# FnIO G-series

# *GT-5521*

## *GT-5521 (2-Phase Bipolar Stepping Motor Driver, 24Vdc 1A)*

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# History

| REV. | PAGES | REMARKS | DATE | Editor |
|------|-------|---------|------|--------|
| 1.00 | All | Initial document release. | 11, 04, 2019 | KIM HONG SEOK |
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# 1. ENVIRONMENT SPECIFICATION

| Environmental specification | |
|---|---|
| Operation Temperature | -40℃ ~60℃ |
| UL Temperature | -20℃ ~60℃ |
| Storage Temperature | -40℃ ~85℃ |
| Relative Humidity | 5%~90%  Non-condensing |
| Mounting | DIN Rail |
| **General specification** | |
| Shock Operating | IEC 60068-2-27 |
| Vibration Resistance | Based on IEC 60068-2-6<br>DNVGL-CG-0039 : Vibration Class B, 4g |
| Industrial Emissions | EN61000-6-4/All : 2011 |
| Industrial Immunity | EN 61000-6-2 : 2005 |
| Installation Position | Vertical and horizontal installation is available |
| Product Certifications | CE, UL, FCC |

## 2. GT-5521(*2-Phase Bipolar Stepping Motor Driver, 24Vdc 1A)*

## 2.1. GT-5521 Specification

| Items | Specification |
|---|---|
| **Digital input** | |
| Number of channel | 4 points, sink type<br>(2 points DI or Encoder Input, 2 point *Hard Stop Input) |
| Indicators | 4 green terminal Input status |
| On–state voltage | 24Vdc nominal<br>12V~28.8V @ 60°C |
| On-state current | 6.4mA @ 28.8Vdc |
| Off-state voltage | 5Vdc @ 25°C |
| Input signal delay | OFF to ON : Max. 0.3ms<br>ON to OFF : Max. 0.3ms |
| Nominal input impedance | 5.4K ohm typical |
| Encoder mode | Incremental encoder support |
| **General specification** | |
| Power dissipation | Max. 100mA @ 5Vdc |
| Isolation | I/O to Logic : photocoupler isolation<br>Field power : non-isolation |
| UL field power | Supply voltage : 24Vdc nominal, Class 2 |
| Field power | Supply voltage : 24Vdc nominal<br>Voltage range : 18~28.8Vdc,<br>Power dissipation : Max. 35mA @ 24Vdc |
| Wiring | I/O Cable Max. 2.0mm$^2$(AWG 14) |
| Torque | 0.8Nm(7 lb-in) |
| Weight | 60g |
| Module size | 12mm x 99mm x 70mm, |
| **Environment condition** | **Refer to 'Environment Specification'** |

*Hard Stop : Stop motor when input is detected

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| Items | Specification |
|---|---|
| **Stepper motor driver power element** | |
| Amount | 1 stepper motor |
| Load type | 2-phase bi-polar motor |
| Rated voltage | 24Vdc nominal<br>18Vdc ~ 28.8Vdc |
| Output current | Max. 1A @-40℃ ~ 60℃ |
| Step resolution | Max. 16 microstepping<br>- full, half, 1/4, 1/8, 1/16 |
| Operation modes | Instant Command Mode<br>Position Table Mode |
| Function modes | Position(absolute/relative),<br>Set Point Change, etc. |
| Protection | Over current / Over voltage<br>Reverse voltage protection |

