

How to wire SINAMICS V drive with a third party PLC

SINAMICS V / V2.0

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1 Introduction

1.1 Introduction of PNP and NPN

The figure 1-1 is the PNP output and the NPN output.

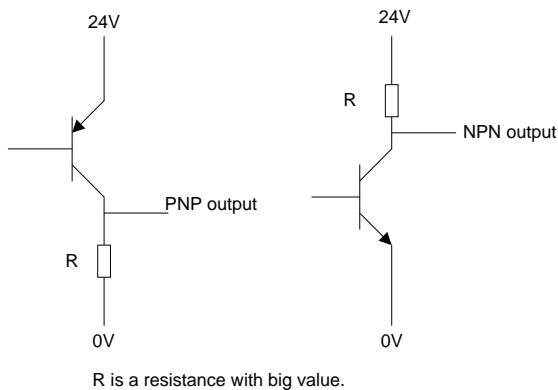


Figure 1-1

For the NPN output, the current is inflow to the output point and for the PNP output the current is outflow to the output point. Normally the NPN output low voltage (0V) and the PNP output high voltage (24V).

1.2 Introduction of common anode and common cathode

The figure 1-2 is the connection of common anode and the connection of common cathode.

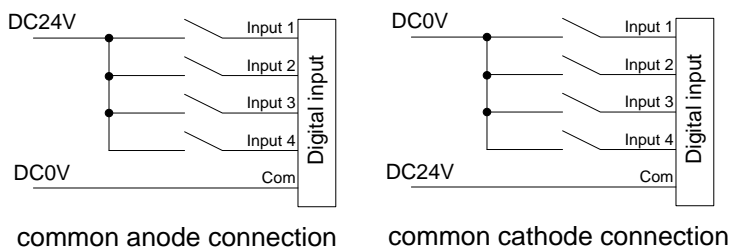


Figure 1-2

For the common anode connection the current outflow from the input terminal and for the common cathode connection the current inflow to the input terminal. The current direction is opposite.

1.3 Introduction of SINAMICS V drive terminal

1.3.1 The control terminal of SINAMICS V20

There is 19 control pins in the SINAMICS V20 drive. See the figure 1-3.

10 V	AI 1	AI 2	AO 1	0 V	P +	N -	DI 1	DI 2	DI 3	DI 4	DI C	24 V	0 V	DO 1+	DO 1-	DO 2 NC	DO 2 NO	DO 2 C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Figure 1-3

There are 2 analog inputs: one analog output, 4 digital inputs and 2 digital outputs. Digital output 1 is the transistor output and digital output 2 is the relay output. The RS485 contains also a communication terminal. If there is no analog input then the two analog inputs also can be used as a digital input.

Pin 5 is the reference potential terminal for the analog input and analog output.

Pin 1 is the 10V output for the power supply of the drive analog input. Pin 13 and pin 14 are the 24V output.

It can be used as the source of the drive digital input.

The table 1-1 is the factory setting about the SINAMICS V20 digital input and digital output:

Table 1-1

Item	Pin	Comments
1	DI1	Forbidden
2	DI2	Forbidden
3	DI3	Fault acknowledge
4	DI4	Fixed frequency selection bit 0
5	DO1	Invert fault active
6	DO2	Invert warning active

1.3.2 The control terminal of SINAMICS V90

There are 50 control pins in the SINAMICS V90 drive. See the figure 1-4.

