IONPURE®

G2 DC POWER CONTROLLER

600 VDC
13.2 Amps

Operation & Maintenance Manual

IP-POWER600-G2 MAN
REV. 11
June 2014

Manual Covers Model #:

IP-POWER600-G2

10 Technology Drive
Lowell, Massachusetts 01851
Tel: (866) 876-3340 Fax: 978-934-9499
www.ionpure.com

Table of Contents

List of Figures

List of Tables

Disclaimer Statement

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Manual Revision History

Event	Date	Changes
Revision 2	February 2010	Original publication
Revision 3	June 2010	Section 2.5.2 and Table 3
Revision 4	June 2010	Section 1.2 and Appendix B
Revision 5	July 2010	Sections 2.3.2, 2.5, 4 and Figure 6
Revision 6	September 2010	Section 2.5.2
Revision 7	October 2010	Section 2.3.2
Revision 8	November 2011	Sections 1.2, 2.1, 2.2.2, 2.2.3, 2.5.2, 2.5.3, 2.5.5, 4, A.1, A.2, Figures 3, 4, 5 and 6
Revision 9	June 2012	Table 3 and Appendix C
Revision 10	November 2012	Sections 1.2, 2.2.1, 2.2.2, 2.2.3, 2.3.2, 2.4.2, 2.5.3, A.2 Figures 3, 4 and 5
Revision 11	June 2014	Sections 1.2, 2.2.1, 2.3.2, Table 2, Table 3, A.1

1 Introduction

1.1 Caution and Warning Messages

WARNING and CAUTION labels are used to attract attention to essential or critical information in this manual. The labels are located to the left of the associated messages. Caution and Warning messages will be located immediately before related text.

⚠WARNING	**Warnings indicate condition, practices, or procedures that must be observed to avoid personal injury or fatalities.**

⚠CAUTION	**Cautions indicate a situation that may cause damage or destruction of equipment or may pose a long-term health hazard.**

Notes are also used to draw attention to information. Notes may be located before or after the related text.

NOTE: *Notes are used to add information, state exceptions, and point out areas that may be of greater interest or importance.*

1.2 General Description

The DC power controller IP-POWER600-G2 was designed specifically as a component of a DC power supply used with continuous electrodeionization (CEDI) modules manufactured by Ionpure®. This unit can be used with the MX, LX and VNX lines of CEDI modules.

The controller is designed for operation in constant current mode. In constant current mode, the output current is maintained at the selected value, regardless of the load resistance, while the voltage varies. As the resistance increases, the required voltage also increases.

NOTE: *When the required voltage reaches the maximum possible DC voltage (90% of the RMS AC input voltage), it cannot increase further. If the resistance continues to increase, the output current must decrease.*

The unit is rated for 50/60 Hz, has an input voltage range of 220 to 660 VAC, and has an output voltage range of 30 to 600 VDC. The unit can deliver a maximum output current of 13.2 amps DC.

The unit has five selectable DC output current ranges: 0 to 2.5 A, 0 to 4.0 A, 0 to 6.5 A, 0 to 10.0 A and 0 to 13.2 A. Each current range may be selected with an on-board DIP switch.

NOTE: *In order for the unit to operate properly, there must be an appropriate resistive load connected to the DC output. If the unit is operated without a load, then the unit will remained powered on but there will be no DC output. This fault condition will be indicated by the on-board LEDs as described in Section 4, Table 2.*

There is no energy storage within the unit, such as electrolytic bulk capacitance. Therefore, the output appears as unfiltered DC power with an AC power component, which is acceptable for its intended use in electrodeionization. The unit contains no formal power factor corrector, but it will provide a high power factor at most outputs other than at the lowest power levels, which is a result of the unit's design as a low bandwidth current source looking into a primarily resistive load. The power controller has input over-voltage protection as well as heat sink over-temperature protection. Output over-current protection occurs automatically as a result of the unit's use as a programmable current source.

The unit is equipped with cooling fans to provide cooling in an environment with a maximum ambient temperature of 50 °C. LED indicators provide unit On/Off and Fault status.

The DC output current can be adjusted by any one of following methods:

- An optional digital display board, Model No. IP-POWERDSP-G2, which can operate *up to sixteen* power controllers.
- An optional display board, Model No. IP-DSP1 or IP-DSP1P, which can operate *one* power controller.
- An optional display board, Model No. IP-DSP8 or IP-DSP8P, which can operate *up to eight* power controllers.
- A 0 to 5 VDC input signal from a remote process controller, such as a PLC.

The power controller output can be turned on and off by a signal from a remote set of contacts. This feature allows the use of remote instrumentation, such as a flow switch, for turning off controller output.

A 0 to 5 VDC output signal proportional to the output voltage (8.33 mV = 1 Volt) and 0 to 5 VDC output signal proportional to the output current range (set through a current range DIP switch) are available for a remote voltmeter and ammeter to indicate the output voltage and current.

The DC power controller IP-POWER600-G2 carries a CE mark to certify its conformity to the Electromagnetic Compatibility (EMC) Directive (2004/108/EC) and the Low Voltage Directive (2006/95/EC).

The DC power controller is a component of the DC power supply used with IONPURE's CEDI modules. A complete DC power supply **must** include all of the following:

- The DC power controller
- An isolation transformer
- Circuit protection (fuses or circuit breakers)
- Controls and operator interface

The overall dimensions of IP-POWER600-G2 are:

- Length: 6.12 in (155.58 mm)
- Width: 6.00 in (152.4 mm)
- Height: 6.56 in (166.64 mm)
- Weight: 6.3 lb (2.9 kg)

A full-size dimensional drawing of the DC power controller unit is included in Appendix C.

