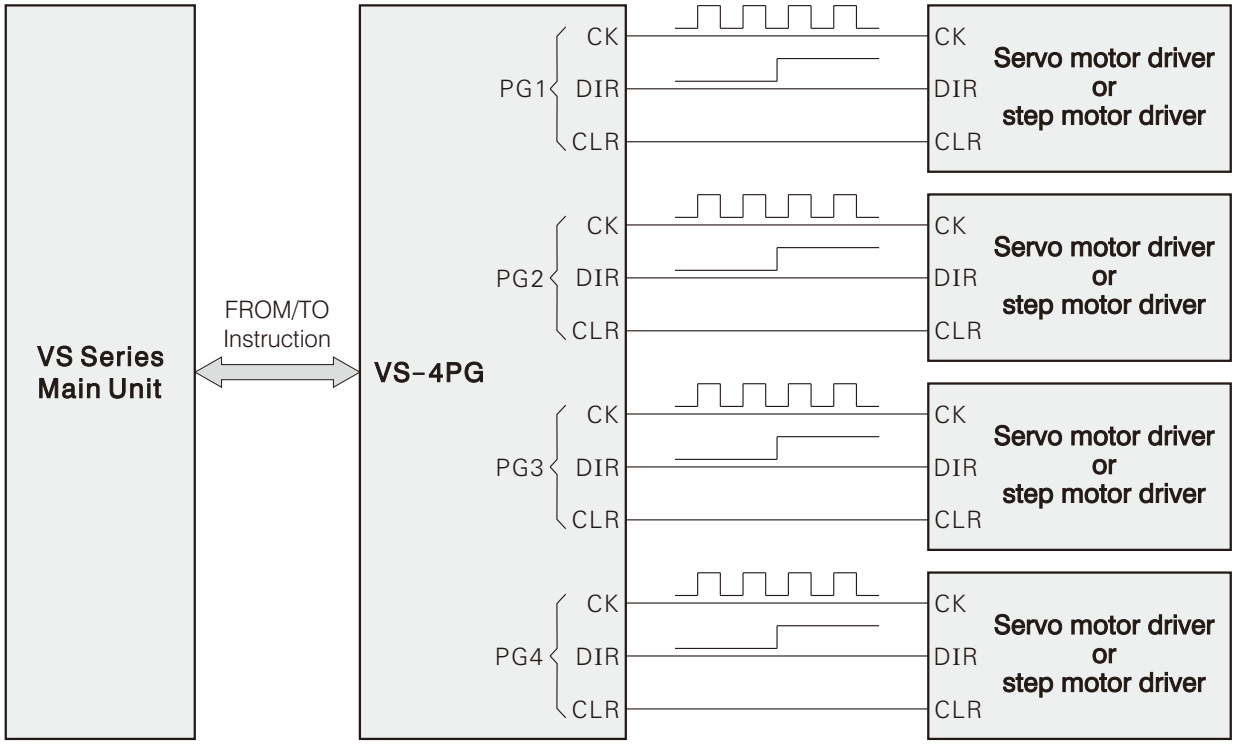
# VS-2PG/VS-4PG Pulse Generator Module

The VS-2PG pulse generator module provides 2 sets of 200 kHz high speed pulse outputs for 2 axes position control.

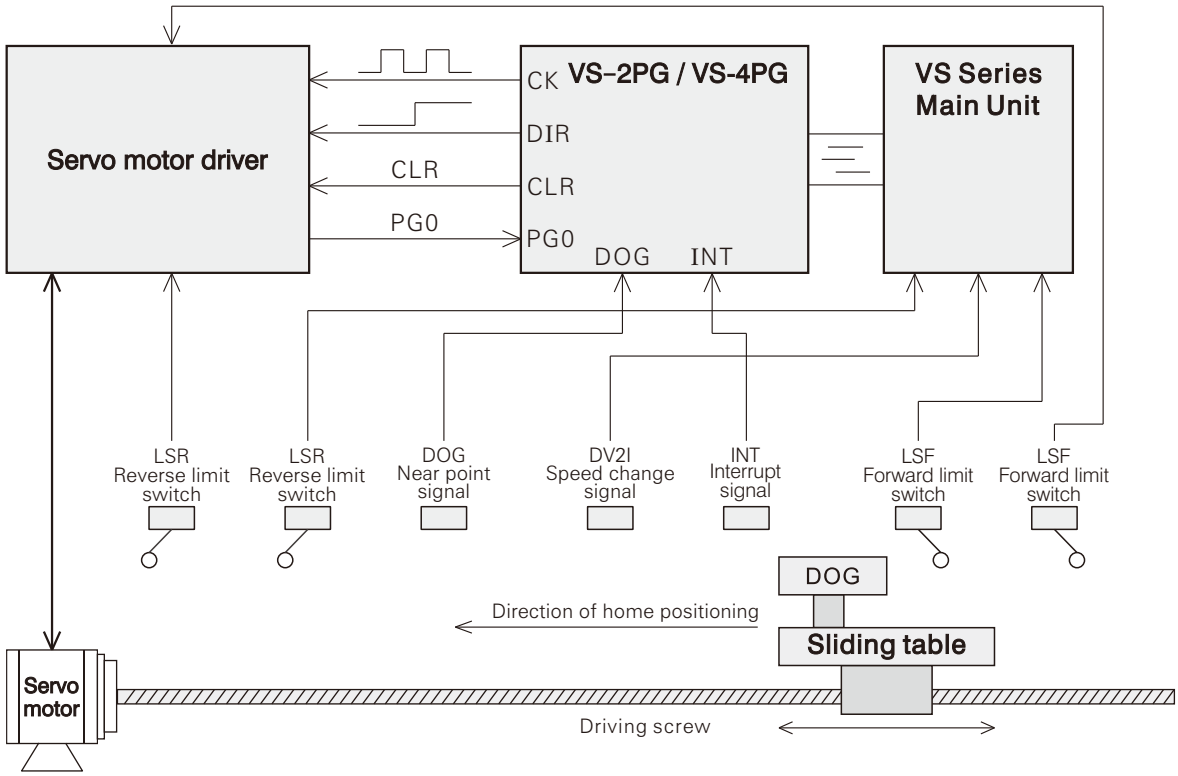
The VS-4PG pulse generator module provides 4 sets of 200 kHz high speed pulse outputs for 4 axes position control.

Each high speed output set can be used to control a step or servo motor driver for the positioning. In addition, this module provides various positioning functions such as the Home positioning (zero return), Jog, Drive to set position, 2-stage positioning, Interrupt constant quantity positioning, 2-stage interrupt constant quantity positioning, Interrupt to stop, Variable speed pulse output, Handwheel positioning and Two axes linear interpolation positioning. With those functions, to complete the complex positioning control is easy.

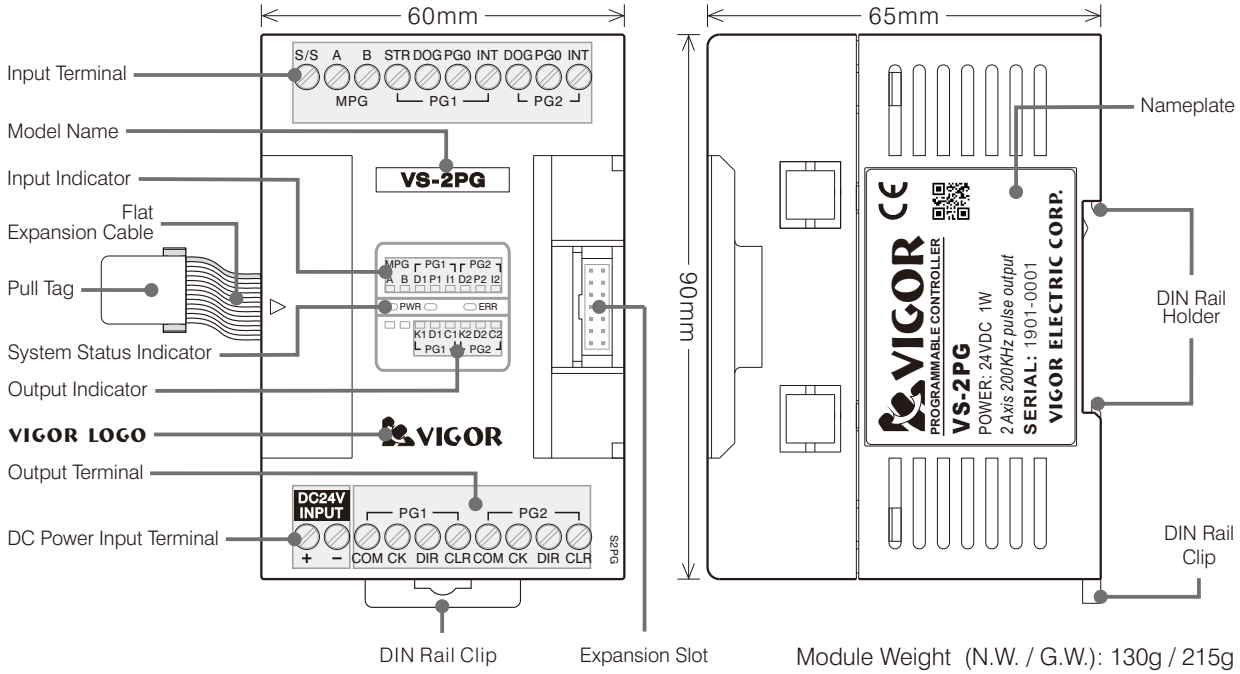
About the positioning control method for each axis at the module is “Pulse train + Direction signal”. Please read following instructions before use.



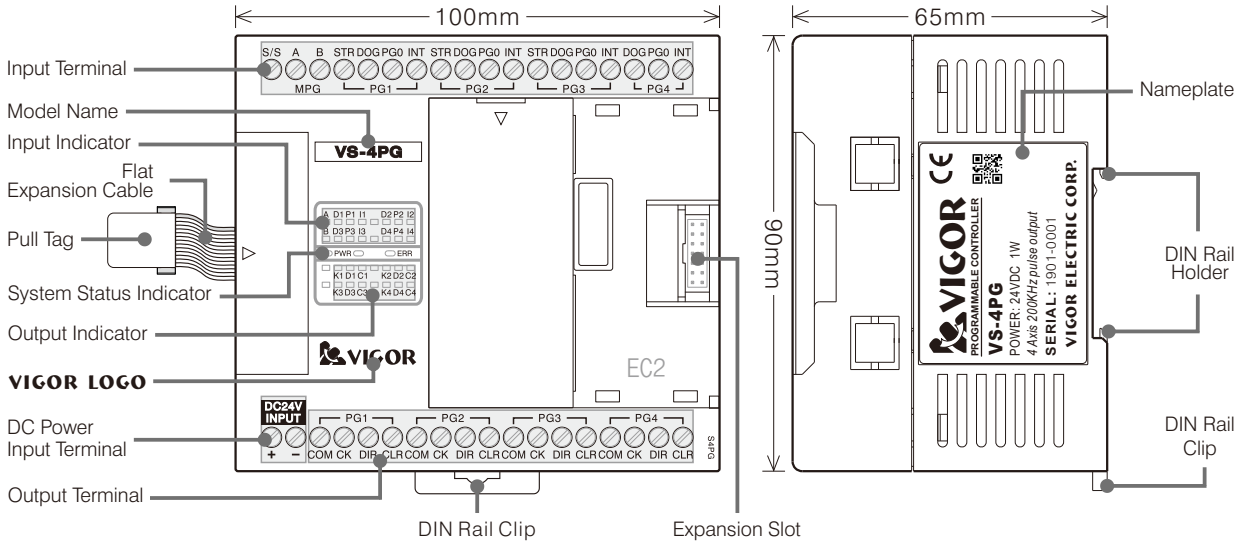

Below is the brief configuration of a general positioning control system about the module.



