VIGOR
PROGRAMMABLE CONTROLLER

VB-2PT Temperature Module

User's Manual

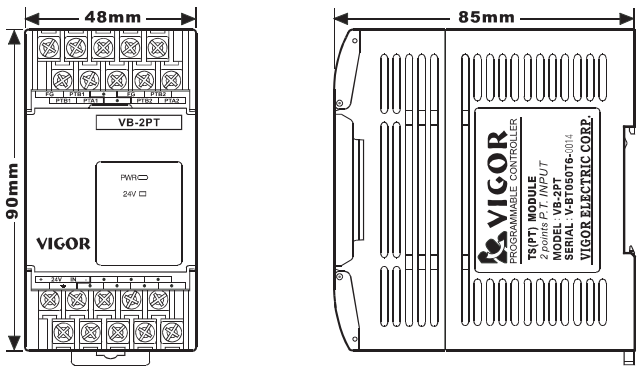
VIGOR ELECTRIC CORP.

This manual contains text, diagrams and explanations which will guide the reader in the correct installation and operation of the VB -2PT 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.

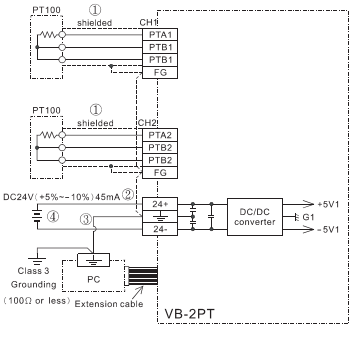
1. INTRODUCTION

- The VB-2PT Temperature measurement block amplifies the analog input from 2 platinum RTDs (PT 100, 3 wire, 100Ω,3850PPM/℃) and converts the data into nearly 18 bit (200,000 readings)digital value and then converts digital value to temperature value. Both Centigrade (℃) and Fahrenheit (℉) can be read. Reading resolution is 0.1℃(0.18℉).
- The VB-2PT is equipped with instrument-class dual-slope ADC and can provide excellent accuracy and measurement stability. It also can filter white noise induced by 50/60Hz power line.
- All data transfers and parameter setups are adjusted through software control of the VB-2PT by use of the TO/FROM applied instructions in the VB series PLC.
- The VB-2PT doesn't occupy any points of I/O on the VB expansion bus. The VB-2PT draws 45mA from the 5V rail of the MPU or powered extension unit.

1.1 External dimensions



2. WIRING



① The cable of the PT 100 sensor or a twisted shielded cable should be used for the analog input cable. This analog input cable should be wired separately from power lines or any other lines which may induce noise. The three wire method improves the accuracy of the sensors by compensating voltage drops.

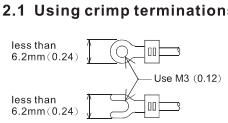
② If there is electrical noise, connect the frame ground Terminal (FG) with the ground terminal.

③ Connect the ground terminal on the VB-2PT unit with the grounded terminal on the base unit. Use class 3 grounding on the base unit, if grounding is possible.

④ Either an external or the 24V built-in supply in the programmable controller may be used.

For additional data regarding EMC considerations please see section 7.0.

2.1 Using crimp terminations



- Use crimp terminations of the type indicated on the left.
- Secure the termination using a tightening torque of between 5 and 8kg cm.
- Wire only to the module terminals discussed in this manual. Leave all others vacant.

