

Remote Control Protocols for EMotorWerks DC Chargers

V14 Firmware

Last Revision: February 7, 2015

This document is always available here: <http://goo.gl/RHX6r0>

Additional relevant materials:

1. [SmartCharge-12000 Quick Start Guide](#)
2. [QuickCharge-25000 Quick Start Guide](#)
3. [EMotorWerks CHAdEMO Controller Datasheet & a Quick Start Guide](#)

As of ~September 2013, any EMotorWerks charger can be controlled remotely via a Serial UART line (5V TTL levels)

1. You can connect the charger with the standard FTDI programming cable to your PC and issue commands via the terminal application such as TeraTerm.
2. Alternatively, you can control the charger directly from another microcontroller with UART TTL serial line – such as another Arduino (UNO, Due, etc). Soon, we will be posting some Arduino Sketches showing how it's done.
3. In either way, you would connect the control cable to the header on top of the small blue arduino board inside the charger (you will have to open the charger box).
4. **You will also need to disconnect the LCD by depressing the black round button on the bottom right from the LCD.** You need to do this before powering up the charger – the firmware checks for LCD presence and defaults into Serial control ONLY if it does not detect LCD
5. If you need to control the charger from an MCU with 3.3v logic, you can do this via direct connection between the two BUT please keep in mind the following:
 - a. Noise immunity will be lower - you will still be able to get to the rated output and have a controllable charger but you will have to pay closer attention to shielding and routing the wires
 - b. You need to protect the 3.3v MCU from excessive voltage / current on its RX line - could be done with a resistive voltage divider from the charger's TX line: 1k connected to the charger's TX line, followed by 2.7k to ground. 3.3v MCU's RX would then connect to the midpoint of such a divider.
6. For important applications please verify logic and command set against the firmware posted [here](#) (firmware is distributed as a zip file in that folder)

Spec for Serial commands

1. 19200bps, 8N1 (standard Serial)
2. Every command is an ASCII string starting with symbols 'M,' and ending with ',E'.
3. Command syntax is 'M,ccc,vvv,sss,E', where ccc is the CC current, vvv is the CV

voltage, and sss is a checksum calculated as $(ccc+vvv)\%1,000$

- a. As of V14.8 firmware revision (November 23, 2014), the DC-DC versions of the charger can be run in both directions via serial commands. Note that hardware has to be configured in a certain way to enable this mode - inquire with EMotorWerks separately).
- b. To reverse the power direction, same command format can be used, with 500 added to the desired value of ccc. For example, 'M,540,400,940,E' will instruct the charger to reverse the direction (from default direction, which is always from higher to lower voltage - or 'BUCK' direction) and set output current to 40A, with a CV point of 400V on the output
- c. This limits the max current setting one can set to 499A in either direction - which is far above the charger ratings so should not affect any aspect of operations
4. 'M,001,000,001,E' is a special command that will stop the charger and move it back into the waiting state
5. In the standby state, the charger will send an ASCII string with major parameters every second. Format: 'M,R:M222,V061,c020,v246,E' - [M]ains voltage 222v, [V]oltage output 61v, [c]urrent setting for the CC step is 20A, [v]oltage setting for the CV step is 246V
6. In the charging state, the charger will send an ASCII string with major parameters
 - a. Reporting frequency is ~10Hz in CHAdEMO mode, in non-CHAdEMO mode - if #define CHAdEMO switch is commented out in firmware - the charger will reduce its reporting frequency to ~3 Hz
 - b. Reporting data format: 'M,D000,C096,V334,T038,O001,SsssE' - [D]uty 0%, output [C]urrent 96A, output [V]oltage 334V, heatsink [T]emp 38C, [O]utput charge 0.1AH, [S]checksum
7. This set obviously is a 'Minimally Viable' set that allows for automatic control of the unit. Feedback welcome.

New functionality in V14.10+ firmware (target release in February 2015):

1. Expanded command set to add voltage source mode of operation (in DC-DC QC-25 units only)
 - a. All our standard products run in Current Source mode. This is what you need in order to charge batteries
 - b. However, one of the recent customers wanted to use our hardware to precisely control output voltage in the MicroGrid application
 - c. So we have developed an addition to our command set that allows you to run the system in Voltage Source mode (with current limit)
 - d. Same command syntax BUT for Voltage Source, add 300 to the current command
 - e. This is compatible with the bidirectional command set modification
 - f. E.g. for a standard buck-topology system use 'M,830,400,230,E' command to run the system in Voltage Source mode, maintaining 400V up to 30A output - in the opposite (boost) direction (same buck-direction command would be 'M,330,400,730,E')

- g. This limits the output current one can specify to
 - i. 299A in the current source mode
 - ii. 199A in the voltage source mode
 - iii. These limits are still far above the charger ratings so should not affect any aspect of operations

Future updates:

We are always working on expanding control protocol set and command set. We will post updates in this document as they become ready.

Current work includes:

1. Add more configuration commands - voltage calibrations, etc