24	22	20	18	16	14	12	10	8	6	4	2	
	AI2-	AI1-	P12AI	PTOA -	DI10	DI8	DI6	DI4	DI2	DI_C OM	PTIA_ D-	
25	23	21	19	17	15	13	11	9	7	5	3	1
	Brake	AI2+	AI1+	PTOZ (OC)	PTOA +	DI9	DI7	DI5	DI3	DI1	DI_C OM	PTIA_ D+
49	47	45	43	41	39	37	35	33	31	29	27	
MEXT _DO	AO_M	AO_M	PTOZ-	PTOB -	PTIB_ 24M	PTIA_ 24M	DO6	DO4	DO2	P24V_ DO	PTIB_ D+	
50	48	46	44	42	40	38	36	34	32	30	28	26
MEXT _DO	AO2	AO1		PTOZ +	PTOB +	PTIB_ 24P	PTIA_ 24P	DO5	DO3	DO1	P24V_ DO	PTIB_ D+

Figure 1-4 Control pins in SINAMICS V90

The hardware version from FS02 and later for V90 200V; FS04 and later for V90 400V, some pins is redefined. DO4 to DO6 support NPN and PNP wiring.

Figure 1-5 show the redefined type.

24	22	20	18	16	14	12	10	8	6	4	2	
M	AI2-	AI1-	P12AI	PTOA -	DI10	DI8	DI6	DI4	DI2	DI_C OM	PTIA_ D-	
25	23	21	19	17	15	13	11	9	7	5	3	1
PTOZ _M(O C)	Brake	AI2+	AI1+	PTOZ (OC)	PTOA +	DI9	DI7	DI5	DI3	DI1	DI_C OM	PTIA_ D+
49	47	45	43	41	39	37	35	33	31	29	27	
DO6-	AO_M	AO_M	PTOZ-	PTOB -	PTIB_ 24M	PTIA_ 24M	DO6+	DO4-	DO2	DO4+	PTIB_ D+	
50	48	46	44	42	40	38	36	34	32	30	28	26
MEXT _DO	AO2	AO1	DO5-	PTOZ +	PTOB +	PTIB_ 24P	PTIA_ 24P	DO5+	DO3	DO1	P24V_ DO	PTIB_ D+

Figure 1-5 Control pins in redefined SINAMICS V90

Figure 1-6 shows how to wire the output as NPN or PNP type. Only DO4 to DO6 support this wiring.

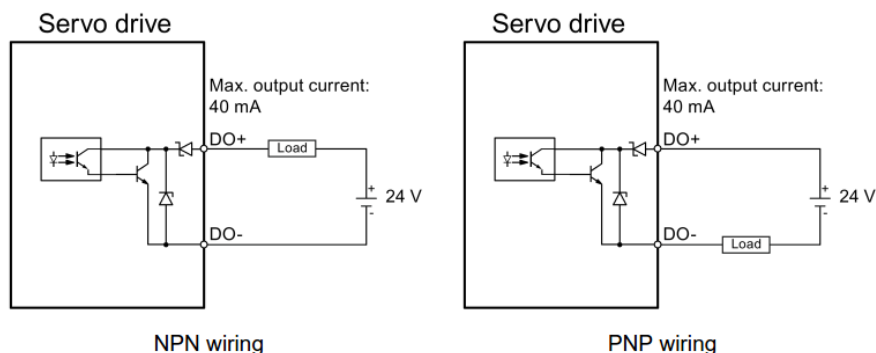


Figure 1-6 NPN wiring and PNP wiring

The table 1-2 is the factory setting about the SINAMICS V90 digital input and digital output:

Table 1-2

Item	Pin	Comments
1	DI1	SON
2	DI2	RESET
3	DI3	CWL
4	DI4	CCWL
5	DI5	G_CHANGE
6	DI6	NOT USED
7	DI7	CLR
8	DI8	TLIM1
9	DI9	EMGS
10	DI10	C_MODE
11	DO1	RDY
12	DO2	FAULT
13	DO3	INP
14	DO4	NOT USED
15	DO5	TLR
16	DO6	MBR

There are 2 analog inputs, 1 analog output, 10 digital inputs, 6 digital outputs, 2 channel pulse train inputs and 1 channel pulse train output.

Pin 23 is effective only for the 200V drive and it's used to control the motor brake of the 1FL6 LI motor. The recommended circuit for it is as the figure 1-7.