- Product Exterior




Module Weight (N.W. / G.W.): 130g / 215g




Module Weight (N.W. / G.W.): 200g / 305g

- Product Specification

Input Specification

| Item | A | B | STR | DOG | PG0 | INT |
|---|---|---|---|---|---|---|
| Input Type | Sinking or Sourcing either (all the input signals should use the same type) | | | | | |
| Input Activating Voltage | DC24V ± 15% | | | | | |
| Input Signal Current | 5.3mA/DC24V | | | | | |
| Input ON Current | > 3.5mA | > 3.5mA | > 3.5mA | > 3.5mA | > 3.5mA | > 3.5mA |
| Input OFF Current | < 1.5mA | < 1.5mA | < 1.5mA | < 1.5mA | < 1.5mA | < 1.5mA |
| Input Resistance | 4.3kΩ approx. | 4.3kΩ approx. | 4.3kΩ approx. | 4.3kΩ approx. | 4.3kΩ approx. | 4.3kΩ approx. |
| Input Response Time | — | — | <200μs | <1ms | <1ms | 10μs |
| BFM Response Time | 10ms | 10ms | 10ms | 10ms | 10ms | 10ms |
| Input Signal Type | Dry contact or NPN / PNP transistor | | | | | |
| Isolation Method | Photocoupler Isolation | | | | | |
| Max. Counting Freq. | 50kHz | 50kHz | — | — | — | — |
| Input Indicator | Activated input causes its indicator ON | | — | Activated input causes its indicator ON | | |

Output Specification

| Item | CK | DIR | CLR |
|---|---|---|---|
| Output Type | MOSFET Output | MOSFET Output | NPN Transistor Output |
| Switch Voltage | DC5V～30V | DC5V～30V | DC5V～30V |
| Rated Current | 0.3A | 0.3A | 0.3A |
| Open Circuit Leakage | — | — | < 0.1mA/DC30V |
| Response Time | 200kHz | < 2.5μs | ON 100ms approximately |
| Isolation Method | Magnetic-coupler Isolation | Magnetic-coupler Isolation | Photocoupler Isolation |
| Output Indicator | Activated output causes its indicator ON | Activated output causes its indicator ON | Activated output causes its indicator ON |

Basic Specification

| Item | Specification | |
|---|---|---|
| Number of Axes | The VS-2PG has 2 axes (PG1～PG2); the VS-4PG has 4 axes (PG1～PG4), each axis is independent. The PG1 & PG2 or PG3 & PG4 can be paired for the two axes linear interpolation | |
| Command of Speed | • The VS Main Unit uses the specific BFM to deliver the setting of positioning speed<br>• The range of positioning speed is 1Hz ~ 200kHz<br>• The unit of speed can use Hz, cm/min, 10deg/min or inch/min | |
| Command of Position | • The VS Main Unit uses the specific BFM to deliver the setting of positioning target<br>• Supports 32-bit position data value for the positioning<br>• The unit of position can use Pulse, μm, mdeg or $10^{-4}$ inch<br>• Can use the $10^0$,$10^1$,$10^2$ or $10^3$multiply rate for the position data | |
| Positioning Control | The positioning procedure is prepared by the PLC's user program, then via the FROM / TO instruction to transfer data between the Main Unit and this module | |
| Power Consumption | VS-2PG | DC 24V ± 20%, 20mA (Max.) from external + DC 5V 110mA from PLC's inner power |
| | VS-4PG | DC 24V ± 20%, 20mA (Max.) from external + DC 5V 140mA from PLC's inner power |

- Definition of Buffer Memory BFM in the VS-2PG/4PG Module

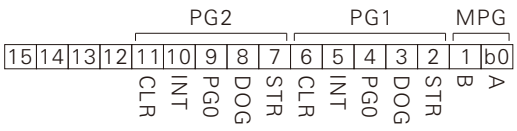
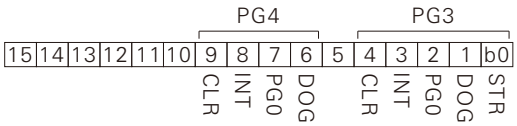
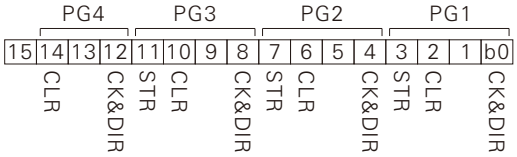
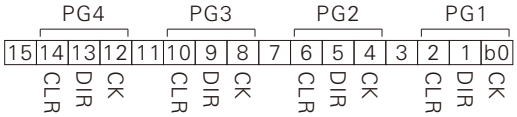
The VS-2PG / VS-4PG module uses the BFM to communicate with the VS Main Unit for the parameter setting and value access. The VS-2PG provides PG1 and PG2, the VS-4PG provides PG1～PG4.

At the list below, a number with the " ■ " symbol means it is a read only BFM.

The BFM#0～31 are shared by all axes.
The BFM#100～137 are specifically for the operation of PG1, the BFM#200～237 are for the PG2, the BFM#300～337 are for the PG3 and the BFM#400～437 are for the PG4.

Since the definitions of BFMs for each axis are equal, at the list below only shows the BFMs of PG1.

The BFM#150～163 are specifically for the linear interpolation operation at the paired PG1 and PG2.
The BFM#350～363 are specifically for the linear interpolation operation at the paired PG3 and PG4.
Since the definitions of BFMs for each linear interpolation group are equal, at the list below only shows the BFMs for the paired PG1 and PG2.

| BFM # | Title | Component Description | Default Value | Unit |
|---|---|---|---|---|
| 1,0 | MPG's Input Current Position | 32-bit data | 0 | Pulse |
| ■ 2 | MPG's Input Frequency | 16-bit data | 0 | Hz |
| 3 | MPG's Gear Ratio Numerator | 1～32,767; over the range will be regarded as 1.<br>MPG's output pulses=Input pulses×Numerator/Denominator | 1 | — |
| 4 | MPG's Gear Ratio Denominator | | 1 | — |
| 5 | MPG's Response Delay Time | 1～500ms; over the range will be regarded as 5ms. | 5 | ms |
| ■ 6 | MPG's Handwheel Input Status | b0=Input from the MPG is forward (current value increase)<br>b1=Input from the MPG is backward (current value decrease) | H0000 | — |
| ■ 20 | PG1 and PG2 Terminal Status |  <br>The input terminals' status showing at this BFM will have 10ms time integration delay. That could avoid the interfering noise when it is used for the ordinary purpose input. | H0000 | — |
| ■ 21 | PG3 and PG4 Terminal Status |  <br>The input terminals' status showing at this BFM will have 10ms time integration delay. That could avoid the interfering noise when it is used for the ordinary purpose input. | H0000 | — |
| 22 | STR, CK, DIR and CLR Terminal Function Select |  <br>STR:0: for the PG use; 1: not for the PG use. When the STR is for the ordinary purpose input, should assign it not for the PG use.<br>CK,DIR,CLR:0: for the PG use; 1: operated by the BFM#23. When the CK, DIR or CLR is for the ordinary purpose output, should assign it not for the PG use. | H0000 | — |
| 23 | CK, DIR and CLR Status Force Command |  | H0000 | — |
| ■ 30 | Identification code | VS-2PG:K209<br>VS-4PG:K210<br>Can use the FROM instruction to check whether the place is this module or not | 209<br>210 | — |
| ■ 31 | Version | Firmware version (the content value □□ indicates Ver. □.□) | 10 | — |

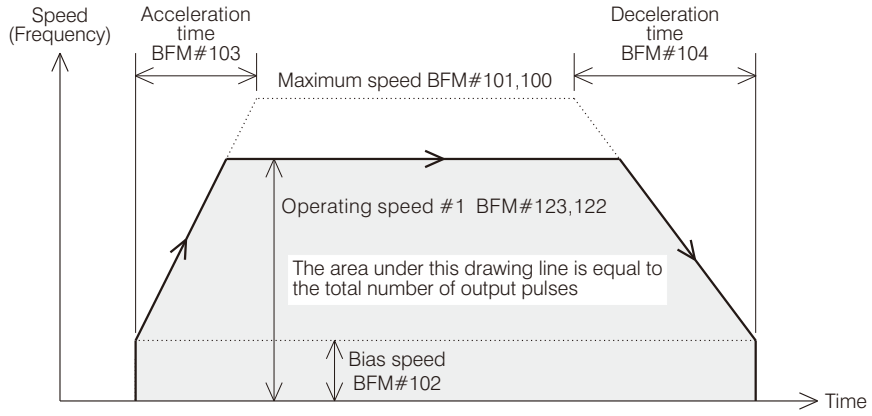
※ The range of a 32-bit data is –2,147,483,648～2,147,483,647.
The range of a 16-bit data is –32,768～32,767.

<table>
<tr><th>BFM #</th><th>Title</th><th>Component Description</th><th>Default Value</th><th>Unit</th></tr>
<tr><td>101,100</td><td>Maximum Speed</td><td>Convert this speed for pulse output it must between 10～200kHz; over the range will be regarded as 200kHz.</td><td>200,000</td><td>User-defined</td></tr>
<tr><td>102</td><td>Bias Speed</td><td>Convert for the real pulse output it must between 1～200kHz; over the range will be regarded as 0.</td><td>0</td><td>User-defined</td></tr>
<tr><td>103</td><td>Acceleration Time</td><td rowspan="2">0～32,000ms<br>If < 0, will be regarded as 0; if > 32,000, will as 32,000.</td><td>100</td><td>ms</td></tr>
<tr><td>104</td><td>Deceleration Time</td><td>100</td><td>ms</td></tr>
<tr><td>106,105</td><td>JOG Operating Speed</td><td>Convert for the real pulse output it must between 1～200kHz</td><td>10,000</td><td>User-defined</td></tr>
<tr><td>107</td><td>JOG Start Delay Time</td><td>1～32,767ms; over the range will be regarded as 1ms.</td><td>300</td><td>ms</td></tr>
<tr><td>109,108</td><td>Home Positioning Speed</td><td>Convert for the real pulse output it must between 1～200kHz</td><td>200,000</td><td>User-defined</td></tr>
<tr><td>110</td><td>Home Positioning Creep Speed</td><td>Convert for the real pulse output it must between 1～30kHz</td><td>1,000</td><td>User-defined</td></tr>
<tr><td>111</td><td>Input No. of PG0 after DOG</td><td>1～32,767; over the range will be regarded as 1.</td><td>1</td><td>Pulse</td></tr>
<tr><td>113,112</td><td>Preset Value of Home Position</td><td>Convert this position to the unit of pulse it must fit 32-bit data</td><td>0</td><td>User-defined</td></tr>
<tr><td>114</td><td>Speed Multiple Ratio</td><td>0.1～3,000.0%; over the range will be regarded as 100.0%.</td><td>1,000</td><td>×0.1%</td></tr>
<tr><td>115</td><td>Parameter Setting</td><td>b1,b0=Operating unit
<table>
<tr><th rowspan="2">b1</th><th rowspan="2">b0</th><th rowspan="2">Item</th><th colspan="2">Unit</th></tr>
<tr><th>Position</th><th>Speed</th></tr>
<tr><td>0</td><td>0</td><td>Motor system</td><td>Pulse</td><td>Hz</td></tr>
<tr><td>0</td><td>1</td><td>Machine system</td><td rowspan="2">• μm<br>• mdeg<br>• $10^{-4}$inch</td><td>• cm/min<br>• 10deg/min<br>• inch/min</td></tr>
<tr><td>1</td><td>X</td><td>Combined system</td><td>Hz</td></tr>
</table>
b3,b2=Multiple rate of position data<br>b3b2=00:X1<br>b3b2=01:X10<br>b3b2=10:X100<br>b3b2=11:X1,000<br>b4=Rotational direction<br>b4=0:Increase present value when forward;<br>b4=1:Increase present value when backward<br>b5=Home return direction<br>b5=0:By the direction of present value decreasing;<br>b5=1:By the direction of present value increasing<br>b8～b6=Home return mode
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>Home return mode</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>DOG Rear End home positioning</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>DOG Front End home positioning</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>DOG Rear End with PG0 count home positioning</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>DOG Front End with PG0 count home positioning</td></tr>
<tr><td>1</td><td>X</td><td>X</td><td>Data-set type home return</td></tr>
</table>
b9=STR input type b9=0:N/O contact; b9=1:N/C contact<br>b10=DOG input type b10=0:N/O contact; b10=1:N/C contact<br>b11=PG0 input type b11=0:N/O contact; b11=1:N/C contact<br>b12=INT input type b12=0:N/O contact; b12=1:N/C contact</td><td>H0000</td><td>—</td></tr>
<tr><td>117,116</td><td>Pulse Per Revolution of Motor</td><td>1～999,999; over the range will be regarded as 2,000.</td><td>2,000</td><td>Pulse</td></tr>
<tr><td>119,118</td><td>Distance Per Rev. of Motor</td><td>1～999,999; over the range will be regarded as 2,000.</td><td>2,000</td><td>User-defined</td></tr>
<tr><td>121,120</td><td>Target Position #1</td><td>Convert this position to the unit of pulse it must fit 32-bit data</td><td>0</td><td>User-defined</td></tr>
<tr><td>123,122</td><td>Operation Speed #1</td><td>Convert for the real pulse output it must between 1～200kHz<br>(For the PLSV, the +/– sign of speed is forward/reverse control)</td><td>200,000</td><td>User-defined</td></tr>
<tr><td>125,124</td><td>Target Position #2</td><td>Convert this position to the unit of pulse it must fit 32-bit data</td><td>0</td><td>User-defined</td></tr>
<tr><td>127,126</td><td>Operation Speed #2</td><td>Convert for the real pulse output it must between 1～200kHz</td><td>50,000</td><td>User-defined</td></tr>
</table>

