SEFTEC

冲床使用説明書

USE MANUAL

TYPE: BEST 系列高速精密冲床

BEST SERIES

HIGH SPEED PRECISION PRESS

PRODUCER: 浙江帅锋精密机械制造有限公司

SEFTEC Precision Manufacturing Co.,Ltd

The Press of BEST Series

Dear Valued Customer：

Sincerely thanks for using Shuai Feng Press.

Shuai Feng Precision Machinery Manufacturing Co.,Ltd. specializes in producing all kinds of press。This machine is fully according to ISO90001-2008 international quality certification.

Over the years, according to customer feedback and our experience in the service, we know that proper use and regular maintenance is the important factor to keep the press having the best performance and maintain its original accuracy and vitality. So we hope this manual will help you take full advantage of the capabilities of our machine.

If you have any questions, please call the service line: **00860573-86572992**

Thank you for purchasing Shuai Feng Precision press

In order to properly use the press, Please read this manual carefully in advance.

Be sure to keep this manual beside the press for operators and maintenance staffs.

The manual corresponds to the technical execution of the machine at the time of print.

We reserve the right to make changes.

Seftec Seiki　Manufacturing Co.,Ltd

Safety Precautions

Before the installation, operation, maintenance and inspection, please make sure you have read this manual. Only after fully understanding the principles of the security situation of the machine and all precautions, you can work on this machine then.

Description of the symbol:



Warning!

Wrong operation may cause an electric shock.



Notice!

Do not put hands or other objects into the danger zone, to avoid any possible accident.



Warning!

The machine must be grounded before operating. Grounding must be done in accordance with national standards or equivalent international standards. Otherwise, shock can happen.



Warning!

Don’t put your hands or any part of the body into the danger zone.

Before a detailed study and fully understanding of the operation manual, don’t operate, repair, adjust the press or install the mold.

If the flywheel and the motor is running, please don’t maintain and install the mold.

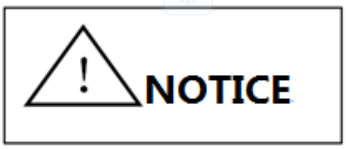
In order to indicate the degree of risk, this manual uses the following symbols：



Indicate an obvious danger, if the danger can not be avoided, it will result in deaths or serious injuries.



Indicate a potential danger, if the danger can not be avoided, it may result in deaths or serious injuries.



Indicate a potential danger, the danger may result in minor injuries or goods damages.

Contents：

	Subject	Content
A	Specification	After understanding this paper ,you can use the press normally according to its capacity.
B	Installation	Initially set and installation methods.
C	Operation	Must be known, in order to properly use the press.
D	Maintenance	To maintain the performance and accuracy. To make trouble shooting of the circuit, gas and oil systems of this press.
E	Information	Operation documents of other devices.

Personnel must read:

	Subject	Supervisor	Maintenance director	Operation director	Operator
A	Specification	◎	◎	◎	◎
B	Installation	◎	◎	○	○
C	Operation	◎	◎	◎	◎
D	Maintenance	◎	◎	◎	○
E	Information	○	◎	○	○

◎and○express that it need to be read and understood,◎express that it need to be read carefully.

Conversion Table

○ Pressure capability conversion table（nominal pressure）

Engineering unit（ton・f）	SI unit（kN）	Engineering unit（ton・f）	SI unit（kN）
5	50	60	600
10	100	70	700
15	150	80	800
20	200	90	900
25	250	100	1000
30	300	110	1100
35	350	120	1200
40	400	125	1250
50	500		

Conversion formula: 1（kN）= 0.1(ton f)

○ Pressure Conversion Table（Air pressure Oil pressure）

Engineering unit（kgf/cm^2）	SI unit（MPa）	Engineering unit（kgf/cm^2）	SI unit（MPa）
0.5	0.05	23	2.25
1	0.10	24	2.35
1.5	0.15	25	2.45
2	0.20	26	2.55
2.5	0.25	27	2.65
3	0.29	28	2.74
3.5	0.34	29	2.84
4	0.39	30	2.94
4.5	0.44	40	3.92
5	0.49	50	4.90
5.5	0.54	60	5.88
6	0.59	70	6.86
7	0.69	80	7.84
8	0.78	90	8.82
9	0.88	100	9.80
10	0.98	110	10.78
11	1.08	120	11.76
12	1.18	130	12.74
13	1.27	140	13.72
14	1.37	150	14.70
15	1.47	160	15.68
16	1.57	170	16.66
17	1.67	180	17.64
18	1.76	190	18.62
19	1.86	200	19.60
20	1.96	210	20.58
21	2.06	220	21.56
22	2.16		

Conversion formula: 1（kgf/cm^2）=0.098（MPa）

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A Specifications

1、Press ability

Press ability is divided in three categories: pressure capacity、torque capacity and operational capability. The Press cannot used beyond any one.

1.1pressure capacity（Be generally called nominal pressure）

 NOTICE	Considering the different die wear and material hardness increases operational pressure, So please limit maximum working pressure within 70% of the pressure capacity.

Under the condition of no mechanical damage, Press is a machine which is used to produce the maximum pressure (unit:KN)for the machining. Press can generate infinite pressure in theory near lower dead point, So the actual pressure which produced by the Press is relative to the load. But if the actual pressure is beyond the limits of pressure capacity, it will damage the Press and happen serious accidents.

Working loads include stress and resistance ,the stress is generated by the forming workpiece's shape、dimension and material, the resistance is generated by the movable template、baffle and so on. The total load must not exceed the pressure capacity

1.2Torque capacity

 NOTICE	Workload's pressure must be within the scope of the pressure curves, exceed the permitted scope will damage the machine.

Please refer to pressure stroke curve. Torque capacity is the distance from the Pressing position to the lower dead point. The pressure stroke curve, shows that, above the stroke position which can produce pressure, the pressure will be reduced. So above the position of the torque capacity. It must not beyond the scope of the curve, although the total load is the scale of the pressure capacity. Over the scope of curve, clutch will slip and heating, or other abnormal wear will happen. In bending or stretching process, the load is extremely high at the lower dead point, please pay special attention.

1.3 Operational ability

 NOTICE	The workload of each stroke should be within the scope of the energy curve 。 Overload will cause motor overheating or stuck the mode.

Working capacity is the maximum available energy in the process of a stroke(unit:N·m)。 Stamping is worked through the energy that it is released by the each rotation of the flywheel .Flywheel release the energy, and it supplement energy from the motor at the same time. Energy release and supplements must be balanced. As can be seen from the graph of energy, when

the speed below the range, the released energy will be reduced. If used outside the range, it will cause motor overheating or stuck the mode or other fault.

1.4 Calculation of the Pressing shear

The formula for calculating the Pressing shear of the plane is showed:

$$P=l \cdot t \cdot k$$

P=Pressing shear N

l=Perimeter of Pressing contour mm

t=Thickness of material mm

k=strength of resisting shear N/mm^2

Here, P should not exceed the pressure capability, But this is just the ideal state after the development of the mold, When the mold wear or some clastic in it, the actual Pressing shear will increase20～30%.If the Pressing shear is equal to the pressure capacity, overload or damage will happen to the mold and during stamping procedure.

1.5 Eccentric load

Please make the center of load coincide with the center of the slider as far as possible. In the processing of progressive die, the processing position of each station in the vertical direction is different, the eccentric load must be considered. If we consider form the center of slider, the left and right part of the load should not exceed about half the pressure capacity.

2. Specification and exterior size

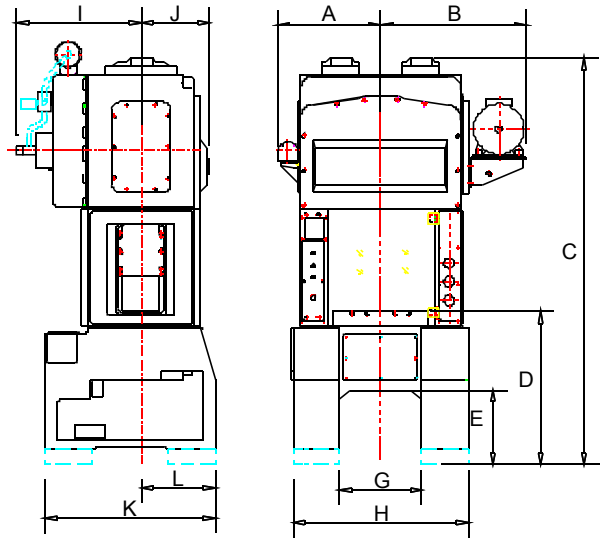
2.1. specification

Type	Best-30		Best-40		Best-50		Best-60		Best-70	
pressure capacity	300		400		500		600		700	
Stroke	25	30	25	30	25	30	25	30	25	30
Number of stroke	200-1050		180-850		180-800		100-700		100-650	
Die height	240		240		240		300		300	
Adjustment of slider	50		50		50		80		80	
Size of slider	600X300		750X340		950X500		1030X500		1280X500	
Table size	600X400		750X500		950X500		1100X600		1350X700	
Table thickness	90		120		120		140		140	
The cut-out dimension	500X100		650X120		850X120		1000X120		1200X140	
Material hole size	500x100		650x100		800x100		1000X900X100		1200X130	
Main motor	11X4P		15X4P		18.5X4P		22X4P		22X4P	

Type	Best-80		Best-80W		Best-100		Best-100W		Best-125	
pressure capacity	800		800		1000		1000		1250	
Stroke	25	30	25	30	25	30	25	30	25	30
Number of stroke	120-550		120-450		120-450		120-400		100-400	
Die height	320		320		340		320		350	
Adjustment of slider	80		80		80		80		80	
Size of slider	1080X580		1480X580		1450X700		1650X600		1480X600	
Table size	1200X800		1600X800		1550X950		1700X950		1600X900	
Table thickness	160		160		160		180		180	
The cut-out dimension	1050X160		1400X160		1300X160		1550X160		1300X160	
Material hole size	1050X150		1400X150		1200X150		1550X150		1260X150	
Main motor	30X4P		30X4P		30X4P		30X4P		37X4P	

Standard Device	Optional Devices	
general converter+ constant speed motor	○	Precision CAM type feeder
Combined air clutch brake	○	Stop switch of materia l end （ proximity print ）
Dynamic balancing device（Weight selection type）	○	one material guide (to work face)
Electronic cam switches	○	Lower dead point detection device
Automatic correction device of stop angle	○	Cut off the counter (6-digit of electronic)
Electronic crankshaft Angle indicator (before)	○	air ejector（with radiotube）DC
Touch screen（Simplified Chinese ）	○	hopper
speedometer	○	die lifter
total counter Electronic 8 digits	○	Move mould arm
Preset counter electronic 8 digits (stop)		
displayer of die height		
Timer 7bit		
Electric slide adjustment device		
Feeding wrong socket (with switch) 1		
A limit stop using socket 1		
220V socket（10A)		
380V socket（1.5Kw) 1		
Micro inching（Can forward/reverse）		
Circulating oil control components		
Air control components		
The air outlet （1/4）		
Material oil feeder device（With the electromagnetic valve）		
safety gate（Only the front of the upper and lower style）		
Mold lamp		
Motor reversing device		
Full stop loop		
Operation counters（With rolling wheel).noumenon operation board		
Hands button		
shock mounting		
cooling device of oil		

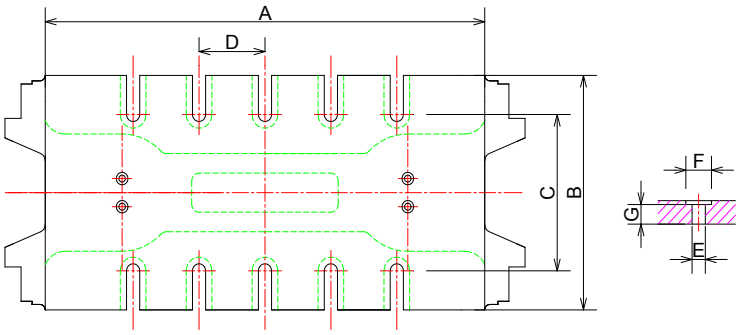
2.2 Profile Dimension



	Best30	Best40	Best50	Best60	Best70
A	700	800	900	1000	1160
B	930	1050	1130	1300	1450
C	2600	2800	2740	3000	3200
D	970	1050	910	1100	1170
E	470	480	480	500	600
G	520	560	760	900	1150
H	1150	1200	1400	1700	1900
I	780	820	820	900	900
J	430	480	480	550	550
K	1100	1700	1700	1300	1300
L	470	500	500	600	600

	Best80	Best80W	Best100	Best100W	Best125
A	1335	1535	1505	1602	1790
B	1395	1595	1545	1670	1705
C	3190	3190	3510	3410	4080
D	1200	1200	1210	1227	1510
E	450	450	450	450	515
G	960	1360	1260	1510	1320
H	1800	2440	2140	2390	2350
I	800	800	890	1010	1030
J	570	570	650	650	640
K	1370	1370	1530	1530	1510
L	620	620	700	700	690

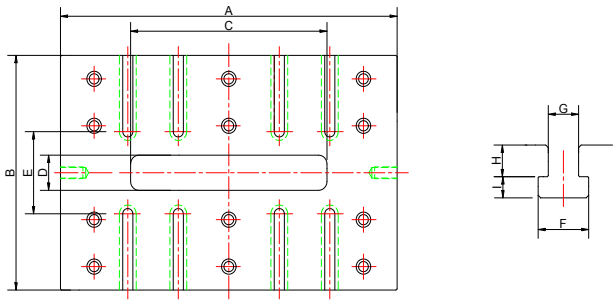
STANDARD SLIDE LOWER AREA



	Best30	Best40	Best50	Best60	Best70
A	600	750	950	1030	1280
B	300	340	500	500	500
C	200	200	200	210	180
D	90	90	90	90	150
E	18	18	18	18	18
F	35	35	35	30	30
G	25	27	27	21	21

	Best80	Best80W	Best100	Best100W	Best125
A	1080	1480	1450	1650	1480
B	580	580	700	600	600
C	210	210	210	210	210
D	150	150	160	150	150
E	18	18	18	18	18
F	30	30	30	30	30
G	21	21	21	21	21

STANDARD BOLSTER



	Best30	Best40	Best50	Best60	Best70
A	600	750	950	1100	1350
B	400	500	500	600	700
C	500	650	800	1000	1200
D	100	100	100	100	130
E	160	170	170	160	200
F	30	30	30	40	40
G	18	18	18	22	22
H	18	18	18	23	23
I	12	12	12	16	16

	Best80	Best80W	Best100	Best100W	Best125
A	1200	1600	1550	1700	1600
B	800	800	950	950	900
C	1050	1400	1400	1550	1260
D	150	150	150	150	150
E	280	280	280	280	280
F	50	50	50	50	50
G	28	28	28	28	28
H	30	30	30	30	30
I	20	20	20	20	20

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B Installation

1. The installation of the Presser

Without anti-vibration device

(1) To prepare according to the foundation drawing. The foundation is stronger, the vibration is smaller.

(2) Please check the leveling of the Presser correctly. Put the adjustable pads between the Press and the earth, until the level of the countertop is correct in all directions. Then fix with plaster.

(3) After plaster hardening, tighten the foundation bolt, check again.

With anti-vibration device

(1) requirements of resettlement surface of Presser:

   a. Smooth cement surface;

   b. Level difference less than 5 mm

(2) With anti-vibration device, special foundation may not be necessary.

(3) Fixing Press and anti-vibration device with the retaining bolt.

(4) Check level with precision leveler which in the workbench.

In all directions, the acceptable tolerance of levelness in 1 meter length is ± 0.05mm allowed

(5) The school level methods of the installation of vibration control box, of refer to "expansion packs anti-vibration device".

(6) The installation and adjustment method of the anti-vibration device is in Information. Anti-vibration Device.

2. Preparation for operation

2.1 Connect compressed air

(1) Joint on the Presser internal diameter of pipe φ19mm

Model	joint dimension	Aperture
Best-30	1/2"	21
Best-40	1/2"	21
Best-50	1/2"	21
Best-60	1/2"	21
Best-70	1/2"	21
Best-80	1/2"	21
Best-80W	1/2"	21
Best-100	1/2"	21
Best-100W	1/2"	21
Best-125	1/2"	21

（2）The required pressure (one side pressure) More than 0.59 MPa

（3）set pressure of regulator 0.44～0.55MPa

(pressure that clutch brake required)

(4) Consumption of compressed air for one cycle of the clutch

Model	consumption
Best-30	1.0 -liter x0.55 MPa
Best-40	1.0 -liter x0.55 MPa
Best-50	1.0 -liter x0.55 MPa
Best-60	1.0 -liter x0.55 MPa
Best-70	1.0 -liter x0.55 MPa
Best-80	1.0 -liter x0.55 MPa
Best-80W	1.0 -liter x0.55 MPa
Best-100	1.0 -liter x0.55 MPa
Best-100W	1.0 -liter x0.55 MPa
Best-125	1.0 -liter x0.55 MPa

（5）The output of air compressor > 500l/min

Note: the required volume for spray wind and inching has been taken into account.

Note: before use, need to check whether there are impurities in the air pipe, whether water or gas is clean.

General use 1/2 b diameter pipe, but if the pipe length is more than 5 m, please use 3/4 b tubes.

2.2 lubricating oil

	If filling lubricating oil to up limit when the Presser is working lubricating oil may overflow when it is ston. When lubricating oil is below the lower limit in the oil gauge, crankshafts and other parts may be burn.

If oil cooler or oil heater is used, the pipe connecting the Presser and cooler of heater must be well connected before fill the oil. Input, output, joint "IN" and "OUT" connected to the Numbers 1, 2, respectively.

(1) Open oil cover of lathe bed left back, adding specify brand, clean lubricating oil.

(2) Oil grades refer to maintain article "categories" section.

(3) Oil mass refer to the table below, adding higher than the middle of the gauge is slightly the appropriate.

Model	capacity of tank (L)
Best-30	60
Best-40	60
Best-50	60
Best-60	90
Best-70	110
Best-80	120
Best-80W	150
Best-100	155
Best-100W	175
Best-125	170

Note: the configuration of a thermostat, about 20 l oil amount should be increased.

(4) Oil drain, open oil drain valve of the bed behind.

(5) The types of oil:

The types of oil	ISO68
Great wall	L-HM68
MOBIL	DTE26
COSMO	COSMO Ulpas 68
SHELL	Shell tellus Oil 68
ESSO	Telesso 68

2.3 power connection

Electrical connection must be conducted by a certificated engineer.

	In order to prevent electric shock, the ground terminal of control box must be grounded. supply voltage AC300V below: the resistance under 100 Ω AC301 ~ 600 V: the resistance under 10 Ω

(1) main power

Each Presser need to set the switch box of protection device separately.

Model	The main motor capacity（kW）	The wire cross section（mm^2）		The switch capacity of retainer（A）
		power line	ground wire	
Best-30	11	10	10	75
Best-40	15	10	10	75
Best-50	18.5	10	10	75
Best-60	22	16	16	100
Best-70	22	16	16	100
Best-80	30	16	16	100
Best-80W	30	16	16	100
Best-100	30	16	16	100
Best-100W	30	16	16	100
Best-125	37	16	16	100

* Power supply voltage of 200 v 50/60 hz or 60 hz, 220 v () for 380 v to 440 v.

* Numerical data of this form is the standard specifications. Special specifications of the occasion, there may be changes.

(2) The order of power supply connection

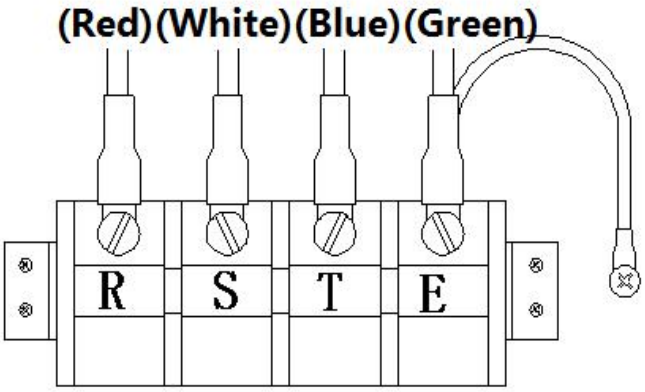
a. Cut off the total power supply

b. Puts the "power switch" operation of the operation box.

c. Open the front door of operation box, the switch should be placed in the "OFF".

d. R.S.T line connect terminal station.

e. Ground wire must be involved in ground terminal (E).



3. Confirmation before test run

All Presser have inspection according to the commissioning and testing standard before they leave the factory. Before users plant commissioning, please check for the following items.

inspection item	Confirm the content	Confirm the content
appearance	1. No foreign bodies in the Press face 2. The appearance of the Press, operation box inside and outside without exception 3. please use antirusting agent	visual Visual visual
oil	1. Lubricating oil quantity 2. The amount of oil the slider locking hydraulic equipment 3. Join the turbine oil into fueler 4. Lubricating oil should be added into feeder	oil level gauge Visual visual visual
Connect compressed air	1. No leakage 2. The clutch pressure in the required range 3. Status of barometric anti-vibration pad is normal, Press without tilt	Open the inlet valve, the pressure to rise to the required pressure. Within 10 minutes and then close the valve, if pressure maintenance in 0.29 MPa above, it is normal. visual Visual, anti vibration level meter
power connection	1. The power line in operating box, ground wire is normal 2. Terminal fastening bolt tightening 3. Open the total power supply, after open the power switch of the operation box, the power indicator 4. press the motor start button, flywheel rotate in accordance with the direction	Visual screwdriver visual Power terminal station

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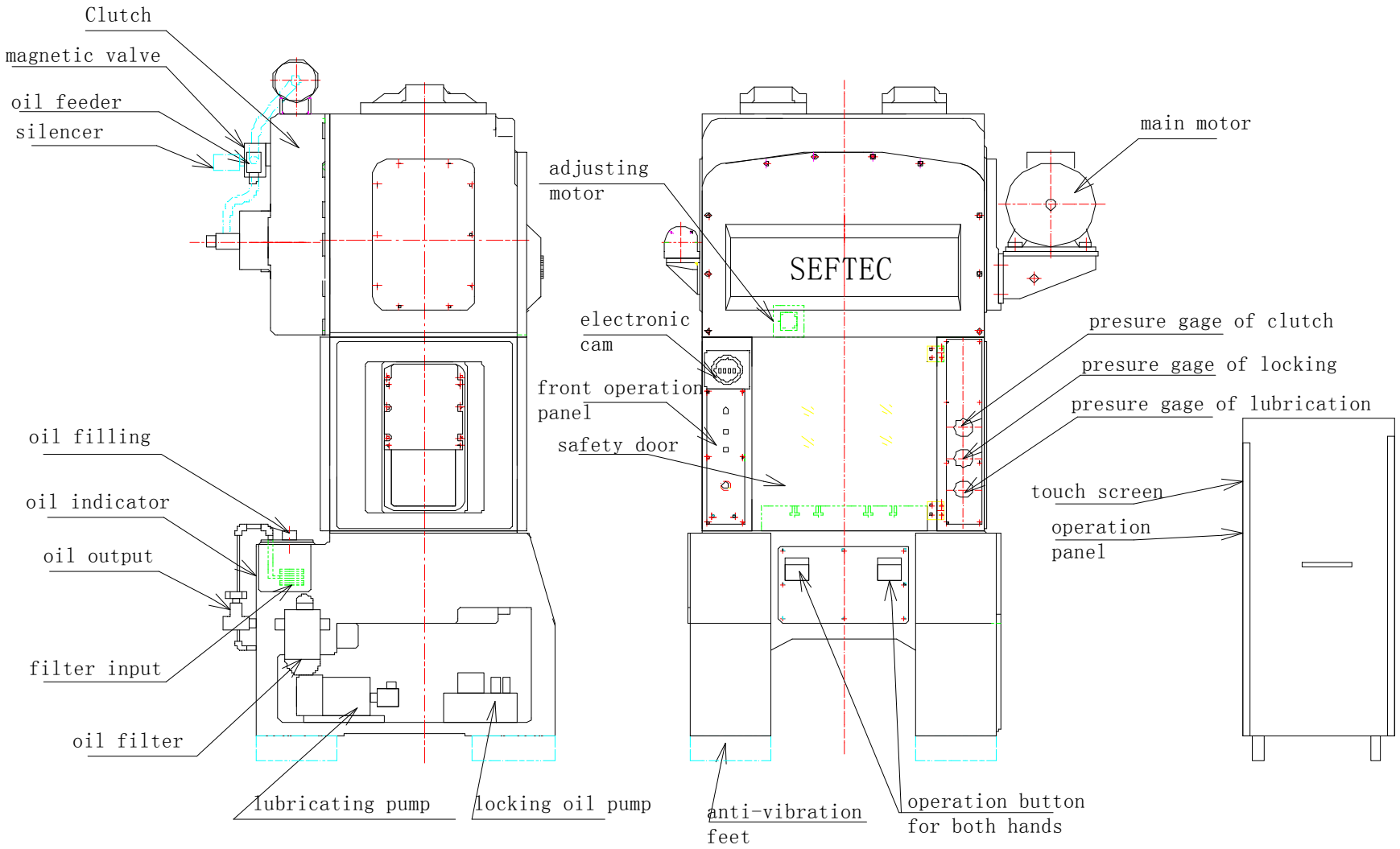
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1. Daily check the project and device

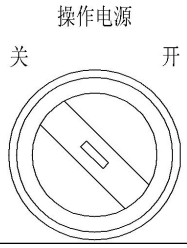
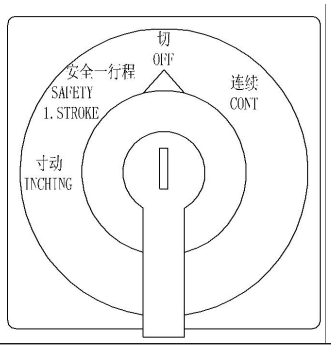
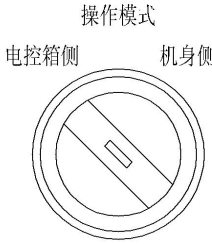


2. the types of the operating Operation

	The key to the switch kept by the operations manager or keeper in a fixed place.

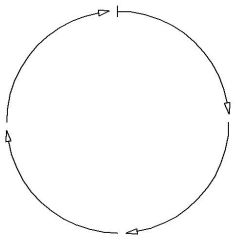
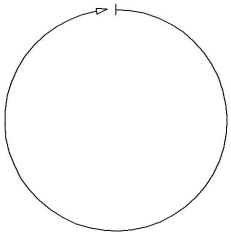
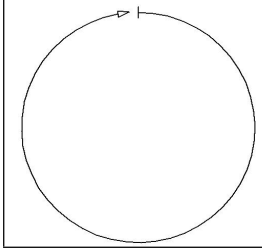
2-1、The use of the key switch

The usage of the key on the electrical box and operation panel:

key switch	function	operation	Key pull plug position
Electric control box control the power switch 	Power on or off Press power supply	Key right, open the power supply; Key left-hand, turn off the power supply.	Can pull out the key in "off" position
Operation selector switch 	Choose the way to work	Key rotating to the right, can rotate switch choice operating method. The key to rotate to the left, rotary switch self-locking.	The key can pull out after rotation to the left
the fuselage panel of the left side 	Choose operation in electric cabinet side or body side	Key to turn right, operation at the side of the fuselage; Key turn left, operation on the electric cabinet.	Can pull out plug in two places

2-2、the method of operation of the switch

switching operation	Press action
turn off	Even if press "running" button and the inching button, slider did not move.
inch	Press the "run" and "inching" button when the slider movement, the slider stop moving after let go of the button.

	
one stroke 	Press the "run" button, the slider movement a reciprocating stroke, stop at top dead center position. To make the slider movement a trip, need to let go of the button before then.
continuous 	After pressing the "continuous operation ready" button within two seconds press the "run" button, slider continuous motion. Release the "run" button slider does not stop. Press the "stop" button when continuous operation, the slider will stop at top dead center position.

：Note:

Because the inching mode can be started by both hands simultaneously, two buttons must be pressed with in 0.5 seconds.

3、Prepare for work

3.1 Before turning on the power supply (prepare operation)

	Check the project before start work, as follows: 1) The performance of the clutch and brake 2) If there is a bolt looseness 3) Performance of a trip to a stop, stop, emergency stop device 4) Performance of prevent the slider or blade dangerous organization 5) State of mould and the workbench

Every day before starting, must be inspected according to the following items. In order to make the Press can safe and normal operation, should carry on the daily inspection and maintenance. The user has an obligation to mechanical routine check and maintenance, record accordingly.

inspection item	Confirm the content	treatment
1) Sorting, reorganization, cleaning	Keep the Press and the surrounding clean examination content： Workbench, slider, mould box operation, safety devices, the ground and Press	Sorting, reorganization, cleaning
2) air pressure Check the clutch pressure	Air pressure should be more than 0.59MPa Open the drain valve, pressure meter back to 0 mpa. Open the air valve and pressure gauge shall be within the specified range. 0.44～0.55MPa	Check the inlet air. If pressure gauge can not come back to zero, it's pressure gauge failure, it's time to replace. When pressure is beyond, voltage regulator can be used.
3) air leakage	The pipeline can not leak	Repair or replacement parts
4) The amount of lubricant Check the oil gauge in oil tank	Pressing machine downtime, the oil level should be within the scope specified in the oil gauge.	Insufficient, gas to the scale of the central.

3.2 Power-on

Open the power switch which in the electric cabinet, open "operating power supply" switch which on the electric cabinet. And then, puts operation select switch to "inching".

	For safety, confirm the main motor in the stop state.	
inspection item	Confirm the content	treatment
1) power supply	The power indicator lights on operation box	If not light, check whether the power input is normal.
2) The slider locking pressure	The "closed mold height adjustment" switch to "Manual", pressure gauge indicates zero.	If not null, pressure gauge has fault, need to change.

Check the oil pressure gauge indicating pressure oil mass	When the " die mold height adjustment" switch to "off", the gauge should be in the range specified below. 。Whether is the volume of oil tank pressure device in the range of allowable oil gauge.	When the pressure is beyond, voltage regulator can be used to adjust. If there is insufficient, come on to the ceiling.
3) oil pressure （Before the motor starting） Check the indicating pressure of oil pressure gauge	Before the main motor starting, pressure gauge refers to the 0 Mpa.	If not refers to the zero point, pressure meter is faulty, please change.

3.3 After the motor start

Press the “motor start” button on the operation panel, the main motor and the flywheel rotating, lubricating oil pump start.

inspection item	Confirm the content	treatment
1) Press the motor start button	Press the button, the main motor according to the indicating arrow direction, operation Angle controller, touch screen will display the main motor speed	Switch the power phase sequence
2) oil pressure （After the motor starting） Check pressure gauge instructions	Press the motor start button, pressure gauge shall be within the specified range. Best30/40/50/60(1.2～2.5MPa) Best70/80/80w/100w/125(1.2～2.0MPa)	Short of setting pressure, clean the filter. Also can adjust pump overflow valve.
3) V belt and the motor	V belt without sliding sound, abnormal vibration. The flywheel should not abnormal vibration.	When v belt skid, adjust the v belt according to the maintenance of the adjustment method of V belt.

4) The clutch action	Press the operation button, and listen to sniff of solenoid valve.	If there is something abnormal about Clutch solenoid valve action, please clean or replace vent valve.
5) Emergency stop working	The switch in "continuous" operation. Press the operation button, Press continuous operation. Then press the emergency stop button, and listen to the solenoid valve and find out If there is something normal.	
6) No material to stop	under no material condition, clutch is not work	Adjusting switch
7) safety gate	When under open State, in a state of self-locking	
8) safety device (optical barrier)	Clean shiny surface and photosensitive surface. Cover the light with the hand, then safety device is action. Please refer to the instructions.	Cleaning up. When action is abnormal, please contact with the company.

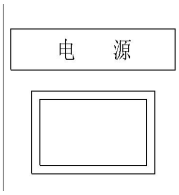
When lubricating oil heating/cooling thermostat (options) is chosen

Thermostat and Press pump moving, even if the main motor does not turn at this time, oil pressure will rise. So the thermostat should be cut off when confirm the oil pressure.

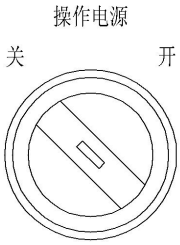
4、Running operation

4-1、The operation from the beginning.

	Please operations after the "daily inspection" and "Adjusting the job".



① All the keys on the electronic control box and the control panel is fully inserted



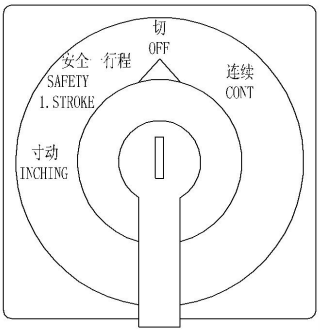
② After confirm the power indicator light is lit, puts "operating power supply" switch to "on"



③ Check whether the emergency stop button is pressed. If yes, release the emergency stop button by turning it in the “REWSET” direction.

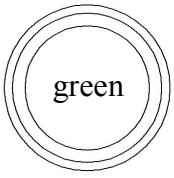


④ Press the “motor start” button on the touch screen, start the main motor, at the same time indicator light turns green.



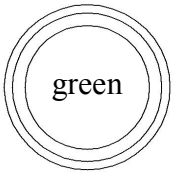
operation for Continuous

⑤According to the operation purpose choose the operation mode; When you first power on, should be in the "jog" position and confirm whether the direction of rotation of the flywheel is consistent with the direction indicated by the arrow.



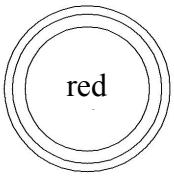
Press operation

⑥-1 When the "operation select" switch on "continuous", touch screen will display a continuous operation



Press stop

⑥ -2 Press "ready" for continuous operation button, and press " Press operation " button for 2 seconds later, the slider will begin to work. If the slider is not near the top dead center, the only inching operation. Then the "operation select" switch must be placed in the "inching", confirm the machine with and without exception in inching operation process; When slider running first near the dead point, a stroke and continuous operation can be performed.

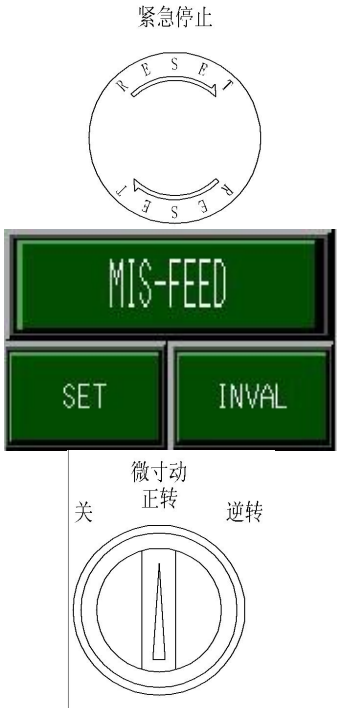


emergency stop

⑦ slider will stop in a designated spot after press the “Punch press stop“ button when continuous operation.

.

⑧ Restart after the emergency stop
Press the "emergency stop" button, the slider will



immediately stop, motor stopped too; Start again, make sure for possible danger, rotary "emergency stop" button to reset.

Start the motor, inching operation.

⑨"Wrong on/remove" switch (touch screen)

When set to "remove" do not do wrong detection, inching operation can be performed only at this time.

⑩ "Micro-inching" toggle switch

Motor rotation, transfer switch to "forward", the motor speed set down to micro inching speed; At this time, the "operation select" switch on "inching", inching operation can be performed; After the switch to switch to the "reverse", motor reversal.

Micro inching operation used for tooling adjustment when there is no material.

(micro inching operation, the motor may halt due to overload. In order to protect the motor, idling motor will automatically shut down after 5 minutes.)

safety switch (Instructions about the "emergency stop" button , please refer to the above instructions)

Once the following switch action, Pressing machine will automatically stop, touch screen will show the cause of the outage. After ruled out the cause of the problem, please press the "reset" button, then you can back up and running.

Urgent stop circuit

1、Miscarriage interface (detection circuit voltage of DC12V. Press stop when open circuit (control cabinet can be set to stop when open circuit)).

2、A limit stop interface (when open circuit Press stop).

3、The slider locking oil pressure switch.

4、Safety door switch (before and after)

5、Clutch air pressure switch

6、Wrong on/remove switch (inching operation only when remove)

7、Operated electric control box side / machine side selector switch (inching operation only when machine side)

8、Micro inching off / forward / reverse switch (when forward or reverse, inching operation only)

9、Operation selector switch

10、Mold height adjustment switch

11、frequency converter

12、Electronic cam controller

13、PLC (programmable controller)

14、Main motor forward/reverse switch

15、Material pressure OFF/ON switch (optional)

16、Upper and lower Clamp (optional)
17、die lifter (optional)
18、The dead point check device (optional)
19、Safety optical barrier (optional)
20、Tonnage detector (optional)

note： When front security door open, can only be used in the machine side for micro inching and inching;
When back security door open, not for micro inching and inching operation.

*Position (top dead point) stop circuits *

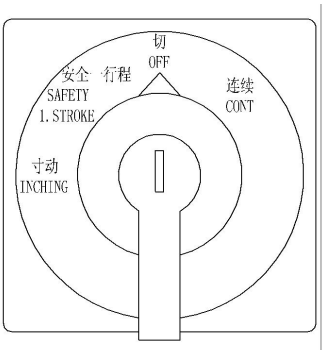
1、Material end stop switch
2、Lubricating oil pressure switch (invalid when the motor stops)
3、preset counter
4、Lubricating oil Heating oil chiller
5、Color tag detector (optional)
6、Materials for oil oil level switch (optional)

*Other safety devices *

1、breaker
2、Each motor thermal overload relay
3、Operating circuit protector

4-2、Operation before stop the operation

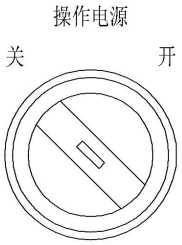
warning	After the shutdown operation, in order to ensure safety, please operate in the following order.



① At the end of the Pressing operation, the "operation choice" switch on "slice".



② Continuous press "motor stop" button on the touch screen more than 1 second, make the main motor stops.



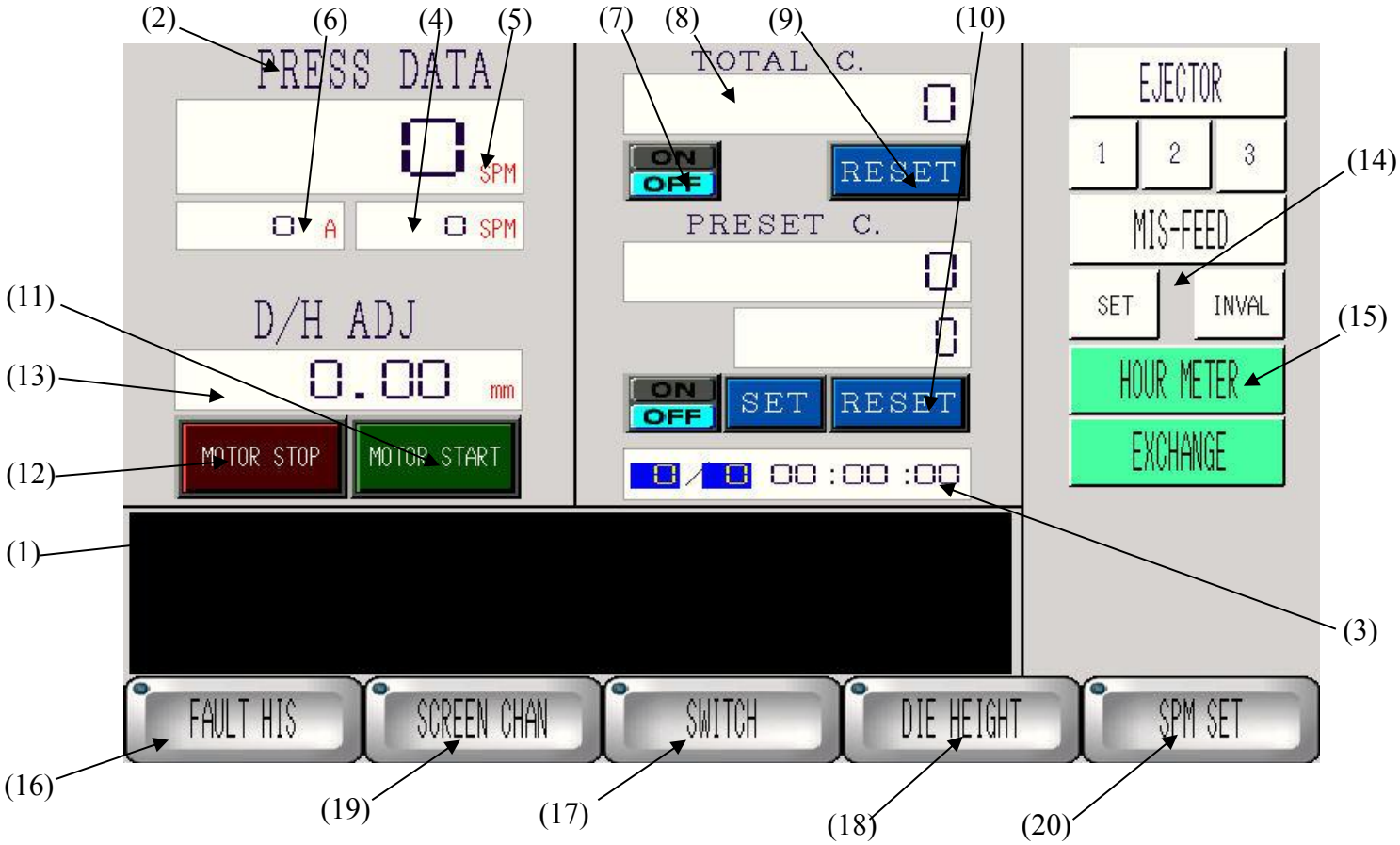
③ Operating a "power" switch on "off";

④ Pull out all the keys, kept by the operations manager or keeper place in fixed place.

warning	Touch screen, please be sure to use finger to operate. If use sharp objects or tools to operate, easy to damage.

4-3、The operation of the touch screen

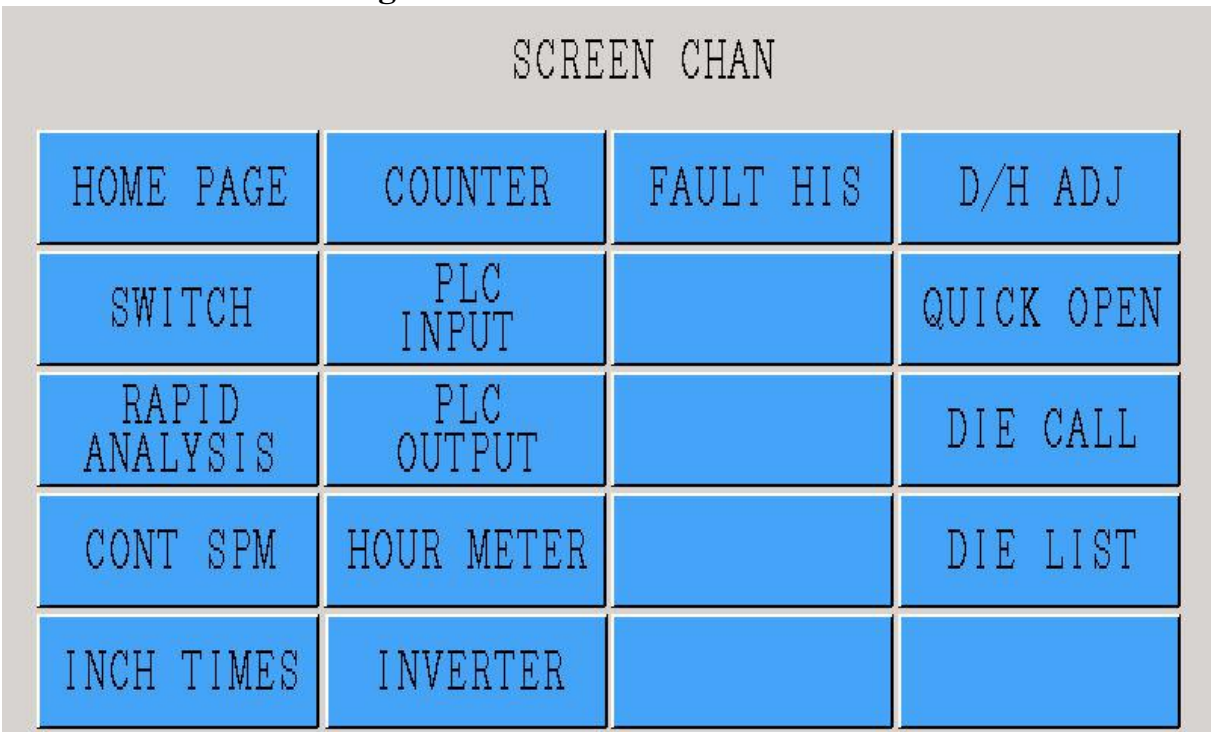
4-3-1、the picture of running



(1) Message Window : Show the current state of the Press.
According to display different content, the background color has the following changes:
Red - exception; Yellow - warning; Green - can be normal operation

(2) Name of the current picture : The screen displays the name of the currently used picture
(3) time display : Display the current date and time.
(4) Speed display Ministry : Displays the current actual operating speed.
Touching speed display unit is switched to "Continuous speed setting" screen;
(5) Set speed display : Display the setting speed of continuous operation.
The error from the set vaule is within 5
(6) Output current display : display inverter output current.
(7) Counter switch : Counter "ON/OFF" switch.
(8) counter displays : Show the current count value.
(9) Counter reset button : To reset the counter, clear the counter current value.
(10) The preset counter setting : Click on the window, can enter the preset counter value.
(11) The motor start button : Start the main motor. light turns green when Start.
(12) The motor stop button : Stop the main motor.
(13) display Shut height : Show the current mode high.
Touch height display department, switch to the "die height adjustment".
(14) on-off state : Show the switch set effective and lit ON.
(15) Working time button : Switch to the "working hours".
(16) Abnormal record button : Switch to the "abnormal record".
(17) Switch control button : Switch to the "switch Settings" screen.
(18) Die height adjustment button : Switch to the "die height adjustment".
(19) The picture switching button : Switch to the "screen switch" screen
(20) speed setting

4-3-2、Picture switching screen



Press each button, switch to the corresponding picture.
home page : display the speed of Pressing machine, counter, mold closing

height, information, etc.

switch : Switch to the picture of switch Settings. Only can be set to name the light switch.
"Motor idling stop" switch is used to set the motor idling time more than the set value would stop. By "+ 10 min" button in the 0 ~ 60 minutes to 10 minutes for the unit changes the set time.

counter : display the pressing time, exceptions, and the total running time of the Press. To the timer is reset, continue to press the "reset" key 1 seconds or more.

Continuous speed : Continuous speed setting.

Frequency changer : Show the inverter output frequency, output current, output voltage and input and output signals.

PLC import : Display the PLC input point.

PLC output : Display the output of the PLC state.

Calendar : Date/time can be set. When show time do not agree with the actual time, can be revised.
Press "set" button more than one second after the numerical input right.

rapid analysis : Shows the device status.

exception record : Displays information about the exception happened in the past.

Die height adjustment : The adjustable die shut height.

Quick Die Change : Can make the height quickly reach maximum.

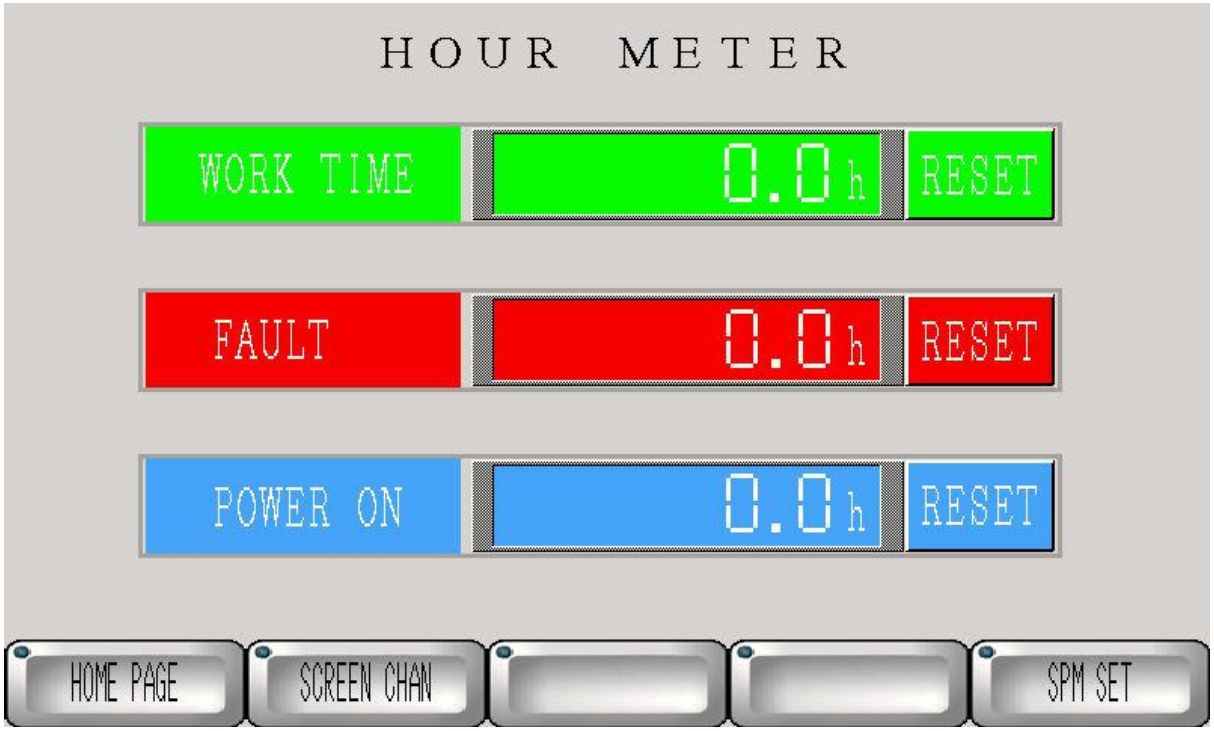
Mold call : Mold can log on and call.

mould List : Can confirm and choose the logged-in mould data.

	Touch screen, please be sure to use finger to operate. If use sharp objects or tools to operate, easy to damage.

4-3-3、Exception information display

The picture shows Press the working state of the connection parts. When it is abnormal, the red light light.



"Home page" button: Return to the home page.
"Speed setting" button: Switch to the speed setting.
"The screen switch" button: Return to the screen to switch the screen.

4-3-4、Abnormal record images





Button: press this button to operate on the line, the next line, previous, next page button



Button: press this button to end the the operation of a line, the next line, previous, next page button



Button: press this button to switch to the on line



Button: press this button to switch to the next line



Button: press this button to switch to the previous page



Button: press this button to switch to the next

Button: press this button to add reset button more than 3 seconds can delete all the police

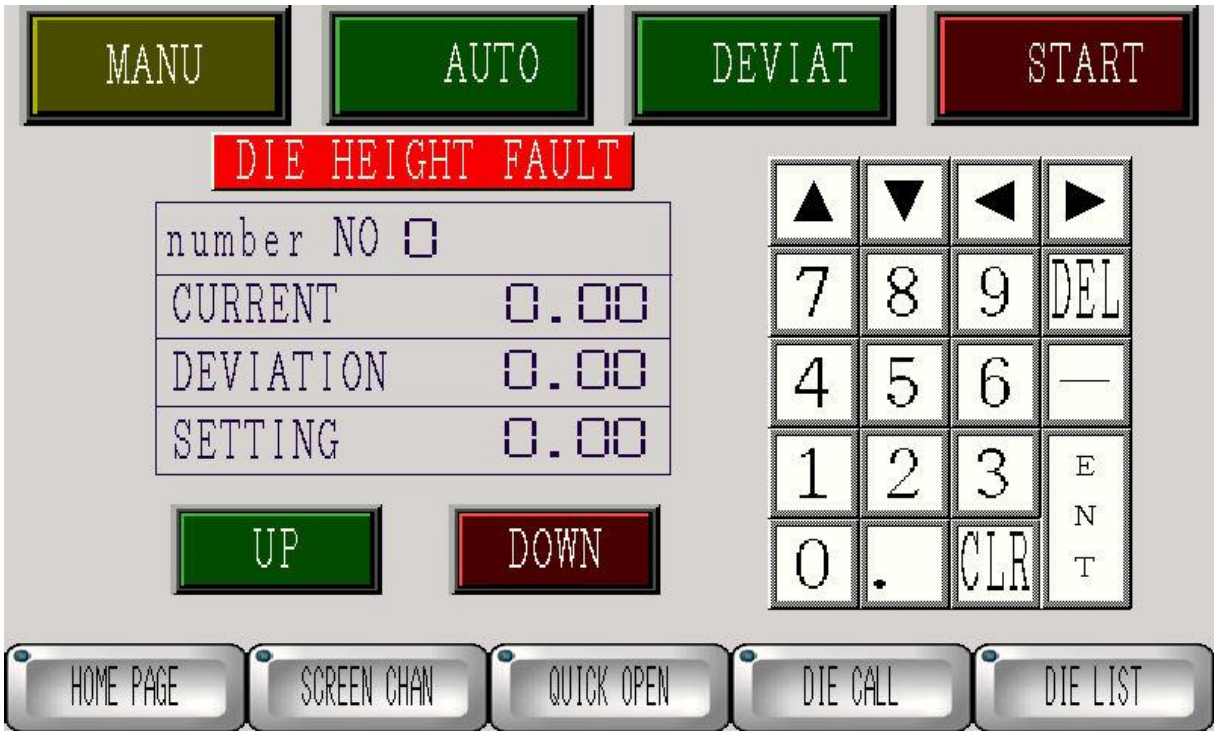
5、Adjust the job

5-1、The height adjustment for the mold closing

5-1-1、The height adjustment for the mold closing

The height adjustment for the mold closing can be done with manual, automatic and automatic deviation three ways. Manual mode, press "up" or "down" button to adjust; Automatic way, location adjustment by the input absolute value, or by the login to locate the serial number of parameters; Automatic deviation method, by input relative to the value of mobile positioning. Three ways using one-way positioning adjustment, so a rise in regulating occasions, the slider will rise to more than the target, then adjust in the direction of falling. In die height adjustment process, can't switch to the other picture.

When die height adjustment is completed, press the "operation picture" button to return to the run screen, at the same time slider locking device will be locked.



（1） Adjust the die height automatically

①Automatic mode, the "auto" button to light. In manual or automatic deviation mode, press "auto" button to enter the automatic mode.

②Input module and high target, after confirmed the high modulus value shown in "set point" accurate, press the "start" button, the mold closing height will adjust automatically according to the set value. In the position control process, "Start" lights up.

Outside the scope of value beyond specification, When the setting value is outside the specification range, you will be prompted that regulation can not be.

（2） Automatic deviation adjustment of closed mold height.

①Automatic deviation mode, "automatic" and "deviation" button to light up at the same time. In automatic mode, press the "deviation" button to enter the automatic deviation method.

②Relative movement of the set value input, after confirmed the high modulus value shown in "set point", press the "start" button, the mold closing height will adjust automatically according to the set value. In position adjustment process, the "start" lights up.

When the setting value is outside the specification range, you will be prompted that regulation can not be.

（3） Manual adjustment of mold closing high degree

① Manual modes, "manual" lights up. Automatic or automatic deviation mode, press the "manual" button to enter it manual mode.

②Observe the "current value", press "up" or "down" button. Adjusted to rise, to rise to more than the target first, then adjusted in the direction of falling automatically.

note： Although you can adjust the die height manually, It is recommended that the final positioning adjustment as far as possible be adjusted automatically.

5-1-2、Mould login and calls of mold closing the height of the

Mold can log on and call data from 1 to 99.

When in die height adjustment or switch images picture, press the "mold call" button, namely into the die mold recipe calls and formula the login screen.



①Press the "mold formula written" button, after login into the mold, at the same time "mould formula written" light.

②Input "mould No.", "mould mark", "height", and "Press velocity".

③After press "mold recipe out" button, enter mould invocation style, "mold recipe out" light at the same time.

④By digital key input mold No. (after mould mark), login "die height" and "Press velocity" is going to be out and transferred automatically to the die height adjustment picture "value.

⑤Press the "die height adjustment" button, and then press "start" button of die height adjustment screen, the machine will be adjusted according to the selected mold closing high value.

5-1-3、Die height list

Log data through the die height mold can be selected.



①In the "scene" screen, click on the "die in" button, enter the mould in the picture, show No. 0 ~ 9 sets of data.
②Press the "+ 10" button, after 10 sets of data can be displayed.
③Press "-10" key to display the first 10 sets of data.
④For press the mold mark of need 1 seconds above, show "height" and "Press velocity" which logged-in.
⑤Continue to press the "delete" button of the need to delete the mold mark line more than 3 seconds, will delete the mold mark data. After deleting, data will not be able to recover.
⑥Continue to press the "delete all" button more than 3 seconds, will delete all the login data. After deleting data will not be able to recover.

5-1-4、exchange of model quickly

Press "Quick open" button, high modulus can be quickly moved to the maximum. Press "Quick returns" button, high modulus can be quickly returned to die height of the front of the rapid opening.



①After click "quick die change" button in a picture of a " The screen switches", enter the picture of quick die change

②Press the "rising" button, the machine will fast moving to the largest high value after memory the current mode high value.

③"Rise" button button shining in the process of rising, "rise" button will light up, after arriving in the maximum, return operation can be performed at this time.

④Press the "decline" button, the machine will return to the front of the "rising" machine mold. " down " button button shining in the process of decline. In positioning adjustment process, the positioning adjustment of "indicator light will light up. If die height adjustment after rapid opening, the "rose" lamp will go out, can't return automatically.

The picture shows the target value of "rise", "the target value of return", "die high current value" and "exception code" at the upper right.

5-1-5、Others

①When to end in the process of positioning adjustment, please press the "emergency stop" button. Later, please be sure to reset closing high.

②Die height adjustment circuit with an exception, die height adjustment will not be able to normal end. Please press the "reset" button, please adjust closing high again.

③In the process of the die height adjustment, should avoid to impose too much load on the slider (such as tapping mould, etc.), otherwise may cause the breakage of the die height adjusting mechanism.

④Do not to die height adjustment card mode, or may lead to the breakage of the die height adjusting mechanism.

⑤Pictures showed "die height anomaly information", please continue to press the "reset" button more than 3 seconds.

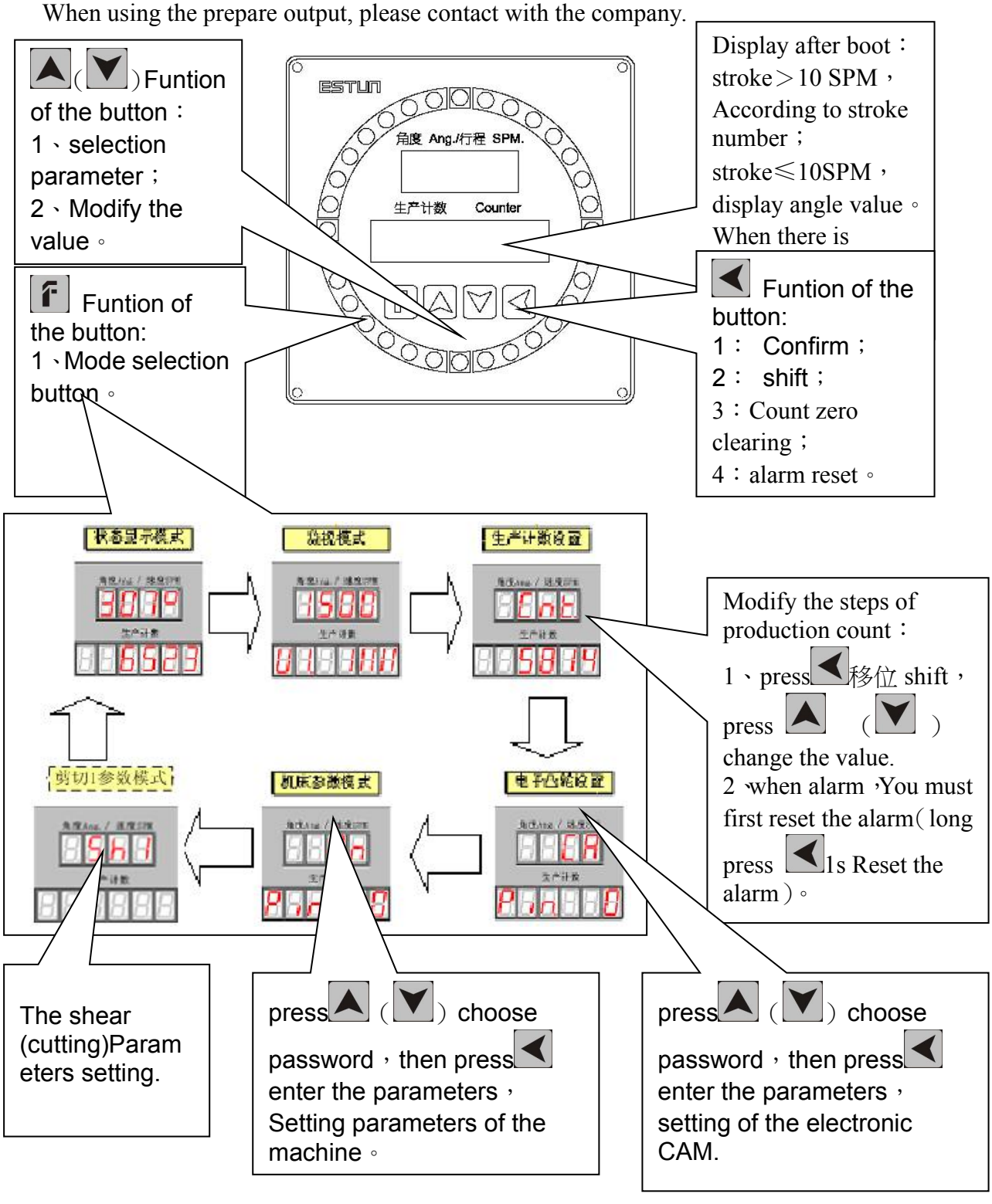
5-2、adjustment of electronic CAM angle controller

This machine use electronic CAM Angle controller.

This control is changing with stamping speed for TDC stop position automatic correction, and for the clutch friction Angle changes as a result of the long-term use of the sliding angle correction since the compensation function.

The output of the Angle of CAM controller is open collector. Can be directly as the output signal to the electronic counter, pull up resistors may need to use in some occasions.

When using the prepare output, please contact with the company.



note： Next to each kind of model for detailed instructions

5-2-1、electronic cam

Electronic CAM parameters is protected by password protection (password is 980). Unexpected change can be avoided. In the following electronic CAM parameters in the table can be confirmed to change the scope of the machine parameters.

Parameter number	The name and function	unit	setting range	The default value
CA01	An opening angle of the electronic cam 1	degree	0~359	0
	An closing angle of the electronic cam 1	degree	0~359	0
~	。。。			
	。。。			
CA10	An opening angle of the electronic cam 10	degree	0~359	0
	An closing angle of the electronic cam 10	degree	0~359	0

Note:

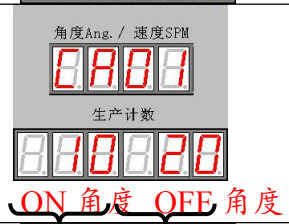
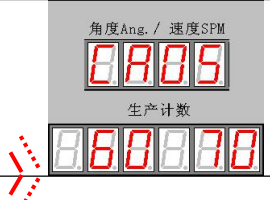
When the output port to use as a general electronic cam:

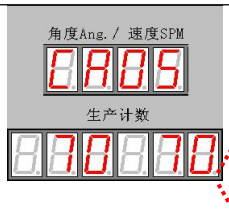
CA01 ~ CA10 opening/closing Angle is set to 0, CA01 ~ 10 has been closed.

CA01 ~ CA10 are set to open/close Angle theta (theta indicates a 0), CA01 ~ 10 has been open.

CA08 ~ CA10 output port functions have multiple definitions, CA08 ~ CA09 either as general electronic cam output port can also be used as an output cut; CA10 either as general electronic cam outputs can also be used as the count reaches output. Different definitions of the port output function by a pre-set parameters to decide.

Examples of electronic cam set: ON angle of the electronic CAM CA05 is changed from 60 degrees to 70 degrees, OFF Angle operation from 70 to 80 degrees.

step	Boundary surface	operating instructions
1		Press F to select electronic CAM setting mode, enter the password test. press increase or decrease key to input password (980).
2		Press the confirmation key, enter display mode of the electronic CAM Angle.
3		CA05。Press increase or decrease keys, select the number of electronic CAM CA05.
4		Press the confirmation key, ON Angle of electronic CAM 05 flicker (Line 2, The former three Nixie tube), enter the modify electronic CAM 05 ON Angle mode.

5		Press increase or decrease keys, change the data of 70. Press the confirmation key, electronic CAM 05 ON Angle came along three digital tube (Line 2, The former three Nixie tube) stop flashing, data is saved. At the same time, the electronic CAM 05 OFF Angle (line 2 after three digital tube), into the modified electronic CAM Angle 05 OFF mode.
6		Apress increase or decrease keys, changet the data of 80. Press the confirmation key, electronic CAM 05 OFF Angle came along three digital tube (Line 2, The former three Nixie tube) stop flashing, data is saved.

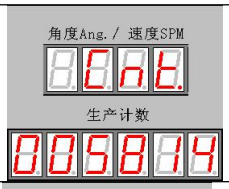
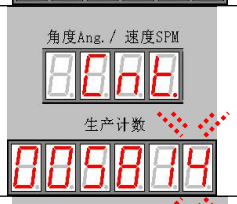
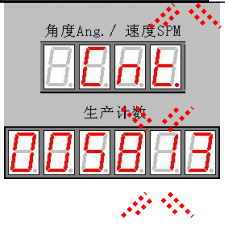
The above is the electronic CAM 05 ON Angle change from 60 to 70, OFF Angle operation process of updates from 70 to 80. To modify the parameters again, can repeat steps 3 to 9.

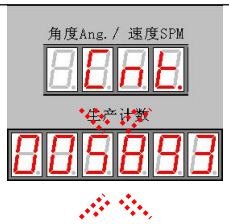
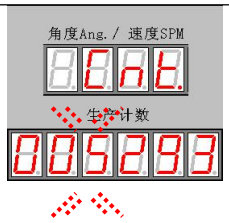
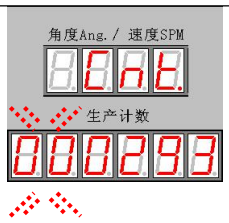
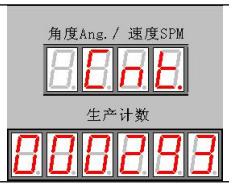
5-2-2、Production count (optional)

When setting, increasing key / minus key is used to modify the value. Short press the Enter key to curser left. Long press the Enter key to save and exit editing mode. Press the F key does not save the changes and return.

parameter number	Name and Description	unit	setting range	The default value
Cnt.	Preset number of production 0： Production doesn't count; 1： Start counting, but don't output signal of production reach ≥2： Start counting and output signal of production reach	piece	0～999,999	0

Example: The following steps are to set production count, the steps of changing preset number of production from 5814 to 293:

Step	Interface	Operating instructions
1		Press F to select production count set model, the second line digital tube is preset number of current production count.
2		Press the enter key, the first bit of preset production count number (the first digital tube from right in row 2) begin to glitter, then enter the model of modifying the first bit of production count preset number.
3		Press minus key once, to change the first bit of production count preset number to 3, and then press enter key one time, the second bit of preset production count number(the second digital tube from right in row 2) begin to glitter, then enter the model of modifying the second bit of production count preset number.

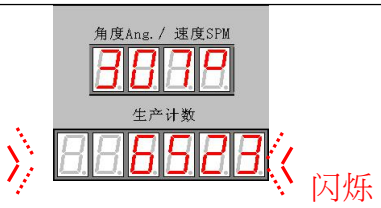
4		Press increasing key / minus key to change the second bit of production count preset number to 9, and then press enter key one time, the third bit of preset production count number(the third digital tube from right in row 2) begin to glitter, then enter the model of modifying the third bit of production count preset number.
5		Press increasing key / minus key to change the third bit of production count preset number to 2, and then press enter key one time, the 4th bit of preset production count number(the 4th digital tube from right in row 2) begin to glitter, then enter the model of modifying the 4th bit of production count preset number.
6		Press increasing key / minus key to change the 4th bit of production count preset number to 0, and then press enter key one time, the 5th bit of preset production count number(the 5th digital tube from right in row 2) begin to glitter, then enter the model of modifying the 5th bit of production count preset number.
7		Long press enter key, first all flashing, loosen the button to stop flashing, data is saved.

The above steps are to change preset number of production from 5814 to 293. To modify the parameters again, repeat steps 2 to 7.

In addition, data will not be saved if press F directly to return when production count flashing display.

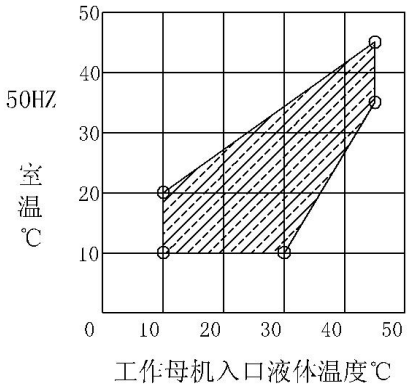
Operation method to reset production counter

Normal display status, the digital tube in row 2 shows production count , it can reset the current production count, operation is as follows.

step	Interface	Operating instructions
1		Long press the enter key for 3 seconds, production count (the second line digital tube) display flashing reset.

5-3、Oil temperature adjustment

warning	The compressor of oil cooler is built-in, so the environmental temperature and oil temperature set point has certain limitations. Please use it in the range as following picture shows, it must be stopped if out of range.



Set oil heating/cooler temperature

surrounding	Set temperature for preheater	Set temperature for cooler
Room temperature at constant	The temperature when start preheating -10˚C	The temperature when start preheating +5˚C
Room temperature range 5～10˚C	The temperature when start preheating -20˚C	The temperature when start preheating +10˚C
Room temperature change is more than 10 ˚C	The expected highest room temperature in the day-10 ˚C	Same as the expected highest room temperature in the day

Please preheat before work 2 hours.

5.4 Air pressure balance adjustment

Pneumatic balancers is the equipment used to balance the slider and the mold when adjust die height, to smooth the adjustment operation.

Move the adjustment slider switch to "manual" or automatic, inflatable air pressure balancer automatically. Please adjust the pressure according to the balancer mold quality.

There is voltage regulator in the plate of left rear pillar, adjust pressure with the voltage regulator according to the upper mold quality.

There is a lock on the adjustment handle, first loosen the lock, adjust and then tighten.

6. Mold replacement work

6.1 Mold installation

	Install or unload the mold operation is set operation select switch to "inching", press "Press operation" button to inching operation. When it must work in the range of mold area, must press the "emergency stop" button before operation, then operate in the range of mold area.

①Inching operation to stop sliding block in the top dead center.
②Adjust die height displayed to greater than the height of the mold apparatus 10mm by slider adjustment. Adjustment method, refer to "Operation section, die height adjustment."
③Press "motor stop" button, then press the "emergency stop" button. Make sure the flywheel is stopped.
④Mold into the mold area, placed in the installation location.
⑤Stop the slider in the bottom dead center with micro inching or inching operation.

	Slider adjustment device does not have the capacity to press the under mold. If press the under mold by adjusting the slider, it will lead to motor fever or the slider for adjusting damage.

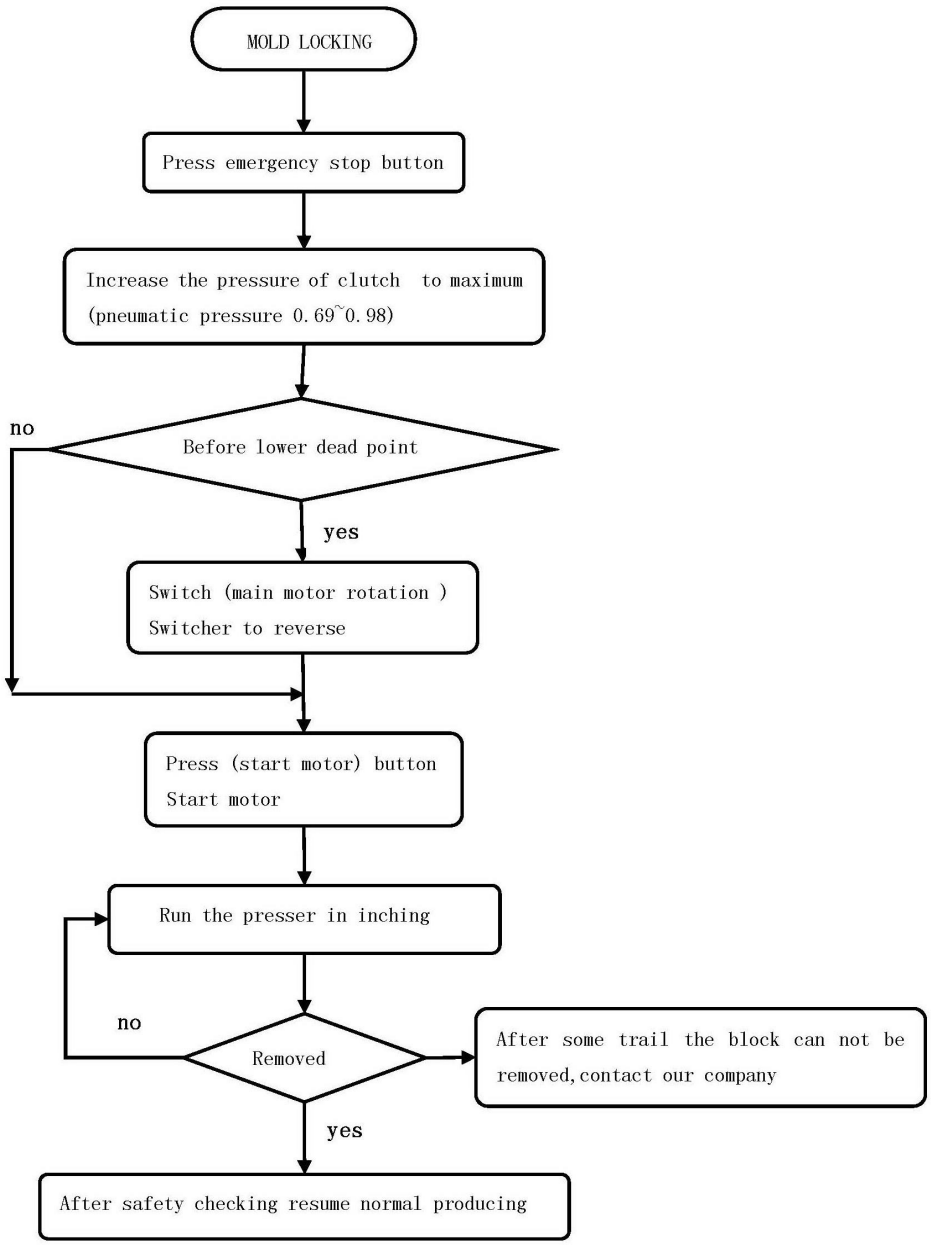
⑥For the slider to adjust operation, adjust separation between the underside of slider and the above side of mold to 1 ~ 2 mm.
⑦Press the "motor stop" button, and then press the "emergency stop" button. Make sure the flywheel is stopped.
⑧Stick the under mold on the pad, upper mold on the slider.
⑨With micro inching or inching operation, operate the slider 2 ~ 3 schedule, confirm no abnormal.
⑩After the mold work finished, with inching operation to try to play, please move the slider to upper dead center, mold micro adjustments.

6.2 Discharge the mold

①Stop the slider in the dead center with inching operation.
②Press "the motor stop" button, and then press the "emergency stop" button. Make sure the flywheel is stopped.
③Take out the processing materials and finished products in the mold.
④Adjust mold height displayed to greater than the height of the mold apparatus 1～2mm by slider adjustment.
⑤Inching operation to stop sliding block in the bottom dead center.
⑥Press "motor stop" button, and then press the "emergency stop" button. Make sure the flywheel is stopped.
⑦Remove bolts fixed mold.

⑧Stop the slider in the upper dead center with inching operation
⑨Press the "motor stop" button, and then press the "emergency stop" button. Make sure the flywheel is stopped.
⑩Pull out the mold from the mold area.

7. Remove the blocked mold



8、Other Function

8-1、Spray wind device

Spray wind device is an optional device for this machine.

Electromagnetic valve ON/OFF time setting, please refer to "5-2, electronic CAM Angle controller adjustment".

Switch to shift the way of spraying wind is in the picture of “control set” on touch screen.



Control mode	Action
Off	Solenoid valve is closed, the air is cut off. Set the switch to "off" when not use the spray wind device.
Interruption	According to the setting of electronic CAM Angle controller, when the Angle of "ON" is suction state, air jet; "OFF" is closed state, turn off the air. Continuous operation, this action again and again.
Continuous	Solenoid valve for the suction state, uninterrupted air jet.

8-2、Motor reversing device

It can be used when the mold is blocked.

Turn the "main motor forward/reverse" switch to "reverse", motor startup when press the "motor start" button. Loosen the button after reach continuous operation speed.

Turn the "operation select" switch to "inching", the slider to be reversed.

9-3、Full stop loop

Turn the "full stops ON/OFF" switch to "ON" when the Press continuous operation, Press will stop when an exception occurs, operating power supply will be shut down at the same time.

Contents

1. Daily maintenance project and device ……D-1

1.1 Check the maintenance issues……D-1

1.2 Check before the beginning of the operation ……D-1

1.3 Weekly check ……D-1

1.4 Monthly check……D-3

1.5 Annual surveys……D-4

2. Treatment of abnormal situation ……D-4

2.1 The structure of the clutch and troubleshooting……D-4

2.2 Sliding block guide rail gap adjustment……D-6

2.3 The adjustment of the V belt ……D-7

3. The types and amount of oil used oil ……D-8

4. Pneumatic system diagram ……D-9

5. Lubrication chart ……D-10

6. Electrical wiring diagram

1. Check and maintenance

1.1 The items of check and maintenance

1) Daily check and maintenance: about the items of daily check and maintenance, please refer to the section of "operating part, Ready to operate, daily check " and then implement.
2) Regular check and maintenance: this part has recorded the items of check and maintenance about the machine how to keep long-term performance in good condition, please follow the instructions and implement.
   (Customer must implement this check and maintenance)
   a. Weekly check: mainly about the check and maintenance of pneumatic circuit and lubrication circuit.
   b. Monthly check: mainly about the check and maintenance of gas oil pressure machine, send drive part and the electrical equipment.
   c. Annual check: according to the labor safety and health rules, implement specific check on its own.
3) The check of the outside of the guarantee period
   The guarantee period of the machine is one year.
   In the condition of must dismount, dismount the check assignments and consumption parts、oil kind of replacement as paid. According to the result of check, if the parts must be replaced, it should be carried out by the customer's operation director, or contact our service department.

Consumption parts list (representative)

No.	Type	Used part	No.	Type	Used part
1	V belt	flywheel	8	pressure gage	Pneumatic, hydraulic circuits
2	Synchronous belt	Feeding connection	9	Loop filter	The two side of the lubricating oil pump
3	o-ring	Clutch, hydraulic parts	10	Pressure regulating valve	Pneumatic, hydraulic circuits
4	brake block	clutch	11	discharge valve	Pneumatic circuit
5	Supporting ring back	Slider locking	12	Coupling	Encoder
6	Ball seat	Guide pillar	13	Indicator light	Operation board
7	Bearing	Crankshaft, motor	14	Relay	Electric circuit
			15	Backup battery	Program control circuit

1.2 Check before starting work

When starting work every day, or every eight hours after operation, daily check must be conducted (see "operation"). Please make the result of check before starting according to "daily check form".

1.3 Weekly check

	The "motor stop" button must be pressed before check, make sure the flywheel has stopped before implementation.

Check item	Content to confirm	Treatment
1) Oil mass of Pressure lubricator (refer to "Maintain section, the types of oil and oil mass")	The oil level must be in the specified range of oil level gauge of oil cup.	When insufficient, refueling to the scale of upper limit.
2) Lubricating oil circuit (refer to "Maintain section, oil supply system diagram")	No oil leaking in the Press ontology and the surrounding. Tubing connection equipment with no loose. There is no high temperature object which is more than 50 ℃ around the plastic tubing.	Tighten the piping connection parts. Rule out high temperature causes.
3) Pressure switch of pneumatic circuit	Slowly reduce air pressure using regulator, when the information display shows "clutch air pressure is too low," confirm the pressure gauge pointer is below the normal value. (after confirmation, back pneumatic pressure to the specified range of pressure gauge, then reset the display)	Adjust to the set pressure. (refer to "information section, pressure switch") 0.35MPa
4) Pressure switch of lubricating oil circuit	Slowly reduce oil pressure using the flood valve of the lube oil pump, when the information display shows "oil shortage", confirm the pressure gauge pointer is below the normal value. (after confirmation, back oil pressure to the specified range of pressure gauge, then reset the display)	Adjust to the set pressure. (refer to "information section, lubricating oil pump") 1.5MPa
5) The pressure switch used by slider locking mechanism	Loosen the pressure adjusting handle loading on the pressure device. First, turn the die height adjustment switch to "manual", make the locking pressure drop to zero. Then the information display will show "slider locking oil pressure is too low". Then press the reset button cannot return to normal display. Then turn the switch to "off", higher the pressure slowly to the set pressure using the adjusting handle of regulator in locked state. Then press the reset button again, the display will return to normal display.	Adjust to the set pressure. (refer to information section, pressure device") 17MPa

1.4 Monthly check

	When check and maintenance, in addition to make sure the clutch state of ON, OFF, the key of the power supply operation must be pulled out.

	Please replace the oil for the first time when buying the machine after one month. Later, it can be replaced once a year, in addition to the oil dirty, sediment, mixed in water etc.,

Check item	Content to confirm	Treatment
1) lubricating oil	The oil is not dirty. (within 1 year)	Replace the lubricating oil.
2) The oil pump suction filter	The mesh of strainer in the oil tank without blocking	Clean strainer or replace mesh.
3) Oil filter (refer to " information section, oil filter")	After pressing the motor start button, the inductor upper oil filter turn "green" color. When removing the filter, there is no iron powder adhered to magnetic rod.	When it turns "Yellow" color, wash the internal filter. Please replace when it turns "red" color. Remove the iron powder.
4) Lubricating oil pressure	After confirm item 1) ~ (3), the pressure gauge pointer within a specified range.	Idle the Press 3 minutes, then confirm again.
5) Hydraulic circuits (refer to " information section, pressure unit")	The slider to adjust the locking mechanism part without oil leaking. The joint of Q.D.C system without oil leaking. Pressurize + 1.5 MPa on the basis of standard locking hydraulic, it will overflow.	Tighten the pipe joint, please exchange when damaged. Please exchange when bad.
6) Pressure meter (refer to "maintenance section, pressure system diagram")	Operate the regulator, make sure the movement of pointer is normal.	Please exchange when bad.
7) The action of the clutch brake (refer to "clutch specification")	The interval within 3.0 mm.	When the interval is too large, please exchange.
8) V belt (refer to " maintenance section, adjustment method of V belt")	Whether the tension is appropriate	When it is too low, please tension again.
9) Felt used to clean material	No dirty, no deformation.	Please clean or replace.
10) The Press ontology	No loose bolt.	Please tighten again.

11) The wire connection parts	Make sure the main power is off (OFF). Small bolt of terminal without loosing.	Please tighten again.
12) Electrical box	Without oil, water, metal as attached.	Please clean up.
13) The insulation resistance of power circuit	More than 2 MΩ	When it is under 2 MΩ, please contact our service department.
14) Limit switch, micro switch	Roller without wastage, deformation.	When it is abrasion, deformation significantly, please replace.
15) Feeding drive and rotating parts	Check if the rotating parts are properly lubricated with grease (grease lubrication interval: once every 6 months)	Inject about 10CC of No. 3 grease with a pressure lower than 1000KPA into the grease nipple. Refer to the grease point label for the location.

1.5 Annual check

	When check and maintenance, in addition to make sure the clutch state of ON, OFF, the key of the power supply operation must also be pulled out.

Specific to check	According to the labor safety and health rules for specific to check.	Take necessary measures according to the results of check.
Static accuracy check	Implement according to the precision check specifications of mechanical Press (JISB6402).	When can not meet the accuracy requirement, please contact our service department.
Check of the connection part	Bolt for immobilizing or adjusting motor without loosing. Bolt and nut of all kinds of cover plate without loosing.	Please tighten again.

2. Abnormalities in processing

2.1 The structure of the clutch brake and fault diagnosis

1) Structure (refer to clutch specification)

2) Action principle

When the clutch brake works, it will use the clutch of air pressure disc clutch and the brake of spring pressure on the brake disc combination as one of the institutions.

Compressed air go into the gas chamber by the rotary seal in the end of shaft to make the piston plate work, press the clutch facings to hang up the clutch when release the brake lining.

When discharge the gas, piston plate pressed by spring will be reset to make the clutch release, and hang up the brake again at the same time. It is to say, the structure type of clutch is gas pressure, brake is hang up by spring pressure.

Piston plate movement range is 2 mm, but as clutch facing and brake lining wear and tear, movement range will gradually increase. Big movement range will degrade the performance of clutch brake. When the movement range reach to 3 mm, the brake lining or clutch facing need to be replaced. Then please contact our service department.
Is to protect seal not fixation, shall be maintained by the normal work of the oil lubricator.

3) Troubleshooting

	When check and maintenance, in addition to make sure the clutch state of ON, OFF, the key of the power supply operation must be pulled out.

If you have the following failure phenomenon appears, please process as following.

a. Hard to release the clutch or brake.

b. The clutch or brake empty slide.

c. The clutch or brake heating.

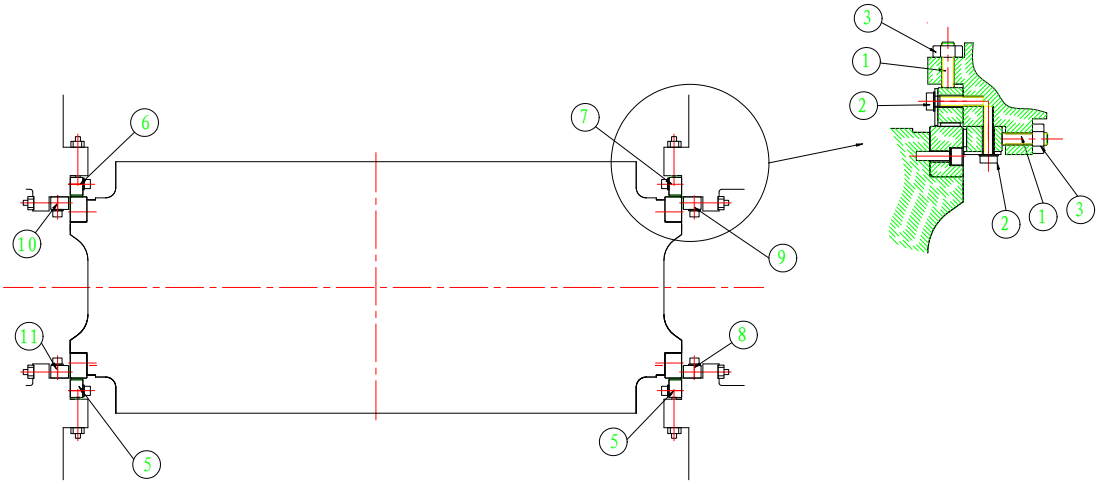
Confirm the items	Application and disposal
The clutch with pressure without falling	Visual confirmation pressure gauge, the use of pressure reducing valve. Check and adjust the amount of air usage of the plant air supply line.
whether Clutch air has leakage	Confirm the outside part of the clutch brake of air leakage, then tighten the inlet to check whether the reduced pressure. Confirmation of leak, please get in touch with our company
Whether the liner wear	Use meter to check the clearance gap between the piston disc brake pads and clutch pads and between. When the gap is more than 3.0mm, please get in touch with the company..
Whether the piston plate movement is smooth	Repeated clutch on-off operation, if discover the piston plate movement is not smooth, please get in touch with our company.
Whether brake disc movement is smooth	After hang clutch with solenoid valve, then determine whether the brake pad and the brake pin work smoothly. If it is not smooth, please

	get in touch with our company.
If there is a oil adhesion liner surface	Visual confirmed from the top or bottom of the clutch brake. When confirm the attachment, use wash liquid to wash them.

2.2 Adjustment of sliding block guide rail gap

warning	Inspection and maintenance, In addition to make sure the clutch ON • OFF state, must also be pulled out the key of the operational power supply.

The native way of sliding block guide using the eight side of needle roller guide rail, when leave factory prepressing has been properly adjusted for zero clearance status. In normal use conditions, do not need to adjust generally. In case produced a gap, making the slider precision declining, please adjust again as the following method.



method of adjustment

1) Screw loose eight sliding block guide rail clamp block adjustment bolt and the retaining bolt.
2) Place the cylinder gauge fixed on the bearing plate.
3) Below the slider device two scale meter which in touch with the right side and back side of cylinder meter.
4) Turn the handwheel manually several times to will scale to zero.
5) Using the central adjusting bolt first, then the before and after guide rail clamp block will be adjusted to scale meter scale 0.01 mm.
6) Using phase wee adjusting bolt will guide rail clamp block transferred back to the original dial zero.
7) Similarly, left-right direction of the guide rail clamp block scale to 0.01 mm.

8) Will guide rail back to dial zero.

9) This time, and then gently bolting each guide rail clamp block retaining bolt.

10) Will the rest of the up and down adjustment bolts hold onto the guide rail clamp block.

11) Tighten the fixed bolt and lock nut.

12) Confirm the scale of scale to zero.

Please adjust according to the above procedure. Please confirm the bolts slide rail clamp device on the block loose.

2.3 adjustment method of V belt

warning	When inspection or maintenance, in addition to make sure the clutch ON, OFF state, must also be pulled out the key of the power supply operation.

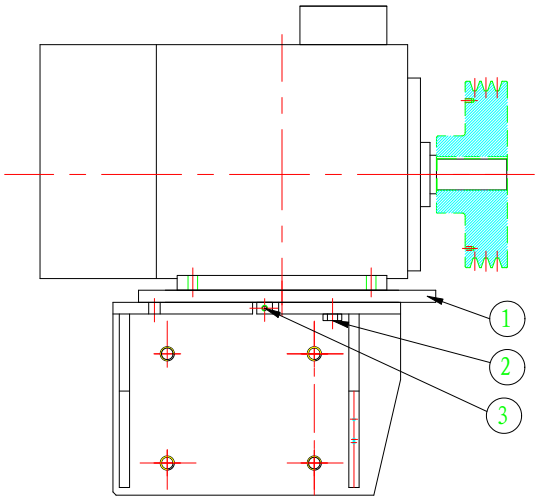
Relax four lock nut of the fixed motor base plate.

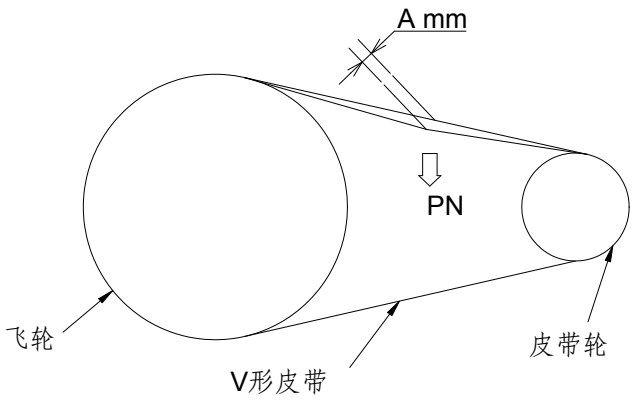
Adjust the four tension bolt to tension V belt.

V belt for proper tension, pressure and P in the middle of the V belt, about A (mm) of the elastic is appropriate.

After the adjustment, confirm the parallelism of the belt, bolt lock nut.

type of machines	best-30/40/40W	best-60/70/80/80W/100/100W/125
pressure P N（kgf）	98(10)	147(15)
Amount of elastic A mm	30	40





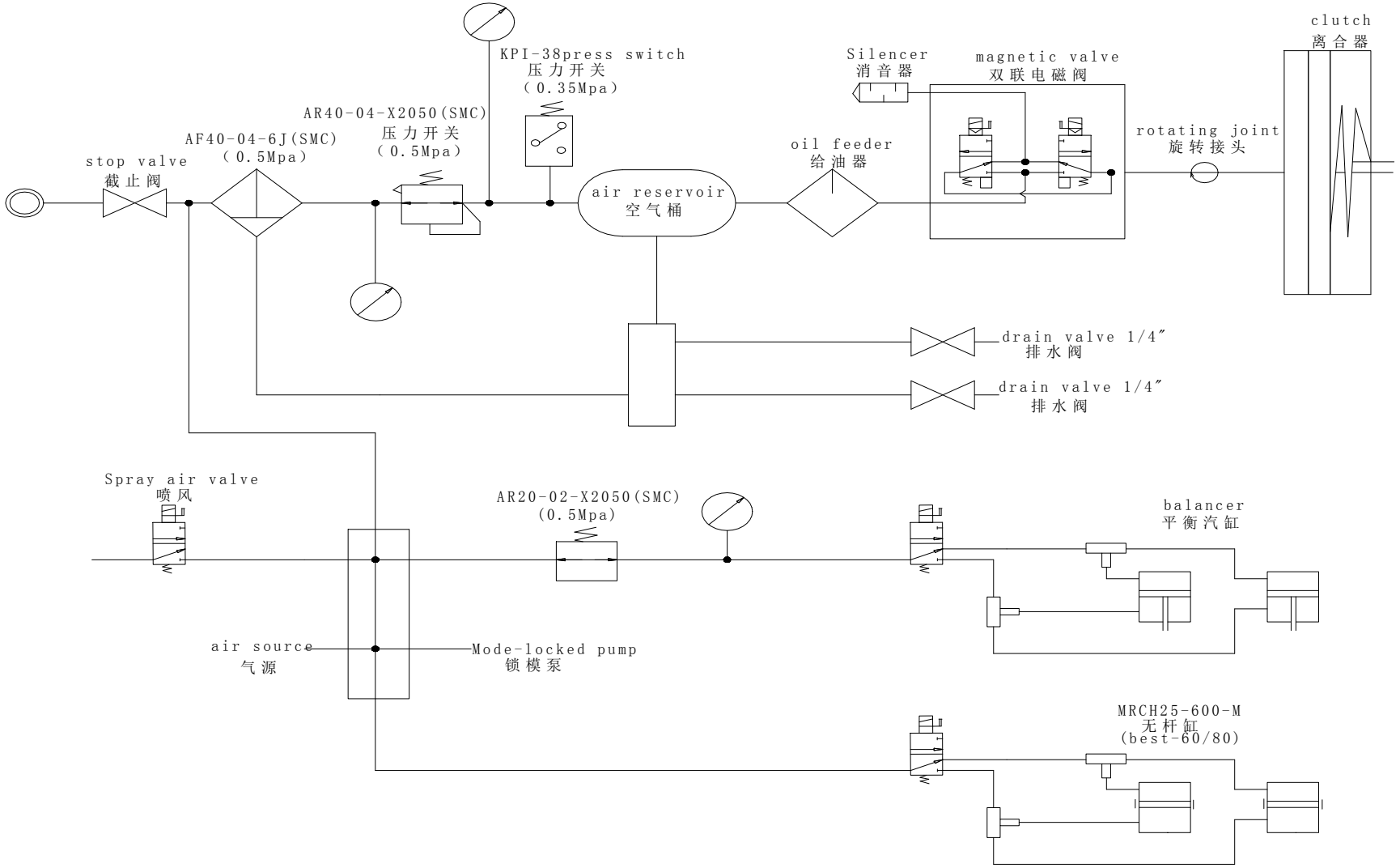
3. The types of used oil and oil mass

	For pressure unit, mechanical oil and spindle oil must not be used . The record table of lubricating oil, contain reality of the oil which the company didn't use .

