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DVP02TK-S / DVP02TU-S

Temperature Control Module Manual

Revision History

Version	Revision	Date
1 st	The first version was published.	2016/11/30
2 nd	The second version was published.	2017-12-06
3 rd	1.Updated specifications. 2.Update device information in chapter 2.	2019/02/20
4 th	1.Update the information in chapter 1: Add Ni200 to thermal resistance; add -100~+100mV to voltage input; add information of microvolt input to A/D function specification; add quick AI information to analog sampling time; update wiring diagrams; update description of DVP02TK-S dimension. 2.Update information concerning CR#8/CR#9/CR#10/CR#11~#42 in chapter 2.1.3. 3.Update information concerning CR#11/CR#23/CR#24 in chapter 2.1.4. 4.Update information concerning CR#13/CR#27~CR#35 in chapter 2.1.5 and add information of CR#26/CR#36/CR#37. 5.Update information concerning CR#13/CR#26 and add information of CR#27~CR#29 in chapter 2.1.6. 6.Add chapter 2.1.11 Automatic PID Calculation Setup page. 7.Add chapter 2.2 Examples of Setting a Control Register. 8.Update the information in chapter 2.3: Add mode28 and 29 to Current /Voltage; add mode27 to Nickel thermal resistance. 9.Add content of PID Tuning Guide in chapter 2.6. 10.Add chapter 2.9 Automatic PID Calculation Feature.	2021/04/28
5 th	1.Correct the wrong wording in chapter 2.	2023/4/25

DVP02TK-S / DVP02TU-S

Temperature Control Module Manual

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Chapter 1 Introduction

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Thank you for using Delta DVP02TK-S/DVP02TU-S Temperature Control Module. To ensure a successful installation and for safety reasons, please read this manual carefully before operating.

- ✓ This manual contains important safety instructions.

Cette notice contient des instructions importantes concernant la sécurité.

- ✓ Disconnect all sources of supply before servicing.

Couper toutes les sources d'alimentation avant de faire l'entretien et les réparations.

- ✓ For use in a controlled environment. Refer to manual for environmental conditions.

Pour utilisation en atmosphère contrôlée. Consulter la notice technique.

- ✓ Warning: proper ventilation is required to reduce the risk of hazardous or explosive gas buildup during indoor charging.

Avertissement : une ventilation adéquate est nécessaire afin de réduire les risques d'accumulation de gaz dangereux ou explosifs durant la recharge à l'intérieur.

- ✓ The analog input circuits shall not be connected to MAINS CIRCUIT for measuring or sensing and limited to SELV circuit only.

- ✓ The supply voltage and transistor (analog) outputs are SELV circuit and limited energy.

- ✓ This is an OPEN TYPE module and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for operating the enclosure) in case danger and damage on the device may occur. Do not touch any terminal when the power is on.

- ✓ This manual provides you with the introductions on the specifications, installation, basic operations, setups and temperature measurements.

- ✓ Read this manual carefully and follow the instructions to avoid danger and damage to people and property.

- ✓ DVP02TK-S series includes DVP02TKR-S, DVP02TKN-S and DVP02TKL-S. DVP02TU-S series includes DVP02TUR-S, DVP02TUN-S and DVP02TUL-S.

1.1 Specification

DVP02TK-S/DVP02TU-S		
Supply voltage		24VDC
Max. rated power consumption		2.4W, supplied by external power source in compliance with UL61010-2-201 \ IEC61131-2
Connector Type		European standard removable terminal block (Pin pitch: 3.5mm)
Operation/storage temperature		Operation: 0°C ~ 55°C (temperature), 5 ~ 95% (humidity), Pollution degree: 2 Storage: -25°C ~ 70°C (temperature), 5 ~ 95% (humidity), Attitude: up to 2000m; For use in dry location only
Vibration/Shock resistance		International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc) / IEC 61131-2 & IEC 68-2-27 (TEST Ea)
Connection to DVP-PLC		The modules are numbered from 0 to 7 automatically by their distance from DVP-PLC. Max. 8 modules are allowed to connect to DVP-PLC and will not occupy any digital I/O points.
I/O points		2 points of universals analog inputs (CH1, CH2), 2 analog outputs (OUT1, OUT2) or 4 digital outputs (OUT1~OUT4)
General Analog Input		
Input	CH1, CH2	Thermal resistance: Pt100, JPt100, Pt1000, Ni100, Ni120, Ni1000, Cu50, Cu100, LG-Ni1000 Thermocouple : J, K, R, S, T, E, N, B, U, L, TXK (L), C, PL II Voltage input: 0~+50mV, 100~+100mV, 0~+5V, 0~+10V Current input: 0mA~+20mA, 4~+20 mA
Hardware Resolution		16 bits
Distance		100 meters
Input disconnection detection		Supported by exceeded temperature input range
Analog / Digital Output		
Analog	OUT1~ OUT2	Analog output, 12-bit: 0~+10V, 0/4~+20mA
Digital	OUT1~ OUT4	4 channels digital output, 250VAC, 60Hz/24VDC, 2A, Relay 4 channels digital output, Voltage pulse output, 24VDC, 300mA

● A/D Function Specification

Analog / Digital	Voltage Input	
Maximum rated input	0V~10V	0V~5V
Overall accuracy (normal temperature)	±0.5%	
Overall accuracy (full temperature range)	±1%	
Hardware resolution	16 bits	
Input impedance	650KΩ	

1

Analog / Digital	Microvolt Input	
Maximum rated input	0mV ~+50mV	-100mV ~+100mV
Overall accuracy (normal temperature)	$\pm 0.5\%$	
Overall accuracy (full temperature range)	$\pm 1\%$	
Hardware resolution	16 bits	
Input impedance	650K Ω	

Analog / Digital	Current Input	
Maximum rated input	0mA~20mA	4mA~20mA
Overall accuracy (normal temperature)	$\pm 0.5\%$	
Overall accuracy (full temperature range)	$\pm 1\%$	
Hardware resolution	16 bits	
Input impedance	249 Ω	

Analog / Digital	Temperature Input	
Maximum rated input	Thermocouple	Thermistor
Overall accuracy (normal temperature)	$\pm 0.4\%$	
Overall accuracy (full temperature range)	$\pm 0.8\%$	
Hardware resolution	24 bits	
Input impedance	2M Ω	

● Analog sampling time (by channel)

Analog input type	AI	Thermocouple	Thermistor	Quick AI (0~10V)*2	Quick AI (4~20Ma)
Setting time (ms)	80	80	160	3	3
Conversion time (ms)	50	50	100	2	2
Response time (ms)	130	130	260	5	5

Response time = setting time + conversion time

*1. Compared to the response time of the thermocouple temperature, it needs two times of time for the thermistor temperature to respond, since the thermistor channels require a temperature compensation.

*2. Since there is only one channel used, the time to stabilize the circuit is not required.

- DVP02TKL-S/DVP02TUL-S D/A Function Specification

Analog / Digital	Voltage Output	
Maximum rated input	0V~10V	
Overall accuracy (normal temperature)	$\pm 0.5\%$	
Overall accuracy (full temperature range)	$\pm 1\%$	
Hardware resolution	12 bits	
Allowable load impedance	1k Ω ~ 2M Ω at 0V~10V	
Analog / Digital	Current Output	
Maximum rated output	0mA~20mA	4mA~20mA
Overall accuracy (normal temperature)	$\pm 0.5\%$	
Overall accuracy (full temperature range) (average number of 100 times)	$\pm 1\%$	
Hardware resolution	12 bits	
Allowable load impedance	$\leq 550\Omega$	

- Analog setup time (by channel)

Analog output type	Voltage	Current
Setting time (μs)	100	250
Conversion time (μs)	500	500
Response time (μs)	600	750

Response time = setting time + conversion time

1

DVP02TKR-S/DVP02TUR-S/DVP02TKN-S/DVP02TUN-S DO Function Specification

Model		DVP02TKR-S DVP02TUR-S	DVP02TKN-S DVP02TUN-S
Item			
Output points		4	4
Connector Type		Removable terminal block	
Output point type		Relay-R	Transistor-T (NPN)
Voltage specification		Below 250VAC, 30VDC	12~30VDC
Maximum load	Resistive	2A/1point (3A/COM) *1	0.3A/1 point (0.6A/COM) *1
	Inductive	Life curves*2, 4	7.2W (24VDC) *3
Maximum output frequency	Resistive	1Hz	100Hz
	Inductive	0.5Hz	0.5Hz
	Lamp	1Hz	10Hz
Maximum response time	OFF→ON	10ms	0.5ms
	ON→OFF		

*1. Complied with UL61010-2-201 & IEC61131-2 (AC or DC resistance)

*2. Complied with UL61010-2-201 & IEC61131-2 (AC/DC general-use or AC pilot duty)

Rated making capacity: 7.5A; rated breaking capacity: 0.75A; 2.5A thermal continuous at 240VAC

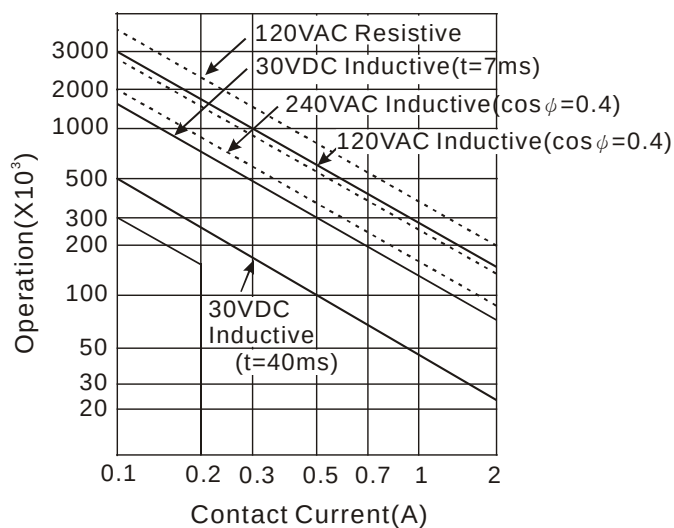
DC pilot duty; rated making capacity: 0.22A; rated breaking capacity: 0.22A; 1A thermal continuous at 30VDC

*3. Complied with IEC/UL61010-2-201 (DC general-use)

*4. Life curves

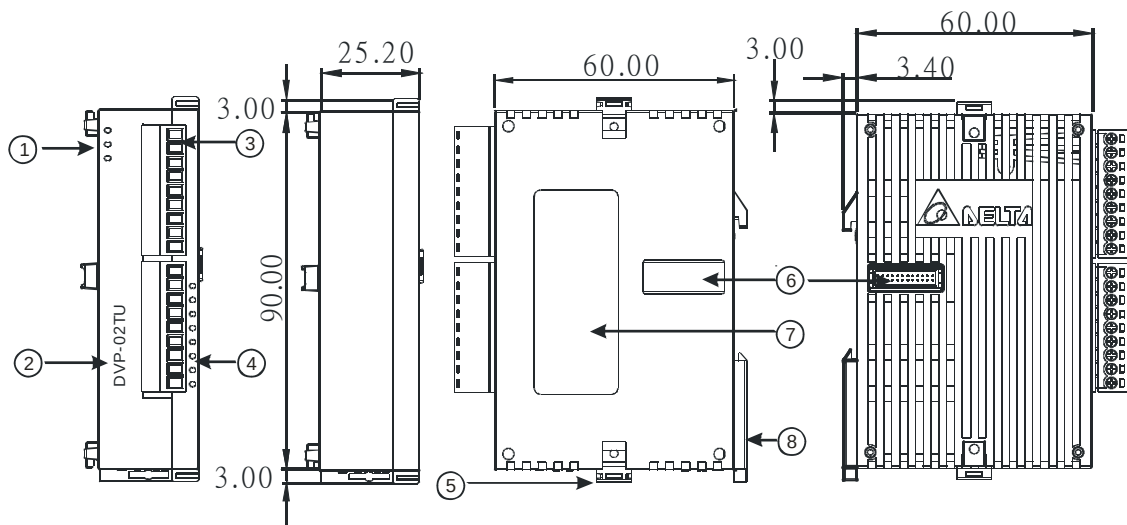
Disconnect power before servicing to avoid the risk of electric shock.

Utilisez relay est sous tension. Risque de choc électrique, couper le courant avant l'entretien.