2 Installation

2.1 Mounting

⚠CAUTION **Electrostatic discharge can damage electronic components. Make contact with a grounded conductive pad and/or wear a grounded wrist strap when you handle the power controller.**

The DC power controller is intended for mounting on a sub-panel inside an enclosure using four to six screws, either M4 or UNC 8-32. The location of the mounting slots is shown in Figure 2 (located in Appendix C).

The environmental limits for operation are 0 to 50 °C at up to 95% relative humidity (non-condensing). An enclosure with at least an IP52/NEMA 12 rating is recommended. The power controller contains two on-board cooling fans; however, the enclosure should also include a cooling fan that draws through ambient air.

In installations where a water resistant enclosure (IP56/NEMA 4) is necessary, cooling the interior of the enclosure is more difficult. Typical cooling methods include:

- Sizing the enclosure for a sufficient rate of heat transfer to the environment through the enclosure walls.
- Using an air-to-air or water-to-air heat exchanger.
- Installing an air conditioning unit.
- Using vortex cooling.

The maximum heat generated by each power controller is approximately 260 watts. Additional heat generation is expected from the isolation transformer and other equipment in the enclosure.

2.2 AC Supply

Electrical schematics for typical installations are shown in Figures 3, 4 and 5 in Appendix C.

2.2.1 Isolation Transformer

The AC input to the power controller must be isolated from the AC mains by an isolation transformer that is correctly sized for the maximum power required from the power controller. The purpose of the transformer is to:

- Provide isolation from the AC mains so that the cathode of the CEDI module can be grounded. This is grounded effectively on the DC-, internally on the power controller.
- Convert the voltage of the AC mains to an AC input voltage (up to 660 VAC) for optimum operation of the power controller and the CEDI module.

  The transformer shown in Figure 3, for example, can convert the 480 VAC from AC mains to a 660 VAC input to the power controller.

⚠CAUTION **The secondary of the transformer <u>MUST NOT</u> be connected to earth ground. Grounding both the secondary and the GND terminal will damage the power controller.**

2.2.2 Over-current Protection

⚠CAUTION **<u>The power controller does not have built-in fuses for the AC input.</u> Over-current protection devices, such as circuit breakers or fuses, must be installed between the isolation transformer and the AC input terminals, for example as shown in Figure 3.**

SELECT "VERY FAST ACTING" FUSES OR A CIRCUIT BREAKER WITH A FAST TRIPPING CURVE.

If the maximum DC output current of the power controller will be limited to 13.2 amps, a current rating of 20 amps for the over-current protection devices is recommended. If the power controller will be limited to a DC current of less than 13.2 amps, size over-current protection devices according to Table 3: Isolation Transformer Size and Secondary Voltages for a Single Power Controller, located in Appendix A.

Over-current protection devices must also be installed on the primary of the isolation transformer and sized correctly according to applicable local electrical codes.

⚠CAUTION **Do <u>NOT</u> install fuses, circuit breakers or any type of switching device between the DC output of the power controller and the CEDI module. Doing so might eventually cause damage to the power controller.**

Schematics of typical single and multiple module installations are located in Appendix C.

2.2.3 Electrical Surge Suppression

Inductive elements in a circuit can generate harmful voltage spikes when a switch, contactor or breaker opens and cuts the current flow abruptly. Snubbers are simple energy absorbing circuits used to suppress those spikes.

<u>Although the G2 power controller's input section is protected by an MOV (metal oxide varistor), a snubber should be installed whenever the power controller is fed with 660 Volts or at sites with poor electric power quality indicated by swells, over-voltages, surges, etc.</u>

Snubbers are most effective when installed on the secondary of the transformer, between any switching devices and the power controller. Schematics showing their ideal location are found in Appendix C.

Ionpure® offers snubber circuits, model numbers IP-SNUBCIRC-1PH and IP-SNUBCIRC-3PH. The 3-phase version is only suitable for installation on the primary side of the isolation transformer, while the single phase version can be installed on the transformer secondary. Refer to the Voltage Snubber instruction manual (available at www.ionpure.com) for details.

2.3 High Voltage Connections

2.3.1 Initial Selection of AC Input Voltage

The AC voltage supplied to the power controller should be at least 1.1 times higher than the maximum DC voltage required by the CEDI module(s). The AC voltage is single-phase and it can range from 220 VAC to 660 VAC.

For example:

If the maximum DC voltage required by a CEDI module is 300 VDC, then the input to the controller must be at least 330 VAC. The maximum design input voltage is 660 VAC. The unit can tolerate input voltage variations of +/- 10%. If the design input voltage is greater than 660 VAC, then typical voltage variations can result in voltages outside the unit's operating conditions.

2.3.2 High Voltage Connections

AC and DC power connections must be made as described in Table 1. Figure 6 shows a basic illustration of these connections.

Table 1: AC and DC Power Connections

Terminal	Connection
T1 and T2	AC input from isolation transformer
DC+	DC positive output to anode of CEDI module
DC-	DC negative output to cathode of CEDI module
GND	Earth ground inside panel enclosure

⚠CAUTION	**The GND terminal of the power controller must be connected to earth ground (PE) inside the power supply enclosure.**

⚠CAUTION	**Do NOT install fuses, circuit breakers or any type of switching device between the DC output of the power controller and the CEDI module. Doing so might eventually cause damage to the power controller.**

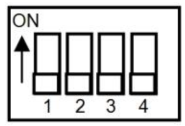
⚠CAUTION	**Do NOT install a jumper between terminals DC- and GND of the power controller, nor between the negative and ground terminals of the CEDI module. Doing so will drive the amplitude of the internal current feedback sensor and short it, which will damage the power controller. Follow the wiring guidelines illustrated in Figure 6.**

2.4 Selector Switches

2.4.1 DIP Switch for Current Range Selection

DC output current range is selected via a current range DIP switch, as described in Figure 1.

