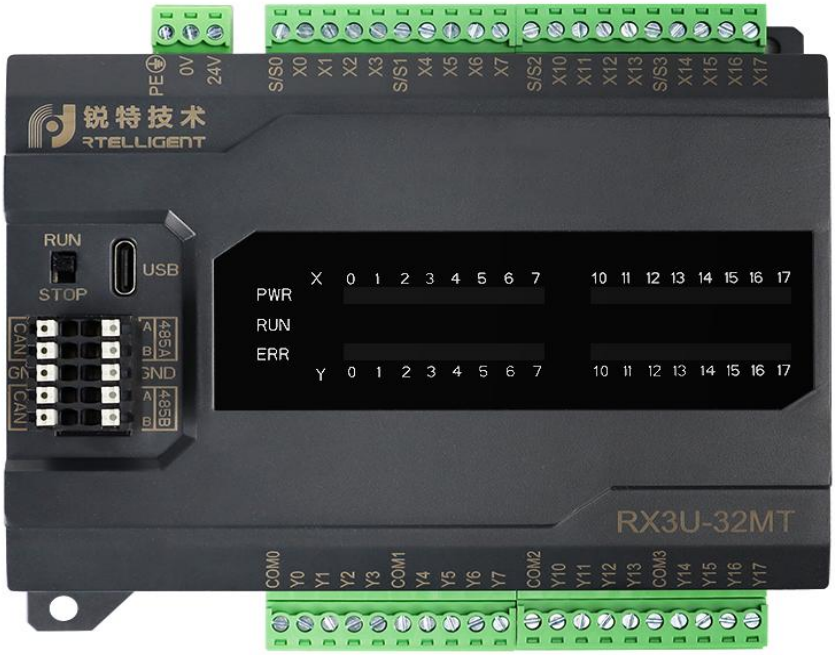
RX3U Series Controller

User Manual



Preface

Thank you for purchasing and using the RX3U series PLC controller of Rtelligent. The RX3U series controller is a compact programmable logic controller developed by Rtelligent. It features instruction specifications fully compatible with Mitsubishi FX3U series controllers, supporting 3 channels of 150kHz high-speed pulse output, 6 channels of 60K single-phase high-speed counting, or 2 channels of 30K AB phase high-speed counting.

This manual is a comprehensive information to guide the use of RX3U series controllers. Before using this product, please read the manual carefully and conduct wiring and programming debugging on the premise of fully understanding the contents of the manual. Only operators with certain electrical knowledge can conduct wiring and programming and debugging of this product. When using this product, please ensure compliance with requirements and safety first. If there are any unclear points during use, please consult our technical personnel for assistance.

Due to continuous improvements in PLC controllers, any changes to the information provided by our company will not be separately notified.

Revision History

Date	Version	Description
2023.06	V1.00	Initial issue
2023.07	V1.01	Add CAN function description

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1. Safety Instructions

1.1. Safety Precautions

- Be sure to disconnect all external power supplies before installing the controller. Otherwise, there is a risk of electric shock.
- After powering on the controller, do not touch the terminal, do not wire and unwire the terminal. Otherwise, there is a risk of electric shock.
- Please install and use the product under the environmental conditions specified in the specification in the manual. Do not use it in humidity, high temperature, dust, smoke, conductive dust, corrosive gas, combustible gas, and in places with vibration and impact. Otherwise, it may cause electric shock, fire, misaction, product damage, etc.
- Please design the security loop of the controller to ensure that the whole system can operate safely when the controller runs abnormally. Otherwise, there is the risk of misaction and failure.
- Please connect the DC 24V power supply to the dedicated power terminal of the controller. The wrong power supply may burn the controller.
- Do not tie the control wiring and the power wiring together, in principle, it should be 10cm apart. Otherwise, it may cause misaction and product damage.
- Do not directly touch the conductive parts of the product. Otherwise, it may cause misaction and failure.
- Please secure the product with DIN46277 rails or M3 screws and install it on a flat surface. The wrong installation may cause misoperation and product damage.
- When processing the screw hole, please do not make the cutting powder and wire debris fall into the product shell. Otherwise, it may cause misaction and failure.
- When connecting or removing peripheral equipment, expansion equipment, battery and other equipment, be sure to power off. Otherwise, it may cause misaction and failure.
- Please use a 2mm² wire to ground the ground terminal of the controller for a third type, not common grounding with the strong electric system. Otherwise, it may cause failure, product damage, etc.
- When using wires to connect terminals, be careful to tighten and do not contact the conductive part to other wires or terminals. Otherwise, it may cause misaction and product damage.
- Be sure to STOP before making changes to the program in the controller. Otherwise, it may cause misaction.
- Do not disassemble or assemble this product without authorization. Otherwise, it may cause damage to the product.
- Please plug and plug the connection cable in case of power failure. Otherwise, it may cause damage to the cable and cause misoperation.
- Please never modify this product, or it may cause injury or mechanical damage.
- When the products are discarded, please treat the industrial waste or the local environmental protection regulations.

1.2. Unpacking Inspection

Items	Description
Check whether the delivered products comply with you ordered.	The packaging box contains the products you ordered. Please confirm through the nameplate model of the controller.
Check whether the products are intact.	Please check the product surface to see if the product is damaged during transportation. If any omission or damage is found, please contact our company or your supplier as soon as possible.

2. Product Information

2.1. Product Feature

The Rtelligent RX3U series programmable logic controller features the following characteristics:

- High integration: The controller is equipped with 16 digital input points and 16 digital output points. You can choose between the transistor output model RX3U-32MT or the relay output model RX3U-32MR.
- Convenient programming connection: The controller comes with a Type-C programming interface, eliminating the need for a dedicated programming cable.
- Two RS485 interfaces on the controller can be configured as MODBUS RTU master and MODBUS RTU slave.
- The controller has a CAN communication interface.
- The transistor model supports 3 channels of 150kHz high-speed pulse output. It supports variable speed and constant speed single-axis pulse output.
- Supports 6 channels of 60K single-phase or 2 channels of 30K AB-phase high-speed counting.
- Data is permanently stored, eliminating concerns about data loss due to expired batteries.
- The upper computer programming software is compatible with GX Developer 8.86/GX Works2.
- Instruction specifications are compatible with the Mitsubishi FX3U series, providing faster operation speed.
- Convenient wiring with plug-in terminals.
- Easy installation using standard DIN35 rails (35mm wide) and fixed holes.

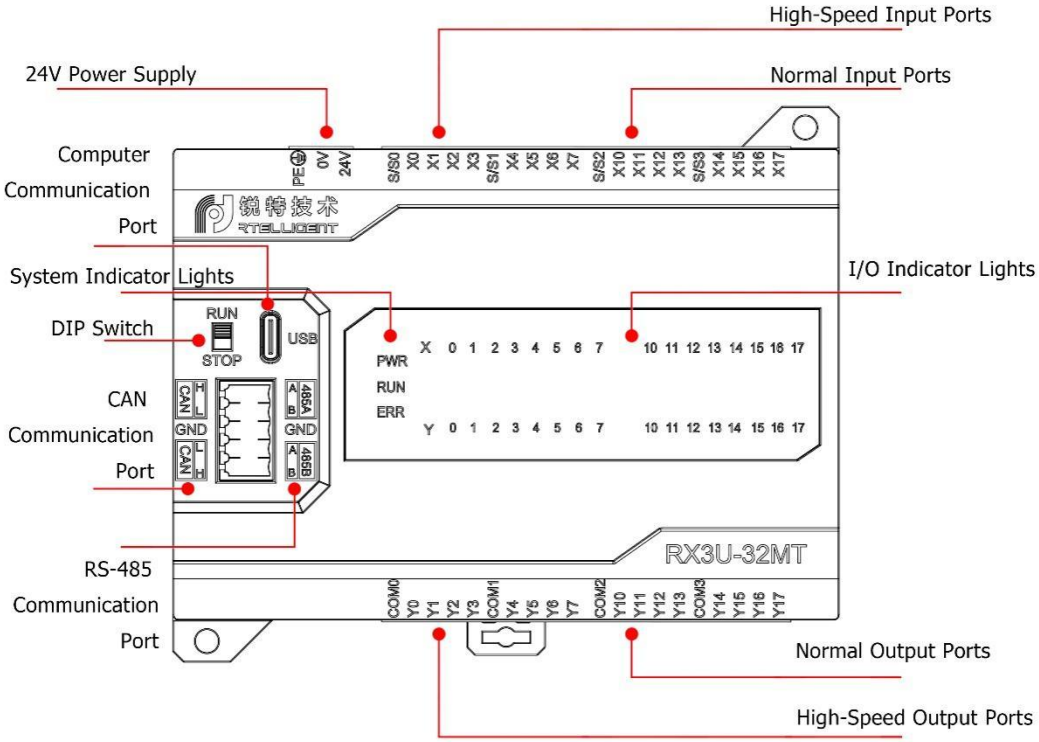
2.2. Product Naming

RX3U - 32 M R

① ②③④

Symbol	Description
①	Series name RX3U: Rtelligent RX3U Series PLC
②	Input/output points 32: A total of 32 input and output points
③	Function code M: General Main Control Module
④	Module classification R: Relay output type T: Transistor output type

2.3. Product Structure Diagram



3. Specification Parameters

3.1. General Specification

Items	Specifications
Operating Environment	
Temperature	0℃~55℃
Humidity	5%~95% (No condensation)
Altitude	-1000m~+2000m
Air	Dust-proof, non-corrosive, low salt spray, humid, dusty environments, SO2<0.5ppm, relative humidity<60%, no condensation H2S<0.1ppm, relative humidity<60%, no condensation
Isolation Voltage:	DC 500V with insulation resistance above 2MΩ
Anti-interference	Noise Voltage: 1000Vp-p, 1μs Pulse, 1 Minute
Storage Temperature: -40°C to 70°C	-25~70℃
Installation	Can be fixed using M3 screws or directly mounted on DIN35 (35mm width) rail.
Ground (FG)	Third type of grounding (not to be connected to the common grounding of strong electrical systems)※1

◆ ※1 Grounding should be done using separate grounding or shared grounding, and not using common grounding. For the significance of the third type of grounding, please refer to Appendix in Section 11.1.

3.2. Electrical Parameter

Project	Electrical Parameters	
Input voltage of power supply	DC 24V, Normal operating voltage range: 20.4~28.8V	
Digital input specifications	RX3U-32MR	RX3U-32MT
Number of digital input points	16-point bipolar inputs (High-speed input points X0, X1, X3, X4 can only be common anode)	
Isolation method	Opto-coupling	
Input impedance	2.4KΩ	
Input is ON	For high-speed input terminals, the input current is greater than 5.8mA/24V, and for regular input terminals, the input current is greater than 9.9mA/24V.	

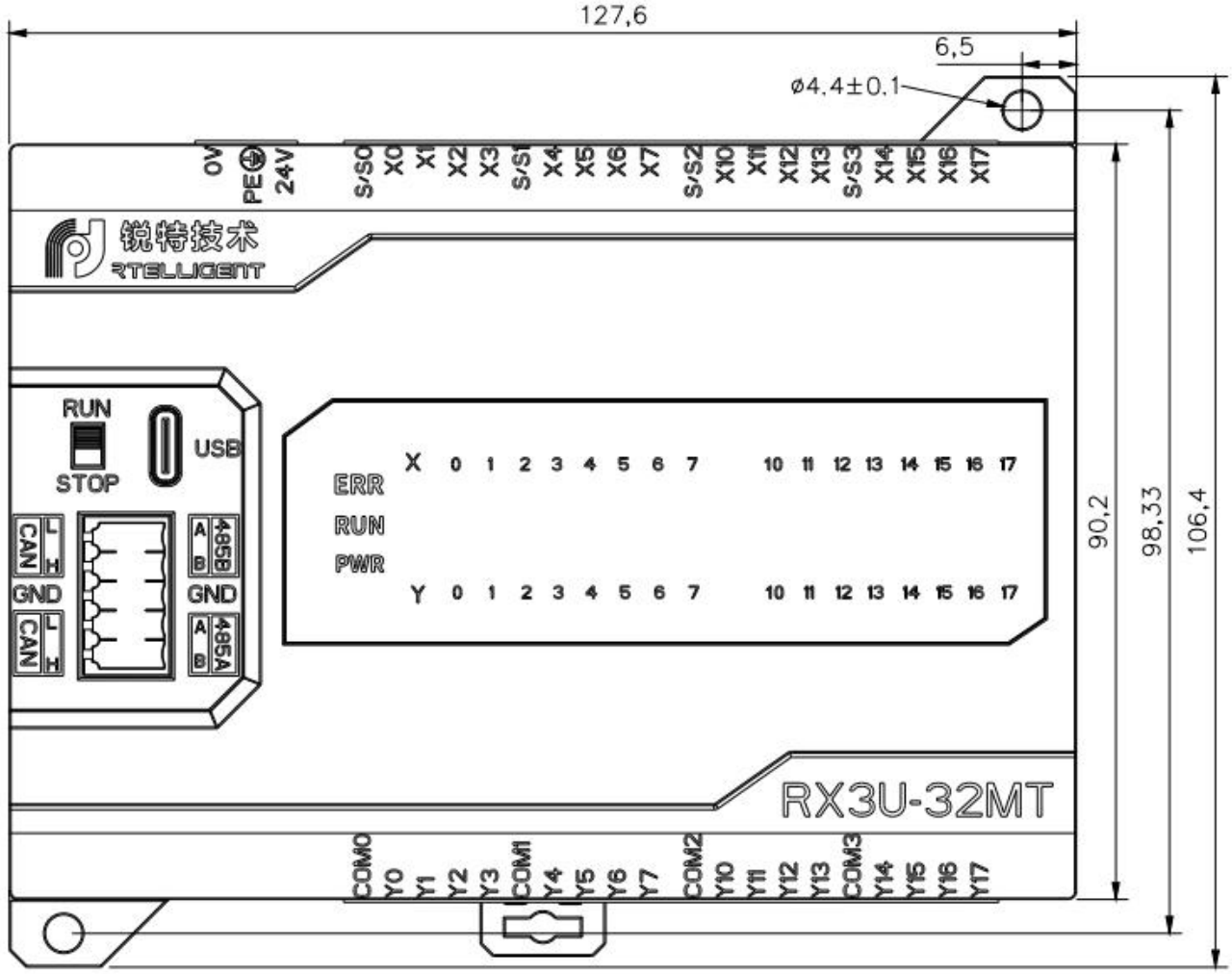
Input is OFF	For high-speed input terminals, the input current is less than 4.5mA/19V, and for regular input terminals, the input current is less than 4mA/17V.	
Filtering function	There is a filtering function with a filtering range adjustable from 0 to 60ms, with a default setting of 10ms.	
High-speed counting function	6 channels of single-phase 60K high-speed counting, or 2 channels of 30K AB-phase counting.	
Input level	Sink/source type, S/S connected to 24V is NPN, S/S connected to GND is PNP. High-speed counting is only supported when S/S is connected to 24V.	
Isolation	Field and Logic Group Isolation, 500V AC, 1 minute.	
Digital output specifications	RX3U-32MR	RX3U-32MT
Number of digital output points	16-point relay outputs	16-point NPN outputs
Allowable maximum current	2A per point	0.5A per point
Loop power supply voltage	DC/AC24V~220V	DC24V
Circuit insulation	Relay mechanical insulation	Optical isolation
ON response time	Approximately 10ms	High-speed output: 10μs, others: 0.5ms
Output level	Normally open dry contact output, COM can be connected to positive or negative.	Low-level NPN, COM connected to negative.

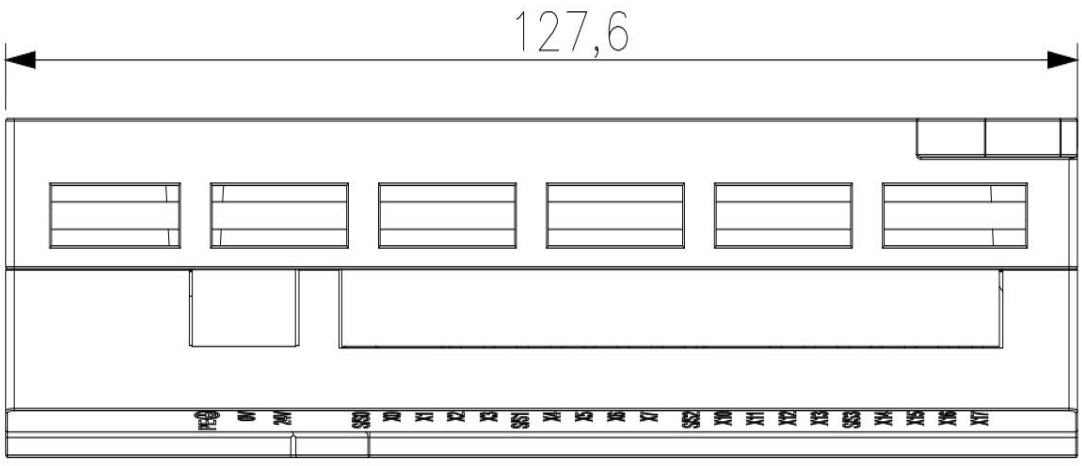
3.3. Performance Specification

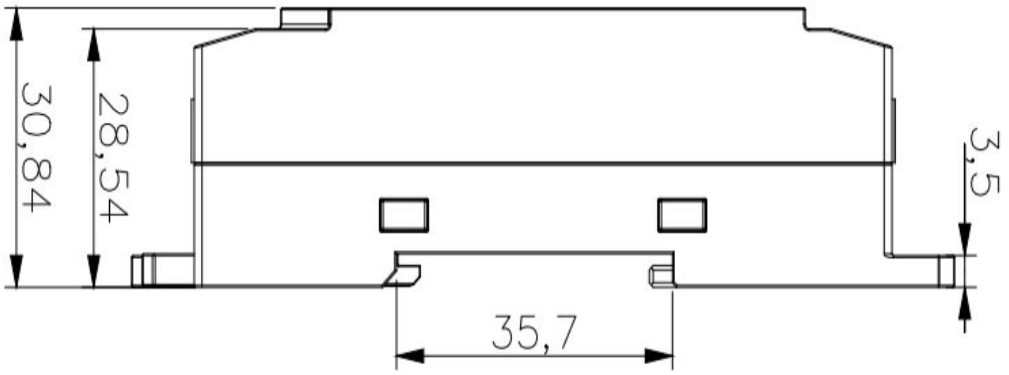
Performance item	Specification description				
Overall dimensions (Unit: mm)	127.6 (Length) × 106.4 (Width) × 30.8 (Height)				
Installation dimensions (Unit: mm)	114.6 (Length) × 98.33 (Width) × 30.8 (Height)				
Installation Method	Fixed hole installation and 35mm standard DIN35 rail installation				
User Program Capacity	16K steps				
Program execution mode	Cycle scanning mode				
Programming mode	Instruction list and ladder diagram				
Power-off retention	Uses FlashROM for permanent retention				
Allocation of soft components and power loss retention	M	General use (Non-power-off retention)	Used for power-off retention (Permanent retention)	General use (Non-power-off retention)	Special use
		M0-M499, 500 points	M500-M1023, 524 points	M1024-M7679, 6656 points	M8000-M8511, 512 points

	S	General use (Non-power-off retention)	Used for power-off retention (Permanent retention)		General use (Non-power-off retention)	
		S0-S499, 500 points	S500-S999, 500 points		S1000-S4095, 3096 points	
	T	100ms type, 0.1-3276.7s	10ms type, 0.01-327.67 s	1ms accumulative type, 0.001-32.767s	100ms accumulative type, 0.1-3276.7s	1ms type, 0.001-32.767s
		T0-T199, 200 points	T200-T245, 46 points	T246-T249, 4 points	T250-T255, 6 points	T256-T511, 256 points
	C	16-bit up counter, 17-count range: 0-32767		32-bit up counter, -2,147,483,648 - +2,147,483,647		High-speed counter
		General use	Used for power-off retention	General use	Used for power-off retention	Used for power-off retention
		C0-C99, 100 points	C100-C199 ,100 points	C200-C219 ,20 points	C220-C234, 15 points	C235-C255, 21 points
	D	General use (Non-power-off retention)	Used for power-off retention (Permanent retention)		General use (Non-power-off retention)	Special use
		D0-D199, 200 words	D200-D2199, 2000 words		D2200-D7999, 5800 words	D8000-D8511, 512 words
Internal coil X	256 points (X0-X377)					
Internal coil Y	256 points (X0-X377)					
Pointer	Support					

3.4. Controller Dimensions Drawing



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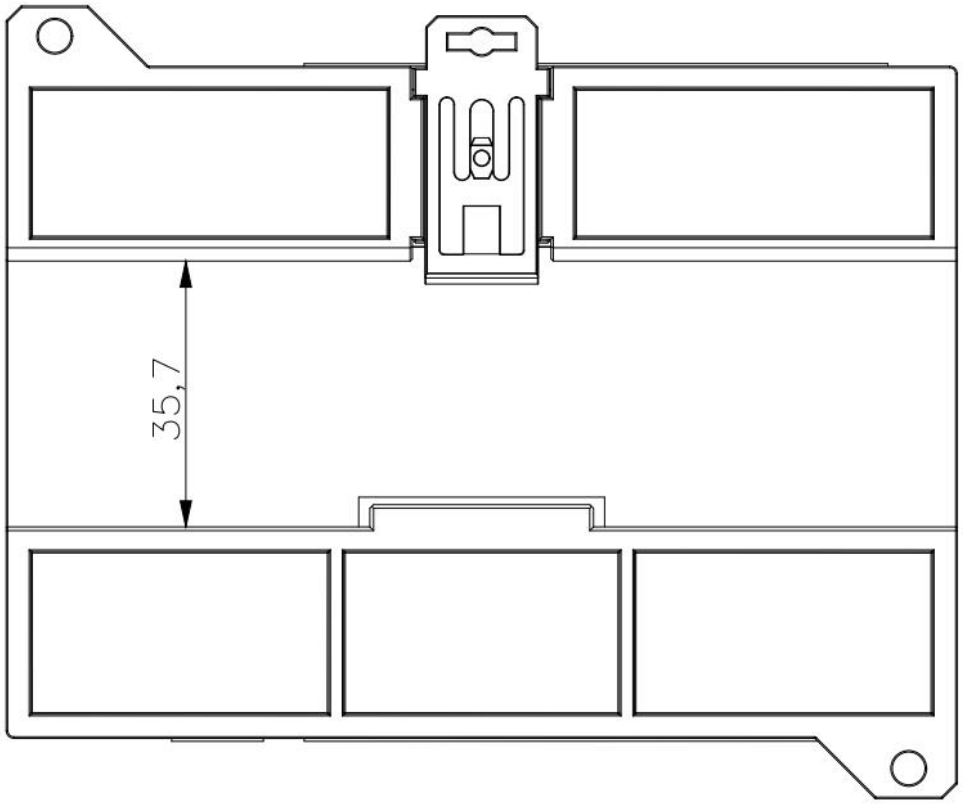
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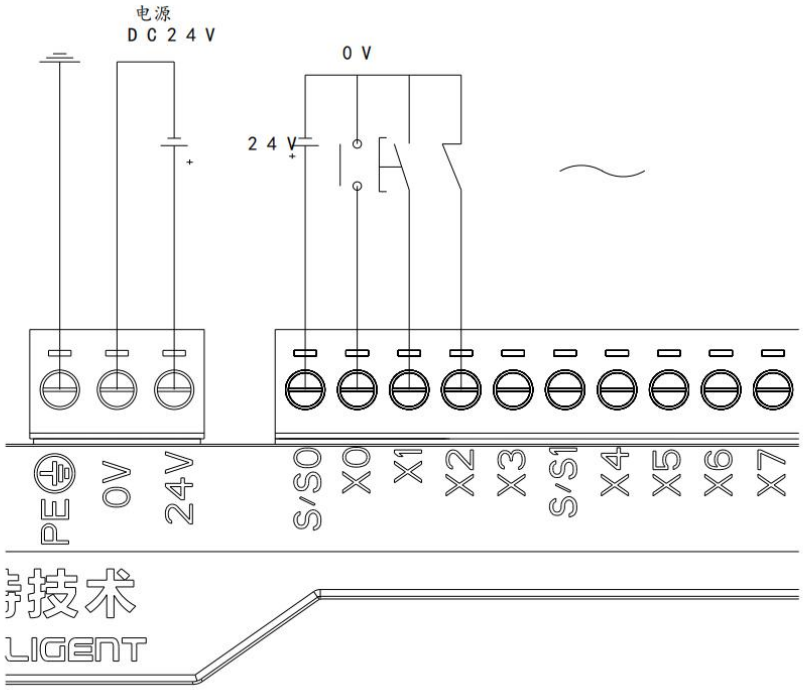
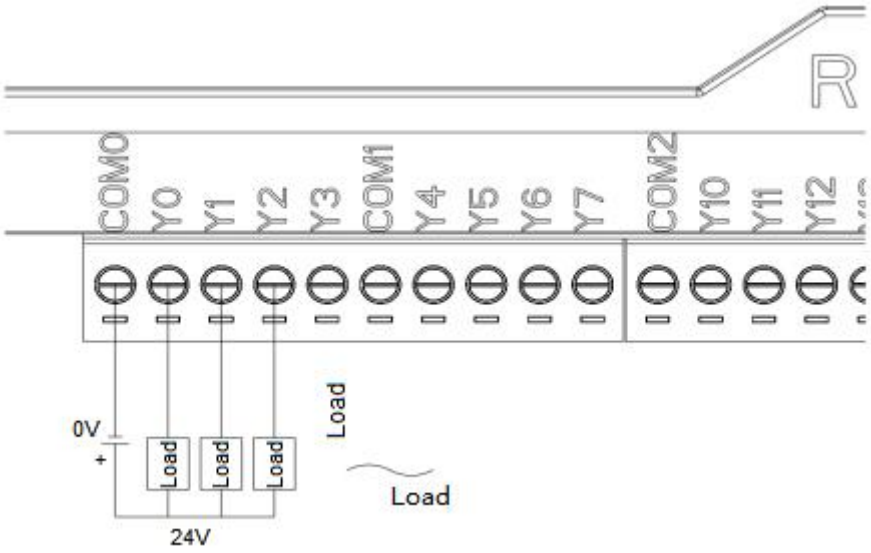
3.5. Input/output wiring

