# VIGOR
PROGRAMMABLE CONTROLLER

VB -1HC SPECIAL FUNCTION BLOCK USER'S GUIDE

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the VB -1HC special function block and should be read and understood before attempting to install or use the unit.
Further information can be found in the VB PROGRAMMING MANUAL and VB SERIES HARDWARE MANUAL.

1. INTRODUCTION

- The VB-1HC is a special function block of Hardware High-Speed Counter for the VB series PLC. It can count pulses up to 150 KHz (1-phase) and performs comparisons then outputs directly.

- Various counter modes, such as 1- phase , 2- phase or AB-phase, 16- bit or 32- bit modes, can be selected using commands from the PLC. Allow the VB -1HC unit to run only after setting these mode parameters properly in advance.

- The source of your input signal should be a 1 or AB-phase encoder. A 5V, 12V, or 24V power source can be used. An initial value setting command input (PRESET) and a count prohibit command input (DISABLE) are also available.

- The VB -1HC has two outputs. When the counter value coincides with an output compare value, the appropriate output is set ON. The output transistors are individually isolated to allow either sink or source connection methods.

- Data transfer between the VB -1HC and the VB Series PLC is by buffer memory exchange. There are 32 buffer memories (each of 16 bits) in the VB -1HC.

- The VB-1HC occupies no points of I/O on the VB series PLC's expansion bus.

1.1 External dimensions

Mass (weight): Approx. 0.2kg Dimensions: mm
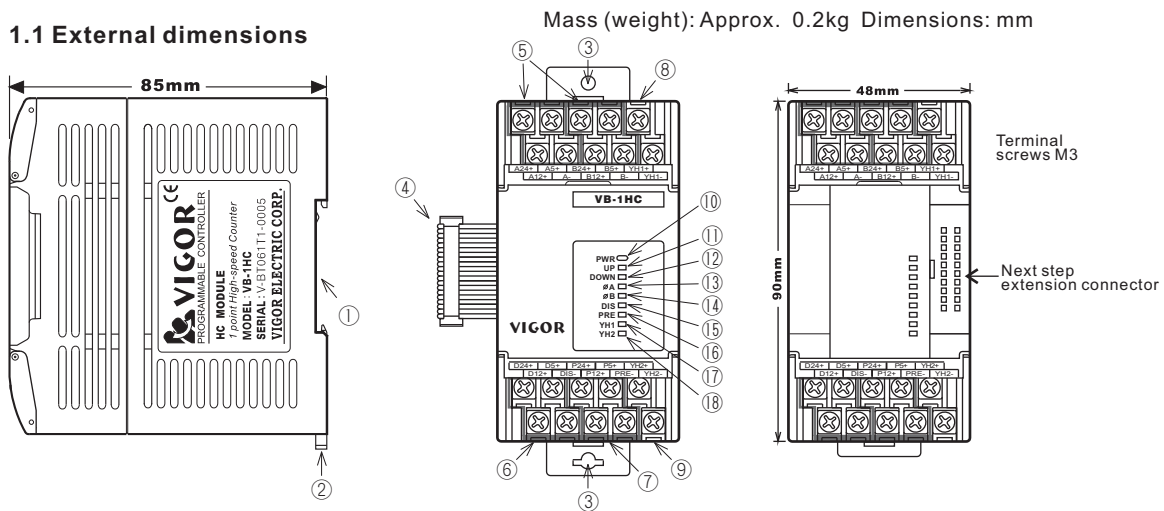
① Attachment groove for 35 wide DIN rail
② DIN rail clip
③ Mounting hole
④ Extension cable and connector
⑤ ∅A,∅B terminal (M3 screws)
⑥ DISABLE terminal (M3 screws)
⑦ PRESET terminal (M3 screws)
⑧ YH1 terminal (M3 screws)
⑨ YH2 terminal (M3 screws)

⑩ PWR (POWER) LED
⑪ Count UP   LED
⑫ Count DOWN   LED
⑬ ∅ A   LED
⑭ ∅ B   LED
⑮ DIS (DISABLE) LED
⑯ PRE (PRESET) LED
⑰ YH1   LED
⑱ YH2   LED

