VIGOR
PROGRAMMABLE CONTROLLER

VB Series
PROGRAMMABLE CONTROLLER

Hardware Manual

VIGOR ELECTRIC CORP.

Safety Notes
Please Read Before Use

This manual should be read and understood before attempting to install, operate, maintain or overhaul a PLC. The user should be completely familiar with all associated documentation, safety practices, guidelines and necessary device knowledge before move on accordingly.

Two symbols are used to highlight the safety notes mentioned in this manual: DANGER and CAUTION. They are listed below with brief descriptions.

⬦ DANGER	Indicates that misoperation could cause severe consequence like death or major injury.
⚠ CAUTION	Indicates that misoperation could cause physical or property damage.

In addition, the ⚠ CAUTION warnings also indicate that severe consequences are possible under certain conditions. Please make sure all operations are carried out in accordance with these guidelines to avoid such consequences.

Keep this manual properly for reference whenever necessary and distribute it to the end users.

Design Guidelines   ⬦ DANGER

- Please set up an external safety circuit for the PLC, so that if the external power fails or the PLC breaks down, the system can still operate with safety.
- Any misoperation or mis-output could possibly cause accident.
- External protective circuits should be designed for a PLC to avoid mechanical damage. E.g. Emergency Stop, Forward/Reverse Inter-Lock or Upper/Lower Limit Positioning.
- A PLC CPU detects abnormal states through self-examine functions such as Watch Dog Timer (WDT) and will then switch off all its outputs. Anyway, it is not able to detect the state of the input/output control circuits and thus may not be able to control the output when error occurs. So in order to protect the mechanical equipment, some external safety circuits and agencies should be designed.
- A PLC may not be able to control the ON/OFF state when error occurs to its output relay and transistor, etc. So for crucial output signals which could cause major accident, some external safety circuit and agencies should be designed, to make sure the mechanical devices operate with safety.

Installation Safety Guidelines   ⚠ CAUTION

- The product should be used under certain conditions as stated in "1-6 General Specifications" of this manual.
- The product should NOT be used under the following conditions:
  (1) Excessive or conductive dust, corrosive or flam. gas, or oily smoke.
  (2) Excessive heat, moisture or rain, condensation, regular impact shocks or excessive vibration. The above-mentioned conditions may cause electric shock, fire or misoperation and damage the product.
- Take special care not to allow debris to fall inside the unit during installation e.g. making screw holes, cut wires etc, for it may cause fire, product damage or mis-reaction.
- Once the installation is complete, remove the protective paper band on the PLC to prevent fire, product damage or mis-reaction caused by the overheating.
- Install the connection cables and expansion modules properly, and make sure they are fixed, for loose contact may cause mis-reaction.
- DO NOT install the product on the basement, top or along the vertical direction of a switchboard, to avoid overheating.
- Ensure that there is a space larger than 50 mm around the installed PLC and it is kept as far as possible from high-voltage cables, high-voltage equipment and power equipment.

Wiring Safety Guidelines   ⬦ DANGER

- Cut all the external power during installation or wiring, to avoid electric shock or product damage.
- Close the terminal cover before switch on the power supply after installation or wiring, to avoid electric shock.

Wiring Safety Guidelines   ⚠ CAUTION

- When wiring AC supplies, it must be connected to correct input terminal, for if it is connected to DC (Direct Current) input/output terminal or DC power terminal, the PLC will be damaged.
- DO NOT connect the 24 V OUT⊞ terminal of a PLC main unit to the 24 V OUT⊞ terminal of an extension unit, or to the ⊞ terminal of an external power supply, for it may damage the PLC.
- DO NOT do external wiring for the empty terminals of a PLC, for it may damage the product.
- Connect the grounding terminal of the main unit using the class 3 grounding standard, but DO NOT ground it with major power systems. (Refer to 1-6)

Operation and Maintenance Safety Notes   ⬦ DANGER

- DO NOT contact the terminal when the power supply switched on, to avoid electric shock or product mis-reaction.
- Switch off the power supply before clean or tighten the terminal, to avoid electric shock.
- Carry program-change-in-operation (force output, RUN, STOP, etc) ONLY after carefully read and understand this manual and safety is ensured, for misoperation may cause equipment damage or accident.

Operation and Maintenance Safety Notes   ⚠ CAUTION

- Switch off the power supply before assemble or overhaul the selected optional units, to avoid damage to the expansion or main units.
- Switch off the power supply before assemble or overhaul the connection cable, to avoid damage or misoperation.
- DO NOT assemble or overhaul the product cage, or alter it by yourself, for it may cause product damage, mis-reaction or fire.
- Contact the nearest distributor or Vigor Electric Corp directly for any product repairing matters.

About the Manual

When purchasing VB series PLC main unit, a copy of this hardware manual will be attached. For programming tutorial or instruction tables, please refer to the "Programming Manual for M, VB and VH Series PLC".
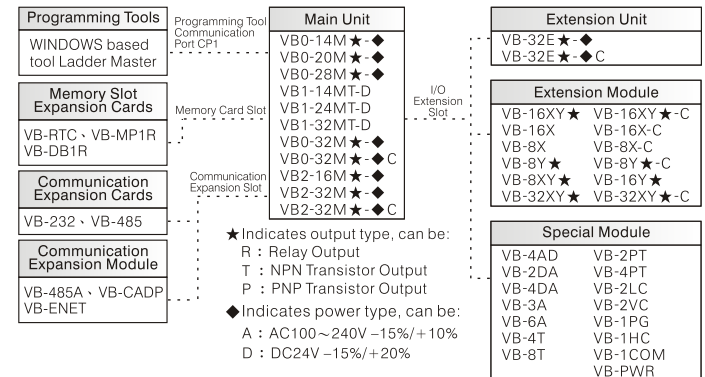
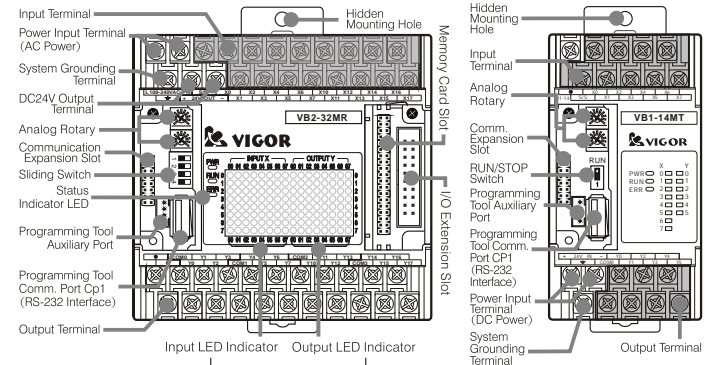| Manual Name	Content
Hardware Manual for VB Series PLC (This manual)	• Introduction to the VB series PLC • Specification and guidelines for the operation environment, wiring and installation of the VB series PLC • Specification and instructions for the installation and operation of the selected optional units. • Instructions for the operation, maintenance and fault repair of the PLC.
Programming Manual for M, VB and VH Series PLC	• Introduction to the various components of the M, VB and VH series PLC. • Introduction to the basic and applied instructions. • Programming guidelines.

