Instruction Manual of PLC WS3U-B Series

-V1.1

For the following models:

WS3U-14MR-K-B

WS3U-14MT-K-B

WS3U-14MRT-K-B

Table of Contents

Chapter 1 Product Overview

1.1 Product overview

- WS3U-F series, using ARMCortex-M3 32-bit MISC core chip, has fast operation speed and large storage space.
- The download speed is 38.4 Kbps ; The software is Mitsubishi GX Developer or GX Works2 for programming, downloading, debugging, monitoring (monitor writing unsupported).
- DC 24V power supply; the quiescent current is 30MA under the condition of the output relays turned-off;

Every output relay turn-on will add 10MA current. For example, the current is 70MA (1.44 W) after the 3U-14mr's output relays are all turned on.

- 6 channels of analog inputs (3 for voltage of 0-10V; 3 for current of 0-21MA; optional 2CH PT100 or 2CH K thermocouple) and 2 channels of analog outputs (voltage of 0-10V).
- 6 channels of 3K High speed inputs (2 channels of 60K optional), supports 3 channels of AB phase inputs,the transistor models have 2 channels of 100K pulse outputs.
- The relay models adopt 5A current relay, which should be less than 3A for long-term use;
- Transistor models are driven by triode, output current 1A, long-term use no more than 500mA.
- A variety of model choices, a wide range of applications, offering bulk customized products.

1.2 Basic specifications

Model	Dimension (mm)	Download	Capacity	IN	Out	Type	Out Current	Load	Counting	Pluse out	Analog IN	Analog Out	MODBUS	RTC	Shell
WS3U-14MR -K-B	90*80*61	38.4Kb	8000	8	6	Relay	5A	24V 220V	6CH/3K (2CH/60K Optional)	/	3AD 0-10V 3AD 4-20MA (2CH 0-10V can be modified to 2CH PT100 or K type)	2CH 0-10V	Yes	Optional	
WS3U-14MT -K-B	90*80*61	38.4Kb	8000	8	6	Transistor	1A	24V		2/100K					
WS3U-14MRT -K-B	90*80*61	38.4Kb	8000	8	6	2CH Transistor 4CH Relay	MT 1A MR 5A	24V 220V		2/100K					

3CH 0-10V can be changed to 2CH PT100 or 2CH K thermocouple.

Scope:

PT100: -50~450℃

K: -60~840℃

1.3 Using environment and installation method

- In order to prevent the PLC from overheating, please install it by hanging. It requires enough space for heat dissipation.
- A gap of 50mm or more is left between the PLC and other equipment. Stay away from high voltage wires, high pressure equipment and motor parts.
- Get away from dusty, oily and corrosive environment; Be careful to electrostatic protection (avoid direct hand contact with the circuit).
- Installed by the rubber isolation column. DIN rail mounting is optional.