Figure 1: Current Range Selection DIP Switch



CURRENT RANGE SETTING	SWITCH 1	SWITCH 2	SWITCH 3	SWITCH 4
0-2.5	OFF	OFF	OFF	OFF
0-4	ON	OFF	OFF	OFF
0-6.5	ON	ON	OFF	OFF
0-10	ON	ON	ON	OFF
0-13.2	ON	ON	ON	ON

The default current setting is 0-2.5 amps.

Refer to Table 3 in Appendix A for correct current range settings (from column “Maximum Required DC Amps”).

2.4.2 Rotary Switch for Selection of Voltage Metering Output Range and Unit ID

Rotary switch SW2 (see Figure 6) has dual functionality:

- Switches the analog output range for voltage metering (Vm, see section 2.5.4) between 0-5VDC and 0-6VDC.

  Positions 0 to E set the voltage range to 0-5 VDC. This range should be set when using Ionpure® IP-DSP1-P or IP-DSP8-P display boards.

  Position F sets the voltage range to 0-6 VDC. This range should be set when using Ionpure® IP-DSP1 or IP-DSP8 display boards.

- Assigns a unique identification number/letter to the power controller when using an Ionpure® G2 display.

2.5 <u>Low Voltage Connections</u>

2.5.1 Analog Signal Wiring Guidelines

Proper grounding and wiring of all electrical equipment is important to help ensure optimum operation of your system and to provide additional electrical noise protection for your application. Please follow these guidelines for your analog signal wiring:

- The ground connections of the DC power controller(s) and the analog signal processing equipment (e.g. PLC module, panel meter, etc.) should be connected to the earth ground of the system.
- All ground wires should be as short as possible.
- Always use shielded twisted-pair cables for analog signals.
- Connect only one end of the cable shield to earth ground.
- Keep cable length as short as possible.
- Keep signal wires as far away as possible from AC wires and rapidly switched DC wires. Place them in separate wire trays or ducts.
- Follow other system grounding and wiring guidelines found in the manual of your analog signal processing equipment.
- If possible, use analog signal metering devices with differential inputs for improved noise immunity.

2.5.2 Control of DC Output Current

It is necessary to provide a command signal to control the DC output current to the CEDI module.

Use **<u>only one</u>** of the following options to control the DC output current:

1. Ionpure® G2 display board, Model No. IP-POWERDSP-G2, which can operate *up to sixteen* power controllers. Use standard Cat 6 cables, Ionpure® model numbers IP-CABLE50CM-G2 or IP-CABLE2M-G2.
2. Ionpure® single-channel display board, Model No. IP-DSP1 or IP-DSP1P, which can operate *one* power controller. Use Ionpure® cables model number IP-LXCABLE06, IP-LXCABLE10 or IP-LXCABLE16 only.
3. Ionpure® eight-channel display board, Model No. IP-DSP8 or IP-DSP8P, which can operate *up to eight* power controllers. Use Ionpure® cables model number IP-LXCABLE06, IP-LXCABLE10 or IP-LXCABLE16 only.
4. A 0 to 5 VDC input signal from a remote process controller, such as a PLC. Connect the control signal as follows (see Figure 6):

Ic+ Signal positive
Ic- Signal negative

The 0-5 VDC corresponds to 0-100% of the selected DC output current range.

2.5.3 Remote ON/OFF

The DC output is switched on/off by a remote isolated non-powered (dry) contact connected to the plug-in terminals labeled “ON/OFF” (see Figure 6). A closed contact enables the power controller’s DC output; an open contact shuts it off.

A possible implementation: flow switches on the feed, product and/or reject streams of the CEDI module or system, and an auxiliary contact of the motor starter of the RO or CEDI feed pump could be wired in series to the coil of a time-delay relay (to allow the flow signals to stabilize before activating). One of the relay contacts would be wired to the remote ON/OFF input to apply DC power to the module only when there is water flow.

2.5.4 Analog Outputs

The analog outputs for the unit are listed below with associated connection information:

- A selectable 0-5 VDC or 0-6 VDC output is provided for remote display of output voltage. The signal is calibrated to 8.33 mV per DC output volt at the 0-5 VDC range or to 10 mV per DC output volt at the 0-6 VDC range. See section 2.4.2 for configuration details.

  Connect the following terminals to a remote voltmeter or display if desired (see Figure 6):

  Vm+ Signal positive
  Vm- Signal negative

⚠CAUTION **These signals are developed by operational amplifiers and <u>must not be connected to power sources or drive load resistance less than 10 KΩ.</u>**

- A 0 to 5 VDC output is provided for remote display of output current. The signal is calibrated to 0-5 VDC corresponding to 0-100% of the selected DC output current range.

  Connect the following terminals to a remote ammeter or display if desired (see Figure 6):

  Im+ Signal positive
  Im- Signal negative

⚠CAUTION **These signals are developed by operational amplifiers and <u>must not be connected to power sources or drive load resistance less than 10 KΩ.</u>**

2.5.5 Output Status Relay

Output relay J8 (see Figure 6) provides a dry signal that indicates the status of the DC output: “Enabled” (closed) or “Off” (open). This signal can be used for remote status indication (e.g. Run/Standby status light).

Relay specifications: normally open contact, 1 Amp @ 30 VDC max.

3 Operation

3.1 Initial Startup

The startup sequence depends on the design of the CEDI system. Please consult the Operation Manual for the CEDI system.

3.1.1 Example of Initial Startup Procedure

The following startup procedure is only an example for a typical single module CEDI system with an electrical schematic as shown in Figure 3.