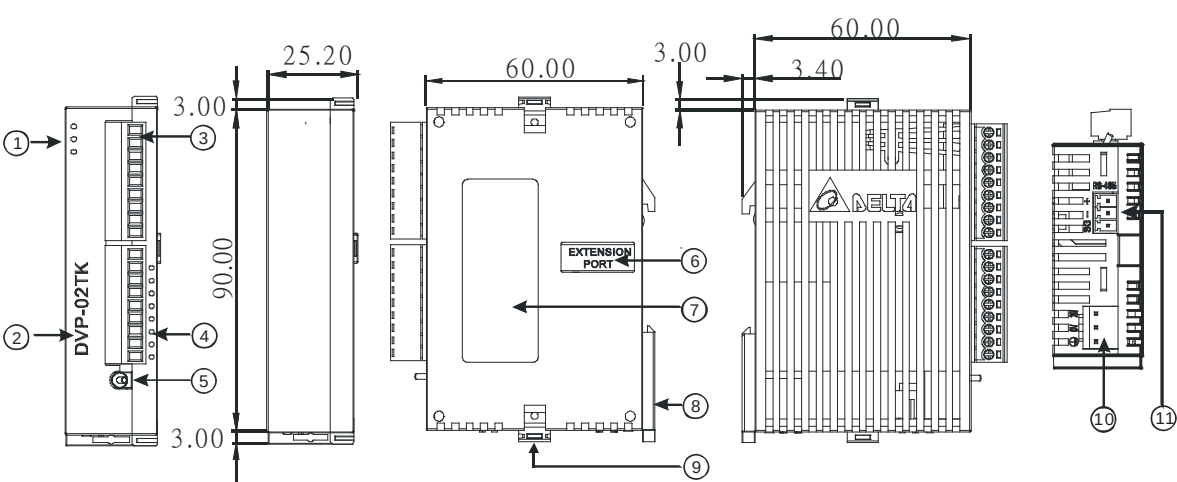
1.2 Dimensions (mm)

1.2.1 DVP02TU-S



Description	
1	Run/Error indicator
2	Model name
3	Removable terminal block
4	I/O terminal layout
5	I/O module clip
6	I/O module connection port
7	Label
8	DIN rail clip

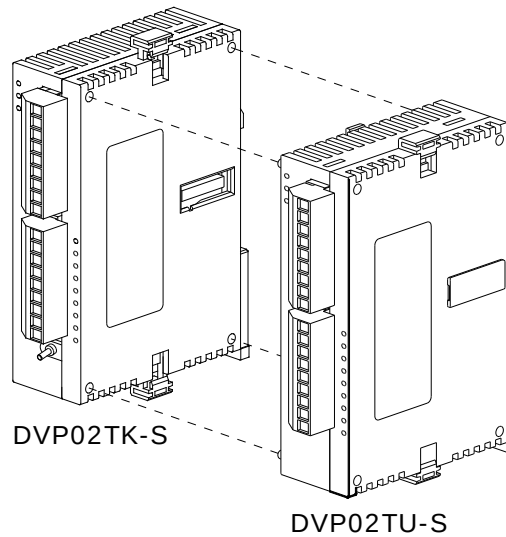
1.2.2 DVP02TK-S



Description	
1	Run/Error indicator
2	Model name
3	Removable terminal block
4	I/O terminal layout
5	Run/Stop switch
6	I/O module extension port
7	Label
8	DIN rail clip
9	I/O module clip
10	Power connection port
11	RS-485 communication port

1.3 Installation

Users can connect DVP02TU-S series modules to the right side of the DVP02TK-S series modules as the image shown below. Up to DVP02TU-S can be connected.



1.4 Terminal arrangement

DVP02TKR-S/DVP02TKN-S DVP02TUR-S/DVP02TUN-S	DVP02TKL-S/DVP02TUL-S

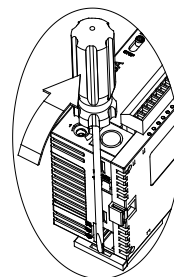
Warning: DO NOT connect wires to the terminals with No Connection (marked by a dot symbol).

● Mounting Arrangements and Wiring Notes

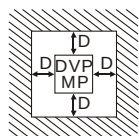
1

How to install DIN rail

DVP-PLC can be secured to a cabinet by using the DIN rail of 35mm in height and 7.5mm in depth. When mounting PLC to DIN rail, be sure to use the end bracket to stop any side-to-side movement of PLC and reduce the chance of wires being loosen. A small retaining clip is at the bottom of PLC. To secure PLC to DIN rail, place the clip onto the rail and gently push it up. To remove it, pull the retaining clip down and gently remove PLC from DIN rail, as shown in the figure.



Please install PLC in an enclosure with sufficient space around it to allow heat dissipation as shown in the figure.

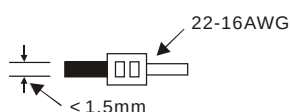


$D > 50 \text{ mm}$

Warning: shock hazard. Only for mounting in a rack or enclosure fully enclosing all live parts.

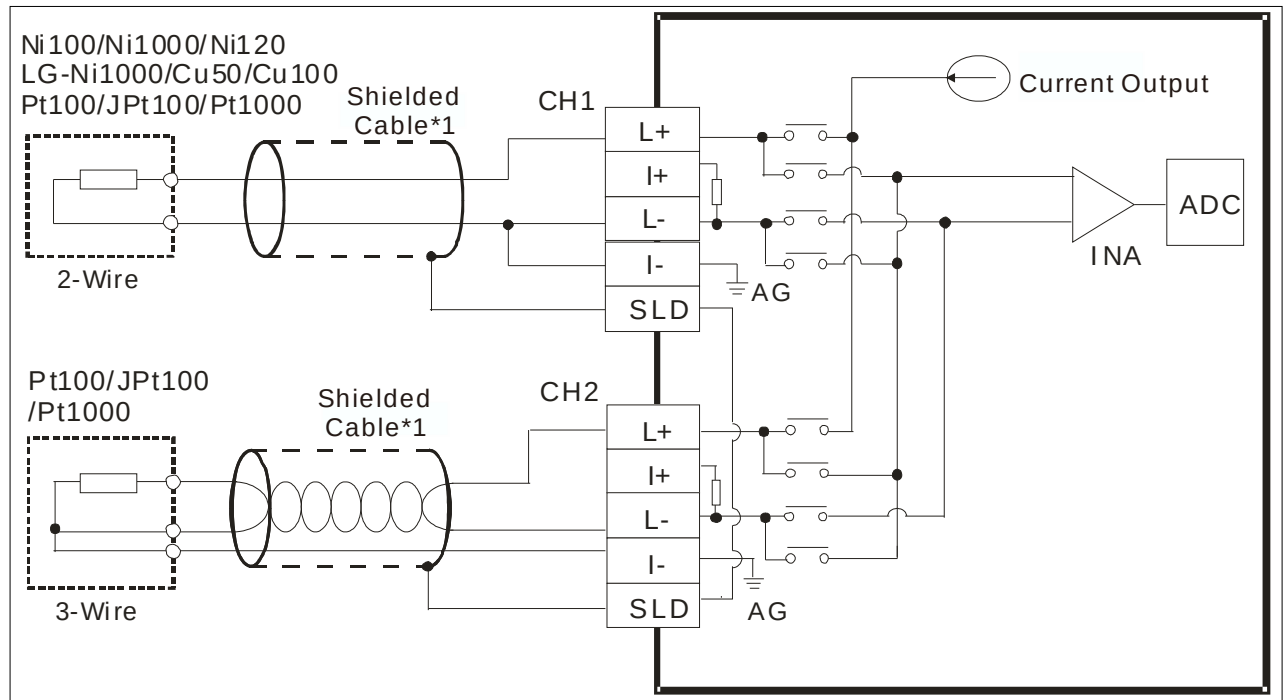
Avertissement : risque d'électrocution. Ne doit être installé que dans un bâti ou un boîtier recouvrant entièrement toutes les pièces sous tension.

1.5 Wiring Diagram

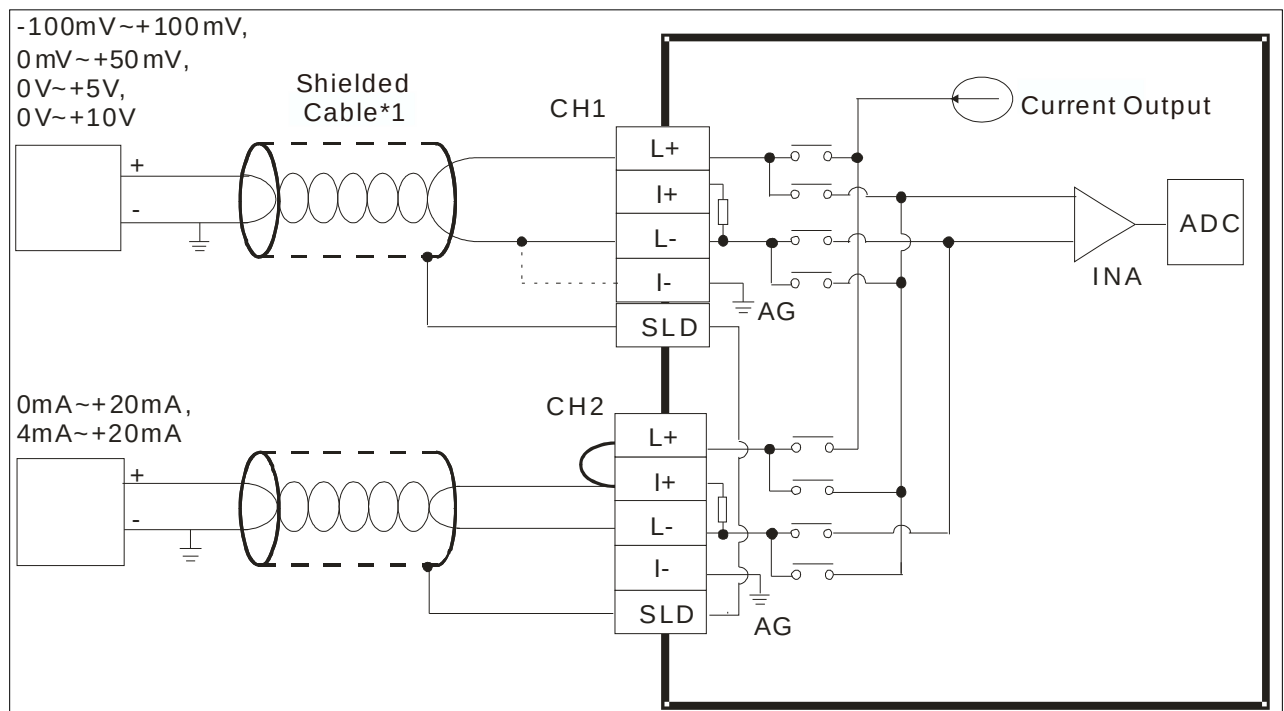


1. Use 22-16AWG (1.5mm) single or multiple core wire on I/O wiring terminals. The specification of the terminal is shown in the figure above. The PLC terminal screws shall be tightened to 1.95 kg-cm (1.7 in-lbs).
2. DO NOT place the I/O signal wires and power supply wire in the same wiring duct.
3. Warning: use conductors with insulation rated for at least 75 °c
Avertissement : employer des conducteurs pour au moins 75 °c.
4. For use with copper conductors only (excluding thermocouples).
destiné à être utilisé avec des conducteurs en cuivre seulement (sauf thermocouples).