| BFM # | Title | Component Description | Default Value | Unit |
|---|---|---|---|---|
| 128 | System Command | b0=Error reset, will reset at the rising edge<br>b1=Stop, will gradually slow down and then stop<br>b2=LSF forward limit switch, level detection<br>b3=LSR reverse limit switch, level detection<br>b4=Absolute/Relative positioning<br>b4=0:Absolute positioning; b4=1:Relative positioning<br>b5=Start command, will begin at the rising edge<br>b6=Speed change signal of the DV2I positioning | H0000 | — |
| 129 | Operation Command | b0=ZRN Home Positioning (Zero Return)<br>b1=JOGF, Jog Forward<br>b2=JOGR, Jog Reverse<br>b3=DRV, Drive to Set Position<br>b4=DRV2, Drive to Set Position by 2 Stages<br>b5=DVIT, Interrupt Constant Quantity Positioning<br>b6=DV2I, 2 Stages Interrupt Constant Quantity Positioning<br>b7=DVS, Interrupt to Stop or Drive to Set Position<br>b8=PLSV, Variable Speed Pulse Output<br>b9=MPG, Handwheel Positioning<br>b10=LI, Linear Interpolation Positioning | H0000 | — |
| ■ 131,130 | Current Speed | 32-bit data | 0 | User-defined |
| 133,132 | Current Location | 32-bit data | 0 | User-defined |
| 135,134 | Current Location | 32-bit data For input the servo's position, the data is read from the Main Unit's ABS instruction. | 0 | Pulse |
| ■ 136 | Status Information | b0=READY/BUSY 0:READY for a new instruction; 1:BUSY<br>b1=Moving forward<br>b2=Moving backward<br>b3=The home positioning completed flag<br>b4=The Current Location at the BFM#133, 132 is exceeded<br>b5=The error flag. Also, the BFM#137 shows the error code.<br>b6=The positioning completed flag | H0000 | — |
| ■ 137 | Error Code | K0=No error<br>K□□□ 1=Setting value is exceeded<br>□□□ shows the number of incorrect BFM<br>K□□□ 2=Setting value is overflow<br>□□□ shows the number of incorrect BFM<br>K3=More than one operation command is given<br>K4=The LSF or LSR is activated at its watching operation<br>Use the JOGF, JOGR or MPG instruction could relieve the limit switch and clear this error code. | 0 | — |

| BFM # | Title | Component Description | | Default Value | Unit |
|---|---|---|---|---|---|
| 150 | Linear Interpolation's Composite Initial Speed | Convert for the real pulse output it must between 0~30kHz; over the range will be regarded as 0. | | 0 | User-defined |
| 152,151 | Linear Interpolation's Composite Operating Speed | Convert for the real pulse output it must between 10~200kHz; over the range will be regarded as 200kHz. | | 200,000 | User-defined |
| 153 | Linear Interpolation's Acceleration/Deceleration Time | 0~32,000ms<br>If < 0, will be regarded as 0; if > 32,000, will as 32,000. | | 100 | ms |
| 155,154 | Linear Interpolation's Target of X-axis | Convert this position to the unit of pulse it must fit 32-bit data | | 0 | User-defined |
| 157,156 | Linear Interpolation's Target of Y-axis | Convert this position to the unit of pulse it must fit 32-bit data | | 0 | User-defined |
| ■ 158 | Linear Interpolation's X-axis Bias Speed | 16-bit data | Result storage area, those are produced by the interpolation instruction | 0 | User-defined |
| ■ 160,159 | Linear Interpolation's X-axis Operating Speed | 32-bit data | | 0 | User-defined |
| ■ 161 | Linear Interpolation's Y-axis Bias Speed | 16-bit data | | 0 | User-defined |
| ■ 163,162 | Linear Interpolation's Y-axis Operating Speed | 32-bit data | | 0 | User-defined |

Since the operational definitions of each axis at this module are the same, at the list below only shows the BFMs of PG1. However, all the PG2 related BFMs are 2□□ (2 at the hundreds digit), all the PG3 related BFMs are 3□□(3 at the hundreds digit) and all the PG4 related BFMs are 4□□ (4 at the hundreds digit).




**BFM #101, 100 Maximum Speed**

As shown in the diagram, this value confines the highest limit of the positioning control speed at a certain axis. If its operation speed exceeds the limit of the maximum speed during the action of any positioning control instruction, the instruction will be operated according to the maximum speed.
The highest output frequency of this module is 200 kHz. The acceptable value range is from 1 to 200 k (Hz).
Any value less than 1 or more than 200 k is regarded as 200 kHz. The default value is 200 kHz.

**BFM #102 Bias Speed**

As shown in the diagram, this value confines the lowest limit of the positioning control speed at a certain axis. If its operation speed is less than the bias speed during the action of any positioning control instruction, the instruction will be operated according to the bias speed. The main purpose is to avoid the low-frequency resonance area of a step motor. Thus, it is usually set to be 0 for a servo motor.
The acceptable value range is from 0 to 30 k (Hz). Any value less than 0 or more than 30 k is regarded as 0 Hz.
The default value is 0 Hz.

**BFM #103 Acceleration Time**

As shown in the diagram, the acceleration time refers to the time it takes for speeding up from the bias speed to the maximum speed (not the operating speed).
The acceptable value range is from 0 to 32,000 (ms). Any value less than 0 is regarded as 0 ms; more than 32,000 is regarded as 32,000 ms. The default value is 100 ms.

**BFM #104 Deceleration Time**

As shown in the diagram, the deceleration time refers to the time it takes for slowing down from the maximum speed (not the operating speed) to the bias speed.
The acceptable value range is from 0 to 32,000 (ms). Any value less than 0 is regarded as 0 ms; more than 32,000 is regarded as 32,000 ms. The default value is 100 ms.

**BFM #106, 105 JOG Operating Speed**

When the JOGF or JOGR instruction is activated, it will use this operating speed to generate pulse string, also could change this content value to modify the output speed.
The real operating speed = JOG operating speed (BFM#106, 105) × Speed multiple ratio (BFM#114)

**BFM #107 JOG Start Delay Time**

When the JOGF or JOGR instruction is activated, a few pulses (just equal to one unit of the position) will be generated at the beginning. Then, after the start delay time is reached, the pulses will be generated continuously.

**BFM #109, 108 Home Positioning Speed**
**BFM #110 Home Positioning Creep Speed**

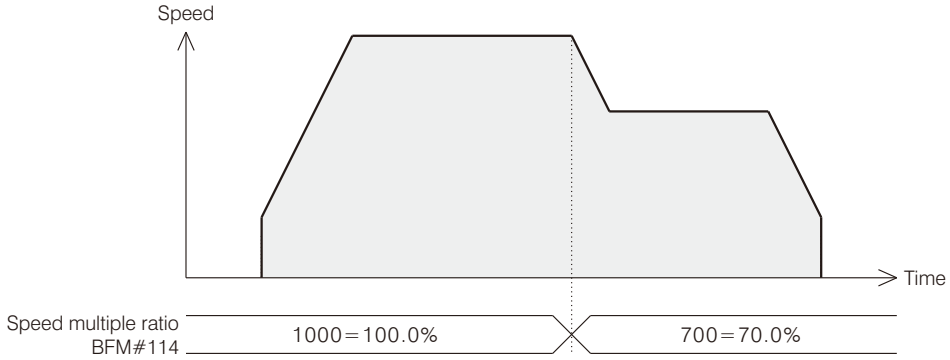
At the beginning of the home return instruction is activated, it will use the faster home positioning speed and the setting of home return direction to drive the motor close to the home point quickly. Then after the near point (DOG) is reached, will slow down to the home return creep speed for the accurately return.
During this instruction is in operation, to change any parameter above will be regarded as invalid. Which is different from other positioning instructions and should pay attention to this.
The real home positioning speed=Home positioning speed (BFM#109, 108)×Speed multiple ratio (BFM#114)
The real home positioning creep speed=Home positioning creep speed (BFM#110)×Speed multiple ratio (BFM#114)

**BFM #111 Input Number of PG0 after DOG for the Home Positioning**

If the “DOG Rear End with PG0 count home positioning” or the “DOG Front End with PG0 count home positioning” return mode is selected, to set up this input number of PG0 after DOG for the home positioning is required.

**BFM #113, 112 Preset Value of the Home Position**

When the return action is completed, this preset value will be duplicated into the current location (BFM#133, 132).




**BFM #114 Speed Multiple Ratio**

As the diagram above, this parameter can be used to change the real operation speed about the positioning, the default value is 1,000 (100.0%).
It will affect to the reaction about all the JOG operating speed (BFM#106, 105), home positioning speed (BFM#109, 108), home positioning creep speed (BFM#110) and operation speed (BFM#123, 122 and BFM#127, 126). During the home positioning is executed, to change this ratio is useless; but for other positioning functions, this ratio can modify the real operating speed instantly.
The acceptable value range is from 1 to 30,000 (Unit: 0.1%), therefore the speed multiple ratio is 0.1%~3,000.0%.

**BFM #117, 116 Pulse Per Revolution of Motor ( Pr: Pulse rate)**
**BFM #119, 118 Distance Per Revolution of Motor ( Fr: Feed rate)**

If the operating unit is using the machine system or combined system, the pulse per revolution of motor and distance per revolution of motor must be set, these two informations are necessary to convert the pulse number and speed of the real output.

**BFM #115 Parameter Setting**

This parameter includes the setting about the operating unit, multiple rate of position data, rotational direction, home return direction, home return mode and external input type. Below are the descriptions for each item.