<Using the solderless termination>

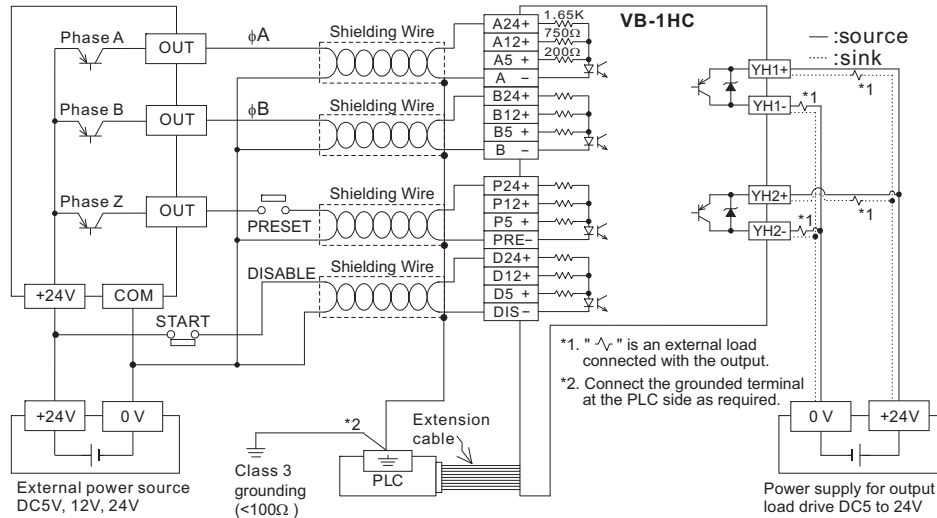6.2mm or less

FOR M3

6.2mm or less
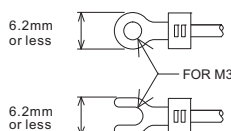
- Use crimp terminals of the dimensions specified in the left figure.
- Secure the terminals using a tightening torque of 0.5 to 0.8 N・m (5 to 8 kg・cm).
- Wire only to the module terminals discussed in this manual. Leave all others vacant.
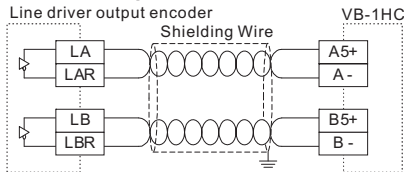
2. WIRING

PNP output encoder

If using on NPN output encoder please take care to match the polarity of the terminals of the encoder to those of the VB-1HC.

Line driver output encoder

3.SPECIFICATIONS

3.1 Environmental specifications

Item	Specification
Environmental specifications (excluding following)	Same as those for the VB main unit
Dielectric withstand voltage	500V AC, 1min (between all terminals and ground)

3.2 Performance specifications

Item		Specification				
Input signal	MAX. frequency	1-phase input	2-phase input	AB-phase input		
				1 edge count	2 edge count	4 edge count
		150 KHz	100 KHz	50KHz		40 KHz
	Signal detail	A:Phase A B:Phase B P:PRESET D:DISABLE	[A24+],[B24+],[P24+],[D24+] :DC24V ± 10% [A12+],[B12+],[P12+],[D12+] :DC12V ± 10% [A5+],[B5+],[P5+],[D5+] :DC5V ± 5% work current : 14mA ± 10% (For positive terminals of each singnal, only one terminal can be wire at a time)			
	Pulse shape	t1 :Rise / fall time is 3μS or less t2 :ON / OFF pulse duration 12 μS or more t3 :Phase difference between phase A and phase B is 6 μS or more PRESET(Z phase) input 6 μS or more DISABLE (count prohibit) input 6 μS or more				
Counting specification	Format	Automatic UP / DOWN (however, when on 1- phase mode, UP / DOWN is determined by BFM#1 or an input terminal.)				
	Range	When 32- bit is specified : -2,147, 483,648 to +2, 147,483, 647 When 16- bit is specified : 0 to 65, 535 (upper limit can be specified by user)				
	Comparison Type	Each output is set when the current value of the counter matches with the compare value (which is transferred from the PLC), and is switched OFF by a reset command from the PLC. Both YH1 and YH2 are output processed by hardware immediately.				
Output signal	Types of outputs	YH1+ : transistor output for YH1 output YH1- : transistor output for YH1 output YH2+ : transistor output for YH2 output YH2- : transistor output for YH2 output				
	Output capacity	5V to 24V DC 0. 5A				
I/O occupation		0 points				
Power from base		5V DC 85mA (Internal power supply from main unit or powered extension unit)				

