

Preferred Utilities Mfg Corp.

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FSC-120

Fuel System Controller
Programmable Logic Controller

Installation Instructions

Description:

The FSC-120 is a general purpose programmable logic controller that is programmed with Function Block logic. A single FSC can be used to control a process, or multiple FSC's can be networked together for coordinated distributed control.

Applications:

The most common application of the FSC is to monitor and control emergency generator fuel oil supply pumping and storage systems.

Applications include:

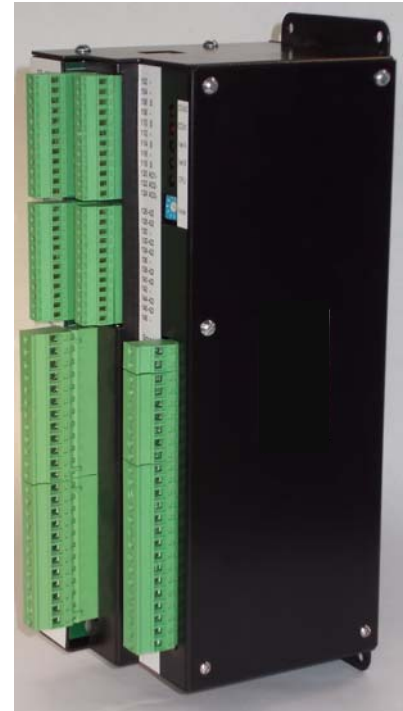
- Duplex transfer pumping skids
- Day tank level control
- Distribution piping Leak Detection
- Multiple Main Tank motorized selector valve control
- Main Tank filtration, water separation, and chemical injection
- Tank truck off-loading pumps
- Boiler burner oil pumping skids

Instruction Manual Scope:

This manual describes the FSC-120 controller hardware.

The application specific control logic is described elsewhere.

The FSC_Draw personal computer based logic creation/editing software is described elsewhere.



Specifications:

Mechanical:

Size 10.61h x 3.50w x 5.18d
(4) 0.17 dia. mounting holes in 10.11 x 2.40 pattern

Weight 5.5 lbs

Environmental:

Operating 32 to 149 F (0 – 65 C)
Storage -20 to 167 F (-28 to 75 C)
Humidity 5 – 95% (non-condensing)
Enclosure Nema1

Electrical

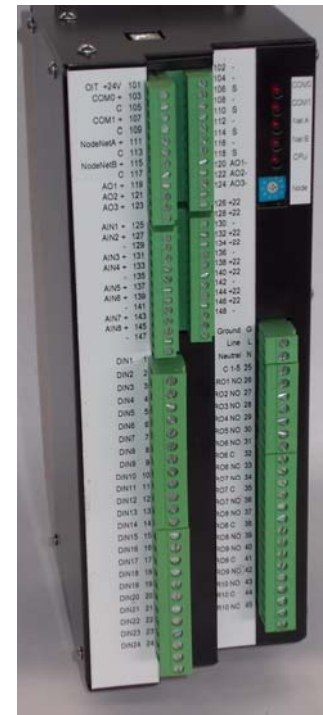
Power 120 Vac +15/-20%, 40VA, 50/60Hz

Discrete Inputs 24 channels
120 Vac, 12 mA typ., >70Vac = ON, <2mA = OFF

Relay Outputs 10 channels
Ch. 1-5: SPST NO, 2A/250Vac each channel
One 'common' for all 5 channels
Ch. 6-10: SPDT, 10A, ½ hp 120/250 Vac

Analog Inputs 8 channels
4-20mA input, 100 ohm input resistor
0.2% accuracy, 13 bit resolution
22Vdc / 30mA supply for each channel
(the control logic enables/disables each 22Vdc supply)

Analog Outputs 3 channels
4-20mA, 800 ohm max loop resistance
0.2% accuracy, 13 bit resolution
(Specifications continued on next page)



(**Specifications** continued from previous page)

Communications

- Com0 Reserved for Touch Screen Interface
RS485, Modbus RTU, Device = 1 for all Nodes, 38.4k baud, 8/1/N
DC common connected to FSC DC common, but isolated from frame ground.
OIT-4k2 power output: 24Vdc / 180mA steady state / 250mA start-up
- Com1 Shared Port for USB interface and RS485/RS232 interface.
Only one is active at a time, When USB is connected to a PC RS485/232 is auto disabled.
USB: USB 1.x, B socket, used for logic upload/download via FSC_Draw
RS485/232: Configured by Logic, reserved for future software upgrades, not currently active.
DC common connected to FSC DC common, but isolated from frame ground.
- NodeNetA Node-to-Node Communications only. Redundant Auto Fail Over: A->B or B->A
Isolated RS485, Custom Protocol, 38.4k baud
NetA data & common is isolated from: NetB, FSC DC common, and FSC frame ground.
- NodeNetB Node-to-Node Communications only. Redundant Auto Fail Over: A->B or B->A
Isolated RS485, Custom Protocol, 38.4k baud
NetB data & common is isolated from: NetA, FSC DC common, and FSC frame ground.