- BFM#115 b1 & b0 are to set the operating unit
  The control method of the positioning module is using the high speed pulse string signal to the motor's driver. Therefore, the control fundamental unit of speed is the frequency (Hz) and the unit of position is the number of pulses (PLS).However, to describe the control through the unit of the machine system is more similar to the real application. Thus, the module provides the unit setting function for the user to select then via this unit conversion could let the user finish the control job by familiar unit.

| b1 | b0 | Item | Unit | |
|---|---|---|---|---|
| | | | Position | Speed |
| 0 | 0 | Motor system | Pulse | Hz |
| 0 | 1 | Machine system | • μm • mdeg • $10^{-4}$inch | • cm/min • 10deg/min • inch/min |
| 1 | X | Combined system | | Hz |

Unit of the position —— At the positioning control, this unit is related to the preset value of home position (BFM#113, 112), target position (BFM#121, 120 / BFM#125, 124) & current location.

Unit of speed —— At the positioning control, this unit is related to the maximum speed (BFM#101, 100), bias speed (BFM#102), JOG operating speed (BFM#106, 105), home positioning speed (BFM#109, 108), home positioning creep speed (BFM#110), operation speed (BFM#123, 122 / BFM#127, 126) & current speed (BFM#131, 130).

Below is an example of unit conversion, its unit of the position is by (μm) and the speed is by (cm/min).

Assume at this machine, the pulse per revolution of motor Pr=10000 (Pulse/REV) and the distance per revolution of motor Fr=1000 (μm/REV)

So, Pr / Fr=10000 (Pulse/REV) ÷ 1000 (μm/REV) =10 (Pulse/μm)
That means, to make this machine move one user-define unit (which is 1 μm) should send out 10 pulses.

Also, to convert the maximum speed by way of the unit of user-defined (cm/min) is using the calculation below.

The maximum speed by the user-defined unit =

$$\text{The maximum speed by frequency} \div Pr \times Fr \div 10^4 \frac{\mu m}{cm} \times 60 \frac{sec}{min}$$

$$= 200 \times 10^3 \frac{Pulse}{sec} \div 10^4 \frac{Pulse}{REV} \times 10^3 \frac{\mu m}{REV} \div 10^4 \frac{\mu m}{cm} \times 60 \frac{sec}{min}$$

$$= 20 \frac{REV}{sec} \times 10^3 \frac{\mu m}{REV} \div 10^4 \frac{\mu m}{cm} \times 60 \frac{sec}{min}$$

$$= 2 \times 10^4 \frac{\mu m}{sec} \div 10^4 \frac{\mu m}{cm} \times 60 \frac{sec}{min} = 2 \frac{cm}{sec} \times 60 \frac{sec}{min} = 120 \frac{cm}{min}$$

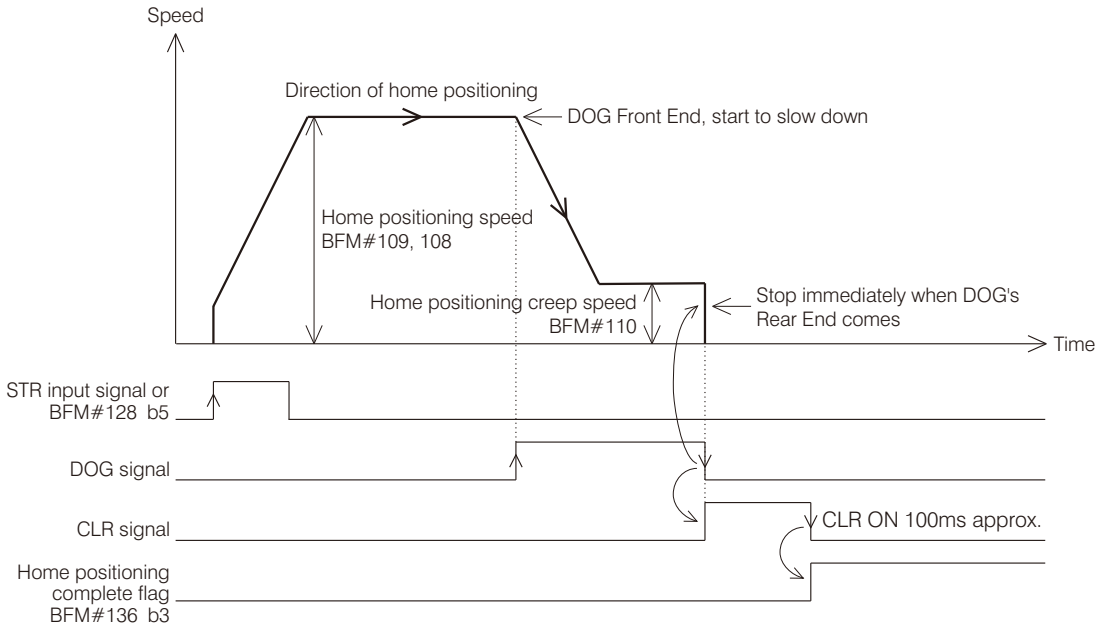
- BFM#115 b3 & b2 are to set multiple rate of position data
  All the data about the preset value of home position (BFM#113, 112), target position #1 (BFM#123, 122), target position #2 (BFM#125, 124) and current location (BFM#133, 132) will be multiplied by this rate.

- BFM#115 b4 is to set the rotational direction
  Users can select the direction control pattern: “Increase present value when forward” or “Increase present value when backward”. That will affect to the direction output of the positioning control. The default is “Increase present value when forward”.
  If the “Increase present value when forward” is selected and the positioning instruction decides to increase its present value, then the direction control point will turn “ON” to drive the motor moving forward.
  If the “Increase present value when backward” is selected and the positioning instruction decides to increase its present value, then the direction control point will turn “OFF” to drive the motor moving backward.

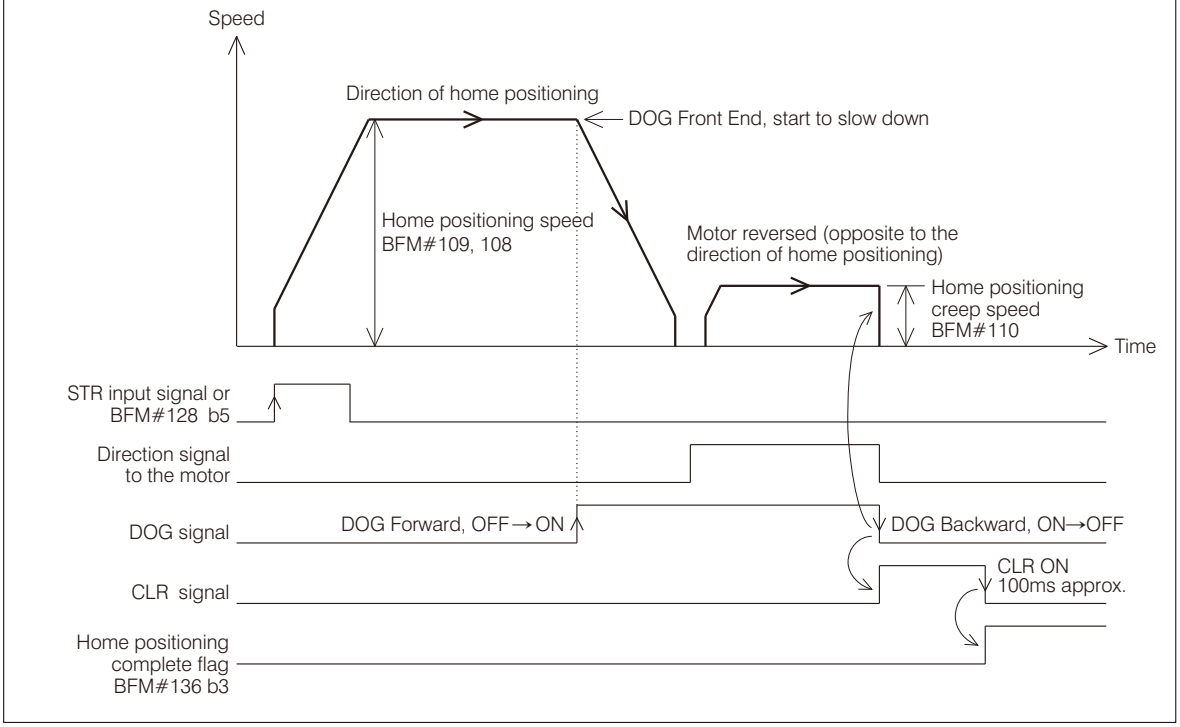
- BFM#115 b8~b6 are to set home return mode
  This module provides a variety of return modes when the home positioning is used, which will be explained one by one below.

| b8 | b7 | b6 | **Home Return Mode** |
|---|---|---|---|
| 0 | 0 | 0 | DOG Rear End home positioning |
| 0 | 0 | 1 | DOG Front End home positioning |
| 0 | 1 | 0 | DOG Rear End with PG0 count home positioning |
| 0 | 1 | 1 | DOG Front End with PG0 count home positioning |
| 1 | X | X | Data-set type home return |

