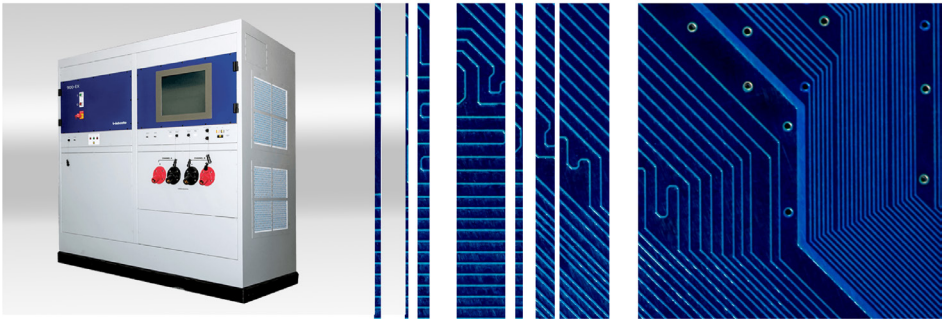
Webasto

Installation, Operation, and Maintenance Manual
EV Test Systems
900 EX



CORPORATE HEADQUARTERS

Webasto Charging Systems, Inc.

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www.evtestsystems.com

OWNER'S RECORD

Model:

900 EX

Serial number (s/n):

.....

Purchase date:

.....

A NOTE ABOUT CUSTOMER SUPPORT

To ensure superior service, please write down the unit's serial number in the owner's record above and have it available when contacting Webasto customer support. The serial number can be found on the nameplate rating label on the upper left corner of the unit.

Webasto EV Test Systems
Customer Support
1-866-767-4242
info.us@webasto-charging.com

SAVE THESE INSTRUCTIONS!

This manual contains important instructions for the installation, operation and maintenance of the 900 EX.

CONTENTS

Chapter 1

Introduction

1.1 SYMBOL USAGE

The 900 EX is designed with safety as the highest priority. Installation must comply with all local codes and the following safety precautions must be read and observed.

DANGER

Indicates information about safety practices which, if not followed, may result in serious injury or death.

WARNING

Indicates information about safety practices which, if not followed, could result in personal injury, fire, or equipment overheating.

NOTE

Indicates helpful information for installation or usage, but does not contain personnel or equipment safety-related information.

1.2 GENERAL SAFETY PRECAUTIONS

BEFORE YOU BEGIN

- Read all instructions and cautionary markings on the 900 EX assembly.
- Read the important safety instructions below.
- Leave these instructions with the installed unit for future reference.
- Only qualified personnel should install, use, or service this unit.
- Read and understand these manufacturer's instructions and your employer's safety practices manual.

ELECTRIC SHOCK CAN KILL

- Touching live electrical parts can cause fatal shocks or severe burns.
- The input power circuitry and internal circuits are live whenever input power is on.
- An incorrectly installed or improperly grounded unit is a hazard.
- Depress and latch the Emergency Off Switch. Turn off local disconnect on the left side of the unit. Leave off for at least five (5) minutes to allow high voltage to discharge.
- Do not operate the unit if there is physical damage to the unit, coupler, or cable.
- Do not subject the cable to damage or stress.
- Do not step on the DC output cable.
- Do not operate the unit if any access panels are open.

Inspect the equipment immediately upon receipt. If the unit was damaged during shipment, keep the shipping cartons and packing materials and file a claim with the freight carrier and/or insurance company for shipping damage. If shipping damage is discovered after acceptance, file a claim for concealed damages.

WARNING

Battery testers should not rely solely on manual operation or automated scripts for safety. Errors can subject batteries to overcharging, which can result in battery damage or fire.

Batteries should be monitored by independent hardware for one or more of these unsafe conditions:

- Over voltage
- Over temperature
- Excess pressure
- Excess gassing (H2)

The HV Interlock on the 900 EX is provided to allow a hardware monitor to shut down the 900 EX in the event of an unsafe battery condition.

Before attempting to service the system, follow these steps:

1. Turn off the Input Circuit Breaker or Main Disconnect Switch.
2. Turn off local disconnect on the left side of the unit.
3. Depress and latch the Emergency Off switch for at least five (5) minutes to allow the high voltage to discharge.
4. Do not open the covers; there are no user serviceable parts inside.

CONTACT WEBASTO'S CUSTOMER SERVICE DEPARTMENT

PRIOR TO PERFORMING ANY SERVICE ON THE UNIT.

1-866-767-4242

Chapter 2

System Description

2.1 ABOUT THE 900 EX

The 900 EX is a bi-directional, computer-controlled, two-channel, DC power processing system offering superior accuracy and flexibility. The system was specifically designed for testing (i.e., "cycling") electric and hybrid-electric vehicle components and subsystems.

The 900 EX is an ideal test system for a wide range of DC loads, in addition to batteries, offering more than a traditional power supply system. Examples include Auxiliary Power Units (APU), flywheels, motors, inverters, batteries, fuel cells, capacitors, and more. The 900 EX uses the bi-directional characteristic of the electric utility (it can deliver and absorb power) to meet the needs of both uni-directional and bi-directional operation.

Power is transferred from the utility to the load or from the load to the utility. Using the utility to absorb power eliminates the need for external resistive loads and conserves energy that is normally lost. In addition, the 900 EX incorporates special power processing algorithms to perform a wide variety of tests.

2.2 900 EX POWER APPLICATIONS

The 900 EX is flexible and may be used for a variety of DC power applications (see Table 1). This section describes a few typical applications to illustrate the different features of the 900 EX.

Table 1. 900 EX Power Applications

Category	Application	900 EX
Battery Testing and Cycling	Battery Cell	
	Battery Module	
	Battery Management Systems	
	Battery Pack	•
	Production Testing	•
Simulation	Battery	•
	Powertrain	•
	Fuel Cell	•
	Hardware in the Loop	•

Category	Application	900 EX
Energy Storage Charging and Testing	Fuel Cell	•
	Super & Ultra Capacitors	•
	Flywheels	•
Power Generation Equipment Testing	Electric Components	•
	Power Supplies	•
	Generators	•
	Stationary Power	•
	Inverters	•
	Military & Aerospace	•
	Life, Run-in, Burn-in	•
	Uninterruptable Power Supplies (UPS)	•
Hybrid and Electric Vehicle Testing	Powertrain	•
	Production Testing	•
	Medium & Heavy-duty EVs (buses, trucks, military, locomotives)	•

2.3 SYSTEM COMPONENTS

Figure 1 and Table 2 illustrate and describe the 900 EX system components.

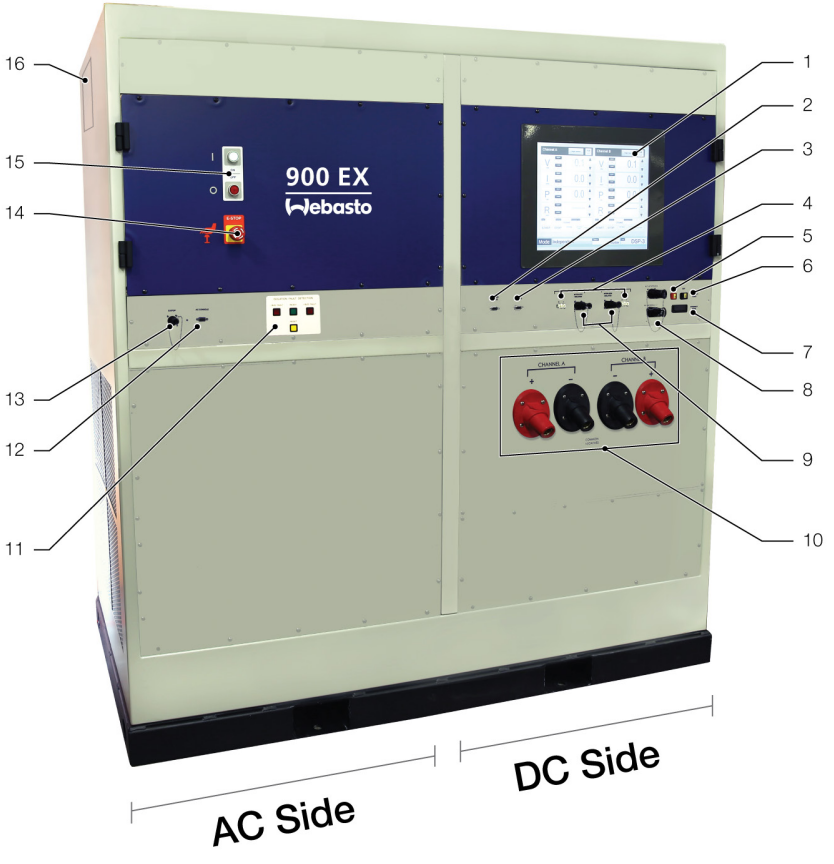


Figure 1. System Components

Table 2. System Components

Number	Description
1	(HMI) User Interface Panel
2	Remote Operation System (ROS) Serial Port
3	CAN BUS Port
4	Remote Voltage Sense (RVS) - Channels A and B
5	Multi-Unit Fiber (IN)
6	Multi-Unit Fiber (OUT)
7	Ethernet Fiber
8	Multi-Unit Interlock
9	High Voltage Interlocks - Channels A and B
10	DC Output - Camlocks Option
11	Isolation Fault Detection
12	AC Diagnostic Port
13	Remote E (Emergency) Stop
14	Local E (Emergency) Stop
15	Power Button
16	Utility IN

2.4 AC INVERTER FUNCTIONS & CONTROLS

The AC Inverter interfaces the utility to an internal Intermediate DC Bus. The Intermediate DC Bus voltage is regulated by the AC Inverter based on the maximum voltage expected by the DC Converter connected. The range for the Intermediate DC Bus is 750 - 910 Volts DC.