3. INSTALLATION NOTES AND USAGE

3.1 Environmental specification

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

3.2 Power supply specification

Item	Specification
Analog circuits	24V DC +5%~-10%,45mA
Digital circuits	5V DC, 45mA (internal power supply from base unit)

3.3 Performance specification

Analog Inputs

Item	Centigrabe	Fahrenheit
	Both ℃ and ℉ readings are available by writing the appropriate value in mode selection buffer memory area.	
Analog input signal	2-channel Platinum RTDs (PT 100, 100Ω,3-wire,3850 PPM/℃ -- DIN 43760, JIS C1604-1989)	
Current to sensor	0.27mA. Sensor: 100Ω PT 100	
Compensated range	-200℃ to +590℃	-328℉ to +1094℉
Digital output	-2000 to 5990	-3280 to 10940
	200,000 reading	
Minimum resolvable temp	0.1℃	0.18℉
Overall accuracy	±0.3 % full scale (compensated range) -see section 7.0 for special EMC considerations	
Conversion speed	0.5S or 1S (according to the channel used in the same group)	

Miscellaneous

Item	Specification
Isolation	1. VB-2PT's analog circuit, supports 2 channels PT100 analog inputs and has its own isolation DC/DC power supply . 2.Photo-coupler isolation between analog circuits and digital circuits. 3.No isolation between analog channels in the same group.
Number of occupied I/O points	0

3.4 Buffer memory assignment (BFM)

The VB-2PT communicates with the programmable controller through use of buffer memories.

BFM No.	Contents	Valid range	Initial value	Access attribute
#0 ~ #1	Mode selection of CH1~CH2	0,300~307 see table 1	302	R/W
#2 ~ #7	Not use	—	—	—
#8 ~ #9	Averaging times of CH1～CH2	1~256	4	R/W
#10 ~ #15	Not use	—	—	—
#16 ~ #17	PV-bias of CH1～CH2	±100 or ±100.0	0	R/W
#18 ~ #23	Not use	—	—	—
#24	EEPROM write command only rising edge (⎍,0 →1) can perform the action	0,1	0	R/W
#25 ~ #26	Not use	—	—	—
#27	Address of set value range error, set value out of range or write to read-only area or access to restricted area	0~33	-1	R
#28	Sensors disconnection or the temperature measurement value below the lowest or above the highest temperature measurement range.	See table 2	0	R/W
#29	Status and error flag	See table 3	0	R
#30	Model ID	—	2041	R
#31	Reserve	—	—	—
#32 ~ #33	PV of CH1~CH2		0	R

- BFM # 0～1

Table 1

Mode	Unit	Reading resolution	Measurement range
K300	C	1°	R1
K301			R2
K302		0.1°	R1
K303			R2
K304	F	1°	R1
K305			R2
K306		0.1°	R1
K307			R2

R1:-200.0℃ ～ +590.0℃ or -328.0℉～1094.0℉
R2:-200.0℃ ～ +180.0℃ or -328.0℉～356.0℉

- The mode selection BFMs will select the following 3 items:
  1.the unit of temperature (C or F)
  2.the reading resolution (1or 0.1°)
  3.the measurement range (R1 or R2)
- The change of item1 and item2 will affect the appropriate BFMs in PV (#32~#33). And the PV-bias (#16~#17) must be modified properly if these value are not equal to zero. About item3, the more narrow range be select (R2),the higher accuracy can be provided. User need to make sure about the temperature range of measurement target.
- A zero value write to mode selection BFMs will inhibit the appropriate channels doing measurement action and to improve the sampling rate.

- BFM #8 ~ #9
  The number of samples to be averaged are assigned in BFMs #8 to #9. Only the range 1 to 256 is valid. Values outside this range are ignored. The default value of 4 is used. A number of recently readings averaged can get a smoother read out.
- BFM #16 ~ #17
  Every VB-2PT is calibrated by VEC with our own sensor. Sensors may have a little bit difference (or error) among them. User can use their own sensors and perform ice-point calibration and then set the properly values in these BFMs.
- BFM #24
  A rising edge (⎍,0 →1) of b0 of BFM #24 will write the current value of BFM #0 ~ #23 to EEPROM. The values in EEPROM will work as default values when the power turn to ON next time. If b12 of BFM #29 is not on a standby state, VB-2PT will ignore the command.
- BFM #27
  User cannot access to all locations which be noted as "not use" or "reserved" ,user cannot write to all location which be noted as "R" (Read-only). It also will not be allowed that the value to be written is not within the valid range. If any of these cases happened, the No. of access location will be written to BFM #27 and b11 of BFM #29 will be set to ON.

