COOLMAY PLC

Programming Manual

Contents

1. Overview

COOLMAY PLC,which is self-developed and produced by Shenzhen Coolmay Technology Co.,Ltd.,is cost-effective and with high quality. They are classified into 3 types according to analog. Specifications of analog please refer to the forth part of this manual.

A	B	C
EX2N-40A Programmable Text Monitor	EX2N 30A Programmable Text Monitor	CX2N-36/68M
EX2N-50A Programmable Text Monitor	EX2N-43H Series All-in-one	DCX2N-36/68M
EX2N-70H HMI/PLC All-in-one	DX2N/DX2NS	CX2N-HM-36/68M
EX2N-100H HMI/PLC All-in-one	FX2NC	
DX2NA	CX2N-24/32M	
DX2NT-68MR/MT/MRT	DCX2N-24/32M	
CX2N-48/64/80M	CX2N-HM-24/32M	
DCX2N-48/64/80M		
CX2N-HM-48/64/80M		

Compared with other brands，COOLMAY PLC have the following features：

- Upper computer software compatible with MITSUBISHI GX Developer8.52/Works 2.
- Adopt Military level 32-bit CPU with fast speed，more adapted to high EMI industrial environment.
- Special encryption, thoroughly resist being read illegally.Setting 12345678 as the user password can totally close the function of reading Ladder Logic Program so that users' program can be protected.
- support clock，real time clock can be preserve above 5 years after outage.
- RS485/232 ports can be added for connecting HMI 、VFD and other facilities.
- Support Mitsubishi PLC programming protocol/Modbus series/free port protocol, can easily realize the communication between PLC and other facilities.
- Support 4-5 high speed pulse outputs，at most 4-5 200KHz at the same time.
- Normally 2 single counting (X0/X3)or 2 AB phase counting（X0-X1/X3-X4）10KHz. At most 6 single counting can be customized（4 100KHz、2 10KHz),Or 3 AB phase counting （2 100KHz、1 10KHz）or 3 ABZ counting (1 100KHz 、2 5-10KHz).
- Support all kinds of analog inputs and outputs, just one sort or mixed ones. The accuracy of analog inputs is 12 bit and outputs accuracy is 10 bit. Analog inputs contain temperature/electric current/voltage,analog outputs contain electric current/voltage.
- Analog inputs contain relay/transistor or both.
- All the wiring terminals are pluggable for easily operation.
- Flexible to use, can be customized.

2. Resource Set

Items		contents
Operation Control Method		Cyclic operation by stored program
IO Control Method		Batch processing method (when END instruction is executed),I/O refresh instruction is available
Programming language		Relay symbolic language+step ladder (compatible with Mitsubishi software FXGP_WIN-C)
Operation time	Basic instruction	0.08μs
	Applied instruction	10-30μs
storage	Bulid-in	8000 steps EEPROM
	Storage boxes	
Numbers of instructions	Basic instruction sequence	27
	STL instruction	2
	Applied instruction	94
Auxiliary relays	general	500points M0-M499
	Latched	1036points M500-M1535
	special	256points M8000-M8255
State relays	general	500points S0-S499
	initial	10points S000-S009
	latched	500points S500-S999
timers	100ms	200points T0-T199
	10ms	46points T200-T245
	1ms integrating	4points T246-T249
	100ms integrating	6points T250-T255
counters	General 16 bit	100points C0-C99
	Latched 16 bit	100points C100-C199
	General 32 bit	
	latched 32 bit	35points C200-C234
High-speed counters	Single phase	At most 6 points,C235-X0 C236-X1 C237-X7 C238-X3 C239-X4 C240-X5;Normally 2 points,C235-X0 C238-X3
	A/B phase	At most 3 points,C251-X0/X1 C253-X3/X4 C254-X10/X11,normally 2 points ,C251-X0/X1 C253-X3/X4
Data register (D.V.Z)	General	200points D0-D199
	Power-down save	800points D200-D999

	File register	
	Externally adjusted	
	Special	256points D8000-D8255
	Index	16points V0-V7 Z0-Z7
Pointers	For use with call	128points P0-P127
	For use with interrupts	
Nest levels	Mater	8points: N0-N7
Constants	Decimal K	16bit ： -32768 to +32767
		32bit：-2147483648 to +2147483647
	Hexadecimal H	16bit：0000-FFFF
		32bit：00000000-FFFFFFFF

3. Instruction Set

3.1 Basic Program Instructions

Mnemonic	Function	Devices	Program steps
LD (Load)	Initial logical operation contact type NO (normally open)	X,Y,M,S,T,C	1
LDI(Load Inverse)	Initial logical operation contact type NO (normally closed)	X,Y,M,S,T,C	1
LDP(Load pulse)	Initial logical operation -Rising edge pulse	X,Y,M,S,T,C	2
LDF(Load falling pulse)	Initial logical operation Falling/ trailing edge pulse	X,Y,M,S,T,C	2
AND (AND)	Serial connection of NO (normally open) contacts	X,Y,M,S,T,C	1
ANI(AND Inverse)	Serial connection of NC (normally closed) contacts	X,Y,M,S,T,C	1
AND (AND Pulse)	Serial connection of Rising edge pulse	X,Y,M,S,T,C	2
ANDF (ANd Falling pulse)	Serial connection of Falling / Trailing pulse	X,Y,M,S,T,C	2
OR (OR)	Parallel connection of NO (normally open) contacts	X,Y,M,S,T,C	1
ORI(OR Inverse)	Parallel connection of NC (normally closed) contacts	X,Y,M,S,T,C	1
ORP (OR pulse)	Parallel connection of rising edge pulse	X,Y,M,S,T,C	2
ORF (Or failing pulse)	Parallel connection of Falling / trailing edge pulse	X,Y,M,S,T,C	2
ANB (AND Block)	Serial connection of multiple parallel circuits		1
ORB (OR Block)	Parallel connection of multiple contact circuits		1
OUT(OUT)	Final logical operation type coil drive	Y,M,S,T,C	Note 1
SET(SET)	Sets a bit device permanently ON	Y,M,S	Note 2
RST (RESET)	Resets a bit device permanently OFF	Y,M,S,T,C,D,V,Z	
MC(Master control)	Denotes the start of a master control block	Y,M（Except special M）	3
MCR(Master control reset)	Denotes the end of a master control block		2
MPS(Point store)	Stores the current result of the internal PLC operations		1
MRD(Read)	Reads the current result of the internal PLC operations		1
MPP(Pop)	Pops (recalls and removes) the currently stored result		1
INV (Inverse)	Invert the current result of the internal PLC operations		1
NOP(No operation)	No operation or null step		1
END(END)	Forces the current program scan to end		1

