Entry type: **FAQ**, Entry ID: **87560033**, Entry date: **03/26/2014**

ET200S TECHNOLOGICAL FUNCTIONS —— 1COUNT

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Part 1: ET200S process module 1Count24V/100kHz

1. Overview

ET200S process module is mainly in 4 types: 1Count24V/100kHz, 1Count5V/500kHz, 1SSI and 2PULSE. This paper uses a simple debugging routine to describe how to set the functional applications of ET200S process module 1Count24V/100kHz according to the process requirements, as well as its related software and hardware for application, operation and test.
The process module 1Count24V/100kHz has the following main Operating modes:
1) Count mode: including Continuous counting, Cyclic counting and Single counting
2) Measurement mode: including frequency measuring, cyclic measurement and speed measuring
3) Position detection: this mode is a part of the continuous counting function and is used as a pure input module in Isochrone mode.
This paper mainly describes application of this module in Count mode, and the other modes such as Measurement mode, may be used by reference to the count function.

2. Hardware architecture of system

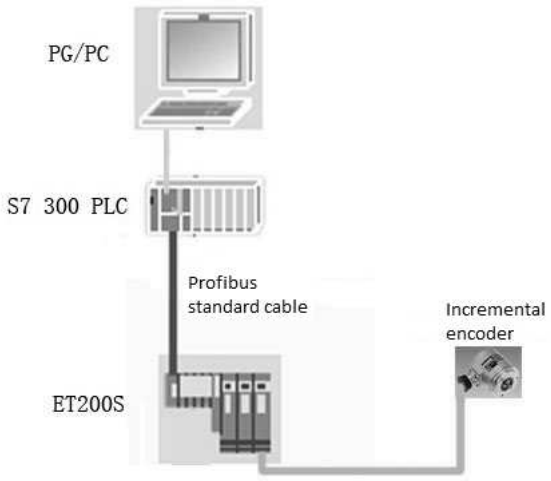

Fig. 1: Hardware Architecture of system

In this example, a S7-300 PLC reads the count data from 24V incremental encoder through ET200S module 1Count24V/100kHz and monitors the rotation state.
Shown in Fig. 1 is configuration of the sample system, which includes the following hardware:
• one laptop or PG/PC
• one CP5512
• one S7-300 PLC
• one ET200S system

3. Hardware and software demands

Table 3-1: Ordering information for hardware

Name	Quantity	Order number
IM151-1 STANDARD interface module and terminating module	1	6ES7151-1AA03-0AB0
TM-P15S23-A0 (screw-type terminal)	1	6ES7193-4CD20-0AA0
TM-E15S26-A1 (screw-type terminal)	1	6ES7193-4CA40-0AA0
PM-E 24–48 VDC/24–230 VAC	1	6ES7138-4CB10-0AB0
1 SSI, 1 unit	1	6ES7 138-4DB01-0AB0
1Count 24V/100kHz, 1 unit	1	6ES7 138-4DB01-0AB0
PROFIBUS FC Standard Cable		6XV1 830-0EH10
PROFIBUS FastConnect bus connector RS 485 with 90° cable outlet (with PG interface)	2	6ES7 972-0BB50-0XA0
CP 5512 communications processor	1	6GK1 551-2AA00
MPI cable For connecting SIMATIC S7 and the PG through MPI; length 5 m	1	6ES7 901-0BF00-0AA0
CPU 315-2 DP	1	6ES7315-2AG10-0AB0

Table 3-2: Ordering information for software

Name	Order number
STEP 7 Professional Edition 2004	6ES7 810-5CC08-0YA5

4. Installation and wiring of hardware

Type of connected encoder:
1) 24V pulse generator (without direction signal)
2) 24V pulse generator (with direction signal)
3) 24V incremental encoder

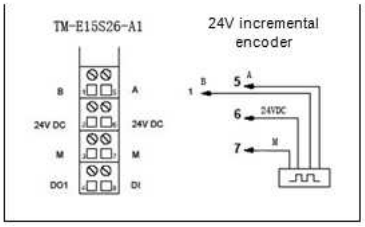

Fig. 2: Connection of encoder

5. System configuration and parameter setting

1) Hardware configuration
Connection shall be made according to Fig. 1: Hardware configuration diagram. One S7-300 PLC shall work as DP master to connect ET200S slave system, and the 24V incremental encoder shall be connected to ET200 1module Count24V/100kHz respectively according to Fig. 2: Wiring diagram.

