# Termi-BUS
# Explanation of Interface functions

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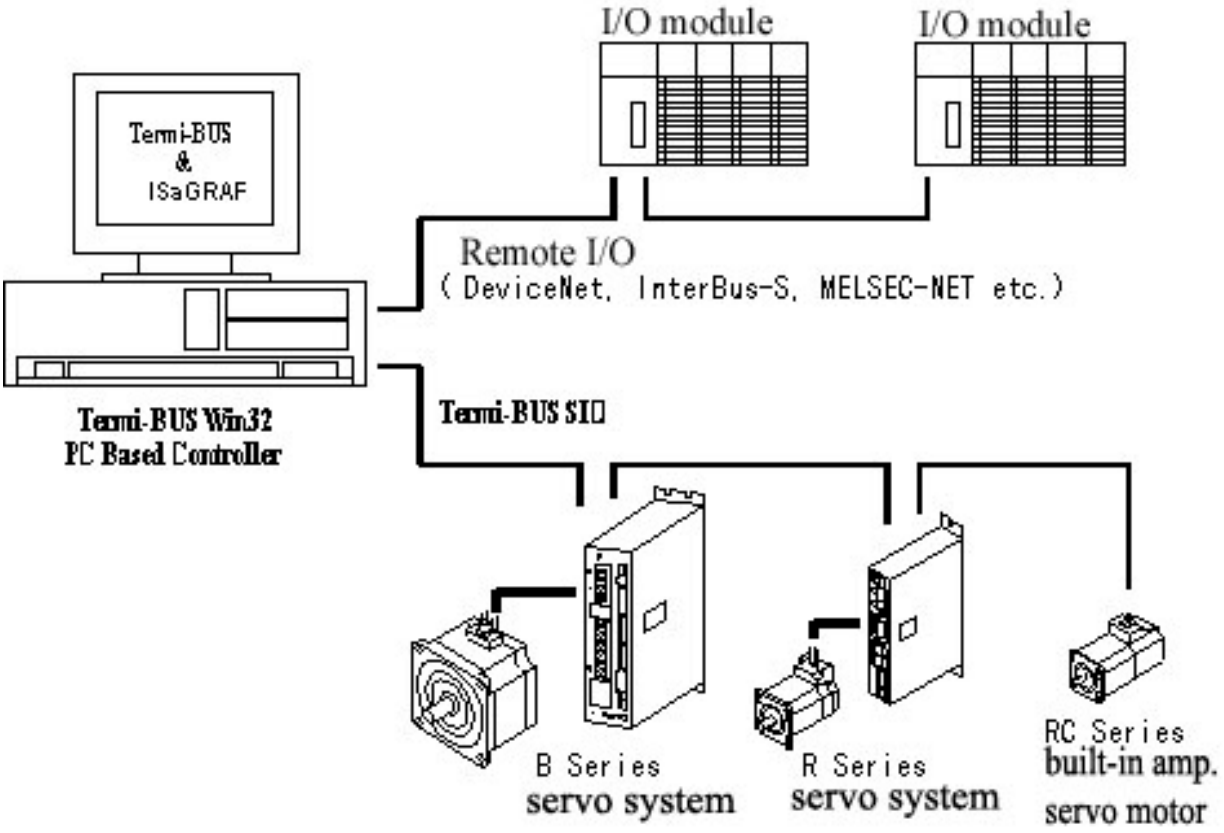
# Index

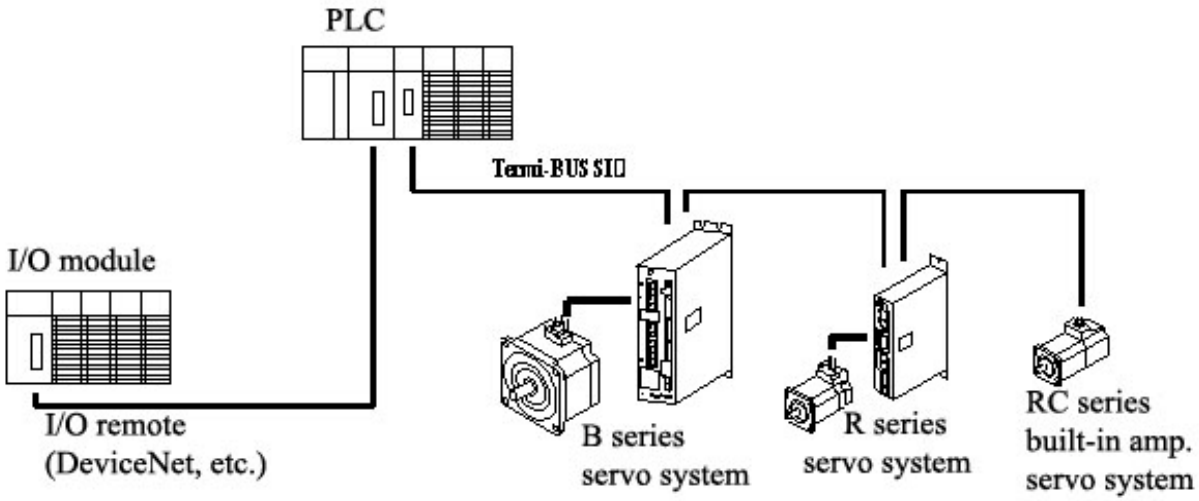
## 1. Termi-BUS for PC based controller

There are many different interfaces for different actuators of mechanical systems. This will make the controller design difficult and the result is to limit the actuator types.
Termi-BUS is an interface between a system controller and servo amplifier to system control the various actuators, it will control different servo actuators with common digital data. Therefore it will allow system to select suitable actuator without over-design.
PC based controller, which establishes FA controller in PC, can utilize the commercial hardware and software to make flexible control in short time, Termi-BUS SIO will give effective servo actuator control functions to PC based controller. By using Termi-BUS Win32 PC based controller programming tool, it will be easy to establish PC based controller with Termi-BUS SIO servo system and software PLC on the Microsoft Win32API environment.
The controller made by above will be the minimum hardware cost due to no need other than PC hardware and it can utilize the commercial hardware and software and it realizes the high extension ability and portability due to no need of special real time operating system for shorten task switch time nor special real time extension.

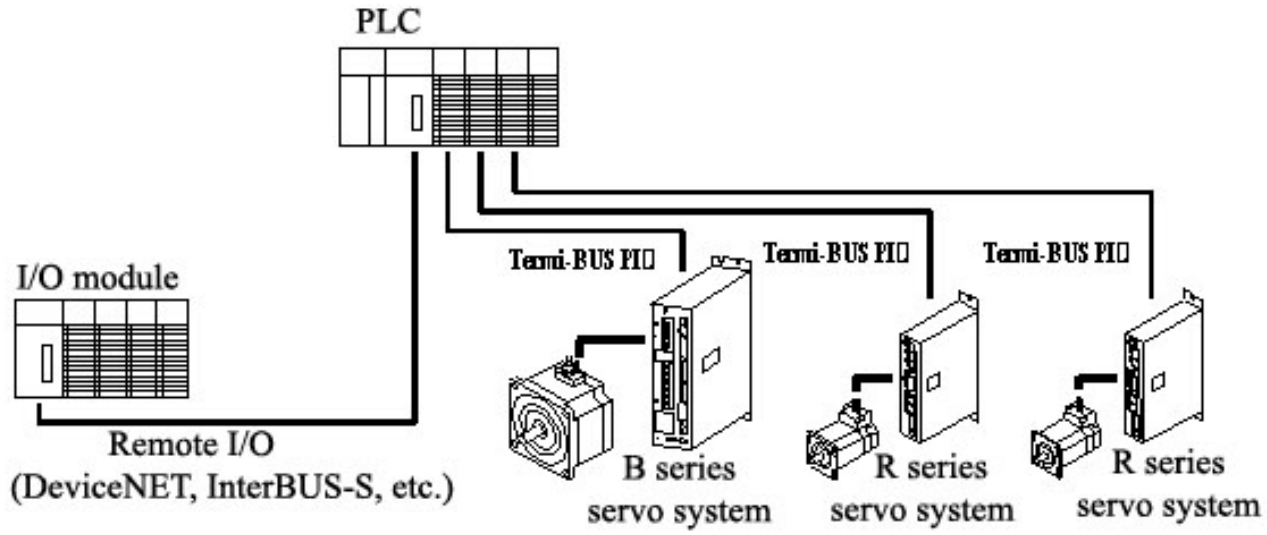


## 2. PLC motion control with Termi-BUS

**Termi-BUS** can be used with PLC and its system to control various servo actuators as effective servo system control interface.
If the PLC can be interfaced with communication module of Termi-BUS SIO, the wide range of functions of Termi-BUS SIO commands, and the result is that the system will realize more flexible servo system control.
In this system control, one communication module can control up to 16 axes servo systems, the total cost of multiple axes control will be much lower.




If Termi-BUS PIO is interfaced in the standard I/O of PLC, any PLC can be used.
The order flexibility is not the same level as use of Termi-BUS SIO but the functions are very simple and easier to handle for any actuator types compared with ladder programming.



## 3. Termi-BUS servo system

**Termi-BUS** servo amplifier contains motion profile creation function for PTP (Position to Position) control and interpolation execution function (option) for linear movement order by each axis, therefore the interface traffic with upper controller drastically smaller compared with the traditional interface which gives motion control orders every mili sec continuously.
In this reason, the system with **Termi-BUS** doesn't need dedicated interface hardware to control servo actuator, and the hardware cost of controller will be minimized.
There are 2 types interfaces in **Termi-BUS** servo system for upper controller, **Termi-BUS PIO** based on parallel I/O (DC24V type) and **Termi-BUS SIO** based on serial communication.
Following will explain the summary of those 2 interfaces.

### 3.1. Summary of Termi-BUS PIO

By **Termi-BUS PIO, Termi-BUS** servo system can be controlled for commonly used parallel I/O.
**Termi-BUS** servo amplifier can memorize multiple PTP (Position To Position) order data in the built-in EEPROM, **Termi-BUS PIO** can select and execute these PTP orders.
PTP order data such as target position, etc. can be inputted into servo amplifier by using **CTA** (Handy programming tool), and both data input (MDI) and jog input are available. PTP order data can be programmed and edited on PC by using the servo system control development support tool, **Termi-BUS tools**, and down loaded through **Termi-BUS SIO**.
**Termi-BUS PIO** interface is built in **Termi-BUS** servo systems as a standard function except RC series.

### 3.2. Summary of Termi-BUS SIO

**Termi-BUS SIO** has flexible and rich command system and effective protocol as dedicated servo actuator control interface. It will execute much more flexible and higher orders compared with the orders to each axis controller through remote I/O or PLC I/O module. **Termi-BUS SIO** is adjustable synchronous type of serial BUS interface based on EIA RS485, and it can be connected to standard COM (serial) port of PC by using RD232=>RS485 converter.
In **Termi-BUS SIO,** servo amplifiers are connected dizzy chain by modular cable, one COM port may connect and control up to 16 axes of **Termi-BUS** servo systems.
**Termi-BUS SIO** interface is built in **Termi-BUS** servo systems as a standard function.

## 4. Termi-BUS PIO

### 4.1. Physical specifications

Electrics specifications ; 24V type parallel DC input / Transistor output (source type)

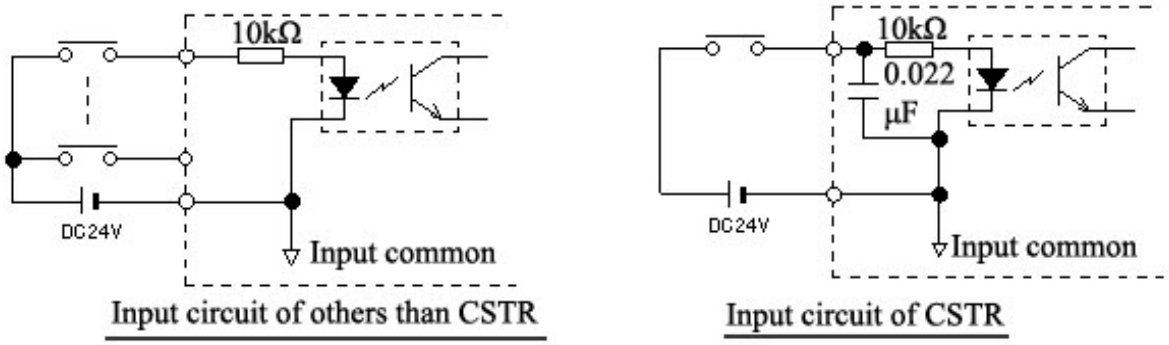



Fig. 1 Input circuit of R series

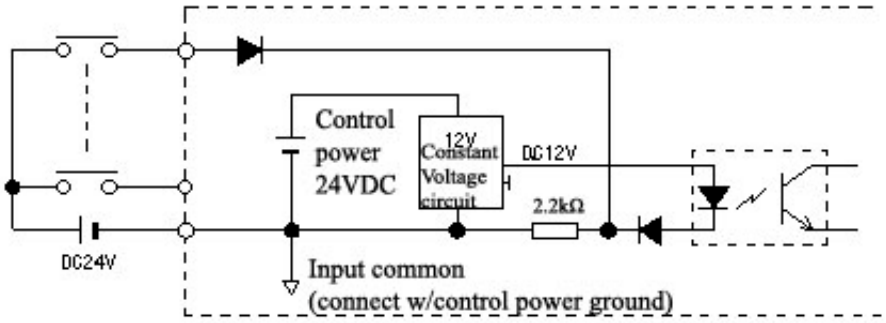



Fig. 2 Input circuit of B series

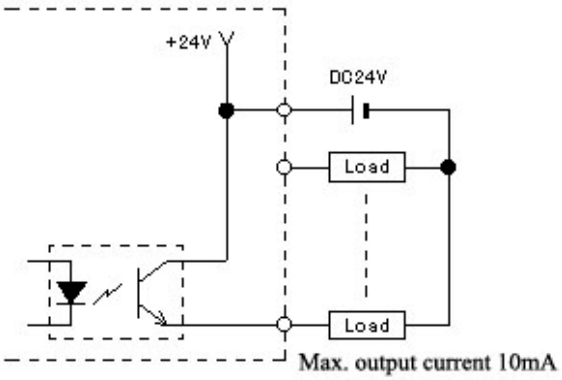



Fig.3 Output circuit of R series

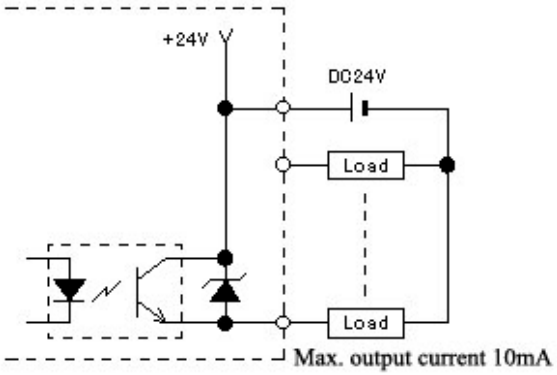



Fig.4 Output circuit of B series

Notes: All of above Input/Output signals are based on logic 1 for external circuit current ON and logic 0 for external circuit current OFF

Connections; Plug (servo amplifier side) --- FCN-235P026-G/MA (Fujitsu)Ω
Socket (User side) --- FCN-237B026-G/W (Fujitsu)
AWG#28-1.27mm pitch flat cable, 13 wires x 2 (26 wires)

Table 1. **Termi-BUS PIO** connector (PIO) signal arrangement

| Pin # | Name | Type | Connection | Pin # | Name | Type | Connection |
|---|---|---|---|---|---|---|---|
| 1 | +24V | Power | Output +common | 14 | | Reserve | No connection |
| 2 | 24G | Power | Input – common | 15 | | Reserve | No connection |
| 3 | CSTR | Input | PTP order strove | 16 | PM1 | Output | Current position number code |
| 4 | PC1 | Input | Target position number code | 17 | PM2 | Output | Current position number code |
| 5 | PC2 | Input | Target position number code | 18 | PM4 | Output | Current position number code |
| 6 | PC4 | Input | Target position number code | 19 | PM8 | Output | Current position number code |
| 7 | PC8 | Input | Target position number code | 20 | PFIN/INP | Output | Positioning completion signal |
| 8 | *INH+ | Input | + side stroke limit | 21 | ZFIN | Output | Homing completion signal |
| 9 | *INH- | Input | - side stroke limit | 22 | ZONE | Output | Zone signal |
| 10 | *ILK | Input | Movement interlock | 23 | *ALM | Output | Servo amplifier alarm condition |
| 11 | SON | Input | Servo ON order | 24 | | Reserve | No connection |
| 12 | | Reserve | No connection | 25 | | Reserve | No connection |
| 13 | | Reserve | No connection | 26 | | Reserve | No connection |

(Note) All of above Input/Output signals are based on logic 1 for external circuit current ON and logic 0 for external circuit current OFF

## 4.2. Functions of Input/Output signal

### 4.2.1. Functions of Input/Output

#### 4.2.1.1. PTP order strove signal (CSTR)

When the signal of OFF-> ON edge is detected, 4 bit binary code of target position number by PC1 to PC8 will be read, then the actuator will be moved to the target position specified by the corresponding position data.
In case of no homing after the power ON for this operation (ZFIN output signal is OFF condition), the actuator will make homing, and then move to the target positioning. All the motion parameters such as target position data, speed, etc. must have been programmed in the EEPROM of servo amplifier prior to this operation. This parameter programming can be done by CTA (Handy programming tool) or PC tool of servo system control development support tool for PC.
In case of the actuator in the system with absolute encoder, usually the homing process may be done manually, the system doesn't accept CSTR signal of positioning order when ZFIN output signal is OFF condition. In this case, it is needed to make homing by CTA. As this will be described later, the default value of homing motion pattern (ORG) is 0 for absolute encoder, therefore the homing operation by CTA will make the current position of the motor home position.
In case of alarm condition (*ALM signal is OFF status) and SON input is OFF condition, turning CSTR ON from OFF can reset the alarm condition. However the cause of alarm must have been cleared and servo ON order signal (SON) must have been OFF prior to such alarm-reset operation.

#### 4.2.1.2. Target position number code signal (PC1-PC8)

On PTP motion order (Position To Position) by turning CSTR signal ON from OFF, PC1 to PC8 signals will be read as target position number of 4 bit binary code. PC1 is $2^0$, PC2 is $2^1$, PC4 is $2^2$ and PC4 is $2^3$, therefore available target position numbers will be 0 to 15.

#### 4.2.1.3. Stroke limit signal (*INH+, *INH-)

In case of *INH+ OFF condition, all the movement of + direction will be prohibited.
In case of *INH- OFF condition, all the movement of - direction will be prohibited.
Usually recovery from the OFF condition of *INH+ or *INH- (This means that the current position is beyond the stroke limit) should be done by the movement order to the opposite direction.
For the homing triggered by the stroke limit signal as reverse position detect signal, signals of *INH+ and *INH- will make continuous homing cycling to both sides.

#### 4.2.1.4. Interlock signal (*ILK)

In *ILK signal OFF condition, any motor motion will be prohibited.
In case of motor stalled with *ILK signal turned OFF, the remained positioning movement will be kept and the actuator will continue the remained positioning movement after *ILK signal is turned ON again.
Therefore if the remained movement should be cancelled once *ILK is turned OFF, SON signal should be turned OFF to cancel the remained movement always after *ILK is turned OFF.

#### 4.2.1.5 Servo ON order signal (SON)

In case of SON signal OFF condition, motor will be inactive and kept movement order and related info. will be cancelled.
If SON signal is turned OFF, the motor won't make any movement, however, in case of emergency stop condition, not only SON signal OFF condition but also servo amplifier power should be turned OFF for the perfect safety purpose. The customer should design such circuit.
On the other hand, in case of servo amplifier power OFF condition, SON signal should be turned OFF as well.

### 4.2.2. Output signal functions

#### 4.2.2.1. Positioning completion signal (PFIN/INP)

This signal can be switched to PFIN signal or INP signal by parameter FPIO stored in EEPROM of servo amplifier.
(1) In case of PFIN
SON signal is turned ON for servo amplifier to be ready after the power is turned ON, PFIN will be turned ON if the positioning deviation is within completion detective width.
CSTR signal is turned ON to order PTP movement, and PFIN will be turned OFF, SON signal is turned ON for servo amplifier to be ready after the power is turned ON, PFIN will be turned ON after CSTR signal is turned OFF if the positioning deviation is within completion detective width.

In case of CSTR signal ON condition, PFIN won't be turned ON even though the positioning deviation is within completion detective width.
If PFIN signal is once turned ON, PFIN won't be turned OFF.
PFIN can be turned OFF by main power turning OFF or SON signal turning OFF.
In the same way, PFIN signal will be turned OFF when any one of signal of *INH+, *INH- is in OFF condition or actuator is in interlock condition due to the software stroke limit defined by parameter LIMM, LIML in EEPROM.

(2) In case of INP signal

After the power is turned ON, SON signal will be turned ON and servo amplifier will be ready. Then INP will be turned ON if the positioning deviation is within completion detective width.
If PTP motion is ordered with CSTR signal ON condition, INP signal will be turned OFF, and INP will be turned ON after CSTR signal is turned OFF if the positioning deviation is within completion detective width.
In case of CSTR signal ON condition, INP signal won't be turned ON even though the positioning deviation is within completion detective width.
If CSTR signal is turned OFF, INP signal will be ON.

Even though INP signal is once turned ON, INP signal will be turned OFF when the actuator position is out of positioning completion signal detect width. INP signal will be turned ON when the actuator position is within positioning completion signal detect width
INP signal will be turned OFF when main power is turned OFF or SON signal is turned OFF.
In the same way, INP signal will be turned OFF when any one of signal of *INH+, *INH- is in OFF condition or actuator is in interlock condition due to the software stroke limit defined by parameter LIMM, LIML in EEPROM.

#### 4.2.2.2. Current position number code signal (PM1-PM8)

Combination signal of PM1 to PM8 output current position number of binary code.
PM1 is $2^0$, PM2 is $2^1$, PM4 is $2^2$ and PM4 is $2^3$, therefore available current position numbers will be 0 to 15.
After the power is turned ON, the combination of PM1 to PM8 will be current position number 0, and then according to PTP order executions, the current position number will be updated at the point of PTP order execution completion (the time when PFIN/INO signal is turned ON).
Signals of PM1 to PM8 will keep previous current position number even though the main power and/or SON signal is turned OFF. In the same way, signals of PM1 to PM8 will keep previous current position number even though signals of *INH+, *INH- and ILK became OFF conditions, or the actuator became interlocked due to the software limit function specified by LIMM and LIML parameters in EEPROM.
In case of servo alarm condition (ALM signal ON condition), signals of PM1 to PM8 output alarm code (abbreviated form).
By using monitoring tool such as CTA, the alarm code can be checked. The details of alarms will be referred in Appendix B, “Alarm code details”.

#### 4.2.2.3. Homing completion signal (ZFIN)

This signal depends on the positioning feed back sensor type of connected servomotor, incremental encoder or absolute encoder.

(1) Incremental encoder

This signal is OFF condition when the power is turned ON. Then when the homing movement by the first PTP order of CSTR signal is completed, this signal will be turned ON. Once ZFIN signal is turned ON, it won’t be turned OFF until position feedback error or control power shut down.

(2) Absolute encoder

ZFIN signal will be turned ON when the home position set by **CTA** is operated, or home position set by o command of **Termi-BUS SIO** (described later) is operated. After that, ZFIN signal will be kept ON condition and it wont be turned OFF until position feedback error is detected and absolute position is corrupted. The signal won’t be OFF even though the power is turned OFF and ON again. Therefore once the home position is taught, the system can position without homing operation after the power is turned OFF and ON again.

