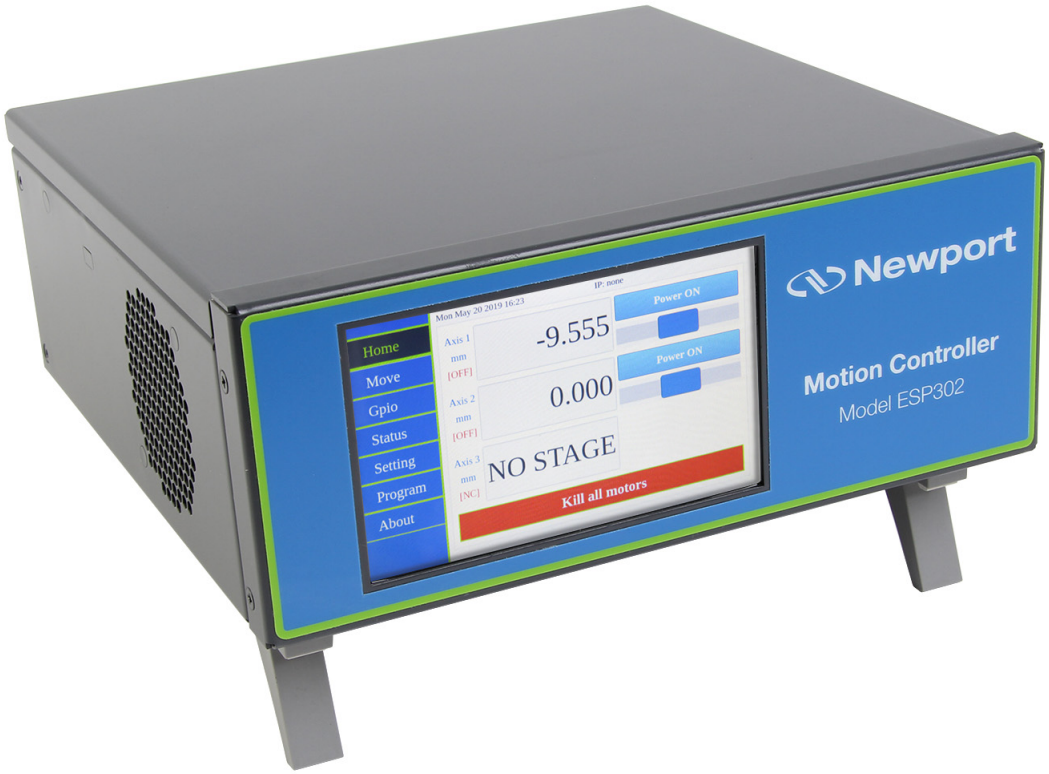
mks

# ESP302

## Friendly Motion Controller/Driver




ESP COMPATIBLE

Newport®

# Programmer's Manual

# Table of Contents


# Friendly Motion Controller/Driver ESP 302 Controller

## 1.0 Introduction

### 1.1 Scope of the Manual

This manual provides descriptions and operating procedures for the integrated 3 axis ESP302 Controller/Driver (ESP = Enhanced System Performance).

It describes the set of commands to be used in REMOTE mode (through one of the COMM., HOST or REMOTE ports) for motion, parameters, status, errors, I/Os, etc.

# 2.0 Remote Mode

## 2.1 Programming Modes

The ESP302 is a command driven system. In general, commands are a series of two letter ASCII characters preceded by an axis number and followed by parameters specific to the command. To communicate with the ESP302 controller, a host terminal has to transfer ASCII character commands according to the respective appropriate communication protocol (see section 2.2: "Remote Interfaces" for IEEE488, RS232 or USB interfaces).

As mentioned in the ESP302 User Interface Manual, tThe ESP302 distinguishes between two different programming modes:

**COMMAND MODE**

In this mode, the ESP302 controller provides a command input buffer enabling the host terminal (e.g., PC) to download a series of commands and then proceed to other tasks while the ESP302 controller processes the commands.

As command characters arrive from the host terminal, they are placed into the command buffer. When a carriage-return (ASCII 13 decimal) terminator is received, the command is interpreted. If the command is valid and its parameter is within the specified range, it will be executed. If the command contains an error, it will not be executed and a corresponding error message will be stored in the error buffer.

**NOTE**

**The ESP302 power up state is command mode.**

An example of a typical command sequence is shown below:

**Example 1:**

| | |
|---|---|
| 1PA + 30 | move axis 1 to absolute position 30 units |
| 1WS | wait for axis 1 to stop |
| 2PR-10 | move axis 2 to relative position 10 units |

Assuming that axis 1 and 2 are configured, ***Example 1*** instructs the ESP controller to move axis 1 to absolute position +30 units, wait for it to stop, and then move axis 2 motor to relative –10 units.

Note that a command prefix identifies the axis or group that should execute a command. Commands received without an axis prefix generate an error. If a command is referenced to a non-existing axis, an error is also generated. See section 2.4 for further details on the command syntax.

Also note that it is necessary to explicitly instruct the ESP controller with the WS (Wait for Stop) command to wait for axis 1 motion to stop. This is necessary because the ESP controller executes commands continuously as long as there are commands in the buffer unless a command is fetched from the buffer that instructs the controller to wait. Executing a move does not automatically suspend command execution until the move is complete. If the **WS** command were not issued in ***Example 1,*** the controller would start the second move immediately after the first move begins and simultaneously move axis 1 and axis 2.

**NOTE**

**Unless instructed otherwise, the ESP controller executes commands in the order received without waiting for completion of previous commands.**

Remember that commands must be terminated with a carriage-return (ASCII 13 decimal). Until a terminator is received, characters are simply kept in contiguous buffer space without evaluation.

**Example 2:**

1PA+30; 1WS; 2PR-10

***Example #1*** and ***Example #2*** perform the same operations. In ***Example #2*** however, semicolons are used in place of carriage-returns as command delimiters, keeping the ESP302 controller from interpreting any commands on that line until the carriage-return terminator is received at the very end of the string.

**PROGRAM EXECUTION MODE**

The ESP302 controller also implements an internal program execution mode that enables the user to store up to 100 programs in a 64kB non-volatile memory.

Even while executing stored programs, the ESP302 controller maintains open communication channels so that the host terminal can continue to direct the ESP302 to report any desired status, and even execute other motion commands.

Let's illustrate program execution mode using the previous example:

**Example 3:**

| | | |
|---|---|---|
| EP | \| | *Invoke program entry mode.* |
| 1PA+30 | \| | *Enter program.* |
| 1WS | | |
| 2PR-10 | | |
| QP | \| | *Exit program entry mode.* |
| 1EX | \| | *Execute compiled program #1.* |

As shown above, the sequence of commands has to be downloaded into the ESP302 controller program memory without inadvertently executing them. To facilitate this, the system provides the EP (Enter Program) command; characters received thereafter are redirected to program memory. Command syntax and parameters are not evaluated (even after the carriage-return). Instead, they are treated as a series of characters to be stored in contiguous memory.

## 2.2 Remote Interfaces

In this manual, *Remote Interface* refers to both communication interfaces that the controller can use to communicate with a computer or a terminal via commands in ASCII format. It is not called a *Computer Interface* since any device capable of sending ASCII characters can be interfaced with the controller.

The remote interface should not be confused with the General Purpose Input/Output (digital I/Os, a.k.a. GPIO).

### 2.2.1 RS-232C Interface

**HARDWARE CONFIGURATION**

The serial (RS-232C) communication interface on the ESP controller is accessed through the COMM. 15 pin Sub-D connector located on the rear panel.

ESP302 Start-Up manual shows the pin out of the COMM. connector that may be used to interface to a computer.

#### COMMUNICATION PROTOCOL

The RS-232C interface must be properly configured on both devices communicating. A correct setting is one that matches **all** parameters (baud rate, number of data bits, number of stop bits, parity type and handshake type) for both devices.

The ESP302's RS-232C configuration is fixed at **8 data bits, no parity, and 1 stop bit.**

To prevent buffer overflow when data is transferred to the ESP302 controller input buffer, a CTS/RTS hardware handshake protocol is implemented. The host terminal can control transmission of characters from the ESP302 by enabling the Request To Send (RTS) signal once the controller's Clear To Send (CTS) signal is ready. Before sending any further characters, the ESP will wait for a CTS from the host.

As soon as its command buffer is full, the controller de-asserts CTS. Then, as memory becomes available because the controller reads and executes commands in its buffer, it re-asserts the CTS signal to the host terminal.

### 2.2.2 TCP/IP Ethernet Interface

#### HARDWARE CONFIGURATION

The Ethernet (TCP/IP) communication interface on the ESP controller is accessed through one of the HOST and REMOTE connectors located on the rear panel.

The provided Ethernet straight-through standard cable can be used to connect the controller either directly to a computer or through a network.

The REMOTE port IP address is fixed (*192.168.254.254*) and the HOST port IP address (*factory default: 192.168.0.254*) can be changed through the front panel display or with the web interface (see **ESP302 Start-Up Manual**).

#### COMMUNICATION PROTOCOL

ESP302 controller supports 10/100/1000 Mbps Ethernet networking.

The port 5001 can be used to send serial commands through a Telnet connection.

The port 5002 is used by the .NET library (see OpenInstrument API in Command interface manual)

## 2.3 Software Utilities

In order to communicate with the controller, the user must have a terminal or a computer capable of communicating through RS-232C or Ethernet. One approach is to use a computer with communications software that can emulate a terminal. Windows XP provides an RS232 terminal emulation program named Hyper Terminal (HyperTrm.Exe) located in Accessories. HyperTrm allows the user to send ASCII commands to the motion controller. The user can even download text files with stored programs. Additionally, it can be used to download controller firmware for future upgrades.

## 2.4 Command Syntax

As mentioned previously, the ESP302 controller utilizes an ASCII command set and also outputs system status in ASCII format. Commands may be either upper or lower case characters.

The diagram below illustrates the ESP302 controller command syntax. As indicated in this diagram, a valid command consists of three main fields. The first field consists of a numerical parameter "**xx**", the second field consists of a two letter ASCII mnemonic, and the third field consists of numerical parameter "**nn**". The command is finally terminated by a carriage return. For example, 3PA10.0 is a valid command.

If a command does not require parameter "**xx**" and/or parameter "**nn**", that field may be skipped by leaving a blank character (space). For example, BO1, 3WS, and AB are all valid commands.

If a command requires multiple parameters in the third field, all these parameters must be comma delimited. For example, 1HN1,2 is a valid command.

In a similar fashion, multiple commands can be issued on a single command line by separating the commands by a semi-colon (;). For example, 3MO; 3PA10.0; 3WS; 3MF is a valid command line.

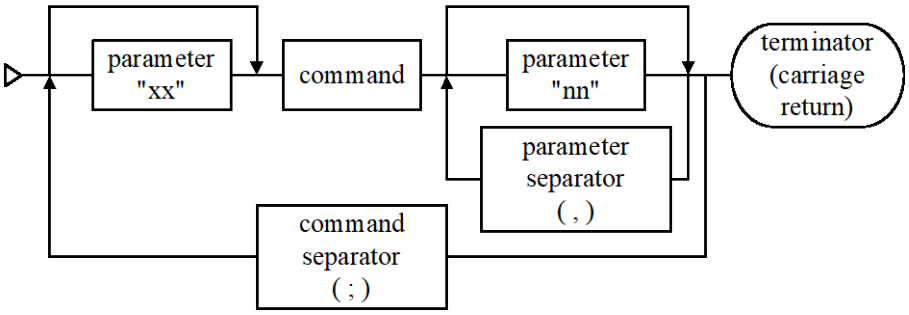



*Figure 1: Command Syntax Diagram.*

**NOTE**

**A controller command (or a sequence of commands) has to be terminated with a carriage return character. However, responses from the controller are always terminated by a carriage return/line feed combination. This setting may not be changed.**

### 2.4.1 Summary of Command Syntax

**Command Format**


The general format of a command is a two character mnemonic (**AA**). Both upper and lower case are accepted. Depending on the command, it could also have optional or required preceding (**xx**) and/or following (**nn**) parameters.

**Blank Spaces**

Blank spaces are allowed and ignored between parameters and commands. For the clarity of the program and memory saving considerations, use blank spaces with restraint. The following two commands are equivalent.

2 PA 1000

2PA1000

but the first example is very confusing and uses more than twice the memory.

**Command Line**

Commands are executed line by line. A line can consist of one or a number of commands. The controller will interpret the commands in the order they are received and execute them sequentially. This means that commands issued on the same line are executed significantly closer to each other than if they would be issued on separate lines. The maximum number of characters allowed on a command line is 80.

**Separator**

Commands issued on the same line must be separated by semicolons (**;**).

Multiple parameters issued for the same command are separated by commas (**,**).

**Terminator**

Each command line must end with a line terminator, i.e., carriage return.

## 2.5 Command Summary

The controller understands many commands. The following tables list all of them, sorted first by category and then alphabetically. The tables also show the operating modes in which each command can be used. The acronyms used in the tables have the following meaning:

| | | |
|---|---|---|
| **IMM** | IMMediate mode | Controller is idle and the commands will be executed immediately. |
| **PGM** | ProGraM mode | Controller does not execute but stores all commands as part of a program. EP activates this mode and **QP** exits it. |
| **MIP** | Motion In Progress | Controller executes command on the specified axis while in motion. |

### 2.5.1 Command List by Category

**General Mode Selection**

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **DO** | Set DAC Offset | ♦ | ♦ | ♦ | 44 |
| **FP** | Set Position Display Resolution | ♦ | ♦ | ♦ | 52 |
| **LC** | Lock/Unlock Touchscreen | ♦ | ♦ | – | 87 |
| **MF** | Motor OFF | ♦ | ♦ | ♦ | 90 |
| **MK** | Motor Kill | ♦ | ♦ | ♦ | 91 |
| **MO** | Motor ON | ♦ | ♦ | ♦ | 92 |
| **QD** | Update Motor Driver Settings | ♦ | ♦ | – | 104 |
| **RS** | Reset the Controller | ♦ | – | ♦ | 114 |
| **TJ** | Set Trajectory Mode | ♦ | ♦ | – | 130 |
| **ZA** | Set Amplifier Configuration | ♦ | ♦ | – | 151 |
| **ZB** | Set Feedback Configuration | ♦ | ♦ | – | 152 |
| **ZE** | Set E-Stop Configuration | ♦ | ♦ | – | 153 |
| **ZF** | Set Following Error Configuration | ♦ | ♦ | – | 154 |
| **ZH** | Set Hardware Limit Configuration | ♦ | ♦ | – | 156 |
| **ZS** | Set Software Limit Configuration | ♦ | ♦ | – | 158 |
| **ZU** | Get ESP System Configuration | ♦ | – | ♦ | 160 |
| **ZZ** | Set System Configuration | ♦ | ♦ | – | 161 |

*Table 1: General Mode Selection.*

**Status Functions**

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **DP** | Read Desired Position | ♦ | ♦ | ♦ | 45 |
| **DV** | Read Desired Velocity | ♦ | – | ♦ | 46 |
| **ID** | Read Stage Model and Serial Number | ♦ | – | ♦ | 76 |
| **MD** | Read Motion Done Status | ♦ | – | ♦ | 89 |
| **PH** | Get Hardware Status | ♦ | – | ♦ | 102 |
| **TB** | Read Error Message | ♦ | – | ♦ | 128 |
| **TE** | Read Error Code | ♦ | – | ♦ | 129 |
| **TP** | Read Actual Position | ♦ | – | ♦ | 131 |
| **TS** | Get Controller Status | ♦ | – | ♦ | 132 |
| **TV** | Get Actual Velocity | ♦ | – | ♦ | 135 |
| **TX** | Read Controller Activity | ♦ | – | ♦ | 136 |
| **VE** | Read Controller Firmware Version | ♦ | – | ♦ | 143 |

*Table 2: Status Functions.*

### Motion & Position Control

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **AB** | Abort Motion | ♦ | – | ♦ | 17 |
| **DH** | Define Home | ♦ | ♦ | – | 42 |
| **MT** | Move to Hardware Travel Limit | ♦ | ♦ | – | 93 |
| **MV** | Move Indefinitely | ♦ | ♦ | ♦ | 94 |
| **MZ** | Move to Nearest Index | ♦ | ♦ | – | 95 |
| **OR** | Search for Home | ♦ | ♦ | – | 99 |
| **PA** | Move to Absolute Position | ♦ | ♦ | ♦ | 101 |
| **PR** | Move to Relative Position | ♦ | ♦ | ♦ | 103 |
| **ST** | Stop Motion | ♦ | ♦ | ♦ | 126 |

*Table 3: Motion & Position Control.*

### Motion Device Parameters

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **FE** | Set Maximum Following Error Threshold | ♦ | ♦ | ♦ | 51 |
| **FR** | Set Encoder Full Step Resolution | ♦ | ♦ | ♦ | 53 |
| **QG** | Set Gear Constant | ♦ | ♦ | – | 105 |
| **QI** | Get Maximum Motor Current | ♦ | ♦ | – | 106 |
| **QM** | Get Motor Type | ♦ | ♦ | – | 107 |
| **QR** | Get Motor Torque Reduction | ♦ | ♦ | ♦ | 109 |
| **QS** | Set Microstep Factor | ♦ | ♦ | – | 110 |
| **QT** | Set Tachometer Gain | ♦ | ♦ | – | 111 |
| **QV** | Set Average Motor Voltage | ♦ | ♦ | – | 112 |
| **SL** | Set Left Travel Limit | ♦ | ♦ | ♦ | 121 |
| **SN** | Set Axis Displacement Units | ♦ | ♦ | – | 123 |
| **SR** | Set Right Travel Limit | ♦ | ♦ | – | 124 |
| **SU** | Set Encoder Resolution | ♦ | ♦ | – | 127 |

*Table 4: Motion Device Parameters.*

### Programming

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **AP** | Abort Program | ♦ | ♦ | ♦ | 22 |
| **EO** | Automatic Execution on Power ON | ♦ | – | ♦ | 47 |
| **EP** | Enter Program Mode | ♦ | – | – | 48 |
| **EX** | Execute a Program | ♦ | ♦ | – | 49 |
| **LP** | List Program | ♦ | – | ♦ | 88 |
| **QP** | Quit Program Mode | ♦ | – | – | 108 |
| **SM** | Save Settings to Non-Volatile Memory | ♦ | ♦ | – | 122 |
| **XM** | Read Available Program Memory | ♦ | – | ♦ | 149 |
| **XX** | Erase Program | ♦ | – | ♦ | 150 |

*Table 5: Programming.*

### Trajectory Definition

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **AC** | Set Acceleration/deceleration | ♦ | ♦ | ♦ | 18 |
| **AE** | Get E-Stop Deceleration | ♦ | ♦ | ♦ | 19 |
| **AG** | Set Deceleration | ♦ | ♦ | ♦ | 21 |
| **AU** | Get Maximum Acceleration and Deceleration | ♦ | ♦ | ♦ | 23 |
| **BA** | Set Backlash Compensation | ♦ | ♦ | ♦ | 24 |
| **CO** | Set Linear Compensation | ♦ | ♦ | ♦ | 34 |
| **JH** | Set Jog High Speed | ♦ | ♦ | ♦ | 77 |
| **JK** | Set Jerk | ♦ | ♦ | ♦ | 78 |
| **JW** | Set Jog Low Speed | ♦ | ♦ | ♦ | 80 |
| **OH** | Set Home Search High Speed | ♦ | ♦ | ♦ | 96 |
| **OL** | Set Home Search Low Speed | ♦ | ♦ | ♦ | 97 |
| **OM** | Set Home Search Mode | ♦ | ♦ | ♦ | 98 |
| **SH** | Set Home Preset Position | ♦ | ♦ | ♦ | 118 |
| **VA** | Set Velocity | ♦ | ♦ | ♦ | 141 |
| **VB** | Set Base Velocity for Step Motors | ♦ | ♦ | ♦ | 142 |
| **VU** | Get Maximum Velocity | ♦ | ♦ | ♦ | 145 |

*Table 6: Trajectory Definition.*

### Flow Control & Sequencing

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **DL** | Define Label | – | ♦ | – | 43 |
| **JL** | Jump to Label | – | ♦ | ♦ | 79 |
| **RQ** | Generate Service Request (SRQ) | ♦ | ♦ | ♦ | 113 |
| **SA** | Set Device Address | ♦ | ♦ | ♦ | 115 |
| **WP** | Wait for Position | ♦ | ♦ | ♦ | 146 |
| **WS** | Wait for Motion Stop | ♦ | ♦ | ♦ | 147 |
| **WT** | Wait | ♦ | ♦ | ♦ | 148 |

*Table 7: Flow Control & Sequencing.*

### I/O Functions

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **BG** | Assign DIO Bits to Execute Stored Programs | ♦ | – | ♦ | 25 |
| **BK** | Assign DIO Bits to Inhibit Motion | ♦ | ♦ | ♦ | 26 |
| **BL** | Enable DIO Bits to Inhibit Motion | ♦ | ♦ | ♦ | 27 |
| **BM** | Assign DIO Bits to Notify Motion Status | ♦ | ♦ | ♦ | 28 |
| **BN** | Enable DIO Bits to Notify Motion Status | ♦ | ♦ | ♦ | 29 |
| **BO** | Set DIO Port Direction | ♦ | ♦ | ♦ | 30 |
| **BP** | Assign DIO Bits for Jog Mode | ♦ | ♦ | ♦ | 31 |
| **BQ** | Enable/Disable DIO Jog Mode | ♦ | ♦ | ♦ | 32 |
| **DC** | Setup Data Acquisition | ♦ | – | ♦ | 36 |
| **DD** | Get Data Acquisition Done Status | ♦ | – | ♦ | 38 |
| **DE** | Enable/Disable Data Acquisition | ♦ | – | ♦ | 39 |
| **DF** | Get Data Acquisition Sample Count | ♦ | – | ♦ | 40 |
| **DG** | Get Acquisition Data | ♦ | – | ♦ | 41 |
| **SB** | Set/Get DIO Port GPIO Bit Status | ♦ | ♦ | ♦ | 116 |
| **UH** | Wait for DIO Bit High | – | ♦ | – | 139 |
| **UL** | Wait for DIO Bit Low | – | ♦ | – | 140 |

*Table 8: I/O Functions.*

### Group Functions

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **HA** | Set Group Acceleration/deceleration | ♦ | ♦ | ♦ | 55 |
| **HB** | Read Current Number of Trajectory Elements | ♦ | – | ♦ | 56 |
| **HC** | Move Group Along an Arc | ♦ | ♦ | ♦ | 57 |
| **HD** | Set Group Deceleration | ♦ | ♦ | ♦ | 60 |
| **HE** | Set Group E-Stop Deceleration | ♦ | ♦ | ♦ | 61 |
| **HF** | Group OFF | ♦ | ♦ | ♦ | 62 |
| **HJ** | Set Group Jerk | ♦ | ♦ | ♦ | 63 |
| **HL** | Move Group Along a Line | ♦ | ♦ | ♦ | 64 |
| **HN** | Create New Group | ♦ | ♦ | – | 66 |
| **HO** | Group ON | ♦ | ♦ | ♦ | 68 |
| **HP** | Read Group Position | ♦ | – | ♦ | 69 |
| **HQ** | Wait For Group Command Buffer Level | ♦ | ♦ | ♦ | 70 |
| **HS** | Stop Group Motion | ♦ | ♦ | ♦ | 71 |
| **HV** | Set Group Velocity | ♦ | ♦ | ♦ | 72 |
| **HW** | Wait For Group Motion Stop | ♦ | ♦ | ♦ | 73 |
| **HX** | Delete Group | ♦ | ♦ | ♦ | 74 |
| **HZ** | Read Group Size | ♦ | ♦ | ♦ | 75 |

*Table 9: Group Functions.*

### Digital Filters

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **AF** | Set Acceleration Feed-Forward Gain | ♦ | ♦ | ♦ | 20 |
| **CL** | Set Closed Loop Update Interval | ♦ | ♦ | ♦ | 33 |
| **DB** | Set Position Deadband | ♦ | ♦ | ♦ | 35 |
| **KD** | Set Derivative Gain | ♦ | ♦ | ♦ | 81 |
| **KF** | Set Corrector Derivative Cutt Off Frequency | ♦ | ♦ | ♦ | 82 |
| **KI** | Set Integral Gain | ♦ | ♦ | ♦ | 83 |
| **KP** | Set Proportional Gain | ♦ | ♦ | ♦ | 84 |
| **KS** | Set Saturation Level of Integral Factor | ♦ | ♦ | ♦ | 85 |
| **KT** | Set Integration Time | ♦ | ♦ | ♦ | 86 |
| **UF** | Update Servo Filter | ♦ | ♦ | ♦ | 138 |
| **VF** | Set Velocity Feed-Forward Gain | ♦ | ♦ | ♦ | 144 |

*Table 10: Digital Filters.*

### Master-Slave Mode Definition

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **GR** | Set Master-Slave Reduction Ratio | ♦ | ♦ | ♦ | 54 |
| **SI** | Set Master-Slave Jog Velocity Update Interval | ♦ | ♦ | ♦ | 119 |
| **SK** | Set Master-Slave Jog Velocity Scaling Coefficients | ♦ | ♦ | ♦ | 120 |
| **SS** | Define Master-Slave Relationship | ♦ | ♦ | – | 125 |

