



# VIGOR

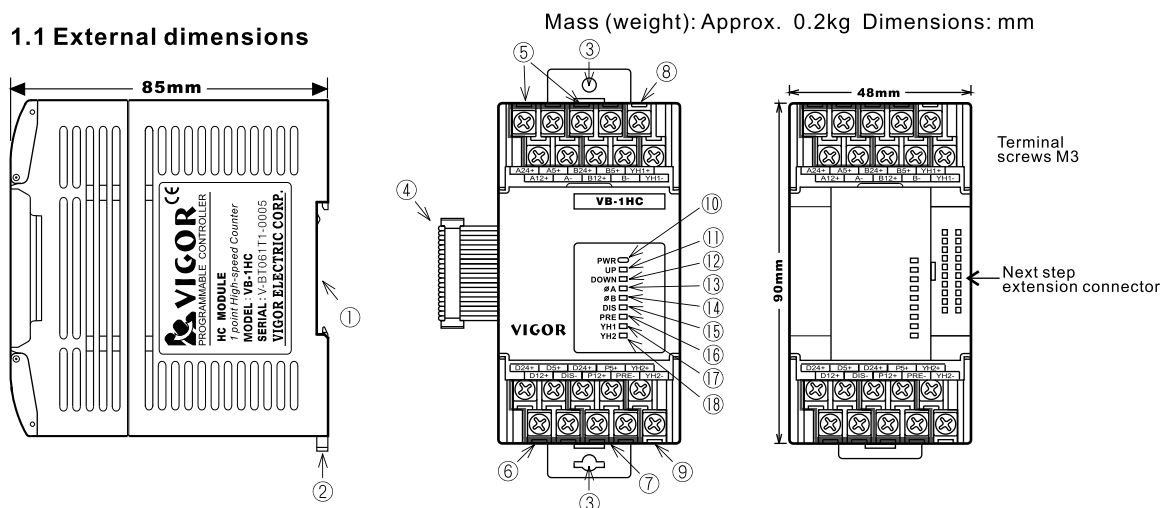
## VB-1HC SPECIAL FUNCTION BLOCK USER'S GUIDE

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. MANUAL.

### 1. INTRODUCTION

- The VB-1HC is a multiple modes and can count up to 45KHz (1-phase ) hardware high- speed counter. It is a special function block for the VB0, VB2 series PLC. The VB-1HC counts at a higher speed than the built- in high-speed counter of the VB series PLCs (AB- phase 5 kHz, 1- phase 10 kHz) and performs comparisons and 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.

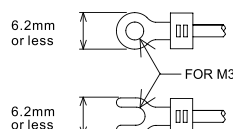
#### 1.1 External dimensions



- 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

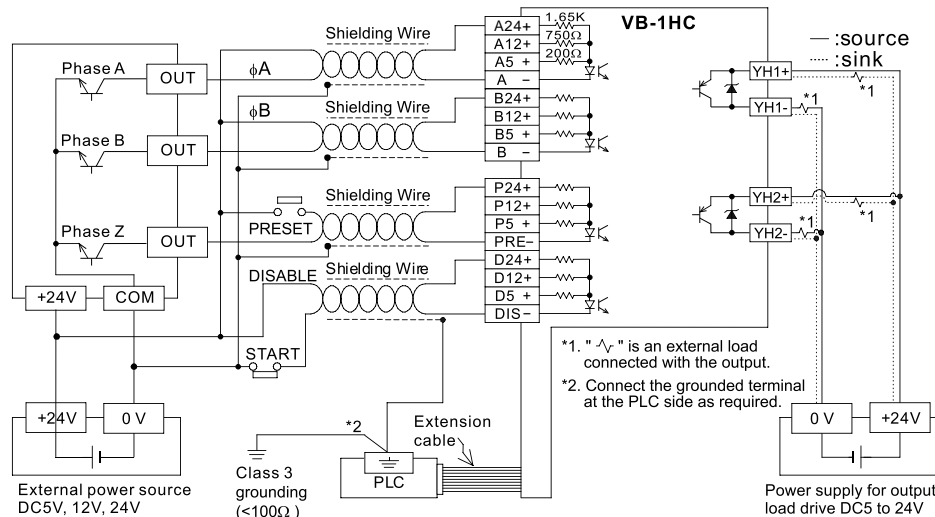
#### <Using the solderless termination>



- 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.

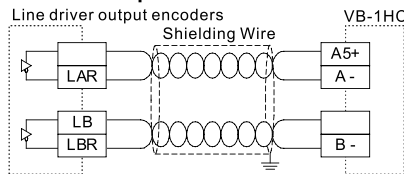
## 2. WIRING

### PNP output encoders



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 encoders



## 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   |
| Signal detail          | 1 edge count     |
|                        | 2 edge count     |
|                        | 4 edge count     |
|                        | 75KHz            |
| Pulse shape            | 150 KHz          |
|                        | 75 KHz           |
|                        | 75KHz            |
|                        | 37.5 KHz         |
| Counting specification | Format           |
|                        | Range            |
|                        | Comparison Type  |
|                        | Output signal    |
| Output signal          | Types of outputs |
|                        | Output capacity  |
|                        | I/O occupation   |
|                        | Power from base  |

A:Phase A  
 B:Phase B  
 P:PRESET  
 D:DISABLE  
 (For positive terminals of each signal, only one terminal can be wire at a time)

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

YH1+ : transistor output for YH1 output  
 YH1- : transistor output for YH1 output  
 YH2+ : transistor output for YH2 output  
 YH2- : transistor output for YH2 output

PNP

### 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    |                  |

#5-#9, #16-#19, #28, #31 are reserved.