- Device is Y and program step of general M is 1. Program step of S/ Special auxiliary relay M/Timer T/Counter C is 2. Program step of data register D and index register V and Z is 3.

3.2 STL Instructions

Mnemonic	Function	Devices	Program steps
STL	Start a STL program	S	1
RET	End a STL program	NULL	1

3.3 Function Instructions（Contrast with MITSUBISHI）

category	FNC NO.	Mnemonic	Function	support	Category	FNC NO.	Mnemonic	Function	support
Program flow	00	CJ	Conditional Jump	★	Data operation	40	ZRST	Zone Reset	★
	01	CALL	Call Subroutine	★		41	DECO	Decode	★
	02	SRET	Subroutine Return	★		42	ENCO	Encode	★
	03	IRET	Interrupt Return			43	SUM	The sum of Active Bits	★
	04	EI	Enable Interrupt			44	BON	Check Specified Bit Status	★
	05	DI	Disable Interrupt			45	MEAN	Mean	★
	06	FEND	First End	★		46	ANS	(Timed) Annunciator Set	
	07	WDT	Watchdog Timer	★		47	ANR	(Timed) Annunciator Reset	
	08	FOR	Start Of A For/Next Loop	★		48	SQR	Square Root	★
	09	NEXT	End A For/Next Loop	★		49	FLT	Floot.(floating Point)	★
Move and compare	10	CMP	Compare	★	High speed processing	50	REF	Refresh	★
	11	ZCP	Zone Compare	★		51	REFF	Refresh and Filter Adjust	
	12	MOV	Move	★		52	MTR	Input Matrix	
	13	SMOV	Shift Move			53	HSCS	High Speed Counter Set	
	14	CML	Compliment	★		54	HSCR	High Speed Counter Reset	
	15	BMOV	Block Move	★		55	HSZ	High Speed Counter Zone Compare	
	16	FMOV	Fill Move	★		56	SPD	Speed Detect	★
	17	XCH	Exchange	★		57	PLSY	Pulse Y Output	★
	18	BCD	Binary Coded Decimal	★		58	PWM	Pulse Width Modulation	★
	19	BIN	Binary	★		59	PLSR	Ramp Pulse Output	★

Arithmetic and logical operation	20	ADD	Addition	★	Handy instructions	60	IST	Initial State	
	21	SUB	Subtraction	★		61	SER	Search	
	22	MUL	Multiplication	★		62	ABSD	Absolute Drum	
	23	DIV	Division	★		63	INCD	Incremental Drum	
	24	INC	Increment	★		64	TTMR	Teaching Timer	
	25	DEC	Decrement	★		65	STMR	Special Timer-definable	
	26	WAND	Word AND	★		66	ALT	Alternate State	★
	27	WOR	Word Or	★		67	RAMP	Ramp-variable Value	★
	28	WXOR	Word Exclusive OR	★		68	ROTC	Rotary Table Control	
	29	NEG	Negation	★		69	SORT	Sort Data	
Rotation and shift	30	ROR	Rotation Right	★	External I/O devices	70	TKY	Ten key Input	
	31	ROL	Rotation Left	★		71	HKY	Hexadecimal Input	
	32	RCR	Rotation right With Carry	★		72	DSW	Digital Switch(thumbwheel input)	
	33	RCL	Rotation Left with Carry	★		73	SEGD	Seven Segment Decoder	★
	34	SFTR	(Bit)Shift Right	★		74	SEGL	Seven Segment With Latch	
	35	SFTL	(Bit)Shift Left	★		75	ARWS	Arrow Switch	
	36	WSFR	Word Shift Right	★		76	ASC	ASC Ⅱ Code	
	37	WSFL	Word Shift Left	★		77	PR	Print To A Display	
	38	SFWR	Shift Register Write	★		78	FROM	Read from A Special Function Block	
	39	SFRD	Shift Register Left	★		79	TO	Write from A Special Function Block	
External service SER	80	RS	RS Communications	★	Inline comparisons	224	LD=	(Sl)=(S2)	★
	81	PRUN	FX2-40AP Parallel Run			225	LD >	(Sl) > (S2)	★
	82	ASCI	Hexadecimal to ASCII	★		226	LD <	(Sl) < (S2)	★
	83	HEX	ASCII to Hexadecimal	★		227	LD◇	(Sl)◇(S2)	★

	84	CCD	Check Code			228	LD≥	(SI)≥(S2)	★
	85	VRRD	FX-8AV Volume Read			229	LD≤	(SI)≤(S2)	★
	86	VRSC	FX-8AV Volume Scale			230	AND=	(SI)=(S2)	★
	87					232	AND >	(SI) > (S2)	★
	88	PID	PID Control Loop	★		233	AND <	(SI) < (S2)	★
	89					234	AND◇	(SI)◇(S2)	★
Floating point	110	DECMP	Compares Two floating point values - results of <, = and > are	★		236	AND≥	(SI)≥(S2)	★
	111	DEZCP	Compares a float range with a float value - results of <, = and >	★		237	AND≤	(SI)≤(S2)	★
	118	DEBCD	Converts floating point number format to scientific number format	★		238	OR=	(SI)=(S2)	★
	119	DEBIN	Converts scientific number format to floating point number	★		240	OR >	(SI) > (S2)	★
	120	DEADD	Adds two floating point numbers	★		241	OR <	(SI) < (S2)	★
	121	DESUB	Subtracts one floating point	★		242	OR◇	(SI)◇(S2)	★
	122	DEMUL	Multiplies two floating point	★		244	OR≥	(SI)≥(S2)	★
	123	DEDIV	Divides one floating point number by another	★		245	OR≤	(SI)≤(S2)	★
	127	DESQR	Calculates the square root of a floating point value.	★					
	129	INT	Float to Integer	★					
	130	SIN	Sine	★					
	131	COS	Cosine	★					
	132	TAN	Tangent	★					

NOTE：

1、★ means function instructions supported by coolmay PLC

2、There isn’t position instructions for 2N, and must be copied from 1N program.

