BRUSHLESS PUMP CONTROL

INSTRUCTIONS

JANUARY 2022 EDITION

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1 SCOPE

This document details general instructions to control pump configurations that include a brushless motor using a Maxon ESCON controller.

2 REFERENCE DOCUMENTS

2.1 CONTROLLER MANUAL DOWNLOADS

2.1.1 ESCON 36/6:
https://www.maxongroup.com/medias/sys_master/root/8834332721182/414533-ESCON-36-3-EC-Hardware-Reference-En.pdf

2.1.2 ESCON 50/5:
https://www.maxongroup.com/medias/sys_master/root/8834332262430/409510-ESCON-50-5-Hardware-Reference-En.pdf

2.1.3 ESCON 70/10:
https://www.maxongroup.com/medias/sys_master/root/8834333179934/422969-ESCON-70-10-Hardware-Reference-En.pdf

NOTE: References in this document are of the following released manual versions:

ESCON 36/3 ... November 2018 Edition

ESCON 50/5 ... November 2018 Edition

ESCON 70/10 ... November 2018 Edition

3 SAFETY

- Installation, integration, and modification of the electrical components of supplied pumps and controllers should be performed by experienced, skilled personnel only.
- Ensure that the supply voltage to any controller apparatus, as well as to any pump, does not exceed the max rated voltage for that component. Consult the controller manual or Flight Works for clarification and/or specs.
- If any errors or issues are experienced (error light on the controller, inoperable pump, etc.) consult the included controller manual or Flight Works immediately.
- Repairs to damaged components should not be attempted by the customer. Please contact Flight Works in case of damage.
- Ensure that no controller apparatus is connected to an electrical supply during pump connection/installation. After switching on, do not touch any live electrical parts or any moving parts such as exposed motor shaft.
- Ensure a clean environment for both pump and controller, free from excessive dust, debris, etc. Keep controllers and non-wetted pump parts (such as the rear shaft) protected from fluids or other objects like towels or wires. Note that the controllers are electrostatic-sensitive devices
- If necessary, contact Flight Works Technical Support (949-387-9502) for any comments / questions.

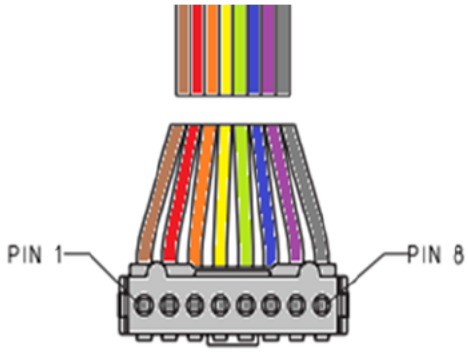
4 MOTOR WIRING

4.1 STANDARD (8-WIRE W/ CONNECTOR)

See **Table 1** for use with all X-Series pumps using standard motors (X01-X07).

Table 1 Standard Motor Wiring

Wire Color	Pin	Description
Brown	1	Motor Winding 1
Red	2	Motor Winding 2
Orange	3	Motor Winding 3
Yellow	4	V_{Hall} 3...24 VDC
Green	5	GND
Blue	6	Hall Sensor 1
Violet	7	Hall Sensor 2
Grey	8	Hall Sensor 3



Wire Gauge AWG 24

4.2 INDIVIDUAL WIRES

See **Table 2** for use with X-Series pumps using individual-wire motors (X09 or higher and some custom configurations).