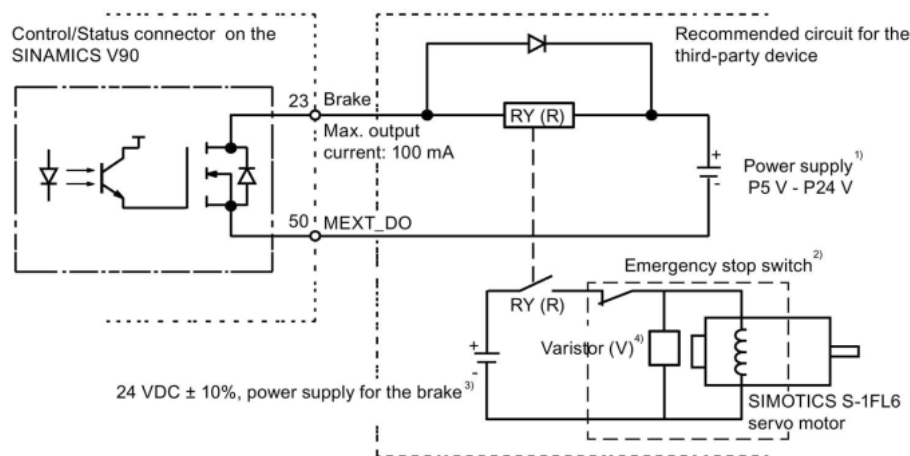


Figure 1-7

NOTE

1. It is the isolated digital output power supply. When you use the 24 VDC power supply, it can be also the controller power supply.
2. The motor brake can be controlled not only by the brake control signal from the SINAMICS V90 servo drive but also by external emergency stop.
3. Never use the same power supply for the brake (24 VDC) and for the brake control signal (P24 V).
4. Install a surge absorber as the above figure shows to suppress surge voltage generated by ON/OFF action of the relay (RY). When you use a diode, the time from the brake release to brake engagement is slower than the case when you use a surge absorber.

Pin 1, pin 2, pin 26 and pin 27 are the 5V differential signal for pulse train input. The pin 15, pin 16, pin 40, pin 41, pin 42 and pin 43 are the 5V differential signal for pulse train output. The 5V differential signal wave should be the same as figure 1-6. If the signal does not match the figure 1-8, then it can't be connected to the 5V differential pulse train input channel. At the same time, the 5V differential pulse train output can't be connected to other controllers whose input signal is not the differential signal.

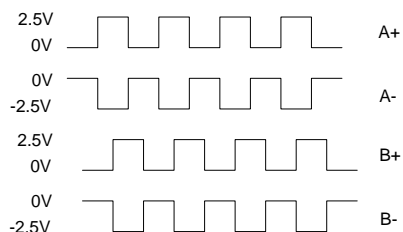


Figure 1-8

Pin 17 is the PNP digital output. Normally the output is high resistance status. If the motor reach the encoder zero mark position then this output will be "0V" only for one pulse.

1.3.3 Communication serial terminal of SINAMICS V90

The SINAMICS V90 drive also has the RS485 communication terminal. It uses the 9 pin Sub-D interface. The description of each pin of the Sub-D is described in the figure 1-9. Pin 3 and pin 8 are used for communication.

Illustration	Pin	Signal name	Description
	1	Reserved	Do not use
	2	Reserved	Do not use
	3	RS485+	RS485 differential signal
	4	Reserved	Do not use
	5	M	Ground to internal 3.3 V
	6	3.3 V	3.3 V power supply for internal signal
	7	Reserved	Do not use
	8	RS485-	RS485 differential signal
	9	Reserved	Do not use
Type: 9-pin, Sub-D, female			

Figure 1-9

1.4 Wiring of SINAMICS V20 drive with third PLC

The connection of V20 input is described in figure 1-10. It depends on the PLC output.

