2004-09-29

5011613802-DE22

DVP02DA-S

DVP02DA-S   *Analog Output Module*

Instruction Sheet

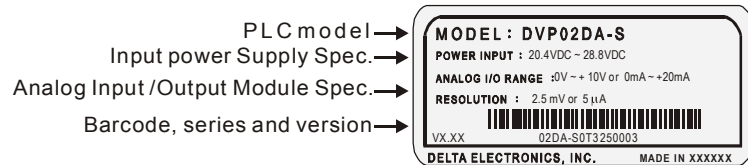http://www.delta.com.tw/products/plc.asp

1 WARNING

⚠ Please carefully read this instruction thoroughly prior to use the DVP02DA-S.

⚠ The DC input power must be **OFF** before any maintenance.

⚠ This is an OPEN-TYPE built-in DVP02DA-S, and the DVP02DA-S is certified to meet the safety requirements of IEC 61131-2 (UL 508) when installed in the enclosure to prevent high temperature, high humidity, excessive vibration, corrosive gases, liquids, airborne dust or metallic particles. Also, it is equipped with protective methods such as some special tool or key to open the enclosure, so as to avoid the hazard to users or any damage to the DVP02DA-S.

⚠ Do not connect the AC power to any of the input/output terminals, or it may the DVP02DA-S. Make sure that all the wiring is well conducted prior to power On.

⚠ Do not touch the internal circuit for at least 1 minute after the power is Off.

⚠ Make sure that DVP02DA-S is properly grounded ⏚, to avoid any electromagnetic noise.
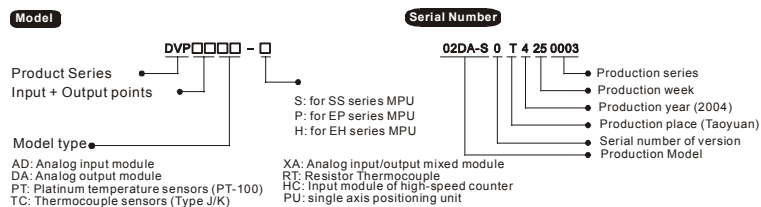
2 INTRODUCTION

2.1 Model Explanation and Peripherals

● Thank you for choosing DELTA DVP PLC Series. The analog output module of DVP02DA-S series can read/write the data of analog output module by using commands FROM / TO via DVP-PLC SS/SA/SX Series MPU program. The analog output module receives 2 group 12-bit digital data from PLC MPU and converts it into 2 points analog output signal (voltage or current). There are 49 CR (Control Register) in each module and there are 16 bits in each register.

● The software version of DVP02DA-S analog output module can be updated via RS-485 communication. Power unit and module are separate. Size is small and easy to install.

● Users can select output either voltage or current via wiring. Voltage output range is 0V ~ +10V DC (resolution is 2.5 mV). Current output range is 0mA ~ 20mA (resolution is 5 μA).
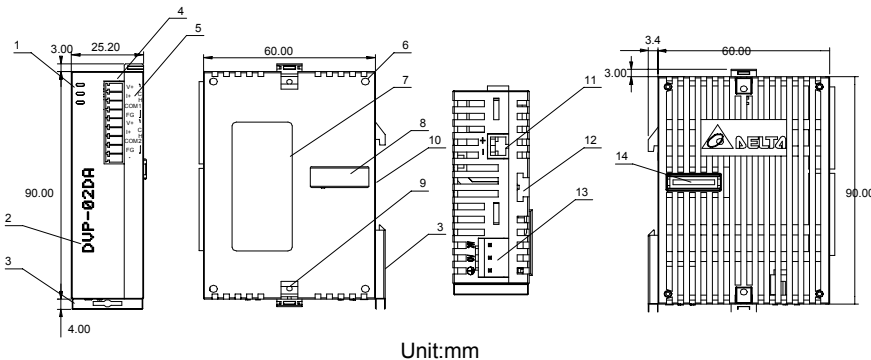
■ **Nameplate Explanation**