3.3 Buffer memories (BFM)

BFM number		Contents	
Write	#0	Counter mode K0 to K11	Default: K0
	#1	DOWN/ UP command (1- phase mode)	Default: K0
	#3,# 2	Ring length Upper / Lower	Default: K65,536
	#4	Command	Default: K0
	#11,# 10	Preset data Upper / Lower	Default: K0
	#13,#12	YH1 compare value Upper / Lower	Default: K32,767
	#15,#14	YH2 compare value Upper / Lower	Default: K32,767
Write / Read	#21,#20	Counter current value Upper / Lower	Default: K0
	#23,#22	Maximum count value Upper / Lower	Default: K0
	#25,#24	Minimum count value Upper / Lower	Default: K0
Read	#26	Compare results	
	#27	Terminal status	
	#29	Error status	
	#30	Model identification code K4010	
	#31	Model version No.	

#5-# 9, #16-# 19 and #28 are reserved.

1) BFM #0 Counter mode (K0 to K11), BFM #1 DOWN/ UP command

Count modes		32 bits	16 bits
AB- phase input (phase difference pulse)	1 edge count	K0	K1
	2 edge count	K2	K3
	4 edge count	K4	K5
2- phase (add/ subtract pulse)		K6	K7
1- phase 1- input	Hardware UP / DOWN	K8	K9
	Software UP / DOWN	K10	K11

The counter mode is selected by the PLC.
As shown below, a value between K0 and K11 is written to buffer memory BFM #0 from the PLC. When a value is written to BFM #0, the contents of BFM #1 to BFM #31 are reset to default values. Therefore, setting this value please use a TOP (pulsed) instruction or use M9002 (initial pulse) to drive the TO instruction.
A continuous command is not allowed.

a) 32- bit counter modes

A 32- bit binary counter which executes UP/ DOWN counting will change from the lower limit to the upper limit or the upper limit to the lower limit when overflow occurs. Both the upper and lower limits are fixed values: the upper limit is +2, 147, 483, 647, and the lower limit is -2, 147, 483, 648.
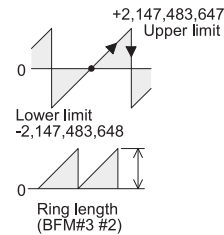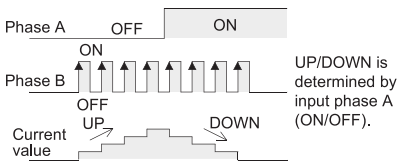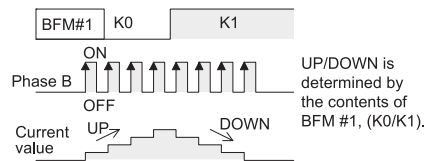
b) 16- bit counter modes

A 16- bit binary counter handles only positive values from 0 to 65, 535. Changes to zero from the upper limit or to the upper limit from zero when overflow occurs; the upper limit is determined by BFMs #3 and #2.
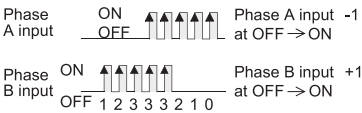

c) 1- phase counter (K8 to K11)

● Hardware UP/DOWN (K8, K9)

UP/DOWN is determined by input phase A (ON/OFF).

● Software UP/DOWN (K10, K11)

UP/DOWN is determined by the contents of BFM #1, (K0/K1).

d) 2- phase counter (K6, K7)

Phase A input -1 at OFF → ON

Phase B input +1 at OFF → ON

If both phase A and phase B inputs are received simultaneously, the counter will count up first and then count down. Both value change of the counter will perform comparison handling.

e) AB- phase counter (K0 to K5)

● 1 edge-count-counter (K0, K1)

Phase B input OFF → ON while phase A input ON Count up by 1.

Phase B input ON → OFF while phase A input ON Count down by 1.

● 2 edge-count counter (K2, K3)

Phase B input OFF → ON while phase A input ON Count up by 1.