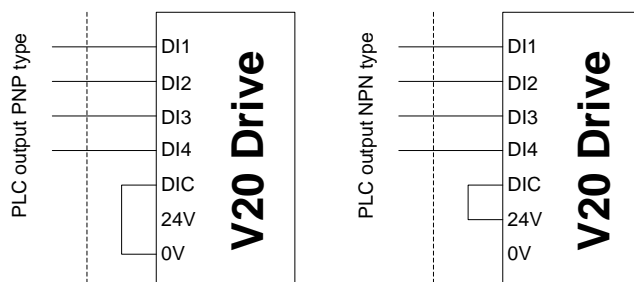


Figure 1-10

If the third party PLC output is NPN type then the V20 input should be common cathode connection type. If the third party PLC output is PNP type then the V20 input should be common anode connection type.

The connection of V20 output is as figure 1-11.

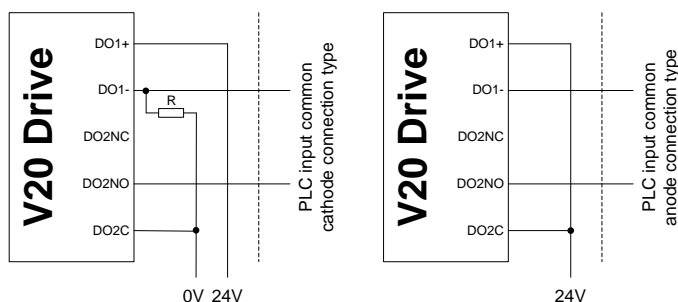


Figure 1-11

The DO1 is the PNP type. This means the DO1 of V20 only can be an output 24V or high resistance status. If the PLC input is common cathode connection type, then we need to connect one resistor between the 0V and the output terminal. At this condition - if the drive internal output is 1 then the external output is 24V. If the drive internal output is 0 then the external output is 0V. If the PLC input is common cathode connection type then the DO1 is NC (normally closed) mode. If the PLC input is common anode connection type then the DO1 is NO (normally open) mode. The suggestion for the resistor value in figure 1-11 is 100kΩ.

The DO2 output is a relay type. Customer can wire it like they need it. The DO2C is the common terminal, DO2NC is the NC output and DO2NO is the NO output.

The Modbus communication of V20 is as figure 1-12.

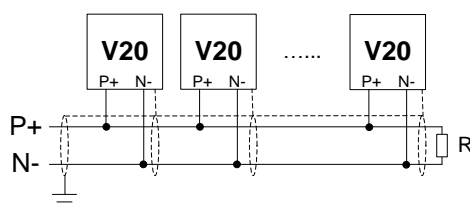


Figure 1-12

For the terminal resistor the customer can buy it from SIEMENS. The order number is 6SL3255-0VC00-0HA0. It is also possible that customer can make it by themselves according to the OPI manual page 141.

The link of the OPI manual is the following:

<https://support.industry.siemens.com/cs/ww/en/view/109482043>

The version of the V20 OPI should be 12/2015.

1.5 Wiring of SINAMICS V90 drive with third PLC

The connection of V90 input is as figure 1-13.