PLC model →
Input power Supply Spec. →
Analog Input /Output Module Spec. →
Barcode, series and version →

```
MODEL : DVP02DA-S
POWER INPUT : 20.4VDC ~ 28.8VDC
ANALOG I/O RANGE : 0V~ + 10V or 0mA ~ +20mA
RESOLUTION :  2.5 mV or 5 μA
VX.XX            02DA-S0T3250003
DELTA ELECTRONICS, INC.    MADE IN XXXXXX
```

■ **Model Explanation**

Model   Serial Number

DVP□□□□ - □   02DA-S 0 T 4 25 0003

Product Series
Input + Output points
    S: for SS series MPU
    P: for EP series MPU
    H: for EH series MPU
Model type
    AD: Analog input module
    DA: Analog output module
    PT: Platinum temperature sensors (PT-100)
    TC: Thermocouple sensors (Type J/K)
    XA: Analog input/output mixed module
    RT: Resistor Thermocouple
    HC: Input module of high-speed counter
    PU: single axis positioning unit

Production series
Production week
Production year (2004)
Production place (Taoyuan)
Serial number of version
Production Model

2.2 Product Profile and Outline

Unit:mm

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1. Status indicator (Power, RUN and ERROR)	8. Expansion port
2. Model name	9. Expansion unit clip
3. DIN rail clip	10. DIN rail (35mm)
4. I/O terminals	11. RS-485 Communication port
5. I/O point indicator	12. Mounting rail of the expansion unit
6. Mounting hole of the expansion unit	13. DC Power input
7. Nameplate	14. Expansion port

2.3 External wiring
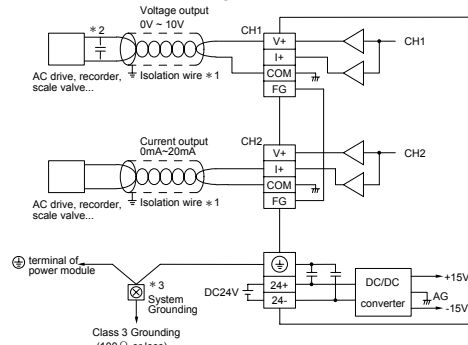
Note 1: Please isolate analog output and other power wiring.

Note 2: If noise interferes from loaded input wiring terminal is significant, please connect a capacitor with 0.1~0.47μF 25V for noise filtering.

Note 3: Please connect ⏚ power module terminal and ⏚ analog output module terminal to system earth point and make system earth point be grounded or connects to machine cover.

Warning: DO NOT wire to the No function terminal ●

2.4 Terminal of analog module layout

DVP04AD-S	DVP02DA-S	DVP04DA-S	DVP04PT-S	DVP04TC-S	DVP06XA-S	DVP08RT-S
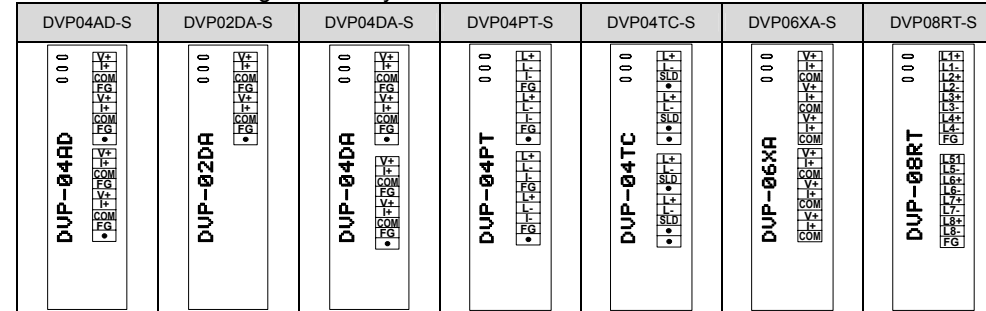
3 STANDARD SPECIFICATIONS