Table 2 Individual Wires

Wire Color	Description	Wire Gauge X09/X10/X11	Wire Gauge X34
Red	Motor Winding 1	AWG 20	AWG 18
Black	Motor Winding 2		
White	Motor Winding 3		
Red & Grey	Hall Sensor 1	AWG 26	AWG 26
Black & Grey	Hall Sensor 2		
White & Grey	Hall Sensor 3		
Green	V_{Hall} 3...24 VDC		
Blue	GND		

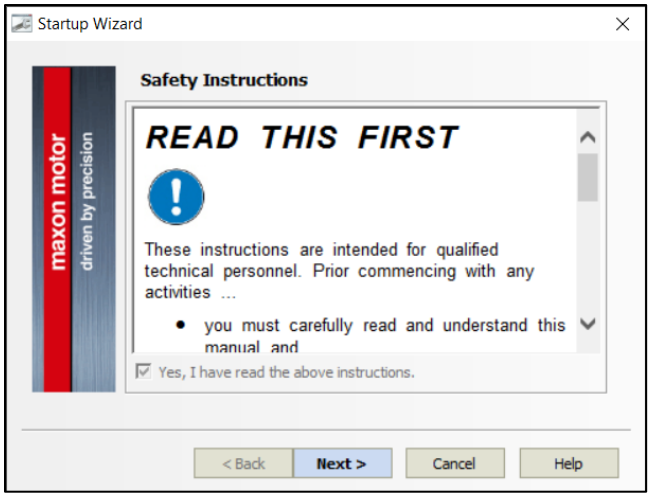
4.3 OTHER/CUSTOM WIRES/CONNNECTORS

For other connections not referenced in Section 4.1 or Section 4.2, contact Flight Works.

5 CONTROLLER INTERFACE/SETUP (ESCON 36/3, ESCON 50/5 AND 70/10)

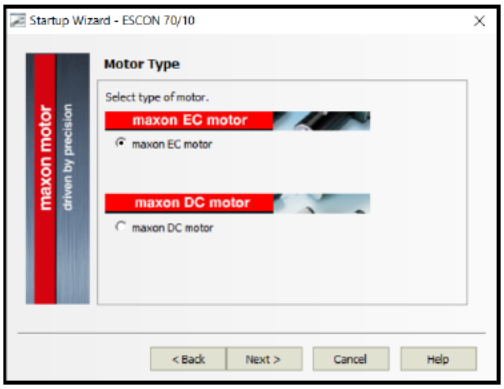
- If the controller was supplied directly by Flight Works, it has been likely set up to the specific motor configuration purchased with the controller. If the Analog and Digital I/O's need to be modified for the setup and/or if the controller needs to be setup up entirely, please follow the instructions below.

1. Download the ESCON Studio software from the Maxon website at:
   a. https://www.maxongroup.com/medias/sys_master/root/8843037835294/ESCON-Setup.zip
2. Connect the controller to a PC via micro-USB cable and open the ESCON Studio software. The startup wizard will open, read carefully, and follow the safety instructions.

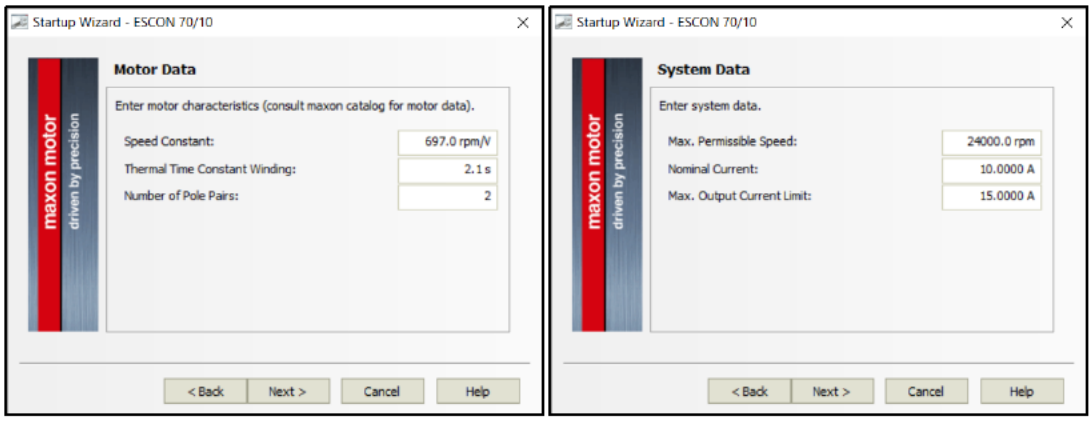


3. If the controller is plugged into the PC, the software should recognize the controller, alternatively a virtual controller can be chosen to get familiar with the setup. **(In the following example, an X34 Motor will be setup to run on an ESCON 70/10 controller.**