2) System configuration and parameter setting
Build a new project with the name Latch_ET200S_1COUNT in STEP7 manager, insert one SIMATIC 300 STATION and name it 1COUNT. Then insert the rack, CPU, ET200S standard slave module and ET200S 1COUNT Counting module (selecting 1COUNT 24V/100kHz C module from the hardware list) successively according to the order numbers and hardware installation sequence.

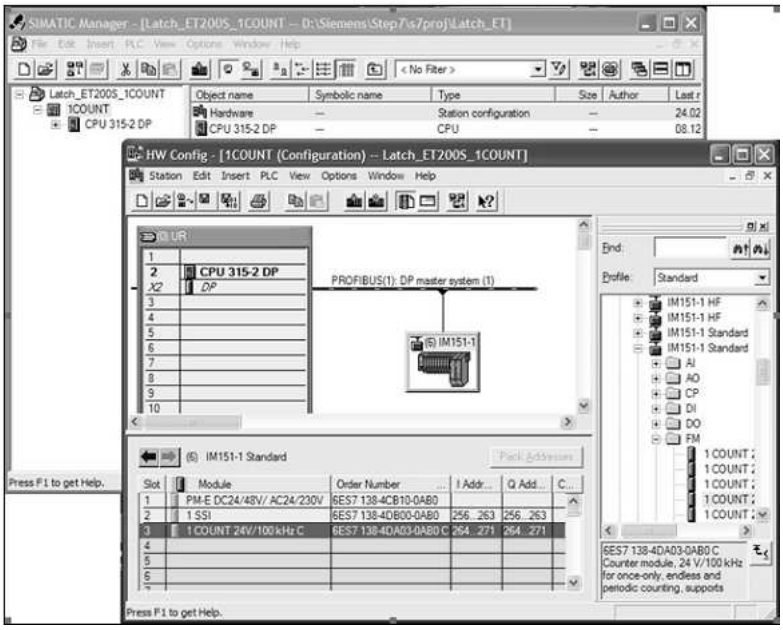

Fig. 3: Hardware configuration of master

The parameter configuration of ET200S 1COUNT module is seen in Fig. 4.

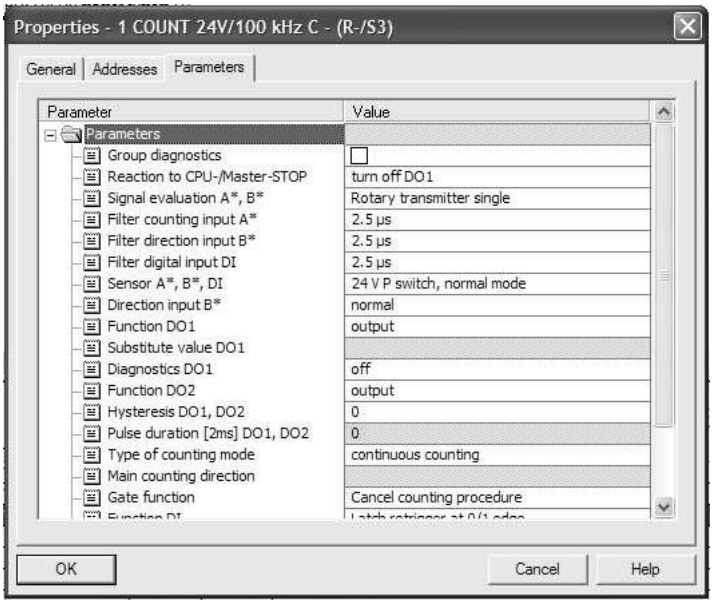

Fig. 4: Parameter configuration

The parameters Signal evaluation A* B* and Sensor A* B * DI shall be selected according to the connected encoder type, and PNP-type 24V incremental encoder is selected here.
The parameter Direction input B * may be set in positive or negative direction.
The parameter "Type of counting mode" may be set as 3 Count modes: Continuous counting, Cyclic counting and Single counting.
The other parameters may be set by selecting the default values.

