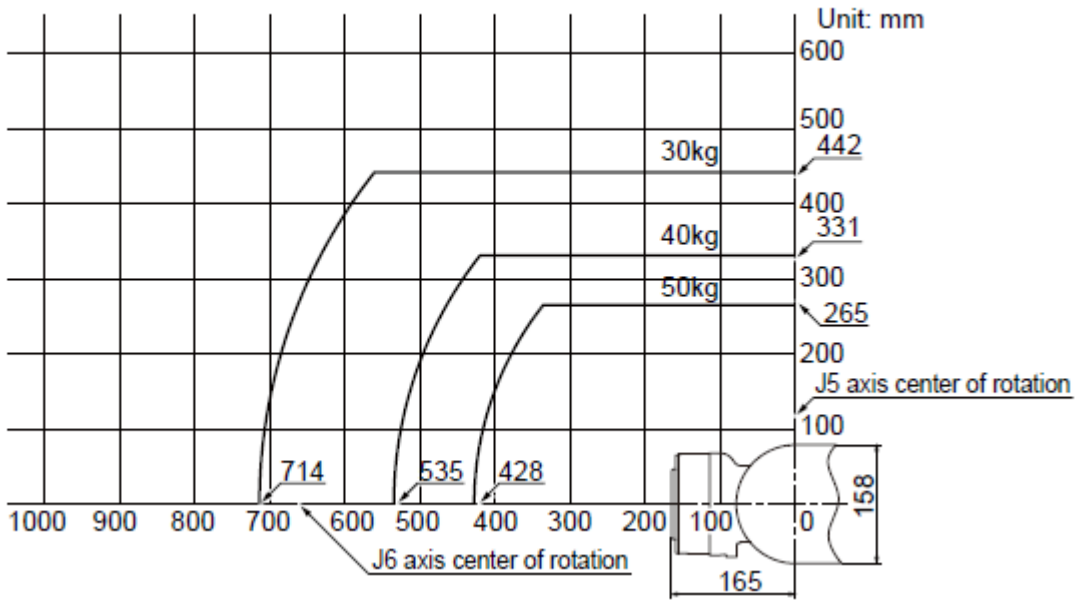
■Load center of gravity position（RV-50F series)



Position of center of gravity for loads (for loads with comparatively small volume): RV-50F

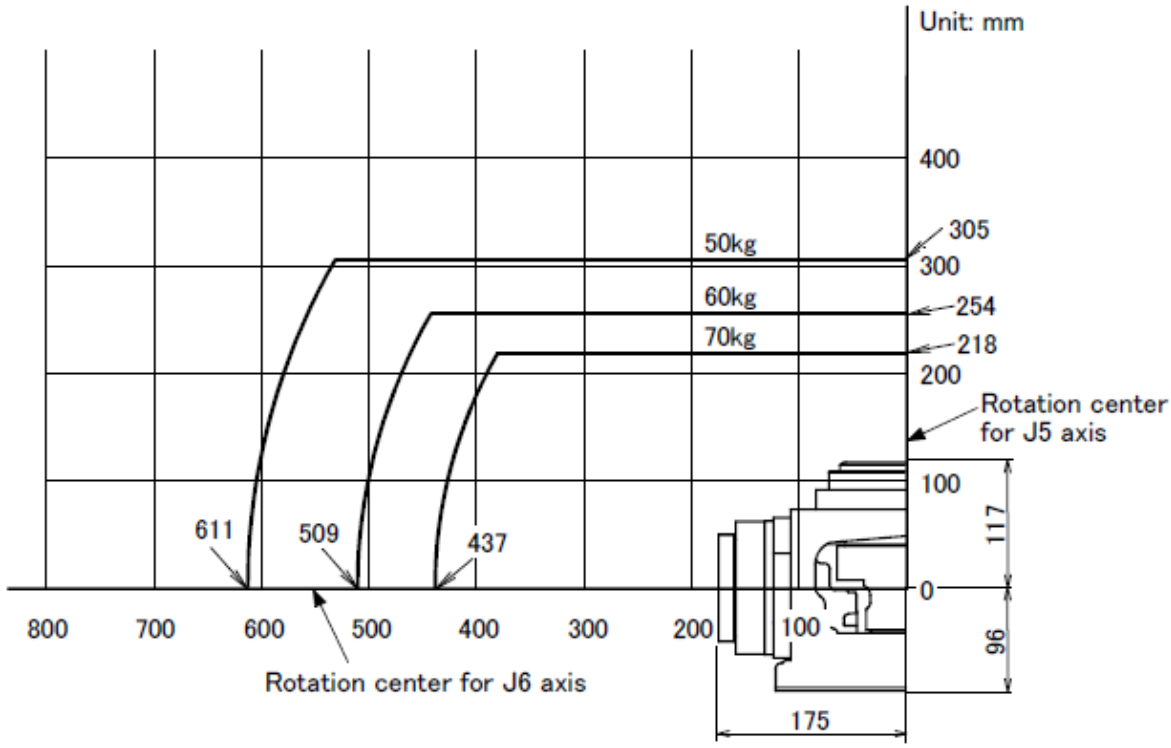
■Load center of gravity position（RV-50FR series)

- RV-50FR (for the loads with comparatively small volume)



2．4　Load center of gravity position（3/3）

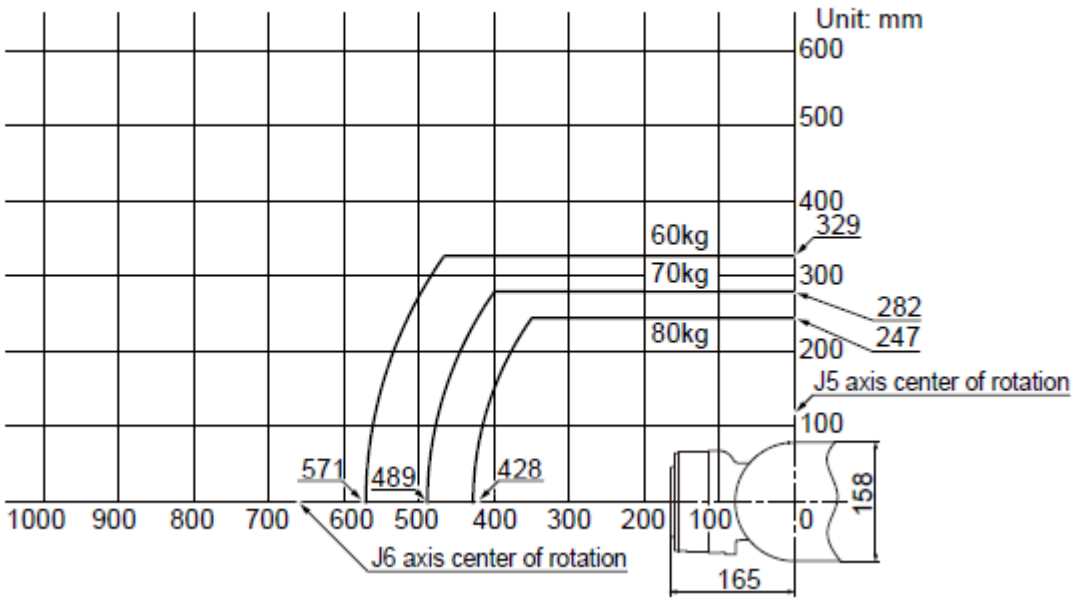
■Load center of gravity position（RV-70F series)



Position of center of gravity for loads (for loads with comparatively small volume): RV−70F

■Load center of gravity position（RV-80FR series)

• RV-80FR (for the loads with comparatively small volume)

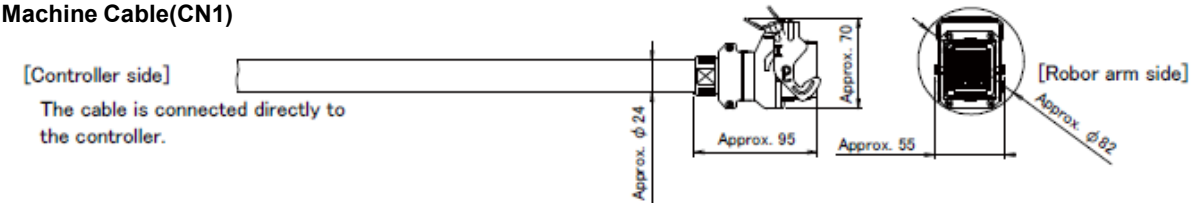


2. 5 Machine cable specification

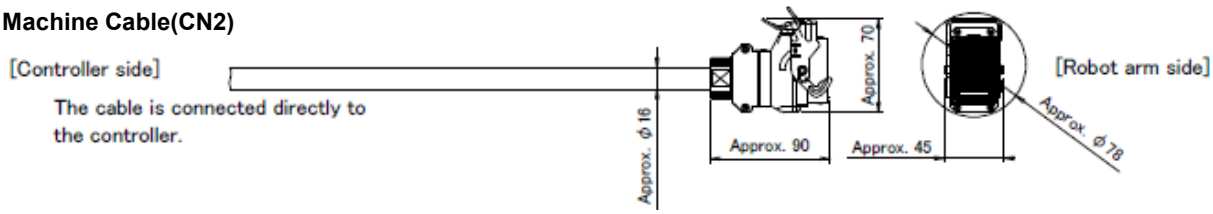
Item	F series	FR series
Machine Cable	Length : 7m **Integrated with the controller**	Length : 7m **Separated from the controller**