Chapter 2 Product display

2.1 Hardware Illustration (WS3U-14MR, for example)

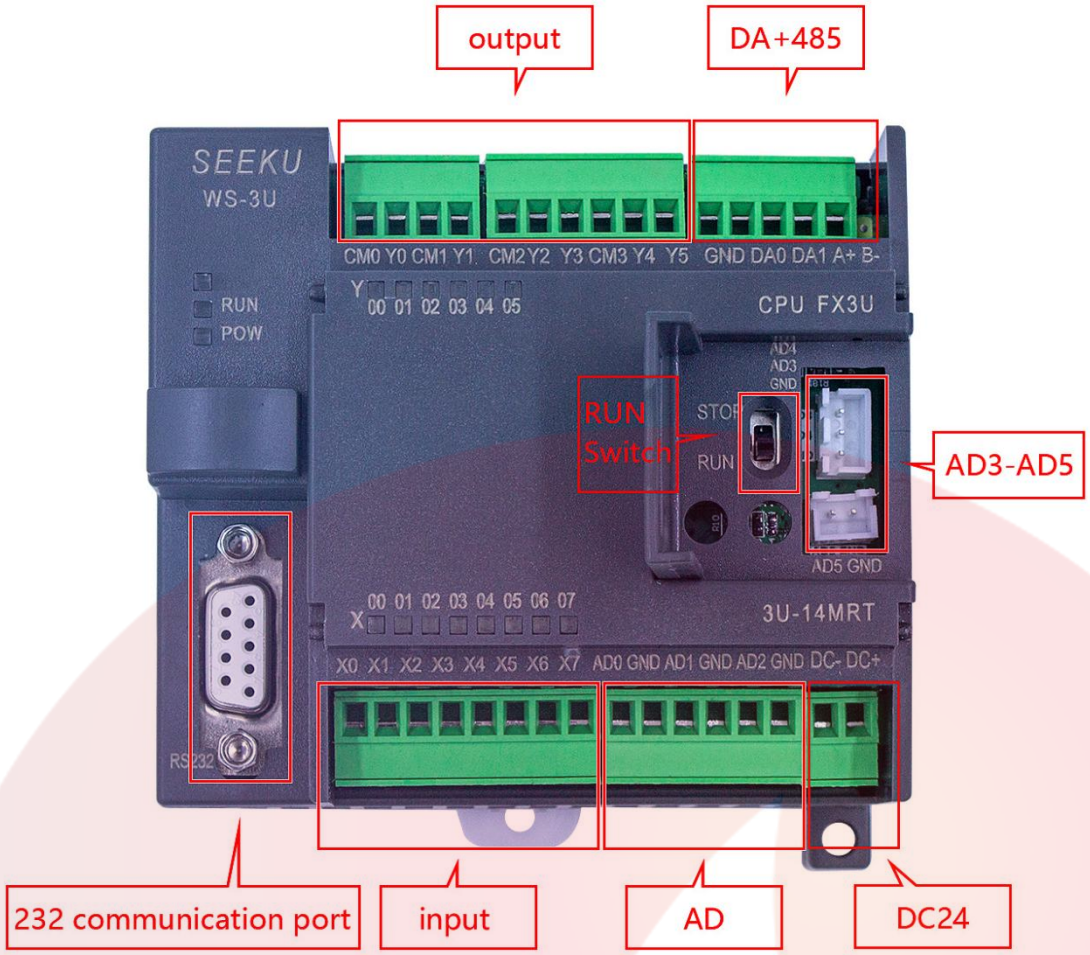


Figure 2-1

Chapter 3 Electrical Part

3.1 Power supply and consumption

DC 24V power supply; the quiescent current is 20MA under the output relays Shutdown;

Every output relay turn-on will add up 8MA current. For example, the current is 70MA (1.44 W) after All the 3U-14mr's output relays are turned on.

Note: If the switching power supply with small ripple is used, when there is strong interference in the circuit, please use an appropriate filter for filtering.

3.2 RS232 Communication interface

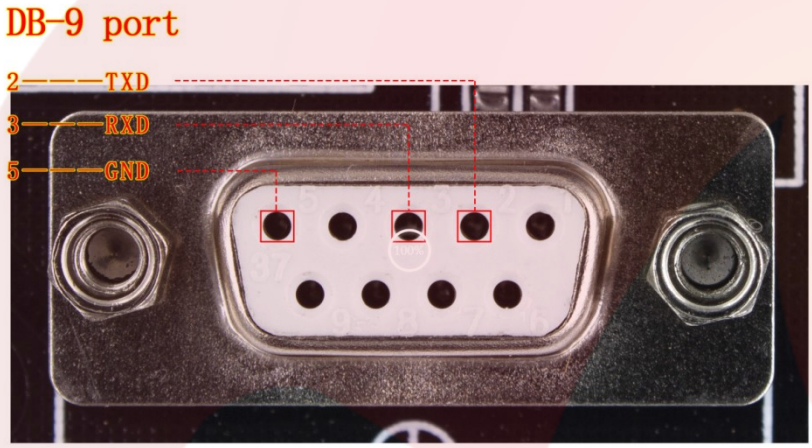
- There is a set of RS232 interface, which is used for program downloading or HMI communication.

Communication Port definition

2---TXD (Transmitting Data)

3---RXD (Receiving Data)

5---GND (Signal Ground)



Picture 3-1 DB-9 Port

Connection with the HMI

The TXD of PLC is connected to the RXD of HMI

The RXD of PLC is connected to the TXD of HMI

The GND of PLC is connected to GND of HMI

- Configuration of connection with OP320: baud rate-38400; data bit-7; check bit-Even; stop bit-1)
- For rewired HMI, please connect the RXD TXD GND of HIM according to the wire port definition.
- DB-9 is RS232 port, which supports Winsun PLC programming protocol,program downloading (using DB-9 or USB to DB-9 port cable) and communication with HMI or text display.

3.3 RS485 communication interface

Serial data transmission

Special register	Description	Special Relay	Description

RS485 communication interface			
D8120	RS485 Communication definition	M8121	Setting when sending data, and automatically resetting from the beginning of data sending
D8121	RS485 Communication station number setting	M8122	Sending request, when M8122 setting, the data will be transmitted once the communication interface is not occupied. It will be automatically reset after finishing data sending
D8122	transmitting the left data	M8123	Mark it after data receiving done, and automatically resetting when one frame of date received. User should reset it after finishing data receiving.
		M8124	Setting when receiving data, and automatically resetting after finishing data receiving.
M8129: Mark the overtime communication . the M8129 will set when the master issues a command and the salve doesn't respond within D8129 time.			