#### 4.2.2.4. Zone signal (ZONE)

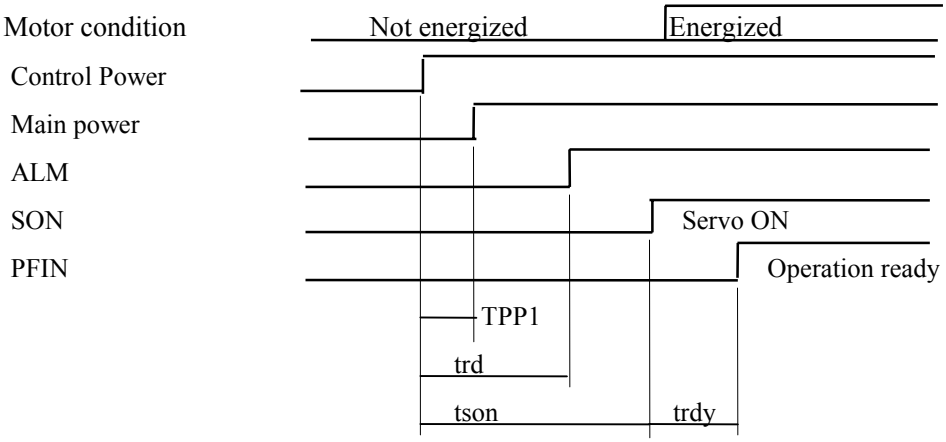
If the current position of the servomotor is within the range between the parameters of ZONM and ZONL specified in EEPROM, ZONE signal will be turned ON, if the position is out of that range, ZONE signal will be turned OFF.
Zone signal will be always valid when absolute position coordinate is valid (ZFIN signal is ON condition) and it won’t be affected by SON signal condition or alarm condition.

#### 4.2.2.5. Servo amplifier alarm condition signal (*ALM)

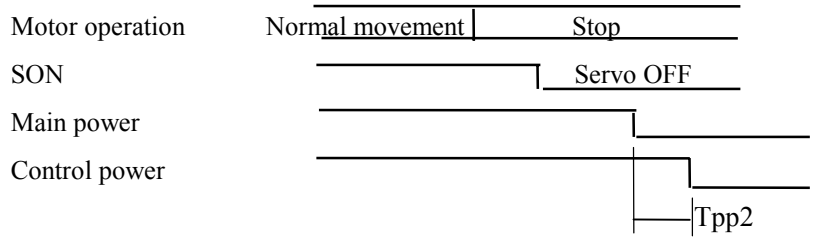
When servo amplifier is in normal condition, *ALM signal will be turned ON, when servo amplifier is in alarm condition, *ALM signal will be turned OFF. If *ALM signal is OFF condition, signal of PM1 – PM8 output abbreviated alarm code.

### 4.3. Timing of power turning ON

Power ON

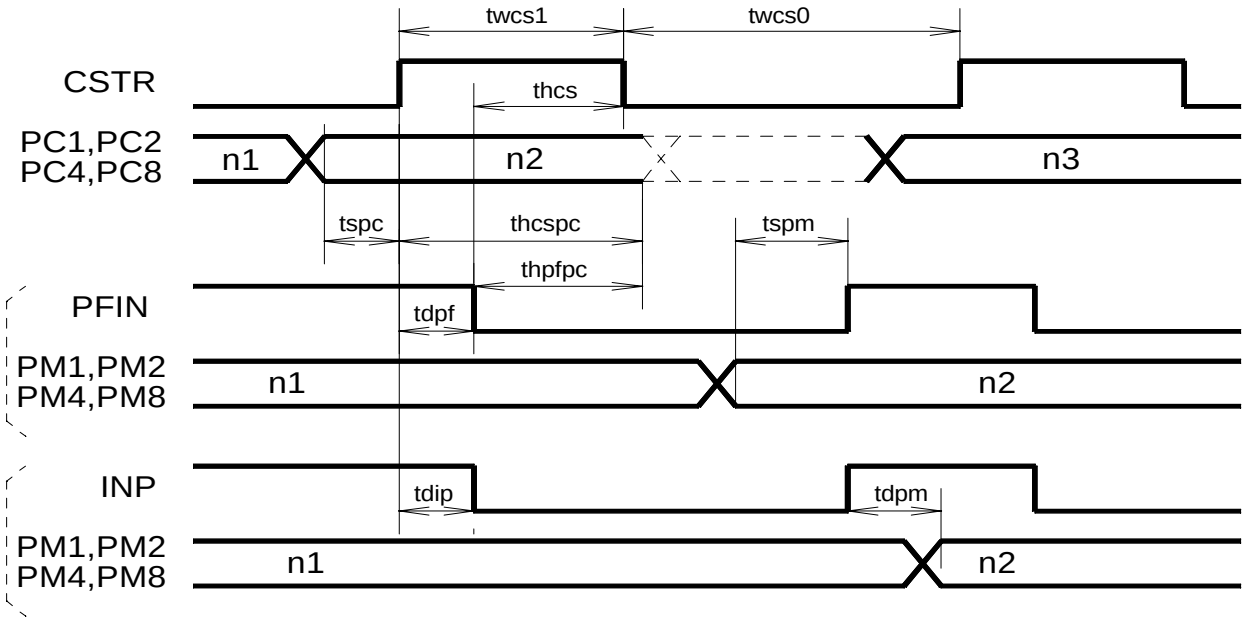



Shut down




| Name | Min value | Max value | Notes |
|---|---|---|---|
| Tpp1 | 0 msec | | Control power ON → Main power ON |
| trd | | 50 msec | Control power ON → ALM signal establish time |
| tson | 0 msec | | Control power ON → SON input available time |
| trdy | 200 msec (Standard value) | | First SON turned ON → Operation ready |
| | 250 msec (Standard value) | | Control power ON →Operation ready |
| Tpp2 | 0 msec | | Main power OFF→ Control power OFF |

**4.4. Interface timing**




| Name | Min value | Max. value | Notes |
|---|---|---|---|
| twcs1 | 4 msec | | Minimum time width of CSTR ON |
| twcs0 | 4 msec | | Minimum time width of CSTR OFF |
| thcs | 0 msec | | PFIN OFF ⊗ CSTR holding time |
| tspc | 0 msec | | CSTR ON ℘ PC1~PC8 set up time |
| thcspc | 4 msec | | CSTR ON ⊗ PC1~PC8 hold time |
| thpfpc | 0 msec | | PFIN OFF ⊗ PC1~PC8 hold time |
| tdpf | | 4 msec | CSTR ON ⊗ PFIN OFF delay time |
| tspm | 0 msec | | PFIN ON ℘ PM1~PM8 set up time |
| Tdip | | 4 msec | CSTR ON ⊗ INP OFF delay time |
| tdpm | | 4 msec | INP ON ⊗ PM1~PM8 establishment delay time |

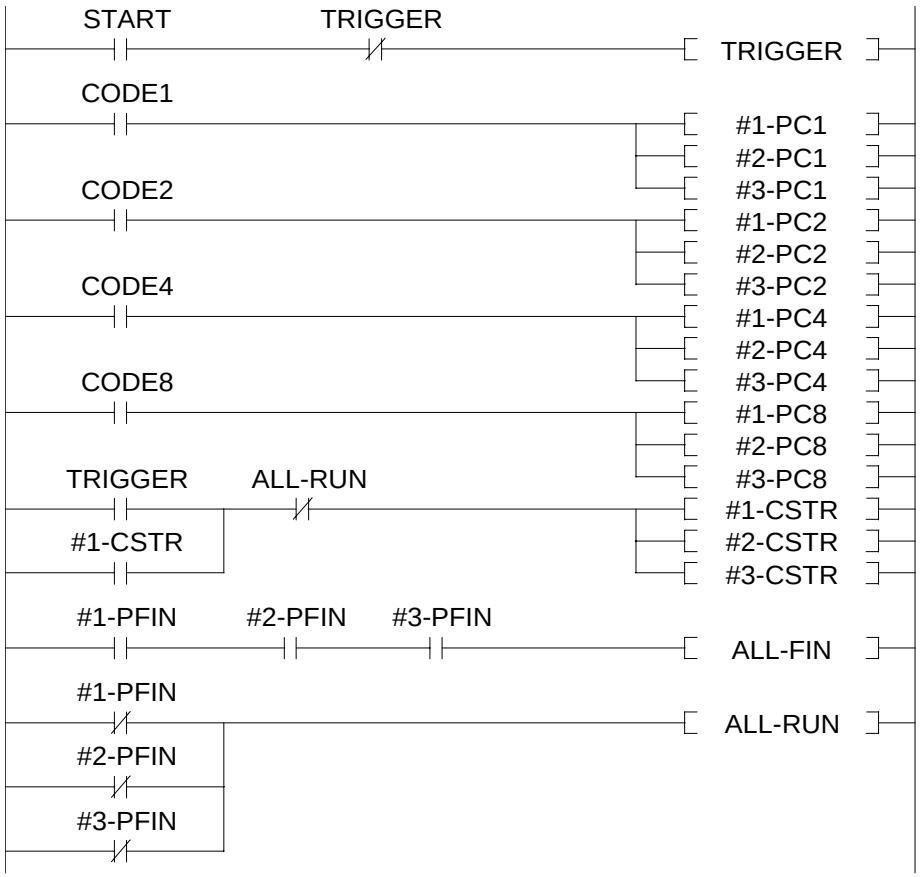
(Note 1) Above timing is based on 10kΩ of output circuit load resistance or smaller

### 4.5. Axis movement control procedure through Termi-BUS PIO

The PTP movement order procedure from **Termi-BUS** is as follows:

- PTP order strove signal (CSTR) at OFF condition is to output target position number for the target position number code signal (PC1~PC8)
- To out put ON for CSTR signal

Positioning completion check for PTP order is to confirm the ON condition of positioning completion signal (PFIN/INP). Even though it's in the middle of PTP movement execution, it can order next PTP movement, and the actuator will move to the new target position. Therefore it is possible to make some kind of pass position movement by checking target position width with using PFIN/INP signal and Zone signal (ZONE).
Following is the example of ladder programming for PTP movement order sequence of 3 axes multiple motions:




(Note) #n means n axis.

START: PTP movement start signal
Trigger: Starting edge signal (One scan cycle width)
CODE 1 ~ 8: Target position number
ALL – FIN : All axes position completion signal
ALL – RUN: All axes moving signal

## 5. Termi-BUS SIO

### 5.1 System structure of Termi-BUS SIO

#### 5.1.1. Physical specifications

Electric Specifications: based on EIA R485

Synchronizing method : Adjustable synchronizing type

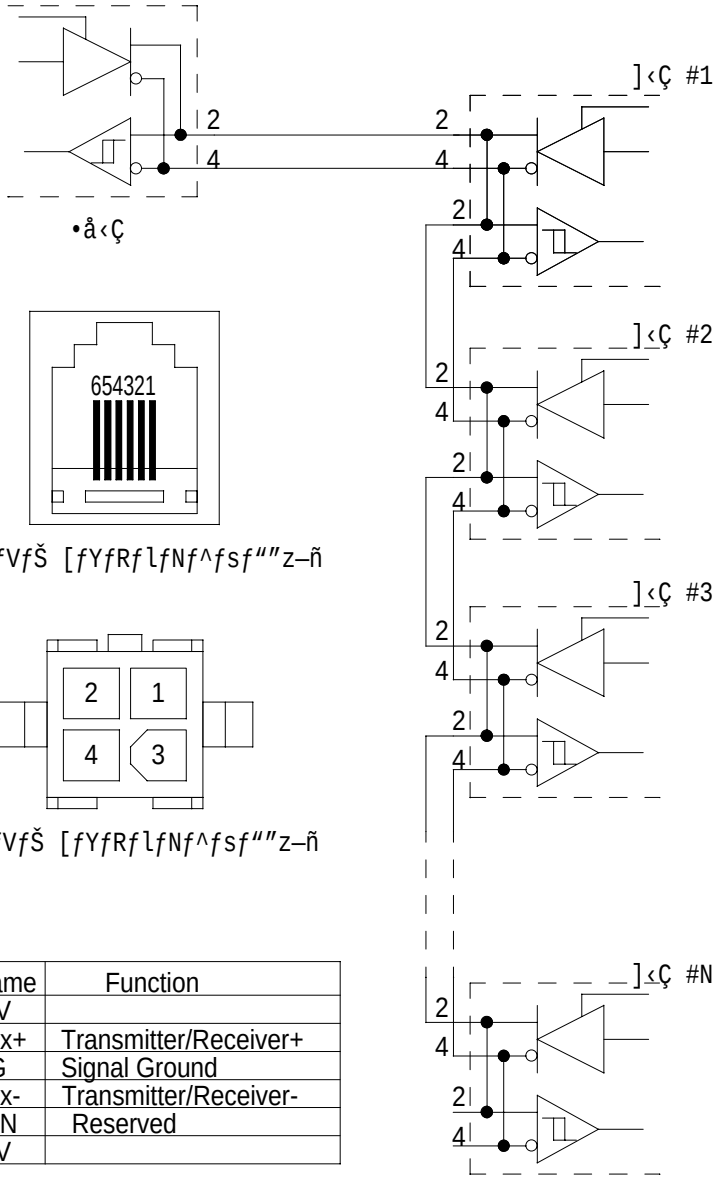
Connections: 1:N Non-balanced connections (1<=N<=16)

Connectors: B/R series ···· 6 wires modular connector

RC series ···· AMP 172159-1 (Motor sided)

Transforming speed: 9.6 kbps, 14.4 kbps, 19.2 kbps, and 28.8 kbps

38.4 kbps, 57.6 kbps, 76.8 kbps, 115.2 kbps (these choices are available)




| No. | Name | Function |
|---|---|---|
| 1 | +5V | |
| 2 | TRx+ | Transmitter/Receiver+ |
| 3 | 5G | Signal Ground |
| 4 | TRx- | Transmitter/Receiver- |
| 5 | SYN | Reserved |
| 6 | +5V | |

### 5.1.2. Topology and area address number of Termi-BUS SIO

Topology of **Termi-BUIS SIO** is as following figure, it has one main portion (Upper controller through ADP-1 or gateway with other network), and 16 sub portions (B/R series servo amplifiers or RC series servo motors) are connected with BUS method.

There must be only one main portion in a Termi-BUS SIO circuit, therefore more than 2 main portions cannot be connected in the same Termi-BUS SIO circuit. The main portion doesn't have its own port number, but each port of servo amplifier/motor can have its own port address from 0 to 15.

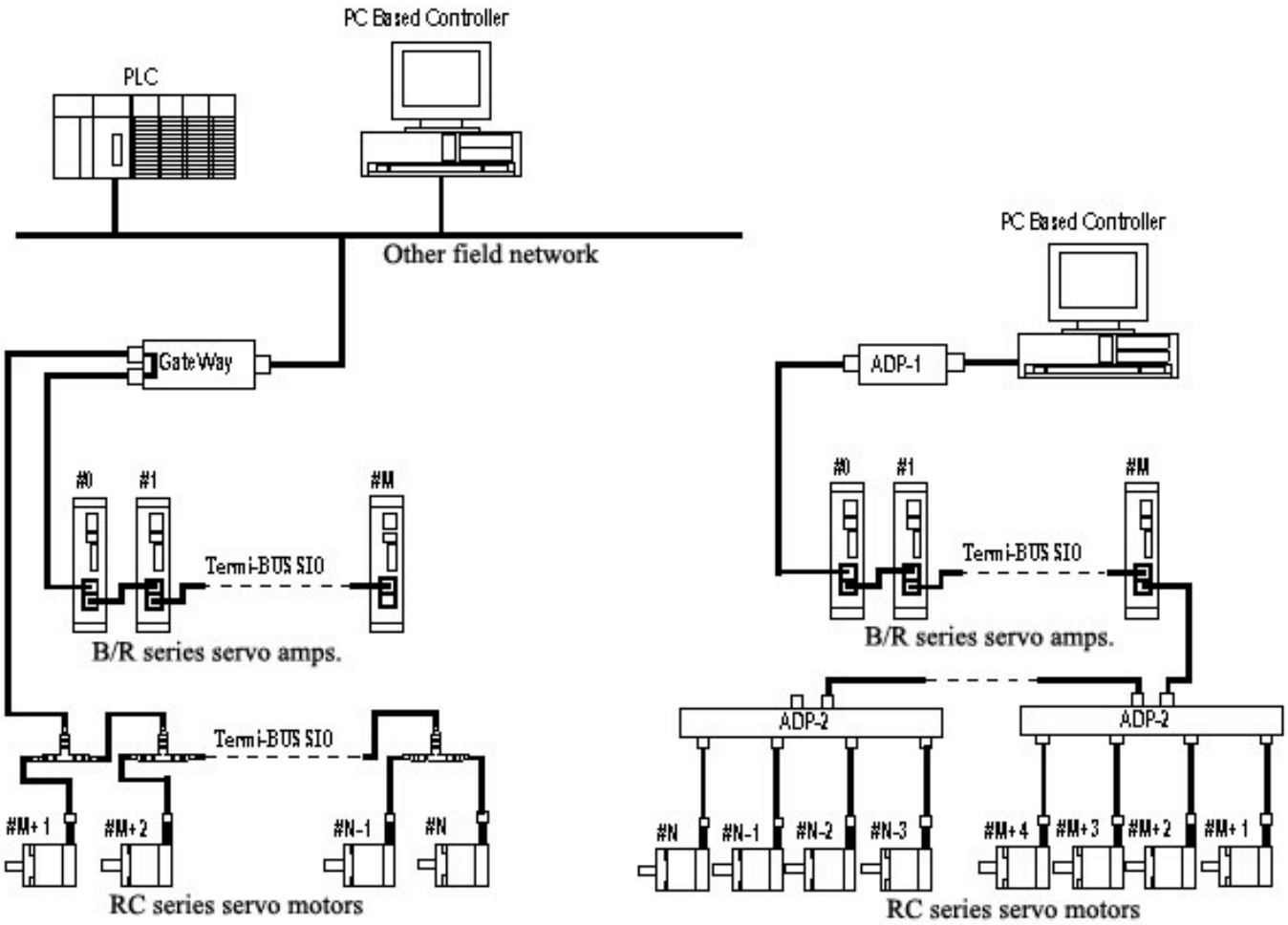
The port addresses are not necessary to be consecutive numbers, but there should not be more than 2 ports with same addresses of the servo amplifier/motor n the Termi-BUS SIO circuit. RC series cannot connect directly with due to its 1 connection of S10 connector, however, it can be extended connections with T joint connectors or ADP-2.

For B/R series amplifier, port address (Axis address) can be set at the rotary switch SWS1 in the front panel.

Set contents of SW1 will be read into servo amplifier only when the power is turned ON, therefore if the axis number is updated during the power ON condition, this information won't be valid until the power is turned OFF and ON again.

For RC series servo motor, the axis number set with using rotary switch cannot be done, therefore the axis number set should be done with axis number set command using **CTA** (Handy programming tool) or **Termi-BUS SIO** prior to the operation. Please refer **"5.8.2.18 x command (RC series only: Axis number set order)"** to set the axis number by its dedicated command.

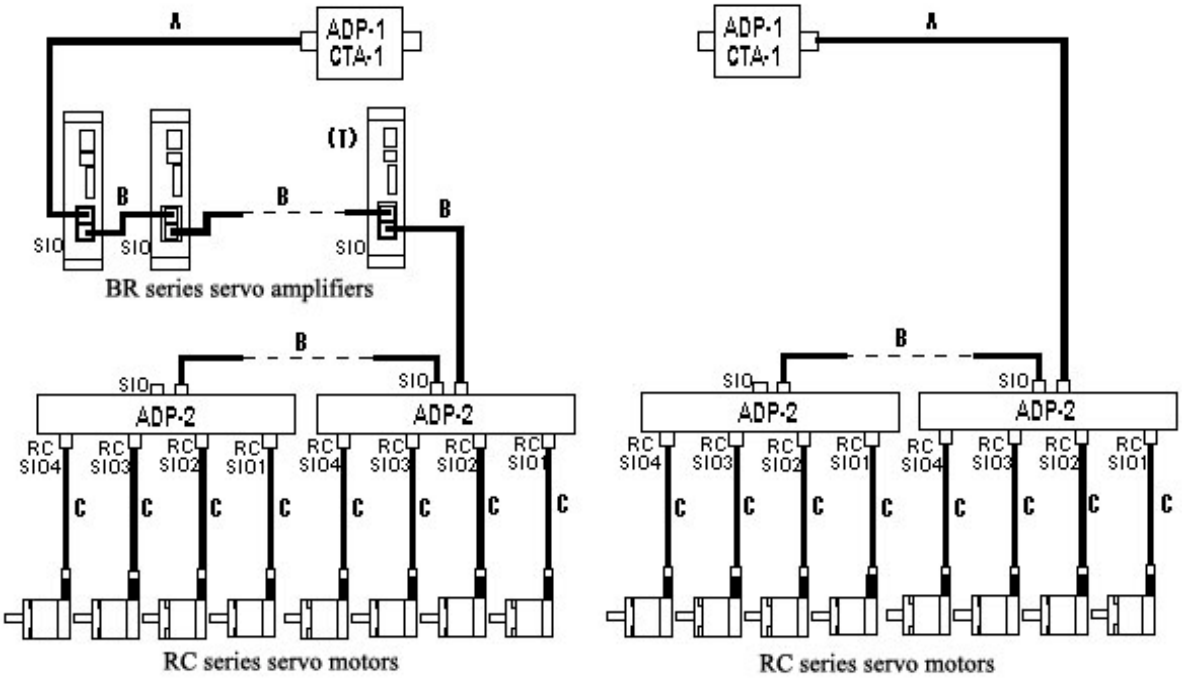
For the setting with using **CTA**, please refer **CTA manual**.



### 5.1.3. Selection of Connector cable and end condition

Power souse of **ADP-1** (RS232C → RS485 converter) and CTA-1 (Handy programming tool) is DC5V supplied from **SIO** connector of B/R series servo amplifier or RC series servomotor to **Termi-BUS SIO** cables. Therefore cable between **ADP-1/CTA-1** and servo amplifier is different from the cable between servo amplifiers.
Please follow the following directions for cable connection. Normally, power connection cable is used from ADP-1 and CTA-1 to first servo amplifier/servo motor, after that, non-power connection cable.

| Symbol | Model/Specs | Wires | Power connection | Notes |
|---|---|---|---|---|
| A | RP9041-*** | 6 | Yes | 6 wires modular cable (conductivity resistance: 125Ω/km or smaller) |
| B | RP9040-*** | 4 | No | 4 wires modular cable |
| C | RP-9050-*** | 4 | Yes | RC series dedicated cable |




DIP switch, bit1 and 2 of SW2 on the B/R series servo amplifier front panel are the exist/non-exist selection switch of terminal resistance, please make the terminal resistance exist at the end servo amplifier from ADP-1 and CTA-1 only ((T) position at above figure.)
The terminal resistance exist is set by both bits 1, 2 of SW2 are ON, the terminal resistance non-exist is set by both bits 1, 2 of SW2 are OFF. Bit 1,2 of SW2 should be either both ON or both OFF.
Please note that DC5V power source from SIO connector of B/R series servo amplifier or RC series servomotor to Termi-BUS SIO cable is power source for ADP-1, CYA-1 and our product gateway only, not for customer's products.