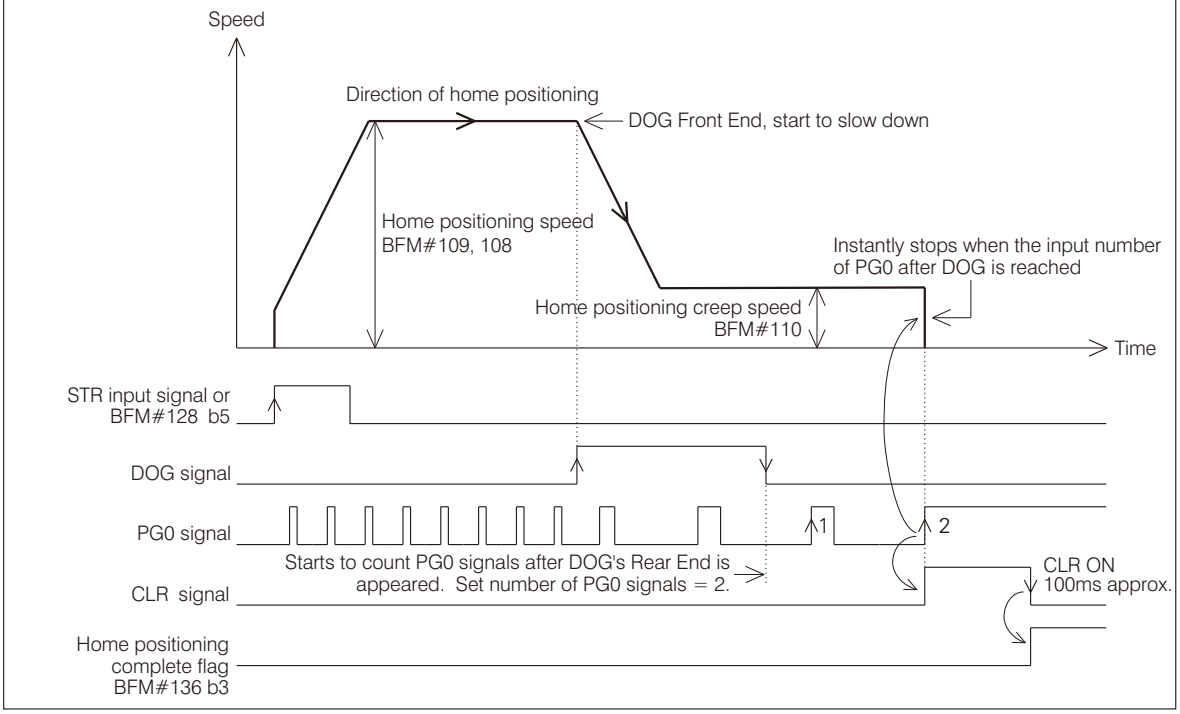
DOG Rear End home positioning



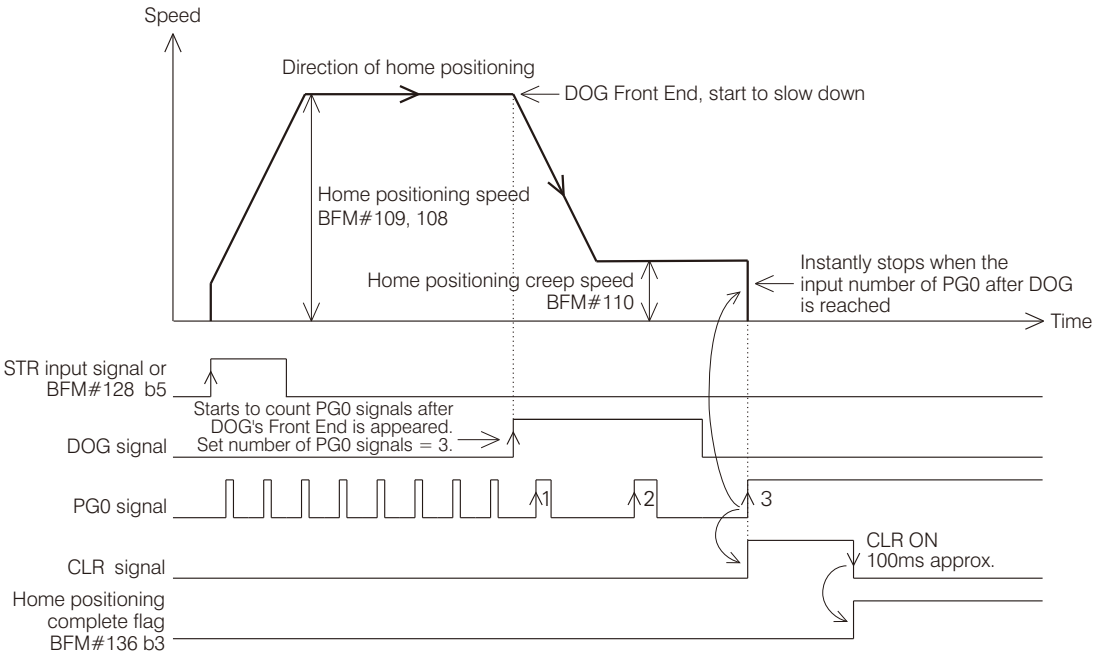
## DOG Front End home positioning




## DOG Rear End with PG0 count home positioning



## DOG Front End with PG0 count home positioning

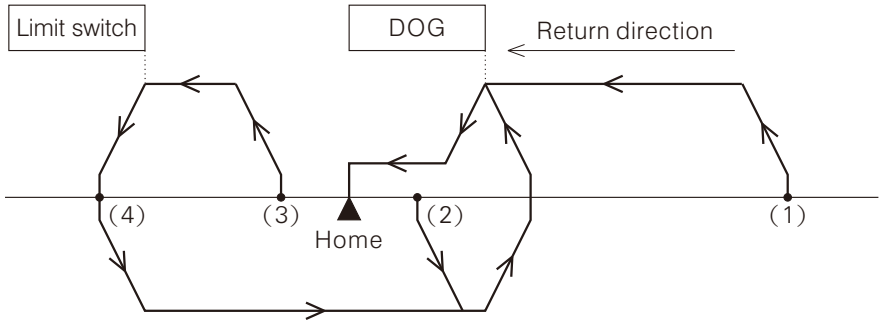



## Data-set type home return

This mode will not generate pulse to control the motor. When the function is operated, it will load the preset value of the home position at BFM#113, 112 into the current position at BFM#133, 132 then turn the CLR signal "ON" about 100ms and set the home positioning complete flag BFM#136 b3 "ON".

## Dog search home positioning

When the positioning system has installed with limit switches to provide the limiter signals for the module, that will provide the automatic DOG search capability for the home positioning. (the examples are using the DOG Rear End home positioning)




The diagram above illustrates the different actions from the starting points (1)～(4) to complete the home positioning.

(1) At the starting point, which DOG is located on the right of the DOG switch:
The home positioning is moving the sliding table by the home positioning speed and the direction of home positioning. Until the Front End of the DOG is reached, the speed decreases to the creep speed, then to finish the home positioning.

(2) At the starting point, which DOG is driving the DOG switch "ON":
The home positioning at the beginning moves the sliding table by the home positioning speed and the opposite direction of home positioning for to make the Front End of the DOG separate (the signal turns from "ON" to "OFF") then it will slow down and then stop. Next, it moves the table by the home positioning speed and the direction of home positioning. Until the Front End of the DOG is reached, the speed decreases to the creep speed, then to finish the home positioning.

(3) At the starting point, which DOG is located on the left of the DOG switch:
The home positioning moves the sliding table by the home positioning speed and the direction of home positioning. When the limit switch is reached, it will slow down and then stop. Next, moves the sliding table by the home positioning speed and the opposite direction of home positioning for to search the DOG. When the Front End of the DOG is separated (the signal turns from "ON" to "OFF"), it will slow down and then stop. Furthermore, it uses the home positioning speed and the direction of home positioning to move the table again. Until the Front End of the DOG is reached, the speed decreases to the creep speed, then to finish the home positioning.

(4) At the starting point, which DOG is driving the limit switch "ON":
The home positioning moves the sliding table by the home positioning speed and the opposite direction of home positioning for to search the DOG. When the Front End of the DOG is separated (the signal turns from "ON" to "OFF"), it will slow down and then stop. Furthermore, it uses the home positioning speed and the direction of home positioning to move the table again. Until the Front End of the DOG is reached, the speed decreases to the creep speed, then to finish the home positioning.

**BFM #121, 120 Target Position #1**
**BFM #125, 124 Target Position #2**

When the DRV (drive to set position, BFM#129 b3), DRV2 (drive to set position by 2 stages, BFM#129 b4), DVIT (interrupt constant quantity positioning, BFM#129 b5), DV2I (2 stages interrupt constant quantity positioning, BFM#129 b6) or DVS (interrupt to stop or drive to set position, BFM#129 b7) instruction is activated, that will use the target position(s) to control the movement. During the instruction is in operation, to change the target will be regarded as invalid.

If it is appointed to the absolute positioning (BFM#128 b4=0),

The real distance to be moved = |Target position−Current location (BFM#133, 132)| × Multiple rate of position data

If it is appointed to the relative positioning (BFM#128 b4=1),
The real distance to be moved = Target position × Multiple rate of position data

※ The multiple rate of position data is determined by the BFM#115 b2 and b3.

**BFM #123, 122 Operation Speed #1**
**BFM #127, 126 Operation Speed #2**

When the DRV (drive to set position, BFM#129 b3), DRV2 (drive to set position by 2 stages, BFM#129 b4), DVIT (interrupt constant quantity positioning, BFM#129 b5), DV2I (2 stages interrupt constant quantity positioning, BFM#129 b6), DVS (interrupt to stop or drive to set position, BFM#129 b7) or PLSV (variable speed pulse output, BFM#129 b8) instruction is activated, that will use the operation speed(s) to control the movement. During the instruction is in operation, to change this setting could modify the real output speed.

The real operating speed = Operation speed × Speed multiple ratio (BFM#114)

**BFM #128 System Command**

This system command includes the error reset, stop command, LSF forward limit switch, LSR reverse limit switch, absolute or relative positioning, start command and speed change signal.

- BFM#128 b0 is the command to reset the error
  When a positioning error occurs, to drive the BFM#128 b0 from OFF to ON could reset the error code and flag.

- BFM#128 b1 is the command to stop the pulse output
  When the BFM#128 b1 is ON, the pulse output will gradually slow down then stop. This stop command is effective to any operation.

- BFM#128 b2 is the LSF forward limit switch signal for the module
  When the LSF limit switch is active, it will limit the forward action to slow down and stop. Furthermore, any new forward operation will be ignored.
  At this moment, only the JOGR or the MPG's reverse movement can be used to release the switch.

- BFM#128 b3 is the LSR reverse limit switch signal for the module
  When the LSR limit switch is active, it will limit the reverse action to slow down and stop. Furthermore, any new reverse operation will be ignored.
  At this moment, only the JOGF or the MPG's forward movement can be used to release the switch.

- BFM#128 b4 is the selective bit for the absolute or relative positioning
  Before a positioning operation starts, should use this bit to appoint that is by the absolute positioning (b4=0) or relative positioning (b4=1).

  The real move distance at the absolute positioning =
  |Target position−Current location (BFM#133, 132)| ×Multiple rate of position data
  The real move distance at the relative positioning = Target position × Multiple rate of position data
  ※ The multiple rate of position data is determined by the BFM#115 b2 and b3.

- BFM#128 b5 is the positioning start command
  After an operation command is selected at the BFM129, should trigger this start command bit from OFF to ON (or use the STR input) then the positioning will start.
  However, the JOGF, JOGR, PLSV or MPG function just need to turn ON its related operation command bit, not necessary to trigger this start command.

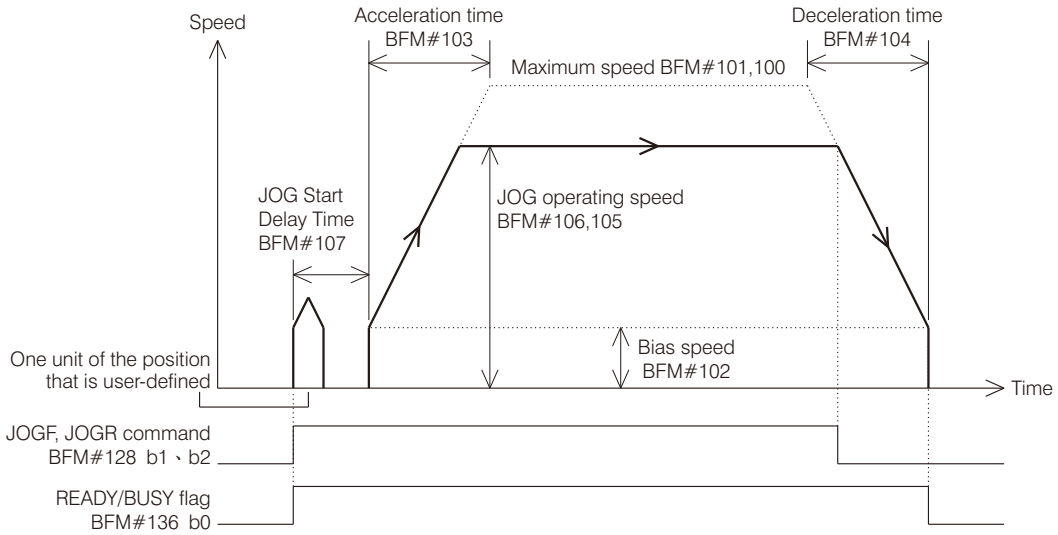
- BFM#128 b6 is the speed change signal of the DV2I positioning
  When the DV2I positioning is started and this BFM#128 b6 turns from OFF to ON, its operation speed will change from #1 to #2.

**BFM#129 Operation Command**

This module provides various positioning functions, below are the descriptions for each function. However, for each axis, only one function can be used at the same time, otherwise that will cause an operational error.