Phase B input ON → OFF while phase A input ON Count down by 1.
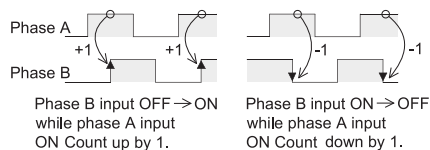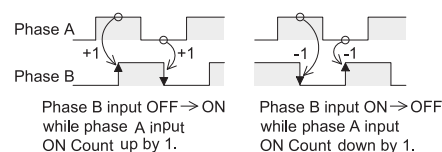
● 4 edge-count counter (K4, K5)

UP COUNT

DOWN COUNT
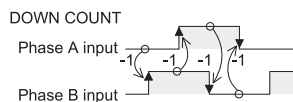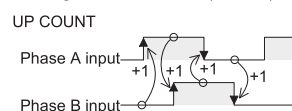
2) BFM #3, #2 Ring length

Stores the data that specifies the length of the 16- bit counter (default: K65,536).

```
   X2
 ──┤├──┤ D  TO  K2  K2  K100  K1 ┤
```

In the above example, K100 is written into BFMs #3 and #2 of special block No. 2 as a 32- bit binary value (BFM #3 = 0, BFM #2 = 100). Permitted values: K2 to K65,536.

UP ──┐ ┌─┐ ┌─┐ ┌─┐ ┌─┐ ┌──
       98 99 0 1

DOWN ──┐ ┌─┐ ┌─┐ ┌─┐ ┌─┐ ┌──
        1 0 99 98
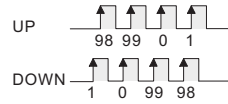
When ring length K100 is specified, the value of the counter changes as shown above.

Note: Write counter data with (D) TO

- Count data is always handled as a pair from two 16- bit values in this special function block. Two of the 16- bit complement value stored in the registers of the PLC cannot be used.
- When you are writing a positive value between K32,768 and K65,535, the data should be treated as a 32- bit value even when a 16- bit ring counter is used.
- When transferring counter data to / from this special function block, always use the 32- bit forms of the FROM / TO instructions ((D) FROM, (D) TO).

3) BFM #4 Command

BFM#4	When "0" (OFF)	When "1" (ON)
b0	Count prohibit	Count permit
b1	YH1 output prohibit	YH1 output permit
b2	YH2 output prohibit	YH2 output permit
b3	YH1/YH2 independent	YH1/YH2 Mutual reset action
b4	Preset prohibit	Preset permit
b5 to b7	Undefined	
b8	No action	Error flag reset
b9	No action	YH1 output reset
b10	No action	YH2 output reset
b11	No action	YH1 output set
b12	No action	YH2 output set

1. When b0 is set to ON and the DISABLE input terminal to OFF, the counter is permitted to start counting input pulses.
2. YH1 can turn to ON ,only if b1 is set to ON.
3. YH2 can turn to ON ,only if b2 is set to ON.
4. b3= ON, YH2 output is reset if YH1 output is set,and YH1 output is reset if YH2 output is set.
   b3= OFF, YH1 and YH2 output act independently, and do not reset each other.
5. When b4= OFF, preset function by the PRESET input terminal is disabled.
6. When b8 is set to ON, all error flags are reset.
7. When b9 is set to ON, YH1 output is reset.
8. When b10 is set to ON, YH2 output is reset.
9. When b11 is set to ON, YH1 output is set ON.
10. When b12 is set to ON, YH2 output is set ON.

4) BFM #11, #10 Preset data

Preset data is used to preset the current value of the counter and will become valid when b4 of BFM #4 is set to ON and PRESET input terminal changes from OFF to ON. (↑ rising edge)

5) BFM #13, #12 Comparison value for YH1output
BFM #15, #14 Comparison value for YH2 output

After comparing the current value of the counter with the value written in BFM #13 and #12, BFM #15 and #14, the comparator in the VB-1HC outputs the comparison result.

YH1, YH2 output will not turn ON if you use PRESET or the TO instruction to set the counter value equal to the comparison value. It will turn ON only when a match occurs by the counting of input pulses.