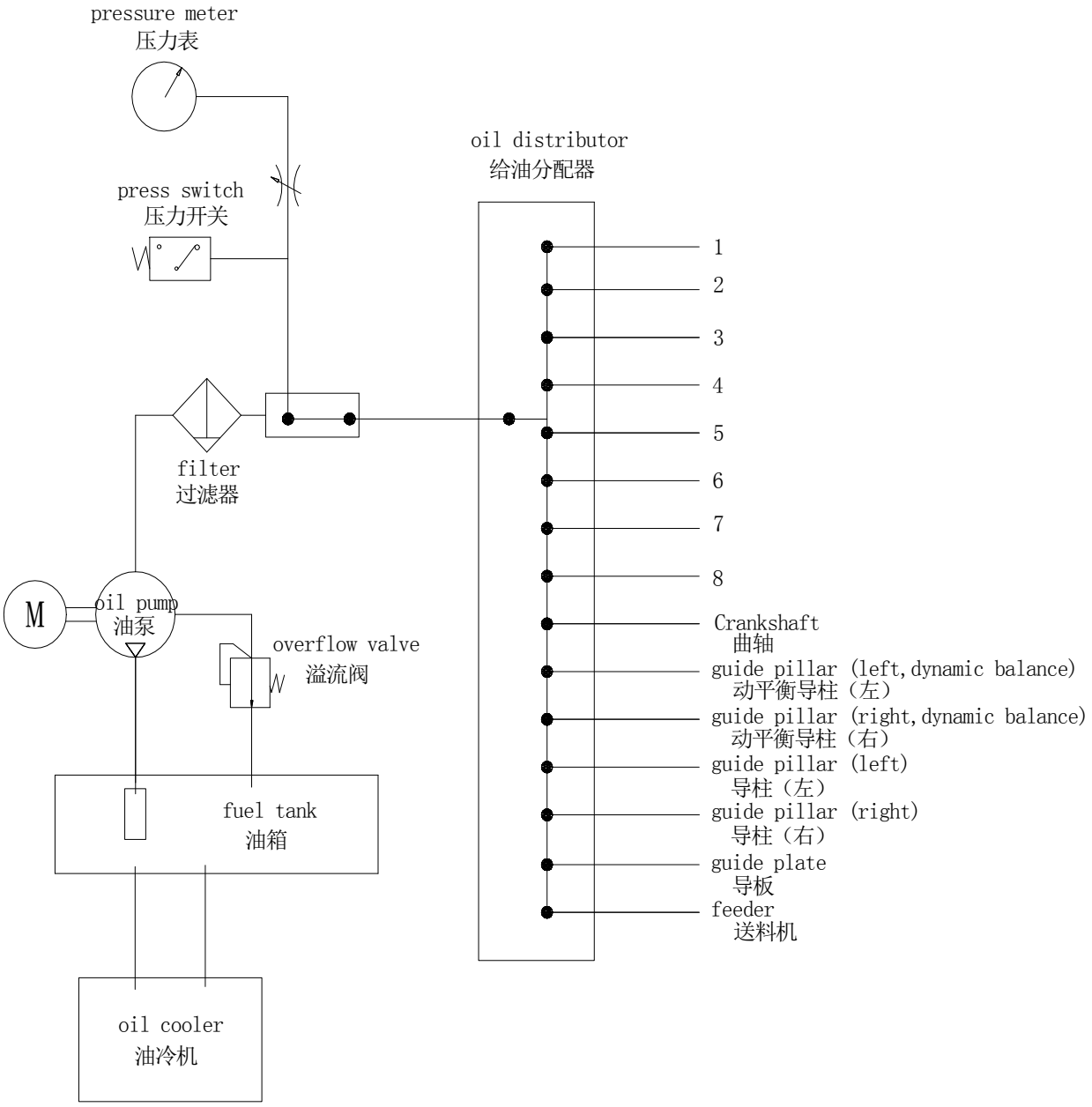
type of machines	lubricating oil of the ontology	Locking pump	Feeder
best-30	60 liter	3 liter	1 liter
best-40	60 liter	3 liter	1 liter
best-50	70 liter	3 liter	1 liter
best-60	90 liter	3 liter	1 liter
best-70	110 liter	3 liter	1 liter
best-80	120 liter	3 liter	1 liter
best-80W	150 liter	3 liter	1 liter
best-100	155 liter	3 liter	1 liter
best-100W	175 liter	3 liter	1 liter
best-125	170 liter	3 liter	1 liter

Manufacturers of lubricating oil	Brand lubricating oil	
	The ontology of lubricating oil	Locking pump
Great wall	L-HM68	L-HM32
MOBIL	DTE 26	DTE24
COSMO	COSMO Ulpas 68	Hydro AW32
SHELL	Shell Tellus Oil 68	Tellus Oil 32
ESSO	Telesso 68	Nuto H32 Nuto HP32

4. Pneumatic system diagram



5. Oil supply system diagram



Safety Considerations

For safety and proper operations of this controller, it's required that all users read this manual carefully before running this controller.

Warning

1. The functions may be weakened if this controller is repaired by a nonprofessional service people. The installation and maintenance of the controller should only be carried out by authorized professional service people.

2. For safety reason, this controller needs a fixed mounting. And the cables should be put in conduits to prevent the cables from being pressed or grinded.

3. The power supply is required to have at least one kind of breaking methods through a switch or a circuit breaker. Besides, the breaker must be close to the equipment, and easy to use by operators. There must be an obvious sign when an open circuit occurs.

4. To reduce the happenings or possibility of accidents which may cause harm to people or mechanical equipments, the operators must follow the instructions and operation procedures as described in this manual, and operators must also comply with the factory's safety work standards.

5. Make sure power is switched off before checking, wiring or testing.

6. Make sure the power supply of the main motor is turned off before testing the outputs of PAC10 controller.

7. It's prohibited to dismantle the controller while power is switched on.

Notices on Circuit Design

1. It's suggested the system should be supplied with separate DC24V/1A power, that is, the I/O power supply should be separate from system power supply.

2. The controller grounding can't be at the same point with either the motor or the transformer, which has to be grounded separately.

3. For user's special attention, both the controller and the machine tool must be well grounded.

4. To prevent the controller from disturbance or interference, please install a filter between the heavy load and inductance load. Impedance absorber device should also be used for AC contactor and AC electromagnetism valve. Resistance is to be 220Ω/2W, and the capacitor is to be 0.1μF/3KV. Absorber devices must be mounted closely to contactor coils or beside the valve coils.

5. Please use special cables.

6. The cables connected with the controller should be as short as possible, and they can't run parallel with AC power cables. If there's some difficulty, you may pull on the wires through metal conduits and then ground the conduits separately.

Notices on Debugging

Encoder position correcting: If you adjust die position when power off, position displayed will be improper after power on. In order to correct position, die operates at least one circle after power on.

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Chapter 1 Functions and Specification

This controller combined with PLC is very suitable for control of mechanical presses. It has following features:

1) SPM/angle display：If the SPM >10, the SPM is displayed; If the SPM ≤0, the angle is displayed.

2) Display and setting of current production count: 6 digits, it can control production count arrival.

3) Electronic cam setting: 10 sets

4) Shear count setting and output: 2 sets

5) BDC setting

6) The second angle setting: detect failures like encoder slippage

7) TDC stop: automatic compensation during TDC stop.

8) Automatic calculation of clutch breaking angle, or breaking on fixed angle.

9) Encoder's FW/REV rotate setting: easy connection

10) High/low speed limit setting: Controller gives an alarm if speed exceeds the limit

11) Braking inertia monitoring: Controller gives an alarm if the maximum setting value is exceeded.

12) Parameter access is protected by password

13) Cumulative count of clutch break action

14) Abnormal alarm

15) Status monitoring of I/O ports

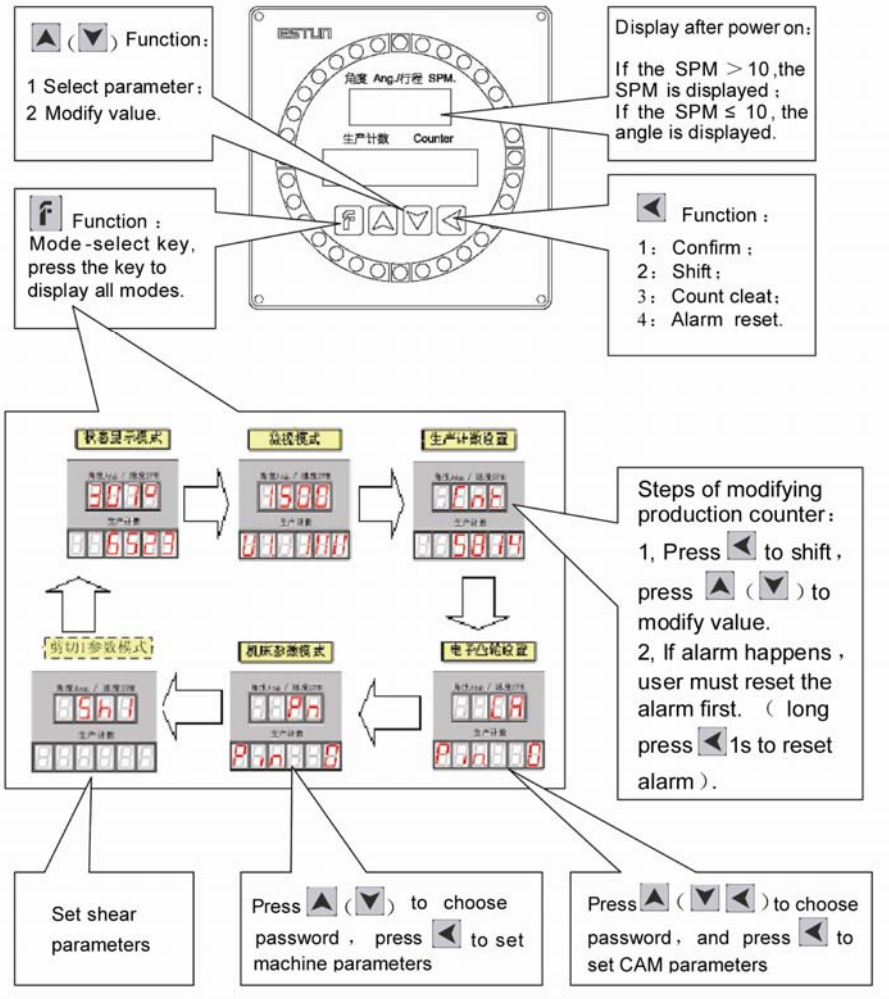
16) Shaft position self-correcting

NOTICE: Element of PAC10 used for collecting signal is encoder and element of PAC10R is resolver in this passage. Their function is basically the same.

Item	Specification
Power Supply	DC24V ± 10%，1A
EMC	Conform to standard GB/T17626，GB/T18268
Shock or Vibration	Conform to standard JB/T8832-2001
Temperature	Conform to standard GB/T2423.3-93
Working Temperature	0～40℃
Storage Temperature	－20～70℃
Humidity	30～85 %
Angle Display	0～359°
Angle Setting	0～359°
Strokes	0～2000 SPM (360P/R)
Angle Sensor	Incremental encoder (360 lines,5V, differential voltage output, input with reference) or resolver
Angle Resolution	0.25 degree
Indicators	32 indicators for shaft position
Display	Angle/speed (4 digits LED digitron) Production counting (6 digits LED digitron)
Keys	4 jiggle switch keys
Cam Output	0～359° 10 channels
Input	5 channels (optically coupled isolator) DC24V ± 10%, maximum input current 20mA
Output	12 channels (optically coupled isolator) DC24V ± 10%, maximum output current 50mA

Chapter 2 Operation and Settings

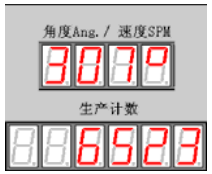
2.1 Display and Operation



NOTICE: There is a specification for each mode as follow.

2.2 Status Display Mode

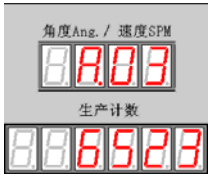
Current angle or position of shaft is displayed in line 1 after PAC10 is switched on or when SPM ≤ 10 during running.



When SPM ＞ 10，SPM is displayed:

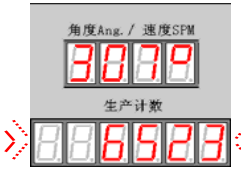


Caution: If there's a system alarm, an alarm code is then displayed:



For example: operation for production count clearing

Production court is displayed in Line 2 under normal display menu, and current production count can be cleared, steps as follow.

Step	Interface	Operation instruction
1	 Glittering	Long press enter key 3 sec., then production count glitters, and is cleared (in Line 2)

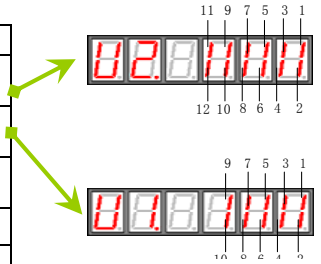
Caution:
When die stops, user can press "count clear" key 1 sec. to clear (system has clearing port).

2.3 Monitoring Mode

User can monitor power level status of I/O ports and braking angle in monitoring mode.

Display of contents in monitoring mode as follow

No.	Contents	Function
U1	Power level status of input port	Monitoring real status of input port
U2	Power level status of output port	Monitoring real status of output port
U3	Real braking angle (degree)	Real braking inertia
U4	Braking SPM	Machine speed
U5	Real second angle (degree)	Display of real second angle (degree)
U6	Cumulative counter of clutch breaking	Display of total breaking count
U7	PAC10 version info	Display of current software version
U8	Output counter of shear 1	Display of output count of shear 1
U9	Output counter of shear 2	Display of output count of shear 2
Followings are for production test use (protected)		
UA	Output diagnostics	Used for PAC10 diagnostics
Ub	Storage FRAM diagnostics	Used for PAC10 diagnostics
UC	LED diagnostics	Used for PAC10 diagnostics
Ud	Maximum set braking angle (degree)	Automatic calculation of maximum braking angle according to Pn05 by user set
UE	Top stop/Top stop output angle	Display of angle at the beginning of breaking
UF	Alarm history	Storage of 10 records of alarm



CAUTION：When U8, U9 is under monitor interface, long press enter key 5 sec. to manual clear. When user modifies shear parameter n3，U8 or U9 will automatic clear. When user restores to default value, U3、U4、U5、U8、U9、Ud will automatic clear.

Warning: User must follow the machine manufacturer's operation instructions when diagnosing UA output port or Ub storage FRAM. In order to avoid dangerous situation, make sure the main motor stop and power supply of main motor be switched off before any operating

Specification of U1/U2 monitoring function

No.	Digits No.	Contents	Relative signals
U1	1	Second angle input	X 1
	2	Run input	X 2
	3	Input of compensation of TDC stop	X 3
	4	Production counter clear input	X 4
	5	Alarm reset	X 5
	6	Offline detection of encoder (resolver)	
	7	Encoder A phase/normal power supply detection input(resolver)	
	8	Encoder B phase	
	9	Encoder C phase	
	10	Normal input of power supply detection (encoder)	
U2	1	Top stop	Y 1
	2	Controller gets ready	Y 2
	3	CAM 1 output	CA1(Y 3)
	4	CAM 2 output	CA2(Y 4)
	5	CAM 3 output	CA3(Y 5)
	6	CAM 4 output	CA4(Y 6)
	7	CAM 5 output	CA5(Y 7)
	8	CAM 6 output	CA6(Y 8)
	9	CAM 7 output	CA7(Y 9)
	10	CAM 8 output/shear 1 output	CA8/S1(Y 10)
	11	CAM 9 output/shear 2 output	CA9/S2(Y 11)
	12	CAM 10/output of production count arrival/output of shear count arrival	CA10(Y 12)

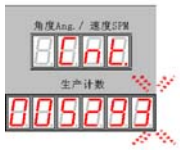
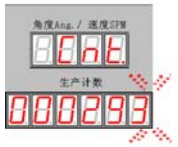
2.4 Production Counter Mode

User can press up/down key to modify value; short press enter key, and then set-position cyclically shifts to left. Long press enter key to save and exit. Press F key to exit but not save.

Parameter NO	Name and function instruction	Unit	Setting range	Default
Cnt.	Preset production count 0：not count； 1：begin to count, not output signals of production count arrival ≥2：begin to count and output signals of production count arrival	piece	0~999,999	0

For example: below are steps to set production count, and change preset production count from 5814 to 293

Steps	Interface	Operation instruction
1		Press F key and choose production count setting mode, current production count is displayed in line 2.
2		Press enter key, the first character of preset production counter in line 2 will glitter, then go into modifying mode of the first character of preset production count.
3		Press down key to 3, then press enter key once time, the second character of preset production count will glitter(2 of line 2), then go into modifying mode of the second character of preset production count
4		Press up/down key to 9; Press enter key once time, the third character of preset production count(3 of line 2) glitters, then go into modifying mode of the third character of preset production count

5		Press up/down key to 2; press enter key once time, the fourth character of preset production count (4 in line 2) glitters, then go into modifying mode of the fourth character of preset production count
6		Press up/down key to 0; press enter key once time, the fifth character of preset production count (5 in line 2) glitters, then go into modifying mode of the fifth character of preset production count
7		Long press enter key, all glitter first, and then stop glittering and save after release the key

Above are operation steps to change preset production count from 5814 to 293. If user wants to modify parameters again, repeat step 2 to step 7.

In addition, when production count glitters, press F key to return but not save value.

CAUTION：

1. Signals of production count arrival, signals of shear count arrival, and CAM10 use the same output port CA10 (Y12)

2. When shear function is shut down:

If preset production count is 0 or 1, output port CA10 (Y10) can be used as output port CAM 10;

If preset production count ≥ 2, CA10 (Y12) is used for output port of production count arrival.

3. When user use shear function, use of CA10 will be defined in the instruction of shear mode.

2.5 Cam Setting Mode

In order to prevent parameters from changing unexpectedly, CAM parameters are protected by password (password is 980). User can confirm machine parameters and the change range in CAM parameters table as follow.

Parameter no.	Name and function	unit	range	Default value
CA01	ON Angle of CAM 1	Degree	0～359	0
	Off Angle of CAM 1	Degree	0～359	135
…	…			
	…			
CA10	ON Angle of CAM 10	Degree	0～359	0
	OFF Angle of CAM 10	Degree	0～359	0

Notice:

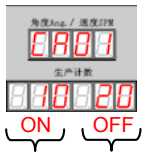
When output ports are used for general cam

If both on and off angle of CA X are set as 0, CA X will be switch off.

If both on and off angle of CA X are all set as θ（θ≠0）, CA X will be always ON.

Function of CA08~CA10 output ports has multiple definition, CA08~CA10 can be used for output of general electric cam, or used for output of shear. CA10 can be used for general cam output, or used for output ports of count arrival. Different definition of output ports function is up to preset parameters.

For example: In following table are the steps to change On angle of CAM CA05 from 60 degree to 70 degree and to change OFF angle from 70 degree to 80 degree.

Steps	Interface	Operation instructions
1		Press F key, choose Cam setting mode and enter into password detection status. Press Up or Down key to input password as 980.
2		Press Enter key and go into cam angle display mode.
3		Press Up or Down key to select CA05 which needs to change.
4		Press Enter key, CA05 ON angle （3 in Line 2) glimmers, then go into CA05 ON angle modifying mode.
5		Press Up or Down keys, set the value as wanted 70. Press Enter key, CAM 05 ON Angle (3 in Line 2) stops glittering, data is saved. Meanwhile, CA05 OFF Angle (3 in Line 2) glitters then go into CAM05 OFF Angle modifying mode.
6		Press Up or Down keys, set the value as wanted 80. Press Enter key, CAM 05 OFF Angle (3 in Line 2) stops glittering, data is then saved.

Above are the operation steps to change angle of CAM CA05 from 60 degree to 70 degree, and to change OFF angle from 70 degree to 80 degree. If user wants to modify again, repeat step3 to step9.

2.6 Machine Parameter Settings

In order to prevent parameters from changing unexpectedly, machine parameters are protected by password (password is 980). Machine parameters are shown as follow:

Parameter No.	Name and Function	Unit	Range	Default	Remark
Pn01	BDC setting	—	—	—	
Pn02	The minimum allowed SPM	SPM	0～2000	0	
Pn03	The maximum allowed SPM	SPM	0～2000	2000	
Pn04	Encoder counting direction [0] increase clockwise [1] increase counterclockwise	—	0～1	0	
Pn05	The maximum allowed braking angle/SPM; Maximum braking angle = Pn05*SPM Controller will alarm if the braking angle exceeds the maximum braking angle.	Degree/SPM	0.01～9.99	9.99	
Pn06	Second angle detection [0] disable [1] enable	—	0～1	0	
Pn07	Second angle setting	—	—	—	
Pn08	Fixed angle output top stop [0] disable [1] enable	—	0～1	0	
Pn09	Fixed top stop output angle	degree	0～359	0	
Pn10	The limit of clutch break count [=0] disable [>0] enable	—	0～999,000	999,000	
Pn11	Scope of top stop without compensation	degree	0～20	5	
Pn12	limit of break angle in single mode [0] disable [1] enable	—	0～1	1	
Pn13	Restore to factory settings	—	—	—	
Pn14	Filtering time of second angle input, parameters for PAC10 (encoder)	ms	0~100	2	Hidden parameters, open only to professionals
	Maximum clutch braking time, parameters for PAC10R(resolver)	ms	0~50000	4000	Hidden parameters, open only to professionals
Pn15	Filtering time of second angle input, parameters for PAC10R (resolver)	ms	0~100	2	Hidden parameters, open only to professionals

Notice:

Setting of Pn05: Pn05 is a slightly larger than the result of U3÷U4.

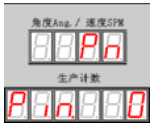
Pn10 is to set clutch breaking count. When clutch breaking count is upon preset value, system will alarm A09 only after switching on, Remove alarm only after count cleared. Value of clutch breaking counter is displayed in monitoring mode U6. Under U6 interface, long press enter key, and U6 will automatic clear.

Pn11's top stop without compensation: when angle stops within the range from –Pn11 to +Pn11, the controller will not make compensation on stop angle.

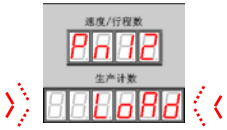
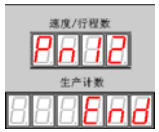
Pn12's breaking inertia limit in single mode: when braking angle limit in single mode is enabled, stop angle should be more than 190 degree, otherwise machine is stopped by force at 190 degree, and controller gives alarm error A.10.

Example 1 of Machine Parameters Setting:

The following table gives the operation steps to change machine parameters Pn03 from 2000 to 1500.

Steps	Interface	Operation Instruction
1		Press F key, select machine parameter mode and enter into password detection status. Press Up or Down key to input password as 980.
2		Press enter key, go into machine parameters display mode.
3		Press Up key or Down key, select parameter number Pn03 which needs to change. Press Enter key again, parameter (in Line 2) glimmers, and go into parameter modifying mode.
4		Press Up key or Down key, change value to wanted 1500. Press the key continuously and the number changes faster. Press Enter key to save value, then parameter data (in Line 2) stops glimmering, and then exit current mode.

Example 2: Restore Default Value

Steps	interface	Operation instruction
1		After going into machine parameter display mode, press Up key or Down key and select Pn13, press Enter key and then let it off. Line2 will glimmer.
2		Press Enter key over 1 second, then release the key till "End" is displayed, that means restoring default value is complete.

Warning:

After restored default, alarm A.11 would happen (BDC is not set). User should reset the BDC after cleared the alarm.

2.7 Shear Mode

NOTICE:

Shear function is special function, which is not used often. If user wants to use this function, please read this passage carefully.

Shear 1 and CA 08 shear the same output port s1, whose parameters are set in Sh1.

Shear 2 and CA 09 shear the same output port s2, whose parameters are set in Sh2.

ON/OFF angle of shear 1 and shear 2 are set in CA08 or CA09.

Parameters of shear are as follow:

Mode	Parameter No	Name and Function	Range	Default	Remark
Sh1 Shear 1 mode	n1	Shear 1 function ON/OFF	0～1	0	0：Relevant port is output of general cam 1：Relevant port is output of shear
	n2	Set S1 to export once after X stamping Port S1 is named shear 1	0~9999	0	Shear 1 (S1) exports signal once after stamping count arrival
	n3	Set output port CA10(Y12) to export once after port S1 has exported X signals	0~999999	0	0: Sh1 continually export count without interruption ＞0: output port CA10/Y12 exports when shear 1(S1)output count arrived Display of shear 1 output count (n3)can be viewed by U8
	n4	current stamping count of n2	0~9999	0	Real time display and modify current stamping count (n2)
Sh2 Shear 2 mode	n1	Shear 2 function ON/OFF	0～1	0	0：Relevant port is output of general cam 1：Relevant port is output of shear
	n2	Set S2 to export once after X stamping Port S2 is named shear 2	0~9999	0	Shear 2 (S2)exports signal once after stamping count arrival
	n3	Set output port CA10(Y12) to export once after port S2 has exported X signals	0~999999	0	0: Sh2 continually export count without interruption ＞0: output port CA10/Y12 exports when shear 2(S2)output count arrived Display of shear 2 output count (n3)can be viewed by U9
	n4	current stamping count of n2	0~9999	0	Real time display and modify current stamping count (n2)
	n5	Only suit for two scissors used together: When shear 1 and shear 2 are used together, shear 2 (S2) exports after shear 1 (n2) X stamping	0~9999	0	Shear 2 (S2) switch on at ON angle when display value of shear 1 (n4) arrived
	n6	Only suit for two scissors used together: When shear 1 and shear 2 are used together, shear 2 (S2) switch off after shear 1 (n2) X stamping	0~9999	0	Shear 2 (S2) switch off at ON angle when display value of shear 1 (n4) arrived

NOTICE：

a) CA10/Y12 port is multiply and interoperable port, which is used for general cam, or output port of count arrival in production counter mode. When it used as count arrival, it can be use to production count arrival or output port of shear count arrival.

b) N1~n4 have the same parameter function in two shear parameters; n5 and n6 work only when shear 1 and shear 2 count at the same time.

c) When shear 1 and shear 2 count at the same time, if n5 and n6 are equal, shear 2 (S2) switch on at ON angle and switch off at OFF angle in one circle.

d) Supposed that when user used shear function and shear 1 and shear 2 mismatched, either n2 is set as 0, and relevant output port would always switch off.

e) When shear 1 and shear 2 are used together: shear 1 and shear 2 should be switched on, and n2 of shear 2 should be set as 0; then shear 2 can work with shear 1, and n2 of shear 2 no longer works; n4 of shear 2 and n4 of shear 1 count at the same time, output and close of shear 2 are determined by parameter n5 and n6.

f) When shear 1 and shear 2 are used together, make sure that n2 of shear 1 be equal or over n6 of shear 2, otherwise alarm A02 would appear and this alarm can not be canceled, only modify parameters.

g) Make sure that n2 be not less than n4, otherwise alarm A02 would happen and this alarm can not be canceled, only modify parameters.

h) Output count of shear 1 and shear 2 are respectively displayed in monitoring mode U8 and U9, and long press enter key to clear. When user modifies parameter n3, relevant output count U8/U9 can automatic clear.

i) When user modifies n2, n4 automatic clears.

j) When user uses shear 1: if n3 of shear 1 is set as 3, output count of shear 1 will continue and be viewed by U8, but will not realize count arrival; user can modify cnt to realize to shut down system after CA10/Y12 port count arrival.

k) When CA10/Y12 is used as output of shear count arrival, it is valid that output time is 1 sec, system will automatic switch off after 1 sec.

Example 1：

Request of producing stator and rotor products: every product is composed of 50 pieces, total number of products is 2000, and machine stops after completed.

Production of this product needs to use mold. When system output control signals to control a valve of mold, which mortise once after the machine has stamped 50 times, system will output stop signal until this valve mortises 2000 times.

According to request, shear 1 (Sh1) is used to control this valve, parameters set as follow:

Shear 1（Sh1）： n1=1 ； n2=50 ； n3=2000 ； n4=0

CAM 8（CA8）： ON angle 90 ， OFF angle 220

Explanation： After machine stamped 50 times, shear 1 start to outputting from 90°and shut off at 220°,then valve act once. Y12 port output arrival signal once after output count of shear 1 arrived 2000 times.

If Y12 do not need to output 2000 count arrival signal, n3 of shear 1 (Sh1) is set as 0.

(This example is also suit to shear 2 outputting alone with the same setting, and n5 and n6 do not need to set)

Example 2：

Request of producing stator and rotor products: every product is composed of 50 pieces, and there is a small hole in each piece from the 1st piece to the 39th piece, there is a big hole in each piece from the 40th piece to the 50th piece, machine will stop after completed 2000 set of products.

Production of this product needs to use mold. When system output control signals respectively to control two valves of mold; valve 1 mortises once after the machine has stamped 50 times; Valve 2 starts to work and maintains from the 40th machine stamping and stops after 50th machine stamping.

According to request, shear 1 (Sh1) is used to control valve 1, and shear 2(Sh2) is used to control valve 2, parameters set as follow:

Shear 1（Sh1）： n1=1 ； n2=50 ； n3=2000 ； n4=0

Shear 2（Sh2）： n1=1 ； n2=0 ； n5=40 ； n6=50 ；（when shear 1 and shear 2 work together, n3 and n4 don't need to set）

CAM 8（CA8）： ON angle 90 ， OFF angle 220

CAM 9（CA9）： ON angle 80 ， OFF angle 270

Explanation ： After machine has stamping 40 times, shear 2 starts to output and maintain, valve 2 starts to work and maintain. After machine stamped 50 times, shear 1 start to outputting from 90°and shut off at 220°,then valve 1 act once , at the same time shear 2 stops outputting at 270°and valve 2 is shut off. Y12 port output arrival signal once after output count of shear 1 arrived 2000 times.

If Y12 do not need to output arrival signals, n3 of shear 1 (Sh1) is set as 0.

Example 3：

In two example above, if n3 of shear 1 is set as 3, system will not stop after shear output count arrival. User can modify cnt to realize to shut down system after CA10/Y12 port count arrival.

Request of producing stator and rotor products: every product is composed of 50 pieces.

Production of this product needs to use mold. When system output control signals to control a valve of mold, which mortise once after the machine has stamped 50 times.

According to request, shear 1 (Sh1) is used to control this valve, parameters set as follow:

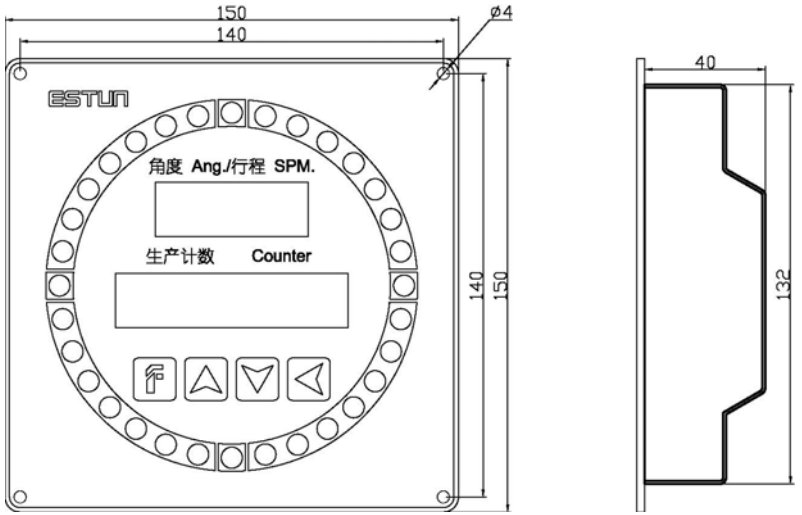
Shear 1（Sh1）： n1=1 ； n2=50 ； n3=0 ； n4=0

CAM 8（CA8）： ON angle 90 ， OFF angle 220

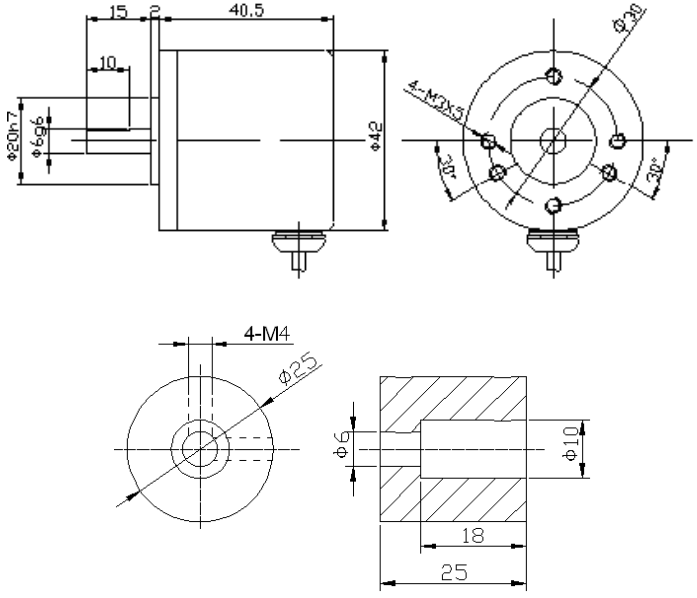
Explanation： After machine has stamped 50 times, shear 1 start to outputting from 90°and shut off at 220°,then valve act once. If cnt is set as 0, production counter in line 2 does not count in the display mode menu; if cnt is set as 1, production counter in line 2 counts but machine do not stop; if cnt is ≥2, production counter in line 2 counts and machine stops after CA10/Y12 outputs arrival signals. Count mode of cnt is that counting once after every stamping.

Chapter 3 Mounting Dimension

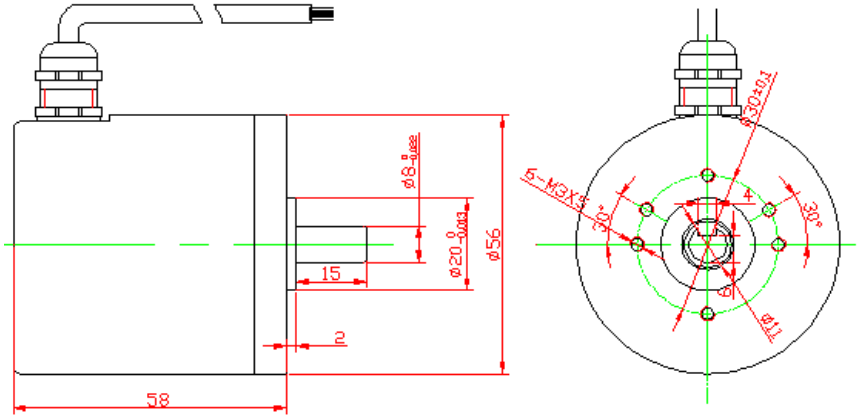
PAC10 Mounting Dimension (the same with PAC10R)

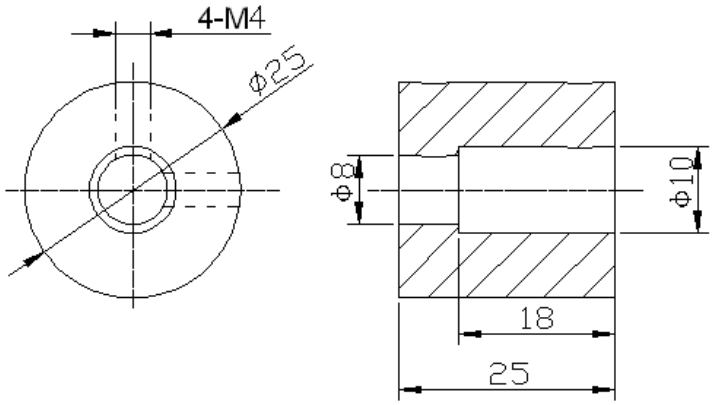


PAC10 with encoder RI41 dimension and axis connector φ6X10 dimension



PAC10-R with resolver RES56 dimension and axis connector φ8X10 dimension:



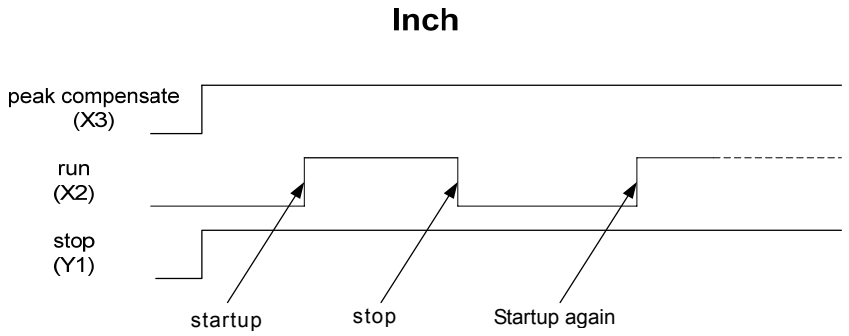


Chapter 4 Connection and Application

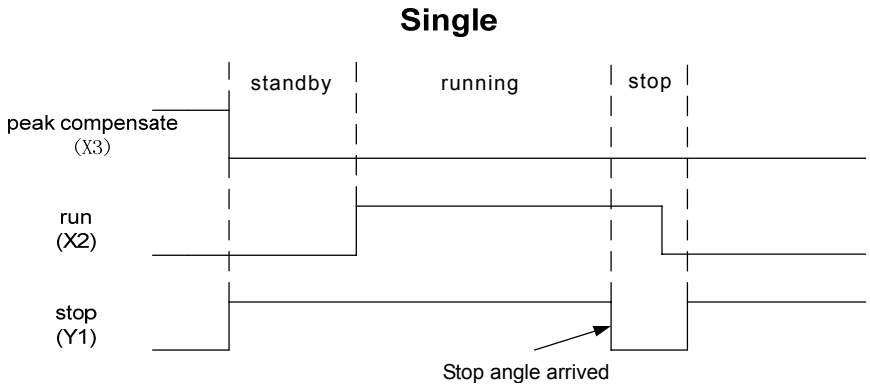
4.1 Wiring (Appendix 3)

4.2 Top Stop Timing

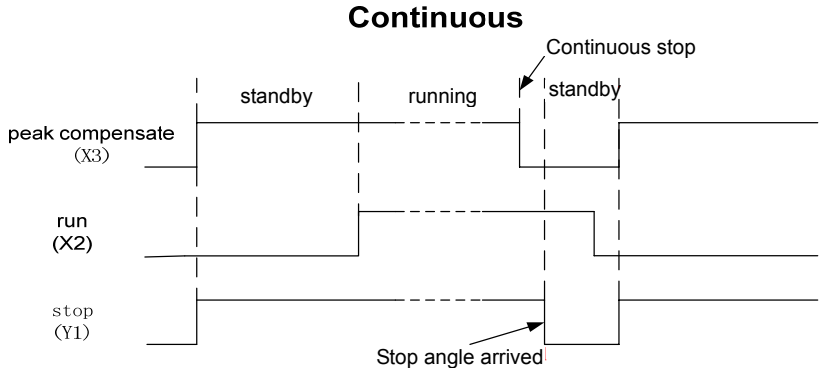
Inch Mode



Single Mode



Continuous Mode



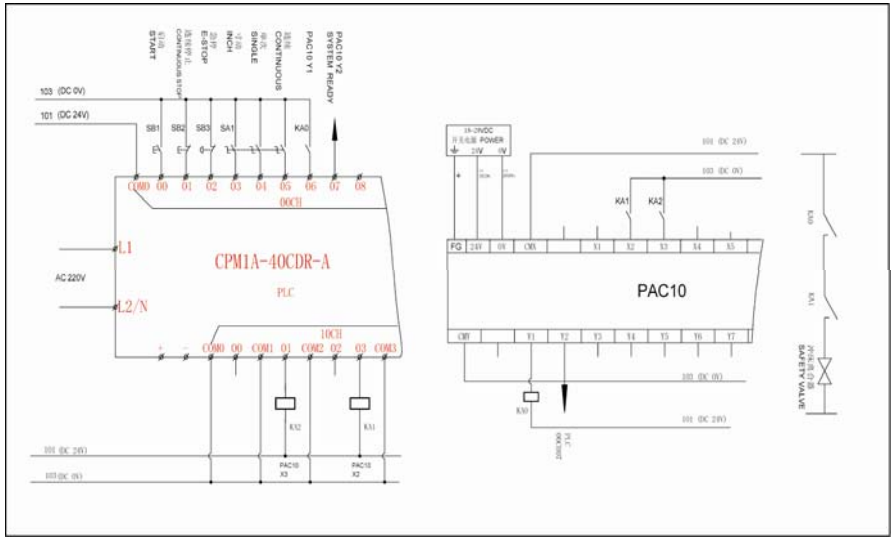
Notice:

1、X3 ON（inch mode）：do not carry on top stop correcting（Y1 always output ON）

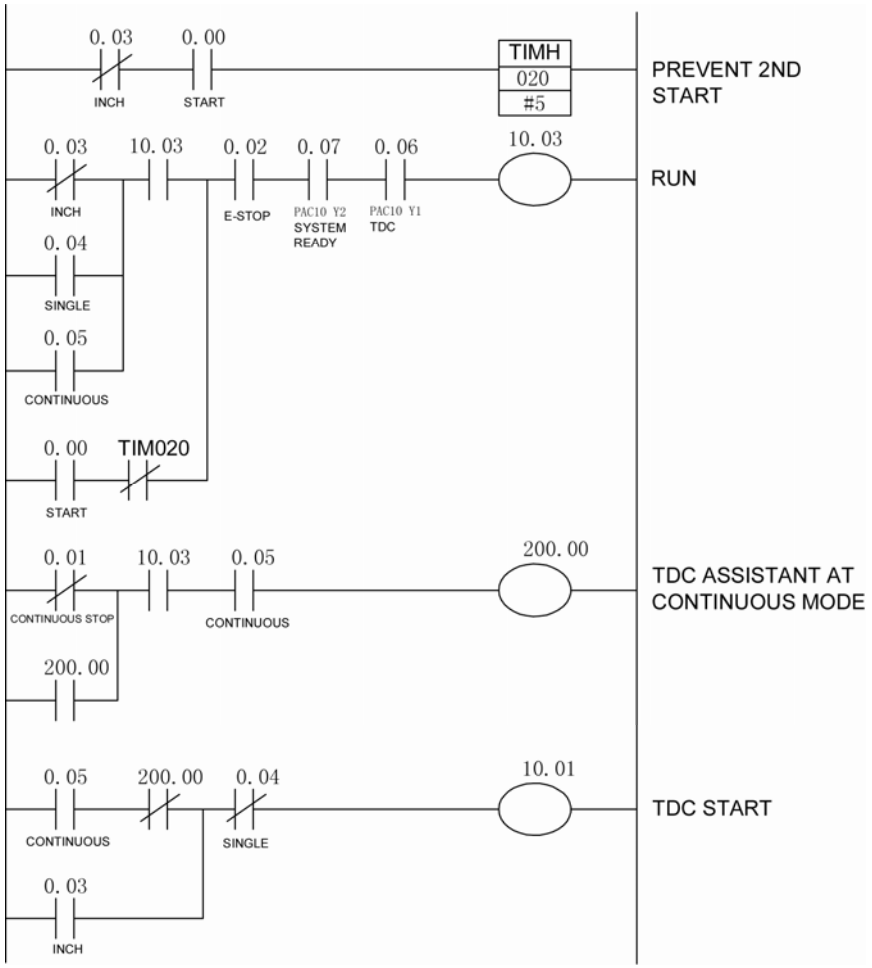
2、X3 OFF，X2 ON（single mode）or X3 ON-> OFF，X2 ON（continuous mode）: Carry on top stop correcting

（When angle of top stop arrive, Y1 ON -> OFF, after X2 OFF, Y1 OFF> ON ）

4.3 Example of Top Stop （Omron PLC）



Simple Program of TDC Stop (example of Omron PLC)



Chapter 5 Debugging

⚠ Warning

To make sure the operation is safe; user must do the checking according to machine manufacturer's operation instructions before running.

5.1 Preparation and Examination

It's required to check wiring and connection when connection is finished.

5.2 Encoder (Resolver) Direction Setting

When displayed angle counting direction is different from rotate direction of the main motor, user can change this parameter Pn04 to adjust angle display direction of the controller.

5.3 Set BDC

（Reference to modify the machine parameters）

1）Inch move die to BDC;

2） Press  and enter into machine parameter mode, and input password and go into parameter setting menu.

3）Press  or , and enter parameter Pn01, Press ;

4）Line 2 glitters, long press  over 1 sec until current angle is180°;

5）Release , line 2 stops glittering, press  to exit machine parameter modifying mode.

5.4 Making machine die to automatically stop on TDC at different speeds.

The range of machine speed is divided into several parts, then make machine to automatically stop on TED in different range.

5.5 Notice

Encoder position correcting: If you adjust die position when power off, position displayed will be improper after power supply. In order to correct position, die operates at least one circle after power supply.

5.6 Optional Function（Set and Enable Second Angle）

This function need to set only after system is installed with second angle sensor.

The press runs over one stroke in inch, single or continuous mode:

Press  enter in machine parameter mode, input password, and go to parameter setting menu

Press  or , enter into Pn07. Press ;

Long press  for 1 sec again to confirm the second angle;

Enter into Pn06, press 。

Press  or , set value as 1 to enable second angle; set value as 0 to disable the function;

Press  again.

Notice:

Second angle setting must be performed after BDC setting is complete.

In order to make sure machine run well, it need to set and modify filter time of second angle. When user modifies filter time, it needs to go to edition display menu in monitoring mode. Long press enter key, enter hidden parameter Pn14 of PAC10 (Pn15 of PAC10R), modify filter time of second angle according to real speed of machine, usually, speed of machine is faster, and filter time is set smaller.

Chapter 6 Alarm Processing

Controller will turn off system ready signal immediately when some abnormal situation is detected during machine running, then the controller will output a machine stop signal, the relative error codes will be displayed.

When alarm is displayed, long press Enter key can clear current alarm, user can also use alarm reset input signal to clear the alarm.

Alarm No.	Description	Reason	Trouble shootings
A.01	Parameter error and verifying error	Storage becomes abnormal	Restore to default value
A.02	Power failure data error or shear parameter set unreasonable	Storage becomes abnormal, power failure detection circuit is abnormal or shear parameter set unreasonable	After clearing the alarm, run in inch mode for over 1 cycle, shut the power and then power on again, or reset shear parameter
A.03	Encoder (resolver)abnormal alarm	Encoder (resolver) is offline or C pulse position error	Replace encoder (resolver) , reset BDC or checkup wires and connection
A.04	Encoder (resolver)slippage (sleek)	Encoder (resolver) slippage	Fix encoder and reset BDC and second angle
A.05	Under min. SPM	Lower than minimum SPM limit	Increase motor rotate speed or modify parameter for lowest SPM limit
A.06	Over max. SPM	Higher than maximum SPM limit	Reduce motor rotate speed or modify parameter for maximum SPM limit
A.07	Braking error	Abnormal braking	Modify parameter for braking angle or replace clutch
A.08	Unexpected power failure alarm	PAC10 power off unexpectedly	After clearing the alarm, run in inch mode for over 1 cycle
A.09	Abnormal clutch	Clutch lifetime expires	Remove top stop output counter manually, or check clutch performance and replace it if necessary
A.10	In single mode, stop angle is abnormal	In single mode, stop angle is smaller than 180 degree.	Lower down running speed in single mode or set machine parameter Pn12 as 0
A.11	BDC error	BDC has not been set	Set BDC or second angle
A.12	Power supply not stable	Power supply abnormal	Replace switch power
A.13	Machine runs abnormal	Connection loose	Check circuit and whether connection is loose

Appendix 1: Hardware Diagnosis

Warning

When user carries on UA output port diagnosis or storage FRAM diagnosis, make sure that main motor stop and power supply is cut off, and there is no hazards condition according to machine use instruction.

➢ Output Ports Diagnosis

When user enters into UA of monitoring mode, long press Enter key for 1 sec to go into output ports diagnosis; press UP/DOWN key to select output port which will be tested, press Enter key to switch power level status of this output port. Press F key or long press Enter key for 1 sec to exit output ports diagnosis.

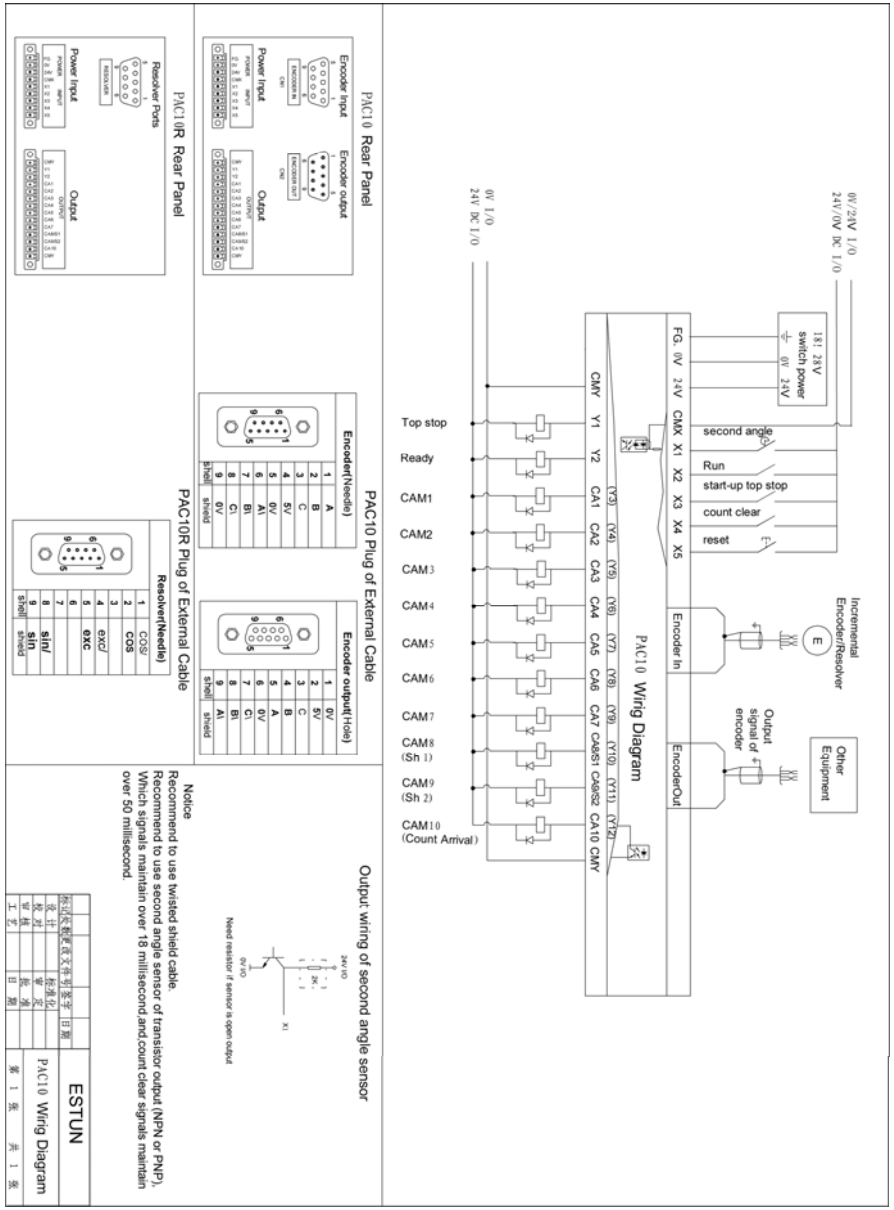
➢ Storage Diagnosis

When user enters into Ub of monitoring mode, press Enter key to go into storage diagnosis mode; If good is displayed, storage is good; and if bAd is displayed, storage is broken. Press F key or Enter key to exit storage diagnosis.

➢ Angle Indicator and LED Diagnosis

When user enters into UC, press Enter key to go into angle indicator and LED diagnosis. LED light cycle, press F key or Enter key to exit angle indicator and LED diagnosis.

Appendix 2：Wiring Diagram



Press Load Monitor

PLA-2N Stage2

User's Guide

We heartily express our gratitude for your making use of our product, Press Load Monitor (Model PLA-2N Stage 2).

In order to ensure safe and proper use of the product, please read and fully understand this User's Guide before operation.
After reading the Guide, please keep it nearby for future reference.

RIKEN OPTECH CORPORATION

Advice on Operation

When operating this device under the following conditions or environments, please allow for an adequate margin of safety in terms of ratings and functions, pay attention to safety measures as a system and consult with our sales staff:

(1) Operation under conditions or environments not described in this Guide.

(2) Application to equipment or facilities requiring particularly high safety (nuclear power control, railway, aviation, vehicles, combustion equipment, medical systems, space development, large-sized recreational machines, etc.).

Safety Instructions

・Alert symbols for safe use and meanings thereof

This Guide indicates safety instructions by using the following symbols. The instructions given here are important for security. Always adhere to them. The symbols and meanings are as follows

 WARNING	Indicates that there is a possibility of death or serious injury resulting from improper use by ignoring this indication.

 PROHIBITION	Indicates general prohibitions.

 WARNING
Never use this device as a safety device that involves human lives.
Once device settings are changed, a qualified person must perform pre-operation inspection to confirm safety before setting to normal operation.
Changes to device settings should be made in strict conformity with the related regulations and standards.

 CAUTION
Do not connect the special cord for the PLA-2N Stage 2 to any other equipment. Possible equipment failure may result.

Request
Do not apply any voltage in excess of the ratings to this product. Possible burst or damage may result.
Do not pour water on this product.

Proper Use
Carry out wiring with the power turned off without fail.
Perform load calibration annually. Strain sensor is a consumable part.
Leave the calibration, sensitivity and alarm values on record.

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Memo

1. INTRODUCTION

This device is an instrument that monitors changes in the load applied to work. It is designed to monitor load changes associated with crank type press machines.

The device is capable of stable load monitoring because it has the function of correcting at proper time for shaking by processing operation of the press machine and for strains produced in environmental conditions around the press machine. When the difference in load between strokes or the actual load exceeds the monitoring range, the device judges this state as a fault and gives a fault signal (emergency stop output) to the outside.

As for the range of detection, the load is detectable while a timing signal given from the outside is on. The load applied to work is detected by measuring the strain generated in the frame of the press machine with a strain gauge.

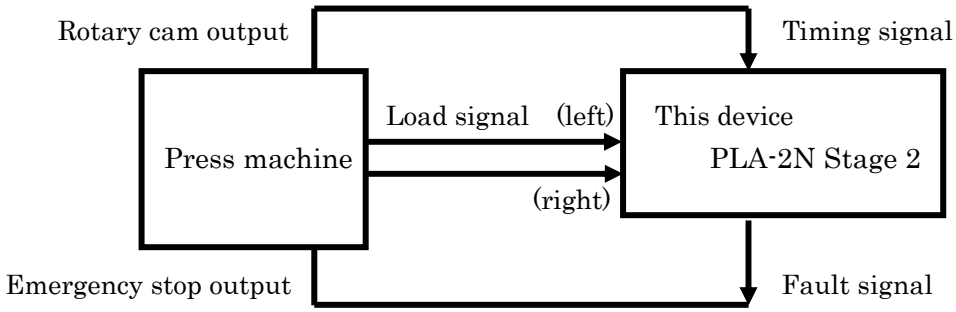


Fig. 1-1 Connection Block Diagram

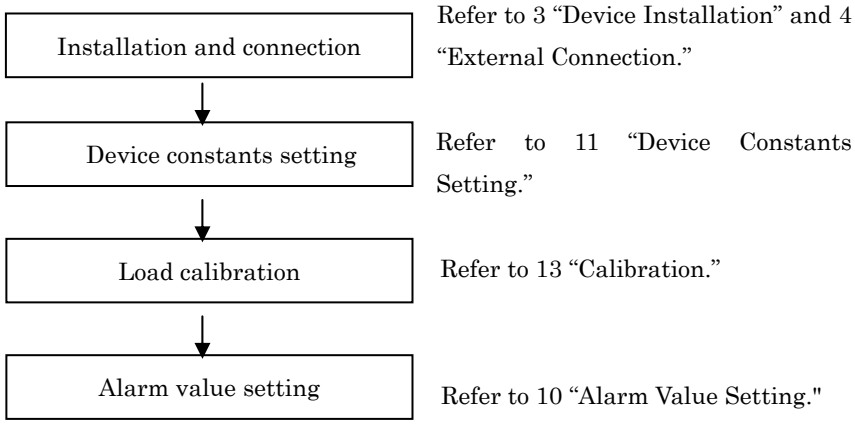


Fig. 1-2 Outside View of PLA-2N Stage 2

The load reading is given in kilonewtons (kN). Fault detection can be selected from two types, i.e., detection of “difference in total load by comparison with last data” and detection of “upper/lower limit of absolute load” in each channel. Upon fault detection, the device gives a fault signal. Details of these types of detection are as follows:

- Detection of difference in total load by comparison with last data
  When the difference between the total load at the current stroke and that at the last stroke exceeds the defined range, the device judges this state as a fault.
- Detection of upper/lower limit of absolute load
  When the difference of load determined by comparison of the load reading given by detection at each stroke per channel with the upper/lower limit setting exceeds the defined range, the device judges this state as a fault.

By carrying out the following steps, the device becomes able to perform load monitoring operation:



2. NAMES OF COMPONENTS

The names and functions of device components are as follows:

2.1 Front Panel

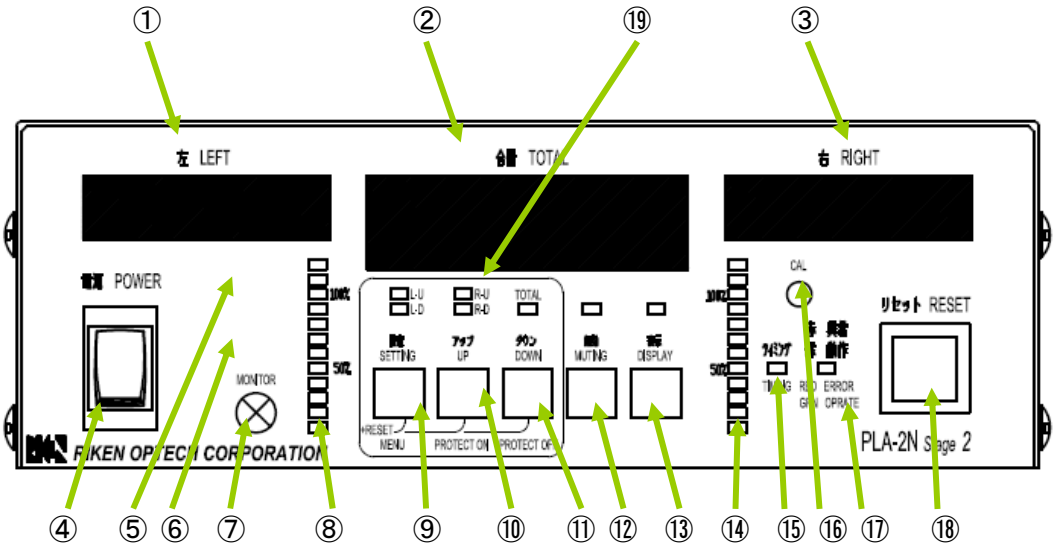


Fig. 2-1 Front Panel

Table 2-1 Names of Front Panel Components

No.	Marking	Name and Description	
①	LEFT	LS (left-side) load display: Gives CH1 side (LS installation) load reading.	
②	TOTAL	Total load display: Gives total load reading of LS and RS load readings added up.	
③	RIGHT	RS (right-side) load display: Gives CH2 side RS (installation) load reading.	
④	POWER	Power switch: The power switch of the device.	
⑤	SPAN L	LS sensitivity control trimmer: The trimmer for controlling LS sensitivity in load calibration.	*1
⑥	SPAN R	RS sensitivity control trimmer: The trimmer for controlling RS sensitivity in load calibration.	*1
⑦	MONITOR	Analog output jack: The jack for checking monitoring voltage (load signal).	
⑧	0～120%	LS level meter: Represents LS load reading as a percentage of one half of press machine capacity.	
⑨	SETTING	Alarm value setting switch: At each push of this switch, settable alarm items are selected in order of LS upper limit, LS lower limit, RS upper limit, RS lower limit, and difference in total load from last data. By pushing it together with RESET switch, you proceed to device constants setting.	

⑩	UP	Setting change switch: The switch for increasing setting in selected item.
⑪	DOWN	Setting change switch: The switch for decreasing setting in selected item.
⑫	MUTING	Monitor muting switch: The switch for temporarily muting load monitoring operation. When load monitoring operation is in mute state, green LED above this switch turns on.
⑬	DISPLAY	Total display indication selector switch: At each push of this switch, “total load reading of LS and RS load readings added up” and “comparative value of total load relative to last data” are indicated alternately on total load display. Green LED above the switch turns off when total load reading of LS and RS load readings added up is indicated and turns on when comparative value of total load relative to last data is indicated.
⑭	0～120%	RS level meter: Represents RS load reading as a percentage of one half of press machine capacity.
⑮	TIMING	Timing LED: Illuminates in red while external timing signal is on.
⑯	CAL	Standard value generating switch: The switch for generating a pseudo signal for operation check.
⑰	RED ERROR / GRN OPRATE	Operation display LED: Indicates ongoing normal operation while it illuminates in green. Indicates ongoing display of fault detection while it illuminates in red.
⑱	RESET	Fault reset switch and fault display LED: The switch for resetting fault detection. Blinks in blue while fault detection is displayed.
⑲	L-U/R-U L-D/R-D/TOTAL	Fault detection item display LED Relations between fault detection items and illuminating LEDs: L-U LED: Fault detection by LS upper limit. R-U LED: Fault detection by RS upper limit. L-D LED: Fault detection by LS lower limit. R-D LED: Fault detection by RS lower limit. TOTAL LED : Fault detection by comparison of total load with last data.

Reference:
The “SPAN L/R” (*1) is not installed in products of standard specifications (for digital sensitivity control). It is installed in a modified version (for analog sensitivity control).

2.2 Rear Panel

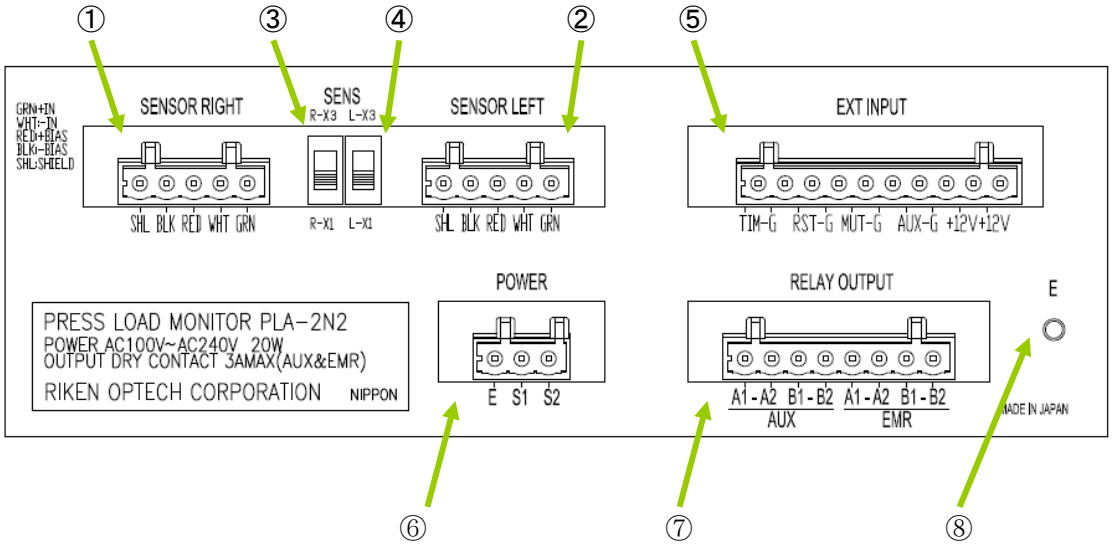


Fig. 2-2 Rear Panel

Table 2-2 Names of Rear Panel Components

No.	Marking	Name and Description	Type of Device Connector & Type of Mating Connector
①	SENSOR RIGHT	RS strain sensor connector: The connector for connecting CH2 side (RS) strain sensor.	721-435/001-000 721-105/037-000
②	SENSOR LEFT	LS strain sensor connector: The connector for connecting CH1 side (LS) strain sensor.	721-435/001-000 721-105/037-000
③	SENS RIGHT	Input signal sensitivity selector switch for RS strain sensor: Amplifies input signal 1-fold when made to slide down and 3-fold when made to slide up.	
④	SENS LEFT	Input signal sensitivity selector switch for LS strain sensor: Same in function as “SENS RIGHT.”	
⑤	EXT INPUT	External input connector: The connector for connecting external timing input signal and mute input signal.	721-440/001-000 721-110/037-000
⑥	POWER	Device power connector: The connector for connecting commercial power.	721-433/001-000 721-103/037-000
⑦	RELAY OUTPUT	Relay output connector: The connector for connecting emergency stop signal and auxiliary output.	721-438/001-000 721-108/037-000
⑧	E	Earth terminal: The screw hole for connecting earth wire.	M4 M4×6 mm screw

2.3 Analog Output Plug

The pin layout (LS (CH1), RS (CH2) and ground) of the 3.5 mm ϕ stereo phone jack connecting to the MONITOR (analog output jack) on the front panel is shown below:

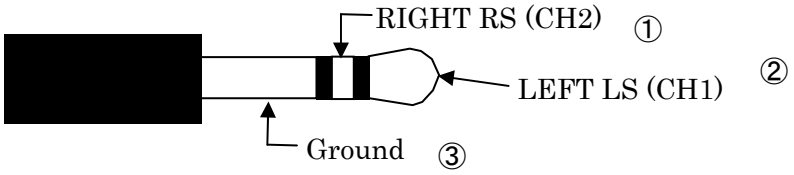


Fig. 2-3 Analog Output Plug

No.	Description
①	CH2 side (RS) monitoring voltage (load signal) is output.
②	CH1 side (LS) monitoring voltage (load signal) is output.
③	Common ground of monitoring voltage (load signal).

Mating plug:
Various 3.5 mm ϕ stereo mini-plugs, 3-prong, are suitable.

3. DEVICE INSTALLATION

This device is easy to install by using the attached rubber pads and fittings. Carry out work, keeping in mind the following procedure and instructions:

(1) Install the device in a place where vibrations are hardly transmitted.

(2) Install the device through rubber pads.
When installing the device on a 2.3 to 3 mm thick steel plate through rubber pads, use M5 x 10 mm Semmes screws, etc. to fix it firmly.。
For the arrangement and size of rubber pads, refer to the dimensional drawing at the end of this book.

(3) The attached fittings should be fastened firmly with M8 x 20 mm hexagon socket head bolts, etc. When the fittings suffer damage by vibrations of the press machine, contemplate making use of ribbed fittings sold separately.

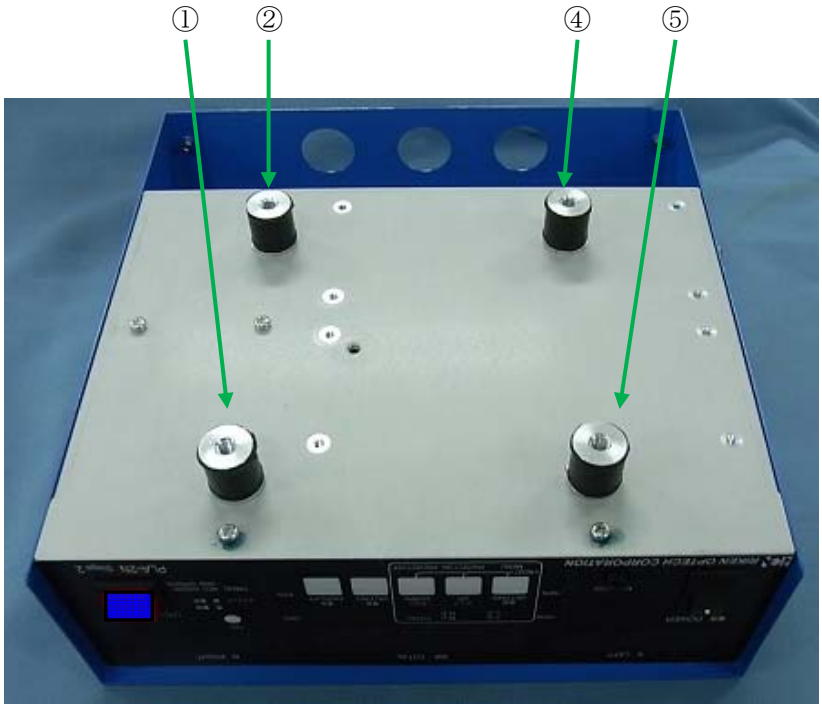


Fig. 3-1 Rubber Pads for Installation

①、②、③、④　Rubber pads 15 mm ϕ x 15-16 mm long

4. EXTERNAL CONNECTION

In order to ensure normal operation of this device, connect the commercial power, strain sensors and signal wires properly.

4.1 Description of Connections

This section describes the details of connections on the rear panel.

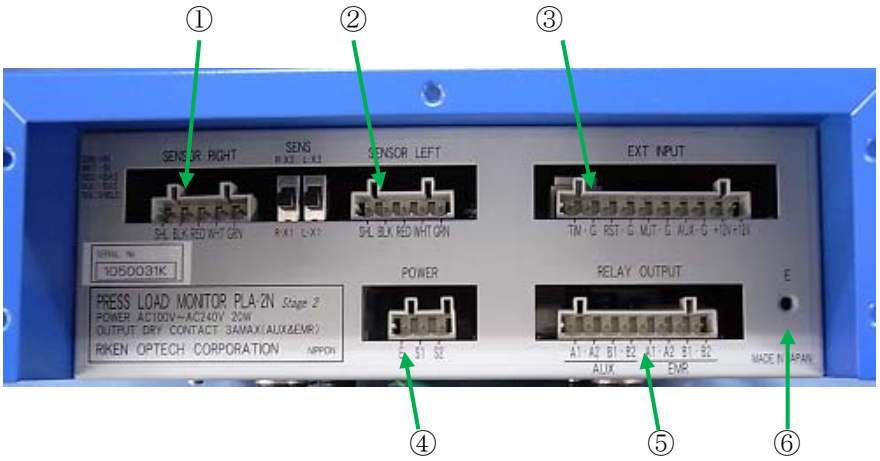


Fig. 4-1 Illustration of Rear Panel Connections

Table 4-1 Connections of Rear Panel Components

No.	Marking	Description	Plug Type
①	SENSOR RIGHT	Connect to RS strain sensor with specified plug attached. For pin layout of plug, refer to Table 5-2" Colors of Connecting Conductors by Type of Strain Sensor."	721-105/037-000 (Made by Wago)
②	SENSOR LEFT	Connect to LS strain sensor with specified plug attached. For pin layout of plug, refer to Table 5-2" Colors of Connecting Conductors by Type of Strain Sensor."	721-105/037-000 (Made by Wago)
③	EXT INPUT	Connect to external input with specified plug attached. For pin layout of plug, refer to Table 4-2 "External Input Pin Layout."	721-110/037-000 (Made by Wago)
④	POWER	Connect external AC power. Connect to 100-240 VAC, 50/60 Hz commercial power by wires suitable for power connection. Perform grounding without fail. For pin layout of plug, refer to Table 4-4" Power Pin Layout."	721-103/037-000 (Made by Wago)
⑤	RELAY OUTPUT	Connect to external output with specified plug attached. For pin layout of plug, refer to Table 4-3"Relay Output Pin Layout."	721-108/037-000 (Made by Wago)
⑥	E	Connect to earth terminal. It is connected to housing.	M4 x 6 mm screw It is recommended to use wire in

size of 1.25 mm^2 or greater for connection.

4.2 Pin Layout of External Input Connector

The pin layout of the external input connector is as shown below.

This connector serves to connect an external timing signal and an external reset signal.

Table 4-2 External Input Pin Layout

Pin No.	Marking	Description of Connection	Remarks
1	+12V	Use as power supply when photoelectric switch or proximity switch is used. The power consumption of the connector should be 100 mA or less.	Do not connect to any other power supply or ground pin (marked "G").
2	+12V		
3	G	Use as signal ground.	
4	AUZ	Standby input.	Not in use.
5	G	Use as signal ground.	
6	MUT	External mute terminal. Load monitoring operation (fault detection operation) is muted while No. 6 pin is shorted to signal ground.	No-volt input External mute signal
7	G	Use as signal ground.	
8	RST	External reset input terminal. Fault detection is reset when No. 8 pin is shorted to signal ground. Same operation as that of "RESET" on front panel.	No-volt input External reset signal
9	G	Use as signal ground.	
10	TIM	External timing input terminal. Load monitoring operation is performed while No. 10 pin is shorted to signal ground.	No-volt input External timing signal

Caution:
Never connect the power terminals (+12V and G) to any other power and to each other.
It is recommended to use a 600V-resistant wire in size of 0.75mm^2 or greater to connect the input signal.

4.3 Pin Layout of Relay Output Connector

The pin layout of the relay output connector is as shown below.

This connector serves to connect a fault signal (emergency stop signal) to the mating equipment.

Table 4-3 Relay Output Pin Layout

<table>
<tr><th>Pin No.</th><th>Marking</th><th>Description of Connection</th><th>Remarks</th></tr>
<tr><td>1</td><td>B2 EMR</td><td rowspan="4">Emergency stop (fault signal) output terminal for no-volt contact output of relevant status. Table below shows output states by status.
<table><tr><th>Status</th><th>A1-A2</th><th>B1-B2</th></tr><tr><td>Power SW OFF</td><td>ON</td><td>ON</td></tr><tr><td>Power SW ON
in normal operation</td><td>ON</td><td>OFF</td></tr><tr><td>Power SW ON
at fault detection</td><td>OFF</td><td>ON</td></tr></table></td><td rowspan="4">ON:
conducting state.
OFF:
non-conducting state.</td></tr>
<tr><td>2</td><td>B1 EMR</td></tr>
<tr><td>3</td><td>A2 EMR</td></tr>
<tr><td>4</td><td>A1 EMR</td></tr>
<tr><td>5</td><td>B2 AUX</td><td rowspan="4">Auxiliary output terminal for no-volt contact output of relevant status. Table below shows output states by status.
<table><tr><th>Status</th><th>A1-A2</th><th>B1-B2</th></tr><tr><td>Power SW OFF</td><td>OFF</td><td>ON</td></tr><tr><td>Power SW ON
in normal operation</td><td>ON</td><td>OFF</td></tr><tr><td>Power SW ON
at fault detection</td><td>ON</td><td>OFF</td></tr></table></td><td rowspan="4">ON:
conducting state.
OFF:
non-conducting state.</td></tr>
<tr><td>6</td><td>B1 AUX</td></tr>
<tr><td>7</td><td>A2 AUX</td></tr>
<tr><td>8</td><td>A1 AUX</td></tr>
</table>

Caution:
Always use a no-volt signal for the rotary cam output, etc. to the input signal.
The load to the output signal should be a resistance load not greater than 250 VAC/3A or 30 VDC/3A or an inductive load not greater than 250 VAC/1.5A or 30 VDC/1.5A.
In addition, it is recommended to make connections using a 600V-resistant wire in size of 0.75mm^2 or greater.

4.4 Pin Layout of Power Input Connector

The pin layout of the power input connector is as shown below.

This connector serves to connect a commercial power to the device.

Table 4-4 Power Pin Layout

Connector Pin No.	Marking	Description of Connection	Remarks
1	S2	ACV IN	Line side
2	S1	ACV IN	Neutral side
3	E	Earth	

Caution:
The voltage applied is within the range of 85-264 VAC, 50/60Hz.
It is recommended to make connections using a 600V-resistant wire in size of 1.25mm^2 or greater.

5. SENSOR CONNECTION

This device and strain sensors should be connected in the following ways, taking note of the details of strain sensor signal wires.

5.1 Method of Installation

Finish the mounting surface so as to come into close contact with the strain sensors.

The strain sensors should be installed on the predetermined side, i.e., on the CH1 side (LS) or CH2 side (RS).

The strain sensors should be installed in such a position as to ensure stable expansion and contraction of the press machine frame. Make mounting holes using a jig such as welding fixture and tap them.

Insert anti-torque washers and torque strain sensors evenly to the specified value for them.

Table 5-1 Tightening Torques by Type of Strain Sensor

Type of Strain Sensor	HELM HT400	Kyowa Dengyo LUM420A	Unipulse UNDLM-400	Remarks
Tightening torque	180	250	180	kgf・cm
	17.6	24.5	17.6	N・m

5.2 Signal Wire

The signal wires of different strain sensors are shown in the table below. Connect your strain sensors, referring to the table.

The sensors on the CH1 side (LS) and those on the CH2 side (RS) are of the same plug type.

Table 5-2 Colors of Connecting Conductors by Type of Strain Sensor

Pin No.	Symbol	Marking	HELM HT400	Kyowa Dengyo LUM420A	Unipulse UNDLM-400	Remarks
1	+IN	GRN	White	Green	White	Sensor + input
2	−IN	WHT	Red	White	Red	Sensor - input
3	+BIAS	RED	Green	Red	Green	Bias +5V power
4	−BIAS	BLK	Black	Black	Black	Bias -5V power
5	SHELD	SHL	Bladed shield	Bladed shield	Yellow	Shield

Note: The “Marking” column indicates the markings on the “SENSOR RIGHT/LEFT.”

5.3 Method of Polarity Inversion

The standard detection method is tension detection. When changing the detection method to compression detection or when the signal output at compression and signal output at tension are inverse in polarity, interchange the connecting wires to “+IN” and “-IN” shown in the “Marking” column of Table 5-2“ Colors of Connecting Conductors by Type of Strain Sensor.”

6. OPERATION

The device should be put into operation when device installation and sensor connection are complete.

6.1 Description

In order to perform load monitoring after completion of installation and connection, it is necessary to set device constants and make load calibration.

To obtain an appropriate load reading from this device, set device constants suitable for the press machine before operation and calibration. Among others, the press machine capacity is an important settable item.

Device constants setting and load calibration can be done on the front panel. The load information in load monitoring is displayed on the front panel.

Make load calibration after completion of device constants setting. To obtain an appropriate load reading continuously, it is recommended to make load calibration at regular intervals.

Load monitoring operation is performed while an external timing signal is on.

During load monitoring operation, the device gives the load reading and automatically makes two types of detection, i.e., detection of "difference in total load by comparison with last data" and detection of "upper/lower limit of absolute load." The detection of difference in total load by comparison with last data begins automatically on the 2nd external timing signal after the start of operation.

When a load reading above or below the alarm value is detected, the device judges this state as a fault and gives a fault signal (emergency stop signal).

The fault signal is reset at the push of the RESET switch, but the load reading remains unchanged.

6.2 Preparation for Operation

The flow of preparation for operation is as follows:

(1) Connect the strain sensors for load detection.
For details of connection, refer to 4 "EXTERNAL CONNECTION" and 0 "

SENSOR CONNECTION."

(2) Connect the external timing signal (rotary cam output) from the press machine to the device. Select as the rotary cam output such a one that turns on at a cam angle of 90° to 270° and use it exclusively for device operation.

Caution: Select the angle at which the external timing signal turns on, referring to 7. "EXTERNAL TIMING SIGNAL." Unless the external timing signal is properly input, the load reading may become unstable. It is recommended to make the external timing signal turn on when the expansion and contraction of the press machine frame is stable.

(3) Turn on the power to the device.

> Caution:
> Connect the strain sensors before turning on the power to the device.
> Input the external timing signal 30 seconds or more after turning on the power to the device. For stable monitoring, it is preferable to energize the device about 30 minutes in the standby state.

(4) Set the press machine capacity, etc., adjusting to the press machine, and set other constants, adjusting to the system as well

(5) Carry out load calibration, comparing the actual load with the load reading, and set the sensitivity of the device.

> Caution:
> Always leave the sensitivity setting and calibration value on record. Use them for future maintenance at device replacement, etc. It is preferable to write the sensitivity setting on the cover, etc.

6.3 Operating Method

(1) Turn on the power to the device.

> Caution:
> Turn on the external timing signal 30 seconds or more after turning on the power to the device. Never push the CAL switch during load monitoring operation.
> For stable monitoring, it is preferable to energize the device about 30 minutes in the standby state.

(2) Load monitoring operation starts by turning on the external timing signal.

(3) Load monitoring operation ends by turning off the external timing signal.

(4) The peak load reading is indicated on the LS and RS load displays, and the total load reading or comparative value of load relative to last data is indicated on the total load display.

(5) Repeat steps (2)-(4) to perform operation.

6.4 Set-up Operation Procedure

Any particular procedure is unnecessary for normal operation. However, when you want to stop detection (fault signal generation) by load monitoring temporarily to improve the operating efficiency in the set-up operation, it will is convenient to make use of the MUTING switch.

When load monitoring operation is in the mute state, the green LED above the MUTING switch turns on.

The mute state is canceled by pushing the MUTING switch again. It cannot be canceled automatically.

6.5 Caution

When the operating mode (selected in the process of device constants setting) is set to single operation by device constants setting, always push the RESET switch after die change.

6.6 Others

This device is not provided with such functions as reverse load display and load monitoring data communication. In cases where these functions are necessary, it is recommended to get them performed by a higher-level system or purchase a sister load monitor provided with these functions.

7. EXTERNAL TIMING SIGNAL

The external timing signal is a very important signal for load monitoring operation.

This device monitors the on/off state of the signal and carries out load monitoring process and automatic zero adjustment. If the signal turns on or off with improper timing, not only a stable load reading will be unable to be obtained, but also the operating behavior of the device will be unstable.

In order to input a proper external timing signal, how the load changes with the external timing signal is shown below:

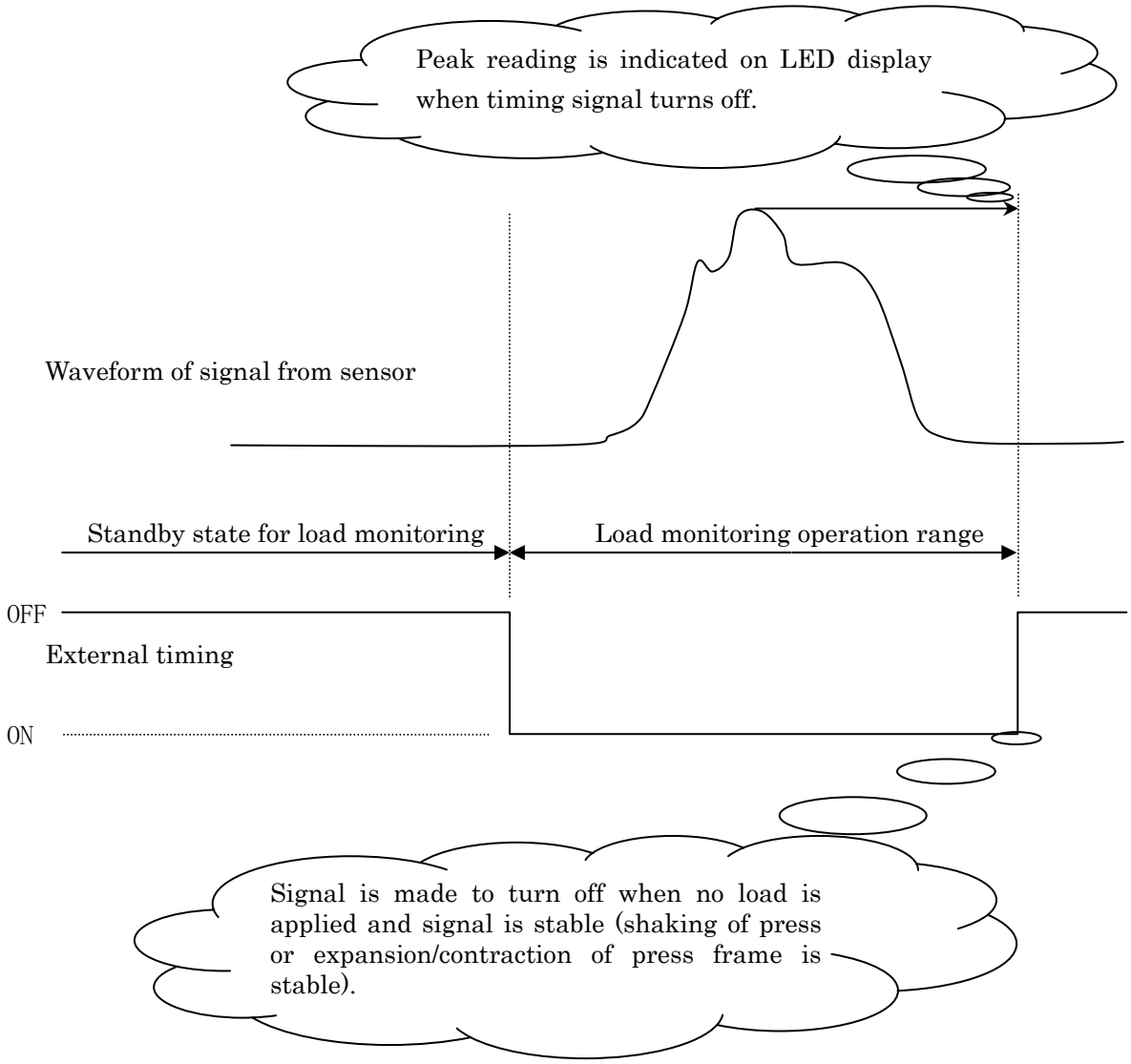


Fig. 7-1 Input of Proper External Timing Signal

8. INTERNAL TIMING SIGNAL

This device has the function of performing load monitoring operation by automatically generating an internal timing signal when an external timing signal is not available.

When using the internal timing signal, change the type of timing signal by device constants.

In order to help understand how an internal timing signal is generated, how the load changes with the internal timing signal is shown below:

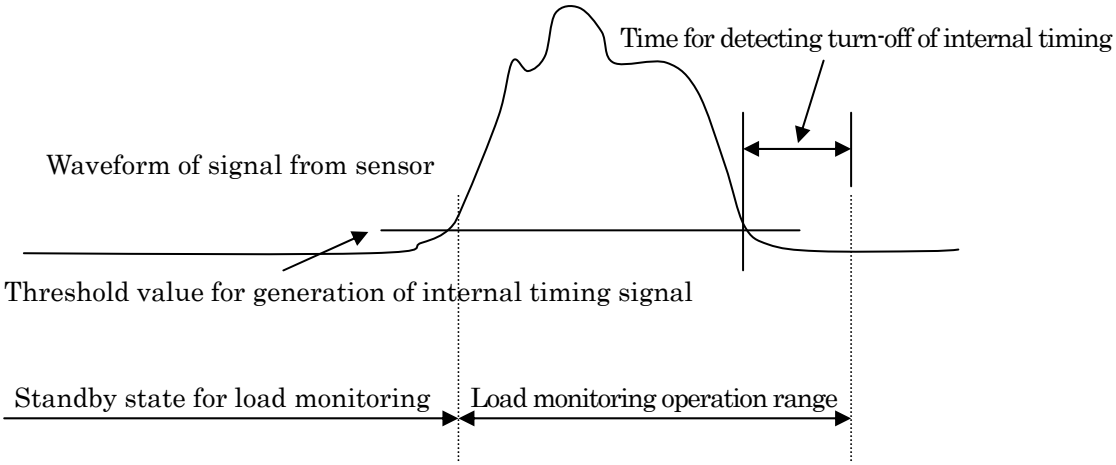


Fig. 8-1 Generating State of Internal Timing

When the waveform of the load monitoring signal from either of the strain sensors exceeds the threshold value for generation of internal timing signal, an internal timing signal is generated to start load monitoring operation The threshold value for generation of internal timing signal can be selected from among device constants of 5%, 10% and 20%.

The internal timing signal ends after the lapse of the time for detecting turn-off of internal timing from when the signal waveform becomes lower than the threshold value for generation of internal timing signal.

9. HARDWARE SETTING

This section shows the settings of the device.

9.1 Switch Setting

Shows the factory default settings within the device.

Table 9-1 Factory Defaults of Switches

Switch No.	Factory Default	Description
SENS R-X3	R-X1(lower position)	Sensitivity selector switch for strain sensor input signal: Located on rear panel. Rear panel is on inner side of mounting plate.
SENS L-X3	R-X1(lower position)	

9.2 Jumper Setting

Shows the factory default settings within the device.

Table 9-2 Factory Defaults of Jumpers

Jumper No.	Factory Default	Description
JP1,JP2	Short btw 1-2	Sensitivity change jumper
JP3	Open btw 1-2	Signal selector switch
S5,S4	All OFF	

10. ALARM VALUE SETTING

This section describes how to set a fault judging value or an alarm value in two types of detection, detection of "difference in total load by comparison with last data" and detection of "upper/lower limit of absolute load," which are made automatically during load monitoring operation.

(1) When you want to change the alarm value, push the SETTING switch, irrespective of whether the device is at halt or in continuous operation, to enter into the setup mode.

(2) At the push of the SETTING switch, the "L-U" LED turns on at first. At each push of the switch, the settable items change. The transition sequence, descriptions and display indications of the settable items are as shown in the table below.

(3) The setup mode ends by pushing the SETTING switch at the set No. 5. By pushing the RESET switch during the process, the setup mode ends as well

(4) The settings can be changed by pushing the UP or DOWN switch. The percent figures of the settings are indicated by the level meters on the respective sides.

(5) When the SETTING switch is pushed, the indicated settings or set numbers are stored.

(6) When no switch is operated at all, the setup mode ends automatically after the lapse of 10 seconds.

Table 10-1 Explanation of Alarm Value Setting Procedure

Set No.	Settable Item	LED "ON"	Display Indication			備　考
			LEFT	TOTAL	RIGHT	
1	LS upper limit	L-U	Setting	0	0	
2	LS lower limit	L-D	Setting	0	0	
3	RS upper limit	R-U	0	0	Setting	
4	RS lower limit	R-D	0	0	Setting	
5	Difference in total load from last data	TOTAL	0	Setting	0	

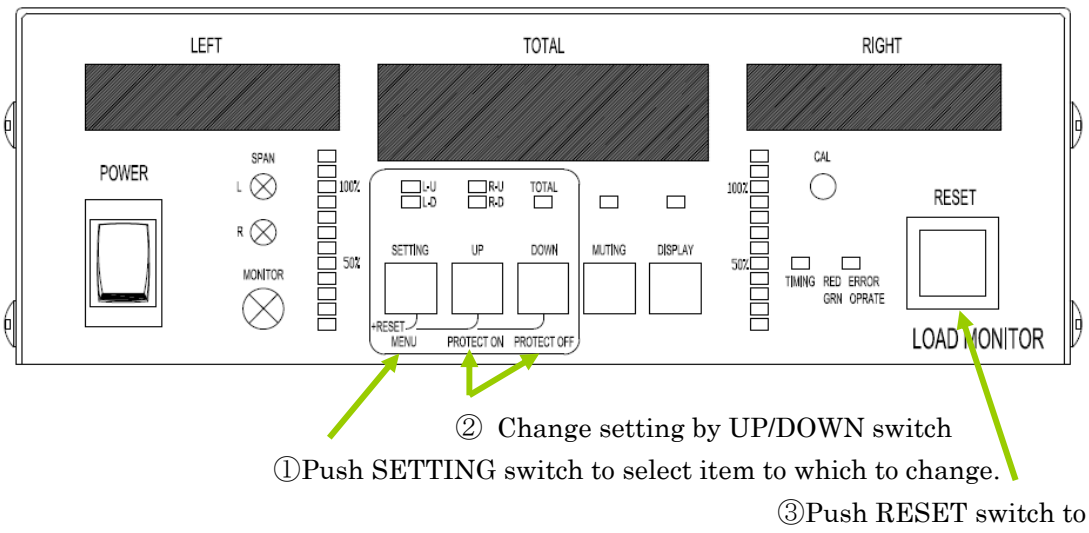


Fig. 10-1 Illustration of Alarm Value Setting Procedure

11. DEVICE CONSTANTS SETTING

This section describes the constants for defining the conditions of load monitoring operation of this device.

Being preset with standard settings at the factory, the device can be used by selecting the press machine capacity and necessary functions. Defaults of device constants are provided so that you can utilize the capability of the device to the full by setting its basic operation. In order to use the device more efficiently, optimize the settings for the intended use of your press machine and this device.

11.1 Method of Starting Setup Mode

To start the setup mode, push the RESET switch while pushing the SETTING switch. When the device enters into the setup mode, the load displays indicate the following:

LEFT	TOTAL	RIGHT
[1]	Press machine capacity	2.00

Note that the numerical value indicated on the "RIGHT" load display might be different from the above value.

11.2 Settable Items

(1) After the start of the setup mode, the settable items change at each push of the RESET switch.

(2) The transition sequence, descriptions and display indications of the settable items are as shown in the table below. The calibration constant given as a settable item is a confirmation value, not a setting.

(3) The RESET switch when pushed at the set No. 10 blinks after the display of equipment information. Then push the RESET switch. The device exits from the setup mode and enters into the standby state for load monitoring.

(4) The settings and set numbers can be changed by pushing the UP or DOWN switch.

(5) When the RESET switch is pushed, the indicated settings or set numbers are stored.

Table 11-1 Explanation of Device Constants Setting Procedure

Set No.	Settable Item	Display Indication			Default
		LEFT	TOTAL	RIGHT	
1	Press machine capacity	[1]	Setting	Version No.	20000kN
2	External input polarity	[2]	Set No.	ditto	0
3	Timing mode	[3]	Set No.	ditto	0
4	Chattering prevention time	[4]	Set time	ditto	30ms
5	Internal timing turn-off detection time	[5]	Set No.	ditto	20ms
6	Total display method	[6]	Set No.	ditto	0
7	Mute mode	[7]	Set No.	ditto	0
8	Operating mode	[8]	Set No.	ditto	1
9	User password	OLDPW	Setting		2010
10	Calibration constant (standard value)	LS calibra-tion value	CAL	RS calibra-value	

11.2.1 Press machine capacity

The press machine capacity is settable in units of 100 kN in the range of 100 to 40,000 kN. In this device, the press machine capacity denotes the LS channel capacity plus the RS channel capacity

The default is 20,000 kN.

11.2.2 External input polarity

Sets the logical level of the external input signal given to the external input connector on the rear panel.

The default is always “ON” (set No. 0).