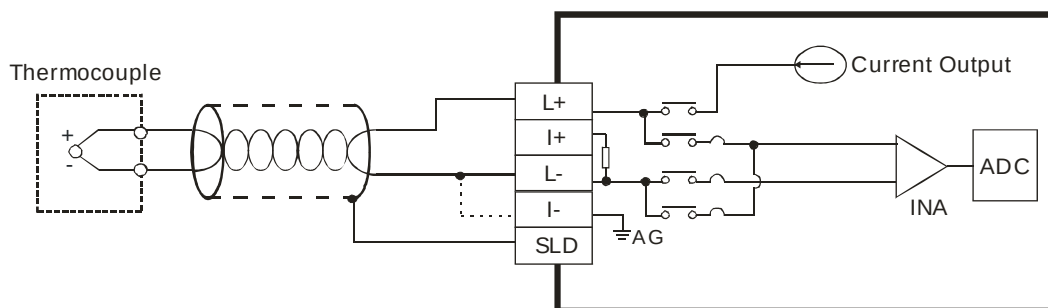
● Sensor input wiring



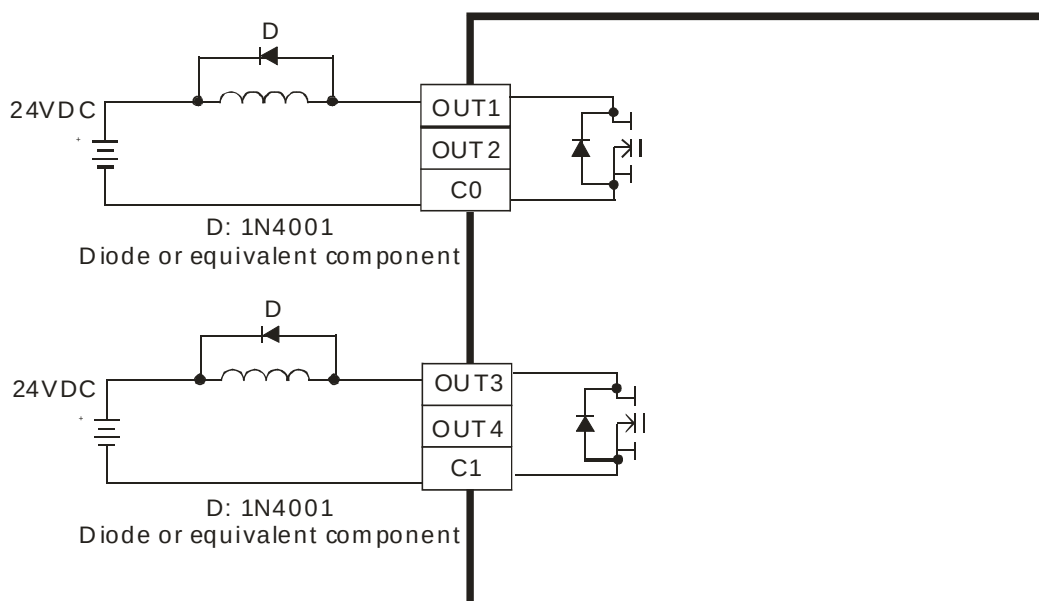
● Voltage/Current input wiring



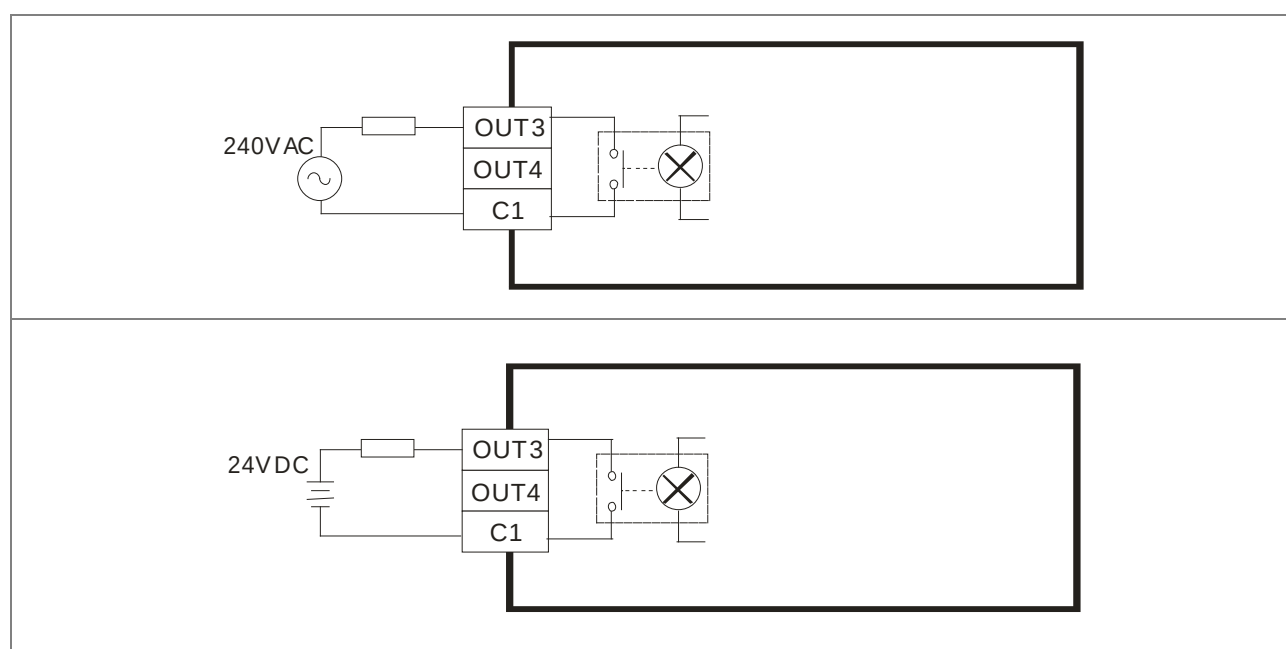
1 Thermocouple input wiring



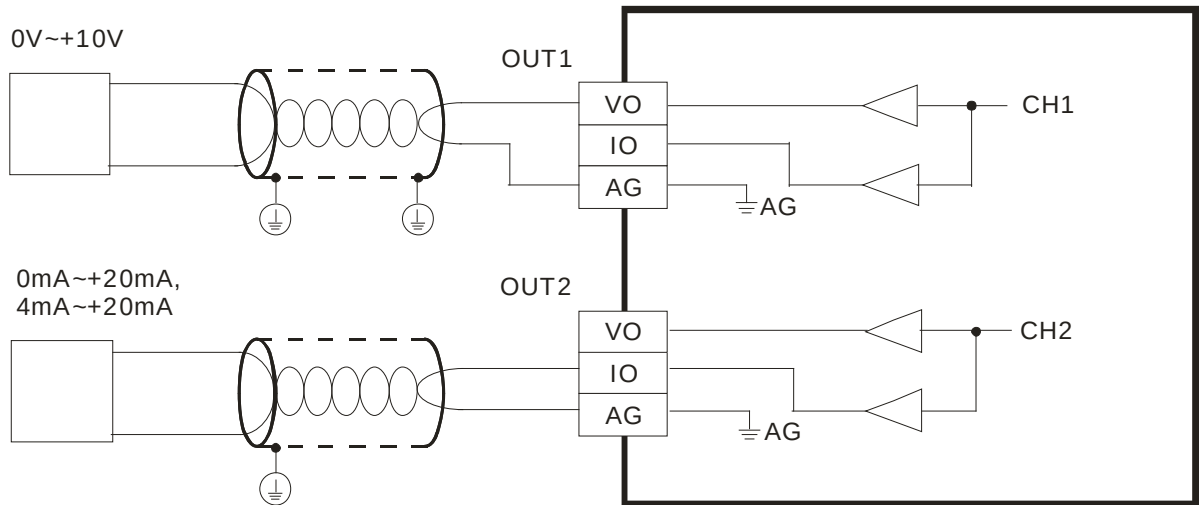
DVP02TKN-S/DVP02TUN-S Output point wiring



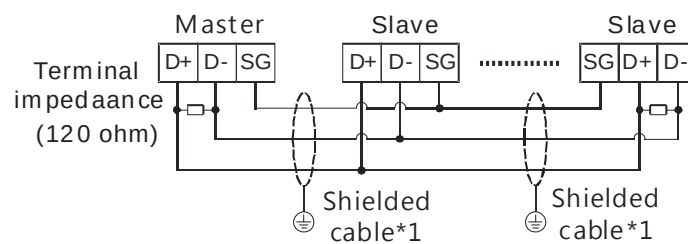
DVP02TKR-S/DVP02TUR-S Output point wiring



● DVP02TKL-S/DVP02TUL-S Output point wiring



● RS-485 Wiring



1.6 LED Indicator Description

LED Indicator	LED Color	Description
POWER	Green	Power status
A/D	Green	Operating status
ERROR	Red	Error display
OUT1~OUT4	Red	Output status

1.7 RS-485 Communication for DVP02TK-S Series

Data Transmission Speed	9,600; 19,200; 38,400; 57,600; 115,200bps		
Communication Format	Stop bit: 1, 2	Parity bit: None, Odd, Even	Data bit: 7, 8
Communication Protocol	MODBUS ASCII/RTU		

MEMO

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Chapter 2 Control Register

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2.1 Control Registers

2.1.1 MODBUS Address List for DVP02TK-S Series

TK MODBUS Address	Description
H0000	TK series, CR#0: starting address
H1000	The 1 st module on the right side of TK series, CR#0: starting address
H2000	The 2 nd module on the right side of TK series, CR#0: starting address
H3000	The 3 rd module on the right side of TK series, CR#0: starting address
H4000	The 4 th module on the right side of TK series, CR#0: starting address
H5000	The 5 th module on the right side of TK series, CR#0: starting address
H6000	The 6 th module on the right side of TK series, CR#0: starting address
H7000	The 7 th module on the right side of TK series, CR#0: starting address
H8000	The 8 th module on the right side of TK series, CR#0: starting address

Note: Modbus address is required while using Modbus-tk to read-write registers over a RS-485 network.

2.1.2 MODBUS Hex Address List for DVP02TK-S Series

Address (Hex)	Attribute		Name	Description	Default
0F00	R	X	Number of connected extension modules	Detecting number of the extension modules connected to the right side of the TK series	--
0F01	R	X	Code of the 1 st module	Code of the 1 st module on the right side of TK series	--
0F02	R	X	Code of the 2 nd module	Code of the 2 nd module on the right side of TK series	--
0F03	R	X	Code of the 3 rd module	Code of the 3 rd module on the right side of TK series	--
0F04	R	X	Code of the 4 th module	Code of the 4 th module on the right side of TK series	--
0F05	R	X	Code of the 5 th module	Code of the 5 th module on the right side of TK series	--
0F06	R	X	Code of the 6 th module	Code of the 6 th module on the right side of TK series	--
0F07	R	X	Code of the 7 th module	Code of the 7 th module on the right side of TK series	--
0F08	R	X	Code of the 8 th module	Code of the 8 th module on the right side of TK series	--
0F09	R/W	O	RS-485 communication setup	Refer to sections for setting up the RS-485 communication mode	K0
0F0A	R/W	X	Reserved		
0F0B	R/W	O	RS-485 communication format	0 : ASCII / 1 : RTU	K0
0F0C	R/W	O	TK station number	TK station number setup	K1
0F0D	R/W	X	TK operation	0 : Stop / 1 : Run	--

2.1.3 List of the Control Registers

TU CR#	TK Add. (Hex)	Attribute		Name	Description	Default
#0	000	R	O	Model	By default, you can see the model name in the program and determine whether there is any extension module. DVP02TUL-S: H014F DVP02TUN-S: H024F DVP02TUR-S: H034F DVP02TKL-S: H044F DVP02TKN-S: H054F DVP02TKR-S: H064F	--
#1	001	R	O	Firmware version	Hexadecimal, displaying the current firmware version, for example the current firmware is 1.02 and it will display H'0102.	--
#2	002	R	O	CH1 PV	Channel current value	--
#3	003	R	O	CH2 PV		
#4	004	R/W	O	CH1 SV setups	Channel target value	K0
#5	005	R/W	O	CH2 SV setups		
#6	006	R/W	X	CH1 setups to run/stop an operation	K0: stop K1: run K2: pause (programmable)	K0
#7	007	R/W	X	CH2 setups to run/stop an operation		
#8	008	R/W	X	CH1 Auto tuning	K0: Auto control mode K1: Auto adjust mode, after adjusting it will switch to the auto control mode and input the most suitable parameters, e.g., Kc_Kp, Ti_Ki, Td_Kd and Tf. K2: Auto adjust mode (enhanced), recommended when the change in temperature reaches 2 degrees. Another channel would be turned off automatically while adjusting, then revert back to the original channel setting once completed.	K0
#9	009	R/W	X	CH2 Auto tuning		
#10	00A	R/W	X	Setups to switch pages	CR#11~CR#42: Definitions may vary according to different setups on the specific page. K0: Basic setup page for CH1 K1: PID setup page for CH1 K2: Program control setup page for CH1 K3: Pattern 0, 1 setup page for CH1 K4: Pattern 2, 3 setup page for CH1 K5: Pattern 4, 5 setup page for CH1 K6: Pattern 6, 7 setup page for CH1 K7: Automatic PID calculation setup page for CH1 K10: Basic setup page for CH2	K0

TU CR#	TK Add. (Hex)	Attribute		Name	Description	Default
					K11: PID setup page for CH2 K12: Program control setup page for CH2 K13: Pattern 0, 1 setup page for CH2 K14: Pattern 2, 3 setup page for CH2 K15: Pattern 4, 5 setup page for CH2 K16: Pattern 6, 7 setup page for CH2 K17: Automatic PID calculation setup page for CH2	
#11~ #42	--	R/W	X	According to each setup page	Please refer to each setup page.	K0
--	00B	R/W	--	Page0	Basic setup page for CH1	--
--	02B	R/W	--	Page1	PID setup page for CH1	--
--	04B	R/W	--	Page2	Program control setup page for CH1	--
--	06B	R/W	O	Page3	Pattern 0, 1 setup page for CH1	--
--	08B	R/W	O	Page4	Pattern 2, 3 setup page for CH1	--
--	0AB	R/W	O	Page5	Pattern 4, 5 setup page for CH1	--
--	0CB	R/W	O	Page6	Pattern 6, 7 setup page for CH1	--
--	291	R/W	O	Page7	Automatic PID calculation setup page for CH1	--
--	0EB	R/W	O	Page10	Basic setup page for CH2	--
--	10B	R/W	O	Page11	PID setup page for CH2	--
--	12B	R/W	O	Page12	Program control setup page for CH2	--
--	14B	R/W	O	Page13	Pattern 0, 1 setup page for CH2	--
--	16B	R/W	O	Page14	Pattern 2, 3 setup page for CH2	--
--	18B	R/W	O	Page15	Pattern 4, 5 setup page for CH2	--
--	1AB	R/W	O	Page16	Pattern 6, 7 setup page for CH2	--
--	2B1	R/W	O	Page17	Automatic PID calculation setup page for CH2	--
#43	24B		X	Error code	Please refer to error code descriptions.	K0
#45	24D	R/W	X	User-defined	0x0501: Restore to defaults 0x0502: Settings written on flash 0x0504: RS-485 mode and latched (parameter/mode/station number) 0x51CC: Manually output 0x51DD : Auto output (the PID will be invalid after switching to manually output mode.) CR control can be set up by the analog output of DVP02TUL-S/DVP02TKL-S and the digital output of /DVP02TUN-S/DVP02TKR-S/DVP02TKN-S. DVP02TUL-S/DVP02TKL-S : CR#4: CH1 analog output value range K0~K4000 CR#5: CH2 analog output value range K0~K4000	K0

TU CR#	TK Add. (Hex)	Attribute		Name	Description	Default
					DVP02TUR-S/DVP02TUN-S/DVP02TKR-S/DVP02TKN-S : CR#4 (bit0/bit1): CH1 digital output Y0/Y1 CR#5 (bit0/bit1): CH2 digital output Y2/Y3	
#46	24E	R	O	CH1 display value	The display value is the measured value after being rounded off or the value set to be displayed for the channels.	
#47	24F	R	O	CH2 display value		
Symbols: O: Latched. X: Non-latched. R: Able to read data by FROM instruction. W: Able to write data by TO instruction.						