Circuitry designed into the AC Inverter monitors the utility to detect any abnormalities. This is accomplished by measuring the frequency and amplitude of the utility and verifying that it remains within the specified range given in Section 2.6 Technical Specifications.

The AC Inverter operates under current control instead of the more common phase control. This allows for a more robust interface to the utility and linear response in the inverter dynamics. In addition, references for the current are obtained from the utility waveforms, thereby maintaining the AC Inverter as a true unity power factor interface regardless of line harmonics.

Figure 2 shows the AC Inverter front panel. See Table 3 for a description of AC Inverter panel functions.

Figure 2. AC Inverter Front Panel

NOTE

The main circuit breaker must be switched off and locked out by authorized factory personnel; and, either the Main Power or Emergency Off switch service must be switched off to remove power from the system for at least five (5) minutes prior to accessing the interior of the cabinet.

Table 3. AC Inverter Controls and Indicators

Panel Functions	Description
Main Power On/Off	Press to apply and remove power to the system. The switch ON is illuminated with a green light when control power is applied to the system. The switch OFF is illuminated with a red light when the control power is off, but input power is present.
Emergency Off	Press to remove all power to the system except input power. The switch has a locking mechanism and must be rotated counterclockwise to power the control system.

2.4.1 ISOLATION FAULT DETECTION

Internal Isolation is monitored with a separate circuit.

Prior to contactor closure, this circuit monitors the impedance between the positive and negative intermediate busses and the chassis or earth ground. Once the contactors have been closed and the Unit Under Test (UUT) is connected to the 900 EX, the Isolation Monitor is disabled to prevent nuisance trips with low impedance loads.

The Isolation Monitor has four indicator lights (i.e., Ready, Reset, - Bus Fault, + Bus Fault) for displaying the state of the system (see Figure 3).

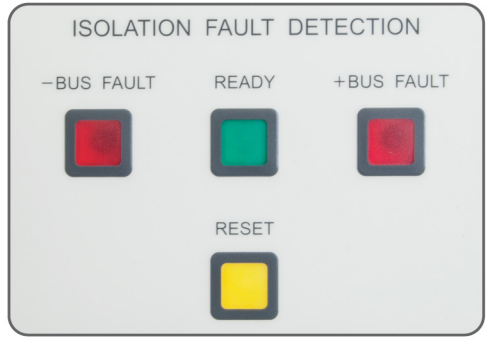


Figure 3. Isolation Fault Detection Panel

Table 4 defines the indicator lights in each state.

Table 4. Indicator Lights Displaying State of System

State	Ready Light (green)	Reset light (yellow)	-Bus Fault (red)	+ Bus Fault (red)
Standby	1 Hz Flash	–	–	–
Standby fault	–	–	On steady	On steady
Monitor	On steady	–	–	–
+ Bus Fault	–	–	–	On steady
- Bus Fault	–	–	On steady	–
Operate	On steady	–	–	–
Reset	–	1 Hz Flash	–	–
Reset complete	–	On steady	–	–

1. Standby. When a power processing session is started, the Isolation Monitoring circuit monitors the DC bus voltage to ensure that it has risen to a sufficient level to prevent nuisance Isolation Monitor trips. While this is happening, the Ready light (green) is flashing. The 900 EX will stay in this state until the voltage threshold is reached, or for a maximum of nine (9) seconds, after which the unit declares a Standby Fault.
2. Standby Fault. When the Isolation monitoring circuit times out during Standby (the DC bus failed to reach the threshold voltage within nine (9) seconds), the circuit disables the 900 EX and illuminates both fault lights (red).
3. Monitor. After the bus voltage has risen to its set point, the Isolation Monitoring circuit evaluates the isolation level of the high voltage power system. If no faults are detected, the system displays the Ready light (green) with steady illumination. The system is now ready to be used.
4. + Bus Fault/- Bus Fault. If loss of internal isolation is detected, the isolation fault detection circuit will prevent the 900 EX from operating. The + or – Bus Fault indicators (red) will be illuminated to aid in determining the cause of the fault. The system will remain in this state until manually reset or reset by a power-down of the system.
5. Operate. If no faults have been detected following connection to a UUT, the system disconnects the Isolation Monitoring, allows the output contactors to close, and continues to display the ready light (green).
6. Reset. After a fault has been detected and the cause of the fault corrected, the unit must be reset. This can be done either by a power-down and restart of the unit (as would have to be done to perform any work inside the unit) or by manually pressing the reset button (yellow). To clear the fault manually, hold the reset button down for eight (8) seconds. The light

will flash while holding down the button. Once the fault is cleared, the light will return to a steady yellow, indicating the circuit is ready to resume monitoring and the 900 EX lockout has been released.

2.5 DC CONVERTER FUNCTIONS & CONTROLS

The DC Converter monitors load connections, processes power from the Intermediate DC Bus for the load, and provides a local control interface. All DC Converter configurations can be set either via the ROS computer, CAN Bus Interface, Ethernet interface, or manually through the front panel (shown in Figure 4).

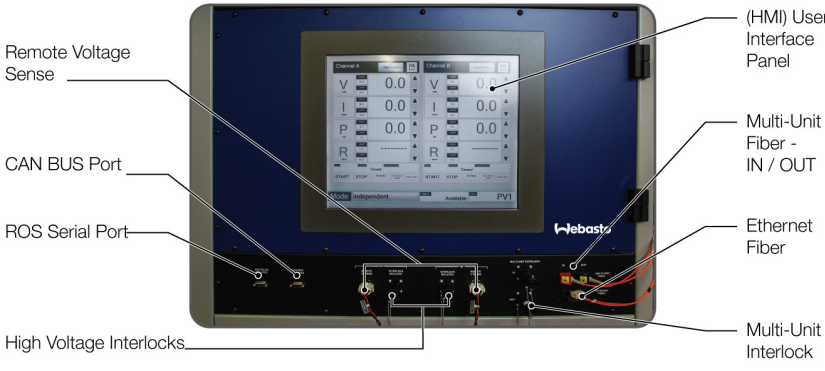


Figure 4. DC Converter Front Panel

The DC Converter is composed of two separately controlled converters: Converter A and Converter B. Each converter has its own output terminals.

The converter has the ability to operate in two different configurations:

1. Independent Configuration
   Two loads can be connected and separately controlled.
2. External Parallel Configuration
   This configuration is called parallel because the two converter circuits internally function in parallel to provide higher current capability. When operating in this mode, use the output on both channel terminals.

The DC Converter incorporates safety features to minimize the possibility of an improperly connected load or hazardous voltage exposure. The DC Converter monitors internal switches, which indicate where load connectors are inserted, and verifies that the load connections and the chosen configuration are compatible.

If the load configuration requested does not match the load connections, the requested configuration will not be acknowledged. Additionally, the output terminals will automatically be disconnected, using internal contactors, if one of the connectors is pulled from the unit.

The internal contactors remain disconnected during load configuration or reconfiguration, and will also be disconnected in the event of a load fault condition (e.g., a short circuit) or an unsafe operating condition (e.g., a voltage higher than the user-defined limit).

2.5.1 DC SIDE CONNECTOR INTERFACE

All of the manual functions of the 900 EX are controllable with the ROS or other scripting tool. In addition, there are serial data output, CAN Bus, and ethernet connectors that are accessible on the DC Connector Panel (Figure 5). Details of the connector pin outs and the function of each are described below.

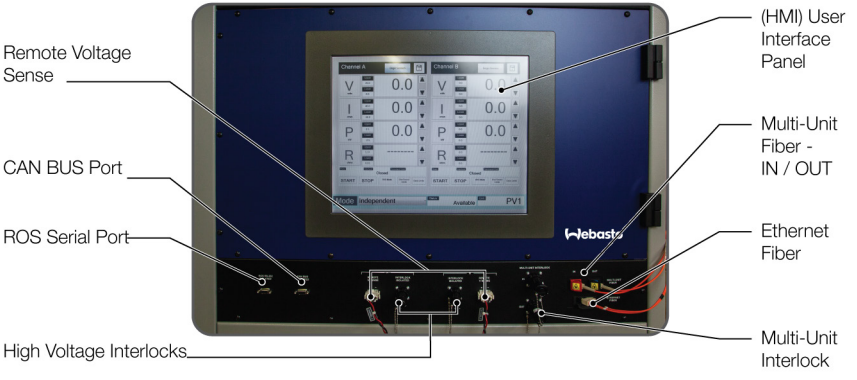


Figure 5. Connector Panel with Jumper Connectors

2.5.1.1 REMOTE OPERATION INTERFACE

The Remote Operation Interface is an isolated input based on the RS-232 communication standard and allows communication between the DC Converter and the 900 EX ROS. The purpose of this interface is to provide status information and DC output measurements from the 900 EX to the ROS and to accept commands from the ROS. For more information on the Remote Operation Interface, please refer to the ROS Manual and/or CAN Interface document.

2.5.1.2 900 EX ROS

ROS is a personal computer-based system for controlling the 900 EX. The system consists of the computer itself and any peripherals, and the 900 EX ROS application.

This software provides a graphical user interface for controlling and monitoring the operation of the 900 EX and a command language interpreter that allows for simple implementation of complex test programs and communication with the

system. The ROS PC connects via RS-232 to the 900 EX (see Figure 7).

2.5.1.3 HV INTERLOCK (FRONT PANEL)

Each channel of the 900 EX has a High Voltage Interlock Switch (HVIS) for added protection (see Figure 6). The HVIS can put one channel of the 900 EX into Standby Mode without affecting the other channel. It is designed to be used as part of an automated test setup. For parallel and multi-unit modes, use HVIS Channel A.