About the Trademark

- The VIGOR trademark belongs to the VIGOR ELECTRIC CORP. of Taiwan.
- WINDOWS is a registered trademark under Microsoft Corporation of United States.
- Any other product or service names mentioned in this manual are all intelligent property of their respective owners.

1. VB Series PLC Introductions

1-1 System Configuration

Programming Tools
WINDOWS based tool Ladder Master

Memory Slot Expansion Cards
VB-RTC、VB-MP1R VB-DB1R

Communication Expansion Cards
VB-232、VB-485

Communication Expansion Module
VB-485A、VB-CADP VB-ENET

Programming Tool Communication Port CP1

Memory Card Slot

Communication Expansion Slot

Main Unit
VB0-14M★-◆
VB0-20M★-◆
VB0-28M★-◆
VB1-14MT-D
VB1-24MT-D
VB1-32MT-D
VB0-32M★-◆
VB0-32M★-◆C
VB2-16M★-◆
VB2-32M★-◆
VB2-32M★-◆C

I/O Extension Slot

Extension Unit
VB-32E★-◆
VB-32E ★-◆C

Extension Module	
VB-16XY★	VB-16XY★-C
VB-16X	VB-16X-C
VB-8X	VB-8X-C
VB-8Y★	VB-8Y★-C
VB-8XY★	VB-16Y★
VB-32XY★	VB-32XY★-C

★Indicates output type, can be:
　R：Relay Output
　T：NPN Transistor Output
　P：PNP Transistor Output

◆Indicates power type, can be:
　A：AC100~240V −15%/+10%
　D：DC24V −15%/+20%

Special Module	
VB-4AD	VB-2PT
VB-2DA	VB-4PT
VB-4DA	VB-2LC
VB-3A	VB-2VC
VB-6A	VB-1PG
VB-4T	VB-1HC
VB-8T	VB-1COM
	VB-PWR

1-2 Component Names

- DO NOT connect any PC USB interface to the Programming Tool Communication Port for the comm. Interface is RS-232 although it is an USB A-type connector.
- Use the MWPC-200 cable to connect the Programming Tool Communication Port to PC RS-232 interface. Use VBUSB-200 cable instead if the PC has no RS-232 interface.

- Status Indicator LED

LED	Action	Status
PWR (GREEN)	ON	Power in Supply
	OFF	Power Cut
RUN (GREEN)	ON	RUN
	OFF	STOP
ERR (RED)	ON	System Error (Stop Running)
	FLICKERING	Abnormal State (Stop Running)
	OFF	Normal State

- Sliding Switch

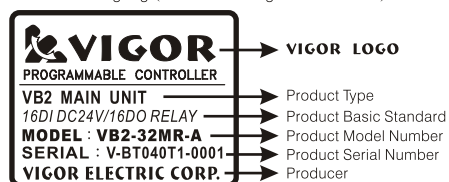| No.	Function	OFF	ON
1	RUN/STOP Switch	STOP	RUN
2	Display Function Switch	I/O Status Display	Multi-Functional Display
3	I/O Display Range Switch	X0~77/Y0~77 X200~277/Y200~277*	X100~177/Y100~177 X300~377/Y300~377*
4	M9082	M9082=OFF	M9082=ON

*When the M9083 is ON (for VB2 only).
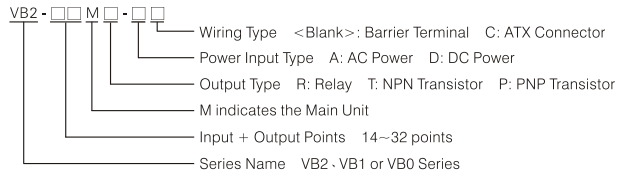The M9080~M9082 will reflect the statuses of switch 2~4.

- ATX connectors wiring solution is provided for this product series to save wiring time.
- The Programming Tool Auxiliary Port (RS-232) may connect to a SCADA (Supervisory Control And Data Acquisition) or HMI. Since it is parallel connected to the Programming Tool Communication Port, Can be used one port only at the same time. (Pin Def. from low to high: #1=Null, #2= RX, #3=TX, #4=SG)
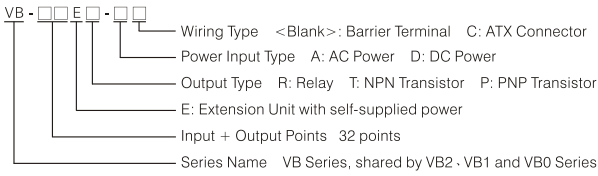
1-3 Model Numbering

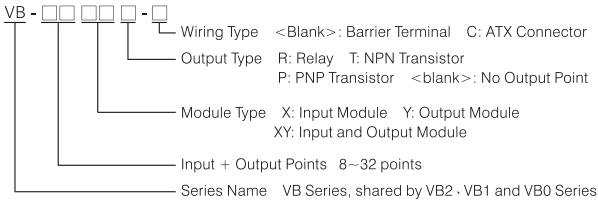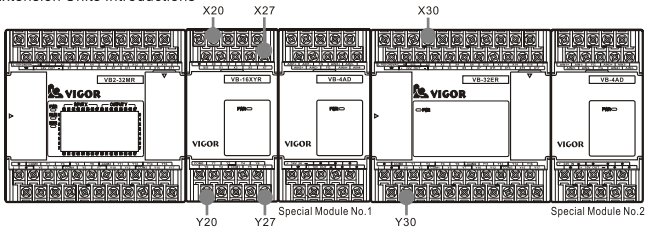- Model Numbering Tag (Pasted on the right side of a PLC)