■External dimensions of machine cable（RV-35F/50F/70F series）

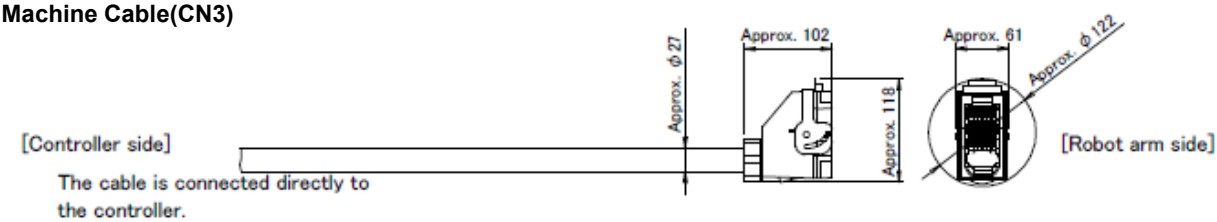
1）Machine Cable(CN1)



2）Machine Cable(CN2)

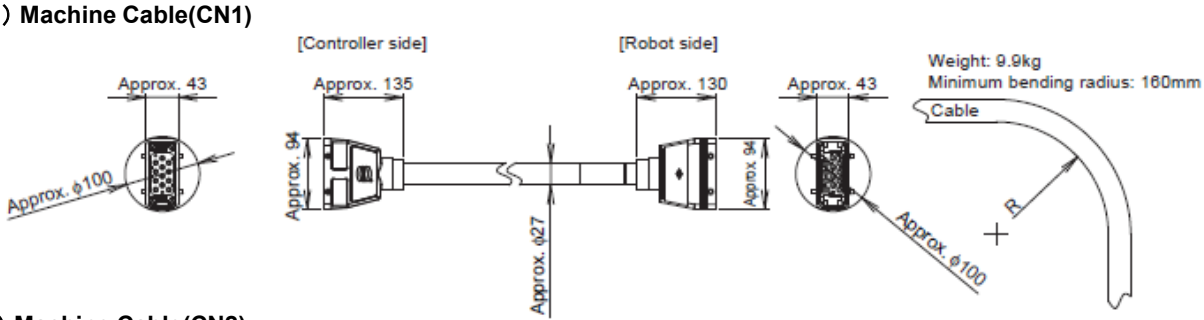


3）Machine Cable(CN3)

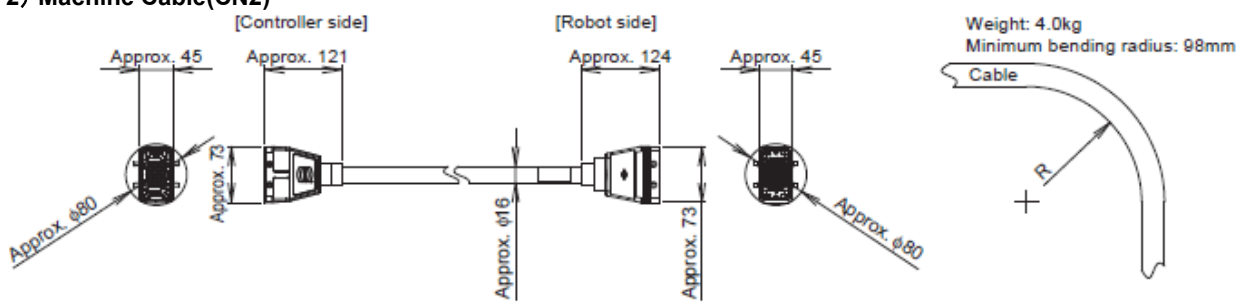


■ External dimensions of machine cable（RV-35FR/50FR/80FR series)

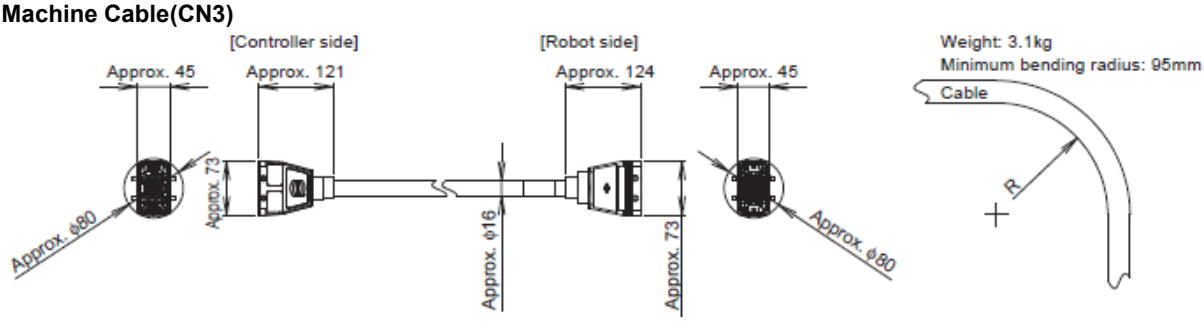
1）Machine Cable(CN1)



2）Machine Cable(CN2)



3）Machine Cable(CN3)



2．6 Controller Specifications（D Type）（1/2）

Item			Unit	Specification CR760	Specification CR860	Remarks
Number of axes				Simultaneously 6	Simultaneously 6	Up to 8 axes can be added.
Memory capacity	Number of teaching positions		Point	13,000	39,000	
	Number of steps		Step	26,000	78,000	
	Number of programs		Point	256	512	
Programming language				MELFA-BASIC Ⅳ、Ⅴ	MELFA-BASIC Ⅴ、Ⅵ	
Position teaching method				Teaching or MDI	Teaching or MDI	
External I/O	General-purpose I/O		Point	0 input points/0 output points (256 inputs/256 outputs max. with an option)	0 input points/0 output points (256 inputs/256 outputs max. with an option)	
		Dedicated I/O		Assigned to general-purpose I/O	Assigned to general-purpose I/O	The signal number of "STOP" is fixed.
	Hand I/O		Point	16 input points/16 output points	12 input points/8 output points (The sink/source type can be switched with parameters.)	
	External emergency stop input		Point	1 Note 1)	1 Note 2)	duplex
	Door switch input		Point	1	1	
	Enabling device input		Point	1	1	
	Emergency stop output		Point	1	1	
	Mode output		Point	1	1	
	Robot error output		Point	1	1	
	Additional axis synchronization output		Point	1	1	
	Encoder input		Channel	2	2	for encoder tracking
Interface	Additional axis		Channel	1 （SSCNETⅢ）	1 （SSCNETⅢ/H）	Connects to general-purpose servo amplifiers
	Remote IO		Channel	1 (Ver.1.0)	1 (Ver.1.0/2.0)	Ver.2.0（Safety is possible）
	USB		Port	1 Only the Ver.2.0 Full Speed device function)	1 (Only the Ver.2.0 High Speed device function)	USB mini-B
	Ethernet		Port	1（For user） 10BASE-T／100BASE-TX／	1（For user） 10BASE-T／100BASE-TX／ 1000BASE-T	
				1（For T/B） 10BASE-T／100BASE-TX	1（For T/B） 10BASE-T／100BASE-TX	
	Option slot		Slot	3	2	For Optional Interfaces
	SD memory card slot		Slot	-	1	For extended memory
	Memory expand slot		Slot	1	—	
	RS-422		Port	1	1	For T/B
	RS-232		Port	1	—	
Power supply	Input voltage range		Vac	Three-phase AC180～253V	Three-phase AC200～240V (＋10%～-15%)	() is the power supply voltage fluctuation rate
	Power capacity		kVA	20	7.5	Inrush current is not included.
	Power supply frequency		Hz	50 / 60	50 / 60	
	Grounding		Ω	100 or less	100 or less	Class D grounding
Ambient temperature(In use)			℃	0～40	0～45	
Ambient humidity(In use)			%RH	45～85	10～85	Non-condensing
External dimensions			mm	670(W)×415(D)×700(H)	670(W)×500(D)×670(H)	Protrusions are excluded.
Weight			kg	About 95	About 80	
Construction			-	Self-contained floor type, Enclose type.	Self-contained floor type, Enclose type.	CR760：IP54 CR860：IP54（FAN part: IP2X）

Note 1) Category 3 , PLd

Note 2) STO function by external emergency stop input with factory default setting is "SIL2, Category 3, PLd". When "Appendix 3: Safety Diagnostic Function (Test Pulse Diagnostics)" in the Standard Specifications is set STO function with external emergency stop input satisfies "SIL3, Category 4, PLe". Be sure to check "Appendix 2: Classification of External I/O Functions" in the standard specifications for the functions of external inputs and outputs.