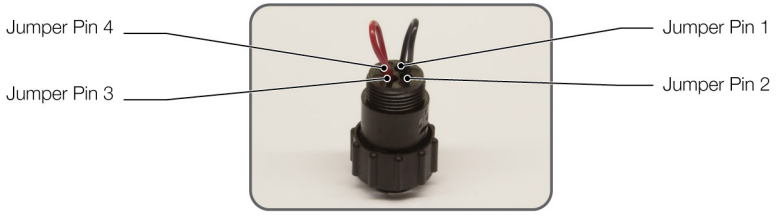


Figure 6. 900 EX Connector Pinouts

Pin 1 (+V) is a system supplied +5V isolated voltage source that is to be connected to Pin 2 (+sense). The Pin 3 (-sense) has to be connected to the Pin 4 (the GND signal), which is the ground of the (+V) isolated supply. A break in either one of these links will put that channel into Standby Mode (open the output contactor and isolate the output of the 900 EX from the load).

If this feature is not used, it is necessary to have mating connectors with the jumper wire provided installed for proper functioning of the unit. Contact Customer Service Department for additional information.

2.5.1.4 REMOTE VOLTAGE SENSE (RVS)

To increase voltage accuracy at the Load, the 900 EX can provide feedback on a remote voltage measurement. The RVS mode is activated by pressing the RVS button on the front panel. This feature can be used in Voltage Mode and Power Mode. (See “Appendix C” on page 57 for proper wiring and use of this feature.) In Current and Resistance Modes, the remotely measured voltage will be displayed once the RVS Mode is enabled.

2.5.1.5 CAN OPERATION

The CAN protocol provides an encapsulated form of the existing datalink used for remote operation. CAN port is shown in Figure 7. This port is not terminated within the unit. The supported bit rate is 250k baud rate. Contact Customer Service Department for additional information.

Figure 7. ROS RS-232 and CAN Bus Ports

2.5.1.6 ETHERNET FIBER OPERATIONS

The Ethernet fiber protocol provides an encapsulated form of the existing datalink used for remote operation (see Figure 8). Contact Webasto's Customer Service Department for additional information.

Figure 8. Connected Ethernet Fiber

2.5.1.7 REMOTE EMERGENCY STOP (OPERATIONAL)

Within the 900 EX there is a provision to allow installation of an external switch to control the emergency stop function of the system. To enable a system provided with this option, an electrical connection must be made between Pins 1 and 4 of this interface (Figure 9). Opening this connection will induce a complete power-down of the 900 EX.

Figure 9. Remote Emergency Stop

2.6 TECHNICAL SPECIFICATIONS

Table 5 shows the features and Table 6 shows the operating range for the 900 EX.

Table 5. Product Features

Parameter	Description				
Input Rating (3 Phase)	480 V	440 V	415 V	400 V	380 V
Current	344 A	375 A	398 A	413 A	435 A
Frequency	60 Hz	50/60 Hz			
Isolation Transformer	288 KVA Internal				
Power Factor*	≥0.95				
Harmonic Distortion*	<3.70%				
Multiple User Interfaces	Local HMI, Serial, CAN, Ethernet Fiber				
*Measured at full processing power					

Refer to product nameplate for input voltage.

Table 6. Operating Range

Configuration	Voltage (Vdc)	Current (Adc)	System Power (kW)
Independent	≥+8 to ≤+750	-500 to +500	-250 to +250
	>+750 to ≤+825	-400 to +400	-225 to +225
	>+825 to ≤+900	-300 to +300	-200 to +200
Parallel	≥+8 to ≤+750	-1000 to +1000	-250 to +250
	>+750 to ≤+825	-800 to +800	-225 to +225
	>+825 to ≤+900	-600 to +600	-200 to +200
Weight	6100 lb. (2767 kg)		
Dimensions	72″ W x 76.5″ H x 39″ D (183 cm W x 194 cm H x 99 cm D)		

Chapter 3

Installation

3.1 ON-SITE INSTALLATION

The purpose of this section is to provide installation instructions for the newly-purchased 900 EX system.

3.1.1 PLANNING

3.1.1.1 INSPECTION

Upon receipt of the unit, conduct a thorough inspection for damage that may have occurred during shipping. Examine the exterior and interior of the unit for any evidence of physical damage. Do not attempt to operate the unit should any damage be detected.

3.1.1.2 FLOOR LAYOUT

There should be a 36" open space on each side of the 900 EX for service access. To allow for adequate air flow, there should be no obstructions on the right or left side of the unit.

3.1.1.3 UTILITY REQUIREMENTS

The input wiring block is located on the top left side of the 900 EX, see Figure 10. A 3 ½" diameter hole can be punched for a 3" conduit to accommodate 3 phase wires plus ground. Input wire selection should be compliant to local electrical code.

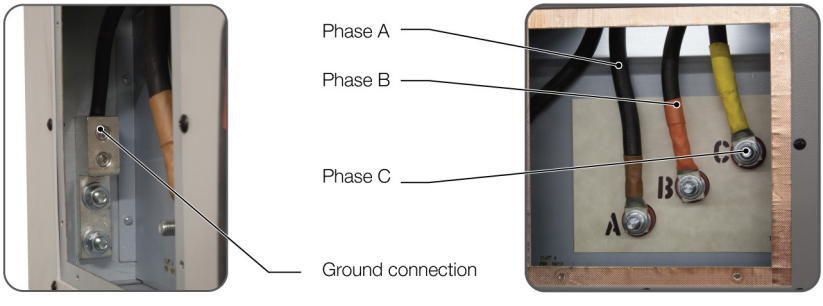


Figure 10. Wiring and Ground Installation

An external circuit breaker or fused disconnect is needed for over-current protection and should have lockout tag out for servicing the equipment. The recommended current rating for the protection current is 20% greater than the input current specified on the nameplate to accommodate low input voltage operation.

3.1.2 VERIFY UNIT

3.1.2.1 INSTALLATION CHECKLIST

Write down the unit serial number on the installation checklist (Figure 11).

900 EX System Installation Checklist

Customer / Location:

Model / Description:

Remote Operating System (ROS) Software Version:

Serial #

Utility Measurements (fill in values)

Voltage			
Overall	Phase A to B	Phase A to C	Phase B to C
	Phase A to Ground	Phase B to Ground	Phase C to Ground

Disconnect / Breaker Rating	Frequency	Input Wire Size

☐	**Ground Connection Checked**
☐	**Unit Powered Up and Working Normally**
☐	**Maintenance Training given to Customer Personnel**
☐	Verify Proper Cooling Fluid Level
☐	Verify Operation of Cooling Fans
☐	**Operating Manual Mode Training**
☐	Power Unit Up
☐	Set Up Configuration
☐	Set Safety Limits
☐	Choose Mode of Operation
☐	Change the Command Set Point
☐	Stop Operation of Unit in Normal and Emergency Situation
☐	Power Down the Unit
☐	**Operating under Software Control (ROS / CAN)**
☐	Set Up Configuration
☐	Set Safety Limits
☐	Choose Mode of Operation
☐	**Verifying Calibration**
☐	Verify Voltage Readings
☐	Verify Current Readings

Notes:

System Checked by:	ACCEPTED BY CUSTOMER:
Name / Signature _____ Date: _____	Name / Position / Signature _____ Date: _____

Figure 11. Installation Checklist

3.1.2.2VERIFY PROPER CONNECTION TO UTILITY

To verify the proper connection to utility, be sure to check the following items:

- 3 phase voltage, correct grounding
- ½" diameter bolts were provided for the 3 phase input connection, torque spec is 350 in.-lb
- Ensure proper phase rotations

NOTE

900 EX must be connected to an equipment grounding conductor run with the circuit conductors. Connections must comply with Chapter 2 and Electromagnetic Interference Section of ANSI/IEEE Standard 142-199, "Recommended Practice for Grounding of Industrial and Commercial Power Systems," Section 250 (Grounding) of NEC, and all local codes and ordinances. We recommend no more than 0.1 Ohms between all equipment and ground. Use copper conductors and terminal lugs only.

3.1.2.3VERIFY COOLANT LEVEL

Verify coolant level before powering up the unit. Coolant level shall be approximately 2" from the bottom of coolant reservoir.

3.1.3 GENERAL OPERATION OF UNIT

Check Utility Power

- Turn unit on.
- Turn unit off.

Check E-Stops

- Local Emergency Stop
- Remote Emergency Stop

Check System Limits and Operation

- Configuration modes
- Safety limits
- Command modes (Voltage, Current, Power, and Resistance).
- Command values (set points)

Check Safety Features

- E-Stops
- HV Channel Interlocks

CHAPTER 4

Operation

WARNING

Battery testers should not rely solely on manual operation or automated scripts for safety. Errors can subject batteries to overcharging, which can result in battery damage or fire.
Batteries should be monitored by independent hardware for one or more of these unsafe conditions:

- Over voltage
- Over temperature
- Excess pressure
- Excess gassing (H2)

The HV Interlock on the 900 EX is provided to allow a hardware monitor to shut down the 900 EX in the event of an unsafe battery condition.

WARNING

In Current, Power, or Resistance Mode, do not open or close the circuit under load. If the external load contact opens, put the 900 EX into Standby Mode before closing the external contact. This can be achieved manually or via instructions in a script. Failure to put the 900 EX in Standby Mode after the external contact is opened may cause serious damage to the equipment.

NOTE

Use the High Voltage Interlock Connector to put the unit into Standby Mode. When the high voltage interlock connection is opened, the unit goes into Standby Mode. Consult the Customer Service Department if assistance is required.