VIGOR LOGO
Product Type
Product Basic Standard
Product Model Number
Product Serial Number
Producer

Main Unit Model Numbering

VB2 - □□M - □□

- Wiring Type ＜Blank＞: Barrier Terminal　C: ATX Connector
- Power Input Type　A: AC Power　D: DC Power
- Output Type　R: Relay　T: NPN Transistor　P: PNP Transistor
- M indicates the Main Unit
- Input + Output Points　14～32 points
- Series Name　VB2、VB1 or VB0 Series

Extension Unit Model Numbering

VB - □□E - □□

- Wiring Type ＜Blank＞: Barrier Terminal　C: ATX Connector
- Power Input Type　A: AC Power　D: DC Power
- Output Type　R: Relay　T: NPN Transistor　P: PNP Transistor
- E: Extension Unit with self-supplied power
- Input + Output Points　32 points
- Series Name　VB Series, shared by VB2、VB1 and VB0 Series

Extension Module Model Numbering

VB - □□□□ - □

- Wiring Type ＜Blank＞: Barrier Terminal　C: ATX Connector
- Output Type　R: Relay　T: NPN Transistor
  P: PNP Transistor　＜blank＞: No Output Point
- Module Type　X: Input Module　Y: Output Module
  XY: Input and Output Module
- Input + Output Points　8～32 points
- Series Name　VB Series, shared by VB2、VB1 and VB0 Series

1-4 Extension Units Introductions

- VB Series Main Unit always occupies I/O addresses X0～X17/Y0～Y17, so the first Extension Unit/ Module uses I/O address from X20/Y20 onwards.
- VB Series Special Module is numbered from K1～K16, and does not occupy I/O address
- All the modules exchange data with the Main Unit using BFM are named Special Modules. The VB-PWR is a power relay module, which does not occupy any Special Module numbering.
- VB-8XY Extension Module occupies 8 input points and 8 output points.
- Maximum output/input points: VB0 Series　128 points　X0～X77, Y0～Y77
  VB1 Series　256 points　X0～X177, Y0～Y177
  VB2 Series　512 points　X0～X377, Y0～Y377

- I/O Extension Conditions Introduction
  VB series Main Units and Extension Units have self-supplied power circuits, but the Extension Modules and Special Modules have not, so they need to depend on the Main Units, Expansion Units or VB-PWR Power Extension Modules to get power

  The number of modules can be extended from the Main/Extension Unit and VB-PWR is stated below:
  2 Conditions must be met for extending modules from the Main Unit:
  (1) 【(Number of Extension Modules) + (Number of Special Modules × 2)】≤ 4
  (2) The Output points of the Main Unit and those extended after the Main Unit
  【(Number of ON Relays × 6) + (Number of ON Transistors)】≤ 192

  2 Conditions must be met for extending modules from the Extension Unit:
  (1) 【(Number of Extension Modules) + (Number of Special Modules × 2)】≤ 12
  (2) The Output points of the Extension Unit and those extended after the Extension Unit
  【(Number of ON Relays × 6) + (Number of ON Transistors)】≤ 192

  2 Conditions must be met for extending modules from the VB-PWR Power Extension Module:
  (1) 【(Number of Extension Modules) + (Number of Special Modules × 2)】≤ 12
  (2) The Output points of the VB-PWR and those extended after the VB-PWR
  【(Number of ON Relays × 6) + (Number of ON Transistors)】≤ 288
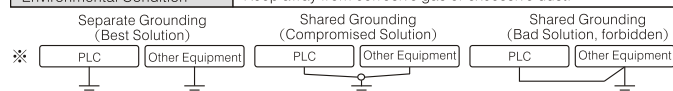
1-5 Multi-Functional Display

When the sliding switch No.2 is at ON side, the PLC display screen will be used as a Multi-Functional Display. The Multi-Functional Display has 8 working modes (Modes 0～7), decided by the value of special register D9080. During the program run, the display working mode can be changed by changing the value of D9080.

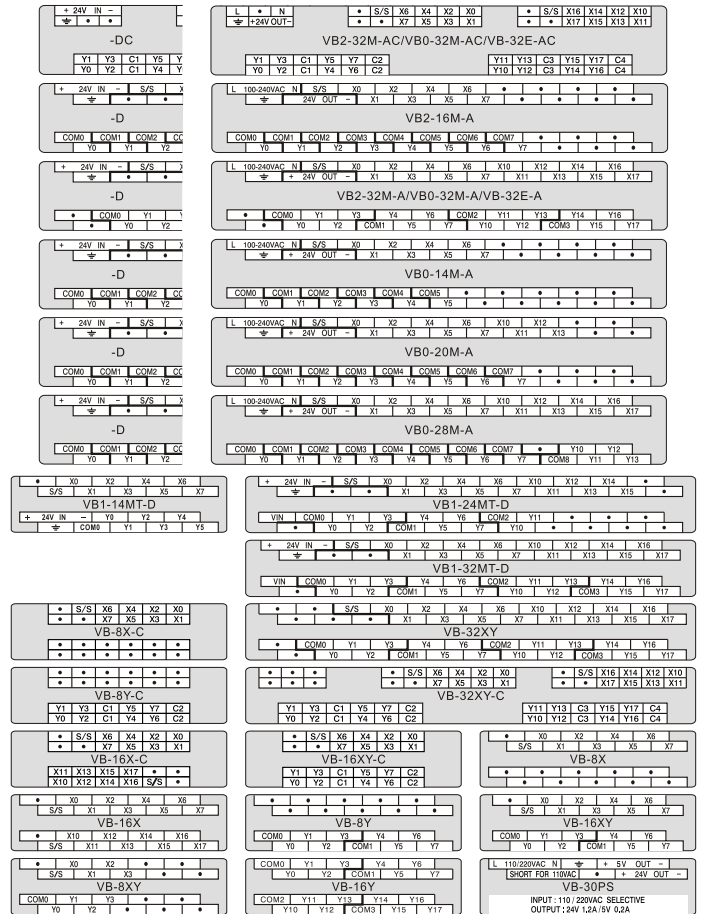| Mode	D9080	D9081	Function	Display Content
Mode 0	K0	Not Used	Displays input/output status	ON/OFF status of input/output points
Mode 1	K1	Pointer (Kn)	Displays numbers, texts or graphics	The bit ON/OFF status of Dn～Dn+7
Mode 2	K2	Pointer (Kn)	Displays error code	"E"+Dn 3-digit number
Mode 3	K3	Pointer (Kn)	Displays 4-digit number (0000～9999)	Dn 4-digit number
Mode 4	K4	Pointer (Kn)	Displays 2-digit number (00～99)	Dn+1 2-digit number, Dn 2-digit number
Mode 5	K5	Pointer (Kn)	Displays a letter and a 3-digit number	Dn+1 1 letter+Dn 3-digit number
Mode 6	K6	Ref. Programm. Manual	Data Access Mode	1 letter +3-digit number
Mode 7	K7	Pointer (Kn)	Displays a 5-digit number (0～32,767)	Dn 5-digit number