Output occurs when the current value becomes equal to the compare value but only if b1 and b2 of BFM #4 are ON. Once an output is set, it remains ON until it is reset by b9 or b10 of BFM #4. If b3 of BFM #4 is ON, however, one of the outputs is reset when the other is set.

Coincidence output   Coincidence output
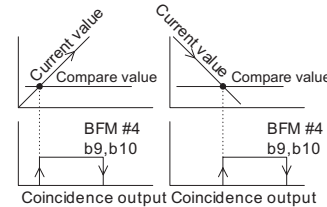
6) BFM #21, 20 Counter current value

The default value of the counter is zero.

The initial counter value can be set by writing a 32-bit value directly into BFM #21 and #20 (current value of the counter).

The current value of the counter can be read by the PLC. It will not be the correct value during high- speed operations because of the communication delay.

7) BFM #23, 22 Maximum count value
BFM #25, 24 Minimum count value

These BFMs store the maximum and minimum value EVER reached by the counter. If the power is turned off, the stored data is cleared.

8) BFM #26 Comparison results

BFM#26		When '0' (OFF)	When '1'(ON)
YH1	b0	Set value ≤ current value	Set value > current value
	b1	Set value ≠ current value	Set value = current value
	b2	Set value ≥ current value	Set value < current value

BFM#26		When '0' (OFF)	When '1' (ON)
YH2	b3	Set value ≤ current value	Set value > current value
	b4	Set value ≠ current value	Set value = current value
	b5	Set value ≥ current value	Set value < current value

BFM #26 is for reading only. Write command from the programmable controller is ignored, doing so will cause M9067 to ON.

9) BFM #27 Terminal status

BFM#27	When '0' (OFF)	When '1'(ON)
b0	PRESET input is OFF.	PRESET input is ON.
b1	DISABLE input is OFF.	DISABLE input is ON.

BFM#27	When '0' (OFF)	When '1'(ON)
b2	YH1 output is OFF.	YH1 output is ON.
b3	YH2 output is OFF.	YH2 output is ON.
b4-b15	Undefined	

10) BFM #29 Error status

Error status in the VB-1HC can be checked by reading the contents of b0 to b9 of BFM #29.

BFM#29	Error status	
b0	Set when any of b1 to b7 is ON.	
b1	Set when the value of the ring length is written incorrectly (other than K2 to K65,536).	
b2	Set when the preset value is written incorrectly.	When value ≥ ring length in 16-bit counter mode.
b3	Set when the compare value is written incorrectly.	
b4	Set when the current value is written incorrectly.	
b5	Set when the counter overflows the upper limit.	When the upper or lower limit is exceeded on a 32-bit counter.
b6	Set when the counter overflows the lower limit.	
b7	Set when the FROM/TO command is used incorrectly.	Counter data doesn't be access by 32-bit
b8	Set when the counter mode (BFM#0) is written incorrectly.	When outside of K0 to K11
b9	Set when the BFM number is written incorrectly.	When outside of K0 to K31
b10-b15	Undefined	

NOTE: b9 will also be set when access to reserved area or Read from Write only or Write to Read only areas.
There error flags can be reset by b8 of BFM #4.
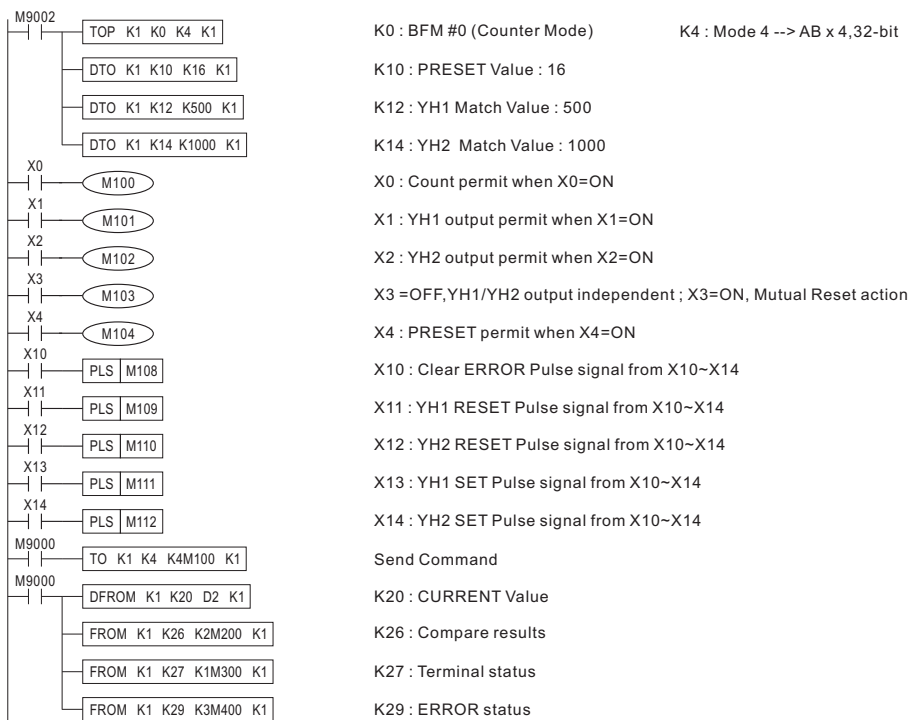
11) BFM #30 Model identification code number