3、PID supported and parameters can be ensure by Auto turning.

4、Specific usage of instructions please refer to <The FX Series of Programmable Control>

	147	SWAP	Float to scientific	★
Localization	155	ABS	Generates multiple	
	156	ZRN	Return original	★
	157	PLSV	Pulse with variable speed	★
	158	DRVI	Relative localization	★
	159	DRVA	Absolute localization	★
Real time clock control	160	TCMP	Compares two times - results of	★
	161	TZCP	Time Zone	★
	162	TADD	Time Add	★
	163	TSUB	Time subtract	★
	166	TRD	Read RTC data	★
	167	TWR	Set RTC data	★
	169	HOUR	timer	★
External device	170	GRY	Decimal to gray code	
	171	GBIN	Gray code to demical	
	176	RD3A	Analog module	
	177	WR3A	Analog module	

3.4 Devices and Error Codes

Devices	Operation	Devices	Operation
M8000	RUN Monitor No contact	D8001	PLC type and version
M8001	RUN Monitor NC contact	D8002	Memory capacity
M8002	Initial pulse NO contact	D8003	Memory type
M8003	Initial pulse NC contact	D8011	Minimum cycle/scan time in units of 0.1msec
M8011	Oscillates in 10 msec cycles	D8012	Maximum cycle/scan time in units of 0.1msec
M8012	Oscillates in 100 msec cycles	D8013-D8019	Sec/min/hour/day/month/year/weekday data for use with an RTC cassette
M8013	Oscillates in 1 sec cycles	D8020	Input filter setting for devices X000 to X017 default is 10MSEC,(0-15)
M8014	Oscillates in 1 min cycles	A analog	See below table

M8020	Set when the result of an ADD is "0"	D8030-D8041	Values of AD0-AD11
M8021	Set when the result of an SUB is less than the min. Negative number	D8042	Value of cold end temperature input
M8022	Set when "Carry" occurs during an ADD or when an overflow occurs as a result of a data shift operation	D8213	Switch between E type and K type thermocouple
M8029	The execution complete flag	D8200-D8211	AD0-AD11 magnification correction
M8039	Constant scan mode	D8220-D8231	AD0-AD11size correction
M8035	Forced operation mode	D8212、D8232	Cold end magnification correction/ size correction
M8037	Forced STOP signal	D8039/D39	Constant scan duration （a defaulted setting 0 msec will be initiated during power ON）； NOTE：if be used by analog, please use **D39** instead
M8068	Operation error latch	**B analog**	**See below table**
M8080	Start analog output	D8030-D8037	Values of AD0-AD7
M8235	C235 as a down counter	D8038	Value of cold end temperature input
M8236	C236 as a down counter	D8049	Switch between E type and K type thermocouple
M8238	C238 as a down counter	D8040-D8047	AD0-AD7 magnification correction
M8239	C239 as a down counter	D8070-D8077	AD0-AD7 size correction
M8240	C240 as a down counter	D8048、D8078	Cold end magnification correction/ size correction
		D8039	Constant scan duration （a defaulted setting 0 msec will be initiated during power ON）；
		EX2N-30A	**See below table（others refer to B type）**
C analog	**See below table**	D8034	Value of cold end temperature input
D8030-D8049	Values of AD0-AD19	D8045	Switch between E type and K type thermocouple
D8049(only when used as cold end)	Value of cold end temperature input	D8044、D8039	Cold end magnification correction/ size correction
		FX2NC	**See below table**
		D8030-D8033	Values of AD0-AD3
D8240	Switch between E type and K type thermocouple	D8034	Value of cold end temperature input

D8200-D8219	AD0-AD19 magnification correction	D8045	Switch between E type and K type thermocouple
D8220-D8239	AD0-AD19 size correction	D8040-D8043	AD0-AD3 magnification correction
D8212、D8232	Cold end magnification correction/ size correction	D8035-D8038	AD0-AD7 size correction
D8039/D39	Constant scan duration （ a defaulted setting 0 msec will be initiated during power ON）；NOTE：if be used by analog, please use **D39** instead	D8044、D8039	Cold end magnification correction/ size correction
D8050-69	Analog scan time adjust	D8039/D39	Constant scan duration （a defaulted setting 0 msec will be initiated during power ON）；NOTE：if be used by analog, please use **D39** instead
D8065	Syntax error		
D8068	Operation error step number latched		
D8080-D8087	Values of DA0-DA7		

When error occurs, the indicator light will be flashing. Error steps can be confirmed by monitoring M8065/D8065.

4. Usage of Analog

4.1 Analog input

A： 12 AI /8AO can be added to EX2N-40A/EX2N-50A/EX2N-70H/EX2N-100H/DX2NA/DX2NT;8AI/4AO to DCX2N-48M/CX2N-48M/DCX2N-64M/CX2N-64M/DCX2N-80M/CX2N-80M/CX2N-HM-48M/CX2N-HM-64M/ CX2N-HM-80M

B.8AI/4AO can be added to DX2NS/EX2N-40B, 4AI/2AO to EX2N-43H/EX2N-30A/DX2N/FX2NC, 2AD to DCX2N-24M/CX2N-24M/CX2N-HM-24M/DCX2N-32M/CX2N-32M/CX2N-HM-32M

C:16AI/8AO can be added to DCX2N-36M/CX2N-36M/CX2N-HM-36M. 20AI/4AO to DCX2N-68M/CX2N-68M/CX2N-HM-68M.

