
Subject: **Drive Configuration using Streaming (SCL) Commands**
Applies to: Stepper Drives
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Description

Applied Motion Products offers software for product configuration that is both free and easy to use. Use of this software makes drive commissioning a quick and painless process and while this is the recommended method for setting up a new drive, there are specific instances where an alternative to *ST Configurator*TM is desired. This document will outline a procedure for configuring a drive using SCL commands, which may be sent to the drive from the user's controller.

Target Audience

This procedure relies heavily on the use of SCL commands, so it is recommended that the user be familiar with the [Host Command Reference](#) document and the use of ASCII strings to transmit data between a drive and a host controller. Depending on the specific drive used, a working knowledge of either RS-232 or Ethernet communications will also be helpful. All relevant information can be obtained from the Host Command Reference, which may be downloaded from <http://www.applied-motion.com>.

Why not use *ST Configurator*TM?

For most systems, a new or replacement drive will be commissioned with *ST Configurator*TM before installation into the machine. This is a one-time event for a drive, and if a predefined configuration file is used, it takes only a few minutes to complete the procedure. It does, however, require a PC to load the configuration data to the drive. For large or very complex machines, this extra step is something that the operators may wish to avoid.

In these situations, it is desired that the controller be able to commission a replacement drive at runtime, either during every machine power cycle or in a dedicated drive commission function.

The following procedure will make use of *ST Configurator*TM to determine proper values for specific parameters. These values however, will be recorded for later use. All runtime configuration of the drive will be possible without specialized software, and can be completed using any program or device capable of sending SCL commands encoded as ASCII strings.

Commissioning

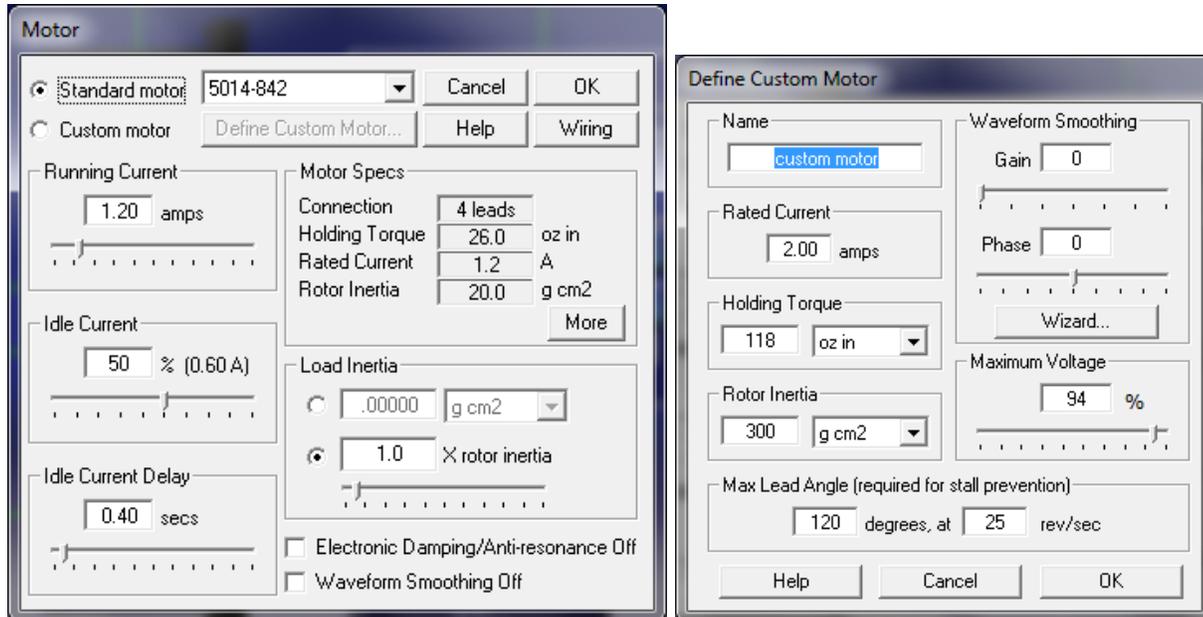
The process of setting up a drive for use is simple and straightforward, consisting of five major steps (three of which are optional):

- 1) Motor
- 2) I/O Configuration (optional)
- 3) Drive Operation Mode
- 4) Encoder (optional)
- 5) Save Changes (optional)

In the following pages we will generate a list of SCL commands with specific parameter values that will act as runtime substitutes for data items typically sent to the drive from *ST Configurator™*.

For the purposes of this document, an ST5-Q drive was used. The procedure applies to all Applied Motion Products stepper drives, but some screens may present the user with slightly different options. It is important to remember that the user must be familiar with the standard configuration and operation of the specific drive in use before this procedure may be attempted.

Step 1 – Configure the Motor



On the left we have the standard motor configuration screen, while on the right you see the custom motor definition screen. If an AMP motor is used with the drive, the motor model may simply be selected from the drop-down list, and most of these fields will automatically populate.