- BFM #28 : Digital range error latch.

  BFM #29 b10(digital range error) is used to judge whether the measured temperature is within the unit's range or not.

  BFM #28 latches the error status of each channel and can be used to check for RTD sensor disconnection.

  Table 2

b15 ～ b4	b3	b2	b1	b0
Not used	High	Low	High	Low
	CH2		CH1	

  Low : Latches ON when temperature measurement value goes below the lowest temperature measurement limit.

  High : Latches ON when temperature measurement value goes above the highest temperature measurement limit, or when a RTD sensor is disconnected.

  After an error bit is latched because an error occurs, and then if the measured value is within valid range again the temperature value will be put in PV BFMs normally. [Note : The error remains latched in (BFM #28)]

  An error can be cleared by writing K0 to BFM #28 using the TO instruction or turning off the power.

- BFM #29 : Error status.

  Table 3

BFM #29	ON	OFF
b0	—	—
b1	—	—
b2	DC24V Power failure	DC24V Power supply normal
b3	H/W or ADC failure	H/W or ADC normal
b4 to b9	—	—
b10	any bit be set in BFM #28	Digital output value is normal
b11	a value between 0 and 35 be set in BFM #27	Access normal
b12	EEPROM writing operation is executing	EEPROM is standby
b13	—	—
b14	Initialization completion	From/To applied instruction can't be excuted.
b15	—	—

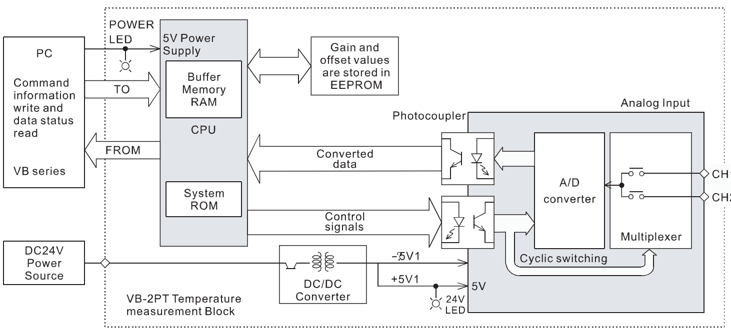
- BFM #30:Identification Code Buffer Memory

  The identification code or ID number for a Special Block is read from buffer memory BFM #30 using the FROM command.
  This number for the VB-2PT unit is K2041.
  The programmable controller can use this facility in its program to identify the special block before commencing data transfer from and to the special block.

- BFM #32~#33

  The averaged temperature values are stored in PV(#32~#33).
  Because the basic resolution of VB-2PT is 0.1℃. The value in Fahrenheit will be translated by the formula. VB-2PT will round up or down when user select the unit to 1℃ or 1℉ (integer presentation format).