1. Close the main disconnect switch (or circuit breaker) for the CEDI system.
2. Open the appropriate valves and start the pretreatment equipment, such as the reverse osmosis (RO) system, upstream of the CEDI system.
3. Adjust the flow rates of the dilute and concentrate streams through the module.
4. Slowly increase the DC output current to the value calculated by the Ionpure Performance Projection Program (Current Startup Calculator). The power controller will maintain the current at that setting if the required voltage to drive the current is lower than the maximum DC voltage available.
5. Verify that the DC output is removed when the CEDI module flow is interrupted.

⚠CAUTION **Operation with DC power on and insufficient water flow can cause irreparable damage to the CEDI module(s) and system.**

During normal operation, no further attention to the DC power controller should be required.

3.2 Output Adjustment

The DC output current may need to be adjusted if there is a change in feed water conditions and/or flow rate.

4 Troubleshooting

⚠WARNING **Troubleshooting should be performed by qualified personnel only. Safety procedures should be reviewed prior to working with the DC Power Controller.**

The controller status can be determined by looking at the LEDs on the circuit board. The LEDs will indicate normal operation or one of six fault conditions.

Table 2 can be used to determine which fault condition has occurred. Then, refer to the specific condition and the Possible Causes/Actions related to that condition for further information.

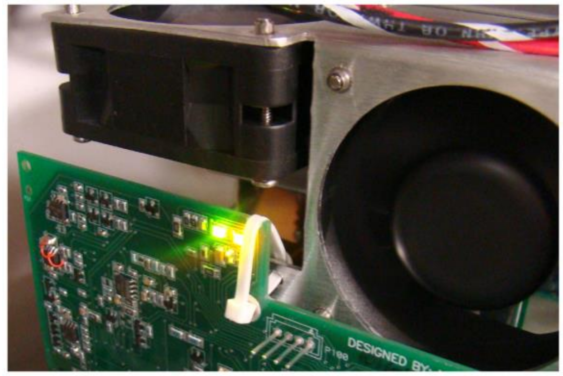


Table 2: LED Troubleshooting Matrix

	Green LED			Amber LED		
Condition	**On**	**Off**	**Blink**	**On**	**Off**	**Blink**
Normal Operation	X				X	
Input Over-voltage (after 3 incidents*)		X		X		
Input Under-voltage or Damaged Unit		X			X	
Over-temperature			X			X
Open On/Off Input			X		X	
No Command Signal or No Load		X				X
Short Circuit			X	X		

* The power controller will monitor AC input and if high voltage is detected, will shut down the DC power stage for 10 seconds. If after this time the AC input voltage has dropped below 726 V, the DC power stage will restart. After 3 consecutive such occurrences within 30 minutes, the DC power stage will shut down until the AC input power to the G2 controller is manually cycled off/on.

Input Over-voltage (after three incidents)

Possible Cause	Action
Source AC too high for power controller	Check AC voltage at isolation transformer primary; ensure that transformer primary is wired to match voltage available at site. Check voltage at transformer secondary with multi-meter, confirm that it is less than 660 VAC +10%.
Improper transformer design or construction	See transformer design requirements in Appendix A.

Input Under-voltage or Damaged Unit

Possible Cause	Action
Low or no AC voltage at input to DC power controller	Check AC voltage at isolation transformer secondary with multi-meter, confirm that it is greater than 220 VAC -10%.
Low or no AC voltage at input to isolation transformer	Check AC voltage at transformer primary with multi-meter, confirm that it meets transformer specification.

Over-temperature

Possible Cause	Action
Fans on G2 controller board not functioning with correct AC voltage at G2 board input	Visually inspect to see if both fans operational – if not board requires repair.
Inadequate cooling of enclosure	Check temperature inside enclosure during operation, ensure is less than 50°C.
Fan-cooling insufficient	Check fan sizing, ambient temperature; possible need for air conditioning or vortex cooling.

Open On/Off Input

Possible Cause	Action
Low flow switch activated (open)	Check operation of flow switch. Check availability of feed water. Check upstream and downstream valves.
No jumper at on/off interlock input on G2 board (if remote on/off interlock not used)	Install jumper.
Remote on/off interlock activated (open)	Check status of RO system, CEDI feed pump or other remote on/off interlock (system specific).

No Command Signal or No Load

Possible Cause	Action
No communications with G2 display board	Check connections and condition of Cat 6 cable. Verify that it is a standard cable, not crossover.
DC output current set to 0.0 amps on G2 display board	Increase the current setpoint.
No analog signal from PLC or “IP-DSP” display board	Check for DC voltage at Ic+ - Ic- terminals (should be >0 and ≤5 VDC).
Defective wiring or “IP-LX” ribbon cable	Check for DC voltage at Ic+ - Ic- terminals (should be >0 and ≤5 VDC).
CEDI module not connected to DC output (no load) or damaged DC output wires	Check connections and wires between DC output and CEDI module.
External control set incorrectly	Determine if the display or PLC will be the source of control, and change to YES/NO accordingly

Short Circuit

Possible Cause	Action
Incorrect wiring to CEDI module	With power off, disconnect wiring at power controller and check for continuity (trace short).

Appendix A Design Considerations

A.1 Isolation Transformer

Basic Transformer Design Considerations:

- Primary: single or three-phase, selected to match the power available at the site.
- Secondary: single-phase, at any voltage from 220 to 660 VAC. The AC voltage required should be at least 1.1 times higher than the maximum DC voltage required by the CEDI module.
- Number of Secondary Windings: a single secondary winding can feed multiple G2 power controllers, which would normally be the least expensive transformer option. Another possible configuration is a dedicated secondary winding for each power controller, which can provide the benefit of preventing failures in one winding from affecting others.
- Frequency: 50 or 60 Hz.
- Duty Cycle: 100%

The DC power requirements, recommended input voltage to the G2 controller (VAC), minimum isolation transformer rating (KVA) and fuse size for secondary (amps) for various CEDI single module systems are listed in Table 3.