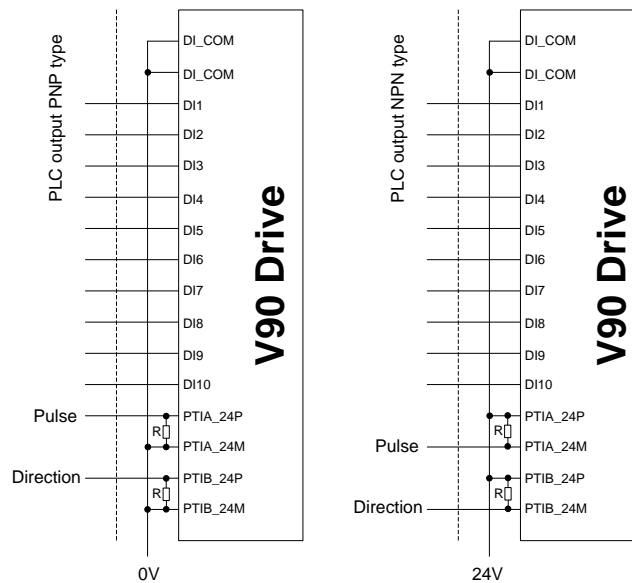


Figure 1-13

If the third party PLC output is NPN type then the V90 input should be common cathode connection type. If the third party PLC output is PNP type then the V90 input should be common anode connection type.

For the V90's first pulse train input channel the PTIA input is the pulse signal and the PTIB is the direction signal. If the frequency of the pulse train is higher than 300 kHz then it's better to connect the resistor between the 24P and 24M. The suggestion for the resistor value in figure 1-12 is 200 Ω to 500 Ω with $P \geq 5W$.

The connection of V90 output is as figure 1-14.

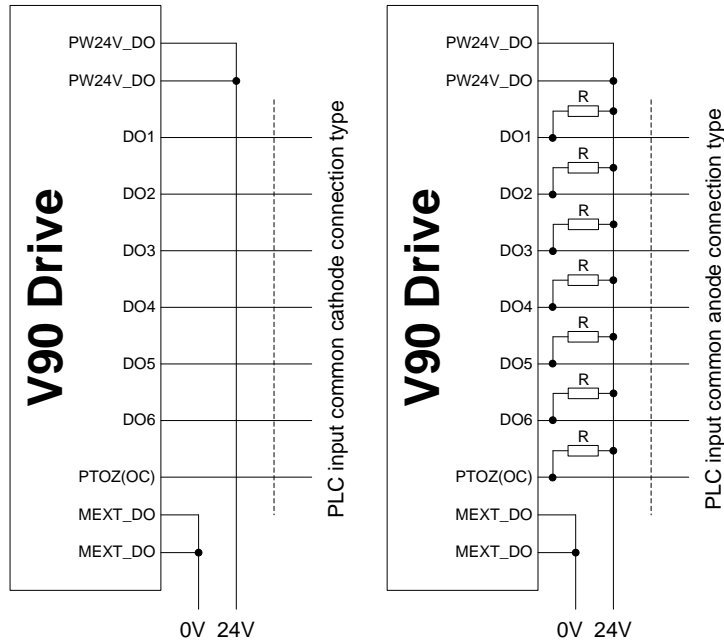


Figure 1-14

The V90 output is the NPN type. That's means the V90 only can output 0V or high resistance status. If the PLC input is common anode connection type then we need to connect one resistor between the DC24V and the output terminal. With this condition - if the drive internal output is 1 then the external output is 0V. If the drive internal output is 0 then the external output is 24V. The characteristic of PTOZ (OC) output is almost the same as the digital output - the difference is caused that the PTOZ (OC) output is only one pulse. The suggestion for the resistor value is 200 Ω to 500 Ω with $P \geq 5W$. If the PLC input is common cathode connection type then the V90 output is NO mode. If the PLC input is common anode connection type, then the V90 output is NC mode.

The Modbus communication connection V90 is as figure 1-15.

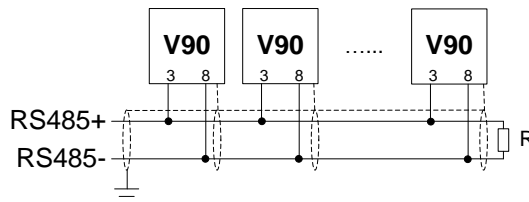


Figure 1-15

If the V90 drive main power supply is 400V then the communication terminal is X12. If the V90 drive main power supply is 200V then the communication terminal is X8. Customer can make the terminal by themselves with connecting one 120Ω resistor between the pin 3 and pin 8. Also a customer can buy the PROFIBUS DP connector from Siemens. With this connector the terminal resistor is already included. The article number of this connector is 6ES7972-0BA42-0XA0.