4. SYSTEM BLOCK DIAGRAM



5. EXAMPLE PROGRAM

In the program shown below, the VB-2PT block occupies the position of special block number 1 (that is the first closest block to the programmable controller). The averaging amount is four. The averaged values in 0.1℃ of input channels CH1 to CH2 are stored respectively in data registers D32~D33.

```
0     ------ This is a demo program for using VB_2PT. ------
      For reference only, user may need to modify for fitting their own applications. Good luck !

2     We wait until the flag of initialization completion(B14 of BFM #29) turn to ON.

4      M14
      --|/|------------------------------------------[FROM K1 K29 K4M0 K1]

14    if (M14 == ON)
          We can execute From/To instruction.

16    We check whether the VB_4PT is placed at correctly position.

18     M14
      --| |----------------------------------------+-[FROMP K1 K30 D200 K1]
                                                   |
                                                   +-[CMPP K2041 D200 M16]

35    1. We write the mode selection to K302 for :
         (Unit : ° C) (Resolution : 0.1) (Range : -200.0° C ~ +590.0° C)

37       if (the temperature of measurement target < 180.0° C * 95%)
            change K302 to K303(Range : -200.0° C ~ +180.0° C) for getting a better accuracy

39    2. We write average times(4) to BFM #8 ~ #9.
         User can change the value to 1 for disable averaging action.

41    3. You can write the PV_bias one by one
         if you perform calibration of ice-point by using your own sensors.

43     M17
      --| |----------------------------------------+-[TOP K1 K0 K302 K2]
                                                   |
                                                   +-[TOP K1 K8 K4 K2]

62    According to sampling rate, we read the PV(Temperature value) to D32 ~ D33.
      An always ON condition is NOT recommended.

64     M17  M9013
      --| |--| |-------------------------------------[FROMP K1 K32 D32 K2]
```

6. DIAGNOSTICS

6.1 Preliminary checks

(1) Check whether the input/output wiring and/or extension cables are properly connected on VB-2PT temperature measurement special function block.

(2) Check that the VB system configuration rules have not been broken, i.e. the number of special function blocks does not exceed 8 for VB2 and 2 for VB0.

(3) Ensure that the correct operating range has been selected for the application.

(4) Check that there is no power overload on either the 5V or 24V power sources, remember the loading on an MPU or a powered extension unit varies according to the number of extension blocks or special function blocks connected.

(5) Put the Main Processing Unit (MPU) into RUN.

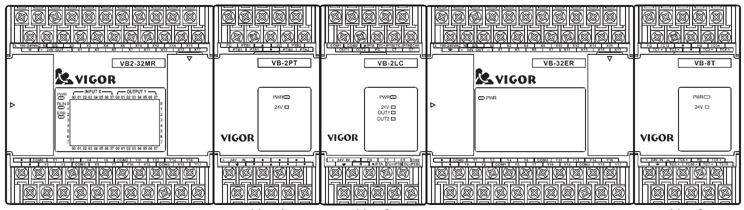
6.2 Error checking

If the VB-2PT special function block does not seem to operate normally, check the following items.

- Check the status of the POWER LED.
  Lit : The extension cable is properly connected.
  Otherwise : Check the connection of the extension cable.
- Check the external wiring.
- Check the status fo the "24V" LED.
  Lit : VB-2PT is ON, 24V DC power source is ON.
  Otherwise : Possible 24V DC power failure or possible VB-2PT failure.

6.3 Checking special function block numbers

Other special units of blocks that use FROM/TO commands, such as analog input blocks, analog output blocks and high-speed counter blocks, can be directly connected to the base unit of the VB programmable controller or to the right side of other extension blocks or units. Each special block is consecutively numbered from 1 to 8 beginning from the one closest to the base unit. A maximum of eight (VB2) special blocks can be connected.



No.1 No.2 No.3

7. EMC CONSIDERATIONS

Electromagnetic compatibility or EMC must be considered before using the VB-2PT.

VEC recommend that the PT 100 sensors used, should be fitted with a form of shielded or screening as protection against EMC noise.

If some form of cable protection is used, the "Shield" must be terminated at the FG ⏚ terminals as shown in section 2.0.

Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors ; up to ±10% of actual values. This is an absolute worst case figure, users who do take good precautions can expect operation within normal tolerances.

EMC considerations should include selection of good quality cables, good routing of those cables away from potential noise sources.

Additionally it is recommended that signal averaging is used as this will reduce the effects of random noise "spikes".

Guidelines for the safety of the user and protection of the VB-2PT

- 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-2PT 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-2PT please consult the nearest VEC distributor.
- Under no circumstances will VEC 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. VEC will accept no responsibility for actual use of the product based on these illustrative examples.