*Table 11: Master-Slave Mode Definition*

### 2.5.2 Command List – Alphabetical

| Cmd. | Description | IMM | PGM | MIP | Page |
|---|---|---|---|---|---|
| **AB** | Abort Motion | ♦ | – | ♦ | 17 |
| **AC** | Set Acceleration/deceleration | ♦ | ♦ | ♦ | 18 |
| **AE** | Get E-Stop Deceleration | ♦ | ♦ | ♦ | 19 |
| **AF** | Set Acceleration Feed-Forward Gain | ♦ | ♦ | ♦ | 20 |
| **AG** | Set Deceleration | ♦ | ♦ | ♦ | 21 |
| **AP** | Abort Program | ♦ | ♦ | ♦ | 22 |
| **AU** | Get Maximum Acceleration and Deceleration | ♦ | ♦ | ♦ | 23 |
| **BA** | Set Backlash Compensation | ♦ | ♦ | ♦ | 24 |
| **BG** | Assign DIO Bits to Execute Stored Programs | ♦ | – | ♦ | 25 |
| **BK** | Assign DIO Bits to Inhibit Motion | ♦ | ♦ | ♦ | 26 |
| **BL** | Enable DIO Bits to Inhibit Motion | ♦ | ♦ | ♦ | 27 |
| **BM** | Assign DIO Bits to Notify Motion Status | ♦ | ♦ | ♦ | 28 |
| **BN** | Enable DIO Bits to Notify Motion Status | ♦ | ♦ | ♦ | 29 |
| **BO** | Set DIO Port Direction | ♦ | ♦ | ♦ | 30 |
| **BP** | Assign DIO Bits for Jog Mode | ♦ | ♦ | ♦ | 31 |
| **BQ** | Enable DIO Bits for Jog Mode | ♦ | ♦ | ♦ | 32 |
| **CL** | Set Closed Loop Update Interval | ♦ | ♦ | ♦ | 33 |
| **CO** | Set Linear Compensation | ♦ | ♦ | ♦ | 34 |
| **DB** | Set Position Deadband | ♦ | ♦ | ♦ | 35 |
| **DC** | Setup Data Acquisition | ♦ | – | ♦ | 36 |
| **DD** | Get Data Acquisition Done Status | ♦ | – | ♦ | 38 |
| **DE** | Enable/Disable Data Acquisition | ♦ | – | ♦ | 39 |
| **DF** | Get Data Acquisition Sample Count | ♦ | – | ♦ | 40 |
| **DG** | Get Acquisition Data | ♦ | – | ♦ | 41 |
| **DH** | Define Home | ♦ | ♦ | – | 42 |
| **DL** | Define Label | – | ♦ | – | 43 |
| **DO** | Set DAC Offset | ♦ | ♦ | ♦ | 44 |
| **DP** | Read Desired Position | ♦ | ♦ | ♦ | 45 |
| **DV** | Read Desired Velocity | ♦ | – | ♦ | 46 |
| **EO** | Automatic Execution On Power ON | ♦ | – | ♦ | 47 |
| **EP** | Enter Program Mode | ♦ | – | – | 48 |
| **EX** | Execute a Program | ♦ | ♦ | – | 49 |
| **FE** | Set Maximum Following Error Threshold | ♦ | ♦ | ♦ | 51 |
| **FP** | Set Position Display Resolution | ♦ | ♦ | ♦ | 52 |
| **FR** | Set Encoder Full Step Resolution | ♦ | ♦ | ♦ | 53 |
| **GR** | Set Master-Slave Reduction Ratio | ♦ | ♦ | ♦ | 54 |
| **HA** | Set Group Acceleration/deceleration | ♦ | ♦ | ♦ | 55 |
| **HB** | Read Current Number of Trajectory Elements | ♦ | – | ♦ | 56 |
| **HC** | Move Group Along an Arc | ♦ | ♦ | ♦ | 57 |
| **HD** | Set Group Deceleration | ♦ | ♦ | ♦ | 60 |
| **HE** | Get Group E-Stop Deceleration | ♦ | ♦ | ♦ | 61 |
| **HF** | Group OFF | ♦ | ♦ | ♦ | 62 |
| **HJ** | Set Group Jerk | ♦ | ♦ | ♦ | 63 |
| **HL** | Move Group Along a Line | ♦ | ♦ | ♦ | 64 |
| **HN** | Create New Group | ♦ | ♦ | – | 66 |
| **HO** | Group ON | ♦ | ♦ | ♦ | 68 |
| **HP** | Read Group Position | ♦ | – | ♦ | 69 |

| | | | | | |
|---|---|---|---|---|---|
| **HQ** | Wait For Group Command Buffer Level | ♦ | ♦ | ♦ | 70 |
| **HS** | Stop Group Motion | ♦ | ♦ | ♦ | 71 |
| **HV** | Set Group Velocity | ♦ | ♦ | ♦ | 72 |
| **HW** | Wait for Group Motion Stop | ♦ | ♦ | ♦ | 73 |
| **HX** | Delete Group | ♦ | ♦ | ♦ | 74 |
| **HZ** | Read Group Size | ♦ | ♦ | ♦ | 75 |
| **ID** | Read Stage Model And Serial Number | ♦ | – | ♦ | 76 |
| **JH** | Set Jog High Speed | ♦ | ♦ | ♦ | 77 |
| **JK** | Set Jerk | ♦ | ♦ | ♦ | 78 |
| **JL** | Jump to Label | – | ♦ | ♦ | 79 |
| **JW** | Set Jog Low Speed | ♦ | ♦ | ♦ | 80 |
| **KD** | Set Derivative Gain | ♦ | ♦ | ♦ | 81 |
| **KF** | Set Corrector Derivative Cutt Off Frequency | ♦ | ♦ | ♦ | 82 |
| **KI** | Set Integral Gain | ♦ | ♦ | ♦ | 83 |
| **KP** | Set Proportional Gain | ♦ | ♦ | ♦ | 84 |
| **KS** | Set Saturation Level of Integral Factor | ♦ | ♦ | ♦ | 85 |
| **KT** | Set Integration Time | ♦ | ♦ | ♦ | 86 |
| **LC** | Lock/Unlock Touchscreen | ♦ | ♦ | – | 87 |
| **LP** | List Program | ♦ | – | ♦ | 88 |
| **MD** | Read Motion Done Status | ♦ | – | ♦ | 89 |
| **MF** | Motor OFF | ♦ | ♦ | ♦ | 90 |
| **MK** | Motor Kill | ♦ | ♦ | ♦ | 91 |
| **MO** | Motor ON | ♦ | ♦ | ♦ | 92 |
| **MT** | Move to Hardware Travel Limit | ♦ | ♦ | – | 93 |
| **MV** | Move Indefinitely | ♦ | ♦ | ♦ | 94 |
| **MZ** | Move to Nearest Index | ♦ | ♦ | – | 95 |
| **OH** | Set Home Search High Speed | ♦ | ♦ | ♦ | 96 |
| **OL** | Set Home Search Low Speed | ♦ | ♦ | ♦ | 97 |
| **OM** | Set Home Search Mode | ♦ | ♦ | ♦ | 98 |
| **OR** | Search for Home | ♦ | ♦ | – | 99 |
| **PA** | Move to Absolute Position | ♦ | ♦ | ♦ | 101 |
| **PH** | Get Hardware Status | ♦ | – | ♦ | 102 |
| **PR** | Move to Relative Position | ♦ | ♦ | ♦ | 103 |
| **QD** | Update Motor Driver Settings | ♦ | ♦ | – | 104 |
| **QG** | Set Gear Constant | ♦ | ♦ | – | 105 |
| **QI** | Get Maximum Motor Current | ♦ | ♦ | – | 106 |
| **QM** | Get Motor Type | ♦ | ♦ | – | 107 |
| **QP** | Quit Program Mode | ♦ | – | – | 108 |
| **QR** | Get Motor Torque Reduction | ♦ | ♦ | ♦ | 109 |
| **QS** | Set Microstep Factor | ♦ | ♦ | – | 110 |
| **QT** | Set Tachometer Gain | ♦ | ♦ | – | 111 |
| **QV** | Set Average Motor Voltage | ♦ | ♦ | – | 112 |
| **RQ** | Generate Service Request (SRQ) | ♦ | ♦ | ♦ | 113 |
| **RS** | Reset the Controller | ♦ | – | ♦ | 114 |
| **SA** | Set Device Address | ♦ | ♦ | ♦ | 115 |
| **SB** | Set/Get DIO Port GPIO Bit Status | ♦ | ♦ | ♦ | 116 |
| **SH** | Set Home Preset Position | ♦ | ♦ | ♦ | 118 |
| **SI** | Set Master-Slave Jog Velocity Update Interval | ♦ | ♦ | ♦ | 119 |
| **SK** | Set Master-Slave Jog Velocity Scaling Coefficients | ♦ | ♦ | ♦ | 120 |

| | | | | | |
|---|---|---|---|---|---|
| **SL** | Set Left Travel Limit | ♦ | ♦ | ♦ | 121 |
| **SM** | Save Settings to Non-Volatile Memory | ♦ | ♦ | – | 122 |
| **SN** | Set Axis Displacement Units | ♦ | ♦ | – | 123 |
| **SR** | Set Right Travel Limit | ♦ | ♦ | – | 124 |
| **SS** | Define Master-Slave Relationship | ♦ | ♦ | – | 125 |
| **ST** | Stop Motion | ♦ | ♦ | ♦ | 126 |
| **SU** | Set Encoder Resolution | ♦ | ♦ | – | 127 |
| **TB** | Read Error Message | ♦ | – | ♦ | 128 |
| **TE** | Read Error Code | ♦ | – | ♦ | 129 |
| **TJ** | Set Trajectory Mode | ♦ | ♦ | – | 130 |
| **TP** | Read Actual Position | ♦ | – | ♦ | 131 |
| **TS** | Get Controller Status | ♦ | – | ♦ | 132 |
| **TV** | Get Actual Velocity | ♦ | – | ♦ | 135 |
| **TX** | Read Controller Activity | ♦ | – | ♦ | 136 |
| **UF** | Update Servo Filter | ♦ | ♦ | ♦ | 138 |
| **UH** | Wait for DIO Bit High | – | ♦ | – | 139 |
| **UL** | Wait for DIO Bit Low | – | ♦ | – | 140 |
| **VA** | Set Velocity | ♦ | ♦ | ♦ | 141 |
| **VB** | Set Base Velocity for Step Motors | ♦ | ♦ | ♦ | 142 |
| **VE** | Read Controller Firmware Version | ♦ | – | ♦ | 143 |
| **VF** | Set Velocity Feed-Forward Gain | ♦ | ♦ | ♦ | 144 |
| **VU** | Get Maximum Velocity | ♦ | ♦ | ♦ | 145 |
| **WP** | Wait for Position | ♦ | ♦ | ♦ | 146 |
| **WS** | Wait for Motion Stop | ♦ | ♦ | ♦ | 147 |
| **WT** | Wait | ♦ | ♦ | ♦ | 148 |
| **XM** | Read Available Program Memory | ♦ | – | ♦ | 149 |
| **XX** | Erase Program | ♦ | – | ♦ | 150 |
| **ZA** | Set Amplifier I/O Configuration | ♦ | ♦ | – | 151 |
| **ZB** | Set Feedback Configuration | ♦ | ♦ | – | 152 |
| **ZE** | Set E-Stop Configuration | ♦ | ♦ | – | 153 |
| **ZF** | Set Following Error Configuration | ♦ | ♦ | – | 154 |
| **ZH** | Set Hardware Limit Configuration | ♦ | ♦ | – | 156 |
| **ZS** | Set Software Limit Configuration | ♦ | ♦ | – | 158 |
| **ZU** | Get ESP System Configuration | ♦ | – | ♦ | 160 |
| **ZZ** | Set System Configuration | ♦ | ♦ | – | 161 |

*Table 12: Command List – Alphabetical.*

## 2.6 Description of Commands

The extensive ESP302 controller command set exists to facilitate application development for wide range of application and needs. However, most simple positioning can be done with just a few commands:

**VA** – Set velocity.

**AC** – Set acceleration.

**AG** – Set deceleration.

**PR** – Position relative.

**PA** – Position absolute.

**TP** – Tell position.

**WS** – Wait for stop.

**NOTE**

**Most of the commands take an axis number as a parameter (xx). For such commands, the valid range of axis number is from 1 to Max. Axes, where Max. Axes is dependent on the configuration of the ESP302 motion controller.**

**Commands related to coordinated motion and contouring (group commands) take a group number as a parameter. For such commands, the valid range of group number is from 1 to Max. Groups, where Max. Groups is one-half the Max. Axes.**

# AA — (Command mnemonic) (Brief definition) (Motor type) *

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

(diamonds mark which mode the command can be used in **)

**Syntax** xx**AA**nn (Generic syntax format).

**Parameters**

**Description**
**xx** [int] — (Description of parameter).
**nn** [float] — (Description of parameter).
(parameter could be **int**eger number, **float**ing point number, **char**acter or **str**ing).

**Range**
**xx** — (**Minimum value** to **maximum value**).
**nn** — (**Minimum value** to **maximum value**).

**Units**
**xx** — (Units description).
**nn** — (Units description).

**Defaults**
**xx** Missing: (Default or error if parameter is missing).
Out of range: (Default or error if parameter is out of range).
**nn** Missing: (Default or error if parameter is missing).
Out of range: (Default or error if parameter is out of range).

**Description** (Detailed description of the command).

---

**NOTE**

**(Notes, reminders and things to consider when using the command, if any).**

---

**Returns** **(Type,** format and description of the return the command is generating, if any).

**Errors** (Error Code) — (Description of errors the command could generate if misused).

**Rel. Commands** (Command) — (Brief definition of related commands).

**Example**

(**Command Discussed**) | *(Description).*
(Other Command) | *(Description).*
(*Controller Return*) | *(Description).*

***(Motor type)** – If the command is specific for a motor type (DC or stepping) it will be labeled here, otherwise this field is blank.

** The mode mnemonics has the following meanings:

**IMM**ediate mode – Controller is in idle mode and the commands are executed immediately.

**P**ro**G**ra**M** mode – Controller does not execute but stores all commands as part of a program.

**M**otion **I**n **P**rogress – Controller is executing a motion on all or the specified axis.

# AB — Abort Motion

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **AB**

**Parameters** None.

**Description** This command should be used as an emergency stop. On reception of this command, the controller invokes emergency stop event processing for each axis as configured by **ZE** (e-stop event configuration) command.

By default axes are configured to turn motor power OFF, however, individual axes can be configured to stop using emergency deceleration rate set by **AE** command and maintain motor power.

It should be used only as an immediate command, not in a program.

**NOTE**

**This command affects all axes, however the action taken is determined by each individual's axis ZE command configuration.**

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| ST | — | Stop motion. |
| AE | — | E-stop deceleration. |
| ZE | — | E-stop deceleration. |
| MF | — | Motor OFF. |
| MO | — | Motor ON. |

**Example**

| | | |
|---|---|---|
| **AB** | \| | Used as an immediate command to stop all motion. |

# AC — Set Acceleration/deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**AC**nn or xx**AC**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Acceleration value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **the maximum programmed value in AU command**, or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Predefined units/second$^2$. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x11, MAXIMUM ACCELERATION EXCEEDED. |

**Description**

This command is used to set the acceleration and deceleration value for an axis. Its execution is immediate, meaning that the acceleration is changed when the command is processed, even while a motion is in progress.

It can be used as an immediate command or inside a program. If the requested axis is a member of a group, the commanded acceleration becomes effective only after the axis is removed from the group. Refer to Advanced Capabilities section in the ESP302 Features Manual for a detailed description of grouping and related commands.

Avoid changing the acceleration during the acceleration or deceleration periods.

For better predictable results, change acceleration only when the axis is not moving or when it is moving with a constant speed.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| VA | — | Set velocity. |
| PA | — | Execute an absolute motion. |
| PR | — | Execute a relative motion. |
| AU? | — | Get maximum acceleration and deceleration. |

**Example**

| | | |
|---|---|---|
| 2AU? | \| | *Read maximum allowed acceleration/deceleration of axis #2* |
| *10* | \| | *Controller returns a value of 10 units/s$^2$.* |
| **2AC9** | \| | *Set acceleration to 9 units/s$^2$.* |

# AE — Get E-Stop Deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**AE**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to get the e-stop deceleration value for an axis.

E-stop deceleration is invoked upon a local e-stop condition (e.g. Inhibit) has occurred, if configured to do so, or if the **AB** (abort motion) command is processed.

**NOTE**

**E-stop deceleration value is read-only and is 10 times the normal acceleration/deceleration.**

**Returns** This command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| VA | — | Set velocity. |
| PA | — | Execute an absolute motion. |
| PR | — | Execute a relative motion. |
| AU? | — | Get maximum acceleration and deceleration. |
| AC | — | Set acceleration. |

**Example**

| | | |
|---|---|---|
| **2AE?** | \| | *Read e-stop deceleration of axis #2.* |
| *100* | \| | *Controller returns a value of 100 units/s$^2$.* |

# AF — Set Acceleration Feed-Forward Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**AF**nn or xx**AF**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Acceleration feed-forward gain factor.

**Range**

**xx** — **1** to **Max. Axes**.

**nn-** — **0** to **Max_Double**, or **?** to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command sets the acceleration feed-forward gain factor **AF**. It is active for any DC servo based motion device.

See the "Feed-Forward Loops" section in the ESP302 Features Manual to understand the basic principles of feed-forward.

**NOTE**

**The command can be sent at any time but it has no effect until the UF (update filter) is received.**

**This command is volatile, to change the parameter permanently change KFeedForwardAcceleration in the configuration file.**

**Returns**

If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

KI — Set integral gain factor.

KD — Set derivative gain factor.

KP — Set proportional gain factor.

KS — Set saturation gain factor.

VF — Set velocity feed-forward gain.

UF — Update filter.

**Example**

3VF1.5 | *Set acceleration feed-forward gain factor for axis #3 to 1.5.*

**3AF?** | *report present axis-3 acceleration feedforward setting.*

*0.9* | *Controller returns a value of 0.9*

**3AF0.8** | *Set acceleration feed-forward gain factor for axis #3 to 0.8.*

3UF | *Update PID filter; only now the AF command takes effect.*

# AG — Set Deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**AG**nn or xx**AG**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Acceleration value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **the maximum programmed value in AU command**, or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Predefined units/second$^2$. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x11, MAXIMUM ACCELERATION EXCEEDED. |

**Description** Obsolete command, but kept for backward compatibility.

This command is equivalent to AC (acceleration = deceleration)

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| AC | — | Set acceleration/deceleration. |

# AP — Abort Program

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **AP**

**xxAP**

**APnn**

**Parameters**

**Description** **xx** [int] — Program number.

**nn** [string] — Program task name

**Range** **xx** — **1** to **2000**

**nn** —. **1** to **20** characters

**Units** **xx** — None.

**nn** — None.

**Description** This command is used to interrupt a motion program in execution. It will not stop a motion in progress. It will only stop the program after the current command line finished executing.

It can be used as an immediate command or inside a program.

Inside a program it is useful in conjunction with program flow control commands. It could, for instance, terminate a program on the occurrence of a certain external event, monitored by an I/O bit.

If AP is sent without program number or task name, all running programs will be aborted.

**Returns** None.

**Rel. Commands** EX — Execute a program.

**Example**

| | | |
|---|---|---|
| 3EX | \| | *Execute program #3.* |
| … | | |
| … | | |
| … | | |
| *3AP* | \| | *Abort program 3* |
| *AP"P3"* | \| | *Abort program with task name "P3"* |
| **AP** | \| | *Stop all program execution.* |

# AU — Get Maximum Acceleration and Deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**AU**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE

**Description** This command is used to get the maximum acceleration and deceleration value for an axis. This parameter is read-only and can be modified only through the MaximumAcceleration parameter in configuration file.

**Returns** This command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| VA | — | Set velocity. |
| PA | — | Execute an absolute motion. |
| PR | — | Execute a relative motion. |
| AC | — | Set acceleration/deceleration. |

**Example**

| | | |
|---|---|---|
| **AU?** | \| | *Read maximum allowed acceleration/deceleration of axis #2.* |
| *10* | \| | *Controller returns a value of 10 units/s$^2$* |

# BA — Set Backlash Compensation

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BA**nn or xx**BA**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | backlash compensation value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **distance equivalent to 10000 encoder counts**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | User units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command initiates a backlash compensation algorithm when motion direction is reversed. The controller keeps track of the motion sequence and for each direction change it adds the specified **nn** correction. Setting **nn** to zero disables the backlash compensation.

**NOTE**

**The command is affective only after a home search (OR) or define home (DH) is performed on the specified axis.**

**This command is volatile, to change the parameter permanently change Backlash in the configuration file.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands** None.

**Example**

| | | |
|---|---|---|
| **1BA0.0012** | \| | *Set backlash compensation value for axis #1 to 0.0012 units.* |
| **1BA?** | \| | *Query backlash compensation value for axis #1.* |
| *0.0012* | \| | *Controller returns a value of 0.0012 units.* |
| 1OR | \| | *Perform home search on axis #1.* |
| 1PA10 | \| | *Move axis #1 to absolute 10 units.* |
| 1PA0 | \| | *Move axis #1 to absolute 0 units.* |

# BG — Assign DIO Bits to Execute Stored Programs

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**BG**nn or xx**BG**?

**xxBGfilename,taskname**

**Parameters**

**Description**

| | | |
|---|---|---|
| **xx** [int] | — | bit number used to trigger stored program execution. |
| **nn** [char] | — | number of stored program to be executed. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **0** to **15**. |
| **nn** | — | **0** to **2000** or **?** to read current setting. |
| **filename** | — | 1 to 250 characters |
| **taskname** | — | 1 to 20 characters |

**Units** None.

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 7, PARAMETER OUT OF RANGE. |
| | Out of range: | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command is used to assign DIO bits for initiating the execution of a desired stored program. Execution of the stored program begins when the specified DIO bit changes its state from HIGH to LOW logic level.

**The trigger is disabled when program number is set to 0.**

The program command has two syntaxes:

- Legacy syntaxe : xxBGnn

  This syntax is the same than ESP301 controller and allows launching a program by its number (created with EP command). The task name of a program launched with this syntax will be Pnn with nn the number of the program.

- Filename syntax : BGnn,"filename","taskname"

This syntax allows to launche any program file from /Admin/Public/Progs/ folder and to attribute a name to the program task (to kill it with AP command)

**NOTE**

**Each DIO bit has a pulled-up resistor to +5 V. Therefore, all bits will be at HIGH logic level if not connected to external circuit and configured as input.**

**ESP302 commands are converted to upcase except for characters in quotation marks; it is advisable to put the filename and taskname in quotation marks.**

**Returns** If the "?" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| BO | — | Set DIO port direction. |
| EP | — | Enter program mode. |
| EX | — | Execute stored program. |
| AP | — | Abort stored program execution. |

**Example**

| | | |
|---|---|---|
| BO00H | \| | *Set DIO ports A and B to input.* |
| **0BG1** | \| | *Start execution of a s*tored program 1 when DIO bit #0 changes state *from HIGH to LOW.* |

# BK — Assign DIO Bits to Inhibit Motion

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BK**nn$_1$, nn$_2$ or xx**BK**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn$_1$** [int] | — | Bit number for inhibiting motion. |
| **nn$_2$** [int] | — | Bit level when axis motion is inhibited. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn$_1$** | — | **0** to **15**. |
| **nn$_2$** | — | **0** = LOW and **1** = HIGH or **?** to read current setting. |

**Units** None.

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn$_1$** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |
| **nn$_2$** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command is used to assign DIO bits for inhibiting the motion of a selected axis. If the selected axis is already in motion, and DIO bit is asserted, e-stop is executed per E-stop configuration (Refer **ZE** command for further details). If the axis is not moving, any new move commands are refused as long as the DIO bit is asserted. In either case, "DIGITAL I/O INTERLOCK DETECTED" error is generated.

**NOTE**

**The direction of the DIO port (A, B) the desired bit belongs to, should be set to "input" in order for the DIO bit to be read accurately. Refer BO command for further details.**

**Returns** If the "?" sign takes the place of **nn** value, this command reports the current assignment.

**Rel. Commands**

| | | |
|---|---|---|
| BL | — | Enable DIO bits to inhibit motion. |
| BO | — | Set DIO port direction. |
| BM | — | Assign DIO bits to notify motion status. |

**Example**

| | | |
|---|---|---|
| BO00H | \| | *Set DIO ports A, B to input.* |
| **2BK1, 1** | \| | *Use DIO bit #1 to inhibit motion of axis #2. This DIO bit should be HIGH when axis #2 motion is inhibited.* |
| 2BL1 | \| | *Enable inhibition of motion using DIO bits for axis #2.* |
| **2BK?** | \| | *Query the DIO bit assignment for axis #2.* |
| *1, 1* | \| | *The controller responds with the assigned values.* |

⚠ Since this function is software dependant, it cannot be used for safety purpose. In this case, use the Inhibit port on controller rear panel.

# BL — Enable DIO Bits to Inhibit Motion

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BL**nn or xx**BL**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Disable or enable.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** = disable, and **1** = enable or **?** to read current setting.

**Units** None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command is used to disable or enable motion inhibition of requested axes through DIO bits.

**Returns** If the "?" sign takes the place of **nn** value, this command reports the current status.

**Rel. Commands**

BK — Assign DIO bits to inhibit motion.

BO — Set DIO port direction.

BM — Assign DIO bits to notify motion status.

BN — Enable DIO bits to notify motion status.

**Example**

BO00H | *Set DIO ports A and B to input.*

2BK1, 1 | *Use DIO bit #1 to inhibit motion of axis #2. This DIO bit should be HIGH when axis #2 motion is inhibited.*

**2BL1** | *Enable inhibition of motion using DIO bits for axis #2.*

2BK? | *Query the DIO bit assignment for axis #2.*

*1, 1* | *The controller responds with the assigned values.*

**2BL?** | *Query the status of inhibiting motion for axis #2 through DIO.*

*1* | *The controller responds with 1 indicating feature is enabled.*

# BM — Assign DIO Bits to Notify Motion Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BM**nn$_1$, nn$_2$ or xx**BM**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn$_1$** [int] | — | Bit number for notifying motion status. |
| **nn$_2$** [int] | — | Bit level when axis is not moving. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn$_1$** | — | **0** to **15**. |
| **nn$_2$** | — | **0** = LOW and **1** = HIGH or **?** to read current setting. |

**Units** None

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn$_1$** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |
| **nn$_2$** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command is used to assign DIO bits for notifying the motion status – moving or not moving – of a selected axis. When the selected axis is not moving, the DIO bit state changes to the level specified with this command (refer parameter nn2).

**NOTE**

**The direction of the DIO port (A, B) the desired bit belongs to, should be set to "output" in order for the DIO bit to be set accurately. Refer BO command for further details.**

**NOTE**

**If a motion feature, such as origin search, involves a sequence of moves, the motion status will be set to not moving only after the entire sequence of moves has completed.**

Returns If the "?" sign takes the place of **nn** value, this command reports the current assignment.

**Rel. Commands**

| | | |
|---|---|---|
| BN | — | Enable DIO bits to notify motion status. |
| BO | — | Set DIO port direction. |

**Example**

| | | |
|---|---|---|
| BO02H | \| | *Set DIO port GPIO1 to input and port GPIO2 to output.* |
| **2BM9, 1** | \| | *Use DIO bit #9 to indicate motion status of axis #2. This DIO bit should be HIGH when axis #2 is not moving.* |
| 2BN1 | \| | *Enable notification of motion using DIO bits for axis #2.* |
| **2BM?** | \| | *Query the DIO bit assignment for axis #2.* |
| *9, 1* | \| | *The controller responds with the assigned values.* |

# BN — Enable DIO Bits to Notify Motion Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BN**nn or xx**BN**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Disable or enable.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** = disable, and **1** = enable or ? to read current setting.

**Units** None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command is used to disable or enable notification of requested axis' motion status through DIO bits.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current status.

**Rel. Commands**

BM — Assign DIO bits to notify motion status.

BO — Set DIO port direction.

BK — Assign DIO bits to inhibit motion.

BL — Enable DIO bits to inhibit motion.

**Example**

| | |
|---|---|
| BO02H | *Set DIO port GPIO1 to input and port GPIO2 to output.* |
| 2BM9, 1 | *Use DIO bit #9 to indicate motion status of axis #2. This DIO bit should be HIGH when axis #2 is not moving.* |
| **2BN1** | *Enable notification of motion using DIO bits for axis #2.* |
| 2BM? | *Query the DIO bit assignment for axis #2.* |
| *9, 1* | *The controller responds with the assigned values.* |
| **2BN?** | *Query the status of notifying motion status of axis #2 through DIO bits.* |
| *1* | *The controller responds with 1 indicating feature is enabled.* |

# BO — Set DIO Port Direction

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **BO**nn or **BO**?