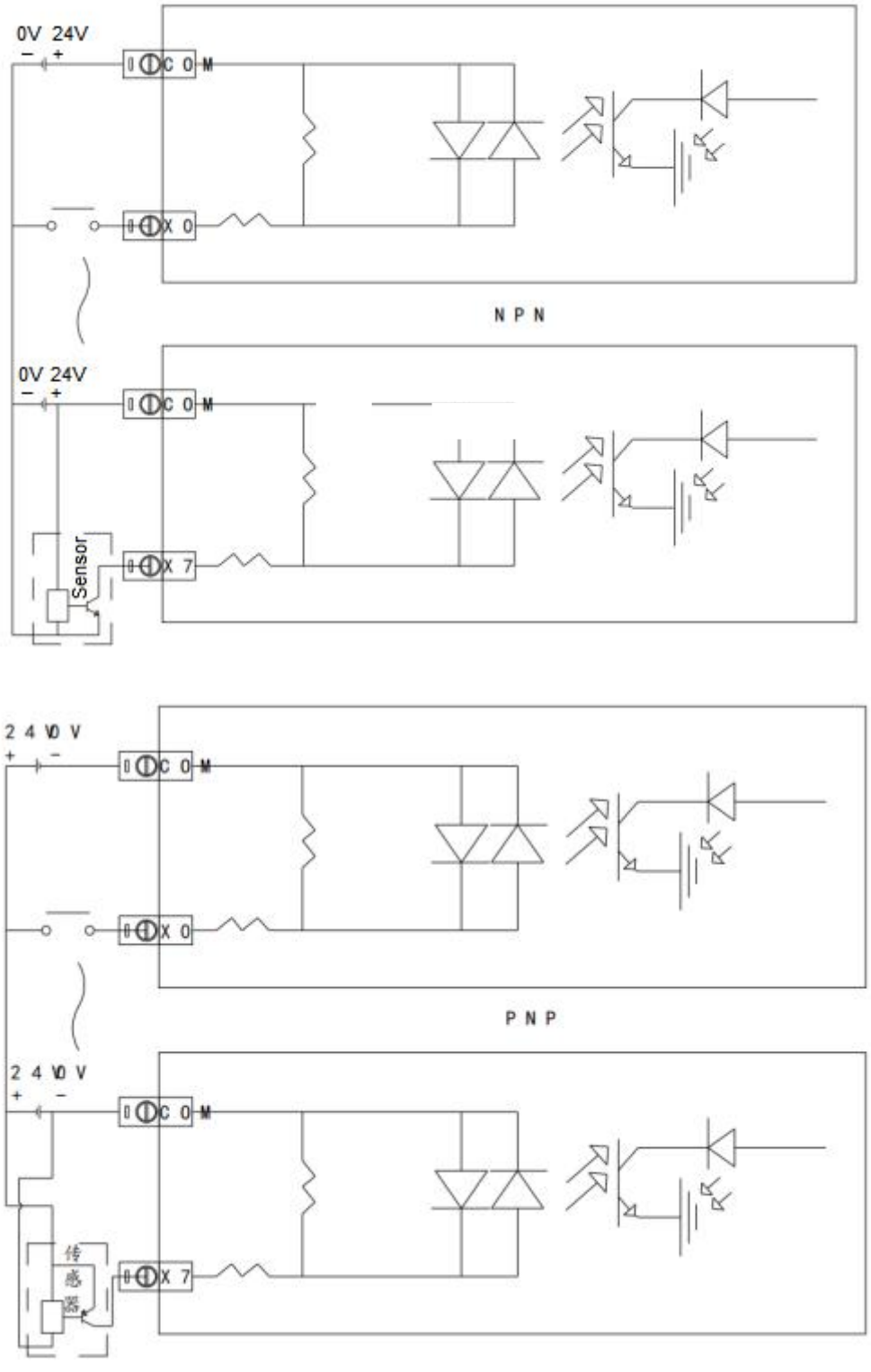
3.5.1. Digital Input Wiring



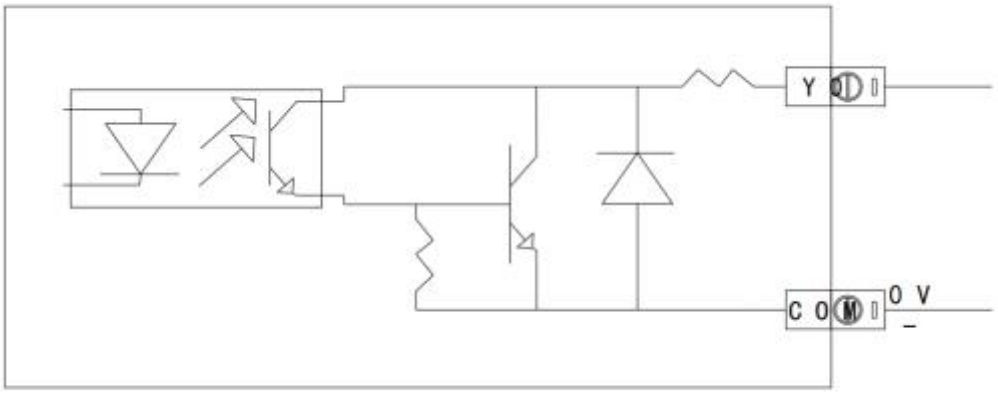
3.5.2. Digital Output Wiring



3.5.3.Internal Schematic Diagram of Digital Input



3.5.4.Internal Schematic Diagram of Digital Output



4. Operation, Debugging, and Maintenance

This chapter introduces the process of using the RX3U series PLC from programming to deployment, involving aspects such as PLC operation, debugging, and routine maintenance.

4.1. Operation and Debugging

4.1.1. Product Inspection

After receiving the product, please check the integrity of its input and output terminals, as well as whether any components are missing. In general, you can directly connect the power supply to the PLC for power-on inspection, and the PWR and RUN indicators should be always on.

4.1.2. Program Writing and Downloading

After confirming that the product is in good condition, you can program the PLC, which is done on a personal computer. The completed program can now be downloaded to the PLC. The general operating steps are as follows:

4.1.3. Program Debugging

Ideally, the PLC is in normal operation, but if errors are found in the program in the PLC and modifications are needed, it is necessary to rewrite the program to the running PLC.

(1) Use a programming cable to connect the PLC to a computer.

(2) Upload the program from the PLC.

(3) Modify the uploaded program and save the modified version separately.

(4) Pause the PLC operation, and download the modified program to the PLC.

(5) Monitor the PLC through ladder diagram monitoring, free monitoring, and other functions.

(6) If requirements are still not met, continue modifying the program and downloading it to the PLC until the desired outcome is achieved.

4.1.4. PLC Indicators

During normal PLC operation, the PWR and RUN indicators should be always on.

When the ERR is always on, there is a problem with the PLC operation, please correct the program.

If the indicator light PWR is not bright, if the power supply is wrong, the power supply wiring should be checked.

4.2. Routine Maintenance

4.2.1. Routine Maintenance

Although programmable controllers have a certain level of anti-interference and strong stability, it is also important to develop a habit of regularly inspecting and maintaining the controllers. The inspection items include:

- Whether the input/output terminals and power terminals of the PLC are loose or not secure.
- Whether the communication port is intact.
- Whether the power indicator light and input/output indicator light can be lit;
- Clean the accumulated dust outside the PLC to prevent dust and conductive dust from falling inside the PLC.
- Efforts should be made to ensure that the operating and storage environment of the PLC meets the standards described in Section 3-1 of this manual.

4.2.2. Battery Considerations

- There are no components within the programmable controller that significantly shorten its lifespan and can be used continuously. But if the real-time clock (RTC) function of the PLC is used, the battery needs to be replaced regularly.
- The service life of batteries is generally 3-5 years.
- After discovering a decrease in battery power, please replace the battery as soon as possible.
- After replacing the battery, please power up the PLC as early as possible, otherwise it may cause the battery to run out.

5. Supported Instructions

Rtelligent RX3U series PLC controller instruction specifications are fully compatible with Mitsubishi FX3U series programmable logic controllers. For more detailed guidance, please refer to the respective documentation.

5.1. Basic logic instructions

Instruction	Function	Whether support or not
LD	Initial logical operation contact type NO (normally open)	★
LDI	Initial logical operation contact type NC (normally closed)	★
LDP	Initial logical operation of rising edge pulse	★
LDF	Initial logical operation of falling/trailing edge pulse	★
AND	Serial connection of NO (normally open) contacts	★
ANI	Serial connection of NC (normally closed) contacts	★
ANDP	Serial connection of rising edge pulse	★
ANDF	Serial connection of falling/trailing edge pulse	★
OR	Parallel connection of NO (normally open) contacts	★
ORI	Parallel connection of NC (normally closed) contacts	★
ORP	Parallel connection of Rising edge pulse	★
ORF	Parallel connection of Falling/trailing edge pulse	★
ANB	Serial connection of multiple parallel circuits	★
ORB	Parallel connection of multiple contact circuits	★
MPS	Stores the current result of the internal PLC operations	★
MRD	Reads the current result of the internal PLC operations	★
MPP	Pops (recalls and removes) the currently stored result	★
INV	Invert the current result of the internal PLC operations	★
MEP	Conversion of operation result to leading edge pulse	★
MEF	Conversion of operation result to trailing edge pulse	★
OUT	Final logical operation type coil drive	★
SET	SET Bit device latch ON	★
RST	RESET bit device OFF	★
PLS	Rising edge pulse	★
PLF	Falling/trailing edge pulse	★
MC	Denotes the start of a master control block	★
MCR	Denotes the end of a master control block	★
NOP	No operation or null step	★
END	Program END, I/O refresh and return to step 0	★

5.2. Data Transfer Instructions

Instruction	Function	Whether support or not
MOV	Move	★
SMOV	Shift move	★
CML	Complement	★
BMOV	Block move	★
FMOV	Block move	★
PRUN	Parallel run (Octal mode)	★
XCH	Exchange	★
SWAP	Byte swap	★
EMOV	Floating point move	★
HCMOV	High-speed counter move	★

5.3. Data Conversion Instructions

Instruction	Function	Whether support or not
BCD	Conversion to binary coded decimal	★
BIN	Conversion to binary	★
GRY	Decimal to gray code conversion	★
GBIN	Gray code to decimal conversion	★
FLT	Conversion to floating point	★
INT	Floating point to integer conversion	★
EBCD	Floating point to scientific notation conversion	★
EBIN	Scientific notation to floating point conversion	★
RAD	Floating point degrees to radians conversion	★
DEG	Floating point radians to degrees conversion	★

5.4. Comparison Instructions

Instruction	Function	Whether support or not
LD=	Load compare (S1)=(S2)	★
LD>	Load compare (S1)>(S2)	★
LD<	Load compare (S1)<(S2)	★
LD<>	Load compare (S1)≠(S2)	★
LD<=	Load compare (S1)≤(S2)	★
LD>=	Load compare (S1)≥(S2)	★
AND=	AND compare (S1)=(S2)	★

AND>	AND compare (S1)>(S2)	★
AND<	AND compare (S1)<(S2)	★
AND<>	AND compare (S1)≠(S2)	★
AND<=	AND compare (S1)≤(S2)	★
AND>=	AND compare (S1)≥(S2)	★
OR=	OR compare (S1)=(S2)	★
OR>	OR compare (S1)>(S2)	★
OR<	OR compare (S1)<(S2)	★
OR<>	OR compare (S1)≠(S2)	★
OR<=	OR compare (S1)≤(S2)	★
OR>=	OR compare (S1)≥(S2)	★
CMP	Compare	★
ZCP	Zone compare	★
ECMP	Floating point compare	★
EZCP	Floating point zone compare	★
HSCS	High-speed counter set	★
HSCR	High-speed counter reset	★
HSZ	High-speed counter zone compare	★
HSCT	High-speed counter compare with data table	★
BKCMP=	Block data compare (S1)=(S2)	★
BKCMP>	Block data compare (S1)>(S2)	★
BKCMP<	Block data compare (S1)<(S2)	★
BKCMP<>	Block data compare (S1)≠(S2)	★
BKCMP<=	Block data compare (S1)≤(S2)	★
BKCMP>=	Block data compare (S1)≥(S2)	★

5.5. Four Operational Instructions

Instruction	Function	Whether support or not
ADD	Addition	★
SUB	Subtraction	★
MUL	Multiplication	★
DIV	Division	★
EADD	Floating point addition	★
ESUB	Floating point subtraction	★
EMUL	Floating point multiplication	★
EDIV	Floating point division	★
BK+	Block data addition	★

BK-	Block data subtraction	★
INC	Increment	★
DEC	Decrement	★

5.6. logical Operation Instructions

Instruction	Function	Whether support or not
WAND	Logical word AND	★
WOR	Logical word OR	★
WXOR	Logical exclusive OR	★

5.7. Special Function Instructions

Instruction	Function	Whether support or not
SQR	Square root	★
ESQR	Floating point square root	★
EXP	Floating point exponent	★
LOGE	Floating point natural logarithm	★
LOG10	Floating point common logarithm	★
SIN	Floating point Sine	★
COS	Floating point Cosine	★
TAN	Floating point Tangent	★
ASIN	Floating point Arc Sine	★
ACOS	Floating point Arc Cosine	★
ATAN	Floating point Arc Tangent	★
RND	Random number generation	★

5.8. Rotate Instructions

Instruction	Function	Whether support or not
ROR	Rotation Right	★
ROL	Rotation Left	★
RCR	Rotation Right with Carry	★
RCL	Rotation Left with Carry	★

5.9. Shift Instructions

Instruction	Function	Whether support or not
SFTR	Bit Shift Right	★
SFTL	Bit Shift Left	★
SFR	Bit Shift Right with Carry	★
SFL	Bit Shift Left with Carry	★
WSFR	Word Shift Right	★
WSFL	Word Shift Left	★
SFWR	Shift Write [FIFO/FILO control]	★
SFRD	Shift Read [FIFO Control]	★
POP	Shift Last Data Read [FILO Control]	★

5.10. Data Processing Command

Instruction	Function	Whether support or not
ZRST	Zone Reset	★
DECO	Decode	★
ENCO	Encode	★
MEAN	Mean	★
WSUM	Sum of Word Data	★
SUM	Sum of Active Bits	★
BON	Check Specified Bit Status	★
NEG	Negation	★
ENEG	Floating Point Negation	★
WTOB	WORD to BYTE	★
BTOW	BYTE to WORD	★
UNI	4-bit Linking of Word Data	★
DIS	4-bit Grouping of Word Data	★
CCD	Check Code	★
CRC	Cyclic Redundancy Check	★
LIMIT	Limit Control	★
BAND	Dead Band Control	★
ZONE	Zone Control	★
SCL	Scaling (Coordinate by Point Data)	★
SCL2	Scaling 2 (Coordinate by X/Y Data)	★
SORT	SORT Tabulated Data	
SORT2	Sort Tabulated Data 2	
SER	Search a Data Stack	★
FDEL	Deleting Data from Tables	
FINS	Inserting Data to Tables	

5.11. String Processing Instructions

Instruction	Function	Whether support or not
LEFT	Extracting Character String Data from the Left	
MIDR	Random Selection of Character Strings	
MIDW	Random Replacement of Character Strings	
INSTR	Character string search	
COMRD	Read Device Comment Data	

5.12. Program Process Control Instructions

Instruction	Function	Whether support or not
CJ	Conditional Jump	★
CALL	Call Subroutine	★
SRET	Subroutine Return	★
IRET	Interrupt Return	★
EI	Enable Interrupt	★
DI	Disable Interrupt	★
FEND	Main Routine Program End	★
FOR	Start a FOR/NEXT Loop	★
NEXT	End a FOR/NEXT Loop	★

5.13. I/O Refresh Instructions

Instruction	Function	Whether support or not
REF	Refresh	★
REFF	Refresh and Filter Adjust	★

5.14. Clock Control Instructions

Instruction	Function	Whether support or not
TCMP	RTC Data Compare	★
TZCP	RTC Data Zone Compare	★
TADD	RTC Data Addition	★
TSUB	RTC Data Subtraction	★
TRD	Read RTC data	★
TWR	Set RTC data	★
HTOS	Hour to Second Conversion	★
STOH	Second to Hour Conversion	★

5.15. Pulse Output, Positioning Command

Instruction	Function	Whether support or not
ABS	Absolute Current Value Read	
DSZR	DOG Search Zero Return	★
ZRN	Zero Return	★
TBL	Batch Data Positioning Mode	
DVIT	Interrupt Positioning	
DRVI	Drive to Increment	★
DRVA	Drive to Absolute	★
PLSV	Variable Speed Pulse Output	★
PLSY	Pulse Y Output	★
PLSR	Acceleration/Deceleration Setup	

5.16. Serial Communication Instructions

Instruction	Function	Whether support or not
RS	Serial Communication	
RS2	Serial Communication 2	
IVCK	Inverter Status Check	
IVDR	Inverter Drive	
IVRD	Inverter Parameter Read	
IVWR	Inverter Parameter Write	
IVBWR	Inverter Parameter Block Write	
IVMC	Inverter Multi Command	
ADPRW	MODBUS Read/Write	★

5.17. Special Function Unit / Module Control Instructions

Instruction	Function	Whether support or not
FROM	Serial Communication	
TO	Serial Communication 2	
RD3A	Inverter Status Check	
WR3A	Inverter Drive	
RBFM	Inverter Parameter Read	
WBFM	Inverter Parameter Write	

5.18. Extension Register / Extended File Register Control Instructions

Instruction	Function	Whether support or not
LOADR	Load From ER	
SAVER	Save to ER	
RWER	IRewrite to ER	
INITR	Initialize R and ER	
INITER	Initialize ER	
LOGR	Logging R and ER	

5.19. Other Convenience Instructions

Instruction	Function	Whether support or not
WDT	Watchdog Timer Refresh	★
ALT	Alternate State	★
ANS	Timed Annunciator Set	★
ANR	Annunciator Reset	★
HOUR	Hour Meter	★
RAMP	Ramp Variable Value	★
SPD	Speed Detection	★
PWM	Pulse Width Modulation	★
DUTY	Timing Pulse Generation	★
PID	PID Control Loop	★
ZPUSH	Batch Store of Index Register	★
ZPOP	Batch POP of Index Register	★
TTMR	Teaching Timer	
STMR	Special Timer	★
ABSD	Absolute Drum Sequencer	
INCD	Incremental Drum Sequencer	
ROTC	Rotary Table Control	
IST	Initial State	
MTR	Input Matrix	★
TKY	Ten Key Input	
HKY	Hexadecimal Input	
DSW	Digital Switch (Thumbwheel Input)	
SEGD	Seven Segment Decoder	★
SEGL	Seven Segment With Latch	
ARWS	Arrow Switch	
ASC	ASCII Code Data Input	
PR	Print (ASCII Code)	
VRRD	Volume Read	
VRSC	Volume Scale	

6. Use of the Timer [T]

A timer is a software component that uses addition to calculate clock pulses of 1ms, 10ms, 100ms, etc. in a programmable controller. When the result of the addition calculation reaches the specified set value, the output contact will act.

As a set value, it can be specified indirectly using a constant (K) in the program memory and through the contents of the data register (D).

6.1. Timer Numbering

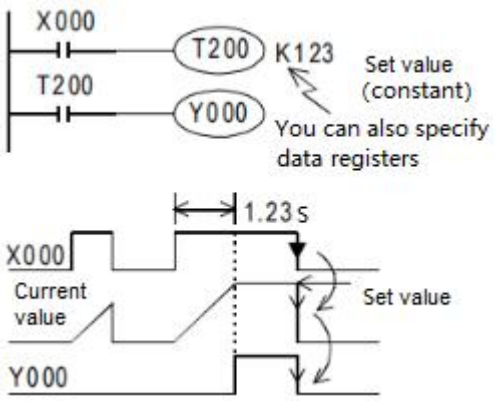
The numbering of the timer (T) is shown in the table below. (Numbers are assigned in decimal digits).

100ms type, 0.1-3276.7s	10ms type 0.01-327.67s	1ms cumulative type, 0.001-32.767s	100ms cumulative type, 0.1-3276.7s	1ms type 0.001-32.767s
T0-T199, 200 points	T200-T245, 46 points	T246-T249, 4 points, retention	T250-T255, 6 points, retention	T256-T511, 256 points

- Timer numbers that are not used as timers can also be used as data registers for storing numerical values.
- The cumulative timer of RX series programmable controllers is maintained during power outage through EEPROM memory.

6.2. Timer Function and Action Examples

6.2.1. General Use

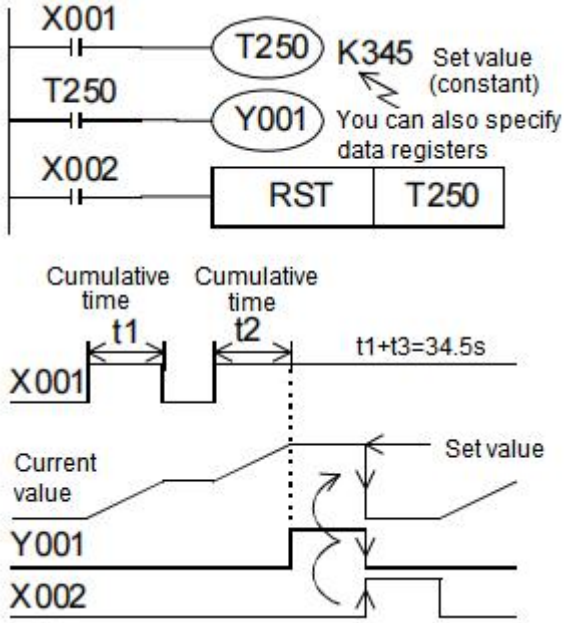


When the driving input X000 of timer coil T200 is ON, the current value counter used by T200 performs addition with the clock pulse of 10ms. If this value equals the set value K123, the timer's output contact actuates.

In other words, the output contact actuates 1.23 seconds after the driving coil is triggered.

When the driving input X000 is turned off or during power loss, the timer will reset, and the output contact will also reset.

6.2.2. Cumulative Type



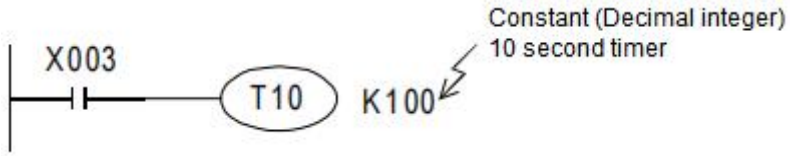
When the driving input X001 of timer coil T250 is ON, the current value counter used by T250 performs addition with the clock pulse of 100ms. If this value equals the set value K345, the timer's output contact actuates.

During the counting process, even if the input X001 goes OFF or there's a power loss, counting continues upon restarting. The cumulative action time is 34.5 seconds.

When the reset input X002 is ON, the timer resets, and the output contact also resets.

6.3. Specifying Timer Set Values

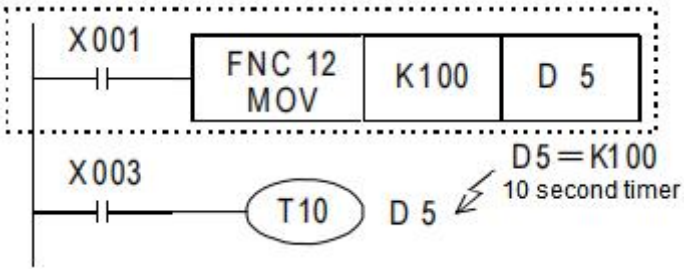
6.3.1. Specify Constant (K)



T10 is a timer in units of 100ms (0.1s).