Signal / Set No.	Auxiliary	Muting	External Reset	External Timing	Remarks
0	ON	ON	ON	ON	Default
1	ON	ON	ON	OFF	
2	ON	ON	OFF	ON	
3	ON	ON	OFF	OFF	
4	ON	OFF	ON	ON	
5	ON	OFF	ON	OFF	
6	ON	OFF	OFF	ON	
7	ON	OFF	OFF	OFF	
8	OFF	ON	ON	ON	
9	OFF	ON	ON	OFF	
10	OFF	ON	OFF	ON	
11	OFF	ON	OFF	OFF	
12	OFF	OFF	ON	ON	
13	OFF	OFF	ON	OFF	
14	OFF	OFF	OFF	ON	
15	OFF	OFF	OFF	OFF	

11.2.3 Timing mode

Sets the type of timing signal.

The percent figure of the internal timing is a threshold value. The load reading equal to set press machine capacity x 0.5 is the 100% value per channel.

For example, when the pressure value of the press machine sets to "20,000kN" and the timing type sets to "internal timing 10%", 1,000kN is a threshold value per channel.

Set No.	Type of Timing	Remarks
0	External timing	Default
1	Internal timing 5%	
2	Internal timing 10%	
3	Internal timing 20%	

11.2.4 Chattering prevention time

Sets the chattering prevention time for the external input signal given to the external input connector on the rear panel.

The chattering prevention time is settable in the range of 1 to 250 ms. The default is 30 ms.

Caution: After an external timing signal is input, load monitoring is not done during the chattering prevention time. Take this into account when setting the time.

11.2.5 Internal timing turn-off time

Sets the time at which to end an internal timing signal when internal timing is selected in at the time of setting the timing mode.

The turn-off time is selectable in units of 10 ms in the range of 10 to 1000 ms. The default is 20 ms.

11.2.6 Total display method

Selects the method of adding up the LS and RS load readings on the total load displays.

Set No.	Description	Remarks
0	Indicate total of peak LS and RS load readings added up.	Default
1	Indicate total peak LS and RS load readings including eccentric loads thereof.	

11.2.7 Mute mode

Sets the operation when the MUTING switch on the front panel is pushed.

Set No.	Description	Remarks
0	In detection during load monitoring operation, do not make (mute) fault check except for upper limit of absolute load in each channel	Default Used for overload detection.
1	In detection during load monitoring operation, do not make (mute) fault check at all.	

11.2.8 Operating mode

Sets the conditions in which to reset the last data when detecting “difference in total load by comparison with last data.”

Set No.	Description	Remarks
0	Continuous operation	Comparative value of total load relative to last data is reset when standby state for load monitoring (operation stop time) continues 2 seconds or more.
1	Single operation	Default Comparative value of total load relative to last data is not reset when standby state for load monitoring (operation stop time) continues 2 seconds or more. Caution:

		When the load reading compared changes as a result of die change, etc., a fault signal is always generated at first. When die change is done, push the RESET switch without fail.

11.2.9 User password

Authentication by user password is provided to prevent the adjusted sensitivity from being changed easily. The press machine controller should set and record a new user password when he has taken over the duty of controlling this device.

Authentication by user password is applied for load calibration.

Set No.	Description	Remarks
0000 ～ 9999	4-digit password	Default 2010

How to change the user password:

The procedure of changing the user password is as follows. The table below shows the display indications by sequence.

(1) When "OLDPW" is displayed, set the old password by the UP or DOWN switch.
By continuing to push the UP/DOWN switch for 1 second or more (long-time pushing), additions or subtractions of numerical values change at high speed.

(2) Then push the SETTING switch.
When the old password does not agree with the setting, "NG" is displayed (refer to the table below) and the device waits for reentry. When the old password agrees with the setting, "NEWPW." is displayed.

(3) When "NEWPW" is displayed, set a new password by the UP or DOWN switch.

(4) Then push the SETTING switch.
The new password is defined. Then proceed to the next settable item (calibration constant).

Set No.	Settable Item	Display Indication			Operating Method
		LEFT	TOTAL	RIGHT	
1	Input of old password	OLDPW	Setting of old password	NG	Push RESET switch down to proceed to next settable item (calibration constant).
2	Input of new password	NEWPW	Setting of new password		

11.2.10 Calibration constant

Indicates a value referenced to the standard internal sensitivity defined by load calibration

In this item, record the readings indicated on the LS and RS load displays when the CAL switch is pushed about 1 second. These readings should be left on record.

11.3 Key protect function

This device has the “key protect” function of protecting alarm values and device constants against accidental change. This function disables responding to operations of front panel switches other than the CAL and RESET switches.

The operating method to enable or disable the key protect function is described in the table below:

Key-protect State	Operating Key	Identification Method
ON (Enables key protect function)	Push UP and RESET switches together.	Decimal point at 1st digit on “TOTAL” load display” illuminates.
OFF (Disables key protect function)	Push DOWN and RESET switches together.	Decimal point at 1st digit on “TOTAL” load display blacks out.

12. DIMENSIONAL DRAWING

The outline and dimensions of this device are as shown below:

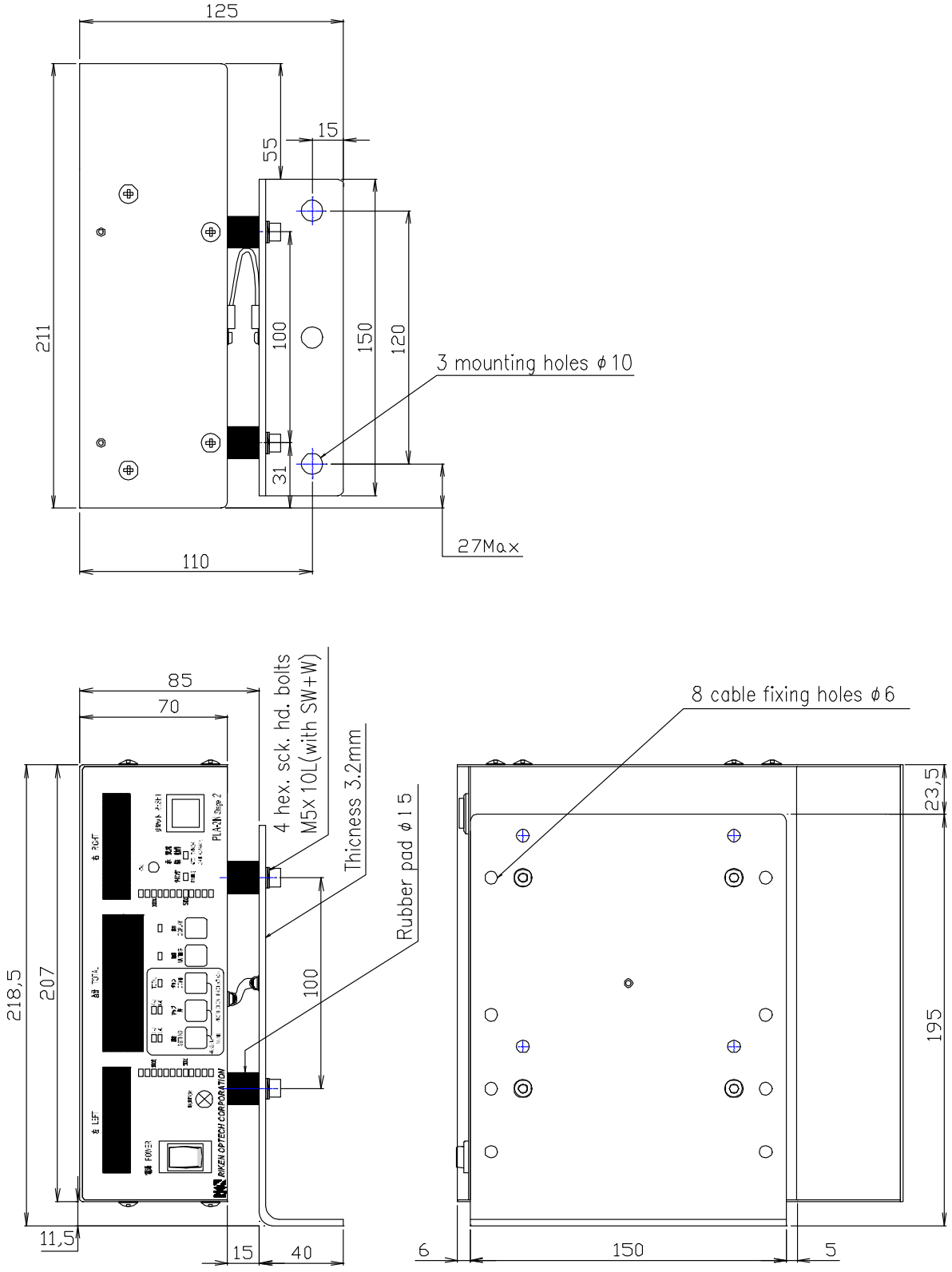


Fig. 12-1 Dimensional Drawing

13. CALIBRATION

Calibration is performed using load cells, etc. to adjust the load reading, obtained through detection by this device, to the actual load. This operation is called "load calibration."

It is recommended to carry out load calibration annually.

Load calibration should be done by an operator who is well-informed about the press machine and this device. This operation may be taken charge of by our dealer or service division. This section gives an outline of the load calibration procedure.

WARNING
When operating the press machine, always check for the absence of obstacles including load cells in the operating rang in order to prevent possible damage to the press machine.
A qualified person appointed by the employer should exercise control responsibly and forbid any other person from operating the device.
Fragments of load cells when damaged during calibration may scatter, resulting in an unexpected danger. During operation, attention should be paid to the surroundings to prevent such a danger.

WARNING
When making slide adjustment, determine its relation with variation in load reading to prevent damage to the press machine.
Grasp the overall amount of movement to prevent damage to the load cells and press machine.

13.1 Load Calibration Procedure

The number, layout and type of load cells vary with the type of the press machine and attached sensors. This section shows the flow of load calibration.

Flow of load calibration:

(1) Install the load cells.
(2) Set the device constants including the press machine capacity, type of timing, total display method, etc. (this step is unnecessary when the device constants are already defined).
(3) Apply pressure.
(4) Adjust the device's load reading in the load calibration mode, comparing with the load cell readings.
(5) Repeat steps (3) and (4) to make the readings agree.
(6) Check and record the LS and RS internal sensitivities.
(7) Push the RESET switch down to exit from the load calibration mode.
(8) Apply pressure and recheck the device reading and load cell readings.
(9) Compile a calibration record.

13.2 Load Calibration Mode

Proceed to the load calibration mode to set the internal sensitivity. How to operate in the load calibration mode is described below:

(1) Turn on the power switch of the device and push the RESET switch down when it blinks.

(2) Push the SETTING switch down while pushing the front panel DISPLAY switch down.
By so doing, you proceed to the load calibration mode.
Disable the key function once beforehand because the device cannot be operated when the function is enabled.

(3) Enter the user password and push the SETTING switch down.
The numerical value can be set by pushing the UP or DOWN switch. By pushing these switches for long, the numerical value changes at high speed.
When the user password does not agree, "NG" is displayed on the CH2 display ("RIGHT") and the device waits for reentry.
To cancel this state (return to the standby state for load monitoring), push the RESET switch down.

(4) The current internal sensitivity of CH1 is indicated on the CH1 display ("LEFT).
Nothing is indicated on the CH2 display.
The numerical value can be set by pushing the UP or DOWN switch. By pushing the SETTING switch down, the display indication changes to the CH2 display.
The settable range is 0 to 255.

(5) By pushing the SETTING switch down, the current internal sensitivity of CH2 is indicated on the CH2 display. Nothing is indicated on the CH1 display.
The numerical value can be set by pushing the UP or DOWN switch.
By pushing the SETTING switch down, the display indication changes to the CH1 display.
The settable range is 0 to 255.

(6) Then, steps (4) and (5) are repeated at each push of the SETTING switch.

(7) Push the SETTING switch down to select the channel subject to load calibration.

(8) Apply pressure in synch with the external timing signal.

(9) When the external timing signal turns off, the peak load reading in kN is indicated on the total load display.
Then, by pushing the DISPLAY switch down, the AD value of peak load reading is indicated.
For identification, turning on of the LED lamp above the DISPLAY switch denotes the indication of the AD value of peak load reading and turning off of the lamp denotes the indication of the peak load reading in kN.

(10) Select the internal sensitivity at which the device reading and load cell reading agree to the maximum.
When the readings cannot be adjusted by setting the internal sensitivity at the maximum (255) or minimum (0), try to adjust by changing the position of the SENS switch on the rear panel.

(11) Repeat steps (8) to (10) and confirm that the device reading and load cell reading agree.

(12) Then select the internal sensitivity of the other channel.

(13) After completion of internal sensitivity selection for the two channels, record the respective internal sensitivities without fail.
It is recommended to write them on the cover, etc.

(14) By pushing the RESET switch down, the values of the respective internal sensitivities are stored and the load calibration mode ends.

Caution: Password authentication is necessary only in the initial stage of this mode after turning on the power to the device. Check for agreement between the readings two or three times.

13.3 Load Calibration Operation

The steps of load calibration operation are described below:

 WARNING
When operating the press machine, always check for the absence of obstacles including load cells in the operating rang in order to prevent possible damage to the press machine.
A qualified person appointed by the employer should exercise control responsibly and forbid any other person from operating the device.
Fragments of load cells when damaged during calibration may scatter, resulting in an unexpected danger. During operation, attention should be paid to the surroundings to prevent such a danger.

 WARNING
When making slide adjustment, determine its relation with variation in load reading to prevent damage to the press machine.
Grasp the overall movement to prevent damage to the load cells and press machine.

13.3.1 Installation of load cells

The flow of load cell installation is as shown below. In the actual work, install the load cells so as to adapt to individual press machines.

(1) Lower the press slide to the bottom dead center.
(2) Locate each load cell on a steel plate laid for load distribution so as to be in a position just under the shaft (called “point position”).
(3) Adjust the height of the load cell (or die height) to such a degree as to keep the load cell off the slide.
(4) Run the press once and check the load cell readings.
(5) Lower the slide to a position at which the total load cell reading is about 80% of the press machine capacity.

Caution: It is recommended to make the slide lower by 0.1 mm or less at a time. Constantly check whether the load cell readings are appropriate.

(6) Repeat steps (3) to (5) until the total load cell reading is about 80% of the press machine capacity.

13.3.2 Check of device constants

Ask the press machine controller whether the device constants and alarm values are appropriate for the press machine.

Change the device constants and alarm values if necessary.

For information on how to set device constants, refer to Sect 11 “Device Constants Setting.”

13.3.3 Pressure application

Apply pressure to the load cells and check for indication of readings on the LS and RS load displays and total load display of the device. Also apply pressure so that the LS and RS load readings are evenly balanced.

Caution:
Perform operation within the limits of about 80% of the press machine capacity.

13.3.4 Selection of internal sensitivity (load calibration mode)

For information on how to operate in the load calibration mode, refer to 13.2 “Load Calibration Mode.”

(1) Proceed to the load calibration mode.
(2) Run the press once and check the load cell readings.
(3) Check the device reading at that time.
(4) Adjust the internal sensitivity in the load calibration mode so that the LS and RS load readings agree with the readings of the LS and RS load cells or the readings of the load cells allotted to the channels.

For information on how to operate in the load calibration mode, refer to 13.2 “Load Calibration Mode.”

Caution:
The internal sensitivity can be adjusted in the range of 0 to 255. Adjustment should be made step by step.

(5) Push the RESET switch down to exit from the load calibration mode once.
(6) Repeat running the press once and check the load cell readings.
(7) When the device reading and load cell readings do not agree, repeat steps (1)-(6).
(8) Repeat step (7) until the respective load readings are within a tolerance of ±1 to 5%.

Caution:
When the device reading is too small for adjustment, change the position of the SENS switch to the X3 side and try to repeat adjustment. On the contrary, when the device reading is too great for adjustment, change the position of the SENS switch to the X1 side and try to repeat adjustment.

13.3.5 Record of calibration value

After calibration, check the internal sensitivities of each channel in the load calibration mode.

The values of the respective sensitivities should be written on the calibration record, cover, etc. for storage.

13.4 Layout and Division of Load Cells

The calibration operation includes three patterns, i.e., case with one load cell, case with two load cells and case with three load cells, depending on the structure of the press machine.

In any case, the layout and number of load cells should be determined with due consideration to the distributed load arising when the press machine applies pressure to

the load cells. Misjudging may not only cause damage to the press machine and load cells, but also give rise to personal injury. Therefore, full study should be made before calibration operation.

A description is made below of the outline in the cases of a C-frame press and a wide-bed press for the purpose of reference.

13.4.1 C-frame press

Usually in the case of a C-frame press, calibration is performed using one load cell.

As the slide is moved up and down by one connecting rod, the load cell is located just beneath the rod, as a rule.

Caution: Do not adjust the reading by moving the load cell. The cell position should be fixed.

13.4.2 Wide-bed press

 **WARNING**
In the case of a high-speed press, take particular note that possible failure may result when the distributed load is applied to the slide.

A wide-bed press with two rods uses two load cells, which are located just beneath the respective rods

Unless the load cells are located just beneath the rods, the load is not transmitted efficiently to the load cells due to pressure application by the rods. Also note that possible failure of the machine and load cells may result because the distributed load is applied to the slide.

14. SPECIFICATIONS

This section describes the specifications of this device.

14.1 Description

This device detects and measures the load generated in the press machine with strain sensors (strain gauges).

The device reads the load while an incoming external timing signal is on and gives the peak load reading just after turning off of the external timing signal.

The device makes zero adjustment automatically on startup and just after turning off of the external timing signal

14.2 Electrical Specifications

14.2.1 Power section

Power	85-264 VAC, 50/60 Hz
Power consumption	20 W max.
Terminal	Totally waterproof receptacle with header protected against mismating, with side plate 721-433/001-000

14.2.2 Detector section

No. of channels	Two (2)
Sensor	Strain gauge type 350Ω
Repeating accuracy	Within 1% of press machine capacity
Max. detection range	Press machine capacity: 100-40,000 kN Not more than 120% of channel capacity (24,000 kN on one side is maximum detection limit) channel capacity [kN]= press machine capacity [kN] / 2 [ch]
Pressurizing time	1 second max.
Connector	Totally waterproof receptacle with header protected against mismating, with side plate 721-435/001-000

14.2.3 Input/output section

External timing signal	Photo-coupler input (12 VDC), electrically turned on, signal ground: connected to ground in internal circuit
Muting signal	Photo-coupler input (12 VDC), electrically turned on, signal ground: connected to ground in internal circuit
Emergency stop output	1A and 1B, not more than 250 VAC/5A (with resistance load)
Auxiliary output	
Connector	Totally waterproof receptacle with header protected against mismating, with side plate 721-438/001-000

14.2.4 Display section

Load display	5-digit red LED display in kN

14.2.5 Others

Method of storing settings	By EEPROM
Record keeping period for settings	10 years or over
Max. operating speed	1,000 spm max However, note that the speed is affected by length of time during which external timing signal remains off. It is recommended that length of time in off-state of external timing signal be not less than 50% of operating time.
Operating temperature range	-10 to +40℃
Storage temperature range	-20 to +55℃
Humidity	10 to 85 % RH No condensation

14.3 Housing Specifications

Dimensions	207(W)×70(H)×211(D), not including projections
Measures against salt damage	Nil
Installation	Screw cramp through rubber pad
Weight	Body: Approx. 1.9 kg L-fitting: Approx. 0.9 kg

14.4 Accessories

User's guide	1 book
Mounting bolt	2 pcs. (M8 x 15 hexagon socket head bolt)
Control lever	2 pcs. (231-131, made by Wago)
Power connecting plug	1 pc. (721-103/037-000, made by Wago)
Strain sensor connecting plug	2 pcs. (721-105/037-000, made by Wago)
External output signal connecting plug	1 pc. (721-108/037-000, made by Wago)
External input signal connecting plug	1 pc. (721-110/037-000, made by Wago)
Blind seal	1 pc.

15. TROUBLESHOOTING

This section prescribes possible remedies for troubles you may encounter when operating this device. Please make use of them.

Phenomenon	Possible Remedy	Remarks
Peak load reading is nearly equal to channel capacity.	Connect earth terminal of this device to earth terminal of good quality.	
Monitoring voltage output signal is oscillating.	ditto	
Monitoring voltage output is over +10V or below –10Vsince just after turning on power to device. Load display remains at zero.	Check for following: (1) Remove strain sensor connector and check that each strain sensor wire is electrically nonconductive to machine housing. (2) Resistance between strain sensor wires +IN and –IN is about 360Ω. (3) Each strain sensor wire is electrically nonconductive to shield wire. (4) Each strain sensor wire is electrically nonconductive to strain sensor frame. (5) Monitoring voltage output becomes about 0V when the device's sensor inputs +IN and –IN are shorted. When the device does not comply with one of above conditions, replace strain sensor with new one, including connecting wire.	
Load display does not change to zero.	Check for following: (1) Strain sensor frame is connected to housing earth with resistance not exceeding several Ω. (2) When strain sensor wire is relayed at some midpoint, resistance between shield wires relayed through relay terminal is below several Ω while they straddle relay terminal. When connection is not judged reliable, replace strain sensor with new one, including connecting wire	
The load reading becomes lower when the press machine is put into operation.	The period during which the external timing signal is on is improper. Adjust it, referring to Sect. 7 "External Timing Signal."	
Something difficult to understand has happened.	Reexamine settings of device constants. Recheck for condition in which external timing signal turns on. Observe on oscilloscope how monitoring voltage output signal is related with timing signal and send observed waveform to manufacturer.	

RIKEN OPTECH CORPORATION

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RECEIPT

For safe and efficient operation of this device, you are requested to submit this form to us after receipt or installation of the device.

1. Device information (Enter basic information on press machine and this device.)

Device	Press load monitor	Press machine type		Manufacturer	
Model	PLA-2N Stage 2	Serial No.		Press capacity	kN
Serial No.		Enter accessory equipment if any below.		PROGRAM VERSION	
Others					

2. Connection between this device and press control panel (Enter terminal Nos., etc., connected to control panel of press machine.)

This device		Press control panel			This device		Press control panel
Power					External input		
S1	ACV				+12V		
S2	ACV				+12V		
E	Earth				G		
Relay output					MUT	Muting	
A1	AUX		EMR		G		
A2	AUX		EMR		RST	Reset	
B1	AUX		EMR		G		
B2	AUX		EMR		TIM	Timing	
—	—				—	TDC	
—	—				—	BDC	

Timing signal 1	Cam No.		Cam angle	～
Timing signal 2	Cam No.		Cam angle	～

3 Strain sensor connection (Enter conditions in which strain sensors are connected.)

No.	Entry	Standard range	CH1(LEFT)	CH2(RIGHT)
1	Manufacturer & serial No.	—		
2	Resistance btw sensor signals	> 350Ω ±3%		
3	Initial unbalanced output	> ±2000		
4	Unbalanced output after installation	—		
5	Strain variation (Item 4 – Item 3)	> ±800		
6	Sensitivity setting	X1/X3	☐X1 ☐X3	☐X1 ☐X3
7	Calibration value	0～255		
8	Polarity	—	☐Tension ☐Compression	

4. Option (unit, light sensor, etc.) (Enter peculiar details of optional equipment, etc.)

5. Checker/Operator

To: Riken Optech Corporation Date:

We received your explanation and user's guide on receipt of product.

Your name Location

Department Person in charge Signature Phone ( ) —

6. Corporate column

Date installed		Job No.			
Installed by		Instruction No.			

LOAD CALIBRATION RECORD

1. Customer and device information　　Date of calibration　/　/

Device model	PLA-2N Stage 2	Serial No.			
Press capacity	kN		Strain sensor SN		Strain sensor SN
Strain sensor manufacturer		CH1 sensor		CH2 sensor	
Customer			Person in charge		
Press machine manufacturer		Control No		Stroke length	mm
Press machine type		Die height	mm	Slide adjustment	mm

2. Readings of dynamic load measuring devices (load cells) and readings of this device
Adjust load cell readings and device readings by controlling sensitivities of detection channels of the device with press capacity of _____ton.

	Load cell reading			Load monitor reading			Die height, mm	Total error	
	LEFT	RIGHT	TOTAL	LEFT	RIGHT	TOTAL		Difference, ton	%
Calibrated load									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

3. Calibration conditions

Press speed	spm		LEFT(CH1)	RIGHT(CH2)	TOTAL
Timing mode	☐EXT ☐INT %	Sensitivity	☐X1 ☐X3	☐X1 ☐X3	—
Delay in internal timing	ms	Calibration value			—
Cam turn-on angle	deg.	Upper limit of absolute load	kN	kN	—
Cam turn-off angle	deg.	Lower limit of absolute load	kN	kN	—
Method of adding up	☐ Peak ☐ Including eccentric loads	Total difference from last data	—	—	

4. Others

	Calibrated by:

NEW SELBER EX　Operation Manual

AUTOMATIC PRESS MONITORING DEVICE　RM-6302　　Rev.1.1



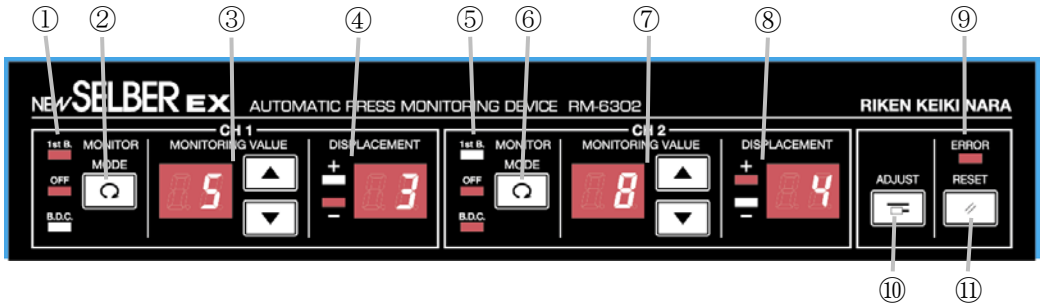
RIKEN KEIKI NARA MFG.Co.,Ltd.

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1. Part Name

Front Panel



①⑤ Monitor Lamp

It has 3 lamps for each channel, for [1st B.] (First Bound), [OFF] (No-Monitoring), and [B.D.C.] (Bottom Dead Center) .
The lamp of selected mode is lit on. OFF (No-Monitoring) Lamp lit on when No-Monitoring function is selected.
If close (ON) [NM] at Rear Panel during a monitoring, OFF (No-Monitoring) Lamps are lit on.

②⑥ [MODE] Key

Monitoring Mode shifts by pushing the key.

③⑦ Monitoring Value and [▲] [▼] Keys

Set Monitoring Value with [²] [¼] Keys. Input the limit values to detect as unusual conditions when Monitoring Value exceeds it. Monitoring Value is available from 0.0 to 99.5µm in 0.5µm step.

※0.5 is indicated as Decimal Point.

※When it is in [No-Monitoring] Mode, Monitoring Value is not indicated.

※± Sign is not on the display. Same value as + and -.



Illustration is 5.5µm.

④⑧ Indication of Sign and Gap

It indicates the current Gap during the a monitoring.
It is indicated from 0.0 to ±99.5µm in 0.5µm step.
Without Sign: 0
± Sign: 0 - 99. (0.0 - ±99.5µm), FF ([FF] is indicated when it exceeds 99.5)
※0.5 is indicated as Decimal Point.

⑨ [ERROR] Lamp

It is lit on or blinked when unusual conditions are occurred. (Such as the Gap level exceeds Monitoring Value).

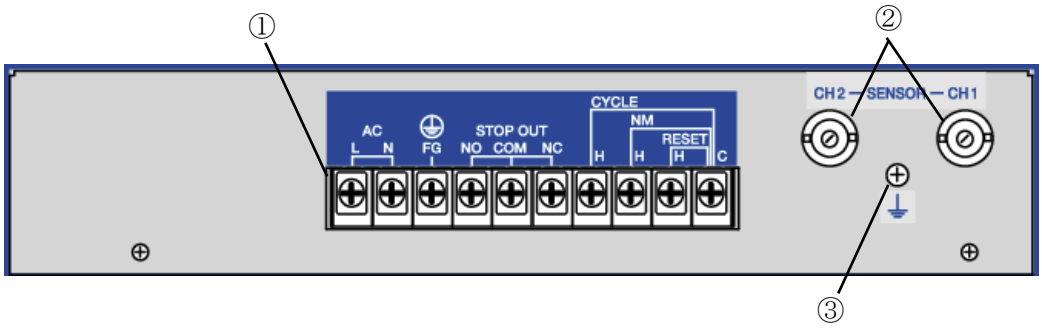
⑩ [ADJUST] Key

Push the key for 1 second, enter Setting Mode. Push the key again to go back to Monitoring Mode.

⑪ [RESET] Key

Cancel Stop Output by pushing the key at the Error Status.
Instead of pushing this key, it can cancel Stop Output with closed "RESET" terminal at Rear Panel.

Rear Panel



① Terminal Block

AC (AC Power Input)

Use power line of AC100V to AC240V. It is recommended to use different power line from a power line of press machine to improve performance of anti-electric noise.

FG (Frame Ground)

Make sure the connection of this equipment to Frame Ground for improvement of anti-electric noise performance.

STOP OUT (STOP OUTPUT)

It activates Relay Contact Output when error is detected such as scrap comes up.
Generally it is connected to the Emergency Stop or the Top Dead Center (continuous) Stop circuit of the press machine.
The maximum capacity of Stop Output is [AC250V 2A (Resistance load)].
※Use [NO-COM] or [COM-NC] depend on the stop circuit of the press machine.

CYCLE (No- Monitoring)

Normally, it monitors the rotation cycle of the press machine, and if the period, which is the period not detected correctly, exceed more than 1.5 times of previous period, output the stop signal for about one second.
If close (ON) this terminal, it does not output the stop signal by Cycle Monitoring Error. Normally it is used with open (OFF). Do not need to connect.

NM (No- Monitoring Input)

It keeps No-Monitoring mode when these terminals are closed (ON). If open (OFF) this terminal during press operation, Monitoring Mode is changed to Monitoring from No-Monitoring status. By using this terminal, it enables to control Monitoring / No-Monitoring from the external signal such as control panel of the press machine.

RESET (Reset Input)

Same as [RESET] key at Front Panel. If close (ON) this terminal, reset Stop Output.
Use with open (OFF) this terminal during operation.

② SENSOR

It is connected to Sensor Extension Cable (Sensor) of each channel.

③ Ground Screw (⏚)

Ground Screw for Main body, connect it to frames or housing of the press (stamping) machine.

2. Wire line and a circuitry

⚠ Warning

Please block the source power supply at the time of wiring work, and please connect an AC power line at the last of construction. It might lead to fire and/or electric shock.

Please refer to the Example of Wiring for connection, and take care to route and connect the wiring properly.
Please use the **crimp terminal** for the connection to the terminal block.
(Recommended model number of the crimp terminal. : 1.25-3.5)

⚠ Warning

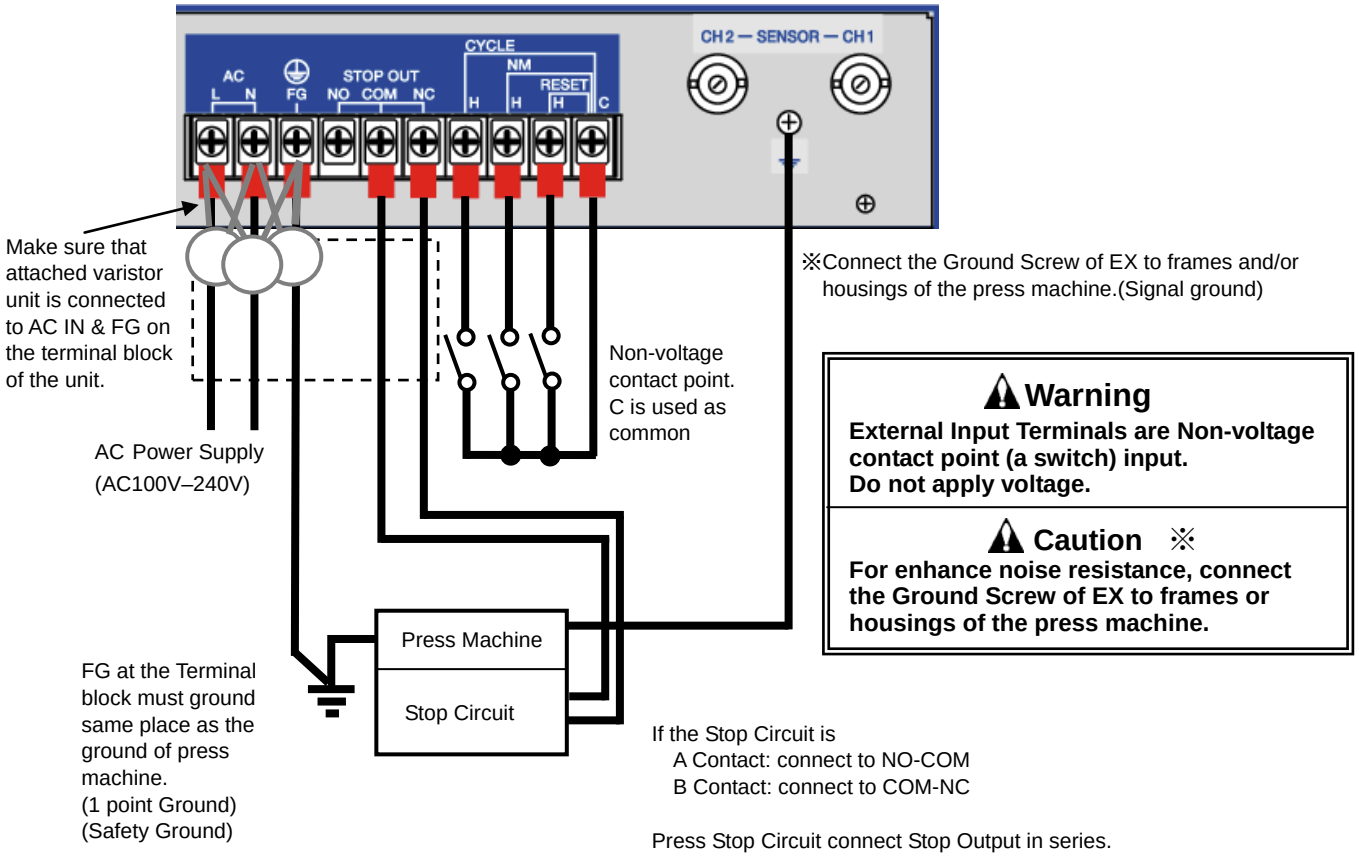
A miss-wiring of a cable causes damage any electrical components and/or a fire hazard.

CYCLE, NM, RESET has polarity. (**H**: Signal, **C:** GND**, C** is used as common.)

⚠ Warning

These input terminals are Non-voltage contact point (a switch) input.
If voltage is applied, it might cause damage any electrical components and/or a fire hazard.

Example of Wiring



⚠ Warning

External Input Terminals are Non-voltage contact point (a switch) input.
Do not apply voltage.

⚠ Caution ※

For enhance noise resistance, connect the Ground Screw of EX to frames or housings of the press machine.

≪Note for Wiring≫

Supply voltage

⚠Caution

Please use it within the rated voltage.

The Input voltage of this equipment is AC100V – 240V 50/60Hz.
Please use it below AC240V.

About AC Power terminal

Make sure attached varistor unit and wiring are connected to both AC IN & FG on the terminal block of unit. Available for both front and rear.

Noise

Recommended to not take AC Power Supply from power cable of a press machine, please take it from different line.

The equipment must be grounded, and connect the Earth Screw of EX to frames and/or housings of the press machine.

Please do not cable Sensor Extension Cable together with any power line etc.

Load Capacity

The load with a large rush current flows at starting, such as solenoids or motors, might cause degradation or damage contact output (Relay).

In these cases, please connect through auxiliary relay which has enough capacity.

External Input

External Input Terminals are Non-voltage contact point (a switch) input, or NPN transistor open collector input.

During NM Input is close (ON), not output the Error Signal by the monitoring,

During CYCLE Input is close (ON), not output the Error Signal by Cycle Monitoring.

During RESET Input is close (ON), cannot cancel Stop Output with [RESET] Key.

⚠Warning

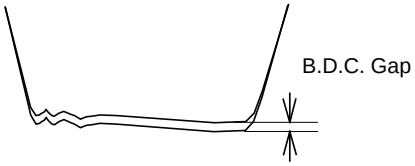
External Input Terminals are Non-voltage contact point (a switch) input.
If voltage is applied, it might cause damage any electrical components and/or a fire hazard.
Do not apply voltage.

3. Detection Mode

Bottom Dead Center Mode (B.D.C.)

If the Scrap Floating is occurred in the die with stripper, a stripper position will change.

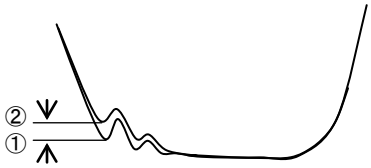
By measuring this fluctuation gap of B.D.C. and detect the Scrap Floating.



The First Bound Mode (1st B.)

In the case of the die with high spring pressure, it is very difficult to detect the Scrap Floating from the fluctuation of B.D.C., because it is almost smashed.

Therefore, catch the first bound of B.D.C., before smash the scrap floating, and detect the scrap floating.



Compare bottom of the 1st Bound ① and ②

The gap of 1st Bound

4. Installation

Installation of Main Unit

Please install the equipment to the press machine or control panels horizontally.

Avoid using the equipment in a place with excessive vibration/shock, and dusty place.

The ambient temperature must be 0-50℃, humidity within 30-90%RH (without condensation).

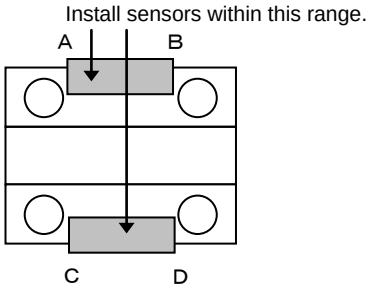
Avoid using the equipment in a place that generates corrosive gas (such as hydrogen sulfide, and ammonia).

⚠Caution

Installing the product in a place with excessive vibration/shock, might cause equipment malfunctions.

Installation of Proximity Sensor (RS-833H)

Install the Proximity Sensor (sell separately) to inside of guid posts of the die, at A, B, C, or D as the illustration bellow.



There are 2 ways for installation of Proximity Sensor, please refer bellow ① and ②.

① Using Sensor Mounting Bracket

Align the mounting holes of Sensor Mounting Bracket and drill screw holes to the die.

② Buried in Sensor to lower die

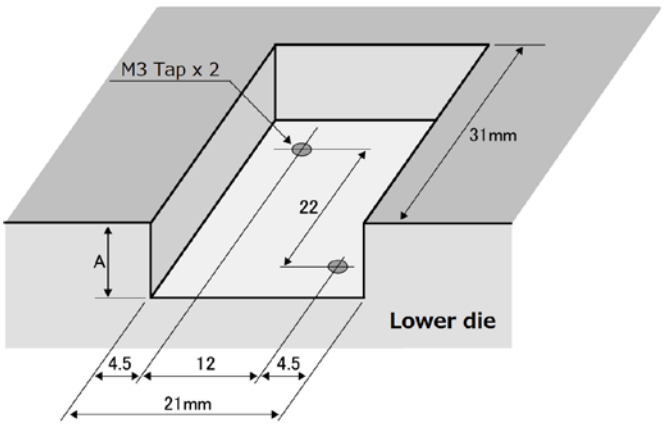
This way is using a stripper plate as Proximity Block.

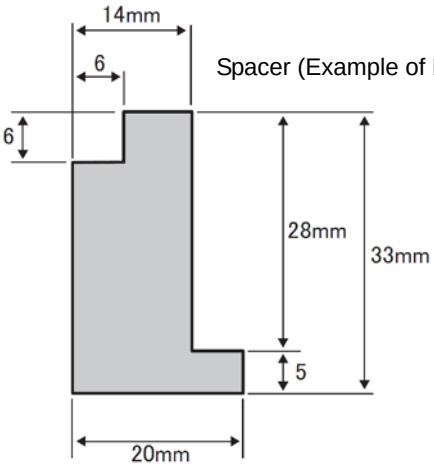
Need to dig a ditch for buried in Sensors as the illustration dimensions bellow.

"A"=9.7-"B" [mm]. This "**B"** is a floating distance between a lower die and a stripper plate.

9.7mm means: the Sensor thickness = 8.0mm, required gap for the Sensor = 1.2mm, and polishing part 0.5mm.

For adjusting the space, please prepare a spacer additional.



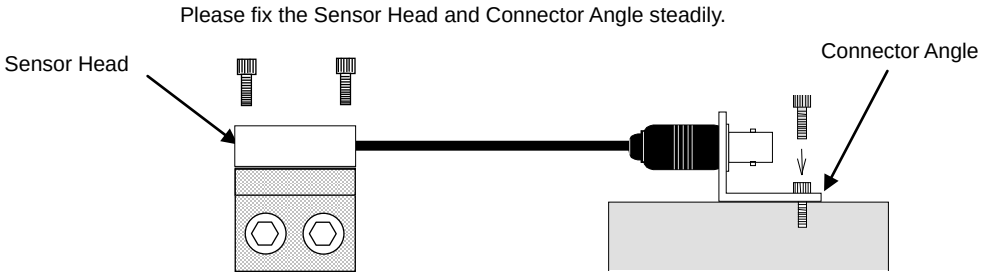


Spacer (Example of Dimensions)

Installation of Sensor Head

Install Sensor steadily with mount locks.

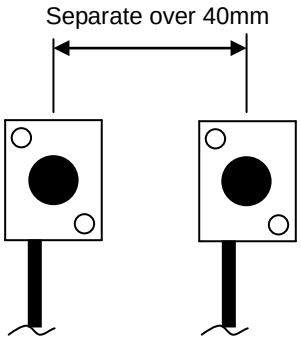
Fix the connector part as well. Fix the Connector Angle with Hex Socket Head Cap Bolt or screw. Sensor head cable may be disconnected by vibration of the press machine if the connector part is not fixed steadily.



Mutual Interference of the Sensor

If put Sensors in parallel, it can be affected by mutual interference and might not output the correct values.

Please keep a distance of 40mm or more between each Sensors.



Proximity Block (Detected Object)

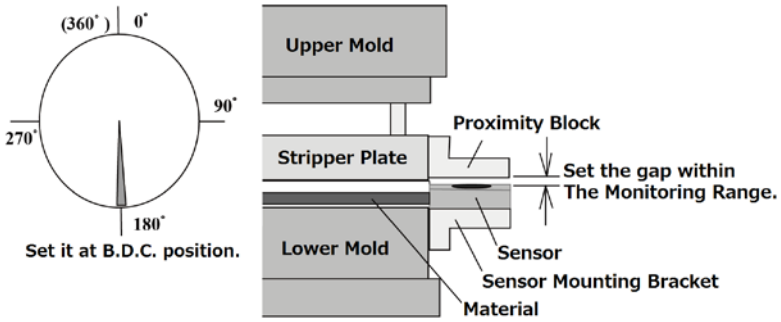
Proximity Block must be [Iron]. If used non-ferrous metals, it may affect the accuracy of measurement and potentially result in values outside of required accuracy.

Extension Cable

Use RS-835C (sell separately) for extension cable. Other extending or reconnecting cable may affect the accuracy of measurement and potentially result in values outside of required accuracy.

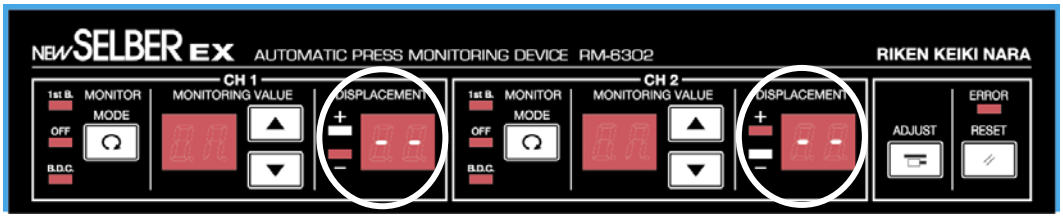
5. Installation Mode

The sensor location must be set within monitoring range while the press machine is at Bottom Dead Center (B.D.C.) position. The **Installation Mode** is for adjusting or confirming the monitoring range. In the Installation Mode, confirm that the gap between Sensor and Proximity Block is within the monitoring range.



For enter the Installation Mode, press [ADJUST] Key at the Monitoring Mode while the press machine is at Top Dead Center. After for 1 second Stop Output, it enters to the Installation Mode.

Sensor Installation



Set the press machine at B.D.C. position, and adjust it as [－－] indication (center) .

Status	Indication	Treatment
Too far		Narrow the gap between Sensor and Proximity Block.
Within the Monitoring Range (1200±400μm)		It is within the Monitoring Range, but far from Proximity Block.
		It is within the Monitoring Range, but little bit far from Proximity Block.
		Complete the Installation Adjustment.(it is on the center value) ※Turned off the sign lamp
		It is within the Monitoring Range, but little bit close to Proximity Block.
		It is within the Monitoring Range, but close to Proximity Block.
Too close		Open the gap between Sensor and Proximity Block.

If press [ADJUST] Key again, back to Monitoring Mode. (Become the Gap 0 indication)

※If it is within the Monitoring Range, adjust it as [－－] indication (center) as possible.

⚠ Caution

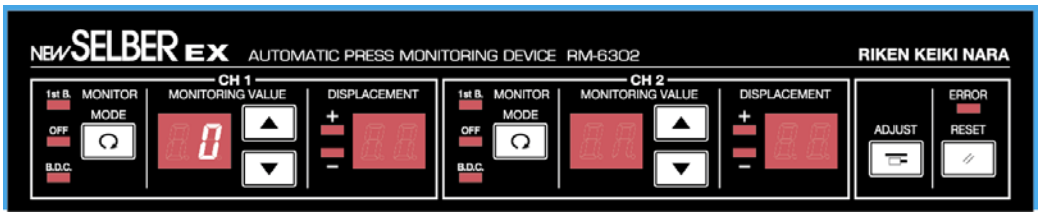
If connect/disconnect the Sensor during the Sensor Installation, or the Sensor touched any metal (die), set the press machine at the Top Bottom Center once, and then put the Sensor at the Bottom Dead Center, after that confirm the installation range again.
If stop the press machine over 45 seconds at the Bottom Dead Center while installation, It is impossible to indicate the correct installation status.
In that case, operate the press machine 1 cycle, and then confirm the installation status.

6. Setting of 1st. Bound Mode Sensitivity

> **⚠ Caution**
> **When monitoring in 1st Bound Mode with using high pressure spring, Change the Sensitivity Setting might make possible to detect. Generally, it doesn't need to change. For the detail, please contact us. The factory default setting is [0: Sensitivity Low].**

Press CH1 [MODE] Key at the Installation Mode, it enters the [Setting of 1st. Bound Mode Sensitivity].

The Installation Gap Indication is disappeared, and the Setting Value is indicated on CH1 MONITORING VALUE.



(1) CH1 [²] [¼] Keys can change the parameter.

0 : Sensitivity Low -- 3 : Sensitivity High

(2) CH1 [MODE] Key can back to [Installation Mode],

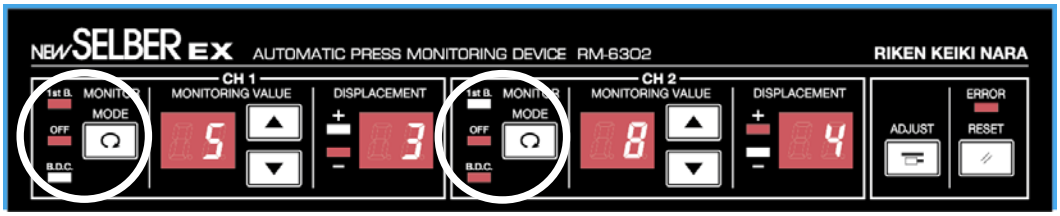
Or [ADJUST] Key can back to [Monitoring Mode].

※When back to [Monitoring Mode], updated the parameter.

> **⚠ Caution**
> **Even though it changed the Sensitivity, it might not be changed the detection point of 1st Bound.**
> **Please check the fluctuation of gap, and judge whether the 1st Bound Mode is effective or not.**
> **If setting the Sensitivity to High, it might increase the possibility of false detection.**
> **In this case, please use a less sensitive setting.**

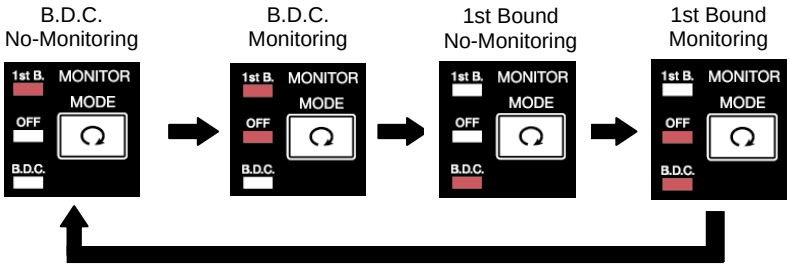
7. Monitoring Mode

Monitoring Mode Selection



Each pressing of [MODE] Key will change the Mode.

Selected Mode Lamp will be lit on. [OFF] Lamp is lit on at No-Monitoring.



Bottom Dead Center No-Monitoring (B.D.C. OFF)

Detect the B.D.C. It does not perform the stop action by error.

Bottom Dead Center Monitoring (B.D.C.)

Detect the B.D.C. It performs the stop action by error.

1st Bound No-Monitoring (1st B. OFF)

Catch the first bound of B.D.C., before smash the scrap floating.

It does not perform the stop action by error.

1st Bound Monitoring (1st B.)

Catch the first bound of B.D.C., before smash the scrap floating.

It performs the stop action by error.

Setting of Monitoring Value

This equipment detects the B.D.C. difference between previous shot and recent shot as the fluctuation gap.

Set Monitoring Value as『If the gap of fluctuation exceed the Setting Value, the function reports an error』.

⚠Caution

・The setting of the Monitoring Value is needed to set as 『If the gap of fluctuation exceed the Setting Value, the function reports an error』.

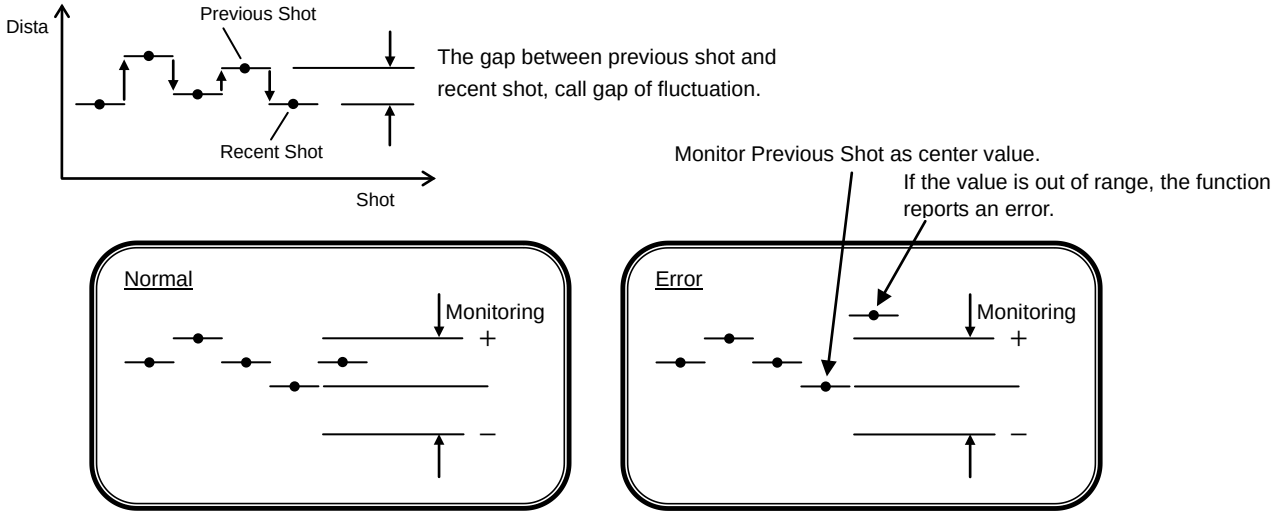
Gap ＞ Monitoring Value : Gap Error

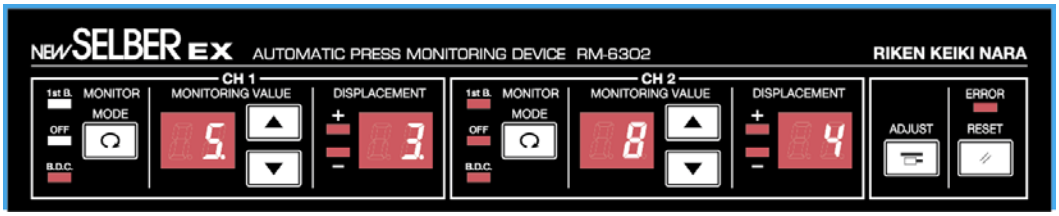
Gap ＝ Monitoring Value : Normal

Gap ＜ Monitoring Value : Normal

・The Monitoring Value is not indicated at No-Monitoring.

It is indicated at [B.D.C. Monitoring] [1st Bound Monitoring].

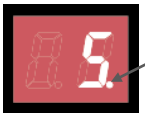




Please set Monitoring Value with [²] [¼] Keys.

It can set from 0.0 to 99.5 μm (Indicate: 0 - 99.).

(0.5 μm unit, no sign, ± same value)



Decimal Point

Illustration is 5.5μm

※0.5 μm is indicated with Decimal Point.

※It need to set at each Channel.

※It is not indicated at No-Monitoring. (When No-Monitoring Input is close (ON), it is

indicated.)

8. Monitoring

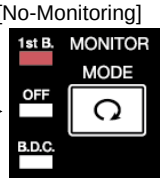
This equipment has 2 monitoring operations, [No-Monitoring] and [Monitoring].

[No-Monitoring]

It does not output the stop signal by Gap Error, Level Error, and Cycle Error.
[OFF] Lamp is lit on, and Monitoring Value is not indicated.
Compare with the Previous Shot, and indicate the Gap.

[No-Monitoring]

[OFF] Lamp is lit on →

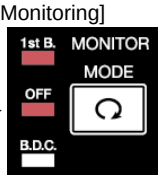


[Monitoring]

It outputs the stop signal by Gap Error, Level Error, and Cycle Error.
[OFF] Lamp is lit off, Monitoring Value is indicated.
Compare with the Previous Shot, and indicate the Gap.

[Monitoring]

[OFF] Lamp is lit off →



[Bottom Dead Center] [1st. Bound] Monitoring

Monitor the Gap between Previous Shot and Recent Shot.
1st shot is No-Monitoring because the previous shot does not exist. ([OFF] Lamp is lit on)
2nd shot is compared with 1st shot within 8 times of Monitoring Value. (×8) ([OFF] Lamp is lit off)
3rd shot is compared with 2nd shot within 4 times of Monitoring Value. (×4)
4th shot is compared with 3rd shot within 2 times of Monitoring Value. (×2)
5th shot is compared with 4th shot within Monitoring Value. (×1)

e.g. B.D.C. Monitoring, Monitoring Value: CH1 [5.0], CH2 [10.0].

1st shot: Monitoring Value
[OFF] Lamp is lit on.



2nd shot: Monitoring Value×8
[OFF] Lamp is lit off



3rd shot: Monitoring Value×4



4th shot: Monitoring Value×2



After the 5th shot: Monitoring Value×1



After power-on, cancel the stop, change Monitoring Mode, or deselect Installation Mode,
It starts from 1st shot. 2nd, 3rd and 4th shot are compared within ×8, ×4, ×2.
However, if Monitoring Value exceeds 99.5, it is compared with 99.5 (It is indicated as [99.]) .
When the gap exceeds Monitoring Value, output the stop signal.
[RESET] can cancel Stop Output.

⚠ Precautions of the [1st Bound Monitoring Mode]

Depend on the condition such as material thickness, material property, and spring pressure of stripper plate, there are possibility to not catch the 1st Bound point correctly.

Level Monitoring

During monitoring, it monitors the distance between the Sensor and the Proximity Block within the Monitoring Range.

Status	Gap Indication
Too far	Hi
Within the Range	Gap or FF
Too close	Lo



LEVEL HIGH



LEVEL OK (Illustration is the example of the gap [+3.0].)



LEVEL LOW

If it indicates [Hi] or [Lo], it output the stop signal because of the Level Error.
However, if there are breaking of sensor wire, sensor disconnection, or the Sensor touches the Proximity Block, etc., it output the stop signal because of the Sensor Error and indicated [Er].

※During No-Monitoring, it does not output the stop signal.



[RESET] can cancel Stop Output.
[Er] indication would back to Gap Indication after recovering from the Error Status.

⚠ Caution

If any Level Error or Sensor Error occurred, please check the Sensor connection and confirm it is within the Monitoring Range in the Installation Mode.

Cycle Monitoring

This equipment detects the [Delay of Press Rotation Cycle] or the [Sensor unresponsive status] by monitoring the Sensor Signal Cycle.

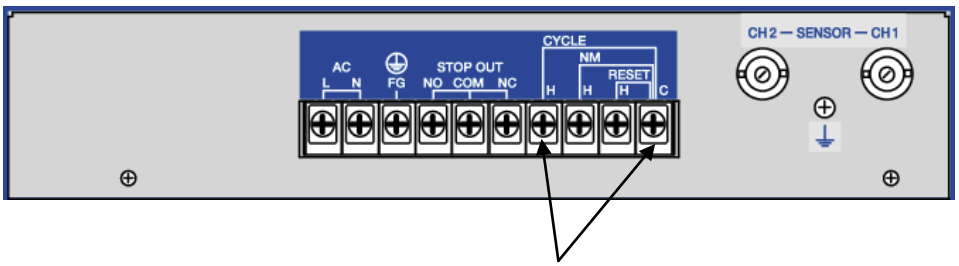
It monitors 1.5 times of previous cycle as cycle delay limit value.

※During [No-Monitoring], it does not perform Cycle Monitoring.

At the Error Status, after output the stop signal for 1 sec, cancel it automatically. ([ERROR] Lamp is lit on for 1 sec.)

If CYCLE Input (Cycle No-Monitoring Input) is closed (ON), it does not output the stop signal by Cycle Monitoring Error. ([ERROR] lamp is not lit on.)

The re-operation after the error, it starts from No-Monitoring → Monitoring Value ×8 → ×4 → ×2 → ×1.

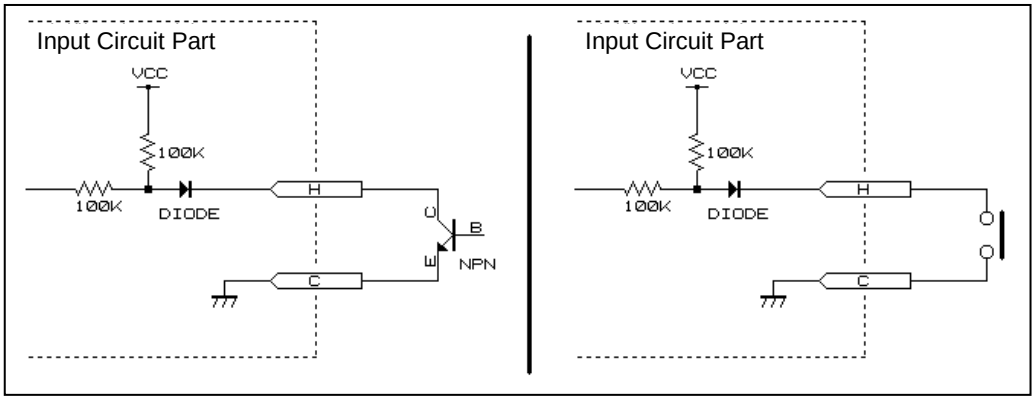


CYCLE Input (Cycle No-Monitor Input)
If the user doesn't want to output the stop signal from Cycle Monitoring Error, Close (ON) it.

⚠ Caution

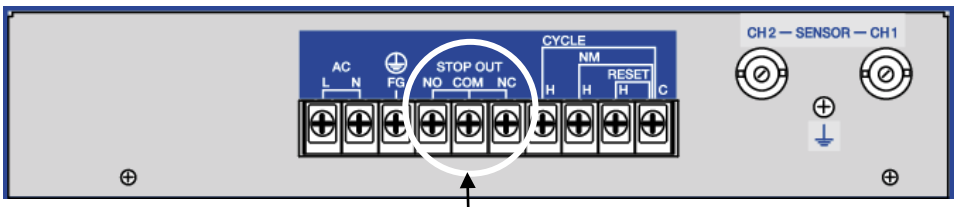
- **After the error, re-start the press stamping process, it start from 1st shot with No-Monitoring.**
- **If CYCLE Input (Cycle No-Monitoring Input) is closed (ON) at the Rear Panel Terminal Block, it does not output the stop signal by Cycle Monitoring Error. However when re-starts the press processing, it start from 1st shot with No-Monitoring.**

※ CYCLE Input is needed to input with NPN Transistor or Non-Voltage Contact Point Input. (The drive current is needed more than 100μA)



9. Stop Output

Relay Contact Output from STOP OUT (STOP OUTPUT).



Relay Contact Output from NO-COM and NC-COM.

It performs the stop action by Gap Error, Level Error, and Cycle Error.
At the Cycle Monitoring Error status, or until enter Installation Mode with [ADJUST] Key, it cancels automatically after 1 sec Stop Output.
If NM Input (No-Monitoring Input) is closed (ON), after output the stop signal for 1 sec, cancel it automatically.
While Stop Output, [ERROR] Lamp is lit on or blinked.
If any Gap Error, Level Error or Sensor Error are occurred during a monitoring,
Indicators or Lamps are blinked.

※After power-on, output the stop signal for about 3 secs.
(All indicators and Lamps are lit on.)

Status	STOP OUT
Power OFF	NO-COM: Close (ON) NC-COM: Open (OFF)
Normal	NO-COM: Open (OFF) NC-COM: Close (ON)
Stop Out	NO-COM: Close (ON) NC-COM: Open (OFF)

⚠ Caution

STOP OUT is Relay Contact Output, Please use it within the rated load.
Rated load: AC250V 2A (Resistance load)

10. [RESET] Key and RESET Input

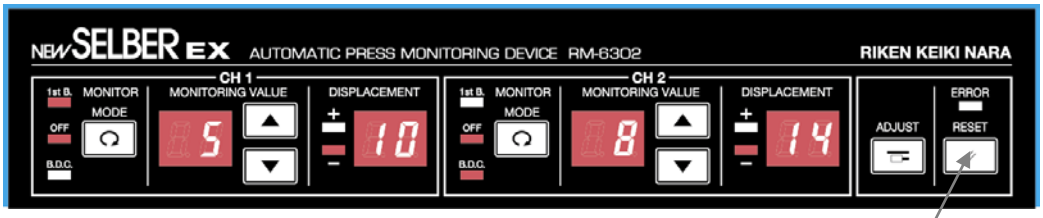
It is used for cancel Stop Output.

Press [RESET] Key at the Front Panel, or close (ON) RESET Input at the Rear Panel,

It cancels Stop Output.

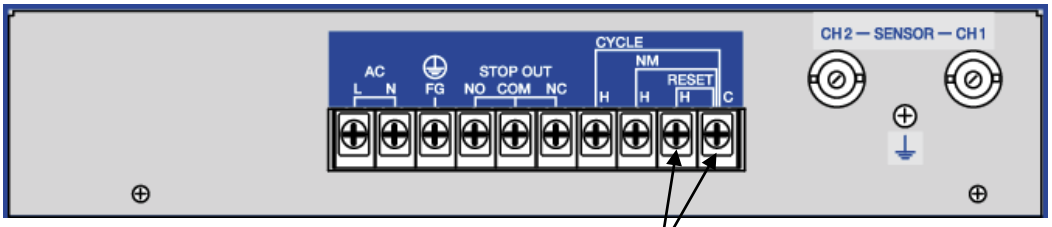
> **⚠ Caution**
>
> **Please open (OFF) the RESET Input after cancel the Stop Output.**
> **If this terminal is left close (ON), [RESET] Key doesn't operate.**

【Front Panel】



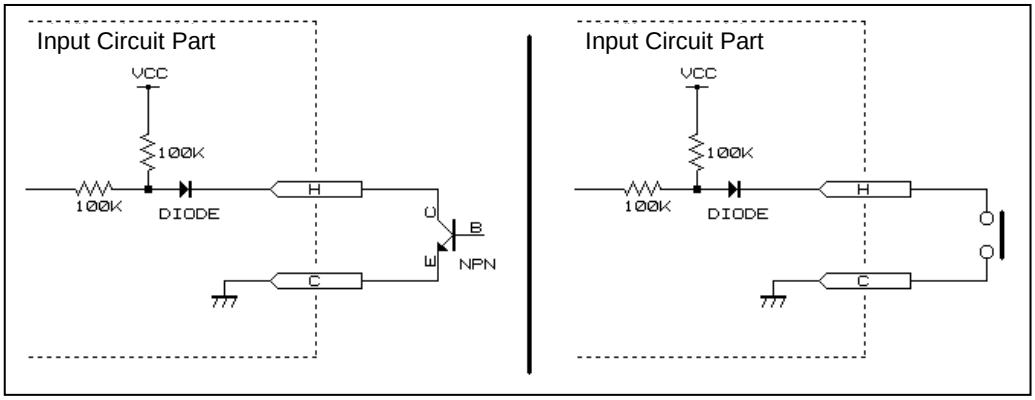
Press [RESET] Key and cancel the Stop Output.

【Rear Panel】



Cancel the Stop Output by closing (ON) the RESET Input.
After cancel the Stop Output, open (OFF) it.

※ RESET Input is needed to input with NPN Transistor or Non-Voltage Contact Point Input.
(The drive current is needed more than 100μA)



11. NM Input (No-Monitoring Input)

This is the terminal which operate No-Monitoring while B.D.C. Monitoring and 1st Bound Monitoring.

If close (ON) this terminal during press processing, after output the stop signal for 1 sec, cancel it automatically. While close (ON) this terminal, lit on [OFF] Lamps and become No-Monitoring operation.

※During No-Monitoring operation, Monitoring Value is indicated. (If Monitoring Mode is No-Monitoring, Monitoring Value is not indicated.)

When open (OFF) this terminal, [OFF] Lamps are lit off, and become Monitoring operation.

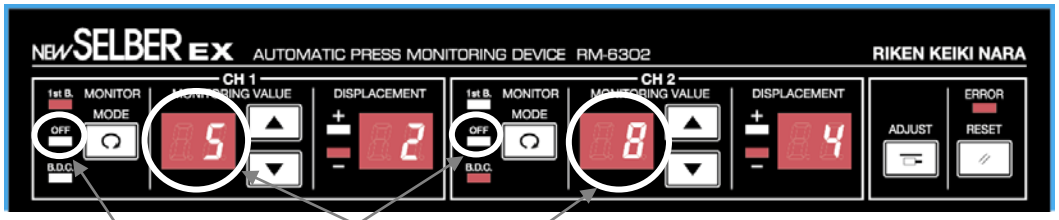
After open (OFF) the terminal, it starts monitoring with Monitoring Value ×1 from 1st shot.

However if it is less than 4 shots with closed (ON) status, it starts monitoring with Monitoring Value ×8 → ×4 → ×2 → ×1.

⚠Caution

If close (ON) NM Input during press stamping process, Output the stop signal for 1 sec.

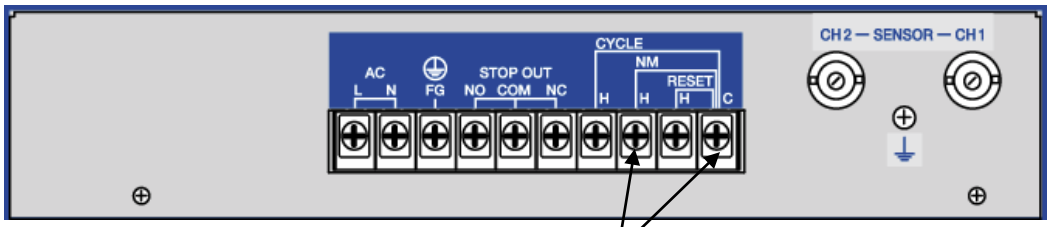
【Front Panel】



[OFF] Lamps are lit on, but Monitoring Values are indicated.

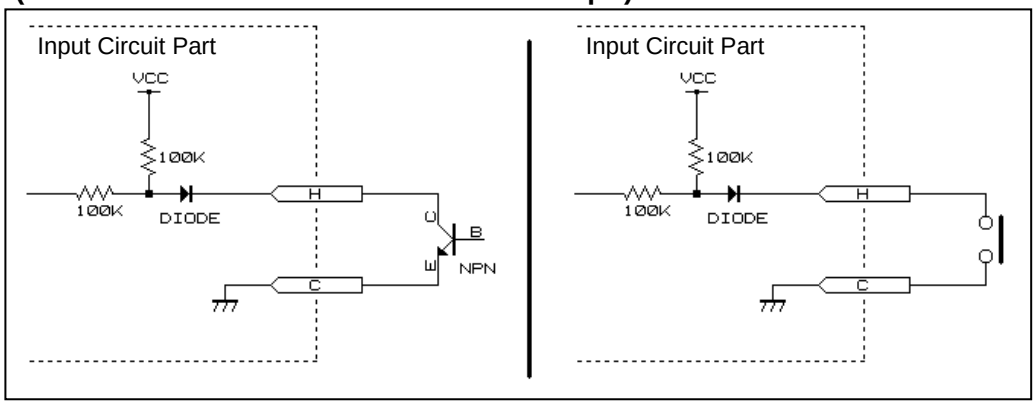
※In usual No-Monitoring, Monitoring Value is not indicated.

【Rear Panel】



If close (ON) NM Input during press processing, it becomes Monitoring operation.
[OFF] Lamps are lit on, but Monitoring Values are indicated.

※ NM Input is needed to input with NPN Transistor or Non-Voltage Contact Point Input.
(The drive current is needed more than 100μA)



12. At the Routine Operation

Operating

After check the Sensor Installation status, Monitoring Mode, and Monitoring Value, it is possible to operate a monitoring.

If any errors are occurred during a monitoring, this equipment output the stop signal and stops the press machine.

When any errors occurred

If any errors are occurred such as scrap floating, this equipment lights on or blinks [ERROR] Lamp, and output the stop signal.

Please follow the Error State Chart below, remove the cause of each error, press [RESET] Key, or close (ON) RESET Input.

> **⚠ Caution**
>
> **Please open (OFF) RESET Input after cancel Stop Output.**
> **If this terminal is left close (ON), [RESET] Key doesn't operate.**

Error State Chart

Error Status	Gap Indication	Error	Cause	Treatment (cancel) Method
Gap Error	Less than 99.(99.5)	Blink	The Gap exceed Monitoring Value because any errors occurred such as scrap floating.	Remove the scrap.
	FF		Because the gap exceed 99.5.	
Level Error	Hi or Lo		At the B.D.C., the gap between Sensor and Proximity Block is out of Monitoring Range.	Please check the Gap in the Installation Mode.
Sensor Error	Er		Insufficient connection or disconnection of Sensor or Sensor touched any Proximity Block etc.	Please check Sensor connection and detection surface of Sensor and Proximity Block.
Cycle Monitoring Error	Less than Monitoring Value	lit off after light on 1 sec	1. During continuous process, the proximity or stripper plate didn't close enough to Sensor. 2. Stop the press machine artificially.	It can re-operate without [RESET]

Checking

Perform checking once half year to once a year. Perform it more frequently when the equipment is used under high temperature, high humidity and dusty circumstances.

Cleaning

Use dry and soft cloth for ordinary cleaning. Use a wet cloth for cleaning when dry cloth does not help to remove the taint.

Check Section

Check following items if they meet the criteria or not. Improve the circumstances or retighten the screws if the items do not meet the criteria.

Item	Detail	Criteria	Equipment
Voltage	Voltage at the power terminal	AC90V-AC250V	Tester
Circumstances	Temperature	0-50℃	Thermometer
	Humidity	30-90%RH (without condensation)	Hygrometer, Visual
	Dust, Foreign materials	No dust, No foreign materials	Visual
	Adhesion of oils	No oil between front sheet and cabinet.	Visual
Fixing condition	Loosing of brackets	Not loosen	Hex Wrench, etc.
	Loosing of external wiring	Not loosen	Screwdriver
	Connection of connectors for sensors and extension cable	Fully inserted and locked. Not loosen, No oils adhesion. Not deformed	Visual
	Mounting of Sensor and Proximity Block.	Not loosen	Hex Wrench, etc.
	External connection cable	No trouble such as breaking	Visual
	Sensors and extension cable	No hardening of cable due to oil incoming by brake of cable cover.	Visual
Appearance	Damage	No abnormality	Visual
Stop Output	Contact Output	Contact react with [ADJUST] Key	Tester, etc.

13. Cause of trouble and treatment method

Please take necessary treatment method according to the chart below when cause of trouble.

When power turns on

Symptom	Cause	Treatment Method
Nothing displays on	No power.	Check the connection and supply the power correctly.
	Malfunction of the hardware.	Contact us.
All LED turned on and not Normal indication.	Malfunction of the hardware.	Contact us.

During operation

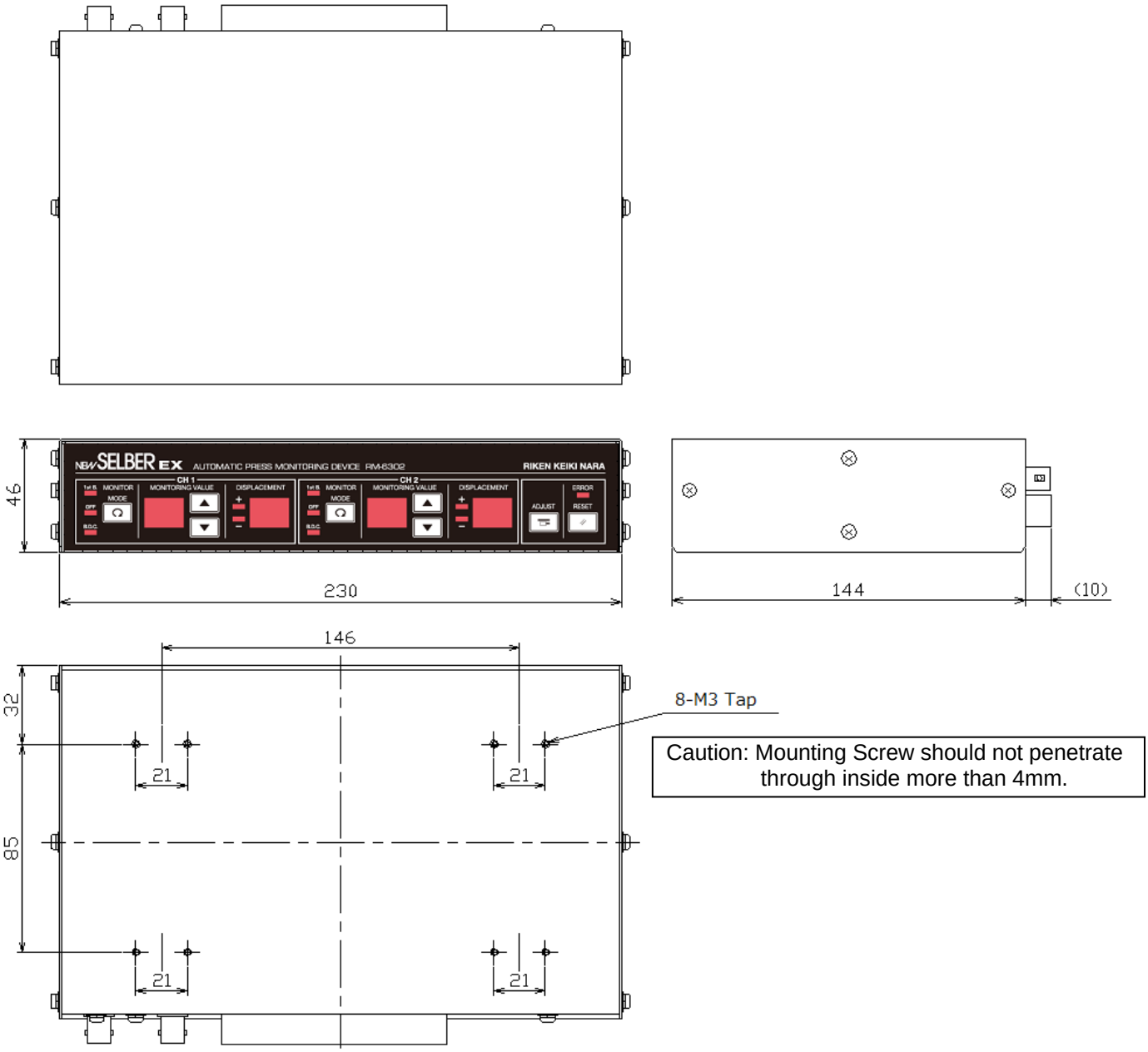
Symptom	Cause	Treatment Method
Not output the stop signal	Malfunction of the hardware.	Contact us.
Fluctuation of deviation values.	The signal is unstable due to the noise coming from outside.	Take anti-noise procedure such as separating Sensor cable from the power line. And check the earth. (Please refer 2. Wire line and a circuitry)
	Insufficient connection of connectors of sensors and extension cable.	Check the connection of connectors and adhesion of oils.
	Insufficient connection or disconnection of Sensor or Sensor extension cable.	Please replace Sensor or Sensor Extension Cable with new one.
Unusual performance.	Malfunction due to the noise coming from outside.	Take anti-noise procedure such as separating Sensor cable from the power line. And check the earth.
Key function is not available.	Malfunction of the hardware.	Contact us.
Output or input of the terminal block is not effective.	Malfunction of the hardware.	Contact us.

※If the symptom is not on the Table, or it is not improve the symptom after took the Treatment Method, please contact us.

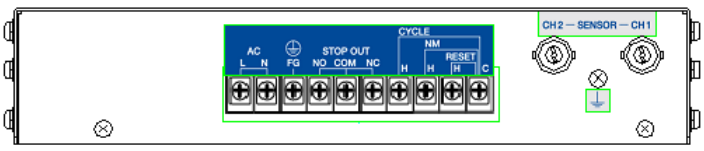
14. Specification

Item	Specification
Name	NEW SELBER EX　AUTOMATIC PRESS MONITORING DEVICE
Type	RM-6302
Measurement Method	Eddy Current Loss Type Proximity Sensor
Monitoring Channel	2 channels
Deviation Display	±99.5μm　LED Digital 2 Figures ※0.5μm is indicated as Decimal Point.
Monitoring Value Display	99.5μm　LED Digital 2 Figures ※0.5μm is indicated as Decimal Point.
Minimum Detection Gap	0.5μm
Error Processing	Display・Lamps Blink, Stop Output　(STOP OUT)
Max. Monitoring spm	2500SPM
Sensor Installation Distance	1.2±0.4mm
Output	Relay Contact (C Contact) Max.AC250V 2A　(Resistance load) STOP OUT (Stop Output)
Input	Non-Voltage Contact Point Input (NPN Transistor Open Collector Input) 3 Lines RESET (Reset Input) CYCLE (Cycle No-Monitoring Input) NM　(No-Monitoring Input)
Operating Temperature and Humidity	0-50℃, 30-90%RH　(without condensation)
Power	AC100V-AC240V　50/60Hz
Power consumption	Max.8VA
Dimensions	Approximately 230(W)×46(H)×144(D)mm (Excluding terminal block and extrusions.)

15. External Dimensions



【Rear Panel】



16. Standard Package and Accessories

Name	Model or Spec.	Qty
Main Unit	RM-6302	1pc.
Varistor Unit	2905 2174 10	1pc.
Manual	RM-6302 Operation Manual	1set

17. Sign of Toxic and Hazardous Substances or Elements

Part name	Toxic and Hazardous Substances or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr^{VI+})	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
PCB	○	○	○	○	○	○
Housings / Chassis	○	○	○	○	○	○
Switching supply	○	○	○	○	○	○
Wiring in case	○	○	○	○	○	○

○ : It shows the contents of toxic and hazardous substance or elements in relevant parts of all homogeneous materials are within the limit defined by standard SJ / T11363-2006.

× : It shows the contents of toxic and hazardous substance or elements in relevant parts of at least one kind homogeneous material is over the limit defined by standard SJ / T11363-2006.

18. Warranty

1. Warranty period

   Warranty period is 1 year after the delivery.

2. Scope of the warranty

   We will replace or fix the part of malfunction with free of charge in case of our faulty during the period. However, following cases are out of warranty.

   (1) When it is used under inadequate conditions, circumstances or handlings out of instructions in this manual or specifications shown separately.

   (2) Malfunction caused by other equipment.

   (3) Malfunction caused by modification or repair by third parties.

   (4) Malfunction caused by inadequate use.

   (5) Malfunction caused by unexpected matter which beyond science and technology level at time of delivery.

   (6) Malfunction caused by natural disaster or accident out of our faulty. The warranty is applied to delivered unit only and we are not in a position to cover any loss caused by malfunction.

3. Limitation of responsibility

   We are not in a position to take any responsibility or special loss, indirect loss or passive loss caused by malfunction.

4. Change of specifications

   The specifications and accessories may be changed without notice in future for improvement or other reasons if necessary.

5. Scope of the service

   The equipment price does not include the cost of engineers dispatch. We will discuss separately according to your request.

【Note】



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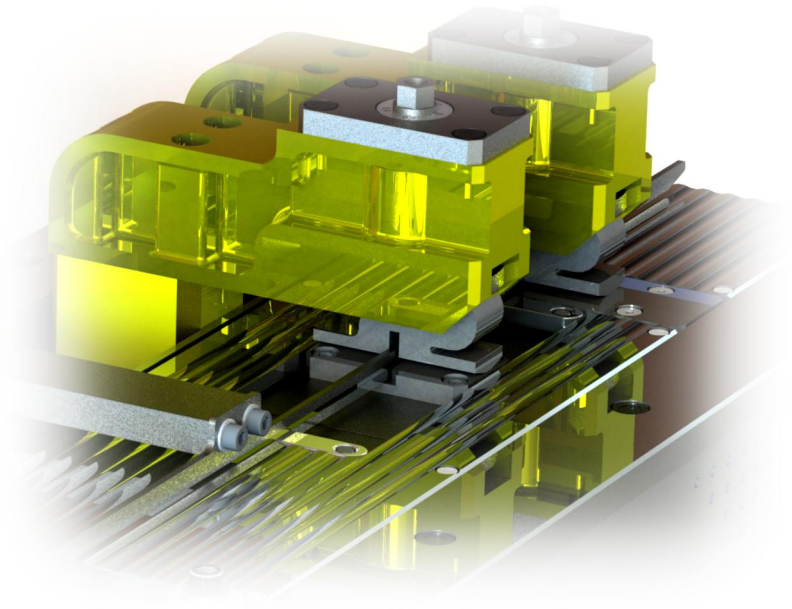
RodaX®

Variax VGi

GRIPPER FEED

VGi40・VGi80 Instruction Manual

[Manual No. SG04-010-001-00]



HANGZHOU SANKYO MACHINERY CO.,LTD.

Revision History

The version number of this document is appended to the manual number that appears on the front cover.

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Revision code

Revision code	Date	Description
00	April 23, 2014	First edition

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1. Introduction

This document describes the overall specifications for the **Variax** VGi Series.

Read and understand this and other related documentation to ensure the full performance and functionality of the **Variax** VGi Series.

1.1. Intended Audience

This manual is intended to be read by personnel who have a basic knowledge of feeders and will,

Install the **Variax**,

Operate the **Variax**, and

Service and maintain the **Variax**.

1.2. Related documentation

Further information about the use of your **Variax** is available in these documents: Familiarize yourself with these documents before operating and servicing the **Variax**. Keep this document in a convenient location for future reference.

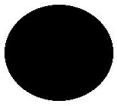
Title	Document Number
Product Specifications	E3Z-E30-193
Specifications Notice	---
Optional Parts Dimensional Diagrams	---

2. Safety Precautions

2.1. Meanings of symbols used to describe safety procedures

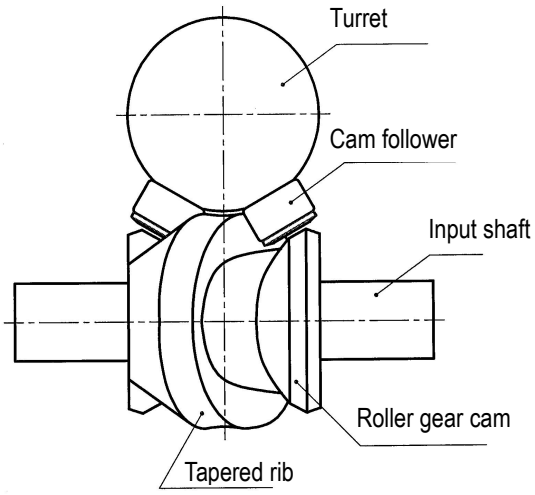
The following pictograms are used in this manual and on the product to advise you how to use this product safely, and how to prevent personal and property damage. If not heeded, precautions classified as Cautions can lead to serious results depending on the circumstances. Always read and heed the precautions that are provided.

 Warning	Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.
 Caution	Indicates precautions that, if not heeded, could result in relatively serious or minor injury, or property damage.

Symbols
 Indicates operations that you must not do. Example)  General  Do not touch
 Indicates a general precaution. Example)  General  Electric shock  Pinch point   Hot surface
 Indicates operations that you must do. Example)  General  Grounding is mandatory

3. About Cams

3.1. Roller Gear Mechanism



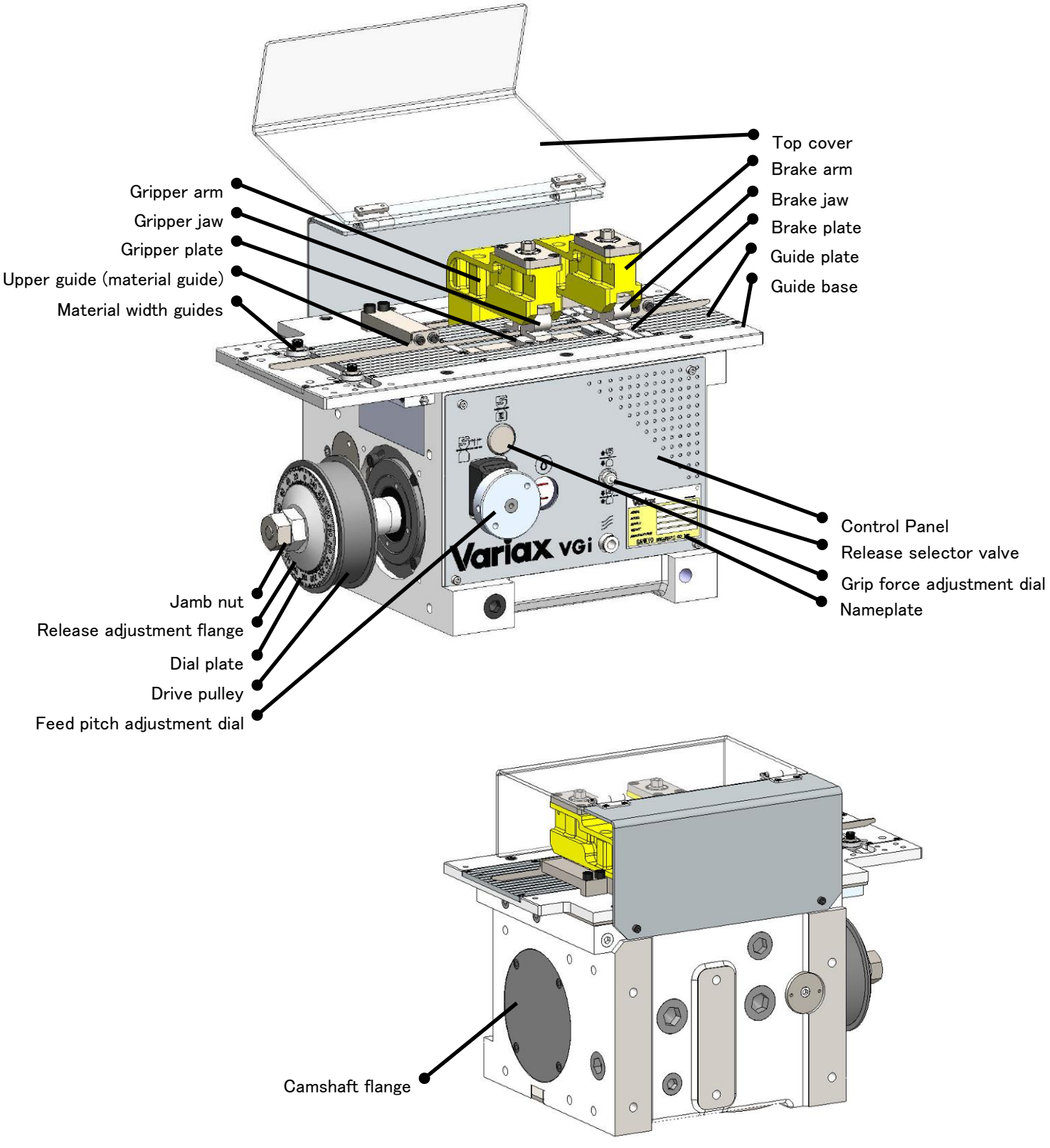
The VGi is a cam-actuated gripper feed. All motions used to feed material are controlled by four cams. The motion to move the grippers left to right is driven by a roller gear cam mechanism. The roller gear cam mechanism is considered the premier technology for intermittent indexing. It is comprised of a roller gear cam that has precision-ground tapered ribs, and a turret that is fitted with cam followers. At all times, there is a pair of cam followers that hold the tapered ribs of the roller gear cam under preload. This ensures minimal lost motion and consistent repeatable accuracy, even in high-speed ranges.

3.2. Cam Curves

To feed material with precision, it is essential to combine a precision positioning mechanism with theoretically proven motion characteristics. Material feeding is the process of advancing and stopping the material intermittently. To reduce the vibratory forces that occur when the material is stopped, Sankyo developed the SMS (Sankyo modified sine) curve for its superior acceleration characteristics over the conventional MS (modified sine).

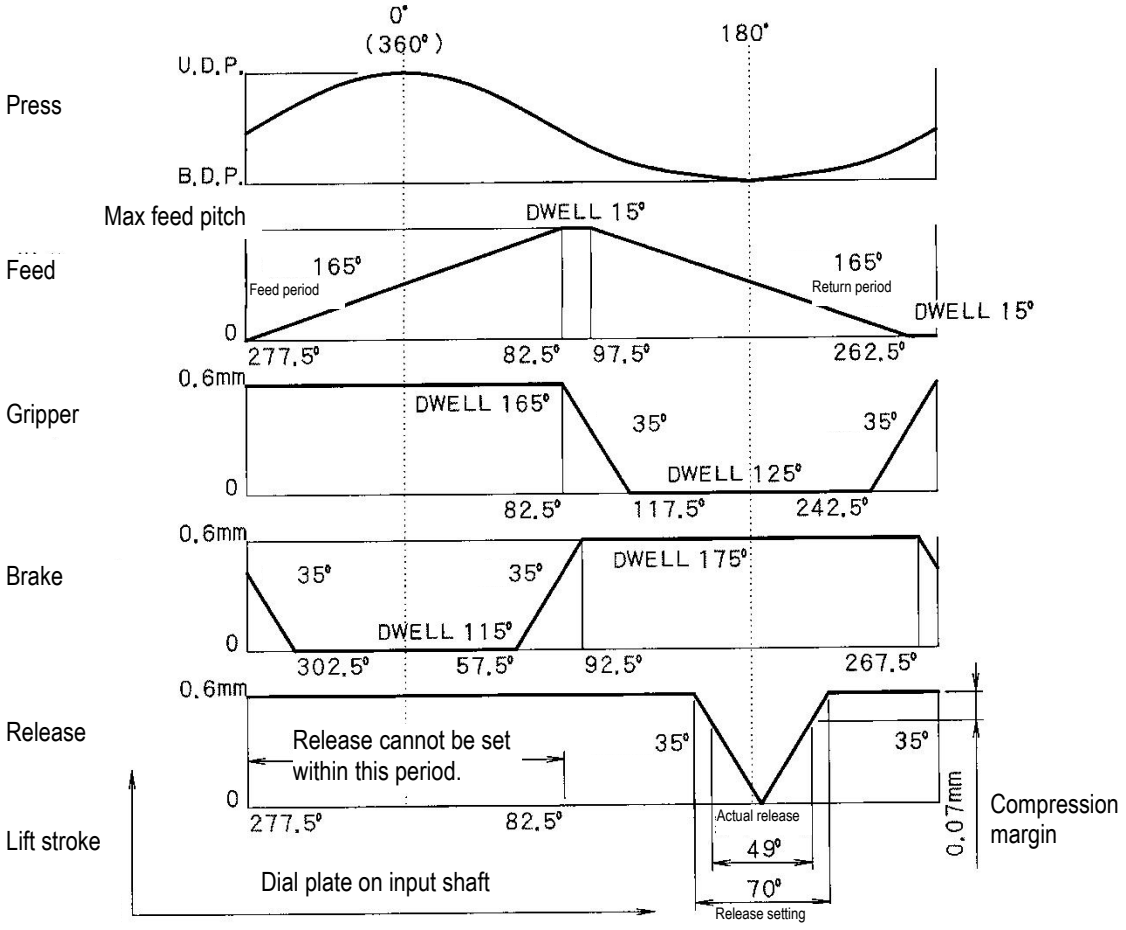
4. Specifications

4.1. Names of Each Part



4.2. Timing diagram (Example for feed angle of 165°)

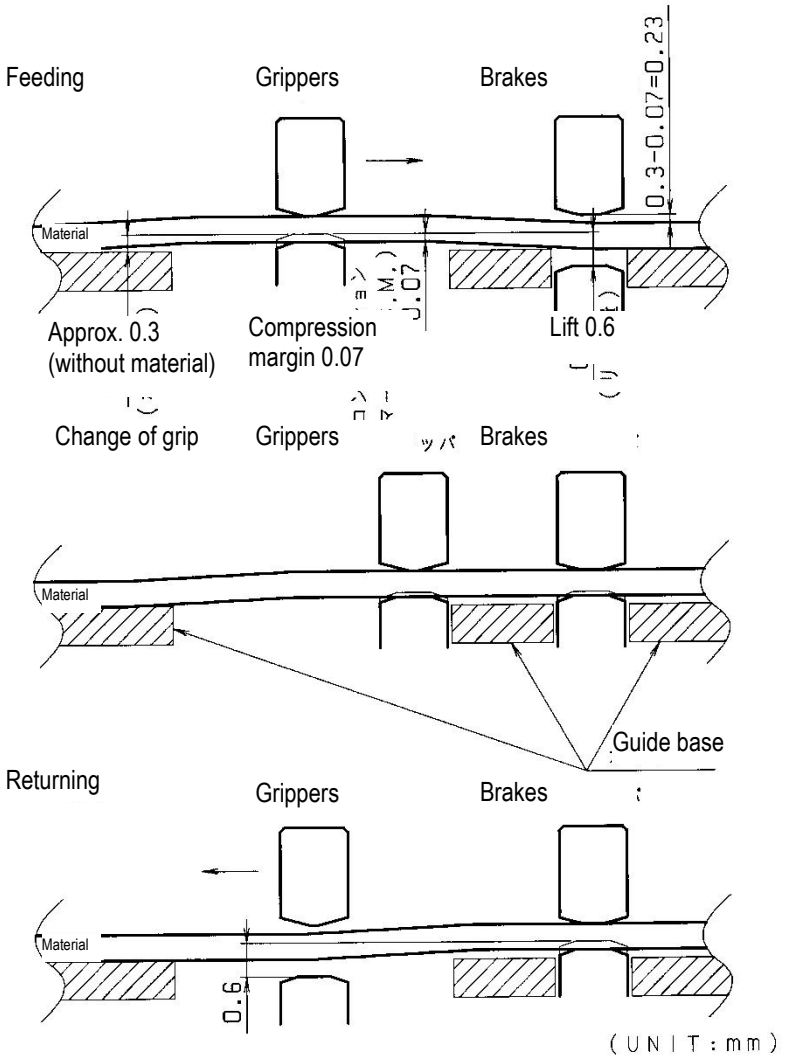
The basic operation of the VGi uses a total of four cams, one roller gear cam for feeding and three plate cams. The following diagram shows the timing for a roller gear cam that has a 165° feed angle. The index period of the cam includes the period for feeding the material and for the return period. The lift cam for the gripper grips the material during the feed period and releases it during the brake period. The lift cam for the brake is timed so that the brake holds the material during the return period. The gripper and brake exchange their hold on the material during the dwell of the roller gear cam. The position of the release cam is independently adjustable from the timing of the other three cams. If the release is set to occur within the feed period, the feeder operates without ever releasing the material, or as a non-release feed. The timing relationship of the VGi to the press is such that the feed period is split equally in half across the top dead center of the press.