2．6 Controller Specifications（Q Type）(2./2)

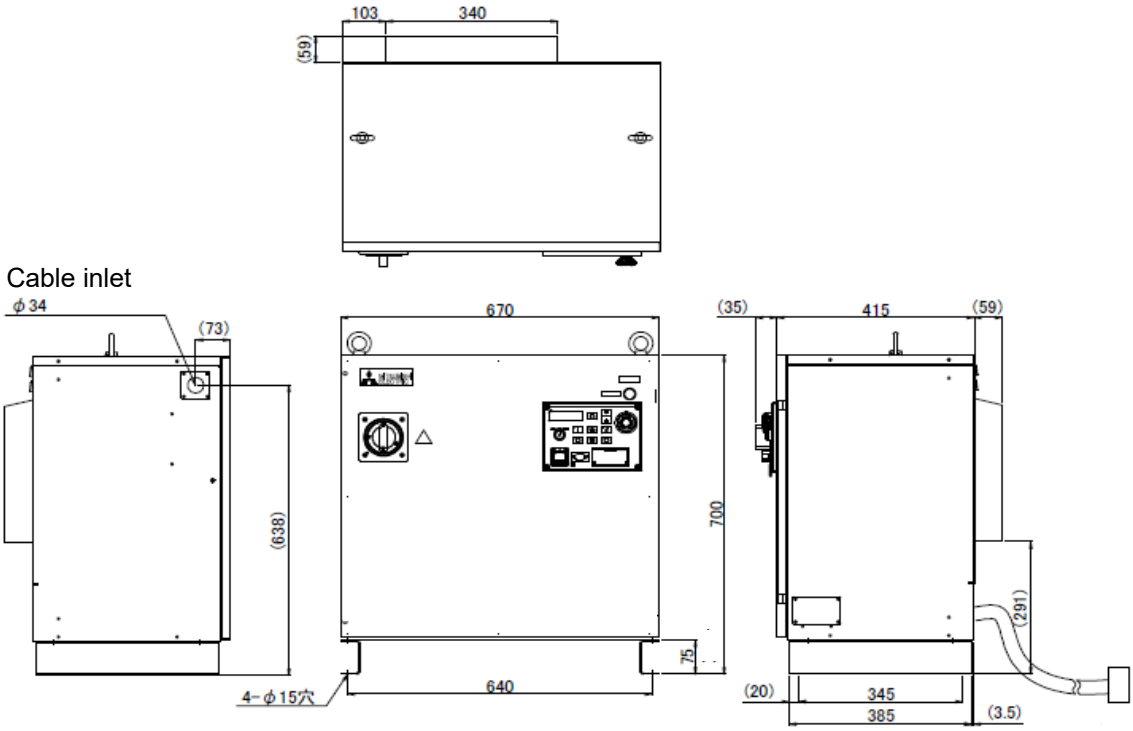
Item			Unit	Specification CR760	Specification CR860	Remarks
Number of axes				Simultaneously 6	Simultaneously 6	Up to 8 axes can be added.
Memory capacity	Number of teaching positions		Point	13,000	39,000	
	Number of steps		Step	26,000	78,000	
	Number of programs		Point	256	512	
Programming language				MELFA-BASIC Ⅳ、Ⅴ	MELFA-BASIC Ⅴ、Ⅵ	
Position teaching method				Teaching or MDI	Teaching or MDI	
External I/O	General-purpose I/O		Point	0 input points/0 output points (256 inputs/256 outputs max. with an option)	0 input points/0 output points (256 inputs/256 outputs max. with an option)	
		Dedicated I/O		Assigned to general-purpose I/O	Assigned to general-purpose I/O	The signal number of "STOP" is fixed.
	Hand I/O		Point	16 input points/16 output points	12 input points/8 output points (The sink/source type can be switched with parameters.)	
	External emergency stop input		Point	1 Note 1)	1 Note 2)	duplex
	Door switch input		Point	1	1	
	Enabling device input		Point	1	1	
	Emergency stop output		Point	1	1	
	Mode output		Point	1	1	
	Robot error output		Point	1	1	
	Additional axis synchronization output		Point	1	1	
	Encoder input		Channel	Use Q173DPX (sold separately)	Use Q173DPX (sold separately)	for encoder tracking
Interface	Additional axis		Channel	1 （SSCNETⅢ）	1 （SSCNETⅢ/H）	Connects to general-purpose servo amplifiers
	Remote IO		Channel	—	1 (Ver.2.0)	Ver.2.0（Safety is possible）
	Ethernet		Port	—	1（For user） 10BASE-T／100BASE-TX／ 1000BASE-T	
				1（For T/B） 10BASE-T／100BASE-TX	1（For T/B） 10BASE-T／100BASE-TX	
	Option slot		slot	—	2 (Only communication expansion cards can be used.)	For Optional Interfaces
	RS-422		port	1	1	For T/B
Power supply	Input voltage range		Vac	Three-phase AC180～253V	Three-phase AC200～240V (＋10%～-15%)	() is the power supply voltage fluctuation rate
	Power capacity		kVA	20	7.5	Inrush current is not included.
	Power supply frequency		Hz	50 / 60	50 / 60	
	Grounding		Ω	100 or less	100 or less	Class D grounding
Ambient temperature(In use)			℃	0～40	0～45	
Ambient humidity(In use)			%RH	45～85	10～85	Non-condensing
External dimensions			mm	670(W)×415(D)×700(H)	670(W)×500(D)×670(H)	Protrusions are excluded.
Weight			kg	About 95	About 80	
Construction			-	Self-contained floor type, Enclose type.	Self-contained floor type, Enclose type.	CR760：IP54 CR860：IP54（FAN part: IP2X）
Robot CPU Unit			-	Q172DRCPU	Q172DSRCPU	

Note 1) Category 3 , PLd

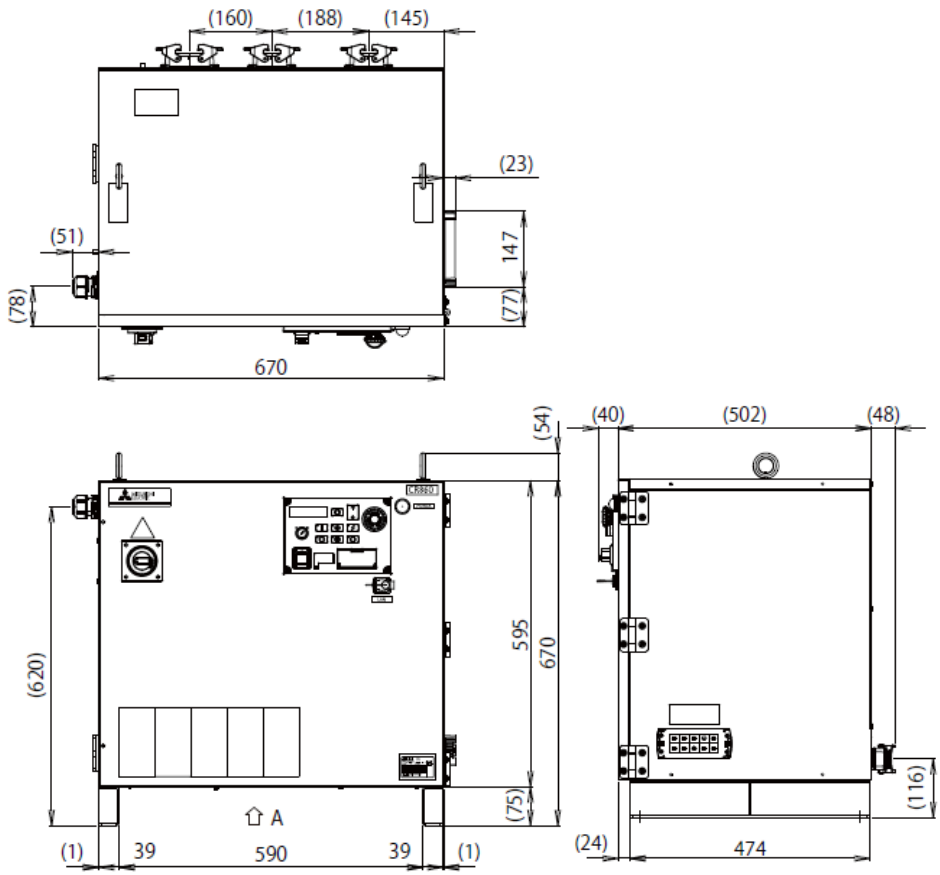
Note 2) STO function by external emergency stop input with factory default setting is "SIL2, Category 3, PLd". When "Appendix 3: Safety Diagnostic Function (Test Pulse Diagnostics)" in the Standard Specifications is set STO function with external emergency stop input satisfies "SIL3, Category 4, PLe". Be sure to check "Appendix 2: Classification of External I/O Functions" in the standard specifications for the functions of external inputs and outputs.