3.1 Specifications

Digital/Analog (2D/A) Module	Voltage Output	Current Output
Power Supply Voltage	24 VDC (20.4VDC~28.8VDC) (−15%~+20%)	
Analog Input Channel	2 channels / each module	
Analog Output Range	0~10V	0~20mA
Digital Data Range	0~4000	0~4000
Resolution	12 bits (1$_{LSB}$=2.5 mV)	12 bits (1$_{LSB}$=5 μA)
Output Impedance	0.5Ω or lower	
Overall Accuracy	±0.5% of full scale of 25℃ (77℉) ±1% of full scale during 0~55℃ (32~131℉)	
Response Time	3 ms × channels	
Max. Output Current	20mA (1KΩ~2MΩ)	—
Tolerance Carried Impedance	—	0~500Ω
Digital Data Format	2's complementary of 16-bit, 13 Significant Bits	
Isolation Method	Isolation between digital area and analog area. But no isolation among channels.	
Protection	Voltage output has short circuit protection but a long period of short circuit may cause internal wire damage and current output break.	
Communication Mode (RS-485)	MODBUS ASCII/RTU Mode. Communication baud rate of 4800 / 9600 / 19200 / 38400 / 57600 / 115200. For ASCII mode, format is 7Bits, even, 1 stop bit (7 E 1), while RTU mode format is 8Bits, even, 1 stop bit (8 E 1). The RS-485 is disabled when the DVP02AD-S is connected in series with an MPU.	
Connect to DVP-PLC MPU in Series	If DVP02DA-S modules are connected to MPU, the modules are numbered from 0 − 7. 0 is the closest and 7 is the furthest to the MPU. 8 modules is the max and they do not occupy any digital I/O points of the MPU.	

3.2 Other Specification

Max. Rated Consuming Power	24 VDC (20.4VDC~28.8VDC) (−15%~+20%), 3W, supply from external power
Environment Condition and Wiring	Follow the DVP-PLC MPU
Spec of Prevent Static Electricity	All places between terminals and ground comply with the spec

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4 CR (Control Register)

DVP-02DA Analog Output Module

CR No	RS-485 Parameters Address	Latched	Register Name	Explanation b15...b0
#0	H 4032	○ R	Model type	System used, data length is 8 bits (b7~b0). DVP-04AD model code=H 49
#1	H 4033	○ R/W	Output mode setting	Reserved / CH2 / CH1 — Output mode setting: factory setting is H0000. Mode 0: output voltage mode (0V~10V). Mode 1: output voltage mode (2V~10V). Mode 2: output current mode (4mA~20mA). Mode 3: output current mode (0mA~20mA). Mode 4: none use.
#2 ~ #9			Reserved	
#10	H 403C	○ R/W	CH1 output value	The output setting range of channel CH1~CH2 is K0~K4000. Factory setting is K0 and unit is LSB.
#11	H 403D	○ R/W	CH2 output value	
#12~#21			Reserved	
#22	H 4048	○ R/W	To adjust OFFSET value of CH1	It is used to set the OFFSET value of CH1~CH2. The setting range is K-2000~K2000. The factory setting is K0 and unit is LSB.
#23	H 4049	○ R/W	To adjust OFFSET value of CH2	
#24 ~ #27			Reserved	
#28	H 404E	○ R/W	To adjust GAIN value of CH1	It is used to set the GAIN value of CH~CH2. The setting range is K-1600~K8000. The factory setting is K2000 and unit is LSB.
#29	H 404F	○ R/W	To adjust GAIN value of CH2	
#30	H 4050	✕ R	Error status	It is the data register to save all error status. Please refer to fault code chart for detail.
#31	H 4051	○ R/W	Communication address setting	It is used to set RS-485 communication address. The setting range is from 01 to 255 and the factory setting is K1.
#32	H 4052	○ R/W	Communication Baud Rate setting	It is used to set communication baud rate (4800, 9600, 19200, 38400, 57600, 115200bps). Communication format: ASCII mode is 7Bit, even bit, 1 stop bit (7 E 1), while RTU mode is 8Bit, even bit, 1 stop bit (8 E 1). b0: 4800 bps (bit/sec). b1: 9600 bps (bit/sec). (factory setting) b2: 19200 bps (bit/sec). b3: 38400 bps (bit/sec). b4: 57600 bps (bit/sec). b5: 115200 bps (bit/sec). b6-b13: reserved. b14: exchange low and high byte of CRC check code (only for RTU mode) b15: ASCII / RTU mode selection
#33	H 4053	○ R/W	Reset to factory setting and set characteristics adjustable priority	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 / Reserved / CH2 / CH1 — Output latched setting, factory setting H0000. Give CH1 setting for example: 1. When b0=0, user can set OFFSET and GAIN value of CH1 (CR#22, CR#28). When b1=1, inhibit user to adjust OFFSET and GAIN value of CH1 (CR#22, CR#28). 2. b1 means if characteristic register is latched. b1=0 (factory setting, latched), b1=1 (not latched). 3. When b2 is set to 1, all settings will be reset to factory setting.
#34	H 4054	○ R	Software version.	In hexadecimal to display software version. For example: H 010A means 1.0A.
#35~#48			System used	