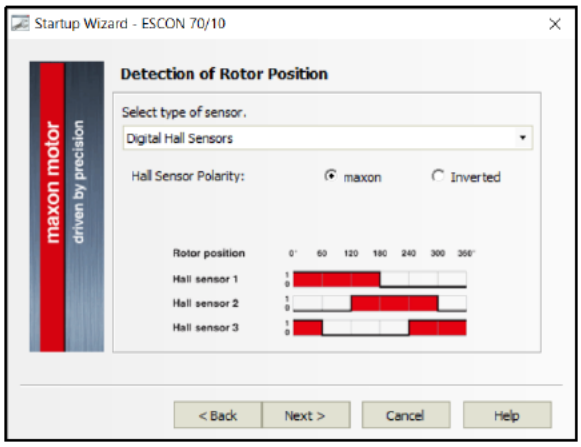
4. Select EC Motor (for brushless) and click Next:



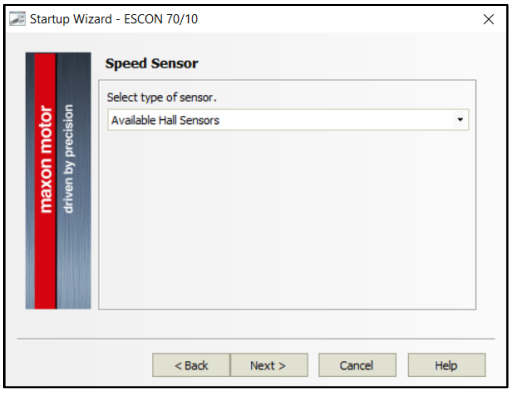
5. Follow the steps in the setup wizard to setup the controller referring to the Appendix for the motor/controller specifications. If the controller was purchased directly from Flight Works, it has been likely set up to the specific motor configuration purchased with the controller. These parameters are for setup purposes **ONLY** and are not necessarily standard operational pump / system parameters. **Contact Flight Works with any questions or concerns. The following parameters shown are for an X34 Motor setup to run on an ESCON 70/10 controller. Refer to the Appendix Section 7.1 for the motor parameters and Section 7.2 for MAX current limits**



6. For "Detection of Rotor Position" select Digital Hall Sensors and Maxon (polarity).

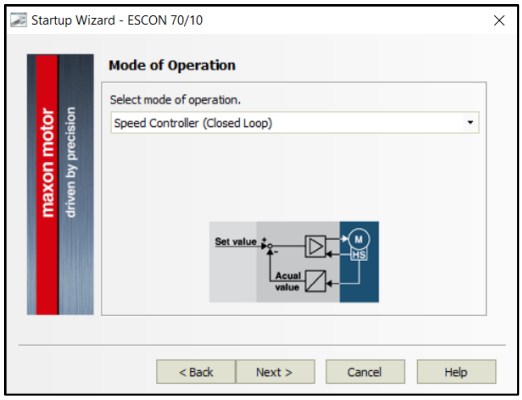


7. For “Speed Sensor” select Available Hall Sensors.

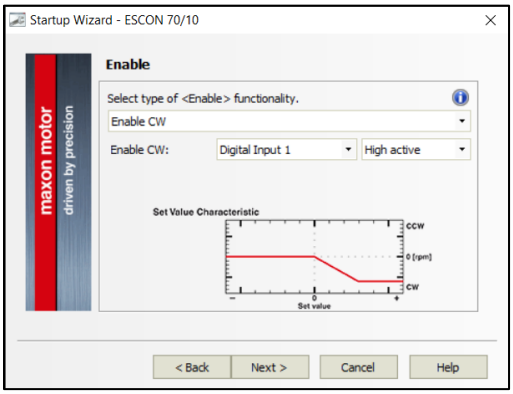


The following steps use the controller’s Digital and Analog I/O’s and are based on how the pump will be operated for the application/setup. The values set below can be changed by the operator to interface directly with the system.