The communication specifications of D8120 and D8126 as below:

No.	Name	Content	
		0 (OFF)	1 (ON)
B0	Data length	7 bit	8 bit
B1 B2	Parity bit	b2 b1 (0, 0)No check (0, 1): ODD (1, 1): EVEN	
B3	Stop bit	1 bit	2 bit
B4 B5 B6 B7	Transfer 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
B8	Start character	None	D8124
B9	Stop character	None	D8125
B10 B11	Not available		
B12 B13 B14 B15	Communication protocol	B15 b14 b13 b12 {0, 0, 0, 0}: Mitsubishi FX2N protocol (slave) {0, 1, 0, 0}: MODBUS RTU (slave) {1, 0, 0, 0}: MODBUS RTU (master, IVRD, IVWR command) {1, 1, 0, 0}: Free communication (RS command ,CCD confirm)	

When M8120 is set and RS command is executed, the parameters given are for RS232 interface; when M8120 is reset and RS command is executed, the parameters given are for RS485 interface.

Figure 3-2

The transmission format of data can be set by the special register D8120.
Please set the number of data sending points as “KO” on the condition of the system without sending data.
Please set the number of data receiving points as “KO” on the condition of the system without receiving data.

CCD command:
N point data starting with the element specified by S, store the sum of each bit data and CRC check data in D. And D.+2,D.+3.It is put in D0 and CRC in D2 and D3 as below.

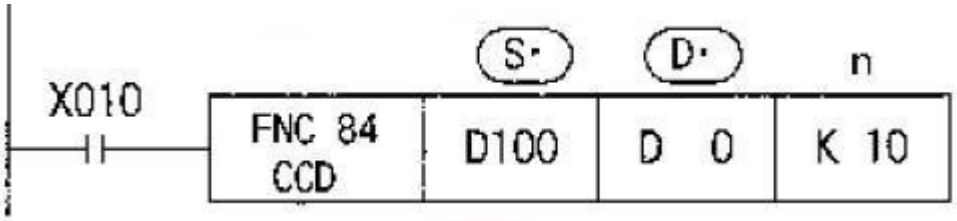


Figure 3-3

3.4 Communication with frequency converter / Instrument

Read:

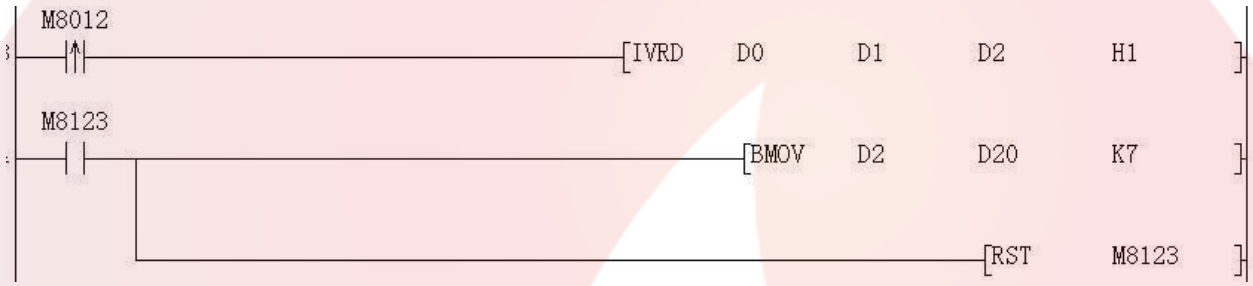


Figure 3-4

D0 is the read station number (high 8 bits) and command code (low 8 bits). If the value of D0 is H103, The station number is 1 and read command is 3.D1 is the data address to be read, D2 is the first address of the data for receiving frequency and the instrument returned. If channel 0, M8123 will be set.H1, high 8-bit channel, low 8-bit read.Read 1 data through channel 0 (485 channel,).If the bit H101, is through the channel (RS232 channel) 1 read 1 data.

Write：

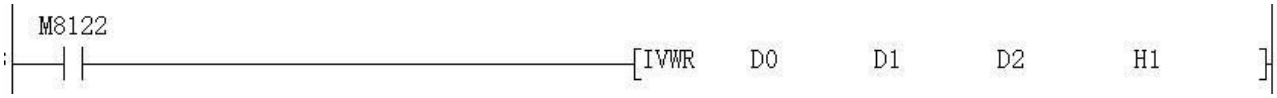


Figure 3-5

D0 is the written station number (high 8 bits) and command code (low 8 bits). If the value of D0 is H106, it is station number 1. Write single data command 6.D1 is the data address to be written, and D2 is the first address to write the variable frequency or meter data.H1, 8 bits high is the channel, 8 bits low is the number of writes.Write 1 data through channel 0 (485 channel,).If it is H101, it is to write 1 data through channel (RS232 channel) 1.M8122 automatically reset after writing

3.5 Analog input and output:

1. Analog reading command:

AD0,AD1 and AD2 are 0-10v analog input, AD3,AD4 and AD5 are 0-20ma analog input, The corresponding value of 0-10v / 0-20ma is 0-4095.