3) Routine
Loop program OB1:
//Preset
L 0 // delete control bit
T DB1.DBD 0

```
T DB1.DBD 4
SET
S DB1.DBX4.0 //open softw are gate

//w rite control interface
L DB1.DBD 0 //w rite 8 digits into 1SSI module
T PQD 264
L DB1.DBD 4 //output start address
T PQD 268

// read feedback interface
L PID 264 // read 8 digits from 1SSI module
T DB1.DBD 8
L PID 268 //input start address
T DB1.DBD 12
```

As show n in Fig. 5, the parameter assignment of the control interface in hardw are configuration matches the 8 bytes (PQB264 - PQB271) in output area of the count module. In the above-stated routine, the 8 bytes (DB1.DBB0 to DB1.DBB7) in DB1 are used to deposit parameters of the control interface.

Byte 4	EXTF_ACK	Bit 7: Diagnostic error acknowledgment
	CTRL_DO2	Bit 6: Enable DO2
	SET_DO2	Bit 5: DO2 control bit
	CTRL_DO1	Bit 4: Enable DO1
	SET_DO1	Bit 3: DO1 control bit
	RES_STS	Bit 2: Start resetting of status bit
	CTRL_SYN	Bit 1: Enable synchronization
	SW_GATE	Bit 0: SW gate control bit
Byte 5		Bit 7: Reserve = 0
		Bit 6: Reserve = 0
		Bit 5: Reserve = 0
	C_DOPARAM	Bit 4: Change function and behavior of DO1, DO2
	CMP_VAL2	Bit 3: Load comparison value 2
	CMP_VAL1	Bit 2: Load comparison value 1
	LOAD_PREPARE	Bit 1: Load counter (preparatory)
	LOAD_VAL	Bit 0: Load counter (direct)
Bytes 6 to 7		Reserve = 0 1)

Fig. 5: Parameter assignment of control interface

As show n in Fig. 6, the parameter assignment of the feedback interface in hardw are configuration matches the 8 bytes (PIB264 - PIB271) in input area of the count module. In the above-stated routine, the 8 bytes (DB1.DBB8 to DB1.DBB15) in DB1 are used to deposit parameters of the feedback interface.

Address	Assignment	Designation
Bytes 0 to 3	Count value or stored count value in the case of the latch function at the digital input	
Byte 4	Bit 7: Short circuit of the sensor supply	ERR_24V
	Bit 6: Short circuit / wire break / overtemperature	ERR_DO1
	Bit 5: Parameter assignment error	ERR_PARA
	Bit 4: Reserve = 0	
	Bit 3: Reserve = 0	
	Bit 2: Resetting of status bit active	RES_STS_A
	Bit 1: Load function error	ERR_LOAD
	Bit 0: Load function active	STS_LOAD
Byte 5	Bit 7: Down direction status	STS_C_DN
	Bit 6: Up direction status	STS_C_UP
	Bit 5: Reserve = 0	
	Bit 4: DO2 status	STS_DO2
	Bit 3: DO1 status	STS_DO1
	Bit 2: Reserve = 0	
	Bit 1: DI status	STS_DI
	Bit 0: Internal gate status	STS_GATE
Byte 6	Bit 7: Zero-crossing in the count range when counting without a main counting direction	STS_ND
		STS_UFLW
	Bit 6: Lower count limit	STS_OFLW
	Bit 5: Upper count limit	STS_CMP2
	Bit 4: Comparator 2 status	STS_CMP1
	Bit 3: Comparator 1 status	
	Bit 2: Reserve = 0	
	Bit 1: Reserve = 0	STS_SYN
	Bit 0: Synchronization status	

Fig. 6: Distribution of feedback interface parameters

6. Test, monitoring and diagnosis

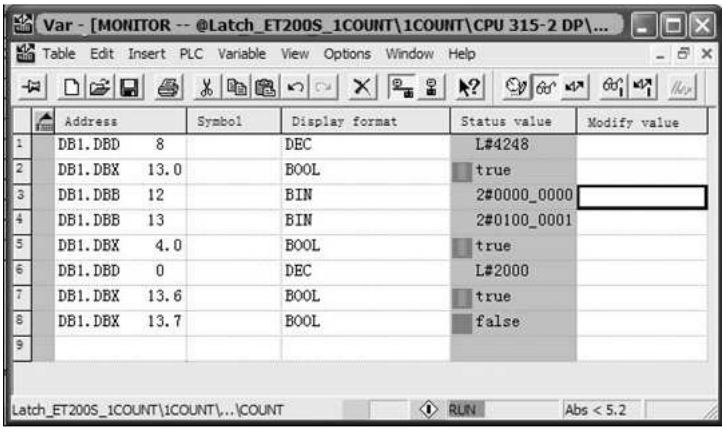

Fig. 7: Variable table monitoring

Establish a Variable table in STEP7 manager Blocks to monitor the measured encoder value in the variable DB1.DBD 8 (feedback interface Bytes 0 to 3), and monitor the encoder value change direction through variables DB1.DBX 13.6 (STS_C_UP) and DB1.DBX 13.7 (STS_C_DN).