4.1.1 Analog input selection

Analog inputs which can be customized are as follows:

Input signals	Measurement range	Registers value read	Resolution	Accuracy (whole measuring range)	Registers D8213/D8049 /D8045
E-type thermocouple	Environmental temperature-599.9℃	Room temperature-5999	0.1℃	1%	0
K-type thermocouple (Regular)	Environmental temperature-999.9℃	Room temperature-9999	0.1℃	1%	1
K-type thermocouple (Special)	Environmental temperature-1300℃	Room temperature-12999	0.1℃	1%	1
J-type thermocouple	Environmental temperature-999.9℃	Room temperature-9999	0.1℃	1%	/
S-type thermocouple	Environmental temperature-1749.9℃	Room temperature-17499	0.1℃	1%	/
PT100	-99.9-499.9℃	-999-4999	0.1℃	1%	/
NTC10K	-19.9-109.9℃	-199-1099	0.1℃	1%	/
NTC50K	-40-199.9℃	-400-1999	0.1℃	1%	/
NTC100K	-40-299.9℃	-400-2999	0.1℃	1%	/
Voltage	0-10V	0-4000	2.5mV	1%	/
Current Type1	0-20mA	0-4000	5uA	1%	/
Current Type2	4-20mA	0-4000	4uA	1%	/

Diagram 1

The transmitter which is integrated inside PLC is one of the above table or mixed ones, it is up to customers.

- **Temperature Sensor**

Below are some suggestions according to our products:

1.Better to choose sensors suit for temperature with smaller measuring range. NTC 10K is more accurate than thermocouple. NTC50K should be used if the highest temperature should less than 200℃ while the testing temperature is about 100℃.

2. If there is a long distant from sensors to PLC,better to use other sensors than PT100. Generally the line-loss of NTC type is less.

3. Thermocouple is the last choice if there is a high request for temp accuracy.Customers should adjust it according to the actual demand.

- **Application of thermocouple**

To ensure measurement accuracy, there are cold end temperature sensor inside transmitters of E and K-type themocouple. Thus the tested temperature should not below the cold temperature. While using thermocouple, cold end processing has been done inside, the measurement is based on the cold end (room temperature), namely the lowest measurement temperature is same with the control box.

A series products can flexibly choose E-type or K-type thermocouple by setting D8213, defaulted as O, E type. While choosing K type, D8213=1 should be set.

While B series products choose K-type thermocouple, D8042=1 should be set. The cold end of 30A and FX2NC is D8034, cold side magnification correction is D8044, size correction is D8039. While K type selected, D8045=1 should be set.

While C series products choose EK, only 19AI can be made, the relevant cold end register is D8049.cold end amplification correction is D8219, size correction is D8239. While choosing K type, D8240=1 should be set.

When the sensor is power off, values of the register may exceed the Max measuring range. If E-type be choosen, AD0 will be power off and D8030 >6000

4.1.2 Analog Sampling

The sampling period of analog can be automatically set.D8050-D8069 act on D8030-D8049 separately. For example, AD0 sampling time=D8050* PLC scan time. If D8050=1, every time when a sample is taken , value of D8030 changes. The setting range is 1 to 32767. Value of D8050 is larger, the result is more stable.

4.1.3 Analog Reading

The Analog inputs accuracy of Coolmay PLC and All-in-one is 12. Read registers of every analog directly. Errors can be corrected. Cold end is the reference temperature of sensor, namely the environmental temperature, only used for EK.

A series analog registers and diagnostic registers refer to diagram 2 as below:

SN	Register value	Amplification Correction （units：milli）	Size Correction
AD0	D8030	D8200	D8220
AD1	D8031	D8201	D8221
AD2	D8032	D8202	D8222
AD3	D8033	D8203	D8223
AD4	D8034	D8204	D8224
AD5	D8035	D8205	D8225
AD6	D8036	D8206	D8226
AD7	D8037	D8207	D8227
AD8	D8038	D8208	D8228
AD9	D8039	D8209	D8229
AD10	D8040	D8210	D8230
AD11	D8041	D8211	D8231
Cold end	D8042	D8212	D8232
NOTE：D8042 is the cold end of thermocouple，K type set D8213=1			

Diagram 2

B type analog registers and diagnostic registers refer to diagram3 as below:(30A refer to Diagram 4)

SN	Register value	Amplification correction （units：milli）	Size correction
AD0	D8030	D8040	D8070
AD1	D8031	D8041	D8071
AD2	D8032	D8042	D8072
AD3	D8033	D8043	D8073
AD4	D8034	D8044	D8074
AD5	D8035	D8045	D8075
AD6	D8036	D8046	D8076
AD7	D8037	D8047	D8077
Cold end	D8038	D8048	D8078
NOTE：D8038 is the cold end of thermocouple，K type set D8049=1			

Diagram 3

*The cold end of **EX2N-30A is** D8034， K type set**D8045=1；** cold end amplification correction set as D8044, size correction as D8039. Please refer to diagram 4.

SN	Register value	Amplification correction （units：milli）	Size correction
AD0	D8030	D8040	D8070
AD1	D8031	D8041	D8071
AD2	D8032	D8042	D8072
AD3	D8033	D8043	D8073
Cold end	D8034	D8044	D8039
NOTE：D8034 is the cold end of thermocouple， K type set D8045=1			

Diagram 4

*the cold end of FX2NC is D8034, K type set D8045=1; cold end amplification correction set as D8044, size correction as D8039. Please refer to diagram 5.