The timing of the motions depends on the feed angle.

See the product specifications document for further details.

4.3. Feed Motion



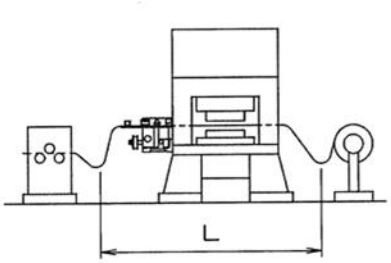
4.3.1. Compression margin (CM)

The clearance between the upper and lower grippers (and brakes) must be adjusted according to the thickness of the material. This dimension is set to a smaller value than the actual thickness of the material. The following formula represents this value.

Compression margin = material thickness - clearance between upper and lower grippers (brakes)

The factory setting for the compression margin is 0.07 mm

4.4. Feed speed



Feed speed (m/min)

= feed pitch (m) x press stroking speed (spm)

M: mass of material to be intermittently fed (kg)

M = material thickness (m) x material width (m) x length L (m) x density (kg/m^3)

* Calculate the length of the material within the distance marked as L in the above drawing.

Reference

Material	Density (kgm^3)
Steel	7.85×10^3
Aluminum	2.56×10^3
Copper	8.6×10^3

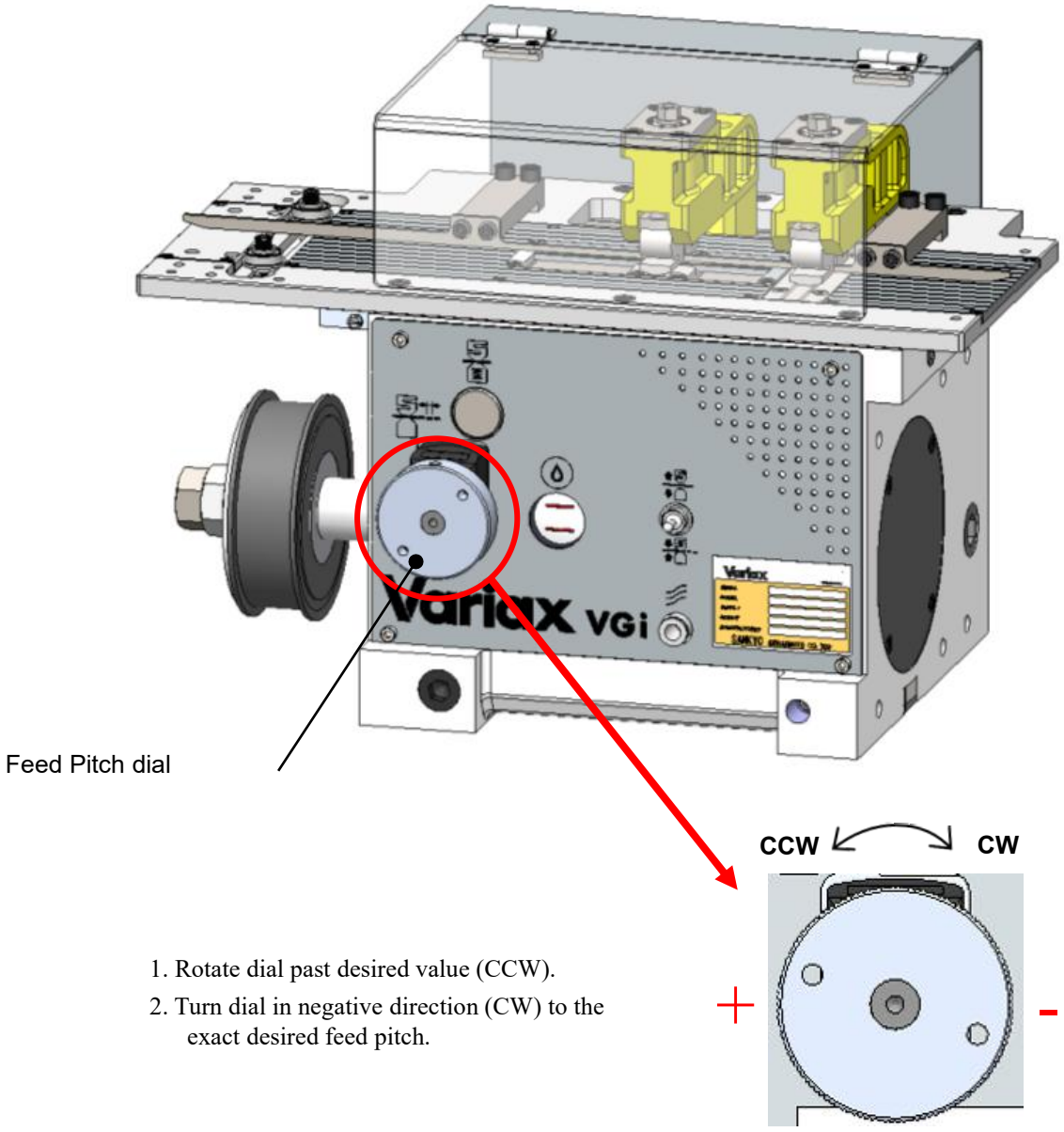
The timing of the motions depends on the feed angle.

See the product specifications document for further details.

5. Functional Overview

5.1. Feed Pitch Adjustment

The VGi has an infinitely adjustable feed pitch within a specified range. Turn the **FEED PITCH** dial on the control panel to adjust the feed pitch. Internally, this changes the radius of the oscillating arm that is linked to the sliderfor the gripper arm. The feed pitch is displayed in a counter that starts at 0.1 mm and increments in units of 0.01 mm. When adjusting the feed pitch, rotate the dial past the desired value and then decrease it to the exact desired value. This minimizes mechanical error in the adjustment mechanism. You can fine tune the feed pitch even while running in continuous operation.



1. Rotate dial past desired value (CCW).
2. Turn dial in negative direction (CW) to the exact desired feed pitch.

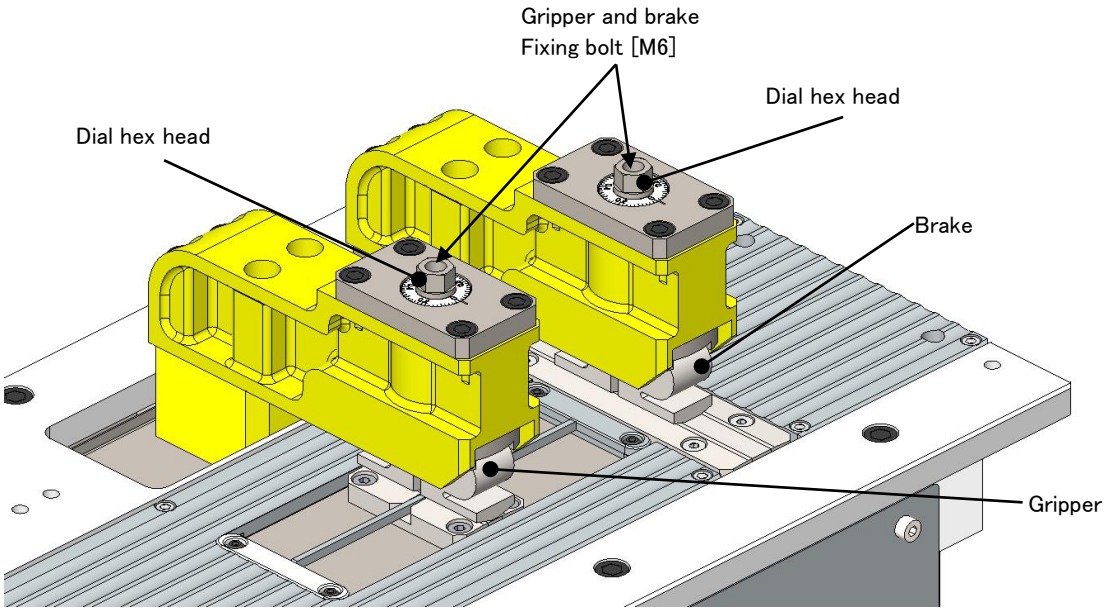
5.2. Material Thickness Adjustment

The VGi Series is available with two methods for material thickness adjustment.

5.2.1. Dial adjustment

The material thickness can be set by turning the dial hex head. The gripper (brake) is infinitely adjustable. This adjustment streamlines efficiency when you have many material types to run, or the material requires fine-tuned compression margin adjustment, or has a wide thickness tolerance.

Caution	In the brochure, the material thickness adjustment range is listed as 0 to 2 mm. This does not mean that you can unconditionally feed 2-mm thick material. The feeder may not perform at capacity with 2-mm thick material. Feeding capacity may be less than capacity if the material is thicker than 1 mm, wide, or heavy.



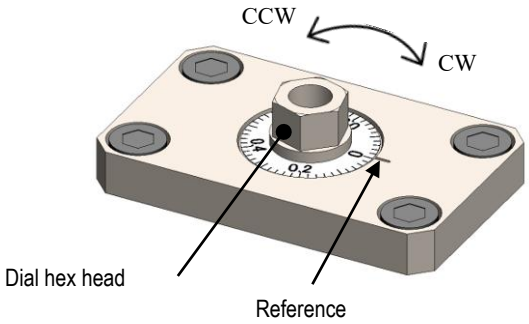
[Notes on material thickness adjustment]

A) Use a wrench 10-mm across flats to turn the dial hex head.

B) Turn the dial clockwise to widen the thickness setting, or counterclockwise to narrow it.

C) The maximum adjustment range is 2 mm.

1 turn provides 1 mm of adjustment.
The smallest setting possible with the dial is 0.02 mm.

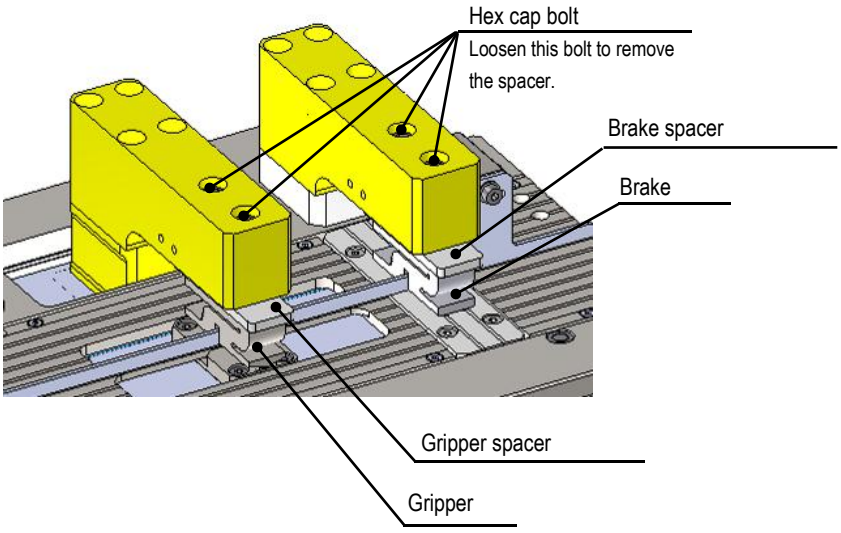


5.2.2. Spacer adjustment (optional)

To adjust the material thickness, replace the spacers to match the thickness of the material. Use spacers based on the actual thickness of the material to be fed.

(Refer to 5.2.2.1 *Shape of spacer*, for the machining dimensions of spacers that are used to adjust the material thickness.)

Caution	In the brochure, the material thickness adjustment range is listed as 0 to 2 mm. This does not mean that you can feed material of 2 mm under any condition. The feeder may not perform at capacity with 2-mm thick material. Feeding capacity may be less than capacity if the material is thicker than 1 mm, wide, or heavy.
	Spacers allow for a material thickness tolerance of -0.02 to +0.05 mm. Thicknesses beyond or below this tolerance range may cause misfeeds. Avoid sharing spacers for materials with different thicknesses. If the tolerance of the material thickness varies greatly, do the following: - use multiple spacers - make spacers that are designed for the expected dimensional tolerance.

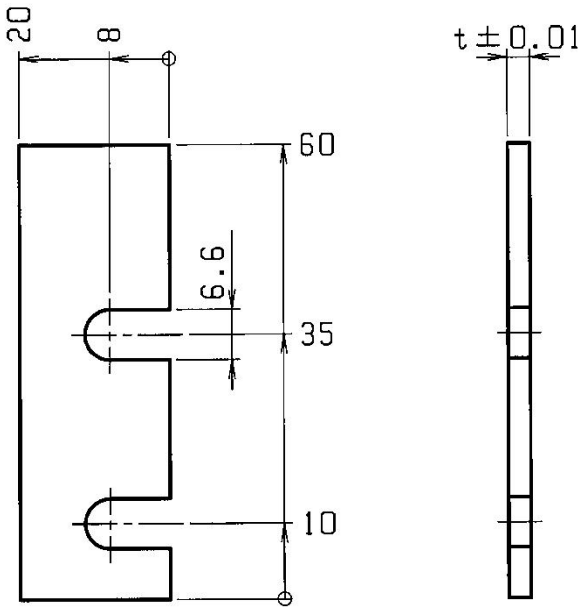


5.2.2.1. Shape of spacer

Use the drawing shown below to calculate the thickness of spacer.

Same spacer used for gripper and brake.

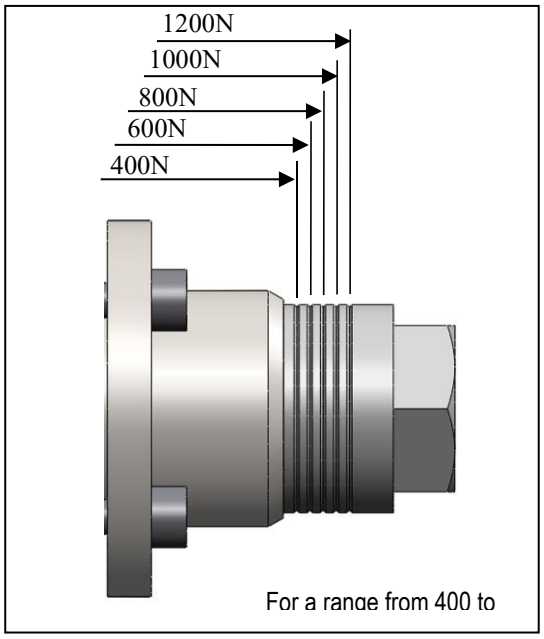
t= 4.07 –material thickness



[Reference thickness]
4.07 mm

5.3. Gripping Pressure Adjustment (optional)

If you purchase the optional gripping pressure adjustment, you can adjust the gripping pressure from 400 to 1200 N by turning the gripping pressure adjustment dial on the control panel. (The standard gripping pressure is fixed at 800 N). Turn clockwise to increase pressure, or counterclockwise to decrease pressure. (The brake gripping pressure is fixed at 400 N.)



[Notes on feed force of the material]

The feed force F of the material is the product of grip force G and friction factor μ.

$F=G\mu$

To feed material accurately, F must be larger than the sum F_W of these two loads:

- Regular inertia load F_k, which is for regular loads, such as feed starts and stops, and
- Load F_m, which is for irregular loads, such as material flapping and friction with the guides.

$F \geqq Fw=Fk+Fm$

$F_k = MA(N)$

M = conveying mass (kg)

$A = 36 \cdot A_m \cdot P \cdot N^2 / \theta^2 \quad (m/s^2)$

$A_m = 4.848$ (constant)

P = feed pitch (m)

N = press stroking speed (spm)

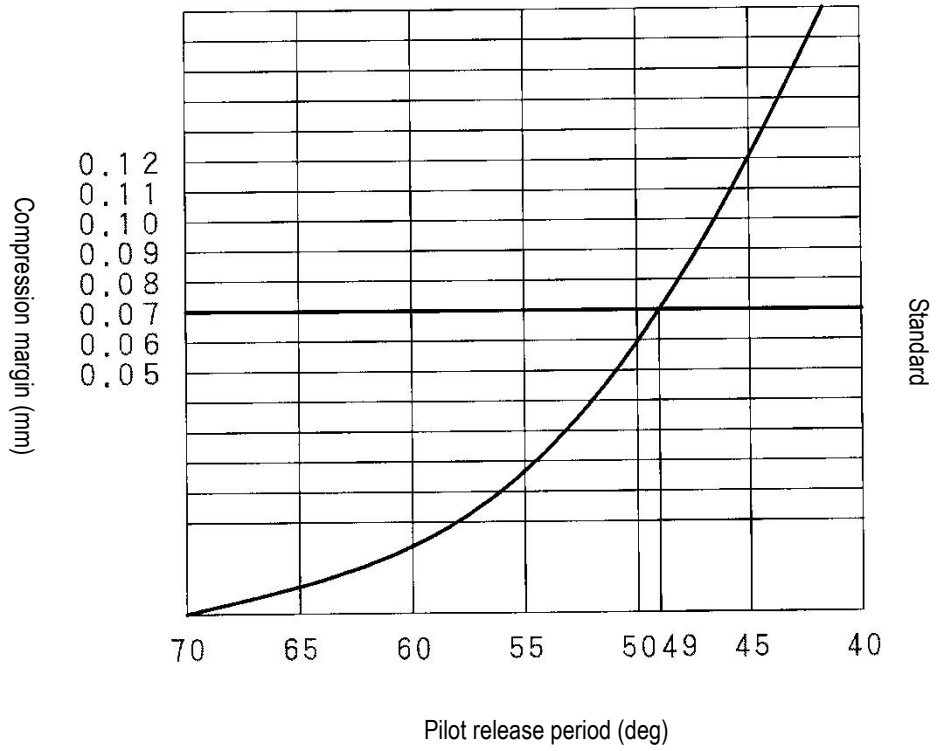
θ = feed angle (°). Standard: 165°

F_m: Depends on other factors such as material and press layout.

Caution	Set the gripping force G to the value that is required for feeding. If set too high, the grippers will leave pressure markings and rolling scars on the material.

5.4. Adjusting the Brake Release

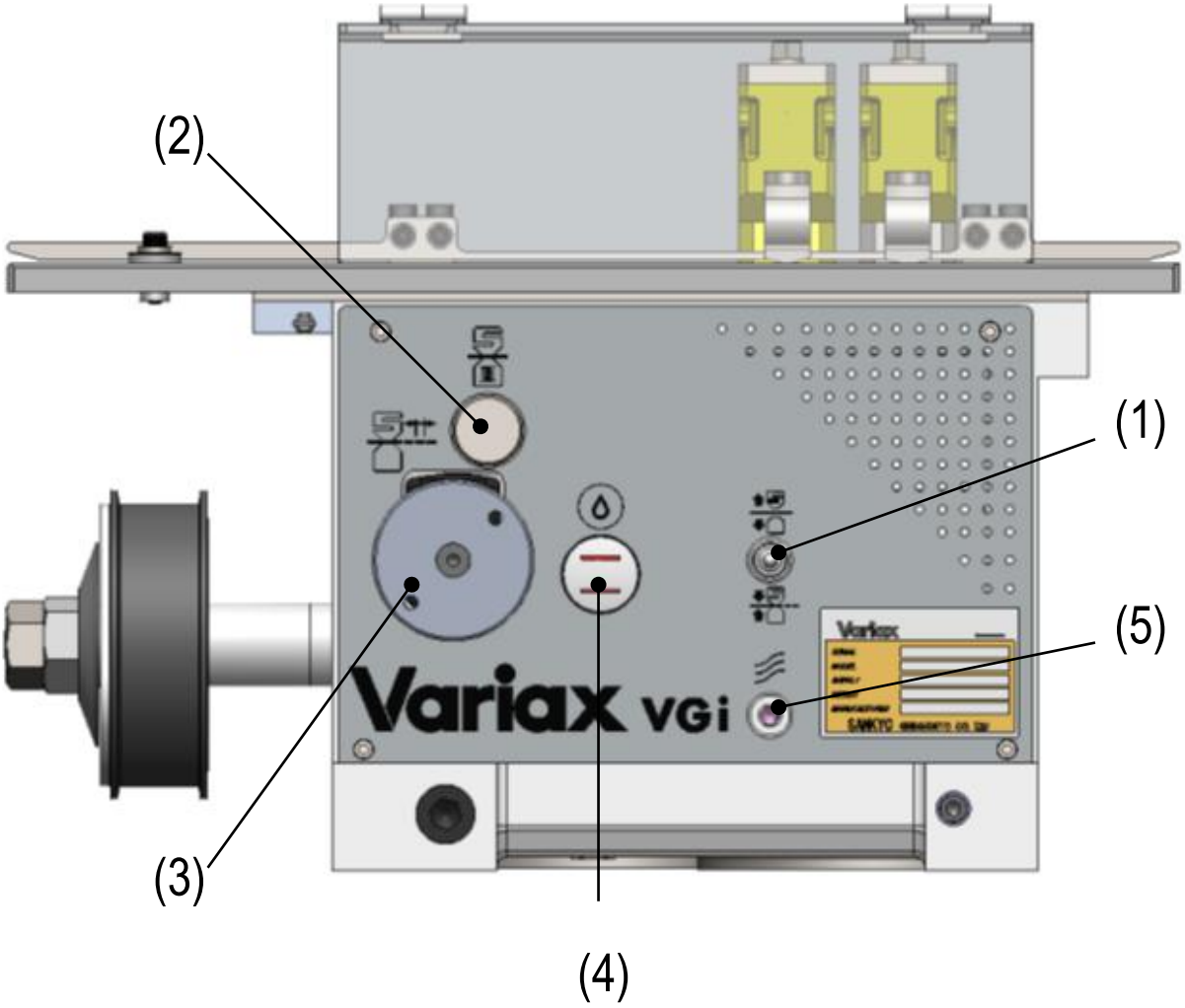
The VGi has a dual input shaft. The outer hollow shaft drives the feed cam, the lift cam for the gripper, and the lift cam for the brake. The inner shaft drives the release cam. Both shafts are physically linked by a jamb nut located outside of the housing. To adjust the timing of the brake release, loosen the jamb nut (27 mm across flats) on the end of the input shaft. Turn the release flange (30 mm across flats) at the center of the shaft. If you set the release period to the feed period, the feeder operates as a non-release feed. The operating period for the pilot release depends on the compression margin. Measure the compression margin to learn the approximate operating period of the pilot release. (The drawing shows the period for an actual release period of approximately 49°.



5.5. Air Release

The grippers or brakes can be opened by activating an air valve to release the grip on the material. Use this to thread or remove the material.

6. Parts and Functions of the Control Panel



	Name	Function
(1)	Air release switch (OPEN)	Upward: Opens grippers and brakes OPEN Downward: Feeding position (grips material) CLAMP
(2)	Grip force adjustment dial	Turn CW: Increases the gripping pressure Turn CCW: Decreases the gripping pressure [Optional] (Standard models are not equipped with the gripping force adjustment dial.)
(3)	Feed pitch adjustment dial	Turn CCW: Increases the feed pitch Turn CW: Decreases the feed pitch
(4)	Oil level	Details on the oil level can be found in Chapter 8, *Preparing for Operation*.
(5)	Air supply port (Rc 1/4)	This is required for the air release.

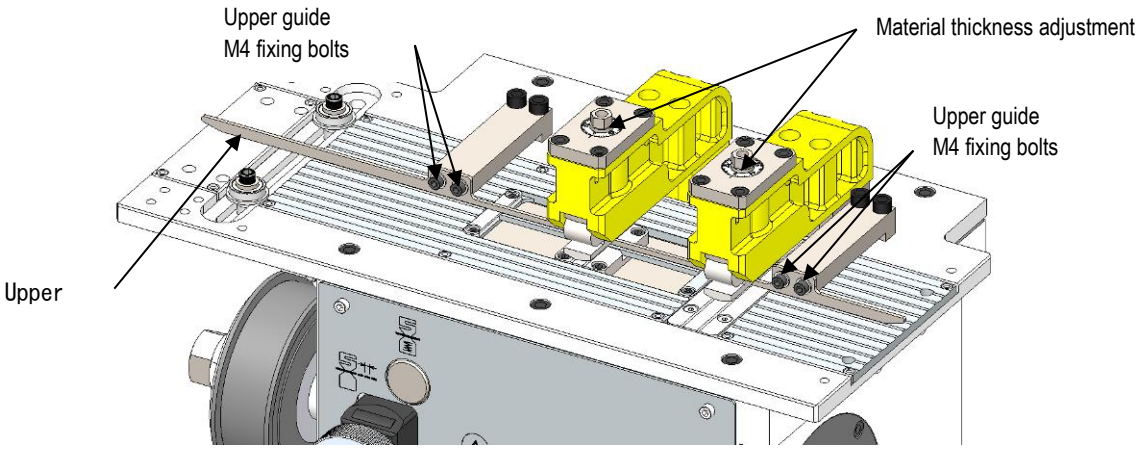
7. Removing and Mounting Parts

7.1. Removing the upper guide and upper guide mounting block

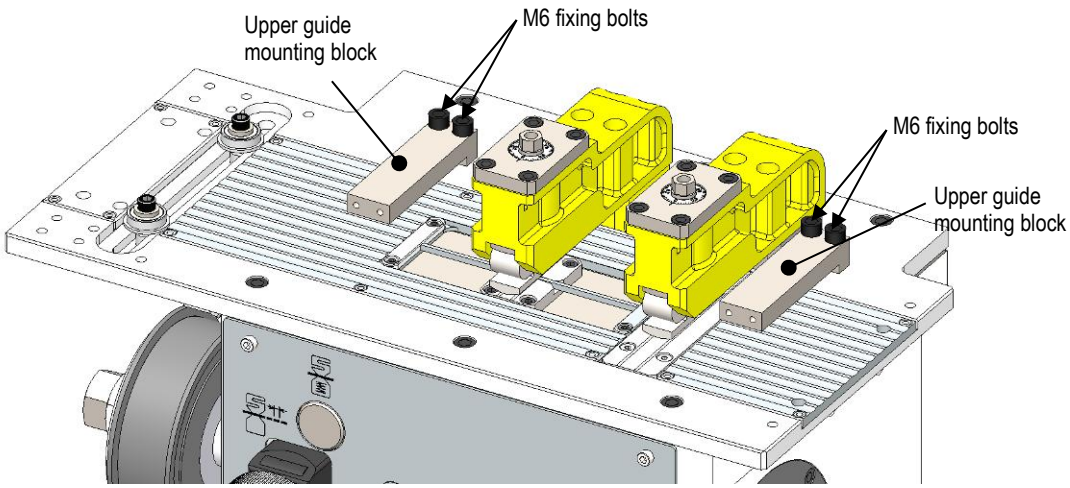
[Dial adjustment model]

A) Turn the hex head dial for the material thickness adjustment to the maximum thickness setting.

B) Remove the four M4 fixing bolts in the upper guide and take off the upper guide.



C) Loosen the four M6 fixing bolts in the upper guide mounting block and remove the block.



D) To attach the guides, perform this procedure in reverse order.

[Spacer adjustment model]

A) Remove the material thickness adjustment spacer, the upper gripper jaw, and the brake jaw.

B) Follow the same procedure as step B in the *Dial adjustment model* section.

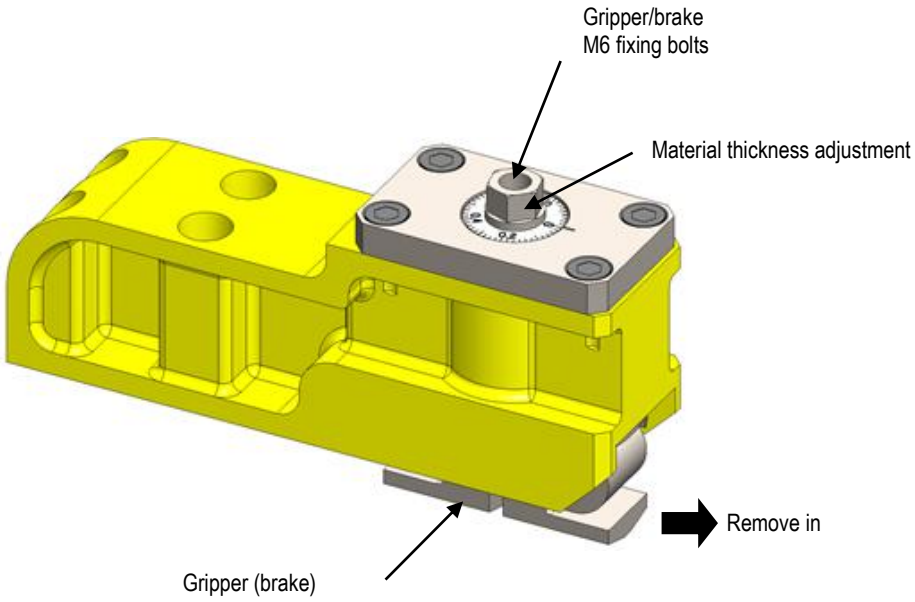
7.2. Removing the upper jaws

[Dial adjustment model]

A) Turn the hex head dial for the material thickness adjustment to the maximum thickness setting. (Open until the adjustment stops.)

B) Loosen and remove the M6 fixing bolts in the gripper (or brake) jaw.
The jaw can now be pulled off toward you (control panel).

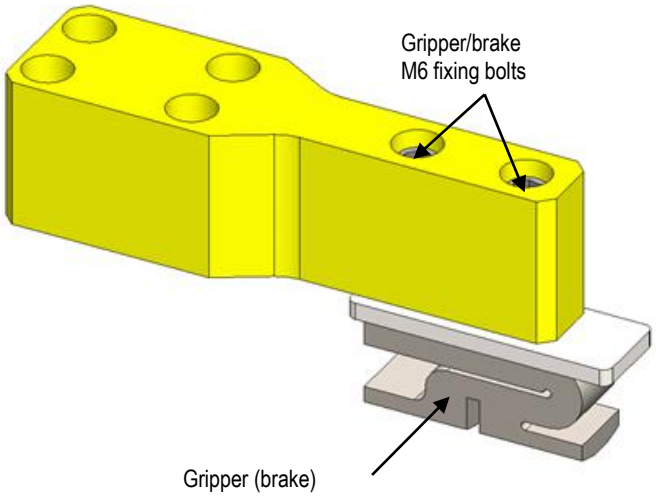
C) To attach the gripper (or brake) jaw, perform this procedure in reverse order.



[Spacer adjustment model]

A) Loosen and remove the M6 fixing bolts in the gripper (or brake).

B) To attach the gripper (or brake), perform this procedure in reverse order.



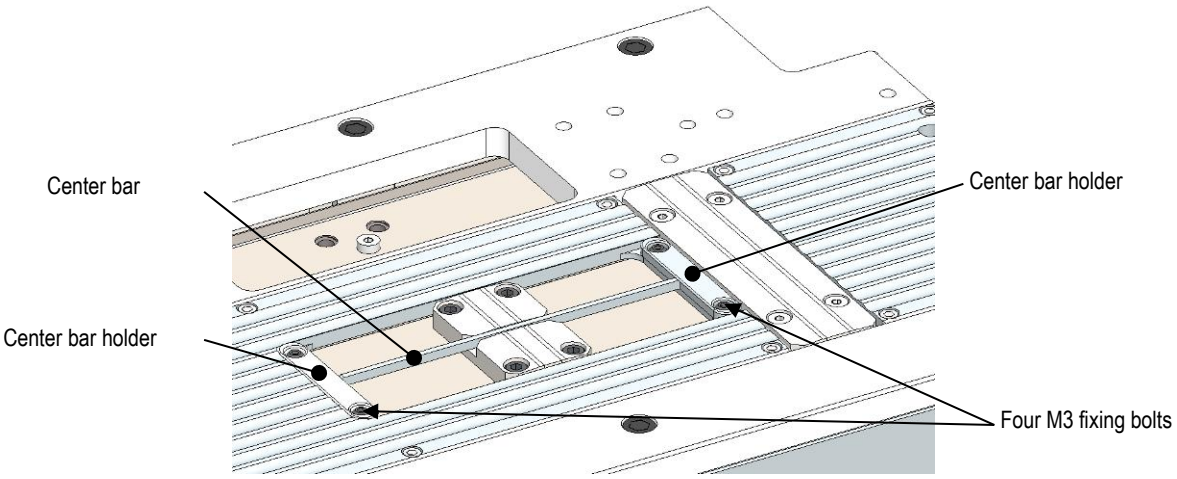
7.3. Removing the center bar

A) Remove the upper guide. (Refer to 7.1, *Removing the upper guide.*)

B) Loosen the four M3 fixing bolts and remove the center bar holder.

C) Remove the center bar.

D) To attach the center bar, perform this procedure in reverse order.



7.4. Removing the gripper plate

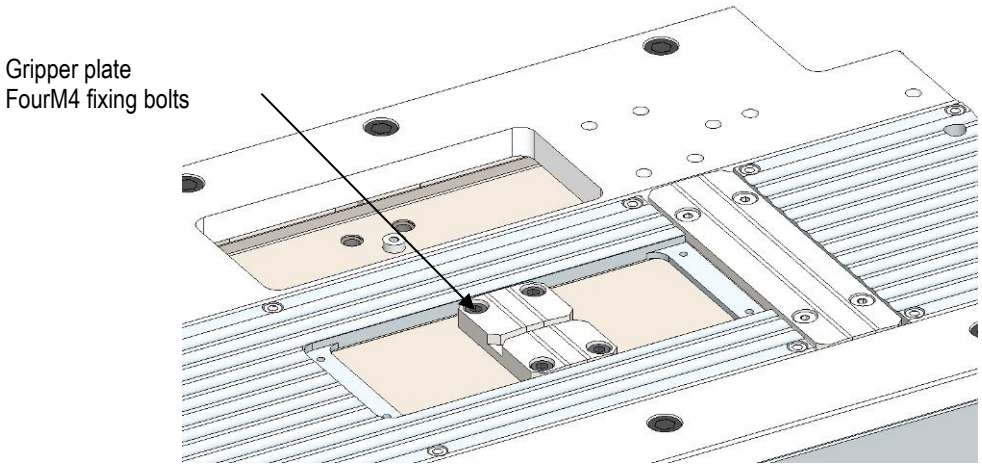
A) Remove the upper guide. (Refer to 7.1, *Removing the upper guide.*)

B) Remove the upper grip jaw. (Refer to 7.2, *Removing the upper jaws.*)

C) Remove the center bar. (Refer to 7.3, *Removing the center bar.*)

D) Loosen and remove the four M4 fixing bolts in the gripper plate.

E) To attach the gripper plate, perform this procedure in reverse order.

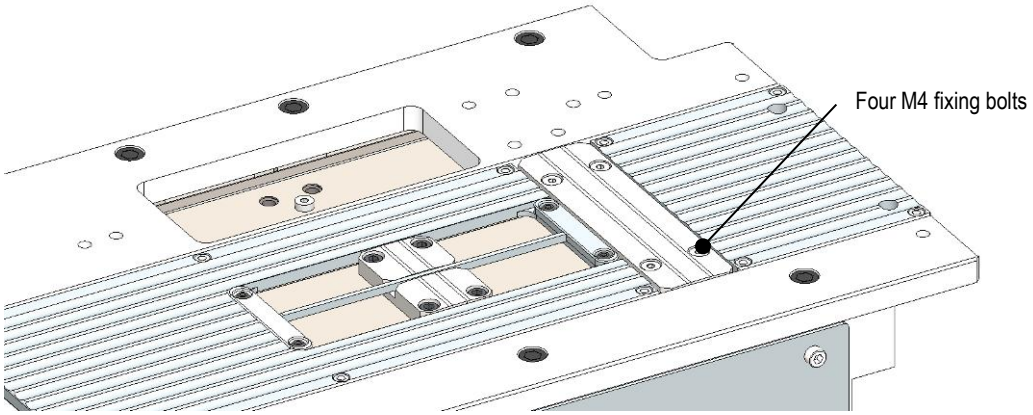


7.5. Removing the lower brake plate

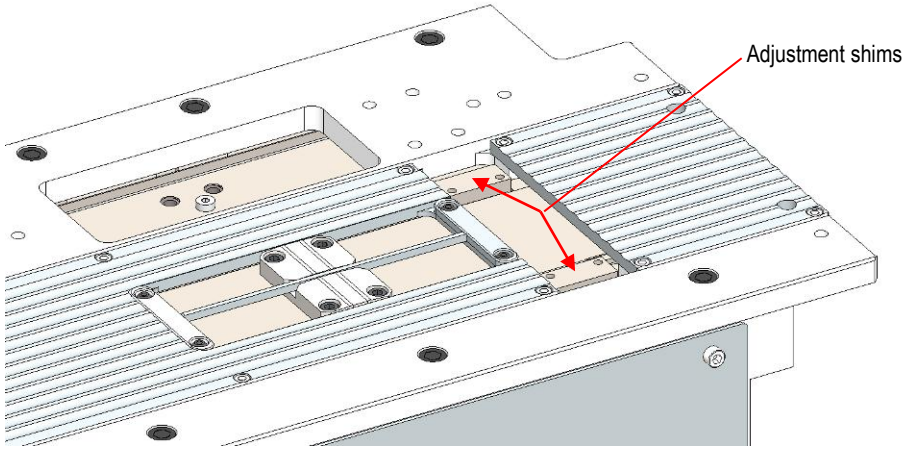
A) Remove the upper guide. (Refer to 7.1, *Removing the upper guide.*)

B) Remove te upper brake jaw. (Refer to 7.2, *Removing the upper jaws.*)

C) Loosen and remove the four M4 fixing bolts in the brake plate.



D) After you remove the brake, be careful not to let the height adjustment shims fall out.



E) To attach the brake plate, perform this procedure in reverse order.

7.6. Removing the guide plate

A) Remove the upper guide. (Refer to 7.1, *Removing the upper guide.*)

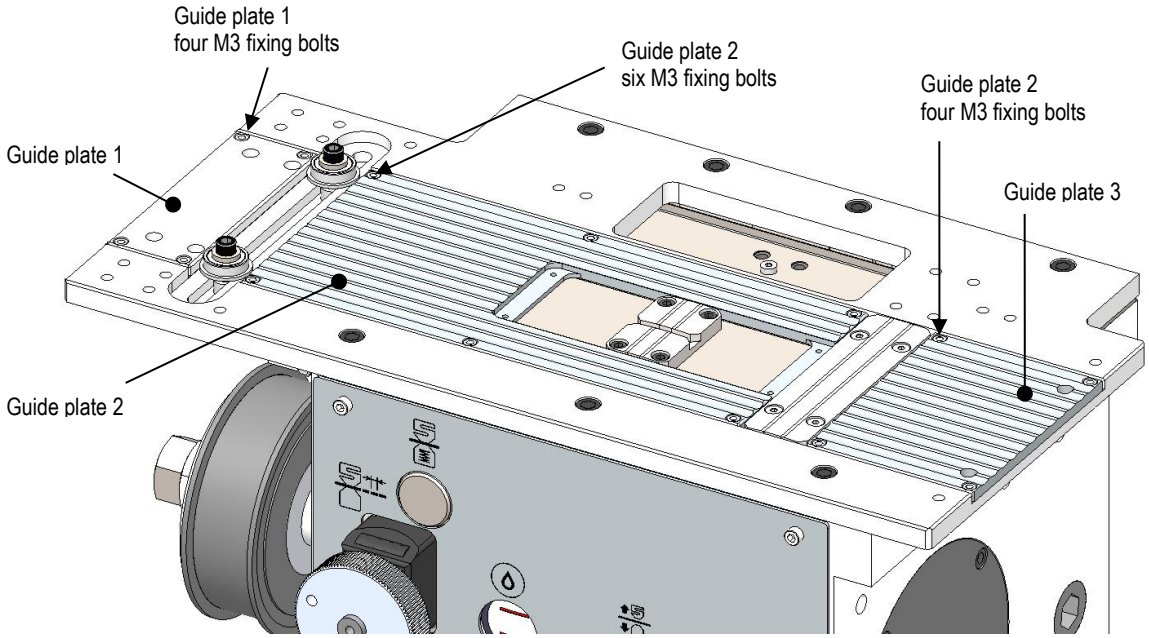
B) Remove the upper grip jaw. (Refer to 7.2, *Removing the upper jaws.*)

C) Remove the center bar. (Refer to 7.3, *Removing the center bar.*)

D) Remove the lower gripper plate. (Refer to 7.4, *Removing the lower gripper plate.*)

E) Loosen the M3 fixing bolts in each guide plate and remove the guide plates.

F) To attach each guide plate, perform this procedure in reverse order.



8. Preparing for Operation

8.1. Filling oil

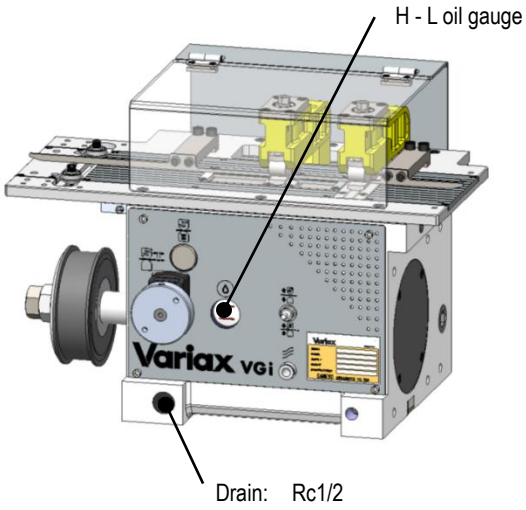
Lubrication for the feeder is to be recycled.

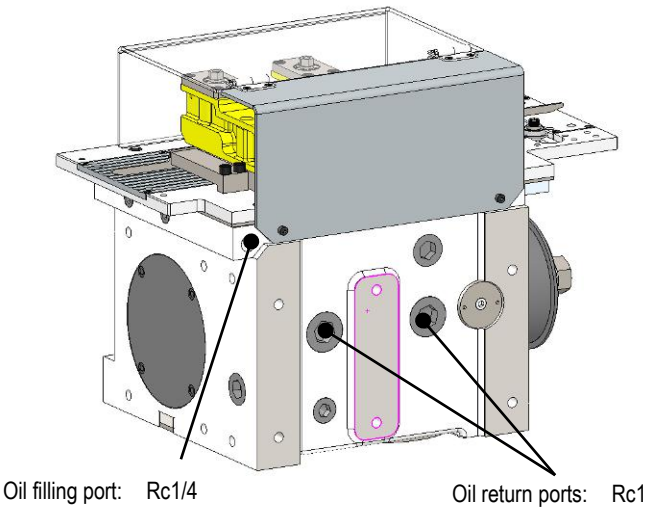
Provide a constant supply of the required amount of oil to the feeder from the press oil tank or oil pump. Make sure this oil is returned to the press tank or oil pump.

Recommend lubrication oil: Industrial gear oil type 2 (ISO #150)

Supply volume: 0.4 L/min

Volume of oil used: 1.4 to 1.6 L





8.2. Lubrication

Lubrication oil will age over prolonged hours of use and lose its initial performance properties. It must be replaced regularly.

Even if the oil is not used, it should still be replaced at least once a year.

(1) Replacement interval

1st time: 1,000 hours

2nd time: every 3,000 hours

Replace the oil immediately if it becomes dirty.

The oil in the feeder does not need to be replaced if it is supplied from the press as the oil replacement cycle for the press will suffice. In this case, refer to the instruction manual for the press.

(2) Recommended lubrication oil

Recommend lubrication oils: (if filled with Shell Omala 150.)

Manufacturer	Brand
ENEOS Industrial	Bonnoc M150
Idemitsu	Daphne Super Gear Oil 150
Mobil	Mobilgear 629
Cosmo	Cosmo Gear SE150
Exxon Mobil	Spartan EP150
Shell	Shell Omala Oil 150

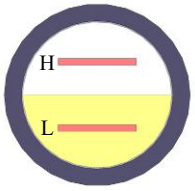
Recommend lubrication oils: (if filled with Shell Omala 68.)

Manufacturer	Brand
ENEOS Industrial	Bonnoc M68
Idemitsu	Daphne Super Gear Oil 68
Mobil	Mobilgear 626
Cosmo	Cosmo Gear SE68
Exxon Mobil	Spartan EP68
Shell	Shell Omala Oil 68

* You can use up to ISO #32 if the oil is supplied from the press oil controller.

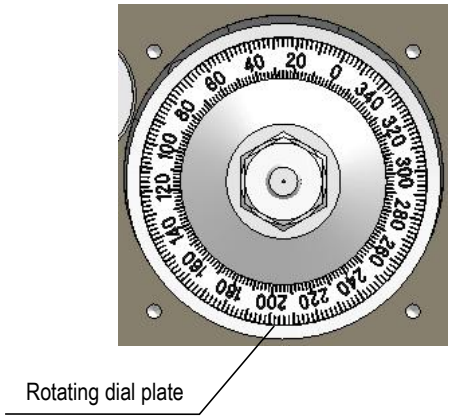
8.3. Checking filling level

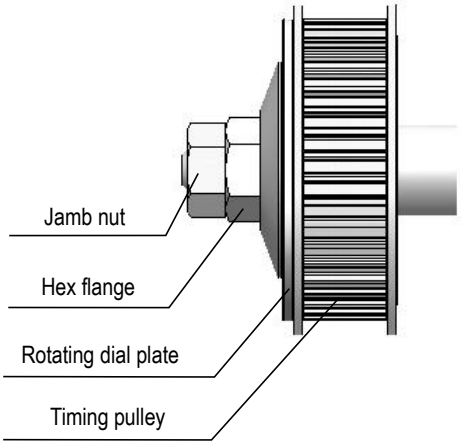
H - L oil gauge: Use the feeder only after you check that the oil level is between the H and L.



9. Synchronizing the VGi to the Press

The rotation of the input shaft of the VGi must be synchronized to the press. Follow these procedures.





[Adjusting the dial plate]

① Inch the press and stop it at the exact top dead center.

② Turn the press stroking selector swith to OFF and make sure the flywheel has stopped.

③ Loosen the clamp element (taper ring) on the tension shaft of the VGi.

Caution	Do not loosen the clamp element on the input shaft pulley. Doing so will alter the phase of the rotary dial plate to the feeder.

④ Turn the input shaft of the VGi so that the 0° position on the dial plate is at the reference position as shown in the drawing. The 0° position on the dial is factory-adjusted to the center of the feed period. Therefore, if the feed period is 165°, there is 82.5° on both sides of 0, so the feed period on the dial plate is from 277.5° to 82.5°.

Caution	When turning the input shaft, make sure the press crankshaft does not turn.

⑤ After the feeder is synchronized, evenly torque the bolts in the clamp element on the pulley. Then, check again to make sure that all bolts are torqued to the prescribed torque.

Tightening torque for bolts (10.9 property class)

- M6: 13.7 N・m
- M8: 34.3 N・m
- M10: 67.6 N・m

10. Handling Instructions

10.1. Operating environment

10.1.1. Humidity

This feeder is designed for use in an ambient temperature range from 0 to 40°C. The following measures are required if the feeder is to be used in high temperature conditions, such as the inside of a sound-proof box with the press, or on a press with a preheater. This applies in particular if the press lubrication oil is to be used.

A) The dynamic viscosity of oil drops as the temperature rises, even with high-quality oils with a high viscosity index. Select an oil grade that meets the ambient temperature during regular operation. Otherwise, the oil may not reach the moving parts where it is needed, which can reduce the life of the feeder.

B) Elements made of high polymer materials, such as acrylic resin, O-rings, and oil seals have a short life when used in high temperature conditions. Perform inspections earlier than recommended, and replace any worn parts to prevent oil and air leaks.

C) If the feeder is to be used in ambient temperatures above 70°C, have the the oil seals and O-rings replaced with heat-resistant types. Mechanical adjustments must also be made in accordance with the ambient temperature.

10.1.2. Water droplets

As with all mechanical parts, moisture causes rust. When rust mixes with oil, the oil will degrade rapidly. If coolants or other liquids are used near or around the feeder, furnish splash covers and/or other precautions.

10.1.3. Stamping Oil

Stamping oil is the most common lubricant used around the feeder. Stamping oil contains substances not commonly found in oils used for lubricating machines. Do not allow it to enter the feeder. Stamping oil can affect the feeding accuracy if it adheres to the grippers. Be careful when setting the amount and application point of the stamping oil.

10.1.4. Dust

The typical stamping line is full of dust and foreign particles that are harmful to the feeder, such as punch slugs, chips, and sludge from the material being rolled. Ambient dust and foreign particles can be drawn into the feeder and cause damage or pressure marks on the material, or cause damage to the internals of the feeder, thus shortening service life. Take the necessary procedures to prevent foreign particles from entering the feeder. If the material is typically covered in dust, install cleaning felt pads before the inlet to the feeder. If the environment is very dusty, take additional measures to protect the entire feeder.

10.2. Lubrication

10.2.1. Lubrication Oil

Lubrication oils must be maintained in proper condition to maintain the performance and life.

A) Checking the oil level and oil supply level

Check the level of the oil in the feeder and the lubrication tank daily before starting production or before operating the feeder. The oil level will fall and rise when the feeder is in operation. Wait for it to stop before checking the oil level.

B) Changing the lubrication oil

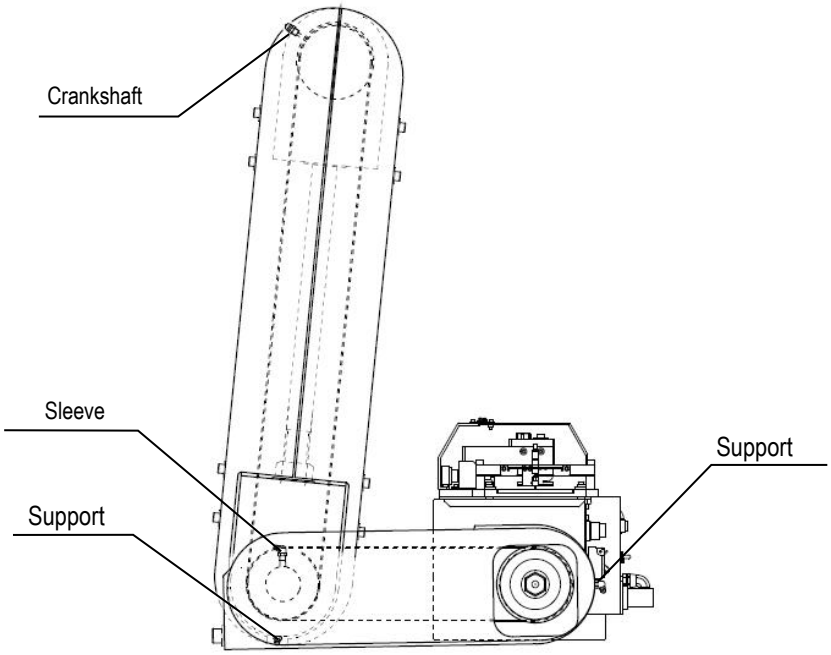
Lubrication oil degrades over hours of use and will eventually show a significant drop in performance. It is important to replace the oil regularly. The first replacement should be after 1,000 hours of use, or at least six months. Thereafter, you should replace the oil after every 3,000 hours of use, or at least once a year. Refer to Chapter 8, *Preparing for operation* for details on how to replace oil.

C) Lubrication oil:

Use a good quality mineral oil with pressure additives for improved performance. Do not mix oil types, or oils with different additives. Doing so may degrade the quality of the oil, or compromise its performance. When changing oil types, drain the previous oil completely before filling new oil.

10.2.2. Lubrication grease

The Sankyo input drive system (the SCT Drive) should be greased once every six months. The amount of grease to inject into the zerk is about 10 cc. The maximum injection pressure is 1000 kPa. Refer to the Specifications Notifications Drawing for the locations of each grease zerk.



Typical locations of grease zerks

Recommended grease (if filled with Daphne Eponex Grease EP2)

Manufacturer	Brand
ENEOS Industrial	Epnoc Grease AP2
Idemitsu	Daphne Eponex Grease EP2
Mobil	Mobilux Grease 2
Cosmo	Rimax No. 2
Exxon Mobil	Beacon 2
Shell	Shell Albania

10.3. Regular inspections

To maintain the performance of the feeder, keep the area around the press and feeder clean, and most importantly, perform daily inspections and maintenance. Inspection and maintenance work is generally performed daily, weekly, monthly, semi-annually, or annually.

Inspection Period	Inspection Items
Daily Inspections	Visually inspect for noticeable changes over the daily operation, including possible causes for serious machine accidents or personal injury. • External damage, loose or fallen parts. • Abnormal noise, odors, heat. • Proper oil level. • Dirt or debris on the material guide base. • Proper synchronization.
Weekly Inspections	Weekly inspections supplement the daily and monthly inspections. You may wish to start the week off with certain daily inspection items. • Make sure all switches operate correctly (feed pitch, material thickness, grip force, etc.)
Monthly Inspections	Inspect machine performance and for wear • Proper parallelism of upper and lower grippers. • Proper amount of compression margin in grippers. • Proper parallelism of upper and lower brakes. • Proper amount of compression margin in brakes. • Bolt loosening • Belt wear, tension. • Check for any play in the bearings in the drive unit.
Semi-annual Inspection	If the feeder has been in service for many years, it may be necessary to perform the annual inspection semi-annually. The semi-annual inspection should be performed after about 2,000 hours of operation. • Supply grease to each grease point. • Fretting on the sliding surfaces. • Lubrication oil replacement (for recirculated lubrication)
Annual Inspections	The annual inspection items are performed with the mandatory inspections for the press. • Wear at the gripping points of the grippers and brakes. • Check for changes in accuracy over time. • Lubrication oil replacement (for oil baths and recirculated lubrication)

10.4. Safety measures and precautions

A) The moving parts of the feeder are guarded with covers. Do not remove or attempt to remove the covers while the equipment is running. If you must remove or assemble the covers, wait for the press flywheel to stop.

B) Do not operate the toggle switch or make large adjustments with the feed pitch dial while the equipment is running. Doing so may cause misfeeds and/or damage to the dieset.

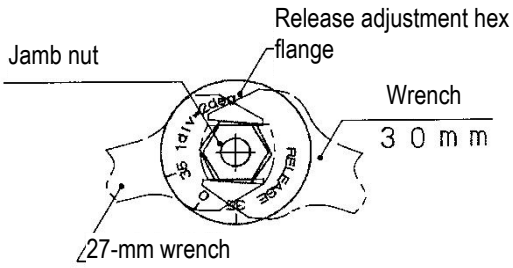
C) Do not drop bolts or other objects into the opening for the gripper and slider arm. This will damage the feeder.

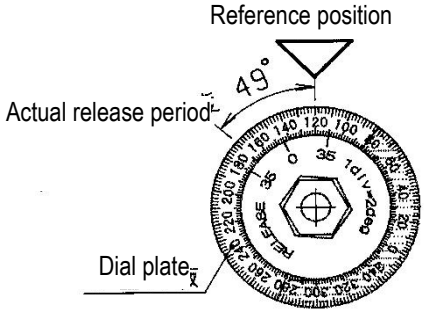
11. Procedures for Supplying Material

Use the following procedure to supply material to the feeder.

① Set the toggle switch on the control panel to the Open position. (The lower gripper moves down.)
② Adjust the feed pitch with the dial on the control panel.
③ Insert the material thickness adjustment spacer that matches the thickness of the material to be used. (For spacer adjustment models.) Adjust the dial on the gripper and brake. (For dial adjustment models.)
④ Set the material guides wider than the width of the material to be used.
⑤ Insert the material into the feeder, and adjust the straightness to the die and material guides. (The material should move freely in the feeding direction.)
⑥ Make sure there are no foreign objects near the grippers, and then close the top cover.
⑦ Set the air release switch to the Feed position so that material can be fed.
⑧ Adjusting the Release Timing
   A) Inch the press and stop where the tip of the pilot pins are about to enter the pilot holes in the material.
   B) Loosen the jamb nut (27 mm across flats) on the end of the input shaft of the VGi.
   C) Turn the release timing adjustment flange (30 mm across flats) while pushing and pulling the until the material starts to come loose.

   Example: If the actual release period is 49° and you want to start the release from 120°, the relationship of the dial plate and the hex flange is as shown below.





   D) Tighten the jamb nut so that the hex head flange for the release timing adjustment does not move.
   E) After tightening the jamb nut, check to make sure the release start at the desired angle. Redo the adjustment if the release timing is off.

⑨ Inch the press several times and make sure there are no problems before starting continuous press operation.

12. Troubleshooting

12.1. Feeder fails to operate when press is running

	Cause	Corrective Action
A	The drive belt for the feeder is broken.	Replace it.
B	The drive belt for the feeder has come off.	Insufficient tension or the pulley is out of alignment.
C	The drive pulley for feeder spins on its own.	Adjust the timing and re-tighten the clamp element on the loose part.

12.2. Feeder breakdown

	Cause	Corrective Action
A	The slider arm crashed into an object during operation.	- Replace any damaged parts. - Check the feeder internals for abnormal noise or play.
B	The feeder seized because it was run without oil.	The feeder must be overhauled.
C	Play in the slider.	- The feeder has reached its life, or has abnormal wear. - The feeder must be overhauled.

12.3. The feeder fails to feed material

	Cause	Corrective Action
A	The material thickness spacers do not match the thickness of the material being fed. Or, the spacers are not inserted.	Use the proper spacers.
B	The material thickness dial setting is incorrect.	Re-adjust the dial.
C	The air release switch on the control panel is set to Open.	Set it to Feed.
D	The material buckle detection switch is activated.	Investigate the cause and set it in the correct position.
E	- The gripper is not sliding (moving). - The lower gripper or brake is not lifting.	Make sure the input shaft is turning. If it is, the feeder may be damaged and must be repaired.

12.4. Material cannot be threaded (during setup)

	Cause	Corrective Action
A	The material thickness spacers do not match the thickness of the material being fed	Use the proper spacers.
B	The material thickness dial setting is incorrect.	Re-adjust the dial.
C	The air release switch on the control panel is set to Feed.	Set it to Open.
D	The air release switch on the control panel does not work.	Check for problems in the air supply.
E	The tip of the material is bent.	Remove any turned up edges in the material when it was cut.
F	The material guides are set too narrow.	Readjust the guides.

12.5. Brake leaves marks on material

	Cause	Corrective Action
A	The material thickness spacers do not match the thickness of the material being fed	Use the proper spacers.
B	The material thickness dial setting is incorrect.	Re-adjust the dial.
C	The material is soft.	Modify the shape of the gripper and brake.

12.6. Gripper leaves marks on material

	Cause	Corrective Action
A	The material thickness spacers do not match the thickness of the material being fed	Use the proper spacers.
B	The material thickness dial setting is incorrect.	Re-adjust the dial.
C	The gripping force setting for the grippers is too strong.	Reduce the gripping force setting.
D	The material is soft.	Increase the area of contact of the grippers. Reduce the gripping force setting. (The stroke speed may also be reduced.)

12.7. Gripper leaves slip marks on material

	Cause	Corrective Action
A	The material thickness spacers do not match the thickness of the material being fed	Use the proper spacers.
B	The material thickness dial setting is incorrect.	Re-adjust the dial.
C	The area of contact between the material and guides is too low, or the grip force setting is too low.	Increase the grip force setting.
D	The material guides are not trammed with the dieset.	Readjustments
E	The feeder is being run above capacity.	Check the specifications and performance curve chart.

12.8. Misfeeds occur frequently

	Cause	Corrective Action
A	The material catches on something inside the dieset that makes it tight.	- Clean the dieset. - Repair any damage in the dieset. - Replace the pilot pins if they are too long and touch the material while it is being fed.
B	The release timing of the feeder does not match the timing of the pilot pin entry.	Inch the press and readjust the timing.
C	The dieset is mounted at an angle with respect to the feed line.	Top stop the press, set the grippers to Open, and reposition the dieset so that material moves freely.
D	The misfeed sensor in the dieset is faulty.	Run the press without material and see if the misfeed sensor activates. If it does, replace it.
E	The dieset clamps the material even though it is being fed.	Check and readjust the timing of the feeder to the press.
F	The rotary solenoid-activated cutter closes while the material is being fed, or the material starts to feed before the cutter rises out of the way.	Adjust the timing of the rotary solenoid to the feeder.
G	The leveller and coilers do not operate.	Check the power supply and motors.
H	The leveller and coilers cannot keep up with the speed of the feeder.	Replace the leveller and coilers with high-speed equipment, or make modifications to increase their speed.
I	The feed level is out of alignment.	Readjust the feed level of the feeder so that it matches the feed level of the dieset.
J	There is no guiding from the feeder to the dieset.	Furnish robust guides with the proper clearance.

	Cause	Corrective Action
K	The material in the guiding between the feeder and the dies is flapping.	The most common causes for material flapping are: the material is not aligned with the dies or, the pilot pins and release timing are off. Stop the press and make sure these settings are correct.
L	The stamping oil on the material causes the material to slip between the grippers.	- If the stamping oil is applied before the grippers, move it between the feeder and dieset. - Increase the grip force setting. - Increase the area of contact of the grippers. - Adjust the amount of stamping oil.
M	The stamping oil on the material causes the material to stick to the guiding.	- Adjust the amount of stamping oil. - Reduce the area of contact between the material and guiding.

13. After-sales Service

Warranty service is available, free of charge, from 8:00 to 17:00 from Monday to Friday, except on designated holidays.

The warranty period and terms are printed on the warranty certificate and product specifications notification drawing.

When contacting Sankyo, always provide the serial code V****** on the legend plate.

Also provide the model code VGI80********.

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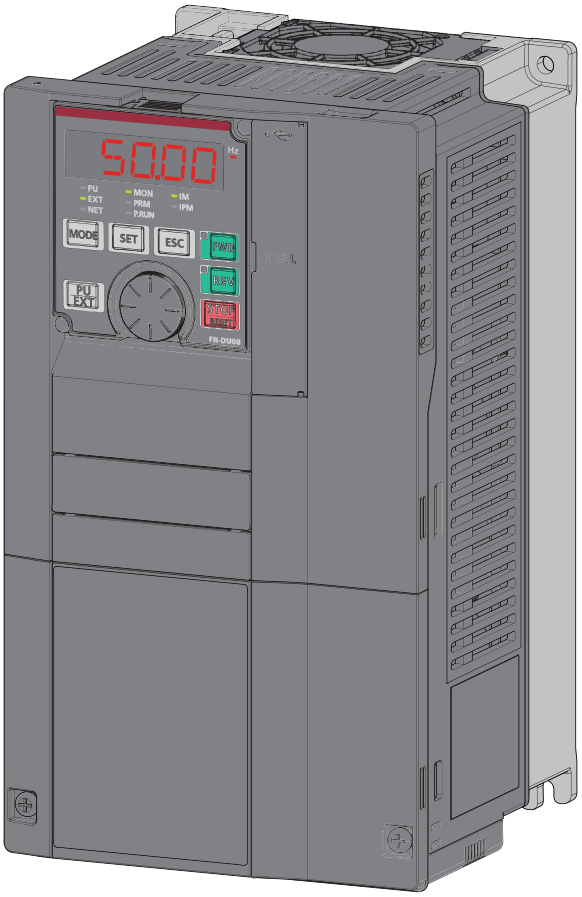
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URL：http://www.rollerdrive.com

MITSUBISHI ELECTRIC

INVERTER

A800

PLC FUNCTION PROGRAMMING MANUAL



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◆About the related manuals

The manuals related to A800 PLC function are shown below. The download of the latest manuals is free at the Mitsubishi Electric FA Global Website.

Related manuals

Manual name	Manual number
FR-A800 Instruction Manual (Startup)	IB-0600493
FR-A800 Instruction Manual (Detailed)	IB-0600503ENG
FR Configurator2 Instruction Manual	IB-0600516ENG
GX Works2 Version 1 Operating Manual (Common)	SH-080779ENG

1 PLC Function

This instruction manual explains the functions and devices required for programming.

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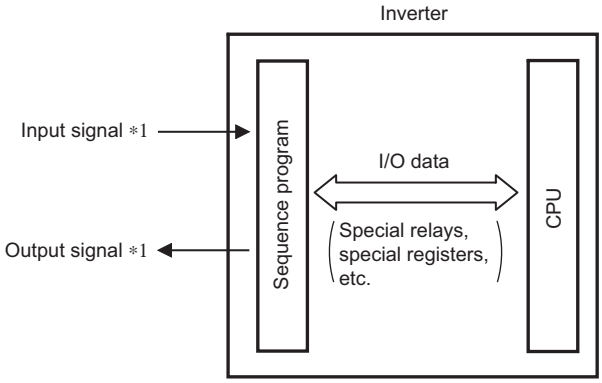
1.1 Applicable inverter model

This manual explains the PLC function of the FR-A800 series.

1.2 Function block diagram

The following function blocks explain I/O information flow to and from the inverter in the PLC function.

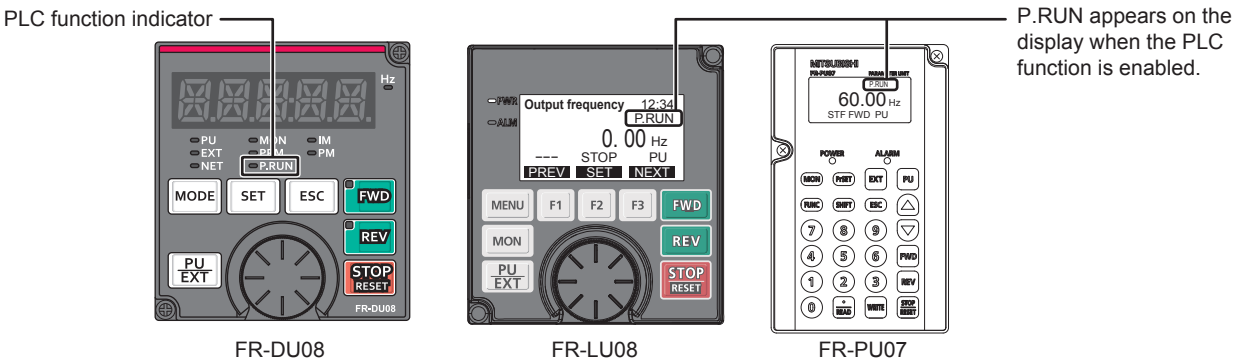
- I/O information can be read or written by accessing the inverter with special relays, special registers, etc. using predetermined methods.
- It is possible to operate the inverter and read and write parameters using input information from control input terminals according to created sequence programs (saved in the inverter).
  Output signals are also be output from control output terminals, not only as status signals of the inverter but as signals to turn the pilot lamp ON and OFF, interlock signals, and other control signals set by users as desired.



*1 Set "9999" in any of **Pr.178 to Pr.189 (input terminal function assignment)** and **Pr.190 to Pr.196 (output terminal function selection)** to use terminals as general-purpose I/O terminals. For details on **Pr.178 to Pr.189** and **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

1.3 Operation panel indication

When a sequence program is running, the following indicators are displayed on the operation panel and parameter unit.



P.RUN state

Indication		Status
FR-DU08 (LED)	FR-DU08 (LCD) FR-PU07 (LCD)	
Off	Normal indication	Sequence program stopped
On	Inverted indication	Sequence program running
Flickering	Inverted and flickering	Sequence error occurring

NOTE

- While the offline auto tuning is being activated by FR-PU07, P.RUN is not displayed even during PLC function operation.

1.4 PLC function specifications

The following table shows the program capacity and devices of the PLC function.

Item			A800 PLC function specifications
Control method			Repeated operation (by stored program)
I/O control mode			Refresh
Programming language			Relay symbolic language (ladder) Function block
No. of instructions	Sequence instructions		25
	Basic instructions		84
	Application instructions		37
Processing speed			Sequence instructions 1.9 µs to 12 µs/step*1
Number of I/O device points			128 (input: 64 points, output: 64 points) 19 points built-in (input: 12 points, output: 7 points)*2 FR-A8AX (input: 16 points) FR-A8AY (output: 6 points) FR-A8AR (output: 3 points)
Number of analog I/O points			3 input points built-in (Terminals 1, 2, and 4) 2 output points built-in (Terminals FM/CA and AM), FR-A8AY: 2 output points (AM0 and AM1)
Pulse train I/O		Input	Terminal JOG (maximum input pulse: 100k pulses/s) *3
		Output	Terminal FM (maximum output pulse: 50k pulses/s) *3
Watchdog timer			10 to 2000 ms
Program capacity			6K steps (24k bytes) (0 to 6144 steps can be set), contained in one program
Device	Internal relay (M)		128 (M0 to M127)
	Latch relay (L)		Not used (Can be set with parameters but will not latch)*4
	Timer (T)	Number of points	16 (T0 to T15)
		Specifications	100 ms timer: 0.1 to 3276.7 s can be set 10 ms timer: 0.01 to 327.67 s can be set 100 ms retentive timer: 0.1 to 3276.7 s can be set
	Counter (C)	Number of points	16 (C0 to C15)
		Specifications	Normal counter: Setting range 1 to 32767 Interrupt program counter: Not used
	Data register (D)		256 (D0 to D255)
	Special relay (SM)		2048 (SM0 to SM2047) with limited functions
	Special register (SD)		2048 (SD0 to SD2047) with limited functions

*1 The scan time is approximately 40 ms for 1K steps as inverter control is also performed in actual operations.

*2 The signals same as the ones assigned to the inverter I/O terminals are used.
One point is always required for a sequence start (RUN/STOP).

*3 The **Pr.291 Pulse train I/O selection** setting is required. The pulse train output is only available for the FM type inverter.

*4 There is no device latch function for power failures.
Use the **Pr.1150 to Pr.1199 PLC function user parameters 1 to 50** (D206 to D255) to store device values in the EEPROM. (Refer to **page 46**.)

NOTE

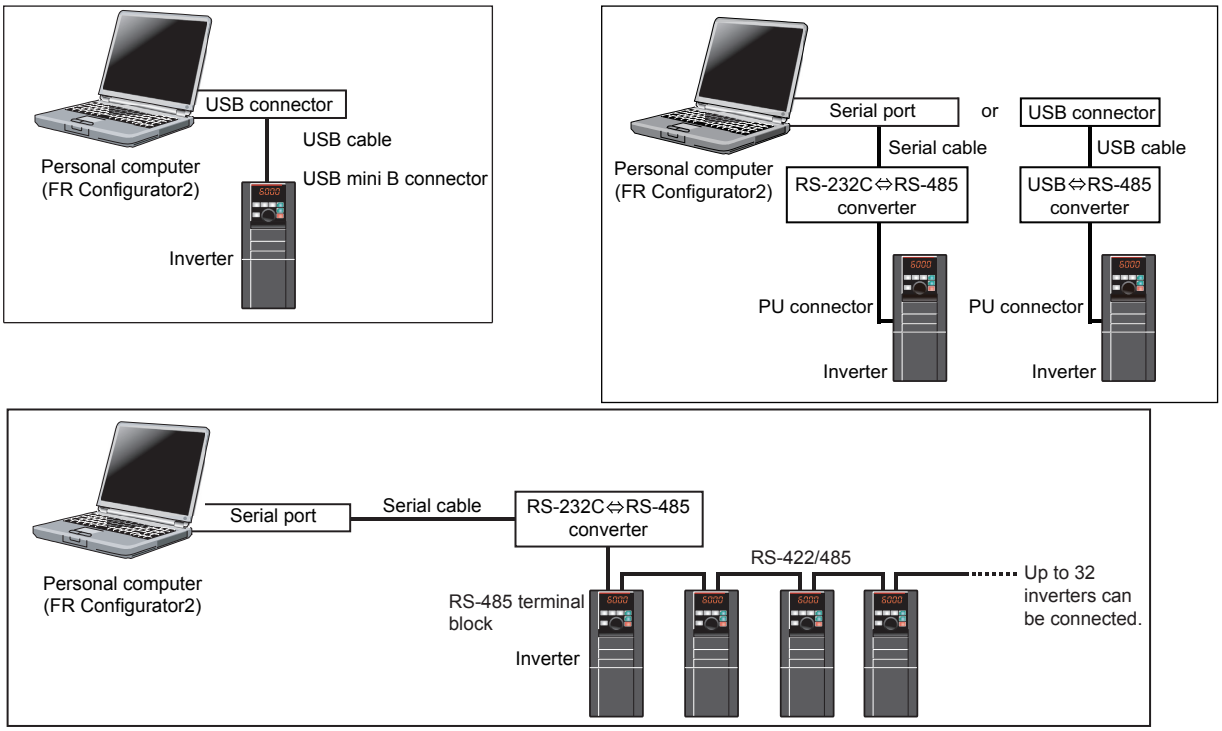
- There is no buffer memory.

1.5 System configuration

For writing sequence programs to the inverter, use FR Configurator2 (Developer) on the personal computer connected to the inverter via RS-485 communication. The inverter and the personal computer are connected via USB communication or RS-485 communication.

The following figure shows the system configuration for use of the PLC function.

<System configuration example>



Commercially available products (as of February 2012)

• RS-232C ⇔ RS-485 conversion cable

Model	Manufacturer
Interface embedded cable dedicated for inverter DINV-CABV *1	Diatrend Corp.

*1 The conversion cable cannot connect multiple inverters. (The computer and inverted are connected in a 1:1 pair.) This product is a RS-232C ⇔ RS-485 conversion cable that has a built-in converter. No additional cable or connector is required. For the product details, contact the manufacturer.

• USB ⇔ RS-485 conversion cable

Model	Manufacturer
DINV-U4	Diatrend Corp.

• Recommended USB cable for connection between the personal computer and the inverter

Model	Manufacturer
MR-J3USBCBL3M (cable length: 3 m)	Mitsubishi Electric Corporation

POINT

- FR Configurator2 (Developer) is a programming tool for designing and debugging of the sequence programs on the Windows personal computer. To use the PLC function of the inverter, write sequence programs to the inverter using FR Configurator2 (Developer). (For the details, refer to the Instruction Manual of FR Configurator2.)

NOTE

- For details on wiring, refer to the Instruction Manual of the inverter.
- For the specifications of the FR Configurator2 (Developer) and personal computers on which FR Configurator2 (Developer) runs, refer to the Instruction Manual of FR Configurator2.
- Programming tools other than FR Configurator2 (Developer) cannot be used. (Tools such as GX Developer and GX Works cannot be used.)

1.6 Operations of PLC function (Pr.414, Pr.415, Pr.498, Pr.1150 to Pr.1199)

I/O information can be read or written by accessing the inverter with special relays, special registers, etc. using predetermined methods.
It is possible to operate the inverter and read and write parameters using input information from control input terminals according to created sequence programs (saved in the inverter).
Output signals are also be output from control output terminals, not only as status signals of the inverter but as signals to turn the pilot lamp ON and OFF, interlock signals, and other control signals set by users as desired.

Parameter number	Name	Initial value	Setting range	Refer to page
414	PLC function operation selection	0	0 to 2	14
415	Inverter operation lock mode setting	0	0, 1	14
498	PLC function flash memory clear	0	0, 9696 (0 to 9999)	50
1150 to 1199	PLC function user parameters 1 to 50	0	0 to 65535	46

1.7 Prior to creating sequence programs

1.7.1 Precautions for creating sequence programs

POINT

- Writing and access to other stations are not possible while a sequence program is running.
  Also, reading and writing the program from and to other stations cannot be performed.
- To avoid accidentally erasing the created sequence programs, use FR Configurator2 (Developer) to regularly save the data in a personal computer, etc.

If a sequence program contains instructions (refer to page 106) or devices (refer to page 10) that cannot be used with the PLC function, an instruction code error occurs at the execution of that instruction.

Error code	SD0 = 4000
Error information	SD5 to SD26
Error flag	SM0: ON

NOTE

- For the error codes, refer to page 33.

1.7.2 The main functions of FR Configurator2 (Developer)

- Reading and writing parameter and sequence programs
- Ladder monitor
- Device batch monitor
- Present value change
- Remote RUN/STOP

NOTE

- Present values can be changed using FR Configurator2 (Developer) ([Debug] -> [Present value change]). Even if changes are made to the devices corresponding to the control terminal signals (STF, STR, etc.), such changes are not applied to the inverter operation. (Device present values of the sequence programs are changed.)

1.7.3 Sequence program execution

Parameter number	Name	Initial value	Setting range	Description	
414 *1	PLC function operation selection	0	0	PLC function disabled	
			1	PLC function enabled	The SQ signal is enabled by input from a command source (external input terminal/ communication).
			2		The SQ signal is enabled by input from an external input terminal
415	Inverter operation lock mode setting	0	0	The start signal of the inverter is enabled regardless of execution instruction of the sequence program.	
			1	The start signal of the inverter is enabled only when the sequence program is in RUN state. (The SQ signal is ON.) When the sequence program is in STOP state (the SQ signal is OFF), the inverter will not start even if the start signal STF or STR is turned ON. (If the state is changed from RUN to STOP during operation, the inverter decelerates and stops.)	

*1 Reset the inverter after configuring settings to enable the PLC function.

◆PLC function operation selection (Pr.414)

- To enable the PLC function, set "1" or "2" in **Pr.414 PLC function operation selection**. When **Pr.414** = "1", the command source for the sequence start (SQ) signal is determined by **Pr.338 Communication operation command source**. When "2" is set in **Pr.414**, SQ signal from the external input terminal is valid regardless of the setting of the **Pr.338**.
- Switch the execution key (RUN/STOP) of the sequence program by turning the SQ signal ON/OFF. The sequence program can be executed by turning the SQ signal ON. To input the SQ signal, set "50" in any of **Pr.178 to Pr.189 (input terminal function selection)** to assign the function to a terminal.
- Remote RUN/STOP of the PLC function can be executed in any of the following methods:
  - Using the PLC function parameters (contact)
  - Using FR Configurator2 (Developer)
  - Via CC-Link communication (refer to page 56.)

NOTE

- Turn OFF (STOP) the SQ signal when creating a sequence program.
- The RUN state output (Y) is internally stored and all outputs (Y) are turned off by turning the SQ signal OFF (STOP) after sequence program execution (SQ signal ON).
  The other devices retain the data prior to STOP. To clear the remaining device data, power OFF or reset (RES signal ON (0.1 s)→OFF) the inverter.

◆Inverter operation lock mode setting (Pr.415)

- When "1" is set in **Pr.415 Inverter operation lock mode setting**, the inverter can be operated only when the sequence program is set to the "RUN" status. By changing the PLC program status from RUN to STOP during inverter operation, the motor decelerates to stop.

POINT

- To run the inverter without using the PLC function, set **Pr.415** = "0" (initial value) (the start signal of the inverter is enabled).

NOTE

- This parameter cannot be written during inverter operation, regardless of the **Pr.77** setting.
- During automatic operation using SD1148 (or SM1200 to SM1211) in the sequence program, the inverter stops operation if the sequence program is in the STOP state while **Pr.415** = "1". However, when **Pr.415** = "0", the device data is retained and the operating status does not change (the inverter continues operation) even if the sequence program is in the STOP state.
- **Pr.415** setting is also enabled for the start signals of the operation panel.

1.7.4 Setting the communication parameter

POINT

- For RS-485 communication between the inverter and FR Configurator2, communication cannot be established when the inverter communication parameter settings and the FR Configurator2 communication settings differ.

- Set "9999" in **Pr.122 PU communication check time interval** for communication using the PU connector, and set "9999" in **Pr.336 RS-485 communication check time interval** for communication with RS-485 terminals.
- Use the same settings for the inverter communication parameters **(Pr.118 to Pr.120, Pr.124, Pr.332 to Pr.334, and Pr.341)** and the FR Configurator2 communication settings.
- Initial values are shown below.

Item	FR Configurator2 initial value	Inverter communication parameters		
		Pr.	Parameter name	Initial value
Communication speed	19200(bps)	118	PU communication speed	192 (19200 bps)
		332	RS-485 communication speed	96 (9600 bps)
Data length/Stop bit	Data length : 8 bits Stop bit : 2 bits	119	PU communication stop bit length / data length	1 (data length: 8 bits, stop bit: 2 bits)
		333	RS-485 communication stop bit length / data length	
Parity	Even	120	PU communication parity check	2 (with even parity check)
		334	RS-485 communication parity check selection	
Communication check time interval	-	122	PU communication check time interval	9999 (without communication check)
		336	RS-485 communication check time interval	0 (Changing to NET operation mode disabled)
Delimiter	CR	124	PU communication CR/LF selection	1 (CR)
		341	RS-485 communication CR/LF selection	

NOTE

- Use the operation panel to change the settings of the inverter parameters.
  The operation panel and FR Configurator2 (personal computer) cannot be connected to the PU connector simultaneously.
- For details on each inverter communication parameter, refer to the Instruction Manual (Detailed) of the inverter. For the setting method of the [Detailed setting] of the [System setting] window of FR Configurator2, refer to the Instruction Manual of FR Configurator2.
- Parameter clear/All parameter clear clears communication parameter settings and may disable the communication with FR Configurator2 (Developer).

1.7.5 Writing sequences programs

POINT

- Sequence programs can be written in any operation mode (External operation mode, PU operation mode and Network operation mode). For the operation modes, refer to **the Instruction Manual (Detailed)** of the inverter.

Check the following points when rewriting the PLC function parameters and sequence programs using FR Configurator2 (Developer):

- The sequence program execution status is in the STOP (SQ signal OFF) (refer to **page 14**).
- The inverter is stopped.
- The communication specifications setting parameters **(Pr.117 to Pr.124)** are correctly set. Communication with FR Configurator2 (Developer) is not possible if these parameter setting values are incorrect.
- The PLC series setting and sequence program capacity are correctly set with FR Configurator2 (Developer) parameters. (Refer to **page 11**.)

Refer to the FR Configurator2 manual and write sequence programs.

NOTE

- A sequence program cannot be written with its steps specified. The sequence program does not run if written in this way. (The program outside the specified range is initialized.)
- To read the PLC function parameters and sequence programs from the inverter, such information must be written to the inverter using FR Configurator2 (Developer) in advance. Always write the PLC function parameters and sequence program at least once as the inverter does not have valid data.
- There is a limitation on the number of times writing can be done (approximately 100,000 times) as the PLC function parameters and sequence program are written to the flash memory.
- A program with more than 6k steps (24k bytes) cannot be written.

1.8 Device map

1.8.1 I/O device map

	Device number	Name	Remarks	Device number	Name	Remarks
External input/output	X00	Terminal STF	External terminal	Y00	Terminal RUN	External terminal
	X01	Terminal STR		Y01	Terminal SU	
	X02	Terminal RH		Y02	Terminal IPF	
	X03	Terminal RM		Y03	Terminal OL	
	X04	Terminal RL		Y04	Terminal FU	
	X05	Terminal JOG		Y05	Terminal ABC1	
	X06	Terminal RT		Y06	Terminal ABC2	
	X07	Terminal AU		Y07	Empty (for temporary retention)	
	X08	Terminal CS		Y08		
	X09	Terminal MRS		Y09		
	X0A	Terminal STP (STOP)		Y0A		
	X0B	Terminal RES		Y0B		
	X0C	Vacant (for temporary retention)		Y0C		
	X0D			Y0D		
	X0E			Y0E		
	X0F			Y0F		
Plug-in option I/O	X10	Terminal X0	16 bits digital input FR-A8AX	Y10	Terminal DO0	Digital output FR-A8AY
	X11	Terminal X1		Y11	Terminal DO1	
	X12	Terminal X2		Y12	Terminal DO2	
	X13	Terminal X3		Y13	Terminal DO3	
	X14	Terminal X4		Y14	Terminal DO4	
	X15	Terminal X5		Y15	Terminal DO5	
	X16	Terminal X6		Y16	Terminal DO6	
	X17	Terminal X7		Y17	Terminal RA1	Relay output FR-A8AR
	X18	Terminal X8		Y18	Terminal RA2	
	X19	Terminal X9		Y19	Terminal RA3	
	X1A	Terminal X10		Y1A	Empty (for temporary retention)	
	X1B	Terminal X11		Y1B		
	X1C	Terminal X12		Y1C		
	X1D	Terminal X13		Y1D		
	X1E	Terminal X14		Y1E		
	X1F	Terminal X15		Y1F		

Device map

	Device number	Name	Remarks	Device number	Name	Remarks
System I/O	X20	Operation mode setting read complete	SD1140	Y20	Operation mode setting read command	SD1140
	X21	Set frequency read complete (RAM)	SD1141	Y21	Set frequency read command (RAM)	SD1141
	X22	Set frequency read complete (EEPROM)	SD1142	Y22	Set frequency read command (EEPROM)	SD1142
	X23	Operation mode setting write complete	SD1143	Y23	Operation mode setting write command	SD1143
	X24	Set frequency write complete (RAM)	SD1144	Y24	Set frequency write command (RAM)	SD1144
	X25	Set frequency write complete (EEPROM)	SD1145	Y25	Set frequency write command (EEPROM)	SD1145
	X26	Fault record batch clear complete	SD1146	Y26	Fault record batch clear command	SD1146
	X27	Parameter clear complete	SD1147	Y27	Parameter clear command	SD1147
	X28	Parameter read complete (RAM)	SD1241, SD1242, SD1234	Y28	Parameter read request (RAM)	SD1241, SD1242, SD1234
	X29	Parameter write complete (RAM)		Y29	Parameter write request (RAM)	
	X2A	Parameter read complete (EEPROM)	SD1243, SD1244, SD1235	Y2A	Parameter read request (EEPROM)	SD1243, SD1244, SD1235
	X2B	Parameter write complete (EEPROM)		Y2B	Parameter write request (EEPROM)	
	X2C	User parameter read complete (RAM)	D206 to D255 (**Pr.1150** to **Pr.1199**)	Y2C	User parameter read (RAM)	D206 to D255 (**Pr.1150** to **Pr.1199**)
	X2D	User parameter write complete (RAM)		Y2D	User parameter write (RAM)	
	X2E	User parameter read complete (EEPROM)		Y2E	User parameter read (EEPROM)	
	X2F	User parameter write complete (EEPROM)		Y2F	User parameter write (EEPROM)	
CC-Link I/O Remote I/O	X30	RY0	FR-A8NC	Y30	RX0	FR-A8NC
	X31	RY1		Y31	RX1	
	X32	RY2		Y32	RX2	
	X33	RY3		Y33	RX3	
	X34	RY4		Y34	RX4	
	X35	RY5		Y35	RX5	
	X36	RY6		Y36	RX6	
	X37	RY7		Y37	RX7	
	X38	RY8		Y38	RX8	
	X39	RY9		Y39	RX9	
	X3A	RYA		Y3A	RXA	
	X3B	RYB		Y3B	RXB	
	X3C	RYC		Y3C	RXC	
	X3D	RYD		Y3D	RXD	
	X3E	RYE		Y3E	RXE	
	X3F	RYF		Y3F	RXF	

1.8.2 Internal relay (M) device map

Device number	Description
M0 to M127	Available for users.

1.8.3 Data register (D) device map

Device number	Description	Refer to page
D0 to D205	Available for users.	-
D206 to D255	**Pr.1150 to Pr.1199** Parameters for user setting. Available for users.	**46**

1.8.4 Special relay

Special relay is an internal relay whose application is already determined in the PLC function. Therefore, do not turn ON/OFF the special relay in the program.

Device number	Name	Description
SM0	Diagnostic error	Turned ON when a diagnostic error has been detected. ON status is retained even after the condition becomes normal.
SM1	Self-diagnostic error	Turned ON when an error is detected by self diagnosis. ON status is retained even after the condition becomes normal.
SM5	Common error information	When SM5 is turned ON, common error information (SD5 to SD15) is stored.
SM16	Individual error information	When SM16 is turned ON, individual error information (SD16 to SD26) is stored.
SM56	Operation error flag	Turned ON when an operation error is detected during instruction execution. ON status is retained even after the condition becomes normal.
SM210	Clock data setting request	At OFF to ON of SM210, the clock data stored in SD210 to SD213 are written to the inverter.
SM211	Clock data error	Turned ON when the clock data (SD210 to SD213) has an error or is not a BCD value.
SM213	Clock data read request	Clock data is read and stored as BCD value in SD210 to SD213 when this relay is turned ON. The process is not executed when the relay is OFF.
SM400	Always ON	SM400 and SM401 are respectively turned ON and OFF regardless of the STOP and RUN statuses.
SM401	Always OFF	
SM402	ON only for one scan after RUN	SM402 and SM403 change depending on the STOP and RUN statuses. In the cases other than STOP: SM402 is ON only for one scan. SM403 is OFF only for one scan.
SM403	OFF only for one scan after RUN	
SM1200	Inverter operating status control flag (STF)	Flag used for controlling the inverter terminal STF.
SM1201	Inverter operating status control flag (STR)	Flag used for controlling the inverter terminal STR.
SM1202	Inverter operating status control flag (RH)	Flag used for controlling the inverter terminal RH.
SM1203	Inverter operating status control flag (RM)	Flag used for controlling the inverter terminal RM.
SM1204	Inverter operating status control flag (RL)	Flag used for controlling the inverter terminal RL.

Device map

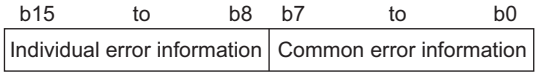
Device number	Name	Description
SM1205	Inverter operating status control flag (JOG)	Flag used for controlling the inverter terminal JOG.
SM1206	Inverter operating status control flag (RT)	Flag used for controlling the inverter terminal RT.
SM1207	Inverter operating status control flag (AU)	Flag used for controlling the inverter terminal AU.
SM1208	Inverter operating status control flag (CS)	Flag used for controlling the inverter terminal CS.
SM1209	Inverter operating status control flag (MRS)	Flag used for controlling the inverter terminal MRS.
SM1210	Inverter operating status control flag STP (STOP)	Flag used for controlling the inverter terminal STP (STOP).
SM1211	Inverter operating status control flag (RES)	Flag used for controlling the inverter terminal RES.
SM1216	Inverter status (RUN)	Inverter running
SM1217	Inverter status (FWD)	Forward rotation
SM1218	Inverter status (REV)	Reverse rotation
SM1219	Inverter status (SU)	Up to frequency
SM1220	Inverter status (OL)	Overload alarm
SM1221	Inverter status (IPF)	Instantaneous power failure/undervoltage
SM1222	Inverter status (FU)	Output frequency detection
SM1223	Inverter status (ALM)	Fault output
SM1224	Inverter status (LF)	Warning output
SM1225	Inverter status (DO0)	Stores the operating status of an output terminal function assigned by **Pr.313**.*1
SM1226	Inverter statusDO1)	Stores the operating status of an output terminal function assigned by **Pr.314**.*1
SM1227	Inverter status (DO2)	Stores the operating status of an output terminal function assigned by **Pr.315**.*1
SM1228	Inverter status (DO3)	Stores the operating status of an output terminal function assigned by **Pr.316**.*1
SM1229	Inverter status (DO4)	Stores the operating status of an output terminal function assigned by **Pr.317**.*1
SM1230	Inverter status (DO5)	Stores the operating status of an output terminal function assigned by **Pr.318**.*1
SM1231	Inverter status (DO6)	Stores the operating status of an output terminal function assigned by **Pr.319**.*1
SM1232	Inverter status (RA1)	Stores the operating status of an output terminal function assigned by **Pr.320**.*1
SM1233	Inverter status (RA2)	Stores the operating status of an output terminal function assigned by **Pr.321**.*1
SM1234	Inverter status (RA3)	Stores the operating status of an output terminal function assigned by **Pr.322**.*1
SM1235	Safety monitor (terminal SO)	The safety monitor (terminal SO) status is stored. This is turned ON when no internal safety circuit failure has occurred.
SM1255	Inverter operating status control selection	Select the inverter operating status of SM1200 to SM1211 and SD1148. OFF: Special relay selection ON: Special register selection
SM1256	2-word parameter access notice	Turned ON when parameter read for the inverter is executed using X28 to X2B, Y28 to Y2B, and the object was 2-word parameter. OFF: Read is completed as 1-word parameter. ON: Read is completed as 2-word parameter.

Device number	Name	Description
SM1257	2-word parameter access setting	Set the object as 2 word parameter when inverter parameter write is executed using X28 to X2B, Y28 to Y2B. OFF: Carries out writing as 1-word parameter. ON: Carries out writing as 2-word parameter.
SM1258	Clock data setting completion flag	Turned ON when the clock data is set using an external peripheral device, parameter, or SM210. This is turned OFF when SM213 is turned ON.

*1 Even if the FR-A8AY or FR-A8AR is not installed, **Pr.313 to Pr.322** are accessible during PLC function operation, and the operating status of the output terminal (virtual output terminal) function is stored in each device.

1.8.5 Special register

Special register is a data register in which the application is already determined in the PLC function. Therefore, do not write data into the special register on the program.

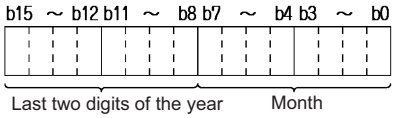
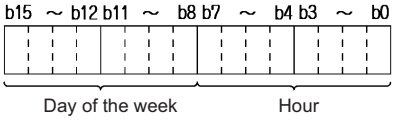
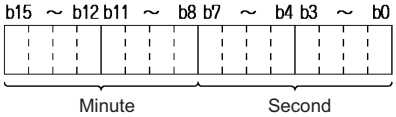
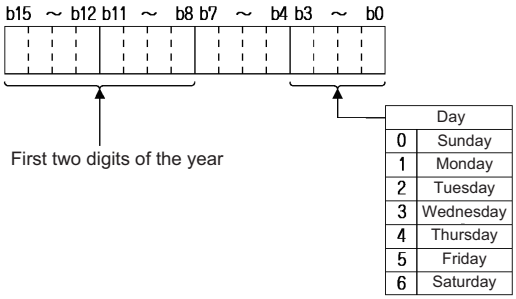
<table>
<tr><th colspan="2">Device number</th><th>Name</th><th>Description</th><th>Page</th></tr>
<tr><td rowspan="4">Special register</td><td>SD0</td><td>Self-diagnostic error</td><td>Error code is stored when an error is detected by self diagnosis.</td><td>33</td></tr>
<tr><td>SD4</td><td>Error information category</td><td>Stores the category codes that show the type of error information stored in the common information (SD5 to SD15) and the individual information (SD16 to SD26).