1-6 General Specifications

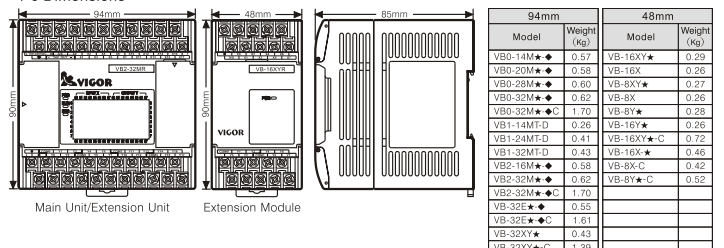| Item	Specifications
Work Ambient Temperature	0～55°C / 32～131°F
Storage Ambient Temperature	−20～70°C /−4～158°F
Work Ambient Humidity	10～90% RH, (at 25°C / 77°F, no condensation)
Storage Ambient Humidity	10～90% RH, (at 25°C / 77°F, no condensation)
Vibration Tolerance	10～55 Hz with amplitude of 0.075 mm / 0.30 inch and acceleration along X, Y and Z axes each for 80 min (8 min/Cycle × 10 times = 80 min) at 55 ～ 150 Hz with 1G.
Shock Tolerance	10 G along X, Y and Z axes each for three times
Noise Immunity	Noise Simulator 1500 Vp-p, 1μS Pulse Width and 25～60Hz Frequency
Dielectric Strength	1500VAC 1 min between AC terminal and rack panel or 500VAC 1 min between DC terminal and rack panel
Insulation Resistance	5 MΩ or above at DC 500V between AC terminal and rack panel
Grounding	Class-3 Grounding (DO NOT ground with major power supply equipment.) ※
Environmental Condition	Keep away from corrosive gas or excessive dust.

Separate Grounding (Best Solution)　Shared Grounding (Compromised Solution)　Shared Grounding (Bad Solution, forbidden)

※

1-7 Performance Specification

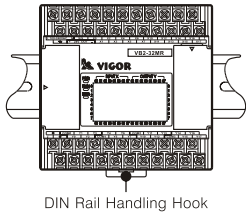| Item		VB0 Series	VB1 Series	VB2 Series
Operation Control Method		Cyclic Operation by Stored Program		
Programming Language		Electric Ladder Diagram + SFC		
I/O Control Method		Batch Processing		
Operation Processing Rate	Basic Instruction	0.375–12.56 μs		
	Applied Instruction	Several ～ Several hundreds of μs		
Number of Instructions	Basic Instruction	27 (including LDP, LDF, ANDP, ANDF, ORP, ORF, INV)		
	Stepladder Instructions	2		
	Applied Instructions	137	145	137
Memory Capacity	Program Capacity	8 K Steps Flash ROM	16 K Steps Flash ROM	16 K Steps Flash ROM
	Component Comment Capacity	2730 comments (16 characters or 8 double-byte characters for each)		
	Program Comment Capacity	20,000 characters or 10,000 double-byte characters		
Max. Input / Output Points		128 points	256 points	512 points
Internal Relay	Auxiliary Relay (M) General	3120 points: M0 ～ M1999, M4000～M5119		
	Latched	2000 points: M2000 ～ M3999		
	Special	256 points: M9000 ～ M9255		
	State Relay (S) Initial	10 points: S0 ～ S9		
	General	490 points: S10 ～ S499		
	Latched	400 points: S500 ～ S899		
	Warning	100 points: S900 ～ S999 (Latched)		
Timer (T)	100 ms	200 points: T0 ～ T199 (Range: 0.1～3276.7 Sec.)		
	10 ms	46 points: T200 ～ T245 (Range: 0.01～327.67 Sec.)		
	1 ms (Retentive)	4 points: T246 ～ T249 (Range: 0.001～32.767 Sec.)		
	100 ms (Retentive)	6 points: T250 ～ T255 (Range: 0.1～3276.7 Sec.)		
Counter (C)	16-bit Up General	100 points: C0 ～ C99		
	Latched	100 points: C100 ～ C199		
	32-bit Up/Down General	20 points: C200～C219		
	Latched	15 points: C220 ～ C234		
High Speed Counter (C)	32-bit Up/Down, Latched 1-phase Counter	11 points: C235 ～ C245 (Signal Frequency: 10 kHz Max.)		
	2-phase Counter	5 points: C246 ～ C250 (Signal Frequency: 10 kHz Max.)		
	A/B Phase Counter	5 points: C251 ～ C255 (Signal Frequency: 5 kHz Max.)		
Data Register (D)	General	7680 points: D0 ～ D6999, D7512～D8191		
	Latched	512 points: D7000 ～ D7511		
	File Register	7000 points: D1000～D7999		
	Special	256 points: D9000 ～ D9255		
	Index	16 points: V0 ～ V7, Z0 ～ Z7		
Pointer	Call Pointer (P)	256 points: P0 ～ P255		
	Interrupt Pointer (I)	15 points: 6 points for external interrupt, 3 points for timer interrupt, and 6 points for counter interrupt		
	Nest Pointer (N)	8 points: N0 ～ N7		
Constants Range	Decimal (K) 16 Bits	～ 32768 ～ 32767		
	32 Bits	～ 2147483648 ～ 2147483647		
	Hexadecimal (H) 16 Bits	0H ～ FFFFH		
	32 Bits	0H ～ FFFFFFFFH		
Hardware 32 Bit High Speed Counter		—	2 points 200 kHz	—
Pulse Output		2 point, Max. 7 kHz	2 points 20 kHz; 2 points 200 kHz	2 point, Max. 7 kHz
Programming Device Link Interface		RS-232C, can connect to PC, HMI or MODEM directly.		
Communication Link Interface (Optional)		RS-232C or RS-422 / RS-485		
Real Time Clock (Optional)		Displays year, month, day, hour, min., sec. and week		
No. of Special Modules can connect		Max. 4 special modules	Max. 8 special modules	Max. 16 special modules
Multi-Functional Display		128 points to display I/O status and various info.		
Analog Rotary		2 analog rotaries, shows 0～255		