**Parameters**

**Description** **nn** [int] — Direction.

**Range** **nn** — **0** to **03H** (hexadecimal with leading zero(0)), or **?** to read current setting.

**Units** **nn** — None.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command is used to set digital I/O (DIO) port GPIO1 and GPIO2 direction where bit-0 corresponds to port GPIO1and bit-1 to port GPIO2. If any bit is set to zero(0) then its corresponding port will become an input only. If any bit is set to one(1) then its corresponding port will become an output only.

A DIO within a port configured as an input can only report its present HIGH or LOW logic level. Whereas a DIO bit within a port configured as an output can set(1) or clear(0) the corresponding DIO hardware to HIGH or LOW logic level.

Reading the status of a port configured as output returns its present output status.

**NOTE**

**All direction bits are automatically zeroed, or cleared, after a system reset. Therefore all DIO ports turn to input by default.**

**NOTE**

**Each DIO bit has a pulled-up resistor to +5 V. Therefore, all bits will be at HIGH logic level if not connected to external circuit and configured as input.**

| Bit# | Definition | Meaning for | |
|---|---|---|---|
| | | Bit LOW | bit HIGH |
| 0 | port GPIO1 (DIO bit-0 through bit-7) direction | INPUT | OUTPUT |
| 1 | port GPIO2 (DIO bit-8 through bit-15) direction | INPUT | OUTPUT |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

**Rel. Commands** SB — set/clear DIO bits.

**Example**

| | | |
|---|---|---|
| **BO?** | \| | *Read DIO port direction configuration.* |
| *0H* | \| | *Controller returns a value of 0H (all ports are input).* |
| **BO01H** | \| | *Configure DIO port GPIO1 as output.* |
| SB0FFH | \| | *Set all port GPIO1 DIO output HIGH.* |

# BP — Assign DIO Bits for Jog Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BP**nn$_1$,nn$_2$ or xx**BP**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn$_1$** [int] | — | Bit number for jogging in negative direction. |
| **nn$_2$** [int] | — | Bit number for jogging in positive direction. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn$_i$** | — | **0** to **15**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn$_i$** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn$_i$** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command is used to assign DIO bits for jogging axes in either negative or positive directions.

**Returns** If "?" sign is issued along with command, the controller returns the DIO bits used for jogging in negative and positive directions respectively.

**Rel. Commands**

| | | |
|---|---|---|
| BQ | — | Enable usage of DIO bits for jogging axes. |

**Example**

| | | |
|---|---|---|
| **1BP3, 4** | \| | *Set DIO bit #3 to jog axis #1 in negative direction and DIO bit #4 to jog axis #1 in positive direction.* |
| **1BP?** | \| | *Query the DIO bits assigned for jogging* |
| *3,4* | \| | *Controller returns the bit assignment.* |
| 1BQ1 | \| | *Enable axis #1 jogging through DIO bits.* |

# BQ — Enable DIO Bits for Jog Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**BQ**nn or **BQ**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Disable or enable**.**

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** = disable, and **1** = enable**.**

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command is used to disable or enable jogging of a requested axis through DIO bits.

**Returns** If "**?**" sign is issued along with command, the controller returns the status of jog through DIO bits.

**Rel. Commands** BP — Assign *DIO bits for jog mode.*

**Example**

1BP3,4 | *Set DIO bit #3 to jog axis #1 in negative direction and DIO bit #4 to jog axis #1 in positive direction.*

1BP? | *Query the DIO bits assigned for jogging.*

*3,4* | *Controller returns the bit assignment.*

**1BQ1** | *Enable axis #1 jogging through DIO bits.*

# CL — Set Closed Loop Update Interval

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**CL**nn or xx**CL**?

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| | **nn** [int] | — | Closed loop update interval. |
| **Range** | **xx** | — | **0** to **Max. Axes**. |
| | **nn** | — | **0** to **60000**. |
| **Units** | **xx** | — | None. |
| | **nn** | — | Milliseconds. |
| **Defaults** | **xx** Missing: | | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the ISR corrector period.

| | | | |
|---|---|---|---|
| **Rel. Commands** | ZB | — | Set feedback configuration. |
| | DB | — | Set position deadband value. |
| **Example** | ZB | \| | *Set feedback configuration.* |
| | DB | \| | *Set position deadband value.* |

# CO — Set Linear Compensation

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**CO**nn or xx**CO**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Linear compensation value.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **-2e+9** to **2e+9**.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command allows users to compensate for linear positioning errors due to stage inaccuracies. Such errors decrease or increase actual motion linearly over the travel range.

The linear compensation value, **nn** is calculated according to the formula given below:

$$nn = \frac{error}{travel}$$

where:

*travel* = Measured travel range.

*Error* = Error accumulated over the measured travel range.

---

**NOTE**

**The command is affective only after a home search (OR) or define home (DH) is performed on the specified axis.**

**This command is volatile, to change the parameter permanently change LinearEncoderCorrection in the configuration file.**

---

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands** None.

**Example** If a stage has a travel range of 100 mm and it accumulates an error of 0.003 mm over the complete travel range,

$$nn = \left(\frac{0.003}{100}\right) = 0.00003$$

| | | |
|---|---|---|
| **1CO0.00003** | \| | *Set linear compensation value for axis #1 to 0.00003.* |
| **1CO?** | \| | *Query linear compensation value for axis #1.* |
| *0.00003* | \| | *Controller returns a value of 0.00003.* |
| 1OR | \| | *Perform home search on axis #1.* |
| 1PA10 | \| | *Move axis #1 to absolute 10 units.* |

# DB — Set Position Deadband

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**DB**nn or xx**DB**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [int] | — | deadband value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **0** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Long**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Encoder counts. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.
This command has no effect.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| ZB | — | Set feedback configuration. |
| CL | — | Set closed loop update interval. |

# DC — Setup Data Acquisition

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **DC**$nn_1$,$nn_2$,$nn_3$,$nn_4$,$nn_5$,$nn_6$

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **Description** | **$nn_1$** [int] | — | Data acquisition mode. |
| | **$nn_2$** [int] | — | Axis used to trigger data acquisition. |
| | **$nn_3$** [int] | — | Data acquisition parameter 3 – not used. |
| | **$nn_4$** [int] | — | Data acquisition parameter 4. |
| | **$nn_5$** [int] | — | Data acquisition rate. |
| | **$nn_6$** [int] | — | Number of data samples to be acquired. |
| **Range** | **$nn_1$** | — | **0** = Start data acquisition immediately.<br>**1** = Start data acquisition when trigger axis starts motion.<br>**2** = Start data acquisition when trigger axis reaches slow speed. |
| | **$nn_2$** | — | **1** to **Max. Axes**. |
| | **$nn_3$** | — | **0**. |
| | **$nn_4$** | — | **0** to **7**. |
| | **$nn_5$** | — | **0** to **15000**. |
| | **$nn_6$** | — | **1** to **1000**. |
| **Units** | None. | | |
| **Defaults** | **nn** Missing: | | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command is used to setup data acquisition — encoder position in increments — using ESP motion controller.

**Parameter $nn_1$:** Data acquisition modes 0—2 support different triggers to start gathering.

**Parameter $nn_2$:** Data acquisition is triggered by the motion of an axis specified through this parameter. Exceptions to this requirement are in the case of data acquisition mode 0. For this case enabling data acquisition is sufficient to start the data acquisition process.

For all other modes, two conditions — enabling of data acquisition and any mode dependent conditions such as trigger axis starting motion or reaching slew speed — must be met in order to start the data acquisition process.

**Parameter $nn_3$:** Set this value to 0.

**Parameter $nn_4$**: This parameter is used to identify the encoder position feedback axes to be collected in increments. Please refer to table below.

| nn4 | Position feedback axes collected |
|---|---|
| 0 | none |
| 1 | axis 1 |
| 2 | axis 2 |
| 3 | axes 1 & 2 |
| 4 | axis 3 |
| 5 | axes 1 & 3 |
| 6 | axes 2 & 4 |
| 7 | axes 1,2,3 |

**Parameter $nn_5$:** The rate at which data is to be acquired is specified through this parameter. The rate specified is in multiples of the servo rate. For example, a value of 1 (or 0) implies data acquisition every servo cycle, a value of 2 implies every other servo cycle, and so on.

**Parameter $nn_6$:** The number of samples of data to be acquired is specified through this parameter. Data acquisition process is considered to be "done" only after the number of samples specified by this parameter is acquired by the controller. The status of data acquisition process may be found by issuing ASCII command **DD**. Once the data acquisition is done, ASCII command **DG** may be used to collect the data from the controller.

**NOTE**

**The controller responds with a servo cycle tick count along with every data sample collected.**

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| DD | — | Get data-acquisition done status. |
| DE | — | enable/disable data-acquisition |
| DF | — | Get data-acquisition status – number of samples collected |
| DG | — | Get data-acquisition data |

**Example**

| | | |
|---|---|---|
| **DC1,2,0,4,1,10** | \| | *Acquire encoder position for axis 3 as soon as the axis 2 motion starts. Collect 10 samples, one sample / servo cycle.* |
| DE1 | \| | *Enable data acquisition.* |
| 3TP | \| | *Get current position of axis 3.* |
| 2.000 | \| | *Axis 3 position = 2.000.* |
| 2PA5 | \| | *Start motion on axis 2.* |
| DD | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| DE0 | \| | *Disable trace variable data acquisition.* |
| DF | \| | *Get the current data acquisition sample count.* |
| 10 | \| | *10 points are acquired in memory.* |
| DG | \| | *Get data collected.* |
| N N N N N N N N N N | \| | *Collected data in binary format (use an adapted software to get data).* |

# DD — Get Data Acquisition Done Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **DD**

**Parameters** None.

**Description** This command returns the status of a data acquisition request.

**Returns** **aa**, where:
aa = **1** for True or **0** for False.

**Rel. Commands**

| | | |
|---|---|---|
| DC | — | setup data acquisition request. |
| DG | — | Get acquired data. |
| DF | — | Data acquisition status, returns #of samples collected. |
| DE | — | Enable/disable data acquisition. |

**Example**

| | | |
|---|---|---|
| DC1,2,0,4,1,10 | \| | *Acquire encoder position for axis 3 as soon as the axis 2 motion starts. Collect 10 samples, one sample / servo cycle.* |
| DE1 | \| | *Enable data acquisition.* |
| 3TP | \| | *Get current position of axis 3.* |
| 2.000 | \| | *Axis 3 position = 2.000.* |
| 2PA5 | \| | *Start motion on axis 2.* |
| **DD** | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| DE0 | \| | *Disable trace variable data acquisition.* |
| DF | \| | *Get the current data acquisition sample count.* |
| 10 | \| | *10 points are acquired in memory.* |
| DG | \| | *Get data collected.* |
| N N N N N N N N N N | \| | *Collected data in binary format (use an adapted software to get data).* |

# DE — Enable/Disable Data Acquisition

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **DE**nn

**Parameters** **nn**

**Description** **nn** [int] — True | False.

**Range** **nn** — **1** for True, **0** for False.

**Description** This command is used to enable/disable the data acquisition request.

**NOTE**

**This command cannot be issued when:**

1. **An axis is being homed (refer ASCII command, OR).**
2. **An axis is being moved to a travel limit (refer ASCII command, MT).**
3. **An axis is being moved to an index (refer ASCII command, MZ).**

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| DC | — | Setup data acquisition request. |
| DG | — | Get acquired data. |
| DF | — | Data acquisition status, returns #of samples collected. |
| DD | — | Data acquisition done status. |

**Example**

| | | |
|---|---|---|
| DC1,2,0,4,1,10 | \| | *Acquire encoder position for axis 3 as soon as the axis 2 motion starts. Collect 10 samples, one sample / servo cycle.* |
| **DE1** | \| | *Enable data acquisition.* |
| 3TP | \| | *Get current position of axis 3.* |
| 2.000 | \| | *Axis 3 position = 2.000.* |
| 2PA5 | \| | *Start motion on axis 2.* |
| DD | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| **DE0** | \| | *Disable trace variable data acquisition.* |
| DF | \| | *Get the current data acquisition sample count.* |
| 10 | \| | *10 points are acquired in memory.* |
| DG | \| | *Get data collected.* |
| N N N N N N N N N N | \| | *Collected data in binary format (use an adapted software to get data).* |

# DF — Get Data Acquisition Sample Count

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **DF**

**Parameters** None.

**Description** This command returns the number of a data acquisition collected to the point of this request.

**Returns** **aa**, where:
aa = **Number of samples**.

**Rel. Commands**

| | | |
|---|---|---|
| DC | — | Setup data acquisition request. |
| DG | — | Get acquired data |
| DD | — | Data acquisition done status |
| DE | — | Enable/disable data acquisition |
| TM | — | Set trace mode |
| TT | — | Read trace data |

**Example 1**

| | | |
|---|---|---|
| DC1,2,0,4,1,10 | \| | *Acquire encoder position for axis 3 as soon as the axis 2 motion starts. Collect 10 samples, one sample / servo cycle.* |
| DE1 | \| | *Enable data acquisition.* |
| 3TP | \| | *Get current position of axis 3.* |
| 2.000 | \| | *Axis 3 position = 2.000.* |
| 2PA5 | \| | *Start motion on axis 2.* |
| DD | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| DE0 | \| | *Disable trace variable data acquisition.* |
| **DF** | \| | *Get the current data acquisition sample count.* |
| 10 | \| | *10 points are acquired in memory.* |
| DG | \| | *Get data collected.* |
| N N N N N N N N N N | \| | *Collected data in binary format (use an adapted software to get data).* |

**Example 2**

| | | |
|---|---|---|
| SP0.001 | \| | *Set sample period to 1ms.* |
| 1TM1000 | \| | *Acquire trace variable data for axis 1. Collect 1000 samples.* |
| 1PR5 | \| | *Start a move on axis 1 to start acquisition.* |
| DD | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| TT Gathering.dat | \| | *Disable trace variable data acquisition.* |

# DG — Get Acquisition Data

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **DG**

**Parameters** None.

**Description** This command is used to retrieve data acquired from a data acquisition request.

**Returns** This command returns byte wide binary data. Each four bytes (b3b2b1b0) represents one DSP 32 bit word. The number of bytes returned depends on the setup request. (See **DC** command).

**NOTE**

**If collected data are ZERO then the binary response will be NULL. In this case, the DG response cannot be seen from a command line.**

Example of returned byte wide binary data after an acquisition of **10 points**:
Returned data: N N N N N N N N N N
Data length = 10 * 4 bytes = 40

```
20 4e 00 00 20 4e 00 00 20 4e 00 00 20 4e 00 00    N.. N.. N.. N..
20 4e 00 00 20 4e 00 00 20 4e 00 00 20 4e 00 00    N.. N.. N.. N..
20 4e 00 00 20 4e 00 00                            N.. N..
```

```
b0 b1 b2 b3  => (hexa)b3b2b1b0
```

```
20 4e 00 00  => (hexa)00004e20 = (decimal)20000
```

**Rel. Commands**

| | | |
|---|---|---|
| DC | — | Setup data acquisition request. |
| DE | — | Enable/disable data acquisition. |
| DF | — | Data acquisition status, returns # of samples collected. |
| DD | — | Data acquisition done status. |

**Example**

| | | |
|---|---|---|
| DC1,2,0,4,1,10 | \| | *Acquire encoder position for axis 3 as soon as the axis 2 motion starts. Collect 10 samples, one sample / servo cycle.* |
| DE1 | \| | *Enable data acquisition.* |
| 3TP | \| | *Get current position of axis 3.* |
| 2.000 | \| | *Axis 3 position = 2.000.* |
| 2PA5 | \| | *Start motion on axis 2.* |
| DD | \| | *Query data-acquisition done status.* |
| 1 | \| | *1 = true, 0 = false.* |
| If true, | | |
| DE0 | \| | *Disable trace variable data acquisition.* |
| DF | \| | *Get the current data acquisition sample count.* |
| 10 | \| | *10 points are acquired in memory.* |
| **DG** | \| | *Get data collected.* |
| N N N N N N N N N N | \| | *Collected data in binary format (use an adapted software to get data).* |

# DH — Define Home

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**DH**nn or xx**DH**?

**Parameters**

**Description**
**xx** [int] — Axis number.
**nn** [float] — Position value.

**Range**
**xx** — **1** to **Max. Axes**.
**nn** — **-2e+9** to **+2e+9**.

**Units**
**xx** — None.
**nn** — Predefined units.

**Defaults**
**xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.
**nn** Missing: Error 38, COMMAND PARAMETER MISSING.
Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command is used to define the value of the current position. This means that the current position will be preset to the value defined by parameter '**nn**'.

**NOTE**

**Soft limits will be changed automatically to the corresponding values.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the last setting value.

**Rel. Commands**
OR — Execute a home search cycle.

**Example**

```
3OR1     |  Perform a home search on axis #3.
…
…
…
3DH      |  Define current position on axis #3 at 0 units
…
…
…
3DH20.0  |  Define current position on axis #3 at 20.0 units.
```

# DL — Define Label

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | – | ♦ | – |

**Syntax** xx**DL**

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Label number. |
| **Range** | **xx** | — | **1** to **100**. |
| **Units** | **xx** | — | None. |
| **Default** | **xx** Missing: | | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command defines a label inside a program. In combination with JL (jump to label) command, they offer significant program flow control.

The operation of the DL/JL command pair is similar to commands in other computer languages that allow conditional jumps (or GOTO's) to pre-defined labels in a program.

**NOTE**

**This command does not generate an error when not used inside a program. Since it can not do any harm, it is only ignored.**

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | JL | — | Jump to label. |

**Example**

| | | |
|---|---|---|
| 3XX | \| | *Clear program 3 from memory, if any.* |
| 3EP | \| | *Create program 3.* |
| **1DL** | \| | *Define label 1.* |
| … | | |
| … | | |
| … | | |
| 1JL 5 | \| | *Jump to label 1 five(5) times.* |
| QP | \| | *End entering program and quit programming mode.* |
| 3EX | \| | *Run stored program number 3.* |

# DO — Set DAC Offset

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**DO**nn or xx**DO**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | DAC channel number. |
| **nn** [float] | — | DAC offset value. |

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.
This command does nothing.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports 0.

**Rel. Commands** None.

# DP — Read Desired Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**DP**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to read the desired position. It returns the instantaneous desired position.

The command could be sent at any time but its real use is while a motion is in progress.

**Returns** **nn**, where:
nn = **Desired position** in pre-defined units.

**Rel. Commands**
PA — Move to an absolute position.
PR — Move to a relative position.
TP — Read actual position.

**Example**
3TP? | *Read position on axis #3.*
*5.32* | *Controller returns position 5.32 for axis #3.*
3PR2.2 | Start *a relative motion of 2.2 on axis #3.*
**3DP?** | *Read desired position on axis #3.*
*7.52* | *Controller returns desired position 7.52 for axis #3.*

# DV — Read Desired Velocity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**DV**

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to read the desired velocity of an axis. The command can be sent at any time but its real use is while motion is in progress.

**Returns** **nn**, where:
nn = **Desired velocity of the axis** in pre-defined units.

**Rel. Commands** PA — Move to an absolute position.
PR — Move to a relative position.

**Example**

| | | |
|---|---|---|
| 3TP? | \| | *Read position on axis #3.* |
| *5.32* | \| | *Controller returns position 5.32 units for axis #3* |
| 3PR2.2 | \| | *Start a relative motion of 2.2 units on axis #3* |
| **3DV** | \| | *Read desired velocity on axis #3.* |
| *0.2* | \| | *Controller returns velocity 0.2 units/s for axis #3* |
| 3DP? | \| | *Read desired position on axis #3* |
| *7.52* | \| | *Controller returns desired position 7.52 units for axis #3* |

# EO — Automatic Execution on Power ON

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**EO**nn

**EOnn,filename**

**EO?**

**Parameters**

**Description**

**xx** [int] — Program number.

**nn** [int] — Number of times of execution.

**Range**

**xx** — **1** to **2000**.

**nn** — **1** to **Max_Long**.

**filename** — 1 to 250 characters

**Units**

**xx** — None.

**nn** — None.

**Defaults** None.

**Description** This command sets the program number that is automatically executed on power on. If **nn** is missing, the **xx** numbered program is executed once.

The program command has two syntaxes:

- Legacy syntaxe : xxEOnn

  This syntax is the same than ESP301 controller and allows launching a program by its number (created with EP command).

- Filename syntax : EOnn,"filename"

  This syntax allows to launche any program file from /Admin/Public/Progs/ folder

The task name of a program launched at boot is BOOTPROG.

**NOTE**

**ESP302 commands are converted to upcase except for characters in quotation marks; it is advisable to put the filename in quotation marks.**

**Returns** If the sign "**?**" takes place of **nn** value, this command reports the file name of the program that is executed on power on and the number of times of execution.

**Rel. Commands**

QP — Quit programming mode.

EX — Execute stored program.

AP — Abort stored program execution.

XX — Erase program.

**Example**

| | | |
|---|---|---|
| **3EO** | \| | *Set program #3 to be executed once on power on.* |
| **EO?** | \| | *Query the program number executed on power on.* |
| *P3.txt,1* | \| | *Controller returns program #3 executed once on power on.* |
| **EO** | \| | *Reset automatic program execution – no program is executed on power on.* |

# EP — Enter Program Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | – |

**Syntax** xx**EP**

**Parameters**

**Description** **xx** [int] — Program number.

**Range** **xx** — **1** to **127**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command sets the controller in programming mode. All the commands following this one will not be executed immediately but stored in memory as part of program number **xx**. To exit program entry mode and return to immediate mode, use QP command.

Programs can be entered in any order. If a program already exists then it must be first deleted using XX command.

**NOTE**

**Programs are automatically stored into in file /Admin/Public/Progs/Pxx.txt when created.**

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| QP | — | Quit programming mode. |
| EX | — | Execute stored program. |
| AP | — | Abort stored program execution. |
| XX | — | Erase program. |

**Example**

| | | |
|---|---|---|
| 3XX | \| | *Clear program 3 from memory, if any.* |
| **3EP** | \| | *Activate program mode and enter following commands as program 3* |
| … | | |
| … | | |
| … | | |
| QP | \| | *End entering program and quit programming mode* |
| 3EX | \| | *Run stored program number 3.* |

# EX — Execute a Program

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**EX**nn

**EXnn,filename,taskname**

**EX?**

**Parameters**

**Description**

**xx** [int] — Program number.

**nn** [int] — **Number** of times to execute the program.

**Range**

**xx** — **1** to **2000**.

**nn** — **1** to **2147385345.**

**filename** — 1 to 250 characters

**taskname** — 1 to 20 characters

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**nn** Missing: 1 assumed.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description**

This command is used to start executing a program. When the command is received the controller executes the program line by line or according to the flow control instructions.

To stop the program execution, use the AP command.

The program command has two syntaxes:

- Legacy syntaxe : xxEXnn

  This syntax is the same than ESP301 controller and allows launching a program by its number (created with EP command). The task name of a program launched with this syntax will be Pnn with nn the number of the program.

- Filename syntax : EXnn,"filename","taskname"

This syntax allows to launche any program file from /Admin/Public/Progs/ folder and to attribute a name to the program task (to kill it with AP command)

**NOTE**

**ESP302 commands are converted to upcase except for characters in quotation marks; it is advisable to put the filename and taskname in quotation marks.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the list of current running tasks separated by a comma.

**Rel. Commands**

QP — Quit programming mode.

EP — enter program mode.

AP — Abort stored program execution.

XX — Erase program.

**Example**

3XX | *Clear program 3 from memory, if any.*

| | | |
|---|---|---|
| 3EP | \| | *Activate program mode and enter following commands as program 3.* |
| … | | |
| … | | |
| … | | |
| QP | \| | *End entering program and quit programming mode* |
| **3EX** | \| | *Run stored program number 3.* |
| *EX?* | \| | *Ask current running programs* |
| *1,P3* | \| | *Controller returns 1 running program with task name P3* |
| *EX10,"MyProg.txt","MyTask"* | \| | *Run 10x stored program "MyProg.txt" with task name MyTask* |
| *EX?* | \| | *Ask current running programs* |
| *2,P3,MyTask* | \| | *Controller returns 2 running programs with tasks names P3 and MyTask* |
| *3AP* | \| | *Abort program 3* |
| *AP"MyTask"* | \| | *Abort program with task name "MyTask"* |

# FE — Set Maximum Following Error Threshold

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**FE**nn or xx**FE**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Maximum allowed following error. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to (**Max_Long * encoder resolution**), or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Predefined units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command sets the maximum allowed following error threshold for an axis. This error is defined as the difference between the real position and the theoretical position of a motion device. The real position is the one reported by the position sensing device (encoder, scale, etc.) and the theoretical position is calculated by the controller each servo cycle (100 µs). If, for any axis and any servo cycle, the following error exceeds the preset maximum allowed following error, the controller aborts motion using e-stop deceleration and turns motor power OFF.

**NOTE**

**This command is volatile, to change the parameter permanently change FatalFollowingError in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands** ZF — Set following error event configuration.

**Example**

| | | |
|---|---|---|
| **3FE?** | \| | *Read maximum following error for axis #3.* |
| *0.5* | \| | *Controller returns for axis #3 following error of 0.5 unit.* |
| **3FE1.0** | \| | *Set maximum following error for axis #3 to 1 unit.* |

# FP — Set Position Display Resolution

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**FP**nn or xx**FP**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [int] | — | Display resolution. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **7**,<br>or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE |

**Description** This command is used to set the display resolution of position information. For instance, if **nn** = 4, the display will show values as low as 0.0001 units. If **nn** = 7, the display will show values in exponential form. If the user units (refer SN command) are in encoder counts or stepper increments, the position information is displayed in integer form, independent of the value set by this command.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands** None.

**Example**

| | | |
|---|---|---|
| **1FP?** | \| | *Read position display resolution for axis #1.* |
| *4* | \| | *Controller returns a value of 4.* |
| 1TP | \| | *Read actual position of axis #1.* |
| *5.0001* | \| | *Controller returns position value.* |
| **1FP2** | \| | *Set position display resolution for axis #1 to 2.* |
| 1TP | \| | *Read actual position of axis #1.* |
| *5.00* | \| | *Controller returns position value.* |
| **1FP7** | \| | *Set position display resolution for axis #1 to 7.* |
| 1TP | \| | *Read actual position of axis #1.* |
| *5.000000E+0* | \| | *Controller returns position value.* |

# FR — Set Encoder Full-Step Resolution

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**FR**nn or xx**FR**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Encoder full step resolution. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **2e-9** to **2e+9** in user defined units, or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command is equivalent to SU.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

| | | |
|---|---|---|
| SU | — | Set encoder resolution. |

# GR — Set Master-Slave Reduction Ratio

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**GR**nn or xx**GR**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Reduction ratio.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **±0.000001 to ±1,000,000**.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command sets the master-slave reduction ratio for a slave axis. The trajectory of the slave is the desired trajectory or actual position of the master scaled by reduction ratio.