SN	Register value	Amplification correction （units：milli）	Size correction
AD0	D8030	D8040	D8035
AD1	D8031	D8041	D8036
AD2	D8032	D8042	D8037
AD3	D8033	D8043	D8038
冷端	D8034	D8044	D8039
NOTE：D8034 is the cold end of thermocouple， K type set D8045=1			

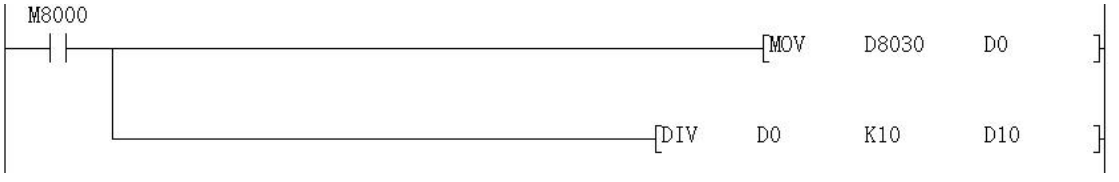
Diagram 5

C-type analog registers and diagnostic registers refer to diagram 6 as below:

SN	Register value	Amplification correction （units:milli）	Size correction
AD0	D8030	D8200	D8220
AD1	D8031	D8201	D8221
AD2	D8032	D8202	D8222
AD3	D8033	D8203	D8223
AD4	D8034	D8204	D8224
AD5	D8035	D8205	D8225
AD6	D8036	D8206	D8226
AD7	D8037	D8207	D8227
AD8	D8038	D8208	D8228
AD9	D8039	D8209	D8229
AD10	D8040	D8210	D8230
AD11	D8041	D8211	D8231
AD12	D8042	D8212	D8232
AD13	D8043	D8213	D8233
AD14	D8044	D8214	D8234
AD15	D8045	D8215	D8235
AD16	D8046	D8216	D8236
AD17	D8047	D8217	D8237
AD18	D8048	D8218	D8238
AD19	D8049	D8219	D8239
AD19 is cold end while used only as thermocouple	D8049	D8219	D8239
Note： D8049 is cold end while used only as thermocouple， K-type set D8240=1			

Diagram 6

Below is an real case of gathering the signal of AD0 of EX2N-70H



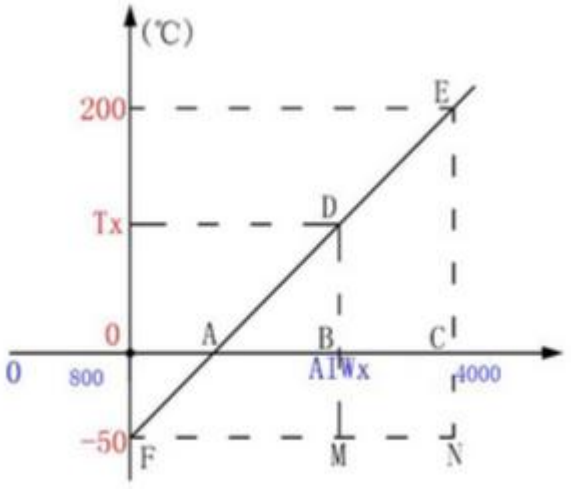
Connect the signal port of temperature sensor into AD0 of HMI/PLC All-in-on, another port connected with GND. While PLC is working, the data register D8030 send data to D0 and performing division operations to D0, then D10 is the actual temperature.In the ladder diagram, division operations can also be performed to D8030 directly.

Note: when the input signal is 0-10v, the actual analog value=register value/400

When the input signal is temperature, the actual analog value=register value/10

When the input signal is 0-20mA, the actual analog value=register value/200

When input signal is 4-20mA, taken an temperature transmitter as an example, if its testing range is -50℃～200℃, namely -50℃ corresponds to 4mA, 200℃ corresponds to 20mA. However setting 0-20mA as the analog input of 4AD analog module, when the signal given to the input port, 4AD can convert 0-20mA to digital 0-4000. The relationship between the tested temperature with the corresponding digital AIWO is as below:



The programming of Coolmay PLC is as below: operation program of temperature

$$\frac{BD}{CE}=\frac{AB}{AC}$$

$$\frac{MD}{NE}=\frac{FM}{FN}$$

$$\frac{Tx+50}{200+50}=\frac{AIWx-800}{4000-800}$$

$$Tx=\frac{(AIWx-800)\,250}{3200}-50$$

There are two ways for analog correction： size correction and amplification correction . Below is an example of correction after AD0 temperature gathering of diagram 1.

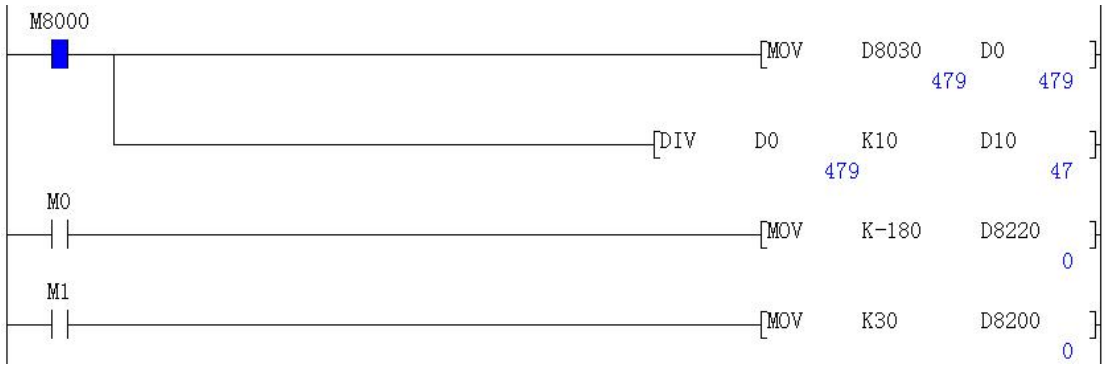


Diagram 2

If the present temperature is 29℃, the testing temperature is 47℃, the error is 18℃ , then the size correction register should be set as below diagram.