1-8 Terminal Layouts

1-9 Dimensions

Main Unit/Extension Unit　Extension Module

	94mm		48mm	
	Model	Weight (Kg)	Model	Weight (Kg)
	VB0-14M★	0.57	VB-16XY★	0.29
	VB0-20M★	0.58	VB-16X	0.26
	VB0-28M★	0.60	VB-8X★	0.27
	VB0-32M★	0.62	VB-8X	0.26
	VB0-32M★-C	1.70	VB-8Y★	0.28
	VB1-14MT-D	0.26	VB-16Y★	0.26
	VB1-24MT-D	0.41	VB-16XY★-C	0.72
	VB1-32MT-D	0.43	VB-16X-C	0.46
	VB2-16M★	0.58	VB-8X-C	0.42
	VB2-32M★	0.62	VB-8Y★-C	0.52
	VB2-32M★-C	1.70		
	VB-32E★	0.55		
	VB-32E★-C	1.61		
	VB-32XY	0.43		
	VB-32XY-C	1.39		

2. Installation Work

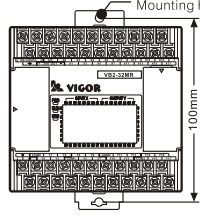### 2-1 Installation Guides

- **DIN Rail Installation**

DIN Rail Handling Hook

Install the product on the 35mm DIN rail handle. Pull down the DIN rail handle when un-install to take the product off.

- **Direct Installation**

2-φ 4.5 Mounting Hole

100mm

Pull out the 2 hidden mounting holes (100mm between) from the top and bottom of the product, and install with screws.

2-2 Wiring Guidelines

- DO NOT use one cable to transmit both Input and Output signals.
- DO NOT make all Input / Output signal cables near power cables.
- Limit the cable length to be within 20 meters for safety reasons.
- Use the O or Y type terminal as the right side diagram.
- Tighten a screw of terminal to a torque of 5~8 kgf/cm.

≤ 6.2mm

≤ 6.2mm

Used by M3
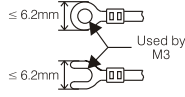
3. Power Specifications and External Wiring

3-1 Power Specifications

Power Specifications (Including All VB Series Main Units and Extension Units)

Item		AC Power	DC Power	VB1 Main Unit
Input Voltage		AC100~240V +10% / -15%	DC24V +20% / -15%	DC24V +20% / -15%
Input Frequency		50/60Hz	—	—
Max. allowable momentary power failure period		Within 10 ms.	Within 1 ms.	Within 1 ms.
Power Fuse		250V 2A	250V 5A	250V 0.5A
Power Consumption		30 VA	12W	8.5W
*Power Unit Output Current		DC5V 400mA	DC5V 400mA	DC5V 400mA
		DC12V 530mA	DC12V 530mA	DC12V 270mA
		DC24V ±15% 420mA; output from terminal	—	—

*The transformed DC 5V and DC 12V are for the internal PLC system use only.

3-2 AC Power Wiring Example

AC100~240V +10%/-15% 50/60HZ

Circuit Breaker

Emergency Stop

MC

Power Input

PL MC

MC

MC

The Load Power that connect to the PLC output.
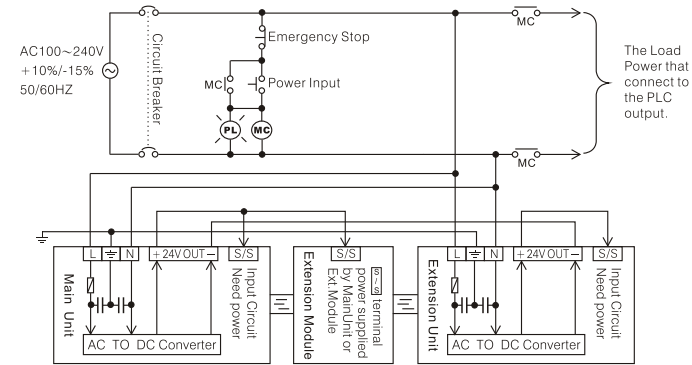
⚠ **CAUTION**
- 24V OUT can be used as sensor power but DO NOT send external power to it.
- DO NOT do external wiring for any empty terminal or use it as a joint terminal.
- DO NOT connect the positive terminal of the Main Unit and Extension Unit together, but please connect their negative terminals together.

3-3 DC Power Wiring Example

DC24V -15% +20%

※The VIN and COM0 terminals must input DC 24V at a VB1-24/32MT Main Unit.