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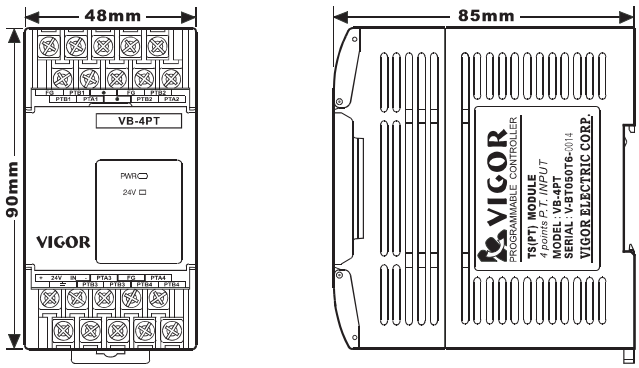
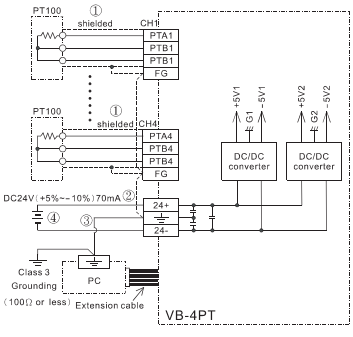
1. INTRODUCTION

- The VB-4PT Temperature measurement block amplifies the analog input from 4 platinum RTDs (PT 100, 3 wire, 100Ω,3850PPM/℃) and converts the data into nearly 18 bit (200,000 readings) digital value and then converts digital value to temperature value. Both Centigrade (℃) and Fahrenheit (℉) can be read. Reading resolution is 0.1℃(0.18℉).
- The VB-4PT is equipped with two groups of totally isolated analog circuits and can perform measurement action simultaneously.
- The VB-4PT is equipped with instrument-class dual-slope ADC and can provide excellent accuracy and measurement stability. It also can filter white noise induced by 50/60Hz power line.
- All data transfers and parameter setups are adjusted through software control of the VB-4PT by use of the TO/FROM applied instructions in the VB series PLC.
- The VB-4PT doesn't occupy any points of I/O on the VB expansion bus. The VB-4PT draws 70mA from the 5V rail of the MPU or powered extension unit.

1.1 External dimensions



2. WIRING



① The cable of the PT 100 sensor or a twisted shielded cable should be used for the analog input cable. This analog input cable should be wired separately from power lines or any other lines which may induce noise. The three wire method improves the accuracy of the sensors by compensating voltage drops.

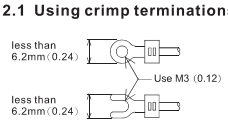
② If there is electrical noise, connect the frame ground terminal (FG) with the ground terminal.

③ Connect the ground terminal on the VB-4PT unit with the grounded terminal on the base unit. Use class 3 grounding on the base unit, if grounding is possible.

④ Either an external or the 24V built-in supply in the programmable controller may be used.

For additional data regarding EMC considerations please see section 7.0.

2.1 Using crimp terminations



- Use crimp terminations of the type indicated on the left.
- Secure the termination using a tightening torque of between 5 and 8kg cm.
- Wire only to the module terminals discussed in this manual. Leave all others vacant.

3. INSTALLATION NOTES AND USAGE

3.1 Environmental specification

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

3.2 Power supply specification

Item	Specification
Analog circuits	24V DC +5%~-10%,70mA
Digital circuits	5V DC, 70mA (internal power supply from base unit)

3.3 Performance specification

Analog Inputs

Item	Centigrabe	Fahrenheit
	Both ℃ and ℉ readings are available by writing the appropriate value in mode selection buffer memory area.	
Analog input signal	4-channel Platinum RTDs (PT 100, 100Ω,3-wire,3850 PPM/℃ -- DIN 43760, JIS C1604-1989)	
Current to sensor	0.27mA. Sensor: 100Ω PT 100	
Compensated range	-200℃ to +590℃	-328℉ to +1094℉
Digital output	-2000 to 5990	-3280 to 10940
	200,000 reading	
Minimum resolvable temp	0.1℃	0.18℉
Overall accuracy	±0.3 % full scale (compensated range) -see section 7.0 for special EMC considerations	
Conversion speed	0.5S or 1S (according to the channel used in the same group)	