CAUTION

A transformer's rated voltage may not match the system voltage exactly, or it may be necessary to raise or lower the output voltage to the power controller. In these cases, voltage taps in the primary of the transformer can adjust the AC input voltage to the power controller.

Table 3: Isolation Transformer Size and Secondary Voltages for a Single Power Controller

Module Type	Maximum Required DC Volts	Maximum Required DC Amps	Recommended Input Voltage to G2 (VAC)	Minimum Transformer KVA rating	Fuse Size for Secondary (Amps)
LX04 X&Z	53	6	220	0.6	4
LX10 X&Z	133	6	220	1.2	7
LX18 X&Z	240	6	330	2.2	9
LX24 X&Z	320	6	440	3.0	8
LX30 X&Z	400	6	440	3.5	10
LX45 X&Z	600	6	660	5.6	11
LX04HI	50	10	220	0.8	5
LX10HI	125	10	220	1.7	10
LX18HI	225	10	330	2.5	9
LX24HI	300	10	330	3.5	13
LX30HI	375	10	440	4.7	14
LX45HI	600	10	660	9	16
VNX25-2, VNX28-2	600	6.6	660	5.6	11
VNX50-1, VNX 50-2	600	13.2	660	10.5	20
VNX50-3, VNX 55-2	600	13.2	660	10.5	20
VNX50-E, VNX55-E	600	13.2	660	10.5	20
VNX50-EX, VNX55-EX	600	13.2	660	10.5	20
VNX15CDIT-2	600	6.6	660	5.6	11
VNX30CDIT-2	600	13.2	660	10.5	20
VNX50-HH	600	10	660	9	16
MX30	27	2.5	220	0.2	1
MX60	53	2.5	220	0.3	2
MX125	106	2.5	220	0.5	3
MX250	213	2.5	330	0.9	4
MX500	426	2.5	550	1.7	4

In some cases, custom designed transformers will be required (example: 660 VAC secondaries are not standard). The primary windings must be wound for the appropriate AC mains voltage.

Other Transformer Design Considerations:

Temperature Rise and Insulation Class:

Transformers with 130 or 150 °C temperature rise with an insulation class of 220 °C are commonly available. Transformers with lower temperature rise are more efficient and have longer service life, but are priced higher.

Selection is left up to the user. IEC standards specify the maximum temperature rise of transformers in relation to the insulating material used, for a maximum ambient temperature of 40°C, as listed in Table 4.

Table 4: Transformer Ratings by Insulation Class

Insulation Class (°C)	Max Permitted Temperature Increase in Windings (ºC)	
(IEC60085)	*(IEC60026)*	*(EN61558)*
105 (A)	60	60
120 (E)	75	75
130 (B)	80	80
155 (F)	100	100
180 (H)	125	125
220	150	---

Construction:

Use open frame transformers with copper windings. Copper-wound transformers are usually more efficient and smaller than aluminum-wound units.

Thermal Switch:

It is recommended to have a thermal switch embedded in the secondary winding to shut off the AC supply to the transformer if the temperature exceeds a set value, below the insulation class temperature.

Voltage Taps:

Voltage taps in the primary are recommended by most transformer manufacturers. A common tap arrangement is two 2.5% taps above and four 2.5% taps below nominal voltage. Transformers are shipped with the taps connected for nominal voltage. The installing electrician must change the taps if the supply voltage differs from the nominal voltage rating.

A.2 Other Power Supply Assembly Components

Fuses and Circuit Breakers:

- “Very fast acting” type fuses or a circuit breaker with a fast tripping curve must be installed between the output of the isolation transformer and the AC input of the power controller.

Use Table 3 to select fuse size (in Amps). The voltage rating should match or exceed the nominal AC input voltage to the power controller.

- Over-current protection devices must also be installed on the primary of the isolation transformer and sized according to applicable local electrical codes.
- Do NOT install fuses, circuit breakers or any type of switching device between the DC output of the power controller and the CEDI module. Doing so might eventually cause damage to the power controller.

Snubbers:

Snubbers should be installed for an extra layer of protection against very high energy spikes whenever the power controller is fed with 660 Volts or at sites with poor electric power quality indicated by swells, over-voltages, surges, etc.

Snubbers are most effective when installed on the secondary of the transformer, between any switching devices and the power controller. Schematics showing their ideal location are found in Appendix C.

Ionpure® offers voltage snubber circuits, model numbers IP-SNUBCIRC-1PH and IP-SNUBCIRC-3PH. The 3-phase version is only suitable for installation on the primary side of the isolation transformer, while the single phase version can be installed on the transformer secondary. Refer to the Voltage Snubber instruction manual (available at www.ionpure.com) for details.

Enclosure:

- Sizing: the width and height will depend on size and number of components inside the enclosure. There should be at least two inches of clearance from the top of the power controller to the door of the enclosure to allow proper air flow.
- Cooling: the G2 power controller will dissipate a maximum of 260 watts in the form of heat. The panel enclosure should have proper ventilation to ensure the power controllers operate at a temperature no higher than 50 °C.

Contactor (optional):

A contactor can be installed downstream of the over-current protection devices (fuses or breakers) to completely remove AC power to the G2 power controller. This might be desired for emergency stop and/or manual override implementation.

Power to the CEDI module must be enabled/disabled using the Remote ON/OFF input of the power controller, as described in section 2.5.3.