8. For “Mode of Operation” select preferred method of control. Flight Works recommends Speed Controller (Closed Loop), which allows for direct setting of the pump RPM.

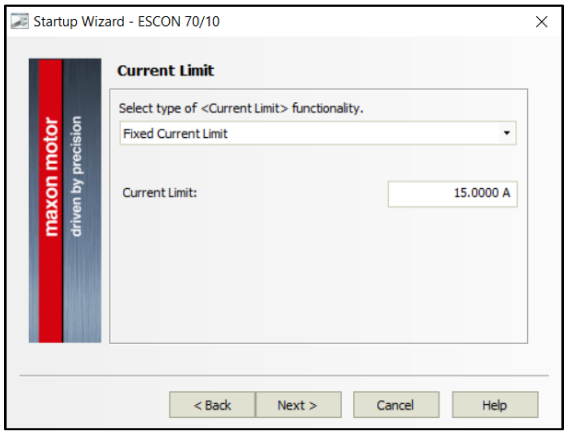


9. The controller requires an ON/OFF signal to enable and disable the motor. For “Enable”, Select Enable CW (clockwise), select preferred digital input and select preferred enable mode “High active”. A 5-24V signal can be used from a separate source or a bridge to the +5V terminal of the J5 Digital I/O connector on the controller (terminal 6) can be used.

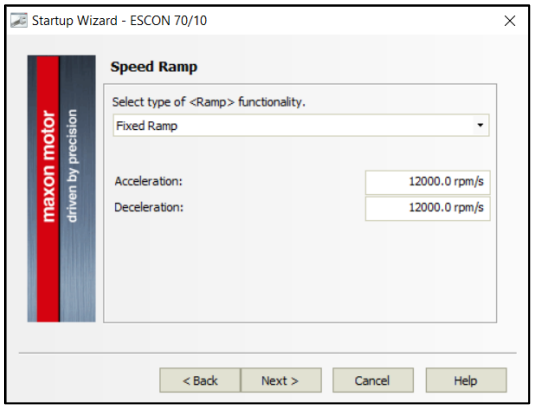


10. The method for controlling Motor RPM can be controlled in the “Set Value” screen. It is recommended using the analog set value with a 0-10V signal with the RPM needed for the application. For simple speed control the onboard potentiometer option can be used as well. (do not exceed max speed per motor parameters). Recommended max speed is approximately 50-60% of the max speed of the motor.

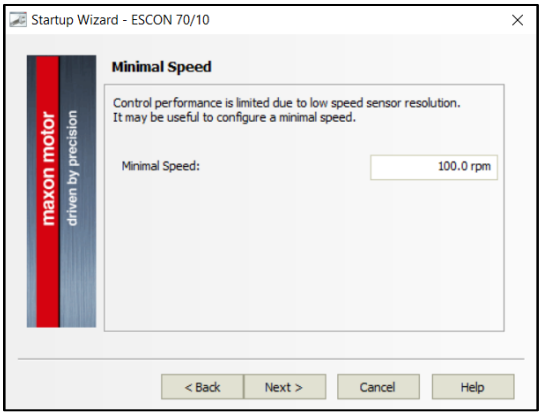
11. For “Current Limit” select Fixed Current Limit and enter the max output current of the controller/system.