NOTE

Channel A and Channel B can be used as a source or sink. When Channel A is used as a source and B as a sink or vice versa, the positive and negative terminals of Channel A are connected to the corresponding terminals of Channel B.

4.1 CHANNEL TO CHANNEL OPERATION

Follow the steps shown below for connecting Channel A to Channel B.

WARNING Damage to the DC power stage can occur if Channel A is connected to Channel B in any other way than the methods described below.

1. Prepare two (2) cables with the appropriate connectors on either end that mate with those provided on the 900 EX unit. One cable should have red terminals on both sides and the other should have black connectors on both sides.
2. Connect to Channel A Positive (Red) terminal first.
3. Next connect to Channel A Negative (Black) terminal.
4. Then connect to Channel B Positive (Red) terminal.
5. Finally, connect to Channel B Negative (Black) terminal.

4.2 PLANNING

Before testing with the 900 EX, decide on certain parameters. The planning checklist may be used as a guideline for preparation (see Figure 12):

Planning Form

Load Configuration Required:

- ☐ Independent
- ☐ Parallel
- ☐ Multi-Unit Parallel _____ # of units

Operating Limits:

Voltage Limit	
Upper _____ Vdc	Lower _____ Vdc
Current Limit	
Upper _____ Adc	Lower _____ Adc
Power Limit	
Upper _____ kW	Lower _____ kW

Control Operation: (Local or Remote)

- ☐ Local
- ☐ Remote

Remote Operation Script Used:

(filename and path)

Control Mode Required:

- ☐ Voltage
- ☐ Current
- ☐ Power
- ☐ Resistance
- ☐ Combination

Figure 12. Planning Checklist

4.3 CHOOSING A LOAD CONFIGURATION

Some loads and test plans may require a particular configuration of the 900 EX load connections.

Figure 13 shows the Operating Limits for the following two configurations, Independent and Parallel. Each of the configurations is described in more detail below.

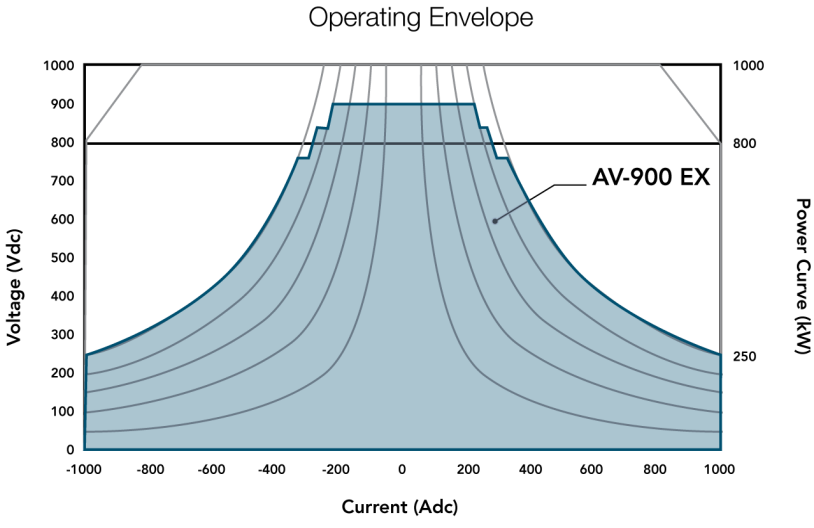


Figure 13. 900 EX Operating Limits

NOTE

Voltage refers to the limit on either channel, not the output.

4.3.1 INDEPENDENT CONFIGURATION

When the 900 EX is powered up, it is always in the Independent Configuration. Output A and Output B operate completely independently, allowing Load A and Load B to be controlled separately. Each load is connected from the positive terminal to the negative terminal of the appropriate output.

The name Independent is used due to the separate set-up procedures required for each output and the independent control that each DC Converter has over its own output. A single load may be connected in Independent Configuration (i.e., either Load A or Load B) with no change in functionality. A load connected to an 900 EX in the Independent Configuration is illustrated in Figure 14.

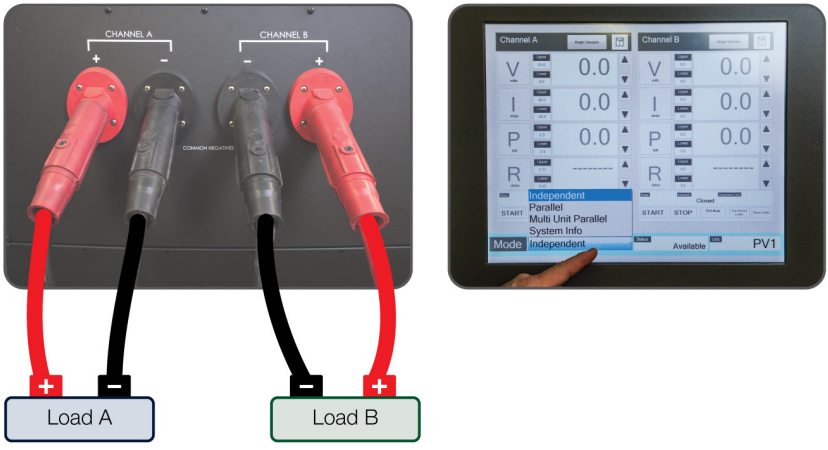


Figure 14. Independent Configuration

4.3.2 EXTERNAL PARALLEL CONFIGURATION

When in External Parallel Configuration, the Parallel Configuration is selected on the front panel as seen in Figure 15 and a single load is connected to both the positive and negative output terminals. Parallel Configuration is illustrated in Figure 15.

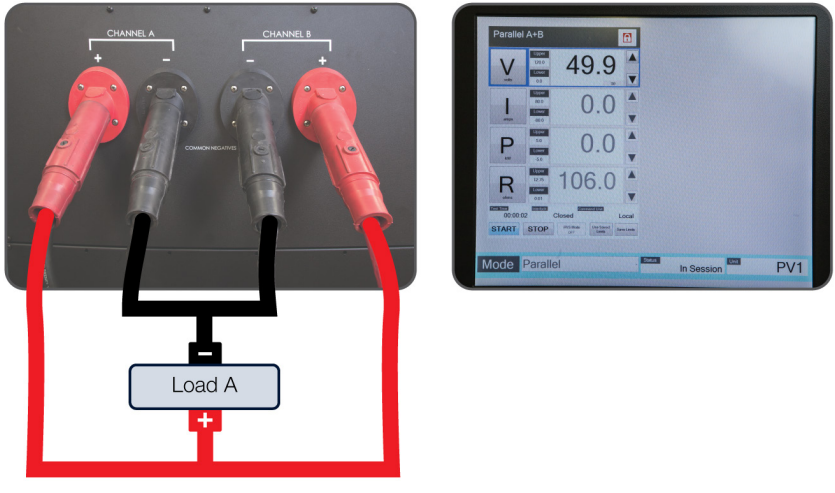


Figure 15. Parallel Configuration

4.3.3 MULTI-UNIT CONFIGURATION

Multi-Unit Configuration is selected on the front panel as seen in Figure 16. When in Multi-Unit Configuration, the load is connected to both the positive and negative output terminals of each paralleled unit. Multi-Unit Screen is shown in Figure 16 and Configuration is illustrated in Figure 17.

Figure 16. Multi-Unit Screen

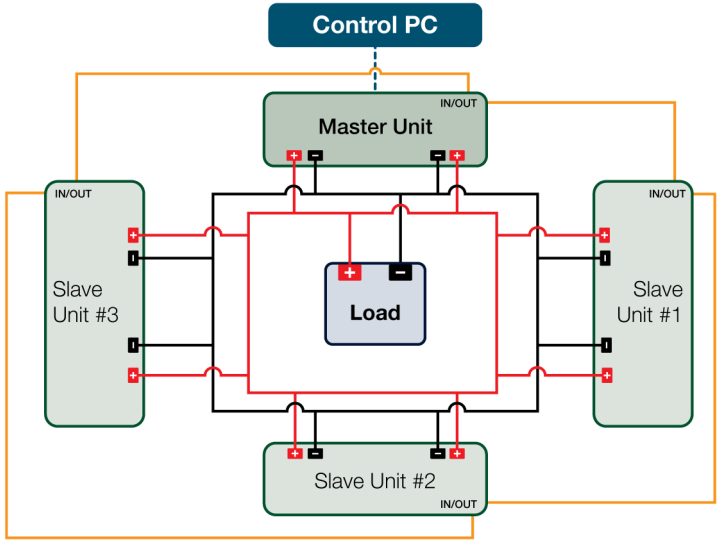


Figure 17. Multi-Unit Configuration

4.4 CHOOSING OPERATING LIMITS

The 900 EX allows the set up of temporary upper and lower Operating Limits for voltage, current, and power that are more restrictive than the absolute system limits defined in the Operating Range table. In many cases, these more restrictive limits may be useful in order to protect the load or avoid unsafe conditions.

For example, in order to protect a battery from overcharging, set an upper voltage limit of 280 Volts, which is substantially below the absolute 900 Volt limit allowed. Similarly, a lower voltage limit could be used to protect against over-discharging.

4.4.1 GENERAL LIMIT CONSIDERATIONS

- Set the upper/lower limits higher/lower than the maximum/minimum commanded values.
- Avoid over/under limit shutdown (caused by commanding modes higher/lower than the set limits).

4.4.2 OPERATING SPACE

The Operating Limits define the Operating Space of the DC Converter. The maximum Operating Space was depicted in the previous section. By setting more restrictive Operating Limits, the Operating Space is reduced.

When operating inside the limits of the Operating Space, the DC Converter will control the output based on the selected Control Mode and value. However, if one of the boundaries of the Operating Space is reached, the DC Converter will override the selected Control Mode and use the boundary condition as its internal Control Mode, if necessary, to stay within the Operating Space.