The identification number for a Special Function Block is read by using the FROM command.
The identification number for the VB-1HC unit is K4010.
By reading this identification number, the user may create built- in checking routines to check whether the
physical position of the VB-1HC matches to that of the software.

4. EXAMPLE PROGRAM

Please use the following program as a guide whenever you use the VB-1HC unit. Other instructions to read the
current value of the counter, status etc. can be added as required.

Ladder	Comment
M9002 — TOP K1 K0 K4 K1	K0 : BFM #0 (Counter Mode) K4 : Mode 4 --> AB x 4,32-bit
DTO K1 K10 K16 K1	K10 : PRESET Value : 16
DTO K1 K12 K500 K1	K12 : YH1 Match Value : 500
DTO K1 K14 K1000 K1	K14 : YH2 Match Value : 1000
X0 — M100	X0 : Count permit when X0=ON
X1 — M101	X1 : YH1 output permit when X1=ON
X2 — M102	X2 : YH2 output permit when X2=ON
X3 — M103	X3 =OFF,YH1/YH2 output independent ; X3=ON, Mutual Reset action
X4 — M104	X4 : PRESET permit when X4=ON
X10 — PLS M108	X10 : Clear ERROR Pulse signal from X10~X14
X11 — PLS M109	X11 : YH1 RESET Pulse signal from X10~X14
X12 — PLS M110	X12 : YH2 RESET Pulse signal from X10~X14
X13 — PLS M111	X13 : YH1 SET Pulse signal from X10~X14
X14 — PLS M112	X14 : YH2 SET Pulse signal from X10~X14
M9000 — TO K1 K4 K4M100 K1	Send Command
M9000 — DFROM K1 K20 D2 K1	K20 : CURRENT Value
FROM K1 K26 K2M200 K1	K26 : Compare results
FROM K1 K27 K1M300 K1	K27 : Terminal status
FROM K1 K29 K3M400 K1	K29 : ERROR status

5. DIAGNOSTICS

5.1 Preliminary checks

1) Check that the I/ O wiring and extension cable of the VB-1HC are properly connected.

2) 5V 85mA power is supplied from the main or extension units for the VB-1HC. Check that there is no
power overload from this and other extension blocks.

