

CANopen torque scaling

When running in CANopen or EtherCAT torque modes, the units used to command torque are defined by the CANopen standard to be 'thousandths of rated torque'. For example, a command of 1000 would command 100% of the motor's rated torque, and a command of -250 would command -25% of the motor's rated torque (i.e. 25% torque in the reverse direction). The torque command objects defined by the standard are 16-bit signed integers, so they have a range of +/-32k, or approximately 32 times the motor's rated torque in either direction.

Copley drives can't directly control torque because they don't have any means to measure the actual torque applied by the motor. Instead, the commanded torque is converted into a commanded current, and the drive controls the current applied to the motor.

Two drive parameters are used to convert the torque command into a current command.

Serial port parameter	CANopen object	Description
0x48	0x2383 sub 12	Motor torque constant. This parameter (found in the motor's data sheet) gives the scaling between current and torque. The value programmed into the drive is in units of 0.00001 Nm/A.
0x4C	0x2383 sub 14	Motor continuous torque rating. This parameter is programmed in units of 0.00001 Nm.

To convert a CANopen style torque command into a current command in Amps, the drive makes the following calculation:

$$I = (T / 1000) * Tc / Kt$$

where

- I current command in Amps
- T Torque command in thousandths of rated torque
- Tc Motor's continuous torque rating in 0.00001 Nm units.
- Kt Motor's torque constant in 0.00001 Nm/A units

For example, the Parker N0701D motor is rated for 0.63 Nm continuous torque with a torque constant of 0.219 Nm/A. When these values are entered into CME, drive parameter 0x48 will be set to 21900 and parameter 0x4C will be set to 63000.

To command 50% of the motor's continuous torque (i.e. 0.315 Nm), the torque command object should be set to 500. The amp will make the following conversion to determine the current required for this setting:

$$I = (500 / 1000) * 63000 / 21900$$

As a result, the drive will output 1.438A of current to command a torque of 0.315 Nm.

Improving command resolution

For some applications, commanding values in units of thousandths of the motor's rated torque may not provide sufficient resolution.

It's possible to adjust the resolution of the torque command by changing the values programmed into the drive parameters used to convert torque to current. These parameters are not used by the drive firmware for anything other than torque to current calculations, so no side effects should occur.

For example, if the above motor's continuous torque value was programmed as 6300 (0.063 Nm) rather than the normal 63000 (0.63 Nm), the result would be a modified scaling factor which would require values ten times larger to be entered to get the same current command. This would have the effect of increasing the resolution of the resulting current commands by a factor of 10. To command 50% of rated torque with these scaling factors, an input value of 5000 would be required, not the normal value of 500.

$$1.438A = (5000 / 1000) * 6300 / 21900$$

The drive firmware will accept any command value in the range +/-32k. This command is then scaled as described above, and the resulting current is clipped based on the drive's current limits.

This simple trick allows a great deal of flexibility in the resolution of the commanded current.

Revision History

Date	Version	Revision
3/13/2012	1.0	Initial release