2．7 Controller outline drawing (1/2)

■CR760

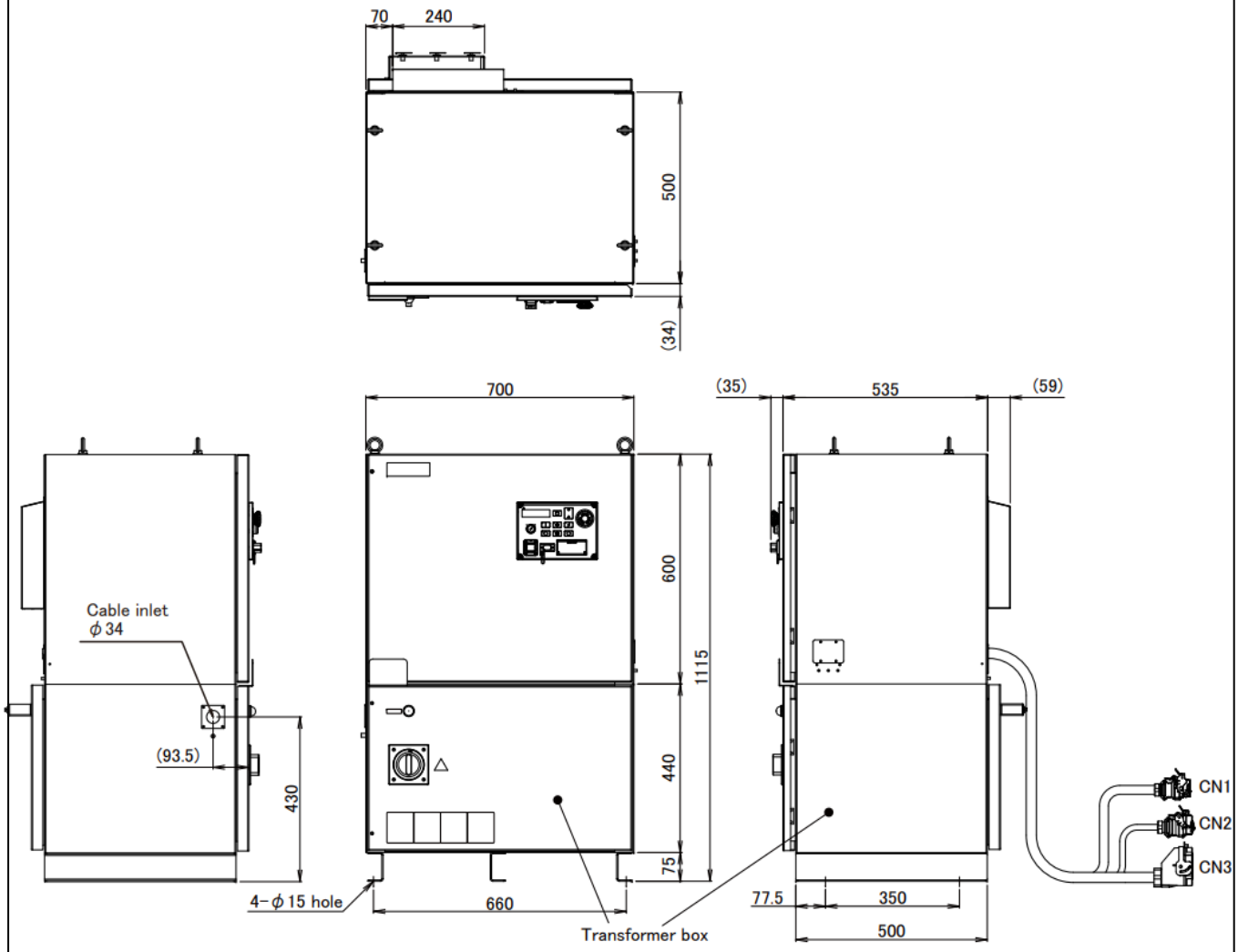


■CR860

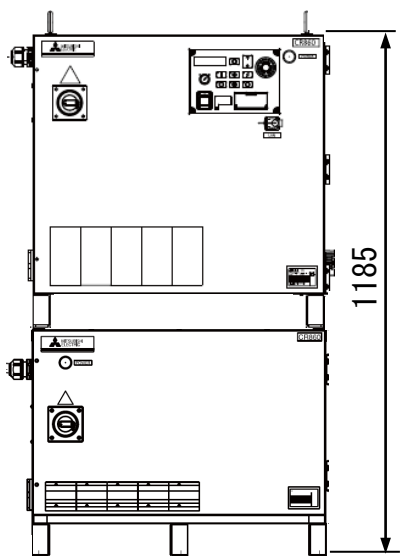


2．7　Controller outline drawing　(2/2)

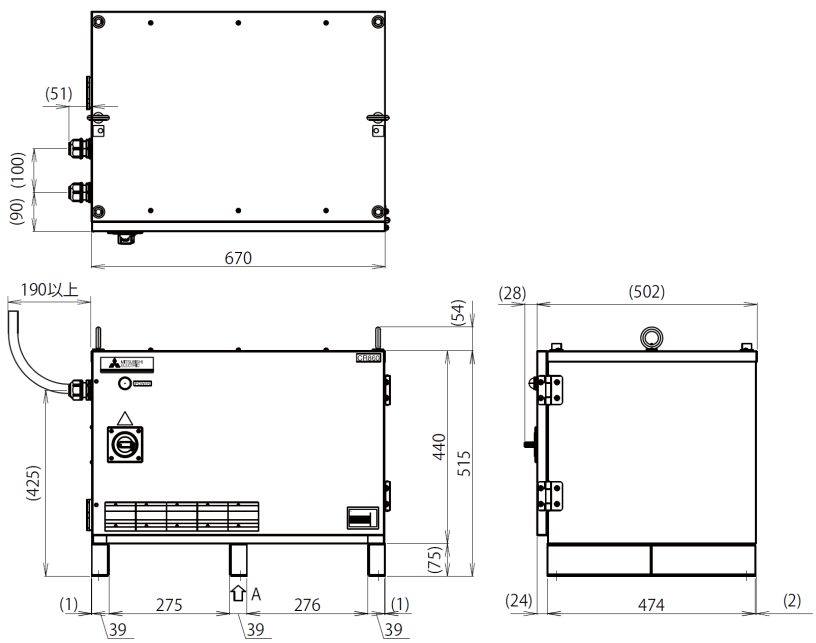
■CR760（CE marking）



■CR860＋2F-ATBOX (Overlapping)



■2F-ATBOX(Trans Unit)



2. 8 Options

■ Comparative Table of Robot Options

Item	Type	division		Remarks
		F series	FR series	
Hand output cable	1F-GR2000S-21	○	—	
	1F-GR2000S-22	○	—	
	1F-GR2000S-44	—	○	
Hand input cable	1F-HC2000S-21	○	—	
	1F-HC2000S-22	○	—	
	1F-HC2000S-44	—	○	
Hand Ethernet cable	1F-LAN2000-44	—	○	
Machine cable extension(Fixed type)	1F-□□CBL-21	○	—	05：5m 10：10m 15：15m
Machine cable extension(Flexed type)	1F- □□ LUCBL-21	○	—	05：5m 10：10m 15：15m
Machine cable (Fixed type)	1F-□□UCBL-44	—	○	12：12m 17：17m 22：22m
Machine cable (Flexed type)	1F-□□LUCBL-44	—	○	07：7m 12：12m 17：17m 22：22m
J2 axis motor cover	1F-MCJ2-21	○	—	
Elbow section external wiring cover set	1F-UT01-21	○	—	
J1 axis operating range change stopper	1F-DH-44J1	—	○	
Brake releasing device	2F-BRKBOX-1	—	○	
Power cable for the brake	2F-BRKCBL-1	—	○	Cable length：5m