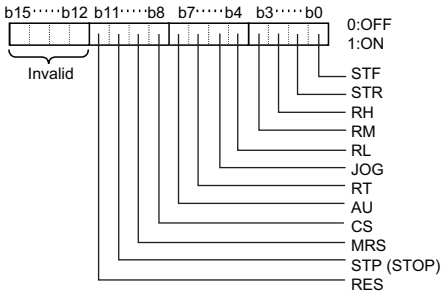
The following codes are stored in the common information category code.
<table><tr><th>Value</th><th>Code</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>2</td><td>File name/drive name</td></tr><tr><td>3</td><td>Time (setting value)</td></tr><tr><td>4</td><td>Program error location</td></tr></table>
The following codes are stored in the individual information category code.
<table><tr><th>Value</th><th>Code</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>3</td><td>Time (actual measurement value)</td></tr><tr><td>5</td><td>Parameter number</td></tr></table></td><td>-</td></tr>
<tr><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 2, the file name or drive name are stored in SD5 to SD11.
<table><tr><th>Number</th><th colspan="2">Description</th></tr><tr><td>SD5</td><td colspan="2">Drive name.</td></tr><tr><td>SD6</td><td rowspan="4">File name
(ASCII code: 8 characters)</td><td rowspan="4"></td></tr><tr><td>SD7</td></tr><tr><td>SD8</td></tr><tr><td>SD9</td></tr><tr><td>SD10</td><td>Extension</td><td>2EH(.)</td></tr><tr><td>SD11</td><td colspan="2">(ASCII code: 3 characters)</td></tr><tr><td>SD12 to SD15</td><td colspan="2">Empty</td></tr></table>The step numbers where errors occurred are stored in SD14 and SD15.</td><td>-</td></tr>
<tr><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 3, the time (setting value) is stored in SD5 and SD6.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD5</td><td>Time: in 1 µs increments (0 to 999 µs)</td></tr><tr><td>SD6</td><td>Time: in 1 ms increments (0 to 65535 ms)</td></tr><tr><td>SD7 to SD15</td><td>Empty</td></tr></table></td><td>-</td></tr>
</table>

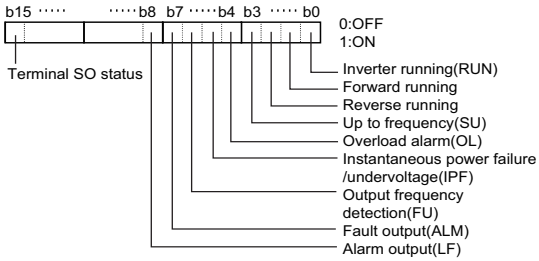
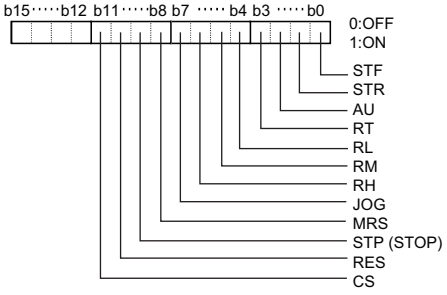
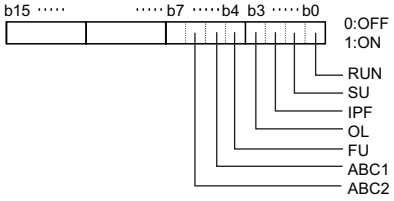
<table>
<tr><th colspan="2">Device number</th><th>Name</th><th>Description</th><th>Page</th></tr>
<tr><td rowspan="3">Special register</td><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 4, the program error location is stored in SD5 to SD15.
<table><tr><th>Number</th><th colspan="2">Description</th></tr><tr><td>SD5</td><td colspan="2" rowspan="4">File name MAIN *1
(ASCII code: 8 characters)</td></tr><tr><td>SD6</td></tr><tr><td>SD7</td></tr><tr><td>SD8</td></tr><tr><td>SD9</td><td>Extension</td><td>2EH(.)</td></tr><tr><td>SD10</td><td>QPG</td><td>(ASCII code: 3 characters)</td></tr><tr><td>SD11</td><td colspan="2">Always 0</td></tr><tr><td>SD12</td><td colspan="2">Always 0</td></tr><tr><td>SD13</td><td colspan="2">Always 0</td></tr><tr><td>SD14</td><td colspan="2" rowspan="2">Sequence step No.(L)
Sequence step No.(H)</td></tr><tr><td>SD15</td></tr></table>*1 Always "MAIN". After "MAIN", four space (20H) characters are stored.
The step numbers where errors occurred are stored in SD14 and SD15.</td><td>-</td></tr>
<tr><td>SD16 to SD26</td><td>Individual error information</td><td>When the individual information category code is 3, the time (actual measured data) is stored in SD16 and SD17.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD16</td><td>Time: in 1 μs increments (0 to 999 μs)</td></tr><tr><td>SD17</td><td>Time: in 1 ms increments (0 to 65535 ms)</td></tr><tr><td>SD18 to SD26</td><td>Empty</td></tr></table></td><td>-</td></tr>
<tr><td colspan="2"></td><td>When the individual information category code is 5, the parameter number is stored in SD16.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD16</td><td>Parameter number</td></tr><tr><td>SD17 to SD26</td><td>Empty</td></tr></table></td><td>-</td></tr>
<tr><td colspan="2">SD203</td><td>CPU module operating status</td><td>

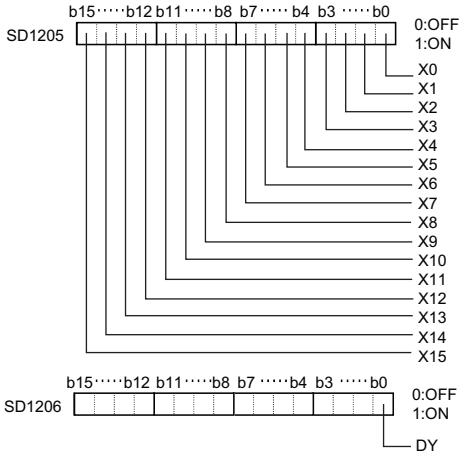
<table><tr><th>bit</th><th>Item</th><th>Value</th><th>Description</th></tr><tr><td>b3 to b0</td><td rowspan="2">CPU module operating status</td><td>0</td><td>RUN</td></tr><tr><td></td><td>1</td><td>STOP</td></tr><tr><td rowspan="4">b7 to b4</td><td rowspan="4">STOP/RUN factor</td><td>0</td><td>Switch</td></tr><tr><td>1</td><td>Remote contact</td></tr><tr><td>2</td><td>Remote operation from the peripheral S/W for the programmable controller</td></tr><tr><td>4</td><td>Error</td></tr></table></td><td>-</td></tr>
</table>

Device map

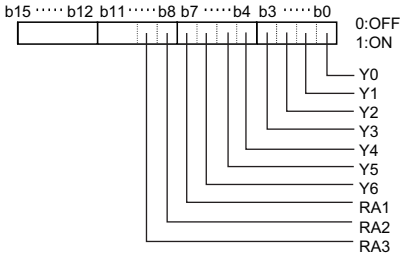
Device number		Name	Description	Page
Special register	SD210	Clock data	Year (the last two digits of the year) is stored in BCD code. 	-
	SD211	Clock data	Date and hour are stored in BCD code. 	-
	SD212	Clock data	Minute and second are stored in BCD code. 	-
	SD213	Clock data	Year (the first two digits of the year) and day of the week are stored in BCD code. 	-
	SD520	Current scan time	Scan time is stored at every END, and is constantly updated. (Measured in 100 µs increments) SD520: Stores the millisecond places (Stored range: 0 to 65535) SD521: Stores the microsecond places (Stored range: 0 to 900)	-
	SD521			-
	SD524	Minimum scan time	Minimum scan time is stored at every END. (Measured in 100 µs increments) SD524: Stores the millisecond places (Stored range: 0 to 65535) SD525: Stores the microsecond places (Stored range: 0 to 900)	-
	SD525			-
	SD526	Maximum scan time	Maximum scan time is stored at every END. (Measured in 100 µs increments) SD526: Stores the millisecond places (Stored range: 0 to 65535) SD527: Stores the microsecond places (Stored range: 0 to 900)	-
	SD527			-
	SD1062 to SD1093	Remote register	Special register for communicating with the master station in CC-Link.	57
	SD1133	Output frequency monitor	Present output frequency is stored. The increment is 0.01 Hz.	30
	SD1134	Output current monitor	Present output current is stored. The increment is 0.01 A.	
	SD1135	Output voltage monitor	Present output voltage is stored. The increment is 0.1 V.	

Device number		Name	Description	Page
Special register for control	SD1136	Faults history 1, 2	Faults in the inverter are stored in the order of occurrence.	31
	SD1137	Faults history 3, 4		
	SD1138	Faults history 5, 6		
	SD1139	Faults history 7, 8		
	SD1140	Operation mode setting read	Stores the present operation mode.	34
	SD1141	Set frequency read (RAM)	Reads and stores the set frequency (RAM).	35
	SD1142	Set frequency read (EEPROM)	Reads and stores the set frequency (EEPROM).	35
	SD1143	Operation mode setting write	Sets the operation mode to be changed.	37
	SD1144	Set frequency write (RAM)	Sets the running frequency (RAM).	37
	SD1145	Set frequency write (EEPROM)	Sets the running frequency (EEPROM).	38
	SD1146	Fault record batch clear	Clears the faults history when H9696 is written.	39
	SD1147	Parameter clear	H9696 write: parameter clear H9966 write: all clear H5A5A write: parameter clear except for communication parameters H55AA write: all clear except for communication parameters While communicating with FR Configurator2, clear the parameters using H5A5A or H55AA.	39
	SD1148	Inverter operating status control	Turn ON/OFF the corresponding bit to control the inverter operating status. All initial values are set as "0". When SM1255 is OFF, this function is disabled. 	40
	SD1149	Inverter operating status control enable/disable setting	The inverter operating status control by SD1148 and SM1200 to SM1211 can be enabled/disabled by turning ON/OFF the corresponding bit. The bit table is the same as SD1148. All initial values are set to "0" (invalid). Input through external terminals is always enabled for the SQ signal. (The SQ signal cannot be controlled with SD1149 bits.)	41
	SD1150	Inverter parameter access error	Stores the error number generated when parameter or data stored in the special register was not successfully reflected to the inverter.	42

Device number		Name	Description	Page
Special register for control	SD1151	Inverter status	Operating status of the inverter is stored. 	42
	SD1152	Frequency setting value	0.01 Hz increments	-
	SD1153	Running speed	1 (0.1) r/min increments **Pr.811 Set resolution switchover** enables 0.1 r/min unit indication	-
	SD1154	Motor torque	0.1% increments	-
	SD1155	Converter output voltage	0.1 V increments	-
	SD1156	Regenerative brake duty	0.1% increments	-
	SD1157	Electric thermal relay load factor	0.1% increments	-
	SD1158	Output power peak value	0.01 A increments	-
	SD1159	Converter output voltage peak value	0.1 V increments	-
	SD1160	Input power	0.01 kW increments	-
	SD1161	Output power	0.01 kW increments	-
	SD1162	Input terminal status	Details of input terminal status 	-
	SD1163	Output terminal status	Details of output terminal status 	-
	SD1164	Load meter	0.1% increments	-
	SD1165	Motor excitation current	0.01 A increments	-
	SD1166	Position pulse	Stores the encoder position pulse	-
	SD1167	Cumulative energization time	1 hour increments	-
	SD1169	Orientation status	Stores the orientation status.	-
	SD1170	Actual operation time	1 hour increments	-
	SD1171	Motor load factor	0.1% increments	-
	SD1172	Cumulative power	1 kWh increments	-
	SD1173	Position command (lower 16 bits)	Stores the position command setting value (lower 16 bits).	-

Device number		Name	Description	Page
Special register for control	SD1174	Position command (upper 16 bits)	Stores the position command setting value (upper 16 bits).	-
	SD1175	Feedback pulse (lower 16 bits)	Stores the feedback pulse value (lower 16 bits).	-
	SD1176	Feedback pulse (upper 16 bits)	Stores the feedback pulse value (upper 16 bits).	-
	SD1177	Droop pulse (lower 16 bits)	Stores the droop pulse value (lower 16 bits).	-
	SD1178	Droop pulse (upper 16 bits)	Stores the droop pulse value (upper 16 bits).	-
	SD1179	Torque command	0.1% increments	-
	SD1180	Torque current command	0.1% increments	-
	SD1181	Motor output	0.1 kW increments	-
	SD1182	Feedback pulse	Stores the feedback pulse quantity.	-
	SD1184	Station number (PU connector)	Stores the station number (PU connector).	-
	SD1185	Station number (RS-485 terminal block)	Stores the station number (RS-485 terminal block).	-
	SD1186	Communication station number (CC-Link)	Stores the communication station number (CC-Link).	-
	SD1187	Remote output 1	Stores the analog remote output setting value 1.	-
	SD1188	Remote output 2	Stores the analog remote output setting value 2.	-
	SD1189	Remote output3	Stores the analog remote output setting value 3.	-
	SD1190	Remote output 4	Stores the analog remote output setting value 4.	-
	SD1191	PTC thermistor resistance value	Stores the PTC thermistor resistance value.	-
	SD1197	Energy saving effect	According to the parameter settings.	-
	SD1198	Cumulative energy saving		-
	SD1199	PID set point	Stores the PID set point. The increment is 0.1%.	-
	SD1200	PID measured value	Stores the PID measured value. The increment is 0.1%.	-
	SD1201	PID deviation	Stores the PID deviation. The increment is 0.1%.	-
	SD1202	Second PID set point	Stores the second PID set point. The increment is 0.1%.	-
	SD1203	Second PID measured value	Stores the second PID measured value. The increment is 0.1%.	-
	SD1204	Second PID deviation	Stores the second PID deviation. The increment is 0.1%.	-
	SD1205	Option input terminal status 1	Stores the input status of the FR-A8AX. All are OFF (0) when there are no options installed. 	-
	SD1206	Option input terminal status 2		-

Device map

Device number		Name	Description	Page
Special register for control	SD1207	Option output terminal status	Stores the output status of the FR-A8AY or FR-A8AR. All are OFF (0) when there are no options installed. 	-
	SD1211	Dancer main speed setting	Stores the dancer main speed setting.	-
	SD1212	PID manipulated amount	Stores the PID manipulated amount. The increment is 0.1%.	-
	SD1213	PID measured value 2	Stores the PID measured value. The increment is 0.1%. (Monitoring can be performed even when PID control is disabled.)	-
	SD1214	User definition error	An inverter fault is initiated by setting the values of "16 to 20" in SD1214.	**43**
	SD1215	Monitor setting selection	Set SD1215 to display the monitor set in SD1216 to SD1218.	**43**
	SD1216	Monitor 1 setting value	The first to the third monitors on the operation panel can be changed by setting the value "40 to 42" in **Pr.774 to Pr.776.**	**43**
	SD1217	Monitor 2 setting value		
	SD1218	Monitor 3 setting value		
	SD1220	Motor thermal load factor	Stores the motor thermal load factor.	-
	SD1221	Inverter thermal load factor	Stores the inverter thermal load factor.	-
	SD1222	Second PID manipulated amount	Stores the second PID manipulated amount. The increment is 0.1%.	-
	SD1223	Second PID measured value 2	Stores the second PID measured value. The increment is 0.1%. (Monitoring can be performed even when PID control is disabled.)	-
	SD1224	32-bit cumulative power (Lower 16 bits)	1 kWh	-
	SD1225	32-bit cumulative power (Upper 16 bits)	1 kWh	-
	SD1226	32-bit cumulative power (Lower 16 bits)	0.01 kWh/0.1 kWh *2	-
	SD1227	32-bit cumulative power (Upper 16 bits)	0.01 kWh/0.1 kWh *2	-
	SD1229	Trace status	Stores the trace status.	-
	SD1234	Second parameter change (RAM)	When setting a calibration parameter (bias/gain) H00: Frequency (torque) H01: Analog value set by parameters H02: Analog value input from terminals	**44**, **45**
	SD1235	Second parameter change (EEPROM)		

*2 Settings differ according to the inverter capacity. (FR-A820-03160(55K) or lower and FR-A840-01800(55K) or lower, FR-A820-03800(75K) or higher and FR-A840-02160(75K) or higher)

Device number		Name	Description	Page
Special register for control	SD1236	Pulse train input sampling pulse	The number of pulses counted in count cycle is stored. (0 to 32767)	48
	SD1237	Pulse train input cumulative count value L	The cumulative value of the number of sampling pulses is stored. (0 to 99999999)	
	SD1238	Pulse train input cumulative count value H		
	SD1239	Reset request of pulse train input count	The sampling pulses and cumulative count value are cleared. Automatically changes to "0" after reset. (1: count clear)	
	SD1240	Count start of the pulse train input	Start counting the sampling pulses and cumulative count value. (0: count stop, 1: count start)	
	SD1241	Parameter number (RAM)	Set the parameter number to read from/write to the inverter.	44, 45
	SD1242	Parameter detail (RAM)	Stores the inverter parameter content (RAM value) specified by SD1241. Input the parameter setting value when writing the parameters.	
	SD1243	Parameter number (EEPROM)	Set the parameter number to read from/write to the inverter.	
	SD1244	Parameter content (EEPROM)	Stores the inverter parameter content (EEPROM value) specified by SD1243. Input the parameter setting value when writing the parameters.	
	SD1245	Terminal 1 input	Stores the analog input value (0.1% increments) to terminal 1.	47
	SD1246	Terminal 2 input	Stores the analog input value (0.1% increments) to terminal 2.	
	SD1247	Terminal 4 input	Stores the analog input value (0.1% increments) to terminal 4.	
	SD1248	PID control set point/ deviation	Set the PID set point or PID deviation. (0.01% increments)	49
	SD1249	PID control measured value	Set the PID measured value. (0.01% increments)	
	SD1250	PID control manipulated amount	Stores the PID manipulated amount. (0.01% increments)	
	SD1251	Terminal FM/CA output	When **Pr.54**="70", analog output can be performed from the terminal FM/CA. (0.1% increments)	47
	SD1252	Terminal AM output	When **Pr.158**= "70", analog output can be performed from terminal AM. (0.1% increments)	
	SD1253	AM0 output	Analog output can be performed from terminals AM0 and AM1 of the FR-A8AY. (0.1% increments)	
	SD1254	AM1 output		
	SD1255	PID operation control	Sets the start/stop of PID operation. Set "1" to start PID control.	49
	SD1308	Second PID control set point/deviation	Set the second PID set point or the second PID deviation. (0.01% increments)	
	SD1309	Second PID control measured value	Set the second PID measured value. (0.01% increments)	
	SD1310	Second PID control manipulated amount	Stores the second PID manipulated amount. (0.01% increments)	
	SD1320	Read parameter content (2-word parameter: L)	When the parameter to be written is 2 words, storage locations are as follows: SD1320: Lower 1 word SD1321: Upper 1 word	-
	SD1321	Read parameter content (2-word parameter: H)		-
	SD1322	Write parameter content (2-word parameter: L)	When the parameter to be read is 2 words, storage locations are as follows: SD1322: Lower 1 word SD1323: Upper 1 word	-
	SD1323	Write parameter content (2-word parameter: H)		-

1.9 Special registers to monitor and control inverter status

Read from and write to user sequences are possible by assigning the data to monitor and change the operating status of the inverter from SD1133 to SD1147. (For the list of registers, refer to page 22.)

1.9.1 Always readable data

The following data is always readable. They are refreshed on every END instruction automatically.

◆Operation monitor

These are the data devices by which the output frequency, output current, and output voltage of the inverter can be monitored, and which are always readable (write is disabled). Pay attention to the setting increments.

Device number	Name	Setting increments	Data example	Data access condition
SD1133	Output frequency monitor	0.01 Hz	Device content 6000→60.00 Hz	Always accessible
SD1134	Output current monitor	0.01 A	Device content 200→2.00 A	
SD1135	Output voltage monitor	0.01 V	Device content 1000→10.0 V	

NOTE

- Setting frequency can be set in increments of 0.01 Hz, but operates at 0.1 Hz increments in actual operation.

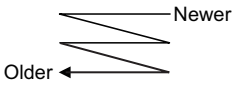
◆Faults history (error code and error definition)

When the inverter fails, it stores error codes.

A maximum of eight faults are stored with error codes in the order shown below, and they are always readable (write is disabled).

<Error code storing method details>

	b15 to b8	b7 to b0
SD1136	Faults history 2	Faults history 1
SD1137	Faults history 4	Faults history 3
SD1138	Faults history 6	Faults history 5
SD1139	Faults history 8	Faults history 7



Error code	Fault record
H00	No failure
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM
H40	E.FIN
H50	E.IPF
H51	E.UVT
H52	E.ILF
H60	E.OLT
H61	E.SOT
H70	E.BE

Error code	Fault record
H80	E.GF
H81	E.LF
H90	E.OHT
H91	E.PTC
HA0	E.OPT
HA1	E.OP1
HA4	E.16
HA5	E.17
HA6	E.18
HA7	E.19
HA8	E.20
HB0	E.PE
HB1	E.PUE
HB2	E.RET
HB3	E.PE2
HC0	E.CPU
HC1	E.CTE

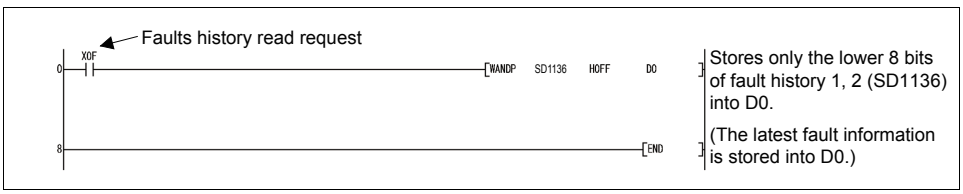
Error code	Fault record
HC2	E.P24
HC4	E.CDO
HC5	E.IOH
HC6	E.SER
HC7	E.AIE
HC8	E.USB
HC9	E.SAF
HCA	E.PBT
HD0	E.OS
HD1	E.OSD
HD2	E.ECT
HD3	E.OD
HD5	E.MB1
HD6	E.MB2
HD7	E.MB3
HD8	E.MB4
HD9	E.MB5

Error code	Fault record
HDA	E.MB6
HDB	E.MB7
HDC	E.EP
HE1	E.IAH
HE4	E.LCI
HE5	E.PCH
HE6	E.PID
HF1	E.1
HF2	E.2
HF3	E.3
HF5	E.5
HF6	E.6
HF7	E.7
HFB	E.11
HFD	E.13

For details of fault records, refer to the Instruction Manual of the inverter.

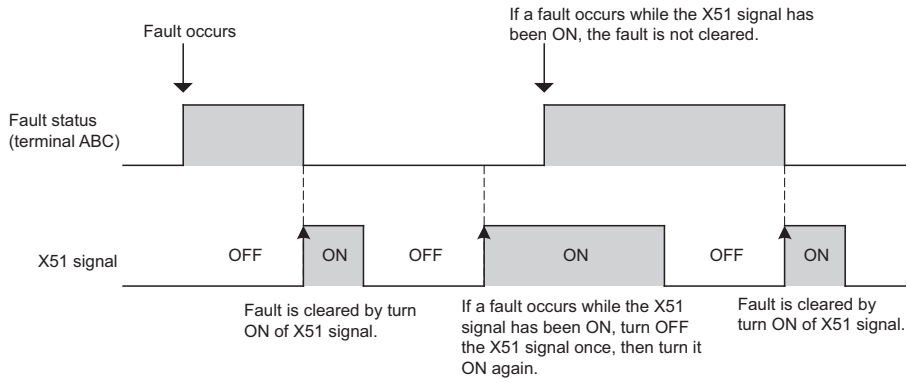
<Program example for reading a fault record>

The following description is of a program that reads out the latest fault record of the inverter and stores to D0.



◆Fault clear signal (X51 signal)

When an inverter fault occurs, X51 signal clears the fault without resetting the inverter.
By using the X51 signal, the inverter fault can be cleared with the PLC function still operating.
Set "51" in **Pr.178 to Pr.189 (Input terminal function selection)** in advance to enable the X51 signal.



- The fault clear function using the X51 signal does not function while the retry function is operating (including during the retry waiting time).
  (The X51 signal operates when the retry count is exceeded (E.RET).
- When the fault is cleared, start commands from PU and communication are also cleared. (All commands except the start command from communication are maintained in the status before the fault is cleared.)

NOTE

- E.CPU, E.P24, E.CTE, E.1 to E.3, E.5 to E.7, E.13, E.16 to E.20, E.SAF and E.PE2 are not cleared by X51 signal.
- When a fault is cleared, the accumulated heat values of the electronic thermal O/L relay and regenerative brake are not cleared. Faults including E.THM, E.THT, and E.BE may occur again.
- The inverter remains in the stop status immediately after a fault is cleared. However, the inverter starts operating again after the fault is cleared if the start command is ON.
- When an error occurs, the normal reset function operates when the STOP/RESET key on the operation panel or parameter unit is pushed. Be careful not to push the key by mistake.
- Changing terminal assignment by using **Pr.178 to Pr.189 (input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆Self-diagnostic error, error number and details

When an operation error occurs during execution of sequence programs, the following error numbers are stored in SD0.
When a self-diagnostic error occurs, the "P.RUN" indicator (LED) blinks.

Error No.	Error name	Details
1010	END NOT EXECUTE	END command was not executed.
2200	MISSING PARA.	No parameter file.
2502	CAN'T EXE.PRG	The program file is not correct. Or the content of the file is not a program.
3000	PARAMETER ERR	The content of the parameter indicated by the individual error information (SD16) is incorrect.
3003	PARAMETER ERR	The number of device points set in the PLC parameter device setting is not within the usable range.
4000	INSTRCT. CODE ERR	An undecodable instruction code is included in the program. An unusable instruction is included in the program.
4010	MISSING END INS.	No END (FEND) instruction in the program.
4100	OPERATION ERROR	Data that cannot be used in instructions is included.
5001	WDT ERROR	The program scan time exceeded the watchdog timer value set in the PLC RAS setting of the PLC parameter.
5010	PRG.TIME OVER	The program scan time exceeded the constant scan time set in the PLC RAS setting of the PLC parameter.

NOTE

- Operation at error stop
  Output (Y) is cleared.
  Other devices remain in the status before the error stop occurred.
  To clear the statuses, turn OFF or reset (turn RES signal ON (0.1 s) and then OFF) the inverter.

1.9.2 Data read by controlling read command (from OFF to ON)

The operation mode and set frequency of the inverter can be read.

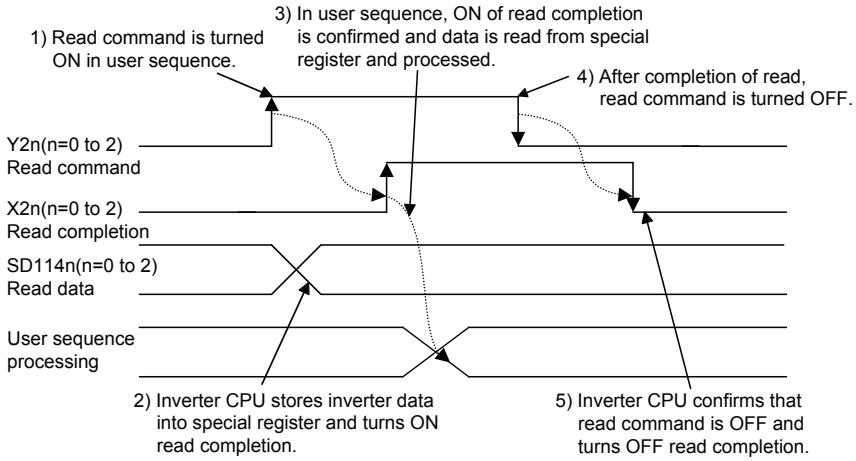
Device number	Name	Read instruction	Read completion	Data access condition
SD1140	Operation mode setting read	Y20	X20	Always accessible
SD1141	Set frequency read (RAM)	Y21	X21	
SD1142	Set frequency read (EEPROM)	Y22	X22	

For the data devices above, data is stored when the read command switches from OFF to ON and read completion switches from OFF to ON.

Data is not refreshed while the read command is ON. (Data is not updated.)

Data is refreshed by turning the read command OFF and ON again.

Time chart of each data read



◆Operation mode setting read (SD1140)

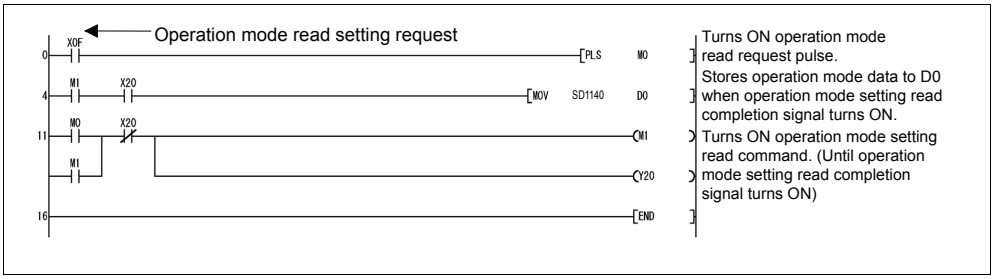
Data content	Operation mode
H0000	NET operation mode
H0001	External operation mode
H0002	PU operation mode

NOTE

- When **Pr.79 Operation mode selection** ≠ "0", the setting is applied. However, if **Pr.79** = "3 or 4", "H0002" (PU operation mode) is applied.

<Program example of reading operation mode settings>

The following description is of a program that reads out the operation mode data to D0.



◆Set frequency read (RAM) (SD1141)

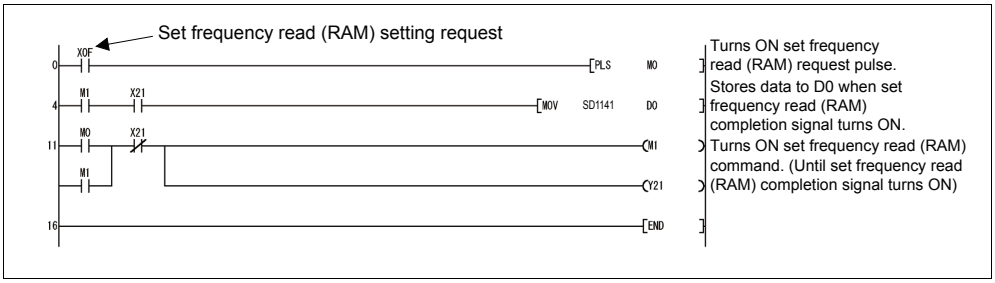
The frequency set in RAM can be read out from SD1141. Its increment is 0.01 Hz.

(For example, "6000" means 60.00 Hz.)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

<Program example of reading the set frequency (RAM)>

The following description is of a program that reads out the set frequency (RAM) to D0.



NOTE

- The frequency to be read is not the command value of an external signal.

◆Set frequency read (EEPROM) (SD1142)

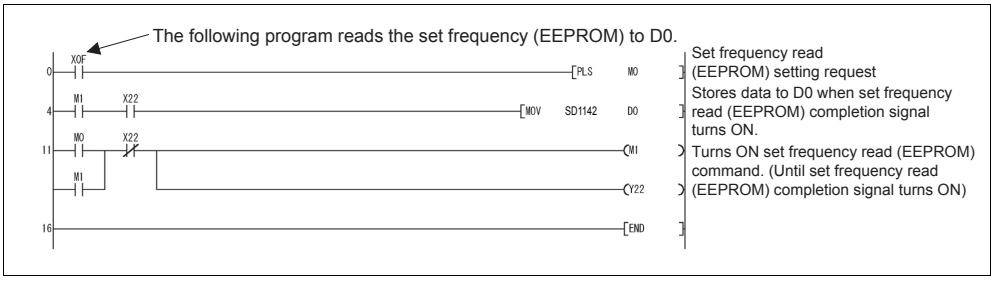
The frequency set in EEPROM can be read from SD1142. Its increment is 0.01 Hz.

(For example, "6000" means 60.00 Hz.)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

<Program example of reading the set frequency (EEPROM)>

The following description is of a program that reads out the set frequency (EEPROM) to D0.



NOTE

- The frequency to be read is not the command value of an external signal.

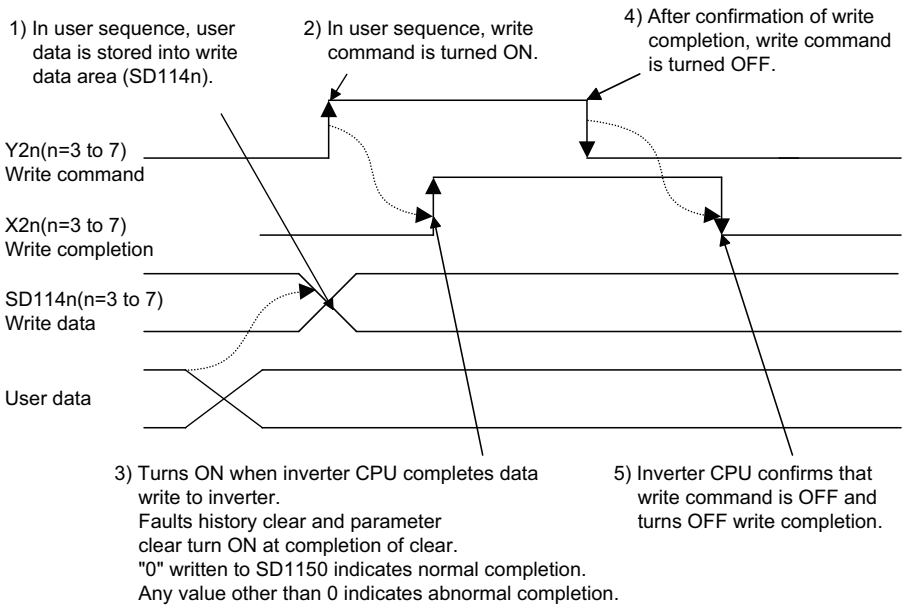
1.9.3 Data writing method by controlling write command (from OFF to ON)

Writing of an operation mode and setting frequency to the inverter, a batch clear of fault records, and all parameter clear can be executed.

Device number	Name	Write instruction	Write completion	Data access condition
SD1143	Writing the operation mode setting	Y23	X23	**Pr.79**=0, 2
SD1144	Writing the setting frequency (RAM)	Y24	X24	PU operation mode or NET operation mode
SD1145	Writing the setting frequency (EEPROM)	Y25	X25	
SD1146	Batch clearing of fault records	Y26	X26	Always accessible
SD1147	All parameter clear	Y27	X27	According to the setting of **Pr.77**

The data above is written at the point when write completion turns ON after the write command turns from OFF to ON.
(Written at clear completion of SD1146 executed for fault record batch clear and SD1147 for all parameter clear.)
To write again, the write command must be turned OFF and then ON again.

Time charts of a data write

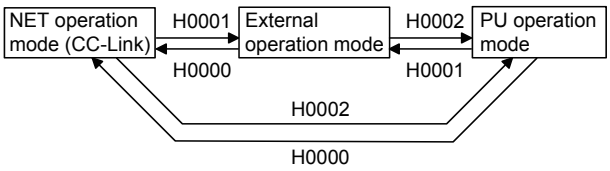


◆Writing operation mode settings (SD1143)

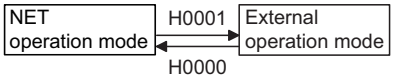
Data content:

Data content	Operation mode
H0000	NET operation mode
H0001	External operation mode
H0002	PU operation mode

The method for changing operation modes is shown in the following chart when **Pr.79 Operation mode selection** = "0".



When **Pr.79** = "2", the chart is as follows.



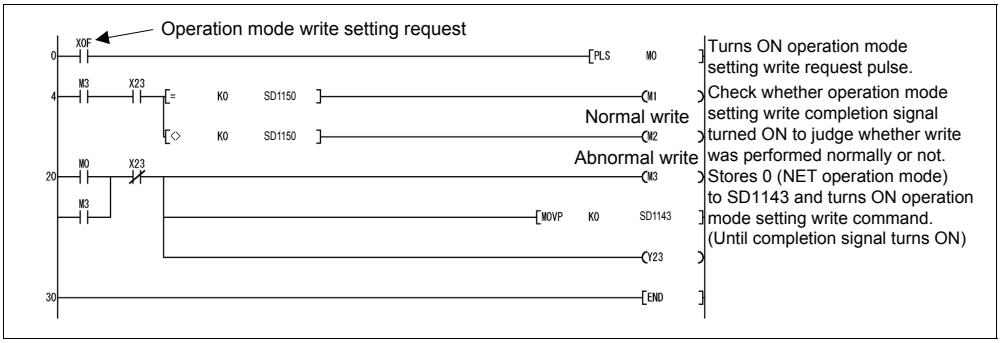
NOTE

- When **Pr.79** ≠ "0", the mode is fixed.

There are no limiting conditions for operation mode transitions.
When the operation mode settings are completed normally, write completion signal (X23) turns ON at the same time as SD1150 is set to "0".
Writing any setting value other than H0000 to H0002 or executing writing while the inverter is operating causes the write completion signal (X23) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion.
If an error completion occurs, the operation mode is not changed.

<Program example of writing operation mode settings>

The following description is of the program that changes the operation mode to NET operation mode.



◆Setting frequency write (RAM) (SD1144)

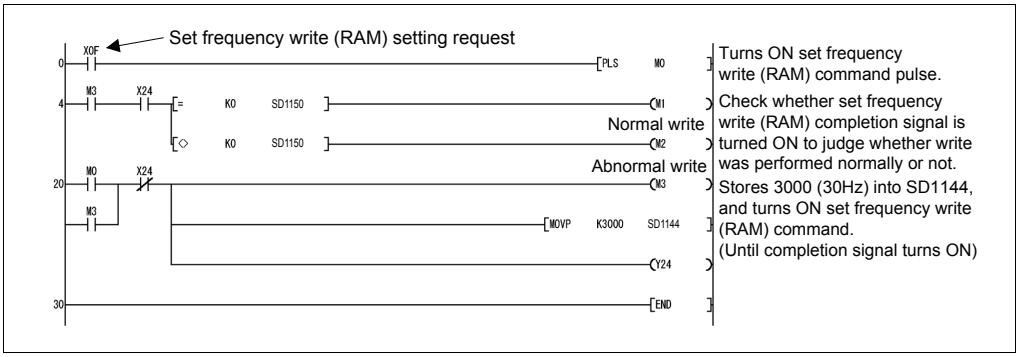
The content of SD1144 is written to the RAM as setting frequency. Its increment is 0.01 Hz.
(For example, 60.00 Hz is written as "6000".)
If the rotation speed is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)
The frequency can be set within the range of 0 to 12000 (0 to 120.00 Hz).
When frequency settings are written normally, the write completion signal (X24) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range causes the write completion signal (X24) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. If an error completion occurs, the setting frequency is not changed.

POINT

- This can be set in PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of writing the setting frequency (RAM)>

The following description is of a program that changes the setting frequency (RAM) to 30 Hz.



◆Setting frequency write (EEPROM) (SD1145)

The content of SD1145 is written to EEPROM as setting frequency. Its increment is 0.01 Hz.

(For example, 60.00 Hz is written as "6000".)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

The frequency can be set within the range of 0 to 12000 (0 to 120.00 Hz).

When frequency settings are written normally, the write completion signal (X25) turns ON at the same time as SD1150 is set to "0".

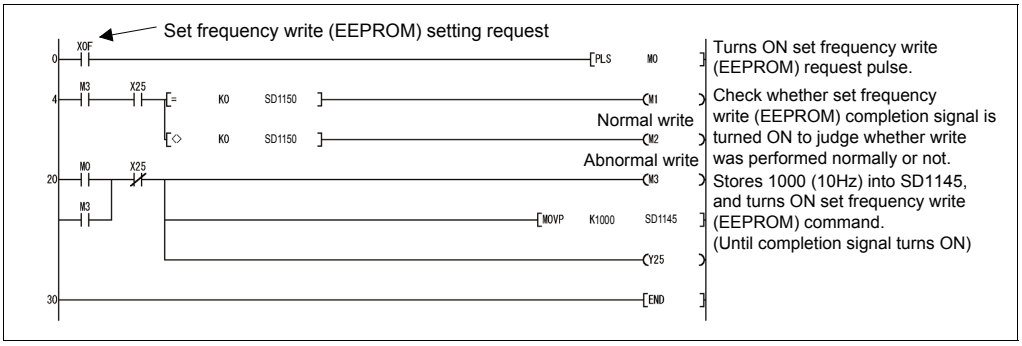
Executing writing with any value that is outside the specified range causes the write completion signal (X25) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. If an error completion occurs, the setting frequency is not changed.

POINT

- This can be set in PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of writing setting frequency (EEPROM)>

The following description is of a program that changes the setting frequency (EEPROM) to 10 Hz.



NOTE

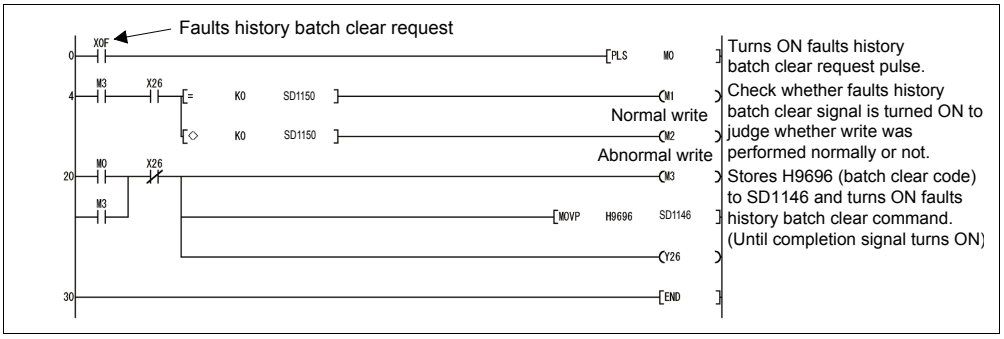
- When set frequencies need to be changed often, use the device SD1144 "set frequency (RAM)". There is a limitation on the number of times EEPROM can be written to. (Approximately 100,000 times)

◆Batch clear of fault records (SD1146)

When H9696 is written to SD1146, fault records are cleared in a batch.
When clearing is completed, the write completion signal (X26) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range or writing while the inverter is running causes the write completion signal (X26) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. In the case of error completion, the fault records are not cleared.

<Program example of batch clearing of fault records>

The following description is of the program that batch clears fault records.



◆Parameter clear (SD1147)

When H9696 or H9966 is written to SD1147, all parameters are cleared. When H5A5A or H55AA is written to SD1147, parameters except the communication parameters are cleared. (Refer to the Instruction Manual of the inverter.)

Device No.	Setting value	Communication parameters	Other parameters	Details
SD1147	H9696	○	○	Terminal functions are not cleared.
	H9966	○	○	Terminal functions are cleared.
	H5A5A	×	○	Terminal functions are not cleared.
	H55AA	×	○	Terminal functions are cleared.

○: Clear, ×: Not clear

When clearing is complete, the write completion signal (X27) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range or writing while the inverter is running causes the write completion signal (X27) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. In the case of an error completion, the parameters are not cleared.

NOTE

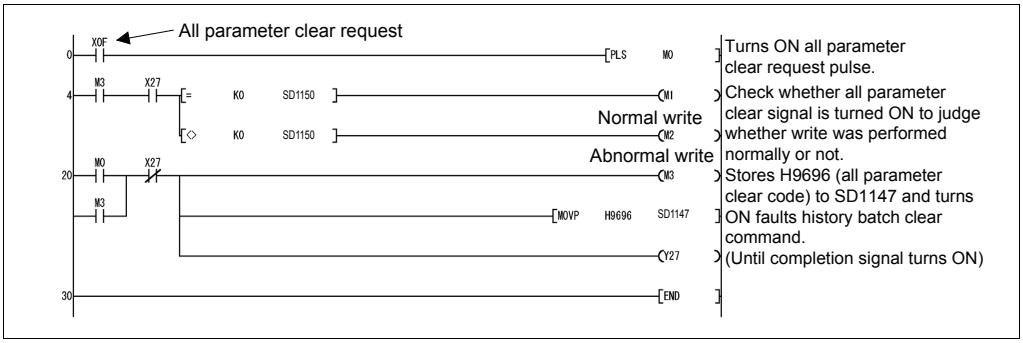
- Identify the terminal function parameters and communication parameters in the parameter list. (Refer to the Instruction Manual of the inverter.)

POINT

- This can be set in the PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of clearing all parameters>

The following description is of the program that clears all parameters.



NOTE

- When parameter clear/all clear is executed, communication parameters are also cleared. Thus communication with FR Configurator2 (Developer) becomes impossible.

♦Related device♦

Device SD1150: inverter parameter access error (refer to page 42)

1.9.4 Inverter operating status control

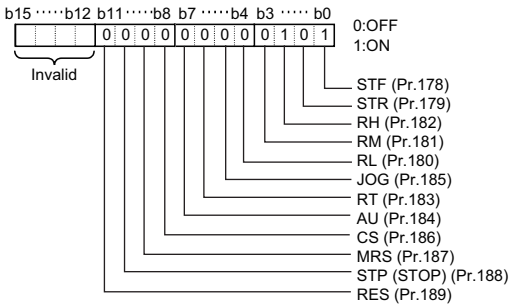
Device number	Name	Data access condition
SD1148	Inverter operating status control	Always accessible. However, this is only active in External/NET operation mode. (Disabled in PU operation mode)
SD1149	Inverter operating status control enable/disable	

◆Inverter operating status control (SD1148)

SD1148 is a device for controlling the operating status of the inverter. The inverter operation can be controlled by turning the bits b0 to b11 of SD1148 ON/OFF (1,0).

All initial values are "0".

Example) When SD1148 is set to "5", the bits b0 and b2 are turned to 1(ON) and thus STF and RH are turned ON, creating the fast forward rotation command.



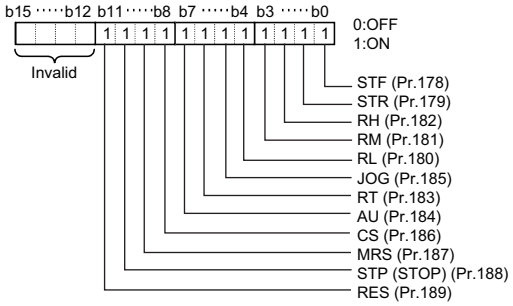
NOTE

- The functions of SD1148 bits are assigned by **Pr.178 to Pr.189** in the same way as for the external input terminal. Note that SQ signal (setting value: 50) cannot be assigned.
- Turn ON SM1255 (special register selection) before using SD1148. (Refer to page 20.)

◆Inverter operating status control enable/disable setting (SD1149)

The inverter operating status control by SD1148 and SM1200 to SM1211 can be enabled/disabled. Control of the bits of SD1148 and SM1200 to SM1211 are enabled by turning the corresponding bits b0 to b11 of SD1149 ON/OFF (1, 0). All initial values are "0".

Example) When SD1149 is set to H1F, the bits b0 to b11 change to 1 (ON) disabling all inputs through external terminals, thus enabling operation control by the inverter operation control (SD1148) and inverter operating status control flag (SM1200 to SM1211).

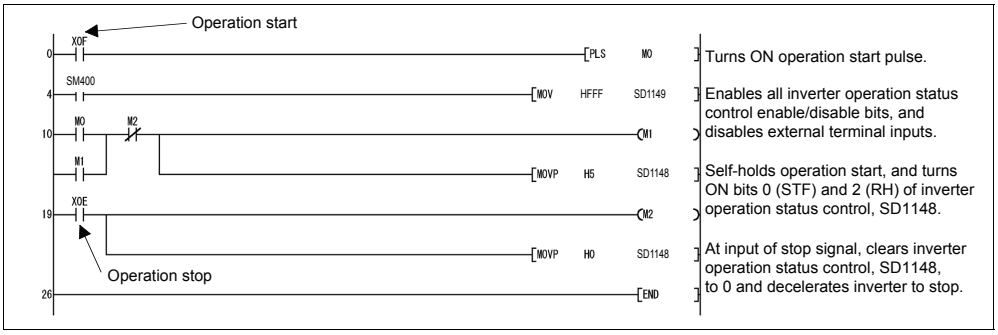


NOTE

- When SD1148 and SM1200 to SM1211 are enabled by SD1149, control by external terminal input or CC-Link remote input are disabled for the bits that are enabled. (Same as setting **Pr.178 to Pr.189** to "no function".)
- When terminals are enabled by PLC function, the control through external terminals is disabled.
- Input through external terminals is always enabled for SQ signal.
  (Control of SQ signal cannot be performed from each SD1149 bit.)

<Program example of operation command settings>

Program example of operating the inverter in fast forward rotation.



1.9.5 Inverter parameter access error (SD1150)

Device number	Name	Data access condition
SD1150	Inverter parameter access error	Always accessible

When an out-of-range setting value is written to a parameter or an out-of-range frequency is set using sequence programs, or when writing is attempted while writing is disabled, a write error occurs and an error code is stored in SD1150.

<Parameters>

Parameter number + H8000 is stored to SD1150.

Example) If an error occurs when **Pr.0 Torque boost** is written, H8000 (H0 + H8000) is stored to SD1150.

If an error occurs when **Pr.10 DC injection brake operation frequency** is written, H800A is stored to SD1150.

<Operation mode, setting frequency, batch clear of fault records, and all parameter clear>

HFFFF is stored to SD1150. (The initial values is "0".)

POINT

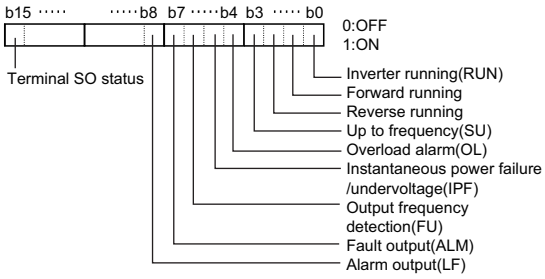
- The error code stored after the error occurrence will be cleared by writing "0" in SD1150. (The error code is retained until "0" is written in SD1150.)

1.9.6 Inverter status (SD1151)

Device number	Name	Data access condition
SD1151	Inverter status	Always accessible

Operating status of the inverter is stored.

Each bit is set according to the status of the inverter.



1.9.7 User-defined error (SD1214)

By setting the values "16 to 20" in SD1214, alarms for the inverter can be created. When an alarm occurs, the inverter stops. Values other than "16 to 20" are invalid. Furthermore, this function is disabled when **Pr.414** = "0".
The created alarms are recognized as E.16 to E.20 by the inverter.

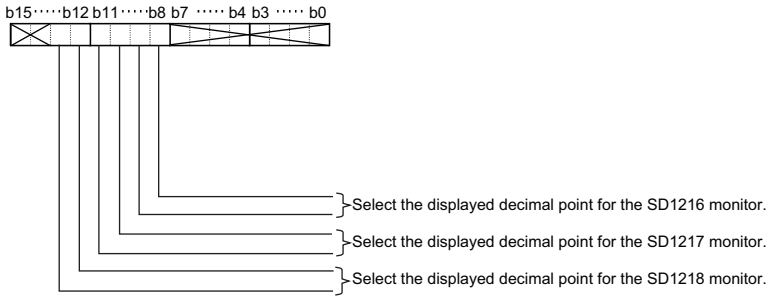
1.9.8 Monitor setting selection (SD1215 to SD1218)

Monitor names and units need to be set in SD1216, SD1217, and SD1218 by using G.PRR, GP.PRR, UMSG instruction (refer to page 193).
To display the monitor names and units set in SD1216 to SD1218 on the parameter unit (FR-PU07), set "40 to 42" in **Pr.774 to Pr.776**. (For details of **Pr.774 to Pr.776**, refer to **the Instruction Manual (Detailed)** of the inverter.)

Device	Monitor description	Pr.774 to Pr.776 setting
SD1216	User monitor 1	40
SD1217	User monitor 2	41
SD1218	User monitor 3	42

To display the monitors set in SD1216 to SD1218 to decimal places, set SD1215 as follows.

<Setting of SD1215>



*1 Ignore bits other than those above.

<Decimal point display setting>

bn + 1	bn	Increment
0	0	1 increment (no decimals)
0	1	0.1 increment
1	0	0.01 increment
1	1	0.001 increment

Setting example:

1. To display SD1216 without decimals
   - Set H0000 in SD1215.
   - Set "40" in **Pr.774**.
2. To display SD1216 in 0.1 increment, and SD1218 in 0.001 increment.
   - Set H3100 in SD1215.
   - Set "40" in **Pr.774** and "42" in **Pr.775**.

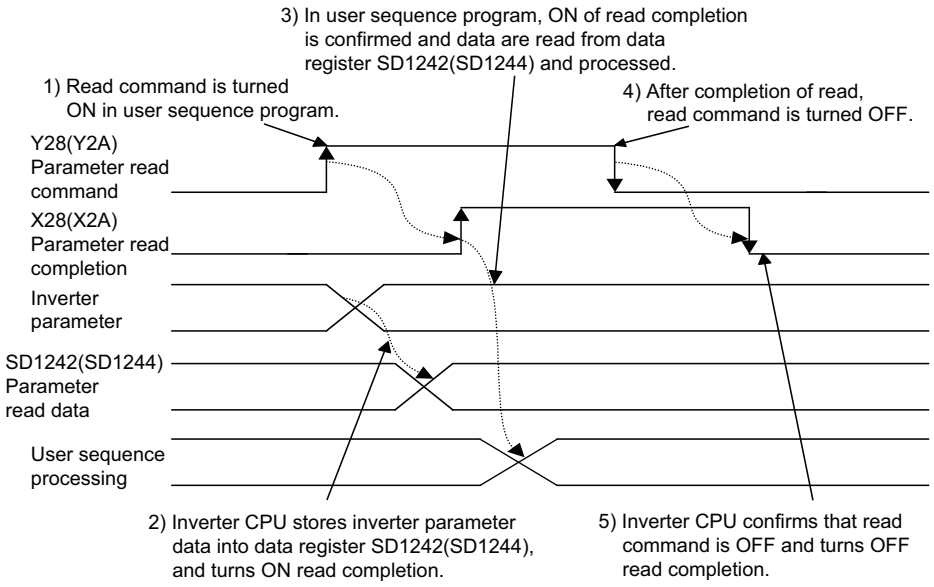
1.10 Read/Write method of inverter parameters

1.10.1 Reading inverter parameters

Device number	Name	Command	Completion	Data access condition (Operation mode)
SD1241	Parameter number (RAM)	Y28	X28	Always allowed
SD1242	Parameter content (RAM)			
SD1234	Second parameter change (RAM)			
SD1243	Parameter number (EEPROM)	Y2A	X2A	
SD1244	Parameter content (EEPROM)			
SD1235	Second parameter change (EEPROM)			

To read a parameter, store the parameter number in SD1241 (SD1243) and turn ON Y28 (Y2A). The parameter content will be stored in SD1242 (SD1244). After the reading is complete, X28 (X2A) turns ON to notify of the completion. (Use the device numbers in parentheses to read a parameter setting value from EEPROM.)
When reading a calibration parameter **(Pr.902 to Pr.935)**, set a value listed below in SD1234 (SD1235) to read each calibration value.
0: Setting value (frequency)
1: Analog value by parameter setting
2: Analog value input from terminal
If an access error such as non-existent parameter occurs, the value of the specified parameter number plus 8000H is stored in SD1150. (Refer to **page 42**.)

Inverter parameter data read timing chart



1.10.2 Writing inverter parameters

Device number	Name	Command	Completion	Data access condition (Operation mode)
SD1241	Parameter number (RAM)	Y29	X29	PU or NET operation mode (depending on **Pr.77**)
SD1242	Parameter content (RAM)			
SD1234	Second parameter change (RAM)			
SD1243	Parameter number (EEPROM)	Y2B	X2B	
SD1244	Parameter content (EEPROM)			
SD1235	Second parameter change (EEPROM)			

To write to a parameter, store the parameter number in SD1241 (SD1243) and the value to be written in SD1242 (SD1244), and turn ON Y29 (Y2B) to execute writing. After the writing completes, X29 (X2B) turns ON to notify of the completion. (Use the device numbers in parentheses to write a parameter setting value to EEPROM.)
When writing to a calibration parameter **(Pr.902 to Pr.935)**, set a value listed below in SD1234 (SD1235) to write each calibration value.

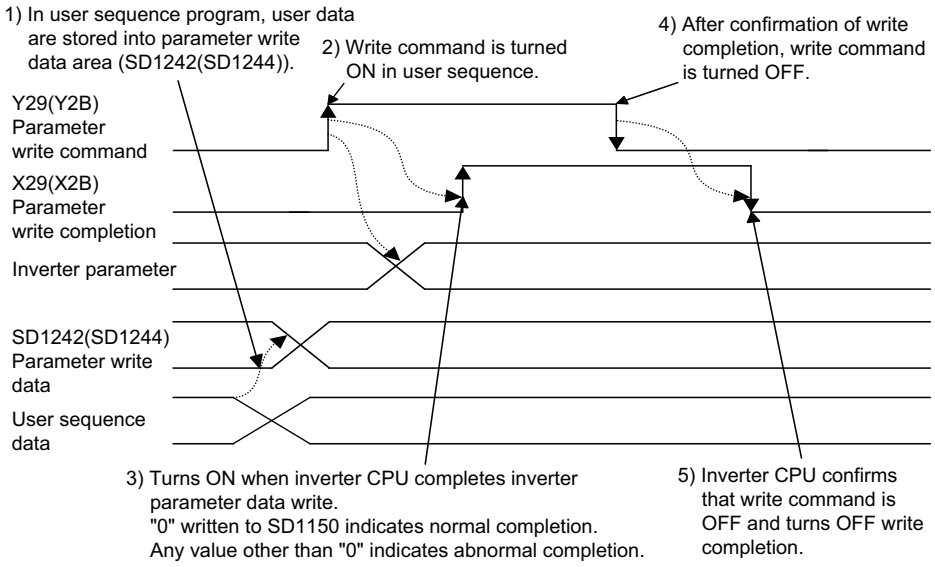
0: Setting value (frequency)
1: Analog value by parameter setting
2: Analog value input from terminal

When the inverter parameter write completion signal (X29 (RAM) or X2B (EEPROM)) turns ON with normal completion, SD1150 is set to 0.
If an error in access to a parameter such as setting an out-of-range value and writing during inverter operation occurs, the write completion signal (X29 (RAM) or X2B (EEPROM)) turns ON and the value of the parameter number plus H8000 is set in SD1150 as soon as the write completion signal (X29 (RAM) or X2B (EEPROM)) is turned ON, resulting in error completion. When an error completion occurs, the parameter is not written. (For example, if an error occurs in **Pr.0 Torque boost**, H8000 is written to SD1150.)
For details on whether inverter parameter writing is allowed, refer to **Pr.77 Parameter write selection**.

POINT

- Inverter parameter writing must be performed in PU operation mode or NET operation mode. (Refer to the Instruction Manual of the inverter.)

Inverter parameter data write timing chart

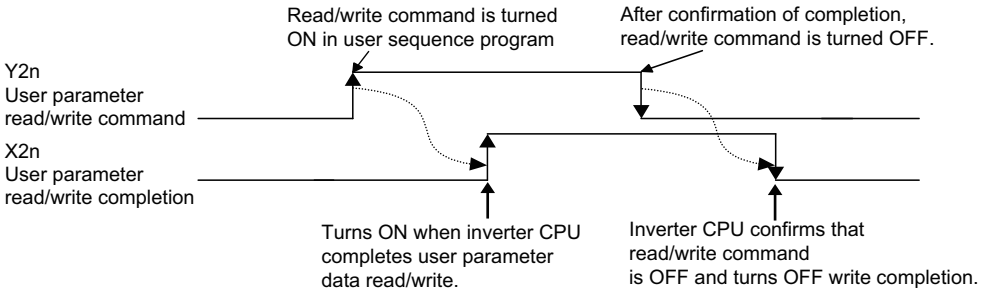


1.11 User area reading/writing

Inverter parameters **Pr.1150 to Pr.1199** can be used as user parameters.
Since this parameter area and the devices D206 to D255 used in PLC function are accessible to each other, values set in **Pr.1150 to Pr.1199** are available in sequence programs. In addition, operation results in sequence programs can be monitored with **Pr.1150 to Pr.1199**.

Device number	Parameter number	Name	Command	Completion	Data access
D206 to D255	Pr.1150 to Pr.1199	User parameter read (RAM)	Y2C	X2C	Always allowed
		User parameter write (RAM)	Y2D	X2D	
		User parameter read (EEPROM/RAM)	Y2E	X2E	
		User parameter write (EEPROM/RAM)	Y2F	X2F	

Turn the read/write instruction from OFF to ON and then turn the read/write completion ON to read/write the user parameters from RAM and EEPROM.



POINT

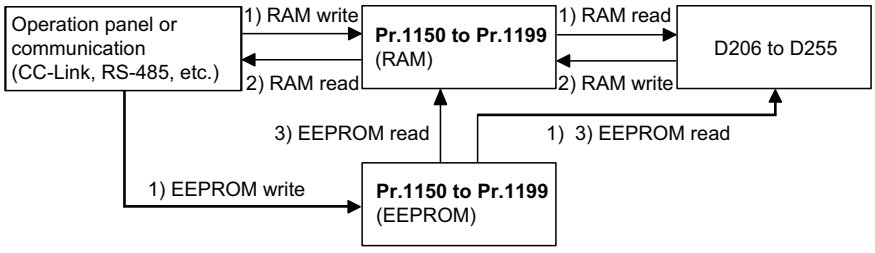
- Application example of user parameter
  Operation timings can be adjusted by assigning a timer in D206 and varying the value set in the timer. Values can be set to the timer with the **Pr.1150** setting without changing the program.

The user parameters **(Pr.1150 to Pr.1199)** and the devices (D206 to D255) can be freely read and written. Data transfer between **Pr.1150 to Pr.1199** and D206 to D255 is automatically executed.

1) Writing of user parameter and devices
When values are written to **Pr.1150 to Pr.1199** via the operation panel, a parameter unit, or communication, they are written to the RAM area and the EEPROM area for parameter storage and also to D206 to D255 at the same time.

2) Reading user parameters and devices
When values are written to D206 to D255 using the PLC function, they are written to the RAM area for storing parameters **(Pr.1150 to Pr.1199)** and read via the operation panel, a parameter unit, or communication. (Since they are not written to EEPROM, resetting the power restores the previous values.)

3) Process at inverter reset or power restoration
When the inverter is reset, the values of **Pr.1150 to Pr.1199** stored in EEPROM are transferred to the RAM area and to D206 to D255.



NOTE

- If EEPROM is read after writing a parameter directly (to RAM), the values in RAM are replaced by the values in EEPROM.
- When **Pr.342 Communication EEPROM write selection** = "1", RAM values are read or written.

1.12 Analog I/O function

1.12.1 Analog input

Analog input values from terminals 1, 2, and 4 can be read from SD1245 to SD1247.

Device number	Terminal name	Setting increments	Data access condition
SD1245	Terminal 1 input	0.1%	Always allowed
SD1246	Terminal 2 input	0.1%	
SD1247	Terminal 4 input	0.1%	

The actual reading is performed at END processing of the sequence program.

NOTE

- The full scale value of analog input depends on the setting values of **Pr.73 Analog input selection** and **Pr.267 Terminal 4 input selection**. Refer to the Instruction Manual of the inverter.

1.12.2 Analog output

Write values from SD1251 to SD1254 to enable analog output from respective terminals.
Write "70" to the output signal selection parameter of each terminal (Terminal FM/CA: **Pr.54**, Terminal AM: **Pr.158**, FR-A8AY Terminal AM0, AM1: **Pr.306**, **Pr.310**) to enable output from PLC function.

Device number	Terminal name	Setting increments	Data access condition
SD1251	Terminal FM/CA	0.1%	Always allowed
SD1252	Terminal AM	0.1%	
SD1253	Terminal AM0 (FR-A8AY)	0.1%	
SD1254	Terminal AM1 (FR-A8AY)	0.1%	

The actual reading is performed at END processing of the sequence program.

1.13 Pulse train input function

Pulse train input values from terminal JOG can be read with the PLC function.

To read pulse train input values with the PLC function, set the terminal JOG by setting **Pr.291 Pulse train I/O selection** = "1, 11, 21, or 100" and **Pr.384 Input pulse division scaling factor** = "0 (initial value)".

After setting terminal JOG, set SD1240 to "1" to start counting the number of sampling pulses and accumulated count values.

Pulse train (the number of sampling pulses) from terminal JOG is stored to SD1236.

When the sampling pulses overflow, make adjustment with the setting of **Pr. 416** and **Pr. 417**.

The number of sampling pulses

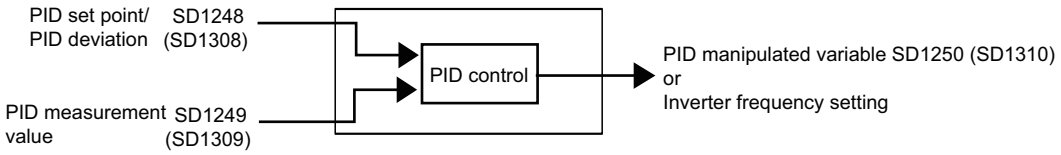
= the number of input pulses per count cycle × pre-scale setting value (**Pr. 417**) × increments scaling factor (**Pr. 416**)

Parameter	Name	Initial value	Setting range	Description
291	Pulse train I/O selection	0	0, 10, 20	Terminal JOG
			1, 11, 21, 100	Pulse train input
416	Pre-scale function selection	0	0 to 5	Pre-scale function selection (increments scaling factor) 0: No function 1: ×1 2: ×0.1 3: ×0.01 4: ×0.001 5: ×0.0001
417	Pre-scale setting value	1	0 to 32767	Set the pre-scale value to calculate the number of sampling pulse when inputting the pulse train.

Device number	Name	Setting range	Description
SD1236	Pulse train input sampling pulse	0 to 32767	The number of pulses counted in count cycle is stored.
SD1237	Pulse train input cumulative count value L	0 to 99999999	The cumulative value of the number of sampling pulses is stored.
SD1238	Pulse train input cumulative count value H		
SD1239	Reset request of pulse train input count	0	Not clear
		1	Count clear
SD1240	Count start of the pulse train input	0	Stop counting
		1	Start counting

1.14 PID control

Set **Pr.128 (Pr.753)** to enable setting of set point/ deviation and measured value for PID control with PLC function.
PID operation is performed using the value of SD1248 (SD1308) as the set point/deviation, and the value of SD1249 (SD1309) as the measured value. The manipulated amount will be stored in SD1250 (SD1310).
To perform PID control using the PLC function, set "1" in SD1255 instead of X14 signal.
When **Pr.128** = "70, 71, 80, or 81", PID operation is performed after the start. Thus, even if "1" is set in SD1255, the manipulated amount of SD1250 remains the same and the value of SD1250 is unchanged from "0".
When **Pr.128** = "90, 91, 100, or 101" and "1" is set in SD1255, PID operation is performed and the operation result is applied to the manipulated amount SD1250.
Set **Pr.753** to enable the second PID control (SD1308 to SD1310).



Parameter	Name	Initial value	Setting range	Description	
128 753	PID action selection	0	0	PID control disabled	
			10, 11, 20, 21, 40 to 43, 50, 51, 60, 61, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	For details, refer to the Instruction Manual of the inverter.	
			70	PID reverse action	Deviation signal input (PLC function)
			71	PID forward action	
			80	PID reverse action	Measured value and set point input (PLC function)
			81	PID forward action	
			90	PID reverse action	Deviation signal input (PLC function) Not applied to inverter output frequency.
			91	PID forward action	
			100	PID reverse action	Measured value and set point input (PLC function) Not applied to inverter output frequency.
			101	PID forward action	

Device number	Name	Setting range	Description
SD1248	PID control set point/ deviation	Set point: 0 to 100% *1 Deviation: -100 to 100%	Set the PID set point or the PID deviation (in 0.01% increments*1).
SD1249	PID control measured value	0 to 100% *1	Set the PID measured value (in 0.01% increments*1).
SD1250	PID control manipulated amount	-100 to 100%	Stores the PID manipulated amount (in 0.01% increments).
SD1255	PID operation control	0	Stops PID control.
		1	Starts PID control.
SD1308	Second PID control set point/deviation	Set point: 0 to 100% *1 Deviation: -100 to 100%	Set the second PID set point or the second PID deviation (in 0.01% increments*1).
SD1309	Second PID control measured value	0 to 100% *1	Set the second PID measured value (in 0.01% increments*1).
SD1310	Second PID control manipulated amount	-100 to 100%	Stores the second PID manipulated amount (in 0.01% increments).

*1 When both **Pr.934** and **Pr.935** are set to values other than "9999", the set point of SD1248 (SD1308) and the measured value of SD1249 (SD1309) are set as coefficients. The setting range is from the smaller coefficient to the larger one set in **Pr.934** and **Pr.935**.
(For details of **Pr.934** and **Pr.935**, refer to the Instruction Manual of the inverter.)

NOTE

- Depending on the setting value of **Pr.128 (Pr.753)**, SD1248 (SD1308) automatically switches between set point and deviation.
- When **Pr.128 (Pr.753)** is set to deviation input "70, 71, 90, or 91", the value set as the measured value in (SD1249 (SD1309)) becomes invalid.
- If an out-of-range value is set, the maximum value (or the minimum value) of the setting range is used for operation.

1.15 Clearing the flash memory of the PLC function

Set **Pr.498** to "9696" to clear the flash memory used for the PLC function.

Parameter	Name	Initial value	Setting range	Description	
498	PLC function flash memory clear	0	0, 9696 (0 to 9999)	0: Clears the flash memory fault display (no operation after writing while the flash memory is in normal operation).	Write
				9696: Clears the flash memory (no operation after writing during flash memory fault).	
				Other than 0 and 9696: Outside of the setting range	
				0: Normal display	Read
				1: The flash memory has not been cleared because the PLC function is enabled.	
				9696: During flash memory clearing operation or flash memory fault	

- If the file password (registered by FR Configurator2 (Developer)) of the PLC function has been forgotten, use **Pr.498** to clear the flash memory and unlock the file password.
- The flash memory can only be cleared when the PLC function is disabled (**Pr.414** ="0").
- Setting **Pr.498** = "9696" clears the flash memory. It takes approximately 30 s at the maximum to clear the flash memory.
- When the flash memory clearing is completed, the **Pr.498** value changes to "0" to notify the completion.
- Check if **Pr.498** = "0" before turning OFF the inverter power or performing an inverter reset after the flash memory is cleared.
- When the inverter power is turned OFF or an inverter reset is performed during the flash memory clearing operation, the flash memory is not cleared properly. The read value of **Pr.498** becomes "9696" when the flash memory clearing has not been completed properly due to turning OFF of the power or the inverter reset. If the read value of **Pr.498** becomes "9696", clear the flash memory according to the following procedure.
  - FR-DU08
    Set **Pr.498** = "0". Then, set **Pr.498** = "9696" again to retry clearing.
  - FR-LU08 or FR-PU07
    Set **Pr.498** = "9696" again to retry clearing.

NOTE

- Executing this function clears the PLC function program and all parameters of the PLC function. Create the program and set the parameters of the PLC function again.
- While the PLC function is enabled (**Pr.414** = "1 or 2"), setting **Pr.498** = "9696" does not clear the flash memory. When the flash memory clearing is attempted while the PLC function is enabled, the **Pr.498** value changes to "1" to notify that the PLC function is enabled. Disable the PLC function (**Pr.414** = "0"). After the inverter is reset, retry clearing.
- If a value other than "0 or 9696" is set in **Pr.498**, Er1 (write disable error) will occur.

1.16 Constant scan

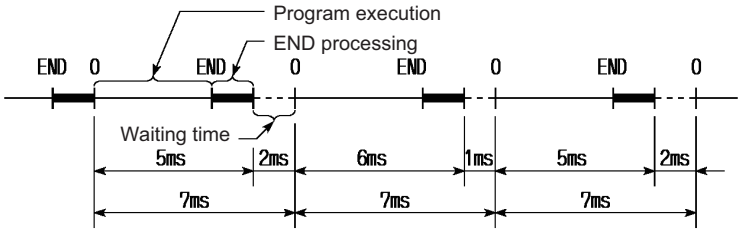
A constant scan time can be maintained for the sequence programs.
Configure the setting using FR Configurator2 (Developer).

PLC parameter	Name	Initial value	Setting range
PLC RAS setting	Constant scan setting	None	0.5 ms to 2000 ms

- A waiting time is automatically set so that the sum of the execution time of the sequence programs and the waiting time is equal to the set constant scan time.
- PLC parameter: Although the setting range of PLC RAS setting is 0.5 ms to 2000 ms, the actual set constant scan time is a minimum of 10 ms. (Increments: 10 ms)

Setting value	Set constant scan time
0.5 ms to 10.0 ms	10 ms
10.5 ms to 20.0 ms	20 ms
...	...
1990.5 ms to 2000.0 ms	2000 ms

- I/O timing
  After END processing is completed, a waiting time is automatically set as shown below.



Constant scan: operation when set to 7 ms.

NOTE

- Processes other than the PLC function are executed even during the waiting time.
- The set constant scan time must meet the following condition:
  Set watchdog timer time > set constant scan time > maximum scan time of program.
- If a scan time is longer than the set constant scan time, "PRG.TIME OVER Error code: 5010" occurs. In this case, the constant scan setting is ignored in the operation.
- If a scan time is longer than the set watchdog timer time, a watchdog timer error is detected and execution of the sequence program stops. (Refer to page 33.)
- Only the "Execute it while waiting for constant scan setting" is enabled for the service processing setting.
  Settings other than "Execute it while waiting for constant scan setting" are ignored and no error occurs even if they are set.
- Scan time monitoring in FR Configurator2 (Developer) monitors the actual scan time excluding the waiting time for constant scan.

MEMO

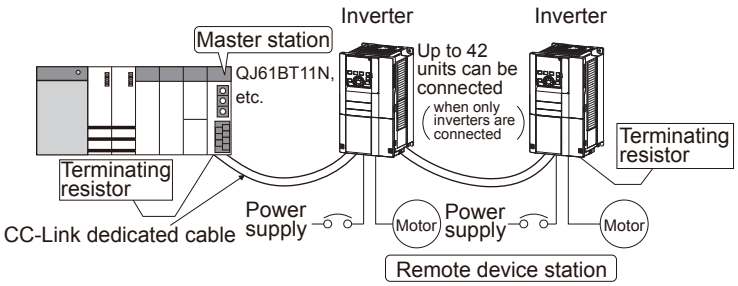
2 CC-Link communication

2.1 System configuration 54
2.2 CC-Link parameter 56
2.3 CC-Link I/O specifications 57
2.4 Buffer memory 64

2.1 System configuration

2.1.1 System configuration example

- Programmable controller side
  Mount the "CC-Link system master/local module" on the main base unit or extension base unit that uses the programmable controller CPU as the master station.
- Use the CC-Link dedicated cable to connect the CC-Link programmable controller module (master station) to the inverter.



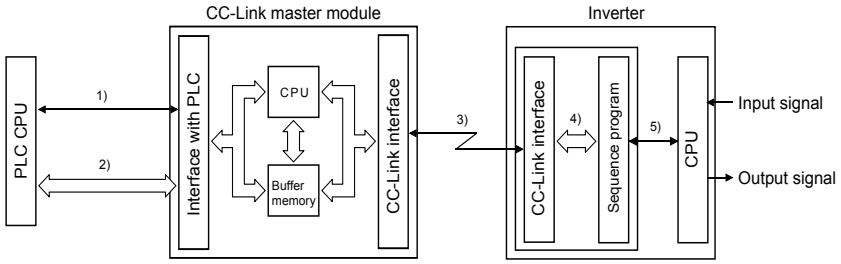
NOTE

- For details on CC-Link communication wiring and the CC-Link cable, refer to the Instruction Manual of the FR-A8NC.

2.1.2 Function block diagram

The following function blocks explain the I/O information flow to and from the inverter in CC-Link.

- Link refresh between the master station of CC-Link system and the inverter is continuously performed at 3.5 to 18 ms (512 points).
- I/O refresh and the sequence program of the master station are executed asynchronously.
- Data read from the inverter is read from the buffer memory of the CC-Link system master/local module using FROM instruction.
- Data to be written to the inverter is written to the buffer memory of the CC-Link system master/local module using TO instruction.



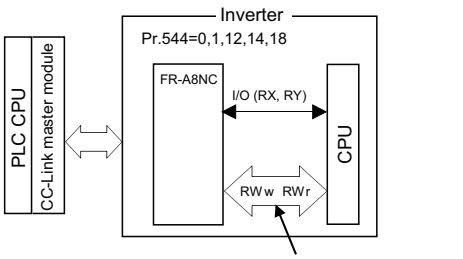
1)	CC-Link module I/O signals	I/O signals assigned to the CC-Link system master/local module. These signals are for communication between the programmable controller CPU and the CC-Link system master/local module.
2)	Reading from/writing to the buffer memory	Information that is input to the inverter can be read, and output information can be written. FROM/TO instruction of the sequence program enables reading from/writing to the buffer memory. For details on the buffer memory, refer to page 64.
3)	CC-Link dedicated cable	The PLC link start instruction is sent from the sequence program. After PLC link starts, link refresh is continuously performed asynchronously with execution of the sequence program.
4)	Sequence program	The sequence program exchanges I/O information between the CC-Link system master/local module and the inverter CPU.
5)	I/O information	The CC-Link system master/local module and the inverter CPU exchange I/O information. (When CC-Link is not used, only 5) is performed and 1) to 4) are not related to the operation.)

NOTE

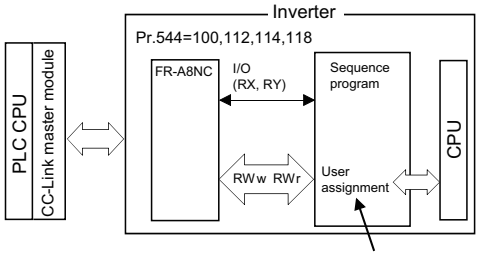
- Programs cannot be read or written via CC-Link communication.

POINT

- The differences between the normal CC-Link communication (**Pr.544** = "1, 2, 12, 14, or 18") and the CC-Link communication with the PLC function (**Pr.544** = "100, 112, 114, or 118") are shown below.



Parameter read/write, monitor, operation commands, etc. have been assigned in advance.



The user must assign parameters, monitors, etc. using sequence programs. Other data read/write, etc. can be assigned freely as user areas.
*Operation and speed commands have been assigned in advance.

2.2 CC-Link parameter

2.2.1 CC-Link extended setting (Pr.544)

The functions of the remote register can be extended.

Parameter number	Name	Initial value	Setting range	CC-Link version	Description
544	CC-Link extended setting	0	0	1	1 station occupied (FR-A5NC compatible) *1
			1		1 station occupied
			12 *2	2	1 station occupied, double
			14 *2		1 station occupied, quadruple
			18 *2		1 station occupied, octuple
			100	1	1 station occupied (PLC function)
			112 *2	2	1 station occupied, double (PLC function)
			114 *2		1 station occupied, quadruple (PLC function)
			118 *2		1 station occupied, octuple (PLC function)

*1 The program used for the conventional series inverter option (FR-A5NC) can be used.

*2 When using the double, quadruple, or octuple settings of the CC-Link Ver.2, station data of the master station must be set to double, quadruple, or octuple. (If the master station is CC-Link Ver.1, this setting is not available.)

NOTE

- The setting becomes valid after inverter reset.

2.3 CC-Link I/O specifications

2.3.1 I/O signals when one station in the CC-Link Ver.1 is occupied (Pr.544 = "100")

The number of device points available in CC-Link communication are 32 input (RX) points (16 points for the PLC function), 32 output (RY) points (16 points for the PLC function), 4 remote register (RWr) points, and 4 remote register (RWw) points.

◆Remote I/O

PLC function device number	Remote output device number	Signal name
X30	RYn0	Forward rotation command
X31	RYn1	Reverse rotation command
X32	RYn2	High-speed operation command (Terminal RH function) *1
X33	RYn3	Middle-speed operation command (Terminal RM function) *1
X34	RYn4	Low-speed operation command (Terminal RL function) *1
X35	RYn5	JOG operation command (Terminal JOG function) *1
X36	RYn6	Second function selection (Terminal RT function) *1
X37	RYn7	Current input selection (Terminal AU function) *1
X38	RYn8	Selection of automatic restart after instantaneous power failure (Terminal CS function) *1
X39	RYn9	Output stop
X3A	RYnA	Start self-holding selection (Terminal STP (STOP) function) *1
X3B	RYnB	Reset (Terminal RES function) *1
X3C	RYnC	General-purpose remote input for PLC function
X3D	RYnD	
X3E	RYnE	
X3F	RYnF	
—	RY (n + 1) 0 to RY (n + 1) 7	Reserved

PLC function device number	Remote input device number	Signal name
Y30	RXn0	Forward rotating
Y31	RXn1	Reverse rotating
Y32	RXn2	Running (Terminal RUN function) *2
Y33	RXn3	Up to frequency (Terminal SU function) *2
Y34	RXn4	Overload alarm (Terminal OL function) *2
Y35	RXn5	Instantaneous power failure (Terminal IPF function) *2
Y36	RXn6	Frequency detection (Terminal FU function) *2
Y37	RXn7	Fault (Terminal ABC1 function) *2
Y38	RXn8	— (Terminal ABC2 function) *2
Y39	RXn9	**Pr.313** assignment function (DO0) *3
Y3A	RXnA	**Pr.314** assignment function (DO1) *3
Y3B	RXnB	**Pr.315** assignment function (DO2) *3
Y3C	RXnC	General-purpose remote input for PLC function
Y3D	RXnD	
Y3E	RXnE	
Y3F	RXnF	
—	RX (n + 1) 0 to RX (n + 1) 7	Reserved

PLC function device number	Remote output device number	Signal name
—	RY (n + 1) 8	Unused (Initial data process completion flag)
—	RY (n + 1) 9	Unused (Initial data process request flag)
—	RY (n + 1) A	Error reset request flag
—	RY (n + 1) B to RY (n + 1) F	Reserved

PLC function device number	Remote input device number	Signal name
—	RX (n + 1) 8	Unused (Initial data process request flag)
—	RX (n + 1) 9	Unused (Initial data process completion flag)
—	RX (n + 1) A	Error status flag
—	RX (n + 1) B	Remote station ready
—	RX (n + 1) C to RX (n + 1) F	Reserved

("n" indicates a value determined by the station number setting.)

*1 These signal names are initial values. The functions of input signals can be changed using **Pr.180 to Pr.186**, **Pr.188**, and **Pr.189**. The signals of RYn0, RYn1, and RYn9 cannot be changed. Signals changed using **Pr.178**, **Pr.179**, and **Pr.187** are invalid. For details on **Pr.178 to Pr.189**, refer to the Instruction Manual of the inverter.

*2 These signal names are initial values. The functions of output signals can be changed using **Pr.190 to Pr.196**. For details on **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

*3 Output signals can be assigned using **Pr.313 to Pr.315**. For details on the signals, refer to the description of **Pr.190 to Pr.196** in the Instruction Manual of the inverter.

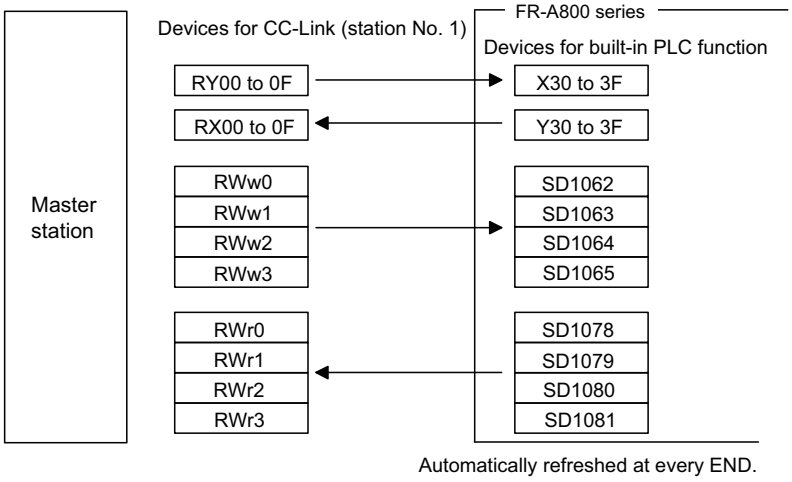
◆Remote register

PLC function device number	Address	Description
SD1062	RWwn	Registers for reading data received from the master station.
SD1063	RWwn + 1	
SD1064	RWwn + 2	
SD1065	RWwn + 3	

PLC function device number	Address	Description
SD1078	RWrn	Registers for writing data to be sent to the master station.
SD1079	RWrn + 1	
SD1080	RWrn + 2	
SD1081	RWrn + 3	

("n" indicates a value determined by the station number setting.)

◆I/O figure



NOTE

• All remote registers are user areas and can be used freely.

2.3.2 I/O signals when the double setting is set in CC-Link Ver.2 (Pr.544 = "112")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 4 remote register (RWr) points, and 4 remote register (RWw) points.

◆Remote I/O

PLC function device number	Remote output device number	Signal name
X30	RYn0	Forward rotation command
X31	RYn1	Reverse rotation command
X32	RYn2	High-speed operation command (Terminal RH function) *1
X33	RYn3	Middle-speed operation command (Terminal RM function) *1
X34	RYn4	Low-speed operation command (Terminal RL function) *1
X35	RYn5	JOG operation command (Terminal JOG function) *1
X36	RYn6	Second function selection (Terminal RT function) *1
X37	RYn7	Current input selection (Terminal AU function) *1
X38	RYn8	Selection of automatic restart after instantaneous power failure (Terminal CS function) *1
X39	RYn9	Output stop
X3A	RYnA	Start self-holding selection (Terminal STP (STOP) function) *1
X3B	RYnB	Reset (Terminal RES function) *1
—	RYnC	Monitor command
—	RYnD	Frequency setting command (RAM)
—	RYnE	Frequency setting command (RAM, EEPROM)
—	RYnF	Instruction code execution request

PLC function device number	Remote input device number	Signal name
Y30	RXn0	Forward rotating
Y31	RXn1	Reverse rotating
Y32	RXn2	Running (Terminal RUN function) *2
Y33	RXn3	Up to frequency (Terminal SU function) *2
Y34	RXn4	Overload alarm (Terminal OL function) *2
Y35	RXn5	Instantaneous power failure (Terminal IPF function) *2
Y36	RXn6	Frequency detection (Terminal FU function) *2
Y37	RXn7	Fault (Terminal ABC1 function) *2
Y38	RXn8	— (Terminal ABC2 function) *2
Y39	RXn9	**Pr.313** assignment function (DO0) *3
Y3A	RXnA	**Pr.314** assignment function (DO1) *3
Y3B	RXnB	**Pr.315** assignment function (DO2) *3
—	RXnC	Monitoring
—	RXnD	Frequency setting completion (RAM)
—	RXnE	Frequency setting completion (RAM, EEPROM)
—	RXnF	Instruction code execution completion

PLC function device number	Remote output device number	Signal name
—	RY (n + 1) 0 to RY (n + 1) 7	Reserved
—	RY (n + 1) 8	Unused (Initial data process completion flag)
—	RY (n + 1) 9	Unused (Initial data process request flag)
—	RY (n + 1) A	Error reset request flag
—	RY (n + 1) B to RY (n + 1) F	Reserved

PLC function device number	Remote input device number	Signal name
—	RX (n + 1) 0 to RX (n + 1) 7	Reserved
—	—	Unused (Initial data process request flag)
—	RX (n + 1) 9	Unused (Initial data process completion flag)
—	RX (n + 1) A	Error status flag
—	RX (n + 1) B	Remote station ready
	RX (n + 1) C to RX (n + 1) F	Reserved

("n" indicates a value determined by the station number setting.)

∗1 These signal names are initial values. The functions of input signals can be changed using **Pr.180 to Pr.186**, **Pr.188, and Pr.189**. The signals of RYn0, RYn1, and RYn9 cannot be changed. Signals changed using **Pr.178, Pr.179**, and **Pr.187** are invalid. For details on **Pr.178 to Pr.189**, refer to the Instruction Manual of the inverter.

∗2 These signal names are initial values. The functions of output signals can be changed using **Pr.190 to Pr.196**. For details on **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

∗3 Output signals can be assigned using **Pr.313 to Pr.315**. For details on the signals, refer to the description of **Pr.190 to Pr.196** in the Instruction Manual of the inverter.

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency/torque command∗1 (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
SD1062	RWwn + 4	Registers for reading data received from the master station.	
SD1063	RWwn + 5		
SD1064	RWwn + 6		
SD1065	RWwn + 7		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
SD1078	RWrn + 4	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 5		
SD1080	RWrn + 6		
SD1081	RWrn + 7		

("n" indicates a value determined by the station number setting.)

∗1 Under vector control (torque control) (**Pr.804** = "3, 5")

2.3.3 I/O signals when the quadruple setting is set in CC-Link Ver.2 (Pr. 544 = "114")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 8 remote register (RWr) points, and 8 remote register (RWw) points.

◆Remote I/O

Same as when **Pr.544** = "112". (Refer to **page 59.**)

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency/torque command *1 (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
—	RWwn + 4	Monitor code 3	
—	RWwn + 5	Monitor code 4	
—	RWwn + 6	Monitor code 5	
—	RWwn + 7	Monitor code 6	
SD1062	RWwn + 8	Registers for reading data received from the master station.	
SD1063	RWwn + 9		
SD1064	RWwn + A		
SD1065	RWwn + B		
SD1066	RWwn + C		
SD1067	RWwn + D		
SD1068	RWwn + E		
SD1069	RWwn + F		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
—	RWrn + 4	Third monitor value	
—	RWrn + 5	Fourth monitor value	
—	RWrn + 6	Fifth monitor value	
—	RWrn + 7	Sixth monitor value	
SD1078	RWrn + 8	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 9		
SD1080	RWrn + A		
SD1081	RWrn + B		
SD1082	RWrn + C		
SD1083	RWrn + D		
SD1084	RWrn + E		
SD1085	RWrn + F		

("n" indicates a value determined by the station number setting.)

*1 Under vector control (torque control) (**Pr.804** = "3, 5")

2.3.4 I/O signals when the octuple setting is set in CC-Link Ver.2 (Pr. 544 = "118")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 16 remote register (RWr) points, and 16 remote register (RWw) points.

◆Remote I/O

Same as when **Pr.544** = 112. (Refer to page 59.)

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
—	RWwn + 4	Monitor code 3	
—	RWwn + 5	Monitor code 4	
—	RWwn + 6	Monitor code 5	
—	RWwn + 7	Monitor code 6	
—	RWwn + 8	Fault record number	H00
—	RWwn + 9	PID set point (0.01% increments) *1	
—	RWwn + A	PID measured value (0.01% increments) *2	
—	RWwn + B	PID deviation (0.01% increments) *3	
—	RWwn + C	Reserved	
—	RWwn + D	H00 (Empty)	
—	RWwn + E		
—	RWwn + F		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
—	RWrn + 4	Third monitor value	
—	RWrn + 5	Fourth monitor value	
—	RWrn + 6	Fifth monitor value	
—	RWrn + 7	Sixth monitor value	
—	RWrn + 8	Fault record number	Fault record data
—	RWrn + 9	Fault record (Output frequency)	
—	RWrn + A	Fault record (Output current)	
—	RWrn + B	Fault record (Output voltage)	
—	RWrn + C	Fault record (Energization time)	
—	RWrn + D	H00 (Empty)	
—	RWrn + E		
—	RWrn + F		

*1 Valid when **Pr.128** = "40, 41, 60, 61, 140, or 141".
*2 Valid when **Pr.128** = "60 or 61".
*3 Valid when **Pr.128** = "50 or 51".

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
SD1062	RWwn + 10	Registers for reading data received from the master station.	
SD1063	RWwn + 11		
SD1064	RWwn + 12		
SD1065	RWwn + 13		
SD1066	RWwn + 14		
SD1067	RWwn + 15		
SD1068	RWwn + 16		
SD1069	RWwn + 17		
SD1070	RWwn + 18		
SD1071	RWwn + 19		
SD1072	RWwn + 1A		
SD1073	RWwn + 1B		
SD1074	RWwn + 1C		
SD1075	RWwn + 1D		
SD1076	RWwn + 1E		
SD1077	RWwn + 1F		

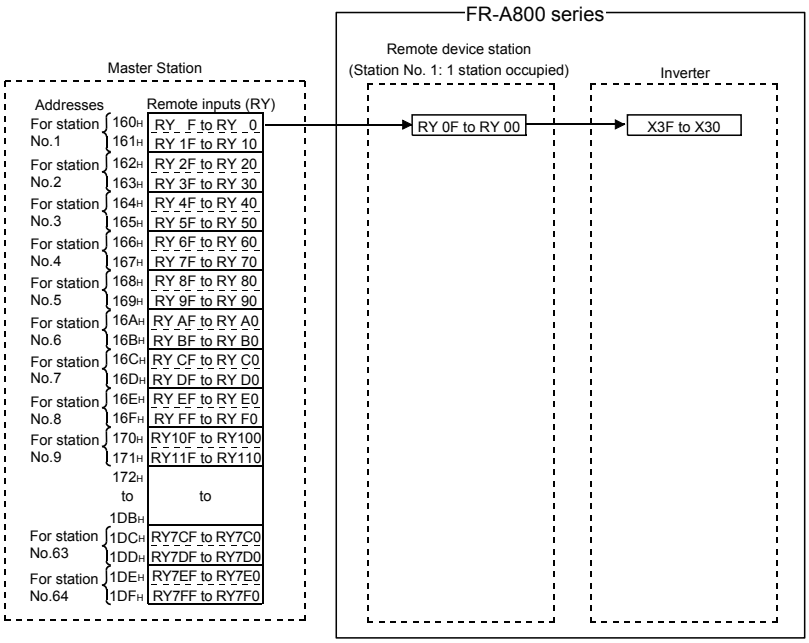
PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
SD1078	RWrn + 10	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 11		
SD1080	RWrn + 12		
SD1081	RWrn + 13		
SD1082	RWrn + 14		
SD1083	RWrn + 15		
SD1084	RWrn + 16		
SD1085	RWrn + 17		
SD1086	RWrn + 18		
SD1087	RWrn + 19		
SD1088	RWrn + 1A		
SD1089	RWrn + 1B		
SD1090	RWrn + 1C		
SD1091	RWrn + 1D		
SD1092	RWrn + 1E		
SD1093	RWrn + 1F		

("n" indicates a value determined by the station number setting.)

2.4 Buffer memory

2.4.1 Remote output signals (master station to inverter (FR-A8NC))

- Input statuses to the remote device station are stored.
- Each station uses two words.
  (Do not use address 16n (n = 2 (X - 1) + 1, X = station number).)