## 2.2. GT-5521 Wiring Diagram
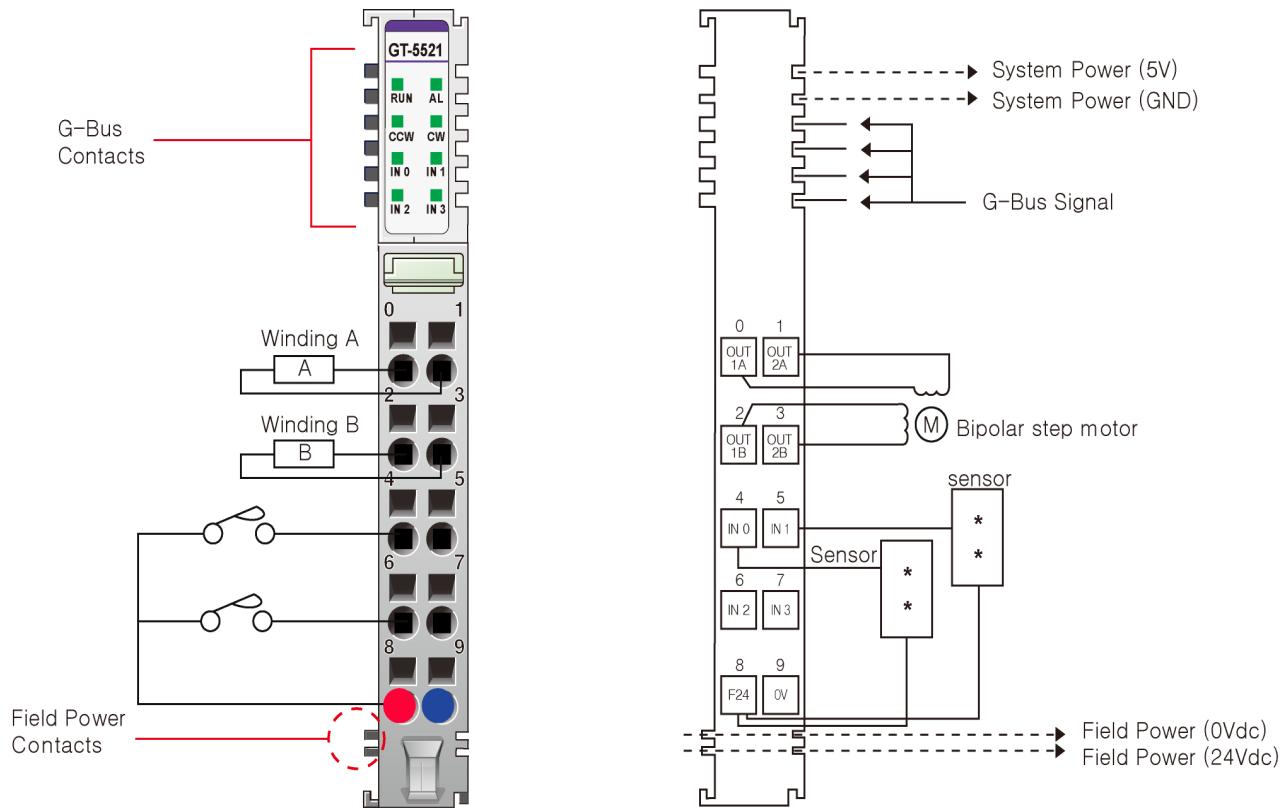


| Pin No. | Signal Description | | Signal Description | | Pin No. |
|---|---|---|---|---|---|
| 0 | Motor Out1_A | | Motor Out2_A\ | | 1 |
| 2 | Motor Out1_B | | Motor Out2_B\ | | 3 |
| 4 | Input Channel 0 | | Input Channel 1 | | 5 |
| | Digital Input | Encoder Mode | Digital Input | Encoder Mode | |
| | DI0 | Enc Aph | DI1 | Enc Bph | |
| 6 | Input Channel 2 | | Input Channel 3 | | 7 |
| | Digital Input | Encoder Mode | Digital Input | Encoder Mode | |
| | *Hard Stop | | *Hard Stop | | |
| 8 | Field Power 24V | | Field Power 0V | | 9 |

## Warning : Do not connect or disconnect a motor while the driver is energized.

*Hard Stop : Stop motor when input is detected

## 2.3. Function Command
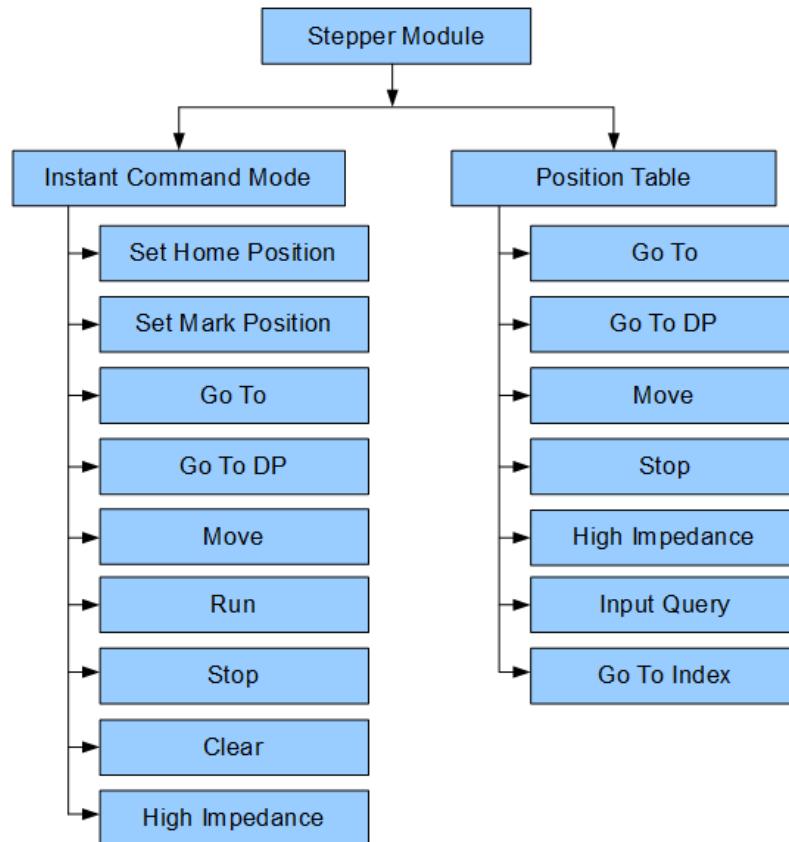


GT-5521 provides two main function commands.

After power on, module will be ready and motor is neutral position(not stopped).

Usually, GT-5521 is on 'Instant Command mode' which is activate function command from master(❶). If function command(from master) of GT-5521 is done(❷), GT-5521 is stay last command status and hold on position(❸).

ex)
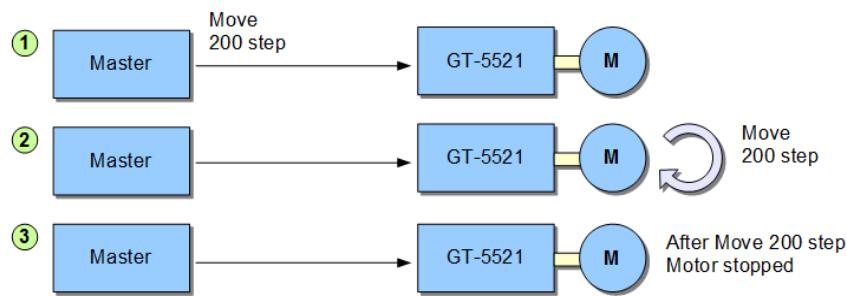


In 'Position Table Mode', module needs some specific commands. In this manual, it will be covered in the 'How to use position table function.' chapter.