● CR#43 Error code descriptions

Error Code		1	0
Bit0	Power Supply abnormal	Abnormal	Normal
Bit1	Hardware abnormal	Abnormal	Normal
Bit2	CH1 conversion error	Abnormal	Normal
Bit3	CH2 conversion error	Abnormal	Normal
Bit4	CH1 circuit control abnormal	Abnormal	Normal
Bit5	CH2 circuit control abnormal	Abnormal	Normal
Bit6	Manually / Auto Output	Manually Output	Auto Output
Bit7-15	Reserved		

2.1.4 Basic Setup Page

TU CR#	TK CH1 Page0 Add. (Hex)	TK CH2 Page10 Add. (Hex)	Attribute		Name	Description	Default
#11	00B	0EB	R/W	O	Sensor type	K-255: Channel closed K0: 0 ~ 5V K1: 0~10V K2: 0 ~ 20mA K3: 4 ~ 20mA K4: 0 ~ 50mV K5: Pt100 K6: JPt100 K7: Pt1000 K8: J K9: K K10: R K11: S K12: T K13: E	K0

TU CR#	TK CH1 Page0 Add. (Hex)	TK CH2 Page10 Add. (Hex)	Attribute		Name	Description	Default
						K14: N K15: B K16: L K17: U K18: TXK K19: C K20: PL II K21: Cu50 K22: Cu100 K23: Ni100 K24: Ni1000 K25: LGNi1000 K26: 0~10V (Quick AI) K27: Ni120 K28 : -100mV ~ 100mV K29 : 4 ~ 20mA (Quick AI)	
#12	00C	0EC	R/W	O	Unit of temperature	K0: °C K1: °F	K0
#13	00D	0ED	R/W	O	Offset temperature error	K-999 ~ K999	K0
#14	00E	0EE	R/W	O	Temperature filter range	Temperature filter ranges from K10 to K10000. When the value inputted is in the range of ± 10 of the last inputted value, the system will run the filtering measurement. Hence, when the noise interference is bigger, the filter range should set to bigger too.	K10
#15	00F	0EF	R/W	O	Filtering factor	Ranging K0~K50. Operational formula: $\text{value} = (\text{last value} * n + \text{this measurement}) / (n+1)$ When the set value is less, the PV will be closer to this measurement. When the set value is bigger, the filtering factor will be bigger and the PV will be similar.	K1
#16	010	0F0	R/W	O	Control type	K0: PID Auto K1: PID Manual K2: PID program control K3: ON/OFF (for DVP02TUR-S/DVP02TUN-S/ DVP02TKR-S/DVP02TKN-S)	K0

TU CR#	TK CH1 Page0 Add. (Hex)	TK CH2 Page10 Add. (Hex)	Attribute		Name	Description	Default
#17	011	0F1	R/W	O	Output 1 control	K0: Heating K1: Cooling K2: Alarm (for DVP02TUR-S /DVP02TUN-S/ DVP02TKR-S /DVP02TKN-S) K3: Proportion (for DVP02TUL-S/ DVP02TKL-S)	K0
#18	012	0F2	R/W	O	Output 2 control	K0: Heating K1: Cooling K2: Alarm Note: not for DVP02TUL-S/ DVP02TKL-S	K0
#21	015	0F5	R/W	O	Output setup	K0: cyclic output K1: immediately output DVP02TUN-S/ DVP02TKN-S: K0 (default) DVP02TUR-S/ DVP02TKR-S: K1 (default) Note: not available for DVP02TUL-S/DVP02TKL-S	K0/K1
#23	017	0F7	R/W	O	Output 1: heating/cooling control cycle setup	DVP02TUN-S/ DVP02TKN-S: K1~K990 at 0.1 per second, default: K10. DVP02TUR-S/ DVP02TKR-S: K30~K990 at 0.1 per second (default), default: K200. Note: not available for DVP02TUL-S/DVP02TKL-S.	K10 /K200
#24	018	0F8	R/W	O	Output 2: heating/cooling control cycle setup		
#25	019	0F9	R/W	O	Alarm 1 output	K0~K12, please refer to chapter 2.4.2 Alarm Features. Note: not available for DVP02TUL-S/DVP02TKL-S.	K0
#26	01A	0FA	R/W	O	Alarm 2 output		K0
#27	01B	0FB	R/W	O	Alarm output 1 upper-limit setup		K0
#28	01C	0FC	R/W	O	Alarm output 1 lower-limit setup		K0
#29	01D	0FD	R/W	O	Alarm output 2 upper-limit setup		K0
#30	01E	0FE	R/W	O	Alarm output 2 lower-limit setup		K0

TU CR#	TK CH1 Page0 Add. (Hex)	TK CH2 Page10 Add. (Hex)	Attribute		Name	Description	Default
#32	020	100	R/W	O	PV upper-limit setup for a corresponding output	For DVP02TUL-S series When the input value varies, the corresponding output will vary accordingly. Take 4~20mA as an example, and set the upper-limit to K1000, lower-limit to K0; when the reading is K0, the output will be 4mA and when the reading is K1000, the output will be 20mA. When set it to a negative slope, and set the range to K0~K1000; when the reading is K0, the output will be 20mA and when the reading is K1000, the output will be 4mA.	K4000
#33	021	101	R/W	O	PV lower-limit setup for a corresponding output		K0
#34	022	102	R/W	X	Reserved for system use		
#35	023	103	R/W	O	Heating hysteresis setup	ON-OFF (For DVP02TUN-S / DVP02TUR-S / DVP02TKN-S / DVP02TKR-S)	K10
#36	024	104	R/W	O	Cooling hysteresis setup		K10
#37	025	105	R/W	O	Analog output mode	For DVP02TUL-S / DVP02TKL-S K0: 0~10V K1: 0~20mA K2: 4~20mA	K0
#38	026	106	R/W	O	Out of the LED setting range	K0=LED blinking K1=LED not blinking	K0
#39	027	107	R/W	O	Dead band setup for dual outputs	Setting range: K-32768~K32767 Note: not for DVP02TUL-S / DVP02TKL-S	K10
#40	028	108	R	X	Outputting	DVP02TUL-S / DVP02TKL-S: analog output value K0~K4000 DVP02TUN-S/DVP02TUR-S/DVP0 2TKN-S/DVP02TKR-S : Bit0: Digital output point, OUT1 Bit1: Digital output point OUT2	--
#41	029	109	R	O	Set up the display value for the channel.	If the preset value (PV) is bigger than the display value, set the PV to be the same as the display value, ranging from K0~K100.	K2

Symbols: O: Latched. X: Non-latched.

R: Able to read data by FROM instruction. W: Able to write data by TO instruction.

2.1.5 PID Setup Page

TU CR#	TK CH1 Page1 Add. (Hex)	TK CH2 Page11 Add. (Hex)	Attribute		Name	Description	Default
#11	02B	10B	R/W	O	MOUT_AUTO	K0 : Normal, the value of MOUT won't be changed with the value of MV. K1 : Auto, the value of MOUT will be changed with the value of MV.	K0
#12	02C	10C	R/W	O	MOUT	When set to PID Manual, the MV value will be outputted as the manually set MOUNT value, between MV_MAX and MV_MIN.	K0
#13	02D	10D	R/W	O	α value	The smaller the value of integral delay parameter the slower the accumulation of integral coefficients would start. Setup range is from K0 to K100.	K65
#14- #17	Reserved						
#18	032	112	R/W	O	PID_EQ	PID formula types K0: Independent Formula K1: Dependent Formula	K1
#19	033	113	R/W	O	PID_DE	The calculation of the PID derivative error K1: Using the variations in the PV to calculate the control value of the derivative (Derivative of the PV). K0: Using the variations in the error (E) to calculate the control value of the derivative (Derivative of the error).	K0
#20	034	114	R/W	O	ERR_DBW	Error dead bandwidth: Range within which an error (E) is 0. An error (E) is equal to SV-PV or PV-SV. If the setting value is 0, the function will not be enabled; otherwise the CPU module will check whether the present error is less than the absolute value of ERR_DBW, and check whether the present error meets the cross status condition. If the present error is less than the absolute value of ERR_DBW, and meets the cross status condition, the present error will be count as 0, and the PID	K0

TU CR#	TK CH1 Page1 Add. (Hex)	TK CH2 Page11 Add. (Hex)	Attribute		Name	Description	Default
						algorithm will be implemented, otherwise the present error will be brought into the PID algorithm according to the normal processing.	
#21	035	115	R/W	O	BIAS	Feedforward output value, used for the PID feedforward.	K0
#22	036	116	R/W	X	MV	The MV output value is K0~K1000 and the unit is 0.1.	--
#23	037	117	R/W	X	I_MV (Low word)	Accumulated integral value temporarily stored is usually for reference. Users can still clear or modify it according to their needs. When the MV is greater than the MV_MAX, or when the MV is less than MV_MIN, the accumulated integral value in I_MV is unchanged.	--
#24	038	118	R/W	X	I_MV (High word)		--
#25	039	119	R/W	O	AUTO Tuning (PID hysteresis)	PID working: SV - PID Range < PV < SV + PID Range	K1
#26	03A	11A	R/W	O	β value	K0 ~ K100 and the unit is 0.01.	K65
#27	03B	11B	R/W	O	Kc_Kp floating point format (Lo word)	Calculated proportional coefficient (Kc or Kp) If the P coefficient is less than 0, the Kc_Kp will be 0. Independently, if Kc_Kp is 0, it will not be controlled by P.	1.0
#28	03C	11C	R/W	O	Kc_Kp floating point format (Hi word)		
#29	03D	11D	R/W	O	Ti_Ki floating point format (Lo word)	Integral coefficient (Ti or Ki) If the calculated coefficient I is less than 0, Ti_Ki will be 0. If Ti_Ki is 0, it will not be controlled by I.	1.0
#30	03E	11E	R/W	O	Ti_Ki floating point format (Hi word)		
#31	03F	11F	R/W	O	Td_Kd floating point format (Lo word)	Derivative coefficient (Td or Kd) If the calculated coefficient D is less than 0, Td_Kd will be 0. If Ti_Ki is 0, it will not be controlled by D.	0.1
#32	040	120	R/W	O	Td_Kd floating point format (Hi word)		
#33	041	121	R/W	O	Tf floating point format (Lo word)	Derivate parameter for suppressing variations can filter derivatives, which would be more effective with greater parameter values. Generally it is suggested to use the result of auto tuning.	0.0
#34	042	122	R/W	O	Tf floating point format (Hi word)		

TU CR#	TK CH1 Page1 Add. (Hex)	TK CH2 Page11 Add. (Hex)	Attribute		Name	Description	Default
#35	043	123	R/W	O	Default integral coefficient	K0~K10000 (The unit is 0.01)	K0
#36	044	124	R/W	O	Max. value of MV	K0~K1000 (The unit is 0.1%)	K1000
#37	045	125	R/W	O	Min value of. MV	K0~K1000 (The unit is 0.1%)	K0
Symbols: O: Latched. X: Non-latched. R: Able to read data by FROM instruction. W: Able to write data by TO instruction.							

2.1.6 Program Control Setup Page

TU CR#	TK CH1 Page2 Address (Hex)	TK CH2 Page12 Address (Hex)	Attribute		Name	Description	Default
#11	04B	12B	R/W	O	Pattern number to start running	K0~K7	K0
#12	04C	12C	R/W	O	Step number to start running	K0~K7	K0
#13	04D	12D	R/W	O	The Cycle index of the Pattern number 0~7 to repeat running	K0~K99 indicates the running times of the Pattern has reached 100 K9999: running continuously	K0
#14	04E	12E	R	X	Read the current running pattern number	K0~K8 (8 indicates ending)	K0
#15	04F	12F	R	X	Read the current running step number	K0~K7	K0
#16	050	130	R	X	Read the step running time left	Unit (seconds)	K0
#17	051	131	R/W	O	Pattern0_ set up for the max. step number to run	K0~K7	K0
#18	052	132	R/W	O	Pattern1_ set up for the max. step number to run	K0~K7	K0
#19	053	133	R/W	O	Pattern2_ set up for the max. step number to run	K0~K7	K0
#20	054	134	R/W	O	Pattern3_ set up for the max. step number to run		K0
#21	055	135	R/W	O	Pattern4_ set up for the max. step number to run		K0
#22	056	136	R/W	O	Pattern5_ set up for the max. step number to run		K0
#23	057	137	R/W	O	Pattern6_ set up for the		K0

TU CR#	TK CH1 Page2 Address (Hex)	TK CH2 Page12 Address (Hex)	Attribute		Name	Description	Default
					max. step number to run		
#24	058	138	R/W	O	Pattern7_ set up for the max. step number to run		K0
#25	059	139	R	X	The current cycle index number of the Pattern number 0~7 to repeat running		K0
#26	05A	13A	R/W	O	Temperature wait function setup	K0~K999 (unit: 0.1) K9999: disable	K0
#27	05B	13B	R/W	O	Go back to the pattern number that is currently running	K0~K7	K0
#28	05C	13C	R/W	O	Go back to the step number that is currently running		K0
#29	05D	13D	R/W	O	Time unit of program control	K0: The unit is 1 min. K1: The unit is 0.1 sec.	K0

2.1.7 Pattern0, 1 Setup Page

TU CR#	TK CH1 Page3 Address (Hex)	TK CH2 Page13 Address (Hex)	Attribute		Name	Description	Default
#11	06B	14B	R/W	O	Pattern0-0 Target temperature	Range: K -32768~K32767	K0
#12	06C	14C	R/W	O	Pattern0-1 Target temperature		
#13	06D	14D	R/W	O	Pattern0-2 Target temperature		
#14	06E	14E	R/W	O	Pattern0-3 Target temperature		
#15	06F	14F	R/W	O	Pattern0-4 Target temperature		
#16	070	150	R/W	O	Pattern0-5 Target temperature		
#17	071	151	R/W	O	Pattern0-6 Target temperature		
#18	072	152	R/W	O	Pattern0-7 Target temperature		
#19	073	153	R/W	O	Pattern0-0 Running time	Range: K0~K900 Unit (minutes)	K0
#20	074	154	R/W	O	Pattern0-1 Running time		
#21	075	155	R/W	O	Pattern0-2 Running time		
#22	076	156	R/W	O	Pattern0-3 Running time		
#23	077	157	R/W	O	Pattern0-4 Running time		
#24	078	158	R/W	O	Pattern0-5 Running time		
#25	079	159	R/W	O	Pattern0-6 Running time		
#26	07A	15A	R/W	O	Pattern0-7 Running time		