4.4.3 SECOND BOUNDARY

If a second boundary is encountered, the DC Converter will again override the Control Mode and use the second boundary as the internal Control Mode, if necessary, to stay within the Operating Space. If the DC Converter is unable to maintain the limits set, it will automatically disconnect the output terminals to protect the system and/or the load from a damaging failure. In summary, the DC Converter will follow the limits originally set in all cases.

4.4.4 LOAD

The load must exist in the Operating Space defined by the limits. A simple sketch to determine the desired Operating Space will be useful and may avoid frustration. There are a few basic rules that must be followed in setting the

Operating Limits. The DC Converter will enforce each of these rules.

1. The lower current limit may not be higher than 0 ADC and the upper current limit may not be lower than 0 ADC.

NOTE

It is not recommended that either of the current limits be set at exactly 0 ADC because this may prevent the DC Converter from controlling the voltage (in Voltage Control Mode) as efficiently as possible at or near zero current.

2. The lower power limit may not be higher than 0 kW and the upper power limit may not be lower than 0 kW.

NOTE

It is not recommended that either of the power limits be set at exactly 0 kW because this may prevent the DC Converter from controlling the voltage (in Voltage Control Mode) as efficiently as possible at or near zero power.

3. The sum of the upper and lower power limits must be no greater than the maximum power for the set voltage limit. These values are ±250 kW, ±225 kW, and ±200 kW for 750V, 825V, and 900 V limits, respectively.
4. The Operating Limits may not be outside the maximum limits of the DC Converter for the chosen configuration.
5. The upper limit for any parameter may not be lower than the lower limit for that parameter.

4.5 OPERATING THE SYSTEM

The 900 EX is designed for easy operation. The flowchart (see Figure 18) describes the typical procedures to follow for any test. The steps are divided into Local Operation and Remote Operation. Depending on the test requirements, only some of these steps will be chosen. Each step on the flowchart is discussed in detail below. Read through the entire section before beginning.

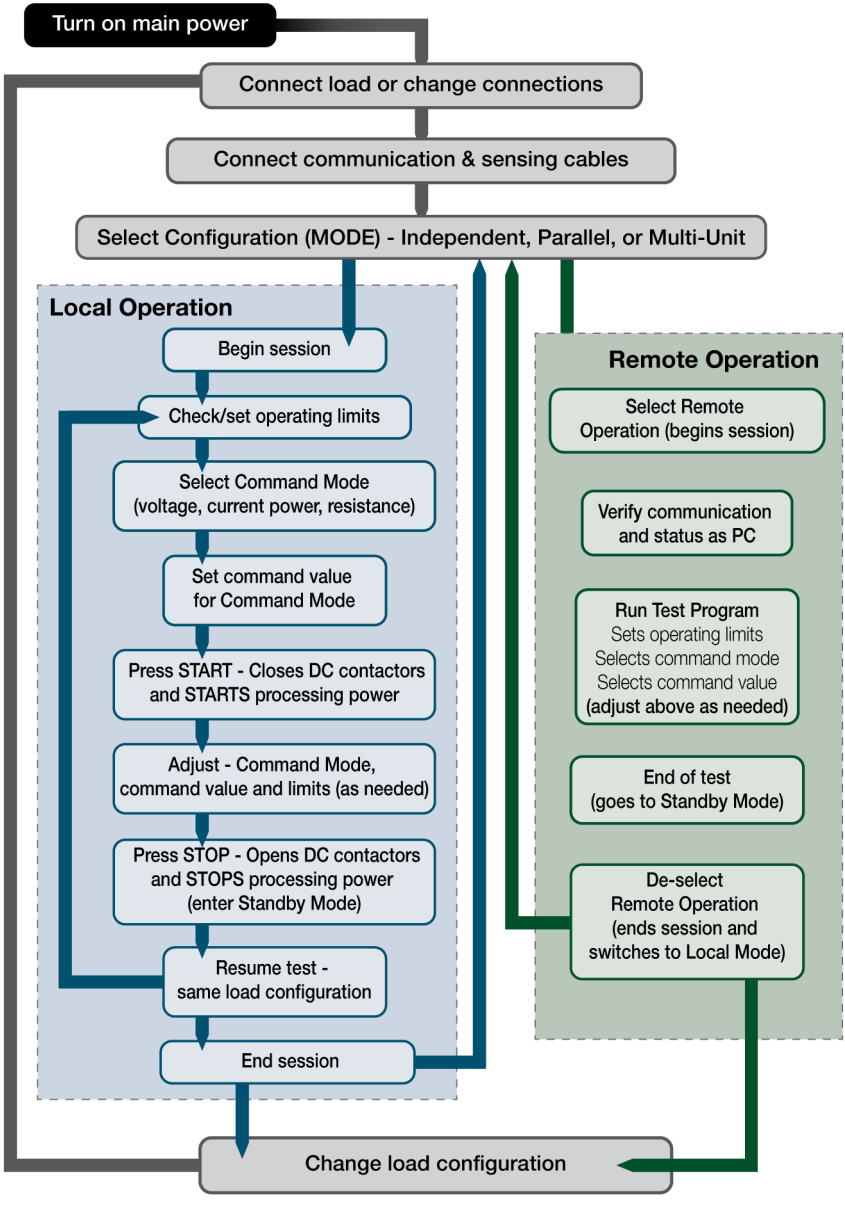


Figure 18. 900 EX Operation Flow Chart

The 900 EX is designed to make setup and operation as easy as possible while ensuring safety. Once the system main power is on, the front panel HMI will start up and connect to the DC controller.

4.6 SYSTEM START-UP

The DC Converter contains the controls to start the 900 EX. To start the system:

1. Confirm that the RED light on the Main Power Off button on the AC Inverter front panel is illuminated to show that input power is available. If the RED light is not illuminated, confirm that the local disconnect is switched ON.
2. Press the Main Power On button. The GREEN light will be illuminated to confirm that the unit is turned on. If the GREEN light does not illuminate, confirm that the Emergency Off button is not actuated (depressed) on the AC Inverter front panel. To deactivate, rotate the switch counterclockwise.
3. Confirm the following front panel indicators for proper operation:
   a. The GREEN light is illuminated.
   b. No fault indicators (RED) are lit on the Isolation Fault Detector.
   c. If either of these conditions is not true, the unit is not functioning properly and the Main Power Off switch should be pressed. Make note of the name and frequency of any flashing LEDs. Reference the tables in Section 5.2 to determine the fault indicated.
4. To completely power down the unit, press the Main Power Off button. The GREEN light is extinguished and the RED light is illuminated. The input power is present and the unit is in standby. Turn off the local disconnect and upstream circuit breaker or fused disconnect switch to cut off power to the unit.

4.7 CONNECTING LOAD & SELECTING CONFIGURATION

The next step is connecting the load.

1. For standard unit with CAMLOCK for DC
   a. Be sure that the load connectors are properly assembled with the load cables attached to the load.
   b. See Appendix B for important information about assembling and using the load connectors.
   c. Use the rubber safety cap for each connector at all times until ready to insert the connector into the panel mounted camlock receptacle.

NOTE

Failure to use the rubber safety cap may result in exposure to dangerous high voltage. If the load cable is connected to an active load that can generate high voltage, such as a battery, this voltage will be present on the brass conductor fitting of the connector. Safety caps should be kept in place at all times when dealing with such loads.

   d. Insert the load connectors into the appropriate DC Output receptacles.
   e. Refer to Section 4.2, Choosing a Load Configuration, to determine which load connections to use.

f. When the 900 EX powers on, it will start in Independent Mode by default.

g. To switch to Parallel Mode, select the Parallel mode from the HMI screen.

h. To switch to Multi-Unit Mode, select the Multi-Unit Parallel mode from the HMI screen.

NOTE

The 900 EX incorporates safety features related to load configuration. If at any time the load connections do not match the selected configuration (e.g., due to a connector being pulled from the unit accidentally or a load connection being changed inappropriately), the unit will automatically disconnect the output terminals of the applicable DC Converter.

2. For NO DC CAMLOCKs unit, once the machine goes through its start-up sequence, the next step is to connect the load.

a. Be sure that the load connectors are properly assembled with the load cables attached to the load.

b. Connect the load cables into the appropriate DC Output. Refer to DC Input/ Output Connectors in APPENDIX B for important information about assembling and using the load connectors.

c. Refer to Section 4.2, Choosing a Load Configuration, to determine which load connections to use.

d. When the 900 EX powers on, it will start in Independent Mode by default.

e. To switch to Parallel Mode, select the Parallel mode from the HMI screen.

f. To switch to Multi-Unit Mode, select the Multi-Unit Parallel mode from the HMI screen.

4.8 ADJUSTING OPERATING LIMITS

Before processing power, the voltage, current, and power limits for the active session need to be set (see Figure 19).

- Press Begin Session.
- After the session has begun, set the limits by pressing the UPPER or LOWER limit text box on the HMI screen. A dialog box will appear.
- Enter the upper and/or lower limit at this point and press ENTER to accept changes.
- If two loads are attached and the unit is configured for Independent mode, repeat the procedure for both sides (Load A and Load B).