No SCL command exists for specifying the motor by model number however, so we must treat each installation as if it used a “Custom Motor”.

With only a couple exceptions, the procedure for obtaining these data points is straightforward.

The data we need are as follows:

- Motor Current
 - Max Current (MC)
 - Datasheet value * 1.4 (RMS → peak-of-sine conversion)
 - Continuous Current (CC)
 - Application specific, typically set equal to max datasheet rating
 - (optional) Idle Current (CI)
 - Set to 50% of Continuous Current by default
 - (optional) Idle Current Delay (CD)
 - Set to 400ms by default

- Motor Mechanical Resonance Properties
 - Anti-Resonance Filter Frequency (CF)
 - See Below
 - Anti-Resonance Filter Gain (CG)
 - See Below
 - (optional) Anti-Resonance Control (RO)
 - Anti-Resonance is enabled by default
 - (optional) Waveform Smoothing Control (HG, HP)
 - Set both HG and HP to zero to disable Waveform Smoothing, which is enabled by default.
 - (optional) Lead Angle (LA)
 - Maximum lead angle is used to generate maximum motor torque. Set to 120° by default, suitable for most motors unless specified otherwise in the datasheet.
 - (optional) Lead Angle Speed (LS)
 - Speed at which the lead angle is maximized. Set to 25rps by default, suitable for most motors unless specified otherwise in the datasheet.

- Motor Electrical Resonance Properties
 - Motor Probe – determines electrical resonance properties automatically (PN)
 - Executing PN will generate no response from the drive, but the motor will make an audible “click” noise as it is briefly energized. This will experimentally determine electrical resonance parameters such as winding resistance and inductance, which are required for smooth motor operation.

- Motor Operation
 - (optional) Step Filter Frequency (SF)
 - Set to 1000kHz by default
 - (optional) Step Resolution (EG)
 - Set to 20,000 steps/revolution by default

Note, parameters CF and CG are normally calculated by *ST Configurator™* when motor and load inertia data are supplied. In this procedure we are circumventing the software calculations and providing the filter and gain values directly. As these calculations are complex and potentially hazardous to the machine, they are kept proprietary. To determine proper values for CF and CG, *ST Configurator™* must be used. The procedure is as follows:

- 1) Configure the motor as usual. Enter all available motor inertia values (supplied automatically if an AMP motor is used), as well as load inertia values. Ensure that all values are as accurate as possible.
- 2) Download the configuration to the drive.
- 3) Query the drive using CF and CG commands. Record the results.
- 4) Use these results in your runtime SCL configuration routine.

Conclusion (step 1):

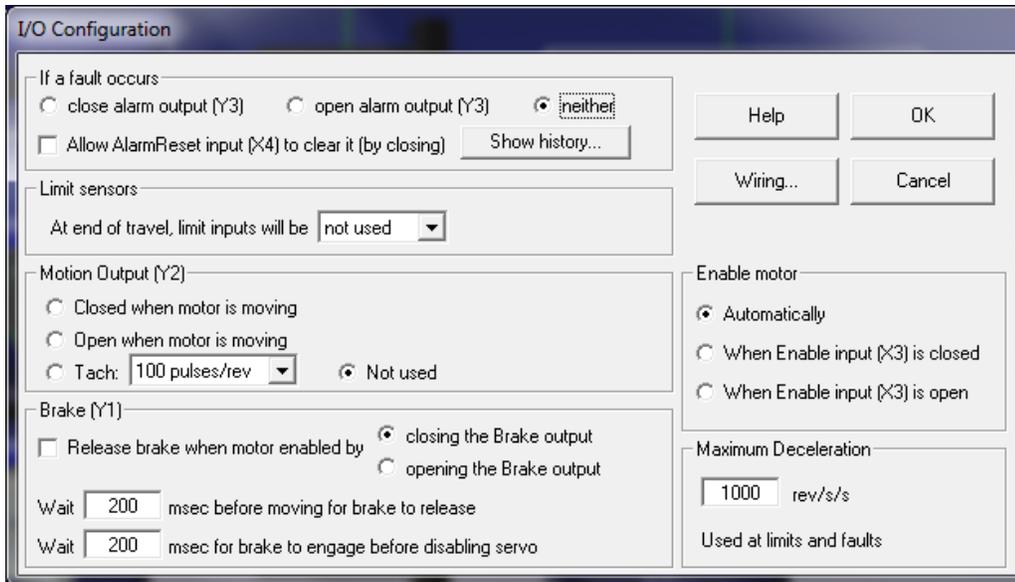
Required Commands

- MCxx xx = _____ Units: Amps
- CCxx xx = _____ Units: Amps
- CFxx xx = _____ (determined from *ST Configurator™*)
- CGxx xx = _____ (determined from *ST Configurator™*)
- PN

Optional Commands

- Clxx xx = _____ Units: Amps
- CDxx xx = _____ Units: Amps
- RO
- HG, HP (set both to zero to disable Waveform Smoothing)
- LAxx xx = _____ Units: Electrical Degrees
- LSxx xx = _____ Units: Revolutions/Second
- SFxx xx = _____ Units: kHz
- EGxx xx = _____ Units: Steps/Revolution