Firmware Upgradeable via SD Memory Card (must be <1Gb size)

Installation:

The FSC-120 is designed to be mounted inside an enclosure which provides environmental protection. The FSC-120 ambient temperature must be in the 32-149F range during normal operation. The mounting location must be free from excessive vibration.

The FSC-120 should be mounted vertically for proper cooling. See the diagram for overall dimensions and mounting hole locations.

Leave clearance room above and below the FSC-120 for cooling and to provide easy maintenance access to the USB port, SD card socket and for fuse replacement.

Wiring:

All panel and field wiring should conform to National and Local Codes. Typically the NEC (National Electric Code) applies to field wiring, while NFPA79 and UL508A applies to panel wiring.

Ground

Connect the AC power ground to both the case ground lug on the top of the enclosure and also to the "G" terminal on the terminal strip.

AC Ground is isolated from all DC Common (-) terminals.

Terminal Blocks

All Field Wiring terminals are separable, and plug-in to the PC board. This allows rapid board level replacement without disconnecting individual field wires. Verify that the terminals are inserted properly before applying power.

The AC line voltage terminals are numbered N, L, and 1 thru 45.

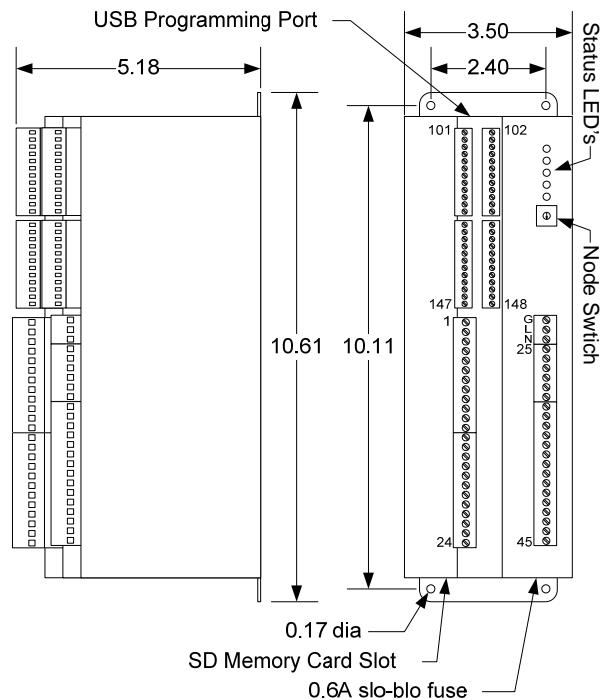
Terminals 26-45 are for the relay output contacts and can have either AC line voltage or DC low voltage wiring. These terminals accept 24 – 12 ga. wire and should be tightened to 4.5 in-lb.

The DC low voltage terminals are numbered 101 thru 148.

These terminals accept 24 – 12 ga. wire and should be tightened to 2.2 in-lb.

Wire Type

All wiring (AC, DC, and shielded cable) should be copper, stranded, 150 V min., and 60° C minimum.



DC Shielded Cable

All 4-20 mA Input and Output wiring should be 22 gauge minimum, 85% shield (min.), and have twisted pairs (Belden 8737 or equal). 100% foil shielding is preferable if available.

The shields of all 4-20 mA / 0-5 Vdc cables should be connected at one end only, as shown on the drawings that follow. Generally, the shield is connected to the DC common of the Power Supply that is powering the signal. All shield foils, and shield wires should be insulated (taped or heat shrink) to prevent accidental connection to earth or power ground. Shields connected at both ends, or unintentional second grounds can actually add extra noise to a signal instead of reducing noise. To prevent noise pick-up, shielded cables should never be run in conduits or trays with AC wiring (any voltage). Ignition transformer and variable frequency drive AC wiring is particularly noisy and should be kept separated from all DC signal wiring.

RS485 Communications Shielded Cable

All RS485 field wiring should use Belden 3106A, or equal, 3 wire shielded cable with 1 low capacitance twisted pair, plus 1 DC common conductor.

AC versus DC wiring physical separation

To reduce electrical noise interference all panel and field AC wiring should be separated from all panel and field DC wiring. AC and DC field wiring should not be run in the same conduit.