TU CR#	TK CH1 Page3 Address (Hex)	TK CH2 Page13 Address (Hex)	Attribute		Name	Description	Default
#27	07B	15B	R/W	O	Pattern1-0 Target temperature	Range: K-32768~K32767	K0
#28	07C	15C	R/W	O	Pattern1-1 Target temperature		
#29	07D	15D	R/W	O	Pattern1-2 Target temperature		
#30	07E	15E	R/W	O	Pattern1-3 Target temperature		
#31	07F	15F	R/W	O	Pattern1-4 Target temperature		
#32	080	160	R/W	O	Pattern1-5 Target temperature		
#33	081	161	R/W	O	Pattern1-6 Target temperature		
#34	082	162	R/W	O	Pattern1-7 Target temperature		
#35	083	163	R/W	O	Pattern1-0 Running time	Range: K0~K900 (Unit minutes)	K0
#36	084	164	R/W	O	Pattern1-1 Running time		
#37	085	165	R/W	O	Pattern1-2 Running time		
#38	086	166	R/W	O	Pattern1-3 Running time		
#39	087	167	R/W	O	Pattern1-4 Running time		
#40	088	168	R/W	O	Pattern1-5 Running time		
#41	089	169	R/W	O	Pattern1-6 Running time		
#42	08A	16A	R/W	O	Pattern1-7 Running time		

2.1.8 Pattern2, 3 Setup Page

TU CR#	TK CH1 Page4 Address (Hex)	TK CH2 Page14 Address (Hex)	Attribute		Name	Description	Default
#11	08B	16B	R/W	O	Pattern2-0 Target temperature	Range: K-32768~K32767	K0
#12	08C	16C	R/W	O	Pattern2-1 Target temperature		
#13	08D	16D	R/W	O	Pattern2-2 Target temperature		
#14	08E	16E	R/W	O	Pattern2-3 Target temperature		
#15	08F	16F	R/W	O	Pattern2-4 Target temperature		
#16	090	170	R/W	O	Pattern2-5 Target temperature		
#17	091	171	R/W	O	Pattern2-6 Target temperature		
#18	092	172	R/W	O	Pattern2-7 Target temperature		
#19	093	173	R/W	O	Pattern2-0 Running time	Range: K0~K900 (Unit minutes)	K0
#20	094	174	R/W	O	Pattern2-1 Running time		
#21	095	175	R/W	O	Pattern2-2 Running time		
#22	096	176	R/W	O	Pattern2-3 Running time		
#23	097	177	R/W	O	Pattern2-4 Running time		
#24	098	178	R/W	O	Pattern2-5 Running time		
#25	099	179	R/W	O	Pattern2-6 Running time		
#26	09A	17A	R/W	O	Pattern2-7 Running time		

TU CR#	TK CH1 Page4 Address (Hex)	TK CH2 Page14 Address (Hex)	Attribute		Name	Description	Default
#27	09B	17B	R/W	O	Pattern3-0 Target temperature	Range: -32768~32767	K0
#28	09C	17C	R/W	O	Pattern3-1 Target temperature		
#29	09D	17D	R/W	O	Pattern3-2 Target temperature		
#30	09E	17E	R/W	O	Pattern3-3 Target temperature		
#31	09F	17F	R/W	O	Pattern3-4 Target temperature		
#32	0A0	180	R/W	O	Pattern3-5 Target temperature		
#33	0A1	181	R/W	O	Pattern3-6 Target temperature		
#34	0A2	182	R/W	O	Pattern3-7 Target temperature	Range: K0~K900 Unit (minutes)	K0
#35	0A3	183	R/W	O	Pattern3-0 Running time		
#36	0A4	184	R/W	O	Pattern3-1 Running time		
#37	0A5	185	R/W	O	Pattern3-2 Running time		
#38	0A6	186	R/W	O	Pattern3-3 Running time		
#39	0A7	187	R/W	O	Pattern3-4 Running time		
#40	0A8	188	R/W	O	Pattern3-5 Running time		
#41	0A9	189	R/W	O	Pattern3-6 Running time		
#42	0AA	18A	R/W	O	Pattern3-7 Running time		

2.1.9 Pattern4, 5 Setup Page

TU CR#	TK CH1 Page5 Address (Hex)	TK CH2 Page15 Address (Hex)	Attribute		Name	Description	Default
#11	0AB	18B	R/W	O	Pattern4-0 Target temperature	Range: K-32768~K32767	K0
#12	0AC	18C	R/W	O	Pattern4-1 Target temperature		
#13	0AD	18D	R/W	O	Pattern4-2 Target temperature		
#14	0AE	18E	R/W	O	Pattern4-3 Target temperature		
#15	0AF	18F	R/W	O	Pattern4-4 Target temperature		
#16	0B0	190	R/W	O	Pattern4-5 Target temperature		
#17	0B1	191	R/W	O	Pattern4-6 Target temperature		
#18	0B2	192	R/W	O	Pattern4-7 Target temperature	Range: K0~K900 (Unit: minutes)	K0
#19	0B3	193	R/W	O	Pattern4-0 Running time		
#20	0B4	194	R/W	O	Pattern4-1 Running time		
#21	0B5	195	R/W	O	Pattern4-2 Running time		
#22	0B6	196	R/W	O	Pattern4-3 Running time		
#23	0B7	197	R/W	O	Pattern4-4 Running time		
#24	0B8	198	R/W	O	Pattern4-5 Running time		
#25	0B9	199	R/W	O	Pattern4-6 Running time		
#26	0BA	19A	R/W	O	Pattern4-7 Running time		

TU CR#	TK CH1 Page5 Address (Hex)	TK CH2 Page15 Address (Hex)	Attribute		Name	Description	Default
#27	0BB	19B	R/W	O	Pattern5-0 Target temperature	Range: K-32768~K32767	K0
#28	0BC	19C	R/W	O	Pattern5-1 Target temperature		
#29	0BD	19D	R/W	O	Pattern5-2 Target temperature		
#30	0BE	19E	R/W	O	Pattern5-3 Target temperature		
#31	0BF	19F	R/W	O	Pattern5-4 Target temperature		
#32	0C0	1A0	R/W	O	Pattern5-5 Target temperature		
#33	0C1	1A1	R/W	O	Pattern5-6 Target temperature		
#34	0C2	1A2	R/W	O	Pattern5-7 Target temperature	Range: K0~K900 (Unit: minutes)	K0
#35	0C3	1A3	R/W	O	Pattern5-0 Running time		
#36	0C4	1A4	R/W	O	Pattern5-1 Running time		
#37	0C5	1A5	R/W	O	Pattern5-2 Running time		
#38	0C6	1A6	R/W	O	Pattern5-3 Running time		
#39	0C7	1A7	R/W	O	Pattern5-4 Running time		
#40	0C8	1A8	R/W	O	Pattern5-5 Running time		
#41	0C9	1A9	R/W	O	Pattern5-6 Running time		
#42	0CA	1AA	R/W	O	Pattern5-7 Running time		

2.1.10 Pattern6, 7 Setup Page

TU CR#	TK CH1 Page6 Address (Hex)	TK CH2 Page16 Address (Hex)	Attribute		Name	Description	Default
#11	0CB	1AB	R/W	O	Pattern6-0 Target temperature	Range: K-32768~K32767	K0
#12	0CC	1AC	R/W	O	Pattern6-1 Target temperature		
#13	0CD	1AD	R/W	O	Pattern6-2 Target temperature		
#14	0CE	1AE	R/W	O	Pattern6-3 Target temperature		
#15	0CF	1AF	R/W	O	Pattern6-4 Target temperature		
#16	0D0	1B0	R/W	O	Pattern6-5 Target temperature		
#17	0D1	1B1	R/W	O	Pattern6-6 Target temperature		
#18	0D2	1B2	R/W	O	Pattern6-7 Target temperature	Range: K0~K900 (Unit: minutes)	K0
#19	0D3	1B3	R/W	O	Pattern6-0 Running time		

TU CR#	TK CH1 Page6 Address (Hex)	TK CH2 Page16 Address (Hex)	Attribute		Name	Description	Default
#20	0D4	1B4	R/W	O	Pattern6-1 Running time	minutes)	
#21	0D5	1B5	R/W	O	Pattern6-2 Running time		
#22	0D6	1B6	R/W	O	Pattern6-3 Running time		
#23	0D7	1B7	R/W	O	Pattern6-4 Running time		
#24	0D8	1B8	R/W	O	Pattern6-5 Running time		
#25	0D9	1B9	R/W	O	Pattern6-6 Running time		
#26	0DA	1BA	R/W	O	Pattern6-7 Running time		
#27	0DB	1BB	R/W	O	Pattern7-0 Target temperature	Range: K-32768~K32767	K0
#28	0DC	1BC	R/W	O	Pattern7-1 Target temperature		
#29	0DD	1BD	R/W	O	Pattern7-2 Target temperature		
#30	0DE	1BE	R/W	O	Pattern7-3 Target temperature		
#31	0DF	1BF	R/W	O	Pattern7-4 Target temperature		
#32	0E0	1C0	R/W	O	Pattern7-5 Target temperature		
#33	0E1	1C1	R/W	O	Pattern7-6 Target temperature		
#34	0E2	1C2	R/W	O	Pattern7-7 Target temperature		
#35	0E3	1C3	R/W	O	Pattern7-0 Running time	Range: K0~K900 (Unit: minutes)	K0
#36	0E4	1C4	R/W	O	Pattern7-1 Running time		
#37	0E5	1C5	R/W	O	Pattern7-2 Running time		
#38	0E6	1C6	R/W	O	Pattern7-3 Running time		
#39	0E7	1C7	R/W	O	Pattern7-4 Running time		
#40	0E8	1C8	R/W	O	Pattern7-5 Running time		
#41	0E9	1C9	R/W	O	Pattern7-6 Running time		
#42	0EA	1CA	R/W	O	Pattern7-7 Running time		
Symbols: O: Latched. X: Non-latched. R: Able to read data by FROM instruction. W: Able to write data by TO instruction.							

2.1.11 Automatic PID Calculation Setup Page

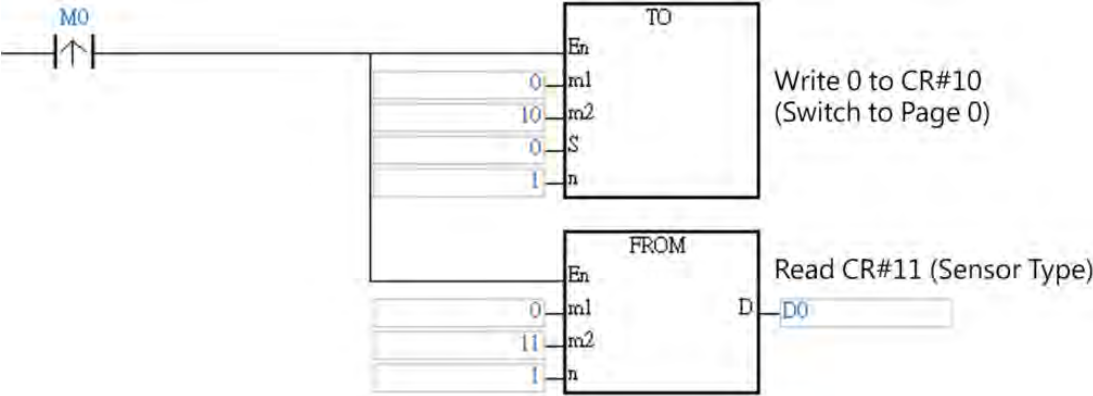
Please refer to chapter 2.9 for the feature descriptions.

TU CR#	TK CH1 Page7 Address (Hex)	TK CH2 Page17 Address (Hex)	Attribute		Name	Description	Default
#11	291	2B1	R/W	X	The set point currently being adjusted	Set the point that you intend to adjust with the setting value K1 and K2. When the adjustment finished, the value would change to another set point automatically.	K0
#12	292	2B2	R/W	O	Switch for auto-calculation	K1: Turn ON K0: Turn OFF After successfully adjusting both point, the auto-calculation feature would be switch ON.	K0
#13~ #19	293~ 299	2B3~ 2B9	R/W	O	For internal calculation.		
#20	29A	2BA	R/W	O	The first set point SV	Value of the first set point SV	K0
#21~ #26	29B~ 2A0	2BB~ 2C0	R/W	O	For internal calculation.		
#27	2A1	2C1	R/W	O	The second set point SV	Value of the second set point SV	K0
#28~ #33	2A2~ 2A7	2C2~ 2C7	R/W	O	For internal calculation.		