NPN type Sensor

PNP type Sensor
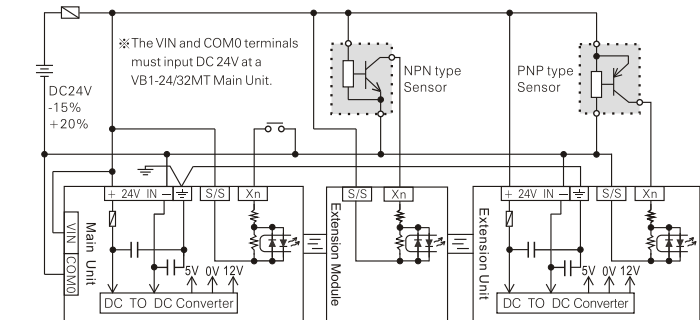
- Connect the 24V IN terminal of the Main Unit with Direct Current power of DC 24V −15%/+20%. Try to use Constant Voltage Power Supply if possible. Make sure a Wave Filter Capacitor is used if need to use a full-wave Rectifying Power Supply
- DO NOT do external wiring for empty terminal or use it as a joint terminal.
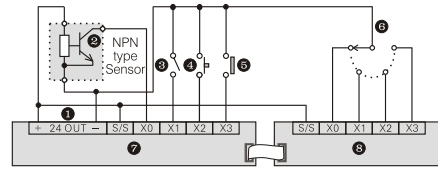
4. Input Specifications and External Wiring

4-1 Input Point Specifications

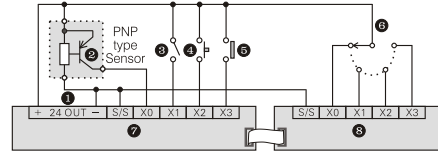| Item	Specification
Input Activating Voltage	DC24V ±15%
Input Signal Circuit	7 mA / DC 24V
Input ON Circuit	Above 3.5 mA
Input OFF Circuit	Below 1.7 mA
Input Resistance	3.3 KΩ approximately
Input Response Time	10 ms approximately, X0—X7 are variable, can be set between 0—60 mS.
Input Signal Type	Dry Contact or NPN/PNP open collector transistor
Isolation Mode	Photocoupler Isolation
Circuit Diagram	AC Power Model AC Power Model DC Power Model DC Power Model

4-2 Input Point Wiring Introduction

- **Input Point Wiring Example with NPN Sensor**

NPN type Sensor

+ 24 OUT S/S X0 X1 X2 X3   S/S X0 X1 X2 X3

- **Input Point Wiring Example with PNP Sensor**

PNP type Sensor

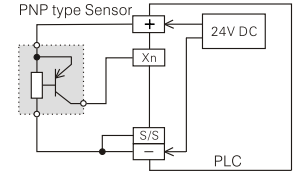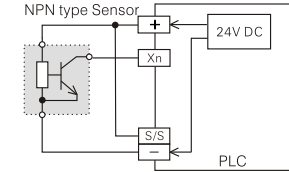+ 24 OUT S/S X0 X1 X2 X3   S/S X0 X1 X2 X3

❶ DC24V

❷ NPN/PNP Close Contact Photoelectric Switch

❸ Switch

❹ Button Switch

❺ Limit (Micro) Switch

❻ Option Switch

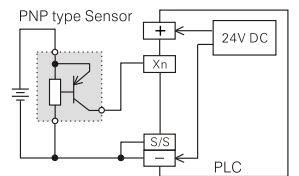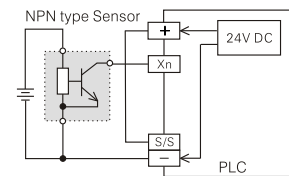❼ PLC Main Unit

❽ PLC Extension Module

- **"Sensor Power Provided by PLC" Wiring**

NPN type Sensor

24V DC

PNP type Sensor

24V DC

- **"Sensor Power Provided by External Source" Wiring**

NPN type Sensor

24V DC

PNP type Sensor

24V DC

4-3 Input Wiring Notes

- The input point current of this product is 7mA/DC24V. So please choose a mini switch as input device, which suits such micro-current. Loose contact problem may occur if macro-current switch is used.
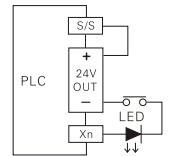
- Keep the voltage drop below 4V approximately if serial diode string is used in the input circuit, as shown in the right hand side diagram.

- Make sure the Parallel Resistor has more than 15KΩ Rp if used in the input circuit, as shown in the diagram below. And if the resistor Rp is less than 15KΩ, please install a pull up resistor Rb.

$$Rb \leq \frac{4Rp}{15 - Rp}(K\Omega)$$

- Install a pull up resistor Rb if the OFF current leakage of the 2-wire-close-contact switch used is more than 1.5mA, as shown in the diagram below.

$$Rb \leq \frac{6}{I\,(OFF\ Current\ Leakage) - 1.5}(K\Omega)$$
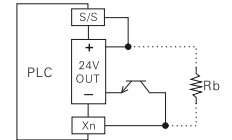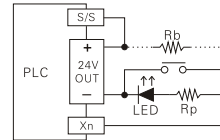
5. Output Specifications and External Wiring

5-1 Output Point Specifications

Item		Specification		
Output Type		Relay Output	NPN Transistor Output	PNP Transistor Output
Switched Voltages		≤ AC 250V / DC 30V	DC5V~30V	DC5V~30V
Rated Current	Resistive Load	2 A /point, 8 A /4 points COM	0.5A/point, 0.8A/4points COM	0.5A/point, 0.8A/4points COM
	Inductive Load	80VA	12W/DC24V	12W/DC24V
	Lamp Load	100W	1.5W/DC24V	1.5W/DC24V
Open Circuit Leakage		—	Below 0.1mA	Below 0.1mA
Output Response Time		10 ms approximately	OFF→ON: below 20uS ON→OFF: below 100uS	OFF→ON: below 20uS ON→OFF: below 100uS
Isolation Method		Mechanic Isolation	Photocoupler Isolation	Photocoupler Isolation
Circuit Diagram				