■Controller Option Comparison Table ○：Option —：None

Item	Type	CR760	CR860	Specification
Simple teaching pendant	R32TB-□□	○	○	07:7m (standard)、 15:15m (special)
High-performance teaching pendant	R56TB-□□	○	—	07:7m (standard)、 15:15m (special)
High-performance teaching pendant	R86TB	○	○	07:7m (standard)
Extension Cable for T/B	2F-32EXTBST-□□M	○	○	Cable length 01M：1m、05M：5m、10M：10m、15M：15m
Parallel I/O unit	2A-RZ361	○	○	32 output points／32 input points (Sink type)
	2A-RZ371			32 output points／32 input points (Source type)
External I/O cable（5m、15m）	2A-CBL□□	○	○	CBL05：5m, CBL15：15m Untreated on one end. For 2A - RZ361/371
Parallel I/O interface	2D-TZ368	○	○	32 output points／32 input points (Sink type)
	2D-TZ378			32 output points／32 input points (Source type)
External I/O cable（5m、15m）	2D-CBL□□	○	○	CBL05：5m CBL15：15m Untreated on one end. For 2D - TZ368/378
CC-Link interface	2D-TZ576	○	○	CC-Link Intelligent Device Station Ver2.0 Compatible(1～4 Stations)
EtherNet/IP interface	2D-TZ535	○	○	Communications interface for installation in an HMS Anybus-CompactCom module. HMS Ethernet/IP module (AB6314-B-218) to be provided by the customer.
PROFINET interface	2D-TZ535-PN	○	○	Communications interface for installation in an HMS Anybus-CompactCom module. HMS PROFINET IO module (AB6489-B) to be provided by the customer.
CC-Link IE Field interface）	2F-DQ535	—	○	Communications interface for installation in an HMS Anybus-CompactCom module. HMS CC-Link-IE Field module(AB6709-B-116) to be provided by the customer.
EtherCAT interface	2F-DQ535-EC	—	○	Communications interface for installation in an HMS Anybus-CompactCom module. HMS EtherCAT module(AB6607-D-224) to be provided by the customer.
Safety option	4F-SF003-05	—	○	Expanded safety monitoring capabilities
MELFA-3D Vision 2.0	4F-3DVS2-PKG3	○	-	Complete set of equipment required for 3D vision sensor function such as 3D camera head, control unit, etc. (Compatible models: RV-F/FR series), Note 1: AI function for automatic adjustment of recognition parameters is not available. Note 2: MELFA Smart Plus card is required for the recognition parameter automatic adjustment AI function.
	2F-3DVS2-OPT3	○	—	For magnification options
	2F-3DVS2-OPT2	○	—	Expand the field of view to about 20~28 degrees
MELFA-3D Vision 3.0	3F-53U-WINM	—	○	MELFA-3D Vison Software. Note 1: AI function for automatic adjustment of recognition parameters is not available.
Encoder distribution unit	2F-YZ581	○	○	Unit for connecting one rotary encoder to multiple robot controllers when using the tracking function
RT ToolBox2	3D-11C-WINE	○	-	with simulation function（CD - ROM）(RT ToolBox2)
RT ToolBox2 mini	3D-12C-WINE	○	-	Simplified Edition(CD - ROM)（RT ToolBox2 mini）
RT ToolBox 3 standard	3F-14C-WINE	○	○	with simulation function（DVD - ROM）(RT ToolBox3)
RT ToolBox 3 mini	3F-15C-WINE	○	○	Simplified Edition(DVD - ROM)（RT ToolBox3 mini）
RT ToolBox 3 Pro	3F-16D-WINE	○	○	Professional Edition(DVD - ROM)（RT ToolBox3 Pro）
Simulator（MELFA-Works）	3D-21C-WINE	○	—	Layout study / Tact time study / Program debugging Add-in software for Solidworks ® (64-bit, DVD version)
Extended memory cassette	2D-TZ454	○	—	After expansion, the user program area is 2 MB
SD memory card	2F-2GBSD	—	○	2GB for logging
Transformer module	2F-ATBOX	—	○	AC400V→AC200V step-down

○：Option —：None

3. Comparison of other specifications

■Type

	F series	FR series
Robot Model	The model name was changed from F to FR. Controller name is the same for standard and CE specifications.	
	【Vertically Articulated】(e.g., 35 kg) RV-35F-D (standard) RV-35F-D-S15 (CE specification)	【Vertically Articulated】(e.g., 35 kg) RV-35FR-D（standard、CE specification）
Controller	**Unified Controller and** CE specification in combinatioin with trans unit(option)	
	【Vertically Articulated】(e.g., 35 kg) CR760-35VD（standard） CR760-35VD-S15（CE specification）	【Vertically Articulated】(e.g., 35 kg) CR860-35VD（standard） CR860-35VD＋**2F-ATBOX**（CE specification）

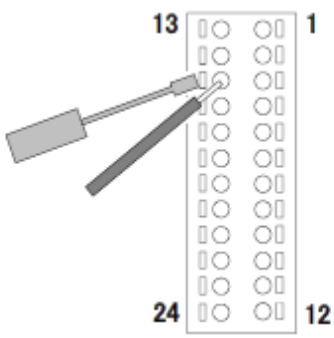
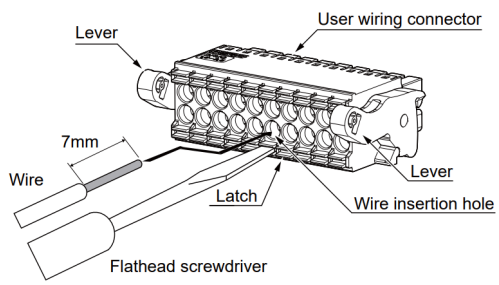
■ Built-in battery of the robot body

Item	F series	FR series
Type / quantity	ER6V × 3	1S1P×2 LS17500 × 1

■ Robot Controller Battery

Item	F series		FR series	
	D Type	Q Type	D Type	Q Type
CR760	Q6BAT×1	-	-	-
CR860	-	-	-	-
Q172DRCPU	-	Q6BAT×1	-	-
Q172DSRCPU	-	-	-	Q6BAT×1

■ User Wiring

Item	F series	FR series
	CR760	CR860
CNUSR	 Peel the sheath of the cable and insert it to the connector directly. Core wires of the cable should be kinked before the cable is used. While pushing the hook inside the tool insertion opening of the connector using a small screwdriver, insert the cable to the back of the cable insertion opening of the connector. Cable size: AWG#28～AWG#16(0.08mm^2～1.5mm^2) [Note]The contact capacity of each input/output terminal is shown below. DC24V: input 10mA/output 100mA	 **Strip 7mm of the cable sheath, and insert the cable to the depth of the insertion slot while pushing the jaws of the connector for user wiring with a flat-blade screwdriver.Cable size: AWG#24 to 16 (0.2 to 1.5mm2)Flat-blade screwdriver: 2.5 mm wide at the tip** **[Note] The contact capacity of each input/output terminal is DC24V: 10mA input / 100mA output.**

■ External emergency stop switch supply power

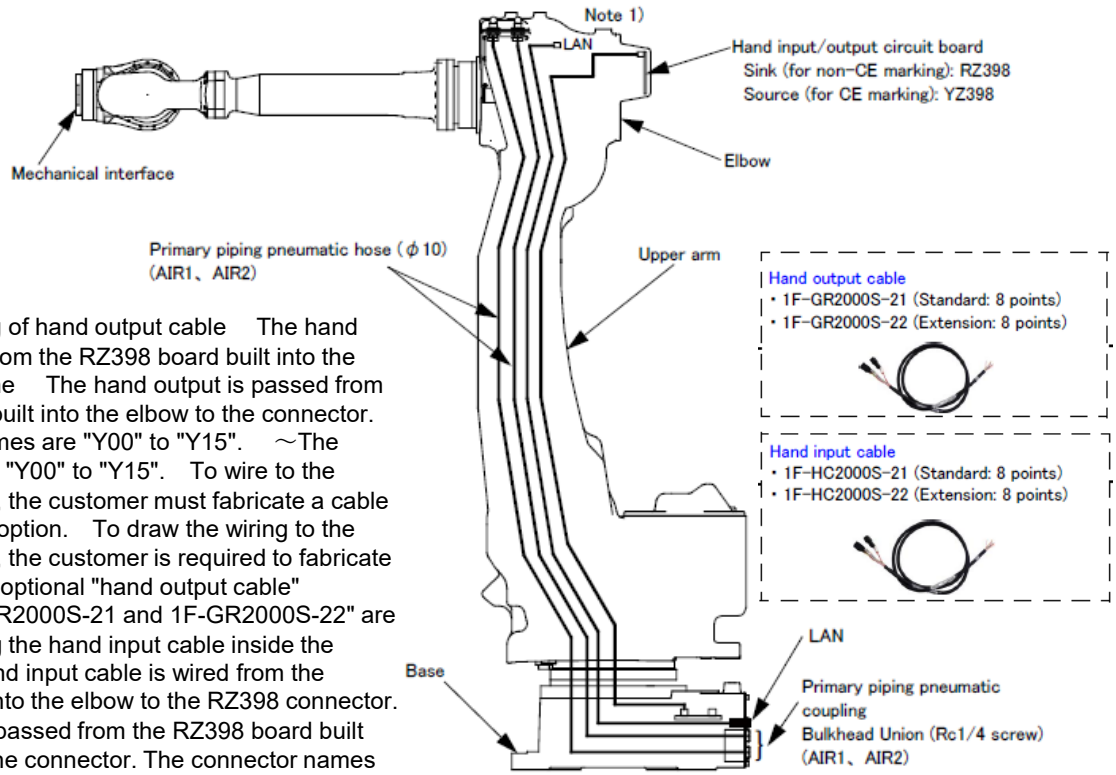
F series（CR760）	FR series（CR860）
Internal power supply, external power supply	Internal power supply (pulse drive)

For details, refer to Standard Specifications: External Emergency Stop Input/Output.