Miscellaneous

Item	Specification
Isolation	1. VB-4PT has 2 groups of analog circuits. Each group supports 2 channels PT100 analog inputs and has its own isolation DC/DC power supply . 2.Photo-coupler isolation between 2 groups of analog circuits and digital circuits. 3.They are isolated between groups. 4.No isolation between analog channels in the same group.
Number of occupied I/O points	0

3.4 Buffer memory assignment (BFM)

The VB-4PT communicates with the programmable controller through use of buffer memories.

BFM No.	Contents	Valid range	Initial value	Access attribute
#0 ~ #3	Mode selection of CH1~CH4	0,300~307 see table 1	302	R/W
#4 ~ #7	Not use	—	—	—
#8 ~ #11	Averaging times of CH1～CH4	1~256	4	R/W
#12 ~ #15	Not use	—	—	—
#16 ~ #19	PV-bias of CH1～CH4	±100 or ±100.0	0	R/W
#20 ~ #23	Not use	—	—	—
#24	EEPROM write command only rising edge (⎍0 →1) can perform the action	0,1	0	R/W
#25 ~ #26	Not use	—	—	—
#27	Address of set value range error, set value out of range or write to read-only area or access to restricted area	0~35	-1	R
#28	Sensors disconnection or the temperature measurement value below the lowest or above the highest temperature measurement range.	See table 2	0	R/W
#29	Status and error flag	See table 3	0	R
#30	Model ID	—	2040	R
#31	Reserve	—	—	—
#32 ~ #35	PV of CH1~CH4		0	R

- BFM # 0～3

Table 1

Mode	Unit	Reading resolution	Measurement range
K300	C	1°	R1
K301			R2
K302		0.1°	R1
K303			R2
K304	F	1°	R1
K305			R2
K306		0.1°	R1
K307			R2

R1:-200.0℃ ～ +590.0℃ or -328.0℉～1094.0℉
R2:-200.0℃ ～ +180.0℃ or -328.0℉～356.0℉

- The mode selection BFMs will select the following 3 items:
  1.the unit of temperature (C or F)
  2.the reading resolution (1or 0.1)
  3.the measurement range (R1 or R2)
- The change of item1 and item2 will affect the appropriate BFMs in PV (#32~#35). And the PV-bias (#16~#19) must be modified properly if these value are not equal to zero. About item3, the more narrow range be select (R2),the higher accuracy can be provided. User need to make sure about the temperature range of measurement target.
- A zero value write to mode selection BFMs will inhibit the appropriate channels doing measurement action and to improve the sampling rate.

- BFM #8 ~ #11
  The number of samples to be averaged are assigned in BFMs #8 to #11. Only the range 1 to 256 is valid. Values outside this range are ignored. The default value of 4 is used.
  A number of recently readings averaged can get a smoother read out.
- BFM #16 ~ #19
  Every VB-4PT is calibrated by VEC with our own sensor.
  Sensors may have a little bit difference (or error) among them. User can use their own sensors and perform ice-point calibration and then set the properly values in these BFMs.
- BFM #24
  A rising edge (⎍0 →1) of b0 of BFM #24 will write the current value of BFM #0 ~ #23 to EEPROM.
  The values in EEPROM will work as default values when the power turn to ON next time.
  If b12 of BFM #29 is not on a standby state, VB-4PT will ignore the command.
- BFM #27
  User cannot access to all locations which be noted as "not use" or "reserved" ,user cannot write to all location which be noted as "R" (Read-only). It also will not be allowed that the value to be written is not within the valid range. If any of these cases happened, the No. of access location will be written to BFM #27 and b11 of BFM #29 will be set to ON.