**NOTE**

**Use this command very carefully. The slave axis will have its speed and acceleration in the same ratio as the position. Also, ensure that the ratio used for the slave axis does not cause overflow of this axis' parameters (speed, acceleration), especially with ratios greater than 1.**

**Returns** If "**?**" sign is issued along with command, the controller returns master-slave reduction ratio.

**Rel. Commands** SS — Define master-slave relationship.

**Example**

| | | |
|---|---|---|
| 2SS1 | \| | *Set axis 2 to be the slave of axis 1.* |
| 2SS? | \| | *Query the master axis number for axis 2.* |
| *1* | \| | *Controller returns a value of 1.* |
| **2GR0.5** | \| | *Set the reduction ratio of axis 2 to 0.5.* |
| **2GR?** | \| | *Query the reduction ratio of axis 2.* |
| *0.5* | \| | *Controller returns a value of 0.5.* |

# HA — Set Group Acceleration/deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HA**nn or **HA**?

**Parameters**

**Description** **nn** [float] — Vector acceleration value.

**Range** **nn** — **0** to **minimum of the maximum acceleration values of all axes assigned to this group**.

**Units** **nn** — Predefined units/second$^2$.

**Defaults**

**nn** Missing: Error 7, PARAMETER OUT OF RANGE.
Negative: Error 30, GROUP PARAMETER OUT OF RANGE.
Out of range: Error 32, GROUP MAXIMUM ACCELERATION EXCEEDED.

**Description** This command is used to set the vectorial acceleration and deceleration value for a group. This value will be used during coordinated motion of axes assigned to the group. It will override any original acceleration values specified for individual axes using AC command. The axes' original values will be restored when the group to which they have been assigned is deleted.

This command takes effect immediately. It can be executed when controller is idling or motion is in progress or inside a program.

**NOTE**

**Avoid changing acceleration during acceleration or deceleration phases of a move. For better predictable results, change acceleration only when all the axes assigned to this group are not in motion.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

AU — Set maximum acceleration and deceleration for an axis.
HN — Create a new group.

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| 1AU? | \| | *Query maximum acceleration of axis #1.* |
| *50* | \| | *Controller returns a value of 50 units/second$^2$.* |
| 2AU? | \| | *Query maximum acceleration of axis #2.* |
| *60* | \| | *Controller returns a value of 60 units/second$^2$.* |
| **HA50** | \| | *Set vectorial acceleration of the group to 50 units/second$^2$.* |
| **HA?** | \| | *Query vectorial acceleration of the group.* |
| *50* | \| | *Controller returns a value of 50 units/second$^2$.* |

# HB — Read Current Number of Trajectory Elements

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | | ♦ |

**Syntax** **HB**

**Parameters** None.

**Defaults** If no group has been created,

controller returns error number 15, GROUP NUMBER NOT ASSIGNED.

**Description** This command is used to read the current trajectory elements in progress.

**Returns** This command reports the current trajectory element in progress and the total number of elements in trajectory buffer.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HX | — | Delete a group. |
| HC | — | Move group along an arc |
| HL | — | Move group along a line. |

**Example**

| | | |
|---|---|---|
| 1HN1,2 | \| | *Create a new group (#1) with physical axes 1 and 2.* |
| 1HN? | \| | *Read axes assigned to group #1.* |
| *1,2* | \| | *Controller returns the axes assigned to group #1.* |
| HL5,5;HC0,10,180;HL-10,10;HC-5,5,180 | \| | *Execute several trajectory elements.* |
| **HB** | \| | *Read current trajectory elements in progress.* |
| *1,4* | \| | *Controller returns the current trajectory element in progress (element #1 here) and the number of elements in trajectory buffer (4 elements here).* |

# HC — Move Group Along an Arc

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HC**nn$_1$,nn$_2$,nn$_3$ or **HC**?

**Parameters**

**Description**

**nn$_1$** [float] — First coordinate of arc center.

**nn$_2$** [float] — Second coordinate of arc center.

**nn$_3$** [float] — Arc sweep angle.

**Range**

**nn$_1$, nn$_2$** — Any position within the travel limits.

**nn$_3$** — Any angle.

**Units**

**nn$_1$, nn$_2$** — Predefined units.

**nn$_3$** — Degrees.

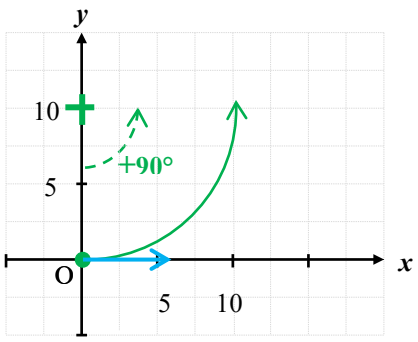
**Defaults**

**nn$_i$** Missing: Error 29, GROUP PARAMETER MISSING.

**Description**

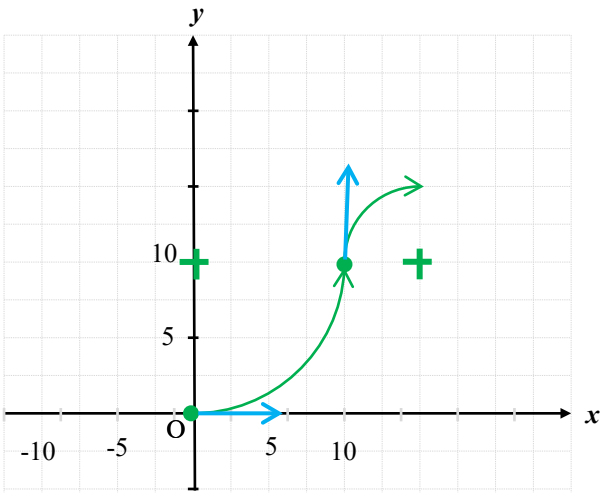
This command initiates motion of a group along an arc. It causes all axes assigned to the group to move with predefined vectorial (tangential) velocity, acceleration and deceleration along an arc. The group target position is determined based on the position of axes at the beginning of move, center of arc and sweep angle.

Example: **HC0,10,90**




If this command is received while a group move is in progress, the new command gets enqueued into a "via point" buffer. Please refer to Advanced Capabilities section in the ESP302 Features Manual for a detailed description of via point buffer implementation. The enqueued commands get executed on a FIFO basis when the move already in progress has reached its destination. The group does not come to a stop at the end of last move. Instead, there will be a smooth transition to the new move command, just as if it were one compound move (combination of multiple moves).

The starting angle, to accept an arc element, must be inferior to 1.15 °.




**NOTE**

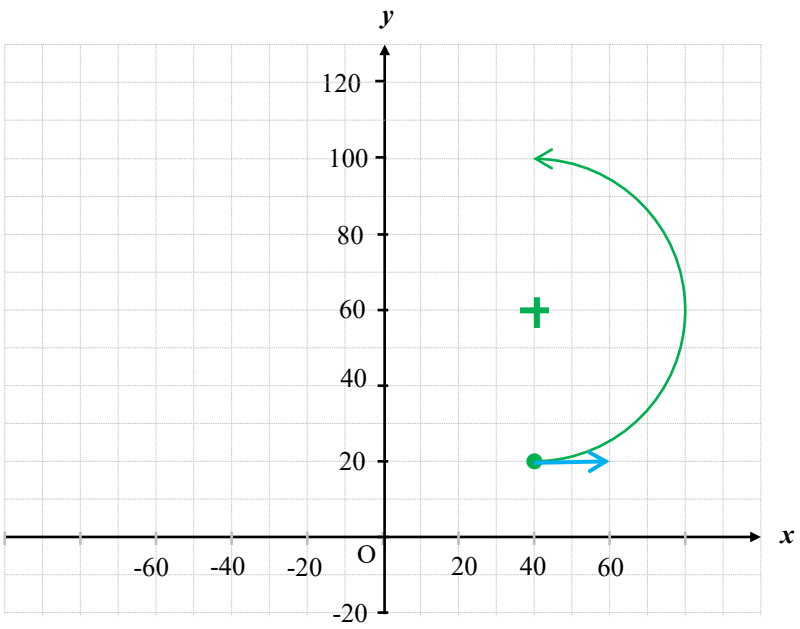
**The transition from last move to new move will be smooth if tangential velocity at the end of last move is the same as that at the beginning of new move.**

**Returns** If "**?**" sign takes the place of **nn** values, this command reports the commanded center position of arc and sweep angle.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HV | — | Set vectorial velocity for a group. |
| HA | — | Set vectorial acceleration and deceleration for a group. |
| HO | — | Enable a group. |
| HF | — | Disable a group. |
| HL | — | Move a group of axes to desired position along a line. |

| | | | |
|---|---|---|---|
| **Example** | HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| | HV10 | \| | *Set vectorial velocity of group to 10 units/second.* |
| | HA50 | \| | *Set vectorial acceleration of group to 50 units/second$^2$.* |
| | HO | \| | *Enable group.* |
| | HP? | \| | *Query current group position.* |
| | *40,20* | \| | *Controller returns axis #1 = 40 units and axis #2 = 20 units.* |
| | **HC40,60,180** | \| | *Set axis #1 arc center = 40 units.*<br>*Set axis #2 arc center = 60 units.*<br>*Set sweep angle of arc = 180 degrees.* |
| | **HC?** | \| | *Query target position of the commanded move.* |
| | *40, 60, 180* | \| | *Controller returns axis #1 arc center = 40 units, axis #2 arc center = 60 units and arc sweep angle = 180 degrees.* |
| | HP? | \| | *Query current group position.* |
| | *40,100* | \| | *Controller returns axis #1 = 40 units and axis #2 = 100 units.* |



# HD — Set Group Deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HD**nn or **HD**?

**Parameters**

**Description** **nn** [float] — Vector deceleration value.

**Range** **nn** — **0** to **minimum of the maximum deceleration values of all axes assigned to this group**.

**Units** **nn** — Predefined units/second$^2$.

**Defaults** **nn** Missing: Error 7, PARAMETER OUT OF RANGE.
Negative: Error 30, GROUP PARAMETER OUT OF RANGE.
Out of range: Error 33, GROUP MAXIMUM DECELERATION EXCEEDED.

**Description** Obsolete command, but kept for backward compatibility.
This command is equivalent to HA (acceleration = deceleration).

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**
AU — Set maximum acceleration and deceleration for an axis.
HN — Create a new group.
HA — Set vectorial acceleration and deceleration for a group.

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| 1AU? | \| | *Query maximum deceleration of axis #1.* |
| *50* | \| | *Controller returns a value of 50 units/second$^2$.* |
| 2AU? | \| | *Query maximum deceleration of axis #2.* |
| *60* | \| | *Controller returns a value of 60 units/second$^2$.* |
| **HD50** | \| | *Set vectorial deceleration of group to 50 units/second$^2$.* |
| **HD?** | \| | *Query vectorial deceleration of group.* |
| *50* | \| | *Controller returns a value of 50 units/second$^2$.* |

# HE — Get Group E-Stop Deceleration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HE**?

**Parameters** None

**Description** This command is used to get the vectorial e-stop deceleration value for a group. This value will be used during coordinated motion of axes assigned to the group.

E-stop deceleration is invoked upon a local e-stop condition (e.g., Inhibit) has occurred, if configured to do so, or if the AB (abort motion) command is processed.

**NOTE**

**E-stop deceleration value is read-only and is 10 times the normal vector acceleration/deceleration.**

**Returns** This command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HV | — | Set vectorial velocity for a group. |
| HA | — | Set vectorial acceleration for a group. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| **HE?** | \| | *Query vectorial e-stop deceleration of group.* |
| *100* | \| | *Controller returns a value of 100 units/second$^2$.* |

# HF — Group OFF

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HF** or **HF**?

**Parameters** None

**Description** This command turns power OFF of all axes assigned to a group. Refer to **MF** command to turn the power OFF of individual axes. The group power is assumed to be OFF if power to anyone of the axes in the group is OFF.

**Returns** If "**?**" sign is issued along with command, the controller returns:

| | | |
|---|---|---|
| 1 | — | Group power is ON |
| 0 | — | Group power is OFF. |

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HO | — | Turn group power ON. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HO | \| | T*urn group power ON.* |
| **HF?** | \| | *Query group power status.* |
| *1* | \| | *Controller returns a value of 1.* |
| **HF** | \| | Turn *group power OFF.* |
| **HF?** | \| | *Query group power status.* |
| *0* | \| | *Controller returns a value of 0.* |

# HJ — Set Group Jerk

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HJ**nn or **HJ**?

**Parameters**

**Description** **nn** [float] — Vector jerk time value.

**Range** **nn** — **0** to **2e9**.

**Units** **nn** — Seconds.

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

Vectorial jerk time = vectorial velocity / vectorial acceleration / 2.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HV | — | Set vectorial velocity for a group. |
| HA | — | Set vectorial acceleration and deceleration for a group. |
| HK | — | Set vectorial e-stop jerk for a group. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| **HJ?** | \| | *Query vectorial deceleration of group.* |
| *0.05* | \| | *Controller returns a value of 0.05 second.* |

# HL — Move Group Along a Line

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HL**$nn_1$, $nn_2$ or **HL**?

**Parameters**

**Description** **$nn_1$** [float] — Target position of first axis in the group.

**$nn_2$** [float] — Target position of second axis in the group.

**Range** **$nn_i$** — Any position within the travel limits.

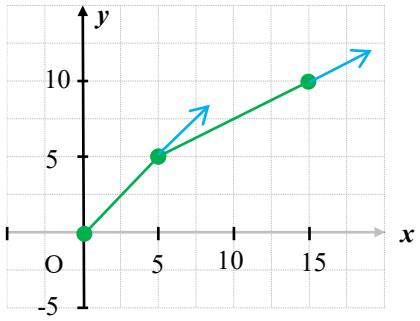
**Units** **$nn_i$** — Predefined units.

**Defaults** **$nn_i$** Missing: Error 29, GROUP PARAMETER MISSING.

**Description** This command initiates motion of a group along a line. It causes both axes assigned to the group to move with predefined vectorial (tangential) velocity, acceleration and deceleration along a line.

If this command is received while a group move is in progress, the new command gets enqueued into a "via point" buffer. Please refer to Advanced Capabilities section in the ESP302 Features Manual for a detailed description of via point buffer implementation. The enqueued commands get executed on a FIFO basis when the move already in progress has reached its destination. The group does not come to a stop at the end of last move. Instead, there will be a smooth transition to the new move command, just as if it were one compound move (combination of multiple moves). The allowed angle discontinuity to accept to chain two lines is set to 45°.

Example: HL5,5;HL15,10

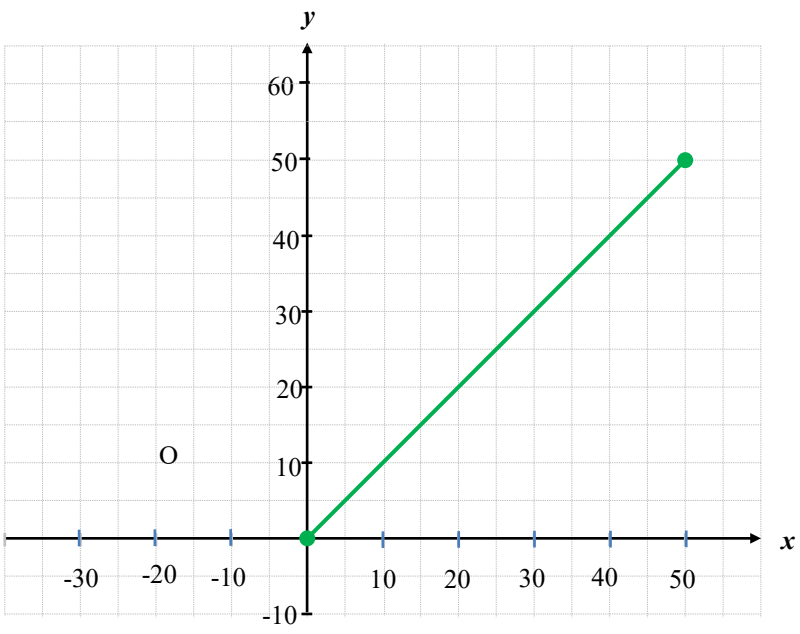



**NOTE**

**The transition from last move to new move will be smooth if tangential velocity at the end of last move is the same as that at the beginning of new move.**

**Returns** If "**?**" sign takes the place of **nn** values, this command reports the target positions of axes assigned to the group.

| | | | |
|---|---|---|---|
| **Rel. Commands** | HN | — | Create a new group. |
| | HV | — | Set vectorial velocity for a group. |
| | HA | — | Set vectorial acceleration and deceleration for a group. |
| | HO | — | Enable a group. |
| | HF | — | Disable a group. |
| | HC | — | Move a group of axes to desired position along an arc. |
| **Example** | HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| | HV10 | \| | *Set vectorial velocity of group to 10 units/second.* |
| | HA50 | \| | *Set vectorial acceleration of group to 50 units/second$^2$.* |
| | HO | \| | *Enable group.* |
| | HP? | \| | *Query current group position.* |
| | *0,0* | \| | *Controller returns axis #1 = 0 units and axis #2 = 0 units.* |
| | **HL50, 50** | \| | *Move axis #1 to a target position = 50 units.*<br>*Move axis #2 to a target position = 50 units.* |
| | **HL?** | \| | *Query target position of the commanded move.* |
| | *50,50* | \| | *Controller returns axis #1 = 50 units and axis #2 = 50 units.* |



# HN — Create New Group

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** **HN**$nn_1$, $nn_2$ or **HN**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **Description** | **$nn_1$** [int] | — | Physical axis number to be assigned as first axis in this group. |
| | **$nn_2$** [int] | — | physical axis number to be assigned as second axis in this group. |
| **Range** | **$nn_i$** | — | **1** to **Max. Axes**. |
| **Units** | **$nn_i$** | — | None. |
| **Defaults** | **$nn_i$** Missing: | | Error 29, GROUP PARAMETER MISSING. |
| | Out of range: | | Error 17, GROUP AXIS OUT OF RANGE. |
| | Already assigned: | | Error 16, GROUP NUMBER ALREADY ASSIGNED. |
| | Duplicated: | | Error 19, GROUP AXIS DUPLICATED. |

**Description** This command is used to create a new group of two axes. A few rules are in place to facilitate easy management of groups.

- A group has to be created with two axes assigned to it before any command related to groups can be issued. The controller returns error 15, GROUP NUMBER NOT ASSIGNED, if, for instance, one tries to set group velocity before creating a group.
- A group has to be deleted (refer **HX** command) before axes assigned to the group can be changed. The controller returns error 16, GROUP NUMBER ALREADY ASSIGNED, if one attempts to change axes assigned to a group already created. Please see the following table for correct method to change axes assigned to a group:

| Correct Method | Incorrect Method |
|---|---|
| HN1,2 | HN1,2 |
| HX | HN2,3 |
| HN2,3 | |

- An axis cannot be assigned more than once in a group. The controller returns error 19, GROUP AXIS DUPLICATED, if one attempts to assign an axis more than once to a group.
- The order in which axes are assigned to a group is very important. This is because it specifies the frame of reference in which coordinated motion of axes takes place. For instance, the command **HN1,2** assigns axis numbers 1 and 2 to the group, where axis #1 is equivalent to X-axis and axis #2 is equivalent to Y-axis in a traditional cartesian coordinate system. Reversing the ordering of axes (viz. **HN2,1**) reverses the axis assignment.

**Returns** If "**?**" sign takes the place of **nn** values, this command reports the axes assigned to the group in the order of their assignment.

**Rel. Commands**

| | | |
|---|---|---|
| HV | — | Set vectorial velocity for a group. |
| HA | — | Set vectorial acceleration and deceleration for a group. |
| HO | — | Enable a group. |
| HF | — | Disable a group. |
| HC | — | Move a group of axes to desired position along an arc. |
| HL | — | Move a group of axes to desired position along a line. |

| | | | |
|---|---|---|---|
| **Example** | **HN1,2** | \| | *Create a new group with physical axes 1 and 2.* |
| | **HN?** | \| | *Query axis assigned to the group.* |
| | *1,2* | \| | *Controller returns the axes assigned to the group.* |
| | **HN2,3** | \| | Try c*reating a new group with physical axes 2 and 3.* |
| | **HN?** | \| | *Query axis assigned to the group.* |
| | *1,2* | \| | *Controller returns the axes assigned to the group.* |
| | TB? | \| | *Read error message.* |
| *0, 450322, GROUP NUMBER ALREADY ASSIGNED* | | \| | *Controller returns error message.* |
| | HX | \| | Delete *group.* |
| | **HN2,3** | \| | *Create a new group with physical axes 2 and 3.* |
| | **HN?** | \| | *Query axis assigned to the group.* |
| | *2,3* | \| | *Controller returns the axes assigned to the group.* |

# HO — Group ON

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HO** or **HO**?

**Parameters** None

**Description** This command turns power ON of all axes assigned to a group. Refer **MO** command to turn the power ON of individual axes. The group power is assumed to be ON if power to all axes in the group is ON.

**Returns** If "**?**" sign is issued along with command, the controller returns:

1 — Group power is ON.

0 — Group power is OFF.

**Rel. Commands** HN — Create a new group.

HF — Turn group power OFF

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| **HO** | \| | Turn *group power ON.* |
| **HO?** | \| | *Query group power status.* |
| *1* | \| | *Controller returns a value of 1.* |
| HF | \| | Turn *group power OFF.* |
| **HO?** | \| | *Query group power status.* |
| *0* | \| | *Controller returns a value of 0.* |

# HP — Read Group Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **HP**

**Parameters** None

**Description** This command is used to read the instantaneous real position of all axes assigned to a group.

**Returns** **$nn_1$**, **$nn_2$** where:
$nn_1$ = **Actual position of *1st* axis** in the group.
$nn_2$ = **Actual position of *2nd* axis** in the group.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HC | — | Move a group of axes to desired position along an arc. |
| HL | — | Move a group of axes to desired position along a line. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| **HP** | \| | *Read position of the group.* |
| *10,50* | \| | *Controller returns axis #1 = 10 units, axis #2 = 50 units.* |

# HQ — Wait for Group Command Buffer Level

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HQ**nn or **HQ**?

**Parameters**

**Description** **nn** [float] — Level in group via point buffer.

**Range** **nn** — **1** to **100** (default for maximum targets in via point buffer).

**Units** **nn** — None.

**Defaults** **nn** Missing: Error 29, GROUP PARAMETER MISSING.

**Description** This command stops enqueuing new commands into the via point buffer until the buffer level equals **nn**. As commands in the buffer get executed on a FIFO basis and the buffer level equals **nn**, commands issued subsequent to this one get executed.

**Returns** If "**?**" sign takes the place of **nn** value, the controller returns the room available in via point buffer for more commands.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HL | — | Move group to target position along a line. |
| HC | — | Move group to target position along an arc. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HV10 | \| | *Set vectorial velocity of group to 10 units/second.* |
| HA50 | \| | *Set vectorial acceleration of group to 50 units/second$^2$.* |
| HO | \| | *Enable group.* |
| HL10,10 | \| | *Move group to target pos. 10,10 (ax. #1 = 10, #2 = 10 units).* |
| HL20,20 | \| | *Move group to target pos. 20,20 (ax. #1 = 20, #2 = 20 units). This command gets enqueued in the via point buffer if it was received prior completion of the previous move command.* |
| HL50,50 | \| | *Move group to target pos. 50,50 (ax. #1 = 50, #2 = 50 units).* |
| **HQ10** | \| | *Wait until the via point buffer level equals 10 commands.* |
| HC40,60,180 | \| | *Move group along an arc with center of arc at (40,60) units, by a sweep angle of 180 deg. from current position.* |

# HS — Stop Group Motion

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HS** or **HS**?

**Parameters** None

**Description** This command stops the motion of all axes assigned to a group using vector deceleration set using **HD** command.

**Returns** If "**?**" sign is supplied along with the command, the controller returns:

| | | |
|---|---|---|
| 1 | — | Group motion is stopped |
| 0 | — | Group motion is in progress. |

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HC | — | Move a group of axes to desired position along an arc. |
| HL | — | Move a group of axes to desired position along a line. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HV10 | \| | *Set vectorial velocity of group to 10 units/second.* |
| HA50 | \| | *Set vectorial acceleration of group to 50 units/second$^2$.* |
| HO | \| | *Enable group.* |
| HP? | \| | *Query current group position.* |
| *0,0* | \| | *Controller returns axis #1 = 0 units and axis #2 = 0 units.* |
| HL50, 50 | \| | *Move axis #1 to a target position = 50 units.*<br>*Move axis #2 to a target position = 50 units.* |
| **HS?** | \| | *Query if motion of group is stopped.* |
| *0* | \| | *Controller returns 0, meaning group is in motion.* |
| **HS** | \| | Stop *motion of group.* |
| **HS?** | \| | *Query if motion of group is stopped.* |
| *1* | \| | *Controller returns 1, meaning group #1 motion has stopped.* |
| HP? | \| | *Query current group position.* |
| *27,26* | \| | *Controller returns axis #1 = 27 units and axis #2 = 26 units.* |

# HV — Set Group Velocity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HV**nn or **HV**?

**Parameters**

**Description** **nn** [float] — Vector velocity value.

**Range** **nn** — **0** to **minimum of the maximum velocity values of all axes assigned to this group**.

**Units** **nn** — Predefined units/second.

**Defaults**

| | | |
|---|---|---|
| **nn** | Missing: | Error 7, PARAMETER OUT OF RANGE. |
| | negative: | Error 30, GROUP PARAMETER OUT OF RANGE. |
| | Out of range: | Error 31, GROUP MAXIMUM VELOCITY EXCEEDED. |

**Description** This command is used to set the vectorial velocity value for a group. This value will be used during coordinated motion of axes assigned to the group. It will override any original acceleration values specified for individual axes using **VA** command. The axes' original values will be restored when the group to which they have been assigned is deleted.

This command takes effect immediately. It can be executed when controller is idling or motion is in progress or inside a program.

**NOTE**

**Avoid changing velocity during acceleration or deceleration phases of a move. For better predictable results, change velocity only when all the axes assigned to this group are not in motion.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| VU | — | Set maximum velocity for an axis. |
| HN | — | Create a new group. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| 1VU? | \| | *Query maximum velocity of axis #1.* |
| *10* | \| | *Controller returns a value of 10 units/second.* |
| 2VU? | \| | *Query maximum velocity of axis #2.* |
| *15* | \| | *Controller returns a value of 15 units/second.* |
| **HV10** | \| | *Set vectorial velocity of group to 10 units/second.* |
| **HV?** | \| | *Query vectorial velocity of group.* |
| *10* | \| | *Controller returns a value of 10 units/second.* |

# HW — Wait for Group Motion Stop

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HW**nn

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **nn** [float] | — | Delay after group motion is complete. |
| **Range** | **nn** | — | **0** to **60000**. |
| **Units** | **nn** | — | Milliseconds. |
| **Defaults** | **nn** Missing: | | Error 7, PARAMETER OUT OF RANGE. |
| | negative: | | Error 30, GROUP PARAMETER OUT OF RANGE. |
| | Out of range: | | Error 26, MAXIMUM WAIT DURATION EXCEEDED. |

**Description** This command stops execution of any commands subsequent to it until the one prior to it has been completed. For instance, if a command preceding it is a group move command such as **HL** or **HC**, it stops execution of any commands following it until the group has reached target position. If **nn** is not equal to zero, the controller waits an additional **nn** milliseconds after the group motion is complete before executing any further commands.