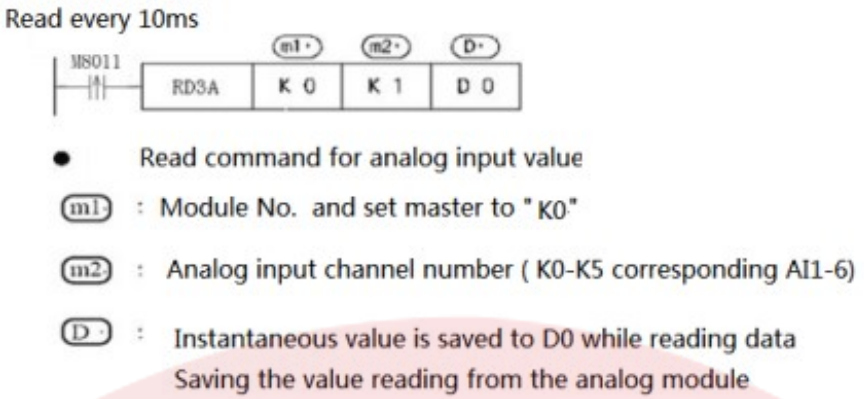


Figure 3-6

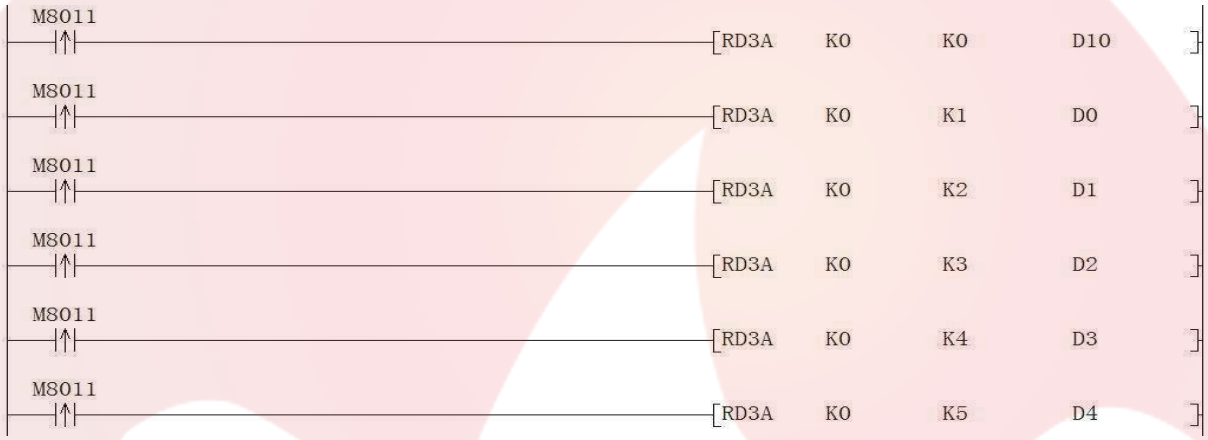


Figure 3-7 an example of analog input program

2. Analog output command:

DA0,DA1 is 0-10v analog output, corresponding value is 0-4095.