## 2.4. LED Indicator

### 2.4.1. Channel Status LED

| Module Win. Label | LED | Color | Status | Description |
|---|---|---|---|---|
| GT-5521 | RUN | Green | Off | Module supply not connected. |
| | | | Blinking | Motor is at constant speed. Absolute positioning or motion command is under execution. |
| | | | On | Motor Normal Operation. |
| | AL * | Green | On | Alarm occurred. |
| | | | Off | No Alarm. |
| | CCW | Green | On | Motor is rotating counter clockwise. |
| | | | Off | Motor is stopped. |
| | CW | Green | On | Motor is rotating clockwise. |
| | | | Off | Motor is stopped. |
| | IN 0 | Green | On | Input 0 is ON. |
| | | | Off | Input 0 is OFF. |
| | IN1 | Green | On | Input 1 is ON. |
| | | | Off | Input 1 is OFF. |
| | IN2 | Green | On | Input 2 is ON. |
| | | | Off | Input 2 is OFF. |
| | IN3 | Green | On | Input 3 is ON. |
| | | | Off | Input 3 is OFF. |
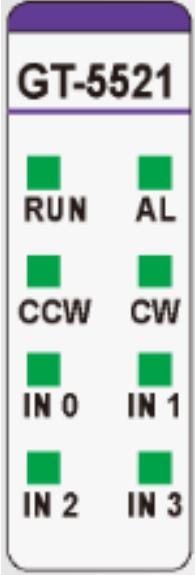
**\*Note : At least one of the following conditions occurs:**

- Over Voltage, Under Voltage, Over Current detection

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## 2.5. Configuration Parameter Data

This section describes the individual parameters that shall be used to configure the GT-5521 Stepper module:

| No. | Name | Description | Type |
|---|---|---|---|
| 1 | Acceleration Current (in peak current) | **Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8\*Value)/100 = Setting Current(A)** | Byte |
| 2 | Deceleration Current (in peak current) | **Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8\*Value)/100 = Setting Current(A)** | Byte |
| 3 | Holding Current (in peak current) | **Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8\*Value)/100 = Setting Current(A)** | Byte |
| 4 | Running Current (in peak current) | **Target phase current generated by controlling the amplitude of motor supply voltage that is assigned to the module. It should be configured with HiZ state. If motor status is not, it will be HiZ State. (7.8\*Value)/100 = Setting Current(A)** | Byte |
| 5 | Step mode & Encoder/Digital Input selection | This byte contains Step mode select(4~7bit) and Encoder/Digital input selection(0~3bit). Step mode range = Full step ~ 1/16 micro step. Digital Input, Encoder mode(AB mode). | Byte |
| 6 | Acceleration Speed | The available range is from 14.55 to 59590 step/s2 with a resolution of 14.55 step/s2. When the value is set to 59590, the device works in infinite acceleration mode. | Float* |
| 7 | Deceleration Speed | The available range is from 14.55 to 59590 step/s2 with a resolution of 14.55 step/s2. When the device is working in infinite acceleration mode, this value is ignored. | Float* |
| 8 | Maximum Speed | The available range is from 15.25 to 15610 step/s with a resolution of 15.25 step/s. | Float* |
| 9 | Minimum Speed | The available range is from 0 to 976.3 step/s with a resolution of 0.238 step/s. Note: If the Minimum Speed is set to '0' then the Module will enable Low Speed Optimization in order to achieve smooth operation at lower speeds. | Float* |
| 10 | Full Step Speed | Defines the threshold speed for the step mode to Switch automatically to full step mode. When the motor speed exceeds this threshold value, the full step mode is automatically switched to full-step. The available range is from 7.63 to 15625 step/s with a resolution of 15.25 step/s. | Float* |

* Float type :

    ex) Maximum speed = 2008.16 step/sec

      Configuration parameter of Maximum speed = 200816 → 0x31070

- When changing the parameter data, set the motor operation to high impedance status.

**(*) WH: writable only when outputs are in high impedance**

| Byte | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Remarks(*) |
|------|------|------|------|------|------|------|------|------|-----------|
| 0 | Acceleration Current | | | | | | | | WH |
| 1 | Deceleration Current | | | | | | | | WH |
| 2 | Holding Current | | | | | | | | WH |
| 3 | Running Current | | | | | | | | WH |
| 4 | Reserved | | | | | | | | |
| 5 | Step mode & Encoder/Digital Input selection | | | | | | | | WH |
| | Step mode | | | | Enc/DI select | | | | |
| | Full Step | 0 | 0 | 0 | Digital Input | 0 | 0 | 0 | |
| | 1/2 Step | 0 | 0 | 1 | | | | | |
| | 1/4 Step | 0 | 1 | 0 | Encoder (AB mode) | 0 | 0 | 1 | |
| | 1/8 Step | 0 | 1 | 1 | | | | | |
| | 1/16 Step | 1 | 0 | 0 | | | | | |
| 6 | Accelation Speed Parameter 0(Low) | | | | | | | | WH |
| 7 | Accelation Speed Parameter 1(Low) | | | | | | | | WH |
| 8 | Accelation Speed Parameter 2(High) | | | | | | | | WH |
| 9 | Accelation Speed Parameter 3(High) | | | | | | | | WH |
| 10 | Deceleration Speed Parameter 0(Low) | | | | | | | | WH |
| 11 | Deceleration Speed Parameter 1(Low) | | | | | | | | WH |
| 12 | Deceleration Speed Parameter 2(High) | | | | | | | | WH |
| 13 | Deceleration Speed Parameter 3(High) | | | | | | | | WH |
| 14 | Maximum Speed Parameter 0(Low) | | | | | | | | WH |
| 15 | Maximum Speed Parameter 1(Low) | | | | | | | | WH |
| 16 | Maximum Speed Parameter 2(High) | | | | | | | | WH |
| 17 | Maximum Speed Parameter 3(High) | | | | | | | | WH |
| 18 | Minimum Speed Parameter 0(Low) | | | | | | | | WH |
| 19 | Minimum Speed Parameter 1(Low) | | | | | | | | WH |
| 20 | Minimum Speed Parameter 2(High) | | | | | | | | WH |
| 21 | Minimum Speed Parameter 3(High) | | | | | | | | WH |
| 22 | Full Step Speed Parameter 0(Low) | | | | | | | | WH |
| 23 | Full Step Speed Parameter 1(Low) | | | | | | | | WH |
| 24 | Full Step Speed Parameter 2(High) | | | | | | | | WH |
| 25 | Full Step Speed Parameter 3(High) | | | | | | | | WH |