7. Functions

7.1 Control of count input

Control through softw are gate
Softw are gate and Hardw are gate ("and" logic operation)

7.2 Gating function

Softw are gate: control through user program
When enabling control bit of the softw are gate, use "interrupt counting procedure" in the parameter configuration and start counting from the load value. When enabling after the softw are gate stops, restart counting from the count value w hen counting stops.
Use "terminate counting procedure" in the parameter configuration and start counting from the load value. When enabling after the softw are gate stops, restart counting from the load value.

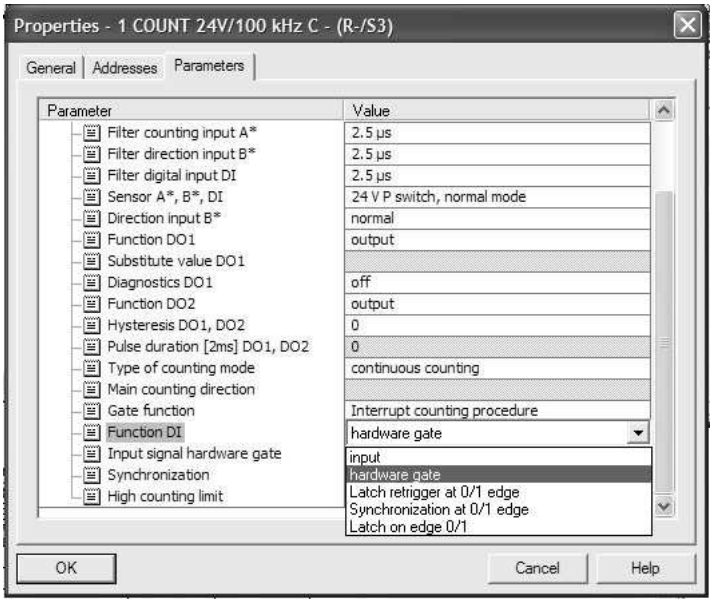

Fig. 8: Use of Hardw are gate

Hardw are gate: after the Hardw are gate is enabled, it controls through digital input, and its function is same as softw are gate control. The precondition is that "hardw are gate" is set in the parameter "Function DI" as show n in Fig. 8.

7.3 latch function

Latch and retrigger:
After enabling " latch and retrigger" in parameter configuration "Function DI" of the hardw are configuration, enable the softw are gate in the user program. When the digital input terminal has rising edge pulse, latch the current count value. Proceed the count function till the digital input terminal has the next rising edge pulse, and latch the current count value and start recounting from the load value.
If the load value is loaded directly in this process, the latch value in the feedback w ord w ill not be changed. Closing the softw are gate w ill only interrupt counting, but the latch and retrigger functions in digital input w ill still w ork w ell.
After the softw are gate is enabled, it shall be cautious that the count mode w ill start w hen the digital input terminal has the first rising edge. Refer to Fig. 9: Timing diagram of latch and retrigger functions.