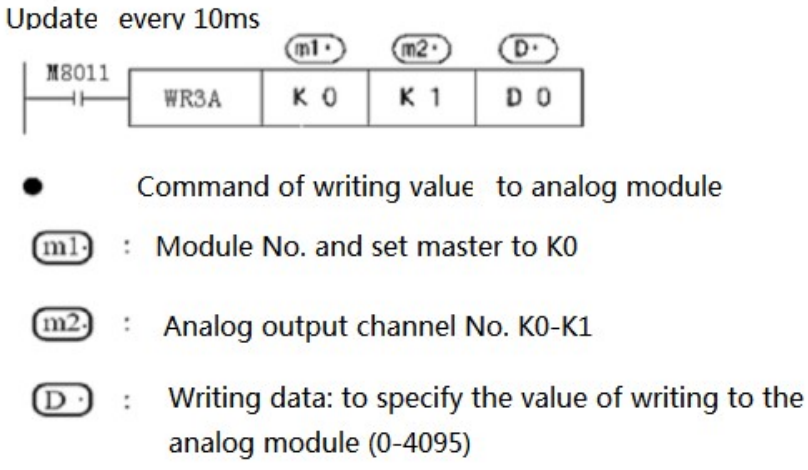


Figure 3-8

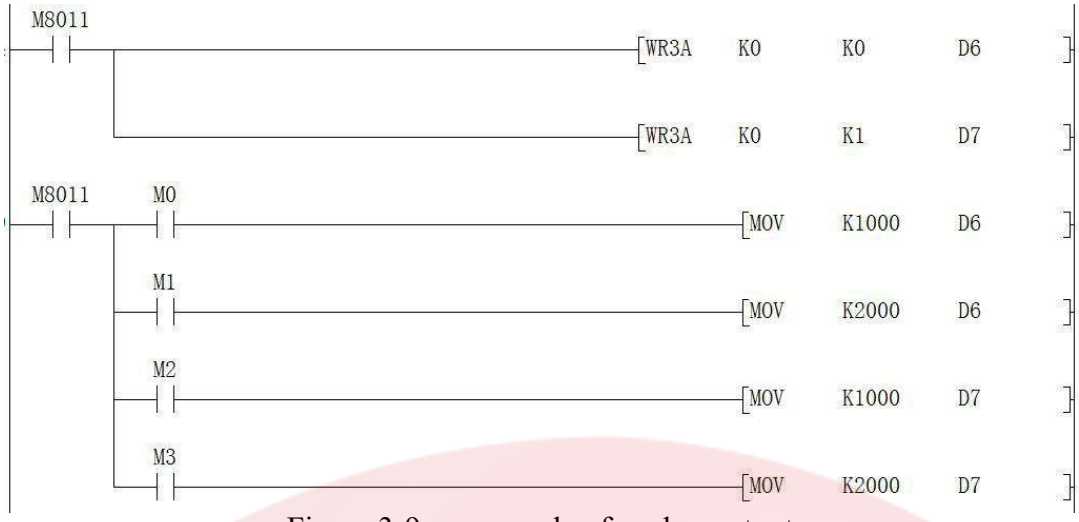


Figure 3-9 an example of analog output program

3.6 Clock module

When setting the clock, M8015 should be set and be reset while resuming running.D8018 for the value of year, D8017 for the value of month, D8016 for the value of day, D8019 for the value of week, D8015 for the value of hour, D8014 for the value of minute, and D8013 for the value of second.The clock data can be used to read command. TRD can be used to read the clock data into a general register, or the clock write command- TWR can be used to modify the clock without setting M8015.

3.7 PID operation command

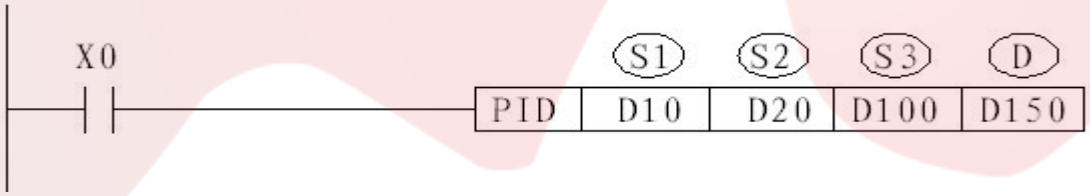


Figure 3-10

This command is used for PID control of the PID running program.S1: target value; S2: current value (feedback value);S3: PID control parameters, occupying 9 consecutive D registers starting from S3.S3 is the PID channel number;S3+1 is the proportional coefficient KP; S3+2 is the integration coefficient KI; S3+3 is the differential coefficient KD; S3+4 is the error coefficient KE. Only when the error value is greater than this value, PID processing will be carried out. S3+5: output upper limit PMAX;S3+6 output lower limit PMIN;S3 + 7 standby; S3 + 8 standby; D: control value output.

3.8 High Speed Input

SPD command (X0-5 is supported). If the encoder has 360 pulses per turn, 720 pulses can be obtained by doubling frequency and 1440 pulses can be obtained by 4 times frequency, thus improving the resolution of the encoder.

Count Input	Single phase counter number	Up/down counting direction switches	Count Input	Single phase double frequency counter	Up/down counting direction switches
X0	C235	M8235	X0	C241	M8241
X1	C236	M8236	X1	C242	M8242
X2	C237	M8237	X2	C243	M8243
X3	C238	M8238	X3	C244	M8244
X4	C239	M8239	X4	C245	M8245
X5	C240	M8240	X5	C246	M8246

Count Input	Two-phase double frequency counter	Up/down counting direction (read only)	Count Input	Two-phase four times frequency counter number	Up/down counting direction (read only)
X0(phase A)	C250	M8250	X0(phase A)	C253	M8253
X1(phase B)			X1(phase B)		
X2(phase A)	C251	M8251	X2(phase A)	C254	M8254
X3(phase B)			X3(phase B)		
X4(phase A)	C252	M8252	X4(phase A)	C255	M8255
X5(phase B)			X5(phase B)		

C247 (X0, X1), C248 (X2, X3), 249 (X6, X7) are single frequency two-phase counters.