○ means latched. , ✕ means not latched.
R means can read data by using FROM command via RS-485.
W means can write data by using TO command via RS-485.
LSB (Least Significant Bit): 1. Voltage output: 1$_{LSB}$=10V/8000=2.5mV. 2. Current output: 1$_{LSB}$=20mA/4000=5μA.

Explanation:

1. The content of CR#0 is model type, user can read the data from program to check if there is expansion module.

2. CR#1 is used to set two internal channels working mode of analog output module. Every channel has four modes to set that can set individually. For example: if set CH1 to mode 2 (b2~b0=010), CH2 to mode 1(b5~b3=001). It needs to set CR#1 to H000A. The factory setting of CR#1 is H0000.

3. CR#2 ~ CR#9, CR#12 ~ CR#21, CR#24 ~ CR#27 Reserved.

4. CR #10 ~ CR#11 display CH1 and CH2 output signal. The setting range is K0~K4000. Factory setting is K0 and unit is LSB.

5. R#22 ~ CR#23 means the value to adjust OFFSET value of CH1 and CH2. The factory setting is K0 and unit is LSB. If output value equal to 0 after calculating, the adjustable range of analog output voltage or current is -2000~+2000.
Voltage adjustable range: -5V~+5V(-2000$_{LSB}$~+2000$_{LSB}$).
Current adjustable range: -10mA~+10mA (-2000$_{LSB}$~+2000$_{LSB}$).

6. R#28 ~ CR#29 means the value of adjust GAIN value of CH1 and CH2. The factory setting is K2000 and unit is LSB. If output value equal to 2000 after calculating, the adjustable range of analog output voltage or current is -1600~+8000.
Voltage adjustable range: -4V~+20V(-1600$_{LSB}$~+8000$_{LSB}$).
Current adjustable range: -8mA~+40mA (-1600$_{LSB}$~+8000$_{LSB}$).
Please be noticed that GAIN VALUE – OFFSET VALUE = +400$_{LSB}$ ~+6000$_{LSB}$ (voltage or current). When this value within this range, the resolution of the output signal will be thin and the value variation will be larger. When this value exceeds this range, the resolution of output signal will be thick and the variation of value will be smaller.

7. CR#30 is the fault code. Please refer to the following chart.

Fault Description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
Power Source Abnormal	K1(H1)		0	0	0	0	0	0	0	1
Analog Input Value Error	K2(H2)		0	0	0	0	0	0	1	0
Setting Mode Error	K4(H4)		0	0	0	0	0	1	0	0
Offset/Gain Error	K8(H8)		0	0	0	0	1	0	0	0
Hardware Malfunction	K16(H10)	Reserved	0	0	0	1	0	0	0	0
Digital Range Error	K32(H20)		0	0	1	0	0	0	0	0
Average Times Setting Error	K64(H40)		0	1	0	0	0	0	0	0
Command Error	K128(H80)		1	0	0	0	0	0	0	0

Note: Each fault code will have corresponding bit (b0~b7). Two or more faults may happen at the same time. 0 means normal and 1 means fault happened.