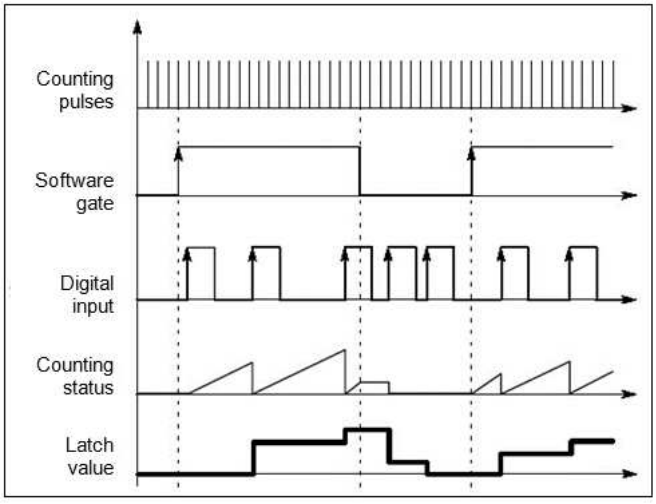

Fig. 9: Timing diagram of latch and retrigger functions

Latch:
After enabling " latch" in parameter configuration "Function DI" of the hardw are configuration, enable the softw are gate in the user program. When the digital input terminal has rising edge pulse, latch the current count value. Proceed the count function till the digital input terminal has the next rising edge pulse, and latch the new count value.
If the load value is loaded directly in this process, the latch value in the feedback w ord w ill not be changed. Closing the softw are gate w ill only interrupt counting, but the latch function in digital input w ill still w ork w ell.

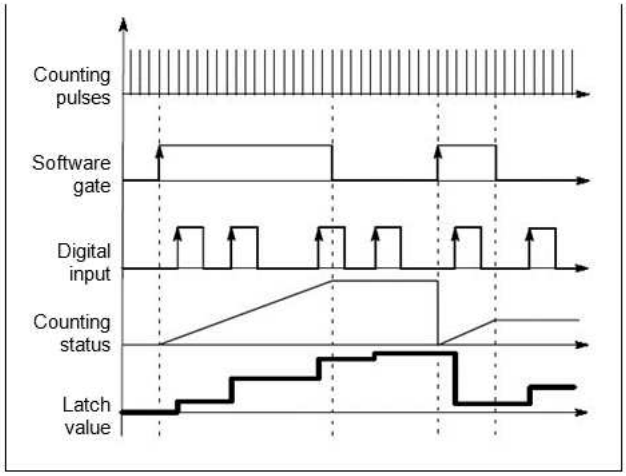

Fig. 10: Timing diagram for latching function

7.4 Synchronizing function

The synchronizing function may only be used in Single counting and Cyclic counting modes, for which the zero flag bit of the rotary encoder may work as the reference signal. Enable the software gate firstly and then the sync control bit. In Single counting synchronization, start synchronizing count of the load value from the first rising edge pulse in the digital input. In synchronizing of Cyclic counting, the first rising edge pulse in the digital input and each succeeding rising edge pulse will make the counter to start synchronizing count from the load value. After synchronizing completes, status bit "STS_SYN" will be set.

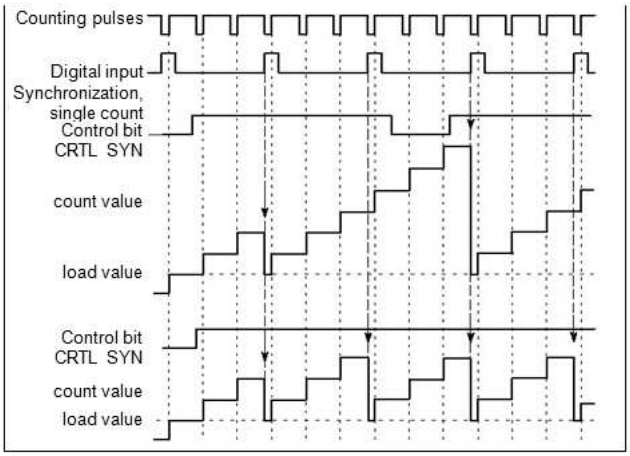

Fig. 11: Timing diagram for synchronizing function

7.5 Output control in count mode

The Counting module has one digital output and one virtual digital output (at status bit of the feedback interface) that may be used to save 2 comparison values, and the output may be controlled based on the relation between these two comparison values:

(1) Direct output control

Enable the control bits CTRL_DO1 and CTRL_DO2, and keep control over the output through control bits SET_DO1 and SET_DO2. The status bits STS_CMP1 and STS_CMP2 display the related output status. These status bits will maintain the current status until they are confirmed. If D01 and D02 are not enabled, these status bits may be impacted directly through control bits SET_DO1 and SET_DO2.

The following 4 output forms are similar to direct control output in application, for which the comparison value shall be loaded firstly and the output shall be controlled according to the comparison conditions.

(2) count value >= comparison value

Example: set a comparison value 2000, and enable D01 output when the count value is larger than or equal to 2000.