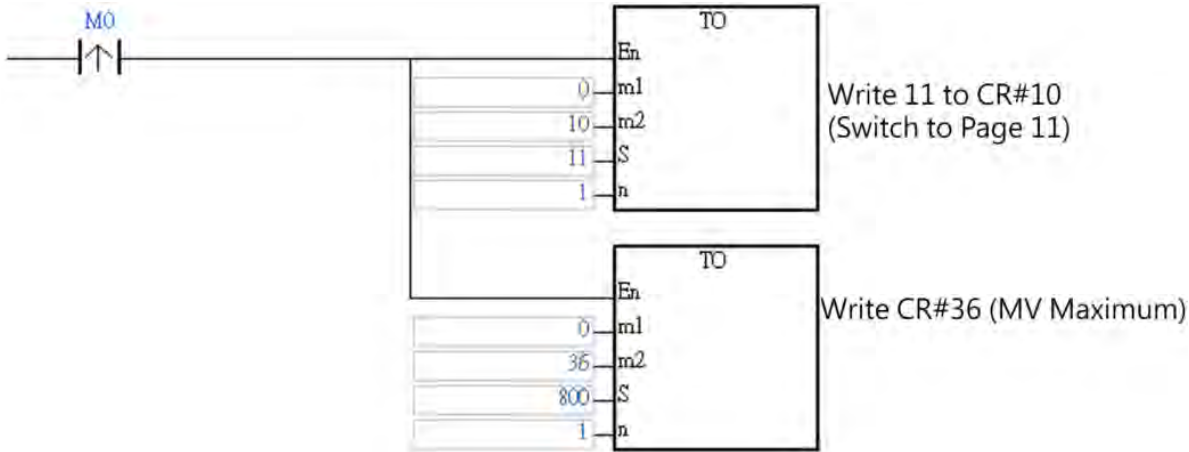
2.2 Examples of Setting a Control Register

Since CR#11~CR#42 are defined differently from page to page, the register module features switching pages on the screen. CR#10 is the register for page control, which should be written with the value of the corresponding page before you read-write CR#11~CR#42. The programming example is shown as follows:

1. Read the sensor type of channel1. (Page0, CR#11)



2. Set the maximum MV value of channel2. (Page11, CR#36)



2.3 Analog Input Description

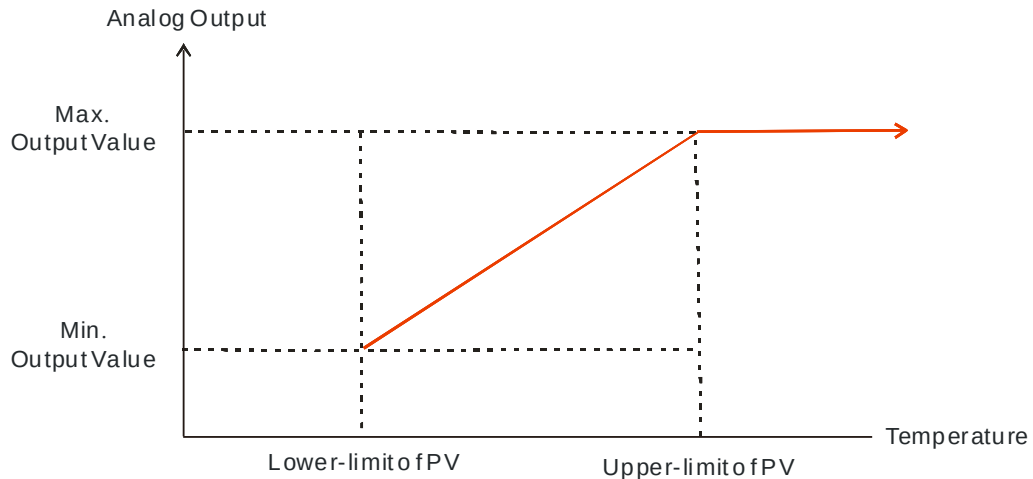
The analog input value of the CH1 is shown at CR#2, and CH2 at CR#3. Please refer to the following table to set the input sensor type register. The temperature of the platinum and thermocouple can be set in Celsius or Fahrenheit, unit 0.1 degree. Users can use offset to edit the settings.

	Mode		Analog Range	Digital Range
Current / Voltage	-1	Channel Closed	X	X
	0	0~5V	0 ~ 5V	K0 ~ K32000
	1	0 ~ 10V	0 ~ 10V	
	2	0 ~ 20mA	0 ~ 20mA	
	3	4 ~ 20mA	4 ~ 20mA	
	4	0 ~ 50mV	0 ~ 50mV	
	26	0~10V (Quick AI)	0 ~ 10V	
	28	-100mV~100mV	-100mV~100mV	K-32000~K32000
	29	4 ~ 20mA (Quick AI)	4 ~ 20mA	K0 ~ K32000
Platinum	5	Pt100	-200 ~ 600°C	K-2000 ~K6000
	6	JPt100	-20 ~ 400°C	K-200 ~ K4000
	7	Pt1000	-200 ~ 600°C	K-2000 ~K6000
Thermocouple	8	J	-100 ~ 1200°C	K-1000~K12000
	9	K	-200 ~ 1300°C	K-2000~K13000
	10	R	0 ~ 1700°C	K0 ~K17000
	11	S	0 ~ 1700°C	K0 ~K17000
	12	T	-200 ~ 400°C	K-2000~K4000
	13	E	0 ~ 600°C	K0 ~K6000
	14	N	-200 ~ 1300°C	K-2000~K13000
	15	B	100 ~ 1800°C	K1000~K18000
	16	L	-200 ~ 850°C	K-2000~K8500
	17	U	-200 ~ 500°C	K-2000~K5000
	18	TXK	-200 ~ 800°C	K-2000~K8000
	19	C	0~1800°C	K0~K18000
	20	PL II	-100~1370°C	K-1000~K13700
Copper thermal resistance	21	Cu50	-50~150°C	K-500~K1500
	22	Cu100	-50~150°C	K-500~K1500
Nickel thermal resistance	23	Ni100	-100~180°C	K-1000~K1800
	24	Ni1000	-100~180°C	K-1000~K1800
	25	LGNi1000	-60~200°C	K-600~K2000
	27	Ni120	-80~260°C	K-800~K2600

2.4 Outputs

2.4.1 The output value varies with the PV value.

This functionality is only available for DVP02TUL-S/DVP02TKL-S series. When the PV varies, the corresponding output will vary accordingly. Take 4~20mA as an example, and set the upper-limit to 1000, lower-limit to 0; when PV is 0, the output will be 4mA and when PV is 1000, the output will be 20mA. When set it to a negative slope, and set the range to 0~1000; when the PV is 0, the output will be 20mA and when the PV is 1000, the output will be 4mA. As the linear graph shown below, the analog output will vary according to the PV value.



2.4.2 Alarm Outputs

The alarm output is only available for DVP02TUN-S, DVP02TUR-S, DVP02TKN-S and DVP02TKR-S series, not for DVP02TUL-S and DVP02TKL-S series. Alarm function is to set the input value to trigger the outputs to do corresponding actions. There are 12 modes available for setups. The alarm output operations are shown below.

Setting Value	Alarm Type	Alarm Output Operation
0	Alarm function disabled.	None
1	Deviation upper- and lower-limit: This alarm output operates when the PV is higher than the setting value SV+AL-H or lower than the setting value SV-AL-L.	
2	Deviation upper-limit: This alarm output operates when the PV is higher than the setting value SV+AL-H.	
3	Deviation lower-limit: This alarm output operates when the PV is lower than the setting value SV-AL-L.	

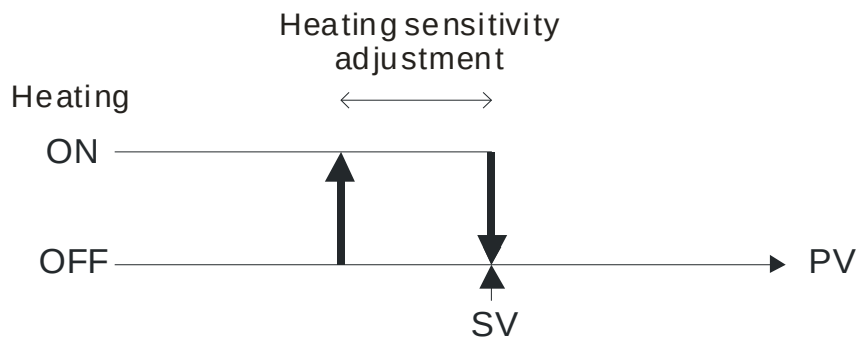
Setting Value	Alarm Type	Alarm Output Operation
4	Upper and lower alarm reverse action: This alarm output operates when the PV is between SV+AL-H and SV- AL_L.	
5	Absolute value upper- and lower-limit: This alarm output operates when the PV is higher than the setting value AL-H or lower than the setting value AL-L.	
6	Absolute value upper-limit: This alarm output operates when the PV is higher than the setting value AL-H.	
7	Absolute value lower-limit: This alarm output operates when the PV is lower than the setting value AL-L.	
8	Standby alarm value upper- and lower-limit: This alarm output operates when the PV is at the set value and the temperature is higher than the setting value SV+AL-H or lower than the setting value SV- AL_L.	
9	Standby alarm value upper-limit: This alarm output operates when the PV is at the set value and the temperature is higher than the setting value SV+AL-H.	
10	Standby alarm value lower-limit: This alarm output operates when the PV is at the set value and the temperature is lower than the setting value SV- AL_L.	
11	Hysteresis upper-limit alarm output: This alarm output operates if PV value is higher than the setting value SV+AL-H. This alarm output is OFF when the PV is lower than the setting value SV+AL-L.	
12	Hysteresis lower-limit alarm output: This alarm output operates if PV value is lower than the setting value SV-AL-H. This alarm output is OFF when the PV is higher than the setting value SV-AL-L.	

2.5 ON/OFF Control Mode

DVP02TUR/DVP02TUN-S/DVP02TKR/DVP02TKN-S series, every channel has 2 digital outputs. Outputs control the ON/OFF mode.

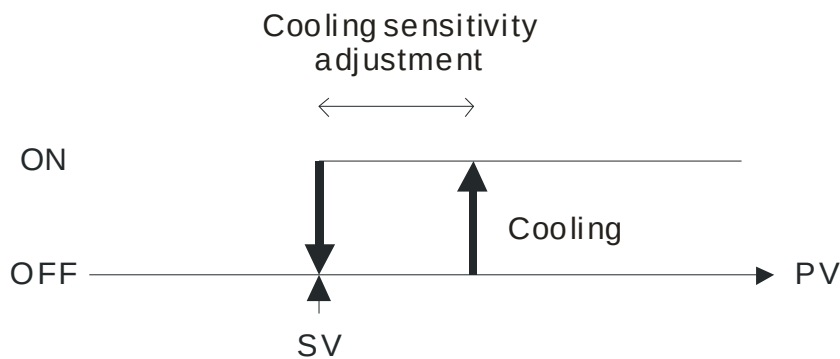
- **Actions for the heating output:**

The output is OFF, when the input is greater than the setting value. Output is ON, when the input is smaller than the total value of the setting value + adjustment sensitivity setting value. For example, set the setting value to 100 degree and the heating sensitivity adjustment to 10 degree; when the temperature reached 100 degree, the digital output switches to OFF. When the temperature is 90 degree, it will heat up to 100 degree, and then the digital output will switch to OFF.



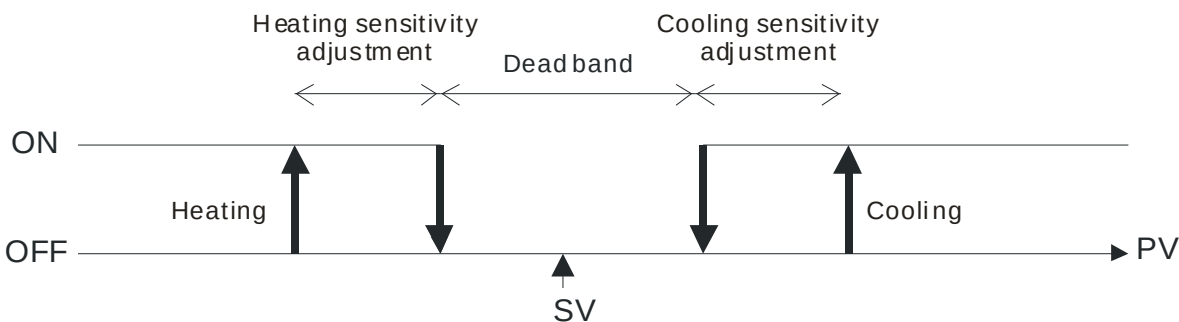
- **Actions for the cooling output:**

The output is ON, when the input is greater than the total value of the setting value + adjustment sensitivity setting value. Output is OFF, when the input is smaller than the setting value. For example, set the setting value to 10 degree and the cooling sensitivity adjustment to 5 degree; when the temperature reached 10 degree, the digital output switches to OFF. When the temperature is 15, it will cool down to 10 degree, and then the digital output will switch to OFF.



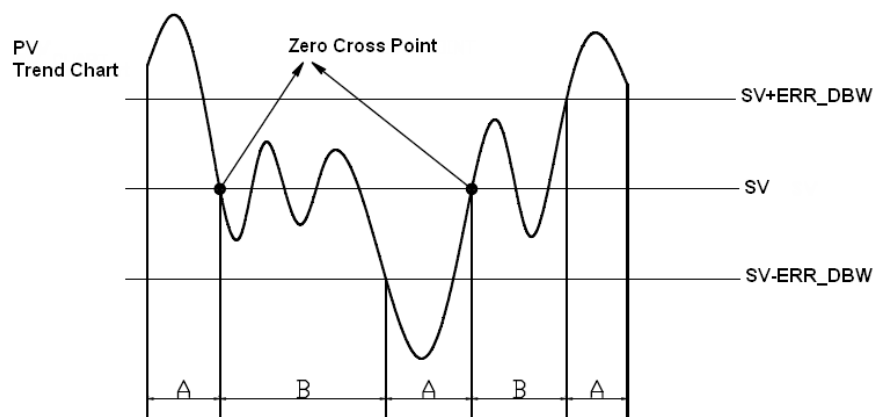
- **Actions for dual outputs:**

When setting one output for heating and the other for cooling, a non-action zone (dead band) can be set as below. For example, set the setting value to 100 degree, heating sensitivity adjustment to 10 degree, cooling sensitivity adjustment to 5 degree and dead band to 20 degree; when the temperature is 90~100 degree, the outputs will be OFF. Heating up the temperature to 90 degree, the output will switch to OFF. When the temperature is below 80 degree, the heating up will be started. Cooling down the temperature to 110 degree, the output will switch to OFF. When the temperature is over 115 degree, the cooling will be started.



2.6 PID Control Mode

When the PV is in the range of ERR_DBW, the PLC will run the PID operation according to the E value. When the PV is over the SV, the cross status will be established and the E value will be seen as 0 while running the PID operation until the PV goes over the range of ERR_DBW. If PID_DE is True, the PLC will run the derivative of PV. When the cross status is established, the Delta PV will be seen as 0 while running the derivative of PID operation. As the example shown below, the PLC will run the PID operation in the section A and will see the values of E and Delta PV as 0 while running the PID operation.