■ Dedicated input/output connector pin assignment

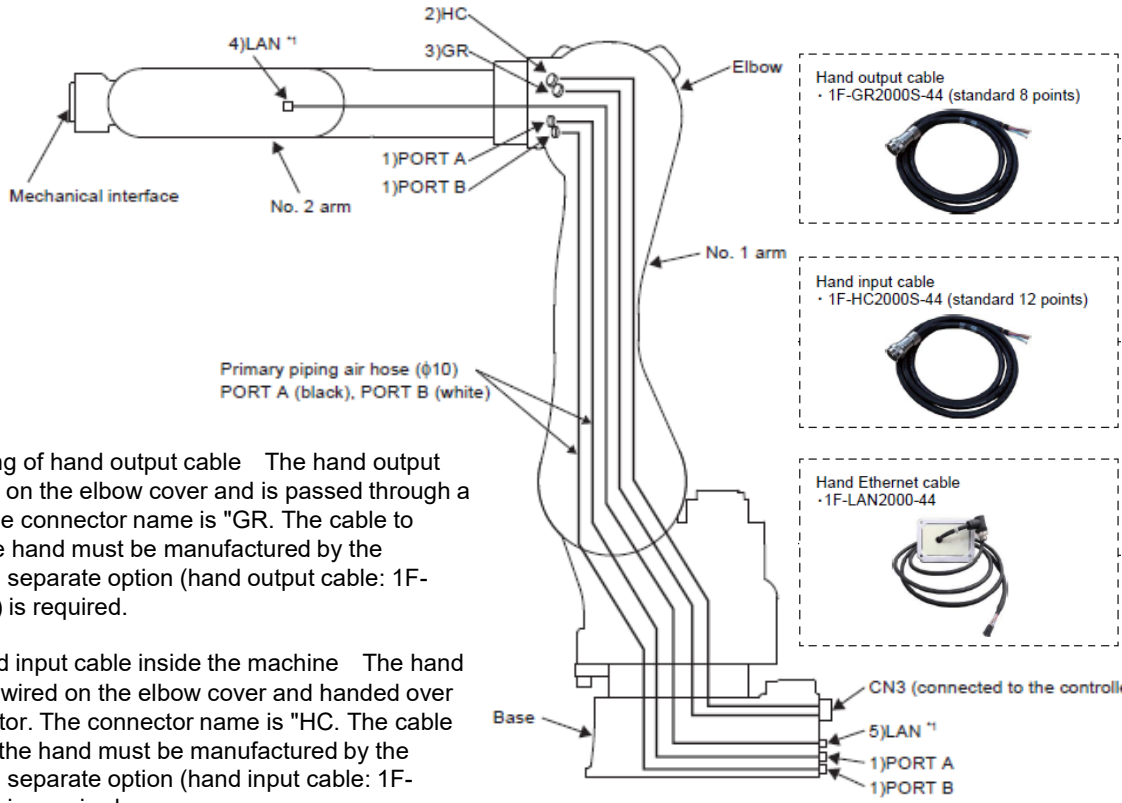
CR760				CR860	
Signal	Feature	connector	pin	connector	pin
EMGIN24V11	（Channel 1）Construction of external emergency stop circuit	EMG1	1	CNUSR11	1
EMGIN24V12			13		12
EMG11			3		3
EMG12			15		11
EXT-GND1			5		13
SG			17		—
EMGIN24V21	（Channel 2）Construction of external emergency stop circuit		2		6
EMGIN24V22			14		17
EMG21			4		8
EMG22			16		16
EXT-GND2			6		18
SG			18		—
ENA11	（Channel 1）Enabling Device Connection		7		5
ENA12			19		10
ENA21	(Channel 2）Enabling Device Connection		8		15
ENA22			20		20
DOOR11	（Channel 1）Door switch connection		9		4
DOOR12			21		9
DOOR21	(Channel 2）Door switch connection		10		14
DOOR22			22		19
AXMC11	（Channel 1）Additional axis contactor control output		11	CNUSR13	4
AXMC12			23		12
AXMC21	(Channel 2）Additional axis contactor control output		12		8
AXMC22			24		16
EMGOUT11	(Channel 1) Emergency stop output	EMG2	5		2
EMGOUT12			17		10
EMGOUT21	(Channel 2) Emergency stop output		6		6
EMGOUT22			18		14
MODEOUT11	(Channel 1) Mode output		7		1
MODEOUT12			19		9
MODEOUT21	(Channel 2) Mode output		8		5
MODEOUT22			20		13
ERR11	(Channel 1) Robot error output		11		3
ERR12			23		11
ERR21	(Channel 2) Robot error output		12		7
ERR22			24		15

■Wiring and piping of hands（RV-35F/50F/70F series) (1/2)



(1) Onboard wiring of hand output cable　The hand output is passed from the RZ398 board built into the elbow section to the　The hand output is passed from the RZ398 board built into the elbow to the connector. The connector names are "Y00" to "Y15".　～The connector name is "Y00" to "Y15".　To wire to the outside of the arm, the customer must fabricate a cable or use a separate option.　To draw the wiring to the outside of the arm, the customer is required to fabricate a cable or use the optional "hand output cable" (optional).　1F-GR2000S-21 and 1F-GR2000S-22" are required.(2) Wiring the hand input cable inside the machine　The hand input cable is wired from the RZ398 card built into the elbow to the RZ398 connector. The hand input is passed from the RZ398 board built into the elbow to the connector. The connector names are "X00" to "X15".　～to "X15".

■Wiring and piping of hands（RV-35FR/50FR/80FR series) (1/2)

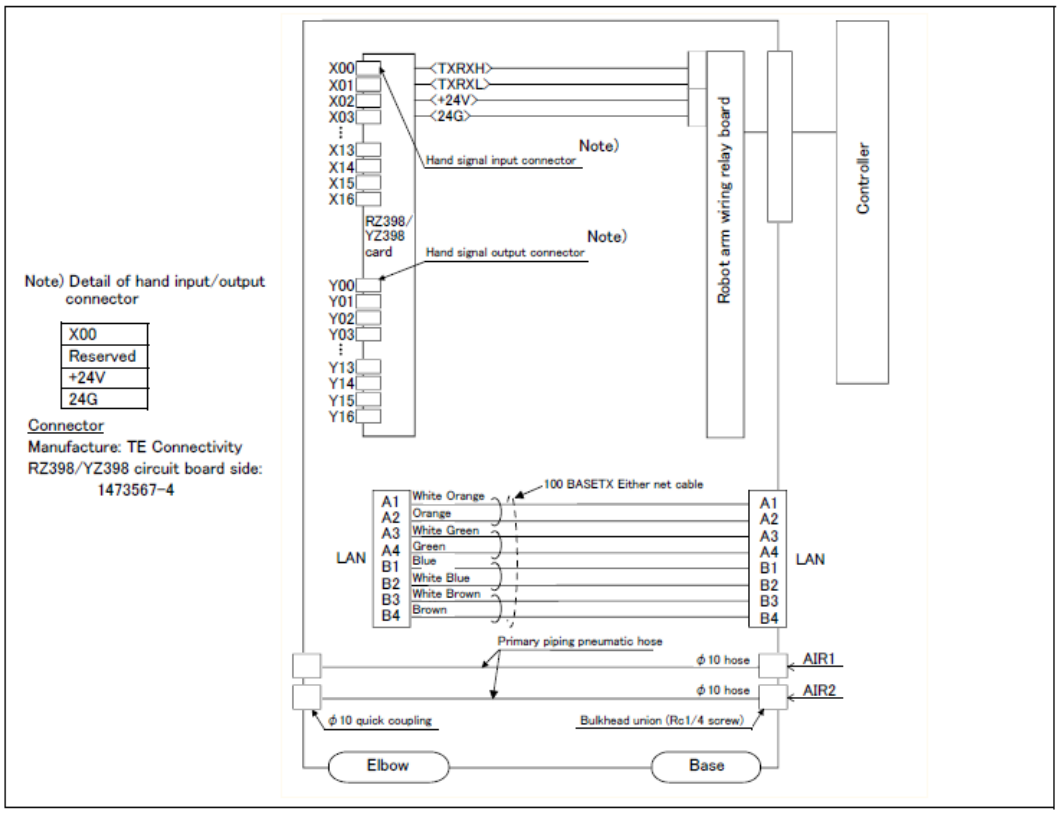


(1)　Onboard wiring of hand output cable　The hand output cable is wired on the elbow cover and is passed through a connector. The connector name is "GR. The cable to connect to the hand must be manufactured by the customer or a separate option (hand output cable: 1F-GR2000S-44) is required.