Specifying the constant as 100 makes the timer operate for 0.1s × 100 = 10s.

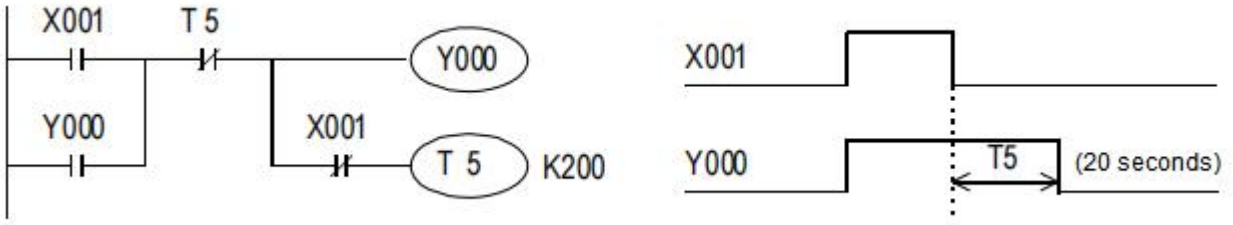
6.3.2. Indirect Specification (D)



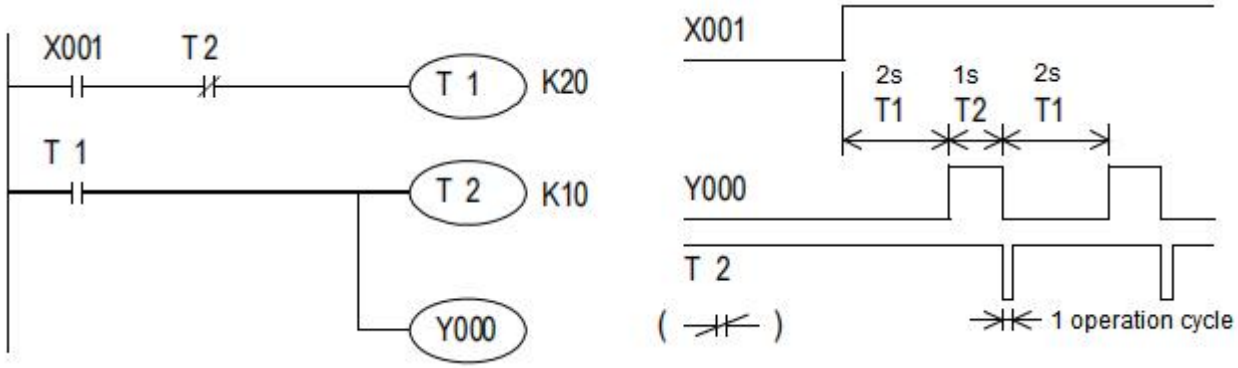
The content of indirectly specified data registers can be pre-written in the program or entered through digital switches or other inputs.

6.4. Program Example [Off-Delay Timer, Blinking]

1. Off-De;ay Timer



2. Blinking



7. Use of the Counter [C]

7.1. Counter Numbering

The numbering of the counter (C) is shown in the table below. (Numbers are assigned in decimal digits).

16-bit increment counter, 0~32767 counts		**32-bit increment/decrement counter, -2,147,483,648 ~ +2,147,483,647 counts**	
General use	Used for power-off retention (Permanent retention)	General use	Used for power-off retention (Permanent retention)
C0-C99, 100 points	C100-C199, 100 points	C200-C219, 20 points	C220-C234, 15 points

7.2. Counter Characteristics

The characteristics of 16-bit counters and 32-bit counters are as follows. They can be used separately based on different usage conditions such as counting direction switching and counting range.

Feature	16-Bit Counter	32-Bit Counter
Counting Direction	Incremental Counting	Incremental/Decremental Counting Switchable
Set Value	1~32767	-2,147,483,648 ~ +2,147,483,647
Set Value Specification	Constant K or Data Register	Same as left, but data registers need to be in pairs (2 registers)
Current Value Change	Stops changing after reaching count value	Continues to change after reaching count value (circular counting)
Output Contact	Action Held After Counting Reaches the Set Value	Holds during Incremental Counting, Resets during Decremental Counting
Reset Action	When executing RST instruction, the current value of the counter is set to 0, and the output contact resets as well	
Current Value Register	16 -bit	32 -bit

7.3. Related Soft Elements (Switching of Increment/Decrement) 【32-Bit Counter】

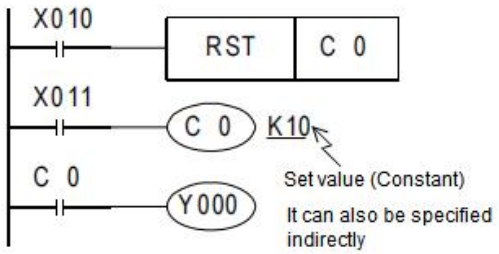
Auxiliary relays for switching between increment and decrement counting. If ON, it switches to decrement counting; if OFF, it switches to increment counting.

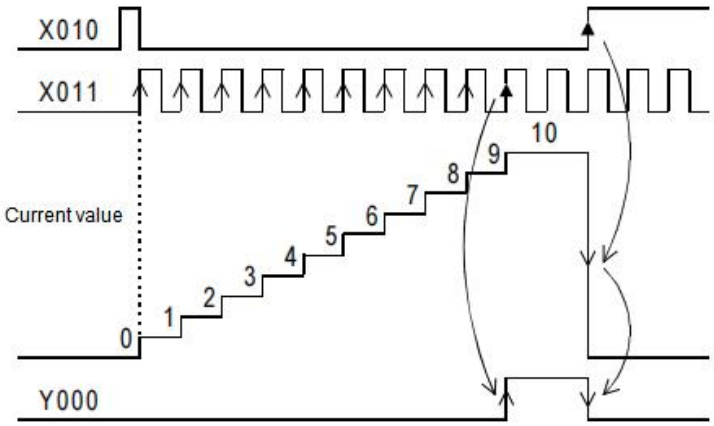
Counter Number	Direction Switch	Counter Number	Direction Switch	Counter Number	Direction Switch
C200	M8200	C212	M8212	C224	M8224
C201	M8201	C213	M8213	C225	M8225
C202	M8202	C214	M8214	C226	M8226
C203	M8203	C215	M8215	C227	M8227
C204	M8204	C216	M8216	C228	M8228
C205	M8205	C217	M8217	C229	M8229
C206	M8206	C218	M8218	C230	M8230
C207	M8207	C219	M8219	C231	M8231
C208	M8208	C220	M8220	C232	M8232
C209	M8209	C221	M8221	C233	M8233
C210	M8210	C222	M8222	C234	M8234
C211	M8211	C223	M8223		

7.4. Function and Action Examples

7.4.1.16-Bit Counter - General Use / Power-Off Holding

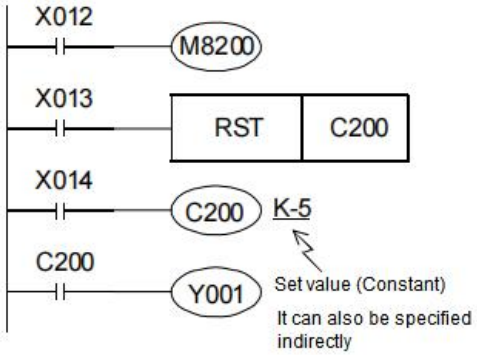
- By using counting input X011, every time the C0 coil is driven, the current value of the counter increases. The output contact activates on the 10th execution of the coil instruction. After this, even if counting input X011 activates, the current value of the counter remains unchanged.
- If the input reset X010 is ON and the RST instruction is executed, the current value of the counter becomes 0, and the output contact resets.

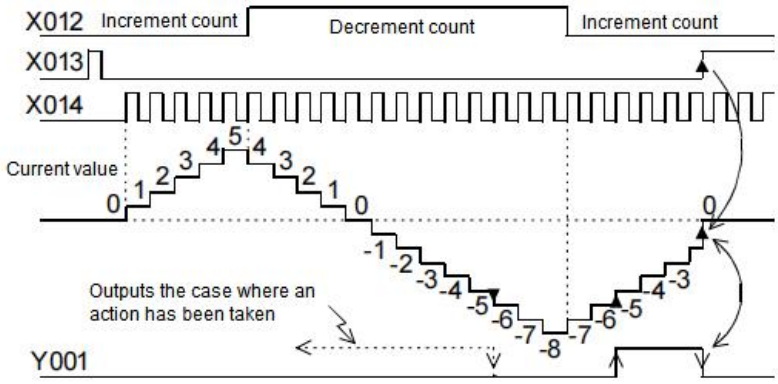




7.4.2.32-Bit Increment / Decrement Counter - General Use / Power-Off Holding

- For counter C△△△, driving M8△△△ sets it as a decrement counter, while not driving it sets it as an increment counter (refer to the previous page).
- Using counting input X014 to drive coil C200 allows both incrementing and decrementing counting.
- When the current value of the counter changes from "-6" to "-5," the output contact is set; when it changes from "-5" to "-6," the contact is reset.
- If the reset input X013 is ON and the RST instruction is executed, the current value of the counter becomes 0, and the output contact resets.



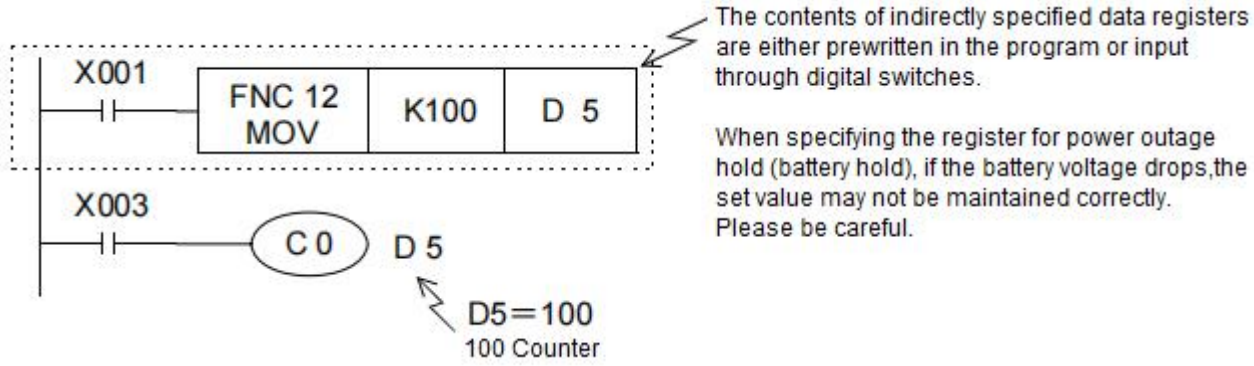


7.5. Setting Value Specification Method

7.5.1.16-bit Counter

1. Specifying a Constant (K)

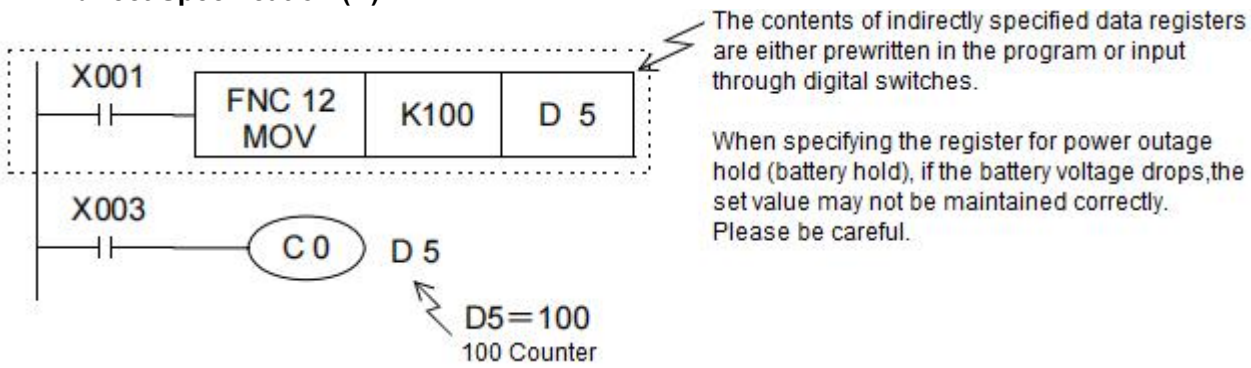
2. Indirect Specification (D)



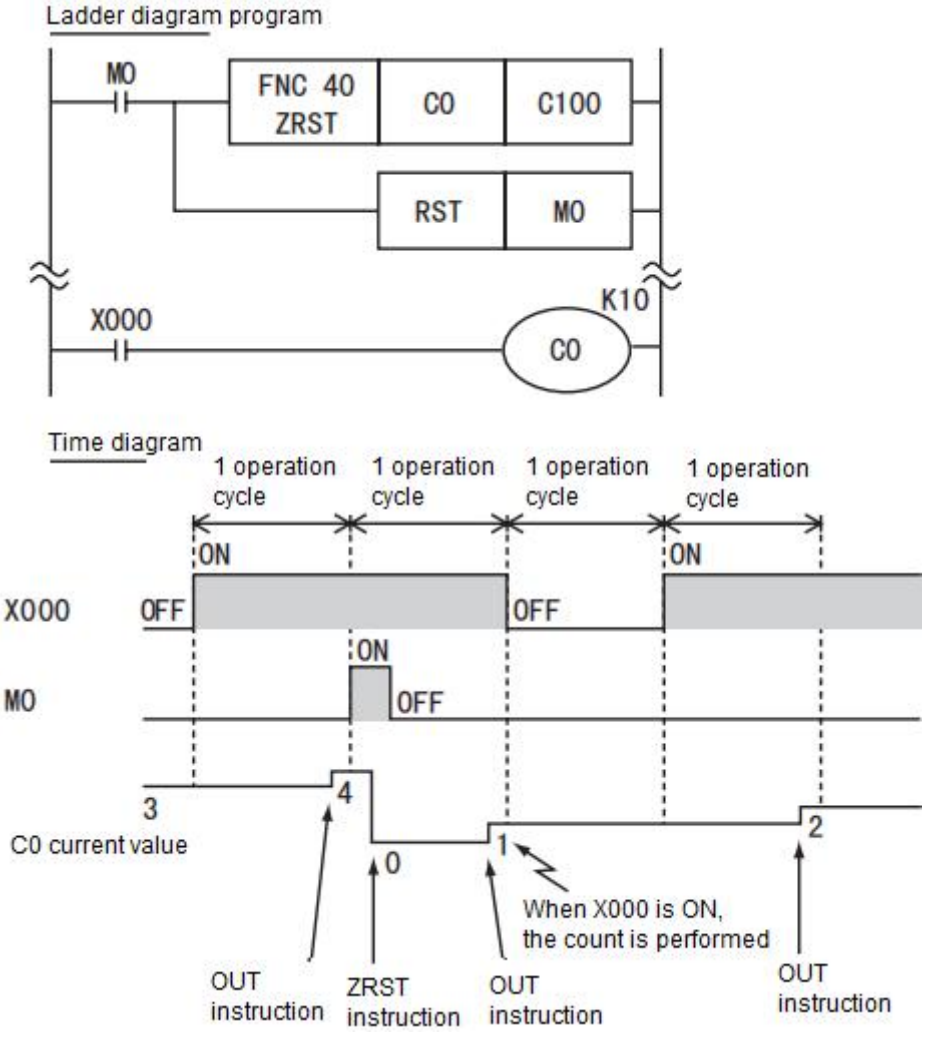
7.5.2.32-bit Counter

1. Specifying a Constant (K)

2. Indirect Specification (D)



7.6. Program Example



The ZRST instruction resets the previous state of T and C coils as well as their reset states.

Therefore, when the driving contact of X000 is ON in the program, the counter will begin counting after the execution of the ZRST instruction.

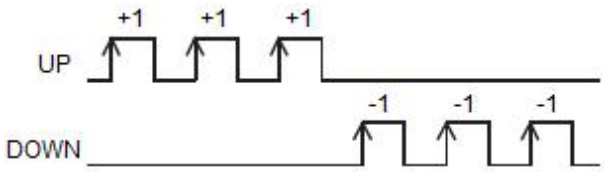
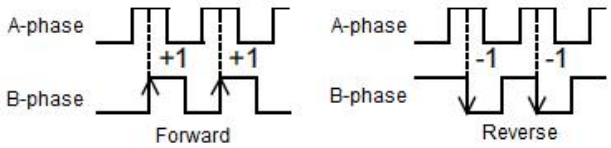
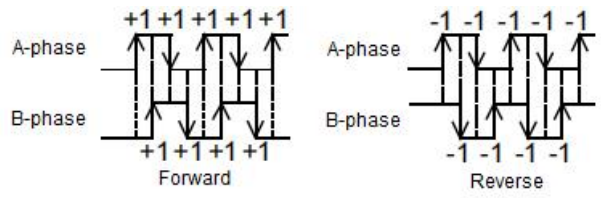
8. Use of the High-speed Counters

8.1. Types of High-speed Counters

Within the PLC basic unit, there are built-in 32-bit increment/decrement high-speed counters (single-phase single-count, single-phase double-count, and double-phase double-count). Moreover, high-speed counters provide the functionality to choose external reset input terminals and external start input terminals (initiating counting).

8.2. Forms of High-speed Counter Input Signals

The types of high-speed counters (single-phase single-count, single-phase double-count, and double-phase double-count) and their input signal forms are as follows:

<table>
<tr><th colspan="2">Items</th><th>Input Signal Form</th><th>Counting Direction</th></tr>
<tr><td colspan="2">Single-phase single-count input</td><td> 
</td><td>Controlled by M8235~M8245 ON/OFF to specify decrement or increment counting.
ON: Decrement
OFF: Increment</td></tr>
<tr><td colspan="2">Single-phase double-count input</td><td> 
</td><td>As shown in the left diagram, performs either increment or decrement counting. The counting direction can be set using M8246~ M8250.
ON: Decrement
OFF: Increment</td></tr>
<tr><td rowspan="2">Double-phase double-count input</td><td>1x Speed</td><td> 
</td><td rowspan="2">As shown in the left diagram, automatically performs increment or decrement counting based on the A-phase/B-phase input state changes. The counting direction can b
e set using M8251~M8255.
ON: Decrement
OFF: Increment</td></tr>
<tr><td>4x Speed</td><td> 
</td></tr>
</table>

8.3. Built-in High-speed Counter Input Allocation Table

Counter type	Counter number	Input point allocation							
		X000	X001	X002	X003	X004	X005	X006	X007
Single-phase single-count input	C235	U/D							
	C236		U/D						
	C237			U/D					
	C238				U/D				
	C239					U/D			
	C240						U/D		
	C241	U/D	R						
	C242			U/D	R				
	C243					U/D	R		
	C244	U/D	R					S	
	C245			U/D	R				S
Single-phase double-count input	C246	U	D						
	C247	U	D	R					
	C248				U	D	R		
	C248(OP)				U	D			
	C249	U	D	R				S	
	C250				U	D	R		S
Double-phase double-count input	C251	A	B						
	C252	A	B	R					
	C253				A	B	R		
	C253(OP)				A	B			
	C254	A	B	R				S	
	C255				A	B	R		S

U: Increment count input D: Decrement count input

A: AB phase A input B: AB phase B input

R: External reset input S: External start input

Single-Phase: Up to 6 channels, maximum frequency 60KHz;

AB (Z) Phase: 2 channels, maximum frequency 30KHz.

8.4. Related Soft Components

8.4.1. Switching Increment/Decrement Count for Single-Phase Single-Count Input Counter

Type	Counter Number	Specified Soft Component	Increment	Decrement
Single-phase single-count input	C235	M8235	OFF	ON
	C236	M8236		
	C237	M8237		
	C238	M8238		
	C239	M8239		
	C240	M8240		
	C241	M8241		
	C242	M8242		
	C243	M8243		
	C244	M8244		
	C245	M8245		

8.4.2. Monitoring Increment/Decrement Count Direction for Single-Phase Dual-Count and Dual-Phase Dual-Count Input Counter

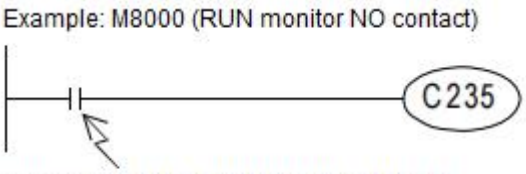
Type	Counter Number	Monitoring Soft Component	OFF	ON
Single-Phase Dual-Count Input	C246	M8246	Increment	Decrement
	C247	M8247		
	C248	M8248		
	C249	M8249		
	C250	M8250		
Dual-Phase Dual-Count Input	C251	M8251		
	C252	M8252		
	C253	M8253		
	C254	M8254		
	C255	M8255		

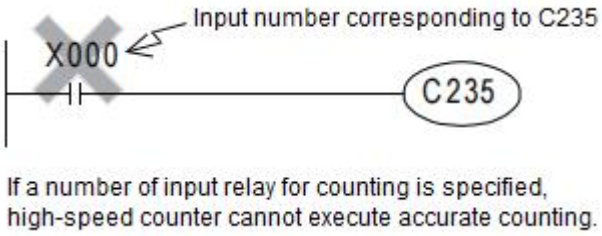
8.4.3. Function Switching for High-Speed Counters

Soft Component Number	Name	Content
M8388	High-speed counter function change contact	High-speed counter function change contact
M8392	Function switching soft component	C248, C253 use function switching soft component
M8198		1x/4x switching soft component for C251, C252, C254
M8199		1x/4x switching soft component for C253, C255, C253 (OP)

8.5. Usage Examples and Precautions for High-speed Counters

- Use a continuously ON contact for the coil drive of the high-speed counter.

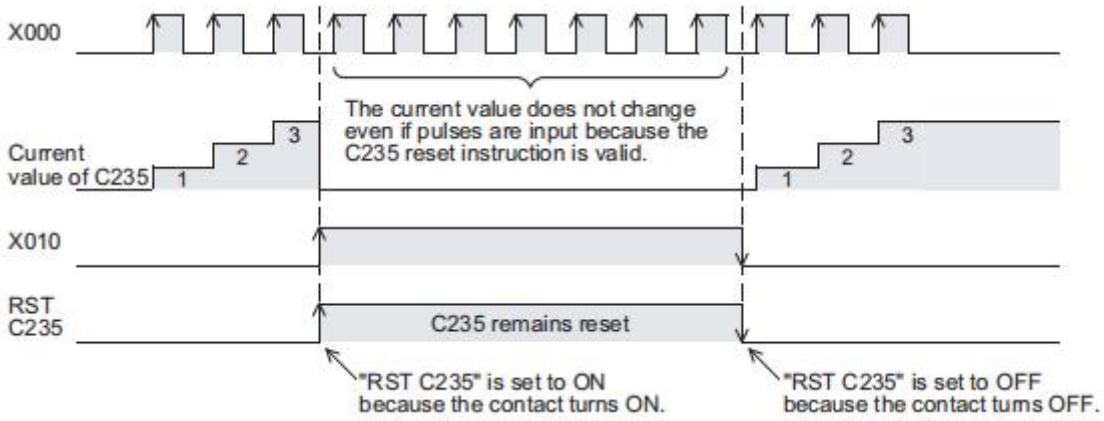




- When using devices with contacts like analog switches for the operation of the high-speed counter, be aware that counting errors might occur due to switch vibrations.
- The input filter for the basic unit input terminals used in high-speed counters will be automatically set to 5μs (X000, X001, X003, X004), or 50μs (X002, X005). Therefore, there's no need to use the REFF instruction or special data register D8020 (input filter adjustment). Additionally, the input filter for input relays not used as high-speed counter inputs remains at 10ms (initial value).
- Signals input to the high-speed counter must not exceed the response frequency. Inputting signals beyond this frequency might result in Watchdog Timer (WDT) errors and parallel linkages might not work correctly.
- When using the RST instruction to reset the high-speed counter, counting cannot occur until after the drive of the line with the RST instruction goes.

1. Program example

2. Timing chart



9. Use of the High-Speed Pulse Output Positioning Function

9.1. High-Speed Pulse Output and Positioning Function

The RX3U series PLC transistor models support 3 channels of 150KHz high-speed pulse output (Y0-Y2) and provide support for constant-speed and variable-speed pulse outputs. The supported instructions include PLSY (constant-speed pulse output), PLSR (pulse output with acceleration and deceleration functions), PLSV (variable-speed pulse output with rotation direction), DRVI (relative positioning), DRVA (absolute positioning), ZRN (origin return), and DSZR (origin return with DOG search).

The original Mitsubishi FX3U pulse programs can be used without modification.