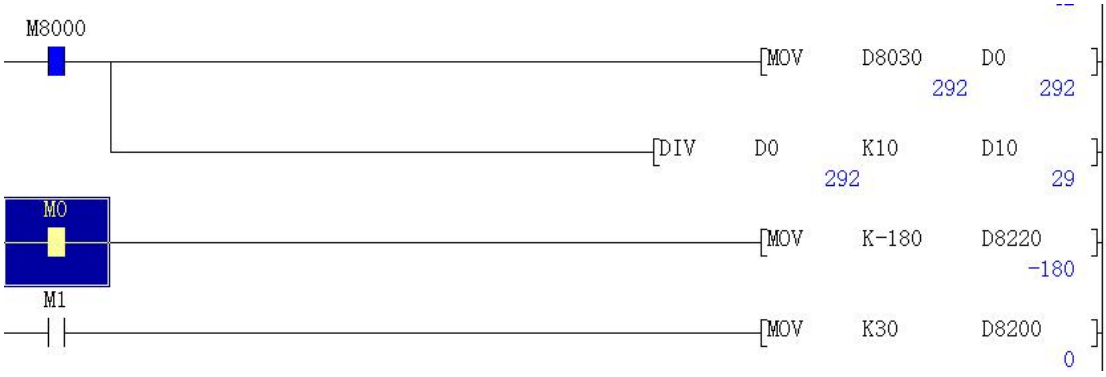


Diagram 3

When M0 is closed In diagram 3, transmit -180 to D8220, then the actual testing temperature is approaching the target 29℃

It can be set by amplification correction if the target temperature is very high. If M1 is closed, assign D8200, this is amplification correction. Normally only if size correction is right, there is no need to set magnification correction.

The relationship between the two corrections is as below:

If D8030 should be decreased to 990‰, D8200 should be set as -10.

If D8030 should increase 5 values, D8220 should be set as 5.

4.2 Analog output

Assign D8080-8087 directly can realize the analog output of Coolmay PLC. DA0-DA7 are AO ports, GND is the public port. 0-10V, 0-5V, 0-20mA is optional. The output accuracy is 10bit, 0-10V/0-5V/0-20mA correspond to 0-1000.

Range of analog output registers and output voltage(current)

	AO Register	Range	Output voltage/current	Resolution	Start contact
DA0	D8080	0-1000	0-10V/0-20mA	10mV/0.02mA	M8080 be driven ON
DA1	D8081	0-1000	0-10V/0-20mA	10mV/0.02mA	
DA2	D8082	0-1000	0-10V/0-20mA	10mV/0.02mA	
DA3	D8083	0-1000	0-10V/0-20mA	10mV/0.02mA	
DA4	D8084	0-1000	0-10V/0-20mA	10mV/0.02mA	M8084 be driven ON
DA5	D8085	0-1000	0-10V/0-20mA	10mV/0.02mA	
DA6	D8086	0-1000	0-10V/0-20mA	10mV/0.02mA	
DA7	D8087	0-1000	0-10V/0-20mA	10mV/0.02mA	

Diagram 4

- M8080 is the start contact of DA0-DA3, there are output signal only when M8080 driven ON.
- M8084 is the start contact of DA4-DA7, there are output signal only when M8084 driven ON.

Below is an example of analog output 0-10V :

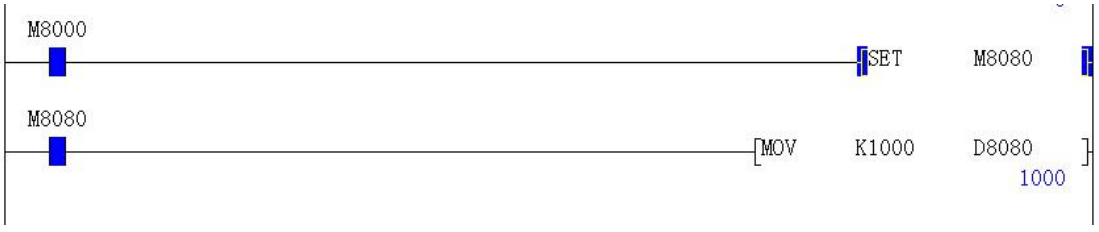


Diagram 5

Driven D8080 ON and then assign it with 1000, the red pen of multimeter connected with DA0, and the black pen connected with GND, then there is 10v signal output.

4.3 Analog interference processing

In case of analog interference, 104 ceramic capacitor can be connected with the input/output ports. One port of 104 ceramic capacitor connected with the positive electrode of analog inputs, the other port connected with ground.

5. The Application of High-speed Counting

5.1 Assignment table of built-in high speed counter

	Single phase						AB phase			ABZ phase		
	C235 10KHz/ 100KHz	**C236** 100KHz	**C238** 10KHz/ 100KHz	**C239** 100KHz	**C240** 10KHz	**C237** 10KHz	**C251** 10KHz/ 100KHz	**C253** 10KHz/ 100KHz	**C254** 10KHz	**C252** 10KHz/ 100KHz	**C253** 10KHz/ 100KHz	**C254** 10KHz
X000	U/D						A			A		
X001		U/D					B			B		
X002										Z		
X003			U/D					A			A	
X004				U/D				B			B	
X005					U/D			R			Z	
X007						U/D						
X010									A			A
X011									B			B
X012												Z

Normal[U]:up counter [D]:down counter [A]: A phase counter [B]: B phase counter [R]: reset

	Single phase counter input					
	C235 10KHz/100KHz	**C236** 100KHz	**C238** 10KHz/100KHz	**C239** 10KHz	**C240** 10KHz	**C237** 10KHz
M8235	Down counter while driving; Up counter without driving					
M8236		Down counter while driving; Up counter without driving				
M8238			Down counter while driving; Up counter without driving			
M8239				Down counter while driving; Up counter		

				without driving		
M8237					Down counter while driving; Up counter without driving	
						Down counter while driving; Up counter without driving

- The max frequency of single phase is 10K, X0/X1/X3/X4 of A type products can be customized to 100KHz if special required. X0/X1 of EX2N-30B/EX2N-40B/FX2NC can be customized to 100KHz.
- Single phase 10KHz is X00/X03 regularly, corresponding to C235/238. At most 6 single phase counters can be added, corresponding to C235-X0；C236-X1；C237-X7；C238-X3；C239-X4；C240-X5；C237 should be connected with X2, now be changed to X7. X0/X1/X3/X4 can be customized to 100KHz, X5/X7 can be customized to 10KHZ
- While 6 single phase counters be used together, there is no conflicts with other counters and pulses, but conflict with ZRN, ZRN will be useless. Only when X3 isn’t used, ZRN of Y7/X7 is useful.
- AB 10KHz regularly is X00-X01/X03-X04, corresponding to C254. X00-X01/X03-X04 can be customized to 100KHz, X10-X11 can be customized to 10KHz.