Hardware configuration:

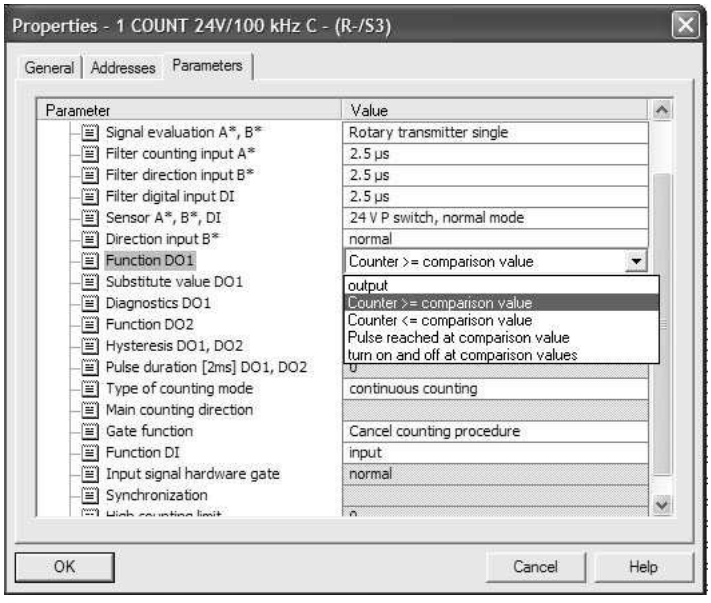

Fig. 12: Comparison value output

The parameter setting of the Counting module is show n in Fig. 12, in w hich it is only necessary to set "Function DI" as "Counter>=comparison value" and other other parameters shall be set by reference to Fig. 4: Common Count mode.

Main routine:

```
//Preset
SET
S DB1.DBX 4.0 // set softw are gate
S DB1.DBX 4.4 // enable D01

// load comparison value
A M 100.0 //trigger bit
S DB1.DBX 5.2
L DB1.DBD 4
T PQD 268

L 2000
T DB1.DBD 0
T PQD 264

AN M 100.0
R DB1.DBX 5.2
L DB1.DBD 4
T PQD 268

//w rite control interface

L DB1.DBD 0 //w rite 8 digits into 1SSI module
T PQD 264
L DB1.DBD 4 //output start address
T PQD 268

// read feedback interface

L PID 264 // read 8 bytes from 1SSI module
T DB1.DBD 8
L PID 268 //input start address
T DB1.DBD 12
```

Monitor and test: load comparison 1(2000) by enabling M100.0. When the count value of the encoder is larger than or equal to 2000, enable output D01, and set the status bits STS_CMP1 (DB1.DBX14.3) and STS_DO1 (DB1.DBX13.3) at the same time.