9.2. Output Point Allocation

Purpose	Output Number	Remarks
Pulse signal (Pulse output terminal)	Y000 Y001 Y002	Connect Y000 to Y002 as pulse output terminals according to the positioning instruction settings.
Direction signal (Rotation direction signal)	All output points	Specify any output connection as the rotation direction signal according to the positioning instruction.
Zero clear signal	All Output Points	**Version 1.0 does not support the zero clear signal.**

9.3. Output Point Allocation

Model Name	RX3U-MT	RX3U-MR
Number of control axes	Independent 3 Axes	Does not support high-speed pulse output
Does not support high-speed pulse output	Transistor	
Pulse output form	Pulse + Direction	
Maximum frequency	150K Hz	
Acceleration/deceleration handling	Trapezoidal	
Control unit	Pulse	
Positioning range	-2,147,483,648-+2,147,483,647	
Other	Output pulses can be generated from general unit outputs (Y000, Y001, Y002)	

9.4. Relevant Auxiliary Relays Overview

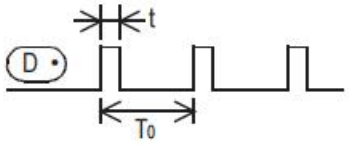
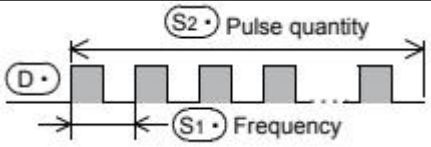
9.4.1. Special Auxiliary Relays

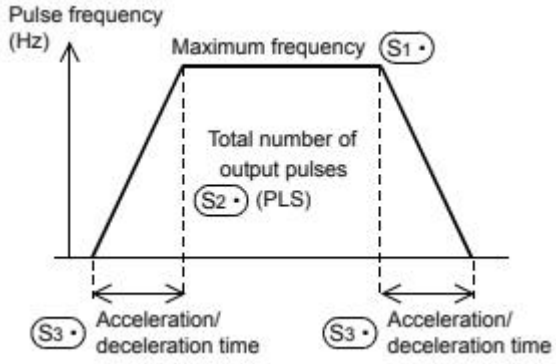
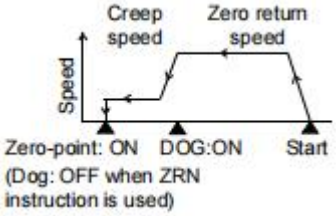
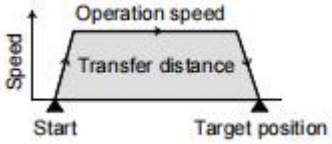
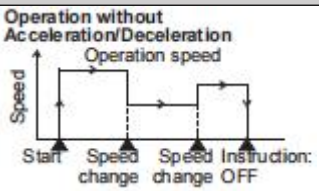
Relay Number			Function	Attribute	Object Instructions
Y000	Y001	Y002			
M8029			Instruction Execution Completion Flag	Readable Only	PLSY/PLSR/DSZR/DVIT/ZRN/ DRVI/DRVA
M8340	M8350	M8360	Pulse Output Monitoring (BUSY/READY)	Readable Only	PLSY/PLSR/DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
M8341	M8351	M8361	Zero Clear Signal Output Function Effective	Read/Write	DSZR/ZRN
M8342	M8352	M8362	Origin Return Direction Specification	Read/Write	DSZR
M8343	M8353	M8363	Forward Limit	Read/Write	PLSY/PLSR/DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
M8344	M8354	M8364	Reverse Limit	Read/Write	PLSY/PLSR/DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
M8345	M8355	M8365	Near-point Signal Logic Reversal	Read/Write	DSZR
M8346	M8356	M8366	Zero-point Signal Logic Reversal	Read/Write	DSZR
M8347	M8357	M8367	Interrupt Signal Logic Reversal Read/Write	Read/Write	DVIT
M8348	M8358	M8368	In Position Command Execution	Readable Only	PLSY/PWM/PLSR/DSZR/DVIT/ ZRN/PLSV/DRVI/ DRVA
M8349	M8359	M8369	Pulse Stop Bit	Read/Write	PLSY/PLSR/DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
M8460	M8461	M8462	User Interrupt Input Instruction	Read/Write	DVIT
M8464	M8465	M8466	Zero Clear Signal Soft Component Specification Effective	Read/Write	DSZR/ZRN

9.4.2. Special Data Registers

Device number						Function	Data length	Initial value	Object Instructions
Y000		Y001		Y002					
D8336						Interrupt input specification	16-bit	0	DVIT
D8340	Low-order	D8350	Low-order	D8360	Low-order	Current value register (PLS)	32-bit	0	DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
D8341	High-order	D8351	High-order	D8361	High-order				
D8342		D8352		D8362		Base speed (Hz)	16-bit	0	DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
D8343	Low-order	D8353	Low-order	D8353	Low-order	Maximum speed (Hz)	32-bit	100,000	DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
D8344	High-order	D8354	High-order	D8354	High-order				
D8345		D8355		D8365		Creep speed [Hz]	16-bit	1,000	DSZR
D8346	Low-order	D8356	Low-order	D8366	Low-order	Zero return speed [Hz]	32-bit	50,000	DSZR
D8347	High-order	D8357	High-order	D8367	High-order				
D8348		D8358		D8368		Acceleration time [ms]	16-bit	100	DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
D8349		D8359		D8369		Deceleration time [ms]	16-bit	100	DSZR/DVIT/ZRN/ PLSV/DRVI/DRVA
D8464		D8465		D8466		Clear signal, device specification	16-bit	0	DSZR/ZRN

9.5. List of Instructions Used for Built-In Pulse Output and Positioning Functions

Pulse width modulation		Operation	Description
PWM instruction	Pulse width modulation		By driving the PWM command, the pulse output according to the specified pulse period and ON time.
Pulse instruction		**Operation**	**Description**
PLSY instruction	Pulse output		By driving the PLSY instruction, the pulse train with the specified number and frequency is output.

PLSR instruction	Pulse output with acceleration and deceleration		By driving the PLSR instruction, the output specifies the highest frequency, executes the acceleration and deceleration of the specified ms time, and outputs the specified number of pulses.
Positioning instruction		**Operation**	**Description**
Mechanical zero return			
DSZR instruction	zero return with DOG search function		If the DSZR/ZRN instruction turns ON, mechanical zero return will be started at the specified zero return speed. If the dog sensor is turned on, the speed will be reduced to the creep speed. If the zero-phase signal is input, the operation will be stopped, and the zero return will be completed. (If the ZRN instruction is used, the dog sensor will be turned off to stop the operation.)
ZRN instruction	zero return		
Relative/absolute positioning			
DRVI instruction	Relative positioning		If the DRVI/DRVA instruction turns ON, the operation will be started at the operation speed.
DRVA instruction	Absolute positioning		
Variable speed operation			
PLSV instruction	Variable Speed Pulse Output		If the PLSV instruction turns ON, operation will be started at the specified speed. With an operation speed change, the speed changes to the specified speed, and operation continues. At PLSV instruction OFF, the pulse output stops.

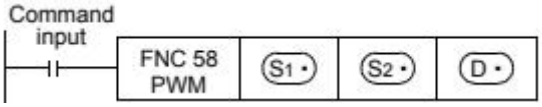
9.6. Instructions for Using PWM/ Pulse Width Modulation Instructions

9.6.1. PWM Instruction Summary

This instruction is used to specify the pulse output of the pulse period and the ON time.

9.6.2. PWM instruction format and parameter instructions

1. Instruction format



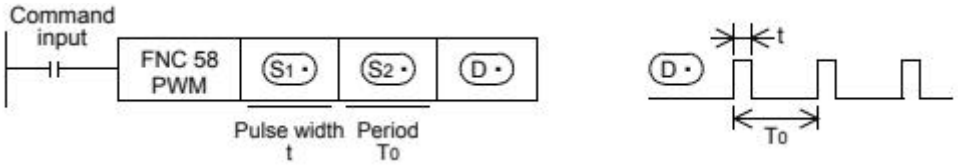
2. Parameter instructions

Operand type	Description	Data type	Word devices	Range
S1.	Pulse width (ms) data or the word software component number to hold the data	BIN 16-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	0~32767ms
S2.	Period (ms) data or the word software component number to hold the data	BIN 16-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	0~32767ms
D.	The Y number of the output pulse	BIN 16-bit	Y0~Y2	Y0~Y2

9.6.3. Explanation of Function and Operation

1. 16-bit operation

Pulses whose ON pulse width is S1.ms are output in periods of S2.ms



2. Cautions

- The value of pulse width S1. and period S2. shall be set to S1.≦S2.
- When the instruction input is OFF, the output from D. is also OFF.
- Do not operate the setting switch for the pulse output mode during the pulse delivery process.
- Soft components that can be specified in D, only the transistor of the basic unit output Y000, Y001, Y002 are valid.

9.6.4. PWM Program Example

In the following program, the average output of Y000 is 0~100% when the content of D10 varies between 0 and 50.

9.7. PLSY/Pulse Output Instructions

9.7.1. PLSY Instruction Summary

This instruction is used to specify the pulse output of the frequency and the number of pulses.

9.7.2. PLSY Instruction Format and Parameter Description

1. Instruction format

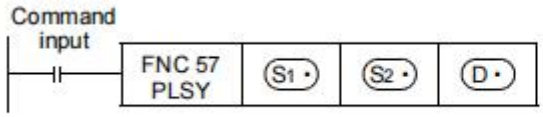
2. Parameter instructions

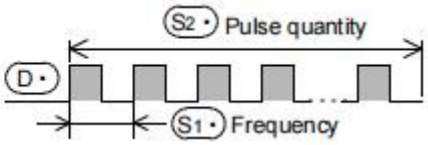
Operand type	Content	Data type	Word devices	Range
S1.	Pulse frequency	BIN16-bit/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	16-bit arithmetic ranges from 1~32767Hz.. 32-bit arithmetic ranges from 1~150,000Hz..
S2.	Output pulse quantity	BIN16-bit/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	16-bit arithmetic ranges from 1~32767. 32-bit arithmetic ranges from 1~2,147,483,647.
D.	The Y number of the output pulse	BIN16-bit/32-bit	Y0~Y2	Y0~Y2

9.7.3.PLSY Function and Operation Instructions

1. 16-bit PLSY instruction function

A pulse train of frequency [S1.Hz] is output in the quantity [S2] from the output [D].



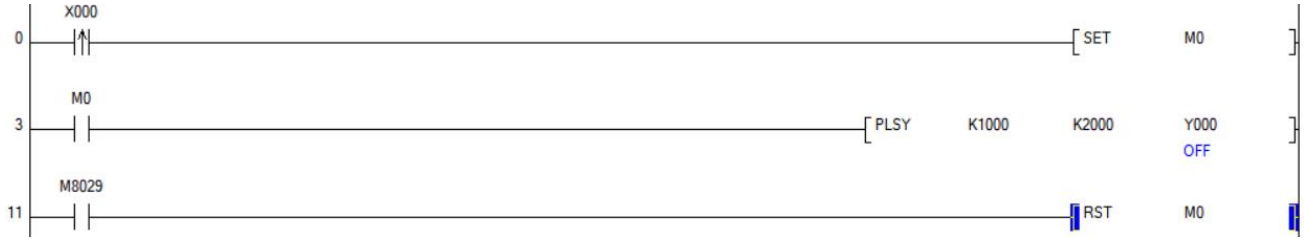


2. Cautions

- If the value of the word software component is changed during instruction execution, the action of the instruction becomes as follows: When the data in S1 is changed, the output frequency also changes accordingly. When S2 is changed, the change takes effect from the next time the instruction is driven.
- When using the transistor output of the basic unit, please set the output frequency below 150000 Hz. When using pulses with frequencies exceeding 150000 Hz to operate the load, the programmable controller may sometimes malfunction. Additionally, please do not set the output frequency to 0.
- The ON/OFF time duty cycle of the pulse is 50% internal to the programmable controller. However, due to the influence of the output circuit, some frequencies may not guarantee 50%.
- The soft components that can be specified in D are only valid for the transistor outputs Y000, Y001, and Y002 of the basic unit.

9.7.4.PLSY Program Example

In the following program, when X0 rises edge, initiate 2000 pulses at Y0 port at frequency of 1000Hz.



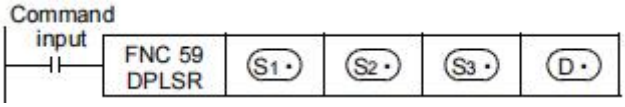
9.8. PLSR / Acceleration/Deceleration Setup

9.8.1.PLSR Instruction Summary

This instruction is used to specify the pulse output with the acceleration and deceleration function of the highest frequency and the number of pulses.

9.8.2.PLSR Instruction Format and Parameter Description

1. Instruction format



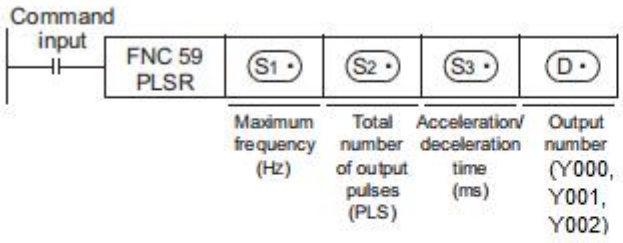
2. Parameter instructions

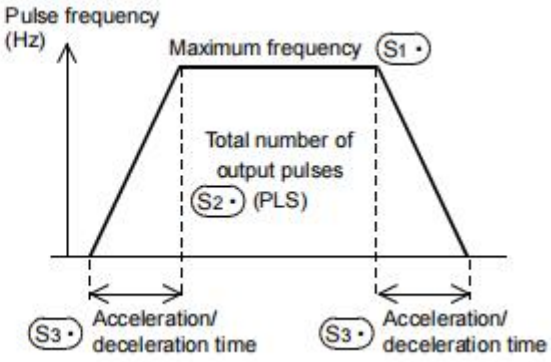
Operand type	Content	Data type	Word devices	Range
S1.	Pulse frequency	BIN16-bit/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	16-bit arithmetic ranges from 1~32767Hz.. 32-bit arithmetic ranges from 1~150,000Hz..
S2.	Output pulse quantity	BIN16-bit/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	16-bit arithmetic ranges from 1~32767. 32-bit arithmetic ranges from 1~2,147,483,647.
S3	Acceleration/deceleration time	BIN16-bit/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K, H	50~5000ms
D.	The Y number of the output pulse	BIN16-bit/32-bit	Y0~Y2	Y0~Y2

9.8.3.PLSR Function and Operation Instructions

1. 16-bit PLSR instruction function

Pulses are output from the output [D], whose highest frequency is [S1.Hz], acceleration and deceleration of [S3.ms] time is performed, and the number of output pulses is [S2].



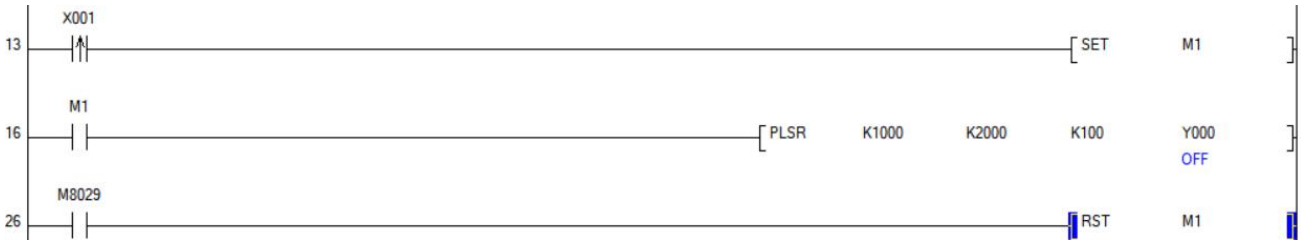


2. Cautions

- When using the transistor output of the basic unit, please set the output frequency below 150,000Hz. When using pulses with frequencies exceeding 150,000Hz to operate the load, the programmable controller may sometimes malfunction. Additionally, please do not set the output frequency to 0.
- The ON/OFF time duty cycle of the pulse is 50% internal to the programmable controller. However, due to the influence of the output circuit, some frequencies may not guarantee 50%.
- The soft components that can be specified in D are only valid for the transistor outputs Y000, Y001, and Y002 of the basic unit.

9.8.4. PLSR Program Example

In the following program, when X1 rises, it starts at Y0 port and outputs 2000 pulses with an acceleration time of 100ms and a maximum frequency of 1000Hz.



9.9. DSZR / Dog Search Zero Return

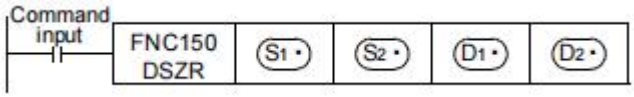
9.9.1. DSZR Instruction Summary

An instruction to perform origin regression to align the mechanical position with the current value register in the programmable controller. In addition, the ZRN instruction does not support the following situations, but this instruction can support them.

- ◆ Support for DOG search function
- ◆ Allow for origin regression using near point DOG and zero point signal

9.9.2. DSZR Instruction Format and Parameter Description

1. Instruction format



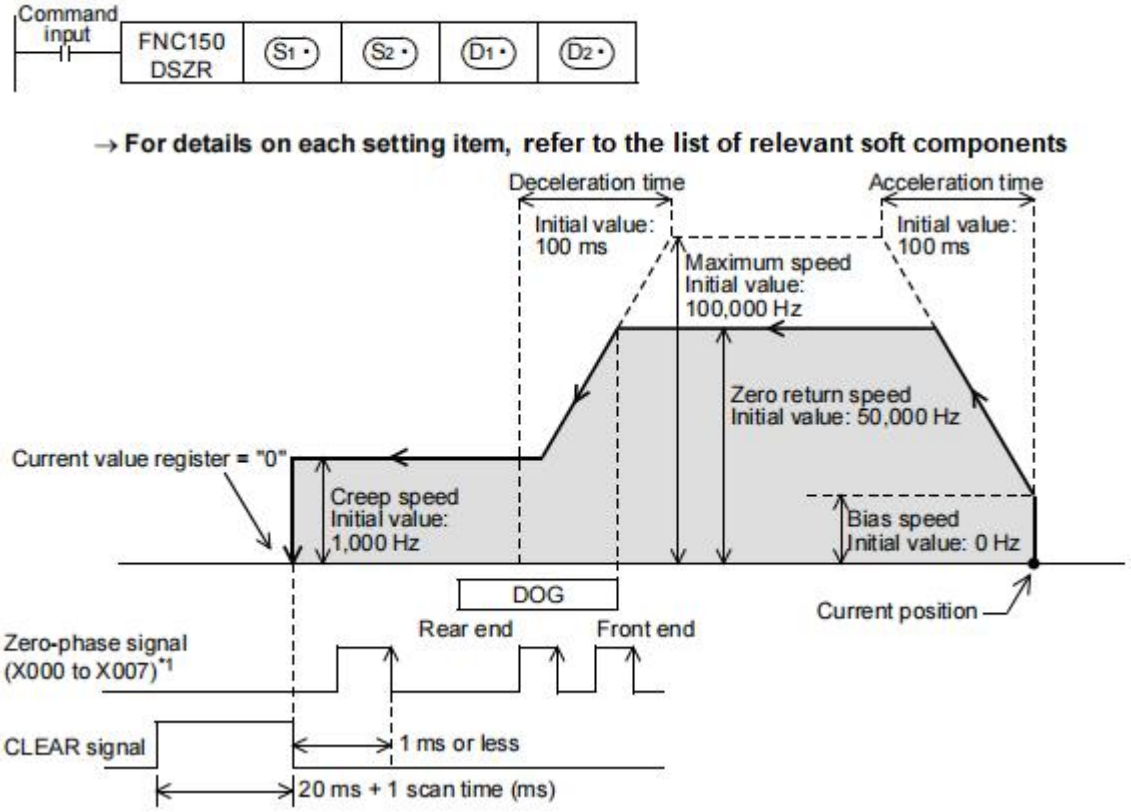
2. Parameter instructions

Operand type	Content	Data type	Word devices	Range
S1.	Device number for near-point signal (dog)	BIN16-bit	X0~X17	X0~X17
S2.	zero point signal	BIN16-bit	X0~X17	X0~X17
D1.	The Y number of the output pulse	BIN16-bit	Y0~Y2	Y0~Y2
D2.	The Y number of the rotation direction signal	BIN16-bit	Y0~Y17	Y0~Y17

9.9.3.DSZR Function and Operation Instructions

1. DSZR instruction function

After output the pulse from the output [D1] and the rotation direction from the output [D2], with [S1] as the near point signal and [S2] as the zero point signal, the mechanical position coincides with the current value register within the programmable controller.



(1) In S1., specify the soft element number for the input near-point signal (DOG).

The logic of the near-point signal (DOG) is specified by the ON/OFF of the near-point signal logic inversion marker bit (the table below).

Pulse output destination device	Near-point signal logic reverse relay	Description
D1. ＝ Y000	M8345	When OFF: positive logic (Turning on the input will turn on the near-point signal). When ON: negative logic (Turning off the input will turn on the near-point signal).
D1. ＝ Y001	M8355	
D1. ＝ Y002	M8365	

The detection of near-point signals (DOGs) (front-end and back-end) is influenced by the scanning period of the input filter and sequence control program. Please leave more than one scanning cycle from the DOG backend to the zero signal being ON.

(2) For S2, specify the zero signal input number in the range of X000 to X017.

The logic of the zero signal is specified by the ON/OFF of the zero signal logic inversion flag bit (as shown in the table below).

In addition, if the near point signal and the zero point signal are specified as the same input, the logic of the zero point signal is not based on the following soft components, but rather on the logic action of the near point signal (DOG). At this point, like the ZRN instruction, it does not use a zero signal, but instead executes actions based on the front and back ends of the near point signal (DOG).

Pulse output destination device	Zero signal logic reverse relay	Description
D1. ＝ Y000	M8346	When OFF: positive logic (Turning on the input will turn on the zero signal). When ON: negative logic (Turning off the input will turn on the zero signal).
D1. ＝ Y001	M8356	
D1. ＝ Y002	M8366	

(3) For D1., specify a pulse output number in the range of Y000 to Y003.

(4) For D2, specify the rotation direction signal output device number.

In the RX3U series programmable controller, please use transistor output for the rotation direction signal. The rotation direction and ON/OFF status of the specified devices are shown in the table below. However, during the execution of this command, please do not control the output specified in D2.

ON/OFF status of device specified by D2.	Rotation direction (Increase or decrease of current value)
ON	Forward rotation [Outputting pulses from D1. will increase the current value]
OFF	Reverse rotation [Outputting pulses from D1. will decrease the current value]

(5) Zero return direction

To specify the zero return direction, turn “zero return direction specification” relay ON/OFF as shown in the following table.

Pulse output destination device	“Zero return direction specification” relay	Description
D1. ＝ Y000	M8342	To perform zero return in the forward rotation direction: Turn on the relay. To perform zero return in the reverse rotation direction: Turn off the relay.
D1. ＝ Y001	M8352	
D1. ＝ Y002	M8362	

(6) Clear signal output

This instruction can output the clear signal after stopping at the origin.

If it is necessary to output the clear signal at the completion of zero return, turn on the "clear signal output function enable" relay (see the following table). Turn on the "clear signal device specification function enable" relay to specify the clear signal output device (output Y) for the pulse output destination device using the clear signal device specification register.

Pulse output destination device	Status of “clear signal output function enable” relay	Status of "clear signal device specification function enable" relay	clear signal device specification register
D1. = Y000	M8341 = ON	M8464 = ON	D8464
D1. = Y001	M8351 = ON	M8465 = ON	D8465
D1. = Y002	M8361 = ON	M8466 = ON	D8466

(7) Zero return speed

Use the devices shown in the following table to set the zero return speed. Be sure to set the zero return speed so that the relation with the other speeds is "bias speed ≤ zero return speed ≤ maximum speed".

If "zero return speed > maximum speed", the operation will be performed at the maximum speed.

Pulse output destination device	Bias speed	Zero return speed	Maximum speed	Initial value
D1. = Y000	D8342	D8347, D8346	D8344, D8343	50,000 (Hz)
D1. = Y001	D8352	D8357, D8356	D8354, D8353	
D1. = Y002	D8362	D8367, D8366	D8364, D8363	

(8) Creep speed

Use the devices shown in the following table to set the creep speed. Be sure to set the creep speed so that the relation with the other speeds is "bias speed ≤ creep speed ≤ maximum speed".

Pulse output destination device	Bias speed	Creep speed	Maximum speed	Initial value
D1. = Y000	D8342	D8345	D8344, D8343	1,000 (Hz)
D1. = Y001	D8352	D8355	D8354, D8353	
D1. = Y002	D8362	D8365	D8364, D8363	

2. Zero return operation

Zero return operation is described below assuming that Y000 is specified as the pulse output destination device . If Y001 or Y003 is specified, it is necessary to change the output number of each related relay (special auxiliary relay, special data register).