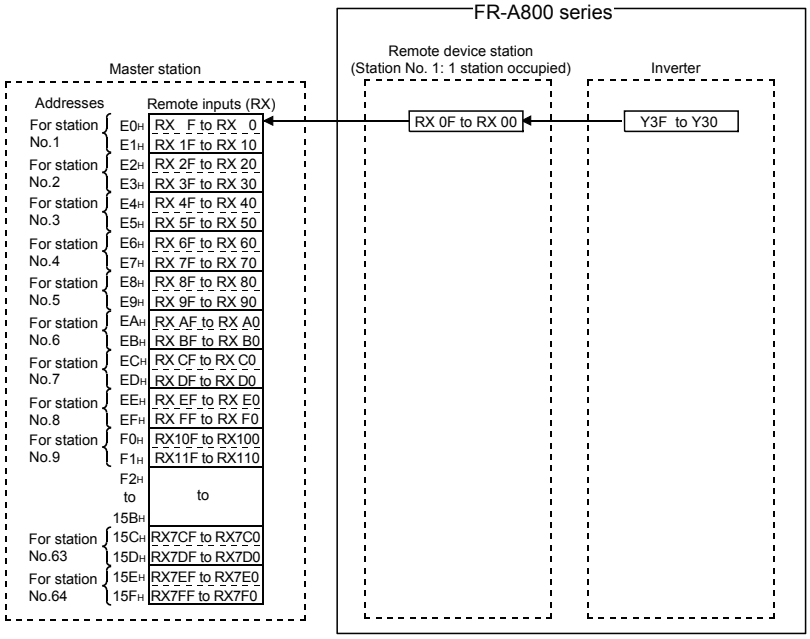


Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	160H	17	180H	33	1A0H	49	1C0H
2	162H	18	182H	34	1A2H	50	1C2H
3	164H	19	184H	35	1A4H	51	1C4H
4	166H	20	186H	36	1A6H	52	1C6H
5	168H	21	188H	37	1A8H	53	1C8H
6	16AH	22	18AH	38	1AAH	54	1CAH
7	16CH	23	18CH	39	1ACH	55	1CCH
8	16EH	24	18EH	40	1AEH	56	1CEH
9	170H	25	190H	41	1B0H	57	1D0H
10	172H	26	192H	42	1B2H	58	1D2H
11	174H	27	194H	43	1B4H	59	1D4H
12	176H	28	196H	44	1B6H	60	1D6H
13	178H	29	198H	45	1B8H	61	1D8H
14	17AH	30	19AH	46	1BAH	62	1DAH
15	17CH	31	19CH	47	1BCH	63	1DCH
16	17EH	32	19EH	48	1BEH	64	1DEH

2.4.2 Remote input signals Pr.544 = "100" (inverter (FR-A8NC) to master station)

- Input statuses from the remote device station are stored.
- Each station uses two words.
  (Do not use address En (n = 2 (X - 1) + 1, X = station number).)

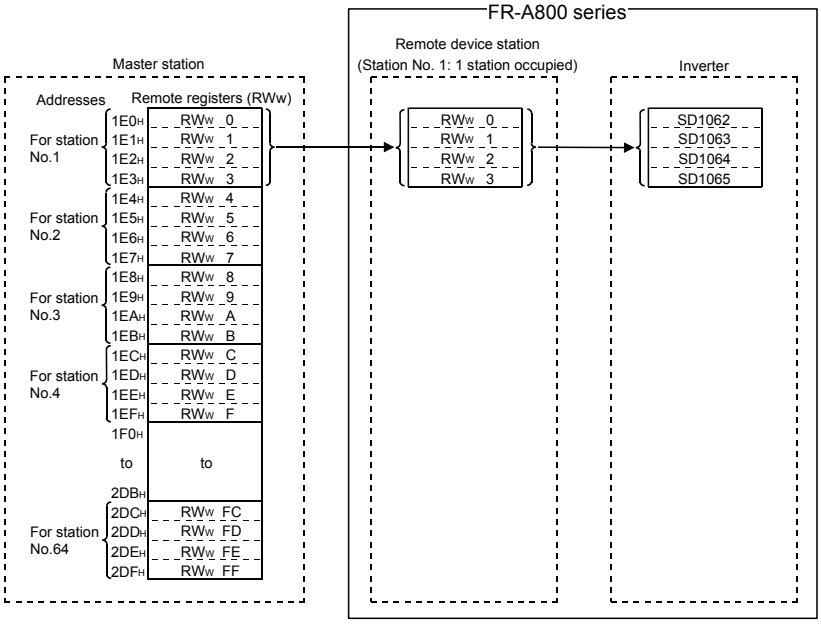


Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	E0H	17	100H	33	120H	49	140H
2	E2H	18	102H	34	122H	50	142H
3	E4H	19	104H	35	124H	51	144H
4	E6H	20	106H	36	126H	52	146H
5	E8H	21	108H	37	128H	53	148H
6	EAH	22	10AH	38	12AH	54	14AH
7	ECH	23	10CH	39	12CH	55	14CH
8	EEH	24	10EH	40	12EH	56	14EH
9	F0H	25	110H	41	130H	57	150H
10	F2H	26	112H	42	132H	58	152H
11	F4H	27	114H	43	134H	59	154H
12	F6H	28	116H	44	136H	60	156H
13	F8H	29	118H	45	138H	61	158H
14	FAH	30	11AH	46	13AH	62	15AH
15	FCH	31	11CH	47	13CH	63	15CH
16	FEH	32	11EH	48	13EH	64	15EH

2.4.3 Remote registers Pr.544 = "100" (master station to inverter (FR-A8NC))

- Data to be sent to remote registers (RWw) of the remote device station are stored.
- Each station uses four words.

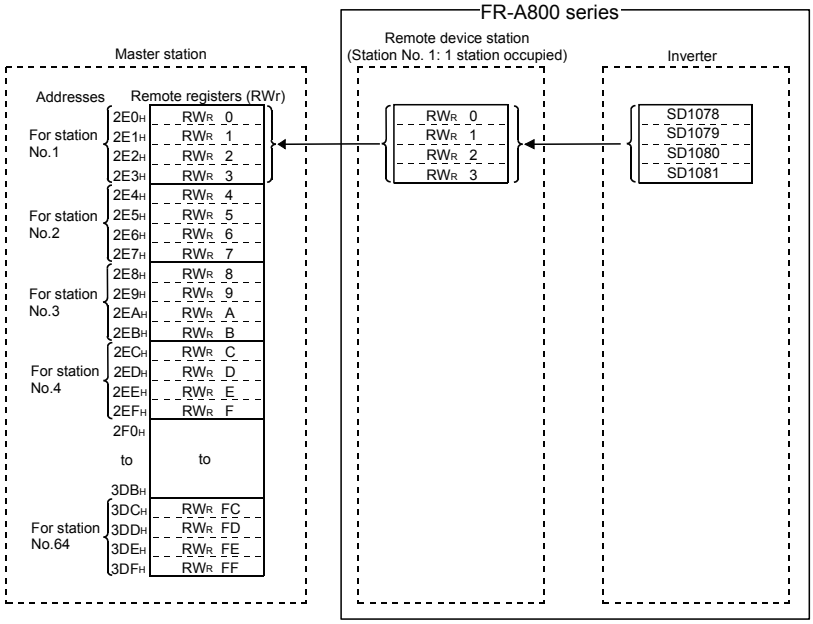


Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	1E0H to 1E3H	17	220H to 223H	33	260H to 263H	49	2A0H to 2A3H
2	1E4H to 1E7H	18	224H to 227H	34	264H to 267H	50	2A4H to 2A7H
3	1E8H to 1EBH	19	228H to 22BH	35	268H to 26BH	51	2A8H to 2ABH
4	1ECH to 1EFH	20	22CH to 22FH	36	26CH to 26FH	52	2ACH to 2AFH
5	1F0H to 1F3H	21	230H to 233H	37	270H to 273H	53	2B0H to 2B3H
6	1F4H to 1F7H	22	234H to 237H	38	274H to 277H	54	2B4H to 2B7H
7	1F8H to 1FBH	23	238H to 23BH	39	278H to 27BH	55	2B8H to 2BBH
8	1FCH to 1FFH	24	23CH to 23FH	40	27CH to 27FH	56	2BCH to 2BFH
9	200H to 203H	25	240H to 243H	41	280H to 283H	57	2C0H to 2C3H
10	204H to 207H	26	244H to 247H	42	284H to 287H	58	2C4H to 2C7H
11	208H to 20BH	27	248H to 24BH	43	288H to 28BH	59	2C8H to 2CBH
12	20CH to 20FH	28	24CH to 24FH	44	28CH to 28FH	60	2CCH to 2CFH
13	210H to 213H	29	250H to 253H	45	290H to 293H	61	2D0H to 2D3H
14	214H to 217H	30	254H to 257H	46	294H to 297H	62	2D4H to 2D7H
15	218H to 21BH	31	258H to 25BH	47	298H to 29BH	63	2D8H to 2DBH
16	21CH to 21FH	32	25CH to 25FH	48	29CH to 29FH	64	2DCH to 2DFH

2.4.4 Remote registers Pr.544 = "100" (inverter (FR-A8NC) to master station)

- Data sent from the remote registers (RWr) of the remote device station are stored.
- Each station uses four words.



Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	2E0H to 2E3H	17	320H to 323H	33	360H to 363H	49	3A0H to 3A3H
2	2E4H to 2E7H	18	324H to 327H	34	364H to 367H	50	3A4H to 3A7H
3	2E8H to 2EBH	19	328H to 32BH	35	368H to 36BH	51	3A8H to 3ABH
4	2ECH to 2EFH	20	32CH to 32FH	36	36CH to 36FH	52	3ACH to 3AFH
5	2F0H to 2F3H	21	330H to 333H	37	370H to 373H	53	3B0H to 3B3H
6	2F4H to 2F7H	22	334H to 337H	38	374H to 377H	54	3B4H to 3B7H
7	2F8H to 2FBH	23	338H to 33BH	39	378H to 37BH	55	3B8H to 3BBH
8	2FCH to 2FFH	24	33CH to 33FH	40	37CH to 37FH	56	3BCH to 3BFH
9	300H to 303H	25	340H to 343H	41	380H to 383H	57	3C0H to 3C3H
10	304H to 307H	26	344H to 347H	42	384H to 387H	58	3C4H to 3C7H
11	308H to 30BH	27	348H to 34BH	43	388H to 38BH	59	3C8H to 3CBH
12	30CH to 30FH	28	34CH to 34FH	44	38CH to 38FH	60	3CCH to 3CFH
13	310H to 313H	29	350H to 353H	45	390H to 393H	61	3D0H to 3D3H
14	314H to 317H	30	354H to 357H	46	394H to 397H	62	3D4H to 3D7H
15	318H to 31BH	31	358H to 35BH	47	398H to 39BH	63	3D8H to 3DBH
16	31CH to 31FH	32	35CH to 35FH	48	39CH to 39FH	64	3DCH to 3DFH

MEMO

3 Sequence program

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3.1 Overview

3.1.1 Overview of operation

The following description is of the overview of processing performed after the inverter is turned ON and through to execution of a sequence program.
PLC function processing can roughly be classified into the following three types.

◆Initial processing

Initial processing is pre-processing to execute sequence operations and is performed only once when the inverter is turned ON or reset.

- Resets to initialize the input and output.
- Initializes the data memory (bit devices are turned OFF and word devices are set to 0).
- Performs self-diagnostic checks on such items as PLC function parameter settings and operation circuits.

NOTE

- PLC function can be checked via FR Configurator2 (Developer). (Refer to the Instruction Manual of FR Configurator2.)

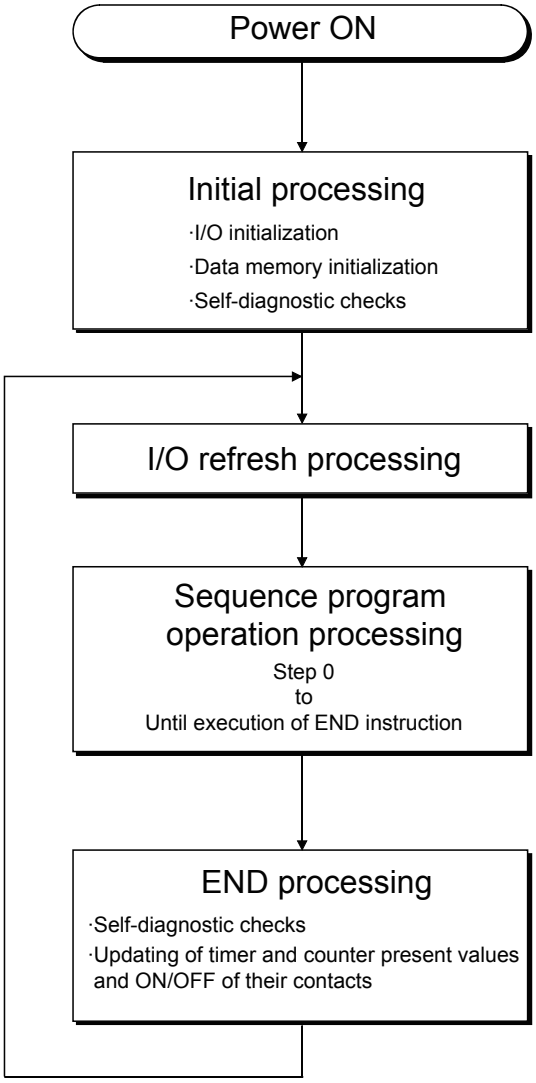
◆Sequence program operation

Executes a sequence program written in the PLC function from step 0 through the END instruction.

◆END processing

End processing is post-processing to end operation processing of a sequence program once and return execution to step 0 in the sequence program.

- Performs a self-diagnostic check.
- Updates timers and counters to the present values and turns contacts on/off.


Power ON
Initial processing
·I/O initialization
·Data memory initialization
·Self-diagnostic checks
I/O refresh processing
Sequence program operation processing
Step 0
to
Until execution of END instruction
END processing
·Self-diagnostic checks
·Updating of timer and counter present values and ON/OFF of their contacts

3.2 RUN/STOP operation

The PLC function has two operating statuses, a RUN state and a STOP state.
The following description is of operation processing of the PLC function in each state.

◆RUN state operation

In the RUN state, the PLC function operates a sequence program in the sequence of step 0→END (FEND) instruction→step 0 repeatedly when the SQ signal is turned ON. (P.RUN is ON)
The output suspended in the STOP state is executed according to the PLC function parameter output mode set for STOP→RUN switching (refer to page 99) when the PLC function enters the RUN state.

◆STOP state operation

In the STOP state, the PLC function stops operating a sequence program when the SQ signal is turned OFF or the inverter is stopped remotely. (P.RUN is OFF)
The PLC function saves the output status and turns off all output points when it enters the STOP state. Data other than the output (Y) is retained in the memory.

POINT

- The PLC function performs I/O refresh processing in both RUN and STOP states. Therefore, input/output can be monitored and tested from peripheral devices even in the STOP state.

3.3 Program configuration

◆Program classification

Programs that can be used in the PLC function are main sequence programs only. Microcomputer programs, interrupt programs, and SFC programs cannot be used.

◆Program capacity

The program capacity is the memory capacity that stores programs and is 6k steps (24k bytes). Set the program capacity using PLC function parameters (PLC parameters).

3.4 Programming language

Programming the PLC function can be performed through two methods. One uses figures and the other uses dedicated instructions.

- Programming with figures is performed by using the relay symbolic language. (Programming in FR Configurator2 (Developer) is performed in "ladder mode.")
- Programming with dedicated instructions is performed by using the logic symbolic language. (Programming that uses FR Configurator2 (Developer) is performed in "list mode.")

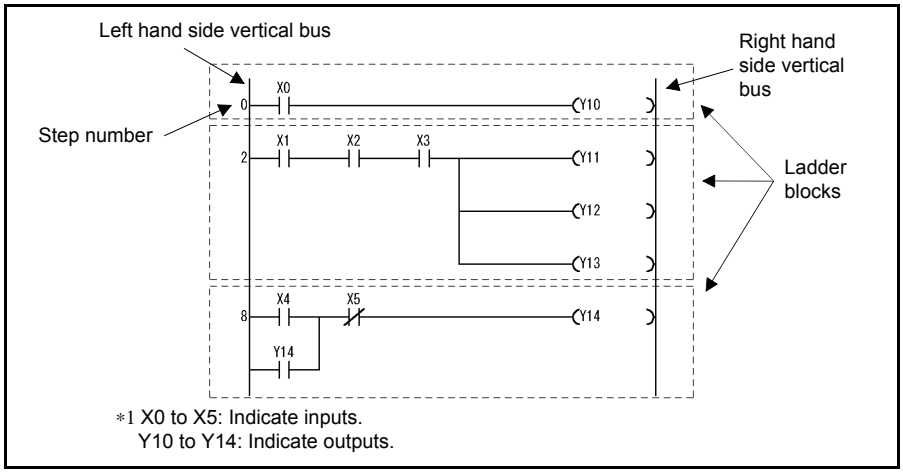
The same program is created with both the relay symbolic language and the logic symbolic language.

3.4.1 Relay symbolic language (ladder mode)

The relay symbolic language is based on the concept of relay control circuits.
This language allows programming through expressions similar to sequential circuits in relay control.

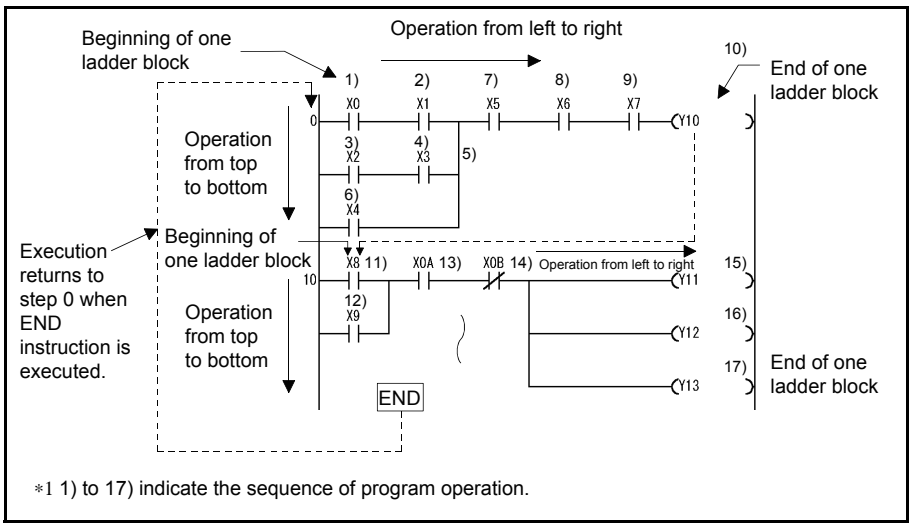
◆Ladder block

A ladder block is the smallest elements for the sequence program operation, and starts at a vertical rail on the left side and ends at the one on the right side.



◆Sequence program operation method

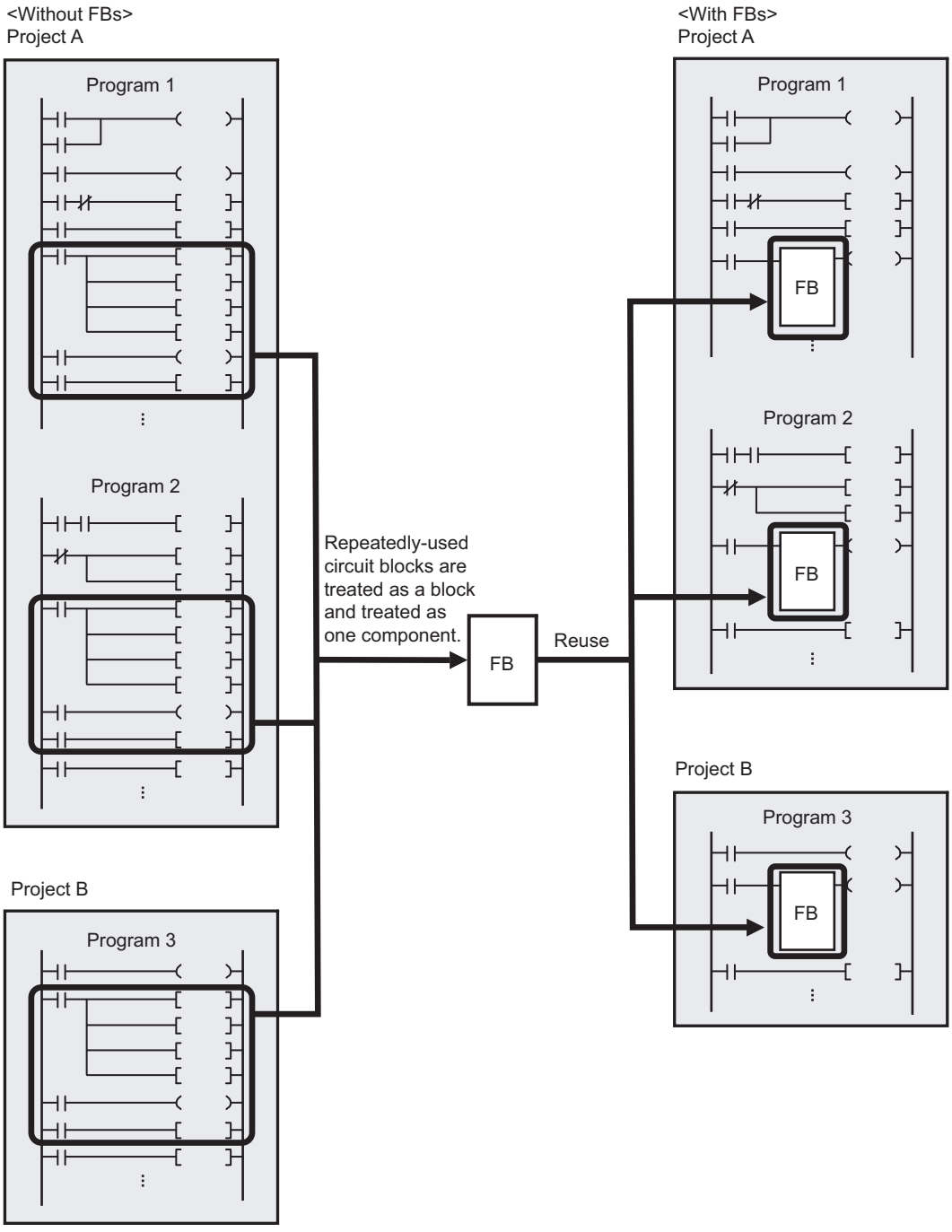
The sequence program is operated repeatedly from the ladder block at step 0 through the END instruction.
A ladder block is operated from the left vertical rail to the right vertical rail and from top down.



∗1 1) to 17) indicate the sequence of program operation.

3.4.2 Function block (FB)

A function block (FB) is a repeatedly used ladder blocks that is treated as a component so that it can also be used in other sequence programs.



3.5 Operation processing method of the PLC function

The PLC function uses the repetitive operation method of stored programs.

◆Stored program method

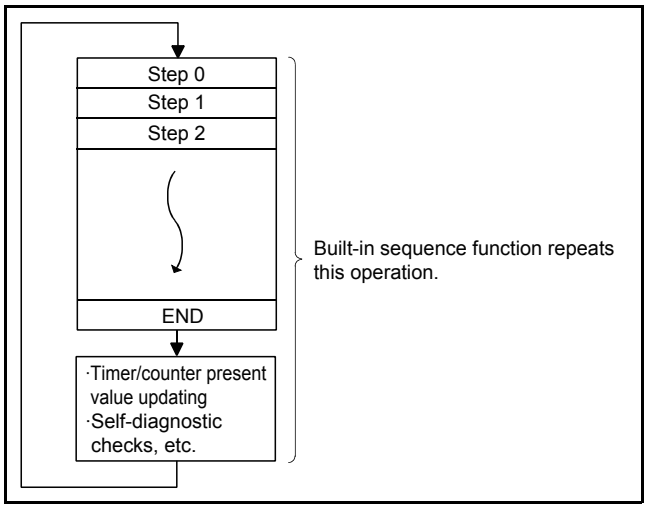
- The stored program method stores a sequence program to be operated in the internal memory in advance.
- At execution of the sequence program, the sequence program stored in the PLC function is read to the CPU by each instruction in order to execute operations, and that result is used to control each device status.

◆Repetitive operation method

The repetitive operation method executes a sequence of operations repeatedly.

The PLC function executes the following process repeatedly.

- The PLC function executes a sequence program stored in the internal memory in sequence from step 0.
- The PLC function performs internal processing such as updating timers/counters to the present values and performing self-diagnostic checks after executing the END instruction, and returns to step 0 in the sequence program.



NOTE

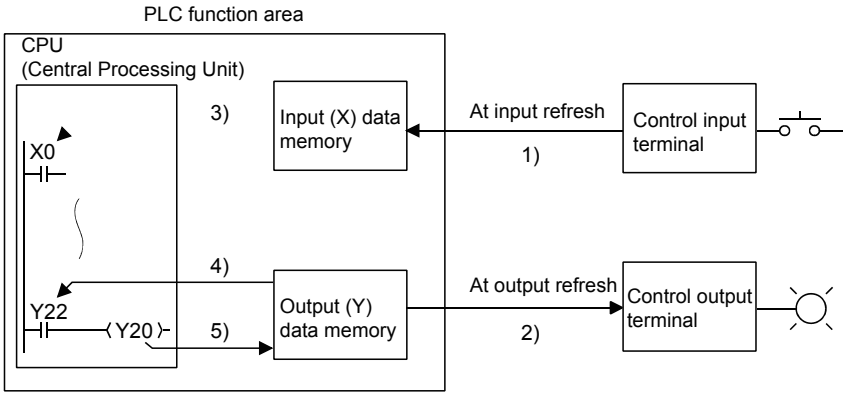
- Processing from step 0 to the next step 0 or END to the next END is called a scan.
  Therefore, a single scan time is the total time to process a user-created program (step 0 through END) and the time for internal processing of the PLC function.

3.6 I/O processing method

The control method is a refresh method.

3.6.1 Refresh method

The refresh method stores changes in the control input terminals to the CPU input data memory in batch before every scan is executed and uses the data stored in this input data memory for operation execution.
Program operation results of the output (Y) are output to the output data memory every time, and contents stored in the output data memory are output in batch from the control output terminals after the END instruction is executed.

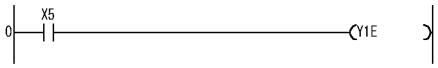


- Input refresh
  Input information is read 1) in batch from the PLC function area and stored in the input data memory (X) before executing step 0.
- Output refresh
  Output information 2) stored in the output data memory (Y) is output in batch to the PLC function area before executing step 0.
- When executing a contact instruction for the input
  Input information is read 3) from the input data memory (X) to execute a sequence program.
- When executing a contact instruction for the output
  Output information is read 4) from the output data memory (Y) to execute a sequence program.
- When executing an OUT instruction for the output
  Operation result of the sequence program 5) is stored in the output data memory (Y).

3.6.2 Response delay in refresh mode

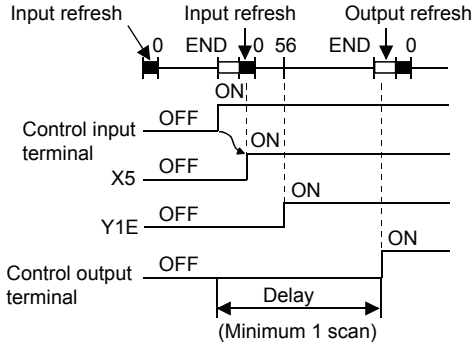
The following description is about the output delay for the varied inputs.
As shown in the figures below, change in the output lags behind that in the input by up to two scans.

Ladder example



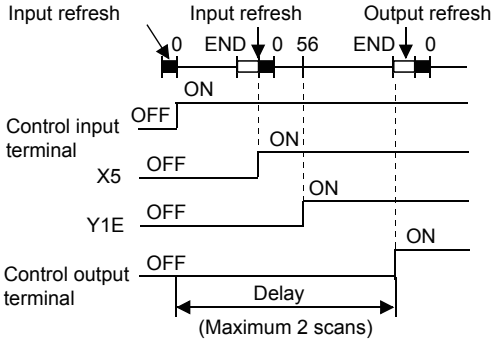
In this ladder, output Y1E turns ON when input X5 turns ON.

◆When Y1E turns ON at the earliest timing



The Y1E output turns ON at the earliest timing when the control input terminal turns ON immediately before the refresh. In this case, X5 turns ON at input refresh, Y1E turns ON at step 0, and then the control output terminal turns ON at output refresh after END instruction execution.
Therefore, change in the control output terminal occurs one scan behind that in the control input terminal.

◆When Y1E turns ON at the latest timing

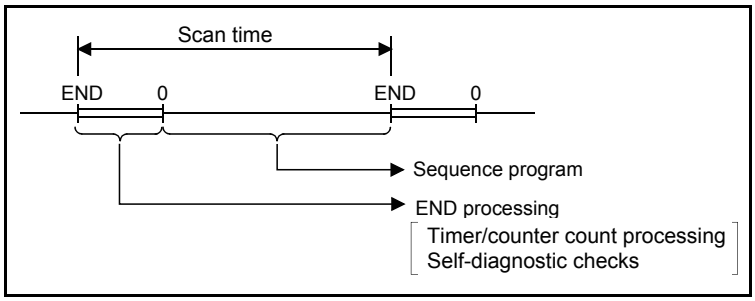


The Y1E output turns ON at the latest timing when the control input terminal turns ON immediately after the refresh. In this case, X5 turns ON at the next input refresh, Y1E turns ON at step 0, and then the control output terminal turns ON at the output refresh after END instruction execution.
Therefore, change in the control output terminal occurs two scans behind that in the control input terminal.

3.7 Scan time

◆Scan time

Scan time is the time period from operation execution of a sequence program from step 0 until executing the next step 0.
The scan time is not constant in every scan but differs according to whether instructions used are executed or not.



◆Scan time check

The scan time from the END instruction to the next END instruction is measured inside the programmable controller and stored in special registers SD520 (SD521), SD524 (SD525), and SD526 (SD527).

Device number	Name	Description
SD520	Current scan time	The scan time is stored at every END and is constantly updated. SD520: Stores the ms places (Stored range: 0 to 65535) SD521: Stores the μs places (Stored range: 0 to 900)
SD521		
SD524	Minimum scan time	The minimum scan time is stored at every END. SD524: Stores the ms places (Stored range: 0 to 65535) SD525: Stores the μs places (Stored range: 0 to 900)
SD525		
SD526	Maximum scan time	The maximum scan time is stored at every END. SD526: Stores the ms places (Stored range: 0 to 65535) SD527: Stores the μs places (Stored range: 0 to 900)
SD527		

- Scan time accuracy

  The accuracy of the scan time observed inside the programmable controller is ±2 ms.

  For example, the actual scan time is within the range of 3 ms to 7 ms when data stored in SD520 is 5.

3.8 Values that can be used in sequence programs

For the PLC function, data such as values and alphabetical characters are represented in two statuses, 0 (OFF) and 1 (ON).
Data represented with 0 and 1 is called BIN (binary).
The PLC function can also use HEX (hexadecimal), which represents four bits of BIN data together.
The following table shows the numeric representations in BIN (binary), HEX (hexadecimal), and DEC (decimal).

DEC (decimal)	HEX (hexadecimal)	BIN (binary)
0	0	0
1	1	1
2	2	10
3	3	11
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111
16	10	10000
17	11	10001
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
47	2F	101111

3.8.1 BIN (binary)

◆Binary

BIN represents a value with 0 (OFF) and 1 (ON).

In decimal notation, when a value increases from 0 to 9, a carry occurs and the next value becomes 10.

In BIN (binary) notation, a carry is generated after 0 and 1, and the next value becomes 10 (2 in decimal notation).

The following table shows the binary and decimal numeric representations.

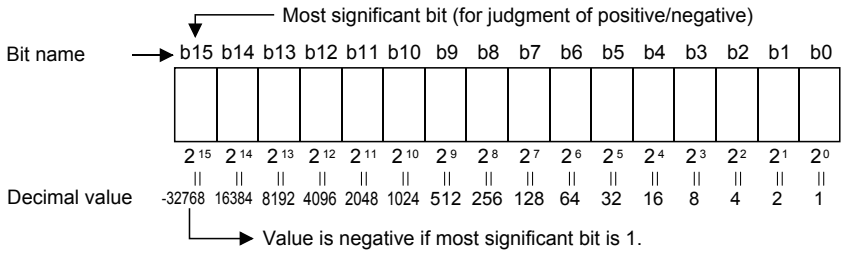
DEC (decimal)	BIN (binary)	
0	0000	
1	0001	Carry
2	0010	
3	0011	Carry
4	0100	
5	0101	
6	0110	
7	0111	Carry
8	1000	
9	1001	
10	1010	
11	1011	

◆Numeric representation in BIN (binary)

Each register (such as a data register) used for the PLC function consists of 16 bits.

- Most significant bit is 0 ... Positive
- Most significant bit is 1 ... Negative

The following figure shows the numeric representation of each register used for the PLC function.



Numerical data that can be used for the PLC function

In the numeric representation shown in the figure above, values can be represented in the range from -32768 to 32767.

Therefore, each register used for the PLC function can store a value between -32768 and 32767.

3.8.2 HEX (hexadecimal)

◆HEX

HEX represents four bits of binary data with one digit.

BIN uses 4 bits to represent the 16 values from 0 to 15.

HEX uses the letter A to represent the bit next to 9 (10) and B to represent 11, and then a carry occurs after F (15).

For the numeric representations of BIN, HEX, and DEC, refer to **page 80**.

◆Numeric representation in HEX

Each register (such as a data register) used for the PLC function consists of 16 bits.

Therefore, the value that can be stored in each register can be represented in the range from 0 to HFFFF in HEX.

3.9 Explanation of devices

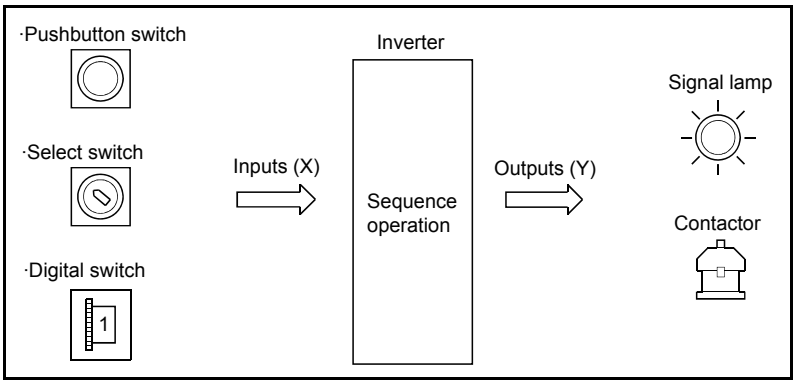
3.9.1 Device list

The following list shows device names and ranges that can be used for the PLC function.

Classification	Category	Device name	Number of points	Range of use	
Internal user device	Bit device	Input (X)	64 points	X0 to X3F <12 points installed>	HEX
		Output (Y)	64 points	Y0 to Y3F <12 points installed>	HEX
		Internal relay (M)	128 points	M0 to M127	DEC
		Latch relay (L)	-	- (Can be set with PLC function parameters but will not latch)	-
	•Bit device (contact/coil) •Word device (present value)	Timer (T)	16 points	T0 to T15 100 ms timer: 0.1 to 3276.7 s can be set 10 ms timer: 0.01 to 327.67 s can be set 100 ms retentive timer: 0.1 to 3276.7 s can be set	DEC
		Counter (C)	16 points	C0 to C15 Normal counter: Setting range 1 to 32767 Interrupt program counter: Not used	DEC
	Word device	Data register (D)	256 points	D0 to D255	DEC
Internal system device	Bit device	Special relay (SM)	2048 points	SM0 to SM2047 (with limited functions)	DEC
	Word device	Special register (SD)	2048 points	SD0 to SD2047 (with limited functions)	DEC

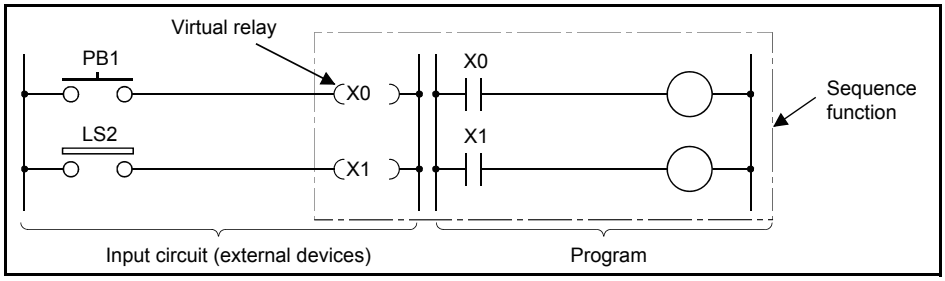
3.9.2 I/O X and Y

The input and output are devices that are used for communication between the inverter and external devices.
The input is given ON/OFF information externally to the control input terminals. Information is used as contacts (NO contact and NC contact) and source data of basic instructions in programs. On the other hand, the output is used to output program operation results from the control output terminals.

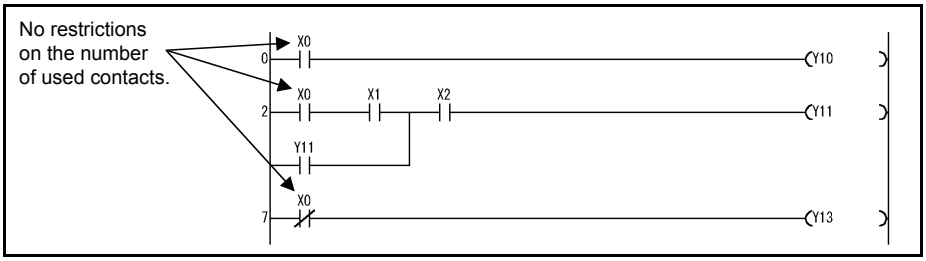


◆Input X

- The input allows external devices, such as push-button switches, selection switches, limit switches, and digital switches, to give commands and data to the inverter (PLC function).
- Assuming that the PLC function has internal virtual relays (Xn), the NO contacts and NC contacts of those Xn are used in programs.



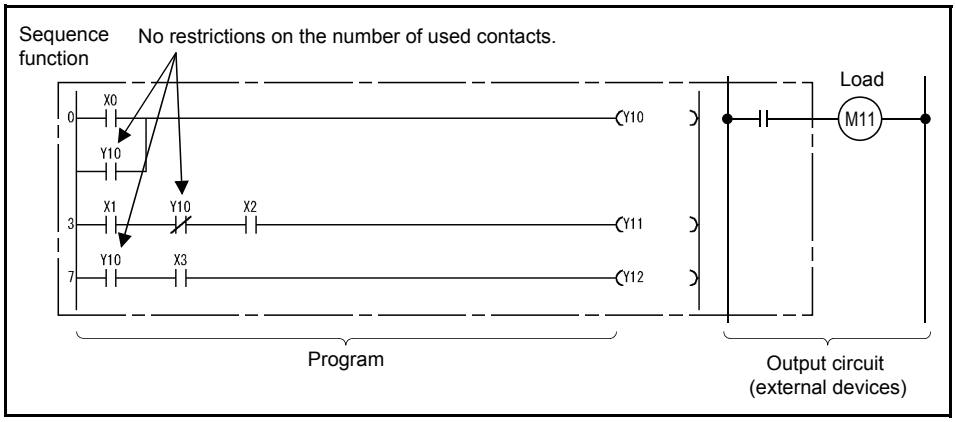
- There is no limit on the number of NO contacts and NC contacts of Xn used in a program.



When the inverter is used without connecting any external device to the control input terminal, "X" can be substituted for internal relay "M".

◆Output Y

- The output performs output of program control results to external devices (signal lights, digital Human Machine Interfaces (HMI), electromagnetic switches (such as contactors and solenoids)).
- Output information can be output through a single NO contact or an equivalent device.
- There is no limit on the number of NO contacts and NC contacts of output Yn used in a program as long as it is within the range of the program capacity.



When the inverter is used without connecting the control input terminals to external devices, "Y" can be substituted for internal relay "M".

3.9.3 Internal relay M

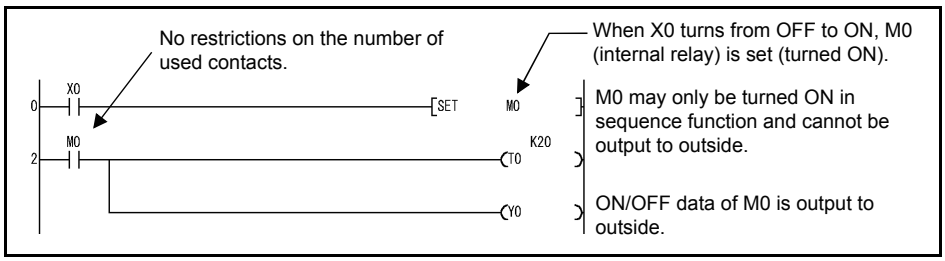
Internal relays are auxiliary relays that are used in the PLC function internally. These relays cannot latch (power failure retention).

Performing any of the following turns all internal relays OFF.

- When the power supply was turned ON
- When resetting

There is no limit on the number of contacts (NO contact and NC contact) to be used in a program.

Use the output (Y) to output sequence program operation results.



3.9.4 Timer T

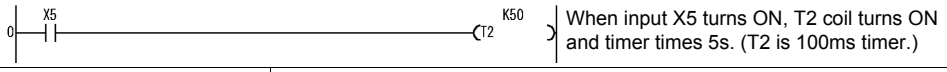
The PLC function uses up-timing timers.
The up-timing timer starts measuring a present value when the timer's coil turns ON, and then the timer's contact turns ON when the present value reaches a setting value.

3.9.5 100 ms timer, 10 ms timer, and 100 ms retentive timer

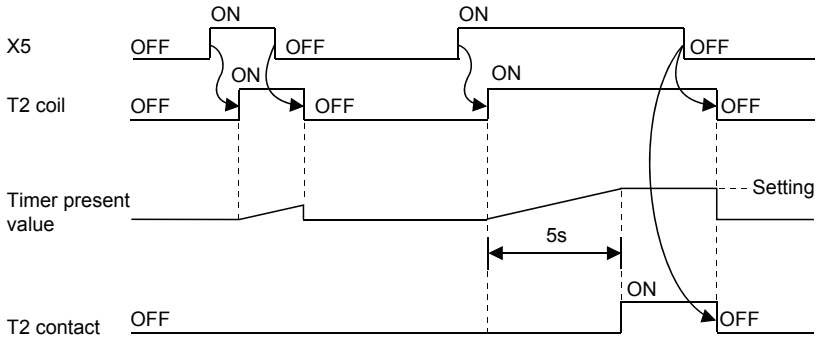
◆100 ms timer and 10 ms timer

The timer starts measuring a present value when the timer's coil turns on, and then the present value returns to 0 and the timer's contact turns OFF when the coil turns OFF.

Ladder example



Timing chart



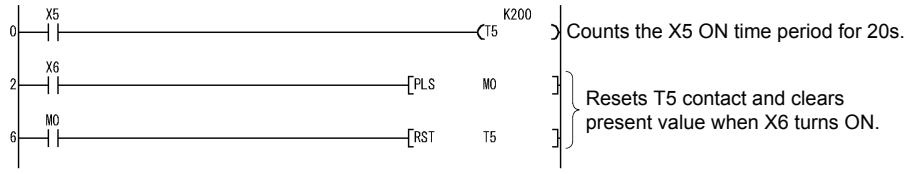
NOTE

- Changing between the 100 ms timer, 10 ms timer, and 100 ms retentive timer can be done using PLC function parameters. (The initial setting is the 100 ms timer.)

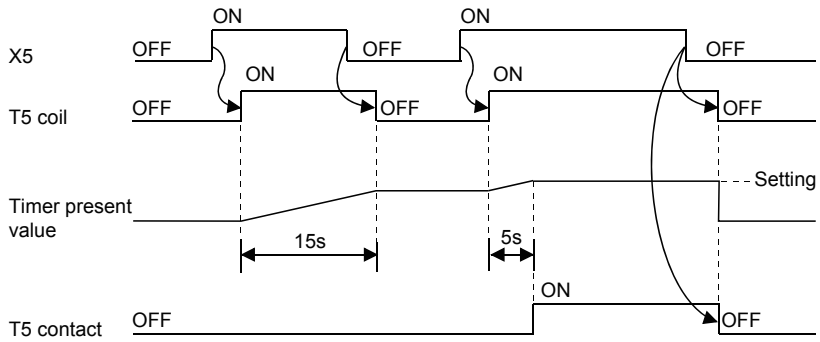
◆100 ms retentive timer

- The 100 ms retentive timer is a timer that measures the time period during which its coil is ON.
  It starts measuring a present value when its coil turns ON and retains the present value and its contact ON/OFF status even when the coil turns OFF.
  It resumes measurement from the retained present value when the coil turns ON again.
- Use the RST T□ instruction to clear the present value and turn OFF the contact.

Ladder example



Timing chart



3.9.6 Processing and accuracy of timers

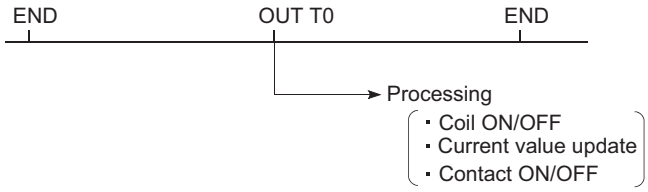
◆Processing

When the OUT T□ instruction is executed, the on/off switching of the timer coil, current value update, and on/off switching of the contact are performed. In the END processing, the current timer value is not updated and the contact is not turned on/off.

[Program example]



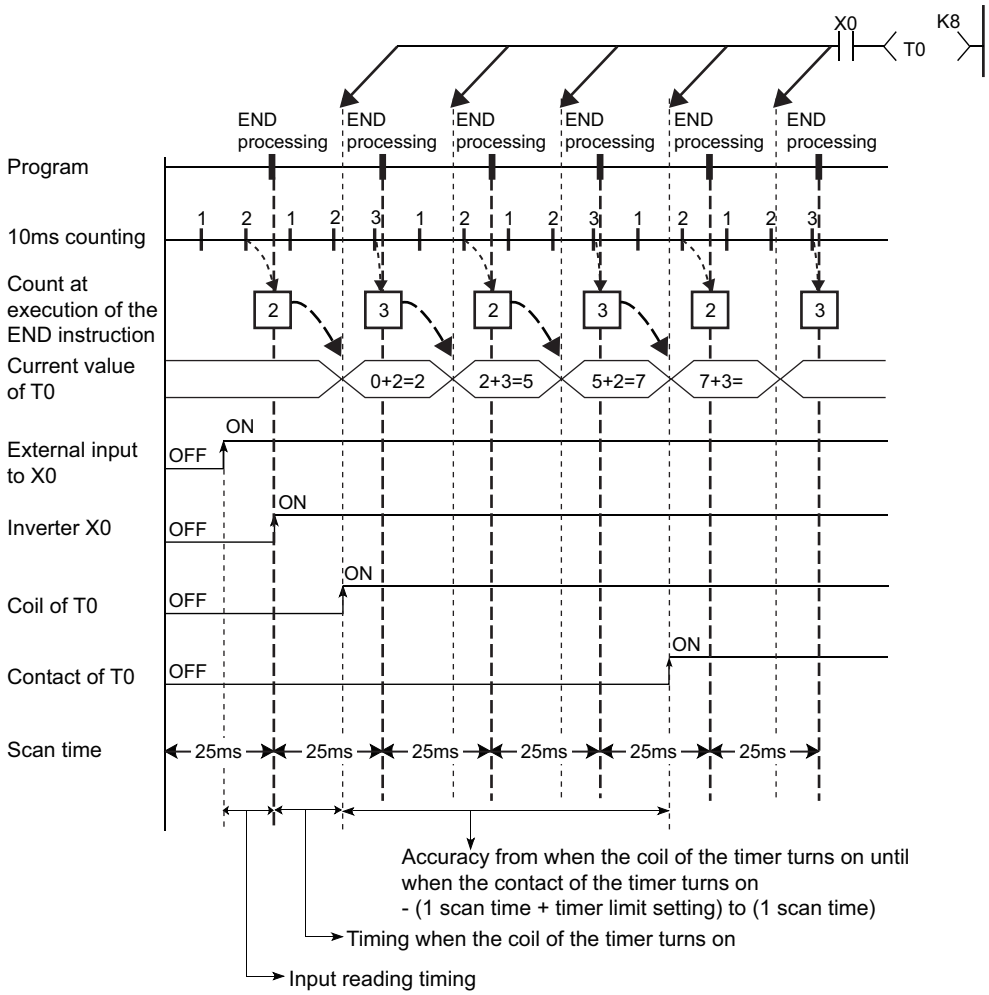
[Processing at execution of OUT T0 instruction]



◆Accuracy

The value obtained by the END instruction is added to the current value when the OUT T☐ instruction is executed. The current value is not updated while the timer coil is off even if the OUT T☐ instruction is executed.

Timer limit setting=10ms, Setting value of T0=8 (10ms×8=80ms), Scan time=25ms



Accuracy of the timer response that is from reading input (X) to output the data are up to "2-scan time + timer limit setting".

3.10 Counter C

The PLC function uses up-timing counters.
The up-timing counter turns its contact ON when the count value reaches a setting value.

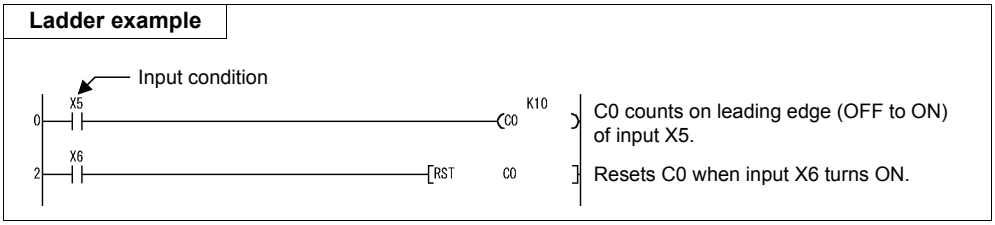
◆Count processing

- The counter's coil turns on/off at execution of the OUT C□ instruction, and then the counter's present value is updated and its contact turns ON after the END instruction is executed.
- The counter detects the coil's rise (OFF→ON) and then starts counting. Therefore, it will not start counting if the coil remains ON.

◆Counter reset

- The count value is not cleared even when the coil turns OFF. Use the RST C□ instruction to clear the count value and turn the contact OFF.
- If the counter is reset with the RST instruction, the counter's present value and contact are cleared at execution of the RST instruction.

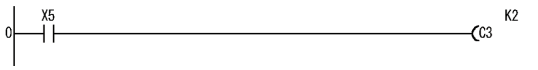
Ladder example



3.10.1 Count process in refresh mode

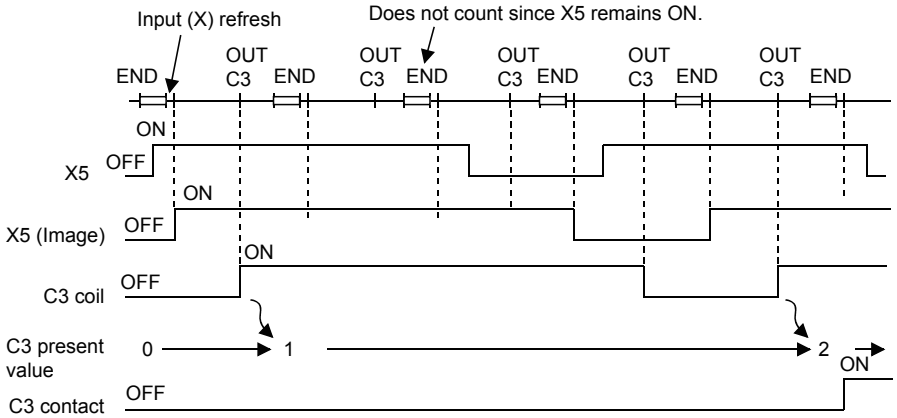
The counter counts at the rise of the counter's input conditions stored at input refresh.

Ladder example



When OFF to ON of X5 is counted twice, C3 contact turns ON.

Counting method



NOTE

- For the maximum counting speed of the counter, refer to **page 90**.

3.10.2 Maximum counting speed of counter

The maximum counting speed of the counter is determined by scan time, and counting is possible only when the ON/OFF time specified in the input conditions is longer than the scan time.

$$\text{Maximum counting speed Cmax} = \frac{n}{100} \times \frac{1}{ts} \text{ [times/s]}$$

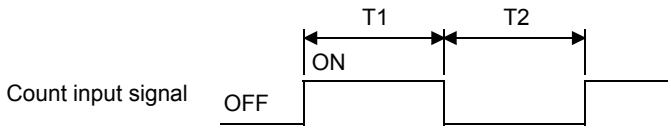
n : Duty (%)
ts : Scan time [s]

NOTE

- Duty n is a ratio between the ON and OFF time of count input signals and is represented as a percentage (%).

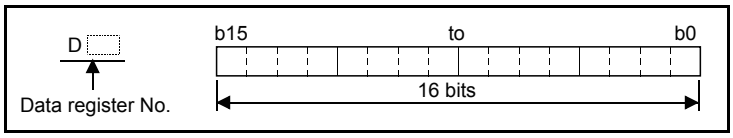
$$\text{When } T1 \leq T2 \quad n = \frac{T1}{T1 + T2} \times 100[\%]$$

$$\text{When } T1 > T2 \quad n = \frac{T2}{T1 + T2} \times 100[\%]$$



3.11 Data register D

- Data registers are memories that can store numerical data (from -32768 to 32767 or from H0000 to HFFFF) within the PLC function.
  Each data register consists of 16 bits; therefore, data can be read and written in 16-bit increments.



- Data stored during execution of a sequence program is retained until overwritten with new data.
- Unused timers (T) and counters (C) can be substituted for data registers if the number of data registers is insufficient.

3.12 Special relays and special registers

Special relays and special registers are internal relays and data registers, respectively, whose applications are already determined in the PLC function.
The following are the main applications of special relays and special registers.

◆Sequence operation check

The following special relays and special registers can be used for checking sequence program operations.

- Operating status (RUN/STOP) check
- Error detection through self-diagnostic function
- Operation error detection
- Scan time check

◆Timing contact

The following items are special relays with different operating statuses that can be used for sequence programs.

- Always ON/OFF flag
- RUN flag (OFF for one scan)
- Initial processing flag (ON for one scan)

NOTE

- For special relays and special registers that can be used in the PLC function, refer to page 17.

Item	Special relay number	Application/description
Diagnostic error	SM0	Turned ON when a diagnostic error has been detected. ON status is retained even after the condition becomes normal.
Self-diagnostic error	SM1	Turned ON when an error is detected by self-diagnosis. ON status is retained even after the condition becomes normal
Common error information	SM5	When SM5 is turned ON, common error information (SD5 to SD15) is stored.
Individual error information	SM16	When SM16 is turned ON, error individual information (SD16 to SD26) is stored.
Operation error flag	SM56	Turned ON when an operation error is detected during instruction execution. ON status is retained even after the condition becomes normal.
Clock data read request	SM213	Clock data is read in BCD value to SD210 to SD213 when this relay is turned ON. The process is not executed when the relay is OFF.
Always ON	SM400	SM400 and SM401 are respectively turned ON and OFF regardless of the STOP and RUN states.
Always OFF	SM401	
ON only for one scan after RUN	SM402	SM402 and SM403 change depending on the STOP and RUN states. In the cases other than STOP: SM402 is ON only for one scan. SM403 is OFF only for one scan.
OFF only for one scan after RUN	SM403	

3.13 Function list

Function	Description
Remote RUN/STOP	This function executes remote RUN/STOP from an external source when the SQ signal is ON (PLC function RUN state (P.RUN is ON)).
Watchdog timer variable (10 to 2000 ms)	This is a PLC function internal timer for detecting errors in the hardware or programs. Its setting value can be changed.
Self-diagnostic function	This function diagnoses the presence of an error within the PLC function itself, and performs error detection, display and stoppage of the PLC function.
Output settings for STOP→RUN	The output (Y) status when the state changes from the STOP state to the RUN state.
Keyword registration	This setting prevents reading/writing of programs (parameter and main/sub programs) and comments.

NOTE

- The following functions cannot be used.
  Constant scan, latch (retention at power failure), PAUSE, status latch, sampling trace, step operation, clock, interrupt processing, comment, microcomputer mode, print title entry, annunciator display mode, ERROR LED priority settings.

3.14 RUN/STOP method of PLC function from an external source (remote RUN/STOP)

The PLC function RUN/STOP is executed by ON/OFF of the SQ signal.
Remote RUN/STOP is performed by RUN/STOP of the PLC function from an external source when the SQ signal remains in the ON state (RUN state).

◆Application of remote RUN/STOP

Remote RUN/STOP can be performed by remote control using remote RUN/STOP in the following types of cases.

- When the inverter is out of reach
- When executing RUN/STOP for the inverter in an enclosure from an external source

◆Operation at remote RUN/STOP

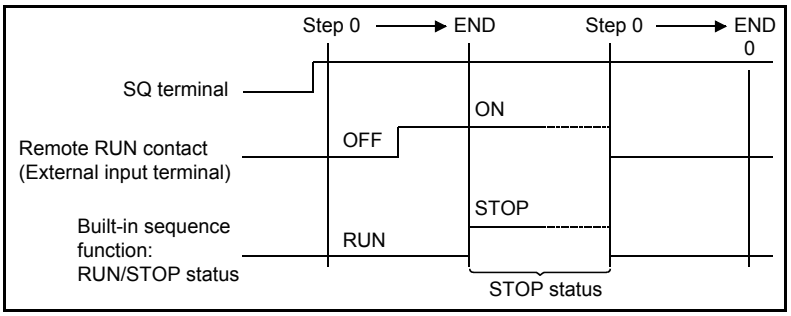
The operations of the sequence program that performs remote RUN/STOP are as follows.

- Remote STOP:
  The sequence program is executed up to the END instruction, and enters the STOP state.
- Remote RUN:
  If remote RUN is executed when the inverter has been switched to the "STOP state" by remote STOP, the state changes to RUN state again, and the sequence program is executed from step 0.

◆Remote RUN/STOP method

The following methods can be used for remote RUN/STOP.

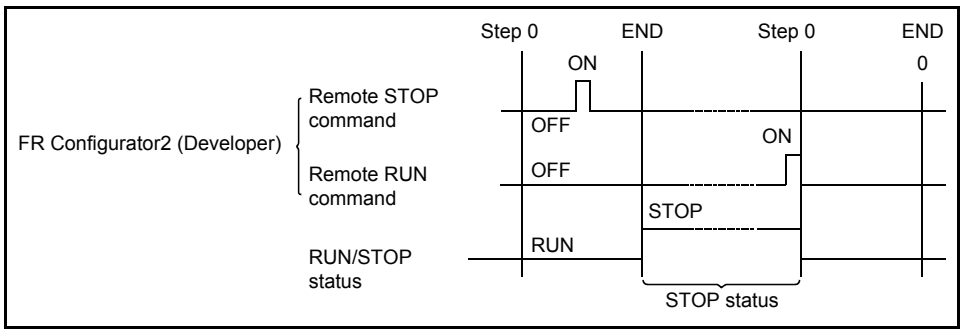
- Setting using the PLC function parameters (by contact)
  Remote RUN/STOP can be executed by turning the remote RUN contact OFF/ON.
  For example, this can be used to STOP the PLC function at the emergency stop contact.
  (The state is "RUN" when the remote RUN contact is OFF, and "STOP" when the remote RUN contact is ON.)



POINT

- PLC function parameter settings for the remote RUN contact
  X0 to X1F can be set for the remote RUN contact.
  (For details, refer to the Instruction Manual of FR Configurator2)

- Using FR Configurator2 (Developer)
  RUN/STOP can be performed by operating remote RUN/STOP from FR Configurator2 (Developer).
  For example, this can be used to STOP the inverter in order to rewrite the sequence program when it is installed in an out of reach location.



◆Note

Note the following points because the PLC function has priority on STOP.

- The PLC function switches to the STOP state when remote STOP is executed from any source such as the remote RUN contact or FR Configurator2 (Developer), etc.
- After switching the PLC function to the STOP state with remote STOP, all external factors (remote RUN contact, FR Configurator2 (Developer), etc.) that executed the remote STOP must be RUN in order to switch the PLC function back to the RUN state.

NOTE

- In the RUN state, the sequence program step 0 to the END instruction are executed repeatedly.
  In the STOP state, all sequence program operations are stopped, and all outputs (Y) are OFF.

3.15 Watchdog timer (watchdog error supervision timer)

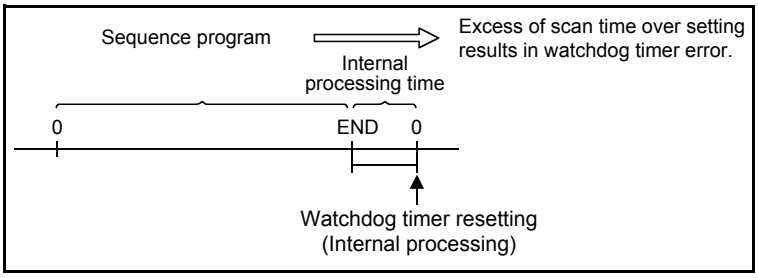
◆Watchdog timer

The watchdog timer is a PLC function internal timer for detecting errors in the hardware or sequence program. Use FR Configurator2 (Developer). Select the [PC parameter] window, [PC RAS setting] tab, and set the watchdog timer.

PLC function parameter	Name	Initial value	Setting range	Minimum setting increments
PLC RAS setting	WDT (Watchdog timer) setting	200 ms	10 to 2000 ms	10 ms

◆Watchdog timer reset

The PLC function resets the watchdog timer before step 0 is executed (after the END processing is executed).
When the PLC function operates normally and the END instruction is executed by the sequence program within the setting value, the watchdog timer does not output the signal.
When a PLC function hardware failure occurs or if the END instruction of the scan time could not be executed well within the setting value, the watchdog timer outputs the signal.



◆Process when the watchdog timer reaches the setting value

If the scan time exceeds the setting value of the watchdog timer, a watchdog timer error occurs and the PLC function is as follows.

- All outputs of the PLC function turn OFF.
- The P.RUN LED blinks.
- SM1 turns on, and an error code is stored in SD0. (Refer to page 33.)

3.16 Self-diagnostic function

The self-diagnostic function diagnoses the presence of an error within the PLC function itself.

◆Self-diagnostic timing

The self-diagnostic is executed at power-on, at reset, when each instruction is executed and when the END instruction is executed.

- At power-on, at reset.
  Diagnoses whether the operation can be executed.
- When each instruction is executed
  An error occurs if the operation of each instruction of the sequence program could not be executed.
- When the END instruction is executed
  Watchdog error supervision is performed.

◆Operation mode when an error is detected

There are two types of PLC function operations for when an error is detected by self-diagnosis; the operation stops or operation continues.
Even if the operation is set to continue, some errors can cause operation stop with the PLC function settings. (Refer to page 97.)

- If an operation-stop error is detected by the self diagnosis, the operation is stopped as soon as the error is detected, and all the outputs (Y) turn OFF.
- If an operation-continued error is detected, the faulty program area is skipped, and the operation continues from the next step.

◆Confirmation of fault record

When an operation error occurs, SM0 (self-diagnosis error) turns ON and an error code is stored in SD0 (self-diagnosis error). Particularly when the operation is set to be continued, use in the program and to prevent a malfunction in the machine system.
For details on the fault record detected by self-diagnosis, refer to the error code list on page 198.

3.16.1 Operation mode when there is an operation error

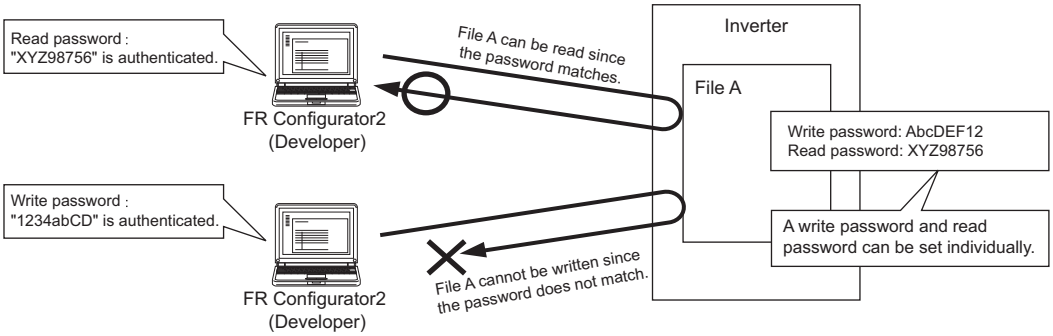
The PLC function can be set to either stop or continue operation of the sequence program when an operation error occurs. The setting of whether to stop or continue operation is set in the PLC function parameters.

- The initial status of the operation mode and PLC function status when there is an operation error are as shown in the following table.

Error definition		PLC function status				P.RUN LED
		Operation Initial status	Special relay turned ON	Special register for data storage	Self-diagnostic error number (SD0)	
Operation error	An error such as an attempting BCD conversion on a value that exceeds 0 to 9999 (or 0 to 99999999) occurred in the sequence program.	Continue	SM0	SD0	50	ON

3.17 Registering file password

This function sets write password and read password for each file stored in the inverter so that files are protected against tampering and theft by unauthorized persons. To set up a file password, select [Online] of FR Configurator2 (Developer), [Password/key word], and then [Registration/change].



◆File protection timing

File protection is enabled immediately after the passwords are registered, and it is disabled immediately after the passwords are deleted.

◆Password target files

A password can be set to the following files.

- Program
- Device comment
- Initial device value
- Parameter
- Source information

◆Operations that are controlled and the number of characters

A password can be set to the following operations. A password can be 4 to 32 alphanumeric characters (capital or lowercase letters).

- Reading files
- Writing files
- Reading/writing files

◆Online operations that require password authentication

Authentication is required to execute the following operations to password-protected files.

- Write to PLC (data writing)
- Read from PLC (data reading)
- Online change (data writing)
- Change TC setting value (data writing)
- Verify with PLC (data reading)
- Create/Change or Delete of a password (data reading and writing)
- Delete PLC data (data writing)

NOTE

- For the procedure and precaution on the password change, cancellation, and unlock, refer to the GX Works2 Version1 Operating Manual (Common).
- Even when the password function **(Pr.296, Pr.297)** is enabled, FR Configurator2 can be used to read/write the inverter parameter settings. To use the password function and PLC function at the same time, register keywords and lock reading/writing of the ladder program.
- The purpose of the file password is different from that of the inverter password function **(Pr.296, Pr.297)**.
- If the password has been forgotten, clear the flash memory. However, doing so will also clear the PLC function programs and the parameters for the PLC function. (Refer to page 50)

3.18 Output (Y) status settings when STOP status → RUN status

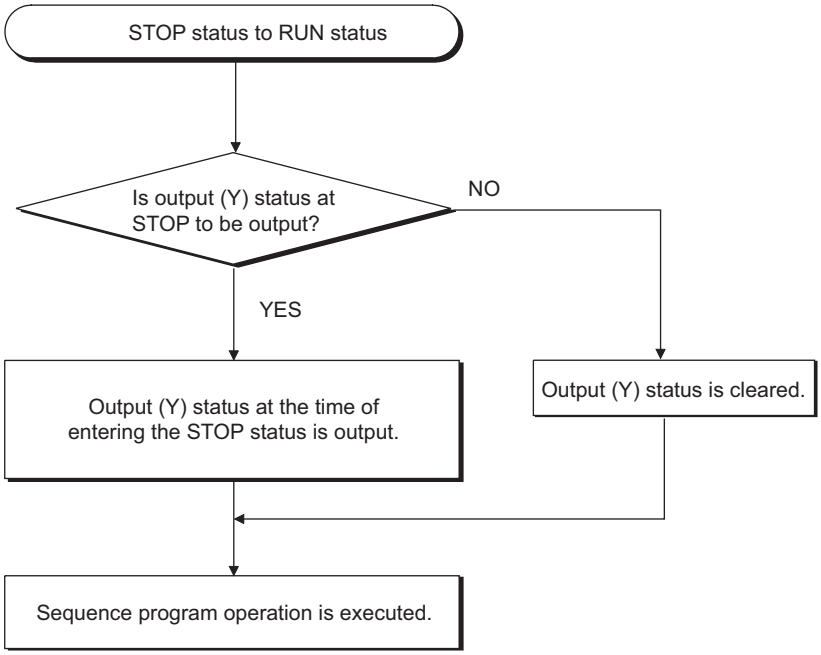
When changing from a state such as the RUN state to the STOP state, the RUN state output (Y) is stored in the PLC function. When changing from the STOP state to the RUN state, the PLC function parameter settings can be configured to either re-output the output (Y) or to output after operation execution.

"Output the output (Y) status before STOP"

After outputting the output (Y) status directly before the STOP state, the sequence program operation is executed.

"Clear the output (Y) (output after 1 scan)"

After clearing all outputs (Y) and executing the sequence program operation, the output (Y) is output.



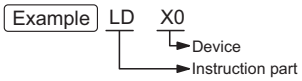
3.19 Structure of instructions

Most of the instructions can be divided between the instruction section and device, and the applications are as follows.

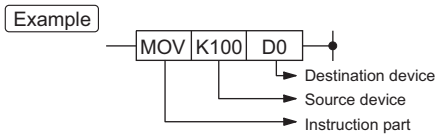
- Instruction section
  Indicates the functions of the instruction.
- Device
  Indicates the data used by the instruction.

The structure of instructions based on a combination of the instruction section and device can be broadly divided into the following categories.

- Instruction section
  Instructions that do not change the device status, and mainly perform program controls.
  Example END
- Instruction section + Device
  Controls device ON/OFF, controls the execution condition according to the device ON/OFF status, and performs program branching, etc.



- Instruction section + Source device + Destination device
  Performs operation on the destination data and source data, and stores the operation result in the destination.



- Others
  Combinations other than those above.

◆Source (S)

A source is the data used in the operation.
It is as shown below depending on the specified device.

- Constant
  Specifies the value used in the operation. It is a fixed value that cannot be changed when the program is being executed because it is set when the program is created.
- Bit device, word device
  Specifies the device in which the data used in the operation is stored. Therefore, the data needs to be stored in the specified device before the operation is executed. The data used in the instruction can be changed by changing the data stored in the specified device while the program is being executed.

◆Destination (D)

The data after operation is stored in the destination.

However, when instructions are constructed of a combination of Instruction section + Source device + Destination device, the data to be used in the operation needs to be stored in the destination before the operation.
The device in which data is to be stored must be specified in the destination.

NOTE

- In this manual, the source and destination shall be indicated as the following abbreviations.
  Source: (S), Source 1: (S1), Source 2: (S2), Destination: (D), Destination 1: (D1)

3.20 Bit device processing method

Processing methods available for when a bit device (X, Y, M) is specified are 1-bit processing, and 16-bit and 32-bit processing which are accompanied by digit specification.

3.20.1 1-bit processing

When sequence instructions are used, the device that is the operation processing target is 1 bit (1 point) of the bit device, and multiple bits cannot be specified.

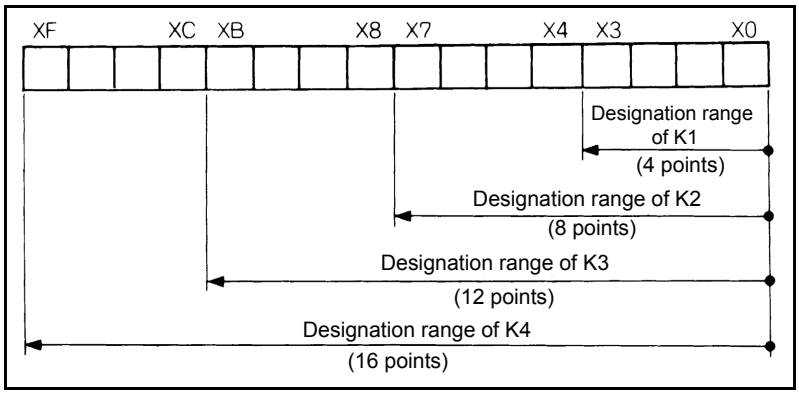
Example LD X0, OUT Y20

3.20.2 Digit specification processing

When basic instructions or application instructions are used, there are situations in which the bit device that is the operation processing target needs to be specified with digit specification. When the processing increment of this digit specification is a 16-bit instruction, up to 16 points can be specified in 4-point increments.

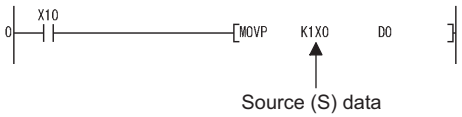
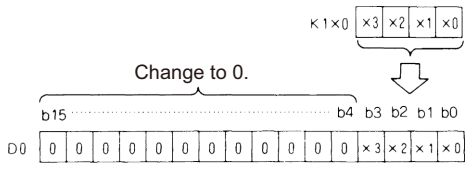
◆16-bit instruction: K1 to 4 (4 to 16 points)

Example Setting range from 16-bit data digit specification of X0 to F

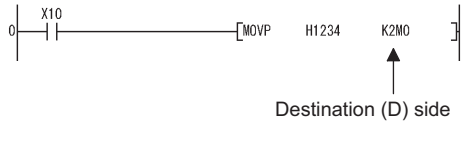
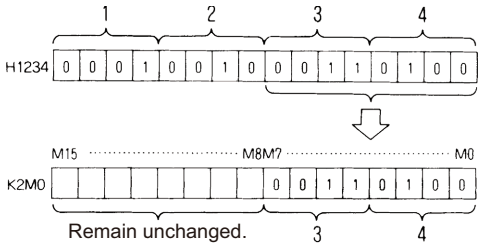
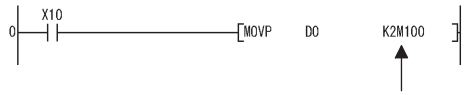
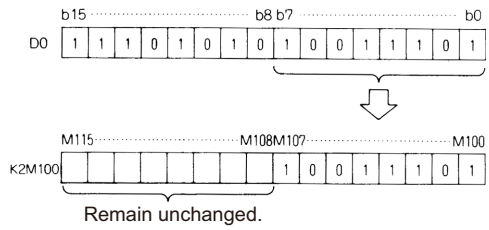


- When there is a digit specification on the source (S) side, the values that can be handled as source data are indicated in the table below.

Specified number of digits	16-bit instruction
K1 (4-point)	0 to 15
K2 (8-point)	0 to 255
K3 (12-point)	0 to 4095
K4 (16-point)	-32768 to 32767

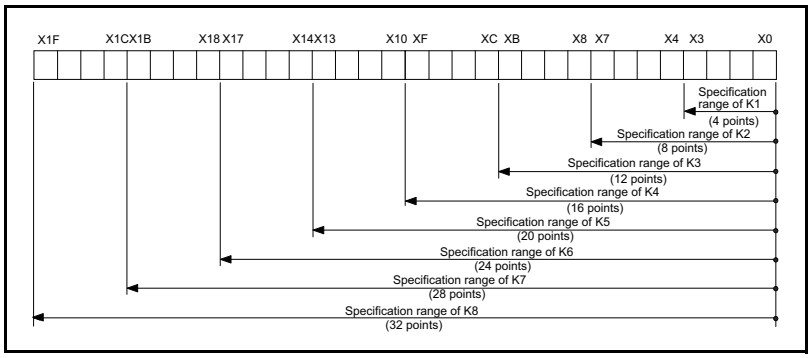
Ladder example	Process
16-bit instruction  	

- When there is a digit specification on the destination (D) side, the number of points from the digit specification is applied to the destination side.

Ladder example	Process
When source (S) data is values 	
When source (S) data is a word device 	

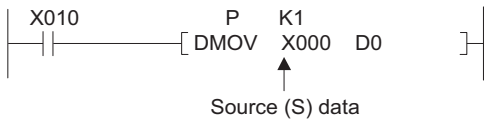
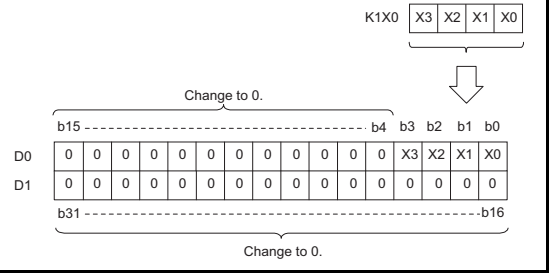
◆32-bit instruction: K1 to 8 (4 to 32 points)

Example Setting range X0 to 1F by 32-bit data digit specification

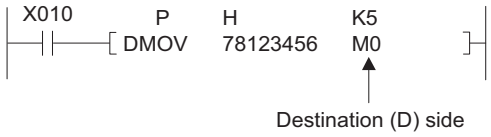
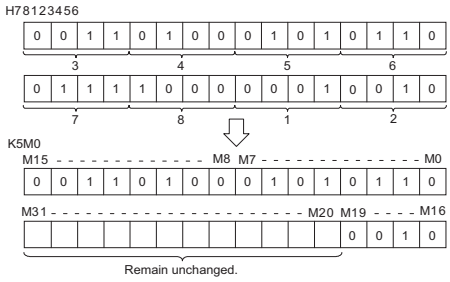
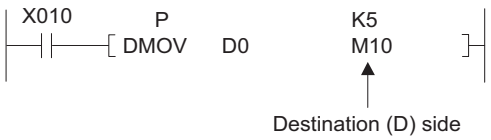
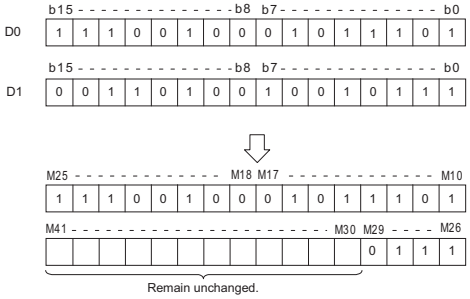


- When there is a digit specification on the source (S) side, the values that can be handled as source data are indicated in the table below.

Specified number of digits	32-bit instruction	Specified number of digits	32-bit instruction
K1 (4-point)	0 to 15	K5 (20-point)	0 to 1048575
K2 (8-point)	0 to 255	K6 (24-point)	0 to 16777215
K3 (12-point)	0 to 4095	K7 (28-point)	0 to 268435455
K4 (16-point)	0 to 65535	K8 (32-point)	-2147483648 to 2147483647

Ladder example	Process
32-bit instruction 	

- When there is a digit specification on the destination (D) side, the number of points from the digit specification is applied to the destination side.

Ladder example	Process
When source (S) data is values 	
When source (S) data is a word device 	

NOTE

- When 32-bit data is stored in word devices, it is stored in two consecutive word devices. An error does not occur even if the stored data exceeds the range of the corresponding device, but the content of devices outside of the range is changed. When storing data, check beforehand that the amount of devices required for storage can be allocated.

3.21 Handling of numerical values

The PLC function has an instruction for handling values indicated in 16 bits and 32 bits.
The most significant bit of the 16 bits and 32 bits is used to judge positive or negative. Therefore, the values that can be handled are as follows.
16-bit: -32768 to 32767
32-bit: -2147483648 to 2147483647

POINT

- Value setting method

1) Decimal



10 is stored into D10 in BIN.



-10 is stored into D10 in BIN.

2) Hexadecimal



10 is stored into D10 in hexadecimal.

Decimal and hexadecimal displays are supported as shown below.

• 16 bits

Decimal display	Hexadecimal display
32767	H7FFF
to	to
5	H0005
4	H0004
3	H0003
2	H0002
1	H0001
0	H0000
-1	HFFFF
-2	HFFFE
-3	HFFFD
-4	HFFFC
-5	HFFFB
to	to
-32768	H8000

• 32 bits

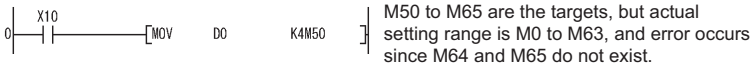
Decimal display	Hexadecimal display
2147483647	H7FFFFFFF
to	to
5	H00000005
4	H00000004
3	H00000003
2	H00000002
1	H00000001
0	H00000000
-1	HFFFFFFFF
-2	HFFFFFFFE
-3	HFFFFFFFD
-4	HFFFFFFFC
-5	HFFFFFFFB
to	to
-2147483648	H80000000

3.22 Operation error

An operation error occurs in the basic instruction in the following cases.
When an error listed in the description of each instruction occurs.

POINT

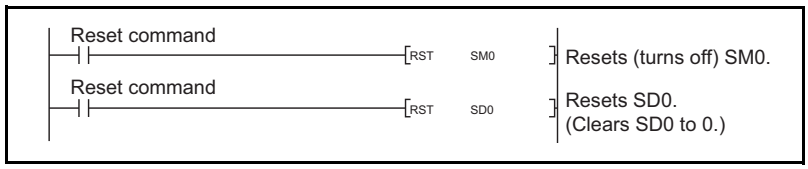
- Note that an operation error does not occur when the device specified range exceeds the corresponding device range, and data is written to devices other than the specified device.



◆Error processing

If an operation error occurs when a basic instruction is executed, SM0 turns ON and an error code is stored in SD0. (SM0 remains ON even if subsequent processing is normal.)

- The error code of the instruction in which the operation error occurred when SM0 changed from OFF to ON is stored in SD0. Therefore, the content of SD0 does not change when SM0 remains ON.
- The following type of program resets SD0 and SM0.



- When an operation error occurs, the choice of whether to stop or continue sequence processing can be made in the PLC function parameter settings. For details, refer to page 97.

3.23 Sequence instructions list

3.23.1 How to view the instruction list table

Classification	Instruction symbol	Symbol	Process description	Execution condition	Number of steps
Transfer	MOV	MOV S D	(S)→(D)		5
	MOVP	MOVP S D			
↑ 1)	↑ 2)	↑ 3)	↑ 4)	↑ 5)	↑ 6)

1): Instructions are classified according to application.

2): Indicates the instruction symbol used in the program.

Instruction symbols are based on 16-bit instructions.

- Change the instruction symbols for 32-bit instructions as shown below.
  32-bit instructions: Add a D to the start of the instruction.

Example + → D+

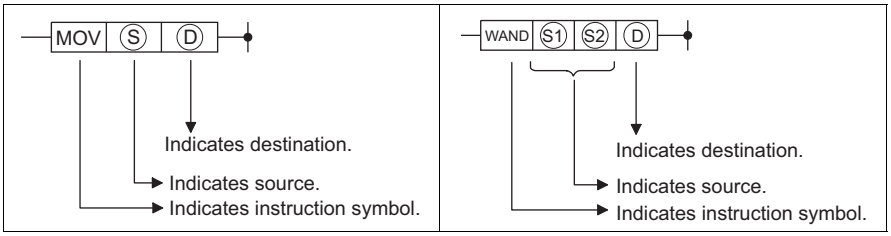
16-bit command 32-bit command

- Change the instruction symbol so that the start execution command is output when the signal is ON, as shown below.
  Add a P to the end of the instruction that is executed only at the leading edge of OFF to ON.

Example MOV ➡ MOVP

Instruction executed during ON Instruction executed only at the leading edge of OFF to ON

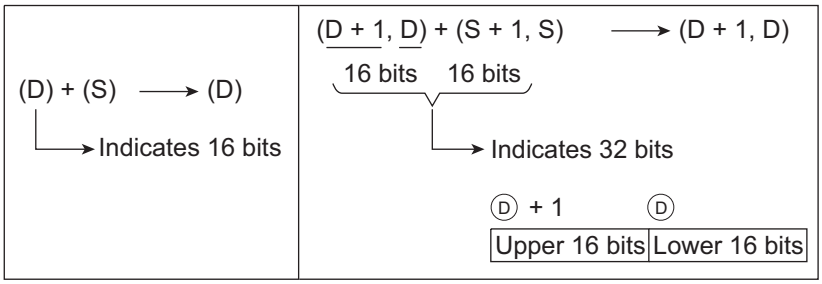
3): Indicates the symbol diagram on the ladder.



Destination: Indicates the destination of the data after operation.

Source: Stores the data before operation.

4): Indicates the process description of each instruction.

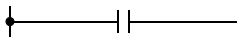
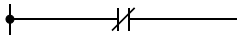
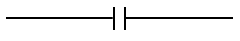
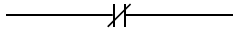
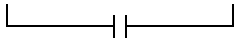
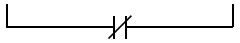
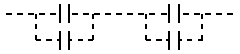
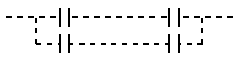
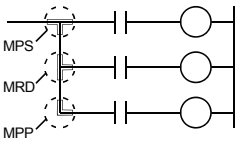
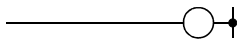
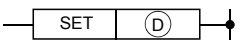
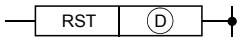
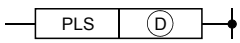
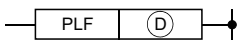
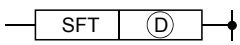
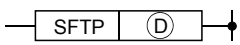
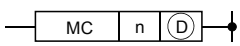
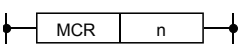
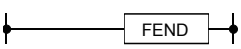
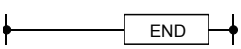


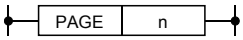
5): Details of the execution conditions for each instruction are as follows.

Symbol	Execution condition
Blank	An always executed instruction. It is always executed irrespective of whether the instruction prior condition is ON/OFF. When the prior condition is OFF, the instruction executes the OFF process.
	The instruction is executed only while the prior condition of the instruction is ON. When the prior condition is OFF, the instruction is not executed and is not processed.
	The instruction is executed one time only at the leading edge of the prior condition (OFF to ON), and is not executed or processed even when any subsequent conditions are ON.
	The instruction is executed only while the prior condition of the instruction is OFF. When the prior condition is ON, the instruction is not executed and is not processed.
	The instruction is executed one time only at the trailing edge of the prior condition (ON to OFF), and is not executed or processed even when any subsequent conditions are OFF.

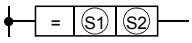
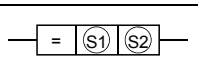
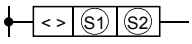
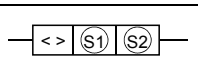
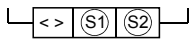
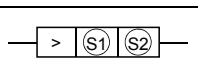
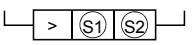
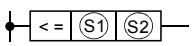
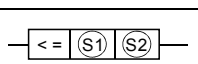
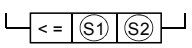
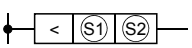
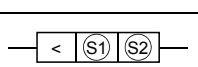
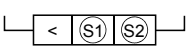
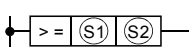
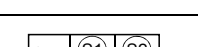
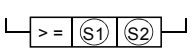
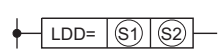
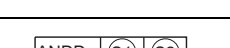
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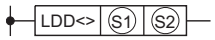
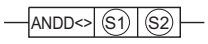
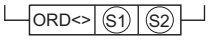
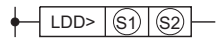
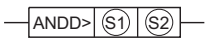
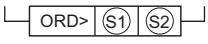
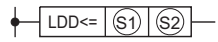
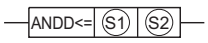
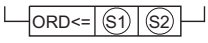
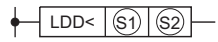
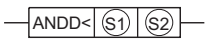
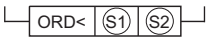
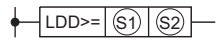
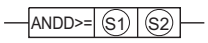
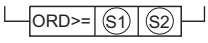
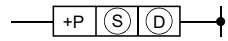
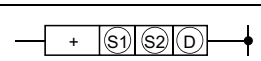
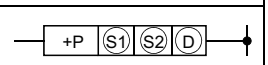
3.23.2 Sequence instructions list

Classification	Instruction symbol	Symbol	Process description	Execution Condition	Refer to page
Contact	LD		Logical operation start (NO contact operation start)		117
	LDI		Logical NOT operation start (NC contact operation start)		
	AND		Logical AND (NO contact series connection)		
	ANI		Logical AND NOT (NC contact series connection)		
	OR		Logical OR (NO contact parallel connection)		
	ORI		Logical OR NOT (NC contact parallel connection)		
Link	ANB		AND between logical blocks (Series connection between blocks)		119
	ORB		OR between logical blocks (Parallel connection between blocks)		
	MPS		Stores operation results		121
	MRD		Reads operation results stored in MPS		
	MPP		Reads and resets operation results stored in MPS		
Output	OUT		Device output		124
	SET		Device set		126
	RST		Device reset		
	PLS		Pulses of 1 program cycle are generated at the leading edge of input signal		128
	PLF		Pulses of 1 program cycle are generated at the trailing edge of input signal		
Shift	SFT		Device 1-bit shift		130
	SFTP				
Master control	MC		Master control start		132
	MCR		Master control release		
Program end	FEND		Termination of main program		135
	END		Always placed at the end of a sequence program to return to step 0.		135

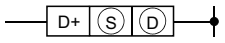
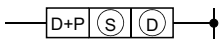
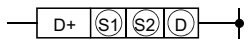
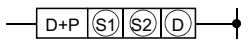
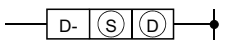
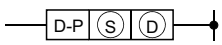
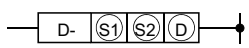
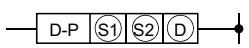
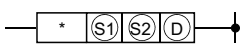
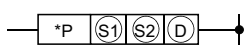
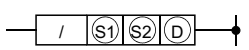
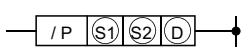
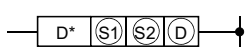
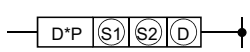
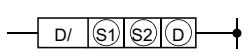
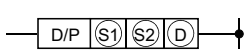
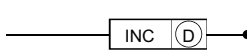
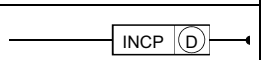
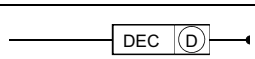
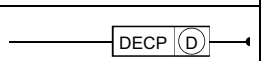
Classification	Instruction symbol	Symbol	Process description	Execution Condition	Refer to page
Non-processing	NOP	-	Non-processing. For program erasure or spacing.		136
	NOPLF		Non-processing. New line instruction for printer output.		
	PAGE		Ignored (Subsequent programs will be controlled from step 0 of page n)		

3.23.3 Basic instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
16-bit data comparison	LD=		When (S1) = (S2), conductive. When (S1) ≠ (S2), non-conductive.		140
	AND=				
	OR=				
	LD<>		When (S1) ≠ (S2), conductive. When (S1) = (S2), non-conductive.		
	AND<>				
	OR<>				
	LD>		When (S1) > (S2), conductive. When (S1) ≤ (S2), non-conductive.		
	AND>				
	OR>				
	LD<=		When (S1) ≤ (S2), conductive. When (S1) > (S2), non-conductive.		
	AND<=				
	OR<=				
	LD<		When (S1) < (S2), conductive. When (S1) ≥ (S2), non-conductive.		
	AND<				
	OR<				
	LD>=		When (S1) ≥ (S2), conductive. When (S1) < (S2), non-conductive.		
	AND>=				
	OR>=				
32-bit data comparison	LDD=		When (S1+1, S1) = (S2+1, S2), conductive. When (S1+1, S1) ≠ (S2+1, S2), non-conductive.		156
	ANDD=				
	ORD=				

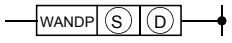
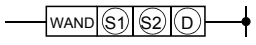
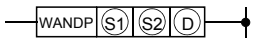
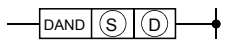
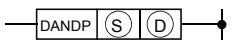
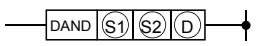
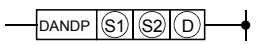
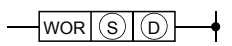
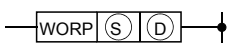
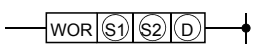
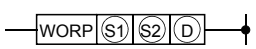
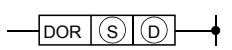
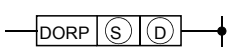
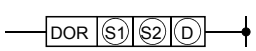
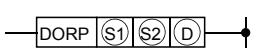
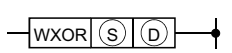
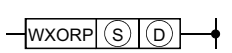
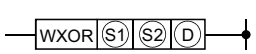
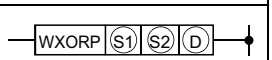
Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
32-bit data comparison	LDD<>		When (S1+1, S1) ≠ (S2+1, S2), conductive. When (S1+1, S1) = (S2+1, S2), non-conductive.		156
	ANDD<>				
	ORD<>				
	LDD>		When (S1+1, S1) > (S2+1, S2), conductive. When (S1+1, S1) ≤ (S2+1, S2), non-conductive.		
	ANDD>				
	ORD>				
	LDD<=		When (S1+1, S1) ≤ (S2+1, S2), conductive. When (S1+1, S1) > (S2+1, S2), non-conductive.		
	ANDD<=				
	ORD<=				
	LDD<		When (S1+1, S1) < (S2+1, S2), conductive. When (S1+1, S1) ≥ (S2+1, S2), non-conductive.		
	ANDD<				
	ORD<				
	LDD>=		When (S1+1, S1) ≥ (S2+1, S2), conductive. When (S1+1, S1) < (S2+1, S2), non-conductive.		
	ANDD>=				
	ORD>=				
BIN 16-bit addition/ subtraction	+		(S) + (D)→(D)		143
	+P				
	+		(S1) + (S2)→(D)		
	+P				
	-		(S) - (D)→(D)		
	-P				
	-		(S1) - (S2)→(D)		
	-P				

Sequence instructions list

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 32-bit addition/ subtraction	D+		(D+1, D) + (S+1, S) →(D+1, D)		158
	D+P				
	D+		(S1+1, S1) + (S2+1, S2) →(D+1, D)		
	D+P				
	D-		(D+1, D) - (S+1, S) →(D+1, D)		
	D-P				
	D-		(S1+1, S1) - (S2+1, S2) →(D+1, D)		
	D-P				
BIN 16-bit multiplication/ division	*		(S1) × (S2)→(D+1, D)		146
	*P				
	/		(S1)/(S2)→quotient(D), remainder (D+1)		
	/P				
BIN 32-bit multiplication/ division	D*		(S1+1, S1) × (S2+1, S2) →(D+3, D+2, D+1, D)		161
	D*P				
	D/		(S1+1, S1)/(S2+1, S2) →quotient (D+1, D), remainder (D+3, D+2)		
	D/P				
BIN 16-bit data increment/ decrement	INC		(D)+1→(D)		149
	INCP				
	DEC		(D) - 1→(D)		
	DECP				
BIN 32-bit data increment/ decrement	DINC		(D+1, D)+1→(D+1, D)		164
	DINCP				
	DDEC		(D+1, D) - 1→(D+1, D)		
	DDECP				

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
16-bit transfer	MOV	MOV (S) (D)	(S)→(D)		150
	MOVP	MOVP (S) (D)			
32-bit transfer	DMOV	DMOV (S) (D)	(S+1, S)→(D+1, D)		165
	DMOVP	DMOVP (S) (D)			
BIN 16-bit 2's complement	NEG	NEG (D)	0 - (D)→(D)		151
	NEGP	NEGP (D)			
BIN 32-bit 2's complement	DNEG	DNEG (D)	0 - (D+1, D)→(D+1, D)		167
	DNEGP	DNEGP (D)			
BIN 16-bit BCD conversions	BCD	BCD (S) (D)	BCD conversions (S) → (D); BIN (0 to 9999)		153
	BCDP	BCDP (S) (D)			
BIN 32-bit BCD conversions	DBCD	DBCD (S) (D)	BCD conversions (S+1, S) → (D+1, D); BIN (0 to 99999999)		168
	DBCDP	DBCDP (S) (D)			
BIN 16-bit BIN conversions	BIN	BIN (S) (D)	BIN conversions (S) → (D); BCD (0 to 9999)		154
	BINP	BINP (S) (D)			
BIN 32-bit BIN conversions	DBIN	DBIN (S) (D)	BIN conversions (S+1, S) → (D+1, D); BCD (0 to 99999999)		169
	DBINP	DBINP (S) (D)			

3.23.4 Application instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 16-bit logical AND	WAND		(D) AND (S)→(D)		171
	WANDP				
	WAND		(S1) AND (S2)→(D)		
	WANDP				
BIN 32-bit logical AND	DAND		(D+1, D) AND (S+1, S)→(D+1, D)		181
	DANDP				
	DAND		(S1+1, S1) AND (S2+1, S2) →(D+1, D)		
	DANDP				
BIN 16-bit logical OR	WOR		(D) OR (S)→(D)		174
	WORP				
	WOR		(S1) OR (S2)→(D)		
	WORP				
BIN 32-bit logical OR	DOR		(D+1, D) OR (S+1, S)→(D+1, D)		184
	DORP				
	DOR		(S1+1, S1) OR (S2+1, S2) →(D+1, D)		
	DORP				
BIN 16-bit exclusive OR	WXOR		(D) XOR (S)→(D)		176
	WXORP				
	WXOR		(S1) XOR (S2)→(D)		
	WXORP				
BIN 32-bit exclusive OR	DXOR		(D+1, D) XOR (S+1, S)→(D+1, D)		187
	DXORP				
	DXOR		(S1+1, S1) XOR (S2+1, S2) →(D+1, D)		
	DXORP				

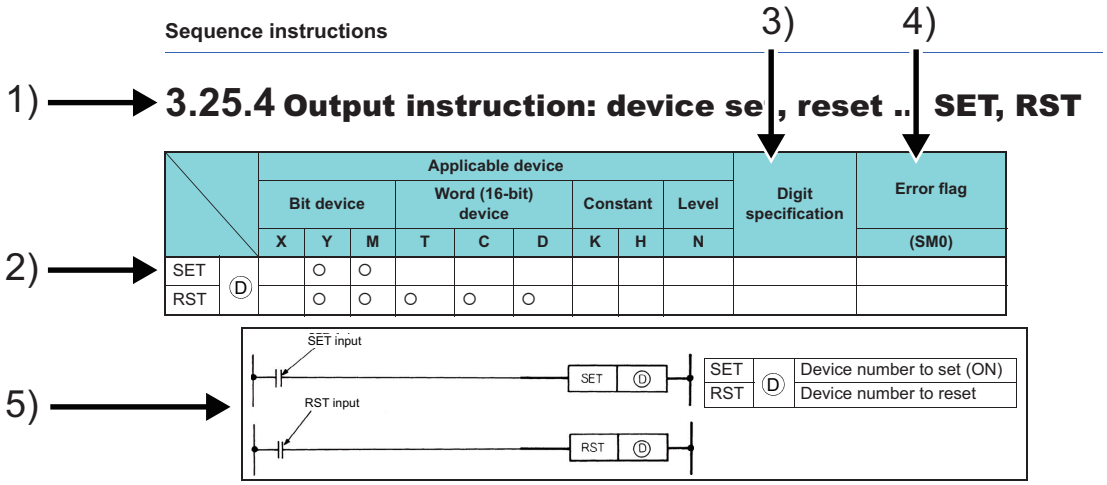
Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 16-bit exclusive NOR	WXNR	WXNR (S) (D)	$\overline{(D) \text{ XOR } (S)} \rightarrow (D)$		178
	WXNRP	WXNRP (S) (D)			
	WXNR	WXNR (S1) (S2) (D)	$\overline{(S1) \text{ XOR } (S2)} \rightarrow (D)$		
	WXNRP	WXNRP (S1) (S2) (D)			
BIN 32-bit exclusive NOR	DXNR	DXNR (S) (D)	$\overline{(D+1, D) \text{ XOR } (S+1, S)} \rightarrow (D+1, D)$		190
	DXNRP	DXNRP (S) (D)			
	DXNR	DXNR (S1) (S2) (D)	$\overline{(S1+1, S1) \text{ XOR } (S2+1, S2)} \rightarrow (D+1, D)$		
	DXNRP	DXNRP (S1) (S2) (D)			

3.23.5 Display instruction

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
Character string data transfer	$MOV	$MOV (S) (D)	Character string specified with (S) is transferred to devices after that specified with (D).		192
	$MOVP	$MOVP (S) (D)			
Character string output	G.PRR	G.PRR n (S) (D)	Data stored in the device specified with (S) is sent to PU. (n, (D) are dummies)		193
	GP.PRR	GP.PRR n (S) (D)			
	UMSG	UMSG (S)	Data stored in the device specified with (S) is sent to PU.		