5-2 Output Wiring Introduction

- **Relay Output Wiring Diagram**

COM0 Y0 Y1 Y2 Y3

MC 5A

MC

COM0 Y0 COM1 Y1

MC 2A
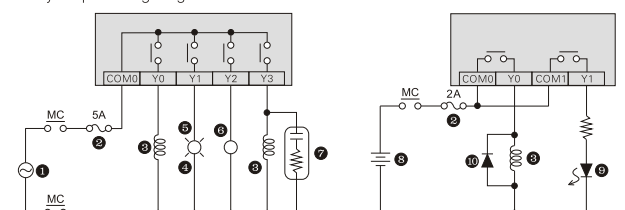
❶ AC Power Supply
❷ Fuse (※)
❸ Inductive Load
❹ Incandescent Light Bulb
❺ Neon Bulb
❻ Contactor
❼ Spark Killer
❽ DC Power
❾ Light Emitting Diode LED
❿ Surge Protective Diode

※ No fuse installed within the PLC's internal output circuit. Please install external fuse to avoid board circuit damage caused by short circuit of the load.
Install 2~3A fuse for single point COM circuit.
Install 5~10A fuse for 4 points COM circuit.
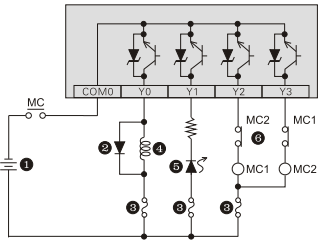
❶ DC Power Supply（※1）   ❷ Surge Protective Diode   ❸ Fuse（※2）

❹ Inductive Load   ❺ Light Emitting Diode LED   ❻ Electric Interlock

※1 Please use a plentiful and stable DC 5～30V power for loads. If it is a VB1-24/32MT Main Unit, must input the positive to the VIN terminal.

※2 There is no fuse installed within the PLC internal output circuit. Please install external fuse to avoid board circuit damage caused by short circuit of the load.
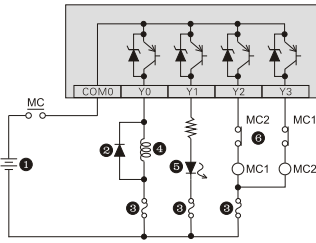
5-3 Output Wiring Notes

● Please add parallel connected Surge Protective Diode to the 2 ends of the DC Inductive Load, as shown in the right hand side diagram, otherwise the pointer life time will be reduced significantly. When choose the Surge Protective Diode, note that the reverse voltage（VR）must be more than 5～10 times of the forward voltage（FR）, and the forward current（IF）must be greater than the load current.

● Please add parallel connected Spark Killer to the 2 ends of the AC Inductive Load, as shown in the right hand side diagram, to reduce noise. A Spark Killer is made by serial connected resistor and capacitor（$0.1\mu F+120\Omega$）, and can be purchased from the producer.

● IT IS DANGEROUS to close the contactors used as the forward（FP）/reverse（RP）control at the same time. For such a load, an external inter-lock circuit should be set up as well as the inter-lock that controlled by the program within the PLC, as demonstrated in the right hand side diagram.
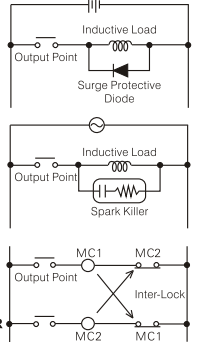
6. Optional Modules

6-1 Models of Optional Modules

The optional modules of VB series PLC are listed in the table below:

Slot	Model	Function
Communication Expansion Slot	VB-232	RS-232 Communication Expansion Card, extend the second communication port（CP2）
	VB-485	RS-422/RS-485 Communication Expansion Card, extend the second communication port（CP2）
Memory Card Expansion Slot	VB-RTC	● Install the RTC（Real Time Clock）Expansion Card for PLC, to do automatic Date and Time control. ● Displays Year, Month, Day, Hour, Minute, Second and Week. ● Battery life is 5 years approximately @ 25℃. ● The special register M9005 will turn ON when the battery is running out of power.
	VB-MP1R	● Memory card used by the VB series PLC to record program, component/program comments and data registers. ● Flash ROM Memory that can be written for more than 10,000 times. ● The program downloading/uploading function makes the program copy and device maintenance work easier. ● Built-in RTC（Real Time Clock）function, battery life is 5 years approximately @ 25℃. ● The special register M9005 will turn ON when the battery is running out of power.
	VB-DB1R	● 128K words Data Storage Capacity using SRAM. Lithium batteries are used for latched data. ● Providing big capacity for latched data storage. The VB-DB1R is usually used for storing formula data or long-time data collection. ● Use DBWR and DBRD instructions to access data in VB-DB1R. ● The programming software Ladder Master is available to modify, archive and upload /download the data in VB-DB1R. ● Including RTC function, the battery life is around 5 years at 25℃ / 77℉. ● When battery power is low, the special relay M9005 will turn ON.

6-2 Connection Cables

Model	Picture	Connection Illustrations	Application
VBUSB-200 (Length: 200cm/6'7")		Connect to PC — USB-RS 232 Converter — USB A-Type Connector — Connect to PLC — USB A-Type Connector	● PC↔VB and M Series PLC
MWPC-200 (Length: 200cm/6'7")		DSUB 9P Female Connector — USB A-Type Connector	● PC↔VB and M Series PLC
MWPC25-200 (Length: 200cm/6'7")		DSUB 25P Female Connector — USB A-Type Connector	● PC↔VB and M Series PLC ● Hitech HMI↔VB and M Series PLC
MWMD-200 (Length: 200cm/6'7")		DSUB 9P Male Connector — USB A-Type Connector	● MODEM↔VB and M Series PLC ● EASY VIEW HMI↔VB and M Series PLC
VBPC25-200 (Length: 200cm/6'7")		DSUB 25P Female Connector — JST 4P Female Connector	● PC↔VB Series PLC ● Hitech HMI↔VB Series PLC
VBMD09-200 (Length: 200cm/6'7")		DSUB 9P Male Connector — JST 4P Female Connector	● MODEM↔VB Series PLC ● EASY VIEW HMI↔VB Series PLC
VBFDHMI-200 (Length: 200cm/6'7")		DSUB 25P Male Connector — JST 4P Female Connector	● FUJI HMI↔VB Series PLC ● DIGITAL HMI↔VB Series PLC
VBEC-050 (Length: 50cm/19.7")		—	● Extended cable for a VB Series PLC Extension Unit/Module. (Keep away from interference during wiring job for the data transferred in this extended cable is unprotected and easy to get interfered.)
VBEC-100 (Length: 100cm/39.4")			

7. Operation Rehearsal, Maintenance and Error Checking

7-1 Operation Rehearsal

● Perform the pre-rehearsal examination with the power supply switched OFF.
Incorrect power terminal connection, short circuit of DC input and power supply wirings or short circuit of output wirings will cause severe damage to the PLC. So DO check the power and input /output wirings before switch on the power, to make sure everything correct.