(1) Specify the zero return direction.

Turn the "zero return direction specification" relay (M8342) ON or OFF to specify the zero return direction.

(2) Execute the DSZR instruction to perform zero return.

(3) Transfer operation will be performed in the direction specified by the "zero return direction designation" flag (M8342) at the speed specified by the "zero return speed designation" device (D8347, D8346).

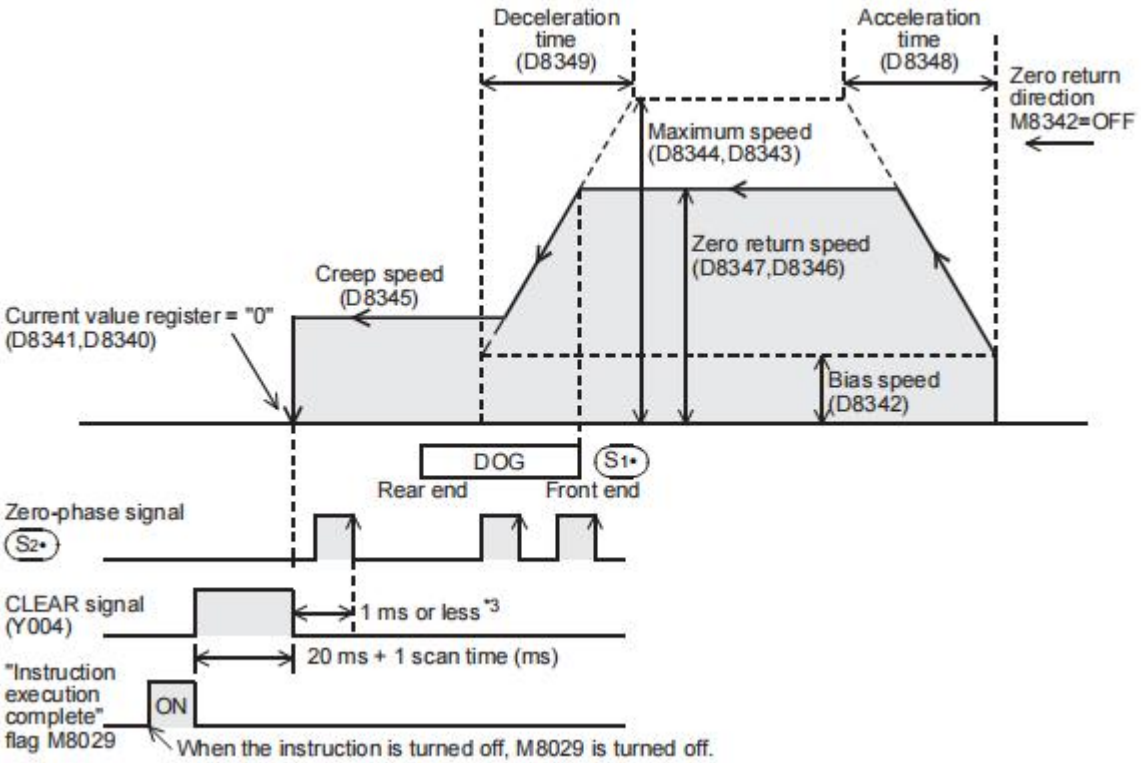
(4) If the specified near-point signal (DOG) is turned ON, the speed will be reduced to the creep speed (D8345).

(5) After turning the near-point signal (DOG) OFF, if the specified zero signal is turned ON, the pulse outputting operation will immediately stop. If the same input is specified for both the near-point signal and the zero signal, turning the near point signal (DOG) OFF will immediately stop the pulse outputting operation (just like the ZRN instruction where the zeroe signal is not used).

(6) If the clear signal output function (M8341) is enabled (set to ON), the clear signal (Y004) will be turned on within 1ms after the zero signal is turned ON, and will be kept ON for "20ms + 1 scan time (ms)".

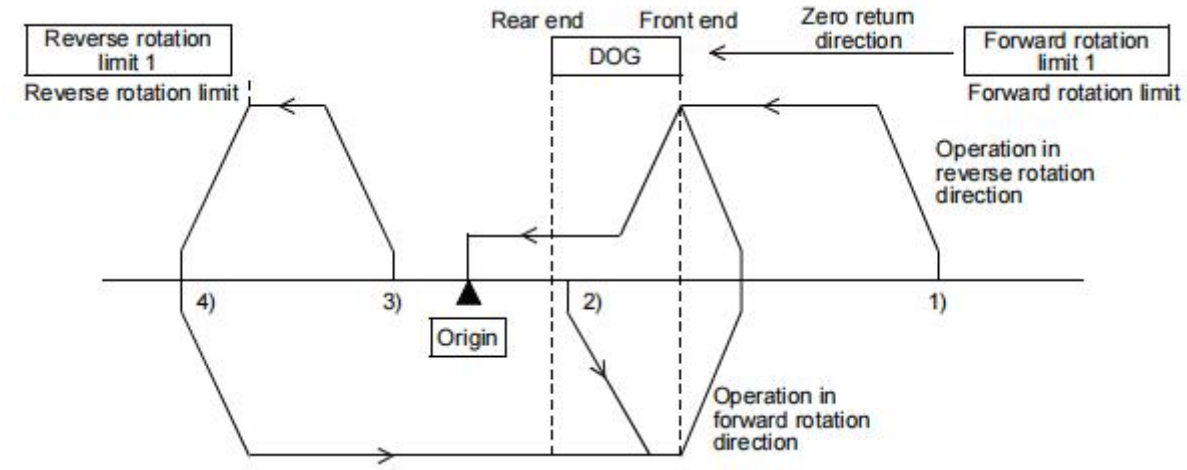
(7) The current value register (D8341, D8340) will be reset to "0" (will be cleared).

(8) The "Instruction execution complete" flag (M8029) will turn on, and the zero return operation will be completed.



3. DOG search function

If the forward rotation limit and the reverse rotation limit are set, the DOG search function can be used for zero return. The zero return operation depends on the zero return start position.



(1) If the start position is before the DOG

a. When the zero return instruction is executed, zero return will be started.

b. Transfer operation will be started in the zero return direction at the zero return speed.

c. If the front end of the DOG is detected, the speed will be reduced to the creep speed.

d. After detecting the rear end of the DOG, if the first zero-phase signal is detected, the operation will be stopped.

(2) If the start position is in the DOG area

a. When the zero return instruction is executed, zero return will be started.

b. Transfer operation will be started in the opposite direction of the zero return direction at the zero return speed.

c. If the front end of the DOG is detected, the speed will decelerate and the operation will stop. (The workpiece will come out of the DOG area.)

d. Transfer operation will be restarted in the zero return direction at the zero return speed (and the workpiece will enter the DOG area again).

e. If the front end of the DOG is detected, the speed will be reduced to the creep speed.

f. After detecting the rear end of the DOG, if the first zero-phase signal is detected, the operation will be stopped.

(3) If the start position is in the near-point signal OFF area (after the DOG)

a. When the zero return instruction is executed, zero return will be started.

b. Transfer operation will be started in the zero return direction at the zero return speed.

c. If the reverse rotation limit 1 (reverse rotation limit) is detected, the speed will decelerate, and the operation will stop.

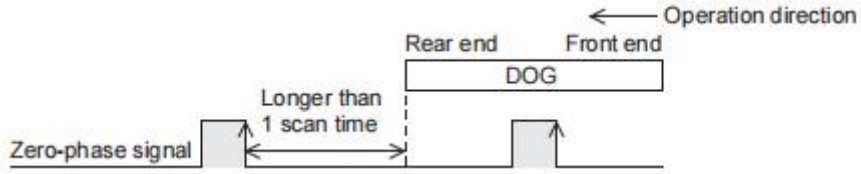
d. Transfer operation will be started in the opposite direction of the zero return direction at the zero return speed.
e. If the front end of the DOG is detected, the speed will be reduced and the operation will be stopped. (The workpiece will detect the DOG and then come out of the DOG area.)
f. Transfer operation will be restarted in the zero return direction at the zero return speed. (The workpiece will enter the DOG area again.)
g. If the front end of the DOG is detected, the speed will be reduced to the creep speed.
h. After detecting the rear end of the DOG, if the first zero-phase signal is detected, the operation will be stopped.

(4) If the limit switch in the zero return direction turns ON (if the start position is at forward rotation limit 1 or reverse rotation limit 1)
a. When the zero return instruction is executed, zero return will be started.
b. Transfer operation will be started in the opposite direction of the zero return direction at the zero return speed.
c. If the front end of the DOG is detected, the speed will decelerate and the operation will stop. (The workpiece will detect the DOG and then come out of the DOG area.)
d. Transfer operation will be restarted in the zero return direction at the zero return speed (and the workpiece will enter the DOG area again).
e. If the front end of the DOG is detected, the speed will be reduced to the creep speed.
f. After detecting the rear end of the DOG, if the first zero-phase signal is detected, the operation will be stopped.

9.9.4.DSZR Uses Note Points

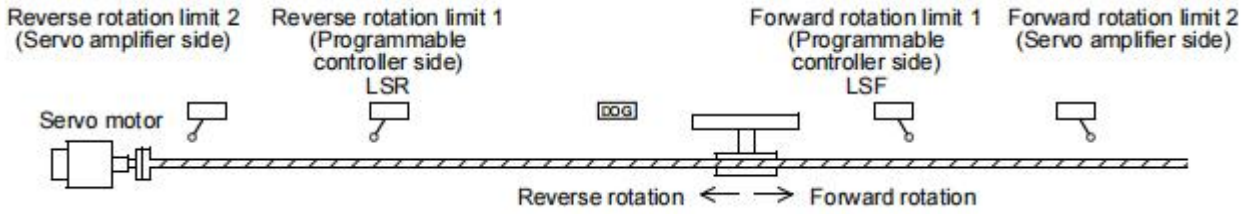
◆ Detection of (the rear end and the front end of) the near-point signal (DOG) will be affected by the input filter and the scan time of the sequence program. Secure 1 scan time or more from the rear end of the DOG to turning ON of the zero-point signal.

◆ Since the zero-phase signal of the servo motor is used, adjust the relation between the rear end of the DOG and the zero-phase signal as shown in the following figure. If fine adjustment of the origin position is needed, adjust the position of the near-point signal (DOG).



- Properly set the DOG so that the near-point signal (DOG) can be kept at the ON status until the speed is reduced to the creep speed. This instruction will start speed reduction at the front end of the DOG, and will stop the operation at the rear end of the DOG or at detection of the first zero-phase signal after passing the rear end of the DOG.The current value register will then be cleared (reset to "0"). If the speed is not reduced to the creep speed before detecting the rear end of the DOG, the operation may not be stopped at the specified position.

- Use the near-point signal (DOG) between the reverse rotation limit 1 (LSR) and the forward rotation limit 1 (LSF). The intended operation may not be performed if the relationship among the near-point signal (DOG), reverse rotation limit 1 (LSR) and forward rotation limit 1 (LSF) is not as shown in the figure below.



- The input device specified for the near-point signal or the zero-phase signal cannot be used for the following items.

- High-speed counter
- Input interruption
- Pulse catch
- SPD instruction
- DVIT instruction
- ZRN instruction

- The creep speed should be sufficiently slow.

The zero return instruction will not decelerate at the stop point. Therefore, if the creep speed is not slow enough, the operation may not stop at the specified position due to inertia.

- If an operand is changed during instruction execution, the change will be ignored and the operation will not be affected. To change the operation, turn off the command contact of the instruction, and then turn it on again.

- If the instruction activation contact is turned off during the zero return operation, the speed will decelerate and the operation will stop. In this case, the "Instruction execution complete" flag (M8029) will not be turned on.

- If the "pulse output monitor" (BUSY/READY) flag is on, a positioning instruction (including PLSR and PLSY) that uses the same output cannot be executed. If the "pulse output monitor" (BUSY/READY) flag is still on after the instruction activation contact is turned off, do not execute a positioning instruction (including PLSR and PLSY instructions) that uses the same output number.

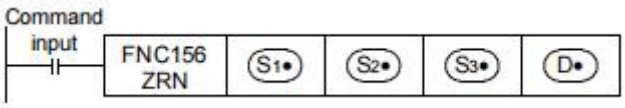
9.10. Zero Return (ZRN Instruction)

9.10.1. ZRN Instruction Summary

An instruction to perform origin regression to align the mechanical position with the current value register in the programmable controller.
When the DOG search function is required, please use the DSZR instruction.

9.10.2. ZRN Instruction Format and Parameter Description

1. Instruction format



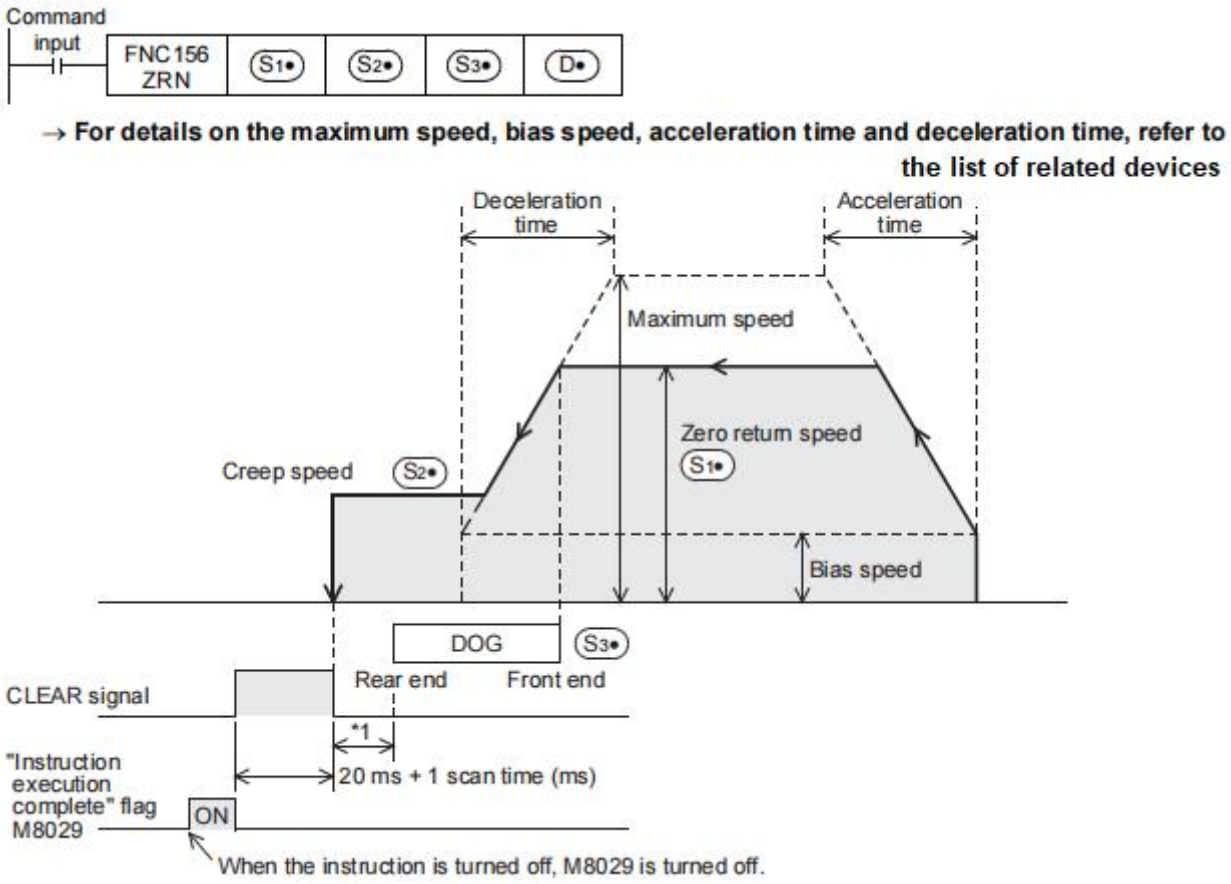
2. Parameter description

Operand type	Content	Data type	Word devices	Range
S1.	Zero return speed	BIN16/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K , H	When performing 16-bit operations, the value range is 10~32,767 (Hz) When performing 32-bit operations, the value range is 10~150000 (Hz)
S2.	Set the creep speed	BIN16/32-bit	KnX, KnY, KnM , KnS, T, C, D, V, Z, K, H	10~32,767Hz
S3.	The X number of the near-point signal (DOG)	BIN16/32-bit	X0~X17	X0~X17
D.	Output number of the output pulse	BIN16/32-bit	Y0~Y2	Y0~Y2

9.10.3. ZRN Function and Operation Instructions

1. ZRN instruction function

Output the pulse from the output [D], with the speed of the [S1] as the zero return, [S2] as the creep speed and [S3] as the near-point input signal (DOG), perform the zero return to make the mechanical position consistent with the current value register within the programmable controller.



(1) For S1., specify the zero return speed

If the set zero return speed value is more than the maximum speed value, the operation will be performed at the maximum speed.

Data type	Setting range
16-bit instruction	10~32,767 (Hz)
32-bit instruction	10~150,000 (Hz)

Note that the zero return speeds shown in the following table will not apply

Pulse output destination device	Zero return speed
D.= Y000	D8347, D8346
D.= Y001	D8357, D8356
D.= Y002	D8367, D8366

(2) For S2., specify the creep speed. Setting range: 10~32,767 (Hz).

(3) For S3., specify the near-point signal (DOG) input device number (NO contact). Turning on the near-point signal will reduce the speed to the creep speed. Turning off the near-point signal will complete the zero return operation.

(4) For , specify a pulse output number in the range of Y000 to Y002.

(5) Zero return direction

For this instruction, the zero return direction is set to the reverse rotation direction. (During zero return operation, the value indicated in the current value register will be decreased.). To perform zero return in the forward rotation direction, follow the example program below to control the direction output.

a. Turn on Y□□□ (rotational direction signal).
b. Refresh Y□□□ output using the REF instruction.
c. Execute the zero return (ZRN) instruction.
d. With the execution completion flag (M8029) of the zero return(ZRN) instruction, reset (OFF) Y□□□ (rotational direction signal).

(6) Clear signal output

This instruction can output the CLEAR signal after stopping at the origin. If the "clear signal output function enable" relay is ON, the clear signal device can be used to specify the clear signal (output Y) of the pulse output destination device supported by the device.

Pulse output destination device	Status of “clear signal output function enable” relay	Status of "clear signal device specification function enable" relay	clear signal device specification register
D1. = Y000	M8341 = ON	M8464 = ON	D8464
D1. = Y001	M8351 = ON	M8465 = ON	D8465
D1. = Y002	M8361 = ON	M8466 = ON	D8466

2. Zero return operation

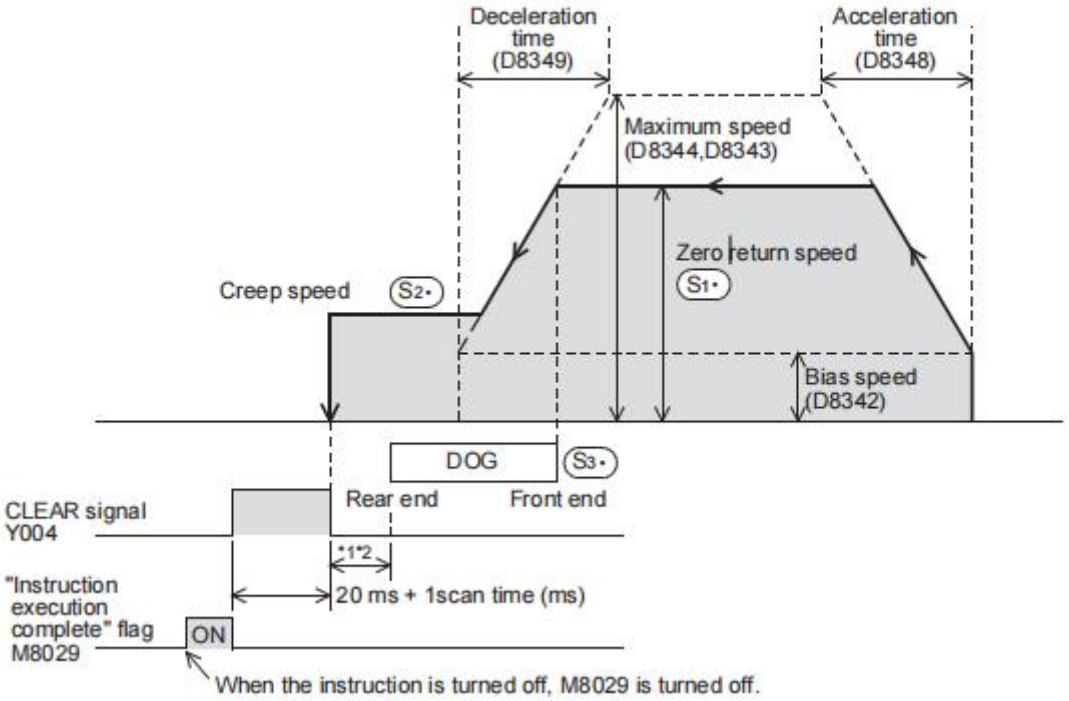
Zero return operation is described below assuming that Y000 is specified as the pulse output destination device . If Y001 and Y002 are specified, it is necessary to change the output number of each related relay (special auxiliary relay, special data register) below.

(1) Execute the ZRN instruction to carry out zero return.
(2) Transfer operation will be performed at the zero return speed specified by.
(3) If the near-point signal (DOG) specified by is turned on, the speed will be reduced to the creep speed specified by.
(4) If the near-point signal (DOG) specified by is turned off, the pulse outputting operation will be immediately stopped.

(5) If the clear signal output function (M8341) is enabled (set to ON), the clear signal (Y004) will be turned on within 1ms after the near-point signal (DOG) is turns from ON to OFF, and will be kept ON for "20ms + 1 scan time (ms)".

(6) The current value register (D8341, D8340) will be reset to "0" (will be cleared).

(7) "Instruction execution complete" flag will be turned on, and the zero return operation will be completed.



9.10.4. ZRN Uses Note Points

◆ Near point signal (DOG) is designated as X000~X017 of the basic unit, and the stop processing is affected by the input filter and the scanning period of the control program.

◆ When X000~X005 of the basic unit is specified in the near-point signal (DOG), it cannot be reused with the following uses.

- High-speed counter
- Input interruption
- Pulse catch
- SPD instruction
- DSZR instruction
- DVIT instruction

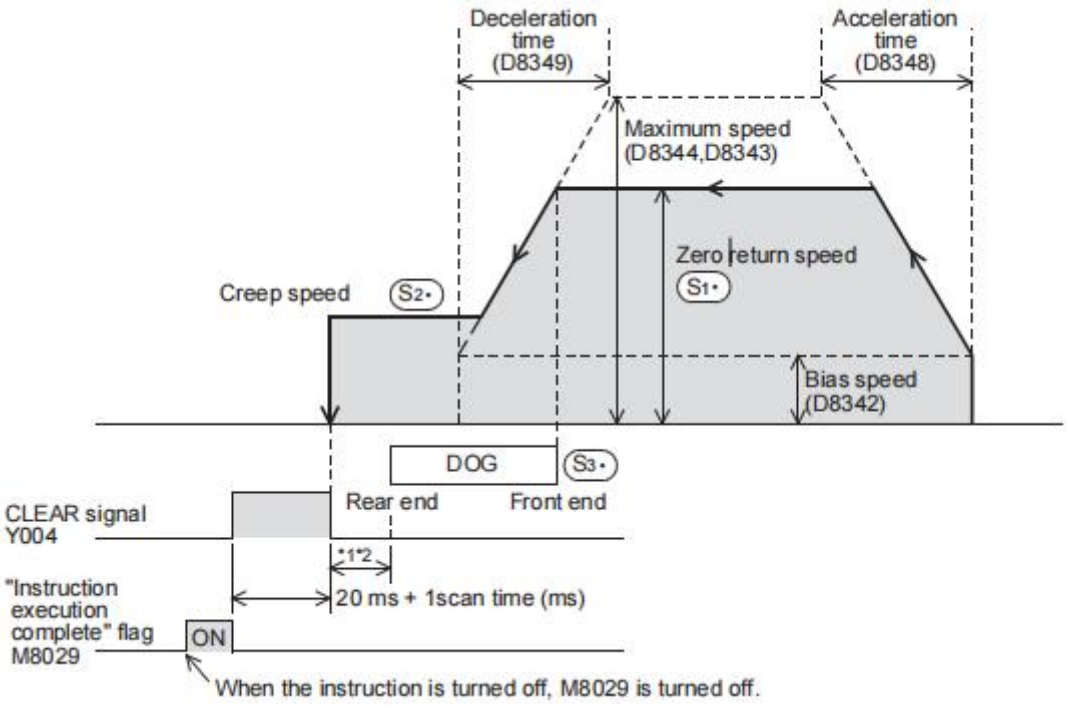
- Properly set the DOG so that the near-point signal (DOG) can be kept ON until the speed is reduced to the creep speed.