Appendix B UL and CE Compliance

B.1 UL (US/CANADA)

The G2 power controller is recognized by UL through compliance with the following standards:

- UL 61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements)
- CAN/CSA-C22.2 No. 61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements)

B.2 EUROPEAN UNION DIRECTIVE

The G2 power controller meets the Electromagnetic Compatibility (EMC) Directive 2004/108/EC and the Low Voltage Directive (LVD) 2006/95/EC through compliance with the following standards:

- EN 61000-6-4 (Generic Standards – Emission Standard for Industrial Environments)
- EN 61000-6-2 (Generic Standards - Immunity for Industrial Environments)
- IEC 61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements)

Appendix C Engineering Documents and Drawings

Engineering Drawings included in this section

- Figure 2: Full-scale Dimensional Drawing for IP-POWER600-G2
- Figure 3: Electrical Schematic of a Typical Single-module installation - Single-phase Transformer
- Figure 4: Electrical Schematic of a Typical Multi-module Installation - Single-phase Transformer with Shared Secondary Winding
- Figure 5: Electrical Schematic of a Typical Multi-module Installation - Three-phase Transformer with Independent Secondary Windings
- Figure 6: Electrical Connections and Switches

Figure 2: Full-Scale Dimensional Drawing for IP-POWER600-G2

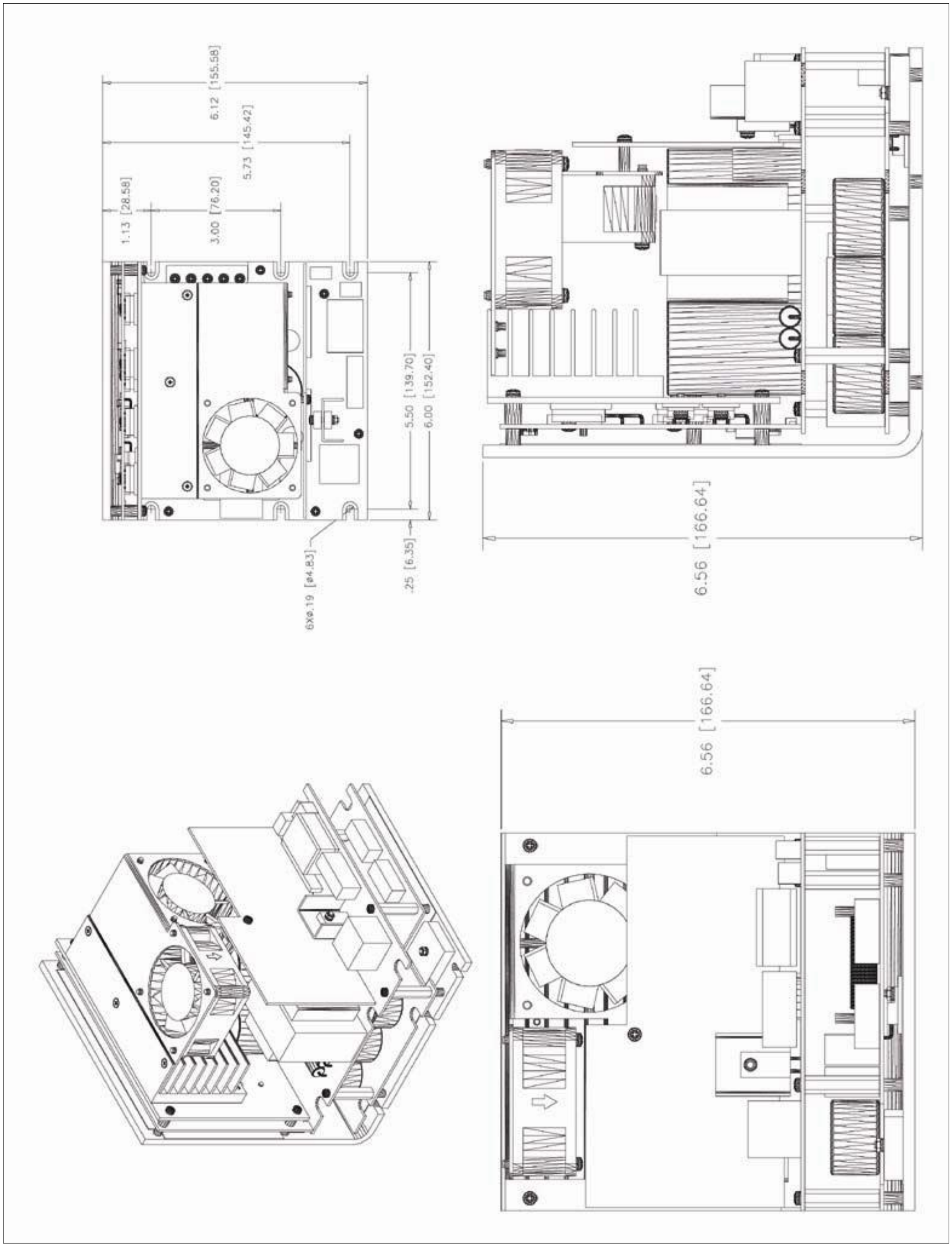


Figure 3: Electrical Drawing of a Typical Single-Module Installation - Single-Phase Transformer