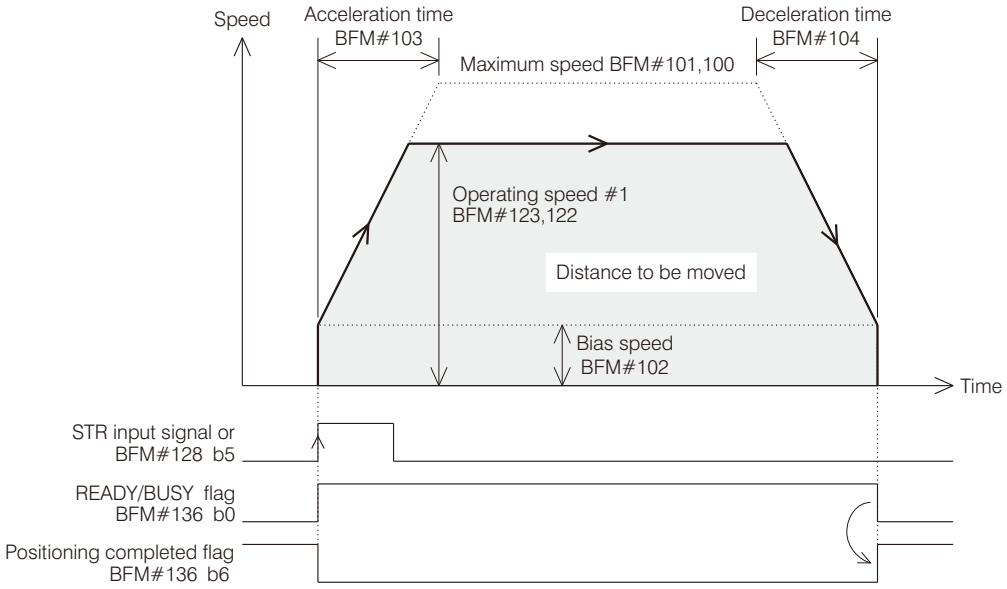
- BFM#129 b0 is the command of ZRN (home positioning, zero return)
  To execute the home return function, the return mode at BFM#115 b8~b6 should be allocated before this function starts. Then, turn the operation command BFM#129 b0 ON to choose the function. At last, trigger the start signal from OFF to ON.
  This module provides 5 different home return modes, please refer to the previous pages about the BFM#115 b8~b6.

• BFM#129 b1 is the command of JOGF (jog forward)
BFM#129 b2 is the command of JOGR (jog reverse)




When the axis is for to use the JOGF (BFM#129 b1 = ON) or JOGR (BFM#129 b2 = ON) function, its output pulse string will be executed as above. During the operation, could change the value of BFM#106, 105 or BFM#114 to modify the real operating speed.
If the period of this command ON is less than the start delay time at BFM#107 or the time needed for one unit of the position, the axis will generate the particular number of pulses that is equal to one unit of the position.
If the period of this command ON is longer than the start delay time at BFM#107, as the diagram above shows, it will generate the particular number of pulses that is equal to one unit of the position first. After the start delay time is reached, it begins to generate pulses continually.
The JOGF function could manage the direction and generate pulses to control the motor moving forward.
The JOGR function could manage the direction and generate pulses to control the motor moving reverse.

• BFM#129 b3 is the command of DRV (single-speed positioning, drive to set position)

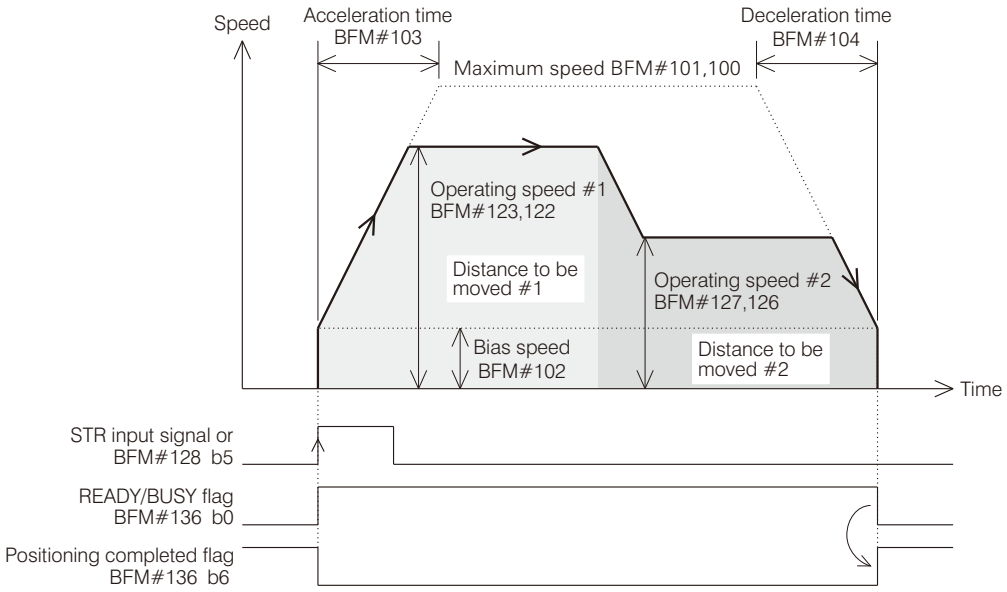



When the axis is for to use the DRV (BFM#129 b3 = ON) function and the start signal is turned from OFF to ON, its output pulse string will be executed as above.

If it is appointed to the absolute positioning (BFM#128 b4=0),
Distance to be moved = |Target position #1 (BFM#121, 120)− Current location (BFM#133, 132) at start|

If it is appointed to the relative positioning (BFM#128 b4=1),
Distance to be moved = Target position #1 (BFM#121, 120)

• BFM#129 b4 is the command of DRV2 (drive to set position by 2 stages)




When the axis is for to use the DRV2 (BFM#129 b4 = ON) function and the start signal is turned from OFF to ON, its output pulse string will be executed as above.

If it is appointed to the absolute positioning (BFM#128 b4=0),

Distance to be moved #1 = |Target position #1 (BFM#121, 120) − Current location (BFM#133, 132) at start|

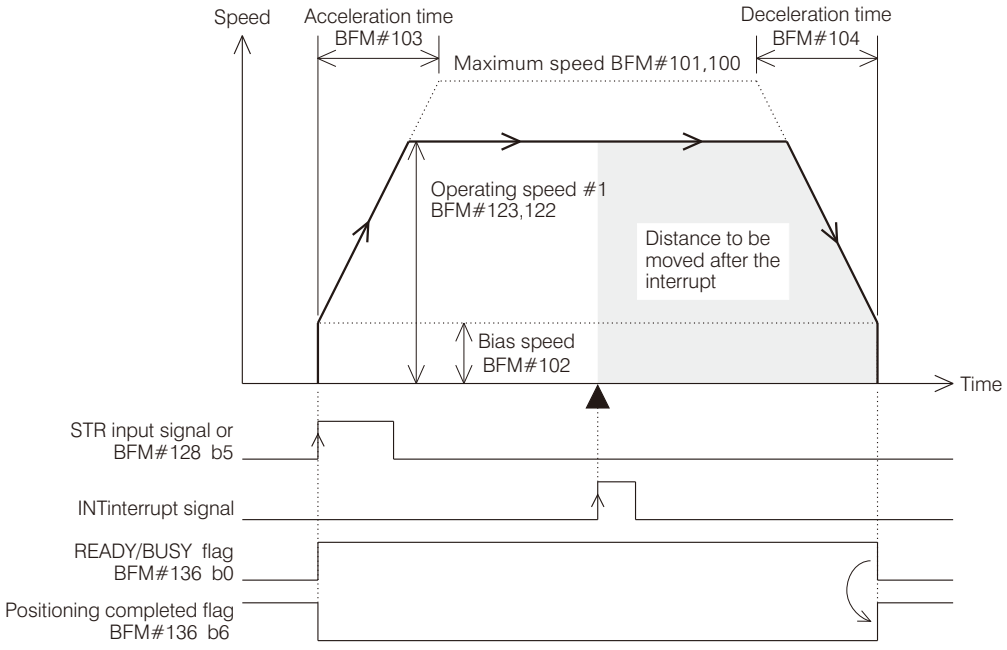
Distance to be moved #2 = |Target position #2 (BFM#125, 124) − Target position #1 (BFM#121, 120)|

If it is appointed to the relative positioning (BFM#128 b4=1),

Distance to be moved #1 = Target position #1 (BFM#121, 120)

Distance to be moved #2 = Target position #2 (BFM#125, 124)

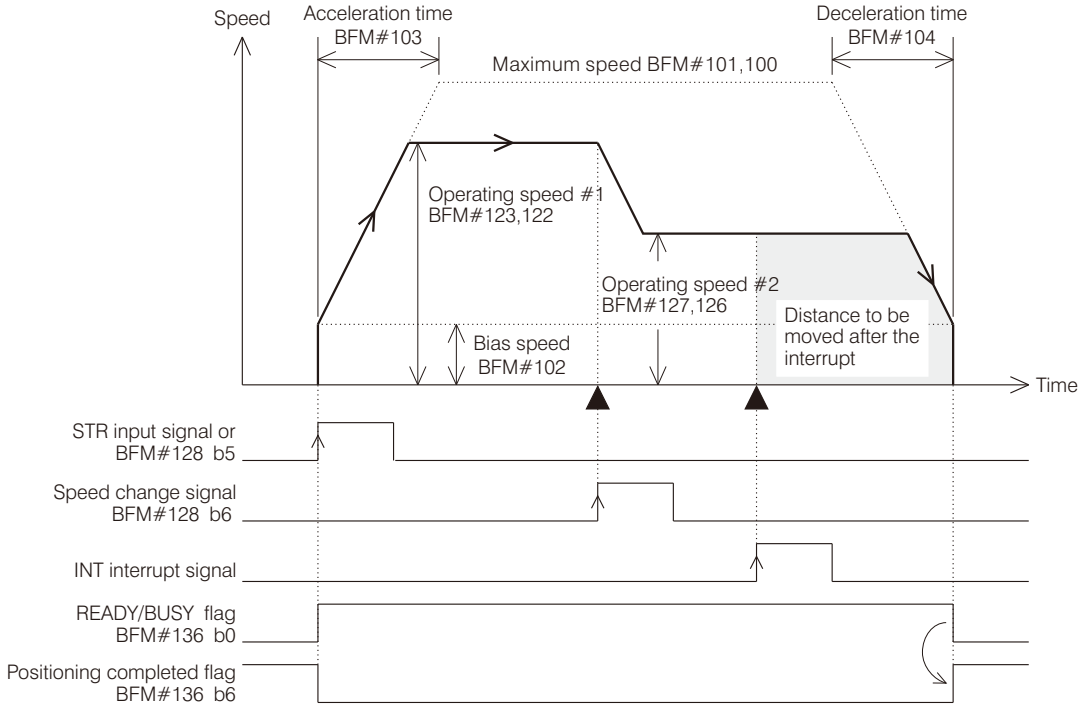
• BFM#129 b5 is the command of DVIT (interrupt constant quantity positioning)




When the axis is for to use the DVIT (BFM#129 b5 = ON) function and the start signal is turned from OFF to ON, its output pulse string will be executed as above.