5.2 Wiring of High-speed Counting AB(Z)

- AB rotary encoder count function added, wiring of C251 is: A connected with X0, B with X1, Z not connected, C251 for PLC ladder diagram.
- AB(Z) rotary encoder count function added, wiring of C252 is: A connected with X0, B with X1, Z with X2, C252 for PLC ladder diagram.
- AB(Z) rotary encoder count function added, wiring of C253 is: A connected with X3, B with X4, Z with X5, C253 for PLC ladder diagram.
- AB(Z) rotary encoder count function added, wiring of C254 is: A connected with X10, B with X11, Z with X12, C254 for PLC ladder diagram.

Note: Normally there are only single phase and AB phase, Z phase is optional and can be customized according to customers.

6. Application of Four/Five High-speed Pulses

Output signals of four or five high-speed pulses simultaneously can be customized in Coolmay PLC according to customers. Pulse instructions and location instructions are supported, and can be used together without conflict. Y with the same SN can be repeatedly used for easily programming.

6.1 Pulse Output Points and Directions

- Y0 sending pulse, Y2 control direction
- Y1 sending pulse, Y3 control direction
- Y6 sending pulse, Y4 control direction
- Y7 sending pulse, Y5 control direction
- Y10 sending pulse, Y11 control direction

Direction controlling can be defined, regularly as stated above.

6.2 Special Devices Used by Pulse Instructions

Special devices used by PLSY、PLSR are as below table:

	Y0	Y1	Y6	Y7	Y10
Send end flag	M8029	M8029	M8029	M8029	M8029
No. of pulse （32bit）	D8140 D8141	D8142 D8143	D8150 D8151	D8152 D8153	D8154 D8155

Special device used by DRVI、DRVA 、ZRN、PLSV are as below table:

	Y0	Y1	Y6	Y7	Y10
Send end flag	M8029	M8029	M8029	M8029	M8029
Current location	D8140 D8141	D8142 D8143	D8150 D8151	D8152 D8153	D8154 D8155
ACC/DEC time during execution	D8148	D8148	D8148	D8148	D8148
Pulse stop bit	M8145	M8146	M8155	M8156	M8159
Pulse busy flag	M8147	M8148	M8157	M8158	M8161

- Regularly Y0,Y1,Y6,Y7 can send 20K pulse, and can also be customized to 100-200K.

- Please note that while changed to 100K-200K, the current load of pulse output port is very small and can only be used to send pulse, digital output not suitable.

- If pulses should be more exact, please connect COM ports of pulse output and input. Besides ,please connect COM port of pulse output with DC24V power supply's 0V of step driver.

- Please note that 2N instructions don't support location, whiling using them, please program it well with 1N instructions and then copy it to the program of 2N.

- The input signal of ZRN is fixed as X2、X5、X6、X7、X12, corresponding to Y0、Y1、Y6、Y7、Y10 of pulse output.

- At most 5 200K high-speed pulse outputs can be customized for 40A/50A/70H/100H/DX2NA/DX2NT, if 5 channels be made, analog output function will be useless.

- When 100k-200k pulse be customized, the frequency is among 20K-60K. Duty ratio inaccurate may result in phenomena such as high noise of motors、pulses inaccurate. Thus, M8149 should be driven ON

7. Limitations of counters and pulses

Coolmay products can be divided into 2 groups according to the limitations of counters and pulses.

ARTICAL	A	B
SERIES	EX2N-40A	EX2N-30A
	EX2N-50A	
	EX2N-70H	EX2N-43H
	EX2N-100H	DX2N/DX2NS
	DX2NA	FX2NC
	DX2NT-68MR/MT/MRT	CX2N-32M
	CX2N-48/64/68/80M	DCX2N-32M
	DCX2N-48/64/68/80M	CX2N-HM-32M
	CX2N-HM-48/64/68/80M	

Note: 5 pulses can be added in A type products while 4 pulses can be added in B type products.

7.1 Counter Limitations

Limitations of B type products

- Y6 can not be used when C235(X0)、C251（AB　X0/X1) be used.
- Y6 and ZRN instruction can not be used when C238（X3）、C253（AB X3/X4）be used

7.2 Pulses Limitations

Limitations of A type products

1、limitations of **4** pulses

- Y6 used for pulse output, X0 can not be used for counter input.
- Y7 used for pulse output, X3 can not be used for counter input.

2、Limitations of **5** pulses

- Y6 used for pulse output, X0 can not be used for counter input.
- Y7 used for pulse output, X3 can not be used for counter input.
- 5 200k pulses be added, the analog output function will be useless.

Please note that B type products(at most 4 pulses can be added) have the following Limitations:

- Y0 used for pulse output，DA0-DA3 can not be used.
- Y7 used for pulse output, X3 can not be used for counter input.
- Y6 used for pulse output or X0 used for counter input, DA4-DA7 will be useless.

8. Application of Analog Extension Module

If the I/O points of one PLC isn’t enough, another PLC can be connected and be used as I/O extension module. Below is an example of 80 I/O system which is combined by two DX2N-40MR/MT.