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | HN | — | Create a new group. |
| | HL | — | Move group to target position along a line. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HV10 | \| | *Set vectorial velocity of group to 10 units/second.* |
| HA50 | \| | *Set vectorial acceleration of group to 50 units/second$^2$.* |
| HO | \| | *Enable group.* |
| HL50, 50; **HW500**; HL60,70 | \| | *Move group to a target position = 50, 50 units (axis #1 = 50 units and axis #2 = 50 units), wait for the group to reach target position, wait an additional 500 ms, and then move group to a target position = 60, 70 units (axis #1 = 60 units and axis #2 = 70 units).* |

# HX — Delete Group

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HX**

**Parameters** None.

**Description** This command deletes the group and makes available any axes that were assigned to it for future assignments.

**Returns** None.

**Rel. Commands** HN — Create a new group.

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HN? | \| | *Query axes assigned to group.* |
| *1,2* | \| | *Controller returns the axes assigned to group.* |
| **HX** | \| | *Delete group.* |
| HN? | \| | *Query axis assigned to group.* |
| TB? | \| | *Read error message.* |
| *0, 475322, GROUP NUMBER NOT ASSIGNED* | \| | *Controller returns error message.* |

# HZ — Read Group Size

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **HZ**

**Parameters** None.

**Description** This command is used to read the number of axes assigned to a group.

**Returns** This command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| HN | — | Create a new group. |
| HX | — | Delete a group. |

**Example**

| | | |
|---|---|---|
| HN1,2 | \| | *Create a new group with physical axes 1 and 2.* |
| HN? | \| | *Read axes assigned to group.* |
| *1,2* | \| | *Controller returns the axes assigned to group.* |
| **HZ** | \| | *Read size of group.* |
| *2* | \| | *Controller returns 2.* |
| **HX** | \| | *Delete group.* |
| **HZ** | \| | *Read size of group.* |
| TB? | \| | *Read error message.* |
| *0, 475322, GROUP NUMBER NOT ASSIGNED* | \| | *Controller returns error message.* |

# ID — Read Stage Model and Serial Number

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**ID**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.
Timeout: Error 2, RS-232 COMMUNICATION TIME-OUT.

**Description** This command is used to read Newport ESP compatible positioner (stage) model and serial number.

**NOTE**

**An important information needed when asking for help with the motion control system or when reporting a problem is the stage model and serial number. Use this command to determine the positioner model and serial number.**

**Returns** **nn$_1$,nn$_2$,nn$_3$**

where: **nn$_1$** = model number.
**nn$_2$** = serial number.
**nn$_3$** = configuration section from stage database file.

**Rel. Commands** None.

**Example** **1ID?** | *Read axis-1 positioner model and serial number.*

*UTS50PP,SNB189401,UTS@UTS50PP@XPS-DRV11* | *Controller returns stage model, serial number and configuration section from stage database file.*

# JH — Set Jog High Speed

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**JH**nn or xx**JH**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — High speed value.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **JogMaximumVelocity**, or **?** to read present setting.

**Units**

**xx** — None.

**nn** — Preset units/second.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x10, MAXIMUM VELOCITY EXCEEDED.

**Description**

This command is used to set the high speed for jogging an axis. Its execution is immediate, meaning that the value is changed when the command is processed, including when motion is in progress. It can be used as an immediate command or inside a program.

**NOTE**

**This command is volatile, to change the parameter permanently change JogMaximumVelocity in the configuration file.**

**Returns**

If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

JW — Set jog low speed.

VU — Set maximum velocity.

**Example**

| | | |
|---|---|---|
| 2VU? | \| | *Read maximum velocity allowed axis #2.* |
| *10* | \| | *Controller returns a value of 10.0 units/second for axis #2.* |
| **2JH7.5** | \| | *Set jog high speed to 7.5 units/second for axis #2.* |
| **2JH?** | \| | *Read jog high speed value for axis #2.* |
| *7.5* | \| | *Controller returns a value of 7.5 units/second for axis #2.* |

# JK — Set Jerk

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**JK**nn or xx**JK**?

**Parameters**

**Description**
**xx** [int] — Axis number.
**nn** [float] — Jerk value.

**Range**
**xx** — **1** to **Max. Axes**.
**nn** — **0** to **2e9**.

**Units**
**xx** — None.
**nn** — Seconds.
or **?** to read current setting.

**Defaults**
**xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.
**nn** Missing: Error 38, COMMAND PARAMETER MISSING.
Out of range: Error xx15, MAXIMUM JERK EXCEEDED.

**Description**
Obsolete command, but kept for backward compatibility.
This command has not effect.

**Returns**
If "?" sign takes the place of **nn** value, this command reports the jerk time value (= current velocity / current acceleration / 2)

.

**Rel. Commands** AC — Set acceleration. VA — Set velocity.

**Example**
**2JK?** | *Read jerk time value of axis #2.*
*0.05* | *Controller returns a jerk time value of 0.05 seconds.*

# JL — Jump to Label

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | – | ♦ | ♦ |

**Syntax** xx**JL**nn

**Parameters**

**Description**

**xx** [int] — Label number.

**nn** [int] — Loop count.

**Range**

**xx** — **1** to **100**.

**nn** — **1** to **65535**.

**Units**

**xx** — None.

**nn** — None.

**Default**

**xx** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**nn** Missing: Assume infinite.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command changes the flow of the program execution by jumping to a predefined label **xx**. This is a flow control command that alters the normal sequential flow of a program. It must be used in conjunction with the DL command which defines a label.

Parameter **nn** determines the number of times to repeat the jump before allowing the program flow to go ahead.

**Returns** None.

**Rel. Commands**

DL — Define label.

**Example**

```
3XX   |  Clear program 3 from memory, if any.
3EP   |  Create program 3
1DL   |  Define label 1.
…
…
…
1JL5  |  Jump to label 1 five(5) times.
QP    |  End entering program and quit programming mode.
3EX   |  Run stored program number 3.
```

# JW — Set Jog Low Speed

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**JW**nn or xx**JW**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Low speed value.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **JogMaximumVelocity**, or **?** to read present setting.

**Units**

**xx** — None.

**nn** — Preset units/second.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x10, MAXIMUM VELOCITY EXCEEDED.

**Description** This command is used to set the low speed for jogging an axis. Its execution is immediate, meaning that the value is changed when the command is processed, including when motion is in progress. It can be used as an immediate command or inside a program.

**NOTE**

**This command is volatile, to change the parameter permanently change JogMaximumVelocity in the configuration file.**

**At startup, JW= JogMaximumVelocity/10**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

JH — Set jog high speed.

VU — Set maximum velocity.

**Example**

| | | |
|---|---|---|
| 2VU? | \| | *Read maximum velocity allowed axis #2.* |
| *10* | \| | *Controller returns a value of 10.0 units/second for axis #2* |
| **2JW2.5** | \| | *Set jog low speed to 2.5 units/second for axis #2.* |
| **2JW?** | \| | *Read jog low speed value for axis #2.* |
| *2.5* | \| | *Controller returns a value of 2.5 units/second for axis #2.* |

# KD — Set Derivative Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KD**nn or xx**KD**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Derivative gain factor Kd. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Double**, or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command sets the derivative gain factor Kd of the PID closed loop. It is active for any DC servo based motion device that has been selected to operate in closed loop.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change KD in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| KI | — | Set integral gain factor. |
| KP | — | Set proportional gain factor. |
| KS | — | Set saturation gain factor. |
| UF | — | Update filter. |

**Example**

| | | |
|---|---|---|
| **3KD0.01** | \| | *Set derivative gain factor for axis #3 to 0.01.* |
| … | | |
| … | | |
| … | | |
| 3UF | \| | *Update PID filter; only now the KD command takes effect.* |

# KF — Set Corrector Derivative Cutt Off Frequency

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KF**nn or xx**KF**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Derivative cut off frequency.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **5000**, or **?** to read current setting.

**Units**

**xx** — None.

**nn** — Hertz.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command sets the derivative filter cut off frequency of the PID closed loop. It is active for any DC servo based motion device that has been selected to operate in closed loop. A value equal to zero disables the filter.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change DerivativeFilterCutOffFrequency in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

KD — Set derivative gain factor.

KI — Set integral gain factor.

KP — Set proportional gain factor.

KS — Set saturation gain factor.

UF — Update filter.

**Example**

**3KF4000** | *Set derivative filter cut off frequency for axis #3 to 4KHz.*

…

…

…

3UF | *Update PID filter; only now the KF command takes effect.*

# KI — Set Integral Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KI**nn or xx**KI**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | integral gain factor. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Double**, or **?** to read current setting**.** |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description**

This command sets the integral gain factor Ki of the PID closed loop. It is active for any DC servo based motion device that has been selected to operate in closed loop.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change KI in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| KD | — | Set integral gain factor. |
| KP | — | Set proportional gain factor. |
| KS | — | Set saturation gain factor. |
| UF | — | Update filter. |

**Example**

| | | |
|---|---|---|
| **3KI0.01** | \| | *Set integral gain factor for axis #3 to 0.01.* |
| … | | |
| … | | |
| … | | |
| 3UF | \| | *Update PID filter; only now the KI command takes effect.* |

# KP — Set Proportional Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KP**nn or xx**KP**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Proportional gain factor Kp. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Double**, or **?** to read current setting**.** |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command sets the proportional gain factor Kp of the PID closed loop. It is active for any DC servo based motion device that has been selected to operate in closed loop.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change KP in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| KI | — | Set integral gain factor. |
| KD | — | Set proportional gain factor. |
| KS | — | Set saturation gain factor. |
| UF | — | Update filter. |

**Example**

| | | |
|---|---|---|
| **3KP0.01** | \| | *Set proportional gain factor for axis #3 to 0.01.* |
| … | | |
| … | | |
| … | | |
| 3UF | \| | *Update PID filter; only now the KP command takes effect.* |

# KS — Set Saturation Level of Integral Factor

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KS**nn or xx**KS**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Saturation level of integrator.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **Max_Double**, or **?** to read current setting**.**

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command sets the saturation level of the integral factor of the PID closed loop and is useful for preventing integral wind-up. It is active for any DC servo based motion device that has been selected to operate in closed loop.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change KS in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

KI — Set integral gain factor.

KP — Set proportional gain factor.

KD — Set derivative gain factor.

UF — Update filter.

**Example**

**3KS0.01** | *Set saturation level for axis #3 to 0.01.*

…

…

…

3UF | *Update PID filter; only now the KS command takes effect.*

# KT — Set Integration Time

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**KT**nn or xx**KT**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Integration time of integrator. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Double**, or **?** to read current setting**.** |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Seconds. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command sets the integration time of the PID closed loop integrator and is useful for preventing integral wind-up. It is active for any DC servo based motion device that has been selected to operate in closed loop.

The command can be sent at any time but it has no effect until the **UF** (update filter) is received.

See the "Servo Tuning" section in the ESP302 Features Manual for a detailed description of how to adjust the PID filter parameters.

**NOTE**

**This command is volatile, to change the parameter permanently change IntegrationTime in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| KI | — | Set integral gain factor. |
| KP | — | Set proportional gain factor. |
| KD | — | Set derivative gain factor. |
| UF | — | Update filter. |

**Example**

| | | |
|---|---|---|
| **2KT3** | \| | *Set integration time for axis #2 to 3 seconds.* |
| … | | |
| … | | |
| … | | |
| 3UF | \| | *Update PID filter; only now the KT command takes effect.* |

# LC — Lock/Unlock Touchscreen

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** **LC**nn or **LC**?

**Parameters**

**Description** **nn** [int] — Lock option.

**Range** **nn** — **0** – **2** or **?** to read current setting.

**Units** **nn** — None.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command is used to lock/unlock the touchscreen of the ESP302. The parameter value means:

**0** = Unlock the touchscreen.

**1** = Lock all buttons but “Motor ON/OFF”.

**2** = Lock all buttons.

**Returns** If the "?" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

**Example**

| | | |
|---|---|---|
| **LC1** | \| | *Lock the touchscreen except "Motor ON/OFF".* |
| **LC?** | \| | *Get lock status.* |
| *1* | \| | *Returns current setting.* |

# LP — List Program

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**LP**

**Parameters**

**Description** **xx** [int] — Program number.

**Range** **xx** — **1** to **127**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 38, COMMAND PARAMETER MISSING.
Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command reads a specified program from non-volatile memory.

**NOTE**

**The program list always terminates with the word "END".**

**Returns** Program listing.

**Rel. Commands** EP — Enter program mode.

**Example**

| | | |
|---|---|---|
| **3LP** | \| | *List program number 3.* |
| 3MO | \| | *Enable axis 3 motor power.* |
| 1DL | \| | *Define return label 1.* |
| 3PR+10 | \| | *Move axis 3 relative +10 units.* |
| 3WS500 | \| | *Wait 500 ms after axis 3 stops.* |
| 3PR-10 | \| | *Move axis 3 relative -10 units.* |
| 3WS500 | \| | *Wait 500 ms after axis 3 stops.* |
| 1JL5 | \| | *Jump to label 1 location 5 times.* |
| END | \| | *End of program list.* |

# MD — Read Motion Done Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**MD**?

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| **Range** | **xx** | — | **1** to **Max. Axes**. |
| **Units** | **xx** | — | None. |
| **Defaults** | **xx** Missing: | | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** This command is used to read the motion status for the specified axis **xx**. The **MD** command can be used to monitor Homing, absolute, and relative displacement move completion status.

| | | | |
|---|---|---|---|
| **Returns** | **nn** | — | **0** or **1**, where:<br>0 = **Motion <u>NOT</u> done** (FALSE).<br>1 = **Motion done** (TRUE). |
| **Rel. Commands** | PA | — | Move to an absolute position. |
| | PR | — | Move to a relative position. |
| | OR | — | Move to home position. |

**Example**

| | | |
|---|---|---|
| **3MD?** | \| | *Read axis #3 move done status.* |
| *1* | \| | *Controller returns status 1 (motion done) for axis #3.* |
| 3PR2.2 | \| | *Start a relative motion of 2.2 on axis #3.* |
| **3MD?** | \| | *Read axis #3 move done status.* |
| *0* | \| | *Controller returns status 0 (motion not done) for axis #3.* |

# MF — Motor OFF

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**MF** or xx**MF**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command turns power OFF of the specified motor (axis).
If the MF command is sent with no axis parameter, all axes are powered OFF.

**Returns** If "**?**" sign is issued along with command, the controller returns:
1: Motor power is ON.
0: Motor power is OFF.

**Rel. Commands**
AB — Abort motion.
ST — Stop motion.
MO — Turn motor power ON.

**Example**

| | |
|---|---|
| **2MF** | *Turn axis #2 motor power OFF.* |
| **2MF?** | *Query axis #2 motor power status.* |
| *0* | *Controller returns a value of 0.* |
| 2MO | Turn *axis #2 motor power ON.* |
| **2MF?** | *Query axis #2 motor power status.* |
| *1* | *Controller returns a value of 1.* |

# MK — Motor Kill

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**MK** or xx**MK**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command turns power OFF of the specified motor (axis), and cancel the position origin done with OR command.
If the MK command is sent with no axis parameter, all axes are killed.

**Returns** If "**?**" sign is issued along with command, the controller returns:

1: Motor power is ON.

0: Motor power is OFF.

**Rel. Commands**

| | | |
|---|---|---|
| AB | — | Abort motion. |
| ST | — | Stop motion. |
| MO | — | Turn motor power ON. |
| MF | — | Turn motor power OFF. |

**Example**

| | | |
|---|---|---|
| 2MO | \| | Turn *axis #2 motor power ON.* |
| 2OR | \| | Execute Axis 2 Home search. |
| 2TS? | \| | *Query axis #2 status.* |
| *B@* | \| | *Controller returns Origine Done & Motor ON* |
| **2MK** | \| | *Kill axis #2.* |
| 2TS? | \| | *Query axis #2 status.* |
| *P@* | \| | *Controller returns Origine not Done & Motor OFF* |

# MO — Motor ON

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**MO** or xx**MO**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — To **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command turns power ON of the specified motor (axis).
If the MO command is sent with no axis parameter, all axes are powered ON.

**CAUTION**

**If the motor power was turned off by the controller detecting a fault condition, before turning the power back on, make sure that the cause of the fault was corrected.**

**Returns** If "**?**" sign is issued along with command, the controller returns:
1: Motor power is ON.
0: Motor power is OFF.

**Rel. Commands**
AB — Abort motion.
ST — Stop motion.
MF — Turn motor power OFF.

**Example**

| | | |
|---|---|---|
| **MO** | \| | *Turn axis #2 motor power ON.* |
| **2MO?** | \| | *Query axis #2 motor power status.* |
| *1* | \| | *Controller returns a value of 1.* |
| 2MF | \| | *Turn axis #2 motor power OFF.* |
| **2MO?** | \| | *Query axis #2 motor power status.* |
| *0* | \| | *Controller returns a value of 0.* |

# MT — Move to Hardware Travel Limit

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**MT**nn or xx**MT**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [char] | — | Direction of motion. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | + for positive direction or – for negative direction. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Positive direction. |

**Description** This command is used to move an axis to its limit (positive or negative). It uses the home search speed during travel to hardware limit.

**NOTE**

**Software travel limits have to be disabled with ZS command to allow a move to hardware limits.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports **1** if motion is done, or **0** if motion is in progress.

**Rel. Commands**

| | | |
|---|---|---|
| OR | — | Home location search. |
| OH | — | Set home search speed. |
| ZS | — | Set software limits configuration. |

**Example**

| | | |
|---|---|---|
| **3MT+** | \| | *Move axis #3 to positive travel limit.* |
| **3MT?** | \| | *Query motion status.* |
| *0* | \| | *Controller returns 0 indicating motion is in progress.* |

# MV — Move Indefinitely

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**MV**nn or xx**MV**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [char] — Direction of motion.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — + for positive direction or – for negative direction.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE

**nn** Missing: Positive direction.

**If a limit is reached:**

Out of range: Error x04, POSITIVE HARDWARE LIMIT DETECTED.

Out of range: Error x05, NEGATIVE HARDWARE LIMIT DETECTED.

Out of range: Error x06, POSITIVE SOFTWARE LIMIT DETECTED.

Out of range: Error x07, NEGATIVE SOFTWARE LIMIT DETECTED.

**Description** This command initiates infinite motion. When received, the selected axis **xx** will move indefinitely, with the predefined acceleration and velocity, in the direction specified by **nn**. If the requested axis is member of a group, this command does not initiate the desired motion. Instead, error x31, "COMMAND NOT ALLOWED DUE TO GROUP ASSIGNMENT" is generated. Refer HL and HC commands to move along a line or an arc.

**NOTE**

**Although the command is accepted while a motion is in progress, care should be taken not to reverse direction of motion.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the motion done status.

**Rel. Commands**

PA — Move to absolute position.

PR — Move to relative position.

ST — Stop motion.

MD — Move done status.

**Example**

| | | |
|---|---|---|
| **3MV+** | \| | *Move axis #3 indefinitely in positive direction.* |
| **3MV?** | \| | *Query status of move.* |
| *0* | \| | *Controller returns 0 meaning, motion is in progress.* |
| 3ST | \| | *Stop axis #3 motion.* |
| **3MV–** | \| | *Move axis #3 indefinitely in negative direction.* |

# MZ — Move to Nearest Index

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**MZ**nn or xx**MZ**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [char] | — | Direction of motion. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | + for positive direction or – for negative direction. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Positive direction. |

**Description** This command is used to move an axis to its nearest index (in positive or negative direction). It uses the home search speed during travel to nearest index.

**Returns** If "**?**" sign takes the place of **nn** value, this command reports **1** if motion is done, or **0** if motion is in progress.

**Rel. Commands**

| | | |
|---|---|---|
| OR | — | Home location search. |
| OH | — | Set home search speed. |

**Example**

| | | |
|---|---|---|
| **3MZ+** | \| | *Move axis #3 to nearest index in positive direction.* |
| **3MZ?** | \| | *Query motion status.* |
| *0* | \| | *Controller returns 0 indicating motion is in progress.* |

# OH — Set Home Search High Speed

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**OH**nn or xx**OH**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | high speed value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **maximum value allowed by VU command**, or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Preset units/second. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x10, MAXIMUM VELOCITY EXCEEDED. |
| | | Error x24, SPEED OUT OF RANGE. |

**Description** This command sets the high speed used to search for home location for an axis. Its execution is immediate, meaning that the value is changed when the command is processed, including when motion is in progress. It can be used as an immediate command or inside a program.

**NOTE**

**This command is volatile, to change the parameter permanently change HomeSearchMaximumVelocity in the configuration file.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

| | | |
|---|---|---|
| OR | — | Search for home. |
| OL | — | Set home search low speed. |

**Example**

| | | |
|---|---|---|
| **3OH10** | \| | *Set home search high speed of axis #3 to 10 units/s.* |
| **3OH?** | \| | *Query home search high speed of axis #3.* |
| *10* | \| | *Controller returns a value of 10.0 units/second.* |

# OL — Set Home Search Low Speed

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**OL**nn or xx**OL**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | low speed value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **maximum value allowed by OH command**, or ? to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Preset units/second. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x10, MAXIMUM VELOCITY EXCEEDED. |
| | | Error x24, SPEED OUT OF RANGE. |

**Description** This command sets the low speed used to search for home location for an axis. Its execution is immediate, meaning that the value is changed when the command is processed, including when motion is in progress. It can be used as an immediate command or inside a program.

**NOTE**

**This command is volatile, to change the parameter permanently change HomeSearchMaximumVelocity in the configuration file.**

**At startup, OL= HomeSearchMaximumVelocity / 2.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

| | | |
|---|---|---|
| OR | — | Search for home. |
| OH | — | Set home search high speed. |
| OL | — | Set home search low speed. |

**Example**

| | | |
|---|---|---|
| **3OL2** | \| | *Set home search low speed of axis #3 to 2 units/s.* |
| **3OL?** | \| | *Query home search low speed of axis #3.* |
| *2* | \| | *Controller returns a value of 2 units/second.* |

# OM — Set Home Search Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**OM**nn

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Home search mode.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **6.**

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command selects the home search type without invoking the home search sequence (see the description of **OR** command for more information on home search). The seven home search types are +0 Position Count, Home Switch and Index Signals, Home Switch Signal, Positive Limit Signal, Negative Limit Signal, Positive Limit and Index Signals and Negative Limit and Index Signals.

If **nn** = 0 and the front panel HOME search push button is pressed, the axes will search for zero position count. If **nn** = 1 and the front panel HOME search push button is pressed, the axis will search for combined Home and Index signal transitions. The controller responds similarly for other values of **nn**.

The **nn** parameter is overwritten by the **OR** command parameter.

**NOTE**

**This command is volatile, to change the parameter permanently change HomeSearchSequenceType in the configuration file.**

**Returns**

If "**?**" sign takes the place of **nn** value, this command reports current setting.

**Rel. Commands**

OR — Search for home.

**Example**

**3OM1** | *Set axis #3 home search mode to 1.*

3OR | *Start home search on axis #3 using mode 1.*

# OR — Search for Home

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**OR**nn

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Home mode**.**

**Range**

**xx** — **0** to **Max. Axes**.

**nn** — **0** to **6** where:

0 = **Find +0 Position Count**.

1 = **Find Home and Index Signals**.

2 = **Find Home Signal**.

3 = **Find Positive Limit Signal**.

4 = **Find Negative Limit Signal**.

5 = **Find Positive Limit and Index Signals**.

6 = **Find Negative Limit and Index Signals**.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command executes a Home search routine on the axis specified by **xx**. If **xx** = 0, a home search routine is initiated sequentially on all installed axes. If **nn** is missing, the axis will search for home using the mode specified using **OM** command. If **nn** = 0, the axis will search for zero position count. If **nn** = 1, the axis will search for combined Home and Index signal transitions. If **nn** = 2, the axis will search for Home signal transition only. If **nn** = 3, the axis will search for positive limit signal transition. If **nn** = 4, the axis will search for negative limit signal transition. If **nn** = 5, the axis will search for positive limit and index signal transition. If **nn** = 6, the axis will search for negative limit and index signal transition.

At the end of a home search routine, the position of axes is reset to the value specified using SH command.

The home search motion status can be monitored with the Motion Done (MD) status command. If a fault condition such as E-stop occurs while home search is in progress or if this command is issued to an axis before enabling it, the controller returns error x20, "HOMING ABORTED".

For a detailed description of the home search routine see the Home Search chapter in the Motion Control Tutorial section in the ESP302 Features Manual.

**NOTE**

**This command should be executed once every time the controller power is turned ON or the controller performs a complete system reset. There is no need to issue this command in any other case since the controller always keeps track of position, even when the motor power is OFF.**

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | DH | — | Define home. |
| | OH | — | Set home search speed. |
| | OM | — | Set home search mode. |
| | MD | — | Read motion done status. |
| | SH | — | Set home preset position. |
| **Example** | 3MO | \| | *Turn axis #3 motor power ON.* |
| | 3SH0 | \| | *Set axis #3 home position to 0 units.* |
| | **3OR1** | \| | *Perform a home search on axis #3.* |
| | 3MD? | \| | *Query axis #3 motion status.* |
| | *1* | \| | *Controller returns a value of 1, when motion is done.* |
| | 3TP | \| | *Query axis #3 position.* |
| | *0* | \| | *Controller returns a value of 0 units.* |

# PA — Move to Absolute Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**PA**nn or xx**PA**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Absolute position destination. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | Any position within the travel limits and within ±**Max_Long * encoder resolution**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Defined motion units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x04, POSITIVE HARDWARE LIMIT EXCEEDED. |
| | Out of range: | Error x05, NEGATIVE HARDWARE LIMIT EXCEEDED. |
| | Out of range: | Error x06, POSITIVE SOFTWARE LIMIT EXCEEDED. |
| | Out of range: | Error x07, NEGATIVE SOFTWARE LIMIT EXCEEDED. |

**Description** This command initiates an absolute motion. When received, the selected axis **xx** will move, with the predefined acceleration and velocity, to the absolute position specified by **nn**. If the requested axis is member of a group, this command does not initiate the desired motion. Instead, error x31, " COMMAND NOT ALLOWED DUE TO GROUP ASSIGNMENT" is generated. Refer HL and HC commands to move along a line or an arc.

**NOTE**

**Even though the command is accepted while a motion is in progress, care should be taken not to reverse direction of motion. When this command is received, the controller verifies if it will produce a change of direction.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current position; the same as TP?

**Rel. Commands**

| | | |
|---|---|---|
| AC | — | Set acceleration/deceleration. |
| PR | — | Move to relative position. |
| ST | — | Stop motion. |
| MD | — | Move done status. |
| VA | — | Set velocity. |

**Example**

| | | |
|---|---|---|
| 3VA8 | \| | *Set velocity of axis #2 to 8 units/s.* |
| **3PA12.34** | \| | *Move axis #2 to absolute position 12.34.* |

# PH — Get Hardware Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **PH**

**Parameters** None.

**Description** This command is used to get general hardware status for all axes. This routine allows user to observe the various digital input signals as they appear to the controller.