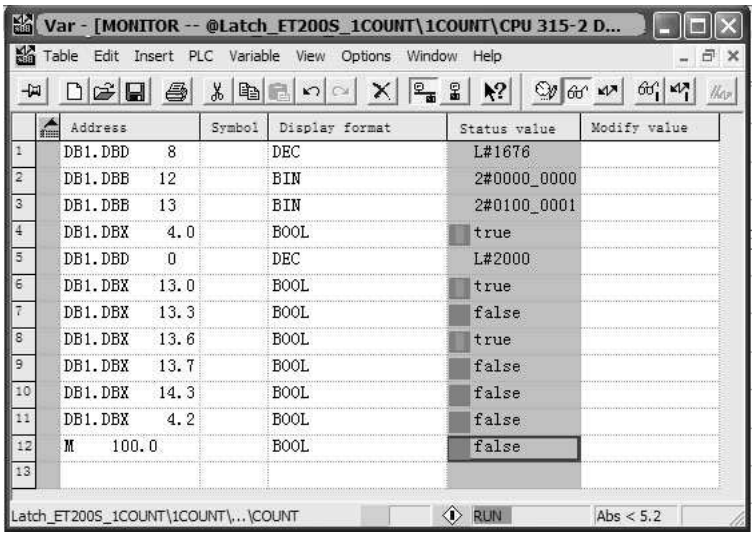

Fig. 13: Comparison value < 2000

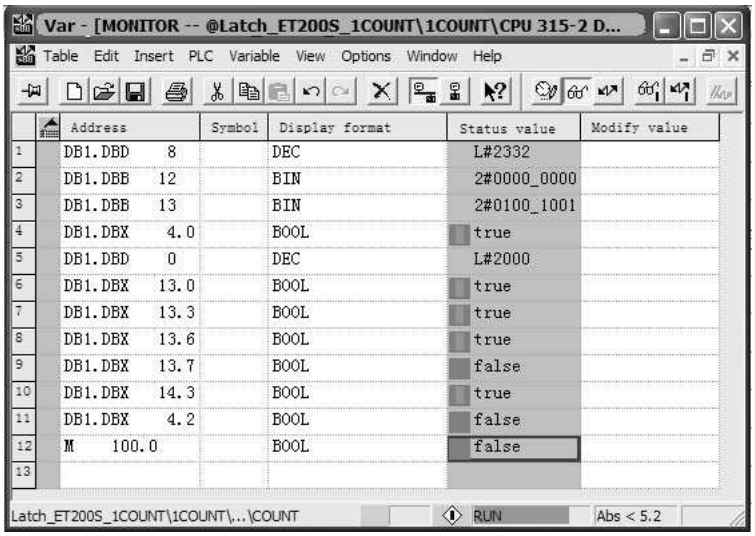

Fig. 14: Comparison value > = 2000

(3) count value < = comparison
(4) output pulse w hen reaching the comparison value
(5) sw itch output (only for D01) w hen reaching the comparison value

Part 2: ET200S process module 1Count5V/500kHz

Please refer to Part 1 for application of the process module 1Count5V/500kHz. Its difference is mainly in hardw are w iring and the parameter setting in hardw are configuration.

1. Hardware w iring diagram

The module may only be connected to 5V incremental encoder.

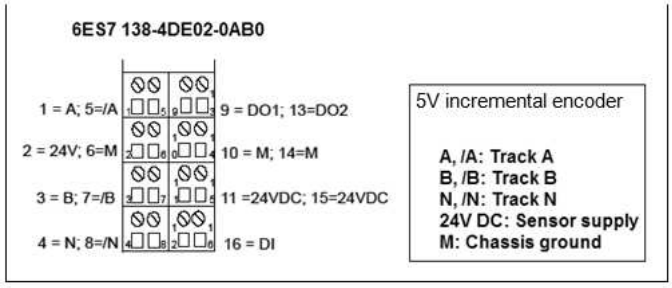

Fig. 15: Hardware wiring diagram

2. Hardware configuration and parameter configuration

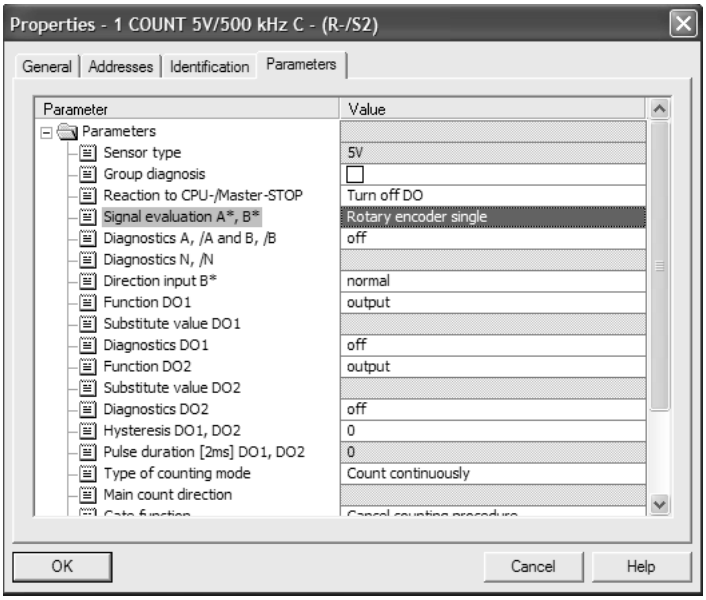

Fig. 16: Parameter configuration for module 1Count5V/500kHz

The parameters Signal evaluation A* B* and Sensor A* B * DI shall be selected according to the connected encoder type, and 5V incremental encoder Single counting is selected here.
The parameter Direction input B * may be set in positive or negative direction.
The parameter "Type of counting mode" may be set as 3 Count modes: Continuous counting, Cyclic counting and Single counting.
The other parameters may be set by selecting the default values.

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