PID Formula:

- Independent Formula & Derivative of E (PID_EQ=False & PID_DE=False)

$$CV = K_p E + K_i \int_0^t E dt + K_d \frac{dE}{dt} + BIAS$$

$$E = SV - PV \quad \text{or} \quad E = PV - SV$$

- Independent Formula & Derivative of PV (PID_EQ=False & PID_DE=True)

$$CV = K_p E + K_i \int_0^t E dt - K_d \frac{dPV}{dt} + BIAS$$

$$E = SV - PV$$

or

$$CV = K_p E + K_i \int_0^t E dt + K_d \frac{dPV}{dt} + BIAS$$

$$E = PV - SV$$

- Dependent Formula & Derivative of E (PID_EQ=True & PID_DE=False)

$$CV = K_c \left[E + \frac{1}{T_i} \int_0^t E dt + T_d \frac{dE}{dt} \right] + BIAS$$

$$E = SV - PV \quad \text{or} \quad E = PV - SV$$

- Dependent Formula & Derivative of PV (PID_EQ=True & PID_DE=True)

$$CV = K_c \left[E + \frac{1}{T_i} \int_0^t E dt - T_d \frac{dPV}{dt} \right] + BIAS$$

$$E = SV - PV$$

or

$$CV = K_c \left[E + \frac{1}{T_i} \int_0^t E dt + T_d \frac{dPV}{dt} \right] + BIAS$$

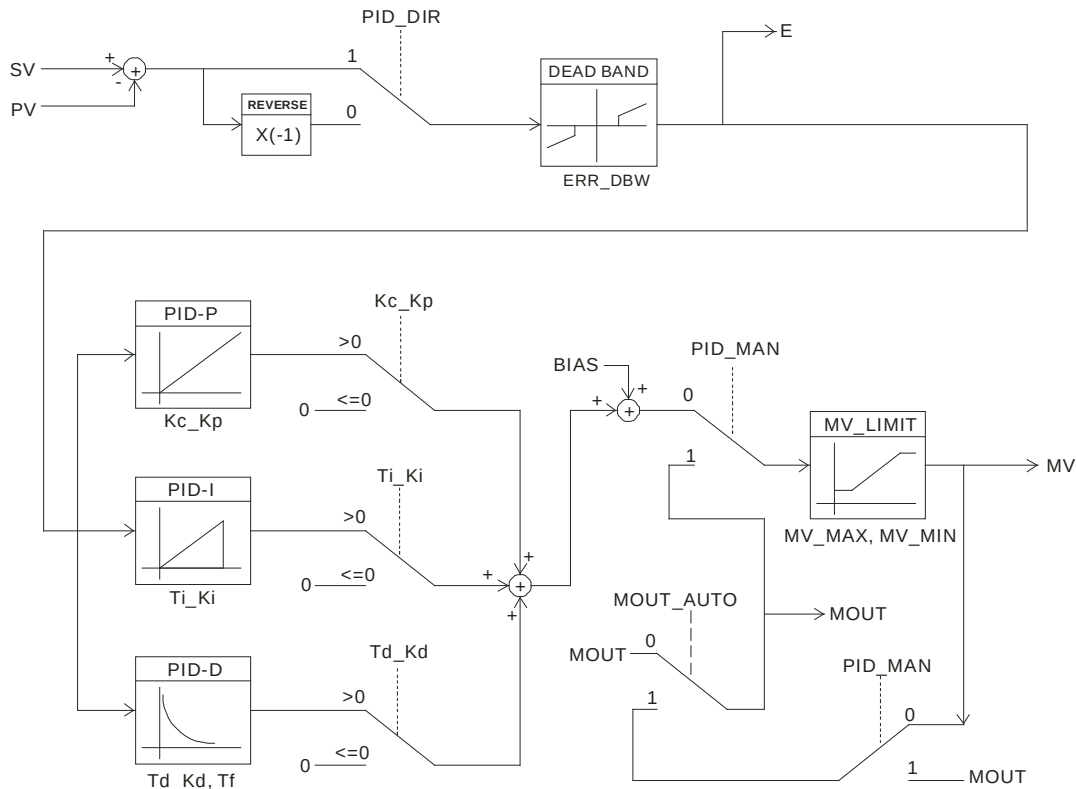
$$E = PV - SV$$

※ All the CVs stated above are the MVs in the formula.

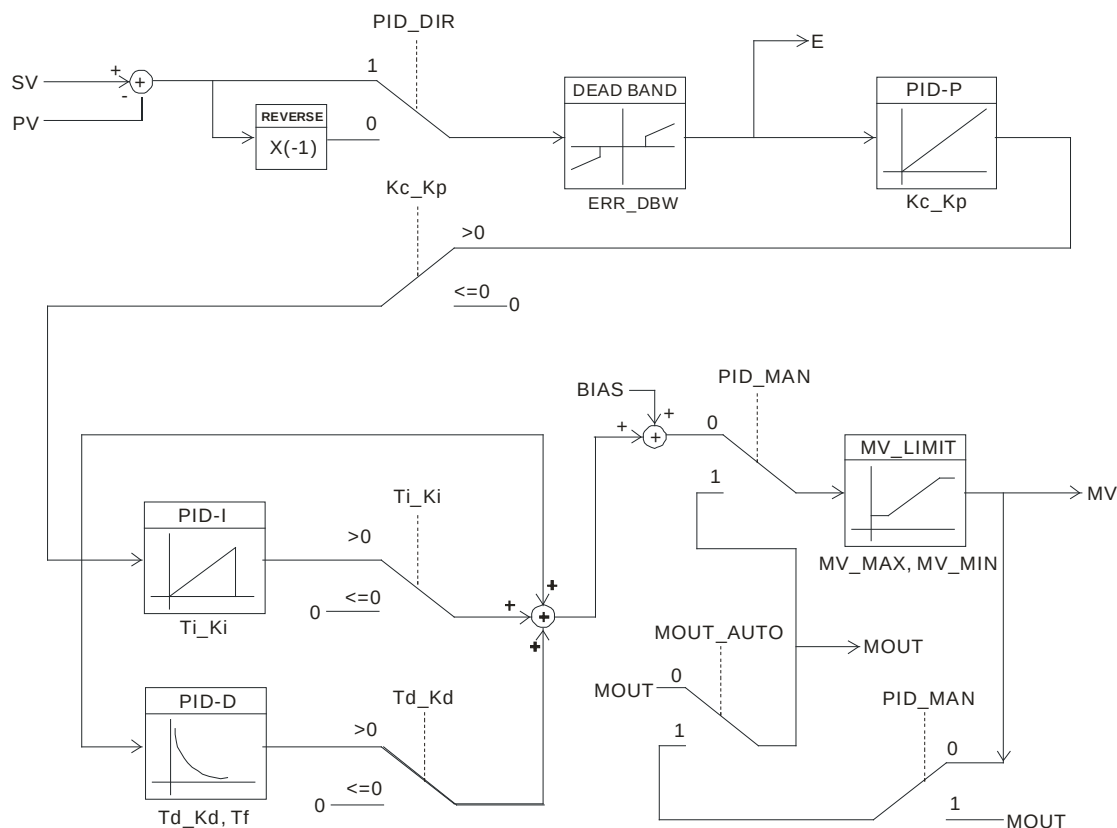
Auto tuning mode: When auto tuning is done, the value will become 0 and switch to the auto tuning mode automatically.

PID Control Block Diagram:

PID Block Diagram (Independent)



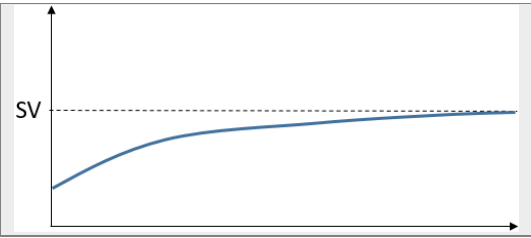
PID Block Diagram (Dependent)

**Note:**

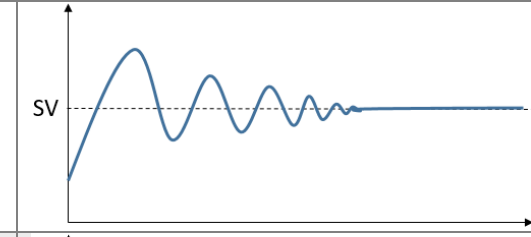
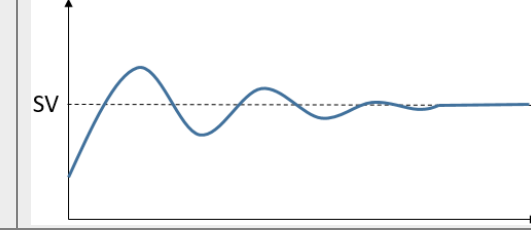
1. When tuning these 3 parameters, Kc_Kp, Ti_Ki and Td_Kd, set the Kc_Kp value first (according to their experiences), and set the Ti_Ki and Td_Kd value to 0. When it can be controlled, users can increase the values of Ti_Ki and Td_Kd. When the value of Kc_Kp is 1, it means that the proportional gain is 100%. That is, the error is increased by a factor of one. When the proportional gain is less than 100%, the error is decreased. When the proportional gain is greater than 100%, the error is increased.
2. The parameters which have been tuned automatically are not necessarily suitable for every controlled environment. Therefore, users can further modify the automatically-tuned parameters. However, it is suggested to modify the values of Ti_Ki or Td_Kd only.

PID Tuning Guide:**P gain**

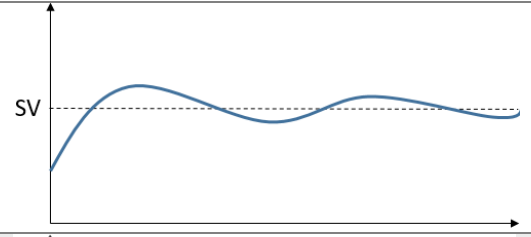
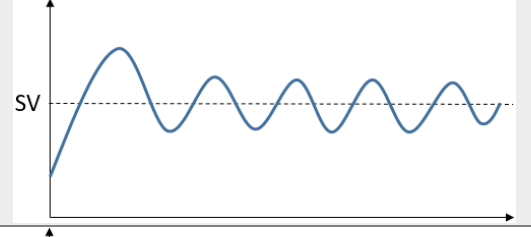
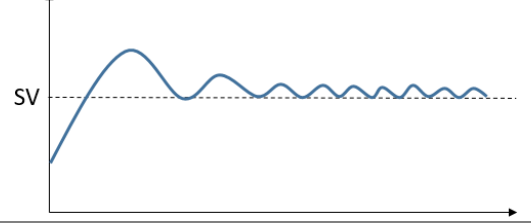
Increase P gain		Achieve the target temperature more quickly with a faster convergence speed, while Overshoot being increased.
-----------------	--	---

Reduce P gain		Prevent overshooting, which would cause longer time to achieve the target temperature with a slower convergence speed.
---------------	--	--

I gain

Increase I gain (Decreasing integral time T_i)		As increasing Overshoot, oscillation amplitude would be increased as well, so as to reach the target temperature with a faster convergence speed.
Decrease I gain (Increasing integral time T_i)		The convergence speed would be slower to minimize overshoot and oscillations.

D gain

Increase D gain		Changes in temperature would be eased.
Decrease D gain		Changes in temperature would become rapid.
Special case		To improve the situation that temperature constantly oscillates over the SV, decrease D gains or simply control with PI.

2.7 Programmable SV Control Mode

The temperature setting value is not fixed but a setting curve defined by users according to their requirements. By way of PID control, the temperature input rises along with the defined temperature curve. The device provides 8 patterns and each pattern with 8 steps, a linking parameter, a loop parameter, and a number of execution steps respectively. Each step has 2 parameters (temperature setting value and time). After setting these parameters up, each temperature controller will have its own set of initial pattern and step for creating its own temperature setting curve. Some of the terms are explained as follows:

1. Initial pattern: set the program to start running at a sequential number of patterns.
2. Initial Step: set the program to start running at a sequential number of steps.
3. Running time: set the temperature duration time, if not necessary, it can be set to 0.
4. Step: includes 2 parameter settings: a setting point X and a Running time T, indicating the setting value (SV) to rise to X degree after the time T. If the setting point X is identical to the previous setting, this process is called a Soak, otherwise a Ramp; therefore this control procedure is also called a Ramp Soak control. The first running procedure is preset as a Soak control, to set the temperature control to setting point X degree in advanced and keep the temperature at X degree, at a duration time of T.
5. Number of loops: Extra loops to be carried out for the pattern. If set to 1, the pattern will be carried out 2 times.
6. Executing step: Number of steps executed for each pattern.
7. Execution: Before execution, users need to set up all the parameters. If the setting control is in the running mode, the program will start running from the initial pattern and initial step, carrying out commands one by one by their set orders. When the setting control is in the ending mode, the SV will stop at the final setting. When the setting control is in the stop mode and the temperature will be at the value before the stop, by re-selecting to run, the program will start running from the initial pattern and initial step. When the setting control is in the pause mode and the temperature is at the value before the pause, by re-selecting to run, the program will start running from the step where the program was paused, carrying out the remaining parts. During execution, the SV cannot be set up.