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**Specification**

## 2.6. Mapping data into the image table

● **Input Image Value ( 16 Byte )**

| Byte | Input Image Data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | Module Status Input Data | | | | | | | |
| 0 | HiZ | Busy | *M_DIR | – | – | – | F_POW | Ready (Module_OK) |
| 1 | - | - | - | - | *CMD_STATUS | | *MOT_STATUS | |
| 2 | Pos Tab Read | Command Data | | | | | | |
| 3 | **Position Table Index** | | | | | | | |
| | Absolute Position Input Data/Position table Read data | | | | | | | |
| 4 | Absolute Position Input 0 byte | | | | | | | |
| | Position Command Parameter1 | | | | | | | |
| 5 | Absolute Position Input 1 byte | | | | | | | |
| | Position Command Parameter2 | | | | | | | |
| 6 | Absolute Position Input 2 byte | | | | | | | |
| 7 | Absolute Position Input 3 byte | | | | | | | |
| | Actual Speed Input Data/Position table Read data | | | | | | | |
| 8 | Actual Speed Input 0 | | | | | | | |
| | Position Command Parameter3 | | | | | | | |
| 9 | Actual Speed Input 1 | | | | | | | |
| | Position Command Parameter3 | | | | | | | |
| 10 | Actual Speed Input 2 | | | | | | | |
| | Position Command Parameter3 | | | | | | | |
| 11 | Actual Speed Input 3 | | | | | | | |
| | Position Command Parameter3 | | | | | | | |
| | Digital Input /Encoder Position Input Data | | | | | | | |
| 12 | -- | | | | | | | DI 0 |
| | Encoder Position Input 0 byte | | | | | | | |
| 13 | -- | | | | | | | DI 1 |
| | Encoder Position Input 1 byte | | | | | | | |
| 14 | -- | | | | | | | DI 2 |
| | Encoder Position Input 2 byte | | | | | | | |
| 15 | -- | | | | | | | DI 3 |
| | Encoder Position Input 3 byte | | | | | | | |

• *M_DIR : Last State in Motor Direction(Reverse[0], Forward[1])

• *CMD_STATUS : Commend Success(0), Commend Error(1), Commend Busy(2)

• *MOT_STATUS : Stop(0), Accelerate(1), Decelerate(2), Constant Speed(3)

• This counter is a cyclic 16−bit counter. The relationship between this counter and the internal position counter depends on the resolution of the encoder and the microsteps defined for the internal position count

• The absolute position value range is -0x001F FFFF to 0xFFE0 0000.

● **Output Image Value ( 10 Byte )**

| Byte | Output Image Data | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Control Word 0 | | | | | | | |
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | Module Output Mode | | | | | | | |
| 0 | -- | | | Pos Tab Read | Pos Tab Run | Pos Tab Save | Pos Tab Write | Instant Command |
| 1 | Position Table Index | | | | | | | |
| | Command Data | | | | | | | |
| 2 | NOP | | | | 0 | 0 | 0 | 0 |
| | SET_HOME_POSITION | | | | 0 | 0 | 0 | 1 |
| | SET_MARK_POSITION | | | | 0 | 0 | 1 | 0 |
| | GOTO | | | | 0 | 0 | 1 | 1 |
| | GOTO_DP | | | | 0 | 1 | 0 | 0 |
| | MOVE | | | | 0 | 1 | 0 | 1 |
| | RUN | | | | 0 | 1 | 1 | 0 |
| | INPUT_QUERY* | | | | 0 | 1 | 1 | 1 |
| | STOP | | | | 1 | 0 | 0 | 0 |
| | GOTO_INDEX* | | | | 1 | 0 | 0 | 1 |
| | CLEAR | | | | 1 | 0 | 1 | 0 |
| | High Impedance | | | | 1 | 0 | 1 | 1 |
| | Command Parameter Data | | | | | | | |
| 3 | Direction ( Reverse : 0 / Forward : 1 ) | | | | | | | Dir |
| | State Change (On -> Off : 0 / Off -> On : 1) | | | | | | | Input Query |
| 4 | Stop Mode ( Soft Stop : 0 / Hard Stop : 1 ) | | | | | | | Stop |
| | Position ( Home : 0 / Mark : 1 / Absolute : 2 ) | | | | | | | GOTO |
| 5 | SPD & POS Output 0 / *Position Table No. | | | | | | | |
| 6 | SPD & POS Output 1 / *Position Table No. | | | | | | | |
| 7 | SPD & POS Output 2 / *Position Table No. | | | | | | | |
| 8 | SPD & POS Output 3 / *Position Table No. | | | | | | | |
| | Reserved | | | | | | | |
| 9 | Reserved | | | | | | | |

* INPUT_QUERY, GOTO_INDEX is only for 'Position Table Function'.

* 'State Change' is only for INPUT_QUERY.

* 'Position Table No.' is only for GOTO_INDEX.

- Since the initial state of the motor is in the high impedance state, it is recommended to change to the STOP operation state before other operations.

- Position Table Index is only for 'Position Table Function'.

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## 2.7. Application Commands

This section describes the output command modes and individual commands of the stepper module in detail.

GT-5521 has two main output mode. 'Instant command mode' and 'Position Table Mode'. It executes only one module output mode at once.