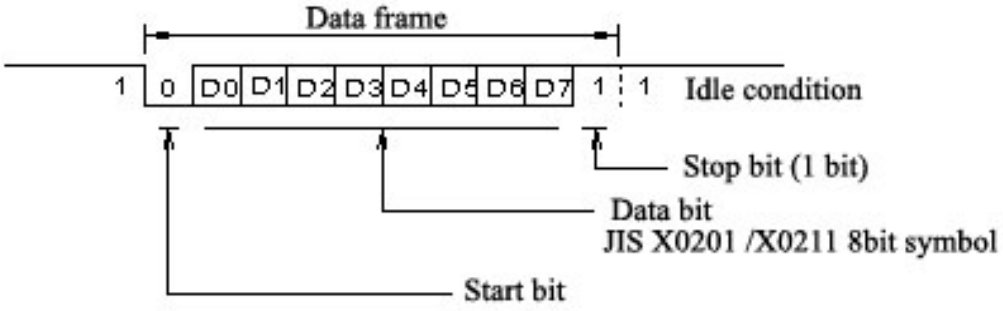
### 5.1.4. Connection of CTA

**CTA** (Handy programming tool) will act as main port on **Termi-BUS SIO**. Therefore in case of connecting **CTA** with **Termi-BUS SIO**, **CTA** should be connected in the system in such way that **CTA** and other main port (Upper controller or the gateway for other network) shouldn't conflict in the same **Termi-BUS SIO**.
If upper controller or gateway has the provision of non-access mode against **Termi-BUS SIO** (high impedance condition of transmitter), **CTA** can be connected in the system as main port. In case of use of ADP-1 as RS232C⊗RS485 converter, the system becomes above said condition automatically because the transmitter will be in high impedance condition in case of no data transmission from RS232C.
In this way, **CTA** is available as long as upper controller or gateway is in this mode. On the other hand, if upper controller or gateway is controlling servo system through **Termi-BUS SIO**, **CTA** should be in initial display (Mode select menu).
If upper controller or gateway doesn't have such mode, such upper controller or gateway should be disconnected when CTA is connected in the system of **Termi-BUS-SIO**.
In any cases, upper controller or gateway should execute later said **"5.10. Communication establishment procedure"** to initialize / re-initialize communication conditions in order to transfer without system power shut-down/re-power up between **CTA** programming ready condition and upper controller/gateway control ready condition.

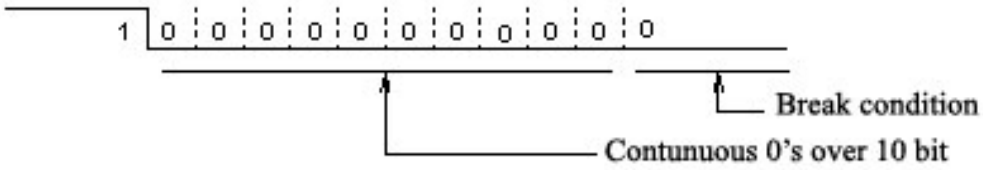
## 5.2. Frame format

There are 3 signal conditions on circuit as follows, data frame, idle condition and break condition.

(1) Data frame and Idle condition




(2) Break condition

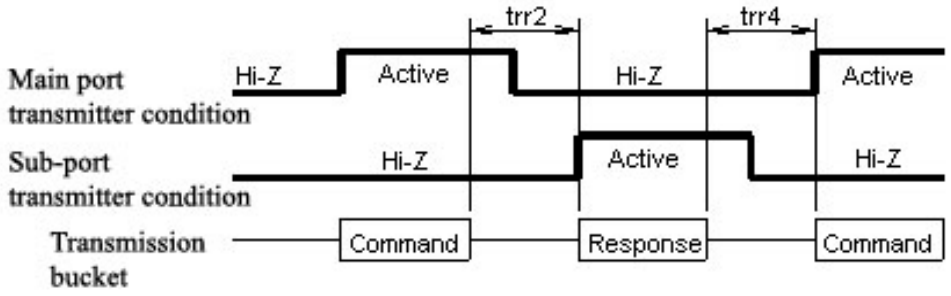



Signal levels

| Name | Level | Logic |
|---|---|---|
| TRx+ | High or Z | 1 |
| TRx- | Low or Z | |
| TRx+ | Low | 0 |
| TRx- | High | |

### 5.3. Bucket and turn around

The basic transmission procedure is both way of one turn-around command bucket transmission from main port (upper controller) and response bucket transmission from its received sub-port (servo amplifier) as one unit transmission. Following chart is the transmitter switching timing chart of main port and sub-port:




trr2: Command receiving complete⊗Sub-port transmitter activate Min. delay time = αmsec

(α is variable transmission control parameter RTIM later explained, and its default set at the shipment is 255msec)

Sub-port will activate own transmitter at this delay time or longer after receiving command bucket. Main port should make own transmitter inactive within above said control parameter time after sending command bucket. In case of using **ADP-1** as RS232C⊗RS485 converter, the transmitter switching will be done automatically. Therefore please make the parameter value 3 msec fixed.

Trr4: Response receiving complete⊗Main-port transmitter activate Min. delay time = 1msec

Sub-port will make own transmitter inactive within this time after sending response command. Main port should make own transmitter active over above said control parameter time after receiving response bucket. In case of using **ADP-1** as RS232C⊗RS485 converter, it is not necessary to consider above because the transmitter switching will be done automatically.

Command bucket and response bucket has fixed format of 16 data frame (16 characters).

(1) Command bucket format

| Header 1char. STX (02H) | Axis No. 1char. | Command Info. 11char. | BCC 2char. | Delimiter 1char. ETX (03H) |
|---|---|---|---|---|

(2) Response bucket format

| Header 1char. STX (02H) | Response ID 1char. 'U' (55H) | Axis No. 1char. | Response Info. 10char. | BCC 2char. | Delimiter 1char. ETX (03H) |
|---|---|---|---|---|---|

Header : Bucket header = Control character STX (02H)

AXIS No. : Numbers of '0' ~ 'F' indicating axis number. In case of command bucket, it will indicate sub-port address sending to, in case of response bucket, it will indicate sub-port address sending from.

Command Info. : Command bucket information portion. 11 characters of alphabet and numbers.

Response ID : ID bit for response bucket = Capital alphabet 'U'(55H)

Response Info. : Response bucket information portion. 10 characters of alphabet and numbers.

Delimiter : Bucket delimiter = Control character ETX(03H)

BCC : Block Check Character, 2 digit Numbers with "00 ~ FF" of Hexadecimal" (or "Base 16").

12 character codes out of all of these bucket numbers deducting header, delimiter and block check character will be added up as 8 bit length, and the result will be calculated as support number of 2, this will be used as block character.

Calculation example of BCC

Using [STX][‘1’][‘a’][“1234567800”][bcc][etx] of command bucket as examples, sum of all character codes in block check range will be:

Sum = 31H+61H+31H+32H+33H+34H+35H+36H+37H+38H+30H+30H = 296H

Taking its support number of 2 as 8 bit length, the answer is 64H, therefore [BCC] will be:

[BCC] = “6A”

There is only single sub-port to send response corresponding to the command sent from main port, the sub-port must have the address corresponding to axis number (Axis No) in the command bucket.
Therefore the Axis number in the command bucket and the Axis number in the response bucket are always same in one unit transmission. This rule will applies to broadcast command (all sub-port in the circuit to receive command at a same time).

### 5.4. Structures of Command / Response Bucket Information Portion

In command bucket and response bucket, there are 2 major groups of memory/response and direct command/response depending on their information structures and functions.

#### 5.4.1. Memory command/Response bucket information structure

(1) Memory command bucket information structure

| Func-CHAR. 1char. | Func-num. 1char. | Operand 9char. |
|---|---|---|

(2) Memory response bucket information structure

| Func-CHAR. 1char. | Func-num. 1char. | Operand 8char. |
|---|---|---|

Func-CHAR.: Functional character indicating memory command/memory response
English capital characters ‘A’ ~ ‘Z’
The Func-CHAR. of command is same as the Func-CHAR. of response in one unit of transmission.

Func-Num.: Numbers ‘0’ ~ ‘7’ supporting functional character decorating Func-CAHR.
The Func-Num. of command is same as the Func-Num. of response in one unit of normal operated transmission.
Some operations are exempted, such as responses against commands Q1, Q2, Q3 and Q4, and response bucket in case of rejected command by sub-port. These will be direct response format and Func-Num of response is different from Func-Num of the command as later described. If the command is rejected, its Func-Num. will be 8~F.

Operand: Operand character digits. Contents and valid character length depend on their functions.

#### 5.4.2. Direct command/response bucket information structures

(1) Direct command bucket information structure

| Func-CHAR. 1char. | Operand 10char. |
|---|---|

(2) Direct response bucket information structure

| Func-CHAR. 1char. | Operand 9char. |
|---|---|

Func-CHAR.: Functional character indicating direct command/response
English capital characters ‘a’ ~ ‘z’

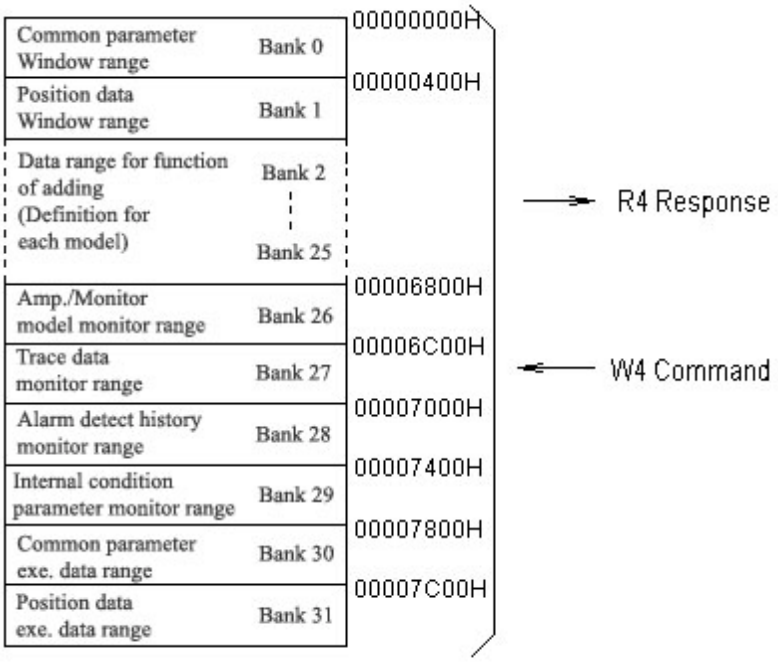
The Func-CHAR. of command is same as the Func-CHAR. of response in one unit of transmission.

Operand: Operand character digits. Contents and valid character length depend on their functions.

### 5.5. Internal interface memory and memory command

Please refer Appendix E, Command list.

Interface data range of servo amplifier against upper controller (main port) is virtual memory area (32 bit words address space) partitioned by bank of 1024 words (32 bit/word) as described later. This memory area is connected with axis control data range and EEPROM range through window range, and axis control data edit, memory and axis movement operation can be executed by transmitting data of memory command/response.




In order to access above virtual memory area, please use memory command as described next.

### 5.5.1. R4 Command/Response

R4 command information structure
["R4"]+[Address 8 char.]+['0'];
Address 8char.: Original address for 32 bit read from.
R4 response information structure
["R4"]+[Data 8char.];
Address 8char.: Original data for 32 bit read from.
By R4 command, any data of address 32 bit word data in virtual memory area can be read out. Address 8 char. of R4 command indicates the original address read from in virtual memory area, the data (32 bit) in this address would be returned for R4 response as data 8char.

### 5.5.2. T4 command/response

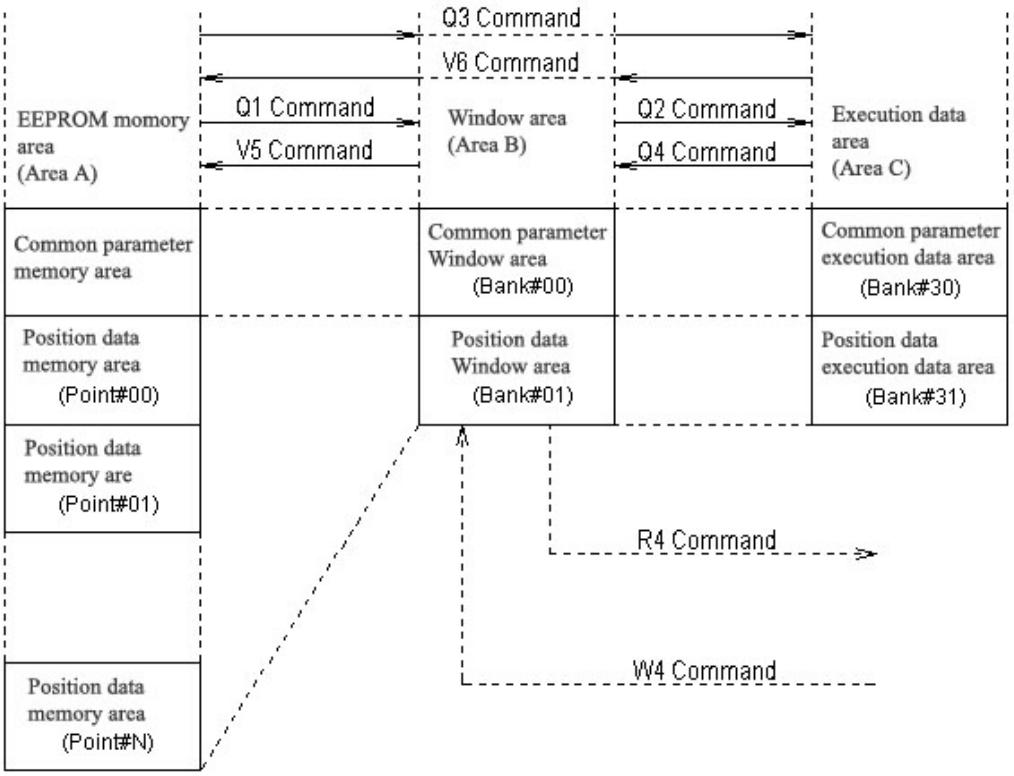
T4 command information structure
["T4"]+[Address 8 char.]+['0'];
Address 8char.: The address for 32 bit write to.
T4 response information structure
["T4"]+[Address 8char.];
Address 8char.: The address for 32 bit write to.
By T4 command, the address written to in virtual memory area can be set.
Address 8char. of T4 command indicates the written to address by W4 command explained next, the same address would be returned as response of T4 command.

### 5.5.3. W4 command/response

W4 command information structure
["W4"]+[Address 8 char.]+['0'];
Address 8char.: Data for 32 bit write to.
W4 response information structure
["W4"]+[Address 8char.];
Address 8char.: The next address for 32 bit write to.
By W4 command, 32 bit word data specified by Data 8char. can be written in address in virtual memory area. The address write to should be specified by T4 command prior to this operation, however, address doesn't need to be pre-set by T4 command for data input in consecutive address space because after T4 command execution, this address will increment internally. Incremented address will be returned for W4 command Address 8char.

**(Notes)** **Addresses in virtual memory area without description in this manual maybe reserved area. Please DO NOT write any data no matter what. In case of data input in this area, the actuator may make unexpected movement.**

EEPROM memory area (Area A), Window area (Area B) and Execution data area (Area C) are connected mutually due to next page relationship, therefore bank unit of data are transmitted at once between those areas by using memory command. The write frequency into EEPROM area has limitation. The limitation is $10^5$ times writing into each data area for bank unit.




The max. value #N of position data is 255 (0FFH) for B series, and 15 (0FH) for others. In order to transmit bank of data between above areas, memory command in the next chapter can be used.

### 5.5.4. Q1 command/response

Q1 command information part

["Q1"]+[Bank 2char.]+[Position 2char.]+[Position 2char.]+["00000"];

Bank 2char.: Bank number of transmitting to (Window area = Area B)

Position 2 char.: Position number of transmitting from. (EEPROM area = Area A)

Q1 response information part

Response of direct response format later explained will be transmitted back.

Please refer **"5.8.1. Direct response format".**

Q1 command can transmit bank unit of common data or position data in EEPROM memory area (Area A) to Window area (Area B). The type of batch transmission data will be indicated in Bank 2char. of Q1 command as bank number of Window area transmitting to, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

In case of Bank=01, position 2char. will indicate position number of position data transmitting from.

### 5.5.5. Q2 command/response

Q2 command information part

["Q2"]+[Bank 2char.]+["0000000"];

Bank 2char.: Bank number of transmitting from (Window area = Area B)

Q2 response information part

Response of direct response format later explained will be transmitted back.

Please refer **"5.8.1. Direct response format".**

Q2 command can transmit bank unit of common data or position data in Window area (Area B) to Execution data area (Area C). The type of batch transmission data will be indicated in Bank 2char. of Q2 command as bank number of Window area transmitting from, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

In Q2 command, "Bank=01" means execution of PTP movement order for the position data in Window area. This PTP movement order is equivalent to PTP movement order based on CSTR signal of **Termi-BUS PIO**, and in case of the order in ZFIN signal OFF condition, the actuator will execute homing then move to the target position.

In case of absolute encoder, PTP movement order in ZFIN signal OFF condition will be rejected and warning code 71H will be returned.

### 5.5.6. Q3 command/response

Q3 command information part

["Q3"]+[Bank 2char.]+[Position 2char.]+["00000"];

Bank 2char.: Bank number of transmitting to (Window area = Area B)

Position 2 char.: Position number of transmitting from. (EEPROM area = Area A)

Q3 response information part

Response of direct response format later explained will be transmitted back.

Please refer **"5.8.1. Direct response format".**

Q3 command can transmit bank unit of common data or position data in EEPROM area (Area A) to Window area (Area B), then will transmit the same data to execution data area (Area C). The type of batch transmission data will be indicated in Bank 2char. of Q3 command as bank number of Window area transmitting to, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

In case of Bank=01, position 2char. will indicate position number of position data transmitting from.

In Q3 command, "Bank=01" means execution of PTP movement order for the position data in EEPROM memory area. This PTP movement order is equivalent to PTP movement order based on CSTR signal of **Termi-BUS PIO**, and in case of the order in ZFIN signal OFF condition, the actuator will execute homing then move to the target position.

In case of absolute encoder, PTP movement order in ZFIN signal OFF condition will be rejected and warning code 71H will be returned.

### 5.5.7. Q4 command/response

Q4 command information part

["Q4"]+[Bank 2char.]+["0000000"];

Bank 2char.: Bank number of transmitting from (Window area = Area B)

Q4 response information part

Response of direct response format later explained will be transmitted back.

Please refer **"5.8.1. Direct response format".**

Q4 command can transmit bank unit of common data or position data in Execution data area (Area C) to Window area (Area B). The type of batch transmission data will be indicated in Bank 2char. of Q4 command as bank number of Window area transmitting to, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

### 5.5.8. V5 command/response

V5 command information part

["V5"]+[Bank 2char.]+[Position 2char.]+["00000"];

Bank 2char.: Bank number of transmitting from (Window area = Area B)

Position 2 char.: Position number of transmitting to. (EEPROM area = Area A)

V5 response information part

["V5"]+[WRC 8char.];

WRC 8char.: Total number of writing into EEPROM memory area transmitting from.

V5 command can transmit bank unit of common parameter or position data in Window area (Area B) to EEPROM memory area (Area A). The type of batch transmission data will be indicated in Bank 2char. of V5 command as bank number of Window area transmitting from, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

In case of Bank=01, position 2char. will indicate position number of position data transmitting to.

WRC 8char. of V5 response will receive total number of writing into EEPROM memory data area.

### 5.5.9. V6 command/response

V6 command information part

["V6"]+[Bank 2char.]+[Position 2char.]+["00000"];

Bank 2char.: Bank number of transmitting to (Window area = Area B)

Position 2 char.: Position number of transmitting to. (EEPROM area = Area A)

V6 response information part

["V6"]+[WRC 8char.];

WRC 8char.: Total number of writing into EEPROM memory area transmitting to.

V6 command can transmit bank unit of common parameter or position data in Execution data area (Area C) to Window area (Area B) and then transmit batch of the same data to EEPROM memory area (Area A).

The type of batch transmission data will be indicated in Bank 2char. of V6 command as bank number of Window area transmitting to, and "Bank=00" means common parameter (Bank 0), "Bank=01" means position data (Bank 1).

In case of Bank=01, position 2char. will indicate position number of position data in EEPROM memory, which is the final transmission destination.

WRC 8char. of V6 response will receive total number of writing into EEPROM memory data area.

## 5.6. Order data edit/write and execution by memory command

**In Termi-BUS servo system,** basically there are 3 ways to command movement from upper controller as follows:

(1) To memorize order data prior to the operation into EEPROM memory area, then **Termi-BUS PIO** to order the execution.

(2) To memorize order data prior to the operation into EEPROM memory area, then Q3 command to move the orders to Execution data area.

(3) To order the movement directly by direct command explained later.

For servo amplifier, (1), (2) are equivalent functionally, the order formats are different.

The operation will be to pick up one of position data in EEPROM memory area, and to transmit it to execution data area.

On the other hand, (3) method is to write data into execution data area by direct command.

In any 3 cases, in case of servo amplifier to execute some kind of movement, all of the contents of the movement are defined the conditions of each item in execution data area (Bank 30, Bank 31) at the execution start point.

Therefore it is necessary to somehow load desired data into execution data area in order to make servo system desired move. Followings are area data structure, data item contents and data set procedure relating to axis movement order of servo system in data area, which can be seen by memory command;

### 5.6.1. Data structure of common parameter

Following list is the data structure of common parameter (Bank 0 to 30) in virtual memory area.

| Off set from Top of the bank (HEX) | Symbol | Contents | Model |
|---|---|---|---|
| ０００ | ＣＮＴＭ | Absolute position coordinate range+side Max. Value | |
| ００１ | ＣＮＴＬ | Absolute position coordinate range-side Max. Value | |
| ００２ | ＬＩＭＭ | Software stroke limit value +side | |
| ００３ | ＬＩＭＬ | Software stroke limit value -side | |
| ００４ | ＺＯＮＭ | Zone border value +side | |
| ００５ | ＺＯＮＬ | Zone border value -side | |
| ００６ | ＯＲＧ | Homing pattern selection code | |
| ００７ | ＰＨＳＰ | Motor energizing signal detect operation parameter | R/RC |
| ００８ | ＦＰＩＯ | PIO function set flag | |
| ００９ | ＢＲＳＬ | SIO communication speed selection code | |
| ００Ａ | ＯＶＣＭ | Speed order for homing, Unit: 0.2r/min | |
| ００Ｂ | ＯＡＣＣ | Acceleration order for homing, Unit: 0.1r/min/ms | |
| ００Ｃ | ＲＴＩＭ | Sub-port transmitter activate min. delay time parameter | |
| ００Ｄ | ＩＮＰ | In position width default value | |
| ００Ｅ | ＶＣＭＤ | Speed order default value, Unit: 0.2r/min | |
| ００Ｆ | ＡＣＭＤ | Acceleration order default value, Unit: 0.1r/min/ms | |
| ０１０ | ＳＰＯＷ | Positioning stop current limit default value | |
| ０１１ | ＤＰＯＷ | Positioning moving current limit default value | |
| ０１２ | ＰＬＧ０ | Servo gain number default value | |
| ０１３ | ＭＸＡＣ | Max. acceleration specify flag default value | R/RC |
| ０１４ | ＣＰＡＣ | CP control mode accel/Decel constant (Reserved for future extension) | B/R |
| ０１５ | ＰＳＷＴ | Collision stop judgment parameter (0.255: Unit=ms) | R/RC |
| ０１６～０１７ | | Reserved for future extension | |
| ０１８ | ＺＲＭＫ | Homing prohibit flag (B series absolute only) | B |
| ０１９ | ＯＤＰＷ | Homing current limit value | R/RC |
| ０１Ａ | ＯＴＩＭ | Homing time out value,　Unit: 1ms | R/RC |
| ０１Ｂ | ＰＬＧ１ | Positioning stop servo gain number default value | B |
| ０１Ｃ | ＰＬＪＬ | Servo gain table select switch by load inertia | B |
| ０１Ｄ | ＦＬＳＬ | Current order filter type selection flag | B |
| ０１Ｅ | ＦＬＦＣ | Current order LP cut off frequency/BEF center frequency | B |
| ０１Ｆ | | EEPROM (Area A) Total write times number | |

Note 1) In case of no model column, it's valid for all models. In case of specified model in the column, it is valid for only the specified model.