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

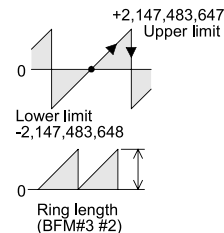
| Count modes                                 |                   | 32bits | 16 bits |
|---|-------------------|--------|---------|
| AB- phase input<br>(phase difference pulse) | 1 edge count      | K0     | K1      |
|   | 2 edge count      | K2     | K3      |
|   | 4 edge count      | K4     | K5      |
| 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 from the PLC. As shown below, values between K0 and K11 are 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. When setting this value use a **TOP** (pulsed) instruction 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,

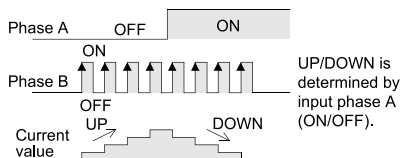


#### b) 16- bit counter modes

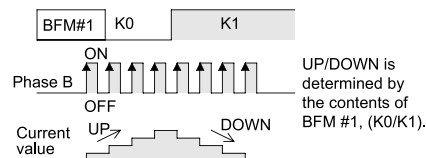
A 16- bit binary counter handles only positive values from 0 to 65, 535. Changes to zero from the upper limit or to the upper limit from zero when overflow occurs; the upper limit is determined by BFMs #3 and #2.

#### c) 1- phase counter (K8 to K11)

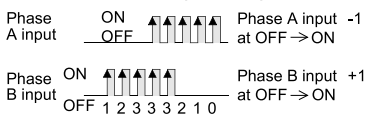
##### • Hardware UP/DOWN (K8, K9)



##### • Software UP/DOWN (K10, K11)



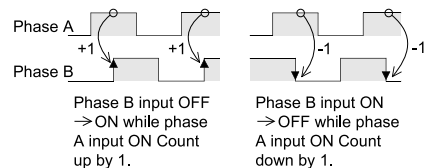
#### d) 2- phase counter (K6, K7)



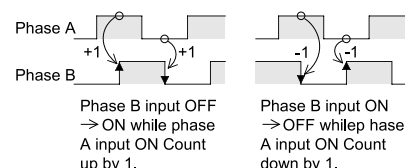
If both phase A and phase B inputs are received simultaneously, the counter will count up first and then count down. Both value change of the counter will perform comparison handling.

#### e) AB- phase counter (K0 to K5)

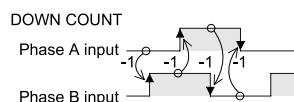
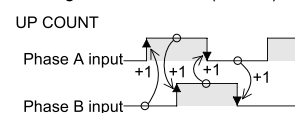
##### • 1 edge-count-counter (K0, K1)



##### • 2 edge-count counter (K2, K3)

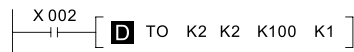


##### • 4 edge-count counter (K4, K5)

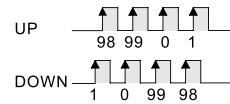


## 2) BFM #3, #2 Ring length

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



In the above example, K100 is written into BFM's #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.



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. 16- bit 2's 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              |

- When b0 is set to ON and the DISABLE input terminal to OFF, the counter is permitted to start counting input pulses.
- YH1 can turn to ON ,only if b1 is set to ON.
- YH2 can turn to ON ,only if b2 is set to ON.
- 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.
- When b4= OFF, preset function by the PRESET input terminal is disabled.
- When b8 is set to ON, all error flags are
- When b9 is set to ON, YH1 output is reset.
- When b10 is set to ON, YH2 output is reset.
- When b11 is set to ON, YH1 output is set ON.
- 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)

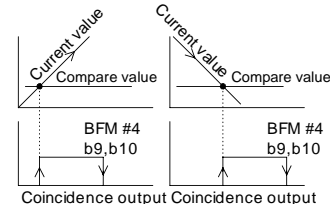
## 5) BFM #13, #12 Comparison value for Yh1 output

### 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.



## 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 BFM's 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 $\leq$ current value | Set value $>$ current value |
|        | b1 Set value $\neq$ current value | Set value = current value   |
|        | b2 Set value $\geq$ current value | Set value $<$ current value |

| BFM#26 | When '0' (OFF)                    | When '1' (ON)               |
|--------|-----------------------------------|-----------------------------|
| YH2    | b3 Set value $\leq$ current value | Set value $>$ current value |
|        | b4 Set value $\neq$ current value | Set value = current value   |
|        | b5 Set value $\geq$ current value | Set value $<$ current value |