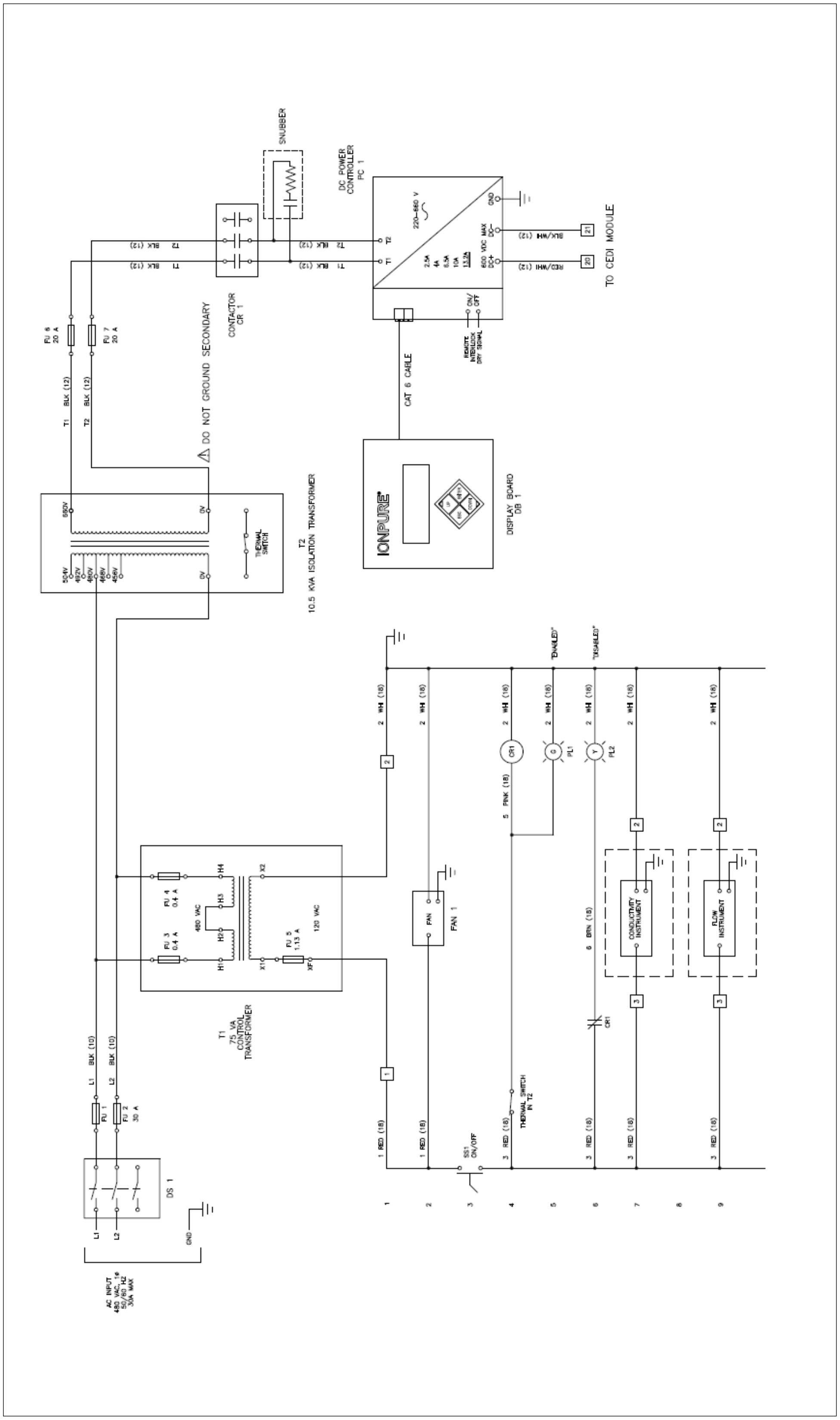


Figure 4: Electrical Drawing of a Typical Multi-Module Installation - Single-Phase Transformer with Shared Secondary Winding