**Hardware Status Register #1**

| BIT# | DEFINITION | Meaning for | |
|---|---|---|---|
| | | BIT LOW | BIT HIGH |
| 0 | axis 1 +hardware travel limit | NO | YES |
| 1 | axis 2 +hardware travel limit | NO | YES |
| 2 | axis 3 +hardware travel limit | NO | YES |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | axis 1 -hardware travel limit | NO | YES |
| 9 | axis 2 -hardware travel limit | NO | YES |
| 10 | axis 3 -hardware travel limit | NO | YES |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | axis 1 motor fault | NO | YES |
| 17 | axis 2 motor fault | NO | YES |
| 18 | axis 3 motor fault | NO | YES |

**Hardware Status Register #2**

| BIT# | DEFINITION | Meaning for | |
|---|---|---|---|
| | | BIT LOW | BIT HIGH |
| 0 | axis 1 home signal | NO | YES |
| 1 | axis 2 home signal | NO | YES |
| 2 | axis 3 home signal | NO | YES |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | axis 1 index signal | NO | YES |
| 9 | axis 2 index signal | NO | YES |
| 10 | axis 3 index signal | NO | YES |

**Returns** This command reports the current status in hexadecimal notation.

**Rel. Commands** ZU — Get ESP system configuration.

ZZ — Get system configuration.

**Example** **PH** | *Read hardware status.*

*18000404H, 4H* | *Controller returns the status of the two hardware regsisters.*

# PR — Move to Relative Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**PR**nn

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Relative motion increment. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | Any value that will not cause exceeding the software limits and within **Max_Long * encoder resolution**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Defined motion units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x04, POSITIVE HARDWARE LIMIT EXCEEDED. |
| | Out of range: | Error x05, NEGATIVE HARDWARE LIMIT EXCEEDED. |
| | Out of range: | Error x06, POSITIVE SOFTWARE LIMIT EXCEEDED. |
| | Out of range: | Error x07, NEGATIVE SOFTWARE LIMIT EXCEEDED. |

**Description** This command initiates a relative motion. When received, the selected axis **xx** will move, with the predefined acceleration and velocity, to relative position **nn** units away from the current position. If the requested axis is member of a group, this command does not initiate the desired motion. Instead, error x31, "COMMAND NOT ALLOWED DUE TO GROUP ASSIGNMENT" is generated. Refer **HL** and **HC** commands to move along a line or an arc.

**NOTE**

**Even though the command is accepted while a motion is in progress, care should be taken not to reverse direction of motion.**

**NOTE**

**Successive relative moves not multiple of encoder resolution can lead to cumulative error due to position rounding.**

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| AC | — | Set acceleration/deceleration. |
| PA | — | Move to absolute position. |
| MD | — | Move done status. |
| ST | — | Stop motion. |
| VA | — | Set velocity. |

**Example**

| | | |
|---|---|---|
| 3VA8 | \| | *Set velocity of axis #3 to 8 units/s.* |
| **3PR2.34** | \| | *Move axis #3 2.34 units away from the current position.* |

# QD — Update Motor Driver Settings

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QD**

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** None.

# QG — Set Gear Constant

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QG**nn or xx**QG**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | gear constant. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **2e9**,<br>or **?** to read present setting. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports 0.

# QI — Get Maximum Motor Current

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QI**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Description** This command is read-only and is used to get the maximum motor current output for axis xx.

This parameter can be changed in the configuration file:

- PeakCurrentPerPhase for stepper motors
- CurrentLimit for others

**Returns** This command reports the current setting nn in Amperes.

**Rel. Commands** QM — Get motor type.

**Example**

**2QI?** | *Read maximum motor current setting of axis #2.*

*1.6* | *Controller returns a value of 1.6 Amp. for axis #2.*

# QM — Get Motor Type

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QM**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — 1 to Max. Axes.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is read-only and returns the motor type for the axis xx.

**Returns** **aa**, **0** to **2** where:
0 = motor type undefined (default)
1 = DC motor
2 = stepper motor

**Rel. Commands** QI — Set maximum motor current.

**Example**

| | | |
|---|---|---|
| **2QM?** | \| | *Read motor type of axis #2.* |
| *0* | \| | *Controller returns a value of 0 (motor undefined) for axis #2.* |

# QP — Quit Program Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | – |

**Syntax** **QP**

**Parameters** None.

**Description** This command quits the controller from programming mode. All the commands following this one will be executed immediately.

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| EX | — | Execute stored program. |
| AP | — | Abort stored program execution. |
| XX | — | Erase program. |

**Example**

| | | |
|---|---|---|
| 3XX | \| | *Clear program 3 from memory, if any.* |
| 3EP | \| | *Activate program mode and enter following commands as program 3.* |
| … | | |
| … | | |
| … | | |
| **QP** | \| | *End entering program and quit programming mode.* |
| 3EX | \| | *Run stored program number 3.* |

# QR — Get Motor Torque Reduction

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**QR**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is read-only and returns the motor's current (i.e., torque) reduction percentage **nn$_2$** after motion has stopped and the time **nn$_1$** has expired. The purpose of this command is to help reduce the motor heating typically generated by stepper motors.

The current reduction percentage can be changed in the configuration file with StandbyPeakCurrentPerPhase:

nn2 = 100 * StandbyPeakCurrentPerPhase / ScalingCurrent

nn1 is a constant equal to 5000ms.

**NOTE**

**For motors other than stepper this command returns 0,0.**

**Returns** **nn$_1$**, **nn$_2$** where:

nn$_1$ = delay period (milliseconds)

nn$_2$ = motor current reduction percentage (%)

**Rel. Commands** QM — Get motor type.

QI — Get maximum motor current.

**Example** **2QR?** | *Query motor #2 torque reduction settings.*

*5000,50* | *Controller returns 5000 ms and 50%.*

# QS — Set Microstep Factor

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QS**nn or xx**QS**?

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| | **nn** [int] | — | Microstep value. |
| **Range** | **xx** | — | **1** to **Max. Axes**. |
| **Units** | **xx** | — | None. |
| | **nn** | — | None. |
| **Defaults** | **xx** Missing: | | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports 0.

| | | | |
|---|---|---|---|
| **Rel. Commands** | QD | — | Update driver. |
| | QI | — | Set maximum motor current. |

**Example**

**2QS?** | *Read microstep factor of axis #2.*

*0* | *Controller returns a value of 0 for axis #2.*

# QT — Set Tachometer Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QT**nn or xx**QT**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Tachometer gain. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **20**,<br>or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Volts/Krpm. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| QD | — | Update driver. |
| QI | — | Set motor maximum current. |

**Example**

| | | |
|---|---|---|
| **2QT?** | \| | *Read tachometer gain setting of axis #2.* |
| *0* | \| | *Controller returns a value of 0 V/Krpm for axis #2.* |

# QV — Set Average Motor Voltage

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**QV**nn or xx**QV**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Motor voltage. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **maximum driver rating**, or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Volts. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports 48.

**Rel. Commands**

| | | |
|---|---|---|
| QD | — | Update driver. |
| QI | — | Set maximum motor current. |

**Example**

| | | |
|---|---|---|
| **2QV?** | \| | *Read average motor voltage setting of axis #2.* |
| *48.0* | \| | *Controller returns a value of 48Volts for axis #2.* |

# RQ — Generate Service Request (SRQ)

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **RQ**nn

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **nn** [int] | — | Interrupt number. |
| **Range** | **nn** | — | **0** to **31**. |
| **Units** | **nn** | — | None. |
| **Defaults** | **nn** Missing: | | 0. |
| | Out of range: | | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command generates an interrupt service request to the host computer. The parameter **nn** is used to identify the **RQ** command which generated the interrupt. Upon receiving the interrupt, the host computer interrupt service routine should perform an IEEE 488 serial poll. If the interrupt was as a result of the **RQ** command, then bit 6 of the response is 1 and the lower five bits equal the parameter **nn**.

This command can be used to notify the host computer of the progress or flow of command execution in the motion controller.

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | SA | — | Set device address. |

**Example**

| | | |
|---|---|---|
| 2PR200;2WS;1PR100;1WS;**RQ3** | \| | *Generate interrupt when RQ command is encountered and set bit 0 and 1.* |

# RS — Reset the Controller

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **RS**

**Parameters** None.

**Description** This command is used to perform a hardware reset of the controller. It performs the following preliminary tasks before resetting the controller:

1) Stop all the axes that are in motion. The deceleration value specified using the command AG is used to stop the axes.
2) Wait for 500 ms to allow the axes to settle.
3) Disable all the axes by turning the power OFF.
4) Reboot the system.

This process can take anywhere up to 20 seconds depending upon the controller configuration.

**Returns** None.

**Rel. Commands** None.

**Example** **RS** | *Reset the controller.*

# SA — Set Device Address

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** SAnn or SA?

**Parameters**

**Description** **nn** [int] — address number.

**Range** **nn** — **1** to **30**.

**Units** **nn** — None.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command is used to set and report the device (i.e., ESP controller) address for use with IEEE-488 communications.

The address change takes affect immediately after the command is processed.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands** None.

**Example**

| | | |
|---|---|---|
| **SA3** | \| | *Set device address to 3.* |
| **SA?** | \| | *Read present device address setting.* |
| *3* | \| | *Controller returns device address #3.* |

# SB — Set/Get DIO Port GPIO Bit Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **SB**nn or **SB**?

**Parameters**

**Description** **nn** [int] — DIO value.

**Range** **nn** — **0** to **0FFFFH** (hexadecimal), or **?** to read current setting.

**Units** **nn** — None.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command is used to either set all digital I/O (DIO) port GPIO1 and GPIO2 logic level or read its present status. Bits 0-7 correspond to port GPIO1, and bits 8-15 to port GPIO2. Each 8-bit port can be set as either input or output with the **BO** command.

A DIO within a port configured as an input can only report its present HIGH or LOW logic level. Whereas a DIO bit within a port configured as an output can set(1) or clear(0) the corresponding DIO hardware to HIGH or LOW logic level.

Reading the status of a port configured as output returns its present output status.

**NOTE**

**All direction bits are automatically zeroed, or cleared, after a system reset. Therefore all DIO ports turn to input by default.**

**NOTE**

**Each DIO bit has a pulled-up resistor to +5 V. Therefore, all bits will be at HIGH logic level if not connected to external circuit and configured as input.**

| BIT# | DEFINITION | 0 | 1 |
|---|---|---|---|
| 0 | GPIO1.DIO[0] | LOW | HIGH |
| 1 | GPIO1.DIO[1] | LOW | HIGH |
| 2 | GPIO1.DIO[2] | LOW | HIGH |
| 3 | GPIO1.DIO[3] | LOW | HIGH |
| 4 | GPIO1.DIO[4] | LOW | HIGH |
| 5 | GPIO1.DIO[5] | LOW | HIGH |
| 6 | GPIO1.DIO[6] | LOW | HIGH |
| 7 | GPIO1.DIO[7] | LOW | HIGH |
| 8 | GPIO2.DIO[0] | LOW | HIGH |
| 9 | GPIO2.DIO[1] | LOW | HIGH |
| 10 | GPIO2.DIO[2] | LOW | HIGH |
| 11 | GPIO2.DIO[3] | LOW | HIGH |
| 12 | GPIO2.DIO[4] | LOW | HIGH |
| 13 | GPIO2.DIO[5] | LOW | HIGH |
| 14 | GPIO2.DIO[6] | LOW | HIGH |
| 15 | GPIO2.DIO[7] | LOW | HIGH |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

**Rel. Commands** BO — Set DIO port direction.

| | | | |
|---|---|---|---|
| **Example** | BO? | \| | *Read DIO port direction configuration.* |
| | *0H* | \| | *Controller returns a value of 0H (all ports are input).* |
| | BO1H | \| | Configure *DIO port GPIO1 as output.* |
| | **SB0FFH** | \| | *Set all port GPIO1 DIO output HIGH.* |

# SH — Set Home Preset Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**SH**nn or xx**SH**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Home preset position**.**

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — Any position within the travel limits**.**

**Units**

**xx** — None.

**nn** — Defined motion units.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command defines the value that is loaded in the position counter when home is found. The default value for all motion devices is 0. This means that unless a new value is defined using this command, the home position will be set to 0 when a home search is initiated using the **OR** command or from the front panel (if available).

**NOTE**

**The change takes effect only when a subsequent home search routine is performed. To make the change permanent, change the HomePreset parameter in the configuration file.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands** DH — Define home.

**Example**

| | | |
|---|---|---|
| 3MO | \| | *Turn axis #3 motor power ON.* |
| **3SH75.0** | \| | *Set axis #3 home position to 75.0 units.* |
| 3OR1 | \| | *Perform a home search on axis #3.* |
| 3MD? | \| | *Query axis #3 motion status.* |
| *1* | \| | *Controller returns a value of 1, when motion is done.* |
| 3TP | \| | *Query axis #3 position.* |
| 75.0 | \| | *Controller returns a value of 75.0 units.* |

# SI — Set Master-Slave Jog Velocity Update Interval

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **SI**nn or **SI**?

**Parameters**

**Description** **nn** [int] — Jog velocity update interval.

**Range** **nn** — **1** to **1000**.

**Units** **nn** — Milliseconds.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.
Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** Obsolete command, but kept for backward compatibility.
This command has no effect.
Slave axis will jog with his master according to GR reduction ratio.

**Returns** If "**?**" sign is issued along with command, the controller returns slave axis.
jog velocity update interval.

**Rel. Commands** SS — Define master-slave relationship.
GR — Set master-slave reduction ratio.

# SK — Set Master-Slave Jog Velocity Scaling Coefficients

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **SK**$nn_1$, $nn_2$ or **SK**?

**Parameters**

**Description** **nn$_i$** [float] — Jog velocity scaling coefficients.

**Range** **nn$_i$** — None.

**Units** **nn$_i$** — None.

**Description** Obsolete command, but kept for backward compatibility.
This command has no effect.
Slave axis will jog with his master according to GR reduction ratio.

**Returns** If "**?**" sign is issued along with command, the controller returns slave axis.
jog velocity scaling coefficients.

**Rel. Commands** SS — Define master-slave relationship.
GR — set master-slave reduction ratio.

# SL — Set Left Travel Limit

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**SL**nn or xx**SL**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — left (negative) software limit.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **-Max_Long * encoder resolution** to **0**.

**Units**

**xx** — None.

**nn** — Predefined motion units.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command defines the value for the negative (left) software travel limit. It should be used to restrict travel in the negative direction to protect the motion device or its load. For instance, if traveling full range, a stage could push its load into an obstacle. To prevent this, the user can reduce the allowed travel by changing the software travel limit.

Since a motion device must be allowed to find its home position, the home switch and/or sensor must be inside the travel limits. This means that both positive and negative travel limits cannot be set on the same side of the home position. A more obvious restriction is that the negative limit cannot be greater than the positive limit. If any of these restrictions is not respected, the controller will return PARAMETER OUT OF RANGE.

**NOTE**

**If the command is issued for an axis in motion, the new limit should not be set inside the current travel.**

**NOTE**

**Be careful when using this command. The controller does not know the real hardware limits of the motion device. Always set the software limits inside the hardware limits (limit switches). In normal operation, a motion device should never hit a limit switch.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

OR — Search for home.

SR — Set right travel limit.

**Example** **1SL41.4** | *Set negative travel limit of axis #1 to 41.4 units.*

# SM — Save Settings to Non-Volatile Memory

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** **SM**

**Parameters** None.

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

To change the settings permanently use the configuration file.

**NOTE**

**User programs created with EP command are automatically saved to non-volatile memory.**

**Returns** None.

**Rel. Commands** None.

# SN — Set Axis Displacement Units

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**SN**nn or xx**SN**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [int] | — | Displacement units. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **11** where:<br>0 = Encoder count,<br>1 = Motor step,<br>2 = Millimeter,<br>3 = Micrometer,<br>4 = Inches,<br>5 = Milli-inches,<br>6 = Micro-inches,<br>7 = Degree,<br>8 = Gradian,<br>9 = Radian,<br>10 = Milliradian,<br>11 = Microradian,<br>or **?** to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command is used to set the displacement units for the for axis **xx**.

Position is automatically converted according to new unit.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| SU | — | Set encoder resolution. |

**Example**

| | | |
|---|---|---|
| **2SN** | \| | *Read displacement unit setting of axis #2.* |
| *2* | \| | *Controller returns a value 2 (millimeter) for axis #2.* |
| **2SN0** | \| | *Set displacement unit to 0 (encoder count) for axis #2.* |

# SR — Set Right Travel Limit

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**SR**nn or xx**SR**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Right (positive) software limit. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **Max_Long * encoder resolution**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Defined motion units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command defines the value for the positive (right) software travel limit. It should be used to restrict travel in the positive direction to protect the motion device or its load. For instance, if traveling full range, a stage could push its load into an obstacle. To prevent this, the user can reduce the allowed travel by changing the software travel limit.

Since a motion device must be allowed to find its home position, the home switch and/or sensor must be inside the travel limits. This means that both positive and negative travel limits cannot be set on the same side of the home position. A more obvious restriction is that the negative limit cannot be greater than the positive limit. If any of these restrictions is not respected, the controller will return PARAMETER OUT OF RANGE

**NOTE**

**If the command is issued for an axis in motion, the new limit should not be set inside the current travel.**

**NOTE**

**Be careful when using this command. The controller does not know the real hardware limits of the motion device. Always set the software limits inside the hardware limits (limit switches). In normal operation, a motion device should never hit a limit switch.**

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| OR | — | Search for home. |
| SL | — | Set left travel limit. |

**Example** **1SR41.4** | *Set positive travel limit of axis #1 to 41.4 units.*

# SS — Define Master-Slave Relationship

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**SS**nn or xx**SS**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number to be defined as a slave. |
| **nn** [int] | — | Axis number to be defined as a master. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **1** to **Max. Axes**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE |

**Description** This command defines master-slave relationship between any two axes. A few rules are in place for ease of use.

- An axis cannot be assigned as its own slave if it is already in a trajectory mode that is specific to master-slaving.
- A slave axis cannot be moved individually using PA or PR commands if its trajectory mode is specific to master-slaving.

This command gets executed immediately, and can also be called from within a program.

To disable the master-slave relationship, set the master axe to 0.

**Returns** If "**?**" sign is issued along with command, the controller returns master axis number.

**Rel. Commands**

| | | |
|---|---|---|
| GR | — | Set master-slave reduction ratio |

**Example**

| | | |
|---|---|---|
| **2SS1** | \| | *Set axis 2 to be the slave of axis 1.* |
| **2SS?** | \| | *Query the master axis number for axis 2.* |
| *1* | \| | *Controller returns a value of 1.* |
| 2GR1.0 | \| | *Set the reduction ratio of axis 2 to 1.0.* |
| 1MO | \| | *Turn axis 1 motor power ON.* |
| 2MO | \| | *Turn axis 2 motor power ON.* |
| 1PA10 | \| | *Move axis 1 to absolute 10 units.* |
| 2PA20 | \| | *Move axis 2 to absolute 20 units.* |
| TB | \| | *Read error messages.* |
| *232, 242000, AXIS-2 INVALID TRAJECTORY MODE FOR MOVING* | \| | *Controller returns appropriate error message.* |

# ST — Stop Motion

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**ST**

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| **Range** | **xx** | — | **1** to **Max. Axes**. |
| **Units** | **xx** | — | None. |
| **Defaults** | **xx** out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** This command stops a motion in progress using deceleration rate programmed with **AC** (set deceleration/deceleration) command on the specified axes. If the **ST** command is sent with no axis parameter, all axes are stopped.

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | AB | — | Abort motion. |
| | AC | — | Set acceleration/deceleration. |
| | MF | — | Motor power off. |

| | | | |
|---|---|---|---|
| **Example** | 2PA40 | \| | *Move axis #2 to absolute position 40.* |
| | **2ST** | \| | *Stop motion on axis #2.* |

# SU — Set Encoder Resolution

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**SU**nn or xx**SU**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Encoder resolution. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **2e-9** to **2e+9** in user defined units, or ? to read present setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** This command is used to set the encoder resolution for axis **xx**.

**NOTE**

**The encoder resolution can only be changed when encoder feedback is enabled. See ZF command.**

**Returns** If "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| SU | — | Set encoder resolution. |
| QD | — | Update driver. |
| ZF | — | set feedback and following error configuration. |

**Example**

| | | |
|---|---|---|
| **2SU?** | \| | *Read encoder resolution setting of axis #2.* |
| *0.0001* | \| | *Controller returns a value of 0.0001 units for axis #2.* |
| **2SU0.0005** | \| | *Set encoder resolution to 0.0005 units for axis #2.* |

# TB — Read Error Message

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **TB**nn or **TB**?

**Parameters**

**Description** **nn** [int] — Error code.

**Range** **nn** — **0** to **Max. error code**.

**Units** **nn** — None.

**Defaults** **nn** Missing: Interpreted as "?"'.

Out of range:Error description not available.

**Description** This command is used to retreive the error code, timestamp, and the associated message of the error code **nn**.

The error code is one numerical value up to three(3) digits long (see Appendix for complete listing). In general, non-axis specific errors numbers range from 1-99. Axis-**1** specific errors range from **1**00-**1**99, Axis-**2** errors range from **2**00-**2**99 and so on.

The timestamp is in terms of servo cycle (100 µs) ticks accumulated since the last System Reset, incrementing at the servo interrupt interval (100us default).

The message is a description of the error associated with it.

All arguments are separated by commas.

If "**?**" sign takes the place of **nn** value or if **nn** is missing, this command reports the description of the older error in the error buffer.

**NOTE**

**Errors are maintained in a FIFO buffer ten(10) elements deep. When an error is read using TB or TE, the controller returns the first error and the error buffer is cleared by one(1) element. This means that an error can be read only once, with either command.**

**Returns** **aa**, **bb**, **cc**, where:
aa = **Error code** (See Appendix for complete listing).
bb = **Timestamp**.
cc = **Error message**..

**Rel. Commands** TE — Read error code.

**Example**

| | | |
|---|---|---|
| **TB** | \| | *Read error message.* |
| *0, 451322, NO ERROR DETECTED* | \| | *Controller returns no error.* |
| 8PA12.3 | \| | *Move axis #8 to position 12.3.* |
| **TB?** | \| | *Read error message.* |
| *9, 451339, AXIS NUMBER OUT OF RANGE* | \| | *Controller returns error code, timestamp, and description.* |

# TE — Read Error Code

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **TE**nn or **TE**?

**Parameters**

**Description** **nn** [int] — Query type.

**Range** **nn** — **1** to **2** where:
1 = get the oldest known error code without removing it,
2 = get the number of errors currently in the FIFO,
or **?** to read oldest known error code.

**Units** **nn** — None.

**Defaults** **nn** Missing: Interpreted as "?".
Out of range: Interpreted as "?".
Timeout: Error 2, RS-232 COMMUNICATION TIME-OUT.

**Description** This command is used to read the error code.

The error code is one numerical value up to three digits long (see Appendix for complete listing).

In general, non-axis specific errors numbers range from 1-99. Axis-**1** specific errors range from **1**00-**1**99, Axis-**2** errors range from **2**00-**2**99 and so on.

**NOTE**

**Errors are maintained in a FIFO buffer ten(10) elements deep. When an error is read using TB or TE, the controller returns the first error and the error buffer is cleared by one(1) element. This means that an error can be read only once, with either command.**

**Returns** **aa**, where:
aa = **Error code number** or **number of errors in the buffer**.
See Appendix for complete listing.

**Rel. Commands** TB — Read error message.

**Example**

| | | |
|---|---|---|
| **TE?** | \| | *Read error message.* |
| *0* | \| | *Controller returns no error.* |
| 8PA12.3 | \| | *Move axis #8 to position 12.3.* |
| **TE?** | \| | *Read error message.* |
| *9* | \| | *Controller returns error code 9 meaning incorrect axis number.* |

# TJ — Set Trajectory Mode

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**TJ**nn or xx**TJ**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [int] | — | Trajectory mode. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **1** to **6**, where:<br>2 = s-curve mode, |

| **Units** | | | |
|---|---|---|---|
| **xx** | — | None. |

| | | |
|---|---|---|
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect. The trajectory mode if fixed to *s-curve.*

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports 2.

**Rel. Commands**

| | | |
|---|---|---|
| SS | — | Set master-slave relationship. |
| GR | — | Set master/slave gear ratio. |

**Example**

| | | |
|---|---|---|
| **1TJ?** | \| | *Report current trajectory mode setting on axis #1.* |
| *2* | \| | *Controller returns trajectory mode 2 (s-curve) for axis #1.* |

# TP — Read Actual Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**TP**

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **1** to **Max. Axes**.
None = all axes

**Units** **xx** — None.

**Defaults** **xx** Missing: Returns position of each axis.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to read the actual position. It returns the instantaneous real position of the specified axis.

**Returns** **nn**, or $\mathbf{nn_i}$, … $\mathbf{nn_i}$ where:
**nn** = **Actual position** of requested axis in pre-defined units
$\mathbf{nn_i}$ = **Actual position** of ith axis in pre-defined units.

**Rel. Commands**

| | | |
|---|---|---|
| PA | — | Move to an absolute position. |
| PR | — | Move to a relative position. |
| DP | — | Read instantaneous desired position. |

**Example**

| | | |
|---|---|---|
| **3TP** | \| | *Read real position on axis #3.* |
| *5.322* | \| | *Controller returns real position 5.322 for axis #3.* |
| **TP** | \| | *Read real position on all axes.* |
| *0,1.452 ,5.322* | \| | *Controller returns real position of each axis:*<br>*0 for axis #1.*<br>*1.452 for axis #2*<br>*5.322 for axis #3* |

# TS — Read Controller Status

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **TS** or xx**TS** or xx**TS1**

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| **Range** | **xx** | — | **1** to **Max. Axes**.<br>None = controller status |
| **Units** | **xx** | — | None. |
| **Defaults** | **xx** Missing: | | Returns controller status. |
| | Out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** This command is used to read the controller axes status byte or an axis/driver status byte.

**TS: Controller axes status**

**xxTS : Axis xx status**

**xxTS1 : Axis xx driver status**

The bytes returned are in the form of an ASCII character. The value of each bit in the status byte can be deduced after converting the ASCII character into a binary value. Each bit of the status byte represents a particular controller parameter, as described in the following table.