Line Voltage Wiring (Terminals L, N, G, 1 - 48)

Terminal	Name	Description
L, N, G		120Vac power supply for FSC-120 internal use. Connect AC Ground to BOTH the "G" terminal and to the enclosure Ground stud.
1 - 24	DIN ch. x	120 Vac Discrete Inputs, Channels 1-24, Terminals 1-24, optically isolated. 12 mA load typical for each channel. 120Vac Hot for DIN inputs supplied and fused externally. All DIN channels internally connected to FSC-120 "N" terminal for current return.
25	C	Relay Output channels 1-5 Common terminal, 10A max Common is isolated from L, N, G and from Relay Outputs 6-10
26	NO	Relay Output ch. 1 SPST NO, 2A / 250Vac
27	NO	Relay Output ch. 2 SPST NO, 2A / 250Vac
28	NO	Relay Output ch. 3 SPST NO, 2A / 250Vac
29	NO	Relay Output ch. 4 SPST NO, 2A / 250Vac
30	NO	Relay Output ch. 5 SPST NO, 2A / 250Vac
31	NC	Relay Output ch. 6 SPDT, 10A, 1/2hp 120/250 Vac
32	C	
33	NO	
34	NC	Relay Output ch. 7 SPDT, 10A, 1/2hp 120/250 Vac
35	C	
36	NO	
37	NC	Relay Output ch. 8 SPDT, 10A, 1/2hp 120/250 Vac
38	C	
39	NO	
40	NC	Relay Output ch. 9 SPDT, 10A, 1/2hp 120/250 Vac
41	C	
42	NO	
43	NC	Relay Output ch. 10 SPDT, 10A, 1/2hp 120/250 Vac
44	C	
45	NO	

Low Voltage DC Wiring (Terminals 101 – 148)

Terminal	Name	Description
101	24 Vdc +	Power for external Touchscreen or other loads. 180mA max
102	24 Vdc - / DC Common	
103	RS485 +	Com0, RS485, Reserved for Touch Screen Interface
104	RS485 -	
105	DC Common	
106	Shield Tie Point (Isol.)	

Low Voltage DC Wiring (Terminals 101 – 148, continued)

107	RS485 + / RS232 Tx	Com1, RS485/RS232, Reserved for Future Use.
108	RS485 - / RS232 Rx	
109	DC Common	
110	Shield Tie Point (Isol.)	
111	RS485 + (Isol.)	NodeNetA, RS485, Node-to-Node Communications Only
112	RS485 - (Isol.)	
113	NetA Isolated. Common	
114	Shield Tie Point (Isol.)	
115	RS485 + (Isol.)	NodeNetB, RS485, Node-to-Node Communications Only
116	RS485 - (Isol.)	
117	NetA Isolated. Common	
118	Shield Tie Point (Isol.)	
119	4-20mA Output +	Analog Output ch. 1
120	DC Common / Shield	
121	4-20mA Output +	Analog Output ch. 2
122	DC Common / Shield	
123	4-20mA Output +	Analog Output ch. 3
124	DC Common / Shield	
125	2 wire 4-20mA Input	Analog Input ch. 1, 22Vdc/30mA max for 2 wire xmtr, or other load
126	Switched 22Vdc +	
127	2 wire 4-20mA Input	Analog Input ch. 2, 22Vdc/30mA max for 2 wire xmtr, or other load
128	Switched 22Vdc +	
129	DC Common / Shield	Connect 4-20 xmtr shields here
130	DC Common / Shield	
131	2 wire 4-20mA Input	Analog Input ch. 3, 22Vdc/30mA max for 2 wire xmtr, or other load
132	Switched 22Vdc +	
133	2 wire 4-20mA Input	Analog Input ch. 4, 22Vdc/30mA max for 2 wire xmtr, or other load
134	Switched 22Vdc +	
135	DC Common / Shield	Connect 4-20 xmtr shields here
136	DC Common / Shield	
137	2 wire 4-20mA Input	Analog Input ch. 5, 22Vdc/30mA max for 2 wire xmtr, or other load
138	Switched 22Vdc +	
139	2 wire 4-20mA Input	Analog Input ch. 6, 22Vdc/30mA max for 2 wire xmtr, or other load
140	Switched 22Vdc +	
141	DC Common / Shield	Connect 4-20 xmtr shields here
142	DC Common / Shield	
143	2 wire 4-20mA Input	Analog Input ch. 7, 22Vdc/30mA max for 2 wire xmtr, or other load
144	Switched 22Vdc +	
145	2 wire 4-20mA Input	Analog Input ch. 8, 22Vdc/30mA max for 2 wire xmtr, or other load
146	Switched 22Vdc +	
147	DC Common / Shield	Connect 4-20 xmtr shields here
148	DC Common / Shield	