3.24 How to view instructions

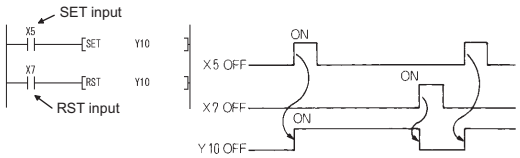
The subsequent descriptions shall be in the following format.



6) ◆Function

SET

- When SET input is turned ON, the specified device turns ON.
- A device that was turned ON remains ON even if the SET input is turned OFF. It can be turned OFF with the RST instruction.



- When the SET input is OFF, the device state does not change.

7) ◆Execution condition

The SET and RST instructions are executed for each scan.

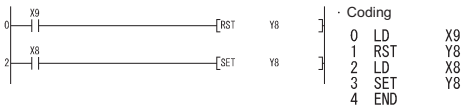
NOTE

- The number of steps is three when the following devices are used.
  SET instruction ... Special relay (M)
  RST instruction ... Special relay (M), all word devices

8) ◆Program example

SET, RST

- Program that sets Y8 (ON) when X8 turns ON, and resets Y8 (OFF) when X9 turns ON.



◆Description

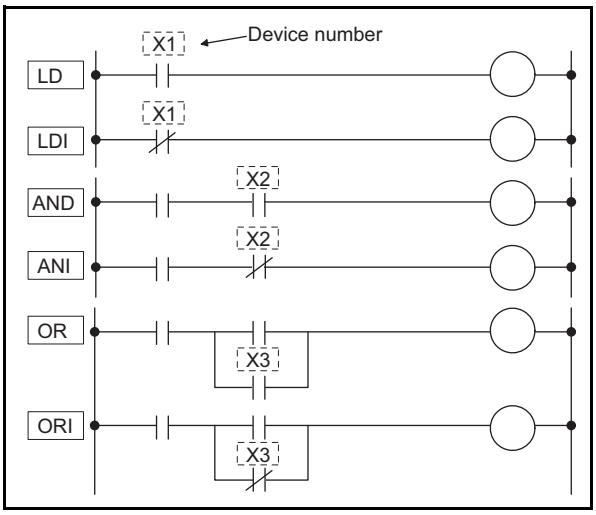
1) Indicates the item number, instruction overview and instruction symbol.
2) Devices that can be used by instructions are marked with ○.
3) When a bit device is used, this indicates digit specifications that can be set in the instruction required by the digit specification.
4) When an operation error occurs, instructions whose error flags turn ON are marked with ○.
5) Indicates the format in ladder mode.
6) Describes the instruction.
7) Indicates the execution conditions of the instruction.
8) Indicates the program example in ladder mode and list mode.

3.25 Sequence instructions

Sequence instructions are used in relay control circuits, etc.

3.25.1 Contact instruction: operation start, series connection, parallel connection ... LD, LDI, AND, ANI, OR, ORI

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)
○	○	○	○	○						



◆Function

LD, LDI

- LD is the NO contact operation start instruction and LDI is the NC contact operation start instruction. They import the ON/OFF information of the specified device as the operation result.

AND, ANI

- AND is the NO contact series connection instruction, and ANI is the NC contact series connection. They import the ON/OFF information of the specified device to perform the AND operation with the operation result up to this point and take the resulting value as the operation result.
- There are no usage limitations on AND and ANI, but the following limitations exist in ladder mode.
  - Write: When AND or ANI are connected in a series, a ladder with a maximum of 21 steps can be created.
  - Read: When AND or ANI are connected in a series, a ladder with a maximum of 24 steps can be displayed. If the ladder exceeds 24 steps, steps up to the 24th step are displayed.

OR, ORI

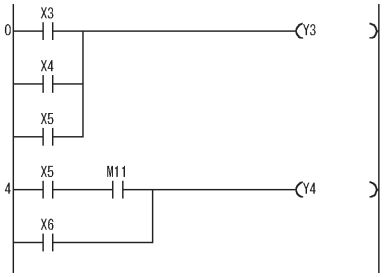
- OR is the parallel connection instruction with a single NO contact, and ORI is the parallel connection instruction with a single NC contact. They import the ON/OFF information of the specified device to perform the OR operation with the operation result up to this point and take the resulting value as the operation result.
- There are no usage limitations on OR and ORI, but the following limitations exist in ladder mode.
  - Write: A ladder that contains 23 OR or ORI continually linked can be created.
  - Read: A ladder that contains 23 OR or ORI continually linked can be displayed. Ladders that contains more than 23 OR or ORI cannot be displayed correctly.

◆Execution condition

The instructions explained in this section are executed every scan irrespective of the device ON/OFF status or the operation result directly prior to the execution.

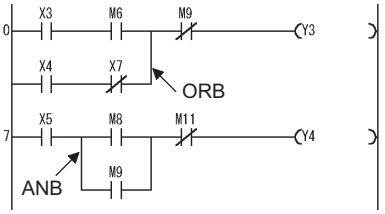
◆Program example

LD , LDI , AND , ANI , OR , ORI



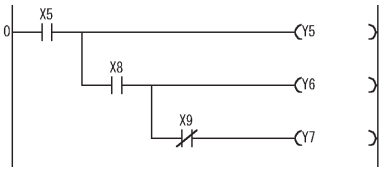
· Coding

```
0   LD      X3
1   OR      X4
2   OR      X5
3   OUT     Y3
4   LD      X5
5   AND     M11
6   OR      X6
7   OUT     Y4
8   END
```



· Coding

```
0   LD      X3
1   AND     M6
2   LD      X4
3   ANI     X7
4   ORB
5   ANI     M9
6   OUT     Y3
7   LD      X5
8   LD      M8
9   OR      M9
10  ANB
11  ANI     M11
12  OUT     Y4
13  END
```

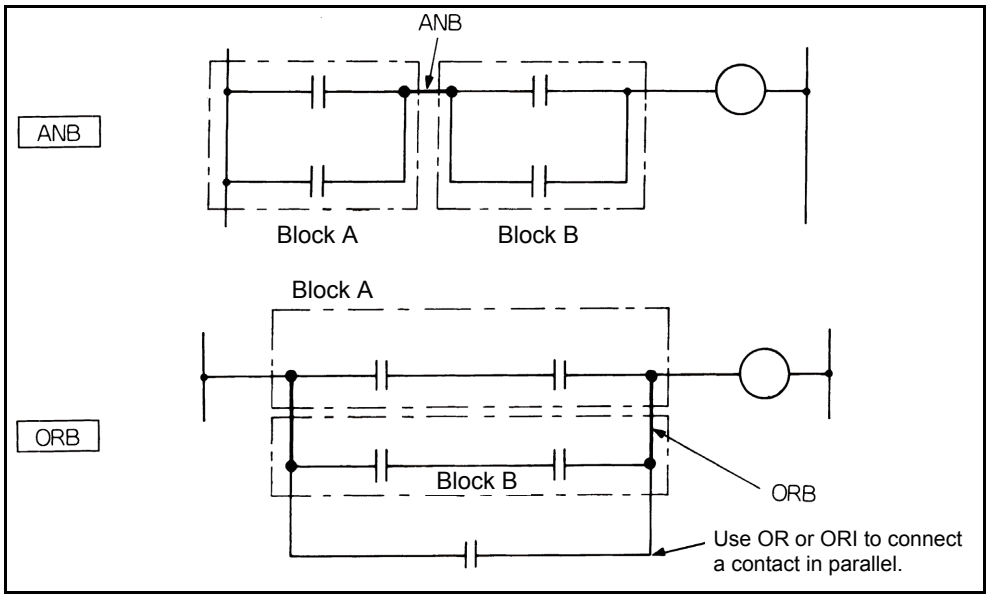


· Coding

```
0   LD      X5
1   OUT     Y5
2   AND     X8
3   OUT     Y6
4   ANI     X9
5   OUT     Y7
6   END
```

3.25.2 Association instruction: ladder block series connection, parallel connection ... ANB, ORB

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



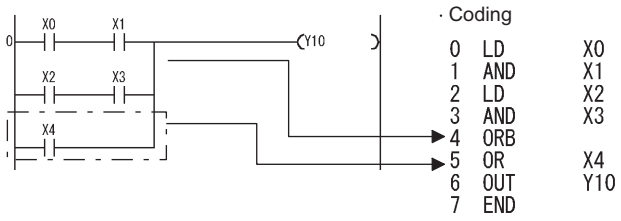
◆Function

ANB

- The AND operation is executed for the A block and B block to produce the operation result.
- The AND symbol is a connection symbol, not a contact symbol.
- A maximum of 7 instructions (8 blocks) can be written continuously for ANB.
  If more ANB instructions than indicated above are written continuously, the PLC function cannot operate correctly.

ORB

- The OR operation is executed for the A block and B block to produce the operation result.
- ORB creates parallel connections with ladder blocks that have two or more contacts. Use OR or ORI to create parallel connections with ladder blocks that only have one contact, there is no need to use ORB.

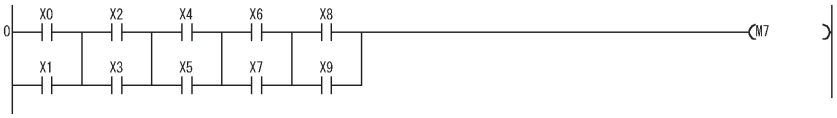


- The ORB symbol is a connection symbol, not a contact symbol.
- A maximum of 7 instructions (8 blocks) can be written continuously for ORB.
  If more ORB than indicated above are written continuously, the PLC function cannot operate correctly.

◆Program example

ANB

The following two types of program coding are available for continuous series connection of ladder blocks. However, the coding example 1 should be applied.



▪ Coding example 1

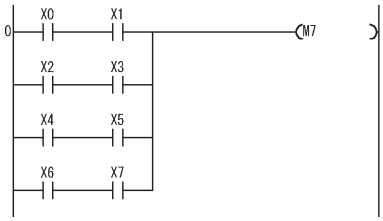
```
 0  LD    X0
 1  OR    X1
 2  LD    X2
 3  OR    X3
 4  ANB
 5  LD    X4
 6  OR    X5
 7  ANB
 8  LD    X6
 9  OR    X7
10  ANB
11  LD    X8
12  OR    X9
13  ANB
14  OUT   M7
15  END
```

▪ Coding example 2

```
 0  LD    X0
 1  OR    X1
 2  LD    X2
 3  OR    X3
 4  LD    X4
 5  OR    X5
 6  LD    X6
 7  OR    X7
 8  LD    X8
 9  OR    X9
10  ANB
11  ANB
12  ANB
13  ANB
14  OUT   M7
15  END
```

ORB

The following two types of program coding are available for continuous parallel connection of ladder blocks. However, the coding example 1 should be applied.



▪ Coding example 1

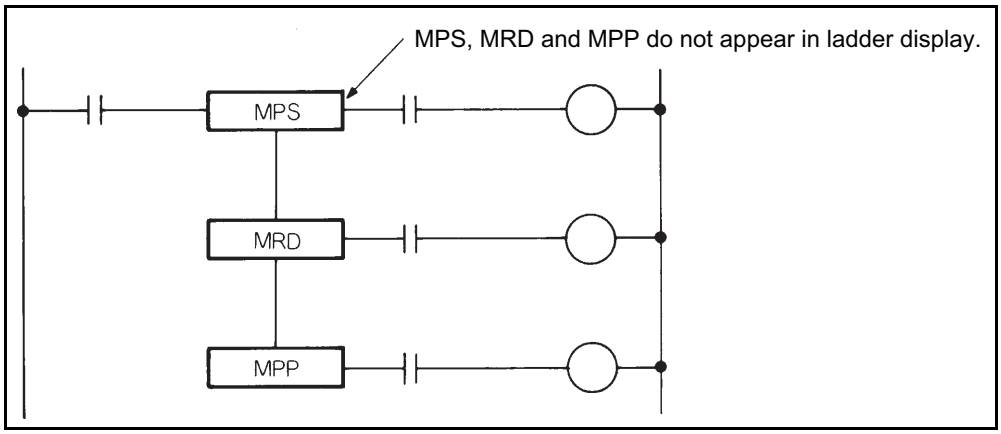
```
 0  LD    X0
 1  AND   X1
 2  LD    X2
 3  AND   X3
 4  ORB
 5  LD    X4
 6  AND   X5
 7  ORB
 8  LD    X6
 9  AND   X7
10  ORB
11  OUT   M7
12  END
```

▪ Coding example 2

```
 0  LD    X0
 1  AND   X1
 2  LD    X2
 3  AND   X3
 4  LD    X4
 5  AND   X5
 6  LD    X6
 7  AND   X7
 8  ORB
 9  ORB
10  ORB
11  OUT   M7
12  END
```

3.25.3 Association instruction: operation results, push, read, pop ... MPS, MRD, MPP

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



◆Function

MPS

- The operation result (ON/OFF) directly prior to the MPS instruction is stored.
- The MPS instruction can be used continuously up to 12 times.
  However, it can only be used up to 11 times when created with ladder mode.
  When the MPP instruction is used during the program, the number of the MPS instructions to be used is reduced by 1.

MRD

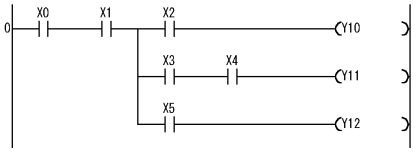
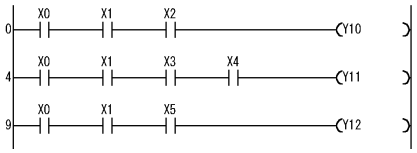
- The operation result stored by the MPS instruction is read, and the operation of the following step is continued by this operation result.

MPP

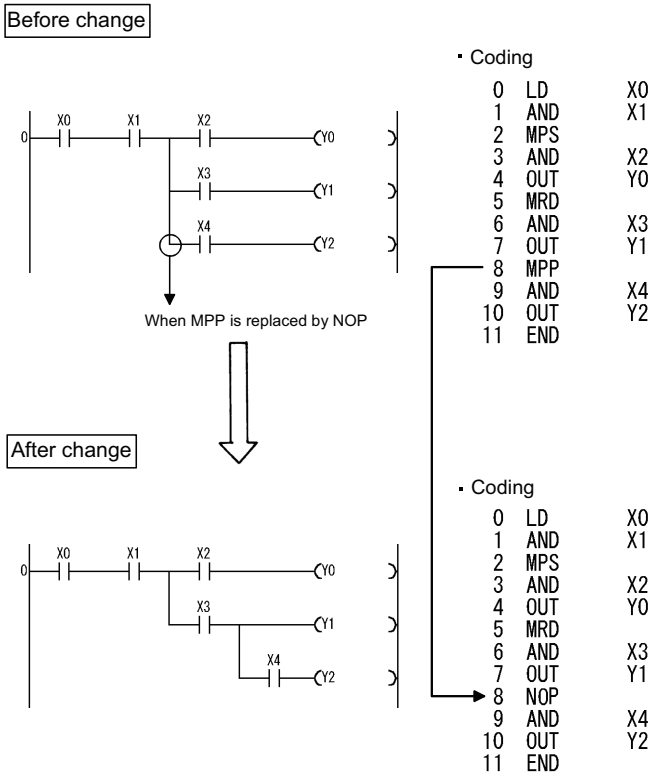
- The operation result stored by the MPS instruction is read, and the operation of the following step is continued by this operation result.
- The operation result stored by the MPS instruction is cleared.

POINT

- The ladder is as shown below when MPS, MRD and MPP are used and when they are not used.

Ladder when MPS, MRD and MPP are used	Ladder when MPS, MRD and MPP are not used
	

- Be sure to match the number of MPS and MPP instructions. The following will occur if the number used is different.
  If the number of MPS instructions is greater, the ladder is changed and the PLC function executes operations on the changed ladder.

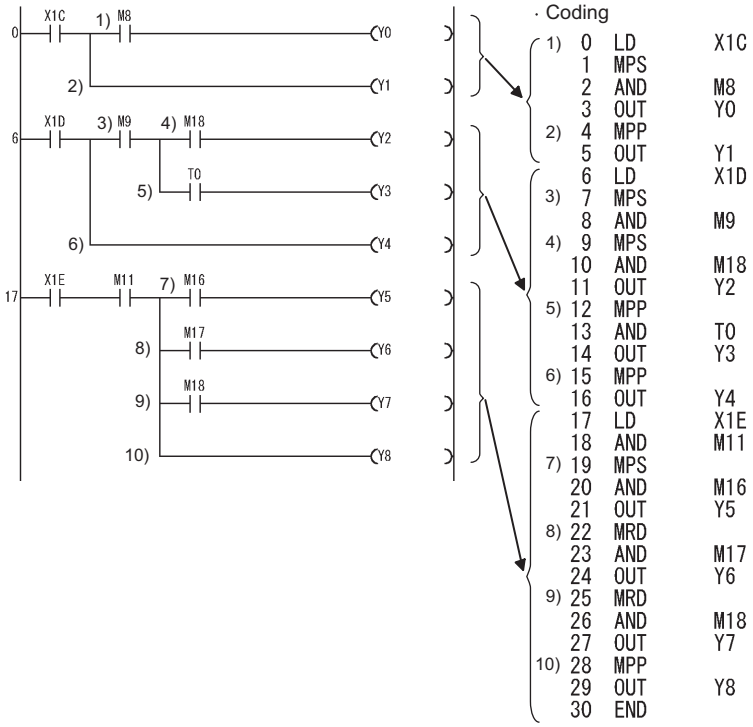


If the number of MPP instructions is greater, a ladder creation failure occurs for that ladder block and the PLC function cannot execute operations normally.

◆Program example

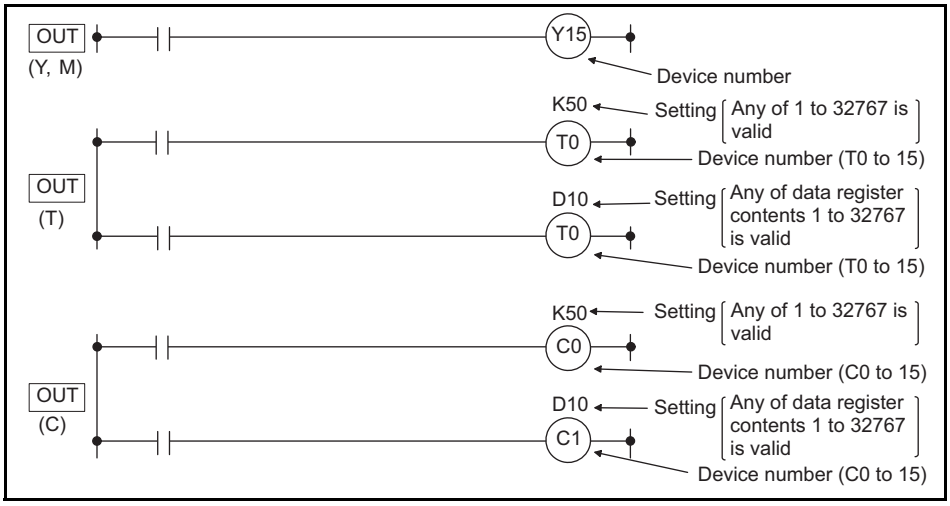
MPS , MRD , MPP

• Program using MPS, MRD and MPP



3.25.4 Output instruction: bit device, timer, counter ... OUT

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
Bit device			○	○								
Timer	Device				○							
	Setting value						○	○				
Counter	Device					○						
	Setting value						○	○				



◆Function

OUT (Y, M)

• Operation results up to the OUT instruction are output to the specified device.

Operation result	OUT instruction		
	Coil	Contact	
		NO contact	NC contact
OFF	OFF	Non-conduction	Conduction
ON	ON	Conduction	Non-conduction

NOTE

• The OUT instruction repuires 3 steps when a special relay (M) is used.

OUT(T)

- When the operation result up to the OUT instruction is ON, the timer coil turns ON and counts up the value up to the setting value. When the coil's timer reaches the setting value (counted value ≥ setting value), the contacts enter the following states:

NO contact	Conduction
NC contact	Non-conduction

- When the operation result up to the OUT instruction changes from ON to OFF, the following occurs.

Type of timer	Timer coil	Present value of timer	Before the time up		After the time up	
			NO contact	NC contact	NO contact	NC contact
100 ms timer	OFF	0	Non-conduction	Conduction	Non-conduction	Conduction
10 ms timer						
100 ms retentive timer	OFF	Retention of present value	Non-conduction	Conduction	Conduction	Non-conduction

- After the timer reaches the setting value, the state of the retentive timer contact does not change until the RST instruction is executed.
- Negative values (-32768 to -1) cannot be set for the setting value.
- The timer's setting value becomes infinity, if its setting value is set to "0". For this reason, the timer does not time up.
- For details on the counting method of the timer, refer to page 87.

OUT (C)

- If the operation result changes from OFF to ON up to the OUT instruction, +1 is added to the present value (count value), and when counting reaches the setting value (present value = setting value), the contact is as follows.

NO contact	Conduction
NC contact	Non-conduction

- The timer will not start counting if the operation result remains ON. (Count input does not need to be converted into pulse form.)
- After a count-up, the count value and state of the contact do not change until the RST instruction is executed.
- Negative values (-32768 to -1) cannot be set for the setting value. Furthermore, if the setting value is 0, the same process as for a setting value of 1 is performed.
- For details on the counting method of the counter, refer to page 89.

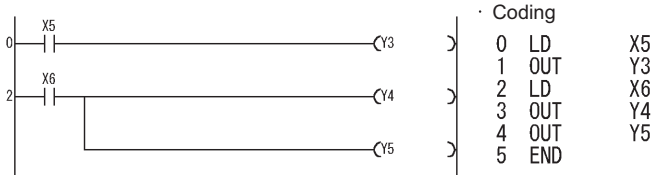
◆Execution condition

The OUT instruction is executed for each scan irrespective of the operation result up to the instruction.

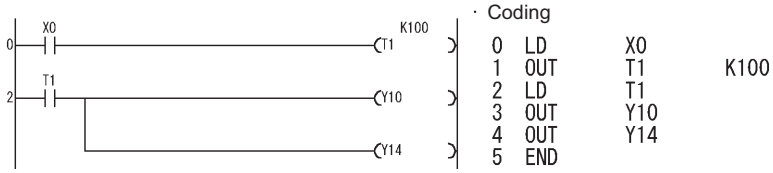
◆Program example

OUT

- Program that outputs to the output module.

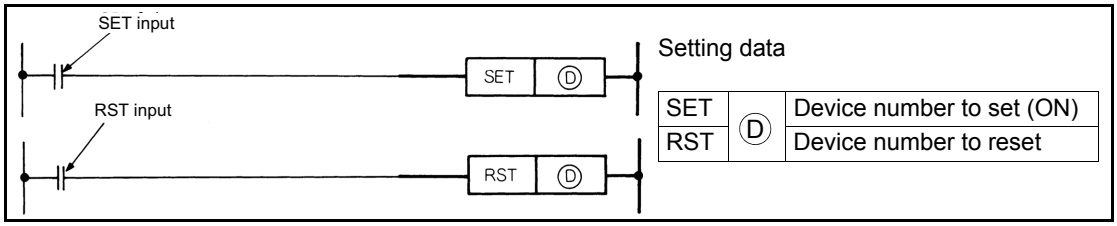


- Program that turns X0 ON, and then 10 seconds later turns Y10 and Y14 ON.



3.25.5 Output instruction: device set, reset ... SET, RST

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
SET	Ⓓ		○	○								
RST	Ⓓ		○	○	○	○	○					



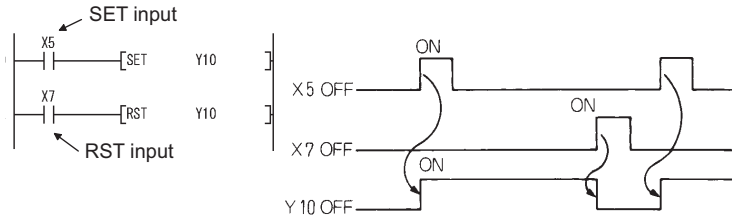
Setting data

SET	Ⓓ	Device number to set (ON)
RST	Ⓓ	Device number to reset

◆Function

SET

- When SET input is turned ON, the specified device turns ON.
- A device that was turned ON remains ON even if the SET input is turned OFF. It can be turned OFF with the RST instruction.



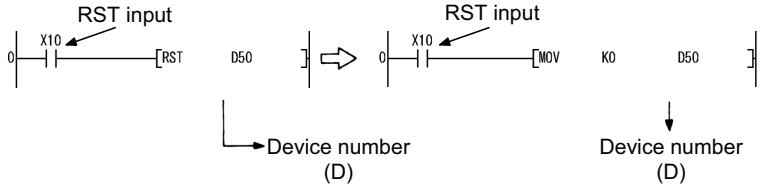
- When the SET input is OFF, the device state does not change.

RST

- When the RST input is turned ON, the specified device is as follows.

Device	Status
Y, M	The coil and contact are turned OFF.
T, C	The present value is set to 0, and the coil and contact are turned OFF.
D	The content is set to 0.

- When the RST input is OFF, the device state does not change.
- The RST (D) function is identical to the following ladder.



◆Execution condition

The SET and RST instructions are executed for each scan.

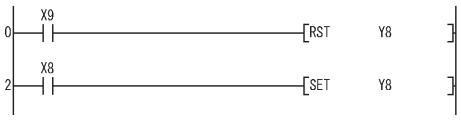
NOTE

- The number of steps is three when the following devices are used.
  SET instruction ... Special relay (M)
  RST instruction ... Special relay (M), all word devices

◆Program example

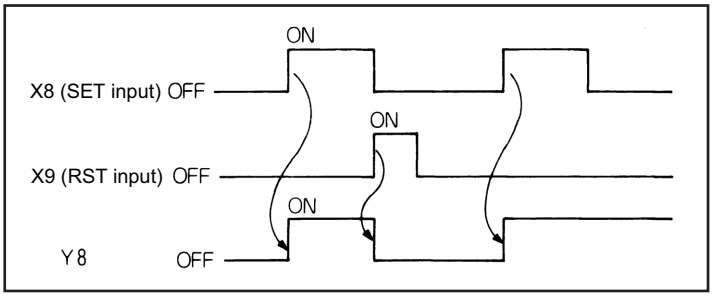
SET , RST

- Program that sets Y8 (ON) when X8 turns ON, and resets Y8 (OFF) when X9 turns ON.



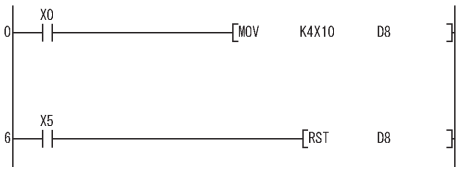
· Coding

```
0  LD    X9
1  RST   Y8
2  LD    X8
3  SET   Y8
4  END
```



Operations of SET and RST instructions

- Program that sets the data register content to 0.



Stores X10 to 1F contents into D8 when X0 turns ON.

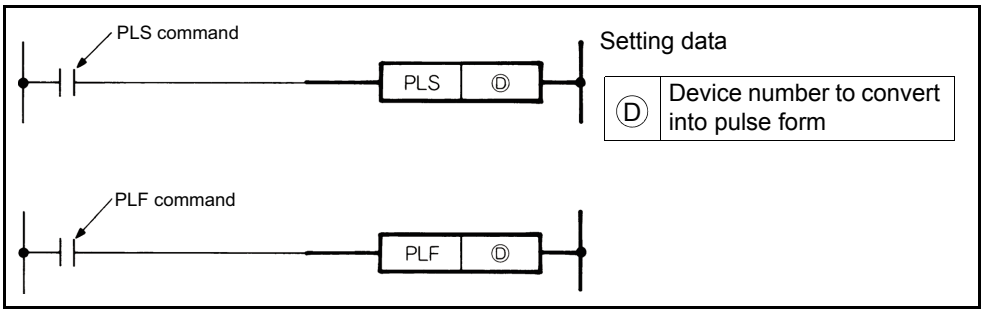
Resets D8 contents to 0 when X5 turns ON.

· Coding

```
0   LD    X0
1   MOV   K4X10   D8
6   LD    X5
7   RST   D8
10  END
```

3.25.6 Output instruction: rising, falling differential output ... PLS, PLF

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ		○	○								

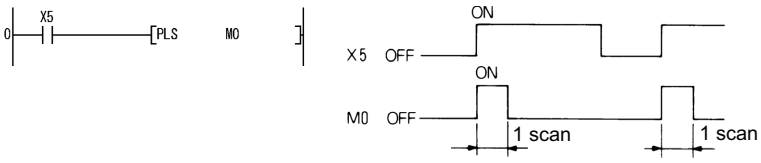


◆Function

PLS

- The specified device is turned ON when the PLS command changes from OFF to ON, and OFF at all times other than when the PLS command is turned OFF to ON (OFF to OFF, ON to ON, ON to OFF).

  If there is one PLS instruction for the device specified by Ⓓ during one scan, the specified device is turned ON for one scan.
  Do not execute the PLS instruction of the same device multiple times during one scan.

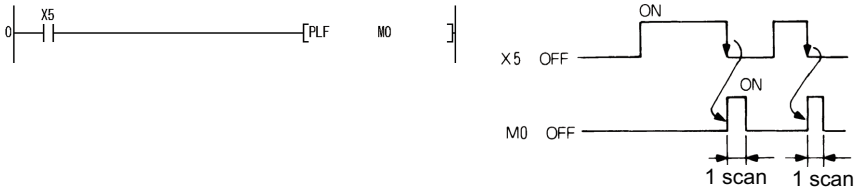


- After the PLS instruction is executed, it will not be executed again even if STOP is executed and RUN is executed again.

PLF

- The specified device is turned ON when the PLF command changes from ON to OFF, and OFF at all times other than when the PLS command is turned ON to OFF (OFF to OFF, OFF to ON, ON to ON).

  If there is one PLF instruction for the device specified by Ⓓ during one scan, the specified device is turned ON for one scan.
  Do not execute the PLF instruction of the same device multiple times during one scan.

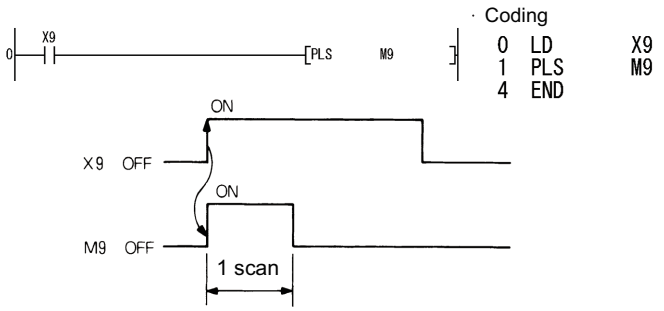


- After the PLF instruction is executed, it will not be executed again even if STOP is executed and RUN is executed again.

◆Program example

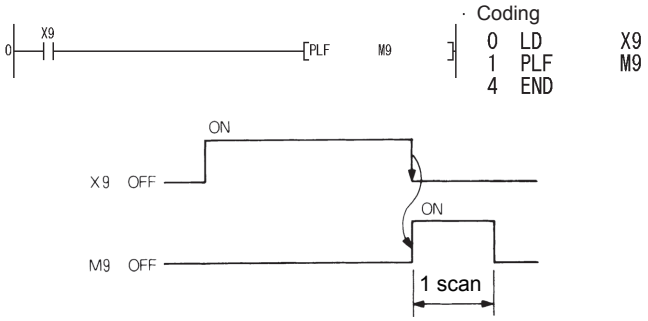
PLS

Program that executes the PLS instruction when X9 is turned ON.



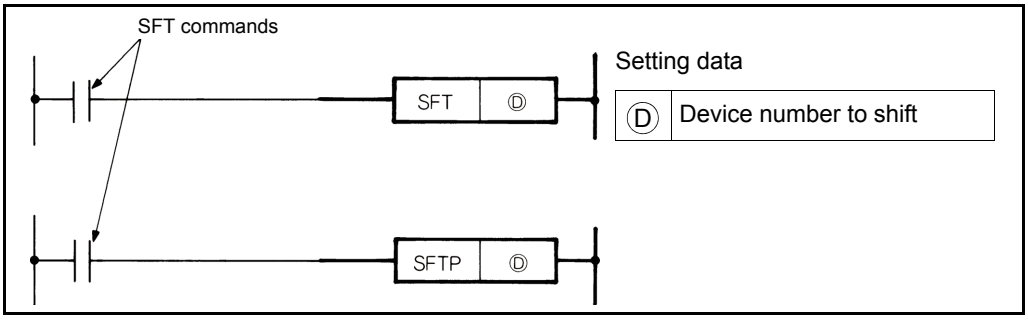
PLF

Program that executes the PLF instruction when X9 is turned OFF.



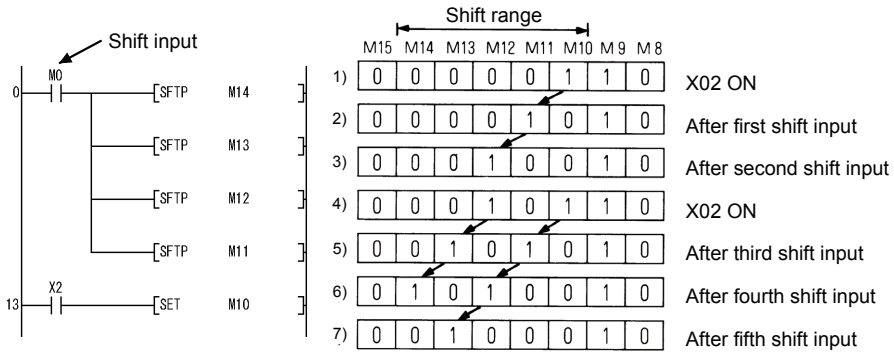
3.25.7 Shift instruction: bit device shift ... SFT, SFTP

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ		○	○								



◆Function

- The ON/OFF status is shifted to the device immediately prior to the device specified with Ⓓ, and the prior device is set to OFF.
- Use the SET instruction to turn ON the start device to be shifted.
- When SFT or SFTP are used continuously, start programming from larger device numbers.

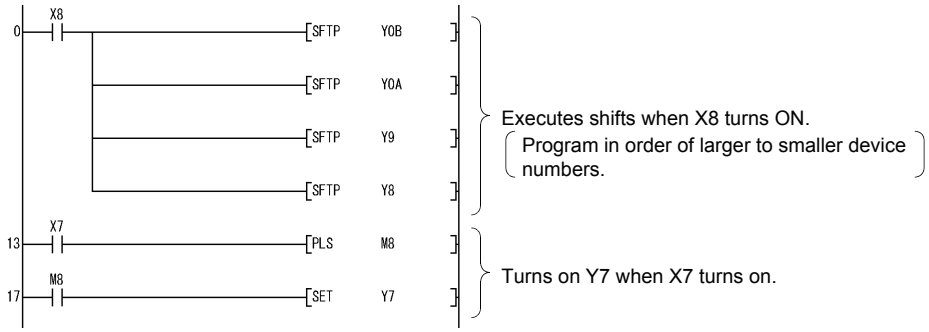


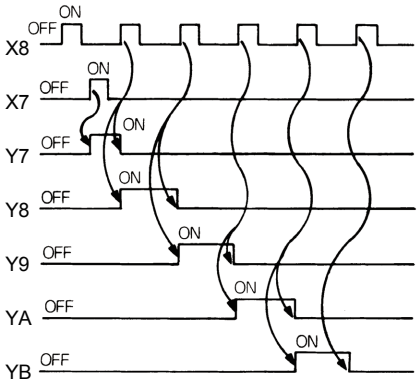
∗1 At M8 to 15, 1 indicates ON and 0 indicates OFF.

◆Program example

SFT

• Program that shifts Y7 to YB when X8 turns ON.



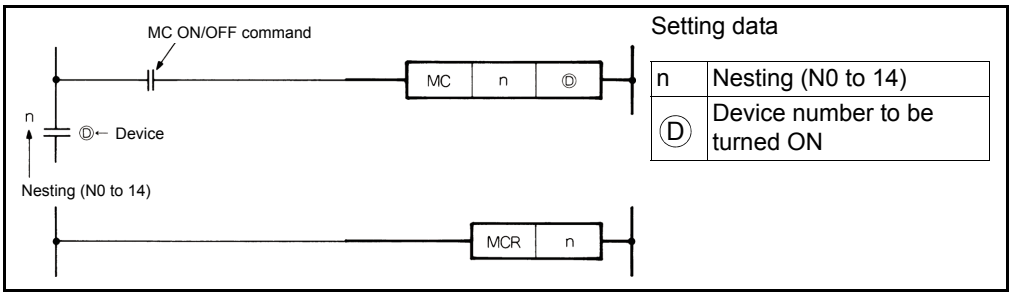


• Coding

```
 0  LD      X8
 1  SFTP    Y0B
 4  SFTP    Y0A
 7  SFTP    Y9
10  SFTP    Y8
13  LD      X7
14  PLS     M8
17  LD      M8
18  SET     Y7
19  END
```

3.25.8 Master control instruction: master control set, reset ... MC, MCR

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
n									○		
Ⓓ		○	○								

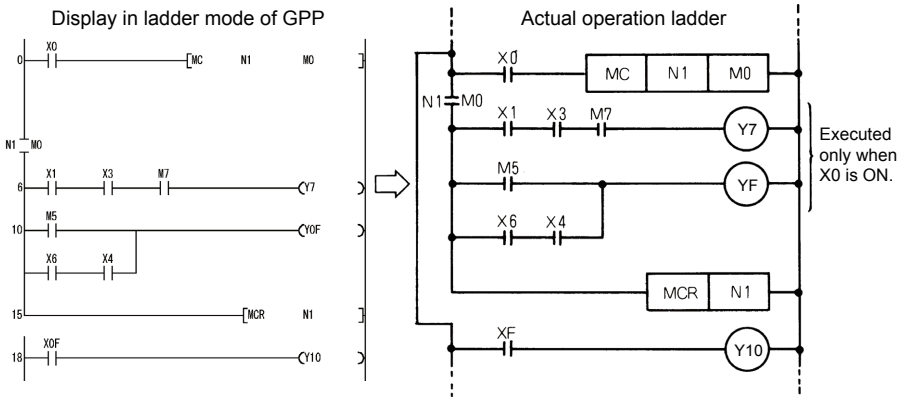


Setting data

n	Nesting (N0 to 14)
Ⓓ	Device number to be turned ON

◆Function

- This instruction is for creating an efficient ladder switching sequence program by opening and closing the common bus of the ladder using the master control instruction. The following ladders use the master control.



MC

- When the MC ON/OFF instruction is turned ON at the start of master control, the operation results from MC to MCR are as per the instruction (ladder).
- Even when the MC instruction is OFF, the scan time is not shortened because the scan is executed between the MC instruction and MCR instruction.
  Also, when the MC instruction is OFF, the operation results of MC and MCR are as follows.

100 ms, 10 ms timer	The count value becomes 0, and both coil and contact turn OFF.
100 ms retentive timer, counter	The coil turns OFF, but the count value and contact both retain the current state.
Device currently under OUT instruction	All turn OFF.
SET, RST or SFT, or devices currently executing basic or application instructions	Retain the current state.

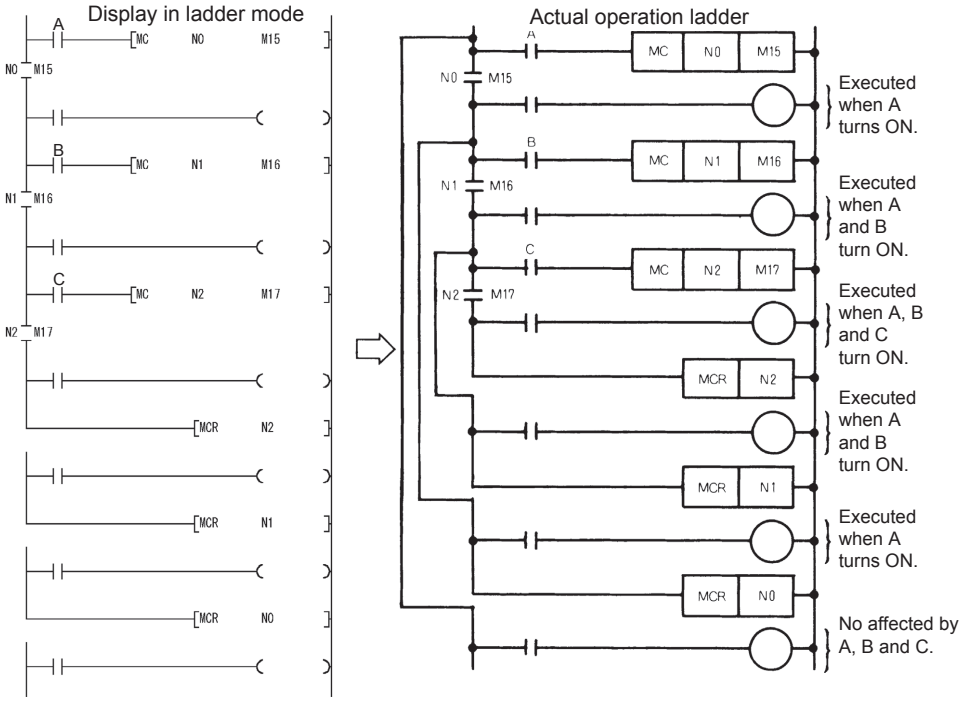
- The MC instruction can use the same nesting (N) number any number of times by changing the Ⓓ device.
- When the MC instruction is ON, the coil of the device specified by Ⓓ is ON. Furthermore, as a double coil occurs when the same device is used by instructions such as the OUT instruction, do not use a device specified by Ⓓ when it is executing a different instruction.

MCR

- The master control release instruction that indicates the end of the master control range.
- Do not add a contact instruction to the front of the MCR instruction.

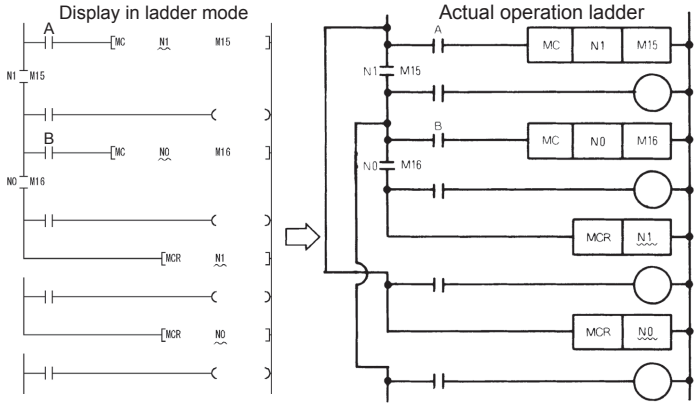
◆Program example

- The master control instruction can be used as a nesting structure. Each master control area is separated by nesting (N). N0 to N14 can be used for nesting.
  A ladder in which the program execution conditions are limited successively can be created by using the nesting structure.
  A ladder that uses a nesting structure is as follows.



Take note of the following points when using a nesting structure.

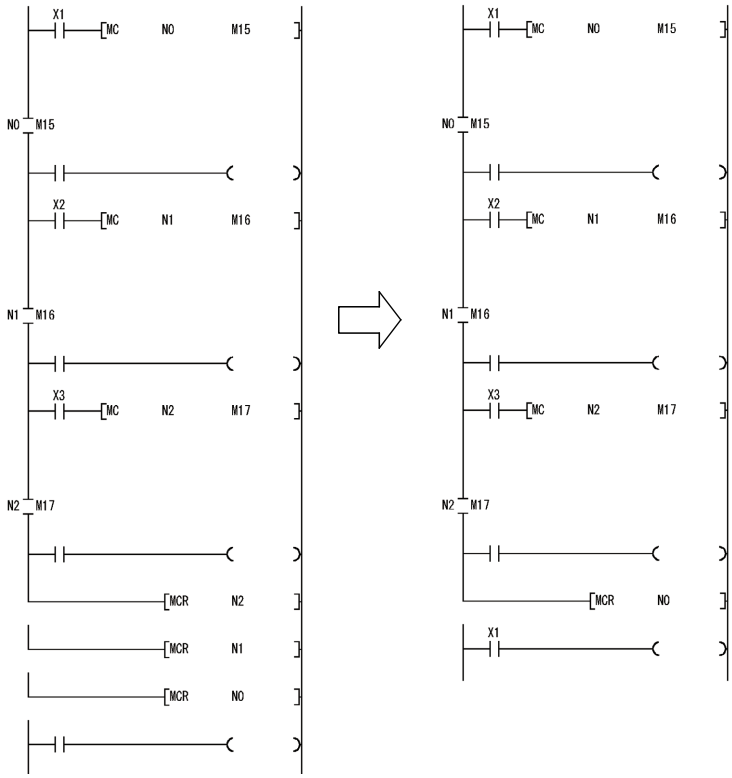
- A maximum of 15 nests (N0 to 14) can be used. When applying nesting, MC uses numbers from the lower nesting (N) numbers upwards, whereas MCR uses numbers from the higher numbers downwards. If the order is reversed, the structure is not a nesting structure and the PLC function cannot operate normally.



Nesting numbers of MCR are opposite.

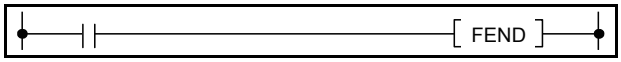
Since buses cross each other, normal master control ladder cannot be created.

- If the nesting structure consists of MCR instructions collected in one location, the single lowest nesting (N) number can be used to terminate all master controls.



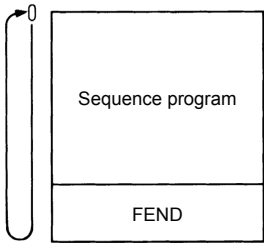
3.25.9 Termination instruction: termination of main program ... FEND

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



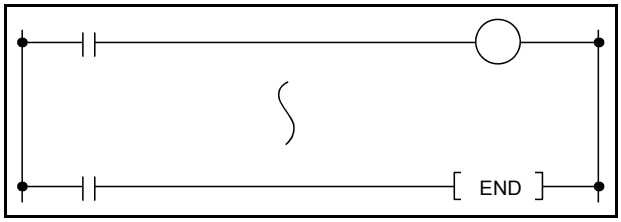
◆Function

- Execution of the FEND instruction will cause the CPU module to terminate the program it was executing.
- Even sequence programs following the FEND instruction can be displayed in ladder display at a peripheral device. (Peripheral devices continue to display ladders until encountering the END instruction.)



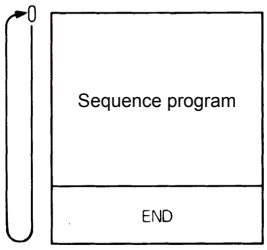
3.25.10 Termination instruction: sequence program termination ... END

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



◆Function

- Indicates the end of a program. Scanning terminates with this step, and returns to step 0.



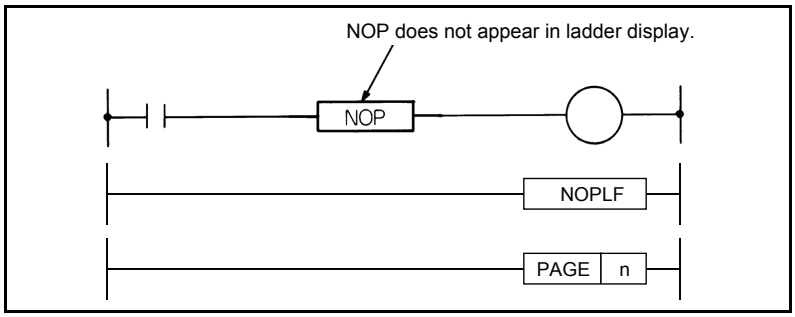
- The END instruction cannot be used during the sequence program.

NOTE

- An operation error occurs if there is no END instruction during the program, and the PLC function does not operate.

3.25.11 Other instructions: non-processing ... NOP, NOPLF, PAGE n

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)
										○



◆Function

NOP

Non-processing instructions do not have an effect on previously executed operations.

NOP are used in the following situations.

- Creating space for sequence program debugging.
- Deleting instructions without changing the number of steps. (Replaced by NOP)
- Temporarily deleting instructions.

NOPLF

This is a no operation instruction that has no impact on any operations up to that point.

The NOPLF instruction is used when printing from a peripheral device to force a page change at any desired location.

- When printing ladders
  - A page break will be inserted between ladder blocks with the presence of the NOPLF instruction.
  - The ladder cannot be displayed correctly if an NOPLF instruction is inserted in the midst of a ladder block.
  - Do not insert an NOPLF instruction in the midst of a ladder block.
- When printing instruction lists
  - The page will be changed after the printing of the NOPLF instruction.

Refer to the Operating Manual for the peripheral device in use for details of printouts from peripheral devices.

PAGE n

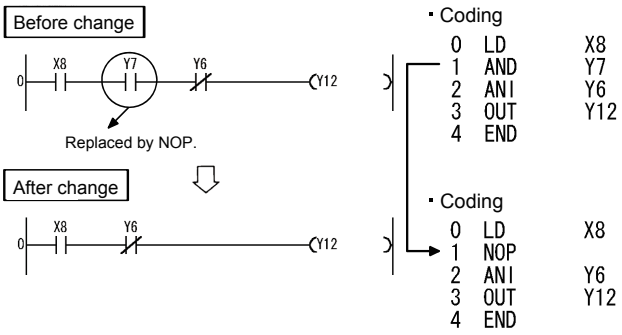
This is a no operation instruction that has no impact on any operations up to that point.

No processing is performed at peripheral devices with this instruction.

◆Program example

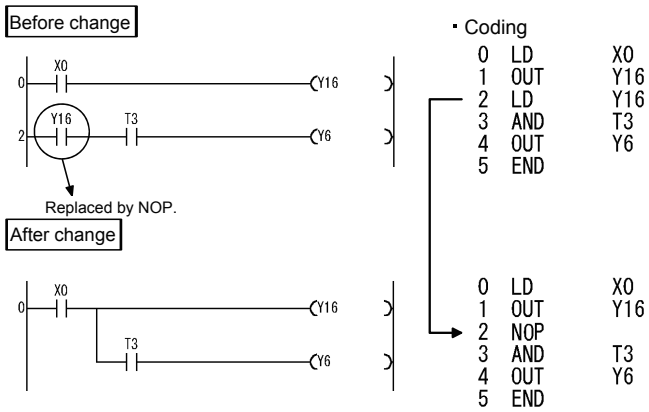
NOP

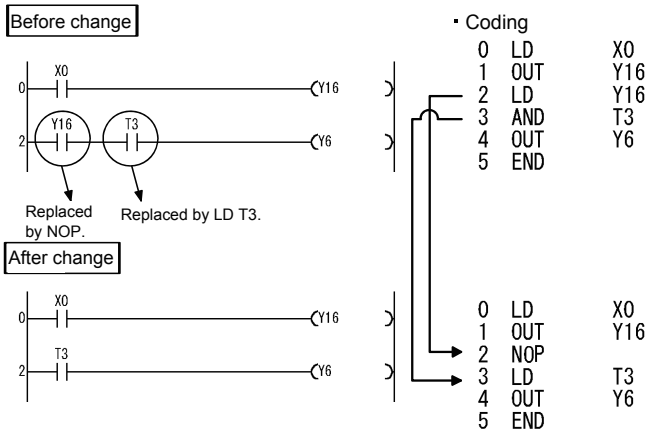
• Contact short-circuit (AND, ANI)



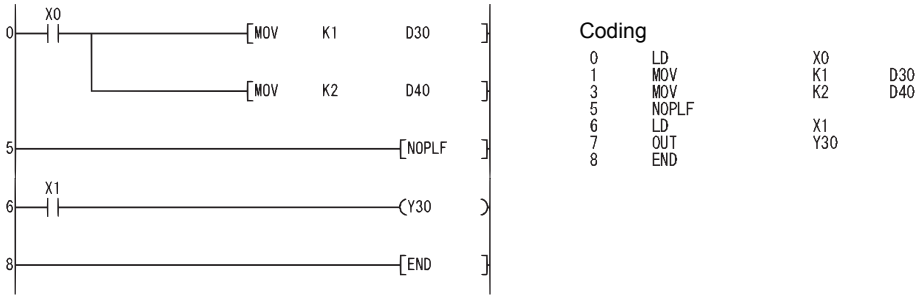
• Contact short-circuit (LD, LDI)

Caution is required because the ladder completely changes if LD or LDI are replaced by NOP.

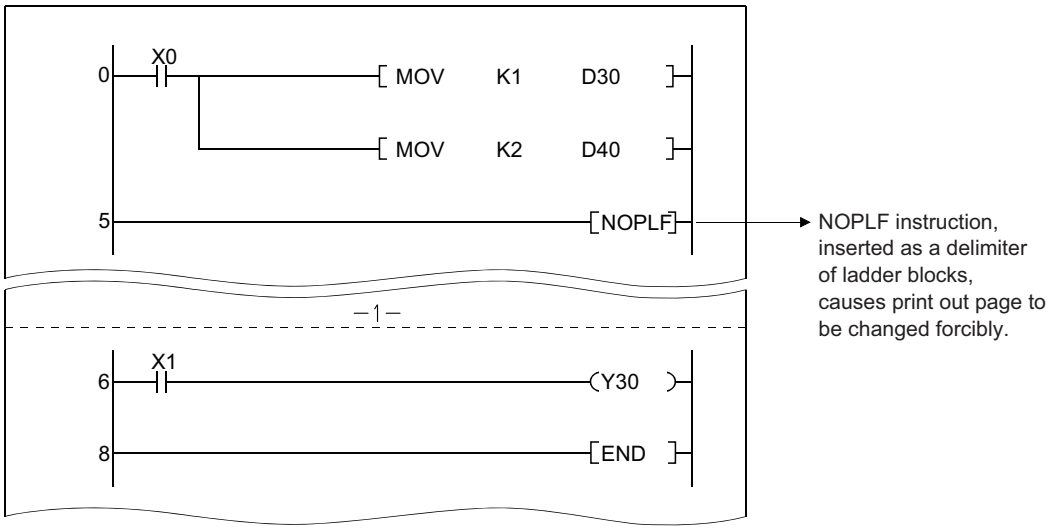




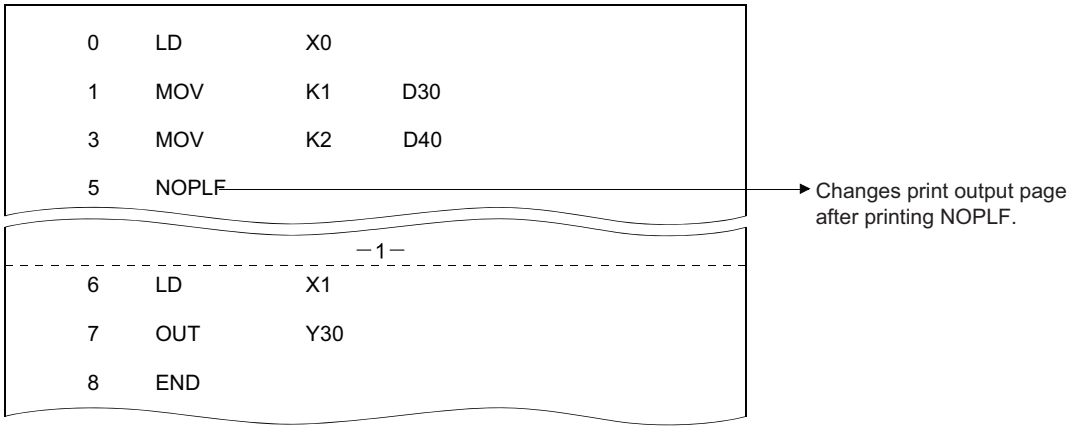
NOPLF



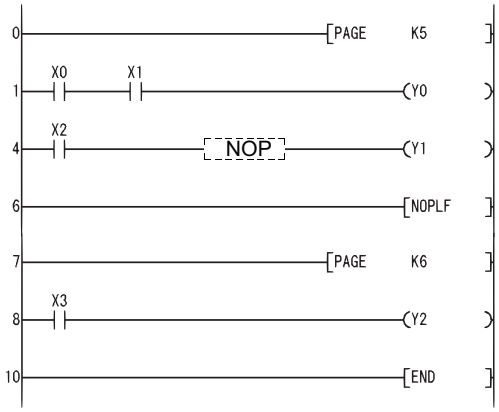
- Printing the ladder will result in the following:



- Printing an instruction list with the NOPLF instruction will result in the following:



PAGE n



Coding

0	PAGE	K5
1	LD	X0
2	AND	X1
3	OUT	Y0
4	LD	X2
5	NOP	
6	OUT	Y1
7	NOPLF	
8	PAGE	K6
9	LD	X3
10	OUT	Y2
11	END	

3.26 Basic instruction (16-bit)

The basic instruction (16-bit) can handle 16 bits of numeric data.

3.26.1 Comparison operation instruction

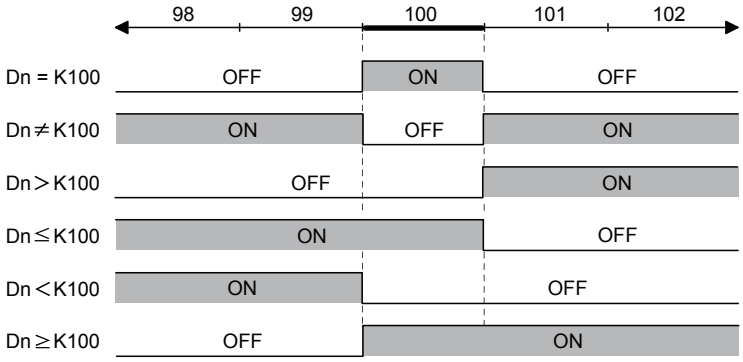
- Comparison operation instructions execute size comparisons (=, >, < etc.) of two data, and instructs a contact to turn ON when the conditions are met.

- The usage method of comparison operation instructions is the same as the contact instructions of sequence instructions, and is as follows.
  - LD, LDI: LD=
  - AND, ANI: AND=
  - OR, ORI: OR=

- There are 18 types of comparison operation instruction as shown below.
  For details, refer to page 140.

Classification	Instruction symbol	Classification	Instruction symbol	Classification	Instruction symbol
=	LD=	>	LD>	<	LD<
	AND=		AND>		AND<
	OR=		OR>		OR<
≠	LD<>	≤	LD<=	≥	LD>=
	AND<>		AND<=		AND>=
	OR<>		OR<=		OR>=

- The conditions for turning comparison operation instructions ON are as follows.

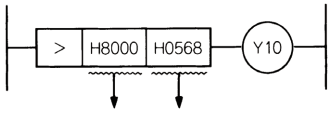


NOTE

- The comparison instruction assumes the specified data as a BIN value for comparison. For this reason, when performing hexadecimal comparison, when the value whose most significant bit (b15) is 1 (8 to F), the BIN value is assumed as a negative number for the comparison.

Example

Comparison of HEX / 4-digit value

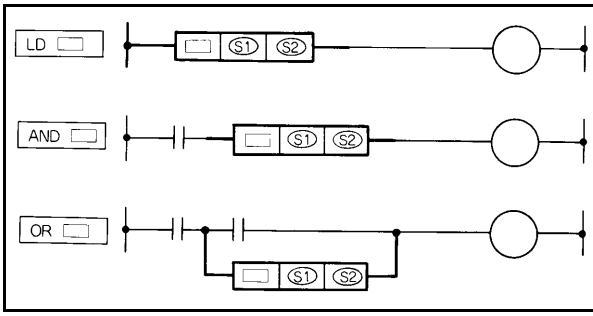


Regarded as -32767 in BIN. Regarded as 1384 in BIN.

Therefore, -32767 < 1384, and Y10 does not turn ON.

3.26.2 Comparison operation instruction: 16-bit data comparison ... =, <>, >, <=, <, >=

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K4	○
(S2)	○	○	○	○	○	○	○	○			



Instruction symbol inside

=, <>, >, <=, <, >=

Setting data

(S1)	Start number of the comparison data or the device in which the comparison data is stored
(S2)	

◆Function

- 16-bit comparison operation is handled as NO contact.
- Comparison operation results are as follows.

Instruction symbol inside	Condition	Comparison operation results
=	(S1) = (S2)	Conducted
<>	(S1) ≠ (S2)	
>	(S1) > (S2)	
<=	(S1) ≤ (S2)	
<	(S1) < (S2)	
>=	(S1) ≥ (S2)	

Instruction symbol inside	Condition	Comparison operation results
=	(S1) ≠ (S2)	Not conducted
<>	(S1) = (S2)	
>	(S1) ≤ (S2)	
<=	(S1) > (S2)	
<	(S1) ≥ (S2)	
>=	(S1) < (S2)	

◆Execution condition

The execution conditions for LD ☐, AND ☐ and OR ☐ are as follows.

Instruction	Execution condition
LD ☐	Each scan execution
AND ☐	Executed when the previous contact instruction is ON
OR ☐	Each scan execution

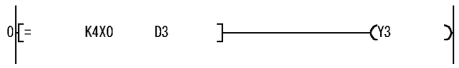
NOTE

- When the digit setting of a bit device is other than K4 and a start bit device value is other than a multiple of 8, the number of steps is 7.

◆Program example

=

Program that compares the X0 to F data with D3 data.



· Coding

```
0  LD=    K4X0   D3
5  OUT    Y3
6  END
```

<>

Program that compares the BCD value 100 with D3 data.

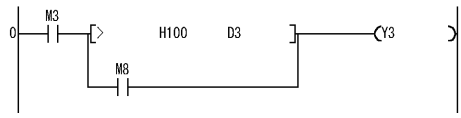


· Coding

```
0  LD     M3
1  AND<>  H100   D3
6  OUT    Y3
7  END
```

>

Program that compares the BIN value 100 with D3 data.

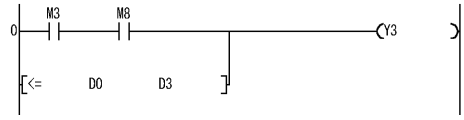


· Coding

```
0  LD     M3
1  LD>    H100   D3
6  OR     M8
7  ANB
8  OUT    Y3
9  END
```

<=

Program that compares the D0 with D3 data.



· Coding

```
0  LD     M3
1  AND    M8
2  OR<=   D0     D3
7  OUT    Y3
8  END
```

3.26.3 Arithmetic operation instruction

An arithmetic operation instruction instructs the addition, subtraction, multiplication or division for two BIN data, or operation of increment or decrement.

◆BIN arithmetic operation (binary)

- If the operation result of an addition instruction exceeds 32767, the value is negative.
- If the operation result of a subtraction instruction is smaller than -32768, the value is positive.
- Operations of positive values and negative values are as follows.

  5 + 8 → 13

  5 - 8 → -3

  5 × 3 → 15

  -5 × 3 → -15

  -5 × (-3) → 15

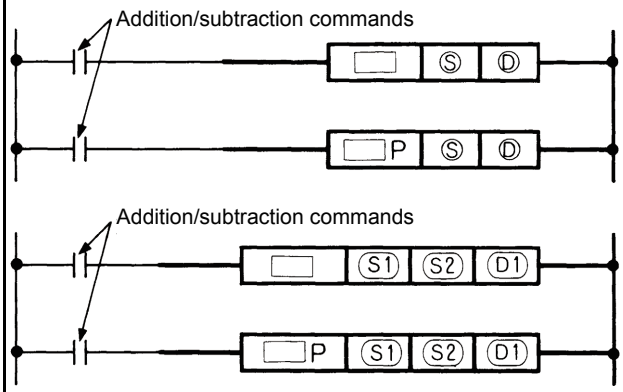
  -5 ÷ 3 → -1 remainder -2

  5 ÷ (-3) → -1 remainder 2

  -5 ÷ (-3) → 1 remainder -2

3.26.4 Arithmetic operation instruction: BIN 16-bit addition/subtraction ... +, +P, -, -P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
Ⓓ		○	○	○	○	○					
Ⓢ1	○	○	○	○	○	○	○	○			
Ⓢ2	○	○	○	○	○	○	○	○			
Ⓓ1		○	○	○	○	○					



Instruction symbol inside □

+, -

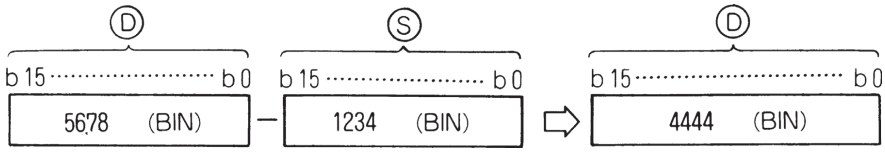
Setting data

Ⓢ	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ	Start number of the device in which the added/subtracted data is stored
Ⓢ1	Start number of the added/ subtracted data or the device in which the added/subtracted data is stored
Ⓢ2	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ1	Start number of the device in which the addition/subtraction results are stored

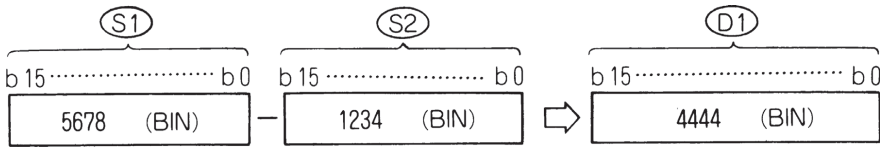
◆Function

+

- Executes addition of the BIN data specified with (D) and BIN data specified with (S), and stores the addition results in the device specified with (D).



- Executes addition of the BIN data specified with (S1) and BIN data specified with (S2), and stores it in the device specified with (D1).

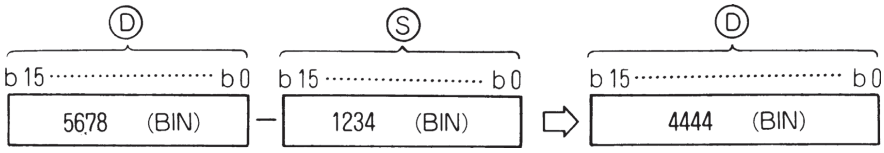


- -32768 to 32767 (BIN 16-bit) can be specified in (S), (S1), (S2) or (D).
- Positive/negative judgment of the (S), (S1), (S2) and (D) data is performed by the most significant bit (b15). (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 15th bit overflow. (There is no carry flag)

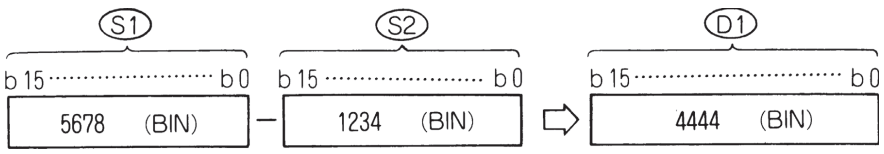
◆Function

-

- Executes subtraction of the BIN data specified with (D) and BIN data specified with (S), and stores the subtraction results in the device specified with (D).



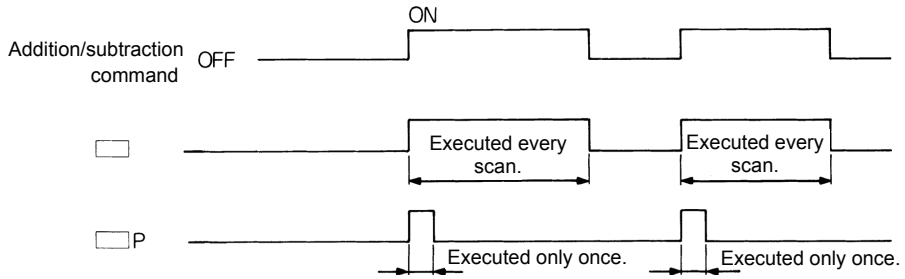
- Executes subtraction of the BIN data specified with (S1) and BIN data specified with (S2), and stores it in the device specified with (D1).



- -32768 to 32767 (BIN 16-bit) can be specified in (S), (S1), (S2) or (D).
- Positive/negative judgment of the (S), (S1), (S2) and (D) data is performed by the most significant bit (b15). (0: Positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn on for the 15th bit overflow. (There is no carry flag)

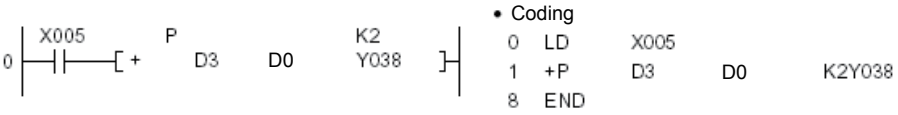
◆Execution condition

Addition/subtraction instruction



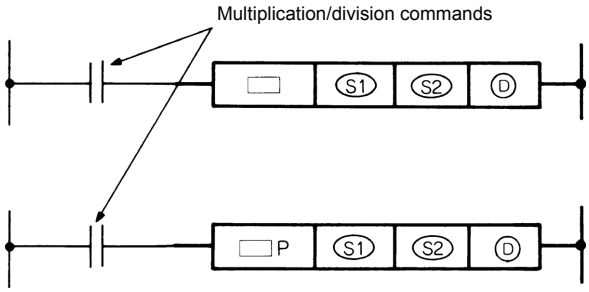
◆Program example

Program that adds the content of D3 to the content of D0 when X5 turns ON, and outputs the results to Y38 to 3F.



3.26.5 Arithmetic operation instruction: BIN 16-bit multiplication/division ... *, *P, /, /P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K4	○
(S2)	○	○	○	○	○	○	○	○			
(D)		○	○	○	○	○					



Instruction symbol inside ☐

*, /

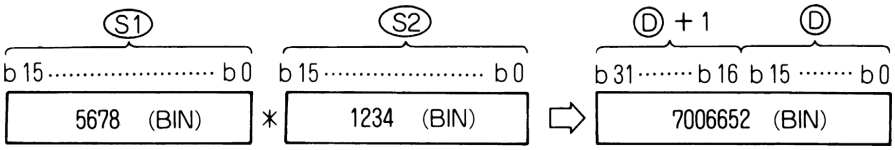
Setting data

(S1)	Start number of the multiplied/ divided data or the device in which the multiplied/divided data is stored
(S2)	Start number of the multiplication/ division data or the device in which the multiplication/division data is stored
(D)	Start number of the device in which the multiplication/division results are stored

◆Function

*

- Executes multiplication of the BIN data specified with (S1) and BIN data specified with (S2), and stores the multiplication results in the device specified with (D).



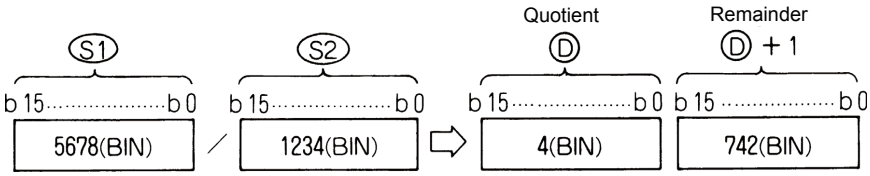
- When (D) is a bit device, specify from the lower bits.
  Example
  K1: Lower 4 bits (b0 to 3)
  K4: Lower 16 bits (b0 to 15)

- -32768 to 32767 (BIN 16-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the data is performed by the most significant bit (b15) for (S1) and (S2), and (b31) for (D).
  (0: Positive, 1: negative)

/

- Executes division of the BIN data specified with (S1) and BIN data specified with (S2), and stores the division results in the device specified with (D).



- The division results are stored as the quotient and remainder using 32 bits for a word device, or stored as only the quotient using 16 bits for a bit device.

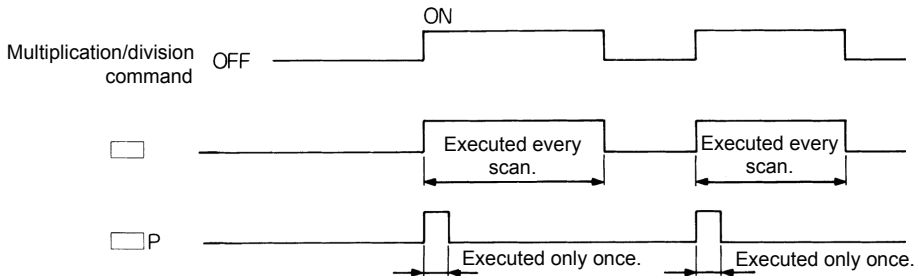
  Quotient: Stored in the lower 16 bits.
  Remainder: Stored in the upper 16 bits. (Only stored for word devices.)

- -32768 to 32767 (BIN 16-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the (S1), (S2), (D) and (D)+1 data is performed by the most significant bit (b15).
  (Both quotient and remainder have a sign.)
  (0: positive, 1: negative)

◆Execution condition

The execution conditions for multiplication/division instructions are as follows.



◆Operation error

An operation error occurs in the following cases, and the error flag turns on.

- When A1 or V are specified for (D).
- When the divisor (S2) is 0.

◆Program example

*

- Program that stores the multiplication results of BIN 5678 and 1234 in D3 and 4 when X5 turns on.

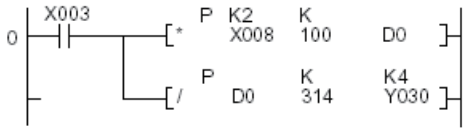


- Coding

```
0   LD    X005
1   *P    K5678   K1234   D3
8   END
```

/

Program that outputs the results of dividing the X8 to F data by 3.14 to Y30 to 3F when X3 turns on.

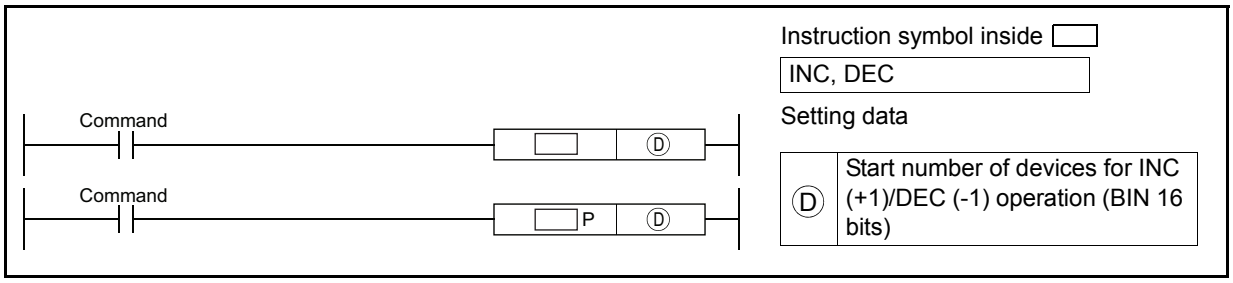


- Coding

```
0   LD    X003
1   *P    K2X008   K100   D0
8   /P    D0       K314   K4Y030
15  END
```

3.26.6 Arithmetic operation instruction: BIN 16-bit data increment/decrement ... INC, INCP, DEC, DECP

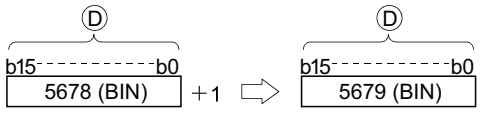
		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
INC, INCP, DEC, DECP	Ⓓ	○	○	○	○	○	○				K1 to K4	○



◆Function

INC

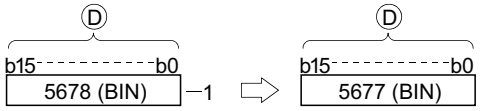
- Adds 1 to the device designated by Ⓓ (16-bit data).



- When INC/INCP operation is executed for the device designated by Ⓓ, whose content is 32767, the value -32768 is stored at the device designated by Ⓓ.

DEC

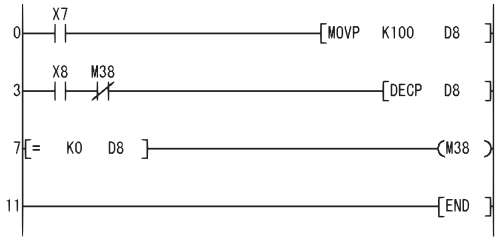
- Subtracts 1 from the device designated by Ⓓ (16-bit data).



- When DEC/DECP operation is executed for the device designated by , whose content is -32768, the value 32767 is stored at the device designated by Ⓓ.

◆Program Example

The following is a down counter program.



Transfers 100 to D8 when X7 goes ON.

In the state M38=OFF, decrement at D8 (D8 - 1) is executed when X8 goes from OFF to ON.

At D8=0, M38 goes ON.

Coding

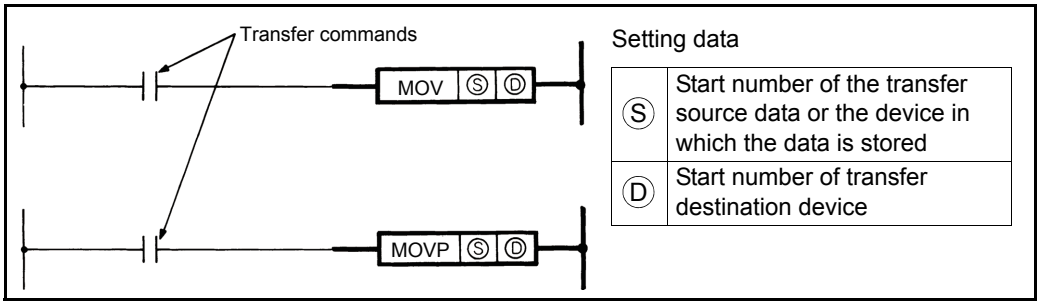
```
0   LD    X7
1   MOVP  K100
3   LD    X8
4   ANI   M38
5   DECP  D8
7   LD=   K0
10  OUT   M38
11  END
```

3.26.7 Data transfer instruction

The data transfer instruction is an instruction that executes the transfer of data.
Data transferred by the data transfer instruction is retained until new data is transferred.

3.26.8 Data transfer instruction: 16-bit data transfer ... MOV, MOVP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
MOV, MOVP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					



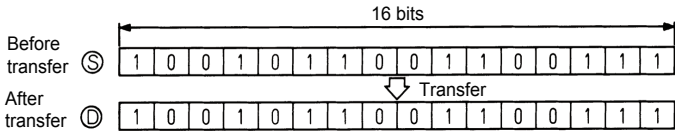
Setting data

Ⓢ	Start number of the transfer source data or the device in which the data is stored
Ⓓ	Start number of transfer destination device

◆Function

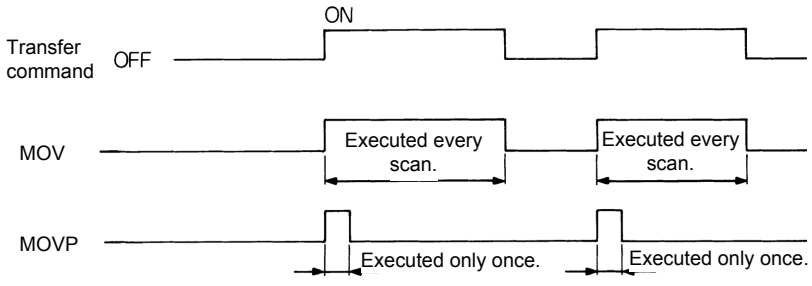
MOV

16-bit data from the device specified with Ⓢ is transferred to the device specified with Ⓓ.



◆Execution condition

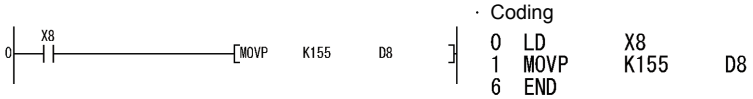
The execution conditions for transfer instructions are as follows.



◆Program example

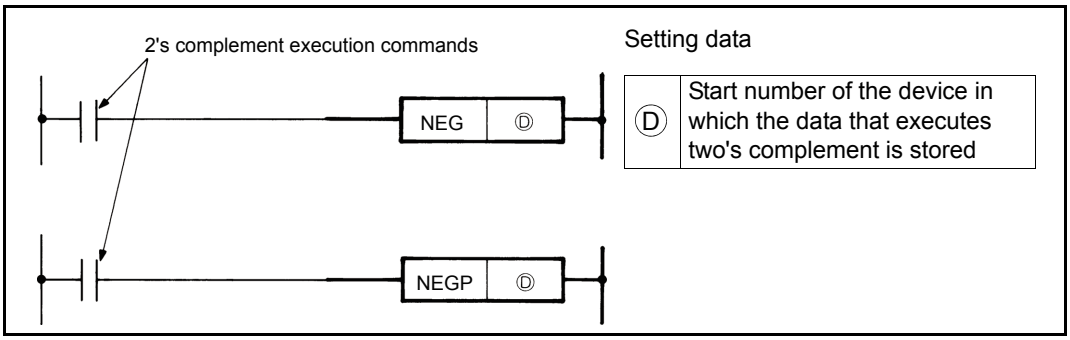
MOV

• Program that stores 155 as a binary value in D8 when X8 turns ON.



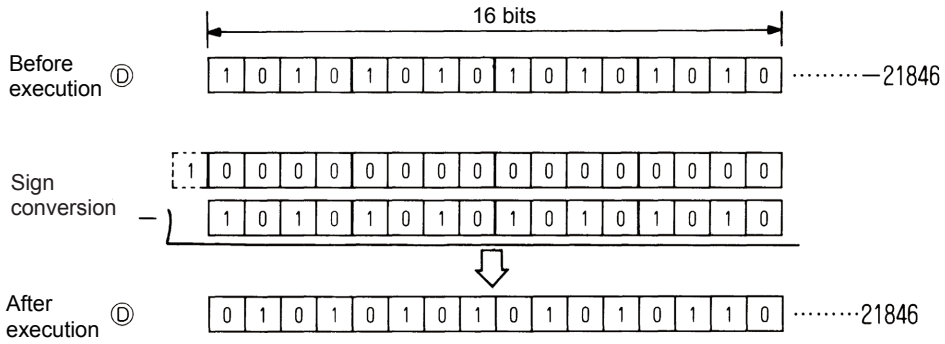
3.26.9 Data conversion instruction: 2's complements of BIN 16-bit data ... NEG, NEGP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
NEG	Ⓓ		○	○	○	○	○	○	○		K1 to K4	○



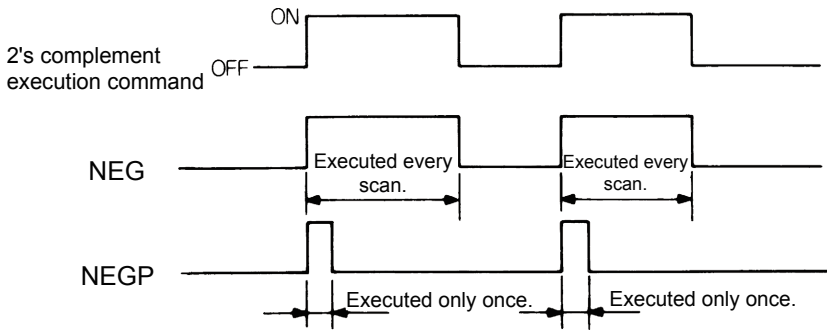
◆Function

- Invert the sign of the 16-bit device specified with Ⓓ, and store the device specified with Ⓓ.



- This is used when inverting the positive/negative signs.

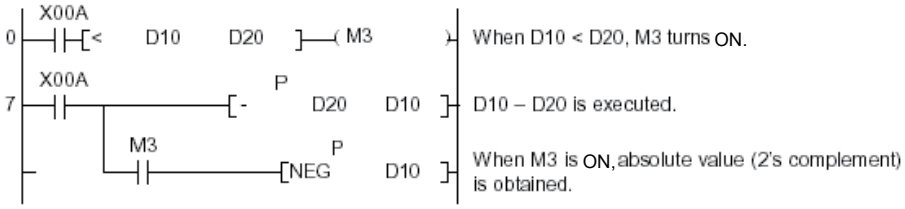
◆Execution condition



◆Program example

NEG

• Program that calculates D10 to D20 when XA is turned ON, and calculates the absolute value when this result is negative.

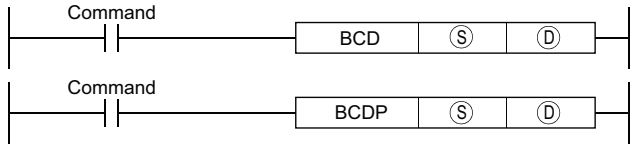


• Coding

```
 0  LD      X00A
 1  AND<    D10     D20
 6  OUT     M3
 7  LD      X00A
 8  -P      D20     D10
13  AND     M3
14  NEGP    D10
17  END
```

3.26.10 Data conversion instructions: BIN 16-bit data BCD conversions ... BCD, BCDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
BCD BCDP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ	○	○	○	○	○	○					



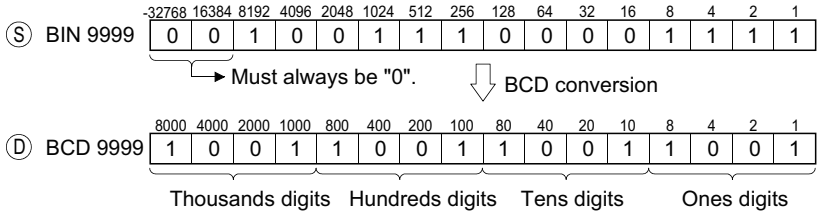
Setting data

Ⓢ	BIN data or start number of the devices where the BIN data is stored (BIN 16 bits)
Ⓓ	Start number of the devices where BCD data will be stored (BCD 4 digits)

◆Function

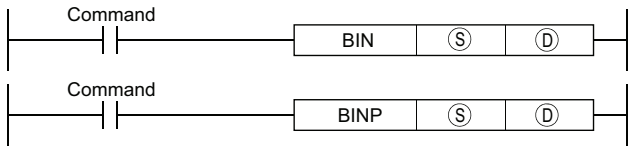
BCD

- Converts BIN data (0 to 9999) at the device designated by Ⓢ to BCD data, and stores it at the device designated by Ⓓ.



3.26.11 Data conversion instructions: BIN 16-bit data BIN conversions ... BIN, BINP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
BIN BINP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ	○	○	○	○	○	○					



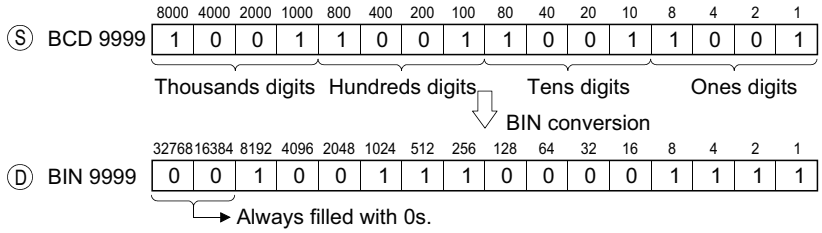
Setting data

Ⓢ	BCD data or start number of the devices where the BCD data is stored (BCD 4 digits)
Ⓓ	Start number of the devices where BIN data will be stored (BIN 16 bits)

◆Function

BIN

• Converts BCD data (0 to 9999) at device designated by Ⓢ to BIN data, and stores at the device designated by Ⓓ.



3.27 Basic instruction (32-bit)

The basic instruction (32-bit) is an instruction that can handle numeric data that is expressed in 32 bits.

3.27.1 Comparison operation instruction

- Comparison operation instructions execute size comparisons (D=, D>, D< etc.) of two data, and instructs the contact to turn ON when the conditions are met.

- The usage method of comparison operation instructions is the same as the contact instructions of sequence instructions, and is as follows.
  - LD, LDI.....LDD=
  - AND, ANI...ANDD=
  - OR, ORI.....ORD=

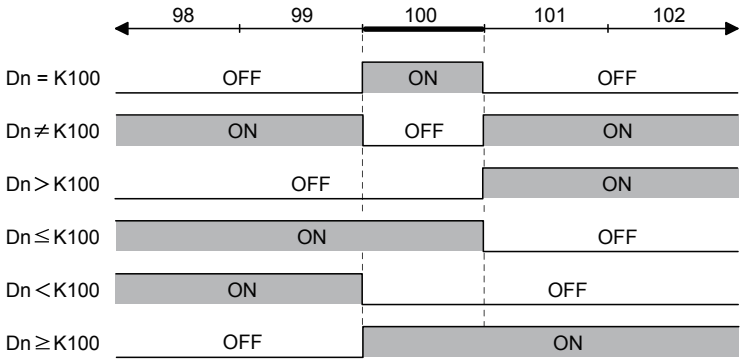
- There are 18 types of comparison operation instruction as shown below.
  For details, refer to page 156.

Classification	Instruction symbol
=	LDD=
	ANDD=
	ORD=
≠	LDD<>
	ANDD<>
	ORD<>

Classification	Instruction symbol
>	LDD>
	ANDD>
	ORD>
≤	LDD<=
	ANDD<=
	ORD<=

Classification	Instruction symbol
<	LDD<
	ANDD<
	ORD<
≥	LDD>=
	ANDD>=
	ORD>=

- The conditions for turning comparison operation instructions ON are as follows.

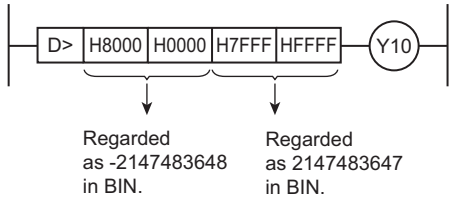


NOTE

- The comparison instruction assumes the specified data as a BIN value for comparison. For this reason, when performing hexadecimal comparison, when the value whose most significant bit (b31) is 1 (8 to F), the BIN value is assumed as a negative number for the comparison.

Example

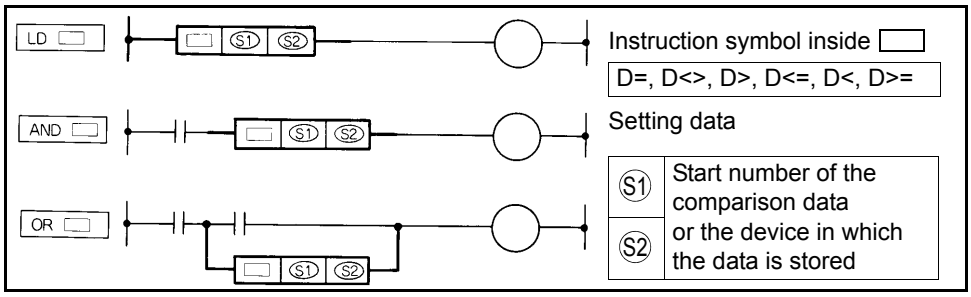
Comparison of HEX/8 digit value



Therefore, -2147483648 < -2147483647, and Y10 does not turn ON.

3.27.2 Comparison operation instruction: 32-bit data comparison ... D=, D<>, D>, D<=, D<, D>=

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K8	○
(S2)	○	○	○	○	○	○	○	○			



Instruction symbol inside
D=, D<>, D>, D<=, D<, D>=

Setting data

(S1)	Start number of the comparison data or the device in which the data is stored
(S2)	

◆Function

- 32-bit comparison operation handled as NO contact.
- Comparison operation results are as follows.

Instruction symbol inside	Condition	Comparison operation results
D=	(S1) = (S2)	Conducted
D<>	(S1) ≠ (S2)	
D>	(S1) > (S2)	
D<=	(S1) ≤ (S2)	
D<	(S1) < (S2)	
D>=	(S1) ≥ (S2)	

Instruction symbol inside	Condition	Comparison operation results
D=	(S1) ≠ (S2)	Not conducted
D<>	(S1) = (S2)	
D>	(S1) ≤ (S2)	
D<=	(S1) > (S2)	
D<	(S1) ≥ (S2)	
D>=	(S1) < (S2)	

◆Execution condition

The execution conditions for LD □, AND □ and OR □ are as follows.