Note 2) Please DO NOT writeW4 command directly in execution data area (Bank 30) no matter what, otherwise the actuator may make unexpected movement. Total writing times number of offset 01FH is read only, it cannot be written.

#### 5.6.1.1. Absolute position coordinate range specify Value (CNTM, CNTL)

Absolute position coordinate range+side Max. Value should be set to CNTM, +side Max. Value should be set to CNTL.
Unit is minimum unit of position feedback count on each model respectively as specified below:

| | |
|---|---|
| B series (Incremental) | 8,192/rev |
| B series (Absolute) | 4,096/rev |
| R/RC series | 800/rev |

Please set +side Max. value 3FFFFFFFH , and -side Min. value –40000000H (C0000000H) for linear motion models. For rotary models, these values are to be set within one revolution range of last axis, but they cannot be set beyond the range of –40000000H (C0000000H) to 3FFFFFFFH. During the absolute positioning coordinate range set, the set cannot have the current position beyond the range.

#### 5.6.1.2. Software stroke limit value (LIMM, LIML)

This chapter explains how to set +side software stroke limit of absolute coordinate to LIMM, -side software stroke limit of absolute coordinate to LIML. Servomotor cannot move beyond this limit.

Set resolution is the smallest unit of position feedback count, and available set range is between –80000000H and 7FFFFFFFH, however, the set should follow the condition of LIMM > LIML.
If +side stroke limit value is set to the value greater than absolute counter +side max. value (CNTM), +side stroke limit cannot move.
If -side stroke limit value is set to the value smaller than absolute counter -side minimum value (CNTL), -side stroke limit cannot move.

#### 5.6.1.3. Zone border values (ZONM, ZONL)

This chapter explains how to set +side zone output signal border value of absolute coordinate to ZONM, -side zone output signal border value of absolute coordinate to LIML. In case of the current position of servo motor is within those borders of + side and –sided, zone signal will be turned ON.
Set resolution is the smallest unit of position feedback count, and available set range is between –80000000H (80000000H) and 7FFFFFFFH, however, the set should follow the condition of ZONM > ZONL.
If +side zone output signal border value is set to the value greater than absolute counter +side max. value (CNTM), zone signal is always turned ON in the range for the current position to be greater than -side zone output signal of absolute coordinate.
If -side zone output signal border value is set to the value smaller than absolute counter -side minimum value (CNTL), zone signal is always turned ON in the range for the current position to be smaller than +side zone output signal of absolute coordinate.
Zone signal output will be output to the output port of **Temi-BUS PIO** later explained, at the same time **Temi-BUS PIO** will read internal condition parameter monitor area (Bank29) out or monitoring can be done through response against direct command later explained.

#### 5.6.1.4. Homing pattern selection code (ORG)

Homing pattern selection code consists of bit pattern specified as below:

Bit0~bit3: Homing pattern selection coded (4 bit)
Bit4~bit6: Reservation of function extension for the future
Bit7 (MSB): Short cut control valid specify bit

(1) Bit0~bit3: Homing pattern selection coded (4 bit)

There are 2 ways of homing operations, operation by o command of direct command later explained, and the operation that after the power is turned ON, PTP movement command (including position number specified PTP move order by **Termi-BUS PIO**) is ordered without homing, homing is executed prior to PTP movement automatically. Homing pattern selection code will specify homing pattern movement sequence.

Homing pattern selection code = 0

This pattern code will make current position coordinate value 0 without movement of servomotor. This pattern is default for absolute encoder, and in case of other pattern selection code entry, the selected pattern of homing movement will be executed.

Homing pattern selection code = 01H (Not available for RC series of Encoder 2ch type)

This pattern code will make servomotor to turn for clockwise at slow speed and stop at encoder marker (Cch) position and make this position 0 coordinate value.

Homing pattern selection code = 02H (Not available for RC series of Encoder 2ch type)

This pattern code will make servomotor to turn for counter clockwise at slow speed and stop at encoder marker (Cch) position and make this position 0 coordinate value.

Homing pattern selection code = 03H (Not available for RC series)

This pattern code will make servo motor to turn for clockwise and detect the edge of stroke limit signal (**Temi-BUS-PIO** *INH+) as the procedure indicated in figure 5, then servo motor to turn opposite direction at slow speed and stop at encoder marker (Cch) position and make this position 0 coordinate value.

Homing pattern selection code = 04H (Not available for RC series)

This pattern code will make servo motor to turn for counter-clockwise and detect the edge of stroke limit signal (**Temi-BUS-PIO** *INH-) as the procedure indicated in figure 6, then servo motor to turn opposite

direction at slow speed and stop at encoder marker (Cch) position and make this position 0 coordinate value.

Homing pattern selection code = 05H (Not available for RC series)

This pattern code will make servo motor turn for clockwise and detect the edge of stroke limit signal (**Temi-BUS-PIO** *INH+) as the procedure indicated in figure 5, then servo motor to stop and make this position 0 coordinate value.

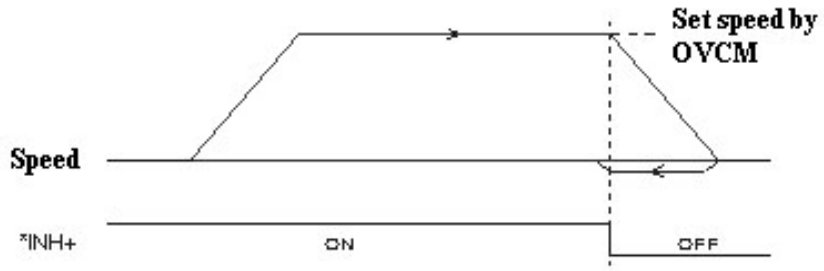



Fig. 5 Sequence of clockwise turn *INH+ edge detection

Homing pattern selection code = 06H (Not available for RC series)

This pattern code will make servo motor turn for counter-clockwise and detect the edge of stroke limit signal (**Temi-BUS-PIO** *INH-) as the procedure indicated in figure 6, then servo motor to stop and make this position 0 coordinate value.

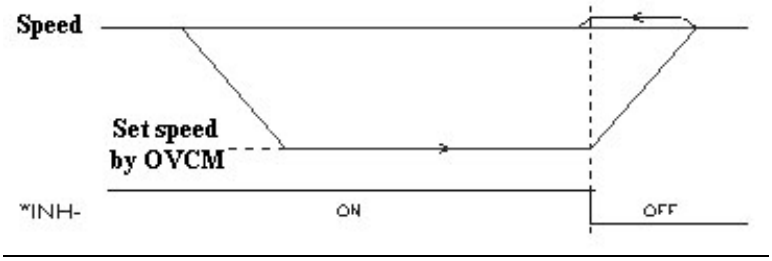



Fig. 6 Sequence of counter-clockwise turn *INH- edge detection

Homing pattern selection code = 07H (Available only for RC series)

This pattern code will make servo motor turn for clockwise at the speed set by parameter OVCM under the condition of controlled current limited to parameter ODPW and collide to mechanical stop, then servo motor to turn backward by 2 counts and make this position 0 coordinate value. In case of no collision condition within parameter OTIM after movement start, it will be alarm condition (BEH).

Homing pattern selection code = 08H (Available only for R/RC series)

This pattern code will make servo motor turn for counter-clockwise at the speed set by parameter OVCM under the condition of controlled current limited to parameter ODPW and collide to mechanical stop, then servo motor to turn backward by 2 counts and make this position 0 coordinate value. In case of no collision condition within parameter OTIM after movement start, it will be alarm condition (BEH).

Homing pattern selection code = 09H (Available only for RC series)

This pattern code will make servo motor turn for clockwise at the speed set by parameter OVCM under the condition of controlled current limited to parameter ODPW and collide to mechanical stop, then servo motor to turn backward at slow speed to stop at encoder marker (Cch) position and make this position 0 coordinate value. In case of no collision condition within parameter OTIM after movement start, it will be alarm condition (BEH).

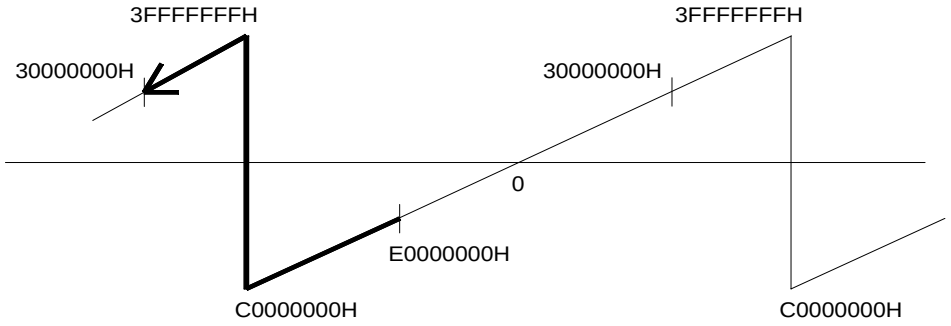
Homing pattern selection code = 0AH (Available only for RC series)

This pattern code will make servo motor turn for counter-clockwise at the speed set by parameter OVCM under the condition of controlled current limited to parameter ODPW and collide to mechanical stop, then servo motor to turn backward at slow speed to stop at encoder marker (Cch) position and make this position 0 coordinate value. In case of no collision condition within parameter OTIM after movement start, it will be alarm condition (BEH).

(2) Bit7: Short cut control valid specify bit

In case of revolutionary system machinery, by setting ORG bit7 to 1, it is possible to make short cut control for the order of 180° or greater.

For example, in the case of revolutionary system of +side max. value (CNTM) of absolute position coordinate range to 3FFFFFFFH and –side min. value (CNTL) of absolute position coordinate range to C0000000H, following figure shows the short cut motion by the order of PTP movement from current position E0000000H to target position 30000000H.




With the set of short cut control valid, the motor will move to opposite direction in case of the movement of 180°.

In case of short cut control valid, stroke limit function is not valid, LIMM and LIML should be set to out of coordinate range and functions of *INH+, *INH- should be masked by FPIO.

### 5.6.1.5. Motor phase energizing signal detect motion parameter (PHSP)

This operation is available only for R/RC series and it is not necessary to set this up for other models. When the servo is turned ON after power is turned ON, automatic motor phase energizing signal detect motion will be executed to establish motor energizing home. In case failure of this motion due to mechanical friction condition or effect of over self-weight load, etc, this function should be adjusted.

Bit0~6: Phase energizing signal detect operation delay time specifying code

In case of detect operation failure due to mechanical friction release delay time of break etc. after servo ON, start delay time equivalent to release operation delay time can be set by 7 bit binary code (unit 100msec/LSB). Available set range is 00H~07FH (0~12.7 sec).

Bit 7: Phase energizing signal detect operation initial movement direction specifying bit

In case of detect operation failure due to over load due to self-weight, etc., initial movement direction is to set to the opposite direction from load direction. Initial movement direction of detect operation is to set to clockwise by code 0, counter-clockwise by code 1.

### 5.6.1.6. PIO function set code (FPIO)

This code is to set mask specifying bit pattern on PFIN/INP output signal function selection and each input signal function for CSTR, *INH+, *INH-, *ILK of **Termi-BUS PIO**.

Definition of function for each bit is as follows (bit 0 = LSB):

Bit 0 = 0 : PFIN output selection / 1 : INP output selection
It switches the output signal functions of PFIN/INP of **Termi-BUS PIO**.
Please refer the chapter '**4.2.2.1. Positioning completion signal (PFIN/INP)**" for each function of PFIN signal and INP signal.

Bit 1~3 : Reserved for future function extension.

Bit 4 = 0 : CSTR valid / 1 : CSTR invalid
It is to mask CSTR functions (position number PTP order strove signal) of **Termi-BUS PIO**. In case of servo system control by using **Termi-BUS SIO**, normally CSTR signal functions should be masked.

Bit 5 = 0 : *INH+ valid / 1 : *INH+ invalid

Bit 6 = 0 : *INH- valid / 1 : *INH- invalid
This will mask the function of *INH+, *INH- (hardware stroke limit signal input) of **Termi-BUS PIO**. This function is to be used for rotary systems that don't need hardware stroke limit function other than homing operation.
Bit 7 = 0 : *ILK valid / 1 : *ILK invalid
This will be used when *ILK (external interlock signal input) should be masked.

#### 5.6.1.7. SIO communication parameter (BRSL, RTIM)

As communication parameter of **Termi-BUS SIO**, this will set communication Baud rate to BRSL, sub-port transmitter activate minimum delay time parameter α to RTIM.

SIO Communication speed (Baud rate) selection code (BRSL)

| | | | |
|---|---|---|---|
| 04H : | 9.6 kbps | 11H : | 14.4 kbps |
| 05H : | 19.2 kbps | 12H : | 28.8 kbps |
| 06H : | 38.4 kbps | 13H : | 57.6 kbps |
| 07H : | 76.8 kbps | 14H : | 115.2 kbps |

Sub-port transmitter activate minimum delay time parameter α (RTIM)

RTIM is the set of minimum delay time from the time of command receipt completion of servo amplifier to the time of own transmitter activated. The set unit is msec and the range is 0~255.

Note) In case of BRSL set data in EEPROM other value than above value, the system will operate under the condition of baud rate and α to default (9.6kbps, 255msec), therefore it is necessary to be well cautious.

#### 5.6.1.8. Homing speed / Acceleration order value (OVCM, OACC)

Homing speed order value is to set to OVCM (set range by unit of 0.2r/min, set range 0000H~57E4H) acceleration order value to be set to OACC (0.1r/min/msec). It is servo motor model unique value for low speed order value in deceleration signal edge detect or encoder marker signal detect.

#### 5.6.1.9. Positioning completion detect width default value (INP)

In case of absolute position order or relative movement order, it will set to INP with the capacity default value of difference that target position minus current position used in positioning movement completion detect. In case of push force movement order, it will set to INP with the default value of maximum push stroke in push force movement after approach movement deceleration completion.
The set unit is encoder division resolution unit and the set range is 00000000H~3FFFFFFFH. Because this item is default value against PTP movement parameter within position data, it doesn't exist in common parameter (bank 30) of execution data area.

#### 5.6.1.10 Speed/Acceleration order default value (VCMD, ACMD)

Speed order default value (set range is 0000H~57E4H with unit of 0.2r/min) of PTP movement is to set to VCMD, acceleration order default value (set range is 0001H~07FFH with unit of 0.1r/min) is to set to ACMD. Because these items are default values against PTP movement parameter within position data, they don't exist in common parameter (bank 30) of execution data area.

#### 5.6.1.11. Current limit order default value (SPOW, DPOW)

Current limit default value of moving servomotor is to set to DPOW, current limit default value of positioning stop condition or push force movement is to set to SPOW. These values are to set within maximum current OFFH with 256 steps. Available set range is 000H~OFFH, however, please note that the values beyond following limit for SPOW will make system alarm (B1H) at execution.

B series 000H~OFFH (No limit)

R series 000H~078H
RC series 000H~0B4H

Because these items are default values against PTP movement parameter within position data, they don't exist in common parameter (bank 30) of execution data area.

#### 5.6.1.12. Servo gain number default value (PLG0, PLG1)

Servo gain number default value at movement is to set to PLG0, servo gain number default value at positioning stop is to set to PLG1. Gain number is from 00H to 0FH with 16 steps, and the higher the number is, the higher the gain will be. For R/RC series, servo gain number at movement is always valid, and there is no servo gain number item at positioning stop.

Current limit default value of positioning stop condition or push force movement is to set to SPOW. These values are to set within maximum current OFFH with 256 steps. Available set range is 000H~OFFH, however, please note that the values beyond following limit for SPOW will make system alarm (B1H) at execution.

For B series, servo gain at positioning stop can be set addition to servo gain at movement, it will help to reduce the stop vibration because it can set only the stop gain small in case of the limit cycle vibration caused by the mechanical system backlash, etc. Because these items are default values against PTP movement parameter within position data, they don't exist in common parameter (bank 30) of execution data area.

#### 5.6.1.13. Maximum acceleration order default value (MXAC)

This item is default value of PTP movement parameter only for R/RC series.

Bit 0 : This will make the acceleration always maximum according to the load conditions if the ultimate acceleration set value of PTP movement is 1. In this case, deceleration will follow the acceleration/deceleration order value. This will follow the set acceleration/deceleration value if the ultimate acceleration set value is 0.

Bit 1: Push force movement order
If the set value is 1, the system will execute push force movement order.
If the set value is 0, the system will execute positioning movement order.

Bit 2: Direction order of push force movement
If the set value is 0, the direction of push force movement will be clockwise after the approach movement. If the set value is 1, the direction will be counter-clockwise.

Bit 3: Absolute positioning order / Increment (relative) movement order
The set value 0 is absolute positioning order, the set value 1 is increment (relative) movement order.
Because these items are default values against PTP movement parameter within position data, they don't exist in common parameter (bank 30) of execution data area.

#### 5.6.1.14. Homing current limit value (ODPW)

This item is valid only for RC series, and it will set the current limit value during push movement of homing motion of homing pattern selection code 7 and 8. These values are set maximum current OFFH with 256 steps. (Available set range 000H~0FFH).

#### 5.6.1.15. Motion time out value of homing (OTIM)

This item is valid only for RC series, and it will set the motion time out value for push movement of homing motion of homing pattern selection code 7 and 8. The set unit is msec, and the available set range is 0000H~0FFFFH.

#### 5.6.1.16. Servo gain selection switch by load inertia (PLJL)

This item is valid only for B series, and it is a switch to make gain corresponding to servo gain number said above suitable value to load inertia condition. Corresponding to load inertia conditions, the value should be set as follows:

0: Light load inertia (approx. 0 to 3 times of rotor inertia)
1: Middle load inertia (approx. 3 to 7 times of rotor inertia)
2: Heavy load inertia (approx. 7 to 14 times of rotor inertia)

#### 5.6.1.17. Stop judge parameter for push force movement (PSWT)

Please refer the chapter "**5.6.3. Push force movement order of position data**" for "Stop judge parameter for push force movement (PSWT)".

#### 5.6.1.18. Acceleration/Deceleration parameter for CP movement (CPAC)

CPAC will be set with time parameter (unit is msec, and available set range is 0000H~03FFH) of acceleration/deceleration process in CP control mode. CP control mode is not in the range of the contents of common specifications in this manual, and it is special function for limited model.

#### 5.6.1.19. Parameter relating to Current order filter (FLSL, FLFC)

This item is valid only for B series, and it is to set the features of current order filter inside of servo loop. This filter function may be used for gain reduction in wide range in the case that servo loop amplifies the equivalent frequency of machine system unique resonate vibration mode and generates vibration.

Filer type (FLSL)

0: Primary low pass filter (LPF)

1: Band elimination filter (BEF)

Filer frequency (FLFC)

LPF means cut off frequency (Unit is Hz and set range is 0010H~07FFH)

BEF means median frequency (Unit is Hz and set range is 0080H~07FFH)

#### 5.6.1.20. Homing motion prohibition flag (ZRMK)

In case of the specs of absolute encoder of B series, machine home is set manually by using type o homing command normally after encoder set up. This operation can be executed through CTA operation or command of Termi-BUS SIO. However, it is very dangerous to use this set and/or accidentally execute this set after the machine system home set. Therefore this flag can be used to prohibit such operation to avoid accident. This flag is valid only for absolute encoder type of B series, and value 0 means homing movement valid, value 1 means homing movement prohibition.

### 5.6.2. Data structure of Position data

Following table is data structure of position data (Bank 01 to 31) in virtual memory area

Position data Window area Bank1 (PNT1)

| Offset from top of bank (HEX) | Symbol | Item | Model |
|---|---|---|---|
| 000 | PCMD | Target position in absolute position coordinate or increment | |
| 001 | FLGP | Axis movement parameter default/position data selection flag<br>0= Axis parameter default valid<br>1= Position data valid<br>Bit7 : In position width (INP)<br>Bit6 : Speed (VCMD), acceleration (ACMD)<br>: Ultimate acceleration (MXAC)<br>Bit5 : Current limit value (SPOW, DPOW)<br>Bit4:Servo gain number (PLG0) | |
| 002 | | Reservation for future extension | |
| 003 | INP | In position width | |

| | | | |
|---|---|---|---|
| 004 | VCMD | Speed order, Unit: 0.2r/min | |
| 005 | ACMD | Acceleration order, Unit: 0.1r/min | |
| 006 | SPOW | Current limit value of positioning stop | |
| 007 | DPOW | Current limit value of positioning | |
| 008 | PLGO | Servo gain number value | |
| 009 | MXAC | Ultimate acceleration specify flag<br>Bit0 : 1 = Ultimate acceleration<br>Bit1 : 1 = Push force movement order<br>Bit2 : 0 = Clockwise direction of push force movement<br>: 1 = Counter-clockwise direction of push force movement<br>Bit3 : 1 = Incremental movement order | R/RC |
| 00A~010 | | Reservation for future extension | |
| 011 | PLG1 | Servo gain number of positioning stop | B |
| 012~01E | | Reservation for future extension | |
| 01F | | Total written number in EEPROM area (area A) | |

Note 1) If there is no model in model column, the item is valid for all models. If there is model in model column, the item is valid only for indicated model.

Note 2) Total written number of offset 01FH is read only, cannot be written. Please do not write it to execution data area (Area C) by W4 command due to the possible accidents.

#### 5.6.2.1. Positioning stop target position in absolute coordinate (PCMD)

Positioning target position of PTP movement is set by absolute coordinate position or increment from current position. For positioning order in absolute coordinate, the available set range is C0000000H~3FFFFFFFH, however, it is not allowed to set the value beyond the coordinate range specified by absolute position coordinate range specify value (CNTM, CNTL) of common parameter described before. Available set range of incremental movement is ±7FFFFFFFH (80000001H~7FFFFFFFH) and set unit is encoder division resolution.

#### 5.6.2.2. Axis movement parameter default / Position data selection flag (FLGP)

This will specify axis movement parameter after offset 003H to either common parameter default value or position data value. Each item of movement parameter is appointed to bit pattern as follows, and 0 will select the default value of common parameter, 1 will select set value in position data. Offset values in the following descriptions are offset values of position data.

Bit 0 : Reservation
Bit 1 : Reservation
Bit 2 : Reservation
Bit 3 : Reservation
Bit 4 : Servo gain (Offset 008H, B series includes 011H)
Bit 5 : Current limit value (offset 0006H, 007H)
Bit 6 : Speed/Acceleration order (offset 004H, 005H, R/RC series includes 009H)
Bit 7 : In position width (offset 003H)

#### 5.6.2.3. Positioning completion detect width (INP)

In case of absolute positioning order or incremental movement order, this will set in INP with capacity value of difference between current position and target position used for positioning completion detect.
In case of push force movement order, this will set in INP with push volume of push force movement after approach movement deceleration completion.
Set unit is encoder division resolution unit and set range is 00000000H~3FFFFFFFH.

#### 5.6.2.4. Speed/acceleration order value of PTP movement (VCMD, ACMD)

This will set in VCMD with speed order value (0.2r/min unit, set range 0000H~07FFH) of PTP movement.

#### 5.6.2.5. Current limit order value of PTP movement (SPOW, DPOW)

This will set in DPOW with servo motor moving current limit value, this will set in SPOW with positioning stop condition current limit value or push force moving current limit value. These values are to set within maximum current 0FFH with 256 steps. (Available set range 000H~0FFH).

#### 5.6.2.6. Servo gain number of PTP movement (PLG0, PLG1)

This will set in PLG0 with moving servo gain number, in PLG1 with servo gain number of positioning stop. Gain number is from 00H to 0FH with 16 steps, and the higher the number is, the higher the gain will be. For R/RC series, servo gain number at movement is always valid, and there is no servo gain number item at positioning stop.
For B series, servo gain at positioning stop can be set addition to servo gain at movement, it will help to reduce the stop vibration because it can set only the stop gain small in case of the limit cycle vibration caused by the mechanical system backlash, etc.