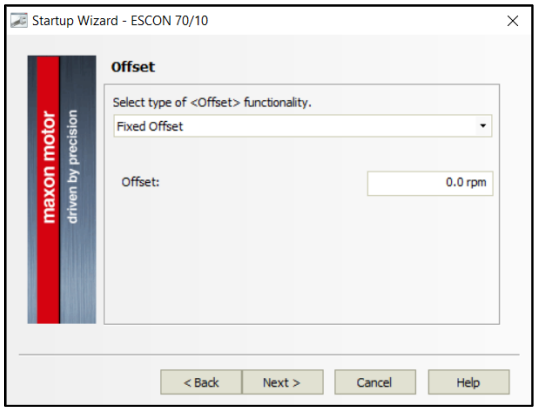
12. For “Speed Ramp” select preferred ramping method and speed. 12000 RPM/s is recommended for typical operations.



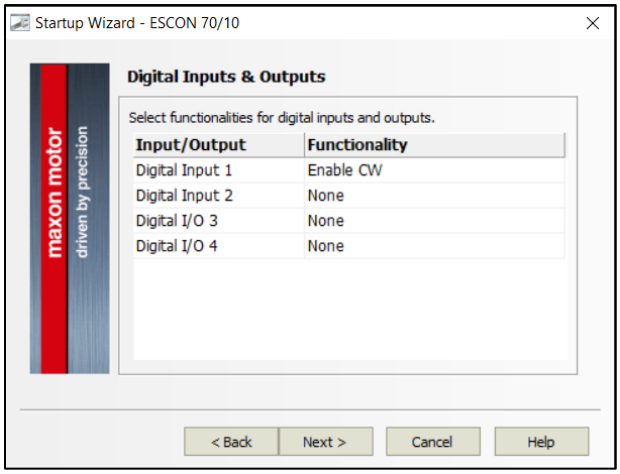
13. For “Minimal Speed”, 100 RPM is recommended for typical operations.