3) The counter works correctly only when data such as the counter mode (set with a pulse command),the TO
command, the compare value, etc. are appropriately specified. Remember to initialize the count (BFM #4 b0),
preset (BFM #4 b4), and output (BFM #4 b2, b1) prohibits. Reset the YH1/ YH2 outputs before you start.
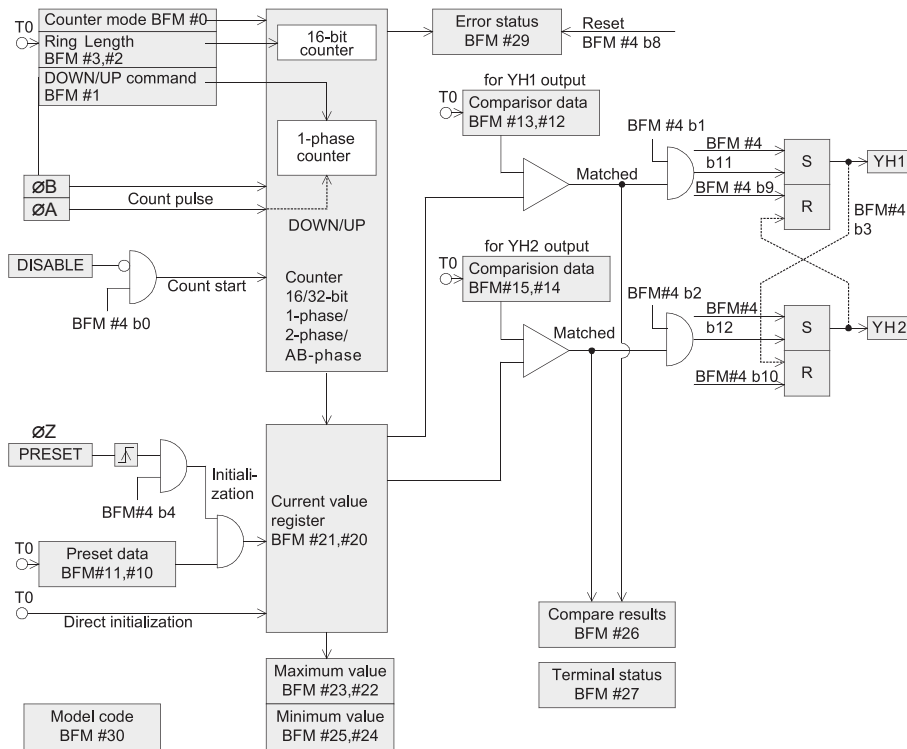
5. 2 Error checking

The following LEDs on the main panel of the VB-1HC may help you to troubleshoot the unit.

⌀A, ⌀B : Goes ON / OFF as ⌀A, ⌀B input turn ON / OFF. It can be checked by rotating the encoder slowly.

● UP, DOWN : Lights up to indicate whether the counter is going up or down .

● PRE and DIS: The appropriate LED lights up when the PRESET terminal or the DISABLE terminal is ON.

● YH1, YH2: The appropriate LED lights up when YH1/ YH2 output is turned on.

You can check the error status by reading the content of BFM #29 to the PLC.
Error contents are shown in section 3.3 (10).

6. SYSTEM BLOCK DIAGRAM

T0
Counter mode BFM #0
Ring Length BFM #3,#2
DOWN/UP command BFM #1

16-bit counter

Error status BFM #29

Reset BFM #4 b8

1-phase counter

for YH1 output
T0 Comparisor data BFM #13,#12

BFM #4 b1

BFM #4 b11

BFM #4 b9

S
R

YH1

BFM#4 b3

ØB
ØA
Count pulse

DOWN/UP

DISABLE

Count start

BFM #4 b0

Counter 16/32-bit 1-phase/ 2-phase/ AB-phase

for YH2 output
T0 Comparision data BFM#15,#14

BFM#4 b2

BFM#4 b12

BFM#4 b10

S
R

YH2

Matched

Matched

ØZ
PRESET

Initiali-zation

BFM#4 b4

T0 Preset data BFM#11,#10

Current value register BFM #21,#20

T0
Direct initialization

Compare results BFM #26

Terminal status BFM #27

Maximum value BFM #23,#22

Model code BFM #30

Minimum value BFM #25,#24

Guidelines for the safety of the user and protection of the VB-1HC special function block

- This manual has been written to be used by trained and competent personnel. This is defined by the European directives for machinery, low voltage and EMC.

- If in doubt at any stage during the installation of the VB-1HC always consult a professional electrical engineer who is qualified and trained to the local and national standards. If in doubt about the operation or use of the VB-1HC please consult the nearest Vigor Electric Corp. distributor.

- Under no circumstances will Vigor Electric Corp. be liable or responsible for any consequential damage that may arise as a result of the installation or use of this equipment.

- All examples and diagrams shown in this manual are intended only as an aid to understanding the text, not to guarantee operation. Vigor Electric Corp. Will accept no responsibility for actual use of the product based on these illustrative examples.

- Owing to the very great variety in possible application of this equipment, you must satisfy yourself as to its suitability for your specific application.

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