#### 5.6.2.7. Ultimate acceleration specification at PTP movement (MXAC)

This item is default value of PTP movement parameter only for R/RC series.

Bit 0 : Ultimate acceleration specification at PTP movement
Set value 1 will make always acceleration ultimate corresponding to load condition only for acceleration. The deceleration will follow the programmed acceleration value. Set value o makes both acceleration and deceleration programmed value.

Bit 1 : Push force movement specify
Set value 1 will execute push force movement order.
Set value 0 will execute positioning movement order.

Bit 2 : Push force movement direction specify
Set value 0 will move clockwise direction after push force movement, set value 1 will move counter-clockwise direction.

Bit 3 : Absolute position order / Incremental movement order specify
Set value 0 will make coordinate positioning order, set value 1 will make incremental movement order.

### 5.6.3. Incremental movement order by position data

R/RC series can order increment from current position using position data in virtual memory area. Value of MXAC bit 3 will judge position data if the order is either coordinate positioning order or incremental movement order. If the value of MXAC 3 is 0, the positioning will be executed as coordinate positioning order, and if the value of MXAC 3 is 1, the positioning will be executed as incremental positioning order.

### 5.6.4. Push force movement order by position data

R/RC series can order push force movement by using position data in virtual memory area. Value of MXAC bit 1 will judge position data if the order is either normal positioning order or push force movement order. If the value of MXAC 1 is 0, the positioning will be executed as normal positioning order, and if the value of MXAC 1 is 1, the positioning will be executed as push force movement order. Each item of position data means as following table. Push force movement can by ordered by Q2, Q3 commands other than P10.

| Symbol | Item of position data |
|---|---|
| PCMD | Target position of approach movement |

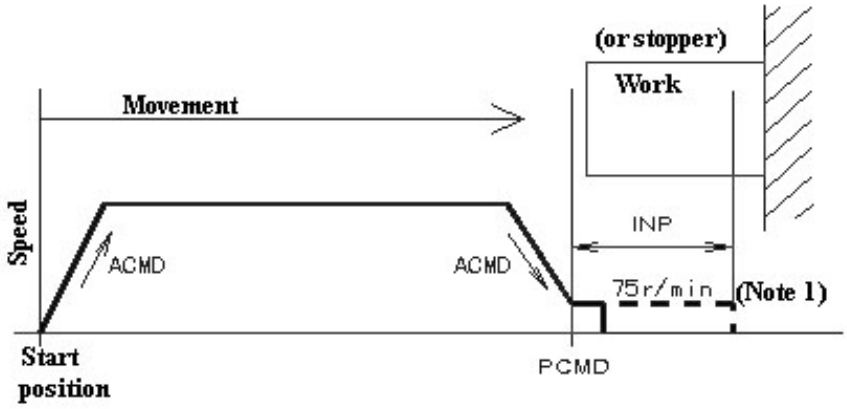
| | |
|---|---|
| FLGP | Axis movement parameter default/position data selection flag |
| INP | Maximum volume of push force |
| VCMD | Speed order value |
| ACMD | Acceleration order value |
| SPOW | Current limit value at positioning stop |
| DPOW | Current limit value at positioning/ Current limit value at push force |
| PLG0 | Servo gain number value |
| MXAC | Ultimate acceleration specify flag/Push force movement specify flag |

The judge of push force movement completion is if the stop is in INP range. The stop recognition time can be updated by PSWT of common parameter range.

| Symbol | Item of common parameter |
|---|---|
| PSWT | Stop judge parameter (0~255: Unit in ms) |

Note) Push force movement functions by position data are not valid for B series.

**5.6.4.1. Approach movement deceleration completion target position (PCMD)**




(Note 1) In case of VCMD smaller than 75r/min, this will be VCMD.

If Bit 3 of MXAC later explained is 0, PCMD at push force movement will be specified on absolute coordinate of deceleration completion target position of approach movement. CTA teaching normally programs this position. If Bit 3 of MXAC is 1, PCMD at push force movement will be specified on absolute coordinate of deceleration completion target position of approach movement showing increment from current position. Actual movement is to approach at the speed specified by VCMD and decelerate to the position as shown in above figure, and start for push force motion at low speed after deceleration.
Set unit of this chapter is same as that of INP at normal positioning movement.

**5.6.4.2. Push force max. volume (INP)**

INP will set max. push force volume at push force movement after approach movement deceleration completion. After approach movement completion, the system will move to the direction specified by bit 2 of MXAC at the speed of 7.5r/min under that condition of current limit to set value SPOW, and PFIN of PIO will be turned ON as soon as the system detects the work push condition (stopper) during this movement.
Incase of no push condition detection due to no work, etc., PFIN of PIO will be turned ON after the stroke movement completion specified in INP.
Set unit of this chapter is same as that of PCMD at normal positioning movement.

**5.6.4.3. Current limit order value during push force movement (SPOW)**

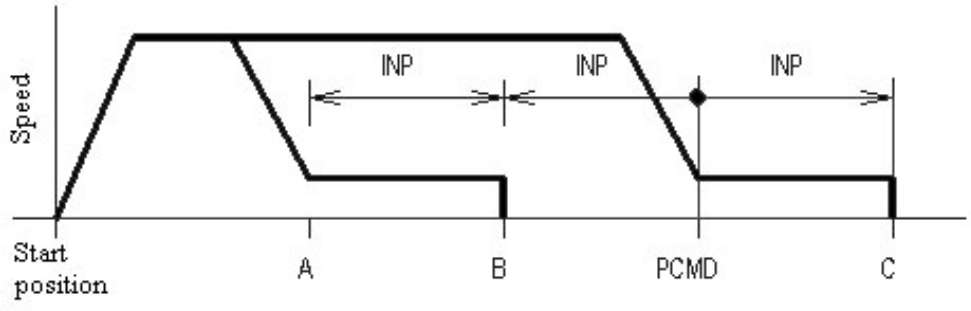
SPOW is to set current limit value during servo motor movement. This set value is also current limit value during push force movement. These values are maximum current of 0FFH with 256 steps. However, available set range of SPOW is 000H~0B4H and please note that the set beyond this range will be turn alarm (B1H) ON. If the normal push force movement is completed (push force condition is detected), the system will keep pushing the work (stopper) limited at the torque generated by the current limited by this set value. This condition will be released by the execution of following next order. After this, if other movement order direct command like a, m are ordered, bit 1 of MXAC will return to o automatically, push movement condition will be released. If d command is ordered during push force condition, push force condition can be released.

#### 5.6.4.4. Ultimate acceleration specify / Push force movement specify flag (MXAC)

Bit 0 : Set value 1 will make always acceleration ultimate corresponding to load condition only for acceleration. The deceleration will follow the programmed acceleration value. Set value o makes both acceleration and deceleration programmed value.

Bit 1 : Set value 1 will execute push force movement order for this position data.
Set value 0 will execute positioning movement order for this position data.

Bit 2 : Set value 0 will move clockwise direction after push force movement, set value 1 will move counter-clockwise direction.
This bit will result the direction of final stop position from PCMD, therefore if the direction is wrong, the movement will be different by the width as following figure (2 x INP):




If bit 1 set value is 0, set value of this bit will be invalid.

Bit 3 : Set value 0 will make PCMD to deceleration completion target position coordinate positioning order during approach movement.
Set value 1 will make PCMD to increment specify deceleration completion target position coordinate positioning order during approach movement from current position.

#### 5.6.4.5. Teaching procedure of push force movement

In case of programming of deceleration completion target position of approach movement on coordinate (in case of bit 3 of MXAC to 0), following the teaching procedure of push force movement:

(1) Complete homing prior to this operation
(2) Start teaching
(3) Teach the start position with the consideration of work position differences
(4) Write in INP with no push stroke
(5) Enter 1 in push force movement selection flag (bit1 of MXAC)
(6) Set in stop target position direction flag (bit2 of MXAC). (1= counter-clockwise, 0= clockwise)
(7) Enter 0 in deceleration completion target position specify of approach movement on coordinate (bit3 of MXAC)
(8) Set in push force stop judge parameter (PSWT). (0~255: Unit=ms)

#### 5.6.4.6. No push stroke of push force movement

If the system completes the movement stroke set in INP without detection of push force movement completion condition, position number won't be updated but PFIN will be turned ON.

### 5.6.5. Procedures for initialization of execution data area and EEPROM memory area update

After power is turned ON, contents of common parameter in EEPROM memory area will be automatically loaded into common parameter (bank 30) of execution data area, and axis movement parameter default value (offset 00DH~013H,01BH) will be also loaded into position data (bank 31) of execution data area automatically at a same time. At this time, o will be set in PCMD (address 00000400H) of bank 1, the value of FLGP (address 00000401H) will become o as well. Absolute position coordinate target position of position data (bank 31) in execution data area will also become o. Therefore by changing common parameter in EEPROM memory area, initial values of execution data area except PCMD, FLGP can be changed at a same time. Following chapters will describe general procedures how to change the common parameter and position data in EEPROM. In case of high-grade upper controller like PC with external memory, these data can be edited on file base at offline. In such case, edited file data is to be written into Window area by W4 command, and transferred into EEPROM memory area by V5 command.
In case of edit equipment without external memory like CTA with external memory, edit subject data in EEPROM memory area is read into Window area by Q1 command, these data is also read into edit buffer of edit equipment by R4 command, then these data can be edited on this edit buffer. Edited data is to be written into Window area again by W4 command, and transferred into EEPROM memory area by V5 command.

### 5.6.6. Notes for data transfer into execution data area

Data in EEPROM memory area can be loaded into execution data area through Window area by using Q3 command at any time. On the other hand, edited data by direct command in execution data area can be written into EEPROM memory through Window area by using V6 command. In such batch data transfer, data are not always transfer the relation of one to one. In the batch data transfer of command parameter and position data between Window area and EEPROM area, data items of transfer from will be transferred to data items of transfer to corresponding to the original items. However, some data transfer between Window area and execution data area are not like this.

#### 5.6.6.1. SIO communication parameter

Regarding SIO communication parameter (BRSL, RTIM), it is possible to transfer data in Window area (bank 0) to execution data area (bank 30) only by using communication parameter set command in communication establish procedure later explained. SIO communication conditions are different from other data items, it is not affected by batch transfer such as batch transfer from Window area to execution data area by Q2 command, and batch transfer from EEPROM memory area to execution data area by Q3 command. When the power is turned ON, SIO communication parameter in EEPROM memory area will be read into execution area (bank 30) through Window area (bank 0), those data will be the initial communication condition of SIO.

#### 5.6.6.2. Servo movement parameters

Servo movement parameters (INP, VCMD, ACMD, SPOW, DPOW, PLG0, MXAC, PLG1) will be used for execution data area following as below:
When position data is transferred from Window area to execution data area by using Q2 command, for data item of O for corresponding bit, default value in common parameter (bank 0) of Window area will be transferred to position data (bank 31) of execution data area by following the contents of axis movement parameter default/position data selection flag (FLGP) in Window area (bank 1). The data item of 1 corresponding to the bit will be transferred from position data (bank 1) of Window area to position data (bank 31) of execution data area.
In case of position data transfer from EEPROM memory area to execution data area through Window area by Q3 command, transfer subject position data on EEPROM memory will be read into Window area (bank 1) once, then this data will be transferred to execution data area (bank 31). At this operation, it will follow the contents of axis

movement parameter default/position data selection flag (FLGP) in Window area (bank 1). The data item corresponding to the bit 0, default value of common parameter (bank 0) in Window area will be transferred to position data (bank 31) of execution data area.

When position data is transferred from Window area to execution data area by using Q2 command, for data item of O for corresponding bit, default value in common parameter (bank 0) of Window area will be transferred to position data (bank 31) of execution data area by following the contents of axis movement parameter default/position data selection flag (FLGP) in Window area (bank 1). The data item corresponding to the bit will be transferred from position data (bank 1) of Window area to position data (bank 31) of execution data area. The data item corresponding to the bit 1 will be transferred from position data (bank 1) of Window area to position data (bank 31) of execution data area.
This operation will be the same for automatic initial values transfer from EEPROM memory area to execution data area when the power is turned ON.

#### 5.6.6.3. Other data items

Other than data items regulated in "**5.6.6.1. SIO communication parameter**" and **"5.6.6.2. Servo movement parameter**" in common data, position data, each item is transferred by batch transfer as it is from Window area or EEPROM memory area to corresponding offset data item in execution data area. The relations of each item for batch transfer are described in following figure 7.

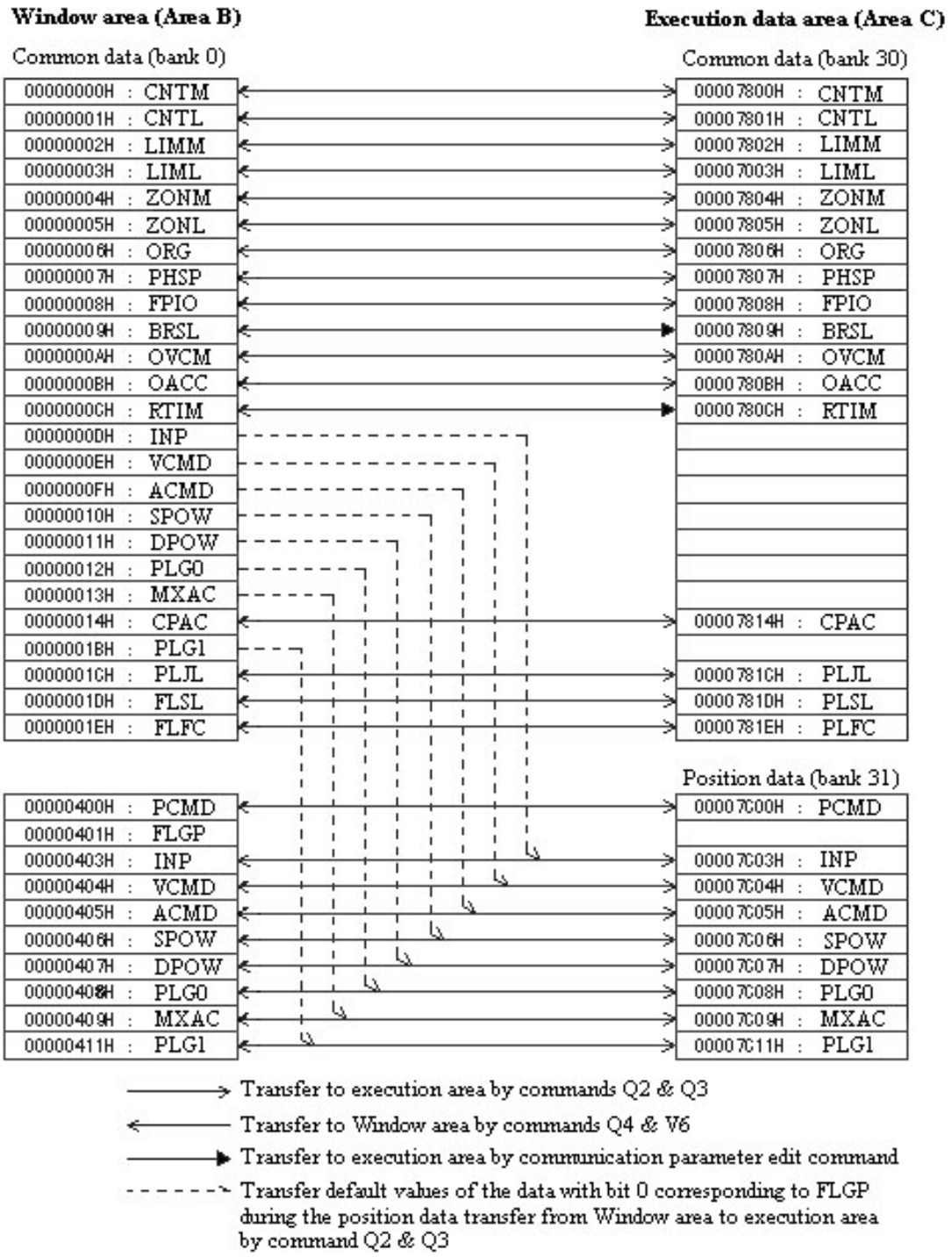



Figure 7. The relation of Window area and execution area at batch transfer

## 5.7. Servo amplifier internal status monitoring by memory command

Servo amplifier internal status like alarm information, etc. can be monitored by reading data indicated as below by using R4 command if it is necessary.

### 5.7.1. Monitor area data structure of amplifier/motor model

Following table shows the data structure of amplifier/motor model monitor (bank 26).

| Address (HEX) | Symbol | Item | Model |
|---|---|---|---|
| 00006800 | ROM | Model code and ROM version code | |
| 00006801 | S/N | Serial number | RC |
| 00006802 | AMP1 | Servo amplifier model character digits, No.1 group 4 characters | |
| 00006803 | AMP2 | Servo amplifier model character digits, No.2 group 4 characters | |
| 00006804 | AMP3 | Servo amplifier model character digits, No.3 group 4 characters | |
| 00006805 | | Reservation | |
| 00006806 | MOT1 | Servo amplifier model character digits, No.1 group 4 characters | |
| 00006807 | MOT2 | Servo amplifier model character digits, No.2 group 4 characters | |
| 00006808 | MOT3 | Servo amplifier model character digits, No.3 group 4 characters | |
| 00006809 | | Reservation | |

Note) Model character digits are stored in above indicated addresses as 32 bit data came from ASCII coded of 4 characters as it is, and the content of character digits read by R4 will be as follows (for response information portion):

B A * 0
↓ ↓ ↓ ↓
"R4 42 41 2A 30"

#### 5.7.1.1. Model code and ROM version code (ROM)

Model of servo amplifier and version of firm ware (ROM) are indicated as follows:

(1) Model code (Upper 16 bit)
0000H～0FFFH : B series
1000H～1FFFH : R series
3000H～3FFFH : RC series

(2) ROM version (Lower 16 bit)

0000H～FFFFH : First time version is 0000H and consecutive numbers afterwards.

Please refer "**Appendix A. Model code table**" for details of model code definition.

#### 5.7.1.2. Serial number (S/N)

Serial number is valid only for RC series, and this number is used unique address for numbering of axis number. This area is invalid for other models, and 0 is always read out in this area.

#### 5.7.1.3. Servo amplifier model name character digit (AMP1~AMP3)

Servo amplifier model name can be read out by 3 words of AMP1. AMP2 and AMP3 as ASCII code character digits. As the example as below, model name has first character with top bit of AMP1 and last character with bottom bit of AMP3.

Example) In case of 400W standard B series servo amplifier

| | | |
|---|---|---|
| BA*0 | 4B3- | 000 |
| ↑ | ↑ | ↑ |
| AMP1 | AMP2 | AMP3 |
| MSD ←LSD | MSD ←LSD | MSD ←LSD |

And '*' character will be read out as wild card in vender code (third character)

#### 5.7.1.4. Servo motor model name character digit (MOT1~MOT3)

Servo motor model names connectable to servo amplifier can be read out by 3 words of MOT1. MOT2 and MOT3 as ASCII code character digits. Please note that those motor model names are not connected ones except RC series. Those names are motor models, which can be connected to the system. As the example as below, model name has first character with top bit of MOT1 and last character with bottom bit of MOT3.

Example) In case of 400W standard B series servo amplifier

| | | |
|---|---|---|
| BM*0 | 4B3- | 00* |
| ↑ | ↑ | ↑ |
| MOT1 | MOT2 | MOT3 |
| MSD ←LSD | MSD ←LSD | MSD ←LSD |

And '*' character will be read out as wild card in vender code (third character) and output axis specification code ($11^{th}$ character)

### 5.7.2. Data structure of Alarm monitor area

Following table shows the data structure of alarm monitor (bank 28) in virtual memory area

| Address (HEX) | Symbol | Item | Model |
|---|---|---|---|
| 00007000 | WARN | Last detection warning code | |
| 00007001 | HYS0 | Last detection alarm code | |
| 00007002 | HYS1 | Detection alarm code one time before last | |
| 00007003 | HYS2 | Detection alarm code 2 times before last | |
| 00007004 | HYS3 | Detection alarm code 3 times before last | |
| 00007005 | HYS4 | Detection alarm code 4 times before last | |
| 00007006 | HYS5 | Detection alarm code 5 times before last | |
| 00007007 | HYS6 | Detection alarm code 6 times before last | |
| 00007008 | HYS7 | Detection alarm code 7 times before last | |
| 00007009 | ARMA | Data address which experienced data fault during execution | |

#### 5.7.2.1. Final detection warning code (WARN)

Final detection warning code shows the code of latest warning content. Please refer the "**Appendix B. Details of warning /Alarm code**" for detail of each code.

#### 5.7.2.2. Last detection alarm code and history (HYS0~HYS7)

Last detection alarm code and history show codes of latest and last 7 alarms.

#### 5.7.2.3 Data address which experienced execution data fault

In case of data fault at execution (alarm code BOH, B1H), this will show the data address of its cause. By checking this address content, the cause of the fault may be detected. This item will be updated only when data

fault at execution occurs, it won't be updated for other alarms.

### 5.7.3. Data structure of internal status monitor area

Following table shows the data structure of internal status monitor (bank 29) in virtual memory area

| Address (HEX) | Symbol | Item | Model |
|---|---|---|---|
| 00007400 | PNOW | Absolute position coordinate counter current position | |
| 00007401 | VNOW | Current speed monitor | |
| 00007402 | | Reservation for future extension | |
| 00007403 | STAT | Internal status flag | |
| 00007404 | ALRM | Current alarm/warning code | |
| 00007405 | PI | PIO input ports monitor | B/R |
| 00007406 | PO | PIO output ports monitor | |
| 00007407 | SW | SW1 (Rotary), SW2 (DIP) status monitor | B/R |
| 00007408 | STAT2 | Bit 0: Homing executing flag<br>1=Homing | |
| 00007409 | WADR | Write to address counter by W4 command | |
| 0000740A | ROM | Model coded and ROM version | |
| 0000740B | A/D0 | Analog data value for check | R/RC |
| 0000740C | A/D1 | Analog data value for check | R/RC |
| 0000740D | A/D2 | Analog data value for check | R/RC |
| 00007412 | OLLV | Over load detection current value, 78H and greater makes alarm | |
| 00007413 | LVPK | Peak hold value of Over load detection level | |
| 00007414 | ICMD | Internal current order value (Torque order value) 100/rating current | B |
| 00007415 | PNTM | Current position number monitor (0~255) | B |

#### 5.7.3.1. Absolute position coordinate counter current position (PNOW)

This is absolute position coordinate position counter with encoder resolution indicating motor current position, and counts position feedback and always updates.

#### 5.7.3.2. Current speed monitor (VNOW)

This is actual motor speed both poles monitor data based on encoder feed back, and its resolution (weight per LSB) is 0.2[r/min].

#### 5.7.3.3. Internal status flag (STAT)

This is described with servo amplifier of bit pattern as follows. This data item is included in direct response type information later explained.

Bit 7: Command reject indication (0=accept / 1=reject)

When STAT is read out normally by R4 command, this bit will become always 0. Command reject response later explained is direct response type against direct command, and it includes both information of STAT and ALRM. Therefore received main port of command reject response can find the reason of command reject by checking the ALRM content. In case of rejection of memory command, its response will be command reject response, and it will find the reason same by the procedure as above.

Bit 6: - (minus) direction interlock condition (1 means – direction interlock condition)

In case of bit to 1, it is indicated that servomotor is interlocked for – direction by hardware stroke limit (**Termi-BUS PIO** Off signal of *INH-) or software stroke limit (common parameter LIML).