Following table summarizes the list of module output modes:

### 1. Mode: Instant Command

**Description**: With this mode, module instantly execute the command, which is received from Network Adpater.

Following table summarizes the list of supported commands:

1.1 **Command:** NOP
**Description**: No action is taken by the module. If this command use in position table function command, it will be used as wait command.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x00 | Byte / Enumeration. | Op-code for NOP Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - Wait Count ( only position table) | 32-bit Integer | 32-bit unsigend integer value. This parameter contains waiting count value. |

**Example Command Code** :

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| Output Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Instant Cmd/ Set Home | 01 | 00 | 01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

1.2. **Command:** Set Home Position
**Description**: This command resets the internal position register to zero. The zero position is also defined as HOME position.
With Encoder Interface mode, this command initialize encoder count.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x01 | Byte / Enumeration. | Op-code for Set Home Position Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | 32-bit Integer | This parameter is ignored by the module. |

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**Example Command Code** :

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ Set Home | 01 | 00 | 01 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

1.3. **Command:** Set Mark Position
**Description**: This command sets the new value for the mark position.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x02 | Byte / Enumeration. | Op-code for Set Mark Position Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Position | 32-bit Integer | 32-bit Integer Value. New position to be loaded in the MARK register. |

**Example Command Code** : Set  Marked Position 200 step

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ Set Home | 01 | 00 | 02 | 00 | 00 | C8 | 00 | 00 | 00 | 00 |

1.4. **Command:** GOTO
**Description**: This command produces a motion to the specified Home / Mark / Absolute position through the shortest path. The Absolute position (output scan) value is always in agreement with the selected step mode; the parameter value unit is equal to the selected step mode (full, half, quarter etc.).
This command keeps the BUSY flag low until the target position is reached. This command can be given only when the previous motion command has been completed (BUSY flag released). Any attempt to perform this command when a previous command is under execution (BUSY low) causes the command to be ignored.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x03 | Byte / Enumeration. | Op-code for GOTO Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Home/Mark / Absolute Position | Byte / Enumeration. | The options 'Home position - 0 / Mark position - 1' uses the values from the internal registers. So, the third parameter is only used with 'Absolute Position - 2'. |
| Position | 32-bit Integer | 32-bit Integer Value. This parameter is used with the option 'Absolute Position' otherwise it will be ignored by the module |

**Example Command Code** : Goto Home/Go to Set/Go to Abs 51,200 steps

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ GOTO Home | 01 | 00 | 03 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Instant Cmd/ GOTO Set | 01 | 00 | 03 | 00 | 01 | 00 | 00 | 00 | 00 | 00 |
| Instant Cmd/ GOTO Abs | 01 | 00 | 03 | 00 | 02 | 00 | C8 | 00 | 00 | 00 |

1.5. **Command:** GOTO_DP

**Description**: This command produces a motion to the specified absolute position imposing a forward or a reverse direction. The Absolute Position (output scan) value is always in agreement with the selected step mode; the parameter value unit is equal to the selected step mode (full, half, quarter, etc.).

This command keeps the BUSY flag low until the target speed is reached. This command can be given only when the previous motion command has been completed (BUSY flag released). Any attempt to perform this command when a previous command is under execution (BUSY low) causes the command to be ignored.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x04 | Byte / Enumeration. | Op-code for GOTO_DP Command. |
| Direction | Byte / Enumeration. | This parameter specifies the direction of rotation –either Reverse – 0 / Forward – 1 to be used with the command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Position | 32-bit Integer | 32-bit Integer Value. This parameter contains the absolute position to be used by the command |

**Example Command Code** : Goto DP Forward / Goto DP Reverse

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ GOTO DP FW | 01 | 00 | 04 | 01 | 00 | 00 | 00 | 00 | 00 | 00 |
| Instant Cmd/ GOTO DP REV | 01 | 00 | 04 | 00 | 00 | 00 | C8 | 00 | 00 | 00 |

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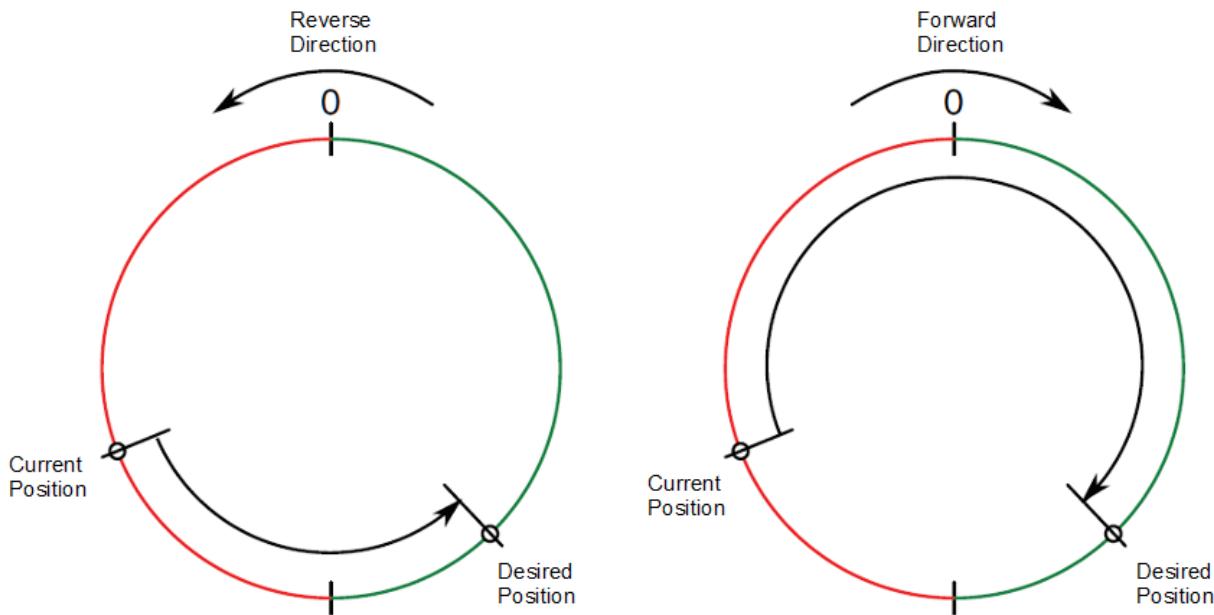
\* Caution : GOTO DP command has direction of motor movement. Thus, motor doesn't work the shortest way to desired position(in absolute position).