● Perform the program examination when the power supply ON and PLC STOP.
Upload the program within the PLC using programming tool and make sure it is correct. The user can also use the "compile program" function of the programming tool to make sure the circuit and grammar are correct.

● RUN/STOP Switch of the PLC
There is a RUN/STOP switch on the PLC. When the PLC power goes from OFFON, the PLC will enter RUN/STOP mode according to the setting of the RUN/STOP switch. And then the RUN/STOP status can be controlled by the RUN/STOP switch and the programming tool.

● Perform the operation rehearsal test when the power is ON and PLC is RUN.
The CPU will execute self-examine function once the PLC power goes from OFFON.
If there is no exception, the PLC enters operation mode.（RUN LED is ON.）
If there is program error（grammar or circuit error）, the ERR LED will flicker, and PLC stop running.
If there WDT triggered, the ERR LED will flicker, and PLC stop running.
Force ON/OFF action can be performed on many components during the program operation.

7-2 Determine Exceptional Behavior through the LED Indicator

When problem occurs during PLC operation, check the power supply voltage, the terminal screw and connection cable（may be loose）, and the I/O component（may be faulty）. Then check the PLC LED indicator. These indicators help to analyze the error is caused by PLC or external components.

● PWR Power Indicator LED（Green）
When power supplied, the PWR indicator LED on main unit panel will be ON. If it is not, check the power circuit wiring and make sure correct voltage is used. Else, may send PLC back for repairing.

● RUN Operation Indicator LED（Green）
When the PLC operates well, the RUN indicator LED on the Main Unit panel will be ON. If the PLC is at STOP status or any error occurs, the RUN LED will be OFF.

● ERR Error Indicator LED（Red）
When error occurs to the PLC, the error indicator LED ERR on main unit panel will be ON or flickering.

＜ERR LED Flicker＞
ERR LED flickers when program changed by improper use, broken circuit, exceptional interruption, and invasion by conductive materials, PLC will STOP and all outputs turn OFF. When this happens, please double-check the program, and whether there is powerful interruption source or conductive materials invasion.

＜ERR LED ON＞
ERR LED turns ON when the CPU out of control and WDT occurs caused by PLC circuit broken or exceptional external interruption, PLC will STOP and all outputs turn OFF. When this happens, please switch off the PLC power supply and switch it on again. If this recovers the PLC normal operation, please double-check whether there is powerful interruption source and whether the PLC grounding is fine. If the ERR LED is still ON, the PLC may be faulty, consider sending it back for overhauling.

● INPUT X Input Status Indicator LED（Left half of the Display）
Put the No.2 sliding switch inside the left cover of the Main Unit to OFF（Left）to make the Display show I/O status.
（1）If the input status indicator LED is not as expectation, please make sure the external input switch status is fine.
（2）Loose switch contact may be caused by over-strong input switch current or invasion of oily dirt.
（3）When parallel LED circuit included in the input switch, the input signal of the PLC may be ON even when the switch is OFF.
（4）The sensitivity of photoelectric switches might be affected by dirt-stuck, and cause it failed to switch to ON mode.
（5）The PLC may not be able to judge the input status accurately if the input switch ON/OFF time is shorter than the PLC scanning time.
（6）The PLC input circuit may not be able to work well when the DC24V power supply used by it is excessively used or has short circuit.
（7）The input circuit might be damaged if the voltage put on it exceeds the appointed limit.

● OUTPUT Y Output Status Indicator LED（Right half of the Display）
（1）If the load doesn't work as the output indicator LED status, please check whether the external load function is fine.
（2）Melting or short circuit of the PLC output point may be caused by overload, short circuit load or surge current of the capacitor load.
（3）Relay point loose contact may be caused by the excessively frequent action of the PLC output point.

● Refer to the Error Examination Flow Chart on the next page for advance examinations.

First Examine Stage

Second Examine Stage

Third Examine Stage
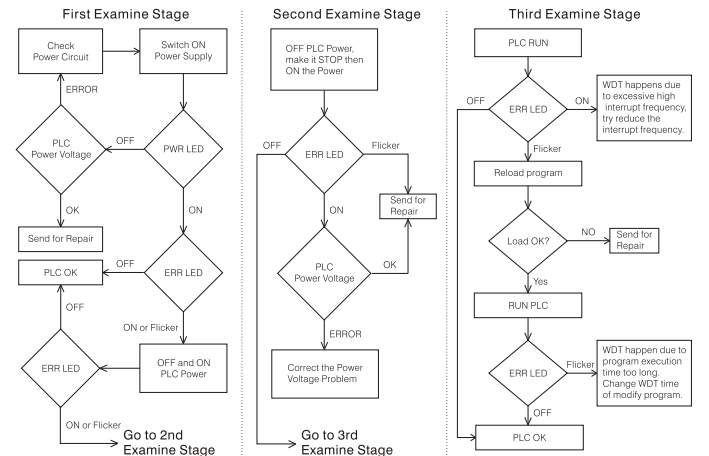
7-3 Maintenance

Recycling Safety Notes ⚠ CAUTION
● Dispose the product as industrial waste when it is to be discarded as worthless.

● The product does not include short-life consumptive parts, so there is usually no need to change parts.

● If the output relay works frequently, or is used to drive big capacity load, please perform constant check on it.

● Perform the following general checks constantly:
（1）Does other heat source or direct sunlight cause the internal temperature of PLC raise abnormally?
（2）Is there dust or conductive dust invasion into the PLC?
（3）Do any of the connection cables or connection terminals, etc, become loose?