**NOTE**

**Please refer to the Appendix for a complete ASCII to binary conversion table.**

**Controller axes status (TS)**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | Axis #1 in motion | Stationary | In motion |
| 1 | Axis #2 in motion | Stationary | In motion |
| 2 | Axis #3 in motion | Stationary | In motion |
| 3 | Reserved | Default | — |
| 4 | Motor power of at least one axis | OFF | ON |
| 5 | Reserved | Default | — |
| 6 | Reserved | — | Default |
| 7 | Reserved | Default | — |

**Axis status (xxTS)**

| | Bit # | Function | Meaning for Bit LOW | Meaning for Bit HIGH |
|---|---|---|---|---|
| 1st byte | 0 | Axis is connected | YES | NO |
| | 1 | Motor state | OFF | ON |
| | 2 | Axis is in motion | NO | YES |
| | 3 | Reserved | Default | — |
| | 4 | Origine done | YES | NO |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |
| 2nd byte | 0 | Following error | NO | YES |
| | 1 | Motor fault | NO | YES |
| | 2 | EOR- is reached | NO | YES |
| | 3 | EOR+ is reached | NO | YES |
| | 4 | ZM is reached | NO | YES |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |

**Driver status (xxTS1)**

| | Bit # | Function | Meaning for Bit LOW | Meaning for Bit HIGH |
|---|---|---|---|---|
| 1st byte | 0 | Short circuit | NO | YES |
| | 1 | Fuse broken or Low supply voltage | NO | YES |
| | 2 | Thermistance (motor or driver) | NO | YES |
| | 3 | Parameters error | NO | YES |
| | 4 | RMS current limit | NO | YES |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |
| 2nd byte | 0 | Reserved (SubD pin 10) | — | Default |
| | 1 | Reserved (SubD pin 11) | — | Default |
| | 2 | Reserved (SubD pin 12) | — | Default |
| | 3 | Current Limit | NO | YES |
| | 4 | Reserved | Default | — |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |

**Returns** ASCII character representing the status byte.

**Rel. Commands** TX — Read controller activity.

| | | | |
|---|---|---|---|
| **Example** | **TS** | \| | *Read controller axes status.* |
| | *S* | \| | *Controller returns character S indicating axes #1 and #2 are in motion, and motor power of at least one axis is ON.* |
| | **3TS** | \| | *Read axis #3 status.* |
| | *@B* | \| | *Controller returns character @ and B indicating axes #3 is connected, motor OFF, not in motion, origine done, and with motor fault.* |
| | **3TS1** | \| | *Read axis #3 driver status.* |
| | *PG* | \| | *Controller returns character P and G indicating axes #3 has a current limit error.* |

# TV — Get Actual Velocity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**TV**

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | Axis number. |
| **Range** | **xx** | — | **1** to **Max. Axes**. |
| **Units** | **xx** | — | None. |
| **Defaults** | **xx** Missing: | | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** This command is used to read the actual velocity of an axis. The command can be sent at any time but its real use is while motion is in progress.

**Returns** **nn**, where:
nn = **Actual velocity of the axis** in pre-defined units.

| | | | |
|---|---|---|---|
| **Rel. Commands** | PA | — | Move to an absolute position. |
| | PR | — | Move to a relative position. |

**Example**

| | | |
|---|---|---|
| 3TP? | \| | *Read position on axis #3.* |
| *5.32* | \| | *Controller returns position 5.32 units for axis #3.* |
| 3PR2.2 | \| | *Start a relative motion of 2.2 units on axis #3.* |
| 3DV | \| | *Read desired velocity on axis #3.* |
| *0.2* | \| | *Controller returns velocity 0.2 units/s for axis #3.* |
| **3TV** | \| | *Read actual velocity on axis #3.* |
| *0.205* | \| | *Controller returns velocity 0.205 units/s for axis #3.* |
| 3DP? | \| | *Read desired position on axis #3.* |
| *7.52* | \| | *Controller returns desired position 7.52 units for axis #3.* |

# TX — Read Controller Activity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **TX** or **TX1**

**Parameters** None.

**Description** This command is used to read the controller activity or status register.

**TX: Controller activity**

**TX1 : Controller status**

The bytes returned are in the form of an ASCII character. The value of each bit in the status byte can be deduced after converting the ASCII character into a binary value. Each bit of the status byte represents a particular parameter, as described in the following table.

**NOTE**

**Please refer to the Appendix for a complete ASCII to binary conversion table.**

**Controller Activity (TX)**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | At least one program is executing | NO | YES |
| 1 | Wait command is executing | NO | YES |
| 2 | Manual jog mode is active | NO | YES |
| 3 | Local mode is inactive | Default | — |
| 4 | At least one trajectory is executing | NO | YES |
| 5 | Reserved | Default | — |
| 6 | Reserved | — | Default |
| 7 | Reserved | Default | — |

**Controller status (TX1)**

| | Bit # | Function | Meaning for Bit LOW | Meaning for Bit HIGH |
|---|---|---|---|---|
| 1st byte | 0 | Controller boot | OK | Failed |
| | 1 | Axis #1 boot configuration | OK | Failed |
| | 2 | Axis #2 boot configuration | OK | Failed |
| | 3 | Axis #3 boot configuration | OK | Failed |
| | 4 | Reserved | Default | — |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |
| 2nd byte | 0 | Hardware Inhibit | Detected | Not detected |
| | 1 | Drivers 48V power supply | Detected | Not detected |
| | 2 | Axis #1 Motor ON | NO | YES |
| | 3 | Axis #2 Motor ON | NO | YES |
| | 4 | Axis #3 Motor ON | NO | YES |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |
| 3rd byte | 0 | Drivers commands underrun | NO | YES |
| | 1 | Reserved | Default | — |
| | 2 | Reserved | Default | — |
| | 3 | Reserved | Default | — |
| | 4 | Reserved | Default | — |
| | 5 | Reserved | Default | — |
| | 6 | Reserved | — | Default |
| | 7 | Reserved | Default | — |

**Returns** ASCII character representing the status byte.

**Rel. Commands** TS — Read controller status.

**Example**

**TX** | *Read controller activity.*

*P* | *Controller returns character P indicating at least one trajectory is executing*

**TX1** | *Read controller status.*

*BD@* | *Controller returns character B, D and @ indicating that axis #2 boot configuration failed and axis #3 motor is ON.*

# UF — Update Servo Filter

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**UF**

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — **0** to **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: No error, is interpreted like 0.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to make active the latest entered PID parameters. Any new value for Kp, Ki, Kd, Ks, Kt and maximum following error are not being used in the PID loop calculation until **UF** command is received. This assures that the parameters are loaded simultaneously, without any transitional glitches in the loop.

If the axis specifier **xx** is missing or set to 0, the controller updates the filters for all axes. If **xx** is a number between 1 and 3, the controller updates only the filter for the specified axis.

**Returns** None.

**Rel. Commands**

| | | | |
|---|---|---|---|
| FE | — | Set maximum following error. |
| KD | — | Set derivative gain factor. |
| KI | — | Set integral gain factor. |
| KP | — | Set proportional gain factor. |

Example

| | | |
|---|---|---|
| 3KP0.05 | \| | *Set proportional gain factor of axis #3 to 0.05.* |
| 3KD0.07 | \| | *Set derivative gain factor of axis #3 to 0.07.* |
| **3UF** | \| | *Update servo loop of axis #3 with the new parameters.* |

# UH — Wait for DIO Bit High

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | – | ♦ | – |

**Syntax** xx**UH**

**Parameters**

**Description** **xx** [int] — DIO bit number.

**Range** **xx** — **0** to **15**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command causes a program to wait until a selected I/O input bit becomes high. It is level, not edge sensitive. This means that at the time of evaluation, if the specified I/O bit **xx** is high already, the program will continue to execute subsequent commands.

**NOTE**

**All DIO bits are pulled high on the board. Therefore, a missing signal will cause the wait to complete and subsequent commands will continue to be executed.**

**Returns** None.

**Rel. Commands** UL — Wait for DIO bit low.

Example

| | | |
|---|---|---|
| 1EP | \| | *Enter stored program #1.* |
| 1MO | \| | *Turn axis #1 motor power ON.* |
| 1MV+ | \| | *Move axis #1 indefinitely in positive direction.* |
| **13UH** | \| | *Wait for DIO bit #13 to go HIGH before executing any subsequent commands.* |
| 1ST | \| | *Stop axis #1.* |
| WT500 | \| | *Wait for 500 ms.* |
| 1MV- | \| | *Move axis #1 indefinitely in negative direction.* |
| QP | \| | *Quit program mode.* |

# UL — Wait for DIO Bit Low

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | – | ♦ | – |

**Syntax** xx**UL**

**Parameters**

**Description** **xx** [int] — DIO bit number.

**Range** **xx** — **0** to **15**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error 7, PARAMETER OUT OF RANGE.

**Description** This command causes a program to wait until a selected I/O input bit becomes low. It is level, not edge sensitive. This means that at the time of evaluation, if the specified I/O bit **xx** is low already, the program will continue to execute subsequent commands.

**Returns** None.

**Rel. Commands** UH — Wait for DIO bit high.

Example

```
1EP   |  Enter stored program #1.
1MO   |  Turn axis #1 motor power ON.
1MV+  |  Move axis #1 indefinitely in positive direction.
13UL  |  Wait for DIO bit #13 to go LOW before executing any subsequent commands.
1ST   |  Stop axis #1.
WT500 |  Wait for 500 ms.
1MV-  |  Move axis #1 indefinitely in negative direction.
QP    |  Quit program mode.
```

# VA — Set Velocity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**VA**nn or xx**VA**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — Velocity value.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **MaximumVelocity**, or **?** to read current setting.

**Units**

**xx** — None.

**nn** — Preset units/second.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x10, MAXIMUM VELOCITY EXCEEDED.

**Description**

This command is used to set the velocity value for an axis. Its execution is immediate, meaning that the velocity is changed when the command is processed, even while a motion is in progress.

It can be used as an immediate command or inside a program. If the requested axis is member of a group, the commanded velocity becomes effective only after the axis is removed from the group. Refer to Advanced Capabilities section in the ESP302 Features Manual for a detailed description of grouping and related commands.

Avoid changing the velocity during the acceleration or deceleration periods. For better predictable results, change velocity only when the axis is not moving or when it is moving with a constant speed.

**Returns**

If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

AC — Set acceleration.

VU — Get maximum velocity.

PA — Execute an absolute motion.

PR — Execute a relative motion.

**Example**

| | |
|---|---|
| **2VA?** | *Read desired velocity of axis #2.* |
| *10* | *Controller returns a velocity value of 10 units/s.* |
| 2PA15 | *Move to absolute position 15.* |
| WT500 | *Wait for 500 ms.* |
| **2VA4** | *Set axis #2 velocity to 4 units/s.* |
| **2VA?** | *Read velocity of axis #2.* |
| *4* | *Controller returns a velocity value of 4 units/s.* |

# VB — Set Base Velocity for Step Motors

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**VB**nn or xx**VB**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | Base velocity value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **MaximumVelocity**, or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Preset units/second. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

| | | |
|---|---|---|
| AC | — | Set acceleration/deceleration. |
| VA | — | Set velocity. |
| VU | — | Get maximum velocity. |
| PA | — | Execute an absolute motion. |
| PR | — | Execute a relative motion. |

**Example**

| | | |
|---|---|---|
| **2VB?** | \| | *Read desired base velocity of axis #2.* |
| *5* | \| | *Controller returns a velocity value of 5 units/s.* |

# VE — Read Controller Firmware Version

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **VE**nn or **VE**?

**Parameters**

**Description** **nn** [int] — Firmware part.

**Range** **nn** — **0** to **4**,
Missing = 0 = "**?**"

**Units** **nn** — None.

**Defaults** **nn** Out of range: Error x01, PARAMETER OUT OF RANGE.
Timeout: Error 2, RS-232 COMMUNICATION TIME-OUT.

**Description** This command is used to read the controller type and version.

The ESP302 is separated into different parts with different versions.

**NOTE**

**Important information needed when asking for technical support for the motion control system or when reporting a problem is the controller version. Use this command to determine the controller type and in particular, the firmware version.**

**Returns**

| | |
|---|---|
| **VE0** or **VE? or VE** | : ESP302 Snapshot version |
| **VE1** | : ESP302 MotionKernel version |
| **VE2** | : ESP302 Host version |
| **VE3** | : ESP302 FrontPanel version |
| **VE4** | : ESP302 Web version |

**Rel. Commands** None.

**Example**

| | | |
|---|---|---|
| | **VE?** | *Read controller Snapshot version.* |
| *ESP302 Snapshot Version N15000* | | *Controller returns model ESP302 Snapshot Version N15000.* |
| | **VE1** | *Read controller MotionKernel version.* |
| *ESP302 MotionKernel Version 1.0.0* | | *Controller returns model ESP302 MotionKernel Version 1.0.0.* |
| | **VE2** | *Read controller Host version.* |
| *ESP302 Host Version 1.0.2* | | *Controller returns model ESP302 Host Version 1.0.2.* |
| | **VE3** | *Read controller FrontPanel version.* |
| *ESP302 FrontPanel Version 1.2.0* | | *Controller returns model ESP302 FrontPanel Version 1.2.0.* |
| | **VE3** | *Read controller Web version.* |
| *ESP302 FrontPanel Web 2.0.1* | | *Controller returns model ESP302 Web Version 2.0.1.* |

# VF — Set Velocity Feed-Forward Gain

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**VF**nn or xx**VF**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [float] — velocity feed-forward gain factor Vf.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **Max_Double**, or **?** to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command sets the velocity feed-forward gain factor **VF**. It is active for any DC servo based motion device.

See the "Feed-Forward Loops" section in the ESP302 Features Manual to understand the basic principals of feed-forward.

**NOTE**

**The command can be sent at any time but it has no effect until the UF (update filter) is received.**

**NOTE**

**This command is volatile, to change the parameter permanently change KFeedForwardVelocity in the configuration file.**

**Returns**

If the "**?**" sign takes the place of **nn** value, this command reports the current setting.

**Rel. Commands**

KI — Set integral gain factor.

KS — Set saturation gain factor.

KD — Set derivative gain factor.

KP — Set proportional gain factor.

AF — Set acceleration feed-forward gain.

UF — Update filter.

**Example**

| | | |
|---|---|---|
| 3AF0.8 | \| | *Set acceleration feed-forward gain factor for axis #3 to 0.8.* |
| **3VF?** | \| | *report present axis-3 velocity feedforward setting.* |
| *1.4* | \| | *Controller returns a value of 1.4.* |
| **3VF1.5** | \| | *Set acceleration feed-forward gain factor for axis #3 to 1.5.* |
| 3UF | \| | *Update PID filter; only now the VF command takes effect.* |

# VU — Get Maximum Velocity

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**VU**?

**Parameters**

**Description** **xx** [int] — Axis number.

**Range** **xx** — To **Max. Axes**.

**Units** **xx** — None.

**Defaults** **xx** Missing: Error 37, AXIS NUMBER MISSING.
Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**Description** This command is used to get the maximum velocity value for an axis. This parameter is read-only and can be modified only through the MaximumVelocity parameter in configuration file.

**Returns** **nn** where:

. nn = maximum velocity (predefined units/second)

**Rel. Commands**
VA — Set velocity.
PA — Execute an absolute motion.
PR — Execute a relative motion.
AC — Set acceleration/deceleration.

**Example**
**2VU?** | *Read maximum allowed velocity of axis #2.*
*10* | *Controller returns a value of 10 units/second.*

# WP — Wait for Position

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**WP**nn

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [float] | — | position value. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **Starting position** to **destination** of axis number **xx**. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | Predefined units. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command stops program execution until a user specified position is reached. The program continues executing any subsequent commands only after axis **xx** has reached position **nn**.

**NOTE**

**Ensure that position nn is within the travel range of axis xx. The controller cannot always detect if a value is outside the travel range of an axis to flag an error, especially while making coordinated motion of multiple axes.**

Wait commands are primarily intended for use in internal program execution or in combination with the **RQ** command. If used in command mode, it is important to note that input command processing is suspended until the wait condition has been satisfied.

**Returns** None.

**Rel. Commands**

| | | |
|---|---|---|
| WT | — | wait. |
| WS | — | wait for motion stop. |

**Example**

| | | |
|---|---|---|
| 2PA-10; 2WS | \| | *Move axis #2 to position –10 units and wait for stop.* |
| 2PA10; **2WP0**; 3PA5 | \| | *Move axis #2 to position 10 units, wait for axis #2 to reach position 0 units and then move axis #3 to position 5 units.* |

# WS — Wait for Motion Stop

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** xx**WS**nn

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Delay after motion is complete.

**Range**

**xx** — **0** to **Max. Axes**.

**nn** — **0** to **60000**.

**Units**

**xx** — None.

**nn** — Milliseconds.

**Defaults**

**xx** Missing: All axes in motion.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE

**nn** Missing: Same as 0

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description**

This command stops the program execution until a motion is completed. The program is continued only after axis **xx** reaches its destination. If **xx** is not specified, the controller waits for all motion in progress to end. If **nn** is specified different than 0, the controller waits an additional **nn** milliseconds after the motion is complete and then executes the next commands.

**NOTE**

**Wait commands are primarily intended for use in internal program execution or in combination with the RQ command. If used in command mode, it is important to note that input command processing is suspended until the wait condition has been satisfied.**

**Returns** None.

**Rel. Commands**

WT — Wait.

WP — Wait for position.

**Example**

2PA10;2**WS500**;3PA5 | *Move axis #2 to position 10 units, wait for axis #2 to reach destination, wait an additional 500ms and then move axis #3 to position 5 units.*

# WT — Wait

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | ♦ |

**Syntax** **WT**nn

**Parameters**

**Description** **nn** [int] — Wait time (delay).

**Range** **nn** — **0** to **60000**.

**Units** **nn** — Milliseconds.

**Defaults** **nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

**Description** This command causes the controller to pause for a specified amount of time. This means that the controller will wait **nn** milliseconds before executing the next command.

**NOTE**

**Even though this command can be executed in immediate mode, its real value is as a flow control instruction inside programs.**

Wait commands are primarily intended for use in internal program execution or in combination with the RQ command. If used in command mode, it is important to note that input command processing is suspended until the wait condition has been satisfied.

**Returns** None.

**Rel. Commands** WS — Wait for stop.

WP — Wait for position.

**Example**

2MO;**WT400**;2PA2.3 | *Turn axis motor ON, wait an additional 400 ms and then move axis 2 to position 2.3 units.*

# XM — Read Available Memory

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **XM**

**Parameters** None.

**Description** This command reports the amount of unused program memory. The controller has 4G bytes of non-volatile memory available for the controller operating system, the firmware, and the user data like programs and gathering files.
This command reports the amount not used.

**Returns** Available storage space.

**Rel. Commands**

| | | |
|---|---|---|
| EP | — | Enter program download mode. |
| EX | — | Execute a stored program. |
| LP | — | List stored program. |
| XX | — | Delete a stored program. |

**Example**

| | |
|---|---|
| **XM** | *Read available memory.* |
| *Available storage space = 495177728* | *Controller reports available storage space.* |

# XX — Erase Program

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** xx**XX**

**Parameters**

| | | | |
|---|---|---|---|
| **Description** | **xx** [int] | — | program number. |
| **Range** | **xx** | — | **1** to **127**. |
| **Units** | **xx** | — | None. |
| **Defaults** | **xx** Missing: | | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | | Error 7, PARAMETER OUT OF RANGE. |

**Description** This command deletes the program **xx** from controller's non-volatile memory.

**Returns** None.

| | | | |
|---|---|---|---|
| **Rel. Commands** | EP | — | Enter program download mode. |
| | EX | — | Execute a stored program. |
| | LP | — | List stored program. |
| | XM | — | Read available memory. |

**Example**

| | | |
|---|---|---|
| **1XX** | \| | *Delete program #1.* |
| XM | \| | *Read available memory.* |
| *Available storage space = 60228* | \| | *Controller reports available storage space.* |
| **2XX** | \| | *Delete program #2.* |
| XM | \| | *Read available memory.* |
| *Available storage space = 61440* | \| | *Controller reports available storage space.* |

# ZA — Set Amplifier I/O Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZA**nn or xx**ZA**?

**Parameters**

**Description** **xx** [int] — Axis number.

**nn** [int] — amplifier I/O configuration.

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.

# ZB — Set Feedback Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZB**nn or xx**ZB**?

**Parameters**

**Description**

| | | | |
|---|---|---|---|
| **xx** [int] | — | Axis number. |
| **nn** [int] | — | Feedback configuration. |

**Range**

| | | |
|---|---|---|
| **xx** | — | **1** to **Max. Axes**. |
| **nn** | — | **0** to **0200H** (hexadecimal with leading zero(0)), or **?** to read current setting. |

**Units**

| | | |
|---|---|---|
| **xx** | — | None. |
| **nn** | — | None. |

**Defaults**

| | | |
|---|---|---|
| **xx** | Missing: | Error 37, AXIS NUMBER MISSING. |
| | Out of range: | Error 9, AXIS NUMBER OUT OF RANGE. |
| **nn** | Missing: | Error 38, COMMAND PARAMETER MISSING. |
| | Out of range: | Error x01, PARAMETER OUT OF RANGE. |

**Description** Obsolete command, but kept for backward compatibility.

This command is equivalent to ZF command.

**Rel. Commands**

| | | |
|---|---|---|
| ZF | — | Set feedback and following error configuration. |

# ZE — Set E-Stop Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZE**nn or xx**ZE**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — E-stop configuration.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **7H**
or **?** to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

out of range: Error x17, ESP CRITICAL SETTINGS ARE PROTECTED.

**Description** This command is used to set the emergency stop (e-stop) configuration , fault checking, and event handling for axis specified with **xx**.

**NOTE**

**If bit-0 or both bits-1 and -2 are set to zero(0) then no action will be taken by the controller.**

**e-stop configuration**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | E-stop checking | Disabled | Enabled |
| 1 | disable motor power on E-stop event | do not disable motor power on E-stop event | disable motor power on E-stop event |
| 2 | abort motion on E-stop event | do not abort motion on E-stop event | abort motion on E-stop event |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

**Rel. Commands**

ZF — Set feedback and following error configuration.

ZH — Set hardware limit configuration.

ZS — Set software limit configuration.

ZZ — Set general system configuration.

**Example**

**2ZE?** | Read e-stop configuration of axis #2.

*03H* | Controller returns a value of 3H for axis #2.

**2ZE5H** | Set e-stop configuration to 5H for axis #2.

# ZF — Set Following Error Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZF**nn or xx**ZF**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — following error configuration.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **0200H** (hexadecimal with leading zero(0)), or ? to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

critical setting: Error x17, ESP CRITICAL SETTINGS ARE PROTECTED.

**Description** This command is used to set the following error configuration , fault checking, and event handling for axis specified with **xx**.

**NOTE**

**If bit-0 or both bits-1 and -2 are set to zero(0) then no action will be taken by the controller.**

**Feedback configuration**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | Position feedback checking | Disabled | Enabled |
| 1 | disable motor power on Following error event | do not disable motor power on Following error event | disable motor power on Following error event |
| 2 | abort motion on Following error event | do not abort motion on Following error event | abort motion on Following error event |
| 3 | Reserved | Default | — |
| 4 | Reserved | Default | — |
| 5 | Reserved | Default | — |
| 6 | Reserved | Default | — |
| 7 | Reserved | Default | — |
| 8 | Closed/Open loop | Open | Closed |
| 9 | Encoder feedback for stepper motors | Normal | Internal |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

| | | | |
|---|---|---|---|
| **Rel. Commands** | ZE | — | Set e-stop configuration. |
| | ZH | — | Set hardware limit configuration. |
| | ZS | — | Set software limit configuration. |
| | ZZ | — | Set general system configuration. |
| | FE | — | Set following error threshold. |
| **Example** | **2ZF?** | \| | *Read following error configuration of axis #2.* |
| | *0107H* | \| | *Controller returns a value of 0107HH for axis #2.* |
| | **2ZF5H** | \| | *Set following error configuration to 5H for axis #2.* |

# ZH — Set Hardware Limit Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZH**nn or xx**ZH**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — Hardware limit configuration.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **0FFFFH** (hexadecimal with leading zero(0) ), or ? to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

critical setting: Error x17, ESP CRITICAL SETTINGS ARE PROTECTED.

**Description** This command is used to set the hardware limit checking, polarity, and event handling for axis specified with **xx**.

**NOTE**

**If bit-0 or both bits-1 and -2 are set to zero(0) then no action will be taken by the controller.**

**Feedback configuration**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | Position feedback checking | Disabled | Enabled |
| 1 | disable motor power on hardware limit event | do not disable motor power on hardware limit event | disable motor power on hardware limit event |
| 2 | abort motion on hardware limit event | do not abort motion on hardware limit event | abort motion on hardware limit event |
| 3 | Reserved | Default | — |
| 4 | Reserved | Default | — |
| 5 | Reserved | Default | — |
| 6 | Reserved | Default | — |
| 7 | Reserved | Default | — |
| 8 | Closed/Open loop | Open | Closed |
| 9 | Encoder feedback for stepper motors | Normal | Internal |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

| | | | |
|---|---|---|---|
| **Rel. Commands** | ZA | — | Set amplifier I/O configuration. |
| | ZE | — | Set e-stop configuration. |
| | ZF | — | Set following error configuration. |
| | ZB | — | Set feedback configuration. |
| | ZS | — | Set software limit configuration. |
| | ZZ | — | Set general system configuration. |
| **Example** | **2ZH?** | \| | *Read hardware limit configuration of axis #2.* |
| | *07H* | \| | *Controller returns a value of 07H for axis #2.* |
| | **2ZH06H** | \| | *Set hardware limit configuration to 06H for axis #2.* |

# ZS — Set Software Limit Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** xx**ZS**nn or xx**ZS**?

**Parameters**

**Description**

**xx** [int] — Axis number.

**nn** [int] — hardware limit configuration.

**Range**

**xx** — **1** to **Max. Axes**.

**nn** — **0** to **07H** (hexadecimal with leading zero(0) ), or **?** to read current setting.

**Units**

**xx** — None.

**nn** — None.

**Defaults**

**xx** Missing: Error 37, AXIS NUMBER MISSING.

Out of range: Error 9, AXIS NUMBER OUT OF RANGE.

**nn** Missing: Error 38, COMMAND PARAMETER MISSING.

Out of range: Error x01, PARAMETER OUT OF RANGE.

critical setting: Error x17, ESP CRITICAL SETTINGS ARE PROTECTED.

**Description** This command is used to set the software limit checking and event handling for axis specified with **xx**.

**NOTE**

**If bit-0 or both bits-1 and -2 are set to zero(0) then no action will be taken by the controller.**

**Feedback configuration**

| Bit # | Function | Meaning for | |
|---|---|---|---|
| | | Bit LOW | Bit HIGH |
| 0 | Position feedback checking | Disabled | Enabled |
| 1 | disable motor power on software limit event | do not disable motor power on software limit event | disable motor power on software limit event |
| 2 | abort motion on software limit event | do not abort motion on software limit event | abort motion on software limit event |
| 3 | Reserved | Default | — |
| 4 | Reserved | Default | — |
| 5 | Reserved | Default | — |
| 6 | Reserved | Default | — |
| 7 | Reserved | Default | — |
| 8 | Closed/Open loop | Open | Closed |
| 9 | Encoder feedback for stepper motors | Normal | Internal |

**Returns** If the "**?**" sign takes the place of **nn** value, this command reports the current setting in hexadecimal notation.

| | | | |
|---|---|---|---|
| **Rel. Commands** | ZA | — | Set amplifier I/O configuration. |
| | ZE | — | Set e-stop configuration. |
| | ZF | — | Set following error configuration. |
| | ZB | — | Set feedback configuration. |
| | ZH | — | Set hardware limit configuration. |
| | ZZ | — | Set general system configuration. |
| | SL | — | Set left limit. |
| | SR | — | Set right limit. |
| **Example** | **2ZS?** | \| | *Read software limit configuration of axis #2.* |
| | *07H* | \| | *Controller returns a value of 7H for axis #2.* |
| | **2ZS5H** | \| | *Set software limit configuration to 5H for axis #2.* |

# ZU — Get ESP System Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | – | ♦ |

**Syntax** **ZU**

**Parameters** None.

**Description** This command is used to get the present ESP system stage/driver configuration. After each system reset or initialization the ESP motion controller detects the presence of Universal drivers and ESP-compatible stages connected.

