MHATT-CAT Stepper Motor Convention

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The purpose of this document is to help people connect stepper motors to the stepper motor drivers at MHATT-CAT, with the NextStep driver being most common [1]. The NextStep drivers are bipolar and can supply a large current, up to 9.9 A. They also micro-step, normally at 25 μsteps/step (but can go to higher values).

Our stepper motor cables use ELCO connectors, which are the standard at the Advanced Photon Source. The cable on the motor uses the male ELCO connector, with a sample motor cable shown in Fig. 1. The pinout diagram for a male ELCO connector is shown in Fig. 2.

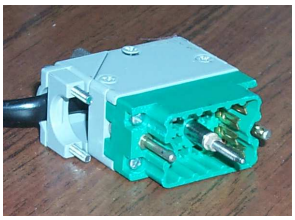

Figure 1: An ELCO motor connector.

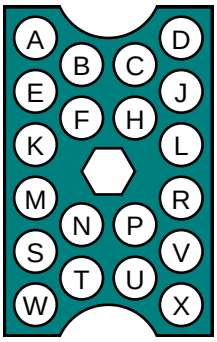

Figure 2: Male ELCO connector pinout diagram.

The wiring diagram for several types of motors is shown in Table 1. Bipolar stepper drivers use four wires to drive a motor, making 4-wire stepper motors simple to hook up.

Table 1: MHATT-CAT configuration of motors

ELCO connector	Signal (phase)	SLO-SYN 4-wire motor	SLO-SYN 6-wire motor	SLO-SYN 8-wire motor (serial mode)	Vexta motor
A	1 out	red	red	red	black
B	1 return	red/white	red/white	red/white	green
C	2 out	white/black	green	green	red
D	2 return	black	green/white	green/white	blue
E *			black	black *and* white †	yellow
J *			white	orange *and* white/black †	white

* not required for MHATT-CAT, but suggested; alternatively, isolate these leads
† **must** connect these wires together

Table 2: MHATT-CAT configuration for limit switches

ELCO connector	Limit switch connection	Huber convention
W	High limit	green
T	*High limit return	white †
X	Low limit	brown
U	*Low limit return	white †

* ground
† the same wire

For 6-wire motors, two of the leads are not actually used, being the ones that are common to two coils while used as a unipolar motor; these two wires should be connected as in the table, which not only keeps them electrically isolated, but allows the motor to be used with an ACS unipolar driver unchanged (which we occasionally use). For 8-wire motors, two pairs of wires need to be connected together so as to put the motor in serial mode, making it functionally the same as a 6-wire motor.

There is support for limit switches corresponding to motors. We can accomodate both *normally open* and *normally closed* limit switches, with Table 2 describing how to hook up the switches to the connector. The polarity of the values for the Huber settings are theoretical at best, and they should be tested while connecting the motor.

Optionally, encoders can be used with the drivers. They need to be wired to a DB-9 connector, using the ACS pinout. This is shown in Table 3 for Heidenhain and Superior encoders. The normal power voltage is 5 V, but the encoder's documentation should be consulted.

There are other conventions for hooking up stepper motors at the APS. The most accepted way is that of SRI-CAT [2, 3] (which is *different* from that of MHATT-CAT). SRI-CAT uses ACS Steppak drivers, which have *unipolar* and micro-stepping *bipolar* types. An SRI-CAT 6-wire motor wired for their *unipolar* driver will work unaltered at MHATT-CAT using our

Table 3: MHATT-CAT configuration for encoders

DB-9 connector	Purpose	Heidenhain wires	Superior wires
1	Index+	red	white
2	Phase A+	brown	orange
3	Phase B+	gray	green
4	Power V+	brown/green	red
5	N/C		
6	Index−	black	white/black
7	Phase A−	green	orange/white
8	Phase B−	pink	green/white
9	Power Common	white/green	black

Table 4: SRI-CAT bipolar to MHATT-CAT bipolar adapter cable wiring

SRI-CAT motor side	MHATT-CAT driver side
A	A
E	B
C	C
H	D

bipolar setup. An SRI-CAT *unipolar* 8-wire motor will also work, but one needs to check to see that the pairs E-F and H-J are shorted together on the cable side (some MHATT-CAT cables don't currently have these shorts in place). SRI-CAT stepper motors of any type wired for their *bipolar* drivers will **not** work at MHATT-CAT, but need an adapter cable, with the wiring shown in Table 4; MHATT-CAT has a limited number of these adapter cables already made. Incidentally, BESSRC-CAT wires all their motors according to the SRI-CAT *unipolar* driver convention [4]. Lastly, the SRI-CAT limit switch convention is the same as for MHATT-CAT.

References

[1] http://www.idcmotion.com/products/stepmotor/microstepping/nextstep.html

[2] http://www.aps.anl.gov/xfd/bcda/Documents/Motion_Standards/motor_table.html

[3] http://www.aps.anl.gov/~goetze/elco.html

[4] http://www.bessrc.aps.anl.gov/StepperMotor/stepper_motor_connections.html