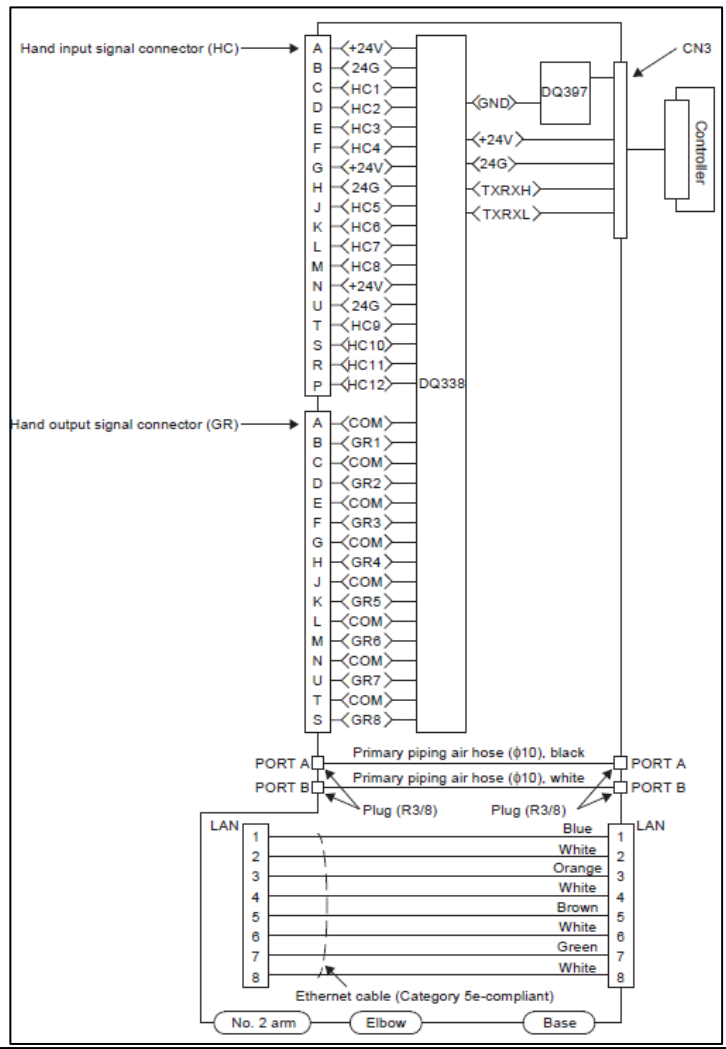
(2)　Wiring of hand input cable inside the machine　The hand input cable is wired on the elbow cover and handed over to the connector. The connector name is "HC. The cable to connect to the hand must be manufactured by the customer or a separate option (hand input cable: 1F-HC2000S-44) is required.

(3)　Eight Ethernet cables are installed from the base to the No. 2 arm. A separate option (hand Ethernet cable: 1F-LAN2000-44) is required to pull them out.

■ Wiring and piping of hands（RV-35F/50F/70F series) (2/2)

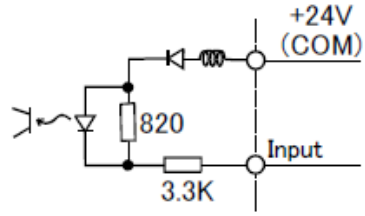


■ Wiring and piping of hands （RV-35FR/50FR/80FR series） (2/2)

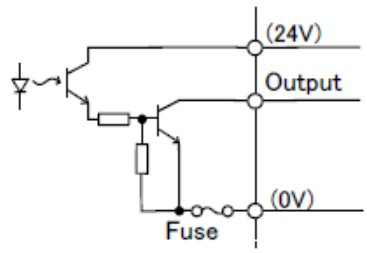


■Electrical specifications of hand input/output（RV-35F/50F/70F series)

Hand input specifications（for non-CE marking specification）

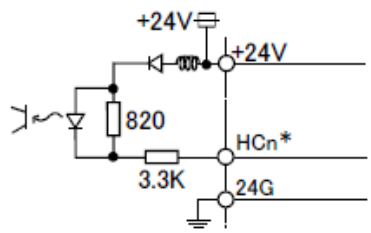
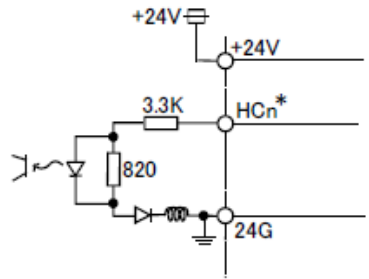
Item		Specification	Internal circuit
Type		DC input	
Number of input points		16	
Insulation method		Photo coupler insulation	
Rated input voltage		DC24V	
Rated input current		Approx. 7mA	
Working voltage range		DC10.2V to DC26.4V (Ripple factor should be less than 5%)	
ON voltage/ON current		DC8V or more/2mA or less	
OFF voltage/ OFF current		DC4V or more/1mA or less	
Input resistance		Approx. 3.3kΩ	
Response time	OFF-ON	10ms or less(DC24V)	
	ON-OFF	10ms or less(DC24V)	
Common method		8 point 1 common	
External cable connection method		Connector	

Hand output specifications（for non-CE marking specification）

Item		Specification	Internal circuit
Type		Transistor output	
Number of output points		16	
Insulation method		Photo coupler insulation	
Rated load voltage		DC24V	
Rated load voltage range		DC21.6V to DC26.4V	
Max. load current		0.1A/1 point (100%)	
Leakage current at OFF		0.1mA or less	
Max. voltage drop at ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2ms or less (Resistance load)(hardware response time)	
Fuse rating		Fuse rating:Fuse 3.2A (A fuse for 16 points)	
Common method		1 point 1 common (common terminal: 4 points)	
External wire connection method		connector (e-Con)	
External power supply	Voltage	DC24V(DC21.6 to 26.4V)	
	Current	60mA (TYP. 24VDC per common)(base drive current)	

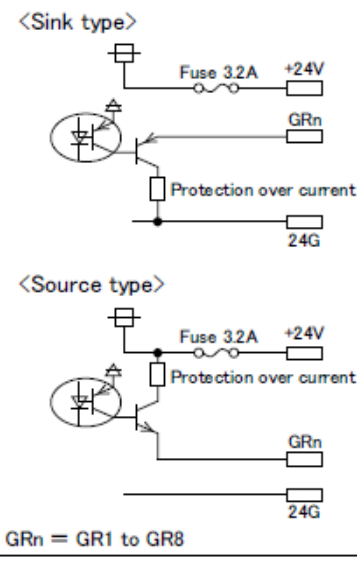
■Electrical specifications of hand input/output（RV-35F/50F/70F series) (1/2)

Hand input specifications（for CE marking specification）

Item		Specification	Internal circuit
Type		DC input	<Sink type> 
Number of input points		8	
Insulation method		Photo coupler insulation	
Rated input voltage		DC24V	
Rated input current		Approx. 7mA	
Working voltage range		DC10.2V to DC26.4V (ripple rate within 5%)	
ON voltage/ON current		DC8V or more/2mA or more	
OFF voltage/ OFF current		DC4V or less/1mA or less	
Input resistance		Approx. 3.3kΩ	
Response time	OFF-ON	10ms or less (DC24V)	
	ON-OFF	10ms or less (DC24V)	
			<Source type> 
			* HCn = HC1 to HC8

■Electrical specifications of hand input/output（RV-35F/50F/70F series) (2/2)

Hand output specifications（for non-CE marking specification）

Item		Specification	Internal circuit
Type		Transistor output	
Number of output points		8	
Insulation method		Photo coupler insulation	
Rated load voltage		DC24V	
Rated load voltage range		DC21.6V to DC26.4V	
Max. load current		0.1A/1 point (100%)	
Leakage current at OFF		0.1mA or less	
Max. voltage drop at ON		DC0.9V(TYP.)	
Response time	OFF-ON	2ms or less (hardware response time)	
	ON-OFF	2ms or less (Resistance load)(hardware response time)	
Protects		Protects the over-current (0.9A)	

＊GRn = GR1 to GR8

■Connector pin assignments

CNX1

	A	B	C	D
1	X00	X01	X02	X03
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNY1