The connection of 5V differential signal is as figure 1-16.

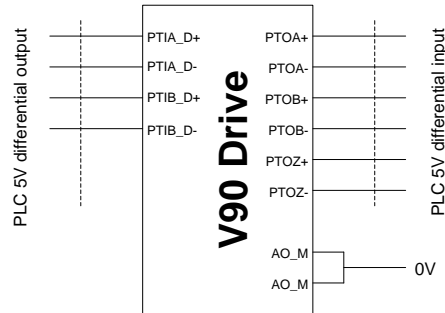


Figure 1-16

If the analog output is not used then the analog output common terminal should be connected to 0V. This 0V should be the same 0V supply voltage like the PLC.

The link of the V90 OPI manual is the following:

<https://support.industry.siemens.com/cs/ww/en/view/109480673>

2 Example

2.1 V90 drive connects to third party PLC (Japan)

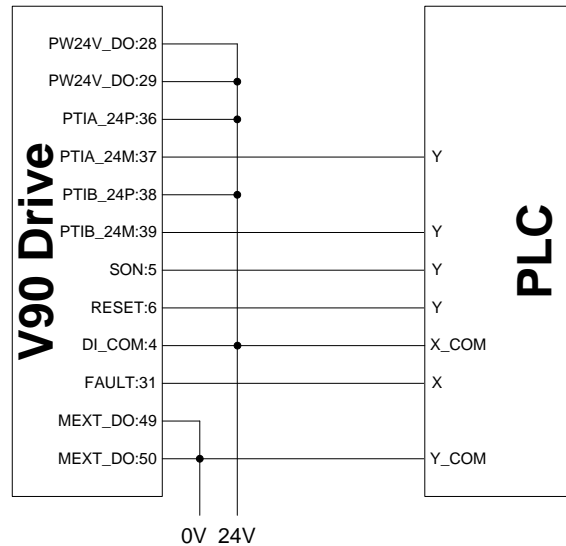


Figure 2-1 Example for V90 connected with Japan PLC

Figure 2-1 is one example of V90 connects to the Japan PLC via PTI control mode. The PLC output is NPN type and the PLC input is common cathode connection type. The PTIA_24M should connect to the pulse output from the PLC and the PTIB_24M should connect to the direction output from the PLC. The other input and output from the V90 can be connected to the normal output and input from the PLC.

This example is used in a labeling machine. It uses the Panasonic PLC to send the pulses and direction to the V90 drive. The drive works in the PTI mode.

2.2 V20 drive connects to third party PLC (Taiwan)

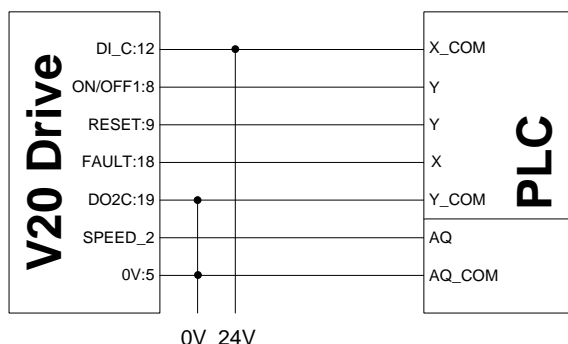


Figure 2-2 Example for V20 connected with Taiwan PLC

Figure 2-2 is one example of a V20 connected to the Taiwan PLC. The PLC output is NPN type and the PLC input is common cathode connection type.

This example is used in a cutting machine. It uses the Delta PLC to send the command via digital output and speed via analog output to control the V20. The drive works in speed mode.

3 Contact

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4 History

Table 4-1

Version	Date	Modifications
V1.0	09/2016	First version
V2.0	01/2018	Update the V90 DO output which support NPN and PNP wiring.