Steps as below:

1. Main PLC: CX2N-48MT Extension:CX2N-48MR

2、Wiring method ：

Main plc	A		A	Extension
RS485	B		B	RS485

9. Network

Control systems with large scale can be constructed by RS485 communicating of multiple PLCs. Detailed information refer to 《COOLMAY PLC MODBUS Seriel Communication User Manual》.

Appendix 1： COOLMAY PLC MODBUS Seriel Communication User Manual

1. Overview

Modbus Seriel Communication as a standard Industrial communication protocol has been wide -ly used in each area. RS485 ports of Coolmay PLC support this protocol so that coolmay PLC ca n communicate with devices which also support MODBUS, such as transducer, temperature and humidity module, configure network, sensors and so on.

There are two serial communication modes:ASCII and RTU. While setting PLC, users should set communication mode and parameters of RS485. Equipments used in the same MODBUS line should have the same communication mode and parameters. Special devices of every PLC must be set in ladder diagram while Modbus communication be used.

Registers of D8120 parameters

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0

b0	Data length 0:7bit 1:8bit
b2b1	Parity 00:None 01:Odd 11:Even
b3	Stop bit 0:1bit 1:2bit
b7b6b5b4	Baud Rate 0100:600bps 0111:4800bps 0101:1200bps 1000:9600bps 0110:2400bps 1001:19200bps
b8	Irrelevance with Modbus
b9	Irrelevance with Modbus
b11b10	Irrelevance with Modbus
b12	Irrelevance with Modbus
b13	Communication Mode 0:RTU 1:ASCII
b14	Start communication protocol 0: programming port protocol or RS command 1: MODBUS Serial
b15	Slave or Master selection 0: Slave 1:Master

Register of slave D8121： Range 1-247

When PLC is a slave, there must be a station number setting for D8121

Delay register before D8126 be send. Range 0-1000， units:ms

Leave 5-20ms for receiving devices to prepare

2.PLC worked as a master

When PLC worked as a master, only the following functions of MODBUS be supported

03: Read the holding register, get the current binary value from the holding registers, valid range:1-32

06: Write the binary value into a holding register, valid range:1-32

16: Preset multiply registers, write specific binary value to a sequence of holding register, valid range: 1-32.

Example of reading slave data: RD3A K1 H0 D0

RD3A originally is analog module read instruction, the original instruction can not be used. RD3A correspond to 03 function of MODBUS, read(4x) register. K1 means the station number of the slave which is read, valid range:1-247;H0 means the address NO. 0000(hexadecimal)of data being read from slave. Value of D0 represents the NO. of registers being read, valid range1-32， data being read successively stored in D1,D2,D3.....

Example of writing data to slave ： WR3A K1 H0 D0

WR3A originally is analog module write instruction, the original instruction can not be used. WR3A correspond to 16 function of MODBUS, write data to each register(4x) of slave devices. K1 means the station number of the slave which is be write, valid range:1-247;H0 represents the starting address NO. 0000(hexadecimal) in slave devices of register which is been written. value of D0 represents the NO. of registers being write, valid range1-32, data being read successively stored in D1,D2,D3.....

D8129（M8129）timeout register： Valid Range 0-32767，units:10ms

When reception is overtime or has errors，M8129=ON。

M8123 A complete communication flag

When a communication completed, M8123=ON, regardless of whether successful or not.

When RD3A or WR3A not be executed, there is no effect to M8129 and M8123. When executed, if in the process of communication, M8129 and M8123 will be driven OFF automatically. If the communication completed, M8129 and M8123 will send out the relevant state.

Multi-Time Programmable

RD3A or WR3A is multi-time programmable. Since communication is a long term process, it should be maintained executive and can not be in pulse form. When there are several instructions being communication, signals will be distribute in turns automatically. The delay of M8123 can easily find out the executive condition of this communication.

D8063（M8063）Serial Communication Error

The delay of M8123 can easily check out the wrong information of this communication.

Values of D8063 represent the error information separately

6315: The selected MODBUS Device Address exceeds the supported range of this slave >255

6316：Registers number exceeds the supported range, regularly 1-32.

6317：Receive Timeout

6318：Responding Station Mismatch

6319：Illegal Response Command

6320：LCR error

6321：Invalid Device Address

6322：CRC error

6323：Data format illegal

6324：Not Set As Master

6325：Address Over Range

6326：Send Timeout

3.PLC worked as a slave

Once be set as slave, it can communicate through MODBUS no matter in the state of STOP or RUN

Modbus functions supported by slave

01: Read Coils, get the current state of logic coils (ON/OFF), valid range:1-512

02: Read input states, get the current state pf inputs (ON/OFF), valid range:1-512

03: Read Holding Registers, read binary from holding registers, valid range:1-32

04: read binary from one or mutiply input registers, valid range:1-32

05: write single coil, write the state of logic coils, valid range: 1

06: Write specific binary value to a register, valid range:1

15: write multiply coils,write on-off of a sequence of logic coils, valid range:1-512

16: write multiply registers, write specific binary value into a sequence of holding registers,valid range:1-32

Addresses corresponded to registers

Hexadecimal Number Addresses	Registers
0000-01FF	D0-D511
1F40-203F	D8000-D8255
A140-A23F	T0-T255
A340-A407	C0-C199
A408-A477	C200-C255，32bit occupy two address

Addresses corresponded to bit units

Hexadecimal number address	Bit units
0000-05FF	M0-M1535
1E00-1EFF	M8000-M8255
2000-23E7	S0-S999
3000-30FF	T0-T255
3200-32FF	C0-C255
3300-33B7	Y0-Y267
3400-34B7	X0-X267

Note: when PLC communicate with kingview as a slave, addresses corresponded to registers and bit units should move backward for one bit. For example, while D0 corresponds to 40000, Kingview corresponds to 40001.while Y0 corresponds to 13056, kingview corresponds to 13057,M0 corresponds to 00000,kingview corresponds to 00001. If registers correspond to floating-point number, the address which kingview corresponds to should move backward for 2 bits. For example, D0 corresponds to 40000, kingview corresponds to 400002.