This instruction will start speed reduction at the front end of the DOG, and will stop the operation at the rear end of the DOG. The current value register will then be cleared (reset to "0"). If the speed is not reduced to the creep speed before detecting the rear end of the DOG, the operation may not be stopped at the specified position.

- The creep speed should be sufficiently slow.

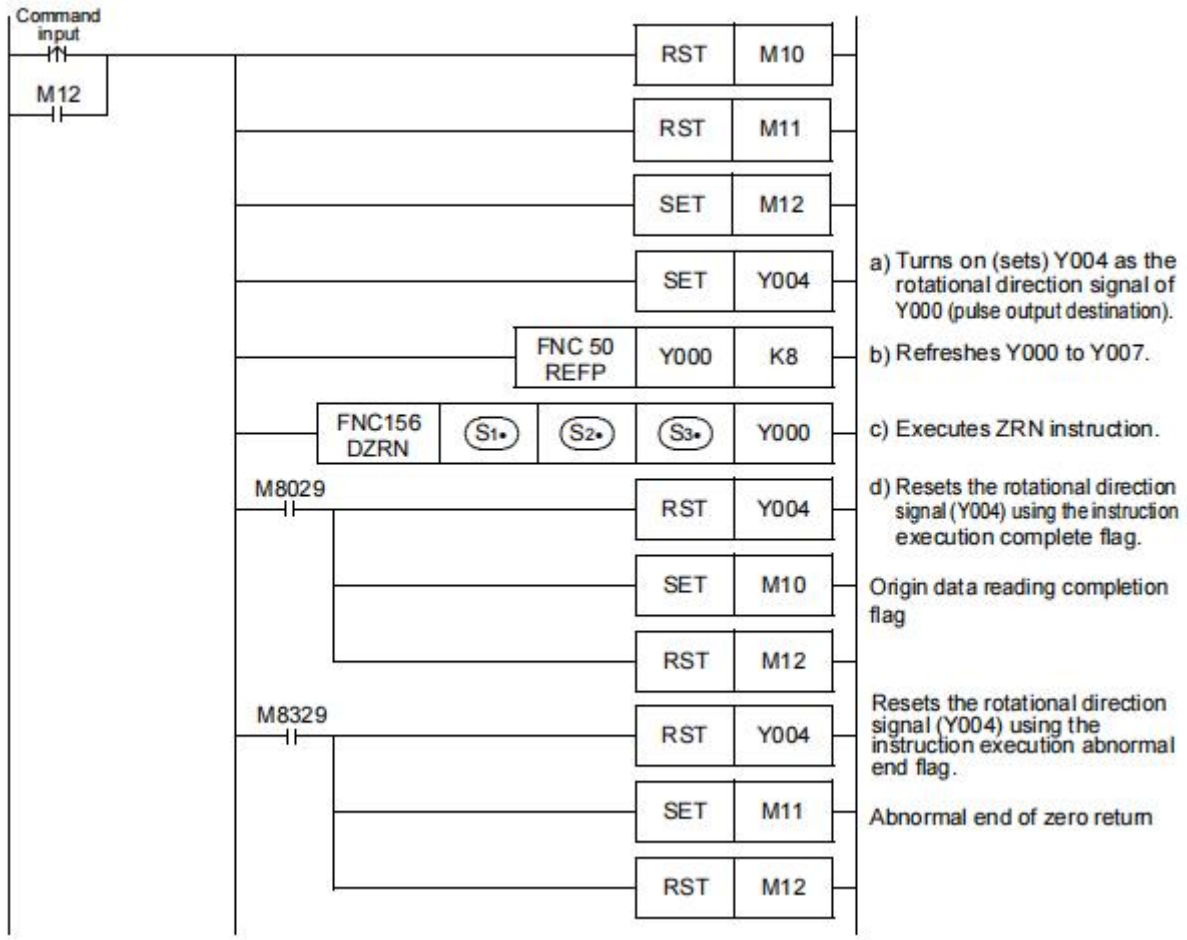
The zero return instruction will not decelerate at the stop point. Therefore, if the creep speed is not slow enough, the operation may not stop at the specified position due to inertia.

- The DOG search function does not apply for this instruction. Therefore, start the zero return operation on the front side of the near-point signal. If it is necessary to use the DOG search function, use the DSZR instruction.
- The zero-phase signal of the servo motor cannot be used. For this reason, if fine adjustment of the origin position is needed, adjust the position of the near-point signal (DOG).
- If the instruction activation contact is turned off during zero return operation, the speed will decelerate and the operation will stop. In this case, the "Instruction execution complete" flag (M8029) will not turn on.
- While the "pulse output monitor" (BUSY/READY) flag is on, a positioning instruction (including PLSR and PLSY) that uses the same output cannot be executed. If the "pulse output monitor" (BUSY/READY) flag is still on after the instruction activation contact is turned off, do not execute a positioning instruction (including PLSR and PLSY instructions) that uses the same output number.



9.10.5. ZRN Example Program

In the program shown below, Y004 is specified as the rotation direction signal output device for Y000.



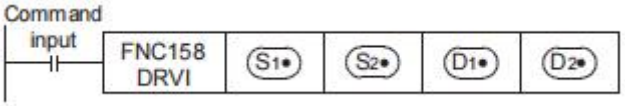
9.11. DRVI/Relative Positioning Instruction

9.11.1. DRVI Instruction Summary

Execute single speed positioning instructions in a relative driving manner. The method of specifying the distance of movement from the current position using positive/negative symbols, also known as incremental (relative) driving method.

9.11.2. DRVI Instruction Format and Parameter Description

1. Instruction format



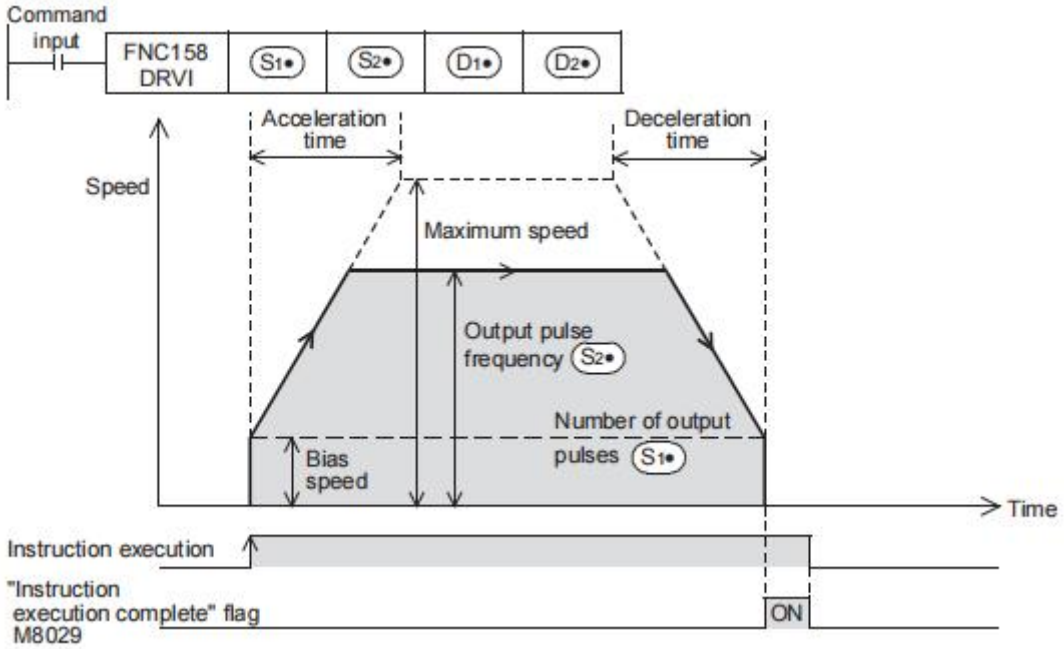
2. Parameter description

Operand type	Content	Data type	Word devices	Range
S1.	Number of output pulses (relative address)	BIN16/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K , H	16-bit operations: -32,768 ~ +32,767 (excluding 0) 32-bit operations: -999,999 ~ +999,999 (excluding 0)
S2.	Output pulse frequency	BIN16/32-bit	KnX, KnY, KnM , KnS, T, C, D, V, Z, K, H	16-bit operations: 10 ~ 32,767 (Hz) 32-bit operations: 10 ~ 150,000 (Hz)
D1.	Output Y number of the output pulse	BIN16/32-bit	Y0~Y2	Y0~Y2
D2.	Output Y number in the direction of rotation	BIN16/32-bit	Y0~Y2	Y0~Y17

9.11.3. DRVI Function and Operation Instructions

1. DRVI instruction function

This instruction uses a relative drive method to perform a 1-speed positioning instruction. For this instruction, the transfer distance from the current position to the target position should be specified together with a plus or minus sign. This method is also referred to as the incremental (relative) drive method.



(1) For S1., specify the number of output pulses (relative address value).
(2) For S2., specify the output pulse frequency.
(3) For D1., specify the pulse output number in the range of Y000 to Y003.
(4) For D2., specify the rotation direction signal output device number

The rotation direction ON/OFF status of the specified device is shown in the following table. During instruction execution, however, do not use the output D2. for other purposes.

ON/OFF status of device specified by D2.	Rotation direction (increase/decrease current value)
ON	If the number of output pulses specified by S1. is a positive number, the operation will be performed in the forward rotation direction. Forward rotation (Outputting pulses from D1. will increase the current value.)
OFF	If the number of output pulses specified by S1.is a negative number, the operation will be performed in the reverse rotation direction. Reverse rotation (Outputting pulses from D1. will decrease the current value.)

9.11.4. DRVI Uses Note Points

- If an operand is changed during instruction execution, the change will be ignored and the operation will not be affected. Note that the changed operand will be enabled at the next activation of the instruction.
- If the instruction activation contact is turned off during execution of the instruction, the speed will decelerate and the operation will stop. In this case, the "Instruction execution complete" flag (M8029) will not be turned on.
- If the limit flag (forward or reverse) in the operation direction is turned on, the speed will decelerate and the operation will stop.
- While the "pulse output monitor" (BUSY/READY) flag is on, a positioning instruction (including PLSR and PLSY) that uses the same output cannot be executed. If the "pulse output monitor" (BUSY/READY) flag is still on after the instruction activation contact is turned off, do not execute a positioning instruction (including PLSR and PLSY instructions) that uses the same output number.

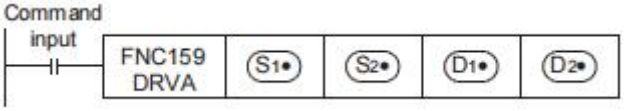
9.12. DRVA / Absolute Positioning Instruction

9.12.1. DRVA Instruction Summary

Execute single speed positioning instructions in absolute drive mode. The method of specifying the distance of movement from the origin (zero point), also known as absolute driving.

9.12.2. DRVA Instruction Format and Parameter Description

1. Instruction format



2. Parameter description

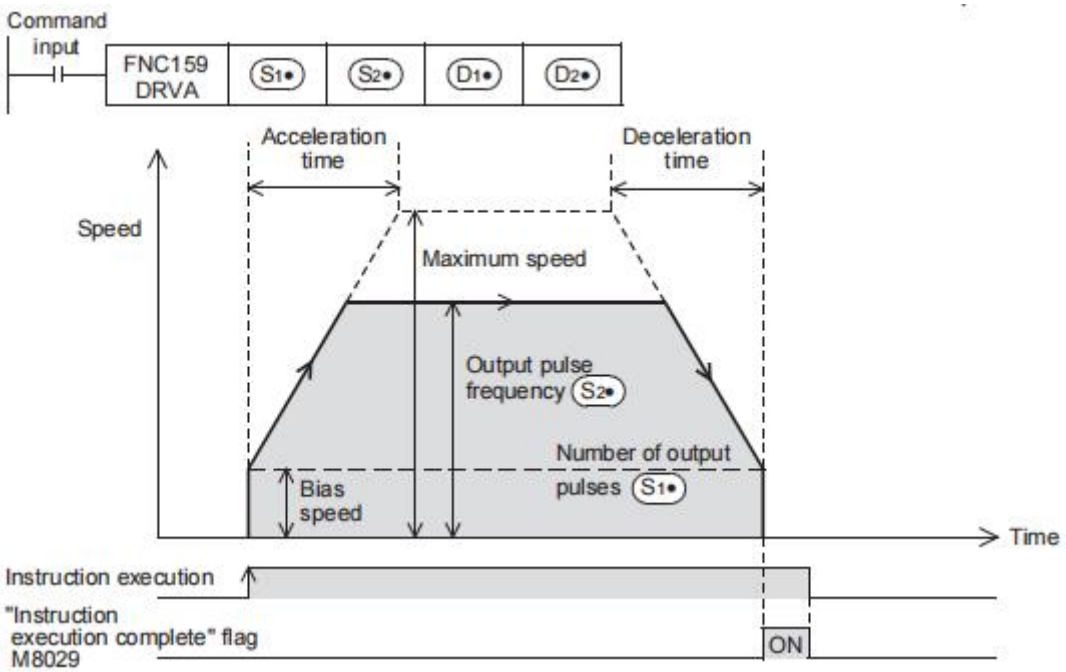
Operand type	Content	Data type	Word devices	Range
S1.	Number of output pulses (absolute address)	BIN16/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K , H	16-bit operations: -32,768 ~ +32,767 (excluding 0) 32-bit operations: -999,999 ~ +999,999 (excluding 0)
S2.	Output pulse frequency	BIN16/32-bit	KnX, KnY, KnM , KnS, T, C, D, V, Z, K, H	17-bit operations: 18-10 ~ 32,767 (Hz) 32-bit operations: 10 ~ 150,000 (Hz)
D1.	Output Y number of the output pulse	BIN16/32-bit	Y0~Y2	Y0~Y2
D2.	Output Y number in the direction of rotation	BIN16/32-bit	Y0~Y2	Y0~Y17

9.12.3. DRVA Function and Operation Instructions

1. DRVA instruction function

This instruction uses an absolute drive method to perform a 1-speed positioning instruction.

For this instruction, the distance from the origin (zero-point) to the target position should be specified.



(1) For S1., specify the number of output pulses (absolute address value).

(2) For S2., specify the output pulse frequency.

(3) For D1., specify the pulse output number in the range of Y000 to Y002.

(4) For D2., specify the rotation direction signal output device number.

The rotation direction ON/OFF status of the specified device is shown in the following table. During instruction execution, however, do not use the output for other purposes.

ON/OFF status of device specified by D2.	Rotation direction (increase/decrease current value)	
ON	Forward rotation [Outputting pulses from D1. will increase the current value.]	Forward or reverse rotation is determined by the relationship between the number of output pulses (absolute address) specified by S. and the size of the current value register.
OFF	Reverse rotation [Outputting pulses from D1. will reduce the current value.]	

9.12.4. DRVA Uses Note Points

- If an the operand is changed during instruction execution, the change will be ignored and the operation will not be affected. Note that the changed operand will be enabled at the next activation of the instruction.
- If the instruction activation contact is turned off during execution of the instruction, the speed will decelerate and the operation will stop. In this case, the "Instruction execution complete" flag (M8029) will not be turned on.
- If the limit flag (forward or reverse) in the operation direction is turned on, the speed will decelerate and the operation will stop.
- If the "pulse output monitor" (BUSY/READY) flag is on, a positioning instruction (including PLSR and PLSY) that uses the same output cannot be executed. If the "pulse output monitor" (BUSY/READY) flag is still on after the instruction activation contact is turned off, do not execute a positioning instruction (including PLSR and PLSY instructions) that uses the same output number.

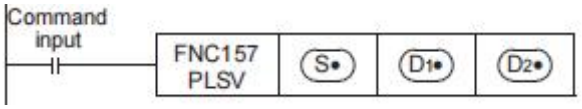
9.13. Variable Speed Pulse Output - PLSV Instruction

9.13.1. PLSV Instruction Summary

This is the instruction to output a variable speed pulse with a rotation direction.

9.13.2. PLSV Instruction Format and Parameter Description

1. Instruction format



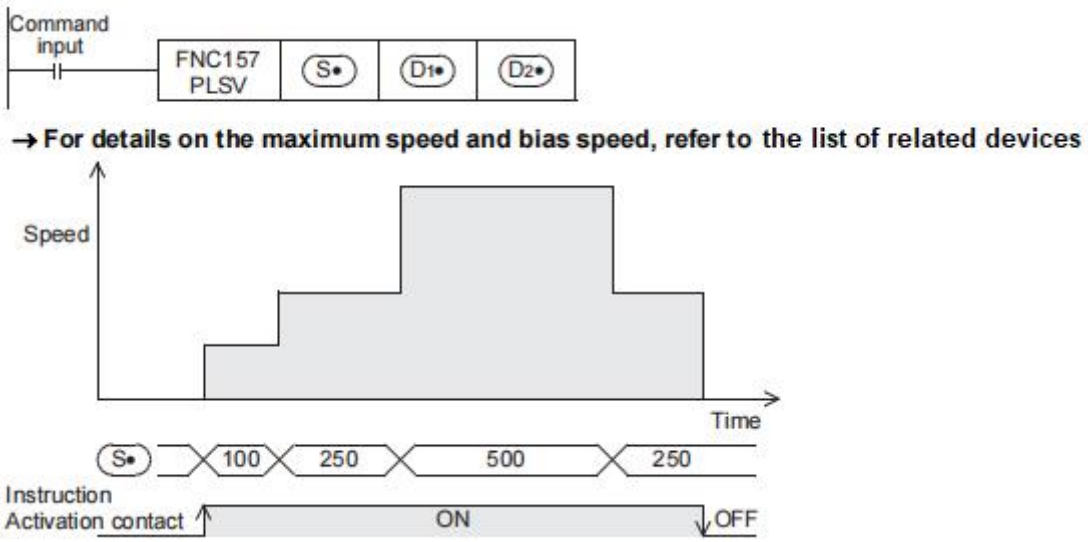
2. Parameter description

Operand type	Content	Data type	Word devices	Range
S.	Output pulses frequency designation device number	BIN16/32-bit	KnX, KnY, KnM, KnS, T, C, D, V, Z, K , H	16-bit operations: -32,768 ~ +32,767 (Hz), excluding 0 32-bit operations: -150,000 ~ +150,000 (Hz), excluding 0
D1.	Output Y number of the output pulse	BIN16/32-bit	Y0~Y2	Y0~Y2
D2.	Output Y number in the direction of rotation	BIN16/32-bit	Y0~Y17	Y0~Y17

9.13.3. PLSV Function and Operation Description

1. PLSV instruction function

This instruction is a variable speed pulse output command with rotation direction output. In the variable pulse output (PLSV) instruction, there is no acceleration or deceleration action.



(1) For S., specify the output pulse frequency. Even if pulses are being output, the output pulse frequency can be changed freely. Acceleration/deceleration, however, will not be performed.

(2) For D1., specify the pulse output number in the range of Y000 to Y002.

(3) For D2., specify the rotation direction signal output device number.

The rotation direction ON/OFF status of the specified device is shown in the following table. During instruction execution, however, do not use the output D2. for other purposes.

ON/OFF status of device specified by D2.	Rotation direction (increase/decrease current value)
ON	If the number of output pulses specified by S1. is a positive number, the operation will be performed in the forward rotation direction. Forward rotation (Outputting pulses from D1. will increase the current value.)
OFF	If the number of output pulses specified by S1.is a negative number, the operation will be performed in the reverse rotation direction. Reverse rotation (Outputting pulses from D1. will decrease the current value.)

9.13.4. PLSV Uses Note Points

- During pulse output operation, if the output pulse frequency is changed to "K0", the PLC will reduce the speed and then stop the pulse outputting operation. Before outputting pulses again, check that the "pulse output monitor" (BUSY/READY) flag is off, and then wait until 1 or more cycles of operation have been completed. After that, set (change) the output pulse frequency to a value other than "K0".

- During pulse outputting operation, do not change the sign attached to the output pulse frequency value. If it is necessary to change the sign, stop the servo motor first by setting the output pulse frequency value to "K0", and wait for the motor to stop completely after decelerating to stop. And then, change the sign attached to the output pulse frequency value. If the sign attached to the output pulse frequency value is changed during pulse outputting operation, the operation may be changed as follows, and the machine, therefore, may be damaged:

(1) Stop pulse output.
(2) "Pulse output monitor" (BUSY/READY) flag is turned off. (The pulse outputting operation is stopped, but the motor does not stop immediately.)
(3) Operation according to the frequency and rotation direction specified in the output pulse frequency.

- If the instruction activation contact is turned off during pulse outputting operation, the operation will stop immediately. The "Instruction execution complete" flag (M8029) will not turn on.

- If a limit flag (forward rotation or reverse rotation) in the operation direction is turned ON, the speed will decelerate and the operation will stop.

- If the "pulse output monitor" (BUSY/READY) flag is on, a positioning instruction (including PLSR and PLSY) that uses the same output cannot be executed. If the "pulse output monitor" (BUSY/READY) flag is still on after the instruction activation contact is turned off, do not execute a positioning instruction (including PLSR and PLSY instructions) that uses the same output number.

- After executing the instruction, the rotation direction signal output will turn off.

10. MODBUS Communication Instruction

10.1. MODBUS Communication Function Summary

The RX3U series PLC controller comes with two RS485 interfaces, each of which can be configured as a MODBUS RTU master station or MODBUS RTU slave station to work independently. One MODBUS master station can be used to control 32 slave stations. Corresponds to a maximum transfer speed of 115.2kbps.

10.2. Related Devices List

10.2.1. Special Data Registers

The table shows the special data registers used in MODBUS serial communication.

<table>
<tr><th colspan="2">Special data register</th><th rowspan="2">Name</th><th rowspan="2">Valid</th><th rowspan="2">Detailed description</th><th rowspan="2">R/W</th></tr>
<tr><th>CH1</th><th>CH2</th></tr>
<tr><td>D8400</td><td>D8420</td><td>Communication format</td><td>Master/ Slave</td><td>This device sets the communication format.
Note: For details on communication format refer to Section 10.2.2.</td><td>R, W</td></tr>
<tr><td>D8401</td><td>D8421</td><td>Protocol</td><td>Master/ Slave</td><td>Select the channel to use and set the master/slave station.
<table>
<tr><th rowspan="2">Bit</th><th rowspan="2">Name</th><th colspan="2">Contents</th></tr>
<tr><th>0 (bit＝OFF)</th><th>1 (bit＝ON)</th></tr>
<tr><td>b0</td><td>Protocol selection</td><td>Other communicati on protocol</td><td>MODBUS protocol</td></tr>
<tr><td>b1-b3</td><td>Not used</td><td></td><td></td></tr>
<tr><td>b4</td><td>Master/ slave setting</td><td>MODBUS master</td><td>MODBUS Slave</td></tr>
<tr><td>b5-b7</td><td>Not used</td><td></td><td></td></tr>
<tr><td>B8</td><td>RTU/ASCII mode setting</td><td>RTU</td><td></td></tr>
<tr><td>b9-b15</td><td>Not used</td><td></td><td></td></tr>
</table>
◆ Note: When both flags (b0 of D8401 and b0 of D8421) are turned on, priority will be given to CH1 and CH2 will no longer operate.</td><td>R, W</td></tr>
</table>

D8402	D8422	Communication error code	Master/ Slave	The latest error code occurring in the MODBUS communication will be stored.	R, W
D8408	D8428	Current retry value	Master	For a communication retry due to the station response timeout, the current number of retries will be stored.	R
D8409	D8429	Slave response timeout	Master	After the master sends a request and no response is received from the slave within the specified time, the master will retry to send the message or terminate the processing of the command with a time out error depending on the setting of the "number of retries" (D8412, D8432). Valid values: 0 ~ 32767[ms] 0 will default the timeout to 3 seconds ◆ Note: This value can also be changed before each command execution.	R, W
D8412	D8432	Number of retries	Master	In the situation where a slave does not respond within the set time by the Slave Response Timeout the master will try to retransmit the message a set number of retries before it terminates the command processing with a timeout error. Valid values: 0 ~ 20 [times] If a value of 20 or more is set the number of retries used by the master is set to 20.	R, W
D8414	D8434	Slave node address	Slave	Slave node address Valid range: 1 ~ 247 ◆ Note: If during the initialization a value outside the valid range is detected, the configuration is invalid and the slave will not respond to any requests.	R, W

R: Read

W: Write

10.2.2. MODBUS Communication Setting

The following devices are used in the communication setting.

When using the communication port (Ch1), set D8400.

When using the communication port (Ch2), set D8420.