1.6. **Command:** MOVE
**Description**: This command produces a motion of 'N' micro steps specified by the third parameter; the direction is specified by the first parameter (forward or reverse). The value of 'N' is always in agreement with the selected step mode (full, half, quarter, etc.).
This command keeps the module BUSY until the target number of steps are performed. This command can only be performed when the motor is stopped. If a motion is in progress, the motor must be stopped and it is then possible to perform a Move command. Any attempt to perform a Move command when the motor is running causes the command to be ignored.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x05 | Byte / Enumeration. | Op-code for MOVE Command. |
| Direction | Byte / Enumeration. | This parameter specifies the direction of rotation –either Reverse – 0 / Forward – 1 to be used with the command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| N-Micro Steps | 32-bit Integer | 32-bit Integer Value. This parameter contains the value of micro steps to be used by the command. |

Note:
1.    If the specified speed is lower than the configured Minimum Speed than the motor attains the target speed starting from zero to allow smooth operation of the motor.

**Example Command Code** : Move Forward 51,200 step / Move Reverse 51,200 step

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ GOTO DP FW | 01 | 00 | 05 | 01 | 00 | 00 | C8 | 00 | 00 | 00 |
| Instant Cmd/ GOTO DP REV | 01 | 00 | 05 | 00 | 00 | 00 | C8 | 00 | 00 | 00 |

1.7. **Command:** RUN

**Description**: This command produces a motion at the speed specified by the third parameter; the direction is specified by the first parameter (forward or reverse). The value of speed is expressed in steps/sec. The specified speed value should be lower than Maximum Speed and greater than Minimum Speed (provided in module configuration) otherwise the Run command is executed at Maximum Speed or Minimum Speed respectively.

This command keeps the module BUSY until the target speed is reached. This command can be given anytime and is immediately executed.

Note:
1. If the specified speed is lower than the configured Minimum Speed than the motor attains the target speed starting from zero to allow smooth operation of the motor.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x06 | Byte / Enumeration. | Op-code for RUN Command. |
| Direction | Byte / Enumeration. | This parameter specifies the direction of rotation –either Reverse – 0 / Forward – 1 to be used with the command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Speed | 32-bit Integer | 32-bit Integer Value. This parameter contains the value of Speed in steps/sec to be used by the command. |

**Example Command Code** : Run Forward 1,000 step per sec / Run Reverse 1,000 step per sec

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Instant Cmd/ GOTO DP FW | 01 | 00 | 06 | 01 | 00 | E8 | 03 | 00 | 00 | 00 |
| Instant Cmd/ GOTO DP REV | 01 | 00 | 06 | 00 | 00 | E8 | 03 | 00 | 00 | 00 |

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1.8. **Command: INPUT_QUERY**

**Description**: This Command is not executed in instant command mode, it is only for Position table function command.

'INPUT_QUERY' function is that check the change of input channel status. If input channel's condition is as same as user-defined condition, module proceed next position table function. If it is not, stay until it is satisfying.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x07 | Byte / Enumeration. | Op-code for Input_Query Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Status Change Check Mode | Byte / Enumeration. | This parameter specifies the method of status change check mode (Off -> On – 1/ On -> Off – 0) used with this command. |
| - | 32-bit Integer | This parameter is ignored by the module. |

**Example Command Code** :

1. Index 6 : Digital Input Ch1 On → Off?

2. Index 4 : Digital Input Ch2 Off → On?

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| Output Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Pos Write/ Input Query Ch1, Off -> On On Index 6 | 02 | 06 | 07 | 00 | 00 | 01 | 00 | 00 | 00 | 00 |
| Pos Write/ Input Query Ch2, On -> Off On Index 4 | 02 | 04 | 07 | 01 | 00 | 02 | 00 | 00 | 00 | 00 |

1.9. **Command: STOP**

**Description**: This command causes the motor to stop. The first parameter specifies the stop method to be used with this command and it can be either with infinite deceleration (Hard stop) or immediate deceleration to zero speed and a consequent motor stop (Soft stop)

This command can be given anytime and is immediately executed. This command keeps the module BUSY until the motor is stopped.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x08 | Byte / Enumeration. | Op-code for STOP Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Stop Mode | Byte / Enumeration. | This parameter specifies the method of stop mode (Soft stop – 0 / Hard stop – 1) used with this command. |
| - | 32-bit Integer | This parameter is ignored by the module. |

**Example Command Code** :

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| Output Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Instant Cmd/ Soft Stop | 01 | 00 | 08 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |
| Instant Cmd/ Hard Stop | 01 | 00 | 08 | 00 | 01 | 00 | 00 | 00 | 00 | 00 |

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1.10. **Command:** GOTO_INDEX

**Description**: This Command is not executed in instant command mode. This is able to change of current position table index while position table program is running.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x0A | Byte / Enumeration. | Op-code for GOTO Index Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - Position Table Index No. | 32-bit Integer | This parameter specifies the desired index number to change. |

**Example Command Code** :

On Index no. 11 : Goto Index no. 7

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | |
| Pos Write/ Goto Index On index 11 | 02 | 0B | 09 | 00 | 00 | 07 | 00 | 00 | 00 | 00 | |

1.11. **Command:** CLEAR

**Description**: This command clears any warnings / alarms flags internally maintained by the module and forces the module to exit from any error state.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x0A | Byte / Enumeration. | Op-code for CLEAR Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| - | 32-bit Integer | This parameter is ignored by the module. |

**Example Command Code** :

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | |
| Instant Cmd/ Soft Stop | 01 | 00 | 0A | 00 | 00 | 00 | 00 | 00 | 00 | 00 | |

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1.12. **Command:** High Impedance
**Description**: This command causes the motor to stop and Power bridge will be disabled. The first parameter specifies the stop method to be used with this command and it can be either with infinite deceleration (Hard stop and Impedance) or immediate deceleration to zero speed and a consequent motor stop (Soft stop and Impedance).
This command can be given anytime and is immediately executed. This command keeps the module BUSY until the motor is stopped and power bridge is disabled.