Instruction	Execution condition
LD □	Each scan execution
AND □	Executed when the previous contact instruction turns ON.
OR □	Each scan execution

NOTE

- When the digit setting of a bit device is other than K8 and a start bit device value is other than a multiple of 8, the number of steps is 7.

◆Program example

D=

Program that compares the M0 to 31 data with D3 and D4 data.

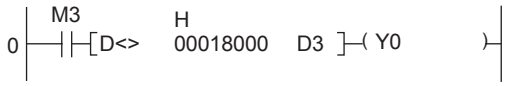


· Coding

```
 0  LDD=   K8M0     D3
11  OUT    Y0
12  END
```

D<>

Program that compares the BCD value 18000 with D3 and D4 data.

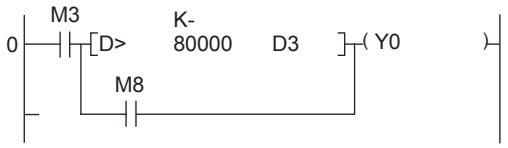


· Coding

```
 0  LD      M3
 1  ANDD<>  H00018000   D3
12  OUT     Y0
13  END
```

D>

Program that compares the BIN value -80000 with D3 and D4 data.

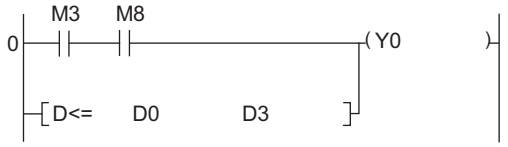


· Coding

```
 0  LD      M3
 1  LDD>    K-80000     D3
12  OR      M8
13  ANB
14  OUT     Y0
15  END
```

D<=

Program that compares D0 and D1 with D3 and D4 data.



· Coding

```
 0  LD      M3
 1  AND     M8
 2  ORD<=   D0      D3
13  OUT     Y0
14  END
```

3.27.3 Arithmetic operation instruction

An arithmetic operation instruction instructs the addition, subtraction, multiplication or division for two BIN data, or operation of increment or decrement.

◆BIN arithmetic operation (binary)

- If the operation result of an addition instruction exceeds 2147483647, the value is negative.
- If the operation result of a subtraction instruction is smaller than -2147483648, the value is positive.
- Operations of positive values and negative values are as follows.

  5 + 8 → 13

  5 - 8 → -3

  5 × 3 → 15

  -5 × 3 → -15

  -5 × (-3) → 15

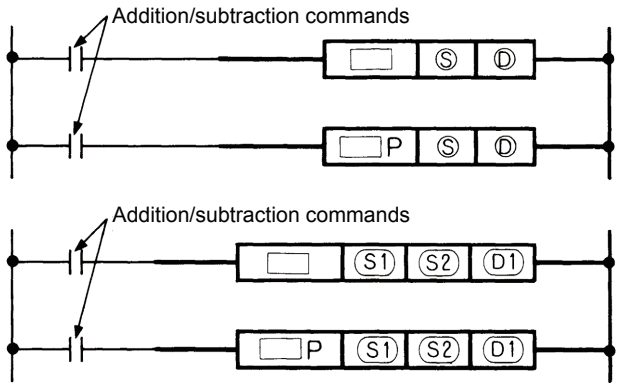
  -5 ÷ 3 → -1 remainder -2

  5 ÷ (-3) → -1 remainder 2

  -5 ÷ (-3) → 1 remainder -2

3.27.4 Arithmetic operation instruction: BIN 32-bit addition/subtraction ... D+, D+P, D-, D-P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
Ⓓ		○	○	○	○	○					
Ⓢ	○	○	○	○	○	○	○	○			
Ⓢ2	○	○	○	○	○	○	○	○			
Ⓢ2		○	○	○	○	○					



Instruction symbol inside ☐

D+, D-

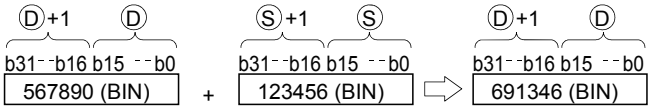
Setting data

Ⓢ	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ	Start number of the device in which the added/subtracted data is stored
Ⓢ1	Start number of the added/subtracted data or the device in which the added/ subtracted data is stored
Ⓢ2	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ1	Start number of the device in which the addition/subtraction results are stored

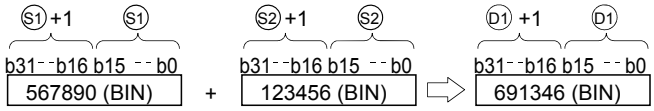
◆Function

D+

- Executes addition of the BIN data specified with Ⓓ and BIN data specified with Ⓢ, and stores the addition results in the device specified with Ⓓ.



- Executes addition of the BIN data specified with Ⓢ1 and BIN data specified with Ⓢ2, and stores the addition results in the device specified with Ⓓ1.

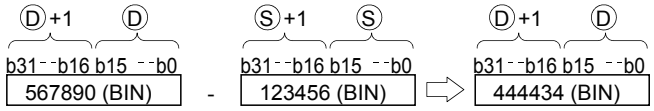


- -2147483648 to 2147483647 (BIN 32-bit) can be specified in Ⓢ, Ⓢ1, Ⓢ2 or Ⓓ.
- Positive/negative judgment of the Ⓢ, Ⓢ1, Ⓢ2 and Ⓓ data is performed by the most significant bit (b31).
  (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 31st bit overflow. (There is no carry flag)

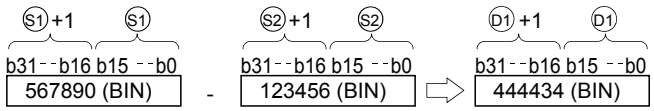
◆Function

D-

- Executes subtraction of the BIN data specified with Ⓓ and BIN data specified with Ⓢ, and stores the subtraction results in the device specified with Ⓓ.



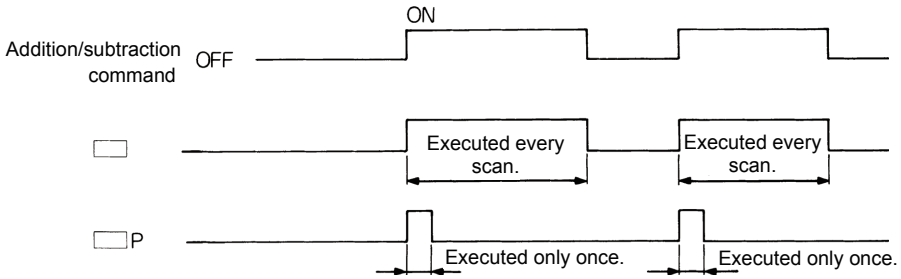
- Executes subtraction of the BIN data specified with Ⓢ1 and BIN data specified with Ⓢ2, and stores the subtraction results in the device specified with Ⓓ1.



- -2147483648 to 2147483647 (BIN 32-bit) can be specified in Ⓢ, Ⓢ1, Ⓢ2 or Ⓓ.
- Positive/negative judgment of the Ⓢ, Ⓢ1, Ⓢ2 and Ⓓ data is performed by the most significant bit (b31).
  (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 31st bit overflow. (There is no carry flag)

◆Execution condition

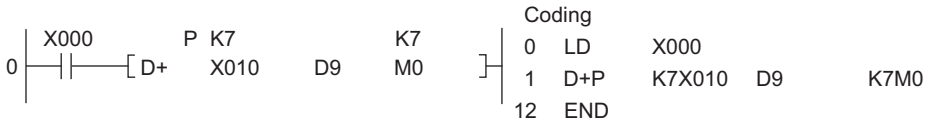
Addition/subtraction instruction



◆Program example

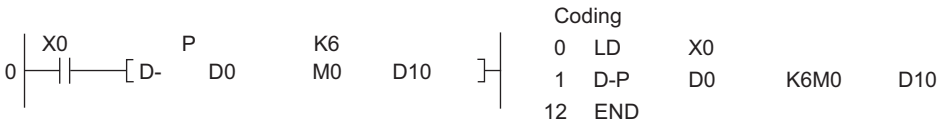
D+

Program that adds the X10 to X2B 28-bit data to the D9 and D10 data when X0 turns ON, and outputs the results to M0 to M27.



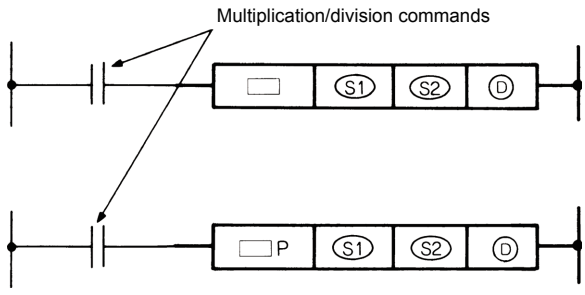
D-

Program that subtracts the M0 to M23 data from the D0 and D1 data when X0 turns ON, and stores the results in D10 and D11.



3.27.5 Arithmetic operation instruction: BIN 32-bit multiplication/division ... D*, D*P, D/, D/P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K8	○
(S2)	○	○	○	○	○	○	○	○			
(D)		○	○	○	○	○					



Instruction symbol inside

D*, D/

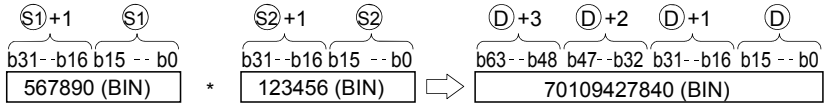
Setting data

(S1)	Start number of the multiplied/divided data or the device in which the multiplied/divided data is stored
(S2)	Start number of the multiplication/division data or the device in which the multiplication/division data is stored
(D)	Start number of the device in which the multiplication/division results are stored

◆Function

D*

- Executes multiplication of the BIN data specified with (S1) and BIN data specified with (S2), and stores the results in the device specified with (D)



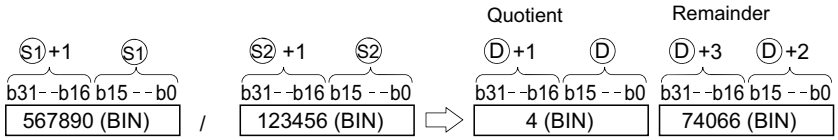
- When (D) is a bit device, specify from the lower bits.
  Example
  K1: Lower 4 bits (b0 to 3)
  K4: Lower 16 bits (b0 to 15)
  K8: Lower 32 bits (b0 to 31)

- -2147483648 to 2147483647 (BIN 32-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the data is performed by the most significant bit (b31) for (S1) and (S2), and (b63) for (D). (0: positive, 1: negative)

D/

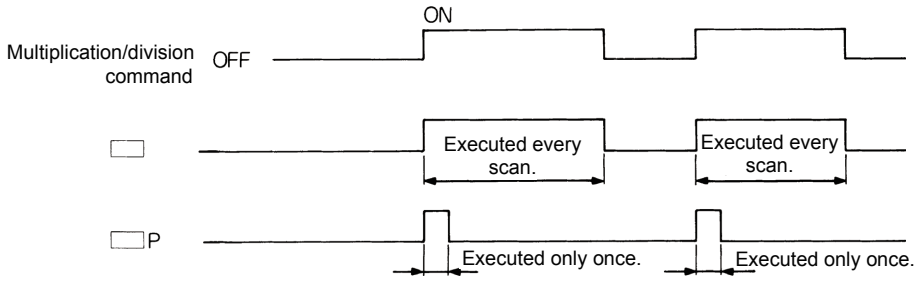
- Executes division of the BIN data specified with (S1) and BIN data specified with (S2), and stores the results in the device specified with (D).



- The division results are stored as the quotient and remainder using 64 bits for a word device, or stored as only the quotient using 32 bits for a bit device.
  Quotient: Stored in the lower 32 bits.
  Remainder: Stored in the upper 32 bits. (Only stored for word devices.)
- -2147483648 to 2147483647 (BIN 32-bit) can be specified in (S1) or (S2).
- Positive/negative judgment of the (S1), (S2), (D) and (D)+2 data is performed by the most significant bit (b31).
  (Both quotient and remainder have a sign.)
  (0: positive, 1: negative)

◆Execution condition

The execution conditions for multiplication/division instructions are as follows.



◆Operation error

An operation error occurs in the following cases, and the error flag turns ON.

- When A1 or V is specified in Ⓢ1 or Ⓢ2, or A0, A1, Z or V are specified in Ⓓ.
- When the divisor Ⓢ2 is 0.

◆Program example

D*

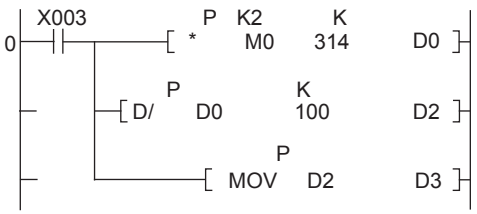
Program that stores the results of multiplying D7 and D8 BIN data with D18 and D19 BIN data in D1 to D4 when X5 turns ON.




```
Coding
 0   LD     X005
 1   D*P    D7      D18     D1
12   END
```

D/

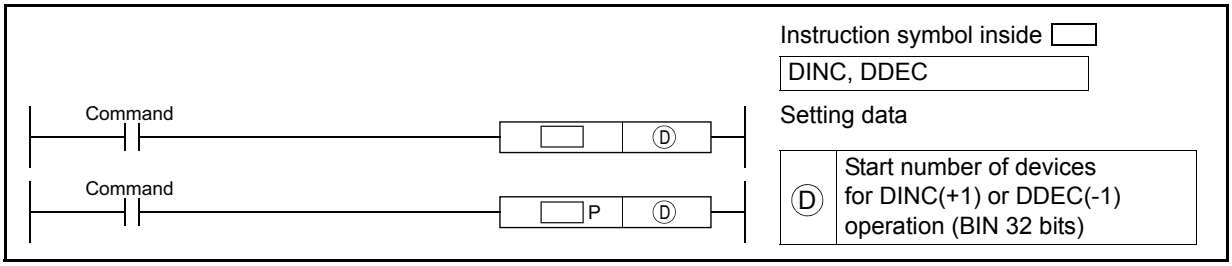
Program that outputs the result of multiplying M0 to 7 by 3.14 to D3 when X3 turns ON.




```
Coding
 0   LD     X003
 1   *P     K2M0    K314    D0
 8   D/P    D0              K100    D2
19   MOVP   D2      D3
24   END
```

3.27.6 Arithmetic operation instruction: BIN 32-bit data increment/decrement ... DINC, DINCP, DDEC, DDECP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DINC, DINCP, DDEC, DDECP	(D)	○	○	○	○	○	○				K1 to K4	○



◆Function

DINC

- Adds 1 to the device designated by (D) (32-bit data).



- When DINC/DINCP operation is executed for the device designated by (D), whose content is 2147483647, the value -2147483648 is stored at the device designated by (D).

DDEC

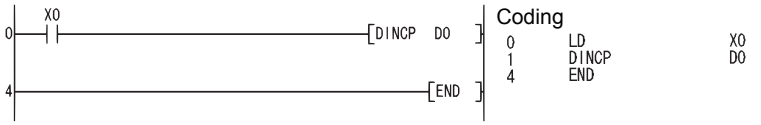
- Subtracts -1 from the device designated by (D) (32-bit data).



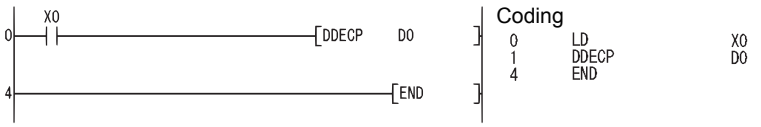
- When DDEC/DDECP operation is executed for the device designated by (D), whose content is 0, the value -1 is stored at the device designated by (D).

◆Program example

- The following program adds 1 to the data at D0 and D1 when X0 is ON.



- The following program subtracts 1 from the data at D0 and D1 when X0 goes ON.

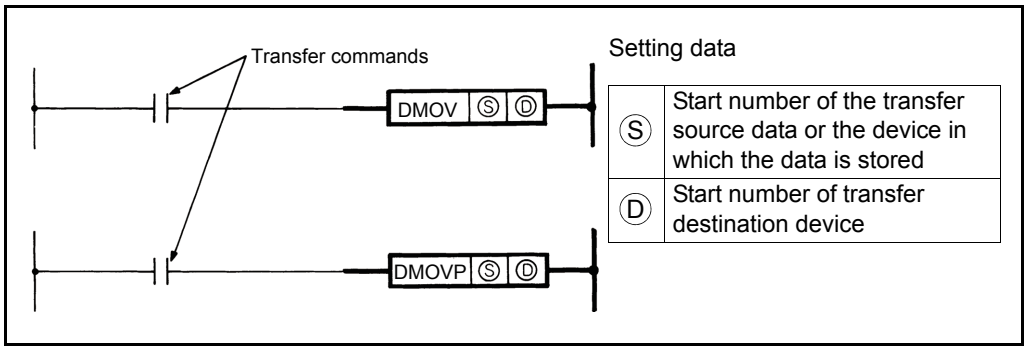


3.27.7 Data transfer instruction

The data transfer instruction is an instruction that executes the transfer of data.
Data transferred by the data transfer instruction is retained until new data is transferred.

3.27.8 Data transfer instruction: 32-bit data transfer ... DMOV, DMOVP

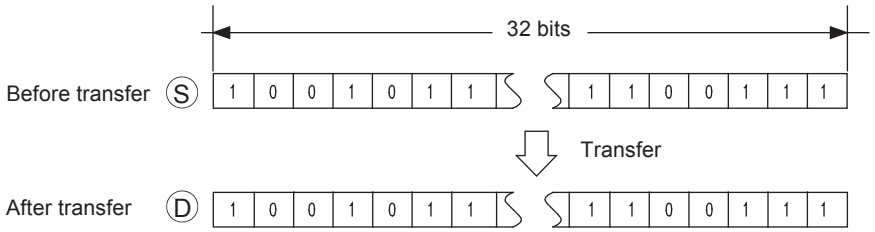
		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DMOV, DMOVP	(S)	○	○	○	○	○	○	○	○		K1 to K8	○
	(D)		○	○	○	○	○					



◆Function

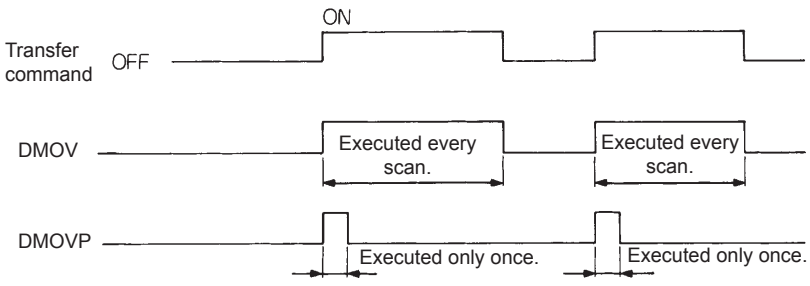
DMOV

32-bit data from the device specified with (S) is transferred to the device specified with (D).



◆Execution condition

The execution conditions for transfer instructions are as follows.



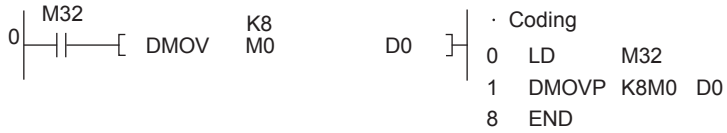
◆Program example

DMOV

• Program that stores the input D2 to D3 data in D0 and D1.

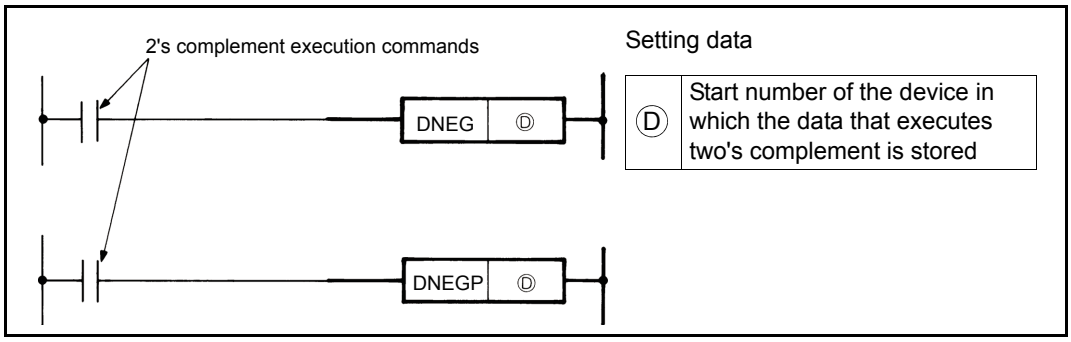


• Program that stores M0 to M31 data in D0 and D1.



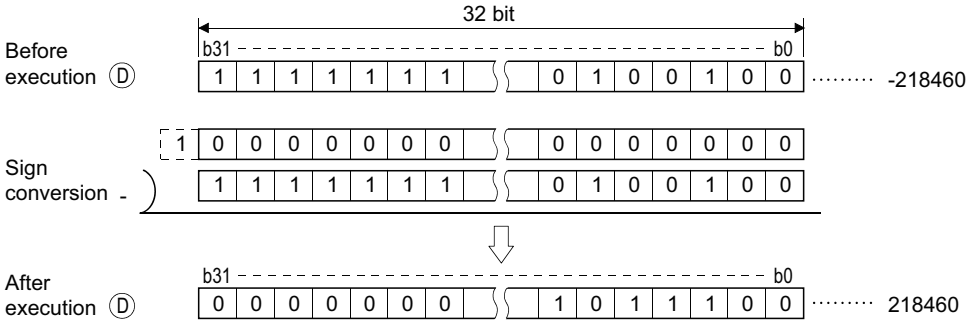
3.27.9 Data conversion instruction: 2's complements of BIN 32-bit data ... DNEG, DNEGP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DNEG(P)	Ⓓ		○	○	○	○	○	○	○		K1 to K8	○



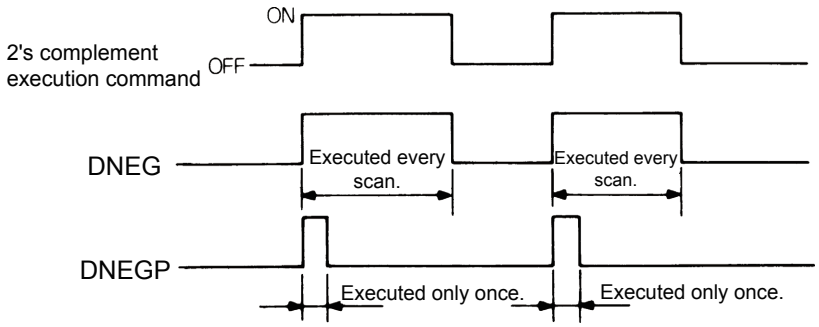
◆Function

- Invert the sign of the 32-bit device specified with Ⓓ, and store the device specified with Ⓓ.



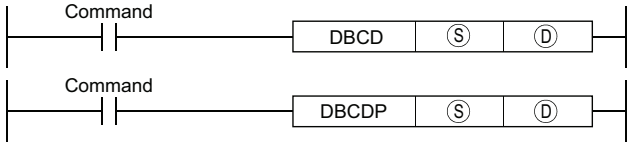
- This is used when inverting the positive/negative signs.

◆Execution condition



3.27.10 Data conversion instructions: BIN 32-bit data BCD conversions ... DBCD, DBCDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DBCD DBCDP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ	○	○	○	○	○	○					



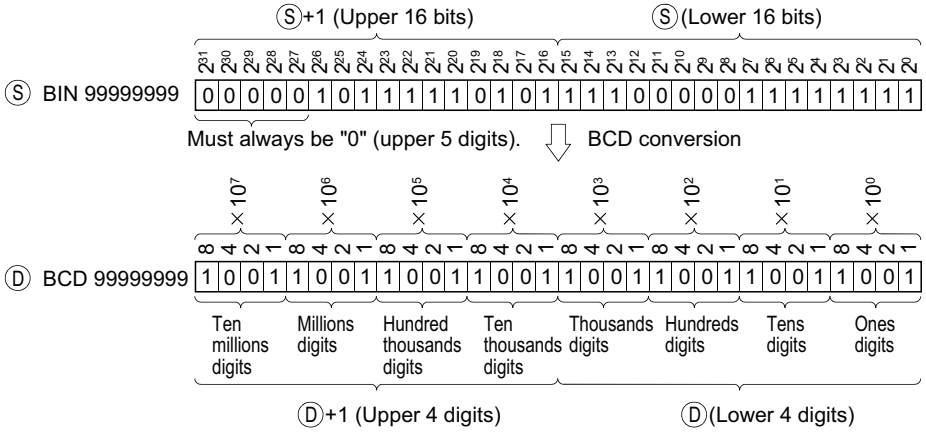
Setting data

Ⓢ	BIN data or start number of the devices where the BIN data is stored (BIN 32 bits)
Ⓓ	Start number of the devices where BCD data will be stored (BCD 8 digits)

◆Function

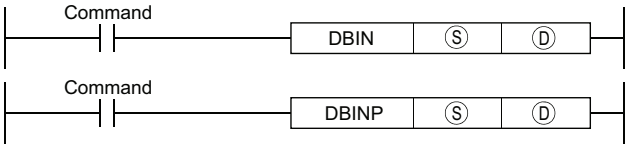
DBCD

- Converts BIN data (0 to 99999999) at the device designated by Ⓢ to BCD data, and stores it at the device designated by Ⓓ.



3.27.11 Data conversion instructions: BIN 32-bit data BIN conversions ... DBIN, DBINP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DBIN DBINP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ	○	○	○	○	○	○					



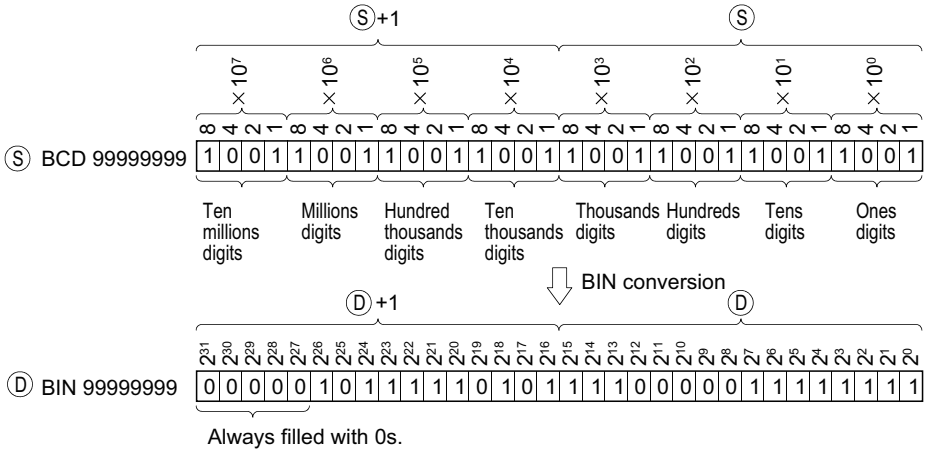
Setting data

Ⓢ	BCD data or start number of the devices where the BCD data is stored (BCD 8 digits)
Ⓓ	Start number of the devices where BIN data will be stored (BIN 32 bits)

◆Function

DBIN

- Converts BCD data (0 to 99999999) at the device designated by Ⓢ to BIN data, and stores at the device designated by Ⓓ.



3.28 Application instructions (16-bit)

Application instructions (16-bit) are used when special processing is required.

3.28.1 Logical operation instructions

- Logical operation instructions are instructions that execute logical operations such as logical OR or logical AND.

- There are 10 types of logical operation instruction as shown below.

Classification	Instruction symbol
Logical AND	WAND
	WANDP
Logical OR	WOR
	WORP

Classification	Instruction symbol
Exclusive OR	WXOR
	WXORP
Exclusive NOR	WXNR
	WXNRP

Classification	Instruction symbol
2's complement (code reversed)	NEG
	NEGP

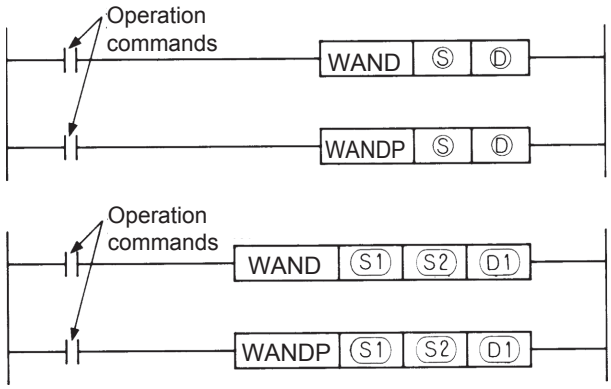
NOTE

- Logical operation instructions execute the following processes in increments of bits.

Classification	Process	Formula	Example		
			A	B	Y
Logical AND	Set 1 when the inputs of both A and B are 1. Set 0 in all other cases.	$Y = A \cdot B$	0	0	0
			0	1	0
			1	0	0
			1	1	1
Logical OR	Set 0 when the inputs of both A and B are 0. Set 1 in all other cases.	$Y = A + B$	0	0	0
			0	1	1
			1	0	1
			1	1	1
Exclusive OR	Set 0 when the inputs of both A and B are equal. Set 1 when they are different.	$Y = \overline{A} \cdot B + A \cdot \overline{B}$	0	0	0
			0	1	1
			1	0	1
			1	1	0
Exclusive NOR	Set 1 when the inputs of both A and B are equal. Set 0 when they are different.	$Y = (\overline{A} + B)(A + \overline{B})$	0	0	1
			0	1	0
			1	0	0
			1	1	1

3.28.2 Logical operation instruction: BIN 16-bit logical AND ... WAND, WANDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WAND	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



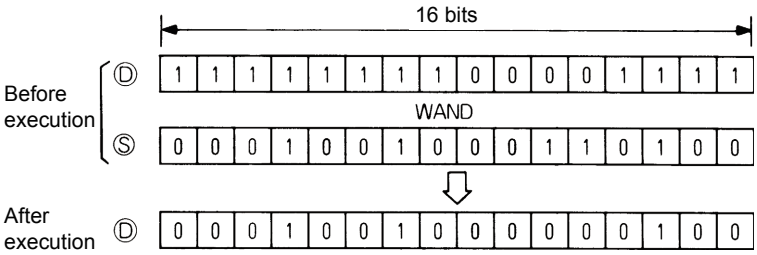
Setting data

Ⓢ	Start number of the data that executes the logical AND or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical AND results are stored

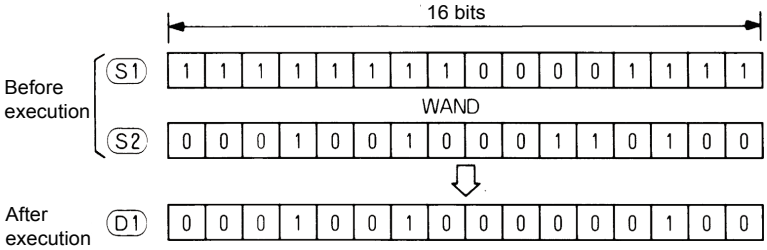
◆Function

WAND

- Logical AND is executed for each bit of the 16-bit data of the device specified with Ⓓ and 16-bit data of the device specified with Ⓢ, and the results are stored in the device specified with Ⓓ.



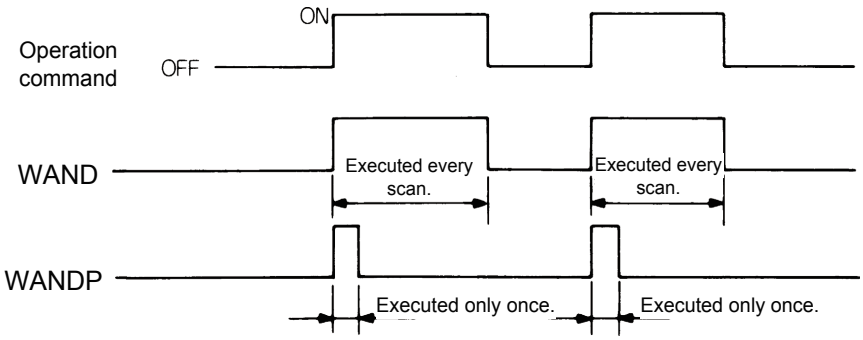
- Logical AND is executed for each bit of the 16-bit data of the device specified with Ⓢ1 and 16-bit data of the device specified with Ⓢ2, and the results are stored in the device specified with Ⓓ1.



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

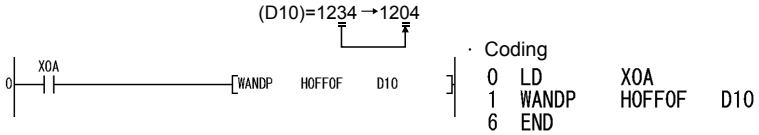
The execution conditions for logical AND instructions are as follows.



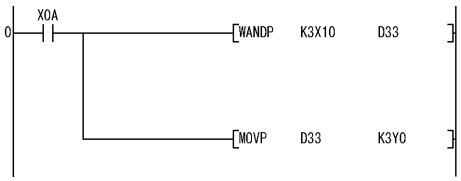
◆Program example

WAND

- Program that masks the tenth digit (the second digit from the bottom) of the BCD 4 digits when XA turns ON.



• Program that executes logical AND for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y0 to B.

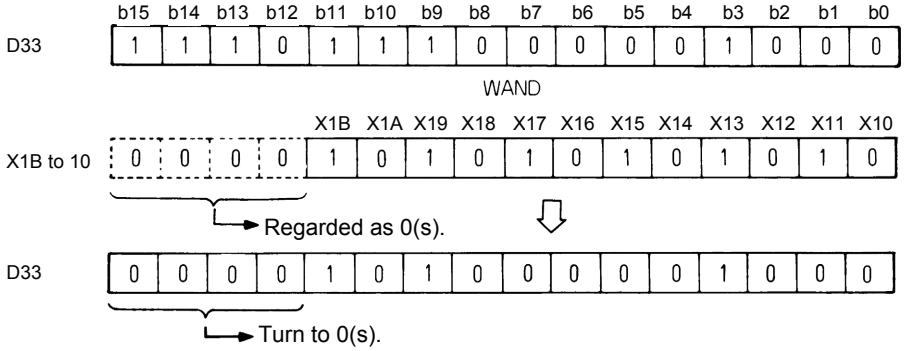


ANDs X10-1B data and D33 data and stores result to D33.

Outputs D33 data to Y0-F.

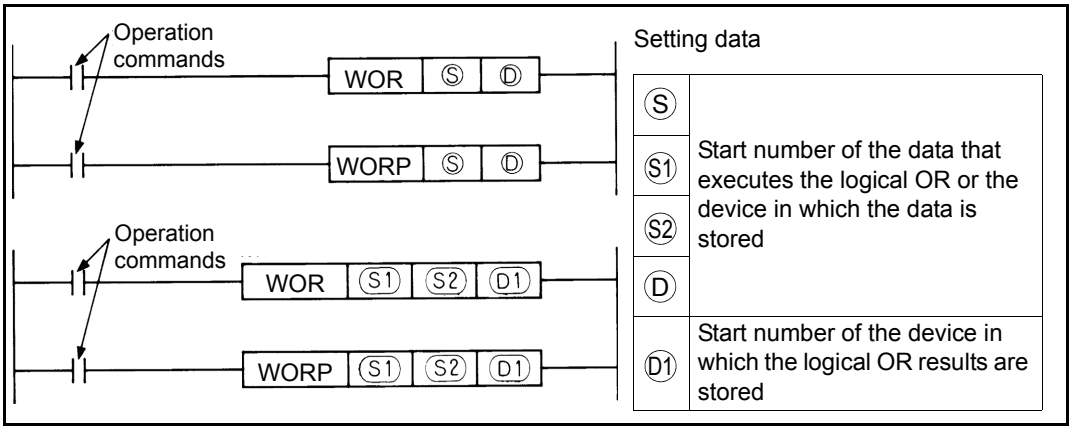
· Coding

```
 0  LD      X0A
 1  WANDP   K3X10   D33
 6  MOVP    D33     K3Y0
11  END
```



3.28.3 Logical operation instruction: BIN 16-bit logical OR ... WOR, WORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WOR	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



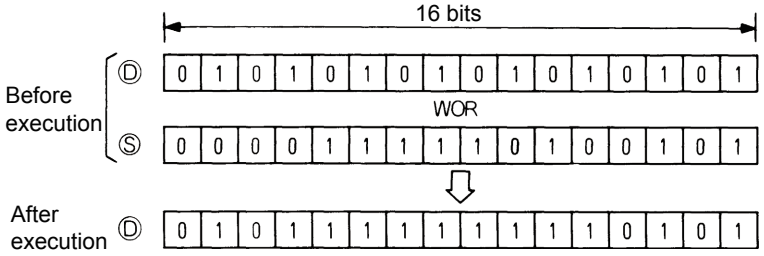
Setting data

Ⓢ	
Ⓢ1	Start number of the data that executes the logical OR or the device in which the data is stored
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical OR results are stored

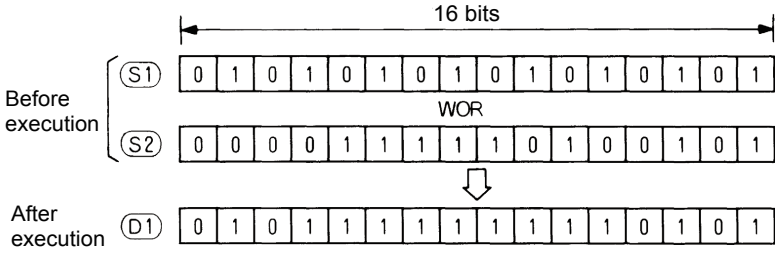
◆Function

WOR

- Logical OR is executed for each bit of the 16-bit data of the device specified with Ⓓ and 16-bit data of the device specified with Ⓢ, and the results are stored in the device specified with Ⓓ.



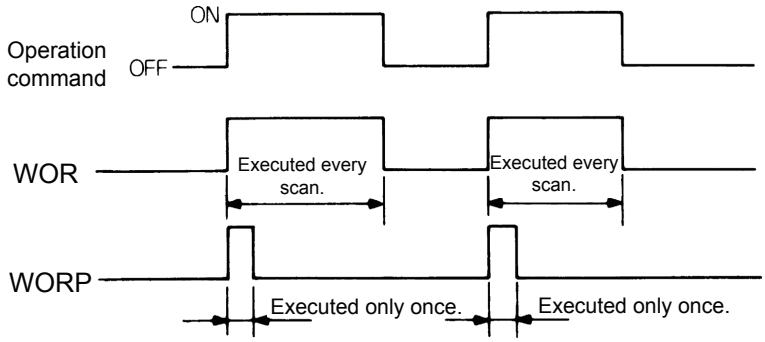
- Logical OR is executed for each bit of the 16-bit data of the device specified with Ⓢ1 and 16-bit data of the device specified with Ⓢ2, and the results are stored in the device specified with Ⓓ1.



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

• The execution conditions for logical OR instructions are as follows.



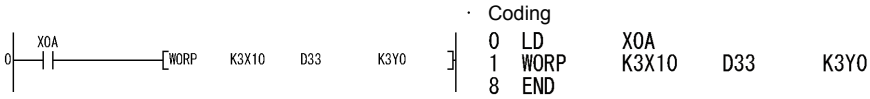
◆Program example

WOR

• Program that executes logical OR for D10 and D20 data when XA turns ON, and stores the results in D10.

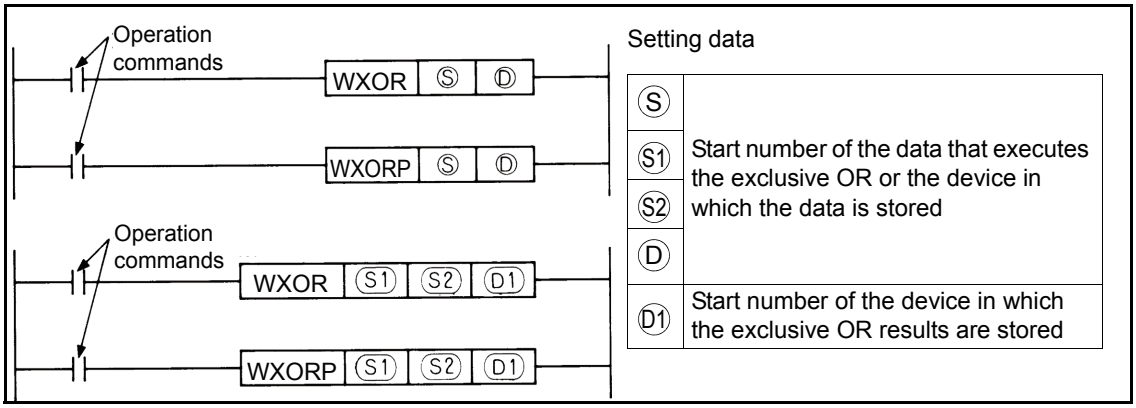


• Program that executes logical OR for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y0 to B.



3.28.4 Logical operation instruction: BIN 16-bit data exclusive OR ... WXOR, WXORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WXOR	(S)	○	○	○	○	○	○	○	○		K1 to K4	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



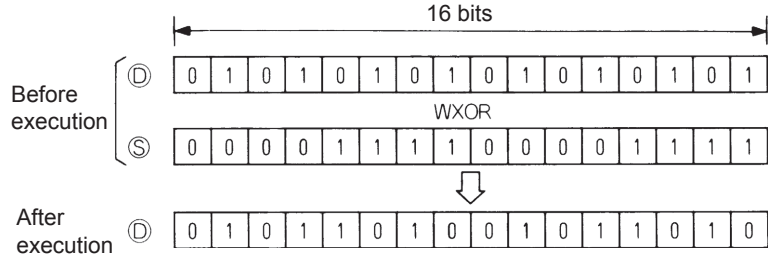
Setting data

(S), (S1), (S2), (D)	Start number of the data that executes the exclusive OR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive OR results are stored

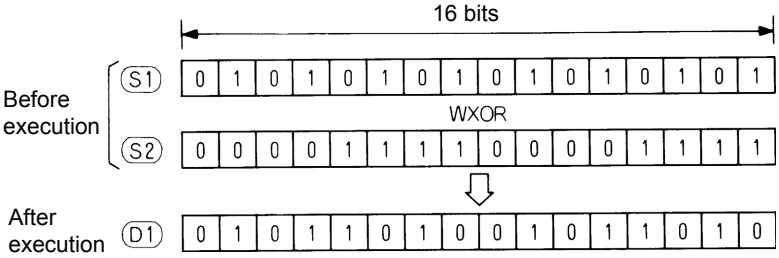
◆Function

WXOR

- Exclusive OR is executed for each bit of the 16-bit data of the device specified with (D) and 16-bit data of the device specified with (S), and the results are stored in the device specified with (D).



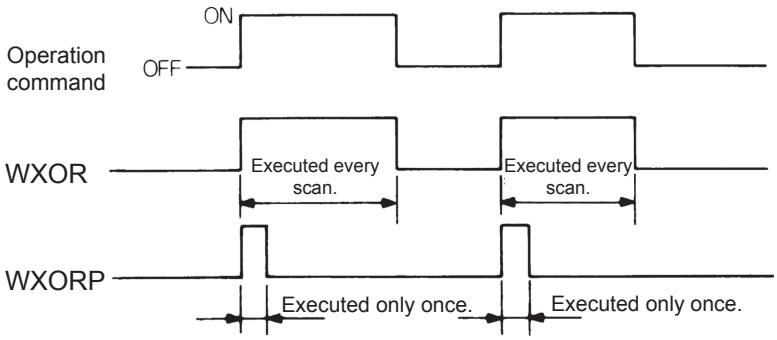
- Exclusive OR is executed for each bit of the 16-bit data of the device specified with (S1) and 16-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

The execution conditions for exclusive OR instructions are as follows.



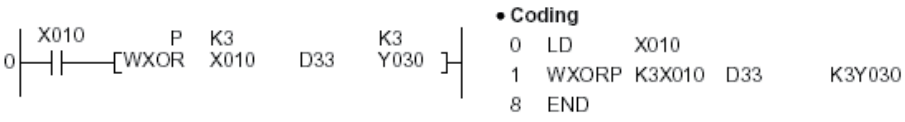
◆Program example

WXOR

- Program that executes exclusive OR for D10 and D20 data when XA turns ON, and stores the results in D10.

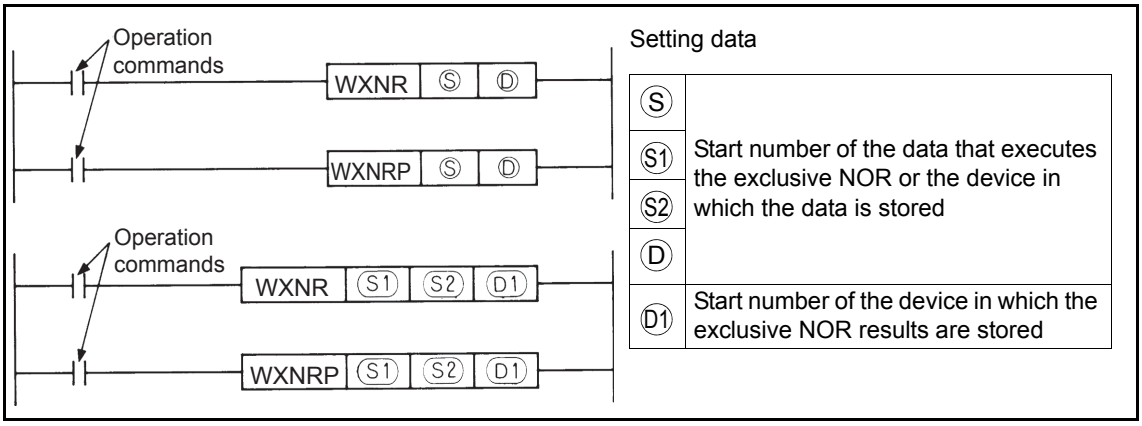


- Program that executes exclusive OR for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y30 to 3B.



3.28.5 Logical operation instruction: BIN 16-bit data exclusive NOR ... WXNR, WXNRP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WXNR	(S)	○	○	○	○	○	○	○	○		K1 to K4	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



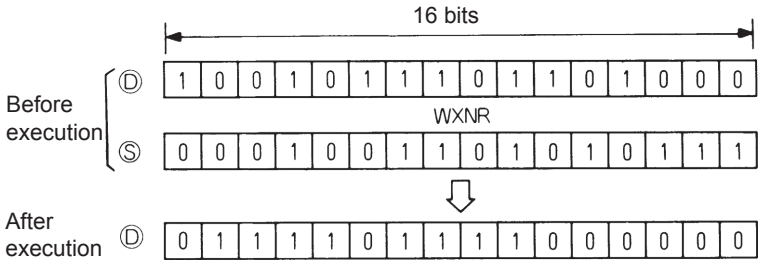
Setting data

(S), (S1), (S2), (D)	Start number of the data that executes the exclusive NOR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive NOR results are stored

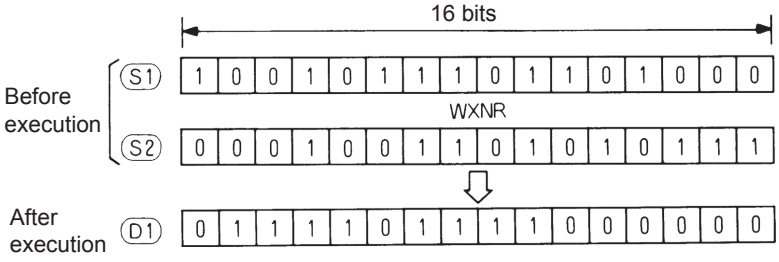
◆Function

WXNR

- Exclusive NOR is executed for the 16-bit data of the device specified with (D) and 16-bit data of the device specified with (S), and the results are stored in the device specified with (D).



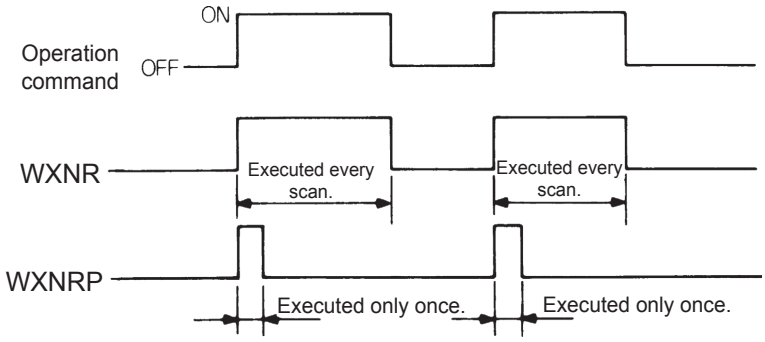
- Exclusive NOR is executed for the 16-bit data of the device specified with (S1) and 16-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

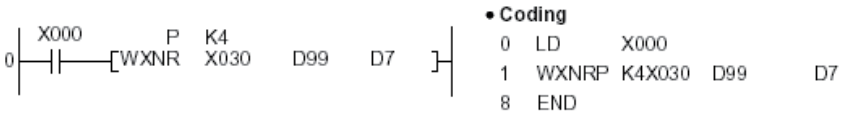
The execution conditions for exclusive NOR instructions are as follows.



◆Program example

WXNR

- Program that executes exclusive NOR for the 16-bit data of X30 to 3F and D99 data when X0 turns ON, and stores the results in D7.



3.29 Application instructions (32-bit)

Application instructions (32-bit) are used when special processing is required.

3.29.1 Logical operation instructions

- Logical operation instructions are instructions that execute logical operations such as logical OR or logical AND.

- There are 10 types of logical operation instruction as shown below.

Classification	Instruction symbol
Logical AND	DAND
	DANDP
Logical OR	DOR
	DORP

Classification	Instruction symbol
Exclusive OR	DXOR
	DXORP
Exclusive NOR	DXNR
	DXNRP

Classification	Instruction symbol
2's complement (code reversed)	DNEG
	DNEGP

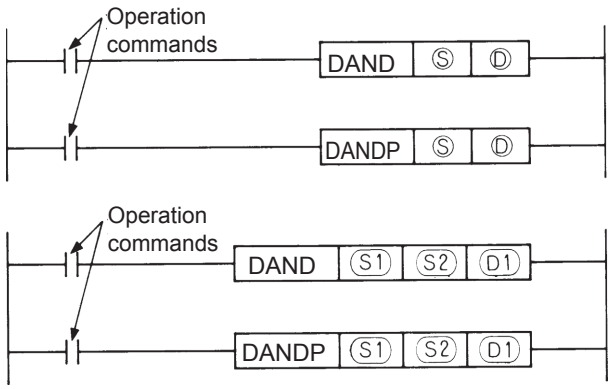
NOTE

- Logical operation instructions execute the following processes in increments of bits.

Classification	Process	Formula	Example		
			A	B	Y
Logical AND	Set 1 when the inputs of both A and B are 1. Set 0 in all other cases.	$Y = A \cdot B$	0	0	0
			0	1	0
			1	0	0
			1	1	1
Logical OR	Set 0 when the inputs of both A and B are 0. Set 1 in all other cases.	$Y = A + B$	0	0	0
			0	1	1
			1	0	1
			1	1	1
Exclusive OR	Set 0 when the inputs of both A and B are equal. Set 1 when they are different.	$Y = \overline{A} \cdot B + A \cdot \overline{B}$	0	0	0
			0	1	1
			1	0	1
			1	1	0
Exclusive NOR	Set 1 when the inputs of both A and B are equal. Set 0 when they are different.	$Y = (\overline{A} + B)(A + \overline{B})$	0	0	1
			0	1	0
			1	0	0
			1	1	1

3.29.2 Logical operation instruction: BIN 32-bit logical AND ... DAND, DANDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DAND (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



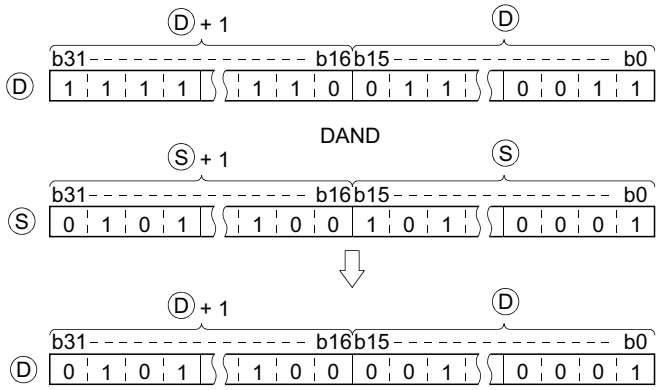
Setting data

Ⓢ	Start number of the data that executes the logical AND or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical AND results are stored

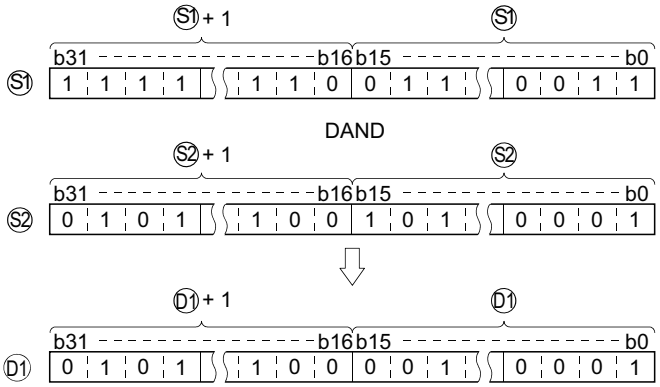
◆Function

DAND

- Logical AND is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



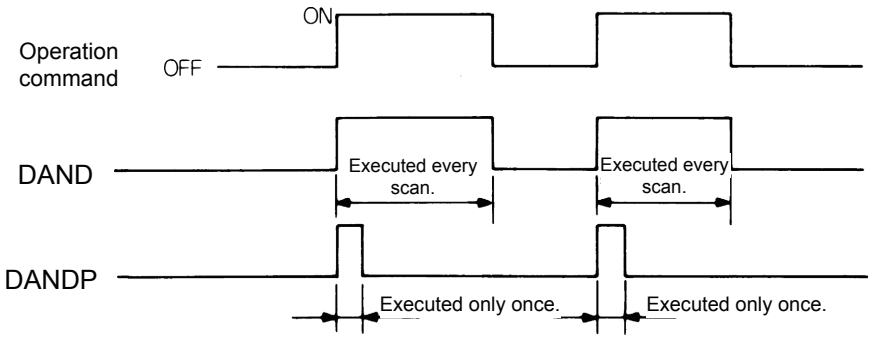
- Logical AND is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

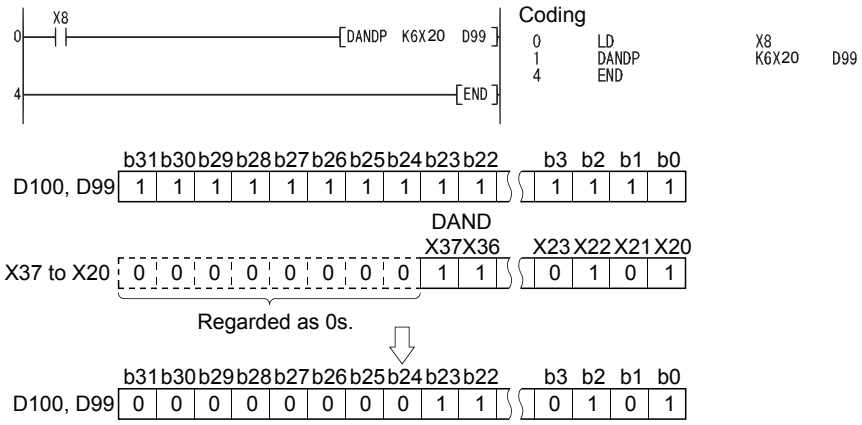
The execution conditions for logical AND instructions are as follows.



◆Program example

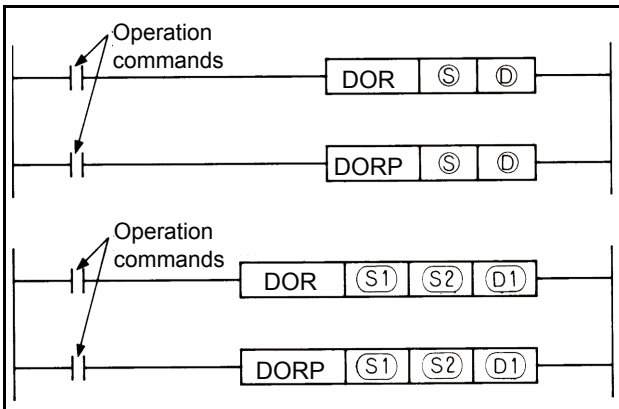
DAND

- The following program performs a logical product operation on the data at D99 and D100, and the 24-bit data between X20 and X37 when X8 is ON, and stores the results at D99 and D100.



3.29.3 Logical operation instruction: BIN 32-bit logical OR ... DOR, DORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DOR (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



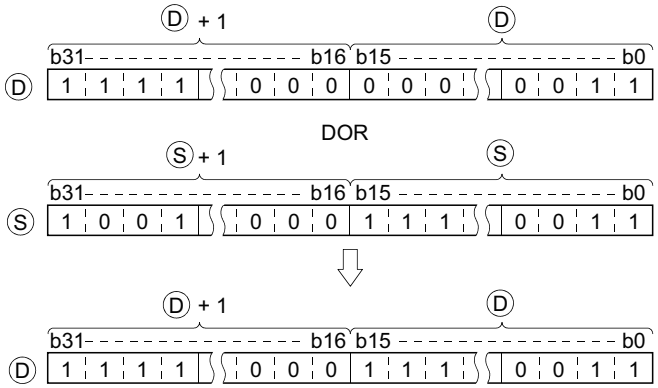
Setting data

Ⓢ	Start number of the data that executes the logical OR or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical OR results are stored

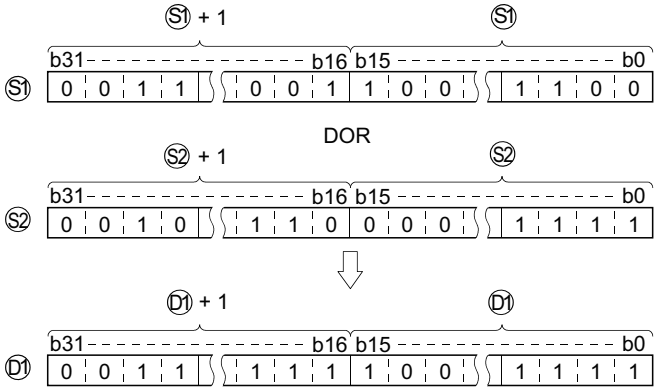
◆Function

DOR

- Logical OR is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



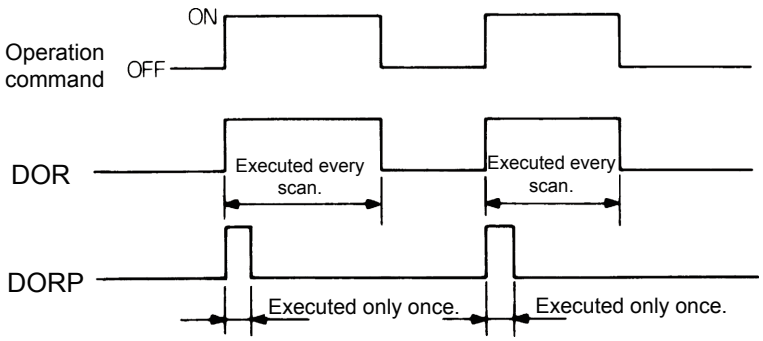
- Logical OR is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

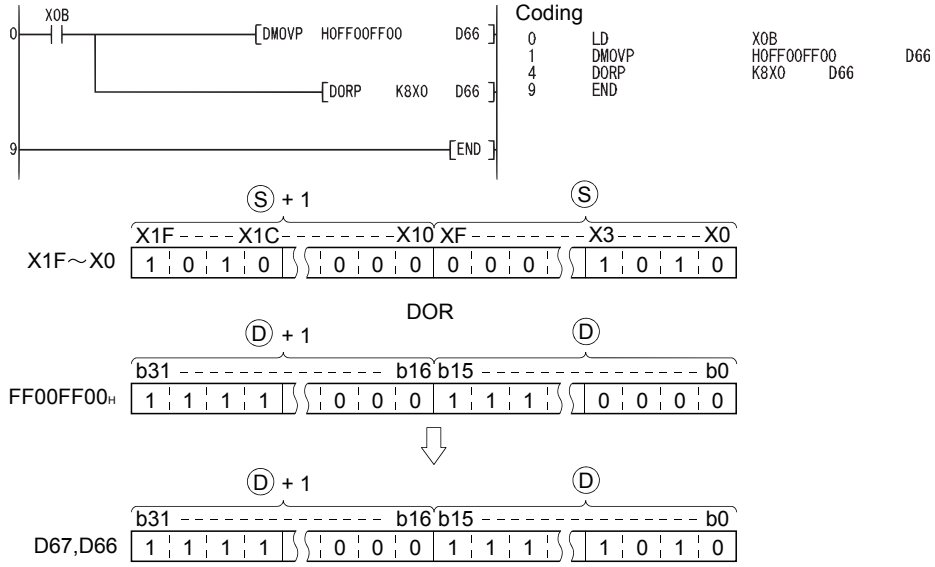
- The execution conditions for logical OR instructions are as follows.



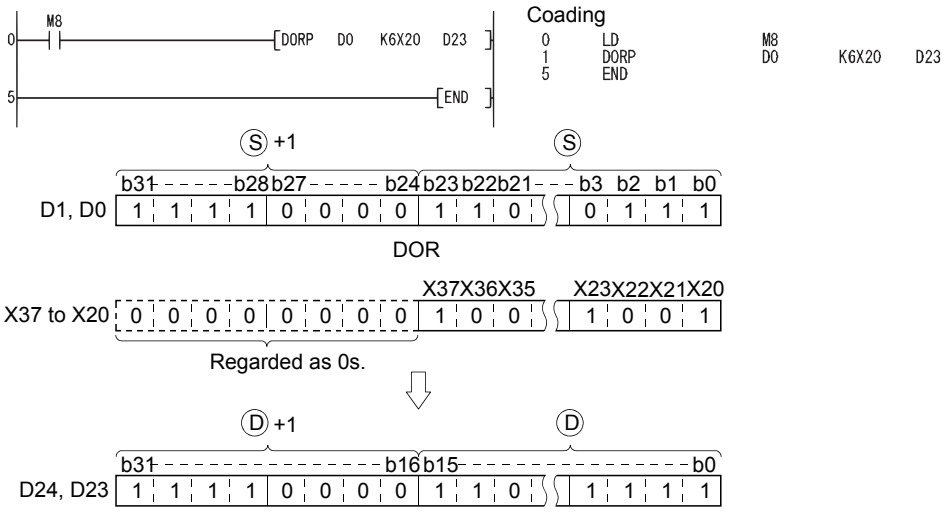
◆Program example

DOR

- The following program performs a logical sum operation on the 32-bit data from X0 to X1F, and on the hexadecimal value FF00FF00H when XB is turned ON, and stores the results at D66 and D67.

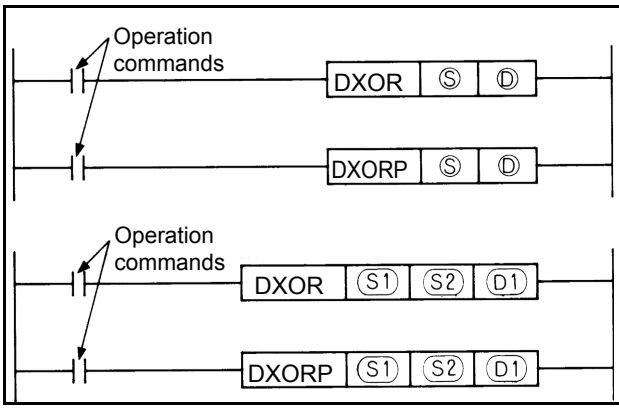


- The following program performs a logical sum operation on the 32-bit data at D0 and D1, and the 24-bit data from X20 to X37, and stores the results at D23 and D24 when M8 is ON.



3.29.4 Logical operation instruction: BIN 32-bit data exclusive OR ... DXOR, DXORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DXOR (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



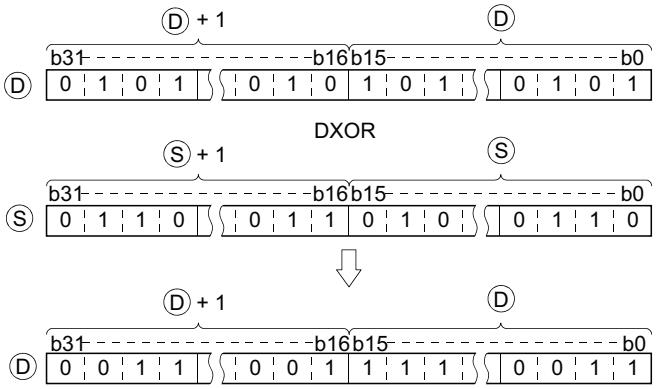
Setting data

Ⓢ	Start number of the data that executes the exclusive OR or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the exclusive OR results are stored

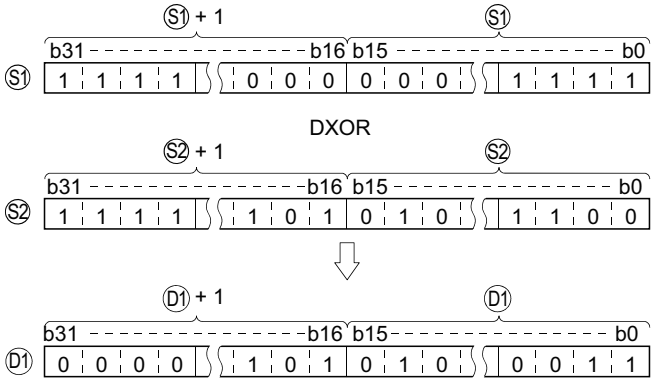
◆Function

DXOR

- Exclusive OR is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



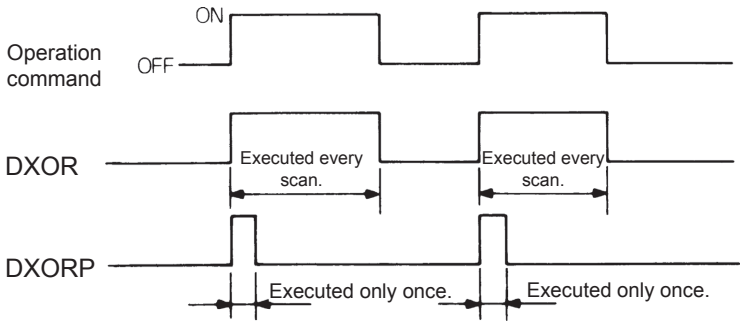
- Exclusive OR is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

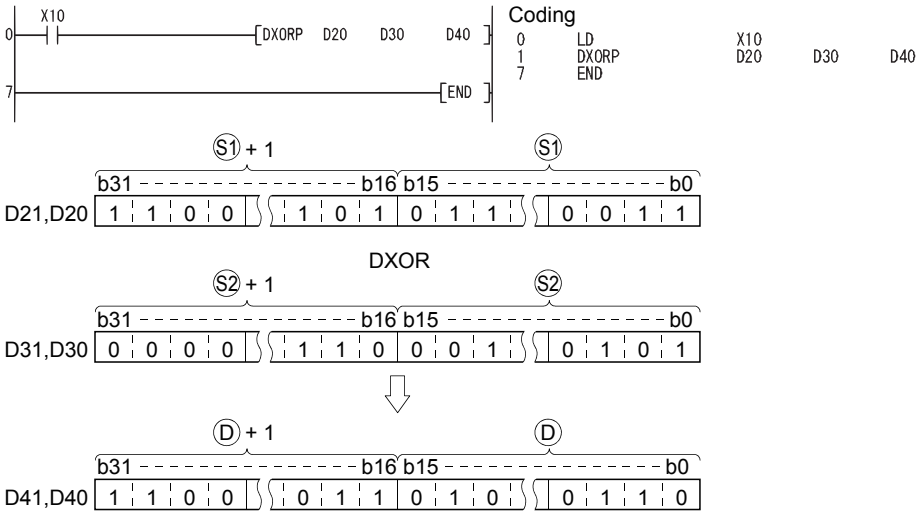
The execution conditions for exclusive OR instructions are as follows.



◆Program example

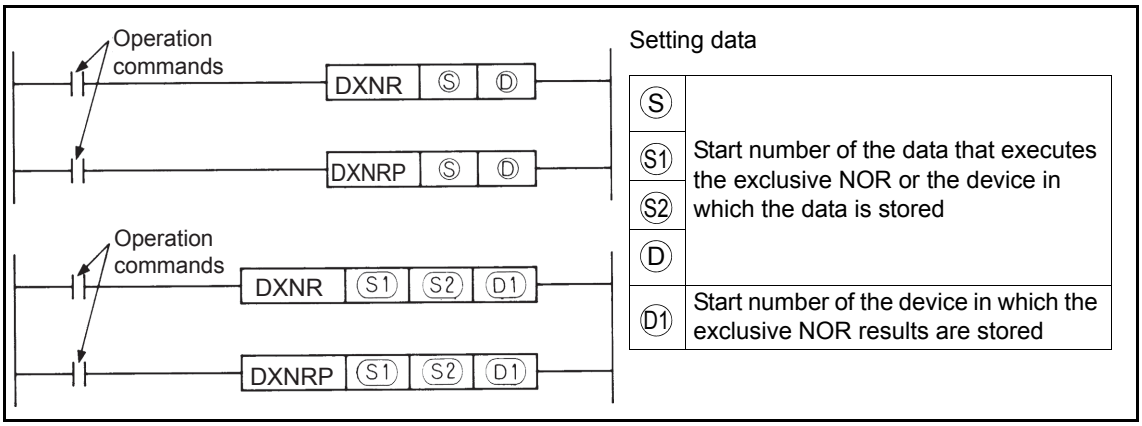
DXOR

- The following program conducts an exclusive OR operation on the data at D20 and D21, and the data at D30 and D31 when X10 is turned ON, and stores the results at D40 and D41.



3.29.5 Logical operation instruction: BIN 32-bit data exclusive NOR ... DXNR, DXNRP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DXNR (P)	(S)	○	○	○	○	○	○	○	○		K1 to K8	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



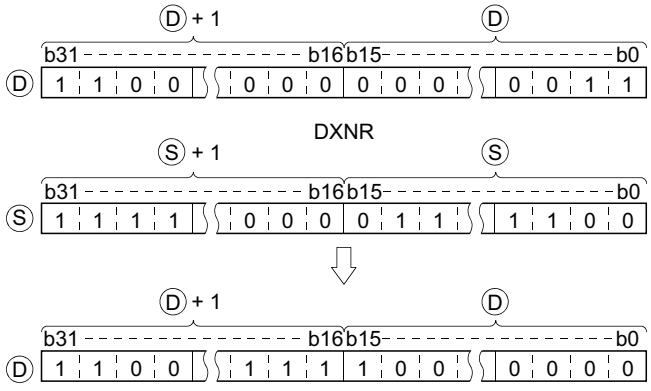
Setting data

(S) (S1) (S2) (D)	Start number of the data that executes the exclusive NOR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive NOR results are stored

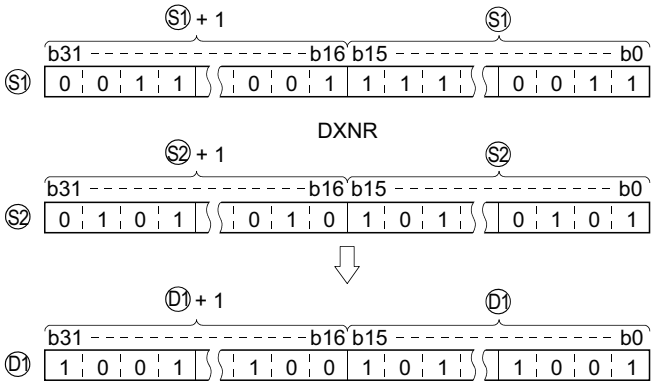
◆Function

DXNR

- Exclusive NOR is executed for the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



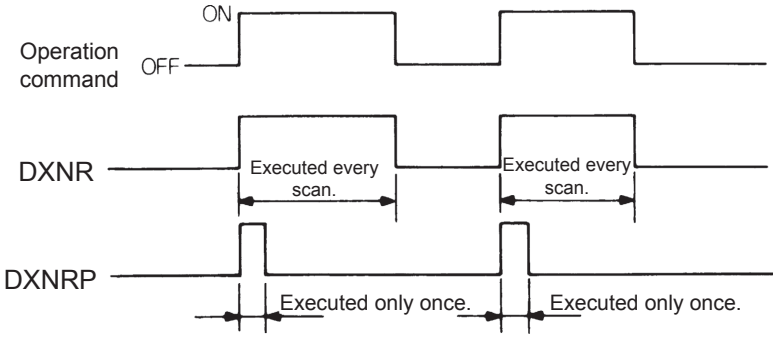
- Exclusive NOR is executed for the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

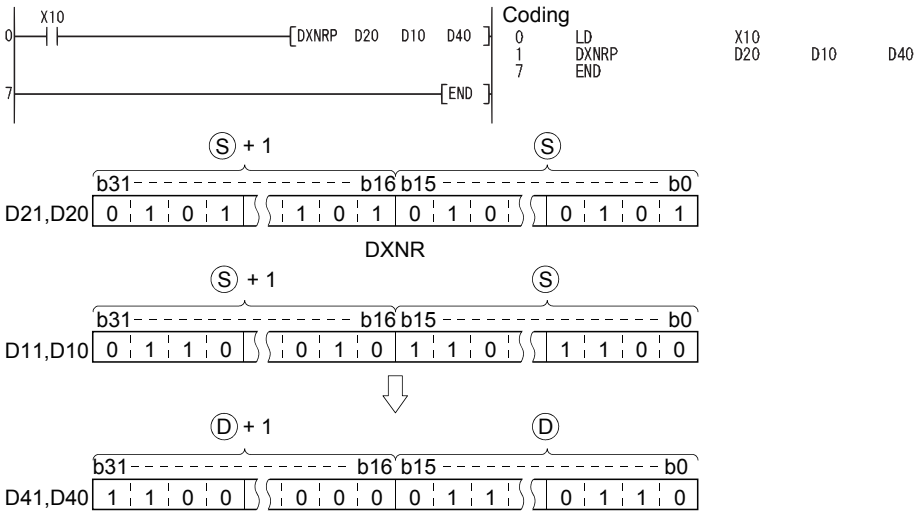
The execution conditions for exclusive NOR instructions are as follows.



◆Program example

DXNR

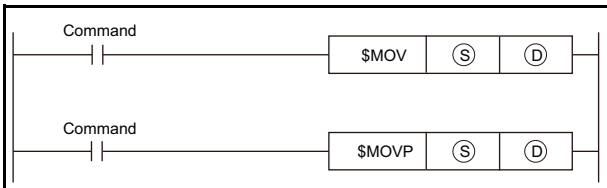
- The following program performs an exclusive NOR operation on the 32-bit data at D20 and D21 and the data at D10 and D11 when X10 is turned ON, and stores the result to D40 and D41.



3.30 Display instruction

3.30.1 Character string data transfer ... $MOV, $MOVP

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ				○	○	○					○

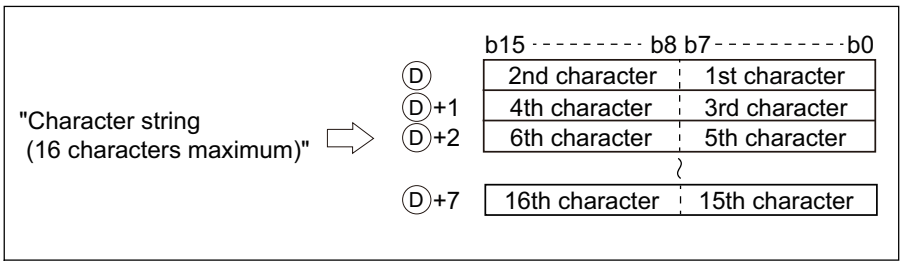


Setting data

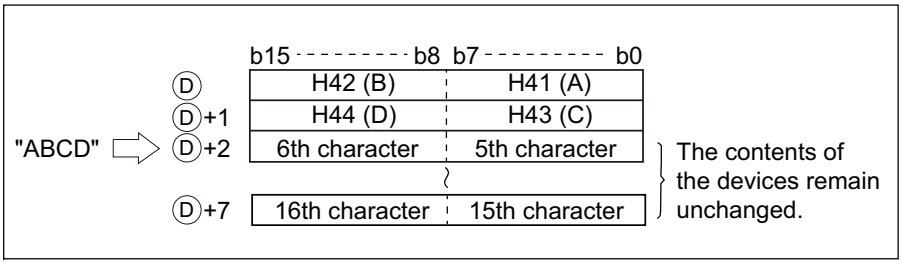
Ⓢ	Transferred character string (Maximum character string: 32 characters (up to 16 characters can be transferred))
Ⓓ	Start number of the device in which the ASCII code is stored

◆Function

- The character string data enclosed in double-quotation marks (" ") specified with Ⓢ are transferred after the device number specified in Ⓓ.
- Only character string data that is enclosed in double-quotation marks (" ") can be set in Ⓢ. A device can also be input, but doing so results in an error at execution (INSTRCT. CODE ERR: 4000).
- Only word devices can be set in Ⓓ. Bit devices can also be input, but doing so results in an error (INSTRCT. CODE ERR: 4000) at execution.
- A maximum of 32 characters can be set in Ⓢ. (Up to 16 characters can be transmitted from Ⓢ to Ⓓ. The 17th character or later are invalid.)



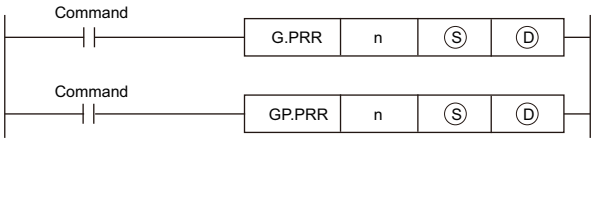
- If the set number of characters is less than 16, the content of Ⓓ in the sections without corresponding characters remains unchanged.



3.30.2 Character string output ... G. PRR, GP.PRR, UMSG

G.PRR, GP.PRR

	Applicable device									Others U	Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level			
	X	Y	M	T	C	D	K	H	N			(SM0)
n										○		
Ⓢ				○	○	○						○
Ⓓ	○	○	○			○						



Setting data

n	Not used, but U is specified
Ⓢ	Character string that is displayed on the display unit or the start number of the devices containing the character string to be displayed
Ⓓ	Not used, but Y is specified

UMSG

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ				○	○	○					○



Setting data

Ⓢ	Character string that is displayed on the display unit or the start number of the devices containing the character string to be displayed

◆Function

G.PRR, GP.PRR

n is not used, but specify U.

Register the data to be displayed on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07) in the device specified with Ⓢ.

Ⓓ is not used, but specify Y.

UMSG

Register the data to be displayed on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07) in the device specified with Ⓢ.

◆Setting data: For user monitor name

Set the monitor name as shown below when SD1216 to 1218 are monitored by the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07).

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	01	←Set the corresponding monitor number to the upper 8 bits, and 01 to the lower 8 bits.
	2nd character	1st character	←Monitor name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
Ⓢ+8	16th character	15th character	

- Set 01 to the lower 8 bits of Ⓢ+0.
- Set the monitor description number to replace the user monitor name display in the upper 8 bits of Ⓢ+0.
  The monitor description number is as shown below.

Monitor description number	Monitor description
40	User monitor 1: SD1216 description
41	User monitor 2: SD1217 description
42	User monitor 3: SD1218 description

- When the upper 8 bits of Ⓢ+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H81), the registered data is cleared and the monitor display returns to normal.
- Settings can be made up to the 16th character. (Data from Ⓢ+1 to Ⓢ+8 are effective as characters.)
- Up to 12 characters can be displayed on the FR-LU08 or the FR-PU07. When the number of characters exceeds 12, the 13th character or later will not appear.

NOTE

- To display the monitor above on the parameter unit (FR-PU07), set "40, 41, 42" in **Pr.774 to Pr.776** in advance. (For details on **Pr.774 to Pr.776**, refer to **the Instruction Manual (Detailed)** of the inverter.)

◆Setting data: For user-defined error name

Set the user-defined error name as shown below to display the user-defined error on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07). (A user defined error occurs when values 16 to 20 are set in SD1214.)

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	02	←Set the corresponding error number to the upper 8 bits, and 02 to the lower 8 bits.
	2nd character	1st character	←Error name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
Ⓢ+8	16th character	15th character	

- Set an error number that corresponds to the upper 8 bits of Ⓢ+0. The setting range is from 16 to 20.
- When the upper 8 bits of Ⓢ+0 are values other than 16 to 20, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H82), the registered data is cleared.
- Settings can be made up to the 16th character. (Data from Ⓢ+1 to Ⓢ+8 are effective as characters.)
- Up to 12 characters can be displayed on the FR-LU08 or the FR-PU07. When the number of characters exceeds 12, the 13th character or later will not appear.

◆Setting data: For user parameter name

Set the parameter name as shown below to display the read user parameters **Pr.1150 to Pr.1159** on the LCD operation panel (FR-LU08).

	Upper 8 bits	Lower 8 bits	
(S)+0	****	03	←Set the corresponding parameter number to the upper 8 bits, and 03 to the lower 8 bits.
	2nd character	1st character	←Parameter name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
(S)+8	16th character	15th character	

- Set the corresponding parameter number the upper 8 bits of (S)+0.

Parameter number	Setting value
1150	01
1151	02
1152	03
1153	04
1154	05
1155	06
1156	07
1157	08
1158	09
1159	10

- When the upper 8 bits of (S)+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4101) is generated.
- When the 7th bit of (S)+0 is executed as 1 (lower 8 bits as H83), the registered data is cleared.
- Settings can be made up to the 16th character. (Data from (S)+1 to (S)+8 are effective as characters)
- Up to 9 characters can be displayed on the FR-LU08. When the number of characters exceeds 9, the 10th character or later will not appear.

◆Setting data: For unit names

This function sets up the increment for the user monitors SD1216 to SD1218 or the user parameters **Pr.1150 to Pr.1159** using the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07).

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	04	← Set the corresponding user monitor number to the upper 8 bits, and 04 to the lower 8 bits.
	2nd character	1st character	← Unit name: Character start
Ⓢ+2		3rd character	

- Set 04 to the lower 8 bits of Ⓢ+0.
- To replace the unit displayed, set the number corresponding to the target monitor or parameter in the upper 8 bits of Ⓢ+0.
  Numbers that can be specified are shown in the following table.

Number of unit name	Item to add unit
01	Unit corresponding to **Pr.1150**
02	Unit corresponding to **Pr.1151**
03	Unit corresponding to **Pr.1152**
04	Unit corresponding to **Pr.1153**
05	Unit corresponding to **Pr.1154**
06	Unit corresponding to **Pr.1155**
07	Unit corresponding to **Pr.1156**
08	Unit corresponding to **Pr.1157**
09	Unit corresponding to **Pr.1158**
10	Unit corresponding to **Pr.1159**
40	User monitor 1: Unit corresponding to the description of SD1216
41	User monitor 2: Unit corresponding to the description of SD1217
42	User monitor 3: Unit corresponding to the description of SD1218

- When the upper 8 bits of Ⓢ+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H84), the registered data is cleared.
- Settings can be made up to the 3rd character. (Ⓢ+1 to Ⓢ+2: Data up to the lower 8 bits are effective as characters.)

◆Quantity that can be set

Setting data	Quantity
User monitor (Refer to **page 194**)	Up to 3*1
User definition error (Refer to **page 194**)	Up to 5*1
User parameter (Refer to **page 195**)	Up to 10*1
Unit name (Refer to **page 196**)	Up to 13*1

*1 If any of the setting quantities is exceeded, an operation error (OPERATION ERROR: 4100) occurs at the point when the exceeded setting is executed. Furthermore, an operation error (OPERATION ERROR: 4100) also occurs if the lower 8 bits of Ⓢ+0 are set to values other than 01 to 04, or H81 to H84.

NOTE

- An error does not occur even if the stored data exceeds the range of the corresponding device, but the content of devices outside of the range is changed. When storing data, check beforehand that the amount of devices required for storage can be allocated.
- Do not change any of the device data while it is being displayed because the data stored in the device is used in actual communication. Changing such data will change the transmitted data.
- If the ASCII data is other than 0x20 to 0x7A that can be displayed on the FR-LU08 or the FR-PU07, it can be replaced with 0x20 (space).
- [^] (H5E), [_] (H5F) and ['] (H60) cannot be displayed by the FR-PU07.

4 Error code list

4.1 How to read error codes..... 198

If an error occurs when PLC function is RUN or during RUN, an error indication is generated by the self-diagnostic function, and an error code and error step are stored in the special register. The error description and corrective action are as follows:

4.1 How to read error codes

When an error occurs, the error code can be read using a peripheral device.
For details on the operation method, refer to the operating manual of the peripheral device.
The error code, error name, error description possible cause, and corrective actions are as follows.
Error codes are stored in SD0, and the error steps are stored in SD4 to SD26.

Error code (SD0)	Error name	Error description possible cause	Corrective action
1010	END NOT EXECUTE	All programs in the program capacity are executed without executing the END instruction. • After the END instruction was executed, a different instruction code was read due to noise, etc. • The END instruction has changed to a different instruction code for some reason.	• Take measures against noise. • Perform an inverter reset and go to the RUN state again. • If the same error is displayed again, a CPU hardware error has occurred. Please contact your sales representative and explain the failure symptom.
2200	MISSING PARA.	• There are no parameter files.	• Set a parameter file.
2502	CAN'T EXE. PRG.	• The program file is not correct, or the content of the file is not a program.	• Check that the program file type is ***.QPG, and check that the file content is a program.
3000	PARAMETER ERROR	• The content of the parameter indicated by the error individual information (SD16) is incorrect.	• Read the error individual information with a programming tool, check the parameter items that correspond to the values (parameter number) and correct them. • Re-write the corrected parameters, reset the power or reset the inverter. • If the same error is displayed again, a CPU hardware error has occurred. Please contact your sales representative and explain the failure symptom.
3003	PARAMETER ERROR	• The number of device points set in the PLC parameter device setting is not within the usable range.	• Read the error individual information with a programming tool, check the parameter items that correspond to the values (parameter number) and correct them. • If the error occurs again after correcting the parameter, a memory error has occurred in the program memory. Please contact your sales representative and explain the failure symptom.
4000	INSTRCT. CODE ERR	• An undecodable instruction code is included in the program. • An unusable instruction is included in the program.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.
4010	MISSING END INS.	• No END (FEND) instruction in the program.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.
4100	OPERATION ERROR	• Data that cannot be used in instructions is included.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.

Error code (SD0)	Error name	Error description possible cause	Corrective action
5001	WDT ERROR	• The program scan time exceeded the watchdog timer value set in the PLC RAS setting of the PLC function parameter.	• Read the error individual information with the programming tool, check the values (time) and shorten the scan time. • Change the initial execution monitoring time or watchdog setting values with the PLC RAS settings of the PLC function parameter. • Delete the infinite loop from the jump transition. • Check the number of executions of the interrupt program with a programming tool, and reduce the number of interrupt occurrences.
5010	PRG. TIME OVER	• The program scan time exceeded the constant scan time set in the PLC RAS setting of the PLC function parameter.	• Review the constant scan time setting. • Review the PLC parameter constant scan time and low-speed program execution time in order to secure sufficient remaining time for the constant scan.

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APPENDIX

Appendix 1 Instruction processing time 202

Appendix 1 Instruction processing time

◆Basic instructions

◆Sequence instructions

Classification	Instruction	Condition (device)	Processing time (μs)
Contact	LD		1.9
	LDI		1.9
	AND		1.9
	ANI		1.9
	OR		2.0
	ORI		2.0
Link	ORB		1.3
	ANB		1.3
	MPS		1.4
	MRD		1.4
	MPP		1.4
Output	OUT	Y,M,SM	2.4
	OUT	T	7.6
	OUT	C	7.9
	SET	Y,M,SM	2.6
	RST	Y,M,SM	2.6
	RST	T	9.2
	RST	C	10.0
	RST	D	4.3
	PLS		3.4
	PLF		3.4
Shift	SFT		3.4
	SFTP		4.2
Master control	MC		3.8
	MCR		1.3
Program end	END,FEND		0.8
Non-processing	NOP		1.3

◆Comparison operation instructions

Classification	Instruction	Condition (device)	Processing time (μs)	
			Subset *1	Other than subset
BIN 16-bit data comparison	LD=	S1 S2	8.0	9.9
	LD<>	S1 S2	8.0	9.9
	LD<	S1 S2	8.0	9.9
	LD>	S1 S2	8.0	9.9
	LD<=	S1 S2	8.1	10.0
	LD>=	S1 S2	8.1	10.0
	AND=	S1 S2	8.2	9.6
	AND<>	S1 S2	8.2	9.7
	AND<	S1 S2	8.4	9.8
	AND>	S1 S2	8.3	9.7
	AND<=	S1 S2	8.3	9.7
	AND>=	S1 S2	8.3	9.7
	OR=	S1 S2	8.7	9.8
	OR<>	S1 S2	8.6	9.8
	OR<	S1 S2	8.6	9.8
	OR>	S1 S2	8.6	9.8
	OR<=	S1 S2	8.8	9.9
	OR>=	S1 S2	8.8	9.9
BIN 32-bit data comparison	LDD=	S1 S2	8.8	11.1
	LDD<>	S1 S2	8.8	11.1
	LDD<	S1 S2	8.8	11.1
	LDD>	S1 S2	8.8	11.1
	LDD<=	S1 S2	8.8	11.1
	LDD>=	S1 S2	8.8	11.1
	ANDD=	S1 S2	9.2	11.0
	ANDD<>	S1 S2	9.2	11.0
	ANDD<	S1 S2	9.2	11.0
	ANDD>	S1 S2	9.2	11.0
	ANDD<=	S1 S2	9.2	11.0
	ANDD>=	S1 S2	9.2	11.0
	ORD=	S1 S2	9.4	9.9
	ORD<>	S1 S2	9.4	9.9
	ORD<	S1 S2	9.4	9.9
	ORD>	S1 S2	9.4	9.9
	ORD<=	S1 S2	9.4	9.9
	ORD>=	S1 S2	9.4	9.9

◆Arithmetic operation instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
BIN 16-bit addition/ subtraction	+	S D	8.4	13.5
	+P	S D	11.0	14.3
	-	S D	8.4	13.5
	-P	S D	11.0	14.3
	+	S1S2 D	8.4	13.6
	+P	S1S2 D	11.0	14.5
	-	S1S2 D	8.4	13.6
	-P	S1S2 D	11.0	14.5
BIN 32-bit addition/ subtraction	D+	S D	9.6	15.6
	D+P	S D	12.0	16.4
	D-	S D	9.6	15.6
	D-P	S D	12.0	16.4
	D+	S1S2 D	9.6	15.7
	D+P	S1S2 D	12.0	16.5
	D-	S1S2 D	9.5	15.7
	D-P	S1S2 D	12.0	16.5
BIN 16-bit multiplication /division	*	S1S2 D	8.7	13.9
	*P	S1S2 D	11.2	14.7
	/	S1S2 D	8.9	14.2
	/P	S1S2 D	11.5	15.0
BIN 32-bit multiplication /division	D*	S1S2 D	9.7	15.7
	D*P	S1S2 D	12.2	16.5
	D/	S1S2 D	10.1	15.9
	D/P	S1S2 D	12.6	16.7
Data increment/ decrement	INC	D	5.8	11.1
	INCP	D	7.6	11.8
	DEC	D	5.8	11.1
	DECP	D	7.6	11.9
	DINC	D	6.5	12.6
	DINCP	D	8.2	13.4
	DDEC	D	6.5	12.6
	DDECP	D	8.2	13.4

◆Data transfer instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
16-bit transfer	MOV		5.8	13.5
	MOVP		7.6	14.2
32-bit transfer	DMOV		6.4	15.6
	DMOVP		8.3	16.4

◆Data conversion instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
2's complement	NEG	D	8.8	11.1
	NEGP	D	9.5	11.8
	DNEG	D	8.8	12.6
	DNEGP	D	9.6	13.4
BCD conversion	BCD	S D	5.8	13.7
	BCDP	S D	8.3	14.5
	DBCD	S D	7.8	16.9
	DBCDP	S D	9.6	17.7
BIN conversion	BIN	S D	5.9	13.7
	BINP	S D	7.6	14.6
	DBIN	S D	6.8	16.1
	DBINP	S D	8.5	16.9

*1 When all the devices used in the instruction satisfy one of the following conditions, they are regarded as a subset.
- All the devices used are word devices.
- When the devices used are bit devices, the specified number of bits is the multiple of 16, or the digits are specified as K4 (word data) or K8 (double word data).
- The devices used are constants.

NOTE

- During inverter control, reading 1000 steps takes a scan time of about 40 ms.

◆Application instructions

◆Logical operation instructions

Classification	Instruction	Condition (device)	Processing time (μs)	
			Subset *1	Other than subset
Logical OR	WOR	S D	8.6	13.6
	WORP	S D	11.2	14.4
	WOR	S1 S2 D	8.6	13.6
	WORP	S1 S2 D	11.2	14.4
	DOR	S D	9.7	15.7
	DORP	S D	12.2	16.5
	DOR	S1 S2 D	9.7	15.7
	DORP	S1 S2 D	12.2	16.5
Logical AND	WAND	S D	8.6	13.6
	WANDP	S D	11.2	14.4
	WAND	S1 S2 D	8.6	13.6
	WANDP	S1 S2 D	11.2	14.4
	DAND	S D	9.7	15.7
	DANDP	S D	12.2	16.5
	DAND	S1 S2 D	9.7	15.7
	DANDP	S1 S2 D	12.2	16.5
Exclusive OR	WXOR	S D	8.6	13.6
	WXORP	S D	11.2	14.4
	WXOR	S1 S2 D	8.6	13.6
	WXORP	S1 S2 D	11.2	14.4
	DXOR	S D	9.7	15.7
	DXORP	S D	12.2	16.5
	DXOR	S1 S2 D	9.7	15.7
	DXORP	S1 S2 D	12.2	16.5
Exclusive NOR	WXNR	S D	8.6	13.6
	WXNRP	S D	11.2	14.4
	WXNR	S1 S2 D	8.6	13.6
	WXNRP	S1 S2 D	11.2	14.4
	DXNR	S D	9.7	15.7
	DXNRP	S D	12.2	16.5
	DXNR	S1 S2 D	9.7	15.7
	DXNRP	S1 S2 D	12.2	16.5

◆Instructions regarding the message display on PU

Classification	Instruction	Condition (device)	Processing time (μs)
Character string data transfer	$MOV		12.6
	$MOVP		13.3
Character string output	G.PRR		8.7
	GP.PRR		9.6
	UMSG		5.3

*1 When all the devices used in the instruction satisfy one of the following conditions, they are regarded as a subset.
- All the devices used are word devices.
- When the devices used are bit devices, the specified number of bits is the multiple of 16, or the digits are specified as K4 (word data) or K8 (double word data).
- The devices used are constants.

NOTE

- During inverter control, reading 1000 steps takes a scan time of about 40 ms.

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