- BFM #28 : Digital range error latch.

  BFM #29 b10 (digital range error) is used to judge whether the measured temperature is within the unit's range or not.

  BFM #28 latches the error status of each channel and can be used to check for RTD sensor disconnection.

  Table 2

b15 or b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	High	Low	High	Low	High	Low	High	Low
	CH4		CH3		CH2		CH1	

  Low : Latches ON when temperature measurement value goes below the lowest temperature measurement limit.

  High : Latches ON when temperature measurement value goes above the highest temperature measurement limit, or when a RTD sensor is disconnected.

  After an error bit is latched because an error occurs, and then if the measured value is within valid range again the temperature value will be put in PV BFMs normally. [Note : The error remains latched in (BFM #28)]

  An error can be cleared by writing K0 to BFM #28 using the TO instruction or turning off the power.

- BFM #29 : Error status.

  Table 3

BFM #29	ON	OFF
b0	—	—
b1	—	—
b2	DC24V Power failure	DC24V Power supply normal
b3	H/W or ADC failure	H/W or ADC normal
b4 to b9	—	—
b10	any bit be set in BFM #28	Digital output value is normal
b11	a value between 0 and 35 be set in BFM #27	Access normal
b12	EEPROM writing operation is executing	EEPROM is standby
b13	—	—
b14	Initialization completion	From/To applied instruction can't be excuted.
b15	—	—

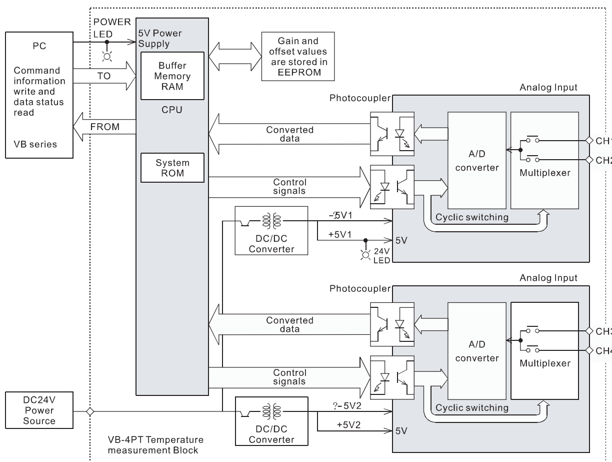
- BFM #30:Identification Code Buffer Memory

  The identification code or ID number for a Special Block is read from buffer memory BFM #30 using the FROM command.
  This number for the VB-4PT unit is K2040.
  The programmable controller can use this facility in its program to identify the special block before commencing data transfer from and to the special block.

- BFM #32~#35

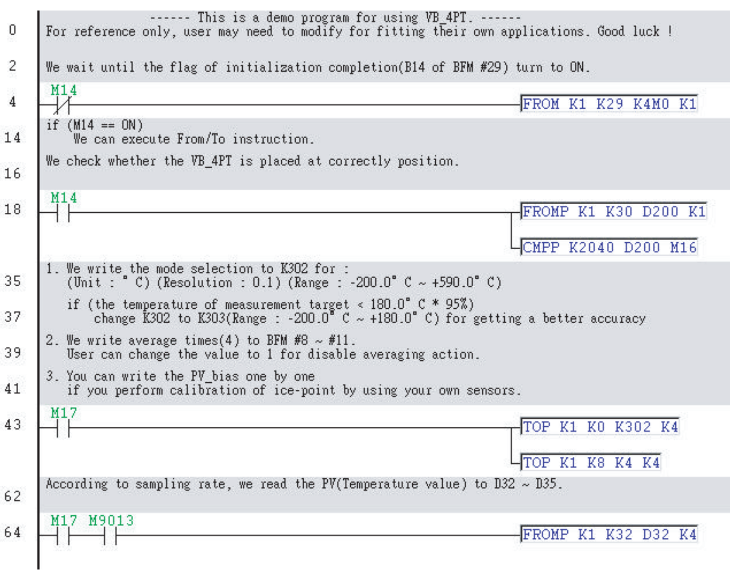
  The averaged temperature values are stored in PV(#32~#35).
  Because the basic resolution of VB-4PT is 0.1℃. The value in Fahrenheit will be translated by the formula. VB-4PT will round up or down when user select the unit to 1℃ or 1℉ (integer presentation format).