8. CR#31 is used to set RS-485 communication address. The setting range is from 01 to 254. The factory setting is K1.

9. CR#32 is used to set RS-485 communication baud rate: 4800, 9600, 19200, 38400, 57600, 115200 bps, b0: 4800bps, b1: 9600bps, (factory setting) b2: 19200bps, b3: 38400 bps, b4: 57600 bps, b5: 115200 bps, b6-b13: reserved, b14: exchange low and high byte of CRC check code. (only for RTU mode) b15=0: ASCII mode, =1: RTU mode.

10. CR#33 is used to set the internal function priority. For example: characteristic register. Output latched function will save output setting to the internal memory before power loss.

11. CR#34 is software version of model type.

12. CR#35~ CR#48 are used for system.

13. The corresponding parameters address H4032~H4062 of CR#0~CR#48 are provided for user to read/write data via RS-485.

  A. Communication baud rate: 4800, 9600, 19200, 38400, 57600, 115200 bps.
  B. Communication format: ASCII mode is 7Bit, even bit, 1 stop bit (7 E 1). Communication format of RTU mode is 8Bit, even bit, 1 stop bit (8 E 1).
  C. Function code: 03H—read data from register. 06H—write one WORD into register. 10H—write multiple WORD into register.

| 5	Adjust D/A Conversion Characteristic Curve

5.1 Adjust D/A Conversion Characteristic Curve

Voltage output mode
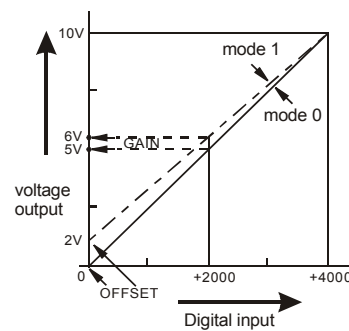
Mode 0 of CR#1: GAIN = 5V(2000_{LSB}), OFFSET=0V (0_{LSB})
Mode 1 of CR#1: GAIN = 6V(2400_{LSB}), OFFSET=2V (800_{LSB})

GAIN: The setting range of voltage output value when digital input value is K2000 should be -4V~+20V(-1600_{LSB} ~+8000 $_{LSB}$).

OFFSET: The setting range of voltage output value when digital input value is K0 should be -5V~+5V(-2000_{LSB} ~ +2000 $_{LSB}$).

GAIN−OFFSET: Setting range: +1V~+15V (+400_{LSB} ~ +6000 $_{LSB}$).
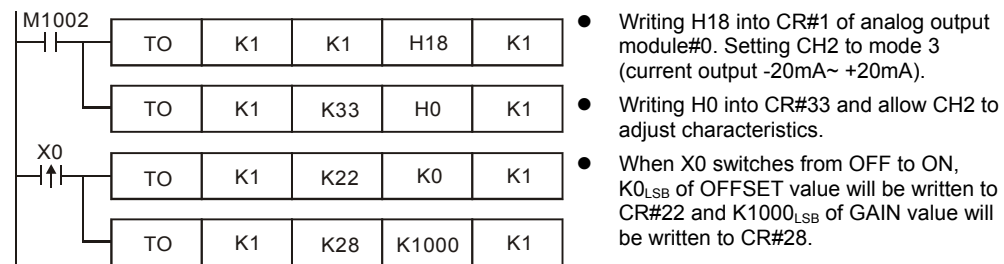
Current output mode
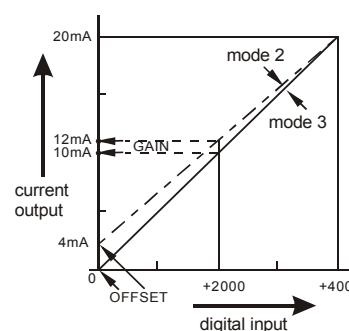
Mode 2 of CR#1: GAIN = 12mA(2400_{LSB}), OFFSET=4mA (800_{LSB}).
Mode 3 of CR#1: GAIN = 10mA(2000_{LSB}), OFFSET=0mA (0_{LSB}).