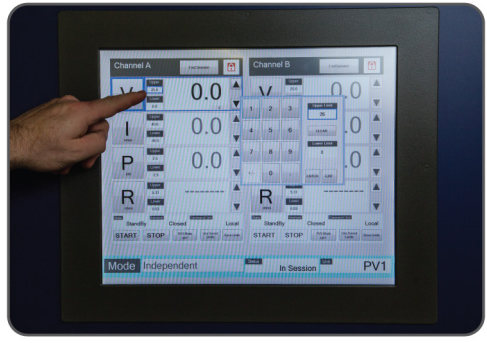


Figure 19. Adjusting Operating Limits

4.9 SELECTING LOCAL OR REMOTE OPERATION

Once the load has been connected and the load configuration has been chosen, the 900 EX is ready to run. At this point, the unit is in Local/Independent Mode operation by default. If ROS is running Remote Operation of each channel, it can be initiated; otherwise, the unit must be operated in Local mode via the front panel controls.

If local operation is planned, Begin Session must be pressed first and then select a Control Mode (i.e., Voltage, Current, Power, or Resistance Control). Local operation is described further below.

4.9.1 LOCAL OPERATION

After a session has begun in local operation, all control and adjustment is done on the HMI screen.

- A Control Mode must be selected to start a test.
- After the test has begun, the control setting may be adjusted and the Control Mode may be changed while running the test, as described below.
- Once the test is completed, select Standby Mode by pressing the STOP button on the HMI screen to open the contactors and internally isolate the load.

4.9.1.1 SELECTING MODE

- To select Voltage Control Mode, press the V button on the HMI screen (see Figure 20). This button lights up, while the other mode buttons (CURRENT: I, POWER: P and RESISTANCE: R) remain dimmed. Similarly, to select Current, Power, or Resistance Mode, press the HMI button corresponding to the mode.

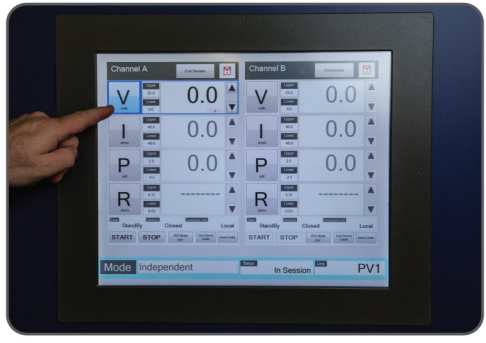


Figure 20. Selecting the Mode

- After selecting the Control Mode, enter the desired command value (set point) for the selected Control Mode (V, I, P, or R). Enter in this command value (set point) by pressing on the corresponding readback value on the HMI (see Figure 21).
- After the command value has been entered, press START to process power (see Figure 22). The DC Converter will immediately close the contactors to connect the load (an audible click will be heard).
- The DC Converter starts processing power at the entered command value.
- The Voltage Control Mode has a setting called Internal Resistance. If this value is set to 0.0 the feature is disabled. If an Internal Resistance value is set, the voltage will rise or fall (with reference to the command value) based on the current being synced or sourced, like a battery.

4.9.1.2 ADJUSTING SETTING

Once the DC Converter is running in V, I, P, or R Control Mode, the command value for that mode can be adjusted as often as necessary (see Figure 21). Adjustments are made via the up and down arrows located next to the appropriate display or by pressing the readback value for that mode and entering in a new command value.

Figure 21. Adjusting Settings

NOTE

Settings cannot be adjusted to a value outside the Operating Limits defined for the parameter being controlled.

- If the DC Converter is unable to adjust the setting further without violating Operating Limits on parameters other than the one being controlled, it will not allow further adjustments.
- If unable to adjust the control setting to the desired value, check the Operating Limits and adjust them if necessary (see Figure 22 and Section 4.8.1.4 on Changing Operating Limits). In particular, if the limit value is flashing for a mode other than the Control Mode selected, check the limits for that parameter.

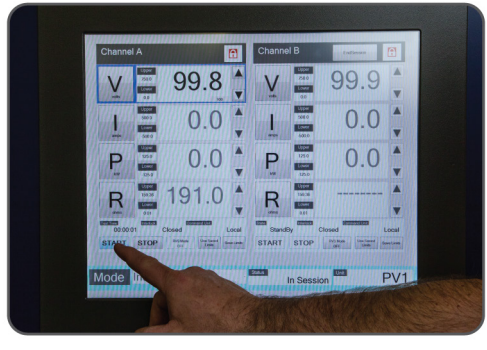


Figure 22. Start Processing Power

4.9.1.3 CHANGING COMMAND MODE WHILE RUNNING A TEST

When running a test, it is possible to change from one Control Mode to another

at any time by pressing the desired command mode button on the HMI screen. The DC Converter will immediately switch to the new Control Mode.

Example: the test is in Current Control Mode (CURRENT mode is highlighted) with output readings of 300 VDC, +50 ADC and 15 kW. If the Voltage Mode button is pressed, the DC Converter will change to Voltage Control Mode (Voltage Mode is highlighted) and begin controlling at 300 Volts. The voltage setting can then be adjusted as necessary.

During the test, modes can be changed between Voltage, Current, Power, and Resistance as often as needed. Each time, the DC Converter will make the change such that the same operating point is maintained.

4.9.1.4 CHANGING OPERATING LIMITS

The Operating Limits originally set can be changed while the test is running. This is done with the same steps as they were initially set.

1. Press the UPPER LIMIT text box to input dialog box.
2. Enter the desired value and press ENTER.
3. Repeat for lower limits, if necessary.

NOTE

Before changing Operating Limits, be sure to carefully consider the potential impact on the load. It is best to maintain an Operating Space that is as small as possible to prevent unwanted or unsafe operation.

4.9.1.5 PAUSING A TEST

To pause a test while in local operation, either control current or power to zero or enter Standby Mode (HMI STOP button) (see Figure 23). For brief pauses, it may be more convenient to reduce current or power to zero (see Adjusting Setting above). For longer pauses and/or for maximum safety choosing, Standby Mode is recommended.

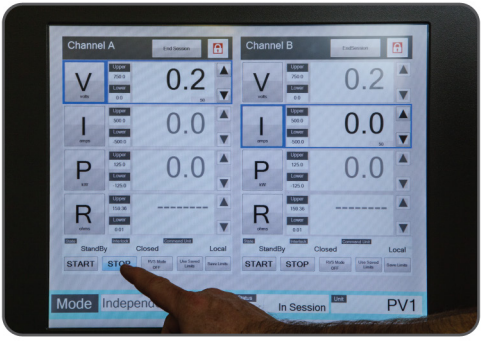


Figure 23. Pausing or Stopping a Test

To enter Standby Mode at any time, press the HMI STOP button for the appropriate converter (A or B). The unit will identify that it is in Standby mode. An audible click will be heard as the DC output contactors open and internally disconnect the load. While in Standby Mode, no power can be transferred to or from the load.

To resume testing in local operation, press the HMI “START” button to begin processing power.

4.9.1.6 ENTERING REMOTE OPERATION

While in local operation, place the channel in Standby Mode to switch either channel to remote operation. Press the HMI "STOP" button. There will be an audible click as the DC output contactors open and internally disconnect the load.

Once Standby Mode is entered, press End Session, then remote operation can be initiated via ROS. The command unit will indicate "ROS Serial" and the system is ready to be controlled remotely. See Section 4.8.2, Remote Operation, to continue.

4.9.1.7 CHANGING LOAD CONFIGURATION

To change the load configuration, the DC Converter must be in local operation and in Standby Mode. If it is not in Standby Mode, press the HMI "STOP" button for each active converter (A and/or B). An audible click will be heard as the DC output contactors open and internally disconnect the load.

While in Standby Mode, disconnect any load connectors that need to be rearranged. At this point, reconnecting the load and selecting a new load configuration is achieved in exactly the same manner as when initially connecting a load. See Section 4.6, Connecting the Load and Selecting the Configuration, and proceed through the remaining setup steps.

4.9.2 REMOTE OPERATION

Once in remote operation, all control can be done from the ROS or other scripting tool. The ROS application provides the complete set of 900 EX front panel controls. Limits and mode selections are easily performed with a few clicks of the mouse. The display indicates limits selected, operating mode and system status. Any test run locally from the front panel can be duplicated using the ROS.

A further advantage provided by the ROS is automatic testing. Test scripts can be easily written to provide a wide range of test and simulation capabilities. Refer to the 900 EX ROS Manual for complete instructions on using the ROS.

To exit remote operation at any time, select LOCAL operation within the ROS environment. The DC Converter will immediately switch to local operation and place the respective channel in Standby Mode.

The Main Power switch and Emergency Off button continue to be available at all times while in remote operation.

NOTE

When in remote operation, the DC Converter uses a time-out timer to monitor the Remote Operation Interface for loss of communication.
When the DC Converter is placed in remote operation, it waits to activate the time-out timer until the first message has been received from the ROS.

4.10 TURNING OFF POWER

To shut down the 900 EX at any time, press the OFF switch or depress the Emergency Off button (both on the AC Inverter front panel). However, in the event of a normal, non-emergency shutdown, it is recommended that the DC Converter be placed in Standby Mode (HMI "STOP" button) before turning off the control power.

Once the power has been turned off, leave the Main Power switch Off (the RED light is illuminated) and/or the Emergency Off button depressed until all indicator lights on the front panel turn off. This allows the high voltage within the system to dissipate (through a bleed resistor) so that the system will be safe for maintenance.

Chapter 5

Maintenance

This section describes preventative maintenance, which may require access to the interior of the AC Inverter and/or the DC Converter cabinets, and should only be performed by a Webasto-authorized technician.

DANGER

Be sure the AC input circuit breaker is off and the system has been turned off (with the OFF or Emergency Off button in the OFF POSITION) for a minimum of five minutes before opening the cabinet for service. Also make sure that the output cables are removed as this could be very dangerous if there is an active load.

5.1 PREVENTATIVE MAINTENANCE

The 900 EX requires minimal regular maintenance. Occasional preventative maintenance as described below should keep the system in good operating condition for many years.