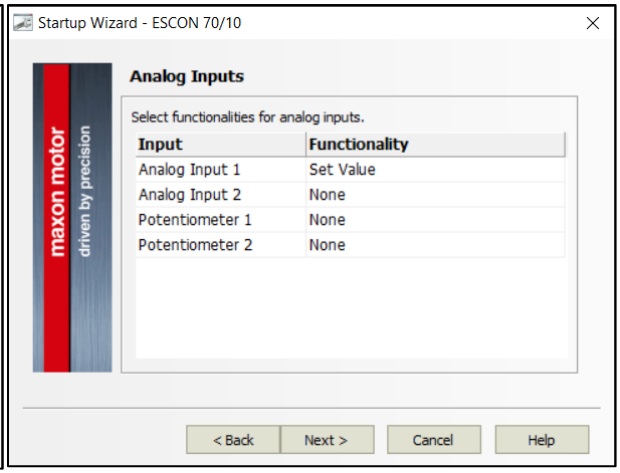


14. For the “Offset” parameter, 0.0 rpm is default.

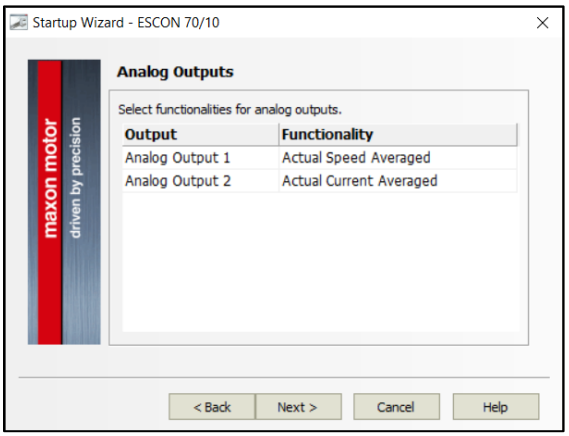


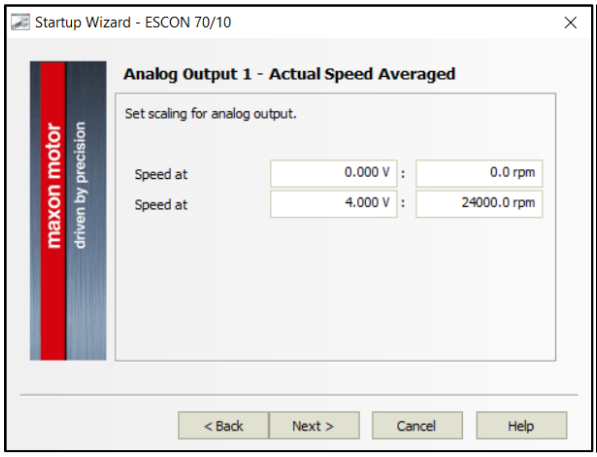
15. Once all the parameters have been set, the setup wizard summarizes the input/output setups as shown below:

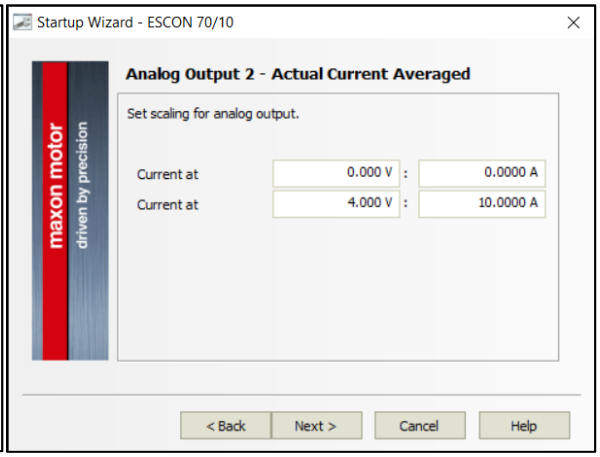




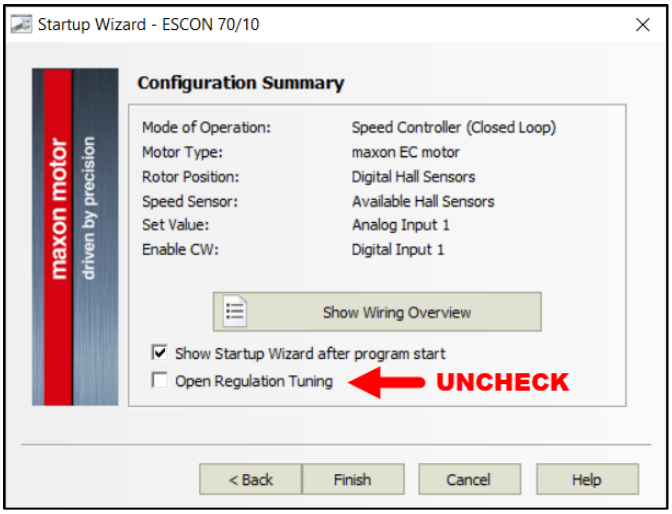
16. The “Analog Outputs” can be set on the following screens. These can be set up to interface with a separate control and data acquisition device. Below are examples of how values could be set:





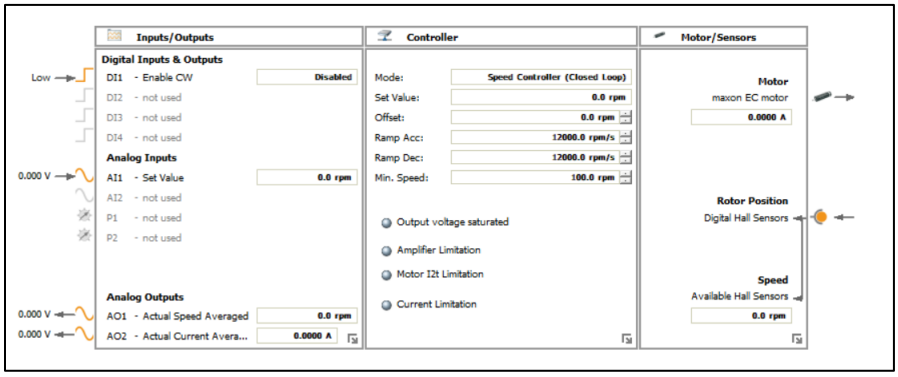


17. Use the wiring overview in **Table 1** or **Table 2** to connect the pump to the controller.
    a. **Uncheck “Open Regulation Tuning” and click “Finish.”**