2.8 ERROR LED Indicator

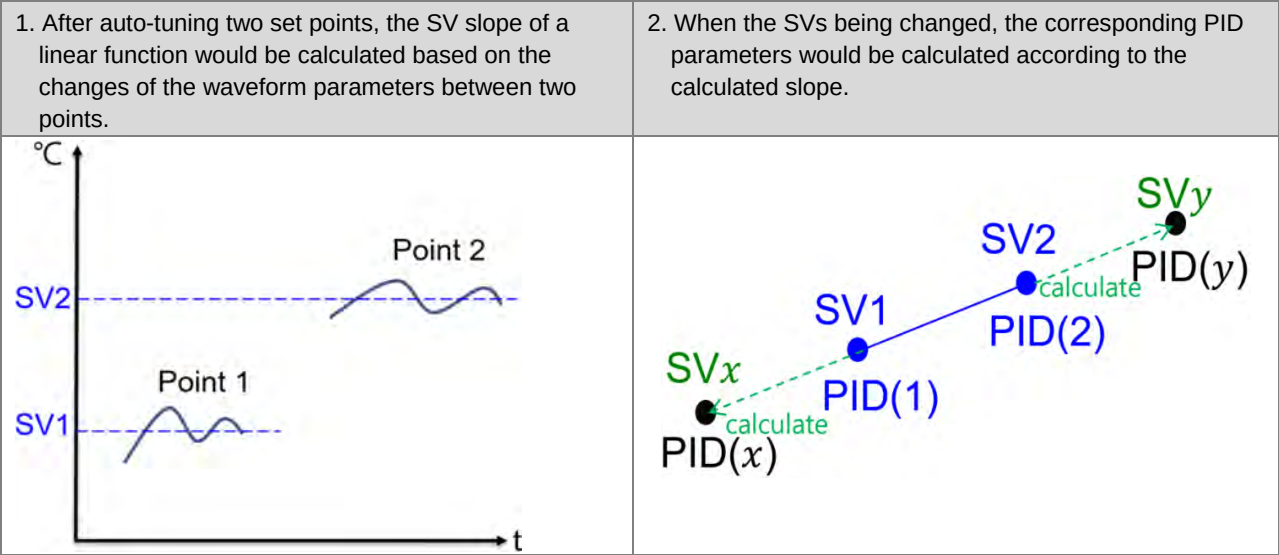
When the analog input channel out of range is detected, the error code will show up and the error LED will also blinking to notify. Users can disable this functionality to inactivate the error LED blinking, but the error code will still show up.

Page	CR	Description	Setting Value
Basic Setup Page	38	Output out of range	K0=LED blinking (default) K1=LED not blinking

2.9 Automatic PID Calculation Feature (Support TK V1.06 /TU V4.18 and above)

2.9.1 Feature Description

As the set value (SV) being changed, the PID parameters would be calculated automatically based on the relation between two set points after performed auto-tuning twice.



2.9.2 Setup Instructions

Follow the below steps to set up (take channel 1 for example):

Step 1: Set the first set value (SV) to adjust.

CR Page	CR#	Description	Setting Value
All pages	4	The target value	User-defined

Step 2: Set the current point for auto-tuning.

CR Page	CR#	Description	Setting Value
Automatic PID Calculation Setup Page (Page7)	11	The current set point for auto-tuning.	K1

Step 3: Start auto-tuning.

CR Page	CR#	Description	Setting Value
All pages	8	Auto-tuning	K1 or K2
	6	Setups to run/stop an operation	K1

After finished auto-tuning, the current set point (Step2 CR) would be changed to the second point (K2) automatically.

Step 4: After both set points being tuned (notice if CR#8 changes back to 0), set the second set value (SV) to adjust (same as step1).

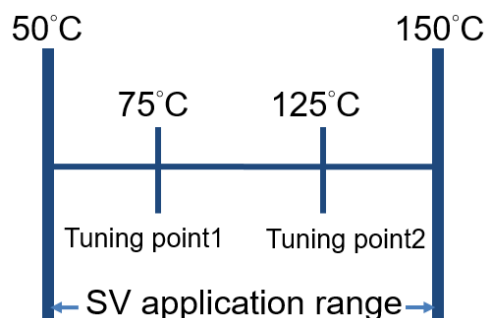
Step 5: Start auto-tuning (same as step3).

Step 6: When the setting is completed, the auto-calculation feature would be switched to ON automatically. And the PID parameters would be output differently according to each SV.

2.9.3 Additional Instructions

1. Choosing tuning point

We suggest to set the tuning points at 25% and 75% of the SV application range.



2. Copying parameters

Under the same environment, CR#12~CR#33 on automatic PID calculation page can be copied to the same position of other modules (including internal calculation parameters) so as to achieve the same calculation effect.

3. Adjusting tuning point

In case that you want to reset a specific tuning point, simply reset the SV and the current tuning point, then perform auto-tuning again.

2.10 RS-485 Communication Setup for DVP02TK-S

2.10.1 MODBUS Communication Protocol

For DVP02TK-S series, MODBUS supports formats such as RTU and ASCII. When RTU is selected, the data length is 8 and the following function codes are supported.

Function code 03: read multiple words, up to 32 words can be read.

Function code 06: write a single word.

Function code 10: write multiple words, up to 32 words can be written.

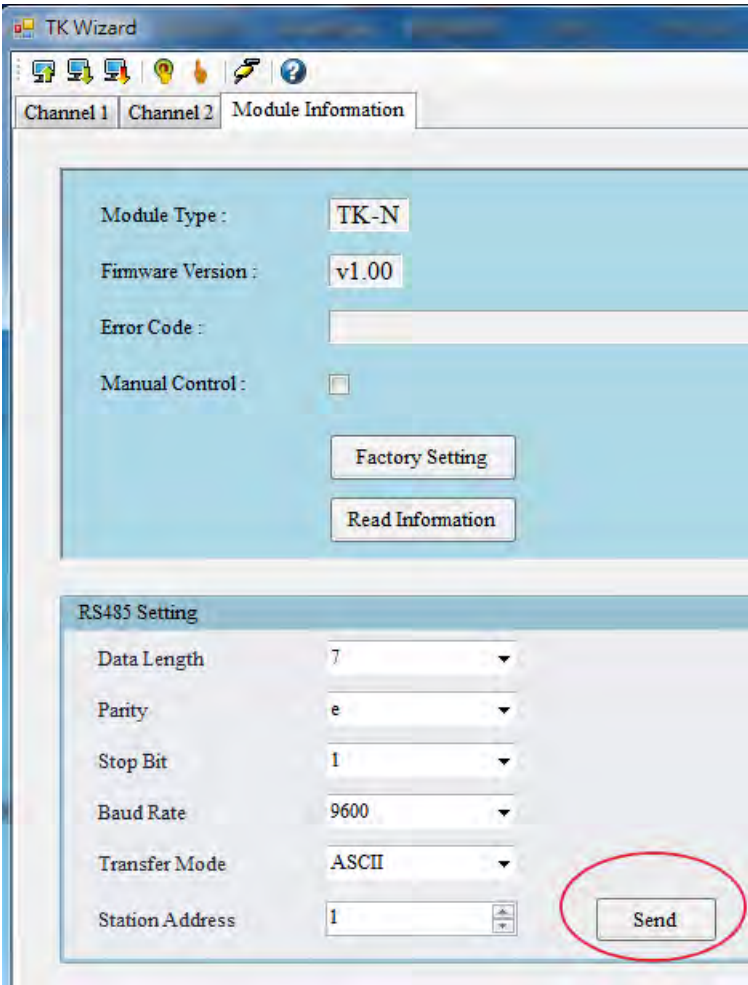
2.10.2 Restore to Factory Settings

Users can restore the RS-485 communication settings back to defaults (9600/7/1/E, station number 1) by switching RUN to STOP and then STOP to RUN after turning on the device within 5 seconds.

2.10.3 RS-485 Communication Setup

There are 2 methods to setup RS-485 communication, via TK Wizard and setting the MODBUS address.

- TK Wizard (TKSoft): click the Module Information and set up baud rate, transfer mode and then click "Send" to save the settings.



• MODBUS address setup:

Write the value 0x00XY (refer to the following list for X and Y setups) in MODBUS address (0x0F09).

Example: the value 0x0000 (X=0/Y=0) indicates the baud rate is 9600, data length is 7, stop bits is 1 and the parity is Even.

RS-485 Communication Setting Address = 0x0F09, written value is 0x00XY				
			Value	Description
X	Bit7~Bit4	Baud Rate (bps)	0	9600 (default)
			1	19200
			2	38400
			3	57600
			4	115200
			5~16	reserved
Y	Bit3	Data Length	0	7 (default)
			1	8

RS-485 Communication Setting Address = 0x0F09, written value is 0x00XY

	Bit2	Stop Bits	0	1-bit (default)
			1	2-bit
	Bit1~Bit0	Parity	0	Even (default)
			1	Odd
			2	None
			3	Reserved

	Data Length	Stop Bits	Parity				
Y value	bit3	bit2	bit1	bit0	Data Bits	Stop Bits	Parity
	0: 7 1: 8	0: 1-bit 1: 2-bit	0: Even; 1: Odd; 2: None; 3: reserved				
0	0	0	0	0	7	1	even
1	0	0	0	1	7	1	odd
2	0	0	1	0	7	1	none
3	0	0	1	1	7	1	even
4	0	1	0	0	7	2	even
5	0	1	0	1	7	2	odd
6	0	1	1	0	7	2	none
7	0	1	1	1	7	2	even
8	1	0	0	0	8	1	even
9	1	0	0	1	8	1	odd
A	1	0	1	0	8	1	none
B	1	0	1	1	8	1	even
C	1	1	0	0	8	2	even
D	1	1	0	1	8	2	odd
E	1	1	1	0	8	2	none
F	1	1	1	1	8	2	even

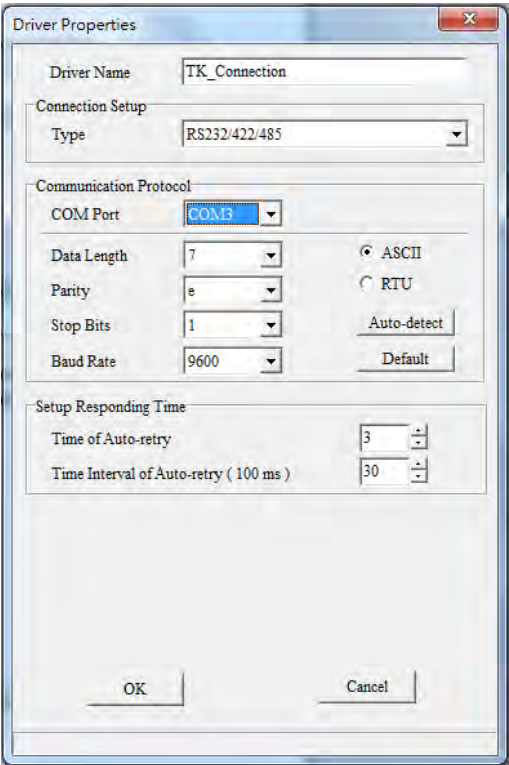
2.11 TK Wizard – Connection Setup

2.11.1 Restore to Factory Settings for DVP02TK-S

Refer to section 2.8.2 for more information on restoring the RS-485 communication settings back to defaults (9600/7/1/E, station number 1).

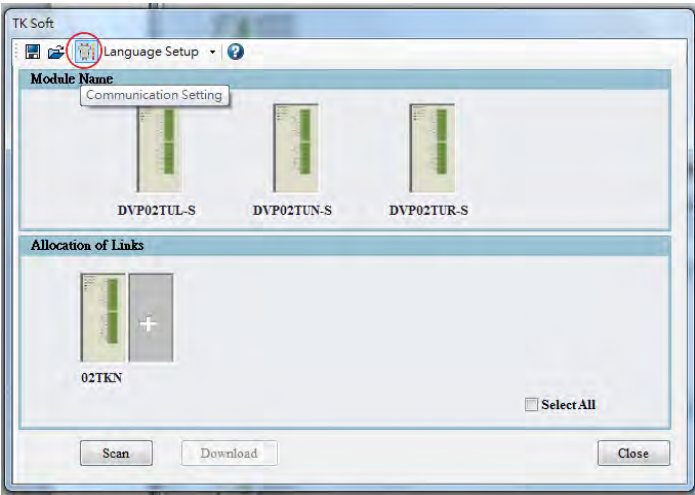
2.11.2 COMMGR Set Up

Input the communication setting values to create a TK connection in COMMGR. After setting the values, click the auto-detect button to check if the connection is successfully established. Click OK to confirm the settings.

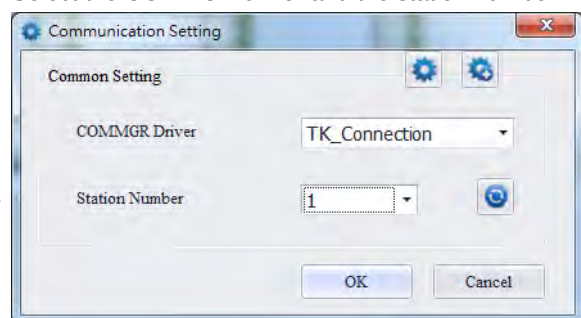


2.11.3 Settings in TKSoft

Click the icon Communication Setting in TKSoft to set up the communication.

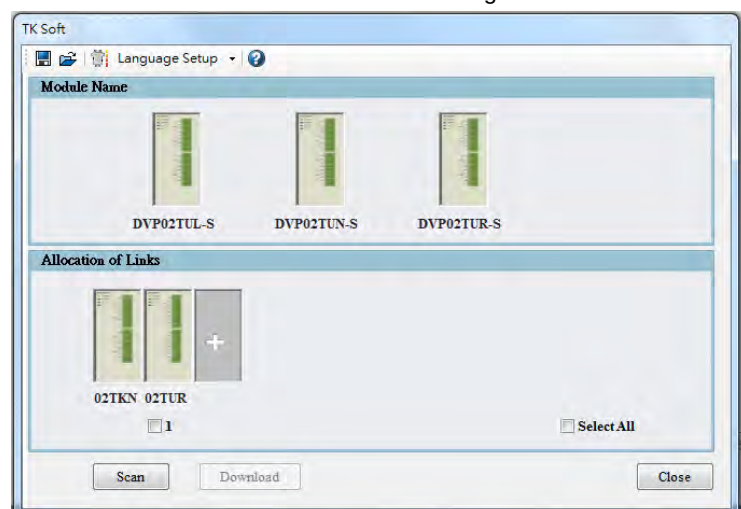


Select the COMMGR driver and the station number.



2.11.4 TKSoft – Scan the Connected Devices

Once the setup is complete, users can click the Scan button to have the system to detect the connected DVP02TK-S series and the extension modules from the right side of DVP02TU-S.



Double click the DVP02TK-S / DVP02TU-S icon to open the setting page.