(1) D8400 and D8420 (communication format)

By setting values to D8400 or D8420, the data length, parity, baud rate, etc. can be set.

The table below shows the contents of communication format.

Bit	Name	Contents	
		0 (bit=OFF)	1 (bit=ON)
b0	Data length*1	7-bit	8-bit
b1 b2	Parity	Parity b2, b1 (0, 0): Not provided (0, 1): Odd (1, 1): Even	
b3	Stop bit	1-bit	2-bit
b4 b5 b6 b7	Baud rate (bps)	b7, b6, b5, b4 (0, 0, 1, 1): 300 (0, 1, 0, 0): 600 (0, 1, 0, 1): 1200 (0, 1, 1, 0): 2400 b7, b6, b5, b4 (0, 1, 1, 1): 4800 (1, 0, 0, 0): 9600 (1, 0, 0, 1): 19200 (1, 0, 1, 0): 38400 b7, b6, b5, b4 (1, 0, 1, 1): 57600 (1, 1, 0, 0): Reserved (1, 1, 0, 1): 115200	
b8~b11	Reserved	-	-
b12	Reserved	-	-
b13~b15	Reserved	-	-

◆ *1. Please set data length as 8 bits for of RTU mode. In the case of 7 bits, there is a possibility that data may be missing.

10.2.3. Special Auxiliary Relays

The table shows the special auxiliary relays used for MODBUS serial communication.

Special device		Name	Valid	Detailed Description	R/W
CH1	CH2				
M8411		MODBUS configuration request flag	Master /Slave	Use in the MODBUS communication settings.	R, W
M8029		Command execution complete	Master	This bit is turned on if the processing of a ADPRW command is completed. Special clear conditions:	R

				1) Power on 2) STOP to RUN 3) If another command using M8029 is triggered (including another ADPRW command)	
M8401	M8421	MODBUS request in process	Master	If the MODBUS stack is processing a command no further commands can be triggered until the current request is completed and the command execution complete flag is on. Special clear conditions: 1) Power on 2) STOP to RUN	R
M8402	M8422	MODBUS communication error	Master /Slave	Set during the processing of the current MODBUS command error. Special clear conditions: 1) Power on 2) STOP to RUN 3) If another ADPRW command is triggered	R
M8403 M8063	M8423 M8438	MODBUS communication Error (latched)	Master /Slave	Set once a MODBUS command error has been processed. Special clear conditions: 1) Power on 2) STOP to RUN	R
M8408	M8428	Retry	Master	Set while the master sends retries when the slave fails to respond in time. Special clear conditions: 1) Power on 2) STOP to RUN 3) If another MODBUS command is triggered As long as the slave responds on one of the retries the error flag will not be set.	R
M8409	M8429	Timeout	Master	Set if a response timeout occurs. Special clear conditions: 1) Power on 2) STOP to RUN 3) If another MODBUS command is triggered Note: If the number of retries is > 0, the error flag is not set until the selected number of retries failed by a timeout (or another failure).	R

R: Read

W: Write

10.3. MODBUS Master Function

10.3.1. MODBUS Standard Instructions Support List

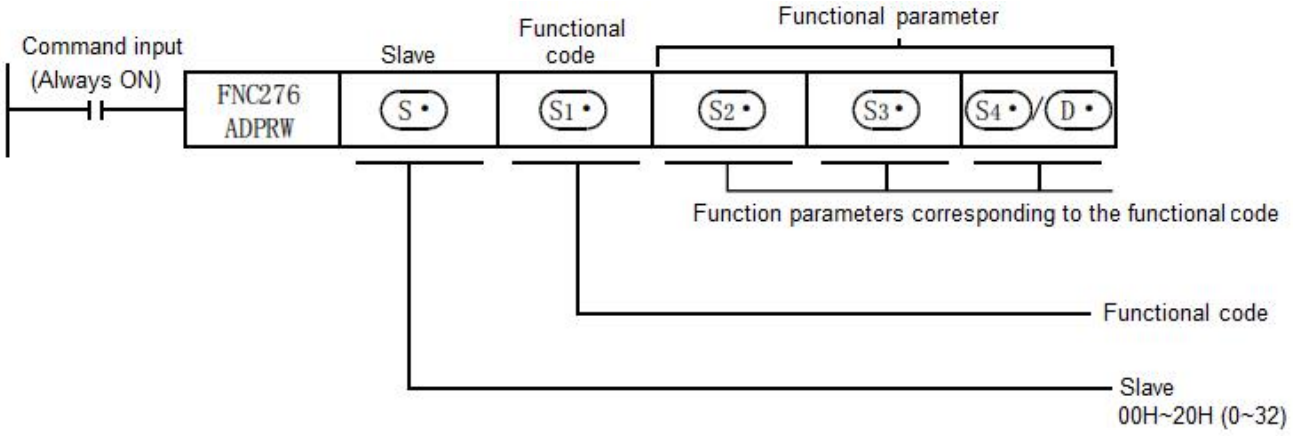
Instruction code	Instruction name	Details
0x01	Read coils	Coil readout (multipoints)
0x02	Read discrete inputs	Input readout (multipoints)
0x03	Read holding registers	Holding register readout (multipoints)
0x04	Read input registers	Input register readout (multipoints)
0x05	Write single coil	Coil write (1 point only)
0x06	Write single register	Holding register write (1 point only)
0x0F	Write multiple coils	Write multiple coils
0x10	Write multiple registers	Multi-point holding register write

10.3.2. ADPRW/MODBUS Read • Write Command

1. ADPRW instruction summary

This is an instruction used to communicate (read/write data) with the corresponding slave station of the MODBUS master station. Function code S. operate according to parameters S2., S3., S4./D.. on the slave station S.. Please specify 0 in the local number of the secondary station when broadcasting.

2. Instruction format



3. Setting parameters

Operand type	Content	Data type
S.	Slave note address	BIN16-bit
S1.	Functional code	BIN16-bit
S2.	Function parameters corresponding to the functional code	BIN16-bit
S3.	Function parameters corresponding to the functional code	BIN16-bit
S4. / D.	Function parameters corresponding to the functional code	Bit / BIN16-bit

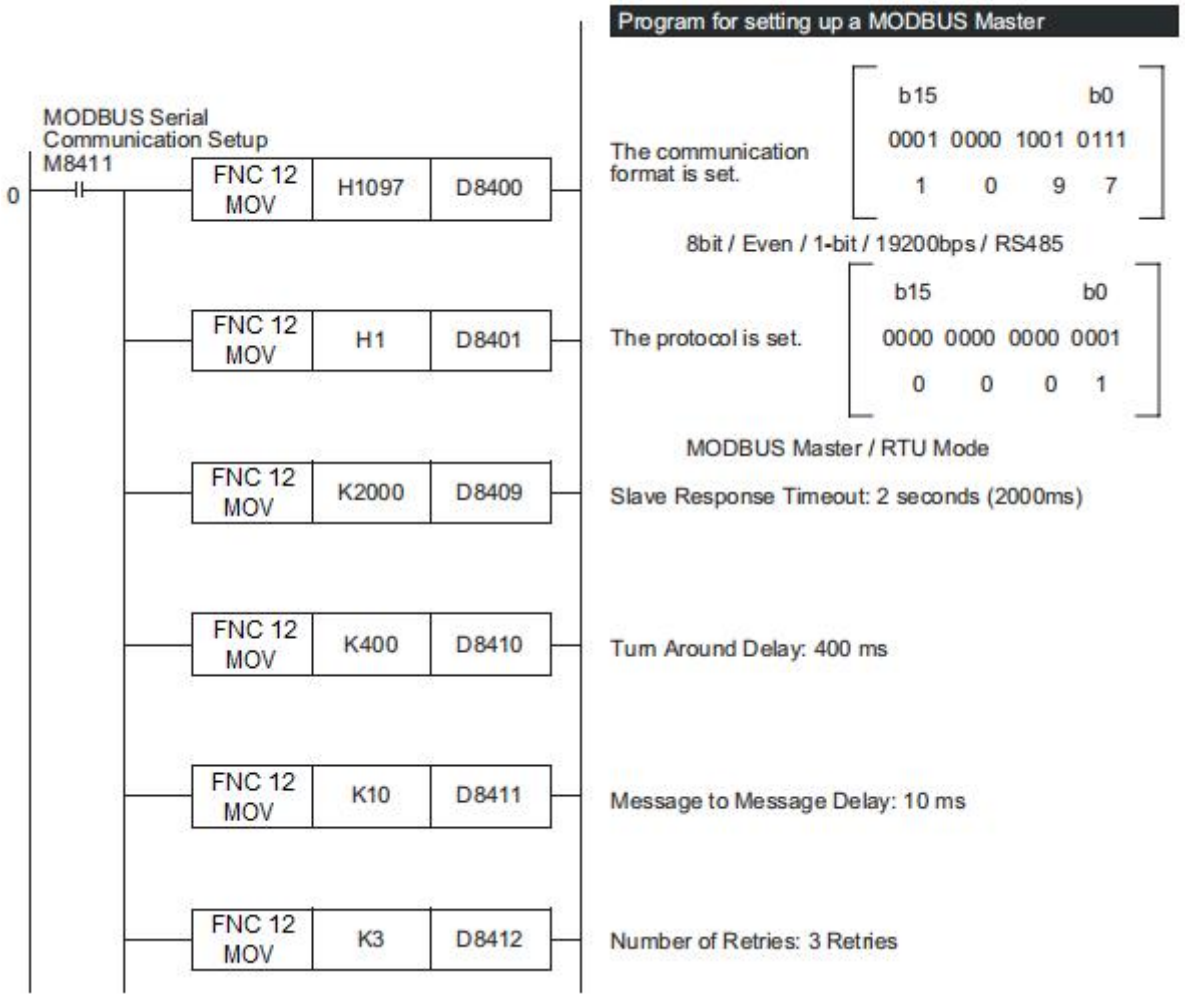
10.3.3. ADPRW Instruction Function Code and Parameters

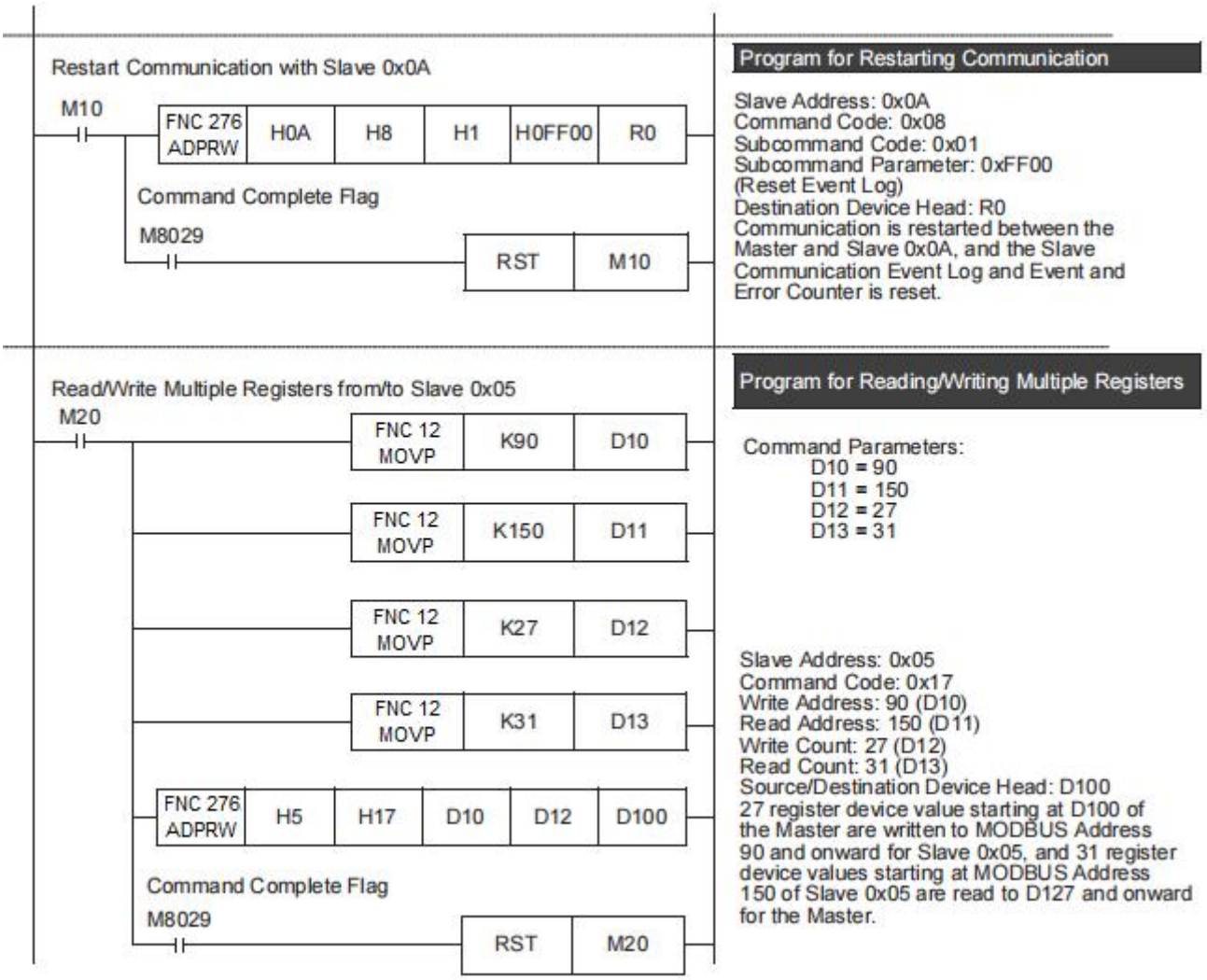
The following table shows the required command parameters for each command code.

S1.	S2.	S3.	S4. / D.	
1H Read Coils	MODBUS Address: 0000H~FFFFH	Device Count: 1~2000	PLC Destination Device (head address)	
			Applicable Devices	D • M • Y • S •
			Block Length	(S3. + 15) ÷16
2H Read Discrete Inputs	MODBUS Address: 0000H~FFFFH	Device Count: 1~2000	PLC Destination Device (head address)	
			Applicable Devices	D • M • Y • S •
			Block Length	(S3. + 15) ÷16
3H Read Holding Register	MODBUS Address: 0000H~FFFFH	Device Count: 1~125	PLC Destination Device (head address)	
			Applicable Devices	D
			Block Length	S3.
4H Read Input Register	MODBUS Address: 0000H~FFFFH	Device Count: 1~125	PLC Destination Device (head address)	
			Applicable Devices	D
			Block Length	S.
5H Write Single Coil	MODBUS Address: 0000H~FFFFH	0 (fixed)	PLC Source Device (head address)	
			Applicable Devices	D • K • H • X • Y • M • S
			Block Length	1 Point
6H Write Single Register	MODBUS Address: 0000H~FFFFH	0 (fixed)	PLC Source Device (head address)	
			Applicable Devices	D • K • H
			Block Length	1 Point
7H Write Bulk Coil	MODBUS Address: 0000H~FFFFH	Device Count: 1~1968	PLC Destination Device (head address)	
			Applicable Devices	D • K • H • M• X • Y • S
			Block Length	(S3. + 15) ÷16
8H Write Bulk Register	MODBUS Address: 0000H~FFFFH	Device Count: 1~123	PLC Destination Device (head address)	
			Applicable Devices	D • K • H
			Block Length	S3.

10.3.4. MODBUS Master Routines

The program that can read/write devices from the master station to the slave station is shown below.





10.4. MODBUS Slave Function

10.4.1. MODBUS List of Slave Functions

Instruction code	Instruction name	Details
0x01	Read coils	Coil readout (multipoints)
0x02	Read discrete inputs	Input readout (multipoints)
0x03	Read holding registers	Holding register readout (multipoints)
0x04	Read input registers	Input register readout (multipoints)
0x05	Write single coil	Coil write (1 point only)
0x06	Write single register	Holding register write (1 point only)
0x0F	Write multiple coils	Write multiple coils
0x10	Write multiple registers	Multi-point holding register write

10.4.2. MODBUS Slave Device Address Allocation (Default Values)

The following table provides the default values for MODBUS address allocation for Bit devices and word devices.

Bit device:

MODBUS Device		FX3U Device
Inputs (Read Only)	Coils (Read / Write)	
0x0000 ~ 0x1DEF	0x0000 ~ 0x1DEF	M0 ~ M7679
0x1E00 ~ 0x1FFF	0x1E00 ~ 0x1FFF	M8000 ~ M8511
0x2000 ~ 0x2FFF	0x2000 ~ 0x2FFF	S0 ~ S4095
0x3000 ~ 0x31FF	0x3000 ~ 0x31FF	TS0 ~ TS511
0x3200 ~ 0x32FF	0x3200 ~ 0x32FF	CS0 ~ CS255
0x3300 ~ 0x33FF	0x3300 ~ 0x33FF	Y0 ~ Y377
0x3400 ~ 0x34FF	-	X0 ~ X377

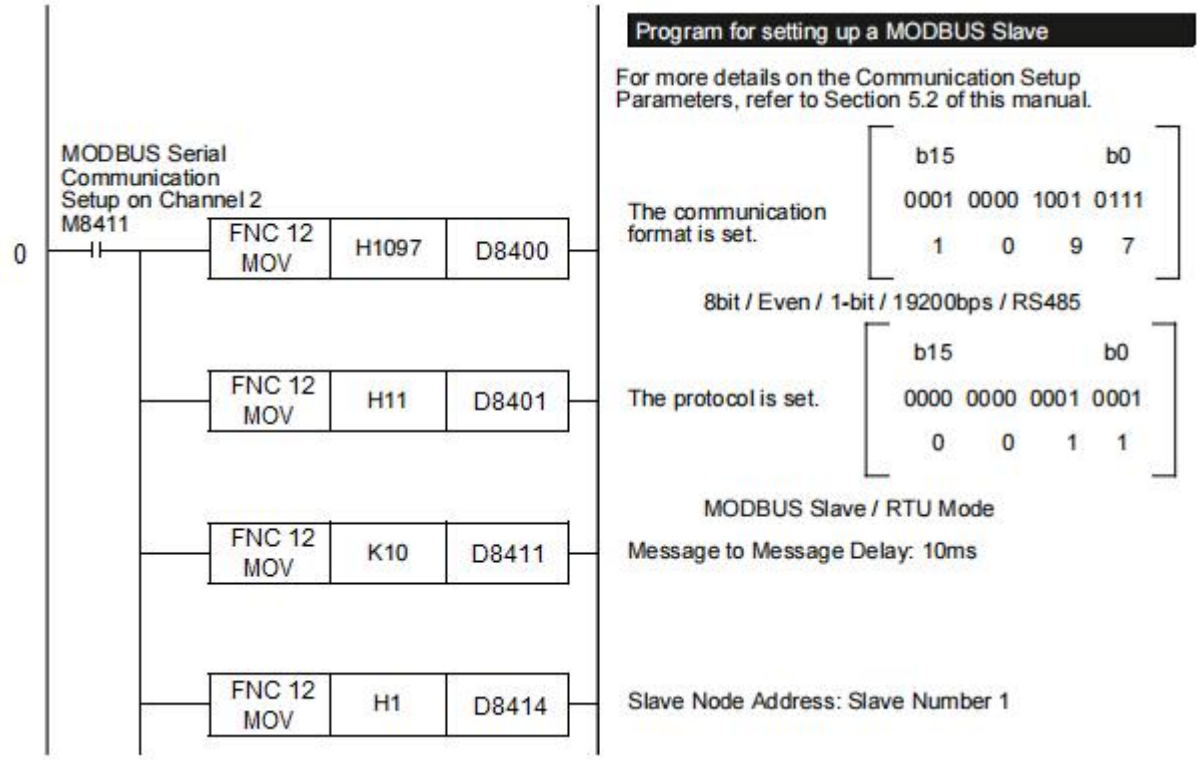
Word device:

MODBUS Device		FX3U Device
Input-Register (Read Only)	Holding-Register (Read / Write)	
0x0000 ~ 0x1F3F	0x0000 ~ 0x1F3F	D0 ~ D7999
0x1F40 ~ 0x213F	0x1F40 ~ 0x213F	D8000 ~ D8511
0x2140 ~ 0xA13F	0x2140 ~ 0xA13F	RO ~ R32767
0xA140 ~ 0xA33F	0xA140 ~ 0xA33F	TNO ~ TN511
0xA340 ~ 0xA407	0xA340 ~ 0xA407	CN0 ~ CN199
0xA408 ~ 0xA477	0xA408 ~ 0xA477	CN200~CN255*1
0xA478 ~ 0xA657	0xA478 ~ 0xA657	MO ~ M7679
0xA658 ~ 0xA677	0xA658 ~ 0xA677	M8000 ~ M8511
0xA678 ~ 0xA777	0xA678 ~ 0xA777	S0 ~ S4095
0xA778 ~ 0xA797	0xA778 ~ 0xA797	TS0 ~ TS511
0xA798 ~ 0xA7A7	0xA798 ~ 0xA7A7	CS0 ~ CS255
0xA7A8 ~ 0xA7B7	0xA7A8 ~ 0xA7B7	Y0 ~ Y377
0xA7B8 ~ 0xA7C7	-	X0 ~ X377

◆ *1: CN200-255 are 32-bit counters.

10.4.3. MODBUS Slave Routines

The program for setting the parameters of the slave station is as follows.



11. CAN Communication Instruction

11.1. CAN Communication Function Summary

The RX3U series PLC controller is equipped with a CAN interface (CAH/CAL), which can use RS2 instructions to send data frames. The sent data frames are all standard frames (11 bit IDs), supporting the sending of CANoepn SDO, and can be configured with a CANopen drive.

11.2. Related Devices List

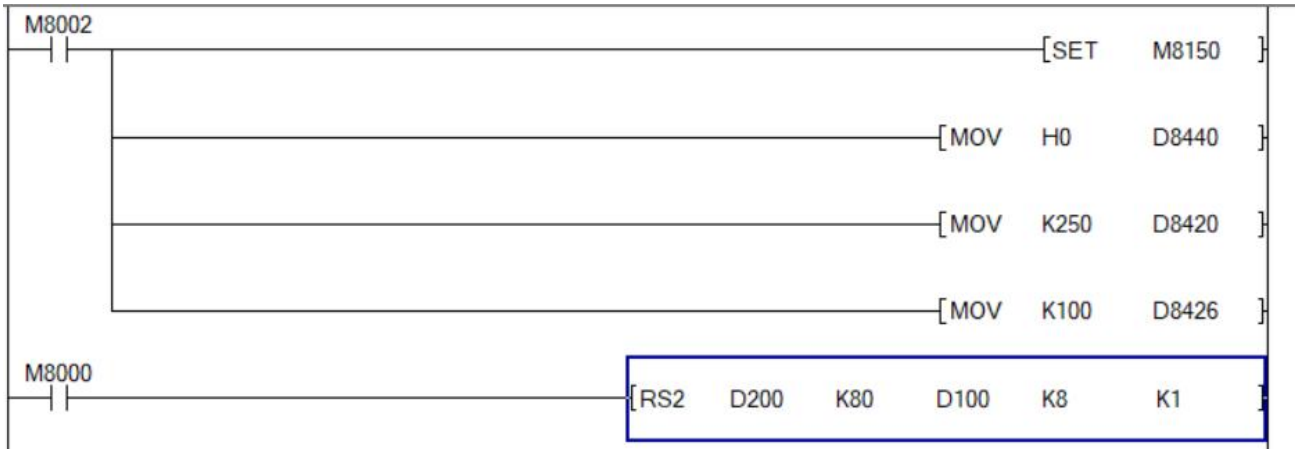
Function Description	CAN(H/L)	Remark
CAN function enabled	M8150=1	
RS2 sending flag	M8422=1	Enable sending
RS2 send completion flag	M8425	Manual reset required
RS2 receive end flag	M8423	Manual reset required
RS2 receiving process flag	M8424	Data receiving
RS2 command sends CANoepn command	M8426=1	Send 2-byte driver enable commands or other commands to facilitate one-time drive configuration
Communication parameters	D8420	0-9 represents the CAN baud rate, ranging from 1K to 1023K. Default 250
Master & slave station number	D8440 D8442	Local ID setting: D8440 Store received data frame ID: D8442
Frame interval	D8426	Default 1ms

- A maximum of 128 bytes can be sent at once.
- When sending data frames, there will be a start frame and an end frame, supporting communication between two PLCs.
- Start frame: 0X7F, 0X8A, 0,0,0XFF, 0XFF, 0XFF, 0XFF (where the two bytes highlighted in red are CRC checksums).
- End frame: 0X01, 0X6C, 0XFF, 0XFF, 0XFF, 0XFF, 0XFF, 0XFF.
- Support sending CANoepn command SDO, which can be customized through RS2 command or directly enable M8426 to send SDO at once to complete drive configuration.
- You can change the baud rate through D8420 or change the local ID through D8440 in the program.