3.9 High speed pulse output and pulse width modulation:

This Series supports 8 channel of pulse output Y0-Y7 (PLSY, PLSV, PLSR, DRVA, DRVI) or 6 channel of pulse width modulation Y0-5 (PWM) at a frequency of 100K.

Pulse	No. of output pulse	Mark of Output	Inhibit pulse	The minimum output frequency	The time of ACC/DEC	The direction of DSZR, DVIT	DVIT interrupted ,Input X address	The speed of DSZR	The crawling speed of DSZR	No. of ZRN crawling pulse
Y0	D8132	M8147	M8141	D8144	D8145	M8080	D8080	D8220	D8090	D8072
Y1	D8134	M8148	M8142	D8146	D8147	M8081	D8081	D8221	D8091	D8073
Y2	D8136	M8149	M8143	D8148	D8149	M8082	D8082	D8222	D8092	D8074
Y3	D8138	M8150	M8144	D8150	D8151	M8083	D8083	D8223	D8093	D8075
Y4	D8140	M8151	M8145	D8152	D8153	M8084	D8084	D8224	D8094	D8076
Y5	D8142	M8152	M8146	D8154	D8155	M8085	D8085	D8225	D8095	D8077
Y6	D8166	M8153	M8155	D8156	D8157	M8086	D8086	D8226	D8096	D8078
Y7	D8168	M8154	M8156	D8158	D8159	M8087	D8087	D8227	D8097	D8079

3.10 Interruption

1. External interrupt supported- X0-X5. The interrupt numbers are as follows:

	Rising edge	Falling edge	DISI Interrupt prohibition
X0	I0	I1	M8050
X1	I100	I101	M8051
X2	I200	I201	M8052
X3	I300	I301	M8053
X4	I400	I401	M8054
X5	I500	I501	M8055

2. The timer interrupt pole is I600 and the interrupt prohibition is M8056. Interrupt time range I601 (1MS)-I699 (99MS)

3. Counter interrupt pointer

Pointer Number	Interrupt prohibition
I10	M8059
I20	
I30	
I40	
I50	
I60	

3.11 Product wiring diagram

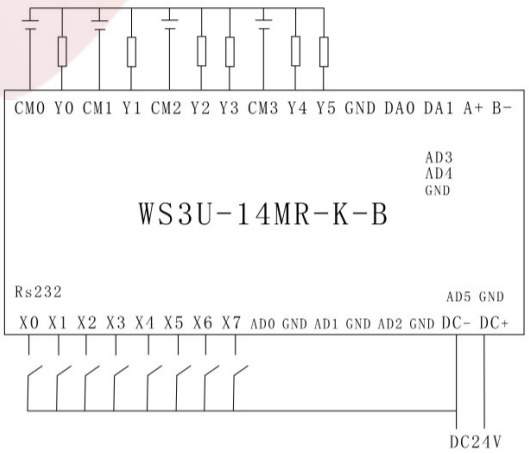


Figure 3-11

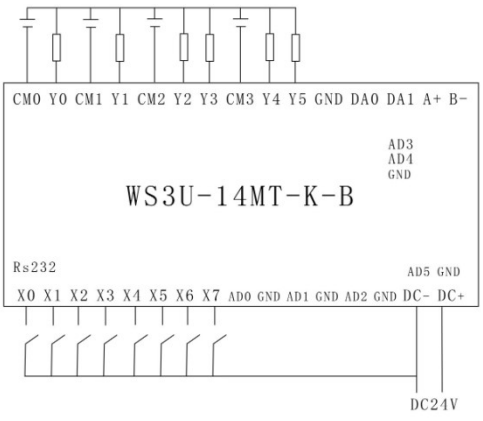


Figure 3-12

when you choose PT100 or K type, AD port wiring instruction:

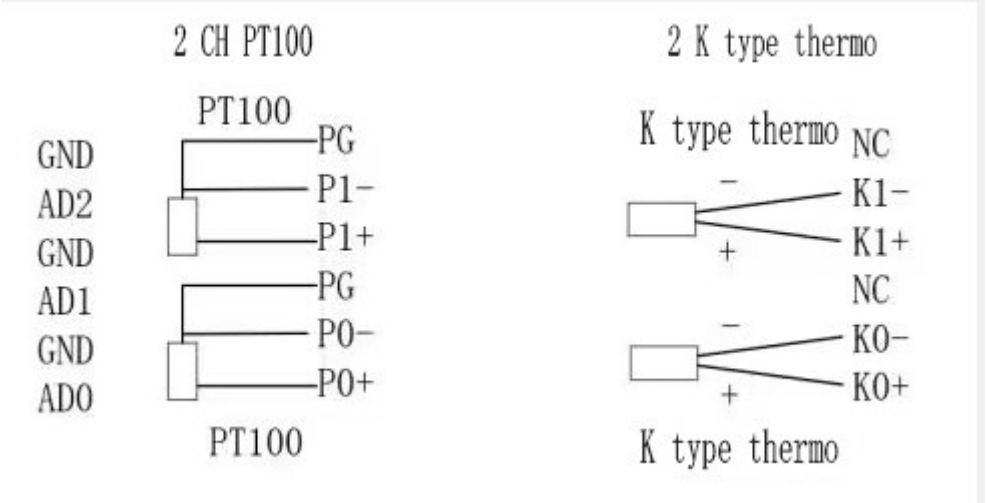


Figure 3-13

Chapter 4 Programming reference

4.1 Application environment

1. GX Developer (compatible with XP and WIN7 32-bit systems)
2. GX Works2 (compatible with WIN7 64-bit system, WIN8 system and WIN10 system)

4.2 Soft component Instruction

Table 4-1 Soft component Instruction

Intermediate relay M	M0-M3071, the range of power-down saving : after the No.of M500
Step Point S	S0-1023, the range of power-down saving : after the No.of 500
100Ms Timer	T0-T199，cumulative power-down saving : T184-T199
10Ms Timer	T200-T249，cumulative power-down saving: T246-T249
1Ms Timer	T250-T383，cumulative power-down saving: T250-255
16-bit Counter	C0-C199，power-down saving: C100-199
32-bit Counter	C200-C219，power-down saving: C220-C234
32-bit high speed Counter	C235-255,C235-240 single-phase counter，single frequency； C241-240 single-phase counter，double frequency； C247-249 two-phase counter，single frequency； C250-252 two-phase counter，double frequency； C253-255 two-phase counter，four times frequency；

Register D	D0-D7999，the range of power-down saving : after the No.of D200
Indirect addressing Pointers V，Z	V0-7，Z0-7
Subprogram jumping No. P	P0-63
Interrupt I	X0-5 external interrupt EINT. Timer interrupt（1MS as a unit）。Counter interrupt
Special element M	M8000: Normally closed in running, M8002: Power-on pulse, M8011: 10Ms pulse M8012 :100Ms pulse, M8013: 1s pulse, M8014: Minute pulse

4.3 Basic command

Table 4-2 basic command

No.	Mnemonic	Function
1	LD	The operation starts with Normally Open Contact
2	LDI	The operation starts with Normally Closed Contact
3	LDP	Rising edge detecting with operation beginning.
4	LDF	Falling edge detecting with operation beginning.
5	AND	Normally Open Contact in series
6	ANI	Normally Closed Contact in series
7	ANDP	Rising edge detecting in Series connection
8	ANDF	Falling edge detecting in Series connection
9	OR	Normally Open Contact in parallel
10	ORI	Normally Closed Contact in parallel
11	ORP	Rising edge detecting in parallel connection
12	ORF	Falling edge detecting in parallel connection
13	ANB	Circuit blocks are connected in series.
14	ORB	Circuit blocks are connected parallel

No.	Mnemonic	Function
17	RST	Releasing coil action holding
18	PLS	Coil rising edge output
19	PLF	Coil falling edge output
20	ALT	Alternate output
21	MC	Common string contact with coil command
22	MCR	the command of releasing common contact
23	MPS	Operation storage
24	MRD	Storage reading
25	MPP	Storage reading and resetting
26	INV	Negation of operation result
27	END	The end of program
28	STL	Step ladder start
29	RET	The end of step ladder
	CALL	Subroutine call

15	OUT	Coil output driving		SRET	Subroutine return
16	SET	Coil action holding			

4.4 Application command

Table 4-3 Application command
Note: 32-bit instructions and pulse execution instructions are supported

Sort	No.	Mnemonic	Function
Program flow	1	CJ	Conditional Jump
	2	CALL	Subroutine call
	3	SRET	Subroutine Return
	4	FEND	End of main program
	5	FOR	Loop Range start
	6	NEXT	Loop Range end
Transmission and comparison	7	CMP	Comparison
	8	ZCP	Regional comparison
	9	MOV	Transmission
	10	CML	Reverse transmission
	11	BMOV	Simultaneous transmission
	12	FMOV	multicast
	13	XCH	Exchange
	14	BCD	BCD conversion
	15	BIN	BIN conversion
Four logical operations	16	ADD	BIN Addition
	17	SUB	BIN Subtraction
	18	MUL	BIN Multiplication
	19	DIV	BIN Division
	20	INC	BIN Add 1
	21	DEC	BIN Minus 1
	22	WAND	Logical word and
	23	WPR	Logical word or
	24	WXOR	Logical Exclusive OR
	25	NEG	Complement code
Cyclic shift	26	ROR	Ring shift right
	27	ROL	Ring shift left
	28	RCR	Right shift
	29	RCL	Left shift
	30	SFTL	Bit left shift
	31	SFTR	Bit Shift Right
Bit data processing	32	ZRST	Batch Reset
	33	MEAN	Average
	34	FLT	BIN integer→Binary floating-point conversion
	35	GRY	BIN integer→Gray Code Conversion
	36	GBIN	Gray code →BIN integer
High Speed Processing	37	DHSCS	High Speed Comparison setting
	38	DHSCR	High Speed Comparison Resetting