Bit 5: + (plus) direction interlock condition (1 means + direction interlock condition)

In case of bit to 1, it is indicated that servomotor is interlocked for + direction by hardware stroke limit (**Termi-BUS PIO** Off signal of *INH+) or software stroke limit (common parameter LIML).

Bit 4: Buffering order hold status (0=clear / 1=hold)

This bit indicates buffering status ordered by h command of direct command later explained. In case of bit to 1, it is indicated that there is a holding command buffered by h command not executed in servo amplifier. In case

of bit to 0, it is indicated that there is no holding command said above in servo amplifier.

Bit 3: Homing completion status (1 means completion of homing)

This bit is same logic of ZFIN signal of Termi-BUS PIO, 1 indicates completion of homing. In case of bit to 0, it is indicated that absolute position order PTP movement command by a command later explained is rejected. And in case of this bit to 0, PTP movement by CSTR signal of **Termi-BUS PIO** will execute both homing movement and positioning movement consecutively.

Bit 2: Run status (1 means run condition)

This bit will become 1 when servo ON order condition. This is not fault condition like servo amplifier alarm, etc. This bit is not affected by the main power conditions for all series other than RC series, however, this bit will become 0 for RC series when the main power is in OFF condition. In case of 0 status of this bit, servo amplifier doesn't accept any motor movement operation order.

Bit 1: Servo ON order status (1 means servo order condition)

1 means servo ON order status, 0 means servo OFF order status.

This bit will indicate servo ON/OFF order status by **Termi-BUS PIO** SON signal and q command of direct command. Therefore the complete condition for servo motor ready will be the case that run status (bit 2), servo ON order status (bit 1) and main power ON status (bit 0) all become 1.

The condition when this bit becomes 1 will be SON signal of Termi-BUS PIO ON status and servo ON side of servo ON/OFF order by q command. The initial status of servo ON/OFF order status after power is turned ON is servo ON side.

Bit 0: Main power ON status (1 means main power ON condition)

This bit indicates main power condition supplying to servo amplifier, and it will become 1 when main power is turned ON.

#### 5.7.3.4. Current alarm/warning code (ALRM)

This will indicate servo amplifier operational status, alarm status and warning status by code. This data item (ALRM) will be included in direct response format information later explained.

Please refer "**Appendix B. Details of warning/alarm code**".

When STAT is read out normally by R4 command, ALRM is operation status (00H) or alarm code (80H or greater), and warning coded is not included.

Warning code will be indicated in ALRM only when it is included in command reject response of direct response format later explained.

#### 5.7.3.5. Termi-BUS PIO input/output port monitor (PI, PO)

Input signal status of **Termi-BUS PIO** will be indicated in PI, output signal status of **Termi-BUS PIO** will be indicated in PO always as per bit pattern below (1 is ON, 0 is OFF). This data item is included direct response format information later explained.

| Input signal status monitor (PI) | | Output signal status monitor (PIO) | |
|---|---|---|---|
| Bit 7: | *ILK | Bit 7: | *ALM |
| Bit 6: | *INH- | Bit 6: | ZONE |
| Bit 5: | *INH+ | Bit 5: | ZFIN |
| Bit 4: | CSTR | Bit 4: | PFIN / INP |
| Bit 3: | PC8 | Bit 3: | PM8 |
| Bit 2: | PC4 | Bit 2: | PM4 |
| Bit 1: | PC2 | Bit 1: | PM2 |
| Bit 1: | PC1 | Bit 0: | PM1 |

#### 5.7.3.6. Status monitor of SW1, SW2 (SW)

Bit status of SW1 (rotary switch) and SW2 (DIP switch) in front of servo amplifier front panel will be indicated as per bit pattern below. Function of each bit of SW2 depends on the model, please refer its manual for the details.

Input signal status monitor (PI)

Bit 7~4: 4 bit code status of SW1 (axis number)
Bit 3: 6 of SW2 (1 is ON, 0 is OFF)
Bit 2: 5 of SW2 (1 is ON, 0 is OFF)
Bit 1: 4 of SW2 (1 is ON, 0 is OFF)
Bit 0: 3 of SW2 (1 is ON, 0 is OFF)

#### 5.7.3.7. Write to address counter of W4 command (WADR)

After set by T4 command, this will indicate current value of incremented address counter every time when write operation by W4 command is executed. This item value is virtual memory address that is written by W4 command next.

#### 5.7.3.8. Model code and ROM version code (ROM)

This indicates version of servo amplifier model and firmware (ROM) version same content as "ROM" of bank 26 as code below.

(1) Code (upper 16 bit)
0000H~0FFFF: B series
1000H~1FFFF: R series
3000H~3FFFF: RC series
Please refer "**Appendix A. Model code list**" for detail definition of model code.

(2) ROM version (lower 16 bit)
0000H~FFFFF: This will indicate version as initial version 0, and consecutive numbers afterward.

#### 5.7.3.9. Overload level monitor

This is a data to indicate current over load level, and it will be alarm if this value becomes 78H or greater. In case of this value 64H or greater, it may be going to be alarm, therefore proper action should be taken to reduce load condition.

#### 5.7.3.10. Peak hold value of overload level

Maximum value of over load level after power ON to the current moment should as said above should be kept in this area.

#### 5.7.3.11. Internal status flag (STA2)

This is an additional set of flag indicating internal operation status in servo amplifier, it will indicate as bit pattern as below.

Bit0: Homing movement executing (0=stop status / 1=executing)
This flag will be turned 1 if homing movement is executing. After homing has been completed, or interrupted, this flag will be turned 0.

#### 5.7.3.12. Current (Torque) order value monitor

This data is valid only for B series, it indicates current order (torque order) value in servo amplifier. Unit is % value in 100 of servo motor current rating.

#### 5.7.3.13. Current position number monitor

Current position number can be monitored by lower 4 bit (PM1~PM8) of output monitor area PO of **Termi-BUS PIO**. However, 4 bit of PO cannot acknowledge the actual position number in case of the position number order

16 or greater by Termi-BUS SIO because position number of B series is 8 bit space (0~255). In order to read out current position number with 8 bit data for B series, it is necessary to read this data out. This data is valid only for B series.

## 5.8. Direct command/response

Direct command is an order of movement by directly setting data in execution data area (area C) on virtual memory said before. It may be more flexible and higher functional movement execution order than the order of memory command. If there is no need to store order data in EEPROM memory area (area A) in servo amplifier, it is possible to give orders for all the axis movement by direct command.

### 5.8.1. Direct response format

Response format against direct command is, regardless of command types, always direct response format as specified below.
This format is used for returned command reject response in case of command reject in memory command, and all necessary information of basic internal status in servo amplifier is contained in responses of this format.

Direct response format information part
[ Func-char. ]+[ stat 2char. ]+[ alrm 2char. ]+[ pi 2char. ]+[ po 2char. ]+['0'] ;
Func-char. : Functional character of response answered command
stat 2char.: the contents of "**5.7.3.3. Internal status flag (STAT)**"
alrm 2char.: the contents of "**5.7.3.4. Current alarm/warning code (ALRM)**"
pi 2char.: Input signal status monitor of "**5.7.3.5. I/O port monitor of Termi-BUS PIO**"
po 2char.: Output signal status monitor of "**5.7.3.5. I/O port monitor of Termi-BUS PIO**"
Please refer corresponding chapter of "**5.7.3. Internal status monitor data structure**" for details of data item.

### 5.8.2. Direct command

Please refer **Appendix E.** for command list.

#### 5.8.2.1. a command (Absolute positioning order PTP movement)

a command information part
[ "a" ]+[ position 8char. ]+[ "00"] ;
position 8char. : PTP movement target position in absolute coordinate system
PTP movement target position in absolute coordinate system
This is to position to target position in absolute coordinate system. This command is to write content of absolute position coordinate positioning stop target position (PCMD) in execution data area position data (bank 31) to position value.
Position order unit is encoder division resolution unit, available order range is c0000000H~3FFFFFFFH, the value cannot exceed the coordinate range specified by absolute position coordinate range specify value (CNTM, CNTL) common parameter (bank 31) in execution data area
Current value of execution data area (bank 31) will be used for other movement parameters such as speed/acceleration orders as soon as a command is ordered.

#### 5.8.2.2. b command (Coordinate system shift)

b command information part
[ "b" ]+[ position 8char. ]+[ "00"] ;
position 8char. : Current position in absolute coordinate system
This is to change current position value in absolute coordinate system inside of servo amplifier equivalent to PNOW of internal status monitor (bank 29) into the value of position. This command is also to change content of absolute position coordinate positioning stop target position (PCMD) of position data (bank 31) in execution data area into the value of position.

Position order unit is encoder division resolution unit, and the value cannot exceed the coordinate range specified by absolute position coordinate range specify value (CNTM, CNTL) common parameter (bank 31) in execution data area.
Function of this command is to shift absolute position coordinate system, and there is no motor movement.

#### 5.8.2.3. d command (remain movement stroke cancellation)

d command information part
[ "d" ]+[ "0000000000" ] ;
This is to change absolute position coordinate positioning target position (PCMD) in position data (bank 31) of execution data area into the value of current position in absolute coordinate system inside of servo amplifier equivalent to PNOW of internal status monitor (bank 29). This command is used for cancellation of movement order on temporary hold due to interlock, etc. It will function as emergency stop order in case of the execution in motor movement.

#### 5.8.2.4. g command (Servo gain parameter update)

g command information part
[ "g" ]+[ gain_sel 1char. ]+[ gain_no 2char. ]+[ +[ "0000000" ] ;
gain_sel 1char. : servo gain parameter type selection
gain_no 2char. : servo gain number

This is to set servo gain number (PLGO) at movement position data (bank 31) of execution data area or servo gain number (PLG1) at positioning stop into value of gain_no. Data item selection in address set to will be done by gain_sel, 0 selects PLG0, 1 selects PLG1.Gain number is from 00H to 0FH by 16 steps and greater value is higher gain. In case of R/RC series, only PLG0 is valid, PLG1 is not invalid.

#### 5.8.2.5. h command (command buffering)

h command information part
[ "h" ]+[ h-command 10char. ] ;
h-command 10char. : command character digits to be buffered
In case of the problem of overhead due to multiple command issues in synchronized order of multiple axes PTP movement and multiple axes movement parameter update order, these orders may be ordered prior to the operation during the previous axis movement execution and by t command, buffering order can be done to move multiple axes at same time. Such buffering by h command can be done for all direct commands except h command itself and Q2, Q3 commands. H-command is that digits minus last digit '0' from command information part to buffering. In order to cancel buffered command by h command prior to the execution of t command, n command later explained should be buffered by h command.

#### 5.8.2.6. i command (positioning completion detect width update)

i command information part
[ "i" ]+[ width 8char. ]+[ "00"] ;
width 8char. : positioning completion detect width
This is to set position completion detect width (INP) in position data (bank 31) of execution data area into value of width.
Unit of width is encoder division resolution unit and set range is 00000000H~3FFFFFFFH.

#### 5.8.2.7. j command (Jog movement)

j command information part
[ "j" ]+[ distance 8char. ]+[ "00"] ;
distance 8char. : unit movement stroke
This is to order servo amplifier jog movement execution. Movement speed of Jog order will be calculated

automatically as follows.

( ( distance * 60 ) / ( delta_T * motor_1rev ) ) [r/min]

delta_T : Time lag between previous receipt and this receipt of jog movement order [sec]

motor_1rev : Unit movement (encoder divisional unit) per one motor revolution

Max. value of above delta_T is 0.1 [sec]. Therefore in order to make continuous jog movement, it is necessary to execute jog movement order function shorter cycle time than this cycle time. Max. value of order unit of movement order value "distance" is the max. movement value within 0.1 [sec] at max. revolution speed for the servomotor. The order unit is encoder divisional unit.

This command will update content of absolute position coordinate positioning stop target position (PCMD) of position data (bank 31) in execution data area.

#### 5.8.2.8. l command (Update of electric current limitation value)

l command information part

[ "l" ]+[ spow 2char. ]+[ dpow 2char. ]+[ "000000" ] ;

spow 2char. : electric current limitation value at positioning stop

dpow 2char. : electric current limitation value at movement

spow is electric current limitation value (SPOW) at positioning stop status in position data (bank 31) of execution data area, dpow is electric current limitation value (DPOW) at positioning movement of servomotor. These values are set within 0FFH maximum current with 256 steps.

#### 5.8.2.9. m command (incremental movement stroke PTP movement)

m command information part

[ "m" ]+[ distance 8char. ]+[ "00" ] ;

distance 8char. : PTP movement stroke

This will make positioning from current position to the position by distance. This command will add distance value in content of absolute position coordinate positioning target stop (PCMD) of position data (bank 31) in execution data area. Order unit of distance is encoder divisional unit and available order range is +/- 7FFFFFFFH (80000001H~7FFFFFFFH).

Other movement parameter relating to PTP movement such as speed/acceleration use the data in execution data area (bank 31) at m command ordered.

#### 5.8.2.10. n command (status check)

n command information part

[ "n" ]+[ "0000000000" ] ;

n command is the command to acknowledgement internal status of servo amplifier by direct response receipt, there is no other movement execution.

In case of cancellation of buffered command by h command, n command will be used as dummy in h command as well.

#### 5.8.2.11. o command (homing movement)

o command information part

[ "o" ]+[ org 2char. ]+[ "00000000" ] ;

org 2char. : Homing pattern selection code

Homing will be executed by following pattern specified in org. This command will update content of homing pattern selection code (ORG) of common parameter (bank 30) in execution data area with org value. Please refer "**5.6.1.4. Homing pattern selection code**" for contents of homing movement sequence corresponding to org numbers.

#### 5.8.2.12. p command (Transmitter switching minimum delay time)

p command information part

[ "p" ]+[ "trw" ]+[ rtim 2char. ]+[ "00000" ] ;

rtim 2char. : Indicating transmitter switching minimum delay time, numbers of 01~FF

It can update value of p transmitter switching minimum delay time (RTIM). By using this code to check communication establishment, execution time of communication establishment can be shorten.

#### 5.8.2.13. q command (Servo ON/OFF)

q command information part
[ “q” ]+[ on-off 1char. ]+[ “000000000” ] ;
on-off 1char.: Servo ON/Off command
q command will control servo ON/OFF through **Termi-BUS SIO**. In order to make servo amplifier to be turned ON, it is necessary to have SON signal of Termi-BUS PIO to be ON addition to servo ON order of q command. In such conditions, bit 1 (servo ON order status) of internal status flag (STAT) in internal status monitor area (bank 29) will be turned 1.
On-off values functions that 1 is servo ON order, 0 is servo OFF order. When power is turned ON, servo ON/OFF order status at q command sided is servo ON side.

#### 5.8.2.14. r command (Internal status reset)

r command information part
[ “r” ]+[ “rsel 2char. ]+[ “00000000” ] ;
rsel 2char. : r command function selection code
r command will initialize internal parameter, or reset alarm condition.
rsel is r command function selection coded, and 2 makes initialization of internal parameter, 3 makes alarm condition reset. Details of internal parameter initialization is that common parameter of **Appendix C. EEPROM memory data at shipping** is to be set to bank 0 and bank 30, default value (offset 00DH~013H, 01BH) of axis movement parameter in common parameter is to be set to bank 1 and bank 31. At this time, current position will be set in PCMD (address 0000400H) of bank 1 and value of FLGP (address 00000401H) will become 0. And absolute position coordinate positioning stop target position of position data (bank 31) in execution data area will be updated to current position as well.
In order to reset alarm condition, it is necessary to have all conditions cleared that cause of alarm is removed and servo off order condition (bit 1 of internal status flag (STAT) in internal status monitor area (bank 29) is 0).

#### 5.8.2.15. s command (Update of PIO function selection flag)

s command information part
[ “s” ]+[ “00” ]+[ fpio 2char. ]+[ “000000” ] ;
fpio 2char.: PIO function selection flag set data
s command will update PIO function selection flag (FPIO) of common parameter (bank 30) in execution data area to fpio value. Please refer “**5.6.1.6. PIO function set coded (FPIO)**” for functions of FPIO bit.

#### 5.8.2.16. t command (Execution of buffering order)

t command information part
[ “t” ]+[ “0000000000” ] ;
t command will execute buffered command by h command. T command is broadcast command so that all servo amplifiers connected through **Termi-BUS SIO** will receive the command at same time. Therefore if there is buffered command in several axes by h command, all axes will execute those commands at same time. If there is any axis with no buffered command by h command, t command won’t make any movement for the axis. In order to see if there is buffered command by h command, it is necessary to check bit 4 (buffering order holding status bit) of internal status flag (STAT) in internal status monitor area (bank 29). In case of 1 in this bit, it indicates that buffered command is in servo amplifier, if t command executes this command, the bit will become 0. t command will be received at same time by all axes with buffered command by h command, however, only axes with corresponding address for [Axis] part number in t command bucket will reply response.

#### 5.8.2.17. v command (Update of speed/acceleration and limitless rotary movement)

v command information part

[ “v” ]+[ vsel 1char. ]+[ vcmd 4char. ]+[ acmd 4char. ]+[ “0” ] ;
vsel 1char. : v command function selection code
vcmd 4char. : Speed order value
acmd 4char. : Acceleration order value

Speed order value (VCMD) of position data (bank 31) in execution data area will be changed to value of vcmd, content of acceleration order value (ACMD) will be changed to value of acmd by v command. When speed / acceleration order value is updated by v command, vsel will select if limitless rotary movement is executed as following values.

vsel. = 0 : Executes clockwise continuous rotary movement
vsel. = 1 : Executes counter-clockwise continuous rotary movement
vsel. = 2 : Changes speed/acceleration only
vsel. = 3 : Change speed/acceleration, and orders ultimate acceleration (R/RC series only)

Limitless rotary movement ordered by v command can be ended by d command as immediate stop, and the movement can continue to make positioning from the position by PTP movement order.

#### 5.8.2.18. x command (Dedicated command for RC series: Axis number set order)

RC series servomotor cannot set axis number by using rotary sw as R/B series servo amplifier. RC series can set axis number by using x command as follows other than by using **CTA**. Axes numbers of RC series are all 0 at shipping, therefore in case of system using multiple axes of RC series, it is necessary to execute this procedure in the beginning to avoid circuit conflict.

X command should be set by placing axis number and command code opposite order which is different from normal direct command format.

x command (total 16 characters)

[ STX ]+[ “x” ]+[ new_ax_no 1char. ]+[ class 2char. ]+[ S/N 8chars. ]+[ check sum ]+[ ETX ] ;
new_ax_no 1char. : Indicates new set axis number, numbers of 0~F
class 2char. : 2 digits number indicated at 4~5 digits of model number in motor main name plate
S/N 8char. : 8 digits number indicated as S/N in motor main nameplate

Response of x command is same format as response of normal direct order. Axis number is same as new_ax_no 1char. specified by x command.

#### 5.8.2.19. z command (Update of Zone border value)

z command information part

[ “z” ]+[ zone 8char. ]+[ dir 1char. ]+[ “0” ] ;
zon 8char. : Zone signal border value
dir 1char. : Speed order value

z command will update zone border value (ZONM, ZONL) of common parameter (bank 30) in execution data area. dir indicates updating zone border direction, 0 of dir is + side zone border (ZONM), 1 of dir is – side zone border (ZONL) and this value will be updated zone. Set unit is encoder divisional resolution unit and available set range is –80000000H (80000000H)~7FFFFFFFH, however, it’s necessary to satisfy the condition of ZONM > ZONL.

### 5.9. Communication establishment procedure

#### 5.9.1. General type of communication establishment

Communication will be established as following procedure.

① All axes to be reset to initial communication condition by break signal at a same time

② Transmitter switching minimum delay time (trr2) to be set with short proper value by p command (3ms set at this time). Delay time (trr2) will be valid after the response of this command.

③ Address of communication speed selection code to be specified.

④ Data of communication speed selection code to be written.

⑤ Address of transmitter switching minimum delay time (trr2) to be set.

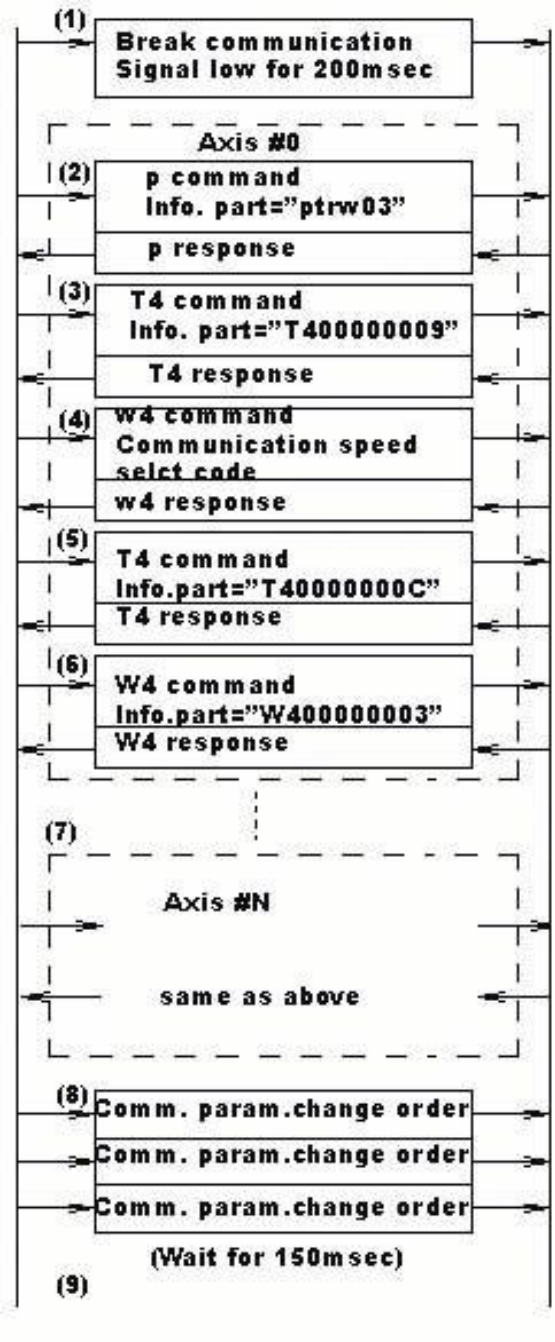
⑥ Data of transmitter switching minimum delay time (trr2) to be written.

⑦ All axes to be proceeded as above procedure ②～⑥.

⑧ Communication parameter update order to be sent 3 times continuously. Communication parameter update order is broadcast command (all slave ports will receive at same time), master port won't response to only this command.
Bucket format is special format with 16 characters length as below.
[STX] [ Consecutive 14 characters of code ENQ(05H) ] [ETX]

⑨ Communication will be valid under the communication condition set by ④, ⑥ after 150ms.
By writing set communication parameter into EEPROM memory area by V5 command, from next time when power is turned ON, communication under set condition will be valid from the beginning, however, above communication establishment procedure should be executed when maintenance is preceded.
Master port should execute communication establishment procedure always when power is turned ON in order to avoid errors by replacement of servo amplifier, etc.

| Master | Slave |
|---|---|
| After sending break signal, Communication starts at communication speed=9.6Kbps (for axis #0) | All slaves receive at same time, after break signal received, communication set will be: Speed=9.6Kbps, transmitter switch delay time=255 msec |
| Communication establishment confirmation and Transmitter switch delay time set | |
| Address set for Communication speed selection code | |
| Address set for Communication speed selection code | |
| Transmitter switch delay time set again | |
| Address set for Communication speed selection code | |
| Against axis N Communication establishment confirmation and Communication parameter set | |
| Sent communication parameter update order 3 times continuously in 100msec | All slaves receive at same time, after break signal received |



## 5.10. Axis movement control procedure from Termi-BUS SIO

### 5.10.1. Homing and initial data set

Homing will be executed as following procedure.