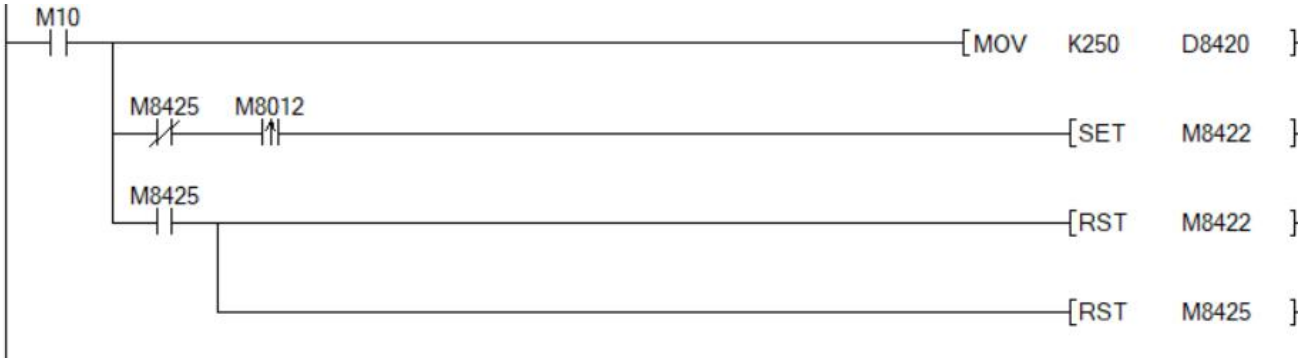
11.3. Program Examples

11.3.1. CAN Function

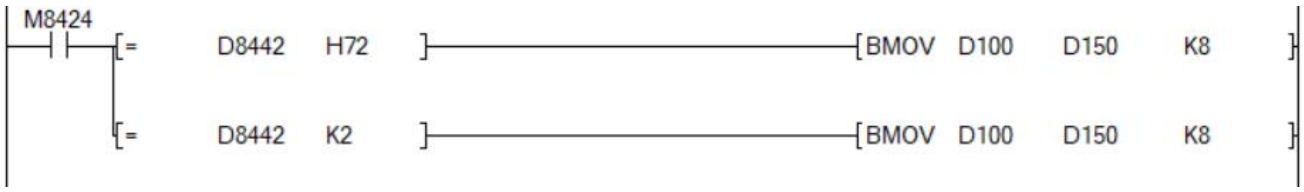
1. Initialization of CAN function



2. Normal data frame communication of CAN

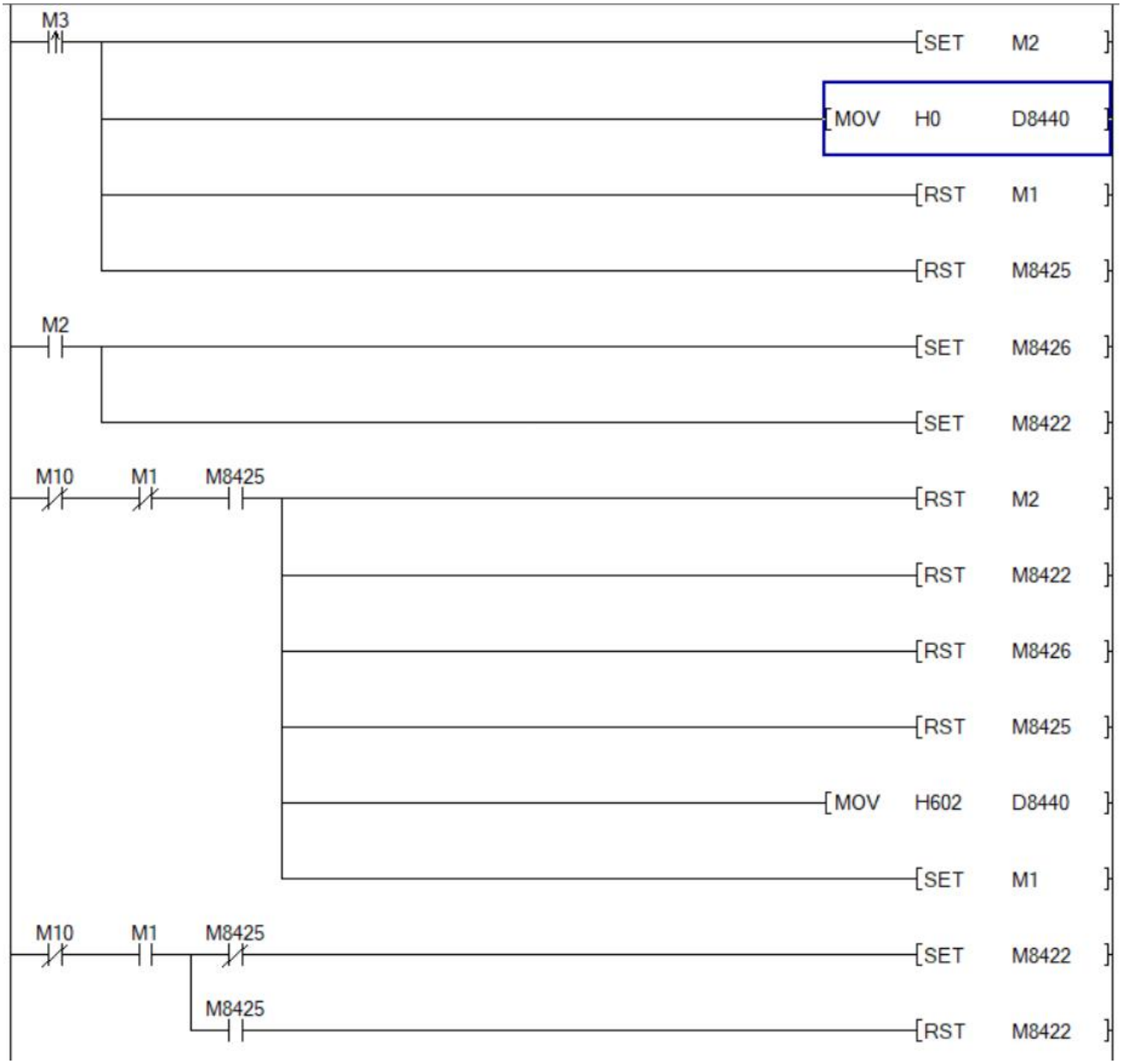


3. CAN data frame ID judgment after receiving data



4. Sending SDO commands

Change the local ID through D8440, and perform one SDO transmission for each M3 rising edge. In the routine, first send the driver enable command, and then send the configuration information. Before sending a command, parameters can be written to the sending location specified in the RS2 command, and the data returned by the driver will be saved in the receiving location specified in the RS2 command.

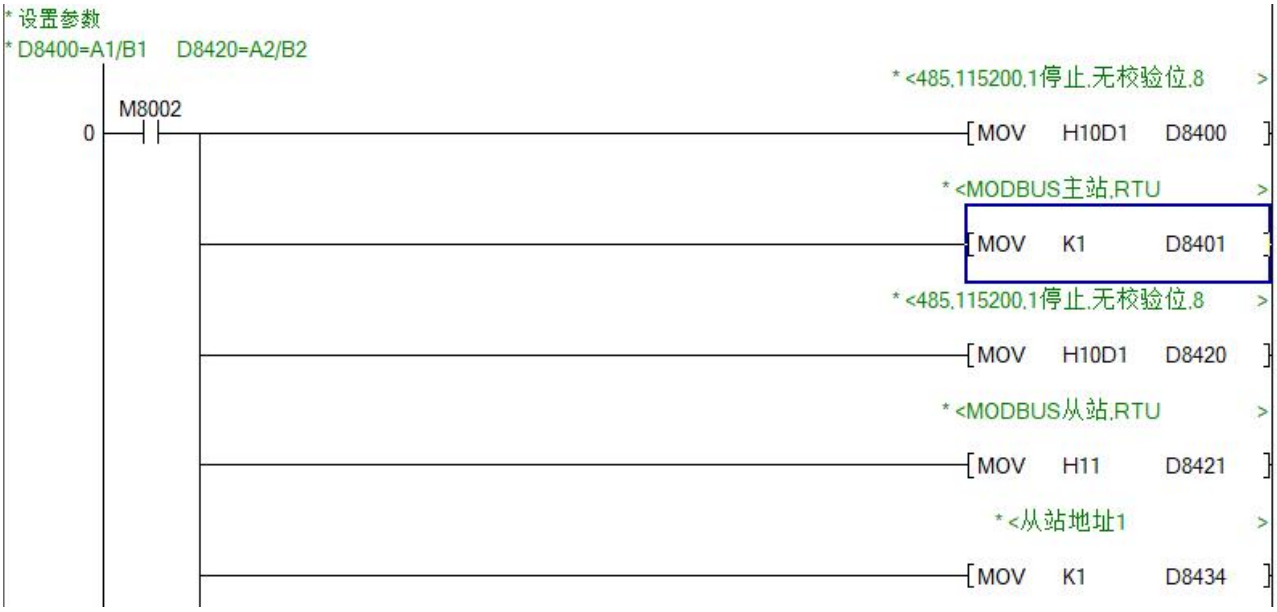


12. Application Case

12.1. MODBUS Function

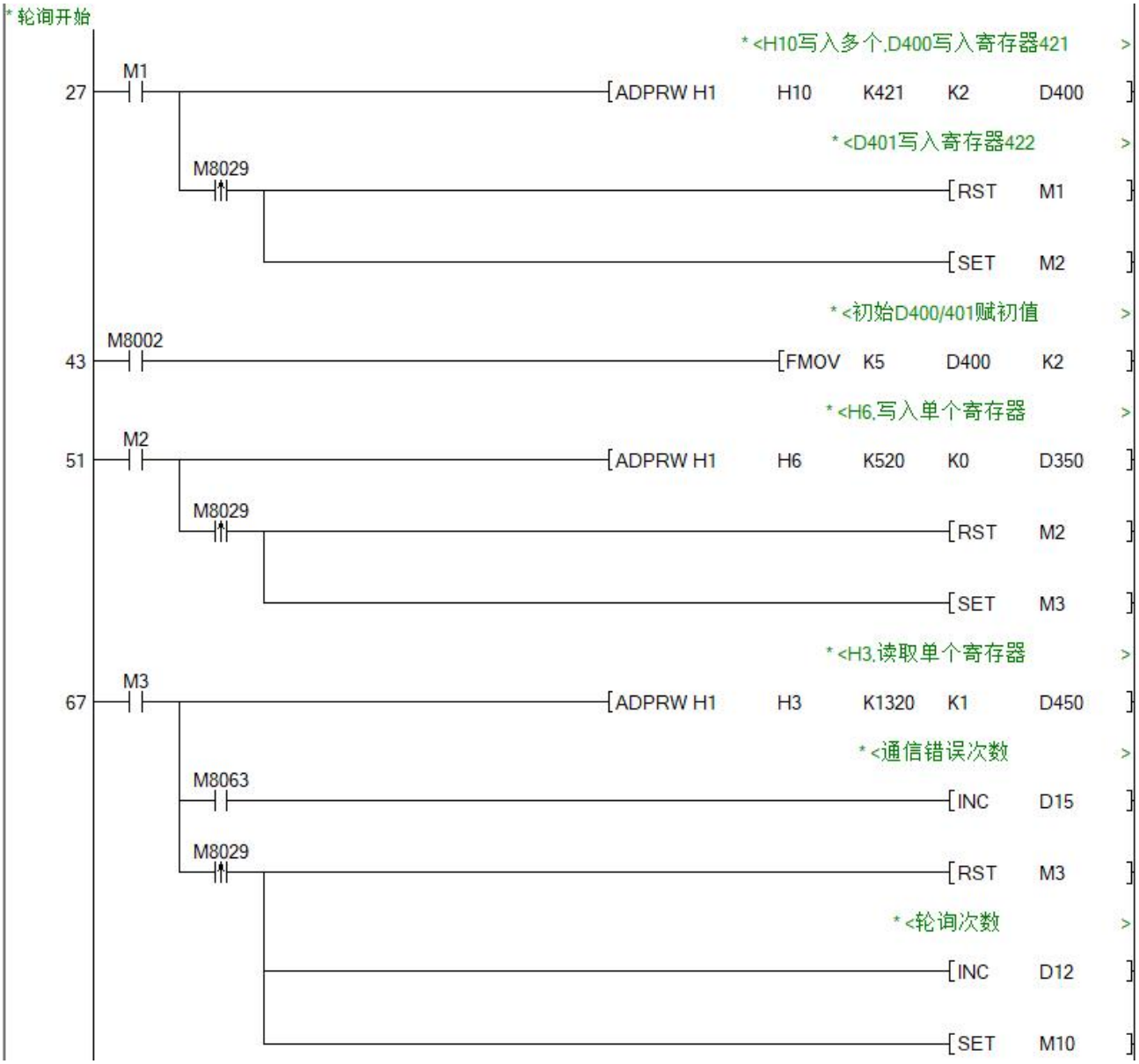
1. Master & Slave

The PLC has two 485 channels, which can serve as both the master and slave stations. You can freely change the master and slave. Here, A1/B1 is set as the master station, A2/B2 is set as the slave station, and the slave station address is 1.



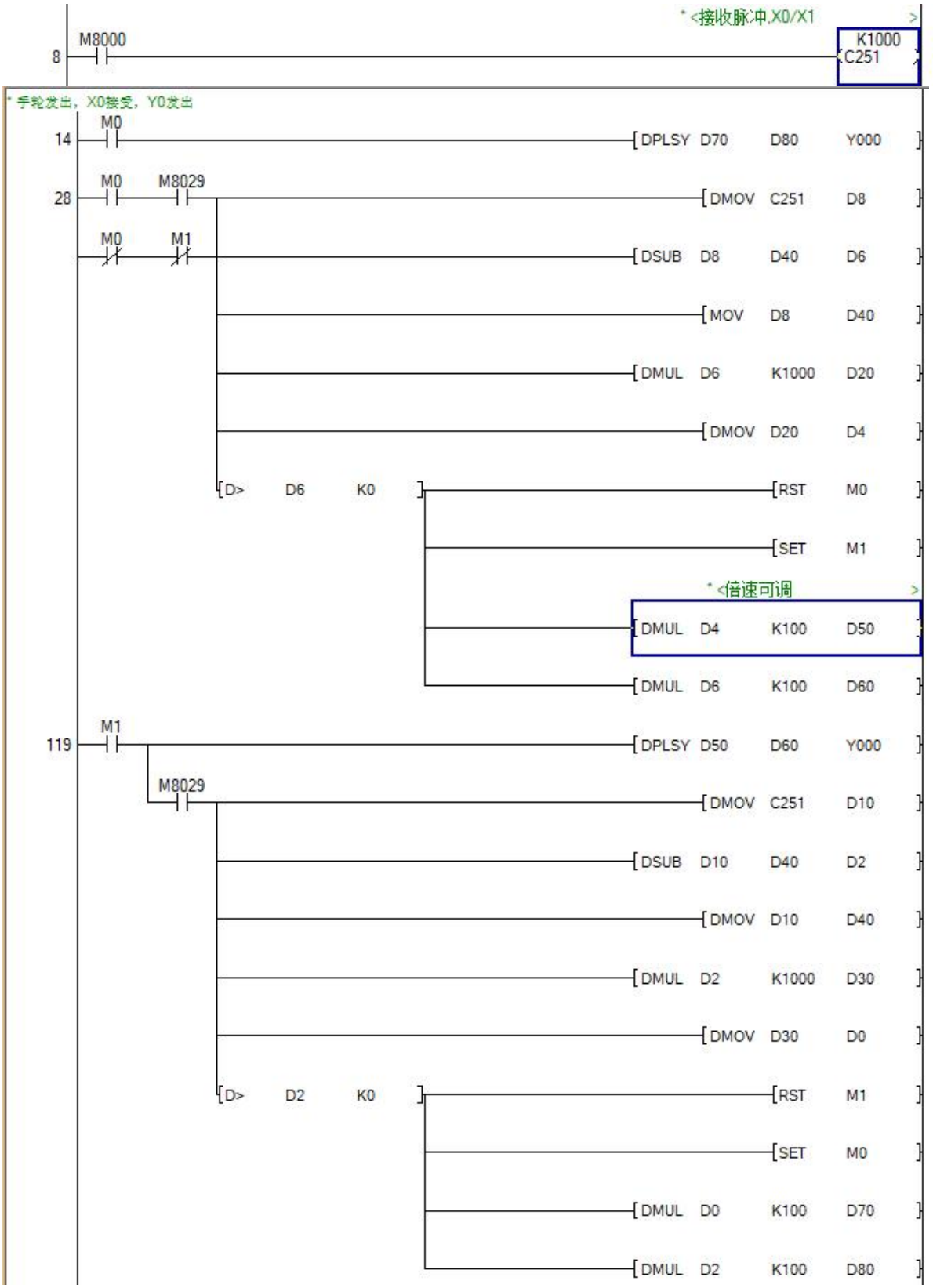
2. Function code 0x10, 0x06, 0x03

Using ADPRW for communication with the slave station, M8029 determines completion, and M8063 determines read and write errors.



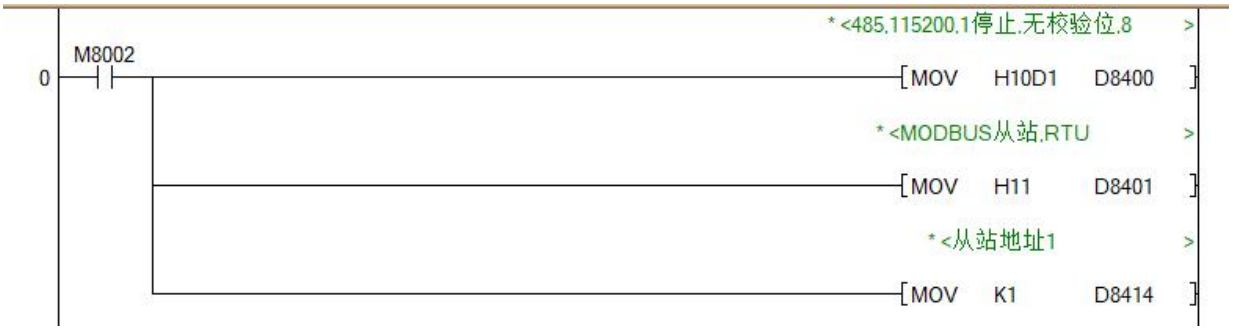
12.2. Handwheel Function

The handwheel function is implemented through a program, which receives the handwheel pulse through the X0 port and then sends it out through the Y0 port. At the same time, it can also achieve the cutting function.



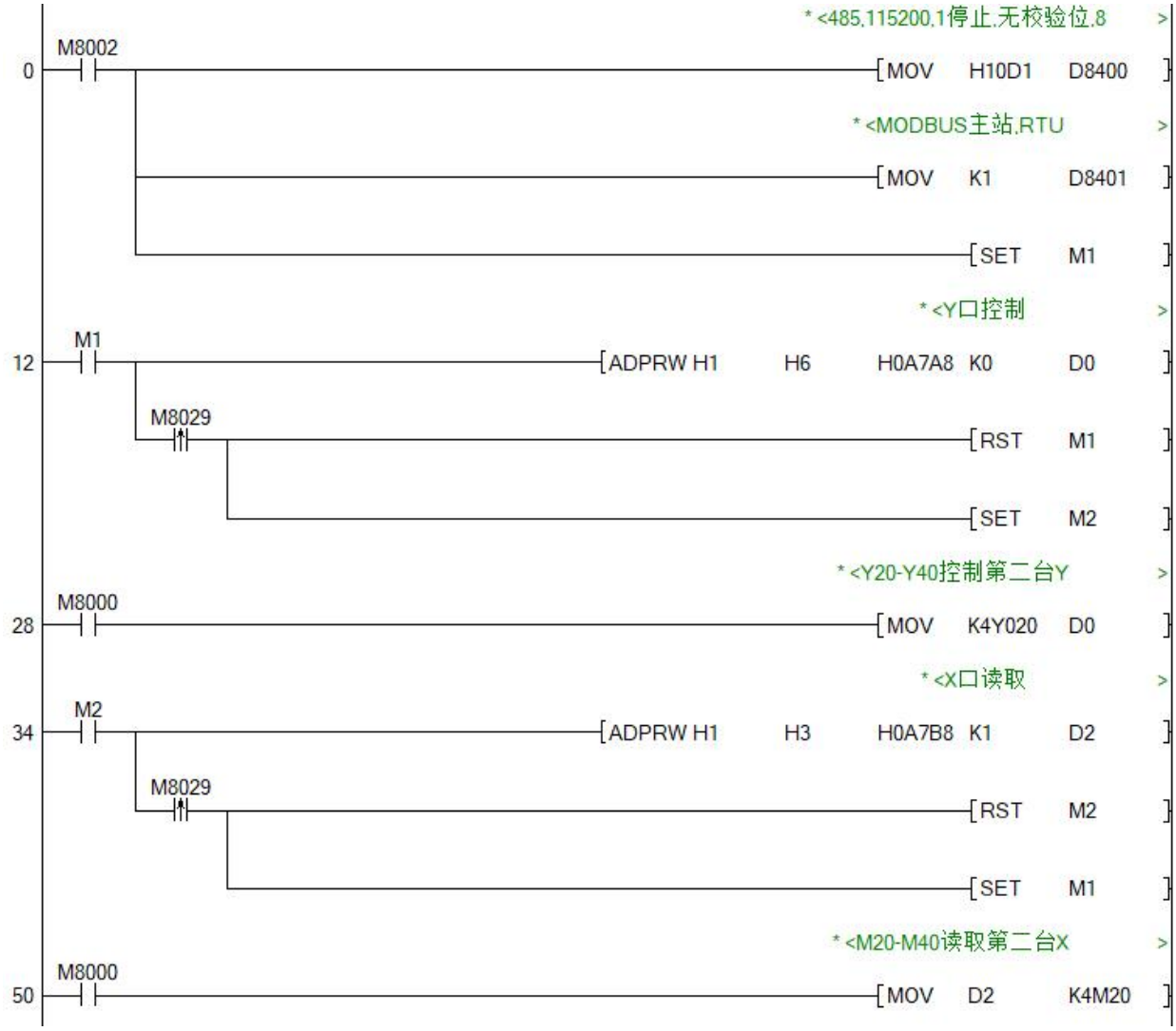
12.3. Communication between the two PLCs

1. Controlled slave setup



2. Master setup, the slave PLC is controlled through 485

Y20 is connected, and the Y0 port of the slave PLC is connected one by one. The master station Y20 corresponds to the slave station Y0, and Y37 corresponds to the slave station Y17. The slave PLC is reading the X port signal to M20 to M37, corresponding one by one. Slave X0 corresponds to M20, and X17 corresponds to M37.



13. Appendix

13.1. What do the three types of grounding in electricians mean?

The single point grounding methods for low-voltage electrical equipment can be divided into series single point grounding, parallel single point grounding, and multi branch single point grounding.

Series single point grounding: also known as the first grounding method. Grounding method: Connect the grounding terminals of multiple low-voltage electrical equipment to the same grounding wire near the equipment, and then connect it to the grounding device through this grounding wire. The benefits of this type of grounding are: saving manpower and material resources; The downside is that when there is an open circuit in the common grounding wire, if one device in the grounding system leaks electricity, it will cause voltage to appear on the shells of other devices, posing a threat to personnel safety.

Parallel single point grounding: also known as the second grounding method. Grounding method: Each grounding terminal of the equipment is connected to a grounding wire, and then these several wires are simultaneously connected to the grounding device. The advantage of this grounding method is that when one of the grounding devices in the grounding system experiences an open circuit, it will not cause voltage to the casing of other devices, which is beneficial for ensuring personal safety. The imperfection of this grounding method lies in the fact that if it is an electronic device or other highly sensitive electrical device to high-frequency interference, high-frequency interference from other devices (such as frequency converters, intermediate frequency furnaces, and other thyristor converter devices) will be connected from a common point, causing the equipment to work improperly.

Multi branch single point grounding: this is the third grounding method. Grounding method: Connect the grounding terminal of each device separately to the grounding device. The difference between the grounding method and the second grounding method is that the equipment has a separate grounding body (or alternatively, it is directly connected to the grounding device (or grounding source) closest to the grounding body, and the distance between each equipment on the electrical grounding circuit is relatively long (such as over 50 meters), which effectively avoids mutual electromagnetic interference between equipment. But this method is time-consuming, labor-intensive, and it may not be easy to obtain a separate grounding source.

In normal construction, if conditions permit, it is recommended to use the third grounding method. However, in fact, the second grounding method is commonly used for PLC grounding. As for electromagnetic interference, if there are multiple high-power frequency converters in the cabinet, a single-phase power filter can be installed at the front end of the PLC power supply.