**ESP configuration**

| Bit# | Value | Definition |
|---|---|---|
| 0 | 0 | axis-1 universal driver not detected |
| 0 | 1 | axis-1 universal driver detected |
| 1 | 0 | axis-2 universal driver not detected |
| 1 | 1 | axis-2 universal driver detected |
| 2 | 0 | axis-3 universal driver not detected |
| 2 | 1 | axis-3 universal driver detected |
| 3 | 0 | reserved |
| 3 | 1 | reserved |
| 4 | 0 | reserved |
| 4 | 1 | reserved |
| 5 | 0 | reserved |
| 5 | 1 | reserved |
| 6 | 0 | reserved |
| 6 | 1 | reserved |
| 7 | 0 | reserved |
| 7 | 1 | reserved |

**Returns** This command reports the current setting in hexadecimal notation.

**Rel. Commands**

| | | |
|---|---|---|
| ZA | — | Set amplifier I/O configuration. |
| ZB | — | Set feedback configuration. |
| ZE | — | Set e-stop configuration. |
| ZF | — | Set following error configuration. |
| ZH | — | Set hardware limit configuration. |
| ZS | — | Set software limit configuration. |
| ZZ | — | Set system configuration. |

**Example**

| | | |
|---|---|---|
| **ZU** | \| | *Read ESP system configuration.* |
| *03H* | \| | *Controller returns a value of 03H.* |

# ZZ — Set System Configuration

| | IMM | PGM | MIP |
|---|---|---|---|
| **Usage** | ♦ | ♦ | – |

**Syntax** **ZZ**nn or **ZZ**?

**Parameters**

**Description** **nn** [int] — System configuration.

**Units** **nn** — None.

**Description** Obsolete command, but kept for backward compatibility.

This command has no effect.


# Appendix

## 3.0 Error Messages

The ESP302 controller has an elaborate command interpreter and system monitor. Every command is analyzed for syntax and correct format after it is received. The result of the analysis is stored in an output buffer in plain English. During moves and while idle, system inputs are monitored and any change is reported to the user via the output buffer. To read the contents of the output buffer, send the command **TB** (tell buffer).

For more compact error messages, use the **TE** command. The ESP302 controller response to this command is a one byte; binary coded error number, e.g., 33.

For the sake of convenience, error messages are divided into two categories – non-axis specific error messages and axis specific error messages. Below is a list of all possible ESP302 controller error messages that are not axis specific:

**0 NO ERROR DETECTED**

No errors exist in the output buffer.

**1 PCI COMMUNICATION TIME-OUT**

A communication transfer was initiated through PCI bus interface and was never completed.

**2 Reserved for future use**

**3 Reserved for future use**

**4 EMERGENCY STOP ACTIVATED**

An emergency stop was executed because the motion controller received a '#' character or "STOP ALL AXES" button was pressed.

**5 Reserved for future use**

**6 COMMAND DOES NOT EXIST**

The issued command does not exist. Check the Command Syntax.

**7 PARAMETER OUT OF RANGE**

The specified parameter is out of range. Refer to the description of issued command for valid parameter range.

**8 CABLE INTERLOCK ERROR**

The 100-pin cable between motion controller board and driver is disconnected.

**9 AXIS NUMBER OUT OF RANGE**

The specified axis number is out of range. Refer to the description of issued command for valid axis number range.

**10 Reserved for future use**

**11 Reserved for future use**

**12 Reserved for future use**

**13 GROUP NUMBER MISSING**

Group number is not specified. The issued command requires a valid group number. Refer to the description of issued command for valid group number range.

**14 GROUP NUMBER OUT OF RANGE**

The specified group number is out of range. Refer to the description of issued command for valid group number range.

**15 GROUP NUMBER NOT ASSIGNED**

No group has been assigned. Refer to the description of HN command to create a new group.

**16 GROUP NUMBER ALREADY ASSIGNED**

A group has already been assigned. Delete group with HX command before creating a new group with HN command.

**17 GROUP AXIS OUT OF RANGE**

At least one of the axis numbers specified to be a member of this group is out of range. Refer to the description of HN command for valid range of axis numbers that can be assigned to a group.

**18 GROUP AXIS ALREADY ASSIGNED**

At least one of the axis numbers specified to be a member of this group is already a member of a different group.

**19 GROUP AXIS DUPLICATED**

At least one of the axis numbers is specified to be a member of this group more than once.

**20 DATA ACQUISITION IS BUSY**

Data acquisition is not yet complete.

**21 DATA ACQUISITION SETUP ERROR**

An error occurred during data acquisition setup. Ensure that data acquisition is disabled and all parameters are within valid range before issuing the command. Refer to the command description for valid range of parameters.

**22 DATA ACQUISITION NOT ENABLED**

Data acquisition is not yet enabled.

**23 SERVO CYCLE (400 µS) TICK FAILURE**

There was a failure to increment the servo tick in the Interrupt Service Routine (ISR) that manages motion control.

**24 Reserved for future use**

**25 DOWNLOAD IN PROGRESS**

Firmware download is in progress.

**26 STORED PROGRAM NOT STARTED**

An attempt was made to execute a stored program and the program could not be started.

**26 COMMAND NOT ALLOWED**

The issued command is not valid in the context in which it was issued.

**28 STORED PROGRAM FLASH AREA FULL**

The flash area reserved for stored programs is full.

**29 GROUP PARAMETER MISSING**

At least one parameter is missing. Refer to the description of issued command for valid number of parameters.

**30 GROUP PARAMETER OUT OF RANGE**

The specified group parameter is out of range. Refer to the description of issued command for valid range of parameter.

**31 GROUP MAXIMUM VELOCITY EXCEEDED**

The specified group velocity exceeds the minimum of the maximum velocities of members of this group. Refer to the description of HV command for more details.

**32 GROUP MAXIMUM ACCELERATION EXCEEDED**

The specified group acceleration exceeds the minimum of the maximum acceleration of members of this group. Refer to the description of HA command for more details.

**33 GROUP MAXIMUM DECELERATION EXCEEDED**

The specified group deceleration exceeds the minimum of the maximum decelerations of members of this group. Refer to the description of HD command for more details.

**34 GROUP MOVE NOT ALLOWED DURING MOTION**

Cannot make a coordinated move when one of the members of the group is being "homed".

**35 PROGRAM NOT FOUND**

The issued command could not be executed because the stored program requested is not available.

**36 Reserved for future use**

**37 AXIS NUMBER MISSING**

Axis number not specified. The issued command requires a valid axis number. Refer to the description of issued command for valid axis number range.

**38 COMMAND PARAMETER MISSING**

At least one parameter associated with this command is missing. Refer to the description of issued command for valid number of parameters.

**39 PROGRAM LABEL NOT FOUND**

The issued command could not be executed because the requested label within a stored program is not available.

**40 LAST COMMAND CANNOT BE REPEATED**

An attempt was made to repeat the last (previous) commanded by just sending a carriage return. This feature is not allowed for commands that carry strings in addition to the two-letter ASCII mnemonic. Issue the last command again.

**41 MAX NUMBER OF LABELS PER PROGRAM EXCEEDED**

The number of labels used in the stored program exceeds the allowed value.

Below is a list of all possible error messages that are axis specific. Here, "x" represents the axis number.

**x00 MOTOR TYPE NOT DEFINED**

A valid motor type was not defined for the requested axis. Refer to the description of **QM** command to define a motor type.

**x01 PARAMETER OUT OF RANGE**

The specified parameter is out of range. Refer to the description of issued command for valid parameter range.

**x02 AMPLIFIER FAULT DETECTED**

There was an amplifier fault condition.

**x03 FOLLOWING ERROR THRESHOLD EXCEEDED**

The real position of specified axis was lagging the desired position by more encoder counts than specified with the **FE** command. Refer to the description of **ZF** command to configure the motion controller tasks upon encountering a following error.

**x04 POSITIVE HARDWARE LIMIT DETECTED**

The motion controller sensed a high level at its positive travel limit input. Refer to the description of **ZH** command to configure the motion controller tasks upon encountering a hardware limit.

**x05 NEGATIVE HARDWARE LIMIT DETECTED**

The motion controller sensed a high level at its negative travel limit input. Refer to the description of **ZH** command to configure the motion controller tasks upon encountering a hardware limit.

**x06 POSITIVE SOFTWARE LIMIT DETECTED**

The motion controller sensed that the axis has reached positive software travel limit. Refer to the description of **SR** command to specify the desired positive software travel limit. Also, refer to the description of **ZS** command to configure the motion controller tasks upon encountering a software limit.

**x07 NEGATIVE SOFTWARE LIMIT DETECTED**

The motion controller sensed that the axis has reached negative software travel limit. Refer to the description of **SL** command to specify the desired negative software travel limit. Also, refer to the description of **ZS** command to configure the motion controller tasks upon encountering a software limit.

**x08 MOTOR / STAGE NOT CONNECTED**

The specified axis is not connected to the driver.

**x09 FEEDBACK SIGNAL FAULT DETECTED**

There was a feedback signal fault condition. Ensure that the encoder feedback is relatively noise free.

**x10 MAXIMUM VELOCITY EXCEEDED**

The specified axis velocity exceeds maximum velocity allowed for the axis. Refer to the description of **VU** command or set maximum velocity for the axis.

**x11 MAXIMUM ACCELERATION EXCEEDED**

The specified axis acceleration exceeds maximum acceleration allowed for the axis. Refer to the description of **AU** command to query or set maximum acceleration or deceleration for the axis.

**x12 Reserved for future use**

**x13 MOTOR NOT ENABLED**

A command was issued to move an axis that was not powered ON. Refer to the description of **MO** and **MF** commands to turn the power to an axis ON or OFF respectively.

**x14 Reserved for future use**

**x15 MAXIMUM JERK EXCEEDED**

The specified axis jerk exceeds maximum jerk allowed for the axis. Refer to the description of **JK** command for valid jerk range.

**x16 MAXIMUM DAC OFFSET EXCEEDED**

The specified axis DAC offset exceeds maximum value allowed for the axis. Refer to the description of issued command for valid range.

**x17 ESP CRITICAL SETTINGS ARE PROTECTED**

An attempt was made to modify parameters that are specific to smart stages or "Unidriver".

**x18 ESP STAGE DEVICE ERROR**

An error occurred while reading a smart stage.

**x19 ESP STAGE DATA INVALID**

Smart stage data is invalid.

**x20 HOMING ABORTED**

Axis home search was aborted. This message is obtained when home search was not completed either due to an axis not being enabled or due to the occurrence of a fault condition. Refer to the description of **OR** command for information related to locating the home position of an axis.

**x21 MOTOR CURRENT NOT DEFINED**

Maximum current for the motor is not specified. Refer to the description of **QI** command to query or set the maximum motor current for an axis.

**x22 UNIDRIVE COMMUNICATIONS ERROR**

There was no communication between motion controller and the Unidriver.

**x23 UNIDRIVE NOT DETECTED**

Unidrive could not be detected by the motion controller.

**x24 SPEED OUT OF RANGE**

The specified home search speed is out of range. Refer to the description of **OH** command for valid home search speed range.

**x25 INVALID TRAJECTORY MASTER AXIS**

The specified trajectory mode in not valid for a master axis. Refer to the description if **TJ** command to specify a valid trajectory mode for a master axis.

**x26 PARAMETER CHARGE NOT ALLOWED**

The specified parameter cannot be changed while the axis is in motion. Wait until the axis motion is complete, and issue this command again. Refer to the description of **MD** command to determine if motion is done.

**x27 INVALID TRAJECTORY MODE FOR HOMING**

The specified trajectory mode is not valid for locating the home position of the axis. Refer to the description of **TJ** command to specify a valid trajectory mode for locating the home position of this axis.

**x28 INVALID ENCODER STEP RATIO**

The specified full step resolution is invalid. Refer to the description of **FR** command for valid range of full step resolution.

**x29 DIGITAL I/O INTERLOCK DETECTED**

A DIO interlock was asserted.

**x30 COMMAND NOT ALLOWED DURING HOMING**

The command issued was not executed because locating the home position of this axis is in progress. Refer to the description of the issued command for further details.

**x31 COMMAND NOT ALLOWED DUE TO GROUP ASSIGNMENT**

The specified command was not executed because this axis is member of a group. Refer to the description of issued command for further details.

**x32 INVALID TRAJECTORY MODE FOR MOVING**

The specified trajectory mode is invalid to make absolute or relative moves. Refer to the description of **PA** and **PR** commands for valid trajectory modes to initiate motion.

# 4.0 Binary Conversion Table

Some of the status reporting commands return an ASCII character that must be converted to binary. To aid with the conversion process, the following table converts all character used and some other common ASCII symbols to decimal and binary. To also help in working with the I/O port related commands, the table is extended to a full byte, all 256 values.

| Number (decimal) | ASCII Code | Binary Code |
|---|---|---|
| 0 | *Null* | 00000000 |
| 1 | *Soh* | 00000001 |
| 2 | *Stx* | 00000010 |
| 3 | *Etx* | 00000011 |
| 4 | *Eot* | 00000100 |
| 5 | *Enq* | 00000101 |
| 6 | *Ack* | 00000110 |
| 7 | *Bel* | 00000111 |
| 8 | *Bs* | 00001000 |
| 9 | *Tab* | 00001001 |
| 10 | *Lf* | 00001010 |
| 11 | *Vt* | 00001011 |
| 12 | *Ff* | 00001100 |
| 13 | *Cr* | 00001101 |
| 14 | *So* | 00001110 |
| 15 | *Si* | 00001111 |
| 16 | *Dle* | 00010000 |
| 17 | *Dc1* | 00010001 |
| 18 | *Dc2* | 00010010 |
| 19 | *Dc3* | 00010011 |
| 20 | *Dc4* | 00010100 |
| 21 | *Nak* | 00010101 |
| 22 | *Syn* | 00010110 |
| 23 | *Eth* | 00010111 |
| 24 | *Can* | 00011000 |
| 25 | *Em* | 00011001 |
| 26 | *Eof* | 00011010 |
| 27 | *Esc* | 00011011 |
| 28 | *Fs* | 00011100 |
| 29 | *Gs* | 00011101 |
| 30 | *Rs* | 00011110 |
| 31 | *Us* | 00011111 |
| 32 | *Space* | 00100000 |
| 33 | *!* | 00100001 |
| 34 | *"* | 00100010 |
| 35 | *#* | 00100011 |
| 36 | *$* | 00100100 |
| 37 | *%* | 00100101 |
| 38 | *&* | 00100110 |
| 39 | *'* | 00100111 |
| 40 | *(* | 00101000 |
| 41 | *)* | 00101001 |
| 42 | * | 00101010 |
| 43 | + | 00101011 |
| 44 | , | 00101100 |
| 45 | - | 00101101 |
| 46 | . | 00101110 |
| 47 | / | 00101111 |
| 48 | *0* | 00110000 |
| 49 | *1* | 00110001 |
| 50 | *2* | 00110010 |
| 51 | *3* | 00110011 |
| 52 | *4* | 00110100 |
| 53 | *5* | 00110101 |

| | | |
|---|---|---|
| 54 | *6* | 00110110 |
| 55 | *7* | 00110111 |
| 56 | *8* | 00111000 |
| 57 | *9* | 00111001 |
| 58 | *:* | 00111010 |
| 59 | *;* | 00111011 |
| 60 | < | 00111100 |
| 61 | = | 00111101 |
| 62 | > | 00111110 |
| 63 | *?* | 00111111 |
| 64 | *@* | 01000000 |
| 65 | *A* | 01000001 |
| 66 | *B* | 01000010 |
| 67 | *C* | 01000011 |
| 68 | *D* | 01000100 |
| 69 | *E* | 01000101 |
| 70 | *F* | 01000110 |
| 71 | *G* | 01000111 |
| 72 | *H* | 01001000 |
| 73 | *I* | 01001001 |
| 74 | *J* | 01001010 |
| 75 | *K* | 01001011 |
| 76 | *L* | 01001100 |
| 77 | *M* | 01001101 |
| 78 | *N* | 01001110 |
| 79 | *O* | 01001111 |
| 80 | *P* | 01010000 |
| 81 | *Q* | 01010001 |
| 82 | *R* | 01010010 |
| 83 | *S* | 01010011 |
| 84 | *T* | 01010100 |
| 85 | *U* | 01010101 |
| 86 | *V* | 01010110 |
| 87 | *W* | 01010111 |
| 88 | *X* | 01011000 |
| 89 | *Y* | 01011001 |
| 90 | *Z* | 01011010 |
| 91 | *[* | 01011011 |
| 92 | \ | 01011100 |
| 93 | *]* | 01011101 |
| 94 | ^ | 01011110 |
| 95 | | 01011111 |
| 96 | ' | 01100000 |
| 97 | *A* | 01100001 |
| 98 | *B* | 01100010 |
| 99 | *C* | 01100011 |
| 100 | *D* | 01100100 |
| 101 | *E* | 01100101 |
| 102 | *F* | 01100110 |
| 103 | *G* | 01100111 |
| 104 | *H* | 01101000 |
| 105 | *I* | 01101001 |
| 106 | *J* | 01101010 |
| 107 | *K* | 01101011 |
| 108 | *L* | 01101100 |
| 109 | *M* | 01101101 |
| 110 | *N* | 01101110 |
| 111 | *O* | 01101111 |
| 112 | *P* | 01110000 |
| 113 | *Q* | 01110001 |
| 114 | *R* | 01110010 |
| 115 | *S* | 01110011 |
| 116 | *T* | 01110100 |
| 117 | *U* | 01110101 |
| 118 | *V* | 01110110 |

| | | |
|---|---|---|
| 119 | *W* | 01110111 |
| 120 | *X* | 01111000 |
| 121 | *Y* | 01111001 |
| 122 | *Z* | 01111010 |
| 123 | { | 01111011 |
| 124 | \| | 01111100 |
| 125 | } | 01111101 |
| 126 | ~ | 01111110 |
| 127 | | 01111111 |
| 128 | | 10000000 |
| 129 | | 10000001 |
| 130 | | 10000010 |
| 131 | | 10000011 |
| 132 | | 10000100 |
| 133 | | 10000101 |
| 134 | | 10000110 |
| 135 | | 10000111 |
| 136 | | 10001000 |
| 137 | | 10001001 |
| 138 | | 10001010 |
| 139 | | 10001011 |
| 140 | | 10001100 |
| 141 | | 10001101 |
| 142 | | 10001110 |
| 143 | | 10001111 |
| 144 | | 10010000 |
| 145 | | 10010001 |
| 146 | | 10010010 |
| 147 | | 10010011 |
| 148 | | 10010100 |
| 149 | | 10010101 |
| 150 | | 10010110 |
| 151 | | 10010111 |
| 152 | | 10011000 |
| 153 | | 10011001 |
| 154 | | 10011010 |
| 155 | | 10011011 |
| 156 | | 10011100 |
| 157 | | 10011101 |
| 158 | | 10011110 |
| 159 | | 10011111 |
| 160 | | 10100000 |
| 161 | | 10100001 |
| 162 | | 10100010 |
| 163 | | 10100011 |
| 164 | | 10100100 |
| 165 | | 10100101 |
| 166 | | 10100110 |
| 167 | | 10100111 |
| 168 | | 10101000 |
| 169 | | 10101001 |
| 170 | | 10101010 |
| 171 | | 10101011 |
| 172 | | 10101100 |
| 173 | | 10101101 |
| 174 | | 10101110 |
| 175 | | 10101111 |
| 176 | | 10110000 |
| 177 | | 10110001 |
| 178 | | 10110010 |
| 179 | | 10110011 |
| 180 | | 10110100 |
| 181 | | 10110101 |
| 182 | | 10110110 |
| 183 | | 10110111 |

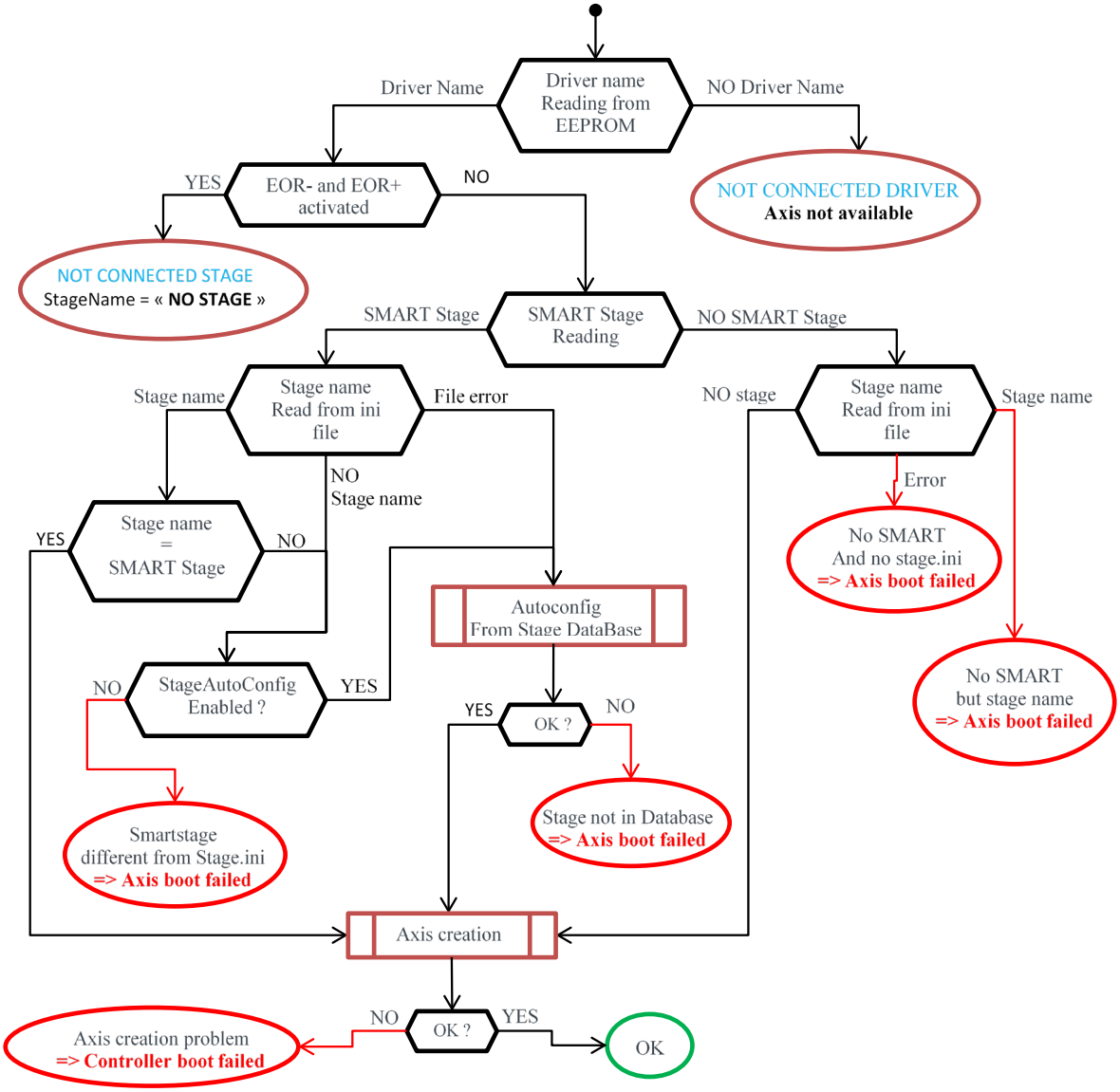
| | | |
|---|---|---|
| 184 | | 10111000 |
| 185 | | 10111001 |
| 186 | | 10111010 |
| 187 | | 10111011 |
| 188 | | 10111100 |
| 189 | | 10111101 |
| 190 | | 10111110 |
| 191 | | 10111111 |
| 192 | | 11000000 |
| 193 | | 11000001 |
| 194 | | 11000010 |
| 195 | | 11000011 |
| 196 | | 11000100 |
| 197 | | 11000101 |
| 198 | | 11000110 |
| 199 | | 11000111 |
| 200 | | 11001000 |
| 201 | | 11001001 |
| 202 | | 11001010 |
| 203 | | 11001011 |
| 204 | | 11001100 |
| 205 | | 11001101 |
| 206 | | 11001110 |
| 207 | | 11001111 |
| 208 | | 11010000 |
| 209 | | 11010001 |
| 210 | | 11010010 |
| 211 | | 11010011 |
| 212 | | 11010100 |
| 213 | | 11010101 |
| 214 | | 11010110 |
| 215 | | 11010111 |
| 216 | | 11011000 |
| 217 | | 11011001 |
| 218 | | 11011010 |
| 219 | | 11011011 |
| 220 | | 11011100 |
| 221 | | 11011101 |
| 222 | | 11011110 |
| 223 | | 11011111 |
| 224 | | 11100000 |
| 225 | | 11100001 |
| 226 | | 11100010 |
| 227 | | 11100011 |
| 228 | | 11100100 |
| 229 | | 11100101 |
| 230 | | 11100110 |
| 231 | | 11100111 |
| 232 | | 11101000 |
| 233 | | 11101001 |
| 234 | | 11101010 |
| 235 | | 11101011 |
| 236 | | 11101100 |
| 237 | | 11101101 |
| 238 | | 11101110 |
| 239 | | 11101111 |
| 240 | | 11110000 |
| 241 | | 11110001 |
| 242 | | 11110010 |
| 243 | | 11110011 |
| 244 | | 11110100 |
| 245 | | 11110101 |
| 246 | | 11110110 |
| 247 | | 11110111 |
| 248 | | 11111000 |

| | | |
|---|---|---|
| 249 | | 11111001 |
| 250 | | 11111010 |
| 251 | | 11111011 |
| 252 | | 11111100 |
| 253 | | 11111101 |
| 254 | | 11111110 |
| 255 | | 11111111 |

*Table 13: Binary Conversion Table (using decimal and ASCII codes).*

# 5.0 ESP Configuration Logic

Each time a stage or stages are disconnected/re-connected, or a system is powered down and then powered back up, the ESP302 controller card verifies the type of stage(s) present and re-configures its own flash memory if necessary (i.e., new stage). The controller card in the ESP302 system configuration, the stage motor and the current type are defined, the controller card will configure the specific axis. Specific ESP logic is shown below.



# Service Form

**Your Local Representative**

Tel.: _____

Fax:_____

Name: _____ Return authorization #:
*(Please obtain prior to return of item)*

Company:_____

Address:_____ Date:

Country:_____Phone Number:

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Item(s) Being Returned:_____

Model#: _____Serial #:

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