WARNING

Coolant used in this product is 25% Peak Long Life and 75% distilled water (herafter referred to as "Webasto-approved coolant"). The system's cooling system may deteriorate and cause failure if any other cooling fluid is used. Contact the Customer Service Department in procuring Peak.

1. Remove dust and dirt from the system every six months. Avoid operating the system in a location that is especially prone to the accumulation of dust or other particulate matter.
   a. Dust build-up should be removed from all interior surfaces. The recommended device for cleaning is a vacuum cleaner with anti-static provisions, specifically designed for use on electronic equipment. Be sure not to disrupt any of the wiring or dislodge any components while doing this. DO NOT clean any of the electrical components with water or water-based solutions, as they may damage the components or cause malfunctions.
   b. If an air filter is being used, inspect the air filter periodically to ensure adequate airflow to maintain system cooling - replace or clean as necessary. Inadequate airflow can cause over-temperature shutdown conditions.
2. Change the coolant mixture once every year. To drain the coolant in the system, be sure to drain both the AC Inverter cooling system and the DC Converter cooling system. It is suggested that this task be performed along with the annual calibration.
   a. First, remove the lower front panel from the left side of the cabinet. There will be a stop valve connected to the cooling system hoses near the pump assembly. This valve is normally closed. When opened, the valve allows coolant to drain. The drain tube is flexible and can be guided through the open front of the cabinet into an appropriate receptacle.
   b. After locating the valve and directing the drain tube, open the valve and let the coolant drain.

c. After all of the coolant mixture has drained, close the valve and proceed to refill the coolant. With the pump off, fill the reservoir with Webasto-approved coolant until it is within 2" from the bottom of the reservoir. Turn the pump on and continue filling with coolant until the reservoir remains full within 2" from the bottom of the reservoir. Turn off the pump and let the system settle for approximately 5 minutes. Turn on the pump and re-fill the reservoir to within 2" from the bottom of the reservoir. Repeat the settling and filling until no appreciable drop in fluid level is noticed.

3. Check the coolant system for leaks and aging hoses every six months. Coolant leaks are not expected in normal operation. However, if a coolant leak does develop, it may damage the system or even cause potentially dangerous conditions.

a. To check the coolant system, carefully remove the upper left panel of the cabinet. Carefully disconnect the wires to the AC panel and remove. Remove the reservoir cap and look into the reservoir to see the coolant level. If the reservoir appears full, coolant leaks are unlikely to have developed.

b. To check the remainder of the coolant system, remove the lower AC front panel and filter side panel as necessary to access all hoses and fittings, as well as the pump assembly. Touch the fittings and connection points to see if any moisture is collecting. Look for other signs of leakage such as residue from evaporated coolant drops or streaks. Also check the cooling system hoses for cracks or hardening.

c. If a leak appears to have developed, DO NOT OPERATE THE 900 EX. Note the leak location and then drain the coolant from the system as described above. Tighten or replace any loose fittings. Replace any hoses that are damaged with hoses from Webasto. If a leak is found in the pump, the heat sink, or the reservoir, contact Webasto for service or a replacement part. Once these procedures have been completed, refill the coolant system with Webasto-approved coolant and allow it to stand for an extended period of time, checking frequently for leaks. When the leaks have been fixed, replace all side panels, and resume operating the system.

4. Calibrate DC output current once per year. The output current of the DC Converter is automatically recalibrated as the system operates. However, over time, typical component aging can cause current accuracy to drift. Follow the Current Calibration/Voltage Verification Instructions available from Webasto's Customer Service Department. Ripple currents can be verified at this same time. However, it is important that the load used while measuring ripple current is NOT a second 900 EX system. Use a battery or resistive load to obtain accurate ripple measurements.

5.2 FAULT INDICATIONS

To aid with fault diagnosis, fault indicators have been built into the design of the 900 EX (see Figure 24). If a system shuts down due to a fault condition, look at the front panel to see if any of the fault lights are lit or fault codes displayed, and refer to Table 7 or if further explanation is needed for any fault messages displayed on the HMI, please contact customer service.

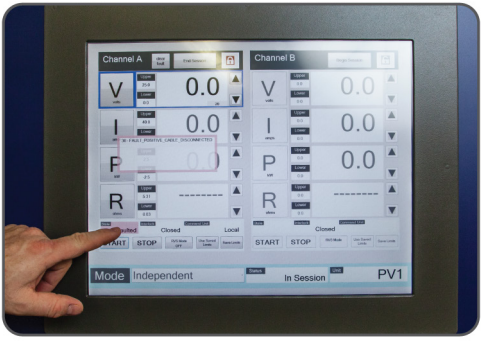


Figure 24. Fault Display

Table 7. Fault Indications

Isolation Fault Indicator	
±Bus Fault	
On Steady	Loss of isolation between the positive or negative bus
Isolation Fault Detection Reset	
Flashing	Isolation fault has been latched

Appendix A

Glossary of Terms

A.1 GLOSSARY OF TERMS

Table 8.Glossary of Terms

Term	Definition
AC Inverter	A subassembly of the 900 EX on the left side of the cabinet. Converts AC to DC to regulate the Intermediate DC Bus.
Air Intake	In a clean lab environment, no air filter is necessary. Ensure that the air is unblocked; intake from the right side of the system and exhaust to the left side of the system vents. The unit is to be installed in an environment with airborne particulate, use with an ultra-low pressure drop air filter (20" x 25" x 1") on the intake panel. Operation with an installed filter de-rates the maximum continuous power by 30 percent (which will increase as the filter gets clogged).
Battery Cycler	A term for the 900 EX that refers to its use in battery charge and discharge cycling.
Configuration	The wiring arrangement used for a particular load or loads. Also the selection on the DC Converter front panel that matches the physical load connections.
Command Mode	See “Control Mode” below.
Control Mode	The DC Converter’s control algorithm, i.e., the parameter being controlled. Voltage Mode, Current Mode, Power Mode, and Resistance Mode are the four control modes in which power transfer can occur. Standby Mode is another mode in which the output terminals are internally disconnected and no power transfer occurs.
Converter A	(Also Side A) The master or left converter in the DC Converter.
Converter B	(Also Side B) The slave or right converter in the DC Converter.

Term	Definition
DC Converter	A subassembly of the 900 EX on the right side of the cabinet. Consists of two independently controllable converters (A and B), each regulating the output (load) terminals based on front panel settings or commands from a remote operation system.
DC I/O Connector	Use 350MCM cables, rated 1000VAC, connected to (-) and (+) marked terminals, per channel for NO CAMLOCKs unit. For CAMLOCKs unit, use ECT 17DSS-350M Connectors in black and red. See Appendix B for instructions.
Grounding	The 900 EX must be connected to an equipment-grounding conductor that is run with the circuit conductors. Connections must comply with Chapter 2 and the Electromagnetic Interference Section of ANSI/IEEE Standard 142-199, "Recommended Practice for Grounding of Industrial and Commercial Power Systems," Section 250 (Grounding) of NEC, and all local codes and ordinances. Webasto recommends no more than 0.1 Ohms between all equipment and ground. Use copper conductors and terminal lugs only.
Independent	One of three load configurations (see also Parallel and Multi-Unit Parallel). Two loads may be controlled independently by Converter A and Converter B. Each load is attached from the positive terminal of a converter to the negative terminal of the same converter.
Input	3 phase, 3 wires plus ground. A 3 ½" diameter hole can be punched on the top of the enclosure for 3" conduit.
Input Ground Wire	Must be a conductor the same size as the input or smaller; 2 AWG wire is acceptable for up to a 450A CB rating. Use a copper wire with green or green with a yellow stripe insulation color connected to a ground stud.

Term	Definition
Input Wire Lug	Solid copper crimp lug with ½" diameter bolt hole. Torque to 350 in.-lb.
Intermediate DC Bus	An internal DC Bus between the AC Inverter. This bus is not accessible to the user.
Limits	See "Operating Limits."
Load	A device or system connected to the 900 EX for the purpose of receiving and/or delivering DC power.
Local Operation	Control of the DC Converter is achieved from the front panel.
Mode	See "Control Mode."
Multi-Unit Parallel	One of three configurations (see also Independent and Parallel Modes), one load is attached to paralleled postive and negative terminals of Converters A and B of multiple 900 EXs.
Operating Limits	The maximum and minimum operating points for the DC output. Upper limits and lower limits may be set on Voltage, Current and Power.
Operating Space	The area enclosed by operating limits on the DC Converter, as plotted on a graph of voltage versus current.
Parallel	One of three load configurations (see also Independent and Multi-Unit Parallel). One load is attached to the paralleled positive and negative terminals of Converters A and B.
Remote Operation	Control of the DC Converter is achieved from a remote operation system via the Remote Operation Interface.
Remote Operation Interface	The interface between the 900 EX and a remote operation system. The physical interface is located on the left side of the DC Converter. The interface also specifies message structure and contents of messages exchanged between the 900 EX and the ROS.

Term	Definition
Remote Operation System (ROS)	A computer-based system that interacts with the 900 EX via the Remote Operation Interface. The remote operation system receives data and status information from the 900 EX and sends operating limit and control commands to the 900 EX.
Side A	(Also Converter A) The master or left converter in the DC Converter.
Side B	(Also Converter B) The slave or right converter in the DC Converter.
Standby Mode	An operational mode in which the output terminals are internally disconnected and no power transfer occurs.
Utility	AC three-phase power source.