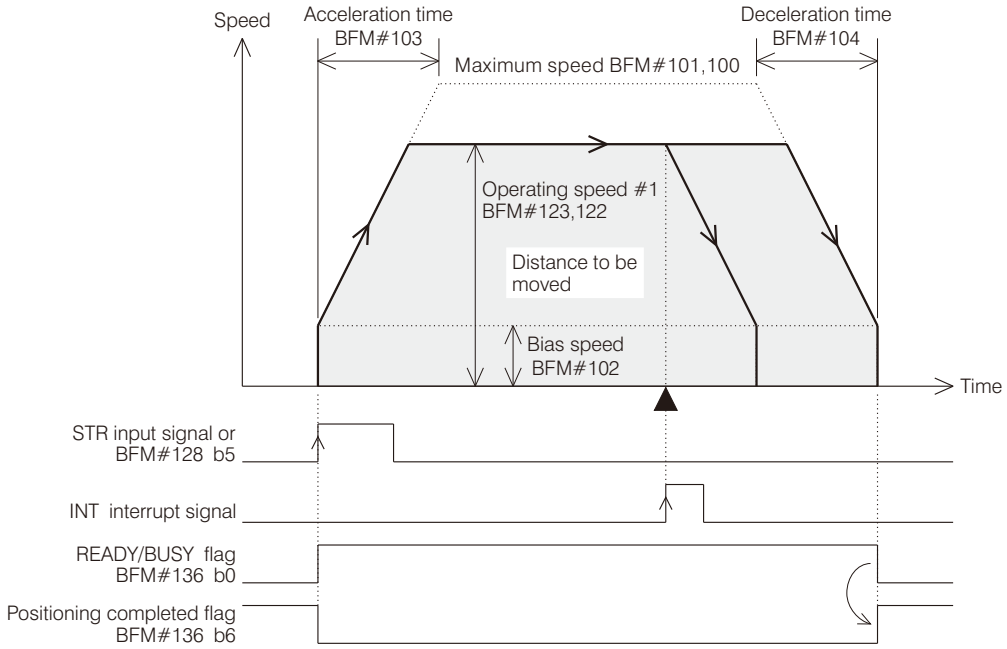
Distance to be moved after the interrupt = Target position #1 (BFM#121, 120)

• BFM#129 b6 is the command of DV2I (2 stages interrupt constant quantity positioning)




When the axis is for to use the DV2I (BFM#129 b6 = ON) function and the start signal is turned from OFF to ON, its output pulse string will be executed as above.
Distance to be moved after the interrupt = Target position #1 (BFM#121, 120)

• BFM#129 b7 is the command of DVS (interrupt to stop or drive to set position)

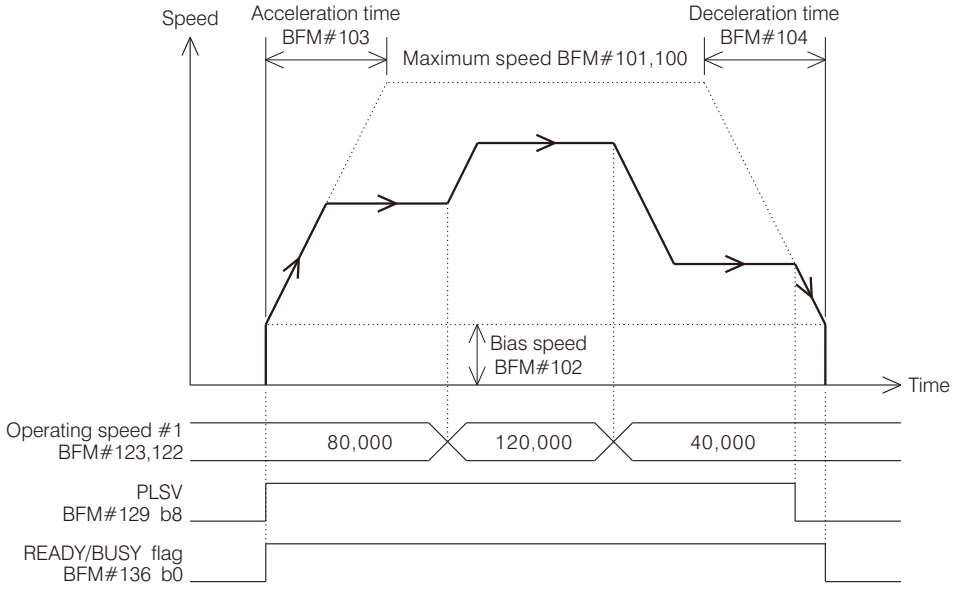



When the axis is for to use the DVS (BFM#129 b7 = ON) function and the start signal is turned from OFF to ON, its output pulse string will be executed as above.
However, the INT interrupt signal is triggered (OFF → ON) during the axis generating pulses, it will immediately slow down then stop (ignore the original target).

If it is appointed to the absolute positioning (BFM#128 b4=0),
Distance to be moved = |Target position #1 (BFM#121, 120) − Current location (BFM#133, 132) at start|

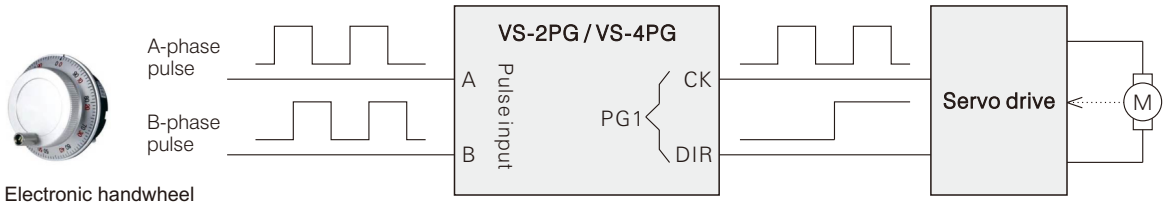
If it is appointed to the relative positioning (BFM#128 b4=1),
Distance to be moved = Target position #1 (BFM#121, 120)

• BFM#129 b8 is the command of PLSV (variable speed pulse output)




When the axis is for to use the PLSV (BFM#129 b8 = ON) function, it will use the value of operating speed #1 (BFM#123, 122) to generate pulses. Give a positive operating speed will have a forward movement; on the other hand, a negative operating speed will move backward.
While the BFM#129 b8 turns OFF, it will slow down then stop. During the operation, could change the value of BFM#123, 122 to modify the operating speed.

• BFM#129 b9 is the command of MPG (handwheel positioning)
The parameters about the MPG function are stored at the BFM#3~5.

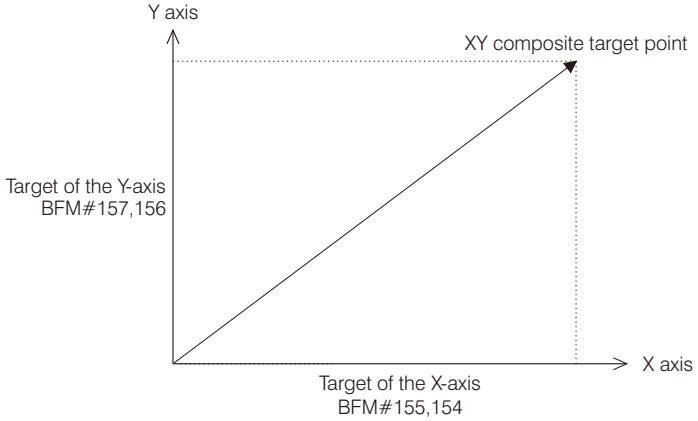


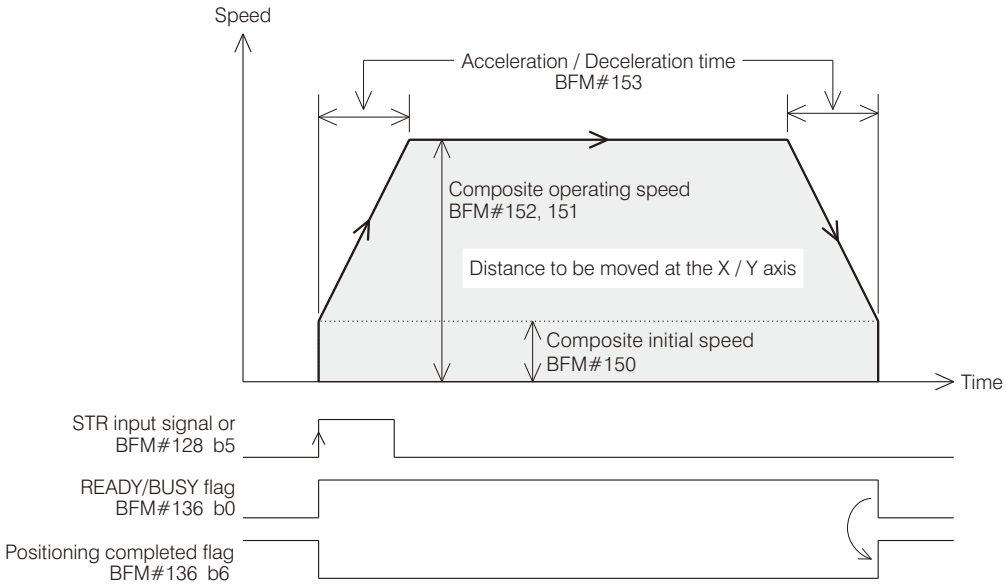

When the axis is for to use the MPG (BFM#129 b9 = ON) function, it is controlled by the input points from the external handwheel.
Above is a electronic handwheel generate the A/B phase pulse signal and connect with the A/B input terminals at the module.
The module will get the speed and quantity from input pulses when the handwheel rotates, then multiply by the electronic gear ratio to generate the proportional pulses.

$$\text{MPG's output pulses} = \text{Input A/B phase pulses} \times \frac{\text{Gear ratio numerator(BFM\#3)}}{\text{Gear ratio denominator(BFM\#4)}}$$

The MPG's response delay time at the BFM#5 is the interval period between the pulses input and output. If this set value is too small, that may cause the mechanical vibration. Usually, the longer delay time will have a smoother move.
If more than one axis use this handwheel function at a same time, those activated axes will follow the handwheel to generate pulses simultaneously.

• BFM#129 b10 is the command of LI (linear interpolation positioning)
The linear interpolation positioning function will combine the PG1 (X axis) and PG2 (Y axis) together to complete it.
The parameters are using the BFM#150~BFM#163.




When the paired axes are for to use the LI (BFM#129 b10 = ON) function and the start signal is turned from OFF to ON, their output pulse strings will be executed as above.

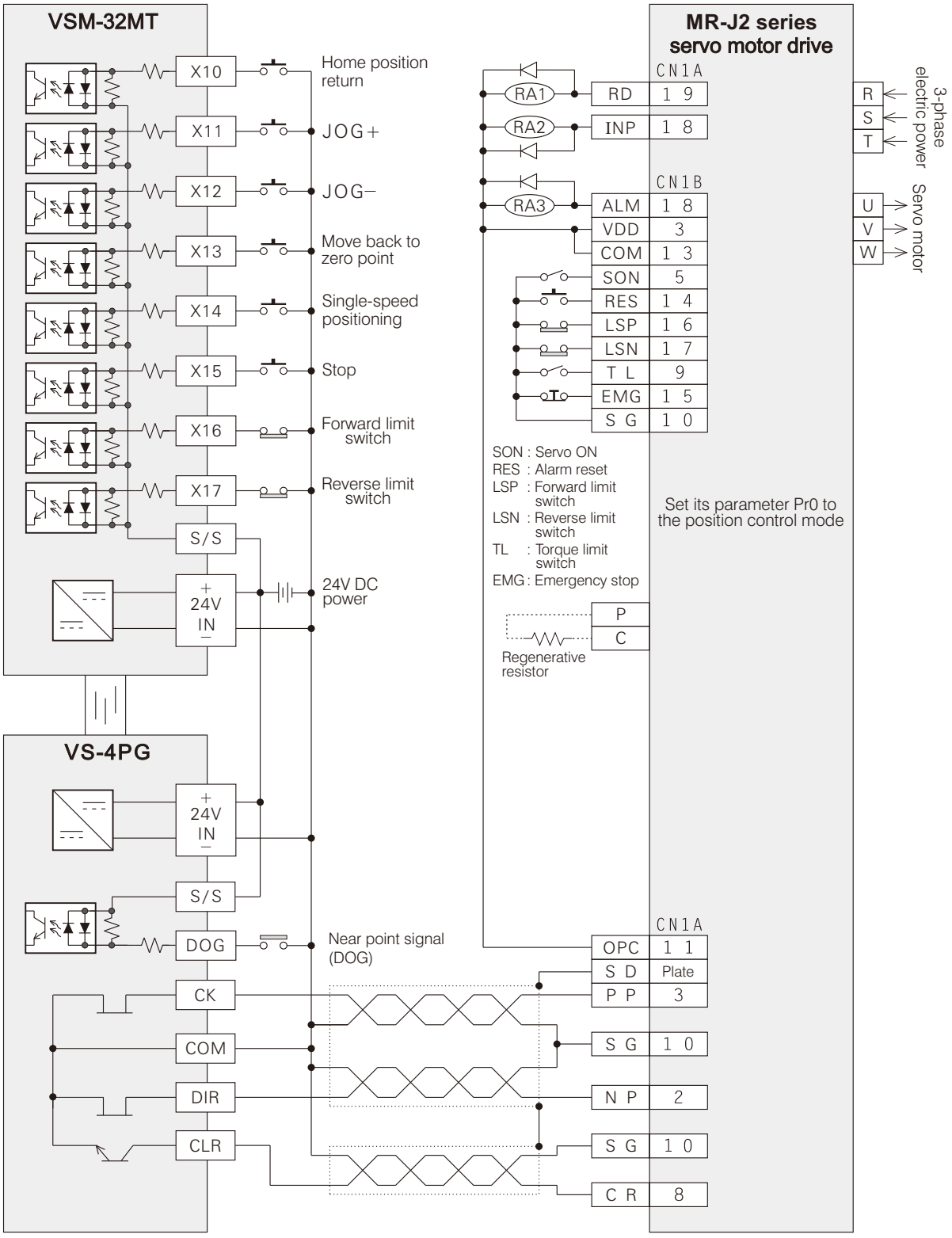
If it is appointed to the absolute positioning (BFM#128 b4=0),