① Servo gain to be set (It may be skipped if initial values in EEPROM is acceptable.)

② Current limitation value to be set (It may be skipped if initial values in EEPROM is acceptable.)

③ Speed and acceleration to be set (It may be skipped if initial values in EEPROM is acceptable.)

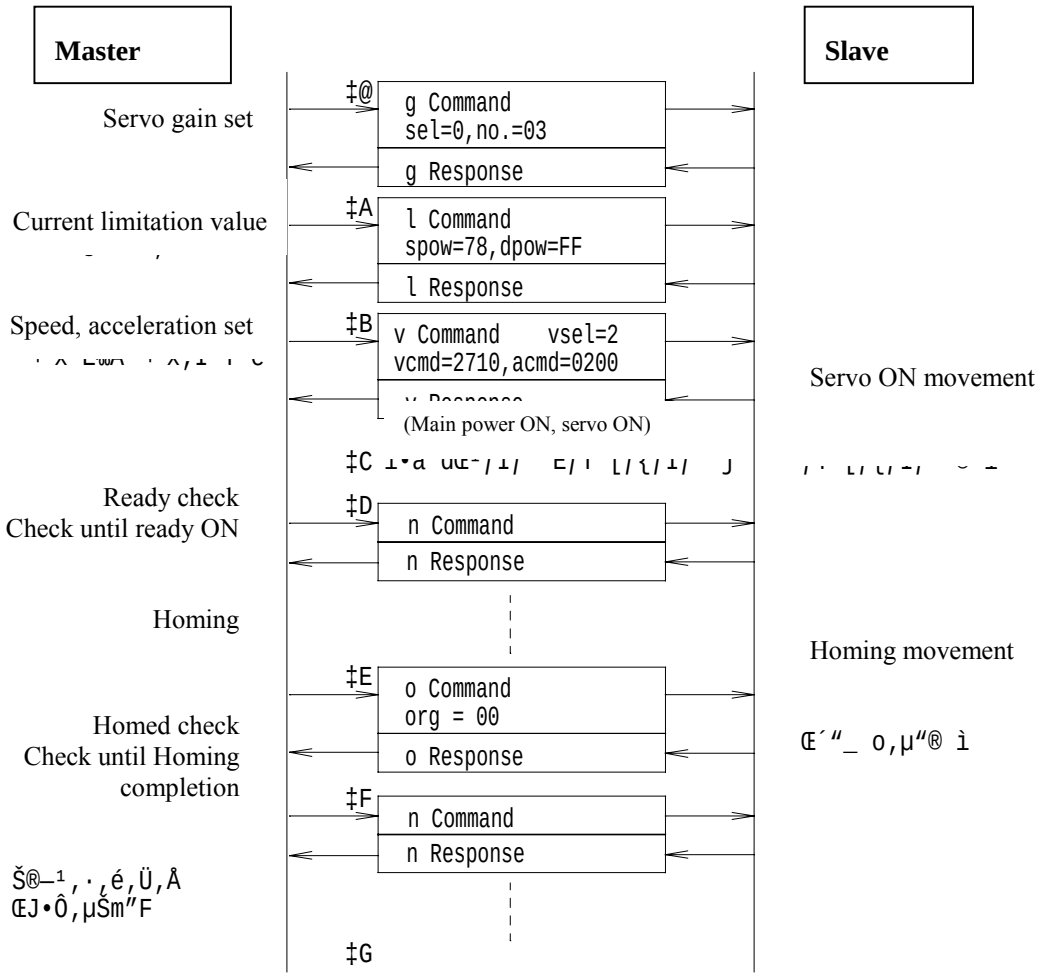
④ Turn main power ON to make servo ON.

⑤ Operation ready to be confirmed. Value 1 of BIT4 (PFIN/INP) of output signal status monitor (PO) to be confirmed by response of n command.

⑥ o command to execute homing. (org=00 is an order to make current position home position).

⑦ Homing completion to be confirmed. Value 1 of BIT5 (ZFIN) of output signal status monitor (PO) to be confirmed by response of n command.

⑧ After the confirmation of homing, a command execution of absolute position order is valid.
(If Q2, Q3 commands of position movement orders are executed prior to execution of o command, the system will execute homing then move to the ordered position automatically, therefore o command can be skipped.)

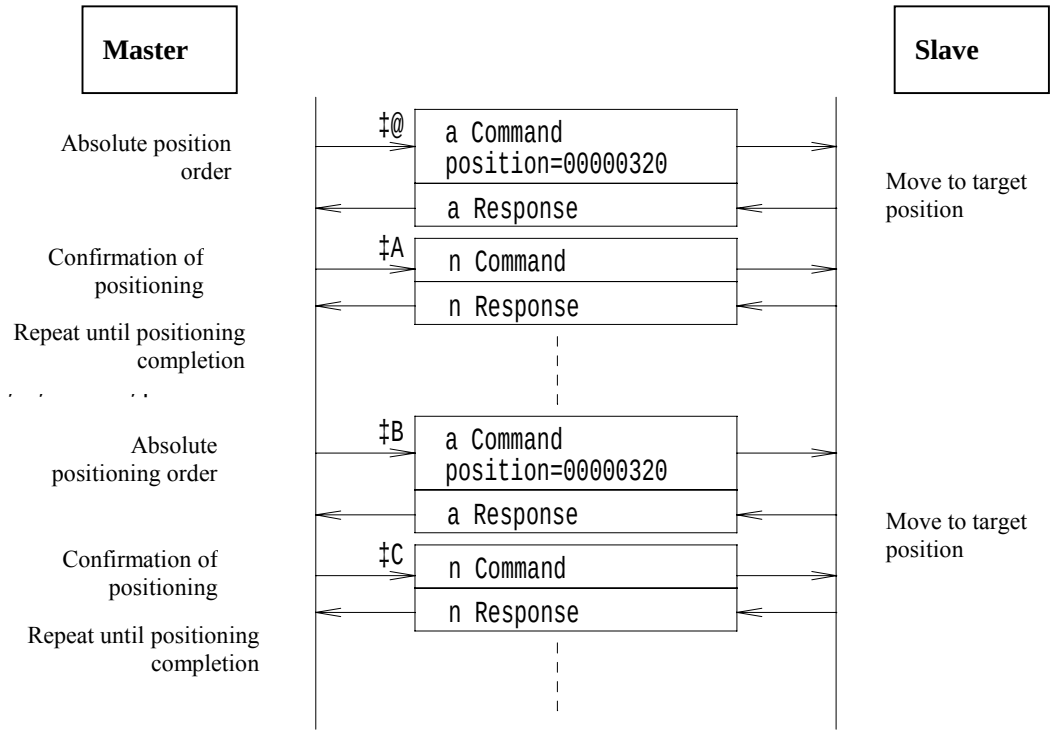


### 5.10.2. PTP movement

PTP movement can be executed by one of following commands. Q2, Q3 commands with order of bank 1 or e, m commands.
Normal positioning completion confirmation by PTP movement order is to be done by confirming BIT 4 (PFIN/INP) of output signal status monitor (PO) with response of n command.
Following is the example of one revolution continuous round stroke movement from the servo ON status after homing completion.

① Absolute positioning order, a command to specify position=00000320
② Confirm positioning completion. To check BIT 4 (PFIN/INP) of output signal status monitor (PO) to 1 by response of n command.
③ Absolute positioning order, a command to specify position=00000000
④ Check positioning completion. . To check BIT 4 (PFIN/INP) of output signal status monitor (PO) to 1 by response of n command.
(Actuator will make continuous cycle by repeating ①~④)

Even though the operation is in execution of PTP movement, movement parameters such as speed/acceleration order value are ready to be updated any time by appropriate command, and it is possible to change the target position in the middle of PTP movement by order of new PTP movement. Therefore it is possible to make rough PASS (position) movement by checking the area of target position by using PFIN/INP signal of **Termi BUS PIO** output port monitor (PO) or ZONE signal.



### 5.10.3. Synchronized order to multiple axes using buffering order

There is a possible problem of execution delay caused by overhead of multiple command issue for multiple axes synchronized PTP order and axes movement parameter update order. In order to avoid such possible problem, h command can order those command prior to the execution during the previous axes movement execution, and t command can make buffering order to execute all axes at same time. PTP order such as a, m commands can be done for buffering and t command executes those at a same time so that the time delays of axes movement timing can be minimized.
This can be done not only for PTP order but also movement parameters updates such as speed/acceleration. In case of multiple parameter updates, memory command can make buffering order. This can be done with Q3 command to PTP order buffering of position data in EEPROM memory area, and also position data (bank 1) of Window area can be used as edit buffer, then Q2 command can execute those. This means that Q2 command is the one that executes data in bank 1, therefore this area can be used as edit buffer of axes movement parameter. After some position data items are set in bank 1 by using W4 command, h command makes Q2 command buffering and then t command executes them. In this way, PTP orders with multiple movement parameters can be started at a same time by one t command.

## 5.11. Error detect and recovery procedure

### 5.11.1. General type of error detect and recovery procedure

All of command sending receiving check and the error detect for all communications are done by Master to check responses from slave. Slave will follow the format as following command bucket format, and send response only when BCC is normal so that the command is recognized normal command. In other cases, slave doesn't send any response.

i,P Command bucket format bfg

| Header 1char. STX (02H) | Axis No. 1char. | Command Info. 11char. | BCC 2char. | Delimiter 1char. ETX (03H) |
|---|---|---|---|---|

Master starts response monitor timer every time command receipt completion and stops it when Master receives normal response from slave. Normal response satisfies following points:

- response satisfies following response bucket format
- and BCC is normal
- and Axis No. is same as that of sent command
- and Top character of Response Info. is same as the top character of Command Info.

i,Q j Response bucket format

| Header 1char. STX (02H) | Response ID 1char. 'U' (55H) | Axis No. 1char. | Response Info. 10char. | BCC 2char. | Delimiter 1char. ETX (03H) |
|---|---|---|---|---|---|

In case that the value of response monitor timer becomes greater than time out value Trt specified as below, Master willl be to execute communication recovery procedure by command re-sending. In case that this re-sending number becomes greater than upper limit value Nrt, please stop the system because it is unrecoverable communication fault.
The value of Nrt is any value among following value.

Trt (other than V4, V6, x commands) > (20 + $\alpha$ + (160/Kbr)) msec

Trt (V4, V6, x commands) > (200 +α + (160/Kbr)) msec
Nrt = 0-3 (to be decided depending on tolerance of system re-sending delay time)
However, α : Minimum delay time parameter of slave transmitter energizing.
Kbr : Communication speed indicated in kbps unit

### 5.11.2. Recovery procedure exception in w4 command

In case that the recovery procedure said previously is executed by re-sending w4 command, there is a possibility to increment address due to double sending of w4 command, and the address will be different from the address that should be. Therefore please re-send w4 command after writing address re-set by T4 command in case that response monitor timer is time out for w4 command.

### 5.11.3 Recovery procedure exception in m command

In case that the recovery procedure said previously is executed by re-sending m command, there is a possibility to send command double times or more, and its execution result may become different from the content that it should be. The m command sending check can be done by confirming execution area (offset 000H of bank 31) of absolute coordinate counter target position if current position in absolute coordinate is known. However, if the case is to use m command, it means that the current position of absolute coordinate may be unknown, and the method of confirming above cannot be used.
Therefore please try not to use m command and convert m command to a command. In case m command is really needed, please make Nrt 0 in m command sending. (recovery process cannot be done)

### 5.11.4 Error detection and exemption of recovery procedure for t command

Because t command is representative port response against broadcast command, it is not possible to confirm its command sending in normal response receipt.
For t command, after the confirmation of normal response receipt, buffering order holding status bit of internal status flag (STAT) for all relating axes should be confirmed to be 0.
In case of response monitor time out for t command, or in case that there is any axis of buffering order holding status bit 1, it depends on the limitation of axes synchronizing movement if it is reasonable to recover by re-sending t command, and it also depends on the characters of applications. Therefore application should order if t command would take re-sending recovery procedure.

## 5.12. Command rejection by slave

Even though command from master is received as normal command by slave, there may be a case that slave cannot execute it due to some conditions. In such case, slave makes command reject display bit (bit 7 of STAT) of response operand to 1 to send notice to master.
In the case of memory command rejection, it will be different from normal response against memory command, Func-Num. will take place of STAT and it will be direct response format. Therefore master should acknowledge command rejection response if Func Num. is the number of 8~F, and understand such operand of the response as direct response format. Only in such case, ALRM means warning code indicating command reject reason, not for alarm coding.
This warning code will be shown in final detect warning code (WARN) of alarm monitor area (bank 28) at the same time. Command rejection should not be cleared unless the cause of such rejection is removed, therefore the system should be designed to stop for system fault and send notice of what is happening to the operator when such command rejection occurs.

## 6. Notes of safety operations

### 6.1. Notes for main power shut down and recovery

In case of servo amplifier main power shut down due to trip of safety circuit or some thing during movement of servomotor, the movement order to target position may not be cancelled only with main power shut down. **Therefore please design the safety circuit definitely to turn SON signal of Termi-BUS PIO OFF together with main power shut down of servo amplifier. If SON signal is kept ON and main power is turned ON again, there is a possibility that servomotor will start to move and it is very dangerous.**

For RC series, main power shut down will cancel movement order, therefore it is not necessary to turn SON signal OFF for main power shut down.

## Appendix A. Details of model coding and function limitation by firmware version

Top 16 bit of virtual memory address 0000740AH is to indicate model as follows:

### 1. B series

0000H：BAA02B3-001 (200W incremental encoder standard)

0001H：BAA04B3-001 (400W incremental encoder standard)

0002H：BAA08C3-001 (750W incremental encoder standard)

0003H：BAA15C3-001 (1500W incremental encoder standard)

0801H：BAA02BW-001 (200W absolute encoder standard)

0802H：BAA04BW-001 (400W absolute encoder standard)

0803H：BAA08CW-001 (750W absolute encoder standard)

0804H：BAA15CW-001 (1500W absolute encoder standard)

### 2. R series

1000H：RAA0411- (R series standard)

1001H：RAA0411- (includes internal parameter trace function)

1005H：RAA0411- (includes CP expansion function)

### 3. RC series

3002H：RCA0411- (RC series 42mm square encoder 3ch type)

3003H：RCA1011- (RC series 56mm square encoder 3ch type)

Lower 16 bit of virtual memory address 0000740AH indicates version of firmware, however, please note that some of functions have some limitation for version as follows:

ROM version corresponding table against additional function

| Additional function | ROM version |
|---|---|
| Push force movement | Over 0010 (include 0010) |
| Positioning movement by position data | Over 0012 (include 0012) |
| | |

## Appendix B. Details of alarm and warning code

### 1. Alarm display list for PIO

○=ON, ●=OFF

| ALM | PM8 | PM4 | PM2 | PM1 | Descriptions |
|---|---|---|---|---|---|
| ○ | ＊ | ＊ | ＊ | ＊ | Normal |
| ● | ● | ○ | ○ | ● | Set defect of EEPROM memory data |
| ● | ● | ○ | ○ | ○ | Relating alarm for homing operation and motor energizing signal detect operation |
| ● | ○ | ● | ● | ● | Alarm for servo system not normal |
| ● | ○ | ● | ● | ○ | Over current in power transformer parts |
| ● | ○ | ● | ○ | ● | Alarm for other abnormal conditions of power transformer parts |
| ● | ○ | ● | ○ | ○ | Overflow of position deviation counter |
| ● | ○ | ○ | ● | ● | Over load |
| ● | ○ | ○ | ● | ○ | Detection of encoder wire disconnected or broken |
| ● | ○ | ○ | ○ | ● | spare |
| ● | ○ | ○ | ○ | ○ | Destruction of EEPROM memory data |

### 2. List of alarm code and warning code

| ALRM | Descriptions | Type |
|---|---|---|
| ００ | Normal operation | Normal |
| ５Ａ | Receipt signal over run error | Warning |
| ５Ｂ | Receipt signal flaming error | |
| ５Ｄ | Abnormal header of bucket receipt signal | |
| ５Ｅ | Abnormal delimiter of bucket receipt signal | |
| ７Ｆ | Block check character fault (BCC) | |
| ６１ | Illegal function character, or illegal write address | |
| 62～64 | Operand illegal in bucket | |
| ７０ | Movement order in RUN condition bit OFF status | |
| ７１ | PTP movement order of absolute position coordinate for ZFIN signal OFF status | |
| ７３ | Alarm reset in case of servo ON order status bit ON | |
| ７４ | Movement order during motor energizing signal detect operation | |
| ７５ | Q2, Q3, m, v, l, j command orders during homing | |
| Ｂ０ | Data abnormal during common parameter execution (Data abnormal of bank 30) | Alarm |
| Ｂ１ | Data abnormal during position data execution (Data abnormal of bank 31) | |
| B8～B9 | Motor energizing phase detect operation abnormal | |
| BB～BE | Encoder signal detect defective during homing, Homing movement abnormal | |
| C0～C1 | Over actual speed, servo abnormal | |
| Ｃ８ | Over current | |
| D0～D1 | Main power input voltage over value, 主電源入力電圧過大、回生電力過大 | |
| Ｄ８ | Over position deviation | |
| Ｅ０ | Over load | |
| E8～EC | Encoder wire disconnected | |
| ED～EE | Absolute encoder abnormal detection | |

| | | |
|---|---|---|
| F 8 | EEPROM memory data broken | |

## 3. Details of alarm code

### 3.1. EEPROM memory data set defective

Following alarm codes indicate that set value of EEPROM memory data is not executable. Therefore alarms of this group should be resolved by edit of such data to executable data. Alarms of this group will be output as code of 06H in PM1~PM8 of **Termi-BUS PIO**.

B0H: Common parameter execution data abnormal (Data abnormal of bank 30)
Set value of data item in execution data area common parameter is out of set range or current position is out of absolute coordinate range specified by CNTM, CNTL.

B1H: Position data set abnormal (Detect at batch transfer to bank 31)
Set value of data item in execution data area position data is out of set range or ordered target position is out of absolute coordinate range specified by CNTM, CNTL.

### 3.2. Alarms relating to homing and motor phase energizing signal detect operation

Following alarm codes indicate that there is some thing wrong in execution of homing or motor phase energizing signal detection operation caused by over load or wiring faults.
Alarms of this group output as code of 07H in PM1~PM8 of **Termi-BUS-PIO**.

B8H : Motor energizing phase detection operation abnormal 1
This indicates that motor couldn't complete positioning when it started motor energizing phase detection. There may be 2 types of causes, relating to its weight and external force and relating to wiring problems of motor or encoder. This alarm doesn't occur other than R/RC series.

B9H : Motor energizing phase detection operation abnormal 2
This indicates that motor couldn't move when it was moving for motor energizing phase detection. There may be 2 types of causes, relating to its weight and external force and relating to wiring problems of motor or encoder. This alarm doesn't occur other than R/RC series.

BBH : C phase signal detection fault in homing operation
This indicates that C phase signal couldn't be detected even though motor has turned one revolution or more in C phase signal search condition of homing operation.

BCH : A, B phase signals detection fault in homing operation
This indicates that phase relationship of A, B phase signals was some thing wrong in C phase signal search condition of homing operation.

BDH : Over speed before Search in homing operation
This indicates that the speed before homing movement was too large in case that homing operation was ordered continuously from unlimited revolution order by v command in the set of homing operation selection code 1 or 2.

BEH : Operation time out in homing operation
In homing operation with collision to dead end in the condition of homing selection code 7 or 8, this indicates that the collision condition couldn't be detected after specific time.

### 3.3. Alarms relating to servo system fault

Following alarm codes indicates that some fault has been detected in servo loop operation inside of servo amplifier.
Alarms of this group output as code of 08H in PM1~PM8 of **Termi-BUS-PIO**.

C0H : Over actual speed

This indicates that actual speed value based on encoder feed back exceeded the speed order upper limit times 1.2.

C1H : Servo abnormal

This will detect motor in abnormal condition from the relationship between ordered speed and actual speed during motor movement order execution.
This alarm won't be detected in B series.

### 3.4. Over current of power converting parts

C8H : Over current

This alarm code indicates that electrical current value of power converting circuit exceeded set value, the possible cause may be short of motor main circuit. This alarm will be output as code of 09H in OM1~PM8 of **Termi-BUS PIO**.

### 3.5. Other alarms relating to power converting parts fault

D0H : Main power input over voltage

This alarm code indicates that input voltage to main power exceeded rating value. Please refer manual for each model for rating voltage of main power input. This alarm won't be detected in B series.

D1H : Over regenerative power

This alarm code indicates that input DC voltage to inverter circuit of power converter circuit exceeded rating value due to regenerative energy absorption.
Please refer manual of each model for solution.

### 3.6. Position deviation counter overflow

D8H : Position deviation counter overflow

This alarm code indicates that position deviation counter became overflow, and motor is seized for some reason.
This alarm will be output as code of 0BH in PM1~PM8 of **Termi-BUS PIO**.

### 3.7. Over load

E0H : Over load

This alarm code indicates that motor load exceeds specification value. In case of this alarm within several seconds without any movement of motor, it indicates that motor seized for some reason. Over load detection data are different for each model, therefore please refer manual of desired model.
This alarm will be output as code of 0CH in PM1~PM8 of **Termi-BUS PIO**.

### 3.8. Encoder wire disconnect detection

This alarm code indicates that wiring disconnection is detected for encoder channels.
Alarms of this group will be output as code of 0DH in PM1~PM8 of **Termi-BUS PIO**.
E8H : A, B phase wire disconnected
E9H : A phase wire disconnected
EAH : B phase wire disconnected

EBH : C phase wire disconnected

This alarm may be detected during homing by c phase signal for series other than B series.

ECH : PS phase wire disconnected

This alarm may be detected only for absolute encoder specification model of B series, it indicates that serial channel to receive absolute position data is disconnected.

EDH : Absolute encoder fault detection 1

This alarm may be detected only for absolute encoder specification model of B series, it indicates that absolute encoder is in one of the internal alarm condition of absolute error, over speed and battery alarm. The possible causes are as follows:

Absolute error:

This indicates that normal absolute signal couldn't be detected due to read out mistake of sensor part or some thing like that.

Over speed:

This alarm will occur if motor is rotating at 400 rpm or faster when power is turned ON. Absolute encoder model requires motor to stop when power is turned ON.

Battery alarm:

This indicates that battery voltage is low or battery is not connected. If battery with proper voltage is connected and power is turned ON, the system will start normally.

These alarms doesn't mean the destruction of absolute position inside of absolute encoder, therefore system will start normal operation after turning power ON.

In case of new motor or the motor disconnected from backup battery for long period of time, there is possible problem that system doesn't start normal operation by turning power ON. In such case, it is necessary to execute encoder set up procedure.

EEH : Absolute encoder fault detection 2

This alarm may be detected only for absolute encoder specification model of B series, it indicates that absolute encoder is in one of the internal alarm condition of backup error, check sum error and extra alarm. The possible causes are as follows:

Backup error:

This error will occur when all encoder powers including battery are down. It may occur when encoder is used for the first time.

Check sum error:

This error indicates that sum check of revolution data at power ON became error due to memory fault inside of encoder.

Extra alarm:

This alarm will always occur when power is turned ON after encoder set up procedure is executed. This alarm is not encoder problem, it will report that encoder internal absolute position data has been reset. Power should be turned OFF and ON again to start normal operation.

These alarms other than extra alarm mean the destruction of absolute position inside of absolute encoder, therefore it is necessary to execute encoder set up procedure.

### 3.9. Destruction of EEPROM memory data

E8H : Destruction of EEPROM memory data

This alarm code indicates that data in EEPROM memory has been destructed and check sum became fault. It is necessary to write all data in EEPROM memory area in order to recover from this alarm. This alarm will be output as code of 0FH in PM1~PM8 of **Termi-BUS PIO**.