Step 2 – I/O Configuration (optional)



- Alarm Reset Input (AI)
 - Controls behavior of the drive's Alarm Reset Input.
- Alarm Output (AO)
 - Controls behavior of the drive's Alarm Output. Note, the specific I/O point used is drive-dependent. In this example, the ST5-Q uses output Y3.
- Brake Output (BO)
 - Controls behavior of the drive's Brake Output, which is typically wired to a relay for use with motor-mounted holding brake devices.
- Brake Engage / Disengage Delays (BD, BE)
 - Specifies the time, in milliseconds, that the drive will wait for the brake to engage or disengage.
- Motion Output (MO)
 - Controls behavior of the drive's In Motion Output, used to indicate when the motor is moving.
- Limits (DL)
 - Controls behavior of the drive's dedicated end of travel limit switches.
- Enable Input Usage (SI)
 - Controls behavior of the drive's Enable input.
- Maximum Accel / Decel rate (AM)
 - Specifies the acceleration / deceleration rate used when an end of travel limit is triggered.

Conclusion (step 2):

Optional Commands

- Alxx xx = _____
- AOxx xx = _____
- BOxx xx = _____
- BDxx xx = _____ Units = milliseconds
- BExx xx = _____ Units = milliseconds
- MOxx xx = _____
- DLxx xx = _____
- Slxx xx = _____
- AMxx xx = _____

Step 3 – Configure the Drive

This step is exceedingly simple. We need only define the operating mode of the drive.

- Power-up Mode (PM)
 - Specify SCL, Q Program, Si or SiNet Hub modes. (drive dependent)
- (optional) Command Mode (CM)
 - Set to CM21 (point-to-point) mode by default. This is the most common setting, and will rarely need to be changed.
- (optional) Pulse Type (PT)
 - In Pulse / Direction mode, this will allow the user to specify various types of input pulses.

Conclusion (step 3):

Required Commands

- PMxx xx = _____

Optional Commands

- CMxx xx = _____
- PTxx xx = _____

Step 4 – Configure the Encoder (optional)

Not all installations use an encoder for feedback. If you do not need an encoder for your system, please skip to Step 3.

To properly configure an encoder, we need the following data:

- Encoder Resolution (ER)
 - Units: Counts / Revolution. This is the “post quadrature” count value.
- Encoder Function (EF)
 - Specify Stall Detection (EF1), Stall Prevention (EF2), or disable the encoder (EF0)
- (optional) Single-Ended Encoder (ES)
 - Specify that a single-ended encoder is used.
- (optional) Encoder Count Direction (ED)
 - Specify if the count increases when the motor moves in the CW (ED0) or CCW (ED1) direction.
- (optional) Hard-Stop Delay (HD)
 - Used only in EF2 (Stall Prevention) mode, specifies the time at full torque before the motor will stall.

Conclusion (step 4):

Required Commands

- ERxx xx = _____ Units: Post-Quadrature Counts/Revolution
- EFxx xx = _____

Optional Commands

- ESxx xx = _____
- EDxx xx = _____
- HDxx xx = _____

Step 5 – Save it all! (optional)

Finally, once all configuration parameters have been defined and sent to the drive, The Save (SA) command is used to permanently save these parameters to the drive's nonvolatile memory.

Other Considerations

While the process for configuring a drive at runtime is now defined, there are still two major considerations left to discuss.

Nonvolatile Memory Limitations

In many situations it is desirable for the configuration block (the list of SCL commands defined above) to be sent to the drive every time the machine is powered up. The rationale here is that the controller shouldn't have to worry about a potentially new or replaced piece of equipment; it will treat the entire machine as "new" on each power cycle, directly and explicitly configuring each device automatically.

In this scenario, we would omit Step 4. This is a subtle but very important point – there is a limit to the number of times the SA command may be invoked. This command saves data to flash memory which, while permanent, will withstand only a limited number of write cycles. This is mitigated by the fact that the drive will retain all configuration parameters in RAM while powered. Thus, if the configuration block is sent to the drive before each operational cycle begins, there is no need to save to nonvolatile memory, and the SA command is not required.

More common would be a drive commissioning screen on the controller's operator interface device that is invoked only in the event of a field replacement. In this scenario, a damaged drive is simply removed and replaced with a spare unit. The operator need only transfer the connectors to the new drive and power up the machine. The controller would be instructed to configure this new drive, at which point the configuration block would be sent to the drive as a series of SCL commands, culminating with the SA function to save everything to nonvolatile memory. The new drive is now configured for use.

Ethernet

SCL commands currently only allow configuration of the basic drive control parameters: motor, drive, encoder, etc. It is not possible to alter any Ethernet-specific settings such as IP address, Netmask, etc. These may be set using the rotary switch on the front of the drive to select from a list of default IP addresses, but *ST Configurator*TM will be required if a custom IP address is required.