	39	SPD	Pulse density and pulse width (pulse interval time) can also be measured.
	40	PLSY	Pulse Output
	41	PLSV	Pulse output with direction control
	42	PWM	Pulse Width Modulation, 0-32767us
	43	PLSR	Pulse output with acceleration and deceleration
	44	DRVA	Absolute position control
	45	DRVI	Relative position control
	46	ABSD	Cam Control (Absolute Mode)
Peripheral equipment	47	RS	Serial data transfer
	48	ASCI	HEX - ASCII conversion
	49	HEX	ASCII - HEX conversion
	50	CCD	Check code
	51	PID	PID operation
	52	SEGD	BCD to 7-segment code digital tube
Floating point arithmetic	53	ECMP	The comparison of binary floating point number
	54	EZCP	Interval comparison of binary floating point number
	55	EBIN	The conversion between decimal floating point number and binary floating point number
	56	EADD	Addition of binary floating point number
	57	ESUB	Subtraction of binary floating point number
	58	EMUL	Multiplication of binary floating point number
	59	EDIV	Division of binary floating point number
	60	INT	Conversion between binary floating point number and BIN integer
	61	SIN	Operation of floating point number SIN
	62	TAN	Operation of floating point number TAN
	63	COS	Operation of floating point number COS
	64	ASIN	Operation of floating point number SIN-1
	65	ATAN	Operation of floating point number TAN-1
	66	ACOS	Operation of floating point number COS-1
	67	EXP	Exponent arithmetic of binary floating point number
	68	LOGE	Natural Logarithm Operation of Binary Floating Point Number
	69	LOGE10	Common Logarithmic Operation of Binary Floating Point Numbers
	70	SWAP	Conversion between Up and down byte
Convenience command	71	SER	Data lookup
	72	ALT	Alternating output
	73	RAMP	Ramp signal
	74	BON	ON bit Decision
	75	SUM	ON bits
	76	ANS	Alarm set
	77	ANR	Alarm Reset
	78	HOUR	Chronograph
Clock command	79	TCMP	Clock data comparison
	80	TRD	Clock data reading
	81	TWR	Clock data writing

Contact comparison	82	LD=	（S1=(S2)
	83	LD>	(S1)>(S2)
	84	LD<	(S1)<(S2)
	85	LD◇	(S1)≠(S2)
	86	LD≦	(S1)≤(S2)
	87	LD≧	(S1)≥（S2）
	88	AND=	（S1=(S2)
	89	AND>	(S1)>(S2)
	90	AND<	(S1)<(S2)
	91	AND◇	(S1)≠(S2)
	92	AND≦	(S1)≤(S2)
	93	AND≧	(S1)≥（S2）
	94	OR=	（S1=(S2)
	95·	OR>	· (S1)>(S2) ·
	96	OR<	(S1)<(S2)
	97	OR◇	(S1)≠(S2)
	98	OR≦	(S1)≤(S2)
	99	OR≧	(S1)≥（S2）

4.5 Directive lists are not supported in this release

No.	Mnemonic	Function
1	ZRN	Regression Through the Origin, only 16-bit command supported
2	DSZR	Regression Through the Origin with DOG search
3	DVIT	Interrupt positioning

Chapter 5 Frequently asked questions and solutions

No.	Questions/Problem	Solutions
1	Wiring method of Analog	The negative electrode to GND. The positive electrode to AD port.
2	Analog reading	Please refer to the section 3.5
3	Encryption	On the condition of communication confirmed: 1,Turn the switch to STOP, and the running light will flash 2, Click and write "keyword" 3, Set the same 8-digit number twice, and then turn the switch back to the original position.
4	RS232 Cable sequence	The sequence : 2-2 3-3 5-5
5	PLC power consumption	Please refer to the section 3.1
6	The PLC doesn't communicate	1, Check if the cable is plugged in and the driver is installed. 2, Check the PLC configuration of SW, baud rate, Com port correct or not.
7	Wiring method	All input ports are NPN input, negative conduction.

Chapter 6 Warranty terms

6.1 Warranty period

The product provides a one-year warranty from the date of delivery. During the warranty period, our company will provide free maintenance services for the product.

6.2 Not supported by warranty

- Positive and negative part of power is reversed.
- Wrong voltage range or using environment.
- Unauthorized changes to internal components