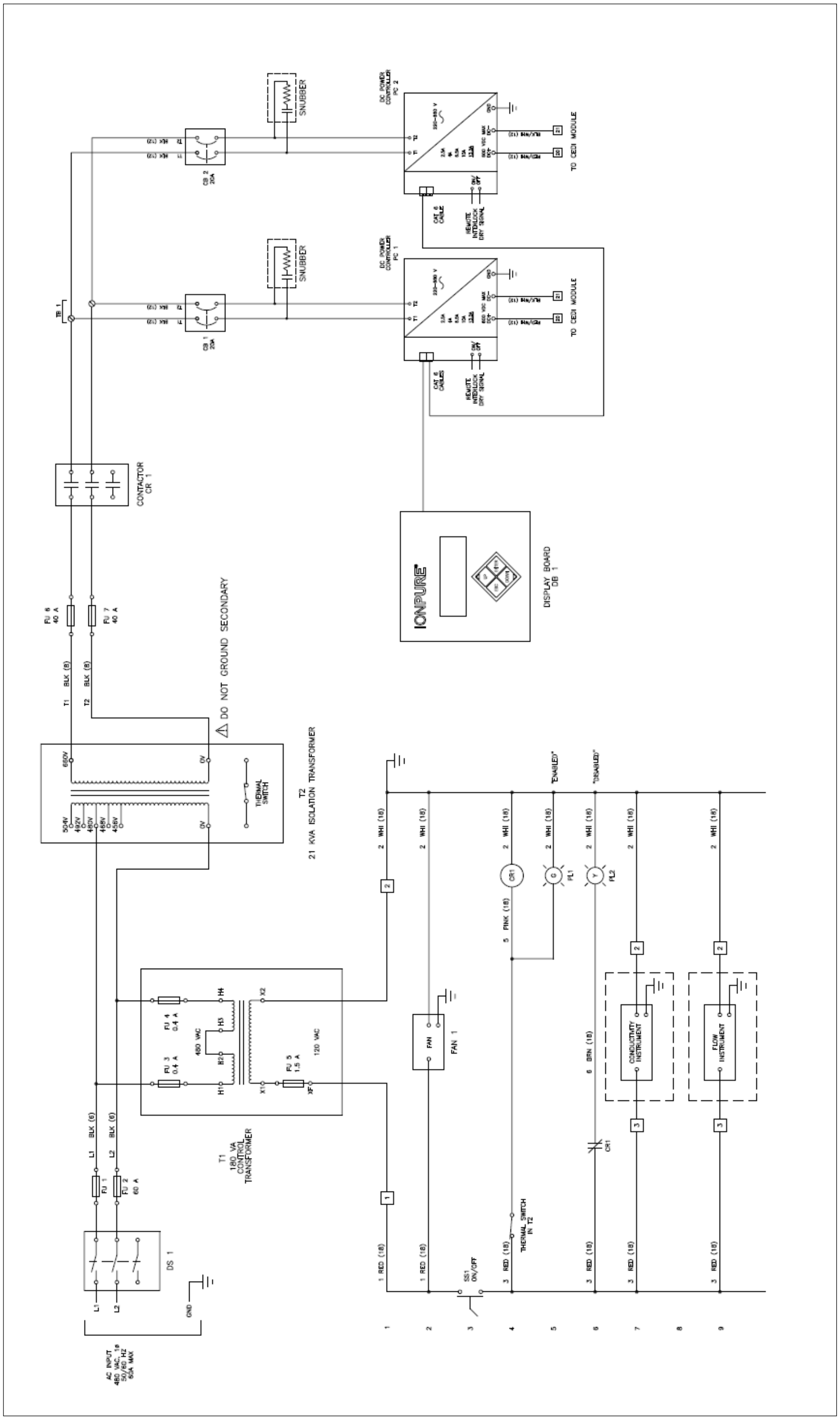


Figure 5: Electrical Schematic of a Typical Multi-Module Installation - Three-Phase Primary with Independent Secondary Windings

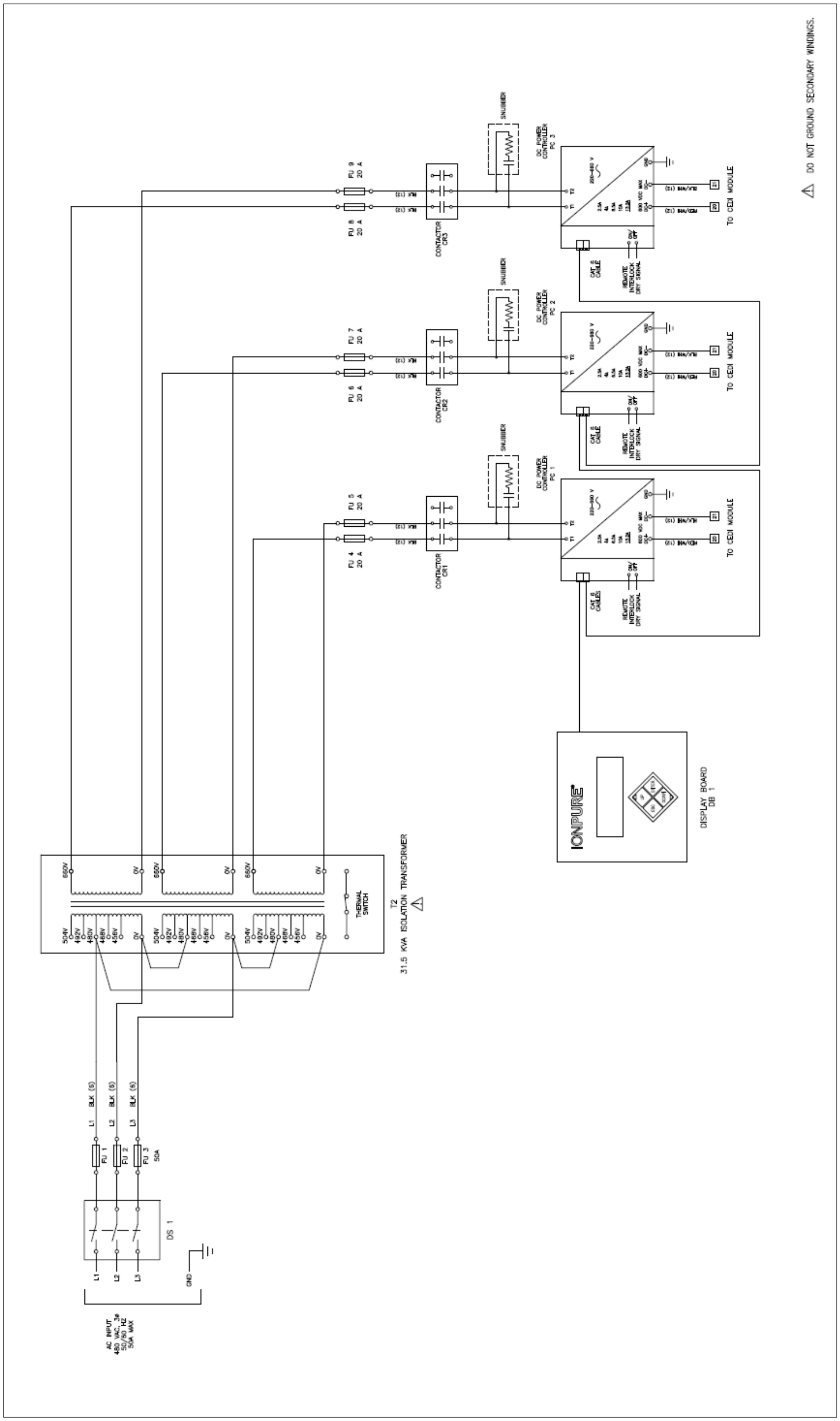


Figure 6: Electrical Connections and Switches