GAIN: The setting range of current output when digital input value is K2000 should be -8mA~+40mA (-1600_{LSB} ~+8000$_{LSB}$).

OFFSET: The setting range of current output when digital input value is K0 should be -10mA ~+10mA (-2000_{LSB} ~+2000$_{LSB}$).

GAIN−OFFSET: Setting range: +2mA~+30mA (+400_{LSB} ~+6000$_{LSB}$).

The charts above are D/A conversion characteristic curve of voltage input mode and current input mode. Users can adjust conversion characteristic curve by changing OFFSET values (CR#22~CR#23) and GAIN values (CR#28~CR#29) depend on application.

LSB (Least Significant Bit): 1.voltage input: 1_{LSB}=10V/8000=2.5mV. 2.current input: 1_{LSB}=20mA/4000=5μA.

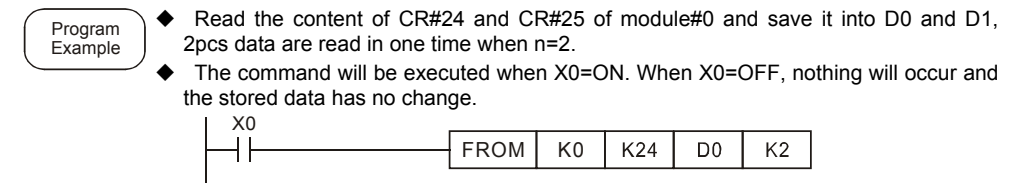## 5.2 Program Example for Adjusting D/A Conversion Characteristics Curve

Example 1: Setting OFFSET value of CH1 to 0V(=$K0_{LSB}$) and GAIN value is 2.5V(=$K1000_{LSB}$).

● Writing H18 into CR#1 of analog output module#0. Setting CH2 to mode 3 (current output -20mA~ +20mA).
● Writing H0 into CR#33 and allow CH2 to adjust characteristics.
● When X0 switches from OFF to ON, $K0_{LSB}$ of OFFSET value will be written to CR#22 and $K1000_{LSB}$ of GAIN value will be written to CR#28.

Example 2: Setting OFFSET value of CH2 to 2mA (=$K400_{LSB}$) and GAIN value to 18mA (=$K3600_{LSB}$).
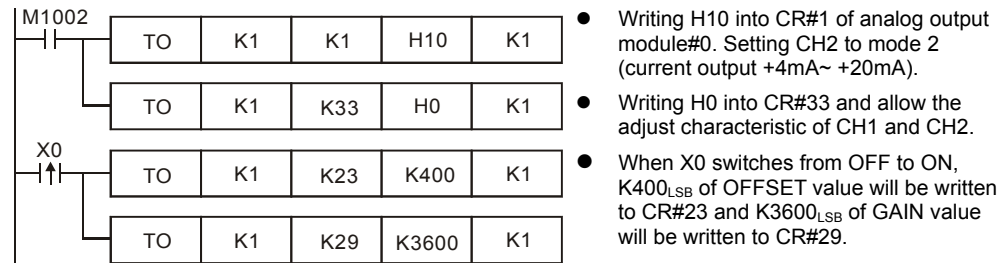
● Writing H10 into CR#1 of analog output module#0. Setting CH2 to mode 2 (current output +4mA~ +20mA).
● Writing H0 into CR#33 and allow the adjust characteristic of CH1 and CH2.
● When X0 switches from OFF to ON, $K400_{LSB}$ of OFFSET value will be written to CR#23 and $K3600_{LSB}$ of GAIN value will be written to CR#29.

6	Initial PLC Start-up

■ Lamp display
1. When power is on, POWER LED will be lit and ERROR LED will be lit for 0.5 second.
2. Normal run: POWER LED should be lit and ERROR LED should turn off. When power supply is lower than 19.5V, ERROR LED will blink continuously till the power supply is higher than 19.5V.
3. When it connects to PLC MPU in series, RUN LED on MPU will be lit and A/D LED or D/A LED should blink.
4. After receiving the first RS-485 command during controlling by RS-485, A/D LED or D/A LED should blink.
5. After converting, ERROR LED should blink if input or output exceeds upper bound or below the lower bound.