	A	B	C	D
1	Y00	Y01	Y02	Y03
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNX2

	A	B	C	D
1	X04	X05	X06	X07
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNY2

	A	B	C	D
1	Y04	Y05	Y06	Y07
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNX3

	A	B	C	D
1	X08	X09	X0A	X0B
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNY3

	A	B	C	D
1	Y08	Y09	Y0A	Y0B
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNX4

	A	B	C	D
1	X0C	X0D	X0E	X0F
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

CNY4

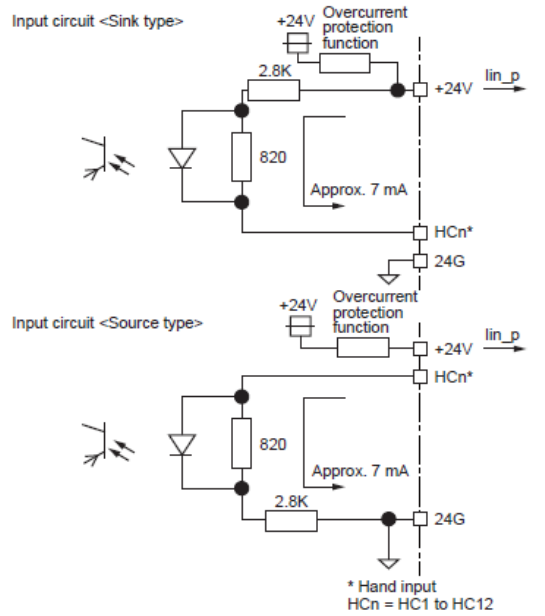
	A	B	C	D
1	Y0C	Y0D	Y0E	Y0F
2				
3	+24V	+24V	+24V	+24V
4	24G	24G	24G	24G

■ Electrical specifications of hand input/output（RV-35FR/50FR/80FR series) (1/2)

Electrical specifications of input circuit

Item		Specifications
Type		DC input
Number of input points		12
Insulation method		Photo-coupler insulation
Rated voltage		24V DC ±10%
Rated current		Approx. 7mA
ON voltage/ON current		19V DC or higher/4mA
OFF voltage/OFF current		4V DC or lower/1mA
Input resistance		Approx. 2.8kΩ
Response time	OFF-ON	10ms or less (24V DC)
	ON-OFF	10ms or less (24V DC)
Protects		Protects the overcurrent (0.8A)

Internal circuit



The total current consumption of the hand I/O needs to meet the following conditions:

I = Iin + Iout < 0.8 [A]

I: Total current consumption of hand I/O

Iin: Total current consumption of hand input

Iout: Total current consumption of hand output

Iin = Iin_p + 7 [mA] × number of hand inputs to be used

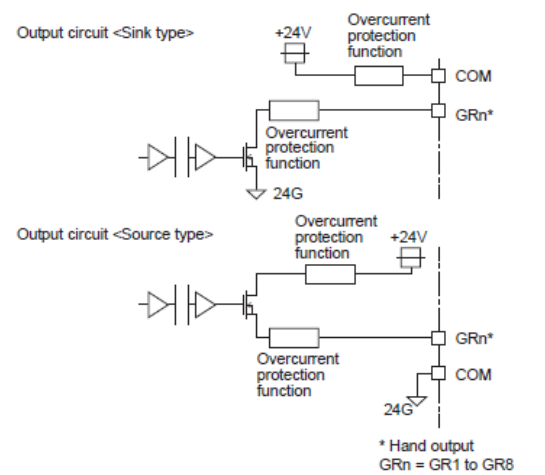
Iin_p: Total current consumption of the device connected to the hand input

If the conditions are not met, the protection function shuts off the output. When the conditions are met, automatic restoration will be performed.

Electrical specifications of output circuit

Item		Specifications
Type		Transistor output
Number of input points		8
Insulation method		Digital isolator
Rated voltage		24V DC ±10%
Rated current		0.1A/1 point (100%)
Current leak with power OFF		0.1mA or lower
Maximum voltage drop with power ON		0.7V (typ.)
Response time	OFF-ON	2ms or less (hardware response time)
	ON-OFF	2ms or less (resistance load) (hardware response time)
Protects		Protects the overcurrent (0.8A)

Internal circuit



The total current consumption of the hand I/O needs to meet the following conditions:

I = Iin + Iout < 0.8 [A]

I: Total current consumption of hand I/O

Iin: Total current consumption of hand input

Iout: Total current consumption of hand output

If the conditions are not met, the protection function shuts off the output. When the conditions are met, automatic restoration will be performed.

■Electrical specifications of hand input/output（RV-35FR/50FR/80FR series)（2/2）

■Pin assignment of hand input cable

Connect the hand input cable to HC.

Cable color	Pin No.	Name	Remarks
Blue	A	+24 V	Twisted pair
White	B	24G	
Yellow	C	HC1	Twisted pair
White	D	HC2	
Red	E	HC3	Twisted pair
White	F	HC4	
Green	G	+24 V	Twisted pair
White	H	24G	
Purple	J	HC5	Twisted pair
White	K	HC6	
Blue	L	HC7	Twisted pair
Brown	M	HC8	
Yellow	N	+24 V	Twisted pair
Brown	U	24G	
Red	T	HC9	Twisted pair
Brown	S	HC10	
Green	R	HC11	Twisted pair
Brown	P	HC12	

■Pin assignment of hand output cable

Connect the hand output cable to GR.

Cable color	Pin No.	Name		Remarks
		Sink type	Source type	
Blue	A	COM(+24V)	COM(24G)	Twisted pair
White	B	GR1	GR1	
Yellow	C	COM(+24V)	COM(24G)	Twisted pair
White	D	GR2	GR2	
Green	E	COM(+24V)	COM(24G)	Twisted pair
White	F	GR3	GR3	
Red	G	COM(+24V)	COM(24G)	Twisted pair
White	H	GR4	GR4	
Purple	J	COM(+24V)	COM(24G)	Twisted pair
White	K	GR5	GR5	
Blue	L	COM(+24V)	COM(24G)	Twisted pair
Brown	M	GR6	GR6	
Yellow	N	COM(+24V)	COM(24G)	Twisted pair
Brown	U	GR7	GR7	
Green	T	COM(+24V)	COM(24G)	Twisted pair
Brown	S	GR8	GR8	

■ Tracking-related connector pin assignments and specification changes

Signal	Feature	CR760		CR860		
		connector	pin	connector	pin	
ENC5V	5V for encoder signal	-	-	CNUSR12	7	Note1
RG	GND for encoder signal	-	-		16	
LAH1	Differential encoder phase-A signal + side CH1	CNENC	2A		9	
LAL1	Differential encoder phase-A signal - side CH1		2B		18	
LBH1	Differential encoder phase-B signal + side CH1		3A		8	
LBL1	Differential encoder phase-B signal - side CH1		3B		17	
LZH1	Differential encoder phase-Z signal + side CH1		4A	-	-	Note2
LZL1	Differential encoder phase-Z signal - side CH1		4B	-	-	
LAH2	Differential encoder phase-A signal + side CH2		6A	CNUSR12	6	
LAL2	Differential encoder phase-A signal - side CH2		6B		15	
LBH2	Differential encoder phase-B signal + side CH2		7A		5	
LBL2	Differential encoder phase-B signal - side CH2		7B		14	
LZH2	Differential encoder phase-Z signal + side CH2		8A	-	-	Note2
LZL2	Differential encoder phase-Z signal - side CH2		8B	-	-	
SG	Control power supply 0V		1A,5A, 1B,5B	-	-	Note3

Note 1: When using the tracking function, prepare a DC5V power supply for encoder signals.
For details, please refer to the Tracking Function Instruction Manual.
Note 2: Encoder Z phase is not used.
Note 3: Since it is designed to supply an external power supply, there is no pin to connect to the control power supply 0V inside the controller

■ Other changes in controller specifications

	F **series**	**FR series**
Robot Language	MELFA-BASIC**Ⅳ** MELFA-BASIC**Ⅴ**	MELFA-BASICIV cannot be used directly. （It is possible to convert to V and VI by RT3 program conversion.） MELFA-BASIC**Ⅴ** MELFA-BASIC**Ⅵ**（Upward compatibility with MELFA-BASIC V） ※If you do not use Function and Include in VI, you can write exactly the same as in V.
Mechanical Serial Number	Input required (T/B or RT ToolBox2)	No input required (already recorded in the ROM inside the robot)
Origin setting	Input required (T/B or RT ToolBox2)	No input required (already recorded in the ROM inside the robot)
Hand Type	・Sink（default） ・Source is a configuration change that is necessity	・Not set (default) ・Sink/source settings are required (parameter setting) （An error occurs when operating by hand in an unset state.）