BFM #26 is for reading only. Write commands from the programmable controller are 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 b7 of BFM #29 to auxiliary relays of the

| 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.  |
| 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.  |
| b6      | Set when the counter overflows the lower limit.  |
| b7      | Set when the FROM/TO command is used incorrectly.  |
| b8      | Set when the counter mode (BFM#0) is written incorrectly.                                |
| b9      | Set when the BFM number is written incorrectly.  |
| 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

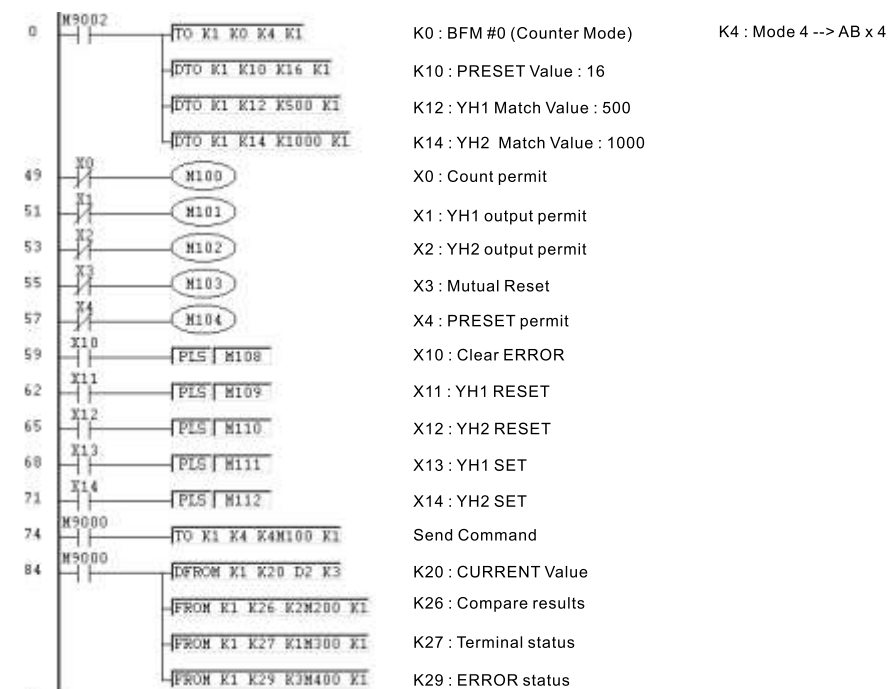
The identification number for a Special Function Block is read by using the FROM command.

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.



## 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.

øA, øB : Goes on/ off as øA, øB input turn ON/ OFF. It can be checked by rotating the encoder slowly.

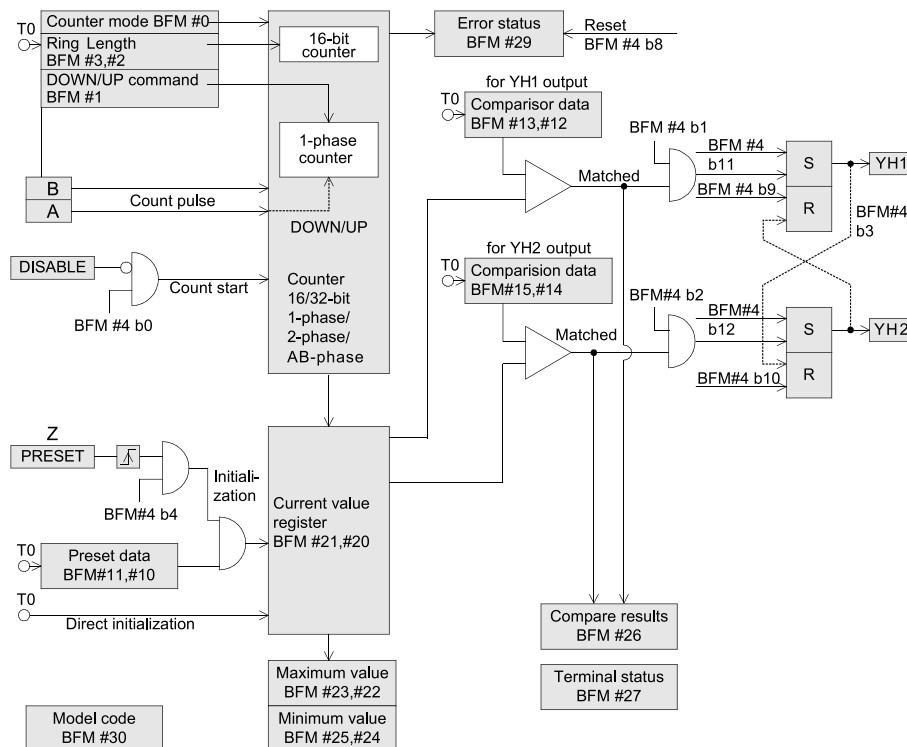
UP, DN : Lights up to indicate whether the counter is going up (UP) or down (DN).

PRESET 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



### 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 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.



# VIGOR

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