**Command Structure**:

| Command Value | Parameters (Data Type) | Description |
|---|---|---|
| 0x0B | Byte / Enumeration. | Op-code for High Impedance Command. |
| - | Byte / Enumeration. | This parameter is ignored by the module. |
| Impedance Mode | Byte / Enumeration. | This parameter specifies the method of High Impedance mode (Soft HiZ – 0 / Hard HiZ – 1) used with this command. |
| - | 32-bit Integer | This parameter is ignored by the module. |

**Example Command Code** :

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | | |
| Output Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 |
| Instant Cmd/ Soft Stop | 01 | 00 | 0B | 00 | 00 | 00 | 00 | 00 | 00 | | 00 |
| Instant Cmd/ Hard Stop | 01 | 00 | 0B | 00 | 01 | 00 | 00 | 00 | 00 | | 00 |

## 2. Mode: Position Table mode

Position Table mode has several command. Each commands are for position table function.
Position commands are consist of 'Write', 'Save', 'Run', 'Read'. GT-5521 execute only one function command at once.

### 2.1. Position Table Write

**Description**: This mode is for create 'Position Table' of GT-5521.
With this mode, GT-5521 make a Position Table List.
GT-5521 provides 250 position table list. Table creation procedure is as following below :

1. Define maximum index of position table.

**Example Command Code** : Create position table(Maximum index size 12)

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Write/ Table Create Index 12 | 02 | FB | 00 | 00 | 00 | 0C | 00 | 00 | 00 | 00 |

1.1 If you **initialize table list**, set the maximum index to 0xFF.

**Example Command Code** : Initialize position table( = Maximum index size 0)

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Write/ Table Initialize | 02 | FF | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

2. Write command on each position table list.

**Example Command Code** : Write on position table index 0, reverse 3200 step move

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Write/ CW 3200 step On Index 0 | 02 | 00 | 05 | 01 | 00 | 80 | 0C | 00 | 00 | 00 |

### 2.2. Position Table Save

**Description**: This mode is for save 'Position Table' of GT-5521.
When 'Position Table Write' procedure is finished, 'Position Table Save' is necessary.
In addition, it should be executed, before 'Position Table Run'.

**Example Command Code** : Position Table Save

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Table Save | 04 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

### 2.3. Position Table Run

**Description**: Position Table Mode activated by this command.

**Example Command Code** : Position Table Run

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Table Run | 08 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

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2.4. Position Table Read

**Description**: With this mode, user can observe the Position Table List.

Each specific position table function command on list will be indicated at input data.

**Example Command Code** : Position Table Read (Index no.1 of position table list)

| Output Byte | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Table Read/ Index 1 | 10 | 00 | 00 | 00 | 00 | 01 | 00 | 00 | 00 | 00 |

## 2.8. How to use position table function.

This section describes how to use position table function of GT-5521.

```
Power on
    |
    v
Position Table Create        Max table size defined
    |
    v
Position Table Write         Write each motion cmd
    |
    v
Position Table Save          Defined motion table list save
    |
    v
Position Table Run           Position table run
```
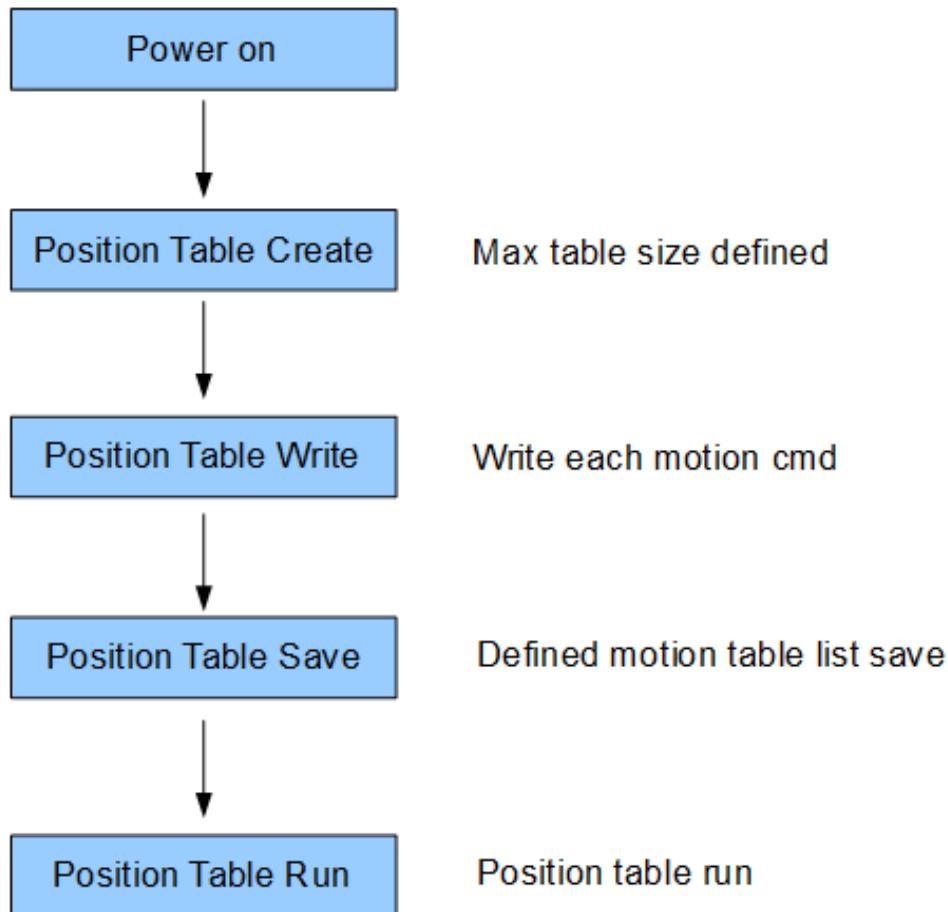
- If 'Position Table Write' function  is executed, 'Position Table Run' function won't be executed before 'Position Table Save' function is activated. Please activate