## 4. Details of warning code

There are 2 kinds of warning code indications, indicating main cause of no response due to communication fault and indicating main cause of command reject.

### 4.1. Warning codes indicating main cause of communication abnormal

Following warning codes indicate main causes of communication abnormal operation for no response, and it will appear only when last detected warning code item in bank 28 is monitored afterward. After recovery procedure to recover abnormal communication, it is not necessary to monitor those warning codes.

5AH : Signal receiving over run error
5BH : Signal receiving flaming error
5DH : Abnormal header bucket signal receiving
5EH : Abnormal delimiter bucket signal receiving
7FH : Block check character (BCC) abnormal

### 4.2. Warning codes indicating command reject by illegal data

Following warning codes indicate main causes of command reject in case of operand data of command including impossible data to receive, and it will appear only in command reject response.

61H : Illegal function character, or illegal write address
62H : No. 1 operand in bucket illegal
63H : No. 2 operand in bucket illegal
64H : No. 3 operand in bucket illegal

### 4.3. Warning codes indicating command reject by execution condition disagreement

Following warning codes indicate main causes of command reject in case of impossible command execution condition by servo amplifier, and it will appear only in command reject response.

70H : Movement order in RUN status bit OFF condition
If RUN status bit (bit 2) of internal status flag (STAT) is 0 condition, system will reject movement order by direct commands of a, j, m, o, and reject non-limited revolution order of v command and PTP order by Q2 command. These commands will be rejected when buffering order by h command is executed by t command.

71H : Absolute positioning PTP movement order in ZFIN signal OFF condition
If ZFIN signal of **Termi-BUS PIO** is in OFF status, PTP order by a command will be rejected. (in case of absolute encoder, Q2 and Q3 commands to be included) These commands will be rejected when buffering order by h command is executed by t command.

73H : Alarm reset in case of servo ON order status bit ON condition in alarm status
In case when servo ON order status bit (bit 1) of internal status flag (STAT) is in 1 condition, alarm reset by r command from alarm condition will be rejected.

74H : Movement order during motor energizing phase detecting condition
In case when motor energizing phase signal detection is being operated in first servo ON order after power is turned ON (RUN status bit (bit 2) of internal status flag (STAT) is in 0 condition, servo ON order condition bit (bit 1) is in 1 condition, and main power ON status bit (bit 0) is in 1 condition), all commands except commands of n. q, R4, T4, W4, Q1. This will occur only for R/RC series.

75H : Q2, Q3, m, v1, j command orders during homing
In case of homing condition, all movement commands of Q2, Q3, m, v1, j will be rejected.

## Appendix C. Set data of EEPROM memory data at shipping

### 1. Common parameter

| OFFSET from top of bank | Symbol | Common parameter set data at shipping |
|---|---|---|
| 000H | CNTM | 3FFFFFFFH |
| 001H | CNTL | C0000000H |
| 002H | LIMM | 7FFFFFFFH |
| 003H | LIML | 80000000H |
| 004H | ZONM | 3FFFFFFFH |
| 005H | ZONL | C0000000H |
| 006H | ORG | 01H (R/B series), 00H (RC series) (note 1) |
| 007H | PHSP | 00H |
| 008H | FPIO | 00H |
| 009H | BRSL | 04H (note 2) |
| 00AH | OVCM | 09C4H (R/B series), 00FAH (RC series) |
| 00BH | OVCC | 0028H |
| 00CH | RTIM | 0FFH (note 2) |
| 00DH | INP | 00000004H |
| 00EH | VCMD | 2710H |
| 00FH | ACMD | 0050H |
| 010H | SPOW | 3CH (R/R series), 0FFH (B series) |
| 011H | DPOW | 0FFH |
| 012H | PLG0 | 06H |
| 013H | MXAC | 00H |
| 014H | CPAC | 0064H |
| 015H~017H | | |
| 018H | ZRMK | 00H (B series absolute specification model only) |
| 019H | ODPW | 3CH (R/R series) |
| 01AH | OTIM | 2000H (R/RC series) |
| 01BH | PLG1 | 06H (B series only) |
| 01CH | PLJL | 01H (B series only) |
| 01DH | FLSL | 00H (B series only) |
| 01EH | FLFC | 07FFH (B series only) |

(Note 1) Shipping data of ORG for absolute encoder specification model of B series is set to 0.

(Note 2) In case of data initialization by r command, BRSL, RTIM are not initialized.

**2. Position data**

| OFFSET from top of bank | Symbol | Position data set data at shipping |
|---|---|---|
| 000H | PCMD | 00000000H |
| 001H | FLGP | 0F0H |
| 002H | | |
| 003H | INP | 00000004H |
| 004H | VCMD | 2710H |
| 005H | ACMD | 0050H |
| 006H | SPOW | 3CH (R/RC series), 0FFH (B series) |
| 007H | DPOW | 0FFH |
| 008H | PLG0 | 06H |
| 009H | MXAC | 00H |
| 009H~010H | | |
| 011H | PLG1 | 06H (B series only) |
| 012H~01EH | | |

Those data in above table are common for all position data of all position numbers. In case of data initialization by r command, PCMD is set to current position.

## Appendix D. Virtual memory data list

Common parameter  Window area  bank 0 (COM0)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 00000000 | CNTM | Absolute position coordinate range + side maximum value | |
| 00000001 | CNTL | Absolute position coordinate range - side maximum value | |
| 00000002 | LIMM | Software stroke limit value + side | |
| 00000003 | LIML | Software stroke limit value - side | |
| 00000004 | ZONM | Zone border value + side | |
| 00000005 | ZONL | Zone border value - side | |
| 00000006 | ORG | Homing pattern selection code<br>Bit 0~3: Homing pattern selection code<br>Bit 7: Short cut control valid specify bit (1=valid) | |
| 00000007 | PHSP | Motor energizing phase signal detection operation parameter<br>Bit 0~6: Energizing phase signal detection operation start delay time specify code<br>Unit: 1ms<br>Bit 7: Energizing phase signal detection movement direction specify bit<br>0/1: = Clockwise / Counter-clockwise | R/RC |
| 00000008 | FPIO | PIO function set flag<br>Bit 0: 0 / 1 = PFIN / INP<br>Bit 4: 1 = CSTR invalid<br>Bit 5: 1 = INH + invalid<br>Bit 6: 1 = INH - invalid<br>Bit 7: 1 = ILK invalid | |
| 00000009 | BRSL | SIO communication speed selection code | |
| 0000000A | OVCM | Homing speed order<br>Unit: 0.2rpm | |
| 0000000B | OACC | Homing acceleration order<br>Unit: 0.1r/min/ms | |
| 0000000C | RTIM | Slave transmitter activation minimum delay time parameter<br>Unit: 1ms | |
| 0000000D | INP | In position width default value | |
| 0000000E | VCMD | Speed order default value<br>Unit: 0.2 rpm | |
| 0000000F | ACMD | Acceleration order default value<br>Unit: 0.1 r/min/ms | |
| 00000010 | SPOW | Electrical current limitation default value for positioning stop | |
| 00000011 | DPOW | Electrical current limitation default value during movement | |
| 00000012 | PLG0 | Servo gain number default value | |
| 00000013 | MXAC | Maximum acceleration specify flag default value | R/RC |
| 00000014 | CPAC | CP control mode acceleration constant (reservation for future expansion) | B/R |
| 00000015 | PSWT | Special specification (reservation) | |
| · | | Reservation for future expansion | |
| 00000018 | ZRMK | Homing prohibition flag (B series absolute model only) | B |
| 00000019 | ODPW | Homing current limitation value | R/RC |
| 0000001A | OTIM | Homing time out value  Unit: 1ms | R/RC |
| 0000001B | PLG1 | Servo gain number default value for positioning stop | B |
| 0000001C | PLJL | Servo gain table selection switch by load inertia  0 = Light load inertia<br>1 = Middle load inertia<br>2 = Heavy load inertia | B |

| | | | |
|---|---|---|---|
| 0 0 0 0 0 0 1 D | F L S L | Type selection flag for current order filter<br>0 = Primary low pass filter<br>1 = band elimination filter 0 = Light load inertia | B |
| 0 0 0 0 0 0 1 E | F L F C | LP cut off frequency/BEF central frequency of current order | B |
| 0 0 0 0 0 0 1 F | | Total write number of times in EEPROM memory area (Area A) | |

Position data window area bank 1 (PNT1)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 0 4 0 0 | P C M D | Absolute position coordinate target positioning stop/relative movement stroke<br>Absolute coordinate position of deceleration completion target position for approach movement/<br>Relative movement stroke from current position of deceleration completion target position for approach movement | |
| 0 0 0 0 0 4 0 1 | F L G P | Axis movement parameter default / Position data selection flag<br>Position data valid<br>Bit 7: In position width<br>Bit 6: Speed, acceleration, ultimate acceleration<br>Bit 5: Electrical current limitation value<br>Bit 4: Servo gain number | |
| 0 0 0 0 0 4 0 2 | | Reservation for future expansion | |
| 0 0 0 0 0 4 0 3 | I N P | In position width / Push force maximum pushing depth | |
| 0 0 0 0 0 4 0 4 | V C M D | Speed order Unit: 0.2 rpm | |
| 0 0 0 0 0 4 0 5 | A C M D | Acceleration order Unit: 0.1 r/min/ms | |
| 0 0 0 0 0 4 0 6 | S P O W | Electrical current limitation value for positioning stop / Electrical current limitation value for push movement | |
| 0 0 0 0 0 4 0 7 | D P O W | Electrical current limitation value during movement | |
| 0 0 0 0 0 4 0 8 | P L G 0 | Servo gain number value | |
| 0 0 0 0 0 4 0 9 | M X A C | Ultimate acceleration specify flag<br>Bit 0: 1 = Ultimate acceleration<br>Bit 1: 1 = Push force movement specify<br>Bit 2: Push force movement direction specify 0=CW, 1=CCW<br>Bit 3: 1 = Incremental movement order | R/RC |
| | | | |
| 0 0 0 0 0 4 1 1 | P L G 1 | Servo gain number of positioning stop | B |
| | | | |
| 0 0 0 0 0 4 1 F | | Total write number of times in EEPROM memory area (Area A) | |

Amplifier / Motor type monitor Bank 26 (TYPE)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 6 8 0 0 | R O M | Model code and ROM version code | |
| 0 0 0 0 6 8 0 1 | S ／ N | Serial number | RC |
| 0 0 0 0 6 8 0 2 | A M P 1 | Servo amplifier model name character digits, Number 1 group 4 characters | |
| 0 0 0 0 6 8 0 3 | A M P 2 | Servo amplifier model name character digits, Number 2 group 4 characters | |
| 0 0 0 0 6 8 0 4 | A M P 3 | Servo amplifier model name character digits, Number 3 group 4 characters | |
| 0 0 0 0 6 8 0 5 | | Reservation | |
| 0 0 0 0 6 8 0 6 | M O T 1 | Servo motor model name character digits, Number 1 group 4 characters | |
| 0 0 0 0 6 8 0 7 | M O T 2 | Servo motor model name character digits, Number 2 group 4 characters | |
| 0 0 0 0 6 8 0 8 | M O T 3 | Servo motor model name character digits, Number 3 group 4 characters | |
| 0 0 0 0 6 8 0 9 | | Reservation | |

Monitor relating data bank 27 (MONI)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 6 C 0 0 | A__F L | Flag of analog monitor (Note 1) | R |
| 0 0 0 0 6 C 0 1 | A__A D | Address of analog monitor (fixed value 7401) (Note 1) | R |
| 0 0 0 0 6 C 0 2 | H__D T | Trace data specify address | B/RC |
| 0 0 0 0 6 C 0 3 | H__S C | Sampling distance for trace data<br>Set value n : (n+1)*500$\mu s$ | B/RC |
| 0 0 0 0 6 C 0 4 | H__WR | Maximum written address for trace data<br>All area write completion when top bit is 1 | B/RC |
| 0 0 0 0 6 C 0 5 | H__B Y | Trace data type<br>BYTE = 1, WORD = 2, LWORD = 4 | B/RC |

(Note 1) Dyadic uses only, please do not use this.

Storage area for trace data

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 1 0 0 0 0 0 0 0 | | First data | |
| 1 0 0 0 0 0 0 1 | | 2nd data | |
| . | | . | |
| * * * * * * * * | | Last data | |

Alarm monitor area bank 28 (ALRM)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 7 0 0 0 | W A R N | Final detected warning code | |
| 0 0 0 0 7 0 0 1 | H Y S 0 | Final detected alarm code | |
| 0 0 0 0 7 0 0 2 | H Y S 1 | Preceding detected alarm code one time before last | |
| 0 0 0 0 7 0 0 3 | H Y S 2 | Preceding detected alarm code 2 times before last | |
| 0 0 0 0 7 0 0 4 | H Y S 3 | Preceding detected alarm code 3 times before last | |
| 0 0 0 0 7 0 0 5 | H Y S 4 | Preceding detected alarm code 4 times before last | |
| 0 0 0 0 7 0 0 6 | H Y S 5 | Preceding detected alarm code 5 times before last | |
| 0 0 0 0 7 0 0 7 | H Y S 6 | Preceding detected alarm code 6 times before last | |
| 0 0 0 0 7 0 0 8 | H Y S 7 | Preceding detected alarm code 7 times before last | |
| 0 0 0 0 7 0 0 9 | A R M A | Data address where execution was something wrong. | |

Internal status monitor area bank 29 (STAT)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 7 4 0 0 | P N O W | Absolute position counter current position | |
| 0 0 0 0 7 4 0 1 | V N O W | Current speed monitor | |
| 0 0 0 0 7 4 0 2 | | Reservation for future expansion | |
| 0 0 0 0 7 4 0 3 | S T A T | Internal status flag | |
| 0 0 0 0 7 4 0 4 | A L R M | Current alarm/Warning code | |
| 0 0 0 0 7 4 0 5 | P I | PIO input port monitor | B/R |
| 0 0 0 0 7 4 0 6 | P O | PIO output port monitor | |
| 0 0 0 0 7 4 0 7 | S W | Status monitor of SW1 (Rotary), SW2 (DIP)<br>Bit 4~7: 4 bit status of SW1 (Axis number)<br>Bit 3: 6 of SW2 (1 / 0 = ON / OFF)<br>Bit 2: 5 of SW2 (1 / 0 = ON / OFF)<br>Bit 1: 4 of SW2 (1 / 0 = ON / OFF)<br>Bit 0: 3 of SW2 (1 / 0 = ON / OFF) | B/R |
| 0 0 0 0 7 4 0 8 | S T A 2 | Bit 0: Homing flag 1 = Homing is in execution | |
| 0 0 0 0 7 4 0 9 | W A D R | Write to address counter by 4 command | |

| | | | |
|---|---|---|---|
| 0 0 0 0 7 4 0 A | ROM | Model code and ROM version | |
| 0 0 0 0 7 4 0 B | A／D 0 | Analog value for inspection | R/RC |
| 0 0 0 0 7 4 0 C | A／D 1 | Analog value for inspection | R/RC |
| 0 0 0 0 7 4 0 D | A／D 2 | Analog value for inspection | R/RC |
| | | | |
| 0 0 0 0 7 4 1 2 | O L L V | Current value of over load detection, Output alarm for 78H or greater | |
| 0 0 0 0 7 4 1 3 | L V P K | Peak hold value of over load detection level | |
| 0 0 0 0 7 4 1 4 | I CMD | Internal electrical current order value (torque order value) 100/Current rating | B |
| 0 0 0 0 7 4 1 5 | P N T M | Current position number monitor (0~255) | B |

Common parameter Execution data area bank 30 (RD30)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 00007800 | CNTM | Absolute position coordinate range + side maximum value | |
| 00007801 | CNTL | Absolute position coordinate range - side maximum value | |
| 00007802 | LIMM | Software stroke limit value + side | |
| 00007803 | LIML | Software stroke limit value - side | |
| 00007804 | ZONM | Zone border value + side | |
| 00007805 | ZONL | Zone border value - side | |
| 00007806 | ORG | Homing pattern selection code<br>Bit 0~3: Homing pattern selection code<br>Bit 7: Short cut control valid specify bit (1=valid) | |
| 00007807 | PHSP | Motor energizing phase signal detection operation parameter<br>Bit 0~6: Energizing phase signal detection operation start delay time specify code<br>Unit: 1ms<br>Bit 7: Energizing phase signal detection movement direction specify bit<br>0/1: = Clockwise / Counter-clockwise | |
| 00007808 | FPIO | PIO function set flag<br>Bit 0: 0 / 1 = PFIN / INP<br>Bit 4: 1 = CSTR invalid<br>Bit 5: 1 = INH + invalid<br>Bit 6: 1 = INH - invalid<br>Bit 7: 1 = ILK invalid | |
| 00007809 | BRSL | SIO communication speed selection code | |
| 0000780A | OVCM | Homing speed order<br>Unit: 0.2rpm | |
| 0000780B | OACC | Homing acceleration order<br>Unit: 0.1r/min/ms | |
| 0000780C | RTIM | Slave transmitter activation minimum delay time parameter<br>Unit: 1ms | |
| 00007814 | CPAC | CP control mode acceleration constant (reservation for future expansion) | B/R |
| 00007815 | PSWT | Special specification (reservation) | |
| 00007819 | ODPW | Homing current limitation value | R/RC |
| 0000781A | OTIM | Homing time out value Unit: 1ms | R/RC |
| 0000781C | PLJL | Servo gain table selection switch by load inertia 0 = Light load inertia<br>1 = Middle load inertia<br>2 = Heavy load inertia | B |
| 0000781D | FLSL | Type selection flag for current order filter<br>0 = Primary low pass filter<br>1 = band elimination filter 0 = Light load inertia | B |
| 0000781E | FLFC | LP cut off frequency/BEF central frequency of current order | B |

Position data Execution data area bank 31 (RD31)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 00007C00 | PCMD | Absolute position coordinate target stop position | |
| 00007C03 | INP | In position width / Push force maximum pushing depth | |
| 00007C04 | VCMD | Speed order Unit: 0.2 rpm | |
| 00007C05 | ACMD | Acceleration order Unit: 0.1 r/min/ms | |
| 00007C06 | SPOW | Electrical current limitation value for positioning stop / Electrical current limitation value for push movement | |

| | | | |
|---|---|---|---|
| 0 0 0 0 7 C 0 7 | D P O W | Electrical current limitation value during movement | |
| 0 0 0 0 7 C 0 8 | P L G 0 | Servo gain number value | |
| 0 0 0 0 7 C 0 9 | M X A C | Ultimate acceleration specify flag<br>Bit 0: 1 = Ultimate acceleration<br>Bit 1: 1 = Push force movement specify<br>Bit 2: Push force movement direction specify 0=CW, 1=CCW<br>Bit 3: 1 = Incremental movement order | R/RC |
| 0 0 0 0 7 C 1 1 | P L G 1 | Servo gain number of positioning stop | B |

Position data Execution data area Bank 31 (RD 31)

| Address (HEX) | Symbol | Data | Models |
|---|---|---|---|
| 0 0 0 0 7 C 0 0 | P C M D | Absolute position coordinate target stop position | |
| 0 0 0 0 7 C 0 3 | I N P | In position width | |
| 0 0 0 0 7 C 0 4 | V C M D | Speed order Unit: 0.2 rpm | |
| 0 0 0 0 7 C 0 5 | A C M D | Acceleration order Unit: 0.1 r/min/ms | |
| 0 0 0 0 7 C 0 6 | S P O W | Electrical current limitation value for positioning stop | |
| 0 0 0 0 7 C 0 7 | D P O W | Electrical current limitation value during movement | |
| 0 0 0 0 7 C 0 8 | P L G 0 | Servo gain number value | |
| 0 0 0 0 7 C 0 9 | M X A C | Ultimate acceleration specify flag<br>Bit 0:1 = Ultimate acceleration | R/RC |
| 0 0 0 0 7 C 1 1 | P L G 1 | Servo gain number of positioning stop | B |

## Appendix E. Command list

### 1. Memory command list

| Memory command | | | |
|---|---|---|---|
| **Code** | **Descriptions** | **Command information part** | **Notes** |
| R 4 | Data read out | [ "R4" ]+[ Address 8char. ]+[“0”] | |
| T 4 | Write to address | [ "T4" ]+[ Address 8char. ]+[“0”] | |
| W 4 | Data write | [ "W4" ]+[ Data 8char. ]+[“0”] | |
| Q 1 | Area A→B Transfer | [ "Q1" ]+[ Bank 2char. ]+[ Point 2char.]+["00000"] | |
| Q 2 | Area B→C Transfer | [ "Q2" ]+[ Bank 2char. ]+["0000000"] | Note 1 |
| Q 3 | Area A→B→C Transfer | [ "Q3" ]+[ Bank 2char. ]+[ Point 2char.]+["00000"] | Note 1 |
| Q 4 | Area B←C Transfer | [ "Q4" ]+[ Bank 2char. ]+["0000000"] | |
| V 5 | Area A←B Transfer | [ "V5" ]+[ Bank 2char. ]+[ Point 2char.]+["00000"] | Note 2 |
| V 6 | Area A←B←C Transfer | [ "V6" ]+[ Bank 2char. ]+[ Point 2char.]+["00000"] | Note 2 |

Note 1: Motor movement is included.
Note 2: EEPROM write is included.

### 2. Direct command list

| Direct command | | | |
|---|---|---|---|
| **Code** | **Descriptions** | **Command information part** | **Notes** |
| a | Absolute positioning order | [ "a" ]+[ position 8char. ]+[ "00" ] | Note 3 |
| b | Coordinate system shift | [ "b" ]+[ position 8char. ]+[ "00" ] | |
| d | Remained movement cancel | [ "d" ]+[ "0000000000" ] | |
| g | Servo gain parameter update | [ "g" ]+[ gain_sel 1char.]+[gain_no. 2char.] +["0000000"] | |
| h | Command buffering | [ "h" ]+[ h-command 9char.] | |
| i | Positioning completion detect width | [ "i" ]+[ width 8char. ]+[ "00" ] | |
| j | JOG movement | [ "j" ]+[ distance 8char. ]+[ "00" ] | Note 3 |
| l | Electrical current limitation value update | [ "l" ]+[ spow 2char. ]+[ dpow 2char.]+["000000"] | |
| m | Incremental movement order | [ "m" ]+[ distance 8char. ]+[ "00" ] | Note 3 |
| n | Status check | [ "n" ]+[ "0000000000" ] | |
| o | Homing movement | [ "o" ]+[ org 2char. ]+[ "00000000" ] | Note 3 |
| p | Transmitter switch | [ "p" ] + [ "trw" ]+ [ rtim 2char.] | |
| q | Servo ON/OFF | [ "q" ]+[ on-off 1char. ]+[ "000000000" ] | |
| r | Internal status reset | [ "r" ]+[ rsel 2char. ]+[ "00000000" ] | |
| s | PIO functions selection | [ "s" ]+[ "00" ]+[ fpio 2char. ]+[ "000000" ] | |
| t | Buffering order execution | [ "t" ]+[ "0000000000" ] | Note 4 |
| v | Speed/acceleration change and unlimited revolution movement | [ "v" ]+[ vsel 1char. ]+[ vcmd 4char. ] +[ acmd 4char. ]+[ "0" ] | Note 5 |

| | | | |
|---|---|---|---|
| x | Axis number change | Special format | Note 6 |
| z | Zone border value update | [ "z" ]+[ zone 8char. ]+[ dir 1char. ]+[ "0" ] | |

Note 3: Motor movement is included.
Note 4: Motor movement is included if buffering order includes motor movement.
Note 5: Motor movement will be included due to unlimited revolution movement order only when vsel is 0 or 1.
Note 6: Special format (Positions of Code and axis number are opposite from normal positions.)
[STX]+["x"]+[Axis number]+[class 2char.]+[S/N 8char.]+[check sum]+[ETX]