■ Program example:
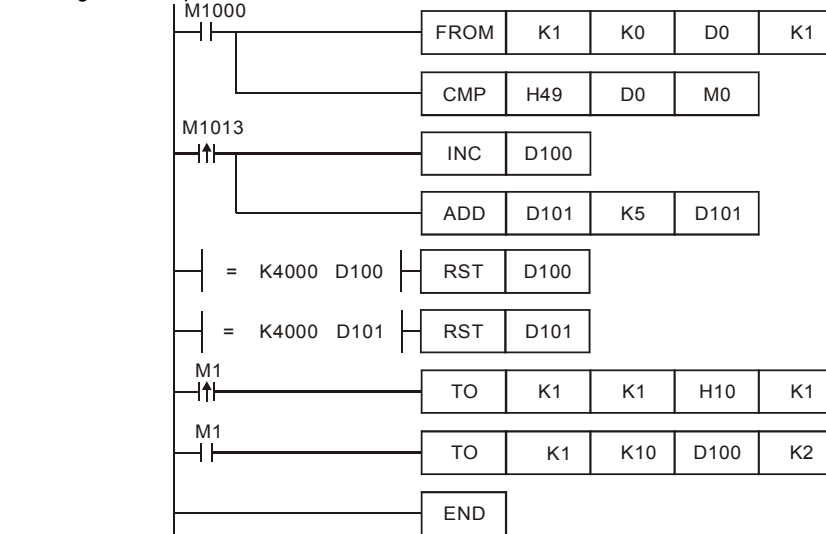
Explanation:
● Reading the data of model type from expansion module K1 and check to see if the data is H49 (DVP-02DA-S model type).
● D100 will increase K1 and D101 will increase K5 every second.
● When value of D100 and D101 attain to K4000, they will be reset to 0.
● For DVP-02DA-S model, M1 will be on and set the output mode: CH1 mode to 0, CH2 mode to 2.
● Writing output setting CR#10 and CR#11 to D100 and D101. Analog output will vary with D100 and D101 value.

7	Command Explanation

API								Adaptive model
78	D	FROM	P	(m1) (m2) (D) (n)		Read special module CR data		ES EP EH
								✓ ✓ ✓

	Bit device				Word device													
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F	
m1					*	*										
m2					*	*										
D							*	*	*	*	*	*	*	*	*	
n					*	*										

16-bit command (9 STEPS): FROM Continuous execution, FROMP Pulse execution
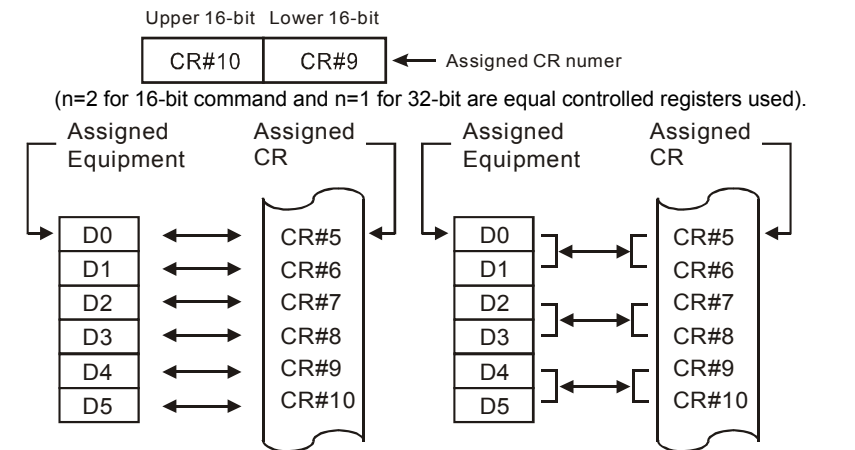32-bit command (17 STEPS): DFROM Continuous execution, DFROMP Pulse execution

● Note: The usage range of operand m1 is 0~7. The usage range of operand m2: ES/EP: 0-48, EH: 0-254. The usage range of operand n: ES/EP: n= 1~(49-m2), EH: 1~(255-m2). ES series model doesn't support pulse execution command (FROMP, DFROMP).