The example command is following below :

1. Position Table Create(define maximum table size)

**Example Command Code** : Create position table(Maximum index size 12)

| | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
| | | | | Para1 | Para2 | Para3 | | | | |
| **Output Byte** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Write/ Table Create Index 10 | 02 | FB | 00 | 00 | 00 | 0A | 00 | 00 | 00 | 00 |

2. GT-5521 create position table list as give command.

| index no. | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 0 | | | | | | | | | | |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |

3. Enter each desired Position table command, until fill the position table list.

**Example Command** : Move to 3200 step position on absolute position axis (Index 0)

| index no. | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 0 | 02 | 00 | 03 | 00 | 02 | 80 | 0C | 00 | 00 | 00 |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | | | |

4. If 'Position Table Write' procedure is finished, please command 'Position Table Save'

**Example Command** : Position Table Save

| Description | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Table Save | 04 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

5. Run Position table list.

**Example Command** : Position Table Run

| Description | Output Mode | | Cmd | Cmd Parameter Data | | | | | | Reserved |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Para1 | Para2 | Para3 | | | | |
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| Pos Table Run | 08 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 00 |

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## 2.8.1. Position Table Run

Once run 'Position Table Run', GT-5521 will be performed function command following position table list. If module is performed final function command on position table list, the module goes to perform first function command on the position table list.
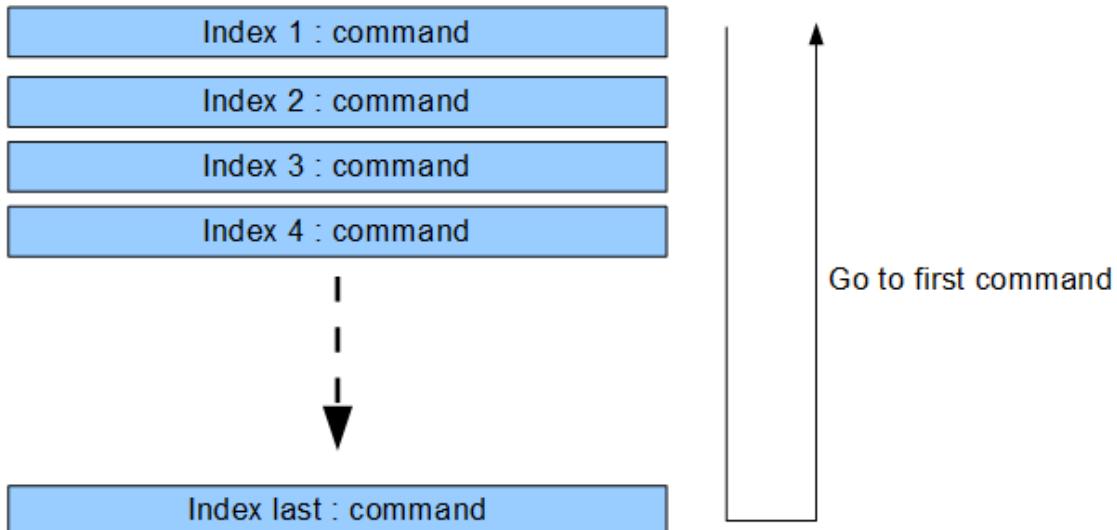


If you want module keep position table run mode, give any command after 'Position Table Run command' or GT-5521 will be stopped.
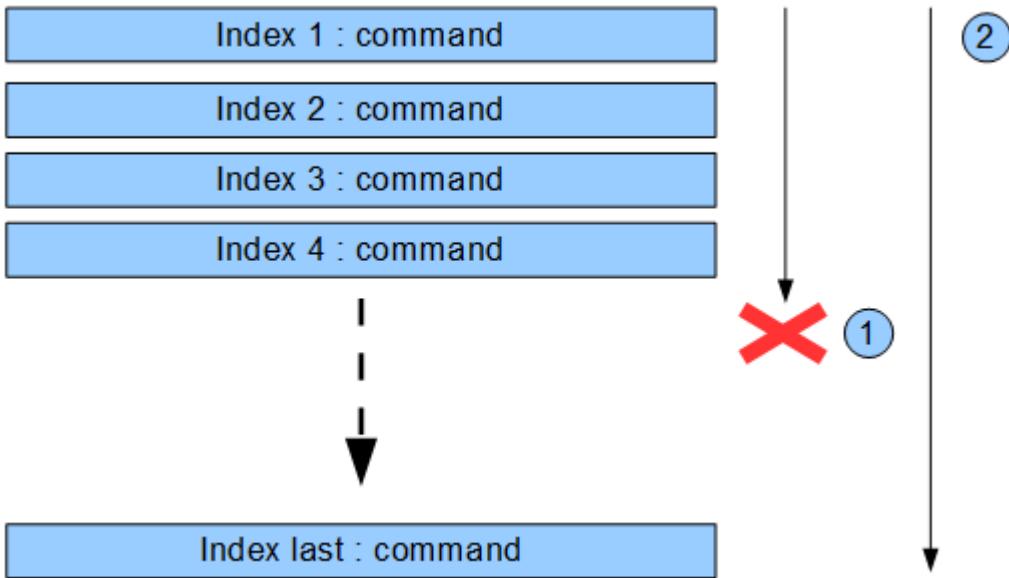


If module is stopped(①) and come back to 'Position Table Run mode', module will be start at first function command on the position table list(②).