Appendix B

DC I/O Connector Assembly

B.1 STANDARD UNIT WITH CAMLOCKS

Table 9. CAMLOCK Connector Part Numbers

900 EX	P/N	Description
Connector, Black	07033	Connector, Plug – ECT 170SS-350M, Black
Connector, Red	07032	Connector, Plug – ECT 17DSS-350M, Red

B.1.1 GENERAL

The male and female contacts are attached to the cable (copper only) by means of a double set screw. Acceptable cables include 350 MCM-type SC, SCE, EISL and Type W. The double set screw contact has a tapped screw hole that will accept a stress relieved, cad-coated screw with an Ultern (glass-filled plastic) head to secure and hold the contact inside the santoprene insulator sleeve.

B.1.2 ASSEMBLY PROCEDURES

1. Strip cable insulation back 2.25 inches from the end.
2. To prevent the cable insulation from moving, use the supplied insulation retaining wire. Centering the wire, make one wrap around the cable's insulation (between 3/8 to ½" back from the insulation end) and twist tight with pliers. Lay the wire ends down and trim flush with the cable end.
3. Wrap the exposed (bare) cable end (including the ends of the retaining wire) with the supplied copper foil.
4. Insert the cable end into the conductor pin. Verify that the foil completely covers the cable where the set screws are to be inserted.
5. Install the 5/8-18 set screws and torque to 150 in-lbs.
6. Insert the conductor pin into the insulator sleeve. Coating the inside of the insulator sleeve and the pin shaft with ECT silicone spray or cable pulling compound will make assembly much easier.
7. Push the conductor pin into the insulator sleeve until the tapped hole in the contact lines up with the screw hole in the port of the insulating sleeve. Insert the thermoplastic head screw into the port in the sleeve. Then use a screwdriver to thread into place, and secure the contact in the sleeve.

B.1.3 DISASSEMBLY PROCEDURES

1. It is simple to remove the contact pin from the insulator sleeve. Use a screwdriver to unthread the screw from the contact pin through the port hole in the insulating sleeve. Once the screw is removed, pull the insulator off the cable. The conductor pin can then be removed by unthreading the 5/8-18 set screws and pulling the conductor pin contact off the cable conductor.
2. To reassemble, follow the above assembly instructions.

NOTE

The simple and easy procedure for assembly or disassembly offers the flexibility to change or replace contacts and/or insulator sleeves in the field as well as easily reuse component parts

B.2 NO CAMLOCKS UNIT

B.2.1 EQUIPMENT REQUIREMENTS

Flexible cable 350MCM, 1000Vac rated to connect to the 500A load.

B.2.2 GENERAL

The DC output cable entry hole is provided on the top of the unit in the front right hand corner. The cables should be suitably routed through the hole and brought down into the output connection box. In order to achieve that, the right hand side panels need to be removed.

Figure 25 shows the cables entering from the top hole.

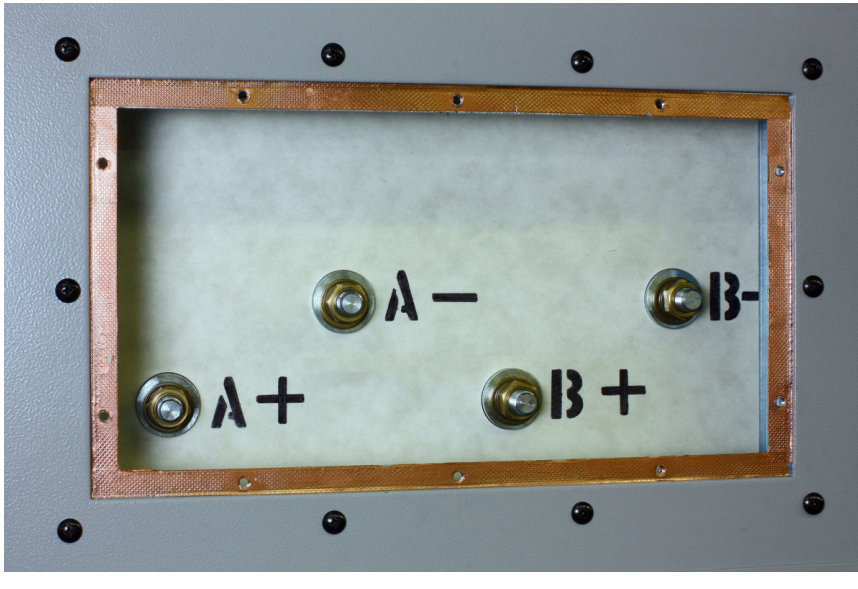


Figure 25. DC output cable connections

B.2.3 ASSEMBLY PROCEDURES

1. Strip cable insulation back 1 inch from the end.
2. Tighten the cable into the solid copper lug with a half inch (1/2”) stud size.
3. Connect the lug with marked cable to the DC terminals.

Appendix C

900 EX Remote Voltage Sense Operation

Table 10. Remote Sense Connector

Connector	Part P/N	Description
Connector, Remote Sense Channel A	05001 (Qty 1)	Connector, Plug (Amp 350766-1)
	04831 (Qty 2)	Contact, Socket (Amp 350550-2)
Connector, Remote Sense Channel B	05001 (Qty 1)	Connector, Plug (Amp 350766-1)
	04831 (Qty 2)	Contact, Socket (Amp 350550-2)

Table 11. RVS Channel

RVS Channel A	Signal Name	RVS Channel B	Signal Name
Pin Outs		Pin Outs	
1	+ Sense	1	+ Sense
2	Not used	2	Not used
3	- Sense	3	- Sense

C.1 REMOTE VOLTAGE SENSE (RVS) OPERATION

1. Independent Mode

The output voltage of each channel of the 900 EX can be regulated directly at the load, eliminating excessive voltage drop across the cables, which carry high current between the 900 EX and the load and yet maintain greater voltage accuracy. This is accomplished by utilizing the V Sense connectors provided on the front panel user I/O strip. This feature is enabled by pressing the front panel-labeled RVS button to activate Remote Voltage Regulation on the selected channel. A connection diagram is provided in Figure 26. The Remote Voltage Sense (RVS) wires must be fused as close as possible to the load in order to eliminate any shock hazard to the operator. It is highly recommended to use twisted pairs or shielded cabling for sensing and then routing them away from any noise emitting sources.

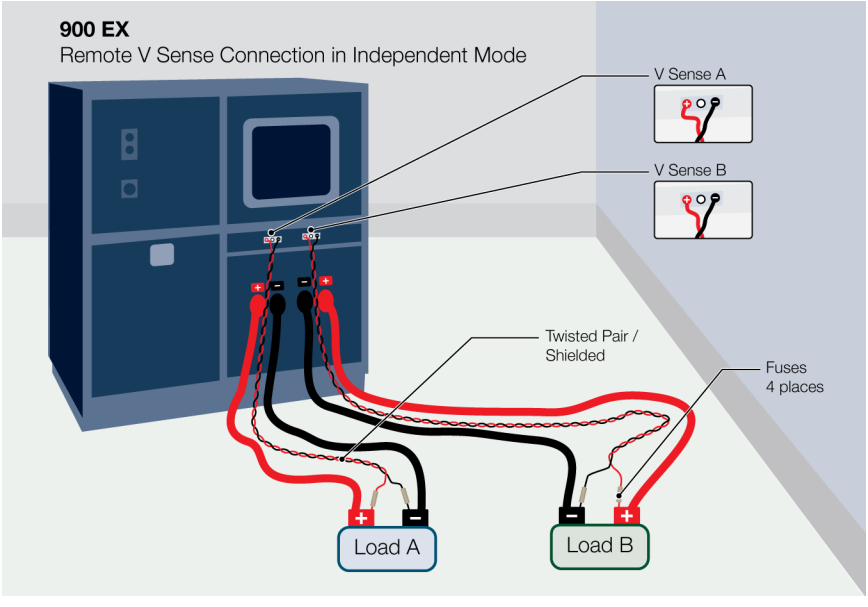


Figure 26. Connection Diagram for RVS in Independent Mode

2. Parallel Mode

In Parallel Mode, only the RVS connector on channel A is used with the load connected up as in Figure 13.

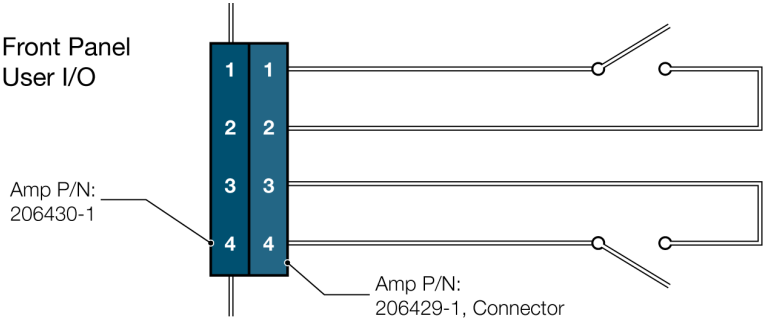
Appendix D

High Voltage Interlock Wiring

The wiring diagram in Figure 27 shows how to wire the mating connector for the HV Interlock provided on the Front Panel User I/O. See below for a list of pin descriptions:

- Pin 1 (+V) is a system-supplied +5 V voltage source.
- Pin 2 (+sense).
- Pin 3 (-sense).
- Pin 4 (GND) is the ground signal of the +5 V voltage source.

In the Independent Configuration, a break in either one of these links will put that channel into Standby Mode (open the output contactor and isolate the output of the 900 EX from the load).



Note: The external switches must be closed to allow output connectors to close

Figure 27. High Voltage Interlock Connector Wiring

In Parallel Configuration, a break in a specific channel's HV Interlock will open that channel's DC Contactor. The firmware will recognize this event and open the other DC Contactor and put the system into Standby Mode, thus isolating the output of the 900 EX from the load.

If a true hardware interlock is desired for both channels in Parallel Configuration, one link in each HV Interlock must be broken at the same time.

Appendix E

Index

Index