FSC Boot Sequence and LED error codes

Boot Sequence:

- 1. Load new firmware from SD card:** When the FSC boots, the first thing it does is look to see if an SD card is present in the card slot. If the SD card has a file called "app.hex" on it, this firmware is loaded into EEPROM.
The front panel LEDs will be completely inactive during this time and the process should take between 30 and 45 seconds.
NOTE! Only first generation SD cards can be read by the FSC. These typically have a capacity of 1GB or less. SDHC or SDXC cards will not work!
- 2. Load new config from SD card:** The FSC will check to see if there is a file named "Config_X.eep" on the SD card, where X is the current position of the node address selector switch.
If so, it will replace its current blockware configuration with the one on the SD card, perform some data integrity checks on the new configuration, and if the checks pass, the configuration will be written to retentive memory.
The FSC will display the "Writing a Configuration to the FSC" error code (see next page).
This process takes between 30 and 45 seconds.
One of the the system tags FSC.System.Status.SD.LoadPass or FSC.System.Status.SD.LoadFail will be set to TRUE. as well.
NOTE! Only first generation SD cards can be read by the FSC. These have a capacity of 1GB or less. SDHC or SDXC cards will not work!
- 3. Load config from memory:** The FSC will load the configuration data from retentive memory and perform some integrity checks on the data.
and then a "...Main EEPROM into memory..." error code (see next page).
This process takes about 10 seconds.

LED Behavior:

- **Normal Operation (Comm LED's blink):**
 - **CPU:** If the checks pass, the FSC will begin running blockware, the CPU LED will blink slowly (once per second) followed by the (4) Communications LED's:
 - **NETB, NETA, COM1, COMO:** In sequence, LED's will blink once per second if bytes are being received on their respective com ports. LED blinks are offset 200ms from each other, so no 2 communications LEDs are lit at the same time.
- **While loading a configuration from FSC Draw or the SD card:**
 - When the write begins, the FSC will display the "Writing a Configuration to the FSC" error code (see next page).
 - When the complete, the FSC will write the data into EEPROM and reboot. The FSC will then load the data from EEPROM into memory, perform checks, and begin running blockware if everything checks out.
 - While the data is being loaded from EEPROM into memory, the "...Main EEPROM into memory..." error code will be displayed (see next page).

LED Diagnostic Mode: COM / NET LED's do NOT blink, CPU blinks faster than normal.

COM 0		<p>FSC Draw is currently Writing a Configuration to the FSC. Wait 30-45 seconds.</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>The SD card is currently Writing a Configuration to the FSC. Wait 30-45 seconds.</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>Processor is loading the Main EEPROM into memory and checking it</p> <p>OR it is not valid</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>Processor is loading the Aux. EEPROM into memory and checking it</p> <p>OR it is not valid</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>Memory Map Version Mismatch. The FSC_Draw version used to make the blockware does not match the FSC Firmware version. Use an SD card to load the matching Firmware.</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>Blockware Version Mismatch. The FSC_Draw version used to make the blockware does not match the FSC Firmware version. Use an SD card to load the matching Firmware.</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>(FUTURE, not enabled now)</p>	Blockware:
COM 1			Stopped
NET A			
NET B			
COM 0		<p>Block Forced. A block in the blockware has its Force Enabled input active.</p>	Blockware:
COM 1			Running
NET A			
NET B			
COM 0		<p>Node Number Mismatch. This blockware is part of a network of FSC's. The Node address switch does not match the blockware. Change the switch ..or..load the correct blockware. The controller will not communicate over the node network.</p>	Blockware:
COM 1			Running
NET A			
NET B			
COM 0		<p>NodeNet Address Collision. The FSC has detected another node on the network with the same address. Check/correct all node addresses. This error can take a few minutes to clear.</p>	Blockware:
COM 1			Running
NET A			
NET B			
COM 0		<p>NodeNet Mismatch. This FSC is part of a node network, but the NodeNet Broadcast Map does not match the other nodes in the system. Use FSC Draw or the SD card to reload the configuration for every node in the system. This is typically caused by adding or removing a tag in FSC draw, then failing to update all nodes.</p>	Blockware:
COM 1			Running
NET A			
NET B			

FSC-120 Controller Spare Parts List

Part Number	Description
92680	12 pt AC terminal strip
92681	15 pt AC terminal strip
92682	6 pt AC terminal strip
92683	3 pt AC terminal strip
92684	12 pt DC terminal strip
92694	0.6A slo-blow 5x20mm fuse

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