4. SYSTEM BLOCK DIAGRAM



5. EXAMPLE PROGRAM

In the program shown below, the VB-4PT block occupies the position of special block number 1 (that is the first closest block to the programmable controller). The averaging amount is four. The averaged values in 0.1℃ of input channels CH1 to CH4 are stored respectively in data registers D32~D35.



6. DIAGNOSTICS

6.1 Preliminary checks

(1) Check whether the input/output wiring and/or extension cables are properly connected on VB-4PT temperature measurement special function block.

(2) Check that the VB system configuration rules have not been broken, i.e. the number of special function blocks does not exceed 8 for VB2 and 2 for VB0.

(3) Ensure that the correct operating range has been selected for the application.

(4) Check that there is no power overload on either the 5V or 24V power sources, remember the loading on an MPU or a powered extension unit varies according to the number of extension blocks or special function blocks connected.

(5) Put the Main Processing Unit (MPU) into RUN.

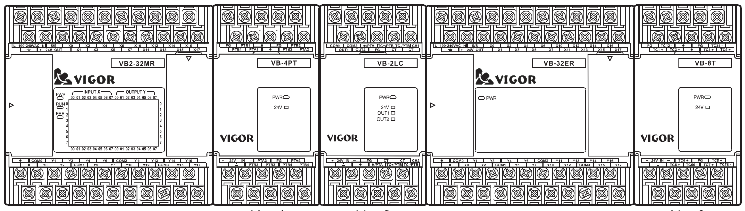
6.2 Error checking

If the VB-4PT special function block does not seem to operate normally, check the following items.

- Check the status of the POWER LED.
  Lit : The extension cable is properly connected.
  Otherwise : Check the connection of the extension cable.
- Check the external wiring.
- Check the status fo the "24V" LED.
  Lit : VB-4PT is ON, 24V DC power source is ON.
  Otherwise : Possible 24V DC power failure or possible VB-4PT failure.

6.3 Checking special function block numbers

Other special units of blocks that use FROM/TO commands, such as analog input blocks, analog output blocks and high-speed counter blocks, can be directly connected to the base unit of the VB programmable controller or to the right side of other extension blocks or units. Each special block is consecutively numbered from 1 to 8 beginning from the one closest to the base unit. A maximum of eight (VB2) special blocks can be connected.



No.1 No.2 No.3

7. EMC CONSIDERATIONS

Electromagnetic compatibility or EMC must be considered before using the VB-4PT.

VEC recommend that the PT 100 sensors used, should be fitted with a form of shielded or screening as protection against EMC noise.

If some form of cable protection is used, the "Shield" must be terminated at the [FG] [⏚] terminals as shown in section 2.0.

Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors ; up to ±10% of actual values. This is an absolute worst case figure, users who do take good precautions can expect operation within normal tolerances.

EMC considerations should include selection of good quality cables, good routing of those cables away from potential noise sources.

Additionally it is recommended that signal averaging is used as this will reduce the effects of random noise "spikes".

Guidelines for the safety of the user and protection of the VB-4PT

- 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-4PT 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-4PT please consult the nearest VEC distributor.
- Under no circumstances will VEC 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. VEC will accept no responsibility for actual use of the product based on these illustrative examples.

VIGOR ELECTRIC CORP.