5.1 ADDITIONAL NOTES

a) Ensure the pump is installed into fluid system to allow for priming when powered on.
b) Connect the controller to a power supply (recommended voltage of approximately 125-150% nominal pump voltage). Note that the pump will immediately power on if there is no switch (set to OFF) on the enable terminal.



c) If there are any issues with the control, the ESCON Studio should indicate the error such as hall sensors not connected, no voltage provided, etc.
d) Consult the controller manual for further control options (including uploading parameters into the controller).

6 TROUBLESHOOTING

6.1 OPERATING STATUS LIGHT

a) The controller operating status light should be a steady green when operating the pump.
b) For any unusual operating status light behavior (blinking, color change, no light) refer to the Operating Status Display section of the appropriate controller manual.
c) If failure mode references “Motor shaft is blocked”, “Load too great” or a similar issue, the failure may be related to the pump head. In this case, it is recommended that Flight Works be contacted immediately.
d) Only skilled/experienced personnel should attempt to troubleshoot control issues. If necessary, contact Flight Works Technical Support (949-387-9502) for troubleshooting help.

6.2 FAILURES DURING OPERATION

a) If there any control issues at any time, **DO NOT** continue operating the pump until the issues have been resolved
b) Disconnect power to the controller before any checking all wiring, and ensure safe, sturdy connections at all solder joints or terminals.
c) Ensure that no debris have come in contact with the controller or exposed motor components (wires, rear shaft).
d) If necessary, contact Flight Works Technical Support (949-387-9502) for troubleshooting help.

7 APPENDIX

7.1 MOTOR INPUT PARAMETERS FOR ESCON SETUP WIZARD***

Pump P/N	Nominal Voltage (V)	Speed Constant (rpm/V)	Thermal Time Constant Winding (seconds)	Pole Pairs	Max Speed (rpm)	Nominal Current (Amps)*	Max Output Current Limit (Amps)**
X01	12	1050	1.99	1	18000	2.71	5.42
X03	24	549	1.99	1	18000	1.4	2.8
X04	48	274	1.99	1	18000	0.716	1.43
X05	6	2070	1.85	1	18000	2.61	5.22
X06	12	1060	1.85	1	18000	1.25	2.5
X07	24	526	1.85	1	18000	0.657	1.314
X09	18	907	5.12	2	25000	4.32	8.64
XS09	18	970	5.12	2	25000	4.24	8.48
XS09A	18	970	5.12	2	25000	4.24	8.48
X10	24	680	5.12	2	25000	3.34	6.68
X11	48	340	5.12	2	25000	0.679	1.358
X12	24	705	4.66	2	25000	4.21	8.42
X34	24	697	2.11	2	25000	7.61	15.22

***Maximum Continuous Current**

****Maximum Output Current Limit is based on a factor of 2x Nominal Current recommended by factory**

*****These parameters are for setup purposes and are not necessarily standard operational pump parameters. Contact Flight Works Technical Support (949-387-9502) for any questions or concerns.**

7.2 CONTROLLER TECHNICAL DATA

Controller	Voltage Range (VDC)	Continuous Current (A)	Maximum Current (A)
ESCON 36/3	10-36	2.7	9 **(< 4 seconds max)**
ESCON 50/5	10-50	5	15 **(< 20 seconds max)**
ESCON 70/10	10-70	10	30 **(< 20 seconds max)**