Distance to be moved at the X / Y axis = |Target of the X / Y axis − Current location of the X / Y axis at start|

If it is appointed to the relative positioning (BFM#128 b4=1),
Distance to be moved at the X / Y axis = Target of the X / Y axis

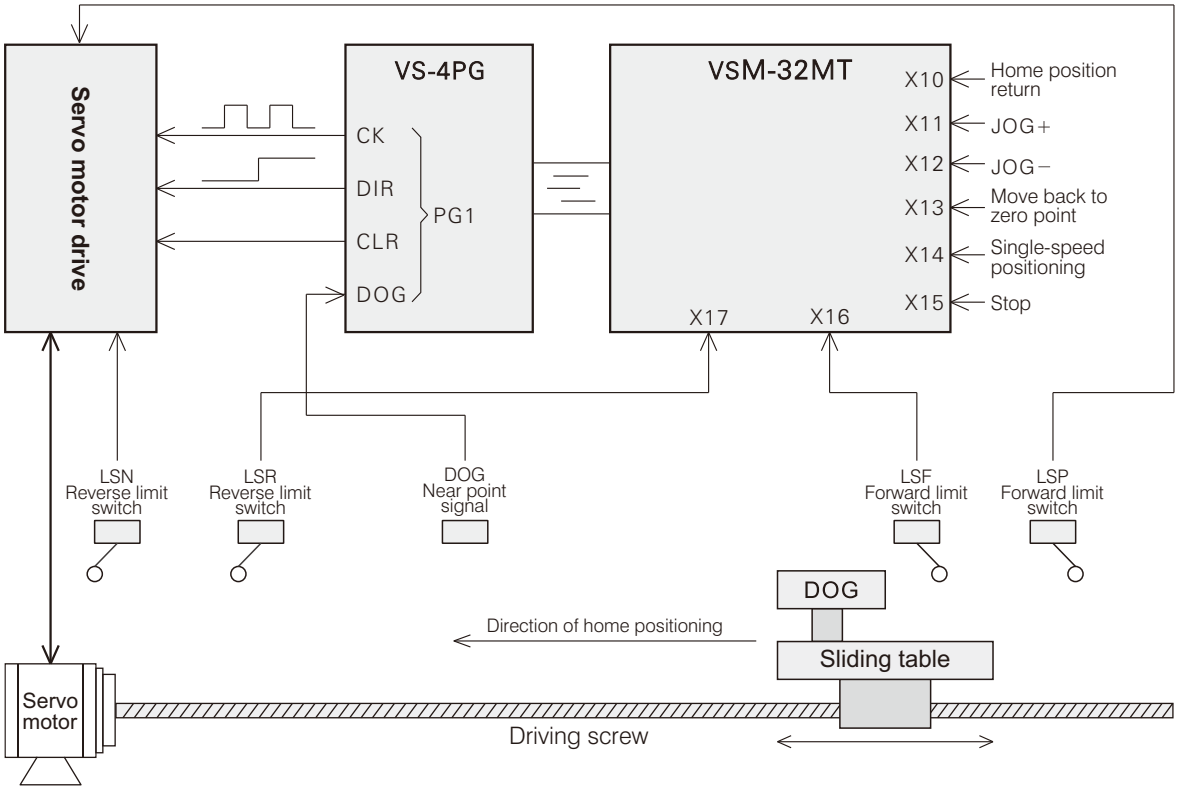
● External Wiring

The wiring example between the VSM Main Unit, VS-4PG Module & Mitsubishi servo drive (MR-J2)



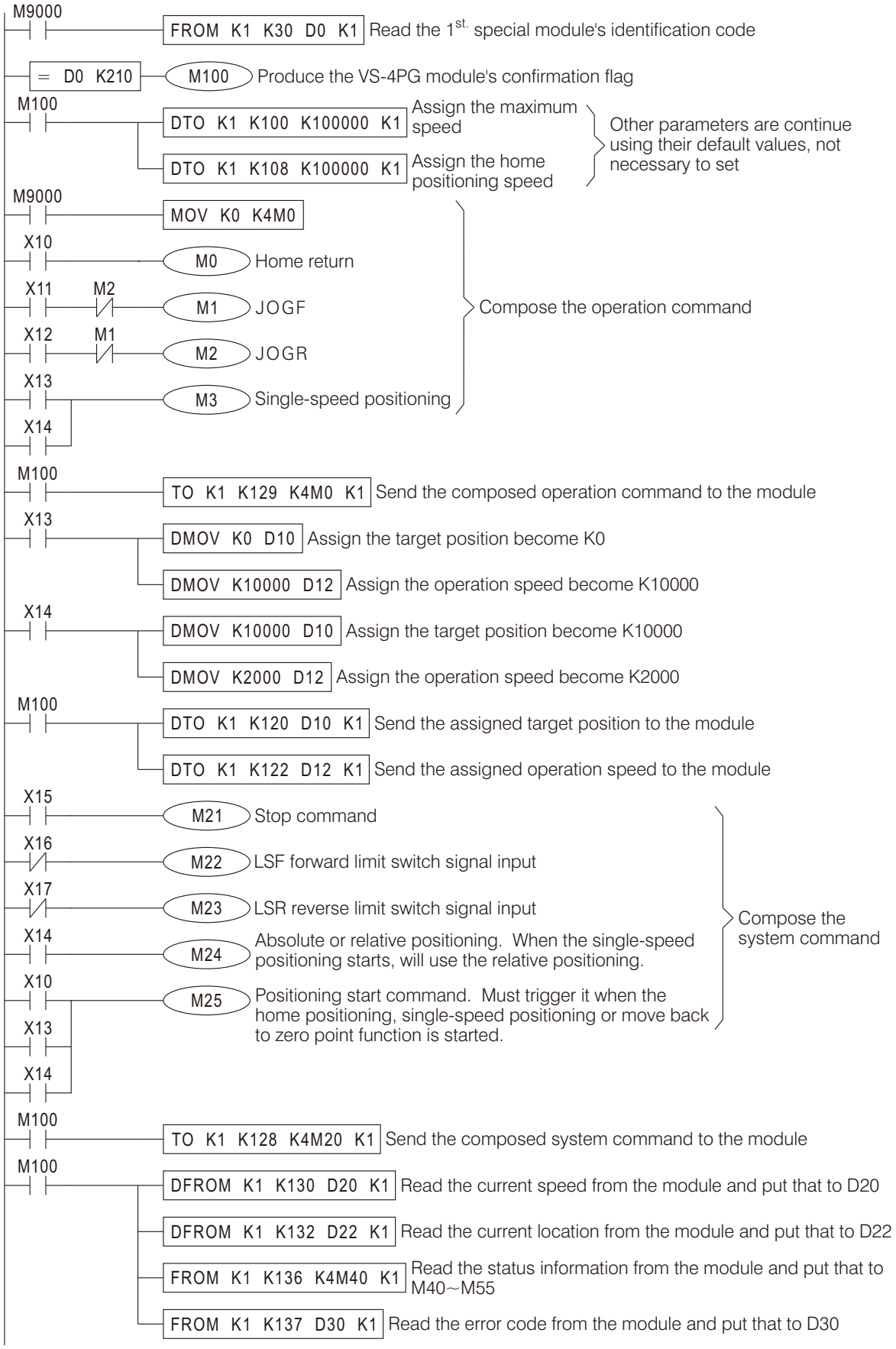
- Example Program

This example carries out the home position return, JOG+, JOG- and single-speed positioning functions. The brief diagram of the system is shown below.




The descriptions of components which are used in the example.

| Component | Description |
|---|---|
| X10 | Home position return button |
| X11 | JOG+ button |
| X12 | JOG − button |
| X13 | Move back to zero point button |
| X14 | Single-speed positioning button |
| X15 | Stop button |
| X16 | Forward limit switch (LSF), N/C contact |
| X17 | Reverse limit switch (LSR), N/C contact |
| M0 | ZRN, home return command |
| M1 | JOGF, jog forward command |
| M2 | JOGR, jog reverse command |
| M3 | DRV, single-speed positioning command |
| M4～M15 | Reserved for future use |
| M20 | Reserved for future use |
| M21 | Stop command |
| M22 | LSF forward limit |
| M23 | LSR reverse limit |
| M24 | By the absolute or relative positioning |
| M25 | Positioning start command |
| M26～M35 | Reserved for future use |
| M40～M55 | Status information |
| D11, D10 | Target position |
| D13, D12 | Operation speed |
| D21, D20 | Current speed |
| D23, D22 | Current location |
| D30 | Error code |


M9000
FROM K1 K30 D0 K1
Read the 1st. special module's identification code
= D0 K210
M100
Produce the VS-4PG module's confirmation flag
M100
DTO K1 K100 K100000 K1
Assign the maximum speed
DTO K1 K108 K100000 K1
Assign the home positioning speed
Other parameters are continue using their default values, not necessary to set
M9000
MOV K0 K4M0
X10
M0
Home return
X11 M2
M1
JOGF
X12 M1
M2
JOGR
X13
M3
Single-speed positioning
Compose the operation command
X14
M100
TO K1 K129 K4M0 K1
Send the composed operation command to the module
X13
DMOV K0 D10
Assign the target position become K0
DMOV K10000 D12
Assign the operation speed become K10000
X14
DMOV K10000 D10
Assign the target position become K10000
DMOV K2000 D12
Assign the operation speed become K2000
M100
DTO K1 K120 D10 K1
Send the assigned target position to the module
DTO K1 K122 D12 K1
Send the assigned operation speed to the module
X15
M21
Stop command
X16
M22
LSF forward limit switch signal input
X17
M23
LSR reverse limit switch signal input
X14
M24
Absolute or relative positioning. When the single-speed positioning starts, will use the relative positioning.
X10
M25
Positioning start command. Must trigger it when the home positioning, single-speed positioning or move back to zero point function is started.
X13
X14
Compose the system command
M100
TO K1 K128 K4M20 K1
Send the composed system command to the module
M100
DFROM K1 K130 D20 K1
Read the current speed from the module and put that to D20
DFROM K1 K132 D22 K1
Read the current location from the module and put that to D22
FROM K1 K136 K4M40 K1
Read the status information from the module and put that to M40~M55
FROM K1 K137 D30 K1
Read the error code from the module and put that to D30