● Flag: When M1083=On, it allows to enable interrupt during FROM/TO. Refer to following for detail.

Command Explanation
◆ (m1): the module number you are probing. (m2): the number of Controlled Registers to be read. (D): the data register location for storing data. (n): the number of CRs to read at one time.
◆ DVP-series PLC uses this command to read CR data of each special module.
◆ (D): When assigning bit operand, K1~K4 are used for 16-bit and K5~K8 are used for 32-bit.
◆ Please refer the footnote below for calculation of the special module number.

Program Example
◆ Read the content of CR#24 and CR#25 of module#0 and save it into D0 and D1, 2pcs data are read in one time when n=2.
◆ The command will be executed when X0=ON. When X0=OFF, nothing will occur and the stored data has no change.

API								Adaptive model
79	D	TO	P	(m1) (m2) (S) (n)		Special module CR data write		ES EP EH
								✓ ✓ ✓

	Bit device				Word device													
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F	
m1					*	*										
m2					*	*										
S					*	*	*	*	*	*	*	*	*	*	*	
n					*	*										

16-bit command (9 STEPS): TO Continuous execution, TOP Pulse execution
32-bit command (17 STEPS): DTO Continuous execution, DTOP Pulse execution

● Note: The usage range of operand m1 is 0~7. The usage range of operand m2: ES/EP: 0-48, EH: 0-254. The usage range of operand n: ES/EP: n= 1~(49-m2), EH: 1~(255-m2). For ES series, it doesn't support pulse execution command (TOP, DTOP)

● Flag: When M1083 On, it allows to enable interrupt during FROM/TO. Refer to following for detail.

Command Explanation
◆ (m1): the module number you are probing. (m2): the number of Controlled Registers that will be written to. (S): the data to write. (n): the number of CRs to write to one time.
◆ DVP-series PLC uses this command to write data into Controlled Registers of special modules.
◆ (S): When assigning bit operand, K1~K4 are used for 16-bit and K5~K8 are used for 32-bit.

Program Example
◆ Using the 32-bit command DTO. The program will write D11 and D10 into CR#3 and CR#2 of special module#0. DTO only allows one group of data to be written at a time (n=1).
◆ Command is executed when X0=ON, command won't be executed when X0=OFF, and the stored data will have no change.


Footnote
◆ The rules for adding multiple special modules to a Main Processing Unit:
  ◆ m1: The maximum number of special modules attached to an MPU is 8. The order of module closest to the MPU is 0, and the module furthest from the MPU is 7.
  ◆ m2: The number of Controlled Registers (CR) built in is 49. (#0~#48).
  ◆ FROM/TO command read/write 16-bit CR data in one command, while DFROM/DTO command to read/write 32-bit CR data in one command. Example below:

Upper 16-bit Lower 16-bit

CR#10	CR#9	← Assigned CR numer

(n=2 for 16-bit command and n=1 for 32-bit are equal controlled registers used).

16-bit command when n=6   32-bit command when n=3

◆ In ES series models, flag M1083 is not provided. When FROM/TO command is executed, all interrupts (including external or internal interrupt subroutines) will be disabled. All interrupts will be executed after FROM/TO command is completed. Besides, FROM/TO command also can be executed in the interrupt subroutine.
◆ The function of the flag M1083 (FROM/TO mode exchange) provided in EP/EH series models:
  1. When M1083=Off, all interrupts (including external or internal interrupt subroutines) will be disabled when FROM/TO command is executed. The Interrupts will resumed after FROM/TO command complete. Please be advised FROM/TO command can be executed in the interrupt subroutine.
  2. When M1083=On, if an interrupt enable occurs while FROM/TO command are executing, the interrupt FROM/TO command will be blocked till the requested interrupt finish. Unlike M1080 off situation, FROM/TO command cannot be executed in the interrupt subroutine.

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